Department of Water
Government of Western Australia

Esperance Groundwater Area
Water Management Plan

MAY 2007

Water Resource Allocation and Planning Series
Report no. WRAP 16

Department of **Water**
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Recommended References

The recommended reference for this publication is: Department of Water, 2007. *Esperance Groundwater Area, Water Management Plan.* Department of Water, Government of Western Australia, Water Resource Allocation Planning Series Report No. WRAP 16.

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May 2007

ISSN 1327-8428 (pbk.)

ISSN 1834-2620 (pdf).

Subject of cover photographs

Aerial photograph of Esperance wetlands, Pink Lake, Woody Lake, Esperance wetlands

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Summary

The Department of Water (the Department) manages and regulates Western Australia's water resources. The Department has produced this Management Plan for the groundwater resources of the Esperance Groundwater Area to achieve sustainable water allocation and development for current and future users and the protection of groundwater dependent ecosystems. The Plan provides the objectives, policies, principles and strategies that will be used to manage groundwater resources to ensure their sustainable use for the benefit of the local community. This Plan has been through a public review process and comments have been incorporated as appropriate.

This Plan is intended to improve certainty for existing and potential water users in the area by aiming to protect the environment, while fostering a sound economy and the social well-being of the people of the Region. It utilises recent groundwater resource assessments to refine previously estimated Allocation Limits and groundwater availability for consumptive use as shown in the following table.

Table 1. Water Availability in the Esperance Groundwater Area

sub-area	Allocation Limit (kL/yr)	Public water supply[1] licensed entitlements (kL/yr)	Other licensed entitlements (kL/yr)	Groundwater Availability (kL/yr)
Town superficial aquifier	1,900,000	1,150,000	394,722*	126,278
Twilight superficial aquifier	700,000	600,000*	67,600	31,200
Butty superficial aquifier	4,200,000	950,000*	0	3,250,000
Warden fractured rock aquifier	1,000,000	N/A	223,570*	776,490* Low yields

*Includes applications under assessment, up-to-date figures are indicated in aquifer allocation report.
All figures are current to 26 May 2006.

The Esperance Groundwater Area has been subdivided into four sub-areas to more appropriately reflect the geological and hydrogeological features of the area. A review of the recharge characteristics has allowed revised Allocation Limits to be set for each sub-area, taking into consideration vertical recharge plus a component of throughflow.

1 Water Corporation

The groundwater resources of the Esperance Groundwater Area are limited and careful management is required to ensure that the quality and quantity of groundwater is not compromised in any way as a result of commercial industry, rural activities and urban development.

This Plan provides the basis for groundwater licence assessments and allocation within the Esperance Groundwater Area. Assessment and allocation are based on managing the impacts of groundwater pumping on identified groundwater dependent ecosystems and other users. It adopts a precautionary approach to water allocation to ensure that the groundwater resource and its beneficial uses are sustained in the long-term.

The Department will continue to review the Allocation Limits as new data and information becomes available. This Plan will be reviewed within seven years.

1 Introduction

1.1 Name of Plan

This Plan should be referred to as the 'Esperance Groundwater Area Water Management Plan, 2007'.

1.2 Status of this Plan

In recognition of the need to manage the increasing demand for groundwater resources in the Esperance Groundwater Area and the potential environmental impacts, the Department of Water (the Department) has produced this Plan to provide information to organisations, industry and individuals about the way in which groundwater resources of the Esperance Groundwater Area will be managed over the next seven years. Within the next seven years, the Department will consider whether action needs to be taken to review, amend or revoke this Plan.

1.3 Esperance Groundwater Area

1.3.1 Location

This Plan covers the area defined as the Esperance Groundwater Area. The location map is shown in Figure 1. The town of Esperance is located within the Esperance Groundwater Area, approximately 725 km south-east of Perth on the Southern Ocean coastline. The Esperance Groundwater Area forms a narrow coastal strip five to ten kilometres wide between Coramup Road in the east and Lake Gore in the west and covers an area of approximately 360 km^2.

1.3.2 Proclamation

The Esperance Groundwater Area was proclaimed on 20 July 1973 under the provisions of the *Rights in Water and Irrigation Act 1914 (RiWI Act)* because of concerns regarding the long-term availability of groundwater. This authorised licensing and management of groundwater abstraction to protect the resource for all users. The Esperance Water Reserve was proclaimed in 1970 under the *Country Areas Water Supply Act 1947* to protect groundwater quality.

1.3.3 History

The Esperance Groundwater Area sub-area boundaries were derived following consideration of the geological and hydrogeological characteristics of the area and water quality characteristics. During the preparation of this Plan, the four sub-areas were renamed Town, Twilight, Butty and Warden, as shown in Figure 1.

The current sub-areas facilitate better management of the resource at a local scale and reflect the response of the groundwater system to abstraction and water quality and recent developments in the town.

1.4 Purpose of this Plan

The Department has developed the Esperance Groundwater Area Water Management Plan to guide the management of the groundwater resources of the Esperance Groundwater Area to achieve:

- Sustainable water allocation and development for current and future users; and
- Protection of groundwater dependent ecosystems.

The Plan provides the objectives, policies, principles and strategies that will be used to manage the groundwater resources of the Esperance Groundwater Area.

1.5 Water allocation in Western Australia

The Department is the lead agency for the allocation and management of water resources in Western Australia. The Department manages the water resources of the State in partnership with other Government agencies, key stakeholder groups and the community. One of the primary objectives is to ensure the State's water resources are managed appropriately and utilised to support sustainable development and conservation of the environment for the long-term benefit of the community. This is achieved through a licensing and water allocation process that ensures the State's water is used efficiently and within sustainable limits.

As part of the water allocation process, the Department determines how much water should be set aside for the environment and how the water available for use should be shared between competing uses.

Water management plans are prepared to formalise the water management objectives in an area. They range from regional plans over a large area to sub-regional and local area plans covering individual surface water or groundwater management areas and sub-areas.

Plans identify the water resources and water regimes to be protected and define the water licensing policies for the area of application of the plan.

1.6 Groundwater overview

The groundwater resources of the Esperance Groundwater Area are drawn from a shallow unconfined aquifer, which contains the only major supply of fresh groundwater for the Esperance Region. As alternative potable water supplies in the Region are scarce, careful management of this limited groundwater resource is essential. The unconfined aquifer is highly vulnerable to contamination, and as it provides the only drinking water source for Esperance, an allocation and quality protection management strategy is essential to ensure conservation of the resource. The *Esperance Water Source Protection Plan* was prepared in 1999 to protect water quality in Esperance.

Esperance's town public water supply wellfield draws water from an extensive unconfined aquifer underlying the town and extending westwards for at least 25 km. Recharge to the aquifer is by direct infiltration of rain into the coastal sands and limestone sediments with minor throughflow from the basement rocks to the north. At current levels of abstraction, widespread permanent water table declines are unlikely, as long as the average annual abstraction remains less than the average annual recharge. However, in local areas, ab-

straction for public water supply has caused deeper saline water to be drawn into the fresh water, described as upconing. Salt water intrusion from the sea could occur if bore abstraction is not managed carefully.

The increasing demand for groundwater supplies in the Esperance Groundwater Area, particularly from the superficial aquifer, has required a review of the allocation status to better manage the resource and the potential ecological impacts. Allocation Limits have been established for the superficial aquifer in each of the sub-areas. The estimated annual sustainable yield has been based on 70 percent of total recharge (Baddock, 1998). Allocation Limits have been based on the adoption of a sustainable yield, and allow a component of the recharge for maintenance of aquifer throughflow.

1.7 Plan objectives

The purpose of this Plan is to manage the allocation of groundwater for consumptive use while ensuring key environmental, social and economic values are maintained or improved.

The primary objectives of this Plan are to:

1. Ensure that the groundwater resources are allocated equitably and used sustainably in the long-term, taking into consideration the social, economic and environmental impacts of such usage, based largely on managing the impacts of groundwater pumping on identified dependent ecosystems and existing users;
2. Prescribe the rules and protocols that will apply in assessing licence applications and water resource development proposals, and the issue of groundwater resource entitlements; and
3. Prescribe the monitoring requirements for the groundwater resource and its ecological dependencies.

1.8 Legislative and policy framework

1.8.1 The role of the Department of Water

In January 2006, the Department of Water was formed and changes to water resources legislation then gave water resources management powers to the Department.

The Department is responsible for allocating the State's water resources responsibly and managing their use to support sustainable development and protection of the environment. The Department implements water allocation decisions and regulates the use of water through the powers assigned to it under the *Rights in Water and Irrigation Act 1914*, the *Rights in Water and Irrigation Regulations 2000* and the *Water and Rivers Commission Act 1995*.

The Department is also responsible for the preparation of Water Resource Protection Plans and guidelines for the protection of water supplies. Legislation related to water quality protection includes the *Metropolitan Water Supply Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*.

1.8.2 Rights in Water and Irrigation Act 1914

The primary legislation for allocating groundwater in Western Australia is the *Rights in Water and Irrigation Act 1914 (RiWI Act or the Act)* and the *Rights in Water and Irrigation Regu-*

lations 2000. The *RiWI Act* vests the 'right to the use and flow, and to the control, of the water at any time in any watercourse, wetland or underground water source' in the Crown.

The *RiWI Act* requires compulsory licensing of all artesian wells throughout Western Australia. Artesian wells are defined as 'a well, including all associated works from which water flows, or has flowed, naturally to the surface'.

In addition, supplies from non-artesian wells within specific areas, proclaimed under the *Act* as Groundwater Areas, require licensing. These areas are proclaimed to ensure equitable opportunity for allocation between competing users including the environment, and to protect existing and future users in areas of major public, agricultural, industrial or mineral developments.

Regulatory controls are designed to:

- Encourage the responsible development of groundwater resources and limit abstraction from the aquifer to a level which can be sustained over the long-term;
- Allocate resources for beneficial private and public purposes and to meet the environmental requirements of the area;
- Enable the resources to be shared in an equitable manner; and
- Protect present and future sources of groundwater for public water supplies and for private use, where appropriate.

Groundwater licence administration in the Esperance Groundwater Area is the principal responsibility of the Department's South Coast Region (Albany Regional Office) and primarily the Esperance District Office.

Currently a review of the *RiWI Act* is underway. This Plan will be reviewed under new legislation that results from the review.

1.8.3 Water Reform

Western Australia signed the National Water Initiative (NWI) agreement in April 2006, about two years after it was released. The overall objective of the NWI is to provide a "nationally compatible, market, regulatory and planning based system of managing water resources in rural and urban settings that optimise economic, social and environmental outcomes". With the signing of the NWI there have been some changes in management and supporting legislation for water management. Considerable ongoing consultation with water users has already begun regarding these changes.

2 Physical Environment

2.1 Geomorphology

The Esperance Groundwater Area is situated on the eastern portion of the Bremer Basin. Rocky headlands and intervening stretches of sandy beaches and bays dominate the physiography of the southern coastline. The coastal landscape extends up to 10 km inland from the coast, and consists primarily of coastal sand dunes parallel to the coast and alluvium. An extensive area of saline alluvium and wetlands occurs on the coastal plain behind the costal sand dunes and includes saline lakes such as Pink Lake and Lake Gore. Creek systems draining from the north flow into the wetland systems. An escarpment marks the inland extent of the coastal plain, where the coastal plain merges with the Esperance Sandplain.

2.2 Geology

Proterozoic rocks of the Albany-Fraser Orogen underlie the Esperance Groundwater Area. Sediments of the Bremer Basin form a veneer infilling palaeovalleys incised into the bedrock. Quaternary sediments near the coast unconformably overlie the basement or Plantagenet Group (Baddock, 1994). Geological cross-sections within the Esperance Groundwater Area are represented in Figures 2-4. Cross-sections A–A and B–B are north-south dissections from Pink Lake to the Southern Ocean. Cross-section C–C is an east-west dissection along the coastal dune area between Pink Lake and the Southern Ocean.

2.2.1 Proterozoic

Proterozoic granite and gneiss of the Albany-Fraser Orogen occurs in the Esperance Groundwater Area.

The basement rocks consist of highly deformed granitoid gneiss and granitoid rock. These basement rocks are poorly exposed due to extensive surficial cover and deep weathering (Johnson and Baddock, 1998). Areas of elevated basement form headlands along the coast, and a ridge extends from Wireless Hill on the edge of the townsite to Observatory Point (Baddock, 1994).

Most of the basement rocks have been deeply weathered and typically comprise a thin laterite duricrust developed over a variable thickness of dense, kaolinitic clay. The weathering profile on the granitoid and gneissic rocks developed through chemical breakdown of the crystalline bedrock during Tertiary and Quaternary times. The upper portion of the weathered profile has been largely eroded as a result of drainage rejuvenation (Johnson and Baddock, 1998).

2.2.2 Cainozoic

2.2.2.1 Tertiary sedimentary rocks

The Proterozoic rocks are unconformably overlain by the Middle to Late Eocene Plantagenet Group (of the Bremer Basin) comprising the Werillup Formation and the Pallinup Siltstone (Johnson and Baddock, 1998).

The Werillup Formation consists of predominantly fluvial and lacustrine sediments deposited as basal units within pre-existing Cretaceous valleys (palaeochannels) and broad topographic depressions in the weathered bedrock. The Werillup Formation rests unconform-

ably on the basement rocks (Johnson and Baddock, 1998). The Werillup Formation is pale brown, grey or dark brown, and consists of fine to coarse-grained quartz sand that may be carbonaceous, silty or clayey. It may also contain glauconite, which is a green mica mineral of marine origin. Lignite (brown coal) occurs in the formation (Baddock, 1994).

The Pallinup Siltstone overlies the Werillup Formation or weathered basement. It was deposited in a shallow-marine environment during a major marine transgression in the late Eocene period (Johnson and Baddock, 1998). In areas of elevated basement, the Pallinup Siltstone has been eroded or may not have been deposited. It is typically a dark brown, carbonaceous siltstone, but may also consist of pale grey and pale green clay, brown micaceous siltstone, or pale brown clay. Glauconite may also occur (Baddock, 1994).

2.2.2.2 Quaternary sediments

The Quaternary surficial sediments form a veneer over the Proterozoic and Tertiary rocks. These comprise coastal deposits, sandplain deposits and alluvium.

Coastal deposits trend parallel to the coast, forming large ridges of dune sand overlying calcareous shelly limestone. The shelly limestone comprises white, fine to coarse-grained, calcareous quartz sand with variable cementation and abundant shells at some localities. Dune sediments blanket the coastal area and consist of white to cream, unconsolidated, very fine to fine-grained quartz sand. The coastal sediments are best developed between Lake Gore and Esperance where ridges are up to 160 m high.

Sandplain deposits occur inland from the coast and comprise eolian, fine-grained quartz sand and silt, which have been derived from reworking of coastal sediments and the Pallinup Siltstone. The sand dunes range in thickness from a few centimetres to several metres in height. The dunes have an irregular distribution.

Alluvium is present within lower parts of mature drainage systems and in the chain of lakes behind the coastal dunes. The alluvial deposits, consisting of grey to brown silt and clay, are up to eight metres thick north-east of Lake Warden (Johnson and Baddock, 1998).

2.3 Climate

The Esperance Groundwater Area has a Mediterranean-type climate, characterised by warm to hot, dry summers and cool wet winters. Climatic conditions become progressively drier and hotter towards the north. In coastal areas, cooling southerly winds moderate climatic extremes.

The average annual rainfall at Esperance is 660 mm, and decreases towards the north. Rainfall generally occurs in winter and is associated with a series of low pressure systems in the Southern Ocean. Periodic summer rainfall occurs as a result of thunderstorm activity or rain-bearing depressions from tropical cyclones.

Average annual potential evaporation is approximately 1,600 mm at the coast. Evaporation is greatest during the summer months of January and February and lowest during the winter months of June and July (Johnson and Baddock, 1998).

3 Hydrogeology

3.1 Groundwater occurrence

The Quaternary coastal sediments and Tertiary sedimentary rocks are the most prospective aquifers in the Region, although there is a large variation in both potential yield and salinity within the aquifers.

Quaternary surficial sediments have a widespread distribution, but are unsaturated except at the coast and within alluvial deposits. The coastal dunes are developed best to the west of Esperance and contain significant fresh water resources. A perched aquifer may be present locally within thick, eolian sandplain deposits, particularly where sand overlies relatively impermeable Tertiary sedimentary rocks and basement rocks.

The Tertiary sedimentary rocks, which overlie the Proterozoic basement, has low permeability due to the fine-grained and clayey nature of the sediments. However, the shoreline and spongolite facies of the Pallinup Siltstone and the Werillup formations are highly permeable, generally saturated and contain significant volumes of groundwater.

The hydrogeology of the Proterozoic granitoid and gneissic rocks is complex with groundwater occurrence restricted to joints, fractures and permeable features within the weathered profile. The basement aquifers are minor localised aquifers (Johnson and Baddock, 1998).

3.2 Aquifers

The Quaternary and Tertiary sediments along the coastline form the regionally significant superficial aquifer. The fractured rock aquifer comprises Proterozoic basement rocks with groundwater present in localised fractures. Groundwater in the Warden sub-area will be considered under the Department's fractured rock policy *Groundwater Allocation Strategy for Fractured Rock Aquifer Systems*, due to the highly variable and heterogeneous nature of the hydrogeology.

Figure 5 indicates the hydrogeology of the Esperance Groundwater Area and Figure 6 indicates the distribution and thickness of fresh water sediments.

For licensing and administrative purposes, the aquifers in the Esperance Groundwater Area have been divided into two distinct groundwater groups based on the hydrogeology:

- Superficial aquifer; and
- Fractured rock aquifer.

Table 2 indicates the aquifer types and the generalised geology and hydrogeology relating to each sub-area.

Table 2 Aquifers of the Esperance Groundwater Area

Aquifer	sub-area	Geology	Hydrogeological Unit
Superficial	Town Twilight Butty	Cainozoic sedimentary rocks	Quaternary surficial sediments (coastal deposits)
			Tertiary sediments (Pallinup Siltstone, Werillup Formation)
Fractured Rock	Warden	Cainozoic sedimentary rocks	Quaternary surficial sediments (sandplain deposits, alluvium)
			Tertiary sediments (Pallinup Siltstone, Werillup Formation)
		Proterozoic basement rocks	Granite and gneiss

3.2.1 Superficial aquifer

In the Esperance Groundwater Area, the coastal sediments form an unconfined aquifer along the coast from Lake Gore to Esperance. The sediments, which comprise fine to medium-grained sand grading into shelly limestone, have intergranular porosity, high permeability and a maximum saturated thickness of up to 30 m (Johnson and Baddock, 1998). The aquifer is regionally important, providing town water supply requirements for Esperance.

