Environmental Protection (Water and Wetland Biodiversity) Policy 2019

Pioneer River and Plane Creek Basins

Environmental Values and Water Quality Objectives

Basins 125 and 126, including all surface waters of the Pioneer River and Plane Creek Basins, and adjacent coastal waters

Queensland Government

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

June 2022

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1 Introduction to 2022 amendments

This amendment document is made pursuant to the Environmental Protection (Water and Wetland Biodiversity) Policy 2019. It amends the *Pioneer River and Plane Creek Basins Environmental Values and Water Quality Objectives* schedule 1 document (2013), as outlined below.

Section 13(2)(b) of the EPP (Water and Wetland Biodiversity), and section 1.5 (Matters for amendment) of the schedule 1 document outline permissible amendment types. These include changes to environmental values, management goals, water quality objectives (WQOs), management intent (level of protection), water type boundaries/descriptions; and updates to information/data sources, websites and email contact details, agency/departmental names, other institutional names, references.

1.1 Amendments

Details of amendments are explained in section 2, tables 1 and 2.

1.2 Great Barrier Reef end-of-basin load objectives

The Reef 2050 Water Quality Improvement Plan 2017–2022 (Reef 2050 WQIP) is a joint commitment of the Australian and Queensland governments that seeks to improve the quality of water flowing from the catchments adjacent to the Great Barrier Reef. The plan identifies how catchment water quality outcomes under the broader Reef 2050 Long-Term Sustainability Plan will be delivered. The long-term (2050) outcome under the Reef 2050 WQIP is that 'Good water quality sustains the outstanding universal value of the Great Barrier Reef, builds resilience, improves ecosystem health and benefits communities'. The Reef 2050 WQIP includes the following commitment, identified as contributing to the delivery of Reef 2050 action 1.2: *Review and update water quality objectives and water quality guidelines at regionally relevant scales under the Environmental Protection Policy (Water) 2009* [remade to become the EPP (Water and Wetland Biodiversity) in 2019].

The Reef 2050 WQIP contains end of basin annual load reduction targets for dissolved inorganic nitrogen and fine sediment across mainland basins draining to the Great Barrier Reef. These have been reflected in the document titled 'Great Barrier Reef River Basins End-of-Basin Load Water Quality Objectives' (September 2019), pursuant to section 11 of the EPP (Water and Wetland Biodiversity), and are available from the department's website.

The Reef 2050 WQIP also contains targets for pesticides such that end of catchment concentrations of pesticides protect 99% of aquatic species. This corresponds to a high ecological value level of protection. Further information is available from the reef plan website.

2 Amendments

2.1 Summary of amendments

Table 1 summarises the 2022 amendments. Content in left column of Table 1 is amended by content in right column. Table 1 amendments include updates to coastal waters mapping, updated references to national water quality guidelines and other sources, and updated aquatic ecosystem WQOs (detailed in Table 2). Where no changes are specified, refer to the 2013 schedule 1 document content.

Table 2 specifies amended aquatic ecosystem water quality objectives:

- toxicant WQOs: updates for fresh, estuarine and coastal waters (new or updated technical guideline sources)
- estuarine and coastal water WQOs: updates to WQOs for a range of parameters (e.g. nutrients, sediments), and specification by season (dry season, wet season), for some coastal water parameters
- updated reference sources and advice on water quality testing protocols, listed after Table 2.

No amendments have been made to freshwater aquatic ecosystem WQOs, except as indicated for toxicants in relation to updated water quality guideline reference sources.

Table 1 Summary of amendments

2013 content	2022 amended content
Coastal waters mapping shown on Mackay Whitsunday Coastal Waters plan WQ1222 (Extracts of coastal waters are also shown on plan WQ1221.)	Refer to amended (2022) Mackay Whitsunday Coastal Waters plan WQ1222, available from the department's website.
References to Environmental Protection (Water) Policy and relevant provisions, definitions	Refer to Environmental Protection (Water and Wetland Biodiversity) Policy 2019 on the Queensland legislation webpage
Table 2 Aquatic ecosystem water quality objectives (WQOs)	Refer to Table 2 of this addendum for updated aquatic ecosystem WQOs (including nutrients, sediments in identified estuarine and coastal waters). This includes seasonal splits (dry season, wet season) for some parameters in coastal waters
Sections 3.1.2, 3.1.3: riparian, stormwater links	Refer to updated legislative links provided in Amendment section 2.3
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (October 2000) AWQG or ANZECC guidelines (2000)	Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG), published on the ANZG website.
Australian Drinking Water Guidelines (2011) ADWG (2011)	Australian Drinking Water Guidelines (ADWG), published on the NHMRC website
Guidelines for Managing Risks in Recreational Water (2008)	Guidelines for Managing Risks in Recreational Water, published on the NHMRC website
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 *Acts Interpretation Act, 1954*, as amended

2.2 Aquatic ecosystem water quality objectives – updates 2022

Table 2 Pioneer River and Plane Creek Basins aquatic ecosystem water quality objectives (2022)

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**TSS** (mg/L)	**pH**
FRESH WATERS – TOXICANTS (INCLUDING METALS, BIOCIDES)																	
HEV, SD fresh waters: **Toxicants** (s5, s6)	**HEV**	• Toxicants (including metals, biocides) in water: refer to 99% species protection values contained in: o ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended o 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): ▪ Biocides: King et al (2017, as amended) (vol 1 and 2) *Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area* (available from Queensland Government publications) • Toxicants in sediments: refer to ANZG 'toxicant default guideline values for sediment quality' • Anti-fouling: Comply with *Anti-fouling and in-water cleaning guidelines* (2015, as amended)															
Fresh waters not mapped as HEV, SD: **Toxicants** (s5, s6)	**SMD**	• Toxicants (including metals, biocides) in water: o Refer to 95% species protection values contained in sources below. Note: refer to 99% species protection values where indicated by ANZG (including for toxicants with bioaccumulation, toxicity effects): ▪ 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) - Biocides: King et al (2017, as amended) (vol 1 and 2) *Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area* (available from Queensland Government publications)															

Water area/type (Source: s1–s6)	Management intent /Level of protection	Amm N (µg/L)	Oxid N (µg/L)	Partic N (µg/L)	Total Diss N (µg/L)	Total N (µg/L)	FRP (µg/L)	Partic P (µg/L)	Total Diss P (µg/L)	Total P (µg/L)	Chl-a (µg/L)	Silicate (µg/L)	DO (% sat)	Turb (NTU)	Secchi (m)	TSS (mg/L)	pH
		PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
		• Toxicants in sediments: refer to ANZG 'toxicant default guideline values for sediment quality' • Anti-fouling: Comply with *Anti-fouling and in-water cleaning guidelines* (2015, as amended)															
ESTUARIES, COASTAL WATERS OUTSIDE PORTS Note: Information on toxicants, seagrass, temperature provided at end of table.																	
MID ESTUARY WATERS																	
SD and HEV Mid estuary waters of Mackay Whitsunday (e.g. fish habitat areas) (s1, s2)	**HEV**	2–5–10 (s1)	1–7–30 (s1)	NA	NA	190–240–380 (s1)	8–15–25 (s1)	NA	NA	15–25–40 (s1)	0.7–1.1–1.8 (s1)	NA	70–105 (s1)	3–5–8 (s1)	1–1.3–1.7 (s1)	ID	7–8.4 (s2)
Mid estuary waters (moderate tidal estuaries from Mackay north) [A] (s1, s2)	**MD**	10 (s1)	30 (s1)	NA	NA	400 (s1)	30 (s1	NA	NA	40 (s1)	2 (s1)	NA	70–105 (s1)	10 (s1)	≥1	ID	7–8.4 (s2)
Mid estuary waters (macro-tidal estuaries south of Mackay)[B] (s1, s2)	**MD**	10 (s1)	30 (s1)	NA	NA	400 (s1)	60 (s1	NA	NA	130 (s1)	5 (s1)	NA	70–105 (s1)	NA Too variable to derive guideline	NA Too variable to derive guideline	ID	7–8.4 (s2)

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**TSS** (mg/L)	**pH**

Notes on mid estuary waters:
A: MD mid estuarine waters from Mackay north include MD reaches of Pioneer River, Proserpine River, O'Connell River, Murray estuaries.
B: MD mid estuarine waters south of Mackay include MD reaches of Sandy, Plane, Rocky Dam, Carmilla Creek estuaries. Note that local WQOs were scheduled for Cabbage Tree and Louisa Creek mid estuaries (TSS, Copper), and no change is proposed to them.

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**TSS** (mg/L)	**pH**
COASTAL/MARINE WATERS – OUTSIDE PORTS (NORTH-SOUTH)																	
HEV2383 open coastal waters seaward of plume line shown in WQ1222 (s3, s4)	**HEV**	1–2–6 (s4)	0.0–0.21–0.99 (s4)	14–18–24 Dry season mean: 16 Wet season mean: 24 (s3, s4)	45–75–95 (s4)	55-90-115 (s4)	1–2–4 (s4)	1.6–2.1–3.0 Dry season mean: 2.3 Wet season mean: 3.3 (s3, s4)	4–9–17 (s4)	6–12–20 (s4)	0.45 (ann. mean) Dry season mean: 0.32 Wet season mean: 0.63 (s3)	40–60–100 (s4)	95–105 (s2)	1 (ann. mean) (s3, s4)	≥10 (ann. mean) (s3)	1.1–1.6–2.4 Dry season mean: 1.6 Wet season mean: 2.4 (s3, s4)	8.1–8.4 (s2)
HEV2386 midshelf waters (Tern, Bushy-Redbill and Sandpiper reefs) (s3, s4)	**HEV**	0–2–6 (s4)	0.25–0.77–2.8 (s4)	11–15–20 Dry season mean: 16 Wet season mean: 24 (s3, s4)	50–65–90 (s4)	70–85–115 (s4)	0–1–3 (s4)	1.4–2.0–2.8 Dry season mean: 2.3 Wet season mean: 3.3 (s3, s4)	3–5–9 (s4)	6–10–15 (s4)	0.45 (ann. mean) Dry season mean: 0.32 Wet season mean: 0.63 (s3)	25–40–90 (s4)	95–105 (s2)	1 (ann. mean) (s3, s4)	11–13–17 (s4)	0.6–1.1–1.7 Dry season mean: ≤1.6 Wet season mean: ≤2.4 (s3, s4)	8.1–8.4 (s2)

PIONEER AND PLANE CREEK BASINS (refer plan WQ1222)
Aquatic ecosystem water quality objectives (WQOs)[1–7]

Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs).

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: Other sources
Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)

Water area/type (Source: s1–s6)	Management intent /Level of protection	Amm N (µg/L)	Oxid N (µg/L)	Partic N (µg/L)	Total Diss N (µg/L)	Total N (µg/L)	FRP (µg/L)	Partic P (µg/L)	Total Diss P (µg/L)	Total P (µg/L)	Chl-a (µg/L)	Silicate (µg/L)	DO (% sat)	Turb (NTU)	Secchi (m)	TSS (mg/L)	pH
SD2382 open coastal waters, landward of the plume line, shown in WQ1222 (s3)	**HEV**	1–2–6 (s4)	0.0–0.21–0.99 (s4)	14–18–24 Dry season mean: 16 Wet season mean: 24 (s3, s4)	45–75–95 (s4)	55-90-115 (s4)	1–2–4 (s4)	1.6–2.1–3.0 Dry season mean: 2.3 Wet season mean: 3.3 (s3, s4)	4–9–17 (s4)	6–12–20 (s4)	0.45 (ann. mean) Dry season mean: 0.32 Wet season mean: 0.63 (s3)	40–60–100 (s4)	95–105 (annual) (s2)	2 (ann. mean) (s3, s4)	≥10 (ann. mean) (s3)	1.1–1.6–2.4 Dry season mean: 1.6 Wet season mean: 2.4 (s3, s4)	8.1–8.4 (s2)
SD2383 and SD2384 open coastal waters (including macro tidal) landward of the plume line, shown in WQ1222 (s3, s4)	**HEV**	1–2–6 (s4)	0.0–0.25–0.88 (s4)	≤20 (ann. mean) Dry season mean: 16 Wet season mean: 24 (s3)	45–75–95 (s4)	55-90-115 (s4)	1–2–4 (s4)	2.8 (ann. mean) Dry season mean: 2.3 Wet season mean: 3.3 (s3)	4–9–17 (s4)	6–12–20 (s4)	0.45 (ann. mean) Dry season mean: 0.32 Wet season mean: 0.63 (s3)	40–60–100 (s4)	95–105 (s2)	ID	≥8 (ann. mean) (s3)	2.4 (ann.mean) Dry season mean: 1.9 Wet season mean: 2.9 (s3)	8.1–8.4 (annual) (s2)
Open coastal waters landward of the plume line, shown in WQ1222 (s3, s4) [Includes OC waters outside of port sub-zones and not identified as SD or HEV]	**SMD, mapped as MD**	2 (s4)	1 (s4)	20 (ann. mean) Dry season mean: 16 Wet season mean: 24 (s3)	75 (s4)	90 (s4)	2 (s4)	2.8 (ann. mean) Dry season mean: 2.3 Wet season mean: 3.3 (s3)	9 (s4)	12 (s4)	0.45 (ann. mean) Dry season mean: 0.32 Wet season mean: 0.63 (s3)	≥60 (s4)	95–105 (s2)	2 (ann. mean) (s3, s4)	≥10 (ann. mean) (s3)	2.0 (ann. mean) Dry season mean: 1.6 Wet season mean: 2.4 (s3)	8.1–8.4 (s2)

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
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Enclosed coastal waters in SD2383, SD2384 (s2)	**HEV**	2–3–8	2–2–3	NA	NA	100–130–200	2–2–6	NA	NA	6–9–20	0.5–1.0–2.0	NA	90–95–100	ID	ID	ID	8.0–8.4
Enclosed coastal waters (where not specified above)	**MD, SD, HEV**	For toxicants, seagrass and temperature refer to rows below. No other updates to WQOs for these waters and indicators. Refer to 2013 schedule document Table 2.															

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
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TOXICANTS (INCLUDING METALS, BIOCIDES)																	
Mid estuary waters mapped as HEV, SD: **Toxicants (s5, s6)**	**HEV**	• Toxicants (including metals, biocides) in water: refer to 99% species protection values contained in: o ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended o 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): ▪ Biocides: - King et al (2017, as amended) (vol 1 and 2) *Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area* (available from Queensland Government publications) • Note: For information on the application of toxicant guidelines in estuaries, refer to ANZG Guideline values for other water types • 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 *Transport Operations (Marine Pollution) Act 1995* and Regulation 2018. (Refer to Maritime Services Queensland website for further information.) • Anti-fouling: Comply with *Anti-fouling and in-water cleaning guidelines* (2015, as amended)															
Mid estuary waters not mapped as HEV, SD: **Toxicants (s5, s6)**	**SMD**	• Toxicants (including metals, biocides) in water: o Refer to 95% species protection values contained in sources below. Note: refer to 99% species protection values where indicated by ANZG (including for toxicants with bioaccumulation, toxicity effects): ▪ 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) - Biocides: King et al (2017, as amended) (vol 1 and 2) *Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area* (available from Queensland Government publications) • Note that local WQOs were scheduled for Cabbage Tree and Louisa Creek mid estuaries (TSS, Copper), and no change is proposed to them. • Note: For information on the application of toxicant guidelines in estuaries, refer to ANZG Guideline values for other water types • Toxicants in sediments: refer to ANZG 'toxicant default guideline values for sediment quality'															

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**TSS** (mg/L)	**pH**
		• Ship-sourced pollutants (including sewage): Discharge of ship-sourced pollutants (including sewage) to be controlled in accordance with requirements of the *Transport Operations (Marine Pollution) Act 1995* and Regulation 2018. (Refer to Maritime Services Queensland website for further information.) • Anti-fouling: Comply with *Anti-fouling and in-water cleaning guidelines* (2015, as amended)															
Coastal waters outside ports, marinas, approved spoil grounds, tidal canals, constructed estuaries (s3, s5, s6)	**HEV**	• Toxicants (including metals, biocides) in water: refer to 99% species protection values contained in: o ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended o 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): ▪ Biocides: - GBRMPA (2010) *Water quality guidelines for the Great Barrier Reef Marine Park 2010* - King et al (2017, as amended) (vol 1 and 2) *Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area* (available from Queensland Government publications) • Note: For information on the application of toxicant guidelines in estuaries, refer to ANZG Guideline values for other water types • 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 *Transport Operations (Marine Pollution) Act 1995* and Regulation 2018. (Refer to Maritime Services Queensland website for further information.) • Anti-fouling: Comply with *Anti-fouling and in-water cleaning guidelines* (2015, as amended)														

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**TSS** (mg/L)	**pH**
ESTUARIES AND COASTAL WATERS – OUTSIDE PORTS – SEAGRASS																	
Coastal waters: biological (s1, s3)	**all**	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. • 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) • Shallow inshore areas (<10m): 6 mol m^{-2} day^{-1} over a rolling 14 day average # (Collier et al 2016; Chartrand et al, 2012) 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 from acute water quality impacts. Locally derived absolute thresholds ideally should be obtained for management of specific activities likely to impact on the light environment. Higher light requirements may be needed for the management of longer term chronic impacts.															
ESTUARIES AND COASTAL WATERS – OUTSIDE PORTS – TEMPERATURE																	
Estuaries and coastal waters: temperature (s2, s3)	**all**	**Estuaries:** Temperature varies daily and seasonally, is depth-dependent and highly site specific. Refer to QWQG for details on how to establish a temperature range (20th – 80th percentiles) based on local waterways not impacted by anthropogenic thermal influence. From an ecological effects perspective, daily maximum temperature and daily variation in temperature are key indicators, and seasonal variations also need to be identified. **Coastal and marine waters:** increases of no more than 1°C above long-term (20 year) average maximum. (GBRMPA, 2010)															

