Landscape condition in the Broadsound Basin
A preliminary assessment (2006 – 2007) to guide investment in natural resource management.



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We apologise for any names inadvertently omitted.

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1.0 Key Findings

1.1 Context

This report considers aspects of the condition of the Broadsound Basin. It is intended to inform the strategic application of investment by the Fitzroy River Coastal Catchments and the Fitzroy Basin Association. Consequently it focuses only on those features of the basin that indicate a need for investment and provides some baseline data as well as establishing opportunities for future monitoring of condition. The report does not consider or pass judgement on the economic or social basis for landuse activities. It is predicated on the assumptions that (a) landuse will influence the downstream environment, (b) landuse will alter natural systems and impact on biodiversity values and ecosystem services, (c) climate change is occurring and will influence both natural and manmade landscapes and systems. We make recommendations for investment only where direct outcomes can be achieved and / or where there is a probable downstream impact. We make no recommendations on matters that do not have manageable impacts beyond property boundaries.

The condition of the Broadsound Basin was assessed during 2006 and 2007 over dry and wet season conditions. Assessment was undertaken by ground survey (on foot and by vehicle), airborne visual assessment as well as air photographic and satellite image assessment. Databases and condition assessment tools from Commonwealth and State agencies were utilised. All ground surveys on freehold and leasehold land and some aerial surveys were undertaken with landholder/manager permission. Local government and state government permission was obtained for entry to state lands. Consequently the number and timeliness of property access approvals limited the extent and intensity of some regional assessment.

The term "Broadsound" is used to apply to the land that drains to coast. The term "Broad Sound" refers to the marine waters offshore from the Broadsound Basin and in the receiving environment for St Lawrence Creek, Waverley Creek, Styx River and Herbert Creek.

1.2 Natural values

The Broadsound Basin encompasses the Clairview Creek, St Lawrence Creek, Waverley Creek, Styx River, Herbert Creek and Stanage Coast catchments. The basin extends over more than 500,000 ha. The majority of the basin supports native vegetation (59%); 41% is cleared. Thirteen percent of the basin supports vegetation that is classified as *endangered* or *of concern*. The remnant vegetation across the basin is composed of 93 regional ecosystems in two bioregions. Seven hundred and eighty three species of plants are recorded from the terrestrial and intertidal ecosystems. Four species are considered *endangered*, five *vulnerable* and six are *rare*. Ninety three species (12%) are exotic. Three hundred and ninety three animal species are recorded from the basin and adjacent waters. Twenty five are classified as *critically endangered*, *endangered*, *vulnerable* or *rare*. Eight are exotic (feral) species. The serpentinite ecosystems of the Marlborough Hills in the south east and the undisturbed and modified intertidal and freshwater wetlands on the coast are of national and international significance from a biodiversity perspective.

In coastal wetlands a high diversity of waterbirds occurs: 90 species have been recorded, including 19 Asian-breeding migrants, and at least 33 species breed in these wetlands. Two nationally threatened species, Australian Painted Snipe and the

Capricorn subspecies of Yellow Chat (*critically endangered*), occur and breed, on both sides of Broad Sound, in sedge swamps, saltmarsh and persistent ponds. Habitat is ample, including landward of sea walls, and these species may continue to occur under present land use regimes.

Broadsound Basin supports critical life stages – migration stop-over, and breeding – of many waterbirds. Eleven high-tide roosts of migratory shorebirds occur, mostly on the western beaches/shore of Broad Sound, the largest (near Charon Point) holding up to 2200 shorebirds. During northward migration (March), larger numbers (up to 7500) sometimes occur on bunded salt flats on western coastal plains. Internationally significant numbers (1% of the Flyway population) have been recorded of Sharp-tailed Sandpiper and Marsh Sandpiper on western salt flats and of Latham's Snipe in far north-eastern Torilla Plain.

Breeding colonies of hundreds to thousands of egrets (4 species) occur in tall mangrove forest on both sides of Broad Sound (un-named eastern islands, and in the Waverley estuary) in January-April if feeding areas on nearby coastal plains are inundated. Other colonial or prolific breeders include ducks, swans, magpie geese, cormorants and terns. Numbers of Straw-necked Ibis, Black-winged Stilt and possibly several other species of Australian-breeding waterbirds in the Broadsound Basin exceed the 1% threshold for international importance. Total waterbird numbers sometimes exceed the level (20,000) for international importance: 37,000 were on Torilla Plain in March 2003 and probably over 20,000 were on the upper western plains in March 2007.

1.3 Land tenure and land use

The majority of land in each catchment within the Broadsound Basin is under freehold or leasehold tenure (Table 1). The predominant landuse is beef production – with the exception of the Clairview Creek catchment where there has been a recent conversion of grazing lands to plantation timber production. With the exception of the Stanage Coast and Clairview Creek catchments, the relative proportion of the land under conservation is about 10% or less. Again, with the exception of the Clairview Creek and Stanage Coast catchments, the basin is notable for the extensive utilisation of intertidal lands for grazing and for the extensive development of seawalls and banks to block tidal incursion and to convert saline lands to freshwater wetland pastures.

Table 1.1 A comparison of the relative land use among catchments (% catchment area)

Catchment	Freehold	Leasehold	National Park	State Forest	Covenant
Clairview Creek	54.36	32.44	0	0	16.54
St Lawrence Creek	49.55	24.22	0	6.08	3.90
Waverley Creek	64.71	22.65	0.20	0.01	4.69
Styx River	61.19	30.36	1.25	1.28	7.85
Herbert Creek	67.47	21.87	0.53	0.39	0
Stanage Coast	67.24	4.16	21.63	0	0

Mineral and petroleum exploration permits have extensive coverage within the basin. Coal exploration permits are centred on Ogmore in the Styx River catchment. Mineral development leases for magnesite and oil shale occur in the Herbert Creek catchment. Active mining for the extraction of magnesite occurs in the Herbert Creek catchment.

1.4 Condition

Land cover: Forty one percent of the Broadsound Basin has been cleared. Generally this is the terrestrial lands with better soil and fertility. In places the condition of this land is poor – especially in the St Lawrence Creek, Styx River and Herbert Creek catchments. In the Styx River and Herbert Creek catchments some 85,000 ha are considered to have a declining land cover and are considered to be highly or very highly disturbed. Undeveloped woodlands and forest cover over 50% of the basin. They occur predominantly on the land less suitable for development. Generally the condition of these wooded lands is good whether grazed or not. Complex habitat structure for native fauna was usually present. Weed invasion is an issue in places, however.

Connectivity: The development of the lowlands for grazing has broadly isolated the coastal ecosystems from the well vegetated western hills and ranges. This loss of connectivity is greatest in the Styx River and Herbert Creek catchments and to a lesser extent in the Waverley Creek Catchment – reflecting the greater extent of land suitable for development. Connectivity has increased in Clairview Creek Catchment with the development of extensive timber plantations.

Clearing and grazing patterns: The approach to clearing further reduces connectivity and probably degrades ecosystem services. Almost all stream lines are cleared to the limit of the upper bank. Many smaller coastal streams are cleared entirely. The vast majority of riparian zones are grazed and are unfenced – precluding regulation of grazing influences. The majority of road reserves are cleared or significantly altered. Fenced road reserves were extremely rare. Almost all are grazed to the same intensity as the adjacent paddocks.

Erosion patterns: Some erosion was apparent wherever land clearing or grazing occurred on terrestrial lands and at the landward margins of many wetlands. Extensive areas of severe land degradation occur in association with particular soil types and predominantly in the central Styx River and southern Waverley Creek catchments. Coastal erosion is evident in the frontal mangroves but these losses are assumed to be mainly a consequence of natural processes.

Weeds: Declared and environmental weeds occur across the basin – although there are regional differences. Lantana (*Lantana camara*) is a more serious issue in the moister Clairview Creek and northwest St Lawrence Creek catchments. Parthenium (*Parthenium hysterophorus*) is most evident along Tooloombah Creek and associated brigalow soils. Prickly acacia (*Acacia nilotica*) is primarily associated with coastal plains and associated wetlands, but currently only occurs in a few isolated locations. Old urban centres, in particular Ogmore and surrounds, are a focus for Sisal (*Agave sisalana*), Harissia cactus (*Eriocereus* spp.), Cat's claw (*Macfadyena unguis-cati*) and Captain Cook tree (*Thevetia peruviana*). Rubber vine (*Cryptostegia grandiflora*) occurs across the region including coastal ecosystems. It is most developed along drainage lines - in places forming impenetrable thickets. Giant Rat's tail grass (*Sporobolus* spp.) is widespread and a problem in places. Hymenachne (*Hymenachne amplexicaulis*) occurs widely in waterbodies across the region – although less frequently in the coastal wetlands. There was no difference among land tenure in the nature of weed infestation. National Parks, State forests, conservation reserves, covenant lands and reserves supported the same weed loads as adjacent freehold and leasehold lands – especially along streams and adjacent flood plains. During the project period weed control efforts were only evident in relation to some stands of Prickly acacia.

Feral animals: Feral cats, dogs, pigs, horses and cattle occur throughout the basin. The impact of pigs is most apparent and widespread in the coastal wetlands.

Wetlands: Large areas of intertidal and non-tidal wetland in the Basin are relatively undisturbed but some areas show small-scale or large-scale impacts. Mangrove

wetlands mostly seemed healthy. Death of back mangrove thicket at the edges of salt-flats occurred widely at a small scale; this is likely to be a consequence of changes to sedimentation due to drought and catchment degradation, and/or raised soil salinity due to drought.

Recent historical construction of sea-walls (some over 10 km long) and channel block banks has occurred in the coastal plains of western Broadsound (and to lesser extent in the east). These structures prevent or reduce landward flow of saline tidal water and increase freshwater conditions – including pasture – to the landward side. These structures have stopped or reduced fish movement between nursery wetland and intertidal areas and contributed to death of back mangroves, but have created substantial areas of more persistent, low-salinity wetland on the plains, thereby increasing habitat for freshwater flora and fauna. Regulations prohibit emplacement of new structures.

The use of the coastal wetlands for beef production is extensive. The long-term impacts of grazing on wetlands are not understood: direct browsing apparently has nearly eliminated one plant (common reed) but similar changes to other key wetland plants are not apparent. Pugging, which is conspicuous in bare saltmarsh, and degradation of Melaleuca swamps, are fairly common but some control of stock access to these sensitive wetlands by fencing has been initiated.

Public use of the coastal wetlands is restricted by limited infrastructure for access (public roads and boat ramps).

The main north-south railway crosses the western edge of the coastal plain and is supported by causeways that have affected drainage within the wetlands.

1.5 Issues

Climate change: Expected changes in relation to rainfall, temperature and fire are unlikely to result in significant changes across most of the Broadsound economy, rural culture or infrastructure management. The region is generally well adapted to managing in the face of uncertain rainfall and extended dry conditions.

There are three areas of risk.

Firstly, the ongoing reduced rainfall and extended dry seasons will see an increase in the extent and duration of conditions where reduced or absent land cover (vegetation) occurs in grazing lands. In conjunction with periodic more intense rainfall events these conditions are likely to result in an increase in erosion and sediment transport to the coast. A review of land management practice to consider land use practice that maintains land condition and downstream water quality may be warranted.
Secondly, large areas (over 83,000 ha) of the region lie very close to or below the level of astronomical high tide. Of this over 55,000 ha is involved in beef production. The largest areas at risk are in the Herbert Creek and Waverley Creek catchments. Sea walls of various sizes and standards of construction have been established over many kilometers of coastline. This infrastructure is likely be challenged by rising sea levels, wave erosion and storm surge over the next 20 to 50 years. Some coastal flats are already in recession reflecting the 76mm tide rise since 1961. Rising sea-level threatens to force a landward shift in the zones of coastal wetland types; at Broad Sound this 'relocation' may succeed to some extent on the wider plains but would be constrained by seawalls. Rates of adjustment by flora and fauna are unknown and the effects on waterbird roosts and colonies are uncertain. Walls and banks could be

damaged by wave action. Some freshwater wetlands against the landward edge of the coastal plains may be lost due to the landward migration of saline ecosystems. Thirdly, the wooded regions within the catchments will be vulnerable to increased fire frequency and intensity where moisture regimes and temperatures allow a rapid regrowth of fire fuel.

Land management: Currently 41 % of the Broadsound Basin has been developed for primary production to the point that natural ecosystem processes probably do not persist. They have been replaced by primary production processes. This change is predominantly associated with the coastal plains and adjacent undulating hinterland. Development is most extensive in the Styx (52 % cleared) and Herbert Creek (38 % cleared) catchments. There are extensive areas of cleared lands that have little ground cover or are seriously degraded across the Broadsound Basin. The situation is most severe in the Styx River catchment but there are examples of poor land management in all catchments. The degree of degradation of some rangelands raises questions about the sustainability of the grazing systems. Ongoing clearing, land degradation under unsustainable grazing systems and climate change impacts (driving fire and drought risk) threaten the loss of remnant connectivity between the western escarpment and the eastern coastal ecosystems.

Mining: Prospective oil shale extraction overlays coastal wetlands in the Herbert Creek catchment. This has the potential to significantly impact on the integrity of wetlands under the mine footprint and downstream of infrastructure development. The associated industrial processing and mine infrastructure are likely to produce a nocturnal light environment with a poorly understood impact avian fauna.

Coastal development: The Stanage Coast and the settlement of Stanage Bay have excellent natural values. The current location of camping and urban development adjacent to breeding beaches places endangered species at risk. The development within coastal dunes and associated beach scrubs has degraded these communities. Sightseeing activity is degrading Alligator Point.

1.6 Opportunities and investments

Communities:

St Lawrence

Biodiversity: It is rare to find such high biodiversity and conservation values in association with a long established historical settlement. The opportunity is present to work with the local community, the Environmental Protection Agency and others to raise awareness of the values and develop strategies allowing regional development, critical land management and biodiversity preservation.

Cultural assets: A visit to St Lawrence raises many questions about the historical buildings, relic structures and general history. The opportunity is present to install appropriate signage and to research and produce interpretative material to inform visitors.

Ogmore

Biodiversity: Ogmore lies within former brigalow and riparian scrub lands. Small pockets of remnant scrub and brigalow community remain. A detailed local biodiversity plan would be needed to achieve outcomes here.

Cultural assets: A visit to Ogmore raises many questions about the historical buildings, relic structures and general history. Unlike St Lawrence there is no general

store or café where a visitor can encounter local knowledge. The opportunity is present to install appropriate signage, research and produce interpretative material to inform visitors.

Stanage Bay
Alligator Point: The Stanage coast has high aesthetic values. Alligator Point is an excellent vantage point to admire the coast, hinterland and islands. It receives heavy usage. There is substantial damage to the headland and significant erosion. This is impacting on the experience of the visitors, degrading the headland ecosystems and limiting access to some visitor classes. There is no interpretation or signage on the point. The opportunity is there to restore the headland, providing controlled vehicle access partway up the headland linked to a fenced ramp (allowing disabled access) to the summit.

Community camp ground at Plumtree: The camp ground at Plumtree is an important asset to the community. There is no charge for the use of this facility that appears to be maintained by the community. This camp ground is located on a highly degraded dry rainforest on an old beach ridge. Remnant canopy trees from this former scrub remain and provide an indication of the former native ecosystem now destroyed. The investment opportunity here is to work with the local community to protect and enhance the remnant natural values while at least maintaining, if not increasing, the amenity of this community asset. As water and toilet facilities are limited, some review of eutrophication risks to the adjacent waters should be considered.

Camping ground at Alligator Beach: This is a public camping ground within a low microphyll vine thicket above the fore dune. It is located on State land under the management of the Department of Natural Resources and Water. The location of the camp ground within this ecosystem and adjacent to a turtle rookery is not ecologically sustainable. There are no facilities provided at this camp ground and effluent contamination must be considered. The investment opportunity here is to work with the State and local government authorities and the local community to provide an appropriate community expereince while maintaining environmental values.

Landscape management:
A number of localities have been identified as priority areas or issues for investment. Their selection was based on (a) potential as a major point source for downstream discharge of sediment and associated nutrients to the Great Barrier Reef Marine Park and associated coastal waters, (b) potential adverse impact on St Lawrence town weir, (c) discrete opportunity for outcomes within a strategic framework. The majority of sites occur in the Styx River catchment reflecting the greater frequency of occurrence and extent of seriously degraded landscapes in this catchment.

Land management issues that do not have an immediate downstream impact and relate to broader long term strategic considerations of sustainable land use and property management are not included here.

Restoration of riparian vegetation and recovery of ecosystem services.
There are a number of small ephemeral streams along the coast of the Styx River and Herbert Creek catchments that have been totally denuded of vegetation: at least 14 small streams have been identified in the Styx River catchment and five in the Herbert Creek catchment. The reconstruction of an ungrazed riparian community would contribute to the retention of sediment and nutrients during periods of high flow.

Larger streams are cleared to the limit of the upper bank. Reconstruction of 50 – 100m vegetation belts under locality appropriate management regimes would intercept sediment and nutrient flows from grazing lands to streams.

Major point source discharge

The management of scalding and broad acre erosion across the grazing lands requires a long term community effort. A number of localities were recognized where erosion and land degradation are considered severe. These most likely represent significant point sources of sediment transport to the streams. In places they represent threats to road infrastructure. Significant engineering works will be required to address these situations. In the Styx River catchment seven very severe and six severe cases were identified where there was direct discharge to streams. The cases fall within a complex of leasehold and freehold lands. In Waverley Creek catchment three severe cases were located – all on freehold land. Seven moderate cases were identified. In the St Lawrence Creek catchment seven moderate cases were located. Two were associated with the immediate catchment of the St Lawrence town weir. All are associated with freehold lands. Some investment may be warranted here to secure the quality of this supply. In the Clairview Creek catchment six potential point sources were recognized. All were moderate cases. They all sit within freehold lands.

Wetlands: Conservation actions could be successfully undertaken at the semi-permanent wetland in the St Lawrence reserve: installment of facilities and signage for visitors to the wetland edges, and restoration of fish passage between the ponds and estuary. Key wetland sites outside private land, such as the egret colonies and high tide roosts, could be incorporated into existing conservation reserves in Broad Sound.

Further assistance to landholders for fencing of sensitive wetlands and for eradication of currently rare but invasive weeds such as Hymenachne, should be considered. Support to complementary field surveys of migratory shorebirds and some other aspects of waterbird usage of the Broadsound wetlands would improve the emerging baseline on present biodiversity assets of the study area.

1.7 Conclusion

Table 1.2 summarises opportunities for investment that the authors saw as priorities within the Broadsound Basin. Clearly such a list could be endless and dependent on the scale of assessment. This condition report was undertaken at a high level and property-wide surveys were not undertaken. They do provide an indication of range and relative magnitude of issues within each catchment. In cleared or modified grazing lands the area of bare ground, the number and severity of erosion gullies discharging directly to streams, the loss or degradation of riparian condition, and the universal grazing and extensive clearing of stream and road fringing vegetation are seen as the most significant issues requiring attention.

Despite this, the survey has identified the international significance of the Broad Sound wetlands for water birds and highlighted the positive association of these waterbird assemblages with current grazing and land use practices.

It also found that the condition of the woodlands was generally good irrespective of land use and expected to provide important zones of habitat and regional connectivity for native biota.

There are opportunities to foster local tourism and environmental education around the three townships. These relate to currently unexplained historical artifacts and opportunities for access and interpretation of wetlands and water birds (St Lawrence) and scenic, rocky coasts and islands (Stanage Bay).

There is uncertainty around the possible mining of shale oil and coal – both of which could bring impacts but also financial and logistical resources to manage some of the other regional issues. The uncertainty is probably greater around the impact of climate change. Loss of coastal grazing lands and biodiversity rich wetlands is underway although slight to date. Fire and drought are likely to impact on the northern catchments placing increased challenges before the new plantation industries and government and volunteer agencies.

None of the issues identified here can be adequately resolved by a single landholder or agency. Careful planning and resourcing along with the involvement of communities and multiple agencies is required to deal with the issues.

Table 1.2 Summary for opportunities for investment

Issue	Locality	Opportunity
Coastal development		
Camping within low microphyll vine thicket (beach scrub) degrading ecosystem.	Alligator Point camp ground	Work with state agency to relocate Alligator Point camp ground to appropriate locality & restore beach scrub.
Camping on coastal dunes threatens turtle rookery, physical degradation of beach community & contamination of adjacent coastal waters	Stanage camp grounds	Work with local community to formalize Plumtree campground; stabilize decline & recover biodiversity values & ecosystem services at both camp grounds; manage impacts on turtle rookery (light, vehicles, dogs, charcoal contamination)
Intensifying coastal development risks costal degradation and contamination of nearshore waters.	Stanage coast	Integrated planning with state agencies, community & landholders. Review environmental risks, baseline & sentinel environmental monitoring.
Erosion & degradation of Alligator Point & approaches.	Alligator Point, Stanage	In conjunction with community & agencies, reconstitute access to Alligator Point facilitating pedestrian & disabled access, strategic vehicle access & parking as well as meaningful environmental interpretation; remediation of erosion.
Wetlands		
Lack of community awareness	St Lawrence & other public access points	Install observation points/hides, Interpretative signage on bird ID, ecosystem types & services. Resource ongoing surveys to support realization of international significance.
Lack of connectivity Environmental protection (of egret colonies & high tide roosts)	St Lawrence reserve Broad Sound wetlands	Install fish ladder, model for community Incorporate key wetland sites on **public lands** within conservation tenure Work with community on **private lands** to fence sensitive wetlands, control weeds (Hymenachne) & manage feral pigs Work with agencies, mining companies & community to mitigate impacts of coal & shale oil exploration & mining
Landscape management		
Degradation or removal of riparian vegetation	Regional	In association with local communities & landholders, develop local regional criteria, local strategies & property plans for recovery of riparian communities & ecosystem services within sustainable agribusinesses & public lands.
Erosion & loss of land cover	Regional	In association with local communities & landholders, develop local regional criteria, local strategies & property plans for the maintenance or increase in dry season land cover to reduce soil and nutrient loss.
	St Lawrence Weir	In association with the landholders & local government develop a local catchment & property plan that maintains water quality in the weir while maintaining a viable grazing enterprise. In association with agencies, local government & landholders develop & implement land remediation plans that restore eroded lands while maintaining viable grazing / landuse enterprises.
Erosion hot spots as sediment point sources	Regional but especially Angelwood Road, Tooloombah Creek Crossing, Ogmore Road, Ogmore	In association with agencies, local government & landholders develop & implement engineering plans for reconstruction, stabilization & revegetation of stream banks & associated waterways.
Fire & climate change	Especially Clairview & St Lawrence Creek catchments	Develop an integrated regional fire management strategy among key land managers & control organizations. Strategy should account for expected climate change scenarios
Coastal grazing, wetlands, climate change & sea level rise.	Especially, St Lawrence, Waverley, Styx and Herbert coasts.	Review the implications of sea level rise for grazing viability, infrastructure (seawall) maintenance & internationally significant wetlands.
Grazing stream banks, road reserves with weediness, loss of biodiversity, connectivity, stream degradation & waterway contamination.	Regional	Instigate a program to fence streams beyond the high bank, develop off-stream watering points and fence road reserves. The program should be integrated with programs for erosion and vegetation cover management (above).

2.0 Introduction

The Fitzroy Basin Association (FBA) and the Fitzroy River and Coastal Catchments Committee (FRCC) sought a condition assessment of the Broadsound Basin. This assessment was to fill some regional knowledge gaps and be at a scale suitable to inform a catchment level investment strategy.

In places (e.g. with relation to coastal wetlands) this study is referred to as the Broadsound Coast Condition Assessment and the acronym BCCA is applied.

The Broadsound Basin is included in Central Queensland Information Paper Volume 3 Capricorn Coast Catchments (Coastal CRC 2003). At that time, the report identified gaps in the understanding of the Broadsound and Livingstone shires (Table 2.1).

Table 2.1 Abridged knowledge gaps identified by Coastal CRC (2003)

Themes	Gaps
Sustainable land management and use	• Data on sustainability indicators are not available at the property level. • Limited baseline data on surface and ground waters at a neighbourhood catchment level. • Consequently, modeling to evaluate management actions is not possible. • No shared understanding of whole of catchment interactions (farm and peri-urban lands). • Appropriate indicators are not being tested in neighbourhood catchment projects. • An integrated information and database management system for community. Reporting is required. • Acid sulphate soils need to be mapped at appropriate accuracy and incorporated into planning and education schemes.
Terrestrial Biodiversity	• Currency of vegetation mapping. • Native vegetation condition and trend in extent, structure and composition. Location of critical habitat requiring fine scale data for management. • Threats to at risk species and reasons for any declines. • A general paucity of biodiversity audit and monitoring data especially on private lands. • Grazing and fire guidelines for sustainable management.
Inland aquatic ecosystems	Very poor knowledge of the spatial and temporal extent of aquatic species. Lack of knowledge of: • Good habitat supporting significant species, • Native fish spawning sites, • Extent, condition and connectivity of off-stream wetlands, • Fish movement barriers, • Invasive species, • Riparian condition.
Estuaries and marine aquatic integrity (only those relating to intertidal wetlands)	• Detailed mapping at appropriate scale, • Seasonal and geographical species and assemblages audits, • Riparian invasive species, • Flood dynamics and importance in extent and frequency of connectivity, • Local catchment contaminants in storm runoff, • Ecological effect of these contaminants, • Long term trends in fisheries, • No reliable data on algal bloom incidence and trends.
Water quality	• Natural turbidity, nutrient levels, • Temporal trends in water quality, and • landuse.

Coastal CRC (2003) points to a general lack of data on the biota and environmental condition of the Broadsound Basin as well as any consideration of interaction between the current and future community exploitation of the coast. Fitzroy Basin Association (FBA) interests were contained under four main themes. These are listed in table 2.2 with some potential topics for consideration.

Table 2.2 FBA interests in relation to the Broadsound Basin.

Theme	Topics
Sustainable Landscapes	o Threats to production values – i.e. declining soil condition (fertility, erosion, and salinity) and production weeds o Inappropriate land management – i.e. overgrazing, fire regimes o Industry (mining, refining)
Biodiversity and Vegetation	o Threats to conservation value due to production use – unsuitable landuse (over utilisation), fire management. o Environmental Pests – (weeds and ferals) o Fragmented landscapes o Potential landuse change o Climate change
Water Quality and River Health	o Riparian Condition o Inappropriate grazing regimes o Storm water o Nutrient and pesticide runoff o Industry (mining, refining)
Coral and Coasts	o Connectivity (marine plains) o Estuarine ecosystem health o Condition of salt pans o Migratory bird habitat o Potential Acid Sulphate problems (as a result of current or potential management – industry, urban, rural) o Recreational areas management and public access to the coast o Climate impacts (weather patterns, sea level rise, storm surge)

The Broadsound Basin is a complex of five larger drainage systems and a series of minor drainage systems lying on the coast immediately north of the Fitzroy River Basin, west of the Capricorn Coast and Shoalwater Bay Military training area, east of the Connors and Broadsound ranges and south of the township of Clairview (Figure 2.1).

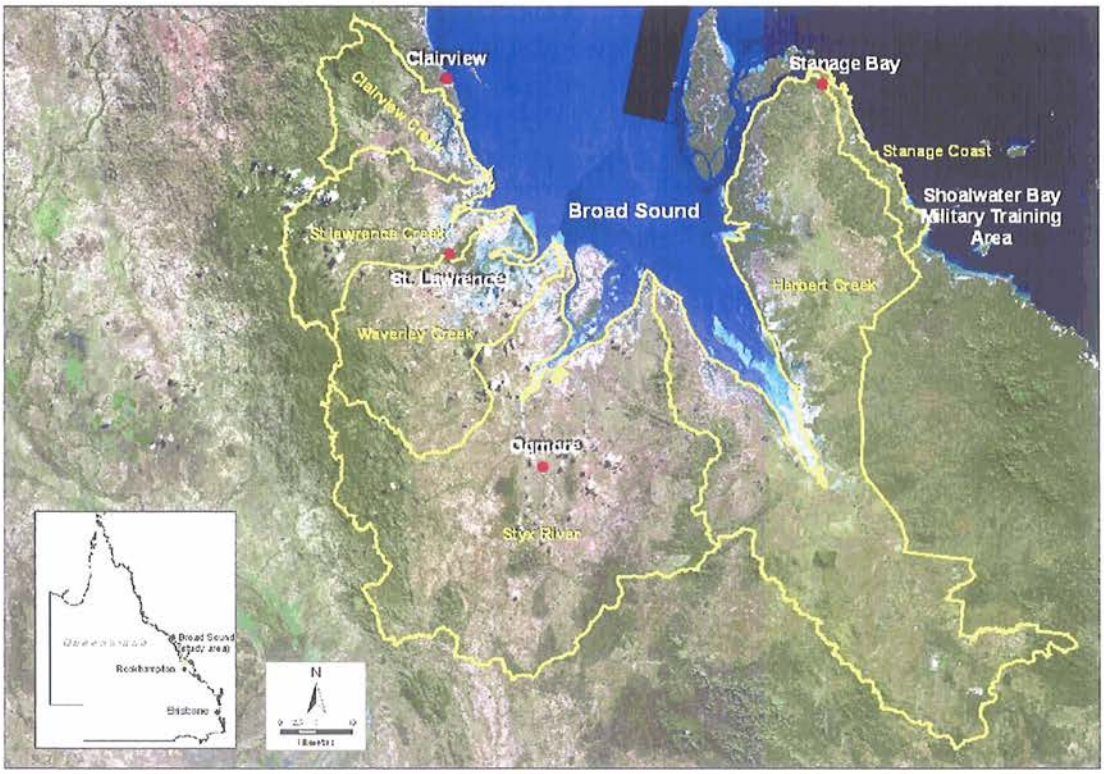


Figure 2.1 Broadsound Basin and constituent catchments.

3.0 Approach and general methods

This report examines the general state of the coastal and terrestrial landscapes within the catchment. Given the extent of the target region relative to the available resources this assessment was undertaken at a high level. Where more detailed data are required actions are recommended as investment proposals.

To facilitate effective natural resource management and investment prioritisation the *Broadsound Basin* has been assessed as six catchments:

- *Clairview Creek*,
- *St Lawrence*,
- *Waverley Creek*,
- *Styx River*,
- *Herbert Creek*, and
- a complex of short drainage systems, south from Stanage Bay to the Shoalwater Bay Military Training Area, flowing into the *north west channel*, referred to here as the *Stanage Coast*.

3.1 Terrestrial lands

Broad aerial surveys, vehicle based ground surveys, local condition assessment and photo point surveys as well as a broad ground cover assessment using the *Rangeland Ground Cover Disturbance Data Package* (Version 1.1 May 2006) QPWS, Qld EPA were undertaken. The ground cover disturbance package examined trends in change in groundcover using data from 1988 to 2004 Landsat imagery. At photo points qualitative data were collected on physical aspects of the environment considered important for understanding biodiversity values and likelihood of sediment transport during peak flows. The methodology is modified from and comparable with that currently being applied in the FBA project *Biodiversity and grazing - the impacts of conservation management of grazing lands on riparian and adjacent vegetation.*

A systematic search of Spot 5 imagery was undertaken to identify potentially major sediment discharge point sources. Target areas were situations where (1) land degradation was likely to discharge sediment and nutrients directly to stream lines, (2) the quality of the St Lawrence Weir water reserve could be compromised and (3) situations where riparian vegetation has been removed from drainage lines and where there is direct discharge to coastal waters. Situations where degraded streams discharge to impoundments and where degraded range lands do not have a major point source discharge have not been highlighted. In these cases it is assumed that a longer term investment in changing landuse customs is required rather than intensive tightly defined resource investment.

The aerial surveys of all catchments were completed in spring 2006. Vehicle based ground surveys were undertaken in spring 2006 and summer 2007. The establishment of local photo points and site specific condition assessment were undertaken from April to November 2007 following extensive summer and early winter rains. This allowed the photo points to reflect the lands in peak condition.

Climate change impacts have been addressed through an examination of the recent observed and predicted changes in relation to some assets in the Broadsound Basin. Climate change and tide height data were derived from CSIRO and Bureau of Meteorology sources cited in the relevant sections of the report. Assets with greatest

vulnerability to sea level rise and storm surge were identified by overlaying bioregional land zones 1 and 2 and DCDB data sets. More detailed case study data were obtained through direct sub-10 cm terrain modelling undertaken in during spring 2007.

Current biodiversity status was derived from an assessment of the status of mapped regional ecosystems and searches of state and commonwealth data bases.

3.2 Wetlands

A separate approach was taken for the project's complementary assessment of intertidal and marine plain (saline, ecotonal and freshwater) wetlands, in recognition of their complexity and of their high diversity and density of fauna – especially waterbirds. Considerable information on wetlands and waterbirds had been obtained from the eastern side of Broad Sound, principally the Torilla Plain system, during 2003-5 (e.g. Jaensch 2004, Jaensch *et al.* 2004), hence the focus of investigation during 2006-7 was on the western side.

The present work, led by Wetlands International, aimed to gather new information for preliminary assessment of wetland condition and identification of important sites for waterbirds. There was no adequate historical baseline on wetland condition or waterbird usage. Conditions for fieldwork on this coast are difficult because of scarce public access, seasonal inundation, a macro tidal regime, strong currents and saltwater crocodiles. These factors ensured that the 2006-7 work would be exploratory and generate 'snapshots' (rapid assessment) of condition, and could not be exhaustive or fully systematic.

The Broadsound coast and its associated marine plains were divided into 84 sectors that were based on EPA wetland mapping polygons, aggregated or subdivided to enable efficient fieldwork (figure 3.1). For detailed characterization of sectors during surveys, 23 wetland types were derived from EPA wetland mapping and wetland management profiles (EPA 2007). For rapid assessment of condition, eight broad categories of disturbance/modification were established. The international definition of 'waterbird' was adopted; special emphasis was given to migratory shorebirds since these are a *Protected Matter* under the *EPBC Act 1999*. Waterbirds were identified and also counted, using standard methods (mainly area searches) at a whole-of-wetland scale wherever possible; plot-based sampling generally was inappropriate due to the waterbirds' high mobility.

Aerial survey with fixed-wing aircraft was employed to obtain an overview of otherwise inaccessible sectors, to locate and estimate the numbers of waterbirds on intertidal and non-tidal wetlands, and to take photographs. Western sectors were surveyed in 2 hour, low-level flights on 21 June 2006, 6 September 2006, 6 March 2007 and 29 March 2007 and eastern sectors on 29 March 2007; 60 sectors were at least partly surveyed from the air. Aerial surveys were planned around high tide – tide height was at least 5.0 metres on each occasion (Hay Point tide prediction) – in order to record aggregations of shorebirds at high tide roosts such as sheltered beaches.

Figure 3.1 Survey sectors applied to the wetland and waterbird surveys for the assessment of landscape condition in the Broadsound Basin. ***Base map provided by the Qld EPA.***

Complementary ground surveys were conducted over 10 short periods in 2006-7, in consultation with landholders (9 properties), to obtain detail such as the identity of certain waterbird and plant species and to find and count inconspicuous waterbirds. Four surveys were in autumn – the season of maximum inundation of non-tidal wetlands and the peak of waterbird breeding activity – and there was at least one survey in each other season.

Considering all surveys from 2003 on, all but one of the survey sectors received at least some coverage. Greatest survey effort occurred within 10 km of St Lawrence (2006-7) and widely across Torilla Plain (2003-6). The survey effort across the basin during 2006-07 is illustrated in figure 3.2.

Rainfall generally was below average in the wet seasons of 2006 and 2007 except in the St Lawrence Creek and Waverley Creek catchments where intense rainfall in January-March caused local flooding and full inundation of most non-tidal wetlands. The extremes of dry and wet conditions therefore were captured in this project.

Survey data and other information on wetland characteristics and condition, and on waterbird numbers and breeding, have been stored in Microsoft Excel spreadsheets. A sector-by-sector summary is provided in chapter 8 S5.

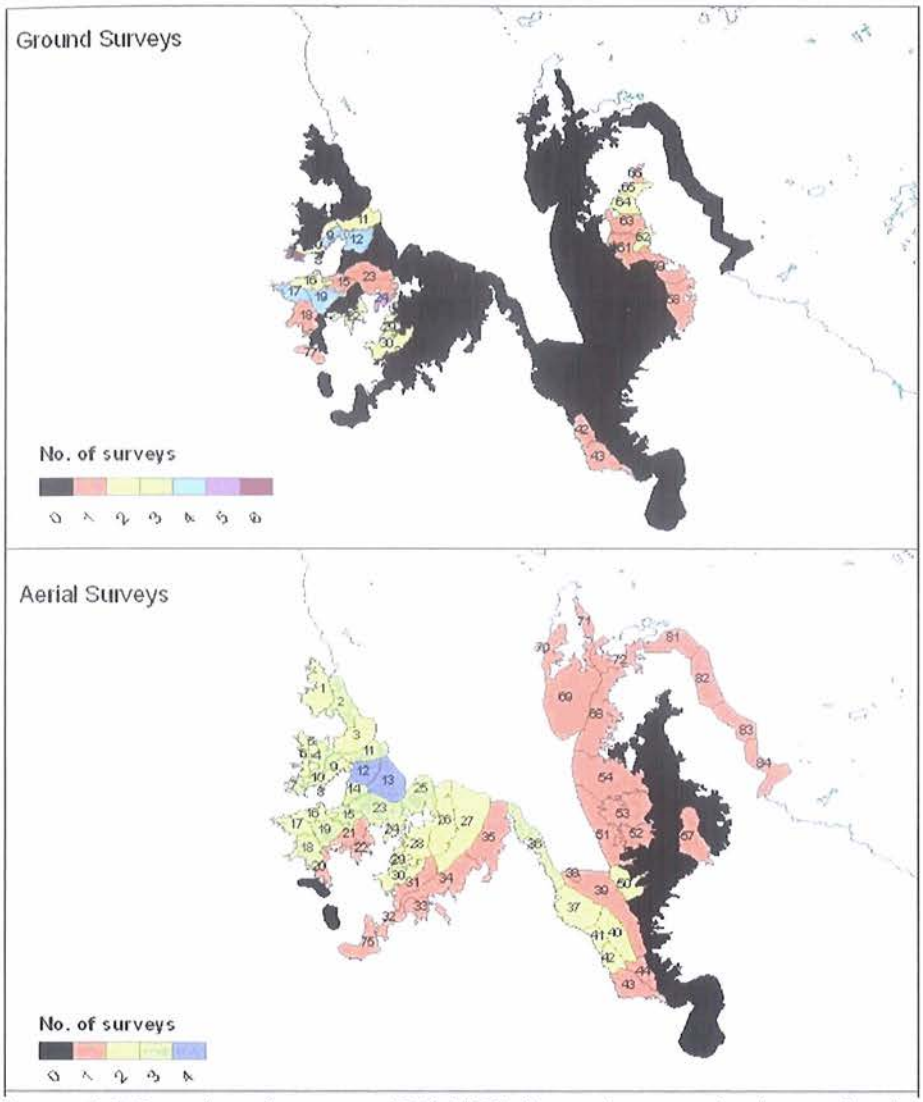


Figure 3.2 Density of surveys (2006/07) for each sector in the wetland and waterbird surveys for the assessment of landscape condition in the Broadsound Basin. **Base map provided by the Qld EPA.**

4.0 Overview of the Broadsound Basin.

4.1 Climate

The Broadsound Basin is centred about 250 km north of the Tropic of Capricorn. It is subject to a seasonally dry tropical climate. Most rain falls between October and April. Driest month is generally September. Annual mean rainfall ranges from about 800mm in the south to about 1,100mm in the north. The Herbert Creek and Styx River catchments tend to be relatively dry while the Clairview Creek catchment and northern part of the St Lawrence Creek catchment are relatively wet. Mean monthly maximum temperatures are highest in January / February (about 32°C) and lowest in June/ July (about 24°C). Mean minimum temperatures drop to 11°C in July. There is a strong seasonal component to the regional weather. Historically, a major climatic driver has been intense cyclonic low pressure influences and associated rain depressions.

A broader regional profile of the Broadsound climate is available through the National Agricultural Monitoring System (NAMS) at http://www.nams.gov.au/ . This site is a decision making tool for evaluating the impact of climate on primary production. It is aimed at dryland and broadacre primary industries.

Detailed weather data can be obtained from the Bureau of Meteorology at http://www.bom.gov.au/ .

More recently there have been unprecedented drought impacts and changing climate patterns with less frequent cyclonic influences. These have been linked to global climate change.

4.1.1 Temperature

Since the 1950's Australia's temperature has risen on average 0.9°C. In the Broadsound region the records show a general warming with the rate varying somewhat among seasons.

Maximum temperature

Annual maximum temperatures have increased at a rate of about 0.1°C per decade. The changes are not so evident in spring and summer, with increases of 0.05 to 0.15°C per decade. Winter increases ranged from between 0.1 to 0.15°C per decade. Autumn temperatures, however, have risen at a rate of 0.2 to 0.3 °C per decade since 1950.

Minimum temperature

Annual minimum temperature has risen from 0.15 to 0.2 °C per decade. The rate of increase was steepest in winter with minimum temperatures rising 0.3 to 0.4 °C per decade. Autumn rates were from 0.2 to 0.3°C per decade. Summer rates were from 0.15 to 0.2 °C. The spring rate was slightly lower at 0.1 to 0.15°C per decade.

4.1.2 Rainfall

The rainfall record shows a general declining trend of greater than 50mm per decade since 1950 across most of east coast Queensland. In the Broadsound region this trend is evident in the summer rainfall record and a slightly slower decline in autumn (- 20 to 30 mm per decade). Winter rainfall has declined very slightly (up to –5 .0 mm per decade). Contrary to these declining trends, spring rains have increased at a rate of up to 10mm per decade.

In the light of these observed changes the use of long-term average data is probably of limited utility in understanding the contemporary climate of the Broadsound basin.

(See Chapter 8 S1 for a broader discussion of climate change in this region).

Table 4.1 Summary weather data for the Broadsound Basin.

Weather Station Location	Mean maximum temperature (°C)	Highest monthly temperature (^{0}C - month)	Mean minimum temperature (°C)	Lowest mean monthly temperature (^{0}C - month)	Mean annual rainfall (mm)
St Lawrence	28.4	31.8 - January	28.4	10.9 - July	1011.5
Pine Inlet	26.5	30.4 - December	26.5	17.3 - July	873.5
Rockhampton	28.3	32.1 - December	28.3	9.5 - July	792.8

(Commonwealth of Australia 2007, Bureau of Meteorology)

4.2 Regional ecosystems and wetlands

The Broadsound Basin lies within two bioregions. The majority is included in the Southern Brigalow Belt bioregion. Parts of the western portions of the St Lawrence Creek catchment and north and western portions of Clairview Creek Catchment fall within the Central Queensland Coast bioregion (EPA 2007).

Based on the DCDB, the Broadsound Basin land tenures cover some 508,445 ha. About 41 % is cleared or significantly altered. About 46 % supports remnant native vegetation that is classified as *not of concern*. Almost 13 % supports native plant communities that are considered *endangered* or *of concern*. There are differences among catchments.

4.2.1 Clairview Creek Catchment

Regional ecosystems

The Clairview Creek catchment covers some 27,292 ha. Just over 29 % is cleared or significantly altered. About 71 % supports remnant native vegetation. Nearly 12 % is considered to be *of concern*. Just over 2 % is *endangered* or contains elements of endangered ecosystems. The endangered ecosystem elements are largely confined to the riparian systems and provide the major biodiversity corridors across the cleared lowlands (figures 4.1 & 4.2).

The Clairview catchment includes about 3,827 ha of intertidal and freshwater wetlands – about 14 % of the catchment area (figure 4.3).

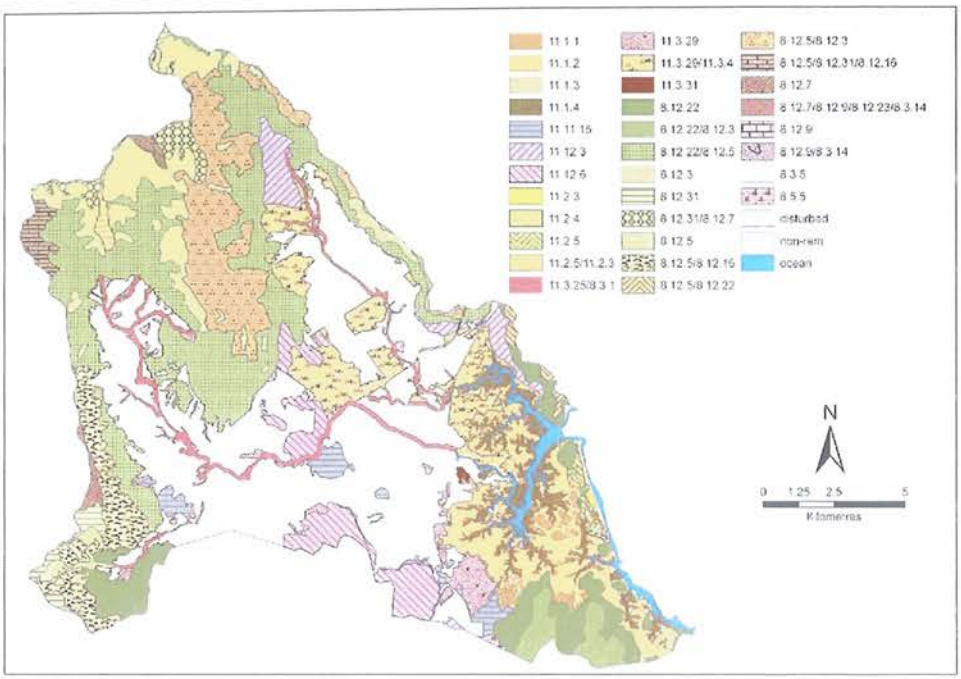


Figure 4.1 Regional ecosystems across the Clairview Creek catchment.

See chapter 8 S6 for a short description of the regional ecosystem codes. Codes beginning in 11 refer to the Brigalow Belt bioregion. Codes beginning in 8 refer to the Central Queensland Coast bioregion. The term *non-rem* refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.

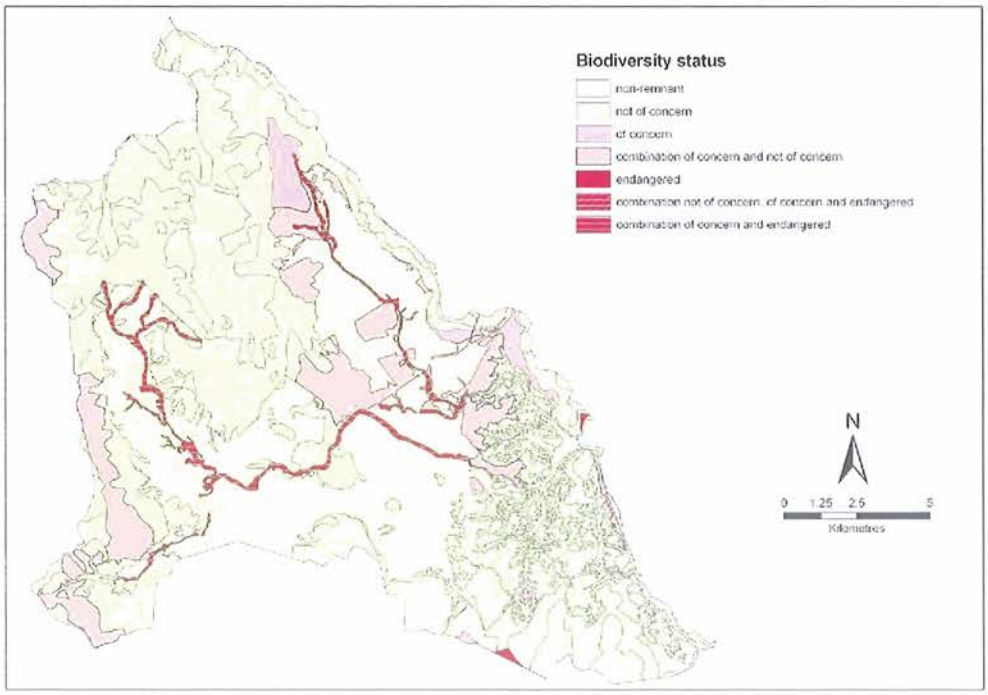


Figure 4.2 Conservation status of regional ecosystems of the Clairview Creek catchment.

***Not of Concern* indicates that greater than 30% of the pre European extent of this ecosystem remains in Queensland. *Of Concern* indicates that 10 -30% of the pre European extent of this ecosystem remains in Queensland. *Endangered* indicates that < 10% of the pre European extent of this ecosystem remains in Queensland. The term *Non-remnant* refers to lands modified to the extent those lands no longer reflect remnant native ecosystems.**

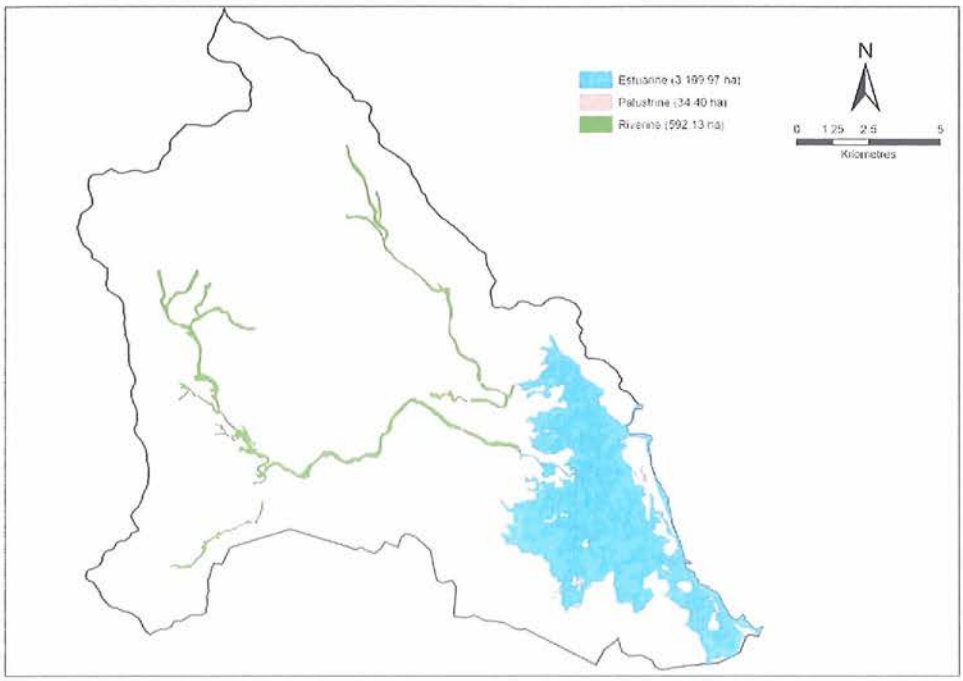


Figure 4.3 Wetland ecosystems in the Clairview Creek catchment.
See chapter 8 S4 for definitions of wetland types.

4.2.2 St Lawrence Creek Catchment

Regional ecosystems

The St Lawrence Creek catchment covers slightly less than 41,441 ha. Just less than 27 % is cleared or significantly altered. So 73 % supports remnant native vegetation. Nearly 8 % of the remnant native vegetation consists of plant communities that are *endangered* or contain elements of endangered ecosystems. Just over 7 % of the remnant native vegetation is considered to have an *of concern* conservation status. The riparian communities fringing the major streams contain elements of endangered ecosystems and, as in the Clairview catchment, form biodiversity corridors across the cleared lowlands. In the St Lawrence catchment, however, there are extensive areas of remnant vegetation (*not of concern*) associated with this riparian matrix. Together these elements form a more extensive and complex biodiversity corridor between the western escarpment and the eastern coast line (figures 4.4 & 4.5).

The St Lawrence Creek catchment includes about 7,041 ha of freshwater and intertidal wetlands (17.4 % of the catchment) (figure 4.6).

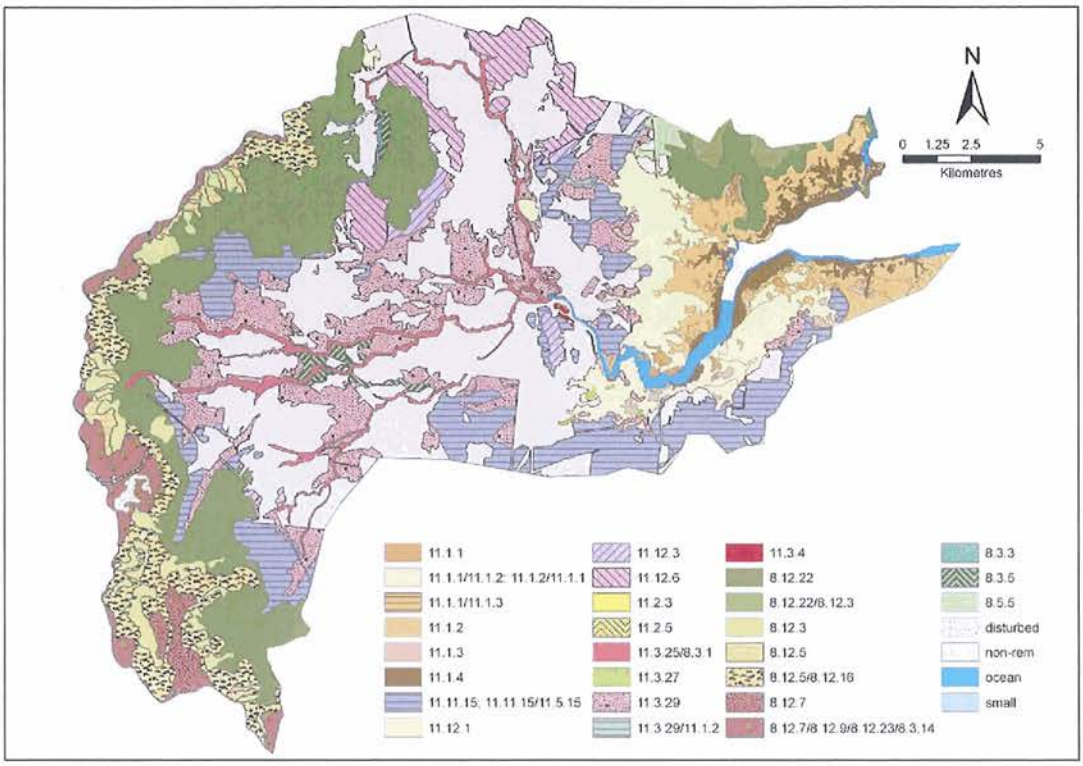


Figure 4.4 Regional ecosystems across the St Lawrence Creek catchment.

See chapter 8 S6 for a short description of the regional ecosystem codes. Codes beginning in 11 refer to the Brigalow Belt bioregion. Codes beginning in 8 refer to the Central Queensland Coast bioregion. The term *non-rem* refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.

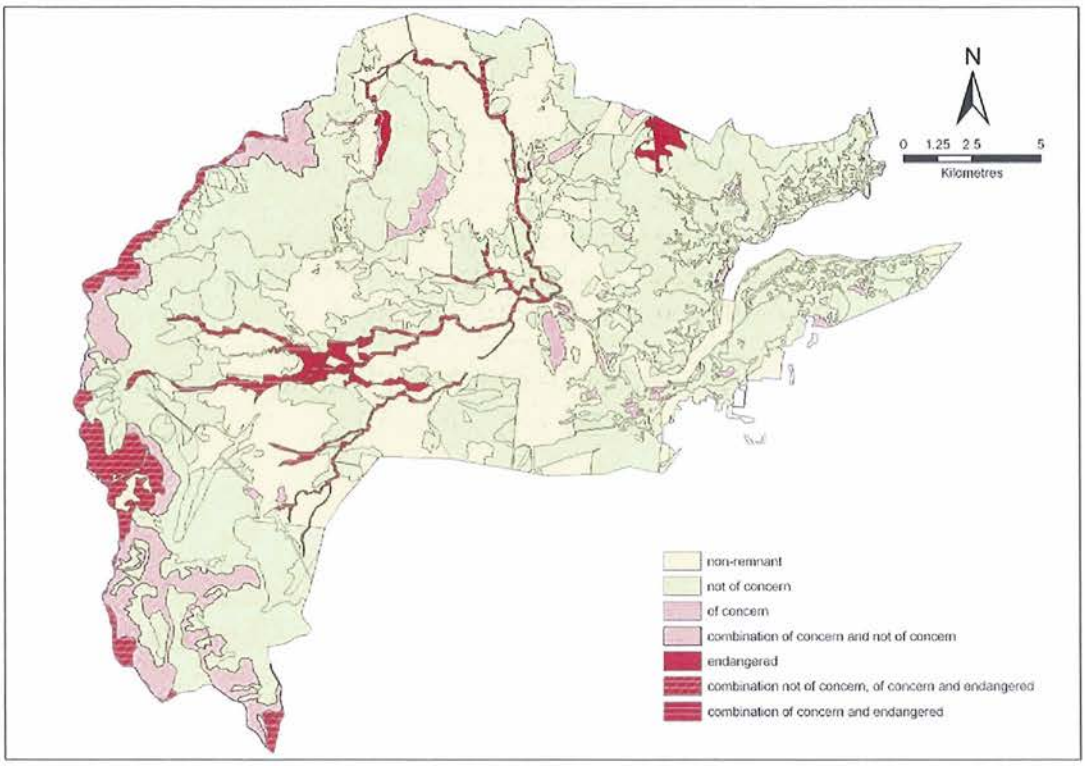


Figure 4.5 Conservation status of regional ecosystems of the St Lawrence Creek catchment.

***Not of Concern* indicates that greater than 30% of the pre European extent of this ecosystem remains in Queensland. *Of concern* indicates that 10 -30% of the pre European extent of this ecosystem remains in Queensland. *Endangered* indicates that < 10% of the pre European extent of this ecosystem remains in Queensland. The term *Non-remnant* refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.**

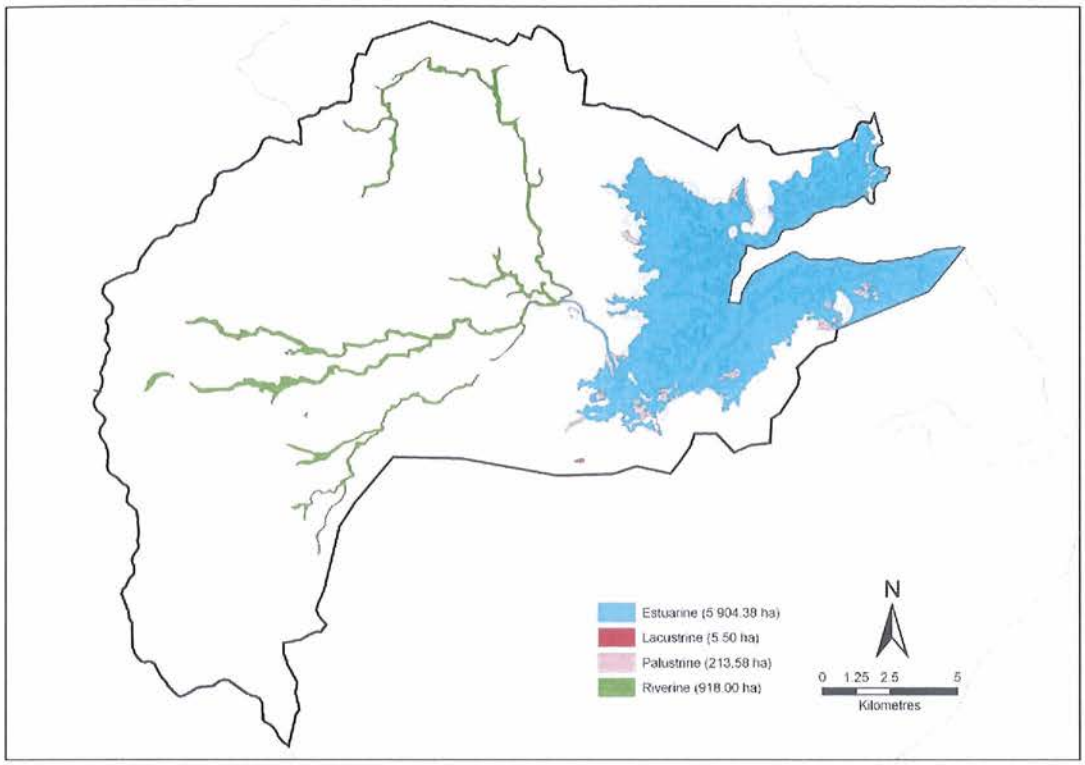


Figure 4.6 Wetland ecosystems in the St Lawrence Creek catchment.
The map depicts the pre-development situation whereas large areas of wetland on marine plains in the Broadsound basin have been modified by sea-walls and banks. These tide-excluding structures have changed wetland to the landward side such that many such wetlands of estuarine origin now exhibit typical features of palustrine or lacustrine freshwater wetlands. See chapter 8 S4 for definitions of wetland types.

4.2.3 Waverley Creek Catchment

Regional ecosystems

The Waverley Creek Catchment is 60,056 ha in area. Almost 22,383 ha (38.2%) is cleared or significantly altered. About 6 % of the remnant native vegetation is classified as *endangered* (936 ha) or *of concern* (2,653 ha) (figures 4.7 & 4.8).

The Waverley Creek catchment includes 17,624 ha of freshwater and intertidal wetlands-over 29.7 % of the catchment (figure 4.9).

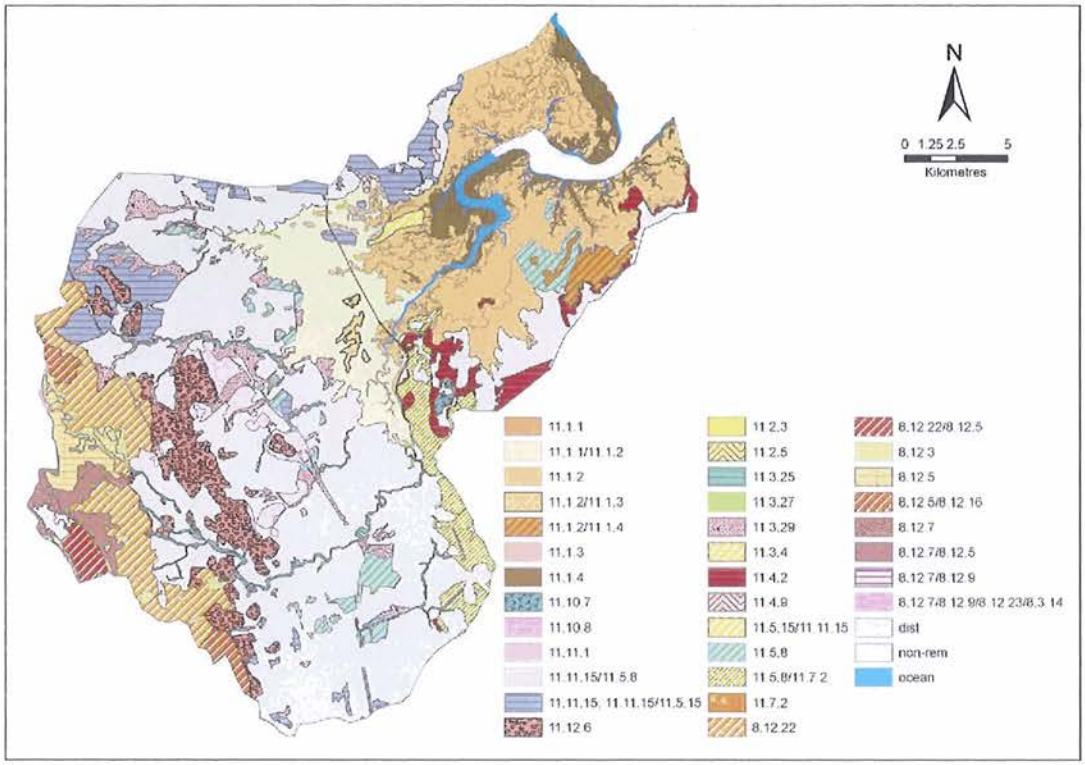


Figure 4.7 Regional ecosystems across the Waverely Creek catchment.

See chapter 8 S6 for a short description of the regional ecosystem codes. Codes beginning in 11 refer to the Brigalow Belt bioregion. Codes beginning in 8 refer to the Central Queensland Coast bioregion. The term *non-rem* refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.

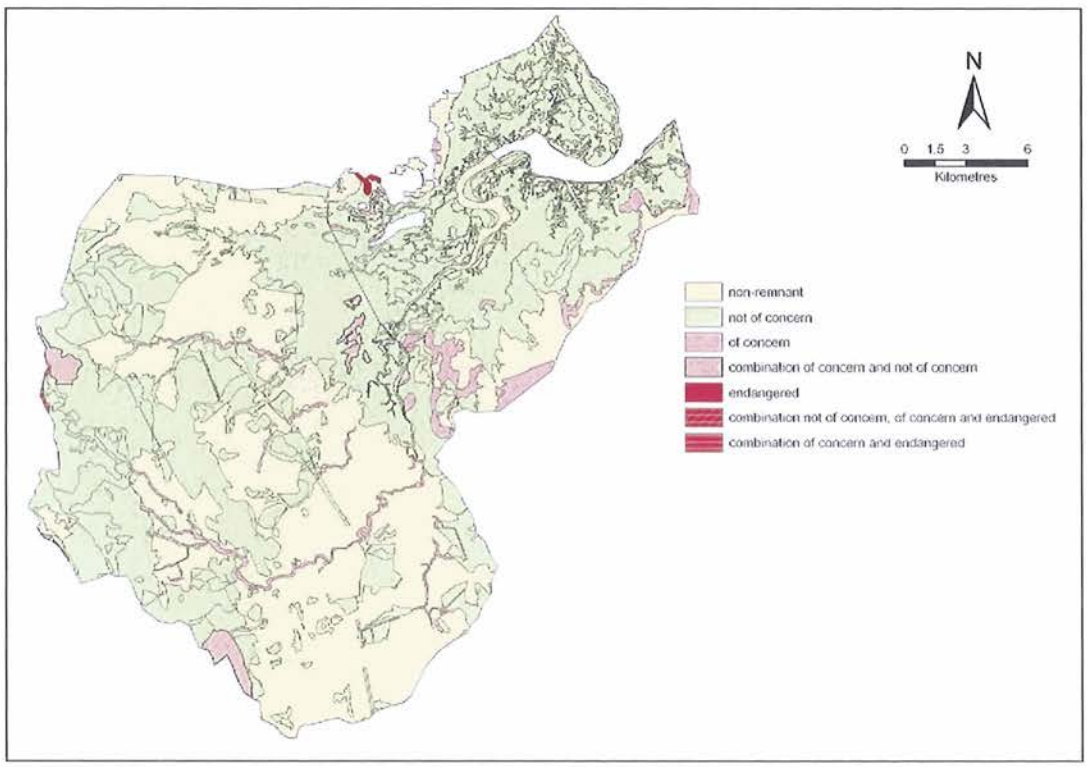


Figure 4.8 Conservation status of regional ecosystems of the Waverley Creek catchment.

***Not of Concern* indicates that greater than 30% of the pre European extent of this ecosystem remains in Queensland. *Of concern* indicates that 10 -30% of the pre European extent of this ecosystem remains in Queensland. *Endangered* indicates that < 10% of the pre European extent of this ecosystem remains in Queensland. The term *Non-remnant* refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.**

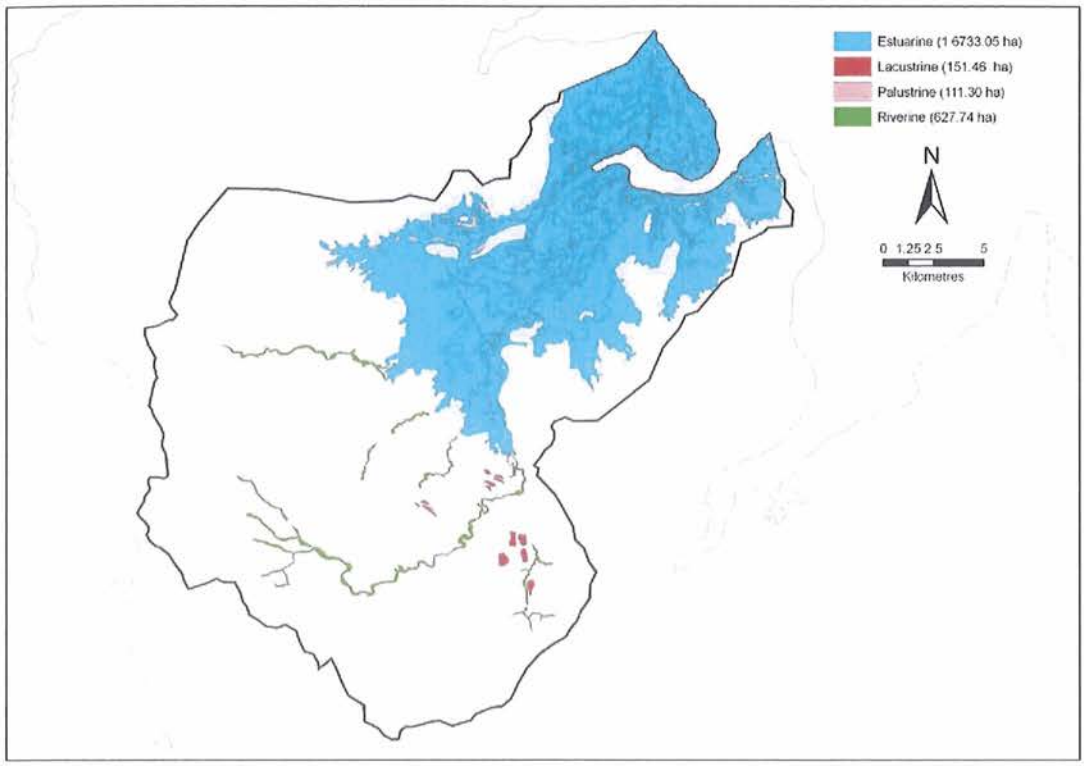


Figure 4.9 Wetland ecosystems in the Waverley Creek catchment.
The map depicts the pre-development situation whereas large areas of wetland on marine plains in the Broadsound basin have been modified by sea-walls and banks. These tide-excluding structures have changed wetland to the landward side such that many such wetlands of estuarine origin now exhibit typical features of palustrine or lacustrine freshwater wetlands. See chapter 8 S4 for definitions of wetland types.

4.2.4 Styx River Catchment

Regional ecosystems

The Styx River catchment covers 177,624 ha. Of this 52 % is cleared or significantly altered. The remnant native vegetation includes 21,974 ha (12.5% of catchment) of native vegetation classified as *of concern* or *endangered* (figures 4.10 & 4.11).

The contribution of wetlands to the Styx River catchment is relatively small with about 8.3% of the catchment comprised of freshwater or intertidal wetlands (14,780 ha) (figure 4.12).

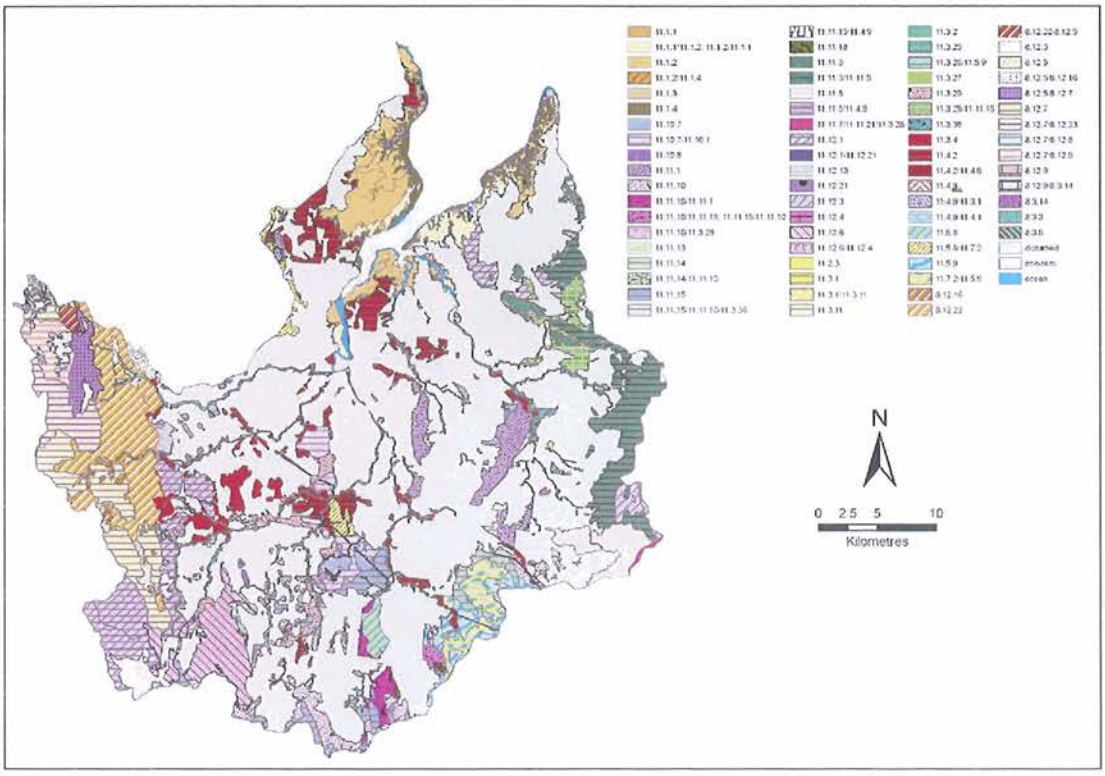


Figure 4.10 Regional ecosystems across the Styx River catchment.
See chapter 8 S6 for a short description of the regional ecosystem codes. Codes beginning in 11 refer to the Brigalow Belt bioregion. Codes beginning in 8 refer to the Central Queensland Coast bioregion. The term *non-rem* refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.

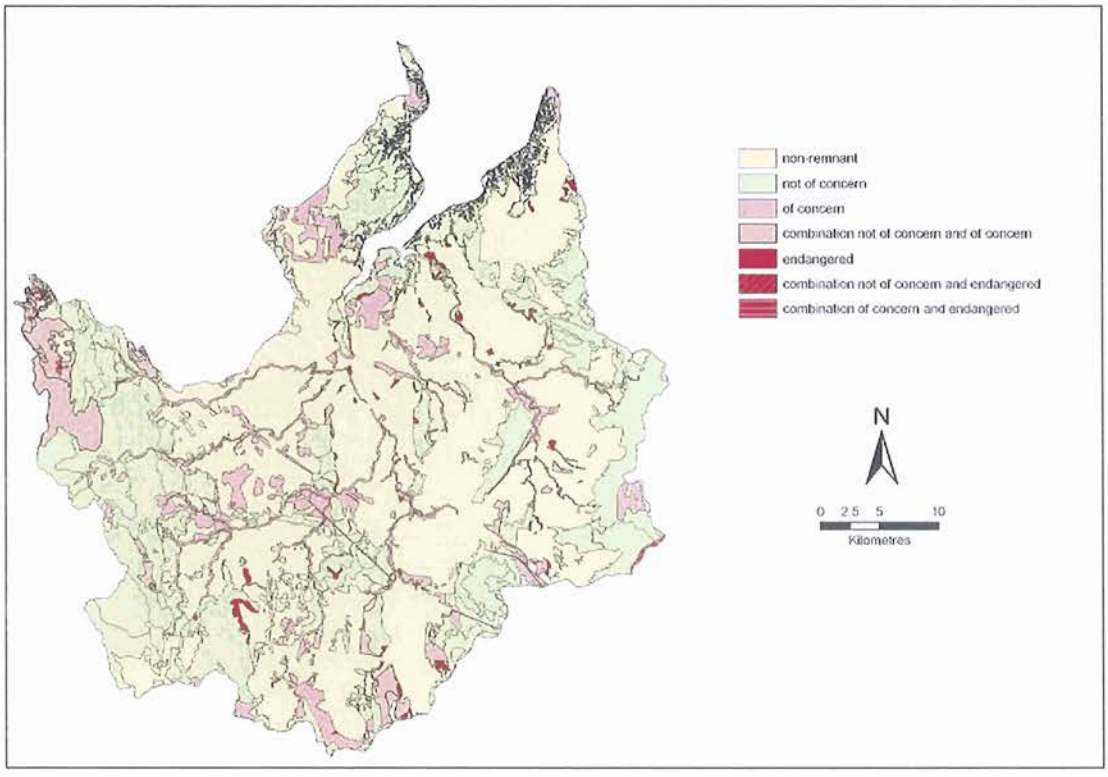


Figure 4.11 Conservation status of regional ecosystems of the Styx River catchment.
***Not of Concern* indicates that greater than 30% of the pre European extent of this ecosystem remains in Queensland. *Of concern* indicates that 10 -30% of the pre European extent of this ecosystem remains in Queensland. *Endangered* indicates that < 10% of the pre European extent of this ecosystem remains in Queensland. The term *Non-remnant* refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.**

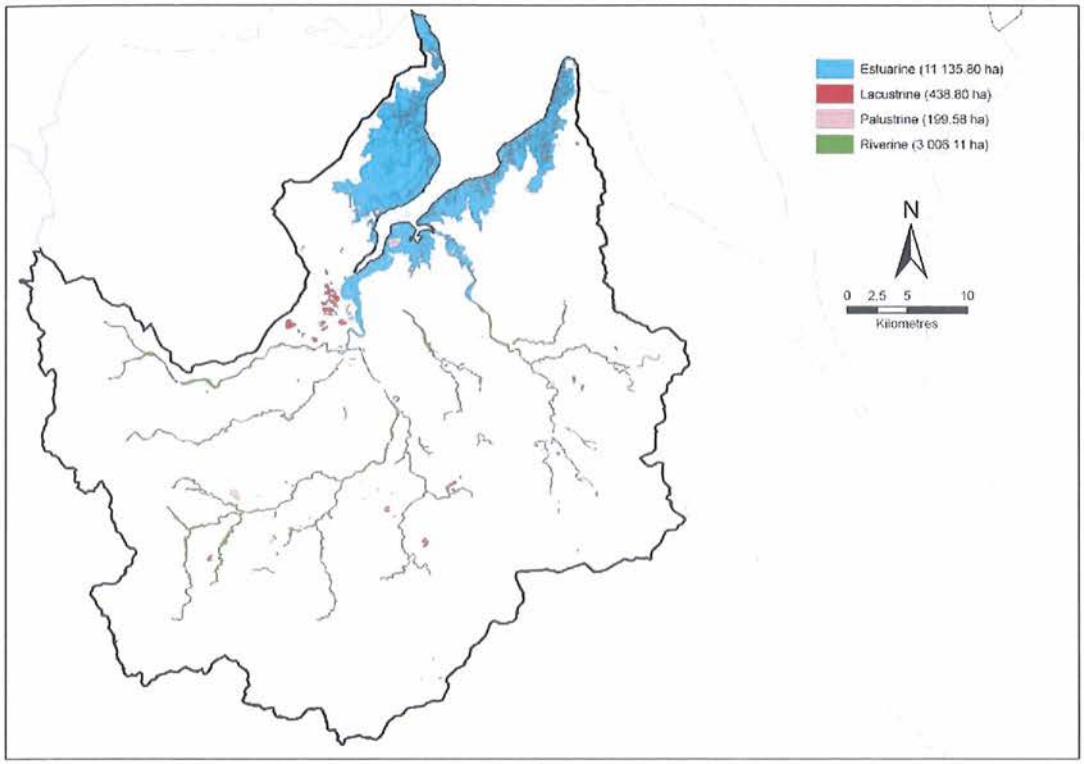


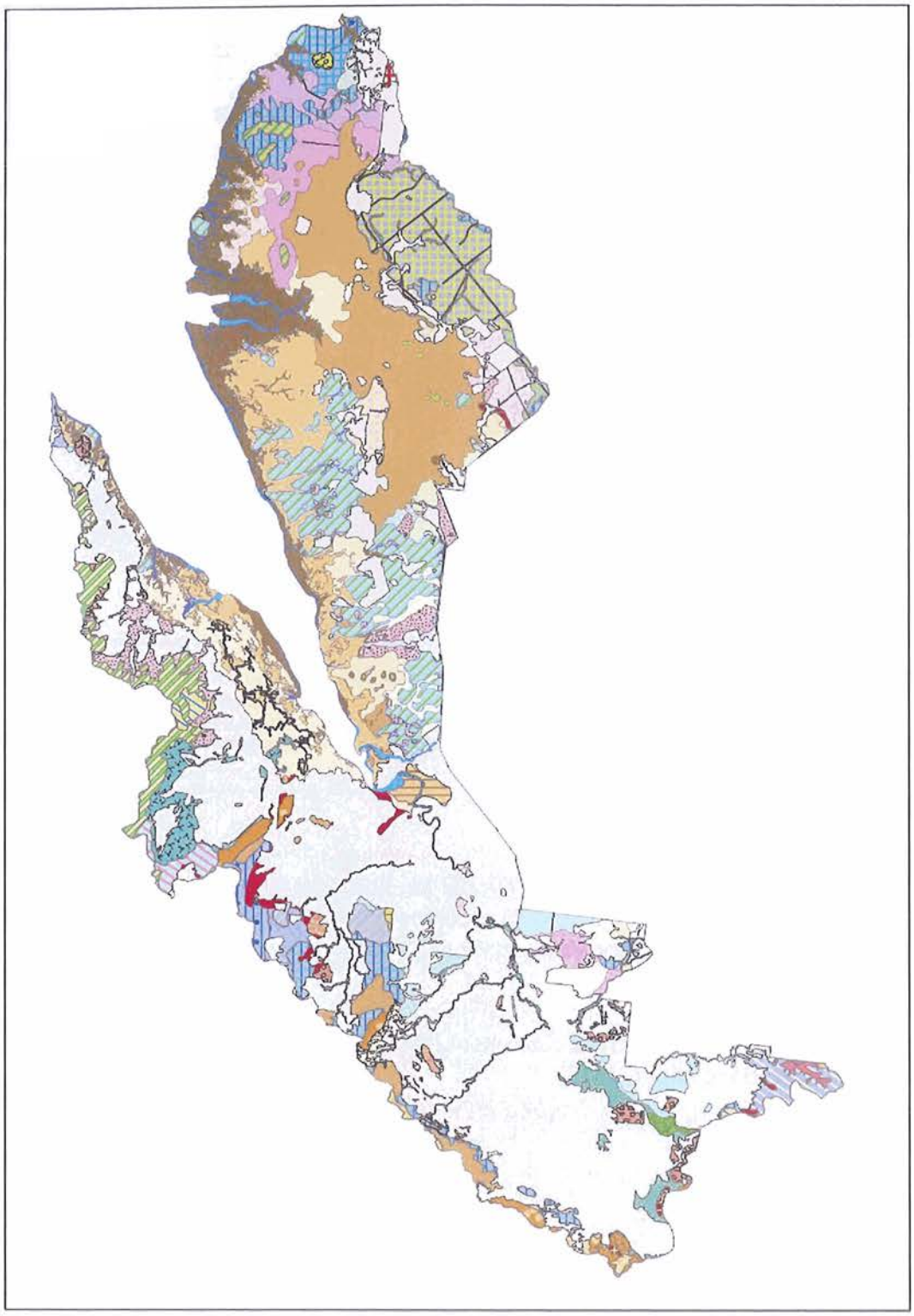
Figure 4.12 Wetland ecosystems in the Styx River catchment.
The map depicts the pre-development situation whereas large areas of wetland on marine plains in the Broadsound basin have been modified by sea-walls and banks. These tide-excluding structures have changed wetland to the landward side such that many such wetlands of estuarine origin now exhibit typical features of palustrine or lacustrine freshwater wetlands. See chapter 8 S4 for definitions of wetland types.

4.2.5 Herbert Creek Catchment

Regional ecosystems

The Herbert Creek catchment covers 189,293 ha. Some 38 % is cleared or significantly altered. Just less than 62 % is remnant native vegetation. About 12 % of the catchment area supports native vegetation classified as *of concern* or *endangered* (figures 4.13 & 4.14).

Nearly 25 % of the Herbert Creek catchment (about 46,719 ha) is classed as intertidal or freshwater wetland (figure 4.15).



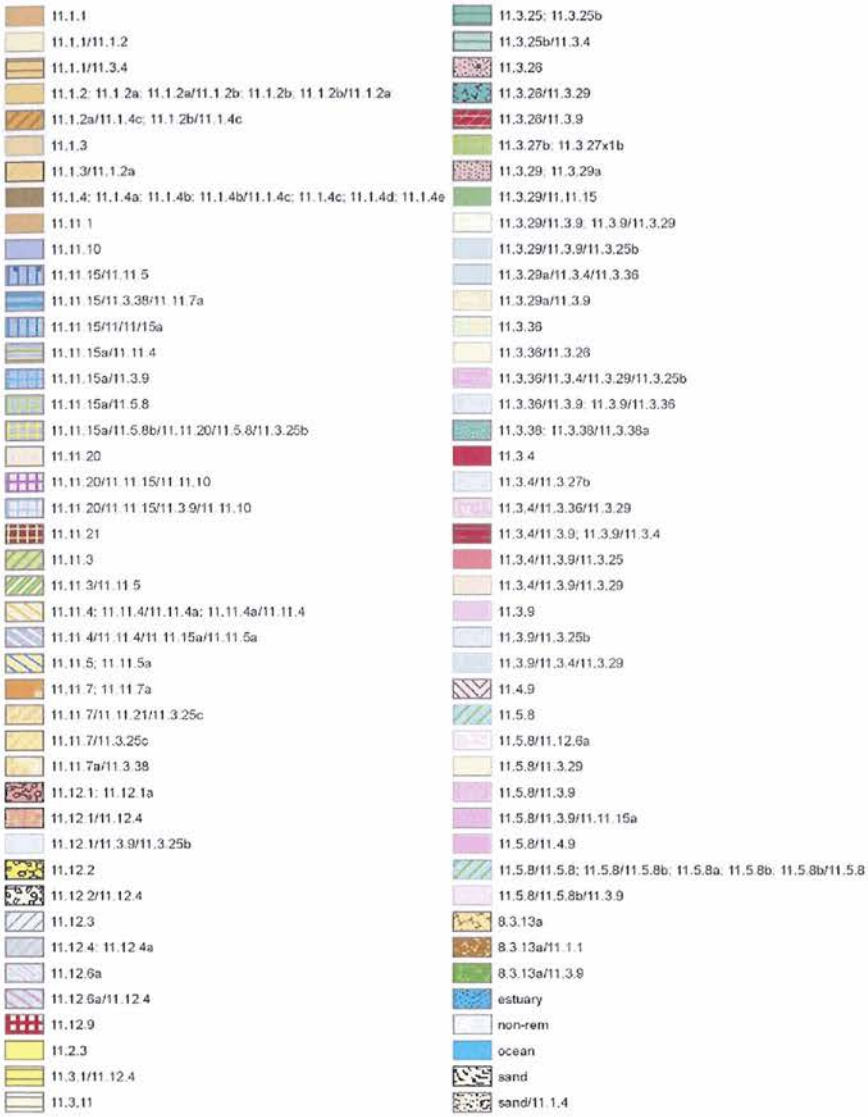


Figure 4.13 Regional ecosystems across the Herbert Creek catchment.

See chapter 8 S6 for a short description of the regional ecosystem codes. Codes beginning in 11 refer to the Brigalow Belt bioregion. Codes beginning in 8 refer to the Central Queensland Coast bioregion. The term *non-rem* refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.

