

ENVIRONMENTAL ASSESSMENT REPORT

Port Douglas Wave Park



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30 June 2021

REPORT

Document status

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Approval for issue

Megan Davis



30 June 2021

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1 INTRODUCTION

RPS Australia East Pty Ltd (RPS) has been engaged by Graben Pty Ltd (Graben) for the development of an integrated wave park located on land described as Lot 123 on SR687, hereafter referred to as 'the site' (**Figure 1**).

1.1 Site Details

The site currently operates as a cane farm with a single detached dwelling, farm sheds and outbuildings, in the south west portion of the site (**Figure 1**).

Graben Pty Ltd are proposing the development of an integrated wave park at the site. The proposed design is to utilise approximately 25 hectares of the site for the wave park and associated accommodation and approximately 15 hectares of the site will be rehabilitated using native species.

Key development details that are of relevance to this assessment are summarised below (**Table 1**). Preliminary layout plans prepared by Hunt Design showing the proposed wave park design are provided in **Appendix A**.

Table 1 Development details

Aspect of Development	Proposal
Current use	Sugar Cane Production
Proposed development	Wave Park Integrated Development
Total site area	40.22 ha
No. of existing lots	1
Total rehabilitation area	Approximately 15 ha
Total developable area	Approximately 25 ha
Extent of built infrastructure within the developable area	Existing residence approximately 30m ²

The proposed development will incorporate rehabilitation of 15 hectares, equating to approximately 40% of the site which adjoins the ecologically significant areas to the north east and north west of the site adjacent to the Mowbray River. This rehabilitation will offset any residual impacts as a result of the proposed development and rehabilitate the existing cane fields which have been in productions since at least the 1960's.

Example— cutting and filling land for creating building lots

(f) screening material on the site from which it has been extracted in the course of carrying out an activity mentioned in paragraphs (a) to (e).

GHD's engineering report indicates that the extracted material will be reused on the site for filling and is likely to be used for constructing foundations of the proposed buildings at the site. Reshaping of the land will not involve blasting and the material extracted will not be removed from the site from which it is extracted.

As a result, the proponent has interpreted Schedule 2 to indicate that an EA for ERA 16 is not required.

2 METHODOLOGY

2.1 Desktop Assessment

The desktop assessment involved reviewing relevant environmental databases, books, technical reports, maps and legislation to identify ecological values with potential to occur within and surrounding the Project area. Aerial photography of recent and historical imagery (Queensland Globe, 2020) was also assessed.

All database searches were undertaken using a standard 5 km buffer surrounding the Project area (using the approximate central point of the site (-16.55, 145.49)).

This review included an assessment of the following information:

- Aerial Photograph Interpretation (API) to determine the broad categorisation of vegetation within and surrounding the site and to review the extent of historical clearing and land use, and any other significant environmental features such as watercourses and wetlands (Queensland Globe, 2020),
- Regulated vegetation management map: The most recent version of the DNRM Regulated Vegetation Management mapping including regional ecosystems, essential habitat mapping.
- Wildlife Online database of flora and fauna. This database holds records of plants and animals that have either been sighted or collected within a given radius of the site. The records held in this database are maintained by DEHP (**Appendix A**).
- Protected matters database of Matters of National Environmental Significance (MNES) as cited under the Commonwealth's Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
- EPBC Act and self-assessable guidelines – management of impacts on Matters of National Environmental Significance, and
- The review previous technical reports/impact assessments relevant to the development.

2.2 Site Investigation

A number of site investigations have been conducted at the site. A geotechnical site investigation was conducted by Golder on 18 December 2020 to assess general site conditions. RPS Environmental Scientists and Dr Fanie Venter, Principal Botanist inspected the site on 17 December 2020 and again on 22 January 2021. The findings of the investigations have been included in this report.

3 EXISTING ENVIRONMENT

Section 3 establishes the regional and local environmental context for the site.

3.1 Climate and weather

The site is located within the Port Douglas Region. Port Douglas experiences a tropical climate dominated by a distinct humid wet season (November to April) and a warm dry season (May to October).

Mean rainfall for the region is plotted in **Figure 2**. The highest rainfall occurs during February and the lowest rainfall occurs during August.

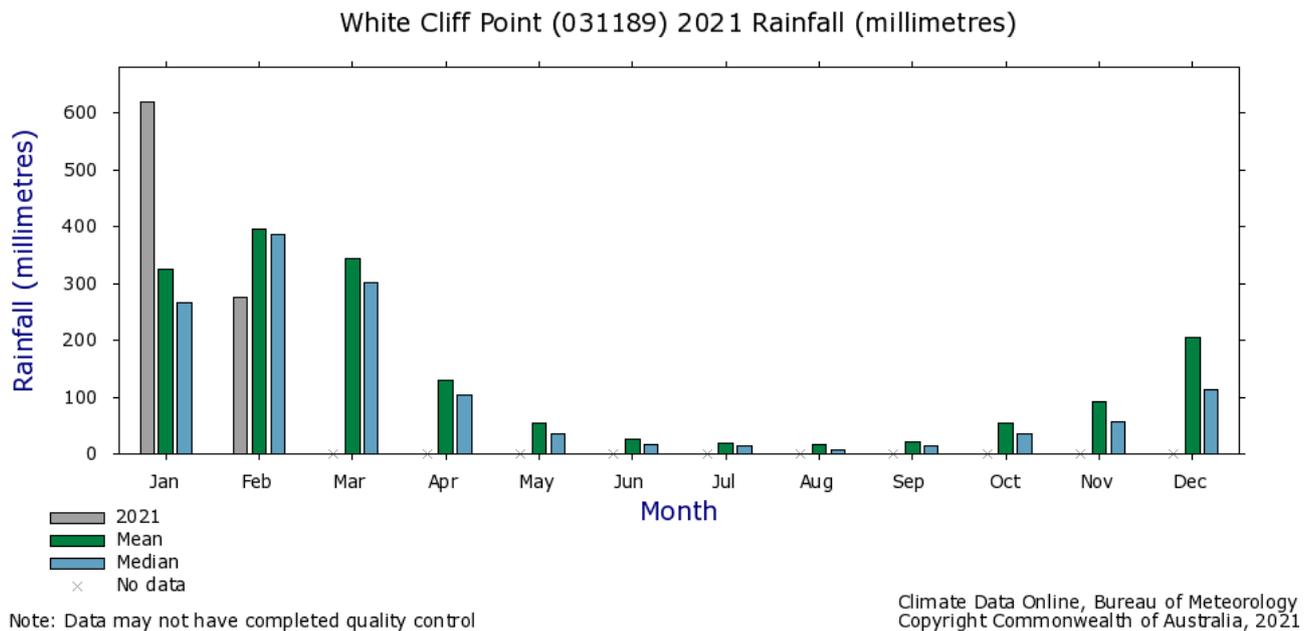


Figure 2 Mean rainfall for Port Douglas Region

A summary of monthly climate statistic from the Bureau of Meteorology White Cliff Point Station (Station number 31189) is provided in **Table 3**.

Table 2 Summary of Regional Climate Statistics

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	325.5	395.0	344.5	128.5	54.9	26.6	18.4	15.8	20.6	53.4	92.6	205.0	1695.0
Low	29.7	30.7	10.0	4.6	0.2	3.6	0.0	0.0	0.0	0.6	0.0	31.2	778.8
High	822.4	900.4	985.2	743.8	267.8	95.8	57.4	86.4	167.8	227.6	493.4	670.0	2488.0

3.2 Land

3.2.1 Catchment

The site forms part of the Mossman drainage basin which spans an area of 473km², 16 km² of which is comprised of estuarine wetlands (DES, 2013). The catchment comprises two major river systems, the Mossman and Mowbray rivers, as well as number of small drainage lines from the ranges to the coast. Rainfall averages 2109 mm a year which results in discharges to the Great Barrier Reef (GBR) of approximately 505 GL each year (Reef plan, 2021).

Most of the catchment is mapped nature conservation land; however, along the foot of the mountain ranges has been developed for sugar cane and urban land uses. The section of the Mowbray River adjacent to the site is mapped as Great Barrier Reef World Heritage area (**Figure 3**) and Estuarine Conservation Zone (**Figure 4**).



Figure 3 GBR world heritage area (green) (Source: WetlandMaps, 2021)



Figure 4 Estuarine conservation zone (dark yellow) (Source: WetlandMaps, 2021)

3.2.2 Landform and Geology

The landform at the site is mapped as beach ridges and alluvial fans (QLD Globe, 2021). Regional geology of the site comprises the following:

- Quaternary age deposits comprising sand ridges in the lower lying areas;
- Quaternary/Tertiary age high-level alluvial deposits comprising sand, silt, clay and minor gravel to the south west;
- Quaternary/Tertiary age colluvial and residual soil deposits (generally on older land surfaces) comprising clay, silt sand and gravel to the south (Golders, 2020).

3.2.3 Soils

Soil mapping for the site includes Hull, Clifton and Mangroves series soils. **Figure 5** indicates the presence of Hull series soils over most of the site. Clifton series soils are present in the area along the Captain Cook Highway and Mangrove series soils are present in parts of the site near the north western and north eastern site boundaries. An agricultural assessment has been undertaken which concluded that due to saline intrusion and poor quality soils, the site is better suited to the proposed use.

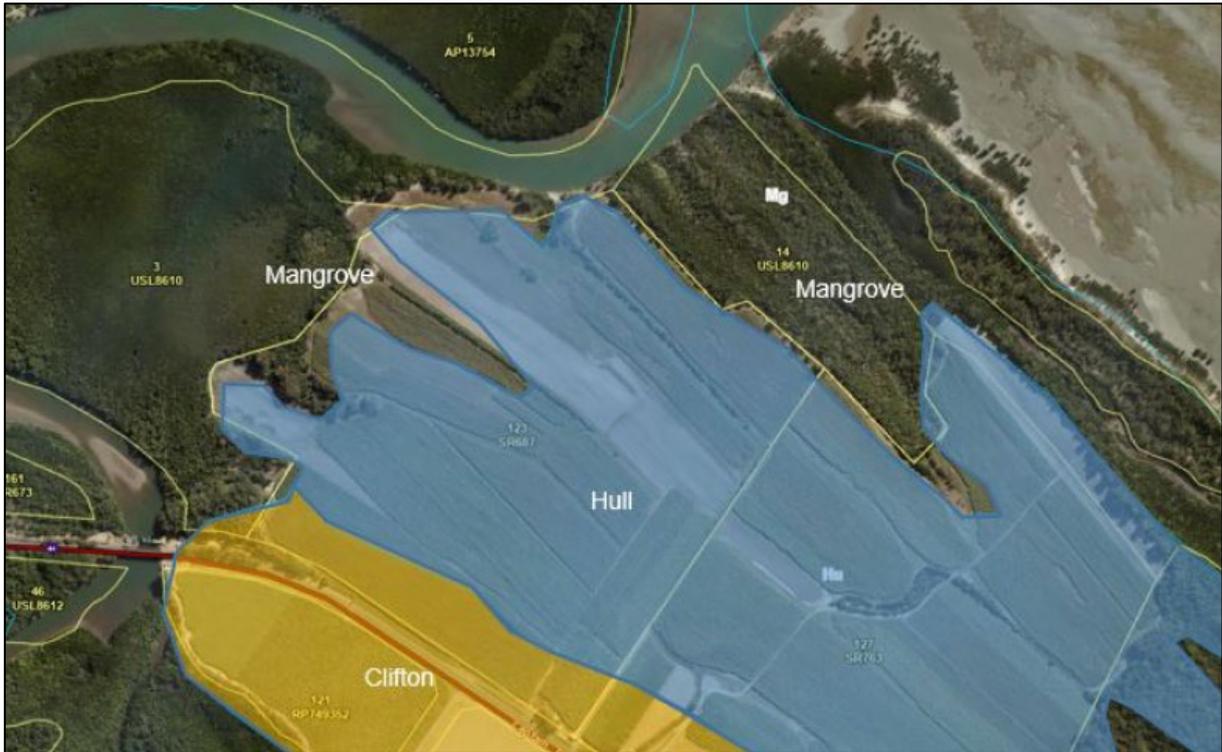


Figure 5 Soil mapping for the site (Source: Golders, 2020)

3.2.3.1 Acid sulfate soils

Figure 6 shows a low probability of ASS occurrence across most of the site; however, a high probability of ASS occurrence near parts of the north western and north eastern site boundaries.

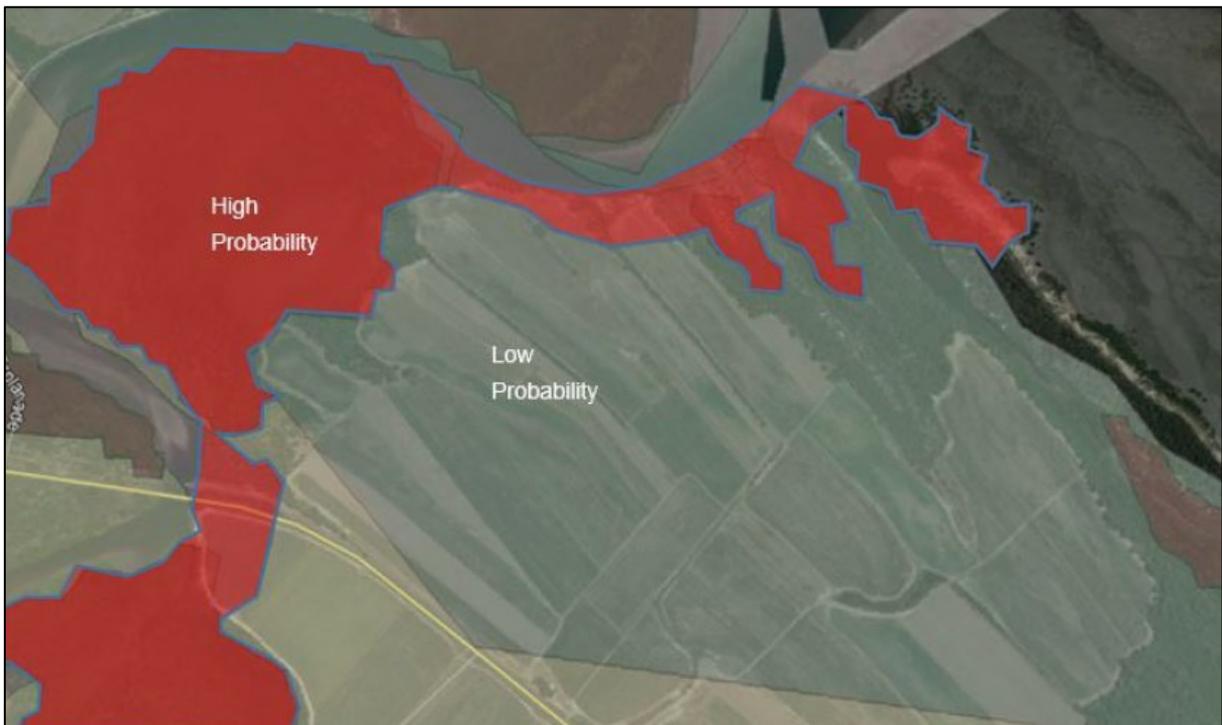


Figure 6 ASS Risk Mapping for the site (Source: Golders, 2020)

3.2.4 Topography and drainage

The site is located on low lying coastal plains (**Figure 7**) and comprises undifferentiated coastal plain deposits: sand, muddy sand and minor mud.

A major drainage line is present immediately to the north of the site (Mowbray River). The site gently grades north east towards the Mowbray River and the coast with surface elevations ranging from ~6 m AHD to ~1m AHD (Golder, 2020).

The site was likely drained to allow for cropping historically with a canal built around the site. The canal has a number of marine plant species present, indicating it is tidal, refer to **Plate 1** below.



Plate 1 Mangrove Species in Canal Drainage Line



Figure 7 Drainage of Site (Qld Globe 2021)

3.2.5 Surface and subsurface conditions

Golders 2020 confirmed most of the site was covered with sugar cane bounded by vegetated land and the Mowbray River to the north. Adjacent cane farms operate to the south east and south west of the site.

Subsurface conditions encountered are summarised from Golder 2020 as follows:

Southern area

- Firm to stiff sandy clay (inferred disturbed/reworked ground) underlain by stiff to hard sandy clay/clay. A layer of firm sandy clay was located near creek inlet.

Central area

- Medium dense to very dense clayey sand/sand (inferred disturbed/ reworked ground) underlain by;
- Medium dense to dense clayey sand/sand underlain by stiff to hard sandy clay/clay.
- A layer of firm sandy clay was located near drain/creek.

Northern Area

- Loose to medium dense sand (inferred disturbed/reworked ground) underlain by;
- Medium dense to dense sand (with some gravel bands) underlain by;
- Very stiff to hard clay/sand clay.

3.3 Ecology

3.3.1 Flora

The site is mapped as predominantly non-remnant vegetation (Category X) with remnant vegetation mapped around the northern and western boundaries of the site (**Figure 8**). For the regional ecosystem report refer to **Appendix C**.

The proposed development will be contained within Category X (existing cleared) areas of the site with the exception of a small area of Remnant Vegetation within the north eastern finger of the site of approximately 2,463m². This area will be offset with the proposed 15 hectare of rehabilitation across the remainder of the site including areas dedicated to wetland rehabilitation, therefore, it is unlikely the proposed impact will result in a Significant Residual Impact. Indeed the rehabilitation will provide habitat values far outweighing the proposed impact of a small area of impacted Regional Ecosystem.

Table 3 Regional ecosystem descriptions

Regional Ecosystem ID	BD Status	Community Description	Area (Ha)
7.1.1	No concern at present	Mangrove closed scrub to open forest of areas subject to regular tidal inundation	1.12
Non-Remnant	None	None	39.1

The site inspection conducted by RPS determined that onsite vegetation is consistent with mapping.

It is proposed that approximately 40% of the site adjoining the north eastern boundary will be rehabilitated with native species to increase connectivity to native vegetation surrounding the Mowbray River.

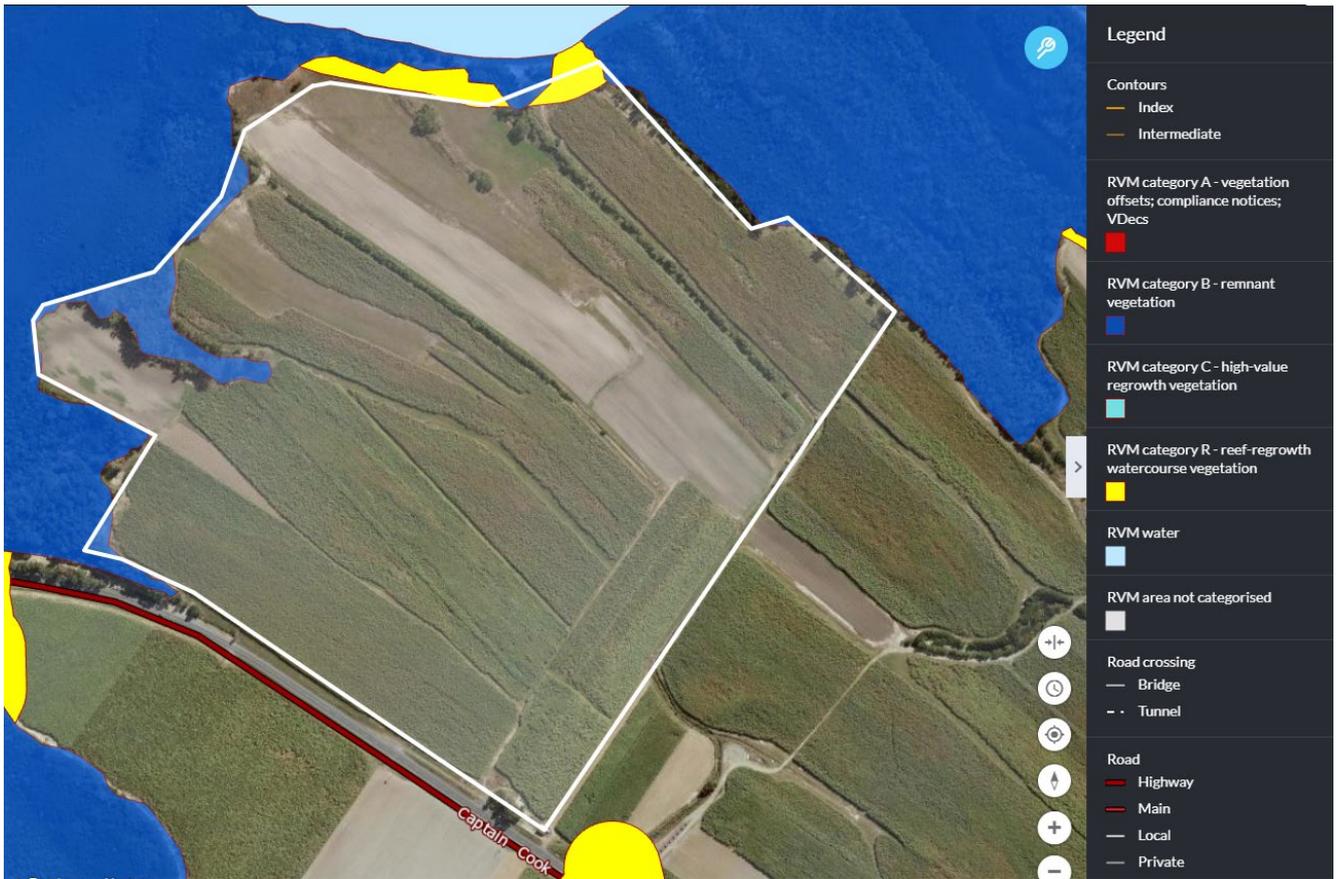


Figure 8 Mapped Regulated Vegetation (Queensland Globe, 2021)

3.3.2 Fauna

Two fauna ecology desktop searches were carried out supporting *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Nature Conservation Act* (NC Act) threatened species. The desktop searches were within a 10 km buffer radius of the project site. Searches came back with 38 EPBC threatened fauna species and 36 NC Act threatened fauna species. A likelihood of occurrence was carried out for 28 of the threatened species. Four (4) species showed potential inhabiting the project site as follows:

- White-throated Needletail (*Hirundapus caudacutus*)
- Masked Owl (northern) (*Tyto novaehollandiae Kimberli*)
- Spectacled Flying-fox (*Pteropus conspicillatus*)
- Water Mouse (*Xeromys myoides*)

The above species underwent an Assessment of Significance to consider any potential impacts that may arise during and after project activities, refer to **Appendix H**. Given only a small area of remnant vegetation is proposed to be impacted, there is little risk of impact to species as a result of the project, and the proposed rehabilitation area is likely to improve habitat values across the site.

3.4 Water

3.4.1 Surface water

The surface water at the site is mapped as moderately disturbed, lowland fresh water under the Environmental Protection (water and wetland Biodiversity) Policy 2019 (EPP). Environmental Values for the Mowbray River Fresh waters as detailed within the EPP include:

- Aquatic ecosystems;

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- Stock water;
- Primary recreation;
- Visual recreation; and
- Cultural and spiritual values.

Water Quality Objectives to protect aquatic ecosystems for the Mowbray River Fresh Waters are summarised in **Table 4**.

Please refer to **Appendix B** for a copy of the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019 Daintree and Mossman River Basins Environmental Values and Water Quality Objectives* (Basins 108 and 109 Adjacent coastal waters).

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Table 4 Water quality objectives for physico-chemical, nutrient, algal and water clarity indicators to protect the aquatic ecosystems EVs under baseflow conditions.

Level of protection	Water type	Water quality objectives												
		Physico-chemical				Nutrients					Algal growth	Water clarity		
		DO	pH	Ammonia N	Oxidised N	Particulate N	Organic N	Total N	FRP	Particulate P	Total P	Chl-a	Turbidity NTU	TSS mg/L
Moderately disturbed waters	Lowland fresh water	85-120 ¹	6.0-8.0 ¹	<10 ¹	<30 ¹	nd	<200 ¹	<240 ¹	<4 ¹	nd	<10 ¹	<1.5 ¹	<15 ¹	<10 ⁴
		Total dissolved N: ≤80 µg/L Total dissolved P: ≤8 µg/L Silicate: ≥165 µg/L Temperature: <1°C increase above long term (20 year) average maximum												

Table Notes:

DO: dissolved oxygen, FRP: filterable reactive phosphorus, Chl-a: chlorophyll-a, TSS: total suspended solids. nd: no (or insufficient) data.
 Units % saturation: percent saturation, µg/L: micrograms per litre, NTU: nephelometric turbidity units, m: metres, mg/L: milligrams per litre.

Source:

Queensland Water Quality Guidelines 2009.

GBRMPA analysis of Reef Rescue Marine Monitoring Program and/or Long Term Monitoring Program datasets.

Analysis of DSITIA water quality monitoring data and Great Barrier Reef Catchment Loads Monitoring Program

3.4.1.1 Surface water quality

A site investigation was conducted by RPS on 17 December 2020 (end of the dry season) and again on 22 January 2021 (start of the wet season) to assess general site water quality conditions.

In accordance with the national framework and *Environmental Protection (Water) Policy 2009* (EPP (Water)), the Daintree and Mossman River Basins Environmental Values and Water Quality Objectives provides local water quality guidelines for the Mowbray River freshwaters (see **Section 3.4.1**).

The water quality analytes that exceeded guideline values are presented in **Table 5** and sampling locations are shown in **Figure 9**.

Table 5 Surface water quality on site

	Date Sampled	pH	Conductivity	Ammonia N	Nitrate / Nitrite	Total Kjeldahl Nitrogen	Total Nitrogen	Total Phosphorus
Units		-	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L
Mowbray River Water Quality Objectives		6.0-8.0		<0.01	<0.03		<0.24	<0.01
Sample 1 (Mowbray)	22 Jan	7.7	14,000	0.04	0.10	0.51	0.61	0.06
Sample 1	17 Dec	7.9	54,000	0.006	0.042	0.21	0.25	<0.02
Canal								
Sample 2	22 Jan	7.4	3,300	0.20	0.42	1.6	2.0	0.36
Sample 2	17 Dec	7.9	54,000	0.029	0.034	0.52	0.55	0.03
Sample 3	22 Jan	7.4	730	0.14	0.55	1.4	1.9	0.26
Sample 3	17 Dec	8.1	52,000	0.013	0.027	1.1	1.1	0.09
Sample 4	22 Jan	7.3	230	0.09	0.27	1.4	1.6	0.27
Sample 4	17 Dec	7.7	570	0.27	0.029	4.1	4.0	1.3
Sample 5	22 Jan	7.2	110	0.03	0.041	0.95	0.99	0.09
Sample 6	22 Jan	7.3	59	<0.01	<0.005	0.25	0.25	<0.02

Note: EPP WQO exceedances highlighted in yellow

The surface water sampled contains concentrations of Ammonia, Nitrate/Nitrite, Total Nitrogen and Total Phosphorous which are above applicable guideline levels.

IMPORTANT NOTE
 This plan was prepared as a concept base plan only and accuracy of all aspects of the plan have not been verified.
 All lots, areas and dimensions are approximate only. Subject to relevant studies, Survey, Engineering and Government approvals.
 No reliance should be placed on the plan and RPS Australia East Pty Ltd accepts no responsibility for any loss or damage suffered howsoever arising to any person who may use or rely on this plan.

DNRM DCDB, DNRM AERIAL PHOTOGRAPHY, DNRM REGULATED VEGETATION MAPPING.
 The boundaries shown on this plan are from DNRM DCDB and are approximate only.
 Based on or contains data provided by the State of Queensland (Department of Natural Resources, Mines & Energy) [2020]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for direct marketing or be used in breach of the privacy laws.
 The aerial photography used in this plan has not been rectified. The image has been overlaid as a best fit on the boundaries shown and position is approximate only.
 Photography publish date: Sep 2019.
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Legend

- Water Sample Location ●
- Marine Plants ■
- Marine Plant Offset Area
- Regulated Vegetation Management Category B - Remnant ■
- Category C - High Value Regrowth ■
- Category R - Reef Regrowth Watercourse ■
- Water ■



**Port Douglas Wave Park
 Figure 9 Vegetation Mapping & Water Sample
 Locations Lot 123 SR687, Mowbray**



PRELIMINARY - FOR DISCUSSION PURPOSES ONLY

Datum: MGA2020 Z55 | Scale: 1:4000 @ A3 | Date: 18-3-2021 | Drawing: PR148361-2a

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3.4.2 Groundwater

The groundwater at the site is mapped as Zone 15 – high calcium – Ca, Na, Cl, low to very high salinity groundwaters under the *Environmental Protection (water and wetland Biodiversity) Policy 2019* (EPP). Environmental Values for the Mossman River Basin Groundwaters as detailed within the EPP include:

- Aquatic ecosystems;
- Irrigation;
- Farm supplies;
- Stock water;
- Drinking water, and
- Cultural and spiritual values.

Water Quality Objectives to protect aquatic ecosystems are summarised in **Table 6**. Water quality objectives for irrigation are summarised in **Table 7** and **Table 8**. Suitability for farm supply use water quality objectives is as per ANZECC 2000 guidelines.

Please refer to **Appendix B** for a copy of the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019 Daintree and Mossman River Basins Environmental Values and Water Quality Objectives (Basins 108 and 109 Adjacent coastal waters)*.

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Table 6 Water quality objectives to protect aquatic ecosystem EVs for Groundwater Chemistry Group – High Calcium – 15

Depth	Percentile	Na		Ca		Mg		HCO ₃		Cl		SO ₄		NO ₃		EC	Hardness (mg L ⁻¹)	pH	Alkalinity (mg L ⁻¹)	SiO ₂ (mg L ⁻¹)	F (mg L ⁻¹)	Fe (mg L ⁻¹)	Mn (mg L ⁻¹)	Zn (mg L ⁻¹)	Cu (mg L ⁻¹)	SAR	RAH (meqL ⁻¹)	eH (mV)
		mg L ⁻¹	%	mg L ⁻¹	%	mg L ⁻¹	%	µS cm ⁻¹																				
shallow	20th	15	65	2	5	2	12	16	9	19	37	2	4	-	0	97	11	6.5	13	13.8	0.000	0.000	0.000	0.010	0.01	1.83	0.00	-
	50th	34	73	7	9	5	16	76	30	34	58	4	5	1	3	246	40	7.0	63	22.0	0.230	0.000	0.000	0.015	0.01	2.45	0.04	-
	80th	3,802	80	240	17	423	17	201	55	6,831	84	568	8	10	5	18,643	2,340	7.7	166	27.9	0.619	0.023	0.147	0.020	0.01	29.85	0.63	-
moderate	20th	44	44	6	4	3	6	45	7	48	38	3	1	-	-	320	31	6.9	38	21.0	0.079	0.000	0.000	0.000	0.00	2.00	0.00	-
	50th	96	68	19	16	7	17	99	23	123	67	7	3	1	0	577	76	7.4	82	33.0	0.220	0.010	0.000	0.010	0.01	5.05	0.93	-
	80th	227	88	60	21	54	25	184	56	522	88	48	7	2	1	1,639	371	7.9	152	38.0	0.601	0.102	0.160	0.030	0.02	13.91	2.13	-
deep	20th	43	43	34	20	7	12	216	51	35	21	2	1	-	-	447	127	7.6	177		0.500	0.000	0.000	0.000	0.00	1.63	0.52	-
	50th	50	47	39	40	7	13	220	77	36	22	2	1	-	-	460	131	7.6	181		0.500	0.000	0.000	0.000	0.00	1.90	1.00	-
	80th	109	53	41	45	30	27	279	77	166	48	4	1	1	0	928	209	8.3	236		0.680	0.009	0.198	0.000	0.00	3.25	1.02	-

Table Notes:

Within each chemistry zone, groundwater quality values are provided for different depths (Shallow: <15m, Moderate: 15–40m, Deep: 40–65m, Very deep: >65m, Artesian: all artesian).

The management intent is to maintain 20th, 50th and 80th percentile values. Values are provided for each of these percentiles.

Abbreviations: EC: Electrical conductivity, CaCO₃: Calcium carbonate, Ca: Calcium, Mg: Magnesium, Na: Sodium, Cl: Chloride, SO₄: Sulfate, HCO₃: Bicarbonate, NO₃: Nitrate, SiO₂: Silica, F: Fluoride, Fe: Iron, Mn: Manganese, Zn: Zinc, Cu: Copper, SAR: Sodium adsorption ratio, RAH: Residual alkali hazard, EH: Redox (oxidation/reduction) potential, '-': insufficient data to perform statistical summaries, or the parameter was not tested.

Source:

Queensland Wet Tropics and Black and Ross catchments: Regional chemistry of the groundwater. Queensland Government (Raymond, M. A. A. and V. H. McNeil, 2013).

Table 7 Irrigation EV: Water quality objective for pathogens

Intended use	Median values of thermotolerant coliforms (colony forming units—cfu) ²
Raw human food crops in direct contact with irrigation water(e.g. via sprays, irrigation of salad vegetables)	<10 cfu/100 mL
Raw human food crops not in direct contact with irrigation water (edible product separated from contact with water, e.g.by peel, use of trickle irrigation); or crops sold to consumers cooked or processed	<1000 cfu/100 mL
Pasture and fodder for dairy animals (without withholding period)	<100 cfu/100 mL
Pasture and fodder for dairy animals (with withholding period of five days)	<1000 cfu/100 mL
Pasture and fodder (for grazing animals except pigs and dairy animals, such as cattle, sheep and goats)	<1000 cfu/100 mL
Silviculture, turf, cotton, etc. (restricted public access)	<10 000 cfu/100 mL

Table Notes:

Adapted from ARMCANZ, ANZECC and NHMRC (1999).

Refer to AWQG, Volume 1, Section 4.2.3.3 for advice on testing protocols. Source: AWQG, Volume 1, Section 4.2.3.3, Table 4.2.2.

For other indicators, such as salinity, sodicity and herbicides, see ANZECC guidelines

Source: AWQG, Volume 1, Section 4.2.3.3, table 4.2.2.

Table 8 Irrigation EV: Water quality objects for heavy metal and metalloids

Element	Soil cumulative contaminant loading limit (CCL) ² (kg/ha)	Long-term trigger value (LTV) in irrigation water (up to 100 years) (mg/L)	Short-term trigger value (STV) in irrigation water (up to 20 years) (mg/L)
Aluminium	ND ²	5	20
Arsenic	20	0.1	2.0
Beryllium	ND	0.1	0.5
Boron	ND	0.5	Refer to AWQG, Vol 3, Table 9.2.18
Cadmium	2	0.01	0.05
Chromium	ND	0.1	1
Cobalt	ND	0.05	0.1
Copper	140	0.2	5
Fluoride	ND	1	2
Iron	ND	0.2	10
Lead	260	2	5
Lithium	ND	2.5	2.5
Manganese	ND	0.2	10
Mercury	2	0.002	0.002
Molybdenum	ND	0.01	0.05
Nickel	85	0.2	2
Selenium	10	0.02	0.05

REPORT

Uranium	ND	0.01	0.1
Vanadium	ND	0.1	0.5
Zinc	300	2	5

Table Notes:

Concentrations in irrigation water should be less than the trigger values. Trigger values should only be used in conjunction with information on each individual element and the potential for off-site transport of contaminants (refer AWQG, Volume 3, Section 9.2.5).

ND = Not determined; insufficient background data to calculate CCL.

For other indicators, such as salinity, sodicity and herbicides, see ANZECC guidelines

Source:

AWQG, Volume 1, Section 4.2.6, Table 4.2.10

Table 9 Drinking water EV: water quality objective for drinking water supply.

Indicator	Water quality objective
<i>Giardia</i>	No guideline value set (ADWG) If <i>Giardia</i> is detected in drinking water then the Water Supply Regulator, DNRME and Queensland Health should be notified immediately and an investigation of the likely source of contamination undertaken.
<i>Cryptosporidium</i>	No guideline value set (ADWG) If <i>Cryptosporidium</i> is detected in treated drinking water then the Water Supply Regulator, DNRME and Queensland Health should be notified immediately and an investigation of the likely source of contamination undertaken.
<i>E. coli</i>	Well designed treatment plants with effective treatment barriers and disinfection are designed to address faecal contamination. <i>E. coli</i> or thermotolerant coliforms should not be present in any 100 mL sample of (treated) drinking water (ADWG). <1 cfu/100ml (Public Health Regulation 2018) and upstream sewage effluent discharges need to be known (catchment management).
Algal toxin	<1.3 µg/L Microcystin (ADWG)
pH	6.5–8.5 (ADWG)
Total dissolved solids (TDS)	<600mg/L The concentration of total dissolved solids in treated drinking water should not exceed 600 mg/L (ADWG, based on taste considerations).
Sodium	General ² : The concentration of sodium in reticulated drinking water supplies should not exceed 180 mg/L (ADWG, based on threshold at which taste becomes appreciable). At-risk groups (medical) ² : The concentration of sodium in water supplies for at-risk groups should not exceed 20 mg/L (ADWG).
Sulfate	The concentration of sulfate in drinking water should not exceed 250 mg/L (ADWG 2011, based on taste/aesthetic considerations). ADWG 2011 health guideline: <500mg/L
Dissolved oxygen	>85% saturation (ADWG)
Pesticides	Raw supplies: Below detectable limits. Treated drinking water: Refer to ADWG.
Other indicators (including physico-chemical indicators) e.g. turbidity	Refer to ADWG. <1 NTU is the target to facilitate for effective disinfection of drinking water (as turbidity of ≥1 NTU inhibits the performance of chlorination (ADWG))

Notes:

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This table outlines WQOs for water before treatment, unless otherwise stated (e.g. ADWG). For water quality after treatment or at the point of use, refer to relevant legislation and guidelines, including *Public Health Act 2005* and Regulation, *Water Supply (Safety and Reliability) Act 2008 and Regulation*, including any approved drinking water management plan under the Act, *Water Fluoridation Act 2008*, the Australian Drinking Water Guidelines (ADWG, 2011 updated December 2013), and the Safe Water on Rural Properties guideline (Queensland Health, 2015).

The ADWG notes that 50 mg/L is a 'typical value' in reticulated supplies. The ADWG value for sodium is 180 mg/L (based on level at which taste become appreciable) however 'sodium salts cannot be easily removed from drinking water' and 'any steps to reduce sodium concentrations are encouraged'. It further notes that 'medical practitioners treating people with severe hypertension or congestive heart failure should be aware if the sodium concentration in the patient's drinking water exceeds 20 mg/L' (ADWG; sodium factsheet).

Source: Australian Drinking Water Guidelines (NHMRC, 2011 as updated 2018). Technical review and advice from Queensland Health and Department of Natural Resources, Mines and Energy (2020).

3.4.2.1 Groundwater levels and quality

In accordance with the national framework and *Environmental Protection (Water) Policy 2009* (EPP (Water)), the Daintree and Mossman River Basins Environmental Values and Water Quality Objectives provides local water quality guidelines for the Mossman River Basin Groundwaters (see **Section 3.4.2**).

Groundwater levels measured within shallow monitoring wells at the site range from 0.15 to 0.96 meters below ground level (Golders, 2020). Please note that groundwater levels are tidally influenced given the proximity to the Mowbray River and associated creeks/drains and may fluctuate seasonally.

The water quality analytes and exceedances of guideline values are presented in **Table 10** and sampling locations are shown in **Figure 10**.



Figure 10 Monitoring well locations on site.

Table 10 Groundwater quality on site (Source: Golder, 2020)

Parameter	EPP WQO		Units	South-west (BH1)	South-east (BH2)	North-east (BH3)	North-west (BH4)
	20 th	80 th					
pH	6.5	7.7	-	6.2	6.8	7.2	7.5
EC	97	18,643	µS/cm	23,641	12,955	498	6,614
Sulfate	-	568	mg/L	-	-	8.3	300
Chloride	-	6,831	mg/L	-	-	44	1,900
Total Alkalinity	-	166	mg/L	-	-	160	220
Dissolved Aluminium	-	-	mg/L	-	-	0.017	0.027
Dissolved Iron	-	0.023	mg/L	-	-	0.066	0.9

Table Note: EPP WQO exceedances highlighted in yellow.

Field and laboratory results from Golders 2020 indicate the following:

- Electrical conductivity (EC) of all locations was brackish, with the exception of the monitoring well in the north-east section of the site which was fresh.
- pH readings indicate slightly acidic to neutral conditions.
- Total alkalinity indicated a high buffering capacity in groundwaters and is adequate to maintain acceptable pH levels in the future.
- Aluminium concentrations do not indicate the presence of ASS.

3.5 Air Quality

The ambient air quality for the site is influenced primarily by agricultural activities within the site and road transport pollution along the Cook Highway.

3.6 Existing Land Use and Sensitive Receptors

The site currently operates as a cane farm with a single detached dwelling, farm sheds and outbuildings, in the south west portion of the site (**Figure 1**). The closest sensitive receptors are four residential properties located in adjacent lots and within proximity of the site. It is unlikely that the operations undertaken on site will cause environmental nuisance given the distance to the receivers.

4 MATTERS OF STATE ENVIRONMENTAL SIGNIFICANCE

Matters of state environmental significance (MSES) are a component of the biodiversity state interest. MSES includes certain environmental values that are protected under Queensland legislation including the:

- *Nature Conservation Act 1992*
- *Marine Parks Act 2004*
- *Fisheries Act 1994*
- *Environmental Protection Act 1994*
- *Regional Interests Planning Act 2014*
- *Vegetation Management Act 1999*
- *Environmental Offsets Act 2014*.

4.1 EPBC Act Protected Matters Report

A desktop search of the Protected Matters Database of the MNES was undertaken on the 16th of March 2021 to identify any MNSES with potential to occur in or within 1km to the project site. A summary of the relevant search results is provided in **Table 11** identifying the number of matters returned and the relevance of the search results to the project. The full search results are presented in **Appendix H**.

