annex g: assets, trends and threats across the region

the sub-regions

The diversity of the Region's geology, soils, vegetation, biodiversity, land use, hydrology, hydrogeology, and aquatic ecology means that geographical classification systems must be adapted to the particular purposes at hand. There is no one unique way of dividing up the Region that will serve all purposes: a case can be made for sub-Regions based purely on river basins, or on bio-regions.

For planning decisions for this RCS, six sub-Regions, shown in Table 1, were developed based on a combination of socio-economic and landscape elements, and guided by community perceptions of differences within the Region. Each has policy and funding structures built around it, making for convenience in aligning the RCS with these.

TABLE 1. RCS SUB-REGIONS

RCS SUB-REGION	LOCALITIES/ CATCHMENTS	RIVER BASINS	BIOREGIONS
1 Lakes Plains & Northern Foothills	Lismore, Woady Yaloak, Stoney Rises	Lake Corangamite	Half of the Plains Bioregion Victorian Volcanic
2 Curdies-Gellibrand	Curdies and Gellibrand catchments	Otway Coast (western part)	Warrnambool Plain Bioregion
3 Otway Coast	Otways streams	Otway Coast (eastern part)	Otway Range Bioregion
4 Otway Foothills	Barwon River catchment above Inverleigh	Barwon (pt)	Otway Plains Bioregion
5 Geelong & Environs	Geelong and Bellarine Peninsula, plus Barwon River catchment below Inverleigh, plus Hovell's Creek and Little River catchments	Barwon (pt) and Moorabool (pt)	Part of the Otway Plains Bioregion
6 Leigh-Moorabool	Moorabool plus Leigh River catchments	Moorabool and Barwon (pt)	Part of the Victorian Volcanic Plains Bioregion

lakes/ plains & northern foothills

This sub-Region comprises the Lake Corangamite Basin, and incorporates portions of Colac Otway, Corangamite and Golden Plains local government areas.

The Basin is a landlocked (terminal) drainage system formed by volcanic activity, which produced a minor north-south divide across the Basalt Plain and separated the area from the Leigh-Barwon system to its east. Lake Corangamite concentrates brackish inflows and is highly saline.

Predominantly small ephemeral waterways feed Lake Corangamite and a mosaic of significant lakes and wetlands. Most of these are Ramsar listed. Many of the wetlands have been drained and many waterways have been channelised.

More than half of the water used in the Lake Corangamite Basin is imported from the fresh surface water resources of the Otway Coast and Moorabool Basins. Most of the water used from within the Basin is groundwater and concerns about extraction rates have resulted in limits on diversions. Urban and industrial use within the Basin accounts for around two thirds of total use, and about a third is for irrigation. Private irrigation relies heavily on groundwater.

With the exception of a small area of natural forest in the north, the Basin is entirely cleared for pasture and agriculture. Fine wool and cereal producers occupy the northern slopes and crops such as oats, barley and wheat are common. Sheep and beef cattle grazing dominate on the basalt plains; dairying and prime lamb grazing are important in the south of the sub-Region. The fertile alluvium to the east of Lake Corangamite supports mixed farming and the Alvie-Cororooke area just north of Colac specialises in the growing of potatoes and onions.

Areas of remnant grasslands and woodlands exist along the Woady Yaloak River and in the Lismore area, and there are good in-stream habitat values in the lower reaches of this stream. Some of the streams in the Lismore area maintain some of the Chain of Ponds characteristics, while Barongarook Creek is frequented for passive recreational activities through Colac.

The Western District Lakes are listed as a Ramsar Site. Indigenous cultural heritage sites are associated with many of the lake foreshores. Many of the associated wetlands contain rare vegetation communities. Some of the lakes, including Colac and Bullen Merri are used for recreational pursuits, including fishing, yachting and rowing. Ecological condition of the Woady catchment is generally moderate.

some trends

Agriculture is intensifying, in particular raised bed cropping systems and grazing systems that actively manage pasture through complementary species and rotational grazing. This means higher risks, and a need for environmental management systems to manage risk.