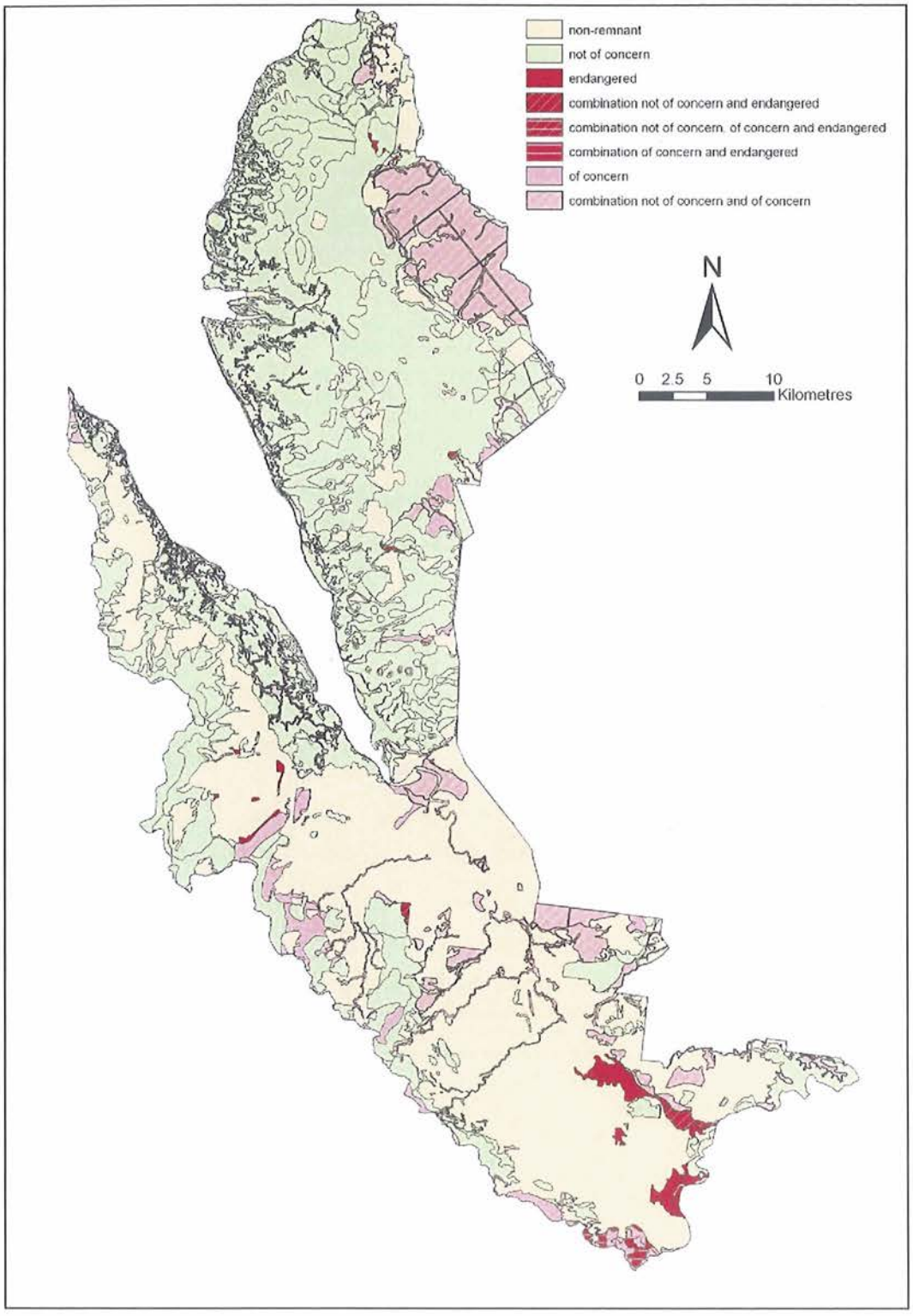


Figure 4.14 Conservation status of regional ecosystems of the Herbert Creek catchment.

Not of Concern **indicates that greater than 30% of the pre European extent of this ecosystem remains in Queensland.** ***Of concern*** **indicates that 10 -30% of the pre European extent of this ecosystem remains in Queensland.** ***Endangered*** **indicates that < 10% of the pre European extent of this ecosystem remains in Queensland. The term** ***non-remnant*** **refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.**

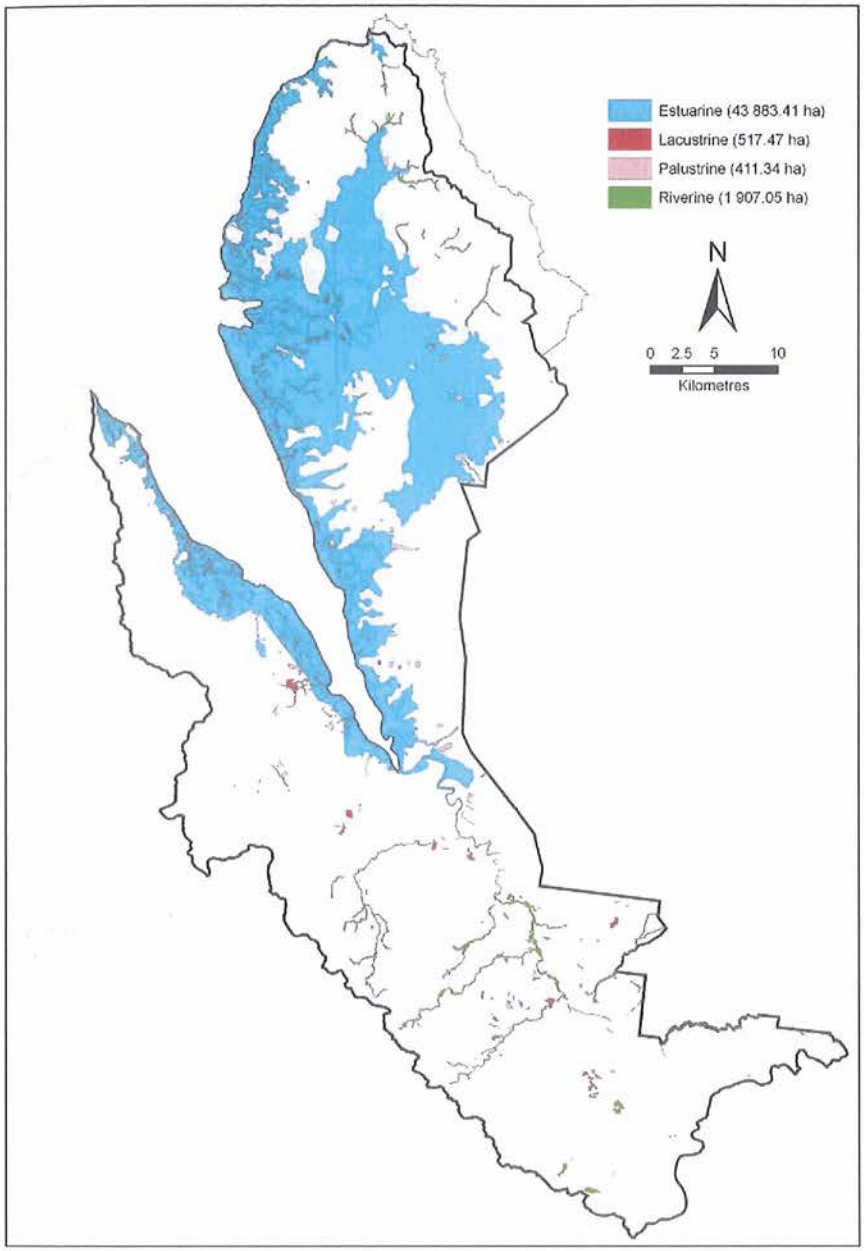


Figure 4.15 Wetland ecosystems in the Herbert Creek catchment.
The map depicts the pre-development situation whereas large areas of wetland on marine plains in the Broadsound basin have been modified by sea-walls and banks. These tide-excluding structures have changed wetland to the landward side such that many such wetlands of estuarine origin now exhibit typical features of palustrine or lacustrine freshwater wetlands. See chapter 8 S4 for definitions of wetland types.

4.2.6 Stanage Coast Catchment

Regional ecosystems

The Stanage Coast catchment covers 7678 ha. Just under 67% (5,042 ha) supports remnant native vegetation that is classified as *of concern* or *endangered*. Nearly 16 % is cleared or significantly altered (figures 4.16 & 4.17).

Only about 6% (453 ha) of the Stanage coast is classified as wetland (figure 4.18).

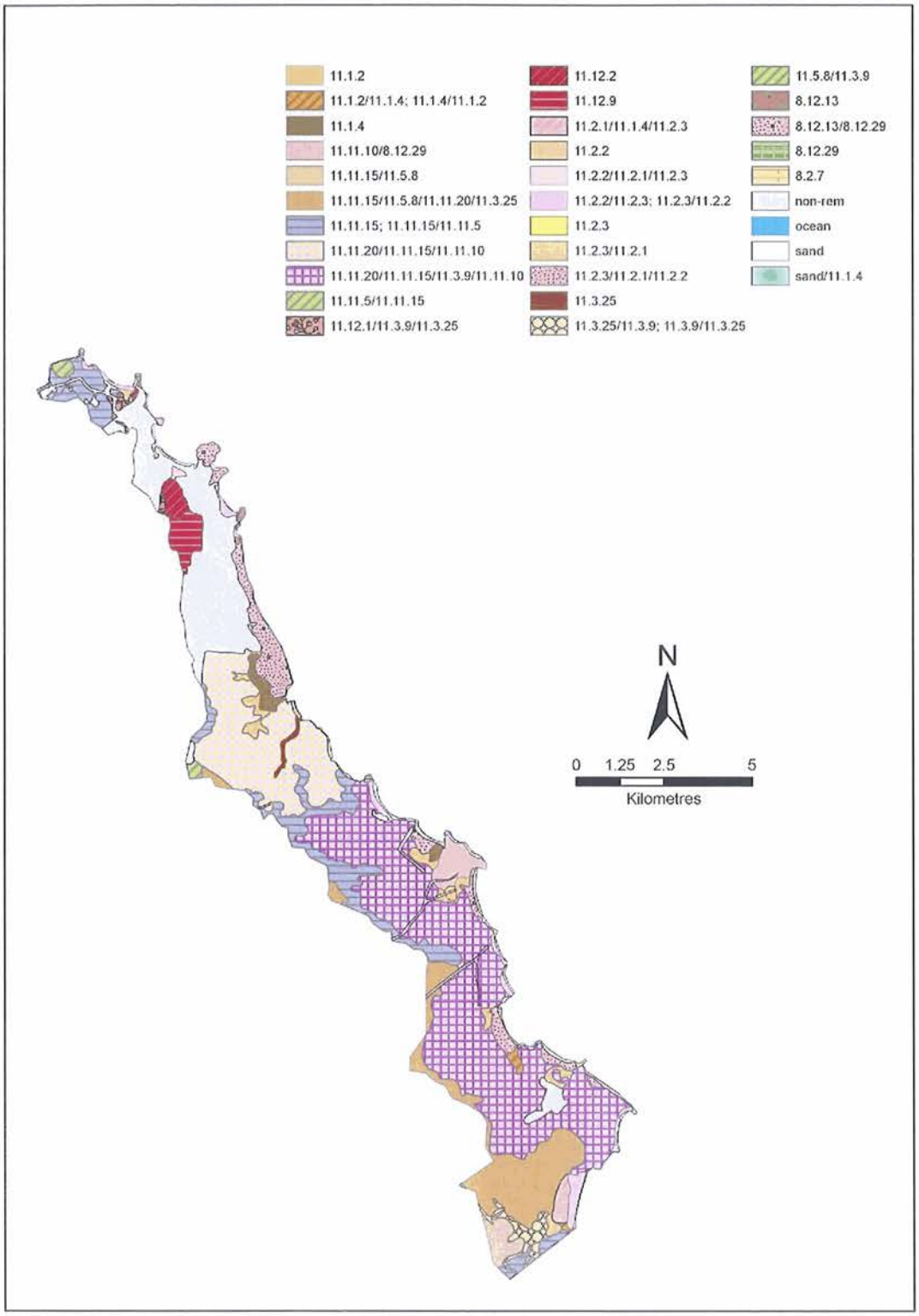


Figure 4.16 Regional ecosystems across the Stanage Coast catchment.
See chapter 8 SX for a short description of the regional ecosystem codes. Codes beginning in 11 refer to the Brigalow Belt bioregion. Codes beginning in 8 refer to the Central Queensland Coast bioregion. The term *non-rem* refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.

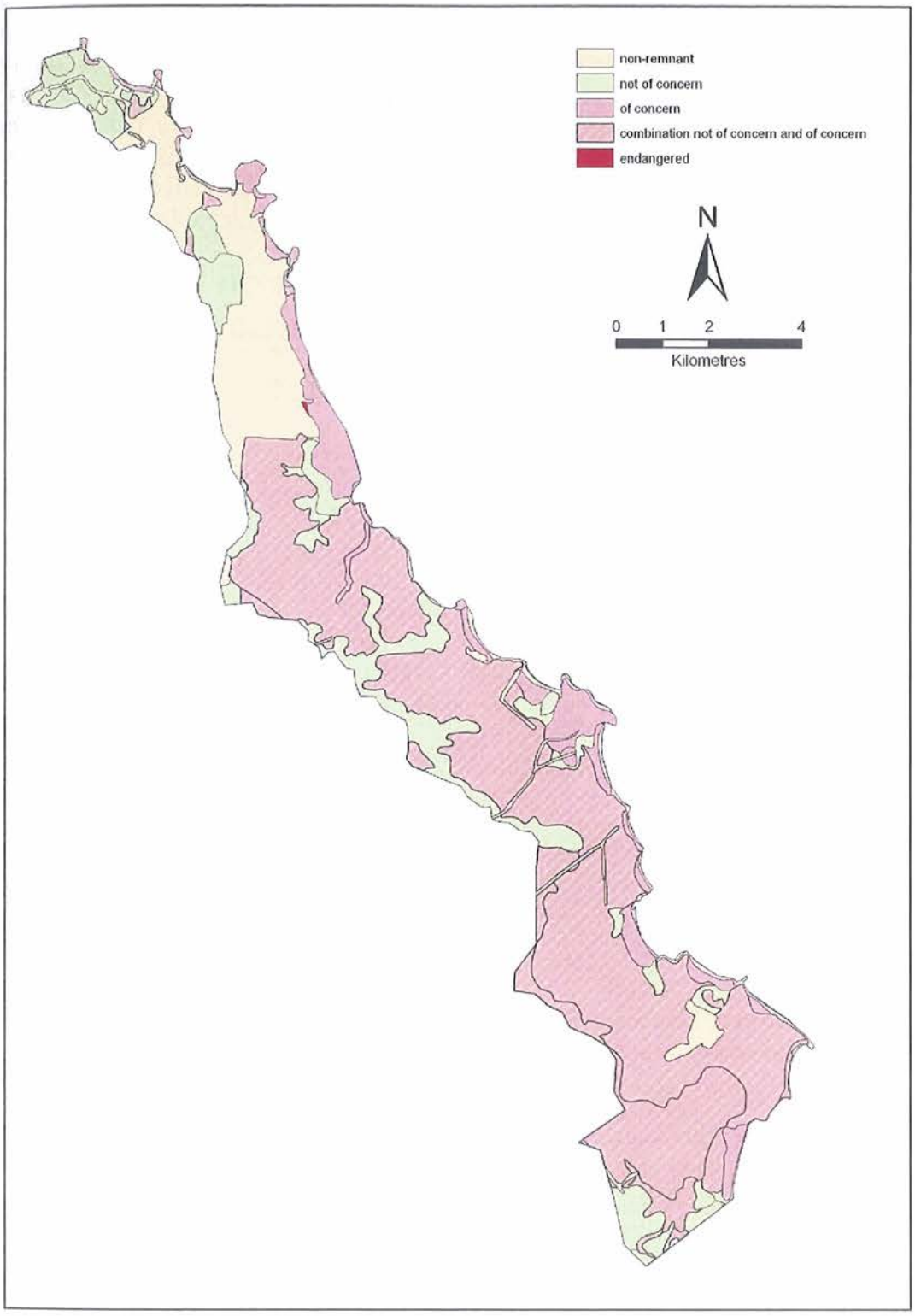


Figure 4.17 Conservation status of regional ecosystems of the Stanage Coast catchment.

Not of Concern **indicates that greater than 30% of the pre European extent of this ecosystem remains in Queensland.** ***Of concern*** **indicates that 10 -30% of the pre European extent of this ecosystem remains in Queensland.** ***Endangered*** **indicates that < 10% of the pre European extent of this ecosystem remains in Queensland. The term** ***Non-remnant*** **refers to lands modified to the extent those lands no longer reflet remnant native ecosystems.**

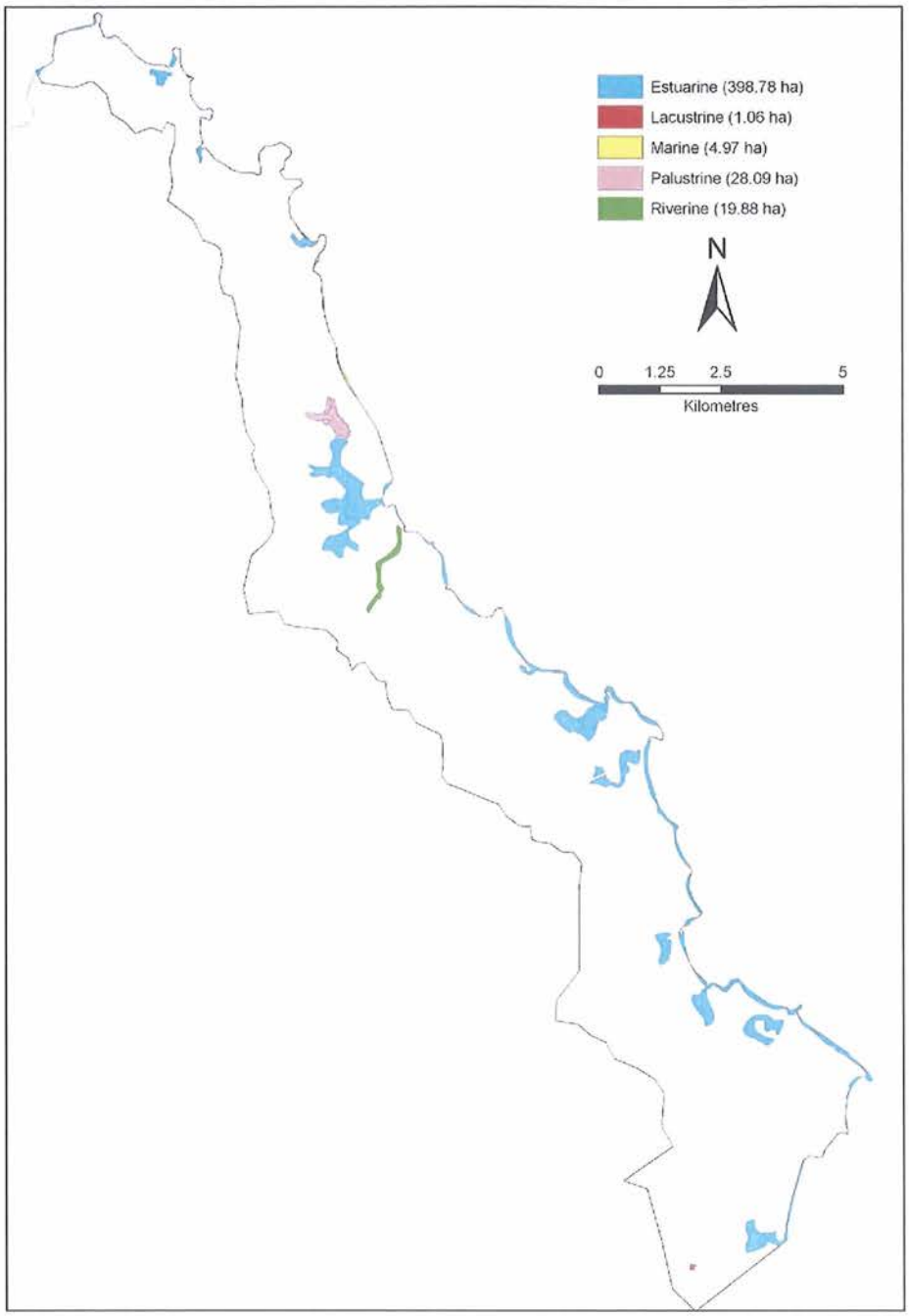


Figure 4.18 Wetland ecosystems in the Stanage Coast catchment.
See chapter 8 S4 for definitions of wetland types.

4.3 Significant biota

4.3.1 Plants

The Queensland Herbarium has records of 783 species within the Broadsound Basin. Of this assemblage 10 specimens were collected by Joseph Banks and D. Solander from Quail Island in May 1770. Four species are listed as endangered, five as vulnerable and six as rare. Ninety three species (12 %) are exotic species. Two endangered species, five vulnerable species and two rare species occur from one ecosystem on the south-western rim of the basin - the Marlborough Hills serpentine landscape. See chapter 8 S7 for a list of significant and exotic species from the Broadsound region.

The Marlborough Hills serpentine landscapes are of extremely high biodiversity value supporting a large number of endemic plant species.

4.3.2 Animals

The Queensland Environmental Protection Agency Wildnet records 393 species within the basin and adjacent waters. This includes two butterflys, seven freshwater fish, 255 species of birds, 19 species of insectivorous bat, two fruit bat species, 30 terrestrial and arboreal mammals, two marine mammals, 23 amphibians, four turtle species, 14 snakes and 34 lizard species. Of these eight are naturalised exotic species and 25 are classified as endangered, vulnerable or rare. The significant and exotic species are listed in chapter 8 S8.

4.4 Terrestrial environmental bench mark sites

4.4.1 Regional ecosystem condition benchmark sites

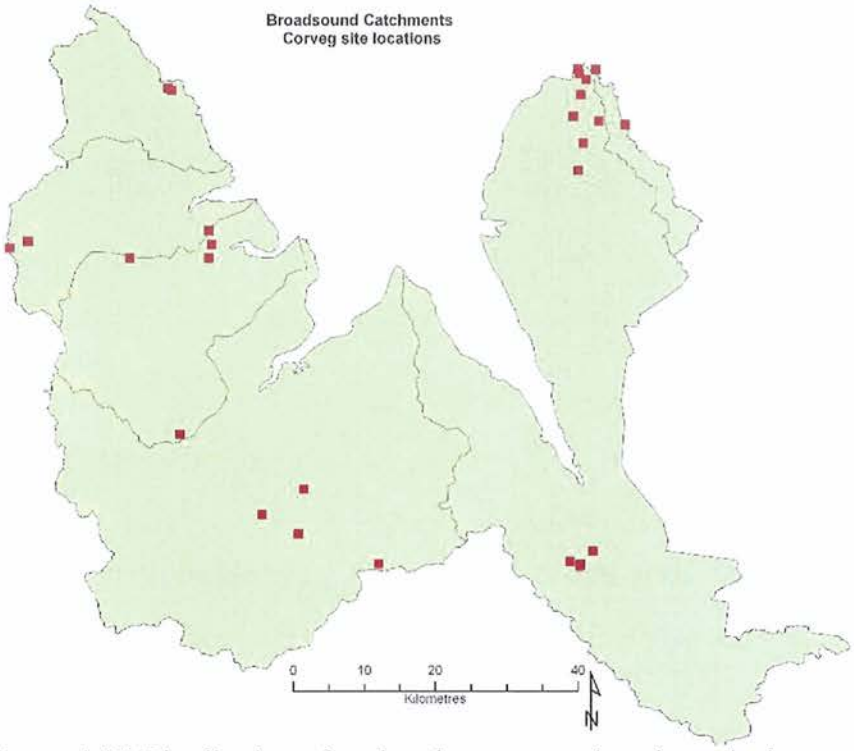


Figure 4.19 Distribution of regional ecosystem bench mark sites across the Broadsound basin. **See chapter 8 S3 Queensland Herbarium Ecosystem Condition Benchmark Sites for more detail.**

Twenty eight bench mark sites have been established by the Queensland Herbarium as part of state wide assessment of regional ecosystem mapping and condition assessment. They are located in a range of environments from coastal beach scrubs, wetlands, eucalypt woodlands and mountainous rainforests (see table S3.1). These sites provide a valuable environmental condition baseline. This baseline is complemented by the regional photo points below.

4.4.2 Regional photo point sites

Fifty one regional photo points have been established across five of the six catchments within the Broadsound Basin (figure 4.19, table 4.2). Sites are associated with four major land use classes (table 4.3) that also included timber plantation and conservation tenures subject to grazing. The site array was influenced by property access permission achieved within the project timeframe. Sites were established after good regional rains and overall land cover was good in the post wet season environment. To be an effective assessment tool the photo point array should be revisited in poor conditions and the array should be expanded to give a more even spread of assessment over the catchments and over lands under a full range of

management regimes. See chapter 8 S2 for a full description of the methodology and the site data summaries.

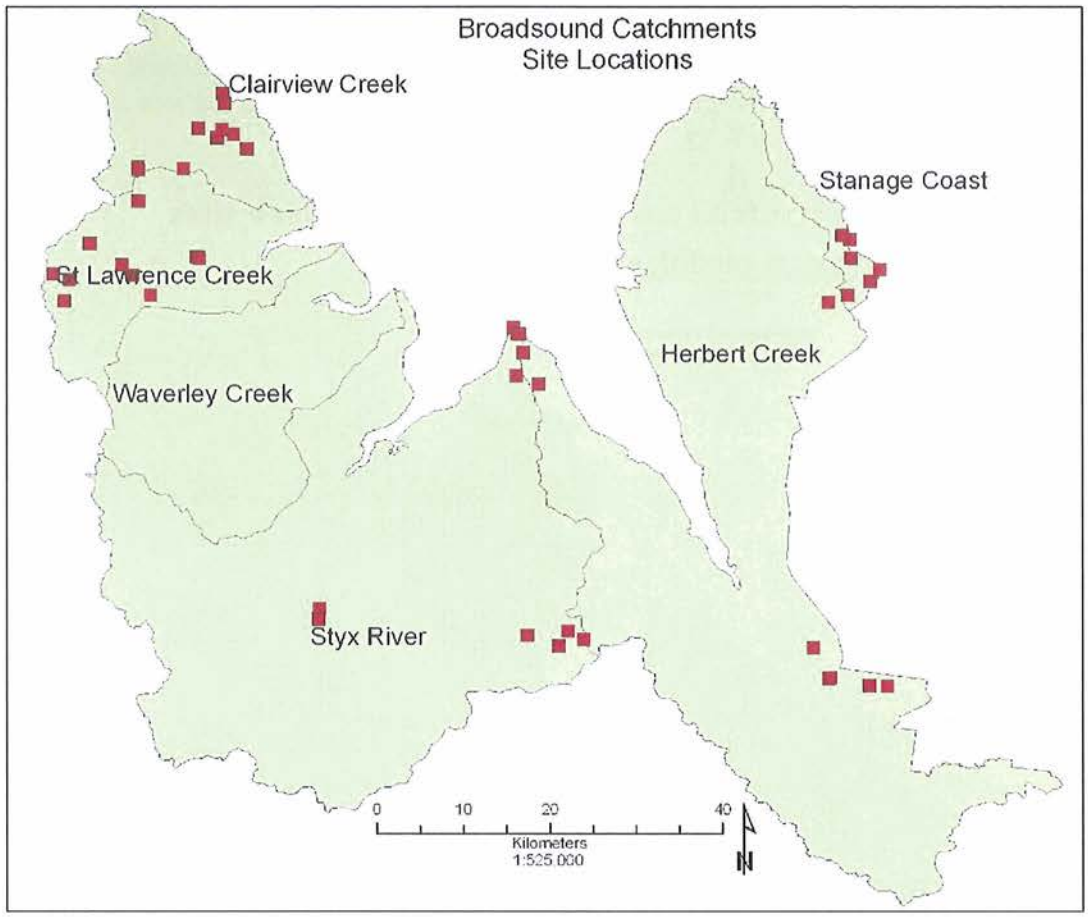


Figure 4.20 Location of regional photo point sites across the Broadsound basin. **See chapter 8 S2 *Field assessment and photo points* for site data and methodology.**

Table 4.2 Photo point sites within Broadsound Basin catchments

Catchment	Catchment Area (ha)	Sites/catchment
Clairview Creek	27222.73	12
St Lawrence Creek	40534.73	13
Waverley Creek	59172.15	none
Styx River	174568.61	12
Herbert Creek	188021.30	8
Stanage Coast	7590.11	6

Table 4.3 Land use classes associated with photo point sites

Land use	Site numbers
Grassland grazing	7
Woodland grazing	21
Reserve	4
Conservation	15

4.5 Land tenure and land use

4.5.1 Clairview Creek Catchment

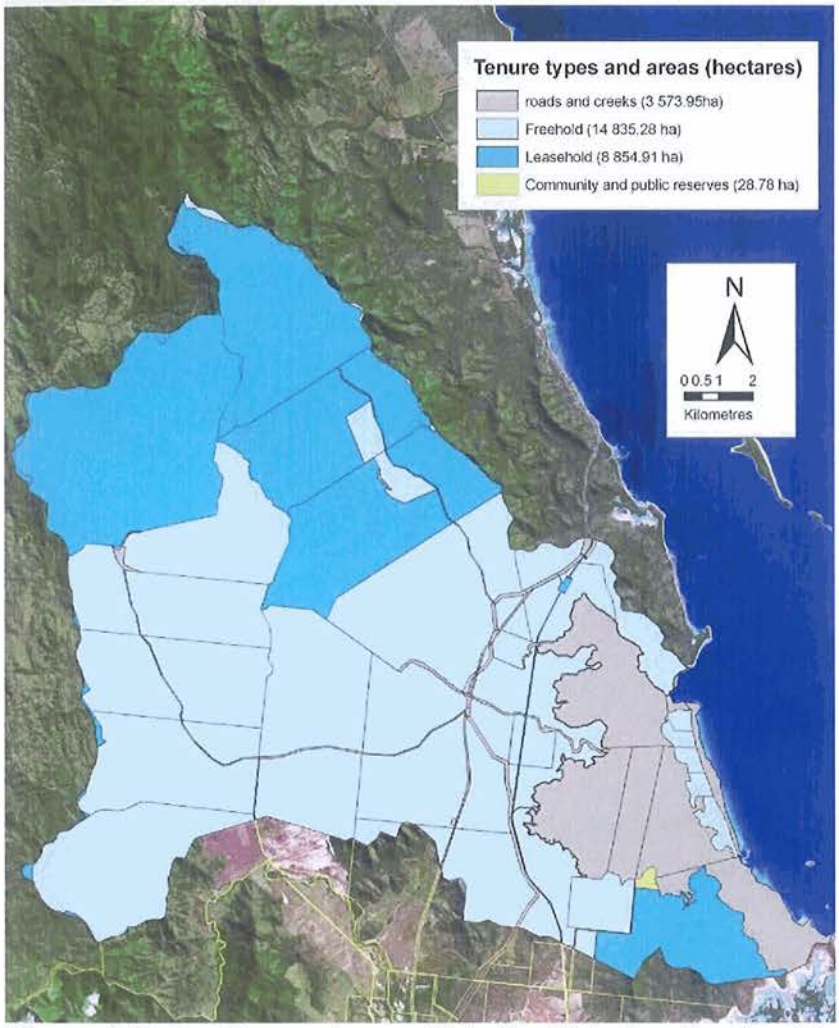


Figure 4.21 Land tenure types within the Clairview Creek catchment. **Data derived from the DNR&W DCDB.**

Table 4.4 Land tenure within the Clairview Creek catchment

Tenure	Area (ha)	%
community and public reserves	28.78	0.11
roads, creeks, mangroves	3573.95	13.09
Leasehold	8854.91	32.44
Free hold	14835.28	54.36
Total	27292.92	
Covenant	4514.57	16.54

Clairview Creek catchment is predominantly under freehold tenure although with a significant leasehold component (figure 4.20, table 4.4). There is little public land. There is about 4,500 ha (16.5%) under an environmental covenant.

4.5.2 St Lawrence Creek catchment

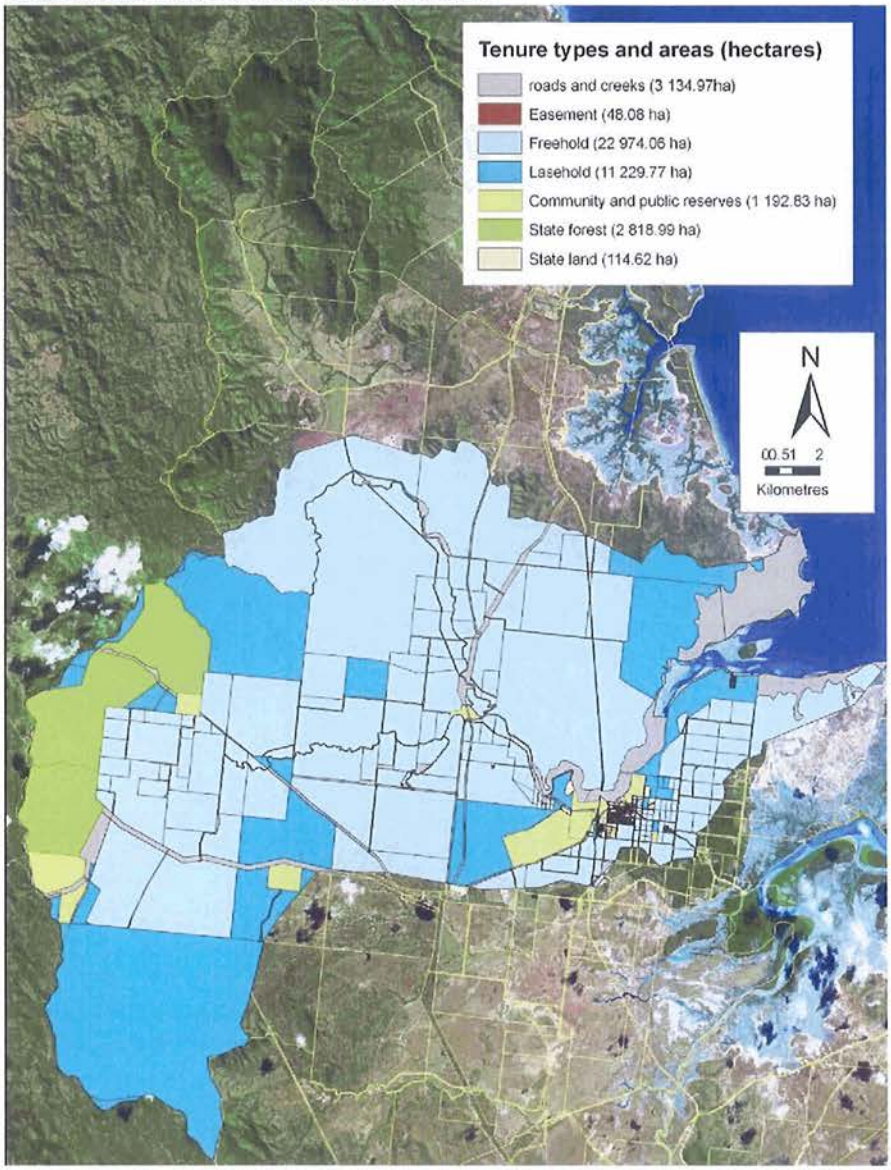


Figure 4.22. Land tenures within the St Lawrence Creek catchment. **Data derived from the DNR&W DCDB.**

Table 4.5 Land tenure within the St Lawrence Creek catchment

Tenure	Area (ha)	%
Easements	48.08	0.10
State land	114.62	0.25
community and public reserves	1192.83	2.57
State forest	2818.99	6.08
roads, creeks, mangroves	7983.3	17.22
Leasehold	11229.77	24.22
Free hold	22974.06	49.55
Total	46361.65	
Covenant	1805.85	3.90

St Lawrence Creek catchment is predominantly covered by freehold tenure with a substantial area of leasehold land. Conservation tenure (state forests) covers about 6% of the catchment. Another 4% of the catchment is under environmental covenant.

4.5.3 Waverley Creek catchment

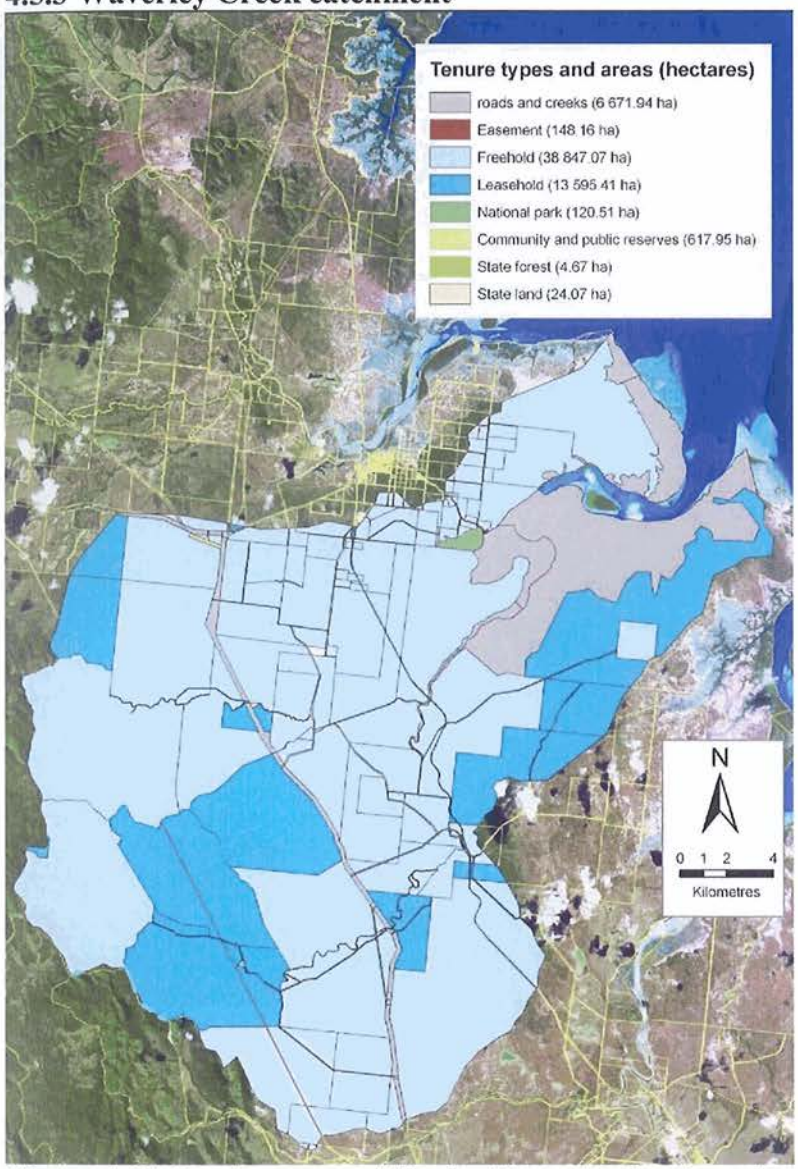


Figure 4.23. Land tenures within the Waverley Creek catchment. **Data derived from the DNR&W DCDB.**

Table 4.6 Land tenure within the Waverley Creek catchment

Tenure	Area (ha)	%
State land	24.07	0.04
National park	120.51	0.20
Easements	148.16	0.25
community and public reserves	617.95	1.03
State forest	4.67	0.01
roads, creeks, mangroves	6671.94	11.11
Leasehold	13595.41	22.65
Free hold	38847.07	64.71
Total	60029.79	
Covenant	2812.48	4.69

Waverley Creek catchment is predominantly covered by freehold tenure with a substantial area of leasehold land. There is little land under conservation tenure in the catchment. However, just less than 5% of the catchment is under environmental covenant.

4.5.4 Styx River catchment

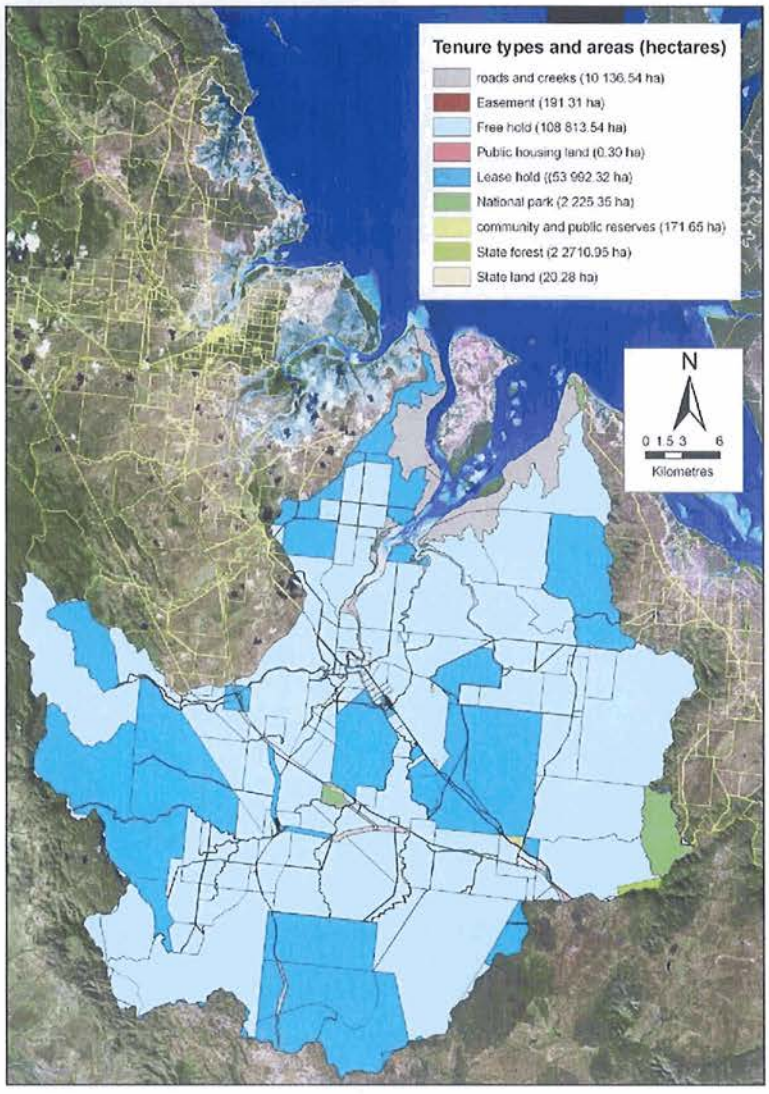


Figure 4.24 Land tenures within the Styx River catchment. **Data derived from the DNR&W DCDB.**

Table 4.7 Land tenure within the Styx River catchment

Tenure	Area (ha)	%
Public housing land	0.31	0.0002
State land	20.28	0.01
community and public reserves	171.65	0.10
Easements	191.31	0.11
National park	2225.35	1.25
State forest	2270.95	1.28
roads, creeks, mangroves	10136.54	5.70
Leasehold	53992.32	30.36
Free hold	108813.5	61.19
Total	177822.2	
Covenant	13957.19	7.85

The Styx River catchment is predominantly covered by freehold tenure with a substantial area of leasehold land. Only 2.5% of the catchment is under conservation tenure. However, just less than 8% of the catchment is under environmental covenant.

4.5.5 Herbert Creek catchment

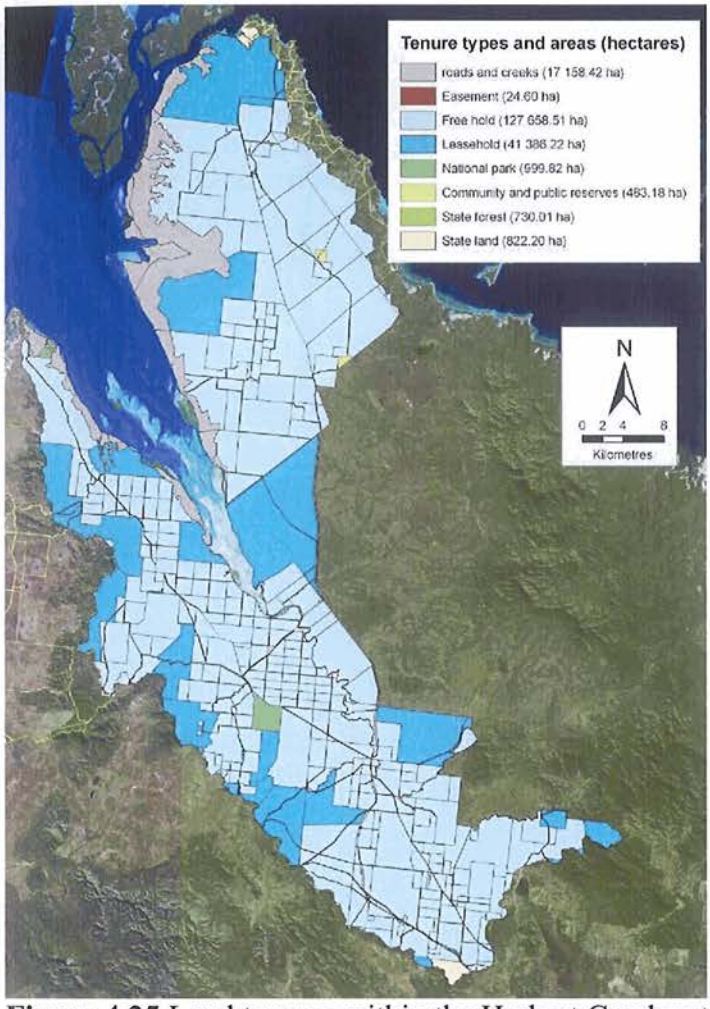


Figure 4.25 Land tenures within the Herbert Creek catchment. **Data derived from the DNR&W DCDB.**

Table 4.8 Land tenure within the Herbert Creek catchment

Tenure	Area (ha)	%
easements	24.60	0.01
community and public reserves	483.18	0.26
State forest	730.01	0.39
State land	822.20	0.43
National park	999.82	0.53
roads, creeks, mangroves	17158.42	9.07
Leasehold	41386.22	21.87
Free hold	127658.5	67.45
Total	189263	

The Herbert Creek catchment is predominantly covered by freehold tenure with a substantial area of leasehold land. Less than 1% of the catchment is under conservation tenure and there are no land covenants in this catchment.

4.5.6 Stanage Coast catchment

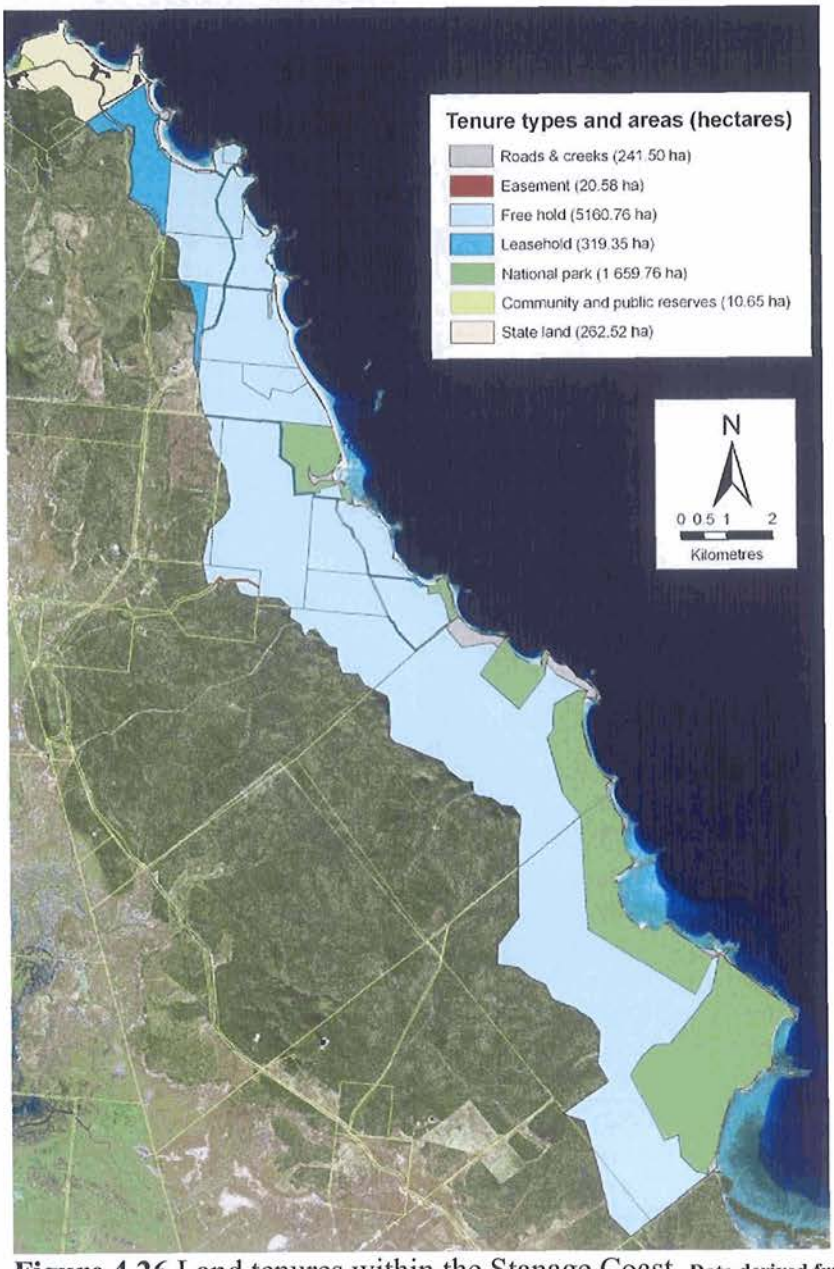


Figure 4.26 Land tenures within the Stanage Coast. **Data derived from the DNR&W DCDB.**

Table 4.9 Land tenure within the Stanage Coast catchment

Tenure	Area (ha)	%
community and public reserves	10.65	0.14
Easements	20.58	0.27
roads, creeks, mangroves	241.50	3.15
State land	262.52	3.42
National park	1659.76	21.63
Leasehold	319.35	4.16
Free hold	5160.76	67.24
Total	7675.13	

The Stanage Coast catchment is the smallest catchment in the Broadsound Basin. It is predominantly covered by freehold tenure. In contrast to the other catchments the Stanage Coast includes a high proportion of national park (22%). There is no land under covenant in this catchment.

4.6 Towns

St Lawrence

St Lawrence is a well managed town with interesting historical and natural values. The well restored and unrestored historical buildings and European cultural relics seem to be an underutilized asset (figure 4.27). The surrounding terrestrial plant communities (figure 4.28) are of high biodiversity and conservation value. The relatively easy access to saline and freshwater wetlands around the town provides excellent opportunities for bird watching and water based recreation and fishing (figure 4.29).

Figure 4.27. Historical relics at St Lawrence.

Figure 4.28. Complex dry rainforests of conservation and scientific importance surround St Lawrence.

Figure 4.29. Aquatic and wading birds using lagoons at St Lawrence as a dry season refuge.

Ogmore

Ogmore is a well managed town with interesting historical values. The unrestored historical buildings and European cultural relics (figure 4.30) seem to be an underutilized asset. There is a local oral history of World War II events that require confirmation and associated sites that are poorly known.

Figure 4.30 Cultural relics at Ogmore

Stanage Bay

The Stanage Coast and the settlement at Stanage Bay contain high aesthetic, recreation, tourism and natural values. The coastline is dramatic and accessible (figure 4.31). There are opportunities for nature based recreation and tourism developments exploiting the appeal of the remote rocky coast and access to the coastal waters and reef. The extensive national park and the complex of offshore islands guarantee the maintenance of many natural values. Long term investment opportunities are high.

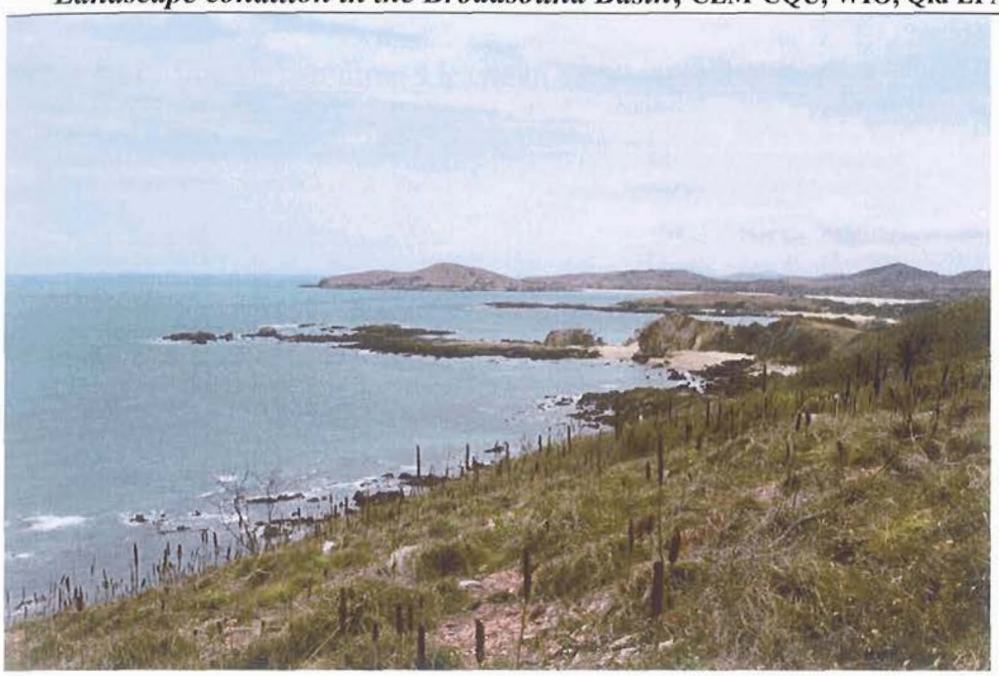


Figure 4.31 Stanage Coast south from Alligator Point.

4.7 Mining and petroleum prospects

There are extensive minerals and petroleum interests in the Broadsound Basin. If fully developed they have the potential to alter the socio-economic profile of the region and have major consequences for the environmental and aesthetic values of the coastline in particular. The interests are summarized in tables 4.10 and 4.11. Interests associated with coal, oil shale and magnesite are the most extensive and have the highest potential to influence the region. Metaliferous mines are small and almost all abandoned. They have some potential to influence the region if poorly managed and downstream contamination occurs. These sites have not been visited as part of this study. The importance of the interests within each of the basin's catchments is summarized in the following maps and tables.

Table 4.10 Mines in the Broadsound Basin

Mine Name	Locality	Status	Size of mine	Commodity	Yield
UNNAMED 984454	1km south of Stanage Point, Shoalwater Bay.	Mineral occurrence	Very small	Copper	Very Small <500 Tonnes Copper
PRINCHESTER ASBESTOS	North of Princhester in headwaters of Paddock Camp Creek.	Abandoned mine	Very small	Asbestos	Very Small <100 Tonnes Asbestos
AMITY CREEK	East of the Broadsound Ranges.	Abandoned prospect	Very small	Gold	Very Small <0.5 Tonnes Gold
IRON KNOB	Stanage Point, Shoalwater Bay.	Abandoned mine	Very small	Copper	Very small <500 tonnes Copper
BOUNDARY FLAT LAGOONS	Herbert creek north of Marlborough, 175km nw of Gladstone.	mineral occurrence (active prospect)	Medium	Oil shale	Medium 10 000 000 - 1 billion barrels oil shale
KUNWARARA	60 km north-west of Rockhampton.	Operating mine (active prospect)	Large	Magnesite	Large >10 000 000 tonnes magnesite
NOB CREEK	10km nne of Marlborough.	Abandoned mine (abandoned prospect)	Very small	Copper	Very small <500 tonnes copper
PRICE MOUNTAIN	East of Thirsty Sound on Stanage Peninsula.	Mineral occurrence (abandoned prospect)	Very small	Zinc	Very small <200 tonnes zinc
STANNAGE BAY COPPER	5km ws of Stanage Bay.	Mineral occurrence (abandoned prospect)	Very small	Copper	Very small <500 tonnes copper
M J JOHNS COPPER LODE	On high ridge north of Mt Magog.	Abandoned mine	Very small	Copper	Very small <500 tonnes copper
SULPHIDE GULLY	West of Clairview Homestead on upper Calabash Creek, near Fort Arthur.	Mineral occurrence (abandoned prospect)	Very small	Gold	Very small <0.5 tonnes gold
SALT HILL	12km north of St Lawrence.	Abandoned mine (abandoned prospect)	Very small	Gold	Very small <0.5 tonnes gold
SHIRLROY	11km north of Marlborough.	Abandoned mine (abandoned prospect)	Very small	Gold	Very small <0.5 tonnes gold
WELLINGTON CREEK	11km nw of Marlborough.	Mineral occurrence (abandoned prospect)	Very small	Gold	Very small <0.5 tonnes gold
MARLBOROUGH MAGNETITE	12km north of Marlborough.	Mineral occurrence (abandoned prospect)	Very small	Iron	Very small <5 000 tonnes iron
LANGDALE HILL	Road to Langdale Hill Telstra stn	Mineral occurrence (abandoned prospect)	Very small	Gold	Very small <0.5 tonnes gold
WITHNALLS FOLLY	Ssw of Anglewood	Mineral occurrence	Very small	Gold	Very small <0.5 tonnes gold
HERBERT CREEK MAGNESITE	20 km north east of Marlborough, 175km nw of Gladstone.	mineral occurrence (active prospect)	Large	Magnesite	Large >10 000 000 tonnes magnesite
BLOCK CREEK	25 km ne of Marlborough, 160km nw of Gladstone.	mineral occurrence (active prospect)	Medium	Oil shale	Medium 10 000 000 - 1 billion barrels oil shale

Table 4.11 Minerals permits and leases in the Broadsound Basin

Tenure type	Tenure number	Status	Date granted	Date expires	Principle holder	Name of lease	Area (ha)
Exploration permit for coal							
	1029	Granted	20-Apr-2006	19-Apr-2011	Waratah Coal Pty Ltd		55746.89
Exploration permit for minerals							
	16551	Application			Drummond West Pty Ltd		3040.86
	16553	Application			Bandanna Oil Shale Pty Ltd		20947.77
	16422	Application			Accord Mining Pty Ltd		1445.81
	15305	Application			Eastern Mining Corporation Pty Ltd		4762.33
	14500	Granted	18-May-2007	17-May-2011	Australia Oriental Minerals NL		21614.43
	15845	Granted	20-Dec-2006	19-Dec-2011	Wonjin Pty Ltd		30979.45
	10006	Granted	29-Mar-1994	28-Mar-2010	Smarttrans Holdings Ltd		174.77
	16427	Granted	24-Oct-2007	23-Oct-2012	Accord Mining Pty Ltd		13444.28
	3469	Granted	05-May-1983	04-May-2009	Queensland Energy Resources Ltd		13235.88
	15092	Granted	29-Nov-2005	28-Nov-2010	King eagle Resources Pty Ltd		5516.28
Exploration permit for petroleum							
	759	Granted	19-Oct-2000	31-Oct-2008	Ome Resources Australia Pty Ltd		797.82
	700	Granted	24-Mar-2003	31-Mar-2019	Arrow Energy NL		106563.30
	758	Granted	19-Oct-2004	31-Oct-2008	Ome Resources Australia Pty Ltd		434.33
	716	Granted	14-Oct-2003	31-Oct-2007	Arrow Energy NL		123460.25
Mining lease							
	5868	Granted	15-Mar-1990	31-Mar-2011	Qmch Pty Ltd	Kunwarara ko510	540.98
	80067	Granted	29-Jun-2000	30-Jun-2012	Qmch Pty Ltd	Kg3	201.24
	5870	Granted	15-Mar-1990	31-Mar-2011	Qmch Pty Ltd	Kunwarara ko540	391.83
	5869	Granted	15-Mar-1990	31-Mar-2011	Qmch Pty Ltd	Kunwarara ko520	4.10
	80125	Granted	06-Apr-2006	30-Apr-2027	Qmch Pty Ltd	Oldman south	131.62
Mineral development lease							
	194	Granted	21-Jun-1996	30-Jun-2011	Wonjin World Wide Pty Limited		900.01
	344	Granted	17-Sep-2003	30-Sep-2008	Qmch Pty Ltd	Kunwarara	6575.61
	196	Granted	11-Sep-1996	30-Sep-2011	Queensland Energy Resources Limited		4896.56
	197	Granted	08-Oct-1996	31-Oct-2011	Queensland Energy Resources Limited		3592.94

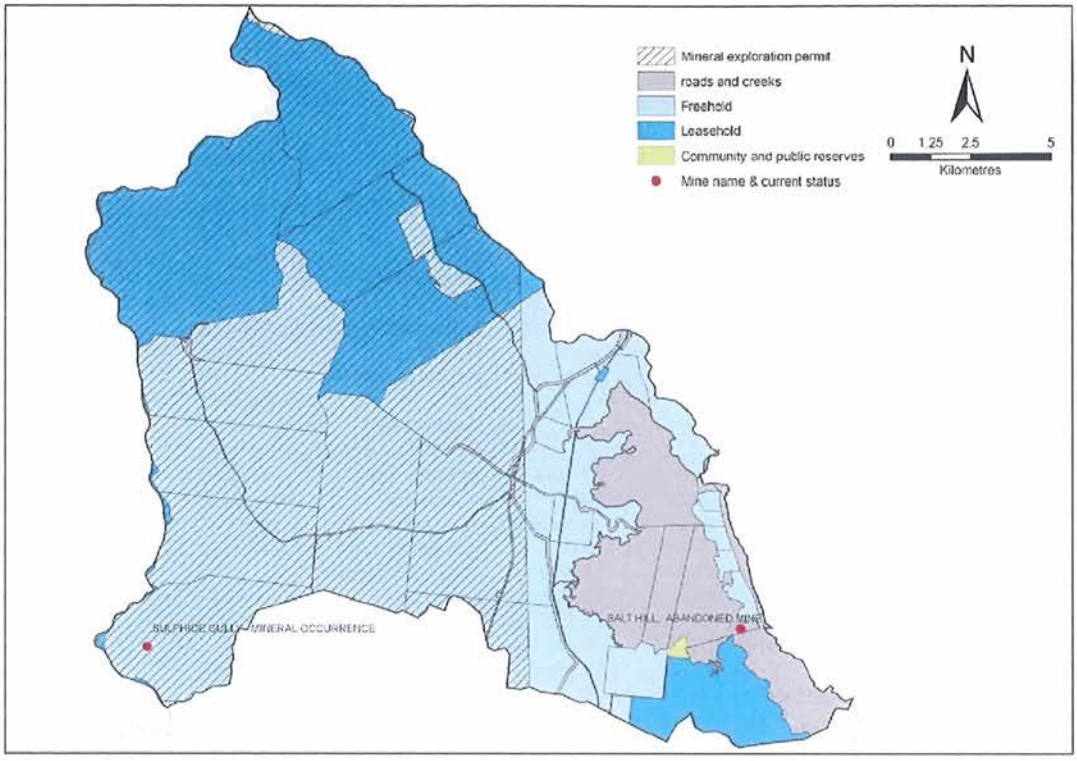


Figure 4.32 Minerals interests within the Clairview Creek Catchment.

Table 4.12 Extent of minerals permits and leases in the Clairview Creek Catchment

Exploration permit for minerals	
Tenure affected	**Area (ha)**
roads	208.89
covenant	4097.28
freehold	11223.26
leasehold	7809.69

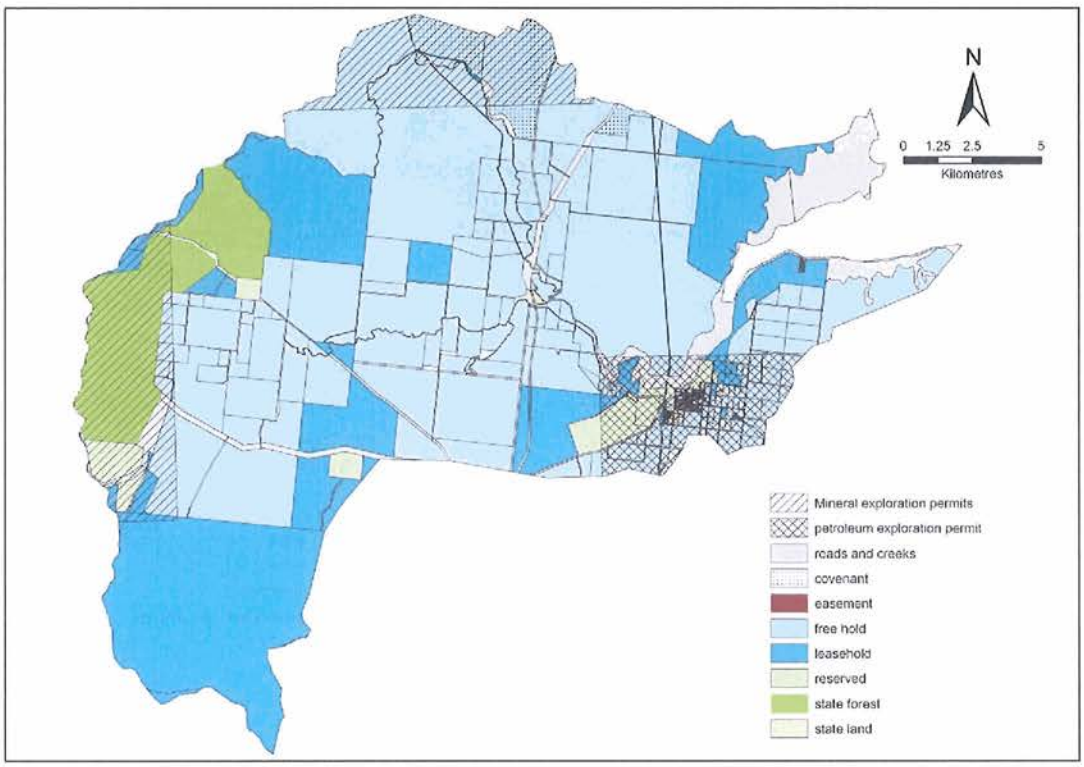


Figure 4.33 Minerals interests within the St Lawrence Creek Catchment.

Table 4.13 Extent of minerals permits and leases in the St Lawrence Creek Catchment

Exploration permit for minerals	
Tenure affected	**Area (ha)**
roads	296.95
covenant	1217.65
easement	2.11
freehold	2845.72
leasehold	389.97
reserve	446.08
state forest	1741.17

Exploration permit petroleum	
roads	387.65
freehold	1303.39
leasehold	466.31
reserved	411.42
state land	107.60

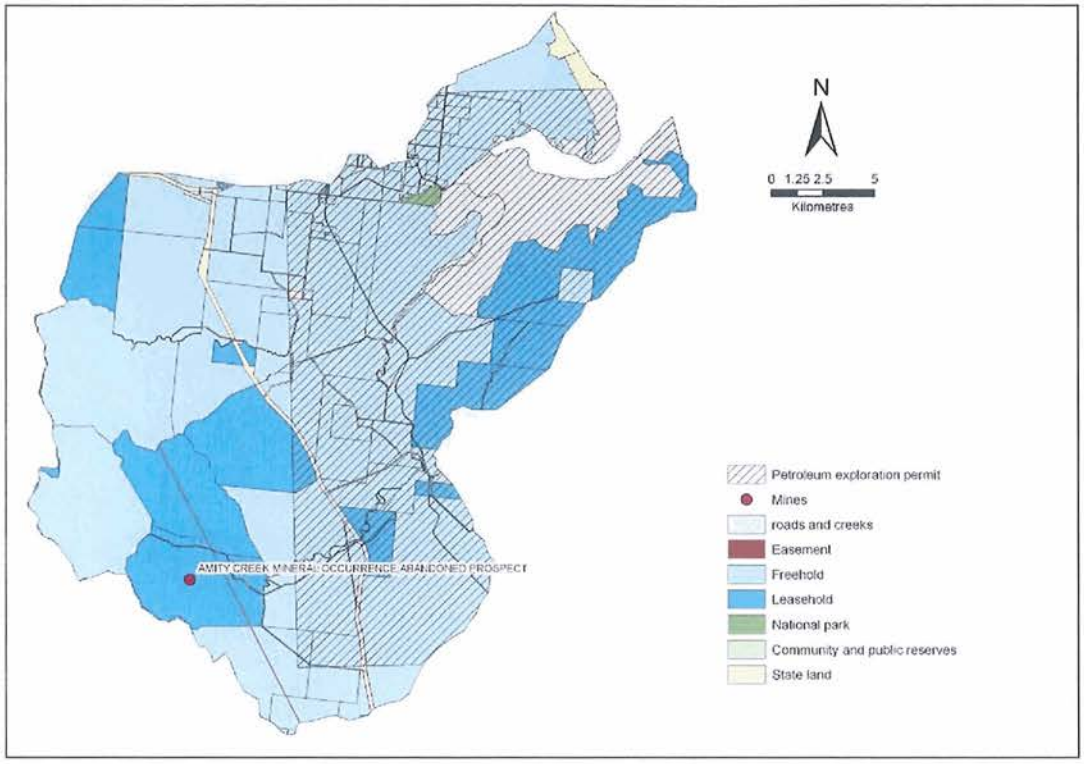


Figure 4.34 Minerals interests within the Waverely Creek Catchment.

Table 4.14 Extent of minerals permits and leases in the Waverly Creek Catchment

Exploration permit petroleum	
Tenure affected	**Area (ha)**
roads	5996.27
easement	13.79
freehold	26152.26
leasehold	5656.37
reserve	0.02
state land	24.07

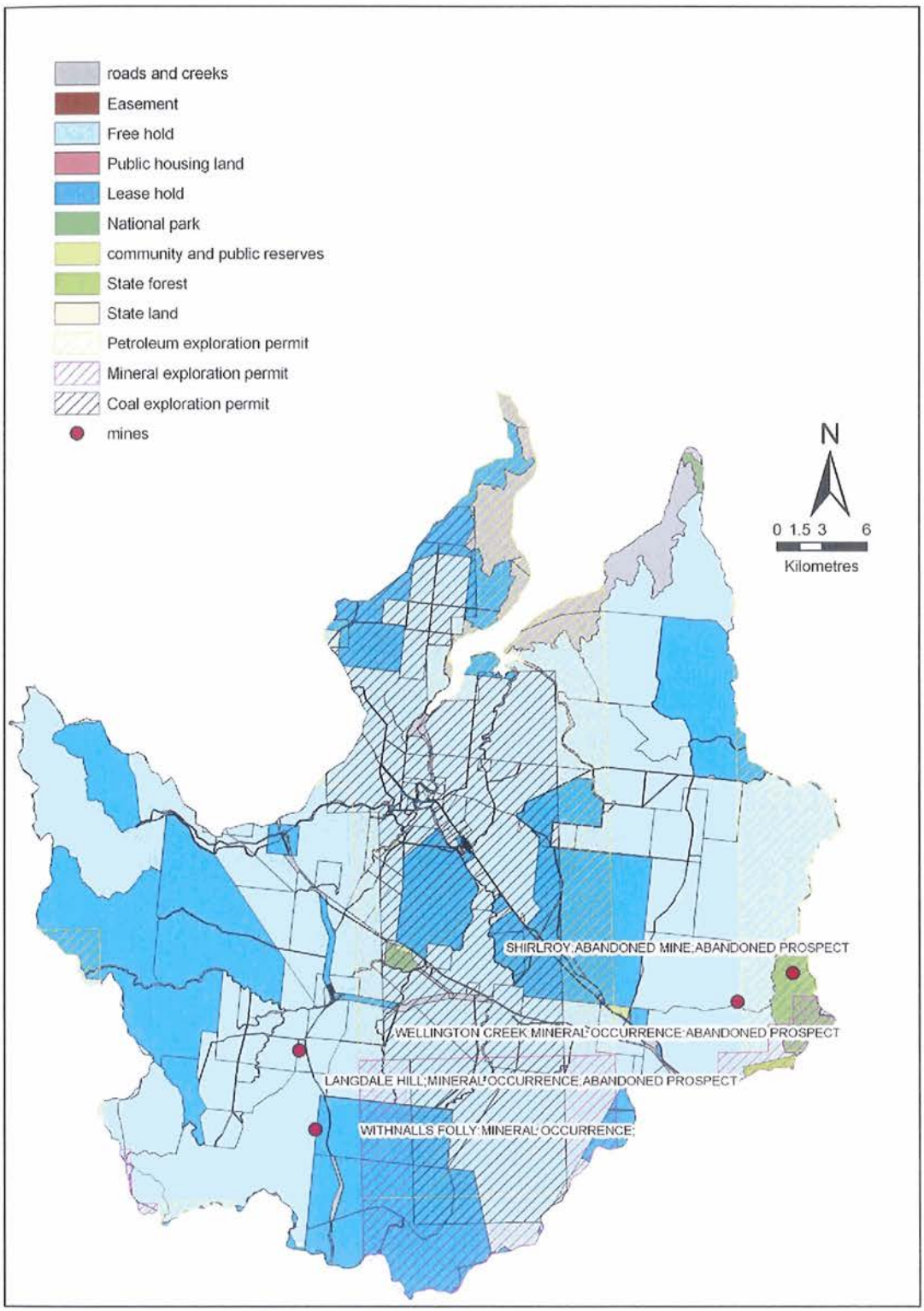


Figure 4.35 Minerals interests within the Styx River Catchment.

Table 4.15 Extent of minerals permits and leases in the Styx River Catchment

Tenure affected	Area (ha)
Exploration permit coal	
road	1894.30
easements	82.88
free hold	34662.43
housing land	0.30
leasehold	12697.17
national park	261.29
reserved	85.43
state land	12.80
Exploration permit for minerals	
roads	259.23
easements	104.18
freehold	30314.61
leasehold	11288.46
national park	1804.59
reserved	0.43
state forest	199.01
Exploration permit petroleum	
road	6377.0
easements	142.22
free hold	84501.17
housing land	0.30
leasehold	41255.70
national park	2065.88
reserved	156.53
state land	12.80

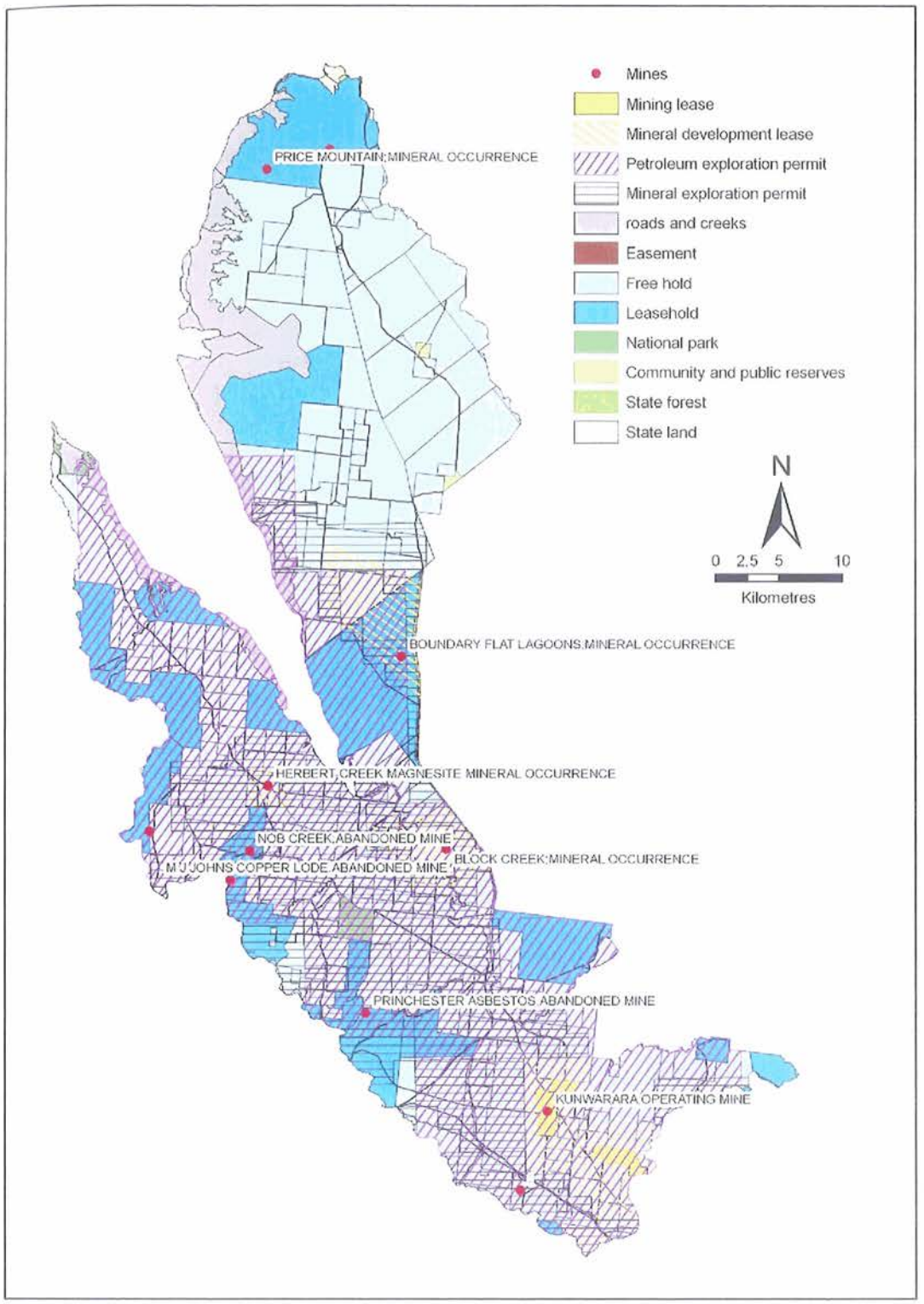


Figure 4.36 Minerals interests within the Herbert Creek Catchment.

Table 4.16 Extent of minerals permits and leases in the Herbert Creek Catchment

Tenure affected	Area (ha)
Exploration permit for minerals	
roads	3016.70
easements	13.34
freehold	52288.50
leasehold	11017.87
national park	760.47
state forest	71.14
state land	538.86
Exploration permit petroleum	
roads	6620.41
easements	15.54
freehold	80601.43
leasehold	25224.11
national park	877.31
state forest	42.18
state land	560.69
Mineral development lease	
roads	522.77
easements	0.43
freehold	12942.80
leasehold	2465.52
state land	27.58
Mining lease	
road	32.08
easement	1.33
freehold	1236.73

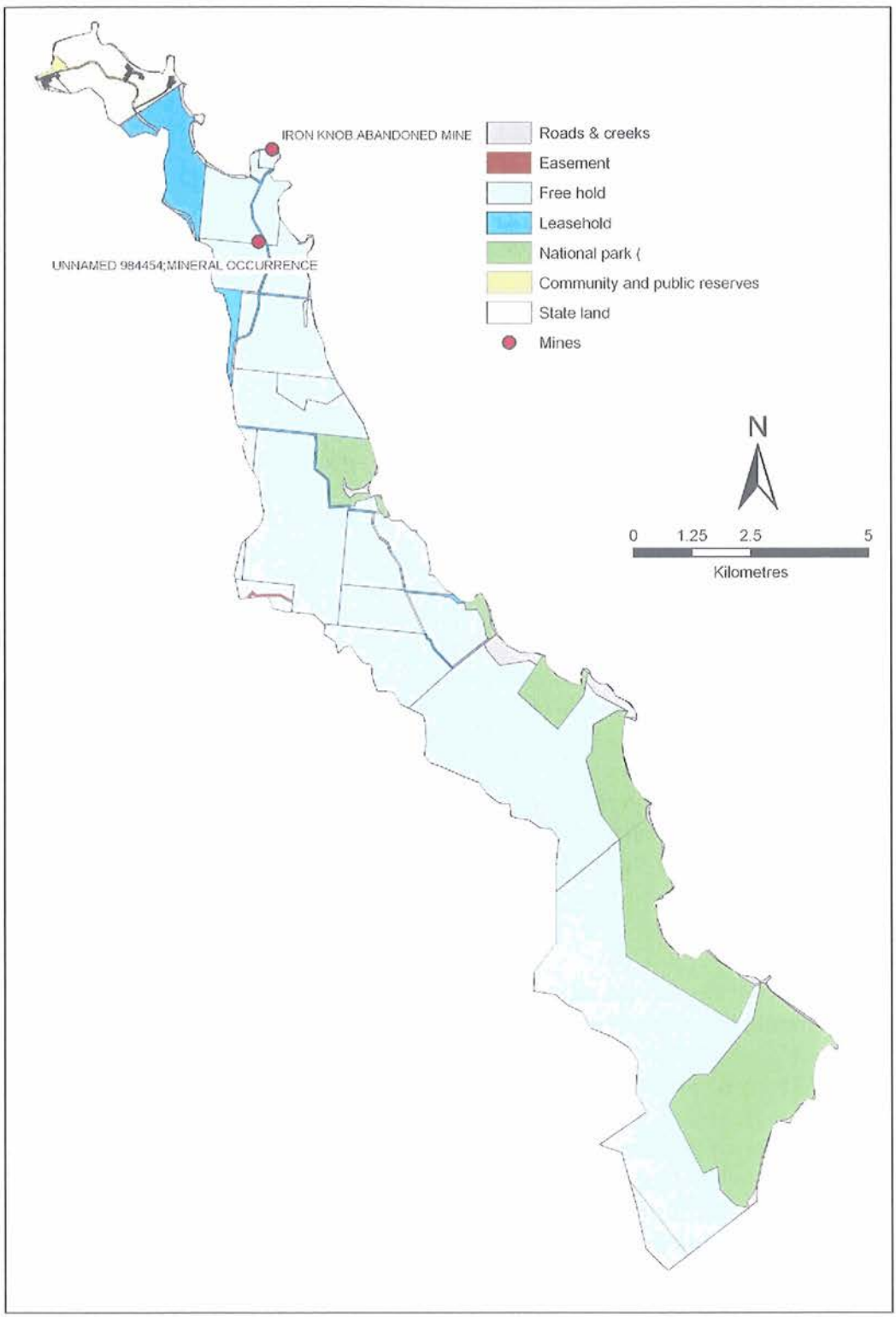


Figure 4.37 Minerals interests within the Stanage Coast Catchment.

There are no mineral prospects or permits issued within the Stanage Coast catchment.

4.8 Intertidal wetlands

Intertidal wetlands comprising intertidal flats, mangrove wetlands and saltmarshes (figure 4.38 a) are well represented in each of the six Broadsound catchments, though only to minor aerial extent on the Stanage Coast. Conversely, beaches (figure 4.38 b) and rocky shores (figure 4.38 c) are prevalent on the Stanage Coast but scarce, often absent, in the other sub-catchments.

Intertidal flats of mud and/or sand may be exposed at low tide in the major estuaries and associated with intervening peninsulas and inner islands of Broad Sound. In the order of 10,000 hectares lie in the inner Herbert Creek estuary, collectively about 5000 hectares are associated with the western estuaries and 2000 hectares with the north-east of the Herbert Creek catchment and adjacent islands. It is assumed that these deposits have increased substantially due to catchment erosion following tree clearing over the past century. High tidal amplitude (around 6-7 metres based on data for Hay Point and local knowledge), twice-daily high tides and deep V-shaped embayments contribute to strong tidal currents and scouring. These factors influence long-term and daily changes in sediments which in turn influence the structure and abundance of invertebrate fauna in this substrate.

Mangrove wetlands in the study area include continuous blocks that are most extensive in the far north-east of the Herbert Creek estuary: over 6000 hectares are attached to the mainland and over 4000 hectares are associated with Long Island. Largest blocks in the western sub-catchments are in the order of 600 hectares. More than 20 islands totally covered by mangrove are spread through Broad Sound, from a few tens to a few hundred hectares in area. Mangrove wetlands are forests and thickets of trees that are tolerant of daily inundation by seawater. These trees have roots that are adapted to substrate that is low in oxygen and high in salt but their survival is influenced by flushing both by sea water and inflowing fresh water. Where extensive salt flats back the mangrove wetlands, the mangrove trees naturally must cope with extreme stress.

Saltmarsh wetlands comprise saline grassland, samphire low shrubland and bare salt flats. Commonly these components occur in complex spatial patterns and lie landward of mangrove wetlands but saltmarsh forms the coastline in a few locations (e.g. part of west side of Herbert estuary). Contiguous blocks of 2000-6000 ha, dominated by bare salt flat, occur on both sides of Broad Sound. Minor tidal creeks provide periodic saline inundation of saltmarshes, though this inundation reaches the landward sides of the largest saltmarshes only with spring tides or storm surges. Human intervention through construction of tide barriers (seawalls, channel block banks) in past decades has altered water flows in many parts of the study area (see Section 5.2 Condition report). Around Broad Sound, there is a marked distinction between saltmarshes that receive significant inflow from freshwater creeks (e.g. central western Torilla Plain) and saltmarshes that receive no significant freshwater inflow other than from direct precipitation. Interplay of local landforms, tidal drainage and freshwater supply determines the persistence of inundation of saltmarsh wetlands and thus the temporal availability of habitat for waterbirds.

(a)

(b)

(c)

Figure 4.38 Intertidal wetlands on the Broad Sound coast include extensive areas of tidal flats and mangroves (a), sandy beaches (b) and more restricted rocky shores (c). **Photo Roger Jaensch.**

Waterbird use of intertidal flats and saltmarshes was extensively, though not exhaustively, assessed in this project; results are presented in Chapter 5 section 5.3 and Chapter 8 S5. Migratory shorebirds are the numerically dominant waterbirds feeding and roosting in these habitats. Relatively small numbers of waterbirds inhabit mangrove wetlands but are not readily detectable in this dense habitat; locally, some waterbirds may establish seasonal breeding colonies in mangroves. Other fauna, including benthic invertebrate food resources for shorebirds, were not assessed.

In the Broadsound Basin, intertidal wetlands support commercial and recreational fisheries and limited tourism. Cattle grazing enterprises value the saline grasslands as seasonal sources of fodder.

(a)

(b)

(c)

Figure 4.39. The Broad Sound intertidal flats are a complex of mud or sand (a) and hypersaline mud plains (commonly at the more landward extent of the intertidal flats), mangrove forests, woodlands and shrublands (b) and saltmarshes as samphire herblands (c) or grasslands. **Photo Roger Jaensch.**

4.9 Non-tidal wetlands

Non-tidal wetlands comprising marine plain wetlands, grass-sedge wetlands, wet meadows, semi-permanent ponds, and wooded swamps are well represented in the Broadsound coastal area, though only to minor aerial extent in the Stanage Coast and Clairview Creek catchments. Torilla Plain, occupying much of the eastern side of the Herbert Creek catchment, is the largest aggregation (over 18,000 ha) of non-tidal wetlands here and is the largest on the Central Queensland coast.

Marine plain wetlands are most extensive on Torilla Plain and (depending on delineation) there are six smaller blocks (ca. 300-4000 ha) on the western side of Broad Sound, some of which are named (Waverley Plain, Bar Plain). They are complexes of relatively small water bodies embedded within coastal plain (Land Zone 1) that is typically tree-less and grass-dominated. Seasonally they support grass-sedge communities but may also have saltmarsh elements such as samphire. Entire marine plains may be briefly inundated from heavy summer rainfall and floods of inflowing freshwater creeks, but, after the wet season, water persists only in ponds and channels with few areas remaining inundated by mid-late dry season. Saline water originally exerted some influence on the seaward sides by penetrating seasonally and/or daily along tidal creeks; since development for cattle grazing, most of this saline influence has been reduced by emplacement of channel block banks (permitting two way flow at high water levels) and elsewhere stopped by seawalls (totally excluding tidal incursion). Consequently, most marine plains and associated saltmarshes landward of these structures provide more persistent (though still temporary), less saline habitat for plants, waterbirds and other fauna than pre-development.

Much of the marine plain and saltmarsh wetland of Torilla Plain, and minor examples in the west, exhibits exceptionally complex, spectacular patterns of channels and ponds which are probably unique in Australia. Presumably these relate to an era when the Plain was sea bed: similar patterns are evident in contemporary intertidal flats in Port Clinton.

Wetlands dominated by sedges (e.g. *Eleocharis*, *Schoenoplectus* and *Cyperus* species) and/or grasses (e.g. *Paspalum*, *Leptochloa* and *Pseudoraphis* species) occupy broad areas (up to 500-1000 ha) on Torilla Plain and (up to 100-300 ha) on marine plain on the western side of Broad Sound. Some basins are effectively small open lakes in the early-mid wet season, before emergent vegetation takes over. Grazing has favoured development of short grass communities that may be referred to as wet meadows; taller sedges may dominate in the wettest sites and in wetter years.

A railway causeway runs north-south through the St Lawrence area (figure 4.41), prolonging inundation of some areas to the west, particularly on Waverley Plain.

Permanent freshwater wetlands are naturally rare on the Broadsound coast. Semi-permanent waterholes associated with creeks are scattered thinly on the landward edges of marine plains. Greater persistence, offering all-seasons refuge for waterbirds, has occurred where channels have been 'ponded' by installation of structures – some quite small – such as road causeways or banks, particularly in the St Lawrence area.

Figure 4.40. *Eleocharis* swamp at Waverly Plains. **Photo Roger Jaensch.**

Figure 4.41. Railway embankment across wetlands at St Lawrence. **Photo Roger Jaensch.**

Wooded swamps dominated by *Melaleuca* species, a regional ecosystem that has been destroyed along much of the Queensland coast, persist as about a dozen isolated patches (1-30 ha, one over 100 ha) at the landward edges of marine plains in the St Lawrence and Waverley catchments and fringing Torilla Plain (figure 4.42). Shallow seasonal inundation provides habitat for secretive waterbirds and the trees and dense underlying sedge provide some nesting sites. Waterbird use of non-tidal wetlands of coastal Broadsound was extensively, though not exhaustively, assessed in this project; results are presented in Chapter 5 section 5.3 and Chapter 8 S5. Ducks/geese and herons/ibises are the numerically dominant waterbirds feeding and (to varied extent) breeding in these habitats (figure 4.43); migratory shorebirds and threatened species also occur.

Figure 4.42. *Melaleuca* open woodlands on the landward edge of the marine plain. Some mature trees are persisting but saplings (foreground) are heavily browsed – preventing regeneration. **Photo Roger Jaensch.**

Other fauna, including food resources for waterbirds, was not assessed but some information on dominant plant species was collected for sectors where ground surveys were possible.

Figure 4.43. Magpie Geese in wetlands along the Broad Sound coast. **Photo Roger Jaensch.**

It should be noted that in certain seasons many of the Broadsound wetlands may appear devoid of conspicuous fauna. From May to July, migratory shorebirds are mostly absent (at Asian breeding grounds) from intertidal flats and, in drier years, no waterbirds may be present on the dry non-tidal wetlands – other than the few deeper ponds – from mid winter to the start of summer.

