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

Pilbara

groundwater allocation plan



Looking after all our water needs

Water resource allocation
and planning report series
Report no 55
October 2013

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Disclaimer

Message from the Minister

As the leading mining region of Western Australia and the base of the nation's offshore oil and gas fields, the Pilbara is undergoing significant growth and development.

With this growth has come an increased demand for water to support these important industries and the growing population that comes with them. There are also important opportunities for further diversification and growth in the agriculture sector in the Pilbara.

The State Government is committed to delivering a sustainable water future that provides certainty for business investment and supports the Pilbara Cities vision of Karratha and Port Hedland transforming into regional centres of 50 000 people by 2035.

The *Pilbara groundwater allocation plan* establishes a clear direction on how the government will allocate and regulate the use of groundwater in the Pilbara.

The plan is underpinned by more than three years of targeted scientific investigations, including work funded through the Australian Government's Water for the Future initiative.

The investigations have provided us with the confidence to set out how much water is available to support the region's growth, as well as to meet the environmental needs of the Pilbara's groundwater resources and their dependent values.

This work has allowed us to increase allocations to important regional scheme water supplies, and identify areas for new scientific investigations and opportunities for increased water use efficiency that may yield even more water for the future.

By working closely with stakeholders we have developed a plan that clarifies the government's approach to making licensing decisions for the use of this water.

The plan is accompanied by a statement of response which summarises how public comments informed the plan.

Together with the recently released *Western Australian water in mining guideline* and the *Use of mine dewatering surplus* policy, as a government, we are providing the regulatory and policy framework for the Pilbara to flourish.

Hon Terry Redman, MLA
Minister for Water

Contents

Contents

Tables

Figures

Tables in Appendices

Summary

Pilbara groundwater allocation plan

Purpose of the plan

The Department of Water is responsible for regulating and managing the state's water resources for sustainable productive use. This plan sets out how we will manage groundwater in the Pilbara through allocation limits, water licensing and ongoing monitoring and evaluation over the next seven years or longer.

This is the first groundwater allocation plan for the Pilbara. The department developed the plan using the most current information, including Water for the Future investigations completed in the plan area between 2007 and 2010. We prepared this plan in response to increasing water demand from coastal centres and the region's rapidly growing mining sector, as well as to an increasing interest for more clarity around regulatory and assessment processes. This plan confirms groundwater availability for water supplies to ports and coastal towns and provides a framework for licensing decisions and adaptive groundwater management across the region.

Water availability in the Pilbara

The department reviewed allocation limits for nine target aquifers important for existing and potential water supply to ports and coastal towns in the plan area; these comprised six alluvial aquifers, the Millstream aquifer and two aquifers in the West Canning Basin. Water is available for further general licensing in five out of the nine target aquifers (see table overpage).

Aquifer	Allocation limit kL/year	Water available for general licensing	Level of risk management *
Lower Cane alluvial	1 000 000	Water available	Medium
Lower Fortescue alluvial	6 600 000	Fully allocated	Low
Lower Robe alluvial	5 090 000	Water available	Low
Millstream**	15 682 500	Fully allocated	High
Lower De Grey alluvial	10 150 000	Fully allocated	High
Lower Turner alluvial	420 000	Fully allocated	Low
Lower Yule alluvial	10 560 000	Water available	High
Broome (West Canning)	10 000 000	Water available	Low
Wallal (West Canning)	31 000 000	Limited water	Medium
Total	**90 502 500**		

* The level of risk management relates to the level of management effort required in response to the risk to dependent values from abstraction and/or water demand.

** 15 GL/yr is the maximum amount that can be taken from Water Corporation's borefield, provided management conditions are met and Harding Dam cannot be used. The long-term reliable allocation is an average of 6 GL/yr.

Existing allocation limits for other aquifers in the plan area are provided in Chapter 3. Allocation limits have not been set for fractured rock aquifers as water availability will be assessed on a case-by-case basis through licensing.

Allocation and licensing approach for the Pilbara

For the nine target aquifers, we assess water availability for licences against an allocation limit. Allocation limits were set with consideration for the Pilbara's highly variable climate and the impacts of abstraction on groundwater-dependent values and resource productivity. Specific licensing policy and monitoring are provided to manage the risks associated with abstraction and maintain the water resources in the long term. The department has strategically reserved water for future public water supply from the target aquifers where there is sufficient water available. Other supply options will be presented in the department's Pilbara regional water supply strategy, to be released in late 2013.

This plan also includes licensing policy that applies across the region, mainly for managing water associated with mining. This includes policy supporting third party use of mine dewater, for example to enable expansion of the agricultural sector. For fractured rock aquifers, where most mining occurs, water availability will be assessed on a case-by-case basis through licensing. For detailed guidance on assessing licence applications for mining, the plan refers to the department's *Western Australian water in mining guideline* (DoW 2013d). We also consider legislative requirements and the policies of other government agencies.

Chapter One

Plan context and scope

1.1 Purpose of the plan

This is the first water allocation plan for groundwater in the Pilbara region. The plan describes how the Department of Water regulates and manages water through allocation limits, licensing, monitoring and evaluation. It draws on decades of experience in groundwater licensing and water management in the region.

We developed this plan in response to:

- increasing demand for water at the ports and coastal towns where the bulk of ore, gas and petroleum processing and handling occurs (and supporting industries and populations are based)
- the lack of water availability assessments for groundwater resources along or close to the coast and the need to confirm water availability to support regional growth
- industry seeking more clarity and certainty around regulatory assessment as water management issues at mines increase.

The *Pilbara groundwater allocation plan* supports the Pilbara Cities vision (Section 1.6) by providing greater certainty on the volumes of water available from existing and potential groundwater resources along or close to the coast where demand is focused. The plan also ensures that resources are managed so that groundwater productivity and water quality are maintained into the future.

1.2 Plan area

The plan covers an area of more than 200 000 km^2 situated about 1000 km north of Perth. It includes the coastal towns of Onslow, Karratha, Wickham, Roebourne and Port Hedland and extends inland to include Marble Bar, Wittenoom, Nullagine, Tom Price, Paraburdoo and Newman (Figure 1).

The plan applies to the Pilbara groundwater area and part of the Canning-Kimberley groundwater area (Figure 1). These groundwater areas were proclaimed on 12 February 1965 and 2 May 1997 respectively, under section 26B of the *Rights in Water and Irrigation Act 1914* (WA). The original Pilbara groundwater area was altered twice under an amendment to the proclamation order on 21 December 1990 and 2 May 1997. The original proclamations and the amendments may be found in the *Western Australian Government Gazette.*

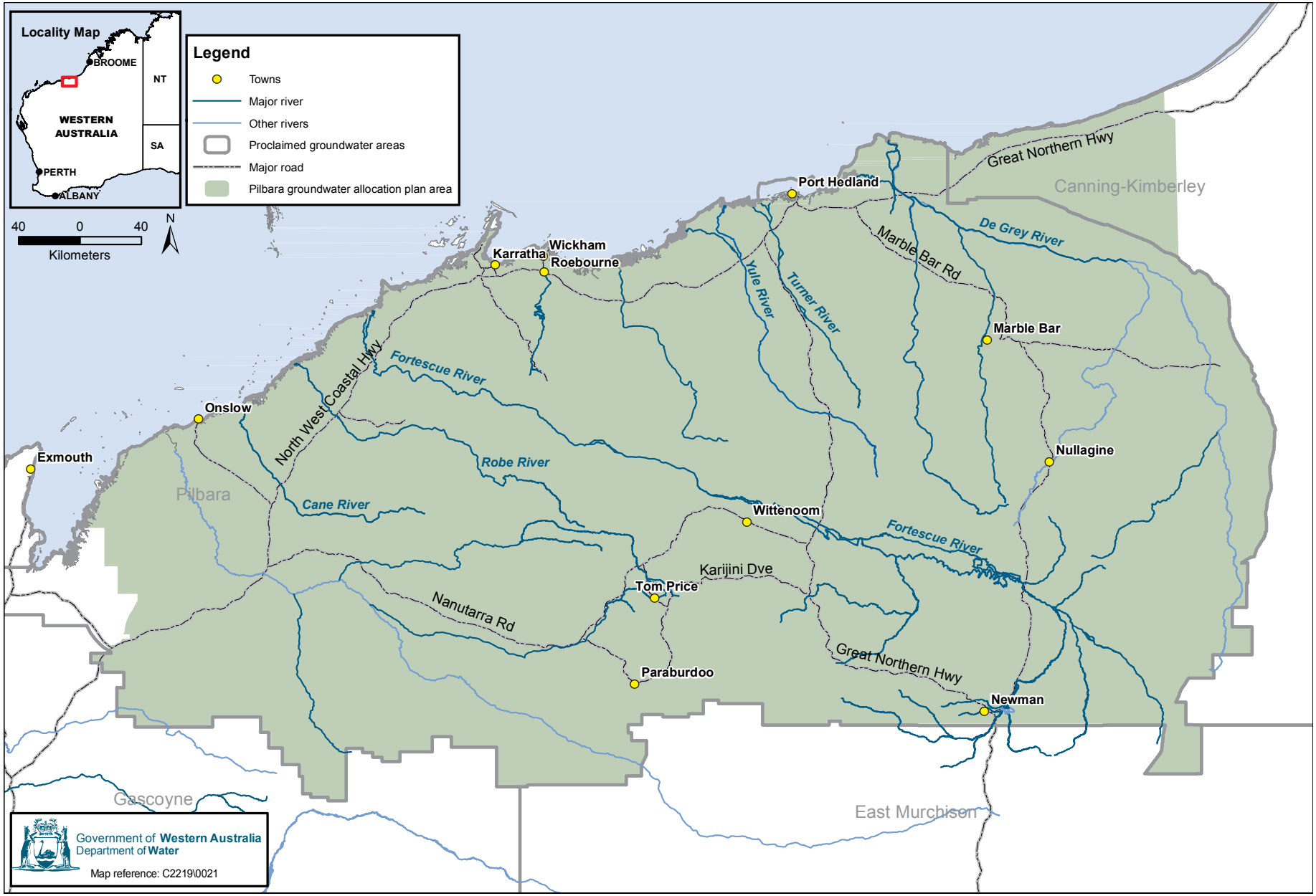

Figure 1

Pilbara groundwater allocation plan area, proclaimed areas and water supply schemes

Pilbara groundwater allocation plan

1.3 Water resources covered

The *Pilbara groundwater allocation plan* covers all groundwater resources in the plan area. This includes alluvial, sedimentary and fractured rock aquifers.

For administrative purposes, the plan area is divided into four subareas:

- Ashburton (Pilbara groundwater area)
- East Pilbara (Pilbara groundwater area)
- West Canning–Pardoo (Canning-Kimberley groundwater area, Broome aquifer)
- West Canning (Canning-Kimberley groundwater area, Wallal aquifer).

Target aquifers

This plan provides detailed management, including objectives, new allocation limits, local policy and performance indicators for nine target aquifers that are existing or potential water supplies for ports and coastal towns (Figure 2). Investigations completed through the Water for the Future initiative focused on these aquifers and provided information to support their management. The target aquifers are:

- coastal alluvial aquifers underlying the lower Cane, Robe, Fortescue, Yule, Turner and De Grey rivers
- the Millstream aquifer
- the Broome Sandstone and Wallal Sandstone sedimentary aquifers of the West Canning Basin.

Most of the water used by Pilbara towns and port facilities, in terms of volume, is delivered through the West Pilbara and Port Hedland regional water supply schemes (Figure 2) operated by the Water Corporation. Water for these schemes is taken from some of the target aquifers.

Port Hedland regional water supply scheme

The Port Hedland regional water supply scheme services Nelson Point, Finucane Island, Port Hedland, Wedgefield and South Hedland. The scheme draws water from existing bore fields in the lower Yule and De Grey alluvial aquifers. Allocation limits and other potential sources for the scheme are discussed in Section 3.2.

1 Plan context and scope

West Pilbara water supply scheme

The West Pilbara water supply scheme supplies the towns and port facilities of Karratha, Dampier, Roebourne, Wickham, Point Samson and Cape Lambert. Harding Dam is the scheme's primary source. Millstream borefield is used when water is not available from the dam or for short periods when demand is high. Allocation limits and other potential water sources for the scheme are discussed in Section 3.2.

Other public water supply

At present the lower Cane alluvial aquifer supplies water to the town of Onslow. Water for the other main towns of Newman, Tom Price, Paraburdoo, Marble Bar and Nullagine comes from a variety of groundwater sources near the towns and is provided by the Water Corporation or mine operators. We recognise the potential for rapid growth and increased water demand in these towns. We will continue to work with the Water Corporation and other water service providers to ensure increases in demand are managed (see also Section 1.6 on water resource protection and water supply planning).

Other aquifers

Fractured rock aquifers (Figure 3) will be managed solely through case-by-case licensing. For these aquifers, the plan provides the department's approach and policy for licence assessments rather than setting out detailed management and allocation limits. The licence assessment approach is described in sections 3.2 and 4.3. Descriptions of Pilbara fractured rock aquifers are detailed in the *Central Pilbara groundwater study* (Johnson & Wright 2001) and The *Pilbara coast water study* (Haig 2009).

For other non-target aquifers (alluvial and sedimentary), (Figure 3), the plan also provides the department's approach and policy for licence assessments rather than provide detailed management (Section 4.3). Allocation limits for these non-target aquifers are provided in Section 3.2, however these have not been reviewed as part of developing this plan and further investigations may be required to confirm water availability.

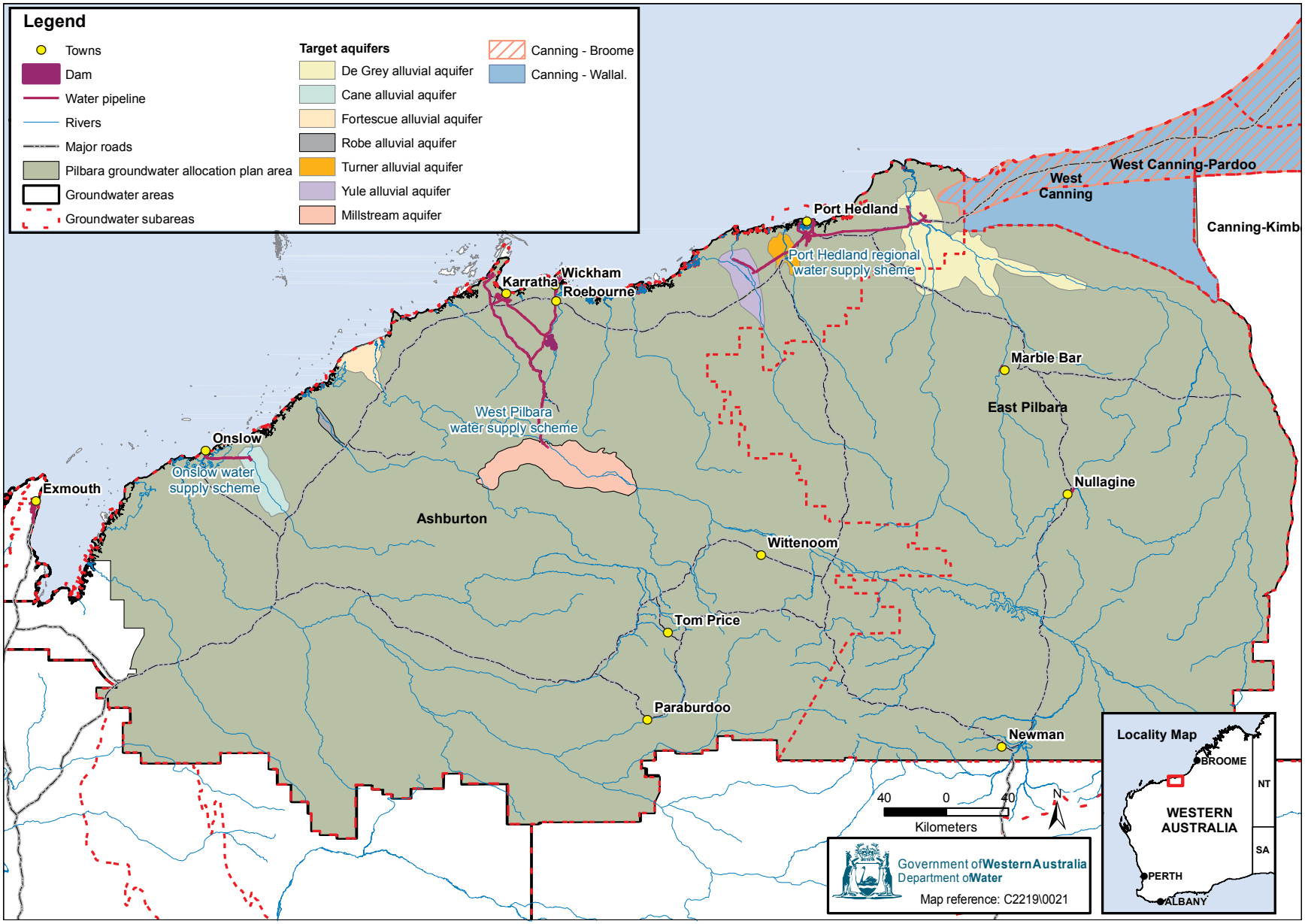

Figure 2

Target aquifers and water supply schemes covered by the Pilbara groundwater allocation plan area

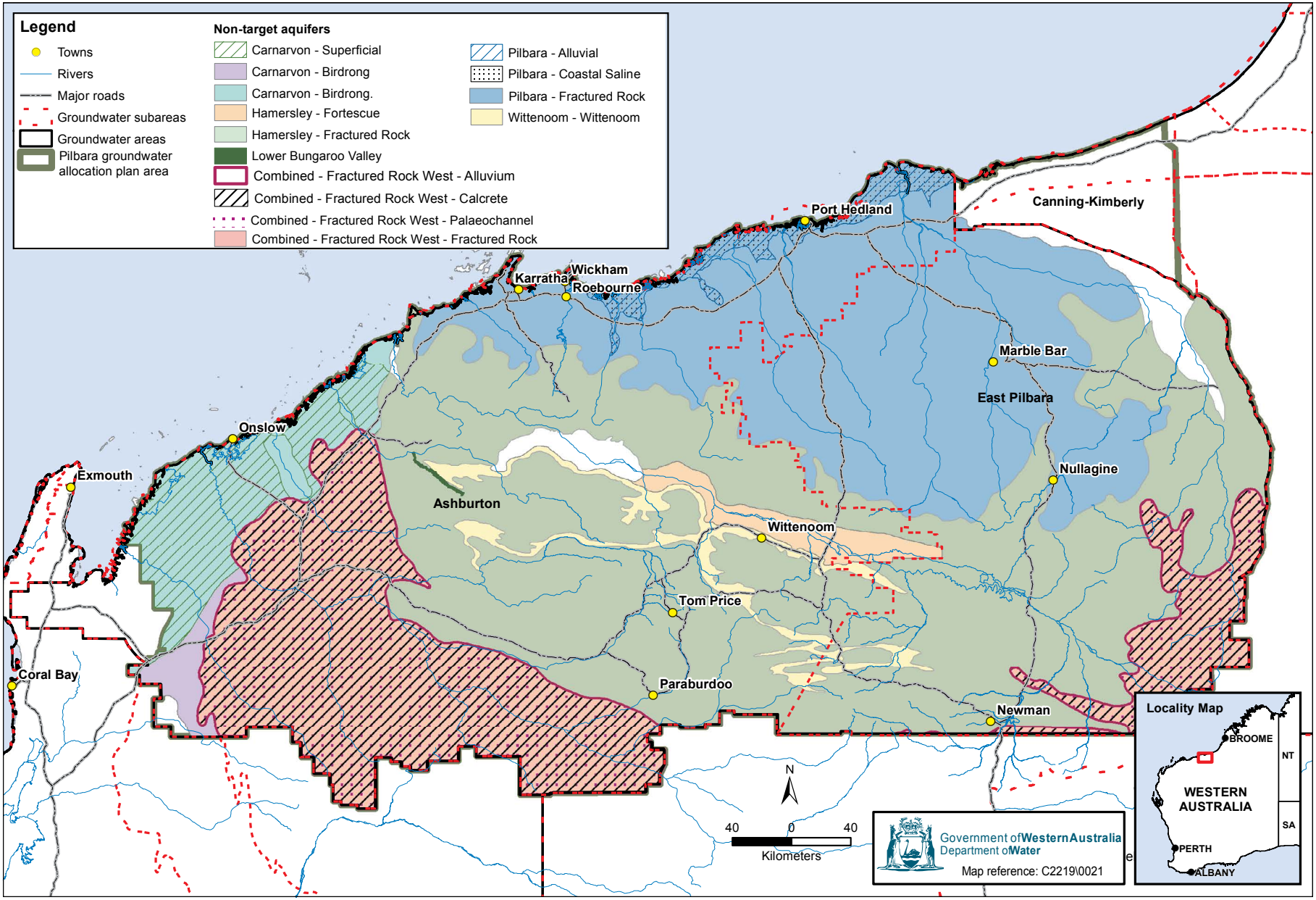

Figure 3

Other aquifers included in the *Pilbara groundwater allocation plan*

Pilbara groundwater allocation plan

1.4 How we developed the plan

The department began investigative work for the *Pilbara groundwater allocation plan* in 2007 supported by over $3 million funding from the Australian Government's Water for the Future initiative. This work focused on current or potential water supply aquifers for ports and coastal towns (the target aquifers).

