7. Aquatic biology

This section describes the existing aquatic environment in the areas affected by the Project. The assessment of the aquatic environment has been based on a review of existing information and the outcomes of supporting field investigations. Potential impacts and mitigation measures have also been identified and discussed.

7.1 Methodology

The aquatic ecology assessment for the Project included an initial review of background information relevant to the project area, including previous consultancy reports and assessments of the area. Field investigations and site assessments were then conducted on the upstream and downstream environs of the main creek systems in the project area to provide baseline evaluations of the conditions of the creek environs prior to construction and to identify any sensitive habitats or species that would need to be considered as part of a construction or operation EMP.

7.1.1 Background searches

Initial desktop studies were carried out during August 2007 as part of the preliminary ecological assessment of the project area. This included a review of existing background information on the aquatic ecology of the Calliope River catchment from previous consultancy and government reports as well as database searches. Data searches and reports relevant to the aquatic ecology component of the survey included:

- The DEWHA's EPBC Protected Matters Search Tool
- The EPA Wildlife Online database
- The EPA RE Mapping
- The EPA Wetland Maps
- Queensland Museum database (fish and crustacean records)

7.1.2 Field assessment

A total of eight sites were selected and sampled during a dry season (August 2007) and a wet season (February 2008) to provide information on the aquatic habitats, flows and conditions present during both seasons. The sites were selected to provide a 'snap shot' of the freshwater aquatic ecological communities of Larcom Creek and the Calliope River upstream and downstream of the project area. Sampling and analyses were undertaken in accordance with QLD Australian River Assessment System (AusRIVAS) Sampling and Processing Manual (2001). The location of the monitoring sites is illustrated in Figure 7.1.

Using the AusRIVAS aquatic ecological assessment methodology, each site assessment included the following:

- A general site description (including illustration of site and photos)
- Stream description (width, depth, substrate composition)
- Water quality (presence of odours, surface scums, etc)
- Riparian vegetation (height, width, species composition)
- Surrounding environmental pressures (eg agriculture linear disturbances such as roads)
- Where practically possible, eight baited fish traps were set up at each site for a period of two hours to assess the fish and crustacean species present at each location. A barrel net was also set for two hours where water depth was suitable (Site 3)

It should be noted that due to dry conditions in August 2007 only seven sites were surveyed (ie the upper reaches of Larcom Creek are ephemeral and no pool habitats were present). During the February 2008 all eight sites were surveyed.

The water quality of the aquatic systems is described in detail in Section 8. An assessment of the terrestrial flora (refer Section 5) and terrestrial fauna (refer Section 6) was also conducted within the general area providing additional environmental information to complement the aquatic ecology assessment.

7.2 Existing environment

7.2.1 Significant wetlands

No Ramsar wetlands or wetlands of national importance (Directory of Nationally Important Wetlands) were identified within the project area. However, the Project is located in the mid reaches of the Calliope River catchment approximately 40 km upstream of where the river flows into Port Curtis to the north of Gladstone.

Port Curtis is listed in the Directory of Nationally Important Wetlands (refer Figure 7.2). This wetland provides important habitat for a number of threatened aquatic fauna species, including dugongs, marine turtles and cetaceans, all of which have been recorded from the region.

The wetland area has also been recognised as an important staging area for a number of wader and wetland migratory bird species prior to commencement of their annual migrations. These include species protected under the international migratory bird agreements with Japan and China (Japan-Australia Migratory Bird Agreements (JAMBA) and China-Australia Migratory Bird Agreements (CAMBA), respectively), and the Commonwealth EPBC Act (C&R Consulting 2005).

The Great Barrier Reef World Heritage Area (GBRWHA) extends from the low mean water mark of the mainland and consequently encompasses Port Curtis. Hence there is the potential for the Project to impact on the values of the GBRWHA. Within this area is also Rodds Bay Dugong Protection Area.

EPA Wetland mapping for the area identified a number of lacustrine and palustrine wetlands within the vicinity of the project area (refer Figure 7.2). These wetland ecosystems are unlikely to be directly impacted by the Project, however changes to the hydrology of the area may impact these ecosystems by reducing catchment areas and inundation periods or altering systems characteristics (ie ephemeral to perennial wetlands). During the field investigations a number of lacustrine and palustrine wetland systems were identified which are currently not mapped on the EPA Wetland Mapping. These systems are discussed in Section 7.2.2.

7.2.2 Major watercourses

The project area is located within the Calliope River catchment, which encompasses an area of approximately 2,236 km^2. The Calliope River catchment has been subject to extensive alteration and clearance (approximately 66% of the remnant vegetation removed) to accommodate agricultural/pastoral use (C&R Consulting 2005). Where this has occurred, the areas have been revegetated with introduced pasture grasses (including areas adjacent to aquatic systems).

Although changes such as these have significantly altered the structural composition of vegetation communities within the catchment, a narrow semi-continuous riparian strip, largely dominated by native vegetation has been retained along the riverine system (C&R Consulting 2005).

The project area is located within the freshwater reaches of the Calliope River catchment (ie above the tidal limit of 32.8 km Adopted Middle Thread Distance (AMTD)). The major riverine environments, creek systems and wetlands located in the project area are described below.

Calliope River

With a channel length of approximate 100 km the Calliope River is an unregulated system with a perennial baseflow. Flowing in an easterly direction from the Calliope Ranges (headwaters), the Calliope River discharges into Port Curtis, north of Gladstone (near the proposed WICT Project at Golding Point). There are five major tributaries of the Calliope River. These include Oakey Creek, Paddock Creek, Double Creek, Farmer Creek and Larcom Creek.

The reaches of the Calliope River system have been described as having a high to very high ecological value with several supporting values in each reach (C&R Consulting 2005). An outstanding feature of Calliope River system is the extent and diversity of aquatic macrophyte assemblages, particularly in the periods following peak flow events. As noted by C&R Consulting (2005), other ecological values include:

- Deepwater/freshwater refugia
- Riffle habitats
- High integrity fish communities
- Diverse macroinvertebrate communities
- Habitat diversity in the flood channel
- Relatively intact riparian zone
- Frontage woodland on alluvial terraces, levees and floodplains
- Floodplain wetlands
- Remnant vegetation (ie mapped as REs)

Within the project area, the reach of the Calliope River is characterised by a series of large, deep waterholes. This is reflected in the EPA Wetland Mapping which classifies the reach as a riverine system (ie wetlands and deepwater habitats contained within the river channel). The river is approximately 100 m wide (high bank to high bank) with the main channel between 20 and 50 m wide. Baseflow was evident during the field activities.

Much of the riparian zone is currently mapped by the EPA as 'Of Concern' RE11.3.4/11.3.25 and contains commonly associated riparian species such as *Callistemon viminalis, Casuarina cunninghamiana, Eucalyptus tereticornis* and *Melaleuca* sp. Whilst narrow, this vegetation is also generally considered to be in good condition (C&R Consulting 2005).