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**TSS** (mg/L)	**pH**
MACKAY and HAY POINT PORTS (NORTH-SOUTH)																	
MACKAY PORT – core waters outside Great Barrier Reef marine park **Note:** Updates incorporate open coastal 50th percentile values from adjacent open coastal waters (replacing previous ID entry)																	
Ports: MD2341: Mackay Port enclosed coastal waters	**MD**	No updates to WQOs for these waters and indicators. Refer to 2013 schedule document Table 2. For open coastal waters, seagrass and toxicants refer to rows below.															
Ports: MD2341: Mackay Port open coastal waters (including approved dredge spoil grounds)	**MD**	2 (s4)	1 (s4)	≤20 (ann. mean) Dry season mean: 16 Wet season mean: 24 (s3)	75 (s4)	90 (s4)	2 (s4)	2.8 (ann. mean) Dry season mean: 2.3 Wet season mean: 3.3 (s3)	9 (s4)	12 (s4)	0.45 (ann. mean) Dry season mean: 0.32 Wet season mean: 0.63 (s3)	≥60 (s4)	95–105 (s2)	Dry: 1–2–8 Wet: 5–12–33 (s1)	≥10 (ann. mean) (s3)	2.0 (ann. mean) Dry season mean: 1.6 Wet season mean: 2.4 (s3)	8.1–8.4 (s2)

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**TSS** (mg/L)	**pH**
HAY POINT PORT – core waters outside Great Barrier Reef marine park **Note:** Updates incorporate open coastal 50th percentile values from adjacent open coastal waters (replacing previous ID entry)																	
Ports: MD2342 Sandringham Bay sub-zone enclosed coastal waters	**MD**	No updates to WQOs for these waters and indicators. Refer to 2013 schedule document Table 2. For seagrass and toxicants refer to rows below.															
Ports: MD2343 Hay Point sub-zone enclosed coastal waters	**MD**	No updates to WQOs for these waters and indicators. Refer to 2013 schedule document Table 2. For open coastal waters, seagrass and toxicants refer to rows below.															
Ports: MD2343 Hay Point sub-zone open coastal waters (including approved dredge spoil grounds) (s1, s2, s3, s4)	**MD**	2 (s4)	1 (s4)	≤20 (ann. mean) Dry season mean: 16 Wet season mean: 24 (s3)	75 (s4)	90 (s4)	2 (s4)	2.8 (ann. mean) Dry season mean: ≤2.3 Wet season mean: ≤3.3 (s3)	9 (s4)	12 (s4)	0.45 (ann. mean) Dry season mean: ≤0.32 Wet season mean: ≤0.63 (s3)	≥60 (s4)	95–105 (s2)	Dry: 1–2–8 Wet: 5–12–33 (s1)	≥10 (ann. mean) (s3)	2.0 (ann. mean) Dry season mean: 1.6 Wet season mean: 2.4 (s3)	8.1–8.4 (s2)

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**TSS** (mg/L)	**pH**
PORTS – TOXICANTS (INCLUDING METALS, BIOCIDES)																	
Coastal waters in ports MD2341, MD2342, MD2343, marinas, boat harbours, approved spoil grounds, tidal canals (s3, s5, s6)	**SMD (biocides: HEV)**	• Toxicants (excluding biocides – see below) in water: refer to 95% species protection values contained in sources below. Note: refer to 99% species protection values where indicated by ANZG (including for toxicants with bioaccumulation, toxicity effects): o ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended • Biocides in water: refer to 99% species protection values (tributyltin: apply 95% species protection values) contained in: o ANZG (2018) 'toxicant default guideline values for water quality in aquatic ecosystems', as amended o 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): ▪ GBRMPA (2010) *Water quality guidelines for the Great Barrier Reef Marine Park 2010* ▪ King et al (2017, as amended) (vol 1 and 2) *Proposed aquatic ecosystem protection guideline values for pesticides commonly used in the Great Barrier Reef catchment area* (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 *Transport Operations (Marine Pollution) Act 1995* and Regulation 2018. (Refer to Maritime Services Queensland website for further information.) • Anti-fouling: Comply with *Anti-fouling and in-water cleaning guidelines* (2015, as amended)															

Water area/type (Source: s1–s6)	Management intent /Level of protection	PIONEER AND PLANE CREEK BASINS (refer plan WQ1222) Aquatic ecosystem water quality objectives (WQOs)[1–7]															
		Note: WQOs 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 should be less than or equal to the WQO, unless otherwise indicated. Except where otherwise stated, HEV/SD WQOs are an annual range, and MD WQOs are an annual median (refer note 7 after table for more details on comparing test data with WQOs). 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: Other sources Seasons: Dry season: May-Oct; Wet season: Nov-April (Refer notes after table for more details on seasonal splits.)														
		Amm N (µg/L)	**Oxid N** (µg/L)	**Partic N** (µg/L)	**Total Diss N** (µg/L)	**Total N** (µg/L)	**FRP** (µg/L)	**Partic P** (µg/L)	**Total Diss P** (µg/L)	**Total P** (µg/L)	**Chl-a** (µg/L)	**Silicate** (µg/L)	**DO** (% sat)	**Turb** (NTU)	**Secchi** (m)	**TSS** (mg/L)	**pH**
PORTS – SEAGRASS																	
Coastal waters in ports MD2341, MD2342, MD2343, marinas, approved spoil grounds (s1, s3)	**all**	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. • 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) • Shallow inshore areas (<10m): 6 mol m^{-2} day^{-1} over a rolling 14 day average # (Collier et al 2016; Chartrand et al, 2012) 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 from acute water quality impacts. Locally derived absolute thresholds ideally should be obtained for management of specific activities likely to impact on the light environment. Higher light requirements may be needed for the management of longer term chronic impacts.															
PORTS – TEMPERATURE																	
Estuaries and coastal waters in ports MD2341, MD2342, MD2343, marinas, approved spoil grounds (s2, s3)	**all**	**Estuaries:** Temperature varies daily and seasonally, is depth-dependent and highly site specific. Refer to QWQG for details on how to establish a temperature range (20th – 80th percentiles) based on local waterways not impacted by anthropogenic thermal influence. From an ecological effects perspective, daily maximum temperature and daily variation in temperature are key indicators, and seasonal variations also need to be identified. **Coastal and marine waters:** increases of no more than 1°C above long-term (20 year) average maximum. (GBRMPA, 2010)															

Abbreviations: ANZG – Australian and New Zealand guidelines for fresh and marine water quality; GBRMPA – Great Barrier Reef Marine Park Authority; QWQG – Queensland water quality guidelines; ID – insufficient data. Will be updated if information becomes available; NA – not applicable; HEV – high ecological value; SD – slightly disturbed; MD – moderately disturbed.

Indicators: Amm N – ammonia nitrogen**;** Oxid N – oxidised nitrogen; Partic N – particulate nitrogen; Total Diss N – total dissolved nitrogen; Total N – total nitrogen; FRP – filterable reactive phosphorus; Partic P – particulate phosphorus; Total P – total phosphorus; Chl-a – chlorophyll-a; DO – dissolved oxygen; Turb – turbidity; TSS – 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 the table (and shown in accompanying plans). An HEV management intent does not preclude the need for management actions to address historical or ongoing threats to those values. .Slightly disturbed (SD) waters are similarly identified in the table. The management intent (level of protection) for waters other than HEV or SD is to achieve a 'moderately disturbed' (MD) condition, for which corresponding WQOs have been derived. 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 Australian water quality guidelines (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:

1. Nutrients: Ammonia N comprises both un-ionised ammonia (NH_3) and ionised ammonium (NH_4^+). Oxidised N = NO_2 + NO_3. Ammonia N + Oxidised N = Dissolved inorganic N (DIN).
Except where specified for event conditions, nutrient WQOs 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 WQOs. Provided that levels of inorganic N (i.e. NH_3 + oxidised N) remain low, then the elevated levels of organic N should not be seen as a breach of the WQOs, 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. 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.

3. Total suspended solids – coastal waters: TSS (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.

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: 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 waters – Secchi depth: For waters shallower than the specified Secchi depth of ≥10m 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 and silicate (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 on protocols for assessing test data against WQOs is provided in the QWQG.

For HEV and SD waters:

- Where the WQO is expressed as a 20^{th}–50^{th}–80^{th} percentile range of values (e.g. Total N: 65–100–125 µg/L), the 20^{th}–50^{th}–80^{th} 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, the median value of preferably five or more independent samples at a monitoring (test) site is 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 with, and should be less than or equal to, the corresponding aquatic ecosystem WQO (except where otherwise indicated).

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 with, and should be less than or equal to, the corresponding aquatic ecosystem WQO (except where otherwise indicated).
- For DO and pH, the median value of preferably five or more independent samples at a monitoring (test) site is compared with, and should fall within, the specified percentile 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 with, and should be less than or equal to, the corresponding aquatic ecosystem WQO (except where otherwise indicated). 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).

Refer to notes after the WQOs tables for further details on marine water season splits.

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

Sources / references:

ANZG (2018, as amended) *Australian and New Zealand guidelines for fresh and marine water quality*.

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2.3 Vegetation management and planning provisions

This following is provided for information on habitat management and planning matters. While it is current at time of publication, readers should refer to relevant Queensland websites and legislation to ensure they are referring to current materials.

2.3.1 Riparian vegetation

The clearing of native vegetation in Queensland is regulated by the *Vegetation Management Act 1999*, the *Planning Act 2016* and associated policies and codes. This includes the regulation of clearing within a defined distance of watercourses and drainage features.

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

- State Development Assessment Provisions (SDAP) State Code 16: Native vegetation clearing. This code requires clearing of native vegetation to meet performance outcomes relating to the protection of wetlands, watercourses and drainage features. The code outlines buffer areas where clearing cannot occur within a specified distance of watercourses or drainage features. If clearing within these buffers cannot be reasonably avoided, an offset must be provided to counterbalance any significant residual impact to a wetland, watercourse or drainage feature. For more information on SDAP State code 16, refer to the Queensland's Planning System website.
- SDAP State Code 9: Great Barrier Reef wetland protection areas
- The relevant Accepted Development Vegetation Clearing Codes (ADVCC) under the *Vegetation Management Act 1999*. These codes allow self-assessable clearing for certain purposes in particular land tenures and regional ecosystems. It is a requirement across all codes for landholders to use best practice methods when clearing vegetation to prevent soil erosion and instability and to prevent increased sediment run-off entering a wetland, watercourse or drainage feature. The codes also contain riparian protection zones to prevent clearing within a defined distance of a wetland, a stream ordered watercourse or a drainage feature. Where a code permits clearing within these areas, there are additional requirements to rehabilitate the area or (for clearing of regulated regrowth vegetation) to legally secure an exchange area to counterbalance the impact. For more information on the ADVCCs and guidance material, refer to the Queensland Government vegetation management and Department of Resources websites.

Clearing of native vegetation in a watercourse may also require a riverine protection permit under the *Water Act 2000*. Further information is available at www.business.qld.gov.au.

Local Government Planning schemes under the *Planning Act 2016* may also specify riparian buffers (for example under catchment protection or waterway codes). Refer to the Queensland's Planning System website and relevant local government websites for further information about planning schemes.

2.3.2 Wetlands

The Environmental Protection (Water and Wetland Biodiversity) Policy 2019 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) State Code 9: Great Barrier Reef wetland protection areas.

This 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.

2.3.3 Marine protected areas

In Queensland, declared fish habitat areas (under the *Fisheries Act 1994*) protect the State's key estuarine and coastal fish habitats from development impacts to support sustainable fishing.

Works within declared fish habitat areas may be assessable development for which a development approval is required under the *Planning Act 2016,* or be accepted development under the *Fisheries (General) Regulation 2019.* The State assesses building work or operational development that may have impacts on declared fish habitat areas against the State Development Assessment Provisions (SDAP) State code 12: Development in a declared fish habitat area. (For more information on SDAP State codes, refer to the Queensland's Planning System website.

Performance outcomes for all assessable development include (but are not limited to):

- development does not increase the risk of mortality, disease or injury, or compromise the health, productivity, marketability or suitability for human consumption of fisheries resources, having regard to (but not limited to)
  - biotic and abiotic conditions, such as water and sediment quality
  - substances that are toxic to plants or toxic to or cumulative within fish
- development maintains or improves water quality
- development likely to cause disturbance to potential or actual acid sulfate soil, prevents the release of contaminants.

In most cases a resource allocation authority is also required under the *Fisheries Act 1994* before assessable development can proceed. The Department of Environment and Science website contains further information on approvals, accepted development requirements and other aspects relating to declared fish habitat areas.

Marine parks (under the *Marine Parks Act 2004*) protect tidal lands and waters to conserve the marine environment while allowing for sustainable use. Depending on the zone, activities can occur "as of right" or with permission. For more information about declared fish habitat areas and marine parks, see the department's website.

2.3.4 Marine plants (including mangroves)

Marine plants grow on or adjacent to tidal lands. They include tidal plants such as mangroves, seagrass, saltcouch, algae, samphire (succulent) vegetation and seasonally connected adjacent plants, such as melaleuca (paper barks) and casuarina (coastal she-oaks). Marine plants support local fish populations, fish catches and general aquatic health, and for this reason they are protected under the *Fisheries Act 1994*.

A material change of use, reconfiguring of a lot, and operational work that will remove, damage or destroy a marine plant is either assessable development for which a development approval is required under the *Planning Act 2016,* or accepted development under the *Fisheries (General) Regulation 2019.* Work types that are described as accepted development must comply with the relevant Accepted Development Requirements in all respects. If all requirements are not met, then the development is assessable and must be applied for.

The State assesses development applications that may have impacts on marine plants using the State Development Assessment Provisions (SDAP) State code 11: Removal, destruction or damage of marine plants. (For more information on SDAP State codes, refer to the Queensland's Planning System website.

Performance outcomes for all development include (but are not limited to):

- development does not increase the risk of mortality, disease or injury, or compromise the health, productivity, marketability or suitability for human consumption of fisheries resources, having regard to (but not limited to)
  - biotic and abiotic conditions, such as water and sediment quality
  - substances that are toxic to plants or toxic to or cumulative within fish
- development likely to cause drainage or disturbance to acid sulfate soils, prevents the release of contaminants and impacts on fisheries resources and fish habitats.

A marine plant is a matter of state environmental significance under the *Environmental Offsets Act 2014* and an environmental offset may be required for any significant residual impact that is approved.

The Department of Agriculture and Fisheries website contains further information on approvals, accepted development requirements and other aspects relating to marine plants.

2.3.5 Waterways providing for fish passage

Waterway barrier works may inhibit the free movement of fish along waterways and onto floodplains, injure fish or affect fish health and habitat. Many native fish need to access a range of habitats for food, breeding and refuge and move or migrate to complete their lifecycle.

Adequate fish passage must be provided at any proposed waterway barrier. Operational work that is to construct or raise a waterway barrier is assessable development for which a development approval is required under the *Planning Act 2016,* or is accepted development under the *Fisheries (General) Regulation 2019.* Work types that are described as accepted development must comply with the relevant Accepted Development Requirements in all respects. If all requirements are not met, then the development is assessable and must be applied for. The State assesses development applications that may have impacts to fish passage using the State Development Assessment Provisions (SDAP) State code 18: Constructing or raising waterway barrier works in fish habitats. For more information on SDAP State codes, refer to the Queensland's Planning System website.

Performance outcomes for all development include (but are not limited to):

- development does not increase the risk of mortality, disease or injury, or compromise the health, productivity, marketability or suitability for human consumption of fisheries resources, having regard to (but not limited to)

  - biotic and abiotic conditions, such as water and sediment quality
  - substances that are toxic to plants or toxic to or cumulative within fish
- sufficient water exchange and flow is maintained and provided to sustain and where necessary restore, water quality and the health and condition of fisheries resources, ecological functions and fish passage
- development likely to cause drainage or disturbance to acid sulfate soils, prevents the release of contaminants and impacts on fisheries resources and fish habitats.

A waterway providing for fish passage is a matter of state environmental significance under the *Environmental Offsets Act 2014* and an environmental offset may be required for any significant residual impact that is approved.

The Department of Agriculture and Fisheries website contains further information on approvals, accepted development requirements and other aspects relating to waterway barrier works and fish passage.

2.3.6 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 *Planning Act 2016*).

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 receiving waters, acid sulfate soils and water supply buffer areas.

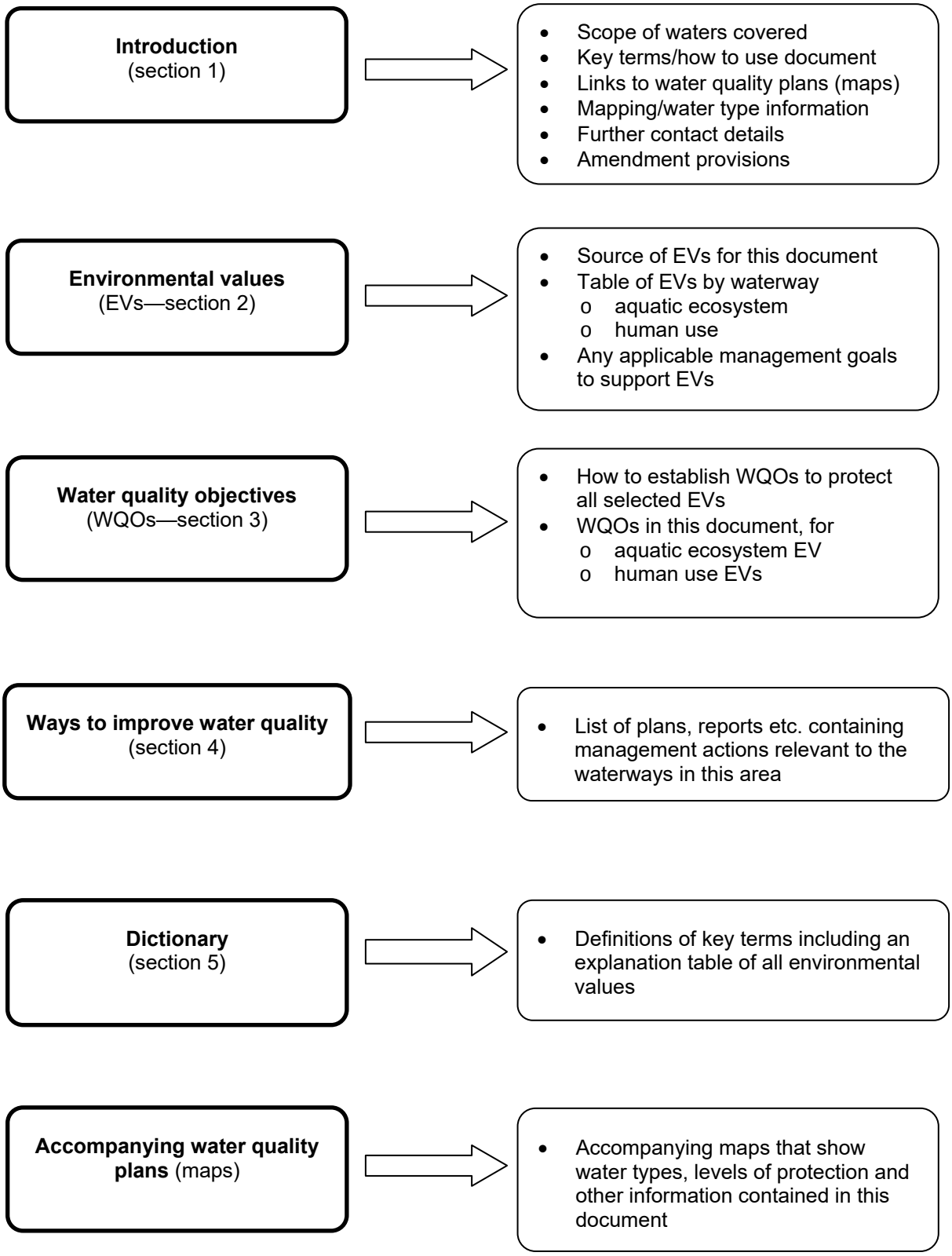
The provisions of the SPP are applied through their 'integration' into local government planning schemes. Planning schemes adopt measures prescribed in the SPP that ensure development is planned, designed, constructed and operated to manage stormwater and wastewater in ways that support the protection of environmental values and meet the water quality objectives identified in the Environmental Protection (Water and Wetland Biodiversity) Policy 2019.