We used that work, *The Pilbara coast water study* (Haig 2009), the *Central Pilbara groundwater study* (Johnson & Wright 2001), consultation from the *Pilbara regional water plan 2010–2030* (DoW 2010) and *Pilbara water in mining guideline* (DoW 2009d), and further consultation with stakeholders to develop this water allocation plan. This involved:

- developing water resource objectives to guide decision making
- using the results of hydrogeological assessments to confirm water availability for existing and potential groundwater resources along or close to the coast
- identifying groundwater-dependent cultural values with traditional owners to work out the amount of water to be left in the aquifers
- using the results of studies of ecological water requirements to work out the amount of water to be left in the aquifers and water management arrangements
- working with industry and other government agencies to identify policy gaps and develop guidance for managing and regulating water for mining.

Due to the level of knowledge and pressure on water resources in the Pilbara, we developed this plan as an intensive water allocation plan through our allocation planning process. For more information, see *Water allocation planning in Western Australia: a guide to our process* (DoW 2011e).

1.5 Stakeholder interests

The department consulted Pilbara stakeholders during development of the *Pilbara regional water plan 2010–2030* (DoW 2010) and *Pilbara water in mining guideline* (DoW 2009d). This helped inform and scope out the *Pilbara groundwater allocation plan.*

For this plan, our consultation process involved a key set of stakeholders at critical stages of plan development. This approach was chosen over forming an advisory or consultative committee, so that more stakeholders could be involved at different stages and on different issues during plan development.

In preparing this plan, and during the Water for the Future project, we consulted with:

- traditional owner groups – on identifying groundwater-dependent cultural values, proposed allocation limits and management arrangements (Pilbara Native Title Service, Indigenous working groups and corporations)
- pastoralists – on existing water use, proposed allocation limits and proposed policy

- Water Corporation (public water supplier) – on proposed allocation limits, policy for assessing water licences and the proposed monitoring program
- other agencies – the proposed allocation limits and policy with other agencies as well as how this plan relates to regional development and the Pilbara Cities vision
- local government – on the allocation planning process
- mining industry – on proposed allocation limits and policy for assessing water licences and town water supplies.

In April 2011 we formally advised stakeholders that development of this plan was underway. They raised a number of interests and concerns relating to water allocation in the plan area, including:

- security of water supply
- managing interference between water users
- managing the impacts of abstraction on groundwater-dependent ecological, social and cultural values
- transparency of and input into allocation planning and licensing processes
- future water demand and water supply planning
- managing the impacts of an arid variable climate on water availability
- water availability and opportunities for development.

We released the plan for a three-month public comment period from 31 October 2012 to 18 January 2013, from which we received 20 submissions. The submissions were very supportive of the plan and our consultative approach. The main issues raised related to clarifying our approach, rights to water, implementation, evaluation and continued consultation.

We have ensured all of the above issues are addressed in this plan to the extent possible. Some issues are beyond its scope but are briefly discussed in Section 1.6.

Issues from submissions and our response is documented in *Pilbara groundwater allocation plan: Statement of response* (DoW 2013b). For this and further information on the issues stakeholders raised, see our Pilbara allocation planning page on <www.water.wa.gov.au>.

1.6 Related plans and strategies

Several of our plans and strategies and those of other agencies relate to groundwater in the Pilbara.

Department of Water plans and guidelines

The department's *Pilbara regional water plan 2010–2030* (DoW 2010) sets the strategic direction for how we manage and develop the region's water resources – to be done in a sustainable manner to maintain and enhance the region's natural environment, cultural and spiritual values, quality of life and economic development. Developing this water allocation plan is one of the regional plan's actions.

Other actions include improving our understanding and management of water supply and demand and protecting environmental, cultural and social values. This plan contributes significantly to those actions.

Our *Western Australian water in mining guideline* was finalised in 2013 (DoW 2013d) and it is referred to throughout Chapter 4 of this plan. The guideline builds on and replaces the *Pilbara water in mining guideline* (DoW 2009d) by including mine closure and updated guidance and policy. The guideline was developed with stakeholders to facilitate consultation between proponents and the department, ensure an efficient pathway through the licence assessment process and align our licence assessment with other assessment processes, such as those under the *Environmental Protection Act 1986* (WA).

This plan discusses public water supply but doesn't cover drinking water resource protection planning. Our water source protection plans in the Pilbara cover the Cane River, De Grey River, Marble Bar, Millstream, Newman, Nullagine, Yule River, Tom Price (Marandoo and Fortescue bore fields) and Bungaroo Creek water reserves and Harding Dam catchment area. These plans and guiding water quality protection notes are available online <www.water.wa.gov.au>. Operators of private drinking water sources (e.g. those of mining companies) in the region should also undertake source protection in accordance with the *Australian drinking water guidelines* (NHMRC, NRMMC 2011).

Pilbara Cities, land use planning and water supply planning

In 2009, the Government of Western Australia announced the Pilbara Cities vision to encourage more people to settle in the Pilbara and deliver a skilled workforce to support economic projects. The vision aims to build on the resources boom, diversify the economy and support towns in the Pilbara to become more attractive and sustainable communities. Karratha and Port Hedland are proposed to become diverse cities with a population of 50 000 people each by 2035 and Newman a large town of 15 000 people by 2035 (DRDL 2012).

Achieving this vision will require new water supplies and water supply infrastructure – for the coastal towns in particular. This is recognised in the vision by one of the key focus areas (securing water supply capacity) and within the Department of Planning's *Pilbara Planning and Infrastructure Framework*, released in January 2012.

The Department of Water has led a cross-government process to consider options for meeting water demand in the Pilbara coastal towns. Significant progress has been made in identifying potential source options and the investment needed to develop them. We are now preparing a water supply strategy to document our approach for ensuring security of supply in the Pilbara, due for release in late 2013.

This plan has provided important input for the water supply strategy by confirming or increasing the sustainable volumes and identifying the potential of aquifers for water supply near coastal ports and towns. Implementing this allocation plan will provide the necessary allocation security to enable planning and safe investment in Pilbara water infrastructure to in turn support growth and land use development in the region.

1.7 Plan timeframe

The *Pilbara 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 during a plan evaluation process.

Chapter Two

What the plan will achieve

The Department of Water is responsible for managing water resources in Western Australia consistent with the objects of Part III 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; and

   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.

Through allocation planning, we manage the amount of water that can be taken from a water resource consistent with the objects of the Act, considering reliability for existing water users and the environment. This water allocation plan confirms water availability for water supply at ports and coastal towns and licensing across the Pilbara plan area, while managing risks to groundwater-dependent values and considering the highly variable climate (including long periods between recharge events).

The outcomes for this plan guided our decision making around the objectives and water allocation limits for each resource. We will meet the plan's objectives by implementing the allocation limits, licensing approach and policy, as well as the monitoring program.

2.1 Outcomes

The outcomes of this plan are that:

- there is certainty about how much water is available to support regional development
- the availability of water is maximised given the particularly high economic value of the water supplies to the state
- groundwater resources are maintained so that they will be useable into the future
- valuable environments and ecosystems dependent on groundwater are protected
- Indigenous values relying on groundwater are managed with input from local traditional owners
- the guidance for regulatory assessment of industry is clarified and improved
- planning and investing in water supplies can be done with certainty about groundwater management requirements
- the understanding of groundwater resources is continually improved.

2 What the plan will achieve

More specific outcomes of this plan are:

- protecting the highly valued groundwater-dependent ecosystems and cultural values of Millstream
- supporting development of the West Canning Basin as a regional water supply.

We will assess and report against how well the plan is contributing to the outcomes by evaluating performance against the water resource objectives.

2.2 Resource objectives

The department has set water resource objectives for the nine target aquifers (Table 1). The resource objectives are based on:

- the desired outcomes outlined above in Section 2.1
- hydrogeological and ecological investigations undertaken as part of the Water for the Future initiative
- input from traditional owners, the mining industry, pastoralists and other agencies.

Resource objectives are specific and measurable targets that relate to water volume and quality, and water to be left in the resource to support dependent values. The objectives reflect how we want each of the resources to perform so that the plan's outcomes are delivered. Together with the performance indicators, they will be used to inform ongoing and adaptive management (Table 8 and Section 7.2).

We have not set objectives for other aquifers as these will be set and evaluated through licensing on a case-by-case basis.

Table 1
Water resource objectives for the target aquifers

Aquifer	Water resource objectives
Lower Cane alluvial	a. Prevent saltwater intrusion into the aquifer caused by abstraction b. Maintain water quality for the most beneficial use (potable water supply) c. Maintain groundwater levels within a target range to avoid impacts to groundwater-dependent ecosystems and long-term productivity.
Lower Robe and Fortescue alluvial	d. Prevent saltwater intrusion into the aquifers caused by abstraction e. Maintain water quality for the most beneficial use (potable water supply) f. Maintain groundwater and pool levels within a target range to maintain aquatic habitat and riparian vegetation that are dependent on groundwater.
Millstream	g. Maintain water quality for the most beneficial use (potable water supply) h. Maintain water quality for the environment i. Maintain target aquifer levels to support groundwater-dependent vegetation and protect groundwater-dependent values in the national park and as listed in the *Directory of Important Wetlands in Australia* (EA 2001) j. Maintain target aquifer discharge to support springs, pools, wetlands and vegetation in the delta and river channel and to protect groundwater-dependent values in the national park and as listed in the *Directory of Important Wetlands in Australia* (EA 2001) k. Maintain target groundwater and discharge levels to support groundwater-dependent cultural and social values.
Lower Yule alluvial	l. Prevent saltwater intrusion into the aquifer caused by abstraction m. Maintain water quality for the most beneficial use (potable water supply) n. Maintain groundwater and pool levels within a target range to maintain aquatic habitat and riparian vegetation that are dependent on groundwater.
Lower Turner alluvial	o. Prevent saltwater intrusion into the aquifer caused by abstraction p. Maintain water quality for ongoing use (potable or industrial water supply depending on demand for water) q. Maintain groundwater levels to avoid impacts to groundwater-dependent ecosystems.
Lower De Grey alluvial	r. Prevent saltwater intrusion into the aquifer caused by abstraction s. Maintain water quality for the most beneficial use (potable water supply) t. Maintain groundwater and pool levels within a target range to maintain aquatic habitat and riparian vegetation dependent on groundwater and protect values as listed in the *Directory of Important Wetlands in Australia* (EA 2001).
West Canning Basin (Broome and Wallal)	u. Prevent seawater intrusion into the Broome Sandstone aquifer caused by abstraction v. Prevent seawater intrusion into the onshore area of the Wallal Sandstone aquifer caused by abstraction w. Maintain groundwater levels in the Broome Sandstone to avoid impacts to coastal wetlands x. Maintain pressure heads in the Wallal Sandstone above the top of the aquifer so that it remains confined.

2 What the plan will achieve

2.3 Strategies

The department's strategies to meet the objectives of the plan are to:

1 License to allocation limits for the target aquifers (Chapter 3)

2 Apply licensing policies for target aquifers to meet resource objectives and manage the risks of abstraction (Chapter 5)

3 Apply licensing policies across the region to improve water management outcomes for the mining industry (Chapter 4)

4 Align our approval process with other regulatory agencies to streamline the approvals process (Chapter 4)

5 Regularly assess water resource trends and evaluate the plan (Chapter 6)

6 Use monitoring to improve our understanding of groundwater resources and refine groundwater models as required (chapters 6 and 7).

2.4 Measuring the success of the plan

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

- assess monitoring information against objectives and performance indicators
- reflect on how we have licensed and managed water abstraction.

We will publish the results of how successful we have been in meeting the outcomes and objectives in evaluation statements. Chapters 6 and 7 have more information about how we will monitor and evaluate the performance of the plan.

Chapter Three

Water allocation limits

This chapter sets out:

- the water available for take under allocation limits (where set) for each groundwater resource
- the water to be left in groundwater resources for maintaining water quality, aquifer productivity, groundwater-dependent values and other non-consumptive uses.

An allocation limit is the annual volume of water set aside from a water resource for consumptive use such as household, urban, irrigation, stock, mining or industrial use. Where allocation limits are appropriate, they are the main tool the department uses to manage sustainable take and security of supply at the resource scale. We will license and manage to the allocation limits for each resource.

For each of the nine target aquifers, we reviewed allocation limits or set them for the first time (Table 2) to provide more certainty around the volume of water available for nearby ports and coastal towns. We have set allocation limits for the target aquifers by taking into account demand for water from the aquifers, the highly variable Pilbara climate (often with long periods between recharge events) and the possible impacts of abstraction on groundwater-dependent values, water quality and aquifer productivity. The allocation limits were set to maximise the water available for use.

The licensing policy and monitoring requirements reflect a high level of risk management to manage the potential impacts of water abstraction up to the allocation limit.

Allocation limits are not appropriate for fractured rock aquifers due to aquifer characteristics (such as storage often being difficult to predict) and how water is abstracted for mining purposes (Section 3.2). Because of this, we have put allocations limits for fractured rock aquifers in the plan area as 'not set'. For other (non-target) aquifers in the plan area, where water supply potential and demand were low or being investigated, allocation limits were not reviewed and existing allocation limits were left in place (Table 3).

The water left in the aquifer and the allocation limit are related. We have set each allocation limit and water to be left in the aquifer based on a trade-off between demand for water and the impacts of abstraction on water levels (ecological water requirements under varying climate conditions). The allocation limit and water to be left in the aquifer are consistent with the resource objectives for each resource, as set out in Chapter 2.

The department used two methods to set allocation limits and decide how much water to leave in the target aquifers:

1 Risk-based approach – for aquifers where no competing demands exist and we have limited information (see below and Section 3.3).

3 Water allocation limits

2 Groundwater modelling – for aquifers with groundwater flow models and ecological water requirements available (see below and Section 3.3).

The Pilbara region has an extreme and variable climate with highly variable rainfall seasonally and from year to year. Most rainfall and recharge to groundwater comes from localised thunderstorms and tropical cyclones over summer. However, extended periods between recharge events often occur and are a key consideration for water resource management. Predictions of future climate for the region from global circulation models have been inconclusive to date with no clear wetting or drying trend predicted. Because of this, we have used historic climate data to incorporate variability in climate into groundwater models.

For more information on aquifers and how we used the risk-based approach to set allocation limits and water to be left in the aquifers, see:

- *Groundwater risk-based allocation planning process* (DoW 2011a)
- *Lower Cane groundwater allocation limit report* (DoW 2011b)
- *Lower Fortescue groundwater allocation limit report* (DoW 2011c)
- *Lower Turner groundwater allocation limit report* (DoW 2011d).

For more information on aquifers and how we included climate variability and modelling to set allocation limits and water to be left in the aquifers, see:

- *Lower De Grey and Yule groundwater allocation limits report* (DoW 2012a)
- *Lower Robe groundwater allocation limit report* (DoW 2012b)
- *Millstream aquifer – determination of a long-term sustainable yield and long-term reliable allocation* (Braimbridge 2010)
- *West Canning Basin groundwater allocation limits report* (DoW 2012c).

3.1 Components of the allocation limit

An allocation limit is the annual volume of water that can be taken from each water resource. The allocation limit does not include water to be left in the aquifer.

Where appropriate, the allocation limit is divided into components for accounting purposes including:

- water available for licensing
  - general licensing
  - public water supply
- water exempt from licensing (unlicensed)
- water we set aside for future public water supply.

These components are described below.

General licensing

The general licensing component of the allocation limit includes the volume of water that can be issued as annual licence entitlements, usually for purposes other than public water supply (see Table 2).

Public water supply and reserved water

There are separate components for current public water supply and water reserved for future public water supply.

The public water supply component is for water that is currently licensed for such use. The reserved water component sets aside water for future public water supply. Currently we only reserve water for public water supply. We do this strategically to support regional growth – where there is sufficient water available. At present 12.35 GL/yr is reserved for future public water supply from three groundwater resources (see Table 2).

Unlicensed use

The unlicensed use component of the allocation limit generally includes groundwater use that is legally exempt from licensing (Section 4.1). This includes water taken solely for stock and domestic purposes (Section 4.1).

3.2 Allocation limits

The allocation limits for each of the target aquifers are listed in Table 2. Allocation limits for the remaining groundwater resources are shown in Table 3. The allocation limits are total volumes measured in kilolitres per year (kL/yr).

Please phone our Karratha office on 08 9144 0200 for up-to-date information on water available for new use. Alternatively, you can view water availability through our online water register at <www.water.wa.gov.au>.

Fractured rock aquifers

The department has decided it is not appropriate to set allocation limits for fractured rock aquifers. This is because fractured rock aquifers have complex and irregular structures and characteristics such as water availability, recharge and storage and the sustainable amount of water that can be taken each year is very localised. Also, mining in fractured rock aquifers often requires dewatering, which can be unsustainable in the long-term.

Instead of using an allocation limit for fractured rock aquifers, we will assess each licence application on a case-by-case basis and develop licence conditions to manage the proposed abstraction and impacts specific to the water resource (Section 4.3).

Table 2
Allocation limits for the target groundwater resources of the Pilbara plan

Resource [1] (subarea – aquifer)	Allocation limit kL/yr	Allocation limit components kL/yr				Status of water availability for licensing [2] (as at June 2013)
		Licensable		Unlicensable	Reserved water	
		General licensing	Public water supply	Unlicensed use	Public water supply	
Pilbara groundwater area						
Ashburton – Carnarvon-Lower Robe Alluvial	5 090 000	3 000 000	0	90 000	2 000 000	Water available
Ashburton – Hamersley-Millstream	15 682 500 [3]	682 500	15 000 000	0	0	Fully allocated
Ashburton – Lower Cane Alluvial	1 000 000	92 500	550 000	7 500	350 000	Water available
Ashburton – Lower Fortescue Alluvial	6 600 000	6 600 000	0	0	0	Water available [4]
Ashburton – Lower Turner Alluvial	420 000	378 500	0	41 500	0	Fully allocated
Ashburton – Pilbara-Lower De Grey Alluvial	10 150 000	0	10 000 000	150 000	0	Fully allocated
Ashburton – Pilbara-Lower Yule Alluvial	10 560 000	1 000	10 500 000	59 000	0	Water available
East Pilbara – Canning-Wallal	1 000 000	1 000 000	0	0	0	Water available
Canning-Kimberley groundwater area						
West Canning-Pardoo – Canning-Broome	10 000 000	10 000 000	0	0	0	Water available
West Canning – Canning-Wallal.	30 000 000	20 000 000	0	0	10 000 000	Limited water [5]
Total	**90 502 500**	**41 754 500**	**36 050 000**	**348 000**	**12 350 000**	

1 Confined aquifers are annotated by a full stop (.) at the end of the resource name where there are both confined and unconfined aquifers with the same name.

