



Government of **Western Australia**
Department of **Water**

Peel Coastal groundwater allocation plan

For public comment

November 2014

Securing Western Australia's water future



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Water Resource Allocation and Planning Report series

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November 2014

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A message from the Director General

The Peel Region is the fastest growing regional area in Western Australia. Mandurah, the second biggest city in Western Australia, continues to develop as a vibrant regional centre.

The region supports a diverse range of urban, industrial, commercial and rural land uses, and is home to some unique natural features such as the internationally recognised Peel–Yalgorup wetland system.

Groundwater resources are central to this diversity. Though most water used to supply households in Mandurah comes from the Water Corporation's integrated water supply scheme, local groundwater is used to irrigate local public open space, support commercial and agricultural activities and meet the stock and domestic needs of the narrow coastal strip covered by this plan.

Groundwater is also critical to wetlands, and the values they maintain, in this coastal area. The thrombolite communities located on Lake Clifton are a unique example of this. Fresh groundwater flow is essential to the survival of these rare prehistoric life forms.

The region is facing some water challenges over the coming decades as land use intensifies and rainfall declines across the South West of the state. The 11 billion litres (Gigalitres) per year of groundwater available from the City of Mandurah along the coast to the southern end of Lake Preston is now fully allocated. The Department of Water encourages greater innovation in the ways in which water is used and managed in this narrow zone.

We are already seeing encouraging signs of local solutions being developed, particularly with the use of treated wastewater for irrigating public open spaces. This smart use of water takes pressure off our precious groundwater resources.

The *Peel Coastal groundwater allocation plan* is an important tool that builds on more than 20 years of groundwater management in this area. It provides an important balance between the water use needs for regional growth, needs of existing groundwater users and the region's important natural values.

Stakeholder input has been critical in developing the plan. We now look forward to receiving your comments and views on the plan by Friday 27 February 2015. The completed plan will be accompanied by a statement of response which will summarise how we addressed your comments.



Maree De Lacey

Director General, Department of Water

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Summary

Purpose of the plan

The Department of Water is responsible for regulating and managing the state's water resources for sustainable productive use. This new plan sets out how we will regulate and manage groundwater in coastal parts of the Peel Region from Mandurah, south along the coast, to the southern end of Lake Preston.

Until now our management was guided by the *South West coastal groundwater area groundwater management review* (Water Authority 1989). This plan updates our management of groundwater resources by:

- setting new allocation limits that incorporate the effects of the drying climate
- setting new local licensing policies that protect current licence entitlements and important wetland values
- aligning water planning with land-use planning
- encouraging trading and alternative water source options
- improving water accounting, including exempt (from licensing) domestic groundwater use
- improving groundwater monitoring
- providing an adaptive management framework which includes regular plan evaluations.

The plan is also part of the department's input to the Strategic Assessment of the Perth–Peel Region currently being conducted by the Government of Western Australia. This assesses the effect of our growing population and proposed future development on matters of national environmental significance listed under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) such as the Ramsar-listed Peel–Yalgorup wetland system.

This plan does not address the supply of scheme water because household water for Mandurah and surrounding urban areas is obtained from outside the plan area, through the Water Corporation's Integrated Water Supply Scheme (IWSS).

Water availability in the Peel Coastal plan area

There are over 11 GL per year of groundwater used in the Peel Coastal plan area. This includes licensed and unlicensed stock and domestic use.

Our review of allocation limits identified that abstracting more water from aquifers in this area of unique coastal geography would result in significant risks to current users, the ongoing productivity of the resource, water quality and important wetland values. These risks are being further increased by the drying climate.

We have identified, through this planning process, that future demand for water can be met through trading or transferring water entitlements, or by utilising alternative water source options. Alternative sources such as wastewater recycling are already an important component of water use in some parts of the plan area.

Water may become available from time to time through relinquished licences or through recouping of unused entitlements. The allocation limits proposed in this plan are summarised below.

Subarea and aquifer	Allocation limit kL/year	Water availability
Coastal Superficial	192 550	Groundwater resources in the plan area are fully allocated.
Coastal Leederville	20 000	
Colburra Downs Superficial	70 000	No further groundwater allocation is available.
Colburra Downs Leederville	0	
Falcon Superficial	2 321 923	Trading and transferring of water entitlements and alternative water sources will meet future water needs.
Falcon Leederville	1 606 420	
Island Point Superficial	568 375	
Island Point Leederville	0	
Lake Clifton Superficial	661 440	
Lake Clifton Leederville	0	
Mandurah Superficial	4 653 729	
Mandurah Leederville	802 100	
Whitehills Superficial	335 909	
Whitehills Leederville	0	
Total	11 232 446	

Allocation and licensing approach for the Peel Coastal plan area

To make best use of the available groundwater we will:

- support low impact trades and transfers of groundwater entitlements
- assess applications for water made available through licence relinquishment or recouping of unused entitlements
- work with local government, developers and private users to identify viable alternative water source options such as using treated wastewater and managed aquifer recharge
- conduct compliance surveys, and where necessary, recover unused entitlements, promote efficiency improvements, or take enforcement action.

We have updated our local licensing policies to ensure that any possible adverse effects on water quality and important wetland values are addressed through licensing.

Managing water resources in a drying climate

Reduced rainfall observed across most parts of south-west Western Australia is having a significant impact in the plan area. In addition to affecting the amount of water we are able to make available for use, it is:

- increasing the risks of water quality problems such as saltwater intrusion and exposure of acid sulfate soils
- contributing to further declines in levels of water that support wetlands and vegetation.

We will continue to monitor how the drying climate is affecting groundwater resources through our monitoring and plan evaluation program.

Have your say

This plan is now released for public comment. We will review and consider each of the comments we receive to help finalise the *Peel Coastal groundwater allocation plan*. We will release a statement of response with the final plan which will summarise the comments received and how we considered them in the final plan.

We will not identify individuals, but we may quote directly from your comments, so please state clearly if you do not wish us to do so.

Please send your comments by 5.00 pm Friday 27 February 2015 to:

allocation.planning@water.wa.gov.au

or to the address below:

Branch Manager
Water Allocation Planning Branch
Department of Water
PO Box K822
Perth Western Australia 6842

1 Plan context and scope

1.1 Purpose of the plan

Since the *South West Coastal groundwater area groundwater management review* was released in 1989, Mandurah and its surrounding areas have grown significantly.

The unique geography of the area and the influence of the drying climate mean that the community will need to use the available groundwater efficiently and look for smart water supply alternatives.

The *Peel Coastal groundwater allocation plan* updates the way in which the Department of Water will regulate and manage the abstraction of groundwater through allocation limits, licensing, monitoring and evaluation. Importantly, it addresses the challenge of making the best use of the 11 GL per year already being used.

This plan:

- aligns water planning with current and future land-use planning in coastal parts of the Peel Region, including Mandurah
- accounts for the declining rainfall trend and the effect this will continue to have on local water availability and water quality
- minimises the risk that groundwater abstraction in the plan area has on the Ramsar listed Peel–Yalgorup wetlands and other groundwater-dependent ecosystems
- encourages trading and alternative water source options in response to reduced groundwater availability.

The plan does not:

- address household potable water supply in Mandurah and surrounding urban areas, as this is obtained outside the plan area through the Water Corporation's Integrated Water Supply Scheme
- address the protection of public drinking water supply areas, flooding, or drainage issues¹
- address water quality (nutrient) management.²

The *Peel Coastal groundwater allocation plan* is a non-statutory plan prepared to guide licensing under the *Rights in Water and Irrigation Act 1914*.

¹ These issues are addressed through other plans developed by the Department of Water and can be obtained from our website <www.water.wa.gov.au> or by contacting the department's Peel office.

² For more information see *Water quality improvement plan for the rivers and estuary of the Peel–Harvey system – phosphorus management* (EPA 2008).

1.2 Plan area

Location

The area covered by the *Peel Coastal groundwater allocation plan* extends along the Swan Coastal Plain from the northern surrounds of Mandurah (approximately 70 km south of Perth) to just north of Myalup. It is bordered to the east by the Peel–Harvey Estuary and west by the Indian Ocean.

The plan area covers approximately 380 km² (Figure 1). Most of the plan area is in the local government areas of the City of Mandurah and the Shire of Waroona. The plan area also borders the areas covered by the *Murray groundwater allocation plan* (DoW 2012a) to the east, the *South West groundwater areas allocation plan* (DoW 2009a) to the south and the *Rockingham–Stakehill groundwater management plan* (DoW 2007) to the north.

Proclamation

The plan incorporates most of the South West Coastal groundwater area. The groundwater area was first proclaimed under the *Rights in Water and Irrigation Act 1914* in 1977 to support the development of horticulture. Its boundary was varied in 1986 to include the Harvey area and modified again in 1988 to include Mandurah.

The proclaimed groundwater area contains nine subareas (Figure 2), two of which are managed under the *South West groundwater areas allocation plan*. The remaining seven subareas are managed under this plan.

As the groundwater area is proclaimed, water users require a licence to lawfully abstract groundwater under section 5C of the *Rights in Water and Irrigation Act 1914*, unless exemptions apply.

Land use

Land use in the northern part of the plan area is primarily urban. Groundwater is used to irrigate public open space, sporting grounds and domestic gardens in, and around, Mandurah. Groundwater in the southern part of the plan area is used for small-scale agriculture, horticulture, plantations and domestic purposes.

A large portion of the western side of the plan area is taken up by the Yalgorup National Park which includes areas of natural bushland and wetlands, including the Ramsar-listed Peel–Yalgorup wetland system. These areas have important value as recreation, tourism and cultural sites.