This is achieved by compliance with the policy provisions of the SPP (state interest – water quality).

Stormwater management design objectives for construction include developments using measures to manage the velocity of stormwater flows and prevent erosion, sediment, litter and other contaminates entering waterways while construction is occurring. Post construction stormwater management design objectives generally apply to lots over 2500m^2 that results in six or more dwellings or lots. The objectives seek to limit the amount of nutrients and litter, including nitrogen, phosphorus and suspended sediments, entering waterways from the operation of the development.

The SPP is supported by guidance materials which include Integrating state interests in a planning scheme – guidance for local governments (by Department of State Development, Infrastructure, Local Government and Planning). These and other SPP materials are available from the State Planning Policy website. Supplementary guidance is available from the Department of Environment and Science website on post construction phase stormwater management (phase 5b).

Main parts of this document and what they contain



Contents

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1 Introduction

This document is made pursuant to the provisions of the Environmental Protection (Water) Policy 2009 (EPP (Water)), which is subordinate legislation under the *Environmental Protection Act 1994*. The EPP (Water) provides a framework for:

- identifying environmental values (EVs) for Queensland waters, and deciding the water quality objectives (WQOs) to protect or enhance those EVs. (WQOs are long term goals for receiving waters, not individual point source emission objectives.)
- including the identified EVs and WQOs under Schedule 1 of the EPP (Water).

This document contains EVs and WQOs for waters in the Pioneer River and Plane Creek Basins (and a small southern component of the O'Connell River Basin) and adjacent coastal waters, and is listed under schedule 1 of the EPP (Water).

1.1 Waters to which this document applies

This document applies to fresh and estuarine surface waters and groundwaters draining the basins of the Pioneer River and Plane Creek (basins 125, and 126[1]), a small part of the O'Connell River Basin (basin 124), and coastal waters. These are indicated in the accompanying plans (WQ1251—surface waters, WQ1222—coastal waters)[2].

Waters covered by this document include:

- all Pioneer River Basin waters, including fresh waters in Blacks and Upper Cattle Creeks, and fresh and estuarine waters of the Pioneer River and Mackay City
- a small southern part of the O'Connell River Basin comprising waters in Mackay City
- all Plane Creek Basin waters, including fresh and estuarine waters of Plane Creek, Bakers Creek, Sandy Creek, Alligator Creek, Cabbage Tree Creek, Rocky Dam Creek, Cape Creek, Marion Creek, Gillinbin Creek, West Hill Creek, Carmila Creek and Flaggy Rock Creek
- wetlands, lakes and reservoirs
- groundwaters
- waters on islands
- enclosed coastal and open coastal waters.

The geographical extent of waters addressed by this document is shown in plans WQ1251 and WQ1222, and is broadly:

- north to the boundary of the Pioneer River Basin with the O'Connell River Basin, and Reliance Creek
- west to the boundary with the Burdekin and Fitzroy river basins
- south to the boundary of the Plane Creek Basin with the Styx River Basin
- east to the boundary of Queensland Coastal Waters.

[1] Australia's River Basins 1997—Product User Guide. Published by Geoscience Australia. Canberra, ACT (3rd edition, 2004).

[2] This document and the accompanying plans are available from the department's website at www.ehp.qld.gov.au. The boundaries in the accompanying plans WQ1251 and WQ1222 are indicative only. EVs, water types and aquatic ecosystem management intent (level of protection) depicted in the accompanying plans are stored in electronic form as part of the Central Queensland Environmental Values Schedule 1 Geodatabase August 2013, and held at the department's offices at 400 George Street Brisbane. Geodatabase regions are based on the regions established in the Queensland Water Quality Guidelines. Spatial (GIS) datasets can be downloaded free of charge from the Queensland Government Information Service (QGIS) at http://dds.information.qld.gov.au/dds. For further information, please contact the department by email at epa.ev@ehp.qld.gov.au.

1.2 Guidance on using this document

1.2.1 Key terms (refer to dictionary for additional terms)

ADWG means the Australian Drinking Water Guidelines (2011), prepared by the National Health and Medical Research Council (NHMRC) in collaboration with the Natural Resource Management Ministerial Council (NRMMC)[3].

AWQG 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)[4].

Environmental values (EVs) for water means the EVs specified in Table 1 of this document for the corresponding water.

EVs for water are the qualities of water that make it suitable for supporting aquatic ecosystems and human water uses. These EVs need to be protected from the effects of habitat alteration, waste releases, contaminated runoff and changed flows to ensure healthy aquatic ecosystems and waterways that are safe for community use. Particular waters may have different EVs. The range of EVs and the waters they can potentially apply to are listed below, and further details are provided in the dictionary (refer section 5).

List of EVs and applicable waters

Environmental value (EV)	Potentially applicable to:	
	Tidal waters	**Fresh (non-tidal) waters**
Protection of aquatic ecosystems (aquatic ecosystem EV)		
Protection or enhancement of aquatic ecosystem values, under four possible levels of ecosystem conditions: • high ecological value (effectively unmodified) waters • slightly disturbed waters • moderately disturbed waters • highly disturbed waters. (Suitability for seagrass and wildlife habitat have also been specifically identified for some Queensland waters as a component of this EV).	✓	✓
EVs other than aquatic ecosystem EV (called human use EVs)		
Suitability for drinking water supplies		✓
Suitability for primary contact recreation (e.g. swimming)	✓	✓
Suitability for secondary contact recreation (e.g. boating)	✓	✓
Suitability for visual (no contact) recreation	✓	✓
Suitability for human consumers of wild or stocked fish, shellfish or crustaceans (suitability for oystering has also been specifically identified for some Queensland waters)	✓	✓
Protection of cultural and spiritual values, including traditional owner values of water	✓	✓
Suitability for industrial use (including mining, minerals refining/processing)	✓	✓
Suitability for aquaculture (e.g. red claw, barramundi)	✓	✓
Suitability for crop irrigation		✓
Suitability for stock watering		✓
Suitability for farm supply/use		✓

[3] The ADWG are available on the National Health and Medical Research Council website at www.nhmrc.gov.au.

[4] The AWQG are available on the Australian Government's National Water Quality Management Strategy website.

Level of protection for a water (aquatic ecosystem EV) means the level of aquatic ecosystem condition specified in Table 2 of this document that the corresponding WQOs for that water are intended to achieve (refer to management intent definition below for further information).

Management goal means the goals (if any) stated in section 2 of this document to support the EVs for waters identified in Table 1.

Management intent (level of protection) for a water (aquatic ecosystem EV) means the level of aquatic ecosystem condition specified in Table 2 of this document that the corresponding WQOs for that water are intended to achieve. For example, the intent for high ecological value waters is that their effectively unmodified condition is maintained.

QWQG means the Queensland Water Quality Guidelines[5].

Water quality guidelines (defined in the EPP (Water)) are numerical concentration levels or statements for indicators that protect a stated environmental value. Under the EVs setting process contained in the EPP (Water), water quality guidelines are used as an input to the development of WQOs.

Water quality indicator (for an EV) means a property that is able to be measured or decided in a quantitative way. Examples of water quality indicators include physical indicators (e.g. temperature), chemical indicators (e.g. nitrogen, phosphorus, metals), and biological indicators (e.g. macroinvertebrates, seagrass, fish).

Water quality objectives (WQOs) means the WQOs specified in Tables 2–12 of this document to support the EVs for waters identified in Table 1.

WQOs are long-term goals for water quality management. They are numerical concentration levels or narrative statements of indicators established for receiving waters to support and protect the designated EVs for those waters. Water quality objectives are not individual point source emission objectives, but the receiving water quality objectives.

They are based on scientific criteria or water quality guidelines but may be modified by other inputs (e.g. social, cultural, economic).

Examples of WQOs include:

- total phosphorus concentration less than 20 micrograms per litre (µg/L)
- chlorophyll a concentration less than 1 µg/L
- dissolved oxygen between 95 per cent and 105 per cent saturation
- family richness of macroinvertebrates greater than 12 families
- exotic individuals of fish less than five per cent.

Water type means groupings of waters with similar characteristics, as shown in the accompanying plans. The water types covered by this document are based on mapping and definitional rules for water types established in the QWQG and, where available, other site-specific studies and documents. Water types can include fresh waters (lowland, upland, lakes/reservoirs), wetlands and groundwaters, estuarine waters (lower, middle and upper estuaries), tidal canals, constructed estuaries, marinas and boat harbours, and coastal marine waters (open coastal, enclosed coastal). WQOs applying to different water types are outlined in this document. More detail on water types is provided in section 1.4.

Refer to dictionary for additional terms.

[5] The QWQG are available on the department's website.

1.2.2 Main components of this document

The main components of this document are:

- Plan WQ1251—showing the spatial extent and boundaries of surface water types covered by this document
- Plan WQ1222—showing the spatial extent and boundaries of coastal water types covered by this document
- Section 1—introduction and guidance on how to use the document
- Section 2 (Table 1)—EVs applying to waters covered by this document
- Section 3 (tables 2–12)—WQOs applying to different EVs:
  - Table 2 provides WQOs to protect the aquatic ecosystem EV, and closely links to the water types shown on plan WQ1251, and plan WQ1222 (coastal waters)
  - tables 3 to 12 provide WQOs to protect human use EVs
- Section 4—ways to improve water quality: containing a list of relevant documents, provided for information purposes only
- Section 5—a dictionary of other terms relevant to EVs and WQOs.

1.2.3 Use of this document

Section 2 (Table 1) lists the identified EVs for protection for particular waters. The aquatic ecosystem EV is a default applying to all Queensland waters. Reference to section 3 (Table 2) provides the corresponding WQOs to protect the aquatic ecosystem EV. Where relevant, different WQOs are specified to protect the aquatic ecosystem EV in different water types (refer to the tables and the accompanying plans). For the human use EVs specified in Table 1, Tables 3 onwards provide the corresponding WQOs to support these EVs.

Where reference to Table 1 indicates more than one EV applies to a given water, the adoption of the most stringent WQO for the identified EVs applies to each water quality indicator in order to protect all identified EVs. Further detail on selection of most stringent WQOs is provided in section 3.

This document also refers to a number of guidelines, codes and other reference sources on water quality. In particular, the QWQG prepared by the department provide a technical basis for the WQOs contained in this document. The QWQG also provide more detailed information on water types, water quality indicators, derivation of local water quality guidelines, application during flood events, monitoring, and predicting and assessing compliance.

1.3 Information about mapped areas and boundaries

The boundaries in the accompanying plans WQ1251 and WQ1222 are indicative only. EVs, water types and aquatic ecosystem management intent (level of protection) depicted in the accompanying plans are stored in electronic form as part of the Central Queensland Environmental Values Schedule 1 Geodatabase August 2013, and held at the department's offices at 400 George Street Brisbane. Geodatabase regions are based on the regions established in the QWQG. Spatial (GIS) datasets can be downloaded free of charge from the Queensland Government Information Service (QGIS) at http://dds.information.qld.gov.au/dds. For further information, please contact the department by email at epa.ev@ehp.qld.gov.au.

1.4 Water types and basis for boundaries

1.4.1 Water types

Waters in this document have been classified into the following different water types (not all water types are present in all areas):

- Fresh waters—freshwater streams and rivers
- freshwater lakes/reservoirs
- groundwaters
- mid estuary—waters extending the majority of the length of estuaries with a moderate amount of water movement from either freshwater inflow or tidal exchange

- enclosed coastal/lower estuary—waters occurring at the downstream end of estuaries and including shallow coastal waters in adjacent enclosed bays
- marinas, boat harbours, tidal canals, and constructed estuaries
- wetlands
- open coastal waters—waters extending to the seaward limits of Queensland waters.

The water types are based on local water quality studies in the Pioneer River and Plane Creek basins (refer to the source documents listed after Table 2), the AWQG and mapping and definitional rules contained in the QWQG. Further detail on water types is contained in these sources.

Water types identified in this document are shown in Table 2 and the accompanying plans (WQ1251, WQ1222).

1.4.2 Water type boundaries

The boundaries of different water types have been mapped using a variety of attributes, including:

1. geographic coordinates
2. catchment or subcatchment boundaries
3. highest/lowest astronomical tide
4. tidal limiting structure (weirs)
5. maritime mapping conventions
6. coastline
7. surveyed terrestrial boundaries
8. altitude.

The basis of different boundaries is shown in the plan. The boundaries of water types may be confirmed or revised by site investigations. Refer to section 1.3 above.

1.5 Matters for amendment

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

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

2 Environmental values

2.1 Environmental values

Table 1 and the accompanying plans WQ1251 and WQ1222 outline the EVs for waters in the Pioneer River and Plane Creek basins, and adjacent coastal waters. These are based on stakeholder EVs consultations undertaken by the department and Mackay Whitsunday NRM (Reef Catchments) as part of the Mackay Whitsunday region water quality improvement plan, and additional consultation by the department in preparing this document. Consultation results from the water quality improvement plan are reported in:

- Mitchell, C & Higham, W 2008, Water quality improvement plan (WQIP): Community consultation, Mackay Whitsunday Natural Resource Management Group, Reef Catchments, Mackay.

The dictionary to this document provides further explanation of EVs (refer section 5).

2.2 Management goals to support environmental values

There are no management goals specified under this document.

Table 1 Environmental values for Pioneer River and Plane Creek Basin waters

	Environmental values[1,2,3,4,5]											
	Aquatic ecosystems	Irrigation	Farm supply/use	Stock water	Aquaculture	Human consumer	Primary recreation [5]	Secondary recreation [5]	Visual recreation	Drinking water	Industrial use	Cultural and spiritual values
Subcatchment / waterway name (alphabetically listed—fresh water, estuarine, coastal/marine)												
PORTS (see Plan WQ1251)												
Dudgeon Point Strategic Port Land waters	✓								✓		✓	✓
Hay Point Port restricted use areas – comprising offshore port infrastructure (includes restricted zones), Restricted Area 'A' and 'B', temporary exclusion area	✓										✓	✓
Hay Point Port sub-zone coastal waters (outside restricted use area)	✓					✓	✓	✓	✓		✓	✓
Sandringham Bay sub-zone waters	✓				✓	✓	✓	✓	✓		✓	✓
Mackay Port restricted zones	✓										✓	✓
Mackay Port sub-zone waters (outside restricted zones)	✓					✓	✓	✓	✓		✓	✓
OUTSIDE PORTS												
Alligator Creek fresh waters	✓	✓	✓	✓			✓			✓		✓
Alligator Creek estuarine waters	✓				✓	✓		✓	✓			✓

	Environmental values[1,2,3,4,5]											
	Aquatic ecosystems	**Irrigation**	**Farm supply/use**	**Stock water**	**Aquaculture**	**Human consumer**	**Primary recreation** [5]	**Secondary recreation** [5]	**Visual recreation**	**Drinking water**	**Industrial use**	**Cultural and spiritual values**
Subcatchment / waterway name (alphabetically listed—fresh water, estuarine, coastal/marine)												
Bakers Creek fresh waters	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Bakers Creek estuarine waters	✓				✓	✓		✓	✓			✓
Blacks Creek fresh waters	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
• Teemburra Dam	✓	✓				✓	✓	✓	✓	✓		✓
Cabbage Tree and Louisa creeks fresh waters (outside Hay Point Port land) - for details on EVs in port areas, refer to 'ports' listing in this table	✓	✓	✓	✓			✓		✓			✓
Cabbage Tree and Louisa creeks estuarine waters (outside Hay Point Port land) - for details on EVs in port areas, refer to 'ports' listing in this table	✓				✓	✓		✓	✓			✓
Cape Creek fresh waters	✓		✓	✓					✓	✓		✓
Cape Creek estuarine waters	✓				✓	✓		✓	✓			✓
Carmila Creek fresh waters	✓	✓	✓	✓			✓			✓		✓
Carmila Creek estuarine waters	✓					✓		✓	✓			✓
Coastal / marine waters - refer to 'Northumberland Islands' row												

