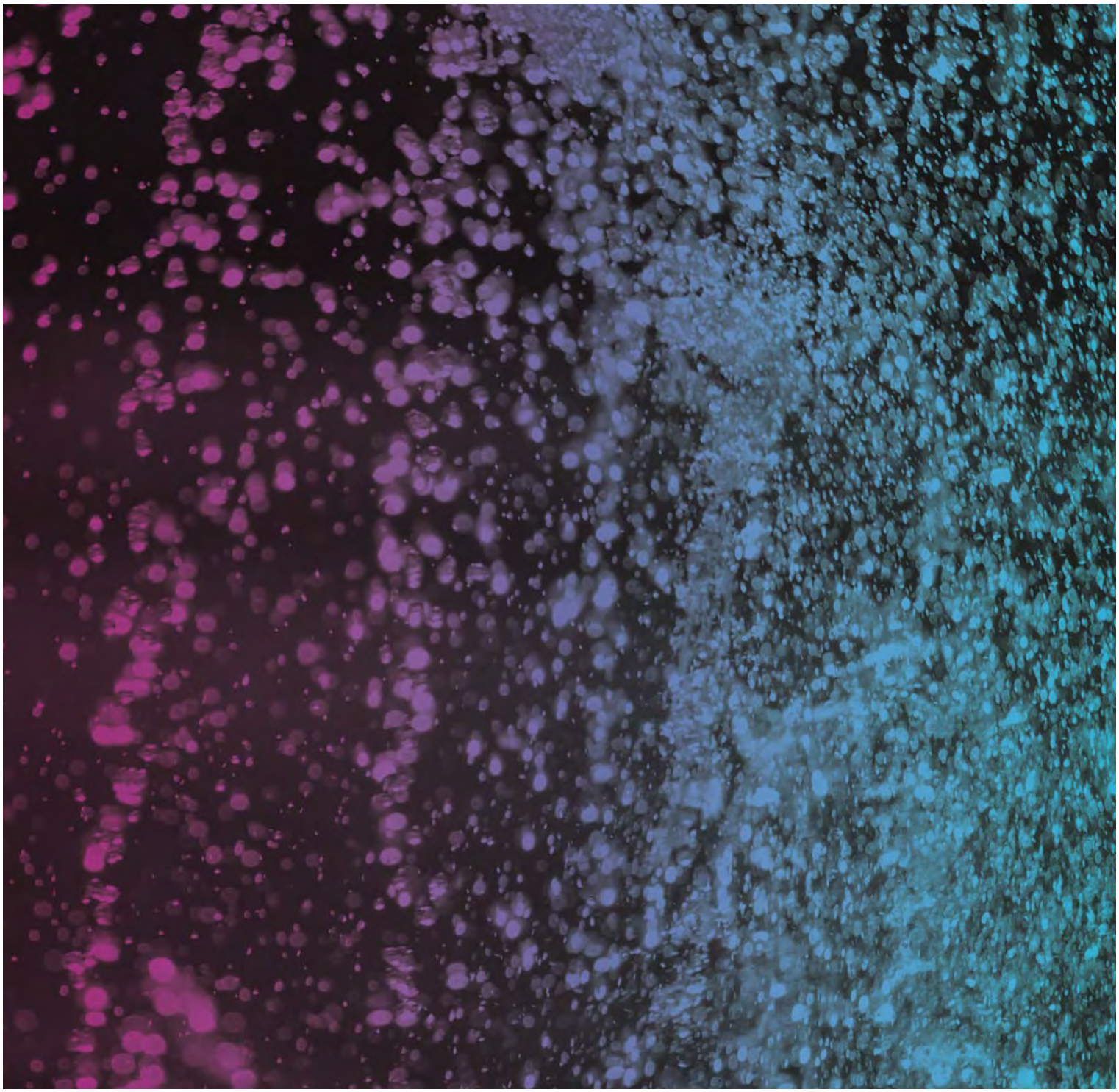
Balannup Wastewater Pressure Main
Water Corporation
05-Sep-2014

