Sunshine Coast COUNCIL | Sunshine Coast AIRPORT

VOLUME B

AIRPORT AND SURROUNDS

(CHAPTERS 9–18)

B9

AIRPORT AND SURROUNDS

AQUATIC ECOLOGY

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GLOSSARY

Assemblages	A group of associated animals found together in a given stratum.
Aquatic	Relating to water, for the purpose of this chapter refers to freshwater ecosystems only.
BoT	Back-on-Track species priority framework.
Confluence	Where two or more streams or rivers merge.
Dissolved oxygen	A relative measure of the amount of oxygen that is dissolved in water.
Electrical conductivity	A measure of how strongly a material accommodates the flow of an electric current.
Electrofishing	Scientific survey method used to sample fish populations that relies on electricity to temporarily stun fish.
EMP	Environmental Management Plan.
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999.*
EVNT	Endangered, Vulnerable or Near Threatened species under the *Nature Conservation Act 1992*.
Family	A taxonomic rank fitting between Order and Genus; a group of related Genera.
ISQG	Interim Sediment Quality Guidelines
Macroinvertebrate	An animal lacking a backbone, visible to the naked eye and retained by 0.595 mm sieve.

AQUATIC ECOLOGY

Macrophyte	An aquatic plant that grows in or near water and is either emergent, submerged or floating.
MNES	Matters of National Environmental Significance as defined under the *Environment Protection and Biodiversity Conservation Act 1999*
NC Act	*Nature Conservation Act 1992.*
pH	A measure of acidity in an aqueous solution.
Riparian	The interface area between land and a water body.
SCA	Sunshine Coast Airport
Stream order	A number which designates the relative position of a stream in a drainage basin network ranked from headwaters to river terminus.
Taxon	A taxonomic category, such as a species or Genus.
Tributary	A stream that flows to a larger stream or other body of water.
Turbidity	Cloudiness of a fluid caused by suspended solids.

9.1 INTRODUCTION

This report addresses the environmental values associated with freshwater ecosystems and the associated aquatic flora and fauna communities on the Sunshine Coast Airport (SCA) site (the Project), exclusive of surface water quality.

In accordance with Section 5.2.4 of the Sunshine Coast Airport Expansion Project Terms of Reference (Queensland Government 2012) this Chapter covers the following:

- A description of environmental values
- Desktop investigations and collation of existing information relating to the environmental values of the waterways within the Project Area
- Baseline field surveys of aquatic ecosystems (physical condition, aquatic flora, macroinvertebrates, fish, sediment quality, in situ surface water quality)
- Impact assessment and mitigation measures for the Project.

In this report the Project area is the area within the proposed airport expansion as represented in **Figure 9.1a**.

9.2 METHODS

The methods used for the collection of baseline aquatic data and the assessment of the potential impacts of the Project on aquatic values are summarised below.

9.2.1 Field surveys

9.2.1.1 Sampling site selection

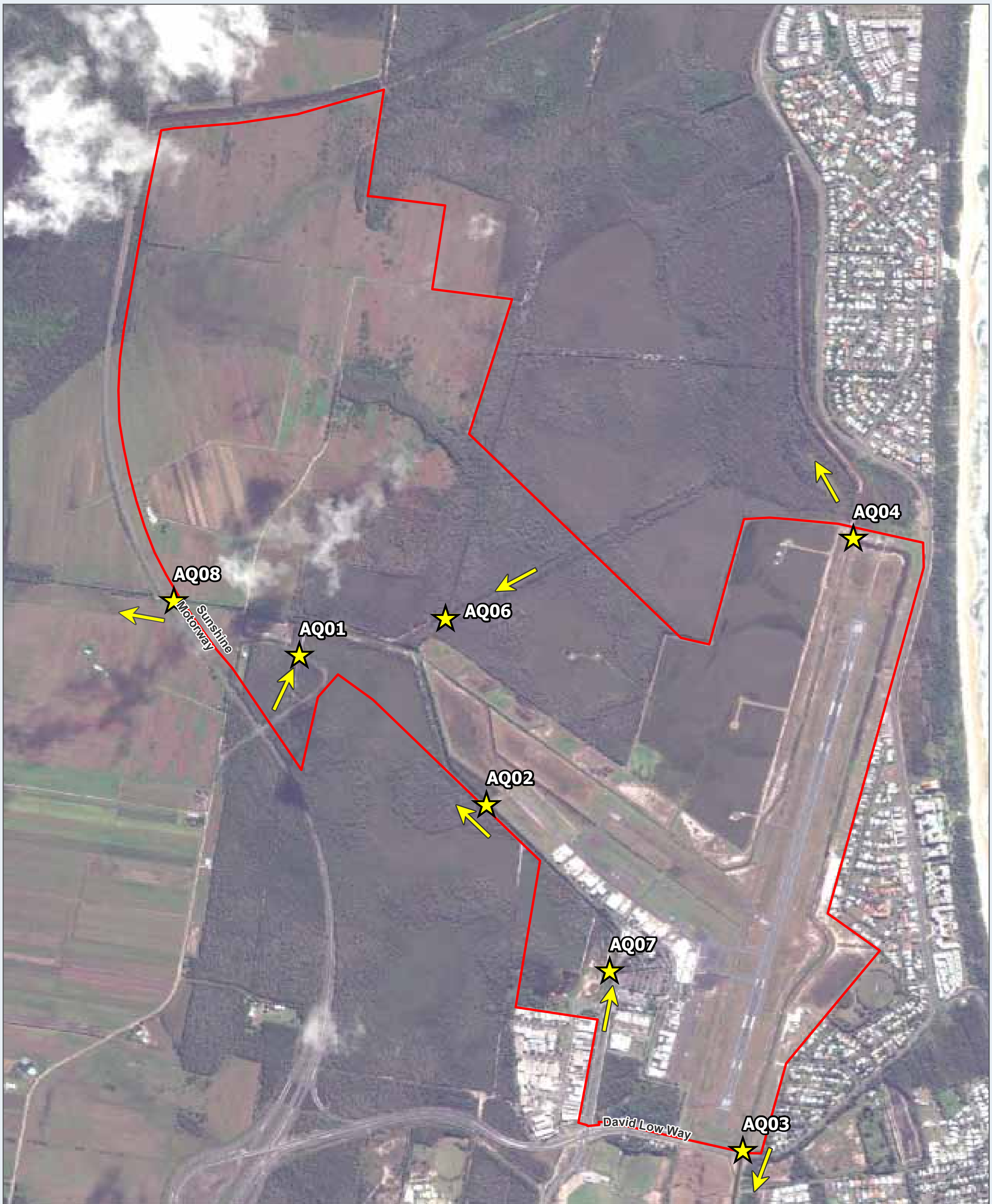
Aquatic environments and associated values across the Project area are highly modified and relatively homogenous. Permanent drains, drainage channels and semi-permanent wetlands comprise the aquatic systems at the site.

Sampling sites were chosen based on:

- Potential for high quality aquatic habitat to be present
- Influences of existing and proposed airport infrastructure, including drains
- Areas representative of aquatic habitat across the proposed Project area and adjacent areas
- Potential to sustain key species of conservation interest (Oxleyan Pygmy Perch (*Nannoperca oxleyana*) and Honey Blue-eye (*Pseudomugil mellis*) identified in previous studies near the Project area
- Physical access and location within the Project area.

Having met the above criteria, it was desirable to select sites as close as practical to the upstream and downstream boundaries of the Project area.

Figure 9.1a: Project area



SUNSHINE COAST AIRPORT - 6613130198 - Airport Expansion EIS Chapter

PROJECT OVERVIEW

WORK REQUEST NUMBER:

DATA SOURCES:
Physical Road Network © State of Queensland 2010
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
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LEGEND

- Flow direction
- Sites
- Project area

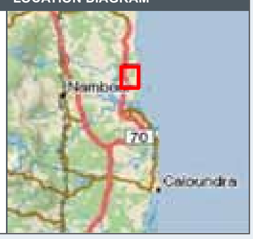
ISSUE DATE	AUTHOR	QA CHECK	APPROVED	MAP REV.	REVISION NOTE
03/07/2014	JH	TH	TH	0	Issued for Use
17/10/13	JH	TH	TH	A	Issued for Review

amec

N

0 100 200
Metres
1:12,500
(A3) GCS GDA 1994

LOCATION DIAGRAM



9.2.1.2 Physical condition of the sampling sites

Instream habitat, substrate, riparian habitat, stream stability and riparian health were assessed using Australian Rivers Assessment System (AusRivAS) protocols (DNRM 2001), and included:

- Channel dimensions
- Substrate description
- Habitat attributes
- Canopy cover and shading
- Instream woody habitat
- Substrate embeddedness
- Width of riparian zone
- Riparian composition.

9.2.1.3 In-situ water quality

Physico-chemical water quality parameters were assessed in situ using a TPS 90FL series multiprobe water quality instrument following the Queensland Water Quality Sampling Manual (1999) methods. The measured parameters included pH, electrical conductivity, turbidity, water temperature and dissolved oxygen.

9.2.1.4 Sediment quality

Sediment sampling was undertaken using the standardised techniques prescribed in the Monitoring and Sampling Manual 2009 V2 (DEHP 2013) and AS/NZS 5667:12 (1999).

At each of the seven aquatic ecology sites, sediment samples were collected from approximately 10 locations within the creek/drain channel (stratified sampling) using a stainless steel trowel to a depth of approximately 50 mm. The samples were mixed in a bucket to form a composite sample and approximately 500 grams was placed into an acid washed glass jar and placed on ice for transport to the laboratory.

The following analyses were undertaken:

- Moisture content
- Metals suite (Al, As, Ba, Cd, Cr, Co, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se, Sb)
- Total nitrogen, total phosphorus
- Total petroleum hydrocarbons (C_6–C_{36}).

Following collection, samples were kept on ice and in the dark prior to being transported to the NATA accredited laboratory facility operated by Symbio Alliance.

9.2.1.5 Aquatic Macroinvertebrates

Macroinvertebrate samples were collected using standard field protocols outlined in the AusRivAS Queensland Field Manual (DNRM 2001), a commonly accepted Australian methodology for aquatic macroinvertebrate assessments. AusRivAS utilises regional models to statistically compare observed invertebrate assemblages at test sites with those expected at comparable but pristine reference sites.

AusRivAS field sampling conventions were followed, including:

- A 250 µM mesh triangular net (250 x 250 x 250 mm) was used to collect kick samples along a 10 m transect at each site, starting from “downstream” and working “upstream”
- Where possible, two habitat types, edge and pool bed, were sampled at each site. Riffle, run and macrophyte habitats were absent at all sites, and not sampled. ‘Gleaning’ of rocks was performed where appropriate, although few rocks were present at any of the sites.

Samples were “live picked” in the field following AusRivAS protocols, including:

- Samples were initially picked for 10 minutes to collect the most abundant and/or visible animals with a maximum of 10 examples of each taxon being collected
- Samples were picked for a further 20 minutes, concentrating on less common or more cryptic taxa. Again, collection of a particular taxon ceased once 10 animals were collected
- A further 10 minutes picking was performed on each sample and picking ceased if no new taxa were found; otherwise the process continued in 10 minute blocks either until no new taxa were found or the total time elapsed was 60 minutes
- Macroinvertebrates were preserved in ethanol whilst on site
- Macroinvertebrate assemblages in the preserved samples were identified and counted at the family level by qualified taxonomists.

9.2.1.6 Fish

Based on an assessment of the aquatic habitats on site, the use of unbaited box traps and electrofishing were considered the most appropriate approach to assessing fish assemblages.

Electrofishing surveys were undertaken at each site using a Smith-Root electrofisher backpack to shock suitable habitat for a total of 1200 seconds “power on” time at each site, enabling catch per unit effort to be considered if required. The electrofisher waveform was adjusted during each survey to optimise the electric field to the ambient conditions and the size and species of the fish that were most frequently being stunned. Captured fish were netted and placed in a bucket with an approved anaesthetic to minimise stress.

Ten unbaited box traps (45 × 25 × 25 cm) were deployed at each site for a minimum of two hours. Traps were positioned near available in-stream habitat (e.g. in-stream wood, draping aquatic vegetation, or in-stream aquatic macrophytes).

9.2.1.7 Macrocrustaceans

Macrocrustaceans were surveyed using various techniques utilised for surveying macroinvertebrates and fish (**Section 9.5.7** and **Section 9.5.9**), as well as targeted visual inspections of the sites for the presence of additional crustaceans not collected by other methods (e.g. crayfish, yabbies).

9.2.2 Impact assessment

Potential impacts of the Project on freshwater ecosystem values have been identified in the context of activities that will be undertaken during the construction, operation, maintenance and decommissioning phases of the Project. The potential significance of these impacts has been quantified as a function of the sensitivity of freshwater aquatic values and the magnitude of the impact, using the matrix shown in **Table 9.2a**.

The resultant significance rankings are described here:

- **Very High Impacts** are permanent, irreversible or very long term, over widespread areas. Environmental receptors are extremely sensitive and/or the impacts are of national significance.
- **High Impacts** are permanent, long or medium term over medium to large scale areas. Environmental receptors are moderate to highly sensitive and/or the impacts are of State significance.
- **Moderate Impacts** may be short to long term, and may be localised or medium scale. Environmental receptors are moderately sensitive and/or the impacts are of local to regional significance.
- **Minor Impacts** are short term, temporary and at the local scale.
- **Negligible Impacts** are those that are beneath the level of detection, within normal limits of variation or within the limits of forecasting error.

9.2.2.1 Significance criteria for aquatic ecosystem values

Table 9.2b shows the criteria used to assign significance rankings to freshwater ecosystems within the Project area.

9.3 ASSUMPTIONS AND TECHNICAL LIMITATIONS

9.3.1 Scope of works

This chapter describes and provides a baseline for only the freshwater aquatic ecosystems across the Project area. Studies for estuarine and marine habitats are detailed in Chapter B10 – Marine Ecology.

Similarly the aquatic macrophytes in this report detail the instream macrophytes across the Project area and emergent macrophyte species for the sites sampled. Further details concerning the occurrence of emergent macrophytes generally across the Project area are provided in Chapter B7 – Terrestrial Flora dealing with vegetation communities.

Vertebrates such as frogs and mammals that are dependent on freshwater waterbodies in the Project area are addressed in Chapter B8 – Terrestrial Fauna of this EIS.

9.3.2 Site selection

All reasonable attempts were made to identify permanent water bodies in the densely vegetated north-western section of the Project area but due to the nature of the vegetation it is possible that small permanent swamps may have not been detected. If such sites exist, they are likely to be disconnected from other waterways except during flooding across the site.

9.4 POLICY CONTEXT AND LEGISLATIVE FRAMEWORK

Primary relevant Commonwealth, Queensland State and local government legislation, plans and policies managing potential impacts to the aquatic environment in the Project area are summarised below.

The two acts of relevance for aquatic communities for the Project are the EPBC Act which protects MNES and the NC Act which addresses matters of State significance.

Table 9.2a: Significance impact assessment matrix for aquatic ecosystems within the Project area

		Significance of Impact				
		Negligible	**Minor**	**Moderate**	**High**	**Very High**
Likelihood Of Impact	**Highly Unlikely**	Negligible	Negligible	Low	Medium	High
	Unlikely	Negligible	Low	Low	Medium	High
	Possible	Negligible	Low	Medium	Medium	High
	Likely	Negligible	Medium	Medium	High	Extreme
	Almost Certain	Low	Medium	High	Extreme	Extreme

Table 9.2b: Significance criteria assigned to aquatic ecosystems within the Project area

Significance	Description
Very high	This impact is critical to the decision making process. Aquatic habitat/communities/processes are pristine and/or support Matters of National Environmental Significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or world heritage listed areas, contains or adjacent to a Ramsar wetland, support a high value commercial or recreational fishery or support a high value ecotourism industry.
High	This impact is important to the decision making process. Aquatic habitat/communities/processes are in good health and/or support Endangered, Vulnerable or Near Threatened (EVNT) species listed under the *Nature Conservation Act 1992* (NC Act), contain or are adjacent to systems listed in the Directory Of Important Wetlands, support a commercial or recreational fishery or support an ecotourism industry.
Medium	This impact is relevant to the decision-making process. Aquatic systems/communities/processes are moderately impacted and/or contain key habitat for Back-on-Track (BoT) or locally relevant species, locally or regionally significant wetland systems, tracts of remnant aquatic habitat, marginal commercial or recreational fishing values or marginal ecotourism usage.
Minor	This impact is within acceptable limits and is unlikely to affect decision making. Aquatic systems/communities/processes are highly disturbed or modified and do not contain key habitat for aquatic species of notable conservation significance. Aquatic habitat is marginal and the systems do not support commercial or recreational fisheries or provide ecotourism opportunities.
Negligible	This impact is unlikely to be noticeable and will not affect decision making. Aquatic systems and processes are heavily modified, impacted or are man-made. They do not support aquatic species, communities or habitat of conservation, commercial or recreational value.