Shifts in management of agricultural enterprises are underway, with more corporate farms and fewer families, and closer links between producers and retailers through quality assurance systems. Greater complexity in natural resource management is putting pressure on volunteer management of Landcare groups.

threats to assets

The surface waters of the Basin are highly saline, primarily due to the leaching of salts from the northern slopes (Woady Yaloak, Naringhil, Salt Creek and Mundy Gully catchments). Groundwater processes are complex, and include both regional and local systems. There are widespread problems with pest plants and animals, and land salinisation is worse in the northern part of this sub-Region than anywhere else in the Corangamite Region, with up to 10% of productive land being lost in some districts. The valley floors that become salty are quickly colonised by Spiny Rush, which provides habitat for foxes and rabbits. The latter are widespread on the lighter soils with many slopes showing extensive burrowing.

Key threats identified include:

- Salinity impacts on productive land, infrastructure and surface water environments is the outstanding issue in this sub-Region.
- Groundwater abstraction for stock and irrigation use.
- Pest animals and plants.
- Soil degradation, considered from both production and environmental viewpoints.
- Surface water environments, including water flow, environmental water quality, physical and biological condition of waterways.
- Negative impacts on native vegetation.
- Negative impacts on native fauna, particularly bird and aquatic life of the lakes systems.
- Integrated management in this sub-Region needs to consider the close association of water quantity and water quality issues across both economic and environmental uses. It also needs to consider downstream impacts of river management on outcomes for the lakes systems and the importance of native vegetation planning and management on outcomes for surface water environments.

leigh-moorabool

This sub-Region comprises the upper reaches of the Leigh and Moorabool River systems. They were combined for RCS purposes because they constitute a predominantly uplands community focussed on Ballarat on the northern perimeter of the Region.

Both the Leigh and the Moorabool Rivers are perennial tributaries of the Barwon River, joining it near Geelong. The east and west branches of the Moorabool River rise in the undulating south-western ranges of the Wombat State Forest. The Wombat State Forest is an important resource for apiarists, recreation and nature study. East Moorabool Gorge contains significant areas of remnant grasslands, while remnant vegetation is also significant in the Sheoaks area. The Leigh River Gorge is also of important conservation significance.

The headwaters of the Leigh River Basin comprise sections of the Brisbane Ranges, the City of Ballarat and smaller communities to its south.

Proclaimed water supply catchments are located in both the east and the west branches of the Moorabool River. There are three significant storages: Lal Lal, Moorabool and Bostock Reservoirs. They are located in higher-rainfall forested catchments and serve Ballarat, Geelong and many small towns. Increasing demands for water throughout the Corangamite Region have left the Moorabool River as one of the most flow stressed systems in Victoria.

Deep pools associated with weirs in the lower Moorabool River provide habitat for migratory native fish and platypus. However, significant weed infestations have the potential to affect waterway health at several locations.

Limeburners Bay, the estuary of Hovell's Creek is listed as a Ramsar wetland. Also, significant remnant grasslands can be found along the riparian zone of Hovell's Creek.

The northern part of the sub-Region falls within the Central Victorian Uplands Bioregion, and the vegetation was formerly dominated by foothill forest, mainly dry, of which only 30% remains. Rainfall is highest in the upland parts. These are hilly and partly forested, though the land and its natural vegetation has been much disturbed by past gold mining operations and urban development around Ballarat.

The bluestone channel of the Yarrowee River through Ballarat has European and cultural heritage values. The River forms the basis for a network of linear open spaces, which the Ballarat community enjoys for recreation. The Leigh River Gorge has significant remnant vegetation, including native grasslands and provides a valuable wildlife corridor, including platypus. The lower reaches of the Leigh catchment run southwards across the Basalt Plain, and the land, which was dominated by grassland communities before European settlement, is now used for dryland agriculture, mainly cereals and sheep grazing. A minor divide on the Basalt Plain separates the south-western margin of the Leigh catchment from the Lake Corangamite Basin.

some trends

Horticulture and viticulture are seeking out pockets with suitable soil and water, close to transport routes and labour. Intensive animal industries are moving to the plains west of Geelong.