	Environmental values[1,2,3,4,5]											
	Aquatic ecosystems	**Irrigation**	**Farm supply/use**	**Stock water**	**Aquaculture**	**Human consumer**	**Primary recreation** [5]	**Secondary recreation** [5]	**Visual recreation**	**Drinking water**	**Industrial use**	**Cultural and spiritual values**
Subcatchment / waterway name (alphabetically listed—fresh water, estuarine, coastal/marine)												
Flaggy Rock Creek fresh waters	✓	✓	✓	✓			✓			✓		✓
Flaggy Rock Creek estuarine waters	✓					✓		✓	✓			✓
Gillinbin Creek fresh waters	✓	✓	✓	✓			✓			✓		✓
Gillinbin Creek estuarine waters / Four Mile Beach	✓						✓	✓				✓
Ince Bay - see plan WQ1222	✓				✓	✓	✓	✓	✓			✓
Islands - refer 'Northumberland Islands' row												
Llewellyn Bay - see plan WQ1222	✓				✓	✓	✓	✓	✓			✓
Mackay City fresh waters (outside Mackay Port land)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mackay City estuarine waters (outside port land - including Pioneer River estuary and Bassett Basin)	✓				✓	✓		✓	✓			✓
Marion Creek fresh waters	✓	✓	✓	✓			✓	✓	✓	✓		✓
Marion Creek estuarine waters	✓				✓	✓		✓	✓			✓
Northumberland Islands fresh waters (including Beverley Group, Percy Isles) [6] - see plan WQ1222	✓	✓[6]						✓	✓	✓[6]		✓

	Environmental values[1,2,3,4,5]											
	Aquatic ecosystems	**Irrigation**	**Farm supply/use**	**Stock water**	**Aquaculture**	**Human consumer**	**Primary recreation** [5]	**Secondary recreation** [5]	**Visual recreation**	**Drinking water**	**Industrial use**	**Cultural and spiritual values**
Subcatchment / waterway name (alphabetically listed—fresh water, estuarine, coastal/marine)												
Northumberland Islands coastal and marine waters (including Beverley Group, Percy Isles, Bushy-Redbill Reef) [6]	✓					✓	✓	✓	✓			✓
Pioneer River fresh waters	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Plane Creek fresh waters	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓
• Middle Creek Dam	✓	✓				✓	✓	✓	✓	✓		✓
Plane Creek estuarine waters	✓				✓	✓		✓	✓			✓
Rocky Dam Creek fresh waters	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓
Rocky Dam Creek estuarine waters	✓				✓	✓		✓	✓			✓
Sandy Creek fresh waters	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
• Lake Kinchant (Kinchant Dam)	✓	✓				✓	✓	✓	✓	✓		✓
Sandy Creek estuarine waters	✓				✓	✓		✓	✓			✓
Sandringham Bay - see plan WQ1222	✓				✓	✓	✓	✓	✓		✓	✓
Sarina Inlet - see plan WQ1222	✓				✓	✓	✓	✓	✓			✓

	Environmental values[1,2,3,4,5]											
	Aquatic ecosystems	**Irrigation**	**Farm supply/use**	**Stock water**	**Aquaculture**	**Human consumer**	**Primary recreation** [5]	**Secondary recreation** [5]	**Visual recreation**	**Drinking water**	**Industrial use**	**Cultural and spiritual values**
Subcatchment / waterway name (alphabetically listed—fresh water, estuarine, coastal/marine)												
Slade Bay - see plan WQ1222	✓					✓	✓	✓	✓			✓
Upper Cattle Creek fresh waters	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
West Hill Creek fresh waters	✓	✓	✓	✓			✓		✓	✓		✓
West Hill Creek (including West Hill Island) estuarine waters	✓					✓		✓	✓			✓
Groundwaters	✓	✓	✓	✓						✓	✓	✓

Notes:

1. Refer to the accompanying plan WQ1251 and WQ1222 for locations of EVs. For fresh water and estuarine rows, the EVs shown relate to waters within each subcatchment. For example the EVs for 'Carmila Creek fresh waters' apply to all riverine freshwaters in Carmila Creek subcatchment.
2. '✓' means the EV is selected for protection. Blank indicates that the EV is not chosen for protection.
3. Refer to the dictionary for further explanation of EVs.
4. Refer to section 3 for WQOs applying to the EVs in this table.
5. The selection of recreational EVs for waters does not mean that these waters are free of venomous or dangerous aquatic organisms, for example venomous organisms (e.g. marine stingers including box jellyfish, irukandji jellyfish), crocodiles, and sharks. Direct contact with venomous or dangerous aquatic organisms should be avoided. Refer to council websites, 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.
6. This is a generic list of EVs for islands. EVs for specific islands may differ according to degree of development, available facilities and management intent for individual islands.
7. For more specific information on activity restrictions in ports areas (including restricted zones) refer to North Queensland Bulk Ports Corporation Port Security Advice documents. For more detail on land use designations and corresponding indicative uses within ports, refer to relevant land use plans for the Hay Point (including Dudgeon Point), and Mackay ports, prepared by North Queensland Bulk Ports Corporation. Land use plans provide an overall framework for management of development and activities on strategic port land (including waters).

3 Water quality objectives to protect environmental values

This section provides WQOs to support and protect different EVs identified for waters within the Pioneer River and Plane Creek basins in Table 1. WQOs are long-term goals for water quality management. They are numerical concentration levels or narrative statements of indicators established for receiving waters to support and protect the designated EVs for those waters. Water quality objectives are not individual point source emission objectives, but the receiving water quality objectives.

This section is in two main parts:

- Section 3.1 (Table 2) outlines WQOs to protect the aquatic ecosystem EV. The aquatic ecosystem EV is a default applying to all Queensland waters, and therefore the WQOs for aquatic ecosystems form the minimum WQOs for all waters. Where no human use EVs are identified, the WQOs identified for aquatic ecosystem protection remain applicable.
- Section 3.2 (tables 3 to 12) provides WQOs for EVs other than aquatic ecosystem ('human use EVs') such as recreational water use, irrigating crops, and aquaculture.

Sources used in deriving WQOs are provided after the tables.

Reference to the identified EVs in Table 1 of this document provides guidance on the EVs applying to waters within the catchment. Where reference to Table 1 indicates more than one EV applies to a given water (for example aquatic ecosystem and recreational use), the most stringent WQO for each water quality indicator applies, which will then protect all identified EVs. Refer to the two following examples on selection of most stringent WQOs. Note that these are examples only and should not be directly adopted for use.

Example 1

For freshwater streams with aquatic ecosystem and drinking water EVs, the respective turbidity WQOs are:

- aquatic ecosystem lowland freshwater stream: less than 10 nephelometric turbidity units (NTU)
- drinking water: less than 25 NTU.

In this case the aquatic ecosystem WQO for turbidity (less than 10 NTU) is the more stringent, and its adoption therefore supports both the aquatic ecosystem and drinking water EVs.

Example 2

In the following situation there are stock watering and irrigation EVs, with differing WQOs for thermotolerant (faecal) coliforms (measured as median number of organisms per 100 millilitre (mL)):

- stock watering: less than 100 organisms per 100 mL
- raw human food crops in direct contact with irrigation water: less than 10 organisms per 100 mL
- pasture and fodder for dairy animals: less than 100 organisms per 100 mL.

The most stringent WQO for faecal coliforms in this example is that for direct irrigation of raw human food crops (less than 10 organisms per 100 mL) and its adoption would in turn provide faecal coliform WQOs that protect all the above-identified human use EVs.

3.1 Water quality objectives to protect aquatic ecosystems

This section provides physico-chemical, biological (section 3.1.1) and riparian (section 3.1.2) WQOs to support the aquatic ecosystem EV. Sources used in deriving locally relevant WQOs are provided after the tables in each of these sections.

Section 5 and Appendix D of the QWQG address procedures for the application of guidelines for aquatic ecosystem protection, and compliance assessment protocols. 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) 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, refer to notes after tables, and protocols contained in *Water quality guidelines for the Great Barrier Reef Marine Park 2010.*

3.1.1 Physico–chemical and biological water quality objectives

Table 2 includes the following information:

- water area or water type (column 1) (for boundaries of specified areas, refer to the accompanying plan)
- the corresponding management intent (level of protection) for the identified waters (column 2)
- the corresponding physico-chemical and biological WQOs to achieve the management intent (level of protection) for the identified waters.

The EPP (Water) s. 14 identifies the management intent (level of protection) for different waters. The framework and how it is addressed in this document are summarised below.

- The EPP (Water) identifies some waters for which the management intent (level of protection) is to maintain or achieve an effectively unmodified waterway condition (‘high ecological value’—HEV). These may include waters that are currently HEV, ‘slightly disturbed’ (SD), or potentially, more modified waters which can be progressively improved to achieve HEV condition.
- In this document, 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' for effectively unmodified waters, 'SD1234' for slightly disturbed waters) which links to labels and cross-hatching on the accompanying plans.
- 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. 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 ANZECC (2000) Australian water quality guidelines. 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).
- The management intent (level of protection) for ‘highly disturbed’ waters is that they be progressively improved. Some highly disturbed waters may require a long timeframe to return to a moderately disturbed condition level. In some circumstances, interim WQOs that reflect a highly disturbed (HD) condition level (which is an improvement on current condition) may be determined for such waters. Any such locations and their corresponding management intent (level of protection) are also identified in the table and accompanying plan.
- Some objectives apply to specific areas or water types as indicated in Table 2 and shown on plans WQ1251 and WQ1222, while others apply to more than one water type, as indicated in the table. The table includes ambient (baseflow) water quality objectives, and also event (high flow) objectives.

Table 2 Water quality objectives to protect aquatic ecosystem environmental value under ambient (baseflow) and event (high flow) conditions

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
SURFACE FRESH WATERS - listed alphabetically by subcatchment (refer plan WQ1251), management intent and flow condition (ambient/event)		
Alligator Creek subcatchment fresh waters in area HEV2346 **(nb: the majority of this HEV area is estuarine)**	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. Note: there is insufficient information available to establish current water quality for these waters. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.

Alligator Creek subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)**
		• dissolved inorganic nitrogen: <30 µg/L[a, b, c, d] (micrograms/Litre)
		• particulate N: <110 µg/L[a, c, d]
		• filterable reactive phosphorus (FRP): <15 µg/L[a, c]
		• particulate phosphorus: <20 µg/L[a, c]
		• dissolved oxygen:
		  − No-flow 20th and 80th percentile: 40%–120% saturation[a, e, f]
		  − Flow 20th and 80th percentile: 85%–120% saturation[a, e, f]
		• suspended solids: <5 mg/L[a]
		• pH: 7.3–7.5[a, g, h]
		• electrical conductivity (EC): <527 µS/cm[a, i]
		• temperature: nd[j, k]
		• macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table)
		• fish: nd[k]
		WQOs for pesticides identified in the Mackay Whitsunday Water Quality Improvement Plan (WQIP)[a]:
		• Ametryn: <0.02 µg/L
		• Atrazine: <0.09 µg/L
		• Diuron: <0.19 µg/L
		• Hexazinone: <0.2 µg/L
		• Tebuthiuron: <LOD
		• other toxicants: refer 'Fresh waters - other toxicants' row

Alligator Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] (micrograms/Litre) • particulate N: <340 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <70 µg/L[a] • suspended solids: <87 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <0.07 µg/L • Atrazine: <0.74 µg/L • Diuron: <1.2 µg/L • Hexazinone: <0.5 µg/L • Tebuthiuron: <LOD

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Bakers Creek subcatchment fresh waters in area HEV2345 **(nb: the majority of this HEV area is estuarine)**	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. Note: there is insufficient information available to establish current water quality for these waters. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.

Bakers Creek subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)**
		• dissolved inorganic nitrogen: <30 µg/L[a, b, c, d]
		• particulate N: <150 µg/L[a, c, d]
		• filterable reactive phosphorus (FRP): <20 µg/L[a, c]
		• particulate phosphorus: <20 µg/L[a, c]
		• dissolved oxygen:
		  − no-flow 20th and 80th percentile: 40%–120% saturation[a, e, f]
		  − flow 20th and 80th percentile: 85%–120% saturation[a, e, f]
		• suspended solids: <4 mg/L[a]
		• pH: 6.8–7.0[a, g, h]
		• electrical conductivity (EC): <390 µS/cm[a, i]
		• temperature: nd[j, k]
		• macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table)
		• fish: nd[k]
		WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]:
		• Ametryn: <0.01 µg/L
		• Atrazine: <0.17 µg/L
		• Diuron: <0.11 µg/L
		• Hexazinone: <0.14 µg/L
		• Tebuthiuron: <LOD
		• other toxicants: refer 'Fresh waters - other toxicants' row

Bakers Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <340 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <70 µg/L[a] • suspended solids: <57mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <0.08 µg/L • Atrazine: <0.83 µg/L • Diuron: <1.4 µg/L • Hexazinone: <0.56 µg/L • Tebuthiuron: <LOD
Blacks Creek subcatchment fresh waters in area HEV2342	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for Blacks Creek subcatchment fresh waters are: • dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d] • particulate N: 39–58–152 µg/L[a, c, d]

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV

		• filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c]
		• particulate phosphorus: 6–12–22 µg/L[a, c]
		• dissolved oxygen:
		  − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f]
		  − flow 20th and 80th percentile: 90%–105% saturation[a, e, f]
		• suspended solids: 1–2–4 mg/L[a]
		• pH: 6.7–6.9–7.1[a, g, h]
		• electrical conductivity (EC): 130–190–350 µS/cm[a, i]
		• temperature: nd[j, k]
		• macroinvertebrates: nd[k]
		• fish: nd[k]
		WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect freshwater species at the HEV level of protection[a]:
		• Ametryn: <LOD
		• Atrazine: <LOD
		• Diuron: <LOD
		• Hexazinone: <LOD
		• Tebuthiuron: <LOD
		• other toxicants: refer 'Fresh waters - other toxicants' row

Blacks Creek[l] subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)[l]	**Ambient (baseflow)**
		Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas.
		The 20th, 50th and 80th percentiles of existing water quality for Blacks Creek subcatchment fresh waters are:
		• dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d]
		• particulate N: 39–58–152 µg/L[a, c, d]
		• filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c]
		• particulate phosphorus: 6–12–22 µg/L[a, c]
		• dissolved oxygen:
		  − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f]
		  − flow 20th and 80th percentile: 90%–105% saturation[a, e, f]
		• suspended solids: 1–2–4 mg/L[a]
		• pH: 6.7–7.1[a, g, h]
		• electrical conductivity (EC): 130–190–350 µS/cm[a, i]
		• temperature: nd[j, k]
		• macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table)
		• fish: nd[k]
		WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]:
		• Ametryn: <LOD
		• Atrazine: <LOD
		• Diuron: <LOD
		• Hexazinone: <LOD
		• Tebuthiuron: <LOD
		• other toxicants: refer 'Fresh waters - other toxicants' row

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Blacks Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <340 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <70 µg/L[a] • suspended solids: <183 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <0.06 µg/L • Hexazinone: <0.03 µg/L • Tebuthiuron: <LOD
Cabbage Tree and Louisa creeks subcatchment fresh waters in area HEV2347	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. Note: there is insufficient information available to establish current water quality for these waters. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.

Cabbage Tree and Louisa creeks subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)**
		• dissolved inorganic nitrogen: <9 µg/L[a, b, c, d] (micrograms/Litre)
		• particulate N: <58 µg/L[a, c, d]
		• filterable reactive phosphorus (FRP): <2 µg/L[a, c]
		• particulate phosphorus: <12 µg/L[a, c]
		• dissolved oxygen:
		  − No-flow 20th and 80th percentile: 40%–120% saturation[a, e, f]
		  − Flow 20th and 80th percentile: 85%–120% saturation[a, e, f]
		• suspended solids: <2 mg/L[a]
		• pH: 6.7–7.1[a, g, h]
		• electrical conductivity (EC): <194 µS/cm[a, i]
		• temperature: nd[j, k]
		• macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table)
		• fish: nd[k]
		WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]:
		• Ametryn: <LOD
		• Atrazine: <LOD
		• Diuron: <LOD
		• Hexazinone: <LOD
		• Tebuthiuron: <LOD
		• other toxicants: refer 'Fresh waters - other toxicants' row

Cabbage Tree and Louisa creeks subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] (micrograms/Litre) • particulate N: <340 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <70 µg/L[a] • suspended solids: <95 mg/L[a]

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
		Event WQOs for pesticides[a]: • Ametryn: <LOD • Atrazine: <0.04 µg/L • Diuron: <0.46 µg/L • Hexazinone: <0.23 µg/L • Tebuthiuron: <LOD
Cape Creek subcatchment fresh waters in area HEV2350	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for Cape Creek subcatchment fresh waters are: • dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d] • particulate N: 39–58–152 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c] • particulate phosphorus: 6–12–22 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f] − flow 20th and 80th percentile: 90%–105% saturation[a, e, f] • suspended solids: 1–2–4 mg/L[a] • pH: 6.7–6.9–7.1[a, g, h] • electrical conductivity (EC): 130–190–350 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: nd[k] • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect freshwater species at the HEV level of protection[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Cape Creek[l] subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)[l]	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for Cape Creek subcatchment fresh waters are: • dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d] • particulate N: 39–58–152 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c] • particulate phosphorus: 6–12–22 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f] − flow 20th and 80th percentile: 90%–105% saturation[a, e, f] • suspended solids: 1–2–4 mg/L[a] • pH: 6.7–7.1[a, g, h] • electrical conductivity (EC): 130–190–350 µS/cm[a, i] • temperature: nd[j, k]