The aquifer is recharged by infiltration of rainfall. The portion of rainfall that reaches the water table to recharge the groundwater system is influenced by interception due to vegetation cover, lithology and water table depth. Recharge rates are highest in the areas of mobile dunes bare of vegetation and lowest adjacent to wetlands where there is a shallow water table with large water losses due to evapotranspiration.

A groundwater mound occurs within the coastal sediments between the coastline and Pink Lake. The water table elevation near the crest of the mound rises from about 3 mAHD[2] near Esperance to over 30 mAHD west of Pink Lake. The groundwater flow is dominated by radial flow away from the crest of the mound towards the ocean and coastal lake discharge boundaries. Groundwater flow associated with the groundwater mound is generally localised with discharge into surface drainages, lakes, and at the coast over the presumed salt water interface. Baddock (1994) noted that pumping from the Esperance town water supply borefield had locally modified the radial flow patterns.

Properly constructed bores within the aquifer are capable of producing several hundred kilolitres[3] of water per day. As lower salinity groundwater occurs as a lens overlying saline

2 Australia Height Datum which means height above sea level

3 1 kilolitre = 1000 litres

water, some bores in the coastal sediments are pumped at low rates to prevent upconing of saline groundwater (Johnson and Baddock, 1998).

3.2.2 Fractured rock aquifer

The basement rocks contain localised aquifer systems with small supplies of groundwater obtainable from fractures and sandy sections of the weathered profile. The weathered profile developed in the basement rocks typically comprises up to 30 m of sandy clay and is generally low-yielding, except where a permeable quartz grit layer is present above the fresh basement. Johnson and Baddock (1998) noted that joints and fractures in the gneissic rocks are very sparse, or have been infilled with low-permeability clay. Bore yields from these aquifers are normally low and suitable only for windmills or small pumps, although yields in excess of 50 kL/day have been obtained outside the Esperance Groundwater Area.

The fractured rock aquifer in the Warden sub-area also includes small areas of Pallinup Siltstone. The Pallinup Siltstone has a low permeability due to the fine-grained lithology and cementation of the sediments. Bores are typically low yielding and often unsuitable for groundwater supplies; however, sandy sections can yield moderate to large supplies of groundwater.

3.3 Groundwater quality

Groundwater in the superficial aquifer is generally fresh to brackish. Potable groundwater (<1000 mg/L TDS[4]) occurs within Quaternary sediments beneath the coastal dunes between Esperance and Lake Gore. The thickness of fresh groundwater ranges from 10 to 30 m. Evapotranspiration of groundwater in low-lying areas where there is convergence of groundwater flow (near Pink Lake) has resulted in brackish groundwater of 1,200 to 3,000 mg/L TDS in the upper part of the aquifer.

South of Pink Lake, there is saline groundwater at the base of the Quaternary sediments beneath a fresh water zone. Saline groundwater flows southwards towards the coast under a density gradient through seaward dipping sediments from Pink Lake to the coast. The salinity of the basal sediments in this zone ranges from approximately 15,400-58,000[5] mg/L TDS. Although the saline groundwater is overlain by up to 25 m of fresh groundwater, abstraction from production bores may result in upconing of saline groundwater and an increase in salinity in those bores (Baddock, 1994).

Groundwater in the basement rocks is generally brackish to saline (Johnson and Baddock, 1998).

4 TDS – Total dissolved salts (or solids)

5 The salinity of seawater is about 35,000 mg/L TDS

4 Groundwater resource management

4.1 Sustainable use of water

The long-term management objectives for groundwater resources are to achieve sustainability of the resource and avoid unacceptable impacts caused by pumping on the associated and dependent environmental, social and economic factors.

The effects of both current and future development must be considered in any management strategy, including the long-term delayed effects of pumping, such as salt water intrusion or saline upconing. They manifest themselves slowly over time, sometimes many years, and these impacts must be recognised and managed.

Any amount of groundwater abstraction will cause alterations to the existing flow regime that in turn will impact to some degree on the other beneficial uses of the resource such as environmental, economic and social uses. The extent of the impact will vary and the acceptability of the impact will depend on the values supported by the resource. Abstracting groundwater in a way that results in unacceptable depletion of storage is not within the definition of sustainable management. Abstraction that causes significant long-term declines in groundwater levels is not acceptable and could ultimately have effects that cannot be reversed.

The sustainable yield of an aquifer system may be subject to change. Monitoring of water levels and water quality trends over time enables adaptive management of the resource, which is used to refine the sustainable yield and Allocation Limits of the aquifer.

4.1.1 Principles

Water resource management principles adopted in this Plan, to be taken into account when considering licensing of groundwater abstraction in the area, are:

1. Where significant impacts[6] are likely, individual licensees are responsible for determining potential groundwater pumping impacts on identified local groundwater dependent ecosystems and existing users.
2. The Department is responsible for determining regional impacts on groundwater dependent ecosystems and existing users.
3. Water will be allocated to the environment, considering environmental, social and economic impacts, before it is allocated to consumptive use.
4. The use of groundwater should be compatible with the desired local, regional and State economic and social development. Its use should generate outputs, which are socially, economically, and environmentally sound as well as of high value to the community.

6 An impact is considered significant when drawdown from abstraction means that the values of any groundwater dependent ecosystems will be compromised. The key steps in identifying a significant impact would therefore be to:

a) Determine the Environmental Water Provisions for a groundwater-dependent ecosystem in the drawdown cone of any proposed or licensed allocation; and

b) Determine whether the resultant change in water level meets the Environmental Water Provisions.

5. The allocation of water should be fair and equitable to allow both short-term and long-term planning objectives to be met.
6. The use of groundwater should generate outputs, which contribute to sustainable regional development.
7. Natural ecological processes and the biodiversity of water-dependent ecosystems are maintained at an acceptable level of risk.
8. Groundwater management and allocation decisions should consider the social, cultural, economic and environmental impacts and apply a balanced approach where appropriate.
9. All groundwater development must include consideration of, and appropriate investment in, water efficiency measures.
10. Community education on groundwater matters and involvement in the decision-making process is essential in sustaining a strong and effective groundwater management effort.

The following national principles[7] will be applied:

(a) *The precautionary principle*

- This principle states that where there are threats of serious or irreversible environmental damage, lack of full scientific knowledge and certainty should not be used as a reason for postponing measures to prevent the environmental damage.

(b) *Inter-generational equity*

- This concept refers to decision-making processes that effectively integrate both short and long-term economic, environmental and social equity considerations.

(c) *Integrated management*

- Integrated management refers to the management of the inter-relationships between surface water, groundwater and land use. In this context, impacts of groundwater abstraction on dependent ecosystems that include surface water regimes and their ecological, social and economic dependencies need to be managed.
- Water management should be integrated with relevant policies of other Government agencies – fostering an holistic management approach.

(d) *Adaptive management*

- Management tools and policies must be able to respond to increasing knowledge of resource dynamics and their interactions with other ecosystems.
- Management tools must also be able to take into account changing community attitudes and perceptions.
- Adaptive management relates to management of water resources in a cycle of assessment, planning, implementation, monitoring, review and responding to change, including provision for re-allocation to accommodate results of reviews.

7 *State-wide Policy No 5 Environmental Water Provisions for Western Australia*, Water and Rivers Commission and National Policies referred to within that report.

4.2 Environmental considerations

4.2.1 Groundwater dependent ecosystems

The Esperance Lakes are of great ecological importance, some of which have been listed as Wetlands of International Importance under the Ramsar Convention. The Ramsar wetland system comprises Lake Warden, Woody Lake and a portion of Mullet Lake Nature Reserves. The system is also listed on the National Estate Register in recognition of its significance for waterbird conservation. Other areas of environmental significance are Shark Lake, Pink Lake and the remainder of Mullet Lake Nature Reserves (CALM, 1999).

The Esperance Lakes are fed predominantly by natural drainage from agricultural districts to the north, although water logging occurs in some relatively flat areas where drainage is internal. Increased runoff and rising water tables resulting from agricultural clearing have a direct impact on the quality of the lakes. High salinity in the lakes is due to very poor flushing which results in concentration of salt due to evaporation (CALM, 1999).

These wetlands are dependent on surface water and groundwater inflows and are sensitive to changes in water flow regimes and water table elevations caused by climatic variations and/or groundwater pumping, and in some cases, tidal influence. There is fresh groundwater flow from the coastal dunes and there may be some minimal saline groundwater recharge from groundwater flows from the north. Groundwater abstraction may result in the lowering of the water table below natural cycles and therefore regulation and control is required to prevent adverse impacts on wetlands and subsequent endangerment of local flora and fauna.

The wetland system in Esperance is home to 65 species of waterbird of which 21 are of international importance with approximately 20,000 waterbirds utilising the system simultaneously (Tiedemann, 1996).

Remnant native vegetation covers a major part of the Esperance Groundwater Area and represents the only perennial vegetation in the area still able to use water during summer and autumn. In most areas it provides the only significant biodiversity which is essential for the long-term survival of some native species, while also providing important aesthetic, recreational and cultural values for the community as a whole (Penn, 1996).

Limited public and private groundwater abstraction, by licensing, occurs near the Pink Lake and Lake Warden systems. Groundwater abstraction for public drinking water supplies occurs to the south of Pink Lake. A desktop study and groundwater drawdown simulation undertaken in 1996 indicated that the pumping from Water Corporation bores showed negligible drawdown at the lakes (Varma, 1996).

4.2.2 Ecological Water Requirements/ Environmental Water Provisions

Ecological Water Requirements are the water regimes needed to maintain ecological values of significant water-dependent ecosystems at a low level of risk. Environmental Water Provisions are the water regimes that are provided as a result of the water allocation decision-making process, taking into account ecological, social and economic impacts. The Department's approach in determining how water will be provided to protect ecological values when allo-

cating the right to use water in Western Australia is described in the *State-wide Policy No. 5 Environmental Water Provisions Policy for Western Australia 2000* (WRC, 2000).

The management of groundwater allocation includes the determination of Ecological Water Requirements on the basis of the best scientific information available. Ecological Water Requirements are used as the primary consideration in the establishment of Environmental Water Provisions.

Environmental Water Provisions are the outcomes of water allocation decisions that may involve some trading off between ecological, social and economic goals. As a consequence, they may be less than Ecological Water Requirements, where some ecological impact is accepted as a trade-off to meet these goals.

The Department will aim to meet all Ecological Water Requirements when Environmental Water Provisions are proposed. If, in the view of the Department, Ecological Water Requirements cannot be met without significantly compromising the identified economic and social benefits of possible water allocation strategies, the Department will ensure that:

- The risks to the ecosystems of not meeting the Ecological Water Requirements are identified, together with the social and economic costs of fully meeting Ecological Water Requirements;
- Community consultation is undertaken in the development of allocation scenarios and Environmental Water Provisions options; and
- The proposed allocation strategy is referred to the Environmental Protection Authority for assessment and/or advice under the *Environmental Protection Act 1986*.

Protection of the environment in the Esperance Groundwater Area has been considered. Significant groundwater dependent ecosystems occur in the Twilight, Butty and Warden sub-areas, but no groundwater dependent ecosystems have been identified in the Town sub-area. The Ecological Water Requirements of these groundwater dependent ecosystems have not been investigated in detail. However, existing levels of abstraction in these sub-areas do not appear to be affecting the groundwater dependent ecosystems adversely. There have been problems in the past with salt water intrusion and upconing due to abstraction in the Town and Twilight sub-areas. However, the Water Corporation has been managing wellfield abstraction to alleviate salt water impacts.

In absence of detailed Ecological Water Requirements investigations and considering potential for salt water impacts, the Allocation Limits in this Plan have been set conservatively. In Twilight sub-area, the Allocation Limit has been limited to the existing level of abstraction (700,000 kL/yr). Further investigative work would need to be undertaken to demonstrate that any potential increase in abstraction would not cause saline intrusion or upconing or adverse environmental impacts. In the Butty sub-area, existing abstraction is relatively low. In view of the potential for environmental impacts, the Allocation Limit has been limited to 30 percent of the estimated sustainable yield (4,200,000 kL/yr). This provides a trigger level for additional work on re-estimating the sustainable yield, estimating Ecological Water Requirements for the sub-area and refining the Allocation Limit. In the Warden sub-area, the Allocation Limit has been set at the estimated sustainable yield of 1,000,000 kL/yr, however each licence application should be individually assessed taking into account any local groundwater dependent ecosystems.

Existing and new applications for allocations greater than 50,000 kL/yr will be assessed based on supporting information provided by proponents regarding the impacts of abstraction, the water level regime required to maintain identified groundwater dependent ecosystems to a low level of risk, and how abstraction will be managed to protect environmental and other significant values (ie. social, economic).

In both the Twilight and Butty sub-areas, Ecological Water Requirements work would need to be undertaken with any significant increase of the Allocation Limit. Additionally, further Ecological Water Requirements work should include determination of the water regime requirements of the Esperance lake systems, particularly Lake Warden and Pink Lake.

Environmental Water Provisions have not been identified for the Esperance Groundwater Area. As a priority, Environmental Water Provisions are required for the Town and Twilight sub-areas, where there is pressure from a high level of allocation. Abstraction in the remainder of the Esperance Groundwater Area has not yet reached a level of allocation where Environmental Water Provisions need to be set.

Any further significant expansion in groundwater use to the west would require Ecological Water Requirements and Environmental Water Provisions for the wetland systems or vegetation systems to be determined. The identification and evaluation of groundwater dependent ecosystems should be undertaken for any significant increases in abstraction in the Butty sub-area, although most of the area has a deep water table.

4.3 Social considerations

Other than an understanding of the aesthetics and social amenities of the area, in particular the lake systems, limited work has been undertaken on social and cultural values.

4.3.1 Population

The town of Esperance is the only major urban locality in the Esperance Groundwater Area, with an estimated population of 9,420 in 2001 (ABS, 2001). The town is a service centre and port for the surrounding agricultural and inland mining area, and is a popular tourist destination and retirement town.

The estimated residential population for the Shire of Esperance in 2000 was 13,271 (GEDC, 2004).

4.3.2 Land use

Esperance thrives on agriculture, fishing, farm forestry and tourism (GEDC, 2004). The town of Esperance is situated within the eastern portion of the Esperance Groundwater Area. The eastern portion of the Esperance Groundwater Area is essentially urban at the townsite and rural in the surrounding areas. The western half is essentially Crown Land. Reserves (vested with the Department of Environment and Conservation) and some rural developments occur on the northern fringe.

Land usage in the Esperance Groundwater Area is subject to the planning schemes and strategies formulated by the Western Australian Planning Commission and the Shire of Esperance, established in response to increasing developmental pressure and the need for appropriately zoned land for the different uses within the area.

4.3.3 Protection of cultural heritage values

Within the Esperance Groundwater Area boundary, there is currently one Native Title claim, that encompasses current water reserves and future sites. This claim is 'The Esperance Nyungars' (ref WAG6097_98 registered 1996 and updated 19-12-2004). Native Title is an important social and cultural issue and should be considered in conjunction with water resource development proposals.

Notification under the *Native Title Act 1993* would not be required where:

- Native Title has been extinguished by a prior grant of an exclusive tenure (eg. Freehold land, residential leases, commercial leases, exclusive agricultural and exclusive pastoral leases, conditional purchase leases and war service settlement (perpetual) leases).
- Water usage is consistent with the purpose of the tenure (eg. water use in relation to a mining tenure is for mining related purposes).
- Taking of water is within the purpose of a reserve or within the statutory powers enabling the management of the reserve (eg. Crown Reserve).
- The licence is a renewal, re-grant, re-making or an extension of term of a previous licence granted before 23 December 1996 and the licence is for the same term as the previous licence.

4.4 Existing groundwater use

Abstraction of water for public water supply purposes is the primary use of groundwater in the Esperance Groundwater Area. Other major use categories include the irrigation of recreation areas and parks and gardens. Smaller quantities are used for domestic, agricultural and industrial purposes.

The largest user of groundwater in the Esperance Groundwater Area is the Water Corporation. The Water Corporation abstracts approximately 2,200,000 kL/yr of groundwater from the superficial aquifer for scheme water supply and plans to increase abstraction in the future to sustain projected urban growth. The increased draw would be gradually taken from new bores to the west of Esperance thus relieving the stress on the area near the town where water quality is a concern.

Any large increase in additional abstraction of groundwater from the superficial aquifer would be curtailed by limited water availability or by constrained use within Public Drinking Water Source Protection Areas (see Section 4.10). Priority protection areas were determined based on an assessment of present and proposed land use, contamination risks and value of the water resource. Most of the available water is in the Priority 1 area having the highest level of protection and potentially would be developed only by a water service provider to supply town water supply needs.

Table 3 shows the groundwater allocation distribution for each sub-area and the whole groundwater area as a percentage of the total groundwater allocated (licensed) based on use categories.

Table 3 Groundwater allocation distribution by use category

Use Category	Town	Twilight	Butty	Warden	TOTAL
Public Water Supply %	60.7	91.7	100.0	0.0	71.1
Recreation %	17.7	8.0	0.0	0.0	10.2
Parks and Gardens %	10.7	0.2	0.0	1.5	5.5
Domestic/Garden/Stock %	0.6	0.0	0.0	4.0	0.6
Mining/Industrial %	1.6	0.0	0.0	1.2	0.9
Agriculture/Fishing %	0.5	0.0	0.0	48.4	4.1
Irrigation/Horticulture %	6.3	0.0	0.0	7.9	3.8
Tourism/Commercial %	1.8	0.0	0.0	37.1	3.8
TOTAL %	100.0	100.0	100.0	100.0	100.0

Use categories as at 17 May 2005

Figure 7 indicates the groundwater allocation distribution as a percentage of the allocated resources by sub-area.

4.5 Potential future groundwater supplies

Investigations by the Geological Survey in 1994 and the Water Corporation in 1998 have confirmed that fresh groundwater is present within the dune system west of Esperance to Lake Gore. In contrast, the coastal dunes east of Esperance are less extensive and contain a thin layer of low salinity groundwater over saline groundwater; this is suitable mainly for low yielding bores and windmills.