Supporting Documentation

Balannup Wastewater Pressure Main



Supporting Documentation

Balannup Wastewater Pressure Main

Client: Water Corporation

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Reviewed by Linda Kirchner

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Rev B	09-Jun-2014	For Internal Review	Jamie Shaw Associate Director - Environment	
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Acronyms

Acronym	Full Name
AH Act	*Aboriginal Heritage Act 1972*
AKMG	Anstey-Keane Management Group
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soils
ASSDMP	Acid Sulfate Soils and Dewatering Management Plan
BAM Act	*Biosecurity and Agricultural Management Act 2007*
BF	Bush Forever
bgl	Below ground level
BWPM	Balannup Wastewater Pressure Main (this proposal)
CCW	Conservation Category Wetland
CCWA	Conservation Commission of Western Australia
CoA	City of Armadale
DAA	Department of Aboriginal Affairs
DER	Department of Environment Regulation
DPaW	Department of Parks and Wildlife
DoW	Department of Water
EAG	Environmental Assessment Guideline
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
FCT	Floristic Community Type
FoF	Friends of Forrestdale
GS	Guidance Statement
HDPE	High Density Polyethylene
JRPCAC	Jandakot Regional Park Community Advisory Committee
KRSL	Keane Road Strategic Link
MRS	Metropolitan Regional Scheme
MU	Multiple Use Wetland
OEPA	Office of the Environmental Protection Authority
PD Act	Planning and Development Act 2005
PEC	Priority Ecological Community
PER	Public Environmental Review
PM	Pressure Main (as in wastewater sewerage pressure main)
PS	Pumping Station (wastewater sewerage pumping station)

Acronym	Full Name
PVC	Polyvinyl Chloride
RE	Resource Enhancement Wetland
RIWI	*Rights in Water and Irrigation Act 1914*
SCP	Swan Coastal Plain
SLIP	Shared Land Information Platform
SPP	State Planning Policy
TEC	Threatened Ecological Community
UBC	Urban Bushland Council
USA	Underground Services Australia
WAPC	West Australian Planning Commission
WC	Water Corporation
WC Act	*Wildlife Conservation Act 1950*
WONS	Weeds of National Significance

Executive Summary

The Balannup Wastewater Pressure Main (BWPM – the 'proposal'), is a proposal by the Water Corporation to construct a 4.5 km long wastewater pressure main from the Collared Street Pump Station (PS) to the Waterworks Road PS. The proposal is required in order to meet increased capacity requirements within the Balannup Sewer District. Recent subdivision developments in suburbs such as Piara Waters, Southern River and Harrisdale, with the resultant population increase, mean that existing Water Corporation sewer assets and their operating arrangement within the Balannup sewerage district are no longer adequate.

Water Corporation has evaluated a number of route options for the BWPM. The preferred option (this proposal) has been chosen as it is the shortest, most cost effective and best engineering solution of the alignment options considered. For 3 km of its 4.5 km length, the BWPM presents no significant environmental issues, other than Acid Sulfate Soils (ASS) and dewatering, and can be constructed using conventional construction methods.

The remaining 1.5 km of the proposed pressure main alignment crosses Bush Forever Site 342, between Skeet Road and Anstey Road. A partially cleared road reserve crosses the Bush Forever site at this location and is used as a strategic fire access track by the Department of Parks and Wildlife (DPaW). Water Corporation is proposing to use a trenchless pipe installing technology within the Bush Forever site to minimise impacts to vegetation, avoid disturbance of ASS and ensure that no dewatering is required in this section.

This supporting document provides information to the Environmental Protection Authority (EPA) in order to determine the level of assessment. This document provides information about the existing environment, existing approvals in place, potential impacts arising from implementation of the Proposal, and proposed management measures to address potential impacts for each of the EPA's environmental factors. Numerous specialist studies have been undertaken to support this and previous local government impact assessment submissions, or as part of ongoing management of the site.

