

Perth Groundwater Replenishment Scheme - Stage 2

Referral - Supporting Document

February 2017

Disclaimer

This report has been prepared by the Water Corporation specifically for the Perth Groundwater Replenishment Scheme Stage 2 proposal. Neither the report nor its contents may be referred to without the express approval of the Water Corporation, until such time as the report has been released for referral and assessment.

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Abbreviations and Acronyms

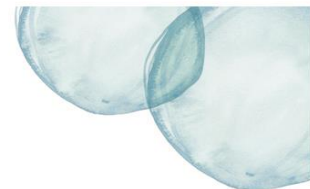
Abbreviation	Definition
ADWG	Australian Drinking Water Guidelines
ANZECC	Australian and New Zealand Environment and Conservation Council
ASS	Acid Sulphate Soils
AWRP	Advanced Water Recycling Plant
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
Bgl	Below ground level
CCP	Critical Control Point
CEMF	Construction Environmental Management Framework
CEMP	Construction Environmental Management Plan
CoJ	City of Joondalup
CoS	City of Stirling
CoW	City of Wanneroo
CS Act	<i>Contaminated Sites Act 2003</i>
DAA	Department of Aboriginal Affairs
DEC	Department of Environment and Conservation
DER	Department of Environment and Regulation
DoEE	Department of the Environment and Energy (Federal)
DoH	Department of Health
DoW	Department of Water
DPaW	Department of Parks and Wildlife, formerly DEC
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities (now DoEE)
EAG	Environmental Assessment Guideline
EPA	Environmental Protection Authority
EP Act	<i>Environmental Protection Act 1986</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EV	Environmental Value
FCT	Floristic Community Type
GL	Gigalitres
GWR	Groundwater Replenishment
GWRT	Groundwater Replenishment Trial
GWRS	Groundwater Replenishment Scheme
IAWG	Interagency Working Group
ILUA	Indigenous Land Use Agreement
IWSS	Integrated Water Supply Scheme
KL	Kilolitres
MRWA	Main Roads Western Australia
ML	Megalitres
MoU	Memorandum of Understanding



Abbreviation	Definition
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NVCP	Native Vegetation Clearing Permit
PCP	Process Control Point
OEPA	Office of the Environmental Protection Authority
PRAWS	Perth Region Aquifer Modelling System
PRCAC	Perth Regional Confined Aquifer Capacity
RO	Reverse osmosis
SWALSC	South West Aboriginal Land and Sea Council
UF	Ultrafiltration
UV	Ultraviolet
WC Act	<i>Wildlife Conservation Act 1950</i>
WWTP	Wastewater Treatment Plant



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1. Proponent and Key Proposal Characteristics

The Water Corporation (the Corporation) is referring Stage 2 of the Perth Groundwater Replenishment Scheme (GWRS) (the Proposal) to the Environmental Protection Authority (EPA) for assessment under the *Environmental Protection Act 1986* (the EP Act). This document has been prepared to support the formal referral of the Proposal under Section 38 of the EP Act and has been developed based on the structure and content proposed for an Environmental Review Document in the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual 2016* (EPA 2016).

1.1. The Proponent

The Proponent for the Proposal is the Water Corporation.

Details for the Corporation are as follows:

Water Corporation
ABN: 28 003 434 917
629 Newcastle Street
Leederville WA 6007
PO Box 100, LEEDERVILLE WA 6902

The contact person within the Corporation for this Proposal is:

Dion Hill
Environmental Scientist
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1.2. Key Proposal Characteristics

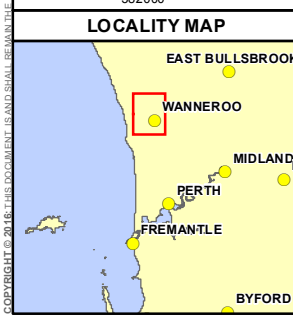
Stage 2 of the Perth GWRS (the Proposal) involves the duplication of the existing Advanced Water Recycling Plant (AWRP) at the Beenyup facility and the construction of water recharge and conveyance infrastructure to recharge approximately 14 GL of recycled water to the Leederville and Yarragadee aquifers. The Proposal represents an expansion of 14 GL per annum to Stage 1 of the GWRS (14 GL per annum), resulting in a total recharge to the Leederville and Yarragadee aquifers of approximately 28 GL per annum.

The key characteristics for the Proposal have been defined in accordance with the *Instructions for defining the key characteristics of a proposal* (EPA 2016). The Proposal involves four physical elements and one operational element, as described in **Table 1.1**. An overview of the Proposal is shown in **Figure 1.1** and the location of the Proposal is shown in **Figure 2.2**. Further detail is provided in Section 2.



