DRAFT COASTAL MANAGEMENT PLAN
CERVANTES AREA

Department of Conservation and Environment
Perth, Western Australia
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1. INTRODUCTION

1.1 LOCATION OF STUDY AREA AND DELINEATION OF MANAGEMENT UNITS

The coastal town of Cervantes is situated in the Shire of Dandaragan, 237 km north of Perth. The closest major settlement is Jurien which is 25 km north.

The coastal management plan will deal with the townsite of Cervantes as outlined on Figure 1 (including Lake Thetis). The management areas are delineated in order to give more specific recommendations for each area. The management units correspond to areas of progradation or erosion (Figure 2).

Unit One: This unit stretches from just south of Talavera Road to north of the Yacht Club and as far inland as Catalonia Street.

Unit Two: This unit stretches from Thirsty Point to Talavera Road and inland as far as the new subdivision.

Unit Three: This unit includes coastal land between Valencia Road and the western end of Seville Street and stretches inland to include all new subdivision.

1.2 CONTEXT OF COASTAL MANAGEMENT PLAN

In the past, coastal management has been "ad hoc" and uncoordinated. In an attempt to have more comprehensive coastal management the Department of Conservation and Environment is producing a series of Coastal Management Plans (CMP's) which will cover sections of the Western Australian coastline.

The "Coastal Planning and Management in Western Australia - A Government Position Paper" (Coastal Management Coordinating Committee, 1983) also outlines the policies of the Western Australian Government towards coastal planning and management which serves as a guideline to all government departments.

Some of the policies relevant to this CMP are:

1. "The Government recognises that the coast is a dynamic environment which requires specialised planning and management".

2. "Before coastal land is allocated for a particular use the physical capability of the land to support that development should be carefully considered".

3. "Public access to the coast should be controlled in such a way as to permit its use as a resource and yet minimise costly environmental damage".

4. "The coast is a visual resource which should be carefully managed. Development which is in harmony with the sensitive nature of the coast should be encouraged".

5. "The West Australian coast exhibits a rich and varied range of resources. Coastal problems arise from the inherent fragility and

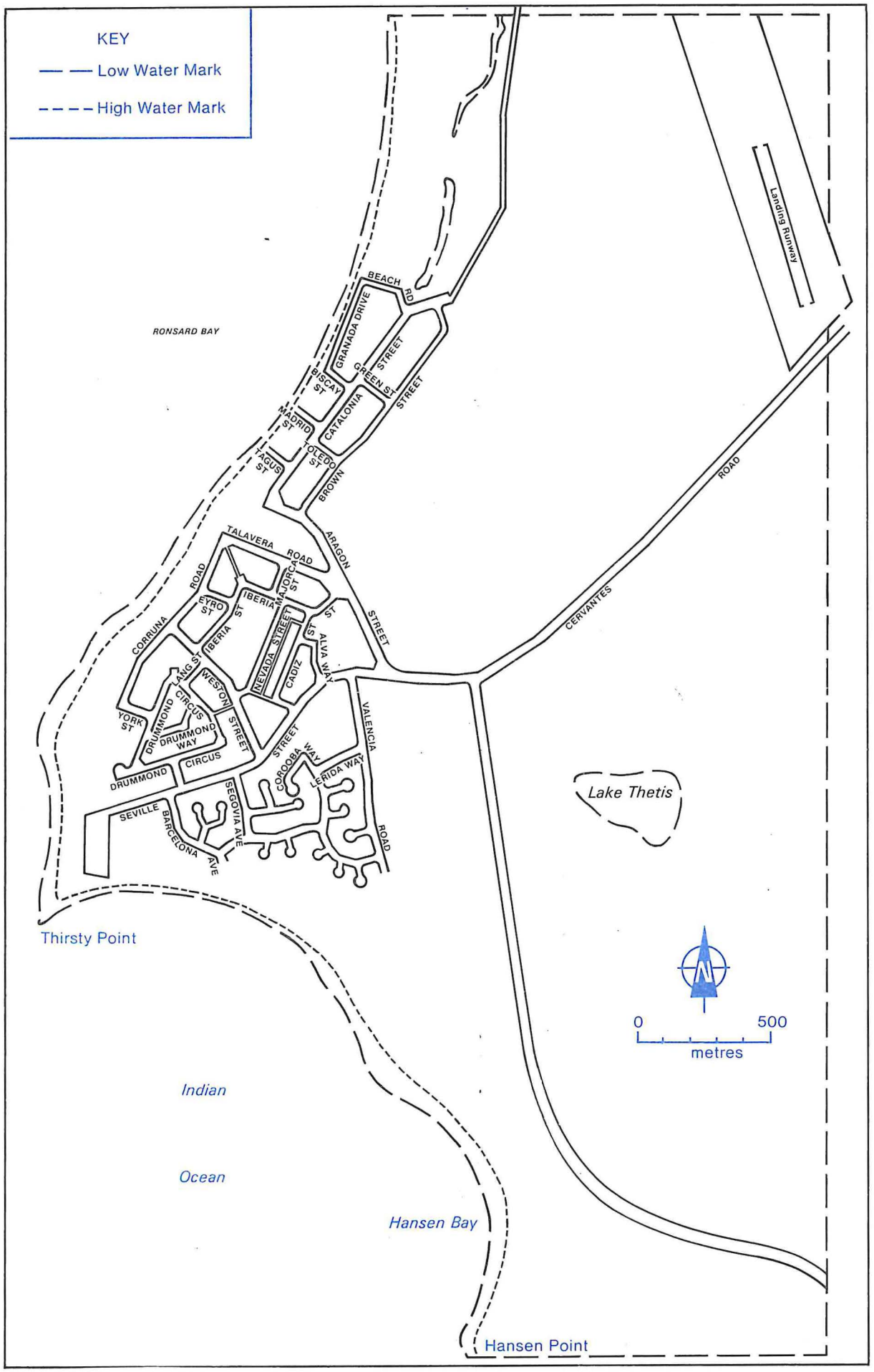

Figure 1. Town of Cervantes - Management Units and Townsite Boundary.

sensitivity of the coastal environment and general lack of understanding of coastal processes".

The aim of coastal management is to ensure that the physical and human components of the environment can compatibly co-exist in the coastal zone, to maintain coastal stability and to minimise degradation either by natural forces or man-made developments. Forward thinking, interactive and comprehensive land management is required to achieve these goals. There should be an overall coordination of coastal management issues to involve all interested parties and prevent "adhoc" decision-making.

1.3 AIMS AND OBJECTIVES OF THE COASTAL MANAGEMENT PLAN

The ultimate aim of the Coastal Management Plan is to integrate the development and use of the coastal environment and hence prevent degradation. It is widely known that the coastal zone is a dynamic and fragile system which in the past has been subjected to "adhoc" decision making. The appropriate siting and management of coastal activities will ensure that the environment is protected and that costly management works can be avoided. An advantage of such a perspective is that the amenity value of the coastal environment is preserved.

The following objectives summarise the main areas of investigation to be examined in this Draft Coastal Management Plan:

- Identify potential and existing management problems and recommend strategies to prevent or resolve them.
- Advise the Shire on the suitability of coastal sites for specific uses and levels of activity.
- Formulate a long-term development, conservation and management guide for the coastal area being studied.
- Identify participants in the planning and management processes.
- Identify possible sources of financial assistance for management proposals.

2. PHYSICAL ENVIRONMENT

2.1 GENERAL

This section will summarise the geology, soils, vegetation, fauna, marine resources and geomorphology of the Cervantes coast.

The geology of the study area has been mapped in detail and published as part of the Dongara and Hill River sheet. (1) Along the coastal strip there is calcareous aeolian and beach sand (more commonly referred to as Safety Bay Sand) which in places is weakly lithified. The eastern half of the study area comprises Tamala limestone which was formerly sand dunes which have become lithified. The Tamala limestone was formed during the Pleistocene period, while the sand dunes were formed more recently in the Holocene period.

Soils in the coastal region coincide with the Holocene sand dune and Pleistocene limestone formations. All the soils of the study area are poor and have a neutral to alkaline soil reaction. They have a sandy

texture and a minimal to non-existent horizonation. The soils on the coastal dunes are chiefly calcareous (UC 1.1). [2] Further inland the soils become more siliceous (UC 1.2) and are associated with smaller areas of brown sand (UC 4.22) and leached sands (UC 2.21) in the wetter sites. The soils are very friable and have low cohesion making them extremely vulnerable to wind erosion, especially if the vegetation cover is removed.

The vegetation of the study area is described by Beard. [3] The study area is part of the Darling Botanical District and more specifically the Guilderton System. Beard describes the Cervantes area as heath with patches of thicket mainly on sand ridges. The dunes, of relatively little weathered white sand, appear to have a climax of Acacia cyclops thicket; but owing to frequent burning, this is only so in patches and is replaced by an earlier seral stage of heath or low scrub dominated by Acacia radiocarpa and Melaleuca acerosa. Other components are Acacia cuneata, Anthocercis littorea, Eremophila glabra, Grevillea sp, Hakea prostrata, Hemiandra pungens, Leptomeria spinosa, L preissiana lianariodis, Melaleuca huegelii, Myoporum gracile, Olax phyllanthi, Olearia axillaris, Ptilotus stirlingii, Senecio lautus, Templetonia retusa, Tersonia brevipes.

A similar heath is seen on flats and interdune areas with the addition of Scaevola sp to the dominants. There are indications that a thicket of Casuarina baxterana is the climax on such sites. On salty patches there is saltbush and samphire, teatree (Melaleuca thyoides) and a few casuarinas.

The Cervantes coast belongs zoogeographically to the same region as Jurien Bay.

Relatively little research has been done on wildlife within the study area.