In the Broadsound Basin, non-tidal coastal wetlands principally support cattle grazing enterprises – for which they are highly valued – and some localized, minor tourism (St Lawrence).

5.0 Condition Assessment

5.1 Terrestrial landscapes

Generally the lowlands with better soils and fertility have been cleared and are fully exploited predominantly for grazing. The exceptions are (1) the Clairview catchment where there has been a recent conversion of grazing lands to broad acre timber plantation and (2) the Stanage Coast where terrain precludes extensive land improvement and national parks preclude grazing and clearing. Marine plains, mostly treeless before settlement, are addressed in section 5.2.

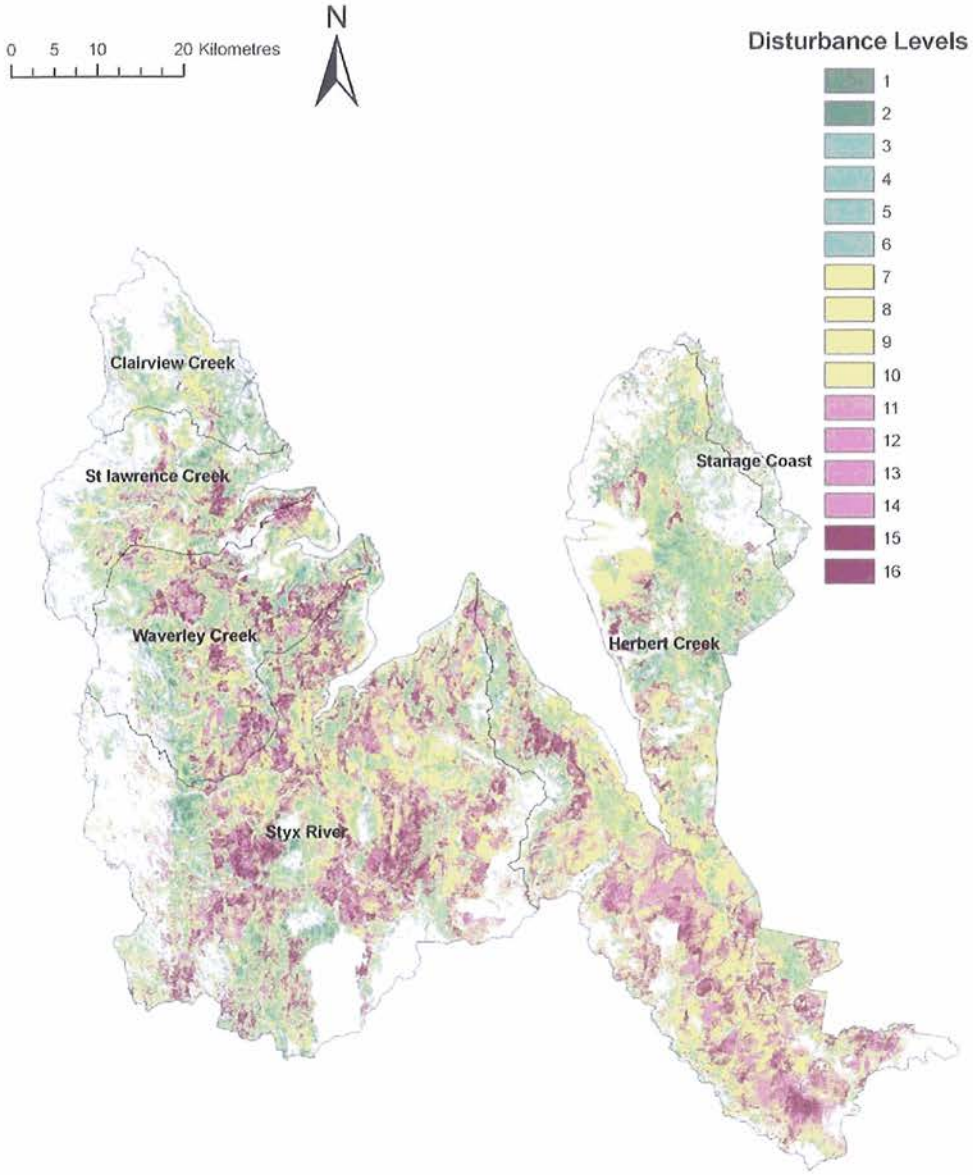
Land cover disturbance

This assessment (figure 5.1) was undertaken using the Qld EPA's *Rangeland Ground Cover Disturbance Data Package* (Version 1.1 May 2006 QPWS). It analyses satellite imagery to develop an index of change in land cover. In this context land cover is the total extent and density of trees, shrubs, grasses and other herbs. Its effectiveness is limited where tree cover exceeds 20 percent as extensive tree canopies mask changes in the groundlayer. So the package is best applied to cleared lands, native grasslands and very sparsely wooded lands. Consequently, it has been applied to cleared lands within the Broadsound Basin. Also, it does not discriminate among the reasons for change such as increasing cover due to weed invasion (e.g. parthenium) or canopy thickening by tree growth (e.g. woody weeds) or decreasing cover due to fire or grazing. The causes of increasing land cover need to be ascertained where sustainability of grazing enterprises is of concern. Similar ground truthing is required to ascertain the nature of losses of cover. The package can be applied at the paddock scale and it may provide a useful tool to monitor success of local investment strategies. In this report, however, the focus is on an index of the relative condition of the catchments within the Broadsound Basin to assist in prioritising investemt strategies. So the approach taken was to consider the area (ha) and relative amount (%) of land in which land cover is declining. Here the "highly" and "very highly" disturbed classes are considered as (1) a measure of likely contribution to down stream environmental degradation and (2) a means of prioritising investment strategies.

The larger catchments have from 25 to 30 percent of the land area classified as highly or very highly disturbed (Figure 5.2). This is a reflection of the extent of land available for improvement and the local climatic regimes that, in part, control vegetation cover responses. The Stanage Coast incorporates a relatively large area that has terrain unsuitable for broadacre development. It also has a relatively extensive national park estate. The Clairview Creek catchment has relatively large areas unsuitable for broadacre development and has a relatively wet climatic regime that favours the maintenance of land cover. There is also a shift from grazing to plantation timber production that is most pronounced in this catchment. The results are summarised in Table 5.1. The proportion of high and very high disturbance class within freehold and leasehold land is summarised in table 5.2. Notably, there is a very high percentage of leasehold land with high and very high disturbance classes in the Herbert, Styx and St Lawrence catchments.

The total area of land with a declining land cover trend and classified as highly and very highly disturbed is much greater in the Styx River and Herbert Creek catchments - about 85,000 ha (Figure 5.3). This pattern is reflected in the broad regional surveys

(by road and air) and by examination of the contemporary satellite images of the region. The greatest extent of bare ground and eroded surfaces is apparent in these two catchments. The extent of severely degraded and eroded lands is greatest in the Styx River catchment. The most severe of these is highlighted in figure 5.3. Significantly, these areas of most severe degradation are associated with streams and represent likely point sources of sediment and nutrient discharge to the streams and receiving waters of the Great Barrier Reef World Heritage Area. Consequently these should receive priority consideration for investment and remediation.



(a)

Disturbance Matrix	High Ground Cover	Above Mean Ground Cover	Below Mean Ground Cover	Low Ground Cover
Increasing Trend	1 Very Low	5 Low	9 Medium	13 High
Slight increase in trend	2 Very Low	6 Low	10 Medium	14 High
Slight decrease in trend	3 Low	7 Medium	11 High	15 Very High
Decreasing trend	4 Low	8 Medium	12 High	16 Very High

(b)

Figure 5.1. (a) Mapped land cover disturbance classes across the Broadsound basin. (b) Translation of disturbance levels or classes to a land cover disturbance

classification. **Derived from the *Rangeland Ground Cover Disturbance Data Package* (Version 1.1 May 2006) QPWS, Qld EPA.**

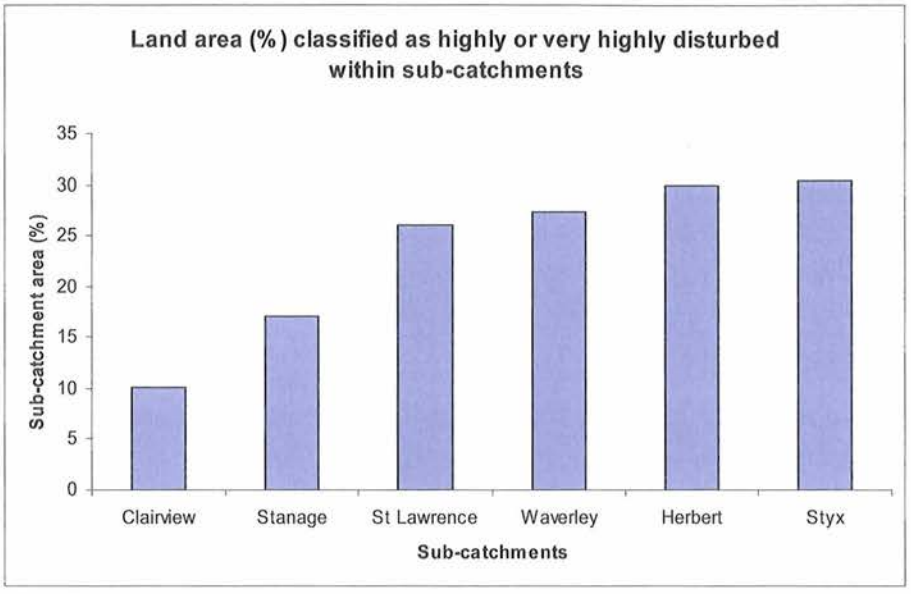


Figure 5.2 Percentage of catchment area with a declining land cover trend and a classification of highly or very highly disturbed. **Derived from the *Rangeland Ground Cover Disturbance Data Package* (Version 1.1 May 2006) QPWS, Qld EPA.**

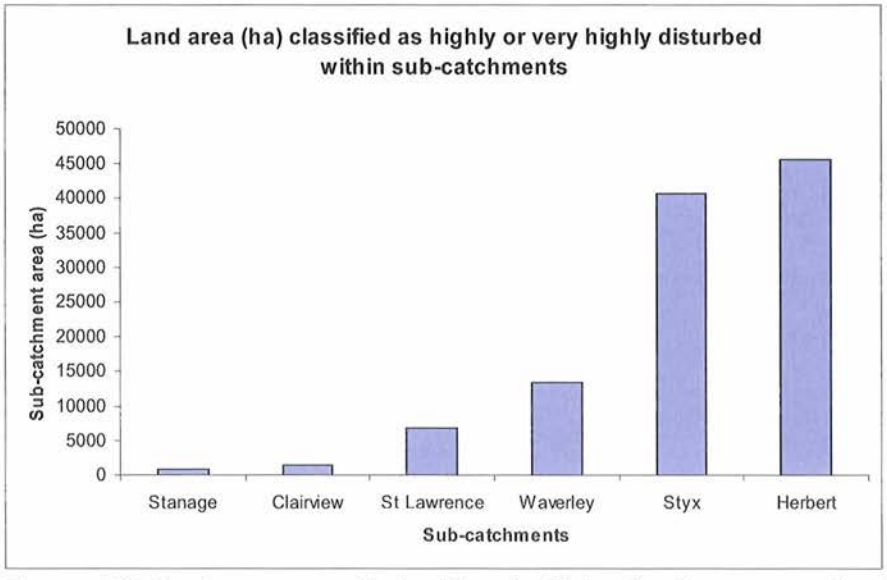


Figure 5.3 Catchment area (ha) with a declining land cover trend and a classification of highly or very highly disturbed. **Derived from the *Rangeland Ground Cover Disturbance Data Package* (Version 1.1 May 2006) QPWS, Qld EPA.**

Table 5.1 Relative change and direction in land cover across the catchments.

Catchment	Total area (ha)	% catchment area with increasing land cover trend	% catchment area with decreasing land cover trend	% high & very high disturbance class
Clairview	13989.63	65.91	34.09	10.10
St Lawrence	26177.94	50.15	49.85	26.01
Waverley	48845.13	54.66	45.34	27.36
Styx	133833.9	57.01	42.99	30.36
Herbert	77987.81	48.80	51.20	29.97
Stanage	5122.75	53.08	46.92	17.04

Table 5.2 Proportion of catchment land with a high and very high land cover disturbance classification.

	Freehold	High/very high disturbance		Leasehold	High/very high disturbance		State land	High/very high disturbance	
	Total area (ha)	area (ha)	Area (%)	total area (ha)	Area (ha)	Area (%)	Total area (ha)	Area (ha)	Area (%)
Clairview	8939	898.44	10.05	2371	294.5	12.42			
St Lawrence	17366	4814.94	27.73	5838	1527	26.16	100	51.25	51.25
Waverley	3585	265.19	7.4	3425	394.56	11.52			
Styx	82703	26778.56	32.38	36775	11053.5	30.06	13	3.625	27.49
Herbert	111661	36865.38	33.02	62298	36792.19	59.06	198	27.625	13.95
Stanage	3853	657.94	17.08	283	41.75	14.78	137	19.125	13.95

Figure 5.4 Degraded landscapes in the Styx River catchment. The evident fence line contrasts suggest that land utilization strategy is an issue here.

Connectivity

The issues associated with the fragmentation of landscapes, loss of connectivity and the investment required to restore landscapes are well illustrated in Bennett (1999), Saunders *et al.* (1987), Saunders and Hobbs (1991) and Saunders *et al.* (1993). Connectivity across habitats is considered to be an important element in regional biological conservation. The Qld EPA and FBA see the maintenance or enhancement of such connectivity as essential. The EPA considers the conservative management of low productivity landscapes or landscapes with little capacity for intensive use has the potential to provide or maintain regional connectivity. Context and connection are one of seven diagnostic criteria in determining regional biodiversity significance (EPA 2002). The restoration of wildlife corridors and linkages especially in riparian areas is

a resource condition target (R14) in relation to Ecosystem Health and Biodiversity (FBA 2005).

Clairview Creek Catchment
There is a relatively high degree of coast to hinterland connectivity in the Clairview Creek catchment. This has been maintained along the rough and steep hills and mountains around the valley and the retention of riparian vegetation along the major drainage lines. Connectivity has been reduced to some extent along the southern boundary with the St Lawrence Creek catchment. The development of broadacre timber plantations with associated buffers is enhancing connectivity. The value of this increased linkage is dependent on the management regime imposed by the land managers and its survival in the plantation's post-harvest phase.

St Lawrence Creek Catchment
The St Lawrence Catchment retains a high degree of connectivity between the coast and the mountainous hinterland. This connectivity has been enhanced through the development of broadacre timber plantations in the north that link to the Clairview Creek catchment.

Waverley Creek Catchment
The Waverley Creek catchment has reduced connectivity across the central plain - especially in the south and north. There are some juxtaposed fragments of remnant vegetation in the north that may facilitate reconstruction of east-west connectivity. In the south connectivity is reliant on narrow and poorly managed riparian strips.

Styx River Catchment
The Styx River catchment is highly fragmented and east-west connectivity based on remnant ecosystems is mostly lost. What little connectivity remains is dependent on fragile, poorly managed and narrow riparian strips. In this catchment the eastern terrestrial coastal habitats have been lost and, in many cases, riparian corridors have been removed entirely.

Herbert Creek Catchment
All effective connectivity across the lowland plains of the southern Herbert Creek catchment has been lost. Few remnant fragments remain. Riparian systems are disrupted or cleared completely. Road reserves are cleared or intensively grazed. Connectivity remains in the north.

Stanage Coast Catchment
Connectivity remains high in this small catchment – reflecting the terrain and the high relative percentage under national park.

Clearing
Currently 41 % of the Broadsound Basin has been developed for primary production to the point that natural ecosystem processes probably do not persist. They have been replaced by primary production processes. This change is predominantly associated with the coastal plains and adjacent undulating hinterland. Development is most extensive in the Styx (52 % cleared) and Herbert Creek (38 % cleared) catchments. Ongoing clearing, land degradation under unsustainable grazing systems and climate change impacts (driven fire and drought risk) threaten the loss of remnant connectivity between the western escarpment and the eastern coastal ecosystems.

Streams

In all catchments, lands were at least cleared to the edge of the upper stream bank in deep cut streams (figure 5.5). Commonly the total riparian forest was cleared or significantly altered along shallower streams and smaller drainage channels. This was particularly evident in the minor drainage systems lower in the respective catchments (figure 5.6 and 5.7). These severely degraded drainage lines have high land cover if not overgrazed. The ecosystem function associated with sediment and nutrient management and all biodiversity values are, however, absent or severely degraded.

(a)

(b)

Figure 5.5. (a) Productive land is cleared to the edge of the top bank of streams throughout the lowlands. (b) This example on Spring Valley Road was the only case found where a portion of the stream bank was fenced.

Road reserves

Most road reserves were cleared or significantly altered wherever they occurred on lowlands with reasonable soils (figure 5.8). Road reserves retained significant natural values only where the landscape and soils were not conducive to effective grass

growth or where the road ran within a fenced reserve. In the Broadsound Basin the road reserves provide little amenity, contribute little to regional aesthetics and have fragmented biodiversity values - at best.

Grazing

The Paddock

Grazing pressure on pasture lands has been intense (relative to the land's capacity) especially, but not only, in the Styx and southern Herbert catchments. This is evident in the declining land cover, extensive areas of degraded lands, eroded surfaces and weed invasion. Not all grazing lands are equally impacted and at paddock boundaries abrupt changes in cover are evident.

Streams

All riparian systems and stream beds across all of the catchments were grazed or subject to stock impacts to some extent. The intensity of grazing or other impact was influenced only by terrain or impenetrable stands of environmental weeds (lantana, rubber vine) and the apparent stocking rate on adjacent lands.

Road reserves

No road reserves were fenced unless the road ran within a larger fenced reserve. These unfenced road reserves were generally grazed to the same extent as the surrounding grazing lands (figure 5.8).

Erosion

Overall the condition of the grazing lands reflected soil type and condition. In particular the duplex soils with sodic characteristics formerly supporting poplar box and narrow-leaved ironbark were in very poor condition with extensive areas of scalded ground and serious erosion in a number of places (figure 5.9). The degradation of these lands was most severe where water channeling had occurred (e.g. stream crossings, old quarry scrapes). These deep gullies are expected to form significant point sources of sediment discharge to the streams during periods of peak flow (figure 5.10).

Figure 5.6. A significantly altered minor stream in the lower Herbert Creek catchment.

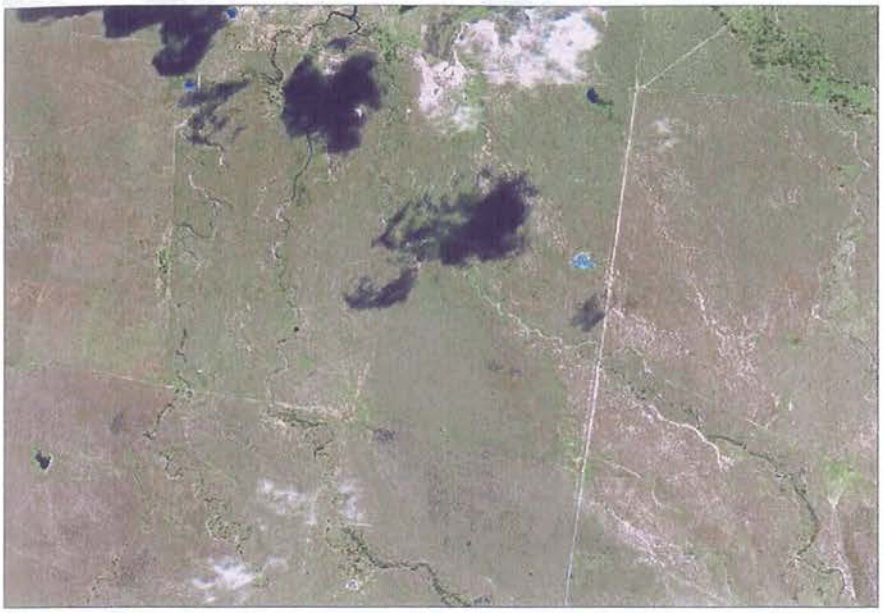


Figure 5.7. Total removal of riparian vegetation was most common along the minor drainage lines particularly in the lower Styx River and Herbert Creek catchments.

Figure 5.8. Road reserve on Stanage Bay Road prior to summer rains.

Weeds

Environmental and declared weeds occurred throughout the catchments. The main regional differences were that lantana (*Lantana camara*) was a more serious issue in the Clairview and northwestern St Lawrence catchments. Parthenium (*Parthenium hysterophorus*) was most evident along Toolombah Creek and is expected to be particularly evident in the brigalow soils of the Ogmore district. Prickly acacia (*Acacia nilotica*) was most apparent along the saline coastal lowlands on the western side of Broad Sound. Old urban centers are commonly a focus for weeds. This is the case with the township of Ogmore. Sisal (*Agave sisalana*), Harissia cactus (*Eriocereus* spp) (figure 5.11) and Cat's claw (*Macfadyena unguis-cati*), amongst others, were apparent. This was the only location where Cat's claw was detected.

Figure 5.9. Hard pan and erosion on duplex soils.

Figure 5.10 Gully erosion draining sheet runoff from eroded paddocks to Tooloombah Creek.

Rubber vine (*Cryptostegia grandiflora*)

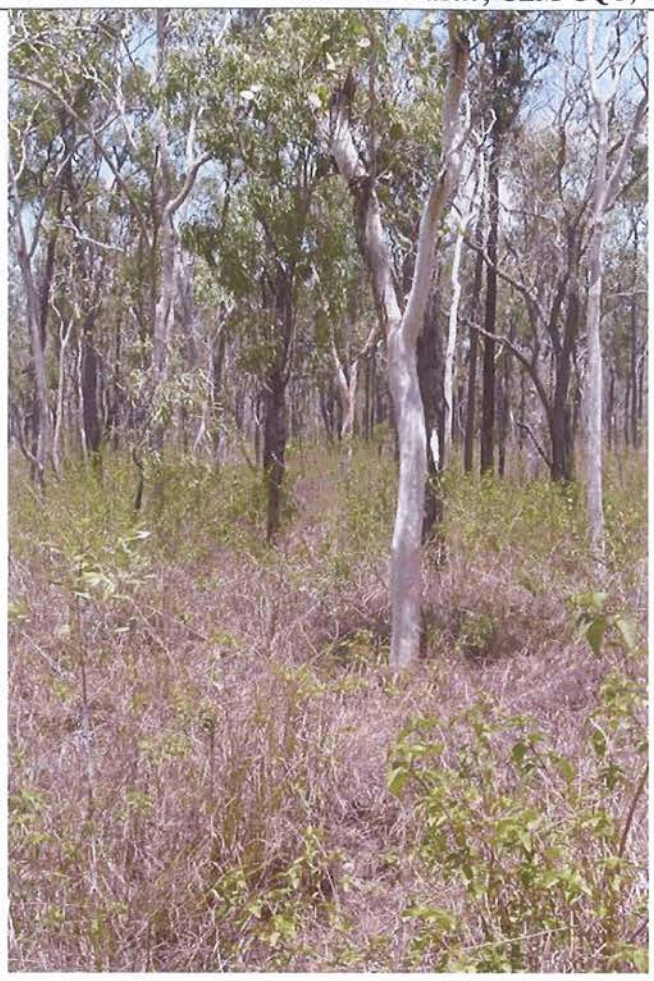
Rubber vine occurred across the Broadsound basin and is smothering riparian vegetation and forming impenetrable tall to low thickets on river terraces and fertile lowlands (figure 5.12). No evidence of control was seen. The leaf rust was not evident and all plants seemed vigorous. This species has demonstrated a capacity to invade the fringes of coastal wetlands.

Figure 5.11. Cactus infestation associated with old residences at Ogmore.

Figure 5.12. Rubber vine thicket at the Styx River

Lantana (*Lantana camara*)

In Clairview and St Lawrence lantana variously formed a low to tall (> 3m) dense shrubby midstorey along stream banks, formed a dense shrub layer under formally grassy poplar gum woodlands and was a significant element in the midstorey of the forests on the western escarpments (figure 5.13). The seasonally droughted environment of the southern catchments has limited the impact of this species.



(a)

(b)

Figure 5.13. (a) Lantana invasion of grassy woodlands in the Clairview catchment. (b) Unmanaged, lantana may have a serious impact on production systems. **Photo from a Central Queensland coast property December 2007 A. Melzer.**

Captain Cook tree (*Thevetia peruviana*)

This species was scattered throughout the catchment but was generally not very abundant (figure 5.14). It was most apparent around the St Lawrence area and Toolombah Creek catchment. This species has the capacity to establish dense thickets along drainage lines.

Figure 5.14. Captain Cook tree escaped into old agricultural land on the St Lawrence estuary.

Prickly acacia (*Acacia nilotica*)

This species occurs in the coastal lowlands (figure 5.15). It is a significant threat as the species forms dense stands covering large areas, threatening production systems and biodiversity values.

Figure 5.15. Prickly acacia (*Acacia nilotica*) on a marine plain in the Broadsound Basin. (Photo R. Black 2007)

Parthenium (*Parthenium hysterophorus*)

At the time of surveying the landscape was very dry. Parthenium was evident along the Tooloombah Creek drainage system (figure 5.16). It is expected that this species would be more evident following regional rains especially in the brigalow soils.

Figure 5.16. Lower bank of Toolombah Creek showing new growth of parthenium and other weedy species in the stock trampled riverine sediment.

Aquatic weeds

Pistia stratiotes and *Salvinia molesta* were in the St Lawrence weir (figure 5.17). See alos section 5.2.

Figure 5.17. Aquatic weeds in the St Lawrence Weir. **Photo Roger Jaensch.**

Coastal Development

Stanage Bay and associated coastline

The Stanage Coast and the settlement of Stanage Bay have excellent natural values (biodiversity, amenity, tourism, aesthetic appeal). Current location of camping and

urban development adjacent to turtle breeding beaches places endangered species at risk (figure 5.18). The development within coastal dunes and associated beach scrubs has degraded these communities - one at least beyond the point of recovery.

Figure 5.18. Camp ground within low microphyll vine thicket adjacent to turtle nesting ground at Alligator Beach, Stanage Bay.

The town of St Lawrence

St Lawrence is a well managed town. It is surrounded by largely undeveloped eucalypt and dry rainforest communities. These harbour very high biodiversity values and include ecosystems of conservation significance (figure 5.19). All of these natural values lie over freehold tenure in small blocks.

Figure 5.19 Eucalypt woodlands at St Lawrence. Tall dry rainforests dominate on red soils. See also figure 4.27.

5.2 Condition of wetlands

Shore erosion

Evidence of coastal erosion (figure 5.20) in recent years was relatively common but localised in the western catchments, but uncommon on the Torilla Peninsula and associated islands. This included: battered outer mangroves (lower spreading trees); collapsed/undercut mangroves (tall straight-trunked forest) and aggregations of logs, stumps and part-buried wood of mangroves in black foreshore mud; retreating beaches; dryland trees collapsed onto beaches; and undercut shoreline (scarps on frontal saltmarsh). Coast exposed to the north-east was among the worst affected but the impacts sometimes also occurred inside estuaries. These phenomena are assumed to be from natural causes. Investigation is continuing, with some preliminary reports of a sustained period of coastal erosion around the end of 2005 associated with unusually persistent north-easterlies.

Figure 5.20 Eroded mangroves along the Broadsound coast. **Photo Roger Jaensch**

Meanwhile, coastal accretion, manifest in substantial beds of seedling mangroves, was observed in some places. Strangely, a number of islands – some in the inner Styx and Herbert estuaries – showed collapsed tall mangroves adjacent to spreading mangrove seedlings. Again, natural causes are assumed but changes to sedimentation in estuaries and outer coast due to reduced river flows during the prolonged regional drought may be an influence on recent patterns of coastal erosion and accretion.

Mangrove health

Dead mangroves were relatively common in the western catchments but uncommon to rare on the Torilla Peninsula and associated islands. Apart from dead frontal mangroves (see above) and occasional small patches of dead trees (perhaps due to disease) within healthy mangrove blocks, dead mangroves were most prominent on the landward edges (figure 5.21). As explained above, loss in this zone is to be expected, particularly during prolonged periods of below average rainfall. Prominent examples were seen during aerial surveys, in all western catchments. Human intervention is, however, a likely contributor to total death of mangroves along some tidal creeks where freshwater inflow has been terminated or reduced by emplacement of seawalls or block banks (see below).

Figure 5.21 Back mangrove zone mortality along the Broadsound coast. **Photo Roger Jaensch**

Seawalls and banks

During past decades (mostly more than 10 years ago), seawalls and block banks were constructed widely throughout the study area to stop or limit saline inflow to marine plains and thereby 'improve' landward areas of pasture for grazing by livestock (figure 5.22). Effectively they have caused an increase in area of freshwater and low-salinity wetlands – these landward wetlands can no longer be considered estuarine – with persistent water in banked-off channels. Generally the larger walls were sited along the seaward edges of marine plain but often include some former saltmarsh. Notable examples, which vary in height, width and durability and provision for overflow, are:

- wide low seawall on the south-west side of the Herbert estuary (continuous for 19 km)
- wide high seawall on the western side of the Waverley estuary (semi-continuous for 11 km)
- narrow low seawall on peninsula between the St Lawrence and Waverley estuaries (semi-continuous for 12 km)

Figure 5.22 Examples of sea wall structures along the Broadsound coast. **Photo Roger Jaensch**

Short low walls, and/or block banks barely wider than the minor channels where they were placed, are common in most other areas of marine plain and saltmarsh, including most of Torilla Plain and north-eastern Rosewood Island. Internal walls and/or banks, landward of the 'outer defenses', also are fairly common. Furthermore, the north-south railway lies on 7.0 km of causeway on plain north of St Lawrence and 7.5 km of causeway south of St Lawrence; despite presence of several culverts, the railway infrastructure nevertheless has reduced or slowed freshwater drainage to seaward.

Substantial areas that have few if any walls/banks are:

- saltmarsh around the Clairview estuary (not ground-truthed)
- saltmarsh and marine plain in northern parts of the St Lawrence estuary
- saltmarsh in the outer northern, and extended south-eastern, parts of the Waverley estuary
- most of the saltmarsh and small areas of marine plain in the Styx estuary
- north-western saltmarsh in the Herbert estuary
- most of the saltmarsh and small areas of marine plain on the east side of the Herbert estuary, including Torilla Plain

A wall across upper parts of a minor estuary on the Stanage Coast seems to be responsible for death (by drowning) of trees landward of the wall.

Connectivity

Wetland that has been modified by major seawalls no longer has a hydrological connection to the sea, except when major flooding causes freshwater to overflow at spillways (figure 5.23). Connection occurs more frequently with block banks and where walls are lower and substantial volumes of freshwater accumulate on the landward side, such as on parts of Torilla Plain and at the St Lawrence Reserve.

As well as denying fresh water to mangroves in high stress sites, these structures also prevent or limit movement of fish between landward nursery areas and marine/source habitat. Prior to construction of walls/banks in the study area, probably rather few off-river wetlands offered permanent nursery/refuge habitat through the dry season where juvenile fish (such as barramundi) were able to survive between events of tidal and/or flood re-connection. Perhaps only Waverley Plains and Torilla Plain had some suitable waterholes, and then only at or just upstream of the landward edge. Fish passage in these areas probably occurs rarely today. However, subject to expert investigation, the construction today of fish passage structures could restore or create nurseries at several sites:

- St Lawrence Reserve wetland (confirmed)
- some sites inside the outer seawall in the Waverley estuary (unconfirmed)
- the main channel inside the outer seawall on the south-west side of the Herbert estuary (unconfirmed)

Figure 5.23 Loss of coastal connectivity due to seawall construction on the Broadsound coast. Seawalls effectively break connectivity between the landward and seaward ecosystems except in the most extreme weather events. This image shows the complete elimination of tidal influence and retention of flood waters on the landward side of the seawall. **Photo Roger Jaensch**

Weeds

The occurrence of declared *Weeds of National Significance* in the Broadsound coastal wetlands was relatively minor and localised. It must be remembered, however, that ground surveys were not exhaustive and did not include the Clairview and Stanage Coast catchments.

Olive Hymenachne was recorded as small infestations (less than 10 ha) at four wetland sites: the eastern edge of St Lawrence Reserve; in railway easement on northern Waverley Plain; and under *Melaleuca* woodland at two sites in the far north-east of Torilla Plain. Destruction of these infestations should be possible at present.

Prickly Acacia (figure 5.24) tends not to grow in persistently wet areas but can form thickets on wetland margins. In 2006-7 it was widespread to the north-west, west and east of St Lawrence and localised on the south-west side of the Herbert estuary. Some St Lawrence landholders had recently addressed this problem through (apparently) poisoning most of the smaller trees; others probably lacked resources to do this. Some landholders may consider the trees useful as shade for cattle but face an explosion of infestation and loss of pasture in the near future due to proliferation of seed and seedlings. The landholder in the Herbert catchment removed all plants by bulldozing during 2007, apparently as part of an ongoing control program.

Other weeds recorded as small/isolated outbreaks in or near the wetlands included Rubber Vine, Noogoora Burr and Prickly Pear; most of these could be removed locally with little effort. Some introduced pasture grasses, notably Para Grass, can form monoculture inside wetlands to the exclusion of native plants, thereby reducing biodiversity. Para Grass is widespread in central southern Torilla Plain and occurs in small patches in some of the western catchments' wetlands; its extent probably will always be limited by saline substrate on these marine plains.

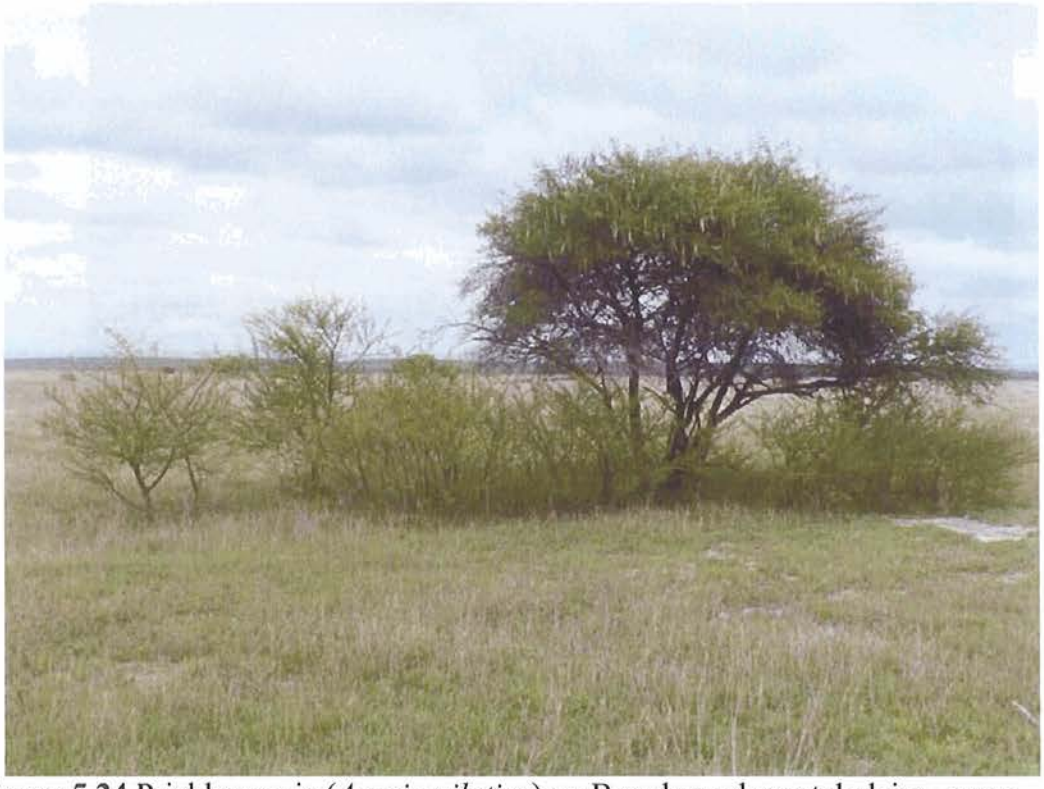


Figure 5.24 Prickly acacia (*Acacia nilotica*) on Broadsound coastal plains. **Photo R. Black.**

Feral animals

Pigs are the principal feral animal of concern in the Broadsound wetlands; by their diggings they reduce subterranean stock of native sedges and they predate native wetland animals including nesting birds (figure 5.25). Their impact was found to be widespread and one or two groups of pigs were regularly seen at favoured swamps, notably on the peninsula between the Waverley and Styx estuaries.

Figure 5.25 Feral pig impacts in Broadsound coastal wetland. **Photo Roger Jaensch**

Acid sulphate soils

It was beyond the scope of the present project to conduct investigations on acid sulphate soils in the study area.

Grazing

The long-term impacts of grazing by cattle in coastal wetlands have not been adequately determined through controlled scientific investigation. The following short-term impacts were widely observed at Broadsound:

- Depending on stage of the annual cycle and availability of alternative fodder, cattle browse native wetland grasses and tall sedges, the latter more so as a secondary choice. These plants may re-establish in subsequent years from root stock, tubers or seed and seasonal exclusion of cattle from wetlands by landholders can enhance recovery. Some breeds of cattle tend to avoid wetlands when fully inundated.
- Cattle cause extensive disturbance (pugging) of the surface of bare salt flats that they cross to reach saline grassland (figure 5.26); some browsing of foliage of certain mangroves apparently also occurs. Conspicuous examples of this pugging were frequently noted in the western catchments. Many paddocks have no fence on the seaward side: a landholder in the Herbert catchment recently obtained funding from FBA to erect fencing to control cattle access to a large area of saltmarsh.
- Despite direct observation of the impact taking place, it seems clear that cattle retard regrowth of *Melaleuca* trees in wooded swamps by browsing of seedlings/suckers. Cattle also damage some mature trees by rubbing/browsing the papery bark which may ultimately casue tree death.

Figure 5.26 Cattle disturbance of salt flats between saline grass meadows. **Photo Roger Jaensch**

Common reed *Phragmites australis* is naturally widespread in freshwater wetlands and less saline estuarine habitats in eastern Australia. However, cattle seem to be fond of grazing it and consequently the reed has declined or disappeared in many places including at some wetlands in Central Queensland (J. McCabe pers. comm.., W. Houston pers. comm.., R. Jaensch pers. obs.). Nearly 100 years ago, Torilla Plain apparently supported substantial stands of common reed, most of it probably along the major channels, and Barnard (1913) describes nesting by ibises and geese in a reedy swamp. Today, only tiny remnant patches remain in some less-grazed parts of the plain (figure 5.27) and specific management strategies may need to be implemented if the reed is to be retained and re-established.

Figure 5.27 Remnant reed bed (*Phragmites australis*) at Torilla Plain. **Photo Roger Jaensch**

Other human use

Infrastructure for recreational or commercial boating activity in Broadsound is limited to just three boat ramps: two rough ramps near St Lawrence and a better facility at Stanage. There are unformed ramps on some private properties and also undeveloped public access to some beaches near Stanage. Newport Conservation Park on the Waverley estuary near St Lawrence is the only mangrove reserve with constructed public access. The reserve immediately west of St Lawrence has incidental access to its edges via the highway connection road but no facilities developed for nature observation.

5.3 Waterbird populations

Key findings of the wetland bird surveys are described below; sector-by-sector findings are in Chapter 8 S5. Full details will be provided to Central Queensland University.

Species richness

Eighty-eight waterbird species were recorded in the 2006-7 surveys of (mainly western) coastal Broadsound wetlands; with another two recorded in 2003-5 (in eastern wetlands) and at least one extra before 2003 (EPA WildNet data), over 90 species have been recorded in the study area. Based on habitat and range, potentially only another 5-10 species, mostly migrants, are likely to occur here on a regular basis. The distribution of species by sector tended to be highest in sectors with the most diverse habitats (highest number of wetland types), though the number of species partly reflects survey effort which was influenced by sector accessibility.

This represents a high level of species richness linked to a high level of habitat diversity and is a predictable outcome for a relatively undeveloped, large study area in coastal tropical Australia.

Threatened species

The Capricorn Yellow Chat (figure 4.28) (Critically Endangered, *EPBC Act 1999*) was discovered on Torilla Plain in 1917 but only rediscovered in 2003 and subsequently found to be resident and widespread there (Jaensch *et al.* 2004), numbering at times over 500 birds (CQU and Wetlands International unpublished data). During 2006-7, outlying breeding populations were discovered on the lower western side of Herbert estuary (15-20 birds) and east of St Lawrence (5-10 birds) and a single bird was seen in the St Lawrence Reserve. The chat feeds and breeds in tall sedge swamps, samphire saltmarsh and saline grassland. Development and implementation of a recovery plan is being undertaken by CQU.

Figure 5.28 Adult male Capricorn Yellow Chat. **Photo Roger Jaensch**

Australian Painted Snipe (figure 5.29) (Vulnerable, *EPBC Act 1999*) has been recorded on at least five occasions – twice in 2006-7, near St Lawrence and these observations include three breeding records. Small numbers have been found in grass-sedge, saltmarsh and persistent pond habitats on both sides of Broad Sound.

Figure 5.29 Australian Painted Snipe near St Lawrence. **Photo R. Black.**

Both of these nationally threatened species appear to have ample habitat in the study area – mostly in areas modified by seawalls/banks – and by present indications should survive under present landuse regimes. However, much remains to be learnt about the local ecological requirements of both of these secretive species. Their presence assigns international importance to Broad Sound on the basis that Ramsar Criterion 2 (on threatened species) is convincingly met.

Species listed as Rare under Queensland's *Nature Conservation Act 1992*, or that are generally uncommon, and that have been recorded in the study area include: Radjah Shelduck, Cotton Pygmy-goose and Black-necked Stork (widespread, many records); Great-billed Heron (Clairview Creek, pre-2003) and Far Eastern Curlew (many

records) in intertidal wetlands; Black Bittern and Little Bittern (few records) in wooded/tall-sedge swamps); and Pectoral Sandpiper (vagrant, marine plain).

Migration

Nineteen of the 90 waterbirds of Broadsound – 18 shorebirds and one tern – are Asian-breeding migrants and, together with several other species, are afforded special protection as migratory species under the *EPBC Act 1999*. Many of the migratory shorebirds only occur on intertidal wetlands feeding at low tide and roosting at high tide on small beaches, in outer mangroves or in adjacent saltmarsh.

No systematic surveys of migratory shorebirds in intertidal habitat of Broad Sound had been done before 2006. The 2006-7 aerial and ground surveys of intertidal areas discovered:

- 5 roosts of up to 50 birds (2 on the west side of Broad Sound, 3 in the east)
- 4 roosts of 51-500 birds (all on the west side)
- 2 roosts of more than 500 birds ('Bar Plain Point', up to 870 birds; cove 2 km SE of Charon Point, up to 2200 birds), and
- up to 3260 birds across all roosts (6 March 2007).

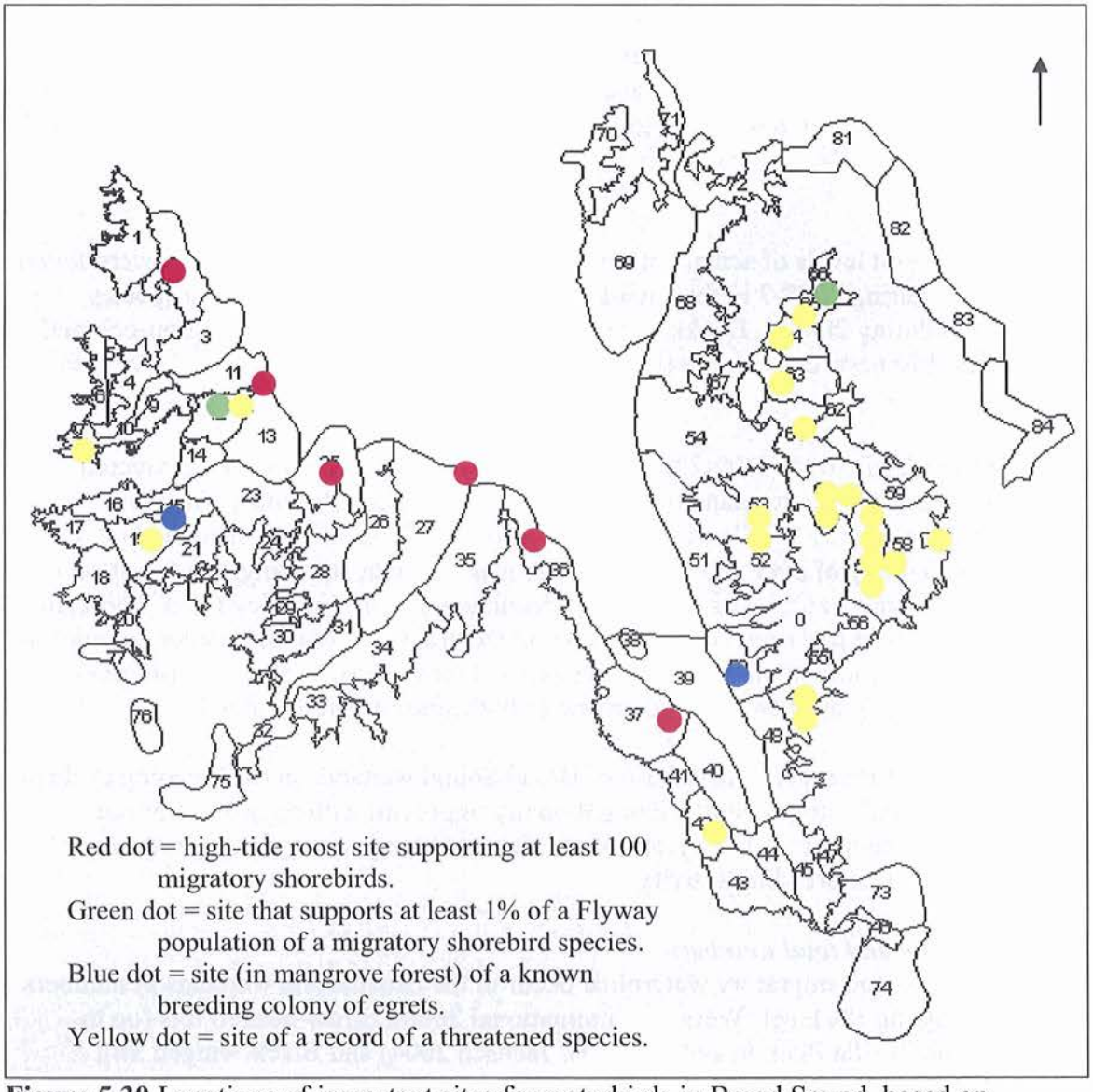


Figure 5.30 Locations of important sites for waterbirds in Broad Sound, based on results of surveys by Wetlands International and Central Queensland University, 2003-7.

These results reveal substantial use of Broad Sound intertidal wetlands in the annual cycle of migration by shorebirds, indicating that it is internationally important with regard to Ramsar Criterion 4 (support for life cycle stages), but not at an international level of importance in terms of Ramsar Criterion 5 (support for over 20,000 waterbirds). Many more roosts (ca. 100) and higher total numbers (over 23,000) occur in Shoalwater Bay Training Area (Driscoll 1996, Jaensch 2008), possibly due to more stable intertidal sediment.

Migratory waterbirds also occur on Broad Sound's non-tidal wetlands; these tend to be a different suite of species to those on intertidal wetlands. Data from 2003 to 2007 reveal many hundreds present, particularly during northward migration on inundated saltmarsh and to lesser extent on drying freshwater lakes and swamps during southward migration, on both sides of Broad Sound. Highest numbers were on 28 March 2007 when over 10,000 shorebirds (7500 of them from six migratory species) were counted on bunded salt flats east of St Lawrence (Bar Plain); numbers of two species (Sharp-tailed Sandpiper and Marsh Sandpiper) exceeded 1% of the population size (Bamford *et al.* 2006, Wetlands International 2006) in the Flyway.

The study area therefore is internationally important with regard to Ramsar Criterion 6 (support for 1% of population size). Numbers of Latham's Snipe using far northern Torilla Plain as a migration stop-over site in late March 2006 also are strongly indicative of international importance. Additional aspects of importance are likely to be revealed if additional, timely ground surveys of roosts and non-tidal habitats can be accomplished.

Breeding

Depending on levels of acceptable evidence, around 25 waterbird species were found breeding during 2006-7 in the Broadsound wetlands, with another eight species detected during 2003-5. Ducks and swans are among the most prolific non-colonial species: 140 nests or broods were recorded on Torilla Plain in May 2003 (Jaensch 2004).

In March-April 2004, 1000-2000 pairs of egrets of four species were discovered nesting on a mangrove island on the east side of the Herbert estuary; food was procured on nearby Torilla Plain (Jaensch *et al.* 2005). In January-March 2007, a breeding colony of over 500 pairs of egrets was active in tall mangrove forest near Newport Conservation Park, adjacent to feeding areas on Waverley Plain. These are among the very few such colonies known in Central Queensland. Smaller colonies, of ibises and cormorants (in wooded swamps) and terns and magpie geese (in grass-sedge swamps), have been found on one or both sides of Broad Sound.

These results reveal substantial use of Broad Sound wetlands in the breeding cycle of waterbirds, indicating that it is internationally important with regard to Ramsar Criterion 4 (support for life cycle stages). Further timely surveys may reveal even greater levels of breeding activity.

Abundance and total numbers

At least two non-migratory waterbirds occur in the Broadsound wetlands in numbers exceeding the 1% level (Wetlands International 2006): Straw-necked Ibis (up to 15,000 on Torilla Plain in autumn 2003: Jaensch 2004) and Black-winged Stilt (around 3000 in the St Lawrence area in March 2007). This threshold probably is met for several other species (egrets, ducks) but comprehensive concurrent surveys across all relevant sectors are needed to confirm this.

Following a major inundation event in summer 2003, over 37,000 waterbirds were counted/estimated on Torilla Plain in late March 2003 (Jaensch 2004). The largest recent total from one sector was 13,800 waterbirds on bunded salt flats east of St Lawrence (Bar Plain) on 28 March 2007; given the extent of water it is likely that well over 20,000 waterbirds were present at that time across all inundated western sectors. In the early to mid Wet season, highest numbers (mainly Magpie Geese and Intermediate Egrets) congregate on the revitalised marine plains; in the late Wet season to early Dry, ibises, whistling-ducks and shorebirds are dominant, on persistent swamps and saltmarshes; in the mid to late Dry season highest numbers (mainly ducks) occur on semi-permanent ponds.

These results also affirm that Broadsound is internationally important for waterbirds, with regard to Ramsar Criteria 5 and 6.

6.0 Issues and threats

Climate change

Expected changes in relation to rainfall, temperature and fire are unlikely to result in significant changes across most of Broadsound economy, rural culture or infrastructure management. The region is generally well adapted to managing in the face of uncertain rainfall and extended dry conditions.

There are three areas of risk.

Firstly, the ongoing reduced rainfall and extended dry seasons will see an increase in the extent and duration of conditions where reduced or absent land cover occurs in grazing lands. In conjunction with periodic more intense rainfall events these conditions are likely to result in an increase in erosion and sediment transport to the coast. A review of land management practice to consider land use practice that maintains land condition (especially over the dry season) and downstream water quality should be considered.

Secondly, large areas (over 83,000 ha) of the region lie very close to or below astronomical high tide. Of this over 55,000 ha is involved in beef production. The largest areas at risk are in the Herbert Creek and Waverley Creek catchments. Sea walls of various sizes and standards of construction have been established over many kilometers of coastline. This infrastructure is likely be challenged by rising sea levels, wave erosion and storm surge over the next 20 to 50 years. Unprotected coastal flats are probably in recession reflecting the 76mm tide rise since 1961. Over 717 ha of conservation tenure across the Waverley Creek, Styx River, Herbert Creek and Stanage Coast will be impacted. These estimates are conservative because fine scale measures of height above sea level are not available. Such finescale altitudinal surveys are easily and quickly completed and should be included in specific risk assessments.

Thirdly, the wooded regions within the catchments will be vulnerable to increased fire frequency and intensity where moisture regimes and temperatures allow a rapid regrowth of fire fuel (dense or tall understorey grasses, shrubs, litter). Here rapid redevelopment of fuel creates the conditions for intense fire in the next season. This has implications for the maintenance of biodiversity habitat structure, fire sensitive ecosystems and for the management of plantation industries. Increased frequency of hot fires results in (a) the removal of flammable coarse litter (logs, large branches), (b) a change in soil litter, (c) suppression of shrubs, seedlings and saplings and (d) the promotion of grasses. If flame heights are increased then overstorey canopies will probably become more open – facilitating the establishment of exotic, tall tropical grasses (Guinea grass) and shrubs (lantana). The impact is to simplify habitat complexity and to eliminate fire sensitive ecosystems.

A different dynamic will apply in dryer regions. Generally relatively frequent low intensity fires would prevent the accumulation of high fuel loads. High fuel loads may take some time to develop where grazing is not present and where low intensity fires do not occur. Under these circumstances there is likely to be a long period (some years) between hot fires. Climate change is unlikely change the fire regime in these dryer environments.

Land management

Currently 41 % of the Broadsound Basin has been developed for primary production to the point that natural ecosystem processes probably do not persist. They have been replaced by primary production processes. This change is predominantly associated with the coastal plains and adjacent undulating hinterland. Development is most extensive in the Styx (52 % cleared) and Herbert Creek (38 % cleared) catchments. There are extensive areas of cleared lands that have little ground cover or are seriously degraded across the Broadsound Basin. The situation is most severe in the Styx River catchment but there are examples of poor land management in all catchments. The degree of degradation of some rangelands raises questions about the sustainability of the grazing systems.

Ongoing clearing, land degradation under unsustainable grazing systems and climate change impacts (driving fire and drought risk) threaten the loss of remnant connectivity between the western escarpment and the eastern coastal ecosystems.

Minerals and petroleum interests

Coal exploration permits cover 55,700 ha of the Broadsound Basin. Petroleum exploration permits cover over 231,000 ha. Minerals exploration permits cover a further 115,000 ha. Mining leases cover 1,270 ha and are for magnesite. Mining development leases cover just less than 16,000 ha and are predominantly for magnesite and oil shale project development. Minerals resource extraction is not necessarily a social or environmental problem depending on location and management regimes. Queensland mining activity has resulted in increased protection of some ecosystems and some net biodiversity gains. Regional industrialization can be at the expense of traditional community structure while increasing infrastructure, employment and economic returns per ha within leases. The oil shale leases correspond with important wetlands and habitat for the critically endangered Capricorn Yellow Chat (table 6.1). The extraction of oil shale is dependent on large open cut mining at the scale of central Queensland open cut coal mining. The extraction of oil from the shale will result in the construction of an industrial plant. This, in turn will have social and environmental influences on the surrounding region.

Table 6.1 Assocation of oil shale prospects and regional ecosystems in the Broadsound basin.

Catchment	Company	Mining authority	re types	area (ha)
Herbert	QERL	Exploration permit		
			11.1.1	15333.68
			11.1.1/11.1.2	403.76
			11.1.1/11.3.4	695.15
			11.1.2/11.1.1	389.57
			11.1.2a	2633.66
			11.1.2b	210.23
			11.1.3	12.34
			11.1.4b	3.54
			11.1.4c	4836.06
			11.1.4d	4.98
			11.1.4e	12.90
			11.2.3	4.04
			11.3.25b	318.79
			11.3.26	573.67
			11.3.26/11.3.9	44.03
			11.3.27b	8.1
			11.3.29	1234.14
			11.3.29/11.3.9	1216.09

			11.3.29/11.3.9/11.3.25b	16.17
			11.3.36	517.88
			11.3.36/11.3.26	2.16
			11.3.36/11.3.9	122.52
			11.3.4	163.96
			11.3.4/11.3.27b	204.79
			11.3.4/11.3.36/11.3.29	33.04
			11.3.4/11.3.9/11.3.29	110.49
			11.3.9	8.05
			11.3.9/11.3.25b	77.67
			11.5.8	3620.99
			11.5.8/11.3.29	1173.96
			11.5.8/11.5.8	11.96
			11.5.8b	812.06
			11.5.8b/11.5.8	2139.83
			8.3.13a/11.1.1	39.88
			estuary	158.68
			non-rem	28926.71
			ocean	179.26
Herbert	QERL	Mineral development lease _196		
			11.1.1/11.1.2	403.76
			11.1.2/11.1.1	389.57
			11.1.2b	114.77
			11.3.25b	0.54
			11.3.26	108.38
			11.3.26/11.3.9	8.46
			11.3.29	971.89
			11.3.29/11.3.9	1158.74
			11.3.4/11.3.27b	204.79
			11.3.9	8.05
			11.5.8	3540.45
			11.5.8/11.5.8	11.96
			11.5.8b	471.85
			11.5.8b/11.5.8	2138.74
			8.3.13a/11.1.1	39.87
			non-rem	1644.27
Herbert	QERL	Mineral development lease_197		
			11.3.25b	30.96
			11.3.4	27.99
			11.3.4/11.3.36/11.3.29	33.04
			11.3.4/11.3.9/11.3.29	23.69
			estuary	52.45
			non-rem	3423.62
Styx	Bandanna	Exploration premit		
			11.10.7	429.43
			11.10.7/11.10.1	549.36
			11.11.1	276.22
			11.11.10	1249.06
			11.11.10/11.11.1	897.11
			11.11.10/11.11.15	340.17
			11.11.10/11.3.26	148.61
			11.11.14	21.34
			11.11.14/11.11.10	10.92
			11.11.15	598.61
			11.11.15a	1372.66
			11.11.18	139.52
			11.3.11	5.23

11.3.25	935.01
11.3.26/11.5.9c	731.46
11.3.29	811.33
11.4.2	507.07
11.4.9	91.18
11.5.8a	636.71
11.5.9c	1430.83
11.7.2/11.5.9c	1859.42
non-rem	91129.10

6.1 Clairview Creek Catchment

6.1.1 Climate change

Sea level rise

A small area is at or below high tide (table 5.2).

Table 6.2 Area of land tenure near or below astronomical high tide in the Clairview Creek Catchment.

Tenure	Area (ha)
community and public reserves	1.88
Free hold	326.15
Leasehold	58.23
roads, creeks, mangroves	2645.21
Total	3031.47

Fire

The relative humidity of the Clairview Creek catchment favours the maintenance of ground cover throughout the year and the relatively rapid recovery of biomass after burning, grazing or clearing. There is a well developed shrub layer throughout the wooded areas of this catchment that has the capacity to carry intense fire into forest canopies and the ability to recover rapidly after fire – reestablishing fuel loads. The development of commercial eucalypt plantations has resulted in extensive stands of eucalypt forest (figure 6.1). These plantations are vulnerable to canopy fire under suitable conditions. The steeply sloping landscape in the upper catchment would facilitate rapid and intensive fire spread in the appropriate conditions. If the prediction of future increased severe fire days are accepted then sensitive, integrated fire planning needs to be established. Careful integration of fire management planning is required because goals and stratagies applicable for conservation reserves will vary from those for plantation and grazing systems, while rural fire services will focus on protection of life, livlihood and infrastructure.

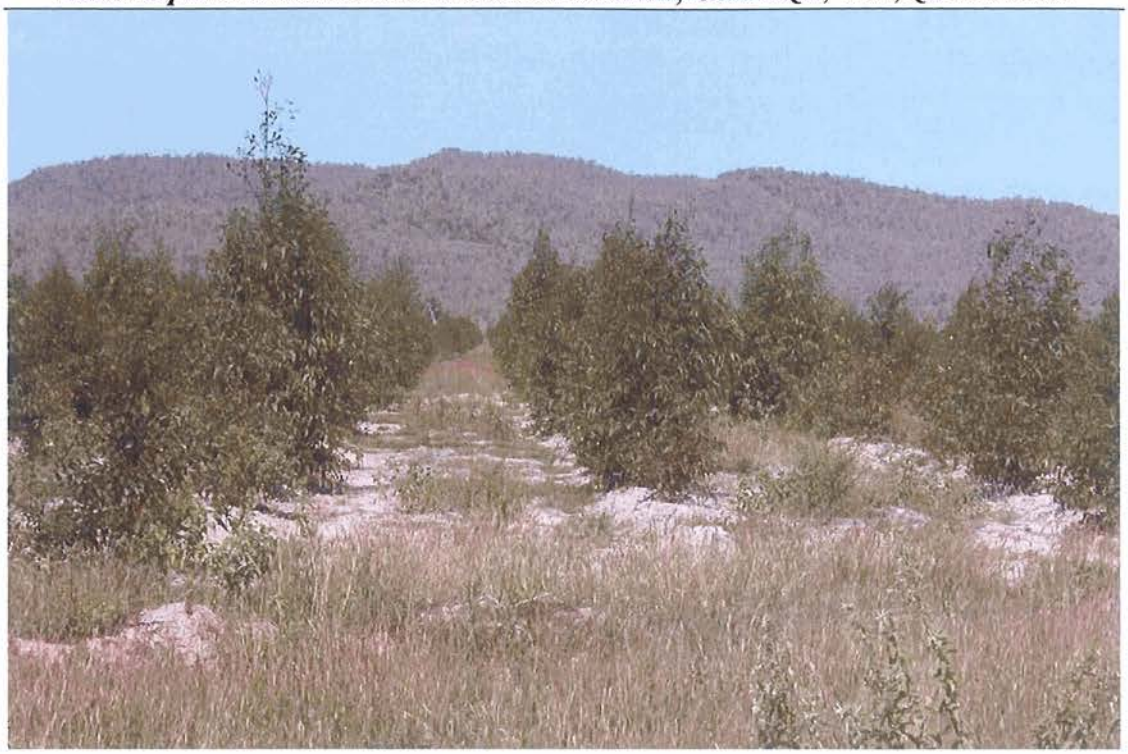


Figure 6.1 Eucalypt plantations along Spring Valley Road, Clairview Creek catchment.

6.2 St Lawrence Creek Catchment

6.2.1 The town of St Lawrence

There is a high risk of incremental loss of these values through progressive clearing of individual blocks and unwitting loss through incompatible land use (e.g. goats, fire). It is expected that pressure on this landscape will increase as low lying coastal lands loose productivity with sea level rise.

Figure 6.2. Conversion of species rich, complex native ecosystems of conservation significance to degraded, species poor, unsustainable grazing lands at St Lawrence.

6.2.2 Climate change

Sea level rise

About 4,000 ha of freehold and leasehold land and a small area of public land are at or below high tide (table 6.3).

Table 6.3 Area of land tenure near or below astronomical high tide in the St Lawrence Creek Catchment.

Tenure	Area (ha)
community and public reserves	254.35
Easements	0.21
Free hold	2952.21
Leasehold	1281.20
roads, creeks, mangroves	1265.79
State land	72.20
Total	5825.95

Fire

The fire sensitive semi evergreen vine forests around the town of St Lawrence are considered increasingly vulnerable if fire risk days increase as predicted. As in the Clairview Creek catchment fire is likely to become an issue along the western ranges where the moisture regime favours the rapid recovery of biomass and fuel loads after burning, grazing or clearing.

6.3 Waverley Creek Catchment

6.3.1 Climate change

Sea level rise

A large area (about 11,000 ha of freehold and leasehold land) and a small area of public land are at or below high tide (table 6.4).

Table 6.4 Area of land tenure near or below astronomical high tide in the Waverley Creek Catchment. Includes land behind seawalls.

Tenure	Area (ha)
community and public reserves	0.02
Free hold	9689.47
Leasehold	1608.05
National park	113.54
roads, creeks, mangroves	4897.56
State land	0.3120
Total	16308.95

Fire

Here again, the western ranges are likely to be most affected by climate change induced increases in fire risks given the better moisture regime.

6.4 Styx River Catchment

6.4.1 Climate change

Sea level rise

About 5,000 ha of freehold and leasehold land and a small area of public land are at or below high tide (table 6.5).

6.4.2 Mining

Forty nine thousand seven hundred hectares are subject to a coal exploration permit. If this leads to a mining development there will be major implications for Ogmore and for land management issues in the vicinity.

Table 6.5 Area of land tenure near or below astronomical high tide in the Styx River Catchment. Includes land behind seawalls.

Tenure	Area
Free hold	2966.61
Leasehold	1917.36
National park	59.58
roads, creeks, mangroves	5778.74
Total	10722.28

6.5 Herbert Creek Catchment

6.5.1 Climate change

Over 34,000 ha of freehold and leasehold land and a small area of public land are at or below high tide (table 6.6).

Table 6.6 Area of land tenure near or below astronomical high tide in the Herbert Creek Catchment. Includes land behind seawalls.

Tenure	Area (ha)
community and public reserves	17.29
Free hold	25670.73
Leasehold	8597.60
National park	29.85
roads, creeks, mangroves	12015.95
State land	79.70
Total	46411.13

6.5.2 Mining

Over 15,400 ha of freehold and leasehold land are under mineral development leases associated with oil shale and magnesite mining. A further 1,200 ha is covered by mining lease.

6.6 Stanage Coast Catchment

6.6.1 Stanage Bay and associated coastline

Incremental real estate development and traditional approaches to coastal tourism development are potential threats to the integrity of the coastline and the quality of inshore waters and dependent ecosystems. Impacts are already evident in terms of degradation of sensitive plant communities and erosion. Resort proposals are in place and the access road is under staged redevelopment. Visitation is expected to increase significantly once the road is sealed. Management of effluent and waste are critical issues for the integrity of the adjacent rocky reef, coastal waters and recreational areas.

6.6.2 Climate change

Less than 700 ha of predominantly national park and some freehold land and a small area of public land are at or below high tide (table 6.7).

Table 6.7 Area of land tenure near or below astronomical high tide in the Stanage Coast Catchment. Includes land behind seawalls.

Tenure	Area (ha)
Free hold	217.49
Leasehold	8.33
National park	514.67
roads, creeks, mangroves	47.38
State land	20.97
Total	808.84

6.7 Intertidal wetlands

Mangroves

The loss of mangroves (Chapter 5 section 5.2) is likely to continue at varying intensity and frequency in accord with normal processes of coastal erosion. Ongoing and accelerated rise in sea-level will accentuate natural processes, probably a gradual process rather than sudden losses from short-term events (e.g. storms). A general consequence is likely to be a landward shift of the zones of wetland type. As most mangrove blocks around Broad Sound are backed by extensive salt flats, in theory the mangroves could migrate to the landward side and on the salt flats. The high soil salinity on these flats may retard mangrove growth until adequate flushing by seawater has occurred. Also, the pace of mangrove establishment may lag behind sea-level rise if that rise is rapid and constrains the establishment of new mangrove stands. Existing seawalls are mostly some distance from the mangroves but where the walls are close to mangrove communities they will constrain the shift of the communities.

Intertidal flats

Rising sea-level will cause some seaward areas of intertidal flat to become sub tidal mud banks while the central area of the flats will be exposed less often - but this may be offset by some landward migration of the intertidal flats. Landward shift of intertidal flats could occur in parts of Broad Sound where the supra-tidal flats are extensive and broad. It may take some time for present mangrove and saltmarsh wetlands to change to bare intertidal flats. The likely influence of coastal sedimentation processes on this coastline regression is not understood. In this transitional period, and possibly as a permanent change, intertidal feeding habitat for animals such as migratory shorebirds surely will be substantially reduced. It is not known if this loss will be a critical influence on their local population sizes.

Roosts and breeding colonies

Migratory shorebird roosts and waterbird breeding colonies are inherently vulnerable because they are scarce point features in the coastal landscape. No critical immediate threats to the shorebird roosts have been identified, although recent, substantial, erosion of at least one beach roost has been observed. Human disturbance of roosting birds is likely to be minimal given the lack of public access by road and limited access by boat due to shallow water. The two egret colonies are not considered to be under threat because mangroves in these sites seem healthy and the sites are inaccessible to humans and livestock, being totally or nearly surrounded by deep water. Both are in a Fish Habitat Area and the mangrove vegetation is protected under the *Fisheries Act*.

Saltmarshes

Initially, the saltmarshes of Broad Sound will be inundated more frequently as sea levels rise and this is likely to be favourable to some waterbirds especially those (e.g. short-legged shorebirds such as sandpipers) that can exploit prey inhabiting the firm salt flat sediments. As wetland systems shift landward, saltmarshes may re-establish on slightly higher ground (marine plains), especially on Torilla Plain because that side of Broad Sound lacks major seawalls. On the western side, areas of saltmarsh are likely to be reduced because of the containing effect of seawalls, but if sea level rise is not too great the overall impact on this extensive wetland type and associated biota seems less likely to be catastrophic.

In the foreseeable future, current industrial and urban development is not expected to be a threat to intertidal wetlands of Broad Sound (but see below).

6.8 Non-tidal wetlands

Rising sea level is also a significant threat to coastal non-tidal wetlands of Broadsound basin. As indicated above, near-natural marine plains (mainly Torilla Plain) will be reduced on the seaward side by extension of saltmarsh wetlands, but will not be able to migrate landward because they abut much higher ground. The distinction between sediments of marine versus alluvial origin and corresponding areas of saline versus freshwater dominance is often unclear in these landscapes but clearly there would be a shift to landward of marine sediment and saline regime. Consequently, grass-sedge swamps and wet meadows will relocate to landward but substantial loss of these biologically rich wetlands – which are important for waterbirds – will occur where the plains are narrow.

On the west side of Broad Sound, current seawalls and banks may initially prevent landward incursion of intertidal wetlands. However, many walls are barely 1.5 m high and 2-3 m wide and so, with rising sea-levels, are likely to be destroyed by wave action unless strengthened and raised in height. Resources may need to be directed to landholders to enable maintenance and possibly improvement of their seawalls in order to protect both their pastures and the biodiversity assets – some of which are internationally important (see above) though not officially recognized as such – of these modified wetlands. Current regulations prohibit further installations of walls in intertidal areas and on watercourses and wetlands in the coastal zone.

No current major threats have been identified in relation to the grass-sedge swamps and wet meadows well to landward of the present limits of saline influence. Long-term impacts of cattle grazing cannot be determined without a comprehensive scientific investigation. Feral pigs are being targeted and probably can be adequately controlled. Declared weeds (Olive Hymenachne) are scarce and could be readily eradicated or contained at present before they become well established (Chapter 5 section 5.2). Although there is potential for spread of Para grass to the exclusion of distinctive, native grass-sedge communities, it is constrained by salinity. However, any proposals for intensification of agriculture (grazing or cultivation) may place new pressures on these wetlands.

The coastal *Melaleuca* swamps of Broadsound are persisting despite considerable disturbance and attain good condition in wet summers, but possibly are slowly disappearing. They can be a focus for grazing pressure due to persistent green feed in the dry season. Major infestation of rubber vine seems to be absent at present.

Semi-permanent ponds appear to be under no immediate threat but their fringing vegetation may be subject to intense grazing pressure especially in drier seasons/years. Infestation by *Hymenachne* is a serious threat: Hymenachne spread rapidly during 2006-7 from a few small clumps in the St Lawrence Reserve and eradication has been planned.

Shale oil

Substantial deposits of oil-bearing shale underly the Central Queensland coast including parts of the Broadsound Basin (see Chapter 6 section 6.2.& table 6.1) and this has attracted the interest of mining companies. About 39,000 ha of petroleum exploration permit zone and 26,000 ha of mineral development lease have been gazetted over land zone 1 (regional ecosystems 11.1.1 to 11.1.4, which are wetland REs) in the Herbert, Styx and/or Waverley catchments and much of this includes oil

shale deposits. Given that open cut would be the likely method of extraction (as per the Stuart trial mine near Gladstone), this represents a serious threat to the existence and integrity of wetlands – including important sites – in the Broadsound Basin. Furthermore, extraction of oil shale is likely to create additional environmental impacts in relation to water requirements, alteration of groundwater tables in the coastal zone (eg. removal of groundwater leading to saline intrusion), disruption of surface flows (eg. road embankments and spoil), waste disposal, and potentially the spilling of oil into wetlands.

If large scale mining of shale oil is proposed, the international, national and regional importance of the Broadsound wetlands must be fully taken into consideration. These values include landscape assets (such as the unique channel complexes on Torilla Plain), biodiversity assets and economic assets (productive pastures, support to regional fisheries). Referral under the *EPBC Act 1999* would be necessary due to – among other things – major occurrence of listed threatened and migratory waterbird species across the Broadsound coastal plains.

7.0 Opportunities and investments

7.1 Terrestrial landscapes

7.2.1 Communities

St Lawrence

Terrestrial biodiversity

It is rare to find such high biodiversity and conservation values in association with a long established historical settlement. There are risks to these natural assets as pressure on coastal and urban land grows. The opportunity is present to work with the local community, the Environmental Protection Agency and others to raise awareness of the values and develop strategies allowing regional development, critical land management and biodiversity preservation. These could include community supported biodiversity audits, facts sheets, high resolution ecosystem mapping and the development of innovative planning solutions.

Cultural assets

A visit to St Lawrence raises many questions about the historical buildings, relic structures and general history. The lack of signage and low level of community awareness leave the visitor guessing. The opportunity is present to install appropriate signage and to research and produce interpretative material to inform visitors. One outcome would be to raise community awareness and valuing of these assets.

Ogmore

Terrestrial biodiversity

Ogmore lies within former brigalow and riparian scrub lands. Small pockets of remnant scrub and brigalow community remain. A detailed local biodiversity plan would be needed to achieve outcomes here.

The rainforest remnants associated with the alluvial terraces of the lower Styx River are small but subject to intense utilization by frugivorous birds. They are under threat from cattle, rubber vine and fire. Fencing, weed management and augmentation planting would secure these relics.

There are extensive patches of regrowth and remnant brigalow communities around Ogmore township. Of particular interest is the road reserve along Bartletts Road. Here the reserve exhibits strong Brigalow recovery and provides an opportunity to establish links between the forested leases and the mouth of the Styx River. An agreement with the Shire Council and private landholders as well as fencing and weed management would be necessary.

There is a diverse array of weeds within the township. Some have the potential to invade surrounding areas. Strategic weed management would be useful

Cultural

A visit to Ogmore raises many questions about the historical buildings, relic structures and general history. The lack of signage and absence of a focal point for visitors leaves the visitor guessing. Unlike St Lawrence there is no general store or café where a visitor can encounter local knowledge. The opportunity is present to install appropriate signage, research and produce interpretative material to inform visitors. One outcome would be to raise community awareness and valuing of these assets.

Stanage Bay

Alligator Point

The Stanage coast has high aesthetic values. Alligator Point is an excellent vantage point to admire the coast, hinterland and islands. There is no interpretation or signage on the point. Here interpretive information could be provided on the land and seascape, ecology and history. Heavy vehicle usage has caused significant erosion (see section 7.2.2 and figure 7.2 below), interfering with pedestrian access and degrading the aesthetic experience. Disabled access is not possible – except by vehicle. The development of constructed pedestrian and wheelchair access using hardened paths and safe lookout stations serviced by defined car and bus parking area would provide a pleasant, informative experience for a range of visitors.

Community camp ground at Plumtree

The camp ground at Plumtree is an important asset to the community. There is no charge for the use of this facility that appears to be maintained by the community. This camp ground is located on a highly degraded dry rainforest on an old beach ridge. Remnant canopy trees from this former scrub remain and provide an indication of the former native ecosystem now destroyed. The adjacent small fore dune is significantly degraded and dominated by exotic grasses. The investment opportunity, here is to work with the local community to protect and enhance the remnant natural values while at least maintaining, if not increasing, the amenity of this community asset. This could include the installation of 5m x 5m exclosures around the base of the remnant canopy scrub trees, the strategic replanting of scrub elements (especially those supporting butterflies and birds), installing bollards to protect the fore dune and other key assets, the restoration of native species dominance to the small fore dune and the more formal delineation of the camping bays. As water and toilet facilities are limited, some review of eutrification risks to the adjacent waters should be considered.

Camping ground at Alligator Beach

This is a public camping ground within a low microphyll vine thicket above the fore dune. It is located on state land under the management of the Department of Natural Resources and Water. The location of the camp ground within this ecosystem is not ecologically sustainable. The structure of the community has been degraded. The overstorey canopy is fragmenting. The edge canopy has been breached allowing light, wind and salt spray to enter the canopy. This is a consequence of harvesting fire wood and ensuring a view to the bay. This results in dieback and weed invasion that in turn risks fire damage to this fire sensitive community. The physical impact of the camps, vehicles and the recreational users is degrading the dune and the associated fore dune. The adjacent beach is sign posted as a nesting area for endangered turtles. Lights from the campers, recreational activity, and changes to the carbon content of the sand and subsequent temperature effects on the gender ratio of hatchlings, disturbance and predation by pet dogs are likely detrimental impacts on the turtle breeding success. Urban settlement is intensifying landward of this scrub. While this will have its own risks for the turtle hatchery, the decay in the light screen provided by the beach scrub is likely to exacerbate this impact.

There are no facilities provided at this camp ground. Issues of effluent contamination must be considered.

The investment opportunity here is to work with the state and local government authorities and the local community to (a) recognize the threats, (b) relocate this camp ground to an ecologically sustainable location, (c) undertake essential restoration

works and (d) provide adequate community and visitor information material and signs.

7.2.2 Landscape management

Priority areas for investment

A number of localities have been highlighted as priority areas or issues for investment. Their selection was based on (a) potential as a major point source for down stream discharge of sediment and associated nutrients to the Great Barrier Reef Marine Park and associated coastal waters, (b) potential adverse impact on St Lawrence town weir, (c) discrete opportunity for outcomes within a strategic framework. The general location of these recommended sites are shown in figure 7.1 The majority of sites occur in the Styx River catchment reflecting the greater frequency of occurrence and extent of seriously degraded landscapes in this catchment. Land management issues that do not have an immediate downstream impact and relate to broader long term strategic considerations of sustainable land use and property management are not included here.

A discussion of some specific opportunities follows.

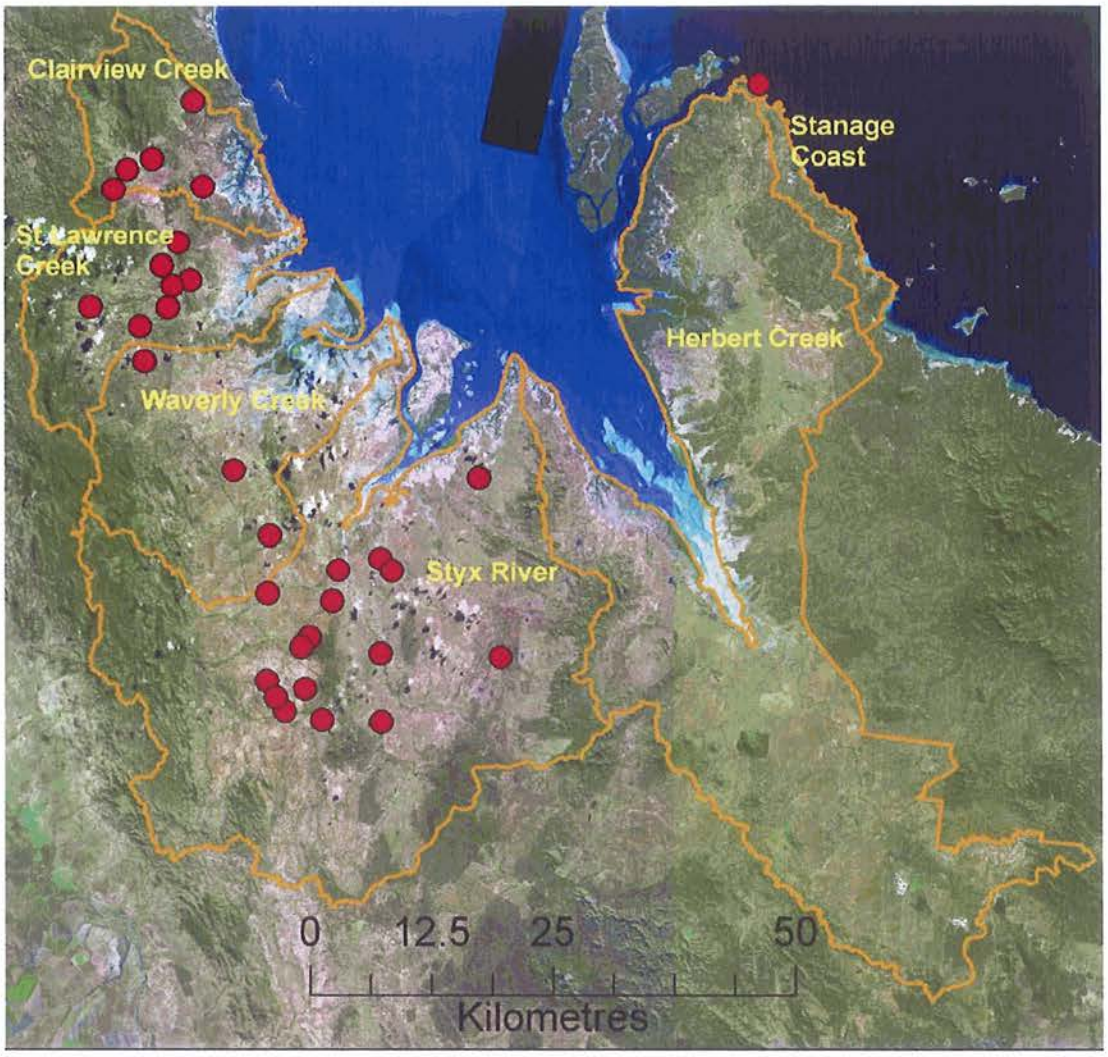


Figure 7.1 Priority opportunities for investment in landscape management across the Broadsound Basin. **The red spots indicate the general location of a priority opportunity.**

Headland erosion – Stanage Coast

Alligator Point is an excellent vantage point to admire the coast, hinterland and islands. It receives heavy usage. There is a vehicle track to the summit of the point.

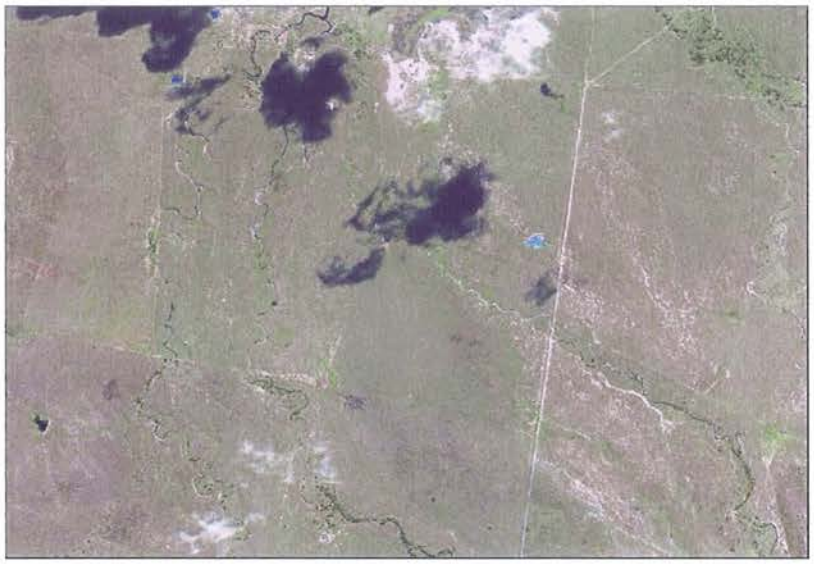
There is substantial damage to the headland and significant erosion (Figure 7.2a). This is impacting on the experience of the visitors, degrading the headland ecosystems and adjacent rocky reef as well as limiting access to some visitors. The opportunity is there to restore the headland, providing controlled vehicle access partway up the headland linked to a fenced ramp (allowing disabled access) to the summit. The headland is unallocated state land (Figure 7.2b).

(a)

(b)

Figure 7.2 Alligator point, Stanage Bay. The unformed vehicle access road (a) is clearly visible on the satellite imagery (b).

Restoration of riparian vegetation and recovery of ecosystem services.
There are a number of small ephemeral streams along the coast of the Styx River and Herbert Creek catchments that have been totally denuded of vegetation (Figure 7.3 a and b). At least 14 small streams could be identified in the Styx River catchment and five in the Herbert Creek catchment (at 1:40,000). The reconstruction of an ungrazed riparian community would contribute to the retention of sediment and nutrients during periods of high flow. In almost all cases the target streams are on freehold land.



(a)

(b)

Figure 7.3. Denuded and grazed minor streams on the coast of the Styx River (a) and Herbert Creek (b) catchments. Clearing and constant grazing have removed ecosystem services associated with sediment retention and nutrient entrapment.

Major point source discharge
The management of scalding and broad acre erosion across the grazing lands requires a long term community effort. A number of localities were recognized where erosion and land degradation must be considered severe (figure 7.1). These most likely represent significant point sources of sediment to the streams. In places they represent threats to road infrastructure. Significant engineering works will be required to address these situations. In the Styx River catchment seven very severe and six severe cases were identified where there was direct discharge to streams. The cases fall

within a complex of leasehold and freehold lands. Two sites with potential for case study investment are illustrated. Firstly at the Anglewood Road – Mt Bison Road junction the complex association of state land (under lease) and unallocated state land along stream lines provides opportunity for a substantial investment to manage and remediate an important point sediment source (Figure 7.4). The second opportunity is at the junction of Tooloombah Creek and the Styx River where leasehold land is associated with some of the degraded lands immediately adjacent to the river (Figure 7.5). In Waverley Creek catchment three severe cases were located – all on freehold land. Seven moderate cases were identified. In the St Lawrence Creek catchment seven moderate cases were located. Two were associated with the immediate catchment of the St Lawrence town weir. All are associated with freehold lands. Some investment may be warranted here to secure the quality of this supply. In the Clairview Creek catchment six potential point sources were recognized. All were moderate cases. They all sit within freehold lands.

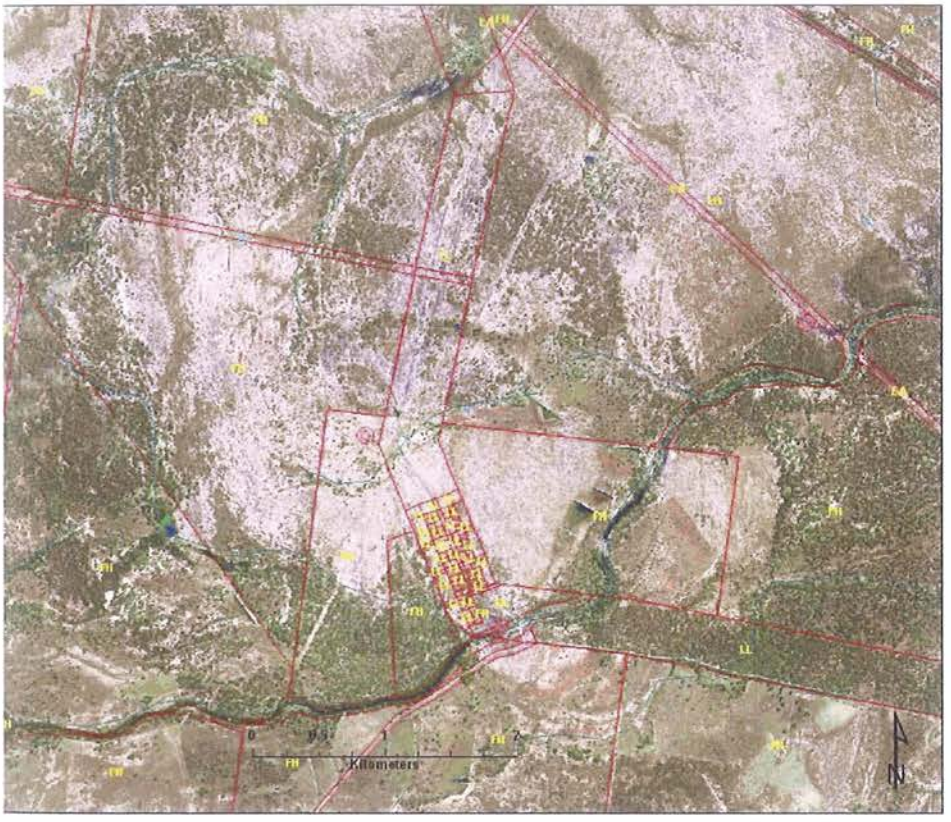


Figure 7.4. Severe erosion gullies drain adjacent degraded grazing land to Tooloombah Creek. These gullies have formed along the road reserve and associated table drains and feed directly to the creek.