In the absence of local guidelines, sediment analyte concentrations are deferred to the ANZECC/ARMCANZ Interim Guidelines (2000).

9.4.1 *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth Department of the Environment (DoE) administers the EPBC Act. The EPBC Act promotes the conservation of biodiversity by providing protection for listed MNES. Lists of protected species and communities are contained within the EPBC Act. The MNES listed in the EPBC Act potentially relevant to this assessment are:

- Threatened ecological communities
- Threatened flora and fauna species
- Migratory and/or marine species.

In conducting an aquatic flora and fauna impact assessment it is necessary to assess the presence or likelihood of the presence of any MNES, including species or communities listed under the EPBC Act, in the vicinity of the Project area through database searches and field surveys. If listed species or communities are present, or are likely to be present, an assessment of the level of impact needs to be made. Assessments of significance are undertaken by addressing the EPBC Act Significant Impact Guidelines (Version 1.1) for the protection category of the species.

A referral to DoE was required to confirm whether the action was a Controlled Action or not prior to the initiation of the EIS process. Referrals require the support of an assessment covering the impacts on a MNES. Following the assessment of the referral documentation, DoE determined the Project was declared 'a Controlled Action' under the EPBC Act.

9.4.2 *Nature Conservation Act 1992*

The NC Act is the principal legislation which establishes a framework for the identification, gazettal and management of protected areas (such as National Parks) and the protection of native flora and fauna (protected wildlife) listed under the *Nature Conservation (Wildlife) Regulation 2006* (NC Regulation). The NC Act is administered by the Queensland Department of Environment and Heritage Protection (DEHP).

All native flora and fauna species are protected under the NC Act. Where a project is proposed to result in a 'take' of protected wildlife, a permit is required from the DEHP subject to specific exemptions. 'Take' is defined under the NC Act in relation to fauna as:

- Hunting; shooting; wounding; killing; skinning; poisoning; netting; snaring; spearing; trapping; catching; dredging for; bringing ashore or aboard a boat; pursuing; luring; injuring; or harming the animal or any attempt to do so.

In relation to flora, it is defined as:

- Gathering; plucking; cutting; pulling up; destroying; digging up; felling; removing; or injuring the plant or any part of the plant or attempt to do any of these acts.

The permit involves the lodgement of an application form stating information such as the size of the area to be cleared, vegetation type to be cleared and reason for clearing. The DEHP may also require offsets to be established.

The NC Regulation classifies native flora and fauna species into the eight following categories:

- Extinct in the Wild
- Endangered
- Vulnerable
- Rare
- Near Threatened
- Least Concern
- International
- Prohibited.

The NC Regulation also states the declared management intent and the principles to be observed in any taking of or destruction for each group.

9.4.3 ANZECC/ARMCANZ Interim Sediment Guidelines

The availability of sediment bound metals to organisms is complex, particularly in relation to the remobilisation of sediment bound contaminants into the water column and aquatic food webs. A detailed analysis of how the toxicity threshold values for sediment contaminants were derived and their limitations is presented in Chapter 8 of the ANZECC/ARMCANZ Guidelines (2000). As noted in these guidelines, there is a great degree of uncertainty with the application of the interim trigger values in the Australian context, due to a general lack of information based on Australian organisms.

Two Interim Sediment Quality Guidelines (ISQG) are provided, based on total metal levels (dry weight). These are the ISQG Low Value Guideline (trigger for further investigation) and the ISQG High Value Guideline. In practical terms, these levels can be considered as an indication of the degree of risk from toxic effects (refer **Table 9.4a**).

9.5 DESCRIPTION OF EXISTING CONDITIONS

9.5.1 Database searches

Relevant environmental databases have been searched to determine potential environmental values associated with aquatic systems at the Project area, as outlined below.

9.5.1.1 EPBC Act protected matters report

A protected matters report was generated from the EPBC Act database using a 10 km buffer from the centre of the Project area (26°35’51”S, 153°05’12”E) (**Appendix B9:C**).

Only one of the 61 listed species identified by the EPBC Act protected matters search as potentially present in the Project area was a freshwater aquatic species: Mary River Cod (*Maccullochella peeli mariensis*), which does not occur naturally (and is unlikely to have been translocated) within the Project area.

Of the 61 species listed as migratory species of concern, none were freshwater aquatic species.

9.5.1.2 Wildlife online database

A search of the Wildlife Online database (search details in **Appendix B9:C**) returned a list of 4023 recorded species within a 25 km radius of the Project area (26°35’51”S, 153°05’12”E), 22 of which were freshwater bony fish. Of these species, two were classified as EVNT species, the Oxelyean Pygmy Perch (*Nannoperca oxleyana*) and the Honey Blue-eye (*Pseudomugil mellis*), both of which are likely to be found in the vicinity of the Project area. Consequently, sampling sites were selected to present an accurate indication of the presence of these species.

Table 9.4a: ANZECC/ARMCANZ Interim Sediment Quality Guidelines (2000) for selected metals

Parameter	Units (dry weight)	ANZECC/ARMCANZ (2000) Interim Sediment Guideline – Aquatic Ecosystems Effects Value	
		ISQG-Low (trigger)	ISQG-High
Arsenic (As)	mg/kg	20	70
Cadmium (Cd)	mg/kg	1.5	10
Copper (Cu)	mg/kg	65	270
Chromium (Cr)	mg/kg	80	370
Lead (Pb)	mg/kg	50	220
Mercury (Hg)	mg/kg	0.15	1
Nickel (Ni)	mg/kg	21	52
Antimony (Sb)	mg/kg	2	25
Zinc (Zn)	mg/kg	200	410

9.5.1.3 Back-on-track listed species

The BoT species prioritisation framework is an initiative of the DEHP that:

- Prioritises Queensland's native species to guide conservation management and recovery
- Enables the strategic allocation of limited conservation resources for achieving greatest biodiversity outcomes
- Increases the capacity of government, NRM bodies and communities to make informed decisions by making information widely accessible.

The BoT prioritisation framework for South East Queensland lists seven freshwater fish species, of which two species, the Oxelyean Pygmy Perch (*Nannoperca oxleyana*) and the Honey Blue-eye (*Pseudomugil mellis*) are listed as of critical importance, and a single species the Ornate Rainbowfish (*Rhadinocentrus ornatus*) classified as being of high importance. As the range of these species means that they may be present within the Project area, sampling sites were specifically selected to present an assessment of their likely utilisation of waterways at the site. The remaining four BoT species were deemed highly unlikely to be present within the Project area due to their distributional ranges and particular habitat requirements (marine or estuarine).

9.5.2 Site locations

The area encompassing the current airport and the proposed airport expansion is composed of low lying coastal swamp, which has been largely drained and the natural waterways channelised. DEHP's Map of Referrable Wetlands shows palustrine wetlands (vegetated swamps) over much of the currently vegetated areas of the Project area. However, no wetlands of international significance (Ramsar wetlands) or wetlands of national importance are present within or adjacent the Project area.

These wetlands (as noted in Chapter B10 – Marine Ecology) are also mapped on Matters of State Environmental Significance. As this chapter will describe, the aquatic habitat on airport is of a poor quality.

On-site examination of the current drainage lines (**Figure 9.1a**) revealed that the flow direction of waterways is variable. The waterways in the north-east of the Project area flowed in either a northerly direction to Coolum Creek, or easterly to the Maroochy River. In the extreme south-east of the Project area the single waterway identified flowed south into the estuarine canals of the suburb of Twin Waters. Due to the small catchment area single sites were located on each of these systems at the boundary of the current (and proposed) airport activities (sites AQ03 and AQ04). Photographs of all survey sample sites are shown in **Figure 9.5a**.

The remaining permanent streams flowed from the south-eastern portion of the airport site towards a main drainage channel, which passes under the Sunshine Coast Motorway to the Maroochy River. This catchment is comprised of two main arms flowing from the south east and north-east of the Project area. Two sampling sites were located on the south-eastern arm. Site AQ07 is just above any influences of the airport, directly below the current industrial estate and site AQ02 is at the downstream extent of all current airport activities. A single site (AQ06) was established on the north-eastern arm of the drainage system to provide a baseline for the channelised waterways flowing from the otherwise undisturbed coastal vegetation. Similarly, a site was located on a southern tributary of the drainage system (AQ01) which was channelised and flowed through otherwise relatively undisturbed coastal vegetation. The remaining site (AQ08) was immediately upstream of the Sunshine Coast Motorway in the main drainage channel at the downstream boundary of the proposed Project area.

Site inspection of the north-western portion of the Project area identified several ephemeral channels and remnant swamps. None of these appeared to hold water for extended periods of time and hence no sampling sites were located in this area.

9.5.3 In-situ water quality

9.5.3.1 July 2012 field physico-chemical sampling results

Physico-chemical surface water quality was measured and recorded at all sampling sites during the July 2012 sampling event to facilitate the interpretation of ecological data.

Physico-chemical water quality was similar across all sites (**Table 9.5a**). Water temperatures were moderate, reflecting relatively cool ambient air temperatures during the survey period.

Table 9.5a: July field physico-chemical water quality

		Site								
Parameter	**Unit**	**AQ01**	**AQ02**	**AQ03**	**AQ04**	**AQ06**	**AQ07**	**AQ08**	**QWQG**	**ANZECC**
Dissolved oxygen	mg/L	6.25	5.74	9.77	9.55	4.85	1.14	5	–	–
Oxygen saturation	%	62	58	103	98	50	12	54	85–110	85–110
pH		5.6	6.14	6.11	5.74	3.36	6.05	4.6	6.5–8.0	6.5–8.0
Temperature	°C	15.3	14.9	17.9	16.3	16.1	16.2	14.6	–	–
Electrical conductivity	µS/cm	219	213	257	237	215	229	183	–	–
Turbidity	NTU	6	12.4	10.7	8.5	7.6	6.4	10.2	50	–

Figure 9.5a: Location of Project area and study sites

Plate 1 AQ01

Plate 2 AQ02

Plate 3 AQ03

Plate 4 AQ04

Plate 5 AQ06

Plate 6 AQ07

Plate 7 AQ08

Electrical conductivity was low, varied little between sites (183–257 µS/cm) and was optimal for electrofishing. Turbidity was consistently low across all sites and less than the QWQG guideline of 50 NTU.

The pH was more variable than other physico-chemical parameters, but was nonetheless consistently low at all sites and below the QWQG and ANZECC/ARMCANZ (2000) default guideline of 6.5 (lower limit) for lowland rivers (south-eastern Australia), which is typical for natural acidic and tannin stained Wallum swamp aquatic habitats. The QWQG note that, for Wallum heath streams in South Eastern Queensland, pH values between 3.6 – 6.0 are within the natural limits. While the Project area is not a Wallum heath environment, adjacent remnant patches of wallum heath and their extended influences result in naturally low pH across the site.

Dissolved oxygen was highly variable between sites, ranging from 12–103 per cent saturation. This is likely to be attributable to the variable physical conditions of the sites and to adjacent and upstream influences. Low dissolved oxygen is usually attributable to organic loading, which appears likely to have occurred at sites AQ06 – AQ08 during this period.

9.5.3.2 September 2012 field physico-chemical sampling results

Physico-chemical surface water quality was measured and recorded at all sampling sites during the September sampling event to facilitate the interpretation of ecological data.

The levels of all parameters were similar across all sites (**Table 9.5b**). Water temperatures were higher than previous surveys, largely due to increased ambient air temperature compared with the July sampling event. Electrical conductivity was low, varied a little between sites (112.9–450.5 µS/cm) and was optimal for electrofishing. With the exceptions of AQ04 (55.1 NTU) and AQ06 (51.2 NTU) that exceeded the QWQG, turbidity was consistently low across all sites and less than the QWQG guideline of 50 NTU.

Though variable (4.4–7.1), pH was low at most sites and below the QWQG and ANZECC/ARMCANZ (2000) default guideline of 6.5 (lower limit) for lowland rivers (south-eastern Australia). AQ04, however (7.1) was within QWQG and ANZECC guidelines. As noted previously, a pH of between 3.6 – 6.0 is typical for natural acidic and tannin stained Wallum swamp aquatic habitats. The influences of adjacent Wallum habitats have previously been noted at the Project area.

Dissolved oxygen levels were highly variable between sites ranging from 5 to 92 per cent saturation. The variability is likely attributable to the physical conditions and to influences adjacent to and upstream of the sites. Low dissolved oxygen values were associated with sites that had high organic loads and/or organic rich sediments.

9.5.4 Sediment quality

Sediment quality was examined at seven sites with a range of parameters examined including petroleum hydrocarbons, nutrients and metals. The results are summarised in **Table 9.5c**.

9.5.4.1 Moisture content

Moisture content provides an indication of the particle size and organic content of the sediments with finely divided, organic rich sediments tending to have very high moisture contents, while sandy, mineralised sediments have much lower moisture content.

The moisture content of sediments collected during this study varied markedly, ranging from 19 to 86 per cent (**Table 9.5c**). The lowest values were recorded at sites AQ01 (23 per cent), AQ03 (19 per cent) and AQ06 (31 per cent). Sediment moisture content (refer **Figure 9.5b**) was higher at AQ02 (67 per cent), AQ04 (60 per cent) and AQ07 (54 per cent) and AQ08 (86 per cent), suggesting sediments at these sites were finer and/or more organic than those of the other sites examined, particularly those at AQ08.

As many contaminants tend to bind to the finer sediment fractions (<63 µm), contaminant levels may be higher in fine sediments than in coarse sediments. This is particularly the case for phosphorous.

