

Chapter 2

Background information

This chapter provides a general overview of the plan area and more detailed description of the physical settings and ecosystems. The information contained in the following section is derived largely from NRMW (2006) to which the reader is referred for further detail on the water resource planning process.

2.1 General overview

The Mackay–Whitsunday Region is located on the Central Queensland coast and covers an area of approximately 7400 km² (QDPI 1993). The plan area lies within this region. The region has an international reputation as a holiday environment, and for the quality of its offshore marine environment. The mainland has a reputation for producing high-quality beef cattle and sugar (Hardy 2003).

The Traditional Owners of the region include the following groups (MWNRM 2005)

- Barada, Barna, Kabalbara, Yetimarla (BBKY)
- Gia
- Koinjmal
- Ngaro
- Wiri
- Yuibera.

The selection of large grazing properties by European settlers occurred primarily during the 1860s (Proserpine Historical Society 1988). The town of Proserpine was established in the 1890s and the sugar industry became established around 1900. Notable cyclone events occurred in 1911, 1913, 1918, 1959, 1970 (Ada), 1979, 1989 and 1990 (Ullman & Nolan 1975 and www.australiasevereweather.com).

The major land uses and industries in the plan area include rangeland beef grazing, sugarcane cultivation, horticulture and tourism. Industries such as sugar mills, aquaculture (particularly prawn farms) and sewage plants occupy a small area (NRMW 2006). A comparison of land use and vegetation cover for the plan area within a regional context is shown in Figure 2-1. Commercial and recreation fisheries, Indigenous interests, conservation and forestry were also identified in the regional natural resource management plan as key sectors for future management planning purposes (MWNRM 2005).

The three main rivers of the plan area are the Proserpine, O’Connell and Andromache rivers. The Andromache River is the main tributary of the O’Connell River and their confluence is approximately at the tidal limit. Flows from these rivers enter Repulse Bay, which forms part of the Great Barrier Reef Marine Park and has important habitat values (including for dugong and turtles) in addition to its value as a recreational and commercial fishery (NRMW 2006).

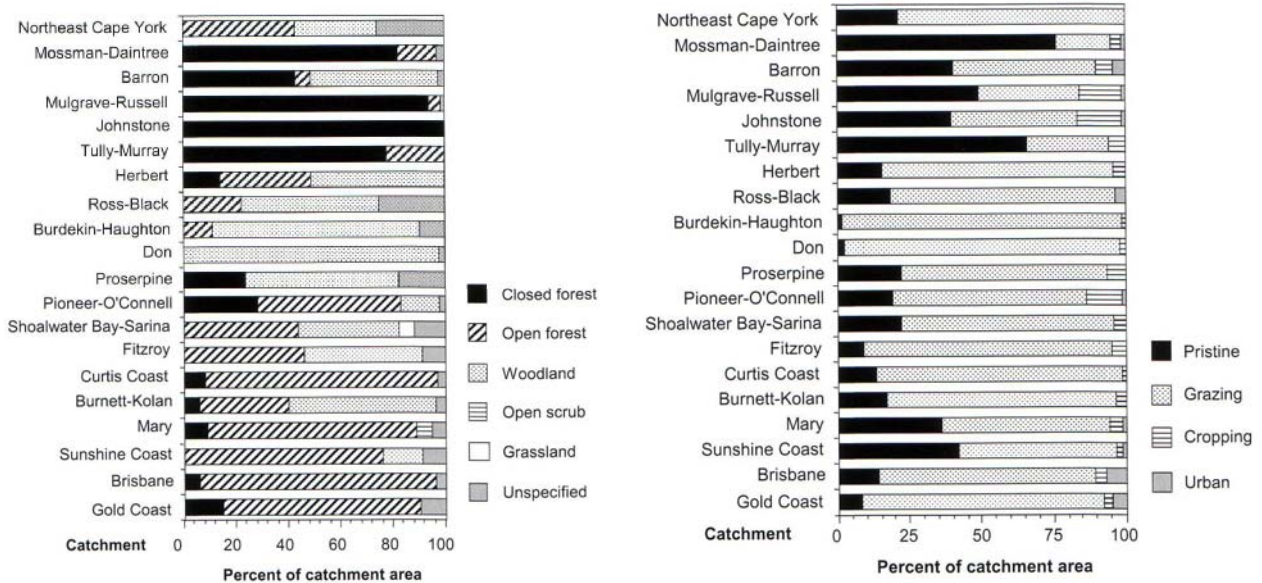


Figure 2-1 Natural vegetative cover (left) and land use variation (right) in a regional context (from Neil et al. 2002)

The Proserpine River has a catchment area of 1081 km² (NRMW 2006). The Proserpine River flows north and then east from Mt Quandong to Lake Proserpine. Downstream from Peter Faust Dam the Proserpine River discharges into the Coral Sea some 20 kilometres east of Proserpine. Presently Peter Faust Dam is the only major storage in the proposed plan area.