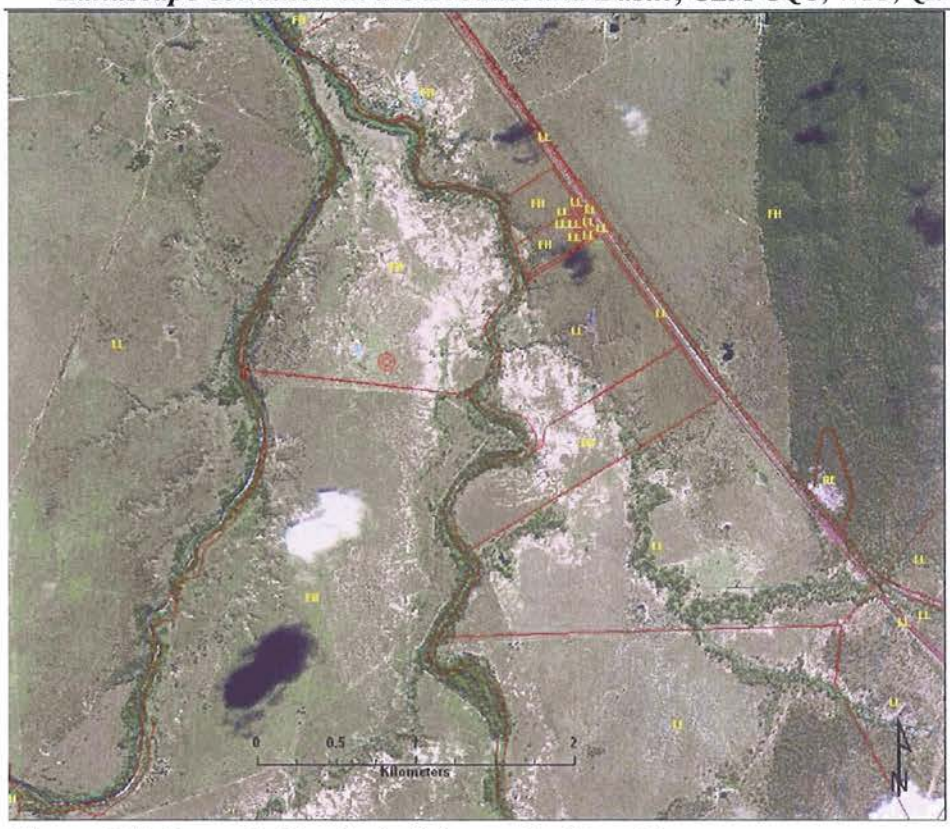


Figure 7.5. Degraded lands draining to the Styx River.

St Lawrence Weir catchment

The small catchment that feeds St Lawrence weir is showing signs of land cover degradation associated with stream riparian zones (Figure 7.6). The pattern of degradation indicates a link to land use and stock activity. Ongoing catchment decline is likely to lead to deteriorating water quality in the weir. While the impacts are not very severe there is an opportunity for preemptive investment with benefits for public health.

Infrastructure impacts

Three sites where erosion was threatening public roads were identified (Figure 7.7 a-c).

Riparian zone management

The management and, in many case, reconstruction of riparian zone structure and function is essential for the management of instream environmental quality and the flow of sediments and nutrients to the down stream reef waters. The investment opportunity here lies in developing micro catchment case studies in partnership with landholders. These case studies would showcase innovative strategies for managing complex riparian systems to deliver ecosystem services within grazing, plantation forestry and mining production systems.

Figure 7.6. Catchment of the St Lawrence weir showing indications of landuse impacts with potential to influence future water quality.

7.2 Wetlands

7.2.1 Awareness and experience of wetland assets

As the above-mentioned natural assets of the Broadsound wetlands largely have not been documented in the past, much would be gained toward increasing community support for maintenance of these assets through an awareness raising campaign. This could include placement of interpretive material at public places such as the camping reserve at St Lawrence (display structures already exist there), public meetings and distribution of hard copy leaflets. At very least, each landholder who has cooperated in the project should be provided with a 'popular report' that concisely summarises the findings of this work. A desirable outcome of such investment would be elevation of the profile of wetlands in planning for natural resource management in the Broadsound Basin and at the property level.

Local residents and visitors to Broadsound currently have no opportunity for close experience of the wetlands. Excellent opportunities to address this need exist in the west. Construction of a maintained gravel trail to the edge of the St Lawrence reserve wetland would be feasible, at relatively low cost, by adding to the present trail network emanating from the nearby camping area. A shelter and interpretive signs on the wetland edge would enhance comfort and learning of key messages. Safe parking bays and maintained viewing points beside the wetland, along the causeway road, would complement these facilities.

No similarly convenient reserves exist in the east, though the Stanage Bay road passes beside Torilla Plain at several points, which may provide future education/awareness opportunities subject to negotiation with freehold landowners. Maintenance of facilities and protection of property would need to be guaranteed, perhaps through fencing. The vicinity of the Wadallah Creek crossing would offer seasonal displays of

waterbirds in several open ponds, beside remnant, old-growth, riparian broadleaf forest at the edge of the Plain.

Newport Conservation Park provides the only opportunity to appreciate mangroves and other shallow estuarine wetlands at present. Visitor facilities there could be upgraded and expanded, including addition of interpretive signs, but like all such investments, long-term maintenance would need to be assured. Signs could also be placed at the Stanage boat ramp.

7.2.2 Formal protection

Assets in the intertidal zone should be managed in conjunction with relevant government agencies; formal protection options may be considered particularly for shorebird roosts on small beaches, the tenure of which may be unclear. Existing conservation reserves could be expanded to include additional high-value wetland in State tenure; notable opportunities are the mangrove block adjacent to and contiguous with Newport Conservation Park, and islands on the middle east side of the Herbert estuary (add to the Long Island protected area perhaps), both of which include an egret breeding-colony site (figure 5.30). The primary shorebird roost in Broadsound could be included in the adjacent Charon Point Conservation Park; other roosts could possibly be designated as outlying elements of this or another of the reserves. None of these measures should affect private property.

7.2.3 Cooperation with landholders (grazing enterprises)

As few if any areas of marine plain or associated freshwater wetlands are protected, development of voluntary conservation agreements with landholders should be considered. In the short-term, assistance to landholders – provision of chemicals, equipment and in some cases (elderly landholders) also labour – for removal of Prickly acacia and Hymenachne infestations would be timely. Landholders should also be informed of the habitat values of plants such as sedges, which tend to be regarded as undesirable from a production viewpoint. Fencing to control stock access to the *Melaleuca* swamps, especially those on reserve tenure, should be considered in conjunction with landholders, though weeds should not be permitted to proliferate in the absence of stock. Fencing may also encourage regeneration of perennial sedges around the deeper ponds. Further investment in fencing to control cattle access to bare salt flats could reduce pugging. The idea of fencing some areas of grass-sedge swamp, to observe vegetation changes and inform development of ecologically sustainable regimes for grazing, should be explored further.

7.2.4 Development of knowledge and expertise for management

Locally relevant research to determine sustainable grazing regimes on the marine plains may ultimately benefit the natural assets. Further surveys are needed to inform comprehensive management of shorebird roosts and egret breeding colonies in Broadsound: ground-level access to and surveys of these sites should be arranged, in some cases by boat. Further surveys are also needed to fully ascertain the status of the threatened Yellow Chat in western catchments; large areas of suitable habitat exist in which chats have not been found. Additional visits should ensure that this often-secretive bird has not been overlooked. It is important to clarify the relative importance to Yellow Chats of the core Torilla Plain refuges in relation to alternative/satellite refuges.

(a)

(b)

(c)

Figure 7.7. (a) The approaches to Tooloombah Creek at Rocky Crossing are at risk of future erosion associated with gully erosion. (b) Tunnel erosion associated with adjacent gullies and stream bank collapse undermines Bartletts Road near Ogmore. (c) Gully erosion associated with stream bank collapse encroaches on Charon Ferry Road near Ogmore.

7.2.5 Restoring connectivity

It may be possible to create fish passage between the persistent ponds in the St Lawrence Reserve and tidal channels on the seaward side of the road causeway; in years of near average rainfall, it is likely that some fish will survive in the ponds through the dry season and return to marine waters when wet season floods return. Subject to feasibility assessment by experts, similar structures could be considered at one or two sites on seawalls besides active tidal channels, e.g. on the Waverley estuary.

8.0 Supplementary material

S1 Climate change and risks

S1.1 Introduction

Australia's climate has been changing over the last 100 years in a measurable way. These changes are reported widely and are available to the community through the Bureau of Meteorology web site (http://www.bom.gov.au/climate/) and the CSIRO web site (http://www.csiro.au/science/ClimateChange.html). Sea level monitoring and analysis is available through the National Tidal Centre (http://www.bom.gov.au/oceanography/projects/ntc/ntc.shtml).

It is generally, but not universally, accepted that climate change will continue for many decades as a consequence of current and future increases in greenhouse gas emissions. This has resulted in an intensive global investment in climate models an attempt to predict the likely direction and extent of changes in future environmental condition and state. These predictions are published periodically through technical reports – most recently internationally (Climate Change 2007:Climate Change Impacts, Adaptation and Vulnerability Fourth Assessment Report Working Group II Contribution to the Intergovernmental Panel on Climate Change, IPPC) (http://www.ipcc.ch/SPM6avr07.pdf) and in Australia (CSIRO and Bureau of Meteorology (2007): *Climate change in Australia*. Technical Report, 140 pp.) (http://www.climatechangeinaustralia.gov.au/).

There is ongoing collaboration among the Australian and international research agencies and scientists and the Australian report draws on the same set of technical data sets applied to the IPPC reports. Consequently, the following discussion focuses on the Australian publication and online data. The discussion will address the nature and consequences of climate change for the Broadsound region. It will not consider the causes of the changes.

S1.2 Observed changes

Temperature

Since the 1950's Australia's temperature has risen on average 0.9°C. In the Broadsound region the records show a general warming with the rate varying somewhat among seasons.

Maximum temperature

In the Broadsound region annual maximum temperatures have increased at a rate of about 0.1°C per decade (Figure X). The changes are not so evident in spring and summer, with increases of 0.05 to 0.15°C per decade, or winter, with increase from between 0.1 to 0.15°C per decade. Autumn temperatures, however, have risen at a rate of 0.2 to 0.3 °C per decade since 1950.

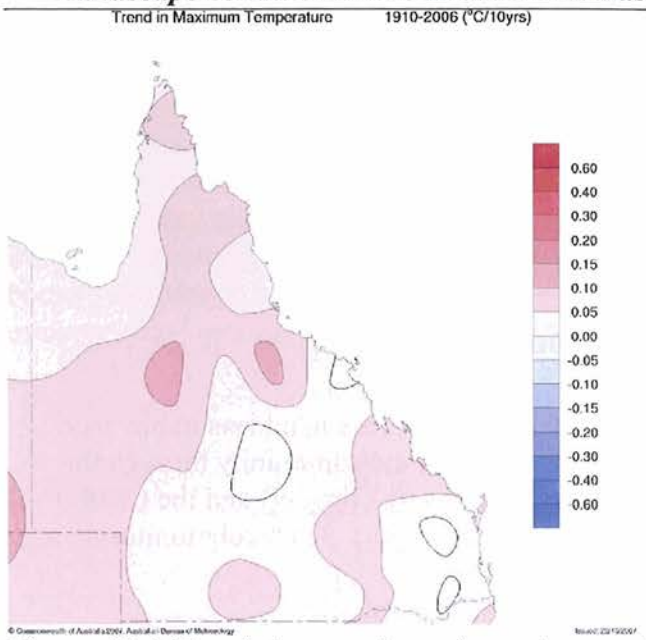


Figure S1.1 Trends in annual maximum temperature (°C/decade) in Queensland from 1910 to 2006.

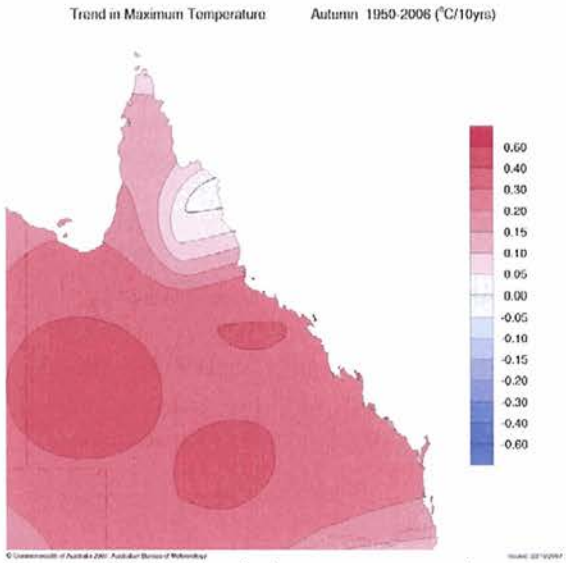


Figure S1.2 Trends in autumn maximum temperature (°C/decade) in Queensland from 1950 to 2006.

Minimum temperature

Annual minimum temperature has risen from 0.15 to 0.2 °C per decade. The rate of increase was steepest in winter with minimum temperatures rising 0.3 to 0.4 °C per decade. Autumn rates were from 0.2 to 0.3°C per decade. Summer rates were from 0.15 to 0.2 °C. The spring rate was slightly lower at 0.1 to 0.15°C per decade.

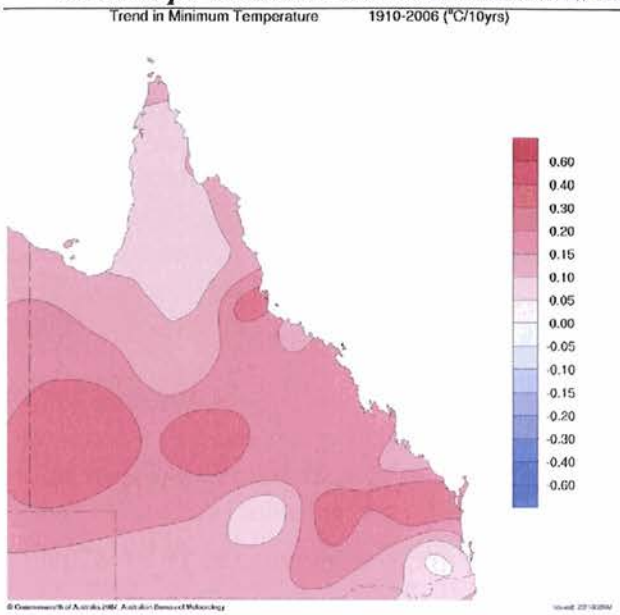


Figure S1.3 Trends in annual minimum temperature (°C/decade) in Queensland from 1910 to 2006.

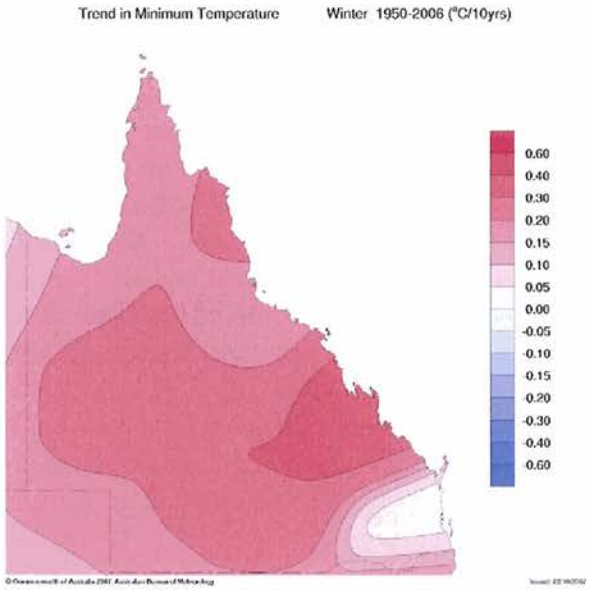


Figure S1.4 Trends in winter minimum temperature (°C/decade) in Queensland from 1950 to 2006.

Rainfall

The rainfall record shows a general declining trend of greater than 50mm per decade since 1950 across most of east coast Queensland. In the Broadsound region this trend is evident in the summer rainfall record and a slightly slower decline in autumn (- 20 to 30 mm per decade). Winter rainfall has declined very slightly (up to –5 .0 mm per decade). Contrary to these declining trends, spring rains have increased at a rate of up to 10mm per decade.

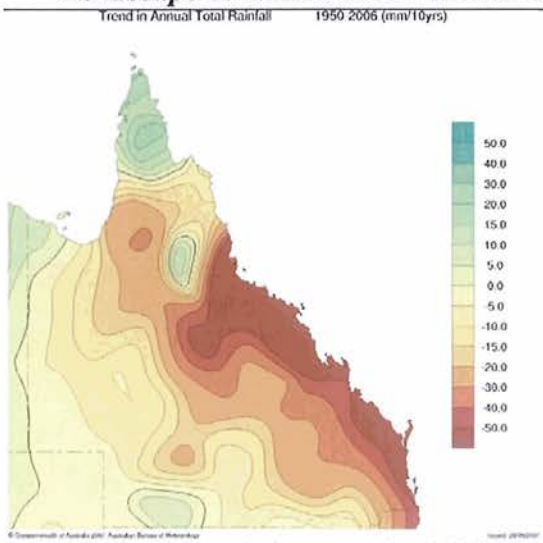


Figure S1.5 Trends in annual rainfall (mm/decade) in Queensland from 1950 to 2006.

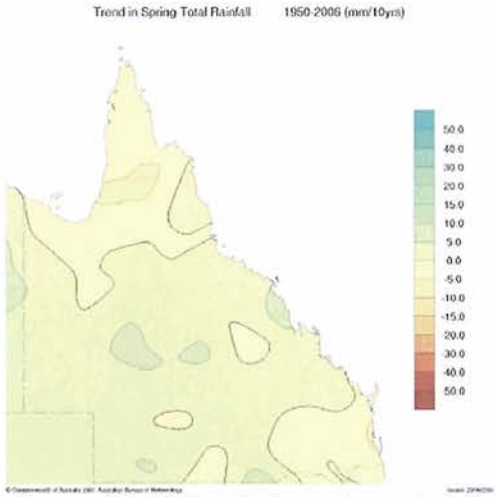


Figure S1.6 Trends in spring rainfall (mm/decade) in Queensland from 1950 to 2006.

Pan evaporation

Annual pan evaporation has increased from 5 to 15 mm per year since 1970 across the Broadsound, reducing to about 5 mm per year in summer, up to 2.5 mm per year in autumn, not changed or even decreased slightly in winter (0 - -2.5 mm/ year) and remaining constant or increasing slightly in spring (0 – 2.5mm/year).

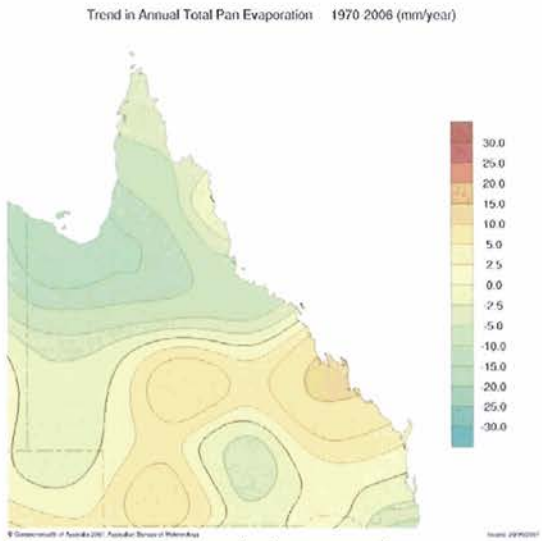


Figure S1.7 Trends in annual pan evaporation in Queensland from 1970 to 2006.

Sea level rise

Baseline sea level monitoring is monitored at 15 Australian mainland sea level monitoring stations. Two of these are located on Queensland's east coast – at Rosslyn Bay (near Yeppoon) and Cape Ferguson (near Townsville). The average rate of sea level rise from 1961 to 2003 is 1.8 +/- 0.5 mm/year (about 76mm in total) although the rate varies significantly and, for example, rates of greater than 3 mm per year have been measured. The overall trend since 1991 at Rosslyn Bay and 1992 at Cape Fergusson to 2007 is 1.2 and 2.5 mm per year respectively (National Tide Centre 2007).

Wind speeds

Trends in wind speed are difficult to determine, but are considered important in understanding climate change (CSIRO 2007). Along the Broadsound coast there have been colloquially associated with increased tidal flooding of saline grazing lands, erosion patterns in mangroves and changes in seagrass assemblages and associated sediments. Wind speed is also a critical element in establishing the rate of evaporation of water from dams and soil as well as water loss from crops and native vegetation (Specht and Specht, 2002, Roderick *et al.* 2007)

Wentz *et al.* (2007) report a slow increase in ocean wind speed, along the tropical Queensland coast, of from 0.2 – 0.4 +/- 0.05 m/s/decade over the period from 1987 to 2006.In contrast Roderick *et al.* (2007) reports a decreasing near surface wind speed (-0.1 m/s/decade). There is clearly a conflict. A review of online historical wind strength data (3.00 pm monthly average) for Gladstone (location 039123 Gladstone Radar), Herron Island (location 039122 Heron Island Research Station), St Lawrence (location 033056 St Lawrence Post Office) and Mackay (location 033119 Mackay meteorological office) allow some insight into changes in wind conditions (Table S1). St Lawrence and Mackay records suggest decreasing wind speeds while Heron Island and Gladstone suggest increasing wind speeds. Wind direction and strength is influenced by local topography and coastlines and together with broader weather conditions and hydrodynamics will affect wave heights and behaviour. A detailed analysis with an understanding of local conditions will be required to understand the impact on the complex Broadsound coastline. It is probable, however, that minor coastal changes may occur during prolonged periods of above and below average winds.

Table S.1 Runs in above and below average wind strengths (annual monthly mean compared against long term averages) influencing the Broadsound coast. (from http://www.bom.gov.au/jsp/ncc/cdio/cvg/av)

Location	Above average years	Average and above years	Average years	Average and below years	Below average years
location 039123 Gladstone Radar	1999-2007 (9y)	1977-1988 (12y) 1993-1998 (6y)		1966-1976 (11y) 1989-1992 (4y)	
location 039122 Heron Island Research Station		1962-1973 (12y) 1999-2006 (7y)		1974-1978 (5y)	
location 033056 St Lawrence Post Office	1957-1965 (9y)		1967-1972 (6y) 1994-1999 (6y)		1973-1992 (20y) 2000-2007 (7y)
location 033119 Mackay meteorological office	1959-1970 (12 y)	1980-1991 (12 y)	2001-2004 (4y)	1992-1998 (7y) 2005-2007 (3y)	1972-1976 (5y)

S1.3 Future changes

The International Panel on Climate Change (Hennessy *et al.* 2007), CSIRO and the Australian Bureau of Meteorology (CSIRO 2007) report on expected changes to

Australia's environment. Key predictions related to Queensland are noted below. Detailed accounts of these can be found in CSIRO (2007).

Temperature
The average Australian temperature by 2030 is expected to have increased from 0.7 to 1.2°C and coastal Queensland from between 0.7 to 0.9°C. There is, however, considerable variability in the estimates.

Precipitation
There is considerable uncertainty in the predictions on rainfall. Reported best estimates are for a general 2 – 5 percent decrease by 2030 with the greatest declines (five percent) in winter and spring. Projected precipitation change for the Broadsound region, for example, ranges from a 15 percent decline in winter to a 10 percent increase in winter.

Solar radiation
Solar radiation is not expected to change significantly.

Relative humidity
Relative humidity is expected to decline slightly (0.5 – 2%) over much of Australia. No change is expected across Queensland up to 2030, however.

Potential Evapotranspiration
Potential Evapotranspiration is predicted to increase across Australia with the greatest increases expected in northern and eastern Australia (2 – 4 %).

Drought
Droughts are predicted to occur more frequently over much of Australia. No data or likely occurrence maps have been presented in the reporting – so, no comment can be given on the applicability of the prediction to the Broadsound region.

Winds
Wind speed is expected to increase on average between two and five percent by 2030 with the greatest increases in spring.

Fire
Fire weather risk is expected to increase in south east Australia. Change in fire weather risk has not been studied elsewhere in Australia as yet.

It would be expected, however, that fire risks would increase very little above existing levels in dry tropical Queensland unless conditions conducive to increases in fuel loads occurred (*e.g.* increased rainfall).

Sea level rise
By the end of this centaury global mean sea level is predicted to rise from 18 to 59 cm with a further increase of 10 to 20 cm if Arctic and Antarctic ice caps melt faster than expected. Rises are expected to impact on mangrove and other intertidal communities with consequent impacts on fisheries and biodiversity and degrees of coastal protection. Recent data indicates that Arctic ice is melting at a much greater rate than modeled so sea level rises at the larger extent of predictions are being anticipated.

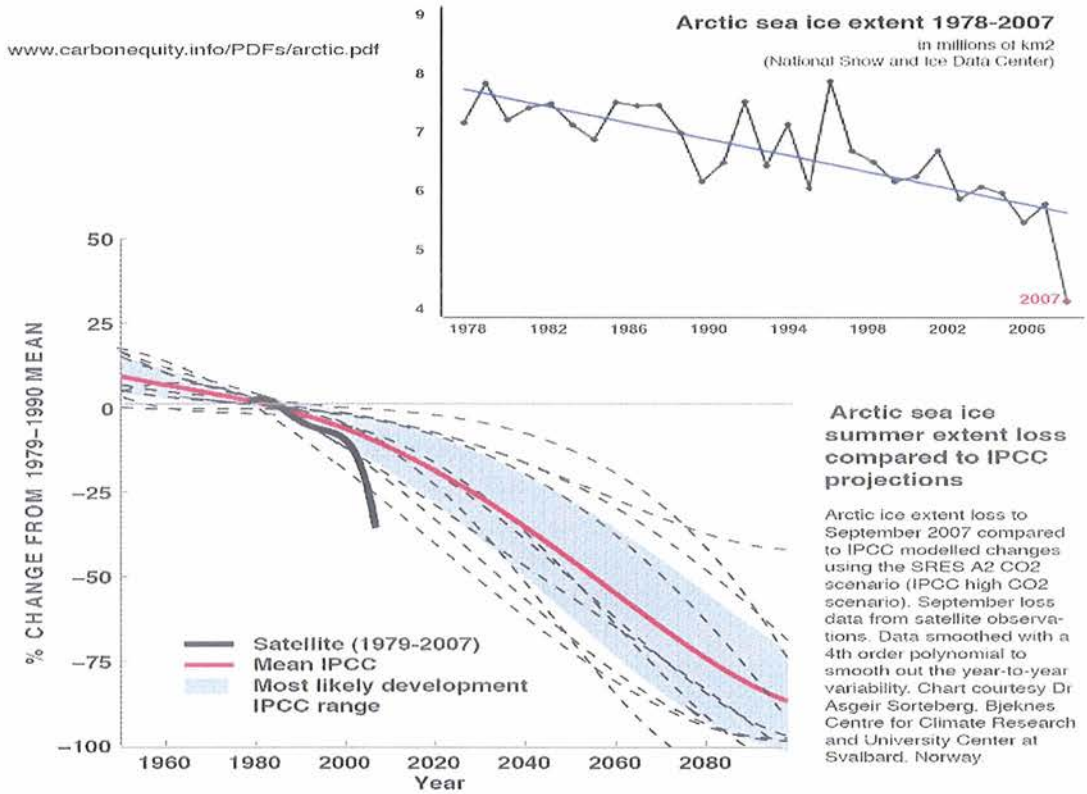


Figure S1.8 Analysis of the loss of the Arctic ice sheet from satellite imagery has revealed a precipitous decline in the extent of summer ice in the last 12 months – well beyond the range of predictions. **Graphic courtesy of Professor Miles, Institute for Sustainable Development.**

The impact of these forecast rises is expected to be exacerbated through the influence of tide, wave and storm surge.

Sea surface temperatures

The predicted annual change in sea surface temperature by 2030 is between 0.6 and 0.8°C.

Tropical Cyclones

There is considerable uncertainty about future changes in cyclone occurrence with two of the three Australian studies suggesting no significant change by 2050. The third study suggests a widespread decrease in west coast cyclones and some increase on the east tropical coast. All three studies, however, predicted an increase of 60% in the intensity of cyclonic storms by 2030.

S1.4 Implications for Broadsound

The expected changes in relation to rainfall, temperature and fire are unlikely to result in significant changes in Broadsound economy, rural culture or infrastructure management. The region is already well adapted to managing in the face of uncertain rainfall and extended dry conditions.

There are two areas of risk.

Firstly the ongoing reduced rainfall, extended dry seasons will see an increase in the extent and duration of conditions where reduced or absent land cover occurs. In conjunction with periodic more intense rainfall events these conditions are likely to result in an increase in erosion and sediment transport to the coast. A review of land

management practice to consider land use practice that maintains land condition and downstream water quality may be warranted.

Secondly large areas (over 83,000 ha) of the region lie very close to or below astronomical high tide. Of this over 55,000 ha is involves in beef production. The largest areas at risk are in the Herbert Creek (table 7.6) and Waverley Creek (table 7.4) catchments. The use of sea walls of various sizes and standards of construction have been established over many kilometers of coastline. This infrastructure is likely be challenged by rising sea levels, wave erosion and storm surge over the next 20 to 50 years. Unprotected coastal flats are probably in recession reflecting the 76mm tide rise since 1961. Two detailed cases are currently being studied and will be reported on in early 2008. In these studies, fine scale altitudinal data will be used to develop a digital terrain model of the target properties. These will be used to predict the extent of sea level incursion associated with forecast sea level changes.

Over 717 ha of conservation tenure across the Waverley Creek, Styx River, Herbert Creek and Stanage Coast will be impacted.

Table S1.2 Area of land tenures across the Broadsound basin most at risk from rising sea levels and associated tides, waves and storm surges. **Derived from cadastral boundaries overlying bioregional land zones 1 and 2 (EPA 2007)**

Broadsound Basin	**area (ha)**
community and public reserves	273.53
Easements	0.21
Free hold	41822.65
Leasehold	13470.77
National park	717.63
roads, creeks, mangroves	26650.64
State land	173.17
total	83108.63

Table S1.3 Area of land tenures across the Clairview Creek catchment most at risk from rising sea levels and associated tides, waves and storm surges. **Derived from cadastral boundaries overlying bioregional land zones 1 and 2 (EPA 2007)**

Clairview Creek catchment	**area (ha)**
community and public reserves	1.88
Free hold	326.15
Leasehold	58.23
roads, creeks, mangroves	2645.21
sub-total	3031.47

Table S1.4 Area of land tenures across the St Lawrence Creek catchment most at risk from rising sea levels and associated tides, waves and storm surges. **Derived from cadastral boundaries overlying bioregional land zones 1 and 2 (EPA 2007)**

St. Lawrence Creek catchment	**area (ha)**
community and public reserves	254.35
Easements	0.21
Free hold	2952.21
Leasehold	1281.20
roads, creeks, mangroves	1265.79
State land	72.20
sub total	5825.95

Table S1.5 Area of land tenures across the Waverley Creek catchment most at risk from rising sea levels and associated tides, waves and storm surges. **Derived from cadastral boundaries overlying bioregional land zones 1 and 2 (EPA 2007)**

Waverley Creek catchment	area (ha)
community and public reserves	0.02
Free hold	9689.47
Leasehold	1608.05
National park	113.54
roads, creeks, mangroves	4897.56
State land	0.31
sub-total	16308.95

Table S1.6 Area of land tenures across the Styx River catchment most at risk from rising sea levels and associated tides, waves and storm surges. **Derived from cadastral boundaries overlying bioregional land zones 1 and 2 (EPA 2007)**

Styx River catchment	area (ha)
Free hold	2966.61
Leasehold	1917.36
National park	59.58
roads, creeks, mangroves	5778.75
sub-total	10722.28

Table S1.7 Area of land tenures across the Herbert Creek catchment most at risk from rising sea levels and associated tides, waves and storm surges. **Derived from cadastral boundaries overlying bioregional land zones 1 and 2 (EPA 2007)**

Herbert Creek catchment	area (ha)
community and public reserves	17.29
Free hold	25670.73
Leasehold	8597.60
National park	29.85
roads, creeks, mangroves	12015.95
State land	79.70
sub-total	46411.13

Table S1.8 Area of land tenures across the Stanage Coast catchment most at risk from rising sea levels and associated tides, waves and storm surges. **Derived from cadastral boundaries overlying bioregional land zones 1 and 2 (EPA 2007)**

Stanage Coast catchment	area (ha)
Free hold	217.49
Leasehold	8.33
National park	514.67
roads, creeks, mangroves	47.38
State land	20.97
sub-total	808.84

S2 Terrestrial field assessment and photo points

S2.1 Methods

Site selection was determined by land holder permission, accessibility, land form and current land use. Areas of state land and parks or recreational areas were targeted to provide some indication of baseline conditions from a biodiversity perspective. National and Conservation Parks were accessed under permissions from the Environmental Protection Agency, permit number WITK04549807. State Forests were accessed under permit number ROC4500.

Sites were assessed on creeks and/or rivers, associated river flats, as well as the inland slopes and hills of the catchment. Current land use was also taken into consideration. The extent of sampling, range of situations and conditions was determined by permission to access properties. No land was accessed where permission had not been provided.

Each site was marked with a star picket labelled with the site number and project details as well as contact details for the researchers (FBA/CQU Broadsound Basin Assessment, Alistair Melzer 49232297). Site locations were noted using a Garmin GPS 12XL, coordinates were recorded in decimal degrees using GeoDatum Australia 1994 (GDA94). Following field assessments, sites were mapped using ESRI ArcMap 9.0, mapped Regional Ecosystems determined from RE Mapping 2003 (from the Queensland Herbarium and Environmental Protection Agency), and land tenure confirmed through DCDB Data from Department of Natural Resources and Water (2007).

Site survey areas were centred on the location of the star picket and in most cases a circular survey area was established around the picket with a radius of 25 m (approximately 1960 m^2). In denser vegetation the radius was reduced to 10 m (approximately 315 m^2), and in riparian vegetation or along gully lines the site was assessed within the width of the vegetation for approximately 50 m along the creek or gully (approximately 1000 m^2). In each instance the details were noted and appropriate calculations were made to extrapolate data to be based on one hectare (10 000 m^2) to allow site comparisons.

From the star picket four photographs were taken looking toward the perimeter of the site in four directions (north, east, south and west). Within each photo a striped pole was centered for a reference of scale for future monitoring.

S2.1.1 Site Assessments

Habitat, vegetation and site condition were assessed using the following elements.

<u>Landform</u>

Landforms were allocated using definitions from the Australian Soil and Land Survey Field Handbook (McDonald et al. 1990). Categories included:

- Crest
- Upper slope
- Mid-slope
- Lower slope
- Simple slope
- Flat
- Marine plain
- Beach dune
- Open depression
- Closed depression
- Hillock
- Ridge

Vegetation Descriptions

Vegetation was described based on the dominant plant species identified at the site. Canopy vegetation and height (measured using a clinometer), mid-storey and ground cover were noted in the field and combined with an estimate of foliage projective cover (% of canopy cover) to determine the structural formation of the community using Specht (1970), with the modified table below (Table 1). Dominant species were also determined using an assessment of basal area. A Basal Area Wedge was used to determine the area of stems per hectare. Each species contribution to the biomass was recorded and used to determine dominance within the community.

Table S2.1 Structural formation of vegetation communities (from Specht 1970)

Tallest Stratum	**Foliage Projective Cover of tallest stratum**				
	100-70%	70-50%	50-30%	30-10%	<10%
Trees > 30m	Tall closed forest	Tall forest	Tall open forest	Tall woodland	
Trees 10-30m	closed forest	Forest	Open forest	Woodland	Open woodland
Trees <10m	Low closed forest	Low forest	Low open forest	Low woodland	Low open woodland
Shrubs > 2m	Closed scrub	Scrub	Open scrub	Tall shrubland	Tall open shrubland
Herbs	Closed herbland	Herbland	Herbland	open herbland	very open herbland

Vegetation and Habitat Assessments

Within the site area (described above) a count was conducted to determine tree, sapling and shrub density (per ha), tree hollow and log density (per ha) as well as the density (per ha) of declared weeds, as follows:

Tree density - All live stems > 10cm dbh (diameter at breast height) were counted and the species of each noted.

Sapling density - Species noted as trees (as above) but had a dbh < 10 cm were considered saplings. Each live plant was counted and allocated to height classes of <1 m, 1-2 m, and >2 m.

Shrub density - any mid-storey native species not counted as a sapling (as above) were considered a shrub. These were also allocated to height classes of <1 m, 1-2 m, and >2 m.

Tree hollows - any trees within the site area that had hollows were counted. These included stags and were recorded as such.

Log density - All logs within the site area were counted and recorded. Categories of size (>10 to <20 cm, 20-50 cm and >50 cm radius) and classed as solid or hollow.

Weed density - Any introduced woody species listed as a Declared Plants of Queensland (NRW) were counted. These plants require a level of control or eradication by the landowners or managers as declared under the *Land Protection (Pest and Stock Route Management) Act 2002*. All declared plants are also considered weeds of national significance (WONS) (Australian Weeds Committee 2007).

Ground Cover

From the center star picket an area within a smaller 10 m radius was assessed for ground cover. Visual estimates of cover were made for each of the following categories:

- Bare ground

    - Bare soil
    - Soil covered by rock
- Litter cover
    - Fine litter (leaves and twigs)
    - Coarser litter (sticks, etc. between 2.5 - 10 cm)
    - Log litter (wood > 10 cm diameter
- Forb cover
    - Grass
    - Herbs
    - Low shrubs (only if forming part of the ground cover - usually below 0.5m)

General site characteristics

Further notes were made about the bearing slope of the land at the site (measured with a clinometer) and the aspect of the slope (using a compass). Any rock formations in the area were recorded.

A description of the soil was also made. pH was measured at three spot locations within a close vicinity to the star picket and the type and colour of the soil recorded. Soil cracks and the presence of water nearby were also noted where applicable.

Disturbance and other factors such as any environmental weeds or forbs, any weeds of national significance that are not declared in Queensland, any erosion, logging, fire or other parameters affecting the habitat or vegetation structure at the site were recorded.

S2.2 Site Summary Descriptions

Site sheets are presented summarising the characteristics at each of the sites assessed. They are ordered by catchment (north to south) and sites within each catchment reported from the headwaters to the coast (west to east). The number of sites within each catchment is shown in Table S2.2. The distribution and location of sites was determined by property permissions and access. Distribution was uneven among and within catchments. This has precluded a comparison among catchments. Consequently consideration of the data has been undertaken for the greater Broadsound basin. Summary statistics in terms of land use are presented in table S2.3.

Those parameters characteristic of wooded landscapes (overstorey foliage projective cover, midstorey cover, basal area, stem density, sapling density, shrub density, hollow tree and log density) were least where land had been cleared to facilitate grassland grazing. Stem density was higher than might be expected but this reflects the retention of vegetation especially along some drainage lines. Major fauna habitat features (tree hollows and fallen logs) had a lower density than that occurring in reserves and on conservation tenure. There was also a low density of native shrubs and, conversely the highest density of woody weeds (lantana and rubber vine) in these grazed woodlands.

Ground cover was generally high across all land use categories. It was greatest in local government reserves (95%) and lowest in grazed grasslands and conservation reserves (68-71%). This high cover reflects the timing of the field surveys (following good summer and winter rains and early spring showers). The nature of that cover varied among land use classes. Litter cover was least in the grazed grasslands while grass cover was greatest in the grazed grasslands and the ungrazed reserves. Grass cover was least in the grazed woodlands and the conservation tenures. Cover from other herbaceous species was greatest in the conservation tenures but also relatively high in the grazed woodlands.

Generally the conservation tenures and reserves contained a set of habitat features likely to support complex faunal assemblages. Overall land cover was good in the post wet season environment. The low litter cover, high grass cover and relatively high extent of bare ground in the grasslands makes this part of the landscape vulnerable to overgrazing. Poorly managed grazing regimes are likely to produce extensive bare ground at the end of the growing season and an associated erosion risk with the resumption of wet season rains.

Table S2.2 Site numbers within catchments

Catchment	Area (ha)	Sites / catchment
Clairview Creek	27222.73	12
St Lawrence Creek	40534.73	13
Waverley Creek	59172.15	none
Styx River	174568.61	12
Herbert Creek	188021.30	8
Stanage Coast	7590.11	6

Table S2.3 Comparison of structural environmental characteristics among land use types within the Broadsound basin.

Parameter	Land use	Site numbers	Mean	Minimum	Maximum	Standard error
Overstorey FPC (%)	Grassland grazing	7	1.71	0.00	8.00	1.10657
	Woodland grazing	21	18.00	0.00	45.00	2.61406
	Reserve	4	32.50	20.00	50.00	7.50000
	Conservation	15	15.00	0.00	80.00	5.9161
Total midstory cover (%)	Grassland grazing	7	2.43	0.00	10.00	1.36027
	Woodland grazing	21	25.57	0.00	60.00	3.90943
	Reserve	4	39.75	22.00	60.00	9.54267
	Conservation	15	21.13	0.00	85.00	6.6453
Basal Area (m^2/ha)	Grassland grazing	7	2.14	0.00	7.00	1.14286
	Woodland grazing	22	8.27	0.00	18.00	0.90497
	Reserve	4	8.75	4.00	13.00	1.88746
	Conservation	15	5.80	0.00	11.00	0.8000
Stem density >10cm (no./ha)	Grassland grazing	7	118.05	0.00	432.08	71.52279
	Woodland grazing	22	271.45	5.09	641.34	37.67301
	Reserve	4	357.98	157.79	534.45	96.24003
	Conservation	15	198.13	0.00	608.02	39.9810
Sapling density <10cm (no./ha)	Grassland grazing	7	12.05	0.00	49.10	7.13483
	Woodland grazing	22	113.03	0.00	407.20	24.77688
	Reserve	4	98.99	0.00	285.04	64.26251
	Conservation	15	223.95	0.00	1718.82	113.6450
Native shrub density (no./ha)	Grassland grazing	7	109.71	10.18	178.15	23.78241
	Woodland grazing	22	180.17	0.00	682.06	41.07651
	Reserve	4	235.25	91.62	417.38	71.57407
	Conservation	15	465.67	0.00	1877.97	173.9616
Hollow tree density (no./ha)	Grassland grazing	7	7.74	0.00	39.28	5.44617
	Woodland grazing	21	7.76	0.00	35.63	2.23858
	Reserve	4	23.91	20.36	29.46	2.20566
	Conservation	14	19.51	0.00	70.70	6.4140
Log density (no./ha)	Grassland grazing	7	35.38	0.00	108.02	16.17978
	Woodland grazing	22	79.68	0.00	351.21	16.88651
	Reserve	4	239.96	58.92	376.66	74.47191
	Conservation	15	129.74	0.00	324.06	24.0973
Weed (lantana, rubber vine, prickly pear) density (no./ha)	Grassland grazing	7	35.80	0.00	206.22	28.91891
	Woodland grazing	22	307.15	0.00	1177.71	79.72429
	Reserve	4	48.19	5.09	157.12	36.62658
	Conservation	15	166.90	0.00	1241.37	92.7597
Bare ground (%)	Grassland grazing	7	32.14	0.00	69.00	11.92123
	Woodland grazing	22	22.86	1.00	60.00	3.71920
	Reserve	4	5.00	5.00	5.00	0.00000
	Conservation	15	29.07	0.00	83.00	6.5024
Litter cover (%)	Grassland grazing	7	12.43	1.00	35.00	4.86903
	Woodland grazing	22	43.27	1.00	89.00	5.50921
	Reserve	4	36.25	10.00	65.00	13.90069
	Conservation	15	37.07	0.00	79.00	6.6551
grass cover (%)	Grassland grazing	7	49.57	23.00	89.00	9.94953
	Woodland grazing	21	21.52	1.00	74.00	4.72865
	Reserve	4	36.50	20.00	73.00	12.27803
	Conservation	13	20.85	2.00	90.00	6.4538
herb cover (%)	Grassland grazing	6	6.00	1.00	16.00	2.19089
	Woodland grazing	20	10.05	1.00	40.00	2.48307

	Reserve	4	6.25	5.00	10.00	1.25000
	Conservation	14	14.29	1.00	93.00	6.9515
low shrub (<0.5m) cover (%)	**Grassland grazing**	4	1.25	0.00	2.00	0.47871
	Woodland grazing	15	3.40	1.00	20.00	1.25281
	Reserve	4	16.00	2.00	55.00	13.01922
	Conservation	9	4.11	1.00	25.00	2.6164
Average grass height (cm)	**Grassland grazing**	7	21.00	5.00	50.00	6.56832
	Woodland grazing	19	13.68	5.00	40.00	2.38300
	Reserve	4	33.75	5.00	80.00	16.25000
	Conservation	13	21.31	5.00	50.00	3.7950

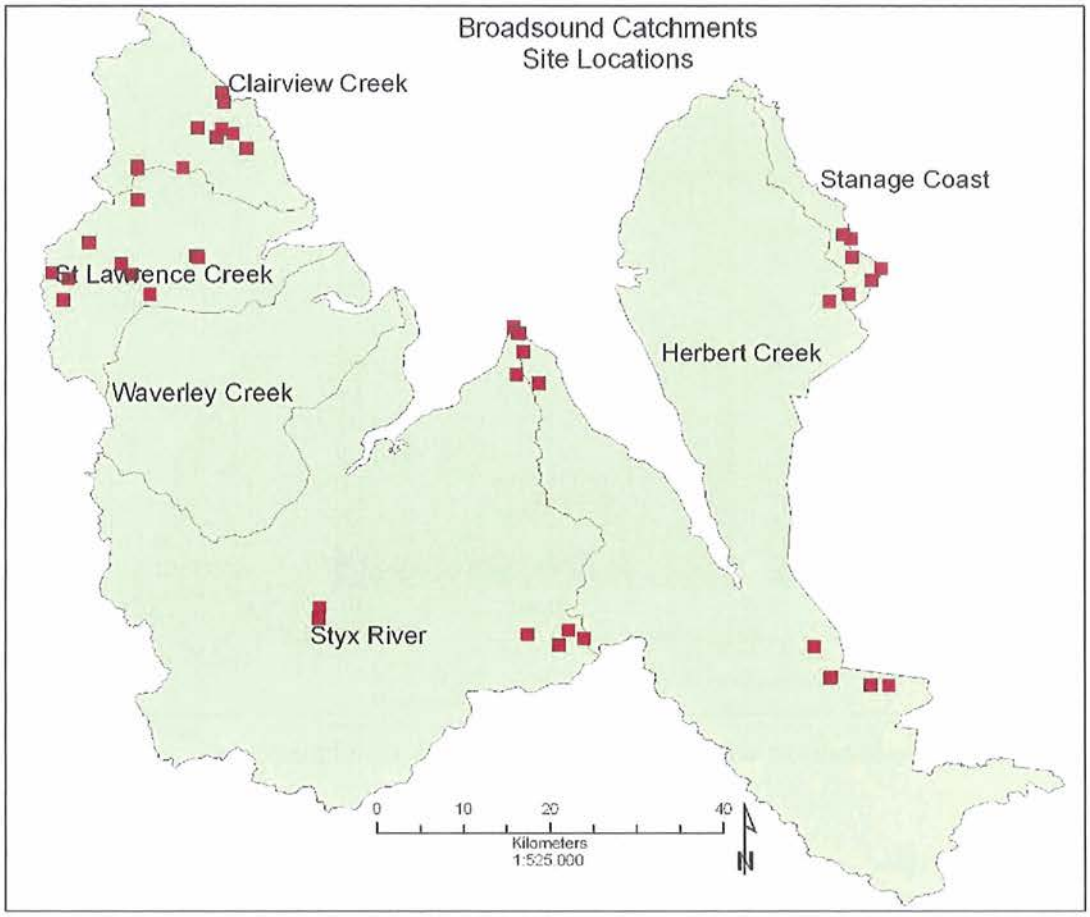


Figure S2 1 Site locations within the Broadsound Basin

S2.2.1 Clairview Creek Catchment

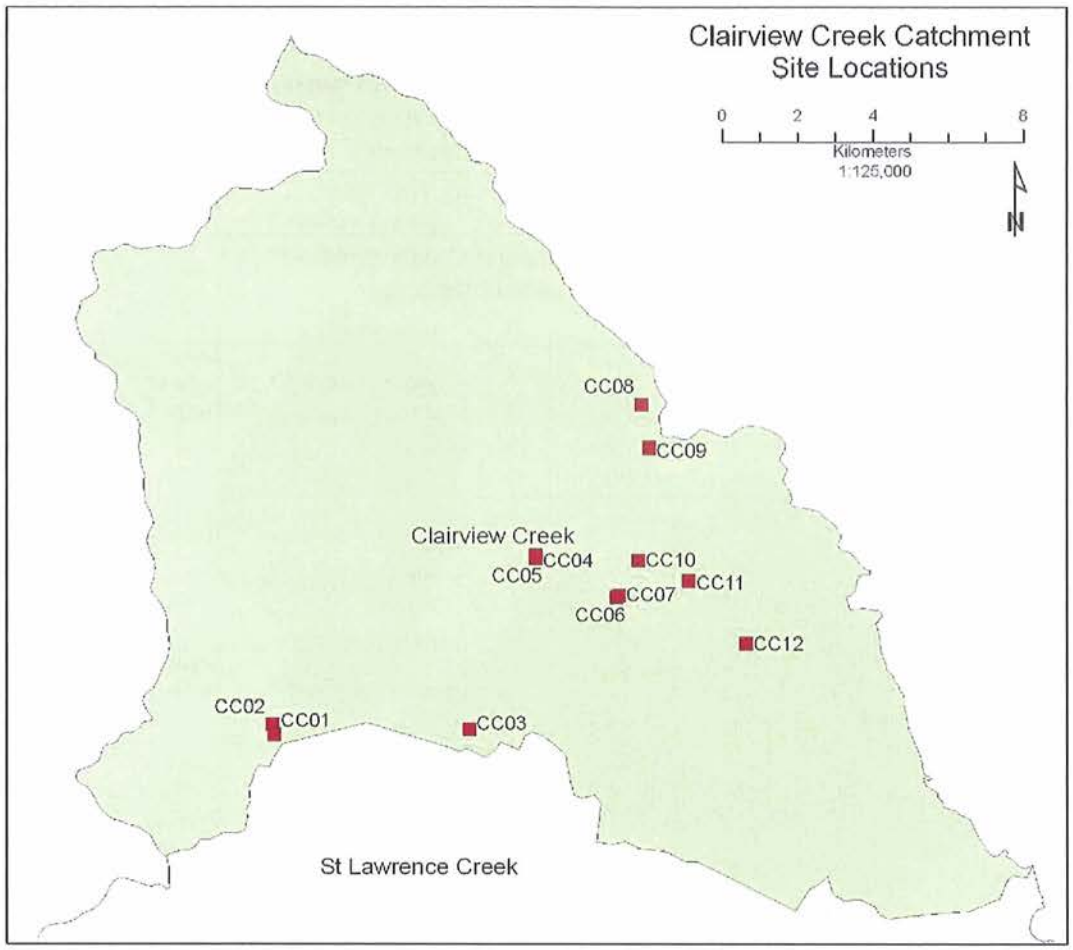


Figure S2.2 Site locations within the Clairview Creek Catchment

Site CC01 — *Clairview Creek Catchment*

Landform	***Lower Slope***
Tenure	***Free Hold, 28 MC46***
Current land use	***Buffer surrounding Timber Plantation***
Lat & Long	***-22.22069, 149.41726*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) open woodland on lower slopes with occasional *E. melanophloia* (silver-leaf iron bark) and *Corymbia tessellaris* (Morton Bay ash) over a grassy and herbaceous ground cover.
Mapped Regional Ecosystem Status	Non-remnant
Vegetation assessment	
Tree density	137.43 per ha
Sapling density	55.99 per ha
Shrub density	10.18 per ha
Tree hollows	none
Log density	35.63 per ha
Declared weeds	534.45 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	35% (30% bare soil, 5% rocks)
Litter	38% (32% fine litter, 5% coarser litter, 1% log litter)
Forbs	27% (5% grass, 20% herbs, 2% low shrubs)
Site disturbances/weeds and other notes	Very light grazing, and extensive weed infestation of *Lantana camara*, *Stachytarpheta jamaicensis* (snakeweed) (WONS) and *Megathyrsus maximus* (Guinea grass)
Other plant species	*Lophostemon confertus* (brush box), *Cycas media* subsp. *media* (cycad)

Site CC02 — *Clairview Creek Catchment*

Landform	***Creek***
Tenure	***Free Hold, 28 MC46***
Current land use	***Buffer surrounding Timber Plantation***
Lat & Long	***-22.21836, 149.41688*** *(GDA94)*


North


East


South


West

Vegetation description	*Melaleuca bracteata* (river teatree), *Casuarina cunninghamiana* (river oak) and *Eucalyptus tereticornis* (forest red gum) open riparian woodland with some notophyll rain forest species in the midstorey with grassy cover on the banks and gravel in the creek bed
Mapped Regional Ecosystem	11.3.25b / 8.3.1a - *Eucalyptus tereticornis* or *E. camaldulensis* (river red gum) woodland fringing drainage lines / Semi-deciduous notophyll / mesophyll vine forest fringing watercourses
Status	Not of concern / of concern
Vegetation assessment	
Tree density	239.23 per ha
Sapling density	285.04 per ha
Shrub density	254.50 per ha
Tree hollows	10.18 per ha
Log density	55.99 per ha
Declared weeds	453.01 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	40% (5% bare soil, 35% rocks)
Litter	23% (13% fine litter, 5% coarser litter, 5% log litter)
Forbs	37% (2% grass, 30% herbs, 5% shrubs)
Site disturbances/weeds and other notes	Severe weed infestation, with *Stachytarpheta jamaicensis* (snakeweed) (WONS) up to 2m tall amongst *Lantana camara* and *Megathyrsus maximus* (Guinea grass).
Other plant species	*Corymbia tessellaris* (Moreton Bay ash), *Planchonia careya* (cocky apple), *Melia azedarach* (white cedar), *Macaranga* sp. (macaranga), *Mallotus phillipensis* (red kamala), *Paraserianthes toona* (Mackay cedar), *Lomandra* sp (mat rush), *Hibiscus* sp. (hibiscus)

Site CC03 — *Clairview Creek Catchment*

Landform	***Lower Slope***
Tenure	***Free Hold, 8 SP183679***
Current land use	***Buffer of Timber Plantation & Grazing***
Lat & Long	***-22.21950, 149.46397*** *(GDA94)*


North


East


South


West

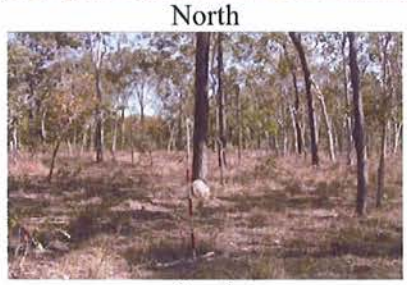
Vegetation description	Open forest of *Eucalyptus platyphylla* (poplar gum) and *Lophostemon* sp. (box tree) with mid-dense midstorey of *Acacia* sp. (wattle) and other scrub species and little ground cover.
Mapped Regional Ecosystem	11.3.29 - *Eucalyptus crebra* (narrow-leaf iron bark), *E. exserta* (Queensland peppermint), *Melaleuca* spp. (paperbark) woodland on alluvial plains
Status	Not of concern
Vegetation assessment	
Tree density	223.96 per ha
Sapling density	132.34 per ha
Shrub density	463.19 per ha
Tree hollows	none
Log density	30.54 per ha
Declared weeds	325.76 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	17% (2% bare soil, 15% rocks)
Litter	75% (72% fine litter, 3% coarser litter)
Forbs	8% (2% grass, 5% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Plantation timber and graded fence line/fire break near by, current light grazing. Other weeds include: *Stachytarpheta jamaicensis* (snake weed) (WONS)
Other plant species	*Eucalyptus tereticornis* (forest red gum), *Acacia* spp. (wattle), *Corymbia tessellaris* (Morton Bay ash), *Melia azedarach* (white cedar), *Cupaniopsis anacardioides* (tuckeroo), *Macaranga tanarius* (macaranga or nasturtium tree), *Mallotus phillipensis* (red kamala), *Alphitonia excelsa* (soap bush), *Diospyros geminata* (ebony), *Amyema* sp. (mistletoe), *Cycas* sp. (cycad), *Exocarpus latifolius*, *Lomandra* sp. (mat rush)

Site CC04 — *Clairview Creek Catchment*

Landform	***Flat***
Tenure	***Free Hold, 9 MC461***
Current land use	***Grazing***
Lat & Long	***-22.17778, 149.47989*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaf iron bark) woodland with occasional *Eucalyptus platyphylla* (poplar gum) and *Corymbia* sp. (bloodwood) with isolated shrubby elements in the midstorey and grassy ground cover
Mapped Regional Ecosystem	11.3.29x1/11.3.4 - *Eucalyptus crebra*, *E. exserta* (Queensland peppermint), *Melaleuca* spp. (paperbark) woodland on alluvial plains / *Eucalyptus tereticornis* (forest red gum) and/or *Eucalyptus* spp. tall woodland on alluvial plains
Status	Not of concern / of concern
Vegetation assessment	
Tree density	381.75 per ha
Sapling density	81.44 per ha
Shrub density	111.98 per ha
Tree hollows	none
Log density	71.26 per ha
Declared weeds	30.54 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	15% (bare soil)
Litter	50% (38% fine litter, 10% coarser litter, 2% log litter)
Forbs	35% (30% grass, 3% herbs, 2% low shrubs)
Site disturbances/weeds and other notes	Current intensive grazing, evidence of an old fire, evidence of feral pigs. Many small depressions (wet for some time after rain)
Other plant species	*Planchonia careya* (cocky apple), *Corymbia tessellaris* (Morton Bay ash), *Melaleuca* spp., *Heteropogon contortus* (spear grass). Cyperaceae (rush) dominant in depression areas, *Cycas media* subsp. *media* (cycad) present away from site.

Site CC05 — *Clairview Creek Catchment*

Location	***Clairview Creek***
Landform	***Creek***
Tenure	***Free Hold, 9 MC461***
Current land use	***Grazing***
Lat & Long	***-22.17844, 149.48002*** *(GDA94)*


North


East


South


West

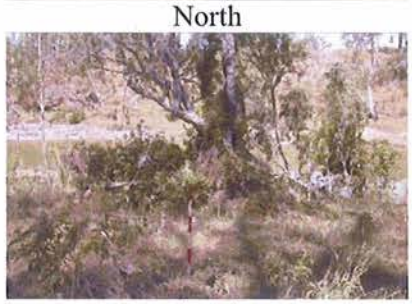
Vegetation description	*Melaleuca leucadendra* (weeping paperbark) and *Casuarina cunninghamiana* (river oak) open forest with midstorey of semi-deciduous notophyll / mesophyll vine forest dominated by *Terminalia sericocarpa* (damson), *Nauclea orientalis* (Liechhardt tree) and *Mallotus phillipensis*, (red kamala) with little ground cover.
Mapped Regional Ecosystem	11.3.25b / 8.3.1a - *Melaleuca leucadendra* and/or *M. fluviatilis* (fine leaf paperbark), *Nauclea orientalis* open forest / Semi-deciduous (complex) notophyll / mesophyll vine forest
Status	Not of concern / of concern
Vegetation assessment	
Tree density	157.79 per ha
Sapling density	none
Shrub density	40.72 per ha
Tree hollows	15.27 per ha
Log density	10.18 per ha
Declared weeds	1177.71 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	7% (bare soil)
Litter	80% (69% fine litter, 10% coarser litter, 1% log litter)
Forbs	13% (2% grass, 10% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Current grazing and severe lantana infestation. Other weeds include: *Xanthium pungens* (noogoora burr) (WONS) and *Stachytarpheta jamaicensis* (snake weed) (WONS)
Other plant species	*Callistemon viminalis* (Weeping bottlebrush), *Cupaniopsis anacardioides* (tuckeroo), *Diospyros geminata* (ebony), *Planchonia careya* (cocky apple), *Eustrephus latifolius* (wombat berry), *Cheilanthes* sp. (rock fern), *Cycas media* subsp. *media*

Site CC06 — *Clairview Creek Catchment*

Location	***Clairview Creek***
Landform	***Creek***
Tenure	***None (creek reserve)***
Current land use	***Grazing***
Lat & Long	***-22.18777, 149.49909*** *(GDA94)*


North


East


South


West

Vegetation description	Mixed riparian open woodland with *Eucalyptus crebra* (narrow-leaf iron bark), *Corymbia tessellaris* (Morton Bay ash) and *Callistemon viminalis* (weeping bottlebrush) dominant with grassy ground cover. Thin strip of mangrove species lining waters edge.
Mapped Regional Ecosystem	11.3.25b/8.3.1a - *Melaleuca leucadendra* (white paperbark) and/or *M. fluviatilis* (fine leaf paperbark), *Nauclea orientalis* (Liechhardt tree) open forest / Semi-deciduous (complex) notophyll / mesophyll vine forest
Status	Not of concern / of concern
Vegetation assessment	
Tree density	636.30 per ha
Sapling density	84.84 per ha
Shrub density	56.56 per ha
Tree hollows	none
Log density	70.70 per ha
Declared weeds	509.04 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3),
Ground cover	
Bare ground	10% (1% bare soil, 9% rocks)
Litter	15% (fine litter)
Forbs	75% (65% grass, 5% herbs, 5% low shrubs)
Site disturbances/weeds and other notes	Flood damage, and current grazing. Highway about 100m from site, many environmental weed species, including: *Megathyrsus maximus* (Guinea grass), *Stachytarpheta jamaicensis* (WONS), *Xanthium pungens* (noogoora burr) (WONS)
Other plant species	*Eucalyptus platyphylla* (poplar gum), *Pandanus tectorius* (screw pine)

Site CC07 — *Clairview Creek Catchment*

Landform	***Flat***
Tenure	***Free Hold, 9 MC641***
Current land use	***Timber plantation & Grazing***
Lat & Long	***-22.18726, 149.49970*** *(GDA94)*


North


East


South


West

Vegetation description Mapped Regional Ecosystem	Low open woodland of *Corymbia citriodora* (lemon scented gum) Non remnant
Vegetation assessment	
Tree density	111.98 per ha
Sapling density	none
Shrub density	none
Tree hollows	none
Log density	none
Declared weeds	636.60 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	10% (bare soil)
Litter	20% (18% fine litter, 2% coarser litter)
Forbs	70% (43% grass, 25% herbs, 2% low shrubs)
Site disturbances/weeds and other notes	Furrowed rows with planted timber species (uneven ground), current grazing and many herbaceous weed species: *Megathyrsus maximus* (Guinea grass), *Stachytarpheta jamaicensis* (snake weed) (WONS), *Melinis repens* (red natal grass)
Other plant species	

Site CC08 — *Clairview Creek Catchment*

Landform	***Lower Slope***
Tenure	***Free Hold, 9 MC461***
Current land use	***Grazing***
Lat & Long	***-22.14161, 149.50511*** *(GDA94)*


North


East

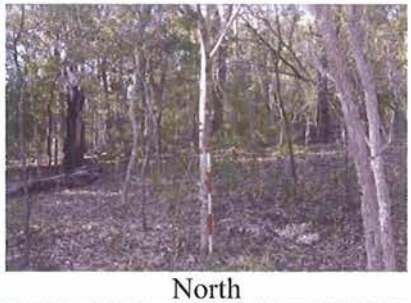

South


West

Vegetation description	*Acacia* sp. (wattle) woodland with occasional *Eucalyptus crebra* (narrow leaf iron bark), sparse midstorey and scrubby lower strata with little ground cover.
Mapped Regional Ecosystem	Non-remnant
Vegetation assessment	
Tree density	117.07 per ha
Sapling density	132.34 per ha
Shrub density	40.72 per ha
Tree hollows	none
Log density	40.72 per ha
Declared weeds	795.75 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	53% (bare soil)
Litter	5% (4% fine litter, 1% coarser litter)
Forbs	42% (1% grass, 40% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Current grazing
Other plant species	*Alphitonia excelsa* (soap bush)

Site CC09 — *Clairview Creek Catchment*

Landform	*Mid slope*
Tenure	*Free Hold, 9 MC461*
Current land use	*Grazing*
Lat & Long	*-22.15194, 149.50703 (GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) open forest with little mid strata and sparse ground cover
Mapped Regional Ecosystem	8.12.22/8.12.5a - Variable woodland to open-forest usually dominated by *Eucalyptus drepanophylla* (grey ironbark), and usually at least one other *Eucalyptus* or *Corymbia* species / *Corymbia intermedia* (pink bloodwood), *E. portuensis* ± *Lophostemon* spp. (brush box) ± *Syncarpia glomulifera* (turpentine tree) ± *Banksia integrifolia* (coast banksia), open forest on Mesozoic to Proterozoic igneous rocks
Status	Not of concern / not of concern
Vegetation assessment	
Tree density	290.13 per ha
Sapling density	20.36 per ha
Shrub density	682.06 per ha
Tree hollows	15.27 per ha
Log density	81.44 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	20% (5% bare soil, 15% rocks)
Litter	75% (66% fine litter, 7% coarser litter, 2% log litter)
Forbs	5% (2% grass, 2% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Evidence of very old fire, light grazing, farm dump and waste area nearby. Glider and wallaby scats present.
Other plant species	*Alphitonia excelsa* (soap bush), *Xanthorrhoea* sp (grass tree). *Acacia falcate* (sickle wattle), *Psydrax* sp.

Site CC10 — *Clairview Creek Catchment*

Location	***Middle Creek***
Landform	***Creek Flat***
Tenure	***Free Hold***
Current land use	***Grazing***
Lat & Long	***-22.17901, 149.50437*** *(GDA94)*


North


East


South


West

Vegetation description	*Corymbia* sp. (bloodwood) open woodland with *Melaleuca bracteata* (river teatree) and scrub species in midstorey over sparse ground cover.
Mapped Regional Ecosystem	11.3.25b / 8.3.1a - *Melaleuca leucadendra* (weeping paperbark) and/or *M. fluviatilis* (Fine leaf paperbark), *Nauclea orientalis* (Liechhardt tree) open forest / Semi-deciduous (complex) notophyll/mesophyll vine forest on Cainozoic alluvial plains fringing or in vicinity of watercourses
Status	Not of concern / of concern
Vegetation assessment	
Tree density	101.80 per ha
Sapling density	40.72 per ha
Shrub density	152.70 per ha
Tree hollows	none
Log density	50.90 per ha
Declared weeds	1114.05 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3), *Cryptostegia grandiflora* (rubber vine) (WONS, Class 2)
Ground cover	
Bare ground	2% (bare soil)
Litter	50% (39% fine litter, 10% coarser litter, 1% log litter)
Forbs	48% (33% grass, 10% herbs, 5% low shrubs)
Site disturbances/weeds and other notes	Current grazing with timber plantation nearby. Environmental weeds include: *Megathyrsus maximus* (Guinea grass)
Other plant species	*Eucalyptus platyphylla* (poplar gum), *Planchonia careya* (cocky apple), *Maytenus disperma* (Orangebush), *Psydrax* sp. *Corymbia tessellaris* (Moreton Bay ash), *Ficus racemosa* (cluster fig), *Mallotus phillipensis* (red kamala), *Diospyros geminata*(ebony), *Passiflora* sp., Nearby tidal reach of Middle Creek (very steep banks) vegetated by: *Pandanus tectorius* (screw pine), *Mallotus philippensis* (red kamala), *Melaleuca* spp., *Acacia* spp., *Exocarpus latifolius*, *Panicum* sp., *Lantana camara* (lantana)

Site CC11 — *Clairview Creek Catchment*

Landform	***Flat***
Tenure	***Free Hold, 9 MC461***
Current land use	***Grazing***
Lat & Long	***-22.18392, 149.51639*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus platyphylla* (poplar gum) and *Corymbia intermedia* (pink bloodwood) dominated open forest with mid-dense midstorey of *Melaleuca viridiflora* (broad-leaved tea-tree) over grassy ground cover.
Mapped Regional Ecosystem	11.3.29x1 / 11.3.4 - *Eucalyptus crebra* (narrow-leaved ironbark), *E. exserta* (Queensland peppermint), *Melaleuca* spp. (paperbark) woodland on alluvial plains / *Eucalyptus tereticornis* (forest red gum) and/or *Eucalyptus* spp. tall woodland on alluvial plains
Status	Not of concern / of concern
Vegetation assessment	
Tree density	661.7 per ha
Sapling density	361.39 per ha
Shrub density	559.9 per ha
Tree hollows	20.36 per ha
Log density	30.54 per ha
Declared weeds	127.25 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	5% (bare soil)
Litter	65% (55% fine litter, 10% coarser litter)
Forbs	30% (20% grass, 10% herbs)
Site disturbances/weeds and other notes	Current grazing, many herbaceous weeds, evidence of old fire.
Other plant species	*Eucalyptus crebra*, *Corymbia tessellaris* (Moreton Bay ash), *Planchonia careya* (cocky apple), *Eucalyptus tereticornis*, *Cupaniopsis anacardioides* (tuckeroo), *Heteropogon contortus* (spear grass)

Site CC12 — *Clairview Creek Catchment*

Landform	***Flat***
Tenure	***Free Hold, 9 MC461***
Current land use	***Grazing***
Lat & Long	***-22.19892, 149.53018*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) open forest with midstorey of *Melaleuca viridiflora* (broad-leaved tea-tree) with little grass cover
Mapped Regional Ecosystem	11.3.29x1 / 11.3.4 - *Eucalyptus crebra*, *E. exserta* (Queensland peppermint), *Melaleuca* spp. (paperbark) woodland on alluvial plains / *Eucalyptus tereticornis* (forest red gum) and/or *Eucalyptus* spp. tall woodland on alluvial plains
Status	Not of concern / Of concern
Vegetation assessment	
Tree density	264.68 per ha
Sapling density	188.33 per ha
Shrub density	25.45 per ha
Tree hollows	35.63 per ha
Log density	162.88 per ha
Declared weeds	5.09 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	1% (bare soil)
Litter	65% (59% fine litter, 4% coarser litter, 2% log litter)
Forbs	33% (32% grass, 1% herbs)
Site disturbances/weeds and other notes	Current grazing, evidence of an old fire, evidence of selective logging. Many herbaceous weed species and grassy ground layer heavily grazed.
Other plant species	*Eucalyptus tereticornis*, *Cupaniopsis anacardioides* (tuckeroo), *Maytenus disperma* (orange bush)

S2.2.2 St Lawrence Creek Catchment

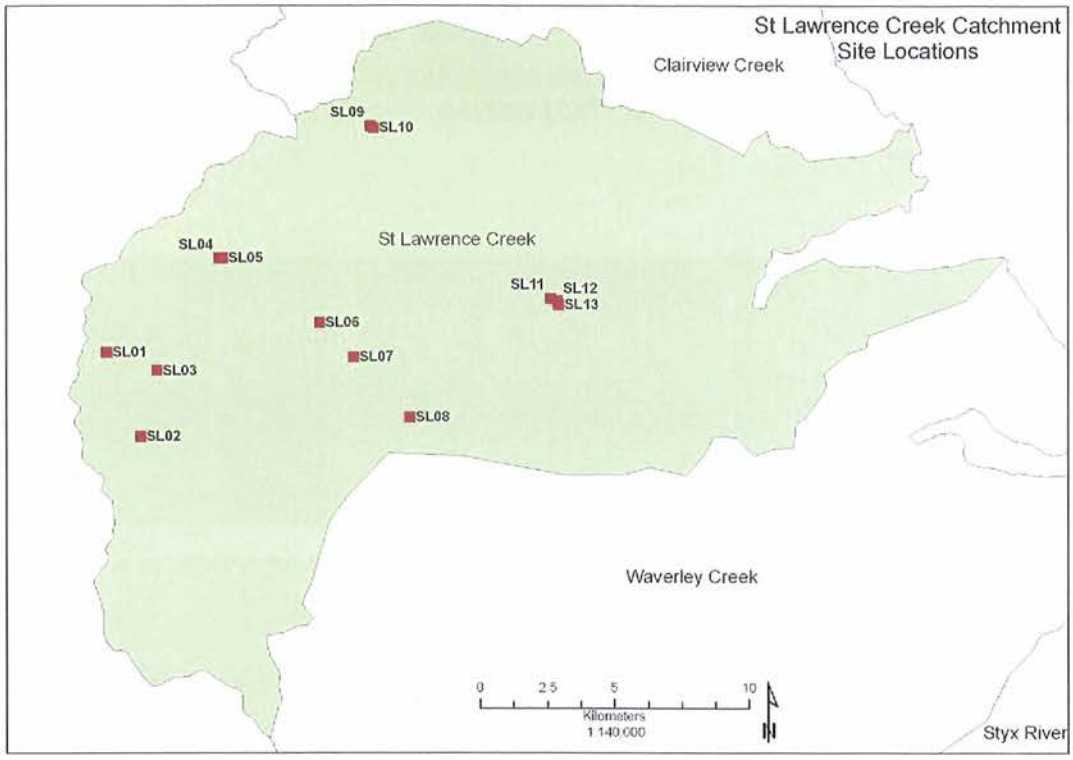


Figure S2.4 Site locations within the St Lawrence Creek Catchment

Site SL01 — *St Lawrence Catchment*

Location	*Glencoe State Forest*
Landform	*Mid - Upper Hill Slope*
Tenure	*State Forest, 198 FTY1647*
Current land use	*Timber Reserve*
Lat & Long	*-22.32918, 149.32851 (GDA94)*


North


East


South


West

Vegetation description	*Corymbia intermedia* (pink bloodwood) and *Lophostemon grandiflorus* (northern swamp box) forest with sparse midstorey and grassy ground cover dominated by *Xanthorrhoea* sp. (grass trees)
Mapped Regional Ecosystem	8.12.5a / 8.12.16 - *Lophostemon confertus* (brush box) and *Eucalyptus portuensis* (white mahogany) open-forest to closed-scrub. Occurs on steep upper slopes / Low microphyll vine forest to semi-evergreen vine thicket on drier subcoastal hills
Status	Not of concern / Of concern
Vegetation assessment	
Tree density	593.88 per ha
Sapling density	113.12 per ha
Shrub density	579.74 per ha
Tree hollows	70.70 per ha
Log density	197.96 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	2% (bare soil)
Litter	28% (15% fine litter, 10% coarser litter, 3% log litter)
Forbs	70% (20% grass, 49% herbs (*Xanthorrhoea* sp.), 1% low shrubs)
Site disturbances/weeds and other notes	Signs of very old fire, and intensive logging approximately 10 years old. Native animal grazing.
Other plant species	*Acacia disparrima* (southern salwood), *A. decora* (western silver wattle)

Site SL02 — *St Lawrence Catchment*

Landform	***Hill Crest***
Tenure	***Reserve, 18 MC321***
Current land use	***Recreation (BSC)***
Lat & Long	***-22.35774, 149.33980*** *(GDA94)*


North


East


South


West

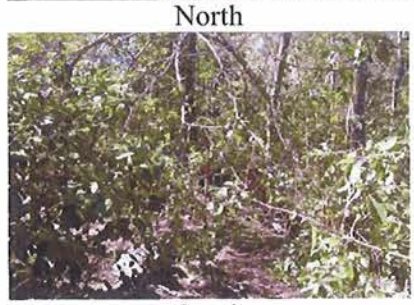
Vegetation description	*Corymbia citriodora* (lemon scented gum) and *C. intermedia* (pink bloodwood) woodland with occasional *Eucalyptus crebra* (narrow-leaved ironbark) over a grassy ground cover with common *Xanthorrhoea australis* (grass tree)
Mapped Regional Ecosystem	8.12.7a / 8.12.9 / 8.12.23 / 8.3.14 - *Corymbia citriodora*, *Eucalyptus portuensis* (white mahogany), and *C. trachyphloia* (brown bloodwood) open-forest to woodland on hills / *Eucalyptus tereticornis* ± *Lophostemon suaveolens* (swamp box) ± *Corymbia intermedia* woodland to open forest on undulating uplands / *Eucalyptus moluccana* (grey box) woodland on elevated tablelands / *Pennisetum alopecuroides* (Swamp Foxtail), *Cynodon dactylon* (couch grass), *Ischaemum australe* and *Fimbristylis dichotoma* (forked fimbry) grassland on drainage channels
Status	Not of concern / not of concern / of concern / of concern
Vegetation assessment	
Tree density	234.75 per ha
Sapling density	285.04 per ha
Shrub density	91.62 per ha
Tree hollows	25.45 per ha
Log density	246.12 per ha
Declared weeds	5.09 per ha
Species:	*Lantana camara* (lantana) (WONS, Class3)
Ground cover	
Bare ground	5% (4% bare soil, 1% rocks)
Litter	65% (50% fine litter, 10% coarser litter, 5% log litter)
Forbs	30% (20% grass, 5% herbs, 5% low shrubs)
Site disturbances/weeds and other notes	Evidence of old fire, no introduced grasses present.
Other plant species	*Lophostemon confertus* (brush box), *Acacia concurrens* (black wattle), *Dianella* sp., *Sporobolus* sp., *Heteropogon contortus* (spear grass), *Grewia latifolia* (dog's balls), *Alternanthera* sp.

Site SL03 — *St Lawrence Catchment*

Landform	***Stream Channel***
Tenure	***Free Hold, 9 MUR40157***
Current land use	***Lifestyle***
Lat & Long	***-22.33536, 149.34520*** *(GDA94)*


North


East


South


West

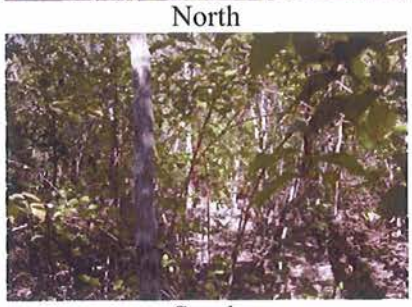
Vegetation description	*Casuarina cunninghamiana* (river oak) and *Callistemon viminalis* (weeping bottlebrush) woodland with elements of a semi-deciduous notophyll / mesophyll vine forest (including *Lophostemon suaveolens* (swamp box) and *Mallotus philippensis* (red kamala)) fringing watercourses on alluvial plains
Mapped Regional Ecosystem	11.3.25b / 8.3.1a - *Melaleuca leucadendra* (weeping tea tree) and/or *M. fluviatilis* (fine leaf paperbark), *Nauclea orientalis* (Liechhardt tree) open forest / Semi-deciduous (complex) notophyll/mesophyll vine forest
Status	Not of concern/Of concern
Vegetation assessment	
Tree density	441.90 per ha
Sapling density	108.02 per ha
Shrub density	343.70 per ha
Tree hollows	29.46 per ha
Log density	98.20 per ha
Declared weeds	245.50 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	20% (8% bare soil, 12% rocks)
Litter	30% (29% fine litter, 10% coarser litter)
Forbs	50% (herbs)
Site disturbances/weeds and other notes	Flood debris, minimal logging and edge clearing. *Lantana camara* infestation and abundant *Xanthium pungens* (noogoora burr) (WONS) and *Passiflora* sp. (passion flower), with *Rivinia humilis* (coral berry) present
Other plant species	*Macaranga tanarius* (macaranga), *Melia azedarach* (white cedar), *Pouteria* sp., *Mallotus philippensis* (red kamala), *Ficus opposita* (sandpaper fig), *Psydrax lamprophylla* (large-leaved canthium), *Dodonaea triquetra* (common hop bush), *Coatesia paniculata* (axebreaker), *Acacia holosericea*.

Site SL04 — *St Lawrence Catchment*

Location	***Glencoe State Forest***
Landform	***Lower Hill Slope***
Tenure	***State Forest, 198 FTY1647***
Current land use	***Timber Reserve***
Lat & Long	***-22.29774, 149.36604*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) open woodland with dense mid stratum including *Alphatonia excelsa* (soap bush) and *Psydrax odorata* (shiny-leaved canthium), and little ground cover.
Mapped Regional Ecosystem	8.12.22 - Variable woodland to open-forest usually dominated by *Eucalyptus drepanophylla* (grey ironbark), and usually one to several of the following species; *E. platyphylla* (poplar gum), *Corymbia clarksoniana* (Clarkson's bloodwood), *E. exserta* (Queensland peppermint), *C. trachyphloia* (shiny-leaved bloodwood) and *C. dallachiana* (ghost gum).
Status	Not of concern (not of concern)
Vegetation assessment	
Tree density	127.25 per ha
Sapling density	none
Shrub density	86.53 per ha
Tree hollows	20.36 per ha
Log density	86.53 per ha
Declared weeds	509.28 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	15% (5% bare soil, 10% rocks)
Litter	70% (54% fine litter, 15% coarser litter, 1% log litter)
Forbs	15% (12% grass, 3% herbs)
Site disturbances/weeds and other notes	Soil lichens present.
Other plant species	*Lomandra* sp., *Carissa ovata* (current bush), *Aristida* sp., *Diospyros geminata* (ebony), *Dodonaea triquetra* (common hop bush), *Acacia implexa* (hickory wattle), *Pouteria sericea*.

Site SL05 — *St Lawrence Catchment*

Landform	***Creek levee***
Tenure	***Stock Route***
Current land use	***Grazing***
Lat & Long	***-22.29773, 149.36724*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) woodland with occasional *Corymbia tessellaris* (Moreton Bay ash), with a mid-dense shrub stratum of *Alphitonia excelsa* (soap bush), *Diospyros geminata* (ebony) and *Acacia* sp., with little ground cover
Mapped Regional Ecosystem	11.11.15 - *Eucalyptus crebra* woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains
Status	Not of concern
Vegetation assessment	
Tree density	203.6 per ha
Sapling density	11.98 per ha
Shrub density	397.02 per ha
Tree hollows	15.27 per ha
Log density	71.26 per ha
Declared weeds	10.18 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	10% (2% bare soil, 8% rocks)
Litter	89% (80% fine litter, 7% coarser litter, 2% log litter)
Forbs	1% (grass)
Site disturbances/weeds and other notes	Light grazing at site. Nearby cleared stock route was dominated by weed species, including: *Stachytarpheta jamaicensis* (snake weed), *Lantana camara* (lantana), and included evidence of wild pigs and dogs.
Other plant species	*Alectryon connatus* (beach alectryon), *Pittosporum spinescens* (wallaby apple), *Breynia oblongifolia* (dwarf's apple). Nearby drainage gully comprised: *Eucalyptus platyphylla* (poplar gum), *E. tereticornis* (forest red gum), *E. crebra*, *Melaleuca* sp., *Mallotus philippensis* (red kamala), *Paraserianthes toona* (Mackay cedar), *Alphitonia excelsa*, *Carissa ovata* (current bush), *Dodonaea triquetra* (common hop bush), *Eustrephus latifolius* (wombat berry), *Dianella* sp., *Lomandra longifolia* (spiny-headed mat-rush), *Diospyros geminata*, *Ficus* sp., *Psydrax* sp., *Xanthorrhoea* sp. (grass tree)

Site SL06 — *St Lawrence Catchment*

Landform	***Flat***
Tenure	***Free Hold, 62 MUR4052***
Current land use	***Grazing***
Lat & Long	***-22.31948, 149.39977*** *(GDA94)*


North


East


South


West

Vegetation description	Grassland with patches of emergent trees including: *Eucalyptus crebra* (narrow-leaved ironbark) and *Acacia* sp. (wattle)
Mapped Regional Ecosystem Status	Non-remnant
Vegetation assessment	
Tree density	5.09 per ha
Sapling density	25.45 per ha
Shrub density	10.18 per ha
Tree hollows	none
Log density	none
Declared weeds	5.09 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	none
Litter	20% (fine litter)
Forbs	80% (78% grass, 2% herbs)
Site disturbances/weeds and other notes	Current grazing and evidence of pig activity,
Other plant species	*Planchonia careya* (cocky apple), *Corymbia tessellaris* (Moreton Bay ash), *Ficus* sp. (fig), *Eucalyptus melanophoia* (silver-leaved ironbark), *Heteropogon contortus* (black spear grass), *Melaleuca viridiflora* (broad-leaved tea-tree), *E. platyphylla* (poplar gum), *Diospyros geminata* (ebony), *Passiflora* sp.

Site SL07 — *St Lawrence Catchment*

Landform	***Alluvial plain***
Tenure	***Leasehold, 8 MC674***
Current land use	***Grazing***
Lat & Long	***-22.33074, 149.41127*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus platyphylla* (poplar gum) open woodland on alluvial plains. Included occasional *Corymbia tessellaris* (Moreton Bay ash), *Eucalyptus tereticornis* (forest red gum) and *E. crebra* (narrow-leaved ironbark), with *Planchonia careya* (cocky apple) and *Acacia* sp. (wattle) mid-storey over a grassy ground storey.
Mapped Regional Ecosystem	8.3.5 - *Corymbia clarksoniana* (Clarkson's bloodwood) + *Lophostemon suaveolens* (brush box) + *Eucalyptus platyphylla* woodland, or *E. platyphylla* woodland on alluvial plains
Status	Of concern
Vegetation assessment	
Tree density	132.34 per ha
Sapling density	40.72 per ha
Shrub density	45.81 per ha
Tree hollows	40.72 per ha
Log density	132.34 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	10% (bare soil)
Litter	20% (19% fine litter, 1% coarser litter)
Forbs	70% (63% grass, 7% herbs)
Site disturbances/weeds and other notes	Site ploughed, very old fire evidence, current grazing as well as native animal grazing. Weeds included sorghum and other pasture grasses. Uneven ground with many depressions.
Other plant species	*Heteropogon contortus* (black spear grass), *Panicum effusum* (hairy panic), *Eragrostis* sp. (love grass), *Cyperus* sp.

Site SL08 — *St Lawrence Catchment*

Landform	***Plain***
Tenure	***Free Hold, 3 RP863038***
Current land use	***Grazing***
Lat & Long	***-22.35123, 149.43008*** *(GDA94)*


North


East


South


West

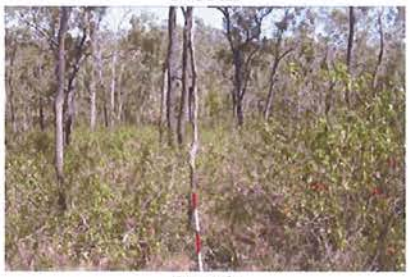
Vegetation description	Grassland of pasture and native grasses and herbs with occasional emergent *Grevillia striata* (beefwood), *Eucalyptus crebra* (narrow-leaved ironbark) and *Acacia bidwillii* (dogwood).
Mapped Regional Ecosystem Status	Non-remnant
Vegetation assessment	
Tree density	5.09 per ha
Sapling density	15.27 per ha
Shrub density	20.36 per ha
Tree hollows	none
Log density	30.54 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	5% (bare soil)
Litter	1% (log litter)
Forbs	94% (74% grass, 20% herbs)
Site disturbances/weeds and other notes	Current intensive grazing and evidence of blade plowing approximately 5 years old. Non-native species included: *Chloris virgata* (red natal), *Pennisetum ciliare* (buffle grass), *Stylosanthes scabra* (Seca Stylo)
Other plant species	*Corymbia tessellaris* (Moreton Bay ash), *Digitaria didactyla* (Queensland blue couch)

Site SL09 — *St Lawrence Catchment*

Landform	***Lower Slope***
Tenure	***Free Hold, 28 MC46***
Current land use	***Buffer of Timber Plantation***
Lat & Long	***-22.25330, 149.41686*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) open woodland over grassy and herbaceous ground cover.
Mapped Regional Ecosystem	8.3.5 - *Corymbia clarksoniana* (Clarkson's bloodwood) + *Lophostemon suaveolens* (brush box) + *Eucalyptus platyphylla* (poplar gum) woodland, or *E. platyphylla* woodland on alluvial plains
Status	Of concern
Vegetation assessment	
Tree density	66.17 per ha
Sapling density	none
Shrub density	none
Tree hollows	none
Log density	35.63 per ha
Declared weeds	458.10 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	7% (2% bare soil, 5% rocks)
Litter	22% (15% fine litter, 5% coarser litter, 2% log litter)
Forbs	71% (46% grass, 5% herbs, 20% low shrubs)
Site disturbances/weeds and other notes	Evidence of very old fire, road and fence nearby. Weeds species *Stachytarpheta jamaicensis* (snake weed) present
Other plant species	*Cycas media* subsp. *media* (cycad), *Heteropogon contortus* (spear grass), *Themeda triandra* (kangaroo grass), *Cymbidium canaliculatum* (black orchid)

Site SL10 — *St Lawrence Catchment*

Landform	***Open Depression***
Tenure	***Free Hold, 28 MC46***
Current land use	***Buffer of Timber Plantation***
Lat & Long	***-22.25389, 149.41793*** *(GDA94)*


North


East


South


West

Vegetation description	*Casuarina cunninghamiana* (river she-oak) and *Melaleuca leucadendra* (weeping paperbark) open-forest with rainforest elements in the mid stratum and *Lomandra longifolia* (spiny-headed mat-rush) ground cover.
Mapped Regional Ecosystem	8.3.3 - *Melaleuca leucadendra* or *M. fluviatilis* (fine leaf paperbark) ± *Casuarina cunninghamiana* open forest to woodland, fringing watercourses
Status	Not of concern
Vegetation assessment	
Tree density	363.34 per ha
Sapling density	49.10 per ha
Shrub density	68.74 per ha
Tree hollows	none
Log density	58.92 per ha
Declared weeds	510.64 per ha
Species:	*Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	40% (1% bare soil, 39% rocks)
Litter	24% (20% fine litter, 3% coarser litter, 1% log litter)
Forbs	36% (30% grass, 3% herbs, 3% low shrubs)
Site disturbances/weeds and other notes	Some light grazing.
Other plant species	*Ficus coronata* (sandpaper fig), *Mallotus philippensis* (red kamala), *Lophostemon confortus* (brush box), *Planchonia careya*(cocky apple), *Melinis repens* (red natal grass)

Site SL11 — *St Lawrence Catchment*

Landform	***River Flat***
Tenure	***Reserve, 7 MC475***
Current land use	***Recreation (BSC)***
Lat & Long	***-22.31129, 149.47726*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus populnea* (poplar box) woodland with occasional *E. crebra* (narrow-leaved ironbark). Midstorey of *Psydrax attenuatum* over grassy ground on alluvial plains
Mapped Regional Ecosystem	11.3.29x1 - *Eucalyptus crebra*, *E. exserta* (peppermint), *Melaleuca* spp. (paperbark) woodland on alluvial plains
Status	Not of concern
Vegetation assessment	
Tree density	157.79 per ha
Sapling density	none
Shrub density	417.38 per ha
Tree hollows	20.36 per ha
Log density	376.66 per ha
Declared weeds	25.45 per ha
Species:	*Opuntia stricta* (prickly pear) (WONS, Class 2), *Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	5% (bare soil)
Litter	55% (43% fine litter, 10% coarser litter, 2% log litter)
Forbs	40% (28% grass, 10% herbs, 2% low shrubs)
Site disturbances/weeds and other notes	Evidence of fire older than 5 years, highway approximately 80m away, native animal grazing. Other weeds present include: *Eriocereus martini* (harrisia cactus) (WONS), *Bidens pilosa* (cobbler's pegs), *Chloris gayana* (Rhodes grass)
Other plant species	*Passiflora* spp. (passion flower), *Heteropogon contortus* (black spear grass), *Arundinella nepalensis* (reed grass), *Cyprus* sp., *Achyranthes aspera* (chaff flower)

Site SL12 — *St Lawrence Catchment*

Landform	***River Flat***
Tenure	***Reserve, 7 MC475***
Current land use	***Recreation (BSC)***
Lat & Long	***-22.31215, 149.47955*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) woodland with *Melaleuca viridiflora* (broad-leaved tea-tree) midstorey over grassy ground cover on alluvial plains
Mapped Regional Ecosystem	11.3.29x1 - *Eucalyptus crebra*, *E. exserta* (peppermint), *Melaleuca* spp. (paperbark) woodland on alluvial plains
Status	Not of concern
Vegetation assessment	
Tree density	229.05 per ha
Sapling density	81.44 per ha
Shrub density	274.86 per ha
Tree hollows	20.36 per ha
Log density	178.15 per ha
Declared weeds	5.09 per ha
Species:	*Opuntia stricta* (prickly pear) (WONS, Class 2)
Ground cover	
Bare ground	5% (3% bare soil, 2% rocks)
Litter	15% (11% fine litter, 2% coarser litter, 2% log litter)
Forbs	80% (73% grass, 5% herbs, 2% low shrubs)
Site disturbances/weeds and other notes	Very old fire, native animal grazing with echidna scratching, minimal weeds (away from road verge), Bruce Highway approximately 80m / road noise, lots of melon holes. Nearby patchs of *Lantana camara* (lantana) (WONS, Class 3) thickets.
Other plant species	*Psydrax attenuatum*, *Alphitonia excelsa* (soap bush), *Grevillea striata* (beefwood), *Grewia latifolia* (dog's balls), *Melinis repens* (red natal grass), *Themeda triandra* (kangaroo grass), *Heteropogon contortus* (spear grass), with sedges and lilies in depressions.