The horticultural belt of Myalup is located south of, and not within, the Peel Coastal plan area. However, abstraction and land-use practices in Myalup may affect Lake Preston in the plan area. How we manage these is outlined in the *South West groundwater areas allocation plan* (2009a).

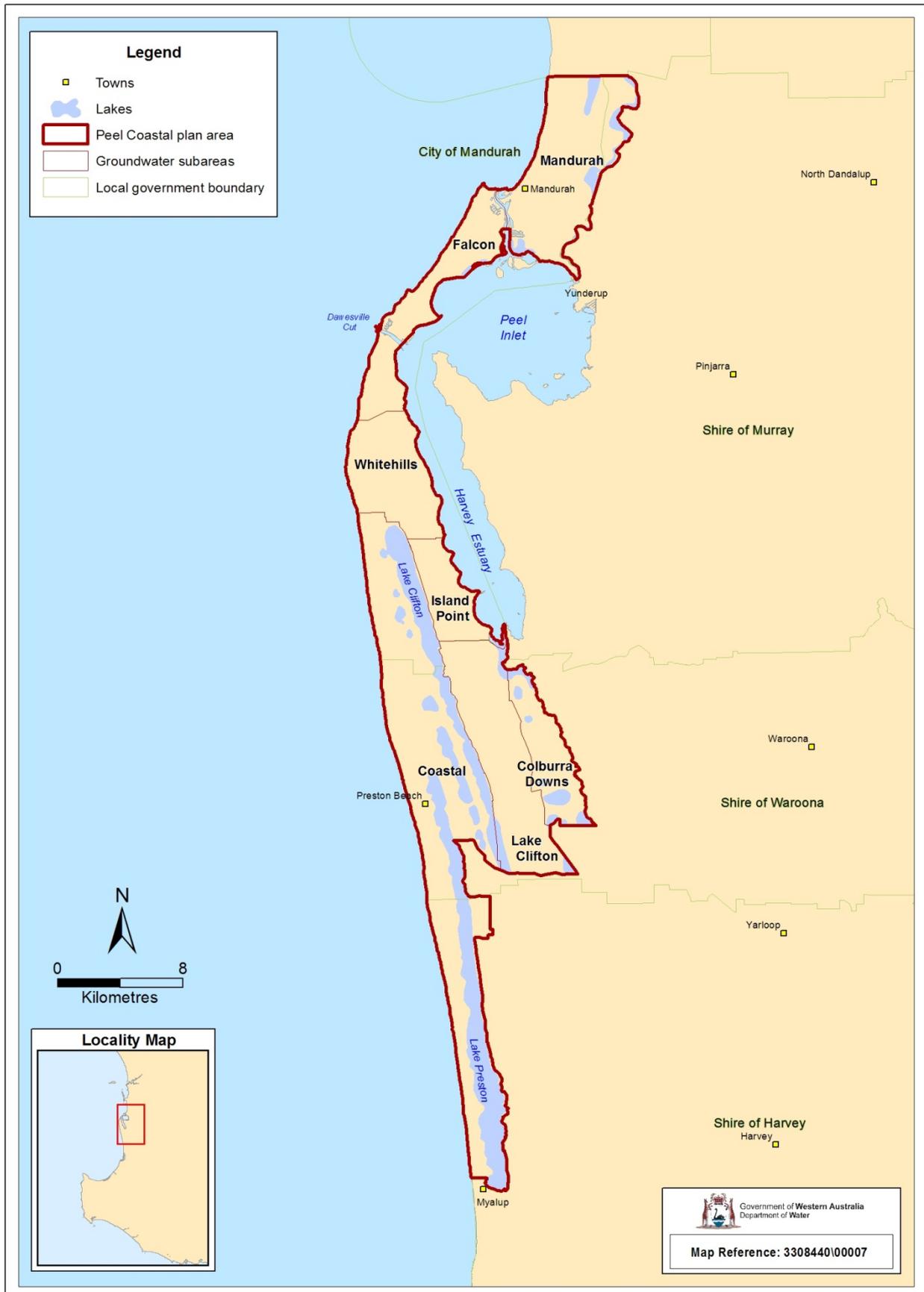


Figure 1 Peel Coastal groundwater allocation plan area

1.3 Water resources covered

The Peel Coastal plan area is divided into seven subareas for allocation planning and licensing purposes:

- Coastal
- Colburra Downs
- Falcon
- Island Point
- Lake Clifton
- Mandurah
- Whitehills

The department defines a 'groundwater resource' as being a particular aquifer in a particular subarea. We set allocation limits for each resource.

There are three aquifers present in the plan area. In order of increasing depth, these are the Superficial and Leederville aquifers, and the Cattamarra Coal Measures. The resource boundaries for the Superficial and Leederville aquifers are shown in Figure 2.

Superficial aquifer

The Superficial aquifer is an unconfined, stratigraphically complex, multilayered aquifer, consisting mainly of porous Tamala limestone, which is generally in hydraulic connection with the underlying Leederville aquifer. It is a shallow aquifer with a maximum saturated thickness of 25 m. The Superficial aquifer is recharged directly by rainfall, with a thin lens of freshwater over more saline water across the majority of the plan area. This thin lens is prone to saline upconing when over-abstracted at a local scale.

The Superficial aquifer in the plan area supports groundwater-dependent ecosystems such as lakes, wetlands, terrestrial vegetation and rare thrombolite communities (Figure 3). These ecosystems rely on either access to the watertable or freshwater through flow and discharge. For more information on groundwater-dependent ecosystems in the plan area refer to the *Peel Coastal plan area: Groundwater-dependent ecosystems and their water use* (DoW in prep.).

The Water Corporation recharges parts of the Superficial aquifer in the Mandurah and Falcon subareas using infiltration ponds at their wastewater treatment plants. It is believed that the artificial recharge is supporting some localised abstraction, as well as preventing saltwater intrusion in the Falcon subarea, just south of the Dawesville Cut. The reliability of wastewater infiltration as a continued source of groundwater depends on future demands for treated wastewater off site.

Leederville aquifer

The Leederville aquifer is a major regional confined aquifer with a thickness that ranges between 140 m and 180 m. In some subareas a sandy, green-clay marker bed divides the Leederville aquifer. Above this marker bed, there is some fresh to

marginal groundwater; however, saline water is also present due to the influence of the Peel Inlet and Harvey Estuary. Below the marker bed, groundwater is marginal to brackish and its salinity increases with depth.

The Leederville aquifer is mainly recharged in the east of the plan area, at the foot of the Darling Range, where it is in direct hydraulic contact and hydraulic connection with the superficial aquifer.

Cattamarra Coal Measures

The Cattamarra Coal Measures aquifer contains brackish to saline groundwater and occurs at depths greater than approximately 290 m. It is confined by the South Perth Shale and will not be dealt with in this plan.