Table 1.1: Key Characteristics Table for the Proposal

Summary of the Proposal		
Proposal Title	Perth Groundwater Replenishment Scheme (GWRS) Stage 2	
Proponent Name	Water Corporation	
Short Description	<p>Duplication of the existing Advanced Water Recycling Plant at the Beenyup facility and the construction of water recharge and conveyance infrastructure to recharge approximately 14 GL of recycled water to the Leederville and Yarragadee aquifers.</p> <p>This additional 14 GL per annum represents an expansion to the GWRS to approximately 28 GL per annum.</p>	
Physical Elements		
Element	Location	Proposed Extent
1. Advanced Water Recycling Plant (AWRP)	Beenyup facility in Craigie, approximately 20 km north of Perth as shown in Figure 1.1.	<p>Development Envelope of 2.83 ha.</p> <p>Clearing of up to 0.10 ha native vegetation required.</p>
2. Recharge pipeline (12.8 km)	From Beenyup facility in Craigie to the southern recharge site and the northern recharge site in Wanneroo as delineated in Figure 1.1.	<p>Development Envelope of 25.26 ha, including additional Temporary Construction Footprint of 2.62 ha and tunnelled area of 0.35 ha.</p> <p>Clearing of up to 2.05 ha native vegetation required.</p>
3. Southern recharge site <ul style="list-style-type: none"> • Yarragadee Aquifer Bore(s) • Leederville Aquifer Bore(s) • Recharge Pump Station • Recycled Water Tank • Access track 	6.5 km north of Beenyup facility in Wanneroo as shown in Figure 1.1.	<p>Development Envelope of 0.83 ha including an access track of 0.23 ha.</p> <p>No clearing of native vegetation is required.</p>
4. Northern recharge site <ul style="list-style-type: none"> • Yarragadee Aquifer Bore(s) • Leederville Aquifer Bore(s) • Recharge Pump Station • Recycled Water Tank 	8.5 km north of Beenyup facility in Wanneroo as shown in Figure 1.1.	<p>Development Envelope of 0.50 ha.</p> <p>No clearing of native vegetation is required.</p>
Operational Elements		
Element	Location	Proposed Extent
1. Yarragadee and Leederville Aquifer recharge	Refer above	Recharge of approximately 14 GL per annum, expanding the GWRS to a total of approximately 28 GL per annum.



LEGEND

- Development Envelope
- Development Envelope (tunnelling)
- Proposed Temporary Construction Footprint
- Beenyup facility

DATA SOURCES

- DEVELOPMENT ENVELOPE AND CONSTRUCTION FOOTPRINT SOURCED WATER CORPORATION 7 SEPTEMBER 2016
- LOCALITY MAP SOURCED LANDGATE 2006 AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016
- (© Western Australian Land Information Authority 2016)

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WATER CORPORATION

CREATED MH	CHECKED TM	APPROVED SS	REVISION 0	DATE 25/10/2016
HORIZONTAL DATUM GDA 1994 MGA Zone 50		PROJECT NO 1551		

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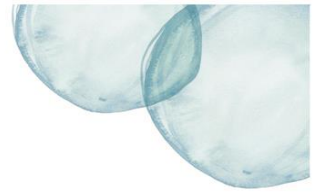
Water Corporation

Groundwater Replenishment Scheme (GWR) Stage 2

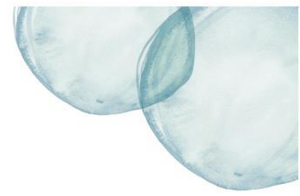
Referral under Section 38 of the EP Act

Figure 1.1
Overview of the Proposal

K:\Projects\2.0 INF\1551 GWRP\Figures\S38 Referral\1551 S38 Figure 1 - Project Location.mxd



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2. General Description of Proposal

The context of water supply planning for the Integrated Supply Scheme (IWSS) and a general description of the Proposal is provided in this section. Additional background information about the groundwater replenishment process, the need for additional water sources in Perth's drying climate and the Groundwater Replenishment Regulatory Framework has been provided in Section 3.

2.1. Overview of the Proposal

The IWSS supplies water to over two million people in Perth, the Goldfields and Agricultural region and some parts of the South West. Over the past decade the State Government, through the Corporation, has planned and invested over \$2 billion to develop a climate resilient water supply for the IWSS.

Groundwater Replenishment (GWR) was identified as a key component of the Corporation's 50 year water source plan for the IWSS in the '*Water Forever: Towards Climate Resilience*' (Water Corporation 2009) and in '*Water Forever: Whatever the Weather*', the ten year plan to reduce reliance on climate dependant sources by 2022 (Water Corporation 2012).

GWR is the process by which secondary treated wastewater undergoes advanced treatment to produce recycled water which meets Australian guidelines for drinking water prior to being recharged to an aquifer for later use as a drinking water source. A conceptual overview of the process for GWR is provided in **Figure 2.1**.

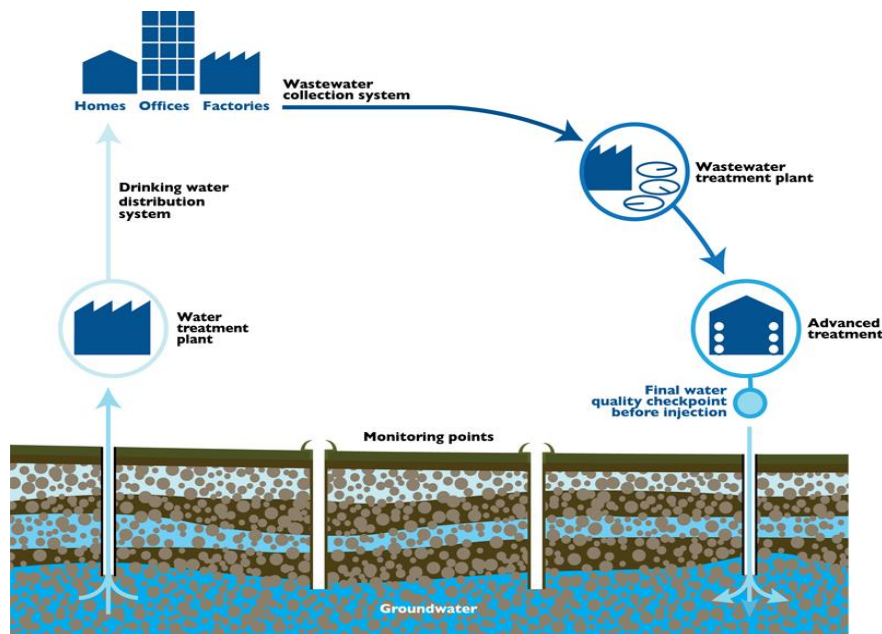
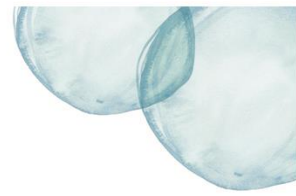


Figure 2.1 – Groundwater Abstraction and Replenishment Process

The Corporation is halfway through implementing '*Water Forever: Whatever the Weather*', which outlines a response to address climate change by reducing reliance on dams and shallow aquifers with significant groundwater dependant ecosystems, reducing water use and increasing wastewater recycling.