Site SL13 — *St Lawrence Catchment*

Landform	***Tidal Stream Channel***
Tenure	***Reserve, 7 MC475***
Current land use	***Recreation (BSC)***
Lat & Long	***-22.31337, 149.48012*** *(GDA94)*


North


East


South


West

Vegetation description	Semi-deciduous notophyll/mesophyll vine forest with emergent *Corymbia tessellaris* (Moreton Bay ash) and *Eucalyptus crebra* (narrow-leaved ironbark) fringing tidal watercourse lined with mangrove species
Mapped Regional Ecosystem	11.3.25b/8.3.1a - *Melaleuca leucadendra* (white paperbark) and/or *M. fluviatilis* (fine leaf paperbark), *Nauclea orientalis* (Liechhardt tree) open forest / Semi-deciduous (complex) notophyll/mesophyll vine forest
Status	Not of concern/Of concern
Vegetation assessment	
Tree density	510.64 per ha
Sapling density	29.46 per ha
Shrub density	157.12 per ha
Tree hollows	29.46 per ha
Log density	58.92 per ha
Declared weeds	157.12 per ha
Species:	*Cryptostegia grandiflora* (rubber vine) (WONS, Class 2), *Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	5% (bare soil)
Litter	10% (fine litter)
Forbs	85% (25% grass, 5% herbs, 55% low shrubs)
Site disturbances/weeds and other notes	Erosion gullies into creek every 50-70m, native animal grazing, and very old fire. Abundant weed species, as above and includes *Xanthium pungens* (noogoora burr) (WONS) and *Megathyrsus maximus* (Guinea grass)
Other plant species	*Diospyros geminata* (ebony), *Cupaniopsis anacardioides* (tuckeroo), *Passiflora* sp., *Mallotus phillipensis* (red kamala), *Melaleuca* sp., *Cryptocarya* sp. (laurel), *Alphitonia excelsa* (soap bush), *Psydrax* sp., and patches of *Eucalyptus platyphylla* (poplar gum).

S2.2.3 Styx River Catchment

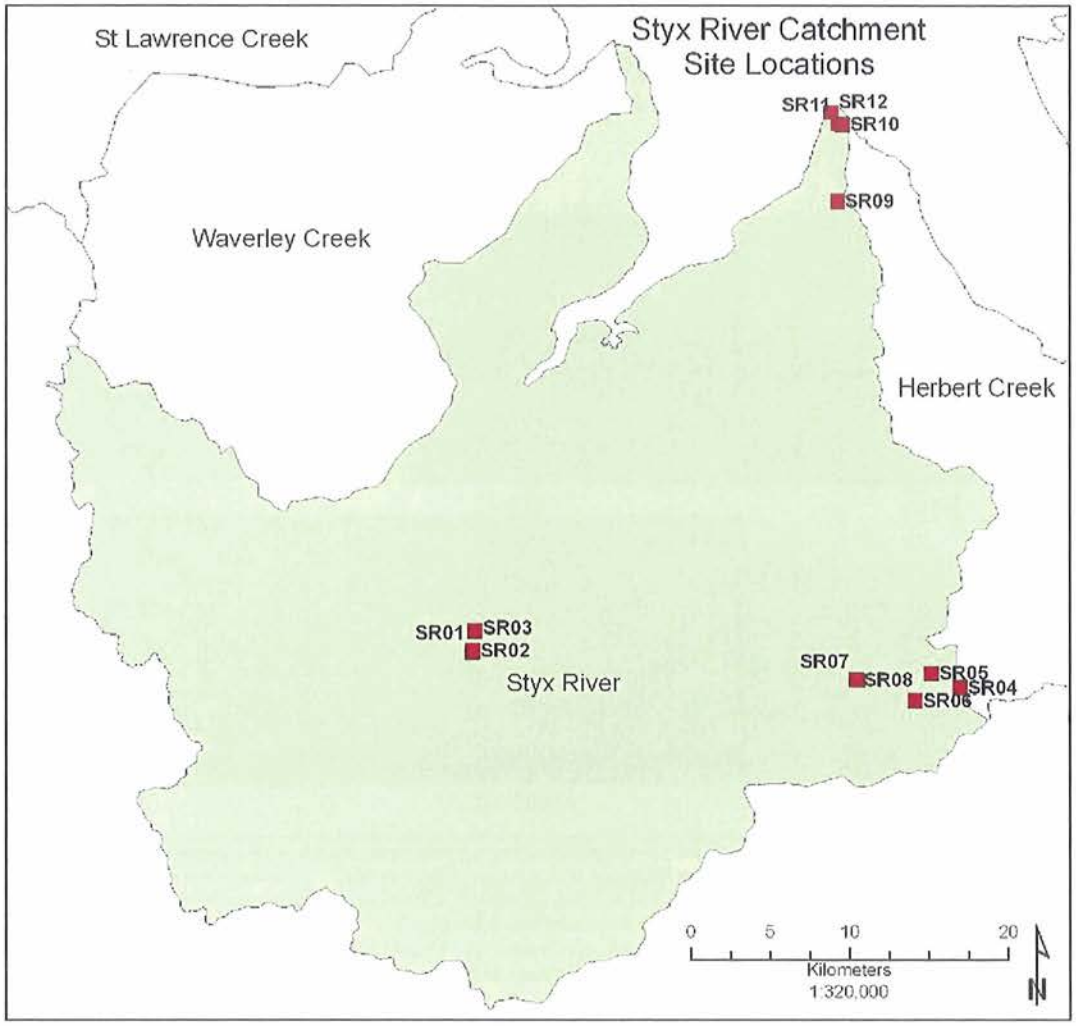


Figure S2.5 Site locations within the Styx River Catchment

Site SR01 — *Styx River Catchment*

Location	***Tooloomba Creek Conservation Park***
Landform	***Creek***
Tenure	***National Park, 1 MC813349***
Current land use	***Conservation***
Lat & Long	***-22.69086, 149.60421*** *(GDA94)*


North


East


South


West

Vegetation description	*Callistemon viminalis* (weeping bottlebrush) and *Melaleuca fluviatilis* (fine leaf paperbark) riparian woodland with scrubby midstorey of *Ficus racemosa* (cluster fig), *Melaleuca leucadendra* (weeping paperbark), *Cryptocarya triplinervis* (three veined laurel) and *Pleiogynium timorense* (Burdekin plum)
Mapped Regional Ecosystem	11.3.25 - *Eucalyptus tereticornis* (forest red gum) or *E. camaldulensis* (river red gum) woodland fringing drainage lines
Status	Not of concern
Vegetation assessment	
Tree density	284.78 per ha
Sapling density	none
Shrub density	68.74 per ha
Tree hollows	49.10 per ha
Log density	324.06 per ha
Declared weeds	648.12 per ha
Species:	*Cryptostegia grandiflora* (rubber vine) (WONS, Class 2), *Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	40% (25% bare soil, 15% rocks)
Litter	30% (10% fine litter, 10% coarser litter, 10% log litter)
Forbs	30% (20% grass, 10% herbs)
Site disturbances/weeds and other notes	Many weeds, national park fencing down (fallen tree) with evidence of some grazing, native animal tracks also present, flood debris up to 5m high. *Xanthium pungens* (noogoora burr) (WONS) also present.
Other plant species	*Lomandra longifolia* (spiny-headed mat-rush)

Site SR02 — *Styx River Catchment*

Location	*Tooloomba Creek Conservation Park*
Landform	*Creek levee*
Tenure	*National Park, 1 MC813349*
Current land use	*Conservation*
Lat & Long	*-22.69005, 149.60432 (GDA94)*


North


East


South


West

Vegetation description	*Acacia harpophylla* tall shrub land
Mapped Regional Ecosystem	11.4.2 - *Eucalyptus* spp. and/or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains
Status	Of concern
Vegetation assessment	
Tree density	891.24 per ha
Sapling density	222.81 per ha
Shrub density	1877.97 per ha
Tree hollows	none
Log density	254.64 per ha
Declared weeds	1241.37 per ha
Species:	*Cryptostegia grandiflora* (rubber vine) (WONS, Class 2), *Opuntia stricta* (prickly pear) (WONS, Class 2)
Ground cover	
Bare ground	30% (bare soil)
Litter	20% (14% fine litter, 5% coarser litter, 1% log litter)
Forbs	50% (23% grass, 2% herbs, 25% low shrubs)
Site disturbances/weeds and other notes	Very old fire, native animal grazing and tracks, severe weed infestation.
Other plant species	*Paspalidium* sp., *Carissa ovata* (current bush), *Eremophila* sp. (emu bush), *Atalaya hemiglauca* (whitewood), *Diospyros geminata* (ebony), *Paspalidium caespitosum* (brigalow grass)

Site SR03 — *Styx River Catchment*

Location	***Tooloomba Creek Conservation Park***
Landform	***Simple lower slope***
Tenure	***National Park, 1 MC813349***
Current land use	***Conservation***
Lat & Long	***-22.67893, 149.60564*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) woodland with very occasional *Eucalyptus populnea* (poplar box) over grassy ground cover.
Mapped Regional Ecosystem	11.3.29 - *Eucalyptus crebra*, *E. exserta* (Queensland peppermint), *Melaleuca* spp. (paperbark) woodland on alluvial plains
Status	Not of concern
Vegetation assessment	
Tree density	137.43 per ha
Sapling density	76.35 per ha
Shrub density	71.26 per ha
Tree hollows	10.18 per ha
Log density	76.35 per ha
Declared weeds	20.36 per ha
Species:	*Opuntia stricta* (prickly pear) (WONS, Class 2), *Cryptostegia grandiflora* (rubber vine) (WONS, Class 2), *Lantana camara* (lantana) (WONS, Class 3)
Ground cover	
Bare ground	1% (bare soil)
Litter	45% (40% fine litter, 5% coarser litter)
Forbs	54% (33% grass, 20% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Evidence of very old fire, native animal grazing (kangaroos present at sampling), stumps present from selective logging
Other plant species	*Alphitonia excelsa* (soap bush), *Grewia latifolia* (dog's balls), *Hibiscus* sp., *Sida* sp., *Pennisetum ciliare* (buffle grass), *Heteropogon contortus* (spear grass), *Cassia ovata* (current bush), *Themeda triandra* (kangaroo grass)

Site SR04 — *Styx River Catchment*

Location	***Bukkulla Conservation Park***
Landform	***Upper slope***
Tenure	***National Park, 1 RP897983***
Current land use	***Conservation***
Lat & Long	***-22.71116, 149.88043*** *(GDA94)*


North


East


South

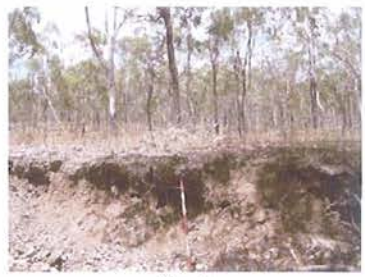

West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) woodland with very sparse mid-story and little ground cover.
Mapped Regional Ecosystem	11.11.3 / 11.11.5 - *Corymbia citriodora* (lemon scented gum), *Eucalyptus crebra*, *E. portuensis* (white mahogany) open forest on old sedimentary rocks / Microphyll vine forest ± *Araucaria cunninghamii* (hoop pine) on old sedimentary rocks
Status	Not of concern / not of concern
Vegetation assessment	
Tree density	183.24 per ha
Sapling density	50.90 per ha
Shrub density	20.36 per ha
Tree hollows	none
Log density	91.62 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	30% (bare soil)
Litter	55% (40% fine litter, 15% coarser litter)
Forbs	15% (13% grass, 2% forbs)
Site disturbances/weeds and other notes	Evidence of old fire.
Other plant species	*Planchonia careya* (cocky apple)

Site SR05 — *Styx River Catchment*

Location	***Bukkulla Conservation Park***
Landform	***Open Depression***
Tenure	***National Park, 1 RP897983***
Current land use	***Conservation***
Lat & Long	***-22.70295, 149.86392*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus tereticornis* (forest red gum) open woodland, with *Melaleuca* spp. (paperbark), *Petalostigma pubescens* (quinine bush) and *Acacia* sp. dominating a sparse mid-stratum over a very sparse ground layer.
Mapped Regional Ecosystem	11.12.3 - *Eucalyptus crebra* (narrow-leaved ironbark), *E. tereticornis*, *Angophora leiocarpa* woodland on igneous rocks especially granite
Status	Not of concern
Vegetation assessment	
Tree density	265.14 per ha
Sapling density	58.92 per ha
Shrub density	392.80 per ha
Tree hollows	none
Log density	98.20 per ha
Declared weeds	58.92 per ha
Species:	*Cryptostegia grandiflora* (rubber vine) (WONS, Class 2)
Ground cover	
Bare ground	73% (13% bare soil, 60% rock)
Litter	20% (16% fine litter, 3% coarser litter, 1% log litter)
Forbs	7% (5% grass, 2% herbs)
Site disturbances/weeds and other notes	Occasional grazing, some stream bank erosion. Other weeds include: *Stachytarpheta jamaicensis* (snake weed), *Melinis repens* (red natal grass)
Other plant species	*Cupaniopsis anacardioides* (tuckeroo), *Melia azedarach* (white cedar), *Planchonia careya* (cocky apple), *Terminalia* sp., *Mallotus philippensis* (red kamala), *Grewia latifolia* (dog's balls), *Themeda triandra* (kangaroo grass), *Cyperus* sp.

Site SR06 — *Styx River Catchment*

Location	***Bukkulla Conservation Park***
Landform	***Lower slope***
Tenure	***National Park, 1 RP897983***
Current land use	***Conservation***
Lat & Long	***-22.71850, 149.85482*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) open woodland with sparse mid and ground stratum.
Mapped Regional Ecosystem	11.11.3 / 11.11.5 - *Corymbia citriodora* (lemon scented gum), *Eucalyptus crebra*, *E. portuensis* (white mahogany) open forest on old sedimentary rocks / Microphyll vine forest ± *Araucaria cunninghamii* (hoop pine) on old sedimentary rocks
Status	Not of concern / not of concern
Vegetation assessment	
Tree density	173.06 per ha
Sapling density	544.63 per ha
Shrub density	162.88 per ha
Tree hollows	10.18 per ha
Log density	137.43 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	50% (20% bare soil, 30% rocks)
Litter	30% (30% fine litter)
Forbs	20% (13% grass, 5% herbs, 2% low shrubs)
Site disturbances/weeds and other notes	Very occasional grazing, evidence of old fires.
Other plant species	*Eucalyptus melanophoia* (silver-leaved ironbark), *Alphitonia excelsa* (soap bush), *Grewia latifolia* (dog's balls), *Heteropogon contortus* (black spear grass), *Dactyloctenium radulans* (button grass), and Malvaceae species.

Site SR07 — *Styx River Catchment*

Landform	***Open Depression***
Tenure	***Free Hold, 2 RP899662***
Current land use	***Grazing***
Lat & Long	***-22.70695, 149.82221*** *(GDA94)*


North


East


South


West

Vegetation description	Remnant riparian community of *Callistemon* sp., *Casuarina cunninghamiana* (river she-oak) and *Melaleuca* sp. (paperbark) with some shrubs in the mid-stratum and sparse grass ground stratum.
Mapped Regional Ecosystem Status	Non - remnant
Vegetation assessment	
Tree density	432.08 per ha
Sapling density	9.82 per ha
Shrub density	117.84 per ha
Tree hollows	9.82 per ha
Log density	108.02 per ha
Declared weeds	206.22 per ha
Species:	*Cryptostegia grandiflora* (rubber vine) (WONS, Class 2)
Ground cover	
Bare ground	25% (15% bare soil, 10% rocks)
Litter	35% (32% fine litter, 2% coarser litter, 1% log litter)
Forbs	40% (38% grass, 2% herbs)
Site disturbances/weeds and other notes	Current heavy grazing and many weeds present.
Other plant species	*Cupaniopsis anacardioides* (tuckeroo), *Paraserianthes toona* (Mackay cedar), *Mallotus philippensis* (red kamala), *Lysiphyllum hookeri* (white bauhinia), *Lysiphyllum carronii*.

Site SR08 — *Styx River Catchment*

Landform	***Flat***
Tenure	***Free Hold, 2 RP899662***
Current land use	***Grazing***
Lat & Long	***-22.70685, 149.82134*** *(GDA94)*


North


East

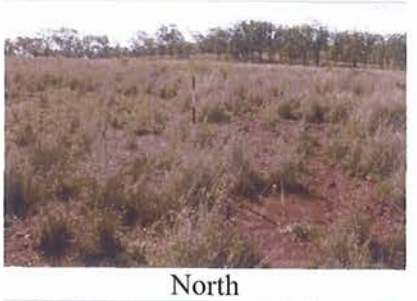

South

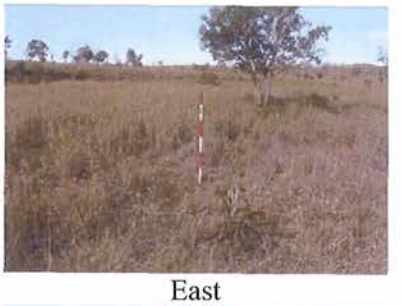

West

Vegetation description	Very open grassland of *Pennisetiun ciliare* (buffel grass) with very sparse emergent *Corymbia tessellaris* (Moreton Bay ash) and some shrubs
Mapped Regional Ecosystem Status	Non - remnant
Vegetation assessment	
Tree density	5.09 per ha
Sapling density	none
Shrub density	132.34 per ha
Tree hollows	none
Log density	5.09 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	5% (bare soil)
Litter	5% (4% fine litter, 1% coarser litter)
Forbs	90% (89% grass, 1% herbs)
Site disturbances/weeds and other notes	Current heavy grazing and extensive ongoing clearing.
Other plant species	*Capparis lasiantha* (wait-a-while)

Site SR09 — *Styx River Catchment*

Landform	*Simple slope*
Tenure	*Free Hold, 98 CP881496*
Current land use	*Grazing*
Lat & Long	*-22.43535, 149.81078 (GDA94)*


North


East


South


West

Vegetation description	Open grassland with sparse emergent *Melaleuca fasciculifera*, *Notolaea microcrpa*.
Mapped Regional Ecosystem Status	Non-remnant
Vegetation assessment	
Tree density	5.09 per ha
Sapling density	none
Shrub density	45.81 per ha
Tree hollows	none
Log density	15.27 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	2% (bare soil)
Litter	20% (18% fine litter, 2% coarser litter)
Forbs	78% (60% grass, 16% herbs, 2% low shrubs)
Site disturbances/weeds and other notes	Moderate grazing, extensive erosion, and land clearing. Weeds included: *Pennisetium ciliare* (buffel grass), *Stylosanthes scabra* (seca stylo), *Panicum* sp., *Gomphrena* sp.
Other plant species	*Grewia latifolia* (dog's balls), *Diospyros geminata* (ebony), *Carissa ovata* (current bush), *Capparis lasianthe*, *Cynodon dactylon* (couch)

Site SR10 — *Styx River Catchment*

Location	***Charon Point Conservation Park***
Landform	***Hill Slope***
Tenure	***National Park, 512 NPW574***
Current land use	***Conservation (with Seasonal Grazing)***
Lat & Long	***-22.39201, 149.81355*** *(GDA94)*


North


East


South


West

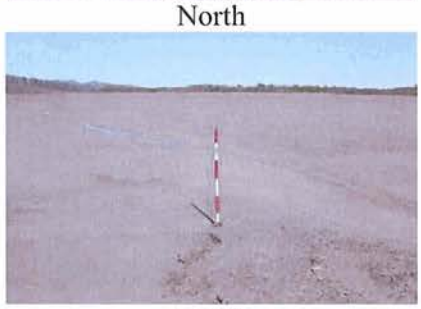
Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) open woodland with occasional *Corymbia dallachiana* (ghost gum) over grassy ground cover.
Mapped Regional Ecosystem	11.11.10 - *Eucalyptus melanophloia* (silver-leaved ironbark) woodland on deformed and metamorphosed sediments and interbedded volcanics
Status	Of concern
Vegetation assessment	
Tree density	101.8 per ha
Sapling density	61.08 per ha
Shrub density	20.36 per ha
Tree hollows	30.54 per ha
Log density	86.53 per ha
Declared weeds	5.09 per ha
Species:	*Opuntia stricta* (prickly pear) (WONS, Class 2)
Ground cover	
Bare ground	40% (30% bare ground, 10% rocks)
Litter	20% (12% fine litter, 7% coarser litter, 1% log litter)
Forbs	40% (33% grass, 5% herbs, 2% low shrubs)
Site disturbances/weeds and other notes	Summer cattle grazing and presence of grazing forbs and grasses including: *Stylosanthes scabra* (seca stylo) and *Pennisetiun ciliare* (buffel grass)
Other plant species	*Alphitonia excelsa* (soap bush), *Themeda triandra* (kangaroo grass), *Heteropogon contortus* (black spear grass), *H. triticeus*, *Grewia latifolia* (dog's balls), *Melinis repens* (red natal grass)

Site SR11 — *Styx River Catchment*

Location	***Charon Point Conservation Park***
Landform	***Mud Flat***
Tenure	***National Park, 512 NPW574***
Current land use	***Conservation (with Seasonal Grazing)***
Lat & Long	***-22.39170, 149.81127*** *(GDA94)*


North


East


South


West

Vegetation description	Forbland of chenopods on marine plain
Mapped Regional Ecosystem	11.1.2a - Samphire forbland on marine clay plains
Status	Not of concern
Vegetation assessment	
Tree density	none
Sapling density	none
Shrub density	none
Tree hollows	none
Log density	none
Declared weeds	none
Species:	
Ground cover	
Bare ground	99% (bare soil)
Litter	none
Forbs	1% (herb)
Site disturbances/weeds and other notes	
Other plant species	

Site SR12 — *Styx River Catchment*

Location	***Charon Point Conservation Park***
Landform	***Coastal Lowland***
Tenure	***None, Coastal Esplanade***
Current land use	***Conservation (with Seasonal Grazing)***
Lat & Long	***-22.38527, 149.80722*** *(GDA94)*


North


East


South


West

Vegetation description	Sparse *Melaleuca* sp. (paperbark) open woodland over grassy ground cover.
Mapped Regional Ecosystem	11.11.10 - *Eucalyptus melanophloia* (silver-leaved ironbark) woodland on deformed and metamorphosed sediments and interbedded volcanics
Status	Of concern
Vegetation assessment	
Tree density	96.71 per ha
Sapling density	35.63 per ha
Shrub density	25.45 per ha
Tree hollows	none
Log density	50.9 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	none
Litter	5% (4% fine litter, 1% coarser litter)
Forbs	95% (90% grass, 5% herbs)
Site disturbances/weeds and other notes	Evidence of pig activity, camping ground nearby, old fire of more than 3 years old, many dead *Melaleuca* (drought effected?). Weeds include: *Stylosanthes scabra* (seca stylo), *Chloris gayana* (Rhodes grass)
Other dominant plant species	*Panicum* sp., *Cyperus* sp., *Heteropogon contortus* (black spear grass). In patches of nearby coastal scrub: *Abutilon* sp., *Ludwigia octovalvis* (water primrose), *Cupaniopsis anacardioides* (tuckeroo), *Lysiphyllum hookeri* (white bauhinia), *Canthium coprosmoides*.

S2.2.4 Herbert Creek Catchment

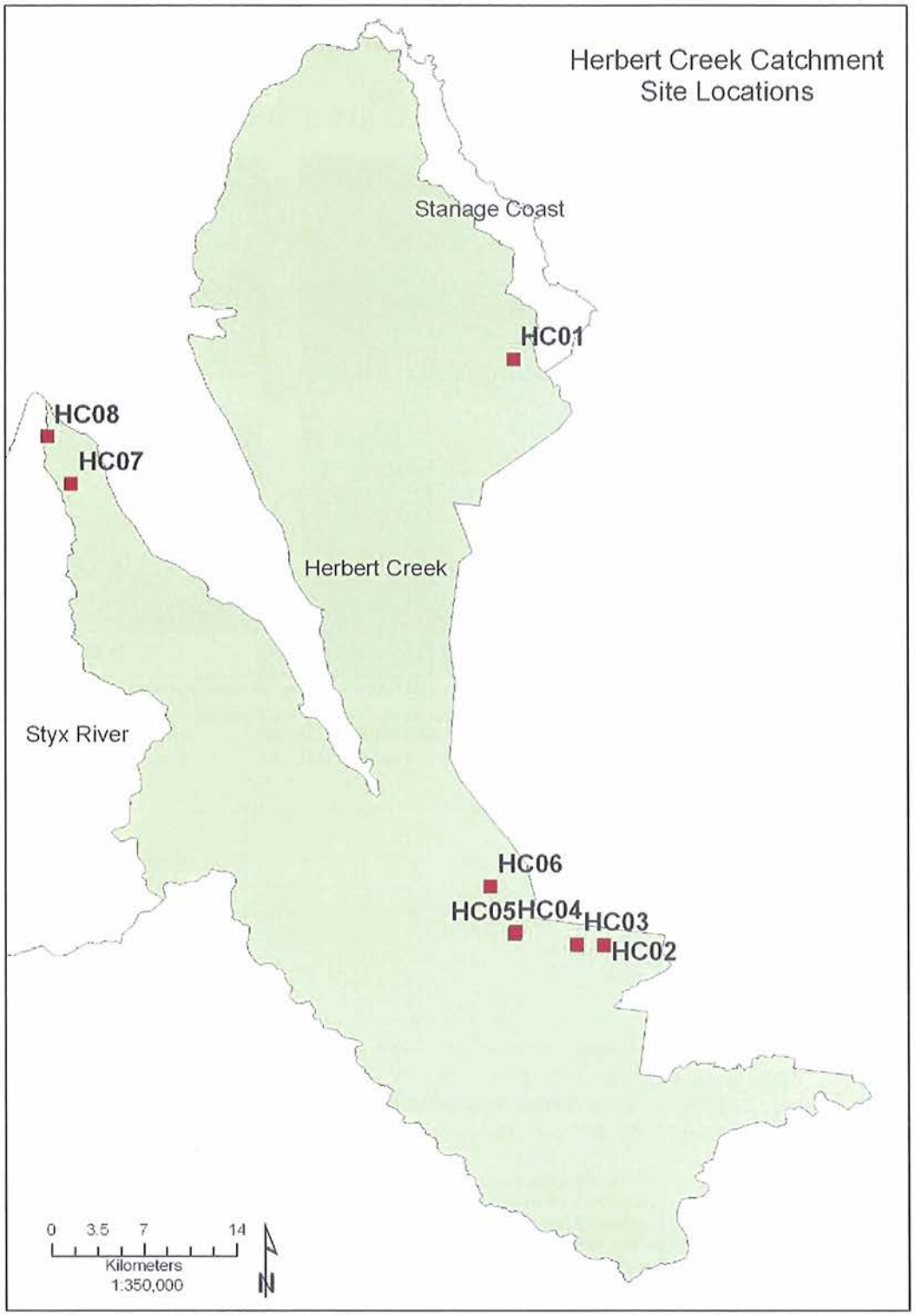


Figure S2.6 Site locations within the Herbert Creek Catchment

Site HC01 — *Herbert Creek Catchment*

Landform	***Creek***
Tenure	***Free Hold, PALM40122***
Current land use	***Grazing***
Lat & Long	***-22.35863, 150.13569*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus tereticornis* (forest red gum) and *Melaleuca* sp. (paperbark) open woodland with sparse mid-storey of *Petalostigma pubescens* (quinine bush) and other shrub species, over a sparse ground story of grasses.
Mapped Regional Ecosystem	11.5.8 / 11.5.8b / 11.3.9 - *Melaleuca* spp., *Eucalyptus crebra* (narrow-leaved ironbark), *Corymbia intermedia* (pink bloodwood) woodland on Cainozoic sand plains / *Corymbia clarksoniana, Eucalyptus exserta* (peppermint),*E. crebra E. tereticornis, E. platyphylla* (poplar gum) woodland with low tree layer dominated by *Melaleuca viridiflora* (broad-leaved tea-tree), *M. nervosa* (paperbark), *Allocasuarina littoralis* (black sheoak), *Grevillea banksii* (banksii grevillea) , *Acacia flavescens* (red wattle) + *Acacia leiocarpa / Eucalyptus platyphylla, Corymbia* spp. (bloodwood) woodland on alluvial plains
Status	Not of concern / Not of concern / Not of concern
Vegetation assessment	
Tree density	391.93 per ha
Sapling density	407.2 per ha
Shrub density	229.05 per ha
Tree hollows	5.09 per ha
Log density	71.26 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	29% (bare soil)
Litter	63% (60% fine litter, 2% coarser litter, 1% log litter)
Forbs	8% (5% grass, 2% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Current grazing, regular fires and very old flood damage.
Other plant species	*Eucalyptus exserta, Corymbia intermedia, Allocasuarina littoralis, Grevillea banksii, Acacia* spp., *Planchonia careya* (cocky apple), *Themeda triandra* (kangaroo grass), *Heteropogon contortus* (black spear grass), *Pandanus tectorius* (screw pine), many species of native grass and ground orchards.

Site HC02 — *Herbert Creek Catchment*

Landform	***Open depression***
Tenure	***Lease Land, 9 L127***
Current land use	***Grazing***
Lat & Long	***-22.76060, 150.19713*** *(GDA94)*


North


East

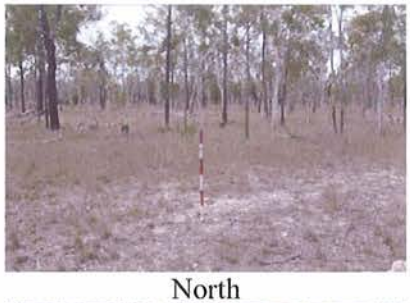

South


West

Vegetation description	Woodland of *Eucalyptus tereticornis* (forest red gum) and *Corymbia clarksoniana* (Clarkson's bloodwood) on drainage line. Understorey species include: *Melaleuca viridiflora* (broad-leaved tea-tree), *E. crebra* (narrow-leaved ironbark), *Petalostigma pubescens* (quinine bush), *Lysiphyllum hookeri* (white bauhinia) and *Planchonia careya* (cocky apple) with little ground cover.
Mapped Regional Ecosystem	11.3.36 / 11.3.4 / 11.3.29 / 11.3.25b - *Eucalyptus crebra* and/or *E. populnea* (poplar box) and/or *E. melanophloia* (silver-leaved ironbark) on alluvial plains / *Eucalyptus tereticornis* and/or *Eucalyptus* spp. tall woodland on alluvial plains / *Eucalyptus crebra*, *E. exserta* (Queensland peppermint), *Melaleuca* spp. (paperbark) woodland on alluvial plains / *Eucalyptus tereticornis* or *E. camaldulensis* (river red gum) woodland fringing drainage lines
Status	Of concern / of concern / not of concern / not of concern
Vegetation assessment	
Tree density	249.41 per ha
Sapling density	55.99 per ha
Shrub density	30.54 per ha
Tree hollows	20.36 per ha
Log density	127.25 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	60% (10% bare soil, 50% rocks)
Litter	20% (10% fine litter, 8% coarser litter, 2% log litter)
Forbs	20% (15% grass, 5% herbs)
Site disturbances/weeds and other notes	Current grazing, flood debris, track crossing about 80m downstream, channel erosion. Weeds include: *Stachytarpheta jamaicensis* (snake weed), *Melinis repens* (red natal)
Other plant species	*Diasporas geminata* (ebony), *Megathyrsus maximus* (Guinea grass), *Sporobolis* sp., *Sida* sp., *Alternanthera* sp.

Site HC03 — *Herbert Creek Catchment*

Landform	***Alluvial Plain***
Tenure	***Lease Land, 9 L127***
Current land use	***Grazing***
Lat & Long	***-22.76000, 150.17845*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) open woodland with occasional *Corymbia dallachiana* (ghost gum) over grassy ground cover
Mapped Regional Ecosystem	11.3.36 / 11.3.4 / 11.3.29 / 11.3.25b - *Eucalyptus crebra* and/or *E. populnea* (poplar box) and/or *E. melanophloia* (silver-leaved ironbark) on alluvial plains / *Eucalyptus tereticornis* (forest red gum) and/or Eucalyptus spp. tall woodland on alluvial plains / *Eucalyptus crebra*, *E. exserta* (Queensland peppermint), *Melaleuca* spp. (paperbark) woodland on alluvial plains / *Eucalyptus tereticornis* or *E. camaldulensis* (river red gum) woodland fringing drainage lines
Status	Of concern / of concern / not of concern / not of concern
Vegetation assessment	
Tree density	249.41 per ha
Sapling density	173.06 per ha
Shrub density	147.60 per ha
Tree hollows	20.36 per ha
Log density	351.21 per ha
Declared weeds	25.45 per ha
Species:	*Opuntia stricta* (prickly pear)
Ground cover	
Bare ground	45% (bare soil)
Litter	30% (18% fine litter, 10% coarser litter, 2% log litter)
Forbs	25% (24% grass, 1% herbs)
Site disturbances/weeds and other notes	Current grazing, farm road about 50m from site, stock fence about 50m from site, evidence of a very old fire, tree stumps present from selective clearing
Other plant species	*Corymbia tessellaris* (Moreton Bay ash), *Eucalyptus tereticornis*, *Melaleuca viridiflora* (broad-leaved tea-tree), *Eucalyptus platyphylla* (poplar gum), *Alphitonia excelsa* (soap bush), *Arundinella nepalensis* (reed grass), *Heteropogon contortus* (black spear grass), *Themeda triandra* (kangaroo grass), *Sporobolus* sp., *Chloris gayana* (Rhodes grass), *Grewia latifolia* (dog's balls), *Acacia crassa* subsp. *longicoma*

Site HC04 — *Herbert Creek Catchment*

Landform	***Alluvial Plain***
Tenure	***Free Hold, 8 L127***
Current land use	***Grazing***
Lat & Long	***-22.75135, 150.1368*** *(GDA94)*


North


East


South


West

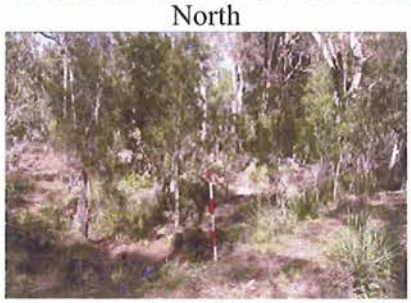
Vegetation description	Grassland with emergent *Eucalyptus platyphylla* (poplar gum), and occasional *Corymbia* sp. (bloodwood) and *Melaleuca* sp. (paperbark)
Mapped Regional Ecosystem Status	Non-remnant
Vegetation assessment	
Tree density	150.1368 per ha
Sapling density	25.45 per ha
Shrub density	178.15 per ha
Tree hollows	5.09 per ha
Log density	40.72 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	55% (bare soil)
Litter	5% (fine litter)
Forbs	40% (34% grass, 5% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Very heavily grazed, evidence of fire, earthworks for dam construction about 80m away. Many herbaceous species present.
Other plant species	*Melinis repens* (red natal), *Gomphrena* sp. (gompha weed), *Heteropogon contortus* (black spear grass), *Sporobolus* sp., *Indigofera* sp., *Eustrephus latifolius* (wombat berry), *Sida* sp., *Arundinella nepalensis* (reed grass), *Megathyrsus maximus* (Guinea grass), *Panicum effusum* (hairy panic), *Chloris gayana* (Rhodes grass), *Cynodon dactylon* (couch).

Site HC05 — *Herbert Creek Catchment*

Location	***Herbert Creek***
Landform	***Open Depression***
Tenure	***Free Hold, 8 L127***
Current land use	***Grazing***
Lat & Long	***-22.75279, 150.13587*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus tereticornis* (forest red gum) and *Melaleuca* sp. (paperbark) woodland on drainage gully, includes species: *Corymbia tessellaris* (Moreton Bay ash), *Casuarina cunninghamiana* (river she oak), *Melaleuca leucadendra* (weeping paperbark), *Macaranga tanarins* (macaranga), and *Callistemon viminalis* (weeping bottlebrush)
Mapped Regional Ecosystem	11.3.25b - *Eucalyptus tereticornis* or *E. camaldulensis* (river red gum) woodland fringing drainage lines
Status	Not of concern
Vegetation assessment	
Tree density	330.85 per ha
Sapling density	45.81 per ha
Shrub density	198.51 per ha
Tree hollows	5.09 per ha
Log density	229.05 per ha
Declared weeds	20.36 per ha
Species:	*Cryptostegia grandiflora* (rubber vine) (WONS, Class 2)
Ground cover	
Bare ground	30% (bare soil)
Litter	50% (39% fine litter, 10% coarser litter, 1% log litter)
Forbs	20% (16% grass, 3% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Evidence of frequent fires, current intensive grazing, flood debris. Other weeds include: *Argemone ochroleuca* (Mexican poppy) (WONS) and *Xanthium pungens* (noogoora burr) (WONS)
Other plant species	*Planchonia careya* (cocky apple), *Ficus racemosa* (sandpaper fig), *Lomandra* sp., *Cyperus* spp., *Sida* spp., *Arundinella nepalensis* (reed grass), *Solanum torvum* (turkey berry)

Site HC06 — *Herbert Creek Catchment*

Location	***Herbert Creek***
Landform	***Creek***
Tenure	***Leasehold Land, 9 L127***
Current land use	***Grazing***
Lat & Long	***-22.71998, 150.11954*** *(GDA94)*


North


East


South


West

Vegetation description	Riparian edge of creek (brackish water) with *Acacia salicina* (sally wattle), *Eucalyptus coolabah* (coolibah) and several mangrove species in a narrow band on the waters edge and creek levy with grassy cover only.
Mapped Regional Ecosystem Status	Non-remnant
Vegetation assessment	
Tree density	353.52 per ha
Sapling density	49.10 per ha
Shrub density	176.76 per ha
Tree hollows	39.28 per ha
Log density	78.56 per ha
Declared weeds	39.28 per ha
Species:	*Cryptostegia gran*diflora (rubber vine) (WONS, Class 2)
Ground cover	
Bare ground	69% (bare soil)
Litter	1% (fine litter)
Forbs	30% (25% grass, 5% herbs)
Site disturbances/weeds and other notes	Bank erosion, current heavy grazing, new fence nearby, heavily cleared, and several fallen trees/logs in. Other non native species include: *Chloris gayana* (Rhodes grass), *Megathyrsus maximus* (Guinea grass), *Melinis repens* (red natal), *Stachytarpheta jamaicensis* (snake weed)
Other plant species	*Heteropogon contortus* (black spear grass), *Grewia latifolia* (dog's balls), *Alectryon diversifolius*, *Lomandra* sp., *Psydrax attenuatum*

Site HC07 — *Herbert Creek Catchment*

Landform	***Drainage Channel***
Tenure	***Free Hold, 98 CP881496***
Current land use	***Grazing***
Lat & Long	***-22.44428, 149.83378*** *(GDA94)*


North


East

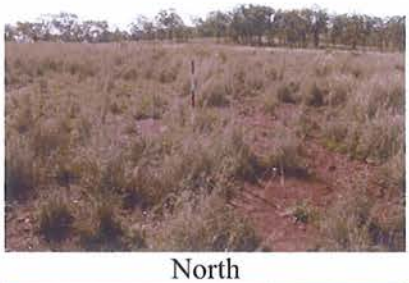

South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) woodland associated with alluvial drainage channel, with elements of *Acacia harpophylla* (brigalow) scrub.
Mapped Regional Ecosystem Status	Non-remnant
Vegetation assessment	
Tree density	203.6 per ha
Sapling density	30.54 per ha
Shrub density	274.86 per ha
Tree hollows	none
Log density	81.44 per ha
Declared weeds	15.27 per ha
Species:	*Opuntia stricta* (prickly pear) (WONS, Class 2), *Cryptostegia grandiflora* (rubber vine) (WONS, Class 2)
Ground cover	
Bare ground	30% (bare soil)
Litter	30% (19% fine litter, 10% coarser litter, 1% log litter)
Forbs	40% (20% grass, 19% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Land clearing, current grazing, evidence of fire about 5 years old. Other weeds include: *Stylosanthes scabra* (seca stylo)
Other plant species	*Alphitonia excelsa* (soap bush), *Achyranthes aspera* (chaff flower), *Planchonia careya* (cocky apple), *Cynodon dactylon* (couch), *Chloris virgata* (rhodes grass), *Heteropogon contortus* (black spear grass), *Alectryon diversifolius* (scrub boonaree), *Denhamia o leaster*, *Hovea longipes*, *Micromelum minutum* (Lime Berry), *Flindersia australis* (crows ash), *Exocarpus latifolius* (wombat berry)

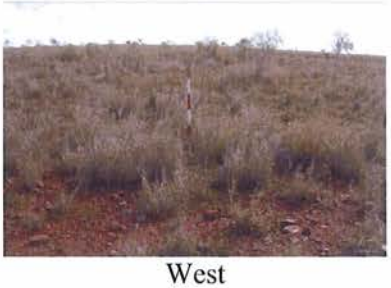
Site HC08 — *Styx River Catchment*

Landform	***Hill Crest***
Tenure	***Free Hold, 98 CP881496***
Current land use	***Grazing***
Lat & Long	***-22.41172, 149.81741*** *(GDA94)*


North


East


South


West

Vegetation description	Open grassland with emergent *Ficus* sp. and *Alstonia constricta* (quinine bush)
Mapped Regional Ecosystem Status	Non-remnant
Vegetation assessment	
Tree density	none
Sapling density	none
Shrub density	106.89 per ha
Tree hollows	none
Log density	none
Declared weeds	none
Species:	
Ground cover	
Bare ground	69% (30% bare ground, 39% rocks)
Litter	1% (fine litter)
Forbs	30% (23% grass, 7% herbs)
Site disturbances/weeds and other notes	Current intensive grazing
Other plant species	*Themeda triandra* (kangaroo grass), *Grewia latifolia* (dog's balls), *Acacia falcata*, *Stylosanthes scabra* (shrubby stylo)

S2.2.5 Stanage Coast Catchment

Figure S2.7 Site locations within the Stanage Coast Catchments

Site SC01 — *Stanage Coast Catchment*

Landform	***Hill Crest***
Tenure	***Free Hold, 28 PS124***
Current land use	***Grazing***
Lat & Long	***-22.35121, 150.15623*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) and *Casuarina* sp. open woodland with sparse mid-stratum and very little ground cover
Mapped Regional Ecosystem	11.3.9 / 11.3.25b - *Eucalyptus platyphylla* (poplar gum), *Corymbia* spp. woodland on alluvial plains/ *Eucalyptus tereticornis* (forest red gum) or *E. camaldulensis* (river red gum) woodland fringing drainage lines
Status	
Vegetation assessment	
Tree density	604.96 per ha
Sapling density	214.92 per ha
Shrub density	199.00 per ha
Tree hollows	none
Log density	55.72 per ha
Declared weeds	7.96 per ha
Species:	*Opuntia stricta* (prickly pear) (WONS, Class 2)
Ground cover	
Bare ground	32% (30% bare soil, 2% rocks)
Litter	62% (56% fine litter, 4% coarser litter, 2% log litter)
Forbs	6% (4% grass, 1% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Evidence of regular burning, vehicle tracks nearby which are very eroded. Echidna diggings common.
Other plant species	*Petalostigma pubescens* (quinine bush), *Melaleuca viridiflora* (broad-leaved tea-tree), *Themeda triandra* (kangaroo grass), *Acacia* spp., *Corymbia intermedia* (pink bloodwood) many species of native grass present.

Site SC02 — *Stanage Coast Catchment*

Location	***Shoalwater Bay Conservation Park***
Landform	***Simple slope***
Tenure	***National Park, 501 NPW699***
Current land use	***Conservation***
Lat & Long	***-22.33711, 150.17943*** *(GDA94)*


North


East


South


West

Vegetation description	*Eucalyptus crebra* (narrow-leaved ironbark) woodland with sparse mid-stratum of *Petalostigma pubescens* (quinine bush) and *Melaleuca viridiflora* (broad-leaved tea-tree) over very sparse ground stratum
Mapped Regional Ecosystem	11.11.20 / 11.11.15 / 11.3.9 / 11.11.10 - *Eucalyptus platyphylla* (poplar gum) woodland on old sedimentary / *Eucalyptus crebra* (narrow-leaved ironbark) woodland on deformed and metamorphosed sediments / *Eucalyptus platyphylla*, *Corymbia* spp. (bloodwood) woodland on alluvial plains / *Eucalyptus melanophloia* (silver-leaved ironbark) woodland on deformed and metamorphosed sediments
Status	Not of concern / Not of concern / Not of concern / Of concern
Vegetation assessment	
Tree density	264.68 per ha
Sapling density	137.43 per ha
Shrub density	356.30 per ha
Tree hollows	25.45 per ha
Log density	101.80 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	27% (bare soil)
Litter	66% (61% fine litter, 4% coarser litter, 1% log litter)
Forbs	7% (5% grass, 1% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Evidence of historic logging.
Other plant species	*Carissa ovata* (current bush), *Cupaniopsis anacardioides* (tuckeroo), *Lomandra* sp (mat rush), *Alphitonia excelsa* (soap bush)

Site SC03 — *Stanage Coast Catchment*

Location	***Shoalwater Bay Conservation Park***
Landform	***Coastal Flat***
Tenure	***National Park, 501 NPW699***
Current land use	***Conservation***
Lat & Long	***-22.32431, 150.18941*** *(GDA94)*


North


East


South


West

Vegetation description	Tall shrubland of *Petalostigma pubescens* (quinine bush), *Planchonia careya* (cocky apple), *Acacia* spp. and *Melaleuca viridiflora* (broad-leaved tea-tree), with a dense mid-stratum of shrubs and saplings with very little herbaceous ground cover
Mapped Regional Ecosystem	11.11.20 / 11.11.15 / 11.3.9 / 11.11.10 - *Eucalyptus platyphylla* (poplar gum) woodland on old sedimentary / *Eucalyptus crebra* (narrow-leaved ironbark) woodland on deformed and metamorphosed sediments / *Eucalyptus platyphylla*, *Corymbia* spp. (bloodwood) woodland on alluvial plains / *Eucalyptus melanophloia* (silver-leaved ironbark) woodland on deformed and metamorphosed sediments
Status	Not of concern / Not of concern / Not of concern / Of concern
Vegetation assessment	
Tree density	668.43 per ha
Sapling density	1718.82 per ha
Shrub density	1814.31 per ha
Tree hollows	none
Log density	222.81 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	25% (bare soil)
Litter	73% (66% fine litter, 5% coarser litter, 2% log litter)
Forbs	2% (1% herbs, 1% low shrubs)
Site disturbances/weeds and other notes	Many dead trees from recent dry conditions, fishing and camping site nearby.
Other plant species	*Alphitonia excelsa* (soap bush)

Site SC04 — *Stanage Coast Catchment*

Location	*Shoalwater Bay Conservation Park*
Landform	*Marine Plain*
Tenure	*National Park, 501 NPW699*
Current land use	*Conservation*
Lat & Long	*-22.32431, 150.18941 (GDA94)*


North


East


South


West

Vegetation description	Forbland on marine clay plain dominated by chenopods
Mapped Regional Ecosystem	11.1.2 / 11.1.4 - Samphire forbland on marine clay plains / Mangrove forest/woodland on marine clay plains
Status	Not of concern / Not of concern
Vegetation assessment	
Tree density	none
Sapling density	none
Shrub density	none
Tree hollows	none
Log density	none
Declared weeds	none
Species:	
Ground cover	
Bare ground	5% (bare soil)
Litter	none
Forbs	95% (93% herbs, 2% low shrubs)
Site disturbances/weeds and other notes	
Other plant species	

Site SC05 — *Stanage Coast Catchment*

Location	***Shoalwater Bay Conservation Park***
Landform	***Simple Slope***
Tenure	***National Park, 501 NPW699***
Current land use	***Conservation***
Lat & Long	***-22.28935, 150.14985*** *(GDA94)*


North


East


South


West

Vegetation description	*Corymbia* spp. (bloodwood) woodland with mid-dense mid-stratum of *Petalostigma pubescens* (quinine bush), *Acacia* spp. and *Melaleuca* spp. (paperbark) over very sparse ground stratum
Mapped Regional Ecosystem	11.11.20 / 11.11.15 / 11.3.9 / 11.11.10 - *Eucalyptus platyphylla* (poplar gum) woodland on old sedimentary / *Eucalyptus crebra* (narrow-leaved ironbark) woodland on deformed and metamorphosed sediments / *Eucalyptus platyphylla*, *Corymbia* spp. (bloodwood) woodland on alluvial plains / *Eucalyptus melanophloia* (silver-leaved ironbark) woodland on deformed and metamorphosed sediments
Status	Not of concern / Not of concern / Not of concern / Of concern
Vegetation assessment	
Tree density	424.50 per ha
Sapling density	339.60 per ha
Shrub density	1457.45 per ha
Tree hollows	56.60 per ha
Log density	212.25 per ha
Declared weeds	none
Species:	
Ground cover	
Bare ground	15% (bare soil)
Litter	79% (75% fine litter, 3% coarser litter, 1% log litter)
Forbs	6% (2% grass, 2% herbs, 2% low shrubs)
Site disturbances/weeds and other notes	Evidence of old fires. Extensive patches of *Stachytarpheta jamaicensis* (snake weed) near park boundary nearby.
Other plant species	*Grevillia striata* (beefwood), *Alphitonia excelsa* (soap bush), *Atalaya hemiglauca* (whitewood)

Site SC06 — *Stanage Coast Catchment*

Location	***Shoalwater Bay Conservation Park***
Landform	***Beach Dune***
Tenure	***National Park, 501 NPW699***
Current land use	***Conservation***
Lat & Long	***-22.29345, 150.15851*** *(GDA94)*


North


East


South


West

Vegetation description	*Casuarina equisetifolia* (coastal sheoak) open woodland on beach ridge, with *Spinifex sericeus* (hairy spinifex) sparse ground cover with patchy beach scrub of *Diospyros geminata* (ebony) and *Canthium coprosmoides* (coast canthium).
Mapped Regional Ecosystem	11.2.3 / 11.2.2 - Microphyll vine forest (beach scrub) on sandy beach ridges / Complex of *Spinifex sericeus*, *Ipomoea pes-caprae* (goat's foot) and *Casuarina equisetifolia* grassland and herbland on foredunes
Status	Of concern / of concern
Vegetation assessment	
Tree density	55.99 per ha
Sapling density	none
Shrub density	50.9 per ha
Tree hollows	none
Log density	5.69 per ha
Declared weeds	20.36 per ha
Species:	*Opuntia stricta* (prickly pear) (WONS, Class 2)
Ground cover	
Bare ground	83% (bare soil)
Litter	15% (10% fine litter, 5% coarser litter)
Forbs	2% (grass)
Site disturbances/weeds and other notes	Camping area nearby with 4WD tracks behind fore dunes, extensive beach erosion with many *Casuarina equisetifolia* having exposed roots or fallen over.
Other plant species	*Ipomoea pes-caprae*

S2.3 Summary Data Tables

S2.3.1 Clairview Creek Catchment

Table S2.4 General site details and characteristics for the Clairview Creek Catchment

Site	CC01	CC02	CC03	CC04	CC05	CC06	CC07	CC08	CC09	CC10	CC11	CC12
Survey date	03-Oct-07	03-Oct-07	03-Oct-07	26-Sep-07	26-Sep-07	26-Sep-07	26-Sep-07	26-Sep-07	26-Sep-07	26-Sep-07	25-Sep-07	25-Sep-07
latitude	22.22069	22.21836	22.2195	22.17778	22.17844	22.18777	22.18726	22.14161	22.15194	22.17901	22.18392	22.19892
longitude	149.41726	149.41688	149.46397	149.47989	149.48002	149.49909	149.49970	149.50511	149.50703	149.50437	149.51639	149.53018
FPC (%)	6		35	20	45	5	10	25	30	25	30	25 - 30
Total cover (%) (inc. mid-storey)	8		50	21	47	6	10	60	45	35	50	35
Tree heights												
1	15	16.5	12.2	27.5	15	16.5	6.5	7.5	17	17	17	17
2	10	16	11.5	20.5	16.5	17	9.5	6.5	15.5	18.5	24	22
3	9	16	12	25.5	17	15	7	6.5	16	16.5	18	16
Slope	5	1	2	1	3	5	1	2	5	2	1	1
Aspect	330	30	300	330	120	210	180	225	195	280	25	325
Rock formations	hollows & exfoliating rock & crevices											
Soil colour	grey	sand	grey brown	grey	grey/light brown	brown	grey brown	grey	grey	grey brown	grey	grey
Soil texture	light clay	sand	loam	light clay	sandy loam	loam	loam	light clay		sandy loam	clay loam	clay loam
Water pools		yes		Clairview Creek nearby	yes	tidal creek				creek nearby		creek
pH												
1	5.5	6.0	5.0	5.5	6.0	6.0	4.5			7.0	6.0	5.0
2	5.5	6.0	5.5	6.0	5.5	6.0	5.0			7.0	6.5	5.5
3	5.0	6.0	5.5	5.5	6.0	6.0	5.0			7.0	6.0	5.5

Table S2.5 Vegetation structure (basal area (m^2/ha)) for the Clairview Creek Catchment

Site	CC01	CC02	CC03	CC04	CC05	CC06	CC07	CC08	CC09	CC10	CC11	CC12
Acacia sp.			2					3				
Alphitonia excelsa (soap bush)									1			
Callistemon viminalis (weeping bottlebrush)						1						
Casuarina sp.		5			1							
Corymbia citriodora (lemon scented gum)							3					
Corymbia intermedia (pink bloodwood)											5	
Corymbia sp.				1						3		
Corymbia tessellaris (Moreton Bay ash)										1	2	
Eucalyptus crebra (narrow-leaved ironbark)	4			5		3			4		2	11
Eucalyptus platyphylla (poplar gum)			3	2							8	
Eucalyptus tereticornis (forest red gum)		2	1									
Lophostemon confortus (brush box)	1		3									
Maytenus disperma (cork wood)												1
Melaleuca sp.		4			7					2	1	1
Nauclea orientalis (Leichhardt tree)					1							
Planchonia careya (cocky apple)										2		
Terminalia sp.					1							
Unknown										1		
Total (m^2/ha)	*5*	*11*	*9*	*8*	*10*	*4*	*3*	*3*	*5*	*9*	*18*	*12*
Trees with loose bark (m^2/ha)	1	0	1	0	4	2	0	0	1	3	5	3
Dead trees	1									2	1	1
Live trees			1		4	2			1	1	4	2

Table S2.6 Vegetation density (no./ha) for the Clairview Creek Catchment. (Tree density - stems >10 cm; Sapling density - stems <10 cm)

Site	CC01	CC02	CC03	CC04	CC05	CC06	CC07	CC08	CC09	CC10	CC11	CC12
Site Area (radius)	25	25	25	25	10	15	10	10	25	10	25	25
Tree stem density	137.43	239.23	223.96	381.75	157.79	636.3	111.98	117.07	290.13	101.8	641.34	264.68
Species (count)												
Acacia holosericea								15				
***Acacia salicina* (sally wattle)**									2			
***Acacia* sp.**			17									
***Alphitonia excelsa* (soap bush)**			1					4	5			
***Callistemon viminalis* (weeping bottlebrush)**					4							
***Canthium* sp.**									2	2		
***Casuarina* sp.**		15			6							
***Corymbia citriodora* (lemon scented gum)**							22					
***Corymbia* sp.**				1						7	14	
***Corymbia tessellaris* (Moreton Bay ash)**	1	1	2	3		16				1	19	
***Cryptocarya triplinervis* (three veined laurel)**					1							
***Cupaniopsis anacardioides* (tuckeroo)**			1									
***Diospyros geminata* (ebony)**			1									
***Eucalyptus crebra* (narrow-leaved ironbark)**	24			27		3		3	47		4	34
***Eucalyptus melanophloia* (silver-leaved ironbark)**	2											
***Eucalyptus platyphylla* (poplar gum)**		5	1	13		1					22	
***Eucalyptus tereticornis* (forest red gum)**		1	1								2	3
***Excoecaria agallocha* (milky mangrove)**						12						
***Ficus racemosa* (sandpaper fig)**					1							
***Hibiscus* sp.**		1										
***Lophostemon grandiflora* (northern swamp box)**			11									
***Macaranga tanarius* (macaranga)**		1	3									
***Mallotus philippensis* (red kamala)**			2		6							
***Maytenus disperma* (cork wood)**										1		3
***Melaleuca* sp.**		11			6							

Site	CC01	CC02	CC03	CC04	CC05	CC06	CC07	CC08	CC09	CC10	CC11	CC12
***Melaleuca viridiflora* (broad-leaved tea-tree)**				6		13					51	11
***Melia azedarach* (white cedar)**		2	2									
***Nauclea orientalis* (Leichhardt tree)**					2							
***Planchonia careya* (cocky apple)**		3		25	1					6	14	
***Terminalia* sp.**					1							
Unknown 1												1
Unknown 2										2		
Unknown 3										1		
Unknown 4					1							
Unknown 5					2							
Unknown 6								1				
Unknown 7									1			
Unknown 8		7	2									
Sapling stem density	55.99	285.04	132.34	81.44	0.00	84.84	0	132.34	20.36	40.72	361.39	188.33
Sapling count < 1 m	0	24	15	8				25	3	2	7	31
Sapling count 1-2 m	7	15	6	1		6			1	3	16	5
Sapling count >2 m	4	17	5	7				1		3	48	1
Shrub density	10.18	254.5	463.19	111.98	40.72	56.56	0	40.72	682.06	152.7	559.9	25.45
Shrub count <1 m		12	45	22	1	1		3	66	18	31	1
Shrub count 1-2 m	2	25	36		2	3		3	47	7	31	2
Shrub count >2 m		13	10		5			2	21	5	48	2
Hollow tree density	0	10.18	0	0	15.27	0	0	0	15.27	0	20.36	35.63
Stag count					2				2			2
Live tree count		2			1				1		4	5
Log density (total)	35.63	55.99	30.54	71.26	10.18	70.7	0	40.72	81.44	50.9	30.54	162.88
Solid log density	20.36	30.54	30.54	45.81	10.18	56.56	0	40.72	81.44	10.18	15.27	76.35
Log count > 10 to 20 cm	3	5	5	8	2	3		3	11	1	3	9
Log count 20 - 50 cm	1	1	1	1		1		3	3	1		5
Log count > 50 cm								2	2			1
Hollow log density	15.27	25.45	0	25.45	0	14.14	0	0	0	40.72	15.27	86.53
Log count > 10 to 20 cm	1	1		4						4	2	9

Site	CC01	CC02	CC03	CC04	CC05	CC06	CC07	CC08	CC09	CC10	CC11	CC12
Log count 20 - 50 cm	2	2		1		1				2		5
Log count > 50 cm		2								2	1	3
Stumps per site (count)		1		3								
Weed density	534.45	453.01	325.76	30.54	1177.71	509.04	636.6	795.75	0	1114.05	127.25	5.09
Species (count)												
***Cryptostegia grandiflora* (rubber vine)**										1		
***Lantana camara* (lantana)**	105	89	64	6	37	36	20	25		34	25	1
Exfoliating bark on dead trees												
Saplings count (<10 cm)	2			1				2	2	1		1
Tree count (>10 cm)	1			2				1	2	2		1

Table S2.7 Groundcover for the Clairview Creek Catchment

Site	CC01	CC02	CC03	CC04	CC05	CC06	CC07	CC08	CC09	CC10	CC11	CC12
Bare ground (%)	35	40	17	15	7	10	10	53	20	2	5	1
bare soil	30	5	2	15	7	1		53	5	2	5	1
rocks	5	35	15			9			15			
Litter cover (%)	38	23	75	50	80	15	20	5	75	50	65	65
fine litter	32	13	72	38	69			4	66	39	55	59
coarser litter (2.5 - 10 cm)	5	5	3	10	10			1	7	10	10	4
log litter (>10 cm)	1	5		2	1				2	1		2
Forb cover (%)	27	37	8	35	13	75	70	42	5	48	30	34
grass	5	2	2	30	2	65	43	1	2	33	20	33
herbs	20	30	5	3	10	5	25	40	2	10	10	1
shrub (if ground cover)	2	5	1	2	1	5	2	1	1	5		
	100	100	100	100	100	100	100	100	100	100	100	100
Maximum grass height (cm)	50	150	40	70	40	80	90			100	80	20
Average grass height (cm)	10	10	15	10	5	15	10			15	10	10

S2.3.2 St Lawrence Creek Catchment

Table S2.8 General site details and characteristics for the St Lawrence Creek Catchment

Site	SL01	SL02	SL03	SL04	SL05	SL06	SL07	SL08	SL09	SL10	SL11	SL12	SL13
Survey date	12-Jul-07	12-Jul-07	12-Jul-07	13-Jul-07	13-Jul-07	13-Jul-07	13-Jul-07	13-Jul-07	03-Oct-07	03-Oct-07	03-Jul-07	03-Jul-07	03-Jul-07
Location latitude	22.32918	22.35774	22.33536	22.29774	22.29773	22.31948	22.33074	22.35123	22.25331	22.25389	22.31129	22.31215	22.31337
Location longitude	149.32851	149.3398	149.34523	149.36604	149.36724	149.39977	149.41127	149.43008	149.41686	149.41793	149.47726	149.47955	149.48012
FPC (%)	60	50	5-10	80	20	0	40	0	7	25	20	20	40
Total cover (%) (inc. mid-storey)	80	52	40	85	30	0	42	0	7	38	22	25	60
Tree heights													
1	11	17	16	6.5	19	2	16	5	16.5	14	24.5	18.5	8
2	12	12	25	6	16	11	21	20	18.5	15	27.5	19.5	8
3	9	13	20	5	17	10	19	6	16.5	15	28.5	18.5	7
Slope	28	5	2	3		1	1	1	15	2	0	3	10
Aspect	155	10	100	60		180	240	300	125	350	180	120	70
Soil colour	grey	grey	sandy	browny red	light brown	dark brown	grey	brown	grey/brown	sand	brown grey	brown	dark brown
Soil texture	sandy loam	sandy loam	sand brown	slight sandy clay	sandy loam	loam	sandy loam	clay	light clay	sand		loamy sand	sandy
Water pools			creek nearby								in car tracks from recent rains	some from recent rain	tidal creek
pH													
1	4.5	5.0	6.5	5.5	5.5	6.5	5.5	5.5	5.0	6.0	6.5	5.5	5.5
2	5.0	5.0	6.0	6.0	6.0	6.0	5.5	5.0	5.5	5.5	6.0	5.5	6.0
3	5.5	5.0	6.5	6.0	6.0	6.0	6.0	5.5	5.5	5.5	6.5	6.0	5.5

Table S2.9 Vegetation structure (basal area (m^2/ha)) for the St Lawrence Creek Catchment

Site	SL01	SL02	SL03	SL04	SL05	SL06	SL07	SL08	SL09	SL10	SL11	SL12	SL13
***Acacia* sp.**					1								
***Alphitonia excelsa* (soap bush)**				5	4								
Breynia oblongifolia											1		
***Callistemon viminalis* (weeping bottlebrush)**			1										
***Psydrax odorata* (shiny-leaved canthium)**				1									
***Psydrax* sp.**													1
***Casuarina* sp.**			6							7			
***Corymbia citriodora* (lemon scented gum)**		5											
***Corymbia intermedia* (pink bloodwood)**	1												
***Corymbia* sp.**	3	6											
***Corymbia tessellaris* (Moreton Bay ash)**					1		1						1
***Diospyros geminata* (ebony)**					1								2
***Eucalyptus crebra* (narrow-leaved ironbark)**	5	2		1	3				11			6	
***Eucalyptus platyphylla* (poplar gum)**							7						
***Eucalyptus populnea* (poplar box)**											9		
***Eucalyptus tereticornis* (forest red gum)**										1			
***Melaleuca* sp.**										4		1	
***Melaleuca viridiflora* (broad-leaved tea-tree)**						1						1	
***Melia azedarach* (white cedar)**			1										
***Paraserianthes toona* (Mackay cedar)**					1								
Total (m^2/ha)	*9*	*13*	*8*	*7*	*11*	*1*	*8*	*0*	*11*	*12*	*10*	*8*	*4*
Trees with loose bark (m^2/ha)	0	3	0	5	2	0	3	0	0	2	0	3	2
Dead trees		3		4	1							1	2
Live trees				1	1		3			2		2	

Table S2.10 Vegetation density (no./ha) for the St Lawrence Creek Catchment. (Tree density - stems >10 cm; Sapling density - stems <10 cm)

Site	SL01	SL02	SL03	SL04	SL05	SL06	SL07	SL08	SL09	SL10	SL11	SL12	SL13
Site Area (radius or area)	15	25	50x20	25	25	25	25	25	25	50x20	25	25	50x20
Tree stem density	608.02	534.45	471.36	127.25	203.6	5.09	132.34	5.09	66.17	363.34	157.79	229.05	510.64
Species (count)													
Acacia bidwillii								1					
Acacia holosericea			1										
***Alphitonia excelsa* (soap bush)**				17	14							1	2
***Callistemon viminalis* (weeping bottlebrush)**			7										
***Psydrax odorata* (shiny-leaved canthium)**				4									
***Psydrax* sp.**				1								2	3
***Casuarina* sp.**			14							12			3
***Corymbia citriodora* (lemon scented gum)**		14											
***Corymbia intermedia* (pink bloodwood)**	1												
***Corymbia* sp.**	19	85											
***Corymbia tessellaris* (Moreton Bay ash)**					2		2					1	6
***Diopyros geminata* (ebony)**					1								6
***Eucalyptus crebra* (narrow-leaved ironbark)**	18	5		1	23	1	1		13		3	35	7
***Eucalyptus platyphylla* (poplar gum)**							22						7
***Eucalyptus populnea* (poplar box)**											28		
***Eucalyptus tereticornis* (forest red gum)**							1						
***Euroschinus falcatus* (ribbonwood)**													1
***Excoecaria agallocha* (milky mangrove)**													13
***Ficus racemosa* (sandpaper fig)**										2			2
***Grevillia striata* (beefwood)**												1	
***Lophostemon confertus* (brush box)**			5										
Lophostemon grandiflorus	5		1							2			

Site	SL01	SL02	SL03	SL04	SL05	SL06	SL07	SL08	SL09	SL10	SL11	SL12	SL13
(northern swamp box)													
***Macaranga tanarius* (macaranga)**			4										
***Mallotus philippensis* (red kamala)**			11							3			
***Melaleuca* sp.**										10			
***Melaleuca viridiflora* (broad-leaved tea-tree)**		1										5	
***Melia azedarach* (white cedar)**			3										1
***Planchonia careya* (cocky apple)**										7			
***Pleiogynium timorense* (Burdekin plum)**			1										
Pouteria sericea				1									
***Terminalia* sp.**			1										1
Unknown 1				1									
Unknown 2										1			
Sapling stem density	113.12	285.04	108.02	0	111.98	25.45	40.72	15.27	0	49.1	0	81.44	29.46
Sapling count < 1 m	3	19	1		7	2	3	2		0		7	
Sapling count 1-2 m	3	13	3		4	2		1		2		5	1
Sapling count >2 m	2	24	7		11	1	5			3		4	2
Shrub density	579.74	91.62	343.7	86.53	397.02	10.18	45.81	20.36	0	68.74	417.38	274.86	157.12
Shrub count < 1 m	5	11	4	1	23	1		4			12	10	7
Shrub count 1-2 m	25	4	15	12	33		4			3	32	12	7
Shrub count >2 m	11	3	16	4	22	1	5			4	38	32	2
Hollow tree density	70.7	25.45	29.46	20.36	15.27	0	40.72	0	0	0	20.36	20.36	29.46
Stag count	5	2	3	4	1						3	3	3
Live tree count		3			2		8				1	1	
Log density (total)	197.96	346.12	98.2	86.53	71.26	0	132.34	30.54	35.63	58.92	376.66	178.15	58.92
Solid log density	169.68	264.68	78.56	66.17	50.9	0	117.07	15.27	35.63	39.28	361.39	157.79	58.92
Log count > 10 to 20 cm	3	21	6	10	7		12	2	5	2	55	17	3
Log count 20 - 50 cm	9	29	1	3	3		11	1	2	2	16	14	3
Log count > 50 cm		2	1										
Hollow log density	28.28	81.44	19.64	20.36	20.36	0	15.27	15.27	0	19.64	15.27	20.36	0

Site	SL01	SL02	SL03	SL04	SL05	SL06	SL07	SL08	SL09	SL10	SL11	SL12	SL13
Log count > 10 to 20 cm		3		4						2		1	
Log count 20 - 50 cm	1	12	1		3		3	3			3	3	
Log count > 50 cm	1	1	1		1								
Stumps per site (count)									3				
Weed density	0	5.09	245.5	509.28	10.18	5.09	0	0	458.1	510.64	25.45	5.09	157.12
Species													
***Cryptostegia grandiflora* (rubber vine)**													5
***Opuntia stricta* (prickly pear)**											1	1	
***Lantana camara* (lantana)**		1	25	16	2	1			90	52	4		11
Exfoliating bark on dead trees													
Saplings count (<10 cm)													
Tree count (>10 cm)		1	2	5	2							2	1

Table S2.11 Groundcover for the St Lawrence Creek Catchment

Site	SL01	SL02	SL03	SL04	SL05	SL06	SL07	SL08	SL09	SL10	SL11	SL12	SL13
Bare ground (%)	2	5	20	15	10	0	10	5	7	40	5	5	5
bare soil	2	4	8	5	2		10	5	2	1	5	3	5
rocks		1	12	10	8				5	39		2	
Litter cover (%)	28	65	30	70	89	20	20	1	22	24	55	15	10
fine litter	15	50	20	54	80	20	19		15	20	43	11	10
coarser litter (2.5 - 10 cm)	10	10	10	15	7		1		5	3	10	2	
log litter (>10 cm)	3	5		1	2			1	2	1	2	2	
Forb cover (%)	70	30	50	15	1	80	70	94	71	36	40	80	85
grass	20	20		12	1	78	63	74	46	30	28	73	25
herbs	49	5	50	3			7	20	5	3	10	5	5
shrub (if ground cover)	1	5				2			20	3	2	2	55
Maximum grass height (cm)	50	30		30	10	70	90	70	90	90	50	90	150
Average grass height (cm)	35	5		20	10	15	45	10	40	40	20	30	80

S2.2.3 Styx River Catchment

Table S2.12 General site details and characteristics for the Styx River Catchment

Site	SR01	SR02	SR03	SR04	SR05	SR06	SR07	SR08	SR09	SR10	SR11	SR12
Survey date	18-Sep-07	18-Sep-07	18-Sep-07	01-Nov-07	01-Nov-07	01-Nov-07	01-Nov-07	01-Nov-07	18-Jul-07	18-Jul-07	18-Jul-07	18-Jul-07
Location latitude	22.69086	22.69005	22.67893	22.71116	22.70295	22.7185	22.70695	22.70685	22.43535	22.39201	22.3917	22.38527
Location longitude	149.60421	149.60432	149.60564	149.88043	149.86392	149.85482	149.82221	149.82134	149.81078	149.81355	149.81127	149.80722
FPC (%)	5	2	10	10	7	4	2	0	0	10	0	5
Total cover (%) (inc. mid-storey)	20	20	15	10	9	9	3	0	1	10	0	6
Tree heights												
1	9.5	13	17.5	16	18.5	17	8	7		8		6
2	8	12.9	16.5	16	12.5	17	7.5	0		18		6
3	10	13.5	18.5	16	11	15.5	11	0		12		7
Slope	1	5	2	6	2	4	2	1	2	3	2	2
Aspect		270	325	345	190	315	300	90	260	260	270	150
Rock formations	crevice					small shale outcrops present				exfoliating rock		
Soil colour	grey		grey	grey	grey	grey/light brown		light brown	reddish brown	grey/red-brown	grey	black
Soil texture				light clay	loamy sand	light clay		loam	sandy clay	sandy clay	clay	clay loam
Water pools	yes								in erosion gully		yes	yes
pH												
1	8.0	6.0	6.0	5.5	6.0	5.5	6.0	5.0	6.0	5.5	7.0	5.0
2	7.5	6.0	6.0	5.5	6.0	5.5	5.5	5.5	6.0	5.5	7.5	5.5
3	7.5	6.0		5.5	5.5	6.0	6.0	5.0	5.5	5.5	6.5	5.5

Table S2.13 Vegetation structure (basal area (m^2/ha)) for the Styx River Catchment

Site	SR01	SR02	SR03	SR04	SR05	SR06	SR07	SR08	SR09	SR10	SR11	SR12
***Acacia harpophylla* (brigalow)**		3										
***Callistemon viminalis* (weeping bottlebrush)**	1						3					
***Casuarina* sp.**							2					
***Corymbia dallachiana* (ghost gum)**				1								
***Corymbia tessellaris* (Moreton Bay ash)**							1					
***Eremophila* sp. (emu bush)**		1										
***Eucalyptus crebra* (narrow-leaved ironbark)**			4	10		10				6		
***Eucalyptus tereticornis* (forest red gum)**					3							
***Melaleuca* sp.**	3				1							5
***Melia azedarach* (white cedar)**					1							
***Petalostigma pubescens* (quinine bush)**					2							
Total (m^2/ha)	**4**	**4**	**4**	**11**	**7**	**10**	**6**	**0**	**0**	**6**	**0**	**5**
Trees with loose bark (m^2/ha)	3	1	0	0	0	0	0	0	0	3	0	1
Dead trees	1	1								2		1
Live trees	2									1		

Table S2.14 Vegetation density (no./ha) for the Styx River Catchment. (Tree density - stems >10 cm; Sapling density - stems <10 cm)

Site	SR01	SR02	SR03	SR04	SR05	SR06	SR07	SR08	SR09	SR10	SR11	SR12
Site Area (radius or area)	50x20	10	25	25	50x20	25	50x20	25	25	25	25	25
Tree stem density	284.78	142.52	137.43	183.24	265.14	173.06	432.08	5.09	5.09	101.8	0	96.71
Species (count)												
Acacia fasciculifera									1			
***Acacia harpophylla* (brigalow)**		20										
***Acacia* sp.**					6							
***Alphitonia excelsa* (soap bush)**				1								
***Atalaya hemiglauca* (whitewood)**		1										
***Callistemon viminalis* (weeping bottlebrush)**	13						26					
***Casuarina* sp.**							2					
***Corymbia dallachiana* (ghost gum)**				1								
***Corymbia tessellaris* (Moreton Bay ash)**								1				
***Cryptocarya triplinervis* (three veined laurel)**	1											
***Cupaniopsis anacardioides* (tuckeroo)**							1					
***Diospyros geminata* (ebony)**		2										
***Eremophila* sp. (emu bush)**		4										
***Eucalyptus crebra* (narrow-leaved ironbark)**			26	34		33				19		
***Eucalyptus melanophoia* (silver-leaved ironbark)**						1						
***Eucalyptus* sp.**										1		
***Eucalyptus tereticornis* (forest red gum)**					6							
***Ficus racemosa* (sandpaper fig)**	2											
***Lysiphyllum hookeri* (white bauhinia)**							1					
***Melaleuca leucadendra* (weeping tea tree)**	2											

Site	SR01	SR02	SR03	SR04	SR05	SR06	SR07	SR08	SR09	SR10	SR11	SR12
***Melaleuca* sp.**	10				6		13					
***Melaleuca viridiflora* (broad-leaved tea-tree)**												19
***Melia azedarach* (white cedar)**					2							
***Paraserianthes toona* (Mackay cedar)**							1					
***Petalostigma pubescens* (quinine bush)**		1			3							
***Planchonia careya* (cocky apple)**					2							
***Pleiogynium timorense* (Burdekin plum)**	1											
***Terminalia* sp.**					1							
Unknown 1					1							
Unknown 2			1									
Sapling stem density	0	222.81	76.35	50.9	58.92	544.63	9.82	0	0	61.08	0	35.63
Sapling count < 1 m		1	4	9	2	48				2		5
Sapling count 1-2 m		4	4		3	8				4		2
Sapling count >2 m		2	7	1	1	51	1			6		
Shrub density	68.74	1877.97	71.26	20.36	392.8	162.88	117.84	132.34	45.81	20.36	0	25.45
Shrub count <1 m		51	6	4	25	14	2		6	2		3
Shrub count 1-2 m	5	8	5		12	15	5	26	3	2		2
Shrub count >2 m	2		3		3	3	5					
Hollow tree density	49.1	0	10.18	0	0	10.18	9.82	0	0	30.54	0	0
Stag count	5		2			2				5		
Live tree count							1			1		
Log density (total)	324.06	254.64	76.35	91.62	98.2	137.43	108.02	5.09	15.27	86.53	0	50.9
Solid log density	176.76	63.66	55.99	71.26	98.2	76.35	78.56	5.09	15.27	76.35	0	45.81
Log count > 10 to 20 cm	13	1	7	6	5	7	3	1	2	6		4
Log count 20 - 50 cm	2	1	4	4	3	6			1	9		5
Log count > 50 cm	3			4	2	2	5					
Hollow log density	147.3	190.98	20.36	20.36	0	61.08	29.46	0	0	10.18	0	5.09
Log count > 10 to 20 cm	7	5	1	3		10	1					

Site	SR01	SR02	SR03	SR04	SR05	SR06	SR07	SR08	SR09	SR10	SR11	SR12
Log count 20 - 50 cm	3		2	1		2	1			2		1
Log count > 50 cm	5	1	1				1					
Stumps per site (count)			6									
Weed density	648.12	1241.37	20.36	0	58.92	0	206.22	0	0	5.09	0	0
Species (count)												
***Cryptostegia grandiflora* (rubber vine)**	50	33	1		6		21					
***Opuntia stricta* (prickly pear)**		6	2							1		
***Lantana camara* (lantana)**	16		1									
Exfoliating bark on dead trees												
Saplings count (<10 cm)		1										
Tree count (>10 cm)	6	4								1		1

Table S2.15 Groundcover for the Styx River Catchment

Site	SR01	SR02	SR03	SR04	SR05	SR06	SR07	SR08	SR09	SR10	SR11	SR12
Bare ground (%)	40	30	1	30	73	50	25	5	2	40	99	0
bare soil	25	30	1	30	13	20	15	5	2	30	99	
rocks	15				60	30	10			10		
Litter cover (%)	30	20	45	55	20	30	35	5	20	20	0	5
fine litter	10	14	40	40	16	30	32	4	18	12		4
coarser litter (2.5 - 10 cm)	10	5	5	15	3		2	1	2	7		1
log litter (>10 cm)	10	1			1		1			1		
Forb cover (%)	30	50	54	15	7	20	40	90	78	40	1	95
grass	20	23	33	13	5	13	38	89	60	33		90
herbs	10	2	20	2	2	5	2	1	16	5		5
shrub (if ground cover)		25	1			2			2	2	1	
	100	100	100	100	100	100	100	100	100	100	100	100
Maximum grass height (cm)	50	40	90	15	30	40	40	50	40	80		120
Average grass height (cm)	30	15	40	7	10	10	5	50	20	20		50

S2.2.4 Herbert Creek Catchment

Table S2.16 General site details and characteristics for the Herbert Creek Catchment

Site		HC01	HC02	HC03	HC04	HC05	HC06	HC07	HC08
Survey date		October	27-Jul-07	27-Jul-07	23-Jul-07	23-Jul-07	27-Jul-07	18-Jul-07	18-Jul-07
Location latitude		22.35863	22.7606	22.76000	22.75135	22.75279	22.71998	22.44428	22.41172
Location longitude		150.13569	150.19713	150.17845	150.13677	150.13587	150.11954	149.83378	149.81741
FPC (%)		7	10	5	2	20	8	20	0
Total cover (%) (inc. mid-storey)		15	12	10	3	20	10	30	0
Tree heights									
	1	19	17	17	16	18	23	21	
	2	17.5	19	18	12	18	16	17	
	3	16.5	17	22	20	28	7	18	
Slope		2	2	0.5	2	2	28		5
Aspect		220	200	200	170	220	260		80
Rock formations			hollows, exfoliating rocks, crevices, sand in creek bed						
Soil colour		orange sand	sandy	grey	grey	brown	grey	redish brown	red
Soil texture		sand	sandy	clay loam	clay	clay loam sand in creek bed	clay	light clay	gravelly clay
Water pools			yes				brackish water in creek		
pH									
	1	5.5	5.5	5.5	5.5	6.0	6.0	6.0	5.5
	2	5.0	6.5	6.0	5.5	6.0	6.0	6.0	6.0
	3	5.5	6.5	6.0	5.5	5.5	6.5	6.0	6.0

Table S2.17 Vegetation structure (basal area (m^2/ha) for the Herbert Creek Catchment

Site	HC01	HC02	HC03	HC04	HC05	HC06	HC07	HC08
***Acacia harpophylla* (brigalow)**					2		1	
***Acacia salicina* (sally wattle)**						4		
***Corymbia* sp.**	1	4						
***Corymbia tessellaris* (Moreton Bay ash)**							1	
***Diospyros geminata* (ebony)**		1						
***Eucalyptus coolabah* (coolibah)**						2		
***Eucalyptus crebra* (narrow-leaved ironbark)**			3				4	
***Eucalyptus platyphylla* (poplar gum)**		1		1				
***Eucalyptus tereticornis* (forest red gum)**	3	3						
***Eucalytpus portuensis* (white stringybark)**	1							
***Excoecaria agallacha* (milky mangrove)**						1		
***Lysiphyllum hookeri* (white bauhinia)**							1	
***Melaleuca* sp.**	3				6			
***Petalostigma pubescens* (quinine bush)**	2							
Total (m^2/ha)	***10***	***9***	***3***	***1***	***8***	***7***	***7***	***0***
Trees with loose bark (m^2/ha)	3	3	0	1	1	2	3	0
Dead trees	1			1		1	2	
Live trees	2	3			1	1	1	

Table S2.18 Vegetation density (no./ha) for the Herbert Creek Catchment. (Tree density - stems >10 cm; Sapling density - stems <10 cm)

Site	HC01	HC02	HC03	HC04	HC05	HC06	HC07	HC08
Site Area (radius or area)	25	25	25	25	25	50x20	25	25
Tree stem density	391.93	249.41	249.41	25.45	330.85	353.52	203.6	0
Species (count)								
***Acacia harpophylla* (brigalow)**					10		3	
***Acacia salicina* (sally wattle)**		2				18		
***Acacia* sp.**	3							
***Alphitonia excelsa* (soap bush)**	2							
***Casuarina* sp.**	6				1			
***Corymbia* sp.**		8	6					
***Corymbia tessellaris* (Moreton Bay ash)**			1		1		1	
***Cupaniopsis anacardioides* (tuckeroo)**						1		
***Diospyros geminata* (ebony)**		3					6	
***Eremophila* sp. (emu bush)**							1	
***Eucalyptus coolabah* (coolibah)**						10		
***Eucalyptus crebra* (narrow-leaved ironbark)**		2	37				7	
***Eucalyptus platyphylla* (poplar gum)**			1	1				
***Eucalyptus tereticornis* (forest red gum)**	5	20	2				3	
***Excoecaria agallocha* (milky mangrove)**						4		
***Grevillia striata* (beefwood)**	1							
Hovea longipes							8	
***Lysiphyllum hookeri* (white bauhinia)**		3					8	
***Macaranga tanarius* (macaranga)**					9			
***Melaleuca leucadendra* (weeping tea tree)**					5	2		

Site	HC01	HC02	HC03	HC04	HC05	HC06	HC07	HC08
Melaleuca sp.	38		2					
Melaleuca viridiflora (broad-leaved tea-tree)		3		4	35			
Petalostigma pubescens (quinine bush)	16	4						
Planchonia careya (cocky apple)	4	4			4			
Unknown 1						1	3	
Unknown 2	2							
Sapling stem density	407.2	55.99	173.06	0	45.81	49.1	30.54	0
Sapling count < 1 m	49	6	11		3	3	4	
Sapling count 1-2 m	17	3	5		2		2	
Sapling count >2 m	14	2	18		4	2		
Shrub density	229.05	30.54	147.61	178.15	198.51	176.76	274.86	106.89
Shrub count <1 m	33	4	12	33	31		28	19
Shrub count 1-2 m	10	2	9	2	8	3	14	2
Shrub count >2 m	2		8			15	12	
Hollow tree density	5.09	20.36	20.36	5.09	5.09	39.28	0	0
Stag count			4			1		
Live tree count	1	4		1	1	3		
Log density (total)	71.26	127.25	351.21	40.72	229.05	78.56	81.44	0
Solid log density	71.26	106.89	315.58	35.63	208.69	78.56	66.17	0
Log count > 10 to 20 cm	7	10	21	6	24	3	7	
Log count 20 - 50 cm	4	11	41	1	16	5	6	
Log count > 50 cm	3				1			
Hollow log density	0	20.36	35.63	5.09	20.36	0	15.27	0
Log count > 10 to 20 cm		1		1	2		1	
Log count 20 - 50 cm		3	7		1		2	
Log count > 50 cm					1			
Stumps per site (count)			6					
Weed density	0	0	25.45	0	20.36	39.28	15.27	0
Species (count)								
Cryptostegia grandiflora (rubber vine)					4	4	2	
Opuntia stricta (prickly			5				1	

Site	HC01	HC02	HC03	HC04	HC05	HC06	HC07	HC08
pear)								
Exfoliating bark on dead trees								
Saplings count (<10 cm)	2							
Tree count (>10 cm)	4	2				1		

Table S2.19 Groundcover for the Herbert Creek Catchment

Site	HC01	HC02	HC03	HC04	HC05	HC06	HC07	HC08
Bare ground (%)	29	60	45	55	30	69	30	69
bare soil	29	10	45	55	30	69		30
rocks		50						39
Litter cover (%)	63	20	30	5	50	1	30	1
fine litter	60	10	18	5	39	1		1
coarser litter (2.5 - 10 cm)	2	8	10		10			
log litter (>10 cm)	1	2	2		1			
Forb cover (%)	8	20	25	40	20	30	40	30
grass	5	15	24	34	16	25		23
herbs	2	5	1	5	3	5		7
shrub (if ground cover)	1			1	1			0
	100	100	100	100	100	100	100	100
Maximum grass height (cm)	30	60	90	80	20	40		80
Average grass height (cm)	5	25	10	10	5	7		40

S2.2.5 Stanage Coast Catchment

Table S2.20 General site details and characteristics for the Stanage Coast Catchment

Site		SC01	SC02	SC03	SC04	SC05	SC06
Survey date		02-Nov-07	02-Nov-07	02-Nov-07	02-Nov-07	02-Nov-07	02-Nov-07
Location latitude		22.35121	22.33711	22.32431	22.31240	22.28935	22.29345
Location longitude		150.15623	150.17943	150.18941	150.15925	150.14985	150.15851
FPC (%)		6	9	10	0	11	2
Total cover (%) (inc. mid-storey)		8	11	20	0	20	2
Tree heights							
	1	18.5	14.5	7	0	11.5	6
	2	17.5	16.5	7	0	12.5	6
	3	14	16.5	7	0	12.5	6
Slope		3	1	0	0.5	2	5
Aspect		225	315	0	10	45	240
Soil colour		orange	sand	grey	grey	grey sand	white
Soil texture		sandy loam	sandy loam	fine sand	marine clay	sandy loam	sand
Water pools							ocean near
pH							
	1	5.5	5.5	5.0	6.5	5.0	5.5
	2	5.0	6.0	5.0	6.0	5.5	5.5
	3	5.0	5.5	5.0	6.5	5.0	5.5

Table S2.21 Vegetation structure (basal area (m^2/ha) for the Stanage Coast Catchment

Site	SC01	SC02	SC03	SC04	SC05	SC06
***Acacia* sp.**			3			
***Alphitonia excelsa* (soap bush)**			1			
***Casuarina* sp 1.**	4					1
***Corymbia* sp 2.**	1	1			3	
***Eucalyptus crebra* (narrow-leaved ironbark)**	9	6				
***Melaleuca* sp.**			1			
***Petalostigma pubescens* (quinine bush)**					1	
***Planchonia careya* (cocky apple)**			3			
Total (m^2/ha)	**14**	**7**	**8**	**0**	**4**	**1**
Trees with loose bark (m^2/ha)	0	0	3	0	0	1
dead			2			1
alive			1			

Table S2.22 Vegetation density (no./ha) for the Stanage Coast Catchment. (Tree density - stems >10 cm; Sapling density - stems <10 cm)

Site	SC01	SC02	SC03	SC04	SC05	SC06
Site Area (radius)	20	25	10	25	15	25
Tree stem density	604.96	264.68	106.89	0	424.5	55.99
Species (count)						
***Acacia* sp.**		1	5		9	
***Canthium coprosmoides* (coast canthium)**						1
***Casuarina* sp. 1**	51					5
***Corymbia* sp. 2**	1				10	
***Diospyros geminata* (ebony)**						3
***Eucalyptus crebra* (narrow-leaved ironbark)**	21	15				
***Melaleuca* sp.**	1	2	2		4	
***Petalostigma pubescens* (quinine bush)**	2	34	5		7	
***Planchonia careya* (cocky apple)**			9			
Unknown 1						2
Sapling stem density	214.92	137.43	1718.82	0	339.6	0
Sapling count < 1 m	23	17	8		22	
Sapling count 1-2 m	2	4	13		2	
Sapling count >2 m	2	6	33			
Shrub density	199	356.3	1814.31	0	1457.45	50.9
Shrub count <1 m	16	37	18		37	5
Shrub count 1-2 m	3	18	10		29	2
Shrub count >2 m	6	15	29		37	3
Hollow tree density	0	25.45	0	0	56.6	0
Stag count		3			1	
Live tree count		2			3	
Log density (total)	55.72	101.8	222.81	0	212.25	5.09
Solid log density	39.8	86.53	190.98	0	56.6	5.09

Site	SC01	SC02	SC03	SC04	SC05	SC06
Log count > 10 to 20 cm	3	3	4		3	
Log count 20 - 50 cm	1	10	1			
Log count > 50 cm	1	4	1		1	1
Hollow log density	15.92	15.27	31.83	0	155.65	0
Log count > 10 to 20 cm	1				9	
Log count 20 - 50 cm		1	1		1	
Log count > 50 cm	1	2			1	
Stumps per site (count)	7					
Weed density	7.96	0	0	0	0	20.36
Species (count)						
***Opuntia stricta* (prickly pear)**	1					4
Exfoliating bark on dead trees						
Saplings count (<10 cm)						
Tree count (>10 cm)	1					

Table S2.23 Groundcover for the Stanage Coast Catchment

Site	SC01	SC02	SC03	SC04	SC05	SC06
Bare ground (%)	32	27	25	5	15	83
bare soil	30	27	25	5	15	83
rocks	2					
Litter cover (%)	62	66	73	0	79	15
fine litter	56	61	66		75	10
coarser litter (2.5 - 10 cm)	4	4	5		3	5
log litter (>10 cm)	2	1	2		1	
Forb cover (%)	6	7	2	95	6	2
grass	4	5			2	2
herbs	1	1	1	93	2	
shrub (if ground cover)	1	1	1	2	2	
	100	100	100	100	100	100
Maximum grass height (cm)	20	20			30	10
Average grass height (cm)	5	15			20	5

S3 Queensland Herbarium Ecosystem Condition Benchmark Sites

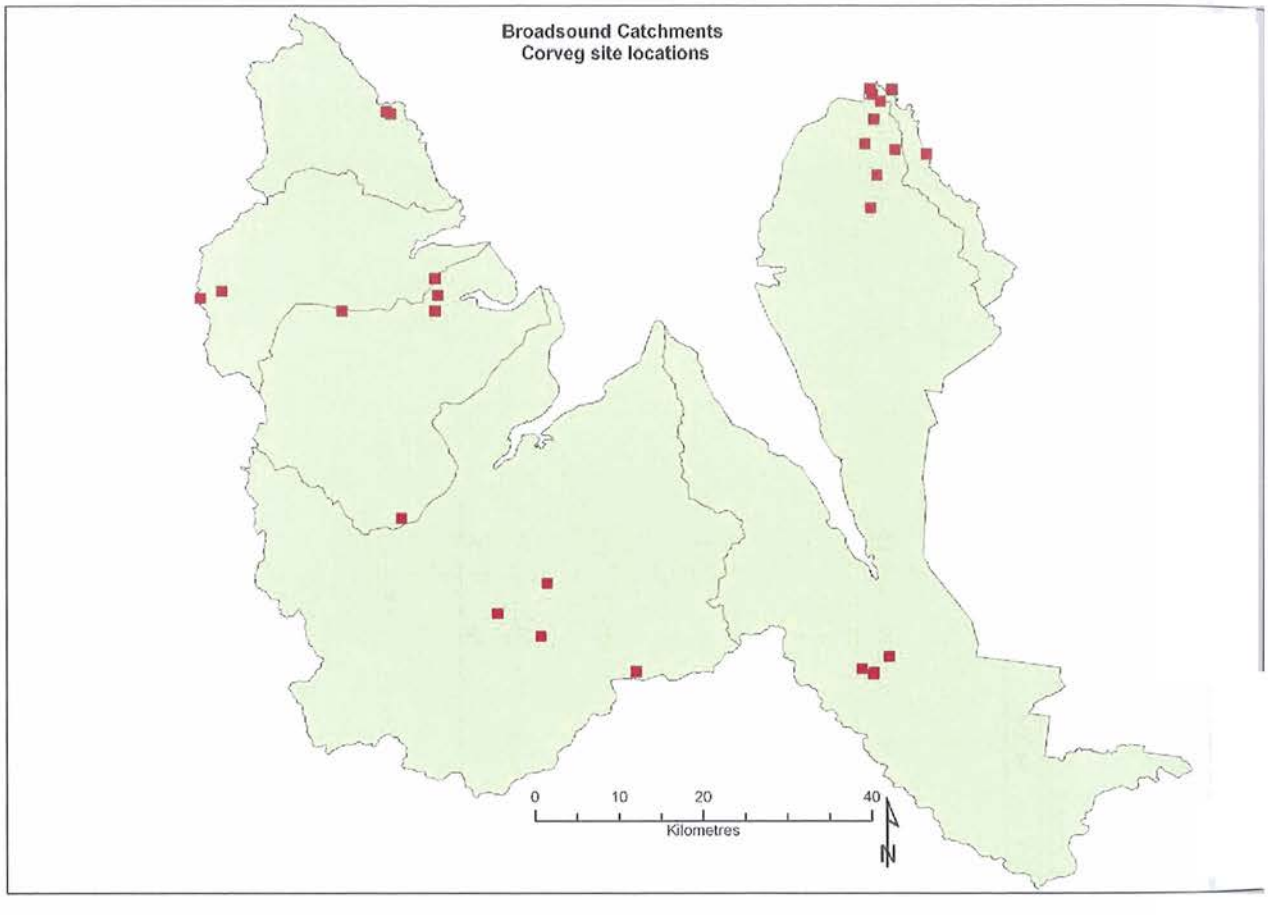


Figure S3.1 Distribution of Queensland Herbarium ecosystem condition benchmark sites across the Broadsound Basin.