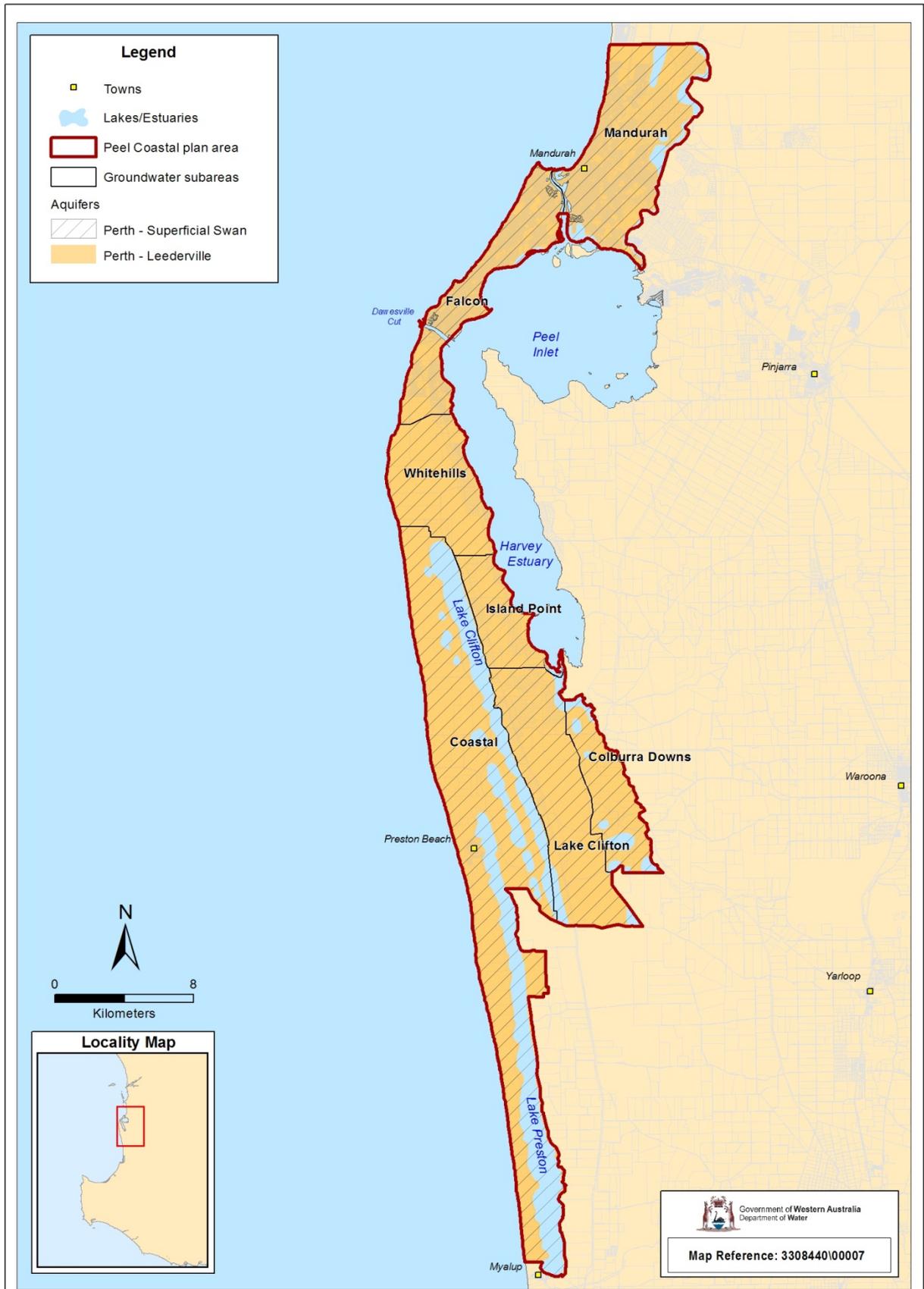


Figure 2 Water resources in the Peel Coastal groundwater allocation plan area

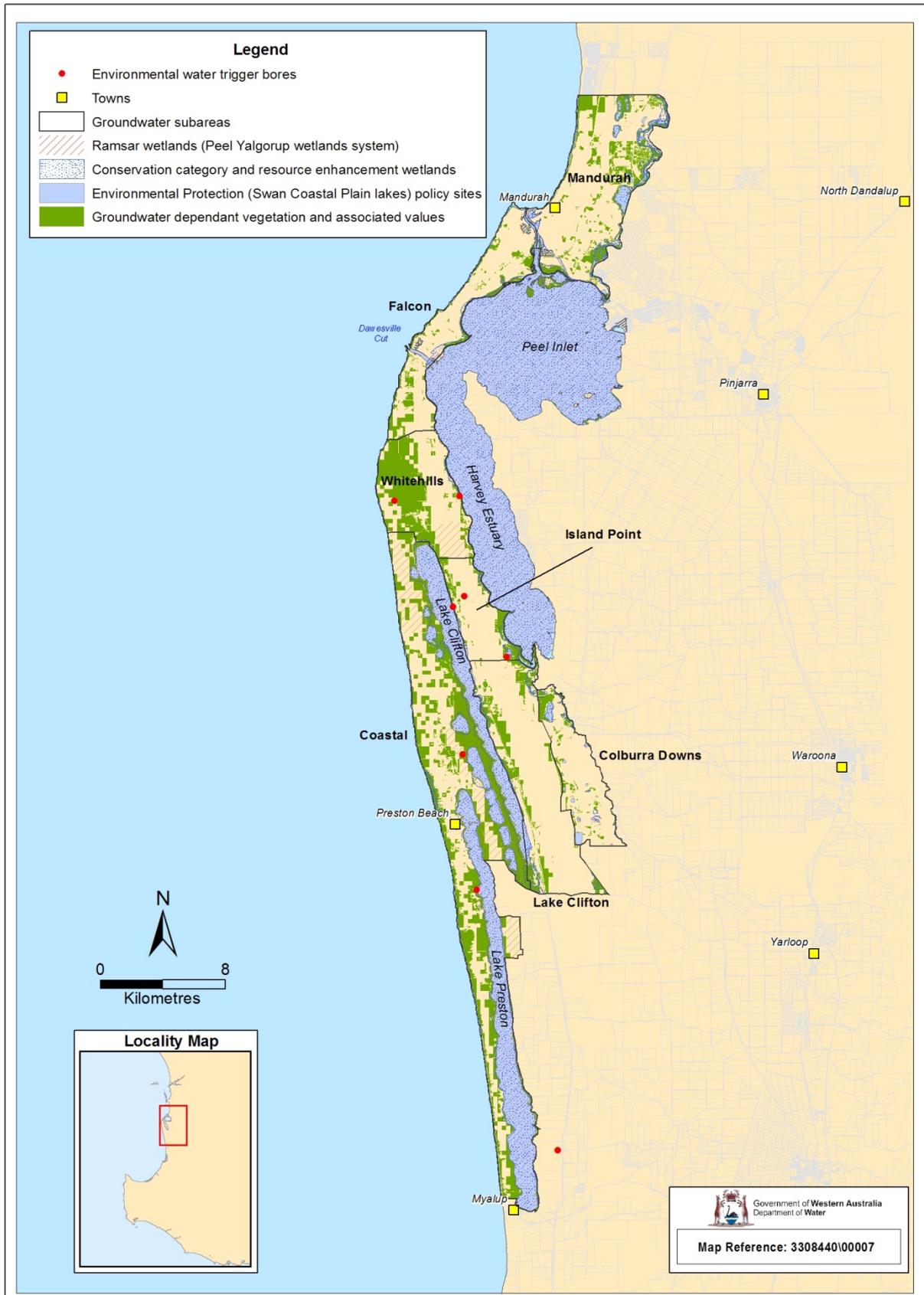


Figure 3 Groundwater-dependent ecosystems in the Peel Coastal groundwater allocation plan area

1.4 How we developed the plan

Work on the *Peel Coastal groundwater allocation plan* began after our review of the *South West Coastal groundwater area groundwater management review* (Water Authority 2009) showed it was insufficient to manage water use issues in a drying climate.

Using the best available hydrogeological, environmental and groundwater use information available we identified the need to:

- align our water planning with current and future land-use planning
- improve our accounting of all groundwater use
- account for the effect that the drying climate will continue to have on groundwater resources, including the effect on:
 - water availability
 - groundwater-dependent ecosystems
- adjust allocation limits
- update our local licensing policies.

In February 2012 we published the *South West Coastal information report* (DoW 2012b) together with a *Notice of intent* to plan. These publications identified the water resource management issues the plan would address and invited comments and feedback from stakeholders. We followed up during development of the plan by consulting directly with stakeholders (see section 1.5 below).

Through the plan development period we referred to the plan as the South West Coastal groundwater allocation plan. We have changed the title to *Peel Coastal groundwater allocation plan* in order to clearly identify the area it applies to.

Stakeholder comments on this plan will be used to modify the plan before its final release. The following supporting documents will be released with the final plan:

- methods report for the allocation limits
- environmental values and requirements report
- statement of response.

For more information about how we develop allocation plans see *Water allocation planning in Western Australia: a guide to our process* (DoW 2011a).

1.5 Stakeholder interests

We consulted the following stakeholders during the planning process:

- City of Mandurah
- Peel–Harvey Catchment Council
- Peel Development Commission
- Office of Environmental Protection Authority
- Water Corporation
- Department of Parks and Wildlife (then the Department of Environment and Conservation)
- local environmental groups and community groups
- holders of large water licences.

The broader community was also given an opportunity to provide input into the planning process as we advertised the *Notice of intent* in the *Mandurah Coastal Times* newspaper.

Generally, stakeholders were supportive of the need for this plan and raised the following issues, which are address throughout this plan:

- ensuring that water planning is aligned with existing and future land-use planning
- concern that groundwater abstraction would have an adverse effect on groundwater-dependent ecosystems (especially Ramsar-listed wetlands and lakes)
- the large number of domestic bores exempt from licensing and their potential effect on the groundwater resource
- the potential for salinity to affect people's ability to have access to groundwater.

1.6 Related plans and strategies

A number of planning strategies and planning related documents have supported development of this plan. The Western Australian Planning Commission's *Directions 2031 and beyond* (WAPC 2010) and the *Outer metropolitan Perth and Peel sub-regional strategy draft for public comment* (WAPC & DoP 2010) provide a clear strategic planning context for the plan area to 2031. It has allowed us to align our water planning, so that our understanding of water availability is clear and where water is limited, strategies are provided for meeting water use demand.

In developing our plan we also considered the recommendations of the Office of Environmental Protection Authority's *Strategic environmental advice on the Dawesville to Binningup area* (EPA 2010). They recommended that a comprehensive groundwater management program be put in place to manage risks to the Peel–Yalgorup wetland system from potential urban development between Mandurah and Bunbury.

Similarly, the Australian and Western Australian governments are currently undertaking the Strategic Assessment of the Perth–Peel Region under Section 146 of the *Environmental Protection and Biodiversity Conservation Act 1999*. The assessment will consider the effect of future development and land use on matters of national environmental significance listed under the EPBC Act, which include the Ramsar-listed Peel–Yalgorup wetland system. This plan forms a critical part of the department's management framework for specifically addressing the effects of abstraction.

1.7 Plan timeframe

The *Peel Coastal groundwater allocation plan* will remain in effect until it is replaced by a new water allocation plan, amended or revoked by the Minister for Water. We will consider the need to replace this plan in 2020 unless it is identified earlier through a plan evaluation process (Chapter 6).

2 What the plan will achieve

The Department of Water is responsible for managing water resources in Western Australia, consistent with the objects of the *Rights in Water and Irrigation Act 1914*, specifically:

- (a) To provide for the management of water resources, and in particular –
 - (i) for their sustainable use and development to meet the needs of current and future users
 - (ii) for the protection of their ecosystems and the environment in which water resources are situated, including by the regulation of activities detrimental to them
- (b) To promote the orderly, equitable and efficient use of water resources.

In administering the Act, the department makes provision for the sustainable use and development of water resources as well as the protection of ecosystems associated with water resources.

This plan ensures that current licensed entitlements are secure, and despite limited groundwater availability, makes sure consideration was given to future land use and its water requirements. All groundwater use, including that used for exempt stock and domestic purposes, was accounted for, and the risks to groundwater-dependent ecosystems and long-term viability of the resource from saline water movement were minimised.

The setting of allocation limits, the developing of the licensing policy, and our monitoring and evaluation program, were guided by the outcomes and resource objectives described below. These objectives will continue to inform our water resource management as we implement the plan.

