2. Open cut mining of magnesite in the Kunwarara area.

11.4.2. Corio Bay Wetlands

Figure 52: Corio Bay wetlands north of Yeppoon

The Corio Bay wetlands (*figure 52*) are an extensive area of coastal wetlands to the north of Yeppoon on the southern side of Corio Bay. The wetland area has a series of bund walls that separate freshwater wetlands from the tidal creeks. The walls have some low areas that allow fish passage during flooding however passage is limited at other times. Capricorn Sunfish (Sawynok, 2002, 2003) and DPI&F (Hyland, 2002) have monitored fish use of this area. The wetlands vary in type from bulkuru swamps to melaleuca and palm forests and open wetland areas.

The Corio Bay wetlands have virtually no grazing and this is leading to an increase in grassy weeds such as para grass. There are also areas of woody weed that require ongoing management. While some areas of ASS have been allowed to oxidise, the impact appears minimal due to the waterlogged nature of the area for substantial periods of time.

Tarpon have been recorded approximately three kilometres upstream from the tidal limit and barramundi have been tagged and released approximately five kilometres above tidal influence in a feeder creek connected through the wetland in an area with undefined watercourses that is semi-permanently inundated (Sawynok, 2002, 2003). Following the 1991 flood, 185 juvenile barramundi were tagged in the wetland. Subsequent to the flood, some of these fish were recaptured throughout Corio Bay, as far north as Island Head Creek north of Port Clinton and as far south as Gladstone (Suntag, 2004).

Figure 53: Pipe under the roadway and levee bank separating brackish water in foreground from freshwater wetlands in background (juvenile barramundi and other species have been recorded below the pipe)

The wetland includes an artificial saltwater pondage in an area adjacent to Fishing Creek where material was extracted for road construction in the 1980s (*figure 53*). This pondage is connected to the creek on king tides and 38 species have been recorded using this habitat (Sawynok, 2002, 2003). While the creation of this wetland was largely incidental it demonstrates that viable wetlands can be created to replace those that have been lost.

Risks or threats to Corio Bay wetlands:

1. Bund walls that limit access to the wetlands to during periods of flooding.
2. Road construction without suitable fish passage devices.