Chalmers and Davies describe the wildlife of this area as follows:

"The coastal dune systems of the region support mammal populations including Macropus fuliginosus (western grey kangaroo), Rattus fuscipes fuscipes (southern bush rat) and Pseudomys albocinereus (ash-grey mouse), the latter two species occurring in relatively high density at times". [4]

The region supports a rich avifauna including terrestrial species and seabirds. Chapman states that most of the resident passerine birds recorded in the Swan River District also occur in the Cervantes region, often existing in greater densities than in more urban areas. [5] These higher population densities indicate that the region has value as a habitat for birds.

"The region represents the northern edge of the range for some birds like Stipiturus malachurus (southern emu-wren) and Eopsaltria georgiana (white breasted robin), (Ford; 1959, 1965). In addition, it is the only location where the four species of Malurus (malurid fairy-wrens) are thought to live near each other in the same heath formations". [6]

Nearby islands provide breeding and resting habitats for a number of seabirds including Pelagodroma marine (white-faced storm-petrel), Puffinus assimilis (little shear-water), Puffinus pacificus (wedge-tailed shear-water), Hydroprogne caspia (caspian tern), and Sterna nereis (fairy tern).

The islands are also used by the local population of Neophoca cinerea (Australian sea lion). The islands also support populations of skinks including Egernia kingii, Egernia pulchra, Egernia box, Lygosome lesueurii,

Ctenotus lineopunctulatum and the gecko Phyllodactylus ocellatus. The distinctive long-tailed subspecies longicauda of Egernia pulchra only occurs on the islands. (7)

Cervantes is one of the most important centres for the WA rock lobster fishery, although most of the catch landed is taken outside the area.

Unpublished reports on amateur fishing in Jurien Bay by the Department of Fisheries and Wildlife, indicate that beach anglers take Tailor, Whiting, Australian Herring, and Skipjack. Anglers fishing near shore from boats take the above species and Garfish, while divers take Dhufish, Coral Trout, Baldchin Groper and Abalone. (8)

The major geomorphic units in the vicinity of the study area are the Pleistocene Barrier complex, Deflation basins, Parabolic dunes, Active Parabolic dunes and blowouts, foredunes and beaches. These geomorphic units are the result of a complex interaction between geology, climate, vegetation, soils and coastal processes. The only major geomorphic unit not found in the study area is the Active Parabolic unit.

The main characteristic of each geomorphic unit is outlined below.

2.1.1 PLEISTOCENE BARRIER COMPLEX

This geomorphic unit is equivalent to Tamala limestone which outcrops extensively to form rocky headlands and pools, as well as submarine shelf chains and islands. The barrier complex consists of cemented aeolian calcarenite (limestone) and is often covered by a veneer of Safety Bay sand. There are no rocky headlands or pools in the study area. The Western half of the study area is dominated by beach ridges, especially where the beaches are prograding.

2.1.2 PARABOLIC DUNES

The geological equivalent of the parabolic dunes is the Quindalup dune system. The parabolic dune system represents more recent (Holocene) activity which has camouflaged the Pleistocene dune ridge complex. They are orientated in a north-south direction (parallel to the coast) which is the dominant wind direction. Parabolic dunes are usually formed during periods of high sand influx and are later cut off by vegetation recolonisation when the sand supply decreases. Relict parabolic dunes exist mostly in the eastern half of the study area.

2.1.3 DEFLATION BASINS

These areas are the flat and gently undulating erosion plains which are bounded by inactive and active parabolic dunes.

2.1.4 FOREDUNE

This unit may be made up of active and relic beach ridges. The ridges are asymmetric and can be vegetated or semi-vegetated. The geological equivalent is Safety Bay sand and Quindalup sand in some sections.

2.1.5 BEACH

The beach is the active surf/swash zone and is an area of highly dynamic coastal processes. Sandy beaches dominate the coastline of the study area.

2.2 CLIMATE

The area under investigation has no meteorological stations within its boundaries. Therefore, data was obtained from the nearest coastal stations in Dongara and Jurien Bay as well as the inland station in Eneabba in order to analyse the climatic characteristics of the project area. The climatic characteristics examined for this report are rainfall, temperature, wind and thunderstorm activity.

The area experiences hot, dry summers and cool, wet winters which typifies a dry, warm mediterranean climate. For example, the annual rainfall for Jurien Bay is 558 mm of which 78% falls in winter, leaving a dry spell of seven months.

The seasonal distribution of rainfall and fluctuation in temperature from January to December 1984 for the three stations is shown in Table 1. The Leeman-Green Head area has an average annual rainfall of 600 mm and it decreases progressively inland to 400 mm (average annual rainfall) at the town of Coorow.

The highest temperatures occur in January and February (approximately 30°C at Jurien Bay) while the minimum temperature occurs during the winter months (approximately 12°C).

Thunderstorms are most frequent in summer with the average annual number of about ten thundery days; although some do occur in winter. Tropical cyclones may affect the coastline between January and March.

2.3 COASTAL PROCESSES

2.3.1 WINDS

Summer winds are generally easterlies in the morning and become south to south-westerlies in the afternoon. The dominant winds are south-westerlies which blow mostly between 21 kph and 30 kph. It is believed that wind speeds greater than 10 kph are responsible for sand movement. (9) Wind direction in winter may vary from the north-west through to the south. The wind direction may vary during the passage of a tropical cyclone but usually they are north to north-westerlies.

2.3.2 WAVES

The coastline is dominated by two major wave forms - swell and wind waves. Swell waves are generally propagated from the south-west but as they approach the coast their direction may be altered by offshore features such as reefs and islands, or structures such as jetties or groynes. The swell waves are diffracted and reflected as they approach the beach.

Wind waves are more variable in direction and usually approach the coastline from the south-west in summer and the north-west in winter.

2.3.3 TIDES

The tidal regime is either predominantly diurnal or semi-diurnal. (10) In the mixed tidal regime there are two highs and two lows per day which are not of the same magnitude. The tidal range is less than 2 m. Since the tidal range is low, the influence of tide-induced currents is limited to constrictions between islands.

Table 1. Climatic Data on the Project Area

Average Monthly Rainfall — mm

1984	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL	S	W
Dongara	-	52	36	68	158	26	74	51	41	17	30	5	558.0	58.0	151.0
Jurien Bay	0.2	13	32	44	174	54	65	73	52	25	33	12	557.2	25.2	192.0
Eneabba	-	40	40	36	160	34	66	67	59	30	55	9	596.0	49.0	167.0

S - Summer W - Winter

Average Max Temperature — °C

1984	J	F	M	A	M	J	J	A	S	O	N	D
Eneabba	36.2	37.3	30.7	29.2	21.3	20.5	18.0	19.4	22.5	25.5	28.5	30.8
Jurien Bay	30.7	32.0	27.8	27.7	22.0	21.2	18.9	19.5	22.1	24.0	25.4	25.0

Average Min Temperature — °C

1984	J	F	M	A	M	J	J	A	S	O	N	D
Eneabba	19.0	20.6	17.9	17.1	12.8	10.1	9.2	8.0	9.7	1.0	13.7	13.6
Jurien Bay	16.6	18.1	14.8	14.8	13.7	9.4	8.2	9.1	9.3	1.9	13.3	13.7

Average annual minimum and maximum temperature for:

Eneabba: 37.3°C 8.2°C
Jurien Bay: 30.7°C 8.0°C

Source: Bureau of Meteorology, (1984)

2.3.4 SEDIMENT BUDGET

There are various inputs and outputs in the sediment supply. The inputs consist of littoral drift in, onshore transport and cliff erosion; while the outputs are littoral drift out, offshore transport and dune migration.

2.3.4.1 Outputs

The term "sink" is used to describe all those processes by which sediment is lost to the coastal system. The first sink is represented by the migration of dunes inland where they can no longer be acted on by waves during times of storm activity; the second by transport offshore on to the seafloor.

Parabolic dunes develop when beach sands blow inland. As the dune travels, the sand body at the head is progressively exhausted and the two trailing edges develop into long slightly converging ridges. The development of such a sequence requires not only time but the frequent occurrence of high velocity winds from one major direction. In the study area the wind transport is mainly from the south to south-west, so if parabolic dunes were to develop, they would be orientated in a north-south direction. The natural development of dunes depends on a fortuitous sequence of events and circumstances.

Transport of sediment occurs in conjunction with nearshore cell circulation and littoral drift. The nearshore cell circulation consists of rip currents and feeding longshore currents and is normally generated by variations in the wave breaker height along the length of the beach. The longshore variations in wave height may be produced either by wave refraction causing divergence and convergence of the wave rays, or by edge waves trapped in the nearshore interacting with normal swell waves. An alternative explanation for nearshore circulation has been developed by Hino [11] and Sonu. [12] longshore currents may also be produced by waves breaking at an angle to the shoreline. The exact processes which cause longshore currents in the study area can not be ascertained.

Longshore movement of sediment at any beach, however, is the sum of transport under all the individual wave trains arriving at the shore from numerous wave generation areas. The beaches in the study area have north-south orientations. Sand may move northward during summer due to waves arriving from the south to south-west, and then, in winter, move to the south under waves coming from the north.

The result of north and south longshore drift is a net dominance of the northward transport system. Thus a small amount of sediment is continually being moved to the north. This phenomenon is responsible for the asymmetric growth of beach ridge plains and erosion of their southern flanks.

2.3.5 SHORELINE STABILITY AND COASTAL EROSION

Shoreline changes have been assessed by the Department of Marine and Harbours. [13] The extent of accretion and erosion is shown by comparing the vegetation line in 1943 with its position in 1982.