Riparian vegetation is important to the function and health of instream communities. These communities act as a buffer by filtering out sediments and reducing overland flows, influence microclimates (ie shading and moisture), important trailing habitats, contribute organic matter, and contributes LWD and snags (logs, twigs, sticks and leaves), which are important sources of in-stream microhabitat and food resources for the aquatic communities present.

This type of erosion is generally caused through stock trampling. Such activities impact bank structure which increases the potential for sedimentation, turbidity and excess nutrients within the waterway. In-stream habitats may also have been greatly reduced due to stock moving through the substrate and feeding on aquatic flora.

The vegetation along the high water bank was generally open eucalypt woodland which had been thinned or fragmented to accommodate land use pressures.

On a local scale the Moura Link Eastern Option intersects the Calliope River in an area already subject to heavy disturbance. This area is a major thoroughfare used by the local landowner to move cattle across the Calliope River. Grazing stock has the capacity to change the structure and composition of lower and mid stratums in the riparian zone, which promotes erosion and in some instances has caused a reduction of in-stream habitat.

Cattle grazing may also impact on instream habitats through the disturbance of substrates and microphyte communities and increased nutrient loading. The instream habitats within this area have also been impacted with limited macrophyte richness and abundance. Also there is limited complexity with a predominantly homogenous substrate (fine clay sediments), no riparian zone (50 m clearing) and limited woody debris.

Conversely, the Moura Link Western Option will cross a relatively intact section of the Calliope River. Within this area the riparian zone is intact and there is good instream habitat (ie macrophyte diversity and heterogenous substrate). The adjoining land pressures were similar, including cattle movement, invasive weeds, thinning and clearing.

Both areas contained declared pest species *Parthenium hysterophorus, Lantana camara* and *Cryptostegia grandiflora* in their riparian zones (refer Section 5).

Observed pressures include cattle grazing, dieback, invasive weeds and recreational use. However, despite these pressures, the structure and integrity of the riparian zone and the instream habitat has generally remained intact. The Calliope River is significant to the local community in terms of recreational value. Evidence suggests that the river is used regularly for camping, swimming, bird watching and fishing.

Larcom Creek

The northern section of the Project is located within the Larcom Creek sub-catchment, which encompasses an area of approximately 34,000 ha. Larcom Creek is a major tributary of the Calliope River, which is sourced to the west of Mount Larcom and flows south west prior to discharging into the Calliope River north of Castlehope (refer Figure 7.2). The dominant land use within this area is cattle grazing.

Characterised by the EPA's wetland mapping as a riverine environment (refer Figure 7.1), Larcom Creek is an ephemeral system which is distinguished by ephemeral watercourses in the upper reaches and a series of large, deep waterholes in the mid and lower reaches.

As shown in Figure 7.2, the project area intersects the upper reaches of Larcom Creek north of Gladstone-Mount Larcom Road. As observed during the field investigations within this area, the creek is ephemeral and characterised by a narrow channel with a rocky and alluvial substrate and a dense (foliage cover >75%) narrow strip of riparian vegetation dominated by *Callistemon viminalis* and *Casuarina cunninghamiana*.

A number of unnamed watercourses drain south from the proposed Aldoga Rail Yard prior to discharging into Larcom Creek south of Gladstone-Mount Larcom Road. These tributaries are also ephemeral and have been significantly cleared leaving the riparian zone between 0 m and 20 m wide. Where the riparian zone exists, the structure is similar to other sections of Larcom Creek. During the field investigations it was noted that the proliferation of introduced grass species had impacted overland and instream flow by choking culverts under the NCL and Gladstone-Mount Larcom Road.

There is evidence that the construction of the EEMBL has altered natural flows along an unnamed watercourse, which discharges into Larcom Creek, with a natural retention basin created. This has resulted in a permanent wetland ecosystem which is of high local value despite the proliferation of weed species such as *Urochloa mutica* (Paragrass).

The Moura Link will intersect Larcom Creek to the south of the EEMBL. Within this area the creek is characterised by large deep pools with an alluvial substrate and a narrow riparian zone similar to that present along the Calliope River and the lower reach of the creek. Adjacent land use pressures include grazing and linear disturbances (eg gas pipeline and power easements) which have removed large areas of remnant vegetation.

There is evidence that changes to morphology of the creek as a result of the Bruce Highway have impacted on structure and integrity of the instream habitats. This has occurred through the proliferation of pest flora which have reduced the structural complexity and consequently choked the system.

Downstream of the Bruce Highway, Larcom Creek is characterised by a narrow channel interspersed with deep waterholes. The riparian zone is generally narrow and continuous, however clearing has fragmented sections of the creek line.

Farmer Creek

Farmer Creek is a minor tributary of the Calliope River with a catchment area of approximately 50 km^2. The creek is characterised by ephemeral flows and is predominantly dry with a number of disjunct freshwater pools in the lower reaches.

A semi-artificial in-stream wetland (permanent water hole) dominates the middle reaches. Forming partially due to the construction of a waterway barrier for irrigation and pastoral purposes, the wetland (Site 3) was surveyed during August 2007 and February 2008 (refer Figure 7.1) and it was noted that macrophyte diversity was high and similar to pool habitats within the Calliope River.

The area is considered of ecological, agricultural and recreational value and as such, is locally significant within the region. Discussions with the local landowner also confirmed that Farmer Creek is utilised for water storage, swimming, bird watching and fishing.

The Moura Link Eastern Option crosses the main channel of Farmer Creek. Within this area the channel is characterised by an open alluvial channel with a permanent pool habitat which extends upstream for approximately 2.5 km to a large pool at Fairview homestead (refer Figure 7.1). The substrate composition forming the bed and bank was predominately silt and mud, which had an anoxic odour when disturbed. Clearing activities have removed vegetation along the creek system and as such there is evidence of rill and gully erosion. Other pressures include cattle grazing.

Downstream of the Moura Link Eastern Option the creek is an open channel which narrows to form steep banks (approximately 5-10 m high) prior to discharging into the Calliope River downstream of the Moura Link Western Option (refer Figure 7.1). Within this area, there is evidence of a high flow rate due in part to the narrowing of the channel. Evidence also shows significant scouring and erosion. It is likely that the creek will eventually alter the geomorphology of the Calliope River/Farmer Creek junction.

In addition, the Moura Link Eastern Option intersects a tributary of Farmer Creek. The tributary contains shallow permanent pools on alluvial substrate and bed rock intrusions. Instream complexity was generally limited with predominantly homogenous substrate and no aquatic macrophyte species identified.