11.4.3. Fitzroy River Floodplain

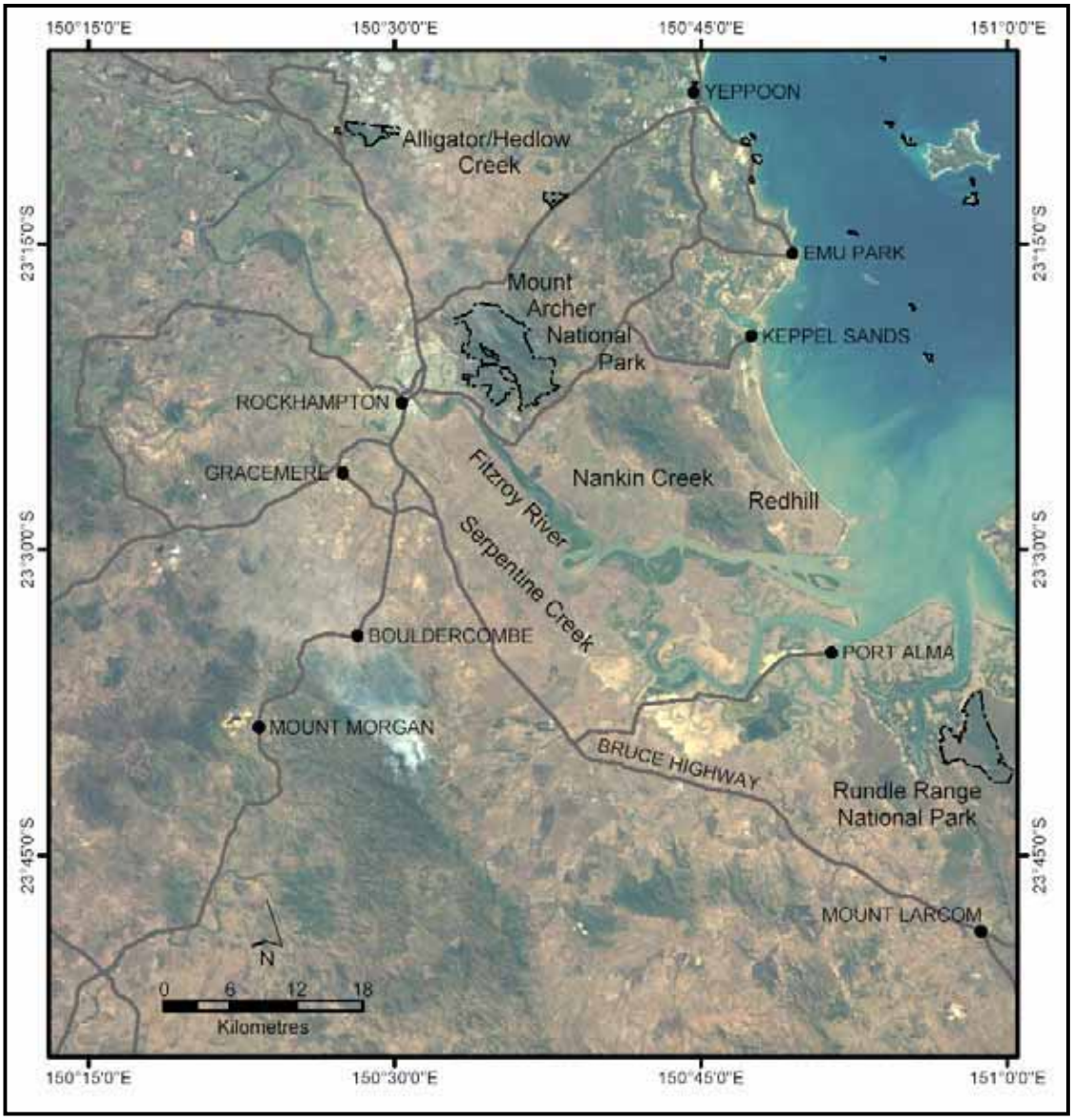

Figure 54: Fitzroy River floodplain and associated wetlands

The Fitzroy River and its tributary and distributary system (*figure 54*) is the largest in area in the GBR (EPA, 2003). Before development, the river and floodplain allowed marine fish access to thousands of kilometres of riverine habitat and numerous off-stream wetlands (Dunstan, 1959).

The construction of the Fitzroy River Barrage in 1970, to supply water to the City of Rockhampton, resulted in access to a large part of the river above the

barrage, and off-stream wetlands, largely denied to fish. The barrage, despite having a functioning fishway since 1997, significantly reduces the number of fish that can migrate upstream. The combined impacts of a number of barrages, weirs and ponded pastures is now denying fish access to approximately 80% of the original extent of habitat that was available, except during major flooding (Sawynok, 2002). Therefore the significance of remaining areas is considerably more important.

The fishway provides good passage for many species, but it is only moderately successful for key species such as barramundi (Stuart, 1997). Following the major flood in the Fitzroy River in 1991 seven barramundi tagged below the barrage were recaptured upstream. Since that time there have been no fish tagged below the barrage recaptured above the barrage (Sawynok, 1998, Suntag data, 2004). The area above the barrage is now regularly stocked with barramundi in areas where these fish have previously been recorded but have largely been absent since the construction of the barrage and upstream weirs.

11.4.3.1 Alligator and Hedlow Creek

Figure 55: Hedlow Creek has good in-stream habitat with modest riparian vegetation

Alligator Creek is a tributary of the Fitzroy upstream of the barrage. Alligator Creek drains a large sub-catchment that extends northwards and eastwards to the coastal hills inland from Yeppoon (*figure 54*). The lower reaches of Alligator Creek are part of the storage of the Fitzroy River Barrage. Hedlow Creek is one of many creeks that flow into Alligator Creek. Part of Hedlow Creek forms a permanent deepwater in-stream habitat 12 kilometres long. Canal Creek is

another tributary of Alligator Creek with smaller permanent deepwater in-stream habitat. Serpentine Lagoon to the north is part of the drainage basin with similar significant habitat. There are also a number of smaller creeks and off-stream lagoons in this area that drain into Alligator Creek.

Hedlow Creek, Serpentine Lagoon and Green Lake have been stocked with barramundi in the last decade to include these fish in a habitat that was previously available to them. Barramundi tagged in Serpentine Lagoon in 2002 were recaptured in the estuarine part of the Fitzroy River following the February 2003 flooding demonstrating that downstream movement is possible during flood events (Suntag, 2004).

Riparian vegetation is poor along both Hedlow Creek (*figure 55*) and Serpentine Lagoon however is more natural along Canal Creek.

Risks or threats to Alligator Creek and Hedlow Creek:

1. The ongoing fish passage restriction through the Fitzroy River barrage.
2. The loss of remaining riparian vegetation.

11.4.3.2 Moore Creek

Figure 56: Moore Creek causeway at the upper tidal limit after moderate rain

Moore Creek is a small creek in the urban area of Rockhampton and is the last off-stream habitat available to fish below the barrage. The creek has been extensively modified in the freshwater reaches with little remaining riparian

vegetation. A low causeway separates the saltwater and freshwater reaches of the creek (*figure 56*). It has some weed infestation and is shallow but now has permanent flow due to seepage from residential and parkland irrigation and water quality, although impacted, supports fish life.