People are moving onto small lots around Ballarat, many relying on non-agricultural income, and some setting up niche agriculture. This will mean more diverse and possibly less cohesive communities, more difficulty containing weeds, pests and fire, more conflict over sprays, smells, noise, weeds, vermin, fire risk, movement of animals.

Sub-division of existing properties may reduce broadacre agriculture and create more intensely settled areas with less biodiversity. Land use planning will be critical to manage the fit between residential, small lot development and agriculture.

There will be more competition for water between urban, agricultural, recreational and environmental uses, and more pressure from waste disposal.

threats to assets

There is a continuing high risk of flash flows down the Leigh River originating from urban Ballarat, bringing erosive problems, nutrients and other toxicants. Water quality is depressed in most reaches of the Leigh River and its tributaries. The major defects are salinity, colour and nutrient concentrations. These are a significant problem for use of the water. Summer flows in the Leigh River are largely provided by treated wastewater from Ballarat.

Changed land use from urban and peri-urban development around Ballarat is threatening many environmental and social values. Urban and rural residential sub-division leads to fragmentation of habitat for native species around Ballarat. Changes in urban or rural land uses such as plantations or woodlots often cause incremental clearing of native vegetation. Firewood collection reduces hollow log habitats.

Water diversion is having serious ecological impacts in the Moorabool River system. Extensive demand for water for both urban and rural uses is impacting significantly on stream flows. Flow stress is a significant problem in the lower reaches. Also, there is channel contraction and willow development below the reservoirs. Surface water quality is slightly depressed, with raised salinity, colour and nutrients. However, the water is generally good for aquatic life. Uncontrolled stock access to watercourses reduces revegetation potential, increases bank erosion and contributes to stream sedimentation.

Serrated Tussock is a prevalent pest plant, especially in the Moorabool Gorge. Waterway weed infestations, which are common in the catchment, include Willows, Gorse and Boxthorn. Serrated Tussock is a prevalent weed in the Region, which threatens wetlands as well as private agricultural land. The ecological condition of the upper Moorabool is generally poor. There are moderate problems of streambed and bank erosion in the Moorabool, but severe examples in Hovell's Creek. The lack of streamside vegetation and widespread stock access are significant issues. There are barriers to fish migration in the Moorabool River. Fire management is an issue for native vegetation in this Region. This area is highly susceptible to Gorse invasion, foxes and rabbits. Pest animals and plants thrive in the disturbed environment left from disused mines and cleared uplands. Large infestations of Gorse are hampering regeneration and revegetation efforts. Weed infestations are significant for much of the length of the Leigh River. Smilax is an emerging environmental weed in this sub-Region.

Lower in the landscape dryland salinity is a threat to both farms and native vegetation.

There are significant threats to:

- Surface water flow for economic purposes. The principal developed resources are the Lal Lal, Moorabool and Bostock Reservoirs, all of which are located in the upper Moorabool catchment, and which supply Ballarat and Geelong. Streamflows are notably low below these diversions.
- Surface water quality for economic purposes. Most of the Leigh and Moorabool river reaches below the forested central highlands are not suitable drinking water due to high levels of salinity, nutrients and other contaminants, but they provide a resource for stock watering and some irrigation.
- Surface water environments, including water flow, environmental water quality, and the physical and biological condition of waterways. Note that this sub-Region has no coastline, but entirely drains into the Geelong & Environs sub-Region and affects the Barwon estuary and associated wetlands. In the far east of the sub-Region, Hovell's Creek and Little River, which suffer from many of the same problems as the Moorabool, drain into Corio Bay.

- Native vegetation retention and enhancement.
- Soil management.