Table 11 Matters of National Environmental Significance within proximity to GTA

EPBC matter	Matters returned	Description
World Heritage Properties	1	Great Barrier Reef
National Heritage Places	1	Great Barrier Reef
Wetlands of International Significance	None	
Great Barrier Reef Marine Park (GBRMP)	1	Conservation Park
Commonwealth Marine Area	None	
Listed Threatened Ecological Communities	None	
Listed Threatened Species	43	<ul style="list-style-type: none"> • Birds – 11 • Fish – 1 • Frogs – 1 • Mammals – 11 • Plants – 8 • Reptiles – 7
Listed Migratory Species	47	<ul style="list-style-type: none"> • Marine Birds – 5 • Marine Species – 22 • Terrestrial Species – 10 • Wetland Species – 10

4.1.1 Listed threatened species

4.1.1.1 Flora

The PMST search of the area within a 10km radius of CBTA indicated that 8 threatened plant species are known to occur within the area, listed in **Table 12** (also refer to **Appendix F**). It is noted that due to the site currently being agricultural sugar cane land it is unlikely that these flora species inhabit the site.

Table 12 Threatened flora that have the potential to occur within 1km of GTA

Species name	Common Name	EPBC Act status
<i>Bruguiera x hainesii</i>	Haines's Orange Mangrove	Critically Endangered
<i>Canarium acutifolium</i>		Vulnerable
<i>Myrmecodia beccarii</i>	Ant Plant	Vulnerable
<i>Phaius australis</i>	Lesser swamp-orchid	Endangered
<i>Phalaenopsis amabilis subsp. rosenstromii</i>	Native Moth Orchid	Endangered
<i>Toechima pterocarpum</i>		Endangered
<i>Vappodes lithocola</i>	Dwarf Butterfly Orchid, Cooktown Orchid	Endangered
<i>Vappodes phalaenopsis</i>	Cooktown Orchid	Vulnerable

4.1.1.2 Fauna

The PMST search of the area within a 10km radius of CBTA indicated that 32 threatened fauna species, listed in **Table 13**. Threatened fauna that have the potential to occur on the site, have the potential to occur within the area (also refer to **Appendix F**). As previously noted above for the flora that due to majority of the site currently being agricultural land it is unlikely that most of these species inhabit the area.

Table 13 Threatened fauna that have the potential to occur within the 1km of GTA

Species name	Common Name	EPBC Act status
Birds		
<i>Calidris canutus</i>	Red knot	Endangered
<i>Calidris ferruginea</i>	Curlew sandpiper	Critically endangered
<i>Casuaris casuaris johnsonii</i>	Southern Cassowary	Endangered
<i>Erythrotriorchis radiatus</i>	Red Goshawk	Vulnerable
<i>Fregetta grallaria grallaria</i>	White-bellied Storm-Petrel	Vulnerable
<i>Hirundapus caudacutus</i>	White-throated Needletail	Vulnerable
<i>Limosa lapponica bauera</i>	Bar-tailed Godwit	Vulnerable
<i>Numenius madagascariensis</i>	Eastern curlew	Critically endangered
<i>Rostralula australis</i>	Australian painted-snipe	Endangered
<i>Tyto novaehollandiae kimberlii</i>	Masked owl	Vulnerable
Mammals		
<i>Balaenoptera musculus</i>	Blue Whale	Endangered
<i>Dasyurus hallucatus</i>	Northern Quoll	Endangered
<i>Hipposideros semoni</i>	Semon's Leaf-nosed Bat	Vulnerable
<i>Macroderma gigas</i>	Ghost Bat	Vulnerable
<i>Megaptera novaeangliae</i>	Humpback Whale	Vulnerable
<i>Mesembriomys gouldii rattoides</i>	Black-footed Tree-rat	Vulnerable
<i>Phascolarctos cinereus</i>	Koala	Vulnerable
<i>Pteropus conspicillatus</i>	Spectacled Flying-fox	Endangered
<i>Rhinolophus robertsi</i>	Large-eared Horseshoe Bat	Vulnerable
<i>Saccolaimus saccolaimus nudicluniatus</i>	Bare-rumped Sheath-tailed Bat	Vulnerable
<i>Xeromys myoides</i>	Water Mouse, False Water Rat	Vulnerable

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Species name	Common Name	EPBC Act status
Frogs		
<i>Litoria dayi</i>)	Australian Lace-lid	Vulnerable
Reptiles		
<i>Caretta caretta</i>	Loggerhead Turtle	Endangered
<i>Chelonia mydas</i>	Green Turtle	Vulnerable
<i>Dermochelys coriacea</i>	Leatherback Turtle	Endangered
<i>Egernia rugosa</i>	Yakka Skink	Vulnerable
<i>Eretmochelys imbricate</i>	Hawksbill Turtle	Vulnerable
<i>Lepidochelys olivacea</i>	Olive Ridley Turtle	Endangered
<i>Natator depressus</i>	Flatback Turtle	Vulnerable

4.2 Essential habitat

There are two MSES wildlife habitat mapped within the site; MSES wildlife habitat (endangered or vulnerable) and MSES wildlife habitat (special least concern animal).

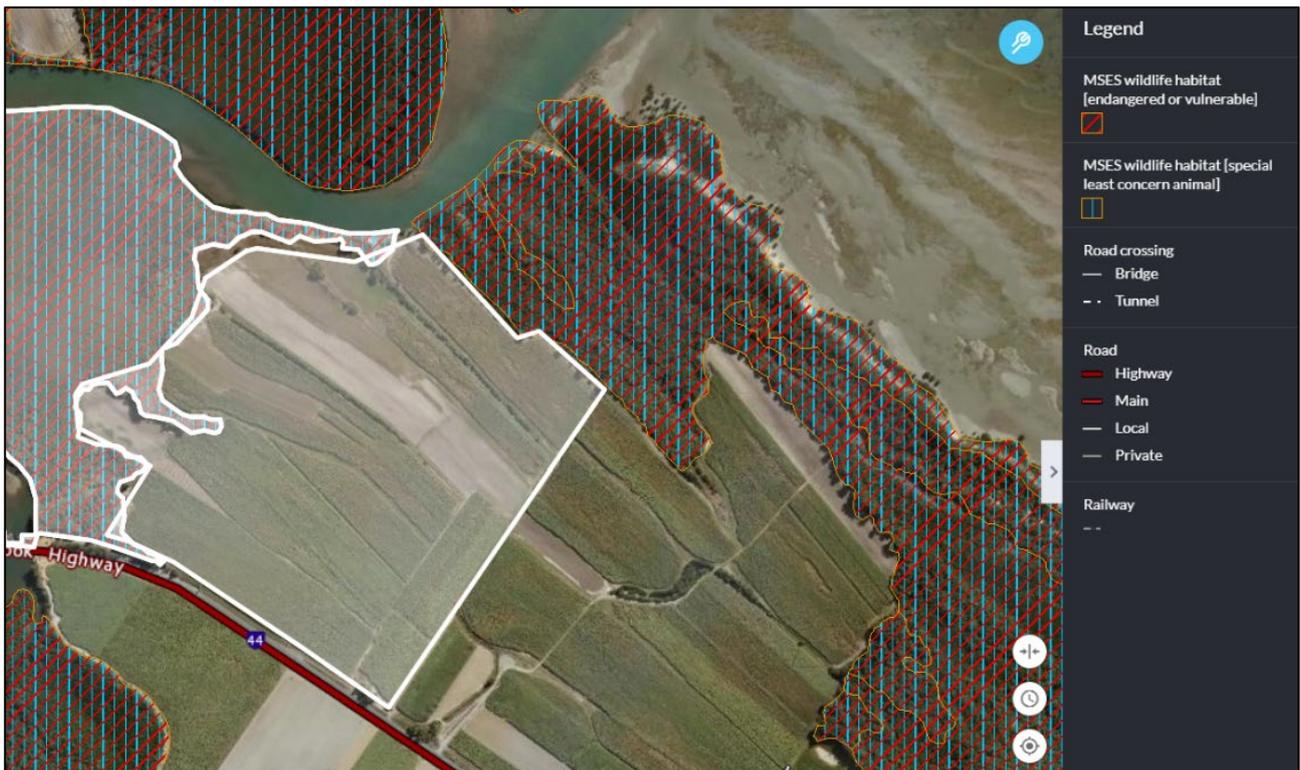


Figure 11 Mapped MSES wildlife habitat (QLD Globe, 2021)

4.3 Regulated vegetation

There are two MSES regulated vegetation mapped within the site; Regulated Vegetation - Category R (GBR riverine regrowth) and Regulated Vegetation (essential habitat). For the MSES search report refer to **Appendix D**.



Figure 12 Mapped MSES regulated vegetation (QLD Globe, 2021)

5 ENVIRONMENTAL VALUES AND IMPACT RISK ASSESSMENT

The following section describes risks to environmental values and likely magnitude of the impacts generated by the proposed amendment.

5.1 Risk Assessment Synopsis

The risk assessment adopted is a qualitative risk-based approach designed to assess risk based on the likelihood of an environmental impact or event occurring (**Table 14**), and the consequences of the occurrence on the surrounding environmental values (**Table 15**). The likelihood and consequences are scored between 1 and 5 for each potential impact or event. The risk assessment has been formulated considering potential for impact without control measures put in place to manage potential risk.

Table 14 Definitions of Likelihood

Rating	Descriptor	Score
Rare	May occur only in exceptional circumstances	1
Unlikely	Could occur but doubtful	2
Possible	Might occur at some point in the future	3
Likely	Will probably occur	4
Almost Certain	Is expected to occur in most circumstances	5

Table 15 Definitions of Consequences

Rating	Descriptor	Score
Negligible	Impacts not requiring any treatment or management action	1
Minor	Nuisance or insignificant environmental harm requiring minor management actions	2
Moderate	Serious environmental impacts, readily manageable at low cost	3
Major	Substantial environmental impacts, manageable but at considerable cost and some disruption	4
Catastrophic	Severe environmental impacts with major consequent disruption and heavy cost	5

The consequence and likelihood scores are then plotted on the risk assessment matrix (**Table 16**). The final risk level assigned is thus a product of the likelihood and consequence scores. The higher the risk score, the higher the priority is for management.

Table 16 Risk Assessment Matrix

Likelihood of an Environmental Impact		Consequence of Said Impact				
		Negligible	Minor	Moderate	Major	Catastrophic
		1	2	3	4	5
Almost Certain	5	5 Medium	10 High	15 High	20 Extreme	25 Extreme
Likely	4	4 Low	8 Medium	12 High	16 High	20 Extreme
Possible	3	3 Low	6 Medium	9 Medium	12 High	15 High
Unlikely	2	2 Low	4 Low	6 Medium	8 Medium	10 High
Rare	1	1 Low	2 Low	3 Low	4 Low	5 Medium

Table 17 describes the possible actions required for each risk assessment rating.

Table 17 Indicative Management Option for Risk Assessment Ratings

Risk Rating	Risk Rating Scores	Indicative Management Option
Extreme	16 - 25	Manage by implementing site management and emergency procedures, plant design controls and regular monitoring.
High	10 - 15	Manage by implementing site management procedures, specific monitoring, and may require some operation/plant design controls.
Medium	5 – 9	Manage by implementing specific monitoring or response procedures.
Low	1 – 4	Manage by routine procedures, unlikely to need specific application of resources.

5.2 Potential Environmental Impacts

Activities associated with the proposed amendment which have the potential to cause environmental harm and/or nuisance have been outlined in **Table 18** below.

This risk assessment is limited to the potential for the activity to impact upon the existing environmental values and does not consider any pre-existing approved impacts of the proposed activity taking place on the site.

Table 18 Identification of Potential Impacts from Activity on Environmental Values

Activity	Potential Impacts				
	Environmental Values Impacted				
	Air	Water	Noise	Land	Waste
Stormwater from construction		x		x	

The identification of potential environmental impacts and associated risk matrix above has informed the control measures set out in **Section 6**.

6 MANAGEMENT PRACTICES

The following section details the management practices proposed that will be implemented to prevent or minimise adverse impacts on Air, Noise, Water, Waste, and Land environmental values as per Schedule 5, Part 3 of the *Environmental Protection Regulation 2019* (EP Reg).

6.1 Air

The Environmental Objective for Air detailed within Schedule 8, Part 3, Table 1 of the EP Reg states:

The activity will be operated in a way that protects the environmental values of air.

Performance Outcomes for Air as detailed in the EP Reg include:

1. *There is no discharge to air of contaminants that may cause an adverse effect on the environment from the operation of the activity.*
2. *All of the following:*
 - a. *Fugitive emissions of contaminants from storage, handling and processing of materials and transporting materials within the site are prevented or minimised;*
 - b. *Contingency measures will prevent or minimise adverse effects on the environment from unplanned emissions and shut down and start up emissions of contaminants to air; and*
 - c. *Releases of contaminants to the atmosphere for dispersion will be managed to prevent or minimise adverse effects on environmental values.*

The *Environmental Protection (Air) Policy 2008* (EPP (Air)) prescribes the Environmental Values that are to be protected or enhanced, which are:

- a. *The qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems;*
- a. *The qualities of the air environment that are conducive to human health and wellbeing;*
- b. *The qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property; and*
- c. *The qualities of the air environment that are conducive to protecting agricultural use of the environment.*

It is anticipated that there will be no discharge to air of contaminants that may cause an adverse effect on the environment from the operation of the activity. Any potential for dust emissions during construction will be managed through a Construction Environment Management Plan (CEMP).

6.2 Water

The Environmental Objective for Water detailed within Schedule 8, Part 3, Table 1 of the EP Reg states:

"The activity will be operated in a way that protects environmental values of waters".

Performance Outcomes for Water as detailed in the EP Reg include:

1. *There is no actual or potential discharge to waters of contaminants that may cause an adverse effect on an environmental value from the operation or the activity.*
2. *All of the following:*

- a. The storage and handling of contaminants will include effective means of secondary containment to prevent or minimise releases to the environment from spillage or leaks;
- b. Contingency measures will prevent or minimise adverse effects on the environment due to unplanned releases or discharges of contaminants to water;
- c. The activity will be managed so that stormwater contaminated by the activity that may cause an adverse effect on an environmental value will not leave the site without prior treatment;
- d. The disturbance of any acid sulfate soil, or potential acid sulfate soil, will be managed to prevent or minimise adverse effects on environmental values;
- e. Acid producing rock will be managed to ensure that the production and release of acidic waste is prevented or minimised, including impacts during operation and after the environmental authority has been surrendered;
- f. Any discharge to water or a watercourse or wetland will be managed so that there will be adverse effects due to the altering of existing flow regimes for water or a watercourse or wetland; and
- g. For a petroleum activity, the activity will be managed in a way that is consistent with the coal seam gas water management policy, including the prioritisation hierarchy for managing and using coal seam gas water and the prioritisation hierarchy for managing saline waste.
- h. the activity will be managed so that adverse effects on environmental values are prevented or minimised.

Water will be sent to sewer therefore no actual or potential discharge to waters of contaminants that may cause an adverse effect on an environmental value from the operation or activity is likely. Any potential for water quality impact during construction will be managed in accordance with a CEMP.

6.3 Wetlands

The Environmental Objective Wetland is detailed within Schedule 8, Part 3, Table 1 of the EP Reg which states:

“The activity will be operated in a way that protects the environmental values of wetlands.”

Performance Outcomes for Wetlands as detailed in the EP Reg include:

- 1. *There will be no potential or actual adverse effect on a wetland as part of carrying out the activity.*
- 2. *The activity will be managed in a way that prevents or minimises adverse effects on wetlands.*

No potential or actual adverse effects on a wetland as part of carrying out the proposed development is likely. Surface water runoff from stormwater will be managed to ensure no adverse effects on wetlands.

6.4 Groundwater

The Environmental Objective for Groundwater detailed within Schedule 8, Part 3, Table 1 of the EP Reg states:

“The activity will be operated in a way that protects the environmental values of groundwater and any associated surface ecological systems.”

Performance Outcomes for Groundwater as detailed in the EP Reg include:

- 1. *Both of the following apply—*
 - a. there will be no direct or indirect release of contaminants to groundwater from the operation of the activity;

- a. *Activities that disturb land, soils, subsoils, landforms and associated flora and fauna will be managed in a way that prevents or minimise adverse effects on the environmental values of land;*
- b. *Areas disturbed will be rehabilitated or restored to achieve sites that are:*
 - i. *Safe to humans and wildlife;*
 - ii. *Non-polluting;*
 - iii. *Stable; and*
 - iv. *Able to sustain an appropriate land use after rehabilitation or restoration.*
- c. *The activity will be managed to prevent or minimise adverse effects on the environmental values of land due to unplanned releases or discharges, including spills and leaks of contaminants; and*
- d. *The application of water or waste to the land is sustainable and is managed to prevent or minimise adverse effects on the composition or structure of soils and subsoils.*

The proposed cut and fill on the site for construction purposes is not proposed to adversely affect the environmental values of the land as part of carrying out the activity.

6.7 Waste

The Environmental Objective for Waste detailed within Schedule 8, Part 3, Table 1 of the EP Reg states:

“Any waste generated, transported, or received as part of carrying out the activity is managed in a way that protects all environmental values”.

Performance Outcomes for Waste as detailed in the EP Reg include:

- 1. *Both of the following apply:*
 - a. *Waste generated, transported or received is managed in accordance with the waste and resource management hierarchy in the Waste Reduction and Recycling Act 2011 (WRRRA); and*
 - b. *If waste is disposed of, it is disposed of in a way that prevents or minimises adverse effects on environmental values.*

Where waste is generated from the development, it will be managed in accordance with the waste and resource management hierarchy in the WRRRA and disposed of in a way that prevents or minimises adverse effects on the EV's.

7 CONCLUSION

This report has been prepared to provide an overview of the proposed integrated wave park development and potential for environmental impacts as a result of the proposed development.

The proposed development has been sited to avoid mapped environmental values as far as feasible located almost entirely within Category X cleared land with only 2,463m³ of Remnant Vegetation likely to be removed which is proposed to be offset by approximately 15 hectares of revegetation across the project site.

As a result, the proposed development is likely to increase environmental habitat which will negate any potential impact on the existing area of vegetated likely to be impacted as a result of the siting of the proposed wave park.

It is proposed that a Construction Environment Management Plan is prepared and implemented to manage any potential impacts from construction activities.

Appendix A Site Layout Plan



MASTER PLAN SCALE 1:2000 01

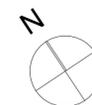
PORT DOUGLAS SURF PARK

DA-01.6

**DEVELOPMENT APPLICATION
FOR : GRABEN PTY LTD
5640 CAPTAIN COOK HIGHWAY
CRAIGLEE, QLD, AUST**

**MASTER PLAN DIAGRAMS
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Appendix B Daintree-Mossman River Environmental Values Water Quality Objectives

Environmental Protection (Water and Wetland Biodiversity) Policy 2019

Daintree and Mossman River Basins Environmental Values and Water Quality Objectives

basins 108 and 109 adjacent coastal waters

Prepared by: Environmental Policy and Planning Division, Department of Environment and Science

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October 2020

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October 2020 Amendments: Daintree and Mossman River basins

1 Introduction

This amendment document (October 2020) is made pursuant to the Environmental Protection (Water and Wetland Biodiversity) Policy 2019, and applies to all Wet Tropics schedule 1 documents, scheduled in 2014.

Section 13 (2) (b) of the EPP (Water and Wetland Biodiversity), and section 1.6 (Matters for amendment) of the respective schedule documents outline permissible amendment types. These include changes to water quality objectives (WQOs); changes to water type boundaries/descriptions; updates to information/data sources, websites and email contact details, agency/departmental names, other institutional names, references.

Table 1 summarises the 2020 amendments. Table 2 provides updated aquatic ecosystem WQOs. Section 3 provides updated human use WQOs. Aside from the changes below, the content from 2014 remains applicable.

Table 1 Summary of amendments

2014 content	2020 amended content
Table 2.1 Water quality objectives for physico-chemical, nutrient, algal and water clarity indicators to protect the aquatic ecosystems EVs under baseflow conditions (Coastal, Midshelf and Offshore Waters only)	Table 2 Aquatic ecosystem water quality objectives: coastal and marine waters, replaces Table 2.1 for coastal and marine waters.
Table 2.3 Water quality objectives for specific pesticides and biocides to protect aquatic ecosystem EVs	ANZG, 2018, replaces Table 2.3
Table 2.4 Water quality objectives for other ions, metals and chemical indicators in surface waters	<u>Wet Tropics basins schedule documents (excluding Barron River Basin)</u> ; ANZG, 2018, replaces Table 2.4
AWQG or ANZECC guidelines Australian and New Zealand Guidelines for Fresh and Marine Water Quality (October 2000)	Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018), as amended.
Monitoring and Sampling Manual 2009	Monitoring and Sampling Manual 2018 , as amended. Published on the department's website.
All legislative references	Refer to the latest version under the <i>Acts Interpretation Act, 1954</i> , as amended
Wet Tropics Coastal waters plan WQ1082	Revised coastal waters plan WQ1082 (available from the department's website)
Section 3.3 Water quality objectives for human use environmental values (including tables 3.1-3.10)	Section 3 Water quality objectives for human use environmental values (including tables 3-12)

2 Amendments

WET TROPICS COASTAL WATERS - AQUATIC ECOSYSTEM WQOs AMENDMENTS 2020

Applying to enclosed coastal, open coastal, midshelf and offshore marine waters of all Wet Tropics basins. Refer accompanying plan, WQ1082.

Table 2 Aquatic ecosystem water quality objectives: coastal and marine waters

Water area/type (Source: s1–s6) (refer plan WQ1082)	Management intent /Level of protection	WET TROPICS - COASTAL AND MARINE WATERS (refer plan WQ1082) Aquatic Ecosystem water quality objectives ¹⁻⁷															
		Note: WQGs for indicators are shown as a range of 20 th , 50 th and 80 th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to 'Note 7: comparison of test data with WQOs' for more details).															
		HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data															
		Sources: S1: Local datasets/reporting; S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)															
		Amm N ¹ (µg/L)	Oxid N ¹ (µg/L)	Partic N ⁵ (µg/L)	Total Diss N (µg/L)	Total N (µg/L)	FRP (µg/L)	Partic P ⁵ (µg/L)	Total Diss P (µg/L)	Total P (µg/L)	Chl-a ⁵ (µg/L)	Silicate (µg/L)	DO ³ (% sat)	Turb (NTU)	Secchi (m)	SS ^{2,5} (mg/L)	pH
WET TROPICS ENCLOSED COASTAL/LOWER ESTUARY WATERS – ALL WET TROPICS BASINS																	
WET TROPICS HEV and SD enclosed coastal/ lower estuary waters HEV3001, HEV3041, HEV3061, HEV3081, HEV3121 SD3041, SD3081, SD3121 (s2)	HEV	7–10–15 (s2)	2–3–10 (s2)	ID	na	95–115–160 (s2)	2–3–5 (s2)	ID	na	9–13–20 (s2)	0.7–1.1–2.0 (s2)	na	85–105 (s2)	1–4–10 (s2)	1–1.6–2.2 (s2)	ID	7.5–8.4 (s2)
WET TROPICS MD enclosed coastal/ lower estuary waters not identified as HEV or SD (s2)	MD	<15 (s2)	<10 (s2)	ID	na	<160 (s2)	<5 (s2)	ID	na	<20 (s2)	<2 (s2)	na	85–105 (s2)	<10 (s2)	>1 (s2)	ID	7.5–8.4 (s2)

Water area/type (Source: s1–s6) (refer plan WQ1082)	Management intent /Level of protection	WET TROPICS - COASTAL AND MARINE WATERS (refer plan WQ1082) Aquatic Ecosystem water quality objectives ¹⁻⁷															
		<p>Note: WQGs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to ‘Note 7: comparison of test data with WQOs’ for more details).</p> <p>HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data</p> <p>Sources: S1: Local datasets/reporting; S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)</p>															
		Amm N ¹ (µg/L)	Oxid N ¹ (µg/L)	Partic N ⁵ (µg/L)	Total Diss N (µg/L)	Total N (µg/L)	FRP (µg/L)	Partic P ⁵ (µg/L)	Total Diss P (µg/L)	Total P (µg/L)	Chl-a ⁵ (µg/L)	Silicate (µg/L)	DO ³ (% sat)	Turb (NTU)	Secchi (m)	SS ^{2,5} (mg/L)	pH
WET TROPICS OPEN COASTAL WATERS – ALL BASINS EXCEPT HERBERT RIVER BASIN (refer separate row below)																	
WET TROPICS HEV and SD open coastal waters HEV3121, SD3121 (EXCLUDES Herbert Palm Island Group) (s2, s3, s4)	HEV	≤2 (s4)	0.07–0.35–1.15 (s4)	≤20 (ann. mean) Dry: ≤16 (May-Oct) Wet: ≤25 (Nov-Apr) (s3, s4)	50–80–100 (s4)	65–100–125 (s4)	0–2–3 (s4)	≤2.8 (ann. mean) Dry: ≤2.3 (May-Oct) Wet: ≤3.3 (Nov-Apr) (s3, s4)	3–6–10 (s4)	5–11–20 (s4)	≤0.45 (ann. mean) Dry: ≤0.32 (May-Oct) Wet: ≤0.63 (Nov-Apr) (s3, s4)	90–165–260 (s4)	95–105 (s2)	0.6–0.9–1.8 (s3, s4)	≥10 (ann. mean) (s3)	≤2 (ann. mean) Dry: ≤1.6 (May-Oct) Wet: ≤2.4 (Nov-Apr) (s3, s4)	8.1–8.4 (s2)
WET TROPICS Open coastal waters not identified as HEV or SD (EXCLUDES Herbert Palm Island Group) (s2, s3, s4)	SMD mapped as MD	≤2 (s4)	≤0.35 (s4)	≤20 (ann. mean) Dry: ≤16 (May-Oct) Wet: ≤25 (Nov-Apr) (s3, s4)	≤80 (s4)	≤100 (s4)	≤2 (s4)	≤2.8 (ann. mean) Dry: ≤2.3 (May-Oct) Wet: ≤3.3 (Nov-Apr) (s3, s4)	≤6 (s4)	≤11 (s4)	≤0.45 (ann. mean) Dry: ≤0.32 (May-Oct) Wet: ≤0.63 (Nov-Apr) (s3, s4)	≥165 (s4)	95–105 (s2)	≤1 (s3, s4)	≥10 (ann. mean) (s3)	≤2 (ann. mean) Dry: ≤1.6 (May-Oct) Wet: ≤2.4 (Nov-Apr) (s3, s4)	8.1–8.4 (s2)
WET TROPICS OPEN COASTAL WATERS – HERBERT RIVER BASIN (Palm Island Group)																	
HERBERT - PALM ISLAND GROUP HEV and SD open coastal waters HEV3124, SD3124 (s2, s3, s4)	HEV/SD	≤3 (s4)	0.14–0.28–1.70 (s4)	≤20 (ann. mean) Dry: ≤16 (May-Oct) Wet: ≤25 (Nov-Apr) (s3, s4)	55–75–95 (s4)	70–100–125 (s4)	0–2–4 (s4)	≤2.8 (ann. mean) Dry: ≤2.3 (May-Oct) Wet: ≤3.3 (Nov-Apr) (s3, s4)	3–6–10 (s4)	7–11–20 (s4)	≤0.45 (ann. mean) Dry: ≤0.32 (May-Oct) Wet: ≤0.63 (Nov-Apr) (s3, s4)	90–165–260 (s4)	95–105 (s2)	0.6–0.8–1.3 (s3, s4)	≥10 (ann. mean) (s3)	≤2 (ann. mean) Dry: ≤1.6 (May-Oct) Wet: ≤2.4 (Nov-Apr) (s3, s4)	8.1–8.4 (s2)

Water area/type (Source: s1–s6) (refer plan WQ1082)	Management intent /Level of protection	WET TROPICS - COASTAL AND MARINE WATERS (refer plan WQ1082) Aquatic Ecosystem water quality objectives ¹⁻⁷															
		<p>Note: WQGs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to 'Note 7: comparison of test data with WQOs' for more details).</p> <p>HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data</p> <p>Sources: S1: Local datasets/reporting; S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)</p>															
		Amm N ¹ (µg/L)	Oxid N ¹ (µg/L)	Partic N ⁵ (µg/L)	Total Diss N (µg/L)	Total N (µg/L)	FRP (µg/L)	Partic P ⁵ (µg/L)	Total Diss P (µg/L)	Total P (µg/L)	Chl-a ⁵ (µg/L)	Silicate (µg/L)	DO ³ (% sat)	Turb (NTU)	Secchi (m)	SS ^{2,5} (mg/L)	pH
HERBERT - PALM ISLAND GROUP Open coastal waters not identified as HEV or SD (s2, s3, s4)	SMD mapped as MD	≤3 (s4)	≤0.28 (s4)	≤20 (ann. mean) Dry: ≤16 (May-Oct) Wet: ≤25 (Nov-Apr) (s3, s4)	≤75 (s4)	≤100 (s4)	≤2 (s4)	≤2.8 (ann. mean) Dry: ≤2.3 (May-Oct) Wet: ≤3.3 (Nov-Apr) (s3, s4)	≤6 (s4)	≤11 (s4)	≤0.45 (ann. mean) Dry: ≤0.32 (May-Oct) Wet: ≤0.63 (Nov-Apr) (s3)	≥165 (s4)	95–105 (s2)	≤1 (s3, s4)	≥10 (ann. mean) (s3)	≤2 (ann. mean) Dry: ≤1.6 (May-Oct) Wet: ≤2.4 (Nov-Apr) (s3, s4)	8.1–8.4 (s2)
WET TROPICS MIDSHELF WATERS – ALL WET TROPICS BASINS EXCEPT HERBERT RIVER BASIN (refer separate row below)																	
WET TROPICS HEV3121 midshelf waters EXCLUDES Herbert Palm Island Group (s2, s3, s4)	HEV	≤2 (s4)	0.14–0.31–0.78 (s4)	10–14–18 Dry: ≤16 (May-Oct) Wet: ≤25 (Nov-Apr) (s3, s4)	60–80–105 (s4)	75–100–130 (s4)	0–2–3 (s4)	1.5–2.0–3.0 Dry: ≤2.3 (May-Oct) Wet: ≤3.3 (Nov-Apr) (s3, s4)	3–6–10 (s4)	6–8–15 (s4)	0.2–0.3–0.46 Dry: ≤0.32 (May-Oct) Wet: ≤0.63 (Nov-Apr) (s3, s4)	50–95–165 (s4)	95–105 (s2)	0.4–0.6–0.8 (s3, s4)	6–9–14 (s4)	0.6–1.1–1.8 Dry: ≤1.6 (May-Oct) Wet: ≤2.4 (Nov-Apr) (s3, s4)	8.1–8.4 (s2)
WET TROPICS MIDSHELF WATERS – HERBERT RIVER BASIN (Palm Island Group)																	
HERBERT PALM ISLAND GROUP HEV3124 midshelf waters (s2, s3, s4)	HEV	≤3 (s4)	0.14–0.31–2.08 (s4)	10–14–20 Dry: ≤16 (May-Oct) Wet: ≤25 (Nov-Apr) (s3, s4)	55–75–95 (s4)	70–100–115 (s4)	0–1–4 (s4)	1.5–2.0–2.8 Dry: ≤2.3 (May-Oct) Wet: ≤3.3 (Nov-Apr) (s3, s4)	3–6–10 (s4)	5–10–15 (s4)	0.18–0.33–0.57 Dry: ≤0.32 (May-Oct) Wet: ≤0.63 (Nov-Apr) (s3,s4)	40–85–150 (s4)	95–105 (s2)	0.4–0.5–0.7 (s3, s4)	9–13–17 (s3, s4)	0.5–0.8–1.6 Dry: ≤1.6 (May-Oct) Wet: ≤2.4 (Nov-Apr) (s3, s4)	8.1–8.4 (s2)

Water area/type (Source: s1–s6) (refer plan WQ1082)	Management intent /Level of protection	WET TROPICS - COASTAL AND MARINE WATERS (refer plan WQ1082) Aquatic Ecosystem water quality objectives ¹⁻⁷															
		<p>Note: WQGs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to ‘Note 7: comparison of test data with WQOs’ for more details).</p> <p>HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data</p> <p>Sources: S1: Local datasets/reporting; S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)</p>															
		Amm N ¹ (µg/L)	Oxid N ¹ (µg/L)	Partic N ⁵ (µg/L)	Total Diss N (µg/L)	Total N (µg/L)	FRP (µg/L)	Partic P ⁵ (µg/L)	Total Diss P (µg/L)	Total P (µg/L)	Chl-a ⁵ (µg/L)	Silicate (µg/L)	DO ³ (% sat)	Turb (NTU)	Secchi (m)	SS ^{2,5} (mg/L)	pH
WET TROPICS OFFSHORE WATERS – ALL WET TROPICS BASINS																	
WET TROPICS HEV3122 offshore waters (s2, s3, s4)	HEV	≤2 (s4)	0–0.6–2 (s4)	10–12–16 Dry: ≤14 (May-Oct) Wet: ≤20 (Nov-Apr) (s3, s4)	55–75–95 (s4)	70–95–120 (s4)	0–2–3 (s4)	1.2–1.7–2.4 Dry: ≤1.5 (May-Oct) Wet: ≤2.3 (Nov-Apr) (s3, s4)	2–5–8 (s4)	4–6–9 (s4)	0.2–0.3–0.5 Dry: ≤0.28 (May-Oct) Wet: ≤0.56 (Nov-Apr) (s3, s4)	25–50–100 (s4)	95–105 (s2)	≤1 (s2, s4)	13–18–23 (s3, s4)	0.3–0.6–1.0 Dry: ≤0.6 (May-Oct) Wet: ≤0.8 (Nov-Apr) (s3, s4)	8.1–8.4 (s2)
WET TROPICS COASTAL AND MARINE WATERS – TOXICANTS (INCLUDING METALS, BIOCIDES)																	
Coastal (including lower estuary and marine waters outside ports, marinas, spoil grounds: toxicants (s1, s3, s5, s6)	all	<ul style="list-style-type: none"> Toxicants (including metals, biocides) in water: refer to 99% species protection values contained in: <ul style="list-style-type: none"> ANZG (2018) ‘toxicant default guideline values for water quality in aquatic ecosystems’, as amended The following sources, where their guideline values post-date the specified ANZG guideline value, or where there is no ANZG value specified for a toxicant (Note: the ANZG specifies the date of guideline development for each toxicant): <ul style="list-style-type: none"> Biocides: <ul style="list-style-type: none"> GBRMPA (2010) <i>Water quality guidelines for the Great Barrier Reef Marine Park 2010</i> King et al (2017, as amended) (vol 1 and 2) <i>Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area</i> (available from Queensland Government publications) Aluminium: <2.1 µg/L (99% species protection. Applies to the measured concentration in seawater that passes through a 0.45 µm filter) [Source: Golding et al. (2015)] Toxicants in sediments: refer to ANZG ‘toxicant default guideline values for sediment quality’ Ship-sourced pollutants (including sewage): Discharge of ship-sourced pollutants (including sewage) to be controlled in accordance with requirements of the <i>Transport Operations (Marine Pollution) Act 1995</i> and Regulation 2018. (Refer to Maritime Services Queensland website for further information.) Anti-fouling: Comply with <i>Anti-fouling and in-water cleaning guidelines</i> (2015, as amended) 															

Water area/type (Source: s1–s6) (refer plan WQ1082)	Management intent /Level of protection	WET TROPICS - COASTAL AND MARINE WATERS (refer plan WQ1082) Aquatic Ecosystem water quality objectives ¹⁻⁷														
		Note: WQGs for indicators are shown as a range of 20 th , 50 th and 80 th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to ‘Note 7: comparison of test data with WQOs’ for more details). HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data Sources: S1: Local datasets/reporting; S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)														
		Amm N ¹ (µg/L)	Oxid N ¹ (µg/L)	Partic N ⁵ (µg/L)	Total Diss N (µg/L)	Total N (µg/L)	FRP (µg/L)	Partic P ⁵ (µg/L)	Total Diss P (µg/L)	Total P (µg/L)	Chl-a ⁵ (µg/L)	Silicate (µg/L)	DO ³ (% sat)	Turb (NTU)	Secchi (m)	SS ^{2,5} (mg/L)
Coastal (including lower estuary) and marine waters in ports, marinas, spoil grounds: toxicants (s1, s3, s5, s6)	all	<ul style="list-style-type: none"> Toxicants (excluding biocides – see below) in water: refer to 95% species protection values (or 99% species protection values for those toxicants identified in ANZG as having bioaccumulation potential) contained in: <ul style="list-style-type: none"> ANZG (2018) ‘toxicant default guideline values for water quality in aquatic ecosystems’, as amended The following sources, where their guideline values post-date the specified ANZG guideline value, or where there is no ANZG value specified for a toxicant (Note: the ANZG specifies the date of guideline development for each toxicant): <ul style="list-style-type: none"> Aluminium: <24 µg/L (95% species protection. Applies to the measured concentration in seawater that passes through a 0.45 µm filter) [Source: Golding et al. (2015)] Biocides in water: refer to 99% species protection values (tributyltin: apply 95% species protection values) contained in: <ul style="list-style-type: none"> ANZG (2018) ‘toxicant default guideline values for water quality in aquatic ecosystems’, as amended The following sources, where their guideline values post-date the specified ANZG guideline value, or where there is no ANZG value specified for a toxicant (Note: the ANZG specifies the date of guideline development for each toxicant): <ul style="list-style-type: none"> GBRMPA (2010) <i>Water quality guidelines for the Great Barrier Reef Marine Park 2010</i> King et al (2017, as amended) (vol 1 and 2) <i>Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area</i> (available from Queensland Government publications) Toxicants in sediments: refer to ANZG ‘toxicant default guideline values for sediment quality’ Ship-sourced pollutants (including sewage): Discharge of ship-sourced pollutants (including sewage) to be controlled in accordance with requirements of the <i>Transport Operations (Marine Pollution) Act 1995</i> and Regulation 2018. (Refer to Maritime Services Queensland website for further information.) Anti-fouling: Comply with <i>Anti-fouling and in-water cleaning guidelines</i> (2015, as amended) 														
COASTAL AND MARINE WATERS – TEMPERATURE, BIOLOGICAL																
Coastal and marine waters	all	Temperature (s3): Increases of no more than 1°C above long-term (20 year) average maximum. (GBRMPA, 2010)														
Coastal waters: biological (s1)	All (where applicable)	<u>Seagrass</u> Light requirements are specified as a photosynthetic active radiation (PAR) moving average, depending on seagrass species. Levels specified here are derived to support the health of all species present either as the dominant species or as one of a suite of species that are known to occur in the region. It does not reflect requirements for macroalgae or other organisms. <ul style="list-style-type: none"> Deep water areas (>10m) 2.5 mol m⁻² day⁻¹ over a rolling 7 day average # (Collier et al 2016; Chartrand et al 2014; Rasheed et al 2014; York et al 2015) 														

Water area/type (Source: s1–s6) (refer plan WQ1082)	Management intent /Level of protection	WET TROPICS - COASTAL AND MARINE WATERS (refer plan WQ1082) Aquatic Ecosystem water quality objectives ¹⁻⁷															
		<p>Note: WQGs for indicators are shown as a range of 20th, 50th and 80th percentiles to be maintained or achieved (e.g. 3–4–5), lower and upper limits (e.g. pH: 7.2–8.2), or as a single value (e.g. <15). For single value WQOs, medians (or means where specified) of test data are compared against the WQO (refer to 'Note 7: comparison of test data with WQOs' for more details).</p> <p>HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed. Refer to accompanying plans for details; ID – insufficient data</p> <p>Sources: S1: Local datasets/reporting; S2: QWQG guidelines and /or data; S3: GBRMPA (2010) WQG; S4: GBRMPA analysis of Marine Monitoring Program and/or AIMS Long Term Monitoring Program datasets; S5: ANZG (2018); S6: CSIRO aluminium studies (Golding et al., 2015)</p>															
		Amm N ¹ (µg/L)	Oxid N ¹ (µg/L)	Partic N ⁵ (µg/L)	Total Diss N (µg/L)	Total N (µg/L)	FRP (µg/L)	Partic P ⁵ (µg/L)	Total Diss P (µg/L)	Total P (µg/L)	Chl-a ⁵ (µg/L)	Silicate (µg/L)	DO ³ (% sat)	Turb (NTU)	Secchi (m)	SS ^{2,5} (mg/L)	pH
		<ul style="list-style-type: none"> Shallow inshore areas (<10m): 6 mol m⁻² day⁻¹ over a rolling 14 day average # (Collier et al 2016; Chartrand et al, 2012) <p>Note: # Absolute light requirements for seagrass may vary between sites. Values described here provide a conservative guide to the levels of light likely to support seagrass growth. Locally derived absolute thresholds ideally should be obtained for management of specific activities likely to impact on the light environment.</p>															

Abbreviations: ANZG – Australian and New Zealand guidelines for fresh and marine water quality; QWQG – Queensland water quality guidelines; ID – insufficient data. Will be updated if information becomes available; na – not applicable; * – limited data. To be used as interim value until further data is available.

Indicators: FRP – filterable reactive phosphorus; Chl-a – chlorophyll-a; DO – dissolved oxygen; SS – total suspended solids;

Units: µg/L – micrograms per litre; % sat – percent saturation; NTU – nephelometric turbidity units; m – metres; mg/L – milligrams per litre;

Management intent: Waters for which all physico-chemical WQOs (e.g. nutrients, toxicants) have been set corresponding to HEV management intent are identified in columns 1 and 2 of Table 2. Each of these waters is given a specific label in the table (e.g. 'HEV1234') which links to the accompanying plans. Slightly disturbed (SD) waters are similarly identified.

The management intent (level of protection) for most waters other than HEV or SD is to achieve a 'moderately disturbed' (MD) condition, for which corresponding WQOs have been derived. Where local WQOs are derived for MD areas these are also identified with specific labels (e.g. 'MD1234'). For some indicators and water types, WQOs correspond with a 'slightly to moderately disturbed' (SMD) level of protection, based on management intent categories specified in source technical guidelines, in particular the ANZG (2018). For ease of interpretation, this document and accompanying mapping include these within the MD level of protection. For some MD waters a higher level of protection may be provided for toxicants (e.g. pesticides).

Notes to Table (where applicable):

1. Nutrients:

Oxidised N = NO₂ + NO₃. Dissolved inorganic N (DIN) = Amm N + oxidised N.