2 Please phone our Karratha office on 08 9144 0200 for up-to-date information on water available. The status indicates how much of the general licensing component is allocated and if water is available for new licences. Water available means < 70 per cent allocated and limited water available means 70 to 100 per cent allocated.

3 15 GL/yr is the maximum amount that can be taken from the Water Corporation's borefield, provided management conditions are met and Harding Dam cannot be used. The long-term reliable allocation for Millstream is an average of 6 GL/yr. The general component is mostly for temporary use away from the borefield and the component will be reduced as this use ceases.

4 The staged development in the lower Fortescue is likely to take up the current allocation limit. We will use new information from the development to review the allocation limit.

5 The Wallal aquifer is likely to become fully allocated soon, as the full amount has been applied for by various proponents. We will review the allocation limit for the Wallal aquifer once investigative work is completed. This may result in an increase and reserving more water for public water supply.

Table 3
Allocation limits for non-target groundwater resources of the Pilbara plan

Resource [1] (subarea – aquifer)	Allocation limit kL/yr	Allocation limit components kL/yr				Status of water availability for licensing [2] (as at June 2013)
		Licensable		Unlicensed	Reserved water	
		General licensing	Public water supply	Unlicensed use	Public water supply	
Pilbara groundwater area						
Ashburton – Canning-Wallal	Not set	Not set	Not set	Not set	Not set	Case-by-case basis
Ashburton – Carnarvon-Birdrong	100 000	100 000	0	0	0	Water available
Ashburton – Carnarvon-Birdrong [3]	300 000	300 000	0	0	0	Fully allocated
Ashburton – Carnarvon-Cape Range Limestone	0	0	0	0	0	No water available
Ashburton – Carnarvon-Superficial	2 000 000	2 000 000	0	0	0	Limited water available
Ashburton – Combined-Fractured Rock West-Alluvium	Not set	Not set	Not set			Case-by-case basis
Ashburton – Combined-Fractured Rock West-Calcrete	Not set	Not set	Not set			Case-by-case basis
Ashburton – Combined-Fractured Rock West-Fractured Rock	Not set	Not set	Not set			Case-by-case basis
Ashburton – Hamersley-Fortescue	Not set	Not set	Not set	Not set	Not set	Case-by-case basis [4]
Ashburton – Hamersley-Fractured Rock	Not set	Not set	Not set			Case-by-case basis
Ashburton – Lower Bungaroo Valley	10 000 000	10 000 000	0	0	0 [5]	Fully allocated
Ashburton – Pilbara-Alluvial	7 000 000	7 000 000	0	0	0	Water available
Ashburton – Pilbara-Coastal Saline	2 000 000	2 000 000	0	0	0	Fully allocated
Ashburton – Pilbara-Fractured Rock	Not set	Not set	Not set			Case-by-case basis
Ashburton – Wittenoom-Wittenoom	20 000 000	19 980 000	20 000	0	0	Water available
East Pilbara – Combined-Fractured Rock West-Alluvium	Not set	Not set	Not set			Case-by-case basis
East Pilbara – Combined-Fractured Rock West-Calcrete	Not set	Not set	Not set			Case-by-case basis
East Pilbara – Combined-Fractured Rock West-Fractured Rock	Not set	Not set	Not set			Case-by-case basis
East Pilbara – Combined-Fractured Rock West-Palaeochannel	Not set	Not set	Not set			Case-by-case basis
East Pilbara – Hamersley-Fortescue	1 000 000	1 000 000	0	0	0	Water available
East Pilbara – Hamersley-Fractured Rock	Not set	Not set	Not set			Case-by-case basis
East Pilbara – Pilbara-Fractured Rock	Not set	Not set	Not set (280 000 [6])			Case-by-case basis
East Pilbara – Pilbara-Lower De Grey alluvial	Not set	Not set	Not set	Not set	Not set	Case-by-case basis
East Pilbara – Wittenoom-Wittenoom	50 000 000	50 000 000	0	0	0	Limited water available
Total	**137 400 000**	**137 030 000**	**20 000**	**0**	**0**	

1 Confined aquifers are annotated by a full stop at the end of the resource name where there are both confined and unconfined aquifers with the same name.

2 Please phone our Karratha office on 08 9144 0200 for up-to-date information on water available. The status indicates how much of the general licensing component is allocated and if water is available for new licences. Water available means < 70 per cent allocated and limited water available means 70 to 100 per cent allocated. Case-by-case basis means that water availability is assessed through licensing.

3 The Carnarvon-Birdrong is managed under the *Carnarvon Artesian Basin water management plan (DoW 2007),* however it is covered here for completeness and because the licensing approach in this plan generally also applies. The Carnarvon-Birdrong is currently being investigated as a water source option for public water supply to Onslow.

4 The Ashburton – Hamersley-Fortescue resource is now assessed on a case-by-case basis using our licensing assessment process.

5 The department will review the allocation limit and availability of additional water for Rio Tinto needs and public water supply once investigative work is completed.

6 The Water Corporation takes 0.28 GL/yr from fractured rock to supply the towns of Marble Bar (0.2 GL) and Nullagine (0.08 GL), which together with water from Wittenoom and the target aquifers is a total of 36.35 GL/yr for public water supply across the plan area.

3 Water allocation limits

Port Hedland regional water supply scheme

Increases to allocation limits through this plan means that up to 20.5 GL/yr can now be taken from the lower Yule and De Grey aquifers for public water supply. The Water Corporation is undertaking infrastructure upgrades to increase the scheme's capacity.

The 10 GL/yr from the De Grey alluvial aquifer can be taken every year with high reliability. The maximum rate of abstraction of 10.5 GL/yr from the Yule alluvial aquifer is subject to recharge in the preceding wet season. Recharge to the Yule aquifer is less reliable than for the De Grey. In seasons when recharge fails (approximately one out of four years based on the current streamflow record), annual abstraction will be reduced to 8.5 GL/yr to manage impacts on dependent values and, in the long-term, water quality. Otherwise, a high level of management and/or additional approvals will be required to manage the impacts – including negotiation with traditional owners.

In 2012 demand on the scheme was around 11 GL/yr with almost half of this being for industry supply at the ports. If the medium population and industry growth scenario occurs, total demand (town and ports) is predicted to reach around 17.5 GL/yr by 2016 and 29 GL/yr by 2031.

We have reserved 10 GL/yr for public water supply from the Wallal aquifer in the West Canning Basin. This resource is currently being assessed and has the potential to become a significant source for the Port Hedland regional water supply scheme. Other supply options will be presented in the department's Pilbara regional water supply strategy (DoW in prep.) to be released in late 2013.

West Pilbara water supply scheme

The allocation limit of 15 GL/yr for the Millstream aquifer is the maximum volume the Water Corporation's borefield can supply to the scheme when supply from Harding Dam is not available. The amount of water available from the aquifer in any one year depends on how recently recharge has occurred. This is because Millstream aquifer is in a national park and supports high cultural, social and environmental values and taking water from the aquifer, if not managed carefully, poses a risk to these values.

Taking into account the variability in recharge, the long-term-average reliable supply from the Millstream borefield is 6 GL/yr (Braimbridge 2010). The combined reliable yield for the scheme, between Harding Dam and the Millstream aquifer, is 10 GL/yr with 94 per cent reliability. The department determined the long-term reliable supply to confirm how much water could reliably be taken from the aquifer while managing risks to groundwater-dependent values. In determining this, as well as the allocation limit and local policy, we took into account historical abstraction and how groundwater-dependent ecosystems have responded to changes in water availability in the past. The local policy on the Millstream aquifer in Section 5.2 outlines the rules that determine how water is taken, to manage risks to dependent values.

In 2012 demand on the scheme was around 12.5 GL/yr. If expected population and industry growth occurs, total demand (town and ports) is predicted to reach around 18.5 GL/yr by 2016 and 26 GL/yr by 2031. Demand and water supply options will be further discussed in the department's Pilbara regional water supply strategy (DoW in prep.) to be released in late 2013.

Through the Royalties for Regions program, the department is completing a two-year project to collate existing information on the northern flanks of the Hamersley Ranges, similar to the Bungaroo Valley. This project is due for completion in 2014 and will include field work to verify the information, and possibly to collect baseline data, and will give us a better understanding of what information is available and where gaps exist.

Lower Bungaroo Valley aquifer

The allocation limit for the Lower Bungaroo Valley aquifer is 10 GL/yr based on current information (Table 3). This is licensed to Rio Tinto Iron Ore to meet its industrial and residential requirements in the West Pilbara. The water will be transported through the West Pilbara water supply scheme via a pipeline to Millstream.

It is likely that more water is available from Bungaroo, but this needs to be confirmed. Potentially up to a total of 25 GL/yr could be allocated from the resource, however assessment of the yield will need to be completed, including a review of how the aquifer responds to current rates of abstraction. If investigations show that more water is available, the department will work with Rio Tinto to ensure the appropriate balance of industrial and public water supply needs.

Other public water supply

The department has reserved 2 GL from the lower Robe alluvial aquifer for potential public water supply to the West Pilbara water supply scheme or to Onslow to meet growing demand. Also, desalination of the brackish Birdrong aquifer and third party supply from the lower Ashburton are currently being investigated as alternative water source options for supply to Onslow.

Once the investigation is complete we will consider revising the allocation limit for the Birdrong and reserving water for public water supply.

3.3 Water that is left in the aquifer

The department has set allocation limits for the target aquifers by taking into account possible impacts on groundwater-dependent values, water quality and the long-term productivity of the aquifers, the likelihood of long periods between recharge events, and the demand for water from the aquifers. An outcome of this process is determining how much water is to be left in these aquifers.

Water is left in the target aquifers to maintain:

- groundwater-dependent ecosystems including river pools, wetlands, riparian vegetation and aquifer ecosystems
- water quality and aquifer productivity
- groundwater-dependent cultural and social values.

The plan outcomes and objectives stated in Section 2.1 guided our decisions on the water to be left in each aquifer and the acceptable level of risk. Further detail on our decision making, including our assessments of how much water should be left in aquifers, is provided in our allocation limit reports and ecological water requirement reports (available online at <www.water.wa.gov.au>).

Risk-based method

For aquifers where there is no competing demand and limited information, we used existing information and our risk-based approach (see the start of this chapter for references) to assess:

- the risk to *in situ* values from abstraction, including groundwater-dependent ecosystems, water quality, aquifer productivity and groundwater-dependent cultural and social values
- the risk to supply from not abstracting.

This considered the significance of groundwater-dependent values and their sensitivity to changes in water availability, as well as our ability to manage the potential impacts.

The department's risk-based assessment has two components:

- *in situ* risk: the risks to the aquifer and associated environmental, social and cultural values that may arise from groundwater abstraction
- development risk: the risks to supply that may arise if water is not made available.

Based on the risk assessment, we used a matrix to decide on a proportion of average annual recharge or throughflow and how much water to leave in each aquifer. The risk-based method used specifies that at least 30 per cent of estimated annual recharge or throughflow is left in the aquifer.

Groundwater modelling

In the target aquifers, where a groundwater flow model was developed and detailed ecological water requirement studies were completed, the department determined the amount of water to be left in the aquifer in more detail.

Water quality and aquifer productivity

The department assessed the risks of abstraction impacting on water quality and aquifer productivity using outputs generated from groundwater flow models for each aquifer. This involved looking at the risk of changes in the position of the seawater interface and/or increases in salinity in the aquifer (which would result in future loss of water production from the aquifer). We used groundwater model outputs to look at how abstraction changed water-level gradients within the aquifers to rate the risk of changes in water quality. The thresholds or limits of acceptable change in water quality have or will be set as part of the monitoring and implementation program for the plan (Table 8, Section 6.1).

Groundwater-dependent ecosystems

The department identified and set groundwater, pool and/or aquifer discharge levels to maintain groundwater-dependent ecosystems. To identify levels we:

- identified parts of the water regime that are critical for each ecological component or process of the ecosystem
- accounted for the highly variable nature of the region's climate and groundwater levels (including the likelihood of long periods between recharge events)

- identified limits of acceptable change in water availability for groundwater-dependent ecosystems.

To account for the natural variability in water availability, we determined ecological water requirements for a range of climatic conditions – drought, dry and average conditions. The amount of water left in or the criteria for the target aquifers may vary each year and is linked to the climatic conditions (rainfall and streamflow) and the amount of recharge received (see Chapter 6 and Appendix A). Details of how we determined ecological water requirements are provided in:

- *Ecological water requirements of the lower De Grey River* (Loomes 2012)
- *Ecological water requirements of the lower Robe River* (Antao 2012)
- *Ecological water requirements of the lower Fortescue River* (Loomes 2013)
- *Ecological water requirements of the lower Yule River* (Braimbridge & Loomes 2013)
- *Ecological water requirements of Millstream* (Antao in prep.).

Groundwater-dependent cultural and social values

The department consulted with traditional owners to identify cultural and social values through meetings and on-country visits. Our consultation showed that groundwater-dependent cultural values were generally consistent with groundwater-dependent ecological values. We therefore combined our assessment of risks to cultural and social values with the assessment of risks to groundwater-dependent ecosystems.

Chapter Four

Water licensing approach

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. Together licensing, allocation limits, groundwater monitoring and reporting ensure the department manages water sustainably and provides security of supply.

The department uses policies to guide how we assess licence applications and apply licence conditions. This chapter provides more clarity and certainty around regulatory assessment in the Pilbara by outlining the relevant legislative requirements, our licensing approach in the Pilbara and the statewide policies commonly used in the Pilbara. The *Western Australian water in mining guideline* (DoW 2013d) is also referred to in this chapter and is repeated to an extent, yet it is included to refine and clarify our approach in the Pilbara.

4.1 Legislative requirements

Rights in Water and Irrigation Act 1914

The department regulates and manages water on behalf of the state under the *Rights in Water and Irrigation Act 1914*. The Act establishes the legislative framework for managing and allocating water in Western Australia. All of the groundwater resources in the Pilbara are covered by the Pilbara or Canning-Kimberley groundwater areas, which are proclaimed under the Act (see Section 1.2).

Water licences

Water users in the Pilbara require a water licence issued under section 5C of the Act to lawfully take groundwater, unless exempt (see section below). A licence is also required to construct or alter wells (including drilling and testing), which is issued under section 26D of the Act.

When assessing water licence applications, the department considers the allocation plan, as well as clause 7 (2) of Schedule 1 of the Act. In granting a licence, the department may apply terms, conditions and restrictions to licences under clause 15 of Schedule 1 of the Act. In the Pilbara, we usually require an operating strategy to achieve this – as a condition of the licence (see statewide policies in Section 4.4).

The department's 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.

Exemptions – stock and domestic and fire fighting water use

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

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

All artesian take, however, requires a licence, even for the above uses.

Exemptions – non-artesian monitoring wells

Under the Rights in Water and Irrigation Exemption (Section 26C) Order 2012 a licence is not required for the construction or alteration of, or the taking of water from, non-artesian wells that are used solely to monitor water levels and/or water quality. The department may still request that licensees with large entitlements provide hydrogeological information for monitoring wells as part of monitoring and reporting requirements.

Surface water licensing and exemptions

Almost all surface water in the plan area is proclaimed under the Pilbara surface water area. This generally means a licence to take surface water is required under section 5C and a permit to interfere with the bed and banks of watercourses is required under clauses 11, 17 and 21A of the Act. Interference includes installing pumps or constructing dams.

Mining tenements granted under the authorisation of the *Mining Act* 1978 are subject to the requirements of the *Rights in Water and Irrigation Act 1914* where activities interfering with watercourses relate to the taking or diversion of water.

Activities on mining tenements not related to the taking or diverting of water are therefore considered exempt from the requirements of a section 17 permit.

The exception is for general purpose leases which confer exclusive possession of land for specified purposes. Because this type of lease gives no statutory rights, there is no exemption from permitting and any activities interfering with watercourses would require a section 17 permit.

Compliance and enforcement

The *Rights in Water and Irrigation Act 1914* requires people and organisations to have appropriate authorisation to take surface water or groundwater. If authorisations are not demonstrated, or the conditions of an authorisation are breached, the department will take appropriate enforcement action.

Other legislation

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

State Agreement Acts

When assessing and approving licence applications, we consider the requirements of State Agreements. Some mining operations in the Pilbara were developed with a State Agreement. In some circumstances the agreement contains clauses regarding water supply and this can affect requirements under the *Rights in Water and Irrigation Act 1914.*

Environmental Protection Act and Conservation and Land Management Act

Significant developments and projects, such as mines and ports, generally require an environmental impact assessment under Part IV of the *Environmental Protection Act 1986*. This assessment is the responsibility of the Environmental Protection Authority (EPA). The department may refer a licence application to the EPA, which will decide whether an environmental impact assessment is required and, if so, at what level.

Management and approvals of the clearing of native vegetation, pollution and industry licensing falls under Part V of the *Environmental Protection Act 1986* and the *Conservation and Land Management Act 1984* (WA). The Department of Environment Regulation (DER) is responsible for this.

Mining acts

The department considers the *Mining Act 1978, Petroleum and Geothermal Energy Resources Act 1967* and *Petroleum Pipelines Act 1969* and their related regulations to ensure assessment and approval processes related to mining and petroleum are considered in developing licensing policies and assessing licence applications for water.

Native title and Aboriginal heritage

The *Commonwealth's Native Title Act 1993* and the *Aboriginal Heritage Act 1972* (WA) must be considered for all projects. Where native title rights have not been extinguished, the rights of traditional owners and obligations under the *Native Title Act 1993* and any relevant Indigenous Land Use Agreements (ILUAs) must be met.

For mining projects, native title issues and access to land are usually addressed through the granting of mining tenements by the Department of Mines and Petroleum (DMP) under the *Mining Act 1978*.

There are known heritage sites in the Pilbara. Aboriginal cultural heritage protection is managed by the Department of Aboriginal Affairs (DAA).

4.2 Aligning regulatory approvals

The Department of Water works with other government agencies to align regulatory approvals. However, it is critical that all proponents have early consultation and ongoing engagement with the department to ensure their licence assessment is aligned with other assessment processes and their water needs are met within their desired timeframe. This is particularly important for large projects being assessed under the *Environmental Protection Act 1986*.

Although the regulation of water resources is the responsibility of the department under the *Rights in Water and Irrigation Act 1914*, other agencies can regulate different aspects of water management, depending on the circumstances.

We align our water licensing approach with the approvals processes of other agencies as follows:

- EPA – we advise the EPA on water-related issues for environmental impact assessments. We subsequently assess the associated licence application to ensure it is consistent with the conditions, commitments and intended outcomes of the environmental impact assessment.

- DER – we mainly liaise with DER in relation to the management and approvals of the clearing of native vegetation, pollution and industry licensing for the Pilbara.
- DMP – we contribute to the assessment of mining proposals and programs of works that may affect water resources to ensure proposals meet current best practice and standards.
- Department of State Development (DSD) – we mainly liaise with DSD when dealing with State Agreements in licence assessments.
- Pastoral Lands Board (PLB) – we advise the PLB on pastoral diversifications involving water use and ensure the water licensing requirements of any intensive land uses are identified during the PLB assessment process.

Water in mining guideline

The department's water licensing approach for mining is described in the *Western Australian water in mining guideline* (DoW 2013d). The guideline was released for public comment in 2012. It builds on and replaces the *Pilbara water in mining guideline* (DoW 2009d).

The approach set out in the guideline is designed to align with the approvals processes of other agencies. The guideline is referred to throughout this section of the plan. However, where the approach or wording in this section differs from the statewide guideline, the approach in this plan is applied for the Pilbara.

Benefits to proponents and the department in following the water in mining guideline include:

- reducing timeframes and cross-over with other agencies where possible
- identifying early what the critical water issues across the life of the project are
- understanding upfront what investigations and information will need to be supplied during the licence assessment process
- understanding any other approvals required and how they will interact with the water licence assessment
- transparency and a better understanding of our process by proponents
- having a consultative approach to developing operating strategies
- aligning ongoing government regulation
- consistency in the information provided across the state
- better water management outcomes.