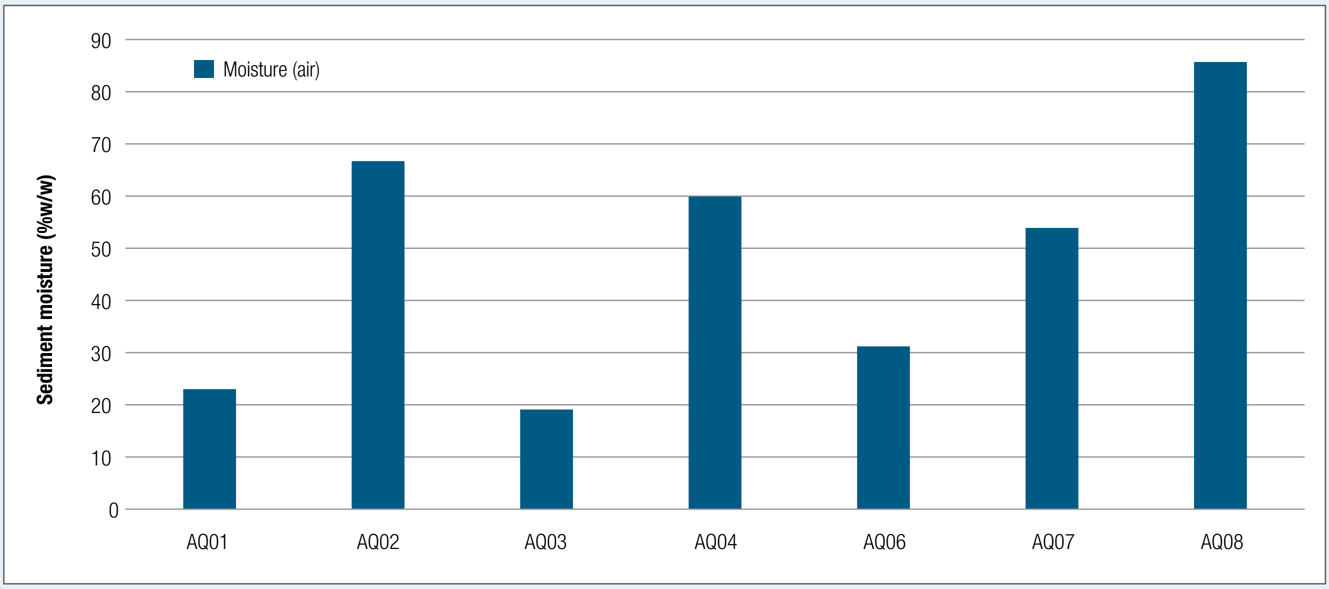
Table 9.5b: September 2012 field physico-chemical water quality

		Site								
Parameter	**Unit**	**AQ01**	**AQ02**	**AQ03**	**AQ04**	**AQ06**	**AQ07**	**AQ08**	**QWQG**	**ANZECC**
Dissolved oxygen	mg/L	3.33	4.2	7.8	4.87	1.93	0.43	1.32	-	-
Oxygen saturation	%	38	50	92	57	22	5	15	85–110	85–110
pH		6.2	5.65	6.24	7.05	4.41	5.79	5.94	6.5–8.0	6.5–8.0
Temperature	°C	21.2	24.1	23.4	23.2	21.75	18.8	20.4	-	-
Electrical conductivity	µS/cm	179.2	198	265	343	450.5	112.9	131.2	-	-
Turbidity	NTU	24	9.2	-	55.1	51.2	4.5	46.7	50	-

Table 9.5c: Sediment parameter levels at sites across the Project area

Sediment Data		Site/Date Sampled							ANZECC	
		AQ01	AQ02	AQ03	AQ04	AQ06	AQ07	AQ08	ISQG-Low (mg/kg dry wt)	ISQG-High (mg/kg dry wt)
Analyte Description	**Units**	**23.7.12**	**25.7.12**	**24.7.12**	**24.7.12**	**25.7.12**	**25.7.12**	**23.7.12**		
Moisture (air)	%w/w	23	67	19	60	31	54	86	-	-
Phosphorus (P)	mg/kg	8	77	22	26	7	42	1360	-	-
Nitrogen (LECO)	%w/w	<0.10	0.17	<0.10	<0.10	<0.10	0.12	0.77	-	-
Metals										
Molybdenum (Mo)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	7.8	-	-
Mercury (Hg)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.15	1
Cobalt (Co)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	8.0	-	-
Selenium (Se)	mg/kg	<1	<1	<1	<1	<1	<1	<1	-	-
Copper (Cu)	mg/kg	1.9	12.4	2.5	2.6	1.9	18.1	16.0	65	270
Chromium (Cr)	mg/kg	<1.0	4.0	<1.0	<1.0	<1.0	3.9	22.5	80	370
Cadmium (Cd)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.8	1.5	10
Arsenic (As)	mg/kg	<1.0	1.7	<1.0	<1.0	<1.0	4.0	18.9	20	70
Lead (Pb)	mg/kg	<1.0	2.3	<1.0	<1.0	<1.0	2.0	10.4	50	220
Zinc (Zn)	mg/kg	<5.0	18.7	7.7	<5.0	<5.0	23.0	55.7	200	55.7
Nickel (Ni)	mg/kg	<0.5	1.3	<0.5	<0.5	<0.5	1.0	23.9	21	52
Barium (Ba)	mg/kg	0.7	5.4	1.6	0.9	0.7	4.0	12.6	-	-
Antimony (Sb)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.3	2	25
Iron (Fe)	mg/kg	294	1320	434	2100	324	824	30 800	-	-
Aluminium (Al)	mg/kg	455	2420	371	1110	505	977	28 500	-	-
Manganese (Mn)	mg/kg	1.1	26.3	5.4	1.7	<1.0	11.2	57.1	-	-
Metals										
C_6–C_9 Fraction	mg/kg	<25	<25	<25	<25	<25	<25	<150	-	-
C_{10}–C_{14} Fraction	mg/kg	<50	<50	<50	<50	<50	<50	<150	-	-
C_{15}–C_{28} Fraction	mg/kg	<100	180	<100	<100	<100	<100	<300	-	-
C_{29}–C_{36} Fraction	mg/kg	<100	110	<100	<100	<100	<100	<300	-	-

Figure 9.5b: Moisture content of sediments across the Project area



9.5.4.2 Nutrients

The ANZECC/ARMCANZ Guidelines for Fresh and Marine Water Quality (2000) do not present sediment nutrient threshold levels, and indeed suggest that the need to do so "is debatable". The key issue relating to the impacts from sediment bound nutrients is their remobilisation to the water column to become available to biological organisms and the resultant problems such as algal blooms, oxygen depletion and fish kills. Thus, sediment nutrient levels in streams may be indicative of the potential for nutrient related water quality problems, and where their sources are anthropogenic, the degree of human impact.

Figure 9.5c shows sediment nitrogen levels were highest at AQ02, AQ07 and AQ08, three of the four sites with highest moisture content and finer sediment. These three sites were all located on the same stream system to the south and east of the Project area.

Figure 9.5d shows phosphorous levels were lowest at the sandy sites AQ01 and AQ06 (8 and 7 mg/kg respectively) and clearly highest at AQ08 (1360 mg/kg), situated in farmland downstream at the edge of the Project area.

An increase in sediment nutrient levels was evident downstream from AQ07 (42 mg/kg) to AQ02 (77 mg/kg) to AQ08 (1360 mg/kg) located on the same waterway draining the area around the southern section of the Project area. Levels at these sites were much higher than those at AQ06, the control site on the northern arm of the same stream flowing off the site, on which AQ08 was located.

Relative to AQ06, sediment nutrient and moisture levels were elevated at AQ07 and even more so at AQ02 within the Project area. AQ07 was located upstream of the Project area, but downstream of an industrial precinct; elevated nutrient levels at this site would not be attributable to airport activities. Levels at AQ02 were even more elevated than those at AQ07. This may be due to accumulation of nutrients and sediment from activities upstream, loading from the Project area or a combination of both.

Nutrient levels at AQ08 were markedly higher than at any other site, more so than would be suggested by the presence of higher levels of fine/organic sediments than was observed at the other sites. It is likely runoff (including sediment) from existing SCA activities contributes to sediment and nutrient build up at AQ08, however, historical and current agricultural activities (e.g. cane growing) are considered likely to be the major contributors.

The dissolved oxygen at AQ07 was very low (12 and 0.4 per cent saturation) during field sampling, with anoxic sediments also noted, suggesting poor water quality and stream condition. This is consistent with the proximity of the site to roads and industrial areas. Persistent anoxia at the sediment – water interface would likely remobilise many elements (including phosphorus) for transport downstream to other sites such as AQ02. The remobilisation of sediment phosphorous may also promote algal and toxic cyanobacterial blooms, although none were noted during sampling.

9.5.4.3 Metals and metalloids

The ANZECC/ARMCANZ (2000) interim sediment quality guidelines (ISQG) are presented in **Table 9.5c**.

For most sites, trace metal and metalloid concentrations were below the practical quantitation detection limits of the laboratory analyses, with the exception of iron and aluminium, which may be found naturally in sediments in high levels. Where measurable concentrations of metals were recorded, they were below the ANZECC/ARMCANZ ISQG-Low trigger value, with the exception of sediments at site AQ08. In the latter case, nickel (23.9 mg/kg) and antimony (2.3 mg/kg) both marginally exceeded the ANZECC/ARMCANZ ISQG-Low (nickel – 21 mg/kg; antimony – 2 mg/kg), but not the ISQG-High.

The metals that are typically more abundant in aquatic sediments (iron, aluminium and to a lesser extent manganese) were found to in relatively high concentrations, but present no risk to aquatic ecosystems.

Metal/metalloid levels were highest in sediments from AQ08, and to a lesser extent those from AQ07 and AQ02. This reflects the nature of the sediments at these sites as well as current and historical land uses. Levels within the Project area were low and well below the ANZECC/ARMCANZ ISQG-Low toxicity guideline trigger level for all metals and metalloids. Slightly elevated copper, arsenic and zinc at AQ07 as compared with AQ02 suggests the source is upstream of the Project area. Refer **Figures 9.5e**, **9.5f** and **9.5g**.

9.5.4.4 Petroleum hydrocarbons

Petroleum hydrocarbon levels were below the limit of detection in the sediment samples from all sites examined, with the exception of AQ02, where low concentrations of the C15-28 and C29-36 fractions were recorded. These long-chain hydrocarbons are semi-volatile compounds associated with minor contamination with lubricating oils or diesel fuel. Whilst there was no visible indication of a source, the levels recorded were very low and are unlikely to have a significant impact on aquatic biota.

9.5.5 Aquatic habitat and substrate

A description of the physical attributes that contribute to aquatic habitat within sites surveyed in the Project area is presented in **Table 9.5d**.

All sites surveyed were found to be dominated by silty substrates with a small amount of filamentous algae, with the exception of AQ01 that was dominated by sand. All sites had similar aged riparian vegetation, with few or no trees greater than 10 m high found during the surveys.

Site AQ01 was found to be a narrow, channelised and moderately vegetated waterway. It was shallow with an anoxic substrate, and instream habitat consisted of moderate amounts of detritus and sticks and small amounts of branches and logs. The riparian zone consisted of exotic species and bare ground, some grass and shrubs, and small trees.

Figure 9.5c: Sediment nitrogen levels

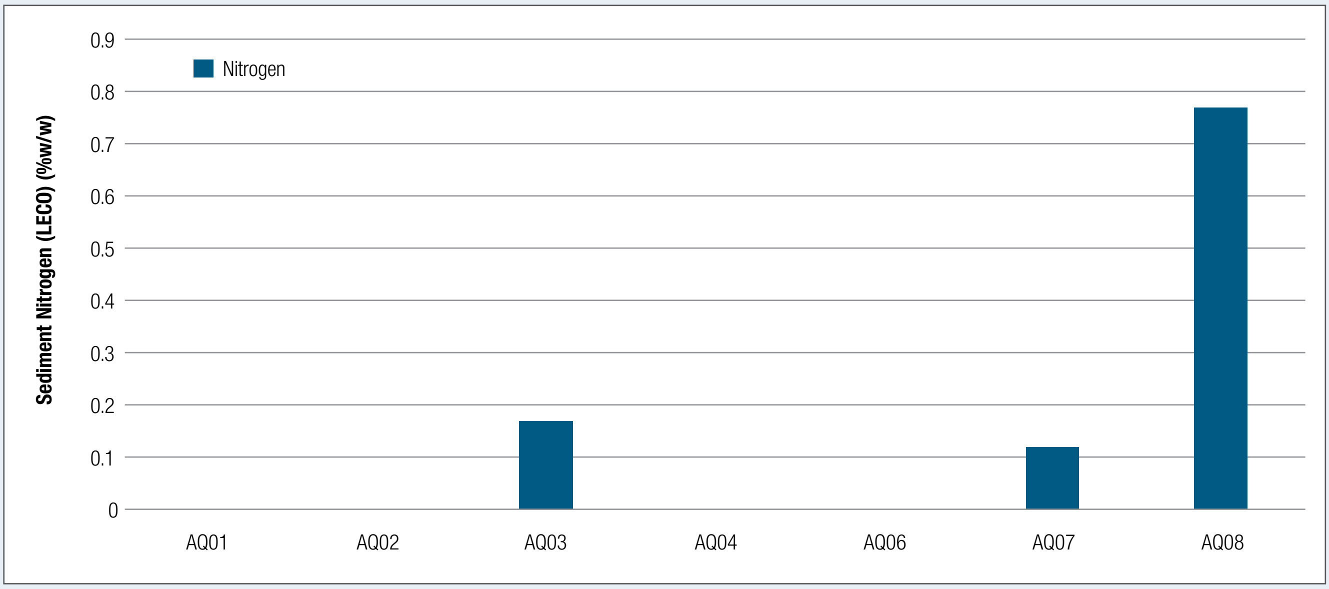
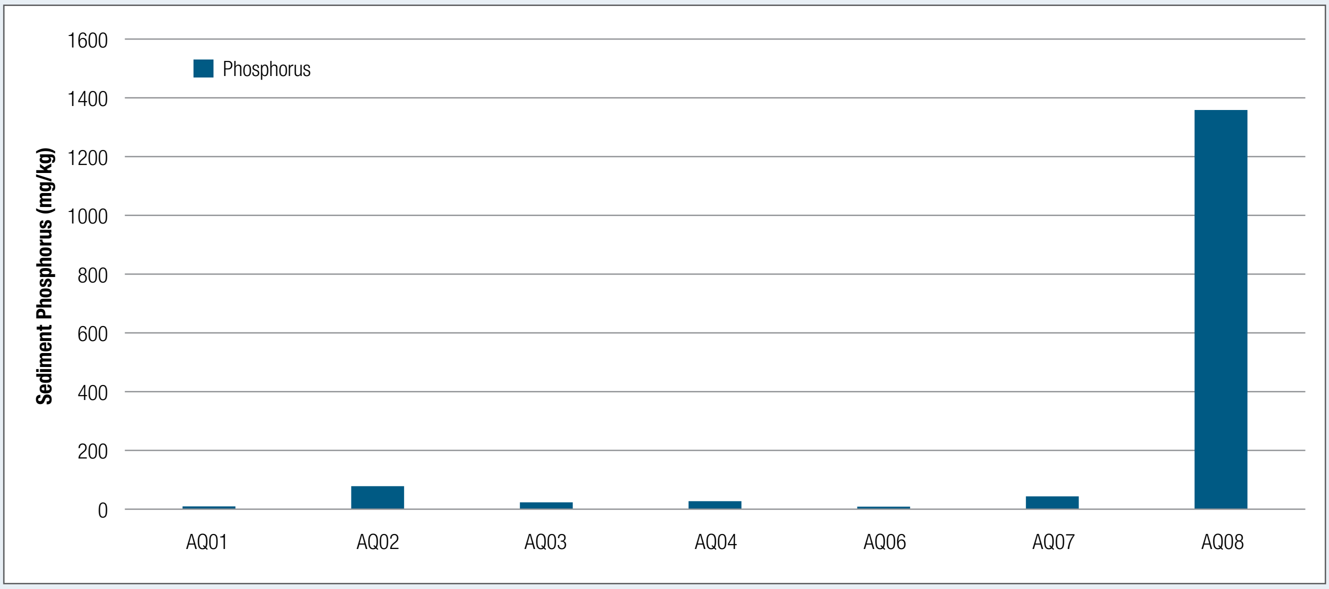


Figure 9.5d: Sediment phosphorous levels



Site AQ02 was found to be a wide, channelised and moderately vegetated waterway of relatively uniform depth, with instream woody habitat consisting of moderate amounts of detritus, sticks and branches. Riparian vegetation comprised small amounts of grasses, and moderate amounts of trees and shrubs.

Site AQ03 was a narrow, concrete drainage channel at the southern end of the Project area, covered with a thin layer of silt over a concrete base. Small amounts of moss, filamentous algae and macrophytes were present, with minimal detritus. Riparian vegetation consisted completely of grasses, which are subject to regular slashing as part of airport maintenance. Downstream of AQ03 the stream flows south under a vehicle crossing within the airport and continues off the Project area under David Low Way.

Site AQ04 was found to be a wide drainage pool with low flow, high macrophyte levels blanketed in silt and small amounts of filamentous algae. Substrate anoxia was noted and instream woody habitat consisted of moderate amounts of detritus, twigs and sticks. Riparian vegetation consisted solely of grasses, which are subject to regular slashing. Downstream of AQ04 the stream flows to the north, under two vehicle crossings and then continues off the Project area.

Site AQ06 is a channelised tributary waterway with small amounts of macrophytes, filamentous algae, trailing bank vegetation, blanketing silt and substrate anoxia. AQ06 had a moderate amount of in stream detritus and small amounts of sticks and branches. Riparian vegetation consisted of low levels of exotic species, along with bare ground, grasses and shrubs.