2.1 Outcomes

Outcomes are what we aim to achieve by managing the water resource in the way described in this plan. The outcomes for this plan are to:

- support the water needs of current and future land uses in the Peel Region
- protect valuable ecosystems dependent on groundwater, including those of the Peel–Yalgorup wetland system, from any adverse effects of groundwater abstraction
- support water trading and the use of alternative water sources.

We will assess and report on these outcomes by conducting regular plan evaluations.

2.2 Resource objectives

To meet these outcomes, our management is directed towards meeting specific water resource objectives. Water resource objectives must be measurable and must relate to maintaining, increasing, improving, restoring, reducing or decreasing groundwater levels or water quality.

The water resource objectives of this plan are to:

1. prevent significant inland movement of the seawater interface due to abstraction
2. prevent saltwater upconing affecting other users
3. maintain groundwater levels in the Superficial aquifer that minimise risk to groundwater-dependent ecosystems
4. maintain fresh groundwater discharge into Lake Clifton, Lake Preston and Martin's Tank to minimise risk to dependent ecological values.

We developed measurable performance indicators for the resource objectives. They are described in Chapter 5.

The drying climate is having a noticeable effect on water resources and their dependent values in the plan area. For example, water level declines in high use areas are similar to those in areas of low use. This suggests that interventions by the department, with the aim of meeting the resource objectives, may be limited by the effects of climate. The response to the drying climate is further described in Section 3.2.

2.3 Strategies

To meet the water resource objectives of the plan our strategies are to:

- licence the 14 groundwater resources in accordance with the allocation limits (Chapter 3)
- encourage water efficiency through trading and alternative water supply options such as the reuse of treated wastewater (Chapter 4)
- apply the local licensing policies outlined in this plan (Chapter 4)
- investigate non-compliance with licence conditions and take appropriate enforcement action (Chapter 4)
- monitor groundwater resources using the department's monitoring network (Chapter 5)
- regularly evaluate whether the plan's outcomes and resource objectives are being met and adjust our management accordingly (chapters 5 and 6).

2.4 Measuring the success of the plan

We will evaluate the plan to see if the outcomes and resource objectives are being met. We will assess:

- the condition of water resources and groundwater-dependent ecosystems using monitoring information
- licensing and water use data
- the effect of the drying climate and reduced rainfall.

We will regularly publish how successful we have been in meeting the outcomes and resource objectives in evaluation statements. Chapters 5 and 6 provide more information about how we will monitor and evaluate the performance of the plan.

3 Water allocation limits

This chapter sets out:

- the allocation limits for consumptive use in each groundwater resource
- the water to be left in aquifers to maintain water quality, aquifer productivity and groundwater-dependent ecosystems.

3.1 Allocation limits

Allocation limits are the annual volume of water set aside from a water resource for consumptive use such as household, urban, irrigation, stock, mining or industrial use. Allocation limits are the main tool we use to ensure that the take of water is sustainable and to ensure security of supply at the resource scale. The allocation limit does not include the water that is left in an aquifer.

The allocation limits for the 14 resources in the plan area are shown in Table 1.

The department allows the take of groundwater up to the allocation limit for each resource in accordance with the licensing and allocation approach described in Chapter 4. Where a resource is fully allocated we are likely to refuse applications for new entitlements (including increases to existing entitlements) and encourage trading, improving water use efficiency or using alternative water sources to meet water requirements.

Please phone our Peel office on 08 9550 4222 for up-to-date water availability information or to discuss opportunities for obtaining water by trading or from alternative sources. Water availability can also be viewed on our online water register at www.water.wa.gov.au/ags/WaterRegister.

Components of the allocation limit

For administrative and accounting purposes, the allocation limit is divided into the following components:

- water that is available for licensing
 - general licensing
 - public water supply licensing
- water that is exempt from licensing (unlicensed)
- water that is reserved for public water supply.

General licensing

The general licensing component of the allocation limit is the total volume of water which can be issued as annual licence entitlements for all uses other than public water supply.

The 11.2 GL/yr in this component across all aquifers is fully allocated.

Public water supply

The public water supply component of the allocation limit is the volume of water that is currently licensed to water service providers.

Groundwater in the plan area is not generally accessed for public water supply, only 20 ML/yr being licensed in the Coastal subarea. This supplies the Preston Beach townsite.

Reserved water

No water is reserved for future public supply. Demand for potable water in Mandurah and surrounding areas is met through the Water Corporation's Integrated Water Supply Scheme and sources from outside the plan area.

Unlicensed use - water that is exempt from licensing

The unlicensed use component is the volume of water that is set aside for uses that are exempt from licensing under the *Rights in Water and Irrigation Act 1914*. This water is for household garden, minor stock, domestic, and emergency fire-fighting purposes only.

Exempt water use was not included in previous allocation limits in the plan area. The methodology used to estimate the exempt volume is documented in the *Peel Coastal groundwater allocation plan: methods report* (DoW in prep.).

The total exempt use is 5.42 GL/yr, which is approximately 48 per cent of the total annual abstraction in the plan area.

The City of Mandurah has indicated that the density of stock and domestic bores in the Island Point subarea may increase in the future due to the rezoning of rural blocks. We have accounted for this potential increase in water use in the exempt component of the allocation limit.

Table 1 Allocation limits for the water resources of the Peel Coastal plan area

Subarea	Resource	Allocation limit kL/year	Allocation limit components kL/year			
			Licensed		Unlicensed	Reserved water
			General	Public water supply	Exempt	Public water supply reserve
Coastal	Superficial	192 550	59 550	0	133 000	0
Colburra Downs	Superficial	70 000	0	0	70 000	0
Falcon	Superficial	2 321 923	654 923	0	1 667 000	0
Island Point	Superficial	568 375	239 775	0	328 600	0
Lake Clifton	Superficial	661 440	306 440	0	355 000	0
Mandurah	Superficial	4 653 729	2 025 729	0	2 628 000	0
Whitehills	Superficial	335 909	92 909	0	243 000	0
Coastal	Leederville	20 000	0	20 000	0	0
Colburra Downs	Leederville	0	0	0	0	0
Falcon	Leederville	1 606 420	1 606 420	0	0	0
Island Point	Leederville	0	0	0	0	0
Lake Clifton	Leederville	0	0	0	0	0
Mandurah	Leederville	802 100	802 100	0	0	0
Whitehills	Leederville	0	0	0	0	0
Total		11 232 446	5 787 846	20 000	5 424 600	0

3.2 How the allocation limits were set

Allocation limits in this plan are based on combining the best available hydrogeological, environmental and abstraction information with an assessment of the effect that current levels of use are having on the resources.

We used a risk-based approach to set allocation limits by determining whether more or less water could be allocated while still achieving the plan's outcomes and objectives. The risk-based approach to setting allocation limits is an appropriate method to use for areas with broad-scale monitoring and relatively low use of groundwater.

After completing our investigations, we set the allocation limit at the level of current use for all resources. Allowing more water to be abstracted would greatly increase the risk of licensees not being able to access their entitlements in the future because of likely declines in water quality. It would also accelerate impacts on valuable ecosystems dependent on groundwater, including the Ramsar-listed Peel–Yalgorup wetland system.

We considered the option of reducing allocations below current use in order to reduce risks to water levels, water quality and groundwater-dependent ecosystems. However, this was not considered a reasonable approach given the reliance on local groundwater in the area and because we are able to regulate and manage the effects of individual abstractions.

Setting allocation limits at the current usage levels allows our resource objectives and outcomes to be met, while encouraging water efficiency and the development of alternative water sources. It means that no additional groundwater is available in the plan area. New urban developments will need to meet their water demands through trading or from alternative supplies.

The risk assessment for each subarea is summarised in the *Peel Coastal groundwater allocation plan: methods report* (DoW in prep.).

How we considered the drying climate

We have observed an eight per cent reduction in rainfall in Mandurah over the past ten years and we are expecting a further eight per cent decline by 2020 (CSIRO 2009).

These declines mean that volumes of fresh water recharging the groundwater system will reduce in the future. Regardless of abstraction, this means that water levels and water quality are also likely to further decline. Water quality declines are more of a risk in the future because water levels in coastal areas may be held relatively stable by the Indian Ocean and the Peel–Harvey Estuary.

Groundwater-dependent ecosystems are also undergoing natural changes as a result of declining rainfall and recharge, changes in water quality, and other climate change effects such as rising sea levels. The text box below provides an example.

We considered the effect that changes to climate are already having, and are likely to continue to have, on water resources in the plan area when assessing risk and setting allocation limits. It will be important to continue to monitor and track the effects of changes in climate over time to inform whether we need to revise our management.

3.3 Water that is left in the aquifers

Leaving water in the aquifer (water that is not abstracted) supports the plan's outcomes and objectives.

Instead of quantifying a volume of water to remain in the aquifers, a set of reference groundwater levels were used to assess the risk to groundwater-dependent ecosystems from varying quantities of water being abstracted. Reference groundwater levels are minimum groundwater levels considered necessary to achieve the ecological objectives for both terrestrial vegetation and wetland sites. They also protect the resource from localised declines in water quality caused by dewatering of acid sulfate soils.

Analysis of historical groundwater level trends shows that reference levels have been maintained under current abstraction, except in years of low (20th percentile) rainfall. Based on this, with current levels of use, sufficient water will be left in the aquifers to manage risk to groundwater-dependent ecosystems. This approach also minimises the risk of groundwater quality deteriorating.

Further reductions in rainfall and recharge are predicted for the plan area and this is likely to increase the risks, regardless of abstraction. The department has put a program in place to monitor these risks and identify when additional management may be needed (Chapter 5).

For detailed information on how we set reference levels refer to the *Peel Coastal groundwater allocation plan: methods report* (DoW in prep.) and the *Peel Coastal plan area: Groundwater-dependent ecosystems and their water use* (DoW in prep.).