4.3 Water licensing

A water licence provides legal and secure access to water. The department's Karratha office manages water licensing in the Pilbara area. Please contact the Karratha office on 08 9144 0200 to discuss your water needs.

4 Water licensing approach

We issue water licences and manage abstraction at an individual scale to:

- support development
- protect the entitlements of existing water users
- protect the environment associated with water resources.

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 – mainly clarifying the complex issues associated with mining and industry in the Pilbara. The approach is generally consistent with existing policy but is included to clarify licensing issues and policy in the region. Specific licensing policy for the target aquifers is covered in Chapter 5.

Licence applications

Legal access to land

Applicants must demonstrate legal access to the land before the department will issue a 5C licence. Under the *Rights in Water and Irrigation Act 1914*, licence applicants must have legal access to the land the water is proposed to be taken from to be eligible to hold a 5C water licence.

If proponents don't own the land or have a relevant lease, tenement or easement (e.g. a tenement issued under the *Mining Act 1978*), they must seek approval in writing from the party with legal access. This may be a pastoral lease holder, mining tenement holder or crown lease holder such as a local government authority or the Department of Lands.

For access to properties that are leased for specific activities, such as pastoral leases, proponents must also seek authority from the body that administers the lease. For example, a pastoral lease holder can only authorise pastoral activities so proponents must seek approval from the Pastoral Lands Board (PLB) in addition to gaining authority from the lease holder.

Proponents must also be able to demonstrate legal access to the properties where water is to be used. Water may be moved between mining tenements/leases if the proponent has legal access to the property, and all the property is recorded on the licence and the operating strategy.

If licence approval is pending legal access to land, the department can provide a letter of undertaking to issue a licence, subject to the proponent obtaining legal access (within a set timeframe). An actual licence to take water will only be issued once we have received proof of legal access to the land.

Licence applications for new or unproven water resources

Although the department supports and encourages proponents investigating water resources, water is not reserved for industries, businesses and individuals investigating new or unproven water resources.

For new or unproven water resources, we suggest that when proponents submit a 26D licence application they also submit a 5C licence application to take water: this will enable early consideration of the scale and timing of water needs and clarification of the information needed to support the licence application. We may refer the application to the EPA if the proposed take and impacts on the environment are significant.

When submitting 26D and 5C applications, proponents will need to:

- outline their investigation program and timelines
- demonstrate a clear use for the water
- provide the usual information associated with a 5C application once investigations are complete – such as legal access to land, operating strategy (if required) and hydrogeological report
- advertise the application/s if the requested volume is for 100 000 kL or more.

For a detailed or H3 level hydrogeological assessment (*Operational policy no. 5.12,* DoW 2009c), the supporting hydrogeological report (and potentially other information) should be submitted to the department within six to 12 months (*Operational policy no. 5.11,* DoW 2009b) or as negotiated with the department.

The department may return incomplete applications where there is insufficient information for us to assess them (e.g. no clear use for the water, no proposed investigation program or no DMP-approved mining proposal). Further, if the required hydrogeological report or other information is not completed within the agreed timelines, with appropriate justification, the 5C application may be returned – resulting in the water in question becoming potentially available to other proponents. If investigations show the proposal will have detrimental impacts or that the water is not available, the department will negotiate alternative options with the applicant or refuse the licence.

The department encourages proponents to begin consultation early in the project's life or as soon as possible if timing of the project's development changes. We will work with proponents on a case-by-case basis to manage competing demands for water.

The department does not provide the results of a proponent's investigations to third parties or use them to assess other pending licence applications. However, once our regional hydrogeologist has reviewed the information we may use it to review water availability and allocation limits or potential impacts in that water management area.

Test pumping

As a guide, the department allows a cumulative total take of up to 50 ML per bore for the purpose of test pumping and commissioning. Proponents requiring a volume above this amount should discuss it with the department.

Proponents completing large-scale or long-term pump-testing may require a 5C licence and/or other approvals.

Applications for increasing an existing licence entitlement

The volumes associated with the dewatering of fractured rock aquifers may vary. If this volume is expected to exceed a current licence entitlement, an application to increase the entitlement is required. The department expects licensees to assess this as part of their ongoing commitment to monitoring and reporting their abstraction/dewatering and to consult with us as soon as it is recognised. It is not acceptable for proponents to exceed their licensed entitlement.

4 Water licensing approach

Licensees who anticipate they will take more water than their volumetric licence entitlement must submit a licence amendment application to the department, with an appropriate hydrogeological assessment to support permanent increases.

These applications should be submitted as early as possible to avoid enforcement action and delays in processing. Licensees should allow one to two months for these applications to be assessed, with the time varying according to factors such as the volume and existing approvals.

The department cannot amend licences in a way that would conflict with environmental conditions set by the EPA. Liaison with the EPA may also be required if the project was assessed under Part IV of the *Environmental Protection Act 1986* and the conditions of approval were linked to volumes of water abstracted or released and/or potential impacts from water abstraction or releases. If this is the case, amendments to Ministerial conditions must be approved before the department can approve the increased entitlement.

Applications for expanding agricultural projects

While non-intensive stock watering is exempt from licensing, any water abstraction for intensive agricultural purposes (e.g. irrigation of fodder crops or water supply for cattle feedlots) requires a water licence. This is particularly relevant for agricultural projects expanding from non-intensive stock watering to irrigation or more intensive land use activities.

As well as a water licence, proponents of irrigation or intensive land use projects may need to obtain:

- PLB authorisation for the proposed activity
- clearing permits from DER
- approval under Part IV of the *Environmental Protection Act 1986* for larger projects or those likely to have a significant environmental impact and/or
- approval or agreement from any native title claimants and/or approval from Department of Aboriginal Affairs (DAA).

The department will provide advice to the relevant agencies as necessary.

Licence assessment

Assessing water source options

When assessing licence applications, the department is required under Schedule 1, clause 7(2) of the Act to consider whether the proposed taking of water is in the public interest and whether the water can be provided by another source. In this context we promote the use of fit-for-purpose water sources.

We will work with licence applicants to ensure that all possible water sources (of varying quality) are considered when planning water supply and assessing 26D and 5C licences. Where applicants propose to use high quality water for industrial purposes, we will assess the application based on the proponent's evaluation of available options and why the proposed option is the best water source.

For guidance on what information to consider when investigating fit-for-purpose water supply and applying for water licences, see the *Western Australian water in mining guideline* (DoW 2013d).

Assessing impacts on water-dependent ecosystems

Applicants must assess the potential impacts of their proposed abstraction and/or dewatering on surface water and groundwater-dependent ecosystems. It is important to consult with the department early in the project planning phase so we can advise on the level of assessment required.

Our requirements for assessing the potential impacts to water-dependent ecosystems in the Pilbara are consistent with the assessment of impacts elsewhere in the state. However, to effectively manage risks to water-dependent ecosystems in the region, the following issues need to be considered:

- regional mapping of ecological communities in the Pilbara is not widely available and proponents will be required to identify ecosystems that may be impacted by water use
- the climate is highly variable and periods of extended drought and major floods are relatively common
- there are a range of aquifer types and recharge mechanisms present that support a range of groundwater-dependent ecosystems
- water regimes that support groundwater-dependent ecosystems vary significantly and generalised rules on response to water regime change are difficult to apply
- diverse stygofauna communities are present throughout the Pilbara.

For details on these issues, data requirements and assessing water-dependent ecosystems in the Pilbara, see Appendix B.

Assessing licences for fractured rock aquifers

The department will assess each licence application in fractured rock aquifers on a case-by-case basis. The focus of assessment will be impact management and we will develop licence conditions and a water management regime with the proponent to suit the proposed abstraction and the specific water resource.

Applicants wanting to access water from a fractured rock aquifer are required to:

- demonstrate their ability to abstract water
- identify and demonstrate their ability to manage any impacts on groundwater-dependent values over the life of the project
- assess the potential impacts on overlying or nearby alluvial aquifers
- provide an appropriate level of hydrogeological reporting, as specified in *Operational policy no 5.12* (DoW 2009c).

For further guidance, applicants should refer to the *Western Australian water in mining guideline* (DoW 2013d) or for non-mining projects, consult with the department directly.

Assessing licences for mine dewatering

In addition to the above, the department requires proponents applying for a water licence for dewatering purposes to define the end use and/or discharge of the dewater.

The department will ask proponents to evaluate all options for managing dewater and to justify the proposed option. The following are the department's options for use and/or release of dewatering volumes in order of preference:

1. Proponents must first:
   a. mitigate impacts on the environment and groundwater-dependent ecosystems through appropriate techniques (such as re-injection or infiltration of water into the aquifer)
   b. make the best use of mine dewater for fit-for-purpose activities (such as processing and dust suppression).
2. Proponents must then consider and evaluate the following options for the best use of mine dewatering surplus:
   a. transfer to a third party to meet other demand, including other proponents in the area and public water supply, as approved by the department (further discussion on third-party use is provided below)
   b. re-injection back into an aquifer at designated sites determined by the proponent and agreed by the department
   c. controlled release to the environment where the dewater release is allowed to flow (either through a pipe or overland) into a designated watercourse or wetland determined by the proponent and agreed by the department.

Applicants that seek to dispose of excess water (option 2c above) need to obtain the relevant approvals from DER under Part V of the *Environmental Protection Act 1986.*

More guidance is provided in the *Western Australian water in mining guideline* (DoW 2013d) and *Strategic policy 2.09 – Use of mine dewatering surplus* (DoW 2013c).

Use of mine dewatering surplus for non-mining purposes

The department supports the use of mine dewatering surplus by a third party or for a purpose other than mining – if there is another lawful authority for such use. It is strongly supported and deserves consideration where use of this water can facilitate appropriate and sustainable development, or have some other social or environmental benefits.

Although an additional water licence isn't necessarily required for third-party use of mine dewatering surplus, an amendment to the miner's licence conditions might be required, and so any proposed agreement with third parties should be done in consultation with the department. We can then advise the proponent and other agencies (if required) on water issues and management in the catchment.

The key considerations when looking at using mine dewatering surplus are:

- Feasibility varies – mining companies and potential third parties should evaluate the use of mine dewatering surplus on a case-by-case basis due to the variability in the quantity and quality of supply, the isolated location of these operations and the associated costs of establishing infrastructure.

- Water service provider requirements – the provision of mine dewatering surplus by mining companies or third parties may be considered a water service and require a water services licence under the *Water Services Licensing Act 1995* (WA). Water service providers should seek advice from the department to determine if a licence or an exemption from the licensing requirement is appropriate. If a licence is required, proponents will need to consult the Economic Regulation Authority.
- Other relevant approvals – possible subjection to the *Country Areas Water Supply Act 1947* if for drinking purposes, environmental approval under the *Environmental Protection Act 1986* and appropriate land tenure approvals.

These and other issues are further discussed in our *Strategic policy 2.09 – Use of mine dewatering surplus* (DoW 2013c). The policy describes the characteristics of dewatering surplus water, the inherent limitations in using it as a resource and the possible approvals required.

Assessing licences based on the proponent's ability to manage adaptively

The department will consider the proponent's ability to adaptively manage the impacts of abstraction when assessing a licence application. Larger applications should include a management trigger and response framework that is supported by a monitoring program. Adaptive management allows both the proponent and the department to continually improve their understanding of hydrogeology and the impacts of abstraction and make appropriate adjustments to management.

We will require proponents to complete the appropriate level of hydrogeological investigation and reporting in consultation with the department and in accordance with *Operational policy no. 5.12* (DoW 2009c).

Further guidance is provided in the *Western Australian water in mining guideline* (DoW 2013d).

Assessing licences for uranium mining

Consistent with other mining assessments, proponents applying to abstract water for uranium mining will need to demonstrate that any risks to aquifers and groundwater-dependent values can be managed through the life of the mine to completion and rehabilitation. Uranium mining requires assessment and approval under the *Environmental Protection and Biodiversity Conservation Act 1999* (Cwlth), which is administered by the federal Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC).

In situ recovery uranium mining should not compromise groundwater in the mineralised area or any aquifer in the vicinity of the mine to the extent that the aquifer cannot be remediated to meet the agreed post-mining use at mine completion.

The department will liaise with DMP and other government agencies throughout the licence assessment process to ensure the proposal meets appropriate standards and has the relevant approvals.

4 Water licensing approach

Managing impacts

Managing cumulative impacts

The increasing concentration of mine operations in parts of the Pilbara and the large volumes of water abstracted has meant the impacts of projects often overlap. Individual assessment of proposals requires consideration of the cumulative impacts of hydrological changes on water resources and dependent ecosystems, as well as the impacts of new proposals on existing licensees.

A cross-agency, coordinated approach is needed to establish clear expectations for new and existing proponents.

To achieve this, the department will take a staged approach to assess and license the water aspect of projects in 'subregions' where management of cumulative impacts is necessary. These stages include:

1. Identify subregions and define objectives – initially we will identify subregions and engage regional stakeholders to develop guidance similar to that developed for the Fortescue Marsh to establish a clear set of objectives for water resource management to guide licensing.
2. Data sharing – we will then investigate data-sharing options among proponents/licensees to facilitate the improved assessment of cumulative impacts.

If required, subsequent steps might include establishing more comprehensive, specific data-sharing and modelling rules, where the department can provide regional assessments or advice to proponents.

The department has worked with industry and other agencies to develop multi-agency guidance on mining in and close to the Fortescue Marsh. When assessing licences in the Fortescue Marsh area, we will use *Environmental and water assessments relating to mining and mining-related activities in the Fortescue Marsh management area* (EPA 2013) to provide consistency in the assessment and approvals processes. The guide identifies key environmental values to be maintained by all proponents operating in the marsh area and helps to define objectives for water management.

In identifying and defining additional subregions, we will develop objectives for proponents and data-sharing arrangements. Shared objectives will help ensure consistency and transparency for project assessment, including licence assessment (Table 10, Action 11). The department will consult stakeholders in developing these.

Sharing hydrogeological data is crucial because discriminating between the impacts (potential and realised) of individual projects requires knowledge of neighbouring projects or projects in the area. This requires access to certain types of data. In the Pilbara, the department will work towards developing a data-sharing process in consultation with stakeholders (Table 10, Action 12). This will focus on:

- sharing between proponents and looking at options to make the necessary hydrogeological information available

- having data-provision standards for proponents
- investigating the legal and commercial issues around data sharing and ensuring easy data storage and
- facilitating access and retrieval within the department's data management systems.

Managing mine closure

Under the *Mining Act 1978,* mine closure plans must be submitted to DMP as part of mining proposal applications. A mine closure plan:

- is required before mining activities are undertaken
- is reviewed regularly throughout the life of the mine
- is required by the EPA if a mining project is assessed under the *Environmental Protection Act 1986*
- must be prepared in accordance with the *Guidelines for preparing mine closure plans* (DMP & EPA 2011).

The department provides advice to DMP and the EPA on closure outcomes related to water, including the management of mine voids. Proponents may also require water licences and operating strategies during closure if water is being abstracted. In these cases, we will issue licences that align with DMP-approved mine closure plans.

For more information on our expectations for managing mine voids and closure, see the *Western Australian water in mining guideline* (DoW 2013d).

Maximising the beneficial use of water

Water use efficiency at ports

Port operators are the largest users of water in the Pilbara's coastal communities. As bulk handlers of iron ore, port operators require significant volumes of high quality water to operate and minimise the impacts of dust emissions on the local population.

Given the scarcity of water in the region, as well as competing demand from industrial and residential consumers, the department expects operators at ports to use water efficiently and minimise water use.

In advice to the EPA and licence assessments, we request that proponents:

- consider all appropriate water source options
- develop a detailed water balance and water use efficiency plan for new or expanding port proposals (these may be included as Ministerial conditions).

The Water Corporation also requires water use efficiency plans from the port operators it supplies water to.

We have developed guidelines with stakeholders, including the Water Corporation, to assist in the preparation of water efficiency plans for ports (DoW in prep.). For information on water balances and efficiency plans, see *Operational policy no. 1.02* (see DoW 2009a and Section 4.4) and the *Western Australian water in mining guideline* (DoW 2013d).

4.4 Statewide licensing policies

The department has statewide 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 accessed on our website at <www.water.wa.gov.au> or by contacting our regional office in Karratha on 08 9144 0200.

The most relevant policies in the Pilbara region relate to:

- hydrogeological reporting
- timely submission of information
- use of operating strategies
- metering
- water conservation and water use efficiency plans
- water trading/transactions
- recouping of unused entitlements.

The local policies stated in this plan have been designed to address local water resource management issues and are consistent with statewide policies. From time to time statewide policies might be updated or new ones introduced. If they affect the local policies in this plan we will notify stakeholders, either directly or through our plan evaluation process.

Chapter Five

Licensing policy for target aquifers

This chapter provides policy specific to the nine target aquifers that are existing or potential water supplies for ports and coastal towns (Figure 2).

5.1 Alluvial aquifers

The local policies for the target alluvial aquifers are stated in Table 4. They were developed consistent with:

- the need to manage the risks of abstraction and ensure the sustainability of water resources in the context of the variable climate
- the level of knowledge we have for each resource
- our objectives for each resource (Section 2.2).

Local policies for the lower Cane, Turner and Fortescue alluvial aquifers were drafted through the risk-based allocation planning process and refined for inclusion in this plan. The level of detail for the lower Cane and Turner policies is adequate for the low level of information, demand and risk for these aquifers. Performance indicator criteria and trigger levels for the lower Fortescue were developed from detailed ecological water requirements because demand is increasing.

For the lower Robe, Yule and De Grey alluvial aquifers we used groundwater modelling and ecological water requirements to develop more detailed policy, including criteria and trigger levels. This matches the higher level of use and risk to these resources from water abstraction.

We defined the level of risk to the resource and its values according to the demand pressure and significance of the values. A high level of management effort is required for the Yule, De Grey and Robe alluvial aquifers for the following reasons:

- The Yule alluvial aquifer is allocated at a high level of risk to dependent values in recognition of their relatively low conservation significance and the high demand from the Port Hedland regional water supply scheme. To manage this higher level of risk, a high level of management is required. This will also help manage potential impacts on salinity in the aquifer in the medium to long term.
- The De Grey River is listed in the *Directory of Important Wetlands in Australia* (EA 2001) and abstraction needs to be managed to minimise impacts on the river.
- The Robe aquifer is yet to be developed as a water supply. Our understanding of how the aquifer responds to abstraction will improve if the supply is developed. Our management of the resource may need to be adapted to suit the aquifer's response.

5 Licensing policy for target aquifers

The department will apply the policies detailed in Table 4 when assessing licence applications, setting licence conditions and working with proponents to develop operating strategies for abstraction in the target alluvial aquifers. Where local policy in this plan differs from a statewide policy, the local policy in this plan is applied.