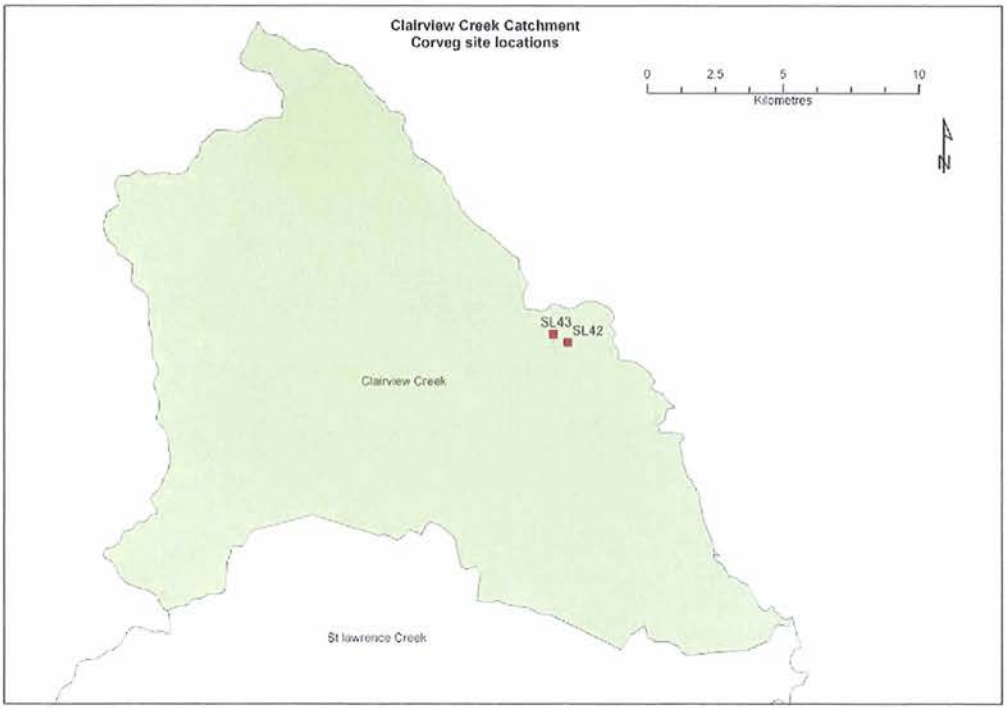


Figure S3.2 Distribution of Queensland Herbarium ecosystem condition benchmark sites within the Clairview Creek catchment.

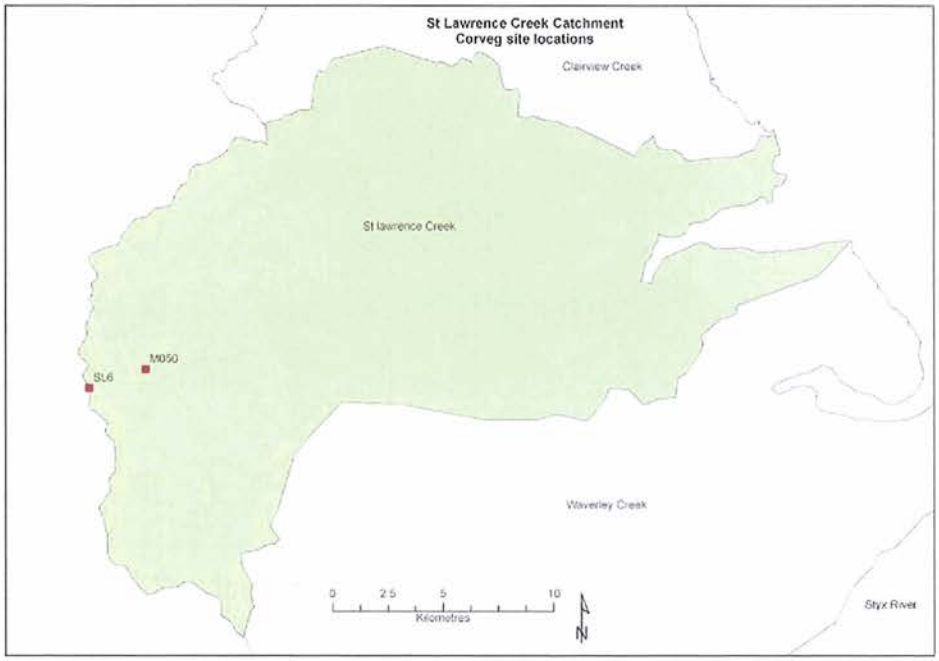


Figure S3.3 Distribution of Queensland Herbarium ecosystem condition benchmark sites within the St Lawrence Creek catchment.

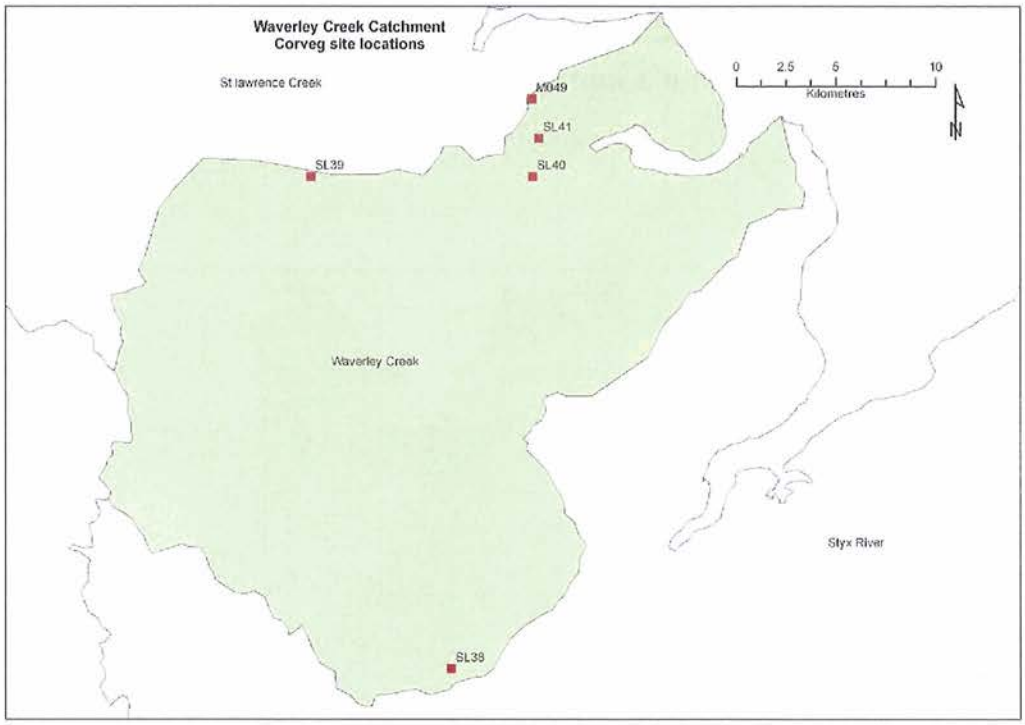


Figure S3.4 Distribution of Queensland Herbarium ecosystem condition benchmark sites within the Waverley Creek catchment.

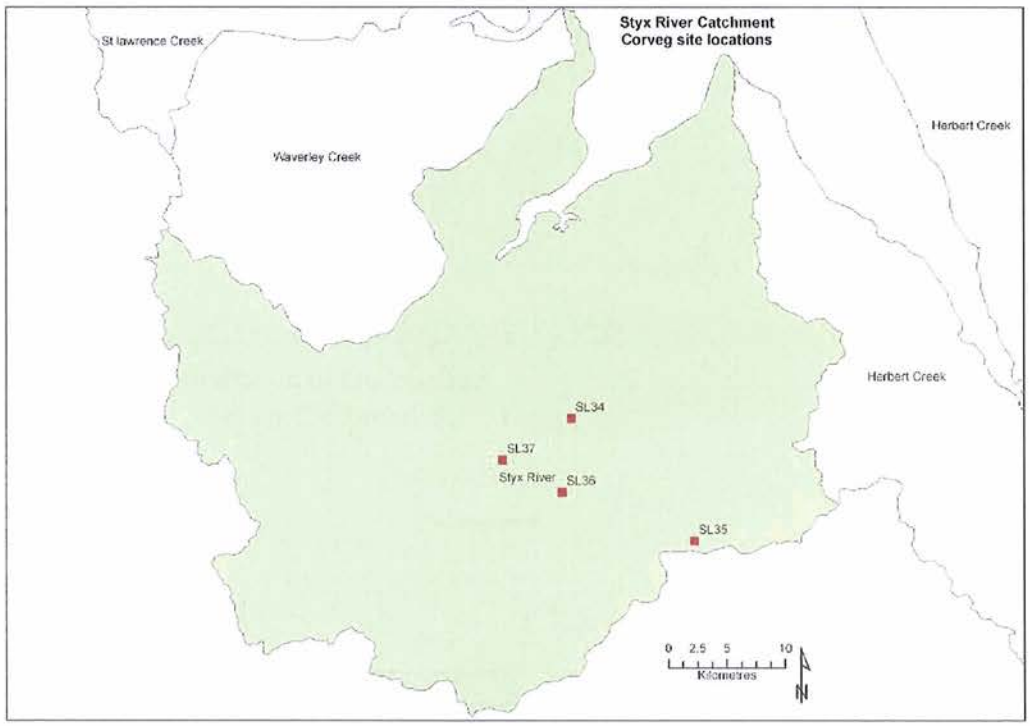


Figure S3.5 Distribution of Queensland Herbarium ecosystem condition benchmark sites within the Styx River catchment.

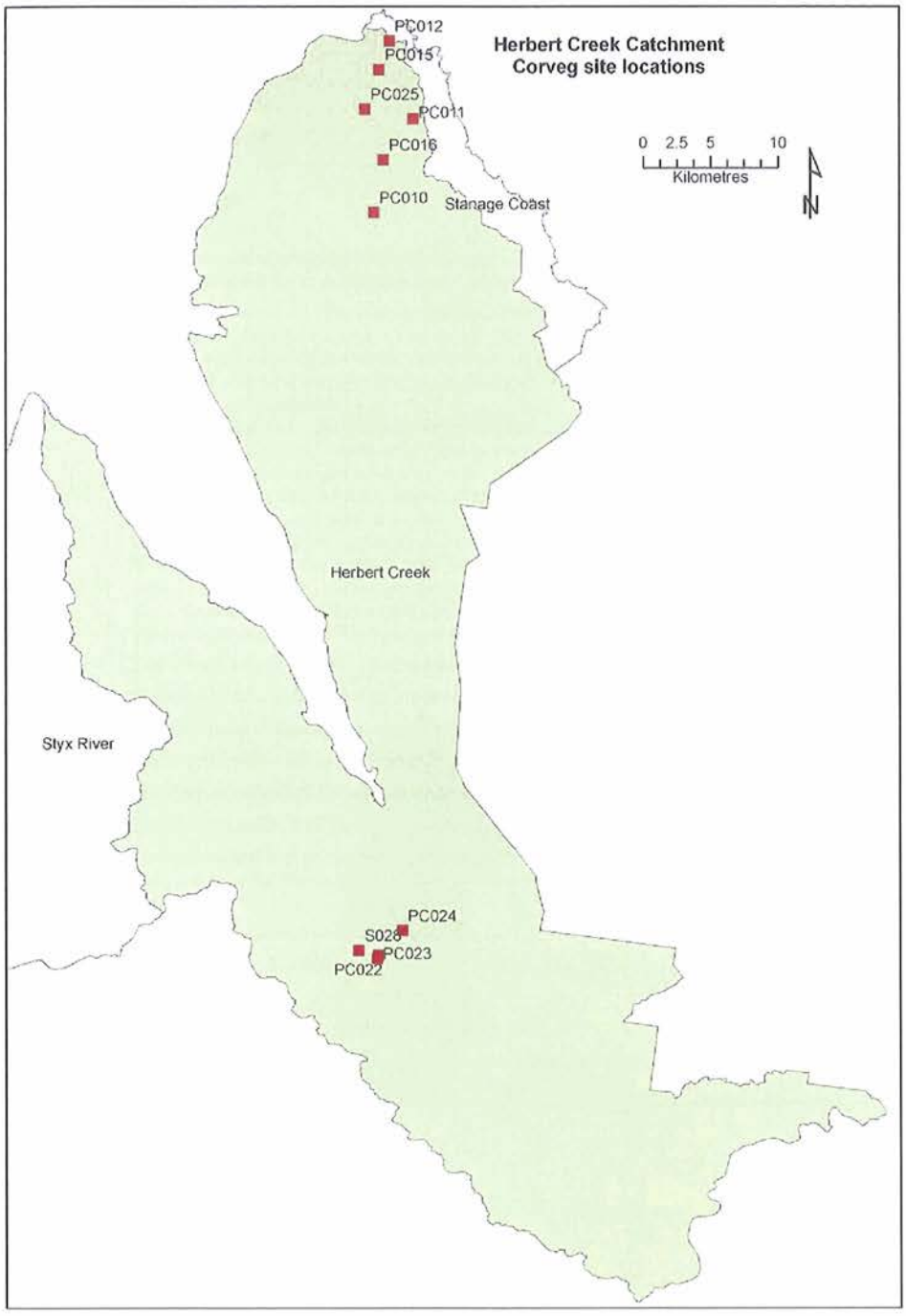


Figure S3.6 Distribution of Queensland Herbarium ecosystem condition benchmark sites within the Herbert Creek catchment.

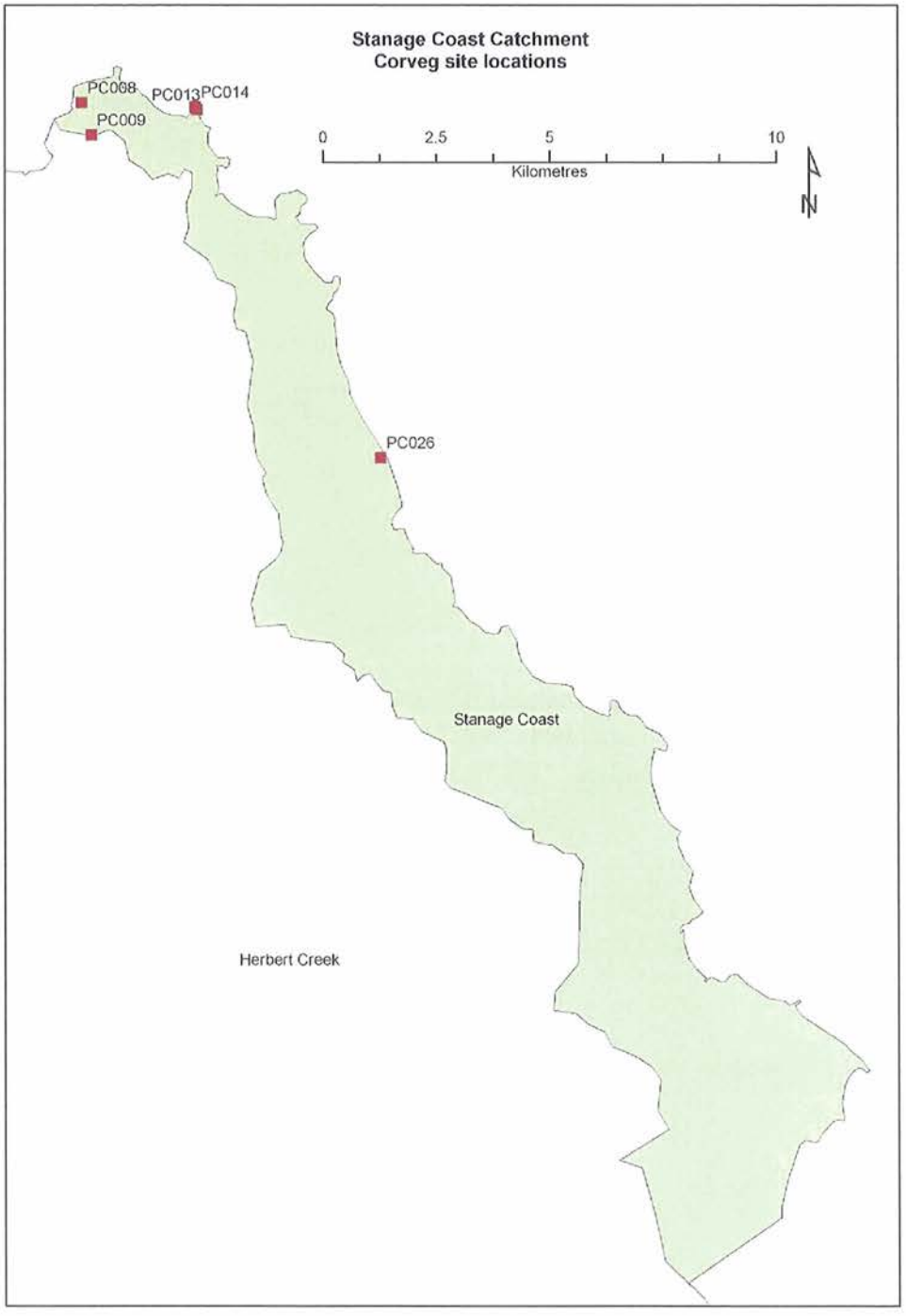


Figure S3.7 Distribution of Queensland Herbarium ecosystem condition benchmark sites within the Stanage Coast catchment.

Table S3.1 Bench mark site descriptions

Site number	Vegetation description
M049	Not provided
M050	Not provided
S028	Not provided
SL43	Not provided
SL42	Not provided
SL6	Woodland of *Corymbia citriodora*, *Eucalyptus acmenoides* with sparse shrub layer. On steep hills. Road sheds water across site. Grass grazed very short.
SL34	*Eucalyptus crebra* tall open woodland with a lower tree layer of *Allocasuarina luehmanii*
SL35	Woodland of *Eucalyptus moluccana*, *Acacia rhodoxylon* with understorey dominated by *A.rhodoxylon*. Gravelly brown clay on low rolling hills. disturbed site eg logging
SL36	Woodland of *Acacia harpophylla* on gilgaied undulating plains. Surrounded by cleared *Eucalyptus* sp. woodland.
SL37	Grassy woodland to open woodland of *Eucalyptus crebra*, *E.platyphylla*, *Corymbia tessellaris*, C.clarksoniana on gently undulating plain. juvenile tress as the shrub layer.
SL38	Grassy open woodland of *Eucalyptus crebra*, *Corymbia clarksoniana* with minimal shrublayer on gently undulating alluvial plain. Impacted by vehicle use.
SL39	Woodland to open woodland of *E. platyphylla*, *E.crebra*, *E.exserta*, *C.dallachiana* on powdery grey clay, alluvial plains. Dense u/s of *Melaleuca nervosa*, *M.viridiflora*.
SL40	Woodland of *Acacia harpophylla* with juvenile trees dominant in understorey. thick mulch layer. adjoins salt flats and *Ceriops tagal* shrubland.
SL41	Semi-deciduous vine thicket on red clay soil, 500m west of slat flats. Canopy dominated by *Paraserianthes toona*, *Gyrocarpus americanus*.
PC008	Tall woodland of *Corymbia clarksoniana*, *Eucalyptus crebra* & *Corymbia intermedia*
PC009	Mid-high to tall woodland of *Eucalyptus crebra*, *Corymbia clarksoniana* & *Eucalyptus exserta*
PC010	Tall woodland of *Eucalyptus crebra* & *Corymbia dallachiana*
PC011	*Eucalyptus crebra* tall open woodland with a lower tree layer of *Allocasuarina luehmanii*
PC012	Mid high woodland of *Eucalyptus exserta*, *Eucalyptus crebra* and *Corymbia clarksoniana*
PC013	Low dense grassland of *Themeda triandra* and *Xanthorrhoea latifolia* subsp. *latifolia*
PC014	Rocky headland low scrub and *Eucalyptus exserta* low woodland
PC015	Very tall fringing woodland of *Eucalyptus tereticornis*, *Corymbia tessellaris* & *Melaleuca fluviatalus*
PC016	*Melaleuca leucadendra* tall open forest
PC025	Semi-evergreen vine thicket
PC026	Dune scrub
PC022	Araucarian microphyll vine thicket
PC023	Tall woodland of *Eucalyptus crebra* with vine thicket elements
PC024	*Casuarina cristata* very tall woodland

S4 Definition of wetlands classification

The definitions are taken from EPA (2005) and are available at http://www.epa.qld.gov.au/register/p01769aa.pdf

S4.1 Estuarine System

Includes wetlands with oceanic water that is at least occasionally diluted with freshwater run-off from the land.

There are two scenarios where the cut-off between estuarine system and freshwater wetlands need to be determined. The two scenarios are:
(1) where the cut-off is across a channel (Longitudinal cut-off); and
(2) where the cut-off is outside a channel (Latitudinal cut-off).

For those within a channel and which consequently often contain water (longitudinal cut-off), the Queensland Water Quality Guideline (2005) definition for estuaries has been adopted with some minor modifications. An estuary is:
(a) the mouth of a river where the tidal effects are evident and where freshwater and seawater mix; and/or
(b) the part of a tidal river that widens out as it approaches the coastline; and/or
Wetland Mapping and Classification Methodology 37
(c) a body of water semi-enclosed by land with sporadic access to water from the open ocean, and where the ocean water is at least occasionally diluted by freshwater run-off from the land; and/or
(d) a body of water where salinity is periodically increased by evaporation to a level above that of the open ocean (such a water body is termed a reverse estuary).

This definition is open to some degree of interpretation and therefore some more precise delineation of the upper and lower boundaries are provided below.

As tidal salinity gradually decreases upstream, a decision must be made on where the salt concentration is deemed to be low enough for the water to be considered fresh. For the longitudinal boundary this line has been determined to be MHWS. This means that an area of tidal influence (the freshwater area that is moved back and forward by the tide but not saline) is included in the freshwater or "riverine" part of the system.

Upstream boundary of estuarine system within a channel (longitudinal cut-off): For the purposes of this document, the upstream boundary is taken as the upstream limit of tidal influence at mean high water springs (MHWS). This is the primary definition. The MHWS is the theoretical upstream limit for the mixing of salt water (see (a) above). However, in some large estuaries, slow rates of mixing and the constant inflow of freshwater means there is a permanent body of freshwater in the upper tidal reaches. This creates an anomaly if estuaries are taken to be where salt and freshwater mix. However, for water quality purposes, the tidal upper reaches are much more akin to an estuarine environment than a riverine environment.

If the MHWS mark is not defined for an estuary, the following surrogates can be used:

• The declared downstream limit (DDL) or Coastal Management District (CMD) lines (if based on officially determined estuary/freshwater cut-offs);
• A barrier or barrage that prevents the movement of any saline waters upstream;
• The upstream extent of the saline vegetation distribution along a stream;
• The limit of saltwater influence as determined by water quality (salinity or conductivity) measurements; and
• Local hydrological studies to estimate the MHWS mark.

Upper boundary of estuarine system outside a channel (latitudinal cut-off): The upper limit of an estuarine system that is outside a channel (i.e. within an embayment, at a river mouth) is defined as the landward limit of tidal inundation or highest astronomical tide (HAT).

Downstream boundary of estuarine system: The lower limit of the estuary is its boundary with fully saline marine waters at the coast. The boundary divides estuarine systems at or out from the mouth of an estuarine channel (where there is typically some residual mixing between fresh and marine waters) from marine systems where there is typically no residual freshwater influence except under extreme conditions such as major flood events.

For estuaries that flow directly into open oceanic waters or for passages, the lower limit is defined as the mouth of the estuary or passage, enclosed by adapting the semicircle rule (Beazley 1978).

Generally, the entrance is defined by the downstream limits of the drainage catchment of the passage or estuary (the heads). Where the heads are undefined, the catchment limits will need to be estimated using other landscape elements.

S4.2 Lacustrine System
From Cowardin et al. 1979.
"The Lacustrine System (Figure S4.1) includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30 percent aerial coverage; and (3) total area exceeds 8ha (20 acres). Similar wetland and deepwater habitats totalling less than 8ha are also included in the Lacustrine System if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 2m (6.6 feet) at low water."
For the WMC project, lacustrine water may be tidal or non-tidal but ocean derived salinity is always less than 0.5ppt (Cowardin et al. 1979).
Limits. The Lacustrine System is bounded by upland or by wetland dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. Lacustrine Systems formed by damming a river channel are bounded by a contour approximating the normal spillway

elevation or normal pool elevation, except where Palustrine wetlands extend lakeward of that boundary. Where a river enters a lake, the extension of the Lacustrine shoreline forms the Riverine-Lacustrine boundary.

Description. The Lacustrine System includes permanently flooded lakes and reservoirs (e.g., Lake Superior), intermittent lakes (e.g., playa lakes), and tidal lakes with ocean-derived salinities below 0.5 percent (e.g., Grand Lake, Louisiana). Typically, there are extensive areas of deep water and there is considerable wave action. Islands of Palustrine wetland may lie within the boundaries of the Lacustrine System."

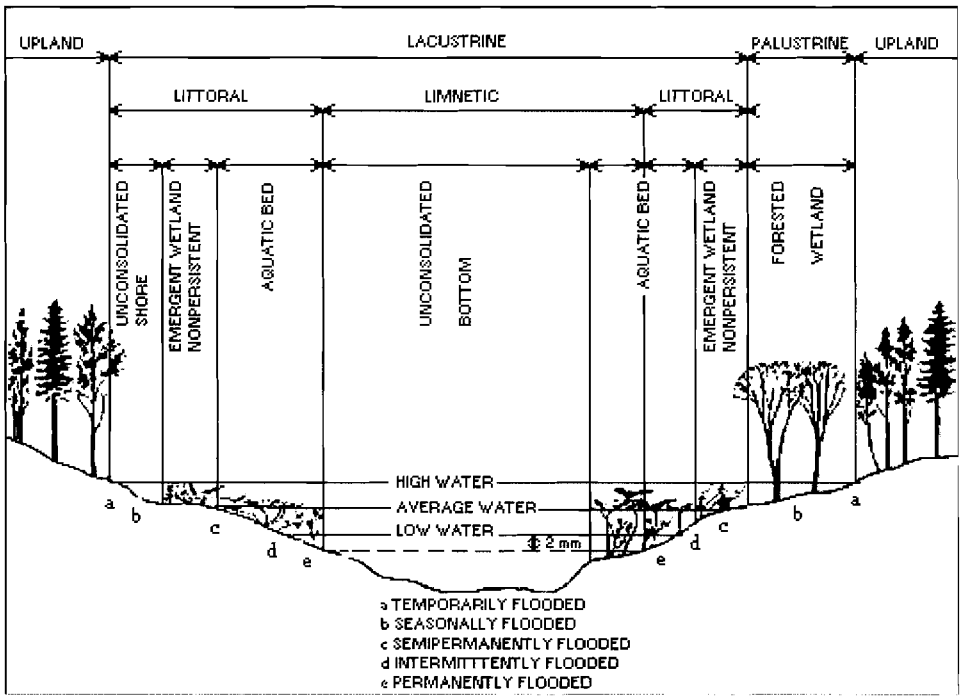


Figure S4.1 Distinguishing features and examples of habitats in lacustrine systems (from Cowardin *et al.* 1979)

S4.3 Palustrine System

The following is taken from Cowardin et al. (1979) and Blackman et al. (1992) and slightly modified to fit the Australian environment.

Wetland Mapping and Classification Methodology 40 The palustrine system includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens, and all such wetlands that occur in tidal areas where salinity due to ocean-derived salts is below 0.5 percent. It also includes wetlands lacking such vegetation which have the following three characteristics: (a) where active waves are formed or bedrock features are lacking; (b) where the water depth in the deepest part of basin less than 2m at low water; and (c) the salinity due to ocean-derived salts is still less than 0.5 percent.

Boundaries. The palustrine system is bounded by upland or by any of the other four systems.

Description. The palustrine system was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie, which are found throughout the world. It also includes the small, shallow, permanent or intermittent water bodies often called ponds. Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries; on river floodplains; in isolated catchments; or on slopes. They may also occur as islands in lakes or rivers. The erosive forces of wind and water are of minor importance except during severe floods.

The emergent vegetation adjacent to rivers and lakes is often referred to as "the shore zone" or the "zone of emergent vegetation" (Reid and Wood 1976), and is generally considered separately from the river or lake. As an example, Hynes (1970:85) wrote in reference to riverine habitats: "We will not here consider the long list of emergent plants which may occur along the banks out of the current, as they do not belong, strictly speaking, to the running water habitat". There are often great similarities between wetlands lying adjacent to lakes or rivers and isolated wetlands of the same class in basins without open water.

S4.4 Riverine System

From Cowardin et al. 1979.

"The Riverine System (Figure S4.2) includes all wetlands and deepwater habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens, and (2) habitats with water containing ocean-derived salts in excess of 0.5 percent. A channel is 'an open conduit either naturally or artificially created which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water' (Langbein and Iseri 1960:5).

Limits. The Riverine System is bounded on the landward side by upland, by the channel bank (including natural and man-made levees), or by wetland dominated by trees, shrubs, persistent emergents, emergent mosses, or lichens. In braided streams, the system is bounded by the banks forming the outer limits of the depression within which the braiding occurs.

The Riverine System terminates at the downstream end where the concentration of ocean-derived salts in the water exceeds 0.5 percent during the period of annual average low flow, or where the channel enters a lake. It terminates at the upstream end where tributary streams originate, or where the channel leaves a lake. Springs discharging into a channel are considered part of the Riverine System. Wetland Mapping and Classification Methodology 41

Description. Water is usually, but not always, flowing in the Riverine System. Upland islands or palustrine wetlands may occur in the channel, but they are not included in the Riverine System. Palustrine Moss-Lichen Wetlands, Emergent Wetlands, Scrub-Shrub Wetlands, and Forested Wetlands may occur adjacent to the Riverine System, often on a floodplain. Many biologists have suggested that all the wetlands occurring on the river floodplain should be a part of the Riverine System because they consider their presence

to be the result of river flooding. However, we concur with Reid and Wood (1976:72,84) who stated, 'The floodplain is a flat expanse of land bordering an old river ....Often the floodplain may take the form of a very level plain occupied by the present stream channel, and it may never, or only occasionally, be flooded . . . It is this subsurface water [the ground water] that controls to a great extent the level of lake surfaces, the flow of streams, and the extent of swamps and marshes.'

Subsystems. The Riverine System is divided into four Subsystems: the Tidal, the Lower Perennial, the Upper Perennial, and the Intermittent. Each is defined in terms of water permanence, gradient, water velocity, substrate, and the extent of floodplain development. The Subsystems have characteristic flora and fauna (see Illies and Botosaneau 1963; Hynes 1970; Reid and Wood 1976). All four Subsystems are not necessarily present in all rivers, and the order of occurrence may be other than that given below.

Tidal. The gradient is low and water velocity fluctuates under tidal influence. The streambed is mainly mud with occasional patches of sand. Oxygen deficits may sometimes occur and the fauna is similar to that in the Lower Perennial Subsystem. The floodplain is typically well developed.
Lower Perennial. The gradient is low and water velocity is slow. There is no tidal influence, and some water flows throughout the year. The substrate consists mainly of sand and mud. Oxygen deficits may sometimes occur, the fauna is composed mostly of species that reach their maximum abundance in still water, and true planktonic organisms are common. The gradient is lower than that of the Upper Perennial Subsystem and the floodplain is well developed.

Upper Perennial. The gradient is high and velocity of the water fast. There is no tidal influence and some water flows throughout the year. The substrate consists of rock, cobbles, or gravel with occasional patches of sand. The natural dissolved oxygen concentration is normally near saturation. The fauna is characteristic of running water, and there are few or no planktonic forms. The gradient is high compared with that of the Lower Perennial Subsystem, and there is very little floodplain development.

Intermittent. In this Subsystem, the channel contains flowing water for only part of the year. When the water is not flowing, it may remain in isolated pools or surface water may be absent.

Classes. Rock Bottom, Unconsolidated Bottom, Aquatic Bed, Streambed, Rocky Shore, Unconsolidated Shore, and Emergent Wetland (nonpersistent)."

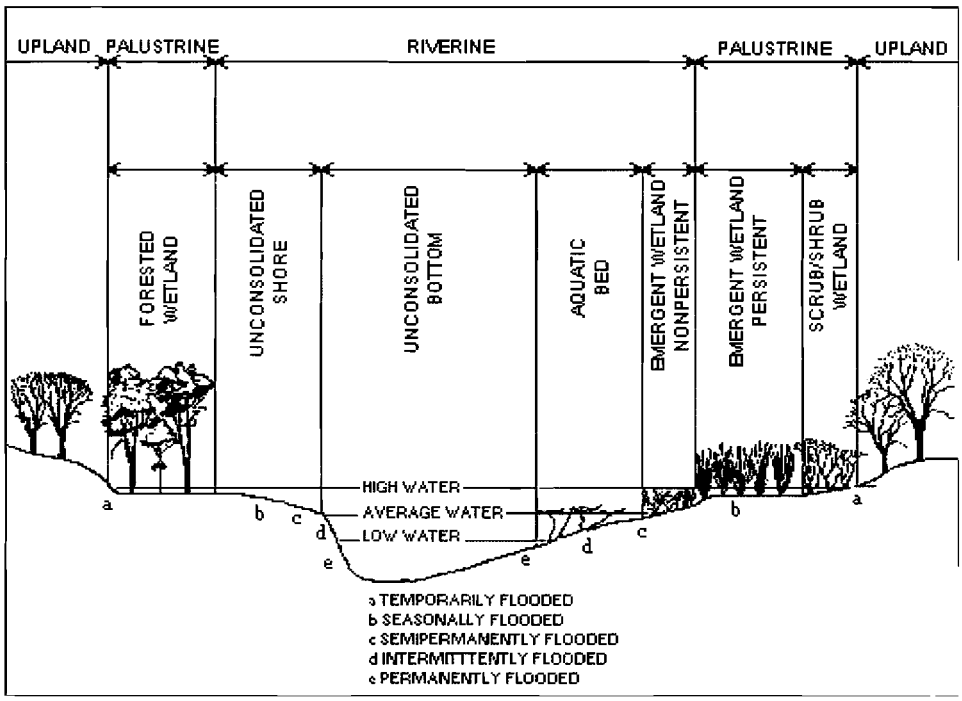


Figure S4.2 Distinguishing features and examples of habitats in riverine systems (from Cowardin *et al.* 1979)

S4.5 Marine System

The following is taken from Cowardin et al. (1979) and Blackman et al. (1992) with slight modifications.

The marine system consists of open ocean overlying the continental shelf and its associated high energy coastline down to a depth of 6m below lowest astronomical tide (LAT). Shallow coastal indentations or bays (or parts thereof) without appreciable freshwater inflows, and coasts with exposed rocky islands that provide the mainland with little or no shelter from wind or waves, are also considered part of the marine system.

Marine habitats are exposed to the waves and currents of the open ocean, and the water regimes are determined primarily by the ebb and flow of oceanic tides. Salinities exceed 33ppt with little or no dilution outside the mouths of estuaries.

Boundaries of marine system:

• The landward boundary of the marine system is the landward limit of tidal inundation or highest astronomical tide (HAT);
• The boundary with the estuarine system; and
• The seaward limit to 6m below lowest astronomical tide (LAT).

S5 Results for coastal wetlands and waterbirds: Sector-by-sector summary

S5.1 Notes on interpretation of sector accounts

Sector code: the number assigned to the survey sector that was devised by Wetlands International for the Broadsound Coast Condition Assessment (BCCA) sub-project on Coastal Wetlands and Waterbirds; a map of the sectors follows this introduction and is available as a GIS shapefile.

Location: coordinates of the approximate centre of the sector, in decimal degrees South and East; a GIS shapefile that defines the sectors is available.

Catchment: as defined for the BCCA, within the Broadsound Basin.

Survey effort and coverage (in 2006-7): poor = 1-2 surveys, fair = 3-5 surveys, good = 6+ surveys, where a 'survey' implies one or more visits to the sector during one of the ten BCCA survey periods. Inclusion of aerial and/or ground survey is indicated; ground surveys did not necessarily cover the entire sector whereas aerial surveys usually provided overview coverage of large parts (if not most) of the sector. Waterbirds were mainly identified and counted in ground surveys but sometimes also in low level aerial surveys, especially along the coastline. Statements refer to the BCCA project 2007-8 unless otherwise specified; a summary of other relevant survey effort by Wetlands International (WIO) and/or the Centre for Environmental Management of the Central Queensland University (CEM-CQU) is given for applicable sectors, mainly in the east.

Wetland types: A list of the wetland types identified within the sector using categories for types, both vegetated and un-vegetated, devised for the BCCA project. Types are listed in descending order of approximate dominance.

Waterbirds recorded: This section starts with results on the number of waterbird species recorded, the number of those species found breeding, and the number of those species that are migratory shorebirds; these data relate only to the BCCA project. Where data from previous work are available, a similar statement may be provided, incorporating results from past and present where applicable (totals for number of species and breeding species, from all surveys 2003-7, have not necessarily been calculated). Subsequent text identifies and describes any nationally threatened species, rare/uncommon species, notable breeding species/efforts, and most abundant species in the sector. The largest total number of waterbirds recorded in one survey may be stated. All information refers only to this sector unless otherwise stated, and data in the section on survey effort should make the context apparent with respect to past and present project work.

Conservation values: This is a statement in general terms to highlight conservation values of the sector with respect to wetland characteristics and waterbirds. 'International importance' refers to criteria of the Ramsar Convention on Wetlands (notably Criterion 2, recognising threatened species, and Criterion 6, recognising 1% of Flyway populations), whereas 'regional importance/significance' is an opinion not defined in any treaty, international agreement or legislation. 'Eastern catchments' refers to the Torilla Peninsula and associated islands; 'western catchments' refers to the remainder of the study area and thus includes western parts of the Herbert Creek catchment.

Wetland condition: Descriptive text identifies (generally negative) aspects of wetland condition as observed during surveys for the BCCA project. General categories include: hydrological modification (banks, seawalls); coastal erosion; mangrove dieback; weed infestations; feral animals; grazing impacts (e.g. pugging of bare salt flats); and other aspects of human use, which are not necessarily negative.

Potential investments: Suggestions are given on potential investment by organisations concerned with natural resource management, to effectively address the wetland management issues identified under 'Wetland condition'. These suggestions have not necessarily been comprehensively researched as to their feasibility, nor discussed with landholders in terms of landholder interest and advice.

Comments: Other matters of interest may be presented.

S5.2 Sources of information

The primary source of information for these accounts is the unpublished data of Wetlands International – Oceania from fieldwork (two projects) led by R. Jaensch in the study area during 2003-7, with funding from the Natural Heritage Trust and/or Fitzroy Basin Association. Unpublished project completion reports are available from Wetlands International – Oceania, subject to permission from the relevant project funding organisation. Several notable elements of earlier results have been published in short articles and citations for these can be provided on request. Raw data from the BCCA project are held by WIO and digital copies will be lodged with CQU.

Some additional data have been gleaned from CEM-CQU, including unpublished data arising from surveys – principally those in which the author participated – contributing to implementation of the Recovery Plan for the Capricorn Yellow Chat (project leader: W. Houston).

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Wetland types – intertidal

Suite of intertidal wetlands – 1 (sector 3) **Photo by Roger Jaensch.**

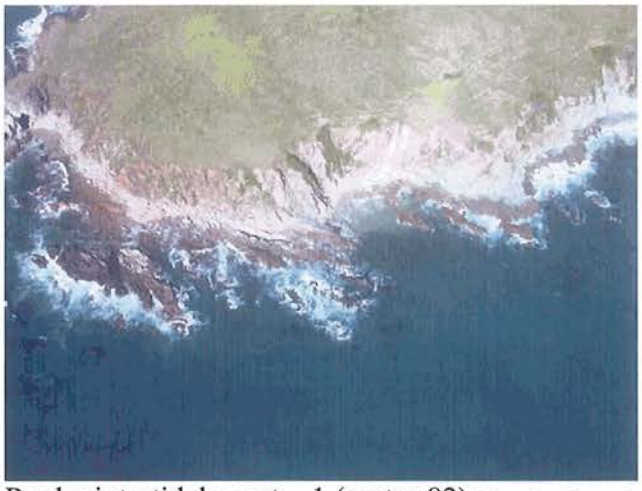
Suite of intertidal wetlands – 2 (sector 36) **Photo by Roger Jaensch.**

Bare intertidal flat – 1 (sector 10) **Photo by Roger Jaensch.**

Bare intertidal flat – 2 (sector 31) **Photo by Roger Jaensch.**

Beach – 1 (sector 11) **Photo by Roger Jaensch.**

Beach 2 – (sector 83) **Photo by Roger Jaensch.**



Rocky intertidal coast – 1 (sector 82) **Photo by Roger Jaensch.**

Rocky intertidal coast – 2 (sector 3) **Photo by Roger Jaensch.**

Estuary – 1 (sectors 4 to 10) **Photo by Roger Jaensch.**

Estuary – 2 (sectors 14 to 23) **Photo by Roger Jaensch.**

Mangrove – 1 (sector 69) **Photo by Roger Jaensch.**

Mangrove – 2 (sector 38) **Photo by Roger Jaensch.**

Mangrove – 3 (sector 11) **Photo by Roger Jaensch.**

Saltmarsh complex – 1 (sector 37) **Photo by Roger Jaensch.**

Saltmarsh complex – 2 (sector 53) **Photo by Roger Jaensch.**

Grassy saltmarsh (sector 21) **Photo by Roger Jaensch.**

Saltmarsh with samphire (sector 49) **Photo by Roger Jaensch.**

Saltmarsh – bare salt flat (sector 25) **Photo by Roger Jaensch.**

Wetland types – non-tidal

Ponded (non-tidal) salt flat (sector 12) **Photo by Roger Jaensch.**

Marine plain – 1 (sector 30) **Photo by Roger Jaensch.**

Marine plain – 2 (sector 29) **Photo by Roger Jaensch.**

Saline grass-sedge swamp – 1 (sector 49) **Photo by Roger Jaensch.**

Saline grass-sedge swamp – 2 (sector 49) **Photo by Roger Jaensch.**

Freshwater grass-sedge swamp – 1 (sector 16) **Photo by Roger Jaensch.**

Freshwater grass-sedge swamp – 2 (sector 65) **Photo by Roger Jaensch.**

Freshwater grass-sedge swamp – 3 (sector 65) **Photo by Roger Jaensch.**

Freshwater grass-sedge swamp – 4 (sector 7) **Photo by Roger Jaensch.**

Wet meadow – 1 (sector 9) **Photo by Roger Jaensch.**

Wet meadow – 2 (sector 7) **Photo by Roger Jaensch.**

Small open lake – 1 (sector 19) **Photo by Roger Jaensch.**

Small open lake – 2 (sector 42) **Photo by Roger Jaensch.**

Melaleuca wooded swamp – 1 (sector 7) **Photo by Roger Jaensch.**

Melaleuca wooded swamp – 2 (sector 65) **Photo by Roger Jaensch.**

Ponded channels – 1 (sector 7) **Photo by Roger Jaensch.**

Ponded channels – 2 (sector 7) **Photo by Roger Jaensch.**

Ponded channels – 3 (sector 42) **Photo by Roger Jaensch.**

Condition of wetlands

Eroded seaward-edge mangrove – 1 (sector 13) **Photo by Roger Jaensch.**

Eroded seaward-edge mangrove – 2 (sector 13) **Photo by Roger Jaensch.**

Dead landward-edge mangrove – 1 (sector 3) **Photo by Roger Jaensch.**

Dead landward-edge mangrove – 2 (sector 28) **Photo by Roger Jaensch.**

Dead landward-edge mangrove – 3 (sector 15) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 1 (sector 16/15) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 2 (sector 15/19) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 3 (sector 15/19) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 4 (sector 13/12) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 5 (sector 11/12) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 6 (sector 18/20) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 6 (sector 63/61) **Photo by Roger Jaensch.**

Railway causeway (sector 6/5) **Photo by Roger Jaensch.**

Road causeway (sector 10/7) **Photo by Roger Jaensch.**

Weed infestation, Hymenachne (sector 16) **Photo by Roger Jaensch.**

Prickly Acacia cluster (sector 12) **Photo by R. Black.**

Prickly Acacia, poisoned (sector 7) **Photo by Roger Jaensch.**

Feral pig diggings – 1 (sector 66) **Photo by Roger Jaensch.**

Feral pig diggings – 2 (sector 24) **Photo by Roger Jaensch.**

Cattle grazing, browsed saplings (sector 65) **Photo by Roger Jaensch.**

Cattle pugging on bare salt flat (sector 37) **Photo by Roger Jaensch.**

Cattle pugging in saltmarsh (sector 40) **Photo by Roger Jaensch.**

Cattle pugging in nardoo marsh (sector 18) **Photo by Roger Jaensch.**

Remnant reed bed (sector 60) **Photo by Roger Jaensch.**

Waterbird conservation values

Capricorn Yellow Chat (threatened) (sector 42) **Photo by Roger Jaensch.**

Yellow Chat habitat – 1 (sector 60) **Photo by Roger Jaensch.**

Yellow Chat habitat – 2 (sector 57) **Photo by Roger Jaensch.**

Australian Painted Snipe (threatened) (sector 19) **Photo by R. Black.**

Australian Painted Snipe, habitat (sector 19) **Photo by Roger Jaensch.**

Australian Painted Snipe, nest (sector 58) **Photo by Roger Jaensch.**

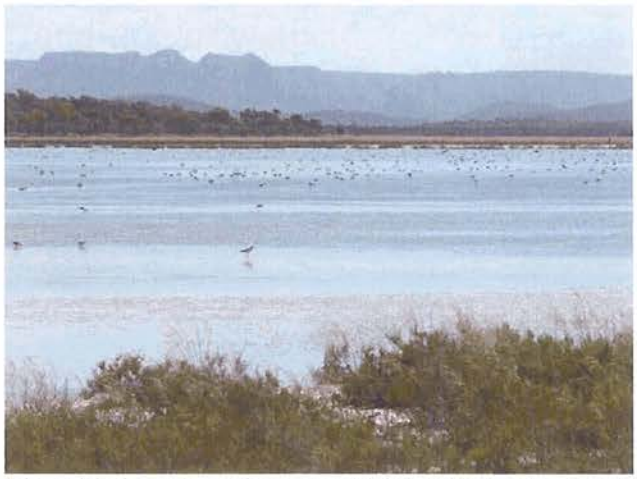
Migratory Black tailed-Godwits (sector 12) **Photo by Roger Jaensch.**

High-tide roost site, shorebirds – 1 (sector 11) **Photo by Roger Jaensch.**

High-tide roost site, shorebirds – 2 (sector 36) **Photo by Roger Jaensch.**

Sharp-tailed Sandpipers, f/w swamp (sector 30) **Photo by Roger Jaensch.**

Important site for Latham's Snipe (sector 65) **Photo by Roger Jaensch.**



Shorebird aggregation, non-tidal salt flat (sector 12) **Photo by Roger Jaensch.**

Egret colony site (near centre) (sector 15) **Photo by Roger Jaensch.**

Nest of Black Swan (sector 12) **Photo by Roger Jaensch.**

Cotton Pygmy-goose, potential nest site (sector 16) **Photo by Roger Jaensch.**

Camp of Plumed Whistling-Duck (sector 24) **Photo by Roger Jaensch.**

Aggregation of Magpie Geese (sector 56) **Photo by Roger Jaensch.**

Condition of wetlands

Eroded seaward-edge mangrove – 1 (sector 13) **Photo by Roger Jaensch.**

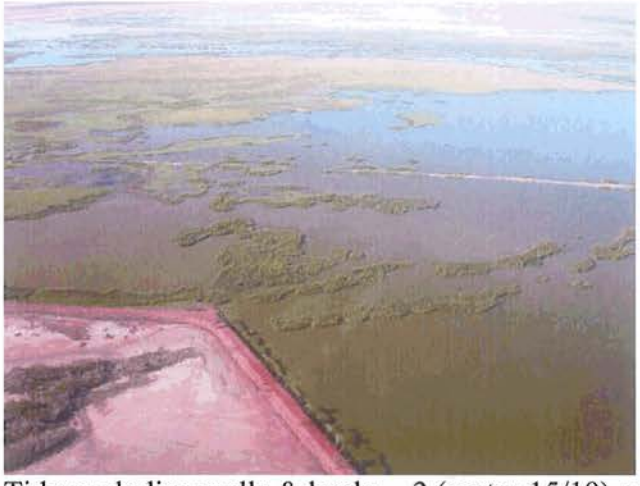
Eroded seaward-edge mangrove – 2 (sector 13) **Photo by Roger Jaensch.**

Dead landward-edge mangrove – 1 (sector 3) **Photo by Roger Jaensch.**

Dead landward-edge mangrove – 2 (sector 28) **Photo by Roger Jaensch.**

Dead landward-edge mangrove – 3 (sector 15) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 1 (sector 16/15) **Photo by Roger Jaensch.**



Tide-excluding walls & banks – 2 (sector 15/19) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 3 (sector 15/19) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 4 (sector 13/12) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 5 (sector 11/12) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 6 (sector 18/20) **Photo by Roger Jaensch.**

Tide-excluding walls & banks – 6 (sector 63/61) **Photo by Roger Jaensch.**

Railway causeway (sector 6/5) **Photo by Roger Jaensch.**

Road causeway (sector 10/7) **Photo by Roger Jaensch.**

Weed infestation, *Hymenachne* (sector 16) **Photo by Roger Jaensch.**

Prickly acacia cluster (sector 12) **Photo by R. Black.**

Prickly acacia, poisoned (sector 7) **Photo by Roger Jaensch.**

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Feral pig diggings – 2 (sector 24) **Photo by Roger Jaensch.**

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Important site for Latham's Snipe (sector 65) **Photo by Roger Jaensch.**

Shorebird aggregation, non-tidal salt flat (sector 12) **Photo by Roger Jaensch.**

Egret colony site (near centre) (sector 15) **Photo by Roger Jaensch.**

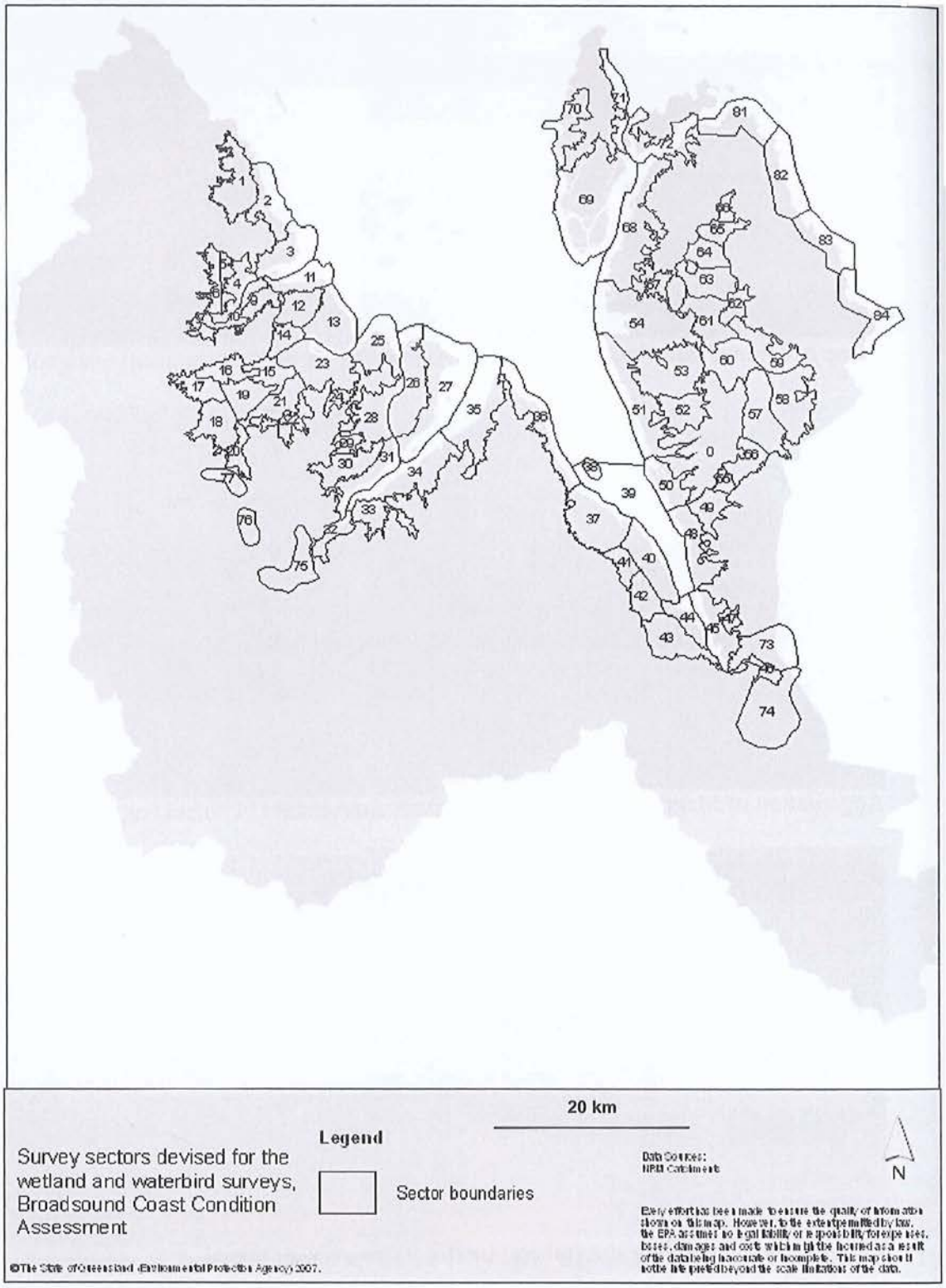
Nest of Black Swan (sector 12) **Photo by Roger Jaensch.**

Cotton Pygmy-goose, potential nest site (sector 16) **Photo by Roger Jaensch.**

Camp of Plumed whistling-duck (sector 24) **Photo by Roger Jaensch.**

Aggregation of Magpie geese (sector 56) **Photo by Roger Jaensch.**

Magpie geese at feeding site (tubers) (sector 9) **Photo by Roger Jaensch.**


20 km
Legend
Survey sectors devised for the wetland and waterbird surveys, Broadsound Coast Condition Assessment
Sector boundaries
Data Sources:
NRM Catchments
N
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S5.3 Sector accounts

Sector 01

Location: 22.2100, 149.5422
Catchment: Clairview Creek.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Estuary, mangrove, salt flat: substantial areas. Grassy saltmarsh, marine plain: small area in the far south.
Waterbirds recorded: None recorded in BCCA project. Apparently there are EPA WildNet records of Great-billed Heron, an iconic mangrove-dwelling species, from this sector (D. Cook pers. com.)
Conservation values: Not adequately known.
Wetland condition: A few dead mangroves were seen at the landward side of some mangrove blocks.
Potential investments: None identified.
Comments: The sector was not a major target for survey effort because it was not expected to contain shorebird roost sites or waterbird aggregations. Therefore, other natural values, such as representativeness of estuarine wetlands, may be understated in the project results.

Sector 02

Location: 22.2267, 149.5759
Catchment: Clairview Creek.
Survey effort and coverage in 2006-7: fair, aerial survey only.
Wetland types: Beach, mangrove, salt flat, bare intertidal flat: substantial areas. Estuary, grassy saltmarsh: small areas.
Waterbirds recorded: Only a few species (4) recorded, including one migratory shorebird species/group; small numbers present, apart from a roost of 500 large migratory shorebirds (not identified to species level but possibly Bar-tailed Godwits) on a stony flat beside the shore, mid sector, in March 2007 – actual numbers may be at least twice as large, based on the normal undercounting factor in aerial surveys. Roost coordinates (decimal degrees S, E): 22.2332, 149.5702
Conservation values: The migratory shorebird roost is of regional significance.
Wetland condition: No evidence of substantial human impact. Only minor coastal erosion.
Potential investments: None identified.
Comments: The shorebird roost deserves further investigation – it may have been missed in some surveys because it is set back a little from the shoreline – and it may be accessible on foot from the north-east corner of the hilly peninsula between catchments.

Sector 03

Location: 22.2758, 149.5926
Catchment: St Lawrence Creek.
Survey effort and coverage in 2006-7: fair, aerial surveys only.
Wetland types: Mangrove, salt flat, estuary, rocky coast: substantial areas. Beach, bare intertidal flat: small areas; one substantial mangrove island.
Waterbirds recorded: Only a few species (6) recorded, two of them migratory shorebirds; in small numbers, with few shorebirds. Included the only record of Sooty Oystercatcher in the BCCA project and one of the few records of Eastern Reef Egret, both species being associated with rocky shore and therefore probably overlooked in the project.
Conservation values: Not adequately known.
Wetland condition: Sector appears relatively undisturbed apart from a little dieback of landward-edge mangrove.
Potential investments: None identified.
Comments: The two sets of red bluffs (coastal cliffs with associated rock platforms) are rare if not unique in the western catchments; several smaller examples were detected near Long Island in the east of the study area. Shorebird roosts may yet be discovered near the bluffs.

Sector 04

Location: 22.3092, 149.5414
Catchment: St Lawrence Creek.
Survey effort and coverage in 2006-7: fair, aerial surveys only.
Wetland types: Salt flat, mangrove, estuary: substantial areas. Grassy saltmarsh, bare intertidal flats (river bed): small areas.
Waterbirds recorded: Only two species recorded: Black-necked Stork, White-faced Heron.
Conservation values: Not adequately known.
Wetland condition: Extensive death of landward-edge mangroves and mangroves along creeks on salt flats, especially in north-east of sector; also a dead patch within a healthy mangrove block. Substantial cattle pugging on bare salt flat. Railway embankment cuts across a short part of the sector. Erosion scarp on riverbank upstream of railway bridge.
Potential investments: Fencing to control cattle access to grassy saltmarsh and mangrove seaward of bare salt flats, could be considered.
Comments: Sector covers the northern side of the middle and upper reaches of St Lawrence Creek to just above the railway bridge, and so is elongated in shape. Some eastward (indirect) inflow of freshwater from sector 6 probably is stopped or reduced by the railway causeway.

Sector 05

Location: 22.2936, 149.5291
Catchment: St Lawrence Creek.
Survey effort and coverage in 2006-7: poor, aerial surveys only.
Wetland types: Marine plain, complex of minor saline channels, saltmarsh with grass and samphire: substantial areas. Saline grass-sedge swamp: possibly small areas present.
Waterbirds recorded: None recorded.
Conservation values: Not adequately known.
Wetland condition: Reduction to eastward freshwater inflow to sector 5 is caused by the railway causeway along full length of sector. Substantial patch of what appears to be prickly acacia at centre of sector.
Potential investments: Assistance to landholder for reduction of prickly acacia infestation.
Comments: This sector would normally be contiguous with sector 6 but the railway causeway apparently has created differences in hydrology and vegetation.

Sector 06

Location: 22.3075, 149.5214
Catchment: St Lawrence Creek.
Survey effort and coverage in 2006-7: poor, aerial surveys only.
Wetland types: Marine plain (complex of minor freshwater channels and ponds): substantial area. Freshwater grass-sedge swamp, grassy meadow, shrubby swamp (regenerating *Melaleuca*?), waterhole on creek, ponded channel, farm dam: small areas present.
Waterbirds recorded: None recorded.
Conservation values: Not adequately known.
Wetland condition: The railway causeway along full length of sector undoubtedly increases persistence of freshwater on this plain and a major bank holds back creek water on the western side of the sector near the homestead. Widespread occurrence of what appears to be prickly acacia across southern part of sector. Extensive bare scalds on the plain did not seem to regain ground cover even after good summer rain.
Potential investments: Assistance to landholder for reduction of prickly acacia infestation.
Comments: This sector would normally be contiguous with sector 5 but the railway apparently has created differences in hydrology and vegetation. Surprisingly, no waterbirds were observed in wet areas during the March aerial survey; ground level investigations are needed as the sector has potential to support at least modest numbers of waterbirds. Attempts to contact the landowner were unsuccessful.

Sector 07

Location: 22.3479, 149.5087
Catchment: St Lawrence Creek.
Survey effort and coverage in 2006-7: good, both aerial and ground survey.
Wetland types: Ponded channel, grassy wet meadow, freshwater grass-sedge swamp, Melaleuca wooded swamp: substantial areas. Waterhole in creek, island: small areas.
Waterbirds recorded: (56 species recorded, 11 of them breeding; 6 migratory shorebird species). A single Yellow Chat (national status: Critically Endangered) was in fringing tall sedge in the Reserve in Sep 06. Two Australian Painted Snipe (national status: Vulnerable) were flushed from grassy margins of the Reserve pond on 25 August 2007; the birds sought refuge in a Melaleuca swamp (A. Briggs pers. com.). The only sector found to support Little Bittern (in bulrush *Typha* beds), Green Pygmy-goose, and Bush-hen (in Melaleuca swamp) in the BCCA sub-project and one of the few to support Great Crested Grebe, Black Bittern (in Melaleuca swamp), and Baillon's Crake. Eleven records of the rare Cotton Pygmy-goose: maximum count was 65 birds (28 Apr 07, A. Briggs & J. McCabe); several instances of suspected breeding including birds in trees in this sector. Breeding mainly by ducks and swans, moorhens and grebes; also, small colonies (ca. 50 pairs) of Little Black and/or Little Pied Cormorants in flooded Melaleuca trees in the north-west meadows in March and July 2007. Most abundant species were: Magpie Goose and Straw-necked Ibis (up to 800 of each), Cattle Egret (600) and Plumed Whistling-Duck (400). A nocturnal roost of several thousand Magpie Geese, Straw-necked Ibises and egrets was situated in inundated Melaleuca trees in the separate north-west marshes of this sector; hundreds of Wandering and Plumed Whistling-Ducks roosted by day in the ponds and swamps of this sector and dispersed at night to feed elsewhere, e.g. to the east. Largest total numbers of waterbirds in one survey of this sector were 2842 on 28 Mar 07 (wet season) and 1148 on 20 Nov 06 (dry season, last remaining water).
Conservation values: Despite its small size this sector is rich in wetland habitats – deep, shallow, open and wooded – including rare (regionally significant) Melaleuca swamps. An important sector in terms of waterbird diversity, reflecting this habitat richness – not just the high survey effort. Internationally important in terms of threatened species; nationally/regionally important in terms of rare/uncommon waterbird species, waterbird breeding, roosting, drought refuge and abundance.
Wetland condition: A causeway supporting a public road separates the main ponds area from adjacent intertidal areas in sector 10; this now prevents saltwater intrusion and prolongs persistence of fresh water in the ponds. Persistence of the north-western marshes probably also has been enhanced, by one or two low banks. Prickly acacia is common around the ponds although most of the smaller specimens were recently poisoned by the leaseholder. Patches of Olive Hymenachne in the far east were few and small in spring 2006 but several, tall and dense in spring 2007; there was one cluster of rubber vine in the Melaleuca swamp. Some local catchment near the Melaleuca swamps was recently cleared. Some Melaleuca trees have lost bark, apparently removed by cattle. Perennial tall sedges fringing the ponds are browsed by cattle in the dry season. Domestic goats sometimes occur in the Reserve.

Potential investments: Support to leaseholder (funds, labour) for ongoing control of prickly acacia. Consideration of fencing for Melaleuca wooded swamps to ensure their integrity. Establishment of fish passage-ways to restore connectivity between intertidal and ponded areas. Emplacement of educational signage at the community/visitor facilities overlooking the wetlands and construction of better visitor access to the (reserve) wetlands including on the roadside. Further waterbird surveys may determine whether or not Yellow Chat is a regular or accidental visitor to this sector; occurrence of more substantial stands of tall perennial sedge may encourage greater use by this bird.

Comments: Southern part of sector is a Shire Reserve used for camping/recreation and leasehold grazing of cattle. Due to its location and reasonable public access, this sector provides a number of opportunities for demonstration of wetland conservation/restoration projects and for raising awareness of wetland assets in the catchment. Public visitors to the camping area and reserve are likely to have collected additional information on waterbirds, some of which may be stored in EPA and Birds Australia databases.

Sector 08

Location: 22.3449, 149.5447

Catchment: St Lawrence Creek.

Survey effort and coverage in 2006-7: poor, aerial survey only.

Wetland types: Ponded channel, minor freshwater channels and ponds, wooded swamp: small areas present.

Waterbirds recorded: None recorded.

Conservation values: Not adequately known.

Wetland condition: A series of small banks has created a set of persistent ponds that trap freshwater flowing off nearby upland. Some prickly acacia present.

Potential investments: Assistance to landholder for reduction of prickly acacia infestation.

Comments: A small pocket of marine plain, somewhat modified. The ponds have potential to be useful as local dry season refuges for ducks/other waterbirds.

Sector 09

Location: 22.3190, 149.5644

Catchment: St Lawrence Creek.

Survey effort and coverage in 2006-7: good, both aerial and ground survey.

Wetland types: Complex of minor freshwater channels and ponds, grassy wet meadow, saltmarsh with grass and samphire: substantial areas. Melaleuca wooded swamp, freshwater grass-sedge swamp, ponded channel, saline grass-sedge swamp, bare saltmarsh, farm dam: small areas present.

Waterbirds recorded: (30 species recorded, 7 of them breeding; 3 migratory shorebird species). Breeding mainly by ducks, including Cotton Pygmy-goose (at potential nest trees on southern edge; and one brood in the east). Over 1900 Magpie Geese digging for *Eleocharis* tubers/shoots in January.

Conservation values: The sector is valuable in terms of diversity of wetland habitats and includes some (central) marine plain that seems (from aerial inspection only, to be confirmed) to have escaped hydrological alteration by embankments. Wooded swamps and associated sedge swamps in the east of the sector represent particularly high conservation value and deserve further study. Breeding by Cotton Pygmy-goose is of regional significance. Part of a local network of feeding sites for Magpie Goose in the early wet season.

Wetland condition: Some block banks in the west and a short seawall in the east, also a gravel road causeway (access to a boat ramp?) in the east, but some central areas may (?) have connectivity to the estuary. Prickly acacias in the west are mostly dead (poisoned by landholder). Substantial pig diggings in a far eastern swamp. Some Hymenachne in a dam in the far east. Deer apparently are kept on one property.

Potential investments: Assistance to landholder for control of prickly acacia infestations.

Comments: Much of this sector has been divided into small cadastral parcels.

Sector 10

Location: 22.3339, 149.5409

Catchment: St Lawrence Creek.

Survey effort and coverage in 2006-7: fair, both ground and aerial surveys.

Wetland types: Mangrove, salt flat, estuary: substantial areas. Saltmarsh with grass and samphire, bare intertidal flats (river bed): small areas.

Waterbirds recorded: Only a few species (6) recorded, with a few individuals of each; these included one migratory shorebird and the infrequently recorded Pied Cormorant.

Conservation values: Sector contains one of the largest mangrove blocks in this catchment. Otherwise, values not adequately known.

Wetland condition: Examples of the following were recorded: undercut river bank (at picnic area near bridge), cattle pugging on bare salt flat, vehicle tracks on bare salt flat, and dead landward-edge mangroves. A rough boat ramp exists beside the railway embankment that narrowly crosses the sector.

Potential investments: Fencing to control cattle access to grassy saltmarsh and mangrove seaward of bare salt flats, could be considered.

Comments: Sector covers the southern side of the middle and upper reaches of St Lawrence Creek to just above the railway bridge, and so is elongated in shape. Some northward inflow of freshwater from sector 9 is reduced by small banks.

Sector 11

Location: 22.2978, 149.6077
Catchment: St Lawrence Creek.
Survey effort and coverage in 2006-7: fair, both ground and aerial surveys.
Wetland types: Mangrove, salt flat, estuary: substantial areas. Saltmarsh with samphire, beach, bare intertidal flat: small areas.
Waterbirds recorded: (16 species recorded, none breeding; 9 migratory shorebird species). The small beach at the point in the far northeast of the sector supported 214 migratory shorebirds on 21 Nov 06 and 869 on 14 Nov 2007; larger numbers may have been present in summer but ground access was impossible at that time. Roost coordinates (decimal degrees S, E): 22.3012, 149.6279. Most abundant species was Red-necked Stint (800 birds, rising tide, Nov 07). Shorebirds also roost at the edge of (or within) saltmarsh or on secondary beaches, along the kilometre of treeless shore immediately west/upstream of the point.
Conservation values: The migratory shorebird roost is of regional significance in terms of number of individuals, holding the second-largest shorebird aggregation recorded in Broad Sound, and is valuable in terms of being the only roost in the study area directly accessible by motor vehicle (but need to traverse freehold property) for research and monitoring purposes. The peak count of Far Eastern Curlew (55, November 06), an iconic migratory species, was the highest from any sector in the BCCA wetlands sub-project (although other roosts did not have the benefit of ground survey).
Wetland condition: A low seawall runs along almost the entire southern boundary of the sector; this presumably prevents outflow (into sector 11) of some fresh to brackish water that accumulates in sector 12 from heavy local downpours in the wet season (there is no stream inflow to sector 12). Dead mangroves were common at the landward edge of mangrove blocks in the sector. Coastal erosion was manifest in undercutting of mangroves along the river and of saltmarsh near the point, and loss of trees and sand from the beach. Sand also was drifting inland from the beach in November. Prickly Acacia shrubs behind the beach had been poisoned by the landholder (as observed in Nov 07).
Potential investments: None identified.
Comments: Condition of the beach at the point may be influenced by whether or not public access remains restricted to (infrequent) boat landings.

Sector 12

Location: 22.3247, 149.6042
Catchment: northern half/third is in St Lawrence Creek catchment; southern part is in Waverley Creek catchment but the watershed is not apparent in this near-flat landscape .
Survey effort and coverage in 2006-7: good, both ground and aerial surveys.
Wetland types: Marine plain (complex of minor channels and ponds, some freshwater some saline), salt flat, saline/freshwater grass-sedge swamp, saltmarsh (with samphire, grassy saltmarsh), ponded channel: substantial areas.
Waterbirds recorded: (51 species recorded, 4 of them breeding; 11 migratory shorebird species). The nationally threatened (Critically Endangered) Capricorn Yellow Chat was recorded, mainly in *Schoenoplectus litoralis* and samphire swamp in the centre (usually within the same 1 ha of habitat) and far west of the sector, in five surveys, over two years, both in the dry and wet seasons. The maximum tally was 5-10 chats including a family group, but higher numbers could occur in the extensive habitat. Sightings of Pectoral Sandpiper, Black-tailed Native-hen, and presumed Swinhoe's Snipe and Yellow Wagtail, all in November, were the only records of these species during the project. Zitting Cisticola was relatively common in sedgey samphire. Relatively little waterbird breeding was recorded but probably was under-reported; old nests of shorebirds/terns were found on samphire mounds around the salt flat. Sector regularly used for migration stop-over, with a maximum of 7475 migratory shorebirds (plus stilts and ducks) on the shallowly inundated, drying, north-western salt flat on 28 March 07, and supported feeding (on inundated old *Eleocharis* tubers) and roosting by flocks of Magpie Goose. The most abundant species were Black-winged Stilt (up to 2990 birds), Sharp-tailed Sandpiper (3050: over 1% of Flyway population), Red-necked Stint (2000), Marsh Sandpiper (1553: over 1% of Flyway population), and Grey Teal (1510). Another seven species each occurred in numbers over 100 birds. Tallies of 460 Black-tailed Godwit and 400 Curlew Sandpiper on 28 March 07 were the highest for the study area and perhaps also for Central Queensland. The total number of waterbirds counted varied from several hundred in November, to 1000+ in January and over 13,800 on 28 March 07 (an incomplete survey, probably several thousand higher).
Conservation values: A regionally important area of marine plain in terms of extent and complexity/diversity, containing some of the largest areas of non-tidal open water, sedgey samphire and *Schoenoplectus litoralis* tall sedgeland (including some broad beds) in the study area. Internationally important in terms of supporting a critically endangered bird as well as over 1% of the Flyway populations of (at least) two migratory shorebird species. The sector is of outstanding regional importance in terms of shorebird migration and overall waterbird totals (in both respects, by far the highest number of birds in the BCCA study, 2006-7), has high species diversity and supports high numbers of species from several families.
Wetland condition: This rhombus-shaped sector is bounded by low hills on the western side and is totally enclosed by a low seawall (with short sections of high ground) on the remaining three sides; the walls are not trafficable and erode with rainfall so require maintenance with a bulldozer. Small internal block banks hydrologically separate the sector into (roughly) quarters and enhance the persistence of water in some basins and channels. There are three farm dams at the margins of the sector and a ponded channel at the centre of the sector, only a few hundred metres long, all of which sometimes provide freshwater refuge habitat for waterbirds at the height of the dry season if renewed by intense thunderstorms (ponded channels against the seawall become highly saline). A major infestation of prickly acacia, including many seedling shrubs, lies across the centre-south of the otherwise tree-less plain. Small areas of pig diggings and damage from the bulldozer were noted on the wetland bed.
Potential investments: Support in the form of labour and funds could be provided to the landholder to control the prickly acacia infestation and establish alternative shade trees for cattle if required. Fencing of several small areas of tall sedgeland to reduce or exclude cattle access may enhance this habitat for wildlife, including chats, but needs to be weighed up in economic terms given the relatively small area of pasture on the property. Given the high conservation value of the sector, negotiation with the landholder on the possibility of establishing voluntary conservation covenants over areas of key habitat in sector 12 should be considered. The landholder has

expressed interest in establishing a seawall fish passageway to restore connectivity between the sector's internal wetlands and a major tidal creek on the northern boundary; unfortunately, this seems unlikely to succeed because there are no substantial permanent refuges for fish inside the boundary and there is no significant creek inflow to (and no waterholes in) the sector; also, the part of the northern channel lying inside the seawall probably becomes hyper-saline seasonally and thus unsuitable for most fish. Under sea-level rise scenarios, the landholder may require assistance to maintain the seawalls.

Comments: Sector contains important wetland, despite substantial modification to hydrology. The north-eastern corner of the sector is less than 300 m from the open sea, near a small beach that supports a minor shorebird roost (sector 11); shorebirds, possibly from this roost, sometimes – such as during windy weather – roost on dry ground or in shallow wetlands inside neighbouring sector 12.

Sector 13

Location: 22.3405, 149.6395
Catchment: Waverley Creek.
Survey effort and coverage in 2006-7: fair, aerial surveys only.
Wetland types: Mangrove, salt flat, saltmarsh with samphire, bare intertidal flats, estuary: substantial areas.
Waterbirds recorded: Only a few species (5) recorded, in small numbers; including small, medium and large sized migratory shorebirds (e.g. Far Eastern Curlew, Whimbrel) roosting in widely spaced outer *Avicennia* mangroves (up to 41 birds, 6 March 07).
Conservation values: Fauna not adequately known; comprehensive surveys using boats may reveal greater numbers of shorebirds roosting in the mangroves. Substantial areas representative of intertidal to supra-tidal ecosystems. Narrow sand ridges with coastal scrub, at the landward edge edge of the mangrove block, may be regionally significant.
Wetland condition: A low seawall along the western boundary of the sector presumably prevents outflow (into sector 13) of some fresh to brackish water that accumulates in sector 12 from heavy local downpours in the wet season (there is no stream inflow to sector 12). Dead mangroves were common at the landward edge of the mangrove block in sector 13. Coastal erosion was manifest in undercutting of mangroves (with many fallen trees) on the exposed eastern shore; meanwhile, many mangrove saplings were established on some parts of this shoreline. At the far northern end, wind blown sand seemed to be smothering some mangroves.
Potential investments: None identified but this may be one of the most accessible sectors in the western catchments for research on exposed mangrove coast, and surveys for the nationally threatened Mangrove Mouse *Xeromys myoides*.
Comments: In this sector, freehold tenure appears to extend some distance seaward of the upper limit of tidal influence.

Sector 14

Location: 22.3531, 149.5910
Catchment: Waverley Creek.
Survey effort and coverage in 2006-7: fair, aerial surveys only.
Wetland types: Salt flat, saltmarsh with samphire, mangrove, estuary: substantial areas.
Waterbirds recorded: None recorded.
Conservation values: Not adequately known.
Wetland condition: A low seawall along the northern boundary of the sector presumably prevents outflow (into sector 14) of some fresh to brackish water that accumulates in sector 12 from heavy local downpours in the wet season (there is no stream inflow to sector 12). Small areas of dead mangrove occur in modified tidal creeks and at the landward edge of mangroves in sector 14.
Potential investments: None identified.
Comments: The south-western corner of this sector may be accessed from the public road to the boat ramp in Newport Conservation Park.

Sector 15

Location: 22.3866, 149.5789
Catchment: Waverley Creek.
Survey effort and coverage in 2006-7: fair, ground and aerial surveys.
Wetland types: Mangrove, salt flat, estuary: substantial areas. Saltmarsh with samphire: small areas.
Waterbirds recorded: Only a few species (5) recorded, principally, four species of egret. A breeding colony of egrets, estimated to comprise at least 500 active nests (hence, 1000 adult birds involved), was discovered in mangrove in the central west of the sector on 6 March 2007. Colony coordinates (decimal degrees S, E): 22.3872, 149.5710. Nests were within a relatively small area within extensive, continuous, tall closed forest dominated by *Bruguiera/Rhizophora* with some paler trees (*Avicennia*?) of equal height, close to the major south-western tributary of Bund Creek. Intermediate Egrets seemed to dominate the colony and Cattle Egrets and Australian White Ibis also were present. Only 70 to 100 egrets remained in the colony on 29 March 2007. Observations of egrets, many of which displayed full breeding colours (egrets have distinctive soft part colours in early stages of the breeding cycle) in wetlands around St Lawrence in late January, indicated that Intermediate, Cattle, Great and Little Egrets were breeding or about to start breeding – stimulated by the filling of local wetlands during that month. Hence, this colony may have started in January. The colony at Newport was central to the main feeding areas. It is possible that other breeding colonies were active in the western catchments in January-March 2007 but were not detected in the aerial surveys.
Conservation values: The sheltered, tall, closed mangrove forest is one of the best representative examples in the western catchments of the study area. Fauna is not adequately known but the egret colony in this sector is of regional (if not State-level) significance, being among the few known on the Central Queensland coast; no colonies had previously been documented in the western catchments.
Wetland condition: Major seawalls along the western boundary of the sector prevent outflow into sector 15 of significant volumes of fresh water from Bund Creek (sector 16) and sector 19 in the wet season; some water overflows the seawall from sector 19 via spillways – this apparently occurred in early 2007. Small areas of dead mangrove (e.g. thickets of *Ceriops*) occur at the landward edge of the mangrove blocks in sector 15; localised slumping of channel banks and mangrove was noted near the boat ramp. Otherwise, the main

block of mangrove forest appeared to be in good condition. The boat ramp is one of the few publicly accessible ramps in the western catchments.

Potential investments: Consideration should be given to extending the Conservation Park to include the greater part of the mangrove block within State land in this sector, especially to include the tall forest supporting the egret colony.

Comments: Includes Newport Conservation Park. In this sector, freehold tenure appears to include some areas of salt flat and marginal mangrove. The egret colony probably is inaccessible on foot due to surrounding channels, dense mangrove forest and (almost certainly) saltwater crocodiles, although boat access at high tide may bring observers close to the edge of the colony.

Sector 16

Location: 22.3846, 149.5331

Catchment: Waverley Creek.

Survey effort and coverage in 2006-7: fair, both by aerial and ground survey.

Wetland types: Grassy wet meadow, freshwater grass-sedge swamp, Melaleuca wooded swamp, ponded channel: substantial areas. Complex of minor freshwater channels and ponds; grassy saltmarsh: small areas.

Waterbirds recorded: (34 species recorded, 3 of them breeding; 1 migratory shorebird species). Rare/uncommon species recorded in the sector were Black Bittern and Cotton Pygmy-goose, associated with Melaleuca wooded swamp, and Black-necked Stork, in grass-sedge swamp. Most abundant species was Intermediate Egret with 400 counted on 31 January 07; more than 913 waterbirds were present on that day (incomplete survey of sector).