In accordance with the EPA Environmental Assessment Guideline (EAG) No. 8 for Environmental Factors and Objectives (EPA 2013), Water Corporation has reviewed the preliminary environmental factors and identified the following as potentially being key environmental factors:

- hydrological processes
- inland waters environmental quality
- flora and vegetation

Through the preparation of the assessment of environmental factors, the significance of the implementation of the proposal on the environmental factors was assessed, in line with the EPA EAG No. 9 for Application of a Significance Framework in the environmental impact assessment process (EPA 2013a). Water Corporation has concluded that the potential key environmental factors will not have a significant residual environmental impact (Table ES).

The information and assessment presented in this supporting document is considered to have adequately identified and addressed environmental aspects and issues relevant to the proposal, and is adequate to enable the EPA to consider the proposal and determine the level of assessment. The proposal is unlikely to result in significant impacts to the environment and appropriate management practices have been identified to minimise impacts through the use of the EcoPlough installation method.

Table ES: Evaluation of Potential Impact Summary

Aspect/Factor	Evaluation of Potential Impacts	Conclusion
Hydrological Processes and Inland Water Quality	- no dewatering will occur within Bush Forever site 342 - potential to expose ASS (managed in accordance with the ASSDMP) - the pipe will not impede groundwater flow within BF 342 due to the extent of the aquifer - there may be a small rise in groundwater upstream of the pipe of the order of 45 mm	Impacts on groundwater level and flow will be minor to insignificant. The thickness and transmissivity of the aquifer beneath the pipe will allow groundwater to be transmitted with an insignificant or no rise in groundwater levels.
Flora and Vegetation	- Disturbance of up to 0.1 ha of native vegetation within BF 342 - 94 flora taxa were identified within the proposal area - No threatened flora within proposal area - Priority 3 *Jacksonia gracillima* was recorded at 8 locations within Bush Forever 342 - one TEC has been recorded within the BF 342 area but will not be directly impacted - two PEC's have been recorded within BF 342 and up to 0.04 ha of these PEC's may be cleared	The proposal will result in minor impacts to vegetation with Bush Forever Site 342. It is unlikely that any Priority flora will be directly impacted by the proposal. Clearing of native vegetation can be assessed and managed under Part V of the *Environmental Protection Act 1986* (EP Act) Native Vegetation Clearing Permit.
Terrestrial Fauna	- direct mortality during construction - minor loss of habitat (up to 0.1 ha)	No significant direct impact on fauna. Impacts on fauna can be managed by standard construction management techniques.
Landforms	- potential mixing of soil layers (to a depth of 1.5 m)	Mixing of soil layers will be minimal and will have little to no impact.
Heritage	- two registered Aboriginal heritage sites are within close proximity to the proposal but will not be impacted	Unlikely to be any impact on heritage from this proposal.
Amenity	- minor impacts on residents adjacent to the proposal area during construction due to dust and noise - minor impacts to visual amenity during construction - readily manageable through standard construction techniques	Impacts on amenity are minor and can be readily managed using standard construction management techniques
Terrestrial Environmental Quality	- no contaminated sites within proposal area - potential to expose ASS (managed in accordance with the Draft ASSDMP)	ASS can be managed through the ASSDMP in conjunction with Water Corporation's ASS and Dewatering Management Strategy (Water Corporation 2007)
Closure and rehabilitation	- areas of disturbance requiring rehabilitation at end of construction	Areas disturbed during construction and not required for maintenance of the infrastructure will be rehabilitated to their pre-construction status.

1.0 Introduction

1.1 Purpose

The purpose of this document is to provide supporting information to the referral of the Balannup Wastewater Pressure Main (BWPM) proposal to the Environmental Protection Authority (EPA) under section 38 (Part IV) of the *Environmental Protection Act 1986* (EP Act). This document is based on project and study information available at the time of writing.