Except where specified for event conditions, nutrient guidelines do not apply during high flow events in fresh and estuarine waters. During periods of low flow and particularly in smaller creeks, build-up of organic matter derived from natural sources (e.g. leaf litter) can result in increased organic N levels (generally in the range of 400 to 800µg/L). This may lead to total N values exceeding the WQGs. Provided that levels of inorganic N (i.e. NH₃ + oxidised N) remain low, then the elevated levels of organic N should not be seen as a breach of the WQGs, provided this is due to natural causes. See QWQG (section 5 and Appendix D) for more information on applying guidelines under high flow conditions.

2. Suspended solids: Suspended solids (and hence turbidity and Secchi depth) levels in coastal waters are naturally highly variable depending on wind speed/wave height and in some cases on tidal cycles. The values in this table provide guidance on what the long term values of turbidity, Secchi depth or TSS should comply with. However, these values will often be naturally exceeded in the short term during windy weather or spring tides. They therefore should not be used for comparison with short term data sets. Where assessable coastal developments are proposed, proponents should

carry out site specific intensive monitoring of these indicators (or equivalent light penetration indicators) and use these as a baseline for deriving local guidelines and for comparison with post development conditions.

3. Dissolved oxygen (DO): Dissolved Oxygen (DO) guidelines apply to daytime conditions. Lower values will occur at night in most waters. In estuaries, reductions should only be in the region of 10–15 per cent saturation below daytime values. In freshwaters, night-time reductions are more variable. Following significant rainfall events, reduced DO values may occur due to the influx of organic material. In estuaries post-event values as low as 40 per cent saturation may occur naturally for short periods but values well below this would indicate some anthropogenic effect. In freshwaters, post-event DO reductions are again more variable. In general, DO values consistently less than 50 per cent are likely to impact on the ongoing ability of fish to persist in a water body while short term DO values less than 30 per cent saturation are toxic to some fish species. Very high DO (supersaturation) values can be toxic to some fish as they cause gas bubble disease. DO values for fresh waters should only be applied to flowing waters. Stagnant pools in intermittent streams naturally experience values of DO below 50 per cent saturation.

4. Open coastal/marine waters – GBR plume line: The GBR plume discharge area is derived from a smoothed version of the ‘high’ and ‘very high’ risk classes of modelled outputs from the risk assessment element of the Reef Plan Scientific Consensus Statement 2013 (Waterhouse et al. 2013).

5. Open coastal/marine waters - seasonal splits: Dry season is generally between May to November, however will vary annually and should be assessed based on rainfall and discharge. Wet season is generally December to April, however will vary annually and should be assessed based on discharge and antecedent rainfall. While seasonal means are estimated based on biotic responses the relationship is not as strong as it is for annual mean values. They are provided here as indicative objectives to allow comparison with single season collected data sets. Wet and dry seasons can start and end at different times of the year. Seasonal dates indicated are generally applicable. Applying these values for any management action should take both of these matters into account.

6. Open coastal/marine waters – Secchi depth. For waters shallower than the specified Secchi depth of $\geq 10\text{m}$ the depth to seafloor is the WQO.

7. Comparison of test data with WQOs: The following protocols are recommended when comparing fresh, estuarine or coastal/marine water quality (at a ‘test’ site) with the corresponding aquatic ecosystem water quality objective (WQO). For concentration-based indicators (e.g. nutrients) and turbidity (NTU), the intent is for test site water quality value to be less than or equal to the corresponding WQO. For WQO indicators where a range is specified (e.g. pH, DO), the intent is that the test site water quality median value falls within the specified WQO range. For Secchi measurements (typically used in estuarine, coastal and marine waters), the intent is for the test site water quality value to be greater than or equal to the stated WQO. Further detail is provided in the QWQG.

For HEV and SD waters:

- Where the WQO is expressed as a 20th–50th–80th percentile range of values (e.g. Total N: 65–100–125 ug/L), the 20th–50th–80th percentile distributions of the test data should meet the specified range of values. The sample number is a minimum of 24 test values over the relevant period (12 months if a continuous activity or alternatively a shorter period for activities where discharge occurs for only part of the year).
- For DO and pH, test sample median values are compared with, and should fall within, the specified percentile range.
- Where a single WQO value is provided, the median value of preferably five or more independent samples at a monitoring (test) site should be compared against the corresponding aquatic ecosystem WQO.

For MD and HD waters:

- The median value (e.g. concentration) of preferably five or more independent samples at a monitoring (test) site should be compared against the corresponding aquatic ecosystem WQO (WQOs in these waters are typically expressed as a single figure).
- For DO and pH, test sample median values are compared with, and should fall within the specified range.

For toxicants in water: unless otherwise stated, WQOs for toxicants are derived from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) default guideline values for the corresponding level of species protection. The ANZG recommends that the 95th percentile of test data is compared against the default guideline value. As the proportion of test values that is required to be less than the default guideline value is high, the ANZG indicates that a single observation greater than the default guideline value is considered an exceedance.

For comparisons of toxicants in sediments, refer to ANZG.

Great Barrier Reef coastal/marine waters: Further to the above, some parameters in Great Barrier Reef waters have WQO values specified as an annual (or seasonal) mean, rather than as a median or percentile range. For these waters, the mean water quality value of a number of independent samples at a particular monitoring ('test') site should be compared against the applicable WQO. The sample number is preferably five or more samples for within season comparison, and five or more samples taken during each of the wet and dry seasons for annual mean comparisons. However, more samples may be required depending on the inherent variability in the measurement data (Queensland Monitoring and Sampling Manual; Section 1.9.1).

Further information: Refer to the QWQG, the Queensland Monitoring and Sampling Manual (2018), and ANZG for more details.

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3 Water quality objectives for human use environmental values

This section outlines water quality objectives (WQOs) to protect human use environmental values (EVs), which comprise those EVs (e.g. recreation, stock watering, aquaculture and crop irrigation) other than the aquatic ecosystem EV. Where a human use EV has been identified, the following tables can be used to identify the WQOs to support that EV. Where more than one EV applies to a given water (for example aquatic ecosystem and recreational use), the adoption of the most stringent WQO for each water quality indicator will then protect all identified EVs.

WQOs in this section are, unless otherwise specified, based on relevant national water quality guidelines including ANZG (2018, as amended) and the Australian Drinking Water Guidelines (ADWG). Where national guidelines or other codes remain the primary source for WQOs, reference to those national guidelines or codes is necessary to obtain comprehensive listings of all indicators and corresponding WQOs.

3.1 Human use EVs water quality objectives

The following table summarises WQOs for human use EVs. More details are provided in subsequent sections by human use EV.

Table 3 Human use EVs water quality objectives

Environmental value	Water type/area	Water quality objective to protect EV (refer to specified codes and guidelines for full details)
Suitability for drinking water supply	All fresh waters including groundwaters	<p>The Australian Drinking Water Guidelines (NHMRC, 2011, as amended) provides a framework for catchment management and source water protection for drinking water supplies.</p> <p>Quality of raw water (prior to treatment) should consider the requirements of water supply operators, and their capacity to treat the water to make it safe for human consumption. Also refer to Table 4.</p> <p>Note: For water quality after treatment or at point of use refer to legislation and guidelines, including:</p> <ul style="list-style-type: none"> • <i>Public Health Act 2005</i> and Regulation • <i>Water Supply (Safety and Reliability) Act 2008</i>, including any approved drinking water quality management plan under the Act • <i>Water Fluoridation Act 2008</i> and Regulation • <i>Australian Drinking Water Guidelines</i> (ADWG, 2011, as amended). • Safe Water on Rural Properties guideline (Queensland Health, 2015) <p>Whether water is drawn from surface catchments or underground sources, it is important that the local catchment or aquifer is understood, and that the activities that could lead to water contamination are identified and managed. Effective catchment management and source water protection include development of a catchment management plan, with the commitment of land use planning authorities to prevent inappropriate development and to enforce relevant planning regulations.</p>
Protection of the human consumer for oystering	Estuarine and coastal waters	As per ANZG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, as amended. (refer Food Standards Australia New Zealand website)
Protection of the human consumer	Fresh waters, estuarine and coastal waters	As per ANZG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, as amended.
Protection of cultural and spiritual values	Fresh waters (including groundwaters), estuarine and coastal waters	Protect or restore indigenous and non-indigenous cultural heritage consistent with relevant policies and plans.

Environmental value	Water type/area	Water quality objective to protect EV (refer to specified codes and guidelines for full details)
Suitability for industrial use	Fresh waters, estuarine and coastal waters	None provided. Water quality requirements for industry vary within and between industries. The ANZG do not provide guidelines to protect industries, and indicate that industrial water quality requirements need to be considered on a case-by-case basis. This EV is usually protected by other values, such as the aquatic ecosystem EV.
Suitability for aquaculture	Fresh waters, estuarine and coastal waters	As per: <ul style="list-style-type: none"> • Tables 5–7 • ANZG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, as amended
Suitability for irrigation	All fresh waters including groundwaters	Pathogens and metal WQOs are provided in Tables 8 and 9 (based on ANZG). For all other indicators, such as salinity, sodicity, sodium adsorption ratio (SAR), and herbicides, refer ANZG.
Suitability for stock watering	All fresh waters including groundwaters	As per ANZG, including median faecal coliforms <100 organisms per 100 mL. For total dissolved solids and metals, refer Tables 10 and 11, based on ANZG. For other indicators, such as cyanobacteria and pathogens, see ANZG.
Suitability for farm supply/use	All fresh waters including groundwaters	As per ANZG.
Suitability for primary contact recreation	Fresh waters, estuarine and coastal waters	<p>Note: at time of publication the NHMRC guidelines for recreational water quality were under review, and updates may supersede the following. Refer to NHMRC website for latest information and updated guidelines.</p> <p>As per NHMRC (2008 – refer NHMRC website) including:</p> <ul style="list-style-type: none"> • water free of physical (floating and submerged) hazards. Where permanent hazards exist (e.g. rips and sandbars), appropriate warning signs should be clearly displayed. • temperature range: 16–34°C • pH range: 6.5–8.5 • DO: >80% • faecal contamination: designated recreational waters are protected against direct contamination with fresh faecal material, particularly of human or domesticated animal origin. Two principal components are required for assessing faecal contamination: <ul style="list-style-type: none"> - assessment of evidence for the likely influence of faecal material - counts of suitable faecal indicator bacteria (usually <i>enterococci</i>) <p>These two components are combined to produce an overall microbial classification of the recreational water body.</p> • direct contact with venomous or dangerous aquatic organisms should be avoided. Recreational water bodies should be reasonably free of, or protected from, venomous organisms (e.g. box jellyfish and bluebottles) • waters contaminated with chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreational purposes.
Suitability for primary contact recreation	Fresh waters	<p>Note: at time of publication the NHMRC guidelines for recreational water quality were under review, and updates may supersede the following. Refer to NHMRC website for latest information and updated guidelines.</p> <ul style="list-style-type: none"> • cyanobacteria/algae: Recreational water bodies should not contain: <ul style="list-style-type: none"> - level 1¹: ≥ 10 µg/L total microcystins; or ≥ 50 000 cells/mL toxic <i>Microcystis aeruginosa</i>; or biovolume equivalent of ≥ 4 mm³/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume or - level 2¹: ≥ 10 mm³/L for total biovolume of all cyanobacterial material where known toxins are not present - where <i>Cylindrospermopsis caciborskii</i> is the dominant species present, advice should be sought for an appropriate guideline for

Environmental value	Water type/area	Water quality objective to protect EV (refer to specified codes and guidelines for full details)
		<p>cylindrospermopsin or</p> <ul style="list-style-type: none"> - cyanobacterial scums consistently present. Further details are contained in NHMRC (2008) and Table 12.
	Estuarine, coastal waters	<ul style="list-style-type: none"> • cyanobacteria/algae: Recreational water bodies should not contain ≥ 10 cells/mL <i>Karenia brevis</i> and/or have <i>Lyngbya majuscula</i> and/or <i>Pfiesteria</i> present in high numbers². Further details are contained in NHMRC (2008) and Table 12.
Suitability for secondary contact recreation	Fresh waters, estuarine and coastal waters	<p>As per NHMRC (2008), including:</p> <ul style="list-style-type: none"> • intestinal enterococci: refer primary recreation above • cyanobacteria/algae—refer primary recreation, NHMRC (2008) and Table 12.
Suitability for visual recreation	Fresh waters, estuarine and coastal waters	<p>As per NHMRC (2008), including:</p> <ul style="list-style-type: none"> • recreational water bodies should be aesthetically acceptable to recreational users. The water should be free from visible materials that may settle to form objectionable deposits; floating debris, oil, scum and other matter; substances producing objectionable colour, odour, taste or turbidity; and substances and conditions that produce undesirable aquatic life. • cyanobacteria/algae—see, NHMRC (2008) and Table 12.

Notes:

1. Level 1 recognises the probability of adverse health effects from ingestion of known toxins, in this case based on the toxicity of microcystins. Level 2 covers circumstances in which there are very high cell densities of cyanobacterial material, irrespective of the presence of toxicity or known toxins. Increased cyanobacterial densities increase the likelihood of non-specific adverse health outcomes, principally respiratory, irritation and allergy symptoms. (NHMRC, 2008; 8).
2. The NHMRC states that its guidelines are concerned 'only with risks that may be associated with recreational activities in or near coastal and estuarine waters. This includes exposure through dermal contact, inhalation of sea-spray aerosols and possible ingestion of water or algal scums, but does not include dietary exposure to marine algal toxins.' (NHMRC, 2008; 121).

Sources:

The WQOs were determined from a combination of sources, including:

- Technical review and advice from Queensland Health and Department of Natural Resources, Mines and Energy (2020)
- Australian Drinking Water Guidelines (NHMRC, 2011 as updated 2016), available from NHMRC website
- Australia New Zealand Food Standards Code (Australian Government: Food Standards Australia New Zealand), available from Food Standards Australia New Zealand website
- [Australian and New Zealand Guidelines for Fresh and Marine Water Quality \(ANZG, 2018, as amended\)](#)
- Guidelines for Managing Risks in Recreational Water (NHMRC, 2008), available from NHMRC website. At time of publication the NHMRC guidelines were under review. Refer to NHMRC website for latest information and updated guidelines.
- [Safe Water on Rural Properties Guideline \(Queensland Health, 2015\)](#)

3.2 Drinking water EV water quality objectives

Table 4 Drinking water EV: Priority water quality objectives for drinking water supply in the vicinity of off-takes, including groundwater, before treatment

Indicator	Water quality objective ¹
<i>Giardia</i>	No guideline value set (ADWG) If <i>Giardia</i> is detected in drinking water then the Water Supply Regulator, DNRME and Queensland Health should be notified immediately and an investigation of the likely source of contamination undertaken.
<i>Cryptosporidium</i>	No guideline value set (ADWG) If <i>Cryptosporidium</i> is detected in treated drinking water then the Water Supply Regulator, DNRME and Queensland Health should be notified immediately and an investigation of the likely source of contamination undertaken.
<i>E. coli</i>	Well designed treatment plants with effective treatment barriers and disinfection are designed to address faecal contamination. <i>E. coli</i> or thermotolerant coliforms should not be present in any 100 mL sample of (treated) drinking water (ADWG). <1 cfu/100ml (Public Health Regulation 2018) and upstream sewage effluent discharges need to be known (catchment management).
Algal toxin	<1.3 µg/L Microcystin (ADWG)
pH	6.5–8.5 (ADWG)
Total dissolved solids (TDS)	<600mg/L The concentration of total dissolved solids in treated drinking water should not exceed 600 mg/L (ADWG, based on taste considerations).
Sodium	General ² : The concentration of sodium in reticulated drinking water supplies should not exceed 180 mg/L (ADWG, based on threshold at which taste becomes appreciable). At-risk groups (medical) ² : The concentration of sodium in water supplies for at-risk groups should not exceed 20 mg/L (ADWG).
Sulfate	The concentration of sulfate in drinking water should not exceed 250 mg/L (ADWG 2011, based on taste/aesthetic considerations). ADWG 2011 health guideline: <500mg/L
Dissolved oxygen	>85% saturation (ADWG)
Pesticides	Raw supplies: Below detectable limits. Treated drinking water: Refer to ADWG.
Other indicators (including physico-chemical indicators) e.g. turbidity	Refer to ADWG. <1 NTU is the target to facilitate for effective disinfection of drinking water (as turbidity of ≥ 1 NTU inhibits the performance of chlorination (ADWG))

Source: Australian Drinking Water Guidelines (NHMRC, 2011 as updated 2018). Technical review and advice from Queensland Health and Department of Natural Resources, Mines and Energy (2020).

Notes:

1. This table outlines WQOs for water **before treatment**, unless otherwise stated (e.g. ADWG). For water quality after treatment or at the point of use, refer to relevant legislation and guidelines, including *Public Health Act 2005* and Regulation, *Water Supply (Safety and Reliability) Act 2008 and Regulation*, including any approved drinking water management plan under the Act, *Water Fluoridation Act 2008*, the Australian Drinking Water Guidelines (ADWG, 2011 updated December 2013), and the Safe Water on Rural Properties guideline (Queensland Health, 2015).
2. The ADWG notes that 50 mg/L is a 'typical value' in reticulated supplies. The ADWG value for sodium is 180 mg/L (based on level at which taste become appreciable) however 'sodium salts cannot be easily removed from drinking water' and 'any steps to reduce sodium concentrations are encouraged'. It further notes that 'medical practitioners treating people with severe hypertension or congestive heart failure should be aware if the sodium concentration in the patient's drinking water exceeds 20 mg/L' (ADWG; sodium factsheet).

3.3 Aquaculture EV water quality objectives

The following tables outline WQOs for aquaculture, depending on water type and species.

Table 5 Aquaculture EV: General water quality objectives for tropical aquaculture

Water parameter	Recommended range		Water parameter	Recommended range
	Fresh water	Marine		General aquatic
Dissolved oxygen	>4 mg/L	>4 mg/L	Arsenic	<0.05 mg/L
Temperature	21–32°C	24–33°C	Cadmium	<0.003 mg/L
pH	6.8–9.5	7–9.0	Calcium/Magnesium	10–160 mg/L
Ammonia (TAN, total ammonia-nitrogen)	<1.0 mg/L	<1.0 mg/L	Chromium	<0.1 mg/L
Ammonia (NH ₃ , un-ionised form)	<0.1 mg/L	<0.1 mg/L	Copper	<0.006 mg/L in soft water
Nitrate (NO ₃)	1–100 mg/L	1–100 mg/L	Cyanide	<0.005 mg/L
Nitrite (NO ₂)	<0.1 mg/L	<1.0 mg/L	Iron	<0.5 mg/L
Salinity	0–5 psu	15–35 psu	Lead	<0.03 mg/L
Hardness	20–450 mg/L	ID	Manganese	<0.01 mg/L
Alkalinity	20–400 mg/L	>100 mg/L	Mercury	<0.00005 mg/L
Turbidity	<80 NTU	ID	Nickel	<0.01 mg/L in soft water <0.04 mg/L in hard water
Chlorine	<0.003 mg/L	ID	Tin	<0.001 mg/L
Hydrogen sulphide	<0.002 mg/L	ID	Zinc	0.03–0.06 mg/L in soft water 1–2 mg/L in hard water

Indicator: psu – practical salinity unit, NTU - nephelometric turbidity units, ID – Insufficient data

Note: The table provides indicative water requirements for a range of aquaculture species (fresh and/or marine), recognising that not all listed species will occur in a given area, and that potential exists for changes in species under culture.

Source: Department of Primary Industries and Fisheries—Water Quality in Aquaculture—DPI Notes April 2004 (as amended) and DAF 2019-2020 technical review and advice.

Table 6 Aquaculture EV: Water quality objectives for optimal growth of particular freshwater species

WATER QUALITY TARGET VALUES FOR AQUACULTURE						
Water parameter	Barramundi	Eel	Silver perch	Jade perch	Sleepy cod	Redclaw
Dissolved oxygen	4–9 mg/L	>3 mg/L	>4 mg/L	>3 mg/L	>4.0 mg/L	>4.0 mg/L
Temperature	26–32°C	23–28°C	23–28°C	23–28°C	22–31°C	23–31°C
pH	7.5–8.5	7.0–8.5	6.5–8.5	6.5–8.5	7.0–8.5	7.0–8.5
Ammonia (TAN, Total ammonia–nitrogen)	ID	<1.0 mg/L	ID	ID	<1.0 mg/L	<1.0 mg/L
Ammonia (NH ₃ , un-ionised form)	<0.46 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L
Nitrate (NO ₃)	ID	ID	<100 mg/L	ID	ID	ID
Nitrite (NO ₂)	<1.5 mg/L	<1.0 mg/L	<0.1 mg/L	ID	<1.0 mg/L	<1.0 mg/L
Salinity (extended periods)	0–35 psu	ID	<5 psu	<5 psu	ID	<4 psu
Salinity bath (short term treatment)	0–35 psu	ID	5–10 psu for 1 hour	ID	max. 20 psu for 1 hour	ID
Hardness (CaCO ₃)	50–100 mg/L	ID	>50 mg/L	>50 mg/L	>40 mg/L	>40 mg/L
Alkalinity	>50 mg/L	ID	100–400 mg/L	100–400mg/L	>40 mg/L	>40 mg/L
Chlorine	<0.04 mg/L	ID	ID	ID	<0.04 mg/L	ID
Hydrogen sulphide	<0.3 mg/L	ID	ID	ID	<0.3 mg/L	ID
Iron	<0.1 mg/L	ID	<0.5 mg/L	<0.5 mg/L	<0.1 mg/L	<0.1 mg/L
Spawning temperature	marine	ID	23–28	23–28	>24 for more than 3 days	ID

Indicator: psu – practical salinity unit, ID – Insufficient data

Note: The table provides indicative water requirements for a range of aquaculture species (fresh and/or marine), recognising that not all listed species will occur in a given area, and that potential exists for changes in species under culture.

Source: Department of Primary Industries and Fisheries—Water Quality in Aquaculture—DPI Notes April 2004 (as amended) and DAF 2019–2020 technical review and advice.

Table 7 Aquaculture EV: Water quality objectives for optimal growth of particular marine species

Water parameter	Barramundi		Giant Tiger prawn (<i>Penaeus monodon</i>)	
	Hatchery	Grow out	Hatchery	Grow out
Dissolved oxygen	saturation	>4 mg/L	>4 mg/L	>3.5 mg/L
Temperature	28–30°C optimum 25–31°C range	28–30°C optimum	28–30°C	26–32°C
pH	approx. 8	approx. 8	7.8–8.2	7.5–8.5
Ammonia (TAN, total ammonia-nitrogen)	ID	0.1–0.5 mg/L	ID	<3 mg/L
Ammonia (NH ₃ , un-ionised form)	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L
Nitrate (NO ₃)	<1.0 mg/L	<1.0 mg/L	<1.0 mg/L	<1.0 mg/L
Nitrite (NO ₂)	<0.2 mg/L	<1.0 mg/L	<0.2 mg/L	<0.2 mg/L
Salinity	28–31psu	0–35psu	30–35psu	10–25 psu optimum
Alkalinity	ID	105–125 mg/L CaCO ₃	ID	>80 mg/L
Clarity	ID	<10mg/L	ID	30–40cm secchi disk
Hydrogen sulphide	ID	<0.3 mg/L	<0.1 mg/L	<0.1 mg/L
Iron	ID	<0.02 mg/L	<1 mg/L	<1.0 mg/L
Spawning temperature	ID	28–32°C	ID	27–32°C

Indicator: psu – practical salinity unit, ID – Insufficient data

Note: The table provides indicative water requirements for a range of aquaculture species (fresh and/or marine), recognising that not all listed species will occur in a given area, and that potential exists for changes in species under culture.

Source: Department of Primary Industries and Fisheries—Water Quality in Aquaculture—DPI Notes April 2004 (as amended) and DAF 2019-2020 technical review and advice.

3.4 Irrigation EV water quality objectives

The following tables outline WQOs for irrigation, based on relevant national guidelines.

Table 8 Irrigation EV: Water quality objectives for thermotolerant (faecal) coliforms in irrigation waters used for food and non-food crops¹

Intended use	Median values of thermotolerant coliforms (colony forming units—cfu) ²
Raw human food crops in direct contact with irrigation water (e.g. via sprays, irrigation of salad vegetables)	<10 cfu/100 mL
Raw human food crops not in direct contact with irrigation water (edible product separated from contact with water, e.g. by peel, use of trickle irrigation); or crops sold to consumers cooked or processed	<1000 cfu/100 mL
Pasture and fodder for dairy animals (without withholding period)	<100 cfu/100 mL
Pasture and fodder for dairy animals (with withholding period of five days)	<1000 cfu/100 mL
Pasture and fodder (for grazing animals except pigs and dairy animals, such as cattle, sheep and goats)	<1000 cfu/100 mL
Silviculture, turf, cotton, etc. (restricted public access)	<10 000 cfu/100 mL

Notes:

1. Adapted from ARMCANZ, ANZECC and NHMRC (1999).

2. Refer to AWQG, Volume 1, Section 4.2.3.3 for advice on testing protocols. Source: AWQG, Volume 1, Section 4.2.3.3, Table 4.2.2.

Table 9 Irrigation EV: Water quality objectives for heavy metals and metalloids in agricultural irrigation water— soil cumulative contamination loading limit (CCL), long-term trigger value (LTV) and short-term trigger value (STV)¹

Element	Soil cumulative contaminant loading limit (CCL) ² (kg/ha)	Long-term trigger value (LTV) in irrigation water (up to 100 years) (mg/L)	Short-term trigger value (STV) in irrigation water (up to 20 years) (mg/L)
Aluminium	ND ²	5	20
Arsenic	20	0.1	2.0
Beryllium	ND	0.1	0.5
Boron	ND	0.5	Refer to AWQG, Vol 3, Table 9.2.18
Cadmium	2	0.01	0.05
Chromium	ND	0.1	1
Cobalt	ND	0.05	0.1
Copper	140	0.2	5
Fluoride	ND	1	2
Iron	ND	0.2	10
Lead	260	2	5
Lithium	ND	2.5 (0.075 for citrus crops)	2.5 (0.075 for citrus crops)
Manganese	ND	0.2	10
Mercury	2	0.002	0.002
Molybdenum	ND	0.01	0.05
Nickel	85	0.2	2
Selenium	10	0.02	0.05
Uranium	ND	0.01	0.1
Vanadium	ND	0.1	0.5
Zinc	300	2	5

Notes:

1. Concentrations in irrigation water should be less than the trigger values. Trigger values should only be used in conjunction with information on each individual element and the potential for off-site transport of contaminants (refer AWQG, Volume 3, Section 9.2.5).

2. ND = Not determined; insufficient background data to calculate CCL.

Source: AWQG, Volume 1, Section 4.2.6, Table 4.2.10.

3.5 Stock watering EV water quality objectives

The following tables outline WQOs for stock watering, according to stock type (cattle, sheep etc.).

Table 10 Stock watering EV: Water quality objectives for tolerances of livestock to salinity, as total dissolved solids, in drinking water¹

Livestock	Total dissolved solids (TDS) (mg/L)		
	No adverse effects on animals expected.	Animals may have initial reluctance to drink or there may be some scouring, but stock should adapt without loss of production	Loss of production and decline in animal condition and health would be expected. Stock may tolerate these levels for short periods if introduced gradually
Beef cattle	0–4000	4000–5000	5000–10 000
Dairy cattle	0–2500	2500–4000	4000–7000
Sheep	0–5000	5000–10 000	10 000–13 000 ²
Horses	0–4000	4000–6000	6000–7000
Pigs	0–4000	4000–6000	6000–8000
Poultry	0–2000	2000–3000	3000–4000

Notes:

1. From ANZECC (1992), adapted to incorporate more recent information.
2. Sheep on lush green feed may tolerate up to 13 000 mg/L TDS without loss of condition or production.

Source: ANZECC, ARMCANZ (2000), Volume 1, Section 4.3.3.5, Table 4.3.1. Note that a review of stock watering tolerances under the ANZG (2018) may lead to revised values from those in this table. Refer to ANZG (2018) for further details.

Table 11 Stock watering EV: Water quality objectives (low risk trigger values) for heavy metals and metalloids in livestock drinking water

Metal or metalloid	Trigger value (low risk) ^{1,2} (mg/L)
Aluminium	5
Arsenic	0.5 (up to 5 ³)
Beryllium	ND
Boron	5
Cadmium	0.01
Chromium	1
Cobalt	1
Copper	0.4 (sheep), 1 (cattle), 5 (pigs), 5 (poultry)
Fluoride	2
Iron	not sufficiently toxic
Lead	0.1
Manganese	not sufficiently toxic
Mercury	0.002
Molybdenum	0.15
Nickel	1
Selenium	0.02
Uranium	0.2
Vanadium	ND
Zinc	20

Notes:

1. Higher concentrations may be tolerated in some situations (further details provided in ANZECC, ARMCANZ (2000), Volume 3, Section 9.3.5).
2. ND = not determined, insufficient background data to calculate.
3. May be tolerated if not provided as a food additive and natural levels in the diet are low.

Source: ANZECC, ARMCANZ (2000), Volume 1, Section 4.3.4, Table 4.3.2. Note that a review of stock watering tolerances under the ANZG (2018) may lead to revised values from those in this table. Refer to ANZG (2018) for further details.

3.6 Recreation EV water quality objectives - cyanobacteria

When cyanobacteria are present in large numbers they can present a significant hazard, particularly to primary contact users of waters. Water quality guidelines for cyanobacteria in recreational waters are provided below. Monitoring and action requirements relative to cyanobacteria 'alert' levels are summarised below, and are explained more fully in the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008). Further details on the process to determine suitability of waters for recreation, relative to historical cyanobacterial levels and susceptibility to cyanobacterial contamination, are contained in sections 6 and 7 of the NHMRC guidelines.

Note: at time of publication the NHMRC guidelines for recreational water quality were under review, and updates may supersede the following. Refer to NHMRC website for latest information and updated guidelines.

Table 12 Recreational waters: Alert levels and corresponding actions for management of cyanobacteria

Green level surveillance mode ¹	Amber level alert mode ¹	Red level action mode ¹
Fresh waters		
≥ 500 to <5000 cells/mL <i>M. aeruginosa</i> or biovolume equivalent of >0.04 to <0.4 mm ³ /L for the combined total of all cyanobacteria.	≥ 5000 to <50 000 cells/mL <i>M. aeruginosa</i> or biovolume equivalent of ≥ 0.4 to <4 mm ³ /L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume ² . or ³ ≥ 0.4 to <10 mm ³ /L for the combined total of all cyanobacteria where known toxin producers are not present.	Level 1 guideline ⁴ : ≥ 10 µg/L total microcystins or ≥ 50 000 cells/mL toxic <i>M. aeruginosa</i> or biovolume equivalent of ≥ 4 mm ³ /L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume. or ³ Level 2 guideline ⁴ : ≥ 10 mm ³ /L for total biovolume of all cyanobacterial material where known toxins are not present. or cyanobacterial scums are consistently present ⁵ .
Coastal and estuarine waters		
<i>Karenia brevis</i>		
≤ 1 cell/mL	> 1– < 10 cells/mL	≥ 10 cells/mL
<i>Lyngbya majuscula</i> , <i>Pfiesteria</i> spp.		
History but no current presence of organism	Present in low numbers	Present in high numbers. (For <i>Lyngbya majuscula</i> this involves the relatively widespread visible presence of dislodged algal filaments in the water and washed up onto the beach)
<i>Nodularia spumigena</i> : See NHMRC, Chapter 6 (Cyanobacteria and algae in fresh water) for details.		

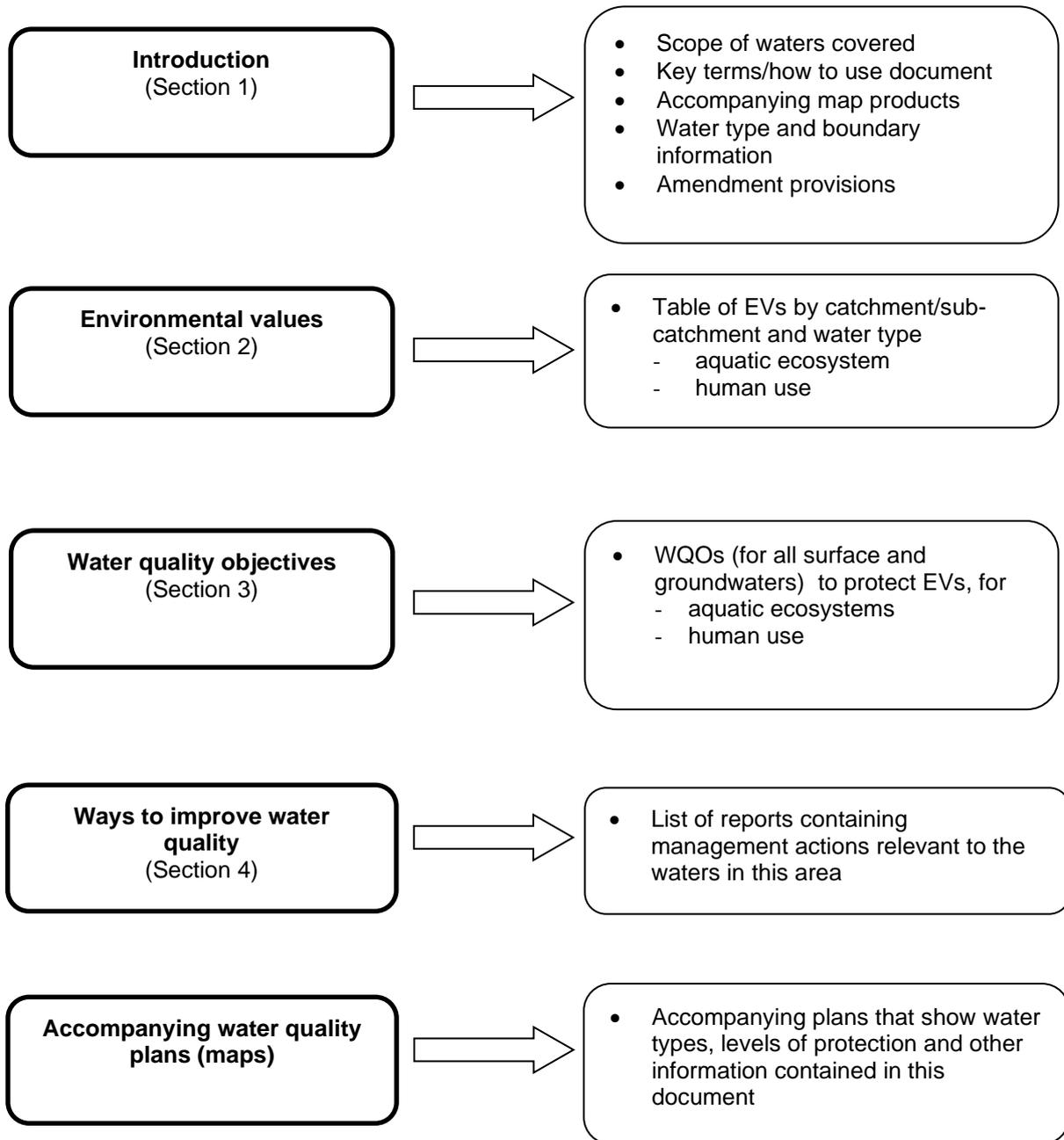
Notes:

- Recommended actions at different alert levels are outlined below (based on NHMRC, 2008, Table 6.6—fresh waters. Similar actions are outlined for coastal/estuarine waters in NHMRC Table 7.6):
 - Green:** Regular monitoring. Weekly sampling and cell counts at representative locations in the water body where known toxigenic species are present (i.e. *Microcystis aeruginosa*, *Anabaena circinalis*, *Cylindrospermopsis raciborskii*, *Aphanizomenon ovalisporum*, *Nodularia spumigena*); or fortnightly for other types including regular visual inspection of water surface for scums.
 - Amber:** Notify agencies as appropriate. Increase sampling frequency to twice weekly at representative locations in the water body where toxigenic species (above) are dominant within the alert level definition (i.e. total biovolume) to establish population growth and spatial variability in the water body. Monitor weekly or fortnightly where other types are dominant. Make regular visual inspections of water surface for scums. Decide on requirement for toxicity assessment or toxin monitoring.
 - Red:** Continue monitoring as for (amber) alert mode. Immediately notify health authorities for advice on health risk. ('In action mode the local authority and health authorities warn the public of the existence of potential health risks; for example, through the media and the erection of signs by the local authority.' NHMRC, 2008; 114). Make toxicity assessment or toxin measurement of water if this has not already been done. Health authorities warn of risk to public health (i.e. the authorities make a health risk assessment considering toxin monitoring data, sample type and variability).

2. The definition of 'dominant' is where the known toxin producer comprises 75 per cent or more of the total biovolume of cyanobacteria in a representative sample.
3. This applies where high cell densities or scums of 'non toxic' cyanobacteria are present i.e. where the cyanobacterial population has been tested and shown not to contain known toxins (microcystins, nodularian, cylindrospermopsin or saxitoxin).
4. Health risks and levels: Level 1 is developed to protect against short-term health effects of exposure to cyanobacterial toxins ingested during recreational activity, whereas the Level 2 applies to the circumstance where there is a probability of increased likelihood of non-specific adverse health outcomes, principally respiratory, irritation and allergy symptoms, from exposure to very high cell densities of cyanobacterial material irrespective of the presence of toxicity or known toxins (NHMRC, 2008;114).
5. This refers to the situation where scums occur at the recreation site each day when conditions are calm, particularly in the morning. Note that it is not likely that scums are always present and visible when there is a high population as the cells may mix down with wind and turbulence and then reform later when conditions become stable.

Source: Based on NHMRC (2008) Guideline for Managing Risks in Recreational Water (tables 6.2, 6.6, 7.3).

Main parts of this document and what they contain



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Introduction and guidance on using this document

1 Introduction

This document is made under the provisions of the Environmental Protection (Water) Policy 2009 (EPP Water), which is subordinate legislation under the *Environmental Protection Act 1994* (EP Act).

The EPP Water and the EP Act provide a framework for:

- establishing environmental values (EVs) and management goals for Queensland waters, and deciding the water quality objectives (WQOs) to protect or enhance those EVs
- listing the identified EVs, management goals and WQOs under Schedule 1 of the EPP (Water).

This document contains the EVs, management goals, WQOs and map products for the waters of the Daintree and Mossman rivers basins (108 and 109)¹ and the adjacent coastal waters, to the limit of Queensland waters.

The document is listed under Column 2 of Schedule 1 of the EPP Water respectively for the Column 1 entries of the Daintree River basin (108) and the Mossman River basin (109) and adjacent coastal waters.

1.1 Purpose

The purpose of this document is to identify locally relevant environmental values and water quality objectives for the region, based on local historical data and in close consultation with the local community. These water quality objectives are used to help set development conditions, influence local government planning schemes and underpin report card grades for ecosystem health monitoring programs. These water quality objectives have been refined from national and state water quality guidelines and present a truer picture of the values and water quality of local waterways. This ensures the values the community holds for its waterways can be maintained and improved into the future, without imposing unrealistic standards from national guidelines that may be inappropriate for local conditions.

1.2 Waters to which this document applies-project waters

This document applies to all surface waters and groundwaters of the Daintree and Mossman River basins and adjacent coastal waters, as indicated in the accompanying plans WQ1081—surface waters, WQ1082—coastal waters and WQ1083—groundwaters.

The surface waters and groundwaters include the:

- Bloomfield River catchment
- Daintree River catchment
- northern coastal creeks, east of Bloomfield and north of the Daintree river catchment
- Saltwater Creek catchment
- Mossman River catchment
- Mowbray River catchment
- central coastal creeks, east of Mossman and north of Mowbray river catchment
- southern coastal creeks, east and south of Mowbray river catchment
- Daintree and Mossman basins wetlands, lakes and drinking water storages

¹ Queensland Drainage Division number and river basin names are published at Geoscience Australia's website www.ga.gov.au.

- Daintree and Mossman rivers basins groundwaters
- Daintree and Mossman enclosed coastal waters and open coastal waters to the limit of Queensland waters.

The geographical extent of waters is shown in the accompanying maps, and extends:

- north to the Endeavour (107) and the Normanby (105) rivers basins
- west to the Mitchell River basin (919)
- south to the Barron River basin (110)
- east to the jurisdictional limit of Queensland waters.

1.3 Guidance on using this document

1.3.1 List of acronyms and terms

ADWG means the Australian Drinking Water Guidelines (2011)-updated December 2013, prepared by the National Health and Medical Research Council (NHMRC)².

AWQG or ANZECC guidelines means the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (October 2000) prepared by the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ)³.

Aquatic ecosystem means the animals, plants and micro-organisms that live in water, and the physical and chemical environment and climatic regime in which they interact. The physical components (e.g. light, temperature) and chemical components (e.g. oxygen, nutrients), and to a lesser extent biological interactions, determine what lives and breeds in the aquatic ecosystem and the food web structure.

Basin means hydrologic drainage basin. Refer to the Geoscience Australia website www.ga.gov.au.

Catchment means the land area draining into a watercourse. The limits of a catchment are the heights of land (watershed) separating it from neighbouring catchments.

Developed fresh waters (or waters in developed areas) are waters in areas impacted through some form of development e.g. urban, industrial, rural residential or agricultural development and land uses. These waters are generally assigned the Moderately Disturbed (MD) level of protection.

Ecological health or condition of an aquatic ecosystem means the ability to maintain key ecological processes and organisms so that their species compositions, diversity and functional organisations are as comparable as possible to those occurring in natural habitats. There are four levels of aquatic ecosystems protection—High Ecological Value (HEV), Slightly Disturbed (SD), Moderately Disturbed (MD) and Highly Disturbed (HD). See 'Management intent' for waters under the EPP Water (section 14).

Environmental values means the EVs at Section 2. EVs for waters are the qualities of water that make it suitable for supporting aquatic ecosystems and human uses. EVs under the EPP Water are shown below.

² The Australian Drinking Water Guidelines are available on the National Health and Medical Research Council website www.nhmrc.gov.au.

³ The ANZECC guidelines are available on the Australian Government's National Water Quality Management Strategy website.