The close interaction of all threats to environmental values in this sub-Region requires a very integrated approach at the landscape unit level, covering water environments, vegetation, pest animals and plants, and indigenous fauna protection. In addition, attention needs to be paid to downstream impacts of any surface water environment target on outcomes for estuaries and coastal waters in the Geelong & Environs sub-Region. The importance of native vegetation planning and management on outcomes for surface water environments also needs to be considered.

otway foothills

This sub-Region covers the upper reaches of the Barwon River system from the Otway Ridge to the Volcanic Plain and as far east as Inverleigh. The headwaters of the Barwon River are mountainous and forested. Further downstream the Barwon intersects firstly the Tertiary sediments of the Otway Ridges and then the Basalt Plain, both of which are largely cleared for agriculture and small urban centres including Forrest, Barwon Downs, Deans Marsh, Moriac, and Winchelsea. A minor divide on the Basalt Plain, near Beeac, separates the north western margin of the Barwon catchment from the Lake Corangamite Basin. The northern divide between the Barwon and Leigh catchments on the Basalt Plain also has minimal relief.

Rainfall is highest in the Otway uplands, which are important sources of water supply for the Geelong urban area, from the West Barwon Reservoir. The Tertiary sediments of the Otway Ridges contain fresh unconfined groundwater, which is also used for urban supply purposes.

Tradeoffs between agricultural land use, ecology and water production are an important consideration in this area. The area has a highly productive rain-fed grazing industry, both beef and dairy cattle. In the upland areas the picturesque rural landscape is attractive for holiday residences and hobby farm developments.

Pressures on the Barwon River system include widespread degradation of riparian and in-stream characteristics, nutrient and sediment loads from land and channels.

some trends

Residential and small lots are growing in the eastern foothills, with people commuting to Geelong, or buying properties for weekenders and retirement. This will mean more intensely settled areas with less biodiversity, and more conflict between landholders over normal agricultural activities, fire risk, weeds, pest animals, impacts of dams on surface water flow. There will be competition for water between urban, agricultural, recreational and environmental uses, particularly for summer flows.

Tourism accommodation and activity will continue to rise throughout the Otways, not just the coast, and there will be pressure to stop agricultural and forestry land uses which do not fit tourist expectations of a "rural landscape." Employment for semi-skilled workers and processing of agriculture products in regional centres will rise.

Forestry plantations will extend further south of the Princes Highway into the foothills.

All this increased activity will put more pressure on the road network, and on all infrastructure: water supply, wastewater treatment, waste disposal, roads.

threats to assets

The principal natural resource management threats in this area are related to water quantity and quality. The intensive nature of the grazing industries is an obvious potential threat. Increasing nutrient loads and increasing frequency of algal blooms throughout the Barwon system threaten environmental, social and economic values.

The sub-Region is threatened by salinity, though the undulating topography of the Otway Ridges below the forest line tends to restrict the areal extent of land salinity. In the east and north of the sub-Region relief is more moderate, and land salinity problems are manifested over greater areas. This affects native vegetation and agricultural production capacity. Stream salinity increases sharply below the upland forested areas.

Increasing levels of population and economic activity in the sub-Region add to the pressure of demand on the available water resource.

In the upland forested areas threats to terrestrial vegetation include incremental losses from plantation establishment and management, uncontrolled stock access to riparian vegetation, inappropriate grazing practices, firewood collection that reduces hollow log habitats, impacts of native and introduced species on native understorey vegetation, and ongoing decline of mature and senescent trees in agricultural landscapes. Road and track maintenance has impacts on some threatened flora species with small and restricted populations.

Lower in the landscape where the Barwon intersects the Basalt Plain there has been extensive loss of native vegetation through changed land use, and this is ongoing. There are also losses from roadsides and rail lines due to chemical spraying and cultivation for fire control, utilities maintenance and upgrades.

There has been invasion of environmental weeds including Serrated Tussock and Phalaris. There has also been "one dimensional" control of Serrated Tussock, in the form of rock clearing and boom spraying, which is aggressive to native plants. Weed invasion, particularly Willow, is pervasive in deep gullies that in some cases were once agricultural drains. The plant's roots disturb and modify streambeds, and this in turn changes the hydrodynamics of streamflow and causes the gullies to migrate upstream. Severe erosion problems are associated with deteriorating stream characteristics.

Hobby farm development poses more general threats including waste management, weed and animal pest control issues.