The effects of changing climate on Lake Clifton

Lake Clifton makes up part of the Peel–Yalgorup wetland system and is located within the Yalgorup National Park. It is understood to be a groundwater-fed lake and is home to rare thrombolite communities. The thrombolites at Lake Clifton require fresh groundwater discharge to survive. By managing in accordance with the allocation limits set in this plan, we will minimise the risk groundwater abstraction has on freshwater discharge to the lake. Lake Clifton is already experiencing increases in salinity.

Modelling conducted by CSIRO suggests that the main cause of the salinity increases is reduced rainfall with Groundwater abstraction having a comparatively small impact (Barr 2003).



Image: Lake Clifton thrombolites

The relationship between rainfall and salinity is shown in Figure 4. It supports the conclusion that declines in rainfall are a strong driver for salinity change.

Based on predicted long-term rainfall decline, salinity levels in Lake Clifton will continue to increase without significant intervention.

The *Ecological character description for the Peel–Yalgorup Ramsar site* (Hale & Butcher 2007) describes the ‘limits of acceptable change’ for Ramsar sites in the Peel region.

Although continuing to identify the system as meeting Ramsar criteria, the report recognises the impact climate change has had on its values, independent of abstraction and land use.

For further reading on the Peel–Yalgorup Ramsar sites, please visit: <www.der.wa.gov.au>.

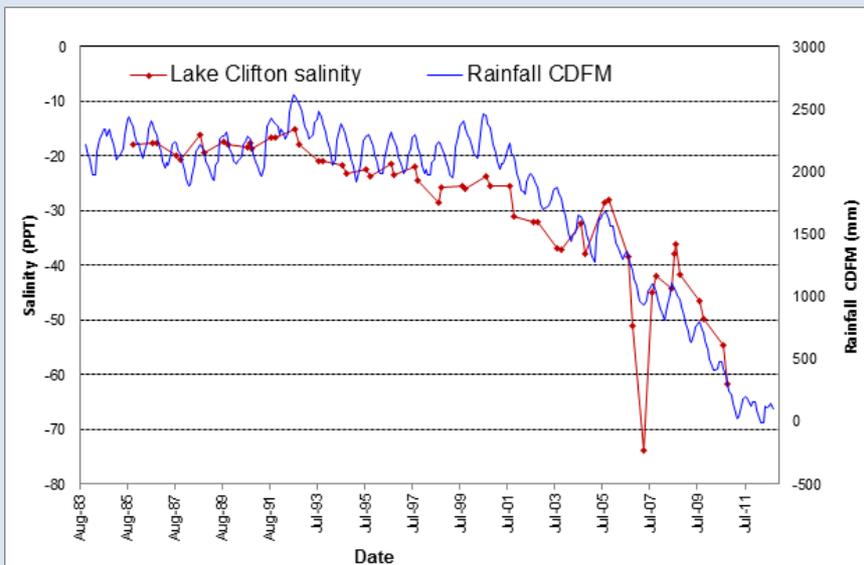


Figure 4 Effect of rainfall on Lake Clifton salinity levels (CDFM – cumulative derivation from the mean rainfall)

4 Water licensing

Water licences are issued under the *Rights in Water and Irrigation Act 1914* to manage and regulate the individual take of surface water and groundwater. The department has policies for assessing licence applications and applying licence conditions. Allocation plans specify the specific policies that apply to a particular plan area.

This chapter describes the policies for managing water allocation and licensing in the Peel Coastal plan area.

4.1 Legislative requirements

Rights in Water and Irrigation Act 1914

The *Rights in Water and Irrigation Act 1914* establishes the legislative framework for managing and allocating water in Western Australia. All of the groundwater resources in the plan area are within the South West Coastal groundwater area, which is proclaimed under the Act (Figure 1).

Water licences

Water users in the *Peel Coastal groundwater allocation plan* area require a water licence under section 5C of the Act to lawfully take groundwater, unless exempt (see section below). A licence issued under section 26D is also required to construct or alter wells. This includes installing pumps or constructing dams, under clauses 11, 17 and 21 of the Act.

The department considers the allocation plan, as well as clause 7(2) of Schedule 1 of the Act, when assessing water licence applications or the reissue of licences. In granting a licence, or reissuing licences, the department may apply terms, conditions and restrictions to licences under clause 15 of Schedule 1 of the Act. In the Peel Coastal plan area this may include the provision of an operating strategy.

Our requirements for altering any licence condition are specified under clause 24(1) of Schedule 1 of the Act. The rights of licensees are covered under clause 26. Any decision made on a licence application can be reviewed through the State Administrative Tribunal.

Exemptions - stock and domestic, dewatering and fire-fighting water use

Under the Rights in Water and Irrigation Act Exemption and Repeal (Section 26C) Order 2011, some uses of water do not require licensing in proclaimed areas. This applies to water taken from non-artesian wells in the watertable aquifer (Superficial aquifer) for:

- fire-fighting purposes
- temporary dewatering
- watering of stock, other than those raised under intensive conditions
- domestic garden and lawn irrigation (not exceeding 0.2 ha)
- other ordinary domestic uses.

The department does not consider the plan area suitable for the drilling of new bores for domestic purposes as:

- water quality may not be suitable in some areas
- there is risk to the groundwater resource and potential for adverse effects on other groundwater users from further unregulated abstraction.

Please refer to the *Perth Groundwater Atlas* on our website to check garden bore suitability areas: www.water.wa.gov.au/idelve/gwa/

Exemptions - non-artesian monitoring wells

Under the Rights in Water and Irrigation Exemption (section 26C) Order 2012 a licence is not required to construct, alter or take water from non-artesian wells that are used solely to monitor water levels and/or water quality.

Compliance and enforcement

Under the *Rights in Water and Irrigation Act 1914*, water users in proclaimed areas must be licensed to take surface water or groundwater, unless otherwise exempted.

The department carries out regular compliance monitoring surveys across the state to ensure that the take and use of water is authorised, and is in accordance with licence terms, conditions and restrictions, such as annual water entitlement. These monitoring surveys include on-ground licence compliance inspections and water meter audits, as well as off-site activities such as remote water use surveying utilising aerial imagery, and the review of licensee submissions such as water use cards and annual reports. Where non-compliance is detected, an investigation is conducted and compliance and enforcement action taken where appropriate.

Water resources located within the Peel Coastal plan area will be categorised according to risk for compliance monitoring purposes. Water resources that are categorised as high risk will be subjected to a greater level of on-ground compliance monitoring activity. The department will also review monitoring and metering data for the Peel Coastal plan area and assess any local effects, to ensure that the licence conditions applied within the plan area are appropriate.

Public drinking water source protection areas

The Peel Coastal plan area has one proclaimed public drinking water source protection area, the *Preston Beach public drinking water source protection area*. This is proclaimed under the *Country Areas Water Supply Act 1947*.

For information about protection of this water source refer to the *Preston Beach Water Reserve Drinking Water Source Protection Plan* (DoW 2006) located on the department's website.

Other legislation

In administering the *Rights in Water and Irrigation Act 1914*, we abide by other state and federal legislation.

Environmental Protection Act 1986

Significant development projects may require an environmental impact assessment under Part IV of the *Environmental Protection Act 1986*. This assessment is the responsibility of the Office of the Environmental Protection Authority (OEPA). The department may refer a licence application to the OEPA if there are potentially significant impacts.

4.2 Water licensing approach

A water licence provides legal and secure access to water. Water allocation plans help us manage licences and abstraction at a collective scale by guiding licence decisions and providing an adaptive management framework for the plan area.

This section outlines our licensing approach across the plan area. The approach is generally consistent with that applied across the state; however, specific local issues such as the lack of water availability are addressed in this section.

Please note that it is important to consult early with the department if you are seeking additional water. The department's Peel office manages water licensing in the Peel Coastal plan area. Please contact them on 08 9550 4222 to discuss your water needs.

Accessing water in fully-allocated resources

Groundwater resources in the plan area are fully allocated. It is unlikely that the department will grant any new licences in fully allocated resources. Where water becomes available in a subarea through relinquishment of entitlements or through recouping of entitlements, we will reallocate that water using the department's standard licensing approach.

Up-to-date groundwater availability in the plan area is available from our Peel office or from our water register at: www.water.wa.gov.au/ags/WaterRegister.

Water use efficiency

The Department of Water will seek to ensure that water licensees use their water entitlement in an efficient manner and make the most of water available under the allocation limit. To that effect, the department may require certain licensees to develop and implement water conservation and efficiency plans as part of the operating strategy of a licence.

The department's policy on water conservation and efficiency plans can be found on our website.

Water trading and transfer

People wishing to obtain new or increased groundwater entitlements should consider transactions with existing licensees. This could involve transferring or trading existing water entitlements, or reaching an agreement to use an existing water entitlement.

Portions of current groundwater entitlements may become available for trading or transfer if those entitlements are supplemented with treated wastewater, as described below. We allow for both permanent and temporary transactions of water entitlements.

The department's trading policy can be found on our website. Please see below for more information on how we assess trades and transfers.

Alternative water source options

While groundwater resources remain fully allocated, the department will encourage the use of alternative water sources to supply water needs. Alternative water sources are already becoming an important part of meeting the growing water demands in the plan area.

Alternative water sources may include, but are not limited to, the use of treated wastewater, sub-surface drainage water and managed aquifer recharge (MAR). Three wastewater treatment sites at Gordon Road, Caddudup and Halls Head are being used to irrigate public open space.

Of these alternative water source options only managed aquifer recharge requires licensing. The department developed *Operational Policy 1.01: Managed aquifer recharge in Western Australia* (DoW 2011b) to provide policy guidance on MAR proposals. All future MAR proposals will be licensed in accordance with this policy.