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
		• macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Cape Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <48 µg/L[a, b, d] • particulate N: <152 µg/L[a, d] • filterable reactive phosphorus (FRP): <3 µg/L[a] • particulate phosphorus: <37 µg/L[a] • suspended solids: <66 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <LOD • Atrazine: <0.02 µg/L • Diuron: <0.05 µg/L • Hexazinone: <LOD • Tebuthiuron: <LOD
Carmila Creek subcatchment fresh waters in area HEV2354	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. Note: there is insufficient information available to establish current water quality for these waters. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.
Carmila Creek subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)** • dissolved inorganic nitrogen: <8 µg/L[a, b, c, d] • particulate N: <78 µg/L[a, c, d] • filterable reactive phosphorus (FRP): <5 µg/L[a, c] • particulate phosphorus: <10 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 40%–120% saturation[a, e, f] − flow 20th and 80th percentile: 85%–120% saturation[a, e, f] • suspended solids: <3 mg/L[a] • pH: 7.3–7.8[a, g, h] • electrical conductivity (EC): <279 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
		• Hexazinone: <0.01 µg/L • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Carmila Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <256 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <53 µg/L[a] • suspended solids: <39 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <LOD • Atrazine: <0.04 µg/L • Diuron: <0.46 µg/L • Hexazinone: <0.23 µg/L • Tebuthiuron: <LOD
Flaggy Rock Creek subcatchment fresh waters in area HEV2355	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for Flaggy Rock Creek subcatchment fresh waters are: • dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d] • particulate N: 39–58–152 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c] • particulate phosphorus: 6–12–22 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f] − flow 20th and 80th percentile: 90%–105% saturation[a, e, f] • suspended solids: 1–2–4mg/L[a] • pH: 6.7–6.9–7.1[a, g, h] • electrical conductivity (EC): 130–190–350 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: nd[k] • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect freshwater species at the HEV level of protection[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Flaggy Rock Creek subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)** • dissolved inorganic nitrogen: 8 µg/L[a, b, c, d] • particulate N: 78 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 5 µg/L[a, c] • particulate phosphorus: 10 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 40%–120% saturation[a, e, f] − flow 20th and 80th percentile: 85%–120% saturation[a, e, f] • suspended solids: 3 mg/L[a] • pH: 7.3–7.8[a, g, h] • electrical conductivity (EC): 279 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <0.01 µg/L • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Flaggy Rock Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <340 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <70 µg/L[a] • suspended solids: <200 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <LOD • Atrazine: <0.03 µg/L • Diuron: 0.12 µg/L • Hexazinone: <0.02 µg/L • Tebuthiuron: <0.05 µg/L
Gillinbin Creek subcatchment fresh waters in area HEV2352	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for Gillinbin Creek subcatchment fresh waters are: • dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d] • particulate N: 39–58–152 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c] • particulate phosphorus: 6–12–22 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f] − flow 20th and 80th percentile: 90%–105% saturation[a, e, f] • suspended solids: 1–2–4 mg/L[a]

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
		• pH: 6.7–6.9–7.1[a, g, h] • electrical conductivity (EC): 130–190–350 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: nd[k] • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect freshwater species at the HEV level of protection[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Gillinbin Creek subcatchment fresh waters in area SD2383 **(nb: the majority of this SD area is estuarine)**	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Achieve effectively unmodified water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for Gillinbin Creek subcatchment fresh waters are provided in the row above.
Gillinbin Creek[l] subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)[l]	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for Gillinbin Creek subcatchment fresh waters are: • dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d] • particulate N: 39–58–152 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c] • particulate phosphorus: 6–12–22 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f] − flow 20th and 80th percentile: 90%–105% saturation[a, e, f] • suspended solids: 1–2–4mg/L[a] • pH: 6.7–7.1[a, g, h] • electrical conductivity (EC): 130–190–350 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Gillinbin Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <48 µg/L[a, b, d] • particulate N: <152 µg/L[a, d] • filterable reactive phosphorus (FRP): <3 µg/L[a] • particulate phosphorus: <37 µg/L[a] • suspended solids: <66 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <LOD • Atrazine: <0.02 µg/L • Diuron: <0.05 µg/L • Hexazinone: <LOD • Tebuthiuron: <LOD
Islands - Northumberland Islands (refer plans WQ1251, WQ1222) Comprising fresh waters on all islands off the Pioneer River and Plane Creek basins. These include Aquila, Curlew, Digby, Knight, Percy Isles (Middle, North east and South islands), Prudhoe, Temple, and West Hill islands		
Northumberland Islands fresh waters in area HEV2385 (various islands) off Pioneer River and Plane Creek basins	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. In the absence of more locally applicable information, the 20th, 50th and 80th percentiles of existing water quality are based on the WQOs for Gillinbin Creek subcatchment fresh waters (mainland): • dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d] • particulate N: 39–58–152 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c] • particulate phosphorus: 6–12–22 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f] − flow 20th and 80th percentile: 90%–105% saturation[a, e, f] • suspended solids: 1–2–4 mg/L[a] • pH: 6.7–6.9–7.1[a, g, h] • electrical conductivity (EC): 130–190–350 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: nd[k] • fish: nd[k] In the absence of more locally applicable information, WQOs for pesticides are based on those identified in the Mackay Whitsunday WQIP for the Gillinbin Creek subcatchment, to protect freshwater species at the HEV level of protection[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Northumberland Islands fresh waters (various islands) off Pioneer River and, Plane Creek basins	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)** In the absence of more locally applicable information, the WQOs are based on the 20th/80th percentile of WQOs for Gillinbin Creek subcatchment (mainland): • dissolved inorganic nitrogen: <13 µg/L[a, b, c, d] • particulate N: <152 µg/L[a, c, d] • filterable reactive phosphorus (FRP): <3 µg/L[a, c] • particulate phosphorus: <22 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f] − flow 20th and 80th percentile: 90%–105% saturation[a, e, f] • suspended solids: <4 mg/L[a] • pH: 6.7–7.1[a, g, h] • electrical conductivity (EC): <350 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: nd[k] • fish: nd[k] In the absence of more locally applicable information, WQOs for pesticides are based on those identified in the Mackay Whitsunday WQIP for the Gillinbin Creek subcatchment[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row Refer to QWQG for details on how to establish a minimum water quality data set for deriving local WQOs.
Mackay City subcatchment fresh waters	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** No HEV waters identified to date. Refer to MD row below.
Mackay City subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)** • dissolved inorganic nitrogen: <30 µg/L[a, b, c, d] • particulate N: <110 µg/L[a, c, d] • filterable reactive phosphorus (FRP): <15 µg/L[a, c] • particulate phosphorus: <20 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 40%–120% saturation[a, e, f] − flow 20th and 80th percentile: 85%–120% saturation[a, e, f] • suspended solids: <5 mg/L[a] • pH: 7.3–7.5[a, g, h] • electrical conductivity (EC): <527 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <0.02 µg/L • Atrazine: <0.09 µg/L

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
		• Diuron: <0.19 µg/L • Hexazinone: <0.20 µg/L • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Mackay City subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <198 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <51 µg/L[a] • suspended solids: <39 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <0.08 µg/L • Atrazine: <0.75 µg/L • Diuron: <1.3 µg/L • Hexazinone: <0.51 µg/L • Tebuthiuron: <LOD

Marion Creek subcatchment fresh waters in HEV2351	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)**
		Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas.
		The 20th, 50th and 80th percentiles of existing water quality for Marion Creek subcatchment fresh waters are:
		• dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d]
		• particulate N: 39–58–152 µg/L[a, c, d]
		• filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c]
		• particulate phosphorus: 6–12–22 µg/L[a, c]
		• dissolved oxygen:
		  − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f]
		  − flow 20th and 80th percentile: 90%–105% saturation[a, e, f]
		• suspended solids: 1–2–4 mg/L[a]
		• pH: 6.7–6.9–7.1[a, g, h]
		• electrical conductivity (EC): 130–190–350 µS/cm[a, i]
		• temperature: nd[j, k]
		• macroinvertebrates: nd[k]
		• fish: nd[k]
		WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect freshwater species at the HEV level of protection[a]:
		• Ametryn: <LOD
		• Atrazine: <LOD
		• Diuron: <LOD
		• Hexazinone: <LOD
		• Tebuthiuron: <LOD
		• other toxicants: refer 'Fresh waters - other toxicants' row

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Marion Creek subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)** • dissolved inorganic nitrogen: <8 µg/L[a, b, c, d] • particulate N: <78 µg/L[a, c, d] • filterable reactive phosphorus (FRP): <5 µg/L[a, c] • particulate phosphorus: <10 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 40%–120% saturation[a, e, f] − flow 20th and 80th percentile: 85%–120% saturation[a, e, f] • suspended solids: <3 mg/L[a] • pH: 7.3–7.8[a, g, h] • electrical conductivity (EC): <279 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <0.01 µg/L • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Marion Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <340 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <70 µg/L[a] • suspended solids: <122 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <LOD • Atrazine: <0.18 µg/L • Diuron: <0.56 µg/L • Hexazinone: <0.21 µg/L • Tebuthiuron: <LOD
Pioneer River subcatchment fresh waters in area HEV2343	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for Pioneer River subcatchment fresh waters are: • dissolved inorganic nitrogen: 5–8–13 µg/L[a, b, c, d] • particulate N: 6–13–26 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 2–3–6 µg/L[a, c] • particulate phosphorus: 1–3–5 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f] − flow 20th and 80th percentile: 90%–105% saturation[a, e, f] • suspended solids: 0–1–1 mg/L[a] • pH: 7.4–7.4–7.5[a, g, h]

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
		• electrical conductivity (EC): 40–40–50 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: nd[k] • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect freshwater species at the HEV level of protection[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Pioneer River subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)** • dissolved inorganic nitrogen: <8 µg/L[a, b, c, d] • particulate N: <102 µg/L[a, c, d] • filterable reactive phosphorus (FRP): <5 µg/L[a, c] • particulate phosphorus: <20 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 40%–120% saturation [a, e, f] − flow 20th and 80th percentile: 85%–120% saturation [a, e, f] • suspended solids: <5 mg/L[a] • pH: 7.4–8.3[a, g, h] • electrical conductivity (EC): <183 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <LOD • Atrazine: <0.02 µg/L • Diuron: <0.02 µg/L • Hexazinone: <0.02 µg/L • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Pioneer River subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <340 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <70 µg/L[a] • suspended solids: <198 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <0.03 µg/L • Atrazine: <0.43 µg/L • Diuron: <0.75 µg/L • Hexazinone: <0.19 µg/L • Tebuthiuron: <LOD

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Plane Creek subcatchment fresh waters in area HEV2348	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. Note: there is insufficient information available to establish current water quality for these waters. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.
Plane Creek subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)** • dissolved inorganic nitrogen: <8 µg/L[a, b, c, d] • particulate N: <101 µg/L[a, c, d] • filterable reactive phosphorus (FRP): <8 µg/L[a, c] • particulate phosphorus: <18 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 40%–120% saturation[a, e, f] − flow 20th and 80th percentile: 85%–120% saturation[a, e, f] • suspended solids: <3 mg/L[a] • pH: 7.5–7.8[a, g, h] • electrical conductivity (EC): <463 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <0.01 µg/L • Hexazinone: <0.04 µg/L • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Plane Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <178 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <61 µg/L[a] • suspended solids: <200 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <LOD • Atrazine: <0.17 µg/L • Diuron: <0.51 µg/L • Hexazinone: <0.14 µg/L • Tebuthiuron: <LOD
Rocky Dam Creek subcatchment fresh waters in area HEV2349	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for Rocky Dam Creek subcatchment fresh waters are: • dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d] • particulate N: 39–58–152 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c]

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV

		• particulate phosphorus: 6–12–22 µg/L[a, c]
		• dissolved oxygen:
		  − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f]
		  − flow 20th and 80th percentile: 90%–105% saturation[a, e, f]
		• suspended solids: 1–2–4mg/L[a]
		• pH: 6.7–6.9–7.1[a, g, h]
		• electrical conductivity (EC): 130–190–350 µS/cm[a, i]
		• temperature: nd[j, k]
		• macroinvertebrates: nd[k]
		• fish: nd[k]
		WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect freshwater species at the HEV level of protection[a]:
		• Ametryn: <LOD
		• Atrazine: <LOD
		• Diuron: <LOD
		• Hexazinone: <LOD
		• Tebuthiuron: <LOD
		• other toxicants: refer 'Fresh waters - other toxicants' row

Rocky Dam Creek subcatchment fresh waters in area SD2382 **(nb: the majority of this SD area is estuarine)**	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Achieve effectively unmodified water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. Note: there is insufficient information available to establish unmodified water quality for these waters. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.

Rocky Dam Creek subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)**
		• dissolved inorganic nitrogen: <10 µg/L[a, b, c, d]
		• particulate N: <142 µg/L[a, c, d]
		• filterable reactive phosphorus (FRP): <6 µg/L[a, c]
		• particulate phosphorus: <20 µg/L[a, c]
		• dissolved oxygen:
		  − no-flow 20th and 80th percentile: 40%–120% saturation[a, e, f]
		  − flow 20th and 80th percentile: 85%–120% saturation[a, e, f]
		• suspended solids: <4 mg/L[a]
		• pH: 7.6–7.9[a, g, h]
		• electrical conductivity (EC): <697 µS/cm[a, i]
		• temperature: nd[j, k]
		• macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table)
		• fish: nd[k]
		WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]:
		• Ametryn: <0.02 µg/L
		• Atrazine: <LOD
		• Diuron: <0.07 µg/L
		• Hexazinone: <0.13 µg/L
		• Tebuthiuron: <LOD
		• other toxicants: refer 'Fresh waters - other toxicants' row

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Rocky Dam Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <340 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <70 µg/L[a] • suspended solids: <122 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <0.04 µg/L • Atrazine: <0.27 µg/L • Diuron: <0.75 µg/L • Hexazinone: <0.55 µg/L • Tebuthiuron: <LOD

Sandy Creek subcatchment fresh waters in area HEV2344	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)**
		Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas.
		The 20th, 50th and 80th percentiles of existing water quality for Sandy Creek subcatchment fresh waters are:
		• dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d]
		• particulate N: 39–58–152 µg/L[a, c, d]
		• filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c]
		• particulate phosphorus: 6–12–22 µg/L[a, c]
		• dissolved oxygen:
		  − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f]
		  − flow 20th and 80th percentile: 90%–105% saturation[a, e, f]
		• suspended solids: 1–2–4 mg/L[a]
		• pH: 6.7–6.9–7.1[a, g, h]
		• electrical conductivity (EC): 130–190–350 µS/cm[a, i]
		• temperature: nd[j, k]
		• macroinvertebrates: nd[k]
		• fish: nd[k]
		WQOs for pesticides in the Sandy Creek subcatchment, to protect freshwater species at the HEV level of protection[a]:
		• Ametryn: <LOD
		• Atrazine: <LOD
		• Diuron: <LOD
		• Hexazinone: <LOD
		• Tebuthiuron: <LOD
		• other toxicants: refer 'Fresh waters - other toxicants' row

Sandy Creek subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)**
		• dissolved inorganic nitrogen: <30 µg/L[a, b, c, d]
		• particulate N: <110 µg/L[a, c, d]
		• filterable reactive phosphorus (FRP): <15 µg/L[a, c]
		• particulate phosphorus: <20 µg/L[a, c]
		• dissolved oxygen:
		  − No-flow 20th and 80th percentile: 40%–120% saturation[a, e, f]
		  − Flow 20th and 80th percentile: 85%–120% saturation[a, e, f]
		• suspended solids: <5 mg/L[a]

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
		• pH: 7.3–7.5[a, g, h] • electrical conductivity (EC): <527 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <0.02 µg/L • Atrazine: <0.09 µg/L • Diuron: <0.19 µg/L • Hexazinone: <0.20 µg/L • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Sandy Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <340 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <70 µg/L[a] • suspended solids: <71 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <0.02 µg/L • Atrazine: <0.4 µg/L • Diuron: <0.75 µg/L • Hexazinone: <0.41 µg/L • Tebuthiuron: <LOD

Upper Cattle Creek subcatchment fresh waters in area HEV2341	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)**
		Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas.
		The 20th, 50th and 80th percentiles of existing water quality for Upper Cattle Creek subcatchment fresh waters are:
		• dissolved inorganic nitrogen: 5–8–13 µg/L[a, b, c, d]
		• particulate N: 6–13–26 µg/L[a, c, d]
		• filterable reactive phosphorus (FRP): 2–3–6 µg/L[a, c]
		• particulate phosphorus: 1–3–5 µg/L[a, c]
		• dissolved oxygen:
		  − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f]
		  − flow 20th and 80th percentile: 90%–105% saturation[a, e, f]
		• suspended solids: 0–1–1 mg/L[a]
		• pH: 7.4–7.4–7.5[a, g, h]
		• electrical conductivity (EC): 40–40–50 µS/cm[a, i]
		• temperature: nd[j, k]
		• macroinvertebrates: nd[k]
		• fish: nd[k]
		WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect freshwater species at the HEV level of protection[a]:
		• Ametryn: <LOD
		• Atrazine: <LOD
		• Diuron: <LOD

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
		• Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Upper Cattle Creek subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)	**Ambient (baseflow)** • dissolved inorganic nitrogen: <8 µg/L[a, b, c, d] • particulate N: <78 µg/L[a, c, d] • filterable reactive phosphorus (FRP): <5 µg/L[a, c] • particulate phosphorus: <10 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 40%–120% saturation[a, e, f] − flow 20th and 80th percentile: 85%–120% saturation[a, e, f] • suspended solids: <3 mg/L[a] • pH: 7.3–7.8[a, g, h] • electrical conductivity (EC): <279 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <0.01 µg/L • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
Upper Cattle Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <118 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <53 µg/L[a] • suspended solids: <43 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <LOD • Atrazine: <0.14 µg/L • Diuron: <0.43 µg/L • Hexazinone: <0.16 µg/L • Tebuthiuron: <LOD
West Hill Creek subcatchment fresh waters in area HEV2353	Aquatic ecosystem—high ecological value (HEV)	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for West Hill Creek subcatchment fresh waters are: • dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d] • particulate N: 39–58–152 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c] • particulate phosphorus: 6–12–22 µg/L[a, c] • dissolved oxygen:

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
		− no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f] − flow 20th and 80th percentile: 90%–105% saturation[a, e, f] • suspended solids: 1–2–4 mg/L[a] • pH: 6.7–6.9–7.1[a, g, h] • electrical conductivity (EC): 130–190–350 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: nd[k] • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect freshwater species at the HEV level of protection[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row
West Hill Creek subcatchment fresh waters in area SD2383 **(nb: the majority of this SD area is estuarine)**	Aquatic ecosystem—high ecological value (HEV)	Achieve effectively unmodified water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for West Hill Creek subcatchment waters are provided in the row above.
West Hill Creek[l] subcatchment fresh waters	Aquatic ecosystem—moderately disturbed (MD)[l]	**Ambient (baseflow)** Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. The 20th, 50th and 80th percentiles of existing water quality for West Hill Creek subcatchment fresh waters are: • dissolved inorganic nitrogen: 4–9–13 µg/L[a, b, c, d] • particulate N: 39–58–152 µg/L[a, c, d] • filterable reactive phosphorus (FRP): 1–2–3 µg/L[a, c] • particulate phosphorus: 6–12–22 µg/L[a, c] • dissolved oxygen: − no-flow 20th and 80th percentile: 50%–120% saturation[a, e, f] − flow 20th and 80th percentile: 90%–105% saturation[a, e, f] • suspended solids: 1–2–4 mg/L[a] • pH: 6.7–7.1[a, g, h] • electrical conductivity (EC): 130–190–350 µS/cm[a, i] • temperature: nd[j, k] • macroinvertebrates: refer to 'Fresh waters - macroinvertebrates' row (listed after 'West Hill Creek' in this table) • fish: nd[k] WQOs for pesticides identified in the Mackay Whitsunday WQIP[a]: • Ametryn: <LOD • Atrazine: <LOD • Diuron: <LOD • Hexazinone: <LOD • Tebuthiuron: <LOD • other toxicants: refer 'Fresh waters - other toxicants' row