In its middle and lower reaches the Proserpine River is bounded by levee banks that extend to a point downstream of Proserpine.

Peter Faust Dam is located 58 km from the mouth of the Proserpine River. At full supply level the dam storage capacity is 491 400 megalitres and it covers an area of more than 4350 hectares. The dam has altered the historical flow patterns in the Proserpine River (NRMW 2006).

The dam was originally constructed for the following purposes (NRMW 2006):

- to provide water for irrigation of assigned cane land by private diversion from the Proserpine River
- to provide water to meet additional urban water needs for the Whitsunday, Bowen and Mackay local government areas
- to provide flood mitigation along the Proserpine River by limiting the outflow from the dam for most floods to 1130 m³ s⁻¹ (cubic metres per second).

A large floodway, called the Breakaway, is present on the right bank floodplain of the Proserpine River and acts as an anabranch during floods. It is thought to have been developed during the 1918 cyclone (Ullman & Nolan 1975).

The catchment areas for the O'Connell and Andromache rivers are 457 km² and 403 km² respectively (NRMW 2006). There are no major storages located in the O'Connell and Andromache river catchments and flows within these rivers are primarily used for irrigation purposes. There has been significant water resource development in recent years

in the O'Connell River, particularly base flows. In contrast, there has been much less water resource development in the Andromache River.

A significant feature of the plan area is the Goorganga Plain wetland, which is of national significance. The Goorganga wetland consists of an extensive grassland interrupted by three groups of beach ridges fronted by a narrow beach ridge and mangrove swamp plain that is contiguous with the beach ridges at the mouth of the O'Connell River (Stephens 1993). The wetland covers an area of approximately 19 544 hectares (Hardy 2004, 2004a), receiving flow from the Proserpine River and, during high floods, the O'Connell River catchment. The Goorganga Plain is drained by Thompson Creek, Goorganga Creek and Lethe Brook. The changed flow regime of the Proserpine River has affected the frequency and duration of flood incursion to these wetlands.

2.2 Climate

The climate of the plan area is tropical. The annual rainfall for the Proserpine, O'Connell and Andromache river catchments is highly variable and ranges from approximately 1400 to 2000 millimetres. A maximum annual total of 3500 millimetres was recorded in 1956. The region is subject to tropical cyclones.

On average, the majority (approximately 80 per cent [QDPI 1993]) of rainfall occurs during the six-month period from December to May, with lower rainfall occurring in the winter months (NRMW 2006). Evaporation is estimated to be approximately 1850 to 2000 millimetres per annum (mm.a^{-1}) (QDPI 1993). Figure 2-2 shows values of rainfall and evaporation (QDPI 1993) and runoff (QDPI 1993 & NRMW HYDSYS dataset) and shows the seasonal reversal of the evaporation–rainfall balance. Runoff was calculated as the sum of the O'Connell (Caping Siding) and Andromache (Jocheim's) gauging stations, over a catchment area of 860 km^2 (NRMW 2006). Across the plan area, rainfall is generally higher for the coastal and western upland areas and lower for the middle catchment areas.