In July 2016, the Minister for Water announced the expansion of the Perth GWRS in response to the need to accelerate additional sustainable water sources following the climate drying faster than anticipated in the southwest of Western Australia. Stage 1 of the GWRS involves the recharge of approximately 14 GL per annum of recycled water that meets drinking water standards into the Leederville and Yarragadee aquifers through onsite recharge at the Beenyup facility. Recharge under Stage 1 of the GWRS is due to commence in December 2016 following extensive commissioning and final approval from the Department of Health (DoH).

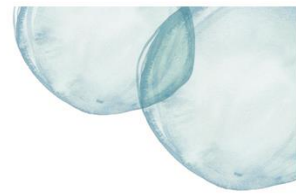
The expansion of the GWRS to Stage 2 (the Proposal) involves the duplication of the existing AWRP at the Beenyup facility, and recharge of approximately 14 GL per annum of recycled water that meets drinking water standards into the Leederville and Yarragadee aquifers at two recharge sites located offsite. A recharge pipeline of approximately 12.8 km in length and approximately 800 mm in diameter will convey recycled water from the AWRP to the southern recharge site and the northern recharge site for recharge into the Leederville and Yarragadee aquifers.

Stage 2 of the GWRS (the Proposal) represents an expansion of 14 GL per annum to the existing 14 GL per annum under Stage 1 of the GWRS, resulting in a total of 28 GL per annum recharge to the Leederville and Yarragadee aquifers.

The main components of this Proposal are:

- The duplication of the existing AWRP at the Corporation's Beenyup facility in Craigie;
- A 12.8 km recharge pipeline from the AWRP to the southern recharge site and the northern recharge site;
- The southern recharge site and associated infrastructure including a recharge pump station, recycled water tank, recharge bores and an access track approximately 6.5 km north-east of the Beenyup facility;
- The northern recharge site and associated infrastructure including a recharge pump station, recycled water tank and recharge bores approximately 8.5 north-east of the Beenyup facility; and
- Groundwater recharge of approximately 14 GL per annum into the Leederville and Yarragadee aquifers, which meets drinking water standards.

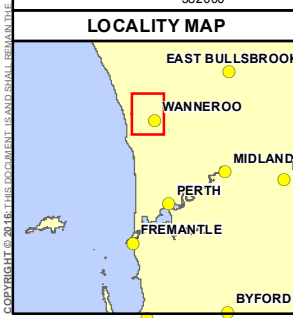
The Development Envelope comprises the AWRP, the recharge pipeline and the northern and southern recharge sites.



2.1 Location of the Proposal

The Proposal will be located approximately 25 km north of Perth between the Corporation's Beenyup site in Craigie, and Neerabup, as shown in **Figure 2.2**. Specific locations of each element of the Proposal are as follows:

- AWRP – located within the Corporation's Beenyup site, Lot number 8278 along Ocean Reef Road in Craigie. The AWRP will be located immediately adjacent the existing AWRP for Stage 1 of the GWRS. The site is bounded by the Mitchell Freeway to the east, Ocean Reef Road to the north, the residential suburb of Craigie to the west and an area of bushland to the south.
- Southern recharge site and bore infrastructure – located on a 60 x 100 m portion of Lot 500 on Plan 64576, vested with DPaW. Site is located within the Yellagonga Regional Park in a Pine Seed Orchard and bounded by Unallocated Crown Land to the south, Wanneroo Road to the east, Ashley Road to the north and Lake Joondalup/Yellagonga Regional Park to the west.
- Northern recharge site and bore infrastructure – located on Corporation owned Lot 800 on Plan 52636, adjacent Wanneroo Road in the suburb of Neerabup. The site is bounded by Wanneroo Road to the east, land owned by Department of Planning to the east, and private land to the north and south.
- Recharge pipeline – located between the Corporation's Beenyup facility in Craigie along a 12.8 km route through the suburbs of Woodvale, Wanneroo, Ashby and Neerabup joining the AWRP, the southern recharge site and the northern recharge site.



LEGEND

- Proposed Development Envelope
- Major Roads
- Minor Roads
- Local Government Area Boundaries
- Cadastral Boundaries

DATA SOURCES

- CADASTRAL BOUNDARY SOURCED FROM LANDGATE VIA SLIP 14 SEPTEMBER 2016
- VEGETATION MAPPED BY 360 ENVIRONMENTAL 2016 AT A SCALE OF 1:1000
- LOCALITY MAP SOURCED LANDGATE 2006 AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016 (© Western Australian Land Information Authority 2016)

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NOTE THAT POSITIONAL ERRORS MAY BE >5M IN SOME AREAS

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WATER CORPORATION

CREATED JJ/MH	CHECKED TM	APPROVED SS	REVISION 0	DATE 25/10/2016
HORIZONTAL DATUM GDA 1994 MGA Zone 50		PROJECT NO 1551		

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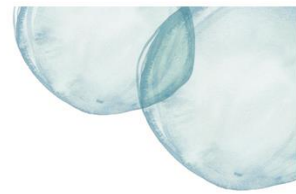
Water Corporation

Groundwater Replenishment Scheme (GWR) Stage 2

Referral under Section 38 of the EP Act

Figure 2.2
Location of the Proposal

K:\Projects\2.0 INF\1551 GWRP\Figures\S38 Referral\1551 S38 Figure 2.5 - Location of the Proposal.mxd



2.2 Proposed Disturbance

The Proposal covers a total area of 29.42 ha (referred to as the Development Envelope), which includes an area of 0.35 ha of tunnelling that will not require any surface disturbance (no clearing) and an additional area of 2.62 ha for temporary construction purposes, referred to as the Temporary Construction Footprint. The Development Envelope requires a maximum disturbance of 2.15 ha of native vegetation. The access track to the southern recharge site will be located between two rows of existing pine trees and will not require any clearing. A breakdown of the disturbance for each physical element of the Proposal is provided in **Table 2.1**.