This document is provided as Attachment 2 to the s38 referral form.

1.2 Proponent Details

Water Corporation
629 Newcastle St
Leederville WA 6007
ABN: 28 003 434 917

Postal Address: PO Box 100, Leederville 6902 WA

1.3 Location

The proposal is located in the suburbs of Harrisdale, Forrestdale and Haynes. The proposed BWPM alignment follows the road reserve along Welcome Meander, Lapwing Approach; Keane Road reserve alignment; and continues along Hanlin Road to the Waterworks Road Pump Station on the eastern side of Tonkin Highway (Figure 1).

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2.0 The Proposal

2.1 Balannup Wastewater Pressure Main

The Balannup Wastewater Pressure Main (BWPM – the 'proposal'), is a proposal by the Water Corporation to construct a 4.5 km long wastewater pressure main from the Collared Street Pump Station (PS) to the Waterworks Road PS (Figure 1).

The existing Collared Street PS at Collared Street, Harrisdale is a standard Water Corporation Type 350 (350L/s) installation constructed in 2011/12. It is outfitted with two Flygt pumps, each of 33 L/s capacity, and currently pumps via a temporary pressure main to the Wright Road PS.

To meet increased capacity requirements in the Balannup Sewer District, the Collared St pump station is to be refitted with new pumps of 128 L/s capacity. A new pressure main is proposed to be constructed to connect the Collared St PS to the Waterworks Road PS in Haynes. This requires connection to 620 m of existing DN375 PVC pressure main and construction of approximately 4,560 m of new pressure main.

Approximately 3 km of the proposed pressure main can be constructed using conventional open-trenching techniques. Traffic and congestion of other infrastructure services will present challenges, as will the presence of acid sulfate soils (ASS) and the potential requirement to dewater. However, these are conventional issues and the Water Corporation and its preferred contractors are familiar with construction and management of these. Three road crossings will need to be installed using thrust boring for this proposal. Again, this presents no new challenges to the capabilities of current Water Corporation construction service providers.

The remaining 1.5 km of the proposed pressure main alignment crosses Bush Forever Site 342, between Skeet Road and Anstey Road. A partially cleared road reserve crosses the Bush Forever site at this location and is used as a strategic fire access track by the Department of Parks and Wildlife (DPaW).

The City of Armadale has referred its Keane Road Strategic Link (KRSL) proposal to the Environmental Protection Authority (EPA) and it was assessed as a Public Environmental Review (PER). The EPA released its report on KRSL on 30 June 2014. The EPA concluded that the KRSL proposal is environmentally unacceptable and recommended that the proposal should not be implemented.

The Water Corporation's pressure main proposal was specifically excluded from the City of Armadale's KRSL proposal. The Water Corporation decided to pursue environmental approvals for the installation of the proposed pressure main independently of the KRSL proposal.

Given the environmental sensitivity of the Anstey-Keane Damplands, the Water Corporation is proposing to install the pressure main using a trenchless construction technology (EcoPlough), along with more traditional impact avoidance techniques for environmental management. This trenchless ploughing technology has been identified as the only technique capable of installing a pressure main that not only operates within the Water Corporation's design and operation standards, but also addresses environmental constraints during construction (see Section 3.1 for more detail).

The section of the proposed pressure main alignment intersecting Bush Forever Site 342 starts at the intersection of Keane Road and Skeet Road and finishes at the intersection of Keane Road and Anstey Road. The proposed pressure main alignment follows the existing strategic fire access track within Bush Forever Site 342.

The existing track coincides with the Keane Road reserve over approximately 70% of the alignment. The proposed pressure main alignment does not follow any cadastral boundary or regular feature, as the fire access track meanders through Bush Forever Site 342. Whilst irregular, the proposed alignment along the existing cleared track minimises clearing requirements and is therefore considered to be the most amenable to construction approvals processes. Steps will be taken to mitigate future issues including:

- Installing a metal tracer within the pressure main to facilitate future location.
- The HDPE pipe to be installed has a wall thickness considerably thicker than necessary for best achievable protection of the pressure main.