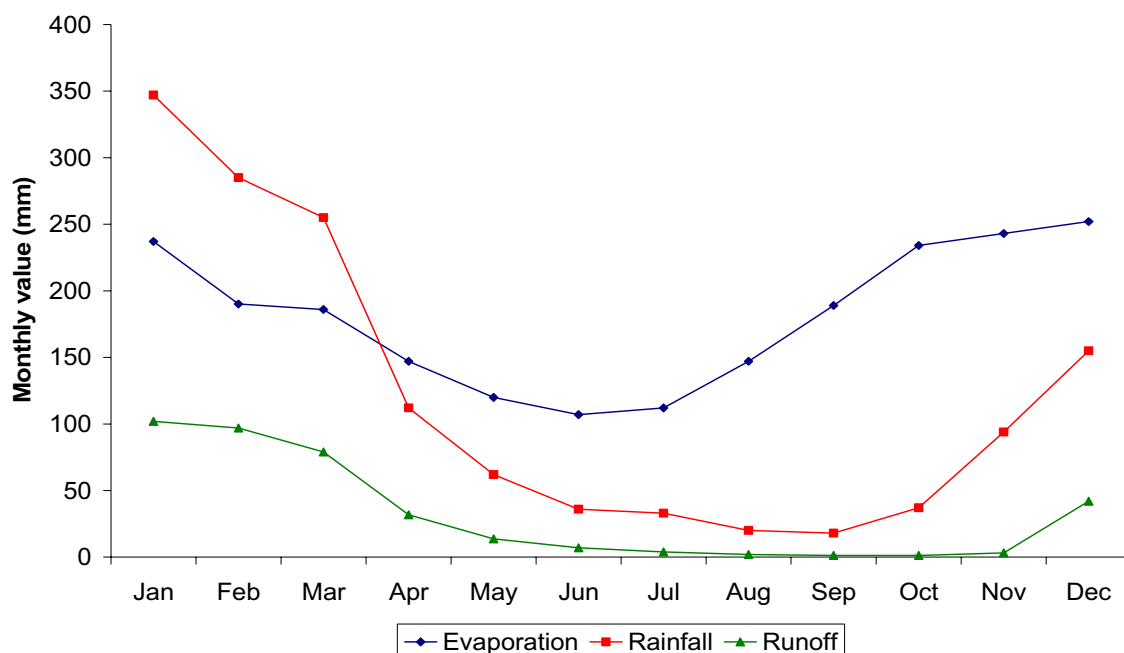


Figure 2-2 Mean monthly values of rainfall, evaporation and runoff for the O'Connell River

2.3 Geology

The catchments of the plan area share many geological features but also differ in some respects that are significant for interpreting the interrelationships among geomorphology, groundwater and water utilisation. Regional geological mapping of the study is described by Jensen (1963), Clarke (1971) and Paine and Cameron (1972). For the purposes of this report the geological features can be broadly described as older bedrock, younger bedrock, recent alluvium and coastal sediments.

2.3.1 Older bedrock

The older bedrock comprises bedded and deformed volcanics and sediments as well as igneous intrusives ranging in age from Devonian or Carboniferous to Permian (370 or 355 to 248 million years ago) and Cretaceous (144 to 65 million years ago). All of these rocks are of medium to very high material strength and extremely low material porosity, but are extensively faulted and fractured. The older bedrock forms the hills and mountains within the plan area and reflects generally north-west to south-east trending linear features.

On the north side of the lower Proserpine River are the Lower Carboniferous Edgecumbe Beds (acid to intermediate volcanic flows, tuffs, minor lithic sandstone, and limestone), Lower Permian Airlie Volcanics (acid to intermediate tuffs and flows), and Lower Cretaceous Proserpine Volcanics (rhyolite, andesite, minor tuffs). On the south side of the Proserpine River along the coastal hills are the Upper Devonian or Lower Carboniferous Campwyn Beds (acid to intermediate flows and tuffs, mudstone, siltstone, quartz sandstone, conglomerate and limestone). Further west, and within a generally low-lying band, are the Lower Permian Carmilla Beds (lithic sandstone, siltstone, mudstone, conglomerate and intermediate tuffs and flows).

The Clarke Ranges form the western uplands of the plan area. As far north as Mt Hector, the upper catchments of the O'Connell River and Andromache River tributaries comprise acid, intermediate and minor basic plutonic rocks of the Upper Carboniferous to Lower Cretaceous Urannah Igneous Complex. North of Mt Hector, forming the upper catchments of the Andromache and Proserpine rivers, is the Lower Cretaceous Hecate Granite.

2.3.2 Younger bedrock

By the early Tertiary age, about 65 million years ago, it is believed that the drainage systems were similar in pattern to the modern day except that the coastline was probably much further to the east. Deposition of younger bedrock took place about this time, after the (modern) lower Proserpine valley and Repulse Bay subsided between major north-west to south-east trending faults, forming the Hillsborough Basin (Grimes 1980). Acid volcanics, conglomerates, clay-bound sands, oil shale and minor basalt flows accumulated, forming a relatively flat landscape away from the western foothills. The younger bedrock materials are relatively unstructured and of low to medium strength, and are underlain by older bedrock.

Renewed subsidence in the Gunyarra to Proserpine area resulted in later Tertiary sedimentation consisting of two documented sequences:

- clay-bound outwash sediments that formed an upper Tertiary terrace
- clayey sandstones and conglomerates that formed a later lower Tertiary terrace.

Parts of all three Tertiary sequences were deeply weathered with local development of laterite and minor silcrete layers.

In the Proserpine River catchment downstream of Peter Faust Dam, upper and lower Tertiary terrace sediments are underlain by older bedrock towards the north, and by the early Tertiary basin sediments towards the south and east (Queensland Water Resources Commission, QWRC, 1981). The extent and limits of younger bedrock have not been established with confidence in the Andromache and O'Connell river catchments.