There are significant threats to:

- Surface water flow for economic purposes. The principal developed resource is the West Barwon Reservoir, which supplies Geelong, but equitable allocation and use of the whole of the Upper Barwon River is a high-profile issue.
- Surface water quality for economic purposes. Most of the Barwon River below Forrest is not suitable as drinking water due to high levels of salinity, nutrients and other contaminants, but it provides a resource for stock watering and some irrigation from its fresher tributaries.
- Groundwater quantity and quality. The Barwon Downs Aquifer is used as a supplementary source for urban supply and is managed as a groundwater protection zone by Barwon Water. However, other groundwater resources, including the Gerangamete aquifer are used for irrigation and stock purposes and are less intensively protected at present.
- Surface water environments, including water flow, environmental water quality, and the physical and biological condition of waterways. The streams of the north-draining Otway Ranges are highly erosive.
- Native vegetation retention and enhancement.
- Indigenous flora, fauna and surface water environments from the impacts of pest animals and plants, with Ragwort in the south west and some Serrated Tussock in the north east of the sub-Region, and Blackberry along waterways and forested areas.
- Protection of heritage and recreational assets.
- Preservation of landscape quality.

There is close interaction of all threats to environmental values in this sub-Region, requiring a very integrated approach at the landscape unit level, covering water environments, vegetation, pest animals and plants, and indigenous fauna protection. Other linkages to consider are the downstream impacts of any surface water environment target on outcomes for estuaries and coastal waters, and the importance of native vegetation planning and management on outcomes for surface water environments.

geelong & environs

Geelong is a major provincial city with an extensive industrial complex. The petrochemical industry has plants near Geelong and, while being a major contributor to the local economy and employment, externalities from the industry have implications for water quality in Port Phillip and Corio Bays, and for surface and groundwater resources.

Water supplies for the area are supplemented by imports from the surface water sources of the Otway Coast and Moorabool Rivers. The major use in the basin is for urban and industrial purposes, from the West Barwon and Wurdiboluc Reservoirs (Otway Foothills sub-Region) and the White Swan Reservoir (Leigh-Moorabool sub-Region).

Below Inverleigh, the Barwon flows through the western Basalt Plain, collecting inflow from the Leigh and Moorabool Rivers, and passing through the western suburbs of Geelong, where it turns south eastwards forming wetlands before discharging to Bass Strait at Barwon Heads. The Barwon River is a significant resource for both recreation and for recreational fishing. The town of Barwon Heads, along with settlements along the Great Ocean Road, is an important tourist destination. The original natural vegetation over much of this sub-Region was coastal heathland and woodland, coastal scrubs and grasslands

Nutrients and salt loads originating from agricultural land, urban settlements and stream channels in the Moorabool, Leigh and Barwon catchments accumulate in the Barwon River through Geelong and the sub-Region's lakes and wetlands, including Lake Connewarre and Reedy Lake wetlands near Geelong, and the Barwon estuary. Nutrient concentrations are compounded by further nutrient and toxic components in the stormwater discharges from the Geelong urban area.

some trends

Geelong is steadily growing, south in a corridor towards Mt Duneed, and in satellite residential areas at Lara and Bannockburn, as people seek cheaper residential land, more space, and access to the coast. There will be development west from Torquay, and at Ocean Grove. In areas around residential centres, new owners on small properties will resist growth of suburbs on their doorstep.

Demands for water supply for Geelong will continue to grow. Barwon Water projects a rise of 30 per cent in water consumption in Greater Geelong over the next 20 years without additional water conservation, and is currently using most of its water allocation for public drinking water supply. There will be more competition for water between urban, agricultural, recreational and environmental uses, and more pressure from waste disposal. Water conservation will become more critical, since using less water is always a cheaper option than reusing it.

threats to assets

The principal threat to environmental values in this sub-Region comes from the pressure of urban and peri-urban development. Land subdivision is particularly affecting existing remnant vegetation. Uses of the lower Barwon River are highly sensitive to water quality, including sediments, turbidity, and nutrients. Blue-green algal blooms are a regular occurrence in the stretch of the river near Geelong, and combined with high tourist, residential and recreational values this makes for potentially high damage costs.