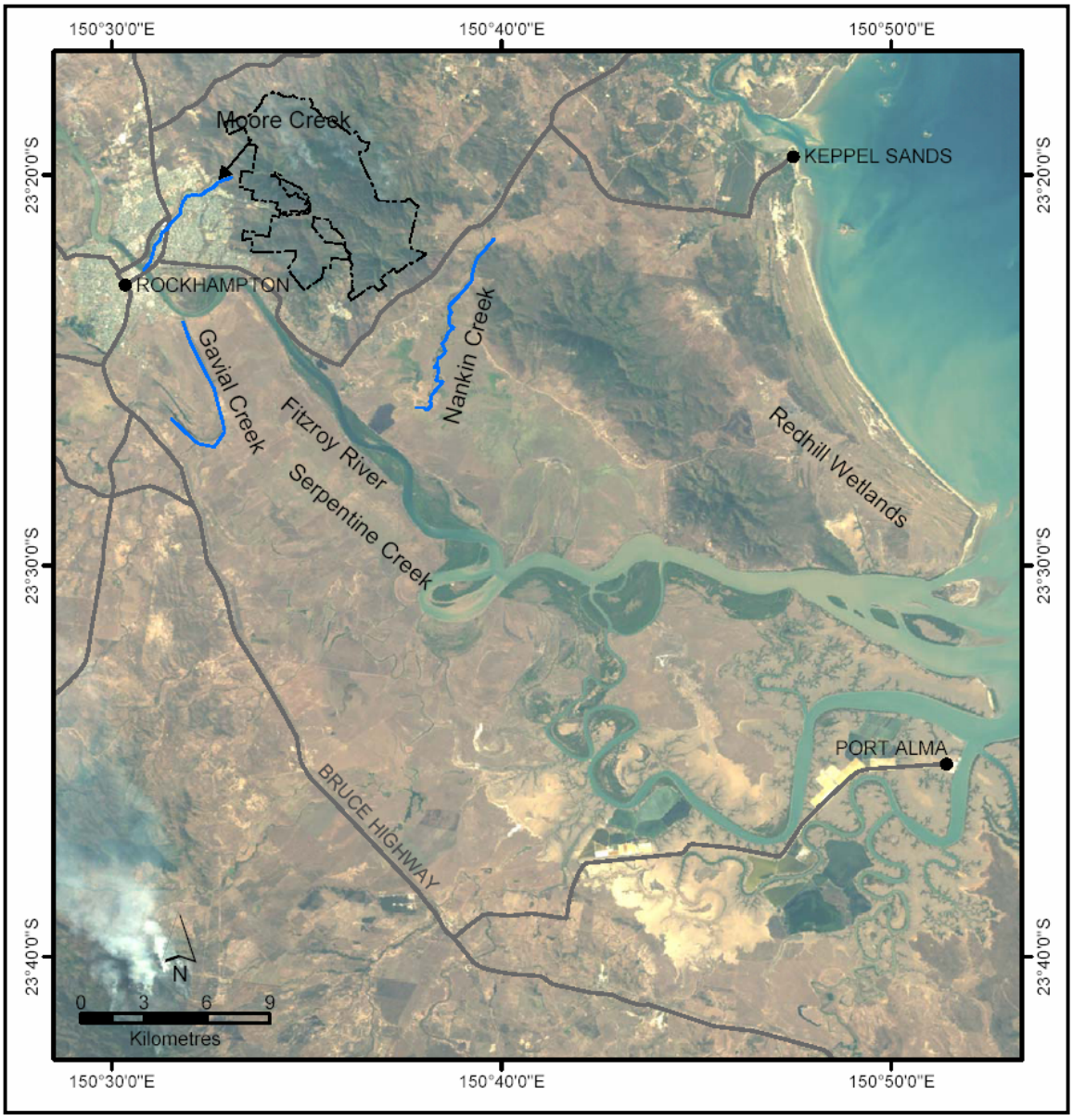

Figure 57: Wetlands adjacent to the Fitzroy River near Rockhampton

While small native fish and gambusia were observed during inspection, the freshwater habitat is not suitable for larger natives such as barramundi, mullet and bony bream that could otherwise reach the area. Over 40 marine and freshwater species have been recorded in the tidal, but mostly fresh, section of Moore Creek below the causeway (Sawynok, 2002, 2003) with few likely to be found in the freshwater above the causeway.

Rockhampton City Council has a program of establishing artificial wetlands in Moore Creek however they are not aimed at improving use by fish.

11.4.3.2 Nankin Creek Wetlands

Approximately 15 kilometres downstream from Rockhampton, the Fitzroy River has a wide floodplain that acts as both a tributary and distributary system, depending on the pattern of rainfall. Nankin Creek is a narrow flow path through a broad flat floodplain forming the Nankin Creek wetlands (*figure 57*). When the Fitzroy River is in flood parts of this plain are inundated. Nankin Creek carries localised runoff when the river is not in flood. Nankin Creek has a large in-stream deepwater hole in it lower section that remains naturally connected to the river. A large oxbow lagoon (*figure 58*) immediately to the east of the creek forms an important part of this wetland and juvenile barramundi are know to use this area (Hyland, 2002).

Figure 58: Oxbow lagoon east of Nankin Creek and part of the Nankin wetlands

While the Nankin Creek wetland is almost devoid of trees, a narrow riparian strip within the creek banks occurs along most of the length of the creek (*figure 59*). During heavy local rainfall and flood events, numerous shallow wetlands form on this floodplain. While some of these dry completely during long dry spells these shallow ephemeral wetlands are important to fish and birds.

Risks or threats to Nankin Creek wetlands:

1. Depth reduction as a result of siltation of the oxbow lagoon.
2. Lack of riparian vegetation.

Figure 59: Nankin Creek saltwater-freshwater interface with ephemeral wetlands in the background

11.4.3.3 Barramundi Creek and Red Hill Coastal Wetlands

Barramundi Creek is a relatively small tidal creek that joins the Fitzroy River near its mouth and drains extensive coastal wetlands that extend northward behind the coastline in the area known as Red Hill (*figure 60*). Barramundi Creek has a barrier at the upper tidal limit that allows ponding of freshwater on the wetlands but limits fish access. Although this system has been subjected to the development of ponded pastures, no on-ground monitoring of fish use has been undertaken. The Coastal CRC and Capricorn Sunfish have undertaken aerial assessments of this area and these wetlands are considered likely to be of significance to fisheries resources. After rain, wetlands connected to Barramundi Creek and smaller coastal creeks extend for approximately 15 kilometres from the mouth of the Fitzroy River to Joskeleigh with extensive shallow areas and some apparent deep areas that may act as refuge during dry periods.