2.3.3 Recent alluvium and coastal sediments

The recent geological history of the plan area involves deposition and reworking of floodplain sediments of the modern drainage system. Cycles of sea-level changes associated with Quaternary ice ages have resulted in downcutting of stream channels followed by alluvial channel backfilling and emplacement of coastal muds and silts behind coastal sand flats and ridges (Coventry et al. 1980).

2.4 Geomorphology

Hardy (2003) described eight main landform patterns across the plan area:

- mountains
- low hills and hills
- undulating rises
- alluvial fans
- Cainozoic terraces
- Quaternary alluvial plain
- coastal beach ridge system
- delta.

The terraces and alluvial plains or floodplains within the plan area have had a complex depositional history (Coutts & Hardy 2001; Hardy 2003). There is evidence of a Tertiary floodplain surface in addition to the more recent Quaternary deposits that are subject to modern flood events. Older Cainozoic alluvium was likely formed by fluvial and colluvial processes that are now less active. During the Holocene, channel erosion has been the dominant process.

The Urannah Igneous Complex and to a greater extent the Hecate Granite provide high sand loads to the drainage network. The sand is stored, with a proportion eventually transported to the coast where it is important for coastal geomorphic processes (see later Section 2.8). However, an important distinction between the Proserpine and O'Connell Rivers is that the Proserpine River flows through a large alluvial tract, whereas the O'Connell River alluvial tract is much smaller with the river generally flowing closer to the bedrock surface.

2.5 Soils

Comprehensive soil mapping of the plan area has been undertaken (e.g., Coutts & Hardy 2001; Hardy 2003). A wide range of soil types were mapped. These soil types were derived from parent material and geomorphic processes occurring in the plan area (further details of soil types in the plan area can be found in Coutts & Hardy 2001, and Hardy

2003). Groundwater may be adversely affected by increased irrigation in locations where soils have high levels of exchangeable sodium or where soil salinity is already high with respect to tolerable limits.

2.6 Groundwater

2.6.1 Groundwater occurrence

Groundwater resources within the plan area have been identified in the following geological settings (McEniery 1980):

- unconfined (Recent) river and coastal alluvium aquifers
- Tertiary terrace (i.e., younger bedrock, upper and lower terrace) aquifers
- fractured rock (i.e., older bedrock and possibly early Tertiary bedrock) aquifers.

2.6.1.1 Unconfined river and coastal alluvium aquifers of the Proserpine River floodplain

The most significant groundwater resource within the plan area is the unconfined recent alluvium aquifer of the modern lower Proserpine River floodplain. Testing has established that this recharges directly from river flow, and that the zone of greatest yield and recharge extends generally 200 metres away from the present-day river-channel banks (QWRC 1981). Prior to availability of maintenance flows from Peter Faust Dam sustainable yields of between 10 and 30 litres per second (Ls^{-1}) were achievable from individual bores depending on the groundwater level, with sand dams constructed within the river channel to raise levels and thereby enhance recharge. Currently river maintenance flows are managed to meet offtake commitments within the Proserpine River Water Supply Scheme area.

The Goorganga Plain, some lower sections of Goorganga Creek, Thompson Creek and the lower O'Connell River are underlain by the Condor oil shale deposit, which is contained within early Tertiary sediments. Groundwater-evaluation studies were undertaken for the proposed Condor mining project (Australian Groundwater Consultants, AGC, 1984). For areas potentially affected by the proposed Condor project, AGC identified groundwater resources within Recent alluvium as summarised in Table 2-1.

Table 2-1 Groundwater characteristics identified for proposed Condor project

Locality	Yield (Ls^{-1})	Salinity (mgL^{-1})	Comment
O'Connell River delta in Lethe Brook area (Recent alluvium)	up to 25	500–1500	Estimated recharge less than 400 ML per year, salinity increases with over-pumping
Andromache and O'Connell rivers (Recent alluvium)	up to 35	500–1600	Estimated recharge 500 ML per year
Thompson Creek, Gunyarra area (Recent alluvium)	not stated	400–1000	Estimated recharge 650 ML per year
Billies Creek area (Recent alluvium)	not stated	800–1600	Estimated recharge 400 ML per year

Sediments along the current coastline may include small perched freshwater lenses. No information has been identified regarding occurrence or yield, and a significant groundwater resource within these materials is considered to be extremely unlikely.

2.6.1.2 Tertiary terrace aquifers of the Proserpine River and Thompson Creek floodplains

In the lower Proserpine River, Kelsey Creek and Lethe Brook areas the Tertiary upper-terrace and lower-terrace sequences include aquifers. Yields from bores in the upper-terrace units are reportedly less than 1 L^{-1} (QWRC 1981). Within the lower-terrace sequence are patchy sandstone aquifers from which yields of 0.2 to 5 L^{-1} have been reported, and in one area close to the Proserpine River upstream from the town a sandstone unit of about 5 metres thickness has yielded between 5 and 70 L^{-1} (QWRC 1981).