Water quality indicator for an environmental value, under the EPP Water, means a physical, chemical, biological or other property that can be measured or decided in a quantitative way. For example:

- the concentration of nutrients and pH value are examples of chemical indicators
- Secchi disc water clarity measure is an example of a physical indicator
- seagrass depth range, macro-invertebrate family richness are examples of biological indicators.

Water quality guidelines under the EPP Water means the quantitative measures (expressed as contaminant concentrations, loads or narrative statements) for indicators which protect a stated EV. For a particular water, the indicators and water quality guidelines for an EV are decided using the following documents (in order of priority):

- site specific documents for the water
- the QWQG
- the AWQG
- other relevant documents published by a recognised entity.

Water quality guidelines may be modified by economic and social impact assessments of protecting the EVs for waters.

Water quality objectives (WQOs) means the WQOs at Section 3 which protect the EVs at Section 2.

WQOs are the quantitative measures of the various water quality indicators that protect receiving waters aquatic ecosystem and human use EVs. WQOs are:

- numerical concentration levels, sustainable loads measures or narrative statements of indicators
- based on water quality guidelines, but may be modified by economic and social inputs
- receiving water quality objectives— not individual point source objectives or emission standards
- long-term goals for water quality management.

WQOs compliance assessment means the compliance assessment at Appendix D of the QWQG.

Water type means the grouping of waters within which water quality is sufficiently consistent that a single guideline value can be applied to all waters within each group (or water type). See section 1.5.

1.3.2 Use of this document

Section 1 – Introduction and guidance on using this document.

Section 2 – lists the identified EVs for protection for particular waters.

Section 3 – lists the WQOs to protect the corresponding aquatic ecosystems and human use EVs for each water type, including both surface waters and groundwaters.

This document refers to a number of water quality guidelines, codes and other reference sources. In particular, the QWQG provide detailed information on water types, water quality indicators, derivation of local water quality guidelines, monitoring and assessing compliance. ANZECC guidelines contain national level water quality guidelines, for example water quality guidelines for toxicants.

Section 4 – lists documents relevant to the improvement of water quality in the Daintree and Mossman River basins.

1.4 Information about mapped areas and boundaries

The boundaries in the accompanying pdf plans are indicative only. The corresponding GIS datasets are available as part of the Wet Tropics Environmental Values Schedule 1 Geodatabase November 2014—held at the department's offices at Level 10, 400 George Street Brisbane.

The GIS datasets may be downloaded free of charge from the Queensland Spatial Catalogue (QSpatial) at <http://qldspatial.information.qld.gov.au/catalogue/custom/index.page>

For further information, please email the department at epa.ev@ehp.qld.gov.au

1.5 Water types and basis for boundaries

1.5.1 Water types

Water types in this document are identified in Section 3 and the accompanying plans. Water types include (see the QWQG and GBRMPA guidelines):

- upland fresh waters—small upper catchments freshwater streams above 150 metres altitude, moderate to fast flowing with steeper gradients than lowland fresh waters, downstream limit – lowland fresh waters
- lowland fresh waters—larger slow moving freshwater streams and rivers, below 150 metres altitude, downstream limit—upper estuary
- freshwater lakes/reservoirs—deep water habitat situated in dammed river channels
- upper/mid estuary waters:
 - upstream tidal limit—determined from EHP wetland mapping, declared downstream fresh water limit, mean high water springs or limiting structure
 - downstream limit—lower estuary
- enclosed coastal/lower estuary waters—occur at the downstream end of estuaries and include shallow coastal waters (<6m depth) in enclosed bays
- open coastal waters—extend from the seaward limit of the enclosed coastal water body to the jurisdictional limit of Queensland waters.⁴
- groundwaters—sub-artesian waters that occur in an aquifer
- wetlands—palustrine, lacustrine and estuarine—see EHP mapping at Wetlandsinfo website.
- marinas, boat harbours, tidal canals and constructed estuaries

1.5.2 Water type boundaries

The boundaries of different water types are mapped in the accompanying plans using the following attributes, see QWQG for definitions, including—

- altitude (from Australian Height Datum, Geoscience Australia)
- catchment or sub catchment boundaries
- coastline mapping
- downstream or tidal limit—structure (limiting), declared downstream limit or mean high water springs
- enclosed coastal waters (GBRMPA 2014)
- geographic coordinates
- highest/lowest astronomical tide

⁴ Beyond the jurisdictional limit of Queensland waters, mid-shelf marine waters extend from the limit of open coastal waters to 24 km offshore and offshore marine waters extend from the limit of mid-shelf waters to 170 km offshore. See GBRMPA guidelines.

- jurisdiction or defined coastal waters limits
- maritime mapping conventions
- plume line—seaward limit of detection of terrestrial impact—chlorophyll-a mapping (GBRMPA 2014)
- surveyed terrestrial and maritime boundaries.

1.6 Matters for amendment

Under section 12 (2) (b) of the EPP (Water), amendments of the following type may be made to this schedule 1 document for the purposes of a replacement document:

- changes to EVs
- changes to management goals
- changes to WQOs
- changes to management intent (level of protection) categories
- changes to water type boundaries/descriptions
- updates to information/data sources, websites and email contact details, agency/departmental names, other institutional names, references.

Environmental values for waters of the Daintree and Mossman River basins and adjacent coastal waters

2 Environmental values

2.1 Environmental values

The EVs for the surface waters and groundwaters of the Daintree and Mossman rivers basins and adjacent coastal waters are listed at tables 1.1 and 1.2, and mapped in the accompanying plans and the GIS datasets.

The EVs were established during stakeholder consultation undertaken by the department and Terrain NRM – see Consultation Report: Environmental Values for Wet Tropics Basins, (Terrain NRM, September 2012).

2.2 Management goals

2.2.1 Management intent for waters – under the EPP Water

It is the management intent for waters that the decision to release waste water or contaminants to the waters must ensure the following:

- for high ecological value (HEV) waters—the measures for the indicators for all EVs are maintained
- for slightly disturbed (SD) waters—the measures for the slightly modified physical or chemical indicators are progressively improved to achieve the WQOs for HEV waters
- for moderately disturbed (MD) waters:
 - if the measures for indicators of the EVs achieve the water quality objectives for the water—the measures for the indicators are maintained at levels that achieve the WQOs for the water or
 - if the measures for indicators of the EVs do not achieve the water quality objectives for the water—the measures for indicators of the EVs are improved to achieve the WQOs for the water
- for highly disturbed (HD) waters—the measures for the indicators of all environmental values are progressively improved to achieve the water quality objectives for the water.

The mapping of HEV waters, SD waters and HD waters, mapped in the accompanying plans (or GIS datasets) informs the determination of management intent for particular waters.

Note 1 – All other waters in the accompanying plans are moderately disturbed (MD).

Note 2 – See the Environmental Protection Regulation 2008, section 51.

Note 3 – See the Environmental Protection (Water) Policy 2009, section 14.

2.2.2 Raw water for treatment for human consumption

- Minimise the risk that the quality of raw water taken for treatment for human consumption results in adverse human health effects.
- Maintain the palatability rating of water taken for treatment for human consumption at the level of good as set out in the Australian Drinking Water Guidelines (ADWG).
- Minimise the risk that the quality of raw water taken for treatment for human consumption results in the odour of drinking water being offensive to consumers.

2.2.3 Irrigation water

The management goal for irrigation water is that the quality of surface water, when used in accordance with the best irrigation and crop management practices and principles of ecologically sustainable development, does not result in crop yield loss or soil degradation.

2.2.4 **Recreational water quality**

The management goal for recreational water quality is to achieve a low risk to human health from water quality threats posed by exposure through ingestion or contact during recreational use of water resources.

Table 1.1 Environmental values for the waters of the Daintree River basin (108) and adjacent coastal waters

Daintree River basin (108)	Environmental values											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation ⁴	Secondary recreation ⁴	Visual recreation	Drinking water	Industrial use	Cultural and spiritual values
												
Surface fresh waters (rivers, creeks, streams) in developed areas (e.g. urban, industrial, rural residential, agriculture, farmlands)												
Daintree River – including Stewart Creek	✓		✓	✓		✓			✓			✓
Bloomfield River	✓	✓		✓		✓	✓	✓	✓	✓		✓
Douglas Northern Coastal fresh waters	✓	✓		✓		✓	✓	✓	✓	✓		✓
Saltwater Creek	✓						✓		✓			✓
Surface fresh waters in undeveloped areas (e.g. National Parks, forest reserves)												
Daintree River – including Stewart Creek	✓								✓	✓		✓
Bloomfield River	✓								✓	✓		✓
Douglas Northern Coastal fresh waters	✓						✓	✓	✓			✓
Saltwater Creek	✓								✓	✓		✓
Groundwaters	✓	✓	✓	✓						✓		✓
Estuaries/bays, coastal and marine waters												
All estuarine waters in Daintree River basin	✓					✓		✓	✓			✓
Daintree coastal waters	✓					✓	✓	✓	✓		✓	✓

Table 1.2 Environmental values for the waters of the Mossman River basin (109) and adjacent coastal waters

Mossman River basin (109)	Environmental values											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation ⁴	Secondary recreation ⁴	Visual recreation	Drinking water	Industrial use	Cultural and spiritual values
												
Surface fresh waters (rivers, creeks, streams) in developed areas (e.g. urban, industrial, rural residential, agriculture, farmlands)												
Mossman River	✓						✓		✓		✓	✓
Packers Creek – including coastal creeks north of Mowbray and east of Mossman River catchments	✓						✓		✓			✓
Mowbray River	✓			✓			✓		✓			✓
Hartleys Creek – including coastal creeks east and south of Mowbray River catchment	✓				✓	✓	✓	✓	✓	✓		✓
Surface fresh waters in undeveloped areas (e.g. National Parks, forest reserves)												
Mossman River	✓						✓		✓	✓		✓
Packers Creek – including coastal creeks north of Mowbray and east of Mossman River catchments	✓								✓	✓		✓
Mowbray River	✓						✓		✓			✓
Hartleys Creek – including coastal creeks east and south of Mowbray River catchment	✓						✓	✓	✓	✓		✓
Groundwaters	✓	✓	✓	✓						✓		✓
Estuaries/bays, coastal and marine waters												
All natural estuarine waters of the Mossman River basin	✓				✓	✓		✓	✓			✓

Daintree and Mossman Rivers Basins Environmental Values and Water Quality Objectives

Mossman River basin (109)	Environmental values											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation ⁴	Secondary recreation ⁴	Visual recreation	Drinking water	Industrial use	Cultural and spiritual values
												
Packers Creek canals, constructed estuaries, marinas and boat harbours	✓				✓	✓	✓	✓	✓		✓	✓
Mossman coastal waters	✓					✓	✓	✓	✓		✓	✓

Notes:

- ✓ means the EV is selected for protection.
- Refer to the accompanying maps for the spatial locations of the EVs.
- Blank indicates that the EV is not chosen for protection.
- The selection of recreational EVs for waters does not mean that these waters are free of dangerous aquatic organisms, for example venomous organisms (e.g. marine stingers including box jellyfish, irukandji jellyfish), crocodiles, and sharks. Direct contact with dangerous aquatic organisms should be avoided. Refer to EHP CrocWatch, council, www.health.qld.gov.au, www.beachsafe.org.au, www.marinestingers.com.au and other information sources for further details on swimming safety and information on specific waters.

Water quality objectives to protect environmental values

3 Water quality objectives to protect environmental values

This section provides WQOs to protect the EVs for the waters at Section 2.

- Section 3.1 information for reference to the State Planning Policy: state interest – water quality.
- Section 3.2 states the surface waters WQOs to protect the aquatic ecosystem EV.
- Section 3.3 states the surface waters WQOs to protect the human use EVs.
- Section 3.4 states the groundwater WQOs to protect the groundwater EVs.

3.1 State planning policy: state interest – water quality

The State Planning Policy (SPP) defines the Queensland Government's policies about matters of state interest in land use planning and development (a state interest is defined under the *Sustainable Planning Act 2009*).

Water quality is a state interest. The SPP (state interest – water quality) seeks to ensure that 'the environmental values and quality of Queensland waters are protected and enhanced'. It includes provisions relating to planning schemes, acid sulfate soils and water supply buffer areas.

The provisions of the SPP are operationalised through the SPP code – water quality (Appendix 3 of the SPP). The purpose of the code is to 'ensure development is planned, designed, constructed and operated to manage stormwater and wastewater in ways that support the protection of environmental values identified in the Environmental Protection (Water) Policy 2009'. The code contains detailed performance objectives for planning schemes, development and land use activities to implement the code's purpose. These include stormwater management design objectives by climatic region (construction and post-construction phases).

The SPP (state interest – water quality) is supported by the State Planning Policy—state interest guideline – water quality. The SPP (including SPP code) and supporting guideline are available from the DSDIP website.

3.2 Water quality objectives to protect aquatic ecosystems and human use environmental values

This section lists the WQOs for the various water types at the stated levels of protection to protect the aquatic ecosystems environmental values for the surface waters of the Daintree and Mossman rivers basins and adjacent coastal waters at Section 2.

Procedures for the application of WQOs for aquatic ecosystem protection, and compliance assessment protocols can be found in Section 5 and Appendix D of the QWQG. For the comparison of test site monitoring data against WQOs, the median water quality value (e.g. concentration) of a number (preferably five or more) of independent samples at a particular monitoring ('test') site should be compared against the water quality objective of the same indicator, water type and level of aquatic ecosystem protection, as listed in table 2 below. For WQOs based on GBRMPA data, where single value WQOs are given for specified indicators (e.g. particulate N, Secchi depth), these should be compared to annual mean (rather than median) values. Relevant seasonal adjustments can be referenced in GBRMPA (2010) Water quality guidelines for the Great Barrier Reef Marine Park 2010. Also refer to notes after the tables.

WQOs for metals and other toxicants in sediments, in all cases reference is made to the ANZECC guidelines.

WQOs for metals and other toxicants in waters, where not stated in this document, are referred to the ANZECC guidelines. In the case of aluminium, reference is made to a recent peer reviewed study of toxicity of aluminium in marine waters by Golding et al. (2014). This study used ANZECC protocols to derive a marine guideline value of 24 µg/L of aluminium (that applies to the measured concentration in seawater that passes through an 0.45 µm filter) to protect 95% of species that applies to slightly to moderately disturbed waters, and 2.1 µg/L to protect 99% of species which applies to HEV waters. This supersedes the existing low reliability guideline of 0.5 µg/L that was derived using conservative safety margins from limited data.

- Golding, L.A., Angel, B.M., Batley, G.E., Apte, S.C., Krassoi, R. and Doyle, C.J. 2014. Derivation of a water quality guideline for aluminium in marine waters. Environmental Toxicology and Chemistry (Accepted) (DOI: 10.1002/etc.2771).

Water quality objectives for surface waters to protect the aquatic ecosystem environmental values

3.2.1 Surface water quality objectives

Tables 2.1 to 2.5 include the following information for the surface waters of the various catchments and adjacent coastal waters:

- Water quality objectives for physico-chemical, nutrient, algal and water clarity indicators under baseflow conditions—Table 2.1.
- Water quality objectives for nutrients and suspended solids during high flow periods – Table 2.2
- Water quality objectives for specific pesticides and biocides – Table 2.3.
- Water quality objectives for other ions, metals and chemical indicators in surface waters—Table 2.4.
- Freshwater macroinvertebrate objectives for moderately disturbed waters – Table 2.5.

Note: Event flow WQOs are provided in table 2.2. Unless otherwise stated all other WQOs provided are for application only during baseflow conditions.

Table 2.1 Water quality objectives for physico-chemical, nutrient, algal and water clarity indicators to protect the aquatic ecosystems EVs under baseflow conditions

Level of protection	Water type	Water quality objectives													
		Physico-chemical		Nutrients								Algal growth	Water clarity		
		DO	pH	Ammonia N	Oxidised N	Particulate N	Organic N	Total N	FRP	Particulate P	Total P	Chl-a	Turbidity	Secchi	TSS
		% Saturation		µg/L										NTU	m
Table Notes		<p>Water Quality Objectives shown as 20th, 50th and 80th percentiles (i.e. 3-4-5) or as a single value of median or 80th percentile (i.e. 15). DO and pH may be shown as a range of 20th and 80th percentiles (i.e. 85-105).</p> <p>Seagrass: Local seagrass distribution and composition is maintained as measured by extent of seagrass, species diversity and depth limit. Minimum light requirement for seagrass is a PAR two week moving average of greater than 6 mol m⁻² day⁻¹. This is minimum requirement only for seagrass health and is generally below average harbour conditions. It does not include potential impacts on benthic microalgae and phytoplankton at this light level. Objective based on Chartrand et al. (2012) <i>Development of a Light-Based Seagrass Management Approach for the Gladstone Western Basin Dredging Program</i>.</p> <p>Mangroves: Objective of no net loss of mangrove area. The Queensland Herbarium conducts biennial mapping of mangrove cover and this could be used as an assessment tool. Mapping is available from EHP.</p> <p>Wetlands: for high impact earthworks within Great Barrier Reef wetland protection areas, refer to the guideline 'Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments', and the Queensland wetland buffer planning guideline, available from the department's website. Also refer to Section 3.2.3.</p>													
High ecological value waters/ slightly disturbed waters	Upland fresh water (HEV3001)	90-95-100 ¹	6.0-6.5-7.5 ¹	3-4-6 ¹	10-15-30 ¹	nd	75-100-125 ¹	90-120-150 ¹	3-4-5 ¹	nd	5-7-10 ¹	0.5 ¹	1-2-5 ¹	nd	1-2-5 ³
	Lowland fresh water (HEV3001/HEV3123)	85-120 ¹	6.0-8.0 ¹	10 ¹	30 ²	nd	200 ¹	240 ¹	4 ¹	nd	10 ¹	1.5 ¹	15 ¹	nd	2-5-10 ⁴
	Fresh water lakes/ reservoirs (HEV3001)	90-120 ¹	6.0-8.0 ¹	10 ¹	17 ³	nd	330 ¹	350 ¹	5 ¹	nd	10 ¹	3 ¹	2-200 ¹	nd	nd
	Wetlands (HEV3001)	90-120 ¹	6.0-8.0 ¹	10 ¹	17 ³	nd	330-1180 ¹	350-1200 ¹	5-25 ¹	nd	10-50 ¹	10 ¹	2-200 ¹	nd	nd
	Mid estuarine and tidal canals, constructed estuaries, marinas and boat harbours (HEV3001)	80-85-105 ¹	6.5-7.3-8.4 ¹	5-10-15 ¹	2-15-30 ¹	nd	100-100-200 ¹	110-130-250 ¹	2-3-5 ¹	nd	10-15-20 ¹	1-2-3 ¹	2-5-10 ¹	2-1.5-1 ¹	nd
	Enclosed coastal/lower estuary (HEV3001)	85-105 ¹	6.5-7.3-8.4 ¹	15	10	nd	135 ¹	160 ¹	5 ¹	nd	20 ¹	2.0 ¹	10 ¹	1.0 ¹	nd
	Open coastal ² (HEV3121)	95-100-105 ²	8.1-8.3-8.4 ²	1-3-7 ²	0-0-1 ²	≤20 ²	nd	76-105-140 ²	0-2-3 ²	≤2.8 ²	8-14-22 ²	<0.45 ²	0.6-0.9-1.8 ²	≥10 ²	≤2 ²

Daintree and Mossman Rivers Basins Environmental Values and Water Quality Objectives

Level of protection	Water type	Water quality objectives													
		Physico-chemical		Nutrients								Algal growth	Water clarity		
		DO	pH	Ammonia N	Oxidised N	Particulate N	Organic N	Total N	FRP	Particulate P	Total P	Chl-a	Turbidity	Secchi	TSS
		% Saturation		µg/L										NTU	m
High ecological value waters/ slightly disturbed waters	Open coastal ² (HEV3121)	Total dissolved N: 57-80-110 µg/L Total dissolved P: 4-8-18 µg/L Silicate: 90-165-260 µg/L Temperature: <1°C increase above long term (20 year) average maximum													
	Offshore waters ² (HEV3122)	95-105 ²	8.1-8.3-8.4 ²	1-4-10 ²	0-1-2 ²	10-13-17 ²	nd	71-96-122 ²	0-1-3 ²	1.2-1.9-2.6 ²	4-6-9 ²	0.2-0.3-0.5 ²	<1 ²	10-13-16 ²	0.3-0.6-1.1 ²
Moderately disturbed waters	Upland fresh water	90-100 ¹	6.0-7.5 ¹	<6 ¹	<30 ¹	nd	<125 ¹	<150 ¹	<5 ¹	nd	<10 ¹	<0.6 ¹	<6 ¹	nd	<5 ³
	Lowland fresh water	85-120 ¹	6.0-8.0 ¹	<10 ¹	<30 ¹	nd	<200 ¹	<240 ¹	<4 ¹	nd	<10 ¹	<1.5 ¹	<15 ¹	nd	<10 ⁴
	Freshwater lakes/ reservoirs	90-120 ¹	6.0-8.0 ¹	<10 ¹	<10 ¹	nd	<330 ¹	<350 ¹	<5 ¹	nd	<10 ¹	<3 ¹	2-200 ¹	nd	nd
	Wetlands	90-120 ¹	6.0-8.0 ¹	<10 ¹	<10 ¹	nd	330-1180 ¹	350-1200 ¹	5-25 ¹	nd	10-50 ¹	<10 ¹	2-200 ¹	nd	nd
	Mid estuarine and tidal canals, constructed estuaries, marinas and boat harbours	80-105 ¹	6.5-8.4 ¹	<15 ¹	<30 ¹	nd	<200 ¹	<250 ¹	<5 ¹	nd	<20 ¹	<3 ¹	<10 ¹	>1 ¹	nd
	Enclosed coastal/lower estuary	85-105 ¹	6.5-8.4 ¹	<15 ¹	<10 ¹	nd	<135 ¹	<160 ¹	<5 ¹	nd	<20 ¹	<2 ¹	<10 ¹	>1 ¹	nd
Slightly – moderately disturbed waters	Open coastal ²	95-105 ²	8.1-8.4 ²	≤3 ²	≤1 ²	≤20 ² (annual mean)	nd	≤105 ²	≤2 ²	≤2.8 ² (annual mean)	≤14 ²	≤0.45 ² (annual mean)	≤1 ²	≥10 ² (annual mean)	≤2 ² (annual mean)
		Total dissolved N: ≤80 µg/L Total dissolved P: ≤8 µg/L Silicate: ≥165 µg/L Temperature: <1°C increase above long term (20 year) average maximum													

Level of protection	Water type	Water quality objectives													
		Physico-chemical		Nutrients							Algal growth	Water clarity			
		DO	pH	Ammonia N	Oxidised N	Particulate N	Organic N	Total N	FRP	Particulate P	Total P	Chl-a	Turbidity	Secchi	TSS
		% Saturation		µg/L								NTU	m	mg/L	
Highly disturbed waters		Assess existing water quality at the highly disturbed test site. Initial objective is to ensure no deterioration from this. Long-term objective is to attain the moderately disturbed objective value. Intermediate objectives can be set based on (a) 95%ile of reference values from a slightly disturbed reference site or (b) on references values from another site that is highly disturbed but that is nevertheless in measurably better condition than the test site ¹ .													

Notes:

- DO: dissolved oxygen, FRP: filterable reactive phosphorus, Chl-a: chlorophyll-a, TSS: total suspended solids. nd: no (or insufficient) data.
- Units % saturation: percent saturation, µg/L: micrograms per litre, NTU: nephelometric turbidity units, m: metres, mg/L: milligrams per litre.

Sources:

1. Queensland Water Quality Guidelines 2009.
2. GBRMPA analysis of Reef Rescue Marine Monitoring Program and/or Long Term Monitoring Program datasets.
3. Analysis of DSITIA water quality monitoring data and Great Barrier Reef Catchment Loads Monitoring Program.

Table 2.2 Water quality objectives for nutrients and suspended solids to protect aquatic ecosystem EVs during high flow periods

Water quality objectives	Ammonia N	Oxidised N	Particulate N	DON	TN	FRP	Particulate P	DOP	TP	TSS
Units	µg/L									mg/L
	WQOs apply to all fresh waters during high flow periods where discharge is above local baseflow. WQO are presented as 20 th -50 th -80 th percentiles.									
	4-8-13	5-66-101	50-153-384	72-106-148	229-370-668	1-3-4	5-10-45	5-5-10	10-20-70	4-20-52

Notes:

1. High flow WQOs are based on measured data from high flow periods at a reference site on the Tully River in Tully Gorge National Park (gauging station 113015A).
2. DON: dissolved organic nitrogen, TN: total nitrogen, FRP: filterable reactive phosphorous, DOP: dissolved organic phosphorous, TP: total phosphorous, TSS: total suspended solids.

Source:

Orr, D., Turner, R.D.R., Huggins, R., Vardy, S., Warne, M. St. J. 2014. Wet Tropics water quality statistics for high and base flow conditions. Great Barrier Reef Catchment Loads Monitoring Program, Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Table 2.3 Water quality objectives for specific pesticides and biocides to protect aquatic ecosystem EVs

Level of aquatic ecosystems protection	Water quality objectives												
	Water type	Pesticides											Biocide
		Diuron	Atrazine	Chlorpyrifos	Endosulfan	Ametryn	Simazine	Hexazinone	2,4-D	Tebu-thiuron	MEMC	Diazinon	Tributyltin (as Sn)
µg/l													
High ecological value waters	All (HEV3001/ HEV3121/ HEV3122/ HEV3123)	No detection of anthropogenic toxicants											
Slightly disturbed waters	Undeveloped fresh water	nd	0.7	0.00004	0.03	nd	0.2	75	140	0.2	nd	0.00003	nd
	Freshwater lakes/reservoirs	nd	0.7	0.00004	0.03	nd	0.2	75	140	0.2	nd	0.00003	nd
	Wetlands	nd	0.7	0.00004	0.03	nd	0.2	75	140	0.2	nd	0.00003	nd
	Mid estuarine and tidal canals, constructed estuaries, marinas and boat harbours	nd	0.7	0.00004	0.03	nd	0.2	75	140	0.2	nd	0.00003	nd
	Enclosed coastal/lower estuary	0.9	0.6	0.0005	0.005	0.5	0.2	1.2	0.8	0.02	0.002	0.00003	0.0004
	Open coastal	0.9	0.6	0.0005	0.005	0.5	0.2	1.2	0.8	0.02	0.002	0.00003	0.0004
Moderately disturbed and highly disturbed waters	Developed fresh water	nd	13	0.01	0.03	nd	3.2	75	280	2.2	nd	0.01	nd
	Freshwater lakes/reservoirs	nd	13	0.01	0.03	nd	3.2	75	280	2.2	nd	0.01	nd

Level of aquatic ecosystems protection	Water quality objectives												
	Water type	Pesticides											Biocide
		Diuron	Atrazine	Chlorpyrifos	Endosulfan	Ametryn	Simazine	Hexazinone	2,4-D	Tebu-thiuron	MEMC	Diazinon	Tributyltin (as Sn)
µg/l													
Moderately disturbed and highly disturbed waters	Wetlands	nd	13	0.010	0.03	nd	3.2	75	280	2.2	nd	0.01	nd
	Mid estuarine and tidal canals, constructed estuaries, marinas and boat harbours	nd	13	0.01	0.03	nd	3.2	75	280	2.2	nd	0.01	nd
	Enclosed coastal/lower estuary	1.6	1.4	0.009	0.005	1.0	3.2	1.2	30.8	2	0.002	0.01	0.006
	Open coastal	1.6	1.4	0.009	0.005	1.0	3.2	1.2	30.8	2	0.002	0.01	0.006

Notes:

1. nd = no data
2. For all other contaminants in waters, including **metals** —see ANZECC guidelines. For aluminium, refer to: Golding, L.A., Angel, B.M., Batley, G.E., Apte, S.C., Krassoi, R. and Doyle, C.J. 2014. Derivation of a water quality guideline for aluminium in marine waters. Environmental Toxicology and Chemistry (Accepted) (DOI: 10.1002/etc.2771).
3. Comply with the Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance, ANZECC (Re Tributyltin and Dibutyltin)

Source:

Freshwater and Mid estuarine WQOs derived from ANZECC (2000). Enclosed coastal/Lower estuary and Open coastal WQOs derived from GBRMPA (2010).

Table 2.4 Water quality objectives for other ions, metals and chemical indicators in surface waters

Percentile	Na		Ca		Mg		HCO ₃		Cl		SO ₄		EC	Hardness (mg·L ⁻¹)	Alkalinity (mg·L ⁻¹)	SiO ₂ (mg·L ⁻¹)	F (mg·L ⁻¹)	Fe (mg·L ⁻¹)	Mn (mg·L ⁻¹)	Zn (mg·L ⁻¹)	Cu (mg·L ⁻¹)	SAR
	mg·L ⁻¹	%	mg·L ⁻¹	%	µS·cm ⁻¹																	
20th	5	40	2	16	1	17	14	47	6	28	1	2	47	8	11	10.1	0.010	0.010	0.000	0.000	0.00	0.60
50th	7	51	3	22	2	26	25	59	9	36	1	3	72	17	20	14.1	0.060	0.050	0.000	0.010	0.01	0.70
80th	11	66	5	28	4	34	40	68	14	48	2	6	106	29	33	21.1	0.110	0.200	0.010	0.020	0.03	0.95

Note:

1. These values are based on local data collected across the Wet Tropics region. ANZECC guidelines apply for some elements, however these locally observed data are below the guideline values and should be maintained.
2. EC = electrical conductivity; SAR = sodium adsorption ratio.

Source:

Queensland Wet Tropics and Black and Ross catchments: Regional chemistry of the groundwater. Queensland Government (Raymond, M. A. A. and V. H. McNeil, 2013).

3.2.2 Riparian and groundcover water quality objectives

The clearing of native vegetation in Queensland is regulated by the *Vegetation Management Act 1999* the *Sustainable Planning Act 2009* and associated policies and codes. This includes the regulation of clearing in water and drainage lines.

For vegetation management relating to waterways, reference should be made to:

- State Development Assessment Provisions (SDAP) Module 8: Native vegetation clearing. This module includes performance requirements relating to clearing of native vegetation and a table relating to watercourse buffer areas and stream order. To review the SDAP Modules, contact the Department of State Development, Infrastructure and Planning website.
- SDAP Module 11: Wetland protection area.
- relevant self-assessable codes under the *Vegetation Management Act 1999*. These codes are activity based, some applying to different regions, and include performance requirements relating to watercourses and wetlands, aimed at maintaining water quality, bank stability, aquatic and terrestrial habitat. Codes include vegetation clearing controls that vary according to stream order. To review the latest applicable self-assessable code (and other explanatory information), contact the Department of Natural Resources and Mines website.

To review the current vegetation management laws contact the Queensland Government website or Department of Natural Resources and Mines website.

To review the SDAP Modules, contact the Department of State Development, Infrastructure and Planning website.

Local Government Planning schemes under the *Sustainable Planning Act 2009* may also specify riparian buffers (for example under catchment protection or waterway codes). Contact the Department of State Development, Infrastructure and Planning website and local government websites for further information about planning schemes.

The **riparian vegetation** target up to 2018 in the Reef Water Quality Protection Plan (Reef Plan) 2013 is that “The extent of riparian vegetation is increased” and the **groundcover target** is for a “Minimum 70 per cent late dry season groundcover on grazing lands”.

3.2.3 Wetlands water quality objectives

The Environmental Protection Regulation section 81A defines Environmental values for wetlands.

The State assesses impacts from earth works that may have impacts on freshwater wetlands of High Ecological Significance in Great Barrier Reef Catchments against State Development Assessment Provisions (SDAP) Module 11: Wetland protection area.

This module includes performance requirements to ensure:

- adverse effects on hydrology, water quality and ecological processes of a wetland are avoided or minimised
- any significant adverse impacts on matters of state environmental significance and on riparian areas or wildlife corridors in strategic environmental areas are avoided.

Note: refer to the guideline 'Protecting Wetlands of High Ecological Significance in Great Barrier Reef Catchments', and the Queensland wetland buffer planning guideline, available from the department's website.

3.2.4 Freshwater macroinvertebrate objectives

Locally derived objectives for freshwater macroinvertebrate indices are listed at Table 2.5, based on reference sites shown at figure 1. Aquatic macroinvertebrates are common and widespread throughout many aquatic ecosystems, are easily sampled and can provide an integrated measure of stream condition. Specific sampling protocols have been used and their training and accreditation requirements (see <http://ausrivas.ewater.com.au/training-and-accreditation3>) mean that sample results from a number of programs can be combined for use in derivation of objective values. In determining macroinvertebrate objectives, 10m of either edge or riffle habitats were sampled with standard protocols. Indices included in these macroinvertebrates objectives:

- SIGNAL index (Stream Invertebrate Grade Number – Average Level) was developed for the bioassessment of water quality in rivers in Australia. A SIGNAL score is calculated by grading each detected macroinvertebrate family based upon its sensitivity to pollutants from 1 (tolerant) to 10 (sensitive) and averaging the grades. These guidelines used SIGNAL version 2.iv (Chessman 2003, available at www.environment.gov.au).
- Taxa richness is the number of different aquatic macroinvertebrate taxa collected in a sample.
- PET taxa richness is the number of aquatic macroinvertebrate families collected from these orders of aquatic insects; Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). These orders are considered to be sensitive to changes in their environment and therefore useful to assess stream condition.
- % sensitive taxa in an index based on the proportion of taxa with 'sensitive' SIGNAL grades of 8–10 (SIGNAL version 2.iv).
- % tolerant taxa in an index based on the proportion of taxa with 'tolerant' SIGNAL grades of 1–3 (SIGNAL version 2.iv).

Samples for the macroinvertebrate objectives were identified in the laboratory to family level, except Chironimidae (non-biting midges) that are identified to sub-family, and lower Phyla (Porifera, Nematoda, Nemertea, etc.), Oligochaeta (freshwater worms), Acarina (mites), and microcrustacea (Ostracoda, Copepoda, Cladocera) that are not identified further. The taxonomy used to calculate the objective indices are based on those used in SIGNAL version 2.iv.

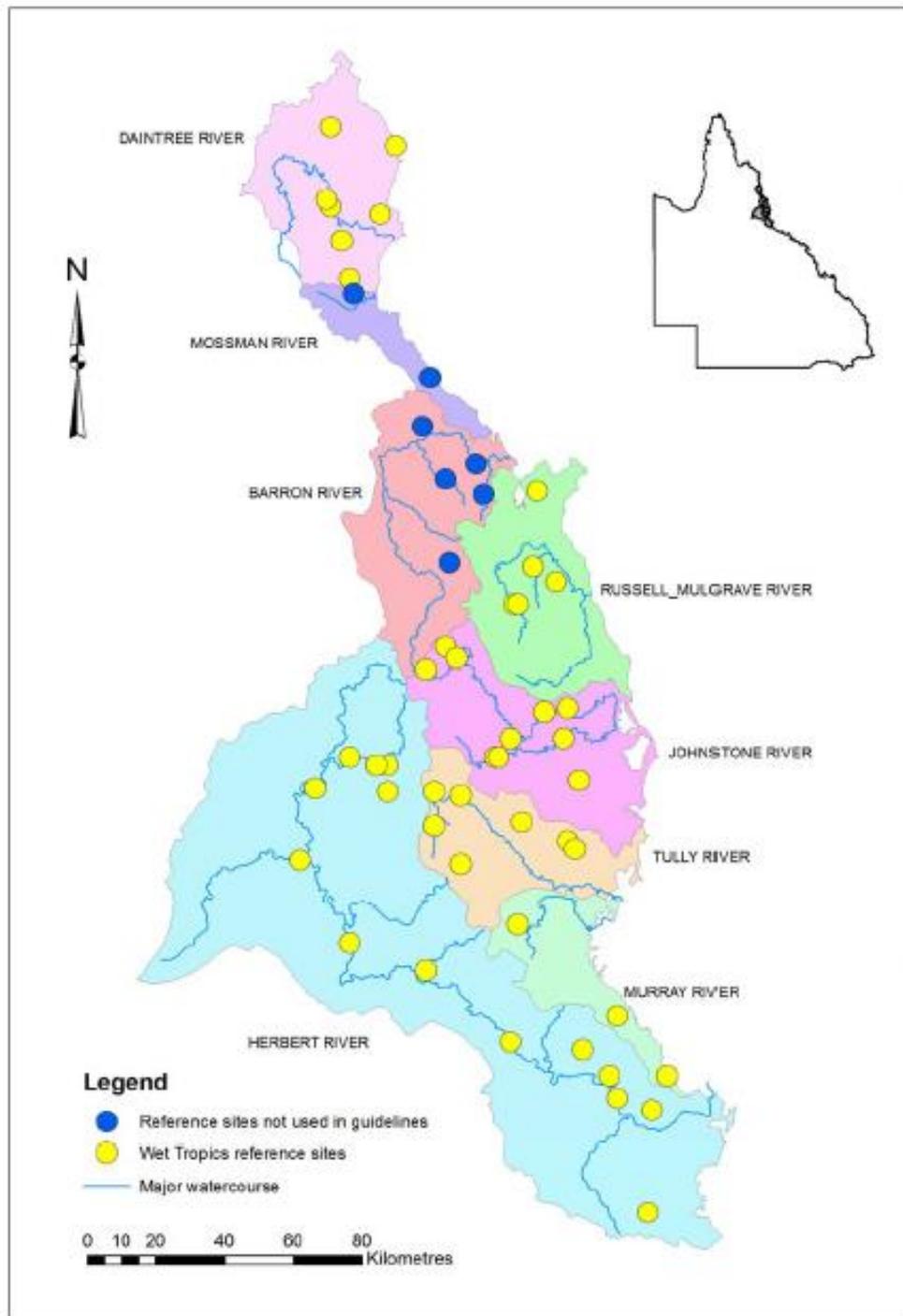


Figure 1 Reference sites (yellow circles) with samples considered or used for development of macroinvertebrate objectives in the Wet Tropics of Queensland

Table 2.5 Freshwater macroinvertebrate objectives for moderately disturbed waters of the Daintree River basin

Index	Edge habitat ¹		Riffle habitat ²	
	20 th percentile	80 th percentile	20 th percentile	80 th percentile
SIGNAL index	4.17	4.94	4.96 ³	5.83 ³
Taxa richness	17	24	20 ³	25 ³
PET taxa richness	4	7	6 ³	9 ³
% sensitive taxa	4.35	11.76	12.5 ³	25 ³
% tolerant taxa	23.53	33.33	17.39 ³	25.00 ³

Notes:

1. Edge Habitat is located along the stream bank.
2. Riffle Habitat is characterised as a reach with relatively steep, shallow (<0.3m), fast flowing (>0.2m/s) and broken water over stony beds.
3. Indicates a limited number of samples were used to develop the guideline value and this should be considered an interim value until further data is available.

Source:

Negus P, Steward A & Blessing J. 2013. Queensland interim biological guidelines for Wet Tropics coastal streams: Aquatic macroinvertebrates, April 2013 – Draft for Comment. Brisbane: Department of Science, Information Technology, Innovation and the Arts, Queensland Government.

Water quality objectives to protect the human use environmental values

3.3 Water quality objectives for human use environmental values

This section outlines the WQOs to protect human use EVs, e.g. recreation, stock watering, aquaculture and crop irrigation. Tables 3.1 to 3.10 list the WQOs to protect the human use EVs for the waters of the Daintree and Mossman rivers basins and adjacent coastal waters.

The WQOs in these tables are based on national water quality guidelines, including ANZECC (2000), the National Health and Medical Research Council Guidelines for managing risks in recreational water, the Food Standards Australia New Zealand and the Australian Drinking Water Guidelines⁵.

Where national guidelines are the source for the stated WQOs, reference is necessary to obtain comprehensive listings of all indicators, corresponding WQOs and up-to-date information.

Table 3.1 Water quality objectives to protect human use environmental values

Environmental value	Water type—refer attached pdf mapping or GIS datasets	Water quality objectives to protect the stated EV
Suitability for raw drinking water supply (before treatment)	Fresh waters and groundwaters	WQOs for drinking water supply are at Table 3.2. Note: For water quality after treatment or at point of use refer to legislation and guidelines, including: <ul style="list-style-type: none"> • <i>Public Health Act 2005</i> and Regulations • <i>Water Supply (Safety and Reliability) Act 2008</i>, including any approved drinking water quality management plan under the Act • Australian Drinking Water Guidelines 2011—updated December 2013
Protection of the human consumer (oysters, fish, crustaceans)	All fresh, estuarine and coastal waters	WQOs as per ANZECC guidelines and Australia New Zealand Food Standards Code ⁶ , Food Standards Australia New Zealand, 2007 and updates.
Protection of cultural and spiritual values	All waters	Protect or restore indigenous and non-indigenous cultural heritage consistent with any relevant policies and plans.
Suitability for industrial use (includes mining, minerals processing, chemical process industries etc.)	Fresh waters, estuarine and coastal waters	No WQOs are stated for industrial uses of water. Water quality requirements for industry vary within and between industries. Where there are specific intake water quality requirements e.g. power station cooling water, the EV is protected by WQOs for other EVs, such as the aquatic ecosystem requirements.

⁵ The AWQG are available on the National Water Quality Management Strategy website.
The ADWG are available on the NHMRC website.

⁶ The Australia New Zealand Food Standards Code is available on the Food Standards Australia and New Zealand website.