The beaches at Thirsty Point are continuing to accrete. One point on the northern side of the Tombolo has prograded by almost 200 m during the last 39 years. By contrast, the northern beaches are receding and have eroded by about 60 metres since 1943. A similar situation is apparent at the beach

south of Thirsty Point which is also receding. The rates of progradation have not been constant. The most rapid periods of beach ridge development were between 1970 and 1975 when the vegetation edge moved seawards 47 metres, at a rate of 9.4 metres/year, and between 1975 and 1980 when it prograded 59 m, a rate of 11.8 metres/year. The topography resulting from these periods of rapid accretion is relatively low and hummocky dunes, compared with the more well-formed dune ridges and swales which develop during periods of slower progradation. The eroding shoreline exhibits a characteristic steep scarp with little sand material at the base, whereas in places where there is a slower rate of erosion, there is a well defined scree or fill material at the base of the scarp (Figures 2 and 3).

3. HUMAN ENVIRONMENT

3.1 FACILITIES

There are a variety of facilities in the town of Cervantes. Their locations are shown on Figure 4.

3.1.1 ROADS

The town is serviced by bitumenised roads and there are a number of unsealed tracks to and from the beach as well as to Nambung National Park. In most instances the coastal roads are situated 125 metres from the beach. However, there are instances where the road is only a few metres from the beach; such is the case with Granada Drive. The road in Unit 3 (the location of the new subdivision) is located at a 100 year setback. The road in Unit 3 (the location of the new subdivision) is located at a 100 year setback. (14) The road system in Unit 2 is unlikely to be threatened by coastal erosion or sand drift as the shoreline is prograding.

There are not many tracks, but in all cases they are on the coastal dune system. They provide access to the beach to fish or to launch fishing boats. The growth and use of tracks is uncontrolled.

3.1.2 CAR PARKS

There is one formalised car park at the southern end of Corunna Street (Figure 5). As it is situated on a prograding shoreline it is not likely to be threatened by coastal erosion. It is constructed of compacted limestone or soil. At the new subdivision there is a car park which will service the beach at Unit 3. There is no car park or formalised access point for the beaches parallel to Catalonia Street in Unit 1.

3.1.3 BEACH ACCESS: VEHICULAR AND PEDESTRIAN

At present, beach access is largely uncontrolled and crosses the dune system at a number of places close to the settlement. There are tracks just north and south of the existing settlement which run parallel to the coast. However, in the future, access will be controlled under the Control of Vehicles (Off-road Areas) Act (1978). The tracks contribute to the degradation of the coastal dune system by destroying vegetation. Attempts have been made to control off-road vehicle activity by fencing off large areas of dunes (Figure 6).

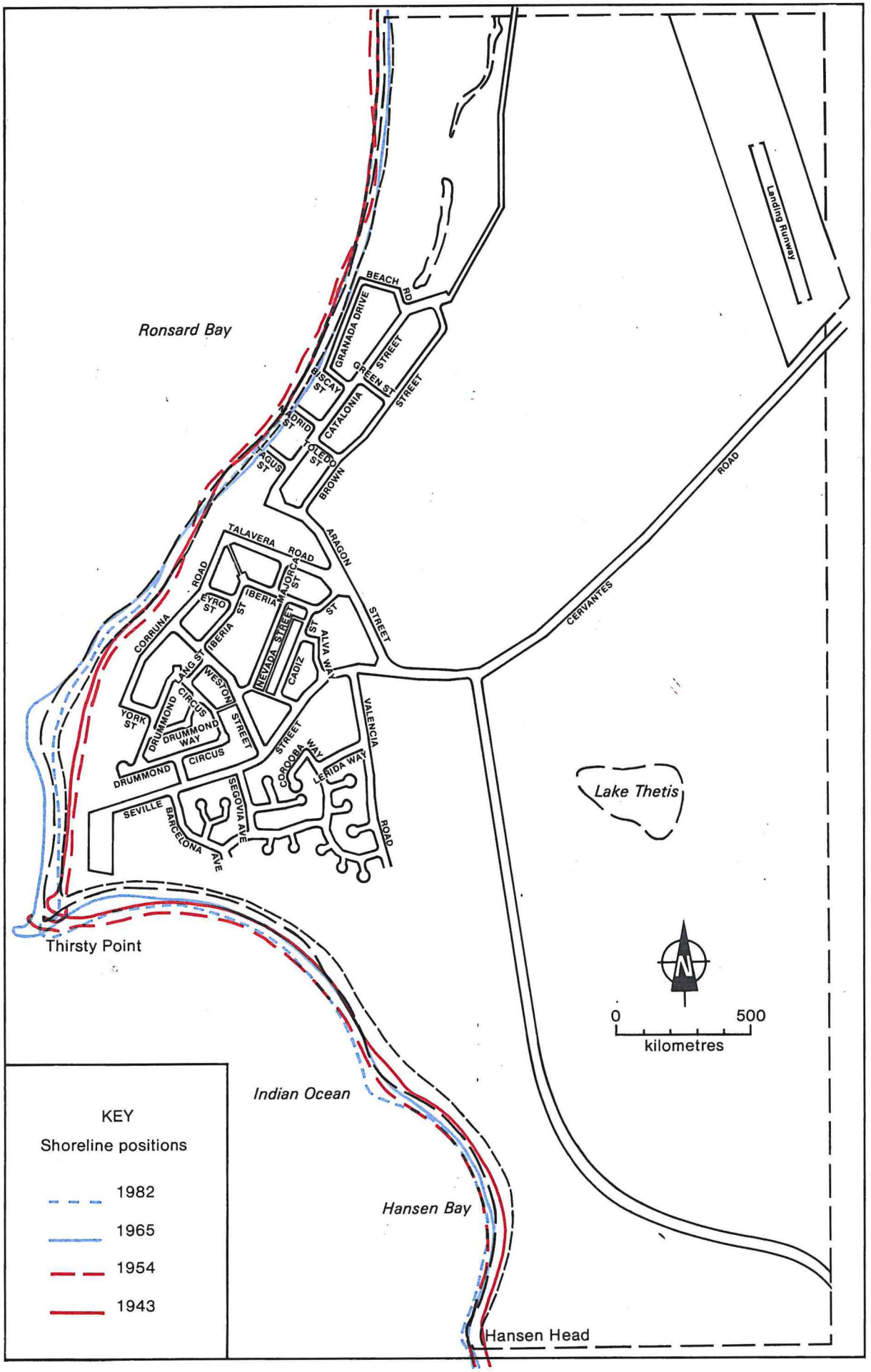

Figure 2. Coastline Changes.

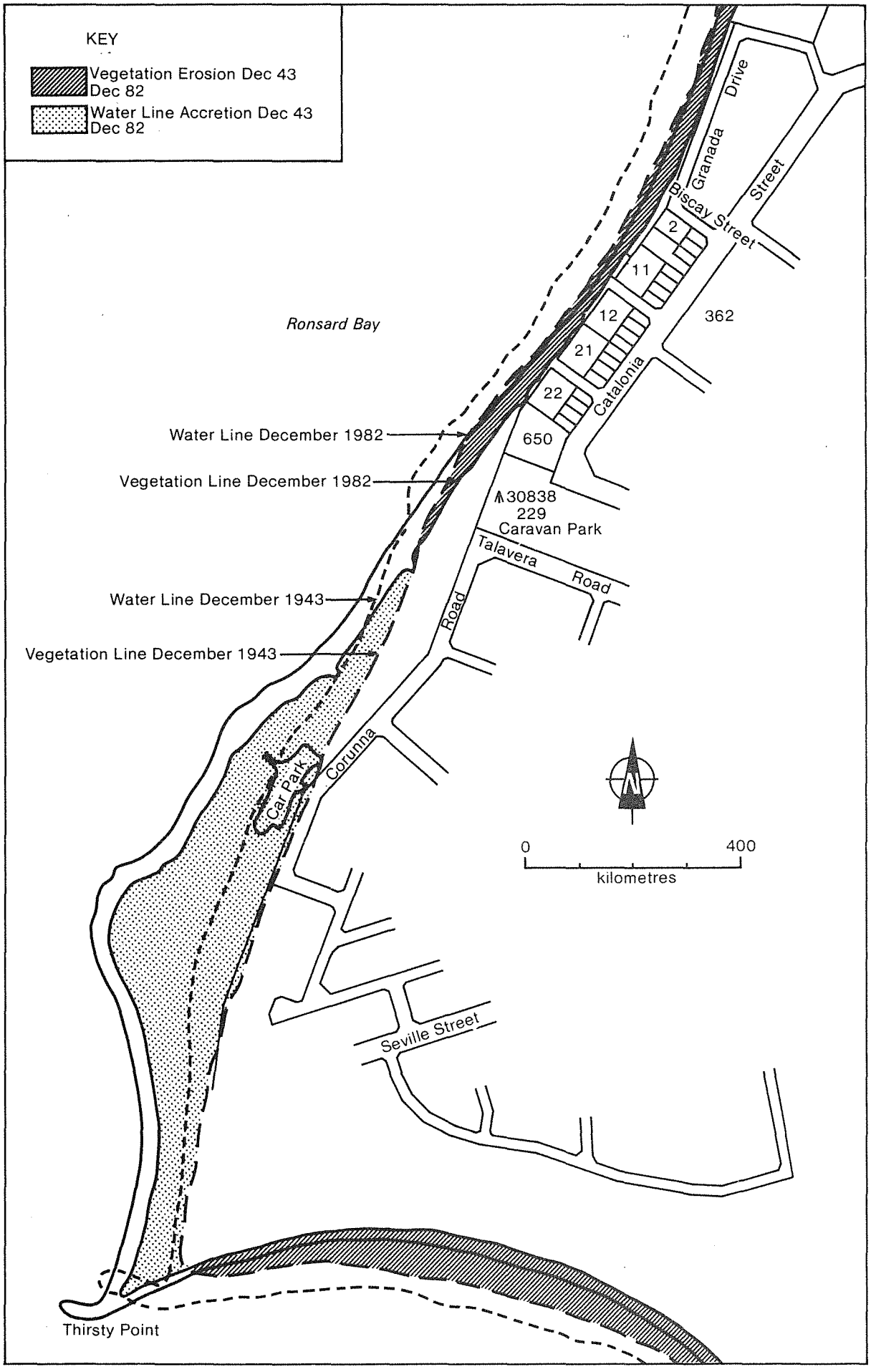

Figure 3. Water Line Accretion and Erosion From 1943 to 1982.