2.6.1.3 Fractured bedrock aquifers within all plan area catchments

Away from the floodplains of the plan area, groundwater has been found in fractured older bedrock aquifers or in localised coarser grained sediments within small-scale yields (McEniery 1980), but larger scale or sustained yields are not considered to be reliable.

Limited QWRC groundwater data exists regarding occurrences within either fractured bedrock or Tertiary terrace sediments of the lower Andromache and O'Connell river catchments, but this has not yet been systematically evaluated or reported. Elsewhere within the Andromache and O'Connell river catchments, groundwater is extracted from recent alluvium close to stream channels or from fractured bedrock, so that some additional information may be available from private sources.

2.6.2 Groundwater interactions with surface water

While the Recent alluvium and current channel of the Proserpine River have intersected Tertiary terrace sediments, there is very little connection between the riverbed sand and the flanking Tertiary deposits until the lower reaches located around Proserpine (QWRC 1981). This means that in the Proserpine River at least, it is unlikely that the Tertiary aquifers provide any significant inflow to the river and any waterholes within the river are within the bed sand storage. Further support for this conclusion is anecdotal experience that, prior to releases from Peter Faust Dam, irrigators could virtually dewater the Recent alluvium storage down to 10 metres below the bed of the river within three months and this level would not recover until after the resumption of surface flows in the river.

Stream channels within the uplands and foothills of all catchments have, in places, intersected fractured bedrock aquifers, forming freshwater 'windows' that generate permanent soaks, pools and baseline flows. Within the flatter alluvial plains drainage channels have, in places, intersected Tertiary terrace aquifers to form windows and permanent waterholes. Other permanent waterholes are formed within Recent alluvium in lower floodplains due to channel scour. All such groundwater windows are considered to be of critical significance for the maintenance of ecological values in riparian corridors. Any increased utilisation of groundwater that results in loss of windows is likely to have significant and long-lasting impacts on riparian corridor values.

To date there has been no systematic evaluation of groundwater occurrence or distribution of yields from groundwater sources for the plan area, other than in the Proserpine River, and Kelsey Creek and Lethe Brook sections of the Proserpine River Water Supply Scheme.

Published information predates the construction and operation of Peter Faust Dam, so that there is a pressing need for evaluation of current groundwater utilisation and interactions with surface water.

2.6.3 Groundwater quality

Groundwater quality throughout the plan area varies depending on the source and recharge characteristics for each aquifer type. The quality of groundwater from unconfined Recent alluvium aquifers is generally comparable with the quality of surface water. Based on information predating construction of Peter Faust Dam, groundwater from Tertiary lower-terrace aquifers within the lower Proserpine River and Thompson Creek catchments appears to vary from potable in some areas, generally acceptable for agriculture in most areas, to occasionally being unacceptably saline.

Groundwater quality and soil chemistry characteristics for the Proserpine River Water Supply Scheme area were evaluated in the lead-up to construction of the Peter Faust Dam (QWRC 1981; Thompson et al. 1981). Typical salinities were reported in the range of 200 parts per million (ppm) to 600 ppm within Recent alluvium, and within the range 400 ppm to 2000 ppm within Tertiary terrace sediments.

Following the development of Peter Faust Dam water supply was extended to include Kelsey Creek and Upper Lethe Brook. Monitoring of groundwater quality in the Kelsey Creek and Lethe Brook area is undertaken to maintain acceptable irrigation application rates while avoiding the identified potential problems of waterlogging and salinisation (Gordon & Shaw 1997).

Groundwater within the Recent alluvium and Tertiary terrace sediments of the Proserpine River, Goorganga Creek and Thompson Creek floodplains is typically non-turbid with ionic composition dominated by calcium, magnesium and carbonate-bicarbonate (QWRC 1981). Pedogenic carbonate nodules occur within Recent alluvium and also within the Tertiary terrace sediments (Grimes 1980; Thompson et al. 1981). Sodic soils with elevated sodium concentrations are found in drier and more deeply leached areas that are not subjected to periodic floodplain inundation.

Condor project studies (AGC 1984) reported salinities within the range of 400 to 1600 mgL⁻¹ within Recent alluvium aquifers over the project site (Table 2-1). Salinity profiles within monitoring bores typically showed increasing salinity with depth. In contrast, groundwater salinity within the early Tertiary (younger bedrock) oil shales was reported to range from 5000 to 45 000 mgL⁻¹. AGC identified two sources of potential groundwater salinisation that could be associated with project development:

- excessive extraction of water from (Recent) alluvium aquifers close to the current coastline and estuaries
- leakage inflows from younger bedrock below the Tertiary terrace horizons.