Environmental value	Water type—refer attached pdf mapping or GIS datasets	Water quality objectives to protect the stated EV
Suitability for aquaculture	Fresh waters, estuarine and coastal waters	WQOs as per: <ul style="list-style-type: none"> • tables 3.3 to 3.5 • ANZECC guidelines and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, 2007 and updates.
Suitability for irrigation	Fresh waters and groundwaters	WQOs for pathogens and metals are provided in tables 3.6 and 3.7. For other indicators, such as salinity, sodicity and herbicides, see ANZECC guidelines
Suitability for stock watering	Fresh waters and groundwaters	WQOs as per ANZECC guidelines, including median faecal coliforms <100 organisms per 100 mL. WQOs for total dissolved solids and metals are provided in tables 10 and 11. For other objectives, such as cyanobacteria and pathogens, see ANZECC guidelines.
Suitability for farm supply/use	All fresh waters including groundwaters	WQOs as per ANZECC guidelines
Suitability for primary contact recreation	Fresh waters, estuarine and coastal waters	Objectives as per NHMRC (2008) ⁷ , including: <ul style="list-style-type: none"> • water free of physical (floating and submerged) hazards • temperature range: 16–34°C • pH range: 6.5–8.5 • DO: >80% • faecal contamination: designated recreational waters are protected against direct contamination with fresh faecal material, particularly of human or domesticated animal origin. Two principal components are required for assessing faecal contamination: <ul style="list-style-type: none"> – assessment of evidence for the likely influence of faecal material – counts of suitable faecal indicator bacteria (usually <i>enterococci</i>) These two components are combined to produce an overall microbial classification of the recreational water body. • intestinal enterococci: 95th percentile ≤ 40 organisms per 100mL (for healthy adults) (NHMRC, 2008; table 5.7) • direct contact with venomous or dangerous aquatic organisms should be avoided. Recreational water bodies should be reasonably free of, or protected from, venomous organisms (e.g. box jellyfish and bluebottles) • waters contaminated with chemicals that are either toxic or irritating to the skin or mucous membranes are unsuitable for recreational purposes.

⁷ Guidelines for Managing Risks in Recreational Water are available on the NHMRC website.

Environmental value	Water type—refer attached pdf mapping or GIS datasets	Water quality objectives to protect the stated EV
Suitability for primary contact recreation--continued	Fresh waters	<ul style="list-style-type: none"> • cyanobacteria / algae: Recreational water bodies should not contain: <ul style="list-style-type: none"> – level 1¹: ≥ 10 $\mu\text{g/L}$ total microcystins; or $\geq 50\,000$ cells/mL toxic <i>Microcystis aeruginosa</i>; or biovolume equivalent of ≥ 4 mm^3/L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume or – level 2¹: ≥ 10 mm^3/L for total biovolume of all cyanobacterial material where known toxins are not present or – cyanobacterial scums consistently present. Further details are contained in NHMRC (2008) and table 3.10.
	Estuarine, coastal waters	cyanobacteria / algae: Recreational water bodies should not contain ≥ 10 cells/mL <i>Karenia brevis</i> and/or have <i>Lyngbya majuscula</i> and/or <i>Pfiesteria</i> present in high numbers ² . Further details are contained in NHMRC (2008) and table 3.10.
Suitability for secondary contact recreation	Fresh waters, estuarine and coastal waters	Objectives as per NHMRC (2008), including: <ul style="list-style-type: none"> • intestinal enterococci: 95th percentile ≤ 40 organisms per 100mL (for healthy adults) (NHMRC, 2008; Table 5.7) • cyanobacteria / algae—refer objectives for primary recreation, NHMRC (2008) and Table 3.10.
Suitability for visual recreation	Fresh waters, estuarine and coastal waters	Objectives as per NHMRC (2008), including: <ul style="list-style-type: none"> • recreational water bodies should be aesthetically acceptable to recreational users. The water should be free from visible materials that may settle to form objectionable deposits; floating debris, oil, scum and other matter; substances producing objectionable colour, odour, taste or turbidity; and substances and conditions that produce undesirable aquatic life. • Cyanobacteria / algae—refer objectives for primary recreation, NHMRC (2008) and Table t.10.

Notes:

1. Level 1 recognises the probability of adverse health effects from ingestion of known toxins, in this case based on the toxicity of microcystins. Level 2 covers circumstances in which there are very high cell densities of cyanobacterial material, irrespective of the presence of toxicity or known toxins. Increased cyanobacterial densities increase the likelihood of non-specific adverse health outcomes, principally respiratory, irritation and allergy symptoms. (NHMRC, 2008; 8).
2. The NHMRC states that its guidelines are concerned 'only with risks that may be associated with recreational activities in or near coastal and estuarine waters. This includes exposure through dermal contact, inhalation of sea-spray aerosols and possible ingestion of water or algal scums, but does not include dietary exposure to marine algal toxins.' (NHMRC, 2008; 121).

Sources:

The WQOs were determined from:

- Australian Drinking Water Guidelines (NHMRC, 2011).
- Australia New Zealand Food Standards Code (Australian Government).
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000).
- Guidelines for Managing Risks in Recreational Water (NHMRC, 2008).

Table 3.2 Drinking water EV – Water quality objectives for raw drinking water supply in the vicinity of off-takes, including groundwater, before treatment

WQOs for drinking water **before treatment** are derived from the Office of the Water Supply Regulator (Department of Energy and Water Supply) and Queensland Health.

Note: For water quality after treatment or at the point of use, refer to relevant legislation and guidelines, including *Public Health Act 2005* and Regulations, *Water Supply (Safety and Reliability) Act 2008*, including any approved drinking water management plan under the Act, *Water Fluoridation Act 2008*, and the Australian Drinking Water Guidelines (ADWG (2011), 2013 update).

Indicator	Water quality objective
<i>Giardia</i>	0 cysts (Office of Water Supply Regulator) If <i>Giardia</i> is detected in drinking water then the health authorities should be notified immediately and an investigation of the likely source of contamination undertaken (ADWG).
<i>Cryptosporidium</i>	0 cysts (Office of Water Supply Regulator) If <i>Cryptosporidium</i> is detected in drinking water then the health authorities should be notified immediately and an investigation of the likely source of contamination undertaken (ADWG).
<i>E. coli</i>	<50 cfu/100mL Treatment plants with effective barriers and disinfection are designed to address faecal contamination. <i>E. coli</i> or thermotolerant coliforms should not be present in any 100 mL sample of (treated) drinking water (ADWG).
Blue-green algae (cyanobacteria)	<100 cells/mL
Algal toxin	<1 µg/L Microcystin
pH	5.5–8
Total dissolved solids	<600mg/L The concentration of total dissolved solids in treated drinking water should not exceed 600 mg/L (ADWG 2011, based on taste considerations).
Sodium	<180mg/L The concentration of sodium in reticulated drinking water supplies should not exceed 180 mg/L (ADWG, based on threshold at which taste becomes appreciable).
Sulfate	<250mg/L The concentration of sulfate in drinking water should not exceed 250 mg/L (ADWG 2011, based on taste/aesthetic considerations). ADWG 2011 health guideline: <500mg/L
Dissolved oxygen	5.5–7 mg/L

Indicator	Water quality objective
Pesticides	Raw supplies: Below detectable limits. Treated drinking water: Refer to ADWG.
Other indicators (including physico-chemical indicators)	Refer to ADWG.

Table 3.3 Aquaculture EV – Water quality objectives for tropical aquaculture

Water parameter	Recommended range		Water parameter	Recommended range
	Fresh water	Marine		General aquatic
Dissolved oxygen	>4 mg/L	>4 mg/L	Arsenic	<0.05 mg/L
Temperature °C	21–32	24–33	Cadmium	<0.003 mg/L
pH	6.8–9.5	7–9.0	Calcium/Magnesium	10–160 mg/L
Ammonia (TAN, total ammonia-nitrogen)	<1.0 mg/L	<1.0 mg/L	Chromium	<0.1 mg/L
Ammonia (NH ₃ , un-ionised form)	<0.1 mg/L	<0.1 mg/L	Copper	<0.006 mg/L in soft water
Nitrate (NO ₃)	1–100 mg/L	1–100 mg/L	Cyanide	<0.005 mg/L
Nitrite (NO ₂)	<0.1 mg/L	<1.0 mg/L	Iron	<0.5 mg/L
Salinity	0–5 ppt	15–35 ppt	Lead	<0.03 mg/L
Hardness	20–450 mg/L		Manganese	<0.01 mg/L
Alkalinity	20–400 mg/L	>100mg/L	Mercury	<0.00005 mg/L
Turbidity	<80 NTU		Nickel	<0.01 mg/L in soft water <0.04 mg/L in hard water
Chlorine	<0.003 mg/L		Tin	<0.001 mg/L
Hydrogen sulphide	<0.002 mg/L		Zinc	0.03–0.06 mg/L in soft water 1–2 mg/L in hard water

Source: Department of Primary Industries and Fisheries: Water Quality in Aquaculture—DPI Notes April 2004.

Table 3.4 Aquaculture EV – Water quality objectives for optimal growth of freshwater species

Water parameter	Barramundi	Eel	Silver perch	Jade perch	Sleepy cod	Redclaw
Dissolved oxygen	4–9 mg/L	>3 mg/L	>4 mg/L	>3 mg/L	>4.0 mg/L	>4.0 mg/L
Temperature °C	26–32	23–28	23–28	23–28	22–31	23–31
pH	7.5–8.5	7.0–8.5	6.5–9	6.5–9	7.0–8.5	7.0–8.5
Ammonia (TAN, Total ammonia-nitrogen)		<1.0 mg/L			<1.0 mg/L	<1.0 mg/L
Ammonia (NH ₃ , un-ionised form)*pH dependent.	<0.46 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L
Nitrate (NO ₃)			<100 mg/L			
Nitrite (NO ₂)	<1.5 mg/L	<1.0 mg/L	<0.1 mg/L		<1.0 mg/L	<1.0 mg/L
Salinity (extended periods)	0–35 ppt		<5 ppt	<5 ppt		<4 ppt
Salinity bath	0–35 ppt		5–10 ppt for 1 hour		max. 20 ppt for one hour	
Hardness (CaCO ₃)			>50 mg/L	>50 mg/L	>40 mg/L	>40 mg/L
Alkalinity	>20 mg/L		100–400 ppm	100–400 ppm	>40 mg/L	>40 mg/L
Chlorine	<0.04 mg/L				<0.04 mg/L	
Hydrogen sulphide	0–0.3 mg/L				0–0.3 mg/L	
Iron	<0.1 mg/L		<0.5 mg/L	<0.5 mg/L	<0.1 mg/L	<0.1 mg/L
Spawning temperature °C	Marine		23–28	23–28	>24 for more than three days	

Source: Department of Primary Industries and Fisheries: Water Quality in Aquaculture—DPI Notes April 2004.

Table 3.5 Aquaculture EV – Water quality objectives for optimal growth of particular marine species

Water parameter	Barramundi		Tiger prawn		Kuruma prawn
	Hatchery	Grow out	Hatchery	Grow out	Grow out
Dissolved oxygen	Saturation	>4 mg/L	>4 mg/L	>3.5 mg/L	>4 mg/L
Temperature °C	28–30 optimum 25–31 range	28–30 optimum		26–32	24
pH	~8	~8	~8	7.5–8.5	7.5–8.5
Ammonia (TAN, total ammonia-nitrogen)		0.1–0.5 mg/L			
Ammonia (NH ₃ , un-ionised form)	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L	<0.1 mg/L
Nitrate (NO ₃)	<1.0 mg/L	<1.0 mg/L	<1.0 mg/L	<1.0 mg/L	<1.0 mg/L
Nitrite (NO ₂)	<0.2 mg/L	<1.0 mg/L	<0.2 mg/L	<0.2 mg/L	<0.2 mg/L
Salinity	28–31 ppt	0–35 ppt		10–25 ppt optimum	30–35 ppt optimum
Alkalinity		105–125 mg/L CaCO ₃			
Clarity				30–40 cm Secchi disk	30–40 cm Secchi disk
Hydrogen sulphide		<0.3 mg/L			
Iron		<0.02 mg/L		<1.0 mg/L	
Spawning temperature °C		28–32		27–32	

Source: Department of Primary Industries and Fisheries—Water Quality in Aquaculture—DPI Notes April 2004 (as amended).

Table 3.6 Irrigation EV – Water quality objectives for thermotolerant (faecal) coliforms in irrigation water used for food and non-food crops¹

Intended use	Median values of thermotolerant coliforms (colony forming units—cfu) ²
Raw human food crops in direct contact with irrigation water (e.g. via sprays, irrigation of salad vegetables)	<10 cfu/100 mL
Raw human food crops not in direct contact with irrigation water (edible product separated from contact with water, e.g. by peel, use of trickle irrigation); or crops sold to consumers cooked or processed	<1000 cfu/100 mL
Pasture and fodder for dairy animals (without withholding period)	<100 cfu/100 mL
Pasture and fodder for dairy animals (with withholding period of five days)	<1000 cfu/100 mL
Pasture and fodder (for grazing animals except pigs and dairy animals, i.e. cattle, sheep and goats)	<1000 cfu/100 mL
Silviculture, turf, cotton, etc. (restricted public access)	<10 000 cfu/100 mL

Notes:

1. Adapted from ARMCANZ, ANZECC and NHMRC (1999).
2. Refer to Australian Drinking Water Guidelines 2000 (AWQG), Volume 1, Section 4.2.3.3 for advice on testing protocols.

Source: AWQG, Volume 1, Section 4.2.3.3, table 4.2.2.

Table 3.7 Irrigation EV – Water quality objectives for heavy metals and metalloids in agricultural irrigation water¹ – long term trigger value (LTV), short-term trigger value (STV) and soil cumulative contamination loading limit (CCL)

Element	Soil cumulative contaminant loading limit (CCL) (kg/ha) ²	Long-term trigger value (LTV) in irrigation water (up to 100 years) (mg/L)	Short-term trigger value (STV) in irrigation water (up to 20 years) (mg/L)
Aluminium	ND	5	20
Arsenic	20	0.1	2.0
Beryllium	ND	0.1	0.5
Boron	ND	0.5	Refer to AWQG, Vol 3, table 9.2.18
Cadmium	2	0.01	0.05
Chromium	ND	0.1	1
Cobalt	ND	0.05	0.1
Copper	140	0.2	5
Fluoride	ND	1	2
Iron	ND	0.2	10
Lead	260	2	5
Lithium	ND	2.5 (0.075 for citrus crops)	2.5 (0.075 for citrus crops)
Manganese	ND	0.2	10
Mercury	2	0.002	0.002
Molybdenum	ND	0.01	0.05
Nickel	85	0.2	2
Selenium	10	0.02	0.05
Uranium	ND	0.01	0.1
Vanadium	ND	0.1	0.5
Zinc	300	2	5

Notes:

1. Concentrations in irrigation water should be less than the trigger values. Trigger values should only be used in conjunction with information on each individual element and the potential for off-site transport of contaminants (refer AWQG, Volume 3, Section 9.2.5).
2. ND = Not determined; insufficient background data to calculate CCL.

Source: AWQG, Volume 1, Section 4.2.6, table 4.2.10.

Table 3.8 Stock watering EV – Water quality objectives for tolerances of livestock to total dissolved solids (salinity) in drinking water¹

Livestock	Total dissolved solids (TDS) (mg/L)		
	No adverse effects on animals expected.	Animals may have initial reluctance to drink or there may be some scouring, but stock should adapt without loss of production	Loss of production and decline in animal condition and health would be expected. Stock may tolerate these levels for short periods if introduced gradually
Beef cattle	0–4000	4000–5000	5000–10 000
Dairy cattle	0–2500	2500–4000	4000–7000
Sheep	0–5000	5000–10 000	10 000–13 000 ²
Horses	0–4000	4000–6000	6000–7000
Pigs	0–4000	4000–6000	6000–8000
Poultry	0–2000	2000–3000	3000–4000

Notes:

1. From ANZECC (1992), adapted to incorporate more recent information.
2. Sheep on lush green feed may tolerate up to 13 000 mg/L TDS without loss of condition or production.

Source: AWQG, Volume 1, Section 4.3.3.5, table 4.3.1.

Table 3.9 Stock watering EV – Water quality objectives (low risk trigger values) for heavy metals and metalloids in livestock drinking water

Metal or metalloid	Trigger value (low risk) ^{1,2} (mg/L)
Aluminium	5
Arsenic	0.5 (up to 5 ³)
Beryllium	ND
Boron	5
Cadmium	0.01
Chromium	1
Cobalt	1
Copper	0.4 (sheep), 1 (cattle), 5 (pigs), 5 (poultry)
Fluoride	2
Iron	not sufficiently toxic
Lead	0.1
Manganese	not sufficiently toxic
Mercury	0.002
Molybdenum	0.15
Nickel	1
Selenium	0.02
Uranium	0.2
Vanadium	ND
Zinc	20

Notes:

1. Higher concentrations may be tolerated in some situations (further details provided in AWQG, Volume 3, Section 9.3.5).
2. ND = not determined, insufficient background data to calculate.
3. May be tolerated if not provided as a food additive and natural level in the diet are low.

Source: AWQG, Volume 1, Section 4.3.4, table 4.3.2.

Table 3.10 Recreational waters – Alert levels and corresponding actions for management of cyanobacteria

The water quality objectives for water used for recreational purposes are that the values for cyanobacteria cell counts or biovolume meet the guideline values set out in Chapter 6 of the Guidelines for Managing Risks in Recreational Water.

When cyanobacteria are present in large numbers they can present a significant hazard, particularly to primary contact users of waters. Monitoring/action requirements relative to cyanobacteria 'alert' levels are summarised below the table, and are explained more fully in the Guidelines for Managing Risks in Recreational Water (NHMRC, 2008).

Further details on the process to determine suitability of waters for recreation, relative to historical cyanobacterial levels and susceptibility to cyanobacterial contamination, are contained in sections 6 and 7 of the NHMRC guidelines.

Green level surveillance mode ¹	Amber level alert mode ¹	Red level action mode ¹
Fresh waters		
≥500 to <5000 cells/mL <i>M. aeruginosa</i> or biovolume equivalent of >0.04 to <0.4 mm ³ /L for the combined total of all cyanobacteria.	≥5000 to <50 000 cells/mL <i>M. aeruginosa</i> or biovolume equivalent of ≥0.4 to <4 mm ³ /L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume ² . or ³ ≥0.4 to <10 mm ³ /L for the combined total of all cyanobacteria where known toxin producers are not present.	Level 1 guideline ⁴ : ≥10 µg/L total microcystins or ≥50 000 cells/mL toxic <i>M. aeruginosa</i> or biovolume equivalent of ≥4 mm ³ /L for the combined total of all cyanobacteria where a known toxin producer is dominant in the total biovolume. or ³ Level 2 guideline ⁴ : ≥10 mm ³ /L for total biovolume of all cyanobacterial material where known toxins are not present. or cyanobacterial scums are consistently present ⁵ .
Coastal and estuarine waters		
<i>Karenia brevis</i>		
≤ 1 cell/mL	>1– <10 cells/mL	≥10 cells/mL
<i>Lyngbya majuscula</i> , <i>Pfiesteria</i> spp.		
History but no current presence of organism	Present in low numbers	Present in high numbers. (For <i>Lyngbya majuscula</i> this involves the relatively widespread visible presence of dislodged algal filaments in the water and washed up onto the beach)
<i>Nodularia spumigena</i> : See NHMRC, Chapter 6 (Cyanobacteria and algae in fresh water) for details.		

Notes:

- Recommended actions at different alert levels are outlined below (based on NHMRC, 2008, table 6.6—fresh waters. Similar actions are outlined for coastal/estuarine waters in NHMRC table 7.6):
 - Green:** Regular monitoring. Weekly sampling and cell counts at representative locations in the water body where known toxigenic species are present (i.e. *Microcystis aeruginosa*, *Anabaena circinalis*, *Cylindrospermopsis raciborskii*, *Aphanizomenon ovalisporum*, *Nodularia spumigena*); or fortnightly for other types including regular visual inspection of water surface for scums.
 - Amber:** Notify agencies as appropriate. Increase sampling frequency to twice weekly at representative locations in the water body where toxigenic species (above) are dominant within the alert level definition (i.e. total biovolume) to establish population growth and spatial variability in the water body. Monitor weekly or fortnightly where other types are dominant. Make regular visual inspections of water surface for scums. Decide on requirement for toxicity assessment or toxin monitoring.

Red: Continue monitoring as for (amber) alert mode. Immediately notify health authorities for advice on health risk. ('In action mode the local authority and health authorities warn the public of the existence of potential health risks; for example, through the media and the erection of signs by the local authority.' NHMRC, 2008; 114). Make toxicity assessment or toxin measurement of water if this has not already been done. Health authorities warn of risk to public health (i.e. the authorities make a health risk assessment considering toxin monitoring data, sample type and variability).

2. The definition of 'dominant' is where the known toxin producer comprises 75 per cent or more of the total biovolume of cyanobacteria in a representative sample.
3. This applies where high cell densities or scums of 'non toxic' cyanobacteria are present i.e. where the cyanobacterial population has been tested and shown not to contain known toxins (microcystins, nodularian, cylindrospermopsin or saxitoxin).
4. Health risks and levels: Level 1 is developed to protect against short-term health effects of exposure to cyanobacterial toxins ingested during recreational activity, whereas the Level 2 applies to the circumstance where there is a probability of increased likelihood of non-specific adverse health outcomes, principally respiratory, irritation and allergy symptoms, from exposure to very high cell densities of cyanobacterial material irrespective of the presence of toxicity or known toxins (NHMRC, 2008;114).
5. This refers to the situation where scums occur at the recreation site each day when conditions are calm, particularly in the morning. Note that it is not likely that scums are always present and visible when there is a high population as the cells may mix down with wind and turbulence and then reform later when conditions become stable.

Source: Based on NHMRC (2008) Guideline for Managing Risks in Recreational Water (tables 6.2, 6.6, 7.3).

Water quality objectives to protect groundwater environmental values

3.4 Water quality objectives to protect groundwater environmental values

This section lists WQOs for the various groundwater types to protect the aquatic ecosystems environmental values stated for the groundwaters of the Daintree and Mossman rivers basins at Section 2.

WQOs are provided according to their chemistry zone and depth category in tables 4.1 to 4.6.

Where groundwaters interact with surface waters, groundwater quality should not compromise identified EVs and WQOs for those waters.

The AWQG recommends that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value.

Where groundwaters are in good condition the intent is to maintain existing water quality (20th, 50th and 80th percentiles).

3.4.1 Wet Tropics groundwater chemistry groups

The Groundwater Chemistry Zones in the Daintree River and Mossman River basins are shown at Plan WQ1083.

The major groups include:

Wet tropical alluvial:

- ID No. 19 – Daintree Nth Barron uplands and slopes (Table 4.1).

Sodic:

- ID No. 10 – Granitic uplands and slopes (Table 4.2)
- ID No. 14 – Daintree delta (Table 4.3).

Coastal and floodplain:

- ID No. 9 – Low salinity coastal floodplains (Table 4.4).

High salinity alluvial deposits:

- ID No. 6 – Cooya Wonga (Table 4.5).

High calcium:

- ID No. 15 – Sth Craiglie (Table 4.6).

Table 4.1 Water quality objectives to protect aquatic ecosystem EVs for Groundwater Chemistry Group (refer to Plan WQ1083) – Wet Tropical Alluvial – 19 Daintree-Nth Barron uplands and slopes

Depth	Percentile	Na		Ca		Mg		HCO ₃		Cl		SO ₄		NO ₃		EC µS·cm ⁻¹	Hardness (mg·L ⁻¹)	pH	Alkalinity (mg·L ⁻¹)	SiO ₂ (mg·L ⁻¹)	F (mg·L ⁻¹)	Fe (mg·L ⁻¹)	Mn (mg·L ⁻¹)	Zn (mg·L ⁻¹)	Cu (mg·L ⁻¹)	SAR	RAH (meqL ⁻¹)	eH (mV)	
		mg·L ⁻¹	%	mg·L ⁻¹	%	mg·L ⁻¹	%																						
shallow	20th	7	56	1	5	1	13	10	17	10	39	-	-	-	-	64	9	6.0	10	13.0	0.000	0.000	0.000	0.010	0.01	1.33	0.00	-	
	50th	16	66	2	9	3	22	20	32	20	57	-	0	3	4	115	17	6.7	16	18.0	0.080	0.000	0.000	0.050	0.01	1.60	0.00	-	
	80th	28	77	4	24	5	27	41	52	31	71	3	6	10	13	167	26	7.3	34	33.5	0.263	0.019	0.010	0.080	0.02	2.40	0.19	-	
moderate	20th	15	57	2	8	3	17	18	25	18	38	-	-	-	-	120	17	6.4	14	19.0	0.100	0.000	0.000	0.011	0.00	1.41	0.00	-	
	50th	19	64	4	14	4	22	35	39	28	57	0	0	1	1	145	26	7.1	29	27.0	0.195	0.000	0.000	0.030	0.00	1.80	0.05	-	
	80th	25	69	6	24	5	25	49	55	34	64	2	4	3	5	189	34	7.6	40	37.5	0.356	0.010	0.000	0.048	0.01	1.90	0.57	-	
deep	20th	8	41	4	27	3	14	31	52	13	16	2	2	-	-	95	23	6.9	25	14.4	0.130	0.000	0.000	0.030	0.00	0.73	0.08	-	
	50th	29	46	7	32	4	17	53	61	15	30	4	4	-	-	225	31	7.4	43	46.0	0.200	0.000	0.000	0.030	0.01	1.10	0.29	-	
	80th	33	51	36	44	8	24	178	79	37	38	5	7	1	1	341	120	7.6	147	51.6	0.990	0.015	0.075	0.030	0.02	1.57	0.85	-	
v deep		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
artesian	20th	20	60	2	9	4	22	24	29	31	52	-	-	-	-	153	23	6.3	20	8.8	0.000	-	-	0.000	0.00	1.63	-	-	
	50th	22	65	3	11	4	24	27	32	33	67	-	-	-	-	160	24	6.6	22	13.5	0.150	-	-	0.000	0.00	1.80	-	-	
	80th	23	69	4	12	6	29	51	47	34	70	-	-	-	-	195	32	7.3	42	23.1	0.720	-	-	0.000	0.00	2.04	-	-	

Table 4.2 Water quality objectives to protect aquatic ecosystem EVs for Groundwater Chemistry Group (refer to Plan WQ1083) – Sodic – 10 Granitic uplands and slopes

Depth	Percentile	Na		Ca		Mg		HCO ₃		Cl		SO ₄		NO ₃		EC µS·c m ⁻¹	Hardness (mg·L ⁻¹)	pH	Alkalinity (mg·L ⁻¹)	SiO ₂ (mg·L ⁻¹)	F (mg·L ⁻¹)	Fe (mg·L ⁻¹)	Mn (mg·L ⁻¹)	Zn (mg·L ⁻¹)	Cu (mg·L ⁻¹)	SAR	RAH (meq·L ⁻¹)	eH (mV)
		mg·L ⁻¹	%	mg·L ⁻¹	%	mg·L ⁻¹	%																					
shallow	20th	16	46	10	9	3	8	68	33	13	26	1	1	0	0	158	38	6.9	56	30.6	0.100	0.000	0.000	0.010	0.00	1.10	0.13	-
	50th	109	55	16	21	7	15	194	45	125	52	5	2	2	0	800	72	7.6	161	70.0	0.200	0.020	0.010	0.030	0.02	3.15	1.07	-
	80th	168	84	45	33	21	24	254	66	175	59	12	8	7	7	997	195	7.9	208	101.1	0.550	0.422	0.037	0.054	0.02	8.47	2.04	-
moderate	20th	64	46	9	8	5	7	135	33	47	27	2	1	0	0	440	46	7.3	113	82.0	0.270	0.000	0.000	0.005	0.01	2.00	0.30	-
	50th	102	63	21	20	10	17	200	50	103	41	4	1	1	0	772	95	7.7	165	96.0	0.375	0.010	0.010	0.020	0.05	4.25	1.67	-
	80th	160	85	46	30	24	23	280	67	210	62	12	3	3	1	1,003	210	8.2	230	110.0	0.500	0.020	0.020	0.023	0.05	8.40	2.70	-
deep	20th	27	41	12	16	5	13	118	66	20	20	1	1	-	0	257	53	6.7	97	79.0	0.280	0.003	0.004	0.007	0.01	1.30	0.43	-
	50th	32	49	18	31	7	20	147	74	26	23	2	1	0	0	300	76	7.0	120	93.0	0.360	0.020	0.010	0.020	0.05	1.60	0.72	-
	80th	113	72	24	35	10	24	219	79	54	31	16	5	1	0	572	99	7.8	182	107.0	0.600	0.100	0.050	0.050	0.05	5.81	2.16	-

Table 4.3 Water quality objectives to protect aquatic ecosystem EVs for Groundwater Chemistry Group (refer to Plan WQ1083) – Sodic – 14 Daintree delta

Depth	Percentile	Na		Ca		Mg		HCO ₃		Cl		SO ₄		NO ₃		EC	Hardness (mg. L ⁻¹)	pH	Alkalinity (mg. L ⁻¹)	SiO ₂ (mg. L ⁻¹)	F (mg. L ⁻¹)	Fe (mg. L ⁻¹)	Mn (mg. L ⁻¹)	Zn (mg. L ⁻¹)	Cu (mg. L ⁻¹)	SAR	RAH (meqL ⁻¹)	eH (mV)	
		mg. L ⁻¹	%	mg. L ⁻¹	%	mg. L ⁻¹	%	µS. cm ⁻¹																					
shallow	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-													
moderate	20th	10	45	3	9	2	13	26	40	14	34	2	4	0	0	99	19	6.6	21	24.5	0.005	0.010	0.010	0.000	0.00	0.84	0.05	-	
	50th	17	56	6	16	4	25	56	55	22	38	3	5	1	1	155	26	7.2	46	31.0	0.100	0.010	0.010	0.000	0.00	1.30	0.20	-	
	80th	76	73	10	30	5	31	110	61	66	49	13	7	2	3	408	45	7.7	91	82.5	8.450	0.983	0.143	0.000	0.00	6.41	1.04	-	

Table 4.4 Water quality objectives to protect aquatic ecosystem EVs for Groundwater Chemistry Group (refer to Plan WQ1083) – Coastal and Floodplain – 9 Low salinity coastal floodplains

Depth	Percentile	Na		Ca		Mg		HCO ₃		Cl		SO ₄		NO ₃		EC	Hardness (ma. L ⁻¹)	pH	Alkalinity (ma. L ⁻¹)	SiO ₂ (mg. L ⁻¹)	F (mg. L ⁻¹)	Fe (mg. L ⁻¹)	Mn (mg. L ⁻¹)	Zn (mg. L ⁻¹)	Cu (mg. L ⁻¹)	SAR	RAH (meqL ⁻¹)	eH (mV)
		mg. L ⁻¹	%	µS. cm ⁻¹																								
shallow	20th	6	57	1	6	1	10	7	18	8	39	-	-	-	-	51	7	5.8	6	9.0	0.000	0.000	0.000	0.010	0.00	1.00	0.00	-
	50th	13	67	2	11	2	18	18	32	17	54	2	4	1	2	96	14	6.6	15	19.5	0.050	0.008	0.018	0.020	0.01	1.50	0.02	-
	80th	24	81	5	21	4	27	41	52	28	70	6	11	4	8	156	26	7.3	34	30.0	0.150	0.040	0.094	0.075	0.02	2.90	0.28	-
moderate	20th	6	50	1	6	1	14	6	12	8	32	-	-	1	0	64	8	6.0	5	11.1	0.000	0.000	0.000	0.010	0.00	0.70	0.00	-
	50th	10	67	2	12	2	21	14	27	12	46	1	2	7	12	85	15	6.5	12	18.0	0.020	0.000	0.010	0.020	0.01	1.20	0.00	-
	80th	25	75	7	22	4	28	62	50	28	64	5	10	13	29	199	34	7.2	52	27.0	0.200	0.020	0.040	0.039	0.02	2.10	0.22	-
deep	20th	6	53	1	8	1	12	6	19	8	22	-	-	-	0	59	6	5.5	5	11.0	0.000	0.000	0.000	0.005	0.00	0.90	0.00	-
	50th	9	65	2	14	2	18	16	35	10	43	1	2	3	5	82	12	6.5	14	17.0	0.050	0.002	0.010	0.010	0.01	1.30	0.10	-
	80th	18	76	6	25	3	24	64	68	15	65	4	5	9	22	163	34	7.2	52	35.0	0.180	0.030	0.060	0.030	0.02	1.65	0.49	-
very deep	20th	7	54	1	10	1	10	13	21	7	20	1	2	1	0	64	9	6.1	11	16.0	0.010	0.000	0.000	0.000	0.00	0.70	0.00	-
	50th	9	59	3	15	3	16	29	46	9	39	1	4	4	9	95	19	6.9	24	23.0	0.100	0.005	0.005	0.010	0.02	1.30	0.13	-
	80th	78	74	18	26	8	25	103	65	65	60	16	8	8	16	511	67	7.5	85	43.7	0.610	0.020	0.020	0.030	0.02	5.25	1.47	-

Table 4.5 Water quality objectives to protect aquatic ecosystem EVs for Groundwater Chemistry Group (refer to Plan WQ1083) – High Salinity – 6 Cooya Wonga

Depth	Percentile	Na		Ca		Mg		HCO ₃		Cl		SO ₄		NO ₃		EC µS·cm ⁻¹	Hardness (mg·L ⁻¹)	pH	Alkalinity (mg·L ⁻¹)	SiO ₂ (mg·L ⁻¹)	F (mg·L ⁻¹)	Fe (mg·L ⁻¹)	Mn (mg·L ⁻¹)	Zn (mg·L ⁻¹)	Cu (mg·L ⁻¹)	SAR	RAH (meqL ⁻¹)	eH (mV)
		mg·L ⁻¹	%	mg·L ⁻¹	%																							
shallow	20th	19	63	3	3	2	9	18	5	24	52	3	3	-	-	166	20	6.7	14	11.0	0.000	0.000	0.000	0.010	0.00	1.66	0.00	-
	50th	41	77	5	6	8	17	43	15	59	70	8	6	0	0	310	51	7.1	36	19.0	0.175	0.010	0.000	0.010	0.01	4.00	0.06	-
	80th	853	86	45	12	83	23	94	44	1,568	88	243	9	2	1	5,296	456	7.8	77	27.0	0.397	0.030	0.020	0.015	0.01	15.02	0.26	-
moderate	20th	14	68	3	6	3	16	2	0	27	65	6	7	-	-	149	20	5.1	2	14.0	0.000	0.000	0.010	0.037	0.00	1.94	0.00	-
	50th	736	76	48	7	91	18	11	0	1,332	89	187	9	2	0	3,595	496	6.5	9	16.0	0.045	0.010	0.160	0.140	0.01	14.10	0.00	-
	80th	3,563	77	283	12	483	19	20	9	6,762	91	972	10	8	1	17,667	2,713	7.2	18	19.3	0.109	0.222	1.896	1.098	0.02	29.73	0.00	-
deep	20th	67	60	6	12	5	17	21	0	64	71	4	1	-	-	323	34	6.5	17	23.0	0.088	0.000	0.000	-	-	3.06	0.00	-
	50th	3,705	69	593	13	498	18	34	7	7,490	87	992	8	-	0	12,540	3,575	6.9	28	27.5	0.100	0.015	5.370	-	-	24.55	0.00	-
	80th	7,407	70	1,243	21	1,006	19	71	21	15,067	91	2,104	9	4	0	37,900	7,261	7.4	58	39.0	0.520	0.160	5.926	-	-	38.03	0.21	-

Table 4.6 Water quality objectives to protect aquatic ecosystem EVs for Groundwater Chemistry Group (refer to Plan WQ1083) – High Calcium – 15 Sth Craiglie

Depth	Percentile	Na		Ca		Mg		HCO ₃		Cl		SO ₄		NO ₃		EC µS·cm ⁻¹	Hardness (mg·L ⁻¹)	pH	Alkalinity (mg·L ⁻¹)	SiO ₂ (mg·L ⁻¹)	F (mg·L ⁻¹)	Fe (mg·L ⁻¹)	Mn (mg·L ⁻¹)	Zn (mg·L ⁻¹)	Cu (mg·L ⁻¹)	SAR	RAH (meqL ⁻¹)	eH (mV)
		mg·L ⁻¹	%	mg·L ⁻¹	%	mg·L ⁻¹	%																					
shallow	20th	15	65	2	5	2	12	16	9	19	37	2	4	-	0	97	11	6.5	13	13.8	0.000	0.000	0.000	0.010	0.01	1.83	0.00	-
	50th	34	73	7	9	5	16	76	30	34	58	4	5	1	3	246	40	7.0	63	22.0	0.230	0.000	0.000	0.015	0.01	2.45	0.04	-
	80th	3,802	80	240	17	423	17	201	55	6,831	84	568	8	10	5	18,643	2,340	7.7	166	27.9	0.619	0.023	0.147	0.020	0.01	29.85	0.63	-
moderate	20th	44	44	6	4	3	6	45	7	48	38	3	1	-	-	320	31	6.9	38	21.0	0.079	0.000	0.000	0.000	0.00	2.00	0.00	-
	50th	96	68	19	16	7	17	99	23	123	67	7	3	1	0	577	76	7.4	82	33.0	0.220	0.010	0.000	0.010	0.01	5.05	0.93	-
	80th	227	88	60	21	54	25	184	56	522	88	48	7	2	1	1,639	371	7.9	152	38.0	0.601	0.102	0.160	0.030	0.02	13.91	2.13	-
deep	20th	43	43	34	20	7	12	216	51	35	21	2	1	-	-	447	127	7.6	177		0.500	0.000	0.000	0.000	0.00	1.63	0.52	-
	50th	50	47	39	40	7	13	220	77	36	22	2	1	-	-	460	131	7.6	181		0.500	0.000	0.000	0.000	0.00	1.90	1.00	-
	80th	109	53	41	45	30	27	279	77	166	48	4	1	1	0	928	209	8.3	236		0.680	0.009	0.198	0.000	0.00	3.25	1.02	-

Notes:

1. Refer to Plan WQ1083 to locate relevant groundwater chemistry zones.
2. Within each chemistry zone, groundwater quality values are provided for different depths (Shallow: <15m, Moderate: 15–40m, Deep: 40–65m, Very deep: >65m, Artesian: all artesian).
3. The management intent is to maintain 20th, 50th and 80th percentile values. Values are provided for each of these percentiles.
4. Abbreviations: EC: Electrical conductivity, CaCO₃: Calcium carbonate, Ca: Calcium, Mg: Magnesium, Na: Sodium, Cl: Chloride, SO₄: Sulfate, HCO₃: Bicarbonate, NO₃: Nitrate, SiO₂: Silica, F: Fluoride, Fe: Iron, Mn: Manganese, Zn: Zinc, Cu: Copper, SAR: Sodium adsorption ratio, RAH: Residual alkali hazard, EH: Redox (oxidation/reduction) potential, '-': insufficient data to perform statistical summaries, or the parameter was not tested.

Source: Queensland Wet Tropics and Black and Ross catchments: Regional chemistry of the groundwater. Queensland Government (Raymond, M. A. A. and V. H. McNeil, 2013).

Ways to improve water quality

4 Ways to improve water quality

The following documents are relevant in considering ways to improve water quality in the Daintree and Mossman basins.

Regional plans

- Wet Tropics Water Quality Improvement Plan, Terrain NRM 2015, in publication. See Terrain website.

Queensland and Australian Government plans

- [Reef Water Quality Protection Plan 2013](#)
- [Reef 2050 Long-Term Sustainability Plan](#)
- Reef Program—The Australian Government Reef Program will be delivered as a component of the National Landcare Program and will build on the success of the first phase of Reef Rescue. [More about the Australian Government Reef Program](#)

Appendix C Regional Ecosystems Report



Queensland Government

Department of Environment and Science

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
Lot: 123 Plan: SR687

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the input coordinates.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no matters of interest have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Resources website <https://www.dnrme.qld.gov.au/>

Please direct queries about these reports to: Queensland.Herbarium@dsiti.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.



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Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Area of interest details: Lot: 123 Plan: SR687

Size (ha)	40.22
Local Government(s)	Douglas Shire
Bioregion(s)	Wet Tropics
Subregion(s)	Daintree - Bloomfield
Catchment(s)	Mossman

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.0	0.0
Of concern	0.0	0.0
No concern at present	1.12	2.78
Total remnant vegetation	1.12	2.78

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and are usually distinguished by differences in dominant species, frequently in the shrub or ground layers and are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2017) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Resources website.

<https://www.dnrme.qld.gov.au/>

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (1000 ha); or patch size (100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
7.1.1	Mangrove closed scrub to open forest of areas subject to regular tidal inundation	No concern at present	1.12	2.78
non-rem	None	None	39.1	97.22

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
7.1.1	Pre-clearing 47000 ha; Remnant 2017 45000 ha	35a	Estuarine wetlands (e.g. mangroves).	High
non-rem	None	None	None	None

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
7.1.1	Important fish nursery areas. Threatened species include: <i>Myrmecodia beccarii</i> (ant plant) and <i>Hypochrysops apollo apollo</i> (apollo jewel butterfly).
non-rem	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at:

<https://publications.qld.gov.au/dataset/redd/resource/>

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
None	None	39.1	97.22
35a	Closed forests and low closed forests dominated by mangroves. (land zone 1) (CYP, GUP, BRB, SEQ, WET, CQC)	1.12	2.78

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See:

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/>

The descriptions are compiled using site survey data from the Queensland Herbarium's CORVEG database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2012 (PDF)* section 3.3.1 of:

<https://publications.qld.gov.au/dataset/redd/resource/>

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community.