Table 2.1: Total Disturbance of the Proposal

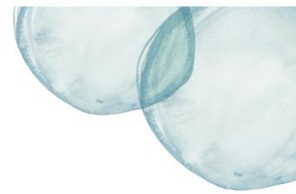
Proposal Aspect	Development Envelope Total Area (ha)	Development Envelope – Tunnelled Sections (no clearing) (ha)	Temporary Construction Footprint Total Area (ha)	Disturbance to Native Vegetation (ha)
AWRP	2.83	N/A	N/A	0.10
Recharge pipeline (12.8 km)	22.29	0.35	2.62	2.05
Northern recharge site and associated infrastructure	0.50	N/A	N/A	N/A
Southern recharge site and associated infrastructure including access track	0.83	N/A	N/A	N/A
TOTAL	26.45	0.35	2.62	2.15
		29.42		

2.3 Tenure

The Proposal is located across various tenure types in the Perth metropolitan area including Corporation owned land, private land holdings, land managed by Local Government authorities and land managed by State Government agencies. Further detail on the land tenure of the Development Envelope is provided in **Table 2.2**.

Table 2.2: Tenure of the Development Envelope

Proposal Element	Tenure / Lease Type	Zoning under Metropolitan Region Scheme	Access Arrangement	DMA/Government Agency
AWRP	Water Corporation Lot 8278 on Plan 30778 Reserve	Public Purposes	N/A	N/A
Northern recharge site	Water Corporation Lot 800 on Plan 52636 Freehold	Parks and Recreation	N/A	N/A
Southern recharge site	Lot 500 on Plan 64576 Reserve 21176 – Pine Seed Orchard	Parks and Recreation, Bush Forever area	Excision of portion of Reserve 21176	DPaW - Regional Parks Unit
Recharge pipeline	Water Corporation Lot 8278 on Plan 30778 Reserve 28921	Public Purposes – WSD (Water Authority of WA), Bush Forever area	N/A	N/A



Proposal Element	Tenure / Lease Type	Zoning under Metropolitan Region Scheme	Access Arrangement	DMA/Government Agency
	Other (Road)	Primary Regional Roads	Consultation	Main Roads Western Australia (MRWA), Public Transport Authority (PTA)
	Reserve 30809 – Woodvale Nature Reserve	Parks and Recreation, Bush Forever area	Use of portion of R30809 from DPaW	DPaW – Swan Coastal District
	Reserve (various)	Urban, Other Regional Roads, Rural, Parks and Recreation	Consultation	City of Wanneroo City of Joondalup
	Unallocated Crown Land Lot 9471 on Plan 91071 -	Parks and Recreation	Consultation	DPaW
	Freehold (various)	Urban	Consultation / Easement	N/A

2.4 Native Title

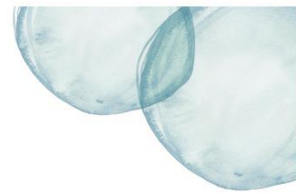
The Development Envelope lies within the Whadjuk Native Title Claim Group (Whadjuk) boundary which is one of the six Noongar native title claims incorporated into the South West Indigenous Land Use Agreement (South West ILUA). The Whadjuk has been consulted during the development of the Proposal and further consultation will take place in November 2016 to ensure compliance with the *Native Title Act 1993* and conditions of the South West ILUA. The South West ILUA is expected to come into force in 2017 and is the most comprehensive native title agreement proposed in Australian history, comprising the full and final resolution of all native title claims in the South West of Western Australia in exchange for a substantial suite of benefits including land, a future fund and cooperative management of the Conservation Estate. The Settlement will resolve native title and remove all 'future act' obligations across the South West.

2.5 Construction Methods

Construction of the proposed recharge pipeline and bores will be carried out using the following open trenching and trenchless methods:

- Trenching;
- Microtunnelling;
- Horizontal Directional Drilling (HDD); and
- Drilling.

The majority of the recharge pipeline will be constructed using open trenching methods, however trenchless techniques will be required for sections of the alignment under roads and bushland (microtunnelling) and in two sections of the pipeline to minimise impacts to native



vegetation (HDD). Additional temporary construction areas have been proposed along the pipeline route (as outlined in Section 2.2; **Figure 1.1**) for other construction purposes. Further detail about the proposed construction methods is provided in **Table 2.3**.