2.2 Justification

The main driver for this proposal is urban development pressure in the City of Gosnells and the City of Armadale creating demand for additional sewerage services. Recent subdivision developments in suburbs such as Piara Waters, Southern River and Harrisdale and the resultant population increase mean that existing Water Corporation sewer assets and their interim operating arrangement within the Balannup sewerage district is reaching the limits of its design capacity.

As the Wright Road PS and Pressure Main (PM) reach capacity, there is a greater risk of system overflows. In order to protect human health the sewerage system is designed to overflow (when the system is overloaded) at low points in the environment such as lakes, drains and rivers. If the increased needs of the Balannup Sewer District are not met through provision of the proposed Balannup PM, which will allow the sewer district to move to its ultimate design configuration, increases in the wastewater overflows and odour issues currently experienced can be expected.

The existing arrangement for flow from Collared Street PS is that it pumps to Wright Road PS, which then pumps into the Waterworks Road PM. This arrangement is unsuitable as a long term option due to the following:

- Wright Road PS does not have the capacity to continue to receive flow from Collared Street PS. Upgrading this pump station to increase its capacity has extensive engineering and cost challenges;
- Wright Road PS currently receives odour complaints as the PS is reaching design capacity;
- Wright Road PM, which connects Wright Road PS to the Waterworks Road PM, does not have the capacity to receive flow from Collared Street PS. Replacing this PM has extensive engineering and cost challenges; and
- Current practice of Wright Road PS ‘injecting’ into the Waterworks Road PM is a temporary solution only as it presents a high level of risk in terms of bursts and failures for the pressure mains and pump stations. It is also an inefficient and high-cost operating method.

There is no alternative destination for wastewater from the Collared Street PS to discharge to other than to the Waterworks Road PS. The Jandakot Underground Water Pollution Control Area prevents the transport of sewerage in a westerly direction.

The alignment of this proposal (Option 1 - the road reserve of Welcome Meander, Lapwing Approach, Keane Road and Hanlin Road) has been chosen as it is the safest to operate/construct, shortest, most cost effective and best engineering solution of the alignment options considered. With the use of trenchless technologies, the proposed pressure main can be installed with minimal environmental impacts. Further discussion of alignment options that have been considered is in Section 3.0.

2.3 Key Characteristics of this Proposal

Table 1 Proposal Summary

Proposal title	Balannup Wastewater Pressure Main
Proponent Name	Water Corporation
Short Description	The construction and operation of a 4.5 km wastewater pressure main from the Collared Road Pump Station (PS) to the Waterworks Road PS.

Table 2 Location and Extent of Physical Elements of the Proposal

Element	Location	Extent
Area of disturbance	Figure 1	Clearing of no more than 0.1 ha within a development envelope of 4.5 ha.
Dewatering		No dewatering within BF 342
Acid Sulfate Soils	Figure 4	Estimated volume of ASS material 2400 m^3. No ASS material to be excavated within BF 342.
Conservation Category Wetlands	Figure 5	Clearing of no more than 0.1 ha of vegetation within conservation category wetlands
Threatened Ecological Communities	Figure 2	No clearing of native vegetation within defined TEC.
Bush Forever 342	Figure 6	Disturbance of no more than 0.6 ha of ground within BF 342. Clearing of no more than 0.1 ha of native vegetation within BF 342

Location Map

Balannup Pressure Main

Figure 1

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000

Metres

LEGEND

Pressure Main

Road Network

State Road

Local Road

AECOM

3.0 Consideration of Alternatives

Water Corporation considered alternatives for both the construction technique to install the pressure main and the alignment of the pressure main. A summary of the options assessment is included below.