<http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/>

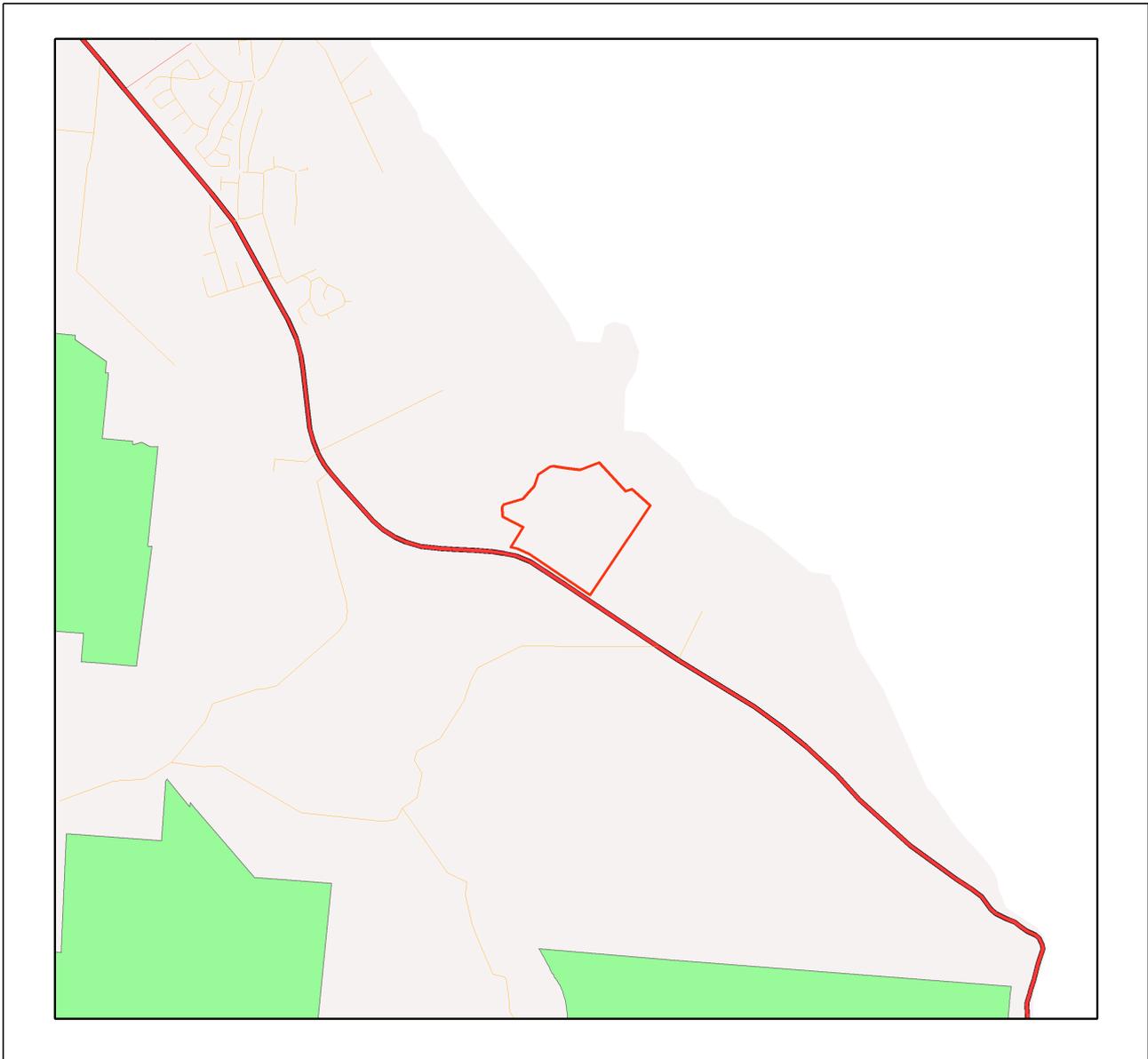
Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
7.1.1	Not currently available	Not currently available
non-rem	Not currently available	Not currently available

Maps

Map 1 - Location



Locality Map

Legend

- Selected Lot and Plan
- Towns
- Highway
- Connector
- Street/Local Road
- Reservoirs
- Lakes
- National Park (Scientific)
- National Park
- National Park (CYPAL)
- Conservation Park
- Resources Reserve
- Forest Reserve
- State Forest
- Timber Reserve
- Nature Refuges
- Coordinated Conservation Areas
- Major rivers/creeks
- Queensland



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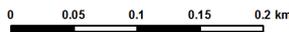
Map 2 - Remnant 2017 regional ecosystems



Remnant 2017 Regional Ecosystems

Biodiversity Status

- Selected Lot and Plan
- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Non-remnant vegetation, cultivated or built environment
- Plantation
- Water
- Cadastral Boundaries



This product is projected into GDA 1994 Queensland Albers

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.

Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The polygons are labelled by regional ecosystem (RE); where more than one RE occurs, the percentage of each is labelled. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".

Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy. Non-remnant vegetation includes regrowth and disturbed native vegetation.

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Map 3 - Pre-clearing regional ecosystems



Pre-clearing Regional Ecosystems

Biodiversity Status

- Selected Lot and Plan
- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Water
- Cadastral Boundaries



This product is projected into GDA 1994 Queensland Albers

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.

Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The polygons are labelled by regional ecosystem (RE); where more than one RE occurs, the percentage of each is labelled. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".

Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

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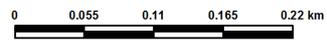
Map 4 - Remnant 2017 regional ecosystems by BVG (5M)



Remnant 2017 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups BVG5M Description (BVG1M codes)

- Selected Lot and Plan
- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Non-remnant vegetation, cultivated or built environment
- Water
- Cadastral Boundaries



This product is projected into GDA 1994 Queensland Albers

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.

Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species, e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework". Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.

Non-remnant vegetation includes regrowth and disturbed native vegetation.

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Map 5 - Pre-clearing regional ecosystems by BVG (5M)



Pre-clearing Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups BVG5M Description (BVG1M codes)

- Selected Lot and Plan
- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Water
- Cadastral Boundaries



This product is projected into GDA 1994 Queensland Albers

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.

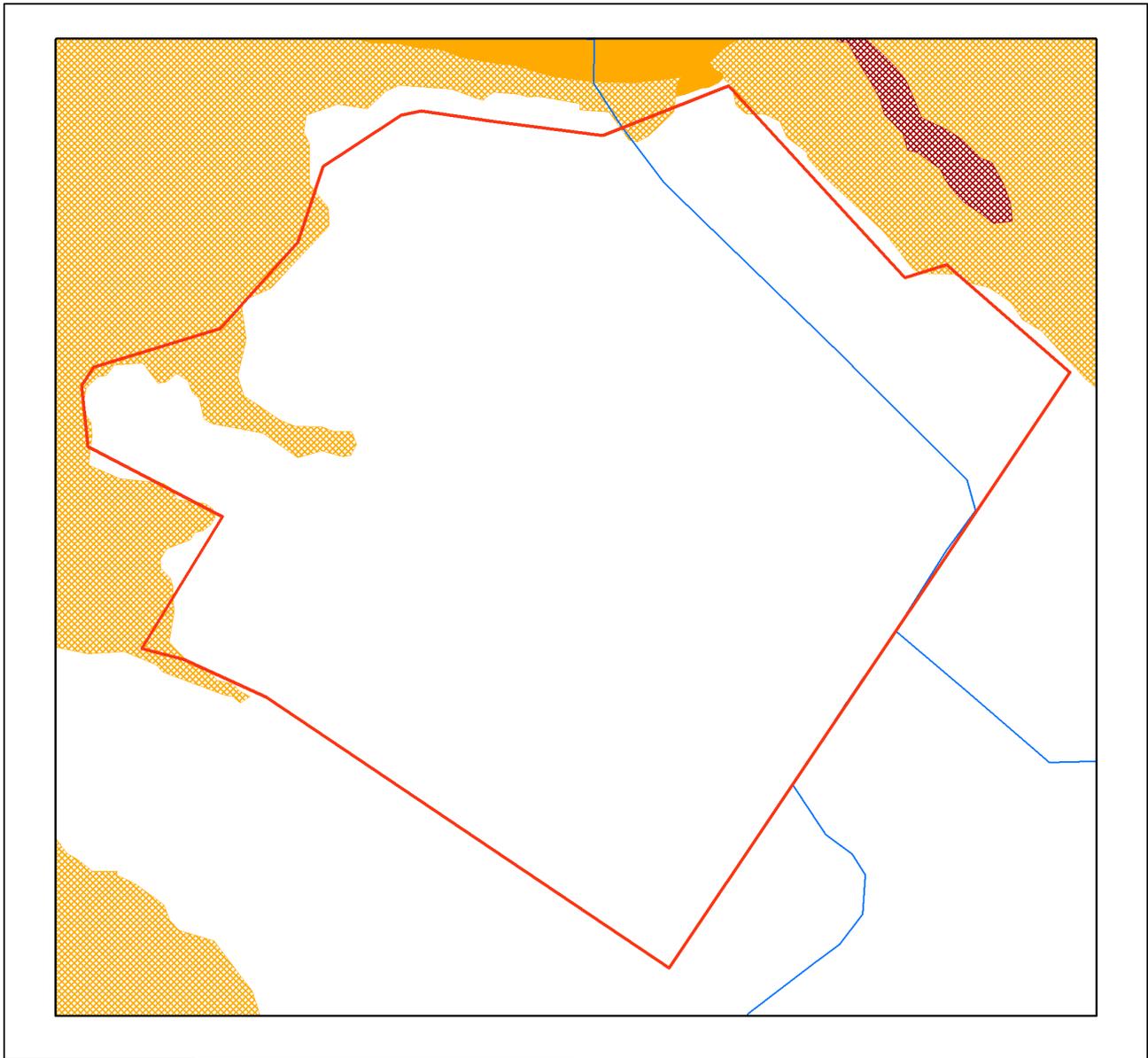
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.

Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".

Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

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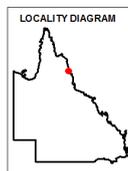
Map 6 - Wetlands and waterways



Queensland Wetland Data

Legend

- Selected Lot and Plan
- ▲ Towns
- Queensland Wetland Data**
- Riverine Drainage Lines
- ▲ Springs
- Wetland System - Water Bodies**
- Marine Waterbodies
- Estuarine Waterbodies
- Riverine Waterbodies
- Lacustrine Waterbodies
- Palustrine Waterbodies
- Wetland System - Regional Ecosystems**
- Marine RE
- Estuarine RE
- Riverine RE
- Lacustrine RE
- Palustrine RE
- RE 51-80% wetland (mosaic units)
- RE 1-50% wetland (mosaic units)



Accuracy information: The positional accuracy of wetland data mapped at a scale of 1:100,000 is +/-100m with a minimum polygon size of 5ha or 75m wide for linear features, except for areas along the east coast which are mapped at the 1:50,000 scale with a positional accuracy of +/-50m, with a minimum polygon size of 1ha or 35m wide for linear features. Wetlands smaller than 1ha are not delineated on the wetland data. Consideration of the effects of mapped scale is necessary when interpreting data at a larger scale, e.g. 1:25,000. For property assessment, digital linework should be used as a guide only. The extent of wetlands depicted on this map is based on rectified 2013 Landsat ETM+ imagery supplied by Statewide Landcover and Trees Study (SLATS), Department of Environment and Science. The extent of water bodies is based on the maximum extent of inundation derived from available Landsat imagery up to and including the 2013 imagery.

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This product is projected into GDA 1994 Queensland Albers

Links and Other Information Sources

The Department of Environment and Science's Website -

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/>

provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from:

<https://publications.qld.gov.au/dataset/redd/resource/>

The methodology for mapping regional ecosystems can be downloaded from:

<https://publications.qld.gov.au/dataset/redd/resource/>

Technical descriptions for regional ecosystems can be obtained from:

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/>

Benchmarks can be obtained from:

<http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/>

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Government Information System portal,

<http://dds.information.qld.gov.au/dds/>

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link:

<http://www.dnrm.qld.gov.au/mapping-data/queensland-globe>

References

Neldner, V.J., Niehus R.E., Wilson, B.A. McDonald, W.J.F., Ford, A.J. and Accad, A. (2017) The Vegetation of Queensland. Descriptions of Broad Vegetation Groups. Version 3.0. Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts.

<https://publications.qld.gov.au/dataset/redd/resource/78209e74-c7f2-4589-90c1-c33188359086>

Neldner, V.J., Wilson, B.A., Dillewaard, H.A., Ryan, T.S. and Butler, D.W. (2017) *Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland*. Version 4.0. Queensland Herbarium, Department of Science, Information Technology, Innovation and the Arts.

<https://publications.qld.gov.au/dataset/redd/resource/6dee78ab-c12c-4692-9842-b7257c2511e4>

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:

<http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/>

- Regional Ecosystem Description Database

The datasets listed below are available for download from:

<http://dds.information.qld.gov.au/dds/>

- Biodiversity status of pre-clearing and 2017 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
VMA	- <i>Vegetation Management Act 1999</i>

Appendix D MSES Report



Queensland Government

Department of Environment and Science

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest
Lot: 123 Plan: SR687

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

Disclaimer

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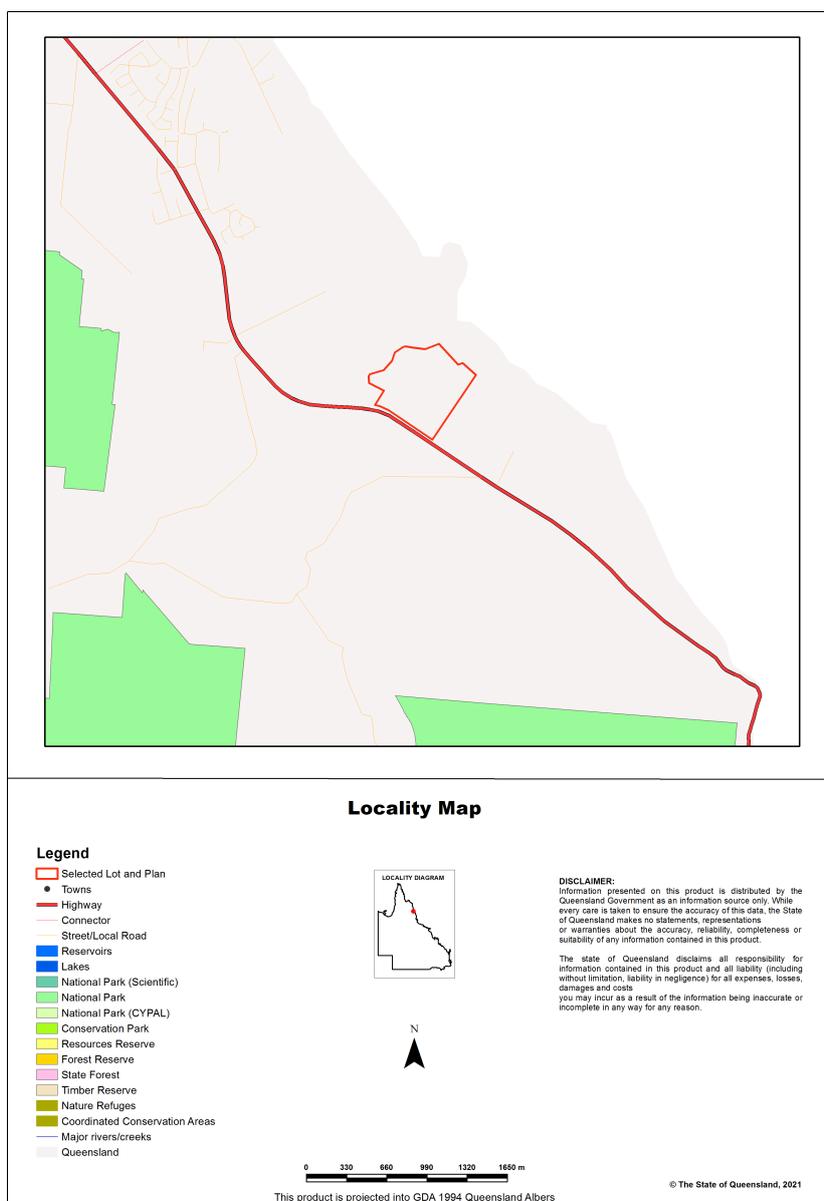
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Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI Lot: 123 Plan: SR687

Size (ha)	40.22
Local Government(s)	Douglas Shire
Bioregion(s)	Wet Tropics
Subregion(s)	Daintree - Bloomfield
Catchment(s)	Mossman



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992* ;
- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the *Marine Parks Act 2004* ;
- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;
- Threatened wildlife under the *Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;
- Regulated vegetation under the *Vegetation Management Act 1999* that is:
 - Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;
 - Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;
 - Category R areas on the regulated vegetation management map;
 - Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;
 - Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;
- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;
- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;
- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;
- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	0.0 ha	0.0 %
1b Protected Areas- nature refuges	0.0 ha	0.0 %
1c Protected Areas- special wildlife reserves	0.0 ha	0.0 %
2 State Marine Parks- highly protected zones	0.0 ha	0.0 %
3 Fish habitat areas (A and B areas)	0.0 ha	0.0 %
4 Strategic Environmental Areas (SEA)	0.0 ha	0.0 %
5 High Ecological Significance wetlands on the map of Referable Wetlands	0.0 ha	0.0 %
6a High Ecological Value (HEV) wetlands	0.0 ha	0.0 %
6b High Ecological Value (HEV) waterways **	0.0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	1.12 ha	2.8%
7b Special least concern animals	1.12 ha	2.8%
7c i Koala habitat area - core (SEQ)	0.0 ha	0.0 %
7c ii Koala habitat area - locally refined (SEQ)	0.0 ha	0.0 %
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	0.0 ha	0.0 %
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0.0 ha	0.0 %
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0.2 ha	0.5%
8d Regulated Vegetation - Essential habitat	1.12 ha	2.8%
8e Regulated Vegetation - intersecting a watercourse **	0.0 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0.02 ha	0.04%
9a Legally secured offset areas- offset register areas	0.0 ha	0.0 %
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0.0 ha	0.0 %

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

(no results)

1b. Protected Areas - nature refuges

(no results)

1c. Protected Areas - special wildlife reserves

(no results)

2. State Marine Parks - highly protected zones

(no results)

3. Fish habitat areas (A and B areas)

(no results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(no results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Values are present

7b. Special least concern animals

Values are present

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
<i>Boronia keysii</i>		V	None
<i>Calyptorhynchus lathami</i>	Glossy black cockatoo	V	None
<i>Casuarus casuarus johnsonii</i>	Sthn population cassowary	E	None
<i>Crinia tinnula</i>	Wallum froglet	V	None
<i>Denisonia maculata</i>	Ornamental snake	V	None
<i>Litoria freycineti</i>	Wallum rocketfrog	V	None
<i>Litoria olongburensis</i>	Wallum sedgefrog	V	None
<i>Melaleuca irbyana</i>		E	None
<i>Petaurus gracilis</i>	Mahogany Glider	E	None
<i>Petrogale persephone</i>	Proserpine rock-wallaby	E	None
<i>Phascolarctos cinereus</i>	Koala - outside SEQ*	V	None
<i>Pezoporus wallicus wallicus</i>	Eastern ground parrot	V	None
<i>Taudactylus pleione</i>	Kroombit tinkerfrog	E	None
<i>Xeromys myoides</i>	Water Mouse	V	None

*For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.

Threatened (endangered or vulnerable) wildlife species records

Scientific name	Common name	NCA status	EPBC status	Migratory status
<i>Crocodylus porosus</i>	estuarine crocodile	V		M-B/E
<i>Numenius madagascariensis</i>	eastern curlew	E	CE	M-C/J/R/B/E
<i>Limosa lapponica baueri</i>	Western Alaskan bar-tailed godwit	V	V	M-C/J/R/B/E
<i>Charadrius mongolus</i>	lesser sand plover	E	E	M-C/J/R/B/E
<i>Charadrius leschenaultii</i>	greater sand plover	V	V	M-C/J/R/B/E

Special least concern animal species records

Scientific name	Common name	Migratory status
<i>Numenius phaeopus</i>	whimbrel	M-C/J/R/B/E
<i>Tringa nebularia</i>	common greenshank	M-C/J/R/B/E
<i>Tringa brevipes</i>	grey-tailed tattler	M-C/J/R/B/E

Scientific name	Common name	Migratory status
<i>Actitis hypoleucos</i>	common sandpiper	M-C/J/R/B/E
<i>Pluvialis fulva</i>	Pacific golden plover	M-C/J/R/B/E
<i>Pluvialis squatarola</i>	grey plover	M-C/J/R/B/E
<i>Xenus cinereus</i>	terek sandpiper	M-C/J/R/B/E
<i>Calidris ruficollis</i>	red-necked stint	M-C/J/R/B/E

*Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL).
Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:

<https://www.qld.gov.au/environment/plants-animals/species-list/>

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals** and **Map 3b - MSES - Species - Koala habitat area (SEQ)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:

<https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/>

For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:

<https://environment.ehp.qld.gov.au/regional-ecosystems/>

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Not applicable

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Not applicable

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Regulated vegetation map category	Map number	RVM rule
R	7964	4

8d. Regulated Vegetation - Essential habitat

Values are present

8e. Regulated Vegetation - intersecting a watercourse**

(no results)

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Regulated vegetation map category	Map number	RVM rule
R	7964	4
B	7964	2

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

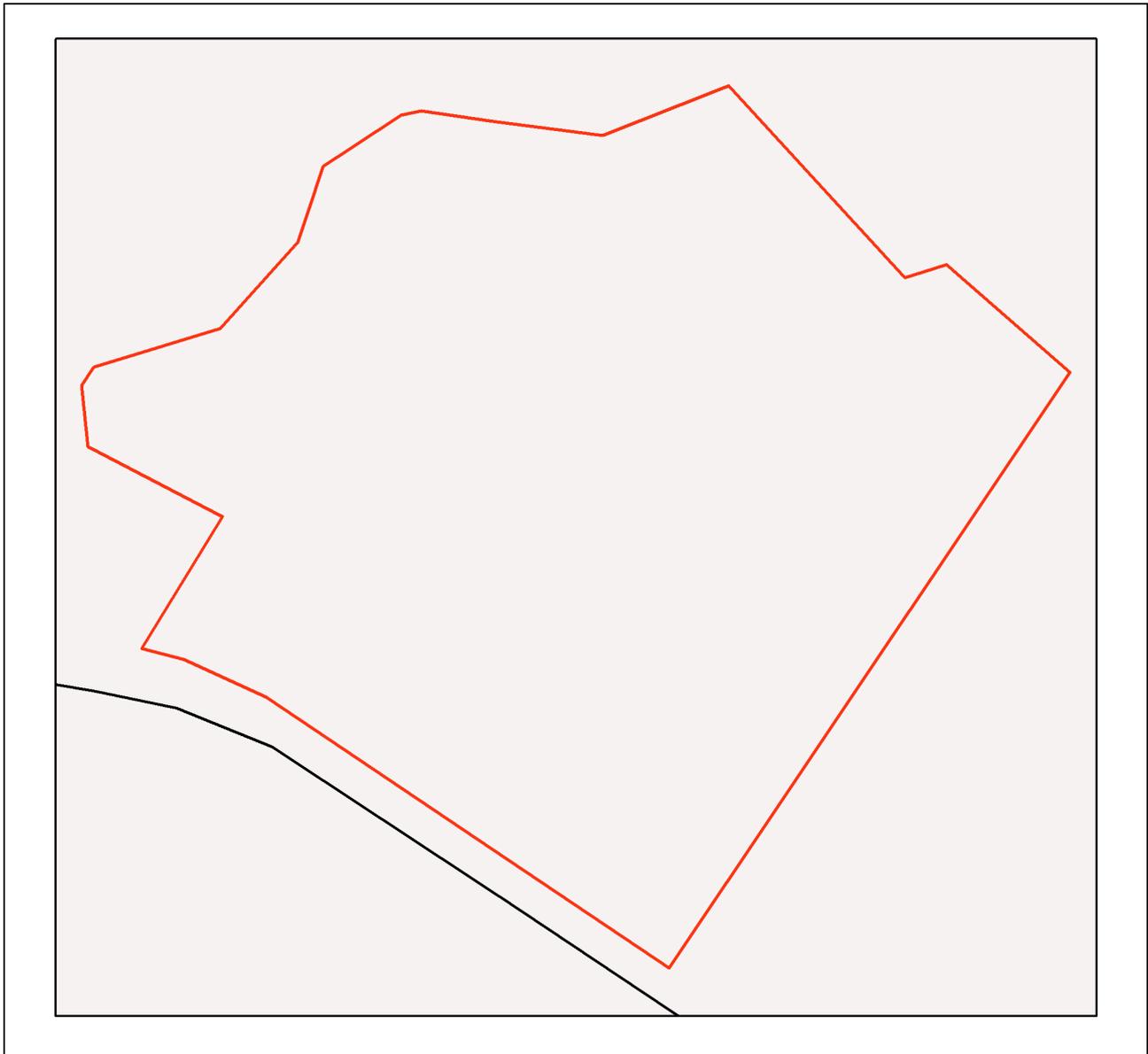
(no results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

(no results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

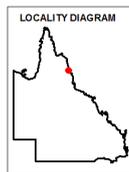
Map 1 - MSES - State Conservation Areas



MSES - State Conservation Areas

Area of Interest

-  Selected Lot and Plan
-  Towns
-  Freeways/Highways
-  Secondary roads
-  Major rivers/creeks
-  Protected area (estates, nature refuges, special wildlife reserves)
-  Declared fish habitat area (A and B areas)
-  Marine park (highly protected)



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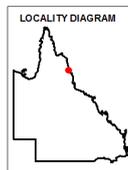
Map 2 - MSES - Wetlands and Waterways



MSES - Wetlands and Waterways

Area of Interest

-  Selected Lot and Plan
-  Towns
-  Freeways/Highways
-  Secondary roads
-  Major rivers/creeks
-  Declared high ecological value waters (watercourse)
-  Strategic environmental area (designated precinct)
-  Declared high ecological value waters (wetland)
-  High ecological significance wetlands



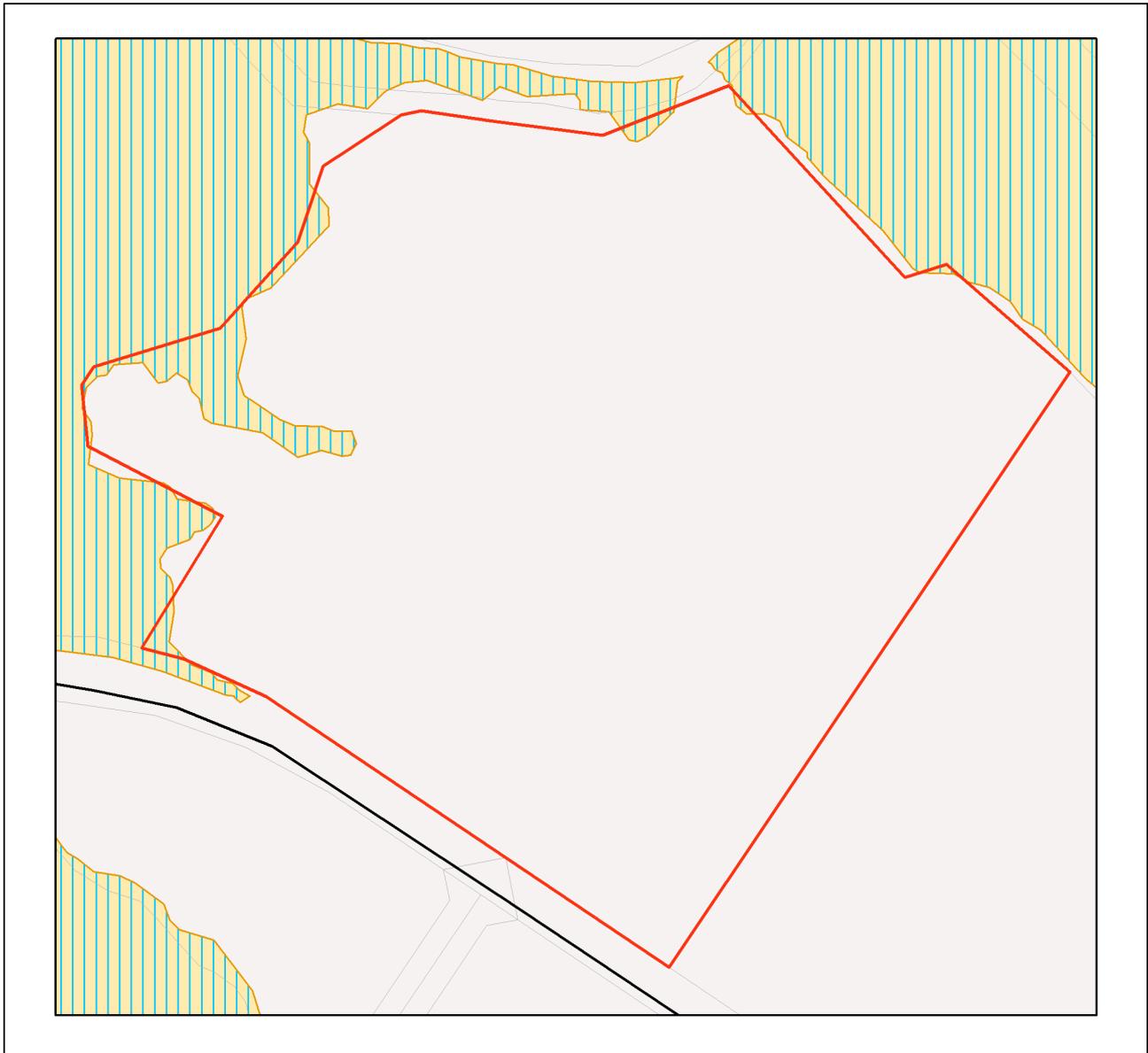
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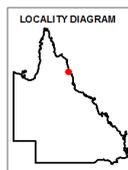
Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals



MSES - Species Threatened (endangered or vulnerable) wildlife and special least concern animals

Area of Interest

- Selected Lot and Plan
- ▲ Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Wildlife habitat (special least concern)
- Wildlife habitat (endangered or vulnerable)



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Map 3b - MSES - Species - Koala habitat area (SEQ)



MSES - Species Koala habitat area (SEQ)

Area of Interest

- Selected Lot and Plan
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Koala habitat area (core)
- Koala habitat area (locally refined)



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The represented layers for SEQ 'koala habitat area-core' and 'koala habitat area- locally refined' in MSES are sourced directly from the regulatory mapping under the Nature Conservation (Koala) Conservation Plan 2017. Whilst every effort is made to ensure the information remains current, there may be delays between updating versions. Please refer to the original mapping for the most recent version. See <https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping>

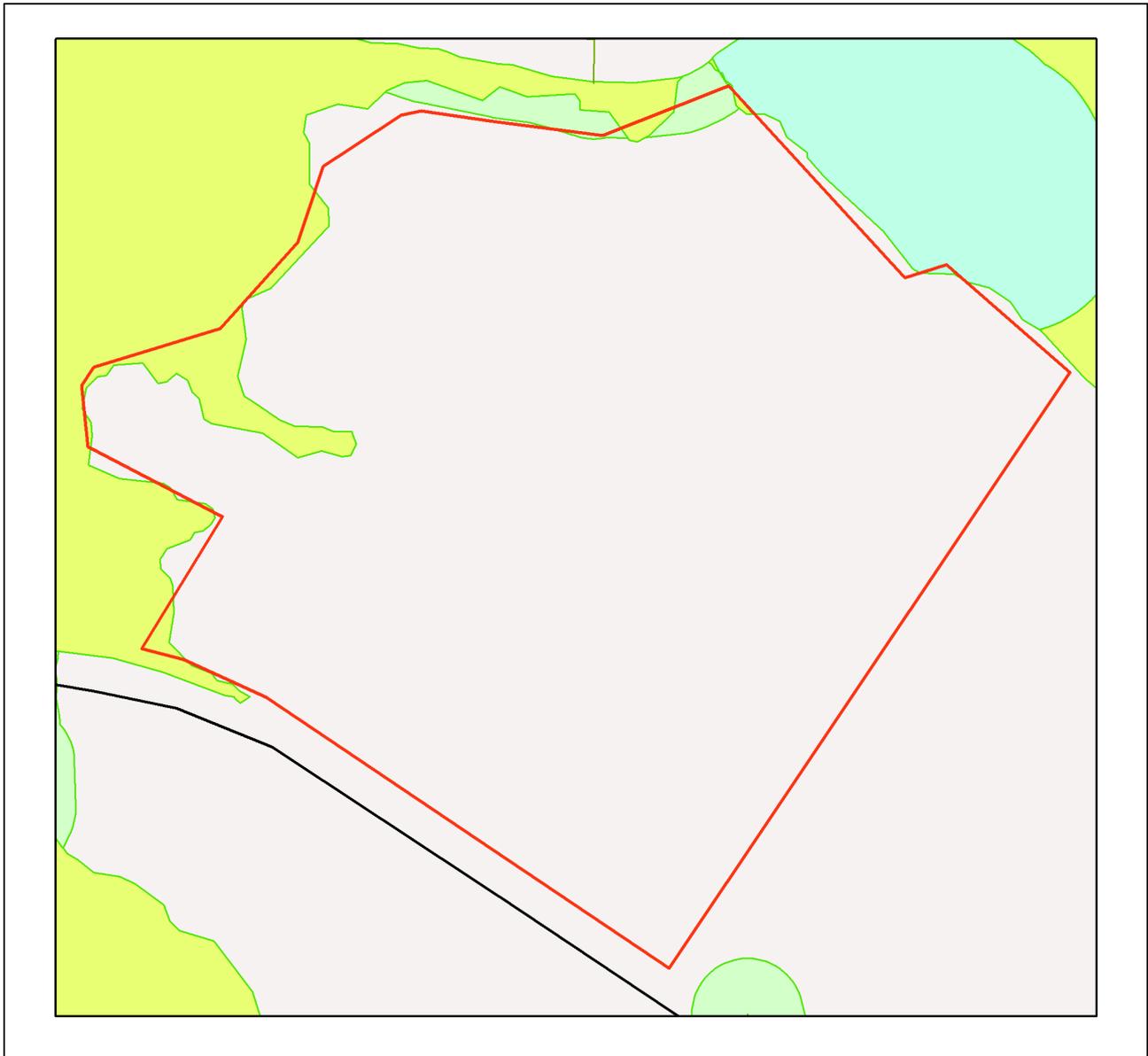
The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.



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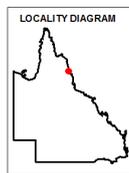
Map 4 - MSES - Regulated Vegetation



MSES - Regulated Vegetation

Area of Interest

- Selected Lot and Plan
- ▲ Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Regulated vegetation (intersecting a watercourse)
- Regulated vegetation (100m from wetland)
- Regulated vegetation (category B - endangered or of concern)
- Regulated vegetation (category C - endangered or of concern)
- Regulated vegetation (category R - GBR riverine)
- Regulated vegetation (essential habitat)



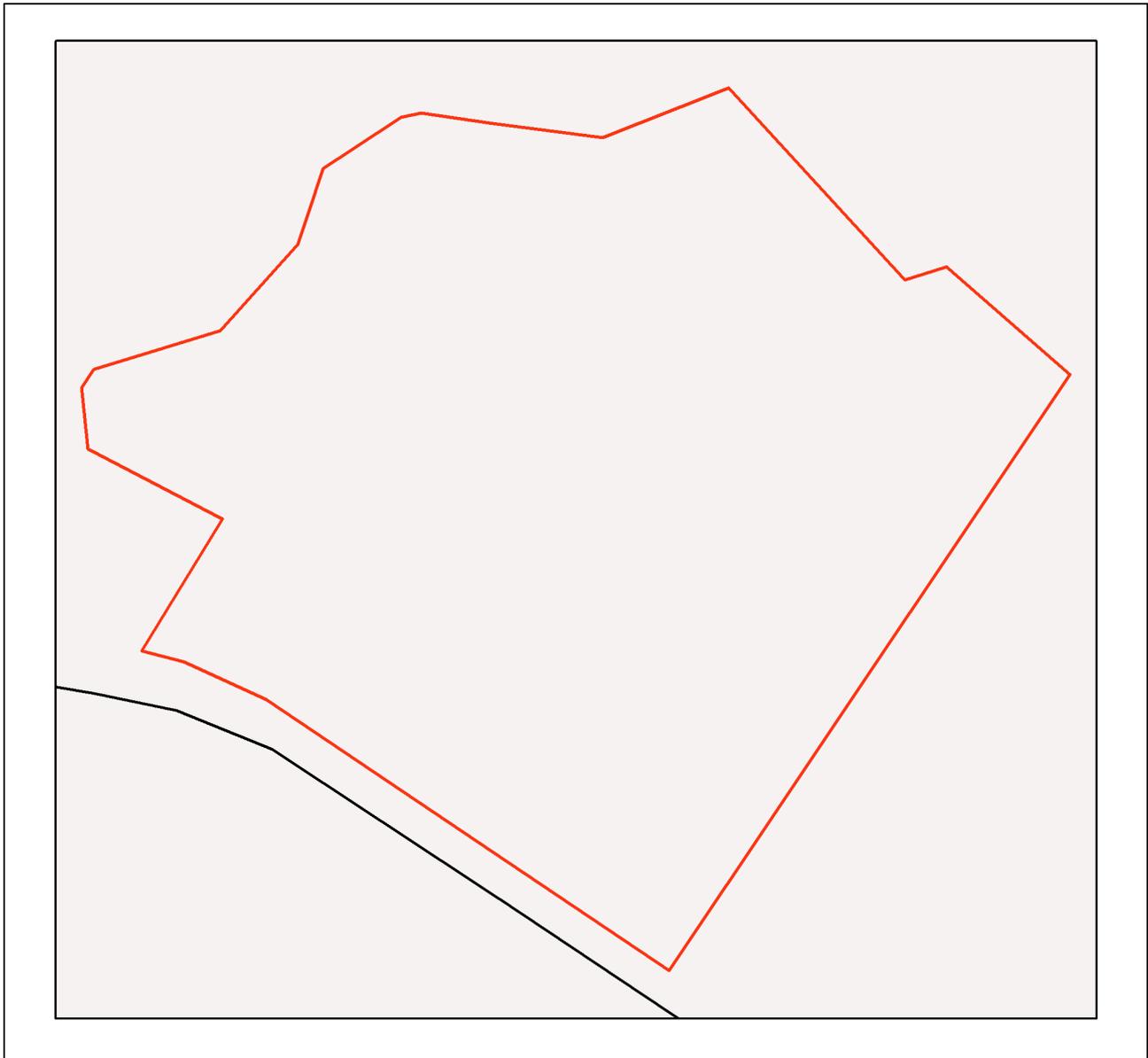
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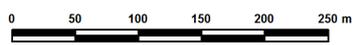
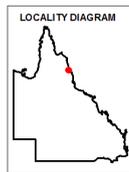
Map 5 - MSES - Offset Areas



MSES - Offsets

Area of Interest

-  Selected Lot and Plan
-  Towns
-  Freeways/Highways
-  Secondary roads
-  Major rivers/creeks
-  Legally secured offset area (offset register)
-  Legally secured offset area (vegetation offsets)



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Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). The compiled MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The Queensland Government's "Method for mapping - matters of state environmental significance for use in land use planning and development assessment" can be downloaded from:

<http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html> .

Appendix 2 - Source Data

The datasets listed below are available on request from:

<http://qldspatial.information.qld.gov.au/catalogue/custom/index.page>

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	current QSpatial data (http://qspatial.information.qld.gov.au)
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	-WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DES
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DES	- Department of Environment and Science
EP Act	- <i>Environmental Protection Act 1994</i>
EPP	- Environmental Protection Policy
GDA94	- Geocentric Datum of Australia 1994
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- <i>Nature Conservation Act 1992</i>
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- <i>Vegetation Management Act 1999</i>

Appendix E Wildlife Online Report



Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point

Species: All

Type: All

Status: All

Records: All

Date: Since 1980

Latitude: -16.55

Longitude: 145.49

Distance: 10

Email: kate.mckenzie@rpsgroup.com.au

Date submitted: Tuesday 16 Mar 2021 08:17:20

Date extracted: Tuesday 16 Mar 2021 08:20:02

The number of records retrieved = 569

Disclaimer

As the DSITIA is still in a process of collating and vetting data, it is possible the information given is not complete. The information provided should only be used for the project for which it was requested and it should be appropriately acknowledged as being derived from Wildlife Online when it is used.

The State of Queensland does not invite reliance upon, nor accept responsibility for this information. Persons should satisfy themselves through independent means as to the accuracy and completeness of this information.