Table 2.3: Description of Construction Methods

Method	Description
Trenching	<p>Trenching is an open cut excavation method of installing underground pipeline, which is required for a majority of the construction of the recharge pipeline alignment. The requirements for trenching will vary depending on specific ground conditions. Trenching requires a maximum disturbance area of approximately 10 to 20 m in width, however this width will be narrowed to approximately 6 m in designated areas along the recharge pipeline alignment to avoid the clearing of significant trees and native vegetation.</p> <p>Where the water table is intercepted during trenching, dewatering is likely to be required. Dewatering is not considered to be a risk to the surrounding environment and management objectives and procedures will be addressed in the Construction Environmental Management Framework (CEMF) and Construction Environmental Management Plan (CEMP), respectively.</p>
Microtunnelling	<p>Microtunnelling involves a tunnel boring machine installing pipes at a minimum depth of approximately 2 m underground without disturbing the surface. The machine digs an underground path, into which the recycled water pipes are installed. A pit is required at each end of the tunnel sections to launch (20 m x 20 m) and retrieve (10 m x 10 m) the pipe using machinery.</p> <p>The Corporation has extensive experience in microtunnelling, which is usually employed to allow water infrastructure to be installed below roads, freeways and water courses.</p> <p>The expected ground disturbance at each end of the tunnel sections is included within the nominated Construction Footprint (Figure 1.1).</p>
Horizontal Directional Drilling	<p>HDD is a steerable trenchless method of installing underground pipe by using a surface-launched drilling rig, with minimal impact on the surrounding area. Prior to installation of the pipe, the entire length of the pipe is required to be strung out and welded before being pulled through the tunnel.</p> <p>The Corporation has extensive experience in HDD, which is usually employed to allow water infrastructure to be installed below water courses or roads however over greater distances than using microtunnelling techniques. The exact depth of each tunnelled section is yet to be confirmed; however the top of the tunnel bore will be at least 2 m below ground level at each of the nominated tunnelling sites. Potential impact to tree roots from the tunnelling has been outlined in Section 7.2.</p> <p>Ground disturbance associated with the stringing and welding of the pipe sections, and that required for the launch and retrieval is included within the nominated Construction Footprint (Figure 1.1).</p>
Recharge and Monitoring bores	<p>All monitoring and recharge bores will be constructed to meet the requirements outlined in the Section 26D licences for each bore (granted by the Department of Water in August 2016) (Appendix K).</p>



2.6 Project Delivery

The Proposal is on an accelerated delivery. It is expected that following the grant of all necessary approvals, construction will commence in 2017 with the aim of commencing aquifer recharge in December 2018.

2.7 Alternative Options

The Corporation has undertaken a detailed assessment of the pipeline route for the Proposal, taking into consideration feedback from key stakeholders during the stakeholder consultation process, as well as environmental, engineering and constructability constraints. The locations of the two recharge sites were determined in consultation with the DoW (Department of Water) based on long term targets proposed by the outcomes of the Perth Regional Confined Aquifer Capacity (PRCAC) study (refer Section 2.7.1 and 3.2.5). Further detail about the pipeline route and selection of recharge site locations is provided below and summarised in **Table 2.4**.

2.7.1 Recharge Site Locations

A range of recharge scenarios have been investigated to determine the most optimal recharge and abstraction scheme for an additional 14 GL of recycled water beyond the 14 GL recharge under Stage 1 of the GWRS. Recharge and abstraction locations have been developed by the Corporation in consultation with the DoW to progress towards longer term environmental targets as proposed by the PRCAC outcomes (DoW, 2016 draft in-prep) and within the operating constraints of the IWSS. Numerous options have been explored, modelled and discussed with the DoW. The selection of the most suitable option has been advised by two principal drivers; progress towards groundwater level recovery as per draft PRCAC targets and working within the operational constraints of the IWSS network. Refer to Section 3.2.5 for further detail on the PRCAC study and groundwater level recovery targets.

The DoW has endorsed the locations for the two proposed recharge locations; the northern recharge site and the southern recharge site. The letter from the DoW endorsing these locations is provided in **Appendix O**.

2.7.2 Pipeline Route

Several options were considered for the location of the recharge pipeline from the Beenyup facility through to the northern recharge site. All alternative routes for the pipeline are shown in **Figure 2.3** and summarised in **Table 2.4**. Key constraints included environmental impact, social and safety considerations, constructability and existing below ground utility services, proposed future road widening, engineering limitations and disturbance to neighbouring residents through construction.

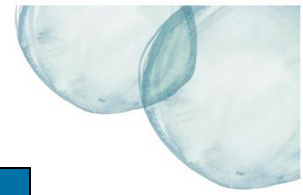


Table 2.4: Assessment of Alternative Options for Recharge Pipeline Route

Route	Potential Factors	Alignment Options	
		Preferred Alignment Through Perry's Paddock	Alternative Alignment/s Ocean Reef Road
Perry's Paddock (Yellagonga Regional Park)	Native vegetation	<ul style="list-style-type: none"> No clearing of native vegetation 	<ul style="list-style-type: none"> Clearing of up to 1.7 ha of native vegetation along eastern margin of Woodvale Reserve. Clearing within Bush Forever Site 407. DPaW not supportive of route along the boundary of Woodvale Nature Reserve due to potential clearing of Tuart trees.
	Heritage	<ul style="list-style-type: none"> Potential impact to European Heritage values 	<ul style="list-style-type: none"> No impact to European Heritage values.
	Fauna	<ul style="list-style-type: none"> Negligible impact to Black Cockatoo foraging habitat 	<ul style="list-style-type: none"> Clearing of Black Cockatoo foraging habitat along eastern boundary of Woodvale Reserve (up to 1.7 ha) Negligible impact to Black Cockatoo foraging habitat along Ocean Reef Road.
	Engineering constraints/feasibility	<ul style="list-style-type: none"> Stream crossing (readily completed via tunnelling) 	<ul style="list-style-type: none"> Proximity to high voltage electricity and gas mains in Ocean Reef Road Safety issues with working close to heavy traffic major road Constrained for maintenance access given number of services in existing road reserve
	Disruption to road users	<ul style="list-style-type: none"> No disruption to road users 	<ul style="list-style-type: none"> Potential closure of one lane of Ocean Reef Road for a five to six week duration causing disruption to the public