QWRC (1981) reported an apparently anomalous bore yielding total dissolved solids (TDS) values in excess of 7000 ppm and dominated by sodium and chloride, relatively close to the Kelsey Creek channel where Recent alluvium yielded a fresh groundwater window of very low TDS level. This area coincides with the older Tertiary bedrock at a

regionally low elevation, approximately at current sea level. This occurrence may be attributed either to a seawater incursion during the most recent postglacial sea-level rise or to leakage of highly saline groundwater from sediments associated with oil shales.

For the Proserpine River Water Supply Scheme and surrounding areas, including Goorganga Creek and Thompson Creek, groundwater-quality data postdating development of Peter Faust Dam has been collected but not yet evaluated other than for routine scheme management purposes.

To date groundwater-quality information from the Andromache River and O'Connell River catchments has not been evaluated, is probably both spatially and temporally patchy and may not be representative of these catchments as a whole.

Based on current knowledge, potentially serious problems of salinisation and groundwater window loss are likely consequences of overusing groundwater from older fractured bedrock or Tertiary terrace aquifers, in all parts of the plan area other than the Proserpine Declared Sub-Artesian Area. For this reason, it is considered essential in the development of any water management plan to firstly assemble and analyse existing groundwater resource distribution and quality information. In the absence of such a preliminary catchment-wide study the precautionary principle should be applied to any proposals for increased or enhanced utilisation of groundwater.

2.7 Surface water

2.7.1 General description

The nature of the rainfall distribution previously described means that seasonal zero-flow periods are recorded for certain reaches of the river system. Subsurface flows can also occur along alluvial aquifers and bed sands when surface flows are zero. Discharge from alluvial aquifers is primarily responsible for maintaining surface base flows.

There are nine stream gauging stations operated by NRW in the plan area, of which four are currently operational. Those stations with the best records, and which were used for analyses in this study, are as follows:

124001A: O'Connell River at Caping Siding (catchment area 363 km² at gauging station)

122003A: Proserpine River at Peter Faust Dam (pre-dam, 269 km²)

122003A: Proserpine River at Peter Faust Dam (post-dam, 269 km²)

124003A: Andromache River at Jochheim's (230 km²).

Typical hydrographs at different time scales for the Andromache, O'Connell and Proserpine (post-dam) rivers are shown in Figure 2-3. The hydrographs show the seasonal regularity and the magnitude of flood flows for the Andromache and O'Connell rivers, and the dramatically altered regulated flow regime of the Proserpine River. Erskine (in FSI 1999) noted the extreme variability of flows in the region's rivers and suggested that the ratio of peak flood to mean flood indicated that the rivers were 'non-equilibrium' and adjusted their morphology in response to 'catastrophic' flood events. Erskine noted further that rates of channel change were much higher following European settlement and removal of bank vegetation. This variability has implications for sediment transport, and Markham (in FSI 1999) calculated that almost the entire annual bed material load would typically be moved during short-duration peak-flood events.

The longer term flow and rainfall record shows evidence of long-term variability. Figure 2-4 shows a residual mass plot for O’Connell River base flow and Proserpine rainfall. A residual mass is the cumulative value of the annual deviation of each yearly value from the overall mean of the dataset. Put simply, positive slopes on the graph indicate runs of above-average flow and rainfall, and negative slopes indicate runs of below-average flow and rainfall.

Although residual mass plots are sensitive to the length of record used, and the variability of the dataset, Figure 2-4 highlights the run of dry years that have been experienced since approximately 1979. It should also be noted that the long-term development of the catchment may have changed the pattern of river flow and hydrograph characteristics over time, this effect cannot be determined from the data and, in the opinion of the author, is likely to be small. The graph also shows that the base-flow trend closely follows the rainfall pattern.