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Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufo	<i>Rhinella marina</i>	cane toad	Y			1
animals	amphibians	Hylidae	<i>Litoria gracilentia</i>	graceful treefrog		C		1
animals	birds	Acanthizidae	<i>Gerygone mouki</i>	brown gerygone		C		21
animals	birds	Acanthizidae	<i>Gerygone palpebrosa</i>	fairy gerygone		C		10
animals	birds	Acanthizidae	<i>Gerygone magnirostris</i>	large-billed gerygone		C		2
animals	birds	Acanthizidae	<i>Sericornis magnirostra</i>	large-billed scrubwren		C		13
animals	birds	Acanthizidae	<i>Gerygone levigaster</i>	mangrove gerygone		C		1
animals	birds	Accipitridae	<i>Accipiter fasciatus</i>	brown goshawk		C		3
animals	birds	Accipitridae	<i>Pandion cristatus</i>	eastern osprey		SL		13
animals	birds	Accipitridae	<i>Elanus axillaris</i>	black-shouldered kite		C		1
animals	birds	Accipitridae	<i>Haliastur indus</i>	brahmyny kite		C		18
animals	birds	Accipitridae	<i>Milvus migrans</i>	black kite		C		12
animals	birds	Accipitridae	<i>Aquila audax</i>	wedge-tailed eagle		C		1
animals	birds	Accipitridae	<i>Aviceda subcristata</i>	Pacific baza		C		4
animals	birds	Accipitridae	<i>Haliastur sphenurus</i>	whistling kite		C		7
animals	birds	Accipitridae	<i>Haliaeetus leucogaster</i>	white-bellied sea-eagle		C		8
animals	birds	Accipitridae	<i>Accipiter cirrocephalus</i>	collared sparrowhawk		C		1
animals	birds	Accipitridae	<i>Accipiter novaehollandiae</i>	grey goshawk		C		3
animals	birds	Accipitridae	<i>Hamirostra melanosternon</i>	black-breasted buzzard		C		1
animals	birds	Alaudidae	<i>Mirafra javanica</i>	Horsfield's bushlark		C		1
animals	birds	Alcedinidae	<i>Ceyx azureus</i>	azure kingfisher		C		5
animals	birds	Alcedinidae	<i>Ceyx pusillus</i>	little kingfisher		C		1
animals	birds	Anatidae	<i>Radjah radjah</i>	radjah shelduck		C		2
animals	birds	Anatidae	<i>Dendrocygna arcuata</i>	wandering whistling-duck		C		4
animals	birds	Anatidae	<i>Dendrocygna eytoni</i>	plumed whistling-duck		C		2
animals	birds	Anatidae	<i>Chenonetta jubata</i>	Australian wood duck		C		1
animals	birds	Anatidae	<i>Anas superciliosa</i>	Pacific black duck		C		10
animals	birds	Anhingidae	<i>Anhinga novaehollandiae</i>	Australasian darter		C		3
animals	birds	Anseranatidae	<i>Anseranas semipalmata</i>	magpie goose		C		2
animals	birds	Apodidae	<i>Aerodramus terraereginae</i>	Australian swiftlet		C		35
animals	birds	Apodidae	<i>Hirundapus caudacutus</i>	white-throated needletail		V	V	3
animals	birds	Apodidae	<i>Apus pacificus</i>	fork-tailed swift		SL		7
animals	birds	Ardeidae	<i>Egretta novaehollandiae</i>	white-faced heron		C		14
animals	birds	Ardeidae	<i>Nycticorax caledonicus</i>	nankeen night-heron		C		2
animals	birds	Ardeidae	<i>Ardea alba modesta</i>	eastern great egret		C		11
animals	birds	Ardeidae	<i>Butorides striata</i>	striated heron		C		17
animals	birds	Ardeidae	<i>Egretta garzetta</i>	little egret		C		11
animals	birds	Ardeidae	<i>Ardea intermedia</i>	intermediate egret		C		5
animals	birds	Ardeidae	<i>Ardea sumatrana</i>	great-billed heron		C		1
animals	birds	Ardeidae	<i>Egretta picata</i>	piebald heron		C		4
animals	birds	Ardeidae	<i>Ardea pacifica</i>	white-necked heron		C		1
animals	birds	Ardeidae	<i>Egretta sacra</i>	eastern reef egret		C		10
animals	birds	Ardeidae	<i>Bubulcus ibis</i>	cattle egret		C		1
animals	birds	Artamidae	<i>Artamus leucorhynchus</i>	white-breasted woodswallow		C		35
animals	birds	Artamidae	<i>Melloria quoyi</i>	black butcherbird		C		33
animals	birds	Artamidae	<i>Cracticus nigrogularis</i>	piebald butcherbird		C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Artamidae	<i>Artamus cinereus</i>	black-faced woodswallow		C		1
animals	birds	Artamidae	<i>Gymnorhina tibicen</i>	Australian magpie		C		2
animals	birds	Artamidae	<i>Strepera graculina</i>	pied currawong		C		2
animals	birds	Burhinidae	<i>Burhinus grallarius</i>	bush stone-curlew		C		7
animals	birds	Burhinidae	<i>Esacus magnirostris</i>	beach stone-curlew		V		25
animals	birds	Cacatuidae	<i>Cacatua galerita</i>	sulphur-crested cockatoo		C		24
animals	birds	Cacatuidae	<i>Eolophus roseicapilla</i>	galah		C		1
animals	birds	Campephagidae	<i>Coracina lineata</i>	barred cuckoo-shrike		C		3
animals	birds	Campephagidae	<i>Lalage tricolor</i>	white-winged triller		C		3
animals	birds	Campephagidae	<i>Coracina tenuirostris</i>	cidadabird		C		1
animals	birds	Campephagidae	<i>Coracina papuensis</i>	white-bellied cuckoo-shrike		C		34
animals	birds	Campephagidae	<i>Lalage leucomela</i>	varied triller		C		61
animals	birds	Campephagidae	<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike		C		5
animals	birds	Casuariidae	<i>Casuarus casuarius johnsonii (southern population)</i>	southern cassowary (southern population)		E	E	1
animals	birds	Charadriidae	<i>Vanellus miles</i>	masked lapwing		C		13
animals	birds	Charadriidae	<i>Pluvialis fulva</i>	Pacific golden plover		SL		11
animals	birds	Charadriidae	<i>Charadrius mongolus</i>	lesser sand plover		E	E	12
animals	birds	Charadriidae	<i>Elseya melanops</i>	black-fronted dotterel		C		12
animals	birds	Charadriidae	<i>Pluvialis squatarola</i>	grey plover		SL		1
animals	birds	Charadriidae	<i>Vanellus miles miles</i>	masked lapwing (northern subspecies)		C		13
animals	birds	Charadriidae	<i>Charadrius ruficapillus</i>	red-capped plover		C		12
animals	birds	Charadriidae	<i>Charadrius leschenaultii</i>	greater sand plover		V	V	11
animals	birds	Ciconiidae	<i>Ephippiorhynchus asiaticus</i>	black-necked stork		C		3
animals	birds	Cisticolidae	<i>Cisticola exilis</i>	golden-headed cisticola		C		4
animals	birds	Climacteridae	<i>Cormobates leucophaea minor</i>	white-throated treecreeper (northern)		C		1
animals	birds	Columbidae	<i>Columba livia</i>	rock dove	Y			3
animals	birds	Columbidae	<i>Lopholaimus antarcticus</i>	topknot pigeon		C		5
animals	birds	Columbidae	<i>Streptopelia chinensis</i>	spotted dove	Y			16
animals	birds	Columbidae	<i>Macropygia amboinensis</i>	brown cuckoo-dove		C		15
animals	birds	Columbidae	<i>Ptilinopus magnificus</i>	wompoo fruit-dove		C		21
animals	birds	Columbidae	<i>Ptilinopus superbus</i>	superb fruit-dove		C		11
animals	birds	Columbidae	<i>Geopelia humeralis</i>	bar-shouldered dove		C		73
animals	birds	Columbidae	<i>Chalcophaps indica</i>	emerald dove		C		9
animals	birds	Columbidae	<i>Ptilinopus regina</i>	rose-crowned fruit-dove		C		10
animals	birds	Columbidae	<i>Phaps chalcoptera</i>	common bronzewing		C		2
animals	birds	Columbidae	<i>Ocyphaps lophotes</i>	crested pigeon		C		1
animals	birds	Columbidae	<i>Columba leucomela</i>	white-headed pigeon		C		2
animals	birds	Columbidae	<i>Ducula bicolor</i>	pied imperial-pigeon		C		40
animals	birds	Columbidae	<i>Geopelia striata</i>	peaceful dove		C		33
animals	birds	Coraciidae	<i>Eurystomus orientalis</i>	dollarbird		C		4
animals	birds	Corvidae	<i>Corvus orru</i>	Torresian crow		C		3
animals	birds	Cuculidae	<i>Chalcites minutillus russatus</i>	Gould's bronze-cuckoo		C		2
animals	birds	Cuculidae	<i>Chalcites minutillus</i>	little bronze-cuckoo		C		4
animals	birds	Cuculidae	<i>Scythrops novaehollandiae</i>	channel-billed cuckoo		C		6
animals	birds	Cuculidae	<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo		C		4

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Cuculidae	<i>Centropus phasianinus</i>	pheasant coucal		C		13
animals	birds	Cuculidae	<i>Cacomantis variolosus</i>	brush cuckoo		C		10
animals	birds	Cuculidae	<i>Eudynamys orientalis</i>	eastern koel		C		7
animals	birds	Cuculidae	<i>Chalcites lucidus</i>	shining bronze-cuckoo		C		4
animals	birds	Cuculidae	<i>Chalcites basal</i>	Horsfield's bronze-cuckoo		C		1
animals	birds	Cuculidae	<i>Cacomantis castaneiventris</i>	chestnut-breasted cuckoo		C		4
animals	birds	Dicruridae	<i>Dicrurus bracteatus</i>	spangled drongo		C		56
animals	birds	Estrildidae	<i>Lonchura punctulata</i>	nutmeg mannikin	Y			12
animals	birds	Estrildidae	<i>Lonchura castaneothorax</i>	chestnut-breasted mannikin		C		9
animals	birds	Estrildidae	<i>Taeniopygia bichenovii</i>	double-barred finch		C		1
animals	birds	Estrildidae	<i>Neochmia temporalis</i>	red-browed finch		C		6
animals	birds	Falconidae	<i>Falco berigora</i>	brown falcon		C		2
animals	birds	Falconidae	<i>Falco longipennis</i>	Australian hobby		C		1
animals	birds	Falconidae	<i>Falco cenchroides</i>	nankeen kestrel		C		2
animals	birds	Falconidae	<i>Falco peregrinus</i>	peregrine falcon		C		1
animals	birds	Haematopodidae	<i>Haematopus longirostris</i>	Australian pied oystercatcher		C		4
animals	birds	Halcyonidae	<i>Dacelo leachii</i>	blue-winged kookaburra		C		3
animals	birds	Halcyonidae	<i>Todiramphus sordidus</i>	Torresian kingfisher		C		6
animals	birds	Halcyonidae	<i>Todiramphus sanctus</i>	sacred kingfisher		C		29
animals	birds	Halcyonidae	<i>Todiramphus macleayii</i>	forest kingfisher		C		22
animals	birds	Halcyonidae	<i>Tanysiptera sylvia</i>	buff-breasted paradise-kingfisher		C		25
animals	birds	Halcyonidae	<i>Dacelo novaeguineae</i>	laughing kookaburra		C		25
animals	birds	Hirundinidae	<i>Petrochelidon ariel</i>	fairy martin		C		4
animals	birds	Hirundinidae	<i>Hirundo neoxena</i>	welcome swallow		C		37
animals	birds	Hirundinidae	<i>Petrochelidon nigricans</i>	tree martin		C		7
animals	birds	Laridae	<i>Sterna sumatrana</i>	black-naped tern		SL		3
animals	birds	Laridae	<i>Thalasseus bergii</i>	crested tern		SL		9
animals	birds	Laridae	<i>Hydroprogne caspia</i>	Caspian tern		SL		12
animals	birds	Laridae	<i>Chroicocephalus novaehollandiae</i>	silver gull		C		15
animals	birds	Laridae	<i>Gelochelidon nilotica</i>	gull-billed tern		SL		12
animals	birds	Laridae	<i>Thalasseus bengalensis</i>	lesser crested tern		C		1
animals	birds	Laridae	<i>Sternula albifrons</i>	little tern		SL		8
animals	birds	Maluridae	<i>Malurus melanocephalus</i>	red-backed fairy-wren		C		2
animals	birds	Maluridae	<i>Malurus amabilis</i>	lovely fairy-wren		C		11
animals	birds	Megapodiidae	<i>Alectura lathamii</i>	Australian brush-turkey		C		2
animals	birds	Megapodiidae	<i>Megapodius reinwardt</i>	orange-footed scrubfowl		C		33
animals	birds	Meliphagidae	<i>Caligavis chrysops</i>	yellow-faced honeyeater		C		1
animals	birds	Meliphagidae	<i>Entomyzon cyanotis</i>	blue-faced honeyeater		C		5
animals	birds	Meliphagidae	<i>Philemon buceroides</i>	helmeted friarbird		C		34
animals	birds	Meliphagidae	<i>Gavicalis versicolor</i>	varied honeyeater		C		33
animals	birds	Meliphagidae	<i>Lichmera indistincta</i>	brown honeyeater		C		19
animals	birds	Meliphagidae	<i>Melithreptus albogularis</i>	white-throated honeyeater		C		11
animals	birds	Meliphagidae	<i>Philemon argenticeps</i>	silver-crowned friarbird		C		3
animals	birds	Meliphagidae	<i>Ramsayornis modestus</i>	brown-backed honeyeater		C		13
animals	birds	Meliphagidae	<i>Philemon corniculatus</i>	noisy friarbird		C		6
animals	birds	Meliphagidae	<i>Meliphaga lewinii</i>	Lewin's honeyeater		C		10

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animals	birds	Meliphagidae	<i>Stomiopera flava</i>	yellow honeyeater		C		5
animals	birds	Meliphagidae	<i>Myzomela obscura</i>	dusky honeyeater		C		80
animals	birds	Meliphagidae	<i>Meliphaga notata</i>	yellow-spotted honeyeater		C		90
animals	birds	Meliphagidae	<i>Melithreptus lunatus</i>	white-naped honeyeater		C		2
animals	birds	Meliphagidae	<i>Xanthotis macleayanus</i>	Macleay's honeyeater		C		31
animals	birds	Meliphagidae	<i>Microptilotis gracilis</i>	graceful honeyeater		C		58
animals	birds	Meliphagidae	<i>Myzomela sanguinolenta</i>	scarlet honeyeater		C		2
animals	birds	Meliphagidae	<i>Philemon citreogularis</i>	little friarbird		C		4
animals	birds	Meropidae	<i>Merops ornatus</i>	rainbow bee-eater		C		48
animals	birds	Monarchidae	<i>Arses kaupi</i>	ped monarch		C		11
animals	birds	Monarchidae	<i>Myiagra alecto</i>	shining flycatcher		C		7
animals	birds	Monarchidae	<i>Myiagra rubecula</i>	leaden flycatcher		C		25
animals	birds	Monarchidae	<i>Myiagra cyanoleuca</i>	satin flycatcher		SL		3
animals	birds	Monarchidae	<i>Myiagra ruficollis</i>	broad-billed flycatcher		C		2
animals	birds	Monarchidae	<i>Grallina cyanoleuca</i>	magpie-lark		C		32
animals	birds	Monarchidae	<i>Monarcha melanopsis</i>	black-faced monarch		SL		7
animals	birds	Monarchidae	<i>Carterornis leucotis</i>	white-eared monarch		C		7
animals	birds	Monarchidae	<i>Symposiachrus trivirgatus</i>	spectacled monarch		SL		29
animals	birds	Monarchidae	<i>Machaerirhynchus flaviventer</i>	yellow-breasted boatbill		C		16
animals	birds	Motacillidae	<i>Anthus novaeseelandiae</i>	Australasian pipit		C		3
animals	birds	Nectariniidae	<i>Dicaeum hirundinaceum</i>	mistletoebird		C		59
animals	birds	Nectariniidae	<i>Cinnyris jugularis</i>	olive-backed sunbird		C		64
animals	birds	Oriolidae	<i>Oriolus sagittatus</i>	olive-backed oriole		C		7
animals	birds	Oriolidae	<i>Oriolus flavocinctus</i>	yellow oriole		C		31
animals	birds	Oriolidae	<i>Sphecotheres vieilloti</i>	Australasian figbird		C		51
animals	birds	Orthonychidae	<i>Orthonyx spaldingii</i>	chowchilla		C		9
animals	birds	Pachycephalidae	<i>Pachycephala pectoralis</i>	golden whistler		C		9
animals	birds	Pachycephalidae	<i>Pachycephala simplex peninsulae</i>	grey whistler		C		20
animals	birds	Pachycephalidae	<i>Colluricincla megarhyncha</i>	little shrike-thrush		C		35
animals	birds	Pachycephalidae	<i>Pachycephala melanura</i>	mangrove golden whistler		C		1
animals	birds	Pachycephalidae	<i>Colluricincla boweri</i>	Bower's shrike-thrush		C		2
animals	birds	Paradisaeidae	<i>Ptiloris victoriae</i>	Victoria's riflebird		C		18
animals	birds	Pardalotidae	<i>Pardalotus punctatus</i>	spotted pardalote		C		1
animals	birds	Passeridae	<i>Passer domesticus</i>	house sparrow	Y			13
animals	birds	Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian pelican		C		1
animals	birds	Petroicidae	<i>Eopsaltria australis</i>	eastern yellow robin		C		1
animals	birds	Petroicidae	<i>Heteromyias cinereifrons</i>	grey-headed robin		C		3
animals	birds	Petroicidae	<i>Microeca flavigaster</i>	lemon-bellied flycatcher		C		2
animals	birds	Petroicidae	<i>Tregellasia capito</i>	pale-yellow robin		C		20
animals	birds	Phalacrocoracidae	<i>Phalacrocorax sulcirostris</i>	little black cormorant		C		2
animals	birds	Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	little pied cormorant		C		5
animals	birds	Phasianidae	<i>Coturnix ypsilophora</i>	brown quail		C		2
animals	birds	Pittidae	<i>Pitta versicolor</i>	noisy pitta		C		12
animals	birds	Podargidae	<i>Podargus papuensis</i>	Papuan frogmouth		C		1
animals	birds	Podicipedidae	<i>Tachybaptus novaehollandiae</i>	Australasian grebe		C		1
animals	birds	Psittacidae	<i>Trichoglossus chlorolepidotus</i>	scaly-breasted lorikeet		C		3

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animals	birds	Psittacidae	<i>Trichoglossus haematodus moluccanus</i>	rainbow lorikeet		C		55
animals	birds	Psittacidae	<i>Aprosmictus erythropterus</i>	red-winged parrot		C		2
animals	birds	Psittacidae	<i>Alisterus scapularis</i>	Australian king-parrot		C		4
animals	birds	Psittacidae	<i>Cyclopsitta diophthalma macleayana</i>	Macleay's fig-parrot		V		24
animals	birds	Psophodidae	<i>Psophodes olivaceus</i>	eastern whipbird		C		11
animals	birds	Ptilonorhynchidae	<i>Ptilonorhynchus violaceus</i>	satin bowerbird		C		1
animals	birds	Ptilonorhynchidae	<i>Ailuroedus maculosus</i>	spotted catbird		C		12
animals	birds	Ptilonorhynchidae	<i>Ptilonorhynchus nuchalis</i>	great bowerbird		C		1
animals	birds	Rallidae	<i>Porphyrio melanotus</i>	purple swamphen		C		1
animals	birds	Rallidae	<i>Amaurornis moluccana</i>	pale-vented bush-hen		C		2
animals	birds	Rallidae	<i>Gallirallus philippensis</i>	buff-banded rail		C		2
animals	birds	Recurvirostridae	<i>Himantopus himantopus</i>	black-winged stilt		C		3
animals	birds	Rhipiduridae	<i>Rhipidura rufiventris</i>	northern fantail		C		7
animals	birds	Rhipiduridae	<i>Rhipidura leucophrys</i>	willie wagtail		C		19
animals	birds	Rhipiduridae	<i>Rhipidura rufifrons</i>	rufous fantail		SL		19
animals	birds	Rhipiduridae	<i>Rhipidura albiscapa</i>	grey fantail		C		15
animals	birds	Scolopacidae	<i>Numenius madagascariensis</i>	eastern curlew		E	CE	34
animals	birds	Scolopacidae	<i>Xenus cinereus</i>	terek sandpiper		SL		1
animals	birds	Scolopacidae	<i>Tringa brevipes</i>	grey-tailed tattler		SL		20
animals	birds	Scolopacidae	<i>Numenius minutus</i>	little curlew		SL		1
animals	birds	Scolopacidae	<i>Tringa nebularia</i>	common greenshank		SL		8
animals	birds	Scolopacidae	<i>Numenius phaeopus</i>	whimbrel		SL		34
animals	birds	Scolopacidae	<i>Actitis hypoleucos</i>	common sandpiper		SL		5
animals	birds	Scolopacidae	<i>Arenaria interpres</i>	ruddy turnstone		SL		1
animals	birds	Scolopacidae	<i>Calidris acuminata</i>	sharp-tailed sandpiper		SL		3
animals	birds	Scolopacidae	<i>Limosa lapponica baueri</i>	Western Alaskan bar-tailed godwit		V	V	28
animals	birds	Scolopacidae	<i>Calidris ruficollis</i>	red-necked stint		SL		10
animals	birds	Scolopacidae	<i>Tringa stagnatilis</i>	marsh sandpiper		SL		1
animals	birds	Strigidae	<i>Ninox connivens</i>	barking owl		C		1
animals	birds	Sturnidae	<i>Acridotheres tristis</i>	common myna	Y			41
animals	birds	Sturnidae	<i>Aplonis metallica</i>	metallic starling		C		15
animals	birds	Threskiornithidae	<i>Threskiornis spinicollis</i>	straw-necked ibis		C		11
animals	birds	Threskiornithidae	<i>Platalea regia</i>	royal spoonbill		C		4
animals	birds	Threskiornithidae	<i>Platalea flavipes</i>	yellow-billed spoonbill		C		1
animals	birds	Threskiornithidae	<i>Plegadis falcinellus</i>	glossy ibis		SL		2
animals	birds	Threskiornithidae	<i>Threskiornis molucca</i>	Australian white ibis		C		7
animals	birds	Timaliidae	<i>Zosterops lateralis</i>	silveryeye		C		17
animals	birds	Turdidae	<i>Zoothera heinei</i>	russet-tailed thrush		C		1
animals	insects	Lycaenidae	<i>Ogyris aenone</i>	sapphire azure				1
animals	insects	Pieridae	<i>Elodina walkeri</i>	small pearl-white				2
animals	insects	Pieridae	<i>Cepora perimale scyllara</i>	caper gull (Australian subspecies)				1
animals	mammals	Delphinidae	<i>Orcaella heinsohni</i>	Australian snubfin dolphin		V		1
animals	mammals	Macropodidae	<i>Dendrolagus lumholtzi</i>	Lumholtz's tree-kangaroo		NT		1
animals	mammals	Miniopteridae	<i>Miniopterus australis</i>	little bent-wing bat		C		1
animals	mammals	Molossidae	<i>Mormopterus ridei</i>	eastern free-tailed bat		C		1
animals	mammals	Molossidae	<i>Mormopterus sp.</i>			C		1

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animals	mammals	Pteropodidae	<i>Pteropus conspicillatus</i>	spectacled flying-fox		E	E	3
animals	mammals	Rhinolophidae	<i>Rhinolophus megaphyllus</i>	eastern horseshoe-bat		C		1
animals	mammals	Vespertilionidae	<i>Nyctophilus bifax</i>	northern long-eared bat		C		1
animals	mammals	Vespertilionidae	<i>Murina florium</i>	tube-nosed insectivorous bat		V		1
animals	ray-finned fishes	Eleotridae	<i>Giuris margaritacea</i>	snakehead gudgeon				1
animals	reptiles	Colubridae	<i>Tropidonophis mairii</i>	freshwater snake		C		1
animals	reptiles	Crocodylidae	<i>Crocodylus sp.</i>			C		1
animals	reptiles	Crocodylidae	<i>Crocodylus porosus</i>	estuarine crocodile		V		8
animals	reptiles	Scincidae	<i>Carlia crypta</i>			C		12
animals	reptiles	Scincidae	<i>Carlia longipes</i>	closed-litter rainbow-skink		C		1
animals	reptiles	Scincidae	<i>Lampropholis coggeri</i>	rainforest sunskink		C		8
animals	reptiles	Varanidae	<i>Varanus varius</i>	lace monitor		C		1
animals	uncertain	Indeterminate	<i>Indeterminate</i>	Unknown or Code Pending				2
chromists	brown algae	Dictyotaceae	<i>Dictyopteris delicatula</i>			C		1/1
chromists	brown algae	Sargassaceae	<i>Sargassum</i>					5/5
chromists	brown algae	Sargassaceae	<i>Sargassum decurrens</i>			C		1/1
chromists	brown algae	Sphacelariaceae	<i>Sphacelaria rigidula</i>			C		1/1
fungi	Agaricomycetes	Marasmiaceae	<i>Omphalotus nidiformis</i>			C		1/1
fungi	lecanoromycetes	Caliciaceae	<i>Dimelaena elevata</i>			C		1/1
fungi	lecanoromycetes	Lecanoraceae	<i>Lecanora pseudistera</i>			C		1/1
fungi	lecanoromycetes	Pannariaceae	<i>Parmeliella brisbanensis</i>			C		1/1
fungi	lecanoromycetes	Pannariaceae	<i>Physma</i>					3/3
fungi	lecanoromycetes	Parmeliaceae	<i>Usnea bismolliuscula</i>			C		1/1
fungi	lecanoromycetes	Parmeliaceae	<i>Xanthoparmelia amplexula</i>			C		1/1
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina confirmata</i>			C		2/2
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina luciae</i>			C		2/2
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina tenella</i>			C		2/2
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina tropica</i>			C		3/3
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina nervulosa</i>			C		1/1
fungi	lecanoromycetes	Ramalinaceae	<i>Ramalina subfraxinea var. subfraxinea</i>			C		4/4
fungi	lichinomycetes	Peltulaceae	<i>Peltula clavata</i>			C		1/1
plants	Florideophyceae	Corallinaceae	<i>Cheilosporum</i>					2/2
plants	Florideophyceae	Corallinaceae	<i>Jania adhaerens</i>			C		1/1
plants	Florideophyceae	Lithophyllaceae	<i>Amphiroa foliacea</i>			C		1/1
plants	land plants	Acanthaceae	<i>Pseuderanthemum variabile</i>	pastel flower		C		1/1
plants	land plants	Acanthaceae	<i>Hemigraphis alternata</i>		Y			1/1
plants	land plants	Acanthaceae	<i>Asystasia gangetica subsp. gangetica</i>		Y			1/1
plants	land plants	Acanthaceae	<i>Barleria strigosa</i>		Y			1/1
plants	land plants	Acanthaceae	<i>Thunbergia alata</i>	black-eyed Susan	Y			1/1
plants	land plants	Acanthaceae	<i>Nelsonia campestris</i>			C		1/1
plants	land plants	Acanthaceae	<i>Avicennia marina subsp. australasica</i>			C		1/1
plants	land plants	Aizoaceae	<i>Trianthema portulacastrum</i>	black pigweed	Y			1/1
plants	land plants	Amaranthaceae	<i>Alternanthera philoxeroides</i>	alligator weed	Y			1/1
plants	land plants	Amaranthaceae	<i>Alternanthera ficoidea</i>		Y			1/1
plants	land plants	Annonaceae	<i>Polyalthia nitidissima</i>	polyalthia		C		1/1
plants	land plants	Annonaceae	<i>Monoon australe</i>			C		1/1

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plants	land plants	Annonaceae	<i>Pseuduvaria froggattii</i>			C		2/2
plants	land plants	Annonaceae	<i>Uvaria concava</i>			C		1/1
plants	land plants	Annonaceae	<i>Miliusa brahei</i>			C		3/3
plants	land plants	Apiaceae	<i>Centella asiatica</i>			C		1/1
plants	land plants	Apocynaceae	<i>Dischidia major</i>	pitcher plant		C		1/1
plants	land plants	Apocynaceae	<i>Ochrosia elliptica</i>	northern ochrosia		C		1/1
plants	land plants	Apocynaceae	<i>Catharanthus roseus</i>	pink periwinkle	Y			2/2
plants	land plants	Apocynaceae	<i>Allamanda cathartica</i>	yellow allamanda	Y			1/1
plants	land plants	Apocynaceae	<i>Parsonsia lenticellata</i>	narrow-leaved parsonsia		C		1/1
plants	land plants	Apocynaceae	<i>Marsdenia longipedicellata</i>			C		1/1
plants	land plants	Apocynaceae	<i>Tabernaemontana orientalis</i>			C		1/1
plants	land plants	Apocynaceae	<i>Alyxia spicata</i>			C		1/1
plants	land plants	Apocynaceae	<i>Kopsia arborea</i>			C		1/1
plants	land plants	Apocynaceae	<i>Alstonia muelleriana</i>	hard milkwood		C		1/1
plants	land plants	Aponogetonaceae	<i>Aponogeton cuneatus</i>			C		1/1
plants	land plants	Araceae	<i>Syngonium podophyllum</i>		Y			1/1
plants	land plants	Araceae	<i>Aglaonema commutatum</i>		Y			1/1
plants	land plants	Araceae	<i>Typhonium wilbertii</i>			C		1/1
plants	land plants	Araceae	<i>Epipremnum pinnatum</i>			C		1/1
plants	land plants	Arecaceae	<i>Calamus australis</i>	hairy Mary		C		1/1
plants	land plants	Argophyllaceae	<i>Argophyllum loxotrichum</i>			C		1/1
plants	land plants	Aristolochiaceae	<i>Aristolochia thozetii</i>			C		1/1
plants	land plants	Asteraceae	<i>Elephantopus mollis</i>	tobacco weed	Y			1/1
plants	land plants	Asteraceae	<i>Praxelis clematidea</i>		Y			1/1
plants	land plants	Asteraceae	<i>Sphagneticola trilobata</i>		Y			4/1
plants	land plants	Asteraceae	<i>Chromolaena odorata</i>	Siam weed	Y			1/1
plants	land plants	Asteraceae	<i>Ageratum conyzoides</i>	billygoat weed	Y			1/1
plants	land plants	Begoniaceae	<i>Begonia hirtella</i>		Y			1/1
plants	land plants	Bignoniaceae	<i>Dolichandra unguis-cati</i>	cat's claw creeper	Y			1/1
plants	land plants	Blechnaceae	<i>Doodia media</i>			C		1/1
plants	land plants	Boraginaceae	<i>Heliotropium indicum</i>		Y			1/1
plants	land plants	Boraginaceae	<i>Ehretia sp. (Whitfield Range R.Jago 17)</i>			C		1/1
plants	land plants	Boraginaceae	<i>Heliotropium peninsulare</i>			C		1/1
plants	land plants	Burseraceae	<i>Canarium australianum var. australianum</i>			C		1/1
plants	land plants	Byblidaceae	<i>Byblis liniflora</i>			C		1/1
plants	land plants	Byttneriaceae	<i>Abroma molle</i>			C		1/1
plants	land plants	Cactaceae	<i>Opuntia monacantha</i>		Y			2/2
plants	land plants	Caesalpiniaceae	<i>Guilandina bonduc</i>			C		1/1
plants	land plants	Caesalpiniaceae	<i>Lysiphyllum binatum</i>			C		2/2
plants	land plants	Caesalpiniaceae	<i>Bauhinia monandra</i>		Y			1/1
plants	land plants	Caesalpiniaceae	<i>Delonix regia</i>	poinciana	Y			1/1
plants	land plants	Caesalpiniaceae	<i>Mezoneuron scortechinii</i>			C		1/1
plants	land plants	Capparaceae	<i>Capparis</i>					1/1
plants	land plants	Capparaceae	<i>Capparis lucida</i>			C		1/1
plants	land plants	Celastraceae	<i>Hedraianthera porphyropetala</i>	hedrianthera		C		1/1
plants	land plants	Celastraceae	<i>Elaeodendron melanocarpum</i>			C		1/1

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plants	land plants	Celastraceae	<i>Hippocratea barbata</i>	knotvine		C		1/1
plants	land plants	Ceratophyllaceae	<i>Ceratophyllum demersum</i>	hornwort		C		1/1
plants	land plants	Chenopodiaceae	<i>Tecticornia indica subsp. indica</i>			C		1/1
plants	land plants	Chenopodiaceae	<i>Suaeda australis</i>			C		1/1
plants	land plants	Chenopodiaceae	<i>Tecticornia halocnemoides</i>			C		2/2
plants	land plants	Chenopodiaceae	<i>Tecticornia indica</i>			C		2/2
plants	land plants	Chenopodiaceae	<i>Tecticornia australasica</i>			C		1/1
plants	land plants	Cleomaceae	<i>Tarenaya aculeata</i>		Y			1/1
plants	land plants	Combretaceae	<i>Terminalia catappa</i>			C		1/1
plants	land plants	Combretaceae	<i>Lumnitzera littorea</i>			C		1/1
plants	land plants	Commelinaceae	<i>Tradescantia zebrina</i>		Y			1/1
plants	land plants	Commelinaceae	<i>Commelina ensifolia</i>	scurvy grass		C		1/1
plants	land plants	Commelinaceae	<i>Commelina diffusa</i>	wandering jew		C		1/1
plants	land plants	Commelinaceae	<i>Cartonema spicatum</i>			C		1/1
plants	land plants	Commelinaceae	<i>Cyanotis axillaris</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Turbina corymbosa</i>		Y			1/1
plants	land plants	Convolvulaceae	<i>Distimake quinquefolius</i>		Y			1/1
plants	land plants	Convolvulaceae	<i>Ipomoea polymorpha</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Ipomoea littoralis</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Operculina riedeliana</i>			C		1/1
plants	land plants	Convolvulaceae	<i>Lepistemon urceolatus</i>			C		1/1
plants	land plants	Cucurbitaceae	<i>Trichosanthes pentaphylla</i>			C		1/1
plants	land plants	Cycadaceae	<i>Cycas media subsp. banksii</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus ohwii</i>			C		1/1
plants	land plants	Cyperaceae	<i>Carex maculata</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus rotundus</i>	nutgrass	Y			1/1
plants	land plants	Cyperaceae	<i>Fuirena ciliaris</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus javanicus</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus trinervis</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fuirena umbellata</i>			C		1/1
plants	land plants	Cyperaceae	<i>Scleria polycarpa</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis recta</i>			C		1/1
plants	land plants	Cyperaceae	<i>Carex cryptostachys</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus brevifolius</i>	Mullumbimby couch	Y			1/1
plants	land plants	Cyperaceae	<i>Cyperus sphacelatus</i>		Y			1/1
plants	land plants	Cyperaceae	<i>Eleocharis sundaica</i>			C		1/1
plants	land plants	Cyperaceae	<i>Eleocharis acutangula</i>			C		1/1
plants	land plants	Cyperaceae	<i>Eleocharis equisetina</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis dichotoma</i>	common fringe-rush		C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis acicularis</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis ferruginea</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis littoralis</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis pauciflora</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis depauperata</i>			C		1/1
plants	land plants	Cyperaceae	<i>Schoenoplectus subulatus</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis fimbristyloloides</i>			C		1/1

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plants	land plants	Cyperaceae	<i>Rhynchospora heterochaeta</i>			C		1/1
plants	land plants	Cyperaceae	<i>Eleocharis philippinensis</i>			C		1/1
plants	land plants	Cyperaceae	<i>Cyperus haspan subsp. juncooides</i>			C		1/1
plants	land plants	Cyperaceae	<i>Fimbristylis polytrichoides</i>			C		1/1
plants	land plants	Dioscoreaceae	<i>Dioscorea transversa</i>	native yam		C		1/1
plants	land plants	Dracaenaceae	<i>Dracaena angustifolia</i>			C		1/1
plants	land plants	Dracaenaceae	<i>Sansevieria trifasciata var. trifasciata</i>		Y			1/1
plants	land plants	Ebenaceae	<i>Diospyros compacta</i>			C		1/1
plants	land plants	Ebenaceae	<i>Diospyros hebecarpa</i>			C		1/1
plants	land plants	Euphorbiaceae	<i>Mallotus surculosus</i>			C		1/1
plants	land plants	Euphorbiaceae	<i>Euphorbia tithymaloides subsp. smallii</i>		Y			2/2
plants	land plants	Euphorbiaceae	<i>Tragia finalis</i>			C		2/2
plants	land plants	Euphorbiaceae	<i>Manihot esculenta</i>		Y			1/1
plants	land plants	Euphorbiaceae	<i>Euphorbia bifida</i>			C		1/1
plants	land plants	Euphorbiaceae	<i>Euphorbia cyathophora</i>	dwarf poinsettia	Y			1/1
plants	land plants	Fabaceae	<i>Tephrosia filipes subsp. filipes</i>			C		1/1
plants	land plants	Fabaceae	<i>Zornia muriculata subsp. angustata</i>			C		1/1
plants	land plants	Fabaceae	<i>Zornia muriculata subsp. muriculata</i>			C		1/1
plants	land plants	Fabaceae	<i>Crotalaria goreensis</i>	gambia pea	Y			1/1
plants	land plants	Fabaceae	<i>Desmodium scorpiurus</i>		Y			2/2
plants	land plants	Fabaceae	<i>Indigofera pratensis</i>			C		1/1
plants	land plants	Fabaceae	<i>Pycnospora lutescens</i>	pycnospora		C		1/1
plants	land plants	Fabaceae	<i>Tephrosia leptoclada</i>			C		1/1
plants	land plants	Fabaceae	<i>Uraria lagopodioides</i>			C		1/1
plants	land plants	Fabaceae	<i>Dalbergia candenatensis</i>			C		1/1
plants	land plants	Fabaceae	<i>Desmodium trichostachyum</i>			C		1/1
plants	land plants	Fabaceae	<i>Mucuna pruriens var. utilis</i>		Y			1/1
plants	land plants	Fabaceae	<i>Crotalaria pallida var. obovata</i>		Y			1/1
plants	land plants	Fabaceae	<i>Galactia</i>					1/1
plants	land plants	Fabaceae	<i>Desmodium tenax</i>			C		1/1
plants	land plants	Fabaceae	<i>Eriosema chinense</i>			C		2/2
plants	land plants	Fabaceae	<i>Millettia pinnata</i>			C		1/1
plants	land plants	Fabaceae	<i>Glycine tomentella</i>	woolly glycine		C		1/1
plants	land plants	Fabaceae	<i>Desmodium filiforme</i>			C		1/1
plants	land plants	Fabaceae	<i>Desmodium nemorosum</i>			C		2/2
plants	land plants	Gentianaceae	<i>Canscora diffusa</i>			C		1/1
plants	land plants	Gleicheniaceae	<i>Dicranopteris linearis var. linearis</i>			C		1/1
plants	land plants	Hydrocharitaceae	<i>Hydrilla verticillata</i>	hydrilla		C		1/1
plants	land plants	Lamiaceae	<i>Premna limbata</i>			C		1/1
plants	land plants	Lamiaceae	<i>Clerodendrum floribundum</i>			C		1/1
plants	land plants	Lamiaceae	<i>Clerodendrum tracyanum</i>			C		1/1
plants	land plants	Lamiaceae	<i>Vitex rotundifolia</i>			C		1/1
plants	land plants	Lamiaceae	<i>Coleus foetidus</i>			C		1/1
plants	land plants	Lamiaceae	<i>Coleus apreptus</i>			C		1/1
plants	land plants	Lauraceae	<i>Cassytha filiformis</i>	dodder laurel		C		1/1
plants	land plants	Laxmanniaceae	<i>Lomandra banksii</i>			C		1/1

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plants	land plants	Laxmanniaceae	<i>Cordyline cannifolia</i>			C		1/1
plants	land plants	Linderniaceae	<i>Artanema fimbriatum</i>			C		1/1
plants	land plants	Loranthaceae	<i>Decaisnina brittenii</i> subsp. <i>brittenii</i>			C		1/1
plants	land plants	Loranthaceae	<i>Amyema sanguinea</i> var. <i>sanguinea</i>			C		1/1
plants	land plants	Loranthaceae	<i>Amylotheca dictyophleba</i>			C		1/1
plants	land plants	Loranthaceae	<i>Amyema quaternifolia</i>			C		1/1
plants	land plants	Loranthaceae	<i>Lysiana subfalcata</i>			C		2/2
plants	land plants	Loranthaceae	<i>Diplatia tomentosa</i>			C		2/2
plants	land plants	Loranthaceae	<i>Amyema villiflora</i> subsp. <i>villiflora</i>			C		2/2
plants	land plants	Malvaceae	<i>Sida cordifolia</i>		Y			1/1
plants	land plants	Meliaceae	<i>Vavaea amicorum</i>			C		1/1
plants	land plants	Menispermaceae	<i>Stephania japonica</i> var. <i>timoriensis</i>			C		1/1
plants	land plants	Menispermaceae	<i>Stephania tuberosa</i>			C		1/1
plants	land plants	Menyanthaceae	<i>Nymphoides geminata</i>			C		1/1
plants	land plants	Mimosaceae	<i>Leucaena leucocephala</i> subsp. <i>leucocephala</i>		Y			2/2
plants	land plants	Mimosaceae	<i>Calliandra haematocephala</i>		Y			1/1
plants	land plants	Mimosaceae	<i>Acacia crassicarpa</i>			C		2/2
plants	land plants	Mimosaceae	<i>Acacia leptocarpa</i>	north coast wattle		C		1/1
plants	land plants	Mimosaceae	<i>Acacia flavescens</i>	toothed wattle		C		2/2
plants	land plants	Mimosaceae	<i>Falcataria toona</i>			C		1/1
plants	land plants	Mimosaceae	<i>Albizia procera</i>			C		2/2
plants	land plants	Mimosaceae	<i>Acacia oraria</i>			C		2/2
plants	land plants	Mimosaceae	<i>Archidendron grandiflorum</i>	lace flower tree		C		1/1
plants	land plants	Mimosaceae	<i>Acacia mangium</i>			C		1/1
plants	land plants	Molluginaceae	<i>Glinus oppositifolius</i>			C		1/1
plants	land plants	Monimiaceae	<i>Wilkiea macrophylla</i>	large-leaved wilkiea		C		2/2
plants	land plants	Moraceae	<i>Trophis scandens</i> subsp. <i>scandens</i>			C		1/1
plants	land plants	Moraceae	<i>Streblus brunonianus</i>	whalebone tree		C		1/1
plants	land plants	Muntingiaceae	<i>Muntingia calabura</i>		Y			1/1
plants	land plants	Myristicaceae	<i>Myristica globosa</i> subsp. <i>muelleri</i>	native nutmeg		C		1/1
plants	land plants	Myrtaceae	<i>Melaleuca quinquenervia</i>	swamp paperbark		C		1/1
plants	land plants	Myrtaceae	<i>Eugenia reinwardtiana</i>	beach cherry		C		1/1
plants	land plants	Myrtaceae	<i>Eucalyptus portuensis</i>			C		4/4
plants	land plants	Myrtaceae	<i>Psidium guineense</i>	cherry guava	Y			1/1
plants	land plants	Myrtaceae	<i>Melaleuca viridiflora</i> var. <i>viridiflora</i>			C		1/1
plants	land plants	Myrtaceae	<i>Gossia retusa</i>			C		2/2
plants	land plants	Myrtaceae	<i>Gossia bidwillii</i>			C		1/1
plants	land plants	Nyctaginaceae	<i>Boerhavia diffusa</i>		Y			2/2
plants	land plants	Oleaceae	<i>Jasminum simplicifolium</i> subsp. <i>australiense</i>			C		1/1
plants	land plants	Onagraceae	<i>Ludwigia octovalvis</i>	willow primrose		C		1/1
plants	land plants	Ophioglossaceae	<i>Ophioglossum costatum</i>	large adder's tongue		C		1/1
plants	land plants	Opiliaceae	<i>Cansjera leptostachya</i>			C		1/1
plants	land plants	Orchidaceae	<i>Dendrobium bigibbum</i>	Cooktown orchid		V	V	1/1
plants	land plants	Orobanchaceae	<i>Buchnera linearis</i>			C		1/1
plants	land plants	Orobanchaceae	<i>Buchnera urticifolia</i>			C		1/1
plants	land plants	Passifloraceae	<i>Passiflora pallida</i>		Y			1/1