Figure 9.5e: Sediment arsenic levels

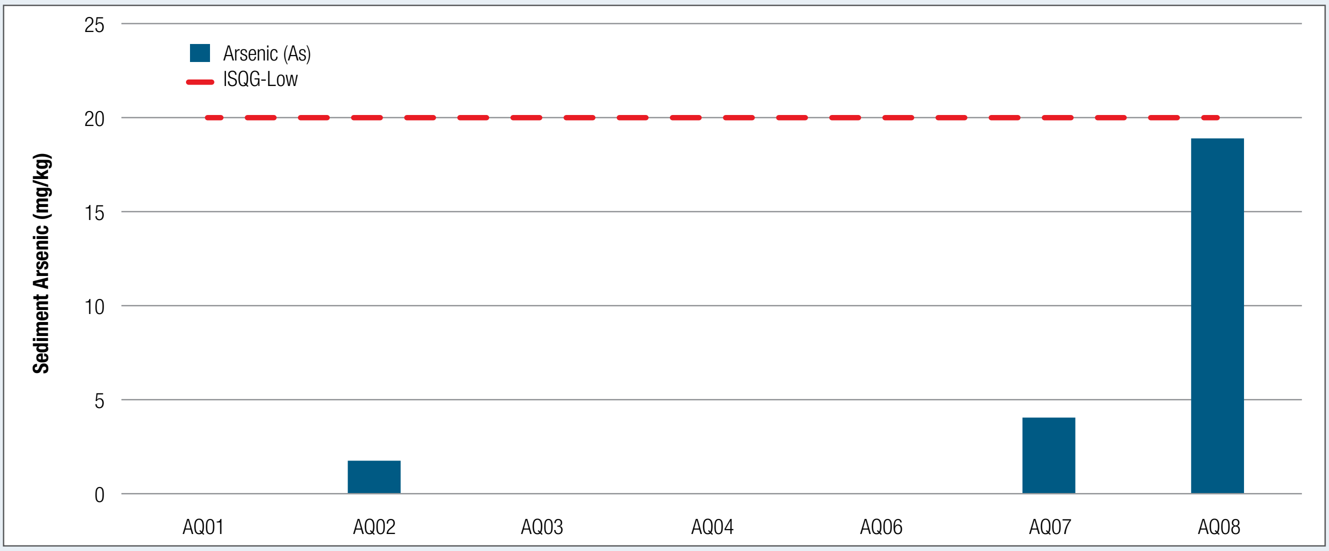


Figure 9.5f: Sediment copper levels

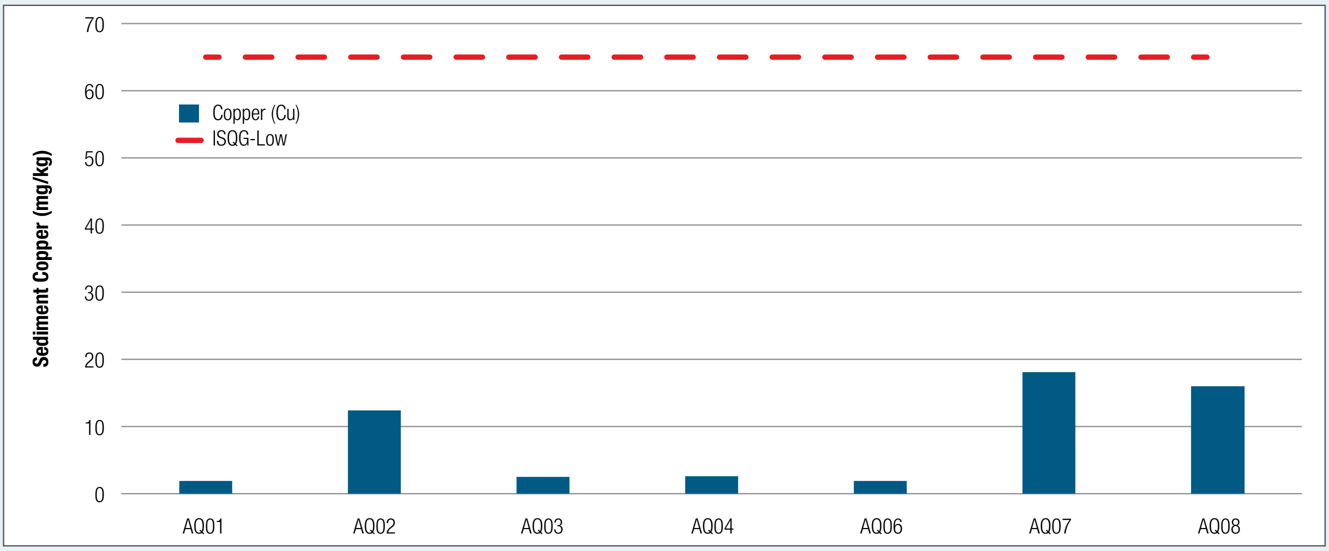


Figure 9.5g: Sediment nickel levels

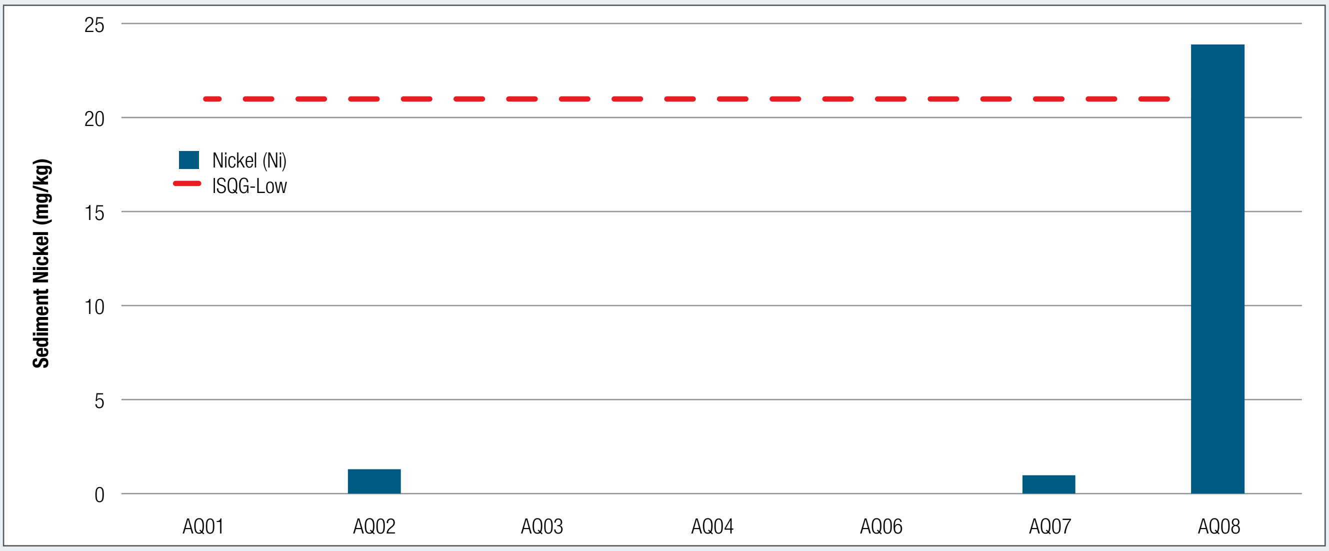


Table 9.5d: Physical attributes of sites within the Project area

Parameter		Unit	AQ01		AQ02		AQ03	AQ04	AQ06		AQ07		AQ08	
			Edge	Bed	Edge	Bed	Edge	Edge	Edge	Bed	Edge	Bed	Edge	Bed
Channel	Mean depth	m	0.6	0.5	0.5	1.0	0.3	0.7	0.5	0.5	1.5	1.5	0.4	0.4
	Mean width	m	3.5	2	7.0	7.0	2.5	8.0	5.0	5.0	12.0	12.0	3.0	3.0
Substrate description	Bedrock	%	0	0	0	0	0	0	0	0	0	0	0	0
	Boulder	%	0	0	0	0	0	0	0	0	0	0	0	0
	Cobble	%	0	0	0	0	0	0	0	0	0	0	0	0
	Pebble	%	0	0	0	0	0	0	0	0	0	0	0	0
	Gravel	%	0	0	0	0	0	0	0	0	0	0	0	0
	Sand	%	60	60	0	0	0	0	10	10	0	0	5	5
	Silt/clay	%	40	40	100	100	100	100	90	90	100	100	95	95
Habitat attributes	Periphyton	%	0	0	0	0	0	0	0	0	0	0	0	0
	Moss	%	0	0	0	0	1–10	0	0	0	0	0	0	0
	Fil. algae	%	0	0	1–10	1–10	1–10	1–10	1–10	1–10	1–10	1–10	1–10	1–10
	Macrophytes	%	1–10	0	10–50	10–50	1–10	50–75	1–10	1–10	10–50	10–50	10–50	10–50
	Bank overhang veg.	%	0	0	1–10	1–10	0	0	1–10	1–10	10–50	10–50	1–10	1–10
	Trailing bank veg	%	50–75	1–10	1–10	1–10	0	0	1–10	1–10	10–50	10–50	1–10	1–10
	Blanketing silt	%	1–10	50–75	1–10	1–10	1–10	1–10	1–10	1–10	1–10	1–10	1–10	1–10
	Substrate anoxia	%	1–10	>75	1–10	1–10	0	1–10	1–10	1–10	1–10	1–10	10–50	10–50
Canopy	Cover	%	30	5	20	20	0	0	40	40	30	30	20	20
	Shading	%	30	5	20	20	0	0	40	40	30	30	20	20
Instream woody habitat	Detritus (leaves, twigs)	%	1–10	>75	10–50	10–50	1–10	10–50	10–50	10–50	10–50	10–50	50–75	50–75
	Sticks (<2 cm dia.)	%	1–10	50–75	10–50	10–50	0	10–50	1–10	1–10	1–10	1–10	1–10	1–10
	Branches (<15 cm dia.)	%	0	1–10	10–50	10–50	0	10–50	0	0	0	0	1–10	1–10
	Logs (>15 cm dia.)	%	0	1–10	0	0	0	0	1–10	1–10	0	0	0	0
Width of riparian zone	Left bank	m	15	5	0	0	>30	10	5					
	Right bank	m	15	5	0	0	>30	5	5					
Riparian composition	Exotic species	%	1–10	0	0	0	1–10	0	1–10					
	Bare	%	1–10	0	0	0	1–10	0	1–10					
	Grass	%	10–50	1–10	>100	>75	1–10	10–50	50–75					
	Shrubs	%	10–50	10–50	0	0	1–10	1–10	10–50					
	Trees <10 m	%	1–10	10–50	0	0	0	10–50	0					
	Trees >10 m	%	1–10	0	0	0	0	1–10	0					

AQ07 is a channelised waterway bordered by an industrial estate and the SCA access road and car park. AQ07 supports moderate amounts of macrophytes, bank overhanging vegetation and bank trailing vegetation, with small amounts of filamentous algae, blanketing silt and substrate anoxia. Instream habitat consisted of moderate amounts of detritus and small amounts of sticks, and riparian vegetation comprised of moderate densities of grass and trees less than 10 m, with low densities of shrubs and trees greater than 10 m.

Site AQ08 is on a narrow, channelised waterway which subsequently flows west under the Sunshine Motorway and out of the Project area. Moderate macrophyte levels were present, as well as small amounts of filamentous algae, bank trailing vegetation, blanketing silt and bank overhanging vegetation. In-stream habitat comprised largely of detritus, with small amounts of sticks and branches also present. Substrate anoxia was noted during sampling. Riparian vegetation comprised primarily of grasses, with moderate amounts of shrubs, and low levels of exotic species and bare ground.

9.5.6 Aquatic flora

The submerged aquatic plant species that were recorded at each of the sites is presented in **Table 9.5e**. None of the macrophytes recorded were listed under any State or Federal legislation. Further description of the emergent macrophytes is provided in Chapter B10 – Marine Ecology.

9.5.7 Aquatic Macroinvertebrates

As is required by the AusRivAS methodology (QDNRM, 2001), sampling was performed in two seasons “early-wet” (Autumn – September 2012) and “late-wet” (Spring – July 2012). The close temporal proximity of the sampling events (and in particular the collection of “early-wet” samples outside of typical AusRivAS sampling periods) was dictated by Project constraints, and whilst not ideal was considered adequate for the purposes of this study. Analysis of the data is cognisant of the fact that early collection of these samples may influence the resulting OE50 scores.

Where possible, two habitats were sampled at each site, edge and pool bed. AQ03 was a concrete channel with no edge vegetation so only a bed sample was collected. Edge and bed samples were collected in both seasons from all other sites, although at three sites (AQ04, AQ06 and AQ07) no macroinvertebrates were found in the bed samples in July 2012.

Apart from AusRivAS and SIGNAL scores, other indicators of stream health are examined below including abundance, family diversity and PET (Plecoptera-Ephemeroptera-Trichoptera) richness.

9.5.7.1 Macroinvertebrate abundance

Macroinvertebrate abundance recorded across all sampling sites during the July and September 2012 sampling events are presented in **Appendix B9:A**, **Figure 9.5h**, **Figure 9.5i** and **Figure 9.5j**.

Abundance was very low in the bed habitat of all sites sampled (except AQ03), and generally greater within the

Table 9.5e: Macrophyte species recorded at survey sites

Scientific Name	Common Name	AQ01	AQ02	AQ03	AQ04	AQ06	AQ07	AQ08
Chara spp.	Stonewort	●						
Cyperus spp.	Sedge						●	
Eleocharis sp.	Spike-rush	●			●			●
Lepironia articulata	Grey Rush					●		
Ludwigia peploides	Water Primrose		●				●	
Nymphoides sp.	Waterlily	●	●		●	●		●
Nymphoides indica	Water Snowflake						●	
Nymphaea gigantea	Giant Waterlily						●	
Philydrum lanuginosum	Frogsmouth	●	●	●	●			
Phragmites australis	Common Reed	●			●		●	●
Persicaria sp.	Knotweed		●				●	
Persicaria attenuata	White Smartweed						●	
Triglochin procerum	Water Ribbon	●	●		●	●		●
Typha orientalis	Cumbungi						●	●

Figure 9.5h: Macroinvertebrate abundance during July 2012 sampling event

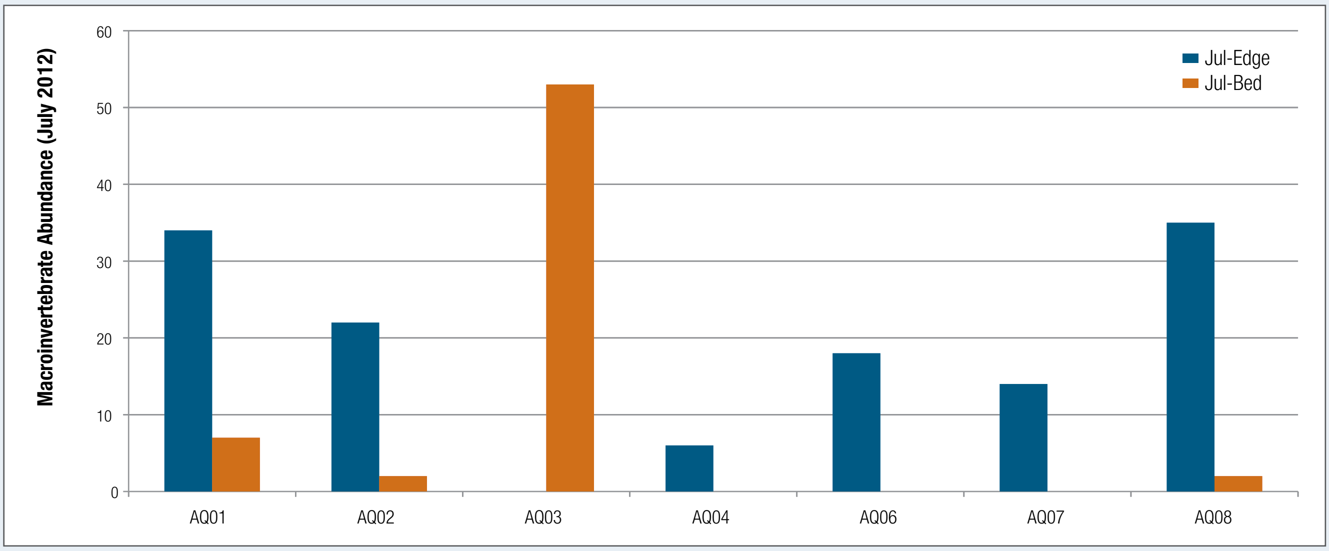
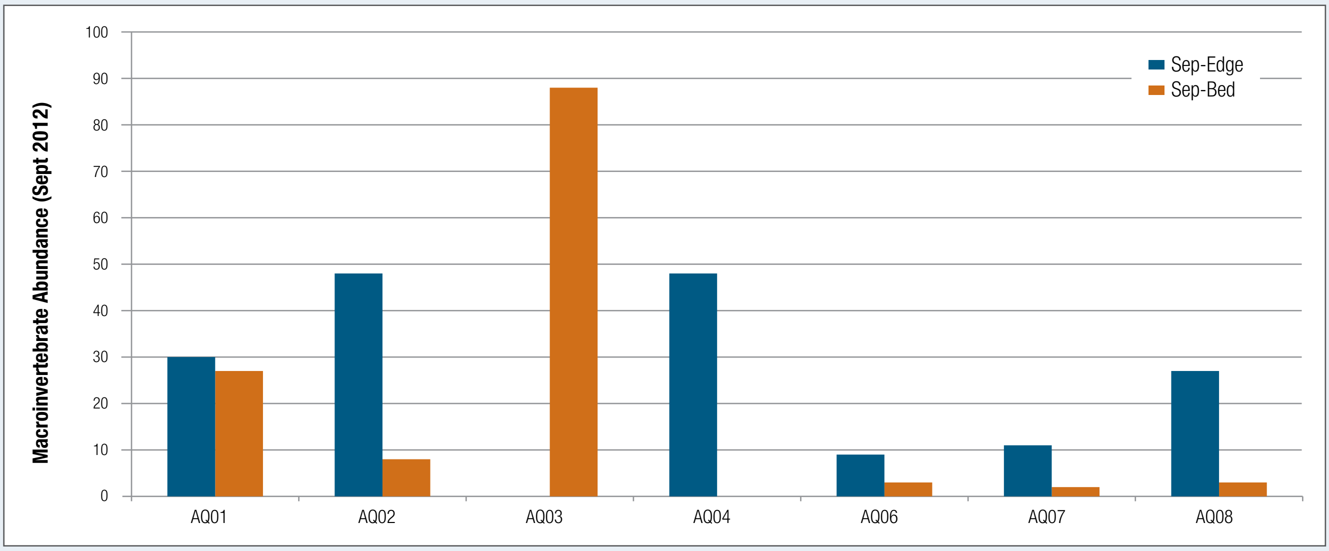