This wetland area may be one of the most significant remaining in the lower Fitzroy River and a priority is to assess its value for fisheries resources to determine if its values should be protected and enhanced where possible.

Figure 60: Barramundi Creek showing the interface between freshwater wetlands and tidal creek

Risks or threats to Barramundi Creek and Red Hill Coastal wetlands:

1. A lack of knowledge of the fisheries values of these wetlands.
2. The unknown impact of the ponded pastures on fish passage.
3. Possible sedimentation and nutrient enrichment of water.
4. Tilapia have been recorded from a dam in the area but are considered to have been eradicated.

11.4.3.5 Gavial Creek and Lagoons

Gavial Creek is a tributary creek on the south side of the Fitzroy River entering the river immediately downstream of Rockhampton. It comprises a number of intermittently connected lagoons that form part of the creek and are also connected to adjacent lagoons (*figure 61, 62*). During large floods, such as in 1991, the Fitzroy River breaks its banks upstream of Rockhampton and flows across this southern floodplain filling and connecting all the lagoons. Some lagoons, including those in Gavial Creek, are also filled and connected during flows in the creek. The main lagoons with known fisheries values are Yeppen, Woolwash, Frogmore and Bates Lagoons (Sawynok, 1998, 2002; Suntag, 2004).

These lagoons in the middle reaches of the floodplain are now critical habitats for a wide diversity of fish species as they are the only off-stream wetlands on the southern side of the river that still have natural connectivity to the tidal

reaches of the river. Yeppen Lagoon is approximately one kilometre in length whilst Woolwash and Frogmore are both two and a half kilometres long and Bates Lagoon is one kilometre long. With the exception of Bates Lagoon all are permanent and Bates Lagoon only dries during long dry periods. In moderate to large floods, this network of lagoons is connected to the river when floodwater backs up Gavial Creek and allows migration of native fish. While this overcomes some of the impacts of the barrage, it cannot replace the major migrations that would have occurred naturally in low flow conditions in the river.

Figure 61: Gavial Creek lagoons south of Rockhampton

The impact of adjacent land practices on these lagoons is limited and a narrow riparian vegetation strip has been retained in most areas. The riparian vegetation has been partly removed and a Landcare project has replanted trees

along a riparian section of Woolwash Lagoon. Para grass and other weed invasion of this section of the lagoon have been treated and infestation is now light. Cattle keep invasive grasses in check in other areas of these lagoons.

Barramundi tagged in these lagoons have been recaptured throughout the Fitzroy River estuary, as far north as Dumbleton Weir on the Pioneer River at Mackay and as far south as the Gregory River at Hervey Bay (Sawynok, 1998, Suntag 2004). This is also a site where a number of fish tagged in the Fitzroy River have been recaptured in the lagoons.

Figure 62: Woolwash Lagoon on the Fitzroy River floodplain

Risks or threats to Gavial Creek and lagoons are:

1. Reduced water flow in the Fitzroy River may reduce the connectivity of the lagoons to the river.
2. Water contaminants from rural residential development on the western side of Frogmore Lagoon and Gavial Creek.
3. Minor weed infestations, particularly para grass.

11.4.3.6 Serpentine Creek

Serpentine Creek is a small floodplain creek on the southern side of the Fitzroy River that enters the river at Pirates Point. Serpentine Creek, with at least five major barriers to fish migration along its length of just 30 kilometres, is an example of the extent to which fisheries habitat can be modified to reduce connectivity and diminish fisheries values. Fish can only access lagoons on this

creek during major flooding such as experienced in 1991 and its value to marine fish is considered very low.

11.4.3.7 8 Mile Creek

On the south side of the Fitzroy River there is an extensive delta with a number of channels and feeder creeks that all once had significant fishery values. Many of the creeks have been degraded as a result of barriers at the tidal limit of feeder creeks and gullies and tree clearing for grazing. It is only some of the larger creeks such as 8 Mile Creek that have been able to maintain limited fishery values.

Figure 63: Bajool weir showing the overflow pipe on the downstream side
Inset: Juvenile barramundi of 67mm caught below the weir

8 Mile Creek has a range of in-stream habitat including some permanent and semi-permanent shallow pools from the tidal reaches upstream to the Bajool Weir, a distance of approximately two kilometres. Riparian vegetation along the creek is mostly sparse and disconnected however where present it provides an important contribution to habitat. The weir wall is part of the Port Alma Road and the dam supplies water to the nearby township of Bajool. The weir wall prevents further upstream access to fish except in periods of major flooding. Juvenile barramundi and other fish species can migrate upstream as far as the weir but when water stops flowing through the overflow pipe, they become

trapped in shallow ponds that dry up at its base (*figure 63*). This causes in regular fish kills of small fish trapped at the weir wall.