3.1 Construction Methodologies

3.1.1 Open Trenching

Open trench excavation is required through all sections of the pressure main alignment, except for the Bush Forever section and major road crossings. This trenching method will involve open cut excavation, the laying of pipe, backfilling and compaction. The surface will be restored to its original condition. The requirements for trenching will vary depending on specific ground conditions.

Where the water table is intercepted during trenching, dewatering will be required. Timing of construction to coincide with low water tables will reduce the risk of intercepting groundwater, but is unlikely to eliminate a requirement to dewater due to the high water table in the project area.

If ASS is encountered during excavation, they will need to be treated and managed in accordance with the ASSDMP.

Open trenching was discarded as an option through Bush Forever Site 342 due to the risk of significant environmental impacts. These impacts include: the amount of disturbance required for open trenching; the requirement to dewater and the likely excavation of ASS. An open trench would disturb a width of at least 10 m, resulting in at least 1 ha of clearing of native vegetation in Bush Forever Site 342. Open trenching within the Bush Forever site would require dewatering and ASS management and would likely result in further impacts to adjacent vegetation.

3.1.2 Trenchless Technology – EcoPlough

Developed in the United States, trenchless technologies for pipe installation have been in use since the 1970s. Three trenchless techniques were evaluated as alternatives to install the pressure main through Bush Forever Site 342 (GHD, 2013 – Appendix A). These were:

- Pipe Jacking and Guided Boring
- Horizontal Directional Drilling
- Ploughing

Pipe jacking and guided boring was discarded as an option as it would require significant surface disturbance and dewatering within the Bush Forever site. This technique requires a 5 m by 5 m pit to be dug every 150 m or so to facilitate the drilling.

Horizontal directional drilling can span areas up to 2.2 km. However the depth of installation is an issue for this proposal. There is a requirement to drill down steeply through the surface material to avoid trapping air and making pumping impossible. GHD (2013) calculated that the low point for the installation would be at least 25 m below ground level (bgl) under Bush Forever Site 342. Any maintenance and repair required to this pipe would require a significant excavation and impacts on the Bush Forever site. Scour valves are required in this scenario and this requirement was considered unacceptable within the Bush Forever site.

Ploughing is a construction technique where a bulldozer inserts a narrow furrow in the ground so that neither soil removal nor dewatering is required to install a pipe (GHD, 2013). A pipe is then inserted at a controlled depth and the furrowline is covered. The EcoPlough is a variant of the ploughing process offered by a pipeline contractor “Underground Services Australia” (USA).

An EcoPlough drags a vertical plough through the ground, creating a narrow furrow in which the pipe is inserted (Appendix B). The EcoPlough then returns to the start of the pipe route where the pipe is mounted on the side of the EcoPlough and installed in equipment mounted behind it. The EcoPlough then drives over the previously created furrow and the pipe is ploughed into the furrow. The plough vibrates at high frequency as it inserts the pipe to encourage smaller particulate matter to accumulate around the pipe to form bedding material. The process is completed within the width of the EcoPlough track, which is less than 4m.

It is proposed to utilise the existing fire access track within Bush Forever Site 342, where the EcoPlough can install the pipeline with a minimum of clearing (max 0.1 ha) and without dewatering. In places where the track is marginally narrower than the EcoPlough track, some clearing will be required. Where possible, the clearing will be restricted to pruning of branches and only where required will whole shrubs be removed. There may be some trampling of understorey species on the edges of the track.

There are a number of potential project risks of the use of the EcoPlough for this proposal including:

- Pipe installation will be along the centreline of an existing fire access track rather than parallel to a cadastral boundary, meaning that locating the pipe post installation may be difficult.
- Material compaction around the pipe after installation may not provide the appropriate support for the pipe.