Table 4
Local licensing policies for target alluvial aquifers in the Pilbara

Policy group	Policy detail
1. Installing bores in the target alluvial aquifers	1.1 New production bores must be located and constructed (screened) to minimise impacts from abstraction on permanent river pools identified by the department. 1.2 Licensees may be required to install new or use existing monitoring bores to monitor (and manage impacts from abstraction on) water quality across the aquifer and the position of the saltwater interface. This may include confirming the position of the saltwater interface. The department will negotiate local water quality triggers and management responses with proponents as part of developing the operating strategy associated with the licence.
2. Lower Cane and Turner alluvial aquifers	2.1 The department will require that abstraction does not significantly impact on culturally significant and permanent river pools and groundwater-dependent vegetation, including those defined in the relevant allocation limit reports. 2.2 Applications for more than 100 000 kL/yr/km (of river length) from the lower Cane alluvial aquifer will need to demonstrate that the impacts on groundwater-dependent values are manageable or not significant. The department will request that the proponent complete an H2 or H3 level assessment (*Operational policy no. 5.12,* DoW 2009c). 2.3 Applications for 200 000 kL/yr or more from the lower Turner alluvial aquifer will need to show that saline intrusion will not be caused. The department will request that the proponent complete an H2 or H3 level assessment (*Operational policy no. 5.12,* DoW 2009c). 2.4 Proponents that take groundwater in the lower Turner alluvial aquifer of less than 1000 mg/L will need to manage abstraction carefully to ensure that the high water quality resource is maintained. If proponents do not require high quality water, then we may accept some change in water quality across the aquifer. This will be assessed on a case-by-case basis.
3. Lower Yule, De Grey, Robe and Fortescue alluvial aquifers	3.1 Licensees must monitor and report to the department on groundwater and pool levels at agreed locations to manage impacts to groundwater-dependent ecosystems and meet water resource objectives. To do this, licensees must maintain groundwater and pool levels using the trigger and response framework presented in Appendix A, which will be finalised in negotiation with the proponent as part of developing the operating strategy for the licence. 3.2 In May each year, we will confirm the applicable trigger and criteria levels for the upcoming water year (May–April) based on the amount of recharge received by the aquifer (recharge class) during the previous wet season (typically October–April). 3.3 The licensee will be required to assess and report on how the aquifer is responding to abstraction in relation to the modelled response, as part of reporting requirements associated with their licence.

5.2 Millstream aquifer

Managing groundwater-dependent values

Discharge from the Millstream aquifer sustains a large wetland complex along about 20 km of the Fortescue River and its tributaries. The Millstream National Park, which encompasses this area, is listed on the Register of the National Estate and in the *Directory of Important Wetlands of Australia* (EA 2001). It is a significant area of isolated habitat for wetland flora and fauna and supports a number of regionally under-represented species. Millstream also holds important cultural and mythological significance for the Yindjibarndi and Ngarluma traditional owners (DEC 2007).

Because of Millstream's high ecological, social and cultural value, the conditions that the department has placed on the Water Corporation's licence for Millstream and Harding Dam require the dam to be used as the primary water source for the West Pilbara water supply scheme. This is consistent with the EPA's approval of Harding Dam, which recommended that Millstream aquifer only be used if water quantity or quality issues are experienced at the dam. More recently, and by prior agreement with the department, Millstream has also been used to supplement supply during peak demand periods.

Recharge of both the Harding Dam and Millstream aquifer is highly variable and occurs largely through cyclonic events. Because of their close proximity, both sources are often recharged by the same event or may concurrently experience a 'failed' wet season. As a result, Millstream may become the scheme's only source when the aquifer has experienced a long period of no recharge and declining groundwater levels.

When Millstream is being used, water abstraction rules are enforced to minimise impacts on the ecosystem. The rules are defined as a set of management criteria (performance indicators) where river flow is used to define water availability and indicate which criteria should be applied in any given year. These criteria can be summarised as:

- minimum groundwater levels – to ensure the watertable does not drop below the root depth of groundwater-dependent vegetation
- minimum rates of spring discharge from the aquifer – to ensure the environmental demand of the downstream environment is met.

These criteria, detailed in *Ecological water requirements of Millstream* (Antao in prep.), represent a revision of the previous *Millstream water management plan* (Welker 1998).

Managing water for public water supply

Together the Millstream aquifer and Harding Dam are currently the only source of fresh water to the West Pilbara water supply scheme. However, with Rio Tinto commissioning the Bungaroo resource in 2013, water it previously used from the West Pilbara scheme will be freed up for use by other demand sources on the scheme. There will also be an opportunity for additional water from Bungaroo, surplus to Rio Tinto's demand, to be provided to scheme water users and relieve pressure on the Millstream aquifer.

5 Licensing policy for target aquifers

The Millstream aquifer and Harding Dam sources are managed conjunctively, with management subject to the recommendations provided in *Harding Dam Project Public Works Department – report and recommendations by the Environment Protection Authority,* Bulletin no.115 (EPA & DEC 1982). This bulletin also recommends that the department provides a three-yearly report to the EPA on the various components of management. This reporting will be included as part of our published evaluation statements for this plan and discussed with the Millstream-Harding Consultative Committee (MHCC) (see Chapter 7, Action10).

Management responsibilities

The Water Corporation is the major licensee for the resource. As the licensee, it is responsible for ongoing groundwater-level and water quality monitoring and compliance with the water management criteria. Monitoring is undertaken and reported to the department every two months. Compliance reporting in the form of a detailed annual statement is supplied to the department.

To ensure that water-dependent values are protected, water management activities at Millstream need to be coordinated across the department, Water Corporation, Department of Parks and Wildlife (DPaW) and the traditional owners. Management is coordinated through the MHCC with representatives from each agency and the traditional owners. The MHCC's role is to coordinate agency and stakeholder activities to ensure that water abstraction from the scheme meets agreed environmental objectives. The committee meets annually and its subsidiary technical working group generally meets every two months.

Local licensing policies

The department will apply the policies in Table 5 (overpage) when reviewing the Water Corporation's licence, conditions and operating strategy. We have designed the policies to meet the objectives in Table 1.

Table 5
Local licensing policies for the Millstream aquifer

Policy group	Policy detail
4. Priority use of scheme supplies	4.1 Supply to the West Pilbara water supply scheme is to be taken from Harding Dam as the first priority source for the scheme. The need for conjunctive use of both sources at the same time needs to be identified annually as part of the annual review of the scheme (see policy 5.3).
5 Monitoring and reporting	5.1 Licensees must monitor and report to the department on groundwater and pool discharge rates at agreed locations to minimise impacts to groundwater-dependent ecosystems and meet water resource objectives. To do this, licensees must maintain groundwater and pool discharge rates using the trigger and response framework presented in Appendix A, which will be finalised in negotiation with the proponent as part of developing the operating strategy for the licence. 5.2 Licensees may be required to install new or use existing monitoring bores to monitor (and manage impacts from abstraction on) water quality across the aquifer. The department will negotiate local water quality triggers and management responses with proponents as part of developing the operating strategy associated with the licence. 5.3 Licensees will review the status of all sources to the scheme in May each year to confirm: • aquifer levels including mean aquifer level (MAL) for the Millstream aquifer • storage capacity for the Harding Dam • revised decline projections for both sources for the next three years • the likelihood of restrictions to scheme users as a consequence of the above points • any anticipated operational issues associated with the scheme • any anticipated changes to the scheme.
6. Supplementation	6.1 Supplementation of pool outflows, when triggered, is to be conducted by the licensee in accordance with the supplementation implementation procedure, which will be included in the operating strategy. Supplementation volumes are included in the total abstraction from the borefield, which is not to exceed 15 GL/yr.
7. Bore construction	7.1 New production bores must be located and constructed (screened) to minimise impacts from abstraction on the Millstream-Chichester National Park and the downstream environment.

5.3 West Canning Basin

The West Canning Basin is an important water resource for regional development. We have designed licensing policy for the West Canning Basin to:

- maximise the beneficial use of all groundwater resources
- minimise interference between water users, including managing impacts on potentiometric heads
- maintain the long-term ability to abstract from the groundwater resources
- recognise that the allocation limit may be revised to allow access to additional volumes of water if appropriate investigative work shows the additional take is sustainable.

We will consider the policies detailed below when conducting licence assessments, setting licence conditions and working with proponents to develop operating strategies in the West Canning Basin.

Maximising the beneficial use of water

Proponents will need to demonstrate that the proposed supply option is optimal and that other supply options are not technically, economically or practically feasible. Proponents should specifically consider:

- the Broome Sandstone aquifer as a potential source
- different locations within the Wallal aquifer depending on the required water quality.

This will ensure that where practical we have maximised the use of all water resources in the basin.

Water quality information is limited in the West Canning Basin but is expected to improve over time with further investigative work. The current understanding of water quality is provided in the *West Canning Basin groundwater allocation limits report* (DoW 2012c).

Managing interference between water users

New licence applicants in the Wallal aquifer must consider whether their proposed abstraction will affect existing users. Some existing licensees use potentiometric pressure in the aquifer to drive irrigation systems. New users need to identify whether and how their proposed abstraction will affect the potentiometric head of existing users and demonstrate how they will minimise any detrimental impacts.

In assessing licence applications, the department is required to review whether the proposed taking and use of water would have a detrimental effect on another person. This is assessed on a case-by-case basis. However, this is only one consideration in assessing licences and on its own may not constitute grounds for refusal.

To enable the department to assess the risk of interference between users, proponents need to demonstrate that they have:

- estimated (modelled) the potential impacts of the proposed abstraction on the potentiometric pressure of existing/operating bores

- designed their infrastructure to minimise the potential impacts (e.g. maximising the spatial spread of abstraction)
- developed an adaptive management approach for monitoring and managing impacts (including trigger and response mechanisms between the proponent's operation and existing users).

We will use this information to consider if there are any detrimental impacts on existing users as part of the licence assessment (section 7(2) of the *Rights in Water and Irrigation Act 1914)* and may include these management measures as licence conditions if deemed necessary.

If impacts are predicted, even with reasonable management measures in place, we will instruct new licence applicants to consult and negotiate with existing water users to address any detrimental impacts. The details of what the licence applicant can do to address any of these impacts should be worked out between the applicant and existing users and outcomes (agreed or otherwise) will be considered by the department on a case-by-case basis.

If detrimental effects become evident after issuing a licence, we may amend licences as per clause 24 of Schedule 1, Division 6 of the *Rights in Water and Irrigation Act 1914.*

Managing seawater intrusion

Licence applicants will have to consider the impacts of their proposal on the seawater interface in the Broome and Wallal sandstone aquifers and design and operate their infrastructure to prevent any significant impacts (e.g. any likely effects on aquifer productivity or dependent values). The proponent may achieve this through:

- modelling the impacts of the proposed abstraction on potentiometric pressure and the hydraulic gradient between the proponent's operation and the coast
- the design and operation of their abstraction infrastructure, including maximising the spatial spread of abstraction
- putting in place monitoring arrangements (including trigger and response mechanisms) between the proponent's operation and the coast.

We may include these measures as licence conditions if deemed necessary through the assessment process.

To prevent the intrusion of sea water into the aquifers, we have developed policy around three management zones (Table 6, Figure 4 and Figure 5). Consistent with the objectives, this includes minimum aquifer levels in each zone to maintain the aquifer as confined (where currently confined) and reduce the risk of seawater intrusion along the coast. These aquifer levels are not intended to be applied as minimum levels to manage interference between users.

Managing impacts on groundwater-dependent ecosystems

No significant ecosystems have been identified as dependent on discharge from the Wallal aquifer. However, discharge from the Broome aquifer (and potentially the Wallal) may provide some hydrological support to a series of wetlands along the coast and Mandora Marsh, which are part of the Ramsar-listed Eighty Mile Beach system. As the hydrological links to these wetlands are not well understood, we will require proponents to assess their potential impacts on these wetlands (Table 6).

In any licence application, proponents must consider all the available information about the location and groundwater dependence of ecosystems and the impact their proposed abstraction will have on these ecosystems (see Appendix B).

The department may choose to amend a proponent's licence if new information on the groundwater dependence of ecosystems becomes available.

Table 6
Local licensing policies for the West Canning Basin management zones

Management zone	Policy details
8. All zones	8.1 Licensees taking water from the Broome or Wallal aquifer (where it is non-artesian) will be required to record groundwater levels for every three-month period and report this information to the department annually. 8.2 Where the Wallal is artesian, licensees will be required to have department-approved flow meters or pressure gauges on each bore, record potentiometric levels for every three-month period and report this information to the department annually.
9. Coastal management zone	9.1 In the coastal zone, we require that hydrogeological assessments for the Broome aquifer demonstrate that proposals will not impact the coastal Ramsar wetlands and assess the risk of seawater intrusion. 9.2 In the coastal zone, proponents taking from the Wallal aquifer must maintain potentiometric heads above 5 mAHD at designated monitoring bores (shown conceptually in Figure 5). 9.3 If modelling indicates that abstraction will reduce pressure heads below ground level in the Wallal aquifer at any location in the coastal zone, we may require proponents to install monitoring bores between the most northerly production bore and the coast to monitor water quality and the position of the seawater interface.
10. Inland management zone	10.1 In the inland zone where the Jarlemai Siltstone is present, proponents taking from the Wallal aquifer must maintain minimum potentiometric levels at designated monitoring bores of: • 5 mAHD, where the top of the aquifer is less than 5 mAHD • 5 m above the top of the aquifer elsewhere (shown conceptually in Figure 5). 10.2 Where the Jarlemai Siltstone is absent, proponents taking from the Wallal aquifer must consider the impacts of their abstraction on (and maintain) the potentiometric levels in the coastal and inland zones.

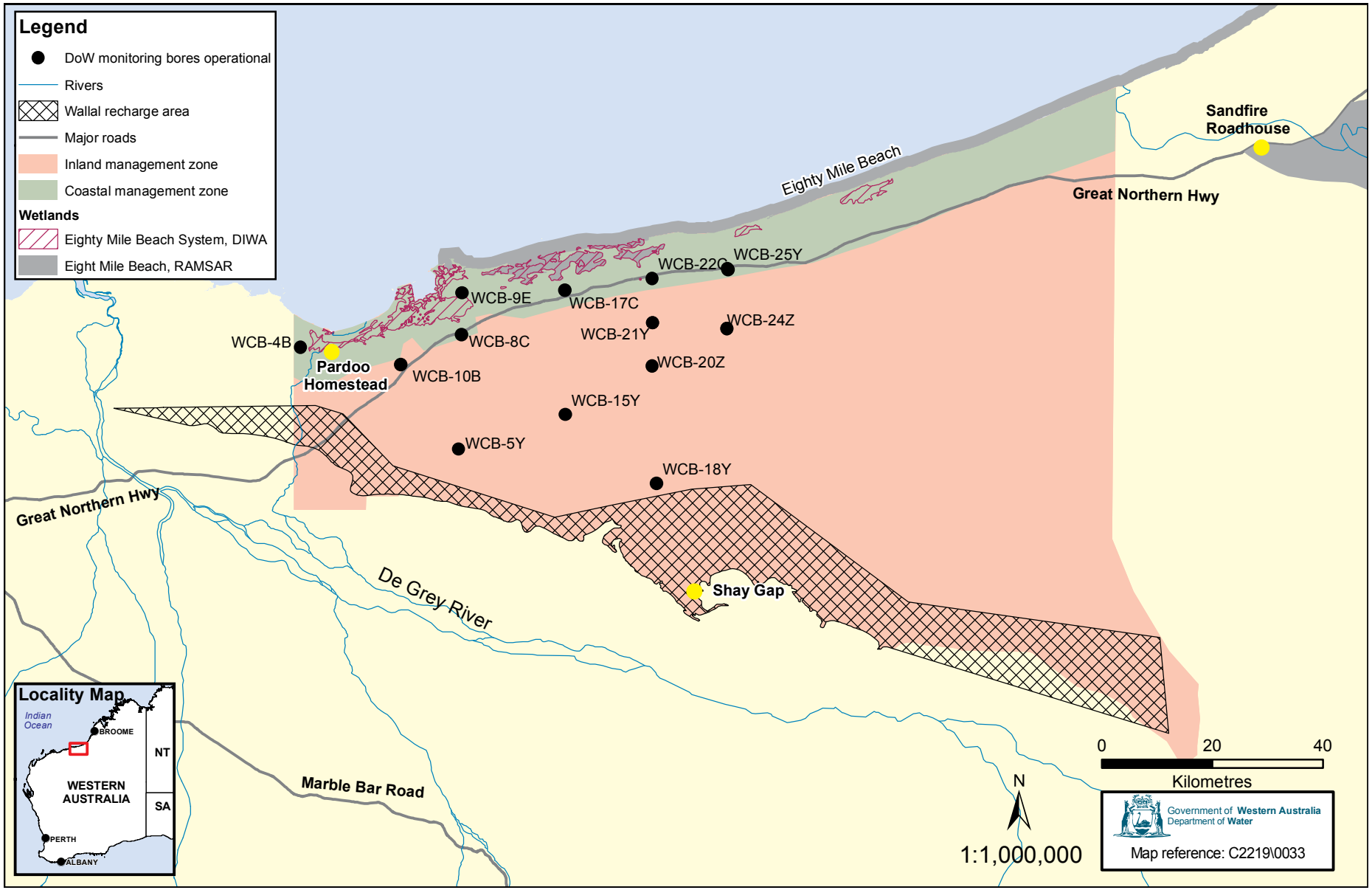

Figure 4

Management zone map of the West Canning Basin

Pilbara groundwater allocation plan

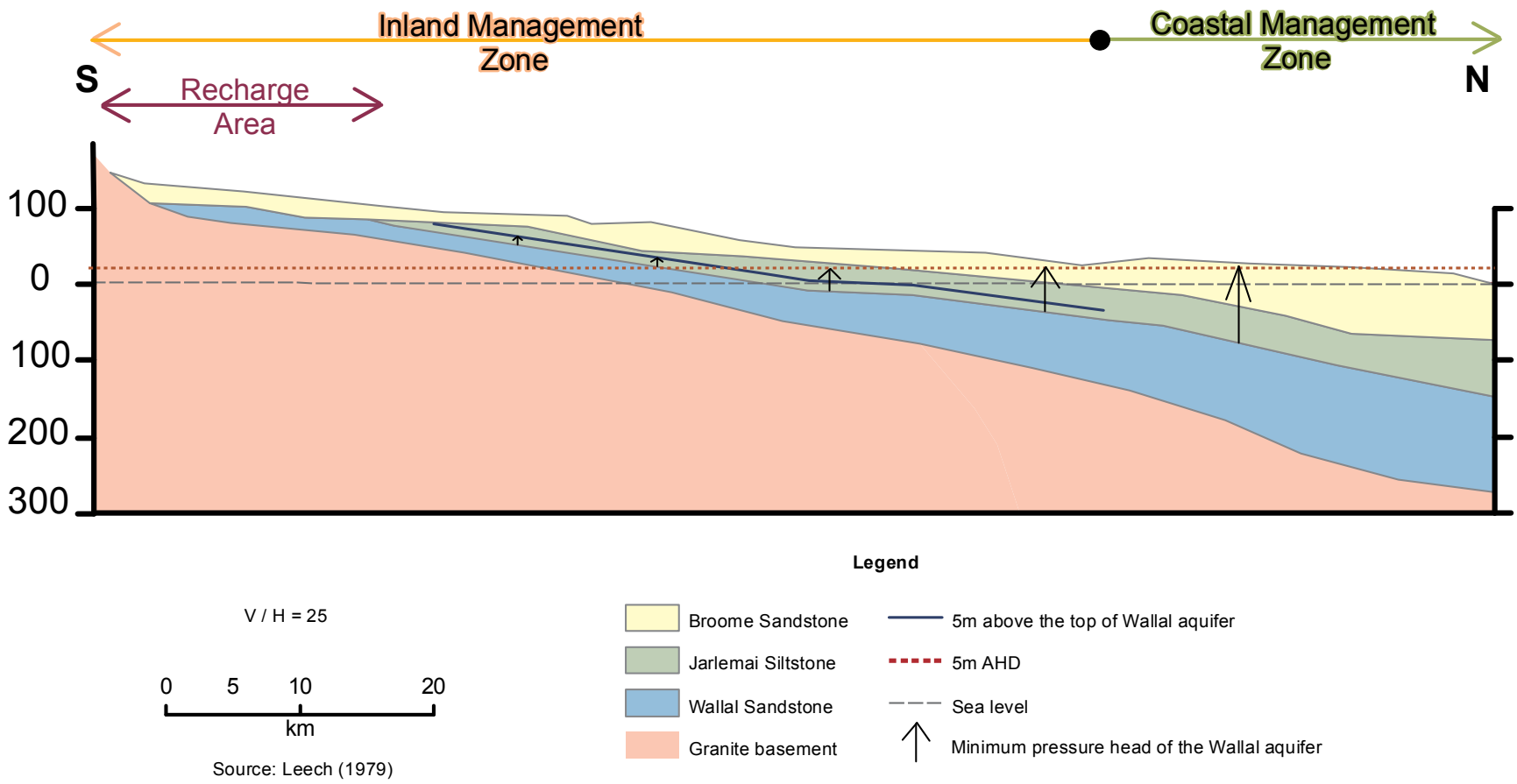

Figure 5

Example of a cross-section and location of management zones of the West Canning Basin

Pilbara groundwater allocation plan

Investigations

Recently the department began a three-year investigative program in the eastern half of the West Canning Basin (known as the Sandfire area, the eastern half in Figure 4). This work has been funded through the Royalties for Regions program as part of the Water for Pilbara Cities project and follows on from work completed as part of the Pilbara Water for the Future project. We are also working with proponents completing independent, local-scale investigations elsewhere in the resource that are likely to provide results in a shorter timeframe.