Route	Potential Factors	Alignment Options		
		Preferred Alignment	Alternative Alignment/s	
Banksia Woodland (Yellagonga Regional Park)		Under Banksia Woodland	Through Banksia Woodland	Wanneroo Road verge
	Native vegetation	<ul style="list-style-type: none"> No clearing of native vegetation. 	<ul style="list-style-type: none"> Clearing of up to 1 ha of native vegetation Fragmentation of native vegetation 	<ul style="list-style-type: none"> Clearing of up to 0.1 ha of native vegetation next to road verge.
	Fauna	<ul style="list-style-type: none"> No impact to fauna 	<ul style="list-style-type: none"> Clearing of up to 1 ha of Black Cockatoo foraging habitat and 22 potential breeding trees. 	<ul style="list-style-type: none"> Clearing of up to 0.1 ha of Black Cockatoo foraging habitat next to road verge.
	Engineering constraints/feasibility	<ul style="list-style-type: none"> Requires a launching and receiving pit at each end, which can be established in cleared areas north and south of the Banksia woodland. Construction duration 4 weeks. Flexibility in alignment to suit design requirements. No other services involved. Minimal excavation required. Possible reduced life of pipeline with risk of abrasion. Difficulty in accessing pipeline for maintenance purposes 	<ul style="list-style-type: none"> No engineering constraints. 	<ul style="list-style-type: none"> Other buried services along Wanneroo Road including water main, Telstra cable, HVE cable and sewer pressure main. Tight tolerance on alignment due to other services. Constraints on productivity due to limited work space. Pipeline easily accessible for maintenance. Construction duration 5 weeks. Retaining wall along Wanneroo Road a major construction limitation.
	Disruption to road users	<ul style="list-style-type: none"> Very minor traffic disruption along Donnelly Ramble and Cuvier Grove, Ashby. 	<ul style="list-style-type: none"> No disruption to road users. 	<ul style="list-style-type: none"> Significant traffic management required due to the need to close one lane of Wanneroo Road during construction.
	Amenity	<ul style="list-style-type: none"> Minor temporary impact to recreational users of Yellagonga Regional Park during construction. 	<ul style="list-style-type: none"> Significant impact to recreational users of Yellagonga Regional Park through removal of native vegetation which holds social and environmental value. 	<ul style="list-style-type: none"> Minor temporary impact in local area during construction.



Route	Potential Factors	Alignment Options		
		Preferred Alignment	Alternative Alignment/s	
		Tunnelling under vegetation	Wanneroo Road	Trenching through vegetation
Joondalup Drive Crossing	Native vegetation	<ul style="list-style-type: none"> Very minimal clearing of native vegetation, if any Minor clearing of vegetation in verge along Joondalup Drive for launch pit. 	<ul style="list-style-type: none"> No clearing required. 	<ul style="list-style-type: none"> Clearing of up to 0.4 ha of native vegetation, within Bush Forever Site 383.
	Fauna	<ul style="list-style-type: none"> Very minimal impact to Black Cockatoo habitat. 	<ul style="list-style-type: none"> No clearing required. 	<ul style="list-style-type: none"> Clearing of up to 0.4 ha of Black Cockatoo foraging habitat.
	Disruption to road users	<ul style="list-style-type: none"> Minor disruption to road users in Drivers Place. No disruption to Joondalup Drive. 	<ul style="list-style-type: none"> Future road widening for Wanneroo Road by MRWA making this route not feasible. MRWA advised of Joondalup Drive crossing to be set back from intersection by 300 m. 	<ul style="list-style-type: none"> No disruption to road users.
	Engineering	<ul style="list-style-type: none"> Can be achieved through microtunnelling (refer Section 2.8). Tunnelling distance within proven capabilities. 	<ul style="list-style-type: none"> Requirement for two or more road crossings along Wanneroo Road. High Voltage power lines in close proximity. 	<ul style="list-style-type: none"> No issues.



Route	Potential Factors	Alignment Options	
		Preferred Alignment	Alternative Alignment/s
		Tunnelling from Beenyup facility to Woodvale Nature Reserve	Tunnelling further south in the Beenyup facility to Camarino Drive road verge in Woodvale
Mitchell Freeway Crossing	Native vegetation	<ul style="list-style-type: none"> Minimal clearing of native vegetation. 	<ul style="list-style-type: none"> Additional clearing required in Beenyup facility (Bush Forever site 303) Clearing in the road verge for tunnelling pit and valve infrastructure.
	Fauna	<ul style="list-style-type: none"> Minimal impact to Black Cockatoo habitat. 	<ul style="list-style-type: none"> Additional impact to potential Black Cockatoo foraging habitat in the Bush Forever Site 303.
	Engineering	<ul style="list-style-type: none"> Sufficient space for engineering and constructability purposes. No constraints to placement of valve infrastructure. 	<ul style="list-style-type: none"> Existing electrical cables, a light pole and a stormwater gully in the verge of Camarino Drive in Woodvale that would need to be avoided for construction purposes. Avoidance of this infrastructure would require the alignment to be moved further south, which would require clearing of vegetation on the Beenyup facility side of the Mitchell Freeway. MRWA and Public Transport Authority requirements must be met for crossings under the freeway which would involve the sleeve for the pipeline extending to the eastern boundary of the Mitchell Freeway. This would not leave enough room in the road verge for the air valve, section valve and a scout valve.
	Disruption to road users	<ul style="list-style-type: none"> Potential requirement for road closure in Woodvale due to works in Woodvale Nature Reserve. Potential disruption to users of bicycle path. 	<ul style="list-style-type: none"> Requirement for road closure in Woodvale due to works in road verge.