Within this area the tributary is surrounded by a flow-dependent vegetation community mapped as RE11.3.4 (refer Figure 5.3). This community occurs on alluvial plains and has a limited link to the within-bank stream flows. The alluvial landform is dependent on occasional flooding to provide wetting and connectivity, and to deposit sediments and nutrients. This was evident after the significant rainfall during December 2007 with an alluvial plain transforming from a dry woodland to a wetland/floodplain ecosystem.

Within the Calliope River the majority of smaller and isolated remnant pockets of floodplain vegetation are in relatively poor condition. The communities along Farmer Creek however, seemed to be in good condition despite being highly impacted by fragmentation and grazing pressures. As a result, this community is unique within the project area and surrounds.

The Moura Link Western Option intersects a large area of floodplain, including that of Farmer Creek. Within this area the landform is characterised by melonhole gilgai which captures overland flow to create localised wetlands and/or floodplain ecosystems. The land use activities within this area have removed much of the remnant vegetation to create a large expanse of open pastoral grasslands. However, the floodplain proved to have high habitat value for wetland birds, frogs and invertebrate species (refer Section 6).

Scrubby Creek

Scrubby Creek is an ephemeral system which drains north from Mount McGuire and Mount Moore prior to discharging into the Calliope River downstream of the Moura Link Eastern Option (refer Figure 7.2).

The riparian zone of Scrubby Creek was relatively intact and consisted of vine thicket and open eucalypt woodlands and forests. Vegetation communities adjoining the riparian zone consisted of primarily *Eucalyptus crebra* and vine thicket in the middle reaches on hilly slopes (north of the Dawson Highway) and open pasture land in the lower and middle reaches.

The headwaters are sourced from intact vine thicket communities occurring on steep mountain slopes (Mount McGuire and Mount Moore) prior to flowing through open grassland communities south of the Dawson Highway.

The Moura Link Eastern Option will intersect the vine thicket communities along the creek line directly downstream of the Dawson Highway (refer Figure 5.5). The channel is characterised by a narrow rocky and sandy substrate. Due to the encroachment of pastoral grasses and weed species into the vine thicket, there is an increased risk of fire, which would reduce the overall habitat value.

Sandy Creek

Sandy Creek is an ephemeral system which drains east from Mount Larcom (headwaters near Flynn Road) prior to joining Spring Creek (near Gladstone-Mount Larcom Road east of Targinie Road) to form Boat Creek (refer Figure 7.2). Boat Creek is tidal system which drains into Port Curtis south of Fisherman's Landing.

Previous surveys have assessed the aquatic ecology of this creek and have restricted its conservation value to that of local significance only. This is due to the species present being common throughout the Calliope River catchment and the habitat diversity to be generally low (Dames and Moore 1998).

The riparian zone is relatively intact and sections of the creek line have been mapped as an 'Endangered' SEVT community (refer Section 5). An opportunistic field observation revealed the landscape surrounding Sandy Creek to be highly disturbed due to horticultural activities, quarrying, linear developments and land use pressures from the township of Yarwun.

Wetlands

Overland flows across floodplains and along watercourses are integral in maintaining the health of a wetland ecosystem. In addition to their high ecological value, their buffering capacity is important for a range of terrestrial and aquatic environments against the negative impacts associated with flooding. This occurs by the system filtering out excess nutrients and sediment that would otherwise enter receiving environments. Wetlands provide significant habitat for species such as floodplain avifauna fish (C&R Consulting 2005).

EPA Wetland Mapping does not identify any wetlands within the project area. However, during the field investigations, a number of natural and artificially occurring wetland systems were located.

These wetlands included a naturally occurring palustrine wetland on Larcom Creek which is of high ecological and conservation value as it proved to be an important frog breeding habitat despite the poor complexity (ie limited vegetation diversity with a homogenous substrate).

A small palustrine wetland system occurring near the Bruce Highway (west of) as a result of the development of the EEMBL was also located.

The project area encompasses large tracts of floodplain vegetation, the majority of which has undergone significant anthropogenic changes due to current land uses. Floodplain vegetation appears to have been impacted substantially more than riparian communities with the majority of smaller and isolated floodplain vegetation remnants in relatively poor condition. However, these attenuated communities form a part of a larger wetland system and are considered ecologically important as amphibian and invertebrate habitats.

Artificial wetlands have primarily been constructed on existing drainage lines and/or overland flows for use as water storage for cattle (refer Photo 7.1). A significant artificial wetland (dam) was observed north of the Calliope River (Moura Link Western Option) and may be impacted by the redirection of overland flow thus causing a potential reduction in catchment size.

Photo 7.1 Palustrine wetland located to the north of the NCL

7.2.3 Monitoring site descriptions

Site 1

Site 1 is a large permanent waterhole located on the Calliope River upstream of the Moura Link Western Option. The site was surrounded by steep banks with relatively dense vegetation cover (refer Photo 7.2). There was some indication of recreational use of the area, including 4WD and motorbike tracks, camp fires and a swing rope.

Photo 7.2 Site 1 Calliope River upstream of project area

The riparian width was approximately 20 m on the right bank and 40 m on the left bank with a maximum vegetation height of 25 m. The riparian vegetation was comprised of native flora, including *Eucalyptus* sp., *Allocasuarina littoralis* and *Callistimon viminalis* and included overhanging and trailing vegetation which provided good shading habitat for the edge environment. The high water banks consisted of open *E. tereticornis* woodlands which had been thinned or cleared extensively.

The stream was approximately 25 m in width (at the sampling site) with a depth of 0.9 m (at the edge) dropping off steeply approximately 1.5 m out from the edge of the rivers bank . The banks were undercut in many areas. There was some discernable flow (approximately 0.05 m/sec) during the February 2008 survey. The water was tannin stained with algae scum present on the surface water at the edges of the reach.

The substrate composition consisted of sand, gravel and pebbles with some silt (10%). Bedrock, snags and LWD, including sticks, branches and logs were also present increasing instream complexity. The pool area included a variety of habitats, including edge habitat, shallow, deep, pool and run. Introduced macrophyte species such as *Urochloa mutica* and *Nymphaea caerulea* were the dominant species recorded.

Fish and crustacean species present during the site survey included the *Melanotaenia splendida splendida* (Eastern Rainbowfish), *Craterocephalus stercusmuscarum* (Fly-speckled hardyhead) and *Glossamia apron* (Mouth almighty).

Site 2

Site 2 is located on Larcom Creek, approximately 250 m upstream of the Calliope River/Larcom Creek junction (refer Figure 7.2). The adjacent land use is dry land grazing. An access trail crosses the creek at this location allowing for vehicle and cattle passage across the creek increasing the anthropogenic and erosion pressures at this site.

The riparian vegetation was dominated by *Callistemon viminalis* and *Casuarina cunninghamiana.* The riparian zone ranged between 5 and 20 m and provided overhanging and trailing vegetation.