The department will review the Wallal allocation limit when the investigative work is finished (Table 11, Action 15). Given the projected growth in industrial activity and population in the Pilbara's coastal towns, we may reserve more water from the West Canning Basin for public water supply when we review the allocation limits. We may also vary the spatial availability of water to manage the impacts of abstraction on neighbouring users, the resource or environmental values. This may include changes to subarea and management zone boundaries.

Proponent investigations

The department encourages independent investigations of water availability in the basin. When investigating taking water above the allocation limits in this plan, proponents will need to:

- demonstrate that their proposed take will not affect the resource's ability to provide any volumes reserved for public water supply
- model the impact of their proposed abstraction on the potentiometric heads of existing/operating bores at their full entitlement and identify how they will prevent any detrimental impacts
- prevent seawater intrusion by considering the policies in Table 6
- maximise the spread of their abstraction
- consider impacts on groundwater-dependent wetlands.

Licence applicants should note that given the size of the resource, significant investigative work (spatial extent and number of bores) may be needed to prove up resources. Proponents should discuss investigative work programs with the department before submitting any 26D or 5C licence applications. We request that any modelling work completed by proponents contribute to the regional model that the department administers.

Chapter Six

Monitoring program for the Pilbara

This chapter sets out how the Department of Water will monitor water resources in the plan area. Monitoring will allow us to understand how resources are performing over time and in particular how they are responding to abstraction. By assessing information provided by the monitoring program against performance indicators, we can evaluate if the plan's resource objectives are being met and whether we need to adapt how we regulate and manage abstraction.

Due to the region's size, the regional monitoring program involves a combination of department and licensee monitoring is used to collect information about water resources in the Pilbara (Table 7). The regional network of monitoring bores for the target aquifers is illustrated in Figure 6 (and Figure 4 for Broome and Wallal).

Comprehensive monitoring programs are in place at resources with significant groundwater-dependent values and water quality constraints, including Millstream, Yule and De Grey.

For fractured rock aquifers and other non-target aquifers throughout the region, monitoring requirements are assessed on a case-by-case basis and are implemented by licensees as a requirement of their licence.

The department also operates a regional network of river gauging stations. These stations are primarily used for our flood warning program, but they also provide critical information about recharge to target aquifers along the coast (Figure 6).

The monitoring activities across all resources in the Pilbara are detailed further in *Monitoring program to support the Pilbara groundwater allocation plan* (DoW 2013a).

Table 7
Monitoring in the Pilbara plan area

Aquifer	Department monitoring	Licensee monitoring
Lower Cane alluvial		✓
Lower Fortescue alluvial	✓	✓
Lower Robe alluvial	✓	✓ (currently unlicensed) [1]
Millstream	✓	✓
Lower De Grey alluvial		✓
Lower Turner alluvial		✓ (currently unlicensed) [1]
Lower Yule alluvial		✓
Broome	✓	
Wallal	✓ [2]	
Fractured rock aquifers		✓ (to be set)
Other alluvial and sedimentary aquifers		✓

1 Licensee monitoring to be implemented as condition of licences when issued.

2 Department monitoring will be introduced using existing bores. See monitoring program (DoW 2013a).

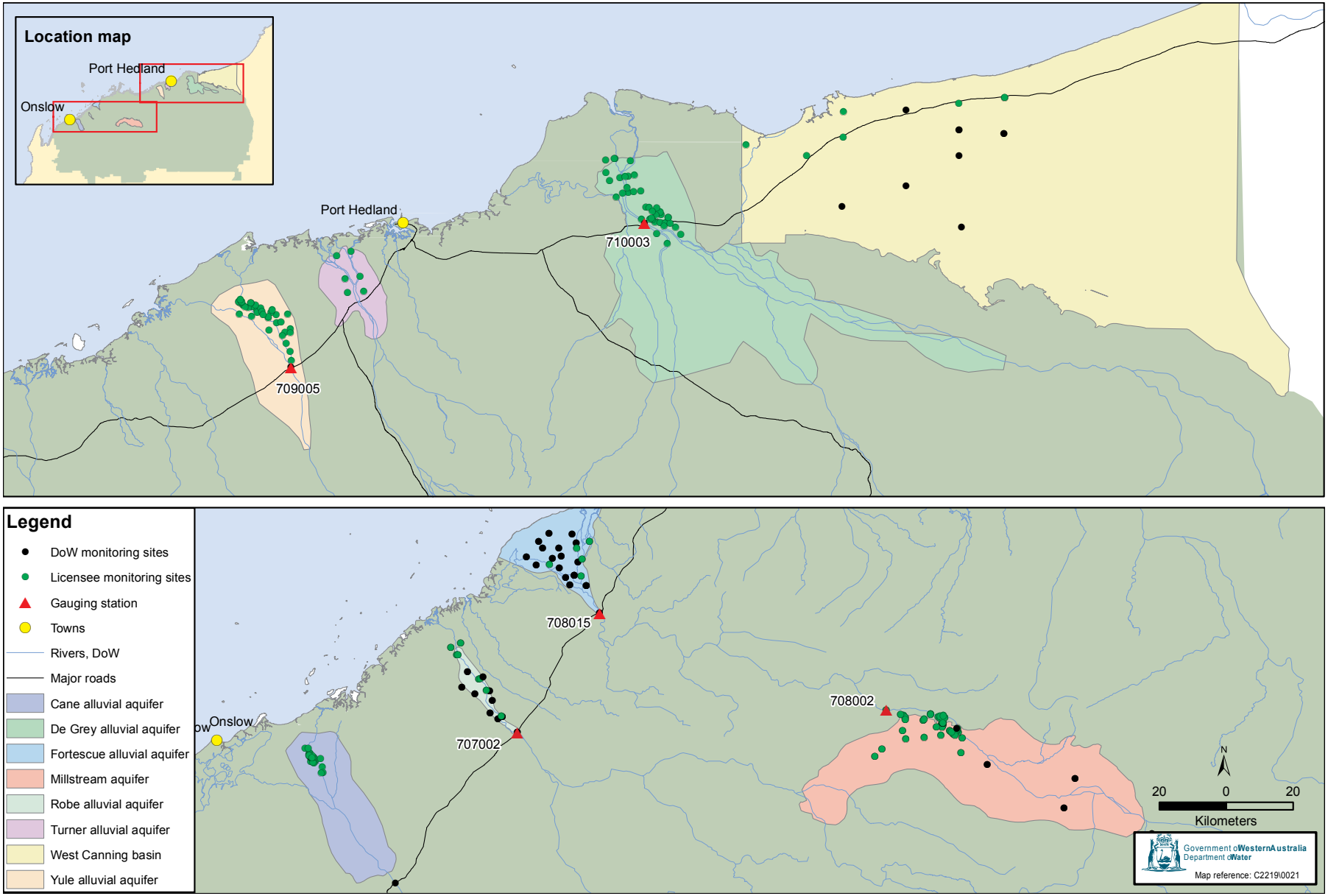

Figure 6

Monitoring sites at target resources in the Pilbara

Pilbara groundwater allocation plan

6.1 Evaluating against the resource objectives

We will use the monitoring and performance indicators in Table 8 to assess whether the plan's resource objectives are being met. For some of the objectives, baseline data needs to be collected before setting performance indicators because the information is not currently available (Table 7 and DoW 2013a). For other objectives, the department will apply performance indicators (criteria groundwater levels) based on annual recharge, using the surface water monitoring sites in Table 9. The process for setting these is outlined in Appendix A.

Criteria groundwater levels and the monitoring of these will in most cases be implemented through the operating strategies associated with licences.

Table 8
Groundwater monitoring in the plan area

Resource objective	Site [1]	Performance indicator	Frequency of data collection
Lower Cane alluvial aquifer			
a. Prevent saltwater intrusion into the aquifer caused by abstraction	Bore 6/88 Bore 10/88	To be set once baseline data collected	3 monthly
b. Maintain water quality for the most beneficial use (potable water supply)	Production bores	Maintain combined average salinity below 500 mg/L TDS	3 monthly
c. Maintain groundwater levels within a target range to avoid impacts to groundwater-dependent ecosystems and long-term productivity	Bore 1/79 Bore11//88 Bore13/88	GW level >3.21 mAHD GW level >12.86 mAHD GW level >12.86 mAHD	3 monthly
Lower Robe and Fortescue alluvial aquifers			
d. Prevent saltwater intrusion into the aquifers caused by abstraction	SWIM bores	To be set once baseline data collected	3 monthly
e. Maintain water quality for the most beneficial use (potable water supply)	Representative monitoring bores	Collect salinity data (TDS mg/L) to set performance indicator	3 monthly
f. Maintain groundwater and pool levels within a target range to maintain aquatic habitat and riparian vegetation that are dependent on groundwater	Representative GDE sites	Criteria groundwater levels as determined by recharge class (see Appendix A)	Continuous (equipped with logger)

1 Coordinates for monitoring sites are provided in the *Monitoring program to support the Pilbara groundwater allocation plan* (DoW 2013a). See also Shortened forms for relevant acronyms.

Table 8 (continued)
Groundwater monitoring in the plan area

Resource objective	Site [1]	Performance indicator	Frequency of data collection
Millstream aquifer			
g. Maintain water quality for the most beneficial use (potable water supply)	Production bores	Maintain combined average salinity below 900 mg/L TDS	November and monthly if operating
h. Maintain water quality for the environment	Supplementation bores	Maintain salinity in individual bores below historical maximum	November and monthly if operating
i. Maintain target aquifer levels to support groundwater-dependent vegetation and protect groundwater-dependent values in the national park and as listed in the *Directory of Important Wetlands in Australia* (EA 2001)	MAL 8 Bores	Criteria groundwater level determined by recharge class (see Appendix A	2 monthly
j. Maintain target aquifer discharge to support springs, pools, wetlands and vegetation in the delta and river channel and to protect groundwater-dependent values in the national park and as listed in the *Directory of Important Wetlands in Australia* (EA 2001)	Representative GDE sites	Criteria groundwater levels as determined by recharge class (see Appendix A)	2 monthly
k. Maintain target groundwater and discharge levels to support groundwater-dependent cultural and social values	Representative groundwater-dependent cultural and social sites	Criteria groundwater levels as determined by recharge class (see Appendix A)	2 monthly
Lower Yule alluvial aquifer			
l. Prevent saltwater intrusion into the aquifer caused by abstraction	Representative SWIM bores	To be set once baseline data collected	Monthly
m. Maintain water quality for the most beneficial use (potable water supply)	Production bores and selected monitoring bores	Maintain salinity below indicator levels set for individual production bores	Production bores: quarterly Monitoring bores: monthly
n. Maintain groundwater and pool levels within a target range to maintain aquatic habitat and riparian vegetation that are dependent on groundwater	Representative GDE sites	Criteria groundwater levels as determined by recharge class (see Appendix A)	2 monthly

1 Coordinates for monitoring sites are provided in the *Monitoring program to support the Pilbara groundwater allocation plan* (DoW 2013a). See also Shortened forms for relevant acronyms.

Table 8 (continued)
Groundwater monitoring in the plan area

Resource objective	Site [1]	Performance indicator	Frequency of data collection
Lower Turner alluvial aquifer			
o. Prevent saltwater intrusion into the aquifer caused by abstraction	SWIM bores (new)	To be set once baseline data collected	3 monthly
p. Maintain water quality for ongoing use (potable or industrial water supply depending on demand for water)	Representative monitoring bores (new)	To be set once baseline data collected	3 monthly
q. Maintain groundwater levels to avoid impacts to groundwater-dependent ecosystems	Representative monitoring bores (new)	To be set once baseline data collected	3 monthly
Lower De Grey alluvial aquifer			
r. Prevent saltwater intrusion into the aquifer caused by abstraction	SWIM bores (3 new)	To be set once baseline data collected	Monthly
s. Maintain water quality for the most beneficial use (potable water supply)	Representative monitoring bores	To be set once baseline data collected	Monthly
t. Maintain groundwater and pool levels within a target range to maintain aquatic habitat and riparian vegetation dependent on groundwater and protect values as listed in the *Directory of Important Wetlands in Australia* (EA 2001)	Representative GDE sites	Criteria groundwater levels as determined by recharge class (see Appendix A)	Monthly
West Canning Basin (Broome and Wallal aquifers)			
u. Limit seawater intrusion into the Broome Sandstone aquifer caused by abstraction	WCB25Y	To be set once baseline data collected	6 monthly
v. Prevent seawater intrusion into the onshore area of the Wallal aquifer	WCB4A WCB9E WCB17C WCB22C	Maintain hydraulic head above 5 mAHD	Monthly or equip with logger
w. Maintain groundwater levels in the Broome Sandstone to avoid impacts to coastal wetlands	WCB25Y	To be set once baseline data collected	6 monthly
x. Maintain pressure heads in the Wallal Sandstone above the top of the aquifer so that it remains confined	WCB4A WCB9E WCB17C WCB22C	Maintain hydraulic head above 5 mAHD	Monthly or equip with logger

1 Coordinates for monitoring sites are provided in the *Monitoring program to support the Pilbara groundwater allocation plan* (DoW 2013a). See also Shortened forms for relevant acronyms.

Table 9
Surface water monitoring used to determine recharge classes

River	AWRC reference	Gauging station name	Frequency
Fortescue	708015	Bilanoo pool	Continuous
Robe	707002	Yarraloola	Continuous
Millstream	708002	Gregory Gorge	Continuous
Yule	709005	Jelliabidina Well	Continuous
De Grey	710003	Coolenar Pool	Continuous

6.2 Triggers and management responses

To ensure that proponents and the department act before criteria groundwater levels are reached, we have developed triggers and management responses for most of the target resources.

Trigger levels are set above the criteria level to ensure that action is taken before water levels become critically low. As with the criteria levels these are applied annually based on what recharge has occurred (Appendix A).

Each trigger level has a corresponding management response so abstraction can be managed and adapted to meet the water resource objectives. This is especially important where recharge and therefore the risk to groundwater-dependent values is highly variable. The department has developed this approach to manage the groundwater-dependent values of the lower De Grey and Yule alluvial aquifers and the Millstream aquifer – because these are critical water sources for the West Pilbara and Port Hedland regional water supply schemes. They have also been developed for the lower Fortescue and Robe alluvial aquifers given demand is expected to increase.

An example of how this works when a trigger is breached, such as a specified water level, the licensee is required to respond with actions such as increasing monitoring and changing abstraction patterns. The water levels and kind of response depend on the amount of recharge the aquifer has received.

Triggers and management responses for other resources may be developed in the future depending on the level of demand and the significance of local groundwater-dependent values.

The trigger and response mechanisms will be implemented through the operating strategies associated with proponent's licences.

Trigger and response mechanisms for the seawater interface and water quality will be developed in association with operating strategies once baseline data have been collected.

6.3 Ecological monitoring

Ecological monitoring is needed to demonstrate that the water provided to meet criteria groundwater levels (Appendix A) achieves the intended environmental outcome.

Ecological monitoring will be done in combination with groundwater-level monitoring (at selected resources) and will target vegetation parameters sensitive to changes in water availability through vegetation surveys and canopy photography. Monitoring will be completed annually at Yule, De Grey and Millstream through a combination of licensee and Department of Water support. For Millstream, we will also be working with DPaW and the Water Corporation. For other resources, such as the Robe and Fortescue, monitoring may be required as water use increases.

6.4 Monitoring for future planning needs

Where practical, the department carries out monitoring in areas where growth in water demand is expected. This allows us to provide some baseline information on water availability as well as understand any constraints to water abstraction.

Investigative work in the eastern part of the West Canning Basin (see Section 5.3) has begun and we plan to start a monitoring program (likely to be in consultation with licensees) to improve our understanding of the resource. We will use information from the investigation and monitoring to refine the allocation limits for the West Canning Basin (Table 11, Action 15).

Chapter Seven

Implementing and evaluating the plan

The Department of Water will implement the *Pilbara groundwater allocation plan* by:

- licensing to the allocation limits in Chapter 3 or on a case-by-case basis for fractured rock aquifers
- issuing licences according to the allocation and licensing approach detailed in chapters 4 and 5
- carrying out monitoring as set out in the monitoring program (Chapter 6).

Once the plan is in place, we will regularly evaluate whether the plan objectives are being met (at least every three years) and adapt our management of abstraction accordingly.

This section sets out additional actions to implement and evaluate the plan, including provisions to identify if and when a new plan is required.

7.1 Implementing the plan

To successfully implement the *Pilbara groundwater allocation plan* we identified a number of actions to carry out over the next seven years (Table 10).

Table 10
Actions to implement the *Pilbara groundwater allocation plan*

Action	Responsibility [1]	Timeline
Licensing		
1. With input from licensees and following review of flow/recharge, confirm applicable criteria levels for the coming water year for target groundwater resources	Water Allocation Planning, Water Resource Assessment and Pilbara Region	May each year
Monitoring		
2. Set up the monitoring program (see DoW 2013a)	Water Allocation Planning, Water Measurement, Pilbara Region and licensees (consistent with licence)	2013

1 Department of Water branch responsible for implementing the actions in the plan area.

Table 10 (continued)
Actions to implement the *Pilbara groundwater allocation plan*

Action	Responsibility [1]	Timeline
3. Update operating strategies with new monitoring requirements and trigger and response tables	Pilbara Region	2013 or as required
Resource assessment		
4. Assess water resource trends using measurement data from licensee reporting and department monitoring	Water Resource Assessment	During plan evaluations
5. For relevant target resources, review baseline monitoring data and develop performance indicators and trigger and response mechanisms for saltwater intrusion and water quality objectives (see Table 8)	Water Allocation Planning, Water Resource Assessment and Pilbara Region	2015—2016
6. Assess and calibrate the recharge relationship for all of the target aquifers	Water Resource Assessment and Pilbara Region	Every three years
7. Assess the need to review the groundwater models for the lower Yule, De Grey, Robe and Fortescue, Millstream and West Canning Basin	Water Resource Assessment (based on reporting from Water Corporation)	Every three years (as part of licensee triennial reporting and plan evaluations)
Reporting		
8. Publish evaluation statement	Water Allocation Planning, Water Resource Assessment and Pilbara Region	At least every three years
9. Organise and hold the MHCC meeting	Pilbara Region	Annually
10. Reporting to the EPA on management outcomes for Millstream to be set up through MHCC and evaluation statements	Water Allocation Planning and Pilbara Region	2014

1 Department of Water branch responsible for implementing the actions in the plan area.

7 Implementing and evaluating the plan

To prepare for future allocation planning in the Pilbara, we identified a number of actions that will improve the knowledge of groundwater resources and how we manage increased demand (Table 11).