4.5.1 Future groundwater use

The Esperance Region population will continue to increase due to diversification of the Region's agricultural industry, residential land releases, upgrades in industry infrastructure and growth of the manufacturing, retail, retirement and tourism sectors. Projections of growth for the town water supply indicate an annual water demand of 4,600,000 kL/yr by 2026 (Hart, 1997).

Future industrial growth in Esperance would most likely be based on development of mineral resources in the Region or local processing of ore which is shipped through the port. Availability of suitable quality water largely limits intensive land uses such as horticulture, viticulture, floriculture and intensive animal industries (Hart, 1997).

4.6 Resource assessment

4.6.1 Monitoring groundwater levels and usage

Monitoring of groundwater levels and usage occurs on a regular basis as per the requirements of abstraction licences.

The Water Corporation is the largest groundwater user in the Esperance Groundwater Area and undertakes extensive monitoring of water levels and usage. Over the last few years, the Water Corporation has developed new bores to the west of the Esperance Townsite within

the Butty sub-area. Groundwater abstraction still occurs from the original borefield in the Town and Twilight sub-areas. Prior to the development of the new bores, there was increasing pressure on the aquifer around the original borefield due to abstraction. Water level monitoring has helped to manage impacts from saline upconing and salt water intrusion from the coast and Pink Lake. The use of new bores has alleviated that risk, and expansion of the borefield towards the west has distributed the draw over a larger zone and has rationalised the operations. The borefield is managed to reduce reliance on susceptible bores or bores with higher nutrient levels (from septic tanks near town bores).

4.6.2 Water quality and salinity

A major risk to the groundwater quality in the Esperance Groundwater Area is the occurrence of salt water intrusion and salt water upconing. Both processes result in groundwater becoming saline. Salt water upconing may be caused by over-pumping fresh water and drawing up the underlying salty water. This can be managed through careful monitoring and management of pumping rates. Salt water intrusion is most likely to occur along the coast. This is the process where saline water moves into areas of fresh water when over-pumping lowers the water level in the aquifer to below sea level for prolonged periods. A long-term reduction in groundwater recharge due to a drying climate for example, may also contribute to this process. If this happens, it takes a long time to reverse.

New projects with the potential to contaminate the groundwater or reduce its beneficial use must include appropriate safeguards in their development plans. Nitrate contamination from septic tanks and fertiliser use presents the most significant concern for public water supply, although other contaminants resulting from industry, rural and urban activities are also of concern. Water quality concerns may arise from land use activities in the Esperance Groundwater Area, including urban development, wastewater disposal, land clearing, over-abstraction and uncontrolled use and disposal of chemicals and fuels. Full details are contained in the *Esperance Water Reserve Water Source Protection Plan* (WRC, 1999).

4.6.3 Monitoring water quality trends

The Water Corporation's Esperance water supply borefield is susceptible to salt water intrusion. The current pumping regime (utilising new bores to the west) has relieved the pressure on the more susceptible bores closer to the town. This does not negate the need to manage pumping rates closely, especially in the area south of Pink Lake where there has been evidence of salt water upconing. A series of salt water interface monitoring bores were constructed within the Town sub-area and are monitored by the Water Corporation to identify changes in salinity and assist in wellfield management. This is addressed in the Water Corporation's operating strategy for the Esperance wellfield.

The Water Corporation undertakes water quality monitoring in the Esperance Groundwater Area and reports the results annually to the Department of Water and Department of Health. The water quality program consists predominantly of monitoring changes and trends in salinity and nitrates, with a range of other parameters. The Water Corporation is required to monitor all potential contaminants in accordance with the *Australian Drinking Water Guidelines* and provide the information to the Department of Health (NHMRC and NRMMC 2004). Data collated from monitoring activities will assist in wellfield management.

Elevated nutrient levels in bores near the townsite (affected by septic tanks) are decreasing due to the Water Corporation's Infill Sewerage Program, which has enabled a significant number of properties to connect to sewer.

4.7 Allocation Limits

The Allocation Limit is the maximum volume of groundwater as authorised by the Department that is potentially available for abstraction on an annual basis. The Allocation Limit is set to ensure that the annual groundwater abstraction regime does not have unacceptable impacts on the groundwater resource (quantity and quality), its dependent ecosystems (wetlands, terrestrial vegetation, river base flow, etc) and its dependent social values.

The Allocation Limits are determined by considering aquifer recharge, the water requirements of dependent ecosystems (Ecological Water Requirements), and the water level/quality regime that will be provided to the environment, taking into account social and economic impacts of such a provision (Environmental Water Provisions).

Groundwater resources have been estimated in terms of rainfall recharge using a percentage of rainfall. The average rainfall for Esperance since 1883 is 660 mm/yr with no signs of recent rainfall decline. The groundwater recharge rates range between five and 57 percent of rainfall and are dependent on the depth to water table and amount of vegetation cover. In scrub-covered areas with a shallow water table, the recharge rates are less than 10 percent, increasing to 10 percent in areas with a deeper water table. Higher recharge rates of about 20 to 30 percent occur in areas of limestone outcrop, while areas of mobile dunes have rates of about 30 to over 50 percent of rainfall.

The total average annual recharge across the Town, Twilight and Butty sub-areas has been estimated at about 25 GL[8]. The sustainable yield has been estimated at 70 percent of total recharge, which allows aquifer throughflow to maintain the salt water interface. Table 4 summarises the determination of the sustainable yield and Allocation Limits. Full details on the determination of the sustainable yield are outlined in Baddock (1998).

In the absence of systematic investigations of groundwater dependent ecosystems in the Esperance Groundwater Area and in view of previous problems with salt water upconing due to abstraction in the Town and Twilight sub-areas, Allocation Limits have been restricted to no more than the estimated sustainable yield.

Allocation Limits have been applied conservatively in the Twilight and Butty sub-areas, where the potential for environmental impact could be significant. The Allocation Limits for the Twilight sub-area has been set at the existing level of abstraction of 700,000 kL/yr. In Butty sub-area the Allocation Limit has been set at 30 percent of the estimated sustainable yield (4,200,000 kL/yr). The hydrogeological mapping, investigations and assessment can be used to re-estimate the sustainable yield when monitoring data becomes available. As the conservative Allocation Limit is approached, studies to determine potential groundwater dependent ecosystems should be undertaken and preliminary Ecological Water Requirements and Environmental Water Provisions should be considered when reviewing the Allocation Limits. Salt water intrusion and saline upconing from abstraction creates management concerns particularly in the Twilight sub-area and potentially in the Town sub-area.

8 1 GL (gigalitre) = 1 million kilolitres

The Allocation Limits for the Twilight sub-area reflects existing licensed entitlements. The Allocation Limits for the Town sub-area reflects the annual sustainable yield (1,900,000 kL/yr).

The Warden sub-area is in a fractured rock aquifer and has been addressed under the fractured rock policy due to the highly variable and heterogeneous nature of the hydrogeology. The Allocation Limit for the Warden sub-area has been set at 1,000,000 kL/yr based on the identification of a localised groundwater resource near Coramup-Bandy Creek area *(Baddock L.J, 1995, Coramup-Bandy Creek, Esperance Groundwater Investigation: Western Australia Geological Survey, Hydrogeology Report 1995/13* – unpublished*)*.

Allocation Limits for groundwater abstraction have been determined after hydrogeological assessment of the resource and consideration of environmental and social values of the area.

Groundwater available for allocation in the Esperance Groundwater Area is shown in Table 5. Groundwater entitlements and availability are dynamic figures. The information within Table 5 is current to 31 March 2005 and is subject to change; therefore, licence applicants are encouraged to contact the Department's South Coast Regional Office for updated information.

Figure 8 indicates the proportion of licensed entitlements versus the Allocation Limits in graphical format.

Table 4 Determination of sustainable yield and Allocation Limits

sub-area	Recharge area (km^2)	Average Rainfall Recharge Rate (%)	Estimated Recharge Volume (kL/yr)	Sustainable yield (70% of recharge) (kL/yr)	Determined Allocation Limit (kL/yr)
Town	21.5	19	2,717,000	1,902,000	1,900,000
Twilight	16.7	16	1,795,000	1,256,000	700,000
Butty	162.5	19	20,566,000	14,396,000	4,200,000
Warden*	N/a	N/a	N/a	1,000,000	1,000,000

* Information based on a groundwater resource assessment in the Coramup-Bandy Creek area.

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Table 5 Allocation Limits and water entitlements

sub-area	Allocation Limit (kL/yr)	Public water supply[9] licensed entitlements (kL/yr)	Other licensed entitlements (kL/yr)	Groundwater Availability as of 26 March 2006 (kL/yr)
Town superficial aquifer	1,900,000	1,150,000	*394,722	126,278
Twilight superficial aquifer	700,000	600,000*	67600	31,200
Butty superficial aquifer	4,200,000	950,000*	0	3,250,000
Warden fractured rock aquifer	1,000,000	N/A	223,570*	776,490* Low yields

*Includes applications under assessment; up-to-date figures are indicated in aquifer allocation report
All figures are current to 26 May 2006.

4.8 Groundwater availability by sub-area

4.8.1 Town sub-area

The Town sub-area covers the area around the original water supply borefield and is situated within the Esperance Townsite. The Allocation Limit for the sub-area was previously set at 1,970,000 kL/yr. The licensed entitlements exceeded the Allocation Limit; consequently, the allocation status in the Town sub-area was a C4 category[10]. The over-allocation was reviewed for this Plan, and it was identified that:

- The Water Corporation's allocation of 2,200,000 kL/yr for the Esperance town water supply was allocated previously in full to the Town sub-area. The Water Corporation has been abstracting approximately 1,150,000 kL/yr from the Town sub-area. Revised entitlements across the remaining sub-areas are being assessed. The Water Corporation's licensed entitlement for the Town sub-area has been set at 1,150,000 kL/yr; and
- A recent survey of licensed users within the sub-area has also shown that some licences are no longer valid. The Department's Esperance Regional Office is in the process of consolidating and recouping entitlements and amending licences to better reflect actual use. The result is that non Water Corporation licensed entitlements would equate to approximately 422,110 kL/yr when recouping has been completed. Recouping unused entitlements would result in approximately 327,000 kL/yr being available in this sub-area.

This Plan recommends an amendment of the Allocation Limit for the Town sub-area to 1,900,000 kL/yr which is equivalent to the sustainable yield estimate (Baddock, 1998). The impact of this amendment and updates to licensed entitlements would reduce the allocation status from C4 (>100 percent allocation) to C3 (70 to 100 percent allocated).

The management objective for the Town sub-area is to account for existing licensed entitlements within the Allocation Limit and ensure that excessive abstraction does not cause salt water intrusion into the aquifer, either from upconing or from movement of the salt water interface inland. There is potential for the Water Corporation to further reduce its abstraction from the Town sub-area and move further to the west into the Butty sub-area if adverse water quality impacts are identified in the monitoring bores.

Bore water use for gardens in the Esperance township has not been quantified, as it is currently exempt from licensing. The Department will consider identifying the amount of water used by garden bores and offset this against the Allocation Limit for the Town sub-area.

4.8.2 Twilight sub-area

The Twilight sub-area comprises coastal limestone dunes that increase in height towards the coast. Apart from some limited vegetation clearing in special rural areas, native vegetation cover remains over much of the area. The vegetation is composed of low-lying coastal heath with some Banksia species dominant on the sand ridges, and pockets of Paperbark and Yate species in the swales between the dunes. The vegetation generally relies on direct rainfall, but vegetation in the ephemeral areas between the swales may be affected

10 The C1 to C4 allocation categories refer to the level of allocation as a percentage of the Allocation Limit. A C4 category indicates an allocation greater than the Allocation Limit (>100 percent)

if groundwater abstraction from the shallower systems becomes significant (ie where there are private bore users). The zoning of land as special rural generally precludes concentrations of developments in small areas and restricts land use activities, so use of groundwater is predominantly for household use.

The Twilight sub-area is underlain by a freshwater aquifer varying in depth to 25 m. At the base of the superficial aquifer, saline groundwater flows from Pink Lake to the coast. The Water Corporation is the main user and abstracts about 600,000 kL/yr from the Twilight sub-area. There is a small amount of private abstraction. Both private and town water supply bores are constructed into the fresh water lens. The management strategy for the Twilight sub-area is to ensure that abstraction rates are limited to prevent saline upconing from the underlying saline aquifer.

4.8.3 Butty sub-area

The Butty sub-area in the western portion of the Esperance Groundwater Area comprises coastal limestone dunes that are directly recharged by rainfall, with the recharge rate varying depending upon the vegetation cover. The Butty sub-area is underlain by the superficial aquifer of variable thickness with the water table varying in depth below ground level. The vegetation type is similar to that of the Twilight sub-area, but generally there has been less interference due to the isolation of the area and the fact that much of this area is reserved land. Vegetation in most of the area is not reliant on groundwater, apart from some influence around the wetland areas on the northern edge of the Butty sub-area. The eventual expansion of the Esperance public water supply into the western parts of Butty sub-area would not have an influence on the vegetation, as it is basically shallow rooted and relies on rainfall rather than the root systems intercepting the water table.

The Butty sub-area is predominantly Crown Land, except for a small portion west of Pink Lake and an area at the western end adjacent to the Lake Gore wetlands, which is zoned rural and special rural. A significant proportion, if not all, of the alienated land near Pink Lake is likely to be subdivided into smaller lots. The majority of this sub-area is a Priority 1 area as defined in the *Esperance Water Reserve Water Source Protection Plan* (WRC, 1999). The water reserve proclaimed under the *Country Areas Water Supply Act 1947* protects the quality of water sources by controlling activities and development. This plan indicates that significant amounts of water are currently available.

4.8.4 Warden sub-area

The Warden sub-area covers the fractured rock aquifer to the north of the dunal system. This area includes Pink Lake and the Lake Warden wetlands. Groundwater abstraction may have some localised effects, but due to the Warden sub-area being a fractured rock aquifer, these are unknown and would be difficult to ascertain. The sub-area has generally low yields and poor groundwater quality. The current policy within the Warden sub-area boundaries is ‘take what you can get’, although planning and environmental factors still have to be considered in accordance to the Department’s *Groundwater Allocation Strategy for Fractured Rock Aquifer Systems*. Some users in the Warden sub-area have been able to abstract reasonable quantities of good quality water, while other users have not had any success in accessing groundwater.

4.9 Future monitoring

Water level and water quality monitoring is a fundamental component of a monitoring program. Monitoring is required to ensure that groundwater resources are managed within their sustainable limits and it provides a basis for adaptive management of groundwater resources.

The Water Corporation is the major licensed groundwater user across three of the sub-areas. It undertakes regional scale monitoring of water level and water quality, including salt water interface monitoring bores, as part of its licensed commitments for the Esperance town water supply scheme. The Water Corporation is required to produce an annual report to the Department showing compliance with its operating strategy.

On-going water level and water quality monitoring will ensure that any undesirable changes and/or trends are identified early to allow intervention to manage the changes. Water quality monitoring may relate to observing the overall condition of the groundwater resource and/or specific sites.

- Monitoring data will be used to ensure management objectives of the groundwater resources are met.
- The monitoring information will be used to reassess the sustainable groundwater yield and Allocation Limits in the future for the protection of the environment and existing users.

4.10 Public drinking water source areas

The Public Drinking Water Source Areas for Esperance is shown in Figure 9. Advice on the protection of this Public Drinking Water Source Area is provided in the *Esperance Water Reserve Water Source Protection Plan* (WRC, 1999).

Public Drinking Water Source Areas identify the surface and/or groundwater catchments of limited drinking water supplies. Their recognition in water resource allocation and management and land use planning processes is important to ensure the availability of 'good quality drinking water' for now and in the future.

Public Drinking Water Source Area include catchments proclaimed under the *Metropolitan Water Supply Sewerage and Drainage Area Act 1909* or the *Country Areas Water Supply Act 1947*. Water Reserves, Catchment Areas or Underground Water Pollution Control Areas proclaimed under these *Acts* are generically referred to as Public Drinking Water Source Areas. These *Acts* also provide by-laws that enable the Department to manage potentially polluting activities, to regulate land use, inspect premises and to take steps to help prevent or clean up pollution in Public Drinking Water Source Areas.

The Department is in the process of preparing 'Drinking Water Source Protection Assessments' and 'Drinking Water Source Protection Plans' for all Public Drinking Water Source Areas in Western Australia, consistent with Government policy. Information on acceptable land uses and activities within Public Drinking Water Source Areas to protect water quality is provided within the *Water Quality Protection Note: Land Use Compatibility in Public Drinking Water Source Areas.* These documents can all be located on the Department's web

site. A full list of 'Gazetted Public Drinking Water Source Area' in Western Australia is also available.

Three levels of priority classification are defined in Drinking Water Source Protection Plans to protect the quality of water:

- Priority 1 (P1) classification areas are managed to ensure that there is no degradation of the drinking water source by preventing the development of potentially harmful activities in these areas. The guiding principle is 'risk avoidance';
- Priority 2 (P2) classification areas are managed to ensure that there is no increased risk of water source contamination/pollution. The guiding principle is 'risk minimisation'; and
- Priority 3 (P3) classification areas are defined to manage the risk of pollution to the water source from catchment areas. Risks are managed by adopting best management practices. The guiding principle is 'risk management'.

In addition to priority classification areas, specific protection zones can be defined to protect areas immediately surrounding public drinking water sources (ie abstraction bores and dams/weirs/reservoirs). Wellhead Protection Zones are normally circular areas surrounding each groundwater bore, with a radius of 500 m in P1 areas and 300 m in P2 and P3 areas. Perth metropolitan area Reservoir Protection Zones consist of a two kilometre buffer around reservoirs/dams, measured from the high water mark and within the Public Drinking Water Source Area. Proposed legislative changes aim to provide for the establishment of smaller Reservoir Protection Zones in country areas and the Perth Metropolitan area.

For further information regarding Public Drinking Water Source Area, please contact the Department of Water, Water Source Protection Branch or visit the web site at www.water.wa.gov.au.

Information on related Department policy, best practice management (water quality protection notes) and industry agreed codes and guidelines are also available from this address.