Baseline flows were evident in this section of Larcom Creek with water movement observed (August 2007) between the pool habitats upstream and downstream of the track. There was moderate erosion along the bank which may have stemmed from cattle grazing.

During the February 2008 survey there was some flow evident and the cattle crossing had created two distinctive habitats, a pool habitat (upstream of the crossing) (refer Photo 7.3) and a riffle habitat (downstream of the crossing) (refer Photo 7.4), each of which were sampled.

Photo 7.3 Site 2 Larcom Creek – pool habitat (February 2008)

Photo 7.4 Site 2 Larcom Creek – riffle habitat (February 2008)

During February 2008 the stream width averaged 5 m in the pool habitat and 3.5 m in the riffle habitat. The depth of the stream in both habitats was approximately 1 m. The substrate in the riffle area was composed of large boulders (30%), cobbles and pebbles (40%) and gravel (30%). The substrate of the pool habitat comprised boulders (25%), pebbles (45%) and silt (30%). The banks were also undercut in some areas, and algae and moss were present covering the boulders and rocks along the bed and bank of the creek.

Macrophytes were generally depauperate with three species recorded from the site during the August 2007 survey. Fish and crustacean species present during the site survey included the *Melanotaenia splendida splendida*, *Craterocephalus stercusmuscarum* and *Glossamia aprion*.

Site 3

Site 3 is a permanent pool habitat located on Farmer Creek near the Moura Link Eastern Option (refer Figure 7.2). The waterbody is located on an alluvial channel with gentle sloping banks with limited riparian vegetation (refer Photo 7.5).

The adjacent land use is cattle grazing and as a result the riparian zone has been significantly cleared with introduced grasslands the dominant vegetation type. The absence of the riparian zone limits instream diversity (ie no riparian zone to contribute organic matter or filter sediments) and also impacts on local water conditions (ie water temperatures are more likely to fluctuate).There was also evidence of dieback within the fringing vegetation due to current land use activities.

The waterbody was approximately 25-30 m in width and the depth was 0.60 m at the edge of the pool. The substrate composition forming the bed and bank was predominately silt and mud, which had an anoxic odour when disturbed.

Photo 7.5 Site 3 Wetland habitat – Farmer Creek

Aquatic macrophyte habitat was present along the edge of the pool and consisted of species common with wetland and pool habitats of Central Queensland. The attached-floating and emergent species which were present included the *Nymphaea caerulea* and *Ludwigia attenuata*.

Fish and crustacean species present during the site survey included the *Melanotaenia splendida splendida* and *Craterocephalus stercusmuscarum*.

Site 4

Site 4 is located in the upper reaches of Larcom Creek in the northern section, downstream of the Gladstone-Mount Larcom Road and the proposed Aldoga Rail Yard. In this area Larcom Creek is ephemeral, characterised by a series of small disjunct waterholes (refer Photo 7.6). The surrounding land influences are dry land grazing.

The banks were steep and the riparian zone was generally limited, due to clearing, to the edge of the waterbody (ie riparian zone was between 0 and 10 m wide and generally below the high water bank). The riparian vegetation was dominated by *Callistemon viminalis* and *Casuarina cunninghamiana* which provided good edge shading for the creek, however most of the surface area of the waterbody is exposed due to an absence of canopy cover. Declared pest flora observed within the riparian zone included *Sporobolus* spp. (Giants rat's tail grass) and *Lantana camara* (Lantana).

Photo 7.6 Site 4 Larcom Creek - waterhole and undercut bank (August 2007)

The stream width at this location is estimated to be approximately 12 m. The depth, at a distance of 0.5 m from the bank, is 0.90 m which increased sharply with progression toward the centre of the waterhole. The average depth of the waterhole was not identified during the survey. The bed substrate at this location is comprised primarily of mud and silt. During the August 2007 survey there was no flow and the pool water and substrate had a distinctive anoxic odour. The creek was flowing during the February 2008 survey (refer Photo 7.7) and the water did not have an odour, however, the substrate was still composed of silt and mud, which had an anoxic odour when disturbed.

Photo 7.7 Site 4 Larcom Creek - in flood (February 2008)

During sampling the following was observed, including evidence of stream bank erosion/undercutting, exposed tree roots and damage to the waterhole access through stock trampling around the riparian zone. Cattle dung was also observed along the creek banks in this location, representing a concentrated source of nutrients to the waterhole.

The main habitat types present at Site 4 included pool, edge, undercut banks, and shallow and deep areas. Snags and LWD, including logs were also present providing good habitat for fish and aquatic species.

Macrophytes were depauperate with the emergent *Bacopa monnieri* the dominant. The community has formed dense macrophyte beds that spread out into the water providing stabilisation of the bed and bank substrate. The *Melanotaenia splendida splendida* was the only fish species recorded from the site during the survey.

Site 5

Site 5 was located within a pool habitat of Larcom Creek upstream of the Bruce Highway (refer Figure 7.2). The proposed Moura Link intersects this habitat.

The surrounding riparian vegetation of the area comprised 65% grass (introduced pasture grasses) and 35% trees (<10 m high), predominately *Callistemon viminalis*, which provided overhanging, trailing and shading habitat along the bank.

Instream habitats included snags, LWD and undercuts banks. During the February 2008 sampling period the pool was found to be deeper and more extensive. The bed and bank substrate was comprised of soft mud and silt, and had an anoxic odour when disturbed. Algae were present on the surface of the water and *Bacopa monnieri* was observed along the banks of the pool.

Photo 7.8 Site 5 Larcom Creek – edge habitat (August 2007)

Fish and prawn species identified from this habitat included *Melanotaenia splendida*, *Hypseleotris compressa* (Western carp gudgeon) and *Craterocephalus stercusmuscarum*.

Site 6

Site 6 is located on the Calliope River at the eastern extent of the project area (ie just upstream of the Moura Link Eastern Option). During the August 2007 survey it was noted that a baseline flow was evident between a series of permanent pools. In February 2008 the river was transformed due to flood waters (refer Photo 7.9).

Photo 7.9 Site 6 Calliope River - pool habitat (February 2008)

At this location the river is surrounded by dense riparian vegetation consisting of *Callistemon viminalis* and *Casuarina cunninghamiana*. The riparian zone ranged between 15 and 30 m and was located between the main channel and the high water bank. The high water bank vegetation consisted of *E. tereticornis* which has been significantly cleared and thinned, and includes introduced grasslands.

Introduced flora present included *Lantana camara* and *Parthenium hysterophorus*. These species were associated with the disturbed areas between the riparian zone and the high water bank.

A cattle access track located adjacent to habitat has impacted on the riparian zone and instream habitats. This includes localised erosion and disturbance of terrestrial and instream substrates and macrophyte communities.