LEGEND

- Alternative options for the Recharge Pipeline
- Development Envelope
- Tunnelled Sections
- Beenyup facility

Bore Type

- Recharge, Leederville
- Recharge, Yarragadee



1:45,000 at A4
 0 500 1000 1500
 Metres
 Coordinate System: GDA 1994 MGA Zone 50
 Vertical Datum: AHD

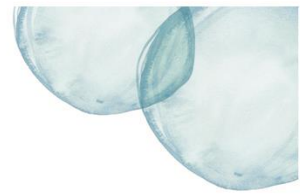
AUTHOR: FLETTNO DATE: 24/10/2016
 BRANCH: APG - MAPPING & GEOSPATIAL

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Alternative Options for the Proposed Recharge Pipeline

Figure 2.3



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3. Background Information

Additional background information about the groundwater replenishment process, the need for additional water sources in Perth's drying climate and the Groundwater Replenishment Regulatory Framework has been provided in Section 3.

3.1 Climate Change

Perth's climate is drying much faster than expected. 2015 was Perth's equal warmest year in 117 years and most of the metropolitan area experience below average rainfall.

Four of the past six years have been among the worst recorded for inflows to Perth's dams and in 2015 Perth's dams received their lowest inflows since records began in 1911. This inflow compares to the annual average of 173 GL between 1975 and 2000, 92 GL between 2001 and 2009 of 92 GL, and 50 GL between 2010 and 2014. Extremely low inflow years and a consistent downward trend in inflows highlights how dramatically the relationship between rainfall and inflow to dams has changed over the last decade. A consistent annual inflow to our dams can no longer be relied upon to deliver a secure share of scheme water supply.

The Corporation is updating the water source planning, including identification and development of new sources which reflect a conservative plan for a future where Perth's dams consistently receive zero inflow. Forecasts indicate, on the basis of ongoing zero inflows to dams and with a continued focus on demand management, a supply gap of up to 70 GL per year may develop over the next 10 years.

In its advice to the Minister for Environment under section 16(e) of the EP Act on the environmental impacts, risks and remedies associated with the Perth and Peel 3.5 Million planning framework, the EPA recommended that the State Government continue to implement measures to reduce water use, increase water recycling and develop alternative fit-for-purpose water sources. In its recommendation, the EPA also outlined the need for the State Government to support the Water Corporation's continued development of managed aquifer recharge into confined aquifers of the Gnangara Mound (EPA 2015c). This Proposal represents the continued work of the Corporation in identifying and developing new and sustainable water sources for the future of Western Australia.

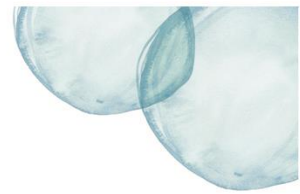
3.2 The Groundwater Replenishment Scheme

The Perth GWRS consists of advanced treatment via an AWRP and a series of recharge bores which will recharge the Leederville and Yarragadee aquifers.

3.2.1 Advanced Water Recycling Plant

The AWRP is designed to produce water that meets Australian guidelines for drinking water. The treatment process involves a multi-stage process in which treated wastewater (from the Beenyp Wastewater Treatment Plant (WWTP) undergoes ultra-filtration, reverse osmosis, ultra violet disinfection, and other processes to produce water that is as safe as drinking water. A conceptual overview of the AWRP treatment processes is shown in **Figure 3.1**.

The Department of Health (DoH) is responsible for setting the water quality guidelines that the recycled water must meet at the point of recharge in order to protect human health.



The *Memorandum of Understanding for Wastewater Services and Groundwater Replenishment between the Department of Health and Water Corporation* (October 2014) (WWS/GWR MoU) defines the water quality guidelines and describes the operational, monitoring and reporting requirements required of the GWRs. The DoH scrutinise the treatment process performance and water quality monthly. Further information on the WWS/GWR MoU and the water quality guidelines is provided in Section 3.3.

The Corporation ensures that the recycled water quality always meets the water quality guidelines by continuously monitoring the performance of the treatment process at 13 Critical Control Points located throughout the WWTP and AWRP and automatically applying a controlling action (divert water from treatment process or cease production) if performance varies from specification.

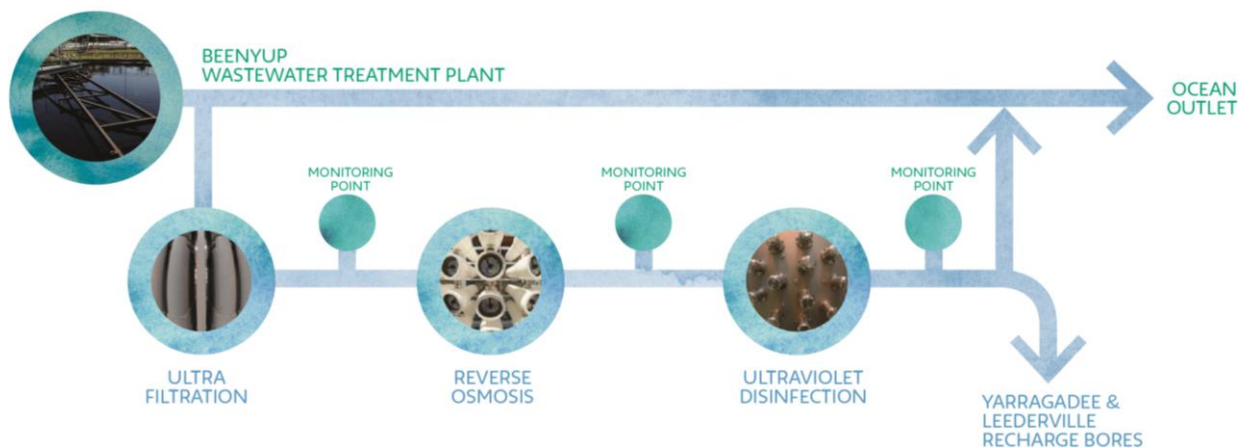


Figure 3.1 – Overview of the AWRP treatment processes

3.2.2 Recharge Management Zones

A Recharge Management Zone (RMZ) is required for each recharge bore within a GWR scheme. The RMZ defines the minimum radial distance between the recharge of recycled water and abstraction of groundwater for public drinking water supplies. Recycled water must meet the water quality guidelines or background groundwater quality at the boundary of the RMZ to ensure that the environmental values are always protected. A conceptual diagram of a RMZ is shown in **Figure 3.2**.