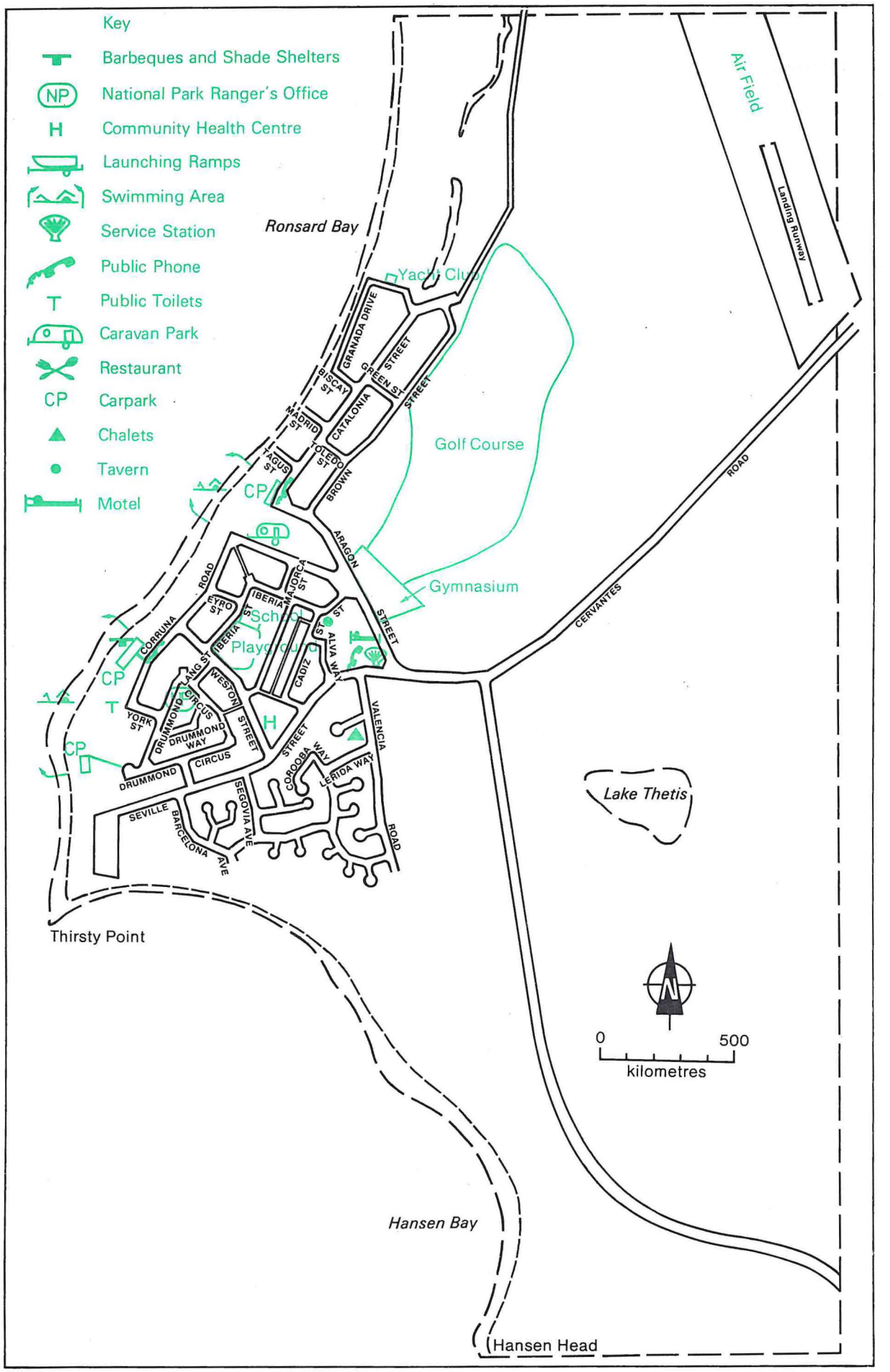

Figure 4. Recreation and Tourist Facilities.

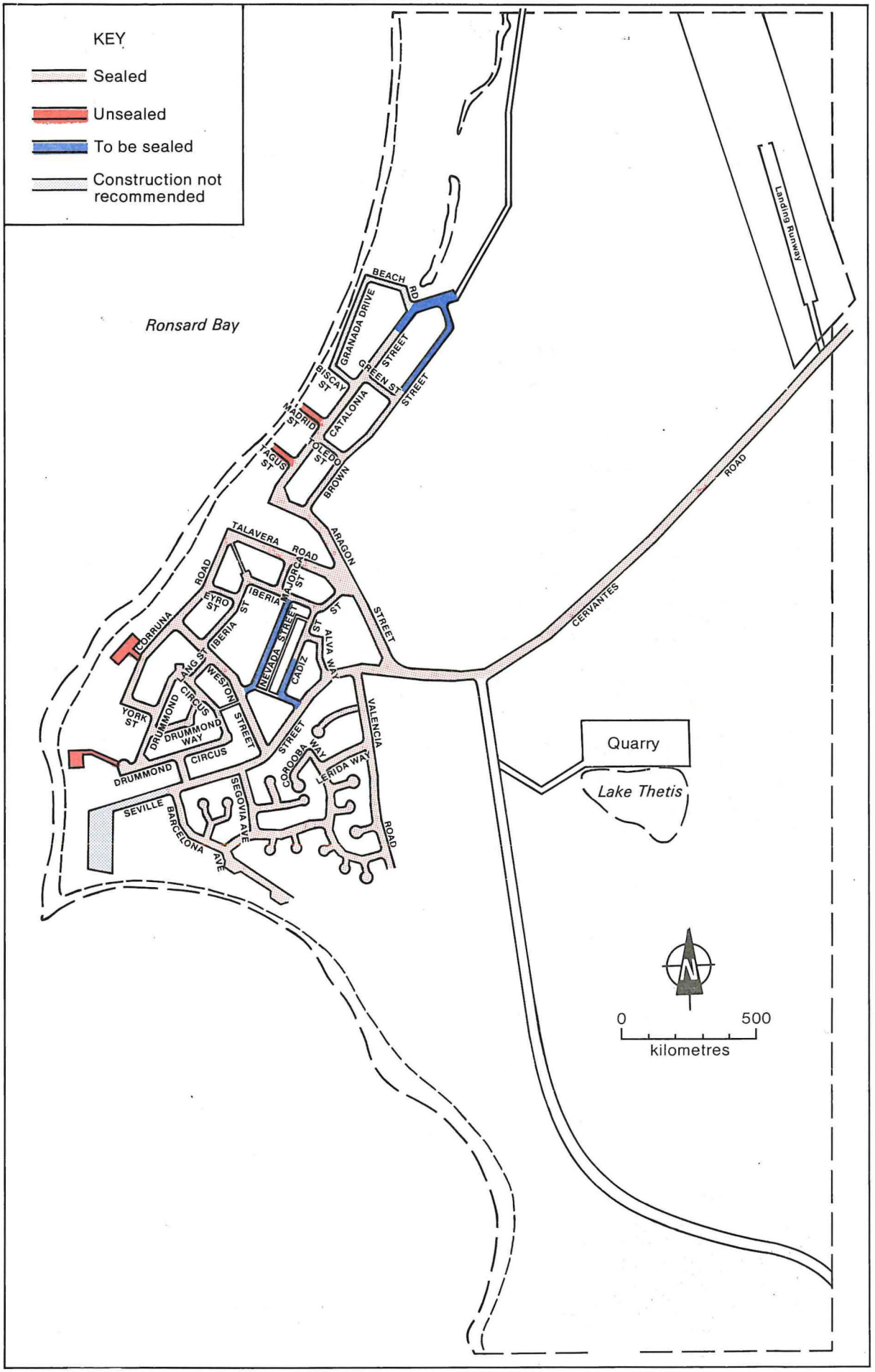

Figure 5. Roads and Car Parks.