The width of the waterhole at this location is approximately 15-20 m. At the edge of the pool habitat the average depth was 0.50 m under dry conditions (August 2007) and 0.60 m under wet conditions (February 2007). The maximum depth of the waterhole was not determined. The bed substrate was composed clay (50%), cobble (15%), pebbles (15%), silt clay (10%) and twigs/detritus (10%). The substrate also had an anoxic odour when disturbed.

This site was particularly rich in the diversity of fish and crustacean species present, which included the *Melanotaenia splendida*, *Ambassis agassizii* (Agassiz's glassfish), *Glossamia aprion*, *Craterocephalus stercusmuscarum*, *Hypseleotris compressa* (Empire gudgeon*)* and *Macrobrachium australiense* (Big-armed prawn).

Site 7

Site 7 is located on Larcom Creek upstream of Mount Alma Road. The dominant surrounding land use was dry land cattle grazing. Trampling by cattle was observed along the banks at this location which has resulted in some localised erosion impacts to the bank.

The area included a diversity of aquatic habitats, including pool, edge, riffle, undercut banks, and shallow and deep habitats. Snags and LWD (twigs, sticks and logs) were also present along the bank as well as overhanging and trailing vegetation which provided good shading for the creek.

The creek is approximately 3 m in width, with an average depth of 1 m in the pool/run area (refer Photo 7.10). The water was tannin stained and there was some foaming observed on the water surface in the area of the riffle habitat (refer Photo 7.11). The substrate of the pool and riffle habitat were composed of mud and silt (50-60%) and gravel and sand (40-50%).

Photo 7.10 Site 7 Larcom Creek at Mount Alma Road – pool habitat

Fish species present during the site survey included the *Melanotaenia splendida*, *Ambassis agassizii*, *Craterocephalus stercusmuscarum* (Fly-speckled hardyhead) and *Hypseleotris compressa*.

Photo 7.11 Site 7 Larcom Creek at Mount Alma Road – riffle habitat

Site 8

Site 8 is located on Larcom Creek, upstream of the Gladstone-Mount Larcom Road within the vicinity of the Aldoga Rail Yard (refer Figure 7.2). The dominant surrounding land use at this site is dry land grazing. A rail bridge is located downstream of the sampling site.

The riparian vegetation was approximately 5 m in width on both the left and right banks, to a height of approximately 25-30 m. The riparian vegetation included *Callistemon viminalis* and *Casuarina cunninghamiana* which provided good trailing habitat. The riparian zone varied between 5 and 20 m and was adjoined by a number of palustrine wetlands. These wetlands were located below the high water bank and in the adjoining floodplain areas. Other communities adjoining the creek included fragmented open *E. tereticornis* woodlands on alluvial plains and introduced grassland adjoining the area.

Larcom Creek is ephemeral at this site, with the presence of intermittent pools formed in shallow depressions within the creek bed. As shown in Photo 7.12, there was no water in the creek bed during August 2007 and therefore sampling could not be undertaken. Sampling was undertaken during the February 2008 survey due to rainfall events occurring prior to the survey.

Photo 7.12 Site 8 Larcom Creek, upstream of project area – dry creek bed (August 2007)

The creek is approximately 7-8 m in width (at the sampling site) with a depth of 0.8-1 m. There was little or no flow at the time of sampling in February 2008. The water in the creek was tannin stained and algae were observed on the surface at the edges of the reach. A large number of trees were growing in the creek bed, indicating that this area may be subject to occasional inundation (refer Photo 7.13). The substrate composition forming the bed and bank was predominately mud and silt, with sticks, twigs, and large snags.

Photo 7.13 Larcom Creek (Site 8) in flood (February 2008)

Fish species present during the February 2008 survey included *Hypseleotris* sp., and *Melanotaenia splendida* and *Ambassis agassizii*, which were both abundant.

7.2.4 Aquatic macrophytes

As primary producers, macrophytes have a vital role in wetland ecology as they underpin many stream processes and dictate the presence of other biota. Macrophytes perform a number of significant functions, including maintaining water quality by filtering out nutrients and sediments, maintaining the integrity of the substrate, and providing food, shelter and breeding habitat to support a range of life cycle stages.

In total, 47 macrophyte species have been recorded from the freshwater reaches of the Calliope River. Previous studies on aquatic macrophyte assemblages within the Calliope River system have typically shown high diversity and abundance, especially in the periods following peak flow events. In terms of macrophytes, Aquatic Biologist Dr Leo Duivenvoorden (Central Queensland University) has described the lower freshwater reaches of the Calliope River as some of the richest microphyte assemblages within Central Queensland (approximately 25 species recorded from a pool habitat).

During field surveys conducted by Connell Hatch during August 2007 and February 2008, 41 species of aquatic macrophytes were identified from riverine and wetland ecosystems within the project area (refer Appendix E5). Species were predominantly semi-attached floating species such as *Nymphoides indica* (Water snowflake) and emergent species such as *Bacopa monnieri* (No Common Name).

Species richness was generally associated with the permanent waterbodies including the Calliope River, Farmer Creek and an agricultural dam. The floodplain and ephemeral wetland environments also supported a diverse array of macrophytes. In total 12 species of macrophytes were recorded from the five sites on Larcom Creek during field investigations, a previous study carried out by Houston *et al* (2000) identified only nine species. The poor species richness along Larcom Creek compared to the Calliope River maybe attributed to the difference in the geomorphology and instream-flows of the systems.

No threatened aquatic macrophyte species have been recorded from the Calliope River catchment (C&R Consulting 2005 and EPA WetlandInfo 2008). However, *Aponogeton queenslandicus* a species listed as rare under the NC Act may potentially occur within the area. This species can survive long periods of drought by remaining dormant and inhabits freshwater ephemeral habitats in drier regions, particularly gilgai and melon-holes (common within the project area).

7.2.5 Pest species

Hymenachne amplexicaulis (Hymenachne) was present in agricultural dams in the southern extent of the project area (Moura Link Western Option) but not from the riverine environment, whilst *Salivinia molesta* (Salvinia) was recorded from pool habitats on the Calliope River and Farmer Creek.

Both species are listed as C2 declared pests under the LP Act and recognised as Weeds of National Significance by the Commonwealth due to their invasive nature and potential to impact both the environment and the economy.

As stated by Weeds CRC (2003), *"Hymenachne amplexicaulis invades permanent water bodies and seasonally inundated wetlands and has the potential to choke waterways by forming dense stands that reduce flows, plant diversity and available habitat for native fauna"*.

Salvinia molesta forms thick floating mats, affecting water quality. This leads to unsuitable habitat conditions for most native aquatic flora and fauna attempting to utilise the waterbody. In extreme infestations the overall biodiversity of the aquatic system and other environmental values of the waterway, such as aesthetic and recreational values, will become affected.