These risks are being mitigated through:

- Installation of a trace wire inside the pressure main to facilitate accurate location in the future.
- The land has a natural west-to-east grade of the Bush Forever site, which allows the EcoPlough to lay the pipe at a suitable grade for safe pipeline operation without the need for air or scour valves within the Bush Forever site.
- Over specification of the pipe wall thickness to provide adequate strength and compensate for compaction issues.
- Compaction will be tested before and after installation with a penetrometer.

The environmental risks of the use of the EcoPlough include:

- direct impacts on vegetation within BF342
- potential compaction restricting water flow through permeable layers
- potential exposure of ASS material.

These risks will be mitigated by:

- avoiding clearing as much as possible by keeping to the previously cleared access track wherever possible
- flagging of any priority species to prevent removal or damage
- furrowing instead of trenching to minimise exposure of ASS material
- minimising the duration of installation
- testing compaction before and after installation with a penetrometer to reinstate the original compaction levels (+/– 20%) to ensure that groundwater flow is not restricted by the over compaction of soil.

GHD (2013) recommended that ploughing is taken forward as the preferred option for installation of the pressure main through Bush Forever Site 342 for the following reasons:

- it minimises environmental impacts, can be installed with minimal clearing, does not require open trenching, and there will be no excavation of ASS or dewatering required
- it can be installed at a suitable grade over the 1.5km Bush Forever Site 342 with no scour or air valve pits in Bush Forever Site 342.
- it is cost effective.

A video of the EcoPlough demonstration can be viewed on the Water Corporation project website at www.watercorporation.com.au/balannup and going to the “background information” tab.

3.2 Pipeline Route Options

Four options were investigated to provide the most suitable pressure main route to connect Collared Street PS to the Waterworks PS (Appendix C). The investigated options were:

- Do nothing – no upgrade of existing wastewater infrastructure
- Option 1 – (this proposal) via the road reserve of Welcome Meander, Lapwing Approach, Keane Road and Hanlin Road.
- Option 2 - via the road reserve of Welcome Meander, Lapwing Approach, Nicholson Road, Armadale Road and Hanlin Road.
- Option 3 - via the road reserve of Welcome Meander, Lapwing Approach, Keane Road, Skeet Road, Ranford Road, Anstey Road, Keane Road and Hanlin Road.

A number of other options were initially considered, but the majority of these were discarded early on in the selection process as they were either a hybrid of Options 1 & 2, impacted private properties or did not avoid impact to the Bush Forever site.

3.2.1 "Do nothing"

The "do nothing" option is not considered feasible, as Water Corporation has an obligation to provide adequate wastewater treatment services in order to protect human and environmental health. The current Collared Street PS discharge infrastructure does not have adequate capacity to provide the services Water Corporation is obliged to provide and a new pressure main is required to transport wastewater to the Waterworks Road PS.

Development pressure in and around the City of Armadale has meant that the existing wastewater sewerage network is approaching capacity. If the sewerage district capacity needs are not met, there will be more failures and overflows to the environment from the existing system.

3.2.2 Option 1

Option 1 starts at the Collared Street PS and follows Welcome Meander, then the road reserve of Lapwing Approach, Keane Road and Hanlin Road before terminating at the Waterworks PS site.

Option 1 traverses approximately 1.5 km of Bush Forever Site 342, along the proposed Keane Road alignment. A trenchless construction technique incorporating EcoPlough technology has been proposed to minimise the impacts of the proposed PM within the Bush Forever site. The PM is proposed to be installed within an existing cleared track in the Bush Forever site without the need for any above ground infrastructure (such as air or scour valves) to service the PM.

Option 1 is deemed to be the most suitable PM route due to the following:

- Option 1 is the shortest option, being approximately 4,500m in length.
- Hydraulically Option 1 is the most suitable with pump pressure approximately 39m head.
- Lowest construction cost.
- Safest option, in terms of construction safety, as it avoids major transport routes and reduces traffic congestion during works.
- Lowest annual operating cost of the three options.
- No significant clearing or dewatering is required.
- No significant traffic management is required.
- Shortest construction time required (using ploughing technology the Bush Forever site construction will be completed within two weeks).
- No significant interruption to existing services.
- PM to be installed within existing road reserves and cleared track.
- The EcoPlough trenchless installation technique is proposed to be used for the PM installation.
- It avoids impacts on the Threatened Ecological Community along the Keane Road alignment.