Figure 9.5i: Macroinvertebrate abundance during September 2012 sampling event



edge habitat than the bed habitat at all sites where both habitats were available to be sampled. This was probably due to the channelised nature of most of the sites, resulting in a reduction of suitable bed habitat, the greater availability of vegetation and habitat diversity at the edges. The highest macroinvertebrate abundance was recorded at site AQ03 in both July and September 2012, although most individuals were either chironomid larvae or dragonfly nymphs. AQ03 is a shallow, concrete channel, with little vegetation, but contained sediment and leaf debris on the bottom. Abundance was quite low at other sites, especially at AQ06 and AQ07.

9.5.7.2 Macroinvertebrate family diversity

As with abundance, macroinvertebrate family diversity (**Figure 9.5k**, **Figure 9.5l** and **Figure 9.5m**) was higher in the edge habitats rather than the pool bed habitat, except for AQ03.

Apart from AQ03, family diversity was relatively low at all sites (combined season: 6–12 families in edge samples, 1–7 families in bed samples). Family diversity was substantially higher at AQ03 than at other sites (23 families over both seasons) and lowest at AQ07 (6 families in edge samples over both seasons). Bed communities were best developed in AQ01 and AQ02, but were nonetheless depauperate.

Tolerant taxa were the most abundant at the majority of sites in both still and flowing waters. They included the shrimp *Caridina* sp. (Atyidae), dragonfly nymphs (Libellulidae and at some sites Hemicorduliidae), and non-biting midge larvae (Chironominae and to a lesser extent Tanypodinae). *Caridina* sp. was not found at AQ03, presumably due to the lack of vegetation. On the other hand, a range of taxa were most common or only found at AQ03, including aquatic leeches (Glossiphoniidae), certain dragonfly nymphs (Lindeniidae) and caddis larvae (Leptoceridae, Ecnomidae).

Figure 9.5j: Combined season macroinvertebrate abundance

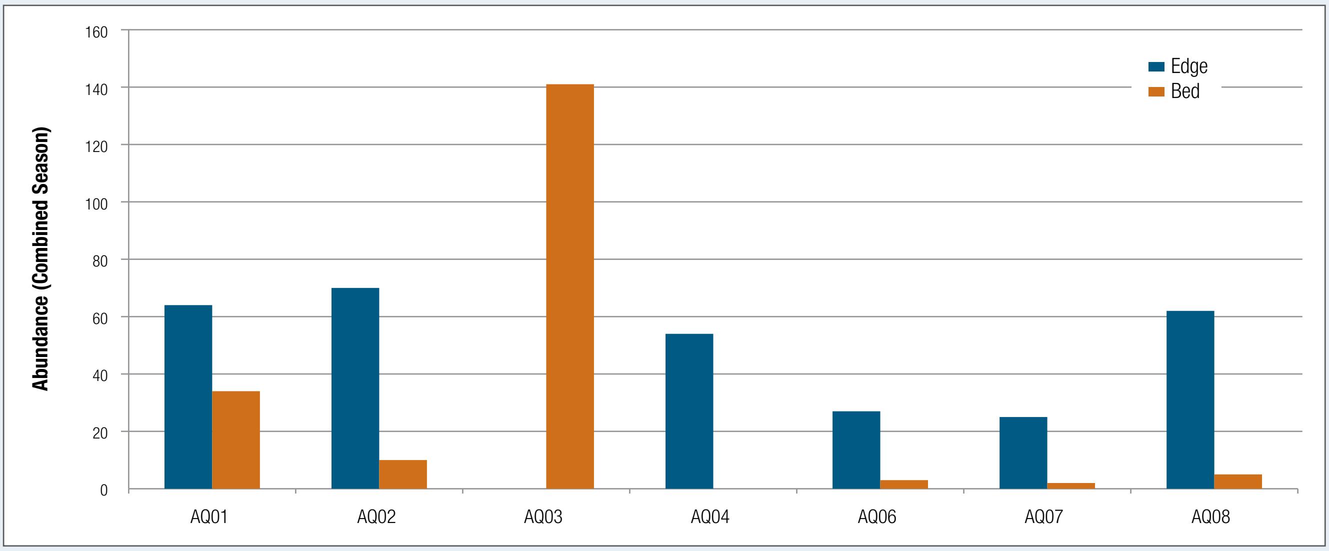


Figure 9.5k: Family macroinvertebrate diversity at each site in July 2012

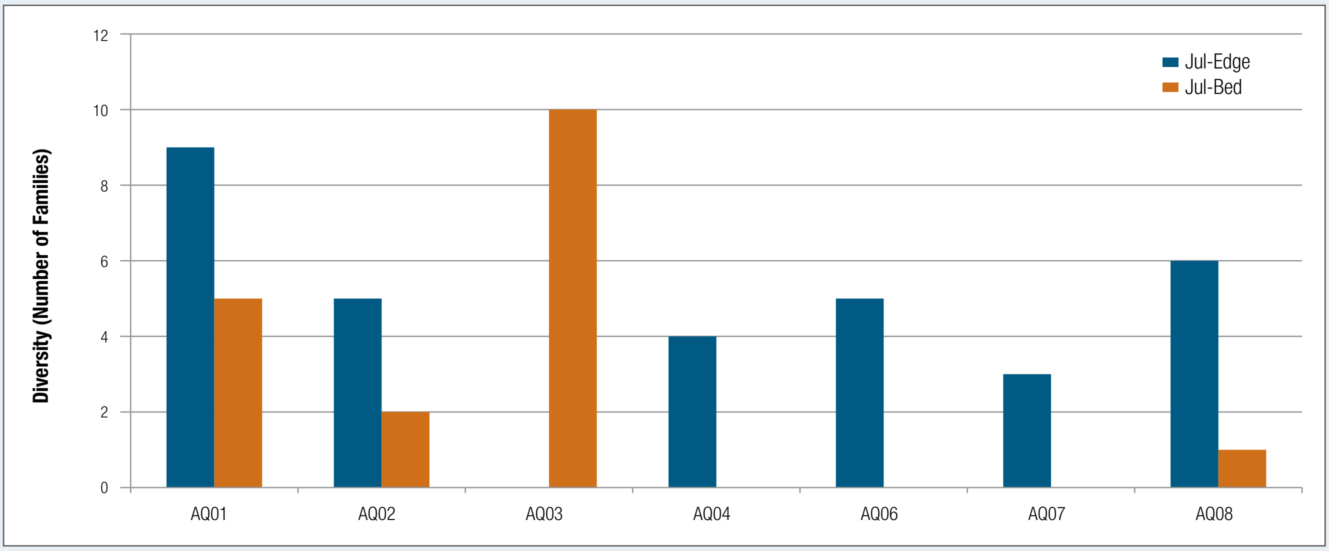


Figure 9.5l: Family macroinvertebrate diversity at each site in September 2012

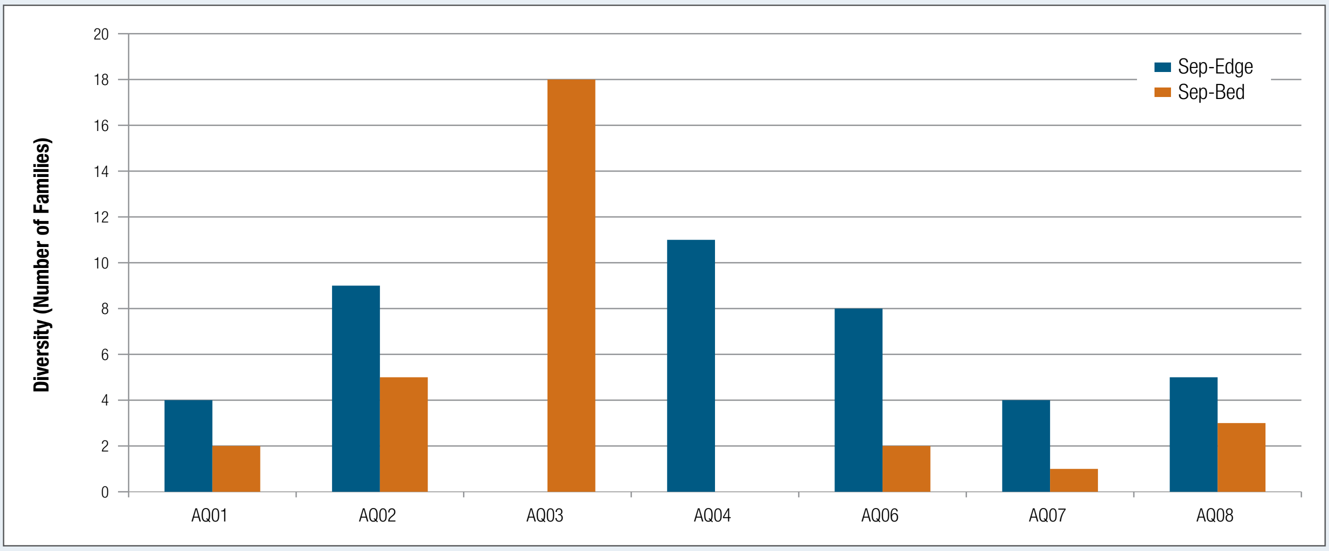
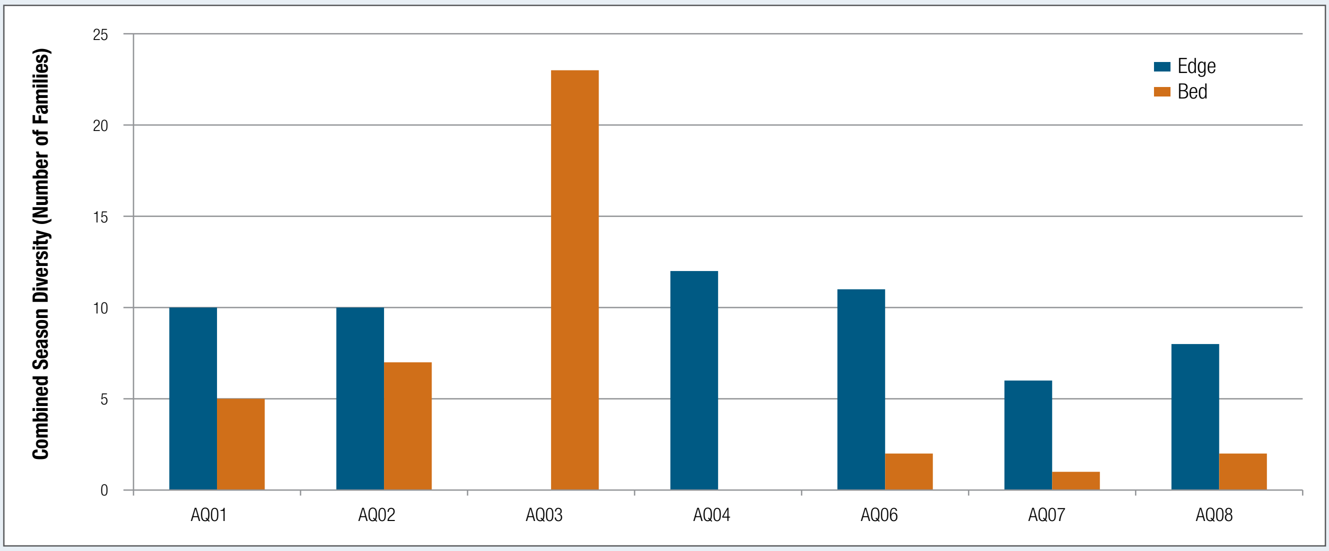


Figure 9.5m: Combined season macroinvertebrate family diversity at each site



Molluscs occurred only at AQ02 and AQ03, but were more diverse and abundant at the latter site, including the widespread exotic pest species *Physa acuta* (Physidae). A number of these differences between AQ03 and other sites relates to the presence of hard substrate rather than sediment at this site. Adult, diving beetles (Dytiscidae) were most common in AQ04, but scarce or absent at other sites. This site was located in a well vegetated area with low flow, a suitable habitat for this group.

9.5.7.3 PET richness

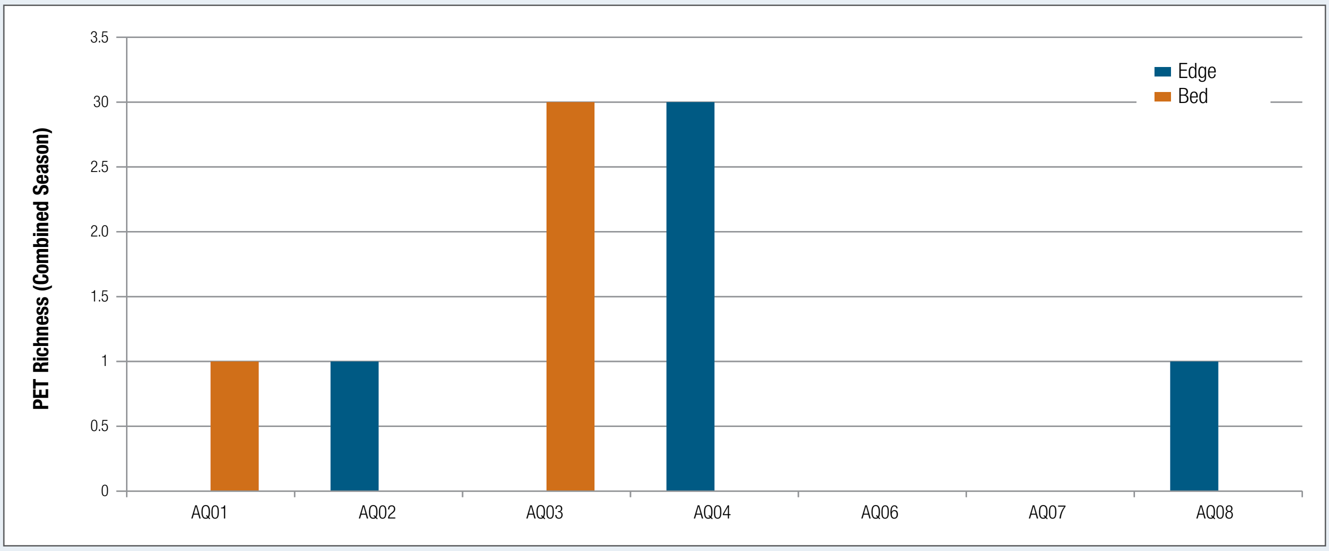
PET richness refers to the number of families of stoneflies (Plecoptera), mayflies (Ephemeroptera) and caddis flies (Trichoptera). PET families are particularly sensitive to poor water quality including those from anthropogenic influences, and low PET scores may be an indication of degraded aquatic ecosystems. However, it should be noted that Plecopterans (stone flies) are generally not well represented in Queensland, hence rarely contribute significantly to the analysis.