During a field inspection in early January 2004, a barramundi 67 mm long was caught and released below the weir. Further small barramundi were caught in the same location in the following weeks, while there was flow in the creek. Some of these barramundi were released upstream above the weir.

This creek is important for fisheries resources and consideration should be given to modifying the overflow arrangements so that fish passage can be restored. As the height of the wall is only around two metres and passage is only required on high flow conditions the fishway technology to deal with this is available. There is an opportunity for such works to be included in upgrade or maintenance plans for the road.

A fish passage problem existed about 5km further east along the Port Alma Road where part of Inkerman Creek was isolated by the roadway. In April 1999 a major fish kill occurred in this location involving over 2,000 fish, including 1,200–1,500 barramundi (Sawynok, 2002). As a result of this the Department of Main Roads addressed the issue and placed a culvert under the roadway and alleviated the problem.

Risks or threats to 8 Mile Creek are:

1. Blocking of fish passage by Bajool Weir.
2. Further degradation of the generally poor riparian zone.
3. Minor rubber vine infestation.

11.4.3.8 12 Mile Creek

12 Mile Creek is a small narrow creek near Marmor (*figure 64*) feeding into a brackish lagoon on the edge of the delta. This lagoon is tidally influenced on 3 or 4 of the largest tides each year and is, at other times, not connected unless there is significant rainfall causing the creek to flow. Riparian vegetation is sparse, disconnected, and mostly within the creek banks along the brackish lagoon. Water quality varies considerably and a number of minor fish kills have occurred. A total fish kill was recorded in 2001 (Sawynok, 2002).

Monitoring of barramundi by the Suntag program in 12 Mile Creek has been undertaken since around 1985 and for all species by Capricorn Sunfish since 1999. 12 Mile Creek is considered to be one of the key juvenile barramundi habitats in Central Queensland with around 1,500 juvenile barramundi tagged in the brackish lagoon in 1996 (Sawynok, 1998, 2002, 2003; Suntag, 2004). The creek has been continually used by barramundi since 1985 with over 4,500 barramundi tagged. Fish have been recaptured downstream in all parts of the

Fitzroy River and as far away to the south as the Kolan River near Bundaberg (Suntag, 2004).

Figure 64: Aerial view of brackish lagoon on 12 Mile Creek showing lack of riparian vegetation

12 Mile Creek has also been a restoration site for Capricorn Sunfish whose members have planted native trees in the riparian and near riparian areas to restore habitat values (Sawynok, 2001).

Risks or threats to 12 Mile Creek are:

1. Proposed future expansion of saltworks on the Fitzroy delta.
2. Unknown causes of fish kills that appear to be increasing in frequency and severity.

11.4.3.9 Raglan Creek

Raglan Creek drains into the lower reaches of the Fitzroy River (*figure 65*). Raglan Creek has extensive in-stream freshwater wetlands that are important to fishery resources within the GBR. Although in-stream and fed by permanent springs, habitat quality and the absence of major barriers to migration results in Raglan Creek having fishery values that are as good as could reasonably be achieved in a productive rural catchment.

A range of marine and freshwater species have been caught in the lower large lagoon known locally as Blacks Hole. Barramundi, mangrove jack, tarpon, forktail catfish, bony bream, rainbowfish, mullet and yellowfin bream have been

recorded at this site. Barramundi tagged in Blacks Hole have been recaptured throughout the Fitzroy River system as far up as the barrage at Rockhampton, as far south as the Calliope River, and as far north as Flock Pigeon Island near Clairview (Suntag, 2004). Blacks Hole has also been assessed for mangrove jack but there have not been any records of fish tagged here that have been recaptured elsewhere (Russell et al, 2003; Suntag, 2004).