5 Allocation policy

The groundwater allocation policy for the Esperance Groundwater Area is provided in this chapter. Specific policies pertaining to sub-areas are provided in Chapter 6.

Note: The policy comprises a number of directions, each of which is accompanied by explanatory text. A summary of these policies without explanatory text is provided in Table 6.

5.1 Groundwater allocation policy

5.1.1 Allocation basis

Groundwater licences in the Esperance Groundwater Area will be issued on a first-in-first-served basis.

Water allocation in Western Australia has been carried out on the basis of the first-in-first-served (FiFS) approach. Under this approach, licence applications are assessed in the order in which they are received. This is standard policy and practice, understood and accepted by the community and has been in place for many years. Under normal licence application procedures, some applicants are requested to provide additional information before their application can progress through the assessment process for approvals. The provision of additional information may take time depending on the site and complexities and the next application in line waiting to be assessed.

5.2 Protocols for licence assessment

5.2.1 Application for a licence

Groundwater entitlements in each sub-area must not exceed the Allocation Limit for the respective sub-area and aquifer.

The process of assessing a groundwater bore licence starts when an application for a groundwater bore licence is submitted to the Department on the prescribed form, in accordance with Schedule 1 Clause 4 of the *RiWI Act*. Licensing of groundwater resources in the Esperance Groundwater Area is administered by the South Coast Region.

An application is required under the following circumstances:

- The bore is defined as artesian under s. 26A of the *RiWI Act*;
- The property upon which a non-artesian bore is to be situated lies within a Groundwater Area proclaimed under s.26B of the *RiWI Act*; and
- Taking of water is prohibited unless it is taken in accordance with the requirements of s. 5C of the *RiWI Act*.

Under these circumstances, an applicant must gain approval in the form of a groundwater bore licence to commence constructing, enlarging, deepening, altering or drawing groundwater from any bore. Anyone in breach of these requirements, or found to be in contravention of a licence condition, may be liable to a fine.

5.2.2 Assessment criteria for managing proposed abstractions

The Department of Water will assess licence applications according to the requirements of the RiWI Act and RiWI Regulations.

The legislative requirements for assessing applications are indicated in the *RiWI Act* and *RiWI Regulations*. Applications for licences made under Division 2 of Schedule 1 of the *RiWI Act* will be accepted by the Department and either granted or refused at the discretion of the Department in accordance with clause 7(1). In exercising that discretion, the Department is to have regard to all matters that it considers relevant in accordance with clause 7(2).

5.2.3 Issue of groundwater bore licences

The Department of Water will assess licence applications according to the requirements of the RiWI Act and RiWI Regulations.

The South Coast Region of the Department of Water can directly approve and issue a groundwater well licence if the licence conforms to the appropriate policies given in the EPA Local Area Groundwater Management Plan.

Before a groundwater licence is issued, applicants must demonstrate proof of legal access to the land upon which the taking of water is to occur. Applicants may submit a copy of the Certificate of Title, Lease Agreement, vesting order or other documented proof of access for the properties where the water-related development is to occur. It is the licensee's responsibility to ensure that all other necessary Government agency, development and environmental approvals have been granted.

All new groundwater bore licences will be issued for a two-year period. Following this period, providing the licensee has met licence conditions including satisfactory progressing with their development plan, the licence may be renewed for a period up to a maximum of 10 years.

The Esperance Groundwater Area is a Proclaimed Area under the *RiWI Act*, and use of groundwater is subject to licensing. Licences are issued when the Department's assessment process has been satisfied. A licensed entitlement is not an implied guarantee that the quantity (and quality) of water will always be available.

The Department may issue a groundwater exploration licence for up to 12 months. Licences for exploration purposes (issued under s. 26D *RiWI Act*) allow applicants to construct bore(s), investigate whether there is sufficient water available to meet the requirements of their development plan and determine any likely impacts caused by pumping. The Department gives no guarantee that a licence to take water (under s. 5C *RiWI Act*) will be issued at the completion of the investigation.

The Department's South Coast Regional Office can approve and issue a groundwater bore licence directly if the assessment has considered all matters required in Schedule 1 clause 7(2), adequate water is available and the assessment indicates that the taking of water is consistent with departmental policies and does not adversely affect the environment or other users.

Further advice on licensing can be obtained by contacting the Department's South Coast Regional Office in Albany.

5.2.4 Refusal of groundwater bore licences

The Department may refuse a licence after undertaking an assessment in accordance with the requirements of Schedule 1 clause 7(2), if the taking of water is inconsistent with policies or plans applying in the area or may cause significant adverse impacts to the aquifer, environment or existing users.

Applications must be refused if the Department considers that an applicant would not be willing or able to comply with terms, conditions and restrictions included in a licence. A licence may be refused if the Department is not satisfied that the applicant has the resources, including financial, to carry out the activity, or if a person has been convicted of an offence under the *RiWI Act*.

5.2.5 Appeals relating to licences to take water

Applicants aggrieved by a decision of the Department relating to a refusal of a licence or transfer of entitlement, or the period for which a licence is granted or any condition or restriction in a licence may apply to the State Administrative Tribunal for a review of the decision (s. 26G of the RiWI Act).

5.2.6 Compliance and monitoring of resources and licences

Site inspections and water use surveys may be undertaken periodically to assess compliance of in-situ development with licensed activities.

Unused entitlements will be managed in accordance with the Department's State-wide Policy No 11 – Management of unused licensed water entitlements (WRC, 2003b).

Action will be taken to address overuse and non-compliance with the terms of the licence on a case-by-case basis depending on the circumstances of the non-compliance.

5.2.7 Re-allocation of entitlements

Where existing entitlements remain unused for a significant period of time as identified in the Department's *State-wide Policy No 11 – Management of unused licensed water entitlements* (WRC, 2003b), or the applicant proposes to reduce their allocation, then the water may be recouped.

Recouped water may become available for re-allocation for consumptive use or to the environment.

5.2.8 Renewal of existing licences

It is the licence holder's responsibility to make an application to extend the term of the existing licence prior to the expiry date.

If a licensee has not abided by all the licence conditions in a fully-allocated sub-area, the licence is unlikely to be extended without demonstration of extenuating circumstances.

In fully-allocated areas, licensees must not allow their licences to expire, as the Department cannot guarantee that the licence will be renewed if the water is not available.

The renewal of an expired licence in a fully-allocated area, may have more stringent conditions placed upon it.

Groundwater licences to take water are valuable documents that should be kept in a safe place and not allowed to expire. The Department will endeavour to notify licence holders in advance that their licences will expire soon; however, it is the licence holder's responsibility to make an application to extend the term of the existing licence prior to the expiry date.

Generally, when a licence to take water is due to expire, and the licensee has abided by all the licence conditions, the licence will normally be extended for a further period. However, if an application for a licence to take water expires and the licensee has not abided by all the licence conditions, there is no guarantee that the term of the licence will be extended automatically. The licensee will need to show cause why the term of the licence in its entirety should be extended or the licensee may need to apply for a new licence. If a licensee has not abided by all the licence conditions in a fully-allocated sub-area, the licence is unlikely to be extended without demonstration of extenuating circumstances.

5.2.9 Applications for increasing an existing entitlement

An application to increase an existing licensed entitlement will be treated as a new application for additional water.

5.2.10 Transferring (trading) water entitlements

Where a groundwater resource is fully-allocated, new groundwater entitlements are unlikely to be approved. Proponents requiring new entitlements will need to enter the trading market.

The ability to transfer (trade) water entitlements is provided by Schedule 1, Division 7 of the *Act* and the relevant procedures or policies detailed in *State-wide Policy No. 6 – Transferable (Tradeable) Water Entitlements in WA, 2001* (WRC, 2001). This enables a licence holder to transfer (trade) all or part of their licensed entitlement to take water to another licensed water user.

Transferring (trading) licensed entitlements is a market-based instrument that can be used to:

- Reallocate scarce water resources to uses with higher economic benefit;
- Achieve more efficient use of water resources;
- Allow the water industry to respond to changing conditions; and
- Assist regional development.

Transfer (trading) of licensed entitlements also offers the potential to solve difficult management issues where demand for use of a limited resource exceeds supply. It allows new water users access to water in a fully-allocated system. An application for a transfer (trade) will be assessed by the Department in accordance with the requirements of the *RiWI Act* and relevant policies, and potential impacts to dependent ecosystems and existing users. A transfer (trade) of a licensed entitlement can occur with the approval of the Department.

5.2.11 Priority use of groundwater

The allocation of water for different uses is to be consistent with the Department's Environmental Provisions Policy for Western Australia.

The order of priority beneficial use for groundwater in the Esperance Groundwater Area is:

1. *environment*
2. *community*
3. *private use*

Allocation Limits are applied in proclaimed management areas to restrict abstraction to sustainable levels.

Regulatory controls enable:

- Abstraction from aquifers and management areas to be maintained at a sustainable level for the long-term;
- Allocation of available groundwater resources for beneficial public and private uses, while protecting environmentally sensitive areas; and
- Sharing of groundwater resources in an equitable manner and identifying and securing the rights of users.

5.2.12 Environment

Pumping from bores exhibiting a significant increase in salinity should be reduced or ceased.

Groundwater management in the Esperance Groundwater Area will recognise statutory environmental protection criteria for:

a. Ramsar wetlands, and
b. Wetlands of national and international importance.

A major limitation for groundwater abstraction in the Esperance Groundwater Area is the maintenance of the salt water interface and prevention of salt water upconing. Regular monitoring and management of bores should be encouraged to prevent upconing and saline intrusion, which would result in deterioration of the fresh water aquifer.

Significant wetlands, some with national and international protection status, are found in the Esperance Groundwater Area. Policies and management objectives for the Lake Warden, Woody Lake, Mullet Lake, Pink Lake and Shark Lake Nature Reserves relate to conservation of the biological, physical, cultural and landscape values, which led to the listing of wetlands of international importance, and managing impacts of catchments and adjacent land uses on water quality, quantity and temporal variations (CALM, 1999).

Figure 9 indicates the extent of significant wetlands and the Department of Environment and Conservation (formally Department of Conservation and Land Management) managed land.

The wetlands in the Esperance Groundwater Area are hydraulically connected to the water table and groundwater abstraction may affect water levels in the wetlands.

An application for a groundwater well licence should be referred to the Water Allocation Branch and Water Investigation and Assessment Branch for assessment and advice if the draw from the well:

1. *exceeds 1,500 kL/yr within 500 metres of, or*
2. *greater than 50,000kL/yr within one kilometre of:*
   - *Ramsar wetlands*
   - *wetlands of NATIONAL and INTERNATIONAL importance.*

5.2.13 Groundwater-dependent environments

Individual licensees are responsible for providing information on their potential pumping impacts on identified local groundwater dependent ecosystems and existing groundwater users. It is up to applicants to demonstrate that their proposed development will be sustainable in the long-term.

If significant environmental impacts on groundwater dependent ecosystems are likely, then the applicant will need to provide an assessment of the water level regime required to maintain groundwater dependent ecosystems at a low level of risk, including advice on how abstraction will be managed to protect the environmental values.

If an applicant's abstraction regime is likely to have significant impacts on local groundwater dependent ecosystems, then the Department may require site-specific work to be done on the value concerned, such as:

- More accurate mapping and identification of the groundwater dependent ecosystems ;
- A values and condition assessment of the groundwater dependent ecosystems;
- Determination of ecological water requirements for the groundwater dependent ecosystems;
- Setting of water level criteria at representative groundwater dependent ecosystems and associated monitoring bores;
- Monthly monitoring of water levels, including baseline levels;
- Annual monitoring of biological condition;
- Reporting to the Department on water level trends, trends in biological condition, the relation between the two and compliance with water level criteria; and
- Triggers and associated management actions, including switching off production bores if criteria were likely to be breached.

5.3 Licensing considerations

5.3.1 New or altered bores

All licences to construct and alter bores shall advise that a certified driller must construct wells.

Bore logs must be submitted for every new or altered bore.

Licensing conditions are normally applied to groundwater bore licences. Licensing conditions specific to a particular sub-area are indicated in Chapter 7.

All licences to take water (s. 5C *RiWI Act*) shall stipulate:

- An annual water entitlement;
- Location of the water source;
- Authorised activities and location where the water use is to occur;
- Duration of licence, including expiry date of licence; and
- Relevant licence conditions or restrictions.

All licences to construct or alter wells (s. 26D *RiWI Act*) shall stipulate:

- Location of the wells;
- Authorised activities and location where the activity is to occur;
- Duration of licence, including expiry date of licence; and
- Relevant licence conditions or restrictions.

Licensees are required to submit information to the Department regarding bore construction on the prescribed form within one month of bore completion (Section 26E *RiWI Act*).

5.3.2 Cement grouting

The casing of collapsed or abandoned bores must be sealed, at the owner's expense, in accordance with Minimum Construction Requirements for Water Bores in Australia (NRM, 2006).

Collapsed and abandoned wells require sealing to prevent potential future aquifer contamination. It is preferable to seal the well with cement poured down the well casing.

National guidelines on *Minimum Construction Requirements for Water Bores in Australia Edition 2* provide guidance regarding cement grouting and abandonment of bores (NRM, 2006).

5.3.3 Hydrogeological assessment

Hydrogeological investigations (completed by a hydrogeological professional employed at the applicant's expense) need to be undertaken for licence applications in the following circumstances:

- *Requirements for significant quantities of water (>50,000 kL/yr);*
- *Within one kilometre of groundwater dependent ecosystems and significant wetlands (refer to Figures 10 to 14). The hydrogeological assessment should assess the impacts of abstraction on the water regime and associated groundwater dependent ecosystems.*

Hydrogeological assessments, including monitoring, may be required to investigate the sustainability of available resources and assess the possible impacts of abstraction on the environment and other groundwater users.

5.3.4 Metering

All new and renewed licences may be subject to a condition requiring installation and maintenance of Department approved flow meter to each bore to monitor abstraction.

Meters may need to be installed, dependent on the volume of water to be taken and any other relevant factors and policies, to enable groundwater use to be measured accurately. Meters will be required for all allocations over 50,000 kL/yr.

It is the responsibility of licensees to ensure that the water pumped is of meterable quality to prevent damage to the meter. The Department may at any time require a meter to be tested by the licensee.

Licensees will be required to read their meters monthly and submit the following information to the Department one month after the end of the water year (generally July to June, although the water year and reporting timeframes may vary between licensees):

- The location and pumping schedules for each bore for each month;
- Volume of groundwater pumped from each bore at the close of each month;
- Area of activity under irrigation; and
- Type of activity under irrigation.

The Department will use this information together with the water level and quality information to assist in the sustainable management of the Esperance Groundwater Area.

5.3.5 Monitoring program

Holders of all new and renewed licences may be required to prepare a monitoring program, undertake regular monitoring and submit the results to the Department.

Any increase in the prevailing salinity of the groundwater resource exceeding 1,000 mg/L TDS[11] *must be reported to the Department within seven days.*

The Department may require a licensee to establish groundwater monitoring bores to monitor the impact of their abstraction on the groundwater levels in sensitive environments or where usage is large. It is in the interest of the licensee to monitor groundwater levels, as any reduction or reducing trend in the levels could limit the availability of the resource or result in the resource becoming susceptible to saline upconing. Licensees should implement measures as part of the normal operation strategy to prevent significant reduction in groundwater levels.

The Department may require a licensee to monitor the quality of the groundwater to ensure it is not compromised by salt water impacts. Monthly monitoring of groundwater salinity may be required.

5.3.6 Water use surveys

The Department may reduce unused portions of licensed entitlements in accordance with Policy No 11, where it cannot be established that extenuating circumstances have resulted in part of the entitlement not being used.

Officers of the Department may conduct random water use surveys to determine if the licensee is utilising their allocation in accordance with their licence conditions. If a licensee

11 TDS is an acronym for total dissolved salts (or solids) and refers to calcium, sodium, carbonates, potassium, chloride, magnesium, etc.

is not utilising all of the authorised allocation, the licensee will be asked to explain why the allocation should not be reduced at the time of licence renewal to better reflect current use and near future requirements.

The Department may reduce unused portions of licensed allocations where it cannot be established that extenuating circumstances have resulted in part of the entitlement not being used, in accordance with *State-wide Policy No 11, Management of unused licensed water entitlements* (WRC, 2003b). The reduction of unused allocations will be strictly adhered to, to ensure unused allocations do not hinder sustainable development of groundwater resources.

Where it is determined that a licensee is using water in excess of that approved, the Department will take appropriate action to limit any additional risk to the groundwater resource and its dependent values and other groundwater users.

5.3.7 Development plans and operating strategies

The Department may require the development and implementation of an operating strategy where:

- *The taking of water may impact on the environment;*
- *The volume of water to be taken is significant;*
- *The water resource being accessed requires stringent management;*
- *Water is abstracted from several sources or from a number of bores and requires careful management; and/or*
- *In the opinion of the Department, it is necessary in order to fulfil the requirements of the RiWI Act.*

A detailed development plan and timetable stipulating the proposed activity, the area of development and the timeframe for each stage of development must accompany all new or amended licence applications.

Refer to *State-wide Policy No. 9 – Water licensing – Staged Developments; State-wide Policy No. 10 – Use of Operating Strategies in the Water licensing process and the State-wide Policy No. 11 – Management of unused licensed water entitlement* (WRC, 2003a; WRC, 2003b; WRC, 2004).

The Department will require applicants requesting large volumes of water, or where the impacts of taking water are significant, to prepare and implement operating strategies at their own cost. Where required, licensees should prepare an operating strategy to the satisfaction of the Department and comply with its requirements, including monitoring.

Operating strategies indicate the licensee's responsibilities for managing the impacts of taking and using the water and specify:

- The licensee's land use, water abstraction regime, and the methods and infrastructure used to abstract, treat or distribute water;
- Monitoring and reporting requirements;
- Methods used to manage impacts on the environment and other water users;

- Contingency plans, describing how the licensee will alter their operations to cope with any directions to temporarily reduce water consumption; and
- Water efficiency measures employed.

Licences will include a condition requiring licensees to comply with Department pre-approved operating strategies. Monitoring requirements are not necessarily restricted to the development area, and the Department may also request off-site monitoring of impacts. This information is used to ensure protection of neighbouring groundwater users, minimise environmental degradation and maintain the long-term sustainability of the aquifer system.