Conservation values: The sector includes regionally significant areas of Melaleuca wooded swamp and freshwater grass-sedge (*Eleocharis ?dulcis* dominated) swamp; wooded swamp is scarce in adjoining marine plain sectors. Substantial use of the sector by waterbirds typical of this region and habitats, but full conservation value not adequately known. Undoubtedly a feeding area for egrets that breed in nearby mangrove forest (sector 15).

Wetland condition: A major seawall across Bund Creek at the eastern end of the sector prevents saltwater incursion and increases persistence of freshwater in the sector. The railway line causeway restricts freshwater flow, from west to east, to a series of three culverts. A substantial patch of Olive Hymenachne weed was present under one of the railway culverts. Some pig diggings and dead Melaleuca trees noted.

Potential investments: Queensland Rail's nearby St Lawrence depot should be encouraged to remove the Hymenachne infestation within its easement. Consider fencing of some Melaleuca wooded swamps to ensure their integrity.

Comments: Narrowly contiguous with sectors 17 and 19 and thus a component of a greater marine plain wetland-complex. Early in the wet season, large areas of open water present as lake-like features; within a month or so, these become dominated by emergent grass-sedge vegetation.

Sector 17

Location: 22.4022, 149.5075

Catchment: Waverley Creek.

Survey effort and coverage in 2006-7: good, both aerial and ground survey.

Wetland types: Grassy wet meadow, freshwater grass-sedge swamp, complex of minor freshwater channels and ponds: substantial areas. Persistent waterhole in creek, saltmarsh with samphire: small areas.

Waterbirds recorded: (31 species recorded, none breeding; 1 migratory shorebird species). This was the only sector in which Australian Pratincole (in dry bare paddock) and Nankeen Night Heron (in bamboo at waterhole) were recorded in the BCCA sub-project; both are widespread species in Queensland. The most abundant species was Magpie Goose with 275 counted on 31 January 07; over 350 mixed egrets of 3-4 species were present on 6 March 07. Other species with over 100 birds counted were Grey Teal, Royal Spoonbill and Straw-necked Ibis. Supported the highest number of Glossy Ibis (80) counted in any sector. The largest total number of waterbirds counted was 857 on 31 January 07 (incomplete survey of sector).

Conservation values: The sector comprises plain that is mostly tree-less and includes regionally significant areas of freshwater grass-sedge (*Eleocharis ?dulcis* dominated) swamp. Substantial use of the sector by waterbirds typical of this region and habitats. Undoubtedly a feeding area for egrets that breed in nearby mangrove forest (sector 15). Sector is difficult to access when wet, hence values are not adequately known.

Wetland condition: The railway line causeway that defines the eastern boundary of this sector, restricts freshwater flow across the plain, from west to east into sector 19, to a series of culverts. Water may be at least 1 m deep through the largest culverts at the height of the wet season but a ford in the railway access road limits eastward flow under the culverts when water levels are low. Some evidence of pig diggings in sedge swamps. Several massive clumps of bamboo at the waterhole, which is associated with the property's homestead.

Potential investments: None identified.

Comments: Contiguous with sectors 16, 18 and 19 and thus a component of a greater marine plain wetland complex. Early in the wet season, large areas of open water against the railway line present as lake-like features; within a month or so, these become dominated by emergent grass-sedge vegetation. Distinctive in Broadsound in having a substantial freshwater catchment, with at least two creeks crossing Bruce Highway to enter the western side of the sector.

Sector 18

Location: 22.4358, 149.5246

Catchment: Waverley Creek.

Survey effort and coverage in 2006-7: fair, both aerial and ground survey.

Wetland types: Grassy wet meadow, freshwater grass-sedge swamp, ponded channel, complex of minor freshwater channels and ponds: substantial areas. Persistent waterhole in creek, saltmarsh with samphire: small areas.

Waterbirds recorded: (15 species recorded, 2 of them breeding; 1 migratory shorebird species (Black-tailed Godwit)). Nine active nests of Magpie Goose were sighted in grass-sedge swamp during a quick aerial sweep over the sector on 6 March 2007; it is likely that more nests were present. Black Swans also nested during February-March 07. The most abundant species was Magpie Goose with 312 counted on 6 March; over 265 mixed egrets also were present. The largest total number of waterbirds counted was 626 on the same date (incomplete survey of sector).

Conservation values: Probably the wettest freshwater sector in the western catchments, with substantial freshwater inflow from Waverley and other Creeks crossing Bruce Highway to enter the western side of the sector. The sector comprises tree-less plain with regionally significant areas of grassy wet meadow and freshwater grass-sedge swamp. The latter includes numerous broad patches dominated by the sedge *Bolboschoenus* sp., which, elsewhere in Broadsound catchment is not generally found in large swathes. Substantial use of the sector by waterbirds – not fully documented – for feeding and breeding, typical of this region and habitats. Undoubtedly a feeding area for egrets that breed in nearby mangrove forest (sector 15).

Wetland condition: The railway line causeway that defines the eastern boundary of this sector, restricts freshwater flow across the marine plain, from west to east into sector 19, to a series of culverts. However, substantial outflows probably occur also through sectors 17 and 20. A large channel complex in the centre-east of the sector has been isolated from the tidal influence of Waverley Creek by low seawalls on the south-east boundary of the sector; the ponded channels also have some internal block banks. Some evidence of pig diggings in sedge swamps.

Potential investments: This is one of the few sectors in the western catchments, which has substantial fresh water inflow that sustains at least one waterhole and a ponded channels complex. Accordingly, there may be potential for restoring connectivity between Waverley Creek estuary and these persistent fresh-water bodies through construction of fish passageways on the south-eastern banks. Botanical assessment could be conducted to clarify the regional status of *Bolboschoenus* communities and identify any conservation requirements.

Comments: Sector is contiguous with sectors 17, 19 and 20 and thus a component of a greater marine plain wetland complex. Early in the wet season, large areas of open water against the railway line present as lake-like features; within a month or so, these become dominated by emergent grass-sedge vegetation.

Sector 19

Location: 22.4085, 149.5522

Catchment: Waverley Creek.

Survey effort and coverage in 2006-7: good, both aerial and ground survey.

Wetland types: Ponded channel/lake complex, saltmarsh with samphire, saline/freshwater grass-sedge swamp, complex of minor saline/freshwater channels and ponds: substantial areas. Grassy wet meadow, islands: small areas.

Waterbirds recorded: (48 species recorded, 4 of them breeding; 5 migratory shorebird species). The nationally threatened Australian Painted Snipe (status: Vulnerable) – three birds, at least two of them juvenile – was recorded in drying marsh (nardoo, sedge, samphire) with small gilgai mounds on 11 May 07. Extensive sedge and samphire habitat potentially is highly suitable also for the threatened Yellow Chat, during or following the wet season. A White-winged Black Tern (in May) was the only record during the project; large flocks seasonally occur in Torilla Plain sectors. Breeding by Black Swan was recorded in March, and May (up to 20 broods); a colony of Silver Gull was seen on an island in this sector and Gull-billed Terns potentially could nest in this same habitat. Small numbers of migratory shorebirds were recorded regularly, including in winter 2007, with up to 21 Black-tailed Godwit and up to 45 Marsh Sandpiper. The most abundant species were Grey Teal (1340 birds), Australian Pelican (1152) and Australian Pelican (1152) and Royal Spoonbill (500 in sector 19 plus 180 adjacent in sector 17), all on 11 May 07. Other abundant species included Pacific Black Duck, Magpie Goose, Black Swan, Intermediate Egret, Brolga (220 in July 07) and Great Egret and the count of 52 Australasian Shoveler in May was the highest from one sector during the BCCA project. The largest total number of waterbirds counted was 4288 on 11 May 07 (incomplete survey of sector, actual total may have been between 5000 and 10,000).

Conservation values: In the wet season, contains the largest area of non-tidal open water and one of the largest areas of *Schoenoplectus litoralis* tall sedgeland (with a number of broad dense beds) in the study area. A complex and diverse tree-less wetland, with freshwater and saline elements, providing regionally important habitat for waterbirds, despite its modification. The sector is internationally important in terms of supporting a threatened waterbird species and regionally important in terms of waterbird species diversity, breeding, and numbers of individuals. Undoubtedly a feeding area for egrets that breed in adjacent mangrove forest (sector 15).

Wetland condition: The sector is almost totally enclosed by embankments or low hills: the eastern half is bounded by a major seawall (with several short gaps including a spillway) that probably prevents significant incursion of seawater from Waverley Creek system; on the western side the railway line causeway restricts freshwater inflow across the marine plain (from sectors 17 and 18) to a series of culverts; and on the northern side there is a narrow connection to sector 16. There are also some internal block banks, most of which are no longer functional. Some outflow can occur via the spillway and seawall gaps into sector 15. Extensive pig diggings in some areas of sedge swamp.

Potential investments: Examination of the south-eastern side in July 2007 showed that there are many scoop-holes inside the seawall where small fish might survive through less severe dry seasons, some being adjacent to active tidal creeks close to Waverley Creek estuary. Fish would enter the sector at present when large floods outflow through gaps in the seawall. The possibility of establishing fish passageways on the SE side may be worth further investigation. Remaining parts of the sector are too shallow to provide prolonged fish refuge.

Comments: A highly modified sector but particularly important for waterbirds when inundated.

Sector 20

Location: 22.4631, 149.5443

Catchment: Waverley Creek.

Survey effort and coverage in 2006-7: poor, aerial survey only.

Wetland types: Grassy wet meadow, estuary, salt flat: substantial areas. Probably also saltmarsh with samphire, freshwater grass-sedge swamp: small areas.
Waterbirds recorded: None recorded.
Conservation values: Not adequately known but potentially has high value as shown by sectors 17-19.
Wetland condition: The railway causeway on the northern boundary of the sector apparently restricts movement of seawater into the sector. Low seawalls on the north-western boundary of the sector prevent or reduce inflow of fresh water from sector 18 (Waverley Creek flood-out). No seawalls or block banks were detected within the sector, hence, connectivity between the estuary and Amity Creek may be good but this needs to be confirmed.
Potential investments: None identified.
Comments: Access to eastern edges of the sector may be possible along the railway service road from Wumalgi.

Sector 21

Location: 22.4155, 149.5860
Catchment: Waverley Creek.
Survey effort and coverage in 2006-7: poor, both aerial and ground surveys.
Wetland types: Salt flat, estuary, saltmarsh with samphire, mangrove: substantial areas. Grassy saltmarsh: small areas.
Waterbirds recorded: None recorded although apparently there is an old WildNet record of Australian Painted Snipe, a nationally threatened species, from this sector (D. Cook pers. com.); the original record has not been sighted but habitat seems less than ideal for this bird in this sector.
Conservation values: Not adequately known.
Wetland condition: No substantial modification; one small block bank on part of the south-eastern edge. No substantial areas of dead mangrove documented. Adjacent landholder indicated that the salt flat was extending landward and that significant areas of grassy saltmarsh within the sector had been lost (now bare) over recent decades.
Potential investments: Adjacent landholder is interested in the possibility of installing banks to prevent or reduce tidal flow across the salt flats in order to protect freshwater/dryland pasture in sector 22. An application to conduct this work on intertidal land may not be likely to be approved under current legislation.
Comments: In this sector, private tenure appears to include some marginal areas under tidal influence.

Sector 22

Location: 22.4304, 149.5986
Catchment: Waverley Creek.
Survey effort and coverage in 2006-7: fair, aerial and ground surveys.
Wetland types: Marine plain (complex of minor channels, mostly freshwater but some probably saline), grassy wet meadow: substantial areas. Freshwater grass-sedge swamp, saltmarsh with grass and samphire, farm dams: small areas.
Waterbirds recorded: (15 species recorded, none of them breeding; no migratory shorebird species). Waterbird fauna dominated by Magpie Geese (up to 285, 31 January 07) and egrets, in the early wet season.
Conservation values: In the western catchments, this is perhaps the largest area of marine plain that has not been bunded to prevent exchange of fresh and salt water. Fauna values not adequately known but, at least, a locally significant feeding area for egrets and Magpie Geese early in the wet season. Egrets could easily travel the short distance across nearby Waverley Creek estuary to the breeding colony in sector 15.
Wetland condition: No substantial modifications, other than one or two short banks. Some non-indigenous grasses in dams near homestead on the eastern side of the sector. (See also below)
Potential investments: The principal landholder is interested in the possibility of installing banks to prevent or reduce saltwater incursion from adjacent salt flats in sector 21, to protect freshwater/dryland pasture in sector 22. Whether or not an application to conduct such an action would be permitted under current legislation may depend on detailed delineation of property boundaries, to determine which legislation may apply. Landholder observations over several decades indicate that significant loss of pasture has occurred; the landholder has suggested that saltwater intrusion may be substantially due to diversion of the (naturally constricted) tidal inflow up Waverley Creek by the major seawall on the opposite side of the Creek (sector 19), but long-term rise in sea-level may be a factor.
Comments: Local catchments are relatively small, such that freshwater inflow to sector 22 and thence seaward to Waverley Creek may be minor.

Sector 23

Location: 22.3784, 149.6269
Catchment: Waverley Creek.
Survey effort and coverage in 2006-7: fair, aerial surveys only.
Wetland types: Salt flat, saltmarsh with samphire, mangrove, estuary, island: substantial areas.
Waterbirds recorded: None recorded.
Conservation values: Sector includes substantial blocks of sheltered mangrove, some with associated saltmarsh, along Waverley Creek estuary opposite sectors 14 and 15 and on an island in the estuary. Fauna values are not adequately known.
Wetland condition: A low seawall along the south-eastern boundary of the sector presumably prevents outflow (into sector 23) of some fresh to brackish water that accumulates in sector 24 from heavy local downpours in the wet season (there is no substantial stream inflow to sector 24). Areas of dead mangrove in modified tidal creeks and at the landward edge of mangroves in sector 23. Areas of sapling mangrove associated with the island.
Potential investments: None identified.
Comments: None.

Sector 24

Location: 22.4091, 149.6460
Catchment: Waverley Creek.
Survey effort and coverage in 2006-7: fair, both aerial and ground survey.
Wetland types: Ponded channel complex, saline/freshwater grass-sedge swamp, saltmarsh with samphire: substantial areas. Grassy wet meadow, farm dam: small areas.
Waterbirds recorded: (42 species recorded, 7 of them breeding; 4 migratory shorebird species). The only sector found to support Chestnut Teal in the BCCA sub-project and one of the few to support Baillon's Crake; Black-necked Stork also recorded here. Contains extensive tall sedge and samphire habitat which is potentially suitable for Yellow Chat. Breeding mainly by ducks/swans, notably by Plumed Whistling-Duck. Most abundant species were: Magpie Goose (up to 1600, 31 January 07), Plumed Whistling-Duck (1035, 27 March 07) and Grey Teal (906, 11 May 07). In the wet season, Plumed and Wandering Whistling-Ducks roost by day on block banks inside this sector and at adjacent farm dams. Largest total number of waterbirds in one survey of this sector was 2356 on 27 March 07.
Conservation values: Contains one of the largest areas of *Schoenoplectus litoralis* tall sedgeland in the study area, principally as beds fringing a complex channel network; unlike in some other sectors, some of these dense beds tend to remain erect during the dry season, rather than collapsing. No other comparably complex channel network in the western catchments: this sector is more typical of Torilla Plain. A tree-less wetland with freshwater and saline elements providing regionally important habitat for waterbirds, despite its modification. Waterbird use is regionally important in terms of species diversity, breeding, and numbers of individuals.
Wetland condition: Most of the northern boundary of the sector is a low seawall that prevents incursion of seawater from Waverley Creek system and that increases the persistence of freshwater within the sector. There are several internal block banks on the main channel. Extensive pig diggings in and around beds of sedge; pigs were usually seen during ground surveys. Beds of bulrush *Typha domingensis* persist in the main channel in the south-western corner; their origin is unknown but this plant does occur in farm dams on the property and in sector 24 the *Typha* is mainly landward of internal block banks.
Potential investments: The temporary wetlands in this sector do not provide continuous dry season refuge for fish and accordingly fish passageway installation may be of limited usefulness.
Comments: A modified sector but important for waterbirds when inundated. In a good wet season, most of the sector may be inundated but the small local catchment and lack of deep channels ensures the area can be expected to be dry later in the year.

Sector 25

Location: 22.3579, 149.6857
Catchment: split between Waverley Creek and Styx River.
Survey effort and coverage in 2006-7: fair, aerial surveys only.
Wetland types: Salt flat, estuary, bare intertidal flats, mangrove: substantial areas. Marine plain, saltmarsh with samphire: small areas.
Waterbirds recorded: Only a few species (6) recorded, including 4 of migratory shorebirds (all three size groups). Shorebirds roost on sheltered mudflat close to the northernmost point of the sector and on a series of bare sand ridges, landward of the north-eastern open shore, on the outer salt flat. Roost coordinates (decimal degrees S, E): 22.3518, 149.6906. Use of the various sub-sites at this roost depends on tide and weather conditions. Numbers of migratory shorebirds counted at the roosts were 426 on 6 September 2006 and 440 on 6 March 2007 (mostly not identified to species level). Actual numbers may be at least twice as large, based on the normal undercounting factor in aerial surveys. Up to 50 Pied Oystercatchers (non-migratory) were counted at the roosts.
Conservation values: Fauna not adequately known; comprehensive surveys on foot may reveal greater diversity and numbers of shorebirds roosting in the sector. As it stands, this sector is regionally important for shorebird migration/roosting.
Wetland condition: Dead mangroves were common at the landward edge of the mangrove blocks in this sector; also there was evidence of coastal erosion – mangrove stumps on the exposed north-western foreshore.
Potential investments: None identified, but in dry periods the shorebird roosts may be accessible for survey/monitoring purposes, once farm tracks and salt flat have been traversed.
Comments: A farm track leads to a small hut on the southern (dryland) edge of the sector; the track also leads to a private boat ramp (in the south-east corner of the sector) used by landholders to access Rosewood Island. At low tide it should be possible to walk from the vicinity of the hut across dry salt flats to the shorebird roost sites.

Sector 26

Location: 22.3934, 149.7211
Catchment: island, adjacent to the Styx River catchment.
Survey effort and coverage in 2006-7: poor, aerial surveys only.
Wetland types: Salt flat, estuary, mangrove, saltmarsh with samphire: substantial areas. Bare intertidal flats, beach, marine plain (grassland with complex of small channels/ponds, seasonally with fresh to brackish water): small areas.
Waterbirds recorded: Only 2 species recorded: Far Eastern Curlew and Whimbrel (both are migratory shorebirds), with a few individuals of each. Beaches and salt flats on the north-western and northern sides of the sector seem suitable for shorebird roosting but no aggregations were recorded during the aerial surveys – perhaps the adjacent sector 25 is preferred?
Conservation values: Beaches in the far north-west of the sector differ from most other beaches in the western catchments in being both steep and complex. Substantial areas of saltmarsh with samphire, in the far south of the sector. Fauna not adequately known.
Wetland condition: Many fallen mangroves, and undercutting of shore, in the exposed north-west of the sector. Extensive areas of dead mangrove at the landward edge of the mangrove blocks. A small causeway traverses part of the northern salt flats to provide vehicle access to a private boat ramp, presumably used to bring cattle on to the island. Extensive pugging of bare salt flat by cattle. Despite

being on a substantial island, it seems that grazing operations throughout have meant that the sector does not provide examples of undisturbed wetland ecosystems.

Potential investments: Introduction of additional fencing may facilitate protection and/or recovery of sensitive wetland areas such as salt flat and saltmarsh.

Comments: The whole island apparently is managed as a single cattle grazing operation.

Sector 27

Location: 22.3996, 149.7489

Catchment: island cluster, adjacent to the Styx River catchment.

Survey effort and coverage in 2006-7: poor, aerial surveys only; outer islands included.

Wetland types: Mangrove, estuary, salt flat, islands: substantial areas. Bare intertidal flats, saltmarsh with samphire, beach, rocky shore: small areas.

Waterbirds recorded: Only 2 'species' recorded: small- and medium-sized migratory shorebirds. A high tide roost on the beach of Turtle Island supported 150 migratory shorebirds on 6 September 2006 and 30 on 6 March 2007. Roost coordinates (decimal degrees S, E): 22.3600, 149.7752. Actual numbers may be at least twice as large, based on the normal undercounting factor in aerial surveys.

Conservation values: The sector includes a particularly large block of mangrove forest in the south and a series of mangrove covered outer islands within the Styx estuary. Fauna not adequately known.

Wetland condition: A network of low seawalls, which also probably serve as causeways for farm tracks, has created two or more large ponds on salt flat in the north of the sector near the homestead. Areas of dead mangrove occur at the landward edge of some mangrove blocks. On the southernmost outer island within the Styx estuary in this sector, it was noted that fallen dead mangrove trees occur around the tall forest (*Bruguiera/Rhizophora*?) edge as an erosion zone, but a perimeter band of small/sapling mangroves (*Avicennia*?) lies immediately seaward as an accretion zone and similar trees are colonising adjacent bare intertidal flats.

Potential investments: Introduction of additional fencing may facilitate protection and/or recovery of sensitive wetland areas such as salt flat and saltmarsh.

Comments: Turtle Island is part of Charon Point Conservation Park; two mangrove islands in the Styx estuary apparently are not in marine park. The whole of the main island apparently is managed as a single cattle grazing operation.

Sector 28

Location: 22.4245, 149.6831

Catchment: Styx River.

Survey effort and coverage in 2006-7: poor, aerial surveys only.

Wetland types: Salt flat, mangrove, estuary: substantial areas. Saltmarsh with samphire: small areas.

Waterbirds recorded: None recorded.

Conservation values: Sector includes substantial blocks of sheltered mangrove. Fauna values are not adequately known.

Wetland condition: Small block banks on the southern boundary of the sector presumably prevent outflow (into sector 28) of some fresh water that accumulates in sectors 29 and 30 in the wet season. There are areas of dead mangrove in sector 28 in tidal creeks affected by these banks.

Potential investments: None identified.

Comments: None.

Sector 29

Location: 22.4489, 149.6561

Catchment: Styx River.

Survey effort and coverage in 2006-7: fair, aerial and ground surveys.

Wetland types: Marine plain (complex of minor channels and ponds, mostly freshwater but some probably saline), grassy wet meadow: substantial areas. Ponded channel, saline grass-sedge swamp, freshwater grass-sedge swamp, saltmarsh with samphire: small areas.

Waterbirds recorded: None recorded.

Conservation values: Sector includes substantial areas of marine plain, most of which has not been bunded against saltwater incursion. The sector also includes an isolated area of *Schoenoplectus litoralis* tall sedgeland (within the ponded channel), which is potentially suitable for use by Yellow Chat (nationally threatened population), and shallow seasonal swamps that are likely to support feeding egrets and other waterbirds. Fauna values are not adequately known.

Wetland condition: Block banks on the easternmost promontory have created a small area of ponded channel. Some evidence of pig activity, and areas of substantial disturbance by vehicle tracks. Areas in the north of the sector included former tussocky swamps that had been reduced to areas of bare mounds; no explanation was evident, possibly in part a seasonal phenomenon.

Potential investments: None identified.

Comments: Contiguous with marine plain in sector 30 but divided arbitrarily with an east-west line to facilitate surveys.

Sector 30

Location: 22.4722, 149.6581

Catchment: Styx River.

Survey effort and coverage in 2006-7: fair, aerial and ground surveys.

Wetland types: Marine plain (complex of minor channels and ponds, mostly freshwater but some probably saline), grassy wet meadow, saline grass-sedge swamp, saltmarsh with samphire, grassy saltmarsh: substantial areas. Freshwater grass-sedge swamp, ponded channel: small areas.

Waterbirds recorded: (19 species recorded, 2 of them breeding; 3 migratory shorebird species). All of these birds were recorded on 27 March 2007. The migratory shorebirds comprised 63 Marsh Sandpiper, 60 Sharp-tailed Sandpiper and 30 Common Greenshank, all feeding in drying flat-bedded channels in grass-sedge swamp in the centre-east. Zitting Cisticola was recorded in several areas of the marine plain with short grass/sedge. Most abundant species was Plumed Whistling-Duck (450, mostly on a farm dam, mid-plain). The total number of waterbirds present on this occasion was 769 (incomplete survey of wetland in the sector).

Conservation values: Sector includes substantial areas of marine plain, which, though mostly bunded against saltwater incursion, have significant conservation value – this, together with sector 29, is by far the largest area of marine plain in the Styx catchment. Within the central plain, there is a substantial bed of the sedge *Cyperus alopecuroides*, one of the few in the western catchments. This, together with small patches of *Schoenoplectus litoralis* tall sedgeland and samphire in the centre-east, constitutes potential habitat for Yellow Chat (nationally threatened population). Fauna values are not adequately known – only one ground survey conducted when substantial areas of water were present – but data indicate that with further surveys the sector may prove to be at least regionally significant for waterbirds, including migratory shorebirds, that use non-tidal habitats.

Wetland condition: A discontinuous chain of short low seawalls and block banks around the seaward perimeter of the sector ensures that incursion of saltwater is minimal. Accordingly, these banks have created a number of small ponded channels (mostly dry). A large farm dam is situated in the centre south of the sector; others are in the centre-west. Small groups of pigs were usually seen during surveys. Para grass is established broadly across wet meadows and swamps in the centre-west of the sector.

Potential investments: Enhanced control of feral pigs in sectors 29 and 30 and neighbouring areas could be supported as a multi-party initiative. Projects to establish fences around grazing-sensitive and/or uncommon vegetation communities in wetlands in this sector could be considered.

Comments: Contiguous with marine plain in sector 29 but divided arbitrarily with an east-west line to facilitate surveys.

Sector 31

Location: 22.4817, 149.6793

Catchment: Styx River.

Survey effort and coverage in 2006-7: poor, aerial survey only.

Wetland types: Salt flat, mangrove, estuary, bare intertidal flats, saltmarsh with samphire: substantial areas. Grassy saltmarsh: probably (at least) small areas present.

Waterbirds recorded: None recorded.

Conservation values: Sector includes substantial blocks of sheltered mangrove. Fauna values are not adequately known.

Wetland condition: Block banks on the north-western boundary of the sector presumably prevent outflow (into sector 31) of some fresh water that accumulates in sector 30 in the wet season. There are small areas of dead mangrove in sector 31 at the landward edge of mangrove blocks and small areas of undercutting of mangrove forest edges along Styx River.

Potential investments: None identified at present. Closer examination of grazing patterns of cattle may reveal that fencing to control cattle access to saltmarsh and mangrove edges in sector 31 may be worth considering.

Comments: In dry periods it is possible to drive to the edge of the Styx River in the middle of the sector, after traversing sector 30. The extent to which extensive bare intertidal sand/mud flats in the bed of the Styx River in sectors 31, 32 and 34 may be attributed to deposition following erosion in the upper Styx catchment, is not known.

Sector 32

Location: 22.5356, 149.6435

Catchment: Styx River.

Survey effort and coverage in 2006-7: poor, aerial survey only.

Wetland types: Saltmarsh (with samphire; presumably also grassy saltmarsh), estuary, bare intertidal flats: substantial areas. Mangrove: only small areas present.

Waterbirds recorded: None recorded.

Conservation values: Sector includes substantial areas of saltmarsh. Fauna values are not adequately known.

Wetland condition: Erosion scarps/cliffs are present along the north-western side of Styx River where there is no wetland fringing the estuary.

Potential investments: None identified at present. Closer examination of grazing patterns of cattle may reveal that fencing to control cattle access to saltmarsh and mangrove edges in sector 32 may be worth considering.

Comments: The extent to which extensive bare intertidal sand/mud flats in the bed of the Styx River in sectors 31, 32 and 34 may be attributed to deposition following erosion in the upper catchment is not known.

Sector 33

Location: 22.5177, 149.6883

Catchment: Styx River.

Survey effort and coverage in 2006-7: poor, aerial survey only.

Wetland types: Saltmarsh (with samphire; presumably also grassy saltmarsh), estuary, bare intertidal flats: substantial areas. Salt flat, mangrove: small areas.

Waterbirds recorded: None recorded.

Conservation values: Sector includes substantial areas of saltmarsh. Fauna values are not adequately known.

Wetland condition: No matters for attention were observed, although the sector was not extensively overflown.

Potential investments: None identified at present.
Comments: In terms of wetland habitats and fauna this may be the most interesting sector on the eastern side of the Styx River, so future on-ground investigations would be worthwhile.

Sector 34

Location: 22.4787, 149.7238
Catchment: Styx River.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Salt flat, mangrove, estuary, bare intertidal flat: substantial areas. Saltmarsh: probably (at least) small areas present.
Waterbirds recorded: None recorded.
Conservation values: Sector includes substantial blocks of sheltered mangrove. Fauna values are not adequately known.
Wetland condition: Small areas of dead mangrove within and at the landward edge of mangrove blocks.
Potential investments: None identified at present.
Comments: The extent to which extensive bare intertidal sand/mud flats in the bed of the Styx River in sectors 31, 32 and 34 may be attributed to deposition following erosion in the upper catchment is not known.

Sector 35

Location: 22.4170, 7879
Catchment: Styx River.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Mangrove, estuary, salt flat: substantial areas. Marine plain: possibly a small pocket of this type present in the far south.
Waterbirds recorded: Ten large migratory shorebirds recorded just south-west of Charon Point on 6 September 2006.
Conservation values: Not adequately known.
Wetland condition: Some areas of undercut outer mangrove along the northern shore.
Potential investments: None identified at present.
Comments: The sector ends just before (does not include) the steep beach at Charon Point.

Sector 36

Location: 22.4351, 149.8554
Catchment: Herbert Creek.
Survey effort and coverage in 2006-7: fair, aerial survey only.
Wetland types: Mangrove, salt flat: substantial areas. Beach, bare intertidal flat: small areas.
Waterbirds recorded: Only a few (4) species/groups recorded, including 3 migratory shorebird species/groups, e.g. Far Eastern Curlew. A shorebird roost is situated in the far north of the sector, at the edge of the first salt flats up-river from the rocky headlands of Charon Point. Roost coordinates (decimal degrees S, E): 22.4010, 149.8218. On most big tides, the birds gather near the water-line in a muddy cove that is partly sheltered by mangrove; on king tides they probably assemble a little to the landward, on a small beach-ridge. Aerial counts, adjusted by inspection of photographs, revealed just over 2200 migratory shorebirds (mostly not identified to species level) present at the roost on 6 March 2007 and over 2000 on 29 March. Roughly 50-75% was large sized, probably Bar-tailed Godwits: ground surveys are needed to confirm the identity of species but if confirmed this would be the largest known roost of Bar-tailed Godwit in Broad Sound.
Conservation values: The sector contains (by far) the most important shorebird roost site so far detected in all of the Broadsound Basin, a site that is regionally important and that with further investigation may prove to be internationally important. Fauna values otherwise are not adequately known.
Wetland condition: No landward impacts observed. Small areas of undercut outer mangrove and dead mangrove trees at the landward edge of mangrove blocks.
Potential investments: The shorebird roost in the far north of the sector should be the highest priority for investment in shorebird surveys in Broadsound. On-ground investigations at strategic times are needed to clarify possible international-level significance. Ground access should be possible on farm tracks in the dry season via the Bald Hills road. The roost site possibly could be included in the Charon Point Conservation Park.
Comments: Charon Point Conservation Park (apparently dryland only) abuts parts of the sector. The sector includes the steep beach at the tip of Charon Point.

Sector 37

Location: 22.5209, 149.9107
Catchment: Herbert Creek.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Saltmarsh (with samphire; grassy saltmarsh), salt flat, estuary, mangrove: substantial areas. Bare intertidal flat, marine plain (complex of small ponds): small areas.
Waterbirds recorded: Only a few (8) species/groups recorded, including 4 migratory shorebird species/groups, e.g. Far Eastern Curlew. On 6 September 2006, 360 migratory shorebirds (mostly not identified to species level) were recorded in the sector; all but a few were roosting in the major inlet, on mud or banks near an islet. Roost coordinates (decimal degrees S, E): 22.5283, 149.9331. Only 30

shorebirds were found in this area on 6 March 2007, mostly roosting farther upstream. Actual numbers may be at least twice as large, based on the normal undercounting factor in aerial surveys.

Conservation values: The sector contains a large block of saltmarsh wetland and supports a regionally important shorebird roost.

Wetland condition: A substantial erosion scarp occurs where saltmarsh plain meets the estuary without the protection of fringing mangrove. Recently collapsed (partly green) tall mangroves were seen inside the relatively narrow channel of Eight Mile Creek and there were a number of areas of dead trees at the landward edge of mangrove blocks. Meanwhile, there was some accretion (mangrove saplings) inside the main tidal inlet. Extensive pugging of bare salt flat by cattle was noted in some places.

Potential investments: Projects to establish fences to control cattle access to salt flats and priority blocks of saltmarsh in this sector could be considered.

Comments: None.

Sector 38

Location: 22.4701, 149.9049

Catchment: Herbert Creek.

Survey effort and coverage in 2006-7: poor, aerial survey only.

Wetland types: Mangrove, estuary: small areas.

Waterbirds recorded: No species recorded.

Conservation values: The sector comprises Woods Island, which is covered by tall mangrove (*Bruguiera/Rhizophora*?) forest, remote from any adjacent land-use impacts. Fauna values not adequately known.

Wetland condition: Fallen mangrove trees lie along the outer south-eastern edge of the tall forest as an erosion zone, but a narrow band of small/sapling mangroves (*Avicennia*?) lies immediately seaward as an accretion zone.

Potential investments: None identified.

Comments: Woods Island is part of Charon Point Conservation Park; surrounding waters are marine park. See comments regarding sector 50; though probably suitable, Woods Island is less likely to be used by colonial breeding egrets than the mangrove islands in sector 50 because it is farther from extensive freshwater feeding areas.

Sector 39

Location: 22.5122, 149.9618

Catchment: Herbert Creek.

Survey effort and coverage in 2006-7: poor, aerial survey only.

Wetland types: Estuary, bare intertidal flat: substantial areas.

Waterbirds recorded: One species (Silver Gull) recorded.

Conservation values: The sector contains a large area of bare intertidal flat, much of which appears to be sand or other coarse sediment. Fauna values not adequately known (only one survey conducted); extreme tidal scouring in this confined marine area that is subject to macro-tidal range (at least 8 m?) may limit benthic fauna and thus also limit use by feeding shorebirds.

Wetland condition: No information.

Potential investments: None identified.

Comments: There are no terrestrial elements to this sector.

Sector 40

Location: 22.5592, 149.9673

Catchment: Herbert Creek.

Survey effort and coverage in 2006-7: poor, aerial surveys only.

Wetland types: Mangrove, saltmarsh (with samphire; and grassy saltmarsh), estuary: substantial areas. Bare intertidal flat, salt flat, marine plain (complex of small ponds): small areas.

Waterbirds recorded: Only a few (3) species recorded, comprising one migratory shorebird (Far Eastern Curlew), and Caspian and Gull-billed Terns.

Conservation values: The sector contains the largest blocks of mangrove and of saltmarsh on the western side of the Herbert Creek estuary; these are among the largest in the western catchments. Fauna values not adequately known.

Wetland condition: A major seawall along the western boundary of the sector prevents wet season outflow via sectors 41 and 42 into sector 40 of (presumably) significant volumes of fresh water from ranges farther to the West. There may be spillways or one-way outlet gates in the wall but these were not investigated during the surveys. Extensive death and collapse of landward-edge mangrove was observed around a small salt flat inside the western edge of the main mangrove block; some recently collapsed (partly green) mangroves were seen at the seaward edge. Extensive pugging of bare salt flat and saltmarsh by cattle in this sector.

Potential investments: see below.

Comments: Until recently, fence lines ran across the plain to the mangroves, perpendicular to the coast, allowing cattle to roam from freshwater grasslands across salt flats right to the mangrove edge. Projects to establish fences to control cattle access to salt flats and priority blocks of saltmarsh in this sector have been approved by FBA/FRCC.

Sector 41

Location: 22.5606, 149.9392

Catchment: Herbert Creek.

Survey effort and coverage in 2006-7: poor, aerial surveys only.
Wetland types: Marine plain (complex of minor freshwater channels and ponds), grassy wet meadow: substantial areas. Freshwater grass-sedge swamp, ponded channel, saltmarsh with samphire: small areas.
Waterbirds recorded: None recorded. CEM-CQU may have some waterbird data from visits prior to the BCCA project.
Conservation values: Fauna values not adequately known; some elements of the fauna in sector 42 are likely to be seasonally present in sector 41.
Wetland condition: This roughly rectangular sector is bounded on two sides by a substantial seawall that prevents saltwater incursion and increases the persistence of freshwater inside the sector. There may be spillways or one-way outlet gates in the wall, and block banks inside the sector, but these were not investigated during the surveys. There were a few trees/shrubs of prickly acacia, some of them dead.
Potential investments: None identified.
Comments: Contiguous with marine plain in sector 42 but divided arbitrarily, to facilitate surveys. CEM-CQU may have some additional wetland and waterbird data from visits prior to the BCCA project.

Sector 42

Location: 22.5921, 149.9600
Catchment: Herbert Creek.
Survey effort and coverage in 2006-7: fair, ground and aerial surveys.
Wetland types: Ponded channel/lake complex, saline/freshwater grass-sedge swamp, complex of minor freshwater channels and ponds, grassy wet meadow: substantial areas. Saltmarsh (grassy, with samphire): small areas.
Waterbirds recorded: (41 species recorded, 3 of them breeding; 4 migratory shorebird species: CEM-CQU may have some additional waterbird data from visits prior to the BCCA project.) Pairs and family groups – with near-dependent immature birds, indicative of recent local breeding – of the critically endangered Capricorn Yellow Chat were recorded in tall sedgeland of *Schoenoplectus litoralis* in shallow channels and in patches around the largest open water body in May 2007. Though only 15 birds were counted, an exhaustive survey may have revealed at least twice that number; at time of writing this was the largest sub-population in the western catchments. Similar numbers were recorded in July 07 (by CQU), and November 07 (18, mostly pairs, possibly preparing to breed). The only sector in BCCA where the migratory Little Curlew was recorded, and one of the few where Great Crested Grebe was recorded. The most abundant species was Eurasian Coot (900 birds); others exceeding 100 were Grey Teal, Straw-necked Ibis, Black Swan and Pacific Black Duck. It can be assumed that Magpie Goose and Intermediate Egret would be plentiful in the early wet season in wetter years. The total number of waterbirds counted on 10 May was 2395 (incomplete survey of sector, actual total may have been over 3000 birds).
Conservation values: The most substantial area of freshwater wetland habitat, including the largest area of *Schoenoplectus litoralis* tall sedgeland and persistent open water, on the western side of the Herbert Creek estuary. The sector has substantial freshwater inflow from creeks. Internationally important in terms of supporting a critically endangered bird. The limited survey data and anecdotal information from landholders also suggest that waterbird use is, or could prove to be, regionally important in terms of species diversity, breeding, and numbers of individuals.
Wetland condition: This roughly rectangular sector is bounded on the seaward side by a substantial seawall that prevents saltwater incursion and increases the persistence of freshwater inside the sector. The wall is substantially responsible for the ponded channel, swamp and lake complex which otherwise would be less persistent and much more saline. There may be spillways or one-way outlet gates in the wall, and block banks inside the sector, but these were not investigated during the surveys. There were a few trees/shrubs of prickly acacia. Some feral pigs seen in the swamps.
Potential investments: Further investigation would be needed to determine if the ponded channels and any associated waterholes upstream could provide adequate refuge for fish in the dry season, to make consideration of a fish passageways project worthwhile. Projects to establish fences around, and thereby enhance the extent and quality of, selected areas of tall sedgeland (especially *Cyperus alopecuroides* which is favoured by Yellow Chats in the dry season) could be considered.
Comments: A highly modified sector but important for waterbirds when inundated. CEM-CQU may have some additional wetland and waterbird data from visits prior to the BCCA project.

Sector 43

Location: 22.6314, 149.9891
Catchment: Herbert Creek.
Survey effort and coverage in 2006-7: poor, ground and aerial surveys.
Wetland types: Ponded channel: substantial areas. Grassy wet meadow, saline/freshwater grass-sedge swamp, complex of minor freshwater channels and ponds, saltmarsh (grassy/samphire): known or probable small areas.
Waterbirds recorded: (10 species recorded, none breeding, no migratory shorebird species: all data based on one ground survey on 10 May 2007). Less than 100 waterbirds recorded in this brief survey, Grey Teal being most abundant; Black-necked Stork present.
Conservation values: Not adequately known, but the sector probably has substantial freshwater inflow from creeks and the series of ponded channels on the landward side of the seawall suggests that substantial waterbird use probably occurs when the channels are all full.
Wetland condition: This elongated sector is bounded on the seaward side by a substantial seawall that prevents saltwater incursion and increases the persistence of freshwater inside the sector. The wall is substantially responsible for the ponded channels that otherwise would be less persistent and much more saline. Substantial occurrence of prickly acacia in the north-west of the sector was observed in May 2007 but the trees had been bulldozed by the landholder by late 2007 – apparently as part of an ongoing control program.
Potential investments: Further investigation would be needed to determine if the ponded channels and any associated waterholes upstream could provide adequate refuge for fish in the dry season, to make consideration of a fish passageways project worthwhile.
Comments: CEM-CQU may have some additional wetland and waterbird data from visits prior to the BCCA project.

Sector 44

Location: 22.6109, 150.0046
Catchment: Herbert Creek.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Bare intertidal flat, estuary, saltmarsh (with samphire/grassy), mangrove: substantial areas. Salt flat: small areas.
Waterbirds recorded: None recorded.
Conservation values: Not adequately known.
Wetland condition: A major seawall along the western boundary of the sector prevents or reduces wet season outflow via sector 43 and 42 into sector 44 of (presumably) significant volumes of fresh water from ranges farther to the west. There may be spillways or one-way outlet gates in the wall but these were not investigated during the surveys. Some pugging of bare salt flat by cattle in this sector.
Potential investments: Projects to establish fences to control cattle access to salt flats and priority blocks of saltmarsh along this coast have been approved by FBA/FRCC for adjacent sector 40.
Comments: At very low tide there may be no surface water left in the estuary in front of this sector other than in one or two channels.

Sector 45

Location: 22.6212, 150.0339
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07 BCCA or previous projects.
Wetland types: (based on satellite imagery) Bare intertidal flat, estuary, saltmarsh, salt flat: substantial areas. Mangrove: small areas.
Waterbirds recorded: No information.
Conservation values: Not known.
Wetland condition: No information.
Potential investments: None identified.
Comments: At very low tide there may be no surface water left in the estuary in front of this sector other than in one or two channels.

Sector 46

Location: 22.6578, 150.0828
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07 BCCA or previous projects.
Wetland types: (based on satellite imagery) Estuary, bare intertidal flat,: substantial areas.
Waterbirds recorded: No information.
Conservation values: Not known.
Wetland condition: No information.
Potential investments: None identified.
Comments: Small seasonal wetlands may occur on adjacent floodplain.

Sector 47

Location: 22.6111, 150.0480
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07 BCCA project; several previous surveys by WIO and/or CEM-CQU during 2003-6.
Wetland types: Saline/freshwater grass-sedge swamp, complex of minor saline/freshwater channels and ponds: substantial areas. Minor pond: small areas. Probably also saltmarsh.
Waterbirds recorded: No information from BCCA project. A moderate variety and small to moderate number of waterbirds was recorded in previous surveys by WIO and/or CEM-CQU. No Yellow Chats recorded despite probably suitable, though relatively small, area of habitat.
Conservation values: The only known, substantial area of saline/freshwater grass-sedge swamp, including beds of *Cyperus alopecuroides*, on eastern marine plain of the Herbert catchment upriver of sector 49 (edge of Torilla Plain). Fauna values not adequately known.
Wetland condition: No recent information.
Potential investments: None identified.
Comments: CEM-CQU may have some additional wetland and waterbird data from visits prior to the BCCA project.

Sector 48

Location: 22.5413, 150.0097
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07 BCCA project; edges viewed in previous surveys by WIO and/or CEM-CQU during 2003-6.
Wetland types: (based mainly on satellite imagery) Salt flat, mangrove, bare intertidal flat, estuary, saltmarsh (samphire/grassy?): substantial areas.

Waterbirds recorded: No information.
Conservation values: Not known.
Wetland condition: A low, discontinuous seawall along the far north-eastern boundary of the sector prevents wet season outflow via sector 49 into sector 48 of (presumably) significant volumes of fresh water from upland farther to the east. There are many dead mangroves at the landward edge of the main block of mangrove, especially near the northern end of the seawall.
Potential investments: None identified.
Comments: The sector includes examples – along its south-eastern boundary – of pockets of marine plain and/or salt flat, which are almost totally enclosed by upland and which appear (on some satellite images) to retain persistent water; these features have not been investigated by WIO.

Sector 49

Location: 22.5055, 150.0256
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07 BCCA project; many previous surveys by WIO and/or CEM-CQU during 2003-6.
Wetland types: Marine plain (complex of minor channels and ponds, mostly saline, some freshwater), salt flat, saline/freshwater grass-sedge swamp, saltmarsh (with samphire, grassy saltmarsh), ponded channel: substantial areas.
Waterbirds recorded: (summary of previous results) In the wet season to mid dry season, the sector supports a high number of waterbird species, a small number of breeding species, several migratory shorebird species, and a small-moderate total number of waterbirds. The nationally threatened (Critically Endangered) Capricorn Yellow Chat occurs annually, with a sub-population of several tens of birds; it is mainly in *Schoenoplectus litoralis* and samphire swamp, mainly in the wet season, when many pairs breed there, and a few birds may persist through the harshest part of the dry season (*The Sunbird* 34: 24-35). Several pairs of Australian Pelican and possibly gulls/terns, apparently nest on tiny islands within the main salt flat, which has prolonged inundation due to the seawall. Egrets (4 species) that breed in sector 50, feed in sector 49, especially Little Egret, which favours saline habitat. Tens to hundreds of migratory shorebirds, including Red-necked Stint, Marsh Sandpiper and Sharp-tailed Sandpiper and smaller numbers of Black-tailed Godwit and Lesser Golden Plover, seasonally feed on inundated salt flat and/or in wet samphire. Uncommon birds in the study area, recorded in this sector, include Australian Spotted Crake.
Conservation values: A regionally important area of marine plain, containing the largest areas of *Schoenoplectus litoralis* tall sedgeland (including some broad beds) in the eastern catchments. Internationally important in terms of supporting a critically endangered bird; also regionally significant in terms of supporting shorebird migration.
Wetland condition: Outflow of freshwater from Torilla Plain and local creeks, via sector 49 to sector 48, is restricted by a discontinuous low seawall (with short sections of high ground); during major floods such as in February 2003, much water presumably spills out into the mangroves and estuary. The extent to which the seawall has increased the extent and vigour of *Schoenoplectus litoralis* tall sedgeland in the sector is not known but it is assumed that there has been some benefit. Grazing of cattle in this sector appears to be at relatively low intensity.
Potential investments: Given the high conservation value of the sector, it would be valuable to negotiate with the landholder on the possibility of establishing voluntary conservation covenants over areas of key habitat on Fernleigh. Fencing of several small areas of tall sedgeland to reduce or exclude cattle access may enhance this habitat for wildlife, including chats, but needs to be weighed up in economic terms given the relatively small area of lowland pasture on the property.
Comments: Conceivably, some migratory shorebirds may roost on the salt flat at high tide, but this has not been verified.

Sector 50

Location: 22.4826, 149.9810
Catchment: Herbert Creek.
Survey effort and coverage: BCCA: poor, aerial surveys only; one previous ground survey (far northern edge) by WIO and CEM-CQU during 2003-6.
Wetland types: Mangrove, island, salt flat, estuary: substantial areas. Bare intertidal flat, saltmarsh (with samphire): small areas.
Waterbirds recorded: BCCA: only a few (3) species recorded, including 2 migratory shorebirds (Far Eastern Curlew and Whimbrel); at least 26 large shorebirds were roosting on mud banks and in saltmarsh at the northern end of the islands on 29 March 07 and additional shorebirds may have been concealed in the mangroves. In summer-autumn 2004, at least 1000-2000 pairs of egrets – dominated by Intermediate Egret but including Cattle, Great and Little Egrets – nested in mangrove in the southern end of the outer islands; this conclusion was based on observations of egrets (in breeding plumage) traveling in constant procession between feeding areas on southern Torilla Plain and the island (*The Sunbird* 35: 20-23). Colony coordinates (decimal degrees S, E): 22.4882, 149.9729. There had been substantial, though not exceptional, inundation of the Plain in that wet season whereas unusually dry conditions prevailed locally in summer-autumn 2007 and no egrets were observed in the mangrove islands during 2007 aerial surveys.
Conservation values: The sector contains two substantial mangrove islands and at times supports a regionally important breeding colony of egrets, which is one of only two such colonies in the study area (see also sector 15).
Wetland condition: On the outer island, some fallen tall mangrove trees lie along the south-eastern edge in an erosion zone. Accretion through stabilisation by new mangrove communities apparently has 'created' the inner island within recent decades (the inner island is not shown on some maps) and is continuing actively at the northern end of the outermost island. There are some dead trees at the landward edge of mangrove blocks on the mainland.
Potential investments: The mangrove islands could be added to the Broad Sound Islands National Park. Conduct aerial survey to clarify the size and composition of the egret colony; timing is critical (usually January-March) and may be influenced by degree of inundation of feeding areas on Torilla Plain.
Comments: Most of the sea and mangrove, but not the outermost island (tenure not determined), is marine park. A farm track provides access to the northern edge of the sector, at a rough boat launching site.

Sector 51

Location: 22.4055, 149.9496
Catchment: Herbert Creek.
Survey effort and coverage: BCCA: poor, aerial survey only; one previous aerial survey by WIO in 2003.
Wetland types: Mangrove, estuary, salt flat: substantial areas. Saltmarsh, marine plain (complex of small saline ponds/channels), bare intertidal flat: probably small areas present.
Waterbirds recorded: Only one species (Whimbrel) recorded, March 2007.
Conservation values: The sector contains substantial blocks of mangrove. Fauna values not adequately known.
Wetland condition: Some recently collapsed/undercut mangroves at the seaward edge of the mangroves and some death of landward-edge mangroves. Minor block banks in sectors 52 and 53 may limit some fresh water outflow (which in any case is probably minor, due to small local catchment) into sector 51 in the wet season.
Potential investments: None identified.
Comments: A farm track provides access to the southern edge of the sector, at a rough boat launching site.

Sector 52

Location: 22.4154, 149.9942
Catchment: Herbert Creek.
Survey effort and coverage: BCCA: poor, aerial survey only.
Wetland types: Marine plain (complex of minor channels and ponds, mostly saline but some probably freshwater), grassy saltmarsh, presumably also saltmarsh with samphire: substantial areas. Estuary (shallow upper tidal creeks), ponded channel (creeks with block banks): small areas.
Waterbirds recorded: None recorded.
Conservation values: The sector contains substantial areas of marine plain, much of which appears to be un-modified. Fauna values not adequately known.
Wetland condition: There is at least one small block bank on the arterial channels in this sector.
Potential investments: None identified.
Comments: One of the least well-known sectors of Torilla Plain, needing further survey work in the wet season and early dry season.

Sector 53

Location: 22.3788, 149.9833
Catchment: Herbert Creek.
Survey effort and coverage: BCCA: poor, aerial survey only; many previous surveys by WIO and/or CEM-CQU during 2003-6.
Wetland types: Marine plain (complex of minor channels and ponds, mostly saline, some freshwater), grassy saltmarsh, saltmarsh with samphire, saline/freshwater grass-sedge swamp: substantial areas. Ponded channel, salt flat: small areas.
Waterbirds recorded: (summary of previous results) In the wet season to early dry season, the sector supports a moderate number of waterbird species, a small number of breeding species, several migratory shorebird species, and a small total number of waterbirds. A family group – including juveniles – of Australian Painted Snipe (nationally Vulnerable) has been seen sheltering in muddy *Schoenoplectus litoralis* swamp. The nationally threatened (Critically Endangered) Capricorn Yellow Chat occurs annually, with a sub-population of at least several pairs; it is mainly in *Schoenoplectus* and samphire swamp, mainly in the wet season, when some pairs apparently breed there. Small breeding 'colonies' of Magpie Goose have been found (after use in summer-autumn) in ponds dominated by *Schoenoplectus* and large crèches of juvenile Radjah Shelducks have been recorded in ponded channels late in the wet season. Habitat for migratory shorebirds is mainly along channel edges and so total numbers of birds generally are small although flocks of Sharp-tailed Sandpipers have been recorded in drying ponds with open shallows and collapsing sedge tussocks.
Conservation values: The sector contains the only substantial patches of *Schoenoplectus litoralis* tall sedgeland in the far western part of Torilla Plain, and includes a large area of grassy marine plain – much of it hydrologically unmodified – with highly complex channel networks (see sector 61). Internationally important in terms of supporting a critically endangered bird and a threatened waterbird; regionally significant in terms of supporting breeding by ducks/geese.
Wetland condition: Inflow of freshwater from Torilla Plain (Wadallah Creek system) via channels flowing west from sector 60 is restricted – except during major flood events – by small block banks in upstream sectors and in the northern part of sector 53. The network of block banks also limits or prevents saltwater entry to some eastern parts of sector 53 and favours some sedge and other plant communities that prefer low salinity. Much of the western side of the sector is not modified by banks and its channel networks often hold tidal/saline water.
Potential investments: Fencing of several small areas of tall sedgeland to reduce or exclude cattle access may enhance this habitat for wildlife, including chats and perhaps breeding Magpie Geese.
Comments: The sector includes parts of two paddocks, with some *Schoenoplectus litoralis* tall sedgeland in each but the largest patches are in the centre-northeast, associated with the most prominent arterial channel.

Sector 54

Location: 22.3309, 149.9537
Catchment: Herbert Creek.
Survey effort and coverage: BCCA: poor, aerial survey only; one previous aerial survey by WIO in 2003.

Wetland types: Mangrove, estuary: substantial areas. Salt flat, saltmarsh, island, rocky coast: small areas.
Waterbirds recorded: Only one species recorded: Whimbrel (4 birds) roosting in mangrove at high tide in March 2007. Potential roost sites for shorebirds occur along the northern edge of the northern major inlet in the sector, on small stony patches/headlands (e.g. Island Bluff) and isolated small patches of salt flat.
Conservation values: The sector contains one of the largest blocks of mangrove in the study area. Historical reports of egrets nesting in mangroves near Torilla Plain may refer to this sector or to the islands in sector 50. Otherwise, fauna values not adequately known.
Wetland condition: Small areas of dead mangrove at the landward edge of the main mangrove blocks, notably on the boundary with sector 67. Block banks in sectors 60 and 61 and beyond presumably limit some freshwater inflow (which previously may have been substantial) into sector 54 in the wet season, although outflow of major floods probably is not restricted.
Potential investments: None identified.
Comments: In addition to a number of major channels, a large number of minor channels flow into sector 54 from sectors 53, 60, 61 and 67. The mangrove in sector 54 is contiguous with similar mangrove in sectors 68 and 51 but was treated separately to facilitate the surveys.

Sector 55

Location: 22.4813, 150.0389
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07 BCCA project; several previous surveys by WIO and/or CEM-CQU during 2003-6.
Wetland types: *Melaleuca* wooded swamp, freshwater grass-sedge swamp: substantial areas. Grassy wet meadow: small areas.
Waterbirds recorded: (summary of previous results) In the wet season to early dry season, the sector supports a moderate number of waterbird species and a high total number of waterbirds. Several thousands of Straw-necked Ibis and other large waterbirds roost in the *Melaleuca* trees at times (notably after the February 2003 floods); some of this habitat may be suitable for nesting by ibises but there has been no evidence of nesting there.
Conservation values: This is the largest area of *Melaleuca* wooded swamp on Torilla Plain, though many of the trees are dead (see below); it complements similar (but healthier) wooded swamp at the far northern end of the Plain. Diverse freshwater plant communities, dominated by *Eleocharis* sedge, occur within the swamp. Fauna values not adequately known.
Wetland condition: Many of the trees in the swamp are dead: the cause of this is not known: possible but unconfirmed factors include excessive inundation or fire, and long-term grazing impacts.
Potential investments: Fencing of parts of the swamp to reduce or exclude cattle access may enhance the regeneration of *Melaleuca* trees, although thickening of tall vegetation may not be favoured by the landholder due to concern over possible reduction of the area of pasture.
Comments: The sector deserves further investigation to fully determine conservation values and wetland condition. In autumn 2003 up to 15,000 Straw-necked Ibises were counted feeding across the Torilla Plain sectors, with daily movements through sector 55 probably from the western side of the Herbert estuary (the origin point of the birds was not determined).

Sector 56

Location: 22.4614, 150.0614
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07 BCCA project; many previous surveys by WIO and/or CEM-CQU during 2003-6.
Wetland types: Grassy wet meadow, freshwater grass-sedge swamp: substantial areas. *Melaleuca* wooded swamp: small areas.
Waterbirds recorded: (summary of previous results) In the wet season to mid dry season, the sector supports a moderate-high number of waterbird species, a small number of breeding species, a small number of migratory shorebird species, and a high total number of waterbirds. Migratory Latham's Snipe and breeding moorhens and swamphens have been recorded at the persistent swampy channel crossed by the homestead access road. Black-necked Storks are often seen in small swamps in the centre of the sector; and this is one of the few areas on Torilla Plain where Comb-crested Jacana occurs. In wet seasons with regular monthly rainfall, lush growth of grass, sedge, bog-lily *Monochoria cyanea* and other aquatic plants occupies the broad shallow basin immediately east of the homestead; this may be inhabited by several thousand waterbirds particularly Magpie Goose (5000+ reported by landholders), Intermediate Egret, ibises and spoonbills. Some of the egrets (4 spp.) that breed in sector 50, presumably feed in sector 56. An Intermediate Egret with a wing tag was confirmed to have originated from the Macquarie Marshes, NSW. Family groups of Brolga and aggregations of White-necked Heron also occur. Large mobs of Plumed Whistling-Duck camp on a dam at the far south-west edge of the sector.
Conservation values: This is probably one of the most regularly inundated parts of Torilla Plain (inflow from hills to the west, and Bark Lagoon Creek and Wadallah Creek to the east) and it supports regionally significant freshwater grass-sedge wetlands. Supports regionally important aggregations of waterbirds.
Wetland condition: The sector seems to have experienced little if any hydrological modification apart from installation of a cross-plain, graveled homestead access track that may restrict some freshwater flows – but that has been inundated (at low points) to a depth of more than 1 m in major flood events such as in February 2003.
Potential investments: None identified.
Comments: Survey teams have understood, from consultation with the landholders, that substantial flow of floodwater may occur from sector 57 through sector 56 to sector 55 and beyond (to be confirmed).

Sector 57

Location: 22.4174, 150.0746
Catchment: Herbert Creek.

Survey effort and coverage: BCCA: poor, aerial survey only; many previous surveys by WIO and/or CEM-CQU during 2003-6 (frequently surveyed by CEM-CQU chat team).

Wetland types: Grassy wet meadow, freshwater grass-sedge swamp (much of it within shallow channels), marine plain (complex of minor freshwater channels and ponds): substantial areas. Saltmarsh (samphire, grassy): small areas.

Waterbirds recorded: (summary of previous results) In the wet season to early dry season, the sector supports a moderate number of waterbird species, a small number of breeding species, a small number of migratory shorebird species, and a moderate-high total number of waterbirds. The nationally threatened (Critically Endangered) Capricorn Yellow Chat occurs, with a sub-population in sector 57 and the south-eastern part of sector 60 of several hundreds of birds (at times 500+); it is mainly in beds of tall perennial sedge *Cyperus alopecuroides* (confined to the channel networks) and surrounding para grass, marine couch and samphire. Chats breed in this habitat complex and occur year round, being most conspicuous in the early dry season while family groups are still together, and in the mid-dry season when flocks congregate in the sector – presumably, converging from other parts of the Plain – to feed on insects in *Cyperus* seed heads. Flocks of hundreds of migratory White-winged Black Tern hawk for insects over wet plain late in the wet season in some years. Thousands of Plumed Whistling-Duck camp on a dam at the far north-west edge and at night presumably disperse across the sector to graze. Magpie Geese and Intermediate Egrets may be abundant in lush shallow swamps of freshwater couch grass, sedge, bog-lily *Monochoria cyanea* and other aquatic plants associated with the floodout of Wadallah Creek near the Stanage Bay Road, in the far south-east. Some of the egrets (4 spp.) that breed in sector 50, presumably feed in sector 56.

Conservation values: One of the most important sectors in Broadsound. It is one of the most regularly and extensively inundated parts of Torilla Plain because it includes the main floodout channels and swamps of Wadallah Creek, the largest creek system feeding on to the Plain. The channel supports by far the largest area of *Cyperus alopecuroides* tall sedgeland in the study area. Internationally important in terms of supporting a critically endangered bird: the sector seems to be the core refuge for the Capricorn Yellow Chat.

Wetland condition: The sector seems to have experienced little if any hydrological modification; channel block banks in sector 60 may have influenced the persistence of freshwater in northernmost channels of sector 57 but are unlikely to have altered the remaining majority of the sector. Westernmost swampy edges of the sector at times appear denuded, probably because these are the first parts of the plain that can be accessed by stock in the wet season. Para grass was long ago introduced to this sector and now covers extensive areas, constituting the principal occurrence on Torilla Plain.

Potential investments: Ongoing research and monitoring of the Yellow Chat, to implement the species' recovery plan, logically should focus on this sector. Fencing of barer sections of channel to reduce/exclude cattle access may increase the density of *Cyperus alopecuroides* plants favoured by the chats but total exclusion of cattle may not be desirable as it may allow para grass to overrun the wetland (and chats do use bare, muddy feeding areas). The adjacent 'delta' of Wadallah Creek is not included in the sector but is a valuable natural asset because in addition to waterholes it supports a rare community of tall, old riparian forest dominated by *Melaleuca*, *Nauclea*, *Ficus* and *Eucalyptus* trees; this forest should be considered for restoration. This corner of the sector offers one of the few parts of Torilla Plain where – subject to landholder cooperation – roadside signage could provide information to visitors on the conservation and production values of the Plain as well as seasonal opportunities to view waterbirds.

Comments: Access to the western side of the sector can be difficult in the wet season.

Sector 58

Location: 22.4048, 150.1028

Catchment: Herbert Creek.

Survey effort and coverage: BCCA: poor, ground survey only; many previous surveys by WIO and/or CEM-CQU during 2003-6.

Wetland types: Marine plain (complex of minor freshwater channels and ponds), grassy wet meadow (some areas are small wet-season lakes): substantial areas. Freshwater grass-sedge swamp, ponded channel, saltmarsh (samphire, grassy): small areas.

Waterbirds recorded: (summary of BCCA and previous results) (BCCA, one survey: 15 species recorded, none breeding; 2 migratory shorebird species). In the wet season to early dry season, the sector supports a high number of waterbird species, a small number of breeding species, a small number of migratory shorebirds species, and a moderate-high total number of waterbirds. Small numbers of Capricorn Yellow Chat (Critically Endangered) occur seasonally inside the western boundary of sector 58. The nationally vulnerable Australian Painted Snipe (six birds) was found breeding (one nest) in April 2003 on muddy islets with freshwater couch in a shallow pond with marshy edges on the far east side of the sector (*The Stilt*: 45, 39-42). Migratory shorebirds such as Marsh Sandpiper and breeding Black-winged Stilt also use the shallow ponds; migratory Latham's Snipe frequent the small roadside *Eleocharis* swamps in March. Black Swans commonly nest in the sector's small lakes and banked pond (see below). Thousands of Straw-necked Ibis roam the plain when conditions are favourable. Zitting Cisticola is widespread on Torilla Plain, including sector 57.

Conservation values: The sector includes seasonal lake-like wetlands and isolated small grass-sedge swamps typical of the eastern side of Torilla Plain. The ponded channel/swamp at the centre-east side of the sector sometimes is the most significant waterbird habitat on southern Torilla Plain, in terms of waterbird species diversity and breeding. The sector is internationally important in terms of supporting a nationally threatened waterbird species.

Wetland condition: A number of the channels across the sector have one or more small block banks that increase the persistence of water (and seasonal wetland vegetation) on the upstream side. The largest example, at the centre-east side of the sector, includes a farm dam, a fenced-off pond behind a long bank and a shallow swamp behind small block banks. Substantial amounts of the introduced pasture plants, Aleman grass and para grass, occur in the pond. Deep pig diggings occur in the pond when dry.

Potential investments: Fencing of some grass-sedge swamps to reduce/exclude cattle access may encourage growth of perennial wetland plants such as *Cyperus alopecuroides*, which are favoured by Yellow Chat (see sector 57), but total exclusion of cattle may not be desirable as it may allow para grass to overrun the wetland.

Comments: Coonyan Creek can seasonally discharge substantial volumes of fresh water onto Torilla Plain at the south-east edge of this sector but there has been little survey effort to assess any wetlands that may be associated with its terminus. The banked pond complex lies close to the Stanage Bay Road. Broad shallow basins in the sector may function as temporary open lakes when full in the wet season but may function as wet grassy meadows when shallow, such as in drier years or as drying out occurs.

Sector 59

Location: 22.3570, 150.0749
Catchment: Herbert Creek.
Survey effort and coverage: BCCA: poor, ground survey only; several previous surveys by WIO and/or CEM-CQU during 2003-6.
Wetland types: Marine plain (complex of minor freshwater channels and ponds), grassy wet meadow (some areas are small wet-season lakes): substantial areas. Saltmarsh (samphire, grassy), ponded channel: small areas.
Waterbirds recorded: (summary of BCCA and previous results) (BCCA, one survey: 15 species recorded, 1 breeding; 4 migratory shorebird species). In the wet season to early dry season, the sector supports a small-moderate number of waterbird species, a small number of breeding species, a small number of migratory shorebirds species, and a small-moderate total number of waterbirds. Migratory shorebirds include Common Greenshank (up to 20) and Latham's Snipe. The most abundant species are Grey Teal and Black Swan. Banded Lapwing occurs regularly at the eastern edges.
Conservation values: The sector includes seasonal lake-like wetlands which are among the largest and most frequently inundated of this type on Torilla Plain. However, fauna values of these hard-to-access lakes are not adequately known; in fact, most of the wetlands are not close to the Stanage Bay Road.
Wetland condition: Some of the channels exiting at the western side of the sector have a small block bank that increases the persistence of water (and seasonal wetland vegetation) on the upstream side and suppresses saltwater intrusion.
Potential investments: None identified.
Comments: Not as well-known as some other sectors on the Plain. Broad shallow basins in the sector may function as temporary open lakes when full in the wet season but may function as wet grassy meadows when shallow, such as in drier years or as drying out occurs.

Sector 60

Location: 22.3666, 150.0434
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07 BCCA project; many previous surveys by WIO and/or CEM-CQU during 2003-6 (frequently surveyed by CEM-CQU chat team).
Wetland types: Marine plain (complex of minor freshwater/saline channels and ponds), freshwater grass-sedge swamp (much of it within shallow channels), grassy wet meadow, grassy saltmarsh: substantial areas. Saltmarsh with samphire: small areas.
Waterbirds recorded: (summary of previous results) In the wet season to early dry season, the sector supports a moderate number of waterbird species, a small number of breeding species, a small number of migratory shorebird species, and a moderate-high total number of waterbirds. The nationally threatened (Critically Endangered) Capricorn Yellow Chat occurs, with a sub-population in sector 57 and the south-eastern part of sector 60 comprising several hundreds of birds (up to 500+); it is mainly in beds of tall perennial sedge *Cyperus alopecuroides* (confined to the channel networks) and surrounding para grass, marine couch and samphire. Chats breed in this habitat complex and occur year round, being most conspicuous in the early dry season while family groups are still together, and in the mid-dry season when flocks congregate in the sector – presumably, converging from other parts of the Plain – to feed on insects in *Cyperus* seed heads, and on the beds of drying channels/ponds. Small to moderate aggregations of waterbirds occur on open ponds beside the escarpment of Torilla Nob Point and at Circle Dam, and thousands of Straw-necked Ibis may feed on the Plain (apparently also breeding in this area in the past, perhaps in reed beds).
Conservation values: This is a transitional sector, comprising the lowest freshwater reaches and uppermost saline reaches of several major cross-plain channels, with associated ecotonal off-channel wetlands. The south-east of the sector includes substantial area of *Cyperus alopecuroides* tall sedgeland contiguous with a regionally significant, greater extent in sector 57. Possibly due to remoteness from dry season watering points and other property infrastructure, northernmost parts of this sector remain one of the few places on Torilla Plain – and in the study area – where substantial patches of common reed *Phragmites australis* still occur; apparently once much more widespread on the Plain, this wetland plant often is selectively removed from landscapes by grazing cattle. The sector is internationally important in terms of supporting a critically endangered bird (see sector 57).
Wetland condition: The sector is divided, north-south through its middle, into freshwater and saline parts by a series of small block banks on the major drainage channels. These prevent saltwater entry, and increase freshwater persistence upstream, but presumably allow passage of major floods. Consequently, upstream channel margins are dominated by *Cyperus alopecuroides* and para grass whereas *Schoenoplectus litoralis* is scarce and only on the downstream side of the block banks. Para grass was long ago introduced to this sector and now covers parts of the south-east, where freshwater predominates.
Potential investments: Recent proposals to intensify cattle grazing in this sector, by introduction of new watering points and creating smaller paddocks, may threaten the long-term viability of the remnant reed *Phragmites* communities. Accordingly, the proposals should be reviewed with a view to addressing this concern, perhaps by experimental fencing of one or more larger *Phragmites* patches to monitor condition under grazed and non-grazed scenarios. Ongoing research and monitoring of the Yellow Chat, to implement the species' recovery plan, logically should continue in this sector.
Comments: Access to the sector can be difficult in the wet season.

Sector 61

Location: 22.3300, 150.0206
Catchment: Herbert Creek.
Survey effort and coverage: BCCA: poor, ground survey only; several previous surveys by WIO and/or CEM-CQU during 2003-6.
Wetland types: Marine plain (complex of saline minor channels and ponds), saltmarsh with samphire: substantial areas. Grassy saltmarsh, salt flat, estuary: small areas.

Waterbirds recorded: (summary of BCCA and previous results) (BCCA, one survey: 5 species recorded, 2 being migratory shorebird species). Throughout the year, the sector supports a small number of waterbird species, a small number of breeding species, several migratory shorebird species, and a small total number of waterbirds. Small numbers of the nationally threatened (Critically Endangered) Capricorn Yellow Chat occur, with a sub-population of at least several pairs, in samphire saltmarsh on the far eastern side, where at least one active nest has been found. Several active nests of the non-migratory Red-necked Avocet were discovered on a samphire island beside an open saline pond in May 2003, this being a rare breeding record for coastal Central Queensland (*The Sunbird*: 33, 113-117). It is highly likely that more breeding by avocets, stilts and terns occurs in this sector than has been detected. Shallow saline ponds and inundated saltmarsh provide extensive feeding habitat for migratory shorebirds; 81 Marsh Sandpiper were counted on 29 March 2006 in just a small portion of the sector.

Conservation values: The highly complex, dense, unmodified network of channels and ponds of Torilla Plain, which occurs in many (if not most) sectors but reaches its greatest development in sector 61, is arguably a unique wetland feature in Australia and thus is of particularly high conservation value. This feature is best illustrated by aerial photographs and high-resolution satellite images. The sector also is internationally important in terms of supporting a critically endangered bird.

Wetland condition: Inflow of freshwater to sector 61 from sectors to the north, east and south is restricted – except during major flood events – by small block banks in the upstream sectors, mostly near the sector 61 boundary. Tidal connections from sector 54 to most of sector 61 appear to remain unaltered. Para grass is largely absent from the sector except for small areas in the south-east corner contiguous with occurrences in sector 60.

Potential investments: None identified.

Comments: There is little if any *Schoenoplectus litoralis* tall sedgeland in this sector.

Sector 62

Location: 22.3136, 150.0476

Catchment: Herbert Creek.

Survey effort and coverage: BCCA: poor, ground survey only; several previous surveys by WIO and/or CEM-CQU during 2003-6.

Wetland types: Marine plain (complex of minor freshwater channels and ponds), freshwater grass-sedge swamp (much of it within shallow channels), grassy wet meadow: substantial areas. Ponded channel, grassy saltmarsh, saltmarsh with samphire: small areas.

Waterbirds recorded: (summary of BCCA and previous results) (BCCA, one survey: 9 species recorded, 2 being migratory shorebird species). In the wet season to early dry season, the sector supports a small number of waterbird species, probably a small number of breeding species, a small number of migratory shorebird species, and a small total number of waterbirds. Channels and swamps with tall perennial sedge *Cyperus alopecuroides* provide potentially suitable habitat for the nationally threatened (Critically Endangered) Capricorn Yellow Chat which breeds in adjacent sectors 61 and 63. At least 18 of the migratory Latham's Snipe were counted in the *Cyperus* swamps on 29 March 2006. Brolgas nest in grass-sedge swamp on the eastern side of the sector. (Additional species, including both Green Pygmy-goose and Cotton Pygmy-goose, occur in a section of Spencer Creek immediately upstream of the sector, above Stanage Bay road, many of them breeding there.)

Conservation values: The sector is part of an internationally important site for the migratory Latham's Snipe on the northern and eastern edges of Torilla Plain: collectively the sectors of this site support several hundred snipe during northward migration in late March, apparently on a regular basis. Otherwise, fauna values of sector 62 are not adequately known.

Wetland condition: Channels exiting the western side of the sector, through a chain of low hills, are modified by small block banks that also serve as causeways for farm tracks (outlets on the southern side have not been investigated but may be similar). These prevent or reduce saltwater entry to the sector from sector 61 and increase freshwater persistence upstream but presumably allow passage of major floods. (The Spencer Creek wetland apparently has been made semi-permanent by the Stanage Bay Road causeway.)

Potential investments: None identified.

Comments: Access to the western side via the hills can be difficult in the wet season.

Sector 63

Location: 22.2930, 150.0190

Catchment: Herbert Creek.

Survey effort and coverage: BCCA: poor, ground survey only; several previous surveys by WIO and/or CEM-CQU during 2003-6.

Wetland types: Marine plain (complex of minor channels and ponds, some saline, some freshwater), grassy saltmarsh, saltmarsh with samphire, ponded channel: substantial areas. Saline/freshwater grass-sedge swamp: small areas.

Waterbirds recorded: (summary of BCCA and previous results) (BCCA, one survey: 14 species recorded, 1 being a migratory shorebird species). In the wet season to early dry season, the sector supports a small-moderate number of waterbird species, a small number of breeding species, several migratory shorebird species, and a small-moderate total number of waterbirds. The nationally threatened (Critically Endangered) Capricorn Yellow Chat occurs in the wet season, with a sub-population of at least several pairs in isolated *Schoenoplectus* swamp in the inner south-west of the sector, where breeding has been recorded. One of the few sectors in which Great Cormorant has been recorded. On 29 March 2006, a partial survey when water was extensive in the channels yielded 350 Grey Teal and 350 Gull-billed Tern; the tern was possibly breeding in small colonies in wet samphire and/or islets (if confirmed this probably would have been a first breeding record for the Central Queensland coast). The total number of waterbirds counted in that survey was 874 but it is likely that the whole sector may support several thousands at times.

Conservation values: The sector contains the only substantial patches of *Schoenoplectus litoralis* tall sedgeland in the northern part of Torilla Plain, and includes a large area of grassy marine plain with highly complex channel networks (see also sector 61). It is internationally important in terms of supporting a critically endangered bird. Fauna values may be much greater than known from present evidence.

Wetland condition: Outflow of freshwater southward to sector 61 from sector 63 is restricted – except during major flood events – by an east-west chain of small block banks along the sector boundary. Probably these modifications do not extend to the far western side of the sector because the major north-south channel seems to be tidal along at least half of the western side. Inflow to sector 63 is partly restricted by a low cross-plain bank along the boundary between sectors 64 and 65.

Potential investments: Fencing of some areas of tall sedgeland to reduce or exclude cattle access may enhance this habitat for wildlife, including chats.
Comments: The sector is transitional between saline and freshwater sectors.

Sector 64

Location: 22.2651, 150.0164
Catchment: Herbert Creek.
Survey effort and coverage: BCCA: poor, ground survey only; several previous surveys by WIO and/or CEM-CQU during 2003-6.
Wetland types: Marine plain (complex of minor freshwater channels and ponds, grassy wet meadow, freshwater grass-sedge swamp: substantial areas. Grassy saltmarsh, saltmarsh with samphire, farm dam: small areas.
Waterbirds recorded: (summary of BCCA and previous results) (BCCA: 5 species recorded; no migratory shorebird species). In the wet season to early dry season, the sector supports a small-moderate number of waterbird species, probably a small number of breeding species, a small number of migratory shorebird species, and a moderate total number of waterbirds. The nationally threatened (Critically Endangered) Capricorn Yellow Chat occurs, with a sub-population in the centre-north of sector 64 and (mainly in the) adjoining centre of sector 65 comprising many tens of birds, mainly in beds of tall perennial sedge *Cyperus alopecuroides* around the margins of channels and small ponds (see sector 65). Roosts of more than 1000 Australian White and Straw-necked Ibises, and Royal Spoonbill, have been recorded at the homestead dam and surrounding trees, on the edge of the Plain. Black Swans (breeding), Black-winged Stilts and White-faced Herons may be plentiful on the Plain; migratory Black-tailed Godwits occur in shallow ponds.
Conservation values: The sector includes a substantial area of *Cyperus alopecuroides* sparse tall sedgeland contiguous with a greater extent in sector 65. It is internationally important in terms of supporting a critically endangered bird. Fauna values may be much greater than known from present evidence.
Wetland condition: Outflow of freshwater southward to sector 63 from sector 64 is unrestricted whereas inflow to sector 64 is partly restricted by a low cross-plain bank along the boundary between sectors 64 and 65. The bank is eroded and has been breached in at least one place; a block bank, which also serves as a causeway for a farm track, occurs across the main arterial channel. A single patch of common reed *Phragmites australis* persists beside the channel; apparently once much more widespread on the Plain, this wetland plant often is selectively removed from landscapes by grazing cattle.
Potential investments: Fencing of barer sections of channel may encourage return and expansion of beds of *Phragmites* and tall perennial sedge.
Comments: Usually the cross-plain track beside the low bank cannot be crossed unless the plain is dry.

Sector 65

Location: 22.2435, 150.0299
Catchment: Herbert Creek.
Survey effort and coverage: BCCA: poor, ground surveys only; many previous surveys by WIO and/or CEM-CQU during 2003-6 (frequently surveyed by CEM-CQU chat team).
Wetland types: Freshwater grass-sedge swamp, grassy wet meadow, marine plain (complex of minor freshwater channels and ponds): substantial areas. Melaleuca wooded swamp, large pond (small lake): small areas.
Waterbirds recorded: (summary of BCCA and previous results) (BCCA: 32 species recorded, 2 of them breeding; 4 migratory shorebird species). This sector includes some of the most persistent water bodies on Torilla Plain; accordingly, in some years waterbirds may be present year round. It supports a high number of waterbird species, a small number of breeding species, a small number of migratory shorebird species, and a high total number of waterbirds. The nationally threatened (Critically Endangered) Capricorn Yellow Chat occurs, with a sub-population in the centre/west of this sector and adjacent parts of sector 65 comprising many tens of birds, primarily in beds of tall perennial sedge *Cyperus alopecuroides* around the margins of channels and ponds. Breeding probably occurs in the wet season and groups congregate through the dry season in years when the *Cyperus* is abundant (see sector 57). Tens to perhaps hundreds of Whiskered Tern nest in inundated beds of *Eleocharis ?dulcis* late in the wet season (*The Sunbird*: 33, 113-117); Black Swans nest around the large open ponds. At the end of March, migratory Latham's Snipe regularly congregate in muddy grass-sedge swamp in the far east and south-east of the sector; the count in March 2006 was 182 birds, with a greater area of additional suitable habitat not surveyed. Tens to hundreds of migratory Black-tailed Godwit, Marsh Sandpiper, Sharp-tailed Sandpiper and White-winged Black Tern also occur. Uncommon species recorded in the sector include Black-necked Stork and Zitting Cisticola. The most abundant species, with tallies of 500 to 1000 birds, are Straw-necked Ibis, Black-winged Stilt, Hardhead, and (mixed) egrets. The highest total from any BCCA survey was 4305 birds on 28 March 2006.
Conservation values: The sector includes the largest area of *Eleocharis* sedgeland on Torilla Plain and a substantial area of *Cyperus alopecuroides* sedgeland; these are regionally important occurrences. Together with open/marshy ponds that are highly persistent, these wetlands provide one of the most regularly inundated and extensive areas of freshwater swamp in the Broadsound catchment. Sector 65 is internationally important in terms of supporting a critically endangered bird. The sector is part of an internationally important site for the migratory Latham's Snipe on the northern and eastern edges of Torilla Plain: collectively the sectors of this site support several hundred snipe during northward migration in late March, apparently on a regular basis. Sector 65 also is one of the few known breeding sites for Whiskered Tern in central Queensland, and it also supports substantial waterbird aggregations.
Wetland condition: Outflow of freshwater southward to sector 64 from sector 65 is partly restricted by a low cross-plain bank along the boundary between sectors 64 and 65. The bank is eroded and has been breached in at least one place; a block bank, which also serves as a causeway for a farm track, occurs across the main arterial channel. Inflow from the north and east is unrestricted apart from minor ponding caused by the Stanage Bay Road where it cuts across the far eastern arm of the plain. A substantial infestation of Olive Hymenachne is present under wooded swamp on a creek on the far eastern side of this sector, with small outbreaks in swamp on adjacent open plain. Old *Melaleuca* trees in a narrow zone along the south-east edge of the sector are not accompanied by a new generation because the short saplings are consistently browsed off below 1 m height – presumably by cattle – preventing regeneration.
Potential investments: Assistance to the landholder to destroy Hymenachne infestations before they become widely established in the sector is a high priority for investment; if no action is taken, Hymenachne could replace large areas of native sedgeland in wetter parts of the

plain. Fencing of selected barer sections of the main arterial channel may encourage return and expansion of beds of tall *Cyperus* and perhaps also reed *Phragmites*. Research and monitoring of the Yellow Chat, to implement the species' recovery plan, logically should continue in this sector.

Comments: Division between sector 65 and sector 66 is arbitrary, for survey purposes; these sectors share similar wetland. Usually the cross-plain track beside the low bank cannot be crossed unless the plain is dry.

Sector 66

Location: 22.2239, 150.0337
Catchment: Herbert Creek.
Survey effort and coverage: BCCA: poor, ground survey only; one previous aerial survey by WIO in 2003.
Wetland types: Freshwater grass-sedge swamp, grassy wet meadow, marine plain (complex of minor freshwater channels and ponds): substantial areas. Melaleuca wooded swamp, waterhole in creek: small areas.
Waterbirds recorded: (summary of BCCA and previous results) (BCCA: no species recorded, plain dry). Likely to support many of the species that have been recorded in sector 65, including migratory Latham's Snipe – possibly in substantial numbers – at the edges of grass-sedge and wooded swamps. Probably not ideal habitat for Yellow Chat.
Conservation values: The sector includes a substantial area of *Eleocharis* sedgeland contiguous with similar habitat in sector 65, and the largest area of Melaleuca wooded swamp in the northern part of Torilla Plain. It is likely to be part of the internationally important site for the migratory Latham's Snipe in this corner of Torilla Plain (see sector 65).
Wetland condition: Apparently there are no hydrological modifications to this sector, though some of the catchment has been cleared recently. A major infestation of Olive Hymenachne is present under wooded swamp on the south-east side of this sector. Extensive pig diggings occur in wetter parts of the same swamp.
Potential investments: Assistance to the landholder to destroy Hymenachne infestations before they become widely established in the sector is a high priority for investment; if no action is taken, Hymenachne could replace large areas of native sedgeland in wetter parts of the plain.
Comments: Division between sector 65 and sector 66 is arbitrary, for survey purposes; these sectors share similar wetland.

Sector 67

Location: 22.2962, 149.9682
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07; a previous ground survey by WIO during 2003-6.
Wetland types: Marine plain (complex of saline minor channels and ponds), saltmarsh with samphire, salt flat: substantial areas. Grassy saltmarsh, estuary: presumably, small areas.
Waterbirds recorded: (summary of BCCA and previous results) A few birds, including Red-capped Plover, recorded in the only (brief) survey conducted.
Conservation values: The sector includes a highly complex, dense, probably unmodified network of channels and ponds similar to that found in greater extent in sector 61. Fauna values not adequately known.
Wetland condition: There is a zone of dead mangrove at the junction between sector 67 sector 54.
Potential investments: None identified.
Comments: This sector is accessible only in the dry season, on a farm track via the western side of sectors 64 and 63.

Sector 68

Location: 22.2442, 149.9431
Catchment: Herbert Creek.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Mangrove, estuary: substantial areas. Salt flat, bare intertidal flat, island: small areas present.
Waterbirds recorded: No species recorded.
Conservation values: The sector contains a large block of mangrove, contiguous with mangrove in sector 54, and in the Broadsound catchment is probably the largest mainland block that has had little if any impact from grazing or changes to upstream water regime. Fauna values not adequately known.
Wetland condition: No dead mangrove observed in the brief survey.
Potential investments: None identified.
Comments: The sector is in many respects similar to mangrove sectors in Shoalwater Bay.

Sector 69

Location: 22.2181, 149.8997
Catchment: Long Island internal catchment.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Mangrove, island, estuary: substantial areas. Salt flat, bare intertidal flat: small areas present.
Waterbirds recorded: A minor roost comprising 23 medium-sized migratory shorebirds was detected at the southernmost tip of the southernmost island in the sector on 29 March 2007. Four Whimbrel were recorded elsewhere in the sector. Several potential roost sites on small stony coves, beaches and salt flats also were noted, on the western side of the sector.

Conservation values: The sector is regionally important in terms of containing one of the largest areas of mangrove in Broadsound catchment, and a large area of mangrove in island-blocks that have had little if any impact from grazing or changes to upstream water regime. Fauna values not adequately known.
Wetland condition: No dead mangrove observed in the brief survey.
Potential investments: None identified.
Comments: Dryland areas within the islands are part of Broad Sound Islands National Park; some intertidal areas are in marine park. The sector is in many respects similar to mangrove sectors in Shoalwater Bay. Land use in adjacent upland was not determined by the survey team.

Sector 70

Location: 22.1446, 149.8721
Catchment: Long Island internal catchment.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Mangrove: substantial areas. Island, estuary, salt flat: small areas present.
Waterbirds recorded: None recorded. Potential for shorebird roosts on tiny coves and on Coal and/or West Side Islands.
Conservation values: The sector contains a substantial area of mangrove, with little if any impact from grazing or changes to upstream water regime. Fauna values not adequately known.
Wetland condition: Small areas of dead mangrove were observed at the landward edge of the mangrove block.
Potential investments: None identified.
Comments: Coal Island and West Side Island are part of Broad Sound Islands National Park; remaining parts of sector are mostly in marine park. The sector is in many respects similar to mangrove sectors in Shoalwater Bay. Land use in adjacent upland was not determined by the survey team.

Sector 71

Location: 22.1230, 149.9258
Catchment: Long Island internal catchment.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Beach, rocky shore, estuary: substantial areas. Mangrove, bare intertidal flat, salt flat: small areas present.
Waterbirds recorded: Several medium-sized migratory shorebirds were observed at the southern end of a major sand spit mid-way on the northern beach; this site potentially could support a larger roost. Several Whimbrel were observed elsewhere in the sector.
Conservation values: The sector contains the principal sandy beach on Long Island and the only sandy beach in the eastern catchments outside the Stanage (Shoalwater Bay) Coast. Fauna values not adequately known.
Wetland condition: A south-east facing section of shore in this sector had been undercut by wave action.
Potential investments: None identified.
Comments: Land use in adjacent upland was not determined by the survey team.

Sector 72

Location: 22.1670, 149.9720
Catchment: Quail Island internal catchment, and Herbert Creek.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Mangrove, island, estuary: substantial areas. Salt flat, rocky shore: small areas present.
Waterbirds recorded: None recorded. Potential for shorebird roosts at the landward edge of mangrove on the smaller islands in this sector.
Conservation values: Fauna values not adequately known.
Wetland condition: No impacts identified.
Potential investments: None identified.
Comments: The north-western island in this sector is part of Broad Sound Islands National Park; remaining parts of sector mostly in marine park. The sector includes parts of both Quail Island and the mainland.

Sector 73

Location: 22.6340, 150.0920
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07 or previous projects.
Wetland types: (based on satellite imagery) Estuary, creek, freshwater swamps: small areas.
Waterbirds recorded: No information.
Conservation values: Not known.
Wetland condition: No information.
Potential investments: None identified.
Comments: This sector, the boundary of which is not based on the EPA wetland mapping, was originally delineated to 'capture' a suite of small seasonal wetlands around the lower reaches of Halfway Creek and Herbert Creek.