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plants	land plants	Passifloraceae	<i>Passiflora edulis</i>		Y			1/1
plants	land plants	Phyllanthaceae	<i>Cleistanthus semiopacus</i>			C		1/1
plants	land plants	Phyllanthaceae	<i>Glochidion benthamianum</i>			C		4/4
plants	land plants	Phyllanthaceae	<i>Phyllanthus virgatus</i>			C		2/2
plants	land plants	Phyllanthaceae	<i>Phyllanthus amarus</i>		Y			1/1
plants	land plants	Phyllanthaceae	<i>Phyllanthus novae-hollandiae</i>			C		1/1
plants	land plants	Phyllanthaceae	<i>Glochidion harveyanum</i> var. <i>harveyanum</i>			C		2/2
plants	land plants	Piperaceae	<i>Piper caninum</i>	peppervine		C		1/1
plants	land plants	Piperaceae	<i>Piper sarmentosum</i>		Y			1/1
plants	land plants	Pittosporaceae	<i>Pittosporum tinifolium</i>			C		1/1
plants	land plants	Pittosporaceae	<i>Pittosporum rubiginosum</i>			C		2/2
plants	land plants	Plantaginaceae	<i>Bacopa lanigera</i>		Y			1/1
plants	land plants	Plantaginaceae	<i>Scoparia dulcis</i>	scoparia	Y			1/1
plants	land plants	Poaceae	<i>Urochloa subquadriflora</i>		Y			1/1
plants	land plants	Poaceae	<i>Eragrostis spartinooides</i>			C		4/4
plants	land plants	Poaceae	<i>Sporobolus jacquemontii</i>		Y			3/3
plants	land plants	Poaceae	<i>Capillipedium spicigerum</i>	spicytop		C		1/1
plants	land plants	Poaceae	<i>Paspalidium scabrifolium</i>			C		1/1
plants	land plants	Poaceae	<i>Cymbopogon queenslandicus</i>			C		1/1
plants	land plants	Poaceae	<i>Panicum seminudum</i> var. <i>seminudum</i>			C		1/1
plants	land plants	Poaceae	<i>Panicum seminudum</i> var. <i>cairnsianum</i>			C		2/2
plants	land plants	Poaceae	<i>Eriachne pallescens</i> var. <i>pallescens</i>			C		1/1
plants	land plants	Poaceae	<i>Cenchrus pedicellatus</i> subsp. <i>pedicellatus</i>		Y			1/1
plants	land plants	Poaceae	<i>Perotis rara</i>	comet grass		C		1/1
plants	land plants	Poaceae	<i>Sarga plumosum</i>			C		1/1
plants	land plants	Poaceae	<i>Eleusine indica</i>	crowsfoot grass	Y			2/2
plants	land plants	Poaceae	<i>Sarga timorense</i>			C		1/1
plants	land plants	Poaceae	<i>Setaria surgens</i>			C		2/2
plants	land plants	Poaceae	<i>Zoysia matrella</i>			C		1/1
plants	land plants	Poaceae	<i>Eriachne ciliata</i>			C		2/2
plants	land plants	Poaceae	<i>Eriachne humilis</i>			C		2/2
plants	land plants	Poaceae	<i>Eriachne trisetia</i>			C		1/1
plants	land plants	Poaceae	<i>Eriochloa crebra</i>	spring grass		C		1/1
plants	land plants	Poaceae	<i>Leersia hexandra</i>	swamp rice grass		C		1/1
plants	land plants	Poaceae	<i>Themeda triandra</i>	kangaroo grass		C		1/1
plants	land plants	Poaceae	<i>Ectrosia leporina</i>			C		1/1
plants	land plants	Poaceae	<i>Eriachne stipacea</i>			C		1/1
plants	land plants	Poaceae	<i>Leptaspis banksii</i>			C		3/3
plants	land plants	Poaceae	<i>Mnesithea formosa</i>			C		2/2
plants	land plants	Poaceae	<i>Paspalidium rarum</i>			C		1/1
plants	land plants	Poaceae	<i>Andropogon gayanus</i>	gamba grass	Y			1/1
plants	land plants	Poaceae	<i>Digitaria ciliaris</i>	summer grass	Y			1/1
plants	land plants	Poaceae	<i>Eragrostis brownii</i>	Brown's lovegrass		C		1/1
plants	land plants	Poaceae	<i>Panicum mitchellii</i>			C		1/1
plants	land plants	Poaceae	<i>Paspalum conjugatum</i>	sourgrass	Y			1/1
plants	land plants	Poaceae	<i>Bothriochloa bladhii</i>			C		1/1

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plants	land plants	Poaceae	<i>Eragrostis pubescens</i>			C		1/1
plants	land plants	Poaceae	<i>Eriachne triodioides</i>			C		1/1
plants	land plants	Poaceae	<i>Paspalum longifolium</i>			C		1/1
plants	land plants	Poaceae	<i>Pseudoraphis jagonis</i>			C		5/5
plants	land plants	Poaceae	<i>Themeda quadrivalvis</i>	grader grass	Y			4
plants	land plants	Poaceae	<i>Tripogon loliiformis</i>	five minute grass		C		1/1
plants	land plants	Poaceae	<i>Whiteochloa airoides</i>			C		1/1
plants	land plants	Poaceae	<i>Cymbopogon bombycinus</i>	silky oilgrass		C		3/3
plants	land plants	Poaceae	<i>Eragrostis unioloides</i>		Y			1/1
plants	land plants	Poaceae	<i>Heteropogon contortus</i>	black speargrass		C		2/2
plants	land plants	Poaceae	<i>Heteropogon triticeus</i>	giant speargrass		C		2/2
plants	land plants	Poaceae	<i>Pogonatherum crinitum</i>			C		2/2
plants	land plants	Poaceae	<i>Saccharum officinarum</i>	sugarcane	Y			1/1
plants	land plants	Poaceae	<i>Schizachyrium fragile</i>	firegrass		C		2/2
plants	land plants	Poaceae	<i>Setaria oplismenoides</i>			C		1/1
plants	land plants	Poaceae	<i>Sporobolus virginicus</i>	sand couch		C		1/1
plants	land plants	Poaceae	<i>Alloteropsis semialata</i>	cockatoo grass		C		1/1
plants	land plants	Poaceae	<i>Arundinella nepalensis</i>	reedgrass		C		1/1
plants	land plants	Poaceae	<i>Cyrtococcum oxyphyllum</i>			C		1/1
plants	land plants	Polygalaceae	<i>Polygala parviloba</i>			C		1/1
plants	land plants	Polygalaceae	<i>Xanthophyllum fragrans</i>			NT		3/3
plants	land plants	Portulacaceae	<i>Portulaca pilosa</i>		Y			1/1
plants	land plants	Pteridaceae	<i>Pityrogramma calomelanos var. calomelanos</i>		Y			1/1
plants	land plants	Pteridaceae	<i>Cheilanthes nudiuscula</i>			C		1/1
plants	land plants	Pteridaceae	<i>Adiantum diaphanum</i>			C		1/1
plants	land plants	Pteridaceae	<i>Pteris ensiformis</i>	slender bracken		C		2/2
plants	land plants	Pteridaceae	<i>Cheilanthes nitida</i>			C		1/1
plants	land plants	Restionaceae	<i>Dapsilanthus ramosus</i>			C		1/1
plants	land plants	Rhamnaceae	<i>Ziziphus mauritiana</i>	Indian jujube	Y			1
plants	land plants	Rhizophoraceae	<i>Cerriops australis</i>			C		1/1
plants	land plants	Rhizophoraceae	<i>Bruguiera sexangula</i>			C		1/1
plants	land plants	Rubiaceae	<i>Ixora biflora</i>			C		1/1
plants	land plants	Rubiaceae	<i>Timonius timon var. timon</i>			C		1/1
plants	land plants	Rubiaceae	<i>Myrmecodia beccarii</i>			V	V	2/2
plants	land plants	Rubiaceae	<i>Randia</i>			C		1/1
plants	land plants	Rubiaceae	<i>Aidia cowleyi</i>			C		1/1
plants	land plants	Rubiaceae	<i>Spermacoce sp. (Lorim Point A.Morton AM1237)</i>			C		2/2
plants	land plants	Rubiaceae	<i>Aidia racemosa</i>			C		1/1
plants	land plants	Rubiaceae	<i>Randia audasii</i>			NT		1/1
plants	land plants	Rubiaceae	<i>Dentella repens</i>	dentella		C		1/1
plants	land plants	Rubiaceae	<i>Ixora timorensis</i>			C		1/1
plants	land plants	Rubiaceae	<i>Richardia scabra</i>		Y			1/1
plants	land plants	Rubiaceae	<i>Randia tuberculosa</i>			C		1/1
plants	land plants	Rutaceae	<i>Medicosma fareana</i>			C		1/1
plants	land plants	Rutaceae	<i>Melicope xanthoxyloides</i>			C		1/1
plants	land plants	Rutaceae	<i>Melicope broadbentiana</i>			C		1/1

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plants	land plants	Salicaceae	<i>Scolopia braunii</i>	flintwood		C		1/1
plants	land plants	Sapindaceae	<i>Guioa acutifolia</i>	northern guioa		C		1/1
plants	land plants	Sapindaceae	<i>Toechima pterocarpum</i>	orange tamarind		E	E	3/3
plants	land plants	Sapindaceae	<i>Allophylus cobbe</i>			C		1/1
plants	land plants	Sapotaceae	<i>Van-royena castanosperma</i>			C		1/1
plants	land plants	Scrophulariaceae	<i>Myoporum acuminatum</i>	coastal boobialla		C		1/1
plants	land plants	Sparrmanniaceae	<i>Trichospermum pleiostigma</i>			C		1/1
plants	land plants	Stackhousiaceae	<i>Stackhousia intermedia</i>			C		1/1
plants	land plants	Stylidiaceae	<i>Stylidium alsinoides</i>			C		1/1
plants	land plants	Symplocaceae	<i>Symplocos puberula</i>			C		1/1
plants	land plants	Thelypteridaceae	<i>Christella dentata</i>	creek fern		C		1/1
plants	land plants	Thymelaeaceae	<i>Lethedon setosa</i>			C		1/1
plants	land plants	Thymelaeaceae	<i>Pimelea cornucopiae</i>			C		1/1
plants	land plants	Urticaceae	<i>Pipturus argenteus</i>	white nettle		C		1/1
plants	land plants	Verbenaceae	<i>Lantana camara</i>	lantana	Y			8
plants	land plants	Verbenaceae	<i>Stachytarpheta australis</i>		Y			1/1
plants	land plants	Verbenaceae	<i>Stachytarpheta cayennensis</i>		Y			2/2
plants	land plants	Vitaceae	<i>Ampelocissus acetosa</i>				C	1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992*. The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ().

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999*. The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens).

This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon.

This number is output as 999 if it equals or exceeds this value.

Appendix F Protected Matters Report

Appendix G Likelihood of Occurrence

Table 19 Likelihood of Occurrence

Birds			
Species Scientific and Common Name	EPBC and NC Status	Habitat and Distribution	Likelihood of Occurrence on Site
<i>Calidris canutus</i> Red Knot	EPBC: E NC: E	Red Knots are widespread around the Australian coast, less in the south and with few inland records. Small numbers visit Tasmania and off-shore islands. It is widespread but scattered in New Zealand. They breed in North America, Russia, Greenland and Spitsbergen. Red Knots are a non-breeding visitor to most continents. Red Knots gather in large flocks on the coast in sandy estuaries with tidal mudflats.	Unlikely. Habitat not suitable.
<i>Calidris ferruginea</i> Curlew Sandpiper	EPBC: CE NC: E	The Curlew Sandpiper is a common summer migrant from north-eastern Siberia and Alaska, found in many Australian coastal sites and may also be seen inland in suitable habitats. It is most common in the far south-east and north-west of Australia. It is also found in Africa, across southern Asia to Indonesia and New Guinea, and in New Zealand. The Curlew Sandpiper is found on intertidal mudflats of estuaries, lagoons, mangroves, as well as beaches, rocky shores and around lakes, dams and floodwaters. Its breeding habitat is the lowland tundra of Siberia.	Potential However this species would only be passing through, Breeding occurs in Siberia. Species is unlikely to be present on site.
<i>Casuarius casuarius johnsonii</i> Southern Cassowary	EPBC: E NC: E	Southern Cassowaries are found in northern Queensland. The species is also found through New Guinea and eastern Indonesia. Rainforests. The dense habitat and the Cassowary's secretive nature make individuals difficult to see. In certain areas birds come near human habitation seeking food. Throughout their range, Southern Cassowaries live alone, and inhabit the same area all year round.	Unlikely Preferred habitat not present. This site is only a small pocket of mangrove vegetation surrounded by disturbed land and human activity. Species unlikely to occur on an isolated block adjoining national highway.
<i>Charadrius mongolus</i> Lesser Sand Plover	EPBC: E NC: E	It breeds above the tree line in the Himalayas and discontinuously across to bare coastal plains in north-eastern Siberia, with the Mongolian plover in the eastern part of the range; it has also bred in Alaska. It nests in a bare ground scrape, laying three eggs. This species is strongly migratory, wintering on sandy beaches in east Africa, south Asia and Australasia. It is a very rare vagrant in western Europe, but of the three individuals recorded in Great Britain up to 2003, one was a Mongolian plover.	Unlikely, migratory species. Species breed in the Himalayas, across the coast of north-eastern Siberia and Alaska. Only a

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			vague visitor to Australia.
<i>Charadrius leschenaultia</i> Greater sand plover	EPBC: V NC: V	It breeds in the semi-deserts of Turkey and eastwards through Central Asia. It nests in a bare ground scrape. This species is strongly migratory, wintering on sandy beaches in East Africa, South Asia and Australasia. It is a rare vagrant in western Europe, where it has been recorded as far west as Iceland.	Unlikely , migratory species. Species breed in semi-deserts of Turkey and eastwards through Central Asia. Only a vague visitor to Australia.
<i>Esacus magnirostris</i> Beach stone curlew	EPBC: I NC: V	The Beach Stone-Curlew has been observed around the north coast of Australia and associated islands from near Onslow in Western Australia to the Manning River in New South Wales. The species has largely disappeared from the south-eastern part of its former range and is now rarely recorded on ocean beaches in New South Wales. The Beach Stone-Curlew occurs on open, undisturbed beaches, islands, reefs, and estuarine intertidal sand and mudflats, preferring beaches with estuaries or mangroves nearby. However, this species also frequents river mouths, offshore sandbars associated with coral atolls, reefs and rock platforms and coastal lagoons.	Unlikely , Ideal habitat not present.
<i>Erythrotriorchis radiatus</i> Red Goshawk	EPBC: V NC: E	Red Goshawks mostly occur in northern Australia, where they occur at scattered sites from the Kimberley in WA, through the Top End in the Northern Territory and Cape York Peninsula and north-eastern Queensland, and a few scattered sites in between; a few also occur in south-eastern Queensland and adjacent areas of north-eastern NSW. Inhabiting tropical and warm-temperate woodlands and forests, the Red Goshawk prefers areas with a mosaic of vegetation types, often near wetlands. They often occur at the boundary between two vegetation types, and often favour forests or woodlands dominated by eucalypts or paperbarks. They avoid very dense or very open habitats.	Unlikely , Ideal habitat not present.
<i>Falco hypoleucos</i> Grey Falcon	EPBC: V NC: V	Grey Falcons occur naturally in most of mainland Australia and Tasmania. Vagrants have been reported in New Guinea. However, they are most common in the arid and semi-arid areas of central and north-western Australia and the Northern Territory with an isolated population in the Top End. They are absent from Cape York and rare on the Nullarbor Plain and in the Great Victoria, Gibson and Great Sandy Deserts. In Australia, they usually inhabit inland drainage systems, where they frequent timbered lowland plains, favouring acacia shrublands cross by tree-lined watercourses. They generally avoid desert. In Tasmania, they are mostly found in forests. They are usually seen in small family groups (parents with first-year juveniles). They are believed to be sedentary (non-migratory), except for juveniles and	Unlikely , Ideal habitat not present.

		single (non-paired) adults that disperse in autumn to spring (after the breeding season) towards the coastal areas of Queensland and New South Wales. It is likely that immature birds are more likely to migrate than adults.	
<i>Fregetta grallaria</i> <i>grallaria</i> Whitebellied Storm-Petrel (Australasian)	EPBC: V NC: I	The white-bellied storm petrel has a widespread range throughout the oceans of the Southern Hemisphere including the Pacific, Atlantic, and Indian Oceans, although little detail is known of its pelagic distribution. It is native in Argentina, Australia, Brazil, Chile, French Polynesia, French Southern Territories, New Zealand, Saint Helena, Ascension, and Tristan da Cunha. It is vagrant in Angola, Antarctica, Maldives, Namibia, South Georgia and the South Sandwich Islands, and Yemen. It is present, with uncertain origin, in American Samoa, Bouvet Island, Congo, Cook Islands, Ecuador, Falkland Islands (Malvinas), Fiji, Gabon, Heard Island and McDonald Islands, Kiribati, Madagascar, Mozambique, New Caledonia, Niue, Norfolk Island, Papua New Guinea, Peru, Pitcairn, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Uruguay, Vanuatu, and Wallis and Futuna. The white-bellied storm petrel is highly pelagic, rare and not commonly observed. As a result, there is limited knowledge of its behaviour and ecology. Visits to land are uncommon and occur near breeding colonies. It is nocturnal when ashore. Flight tends to be low gliding with pattering and dipping to feed, stepping off the water's surface with their legs, an asymmetrical gait having been observed. It has been known to feed with other seabirds and to follow ships.	Unlikely , Ideal habitat not present.
<i>Hirundapus caudacutus</i> White-throated Needletail	EPBC: V NC: V	White-throated Needletails often occur in large numbers over eastern and northern Australia. White-throated Needletails are aerial birds and for a time it was commonly believed that they did not land while in Australia. It has now been observed that birds will roost in trees infrequently.	Potential – Assessment of Significance is required.
<i>Limosa lapponica baueri</i> Bar-tailed Godwit (<i>baueri</i>)	EPBC: V NC: V	Bar-tailed Godwits arrive in Australia each year in August from breeding grounds in the northern hemisphere. Birds are more numerous in northern Australia. Bar-tailed Godwits inhabit estuarine mudflats, beaches and mangroves. They are common in coastal areas around Australia. They are social birds and are often seen in large flocks and in the company of other waders.	Unlikely , species migrate to Australia for breeding in August. If works are carried out in August – December, there is potential species may occur onsite.
<i>Numenius madagascariensis</i> Eastern Curlew	EPBC: CE NC: E	The Eastern Curlew is widespread in coastal regions in the north-east and south of Australia, including Tasmania, and scattered in other coastal areas. It is rarely seen inland. It breeds in Russia and north-eastern China. On passage, they are commonly seen in Japan, Korea and Borneo. Small numbers visit New Zealand.	Potential However this species would only be passing through, Breeding occurs in Russia and

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		The Eastern Curlew is found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons.	north-east China.
<i>Rostratula australis</i> Australian Painted Snipe	EPBC: E NC: E	Endemic to Australia, the Australian Painted Snipe has been recorded in all mainland states, where the records are widely and sparsely scattered, though most records have come from eastern Australia, and most of these records are from the Murray–Darling Basin. There are also historical records from Tasmania. The Australian Painted Snipe inhabits many different types of shallow, brackish or freshwater terrestrial wetlands, especially temporary ones which have muddy margins and small, low-lying islands. Suitable wetlands usually support a mosaic of low, patchy vegetation, as well as lignum and cane-grass.	Unlikely , Ideal habitat not present.
<i>Tyto novaehollandiae kimberli</i> Masked Owl (northern)	EPBC: V NC: V	Northern masked owl predominantly forage in eucalypt open forests and woodlands with open understories and roost in closed monsoon forests and tree hollows. Foraging also occurs in more open habitats and masked owls have also been recorded in Melaleuca forests, rainforest, riparian forest, grasslands, mangroves, grassland and coastal dunes. In the Northern Territory, northern masked owls frequently occur in Darwin stringybark (<i>Eucalyptus tetradonta</i>) and Darwin woollybutt (<i>Eucalyptus miniata</i>) tall open forest. On Groote Eylandt they are mainly observed foraging in tall open forest and woodland, on the margins of sandstone escarpments and one occasion on beach dunes adjacent to open forest. The Northern Masked owl is uncommon and widely dispersed across broad areas of northern Australia, with the main areas of distribution including the north-west Kimberley region of Western Australia, the northern section of the Northern Territory between the Victoria River and eastern Arnhemland, and Groote Eylandt in the east. Significant populations occur in the north-west of the Kimberley, the Northern Territory mainland between Victoria River and Kakadu National Park, Garig Gunak Barlu National Park (Coburg Peninsula) and Groote Eylandt. Island populations are known from Augustus and Koolan Islands in the Kimberley region of Western Australia and Groote Eylandt, Akwamburkba (Winchelsea Island) and North Goulburn Islands in the Northern Territory.	Potential – Assessment of Significance is required.

Amphibians			
Scientific Species Name	EPBC and NC Status	Habitat and Distribution	Likelihood of Occurrence on Site
<i>Litoria dayi</i> Australian Lace-lid	EPBC: V NC: V	<i>Litoria dayi</i> is a rainforest specialist, endemic to the Wet Tropics Bioregion associated with rainforests and rainforest margins. In montane areas the species prefers fast-flowing rocky streams although they also frequent slower watercourses where ample vegetation exists along the margins. At low elevations, L.	Unlikely. Habitat not suitable.

dayi favours rock soaks, narrow ephemeral streams and rock outcrops in larger watercourses. It may also be found on rocks, boulders and vegetation in or adjacent to streams.

L. dayi occurs throughout the Wet Tropics Bioregion from Paluma to Cooktown, n. Qld, at altitudes between 0 and 1200 m. The area of occurrence of the species is approximately 9000 km². The species includes two divergent genetic lineages separated by Barron Ck - diversity within each lineage is very low. *L. dayi* has disappeared from upland sites throughout the Wet Tropics. The *L. dayi* is still common at most foothill and lowland sites and recorded adults and larvae from upland sites north of the Daintree R. These populations subsequently disappeared.

L. dayi is known from Cedar Bay, Crater, Daintree, Lumholtz, Millstream, Paluma Range and Wooroonooran NP, Daintree Timber Reserve, Lamb Range, Mt Lewis, Mt Spec and Windsor Tableland SF, SF 768 Alcock, Crystal Cascades NP, Wallaman Falls (Seaview), Palmerston NP.

Reptile			
Scientific Species Name	EPBC and NC Status	Habitat and Distribution	Likelihood of Occurrence on Site
<i>Crocodylus porosus</i> Estuarine Crocodile	EPBC: I NC: V	The species can be found in a wide range of habitats, including rivers, estuaries, creeks, swamps, lagoons and billabongs. They can tolerate salinities ranging from 0% (freshwater) to 35% in full strength sea water, and have even been recorded in water twice as saline (70%) as sea water. Estuarine Crocodiles seem to be limited in their upstream movement primarily by physical barriers such as escarpments and other types of rapidly rising ground. In north-eastern Queensland, they do not occur above 250m. Historically, Estuarine Crocodiles occurred from south-western India and Sri Lanka east through south-eastern Asia, the Philippines, the Indonesia Archipelago and northern Australia to the Solomon Islands. They are able to cross large stretches of open ocean, with records of individuals being found on remote islands in the Indian Ocean and the western Pacific Ocean, e.g. Fiji. In Australia, Estuarine Crocodiles are found in northern coastal areas and drainages, from Broome in north-western Western Australia to the Gladstone area in south-eastern Queensland. They also occur on a number of islands off the Northern Territory and Queensland coasts which may be as far as 96km from the nearest point on the mainland.	Potential , species have been sighted nearby within the site is dominated by cane farm. It is not ideal habitat for this species therefore it is unlikely for this species to be present onsite.

Mammals			
Scientific Species Name	EPBC and NC Status	Habitat and Distribution	Likelihood of Occurrence on Site
<i>Dasyurus hallucatus</i> Northern Quoll	EPBC: E NC: I	Northern quolls are the most arboreal of the Australian quolls although they inhabit a variety of terrestrial habitats. They are most often found in rocky escarpments and open eucalyptus forests of lowland savannahs. This species has experienced an overall decline in population throughout its range; however, the savannah habitats have experienced the most drastic population decline. Northern quolls have been known to den in tree hollows, rock crevices, logs, termite mounds and goanna burrows. Northern quolls are native to a 150-kilometre band, across the northern Australian coast, from Pilbara in western Australia, to the northeast coast of Queensland. Since European settlement, the species has declined drastically over much of its range and has even become locally extinct on some Australian Islands. It is currently found in six isolated populations: in the Hamersley Range, northern and western Top End, North Cape York tip, Atherton Tableland and the Carnarvon Range.	Unlikely , Ideal habitat not present.
<i>Dasyurus maculatus gracilis</i> Spotted-tailed Quoll (North Queensland)	EPBC: E NC: E	Spotted-tail quolls have been found in dry and wet sclerophyll forests, riparian forests, rainforests, woodlands, and open pastures. Dry sclerophyll are typically multi-aged tree stands with hard-leaved dominated under stories consisting of shrubs, sedges, and bracken ferns. Wet sclerophyll are the areas between dry sclerophyll forests and rainforest. They also had tendencies to use gullies and riparian flats to avoid mid-slopes as well as having more availability to prey. Spotted-tail quolls from the subspecies <i>D. m. maculatus</i> require a lot of ground cover for denning sites as well as rock out cropping for denning. Rocky outcrops are more preferential for denning than wooden den sites. Spotted-tail quolls (<i>Dasyurus maculatus</i>) are found in Australia. Their distribution in Australia ranges from south-eastern Queensland to eastern New South Wales, Victoria, south-eastern South Australia, and Tasmania. Within these geographical ranges, two subspecies of spotted-tailed quolls exist: <i>D. maculatus maculatus</i> and the <i>D. maculatus gracilis</i> . Spotted-tail quolls from the subspecies <i>D. m. maculatus</i> are rarely found in south-eastern Queensland and almost extirpated from south-eastern South Australia, but most commonly found in Victoria and New South Wales from the coast to the snowlines. Spotted-tail quolls from the other subspecies, <i>D. m. maculatus</i> , are most commonly reported in Tasmania. They occur in Northern Queensland from sea level to the Wet Tropics Area and higher altitude areas.	Unlikely , Ideal habitat not present.
<i>Dendrolagus lumholtzi</i> Lumholtz's tree-kangaroo	EPBC: I NC: NT	Lumholtz's Tree Kangaroo, inhabit an area of approximately 5,500 sq. km in Northeast Queensland, Australia. Their range extends from the Daintree River (northern limit) to the southern end of Cardwell Range	Unlikely , Ideal habitat not present.

(southern limit), west to the rainforest/wet sclerophyll forest interface, and east to the coast. Their greatest concentration is in the fragmented forests of the Atherton tablelands. While possibly occurring sympatrically with Bennett's tree kangaroos in the Mt. Carbine Tableland, the two species are generally considered allopatric. Lumholtz's Tree Kangaroo is often found in remnant and secondary rainforests on basalt soils. It is a non-migratory species, and is only found in its native range. An estimated 12% of its distribution is within national parks; there is also considerable overlap with a World Heritage Area. Lumholtz's Tree Kangaroo inhabits upland rainforest and is generally restricted to higher elevations – approximately 600 to 1200 meters above sea level. It occurs at very low densities in lowland forests. Within its optimal altitudinal range, it prefers to reside in basalt soil rainforest, with densities twice as high on basaltic soil as on acid igneous or metamorphic rock substrate (possibly due to basalt soil's higher nutrient content). It may inhabit secondary and remnant forest patches as small as 20 hectares. Preferred habitats include microphyll vine forest, notophyll vine forest (both complex and simple), sclerophyll communities, and cleared land. Lumholtz's Tree Kangaroo is often found in edge forest communities. It is unclear if this is where it spends the majority of its time, or if this is just where it is most easily spotted by humans. It is hypothesized that Lumholtz's Tree Kangaroo may prefer drier edge communities because too much rain leeches nutrients from the soil.

<i>Hipposideros semoni</i> Semon's Leaf-nosed Bat	EPBC: V NC: E	Semon's Leaf-nosed Bats roost in caves, old mines, cracks in rocks and under rock overhangs. They prefer very dark places. They do not appear to roost together in colonies. Little information known on this species, they have been identified to inhabit tropical parts of Queensland and Pappa New Guinea.	Unlikely , Ideal habitat not present.
<i>Macroderma gigas</i> Ghost Bat	EPBC: V NC: E	Ghost Bats have been recorded in both arid regions (Pilbara region) and rainforest areas (north Queensland). <i>Macroderma gigas</i> roost in caves, old mine tunnels and in deep cracks in rocks. They usually roost in colonies but, because many of their roosting sites are being destroyed, it is rare to find large colonies. Ghost Bats are distributed widely but patchily across the northern half of Australia and are found in a variety of tropical habitats. Perhaps the species' most famous roosting and nesting sites, and largest colonies, are at Mount Etna caves, near Rockhampton in Queensland. Macroderma gigas or the Ghost Bat is found in Northern Australia where it has a scattered distribution. It is found north of 29°S in Western Australia, Northern Territories, and Queensland.	Unlikely , Ideal habitat not present.
<i>Mesembriomys gouldii rattoides</i> Black-footed Tree-rat (north Queensland)	EPBC: V NC: I	The Tree Rat is solitary and nocturnal, it is arboreal sheltering in tree hollows and pandanus stands during the day. The Tree Rat have a range extending from the savannahs of Cape York	Unlikely , Ideal habitat not present.

		<p>Peninsula in Queensland westward to the Kimberley region of Western Australia. Habitats such as tropical woodlands or open forest are suitable for the Tree Rat. It is not commonly found across the area and the population has been reduced between 30 and 50% in the last decade. The estimated population is 30,000.</p>	
<p><i>Murina florium</i> Flute-nosed Bat</p>	<p>EPBC: I NC: V</p>	<p>Found in the north-eastern forest of the Australian continent, restricted to rainforest and associated wet sclerophyll forest, between altitudes of 200 and 1000 metres asl. Flute-nosed Bat is recorded in a narrow range along the coast, south of Cooktown at Shipton Flat to the town of Paluma, Queensland.</p> <p>The species is observed foraging in the higher canopy of forest and descending to the mid-storey while seeking prey. The fluttering manner of flying allows them to navigate through the mid and upper storey of the vegetation while investigate the foliage. The mode of hunting used by species Flute-nosed Bat is gleaning, searching surfaces for prey, in this case arthropods discovered on the taller plants in their wetter forest environment. They retire to foliage, hanging under a leafy branch or occupying a bird nest, those of Scrub or Fern-wrens, which dangle from the trees.</p>	<p>Unlikely, Ideal habitat not present.</p>
<p><i>Phascolarctos cinereus</i> (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory)</p>	<p>EPBC: V NC:</p>	<p>The koala occurs in eastern Australia, from north-eastern Queensland to south-eastern South Australia and to the west of the Great Dividing Range. Historically, koalas had a largely continuous distribution throughout much of coastal and inland Queensland and New South Wales, throughout the majority of Victoria and in the south-eastern portion of South Australia. However, as a result of habitat loss, drought, hunting and disease, koala numbers rapidly declined and by the 1930s koalas were present in less than 50% of their previous distribution.</p> <p>The koala inhabits a range of eucalypt forest and woodland communities, including coastal forests, the woodlands of the tablelands and western slopes, and the riparian communities of the western plains. Koalas also utilise isolated paddock trees. The quality of forest and woodland communities as habitat for koalas is influenced by a range of factors, such as; species and size of trees present, structural diversity of the vegetation, soil nutrients, climate and rainfall, and size and disturbance history of the habitat patch.</p>	<p>Unlikely, Ideal habitat not present. Isolated vegetation with cut off roaming corridors. Few feed trees present.</p>
<p><i>Pteropus conspicillatus</i> Spectacled Flying-fox</p>	<p>EPBC: E NC: E</p>	<p><i>Pteropus conspicillatus</i> occupies primary and secondary growth tropical rainforest. Roosting generally occurs in dead trees or trees stripped of their foliage. The range of <i>Pteropus conspicillatus</i> comprises Northeast Queensland, Australia above 19 degrees South; the Halmahera Islands; and New Guinea and adjacent islands.</p>	<p>Potential – Assessment of Significance is required.</p>
<p><i>Rhinolophus robertsi</i></p>	<p>EPBC: V NC: E</p>	<p>Large-eared Horseshoe Bats roost in caves and old mines that are warm and humid. They don't roost together in large colonies, though they are found</p>	<p>Unlikely. Habitat not suitable.</p>

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Large-eared Horseshoe Bat		roosting with Eastern Horseshoe Bats. These bats hang from the cave ceiling rather than on the walls like other microbats. Distribution unknown.	
<i>Saccolaimus saccolaimus nudicluniatus</i> Bare-rumped Sheath-tailed Bat	EPBC: V NC: E	Bare-rumped Sheath-tail Bats are found in caves, hollow trees, between rocks, and under house eaves. They roost together in colonies but hang apart from each other. Distribution is poorly known, sightings have been confirmed in far north Queensland, Northern Territory, South Australia, and surrounding islands.	Unlikely. Habitat not suitable.
<i>Xeromys myoides</i> Water Mouse	EPBC: V NC: V	The Water Mouse has been recorded in saline and coastal freshwater habitats in the Northern Territory and Queensland, specifically distributed in coastal areas from Round Hill Head in north to South Stradbroke Island on the Gold Coast, Great Sandy Strait and Moreton Bay, Fraser Island, Russell and North and South Stradbroke Islands in the Redlands. The Water Mouse inhabit intertidal mudflats of estuaries, lagoons, mangroves, as well as beaches, rocky shores and around lakes, dams and floodwaters.	Potential – Assessment of Significance is required.

Appendix H Assessment of Significance

Table 20 Assessment of Significance for vulnerable fauna species

Significant Impact Criteria	White-throated Needletail (<i>Hirundapus caudacutus</i>)
Lead to a long-term decrease in the size of an important population	Unlikely. Migratory bird, The White-throated Needletail breed in northern Asia. This species migrates to Australia during the months September – November. This species does not stay long in Australia. It is unlikely the activities caused by the project will lead to long-term decrease in in size of an important population.
Reduce the area of occupancy of an important population	Unlikely. Although the White-throated Needletail often occur in large numbers over eastern and northern Australia, the White-throated Needletail are predominantly aerial birds that will on the odd occasion roost amongst trees. It is unlikely for this species to roost on the project site during site activities. It is highly unlikely the project activities will reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely. This is a highly mobile species. The White-throated Needletail are known to stay in large numbers while in flight and roosting. Due to the behavioural nature of the species, it is highly unlikely for fragment of existing population to occur.
Adversely affect habitat critical to the survival of a species	Highly unlikely. Migratory bird, the White-throated Needletail are predominantly aerial birds that will on the odd occasion roost amongst trees. It is highly unlikely that the project activities will adversely affect habitat critical to the survival to the survival of the species.
Disrupt the breeding cycle of an important population	Highly unlikely. Migratory bird, the White-throated Needletail breed in northern Asia. It is highly unlikely the species breeding cycle of an important population will be disturbed.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Highly unlikely. The White-throated Needletail are predominantly aerial birds that roam the sea, they will on the odd occasion roost amongst trees however due to the size of the project site it is unlikely the project activities will modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Highly unlikely. Migratory bird, the White-throated Needletail are present in Australia September to November before migrating back to northern Asia. The White-throated Needletail White-throated Needletail are predominantly aerial birds that roam the sea and roost amongst trees on the odd occasion. It is unlikely the project activities will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.

Introduce disease that may cause the species to decline	Unlikely. The White-throated Needletail White-throated Needletail are predominantly aerial birds, it is unlikely the project activities will introduce a disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely. Migratory bird, the White-throated Needletail are present in Australia September to November before migrating back to northern Asia. Breeding does not occur in Australia. The species is only present in Australia for a short period of time. It is unlikely that the project activities will interfere substantially with the recovery of the species.

Significant Impact Criteria	Masked Owl (northern) (<i>Tyto novaehollandiae Kimberli</i>)
Lead to a long-term decrease in the size of an important population	Unlikely. The Masked Owl are predominantly a solitary species and primarily inhabit eucalypt open forests and woodlands with open understories and closed monsoon forests. However, the Masked owl have been intermittently known to forage in mangroves and coastal dunes. The presence of this species on the project site would be for foraging which would occur within the night / early morning due to this species being nocturnal. It is unlikely that this species would utilise the project site for roosting. The Masked Owl may use this site at night / early morning for foraging. Therefore, it is unlikely the protect activities that occur in the day would lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	Unlikely. The Project site would only be utilised for foraging for the Masked Owl. It is unlikely the project activities that will be occurring in the day will reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely. The Masked Owl are predominantly a solitary species. It is unlikely project activities will cause fragment to an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species	Highly unlikely. The Masked Owl primarily inhabit eucalypt open forests and woodlands with open understories and closed monsoon forests. However, the Masked owl have been intermittently known to forage in mangroves and coastal dunes. It is not a common foraging area for the Masked Owl therefore it is unlikely the project activities will adversely affect habitat critical to the survival of a species.
Disrupt the breeding cycle of an important population	Highly unlikely. The Masked Owl primarily inhabit eucalypt open forests and woodlands with open understories and closed monsoon forests where they nest in tree hollows. Nesting habitat not present onsite. It is unlikely the project will disrupt the breeding cycle of an important population.

<p>Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>Highly unlikely. Highly mobile species. The project site would more than likely only used for foraging. It is unlikely project activities will modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.</p>
<p>Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat</p>	<p>Highly unlikely. Highly mobile species. The project site would more than likely only used for foraging. It is unlikely project activities will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.</p>
<p>Introduce disease that may cause the species to decline</p>	<p>Unlikely. Highly mobile species. The project site would more than likely only used for foraging with short visits to the site for predatory hunting. It is unlikely the project activities will introduce disease that may cause the species to decline.</p>
<p>Interfere substantially with the recovery of the species</p>	<p>Unlikely. The project site would be utilized sporadically by the Masked Owl for foraging activities. The foraging activity on the project site is unlikely to be a daily event. It is unlikely the project activities will interfere substantially with the recovery of the species.</p>

<p>Significant Impact Criteria</p>	<p>Spectacled Flying-fox (<i>Pteropus conspicillatus</i>)</p>
<p>Lead to a long-term decrease in the size of an important population</p>	<p>Unlikely. The species is restricted to north-eastern Queensland, where it occurs in association with extensive areas of rainforest. The site contains and is surrounded by suitable habitat for Spectacled Flying-fox. It is known to occur and roost in the local area, with WildNet Atlas records for this species occurring approximately 4-6km north and east of the site in urban environments. The Spectacled Flying-fox are known to roost in Camps, which are conspicuous due to their smell and noise, although roosts have not been recorded in the project area, the species may forage within the project site. Surrounding national parks and bushland provide a wide range of suitable forested habitat, which this species may occupy. It is unlikely the project activities will lead to a long-term decrease in the size of an important population.</p>
<p>Reduce the area of occupancy of an important population</p>	<p>Unlikely. The Spectacled Flying-fox are highly mobile species and may forage within the project site, they also have the ability to disperse to adjacent areas of high-quality, intact habitat. Therefore, it is unlikely the project activities will reduce the area of occupancy of the species.</p>
<p>Fragment an existing important population into two or more populations</p>	<p>Unlikely. This highly mobile species was not detected within the project site. The Spectacled Flying-fox may forage within the project site, it has the ability to disperse to adjacent areas of high-quality, intact habitat. Therefore, it is considered</p>

	unlikely that the proposal would fragment an existing population into two or more populations.
Adversely affect habitat critical to the survival of a species	Potential. This Spectacled Flying-fox may forage within the project site, with the ability to disperse to adjacent areas of high-quality, intact habitat. Therefore, it is considered that the proposal may potentially adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	Unlikely. The Spectacled Flying-fox is a highly mobile species though it was not detected within the project site. Whilst this species may forage within the project site, it has the ability to disperse to adjacent areas of high-quality, intact habitat. Therefore, it is considered unlikely that the proposal would disrupt the breeding cycle of a population.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely. The Spectacled Flying-fox is a highly mobile species though it was not detected within the project site. This species may forage within the project site, it has the ability to disperse to adjacent areas of high-quality, intact habitat. Therefore, it is considered unlikely that the proposal would modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Highly unlikely. It is unlikely the project activities will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely. The Project is unlikely to introduce a disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely. The project site would be utilized for foraging by the Spectacled Flying-fox. The foraging activity on the project site is unlikely to be a daily event due to what fruits are in season. It is unlikely the project activities will interfere substantially with the recovery of the species.

Significant Impact Criteria	Water Mouse (<i>Xeromys myoides</i>)
Lead to a long-term decrease in the size of an important population	Unlikely. The project site leads onto ideal habitat for foraging activities for the Water Mouse. Water Mice nest amongst intertidal mudflats of estuaries, lagoons, mangroves, as well as beaches, rocky shores and around lakes, dams and floodwaters. The Water Mouse tend to roam amongst surrounding bushland to carry out foraging activities. The project site is less than 5 hectares therefore it is unlikely the project activities will lead to long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	Unlikely. The Project site would be more so utilised by the Water Mouse for foraging activities. The project site is less than 5 hectares therefore it is unlikely the project activities will

	reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Unlikely. The project site is not ideal nesting habitat for the Water Mouse therefore it is unlikely project activities will cause fragment of an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species	Highly unlikely. The project site is not ideal nesting habitat for the Water Mouse. Water Mice would more so utilise the site for foraging. The side has surrounding foraging habitat present that will not be disturbed therefore, it is unlikely the project activities will adversely affect habitat critical to the survival of a species.
Disrupt the breeding cycle of an important population	Highly unlikely. The Water Mouse primarily nest amongst intertidal mudflats of estuaries, lagoons, mangroves, as well as beaches, rocky shores and around lakes, dams and floodwaters. It is unlikely breeding would occur on the project site due to lack of preferred nesting habitat. It is unlikely the project will disrupt the breeding cycle of an important population.
Modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Highly unlikely. The project site backs into undisturbed ideal habitat for the Water Mouse. It is unlikely the project will modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Highly unlikely. The project site would more than likely only used for foraging. It is unlikely project activities will result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.
Introduce disease that may cause the species to decline	Unlikely. The project site would more than likely only be used for short periods to carry out foraging activities. It is unlikely the project activities will introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	Unlikely. The project site would be utilized sporadically by the Water Mouse for foraging activities. The foraging activity on the project site is unlikely to be a daily event. It is unlikely the project activities will interfere substantially with the recovery of the species.