Should the total allocation requested be available, the Department may approve entitlements for staged development of the project. The entitlement may be increased gradually to satisfy water needs in accordance with the agreed development timetable. If the proposed development does not take place or is delayed, the licensee should justify why the entitlement should be renewed for the following years or stages. In the event that less water is required for the development than originally anticipated, or there is adverse impact on other users or the environment, the entitlement may be reduced.

Groundwater is an essential requirement and a valuable resource for many developments. Licensees must use groundwater efficiently and ensure that all practical water conservation methods are being considered and where practical, utilised. Those projects planning to use large volumes of groundwater may be required to demonstrate that water conservation methods have been considered and will be implemented where possible.

5.3.8 By-laws

The Department may develop local by-laws in accordance with Section 26N(2) RiWI Act. There are no by-laws relating to water management in the Esperance Groundwater Area at the time of publishing this Plan.

5.3.9 Advertising licence applications

A licensee is required to advertise any new and additional applications to take water in excess of 100,000 kL/yr, or where sufficient impacts on a water resource may occur (Part 3, s. 23 RiWI Regulations).

The notice should be advertised in a newspaper circulating daily in State and in the local media or where the Department considers advertising to be appropriate. The Department will have regard for any submission made by a person who may be affected by an activity authorised by the proposed licence.

5.3.10 Acid sulphate soils

It is the responsibility of the applicant to establish whether the area of application contains acid sulphate soils, and whether the proposed groundwater abstraction, including drainage, will be susceptible to the generation of acidic water and soils.

Acid sulphate soils are naturally occurring soils that contain iron sulphides, predominantly as pyrite. These soils are benign when undisturbed, but the exposure of the pyrite to air by the drainage, dewatering (water level declines by pumping groundwater) or excavation of soil can generate substantial amounts of sulphuric acid. Discharge of acidic water into

waterways and wetlands can cause fish kills and loss of aquatic biodiversity. Infiltration of acidic water may contaminate groundwater with acid, metals and other contaminants which are toxic to humans and other biota. Lowering of pH in soil water or water bodies can change community composition of dependent biota whereby acid-tolerant species are favoured, and those that are intolerant disappear from that environment. In effect, the impact will lead to the deterioration of the quality of the groundwater.

It is in the interest of the applicant that such understanding is established, as the generation of acid will also have a devastating impact on property and the activities of the applicant.

5.3.11 Water efficiency and conservation

Groundwater should be used efficiently and in accordance with best management practices.

Applicants for groundwater licenses should be aware that groundwater is an important resource and should be used efficiently. Those projects planning to use large volumes of groundwater may be required to demonstrate that water conservation methods have been considered and will be implemented where possible.

5.4 Stock and domestic water use

Groundwater abstraction for domestic or stock purposes is generally exempt from licensing in the Esperance Groundwater Area.

Domestic and stock water demand is acknowledged as a priority need for all landholders in areas where no reticulated water supply exists.

Domestic and stock bores are currently exempt from licensing requirements in the Esperance Groundwater Area. The Department is in the process of preparing state-wide guidelines for domestic and stock water supplies, which may remove the exemptions from some of the Esperance Groundwater Area sub-areas.

Summary of allocation policies

For an explanation of policy directions, please refer to Section 5.1 to 5.4

Ref. No.	Policy Directions
5.1.1	Groundwater licences in the Esperance Groundwater Area will be issued on a first-in-first-served' basis.
5.2.1	Groundwater entitlements in each sub-area should not exceed the allocation limit for the respective sub-area and aquifer.
5.2.2	The Department will assess licence applications according to the requirements of the *Rights in Water and Irrigation Act 1914* and the *Rights in Water and Irrigation Regulations 2000*.
5.2.3	The Department's South Coast Regional Office can directly approve and issue a groundwater well licence if the licence conforms to the appropriate policies given in the Esperance Groundwater Area Local Area Water Management Plan.
5.2.3	Before a groundwater licence is issued, applicants must demonstrate proof of legal access to the land upon which the taking of water is to occur. Applicants may submit a copy of the Certificate of Title, Lease Agreement, vesting order or other documented proof of access for the properties where the water-related development is to occur. It is the licensee's responsibility to ensure that all other necessary Government agency, development and environmental approvals have been granted.
5.2.3	All new groundwater well licences will be issued for a two-year period. Following this period, providing the licensee has met licence conditions including satisfactory progressing with development, the licence may be renewed for a period up to a maximum of 10 years.
5.2.4	The Department may refuse a licence after undertaking an assessment and finding taking of water to be inconsistent with the policies or plans applying to the area or may cause significant adverse impacts on the aquifer, environment or other users.
5.2.5	Applicants aggrieved by a licensing decision by the Department may apply to the State Administrative Tribunal for a review of the decision.
5.2.6	Site inspections and water use surveys may be undertaken to assess compliance of licensed activities.
5.2.6	Unused entitlements will be managed in accordance with the Department's State Policy No 11.
5.2.7	Recouped water from managing unused allocations may become available to re-allocate to consumptive use of the environment.

5.2.8	Licensees are responsible for applications to extend the term of the existing licence prior to expiry.
5.2.8	Licences may not be renewed if licensees have not abided by all licence conditions.
5.2.8	Licence conditions may be changed if an area becomes fully allocated.
5.2.9	Applications to increase a licence will be considered as a new application.
5.2.10	Where the groundwater resource is fully allocated, new entitlements are unlikely to be approved. Proponents requiring water will need to enter into the trading market for new water.
5.2.11	The order of priority of beneficial uses for groundwater in the Esperance Groundwater Area is: 1. environment 2. community 3. private use.
5.2.12	Pumping from wells exhibiting an increase in salinity should be reduced or ceased.
5.2.12	Groundwater management in the Esperance Groundwater Area will recognise statutory environmental protection criteria for: 1. RAMSAR wetlands 2. Wetlands of NATIONAL and INTERNATIONAL importance.
5.2.12	An application for a groundwater well licence should be referred to the Water Allocation Branch and Water Investigation and Assessment Branch for assessment and advice if the draw from the well: 1. exceeds 1,500 kL/yr within 500 metres of, or 2. greater than 50,000kL/yr within one kilometre of: - Ramsar wetlands - wetlands of NATIONAL and INTERNATIONAL importance.
5.2.13	Individual licensees are responsible for providing information on their potential pumping impacts on identified local groundwater dependent ecosystems and existing groundwater users. It is up to applicants to demonstrate that their proposed development will be sustainable in the long-term.
5.2.13	If significant impacts are likely, then the applicant will need to provide an assessment of the water level regime required to maintain groundwater dependent ecosystems at a low level of risk, including advice on how abstraction will be managed to protect the environmental values.
5.3.1	All licences to construct and alter wells shall advise that a certified driller must construct wells.
5.3.1	Bore logs are to be submitted for every new or altered well.
5.3.2	The casing of collapsed or abandoned wells must be sealed, at the owner's expense, in accordance with Minimum Construction Requirements for Water Bores in Australia.

5.3.3	Hydrogeological investigations (completed by a hydrogeological professional employed at the applicant's expense) need to be undertaken for licence applications in the following circumstances: 1. Requirements for significant quantities of water (>50,000 kL/yr); or 2. Within one kilometre of groundwater dependent ecosystems and significant wetlands (refer to Figures 10-14). The hydrogeological assessment should assess the impacts of abstraction on the water regime and associated groundwater dependent ecosystems.
5.3.4	All new and renewed licences for abstractions greater than or equal to 50,000 kL/yr will be subject to a condition requiring installation and maintenance of Department approved flow meters to monitor abstraction.
5.3.5	All new and renewed licences for abstractions greater than or equal to 50,000 kL/yr will be required to prepare a monitoring program, undertake regular monitoring and submit the results to the Department.
5.3.5	Any increase in the prevailing salinity of the groundwater resource exceeding 1,000 mg/L TDS must be reported to the Department within seven days.
5.3.6	The Department may reduce unused portions of licensed entitlement in accordance with Policy No 11, where it cannot be established that extenuating circumstances have resulted in part of the entitlement not being used.
5.3.7	A detailed development plan and timetable stipulating the proposed activity, the area of development and the timeframe for each stage of development must accompany all licence applications.
5.3.7	All new and renewed licences for abstractions greater than or equal to 50,000 kL/yr will be required to prepare an operating strategy to the satisfaction of the Department of Water and comply with its requirements including monitoring.
5.3.8	The Department may develop local by-laws to assist in managing water resources.
5.3.9	A licensee is required to advertise any new or additional applications to take water in excess of 100 000 kL/yr, or where sufficient impacts on a water resource may occur.
5.3.10	It is the responsibility of the applicant to establish whether the area of application contains acid sulphate soils, and whether the proposed groundwater abstraction, including drainage, will be susceptible to the generation of acidic water and soils.
5.3.11	Groundwater should be used efficiently and in accordance with best management practices.
5.4	Groundwater abstraction for domestic or stock purposes is generally exempt from licensing.

6 Sub-areas information sheets

6.1 Town sub-area

Description

Area: 33.7 km^2	**Local Government:** Shire of Esperance
Comments:	• Saline water intrusion and upconing is a risk factor in this sub-area and abstraction from wells needs to be managed to prevent deterioration of the fresh water aquifer. • Elevated nitrate levels may occur in groundwater due to the presence of septic tanks. • The Town of Esperance is located within this sub-area. • Major water use category: public water supply. • The sub-area is generally bounded by the Southern Coast in the south and Lake Warden in the north. Figure 1 shows the extent of the sub-area.

General hydrogeology and management strategy

Superficial aquifer	• Major groundwater supplies are located in the Quaternary coastal deposits. Groundwater salinity is generally fresh to brackish. Salt water intrusion or upconing is a risk factor. • The sustainable yield for the aquifer in this sub-area has been estimated to be 1,900,000 kL/yr. The existing Allocation Limit exceeds this amount. This Plan has reduced the Allocation Limit to the estimated sustainable yield.

Groundwater resources (kL/yr)

Aquifer	**Allocation Limit**		**Licensed Entitlements***		**Groundwater Availability***	
	Previous	**New**	**Previous**	**Current**	**Previous**	**Current**
Superficial aquifer	1,970,000	1,900,000	2,985,950	1,544,722*	0	126,278*

Groundwater monitoring

Aquifer	**Monitoring regime**
Superficial aquifer	• Water Corporation monitors aquifer performance in accordance with operating strategy for Esperance TWS wellfield.

* Licensed entitlements and groundwater availability are subject to change. Information as at 31 March 2005.

** Includes applications under assessment, up-to-date figures are indicated in aquifer allocation report.

6.2 Twilight sub-area

Description

Area: 22.5 km^2	**Local Government:** Shire of Esperance
Comments:	• Saline water intrusion and upconing is a risk factor in this sub-area and abstraction from wells needs to be managed to prevent deterioration of the fresh water aquifer. • Major water use category: public water supply. • The Twilight sub-area is generally bounded by the Southern Coast in the south and Pink Lake in the north. Figure 1 shows the extent of the sub-area.

General hydrogeology and management strategy

Superficial aquifer	• Major groundwater supplies are located in the Quaternary coastal deposits. Groundwater salinity is generally fresh to brackish. Salt water intrusion or upconing is a risk factor. • South of Pink Lake, saline groundwater occurs at the base of the Quaternary sediments beneath a fresh water zone. • Water quality in bores should be observed and pumping should be reduced or ceased in bores with elevated salinity. • Pumping rates are to be limited to prevent saline upconing from the underlying saline aquifer.

Groundwater resources (kL/yr)

Aquifer	**Allocation Limit**	**Licensed Entitlements***		**Groundwater Availability***	
		Previous	**Current**	**Previous**	**Current**
Superficial aquifer	700,000	54,250	667,600**	645,750	31,200**

Groundwater monitoring

Aquifer	**Monitoring regime**
Superficial aquifer	• Water Corporation monitors aquifer performance in accordance with operating strategy for Esperance TWS wellfield.

* Licensed entitlements and groundwater availability are subject to change. Information as at 31 March 2005.

** Includes applications under assessment, up-to-date figures are indicated in aquifer allocation report.

6.3 Butty sub-area

Description

Area: 068.7 km^2	**Local Government:** Shire of Esperance
Comments:	• Saline water intrusion and upconing is a risk factor in this sub-area and abstraction from wells needs to be managed to prevent deterioration of the fresh water aquifer. • Land use is restricted due to the presence of Crown Reserves and reserved land in this sub-area. • Major water use category: public water supply. • The Butty sub-area is generally bounded by the Southern Coast in the south, Pink Lake in the east and Lake Gore and Lake Mortiniup in the north. Figure 1 shows the extent of the sub-area.

General hydrogeology and management strategy

Superficial aquifer	• Major groundwater supplies are located in the Quaternary coastal deposits. Groundwater salinity is generally fresh to brackish. Salt water intrusion or upconing is a risk factor. • The Allocation Limit has been conservatively applied.

Groundwater resources (kL/yr)

Aquifer	**Allocation Limit**	**Licensed Entitlements***		**Groundwater Availability***	
		Previous	**Current**	**Previous**	**Current**
Superficial aquifer	4,200,000	0	950,000**	4,200,000	3,250,000**

Groundwater monitoring

Aquifer	**Monitoring regime**
Superficial aquifer	• Water Corporation monitors aquifer performance in accordance with operating strategy for Esperance TWS wellfield.

* Licensed entitlements and groundwater availability are subject to change. Information as at 31 March 2005.

** Includes applications under assessment, up-to-date figures are indicated in aquifer allocation report.

6.4 Warden sub-area

Description

Area: 135.1 km^2	**Local Government:** Shire of Esperance
Comments:	• National and International wetlands of significance are located in this sub-area (eg Pink Lake, Lake Warden). • Major water use category: private water use (eg agriculture, fishing, tourism and commercial). • The Warden sub-area is generally bounded by the Town, Twilight and Butty sub-areas in the south. Figure 1 shows the extent of the sub-area.

General hydrogeology and management strategy

Fractured rock aquifer	• The aquifer generally comprises weathered granite, Pallinup siltstone or alluvial sands. • The aquifer generally exhibits low yields and brackish groundwater quality. • Quaternary coastal deposits occurring in the Town, Twilight and Butty sub-areas are generally not present in the Warden sub-area.

Groundwater resources (kL/yr)

Aquifer	**Allocation Limit**	**Licensed Entitlements***		**Groundwater Availability***	
		Previous	**Current**	**Previous**	**Current**
Fractured rock aquifer	1,000,000	291,350	223,510**	708,650	776,490** low yields

Groundwater monitoring

Aquifer	**Monitoring regime**
Fractured rock aquifer	• No regional monitoring network exists

* Licensed entitlements and groundwater availability are subject to change. Information as at 31 March 2005.

** Includes applications under assessment, up-to-date figures are indicated in aquifer allocation report.

Glossary

Allocation Limit	Estimated maximum level of allocation (including Public Water Supply Reserves and approved reserves) that can be abstracted during a water accounting year, which allows acceptable levels of pumping stress, and protects dependent economic, social and environmental values. Allocation Limits are set for each water resource (aquifer) within a sub-area and may be amended over time to reflect significant monitoring outcomes and sustainability determinations.
Aquifer	A geological formation or group of formations that are able to receive, store and transmit significant quantities of groundwater.
Ecological values	The natural ecological processes occurring within water-dependent ecosystems and the biodiversity of those systems.
Ecological water requirements	The water regime needed to maintain ecological values of water-dependent ecosystems at a low level of risk.
Environmental water provisions	The water regimes that are provided as a result of the water allocation decision-making process, taking into account ecological, social and economic impacts.
Equity	Treating those in the same circumstances in the same manner, through a system of principles, policies and processes that supplement the common and statutory law framework.
Evapotranspiration	The loss of water to the atmosphere by evaporation and by transpiration through living organisms.
First-in-first-served (FiFS)	A process by which groundwater entitlements are allocated consistent with the order in which licence applications are received by the Department of Water.
Groundwater	Any underground water, including water that percolates from the ground surface into a bore, well or other works.
Groundwater Area	An area of land that overlies a particular water resource, or resources, that has been proclaimed under the *Rights in Water and Irrigation Act 1914*, for the purposes of controlling through licensing, the construction of water wells and the taking and use of the water resource(s).

Groundwater-dependent ecosystem	An ecosystem that is partially or fully dependent on groundwater for its sustained existence.
Leakage	The flow of water from one aquifer to another.
Policy	Refers to a guideline that is not directly supported by any legislation but has been adopted by the Department of Water as a guideline.
Precautionary Principle	Where threats of serious or irreversible environmental damage could occur, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the Precautionary Principle, public and private decisions should be guided by: • Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and • An assessment of the risk-weighted consequences of various options.
Public water supply reserve	A volume of groundwater that has been reserved for town water supply purposes (drinking water for human consumption) and, where appropriate, to satisfy the water requirements for developments of state-wide significance under State Agreements to which the *Government Agreements Act 1979* applies.
Surface water	An open body of water such as a stream, lake, or reservoir.
Sustainability	Meeting the needs of current and future generations through integration of environmental protection, social advancement and economic prosperity.
Sustainable yield	The volume of water abstracted from a source that can be sustained on a long-term basis without exceeding the rate of replenishment.
sub-area	A subdivision of a proclaimed Groundwater Area on the basis of hydrogeological and land use boundaries, for the purpose of closer management of the water resource(s).
Throughflow	The flow of water within an aquifer.

Transferable (tradeable) water entitlement	The ability to transfer or trade a water entitlement, or a part thereof, to another person within a common water resource.
Water conservation	The management of water use to achieve and maintain an appropriate level of water use efficiency.
Water efficiency	The minimisation of water use through adoption of best management practices.
Water entitlement	The quantity of water that a person is entitled to take on an annual basis in accordance with the *RiWI Act* or a licence.
Water resource	A watercourse, wetland or underground water source to which section 5C of the *RiWI Act* applies.
Water regime	A description of the variation of flow rate in surface water or water level in groundwater over time; it may also include a description of water quality.