PET scores were very low (0–3), with mayflies and caddisflies not occurring at all in AQ06 and AQ07 (**Figure 9.5n**). The highest PET scores were at AQ03 and AQ04, each with only three families.

9.5.7.4 AusRivAS modelling and risk bands

AusRivAS is a rapid bio-assessment methodology using macroinvertebrates and a range of other indicators for the assessment of the health of freshwater rivers. It is a referential system, comparing the macroinvertebrate communities at test sites with a set of similar relatively unimpacted reference sites. A series of models are available for regional Queensland and typically require the collection of macroinvertebrate samples, physico-chemical data and site descriptors during both "pre-wet" (October–December) and "post-wet" (May–July) seasons. Ephemeral streams present challenges for the AusRivAS approach, since it is often necessary to collect samples opportunistically when water is present, which frequently occurs outside of the

Figure 9.5n: Combined season PET richness at each site



defined sampling periods. This creates a mismatch between sampling data and reference data, as macroinvertebrate assemblages vary seasonally, often resulting in an underestimate of stream health.

The AusRivAS models utilise only those taxa calculated to have a 50 per cent or greater probability of occurring at a test site, based on reference site data. This level of resolution represents a compromise that reduces the occurrence of low probability taxa whilst maintaining sufficient analytical resolution to detect significant shifts in species assemblages. The ratio of observed over expected taxa (OE) with an occurrence probability of ≥0.5 (50 per cent) is referred to as the OE50 score for a site.

The OE50 score assigned to a site is normally within the range within 0–1, with lower scores indicating impacted sites at which the observed macroinvertebrate fauna are depleted in comparison to reference sites. Conversely, sites for which the OE50 score nears a value of 1 have observed macroinvertebrate assemblages similar to those expected from comparable unimpacted sites. On some occasions the species richness may exceed that expected based on the reference sites, resulting in an OE50 score of greater than 1.

To simplify interpretation of modelled outputs, the AusRivAS models divide sites into bands based on the OE50 scores obtained. The thresholds for each of these bands are provided in **Table 9.5f**, along with interpretive information.

Table 9.5f: Species richness thresholds for AusRivAS assigned OE scores

Band	Description	OE Taxa	OE Taxa Interpretations
X	Greater biological diversity than reference sites.	OE greater than 90th percentile of reference sites used to create the model.	More families found than expected. Potential biodiversity "hot-spot" or mild organic enrichment. Continuous irrigation flow in a normally intermittent stream.
A	Biodiversity similar to reference.	OE within range of central 80 per cent of reference sites used to create the model.	Expected number of families within the range found at 80 per cent of the reference sites.
B	Biodiversity significantly reduced.	OE below 10th percentile of reference sites used to create the model. Same width as band A.	Fewer families than expected. Potential impact either on water and/or habitat quality resulting in a loss of families.
C	Biodiversity severely impaired.	OE below band B. Same width as band A.	Many fewer families than expected. Loss of families from substantial impairment of expected biota caused by water and/or habitat quality.
D	Biodiversity extremely impaired.	OE below band C down to zero.	Few of the expected families and only the hardy, pollution tolerant families remain. Severe impairment.

Table 9.5g: Combined July 2011/November 2011 OE50 and OE50 signal results

	Combined Season							
Site	Habitat	OE50	OE50 Signal	Band	Habitat	OE50	OE50 Signal	Band
AQ01	Edge	0.3	0.76	C	Bed	0.42	0.74	C
AQ02	Edge	0.36	0.87	C	Bed	0.28	0.6	C
AQ03	Edge	NS			Bed	0.56	0.9	B
AQ04	Edge	0.54	0.81	B	Bed	NR		
AQ06	Edge	0.24	0.77	C	Bed*	0.45*	0.87*	B*
AQ07	Edge	0.18	0.79	C	Bed*	0.23*	0.75*	C*
AQ08	Edge	0.18	0.79	C	Bed	0.42	0.74	C

Notes:
NS Not sampled as habitat not available.
NR Nothing recorded in sample
** Spring (September 2012) single season data only (nothing recorded in July 2012 sample)*

In addition to OE50 scores, AusRivAS assigns an OE50 SIGNAL score to each of the test sites, based on the sensitivity of macroinvertebrate families to pollution. High SIGNAL scores indicate the presence of taxa that are sensitive to pollution. Again, a threshold of a 50 per cent probability of a taxon occurring is considered appropriate for the OE50 Signal score.

The results of the AusRivAS modelling for the combined edge and pool bed samples for July and September 2012 are presented in **Table 9.5g**.

OE50 scores were low at all sites, but highest at AQ03 (0.56 Bed) and AQ04 (0.54 Edge). The latter two sites were rated as Band B, showing fewer families than expected when compared to relatively unimpacted reference sites. All other sites were allocated to Band C, showing far fewer families than expected. Thus all sites showed significantly reduced to severely impaired biodiversity, and stream condition was poor OE50 SIGNAL was also reduced, indicating a loss of sensitive families relative to what was predicted by the models. SIGNAL scores were low (generally between 3 and 4) indicting "moderate pollution" (Chessman 1995). The most likely causes are a loss of normal stream habitat and poor water quality.

9.5.7.5 Macroinvertebrate community condition

All indicators of macroinvertebrate community condition, including taxa abundance, diversity, PET richness and AusRivAS models indicate that stream macroinvertebrate condition was poor in all of the waterways examined, though somewhat higher at AQ03 and AQ04 than at the other sites. Taxa diversity and abundance was very low at most sites and the AusRivAS modelling indicated that significantly reduced biodiversity at all sites. The most likely causes for this were the loss of normal stream habitat, the hydrological regime and poor water quality. The waterways examined were not natural rivers, as they were channelised and had very low flows at the time of sampling. A number of sites were exposed and lacking riparian vegetation, e.g. AQ03, AQ04, AQ07 and one was a concrete channel (AQ03).

9.5.8 Macrocrustaceans

Three species of macrocrustaceans were recorded in the field during the July 2012 surveys, an unidentified species of the shrimp *Macrobrachium* (two specimens at AQ08), *Cherax robustus* (AQ04, AQ06) and the shrimp *Caridina* sp. (Atyidae) which was common in the macroinvertebrate samples collected from most sites.

Approximately 13 species of *Macrobrachium* are common throughout a wide range of freshwater and, in some cases, estuarine habitats across Northern and Eastern Australia. Their taxonomy and distribution was revised by Short (2004).

Although their taxonomy is confused at species level, shrimps of the genus *Caridina* are widespread in still and flowing waters in eastern and northern Australia.

Cherax robustus has a restricted distribution in South East Queensland and is closely associated with wallum swamps which are characterised by low pH (3.3–5.3). It is thought that populations of *Cherax robustus* on the mainland are threatened by loss of habitat and reduction in water quality (Alletson 2000) which is supported by preliminary work by Garvie (1998). Populations on Fraser and Bribie Islands are thought to be stable.

9.5.9 Fish

Table 9.5h lists the 29 fish species that have previously been recorded in freshwater waterways of the Maroochy River catchment. Of these species four are considered exotic, two have been listed under either national or State legislation, specifically Oxleyan Pygmy Perch (*Nannoperca oxleyana*) and Honey Blue-eye (*Pseudomugil mellis*), and one has been listed under the BoT Species prioritisation framework, specifically Ornate Rainbowfish (*Rhadinocentrus ornatus*). However, waterways around the Project area are considered marginal habitat for all of these species, which are more typically recorded from larger permanent flowing waterways. The biological characteristics for each of the species recorded in the current surveys (plus listed species not recorded during the surveys) are summarised in **Appendix B9:B**.

Table 9.5h: Fish species that have previously been recorded from the Maroochy catchment (Pusey et al. 2004)

Common Name	Scientific Name
Freshwater Species	
Agassiz's Glassfish	*Ambassis agassizii*
Australian Smelt	*Retropinna semoni*
Crimson-spotted Rainbowfish	*Melanotaenia duboulayi*
Barramundi	*Lates calcarifer*
Eel-tailed Catfish	*Tandanus tandanus*
Empire Gudgeon	*Hypseleotris compressa*
Firetail Gudgeon	*Hypseleotris gallii*
Flathead Gudgeon	*Philypnodon grandiceps*
Fly-specked Hardyhead	*Craterocephalus stermuscarum*
Goldfish*	*Carassius auratus*
Honey Blue-eyeˆ†	*Pseudomugil mellis*
Mosquito Fish*	*Gambusia holbrooki*
Ornate Rainbowfish†	*Rhadinocentrus ornatus*
Oxleyan Pygmy Perchˆ†	*Nannoperca oxleyana*
Pacific Blue-eye	*Pseudomugil signifer*
Platy*	*Xiphophorous maculatus*
Purple-spotted Gudgeon	*Mogurnda adspersa*

Common Name	Scientific Name
Spangled Perch	*Leiopotherapon unicolor*
Striped Gudgeon	*Gobiomorphus australis*
Swamp Eel species	*Ophisternon* spp.
Swordtail*	*Xiphophorous helleri*
Western Carp Gudgeon	*Hypseleotris klunzingeri*
Estuarine-dependent Species	
Australian Bass	*Macquaria novemaculeata*
Bullrout	*Notesthes robusta*
Freshwater Mullet	*Myxus petardi*
Jungle Perch	*Kuhlia rupestris*
Long-finned Eel	*Anguilla reinhardtii*
Sea Mullet	*Mugil cephalus*
Short-finned Eel	*Anguilla australis*

Notes:
* *Exotic pest species.*
o *Australian native species protected by state and federal legislation.*
ˆ *State and nationally listed species.*
† *Back On Track listed species.*

9.5.9.1 July results

Six species of fish were recorded during the July 2012 surveys for a total of 1048 individuals (**Table 9.5i**). This represents a small proportion (21 per cent) of species that have been recorded in past surveys in streams within the Maroochy River catchment. This is not unexpected considering the nature of the watercourses on site and the history of past disturbance within the Project area. Two of the fish species were exotic (introduced) species with the remaining four species native. The most abundant species were Empire Gudgeon (*Hypseleotris compressa*) (71.2 per cent) followed by the introduced Mosquito Fish (*Gambusia holbrooki*) (17 per cent).

While the number of individual fish and species caught was variable across all seven sites (**Figure 9.5o** and **Figure 9.5p**), the highest abundance and diversity in July 2012 was recorded at site AQ01. No Oxleyan Pygmy Perch (*Nannoperca oxleyana*), Honey Blue-eye (*Pseudomugil mellis*) or Ornate Rainbowfish (*Rhadinocentrus ornatus*) were recorded in the July 2012 surveys.

9.5.9.2 September results

Six species of fish were recorded during the September 2012 surveys for a total of 1388 individuals **(Table 9.5j**). This represents a small proportion (21 per cent) of species that have been recorded in past surveys in streams within the Maroochy River catchment. This is not unexpected considering the size and history of past disturbance within the Project area. Two of the fish species were exotic (introduced) with the remaining four species being native, including one BoT priority species, the Ornate Rainbowfish (*Rhadinocentrus ornatus*).

The most abundant species were Empire Gudgeon (*Hypseleotris compressa*) (47 per cent) followed by the introduced Mosquito Fish (*Gambusia holbrooki*) (42 per cent) (**Figure 9.5q** and **Figure 9.5r**).

While the number of individual fish and species caught was variable across all seven sites, the highest abundance and diversity in September 2012 was recorded at site AQ01. No Oxleyan Pygmy Perch (*Nannoperca oxleyana*) or Honey Blue-eye (*Pseudomugil mellis*) were recorded in the September 2012 surveys; however three Ornate Rainbowfish (*Rhadinocentris ornatus*) were found across two sites (AQ06 and AQ08).

This assessment of fish communities at the site is consistent with the findings of BMT WBM (2010), which reported very similar fish communities and habitat values.

Table 9.5i: Fish species and abundance recorded during the July 2012 surveys

Species	Common Name	AQ01	AQ02	AQ03	AQ04	AQ06	AQ07	AQ08	Totals
Anguilla reinhardtii	Longfin Eel	4	1						5
Gambusia holbrooki	Mosquito Fish*	1	34	56	36		51		178
Gobiomorphus australis	Striped Gudgeon	12	5			20	3	13	53
Hypseleotris compressa	Empire Gudgeon	343	101	33	21	72	119	58	747
Hypseleotris galii	Firetail Gudgeon				35				35
Xiphophorus maculatus	Platy*			27	2		1		30
TOTAL		360	141	116	94	92	174	71	1048

Note:
* *Exotic fish species.*

Figure 9.5o: Fish species and relative abundance recorded during the July 2012 surveys

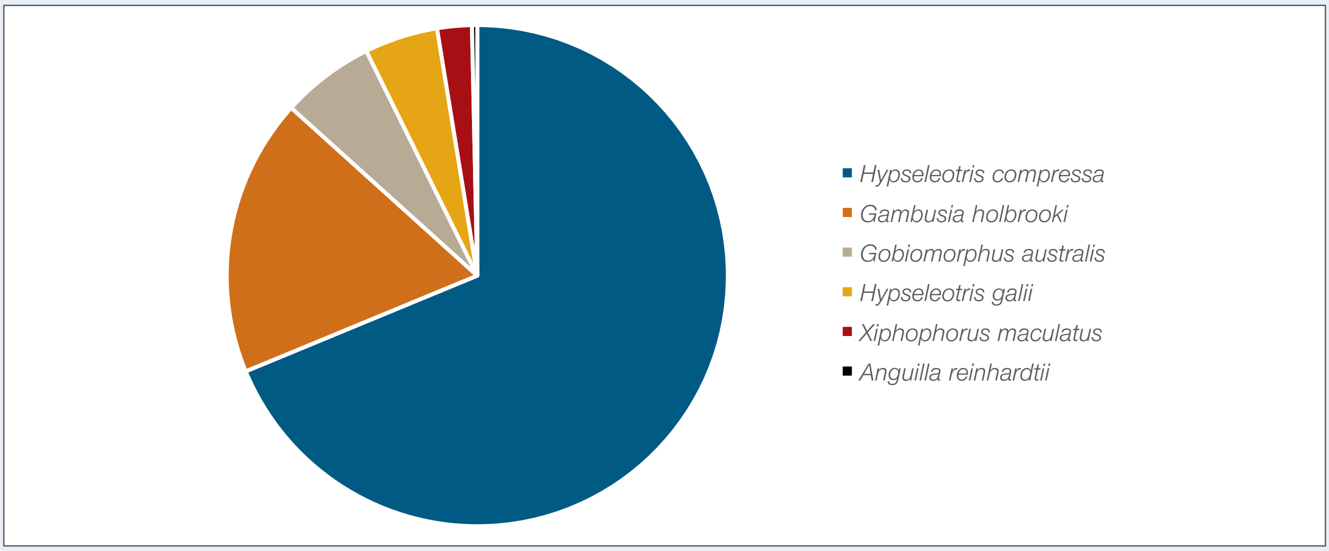


Figure 9.5p: Fish species and abundance recorded during the July 2012 surveys

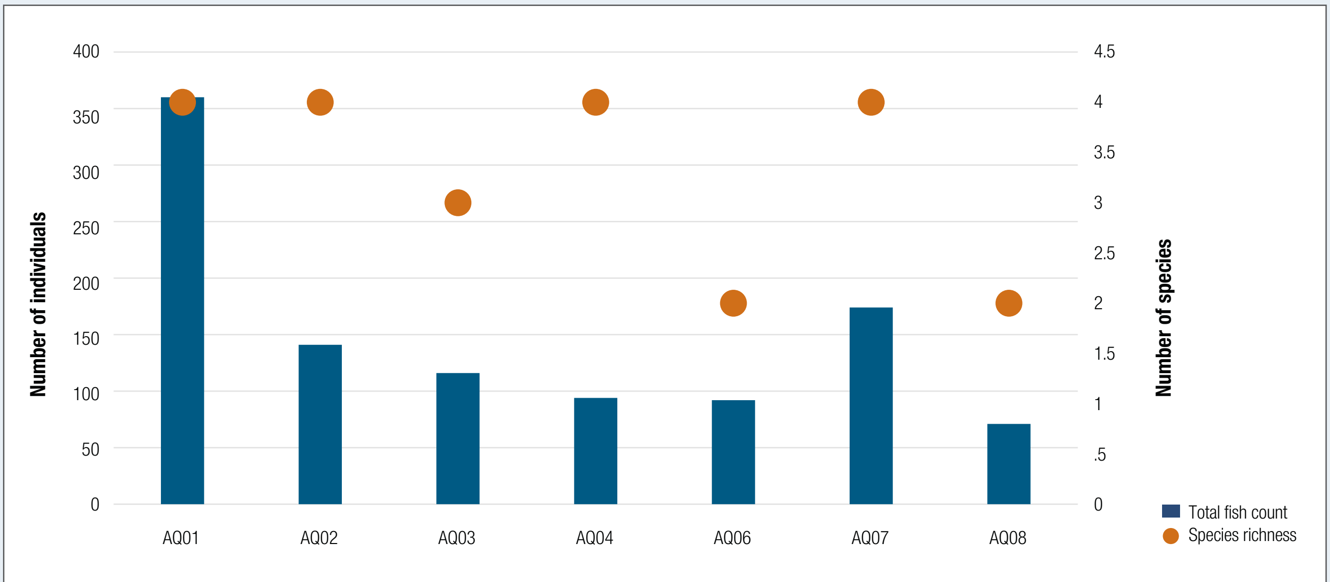


Table 9.5j: Fish species and abundance recorded during the September 2012 surveys