The lower Barwon River receives water from the Woady Yaloak and the Lough Calvert Drainage Schemes, which export water from the Lake Corangamite Basin in high rainfall years, and under tight government regulation. The diverted water can be higher in salinity than that of the water in the Barwon River. High salinity levels exist in the Barwon River around Inverleigh in deep pools no longer flushed by high flows.

The Waurn Ponds Creek and the lower Barwon River system are being increasingly impacted by urbanisation. There has also been draining and cropping of shallow wetlands, with detrimental effects on vegetation.

Significant barriers to fish migration, and the spread of European Carp are affecting aquatic ecology. Stock access is damaging riparian vegetation. Environmental weed invasion is affecting near-urban waterways and estuaries. Serrated Tussock is a prevalent weed, which threatens wetlands as well as private agricultural land.

Because of its location within the Region, the Geelong & Environs sub-Region expresses nearly all the issues that are found region-wide. Water resources management throughout the upstream basins needs to be highly integrated for appropriate outcomes in this sub-Region. Of particular note are significant threats to:

- Water quality in the Barwon River due to saline groundwater tables in the north east of the sub-Region.
- Remnant native vegetation from new urban development.
- Wetlands, estuaries and the coastline from development pressures and water flow and quality regimes, and
- The marine environment from the large volume of passenger and freight shipping in the vicinity of the south west part of Port Phillip Bay and the Otway Coast.

otway coast

The Otway Coast sub-Region drains the southern slopes of the Otway Ranges east of Johanna and forms a part of the Otway Coast Basin. The remaining, western part, of the Otway Coast Basin comprises the Curdies-Gellibrand sub-Region.

The outstanding asset of this sub-Region is the wonderful coastline along the Great Ocean Road, and the forested hills of the Otway Ranges.

The valleys and streams support high biodiversity values, draining to small estuaries that are valued for urban development, recreation and tourism as well as their biodiversity. The Aire River is the only heritage-listed river in the Corangamite Region.

Groundwater quality is generally good, though it deteriorates towards the north-east and north-west corners of the Basin.

This sub-Region contains by far the highest proportion of forested land of the six RCS sub-Regions, and its stream quality characteristics are generally superior to those elsewhere in the Region. The many rivers are short, fast-flowing and perennial. They yield fresh water, though turbidity is higher than elsewhere in the Region. There are no major water storages in the Basin, but water is diverted for urban use through a network of pumping stations and small weirs. Towns in the eastern part of the sub-Region are included in the Geelong water supply system.

Around 70% of the land in the sub-Region is still covered by native hardwood forests. The old growth rain forests of the Otway Ranges are also significant features for water quality and for tourism and biodiversity protection. Urban developments in the south west of the sub-Region have concentrated in the dissected valley floors, estuaries and slopes around Marengo, Apollo Bay, Lorne and Anglesea. Closer to Geelong, the Otway Ranges subside and land constraints have been less of a problem for towns such as Torquay and Barwon Heads. Urbanisation and tourism are proceeding at a rapid rate in this sub-Region, with significant pressures on the surrounding environment.

some trends

Melbourne and Geelong people are buying along the coast for weekenders and retirement. In coastal towns bounded by State Parks, residential density will rise. Some coastal towns may extend up valleys on private land where available. A shift to permanent occupancy of former holiday homes will see a significant rise in resident populations. For example, the population of Anglesea, Lorne and Apollo Bay will rise from 4,000 to more than 11,000. Rising property values will displace some current residents, and coastal towns may change their character.

Tourism will grow. Visitation is forecast to double between 2000 and 2010, and traffic on the Great Ocean Road is growing at 4% annually. Employment in tourism is rising, especially part-time employment. Pressure on all infrastructure and services, especially during peak holiday periods, will increase.

Membership of environmental groups will grow. There will be more public awareness of pressure on estuaries, parks, reserves and foreshores and pressure to stop agricultural and forestry land uses which threaten estuary health or do not fit tourist expectations of a "natural landscape."

threats to assets

An omni-present threat in this sub-Region is posed by poorly planned urban, tourist and semi-rural sub-divisions, which threaten the prized landscape amenity of the coast through unsightly or inappropriately sited developments that can destroy the grandeur of the vistas. Coastal plans have drawn attention to the urgency of this problem. As a world-class environmental attraction this coastline deserves world-best planning practices, which cannot be said to be happening at present.