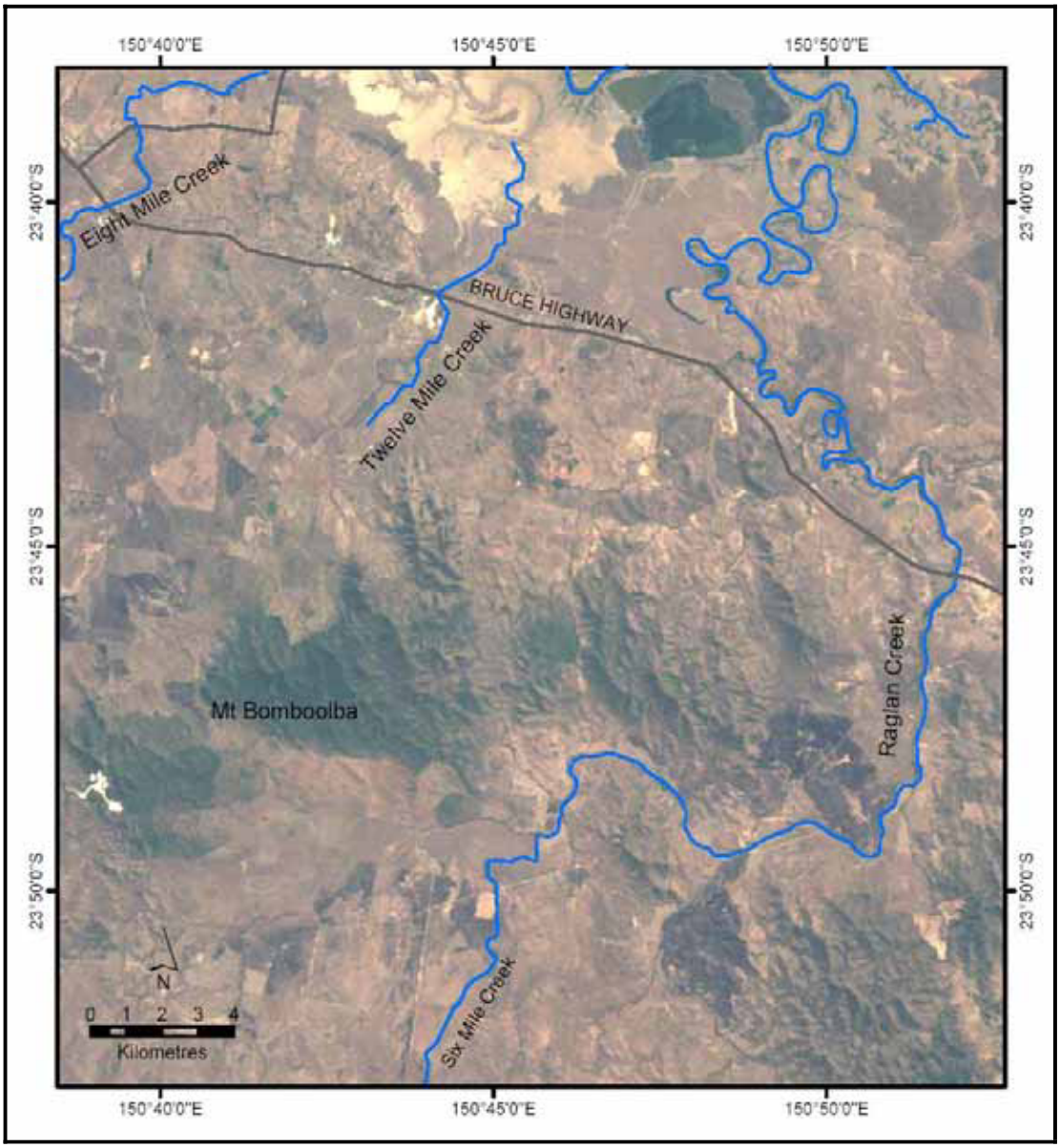

Figure 65: Raglan Creek, 12 Mile Creek and 8 Mile Creek to the south of the Fitzroy River

Fish passage, particularly upstream migration of barramundi to Blacks Hole, has been effectively stopped during low flow periods following the upgrading of an old wooden bridge to a culvert on Raglan Station Road in 2003 (*figure 66*). A

300mm drop in water level below the culvert now effectively prevents migration during low flows where previously fish were unimpeded in their upstream movement. Further upstream, the old highway culvert also presents a barrier to migration (*figure 67*).

Figure 66: The causeway on Raglan Creek during a flow event indicating obstacles to fish migration

From March to May 2004 a total of 19 barramundi up to 300mm in length were caught below the culvert and moved to above the culvert. Further barramundi were also tagged in the waterhole below the culvert.

Risks or threats to Raglan Creek are:

1. Water extraction for local irrigation has stopped the creek flowing when it would normally flow all year round.
2. Weed infestations from pasture grasses and woody weeds in the riparian zone.
3. Stopping of fish migration in low flow events from a culvert and causeway on roads crossing the creek;
4. Development of intensive agriculture to replace existing grazing use.

Raglan Creek is one of the least impacted and more important wetland systems in the developed GBR catchment and should be considered for the development of a neighbourhood catchment plan to maintain and improve its habitat and fisheries values. Resolution of the fish passage issues is a priority.

Figure 67: The culvert on Raglan Creek that now prevents upstream migration of juvenile barramundi

Figure 68: Pelican Lagoon adjacent to Raglan Creek showing the lack of riparian vegetation

Raglan Creek also has an off-stream freshwater to brackish wetland adjacent to the tidal reaches of the creek to the northwest of Raglan. Pelican Lagoon has good connectivity to Raglan Creek but it has no riparian vegetation and its water quality is unknown (*figure 68*). Local anecdotal information indicates that barramundi use this wetland but no investigation of its use by fish has been undertaken. The lagoon is located on private property.

11.4.4. Curtis Island

Figure 69: Aerial view of the extensive freshwater wetlands upstream from Yellow Patch on Curtis Island

An extensive wetland area exists at the northern end of Curtis Island that feeds into the Yellow Patch Creek system near Cape Capricorn. This wetland area has an old bund wall that was built to separate freshwater and saltwater areas of the wetland. This is an extensive grassed, mostly treeless wetland of about 30km^2 but it has little or no permanent freshwater and is not considered significant to fish (*pers comm.* P Stoneley)(*figure 69*).

A number of small, short creeks drain into the Narrows on the western side of the island. Graham Creek is a larger creek at the southern end. There are small semi-permanent to permanent freshwater in-stream pools on some of these creeks however their value to fish is likely to be limited. There are no off-stream wetlands that are likely to be significant (*figure 70*).