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List of water management plans published by the Department of Water

1. *Groundwater Management Plan: Derby Groundwater Area* – published in 1992
2. *Wanneroo Groundwater Area Allocation Plan* – published in 1993
3. *Groundwater Area Management Plan: Cockburn Groundwater Area* – published in 1993
4. *Groundwater Area Management Plan: Busselton-Capel Groundwater Area* – published in 1994
5. *Groundwater Area Management Plan: Bunbury Groundwater Area* – published in 1994
6. *Groundwater Management Plan: Broome Groundwater Area* – published in 1994
7. *Groundwater Allocation Plan: Swan Groundwater Area* – published in 1997
8. *Harvey Basin Surface Water Allocation Plan* – published in 1998
9. *Groundwater Allocation Plan: Exmouth* – published in 1999
10. *Sub-Regional Allocation Strategy* – published in 2002
11. *Managing the Water Resources of the Gingin Groundwater Area, WA: Interim*
12. *Managing the Water Resources of the Jurien Groundwater Area, WA: Interim Sub-Regional Allocation Strategy* – published in 2002
13. *Managing the Water Resources of the Arrowsmith Groundwater Area, WA: Interim Sub-Regional Allocation Strategy* – published in 2002
14. *Groundwater Management Strategy: Managing the Groundwater Resources of the Lower Gascoyne River (Carnarvon), WA* – published in 2004
15. *Ord River Water Management Plan, WA* – published in 2006