Whilst no pest aquatic fauna were observed or collected during the aquatic habitat assessment, Houston *et al* (2000) noted that *Gambusia holbrooki* (Mosquitofish) had been recorded from the Calliope River catchment (including pool habitats on Larcom Creek). This species is listed under Schedule 5A of the *Fisheries Regulation 1995*.

In addition, introduced species *Poecilea* spp. has also been identified during other studies within the local area (EPA 2008). It should be noted however, that this species is not listed under the *Fisheries Act 1994*.

7.2.6 Fish species

Native fish are an important biological indicator of aquatic ecosystem health, whereby fish communities reflect a range of natural and human-induced disturbances through changes in abundance and species composition. Ecological assessments based on fish community structure have the advantage over more traditional physical and chemical indices (eg conductivity, turbidity, nutrients) in that fish provide an integrated measure of stream condition due to the mobility, relatively long-life, and high trophic level of the animals involved (EHMP 2006).

Comprehensive surveys carried out by others have revealed a total of 41 native fish species as occurring within the Calliope River catchment (EPA 2008). This species richness observed may be attributed to the connectivity between habitats facilitated by the lack of physical barriers and the perennial base flow characteristic of the Calliope River (C&R Consulting 2002).

Despite the extensive alteration of the catchment, the stream channel habitat structure has been largely maintained and is vital to the continued high fish species richness (C&R Consulting 1995). Even during baseflow the broad range of habitat types is maintained in many areas providing food and habitat resources for a full size range of fish species. This along with the unregulated nature of the systems ensures that the overall freshwater fish diversity within the Calliope River compares favourably with other river systems (eg Fitzroy River catchment 44 native fish species).

According to C&R Consulting (2005), no threatened freshwater fish species are known to inhabit the Calliope River catchment. However, some of the species identified from the catchment such as *Lates calcarifer* (Barramundi) are considered important for recreational and commercial purposes. The identification of catadromous[1] fish species such as the Barramundi in the upstream extremities reflects the lack of substantial fish passage barriers within the system (Platten 2008).

During field surveys of freshwater habitats on the Calliope River, Farmer Creek and Larcom Creek systems carried out by Connell Hatch staff, a total of seven fish species were trapped (refer Table 7.1). These species are potamodromous species migrating wholly within freshwater systems for breeding. Houston *et al* (2000) noted a similar fish assemblage from pool habitats on both Larcom Creek and Boat Creek.

The low species richness with respect to the catchment (ie approximately 18% of species known to occur within the Calliope River) reflects the instream complexity of the habitats sampled and the sampling techniques adopted for the Project. Larger fish species such as perch, mullet and eel-tailed catfish were observed in the pool habitats of the Calliope River but were note captured for identification purposes.

Table 7.1 Fish species recorded from aquatic habitats within and surrounding the project area (2007 and 2008)

Scientific name	Common name	Survey sites							
		Site 1 - CR	Site 2 - LC	Site 3 - CR (wetland)	Site 4 - LC	Site 5 - LC	Site 6 - CR	Site 7 - LC	Site 8 - LC
Morgunda adspersa	Purple spotted gudgeon		✓			✓		✓	
Melanotaenia splendida splendida	Eastern rainbowfish	✓	✓	✓	✓	✓	✓	✓	✓
Hypseleotris sp A	Midgely's carp gudgeon	✓	✓	-	-	✓	✓	-	✓
Hypseleotris compressa	Empire gudgeon	✓	-	-	-	-	-	✓	-
Craterocephalus stercusmuscarum	Fly-speckled hardyhead	✓	✓	✓	-	✓	✓	✓	-
Glossamia apron	Mouth almighty	✓	✓	-	-	-	✓	-	-
Ambassis agassizii	Agassizi's glassfish	-	-	-	-	-	✓	✓	✓
Total number of species		**5**	**6**	**2**	**1**	**4**	**5**	**5**	**3**

Table notes:
LC – Larcom Creek
CR – Calliope River

7.2.7 Other aquatic vertebrates

A number of other aquatic vertebrate species have also been recorded as inhabiting the freshwater reaches of the project area (refer Section 6). This includes aquatic reptiles such as *Crocodylus porosus* (Saltwater crocodile), *Elseya albagula* (Southern snapping turtle) and *Wollumbinia latisternum* (Saw-shelled turtle) which have been recorded within Calliope River catchment by others. *Emydura macquarii krefftii* (Krefft's River turtle) has also been identified from the pool habitats in Larcom Creek.

[1] Species that migrate to breed in marine environments

Crocodylus porosus is listed as rare under the NC Act and is also protected under the EPBC Act (migratory). *Rheodytes leukops* (Fitzroy River turtle) is another nationally threatened species, however it has not been recorded within the Calliope River catchment.

The SKM (1999a) survey identified potential habitats along the Calliope River and tributaries which would provide suitable habitat for *Ornithorhyncus anatinus* (Platypus), however anecdotal evidence suggested they are not present in this system.

In general, the wetland systems present throughout the project area are likely to be important roosting and feeding sites for wetland species on a local scale. This includes a number of species, including *Ardea alba (*Greater egret*), Nettapus coromandelianus (*Australian cotton pygmy goose*)* and *Ephippiorhynchus asiaticus (*Black-necked stork*)* which were observed foraging within the riverine and wetland ecosystems (refer Section 6). These species are protected under State and/or Commonwealth legislation.

7.2.8 Aquatic invertebrates

Macroinvertebrate species such as prawns, shrimps, crayfish, snails, mussels and aquatic insects are important biological indicators of aquatic ecosystem health due to their diversity, abundance and sedentary nature. They are also useful indicators because they are affected by changes in habitat condition (including pollution), alterations in flow regimes and are sensitive to changes in water quality (DNRM 2001).

Previous assessments of Calliope River sites by the GAWB (1999) and the DNRW have indicated that macroinvertebrate communities of the Calliope River are diverse and abundant.

The GAWB (1999) identified a diversity of 69 taxa from 91 samples and a mean abundance of 162,000/m^2 in riffle habitats in the Calliope River. Within pool habitats, a diversity of 39 taxa from 68 samples and an abundance of 3,700/m^2 were observed.

The regulation of flows in a currently unregulated Calliope River would be expected to strongly affect the riffle dwelling macroinvertebrates. Monitoring carried out by the DNRW also showed that the assemblages of macroinvertebrates in the Calliope River were also taxa rich. The two Calliope River sites that were sampled contained Plecopteran, Ephemeropteran and Trichopteran (stonefly, mayfly and caddisfly) taxa in all samples (up to seven taxa per habitat).

Houston *et al* (2000) identified a total of 34 taxa and a mean abundance of 2,032/m^2 from field surveys conducted on an upper Larcom Creek from 1998 to 1999. The preservation of good taxonomic richness in the Calliope River catchment probably reflects the continuance of good instream microhabitat structure and diversity (C&R Consulting 2005).