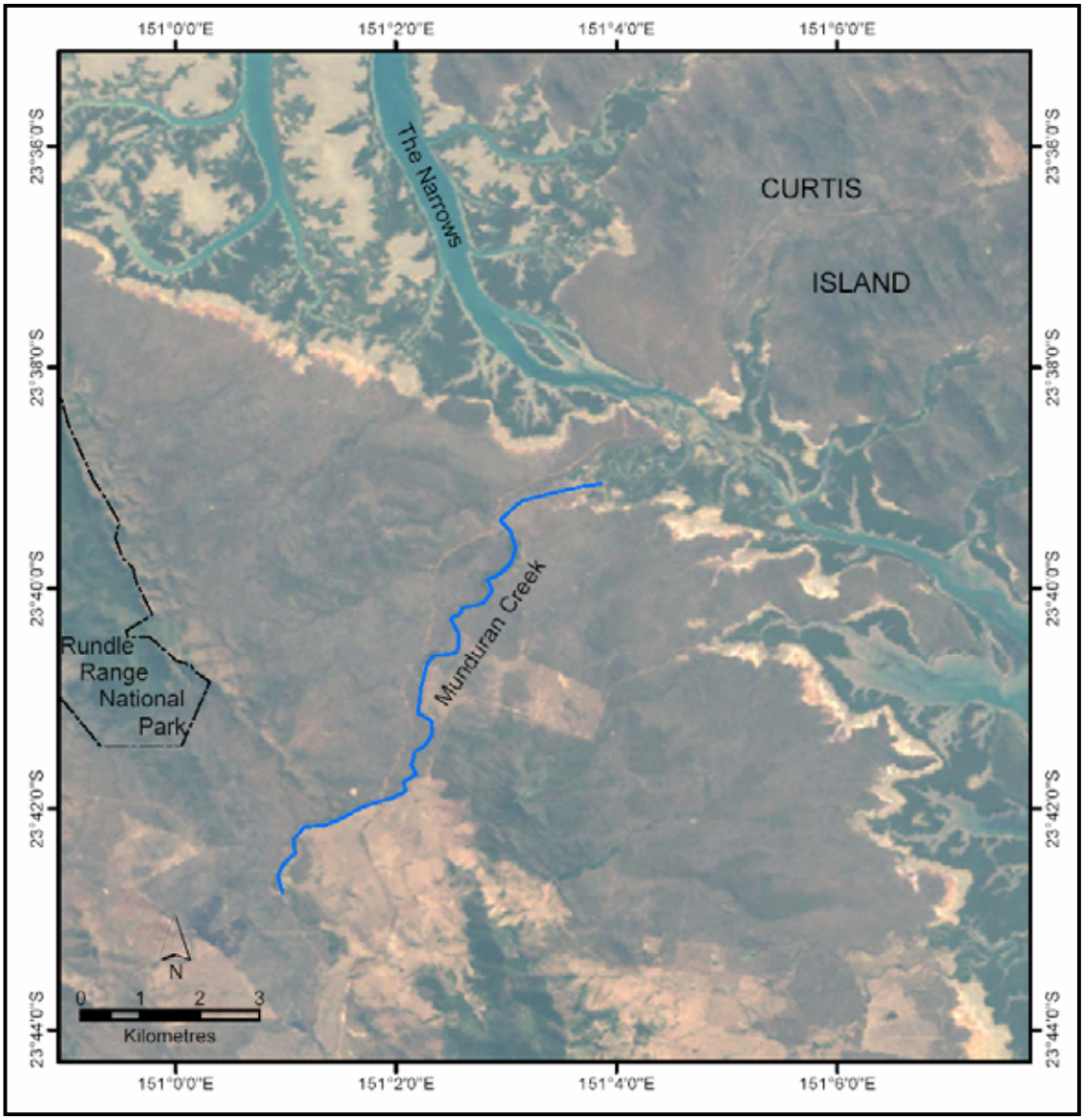

Figure 70: Munduran Creek and the Narrows between the mainland and Curtis Island

11.4.5. The Narrows

A number of small creeks drain into the Narrows from the mainland to the west. Munduran Creek is the only creek with significant in-stream freshwater wetlands (*figure 70*). There are no significant off-stream freshwater wetlands.

Munduran Creek is a small catchment entering the Narrows at Ramsay Crossing. It is largely pristine in the lower section with a significant part of its catchment in State Forest. Natural vegetation occurs for 10 kilometres from the creek's mouth at the Narrows. There are some permanent and semi-permanent sections of freshwater habitat above a relatively shallow tidal lagoon at the upper tidal limit, including a permanent deepwater hole about 0.3 km long about four

kilometres above the tidal limit (*figure 71*). Mullet have been observed in this waterhole and there is anecdotal evidence of juvenile barramundi (*pers comm.* P Stoneley). Upstream of the State Forest area the creek runs through grazing country that has been mostly cleared although there is a continuous narrow riparian vegetation strip within the banks of the creek. There are no permanent waterholes or wetlands above the State Forest area.