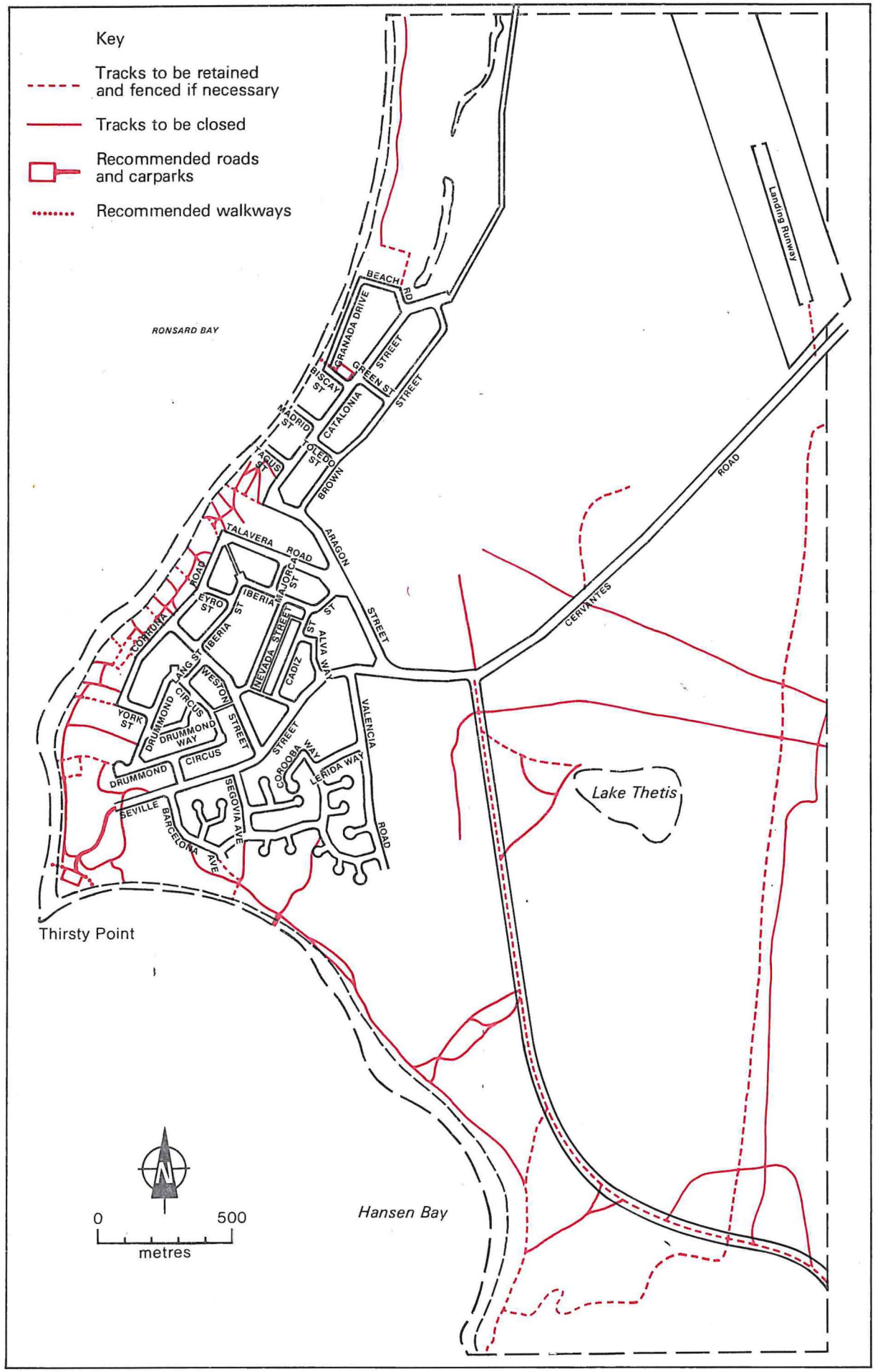

Figure 6. Vehicular and Pedestrian Tracks.

3.1.4 TOILET AND PICNIC FACILITIES

The toilet facilities at the Corunna Road car park are the only such facilities presently available to the beach-goer. The toilet block is bare and austere in construction. There are as yet no picnic facilities in the area.

3.1.5 BOAT RAMPS AND MOORING FACILITIES

There are three jetties at Ronsard Bay where the rocklobster boats off-load their catches. The boats are launched off the beach at various points along Corunna Road. There is no formalised boat ramp. Cervantes, like many other coastal towns, offers sheltered mooring facilities due to low energy beaches and protection by off-shore reefs and islands.

3.1.6 TOURIST ACCOMMODATION

Cervantes has one caravan park and a motel. The caravan park has on-site caravans and chalets. The caravan and motel facilities are used sporadically with the busiest influxes being the Christmas and New Year period, long weekends such as the Australia Day long weekend, and Easter. The school holidays in May and September are also fairly busy periods for tourism. Most visitors are holiday-makers originating from Perth or the Eastern States.

There is no camping reserve in Cervantes; in fact camping is prohibited in the study area. A $40.00 fine is imposed on anyone found illegally camping.

3.1.7 RECREATION FACILITIES

Cervantes has a sports complex which offers facilities for badminton, basketball, cricket, football, golf, lawn bowls, netball, tennis and volleyball. Water-based recreation opportunities include a small yacht club, safe swimming and windsurfing localities, and ample beaches and ocean fishing spots.

3.1.8 CROWN RESERVES

There are a number of crown reserves within the study area. These are controlled by the Department of Land Administration and may be vested in the Shire of Dandaragan or other government authorities for a variety of purposes. Their locations are shown on Figure 7.

4. MANAGEMENT ISSUES AND RECOMMENDATIONS

4.1 FACILITIES

4.1.1 ROADS

The careful design and siting of coastal roads is an essential part of sound coastal planning and management. The streets of Cervantes are reasonably well located with the exception of Granada Drive.

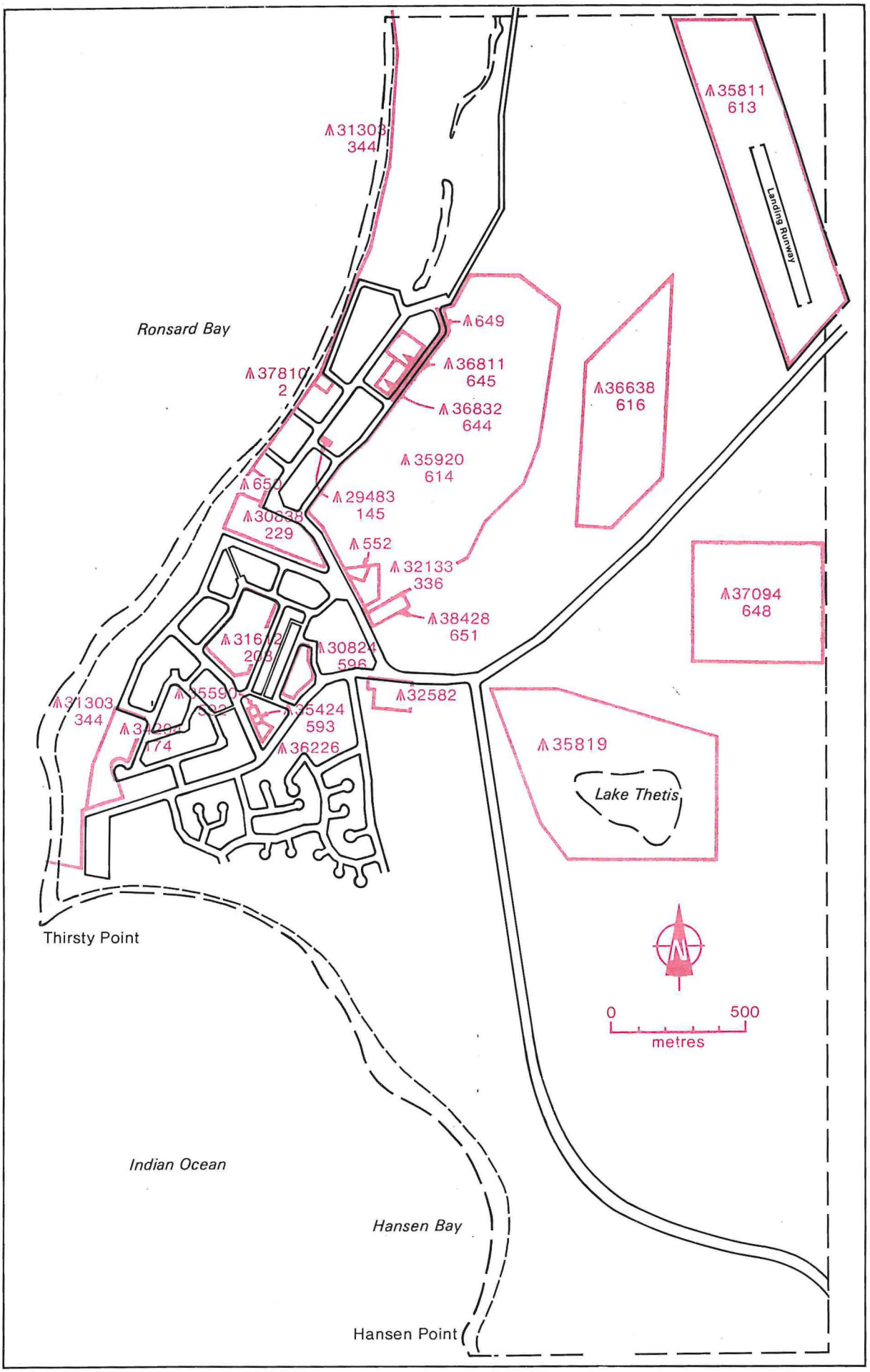

Figure 7. Crown Reserves.

Recommendations

The following recommendations will be considered when designing and siting roads:

. Roads and paths will be set back far enough to allow the natural beach sand cycle or secular recession to continue without damaging the road or causing sand drift problems. Roadways should be sited sufficiently landward of the existing dune line to permit natural sand movement.

. No development will occur on the foredune except where vehicle access to the beach is being provided.

. Granada Drive will be closed and included in the foreshore reserve.

4.1.2 CAR PARKS

There are several car parks at the town of Cervantes. There is one at the southern end of Granada Drive where it becomes York Street, and another 400 m away on the seaward side of Drummond Way. Both car parks are located on a prograding shoreline. Two proposed car parks will be located at the southern end of Barcelona Avenue which is in the new subdivision.

Recommendations

It is recommended that:

. Car parks should be surrounded by post and rail fencing to confine the motorists to the assigned area and prevent the indiscriminate use of any track to obtain access to the beach.

. New car parks will be provided at the western end of Aragon Street and at Biscay Street.

. Car parks constructed near receding shorelines will be of a temporary nature ie unsealed to limit financial and environmental loss when they are eventually destroyed by storm waves.

4.1.3 ACCESS: VEHICULAR AND PEDESTRIAN

Proliferation of tracks is not a serious problem in the project area. Tracks are usually associated with people obtaining access to and from the beach either to go fishing or to launch their boats. In addition people seek access to the beach to take part in other water-based activities like windsurfing and sunbathing.

Recommendations

It is recommended that:

. Any access should be controlled to prevent unnecessary replication of function. Tracks (vehicular and pedestrian) should be sited and designed so as to minimise disturbance of the coastal environment yet still be functional.

. Unnecessary tracks should be sealed off by dumping sand at the entrance or with signs which read "no vehicles".

. Recommended changes to the track system in each management unit are illustrated in Figure 3.

. New tracks should be controlled by fencing.