7.3 Potential impacts

7.3.1 Construction

Fauna assemblages

Aquatic ecosystems are important habitats for a diverse array of aquatic and semi-aquatic flora and fauna. The proposed Project has the potential to impact on these species through impacts such as noise, dust, the promotion of weed proliferation, excess light through the opening of the canopy and artificial lighting during the construction and operational phases.

The Project also has the capacity to impact on species behaviour by impeding migration/movement and feeding patterns of aquatic and semi-aquatic fauna within the freshwater reaches of the Calliope River.

No major roosting sites for wetland bird species were identified during the field activities, however large birds such as *Ardea alba* and *Ephippiorhynchus asiaticus* were recorded from the area. These species require a large runway prior to taking off and may risk an increase in mortality if there is an increase in structures and human activity within close proximity to existing watercourses and wetlands.

Other impacts posed to species such as these include the construction of powerlines and other overhead services within the area. However, this is generally associated with the NCL quadruplication and is unlikely to pose a significant risk to wetland species.

Connectivity between aquatic habitats is a critical factor in maintaining healthy systems. Connectivity in the Calliope River is facilitated by the combination of the lack of physical barriers and perennial base flow. Changes to these systems as a result of the Project may have an impact on the local populations, including a decline in species richness.

Periodic inundation of wetlands provides connectivity between the riverine environment, pool habitats and floodplains. A number of fish species such as barramundi, bony bream and mullet exploit these periods to move along and to watercourses for breeding purposes.

Within the instream habitats this impact is likely to be localised and relatively short term (ie for the period of construction). In addition, the fish movement can be dependent on instream flows and the absence of significant rainfall will also reduce the risk.

However, the construction of the rail abutments will potentially impede overland flows within the floodplain areas. Other potential risks include changes to the velocity of instream and overland flows due to increases in the movement of water from non-permeable surfaces such as culverts and concrete surfaces. These flows are important triggers and pathways for fish breeding and dispersal purposes.

Impacts to terrestrial flora and fauna species inhabiting the project area have also been discussed in Sections 5 and 6.

Watercourses and wetland systems

Earthwork operations (cut and fill) will occur in the upper and/or mid catchment areas of the watercourses within the project area. Localised impacts to the environment will include loss of riparian vegetation, localised changes to bed and bank stability and structure, loss of instream habitat and displacement and/or loss of biodiversity. The activities may also impact the health of downstream environments through the alteration of drainage lines, loss of catchment size and complexity, reduced environmental and overland flows and degradation of water quality.

Riparian vegetation is present along the banks of Calliope River and associated tributaries forming a semi continuous corridor, which is predominately composed of native vegetation. The riparian vegetation along Calliope River, Larcom Creek and other watercourses within the project area will be disturbed through direct removal and/or construction works (eg damage from vehicle movement and storage of equipment). Approximately 10 ha of riparian vegetation (remnant vegetation) will be removed. Loss or degradation of the riparian vegetation has the potential to impact on the freshwater ecosystems through:

- The destabilisation of banks which increases the risk of erosion and scouring
- Reduce water quality values (eg sedimentation and decreased dissolved oxygen)
- Change microclimates (eg increased water temperatures and removal of woody debris)
- Loss/degradation of instream habitat complexity
- Reduce terrestrial and aquatic biota diversity
- Limit instream habitat

The loss of the riparian zone can have a flow on effect through the system. This may include the degradation of downstream environments, changes to water quality and loss of in-stream complexity and biodiversity. This buffer also absorbs excess nutrients and contaminants. The loss of vegetation within the project area will also increase the pressure on and the importance of retained communities such as the riparian communities.

The aquatic macrophytes within the Calliope River catchment and associated floodplain systems within the project area are also likely to be subject to disturbance through direct removal for construction works. The loss or degradation of aquatic macrophytes has the potential to impact on freshwater ecosystems through:

- Reduced water quality values (eg dissolved oxygen, filtering out nutrients and sediments)
- Change microclimates (eg increased water temperatures)
- Loss/degradation of instream habitat complexity
- Limit instream habitat

The macrophyte communities within the Calliope River are diverse and are important to the function and health of the system. The geomorphology and hydrology limits macrophyte diversity within Larcom Creek and other ephemeral watercourses within the project area. The ephemeral wetlands and floodplain areas also supported a rich diversity of macrophytes and may potentially support *Aponogeton queenslandicus*.

Impacts on the abiotic characteristics of the freshwater ecosystems will adversely impact on the biodiversity. It is important to note that the majority of the works will occur upstream of the wetlands and in close proximity to drainage lines which increases the risk of environmental impacts. The construction activities within the project area will potentially increase the risk of contamination and nutrient loading within aquatic and marine environments through:

- Sedimentation
- Eutrophication
- Introduction of contaminants (eg hydrocarbons, metals)

Sedimentation is a during the construction phase of the Project. Sedimentation can smother existing communities and habitats, change the substrate composition and increase nutrient loading and turbidity which will impact plant growth (phytoplankton and macrophytes). Areas of risk include Farmer Creek, Calliope River within the vicinity of the Moura Link Eastern Option and areas adjacent to Larcom Creek (proposed Aldoga Rail Yard). Within these areas there is already gully and rill erosion.

The Project also requires a significant amount of cut and fill. The stockpiling of the material and clearing of vegetation will also be major potential sources for sediments. Up to 90% of sediment transported overland to waterways may be trapped by a riparian buffer strip consisting of vegetation and grasses.

Nutrients may enter the systems through the discharges from onsite facilities and/or as a result of sedimentation. The removal of vegetation will also impact on nutrient levels as riparian vegetation plays an important role in buffering wetlands (ie filtering nutrients, reducing flows and maintaining the integrity of the substrate).

Increased nutrients within the freshwater ecosystems increases the potential of nuisance plant growth (eg algae and macrophytes). It is important to note that nutrient levels within the Calliope River and associated tributaries during the EIS monitoring exceeded the Queensland Water Quality Guidelines.

Nuisance plant growth has the potential to adversely impact biodiversity and the ecological value of the areas. This was observed within Larcom Creek, directly upstream of the Bruce Highway and a number of agricultural dams within the project area where introduced species smothered the waterbodies.

It is likely that the construction activities within the project area will result in temporary and permanent changes to the drainage and flow regimes. Temporary impacts will include the construction and/or placement of impoundment/bunds upstream and/or downstream of the proposed works and stockpiling of materials. Permanent impacts may include the realignment of existing drainage lines, construction of new drainage lines and channelisation.

The installation of temporary bunds upstream/downstream of works may also mitigate potential impacts on the downstream environments as a result of sedimentation and pollution. The proposed Moura Link construction activities will reduce the catchment size of farm dams and watercourses.