Figure 71: Near pristine in-stream freshwater lagoon on Munduran Creek

Water temperatures in the tidal lagoon are consistently higher than in similar adjacent creeks and can be high enough to restrict use by some species. The water temperature has been measured above 35°C regularly during summer months (Sawynok, 2002). There are no artificial barriers to prevent migration and the area is protected by its present land tenure. Some rubber vine exists along the creek but weed levels are generally low and the only impact is from sediment run-off from dirt roads in the area. Although saltwater stretches of Munduran Creek are monitored regularly by Capricorn Sunfish, no monitoring has been undertaken above the tidal limit. The Coastal CRC will begin monitoring the creek for fisheries resources in a current project.

This area is presently lightly impacted by grazing and some limited cropping. It is close to industrial development from a resource perspective and some areas are underlain by extensive shale deposits. Shale mining has the potential to threaten the ecological functioning of wetlands in the vicinity of The Narrows.

Risks or threats to Munduran Creek are:

1. Possible future mining of oil shale.
2. Temperatures significantly higher than other creeks in the area may limit its use by fish during summer.

11.4.6. Calliope River

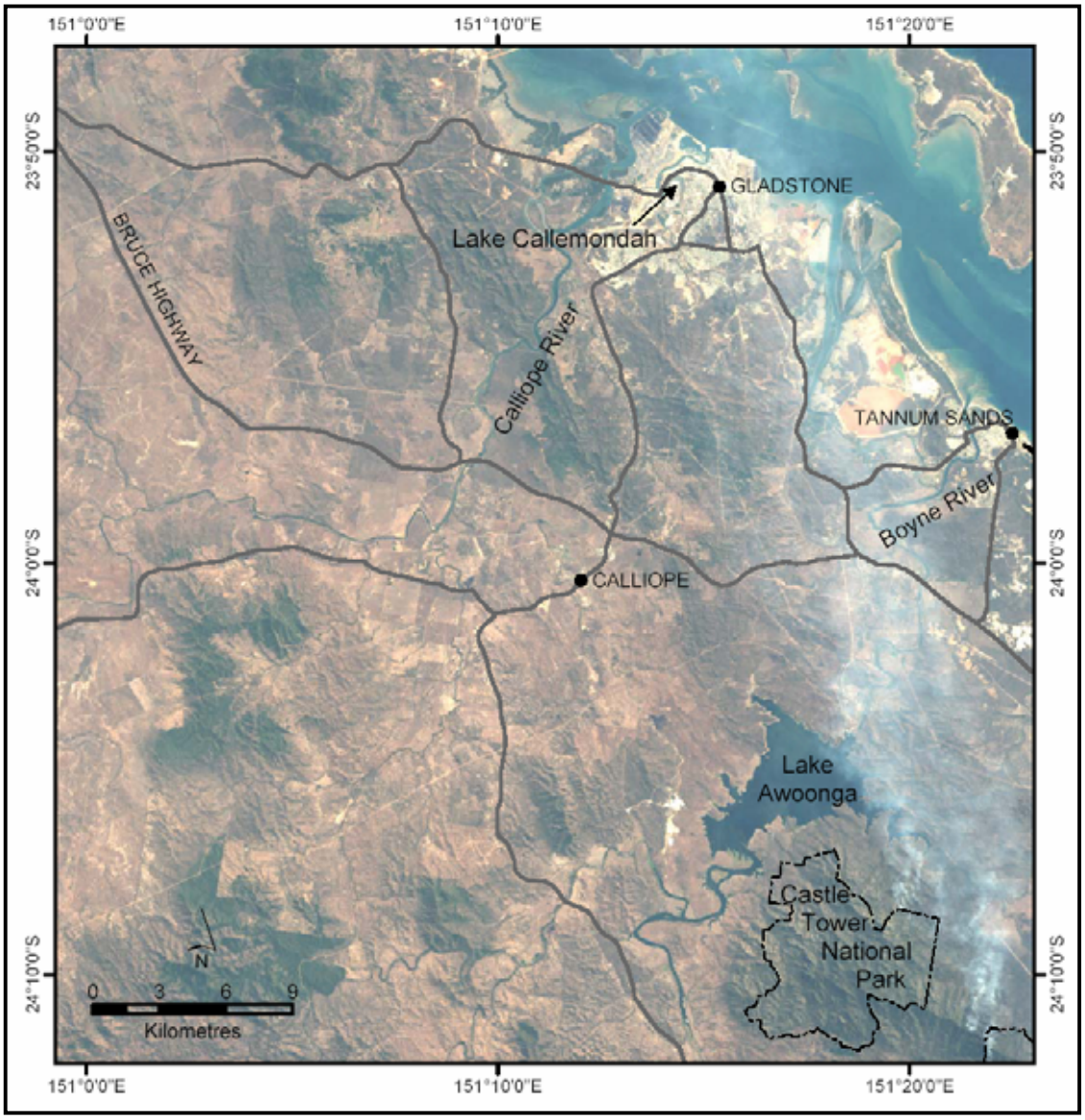

Figure 72: Calliope River and Boyne River near Gladstone

The Calliope River to the north of Gladstone is one of two rivers in the Gladstone area (*figure 72, 73*). It has no significant barriers to fish movement and has natural flows. In the upper tidal reaches there is a natural rock bar below the Bruce Highway and a causeway on the old highway bridge. Larger tides push saltwater up above these minor barriers and they do not limit fish passage to any significant extent. There are few off-stream freshwater wetlands along the