. Pedestrian tracks down to the beach should be fenced on either side by post and rail fencing to discourage people from creating new tracks.

For access over a vegetated frontal dune system to be effective it must comply with specific requirements. These requirements are:

. Access tracks should be located over existing dunes and not through them, to avoid the formation of blowouts along the tracks, or the excessive accumulation of sand.

. Access tracks should be narrow (1.5 to 2.5 m) and fenced off to protect vegetated areas.

. Tracks should be orientated away from prevailing winds.

. To encourage use of the formal access, suitably worded and prominently placed signs will be used to make people aware of their location.

. Off-road vehicles can be constrained by various regulations or laws (Control of Vehicles (Off-road areas) Act 1978). The Act can control access and restrict off-road vehicles from traversing foredunes where vegetation can be destroyed and dune restoration projects jeopardised (section 4.2.4).

. Pathways can be stabilised by limestone, gravel, bitumen, board and chain walkways and wooden steps.

4.1.4 BOAT RAMPS AND MOORING FACILITIES

The Personnel Administration Pty Ltd placed the project area within the Geraldton to Cervantes sector for boating facilities. [15] This sector includes the Shires of Greenough, Irwin, Carnamah and Coorow as well as Dandaragan.

The Geraldton-Cervantes sector caters mainly for boaters from the central and metropolitan areas. Currently there is no formal boat ramp at Cervantes and rocklobster boats are launched from jinkers operating across the beach from the slip yard on lot 362, while small boats are launched from the beach. It is not considered that current use justifies the cost of constructing a formal ramp but if one is required in the future its planning should be undertaken in consultation with the Department of Marine and Harbours.

4.1.5 TOURIST ACCOMMODATION

Presently there is a well developed caravan park and newly-constructed motel in Cervantes which provide for the needs of travellers and tourists in all but the busiest periods such as the Easter holidays. As tourist use of the area is increasing steadily it would be fortuitous to plan to provide for further development in the future.

Recommendations

- Any type of tourist accommodation development should not proceed before a detailed evaluation of the site's potential and alternative proposals have been examined.

- Other types of developments such as roads, car parks and houses should be located outside the coastal buffer zone, away from areas of dune instability and shoreline recession.

- Any tourist accommodation should complement the "low key" character of the area. For example, buildings should be constructed of light-coloured materials such as sandstone or sandstone coloured brick to assist them to blend into the landscape. No tourist development should be taller than two storeys.

4.1.6 RECREATION ACTIVITIES, PARKS AND LANDSCAPED AREAS

Cervantes provides opportunities for a variety of recreational activities. Water sports including sailing, fishing, golf, tennis and swimming are possible within the study area. Facilities are also available for golf, tennis and other games. The sports complex located in Aragon Street has a hall which can be used as a gymnasium.

Cervantes has a major role as a centre for recreational activities related to the coastal environment. Certain areas are defined as recreation areas. Some landscaping work has also been carried out in the townsite area.

Recommendations

- Information about tourism opportunities in the area should be provided.

- Facilities such as car parks, toilets and change rooms should be improved.

- Landscaping of the town centre and residential areas is recommended. A planning study on this matter should first be made. The landscaping of some areas along the coast might be combined with dune stabilisation measures.

- Lot 650 will be developed as a car park and picnic area providing access to the swimming beach.

4.1.7 RUBBISH DISPOSAL

Rubbish bins are located at various places around the foreshore.

Recommendations

If new areas are to be set up for camping and picnic areas there should be an adequate number of rubbish bins. Convenient but unobtrusive positions should be chosen. For example, they could be located at the entrance of paths leading to the beach so that people can use them as they leave from or arrive at the beach area.

4.2 LAND USE PRESSURES

4.2.1 RESIDENTIAL DEVELOPMENT

In recent years a new residential area has been developed south of Seville Street, on the large piece of vacant crown land. This newly-developed area occupies a strategic position in the town because of its proximity to the school, the town centre and the popular swimming area of the southern beach.

The area on which housing will be developed lies north of the conservation and preservation zones. The area zoned for residential development is shown on Figure 8.

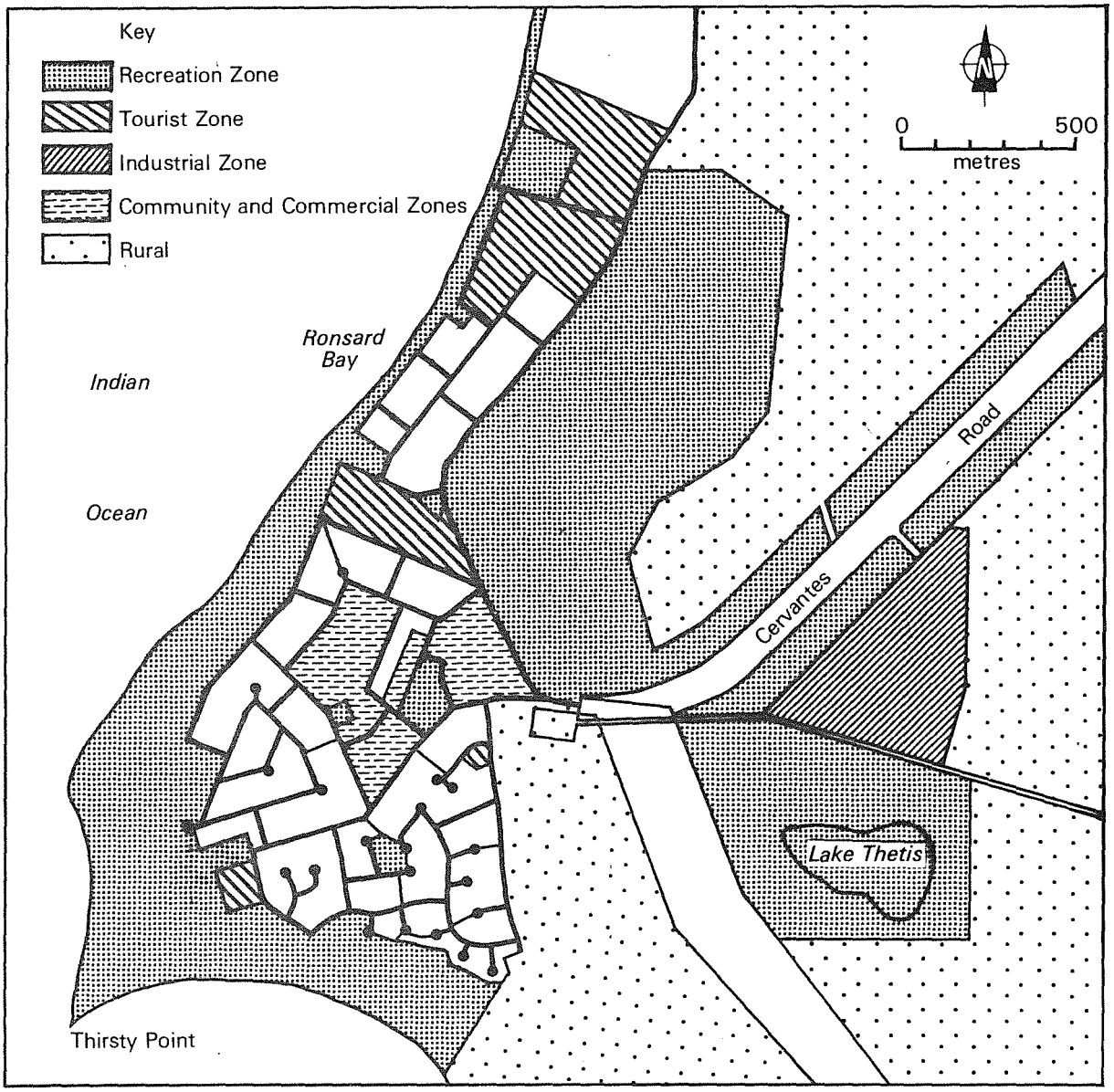

Figure 8. Outline of the current Town Planning Scheme.

4.2.2 COMMERCIAL FISHING

Cervantes is an important centre for the Western Australian Rock Lobster fishing industry. The Fremantle Fishermen's Cooperative and Planet Fisheries have receival deposits in the area. The catch of rock lobster is not being processed in Cervantes, but is being collected from the fishermen and transported for processing at Jurien Bay or Fremantle. The existing jetties at Cervantes are located on a fragile eroded coast, and require frequent maintenance.

4.2.3 TOURISM AND RECREATION

Cervantes has considerable potential as a tourist centre, as it is a major settlement close to a number of tourist attractions. The principal attraction of the area is the Nambung National Park which features the Pinnacles 20 km south of Cervantes.

Cervantes is also close to the Drovers Cave and Badgingarra and Watheroo National Parks. During spring these areas and other uncleared areas provide rich wildflower displays. The area also features the Nylagarda Bird Park and Shell Museum. Besides these inland tourist attractions, fishing, water skiing, windsurfing and other water-based recreational activities can be pursued.

Nevertheless, a number of difficulties exist in developing Cervantes as a tourist centre. Firstly, there are limitations in tourist accommodation as at present there is only a motel and caravan park. Secondly, there is a lack of public beach access since residential and fishing developments have been allowed to develop along the coast.

4.2.4 OFF-ROAD VEHICLES

Off-Road Vehicles have a detrimental effect on the environment. This section shall briefly outline the main problems involved in off-road vehicle use, especially on the coastal environment.

Coastal sand dunes are fragile and unfortunately are a popular area for off-road vehicles. Off-road vehicle activity is responsible for the deterioration of dune vegetation, which often leads to erosion. Tracks crossing the dunes are unsightly and spoil the amenity of the area. Off-road vehicles damage the coastal heath vegetation and cause soil compaction. This in turn is responsible for the loss of soil fauna which reduces nutrient cycling in the soil. (16)

In addition, off-road vehicles cause social problems including noise and visual, and environmental factors such as disturbance of wildlife, spreading plant diseases, and creation of tracks. (17)

The Shire of Dandaragan has decided to control off-road vehicles and has appointed a ranger for the coastal towns of Jurien and Cervantes. One of his responsibilities will be to enforce the Control of Vehicles (Off-road areas) Act 1978. The Shire has proposed that all the land west of the Brand Highway and within the Shire boundaries to the low water mark be under control of the Control of Vehicles (Off-road areas) Act 1978 (Figure 9).