Loss or changes to environmental flows may destabilise the environmental value of downstream environments. It may lead to changes in the habitat structure, loss of ecological value and changes to water quality. Environmental flows are also important dispersal mechanisms and breeding triggers for some plant and animal species.

Environmental flows are also important for the health of riparian and flow-dependent ecosystems (ie nutrients and dispersal). Unless properly managed, changes to overland runoff and flow regimes as a result of construction activities could impact on the flow-dependent ecosystems, increase the risk of erosion and the proliferation of weed flora.

Other impacts occurring from construction activities include loss of habitat complexity, changes to water quality, loss of aesthetic value and increase risk of toxins due to cyanobacteria (blue green algae) blooms.

Hydrology

The Project has the potential to alter the hydrology of the catchment on a local scale. Impacts relating to the construction of the rail infrastructure include a reduction in the catchment area for a number of creek and wetland systems within the general area, including dams currently used by landowners for hydrating and nourishing stock.

The majority of watercourses intersected by the Project are ephemeral, however the alignment does cross a number of large pool habitats. Temporary impoundments will be required during the construction phase when working within the in-stream environment. These impoundments will impact on species movement spatially within the pool and along the reach of the creek. Other risks include changes to water quality due to alterations in the profile of the waterbody (ie increase in depth would generally decrease light penetration which impacts on biological activity).

Other impacts include loss and/or redirection of overland flows away from wetlands and/or flow-dependent ecosystems. The proposed Moura Link intersects a number of drainage paths and if not properly managed overland flow maybe redirected from dependent ecosystems to areas susceptible to flow (eg erodible soils). Another risk is reducing the catchment size of agricultural dams which are important water storages for cattle. These water storages also protect the riverine ecosystems by reducing the reliance of the cattle on instream waterbodies.

There is also the opportunity to upgrade existing structures to facilitate environmental flows. During field investigations, there were noticeable impacts on overland flow to the north of the NCL. During the detailed design and construction phases there may be an opportunity to upgrade the existing infrastructure and improve the current restrictions of overland flow in this area.

7.3.2 Operation

The Project will result in an increase in the volume of rail traffic utilising the MSL and NCL (refer Section 13). The increase in rail traffic has the potential to impact on the health and ecological values of Calliope River and associated tributaries through the issues discussed below.

Noise and vibration

Noise and vibration impacts associate with train operation are minimal in relation to aquatic ecology. Railway workings near existing waterways may influence fish and other aquatic species behaviour through the vibrations and disturbance during rail traffic movements.

The Aldoga Rail Yard has the potential to impact on the fauna and floral assemblages of Larcom Creek. This will include the continuous disturbance of existing populations inhabiting the creek system which may result in species displacement and/or the recolonisation by disturbance tolerant species. This can impact on the equilibrium of the area which could result in a sharp decline in biodiversity. It is important to note that the creek is ephemeral and the main risk is to the ecological value and integrity of the riparian zone.

It should be noted however, that the majority of impacts resulting from noise and vibration are likely to be negligible.

Water quality

Potential water quality impacts during the operational phase will be minor. However, if not properly managed some increase in pollutant loads from the Project could occur, including hydrocarbons and herbicides (used for track maintenance).

These pollutants may accumulate during dry periods and be washed into the Calliope River, its tributaries and freshwater ecosystems during subsequent rainfall. Depending on the pollutant and its bioavailability, there may be chronic and/or acute impacts on aquatic biota or indirectly through changes to availability of essential elements. It is not envisaged that this impact will be significant. Runoff from the rail tracks may cause localised build-up of inert coal particles, which although unsightly, are not environmentally damaging.

The proposed Aldoga Rail Yard has the potential to impact on the environmental values of Larcom Creek and downstream receiving environments, such as the Calliope River through contamination as a result of spills and leaks. Changes to water quality will have a flow on effect on the composition and abundance of floral and faunal assemblages inhabiting Larcom Creek. Section 8 discusses the potential impacts to water quality in further detail.

Lighting

The proposed Aldoga Rail Yard will operate 24 hours a day, seven days week. Lighting associated with the yard has the potential to impact on the adjacent ecological communities, including the riparian zone and instream habitats of Larcom Creek and the surrounding floodplain. As mentioned previously, Larcom Creek is an ephemeral creek system with pool habitats associated with intermittent rainfalls patterns. Therefore, lighting requirements will need to consider impacts on aquatic habitats with consideration to health and safety constraints.

In-stream fauna, including insect species, have life-stages dependant on aquatic habitats (eg some species of dragonfly larvae are entirely aquatic dependant). Artificial lighting may impact on these species directly, or through changes in invertebrate assemblages due to competition for resources, displacement and predation (attracts and impairs species).

Where the canopy of the riparian zone remains closed, lighting that does reach the substrate will be filtered. It is therefore important that vegetation be retained and where necessary rehabilitated where practical.

Lighting associated with the operation of the Moura Link and NCL is anticipated to be intermittent, short term and directional. It is therefore unlikely to significantly impact on aquatic values of the area.

7.4 Mitigation measures

The measures proposed to mitigate potential impacts on aquatic biology for the Project are discussed in Section 20.

7.5 Conclusion

The Project is located within the freshwater reaches of the Calliope River catchment, which is important to the function and health of Port Curtis. Environmental flows from the Calliope River are an important source of nutrients and triggers for biota.

Although the Calliope River basin has been disturbed considerably by past anthropogenic activities (66% native vegetation removed, extensive cattle grazing), in stream flora and fauna has retained a high species diversity which is maintained by the perennial base flow and the intact integrity of the riparian buffer zone. Key factors which have contributed to maintaining the high integrity (lack of exotic fish species) and diversity of the aquatic flora and fauna include:

- The Calliope River is adjacent to the much larger Fitzroy River basin, and species richness in the Calliope River is thereby enhanced as a result of recruitment from the neighbouring system.
- The maintenance of a diversity of aquatic habitats in the Calliope River catchment, with a sustained base flow and the lack of fish passage barriers, thereby facilitating and maintaining connectivity between habitats.
- The remaining vegetation is in good condition, predominately composed of native vegetation and forms a semi-continuous corridor.
- The presence of bedrock controlled channel pools in the lower Calliope River (C&R Consulting 2005).

The Project is likely to have a localised impact on the ecological value of the Calliope River due to the scale and nature of the works. However, the proposed Aldoga Rail Yard could potentially have an impact on the environmental value of Larcom Creek. The implementation of mitigation and management measures during the design, construction and operation of the rail infrastructure will minimise potential impacts to the aquatic environments within the Calliope River Basin.

7.6 Commitments

The aquatic biology commitments relevant to the Project have been address in Sections 5 and 6. In addition, Sections 8 and 9 also highlight commitments relevant to the protection of the aquatic environment.