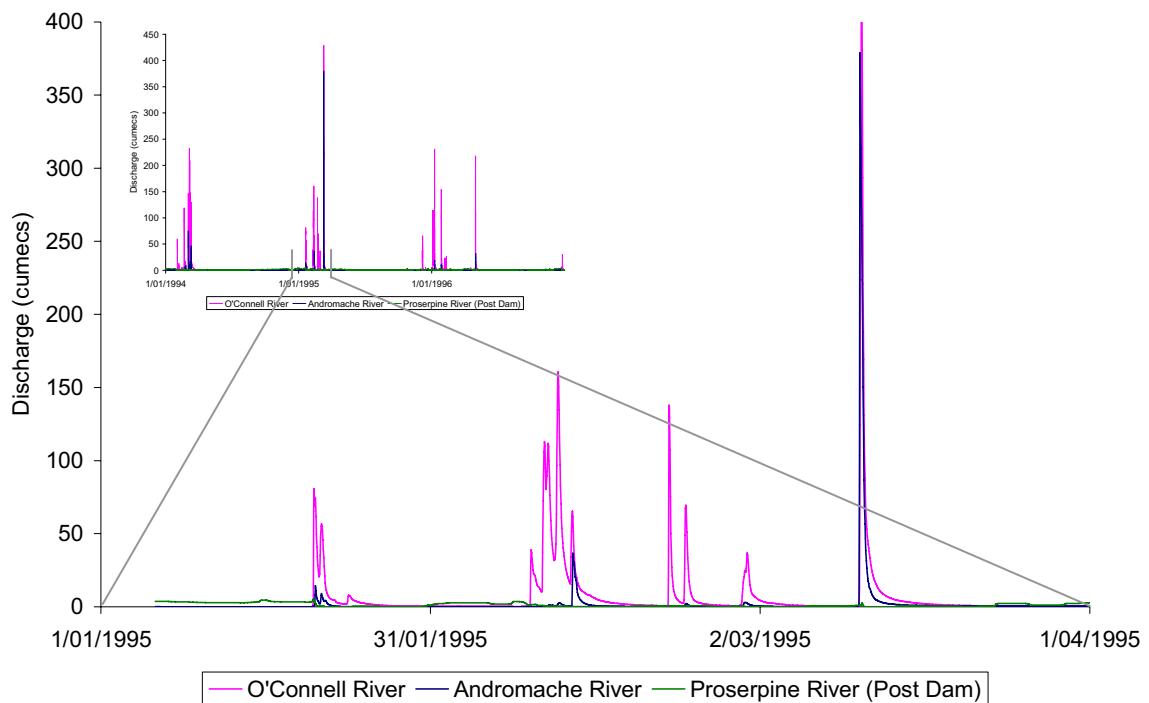


Figure 2-3 Typical hydrographs for the Andromache River, O’Connell River and Proserpine River (post-dam)

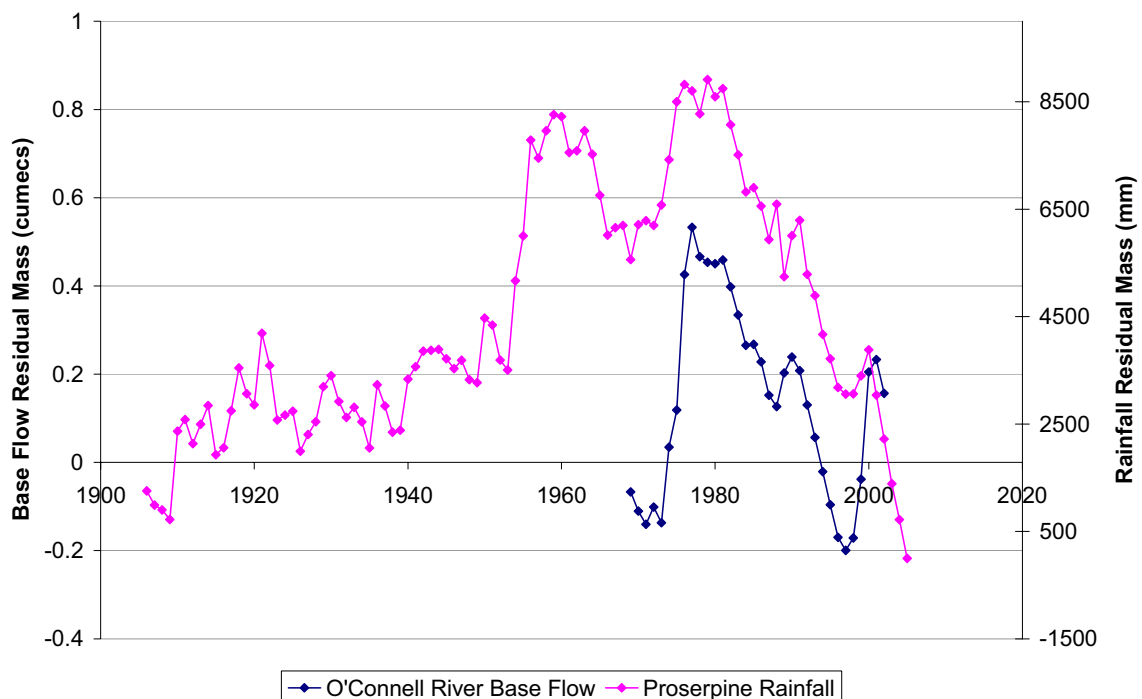


Figure 2-4 Residual-mass plot of Proserpine rainfall and O'Connell River base flow