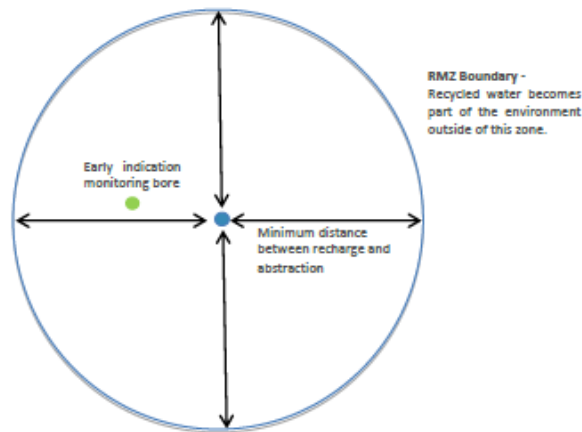
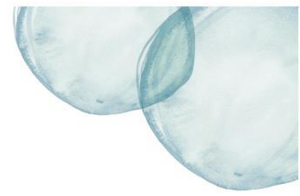


Figure 3.2 – A Conceptual Recharge Management Zone

3.2.3 Groundwater Replenishment Trial (GWRT)

The Corporation conducted the three year Groundwater Replenishment Trial (GWRT) adjacent to the Beenyup WWTP at the Beenyup facility in Craigie to assess the technical and social feasibility of an advanced water recycling process for producing water that is suitable for replenishing groundwater. The Corporation undertook the GWRT with three principal objectives:

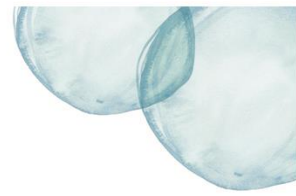
- To provide a context for the States' regulatory agencies to develop health and environmental regulation and water allocation policy for groundwater replenishment.
- To demonstrate the technical feasibility of the treatment process and aquifer response to reliably meet health and environmental water quality guidelines.
- To raise awareness and encourage community discussion about groundwater replenishment and it's potential as a future water source.

A 1.5 GL AWRP was located adjacent to the Beenyup WWTP and involved further treating secondary treated wastewater using ultrafiltration (UF), reverse osmosis (RO), and ultraviolet (UV) disinfection to produce water that met Australian guidelines for drinking water. The water was then recharged into the confined Leederville aquifer at a depth of 120 to 220 m onsite at the Beenyup facility, remote from existing drinking water abstraction bores.

Water quality was monitored throughout the treatment process and via an extensive network of 22 groundwater monitoring bores located at the Beenyup facility.

An Inter-Agency Working Group (IAWG), consisting of the DoH, the Department of Environment and Conservation [now the Department of Parks and Wildlife (DPaW) and the DER, the DoW and the Corporation, was formed to identify the required approvals and water quality guidelines for the GWRT, oversee the performance of the GWRT and use information from the GWRT to develop policy and regulation for large scale GWR schemes in Perth.

The GWRT was referred to the EPA for assessment under Section 38 of the EP Act in March 2008 and was deemed to not require formal assessment as it could be adequately



managed under Part V of the EP Act through the Works Approval and Operating Licence regulatory processes.

Recharge to the Leederville aquifer under the GWRT commenced in November 2010 following extensive performance validation of the AWRP.

Over 58,200 groundwater and 4,100 water quality samples of the AWRP were collected during the GWRT, and all samples met the water quality guidelines with the exception of some naturally occurring metals and major ions (e.g., iron and chloride) which were above guideline levels in the ambient groundwater.

The GWRT was successfully completed in December 2012 and demonstrated that groundwater replenishment can deliver a safe, reliable and sustainable water source option that adequately protects human health and the environment.

Following completion of the GWRT, the IAWG developed the Groundwater Replenishment Regulatory Framework (GWR Regulatory Framework) which describes the legislation, statutory and approvals processes applicable to GWR, and the roles and responsibilities of the participating State Government agencies.

The AWRP continued to operate until 2 September 2014 when it was shut down to allow for construction of Stage 1.

3.2.4 Groundwater Replenishment Scheme Stage 1 (Onsite recharge)

Following the success of the GWRT, the Corporation planned the development of the GWRS in stages, allowing a flexible approach to meet water demand in the IWSS. Stage 1 of the GWRS was announced by the State Government in mid-2013 as the next water source for the IWSS. Stage 1 of the GWRS is currently under construction at the Beenyup facility and consists of an AWRP (approximately 14 GL per annum) and onsite recharge via three Leederville bores and one Yarragadee bore. An overview of the infrastructure for GWRS Stage 1 relative to the Proposal is shown in **Figure 3.3**.

In August 2013, Stage 1 of the GWRS was referred to the EPA for assessment under Section 38 of the EP Act and was also deemed to not require formal assessment as it could be adequately managed through the GWR Regulatory Framework and under Part V of the EP Act. Appendix 3 of the supporting documentation for Stage 1 of the GWRS outlined the potential staging options for a 28 GL per annum GWRS.

Recharge under Stage 1 is scheduled to commence in December 2016, following DoH approval. This approval is based on demonstrating throughout commissioning that the AWRP can meet stringent requirements for performance and recycled water quality. A RMZ was set at 250 m for each recharge bore, with an early indication monitoring bore for each recharge bore located between 50 m and 100 m from the point of recharge.

The DoW has granted an additional abstraction allocation for GWR which is equivalent to recharge. This additional allocation will come from existing abstraction bores.