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
West Hill Creek subcatchment (end of system)	Aquatic ecosystem—moderately disturbed (MD)	**Event (high flow)** • dissolved inorganic nitrogen: <300 µg/L[a, b, d] • particulate N: <340 µg/L[a, d] • filterable reactive phosphorus (FRP): <30 µg/L[a] • particulate phosphorus: <70 µg/L[a] • suspended solids: <156 mg/L[a] Event WQOs for pesticides[a]: • Ametryn: <LOD • Atrazine: <0.17 µg/L • Diuron: <0.54 µg/L • Hexazinone: <0.2 µg/L • Tebuthiuron: <LOD
Fresh waters - macroinvertebrates		
All HEV waters	Aquatic ecosystem—high ecological value (HEV)	• Insufficient data
Island fresh waters	All	• Insufficient data
Pioneer River Basin: fresh water riverine - edge habitat	Aquatic ecosystem—moderately disturbed (MD)[w]	• Taxa richess (edge) 20th and 80th percentiles: 18.6–23.4[w] • PET richness (edge) 20th and 80th percentiles: 4–6[w] • SIGNAL (v2.iv) (edge) 20th and 80th percentiles: 3.91–4.48[w] • % sensitive taxa (edge) 20th and 80th percentiles: nd–9.03[w] • % tolerant taxa (edge) 20th and 80th percentiles: 23.52–39.33[w]
Pioneer River Basin: fresh water riverine - riffle habitat	Aquatic ecosystem—moderately disturbed (MD)[w]	• Taxa richess (riffle) 20th and 80th percentiles: 17.6–24.4[w] • PET richness (riffle) 20th and 80th percentiles : 5.6–9.0[w] • SIGNAL (v2.iv) (riffle) 20th and 80th percentiles: 4.76–5.32[w] • % sensitive taxa (riffle) 20th and 80th percentiles: 7.88–17.86[w] • % tolerant taxa (riffle) 20th and 80th percentiles: 16.67–24.4[w]
Plane Creek Basin: fresh water riverine - edge habitat	Aquatic ecosystem—moderately disturbed (MD)[w]	• Taxa richess (edge) 20th and 80th percentiles: 19–28[w] • PET richness (edge) 20th and 80th percentiles: 3–6[w] • SIGNAL (v2.iv) (edge) 20th and 80th percentiles: 3.66–4.38[w] • % sensitive taxa (edge) 20th and 80th percentiles: nd–6.22[w] • % tolerant taxa (edge) 20th and 80th percentiles: 26.18–45.83[w]
Plane Creek Basin: fresh water riverine - riffle habitat	Aquatic ecosystem—moderately disturbed (MD)[w]	• Taxa richess (riffle) 20th and 80th percentiles: 18–26[w] • PET richness (riffle) 20th and 80th percentiles: 5–8[w] • SIGNAL (v2.iv) (riffle) 20th and 80th percentiles: 4.57–5.19[w] • % sensitive taxa (riffle) 20th and 80th percentiles: 7.69–15.63[w] • % tolerant taxa (riffle) 20th and 80th percentiles: 20.0–30.0[w]
FRESH WATERS - OTHER TOXICANTS (where not listed above)		
Other toxicants for ALL HEV and SD fresh waters in this table	Aquatic ecosystem—high ecological value (HEV)	WQOs are as per AWQG, to protect fresh water species at the HEV level of protection: • Toxicants in water[q]: refer to AWQG section 3.4—'water quality guidelines for toxicants' (including Tables 3.4.1, 3.4.2, and Figure 3.4.1), and AWQG volume 2 (section 8) • Toxicants in sediments: refer to AWQG section 3.5—'sediment quality guidelines' (including Table 3.5.1, Figure 3.5.1), and AWQG volume 2 (section 8) Comply with Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance, ANZECC.

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Other toxicants for ALL other fresh waters in this table	Aquatic ecosystem—moderately disturbed (MD)	WQOs are as per AWQG, to protect fresh water species at the MD level of protection (identified in AWQG as slightly to moderately disturbed): • Toxicants in water[q]: refer to AWQG section 3.4—'water quality guidelines for toxicants' (including tables 3.4.1, 3.4.2, and Figure 3.4.1), and AWQG volume 2 (section 8) • Toxicants in sediments: refer to AWQG section 3.5—'sediment quality guidelines' (including Table 3.5.1, Figure 3.5.1), and AWQG volume 2 (section 8) Comply with Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance, ANZECC.
Freshwater riparian areas	Aquatic ecosystem—moderately disturbed (MD)	Protect or restore riparian areas. Refer section 3.1.2—riparian WQOs.
Wetlands	Aquatic ecosystem—moderately disturbed (MD)	Objectives as per AWQG and section 3.1.2. Note: 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.
GROUNDWATERS		
Groundwaters	Aquatic ecosystem—high ecological value (HEV)	Where groundwaters interact with surface waters, groundwater quality should not compromise identified EVs and WQOs for those waters. Note: the AWQG (2000) 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). There is insufficient information available to establish WQOs for this water type[p]. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
ESTUARINE AND COASTAL WATERS - listed by Port sub-zones MD2341, 2342, 2343, then waters outside ports (estuarine, enclosed coastal, open coastal) The following WQOs apply to Pioneer River and Plane Creek estuarine and coastal waters within the boundaries shown in plans WQ1251 and WQ1222		
Estuarine and coastal waters	Aquatic ecosystem—all	Release of sewage from vessels to be controlled in accordance with requirements of the *Transport Operations (Marine Pollution) Act 1995* and Regulations. (Refer to Maritime Services Queensland website for further information.)
PORT SUB-ZONES MD2341, 2342, 2343		
Ports: MD2341 Mackay Marina and harbour (within walls), enclosed coastal waters	Aquatic ecosystem—moderately disturbed (MD)	• ammonia N: <15 µg/L[c, n] • oxidised N: <10 µg/L[c, n, s] • dissolved inorganic N: <25 µg/L[b, c] • total N: <160 µg/L[c, n] • filterable reactive phosphorus (FRP): <5 µg/L[c, n] • total P: <20 µg/L[c, n] • chlorophyll a: <2.0 µg/L[n] • dissolved oxygen: 85–105% saturation[e, n] • turbidity: − dry weather: 1–2–8 NTU [z] − wet weather: 5–12–33 NTU [z] • Secchi depth: >1.0 m[n, v] • suspended solids: nd[k, n, v] • pH: 8.1–8.4[n] • temperature: nd[j, k, n] • toxicants: refer to toxicants rows later in this table
Ports: MD2341 Mackay Port open coastal waters (including approved dredge spoil grounds)	Aquatic ecosystem—moderately disturbed (MD)	• particulate N (annual mean): <20 µg/L[m, o] • particulate P (annual mean): <2.8 µg/L[m, o] • chlorophyll a (annual mean): <0.45 µg/L[m, o] • dissolved oxygen: 95–105 % saturation[m] • turbidity: − dry weather: 1–2–8 NTU [z] − wet weather: 5–12–33 NTU [z] • Secchi depth (annual mean): >10 m[m, o, v] • suspended solids (annual mean): <2.0 mg/L[m, o, v] • pH: 8.1–8.4[m] • temperature: < 1° C increase above long term average maximum[o] • toxicants: refer to toxicants rows later in this table Note: there is insufficient information available to establish local WQOs for the following indicators in these waters: ammonia N, oxidised N, dissolved inorganic N, total N, filterable reactive phosphorus, total P. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local WQOs.

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV

Ports: Sandringham Bay MD2342 sub-zone enclosed coastal waters	Aquatic ecosystem—moderately disturbed (MD)	• ammonia N: <15 µg/L[c, n]
		• oxidised N: <10 µg/L[c, n, s]
		• dissolved inorganic N: <25 µg/L[b, c]
		• total N: <160 µg/L[c, n]
		• filterable reactive phosphorus (FRP): <5 µg/L[c, n]
		• total P: <20 µg/L[c, n]
		• chlorophyll a: <2.0 µg/L[n]
		• dissolved oxygen: 85–105% saturation[e, n]
		• turbidity:
		  − dry weather: 1–2–8 NTU [z]
		  − wet weather: 5–12–33 NTU [z]
		• Secchi depth: >1.0 m[n, v]
		• suspended solids: nd[k, n, v]
		• pH: 8.1–8.4[n]
		• temperature: nd[j, k, n]
		• toxicants: refer to toxicants rows later in this table

Ports: MD2343 Hay Point sub-zone enclosed coastal waters	Aquatic ecosystem—moderately disturbed (MD)	• ammonia N: <15 µg/L[c, n]
		• oxidised N: <10 µg/L[c, n, s]
		• dissolved inorganic N: <25 µg/L[b, c]
		• total N: <160 µg/L[c, n]
		• filterable reactive phosphorus (FRP): <5 µg/L[c, n]
		• total P: <20 µg/L[c, n]
		• chlorophyll a: <2.0 µg/L[n]
		• dissolved oxygen: 85–105% saturation[e, n]
		• turbidity:
		  − dry weather: 1–2–8 NTU [z]
		  − wet weather: 5–12–33 NTU [z]
		• Secchi depth: >1.0 m[n, v]
		• suspended solids: nd[k, n, v]
		• pH: 8.1–8.4[n]
		• temperature: nd[j, k, n]
		• toxicants: refer to toxicants rows later in this table

Ports: MD2343 Hay Point sub-zone open coastal waters
(including approved dredge spoil grounds)
		• particulate N (annual mean): <20 µg/L[m, o]
		• particulate P (annual mean): <2.8 µg/L[m, o]
		• chlorophyll a (annual mean): <0.45 µg/L[m, o]
		• dissolved oxygen: 95–105 % saturation[m]
		• turbidity:
		  − dry weather: 1–2–8 NTU [z]
		  − wet weather: 5–12–33 NTU [z]
		• Secchi depth (annual mean): >10 m[m, o, v]
		• suspended solids (annual mean): <2.0 mg/L[m, o, v]
		• pH: 8.1–8.4[m]
		• temperature: < 1° C increase above long term average maximum[o]
		• toxicants: refer to toxicants rows later in this table
		Note: there is insufficient information available to establish local WQOs for the following indicators in these waters: ammonia N, oxidised N, dissolved inorganic N, total N, filterable reactive phosphorus, total P. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local WQOs.

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
WATERS OUTSIDE PORT ZONES MD2341, MD2342, MD2343		
Mid estuary waters in areas HEV2344, 2345, 2346, 2347, 2350, 2353, 2355, 2385	Aquatic ecosystem—high ecological value (HEV)	Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, flow and riparian areas. Note: there is insufficient information available to establish current water quality for these waters. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local 20th, 50th and 80th percentiles.
Mid estuary waters in areas SD2382, 2383, 2384	Aquatic ecosystem—high ecological value (HEV)	Achieve effectively unmodified water quality (20th, 50th and 80th percentiles of HEV waters), habitat, biota, flow and riparian areas. Note: there is insufficient information available to establish WQOs for these waters. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local WQOs.

Mid–estuary waters - outside Ports
(also applies to any marinas, boat harbours, tidal canals, constructed estuaries within this water type/management intent that are outside port sub-zones)
	Aquatic ecosystem—moderately disturbed (MD)	Note: For waters shown on the plan as being mid–estuary (orange colour) and occurring within inter-tidal zone adjacent to the enclosed coastal/lower estuary water type, these waters might have water quality characteristics more in common with the adjacent enclosed coastal/lower estuary water type. Under such circumstances, reference should be made to the WQOs for enclosed coastal/lower estuary water type.
		• ammonia N: <15 µg/L[c, n]
		• oxidised N: <30 µg/L[c, n, s]
		• dissolved inorganic N: <45 µg/L[b, c]
		• organic N: <200 µg/L[c, n]
		• total N: <250 µg/L[c, n]
		• filterable reactive phosphorus (FRP): <5 µg/L[c, n]
		• total P: <20 µg/L[c, n]
		• chlorophyll a: <3.0 µg/L[n]
		• dissolved oxygen: 80-105% saturation[e, n]
		• turbidity: <10 NTU[n]
		• Secchi depth: >1.0 m[n]
		• suspended solids - Cabbage Tree and Louisa Creek subcatchment mid estuaries:
		  − dry weather: 1.1–2.9–5.5 mg/L[y]
		  − wet weather: 7.1–13.0–22.7 mg/L[y]
		• suspended solids - other subcatchment mid estuaries: nd[k, n]
		• pH: 6.5-8.4[n]
		• temperature: nd[j, k, n]

Toxicants for ALL estuarine waters within this table	All	• Cabbage Tree and Louisa Creek subcatchment mid estuaries:
		  − Copper dry weather: <1.6 µg/L[y]
		  − All other toxicants: as per AWQG (see below)
		• Other subcatchment mid estuaries (see below):
		Toxicants in water and sediment as per AWQG (2000):
		• Toxicants in water[q]: refer to AWQG section 3.4—'water quality guidelines for toxicants' (including tables 3.4.1, 3.4.2, and Figure 3.4.1) and AWQG volume 2 (section 8)
		• Toxicants in sediments: refer to AWQG section 3.5—'sediment quality guidelines' (including Table 3.5.1, Figure 3.5.1) and AWQG volume 2 (section 8)
		
		Comply with Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance, ANZECC.

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Estuarine riparian areas	Aquatic ecosystem—moderately disturbed (MD)	Protect or restore riparian areas. Refer section 3.1.2—riparian WQOs.
Enclosed coastal/ lower estuary waters in areas SD2382, 2383, 2384	Aquatic ecosystem—high ecological value (HEV)	Achieve effectively unmodified water quality (20th, 50th and 80th percentiles), habitat, biota, and flow. The 20th, 50th and 80th percentiles to be achieved are: • ammonia N: 7–10–15 µg/L[c, n, u] • oxidised N: 2–4–10 µg/L[c, n, s, u] • total N: 110–120–160 µg/L[c, n, u] • filterable reactive phosphorus (FRP): 2–3–5 µg/L[c, n, u] • total P: 10–15–20 µg/L[c, n, u] • chlorophyll a: 0.8–1.3–2 µg/L[n, u] • dissolved oxygen: 85–90–105 % saturation[n, u] • turbidity: nd[k, v] • Secchi depth: nd[k, v] • suspended solids: nd[k, n, v] • pH: 8.1–8.3–8.4[n, u] • temperature: nd[j, k, n] • toxicants: refer to toxicants rows later in this table
Enclosed coastal/lower estuary waters outside port sub-zones Applies to EC waters outside port sub-zones, and not identified as SD or HEV. Also applies to any marinas, boat harbours, tidal canals, constructed estuaries within this water type/management intent that are outside port sub-zones.	Aquatic ecosystem—moderately disturbed (MD)	• ammonia N: <15 µg/L[c, n] • oxidised N: <10 µg/L[c, n, s] • dissolved inorganic N: <25 µg/L[b, c] • total N: <160 µg/L[c, n] • filterable reactive phosphorus (FRP): <5 µg/L[c, n] • total P: <20 µg/L[c, n] • chlorophyll a: <2.0 µg/L[n] • dissolved oxygen: 85–105% saturation[e, n] • turbidity: <10 NTU[n, v] • Secchi depth: >1.0 m[n, v] • suspended solids: nd[k, n, v] • pH: 8.1–8.4[n] • temperature: nd[j, k, n] • toxicants: refer to toxicants rows later in this table

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Open coastal waters in area HEV2383, seaward of the plume line[t] shown in WQ1222	Aquatic ecosystem—high ecological value (HEV)	Maintain existing water quality (20th, 50th and 80th percentiles), habitat, biota, and flow. The 20th, 50th and 80th percentiles to be maintained are: • ammonia N: 1–2–6 µg/L[x] • oxidised N: 0–0–1 µg/L[x] • particulate N: 14–18–24 µg/L[x] • total dissolved N: 44–74–95 µg/L[x] • total N: 45–90–115 µg/L[x] • filterable reactive phosphorus (FRP): 1–2–4 µg/L[x] • particulate P: 1.6–2.1–3.0 µg/L[x] • total dissolved P: 4–9–18 µg/L[x] • total P: 5–12–21 µg/L[x] • silicate: 41–55–96 µg/L[x] • chlorophyll a (annual mean): ≤ 0.45 µg/L [m, o] • dissolved oxygen: 95%–105% saturation [m] • turbidity: <1 NTU[m] • Secchi depth (annual mean): ≥ 10 m [m, o, v] • suspended solids: 1.1–1.6–2.4 mg/L [r, v] • pH: 8.1–8.3–8.4[m] • temperature: <1°C increase above long-term average maximum[o] • toxicants: refer to toxicants rows later in this table
Offshore waters in area HEV2386 (Tern, Bushy-Redbill and Sandpiper reefs)	Aquatic ecosystem—high ecological value (HEV)	Maintain existing water quality (20th, 50th and 80th percentiles), habitat and biota. The 20th, 50th and 80th percentiles to be maintained are: • ammonia N: 0–2–9 µg/L[x] • oxidised N: 0–1–3 µg/L[x] • particulate N: 11–14–19 µg/L[x] • total dissolved N: 46–63–86 µg/L[x] • total N: 70–85–120 µg/L[x] • filterable reactive phosphorus (FRP): 0–1–3 µg/L[x] • particulate P: 1.4–1.8–2.4 µg/L[x] • total dissolved P: 3–5–9 µg/L[x] • total P: 6–10–15 µg/L[x] • silicate: 18–33–89 µg/L[x] • chlorophyll a (annual mean): ≤ 0.45 µg/L [m, o] • dissolved oxygen: 95%–105% saturation [m] • turbidity: <1 NTU[m] • Secchi depth (annual mean): ≥ 17m[x] • suspended solids: 0.4–0.6–1.1 mg/L [v, x] • pH: 8.1–8.3–8.4[m] • temperature: <1°C increase above long-term average maximum[o] • toxicants: refer to toxicants rows later in this table