Table 11
Actions to support future planning

Action	Responsibility [1]	Timeline
11. Identify subregions and develop qualitative objectives for managing cumulative impacts	Pilbara Region and OEPA	2013 onwards
12. Investigate data-sharing options to facilitate cumulative impact assessment in the Pilbara	Pilbara Region and Water Information	2014 onwards
13. Revise the operating rules for Bungaroo and Millstream and the sustainable yield and reliability for the West Pilbara water supply scheme	Water Allocation Planning, Water Supply Planning and Pilbara Region	2013
14. Review the allocation limit for Bungaroo, with consideration of Rio Tinto's water needs, to ensure the appropriate balance of industrial and public water supply needs from any additional water found	Water Allocation Planning, Water Resource Assessment and Pilbara Region	As required
15. Review allocation limits for the West Canning Basin after the Royalties for Regions and proponent investigations are complete	Water Allocation Planning, Water Resource Assessment and Pilbara Region	2016—2017

1 Department of Water branch responsible for implementing the actions in the plan area.

7.2 Evaluating the plan

We will annually evaluate whether the plan outcomes are being delivered 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 evaluation
- a snapshot of resource status for target aquifers
- the status of plan management and actions due in the evaluation period
- our performance against the plan outcomes and resource objectives
- how we will adapt our water resource management (if necessary).

Appendices

Pilbara groundwater allocation plan

A Appendix A
Trigger and criteria levels for monitoring the target aquifers

The Department of Water has set trigger and criteria water levels to manage risks to groundwater-dependent river pool and riparian vegetation ecosystems. The criteria water levels are the performance indicators the department will use to manage abstraction in accordance with the water resource objectives. The levels set the amount of water that is left in the target aquifers following abstraction and are based on the ecological water requirements (EWR/s) we determined for the groundwater-dependent ecosystems associated with the target aquifers. More detail is provided in the *Monitoring program to support the Pilbara groundwater allocation plan* (DoW 2013a).

In this section we explain how we set these levels and provide the levels for the lower Yule, De Grey, Robe and Fortescue alluvial aquifers. We used a different approach for Millstream and this is explained separately. Water levels for the lower Cane and Turner alluvial aquifers will be developed when licensing increases.

How the department set levels for lower Yule, De Grey, Robe and Fortescue

Rather than set static water-level criteria, the department has determined water levels for a range of water availability conditions – drought, dry, average and above average/wet conditions. This was done to:

- account for the natural variability in water availability from year to year and
- recognise that a range of water levels are important for maintaining robust, resilient ecosystems.

We developed water levels based on the results of a field experiment at the lower Yule alluvial aquifer and EWR studies at the target resources. EWRs were set based on percentiles of groundwater-level distributions, for example, using the 5th percentile for drought conditions, 20th for dry conditions and 50th for average and wet conditions.

Because we need to balance the demand for water supply with water to support the environment and aquifer productivity, the full EWR cannot be met in all cases. Therefore, we have determined environmental water provisions (EWPs) that represent some compromise on the EWRs based on the level of allocation and risk associated with the resources. The EWPs represent post-abstraction water levels depending on the recharge received (5th percentile for drought, 20th for dry and 50th for average and wet conditions).

To develop a management framework, we set criteria levels that must be met (performance indicators) as well as trigger levels that sit above criteria to ensure that action is taken before water levels become critically low. Generally, we used the EWRs as trigger levels and the EWPs as criteria levels for each of the drought, dry and average conditions. Under average and wet conditions, a target water level representing the 50th percentile EWR is set instead of a trigger or criteria level. The target level allows some recovery in the system while there is more water available, but does not impose the same level of management and response.

Appendix A
Trigger and criteria levels
for monitoring the target aquifers

A

Applying trigger and criteria levels annually

Trigger and criteria levels (or target levels) are applied depending on water availability conditions, defined by recharge classes. We developed the recharge classes based on river flow (the major source of recharge to these aquifers). There are four recharge classes:

- Class 1 – drought conditions.
- Class 2 – dry conditions.
- Class 3 – average conditions.
- Class 4 – above average/wet conditions.

Based on the flow in the preceding wet season or water year, a recharge class is determined for the coming water year and the appropriate water levels are applied (Table A 1).

Table A 1
How to apply trigger, criteria and target water levels

Percentile water level	Recharge class			
	1 Drought	2 Dry	3 Average	4 Above average/ wet
50th			Target (EWR)	Target (EWR)
20th		Trigger (EWR) Criteria (EWP)	Criteria (EWR)	
5th	Trigger (EWR) Criteria (EWP)			

How we set levels and recharge classes varied slightly between resources. This is because of differences between resources in the:

- relationship between flow and aquifer response (to recharge)
- reliability of river flow and recharge
- data available to develop the framework
- level of resource use and therefore management requirements.

More detail on the development of the levels and recharge classes is provided in the relevant allocation limit reports and other supporting documents including EWR reports (listed in Chapter 3 and the References).

A

Appendix A
Trigger and criteria levels
for monitoring the target aquifers

Port Hedland regional water supply scheme

Lower De Grey alluvial aquifer

Trigger and criteria levels have been set for seven groundwater-dependent river pools and/or areas of riparian vegetation along the lower De Grey. The approach is described in more detail in the *Lower De Grey and Yule groundwater allocation limits report* (DoW 2012a).

In May each year we will use the total wet season (October – April) flow from Coolenar Pool gauging station to determine the recharge class as shown in Table A 2.

Once the recharge class is determined the applicable trigger and criteria (or target) for the following water year (May–April) is set in accordance with Table A 3.

Table A 2
Lower De Grey recharge classes

Recharge class	Water availability conditions	Total wet season flow (October - April) ML
1	Drought	<100 000
2	Dry	100 000 – 450 000
3	Average	450 000 – 2 000 000
4	Above average/ wet	>2 000 000

Table A 3
Trigger and criteria groundwater and pool levels for the lower De Grey alluvial aquifer

Site	Recharge class	Trigger (mAHD)	Criteria (mAHD)	Target (mAHD)
Bore U1	1 Drought	9.26	9.15	
	2 Dry	9.65	9.61	
	3 Average	-	9.65	10.06
	4 Wet	-	-	10.06
J96 Pool	1 Drought	9.86	9.56	
	2 Dry	10.16	9.79	
	3 Average	-	10.58	10.62
	4 Wet	-	-	10.62

Appendix A
Trigger and criteria levels for monitoring the target aquifers

A

Table A 3 (continued)
Trigger and criteria groundwater and pool levels for the lower De Grey alluvial aquifer

Site	Recharge class	Trigger (mAHD)	Criteria (mAHD)	Target (mAHD)
Bore 9/04	1 Drought	7.05	6.90	
	2 Dry	7.38	7.25	
	3 Average	-	7.38	7.72
	4 Wet	-	-	7.72
Homestead Pool	1 Drought	6.54	6.31	
	2 Dry	6.77	6.64	
	3 Average	-	6.98	7.10
	4 Wet	-	-	7.10
Bore 6/04	1 Drought	7.87	7.81	
	2 Dry	8.48	8.38	
	3 Average	-	8.48	9.14
	4 Wet	-	-	9.14
Makanykarra Pool	1 Drought	8.53	8.38	
	2 Dry	8.84	8.81	
	3 Average	-	9.51	9.52
	4 Wet	-	-	9.52
Bore 7/04 (Coolenar Pool)	1 Drought	14.42	13.96	
	2 Dry	14.47	14.45	
	3 Average	-	14.47	14.96
	4 Wet	-	-	14.96
Bore H2 [1] Nardeegeecarblin Pool)	1 Drought	18.15	18.05	
	2 Dry	18.39	18.30	
	3 Average	-	18.39	18.94
	4 Wet	-	-	18.94
Bore I2 [1]	1 Drought	20.33	20.17	
	2 Dry	20.48	20.36	
	3 Average	-	20.48	20.82
	4 Wet	-	-	20.82
Bore F1 [1]	1 Drought	21.65	21.30	
	2 Dry	22.16	21.88	
	3 Average	-	22.16	23.38
	4 Wet	-	-	23.38

1 Water levels determined from modelled data and will be refined as monitoring data becomes available.

A

Appendix A
Trigger and criteria levels
for monitoring the target aquifers

Yule alluvial aquifer

Trigger and criteria levels have been set for 10 groundwater-dependent river pools and/or areas of riparian vegetation along the lower Yule. Eight sites are predicted to experience drawdown impacts and two sites upstream of the borefield are reference sites. The approach is described in more detail in the *Lower De Grey and Yule groundwater allocation limits report* (DoW 2012a).

In May each year the total water year (May–April) flow from Jelliabidina Pool gauging station is used to define the recharge class as shown in Table A 4.

Once the recharge class is determined the applicable trigger and criteria (or target) for the following water year (May–April) is set in accordance with Table A 5.

Table A 4
Yule recharge classes

Recharge class	Water availability conditions	Total wet season flow (November –April) ML
1	Drought	<3000
2	Dry	3000 – 50 000
3	Average	50 000 – 500 000
4	Above average/ wet	>500 000

Table A 5
Trigger and criteria groundwater levels for the Yule alluvial aquifer

Site	Recharge class	Trigger (mAHD)	Criteria (mAHD)	Target (mAHD)
Bore 8/04	1 (Drought)	8.27	7.28	
	2 (Dry)	9.23	8.25	
	3 (Average)	-	9.23	10.78
	4 (Wet)	-	-	10.78
Bore 10/04	1 (Drought)	8.47	7.45	
	2 (Dry)	9.86	8.88	
	3 (Average)	-	9.86	12.18
	4 (Wet)	-	-	12.18
Bore 12/04	1 (Drought)	12.08	11.09	
	2 (Dry)	14.30	13.32	
	3 (Average)	-	14.30	15.39
	4 (Wet)	-	-	15.39

Table A 5 (continued)
Trigger and criteria groundwater levels for the Yule alluvial aquifer

Site	Recharge class	Trigger (mAHD)	Criteria (mAHD)	Target (mAHD)
Bore 13/04	1 (Drought)	15.59	14.61	
	2 (Dry)	17.53	16.55	
	3 (Average)	-	17.53	18.34
	4 (Wet)	-	-	18.34
Bore 14/04	1 (Drought)	17.44	16.46	
	2 (Dry)	18.77	17.79	
	3 (Average)	-	18.77	19.82
	4 (Wet)	-	-	19.82
Bore 15/04	1 (Drought)	22.35	21.37	
	2 (Dry)	23.12	22.14	
	3 (Average)	-	23.12	24.22
	4 (Wet)	-	-	24.22
Bore 34/04	1 (Drought)	9.41	8.42	
	2 (Dry)	10.06	9.07	
	3 (Average)	-	10.06	10.68
	4 (Wet)	-	-	10.68
Bore 37/04	1 (Drought)	8.12	7.19	
	2 (Dry)	8.87	7.88	
	3 (Average)	-	8.87	10.32
	4 (Wet)	-	-	10.32
Bore 17/04	1 (Drought)	28.28	27.98	
	2 (Dry)	28.96	28.66	
	3 (Average)	-	28.96	29.48
	4 (Wet)	-		29.48
Bore 21/04	1 (Drought)	31.45	31.16	
	2 (Dry)	32.03	31.73	
	3 (Average)	-	32.03	32.48
	4 (Wet)	-	-	32.48

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Appendix A
Trigger and criteria levels for monitoring the target aquifers

Management response for the Port Hedland regional water supply scheme

For the Yule and De Grey aquifers the water levels have been included in a trigger and response framework for the Port Hedland regional water supply scheme. The framework incorporates reporting, monitoring and responses in the management of take from the bore fields – with increasing levels of effort towards the most critical drought condition (Table A 6).

This framework will be implemented as part of an operating strategy attached to the licences held by the Water Corporation for both aquifers.

Table A 6
Responses when water levels are breached for the lower De Grey, Yule alluvial aquifers

Response	Recharge class						
	4 (Wet)	3 (Average)		2 (Dry)		1 (Drought)	
	Target	Target	Criteria	Trigger	Criteria	Trigger	Criteria
1. Reporting:							
• annually	✓	✓	✓		✓	✓	✓
• monthly			✓		✓	✓	✓
2. Increased monitoring:							
• fortnightly			✓	✓	✓	✓	✓
3. Local response:							
• spread take across borefield (to minimise impacts)			✓		✓	✓	
4. Scheme response:							
• consider spread across scheme					✓		
5. Critical response:							
• spread across scheme							✓
• reduce take							✓
• use contingency sources							✓

Lower Robe alluvial aquifer

Trigger and criteria levels were determined for four groundwater-dependent river pools and/or areas of riparian vegetation along the lower Robe.

In May each year the previous year/s total wet season (Oct–Apr) flow from Yarraloola gauging station is used to define the recharge class as shown in Table A 7.

Once the recharge class is determined the applicable trigger and criteria (or target) for the following water year (May–April) is set in accordance with Table A 8.

Table A 7
Robe recharge classes

Recharge class	Water availability conditions	Total wet season flow (November – April) ML
1	Drought	Previous two years flow < 4000
2	Dry	< 20 000 (except where class 1 applies)
3	Average	20 000 – 100 000
4	Above average/ wet	> 100 000

Table A 8
Trigger and criteria levels for the lower Robe alluvial aquifer

Site	Recharge class	Trigger (mAHD)	Criteria (mAHD)	Target (mAHD)
Bore 1A (Little Jimutda pool)	1 (Drought)	41.57	40.47	
	2 (Dry)	42.28	41.25	
	3 (Average)		42.28	42.94
	4 (Wet)			42.94
Bore 9A (unnamed pool)	1 (Drought)	30.73	29.57	
	2 (Dry)	30.82	30.27	
	3 (Average)		30.82	31.71
	4 (Wet)			31.71
Bore new (Maraminji Pool) [1]	1 (Drought)	23.32	22.56	
	2 (Dry)	23.74	23.19	
	3 (Average)		23.74	24.18
	4 (Wet)			24.18
Bore new (Warali Pool) [1]	1 (Drought)	11.45	10.53	
	2 (Dry)	11.77	11.00	
	3 (Average)		11.77	12.14
	4 (Wet)			12.14

1 interim pending baseline data

A

Appendix A
Trigger and criteria levels
for monitoring the target aquifers

Lower Fortescue alluvial aquifer

Trigger and criteria water levels were determined for five groundwater-dependent river pools and/or areas of riparian vegetation along the lower Fortescue. As abstraction impacts were not modelled for the Fortescue, criteria levels were based on average drawdown modelled for other alluvial aquifers.

In May each year the total wet season (October – April) flow from Bilanoo Pool gauging station is used to define the recharge class as shown in Table A 9.

Once the recharge class is determined the applicable trigger and criteria (or target) for the following water year (May–April) is set in accordance with Table A 10.

Table A 9
Fortescue recharge classes

Recharge class	Water availability conditions	Total wet season flow (October – April) ML
1	Drought	<1000
2	Dry	1000 – 50 000
3	Average	50 000 – 600 000
4	Above average/ wet	>600 000

Table A 10
Trigger and criteria levels for the lower Fortescue alluvial aquifer

Site	Recharge class	Trigger (mAHD)	Criteria (mAHD)	Target (mAHD)
Bilanoo Pool [1]	1	9.27	9.00	
	2	9.28	9.01	
	3	-	9.28	9.63
	4	-	-	9.63
2B (Stewart Pool)	1	16.55	16.28	
	2	17.75	17.48	
	3	-	17.75	19.41
	4	-	-	19.41
8A (Jilan Jilan Pool)	1	13.28	13.01	
	2	14.07	13.80	
	3	-	14.07	15.59
	4	-	-	15.59
22A (Mungajee Pool)	1	5.59	5.32	
	2	5.97	5.70	
	3	-	5.97	7.66
	4	-	-	7.66

1 interim pending bathymetry

Management response for the Robe and lower Fortescue alluvial aquifers

We have developed a trigger and response framework for the lower Robe and Fortescue aquifers (Table A 11). However, licensed use at both aquifers is currently very low and does not require this level of management. We will apply the management framework when licensed use exceeds 70 per cent of the allocation limits.

This framework will be implemented as part of an operating strategy attached to the licences for both aquifers.

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Appendix A
Trigger and criteria levels for monitoring the target aquifers

Table A 11
Responses when water levels are breached for Robe and lower Fortescue aquifers

Response	Recharge class						
	4 (Wet)	3 (Average)		2 (Dry)		1 (Drought)	
	Target	Target	Criteria	Trigger	Criteria	Trigger	Criteria
1. Reporting:							
• annually	✓	✓	✓		✓	✓	✓
• monthly			✓		✓	✓	✓
2. Increased monitoring:							
• fortnightly			✓	✓	✓	✓	✓
3. Local response:							
• spread take across borefield (to minimise impacts)			✓		✓	✓	
4. Critical response:							
• spread take							✓
• reduce take							✓
• use contingency sources							✓

Millstream aquifer

EWRs were set for sites representative of the groundwater-dependent vegetation occurring across Millstream and for the Millstream wetlands.

Because of the different ways the aquifer supports ecosystems, these EWR are in the form of spring discharge flow rates (for wetlands ecosystems), local groundwater levels (for delta and riverine riparian vegetation) or groundwater levels represented by the mean aquifer level (MAL) (for riparian vegetation on the aquifer).

Further information will be provided in *Ecological water requirements of Millstream* (Antao in prep.).

Applying criteria levels annually at Millstream

Because of the ecological objectives that have been set for Millstream (to protect and support groundwater-dependent values), we have used the EWRs as criteria (Table A 12). That is, we have accepted a lower level of risk to the environment by setting criteria at the EWR (rather than some compromise as we did for the other target resources).

Appendix A
Trigger and criteria levels for monitoring the target aquifers

A

Table A 12
Criteria and triggers for groundwater and outflow levels for the Millstream aquifer

Groundwater-dependent value	5th %ile (Drought Criteria)	15th %ile (Drought Trigger)	20th %ile (Dry Criteria)	50th %ile (Average/ wet Criteria)	Measure	Unit
Wetlands						
Deep Reach Pool discharge	0.20	0.22		0.26	flow	kL/s
Chinderwarriner Pool discharge	0.11	0.14	0.16	0.21	flow	kL/s
Aquifer vegetation						
MAL8 (representing 08/04, 1E, P7/78, P8/77, Palm Spring P8)	293.50	293.57	293.60	293.80	MAL8 groundwater level	MAL8
Palm Spring P2	278.74	278.68	278.80	278.93	groundwater level	mAHD
Riverine and delta vegetation	5th %ile (Criteria)		20th %ile (Trigger)	50th %ile (Trigger)	Measure	Unit
P10	270.07		270.28	270.70	groundwater level	mAHD
P7/77	290.46		290.70	291.02	groundwater level	mAHD
03/04	285.76		285.81	285.86	groundwater level	mAHD
12/04	283.96		284.14	284.27	groundwater level	mAHD
04/04	287.32		287.43	287.65	groundwater level	mAHD
P2/77	278.70		279.28	279.73	groundwater level	mAHD
P3/77	278.01		278.20	278.35	groundwater level	mAHD
P4/78	283.22		283.51	283.79	groundwater level	mAHD

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Appendix A
Trigger and criteria levels
for monitoring the target aquifers

For wetlands and riparian vegetation on the aquifer, criteria levels are applied depending on water availability conditions, defined by recharge classes. To allow lead time for management responses to be implemented before critical drought levels are reached we have set a trigger level above the drought criteria (Table A 13). These trigger levels are therefore set above the EWR.

For riverine and delta riparian vegetation recharge classes do not apply. Groundwater levels in this area are influenced by a range of factors and do not relate well to river flow, and so recharge classes could not be established.

Table A 13
How to apply criteria for recharge classes for the Millstream aquifer

Percentile water level/ flow	Recharge class		
	1 Drought	2 Dry	3 Average/wet
50th			Criteria (EWR)
20th		Criteria (EWR)	
15th	Trigger		
5th	Criteria (EWR)		

In May each year we will use the total wet season (December–April) flow from Gregory Gorge gauging station to determine the recharge class, as shown in Table A 14. Once the recharge class is determined the applicable criteria for the following water year (May–April) is set in accordance with Table A 15.

Table A 14
Millstream recharge classes

Recharge class	Water availability condition	Total wet season flow/s (December – April) ML
1	Drought	< 43 000 for previous 3 or more years
2	Dry	< 43 000 for previous 1 or 2 years
3	Average to wet	> 43 000

Management response for Millstream

For Millstream the EWRs have been included in a trigger and response framework for the West Pilbara water supply scheme. The framework incorporates reporting, monitoring, ecological supplementation and management of take from the borefield – with increasing levels of effort as levels or flows fall (Table A 15).