The rivers in this sub-Region are generally in good condition, due to the retention of forest over most of the catchment areas. The Aire River is listed as a heritage river because of its pristine nature and natural catchment. High value remnant vegetation and aquatic habitat values exist through much of the Otway Ranges. Cultural heritage sites are associated with these coastal waterways. However, water allocation and the construction of many small dams in the Spring Creek and Thompson Creek catchments are threatening aquatic habitats. Stock access to streams, and stream bank and bed erosion are widespread threats to both agriculture and to aquatic values.

The health of the small estuaries and backwaters in the frontal dunes is threatened by nutrient loads, which originate primarily in nearby urban developments if adequate wastewater and stormwater management is not

implemented. Development impacts are evident at locations such as the Erskine River (Lorne), Wye River and Kennett River. Significant areas of remnant grassland and woodland communities are located in streamside reserves along the Thompson Creek.

Some of the threats to terrestrial vegetation in the Otway forests are the same as those described above for the Upper Barwon sub-Region and include incremental losses from plantation establishment and management, uncontrolled stock access to riparian vegetation, inappropriate grazing practices, firewood collection that reduces hollow log habitats, and the impacts of native and introduced species on native understorey vegetation. Road and track maintenance has impacts on some threatened flora species with small and restricted populations. In addition to these, there has been a decline in some rainforest communities due to Myrtle Wilt. There are some questions about forest management as it impacts native vegetation: for example regrowth forests may not attain mature or senescent growth before harvesting, harvesting and fire management regimes are inappropriate for native vegetation in some instances, and the increasing level of motorised access increases the risks of spread of pathogens such as *Phytophthera*. Wetland communities have suffered from grazing pressures.

Invasion of environmental weeds is an ongoing threat, including Blackberry, Gorse and Ragwort. Pest plants including Gorse are a major threat to the integrity of riparian vegetation in Spring and Thompson Creeks. Ragwort is widespread throughout the coastal fringe. Although noxious, it does not threaten the small amount of agriculture present in the sub-Region and does not invade dense forest areas. It is a problem, however, in cleared areas and estuaries. There has been pressure on threatened fauna (Tiger Quoll) from forest fragmentation.

There are significant threats to:

- Surface water flow for economic purposes.
- Surface water environments, including water flow, environmental water quality, physical and biological condition of waterways, estuary health and coastal waters.
- Native vegetation retention and enhancement.
- Indigenous flora, fauna and surface water environments from pest animals and plants; Ragwort is in the south western part and Serrated Tussock in the north east of the sub-Region, whilst Blackberry is a problem along waterways and forested areas.
- Protection of heritage and recreational assets, and
- Preservation of landscape quality.

Integrated management needs to consider the close interaction of all threats to environmental values in this sub-Region. This requires a very integrated approach at the landscape unit level covering water environments, vegetation, pest animals and plants, and indigenous fauna protection.

Integrated management also must consider the downstream impacts of any surface water environment target on outcomes for estuaries and coastal waters,

and the importance of native vegetation planning and management on outcomes for surface water environments.

Given that the focus for water quality in this sub-Region is predominantly environmental, the threat of sediments and contaminants of surface water used for economic purposes are less important.

Given this sub-Region's inability to alter climate change and variability this is also considered a less important issue. It has not been eliminated entirely, because it will remain important to make choices for natural resource management in the light of best available information on likely climate changes (e.g. the possibility of increased tidal surges affecting estuary management).

curdies-gellibrand

The Curdies-Gellibrand sub-Region comprises the catchments of the Curdies and Gellibrand Rivers. The Gellibrand River drains the western slopes of the Otway Ranges to its estuary west of Cape Otway.

The Curdies River system supports excellent riparian vegetation between Jancourt and Curdievale, providing good habitat for a diverse native fish population including species of trout, and saltwater species for recreational fishing. The forested upper Gellibrand catchment supplies water to Colac and the Glenelg-Hopkins Region. The Gellibrand River contains a healthy Blackfish population, which is valued by recreational fishers.