The City of Mandurah, in partnership with the Water Corporation, proposes to increase the use of treated wastewater to meet public open space needs in the Mandurah and Falcon subareas. With Mandurah being one of the fastest growing cities in Western Australia, the need to dispose of excess wastewater has provided the opportunity to reuse fit-for-purpose water for community benefit.

The department will work with existing and potential water users to explore and facilitate new and alternative water source options.

Water in the Leederville aquifer in the Falcon subarea

The Leederville aquifer in the Falcon subarea is a non-renewable resource. As freshwater is abstracted from the aquifer it is recharged by saline water from the overlying Peel–Harvey estuary. In order to minimise the risk of supply to existing users, the department will not allocate any more water from this aquifer. Additionally, where licensed allocations are relinquished or cancelled, water will not be re-allocated for new entitlements.

Water for future urban development and public open space

An estimated 268 ha of new urban areas were identified in the plan area, mostly in the Mandurah subarea. We have projected water needs for public open space in these areas, and although local groundwater is typically the lowest direct cost water source for public open space, the department expects these water requirements to be met by alternative water sources, trading or transferring from existing users.

Assessing the effects of trades, transfers and new applications

Although there is currently no new water available for licensing in the plan area, from time to time some volumes may become available through the relinquishment or recouping of entitlements. Water is also available through trading and transfers.

We will assess any application for new water or trades to ensure that any possible adverse effects on groundwater-dependent ecosystems and water quality can be managed.

The local licensing policies given in Table 2 will be considered as part of the Clause 7 (2) assessment. The department may refuse a licence application or require changes to a proposal if local effects are deemed to be unacceptable, even if water is available within the allocation limit.

4.3 Local licensing policies

The local licensing policies in Table 2 provide detailed guidance for licensing in the Peel Coastal plan area. Clause 7(2) of Schedule 1 of the Act is used when assessing water licence applications. The local licensing policies in Table 2 define specific considerations for licence assessments and management in this plan area.

The policies apply either because the local issues are not addressed in state-wide policy, or because an alternative, more specific approach is required for managing a local issue. Where local policy in the allocation plan differs from a state-wide policy, the policy in this allocation plan is applied.

Table 2 Local licensing policies specific to the Peel Coastal plan area

Policy group	Policy detail
Licence assessment	
1.1 Assessing the impacts of a proposal on groundwater-dependent environmental values and water quality	<p>1.1.1 If water becomes available new 5C licence applicants may need to assess and demonstrate how they will prevent, or manage, the impacts of their proposal on significant wetlands. Significant wetlands include:</p> <ul style="list-style-type: none"> • Ramsar-listed sites • Environmental Protection (Swan Coastal Plain Lakes) Policy sites, Office of Environmental Protection Authority • Conservation category wetland sites, Department of Parks and Wildlife. <p>Approvals from other agencies may also be required.</p> <hr/> <p>1.1.2 Proponents must assess and demonstrate how they will prevent, or manage, the effect of their proposal on acid sulfate soils, local saltwater upconing, and the landward movement of the seawater interface when applying for a 5C licence.</p>

Policy group	Policy detail
Managing impacts	
2.1 Managing impacts on groundwater-dependent environmental values	<p>2.1.1 Existing production bores within 200 m of significant environmental values will be assessed upon renewal using our most up-to-date monitoring data, and licensees may be required to relocate them.</p> <hr/> <p>2.1.2 New or replacement production bores are unlikely to be permitted within 200 m of:</p> <ul style="list-style-type: none"> • Ramsar-listed sites • Environmental Protection (Swan Coastal Plain Lakes) Policy sites, Office of Environmental Protection Authority • Conservation category wetland sites, Department of Parks and Wildlife.
2.2 Managing impacts on water quality	<p>2.2.1 New or replacement production bores should be spaced as far as practical away from existing production bores (including bores on a proponent's or adjacent properties) to minimise risk of salinity increases and to bore productivity.</p> <hr/> <p>2.2.2 If there are significant water quality risks to existing users or the water resource the department may apply licence conditions that specify:</p> <ul style="list-style-type: none"> • a rate of abstraction • installation of monitoring bores • water quality monitoring and reporting.
2.3 Licences requiring operating strategies	<p>2.3.1 Renewed groundwater licences or any new licences may require an operating strategy. Examples of water uses requiring an operating strategy in this plan area are:</p> <ul style="list-style-type: none"> • irrigating parks, gardens, public open space and maintenance of artificial wetlands or lakes • dewatering that is likely to affect an existing user, expose acid sulfate soils or affect the environment.
2.4 Amending licences if impacts on groundwater-dependent environmental values or water quality are observed	<p>2.4.1 Where the department observes impacts on water quality, or groundwater-dependent environmental values, through assessment of our monitoring data, we may:</p> <ul style="list-style-type: none"> • restrict abstraction (e.g. timing, rate of abstraction) • require relocation of production bores • require the licensee to install new monitoring bores • amend or require an operating strategy.

Policy group	Policy detail
Metering	
3.1 Requirements for metering	3.1.1 The department may require a meter to be installed in addition to <i>Strategic policy 5.03 – Metering the taking of water</i> (DoW 2009c) where the following uses may pose further risks specific to local area conditions: <ul style="list-style-type: none"> • where a community bore is supplying water for irrigation of domestic gardens • a bore for irrigation of public open space, parks and gardens or maintenance of artificial lakes • where groundwater is supplying school grounds • a bore is abstracting from a confined aquifer in the Falcon subarea.

State-wide licensing policies

The department has state-wide policies that guide our licensing processes and decisions. They ensure that licences are assessed and issued consistently and equitably across the state.

These policies can be viewed on our website at www.water.wa.gov.au or by contacting our Peel office on 08 9550 4222.

4.4 Factors that may affect future licensing

The main factors that may affect how we licence the taking of water in the plan area, in the future include, but are not limited to:

- changes to current land use
- new information on hydrogeology and ecology from departmental and private sources
- the extent to which the climate continues to dry and other climate change related factors, such as sea level rise.

In the future alternative water sources may replace groundwater use in the Mandurah and Falcon subareas. This will depend on how the groundwater resources, in particular water quality, responds to the drying climate and changes in use.

5 Monitoring program

This chapter sets out how the Department of Water will monitor water resources in the plan area. Monitoring allows us to understand how the water resources are performing over time and in particular how they are responding to abstraction and changes in climate. Using this information we can evaluate if the plan's objectives are being met and whether we need to adapt how we regulate and manage abstraction.

The department has a network of monitoring bores (29 sites) in the plan area that are recording groundwater levels from as early as 1975. However, compared to areas of higher use across the state the network is relatively limited. The majority of monitoring bores are in the Superficial aquifer (not the confined aquifers) and some subareas have minimal to no monitoring data available (refer to Figure 5).

The department continually maintains its monitoring network and upgrades it where more information is necessary, to help manage the cumulative risks from abstraction. In 2012, as part of the Murray–Peel groundwater investigation project, two additional monitoring bores were installed in the confined Leederville aquifer in the Island Point and Lake Clifton subareas.

In the future we will continue to improve groundwater level and water quality information gathered from the Peel Coastal plan area. The focus will be on improving coverage of all subareas and resources, understanding the effects of both climate and abstraction, and ensuring that the seawater interface does not move landward rapidly.

We also obtain water resource information from licensees and other water users.

A full list of departmental monitoring sites currently used in the Peel Coastal plan area is provided in Appendix A.



Figure 5 Groundwater monitoring sites in Peel Coastal plan area

5.1 Evaluating resource objectives

We will use the monitoring and performance indicators shown in Table 3 to assess whether the plan's objectives are being met. Each objective and performance indicator will be assessed annually.

Table 3 Monitoring in the plan area

Resource objective	Monitoring sites	Performance indicator
1 Prevent significant inland movement of the sea or estuary water interface due to abstraction	All sites	Monitoring bore hydrographs show water level or pressure head trend that is consistent with rainfall trends.
2 Prevent saltwater upconing affecting other users	Private bores, where information from licensees is received	Private monitoring data or other information indicates no change in water quality.
3 Maintain groundwater levels in the Superficial aquifer that minimise risk to groundwater-dependent ecosystems	Groundwater-dependent vegetation monitoring sites: <ul style="list-style-type: none"> • Lake Thompson T630 • Lake Clifton A1 • Lake Clifton A5 • Harvey Shallow HS62C • YSH4 • Lake Clifton B2 • Lake Clifton C2. 	Groundwater levels at groundwater-dependent ecosystem target sites remain above reference groundwater levels (See Appendix B for levels).
4 Maintain sufficient groundwater discharge into Lake Clifton, Lake Preston and Martin's Tank	Groundwater discharge monitoring sites: <ul style="list-style-type: none"> • Yalgorup Lakes NLP Y2-4B • YSH4 • Lake Clifton B2 • Lake Clifton C2. 	Groundwater levels at discharge monitoring sites remain above reference groundwater levels (See Appendix B for levels).

Assessing the impact of climate on resource objectives

The monitoring information and performance indicators listed in Table 3 will be assessed as part of regular plan evaluations. When reviewing this information a critical step will be identifying if the hydrographs of groundwater levels follow climate trends. We will use cumulative deviation from the mean (CDFM) methodology to determine this, where possible.

If groundwater levels follow a pattern similar to the drying climate, it is likely that rainfall is having the greatest impact on water levels. Over time, performance

indicators may not be met as a result of the long-term drying trend. If this happens the department will consider the appropriate management response, in consultation with other relevant agencies and stakeholders.

If groundwater levels are showing behaviour that is significantly different to that expected from the observed climate trends, then further investigation will determine whether other factors, such as abstraction or land use, are the cause. This investigation may include increased compliance activity, and where necessary, changes to abstraction may be required.

The process for assessing performance indicators is summarised in Appendix C.