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
Open coastal waters in areas SD2382, 2383, 2384, landward of the plume line[t], shown in WQ1222	Aquatic ecosystem—high ecological value (HEV)	Achieve effectively unmodified water quality (20th, 50th and 80th percentiles), habitat, biota, and flow. Note: there is insufficient information available to establish local WQOs for these waters. In the absence of locally derived WQOs, the following apply: • particulate N (annual mean): <20 µg/L[m, o] • particulate P (annual mean): <2.8 µg/L[m, o] • chlorophyll a (annual mean): <0.45 µg/L[m, o] • dissolved oxygen: 95% – 105% saturation[m] • turbidity: <1 NTU[m, v] • Secchi depth (annual mean): >10 m[m, o, v] • suspended solids (annual mean): <2.0 mg/L[m, o, v] • pH: 8.1–8.4[m] • temperature: < 1°C increase above long-term average maximum[o] • toxicants: refer to toxicants rows later in this table Note: there is insufficient information available to establish local WQOs for the following indicators in these waters: ammonia N, oxidised N, dissolved inorganic N, total N, filterable reactive phosphorus, total P. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local WQOs.
Open coastal waters landward of the plume line[t], shown in WQ1222 Includes OC waters outside of port sub-zones and not identified as SD or HEV	Aquatic ecosystem—slightly to moderately disturbed (SMD), mapped as MD	• particulate N (annual mean): <20 µg/L[m, o] • particulate P (annual mean): <2.8 µg/L[m, o] • chlorophyll a (annual mean): <0.45 µg/L[m, o] • dissolved oxygen: 95–105 % saturation[m] • turbidity in open coastal waters between port sub-zones MD2341 and MD2343 and south of Hay Point sub-zone MD2343[z] to parallel of latitude 21° 27’ South (datum: GDA 94) (dry weather): 0.5–1–4 NTU[z] • turbidity (all other OC MD waters): <1 NTU[m, v] • Secchi depth (annual mean): >10 m[m, o, v] • suspended solids (annual mean): <2.0 mg/L[m, o, v] • pH: 8.1–8.4[m] • temperature: < 1° C increase above long term average maximum[o] • toxicants: refer to toxicants rows later in this table Note: there is insufficient information available to establish local WQOs for the following indicators in these waters: • ammonia N, oxidised N, dissolved inorganic N, total N, filterable reactive phosphorus, total P. Refer to QWQG for details on how to establish a minimum water quality data set for deriving local WQOs.

Water area/type (refer plans WQ1251, WQ1222)	Management intent (level of protection)	Water quality objectives to protect aquatic ecosystem EV
COASTAL WATERS – TOXICANTS		
Toxicants for ALL enclosed and open coastal waters in this table, excluding waters in MD2341 - Mackay Port, MD2342 - Sandringham Bay, and MD 2343 - Hay Point Port sub-zones, approved spoil grounds, marinas, boat harbours, tidal canals, constructed estuaries (for ports sub-zones, refer following row)	Aquatic ecosystem—high ecological value (HEV)	WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect marine species at the HEV level of protection[o]: • Ametryn: <0.5 µg/L • Atrazine: <0.6 µg/L • Diuron: <0.9 µg/L • Hexazinone: <1.2 µg/L • Tebuthiuron: <0.02 µg/L • Tributyltin: <0.0004 µg/L WQOs for all other toxicants in these waters as per GBRMPA and AWQG water quality guidelines, to protect marine species at the HEV level of protection. For toxicants not listed in GBRMPA guidelines: • Toxicants in water[q]: refer to AWQG section 3.4—'water quality guidelines for toxicants' (including Tables 3.4.1, 3.4.2, and Figure 3.4.1), and AWQG volume 2 (section 8) • Toxicants in sediments: refer to AWQG section 3.5—'sediment quality guidelines' (including Table 3.5.1, Figure 3.5.1), and AWQG volume 2 (section 8) Comply with Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance, ANZECC.
Toxicants for waters in port sub-zones: • **MD 2341 - Mackay Port** • **MD2342 - Sandringham Bay** • **MD2343 - Hay Point Port** **Approved spoil grounds, marinas, boat harbours, tidal canals, constructed estuaries**	Aquatic ecosystem—moderately disturbed (MD) (pesticides: high ecological value (HEV))	WQOs for pesticides identified in the Mackay Whitsunday WQIP, to protect marine species at the HEV level of protection[o]: • Ametryn: <0.5 µg/L • Atrazine: <0.6 µg/L • Diuron: <0.9 µg/L • Hexazinone: <1.2 µg/L • Tebuthiuron: <0.02 µg/L • Tributyltin: <0.006 µg/L (SMD / 95% species protection) WQOs for all other toxicants in these waters as per as per GBRMPA and AWQG water quality guidelines to protect marine species at the MD level of protection (identified in the AWQG as slightly to moderately disturbed). For toxicants not listed in GBRMPA guidelines: • Toxicants in water[q]: refer to AWQG section 3.4—'water quality guidelines for toxicants' (including tables 3.4.1, 3.4.2, and Figure 3.4.1), and AWQG volume 2 (section 8) • Toxicants in sediments: refer to AWQG section 3.5—'sediment quality guidelines' (including Table 3.5.1, Figure 3.5.1), and AWQG volume 2 (section 8) Comply with Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance, ANZECC.
WATER QUALITY REFERENCE SITES		
Fresh, estuarine, and coastal waters: water quality reference (least disturbed) sites	Aquatic ecosystem—high ecological value (HEV)	For sites identified in the Queensland Water Quality Guidelines, the water quality improvement plan, or by other recognised entities under the EPP Water as reference (least disturbed) sites for water quality monitoring, the management intent is to maintain or achieve effectively unmodified water quality (20th, 50th and 80th percentiles), habitat, biota, and flow.

Notes:

Units:

µg/L = micrograms/Litre; mg/L = milligrams/Litre; µS/cm = microSiemens/centimetre; mg/kg = milligrams/kilogram

LOD = limit of detection, which is currently 0.01 µg/L for all herbicides in this table

a) The values for these indicators are based on the QWQG Mackay Whitsunday sub-regional water quality guidelines, which are derived from values in the Mackay Whitsunday Water Quality Improvement Plan (WQIP). These include objectives for both ambient/baseflow conditions

and high flow ('event') conditions. The event quality objectives are expressed as end of system (e.g. subcatchment) event mean concentrations (EMC). Further details are provided in source documents (refer below).

b) DIN = ammonia N + oxidised N.

c) Ambient (baseflow) nutrient objectives do not apply during high flow events. Refer to 'event/high flow' rows for applicable high flow objectives. See QWQG Section 5 and Appendix D for more information on applying guidelines under high flow conditions.

d) 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 WQOs. Provided that levels of inorganic N (i.e. NH_3 + oxidised N) remain low, then the elevated levels of organic N should not be seen as a breach of the WQOs, provided this is due to natural causes.

e) Dissolved oxygen (DO) objectives 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 waterbody 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.

f) 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.

g) Wallum/tannin-stained waters contain naturally high levels of humic acids (and have a characteristic brown tea-tree stain). In these types of waters, natural pH values may range from 3.6 to 6.

h) During flood events or nil flow periods, pH values should not fall below 5.5 (except in wallum/tannin waters) or exceed 9.

i) Conductivity, under natural conditions, is highly dependent on local geology and soil types. Values in this table are based on QWQG Mackay Whitsunday sub-regional water quality guidelines. In the absence of sub-regional conductivity WQOs, the QWQG (Appendix G) provides information on conductivity values in a set of 18 defined salinity zones throughout Queensland. For each zone, the QWQG provide a range of percentile values based on data from all the sites within that zone. This provides a useful first estimate of background conductivity within a zone. However, even within zones there is a degree of variation between streams and therefore the values for the zone would still need to be ground truthed against local values.

j) Temperature varies both daily and seasonally, it is depth dependent and is also highly site specific. It is therefore not possible to provide simple generic WQOs for this indicator. The recommended approach is that local WQOs be developed. Thus, WQOs for potentially impacted streams should be based on measurements from nearby streams that have similar morphology and which are thought not to be impacted by anthropogenic thermal influences. From an ecological effects perspective, the most important aspects of temperature are the daily maximum temperature and the daily variation in temperature. Therefore measurements of temperature should be designed to collect information on these indicators of temperature and, similarly, local WQOs should be expressed in terms of these indicators. Clearly, there will be an annual cycle in the values of these indicators and therefore a full seasonal cycle of measurements is required to develop guideline values.

k) nd = insufficient or no data, n/a = not applicable for this indicator and water type, ng = no guideline.

l) For Blacks Creek, Cape Creek, Gillinbin Creek and West Hill Creek, current water quality was comparable to adjacent HEV waters. The WQOs for these waters have been set to maintain current water quality (based on QWQG sub-regional guidelines and WQIP).

m) The values for these indicators are based on the QWQG Central Coast regional water quality guidelines.

n) The values for these indicators are based on the QWQG Wet Tropics regional water quality guidelines.

o) The values for these indicators are based on GBRMPA (2010) Water Quality Guidelines for the Great Barrier Reef Marine Park 2010 (refer 'sources' below). For open coastal waters, where single value WQOs are given for Particulate N, Particulate P, chlorophyll a, Secchi and suspended solids, these should be compared to annual mean (rather than median) values. Refer to GBRMPA Water Quality Guidelines for further details. WQOs for coastal water pesticides in this table are based on GBRMPA species protection levels. For Hexazinone there is insufficient data to determine species protection levels. Note that coastal water values for Diazinon, Hexazinone, and Tebuthiuron are based on low reliability guidelines that may be updated with additional information. Refer to GBRMPA Water Quality Guidelines for further details. Also refer to note 'q' re toxicants.

p) Local groundwater WQOs have not been developed for this region.

q) The values for these indicators are based on the AWQG. Under the AWQG, a single set of values is provided for the 'slightly to moderately disturbed' (SMD) level of protection, which is identified in this document as 'moderately disturbed' (MD). The HEV and SMD levels of protection typically correspond to 99% and 95% species protection, respectively. For a small number of toxicants with potential toxicity and bioaccumulation effects, the AWQG identify SMD protection level values corresponding to 99% species protection. For further details on toxicant guidelines, e.g. toxicant species, and variability in relation to water quality characteristics (such as pH, hardness) refer to AWQG.

r) The values for these indicators are based on monitoring data and analysis by GBRMPA. For particulate N and P and SS, values are based on water quality monitoring data (dry and wet season) at Double Cone Island (2005 to 2011). Chl-a values are based on grouped data from Hook Passage, Cid, Henning, Dent Passage and west of Lindeman Island. Turbidity is based on logger data at Double Cone Island (2007 to 2011). For open coastal waters, where single value WQOs are given for Particulate N, Particulate P, chlorophyll a, Secchi and suspended solids, these should be compared to annual mean (rather than median) values.

s) Oxidised N = NO_2 + NO_3. Units for nitrogen indicators are micrograms per litre (µg/L) N.

t) The GBR plume discharge area is derived from combining the high and very high frequency influence areas of river discharges that contain high and very high pollutant loads including of sediment and nutrient. Refer to Devlin *et al* in 'sources' below for more details.

u) The values for these indicators are based on monitoring data and analysis by the department.

v) 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.

w) Macroinvertebrates: WQOs for macroinvertebrates are preliminary. The median value of macroinvertebrate indicators at test sites is to be compared and assessed against the macroinvertebrate values in this table. The values do not apply to waters identified for HEV level of protection/management intent. Values were derived for the 'slightly to moderately disturbed' (SMD) level of protection, which is identified in this document as 'moderately disturbed' (MD). Refer to sources below for monitoring/assessment protocols.
Habitats (i.e. edge, riffle): Edge habitat is located along the stream bank. Riffle habitat is characterised as in a reach with relatively steep, shallow (<0.3 m), fast flowing (>0.2 m/s) and broken water over stony beds.
Sample processing: Samples are identified in the laboratory to family level, except for Chironomidae 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 of macroinvertebrates can change over time. The taxonomy used to calculate these indices are based on those used in determining the SIGNAL 2.iv taxa scores.
Taxa richness: Taxa richness is the number of aquatic macroinvertebrate taxa collected in a sample. Use of taxa richness is based on the premise that with changes in the condition of a site the taxa richness will increase or decrease from 'reference'. Increases or decreases will depend on the nature of the threats that are influencing the ecosystem.
PET taxa richness: PET taxa richness (or EPT) is the number of aquatic macroinvertebrate families collected from three orders of aquatic insects: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). Macroinvertebrates belonging to these three orders are considered to be sensitive to changes in their environment and therefore PET can be used to assess condition.
*SIGNAL Inde*x : The Stream Invertebrate Grade Number - Average Level (SIGNAL) index was developed for the bioassessment of water quality in rivers in Australia. It is calculated by grading each macroinvertebrate family based upon the level of its sensitivity to various pollutants. The grades applied range from 1 (tolerant) to 10 (sensitive) (Chessman, 2003). The SIGNAL score for a sample is calculated by averaging the sensitivity grades of the macroinvertebrate families collected. The version applied here is SIGNAL version 2.iv (Chessman, 2003).
% tolerant taxa, % sensitive taxa: are indices based on the proportion of taxa with a SIGNAL grade that are determined to have 'tolerant' sensitivity grades (SIGNAL grades 1, 2 and 3) and 'sensitive' sensitivity grades (SIGNAL grades 8, 9 and 10) respectively. A change in these may reflect changes in water quality, habitat condition, or other causative factors influencing these indices. The version of SIGNAL grades applied here is SIGNAL version 2.iv.

x) The values for these indicators are based on monitoring conducted from 1985 to 2006, supporting publication by De'ath and Fabricius (2008). Refer to sources below.

y) Based on water quality monitoring data from Salonika and Mick Reedy creek estuaries from 2011 to 2012 (BMA), and analysis by DSITIA.

z) Based on coastal water quality monitoring (continuous turbidity logger data) 2010 to 2012 from sites within and around the ports, including Hay Point, Dudgeon Point, Round Top Island (BMA), and analysis by DSITIA.

Sources:

The following sources contain further background information relevant to WQOs:

ANZECC (1997) Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance.

ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality (AWQG).

Chessman, B (2003) SIGNAL 2 – A Scoring System for Macro-invertebrate ('Water Bugs') in Australian Rivers, Monitoring River Heath Initiative Technical Report number 31, Commonwealth of Australia, Canberra.

De'ath G, Fabricius KE (2008) Water quality of the Great Barrier Reef: distributions, effects on reef biota and trigger values for the protection of ecosystem health. Final Report to the Great Barrier Reef Marine Park Authority. Australian Institute of Marine Science, Townsville. (104 pp.).

Devlin, M, Harkness, P, McKinna, L & Waterhouse, J (2011) Mapping the surface exposure of terrestrial pollutants in the Great Barrier Reef. Report to the Great Barrier Reef Marine Park Authority, August 2010. Australian Centre for Tropical Freshwater Research. Report Number 10/12.

Drewry, J, Higham, W & Mitchell, C (2008) Water quality improvement plan (WQIP). Final report for the Mackay Whitsunday region. Mackay Whitsunday Natural Resource Management Group.

Drewry, J, Higham, W, Mitchell, C Rohde, K, Masters, B & Galea, L (2008) Water quality improvement plan (WQIP). Turning environmental values into water quality objectives and targets. Mackay Whitsunday Natural Resource Management Group.

Drewry, J, Higham, W, Mitchell, C & Rohde, K (2008) Water quality improvement plan (WQIP). Modelling sediment and nutrient exports and management scenarios. Mackay Whitsunday Natural Resource Management Group.

Galea, L, Pepplinkhouse, D, Loft, F & Folkers, A (2008) Mackay Whitsunday Healthy Waterways Baseline Monitoring Program Regional Report. Queensland Department of Natural Resources and Water for the Mackay Whitsunday Natural Resource Management Group, Australia.

Great Barrier Reef Marine Park Authority (2010) Water quality guidelines for the Great Barrier Reef Marine Park 2010, Great Barrier Reef Marine Park Authority, Townsville, available on the Great Barrier Reef Marine Park Authority's website.

Negus P, Steward A and Blessing J (2013). Macroinvertebrate water quality guidelines: Townsville and Mackay-Whitsunday regions. Water Planning Ecology Group, Science Delivery Division. DSITIA, The State of Queensland.

NRM (2001). Australia-wide Assessment of River Health: Queensland AusRivAS Sampling and Processing Manual. Monitoring River Health Initiative Technical Report Number 12. Environment Australia, Canberra.

Queensland Government (2009, as amended) Queensland Water Quality Guidelines. (Refer to section 5 and Appendix D of the QWQG for more detail on compliance assessment protocols.)

Rohde, K, Masters, B, Fries, N, Noble, R & Carroll, C 2008, Fresh and Marine Water Quality in the Mackay Whitsunday Region 2004/05 to 2006/07. Queensland Department of Natural Resources and Water for the Mackay Whitsunday Natural Resource Management Group, Australia.

Schaffelke B, Carleton J, Doyle J, Furnas M, Gunn K, Skuza M, Wright M, Zagorskis I (2011) Reef Rescue Marine Monitoring Program. Final Report of AIMS Activities 2010/11– Inshore Water Quality Monitoring. Report for the Great Barrier Reef Marine Park Authority. Australian Institute of Marine Science, Townsville. (83 p.). Additional years also published accessible for download from GBRMPA.

Transport Operations (Marine Pollution) Act 1995 and Regulations 2008, available on the Office of Queensland Parliamentary Counsel website.

3.1.2 Riparian water quality objectives

For vegetation management relating to waterways, reference should be made to the relevant regional vegetation management codes under the *Vegetation Management Act 1999*. These codes 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 vegetation management code (and other explanatory information) for waters for this area, contact the Department of Natural Resources and Mines website.