Sector 74

Location: 22.6957, 150.0915
Catchment: Herbert Creek.
Survey effort and coverage: not surveyed in 2006/07; one aerial survey by WIO in March 2003.
Wetland types: (based on satellite imagery) Estuary, freshwater creek channel, riverine floodplain wetlands (oxbows, scroll wetlands, freshwater swamps): substantial areas.
Waterbirds recorded: No information.
Conservation values: Not known, but based on the extent and complexity of wetlands present, when fully inundated (e.g. February 2003) the freshwater wetlands are likely to support significant diversity and numbers of waterbirds.
Wetland condition: No information.
Potential investments: None identified.
Comments: This sector, the boundary of which is not based on the EPA wetland mapping, was originally delineated to 'capture' a broad suite of small seasonal wetlands around the junction and lower floodplains of Banyan Creek and Herbert Creek.

Sector 75

Location: 22.5716, 149.6094
Catchment: Styx River.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Ponded pasture?, freshwater swamps: small areas.
Waterbirds recorded: No information.
Conservation values: Not known.
Wetland condition: No information.
Potential investments: None identified.
Comments: This sector, the boundary of which is not based on the EPA wetland mapping, was originally delineated to 'capture' a broad suite of small wetlands straddling the railway line, adjacent to sector 32.

Sector 76

Location: 22.5331, 149.5574
Catchment: Waverley Creek.
Survey effort and coverage in 2006-7: poor, aerial survey only. (distand view, not adequately surveyed)
Wetland types: Ponded pasture: substantial areas.
Waterbirds recorded: No information.
Conservation values: Not known.
Wetland condition: Wetlands in this sector probably comprise some natural freshwater swamps that have been modified by emplacement of banks, as well as artificial wetlands established as ponded pasture.
Potential investments: None identified.
Comments: This sector, the boundary of which is not based on the EPA wetland mapping, was originally delineated to 'capture' a suite of small artificial wetlands, thereby providing an opportunity to conduct ground surveys of ponded pasture wetlands – but this did not eventuate.

Sector 77

Location: 22.4881, 149.5384
Catchment: Waverley Creek.
Survey effort and coverage in 2006-7: poor, ground survey only.
Wetland types: Ponded pasture: substantial areas.
Waterbirds recorded: White-necked Heron, White-faced Heron: several of each.
Conservation values: Fauna values not adequately known.
Wetland condition: Wetlands in this sector comprise artificial wetlands established through construction of banks, as ponded pasture. They included beds of introduced Olive Hymenachne.
Potential investments: None identified.
Comments: This sector, the boundary of which is not based on the EPA wetland mapping, was originally delineated to 'capture' a suite of small artificial wetlands, thereby providing an opportunity to conduct ground surveys of ponded pasture wetlands.

Sector 78, 79, 80

These codes were omitted from the sequence used to define survey sectors. Go to sector 81.

Sector 81

Location: 22.1356, 150.0522
Catchment: Stanage Coast.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Beach, rocky shore, mangrove, estuary: substantial areas. Salt flat: small areas.
Waterbirds recorded: None recorded.
Conservation values: The sector includes particularly scenic coast with high headlands and short sandy beaches. Fauna values not adequately known.
Wetland condition: Some catchment immediately adjacent to the mainland side of the sector had been cleared recently. The sector includes the township of Stanage Bay and satellite settlements, with associated boat launching sites and boating activity.
Potential investments: None identified other than a general opportunity to raise public awareness of conservation values of nearby sectors.
Comments: The sector was originally delineated to facilitate survey of beaches and small patches of other intertidal wetland along this coast; hence the sector boundary does not follow the EPA wetland mapping and includes considerable non-wetland area.

Sector 82

Location: 22.1947, 150.0937
Catchment: Stanage Coast.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Beach, mangrove, estuary: substantial areas. Rocky shore, salt flat, ponded channel: small areas.
Waterbirds recorded: Unidentified large migratory shorebirds (5 on beach).
Conservation values: The northern part of this sector includes particularly scenic coast with high headlands and short sandy beaches. Fauna values not adequately known.
Wetland condition: A short wall across the northern end of the tidal inlet that emerges at The Shacks has created a ponded channel/lake upstream; presumably this reduces freshwater flow into the inlet. Areas of dead trees at the landward margins of this modified wetland may have been killed by prolonged inundation. The sector includes a number of house clusters along the coast, presumably with associated minor boat launching sites and activity.
Potential investments: None identified.
Comments: Properties: Most of the tidal inlet at The Shacks is part of Shoalwater Bay Conservation Park. The sector was originally delineated to facilitate survey of beaches and small patches of other intertidal wetland along this coast; hence the sector boundary does not follow the EPA wetland mapping and includes considerable non-wetland area.

Sector 83

Location: 22.2532, 150.1403
Catchment: Stanage Coast.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Survey effort and coverage: poor, aerial survey only.
Wetland types: Beach: substantial areas. Rocky shore, estuary, mangrove, salt flat, saltmarsh: small areas.
Waterbirds recorded: None recorded.
Conservation values: Fauna values not known.
Wetland condition: No impacts noted.
Potential investments: None identified.
Comments: The sector was originally delineated to facilitate survey of beaches and small patches of other intertidal wetland along this coast; hence the sector boundary does not follow the EPA wetland mapping and includes considerable non-wetland area.

Sector 84

Location: 22.3162, 150.1833
Catchment: Stanage Coast.
Survey effort and coverage in 2006-7: poor, aerial survey only.
Wetland types: Beach: substantial areas. Estuary, salt flat, rocky shore, mangrove, bare intertidal flat, grassy saltmarsh, saltmarsh with samphire: small areas.
Waterbirds recorded: (3 species/groups recorded; 2 of them migratory shorebirds) Small groups of 15-30 terns, unidentified large migratory shorebirds, and unidentified medium migratory shorebirds, were recorded on beaches in the far north and far south of the sector.
Conservation values: The sector includes small areas of saltmarsh which is otherwise relatively rare on the Shoalwater Bay coastline within the study area. Fauna values not adequately known.
Wetland condition: No impacts.
Potential investments: None identified.
Comments: Properties: The tidal inlets may be wholly or partly within Shoalwater Bay Conservation Park which covers much of the landward surrounds. The sector was originally delineated to facilitate survey of beaches and small patches of other intertidal wetland along this coast; hence the sector boundary does not follow the EPA wetland mapping and includes considerable non-wetland area.

S6 Short description of Broadsound regional ecosystems.

These descriptions are taken from the regional ecosystem descriptions at http://www.epa.qld.gov.au/projects/redd/ on 18 January 2008. Please consult this address for full ecosystem descriptions and for any changes to the descriptions or classifications. Regional ecosystem codes beginning with 8 refer to the Central Queensland Bioregion. Codes beginning with 11 refer to the Brigalow Belt bioregion.

Regional Ecosystem:	**8.2.7**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Endangered. Has been extensively cleared and remnant areas degraded from weed invasion, erosion caused by recreational activities and changes in hydrology.
Sub region:	5, 2, (11.14)
Estimated Extent:	In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	High
Wetland:	Contains palustrine wetland (e.g. in swales).

Short Description:
Melaleuca spp. and/or *Lophostemon suaveolens* and/or *Eucalyptus robusta* open woodland to open forest in wetlands associated with parabolic dunes

Regional Ecosystem:	**8.3.1**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Endangered. Under review
Sub region:	2, 3, 4, 6, (5)
Estimated Extent:	In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low
Wetland:	Riverine wetland or fringing riverine wetland.

Short Description:
Semi-deciduous notophyll/mesophyll vine forest fringing watercourses on alluvial plains

Regional Ecosystem:	**8.3.3**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	Of concern. The linear nature of the RE makes it prone to disturbance from cane fires and earthworks associated with river drainage enhancement. This has resulted in invasion by aggressive introduced grasses and other weeds including vines.
Sub region:	2, 3, 4, 6, (5)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low
Wetland:	Riverine wetland or fringing riverine wetland.

Short Description:
Melaleuca leucadendra or *M. fluviatilis* ± *Casuarina cunninghamiana* open forest to woodland, fringing watercourses

Regional Ecosystem:	**8.3.5**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Endangered. Fragmented nature of remnants and their susceptibility to weeds, and, in the absence of fire, rainforest pioneer species.
Sub region:	2, 6, 3, (1)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves:	Low

Short Description:
Corymbia clarksoniana + *Lophostemon suaveolens* + *Eucalyptus platyphylla* woodland, or *E. platyphylla* woodland on alluvial plains

Regional Ecosystem:	**8.3.9**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Of concern
Sub region:	1
Estimated Extent:	In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	High

Short Description:
Complex notophyll vine forest on perched alluvium in valleys of undulating mountain ranges

Regional Ecosystem:	**8.3.13**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Endangered. Under review
Sub region:	2, 5, 4, (11.14)
Estimated Extent:	In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low
Wetland:	Palustrine wetland (e.g. vegetated swamp).

Short Description:
Eucalyptus tereticornis and/or *Corymbia tessellaris* and/or *Melaleuca* spp. open woodland to open forest on alluvial and old marine plains, often adjacent to estuarine areas

8.3.13a: Palustrine wetland (e.g. vegetated swamp). Mixed *Melaleuca* spp. woodlands. Occurs on marine plains or alluvial plains, usually adjacent to estuarine areas

Regional Ecosystem:	**8.3.14**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Endangered. Under review
Sub region:	3
Estimated Extent:	In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	No representation
Wetland:	Floodplain (other than floodplain wetlands).

Short Description:
Pennisetum alopecuroides, *Cynodon dactylon*, *Ischaemum australe* and *Fimbristylis dichotoma* grassland on drainage channels in gently undulating upland areas

Regional Ecosystem:	**8.5.5**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Endangered. Under review
Sub region:	2, (11.14)
Estimated Extent:	In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	No representation

Short Description:
Eucalyptus exserta and/or *Corymbia clarksoniana* woodland ± E. sp. (Jimboomba A. R. Bean 7772) usually with a lower tree layer of *Melaleuca viridiflora* and *M. nervosa* on Tertiary sand plains

Regional Ecosystem:	**8.12.3**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	3, 2, (4)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	High

Short Description:
Notophyll rainforest/microphyll rainforest often with *Argyrodendron polyandrum* and *Paraserianthes toona*, ± *Araucaria cunninghamii*, on low to medium ranges on Mesozoic to Proterozoic igneous rocks

Regional Ecosystem:	**8.12.5**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	3, 4, 1, (2)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Medium

Short Description:
Corymbia intermedia, *E. portuensis* ± *Lophostemon* spp. ± *Syncarpia glomulifera* ± *Banksia integrifolia*, open forest on Mesozoic to Proterozoic igneous rocks

Regional Ecosystem:	**8.12.7**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	3, (4)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low

Short Description:
Corymbia citriodora ± *Eucalyptus portuensis* ± *E. drepanophylla* (or *E. crebra*) open forest to woodland on hillslopes and undulating plateaus, on Mesozoic to Proterozoic igneous rocks

Regional Ecosystem:	**8.12.9**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	Of concern. Due to long term effects of grazing on logged stands. The RE has been a major supplier of saw logs and grazing of logged stands inhibits regeneration.
Sub region:	3
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low

Short Description:
Eucalyptus tereticornis ± *Lophostemon suaveolens* ± *Corymbia intermedia* woodland to open forest on undulating uplands, on Mesozoic to Proterozoic igneous rocks

Regional Ecosystem:	**8.12.13**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Of concern
Sub region:	2, 1, 5, (6), (11.14)
Estimated Extent:	In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	High

Short Description:
Xanthorrhoea latifolia sub sp. *latifolia* or *Imperata cylindrica* grassland, including some areas recently colonised by *Timonius timon* shrubland, on slopes of islands and headlands, on Mesozoic to Proterozoic igneous rocks and Tertiary acid to intermediate v

Regional Ecosystem:	**8.12.14**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	1, 2, (5), (6), (11.14)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	High

Short Description:
Variable eucalypt dominated associations, often with *Eucalyptus drepanophylla*, *E. crebra*, *Acacia spirorbis*, sub sp. *solandri*, *Lophostemon confertus* and *E. exserta*, on islands and rocky headlands, on Mesozoic to Proterozoic igneous rocks, and Tertiary acid

Regional Ecosystem: **8.12.16**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 3, (11.2), (11.12)
Estimated Extent: In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Medium

Short Description:
Low microphyll vine forest to semi-evergreen vine thicket on drier subcoastal hills on Mesozoic to Proterozoic igneous rocks

Regional Ecosystem: **8.12.22**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 3, 2, (11.14)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low

Short Description:
Eucalyptus drepanophylla ± *E. platyphylla* ± *Corymbia clarksoniana* ± *E. exserta* ± *C. trachyphloia* woodland including small areas of *E. portuensis* and *C. intermedia*, and stands of *E. melanophloia*. Hills and ranges at low to moderate altitudes, in drier area

Regional Ecosystem: 8.12.23
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 3
Estimated Extent: In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: High

Short Description:
Eucalyptus moluccana woodland on elevated tablelands on Mesozoic to Proterozoic igneous rocks

Regional Ecosystem: 8.12.29
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 1, 6, 5, 2, (11.14)
Estimated Extent: In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: High

Short Description:
Lophostemon confertus ± *Acacia leptostachya* ± *Acacia aulacocarpa* ± *Corymbia dallachiana* ± *Eucalyptus* spp. ± *Melaleuca viridiflora* ± *Allocasuarina littoralis* shrubland to open forest on exposed hillslopes of islands with abundant rock at the surface.

Regional Ecosystem: **8.12.31**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 3, 4
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: High
Short Description:
Corymbia intermedia and *Allocasuarina* spp. open to closed forest, or Allocasuarina spp. closed forest to closed shrubland on moist upper slopes and ridges of ranges, on Mesozoic to Proterozoic igneous rocks

Regional Ecosystem: **11.1.1 Note may be reclassified as 11.3.27 in places behind seawalls**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 14, 1
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Medium
Wetland: Estuarine wetlands (e.g. mangroves).
Short Description:
Sporobolus virginicus grassland on marine clay plains

Regional Ecosystem:	**11.1.2**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	14, 1
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	High
Wetland:	Estuarine wetlands (e.g. mangroves).
Short Description:	
Samphire forbland on marine clay plains	

11.1.2a: Estuarine wetlands (e.g. mangroves). Bare mud flats on Quaternary estuarine deposits, with very isolated individual stunted mangroves such as *Avicennia marina* and/or *Ceriops tagal*. May have obvious salt crusts on the soil surface.

11.1.2b: Estuarine wetlands (e.g. mangroves). Samphire forbland on Quaternary estuarine deposits.

Regional Ecosystem:	**11.1.3 Note may be reclassified as 11.3.27 in places behind seawalls**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Of concern
Sub region:	14
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves:	No representation
Wetland:	Palustrine wetland (e.g. vegetated swamp).
Short Description:	
Sedgelands on marine clay plains	

Regional Ecosystem:	**11.1.4**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	14, 1, (2)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	High
Wetland:	Estuarine wetlands (e.g. mangroves).
Short Description:	
Mangrove forest/woodland on marine clay plains	

11.1.4a: Estuarine wetlands (e.g. mangroves). *Rhizophora* spp. open-forest on Quaternary estuarine deposits. This may include *Rhizophora stylosa* or *R. apiculata* as dominants, with occasional *Avicennia marina* as emergents, and subdominant *Bruguiera gymnorhiza* and/or *Ceriops tagal*. In northern areas, occasional *Xylocarpus moluccensis* may also occur. A shrub layer is usually not present. Occurs on fringing waterways low in intertidal zone, with roots submerged during high tides

11.1.4b: Estuarine wetlands (e.g. mangroves). *Avicennia marina* low open-shrubland to closed forest on Quaternary estuarine deposits. There may be occasional *Ceriops tagal*, *Rhizophora* spp., *Bruguiera* spp., *Excoecaria agallocha* or *Lumnitzera* spp. An occasional presence of species such as *Aegialitis annulata* and/or *Aegiceras corniculatum* may occur. Open-shrublands of *Avicennia marina* may have a sparse presence of samphires such as *Suaeda* spp., *Tecticornia australasica* and *Sarcocornia* spp. Occurs in all intertidal environments from the seaward edge (as a pioneer) to accreting banks (as a fringe), to the landward edge adjacent to claypans

11.1.4c: Estuarine wetlands (e.g. mangroves). *Ceriops tagal*, +/- *Avicennia marina* open forest on Quaternary estuarine deposits. Other mangrove species may be present as occasional individuals including *Rhizophora* spp., *Bruguiera* spp., *Lumnitzera* spp., and *Sonneratia* spp. A shrub layer is not usually present. Occurs on upstream creek edges, and toward the landward edge of the upper intertidal limit. Only inundated by spring tides

11.1.4d: Estuarine wetlands (e.g. mangroves). Dominated by a range of species from genera such as from *Avicennia* sp., *Ceriops* sp., *Rhizophora* sp. and *Bruguiera* sp. which form a closed forest. A low shrub layer composed of species such as *Acanthus ilicifolius*, *Acrostichum speciosum*, *Crinum pedunculatum* or juvenile canopy species is often present. Epiphytes on the canopy are common. Occurs on the landward edge of the tidal flats and in the upper tidal reaches of creeks and rivers where there is a high freshwater influence.

11.1.4e: Estuarine wetlands (e.g. mangroves). *Avicennia marina* usually dominates the canopy which forms an open-forest although may vary from a low open-forest to a woodland or shrubland. *Ceriops tagal* sometimes occurs as a co dominant. Occurs on intertidal flats which are often dissected by tidal streams. Occurs on the seaward edge of the tidal flats as a pioneer and on landward edge in areas bordering saltpans and that are inundated by the highest spring tides.

Regional Ecosystem: **11.2.1**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 1, 14
Estimated Extent: In September 2003, pre-clearing area was < 1,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: High
Short Description:
Eucalyptus platyphylla, *Corymbia tessellaris* woodland on sandy coastal plains

Regional Ecosystem: **11.2.2**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 1, 14, (2)
Estimated Extent: In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: High
Short Description:
Complex of *Spinifex sericeus*, *Ipomoea pes-caprae* and *Casuarina equisetifolia* grassland and herbland on foredunes

Regional Ecosystem: **11.2.3**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 14, 1, 2
Estimated Extent: In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: High
Short Description:
Microphyll vine forest (beach scrub) on sandy beach ridges

Regional Ecosystem: **11.2.4**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 1, 14
Estimated Extent: In September 2003, pre-clearing area was < 1,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: No representation
Wetland: Palustrine wetland (e.g. vegetated swamp).
Short Description:
Lagoons in swales

Regional Ecosystem: **11.2.5**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 1, 14, (2)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Medium
Wetland: Contains palustrine wetland (e.g. in swales).
Short Description:
Corymbia-Melaleuca woodland complex of beach ridges and swales

Regional Ecosystem: **11.3.1**
Vegetation Management Act status (December 2005): Endangered
Biodiversity Status: Endangered
Sub region: 11, 31, 7, 21, (6), (8), (13), (14), (18), (19), (20), (35), (36)
Estimated Extent: In September 2003, <10% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Acacia harpophylla and/or *Casuarina cristata* open forest on alluvial plains

Regional Ecosystem:	**11.3.2**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Of concern
Sub region:	26, 31, 11, 24, 21, (6), (7), (8), (13), (15), (16), (18), (20), (25), (27), (32), (35), (36)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves:	Low
Wetland:	Contains palustrine wetland (e.g. in swales).
Short Description:	

Eucalyptus populnea woodland on alluvial plains

Regional Ecosystem:	**11.3.4**
Vegetation Management Act status (December 2005):	Of concern
Biodiversity Status:	Of concern
Sub region:	14, 18, 12, 19, 22, 31, 6, 27, (1), (2), (7), (10), (11), (16), (20), (21), (32)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves:	Low
Wetland:	Floodplain (other than floodplain wetlands).
Short Description:	

Eucalyptus tereticornis and/or *Eucalyptus* spp. tall woodland on alluvial plains

Regional Ecosystem:	**11.3.9**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	1, 14, 2, (3)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low
Wetland:	Floodplain (other than floodplain wetlands).
Short Description:	

Eucalyptus platyphylla, *Corymbia* spp. woodland on alluvial plains

Regional Ecosystem:	**11.3.11**
Vegetation Management Act status (December 2005):	Endangered
Biodiversity Status:	Endangered
Sub region:	19, 11, 21, 14, (1), (12), (17), (18), (22)
Estimated Extent:	In September 2003, remnant extent was < 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves:	Low
Short Description:	

Semi-evergreen vine thicket on alluvial plains

Regional Ecosystem:	**11.3.25**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	Of concern. Threatening processes other than clearing.
Sub region:	26, 11, 22, 1, 2, (3), (6), (7), (12), (13), (14), (15), (16), (18), (20), (21), (24), (25), (27), (29), (31), (32), (35), (36)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low
Wetland:	Riverine wetland or fringing riverine wetland.
Short Description:	

Eucalyptus tereticornis or *E. camaldulensis* woodland fringing drainage lines

11.3.25b: Riverine wetland or fringing riverine wetland. *Melaleuca leucadendra* and/or *M. fluviatilis*, *Nauclea orientalis* open forest . A range of other canopy or sub canopy tree species also occur including *Pandanus tectorius*, *Livistona* spp., *Eucalyptus tereticornis*, *Corymbia tessellaris*, *Millettia pinnata*, *Casuarina cunninghamiana*, *Livistona decora*, *Lophostemon suaveolens* or *L. grandiflorus*, rainforest species and, along drainage lines, *Eucalyptus camaldulensis* or *E. tereticornis*. A groundlayer of tall grasses such as *Chionachne cyathopoda*, *Mnesithea rottboellioides* or *Heteropogon triticeus* may be present. Often occurs on coarse sand spits and levees within larger river channels.

11.3.25c: Riverine wetland or fringing riverine wetland. *E. camaldulensis* or *E. tereticornis* open-forest to woodland. Occurs fringing drainage lines derived from Serpentinite.

Regional Ecosystem:	**11.3.26**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	18, 14, 27, 22, 31, (11), (16)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low

Short Description:
Eucalyptus moluccana or *E. microcarpa* woodland to open forest on margins of alluvial plains

Regional Ecosystem:	**11.3.27**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	Of concern. Subject to trampling by domestic and feral animals. Impacted by modification of hydrology due to irrigation and water extraction from the wetland or surrounding catchment.
Sub region:	1, 20, 11, 14, 35, (2), (7), (26), (27), (30), (31), (36)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low
Wetland:	Palustrine wetland (e.g. vegetated swamp).

Short Description:
Freshwater wetlands

11.3.27x1b: Palustrine wetland (e.g. vegetated swamp). Sedgelands to grasslands on Quaternary deposits. Often occurs as an *Eleocharis dulcis* sedgeland but a variety of other species dominate in local areas including *Typha orientalis* and *Phragmites australis*. Trees and large shrubs are generally absent. Occurs on broad drainage depressions situated on old alluvial plains.

11.3.27x1c: Palustrine wetland (e.g. vegetated swamp). Sedgelands to grasslands on Quaternary deposits. Sedgeland areas typically dominated by *Schoenoplectus litoralis* although a range of other sedges and grasses may also dominate localised areas. Other dominant species include the sedges *Eleocharis philippinensis*, *Cyperus alopecuroides*, *C. scariosus* and *C. iria* and the grasses *Phragmites australis*, Sporobolus virginicus and *Paspalum vaginatum*. Other typical species in shallower margins include *Fimbristylis ferruginea*, *Phyla nodiflora* and *Cyperus polystachyos*. Occasional twiners such as *Cynanchum carnosum* may be present. Occurs in depressions on old Quaternary estuarine deposits. These are seasonally inundated with fresh water but become more brackish as they dry. Dry out completely before the next season's rain.

11.3.27b: Palustrine wetland (e.g. vegetated swamp). Vegetation ranges from open water ± aquatics and emergents such as *Potamogeton crispus*, *Myriophyllum verrucosum*, *Chara* spp., *Nitella* spp, *Nymphaea violacea*, *Ottelia ovalifolia*, *Nymphoides indica*, *N. crenata*, *Potamogeton tricarinatus*, *Cyperus difformis*, *Vallisneria caulescens* and *Hydrilla verticillata*. Often with fringing woodland, commonly *Eucalyptus camaldulensis* or *E. coolabah* but also a wide range of other species including *Eucalyptus platyphylla*, *E. tereticornis*, *Melaleuca* spp., *Acacia holosericea* or other *Acacia* spp. Occurs on billabongs no longer connected to the channel flow.

Regional Ecosystem:	**11.3.29**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	14, 2, (12)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low

Short Description:
Eucalyptus crebra, *E. exserta*, *Melaleuca* spp. woodland on alluvial plains

11.3.29a: *Eucalyptus crebra* + *Corymbia dallachiana* ± *C. erythrophloia*, *E. moluccana* woodland.

Regional Ecosystem:	**11.3.31**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	Of concern. Threatening processes other than clearing. Under review.
Sub region:	1, 2
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Low
Wetland:	Floodplain (other than floodplain wetlands).

Short Description:
Ophiuros exaltatus, *Dichanthium* spp. grassland on alluvial plains

Regional Ecosystem: **11.3.36**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 14, 2, (6), (11)
Estimated Extent: In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus crebra and/or *E. populnea* and/or *E. melanophloia* on alluvial plains. Higher terraces

Regional Ecosystem: **11.3.38**
Vegetation Management Act status (December 2005): Endangered
Biodiversity Status: Endangered
Sub region: 14
Estimated Extent: In September 2003, remnant extent was < 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves: Low
Wetland: Floodplain (other than floodplain wetlands).
Short Description:
Eucalyptus tereticornis, *Melaleuca viridiflora*, *Corymbia tessellaris* and *Eucalyptus fibrosa* sub sp. (Glen Geddes) woodland with a grassy ground layer. Occurs on alluvial plains and broad drainage lines derived from serpentinite

11.3.38a: Riverine wetland or fringing riverine wetland. *Melaleuca bracteata* low woodland.

Regional Ecosystem: **11.4.1**
Vegetation Management Act status (December 2005): Endangered
Biodiversity Status: Endangered
Sub region: 11, 10, 21, 2, (6), (17), (22), (27)
Estimated Extent: In September 2003, <10% of the pre-clearing area remained.
Extent in Reserves: Medium
Short Description:
Semi-evergreen vine thicket ± *Casuarina cristata* on Cainozoic clay plains

Regional Ecosystem: **11.4.2**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 11, 14, 6, 21, 10, (2), (7), (8), (12), (13), (15), (16), (20)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus spp. and/or *Corymbia* spp. grassy or shrubby woodland on Cainozoic clay plains

Regional Ecosystem: **11.4.9**
Vegetation Management Act status (December 2005): Endangered
Biodiversity Status: Endangered
Sub region: 11, 7, 10, 21, 6, (13), (14)
Estimated Extent: In September 2003, <10% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Acacia harpophylla shrubby open forest to woodland with *Terminalia oblongata* on Cainozoic clay plains

Regional Ecosystem: **11.5.8**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 14, (12)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Melaleuca spp., *Eucalyptus crebra*, *Corymbia intermedia* woodland on Cainozoic sand plains/remnant surfaces

11.5.8a: *Eucalyptus platyphylla*, *Corymbia intermedia*, *Lophostemon suaveolens* ± *Eucalyptus tereticornis* woodland. Occurs on rises and low hills.

11.5.8b: *Corymbia clarksoniana*, *Eucalyptus exserta*, *E. crebra*, *E. tereticornis*, *E. platyphylla* woodland with low tree layer dominated by *Melaleuca viridiflora*, *M. nervosa*, *Allocasuarina littoralis*, *Grevillea banksii*, *Acacia flavescens* + *Acacia leiocalyx*

Regional Ecosystem: **11.5.9**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 11, 6, 16, 5, 3, (1), (7), (14), (25), (26)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus crebra and other *Eucalyptus* spp. and *Corymbia* spp. woodland on Cainozoic sand plains/remnant surfaces. Plateaus and broad crests

Regional Ecosystem: **11.5.15**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: Endangered. under review
Sub region: 18, 6, 11, 3, 22, 27, (21), (9.4)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Semi-evergreen vine thicket on Cainozoic sand plains/remnant surfaces

Regional Ecosystem: **11.7.2**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 29, 11, 26, 5, 16, 6, 3, 7, (15), (34)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Acacia spp. woodland on lateritic duricrust. Scarp retreat zone

Regional Ecosystem: **11.10.1**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 24, 20, 6, 27, 26, 31, (15), (16), (21), (23)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Medium
Short Description:
Corymbia citriodora open forest on coarse-grained sedimentary rocks

Regional Ecosystem: **11.10.7**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 24, 26, 6, 27, 15, (5), (11), (13)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus crebra woodland on coarse-grained sedimentary rocks

Regional Ecosystem: **11.10.8**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 21, 6, 10, 15, 11, 18, 22, (5), (13), (16), (20), (24), (27)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves: Medium
Short Description:
Semi-evergreen vine thicket in sheltered habitats on medium to coarse-grained sedimentary rocks

Regional Ecosystem: 11.11.1
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 17, 9, 6, 18, 14, (2), (11), (12)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Medium
Short Description:
Eucalyptus crebra ± *Acacia rhodoxylon* woodland on old sedimentary rocks with varying degrees of metamorphism and folding

Regional Ecosystem: 11.11.3
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 18, 13, 14, 17
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Medium
Short Description:
Corymbia citriodora, *Eucalyptus crebra*, *E. acmenoides* open forest on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges

Regional Ecosystem: 11.11.4
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 18, 14, 22, (27)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus crebra woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Coastal ranges

11.11.4a: *Eucalyptus tereticornis* dominated woodland. Other tree species may occur as sub or co-dominant species.

Regional Ecosystem: 11.11.5
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 18, 17, 14, (12), (13), (21)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Medium
Short Description:
Microphyll vine forest ± *Araucaria cunninghamii* on old sedimentary rocks with varying degrees of metamorphism and folding

11.11.5a: Vine thicket, usually with no *Araucaria cunninghamii* emergents.

Regional Ecosystem: 11.11.7
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: Of concern. Threatening processes other than clearing. Under review.
Sub region: 14
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus fibrosa sub sp. (Glen Geddes), *E. xanthope* woodland on serpentinite

11.11.7a: *Eucalyptus fibrosa* sub sp. *fibrosa* ± *Corymbia* spp. ± *Eucalyptus* spp. woodland with a diverse shrub layer including several endemic species. Occurring on undulating low hills and colluvial aprons.

Regional Ecosystem: **11.11.10**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 13, 18, 12, (3), (5), (14), (17), (22)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus melanophloia woodland on deformed and metamorphosed sediments and interbedded volcanics

Regional Ecosystem: **11.11.13**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Of concern
Sub region: 13, 3, 7, (4), (5), (15), (10.3)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Acacia harpophylla or *A. argyrodendron*, Terminalia oblongata low open forest on deformed and metamorphosed sediments and interbedded volcanics

Regional Ecosystem: **11.11.14**
Vegetation Management Act status (December 2005): Endangered
Biodiversity Status: Endangered
Sub region: 18, 17, 12, 21, 22, (14), (19)
Estimated Extent: In September 2003, remnant extent was < 10,000 ha and 10-30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Acacia harpophylla open forest on deformed and metamorphosed sediments and interbedded volcanics

Regional Ecosystem: **11.11.15**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 18, 13, 3, 14, 9, 22, (4), (12)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus crebra woodland on deformed and metamorphosed sediments and interbedded volcanics. Undulating plains

11.11.15a: *Eucalyptus crebra, E. exserta* woodland.

Regional Ecosystem: **11.11.18**
Vegetation Management Act status (December 2005): Endangered
Biodiversity Status: Endangered
Sub region: 18, 19, 14, 17, (12), (13), (22)
Estimated Extent: In September 2003, <10% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Semi-evergreen vine thicket on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands

Regional Ecosystem: **11.11.20**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 14
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus platyphylla woodland on old sedimentary rocks with varying degrees of metamorphism and folding. Lowlands

Regional Ecosystem: **11.11.21**
Vegetation Management Act status (December 2005): Of concern
Biodiversity Status: Endangered. A rare (< 1000 ha) ecosystem that is threatened by clearing.
Sub region: 14
Estimated Extent: In September 2003, remnant extent was < 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Semi-evergreen vine thicket on serpentinite

Regional Ecosystem: **11.12.1**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 22, 2, 12, 5, 18, (1), (4), (14)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus crebra woodland on igneous rocks

11.12.1a: *Eucalyptus crebra* ± *E. exserta* woodland. Occurs on undulating rises.

Regional Ecosystem: **11.12.2**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 22, 9, 12, 18, 5, 2, (14), (17)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus melanophloia woodland on igneous rocks

Regional Ecosystem: **11.12.3**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: Of concern. under review
Sub region: 22, 12, 2, 18, (14)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Eucalyptus crebra, E. tereticornis, Angophora leiocarpa woodland on igneous rocks especially granite

Regional Ecosystem: **11.12.4**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 18, 2, 12, 22, 14, 1, 17, (9)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: High
Short Description:
Semi-evergreen vine thicket and microphyll vine forest on igneous rocks

11.12.4a: Semi-evergreen vine thicket with open patches of *Acacia fasciculifera, Archidendropsis thozetiana, Pleiogynium timorense* and various other species

Regional Ecosystem: **11.12.6**
Vegetation Management Act status (December 2005): Not of concern
Biodiversity Status: No concern at present
Sub region: 22, 12, 18, 14, (2)
Estimated Extent: In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves: Low
Short Description:
Corymbia citriodora open forest on igneous rocks (granite)

11.12.6a: *Eucalyptus crebra* + *Corymbia citriodora* and/or *E. acmenoides* + *Lophostemon suaveolens* woodland to open-forest.

Regional Ecosystem:	**11.12.9**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	2, 1
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	Medium

Short Description:
Eucalyptus platyphylla woodland on igneous rocks

Regional Ecosystem:	**11.12.13**
Vegetation Management Act status (December 2005):	Not of concern
Biodiversity Status:	No concern at present
Sub region:	1, 2, 12, (7.5)
Estimated Extent:	In September 2003, remnant extent was > 10,000 ha and >30% of the pre-clearing area remained.
Extent in Reserves:	High

Short Description:
Eucalyptus crebra, *Corymbia* spp., *E. acmenoides* woodland on igneous rocks. Coastal hills

Regional Ecosystem:	**11.12.21**
Vegetation Management Act status (December 2005):	Endangered
Biodiversity Status:	Endangered
Sub region:	22, 18, 19, (12), (21)
Estimated Extent:	In September 2003, <10% of the pre-clearing area remained.
Extent in Reserves:	Low

Short Description:
Acacia harpophylla open forest on igneous rocks. Colluvial lower slopes

S7 Plants of conservation significance and exotic species recorded within the Broadsound region.

This listing is an extract of the HERBRECS records from the Queensland Herbarium December 2007. * indicates an exotic species naturalized in the wild, **E** indicates a classification of Endangered, **V** indicates a classification of Vulnerable, **R** indicates a classification of Rare.

Family Name	Status	Botanical Name	Collector	Additional Collectors	Date	Locality	Notes
Amaranthaceae	*	Amaranthus viridis L.	Batianoff G.N.	Halford,D.A.; Stacey,W.;	29NOV 2004	Livingstone Shire, road to Stanage Bay, 13.7km from Bruce Hwy, Herbert Creek	Livingstone Shire, road to Stanage Bay, 13.7km from Bruce Hwy, Herbert Creek. River bank, silty clay soil on the bank of sandy creek bed, riparian Eucalyptus forest. Annual herb. Occasional on site.
Amaranthaceae	*	Gomphrena celosioides Mart.	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Granite Creek Bruce hwy, 46km n of Marlborough	Livingstone Shire, Granite Creek, Bruce Hwy, 46km N of Marlborough. Creek flat under bridge, seasonal wetland, Eucalyptus - Melaleuca low forest, grassy understorey. Weedy herb, annual vegetative growth, perennial rootstock, widespread. Common on site.
Annonaceae	*	Annona squamosa L.	Batianoff G.N.	Halford,D.A.; Stacey,W.;	29NOV 2004	Livingstone Shire, Stanage Bay, Endeavour Seashore Park	Livingstone Shire, Stanage Bay, Endeavour Seashore Park. Seashore, native vegetation of Casuarina beach scrub species. Self sown small tree drainage line. Rare on site.
Apocynaceae	*	Cascabela thevetia (L.) Lippold	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Kooltandia siding, west of Marlborough	Livingstone Shire, Kooltandia siding, west of Marlborough. Open-forest partially cleared once near the dam. Shrub 2.5m high, naturalised from planted individuals nearby. Occasional on site.
Apocynaceae	*	Catharanthus roseus (L.) G.Don	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, Halfway Creek Rd to Stanage Bay, 34km ne of Bruce Hwy	Livingstone Shire, Halfway Creek, road to Stanage Bay, 34km NE of Bruce Hwy. Creek bed, flood plain, herbland. Naturalised weed, Garden escape. Herb, milky sap. Occasional on site.
Asclepiadaceae	*	Araujia sericifera Brot.	Hanger D.		21MAY 2006	'Bukulla', c. 17km nw of Marlborough.	'Bukulla', c. 17km NW of Marlborough. N.E. boundary. Amongst grante rocks on ridge top with Jasminum didymum, Cissus repens, Melia, Turraea. Vigorous vine with milky sap. Only one seen.
Asclepiadaceae	*	Cryptostegia grandiflora R.Br.	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, Stanage Bay, Alligator Pt, Hollins property	Livingstone Shire, Stanage Bay, Alligator Point, Hollins Property. Creek bed, riparian forest infested with rubber vine.Invasive vine, milky sap. Occasional on site.
Asclepiadaceae		Cynanchum bowmanii S.T.Blake	Clemens M.S.		01DEC 1947	Ogmore	Ogmore.
Asclepiadaceae	*	Gomphocarpus physocarpus E.Mey.	Forster P.I.		21FEB 1990	117km from Sarina on Marlborough Rd nr Blackfellow Ck crossing	Near Blackfellow Creek crossing, on Marlborough Road, 117km from Sarina. Disturbed roadside. Bush to 2.5metres, fruiting.
Asclepiadaceae	V	Marsdenia brevifolia (Benth.) P.I.Forst.	Bowman			Princhester Ck	Princhester Creek.
Asteraceae	*	Acanthospermum hispidum DC.	Johnson R.W.		21JUN 1960	Couti-Outi 70m nnw of Rockhampton	Couti-Outi, 70 miles NNW of Rockhampton. In grey brown loamy sand.

Asteraceae	*	Ageratum conyzoides L. subsp. conyzoides	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Sarsfield Creek 20.3km e from Sarina/Marlborough rd on Anglewood d to Ogmore	Livingstone Shire, Sarsfield Creek, 20.3km E from Sarina/Marlborough road on Anglewood Road to Ogmore. Lowland flat, Eucalyptus/Melaleuca/Casuarina woodland, weedy understorey. Annual herb, common on sandy creek bed.
Asteraceae	*	Aster subulatus Michx.	Bean A.R.		28JUL 1997	Coonyan Ck Stanage Bay Rd n of Rockhampton	Coonyan Creek, Stanage Bay Road, N of Rockhampton. Sandy creekbed with Eucalyptus tereticornis, Melaleuca leucadendra, M. fluviatilis. Herb 80cm. high, flowers mauve. Rare at site.
Asteraceae	*	Bidens pilosa L.	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, 56km ne from Bruce Hwy, road to Stanage Bay, Wadallah Creek crossing	Livingstone Shire, 56km NE from Bruce Hwy, road to Stanage Bay, Wadallah Creek crossing. Creek line, Melaleuca - Eucalyptus overstorey, herbland on sandy creek bed. Annual herb. Common on site.
Asteraceae	*	Gamochaeta pensylvanica (Willd.) Cabrera	Johnson R.W.		21JUN 1960	Couti-Outi 70m nnw of Rockhampton	Couti-Outi, 70 miles NNW of Rockhampton. In grey-brown loamy sand.
Asteraceae	E	Olearia macdonnellensis D.A.Cooke	Hanger D.		15JUN 2004	Bukulla, below Rhonda's rock, ca 10km nw Marlborough	Bukulla - ca 10km NW Marlborough. Rocky hillside just below Rhonda's Rock, red soil. Shrub to 2m. Occasional.
Asteraceae	*	Parthenium hysterophorus L.	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, 6km n of Sarina/Marlborough rd on Apis Creek rd to Ogmore, Oakey Creek	Livingstone Shire, 6km N of Sarina/Marlborough road on Apis Creek Rd to Ogmore, Oakey Creek.Riparian low flat seasonal wetland, Eucalyptus - Casuarina forest, weedy understorey. Declared C2 weed. Annual herb 0.5m tall. Occasional on site.
Asteraceae	*	Verbesina encelioides (Cav.) Benth. & Hook.f. ex A.Gray	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Oakey Creek, 5.8km north from Sarina/Marlborough road to Ogmore.	Livingstone Shire, Oakey Creek, 5.8km north from Sarina/Marlborough road to Ogmore. Riparian forest, sandy creek bed. Short lived daisy, 0.4m tall, toxic to stock. Occasional population on roadsides.
Asteraceae	*	Xanthium occidentale Bertol.	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, Boundary Lagoons, 43km ne of Bruce Hwy on Stanage Bay Rd	Livingstone Shire, Boundary Lagoons, 43km NE of Bruce Hwy on Stanage Bay rd. Flood plain, grassland. Roadside herb, annual weed. Occasional on site.
Boraginaceae	*	Heliotropium amplexicaule Vahl	Batianoff G.N.	Halford,D.A.; Stacey,W.;	29NOV 2004	Livingstone Shire, Wadallah Creek crossing, road to Stanage Bay, 55.4km n from Bruce Hwy	Livingstone Shire, Wadallah Creek crossing, road to Stanage Bay, 55.4km N from Bruce Hwy. Creek flat, sandy soil, Melaleuca forest, weedy ground cover. Perennial herb, occasional. Occasional.
Boraginaceae	*	Heliotropium indicum L.	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire Boundary Lagoons, 43km ne of Bruce Hwy rd to Stanage Bay	Livingstone Shire Boundary lagoons, 43km NE of Bruce Hwy Rd to Stanage Bay. Flood plain, wetland area sedges & weedy herb. Wetland annual herb. Occasional on site.
Cactaceae	*	Acanthocereus tetragonus (L.) Hummelinck	Gleeson T.J.		12SEP 1967	St Lawrence township	St Lawrence township. Growing tip and stein bright green.
Caesalpiniaceae	*	Bauhinia purpurea L.	Batianoff G.N.	Halford,D.A.; Stacey,W.;	28NOV 2004	Livingstone Shire, road to Stanage Bay, 13.7km n from Bruce Hwy, upper reaches of Herbert Creek	Livingstone Shire, road to Stanage Bay, 13.7km N from Bruce Hwy, upper reaches of Herbert Creek. Creek banks deep clay soil, riparian eucalypt forest, weedy understorey of Lantana etc. Naturalised garden escapee, tree 5-6m tall, possible garden dumping. Occasional on site.

Caesalpiniaceae	*	Chamaecrista rotundifolia (Pers.) Greene var. rotundifolia	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, alfway Creek, 34km ne of Bruce hwy rd to Stanage Bay	Livingstone Shire, Halfway Creek, 34km NE of Bruce Hwy, road to Stanage Bay. Coastal plain, flood plain, herbland, pasture. Invasive creeping prostrate herb, spreading on creek bank. Common on site.
Caesalpiniaceae	*	Delonix regia (Bojer ex Hook.) Raf.	Batianoff G.N.	Halford,D.A.; Stacey,W.;	29NOV 2004	Livingstone Shire, road to Stanage Bay, 13.7km n from Bruce Hwy, upper reaches of Herbert Creek	Livingstone Shire, road to Stanage Bay, 13.7km N from Bruce Hwy, upper reaches of Herbert Creek. Creek bank, riparian Eucalyptus open forest, weedy understorey. Tree 8m tall, possible garden dumpings, garden escapee. Rare on site.
Caesalpiniaceae	*	Tamarindus indica L.	Batianoff G.N.	Ryan,T.;	14MAY 1998	Pine Mountain Marlborough (r)	Pine Mtn, Marlborough. Serpentinite soil, plain, drainage line fringing forest. 6m tree. Occasional.
Commelinaceae	R	Cartonema brachyantherum Benth.	Plumb J.		10MAR 1999	By Halfway Ck on Stanage Bay rd between Rockhampton and Marlborough (gps 22 37 41 150 05 18)	By Halfway Creek on Stanage Bay Road between Rockhampton and Marlborough.(GPS 22 37 41 150 05 18). Alluvial flats beside creek of red, sandy soil near Thysanotus, Mitrasacme, Centrolepis, Commelina species. Circular spreading plant to about 10 cm tall. Flowering heads with 3-petaled yellow flowers on separate stems to leaves. Reasonably common within area.
Convolvulaceae	*	Convolvulus arvensis L.	Kelly T.K.		02JUN 1966	Marlborough Hack property	Marlborough, property of G.J.A. Hack. Dark brown clay soil; weed in cultivated maize and barley. Deep rooting, trailing growth.
Convolvulaceae	*	Ipomoea carnea subsp. fistulosa (Mart. ex Choisy) D.F.Austin	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Ogmore, Belar St	Livingstone Shire, Ogmore, Belar St. Roadside grassland with few Ipomoea shrubs & Acacia regrowth. Shrub 1.5m tall naturalised from garden refuse. Occasional on site.
Crassulaceae	*	Bryophyllum delagoense (Eckl. & Zeyh.) Schinz	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Ogmore track to Styx	Livingstone Shire, Ogmore, track to Styx. Roadside verge, weedy herbland, garden escapee. Succulent herb, growing in clumps. Common on site.
Cucurbitaceae	*	Cucurbita pepo L.	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, Boundary Lagoon, 42.6km n of Bruce Hwy, east to Stanage Bay	Livingstone Shire, Boundary Lagoon, 42.6km N of Bruce Hwy, east to Stanage Bay. Drainage line, sandy soil, grassed area, Melaleuca woodland, grassy groundcover. Annual herb, yellowy flowers. Creeper, wild pumpkin. Occasional on site.
Cyperaceae	*	Cyperus compressus L.	Johnson R.W.		21JUN 1960	Couti-Outi 70m nnw of Rockhampton	Couti-Outi, 70M NNW of Rockahmpton. Grey brown loamy sand. Sedge.
Euphorbiaceae	R	Actephila sessilifolia Benth.	Sattler P.		MAY 1984	Mt O'Connell ne of Marlborough	
Euphorbiaceae	*	Chamaesyce hirta (L.) Millsp.	Bean A.R.		27APR 2000	0.9km from Bruce Hwy towards St Lawrence (gps 22 19 07 149 29 06)	0.9km from Bruce Hwy, towards St Lawrence. (GPS 22 19 07 149 29 06). Woodland of Eucalyptus tereticornis, E.tessellaris, Acacia holosericea. Sandy soil. Erect herb 15cm high. Rare at site.
Euphorbiaceae	*	Euphorbia cyathophora Murr	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, Stanage Bay, Alligator Pt	Livingstone Shire, Stanage Bay, Alligator Pt. Coastal seashore, beach scrub, weedy understorey. Weedy succulent herb, milky sap. Common on site.
Euphorbiaceae	*	Jatropha gossypiifolia L.	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, nw of Marlborough, Kooltandra - abandoned rail station	Livingstone Shire, NW of Marlborough, Kooltandra - abandoned rail station. Creek bank, riparian Eucalyptus - Melaleuca open forest. Garden escapee from abandoned railway station. Shrub 0.8m tall. Rare on site.

Euphorbiaceae	V	Neoroepera buxifolia Muell.Arg. & F.Muell.	Hendry R.	Hendry,R.;	03JUN 2006	Creekline below Mt Bonnie Doon, c. 25km n of Yaamba	Creekline below Mt Bonnie Doon, c. 25km N of Yaamba. Dry creek bed; Eucalyptus fibrosa (Glen Geddes), Corymbia xanthope woodland with dry rainforest species in the understorey dominated by Citriobatus spinescens with Pimelea leptospermoides and Leucopogon cuspidatus in the ground stratum; serpentinite. Tree, juvenile foliage.
Euphorbiaceae	*	Ricinus communis L.	Forster P.I.	Figg,S.J.;	20JUL 1995	Greta Ck Xing Sarina to Marlborough Rd (gps 22 27 10 149 28 56) (r) (p)	Greta Creek Crossing, Sarina to Marlborough road (GPS 22 27 10 149 28 56). Disturbed bank of sandy creek. Shrub to 4m, yellow male flowers, pink styles, fruit. Very common in area.
Fabaceae	*	Alysicarpus bupleurifolius (L.) DC.	Blake S.T.		06JUN 1934	St Lawrence	St Lawrence. Spreading.
Fabaceae	*	Alysicarpus vaginalis (L.) DC.	Bean A.R.		27APR 2000	4km wsw of St Lawrence (gps 22 21 44 149 30 12)	4km WSW of St Lawrence. (GPS 22 21 44 149 30 12). Woodland of Eucalyptus tereticornis, E.platyphylla, Melaleuca viridiflora, grassy understorey. Flat. Loamy soil. Prostrate shrub, flowers purple. Rare at site.
Fabaceae	*	Centrosema molle Mart. ex Benth.	Batianoff G.N.	Halford,D.A.; Stacey,W.;	29NOV 2004	Livingstone Shire, Wadallah Creek Crossing, road to Stanage Bay, 55.6km n from Bruce Hwy	Livingstone Shire, Wadallah Creek crossing, road to Stanage Bay, 55.6km N from Bruce Hwy. Creek flat, sandy soil, fringing Melaleuca forest, weedy ground cover. Vine, possibly pasture introduction, now naturalised. Rare on site.
Fabaceae	*	Crotalaria incana L. subsp. incana	Bean A.R.		27JUN 1992	Montrose Ck 42km nw of Marlborough	Montrose Creek, 42km NW of Marlborough. On creekbank, with Casuarina cunninghamiana, Melaleuca sp. Shrub 1.2 metres high. Flowers yellow.
Fabaceae	*	Crotalaria juncea L.	Anderson E.R.		19APR 1979	Nullegar 2km w of	2km W of Nullegar. Plain, flat. Sandy clay loam, duplex. Eucalyptus alba woodland, cleared, planted to pasture, weed. Erect herbaceous bush, woody.
Fabaceae	*	Crotalaria pallida var. obovata (G.Don) Polhill	Batianoff G.N.	Halford,D.A.; Stacey,W.;	29NOV 2004	Livingstone Shire, road to Stanage Bay, 13.7km n from Bruce Hwy, upper reaches of Herbert Creek	Livingstone Shire, road to Stanage Bay, 13.7km N from Bruce Hwy, upper reaches of Herbert Creek. Creek bank, riparian Eucalyptus forest, weedy understorey, sandy soil. Annual herb growing on creek bed. Occasional on site.
Fabaceae	*	Desmodium triflorum (L.) DC.	Bean A.R.		27APR 2000	4km wsw of St Lawrence (gps 22 21 44 149 30 12)	4km WSW of St Lawrence. (GPS 22 21 44 149 30 12). Woodland of Eucalyptus tereticornis, E.platyphylla, Melaleuca viridiflora, grassy understorey. Flat. Loamy soil. Prostrate shrub, flowers purple. Occasional at site.
Fabaceae	*	Macroptilium atropurpureum (DC.) Urb.	Hanger D.		14JUL 2001	Lornavale lot 1 on rp897983 - 10km from Marlborough	Lornavale Lot 1 on RP897983 - 10km from Marlborough. On creek bank climbing amongst sparse shrubs. Climbing vine. Not common.
Fabaceae	*	Macroptilium lathyroides (L.) Urb.	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, 1km n of Ogmore	Livingstone Shire, 1km N of Ogmore. Cleared land, regrowth weedy area. Annual herb. Occasional on site.
Fabaceae	*	Macroptilium lathyroides (L.) Urb.	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, Halfway Creek 34km ne of Bruce Hwy rd to Stanage Bay	Livingstone Shire, Halfway Creek 34km NE of Bruce Hwy Rd to Stanage Bay. Roadside, flood plain, herbland. Annual herb, purple flowers, widespread in central Qld. Occasional on site.
Fabaceae	V	Pultenaea setulosa Benth.	Bowman			Broad Sound	Broad Sound.
Fabaceae	*	Stylosanthes humilis Kunth	Johnson R.W.		21JUN 1960	Couti-Outi 70m nnw of Rockhampton	Couti-Outi, 70 miles NNW of Rockhampton. In grey-brown loamy sand.

Fabaceae	*	Stylosanthes scabra Vogel	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, 46km n of Marlborough, Granite Creek	Livingstone Shire, 46km N of Marlborough, Granite Creek. Riparian Eucalyptus - Melaleuca open forest, sandy creek bed full of weedy herbs. Widespread, invasive, 1.1m shrubby herb in disturbed areas. Common on site.
Flacourtiaceae	R	Xylosma ovatum Benth.	Webb L.J.	Tracey,J.G.;	28JUL 1971	Shoalwater Bay Torilla Holding	Torilla Holding, property of L.Geddes, Portion 2, Parish of Torilla, W shore of Shoalwater Bay, S of Strange Bay. Flat coastline of white sand and shellgrit. In fragmented semi-evergreen vine thickets with Pouteria obtusa and Diospyros ferrea var.geminata.Much-branched small tree to 3m. Rainfall c 1000mm.
Lamiaceae	*	Hyptis suaveolens (L.) Poit.	Bean A.R.		27APR 2000	0.9km from Bruce Hwy towards St Lawrence (gps 22 19 07 149 29 06)	0.9km from Bruce Hwy, towards St Lawrence. (GPS 22 19 07 149 29 06). Woodland of Eucalyptus tereticornis, E.tessellaris, Acacia holosericea. Sandy soil. Herb 90cm high, unbranched, strong-smelling. Flowers purple. Occasional at site.
Lamiaceae	*	Hyptis suaveolens (L.) Poit.	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Granite Creek, Bruce Hwy, 46km n of Marlborough	Livingstone Shire, Granite Creek, Bruce Hwy, 46km N of Marlborough. Bridge site, riparian Eucalyptus - Melaleuca open forest, weedy ground cover on creek bed.Short lived perennial 2m tall. Occasional on site.
Malvaceae	*	Urena lobata L.	Hanger D.		15JUL 2001	Along logging track near Shoalwater Bay Military Training Area	Along logging track near Shoalwater Bay Military Training Area. Close to creek, (Wellington Creek) - alluvium. Associated species Denhamia, Diospyros, Hovea, Micromelum. Low shrub to 1m tall. Not common.
Mimosaceae	*	Acacia farnesiana (L.) Willd.	Coveny R.	Hind,P.;	02SEP 1975	45km (28.8m) wnw of Marlborough towards St Lawrence	45km (28.8 miles) WNW of Marlborough towards St Lawrence. Spreading shrub to 2m high, branching low with smooth grey bark and orange flowers. Solitary plant in cleared grazing paddock. Woodblock for phytechemical survey.
Mimosaceae	*	Acacia nilotica subsp. indica (Benth.) Brenan	Pedley L.		10MAY 1982	7km w of St Lawrence	7km W of St Lawrence. On clay soil on roadside. Spreading tree to 4m., flowers bright yellow.
Mimosaceae	*	Leucaena leucocephala (Lam.) de Wit subsp. leucocephala	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, 44km n of Marlborough, Bruce Hwy	Livingstone Shire, 44km N of Marlborough, Bruce Hwy. Riverside and creek flat, seasonal wetland, disturbed riparian forest, invaded by Leucaena. High population about 2ha, shrub 2m tall. Common on site.
Mimosaceae	*	Mimosa pudica var. unijuga (Walp. & Duchass.) Griseb.	Bean A.R.		27APR 2000	4km wsw of St Lawrence (gps 22 21 44 149 30 12)	4km WSW of St Lawrence (GPS 22 21 44 149 30 12). Woodland of Eucalyptus tereticornis, E. platyphylla, Melaleuca viridiflora, grassy understorey. Flat. Loamy soil. Prostrate shrub. Leaflets folding onto each other at the slightest touch. FLowers mauve. Occasional at site.
Mimosaceae		Paraserianthes toona (F.M.Bailey) I.C.Nielsen	Forster B.A.		04JUN 1992	Granite Ck nw of Ogmore	Granite Creek, north-west of Ogmore, Broadsound Shire. Creek bank. Tree to 8metres, dark tough bark. Mackay Cedar.New southern limit.
Papaveraceae	*	Argemone mexicana L.	Stanley T.D.	Ross,E.;	17NOV 1978	6km from St Lawrence	C 6K from St Lawrence. Roadside.
Papaveraceae	*	Argemone ochroleuca Sweet subsp. ochroleuca	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, 6km n from Sarina-Marlborough Rd, Apic Creek Rd to Ogmore, Oakey Creek	Livingstone Shire, 6km N from Sarina-Marlborough road, Apic Creek Rd to Ogmore, Oakey Creek. Creek flat, seasonal wetland, riparian Eucalyptus-Casuarina forest, weedy understorey. Weedy annual herb, yellow sap, widespread. Occasional on site.

Passifloraceae	*	Passiflora foetida L.	Bean A.R.		24FEB 2003	47km from Marlborough, towards St Lawrence	47km from Marlborough, towards St Lawrence. Roadside; grassland with scattered trees of Eucalyptus crebra, clay soil. Flat terrain. Prostrate vine, strong smelling. Flowers white, fruits immature. Occasional at site.
Passifloraceae	*	Passiflora suberosa L.	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Granite Creek 46km n of Marlborough, Bruce Hwy	Livingstone Shire, Granite Creek, 46km N of Marlborough, Bruce Hwy. Seasonal wetland, creek flats, Melaleuca - Eucalyptus low forest, grassy understorey. Perennial creeping herb or vine. Occasional on site.
Phytolaccaceae	*	Rivina humilis L.	Batianoff G.N.	Ryan,T.;	14MAY 1998	Pine Mountain Marlborough Station	Pine Mountain, Marlborough Station. Hoop pine emergent 30m, dry scrub understorey 8-12m tall. 0.5-1m ground cover herb. Common.
Pittosporaceae	V	Bursaria reevesii L.Cayzer, Crisp & I.Telford	Hendry R.	Hendry,R.;	03JUN 2006	Lower slopes of Mt Bonnie Doon, c. 26km n of Yaamba	Lower slopes of Mt Bonnie Doon, c. 26km N of Yaamba. Lower hillslope, moderately steep, southern aspect; Eucalyptus fibrosa (Glen Geddes), Corymbia xanthope open woodland with Acacia leptostachya, Hakea trineura in the mid layer with mid-dense lower mid layer of Xanthorrhoea sp., Leucopogon cuspidatus and hummocks of grasses; exposed serpentinised rocks/gravels, serpentinite. Shrub 1.5m high. One plant only.
Poaceae	*	Cenchrus echinatus L.	Johns Y.J.		16NOV 1933	Marlborough north coast line	Marlborough, North Coast Line.
Poaceae	*	Chloris inflata Link	Simon B.K.	Andrews,S.B.;	05MAY 1975	Sarina-Marlborough Rd 80km from Sarina	Sarina-Marlborough Road, 80km from Sarina. Eucalyptus drepanophylla open woodland.
Poaceae	*	Chloris inflata Link	Batianoff G.N.	Halford,D.A.; Stacey,W.;	29NOV 2004	Livingstone Shire, Wadallah Creek crossing, road to Stanage Bay, 55.6km n from Bruce Hwy	Livingstone Shire, Wadallah Creek crossing, road to Stanage Bay, 55.6km N from Bruce Hwy. Creek bed, sandy soil, Melaleuca fringing forest, weedy ground cover. Perennial herb. Occasional on site.
Poaceae	*	Chloris virgata Sw.	Blake S.T.		06JUN 1934	Wumalgi	Wumalgi. By river. More or less tufted ascending and erect. Green. Spikelets paler.
Poaceae	*	Cynodon dactylon (L.) Pers. var. dactylon	Johnson R.W.		21JUN 1960	Couti-Outi 70m nnw of Rockhampton	Couti-Outi, 70 miles NNW of Rockhampton. In grey brown loamy sand. Prostrate culms rooting at the nodes.
Poaceae	*	Dactyloctenium aegyptium (L.) Willd.	Simon B.K.	Andrews,S.B.;	05MAY 1975	Sarina-MarlboroughRrd 80km from Sarina	Sarina-Marlborough Road, 80km from Sarina. Eucalyptus drepanophylla open woodland.
Poaceae	*	Dichanthium annulatum (Forssk.) Stapf	Blake S.T.		01JUN 1942	Styx Charons Ferry stn nr	Charons Ferry Station, near Styx. In Eucalypt forest on hard yellowish, often melon holy soil. Tufted, erect 2-3 ft, rather glaucous; spikelets purple.
Poaceae	*	Dichanthium aristatum (Poir.) C.E.Hubb.	Hanger D.		31AUG 2003	'Bukulla' 10km nw of Marlborough	'Bukulla' 10km NW of Marlborough. Grass in gully. Erect grass 0.5m tall. Occasional.
Poaceae	*	Digitaria ciliaris (Retz.) Koeler	Johnson R.W.		21JUN 1960	Couti-Outi 70m nnw of Rockhampton	Couti-Outi, 70 miles NNW of Rockhampton. In grey brown loamy sand. Culms prostrate or weakly ascending.
Poaceae	*	Digitaria violascens Link	Anderson E.R.		19MAR 1982	The Springs 20km n of Glen Geddes	The Springs, 20km N of Glen Geddes. Flat plain, sandy clay loam surface duplex soil. Eucalyptus populnea woodland, cleared grassland. Grass - not common.
Poaceae	*	Echinochloa colona (L.) Link	Anderson E.R.		18MAR 1982	The Springs 20km n of Glen Geddes	The Springs, 20km north of Glen Geddes. Flat plain, sandy clay loam surface duplex soil. Eucalyptus populnea woodland, cleared-grassland. Grass - not common.
Poaceae	*	Echinochloa crus-galli (L.) P.Beauv.	Bean A.R.		24FEB 2003	47km from Marlborough, towards St Lawrence	47km from Marlborough, towards St Lawrence. Roadside; grassland with scattered trees of Eucalytpus crebra. Clay soil. Flat terrain. Grass 50cm high, spikelets purple or green. Occasional at site.

Poaceae	*	Echinochloa polystachya (Kunth) Hitchc. cv. Amity	Snow N.	Simon,B.K.;	15APR 1996	C 26 rd km nw of Marlborough along the Bruce Hwy (hwy 1) (ex coll 22 42 46 149 40 12)	NW of Marlborough (EX COLL 22 42 46 149 40 12). Pond pasture. Large monospecific stand.
Poaceae	*	Eleusine indica (L.) Gaertn.	not known		31AUG 2003	'Bukulla', 10km nw of Marlborough.	'Bukulla', 10km NW of Marlborough. On grey loam near trough near northern mill. Grass, more or less prostrate. Common at the site.
Poaceae	*	Eragrostis pilosa (L.) P.Beauv.	Brown R.		16SEP 1802	Broad Sound near Upper Head	Broad Sound, near Upper Head.
Poaceae	*	Eragrostis tenuifolia (A.Rich.) Hochst. ex Steud.	Anderson E.R.		23MAY 1986	'The Springs' c 18km n of Glen Geddes	The Springs, ca 18km north of Glen Geddes. Plain, flat. Duplex soil with sandy clay loam surface. Cleared Eucalyptus populnea woodland. Grassy.
Poaceae	*	Eriochloa meyeriana (Nees) Pilg.	Wildin J.		08JAN 1988	Granite Vale Wumalgi nr St Lawrence	Granite Vale, Wumalgi, near St Lawrence. Wetlands on clay. Observed to be relatively more palatable than poa grass.
Poaceae	*	Hymenachne amplexicaulis (Rudge) Nees cv. Olive	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Marlborough area, Koottrandra siding	Livingstone Shire, Marlborough area, Koottrandra siding. Dam, aquatic herbland, Hymenachne 20% of the area. Aquatic grass. Common on site.
Poaceae	*	Hyparrhenia rufa (Nees) Stapf	Alcock C.R.		02AUG 1981	80km s of Sarina on Bruce Hwy	80km S of Sarina on Bruce Highway.
Poaceae	*	Megathyrsus maximus var. pubiglumis (K.Schum.) B.K.Simon & S.W.L.Jacobs	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, Stanage Bay, Alligator Point	Livingstone Shire, Stanage Bay, Alligator Point. Seashore beach scrub, disturbed area by camping, sand. Tall tropical grass. Occasional on site.
Poaceae	*	Megathyrsus maximus var. pubiglumis (K.Schum.) B.K.Simon & S.W.L.Jacobs	Batianoff G.N.	Halford,D.A.; Stacey,W.;	29NOV 2004	Livingstone Shire, Wadallah Creek Crossing, road to Stanage Bay 55.6km n from Bruce Hwy	Livingstone Shire, Wadallah Creek crossing, road to Stanage Bay, 55.6km N from Bruce Hwy. Low silty clay plain, Melaleuca woodland, weedy understorey exotics. Tall tropical grass. Occasional at site.
Poaceae	*	Melinis repens (Willd.) Zizka	Fagg M.		18MAY 1970	97m N Rockhampton on Mackay road	97 miles N of Rockhampton on road to Mackay. Savanna woodland, undulating hills, rocky soil.
Poaceae	R	Paspalidium scabrifolium S.T.Blake	Simon B.K.		04APR 1978	27km from Marlborough on St Lawrence Rd	Marlborough-St. Lawrence Road, 27km from Marlborough. Open forest of Eucalyptus alba, E. papuana, E. microtheca and E. decepta/crebra. Grass cover of Digitaria divaricatissima, Eulalia fulva, Dichanthium annulatum, Themeda australis, Aristida calycina, Eragrostis leptostachya and Paspalidium scabrifolium; Sporobolus diander in creek bed.
Poaceae	*	Pennisetum ciliare (L.) Link	Batianoff G.N.	Halford,D.A.; Stacey,W.;	29NOV 2004	Livingstone Shire, Stanage Bay S of boat ramp, squatters camp	Livingstone Shire, Stanage Bay, S of boat ramp, squatters camp. Seashore sandy beach, Casuarina equisetifolia woodland. Perennial herb on frontal dune. Occasional on site.
Poaceae	*	Sorghum arundinaceum (Desv.) Stapf	Durrington L.		28SEP 1973	Stanage Bay	Stanage Bay. Low sand dunes. Roadside.
Poaceae	*	Sorghum halepense (L.) Pers.	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, Styx railway siding	Livingstone Shire, Styx Railway Siding. Roadside verge, herbland. Tall grass 1.8m tall, widespread on roadsides. Occasional on site.

Poaceae	*	Sporobolus jacquemontii Kunth	Simon B.K.		04APR 1978	St lawrence Rd 27km from Marlborough	St Lawrence Road, 27 km from Marlborough. Open forest of Eucalyptus alba, E. papuana, E. microtheca and E. decepta/crebra. Grass over of Digitaris annulatum, Themeda australis, Aristida calycina, Eragrostis ceptostchya and Paspalidium scabrifolium; Sporobolus diander in creek bed.
Poaceae	*	Sporobolus pyramidalis P.Beauv.	Simon B.K.	Bishop,H.;	23APR 1991	'Olympus' property of Jack O'Regan 2km s of Kalarka on Bruce Hwy	Olympus, property of Jack O'Regan, 2km S of Kalarka, on Bruce Highway. Around homestead and several pastures. Tufted perennial weed.
Poaceae	*	Themeda quadrivalvis (L.) Kuntze	Tomley A.J.		MAY 1970	40m nw Rockhampton on Bruce Hwy	40 miles NW of Rockhampton on the Bruce Highway.
Poaceae	*	Urochloa mosambicensis (Hack.) Dandy	Simon B.K.	Andrews,S.B.;	05MAY 1975	Broadsound ra 51km from Marlborough on Sarina rd	Broadsound Range, 51km from Marlborough on Sarina Road. Eucalyptus spp. open woodland.
Polygonaceae	*	Antigonon leptopus Hook. & Arn.	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Ogmore	Livingstone Shire, Ogmore. Roadside, vacant land. Vine, purple flowers.Occasional on site.
Proteaceae	V	Hakea trineura (F.Muell.) F.Muell.	White C.T.		30AUG 1938	Near Old Marlborough	Near Old Marlborough. Upright shrub 2-3m high; flowers yellow tinged with green, honey scented.
Rhamnaceae	*	Ziziphus mauritiana Lam.	Johnson R.W.		18MAY 1960	Clive 30m w of Marlborough	Clive, ca. 30 miles W of Marlborough. In open forest.Tree to 20ft.
Scrophulariaceae	*	Mecardonia procumbens (Mill.) Small	Anderson E.R.		18MAR 1982	The Springs ca 20km n of Glen Geddes	Livingstone Shire, in paddock 3 of Stylo Grazing Trial, 'The Springs', ca. 20km N of Glen Geddes. Flat plain, sandy clay loam surface Duplex, cleared woodland-open forest of Eucalyptus populnea, now grassland mainly Heteropogon contortus and Chrysopogon fallax. Small prostrate decumbent herb in wettish areas, light yellow flowers, fairly common.
Scrophulariaceae	*	Scoparia dulcis L.	Batianoff G.N.	Halford,D.A.;	29NOV 2004	Livingstone Shire, north of Marlborough, Kooltandra railway siding	Livingstone Shire, north of Marlborough, Kooltandra Railway Siding. Drainage line, riparian fringing forest of Eucalypt & Melaleuca; serpentine soils. Annual herb in creek beds. Occasional on site.
Solanaceae	*	Capsicum frutescens L.	Speck N.H.		24AUG 1963	3.8m n of Toorilla Hs	3.8M N of Toorilla Homestead. Alluvial drainage floor. Undershrub 3-4ft, leaves bright green. Pepper red.
Solanaceae	*	Datura leichhardtii F.Muell. ex Benth.	Bailey F.M.			Tooloombah	Tooloombah.
Solanaceae	E	Solanum adenophorum F.Muell.	Johnson R.W.		19MAY 1960	C 45m from Marlborough Bruce Hwy	Marlborough-Sarina Road (Bruce Highway) ca 45 miles from Marlborough. In brigalow scrub. Fruit green succulent.
Solanaceae	*	Solanum erianthum D.Don	Anderson E.R.		12OCT 1989	Mt O'Connell 15km ne of Marlborough	Mount O'Connell, 15km NE of Marlborough. Undulating plain, clay loam surface duplex soil, cleared softwood/dry vine scrub.Shrub to 2m, ripe fruit.
Solanaceae	*	Solanum seaforthianum Andrews	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, Sarsfield Creek 20.3km n on Anglewood Rd to Ogmore, ne from Sarina/Malborough rd	Livingstone Shire, Sarsfield Creek, 20.3km N on Anglewood Rd to Ogmore, NE from Sarina/Malborough road. Riparian vegetation, permanent water pools. Eucalyptus, Melaleuca, Casuarina open forest infested with rubber vine. Perennial herb/vine.Occasional on site.
Solanaceae	*	Solanum torvum Sw.	Durrington L.		SEP 1973	Ca 20km n along stanage bay rd from junction with Bruce Hwy at Kunwarara	About 20km N along Stanage Bay Road from junction with Bruce Hwy at Kunwarara. Creek bank, sandy loam, Eucalypt-Melaleuca open forest. Shrub 180cm. high, flowers white, stamens yellow.

Sparrmanniaceae	*	Triumfetta rhomboidea Jacq.	Bean A.R.		27JUN 1992	Montrose Ck 42km nw of Marlborough	Montrose Creek, 42km NW of Marlborough. Growing beside creek, with Melaleuca leucadendra, Casuarina cunninghamiana. Shrub 80cm high. Flowers yellow.
Stackhousiaceae	R	Stackhousia tryonii F.M.Bailey	Reeves R.D.		08MAR 1989	Princhester overpass on Bruce Hwy	Princhester overpass, on Bruce Highway. Railway track, serpentine soils. Themeda grassland with Eucalyptus fibrosa and Macrozamia. Herb. Abundant.
Thymelaeaceae	R	Pimelea leptospermoides F.Muell.	Specht R.L.	Reeves,R.D.;	26JAN 1989	Mt Bonnie Doon Rockhampton-Marlborough area	Mt Bonnie Doon, Rockhampton-Marlborough area. Serpentinite rock/soil. Shrub.
Verbenaceae	*	Lantana camara L.	Batianoff G.N.	Halford,D.A.;	28NOV 2004	Livingstone Shire, 9km n of Sarina/Marlborough Rd to Ogmore	Livingstone Shire, 9km N of Sarina/Marlborough road to Ogmore. Dry creek flat, Eucalyptus-Lophostemon forest with rubber vine and Lantana weeds.Shrub sprawling, multi stemmed, 2-3m tall. Common on site.
Verbenaceae	*	Lantana montevidensis (Spreng.) Briq.	Bean A.R.		15NOV 1990	Arthur Point (Alligator Point) 100km n of Kunwarara	Arthur Point (Alligator Point), 100km N of Kunwarara. In shallow sandy soil, on rocky headland, with Planchonia careya and Passiflora foefida. Vine with purple flowers. Common.
Verbenaceae	*	Stachytarpheta jamaicensis (L.) Vahl	Johnson R.W.		21JUN 1960	Couti-outi 70m nnw of Rockhampton	Couti-Outi, 70 miles NNW of Rockhampton. In grey brown loamy sand. Erect herb.
Cycadaceae	E	Cycas ophiolitica K.D.Hill	Healy R.		12NOV 2004	State Forest 794 Alligator Creek, 52km nnw of Rockhampton at 345 degrees	State Forest 794 Alligator Creek, 52km NNW of Rockhampton at 345 degrees. Plain - 80m from creek bank. Shown as alluvium on geology map. Sandy, loam orange to grey colour. Open forest of Corymbia citriodora, C. intermedia, C. dallachyana, Lophostemon suaveolens, Eucalyptus crebra or E. drepanophylla, Lophostemon conferta, Acacias, Cycads, and Coleospernum reticulatus. Bush 500mm high, abundant seeds, leaves dark green. Hundreds of cycads in mmediate area, within 100m. Numerous old male cones and abundant fresh seeds.
Zamiaceae	E	Macrozamia serpentina D.L.Jones & P.I.Forst.	Hanger D.		16JUN 2004	Burkulla - ca 10km nw Marlborough	Burkulla - ca 10km NW Marlborough. Serpentinite on S ridge. Associated species: Pimelea, Xanthorrhoea, Acacia, Leucopogon. Very common on ridge.

S8 Animals of conservation significance and exotic species recorded within the Broadsound region.

This listing is extracted from Wildlife Online (http://www.epa.qld.gov.au/nature_conservation/wildlife/wildlife_online/#defined_area accessed 31/01/08) related to the Queensland Nature Conservation Act 1992 and lists under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. * indicates an exotic species naturalized in the wild. Under the Queensland Nature Conservation Act (Qld NCA) **E** indicates a classification of Endangered, **V** indicates a classification of Vulnerable, **R** indicates a classification of Rare. Under the Environment Protection and Biodiversity Conservation Act 1999 (Cmwlth EPBC) **CE** indicates a classification of critically endangered, **E** indicates a classification of Endangered, **V** indicates a classification of Vulnerable, **Cet** indicates protected as a marine whale or dolphin, **M** indicates a migratory species. (Listed migratory species are a matter of national environmental significance under the EPBC Act's assessment and approval provisions), **L** indicates a species listed under the act (Listed species are protected under Cmwlth EPBC),

	Scientific Name	Common Name	Qld NCA	Cmwlth EPBCA	Exotic	Notes
Crocodiles	*Crocodylus porosus*	Estuarine Crocodile, Salt-water Crocodile		M, L		Species or species habitat likely to occur within area
Lizard	*Paradelma orientalis*	Brigalow Scaly-foot		V		Species or species habitat likely to occur within area
Lizard	*Varanus semiremex*	rusty monitor	R			
Lizard	*Egernia rugosa*	Yakka Skink		V		Species or species habitat likely to occur within area
Snake	*Acalyptophis peronii*	Horned Seasnake		L		Species or species habitat may occur within area
Snake	*Acanthophis antarcticus*	common death adder	R			
Snake	*Aipysurus duboisii*	Dubois' Seasnake		L		Species or species habitat may occur within area
Snake	*Aipysurus eydouxii*	Spine-tailed Seasnake		L		Species or species habitat may occur within area
Snake	*Aipysurus laevis*	Olive Seasnake		L		Species or species habitat may occur within area
Snake	*Anomalopus brevicollis*		R			
Snake	*Astrotia stokesii*	Stokes' Seasnake		L		Species or species habitat may occur within area
Snake	*Denisonia maculata*	Ornamental Snake		V		Species or species habitat likely to occur within area
Snake	*Disteira kingii*	Spectacled Seasnake		L		Species or species habitat may occur within area
Snake	*Disteira major*	Olive-headed Seasnake		L		Species or species habitat may occur within area
Snake	*Emydocephalus annulatus*	Turtle-headed Seasnake		L		Species or species habitat may occur within area
Snake	*Furina dunmalli*	Dunmall's Snake		V		Species or species habitat may occur within area
Snake	*Hydrophis elegans*	Elegant Seasnake		L		Species or species habitat may occur within area
Snake	*Hydrophis mcdowelli*	a seasnake		L		Species or species habitat may occur within area
Snake	*Hydrophis ornatus*	a seasnake		L		Species or species habitat may occur within area
Snake	*Lapemis hardwickii*	Spine-bellied Seasnake		L		Species or species habitat may occur within area
Snake	*Laticauda colubrina*	a sea krait		L		Species or species habitat may occur within area
Snake	*Laticauda laticaudata*	a sea krait		L		Species or species habitat may occur within area

Snake	*Lepidochelys olivacea*	Pacific Ridley, Olive Ridley		E, M, L		Species or species habitat may occur within area
Snake	*Pelamis platurus*	Yellow-bellied Seasnake		L		Species or species habitat may occur within area
Turtles	*Caretta caretta*	Loggerhead Turtle		E, M, L		Species or species habitat may occur within area
Turtles	*Chelonia mydas*	Green Turtle		V, M, L		Species or species habitat may occur within area
Turtles	*Dermochelys coriacea*	Leathery Turtle, Leatherback Turtle, Luth		V, M, L		Species or species habitat may occur within area
Turtles	*Eretmochelys imbricata*	Hawksbill Turtle		V, M, L		Species or species habitat may occur within area
Turtles	*Natator depressus*	Flatback Turtle		V, M, L		Breeding likely to occur within area
Turtles	*Rheodytes leukops*	Fitzroy Tortoise		V		Species or species habitat may occur within area
Amphibians	Bufo marinus	cane toad			*	
Marine mammal	*Balaenoptera acutorostrata*	Minke Whale		Cet		Species or species habitat may occur within area
Marine mammal	*Balaenoptera edeni*	Bryde's Whale		M, Cet		Species or species habitat may occur within area
Marine mammal	*Balaenoptera musculus*	Blue whale		E, M, Cet		
Marine mammal	*Delphinus delphis*	Common Dolphin		Cet		Species or species habitat may occur within area
Marine mammal	*Dugong dugon*	dugong	V	M, L		
Marine mammal	*Grampus griseus*	Risso's Dolphin, Grampus		Cet		Species or species habitat may occur within area
Marine mammal	*Megaptera novaeangliae*	Humpback Whale		V, M, Cet		Congregation or aggregation known to occur within area
Marine mammal	*Orcaella brevirostris*	Irrawaddy Dolphin		M, Cet		Species or species habitat may occur within area
Marine mammal	*Orcinus orca*	Killer Whale, Orca		M, Cet		Species or species habitat may occur within area
Marine mammal	*Stenella attenuata*	Spotted Dolphin, Pantropical Spotted Dolphin		Cet		Species or species habitat may occur within area
Marine mammal	*Sousa chinensis*	Indo-Pacific Humpback Dolphin		M, Cet		Species or species habitat may occur within area
Marine mammal	*Tursiops aduncus*	Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin		Cet		Species or species habitat likely to occur within area
Marine mammal	*Tursiops truncatus s. str.*	Bottlenose Dolphin		Cet		Species or species habitat may occur within area
Insectiverous bat	*Chalinolobus dwyeri*	large-eared pied bat	R	V, L		
Insectiverous bat	*Kerivoula papuensis*	golden-tipped bat	R			
Insectiverous bat	*Nyctophilus timoriensis (South-eastern form)*	Eastern Long-eared Bat		V		Species or species habitat may occur within area
Insectiverous bat	*Taphozous australis*	coastal sheathtail bat	V			
Fruit bat	*Pteropus conspicillatus*	Spectacled Flying-fox		V		Species or species habitat may occur within area
Terrestrial mammal	*Bos taurus*	European cattle			*	
Terrestrial mammal	*Canis familiaris*	dog			*	
Terrestrial mammal	*Dasyurus hallucatus*	northern quoll		E		
Terrestrial mammal	*Equus caballus*	horse				
Terrestrial mammal	*Felis catus*	cat			*	

Terrestrial mammal	*Mus musculus*	house mouse			*	
Terrestrial mammal	Oryctolagus cuniculus	rabbit			*	
Terrestrial mammal	*Sus scrofa*	pig			*	
Terrestrial mammal	*Xeromys myoides*	Water Mouse, False Water Rat	V	L		Species or species habitat known to occur within area
Bird	*Accipiter novaehollandiae*	grey goshawk	R			
Bird	*Anseranas semipalmata*	Magpie Goose		L		Species or species habitat may occur within area. overfly marine area
Bird	*Apus pacificus*	Fork-tailed Swift		M, L		Species or species habitat may occur within area, overfly marine area
Bird	*Ardea alba*	Great Egret, White Egret		M, L		Species or species habitat may occur within area, overfly marine area
Bird	*Ardea ibis*	Cattle Egret		M, L		Species or species habitat may occur within area, overfly marine area
Bird	*Calidris tenuirostris*	Great Knot		M, L		Species or species habitat likely to occur within area, overfly marine area
Bird	*Ephippiorhynchus asiaticus*	black-necked stork	R			
Bird	*Epthianura crocea macgregori*	Yellow Chat (Dawson)		C E		Species or species habitat known to occur within area
Bird	*Erythrotriorchis radiatus*	red goshawk	E	V		
Bird	*Esacus neglectus*	beach stone-curlew	V			
Bird	*Falco hypoleucos*	grey falcon	R			
Bird	*Gallinago hardwickii*	Latham's Snipe, Japanese Snipe		M, L		Species or species habitat may occur within area, overfly marine area
Bird	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)	V	V		
Bird	*Haematopus fuliginosus*	sooty oystercatcher	R			
Bird	*Haliaeetus leucogaster*	White-bellied Sea-Eagle		M, L		Species or species habitat likely to occur within area
Bird	*Hirundapus caudacutus*	White-throated Needletail		M, L		Species or species habitat may occur within area, overfly marine area
Bird	*Hirundo rustica*	Barn Swallow		M, L-		Species or species habitat may occur within area, overfly marine area
Bird	*Larus novaehollandiae*	Silver Gull		L		Breeding known to occur within area
Bird	*Lophoictinia isura*	square-tailed kite	R			
Bird	*Macronectes giganteus*	Southern Giant-Petrel		M, L, E		Species or species habitat may occur within area
Bird	*Melithreptus gularis*	Black-chinned honeyeater	R			
Bird	*Merops ornatus*	Rainbow Bee-eater		M, L-		Species or species habitat may occur within area, overfly marine area
Bird	*Monarcha melanopsis*	Black-faced Monarch		M, L-		Species or species habitat may occur within area, overfly marine area
Bird	*Monarcha trivirgatus*	Spectacled Monarch		M, L-		Breeding likely to occur within area, overfly marine area
Bird	*Myiagra cyanoleuca*	Satin Flycatcher		M, L-		Species or species habitat likely to occur within area, overfly marine area
Bird	*Neochmia phaeton*	Crimson finch	V			

Bird	*Neochmia ruficauda ruficauda*	Star Finch (eastern), Star Finch (southern)		E		Species or species habitat likely to occur within area
Bird	*Nettapus coromandelianus*	Cotton pygmy-goose	R			
Bird	*Nettapus coromandelianus albipennis*	Australian Cotton Pygmy-goose		M, L		Species or species habitat may occur within area, overfly marine area
Bird	*Ninox strenua*	Powerful owl	V			
Bird	*Numenius madagascariensis*	Eastern curlew	R			
Bird	*Numenius minutus*	Little Curlew, Little Whimbrel		M, L		Species or species habitat may occur within area, overfly marine area
Bird	*Numenius phaeopus*	Whimbrel		M, L		Species or species habitat likely to occur within area
Bird	*Passer domesticus*	house sparrow			*	
Bird	*Poephila cincta cincta*	Black-throated finch (white-rumped subspecies)	V	E		
Bird	*Pterodroma neglecta neglecta*	Kermadec Petrel (western)		V		Species or species habitat may occur within area
Bird	*Rhipidura rufifrons*	Rufous Fantail		M, L		Breeding may occur within area, overfly marine area
Bird	*Rostratula australis*	Australian Painted Snipe		V		Species or species habitat may occur within area
Bird	*Rostratula benghalensis s. lat.*	Painted Snipe		M, L		Species or species habitat may occur within area, overfly marine area
Bird	*Sterna albifrons*	Little tern	E			
Bird	*Sterna albifrons*	Little Tern		M, L		Species or species habitat may occur within area
Bird	*Sterna bergii*	Crested Tern		M, L		Breeding known to occur within area
Bird	*Sterna caspia*	Caspian Tern		L		Breeding known to occur within area
Bird	*Tadorna radjah*	Radjah shelduck	R			
Bird	*Turnix melanogaster*	Black-breasted button-quail	V	V		
Butterfly	*Jalmenus evagoras eubulus*	imperial hairstreak (northern subspecies)	V			
Pipefish & seahorses	*Acentronura tentaculata*	Hairy Pygmy Pipehorse		L		Species or species habitat may occur within area
Pipefish & seahorses	*Campichthys tryoni*	Tryon's Pipefish		L		Species or species habitat may occur within area
Pipefish & seahorses	*Choeroichthys brachysoma*	Pacific Short-bodied Pipefish, Short-bodied Pipefish		L		Species or species habitat may occur within area
Pipefish & seahorses	*Corythoichthys amplexus*	Fijian Banded Pipefish, Brown-banded Pipefish		L		Species or species habitat may occur within area
Pipefish & seahorses	*Corythoichthys flavofasciatus*	Yellow-banded Pipefish, Network Pipefish		L		Species or species habitat may occur within area
Pipefish & seahorses	*Corythoichthys haematopterus*	Reef-top Pipefish		L		Species or species habitat may occur within area
Pipefish & seahorses	*Corythoichthys intestinalis*	Australian Messmate Pipefish, Banded Pipefish		L		Species or species habitat may occur within area
Pipefish & seahorses	*Corythoichthys ocellatus*	Orange-spotted Pipefish, Ocellated Pipefish		L		Species or species habitat may occur within area
Pipefish & seahorses	*Corythoichthys paxtoni*	Paxton's Pipefish		L		Species or species habitat may occur within area
Pipefish & seahorses	*Corythoichthys schultzi*	Schultz's Pipefish		L		Species or species habitat may occur within area

Pipefish & seahorses	*Doryrhamphus excisus*	Indian Blue-stripe Pipefish, Blue-stripe Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Festucalex cinctus*	Girdled Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Filicampus tigris*	Tiger Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Halicampus dunckeri*	Red-hair Pipefish, Duncker's Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Halicampus grayi*	Mud Pipefish, Gray's Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Halicampus nitidus*	Glittering Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Halicampus spinirostris*	Spiny-snout Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Hippichthys cyanospilos*	Blue-speckled Pipefish, Blue-spotted Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Hippichthys heptagonus*	Madura Pipefish, Reticulated Freshwater Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Hippichthys penicillus*	Beady Pipefish, Steep-nosed Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Hippocampus bargibanti*	Pygmy Seahorse	L	Species or species habitat may occur within area
Pipefish & seahorses	*Hippocampus kuda*	Spotted Seahorse, Yellow Seahorse	L	Species or species habitat may occur within area
Pipefish & seahorses	*Hippocampus planifrons*	Flat-face Seahorse	L	Species or species habitat may occur within area
Pipefish & seahorses	*Hippocampus zebra*	Zebra Seahorse	L	Species or species habitat may occur within area
Pipefish & seahorses	*Lissocampus runa*	Javelin Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Micrognathus andersonii*	Anderson's Pipefish, Shortnose Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Micrognathus brevirostris*	Thorn-tailed Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Nannocampus pictus*	Painted Pipefish, Reef Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Solegnathus hardwickii*	Pipehorse	L	Species or species habitat may occur within area
Pipefish & seahorses	*Solenostomus cyanopterus*	Blue-finned Ghost Pipefish, Robust Ghost Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Solenostomus paradoxus*	Harlequin Ghost Pipefish, Ornate Ghost Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Syngnathoides biaculeatus*	Double-ended Pipehorse, Alligator Pipefish	L	Species or species habitat may occur within area
Pipefish & seahorses	*Trachyrhamphus bicoarctatus*	Bend Stick Pipefish, Short-tailed Pipefish	L	Species or species habitat may occur within area
Sharks & rays	*Carcharias taurus (east coast population)*	Grey Nurse Shark (east coast population)	C E	Species or species habitat may occur within area
Sharks & rays	*Rhincodon typus*	Whale Shark	M, V	Species or species habitat may occur within area

9.0 Further reading

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