2.8 Coastal processes

2.8.1 Evolution of the Proserpine Coastal Plains

The evolution of the Proserpine Coastal Plains over the last 6000 years was described in detail by Stephens (1993). In summary, the plains have prograded seaward in stages as beach ridges have developed on top of mangrove mud. Interestingly, Stephens (1993) noted that:

‘The modern fore-dune ridge is unique in the history of the Proserpine Plains. It is symptomatic of shoreline recession, evidence for which is not recognizable in any of the previous geological record of the past 6000 y’.

The key characteristics of the coastal geomorphology are as follows:

- The O'Connell and Proserpine river deltas are quite different morphologically. The O'Connell delta is wave dominated whereas the Proserpine delta is tide dominated.
- The O'Connell River is a significant source of sand to the estuary, more so than the Proserpine (pre-dam), as much of the Proserpine River sand is reworked by tidal processes and stored in its upper estuary. The O'Connell River sand is exported from its mouth by wave action, and is important for the maintenance of the Repulse Bay shoreline. Although the construction of Peter Faust Dam has cut off sediment supplies from the upper Proserpine River catchment, there is still a significant store of sand below the dam wall. Therefore the limiting factor relating to sand supply from the Proserpine River is likely to be the lack of transporting flows rather than the lack of sand.
- There is a northward littoral drift of sand from the O'Connell River. It is likely that some of this sand is transported into the delta of the Proserpine River.

- Anecdotal evidence supported by field observations suggests that the mouth of the Proserpine River is ‘silting up’. We believe that this perception is correct and probably due to the effect of tidal pumping (the net upstream transport of sediment caused by tidal asymmetry), combined with the lack of flushing flows due to flow regulation.
- There is some debate in the available literature relating to whether the shoreline is eroding or prograding.



Plate 2-1 Northward drift of sand along Repulse Bay shoreline

2.8.2 Export of sediment and nutrient to the Great Barrier Reef

There have been a number of studies that have described the export of nutrients and suspended sediments from Queensland coastal catchments and have included the Proserpine and O’Connell and Pioneer river systems (e.g., Moss et al. 1992; Neil et al. 2002; and, more recently, the National Land and Water Resources Audit, www.audit.ea.gov.au).

Catchment-scale modelling of the sediment balance of the Proserpine River and O’Connell River was undertaken as part of the National Land and Water Resources Audit (www.audit.ea.gov.au). Summary results are presented in Table 2-2 and suggest that most sediment is supplied to these rivers through hill slope erosion, with relatively minor contributions from riverbank erosion and gully erosion. Although some areas of hill slope erosion were noted during the study flyover, these results were somewhat surprising and field trip observations indicated that a much higher proportion of sediment would be supplied from the alluvial tracts of the Proserpine and Andromache rivers and, to a lesser extent, the alluvial tract of the O’Connell River. Therefore, the results of the NLWRA that apply to the plan area should be treated with some caution.

Table 2-2 also indicates the high increase in sediment delivery since European settlement and the relatively high sediment-delivery ratio compared with Australia-wide values. This is largely consistent with the results of Neil et al. (2002), although the latter study indicated that the increase was not so large as this. Table 2-2 also indicates that 66 per cent and 77 per cent respectively of sediment supplied to the Proserpine River and O'Connell River reaches the coast (over the time scale of model simulation, hundreds of years). However, we assume that the sediment delivery from the Proserpine River for the post-dam period is much less, as the trap efficiency of this structure is greater than 99 per cent (Erskine in FSI 1999).

Table 2-2 NLWRA catchment modelling

Attribute	Unit	Proserpine River (pre-dam condition) ¹	O'Connell River	Median Australia-wide value
Sediment supplied to rivers	t y ⁻¹	360 226	476 556	166 621
Sediment supply	t ha ⁻¹ y ⁻¹	1.95	2.41	0.5
Hill slope erosion	%	88.13	88.54	14
Stream bank erosion	%	6.96	7.57	30
Gully erosion	%	4.91	3.9	32
Length with riverbed deposition	proportion	0.07	0.06	0
European to Pre-European sediment	ratio	31	45	29
Sediment export to coast	t y ⁻¹	227 314	366 309	30 062
Contribution of sediment to coast	t ha ⁻¹ y ⁻¹	1.23	1.85	0.1
Sediment delivery	ratio	0.63	0.77	0.34

¹ Results presented are for 100-year average conditions and therefore would largely reflect the pre-dam condition for the Proserpine River.