Species	Common Name	AQ01	AQ02	AQ03	AQ04	AQ06	AQ07	AQ08	Totals
Gambusia holbrooki	Mosquito Fish*	318	87	79	38	0	42	21	585
Gobiomorphus australis	Striped Gudgeon	50	24	0	0	37	6	5	122
Hypseleotris compressa	Empire Gudgeon	143	179	62	5	81	125	53	648
Anguilla reinhardtii	Longfin Eel	8	3	0	2	0	0	2	15
Xiphophorus maculatus	Platy*	0	0	14	1	0	0	0	15
Rhadinocentris ornatus	Ornate Rainbowfish†	0	0	0	0	1	0	2	3
TOTAL		519	293	155	52	125	173	83	1388

Notes:
† Back On Track listed species.
** Exotic fish species.*

Figure 9.5q: Fish species and relative abundance recorded during the September 2012 surveys

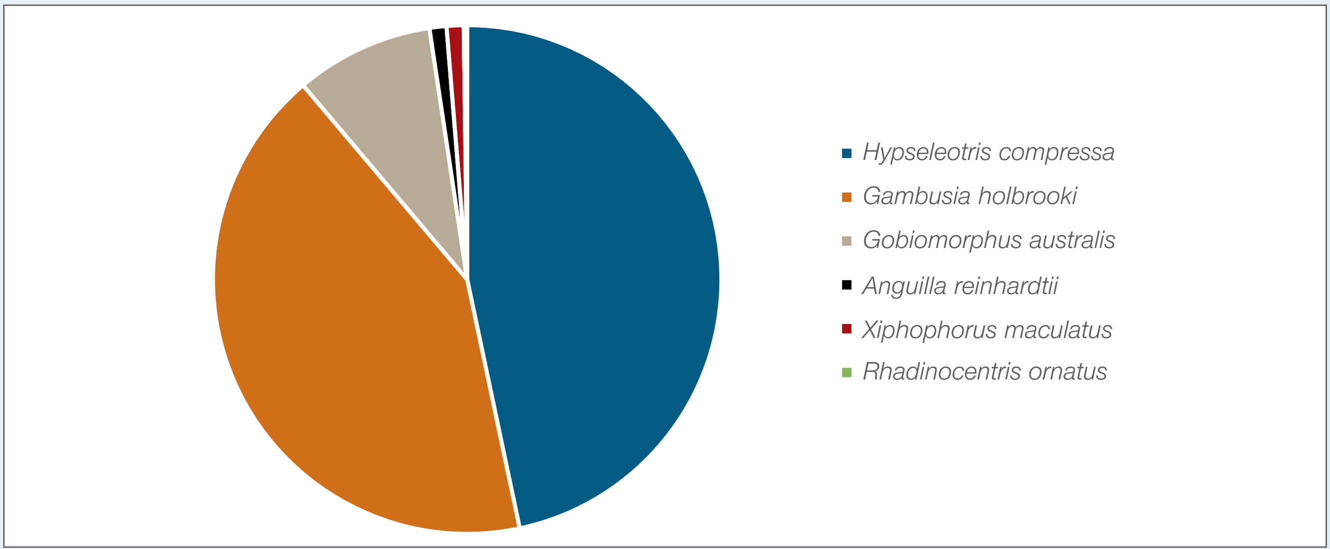
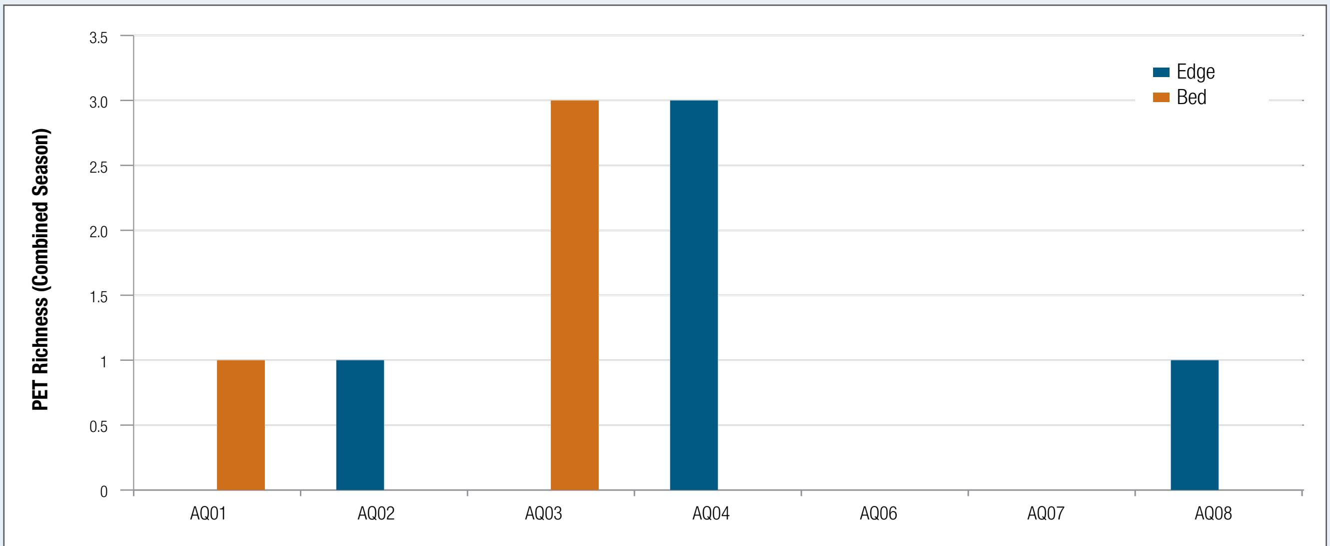


Figure 9.5r: Fish species and abundance recorded during the September 2012 surveys



9.6 SUMMARY OF SITE AQUATIC VALUES

The aquatic ecosystems within the current and proposed Project area are highly channelised, modified water bodies with very small catchments that drain areas within the Project area and immediately adjacent. Most of these waterways cease to flow and many do not hold water during the drier months. They do not provide connectivity to any higher value aquatic ecosystems and generally contain marginal aquatic habitat. Aquatic flora and fauna communities are consistent with highly disturbed, low ecological value systems.

9.6.1 Conservation values

The water bodies within the Project area are not listed as having special conservation status and although database searches indicate the potential for three fish species of concern to be present, only the Ornate Rainbowfish (*Rhadinocentrus ornatus*) ("HIGH" priority under the DEHP BoT species prioritisation framework) was recorded during field surveys, and then only in low numbers within marginal habitat. Honey Blue Eye (*Pseudomugil mellis*) and Oxyleyan Pygmy Perch (*Nannoperca oxleyana*) were not recorded during field surveys, and although their presence cannot be excluded, habitat assessments suggest that their utilisation of these waterways would be minimal and that no critical spawning, sheltering or foraging habitat would be impacted by the Project.

Waterways at the site do not support recreational or commercial fisheries and or aquatic ecotourism opportunities, are not designated fish habitat areas and do not provide critical spawning habitat for species that might be of recreational, commercial or ecotourism value.

9.6.2 Intactness

The aquatic ecosystems within the Project area have been substantially impacted by the airport development and are subject to channelisation, sediment input, disturbance to riparian vegetation and colonisation by riparian weeds. Historical works to facilitate drainage of the airport site, ongoing vegetation management associated with airport operations and the construction of impervious surfaces (e.g. runways, aprons, taxiways and terminals) have altered the natural flow regimes, changed flow volumes and directions and fragmented minor drainage lines. The waterways within the Project area do not provide connectivity to other, higher value aquatic ecosystems.

9.6.3 Uniqueness

High quality coastal stream and wetland systems within South East Queensland are increasingly scarce as a result of urbanisation and development and are therefore of great conservation value. However, whilst the waterways of the Project area may historically have supported locally, regionally or nationally significant aquatic communities, species or wetland systems, these values have already been lost as a result of development. In their current condition, aquatic systems at the site are not considered to be unique or to support unique communities, species or processes. Ongoing management requirements of the existing airport facilities and adjacent industrial, agricultural and urban land use preclude the possibility of these waterways becoming unique, high value aquatic ecosystems.

9.6.4 Resilience to change

As a result of historical disturbance within the Project area, the remaining aquatic communities, including fish, macroinvertebrates and macrophytes tend to be very tolerant of a range of water quality and habitat stressors, making them resilient to both short term changes associated with construction activities, as well as the longer term impacts of altered habitat quality and altered hydrological regime. In the event of a major disturbance, these species are likely to recolonise relatively quickly after the event stabilises.

9.6.5 Replacement potential

The aquatic communities within the Project area exhibit poor diversity, with macroinvertebrates characterised by hardy, pollution tolerant species and fish communities dominated largely by hardy and/or exotic species. With the possible exception of the Ornate Rainbowfish (*Rhadinocentrus ornatus*), these communities are likely to 'self-replace' following a disturbance event.

The replacement potential for Ornate Rainbowfish (*Rhadinocentrus ornatus*) is not known; however it is considered that these systems provide only marginal habitat for the species and that their loss from watercourses within the Project area would have negligible impact when considered in the context of the Sunshine Coast population.

Waterways within the Project area are not considered critical habitat for Ornate Rainbowfish (*Rhadinocentrus ornatus*) spawning, sheltering or foraging and do not provide connectivity between populations of this species.

9.6.6 Summary

As a result of substantial historical degradation through urbanisation, agriculture and the development and operation of the Sunshine Coast airport, aquatic communities and values within the Project area are highly disturbed, of relatively low value, provide little connectivity to high value aquatic habitat and remaining communities are likely to be resilient to further impacts.

9.7 IMPACT ASSESSMENT

This impact assessment assumes that standard best practice codes, guidelines and protocols for each of the construction activities will be adhered to (as per the Environmental Management Plan (EMP) provided in Chapter E3). As the freshwater ecosystems within the Project area exhibit historical degradation, largely disconnected from any aquatic habitat value, within close proximity to estuarine influences and are of generally low ecological value, no additional mitigation measures specific to aquatic ecosystems are suggested.

The potentially threatening processes and activities on aquatic ecosystems associated with the Project are provided below and a summary of the risk discussion is provided in **Table 9.7a**.

The Project components and infrastructure detailed in Chapter A4 – Project Description and the impacts of these activities on surface water quality have been addressed in Chapter B6 – Surface Water and Hydrology.

9.7.1 Potential impacts of construction activities

The following activities are associated with the construction phase of the Project and have the potential to impact on aquatic ecosystems.

<u>Access tracks (including creek crossings)</u>

The construction of both temporary and permanent access tracks will be necessary to enable plant and machinery to access construction and stockpile areas and for maintenance of dredge infrastructure and flood mitigation structures. In some places these access tracks may cross waterways and drainage lines.

Unmitigated, the potential for impacts associated with access track construction is largely related to sediment transport into drainage lines and waterways, which may occur as a result of ground breaking or track forming activities. The deposition of sediments into waterways has the potential to result in smothering of submerged aquatic vegetation and benthic habitat, transport of nutrients and other contaminants and the enrichment of waterways with organic material, which can result in stress on aquatic communities as a result of oxygen depletion.

However, field surveys have indicated that aquatic substrates and benthic habitat across the Project area are entirely comprised of sand, silts and clays, negating the potential for smothering of higher quality benthic substrates. Only one species of submergent aquatic plant was identified, the Stonewort (*Chara* spp.), which is a fast growing, low light tolerant species that is an early coloniser following disturbance events. The aquatic flora and fauna at the site are hardy, largely disturbance tolerant and are indicative of waterways that experience periodic poor water quality.

Short term impacts associated with access track construction would largely be avoided through the implementation of standard protocols (e.g. avoiding construction during wetter periods, use of sediment curtains etc.) as outlined in the EMP in Chapter E3.

Through effective implementation of appropriate mitigation measures, the overall impacts associated with access track construction are considered negligible.

Vehicles, plant, machinery and associated infrastructure

For the purposes of this impact assessment, vehicles, plant and machinery includes:

- Earth moving equipment
- Heavy vehicles used to transport machinery, components or materials to site
- Dredge spoil pipelines
- Hard stand areas, site office and amenities
- Light vehicles
- Generators, lighting etc.

Potential impacts and management options for aquatic ecosystems includes:

- Increased potential for sediment transport as a result of the removal of vegetation, ground breaking activities and vehicle usage (e.g. rutting). Standard best practice, such as completion of works during drier months, use of sediment management devices and minimising the exposure of bare soils are expected to minimise or avoid this impact.
- Contamination of waterways with fuels, oils and other fluids associated with vehicle use and maintenance. It is anticipated that refuelling and machinery maintenance will occur off-site, or at appropriate on-site facilities. Contamination as a result of machinery failure (e.g. ruptured fuel line) is unlikely and will be minimised through the implementation of an appropriate maintenance regime.
- Contamination of waterways with gross pollutants (e.g. litter) will be avoided through the implementation of waste management protocols.
- Contamination of waterways with nutrients, organic material and microbiological contaminants emanating from site sewerage facilities will be avoided as this waste will be contained on-site and removed for disposal as required.
- Contamination of freshwater sites with saline water is expected to be minimal. Minor leakage from the pipeline carrying the dredge spoil slurry is anticipated in the vicinity of pipe couplings, with water likely to be absorbed into the soil in the immediate vicinity of the couplings. Major discharge as a result of catastrophic pipe failure is exceedingly unlikely (see Chapter A5 – Project Construction).
- There is potential for the introduction of aquatic weeds or pest plants that can be transported on equipment and machinery used within waterways. However, standard machinery hygiene protocols and avoiding the use of equipment within stream beds will manage this risk. Currently there are two species of introduced fish known to be present within the Project area, specifically Gambusia (*Gambusia holbrooki*) and Platy (*Xiphophorus maculatus*). It is considered unlikely that aquatic pest species other than weeds could be introduced to the Project area due to proposed construction activities.

The EMP (Chapter E3) outlines these and other standard best practices for all of the activities and impacts described above. It is considered that the potential impacts on aquatic ecosystems are manageable in the context of the proposed construction activities within the Project area.

Aquatic communities within the Project area are tolerant of a wide range of impacts and are likely to quickly recolonise following short-term disturbance events.

On the basis of the above assessment, the likelihood of an impact associated with the use of vehicles, plant and equipment within normal operational protocols is considered to be negligible.

Altered flow hydrology, flow diversion

Construction of the RWY 13/31 requires the development of major drainage infrastructure including the northern and western perimeter drains, which have base widths of 10 m. These drainage channels will direct runoff from the Project area north to Marcoola drain and south around the end of RWY 13/31 to the southern perimeter drain. The connection of existing minor drainage lines into the northern perimeter drain will be designed to ensure that water levels in the minor drains are maintained at similar levels to baseline. This will help to protect the existing aquatic habitat north of the runway from hydrological changes introduced by the northern perimeter drain.