5.2 Ecological monitoring

Groundwater reference levels are set to act as indicators that groundwater-dependent ecosystems may be under threat. These levels were based on regional environmental information. Further ecological monitoring will be undertaken if:

- reference levels are reached
- declines in water levels or quality cannot be attributed to decreases in rainfall
- concern regarding health of groundwater-dependent ecosystems is raised by other agencies or the public.

The majority of significant groundwater-dependent ecosystems in this plan area are located in a national park or protected lands. We will work with the Department of Parks and Wildlife to undertake further ecological monitoring when it is required.

We expect that groundwater-dependent ecosystems will undergo natural changes over time as a result of declining rainfall.

6 Implementing and evaluating the plan

The Department of Water will implement this plan by following the strategies listed in Section 2.3. Once the plan is in place, we will regularly evaluate whether the plan's objectives are being met by conducting periodic evaluations.

This chapter sets out some additional actions necessary to implement and evaluate this plan.

6.1 Implementing the plan

To ensure that we are able to effectively manage groundwater abstraction in accordance with this plan, we identified a number of actions that we will need to carry out. These are listed in Table 4.

Table 4 Actions to implement the Peel Coastal groundwater allocation plan

	Action	Timeline
Alternative water sources		
1	Work with Water Corporation, local government and other regulatory agencies, to facilitate the use of alternative water sources such as wastewater recycling and managed aquifer recharge (MAR).	Ongoing.
2	Identify and map MAR infiltration zones and licence groundwater users accessing MAR inside these zones. Account for the volume licensed for MAR in the allocation limits.	Within 2 years of the final plan release.
Compliance		
3	Undertake compliance inspections on high risk resources in the plan area.	Annually or as identified in the State compliance plan.
Monitoring		
4	Establish groundwater reference levels where a level is not set.	Within three years of plan release.
5	Review and implement Peel Coastal water quality program.	Within three years of plan release.
6	Review Peel-Murray drilling program results.	Report due 2015.
Plan evaluation		
7	Assess performance indicators and resource objectives.	Annually.
8	Publish an evaluation statement on the plan and its implementation.	At least every three years.

One of the ways in which the department improves its management of water resources is by conducting reviews of allocation limits and by making changes to licensing policies. In some cases where there are significant changes to water use or the resource, it may become necessary to replace this allocation plan.

To ensure that we are continuing to manage groundwater resources appropriately in the Peel Coastal plan area, we will undertake the actions in Table 5.

Table 5 Actions to support ongoing water resource management

Action	Timeline
8 Review exempt estimates and amend where appropriate to guide future resource management.	When there is significant changes to land use in the plan area.
9 Review changes in current and future land use.	At least every three years.
10 Refine understanding of water requirements of groundwater-dependent ecosystems.	When reference levels are reached.
11 Review climate trends and projections.	At least every three years.
12 Work with the Water Corporation to better understand the effects of treated wastewater in aquifer recharge.	Ongoing.

6.2 Evaluating the plan

We will regularly evaluate whether the desired outcomes of this plan are being achieved and if the water resources covered by the plan are meeting the resource objectives. We will publish the evaluation results in an evaluation statement at least every three years.

The evaluation statement will include:

- the allocation status for each resource, including any changes in licensed entitlements since the last year
- the status of plan actions due in the evaluation period
- the department's performance against the plan outcomes and resource objectives
- how we will adapt our water resource management (if necessary).

The statement will be available on the department's website or by contacting the department's Peel office.

Appendices

Appendix A.— List of monitoring sites in the Peel Coastal plan area

Aquifer	Subarea	Bore name	ID number	Period of record	Readings per year	Easting	Northing	
Superficial	Mandurah	Lake Thomson T630	61410026	1975–present	2	384310	6403811	
Superficial		Lake Thomson T580A	61410723	2009–present	2	386077	6407238	
Yarragadee North		Artesian Monitoring AM67	61415004	1980–present	12	382835	6402182	
Leederville		Artesian Monitoring (AM 67A)	61415005	1983–present	12	382834	6402157	
Leederville		Mandurah Line (1/86)	61419333	1989–present	6	382943	6398560	
Superficial	Whitehills	Lake Clifton A1	61319123	1979–present	6	370553	6382267	
Superficial		Lake Clifton A2	61319124	1979–present	6	371439	6382324	
Superficial		Lake Clifton A3B	61319126	1978–present	6	372507	6382292	
Superficial		Lake Clifton A4	61319127	1979–present	6	373883	6382587	
Superficial		Lake Clifton A5	61319128	1979–present	6	374689	6382599	
Lower Leederville		MPL1A	TBD	2012–current	TBD	372396	6381558	
Upper Leederville		MPL1B	TBD	2012– current	TBD	372396	6381558	
Superficial		Island Point	Yalgorup Lakes NLP Y2-4A	61319507	1995–present	6	374983	6376152
Superficial			Yalgorup Lakes NLP Y2-4B	61319508	1995–present	6	374983	6376152
Superficial			Yalgorup Lakes NLP Y2-5A	61319509	1995–present	6	376065	6376171
Superficial	Harvey Shallow HS62B		61330102	1982–present	6	377710	6372224	

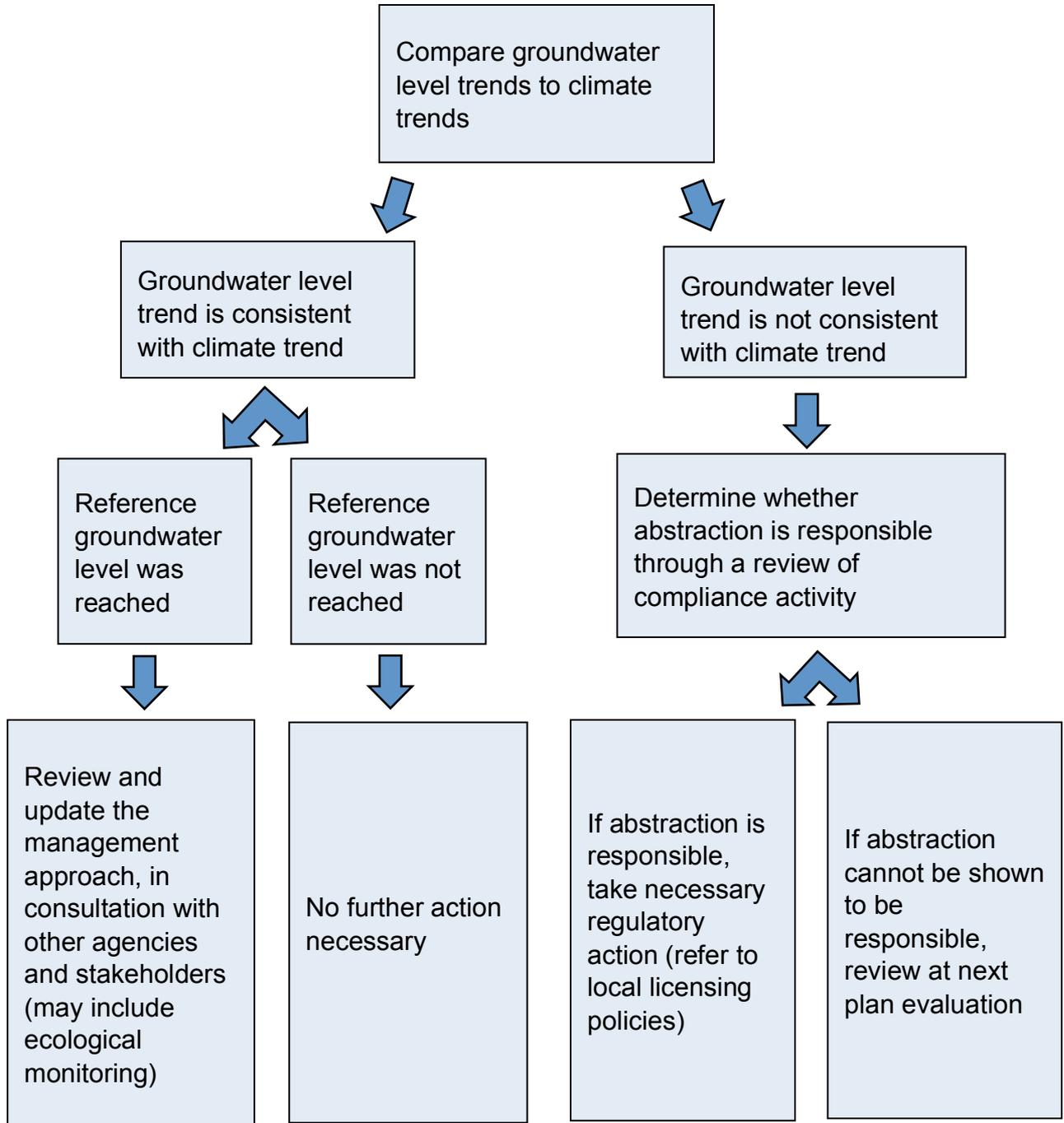
Aquifer	Subarea	Bore name	ID number	Period of record	Readings per year	Easting	Northing
Superficial		Harvey Shallow HS62C	61330103	1982–present	6	377710	6372224
Superficial		YSH4	61319530	1995–1998	6	TBD	TBD
Leederville		Yalgorup Lakes Y2-5B	61319510	1995–present	6	376063	6376170
Superficial		Lake Clifton B5	61319133	1979–present	6	378506	6366690
Superficial	Lake Clifton	Lake Clifton E2A	6139152	1979–present	6		
Lower Leederville		MPL6A	TBD	2012–current	TBD	377160	6368539
Upper Leederville		MPL6B	TBD	2012– current	TBD	377160	6368539
Superficial	Coastal	Lake Clifton B2	61319130	1979–present	6	374889	6365948
Superficial		Lake Clifton C2	61319137	1979–2008	1	TBD	TBD
Superficial		Lake Clifton B6	61319134	1979–present	6	380533	6366760
Superficial	Colburra	Harvey Shallow HS63A	61330104	1982–present	6	381783	6362356
Superficial	Downs	Harvey Shallow HS63B	61330105	1982–present	6	381783	6362356
Superficial		Harvey Shallow HS63C	61330107	1982–present	6	381783	6362356