There are several classified zones which have different requirements:

Permitted Areas: areas of land which are specifically set aside to allow for off-road vehicle activity.

Prohibited Areas: areas of land from which all vehicles are banned. However, within prohibited areas there may be exemptions which allow particular vehicles to enter the area.

In Cervantes the Prohibited and Permitted Areas are outlined below.

4.2.4.1 Prohibited Areas

All dune areas are prohibited to all vehicles. All beach areas are also prohibited to off-road vehicle activity except in the swimming beach areas between the low and high water mark. Road registered vehicles (but not motor bikes) and three or four wheeled motorbikes are allowed. This exemption was inserted so that fishermen could still obtain access to their favourite beach fishing spots.

4.2.4.2 Permitted Area

The permitted area for off-road vehicles in Cervantes is located adjacent to the Cervantes Road approximately 4 km from the outer boundary of the Cervantes townsite.

4.3 DUNE STABILISATION

4.3.1 THE IMPORTANCE OF NATURAL VEGETATION IN DUNE STABILITY

Appendix 2 indicates the type of coastal vegetation found in the area. The list of vegetation species is not complete but provides a brief expose of the most important plants. The dune vegetation of the region is severely damaged in several places along the coast. The most vulnerable areas are those which are situated close to the fish processing works and ship yards. In addition, the dunes in Unit 3 are also affected by erosion.

Recommendations

- Vegetation stabilises the foredune and prevents sand being blown inland, thereby ensuring that sand is available during the erosion phase of the beach sand cycle. Hence, the protection of dune vegetation is important in avoiding sand drift or wave erosion.

- The use of off-road vehicles, pedestrian traffic, grazing by cattle and fire must be controlled in order to preserve and maintain the dune vegetation.

- Fencing is a major method of controlling access to the beach-dune system by people and off-road vehicles and will be used around Cervantes. Fences are usually constructed of pine and fabricated wire. Another technique used in controlling movement of people is to concentrate them in certain areas by using carparks, pathways and signs. This management technique defines access to the beach and prevents indiscriminate walking over the foredune.

4.3.2 USE OF SOIL CONSERVATION AND FIRE MANAGEMENT IN DUNE STABILISATION

4.3.2.1 Soil Conservation

The coastal belt is dominated by unconsolidated and relatively unstable Holocene sands. Vegetation plays an important role in stabilising these soils. The Western Australian Department of Agriculture's Division of

Resource Management administers the Soil and Land Conservation Act (1945-82) and may issue Soil Conservation Notices on both freehold and Crown Land.

Recommendations

Typical soil conservation techniques which could be employed through the Soil Conservation Act (1945-1982) and have not already been discussed are:

. To prevent clearing where there is significant potential risk for soil erosion.

. To declare an area a Soil Conservation District and plan soil conservation projects. Once an area is declared a Soil Conservation District it is possible to prohibit or restrict any activity which might cause soil erosion, and order remedial works. These could include regulation of changes in land use and requirements for management programmes. Thus, the Soil Conservation Act (1945-82) could lend valuable support to town planning controls in sensitive coastal areas. Land can also be acquired and managed as a Soil Conservation Reserve, within which soil conservation works and research projects may be carried out.

  The Commissioner, subject to the agreement of the Soil Conservation Advisory Committee, is able to issue soil conservation orders requiring land owners to prevent, control or restore erosion damage. This power may not be useful in the project area since the vast majority of coastal land is vested in the crown.

4.3.2.2 Fire Management

Fire management in the area is the responsibility of a voluntary fire brigade organisation set up in the town.

The Bush Fires Board advises that access tracks running east-west be maintained to act as firebreaks for fires moving north. The bitumen roads can protect the coastal vegetation from bush fires travelling west by serving as a firebreak.

Recommendations

. Council should set aside areas for camp fires and barbecues.

4.3.3 METHODS OF DUNE REHABILITATION

Within the study area there are small active blowouts; but there is no major mobile or active sand dune.

The major areas of instability are probably natural, but the smaller areas of erosion are probably due to "people pressure" such as pedestrian tracking and off-road vehicles. Some of the sand dune drift problems are in locations which will have little effect on people, while others may affect property and man-made structures.

Recommendations

There are several techniques for sand dune stabilisation. (18, 19 & 20) Some of the main methods, the approximate cost, advantages and disadvantages are listed below. However, detailed advice from the Department of Agriculture should be sought before any significant soil stabilization project is undertaken.

4.3.3.1 Mats, Netting, Mulches and Stones

(a) Mats and Netting

Bare surface sands can be quickly protected by matting and nets. They protect the sand surface but collect little sand. All nets and matting are subject to traffic damage and require protection.

(b) Brush

Brush is an effective temporary stabiliser. This method has a high labour requirement which may limit its use to small blowout areas.

(c) Mulches

Mulches of straw or wood fibre may be useful on larger blowouts.

(d) Crushed Stone

A cover of crushed stone or clay will provide immediate protection to the dune surfaces. However, it is expensive and usually can be confined to small parts of the dune. The material may become buried and lost unless the surrounding areas are stabilised.

4.3.3.2 Fences

A system of sand fences may effectively stabilise an area of blowing sand for one or two years, but dune protection with fences usually becomes a continuing process. Most fences tend to deteriorate due to corrosion or decay as well as from storm damage of vandalism. However, fences are more durable than most netting and mats. The installation of additional fence is necessary once a fence system has become filled and stops catching sand. Consequently, a sand fence is a temporary dune stabiliser which must be supplemented or followed by longer dune restoration works such as painting.

Fences have two distinct advantages over planting vegetation. Firstly, they may be installed at any season (vegetation usually must be planted in cooler and wetter seasons of spring and winter); and secondly, they are fully effective as soon as installed. Unlike fencing, vegetation has to grow for trapping capacity to develop. The volume of sand moved by strong winds may be too large to permit the establishment of vegetation. Thus, temporary protection by low fences is a possible solution. The design of fence systems to stabilise areas of blowing sand should consider the characteristics of the particular site, including wind patterns and the ultimate dune configuration desired. Fences may be used to trap sand to form a new foredune or enlarge a small one.

4.3.3.3 Vegetation

Vegetation is the best long-term stabiliser suitable for general use on sand dunes. It is the only stabilisation technique with self-healing capability and the ability to grow and change with the dune. Four important areas of consideration are plant selection, preparation of site, planting procedures and maintenance of dune restoration projects. [21] In general, the following points are useful to remember.

(a) Selection of Plant Species

The first colonisers of mobile sands are (Sea Rocket) Cakile edentula, (Marram Grass) Ammophila arenaria, and (Spiny Rolling grass) Spinifex hirsutus. These species are particularly tolerant to sandblast, wind, wind-borne salt and hot, dry infertile soils. They, also have an ability to accumulate sand around themselves and grow up through the accumulating sand.

The Departments of Agriculture and Land Administration use various dune species and have conducted experimental plantings of Marram Grass (Ammophila arenaria), Sea Wheat (Agropyron distichum), Pyp grass (Ehrharta villara), Cereal Rye (Secale cereale), Spinifex longifolius, Acacia cyclops, Acacia cyanophylla, Creeping Grounsel (Senecio Lautus), Tetragonia spp, American Beach grass (Ammophila breviligulita), Pigface (Carpobrotus aequilaterns), Atriplex spp and Tamarisk sp.

(b) Preparation of the Site

Some reshaping of the dunes by a bulldozer or grader may be required if unstable areas have steep slopes. If no foredune exists one may be constructed using sand trapping fences or mechanical means. The site should be fenced before rehabilitation works commence.

(c) Planting Procedure

May to July is the best period to plant trees and shrubs but ground cover species could be planted during April or September.

Plants may need protection against wind, sand and salt blasting if there is no vegetation cover. Plastic mesh or brushwood which reduces wind velocity by about 50% can be used.

Plant spacing should vary with plant species and site exposure. Spacings should be less on exposed sites such as dune crests. Planting should begin on the windward side and extend over the entire sand surface. Establishment of vegetative cover will be difficult if the restoration area is large, particularly under windy or dry conditions.

Fertiliser may be added when establishing the vegetative cover as the addition of complete fertiliser mixtures will increase vigour and growth rates.

4.3.4 AREAS RECOMMENDED FOR DUNE RESTORATION

Two issues should be considered when establishing priorities in a sand dune rehabilitation programme:

- Will continuing erosion have any detrimental effect on the sand cycle, beach amenity, beach facilities or recreational value of the beach or nearby improvements?

- What is the estimated cost of rehabilitation; who will finance, manage and execute the programme?

4.4 BEACH EROSION AND PROTECTION

As described in Section 2.3.5 and illustrated on Figure 5, the shoreline is receeding north of Talavera Road because of marine erosion. The Department of Marine and Harbours have considered a number of engineering strategies to protect the following properties:

- Lot 22 - Leased by Fremantle Fishermen's Cooperative for a lobster receival depot.
- Lot 21 - Leased by Planet Fisheries for a lobster receival depot.
- Lot 12 - Vacant Crown Land - proposed for a passive recreation/park area.
- Lot 11 - Australian Seafood Producers factory for lobster processing.
- Lot 146 - Leased by Australian Seafood Producers for full storage (now relocated.
- Lot 362 - Owned by L J and M M Hoy for a slipyard.
- Lot 2 - Reserve 37810 for foredune preservation.