The steady supply of water in the streams is of significant value for water supply for rural domestic, stock and irrigation uses and particularly to the dairy and grazing industries.

The native hardwood forests in this area have been extensively cleared, and dairying and cattle grazing are now the principal land uses on the rich floodplains. There is substantial intensification of animal production with increasing investment in feedlots for both dairy and beef production.

Potato growing is also significant in this sub-Region.

some trends

Dairying will increase production, perhaps doubling output by 2010. There will be consolidation into larger properties, larger herds, more mechanisation, and an even closer relationship between producers and processors. Dairying will move out of areas not ideally suited to dairying, and in general shift west. Water quality may be affected by more intensive agriculture and higher numbers of small landholdings.

Environmental management systems will be adopted more widely. Environmental flows will set an upper limit on extraction for economic uses, and reduced summer flows will increase pressure on winter use of flows.

Larger farms and the loss of farming families will bring more demand for semi-skilled labour on farms. Processing of dairy, meat and timber products in regional centres will continue to push up employment. More properties will be bought for weekenders and retirement, and taken out of agricultural use.

Larger vehicles and more traffic on all roads and bridges will mean increased maintenance costs for municipalities.

threats to assets

There are some surface water quality problems in the streams in this sub-Region, including salinity, low dissolved oxygen, and elevated nutrient concentrations. High nutrient levels are found in the lower Curdies system and Blue-green algal blooms have been recorded. Stock access is present in a large proportion of the system, and this accelerates bank erosion, compacts soils and prevents regeneration of native riparian vegetation. Bed and gully erosion are an emerging threat in much of the catchment. High nutrient levels and other land use impacts are resulting in moderate ecological condition of the Gellibrand River.

The growth of agriculture in many parts of the area has been a comparatively recent phenomenon, with major sub-divisions for agriculture taking place only 50 years ago. Thus the full response in terms of groundwater and water quality dynamics may yet to be seen. There is already some dryland salinity that affects agricultural production and native vegetation.

Specific threats to native vegetation include grazing pressures from unfenced land, incremental removal from roadsides through electric fencing and then grazing, habitat fragmentation, inappropriate fire management regimes, some dieback caused by wind in exposed areas following clearing, impacts of introduced animals including deer, feral pigs, and hares, and of some native species such as the Grey Kangaroo on understorey vegetation, inadequate attention to management of fenced native vegetation, the ongoing decline of mature and senescent trees in agricultural areas, and firewood collection.

The coastline is a valuable recreational and tourism resource, and is experiencing similar pressures for lifestyle developments as the Otway Coast sub-Region. In this sub-Region the pressure is concentrated in towns such as Peterborough and Port Campbell. Issues of wastewater and stormwater management therefore arise.

Environmental weeds, including Pampas Grass, Ivy, Blackberry, Sweet Pittosporum, and Spanish Heath, are spreading in areas of remnant vegetation on both public and private land. Extensive Willow infestations have overgrown many sections of the upper Curdies River. Ragwort is widespread throughout this sub-Region, and is a particular problem in estuarine locations.

There are significant threats to:

- Surface water flow for economic purposes.
- Soil management, considered from both production and environmental viewpoints.
- Surface water environments, including water flow, environmental water quality, physical and biological condition of waterways, estuary health and coastal waters.
- Native vegetation.

Integrated management needs to consider the close association of water quantity and water quality issues across economic and environmental uses and the downstream impacts of any surface water environment target on outcomes for estuaries and coastal waters. The importance of native vegetation planning and management on outcomes for surface water environments also needs consideration.

Sediments and contaminants are less important as an issue given the focus for water quality is predominantly an environmental one. It is acknowledged that the Upper Gellibrand catchment includes the water supply reservoir for Colac. However, sedimentation and water quality deterioration are not seen as significant threats to that water supply.

Given the sub-Region's inability to alter climate change and variability this is also considered a less important issue. It has not been eliminated entirely, because it will remain important to make choices for natural resource management in the light of best available information on likely climate changes.