Appendix B – Location specific details and reference groundwater levels for environmental assessment sites

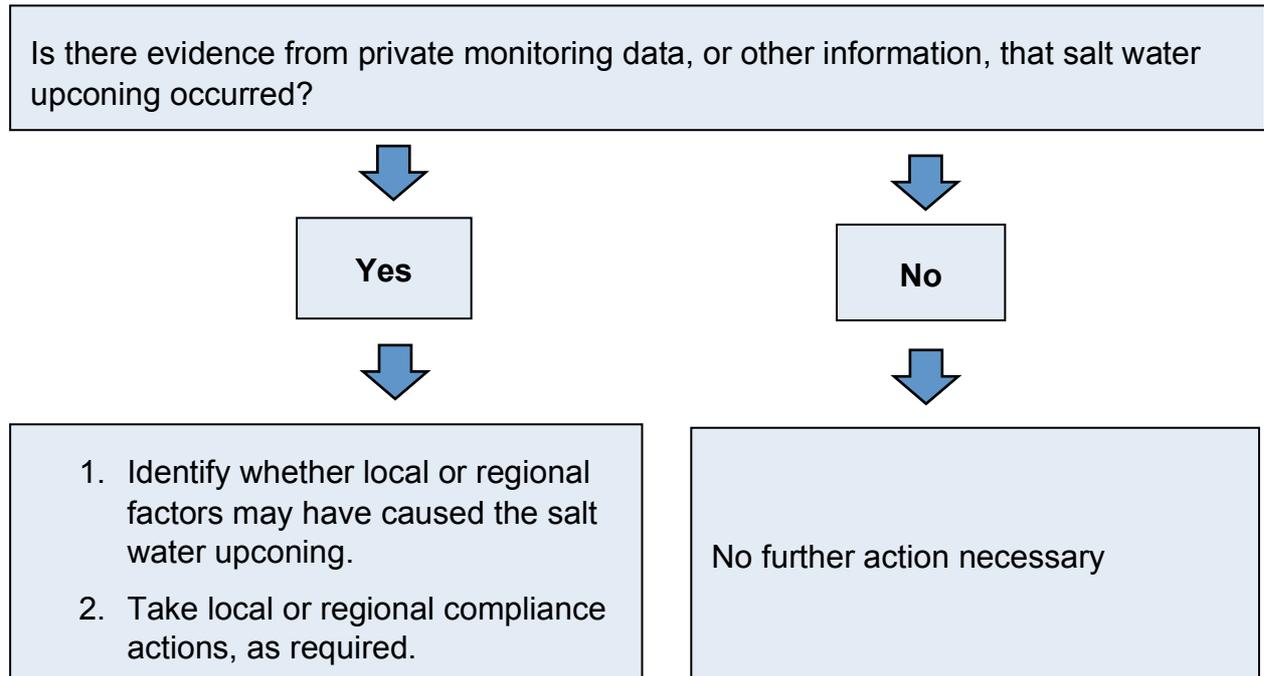
Resource objective	Subarea	Monitoring bore	Ecological value	Reference groundwater levels
Maintain groundwater levels in the Superficial aquifer that minimise risk to groundwater-dependent ecosystems	Mandurah	T630 (61410026)	Remnant groundwater-dependent vegetation	Groundwater level above 0.13 m AHD
	Whitehills	Lake Clifton A5 (61319128)	Tuart woodlands and Estuarine interface	Currently collecting data for determination of level
		Lake Clifton A1 (61319123)	Estuarine Interface and riparian vegetation	Currently collecting data for determination of level
	Island Point	YSH4 (61319530)	Riparian vegetation	Currently collecting data for determination of level
		HS62C (61330103)	Riparian vegetation and EPP wetland	Groundwater level above 0.01 m AHD
	Coastal	Lake Clifton C2 (61319137)	Riparian vegetation	Groundwater level above -0.45 m AHD
		Lake Clifton B2 (61319130)	Riparian vegetation	Groundwater level above -0.26 m AHD
	Maintain sufficient groundwater discharge into Lake Clifton, Lake Preston and Martin's Tank	Island Point	HS62C (61330103)	Maintain minimum groundwater contribution to Lake Clifton
Y2-4B (61319508)			Throughflow to Lake Clifton	Groundwater level above -0.05 m AHD
YSH4 (61319530)			Discharge into Lake Clifton	baseline
Coastal		Lake Clifton C2 (61319137)	Discharge into Martin's Tank Lake	-0.45 m AHD
		Lake Clifton B2 (61319130)	Discharge into Lake Preston	-0.26 m AHD

Appendix C – Process for assessing resource objectives

Objectives 1, 3 and 4



Objective 2



Appendix D— Map information and disclaimer

Datum and projection information

Vertical datum: Australian Height Datum (AHD)

Horizontal datum: Geocentric Datum of Australia 94

Projection: MGA 94 Zone 50

Spheroid: Australian National Spheroid

Project information

Client: Tim Grose

Map author: Michael Fifield; Maia Williams; Martin Drake

File path:

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Disclaimer

These maps are a product of the Department of Water, Water Assessment and Allocation Division.

These maps were produced with the intent that they be used for information purposes at the scale as shown when printed.

While the Department of Water has made all reasonable efforts to ensure the accuracy of this data, the department accepts no responsibility for any inaccuracies and persons relying on this data do so at their own risk.

Sources

The Department of Water acknowledges the following datasets and their custodians in the production of this map:

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Shortened forms

AHD	Australian height datum
CDFM	Cumulative deviation from the mean
DPaW	Department of Parks and Wildlife
DoW	Department of Water
DoP	Department of Planning
DWAID	Divertible water allocation information database
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
IWSS	Integrated Water Supply Scheme
OEPA or EPA	Office of the Environmental Protection Authority
WAPC	Western Australian Planning Commission
WIN	Water Information Network
WRC	Water and Rivers Commission

Volumes of water

One litre	1 litre	1 litre	(L)
One thousand litres	1000 litres	1 kilolitre	(kL)
One million litres	1 000 000 litres	1 Megalitre	(ML)
One thousand million litres	1 000 000 000 litres	1 Gigalitre	(GL)

Glossary

The terms that are used the most in reference to water resource management of the Peel Coastal plan area are listed below.

Abstraction	Withdrawal of water from any surface water or groundwater source of supply.
Allocation limit	Annual volume of water set aside for use from a water resource.
Conservation category wetland	Wetlands identified in geomorphic wetland mapping (Hill <i>et. al</i> 1996), which is considered to be of high conservation significance.
Consumptive use	Water used for consumptive purposes considered as a private benefit including irrigation, industry, urban and stock and domestic use.
Cumulative derivation from the mean (CDFM)	Cumulative deviation from the mean rainfall (CDFM) is a simple arithmetic technique used for rainfall evaluation. In this method the actual rainfall over a defined period is subtracted from the long-term mean rainfall of the same period. The deviations are plotted cumulatively in a diagram showing periods of above mean rainfall by the upward tending graph (Wet Seasons) and of below mean rainfall in downward tending graph (dry seasons).
Ecological values	The natural ecological processes occurring within water-dependent ecosystems and the biodiversity of these systems
Ecological water requirement	The water regime needed to maintain the current ecological values (including assets, functions and processes) of water-dependent ecosystems consistent with the objectives of an ecological water requirements study.
Environmental Protection Policy wetland	Wetlands deemed to be of high conservation value under the <i>Environmental Protection Act (1986)</i> .
Fit-for-purpose water	Water that is of suitable quality for the intended end purpose. It implies that the quality is not higher than needed.
Groundwater area	The boundaries proclaimed under the <i>Rights in Water and Irrigation Act 1914</i> and used for water allocation planning and management.

Groundwater-dependent ecosystem	An ecosystem that is at least partially dependent on groundwater for its existence and health.
Groundwater-dependent social value	An in situ quality, attribute or use associated with a groundwater resource (or dependent on a groundwater resource) that is important for public benefit, welfare, state or health.
Licence (or licensed entitlement)	A formal permit which entitles the licence holder to take water from a watercourse, wetland or underground source under the <i>Rights in Water and Irrigation Act 1914</i>
Non-artesian well	A well, including all associated works, from which water does not flow, or has not flowed, naturally to the surface but has to be raised, or has been raised, by pumping or other artificial means.
Ramsar-listed Wetland	Wetlands recognised as internationally significant and registered on the list of Convention of Wetlands of Importance (Ramsar 1971)
Reference groundwater level	A groundwater level that triggers management actions or responses to be implemented so that the risk of abstraction having an adverse effect on the water resource and dependent values is reduced.
Reliability	The frequency with which a water licence holder can obtain their full licensed volume.
Seawater or saltwater intrusion	The inland or up-gradient intrusion of salt water into a layer of fresh groundwater, from the sea or from the edges of the aquifer.
Saltwater upconing	The upward movement of saline water caused from excessive pumping, affecting fresh groundwater resources above.
Subarea	A subdivision, within a surface or groundwater area, defined to better manage water allocation. Subarea boundaries are not proclaimed and can therefore be amended without being gazetted.
Water reserve	An area proclaimed under the <i>Metropolitan Water Supply, Sewerage and Drainage Act 1909</i> or <i>Country Areas Water Supply Act 1947</i> to protect and use water for public water supply.

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