Construction of the runway will require any existing drainage lines within the Project footprint to be filled. Construction of the runway and taxiway pavements will also change approximately 15 ha of permeable surface (soil) to impermeable surface (asphalt). Consequently, the volume of runoff from the site will increase. This additional runoff will flow to the proposed perimeter drains which have been designed to accommodate the predicted flow at velocities that are unlikely to cause scour.

Tailwater from the reclamation area will be discharged into the northern perimeter drain where it will flow into Marcoola drain and further downstream into the Maroochy River.

The results of the water quality and flow assessed (refer Chapter B6) indicate that the tailwater discharge would be brackish to saline and impacts have been discussed in this chapter.

On the basis of this assessment, it is considered that impacts associated with altered hydrology and flow diversion on the existing aquatic ecosystems are low.

Loss of riparian vegetation

The impacts of vegetation removal in this document have been assessed in the context of threatened species, habitat and communities perspective elsewhere in this document; however this section assesses the potential impacts on aquatic communities, processes or species as a result of vegetation removal.

It is anticipated that some vegetation will be removed during the construction process, although this will largely be away from riparian zones. However, the removal or management of vegetation within or immediately adjacent to watercourses will be required along the existing drainage lines north of site AQ06 within areas that will be lost to land reclamation.

Unmitigated, this loss of riparian and instream habitat could result in a reduction in the quality of aquatic habitat downstream as a result of reducing capacity of the riparian zone to buffer the waterways from sediment laden surface runoff and/or the increased potential for stream bank erosion during flood events. The deposition of sediments into waterways has the potential to result in smothering of submerged aquatic vegetation and benthic habitat, transport of nutrients and other contaminants and the enrichment of waterways with organic material, which can result in stress on aquatic communities as a result of oxygen depletion.

However, field surveys have indicated that aquatic substrates and benthic habitat across the Project area are entirely comprised of sand, silts and clays, negating the potential for smothering of higher quality benthic substrates. Only one species of submergent aquatic plant was identified, the Stonewort (*Chara* spp.), which is a fast growing, low light tolerant species that is an early coloniser following disturbance events. The aquatic flora and fauna at the site are hardy, largely disturbance tolerant and are indicative of waterways that experience periodic poor water quality.

Short term impacts associated with riparian vegetation removal would largely be avoided through the implementation of standard protocols (e.g. avoiding construction during wetter periods, use of sediment curtains etc.) as outlined in the EMP in Chapter E3.

Overall the impact of this is considered to be low.

Loss of aquatic habitat

The reclamation of land for construction of the new runway will result in the loss of aquatic habitat at the western end of the Project area, including field survey site AQ06. The loss of this habitat is an unavoidable impact of the Project.

These habitats are of a slightly higher quality/value than other aquatic habitats recorded within the Project area but are nonetheless of low ecological value and the aquatic communities that they support are characterised by hardy, pollution tolerant species. A single specimen Ornate Rainbowfish (*Rhadinocentrus ornatus*) was recorded at site AQ06 indicating their presence but suggesting that it is marginal habitat.

On the basis of this assessment, it is considered that impacts associated with loss of habitat are low.

Fish Passage and/or fragmentation of aquatic systems

The movement of fish and/or other aquatic biota within a watercourse can be impeded by physical structures (e.g. culverts, weirs and bridges), hydrological changes (e.g. high/low velocity flows and changes in water depth) or other factors such as habitat modification, noise and light, etc.

Fragmentation of aquatic systems occurs when areas of quality aquatic habitat become cut off and isolated or the passage of species becomes restricted as a result of construction operations or activities. In these circumstances, isolated pockets of aquatic habitat may experience reduced recruitment and gene exchange, while individual animals within this habitat may be unable to access important spawning or foraging habitat.

Whilst there is loss of some aquatic habitat within the runway footprint, the existing waterways do not provide connectivity to other higher conservation value waterways. Communities within the existing aquatic habitats are of low conservation significance and the construction of diversion channels for site water management is expected to mitigate these impacts to some extent. Therefore, impacts are considered to be negligible.

Fish spawning

Unmitigated, impacts from construction activities such as increased sedimentation have the potential to smother fish eggs and cause reductions in endemic freshwater fish populations. The EMP (Chapter E3) outlines general mitigation measures to minimise sediment mobilisation into streams. As the aquatic ecosystems within and adjacent to the Project area are generally of low ecological value and provide only marginal habitat for one fish species of conservation significance, impacts are therefore considered to be negligible. As such, no additional mitigation measures relating to altering construction activities around spawning periods of freshwater fish are considered necessary.

9.7.2 Potential impacts of operational activities

Surface water hydrology

The surface water hydrology of the system will be impacted by an increase in the area (approximately 15 ha) of impermeable surface that would be created by the construction of the new runway, aprons, taxiways and other paved areas. The reduced permeability and altered drainage regime of the Project area are discussed in Chapter B6 – Surface Water and Hyrdrology.

It is anticipated that the altered drainage regime will change the flow characteristics of existing and newly created aquatic habitats within the Project area, however, operational impacts are anticipated to be very similar to those encountered in the final stages of the construction phase.

Assessment of aquatic communities has ascertained that it is very unlikely that species of conservation concern are supported by the existing habitat recorded within the Project area. Further, the communities that are present are expected to be resilient and tolerant of changes associated with altered hydrology. Due to the nature of these communities and the lack of connectivity with more substantial aquatic habitats or populations, altered flow regimes are unlikely to have a significant impact on aquatic biota. Therefore, impacts are considered to be low.

Sediment transport

The transport of sediment from the Project area into waterways and drainage lines both on-site and off-site is expected to be managed during the operational phase of the Project by utilising grassed areas between the runway and the proposed new drainage structures that will trap and retain sediments.

Assessments of aquatic communities and habitats that currently exist at the site indicate a high degree of historical disturbance, with communities comprised of taxa that are tolerant of turbid water and a silt/clay substrate that suggests that the influx of sediment has occurred frequently in the past.

Due to the anticipated low level transport of sediments during the operational phase and the resilience and tolerance of existing communities, operational impacts associated with sediment transport are considered negligible.

Altered water quality

Potential impacts of airport operations and maintenance on water quality have been dealt with in the water quality section of this EIS (Chapter B6). However, as reduced water quality has the potential to adversely impact on aquatic communities, key aspects of concern for aquatic communities are considered in this section. These include:

- Sediment transport and turbidity in the context of operational impacts has been previously discussed
- Disturbance of Potential Acid Sulphate Soils (PASS) and/or the mobilisation of metals and nutrients are considered unlikely, as it is understood that PASS are not present at this site
- Contamination associated with hydrocarbons, particularly those associated with aircraft fuels and lubricating oils is possible, although this is minimised through normal procedures for aircraft refuelling and maintenance
- The transport of organic loads that might deplete oxygen concentrations is considered likely. Specifically, these loads are likely to be associated with grass cutting and vegetation management in proximity to drainage lines
- The transport of nutrients associated with sediments and/or organic material, with the potential for algal blooms and altered aquatic processes is considered likely.

Whilst the majority of these pollutants are considered unlikely to occur under normal circumstances, the transport of organic materials and nutrients to waterways on-site (as a result of grass cutting) is considered likely. Due to the resilience and tolerance of existing communities, operational impacts associated with altered water quality are considered to be low.

Access tracks (including creek crossings)

It is anticipated that some of the access tracks to be built during the construction phase will not be required upon completion of the Project and will be rehabilitated. However, some permanent tracks will remain for operational access and maintenance purposes where some may cross waterways and drainage lines.

The potential for impacts associated with track maintenance is largely related to sediment transport into drainage lines and waterways, which may occur during scraping and vegetation management.

The deposition of sediments into waterways has the potential to result in smothering of submerged aquatic vegetation and benthic habitat, transport of nutrients and other contaminants and the enrichment of waterways with organic material, which can result in stress on aquatic communities as a result of oxygen depletion.

Field surveys have indicated that aquatic substrates and benthic habitat across the Project area are entirely comprised of silts and clays, negating the potential for smothering of higher quality benthic substrates. Only one species of submergent aquatic plant was identified, specifically Stonewort (*Chara* spp.), which is fast growing, low light tolerant and is capable of rapid colonisation following disturbance events. The aquatic flora and fauna recorded at the site are hardy, largely disturbance tolerant and are indicative of waterways that experience periodic poor water quality.

Short term impacts associated with track maintenance can be largely avoided through the implementation of standard protocols (e.g. avoiding operations during wetter periods, use of sediment curtains etc.).

Given the nature of aquatic habitat and communities on site, impacts as a result of track maintenance are considered negligible.

Vehicles and aircraft

For the purpose of this impact assessment, vehicles and aircraft are considered to include:

- Light vehicles
- Commercial jets
- Private aircraft (including helicopters)
- Refuelling and maintenance infrastructure.

Potential impacts on aquatic ecosystems include:

- Sediment transport as a result of vehicle usage (e.g. rutting)

- Contamination of waterways with fuels, oils and other fluids associated with vehicle/aircraft use and maintenance. It is anticipated that refuelling and maintenance will occur off-site or at appropriate on-site facilities. Contamination as a result of machinery failure (e.g. ruptured fuel line) is very unlikely and will be minimised through an appropriate maintenance regime and the fact that aircraft and vehicles will not normally be used in close proximity to drainage lines
- Contamination of waterways with gross pollutants (e.g. litter) is expected to be avoided through the effective implementation of SCA's waste management practices, which will be expanded to accommodate new development areas.

Aquatic communities at the site are tolerant of a wide range of impacts and are likely to quickly recolonise following a short-term disturbance event.

On the basis of the above assessment, the likelihood of an impact associated with the use of vehicles, plant and equipment within normal operational protocols is considered to be negligible.

9.8 CUMULATIVE IMPACTS

The following projects have been identified as potential contributors to cumulative impacts on aquatic ecosystems, communities or processes, being sited within 40 km of the Project area:

- Potential desalination plant site
- Sunshine Motorway Upgrades, including the Sunshine Coast Transport Project
- Upgrades to the Bruce Highway
- The CAMCOS (passenger rail) Project
- Canelands Plan.

The waterways within and surrounding the Sunshine Coast Airport site have been found to be in poor physical condition and to support aquatic assemblages that are consistent with highly disturbed systems. No EVNT or EPBC Act listed species were recorded during field studies, and the available habitat is considered unlikely to support the relevant aquatic EVNT and EPBC Act listed species (*Oxleyan Pygmy Perch (Nannoperca oxleyana*), Honey Blue-eye (*Pseudomugil mellis*)). Watercourses within the Project area are small and emanate from within the airport footprint or nearby adjacent areas. They do not provide connectivity to higher quality aquatic habitat or communities.

One BoT priority fish species, Ornate Rainbow Fish (*Rhadinocentrus ornatus*) ("HIGH" priority), was recorded during field surveys, although habitat within the Project area site is marginal for this species, does not constitute critical spawning, sheltering or foraging habitat and doesn't provide connectivity between populations of this species.

Due to the minimal impacts of the proposed airport expansion, the contribution of the Project to the cumulative impacts of the above projects on local aquatic systems, communities and processes is considered to be negligible.

9.9 CONCLUSION

Field surveys undertaken during July 2012 and September 2012 have revealed that waterways within the Sunshine Coast Airport site are in relatively poor ecological health and show signs of substantial historical disturbance associated with urbanisation, agriculture and airport operations. As a result, the aquatic communities, habitat and processes that are supported by these waterways tend to be dominated by fish and invertebrate assemblages comprised of hardy, pollution and disturbance tolerant taxa.

Many of the values inherent in more pristine coastal streams within South East Queensland are not present within waterways of the Sunshine Coast Airport, including EVNT/EBPC Act listed Oxleyan Pygmy Perch (*Nannoperca oxleyana*) and Honey Blue-eye (*Pseudomugil mellis*). These species were not recorded during field surveys, and assessments of the available habitat revealed that the site unlikely to support them.

One BoT priority fish species, the Ornate Rainbowfish (*Rhadinocentrus ornatus*), was recorded in low numbers within the airport waterways, although the available habitat is considered marginal for this species and does not include critical spawning, foraging or sheltering habitat.

All of the waterways on site were relatively small, emanating either from within the airport or in close proximity, and providing no connectivity to higher value waterways or aquatic communities upstream.

The most profound impacts of the proposed airport expansion on aquatic systems would be the complete loss of aquatic habitat that currently exists within the footprint of the proposed new runway and the loss of riparian vegetation adjacent to the runway footprint. It is anticipated that these systems will be redirected around the new runway to facilitate drainage on the site. Whilst this is considered an unavoidable impact of the Project, the current status of these waterways (very small, local nature, lack of connectivity and lack of potential to support high conservation value taxa) limits the magnitude of the impact.

Due to the low conservation value of both habitats and aquatic assemblages within waterways of the Project area, specific impact avoidance, minimisation, mitigation or offset strategies are not considered necessary for the Project. The development and implementation of an EMP that complies with current best practice for projects of this nature is considered sufficient to maintain or improve the status of waterways at the site, with particular emphasis on maintaining or improving water quality and minimising the transport of sediments.

As the impacts of the Project are considered negligible at a local/regional scale, it is considered highly unlikely to contribute to cumulative impacts associated with other projects nearby.

Table 9.7a: Aquatic ecosystem impact assessment

Aquatic Ecosystems	Initial Risk Assessment with Inherent Preliminary Design and Compliance with Relevant "Best Practice" Guidelines				Residual Risk Assessment with Additional Mitigation in Place			
Impacting Processes	**Inherent Mitigation**	**Significance of Impact**	**Likelihood of Impact**	**Risk Rating**	**Additional Mitigation Proposed**	**Significance of Impact**	**Likelihood of Impact**	**Risk Rating**
Construction								
Construction of access tracks	Use of silt curtains, minimisation of exposed soils, appropriate design of drainage etc. Provisions to be made in the erosion, acid sulphate soils, hydrology, water quality and traffic components of the EMP	Negligible	Unlikely	Negligible	None required	Negligible	Unlikely	Negligible
Vehicle, plant, machinery impacts	Refuelling and maintenance operations remote from water drainages, appropriately bunded or off-site facilities. Provisions made in the EMP and DMP for the Project.	Negligible	Possible	Negligible	None required	Negligible	Possible	Negligible
Altered hydrology/ flow diversion	Design drain cut off in Northern Perimeter Drain	Negligible	Almost certain	Low	n/a	Minor	Almost certain	Low
Removal/ management of riparian vegetation	Minimisation of vegetation removal as far as possible, minimisation of soil exposure	Negligible	Almost certain	Low	n/a	Negligible	Almost certain	Low
Removal of aquatic habitat (land reclamation)	None	Negligible	Almost certain	Low	n/a	Minor	Almost certain	Low
Construction (continued)								
Reduced fish passage/ fragmentation of aquatic habitat	Avoid installation of weirs, dams or other barriers to fish, minimise the redirection of drainages as far as possible	Negligible	Unlikely	Negligible	n/a	Negligible	Unlikely	Negligible
Fish spawning	Use of silt curtains, minimisation of exposed soils, appropriate design of drainage etc. Provisions to be made in the erosion, hydrology, water quality and traffic components of the EMP	Negligible	Unlikely	Negligible	n/a	Negligible	Unlikely	Negligible
Operation								
Altered hydrology	None possible	Negligible	Almost certain	Low	n/a	Negligible	Almost certain	Low
Sediment transport	Minimise the exposure of bare soils as much as practicable, maintain vegetative cover, silt curtains or other means to contain the transport of sediment to watercourses,	Negligible	Possible	Negligible	n/a	Negligible	Possible	Negligible
Altered water quality		Minor	Possible	Low	None required	Minor	Possible	Low
Access track maintenance	Use of silt curtains, minimisation of exposed soils, appropriate design of drainage etc. in compliance with relevant guidelines and codes	Negligible	Unlikely	Negligible	None required	Negligible	Unlikely	Negligible
Vehicle and aircraft activities	Minimise use of vehicles within waterways through construction of appropriate crossings where required	Negligible	Possible	Negligible	None required	Negligible	Possible	Negligible

9.10 REFERENCES

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