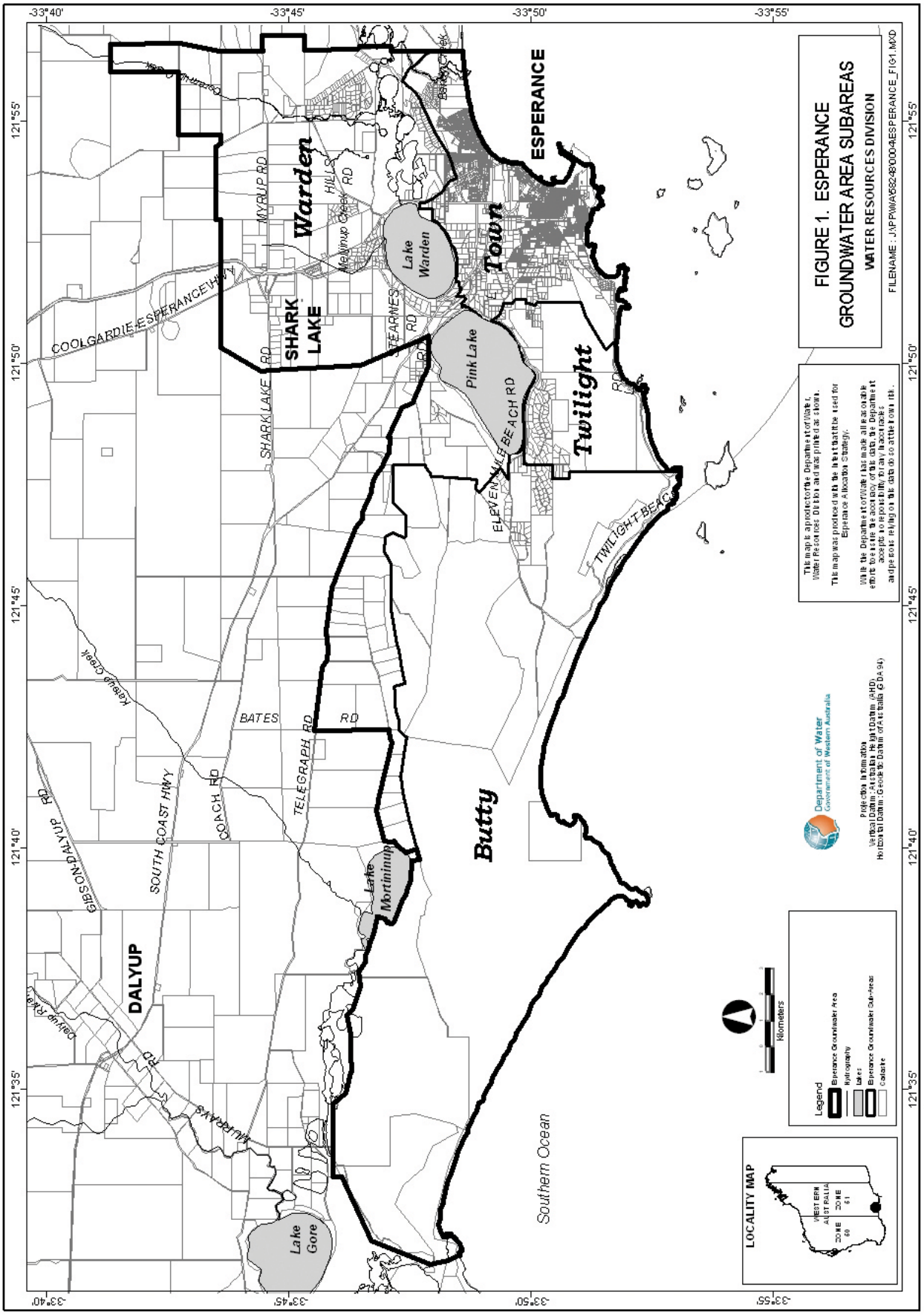

Figure 1. Esperance Groundwater Area sub-areas

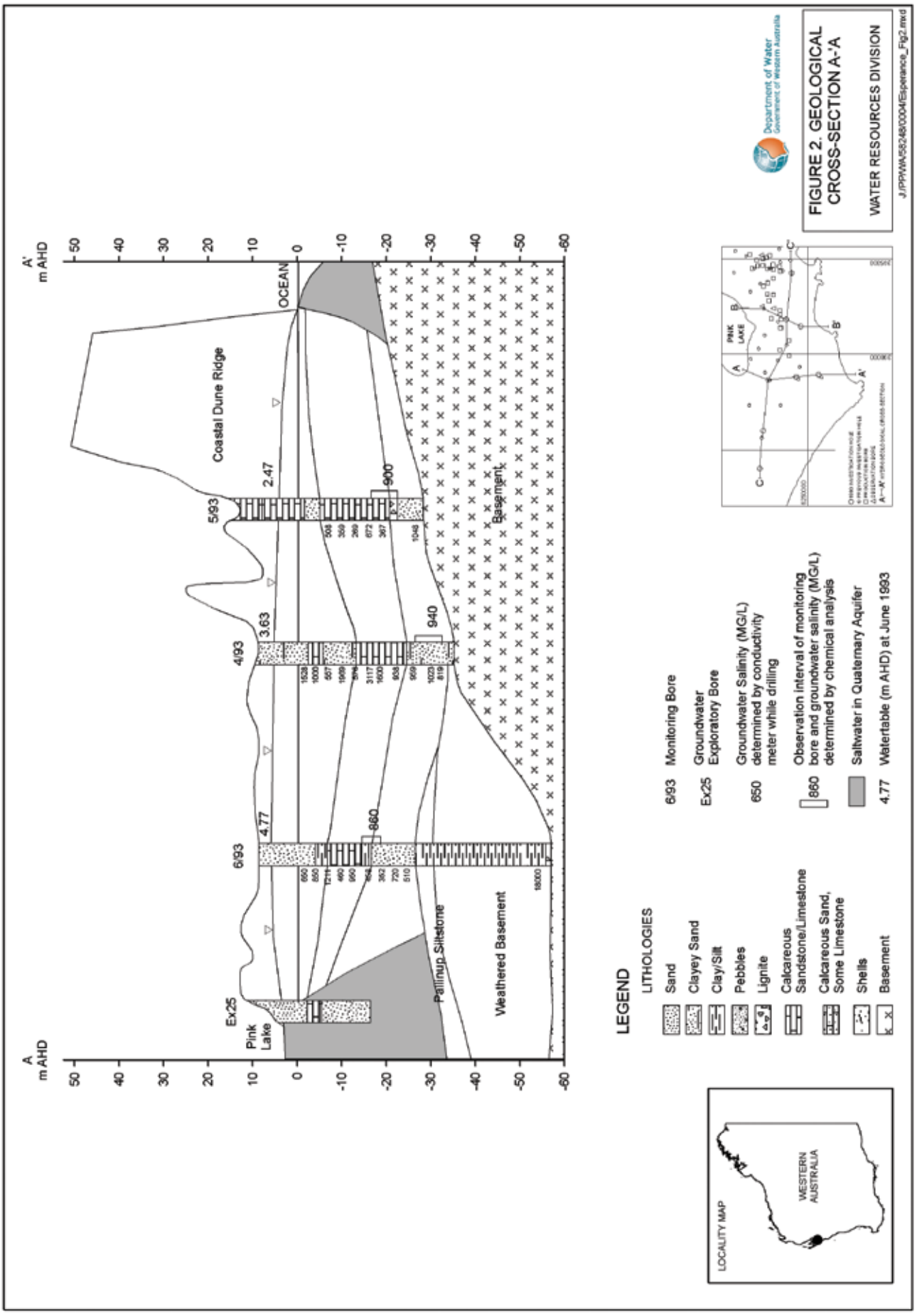

Figure 2. Geological cross-section A-A

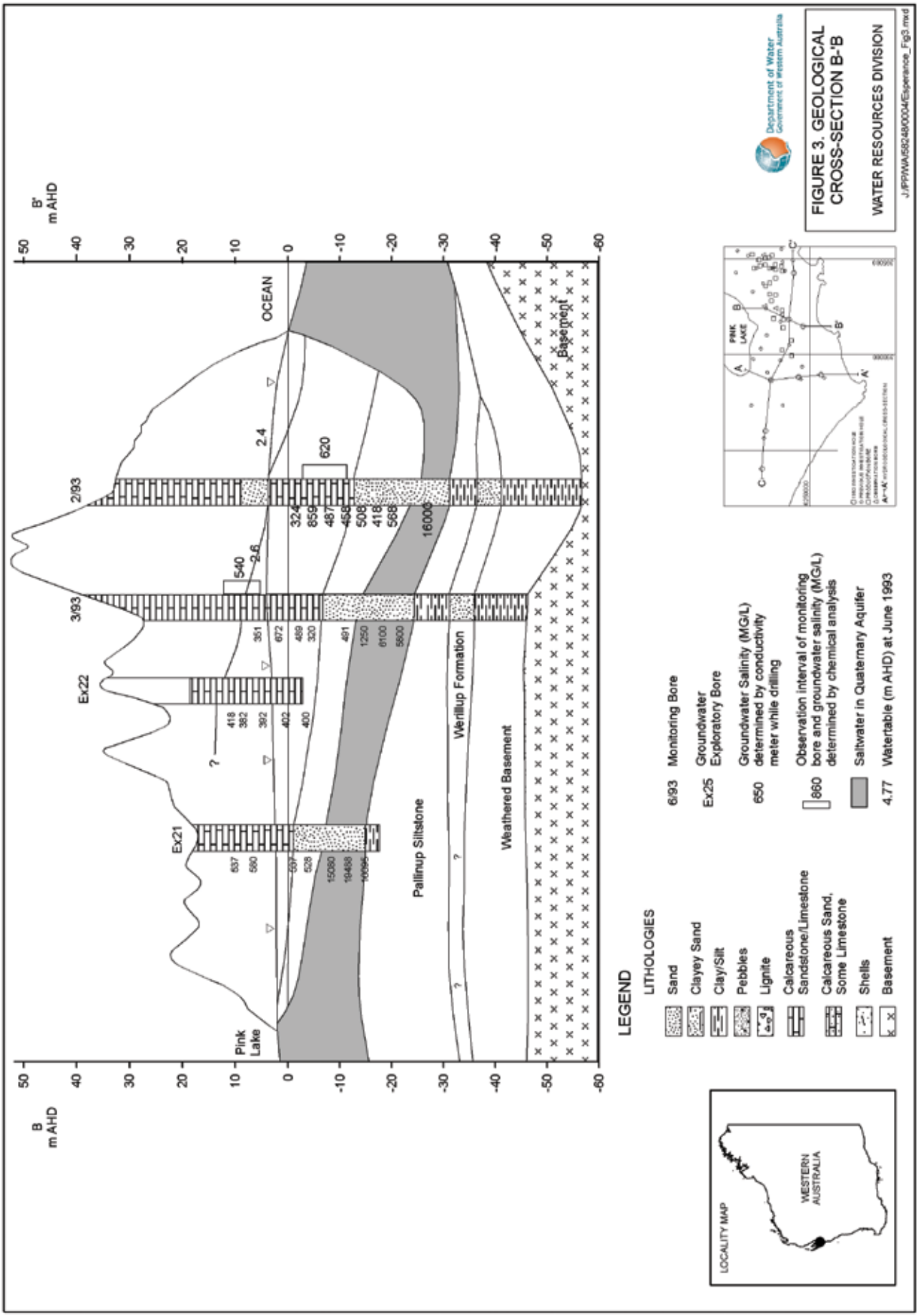

Figure 3. Geological cross-section B-B

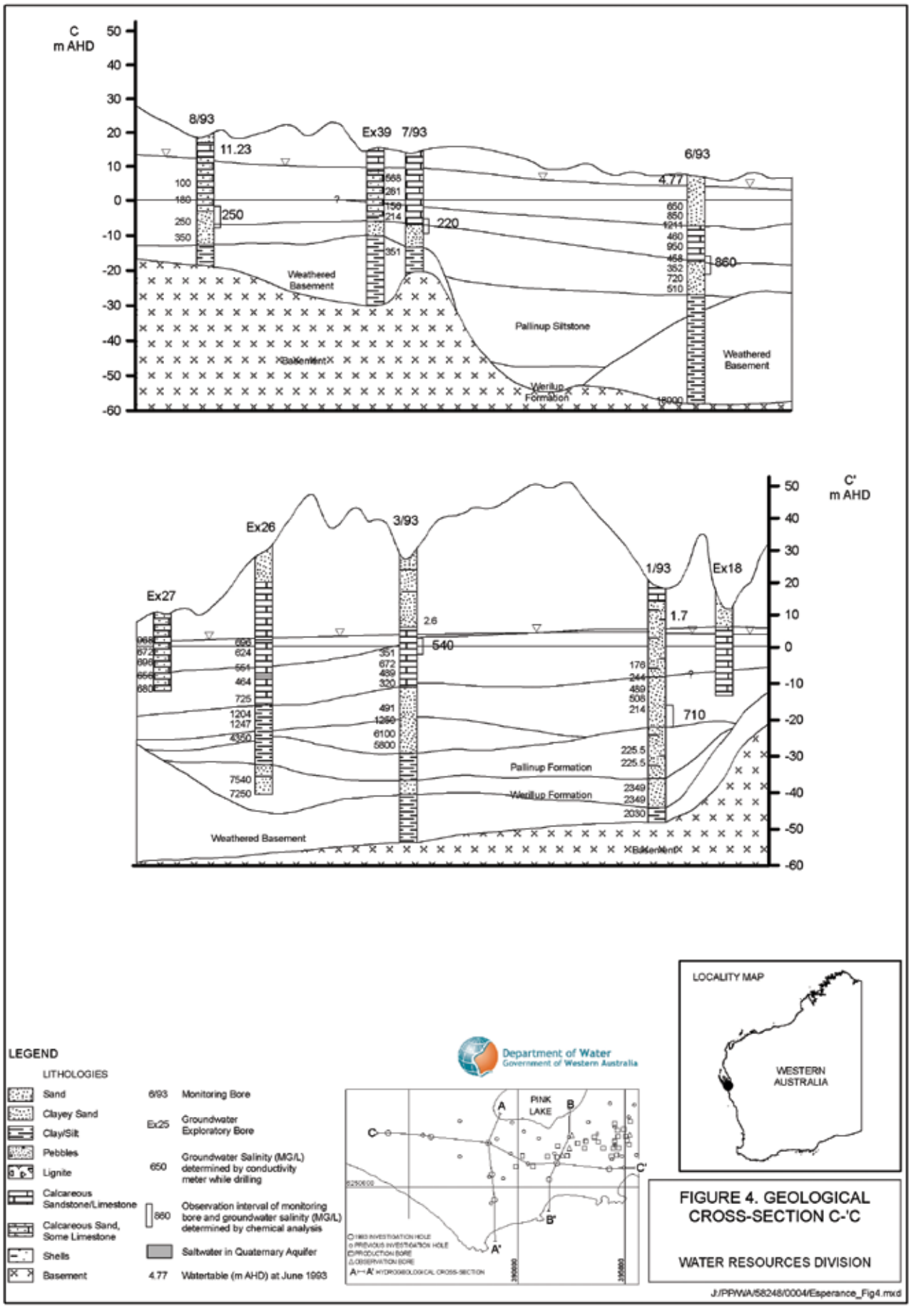

Figure 4. Geological cross-section C-C

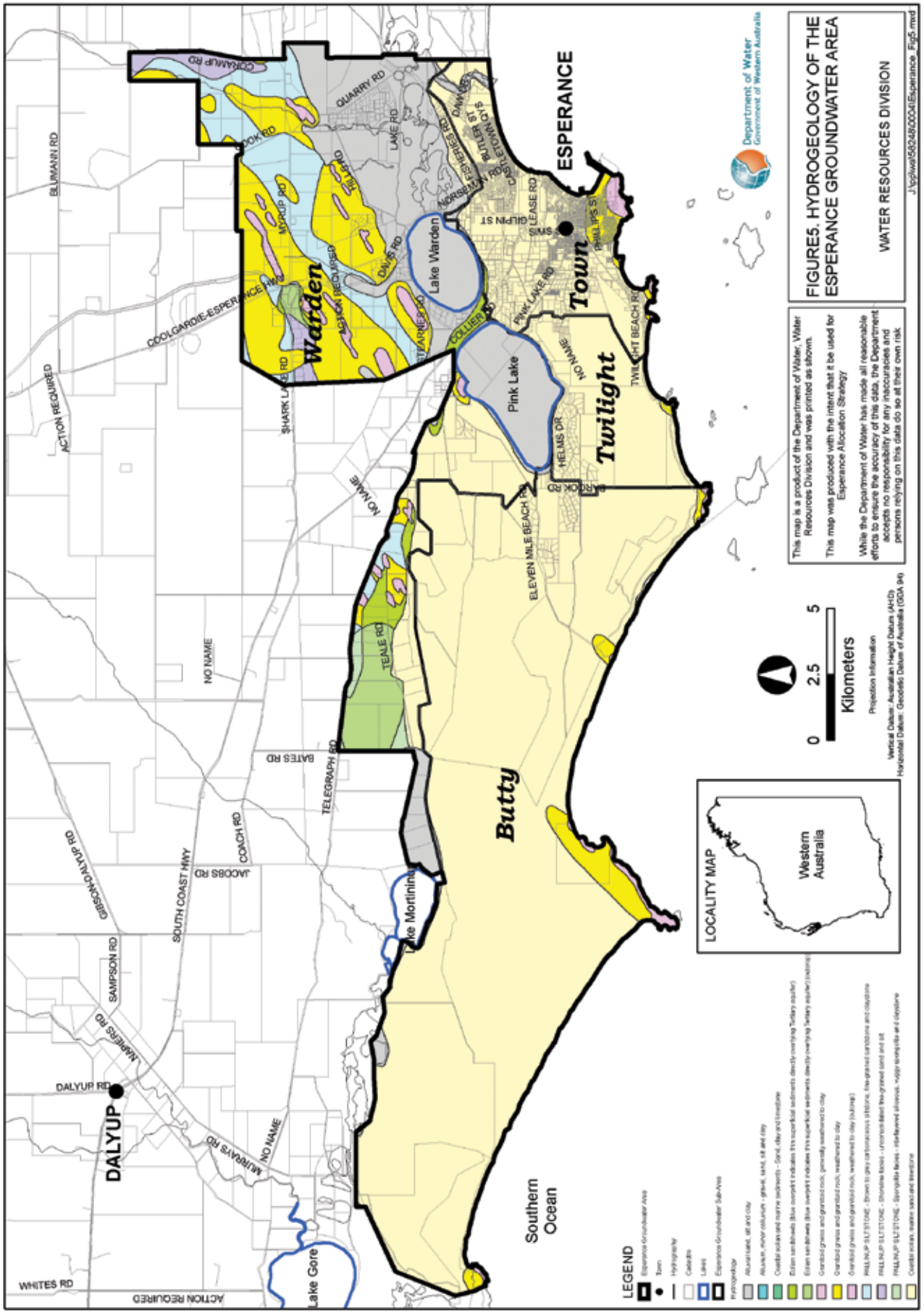

Figure 5. Hydrogeology of the Esperance Groundwater Area

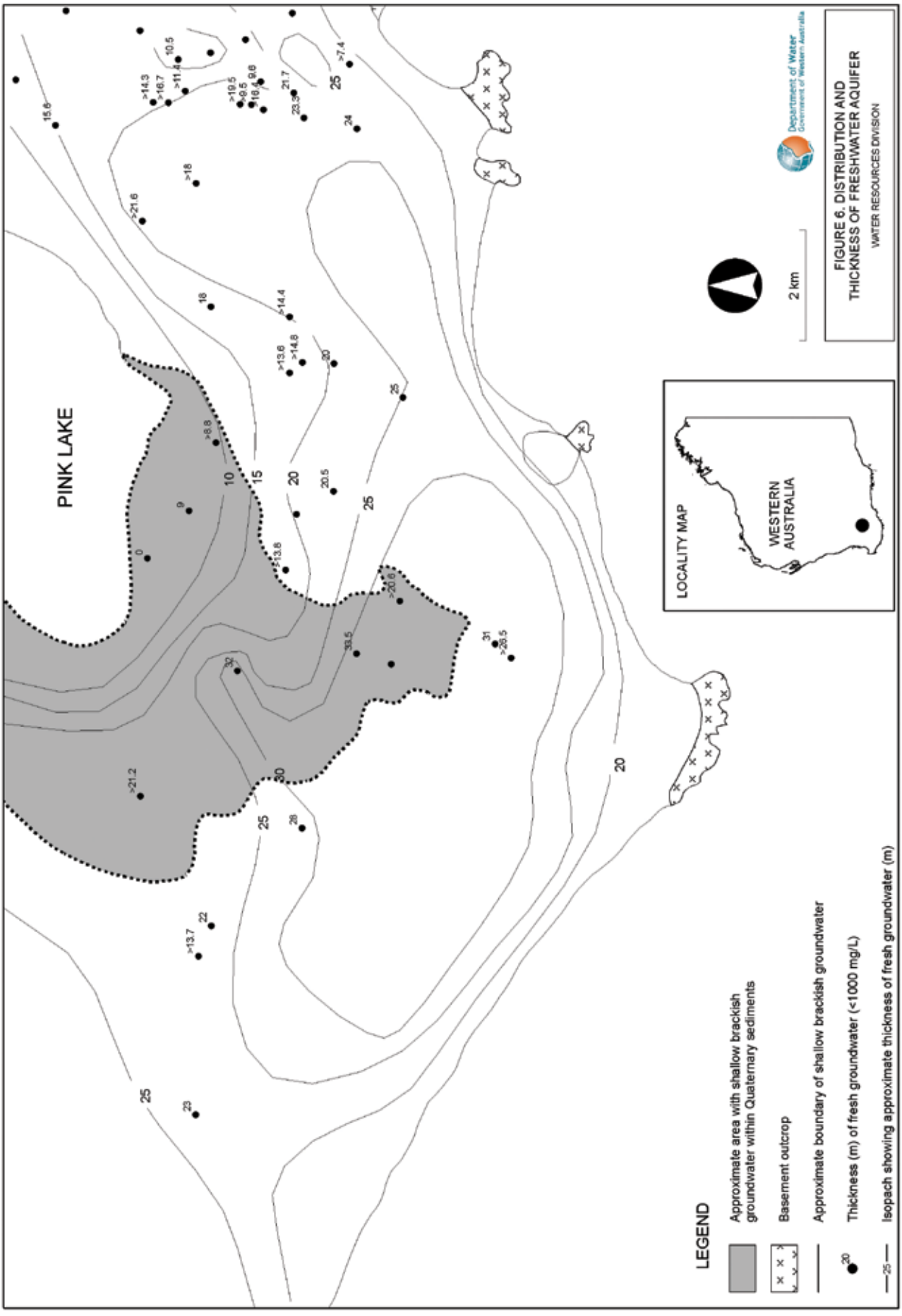

Figure 6. Distribution and thickness of freshwater aquifer

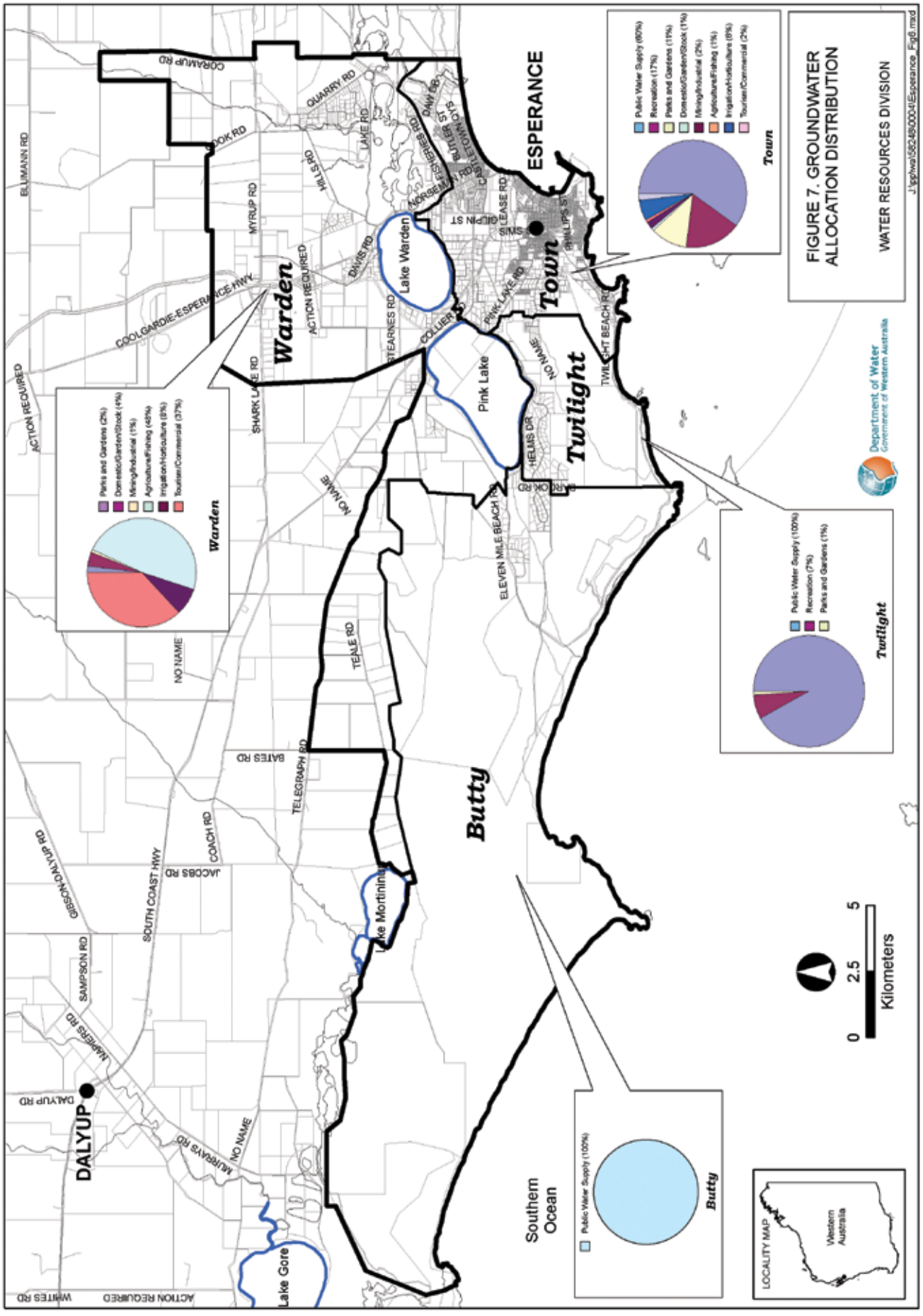

Figure 7. Groundwater allocation distribution

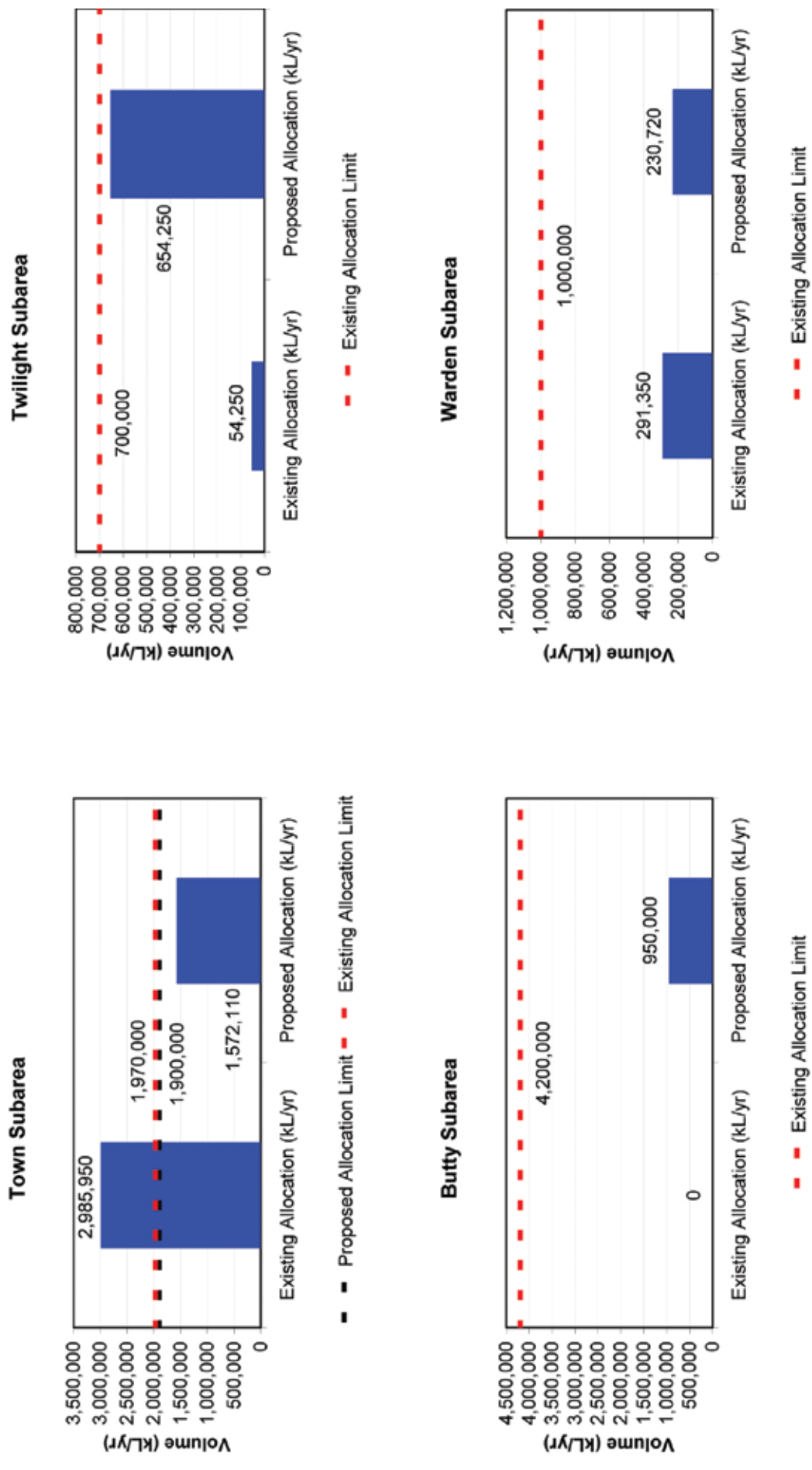

Figure 8. Licensed entitlements and Allocation Limits by sub-area (31 March 2005)