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.

3.1.3 Stormwater management design objectives

Stormwater management design objectives for urban development are detailed in the department's Urban Stormwater Quality Planning Guidelines 2010 (as amended). Stormwater quality and flow management design objectives are specified for both the construction and operational phases of development in accordance with landscape features and the regional location of proposed development. The guidelines are available on the department's website.

3.2 Water quality objectives for human use environmental values

This section outlines WQOs to protect human use EVs, which comprise those EVs other than the aquatic ecosystem EV (e.g. recreation, stock watering, aquaculture and crop irrigation). Table 1 of this document outlines the EVs that have been identified for different waters in the catchment. Where a human use EV has been identified, the following tables can be used to identify the WQOs to support that EV. Where Table 1 indicates 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 AWQG and the ADWG[6]. Table 3 outlines human use EVs, applicable water types, and a selection of more commonly used WQOs to support those EVs. Tables 4 to 12 provide further WQOs to protect particular human use EVs (based on national guidelines or other more local studies). 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.

Table 3 Water quality objectives to protect human use environmental values

Environmental value	Water type/area (refer Table 1 and plans WQ1251, WQ1222)	Water quality objectives to protect EV (refer to specified codes and guidelines for full details)
Suitability for drinking water supply	All fresh waters including groundwaters	Local WQOs for drinking water supply are provided in Table 4. Note: For water quality after treatment or at point of use refer to legislation and guidelines, including: • *Public Health Act 2005* and Regulations • *Water Supply (Safety and Reliability) Act 2008*, including any approved drinking water quality management plan under the Act • *Water Fluoridation Act 2008* • ADWG 2011.
Protection of the human consumer for oystering	Estuarine and coastal waters	Objectives as per AWQG and Australia New Zealand Food Standards Code[7], Food Standards Australia New Zealand, 2007 and updates.
Protection of the human consumer	Fresh waters, estuarine and coastal waters	Objectives as per AWQG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, 2007 and updates.
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.
Suitability for industrial use	Fresh waters, estuarine and coastal waters	No WQOs are provided in this scheduling document for industrial uses. Water quality requirements for industry vary within and between industries. The AWQG 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	Objectives as per: • tables 5–7 • AWQG and Australia New Zealand Food Standards Code, Food Standards Australia New Zealand, 2007 and updates.
Suitability for irrigation	All fresh waters including groundwaters	ANZECC objectives for pathogens and metals are provided in tables 8 and 9. For other indicators, such as salinity, sodicity and herbicides, see AWQG.

[6] The AWQG are available on the National Water Quality Management Strategy website.

The ADWG are available on the NHMRC website.

[7] The Australia New Zealand Food Standards Code is available on the Food Standards Australia and New Zealand website.

Environmental value	Water type/area (refer Table 1 and plans WQ1251, WQ1222)	Water quality objectives to protect EV (refer to specified codes and guidelines for full details)
Suitability for stock watering	All fresh waters including groundwaters	Objectives as per AWQG, including median faecal coliforms <100 organisms per 100 mL. WQOs for total dissolved solids and metals are provided in Tables 10 and 11, based on AWQG. For other objectives, such as cyanobacteria and pathogens, see AWQG.
Suitability for farm supply/use	All fresh waters including groundwaters	Objectives as per AWQG.
Suitability for primary contact recreation	Fresh waters, estuarine and coastal waters	Objectives as per NHMRC (2008)[8], including: • 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: − assessment of evidence for the likely influence of faecal material − counts of suitable faecal indicator bacteria (usually *enterococci*) 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.
Suitability for primary contact recreation	Fresh waters	• cyanobacteria/algae: Recreational water bodies should not contain: − level 1[1]: ≥ 10 µg/L total microcystins; or ≥ 50 000 cells/mL toxic *Microcystis aeruginosa*; 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 2[1]: ≥ 10 mm^3/L for total biovolume of all cyanobacterial material where known toxins are not present − cyanobacterial scums consistently present. Further details are contained in NHMRC (2008) and Table 12.
	Estuarine, coastal waters	• cyanobacteria/algae: Recreational water bodies should not contain ≥ 10 cells/mL *Karenia brevis* and/or have *Lyngbya majuscula* and/or *Pfiesteria* present in high numbers[2]. Further details are contained in NHMRC (2008) and Table 12.
Suitability for secondary contact recreation	Fresh waters, estuarine and coastal waters	Objectives as per NHMRC (2008), including: • 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 12.
Suitability for visual recreation	Fresh waters, estuarine and coastal waters	Objectives as per NHMRC (2008), including: • recreational water bodies should be aesthetically acceptable to recreational users. The water should be free from visible materials that may settle to

[8] Guidelines for Managing Risks in Recreational Water are available on the NHMRC website.

Environmental value	Water type/area (refer Table 1 and plans WQ1251, WQ1222)	Water quality objectives to protect EV (refer to specified codes and guidelines for full details)
		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 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 documents, including:

Australian Drinking Water Guidelines (NHMRC, 2011).

Australia New Zealand Food Standards Code (Australian Government: Food Standards Australia New Zealand)

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000).

Guidelines for Managing Risks in Recreational Water (NHMRC, 2008).

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

This table outlines WQOs for water **before treatment**, unless otherwise stated. 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 quality management plan under the Act, *Water Fluoridation Act 2008*, and the Australian Drinking Water Guidelines (ADWG, 2011). Objectives are derived following advice from Mackay Water, Queensland Health and the Queensland Water Supply Regulator.

Indicator	Water quality objective[1]
Giardia	0 cysts (Queensland Water Supply Regulator) If *Giardia* is detected in drinking water then the health authorities should be notified immediately and an investigation of the likely source of contamination undertaken (ADWG).
Cryptosporidium	0 cysts (Queensland Water Supply Regulator) If *Cryptosporidium* is detected in drinking water then the health authorities should be notified immediately and an investigation of the likely source of contamination undertaken (ADWG).
E. coli	<100 cfu/100mL
Enterococci	<100 cfu/100mL Often in large catchments Enterococci is a better indicator of faecal contamination since it is shown to live longer in the environment
Blue-green algae (cyanobacteria)	<10000 cells/mL
Algal toxin	<1 µg/L Microcystin
Turbidity	<30 NTU
Colour	<35 TCU
pH	6.5–8.0
Total hardness	<115 mg/L
Conductivity	<300 µS/cm
Total dissolved solids	ADWG 2011 aesthetic guideline: <600 mg/L
Total organic carbon	<2 mg/L
Sodium	Raw water supply: <25 mg/L[2] 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). Sudden changes in sodium levels in raw water supplies should be advised to Queensland Health, as these can affect medical equipment.
Sulfate	<4 mg/L The concentration of sulfate in drinking water should not exceed 250 mg/L (ADWG, based on taste/aesthetic considerations). ADWG 2011 health guideline: <500mg/L

Indicator	Water quality objective[1]
Dissolved oxygen	>80 % saturation
Pesticides	<0.1 µg/L for an individual compound <1.0 µg/L combined total for all compounds
Nitrite	<0.2 mg/L
Nitrate	<1.0mg/L
Chloride	<40 mg/L
Phosphate	<0.3 mg/L
Iron	<0.8 mg/L
Manganese	<0.06 mg/L
Other indicators (including physico-chemical indicators)	Refer to ADWG

Notes:

1. All values are based on advice/historical data provided by Mackay Water, except where otherwise indicated.

2. Sudden changes in sodium levels impact on medical equipment use, operation and calibration. Queensland Health should be advised of any such changes. 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 '*water authorities are strongly encouraged to keep sodium concentrations as low as possible*'. 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). The US EPA (2012 Drinking Water Standards and Health Advisories) health based value for sodium is 20 mg/L (for individuals on a 500 mg/day restricted sodium diet).

Source: Mackay Water, Qld Health, Queensland Water Supply Regulator, Australian Drinking Water Guidelines (NHMRC, 2011)

Table 5 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	>100 mg/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 6 Aquaculture EV: Water quality objectives for optimal growth of particular species in fresh water

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 ºC	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		<1.0mg/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 ºC	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 7 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 8 Irrigation EV: Water quality objectives for thermotolerant (faecal) coliforms in irrigation waters used for food and non-food crops[1]

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 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[1]—long-term trigger value (LTV), short-term trigger value (STV) and soil cumulative contamination loading limit (CCL)

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.

Table 10 Stock watering EV: Water quality objectives for tolerances of livestock to total dissolved solids (salinity) in drinking water[1]

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 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 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 levels in the diet are low.

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

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

When cyanobacteria are present in large numbers they can present a significant hazard, particularly to primary contact users of waters. Water quality objectives for cyanobacteria in recreational waters are provided in Table 3. Monitoring/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.

Green level surveillance mode[1]	Amber level alert mode[1]	Red level action mode[1]
Fresh waters		
≥ 500 to <5000 cells/mL *M. aeruginosa* 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 *M. aeruginosa* 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 *M. aeruginosa* 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		
Karenia brevis		
≤ 1 cell/mL	> 1– < 10 cells/mL	≥ 10 cells/mL
Lyngbya majuscula, Pfiesteria spp.		
History but no current presence of organism	Present in low numbers	Present in high numbers. (For *Lyngbya majuscula* this involves the relatively widespread visible presence of dislodged algal filaments in the water and washed up onto the beach)
Nodularia spumigena: See NHMRC, Chapter 6 (Cyanobacteria and algae in fresh water) for details.		

Notes:

1. 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):

   a. **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.

   b. **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.

   c. **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 (mycrocystins, 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).

4 Ways to improve water quality

The following documents are relevant in considering ways to improve water quality in the Pioneer River and Plane Creek basins. The document list below is additional to the plans, guidelines and other sources referred to in previous sections, **and is provided for information only**.

Local plans, studies

- Council planning scheme and supporting codes, policies, available from relevant council websites.

Regional plans, studies

- Mackay, Isaac and Whitsunday Regional Plan, Queensland Government, February 2012, available from the Department of State Development, Infrastructure and Planning.
- Drewry, J, Higham, W, Mitchell, C 2008, Water quality improvement plan (WQIP). Final report for the Mackay Whitsunday region. Mackay Whitsunday Natural Resource Management Group (Reef Catchments).

State plans, policies, guidelines, agreements etc

- State Planning Policy 4/10: Healthy Waters, available from the department's website.
- Urban Stormwater Quality Planning Guidelines (Queensland Government), available from the department's website.
- Queensland Water Quality Guidelines (QWQG), available from the department's website.
- Water Resource (Pioneer Valley) Plan 2002, available from the Office of Queensland Parliamentary Counsel website, and supporting documents available from the Department of Natural Resources and Mines website.
- Monitoring and Sampling Manual, available from the department's website.
- Reef Water Quality Protection Plan, Australian and Queensland Governments, available from the Reef Water Quality Protection Plan's website.

Other supporting technical information – riparian management

- Managing riparian widths to achieve multiple objectives, fact sheet 13, Land and Water Australia, Australian Government, 2004.
- Improving water quality, fact sheet 3, Land & Water Australia, Australian Government, 2002.
- Riparian Land Management Technical Guidelines—Volume 1 and 2, November 1999, Land and Water Resources Research and Development Corporation (LWRRDC).
- Guidelines for Queensland Streambank Stabilisation with Riparian Vegetation, CRC for Catchment Hydrology, September 1999.
- Restoration of Fish Habitats—Fisheries Guidelines for Marine Areas, FHG002, available from the Department of Agriculture, Fisheries and Forestry.
- Fisheries Guidelines for Fish Habitat Buffer Zones, FHG003, available from the Department of Agriculture, Fisheries and Forestry.
- Guidelines for Riparian Filter Strips for Queensland Irrigators, CSIRO Land and Water, September 1999.

5 Dictionary

AMTD means the adopted middle thread distance which is the distance in kilometres, measured along the middle of a watercourse, that a specific point in the watercourse is from the watercourse's mouth or junction with the main watercourse (definition based on Water Regulation 2002).

ANZECC means the Australian and New Zealand Environment and Conservation Council.

Aquatic ecosystems (defined in the AWQG) comprise the animals, plants and micro-organisms that live in water, and the physical and chemical environment and climatic regime in which they interact. It is predominantly the physical components (e.g. light, temperature, mixing, flow, habitat) and chemical components (e.g. organic and inorganic carbon, oxygen, nutrients) of an ecosystem that determine what lives and breeds in it, and therefore the structure of the food web. Biological interactions (e.g. grazing and predation) can also play a part in structuring many aquatic ecosystems.

ARMCANZ means the Agriculture and Resource Management Council of Australia and New Zealand.

Basin means the basin name and number provided by Geoscience Australia, Canberra (3rd edition, 2004).

Biological integrity, of water, means the water's ability to support and maintain a balanced, integrative, adaptive community of organisms having a species composition, diversity and functional organisation comparable to that of the natural habitat of the locality in which the water is situated.

Biotoxin (defined in the AWQG): means a toxin (poison) which originates from a living thing (a plant, animal, fungi, bacteria, etc).

Catchment means the total area draining into a river, creek, reservoir or other body of water. The limits of a given catchment are the heights of land (such as hills or mountains) separating it from neighbouring catchments. Catchments can be made up of smaller subcatchments.

Ecological health (defined in the AWQG) means the 'health' or 'condition' of an ecosystem. It is the ability of an ecosystem to support and 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 within a region (also termed ecological integrity).

Environmental value (EV) means:

(a) a quality or physical characteristic of the environment that is conducive to ecological health or public amenity or safety; or

(b) another quality of the environment identified and declared to be an environmental value under an Environmental Protection Policy or Regulation (e.g. water suitable for swimming in or drinking).

The EVs for water that can be identified for protection are outlined in Table 13.

Highest astronomical tide (HAT) (defined in Marine Parks (Declaration) Regulation 2006) means the highest level of the tides that can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.

High water mark (defined in *Coastal Protection and Management Act 1995*) means the ordinary high water mark at spring tides.

Mean high water spring refer high water mark.

Queensland waters (as defined in *Acts Interpretation Act 1954*): means all waters that are a) within the limits of the State; or b) coastal waters of the State.

Sub-basin means part of a basin.

Subcatchment means part of a catchment.

Toxicant (defined in the AWQG): means a chemical capable of producing an adverse response (effect) in a biological system at concentrations that might be encountered in the environment, seriously injuring structure or function or producing death. Examples include pesticides, heavy metals and biotoxins.

Table 13 Suite of environmental values that can be chosen for protection

Environmental values and definitions	ICON (as shown on plans)
Aquatic ecosystem 'A community of organisms living within or adjacent to water, including riparian or foreshore area.' (EPP (Water), schedule 2 - Dictionary) The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways and riparian areas, for example, biodiversity, ecological interactions, plants, animals, key species (such as turtles, platypus, seagrass and dugongs) and their habitat, food and drinking water. Waterways include perennial and intermittent surface waters, groundwaters, tidal and non-tidal waters, lakes, storages, reservoirs, dams, wetlands, swamps, marshes, lagoons, canals, natural and artificial channels and the bed and banks of waterways. (This EV incorporates the 'wildlife habitat' EV used in the South East Queensland Regional Water Quality Management Strategy). See below for more details on aquatic ecosystems, based on the EPP (Water).	
High ecological/conservation value waters 'Waters in which the biological integrity of the water is effectively unmodified or highly valued.' (EPP (Water), schedule 2)	None
Slightly disturbed waters 'Waters that have the biological integrity of high ecological value waters with slightly modified physical or chemical indicators but effectively unmodified biological indicators.' (EPP (Water), schedule 2)	None
Moderately disturbed waters 'Waters in which the biological integrity of the water is adversely affected by human activity to a relatively small but measurable degree.' (EPP (Water), schedule 2)	None
Highly disturbed waters 'Waters that are significantly degraded by human activity and have lower ecological value than high ecological value waters or slightly or moderately disturbed waters.' (EPP (Water), schedule 2)	None
Seagrass (goal within the aquatic ecosystem EV) Maintenance or rehabilitation of seagrass habitat. (Applies only to tidal waterways.)	

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Environmental values and definitions	ICON (as shown on plans)
Irrigation Suitability of water supply for irrigation, for example, irrigation of crops, pastures, parks, gardens and recreational areas.	
Farm water supply/use Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.	
Stock watering Suitability of water supply for production of healthy livestock.	
Aquaculture Health of aquaculture species and humans consuming aquatic foods (such as fish, molluscs and crustaceans) from commercial ventures.	
Human consumers of aquatic foods Health of humans consuming aquatic foods, such as fish, crustaceans and shellfish from natural waterways. Note that in some areas oystering is a more specific goal identified under the human consumer EV (see below).	
Oystering (goal within the EV of human consumers of aquatic foods) Health of humans consuming oysters from natural waterways and commercial ventures. (Applies only to tidal waterways.)	
Primary recreation Health of humans during recreation which involves direct contact and a high probability of water being swallowed, for example, swimming, surfing, windsurfing, diving and water-skiing. Primary recreational use, of water, means full body contact with the water, including, for example, diving, swimming, surfing, waterskiing and windsurfing. (EPP (Water), s. 6).	
Secondary recreation Health of humans during recreation which involves indirect contact and a low probability of water being swallowed, for example, wading, boating, rowing and fishing. Secondary recreational use, of water, means contact other than full body contact with the water, including, for example, boating and fishing. (EPP (Water), s. 6).	
Visual recreation Amenity of waterways for recreation which does not involve any contact with water—for example, walking and picnicking adjacent to a waterway. Visual recreational use, of a water, means viewing the water without contact with it. (EPP (Water), s. 6).	
Drinking water supply Suitability of raw drinking water supply. This assumes minimal treatment of water is required, for example, coarse screening and/or disinfection.	

Environmental values and definitions	ICON (as shown on plans)
Industrial use Suitability of water supply for industrial use, for example, food, beverage, paper, petroleum and power industries, mining and minerals refining/processing. Industries usually treat water supplies to meet their needs.	
Cultural and spiritual values Indigenous and non-indigenous cultural heritage, for example: • custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities • symbols, landmarks and icons (such as waterways, turtles and frogs) • lifestyles (such as agriculture and fishing). Cultural and spiritual values, of water, means its aesthetic, historical, scientific, social or other significance, to the present generation or past or future generations. (EPP (Water), s. 6).