Various methods have been used to control erosion in the area. In the late 1970's car bodies were dumped on the beach to control erosion, however, this technique is unsightly and largely ineffective. While the car bodies may serve to dissipate wave energy for a short while, the surrounding beach will continue to scour. In the long term such measures will not be effective and results in a loss of beach and visual degradation of the foreshore.

Sand replenishment has been carried out since March 1984 as an interim measure while possible permanent works have been investigated. Rather than the natural foreshore continuing to erode, the sand fill is eroded and deposited offshore to form a bar similar to the natural beach sand cycle.

Sand replenishment involving the depositing of 8 000 m^3 of sand was carried out on three occasions at a cost of $30 000. It was necessary to renourish the each twice in 1985.

The Department of Marine and Harbours considers that continued sand replenishment is only a temporary solution which will become more expensive with time, and that more permanent works are required.

Three alternative marine engineering proposals have been considered by the Department of Marine and Harbours, and they recommend the construction of a 75 m and a 70 m long groynes at the end of Biscay and Madrid Streets respectively. The space between the two groynes would be filled with 77 000 m^3 of sand and a new foredune established and vegetated. It is anticipated that this work will commence in 1987.

5. IMPLEMENTATION OF MANAGEMENT RECOMMENDATIONS

5.1 MANAGEMENT PRIORITIES

Appendix 3 indicates more specific areas within management areas which require attention. The tables summarise the vegetation condition, dune

stability, shoreline stability, land based development, facilities, usage and finally management priorities for each management unit.

Unless otherwise stated, the management objectives are listed in order of decreasing priority. To properly manage the areas the activities listed in the management objectives need to be undertaken. Preparation of a timetable for the implementation of the management priorities is not possible without information about the amount of funds available to the council.

5.2 ROLE OF STATE AND LOCAL GOVERNMENT

5.2.1 PUBLIC EDUCATION PROGRAMME

The public education programme should be part of the tourism information programme for the area. The programme would aim: to direct people to "key" recreation and tourism areas; to divert people away from environmentally sensitive areas; and provide information about the coastal environment and the need to protect it.

The above objectives may be achieved by providing people with information about facilities in the area such as boat launching, accommodation, beaches and picnic areas. In this way people's movements can be subtly guided and environmentally sensitive areas can be protected. The information bulletins should also contain information on the proper use of off-road vehicles and boats in the area, and a brief explanation of the coastal processes and some environmental issues in the region.

5.2.2 LAND USE

A land use policy in the study area was adopted by the Shire of Dandaragan Council following recommendations by various government departments and submissions from the local residents. The land use structure of the Cervantes townsite is shown in Figure 4.

5.2.3 FUNDING - THE COST OF DUNE STABILISATION AND BEACH PROTECTION

Funding is required to implement management works and is currently being borne by the Shire, with occasional assistance from State Government Departments. To ensure sufficient, long term funding Council should refer its application to the Coastal Management Coordinating Committee (CMCC).

For areas which require prompt attention and implementation of management proposals the Council can apply for grants provided from the Department of Sport and Recreation for work on community and recreation facilities; Main Roads Department for tourist road grants; Department of Agriculture for soil conservation works; Department of Marine and Harbours for foreshore restoration and control of erosion; and the State Planning Commission (SPC) for beach management programmes.

Community Employment Programme (CEP) could be utilised to provide funding and manpower for the necessary dune stabilisation works. To be eligible for a CEP grant:

- the community must provide at least 20% of the grant money including cash component of 10%; and
- at least 65% of the Commonwealth grant must be paid in wages and allowances to the "target" group.

One of the difficulties for the Shire of Dandaragan is that unemployment in the district is low. Therefore eligible, unemployed people would have to be brought in from other areas where unemployment is higher. The other difficulty is the provision of suitable living accommodation for the worker.

The CEP project would also have to be supervised to ensure efficient and correct use of materials and equipment.

5.2.4 SURVEILLANCE AND POLICING

The Shire of Dandaragan has employed a ranger who will patrol the beaches at Jurien Bay and Cervantes. Policing is necessary to enforce the Control of Vehicles (Off-road areas) Act (1978) as well as to check on dune management projects.

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APPENDICES

APPENDIX 1 RESERVES AND PURPOSES

RESERVES	AREA	VESTING DATE	VESTED IN	PURPOSE OF VESTING
29483	0.0994	6.12.1968	Minister for Fisheries and Wildlife	Office and Quarters Dept of Fisheries
30824	1.3453	26.03.1971	Shire of Dandaragan	Parking Area
30838	4.6134	25.06.1971	Shire of Dandaragan with power to lease	Caravan Park
31303	29.2067	19.05.1972	Shire of Dandaragan	Recreation
31612	5.0417			School Site
32133	0.8886	29.06.1973	Shire of Dandaragan with power to lease	Club & Club Premises
32582	5.2703	28.06.1974	Minister for Water resources	Water Supply
34294	4.1759	04.02.1977	Shire of Dandaragan Special Conditions	Parking and Recreation
35424	0.1198	14.07.1978	Minister for Public Health	Community Health Centre
35811	57.1616 Total within a Townsite Boundaries 36.9104	22.12.1978	Shire of Dandaragan	Aerial Landing Ground
35590	0.1747	23.09.1983	Shire of Dandaragan	Ambulance and Fire Brigade Site
35920	65.9040	23.09.1983	Shire of Dandaragan with power to lease	Recreation
36226	0.3764			Police Purposes
36638	17.6367	9.05.1980	Shire of Dandaragan	Rubbish Disposal Site
36811	1.2062	12.09.1980	Shire of Dandaragan	Boat Storage Site
36832	0.7868	26.09.1980	Shire of Dandaragan	Shire Depot Site
37094	20.5027	27.02.1981	Minister for Water Resources	Waste Water Treatment Works Site
37810	0.2428	2.07.1982	Shire of Dandaragan	Sand Dune Protection
38428	0.8131	26.08.1983	Shire of Dandaragan with power to lease	Recreation

APPENDIX 2 LIST OF COASTAL PLANTS COMMONLY FOUND IN MANAGEMENT AREAS

ALPHABETIC LISTING OF SPECIES	LOCATION IN THE DUNE SYSTEM	NOTES
Acacia lasiocarpa	stable dune (S D)	This species dominates the well established low closed heath community.
Acacia rostellifera	S D	
Acacia truncata	S D	
Acanthocarpus preissii	S D Foredune (F D)	
Acanthocarpus littorea	S D	
Allocasuarina lehmanniana		
Atriplex isatidea	F D Mobile dune (M D)	
Cakile maritima	F D	Pioneer species.
Carpobrotus aequilaterus	M D S D Limestone Cliff (L C)	
Hardenbergia comptoniana	S D	
Hemiandra pungens		
Leptocarpus sp		
Leucopogon ovalifolius	S D	
Melaleuca acerosa	S D	This species dominates the well established low closed heath community.
Melaleuca huegelii	S D Limestone ridges of dune (L R)	Found in low lying swamp areas.
Myoporum adscendens		
Myoporum insulare	F D M D S D	Sheltered rear slopes of coastal dunes.
Myrtaceae sp		
Nitraria billardieri		
Olearia axillaris	M D S D L C	Usually dominate in rapidly accreting zones.
Rhagodia baccata	S D	Often found in the lee of an eroding beach ridge or just back from an escarpment in a protect pocket.

APPENDIX 2 LIST OF COASTAL PLANTS COMMONLY FOUND IN MANAGEMENT AREAS

ALPHABETIC LISTING OF SPECIES	LOCATION IN THE DUNE SYSTEM	NOTES
Salsola kali	I D (Incipient dune) F D	Sheltered beaches - features early in succession on dune lands which have been levelled or disturbed.
Santalum acuminatum		
Scaevola crassifolia	M D S D L R L C	Secondary coloniser.
Scirpus nodosus	F D M D S D Wetland littoral (W L)	
Spinifex hirsutus	F D	Pioneer species.
Spinifex longifolius	I D F D M D	Pioneer species.
Spyridium globulosum	F D	Dominate secondary species.
Tamarix sp		
Templetonia retusa	S D L R	
Tetragonia decumbens	I D F D M D	Especially prevalent in areas of drifting sand.
Threlkeldia axillaris	L D S D Salt Marsh (S M)	

APPENDIX 3 MANAGEMENT UNITS (Recommendations and Priorities)

UNIT	VEGETATION	SHORELINE STABILITY	DUNE STABILITY	LANDWARD DEVELOPMENT	ACTIVITIES	MANAGEMENT PRIORITIES
1 Yacht Club to Talavera Road and inland to Catalonia St.	Vegetation cover is moderate to high. Only at track openings is it sparse.	The shoreline is receding.	The dune system is very low to non-existent. There is no 'real' foredune. This situation is true for the whole area especially between Lots 2 and 22 which are built on the dune system.	. Fish Processing Plant . Slip-yards . Residential . Fish Depot	Crayfishing	*Shore stabilisation work. *Dune stabilisation work by sand replenishment as an interim measure.
2 Thirsty Pt to Talavera and inland as far as the new subdivision.	Moderate to high cover but lower near the beach where prograd-ation is rapid and vegetation is unable to colonise the dune system.	The beach is prograding.	The dune system is prograding and therefore is not stable. If vegetation is unable to colonise the dunes there will be a threat of sand drift.	Residential	Swimming Beach-fishing Boat Launching	*Define carpark by position and rail access to beach. *Planting of native tree for aesthetic and shade value. *Upgrading of picnic and barbecue facilities at the Drummond carpark. *Rationalise size of Granada Rd carpark.
3 From Valencia Road to the western end of Seville St. This includes the new sub-division.	There is moderate to low vegetation cover. Cover is low around the unstable areas.	The shoreline is receding.	Relatively unstable. Scarping along dune, especially high at the southern end of the bay.	Residential	Swimming Beach-fishing	*Control access. *Define access to and from beach. *Establish picnic/BBQ and playground facilities at the area abutting the carparks.