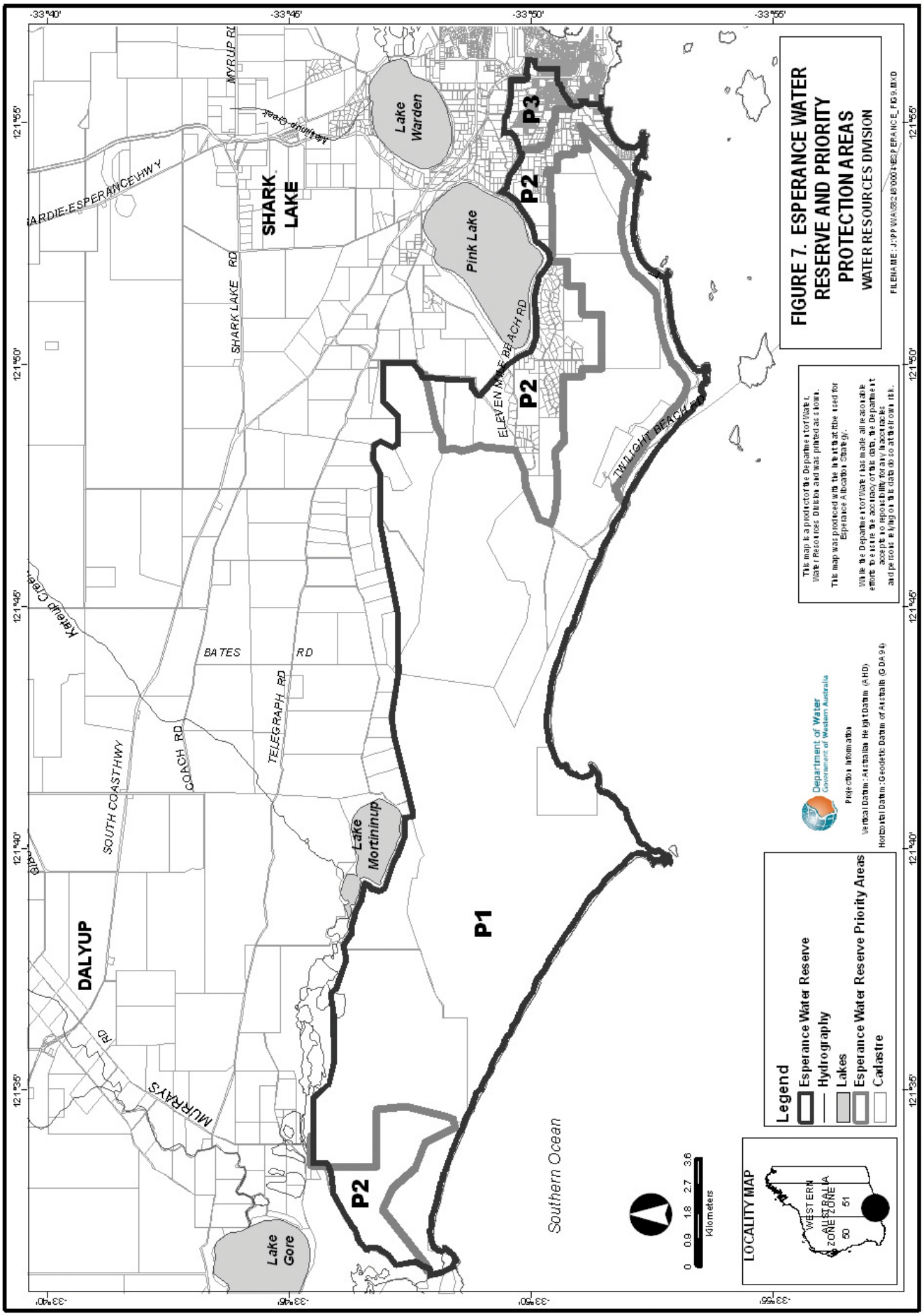

Figure 9. Esperance Water Reserve and Priority Protection Areas

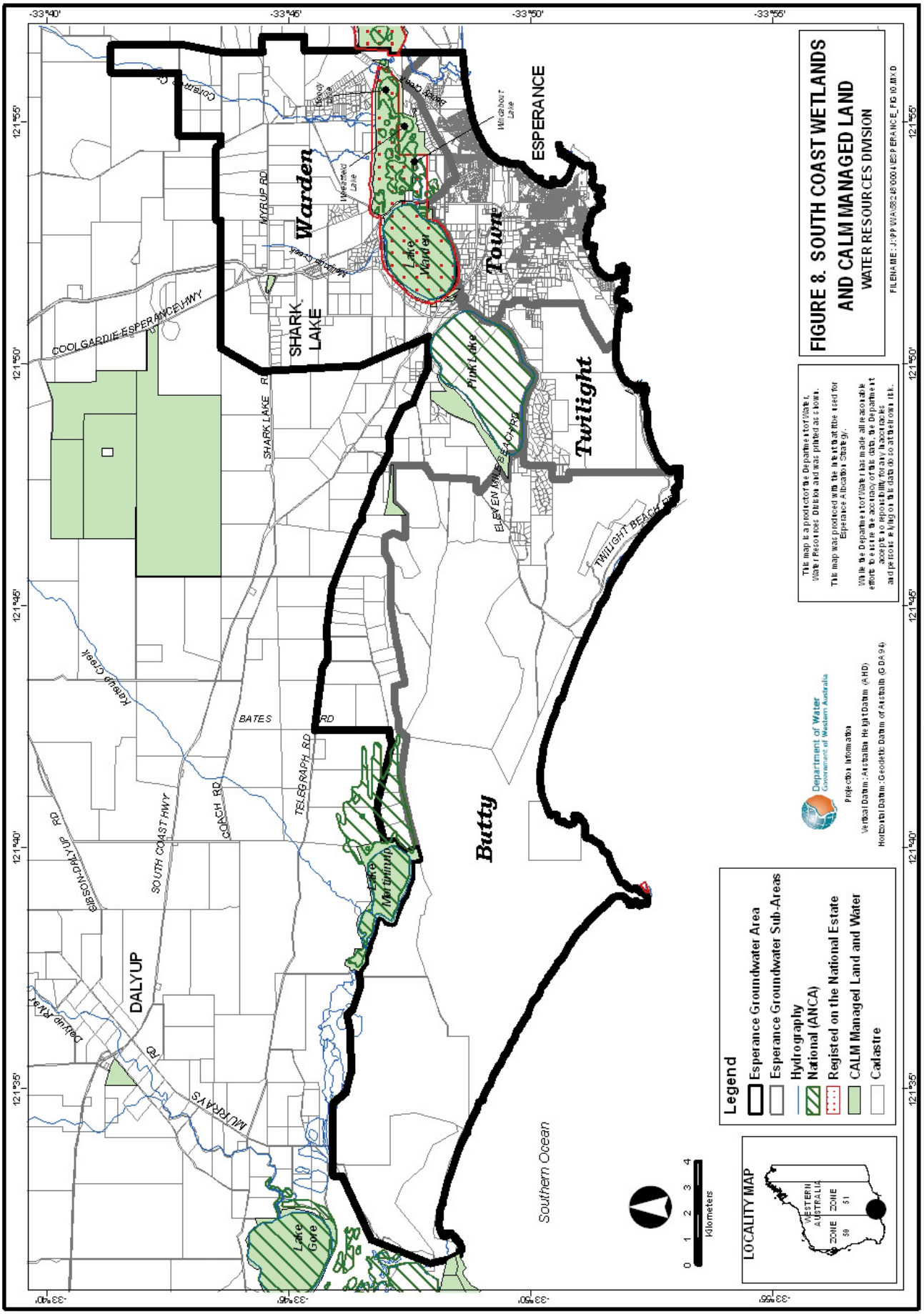

Figure 10. South Coast wetlands and CALM managed land

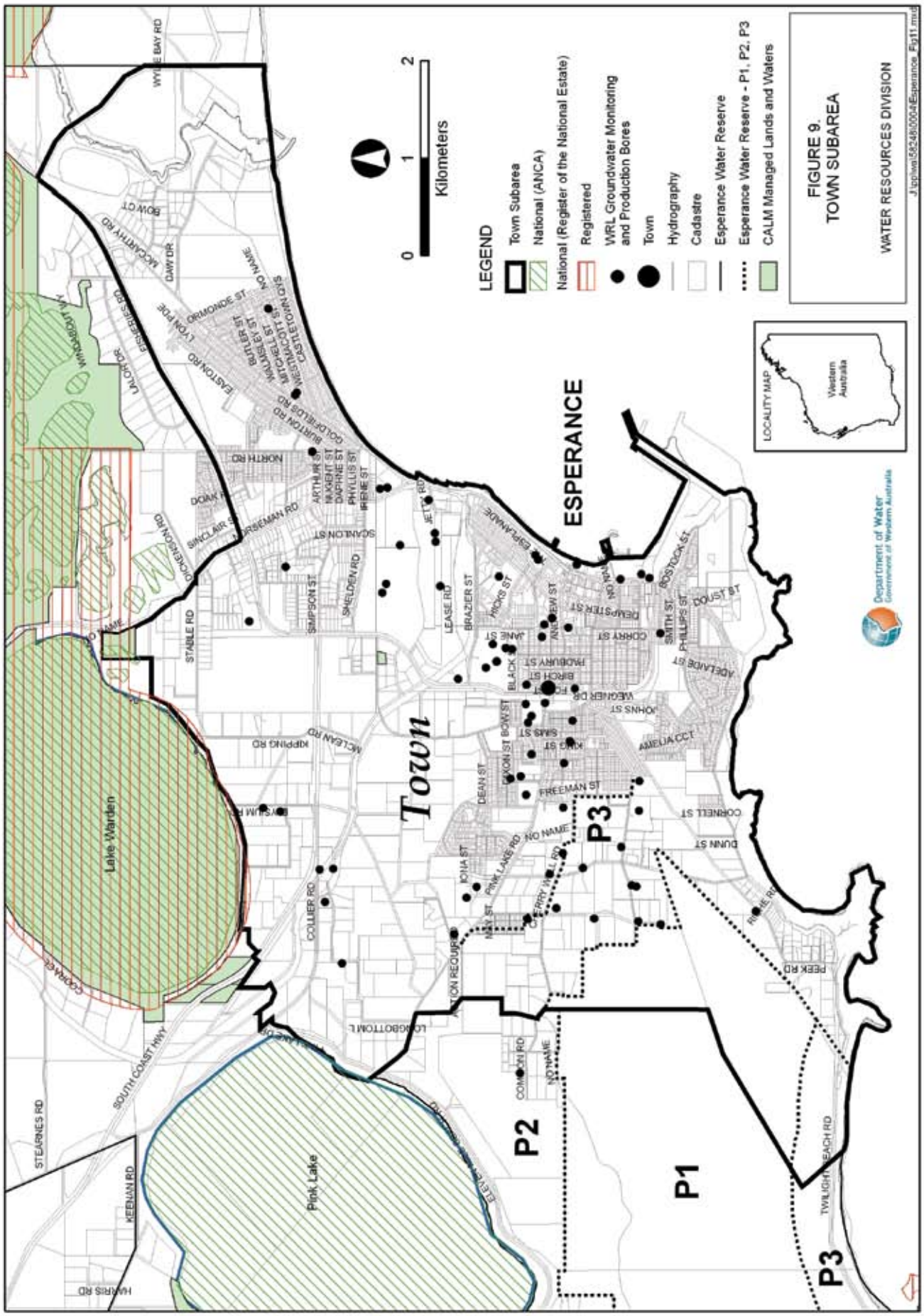

Figure 11. Town sub-area

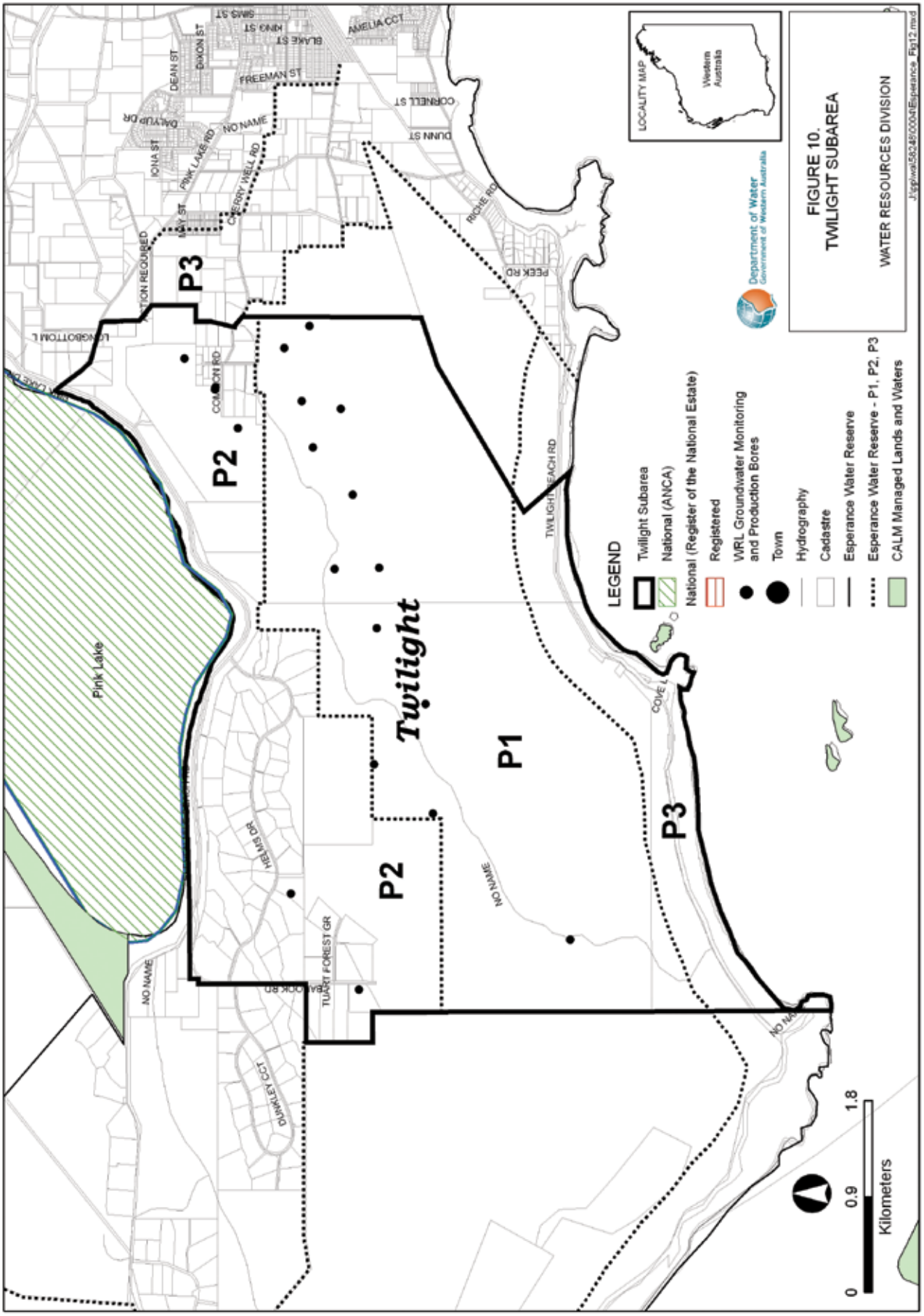

Figure 12. Twilight sub-area

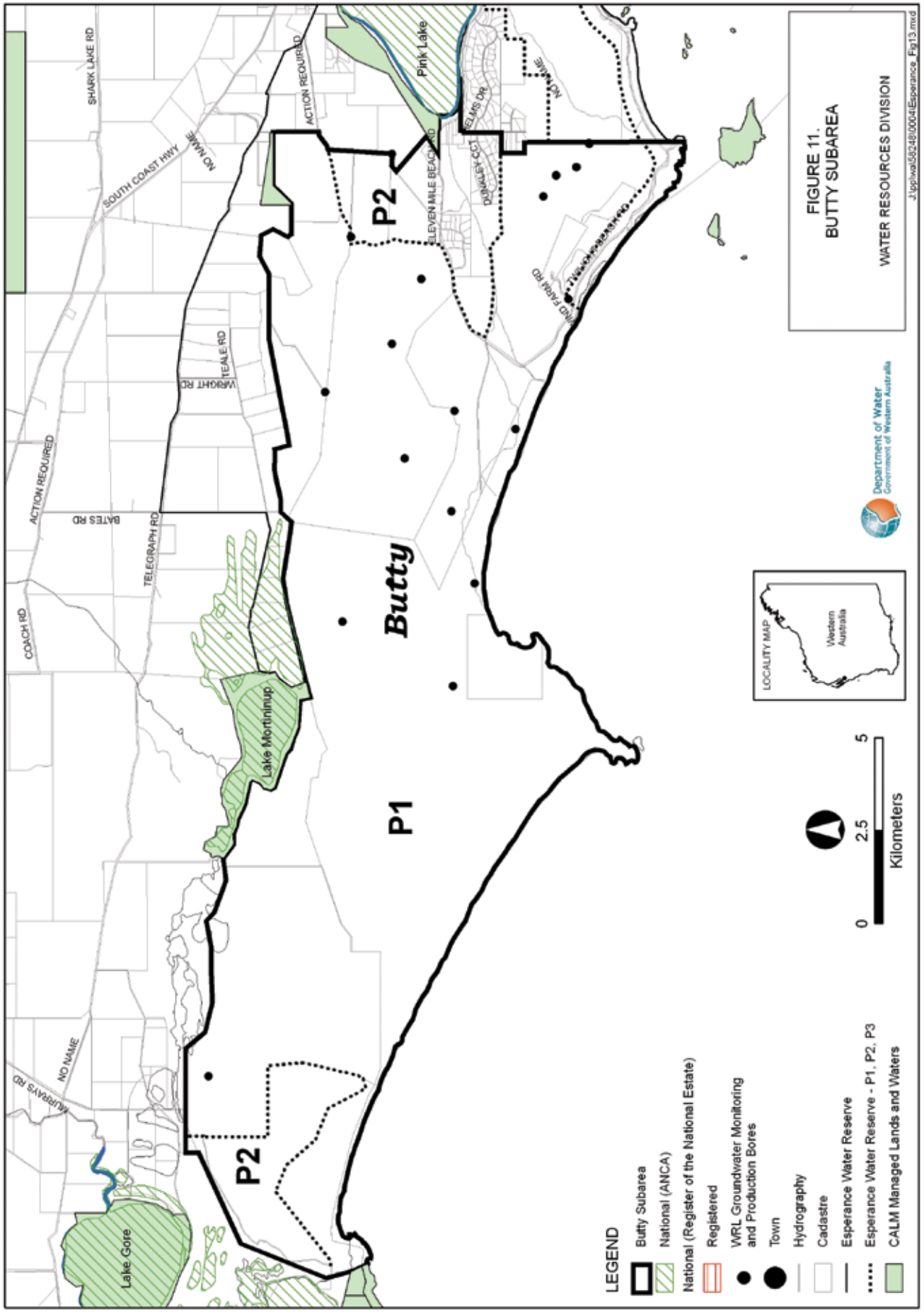

Figure 13. Butty sub-area

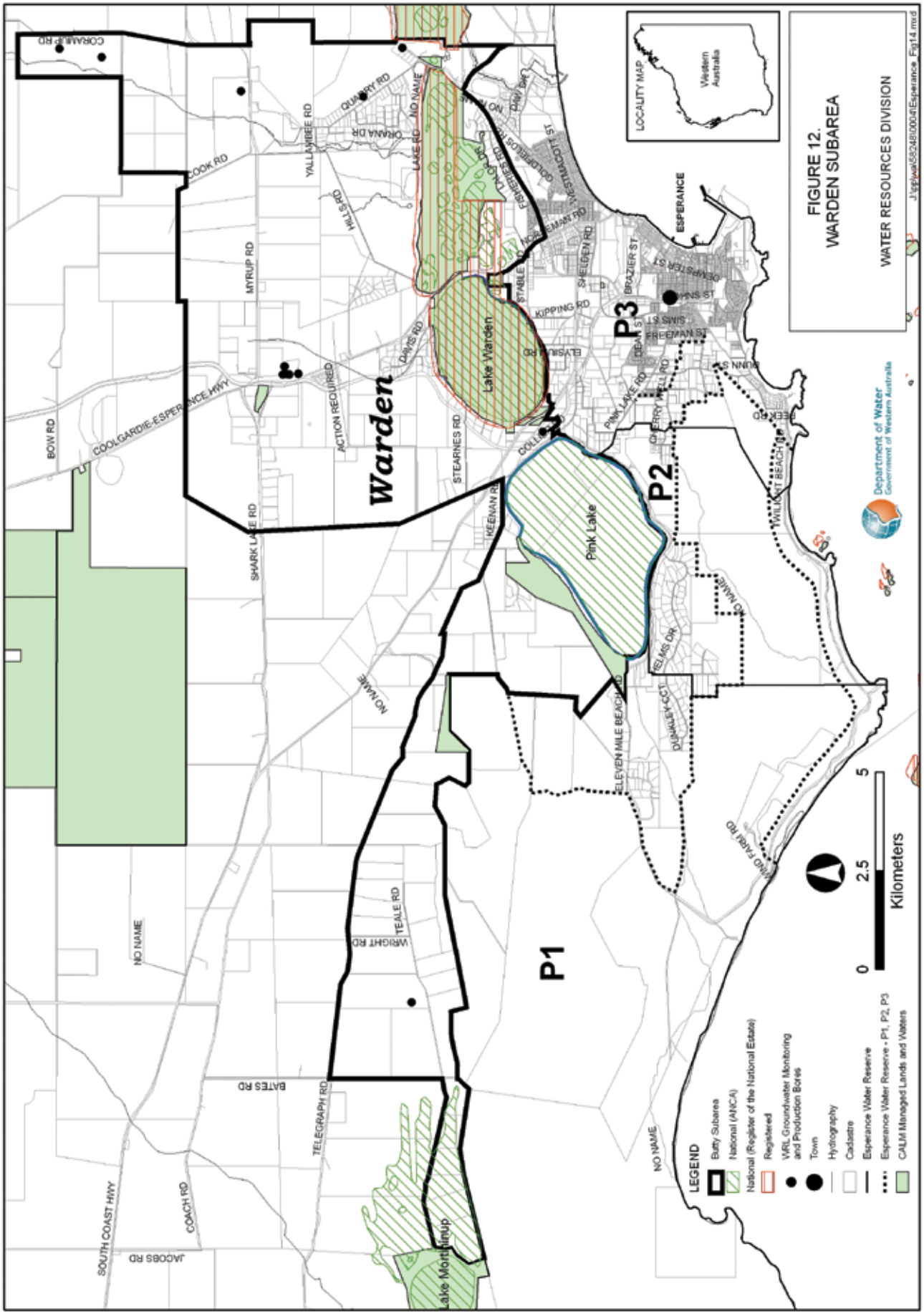

Figure 14. Warden sub-area

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