This framework will be implemented as part of an operating strategy attached to the licences held by the Water Corporation for the West Pilbara water supply scheme.

Table A 15

Responses when criteria are breached for the Millstream aquifer

Response	Wetlands (Spring discharge rates)				Aquifer vegetation (GW levels)				Riverine and delta vegetation (GW levels)		
	Recharge class				Recharge class				(Classes not applicable)		
	3 (Wet)	2 (Dry)	1 (Drought)		3 (Wet)	2 (Dry)	1 (Drought)		50th percentile	20th percentile	5th percentile
	Criteria	Criteria	Trigger	Criteria	Criteria	Trigger	Trigger	Criteria			
1. Monitoring and reporting:											
• increase frequency of groundwater or flow monitoring	✓	✓	✓		✓	✓	✓		✓	✓	✓
• increase reporting to department and scheme technical working group (TWG)	✓	✓	✓		✓	✓	✓		✓	✓	✓
• commence downstream flow monitoring	✓	✓	✓								
• commence additional vegetation monitoring						✓	✓			✓	✓
2. Supplementation											
• Trigger supplementation plan	✓*	✓	✓							✓**	
3. Local response:											
• spread take across borefield (to minimise impacts)		✓	✓			✓	✓				
4. Scheme response:											
• Consider spread across scheme			✓				✓			✓	
5. Critical response:											
• commence supplementation		✓	✓**								✓**
• reduce take			✓					✓**			✓
• use contingency sources			✓					✓**			✓

* This response should only be triggered at this level if flow from Livistona Pool has ceased, flow across the Delta is insufficient or Gregory Gorge targets are not being met.

** This response can be triggered earlier if monitoring indicates that ecosystems are responding to reduced water availability.

Appendix B
Groundwater-dependent ecosystems:
guideline for assessing licences in the Pilbara

Intent of this guideline

The Department of Water manages water abstraction through individual water licences issued under the *Rights in Water and Irrigation Act 1914*. Through the licensing process we manage the potential impacts of abstraction on the water resource and its dependent environment.

This guideline describes how proponents should identify the potential ecological risks and impacts of groundwater abstraction for a proposed project and then demonstrate how these will be managed.

It provides guidance on:

- the steps for assessing impacts on groundwater-dependent ecosystems (GDEs) as part of a water licence assessment process
- aligning GDE and water licence assessment with environmental impact assessment and approvals under the *Environmental Protection Act 1986* (where this is relevant), using reference to the department's *Water in mining guideline* (DoW 2013d)
- key issues that need to be considered for Pilbara GDEs
- sources and availability of relevant information that will be useful to proponents in identifying and planning how to manage potential impacts on GDEs.

This guideline supplements *Operational policy no. 5.12 – Hydrological reporting associated with a groundwater well licence* (DoW 2009c) and the *Water in mining guideline* (DoW 2013d), which together outline the information the department needs to assess a 5C licence application where there are likely to be impacts on GDEs.

Types of groundwater-dependent ecosystems

GDEs rely, at least in part, on access to groundwater for survival. GDEs may be associated with the range of aquifer types in the Pilbara: shallow alluvial, fractured rock or deep sedimentary.

We know that the following GDEs are present in the Pilbara region:

- Ecosystems dependent on surface expressions of groundwater
  - wetlands including river pools, springs, marshes and lakes
  - dependent aquatic and emergent macrophytes, fish, macroinvertebrates and terrestrial vertebrate fauna.
- Ecosystems dependent on subsurface groundwater
  - riparian and floodplain flora, vegetation and dependent terrestrial fauna
  - aquifer ecosystems such as stygofauna.

Assessment process

The GDE assessment process has four steps.

Step 1 Locate, map and describe the potential GDEs.

Step 2 Assess the degree of dependence on groundwater and describe the pre-project water regime.

Step 3 Assess the level of impact the proposed groundwater abstraction and/or dewatering is likely to have on the GDEs.

Step 4 Set up a management framework to manage against objectives and reduce any impacts on GDEs.

The process matches the stages of the *Water in mining guideline* (DoW 2013d) which, for larger projects, aligns approvals under the *Rights in Water and Irrigation Act 1914* with approval processes administered by the EPA and DER.

Aligning the GDE and *Water in mining guideline*

<table>
<tr><th>GDE guideline steps</th><th>Water in mining guideline</th></tr>
<tr><td colspan="2">A. Preliminary consultation</td></tr>
<tr><td>1. Identify, map and describe GDE condition</td><td rowspan="2">B. Scoping (and undertaking) the water management task</td></tr>
<tr><td>2. Degree of dependence on groundwater</td></tr>
<tr><td>3. Level of project's impact on GDE</td><td>C. Water licence application (and EPA assessment)</td></tr>
<tr><td rowspan="2">4. Management framework</td><td>D. Operating strategy and final licence decision</td></tr>
<tr><td>E. Construction and operation</td></tr>
<tr><td></td><td>F. Decommissioning and closure</td></tr>
</table>

Preliminary consultation for the water licence needs to include consideration of GDEs. Consultation early in project development, to confirm the scope of investigations, should help to streamline and align approvals to meet requirements for all agencies.

Appendix B
Groundwater-dependent ecosystems:
guideline for assessing licences in the Pilbara

The assessment process is also applicable to smaller scale or lower impact projects (where approval under the *Environmental Protection Act 1986* may not be required). The level of detail required at each stage should match the scale and risk (to GDEs) of the project. The scope of and need to complete each stage should be informed by the results of the assessment/information collected throughout the process.

Step 1 Identify, map and describe the groundwater-dependent ecosystems

Identify and map potential groundwater-dependent ecosystems

Potential GDEs need to be identified and mapped through a combination of interpretation of local hydrogeology and ecosystems. A desktop study using available information is a relatively simple first step that should be completed at this stage.

Existing datasets can provide useful information to help identify potential GDEs. The department has available the following datasets and information relevant to identifying and mapping GDEs in the Pilbara:

- river pool mapping
- watercourse mapping
- hydrological data (groundwater and river pool or wetland levels where available)
- *Determining water level ranges of Pilbara riparian species* (Loomes 2010)
- other published reports (e.g. Pilbara GDE ecological value and issues papers).

Other datasets that may also be useful:

- Department of Agriculture and Food's rangeland mapping dataset
- recent high resolution aerial photography or satellite imagery
- national groundwater-dependent ecosystems atlas (hosted by BoM).

Depending on the results of a desktop survey, we can advise on whether a field survey will be needed.

Key information to consider at this stage should include:

- depth to groundwater
- known or potential groundwater discharge zones
- aquifer type and characteristics
- location of rivers, pools, floodplains, springs and vegetation communities likely to be dependent on groundwater
- whether wetlands and deep-rooted vegetation may be accessing shallow groundwater (less than about 10 m below the ground surface) for part of their water requirements
- whether ecosystems are dependent on surface discharge (usually at springs) from groundwater at greater depths or from confined aquifers.

The distribution of riparian and floodplain plant communities can reflect the depth to groundwater and the area inundated during flooding. Shallow groundwater underlying rivers provides areas where deep-rooted vegetation can access groundwater. Groundwater can be important in sustaining these communities, particularly in the absence of rainfall and/or surface flow.

If monitoring bores are used to represent the depth to groundwater it is important to consider their construction and whether they are representative of the watertable at the GDE.

Condition and conservation value of groundwater-dependent ecosystems

Applicants need to identify the conservation value and environmental condition of the GDE. Values should be considered in both a local and regional context; that is, how important, valuable and representative the specific GDE is within the local area and the Pilbara region.

The department will follow advice from the Office of the Environmental Protection Authority (OEPA) and DPaW on the assessment of the conservation value of ecosystems. Ecosystems, species or sites that are listed in the following databases are recognised as having elevated conservation significance:

- Register of National Estate, see DSEWPAC website <www.environment.gov.au>
- ecosystems within public conservation reserves (e.g. nature reserves, national parks, conservation parks) – see DPaW website
- threatened and priority ecological communities, declared rare and priority flora and threatened and priority fauna lists and databases administered by DPaW
- Ramsar-listed wetlands <www.ramsar.org>
- *Directory of Important Wetlands in Australia* (EA 2001) (Australian National Conservation Areas) <www.environment.gov.au/heritage>.

Applicants/proponents should also consider EPA policy and guidance for terrestrial flora and vegetation, and subterranean and terrestrial fauna surveys in Western Australia.

To identify values and the GDE's condition, applicants should also consider

- previous (recent) condition assessments completed for another project or agency as part of other government approvals
- Aboriginal heritage sites register (DAA) <www.daa.wa.gov.au>.

Field survey

To confirm the locations, condition and conservation significance of the potential GDE, a targeted field survey may be required in the area of potential impact. A list of potential GDEs and/or species should be produced based on the field survey.

Field surveys should be incorporated into other surveys for environmental impacts assessments (where relevant). Proponents should be aware of the EPA's policy and guidance for terrestrial flora and vegetation, and subterranean and terrestrial fauna surveys in Western Australia.

Appendix B
Groundwater-dependent ecosystems:
guideline for assessing licences in the Pilbara

Proponents should seek advice from DPaW on the likelihood of stygofauna occurring in GDEs in the proposal area, as well as on assessment expectations – see *Guidance statement no. 54, Consideration of subterranean fauna in groundwater and caves during environmental impact assessment* (EPA 2003).

Alignment with Water in mining guideline stages

Step 1 of the GDE assessment aligns with the first part of stage B of the mining guideline. Depending on the project's scale, proponents might complete a desktop review of potential GDEs using available information to confirm whether impacts on GDEs from the project are likely to occur. This will determine the need for and scope of field surveys (and subsequent steps of the assessment process).

Step 2 Assess the level of groundwater dependence

To assess potential impacts and sensitivity to water regime change, proponents and the department need to understand the pre-project water regime and the connectivity of ecosystems to the water resource. Hydrogeological information and data collected to help identify where GDEs might occur (previous step) will help to determine groundwater dependence.

In some cases dependence may be assessed through a desktop study. The general water dependencies of some well-studied ecosystems are described in published information.
For example, it is generally understood that aquatic flora and fauna in springs may be totally dependent on groundwater, whereas riparian vegetation may use surface water where and/or when it is available.

In most cases the local water regime supporting GDEs will need to be understood to determine dependency, because ecosystems establish and adapt to local water conditions. For example, in the department's study of a set of four shallow alluvial systems across the Pilbara, the common riparian species *E. camaldulensis* occurred in much 'wetter' conditions (< 3 m depth to groundwater) at some sites on the De Grey River and at Millstream than in other parts of the Pilbara. Trees at these sites are likely to be less tolerant to changes in groundwater availability than the same species at other sites.

Variability and dependence

Variability in climate and the resulting variability in water level over time and across the site also need to be considered to determine the level of groundwater dependence. Extended periods between recharge events are relatively common in the Pilbara, and can last up to three years or more.

For river pools, in addition to average and extreme groundwater levels in nearby bores, it is important to determine pool permanence and depths. Pool depth is a good indicator of permanence or stability, which in turn is important for ecological diversity. Deep pools that maintain connectivity with the groundwater throughout the dry season are critical refuges from which fauna repopulate a river when floods return. Continued discharge of groundwater to permanent pools maintains adequate habitat and water quality during the dry season and extended droughts.

Predicting changes to the groundwater regime

Ideally water monitoring data will be available to assess the degree of groundwater dependence and predict the potential changes to the groundwater regime. Numerical model outputs may be used to supplement monitoring data to increase spatial or temporal coverage. The department supports use of the *Australian groundwater modelling guidelines* as a point of reference for numerical groundwater modelling.

The period covered by the groundwater data (monitored and/or modelled) should be long enough to characterise the regional climate variability in the Pilbara (wet and dry periods), and additional climate data may be required to carry out this step. Where available, modelling reports should include details of climate inputs and the estimated accuracy of water-level predictions relevant to the dependent ecosystems.

Hydrological parameters produced by the model and/or monitoring data should include:

- extremes in water availability – maximum and minimum recorded or modelled surface water and/or groundwater levels
- average conditions – average annual maximum and minimum groundwater and/or surface water levels
- degree of permanence of river pools and wetlands (e.g. permanent, semi-permanent or intermittent)
- complete hydrographs of recorded and/or modelled data.

Depending on the project's scale and the risks involved, other techniques may be suitable to assess the degree of groundwater dependence. The recently revised *Australian groundwater-dependent ecosystems toolbox part 2: assessment tools* (Richardson et al. 2011b) provides a good summary of potential techniques and their application.

Alignment with Water in mining guideline stages

Step 2 of the GDE assessment aligns with the last part of stage B of the mining guideline. Completion of this step will directly influence the scope of and need for subsequent stages of the assessment process.

Step 3 Assess the level of impact

Use the information collected in steps 1 and 2 and predictions of changes to the groundwater regime, including drawdown, over the life of the project to assess the risk and potential impact of groundwater abstraction on GDEs. Define the extent and timeframe of the impacts on GDEs. In preparing for the licence assessment process, proponents need to discuss management options to remove or reduce the risk with the department.

Where good hydrological (observed or modelled) and ecological data are available, ecohydrological response models may be developed (Richardson et al. 2011a, 2011b). In the absence of response models or published information on possible ecosystem response to changed water availability, potential impacts (or risk of impact) can be assessed by comparing the pre- and post-project groundwater regimes.

Appendix B
Groundwater-dependent ecosystems:
guideline for assessing licences in the Pilbara

As a minimum the potential or predicted changes in groundwater availability (levels) at GDE sites should be presented in comparison with the pre-project groundwater regime (described in Step 2). Where predictive modelling is used to generate these outputs, the climate inputs and model accuracy and assumptions need to be clearly described.

Variability is a key consideration in assessing the potential impacts to water-dependent ecosystems in the Pilbara. In some situations the climate variability and links between aquifers and ecosystems results in a variable water regime. Elsewhere, aquifers and the provision of groundwater is less variable, thus buffering ecosystems from the variability of the region's climate.

Alignment with Water in mining guideline stages

Step 3 of the GDE assessment aligns with stage C of the mining guideline. Completion of this step will directly inform the licence assessment, the department's advice to the EPA and the scope of a management framework to manage impacts on GDEs.

Step 4 Set up a management framework

Consideration of ways to reduce the risk of impacts to GDEs is critical to project planning, assessment of licence applications and development of licence (and other approval) conditions. Development of a framework to manage the potential impacts to GDEs will be required for water licences likely to cause impacts to GDEs. Where appropriate the management framework will be incorporated into an operating strategy as a condition of the licence (see the *Western Australian water in mining guideline,* DoW 2013d). The level of management should be appropriately matched to the risk to GDEs.

Set GDE objectives

For projects where water management has been assessed under the *Environmental Protection Act 1986* approvals process, the department will issue a water licence consistent with the approved Ministerial conditions related to GDEs. The conditions or their intent need to be included in the management framework as objectives to manage to. To ensure the program reflects the approved conditions, we will consult with the EPA and DER where appropriate.

Where projects have not been assessed by the EPA, we will work with proponents to set objectives to be included in the operation strategy.

Identify management options

To develop the management framework, proponents must identify reasonable water management options to achieve the objectives through removing, reducing or adjusting risk to GDEs. These options may include:

- reducing the impact of pumping through bore location and design, timing or sequencing of pumping and/or rate of pumping
- reducing the impact of discharge
- supplementation
- rehabilitation.

Develop monitoring program

The management framework should incorporate monitoring that can be used to measure whether the objectives are being met. Where appropriate the program should include thresholds or targets (such as groundwater levels) based on the anticipated extent and scale of abstraction impacts.

Develop response program

The management framework should also clearly state the management responses that will be triggered, and the timeframe for response, when trigger levels are reached or objectives are not met.

Alignment with Water in mining guideline stages

Development of a management framework should be completed and submitted with the licence application at stage C of the mining guideline. The agreed and approved management framework will be included in an operating strategy as a condition of a licence (stage D of the guideline).

C

Appendix C
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: Emily Harrington and Robyn Loomes

Map author: Chelsea Samuel and Michelle Antao

File path: J:\gisprojects\Project\C_series\C2219\033_West_Canning\mxd

File path: J:\gisprojects\Project\C_series\C2219\0021 Pilbara_Maps\mxd

Filename: Pilbara_Plan_Area, Pilbara_Water_Resources_Non_Target, Pilbara_ Water_Resources_Target, WCB Management Zone, WCB2_Cross_Sections, Pilbara_ Monitoring,

Compilation date: April 2013

Disclaimer

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

While the Department of Water has made all reasonable efforts to ensure the accuracy of this data, we accept 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 these maps:

Hydrography, Linear (Hierarchy) – DoW – 2007
Western Australia Towns – Landgate – 08/2012
DWAID Aquifers – DoW – 08/2012
Road Centrelines – Landgate – 08/2012
WIN Surface Water Sites – Stream Gauging – DoW – 08/2012
WIN Groundwater Sites – DoW – 08/2012
RIWI Act, Groundwater Areas – DoW – 03/2008
DWAID Subareas – DoW – 08/2012
DWAID Groundwater Areas – DoW – 08/2012
Water Dam Area – Water Corporation – 03/2009
WIN surface water sites – stream gauging – DoW – 2012
WIN groundwater sites – all – DoW –2012

Shortened forms

Shortened forms	
AHD	Australian Height Datum
AWRC	Australian Water Resources Council
DAA	Department of Aboriginal Affairs
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Conservation and Environment
DER	Department of Environment Regulation
DIWA	Directory of Important Wetlands in Australia
DLI	Department of Land Information
DMP	Department of Mining and Petroleum
DoW	Department of Water
DPaW	Department of Parks and Wildlife
DRDL	Department of Regional Development and Lands
DSD	Department of State Development
DSEWPAC	Department of Sustainability, Environment, Water, Population and Communities
EA	Environment Australia
EPA	Environmental Protection Authority
EWP	Environmental water provision
EWR	Environmental water requirement
GDE	Groundwater-dependent ecosystem
GW	Groundwater
MAL	Mean aquifer level
MHCC	Millstream-Harding Consultative Committee
NHMRC, NRMMC	National Health and Medical Research Council, National Resource Management Ministerial Council
OEPA	Office of the Environmental Protection Authority
RMS	root mean square
PLB	Pastoral Lands Board
SWIM	Saltwater interface/intrusion monitoring
TDS	total dissolved salts or solids
WCB	West Canning Basin
WRC	Water and Rivers Commission

Shortened forms

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

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.
Consumptive use	Water used for consumptive purposes considered as a private benefit including irrigation, industry, urban and stock and domestic use.
Criteria water level	A groundwater or pool level that should not be breached, usually relating to maintaining water quality, aquifer productivity and/or water for ecology. This is the performance indicator used to assess whether water resource objectives are being met.
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 water provision	The water regime provided to, or left in, the environment resulting from the water allocation decision-making process taking into account ecological, social, cultural and economic impacts. It may meet in part, or in full, the ecological water requirements.
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 *Rights in Water and Irrigation Act 1914* 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 instrument which entitles the licence holder to take water from a watercourse, wetland or underground source under the *Rights in Water and Irrigation Act 1914*.
Management area	A defined surface water area or groundwater area proclaimed under the *Rights in Water and Irrigation Act 1914*.
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.
Reliability	The frequency with which a water licence holder can access 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.
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.
Target water level	A groundwater or pool level that is a goal to meet in average or above average years for allowing some recovery of the aquifer or ecosystem to occur.
Target resource (or aquifer)	A water resource in the *Pilbara groundwater allocation plan* that is being targeted or focused on for water supply and management, due to its importance and proximity to coastal centres where water demand is high.
Trigger water level	A groundwater or pool level that triggers management actions or responses to be implemented so that the risk of abstraction impacting on the water resource and dependent values is reduced.
Water reserve	An area proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or *Country Areas Water Supply Act 1947* to protect and use water for public water supply.
Yield	The amount of water that can be abstracted out of the system, after environmental water is met.

References

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Notes

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