3.2.3 Option 2

Option 2 heads south from the Collared Street PS along Nicholson Road then Armadale Road and Hanlin Road before terminating at the Waterworks PS site.

The main constraint on this route is the congested services and traffic along Nicholson Road and Armadale Road. Also, operating the PS using this route would require high pressure pumps, which are beyond the WC standard operating pumps. This would significantly restrict the capacity for upgrades required for future growth in the area. Option 2 is deemed to be unsuitable due to the following:

- Significantly longer than Option 1, being 7,000m in length.
- Hydraulically unsuitable, requiring high pressure pumps to operate.
- Pump pressure rating is beyond WC standard max pump head of 50m for wastewater PM.
- Future flow increase is difficult due to pump head limitation. An additional pump station along the route is highly likely to be required.
- Construction cost is the highest of all three options and approximately 1.7 times the construction cost of Option 1.
- Higher operating cost per annum than Option 1.
- Significant traffic management, including night works, will be necessary along Nicholson Road and Armadale Road. This makes this option considerably less safe than Option 1 to both construction workers and the public.
- Difficult to determine suitable alignment within the extremely congested service corridor along Armadale Road (Appendix C).
- More road crossings would be required.

3.2.4 Option 3

This route comprises the use of the Option 1 route and deviates north around the edge of the Bush Forever site by following Skeet Road north to Ranford Road and then south again along Anstey Road.

The main constraint on this route is the congested services and traffic along Ranford Road and Anstey Road. To operate the pressure main using this route will require high pressure pumps for the interim stage, which are beyond the Water Corporation standard operating pumps. This option is deemed to be unsuitable due to the following reasons:

- The alignment is the longest at 9,000m in length.
- Hydraulically unsuitable with pump pressure of approximately 61m head for interim stage.
- Pump pressure rating is beyond WC standard max pump head for wastewater.
- Future flow increase is impossible due to pump head limitation. An additional pump station along the route is highly likely to be required.
- Second highest construction cost, at 1.6 times the cost of Option 1.
- Option 3 will have the highest operating cost.
- Significant traffic management including night works will be required during construction along Ranford Road.
- Difficult to determine suitable alignment within the extremely congested service corridor along Anstey Road and Ranford Rd. See Appendix C.
- More air and scour valves are required, leading to a greater chance of failures and spills.
- Significant interruption to existing services is anticipated.
- More road crossings would be required.

3.2.5 Evaluation of Route Options

The three proposed pipe routes have been assessed based on pump hydraulics, operability, constructability constraints, environmental impact, interruptions to existing services and cost. These route options are shown in Appendix C.

Route Option 1 was recommended based on less air and scour valves required, reducing chance of failures and spills, hydraulic advantages and economic feasibility.

Route Option 2 was rejected based on factors such as length, hydraulics, cost and construction difficulties due to highly congested services in several parts along the route. In addition, this option is significantly impacted by the presence of major roads (Armadale Road and Nicholson Road) along the route which would require significant traffic management and night works and raises safety concerns.

Route Option 3 was rejected due to length, hydraulic, cost and construction difficulties due to highly congested services in several parts along the route. In addition, this option is significantly impacted by the presence of major roads (Ranford Road) along the route which would require night works and significant traffic management and raises safety concerns.

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4.0 Other Legislation and Approvals

Other applicable legislation and approvals that may be required prior to the implementation of the proposal are listed in Table 3 below. Water Corporation will comply with all relevant legislation (including obtaining specific approvals where required) prior to, and during implementation of the proposal.

Table 3 Other Legislation and Approvals

Legislation/Regulation	Acronym	Agency	Approval	Requirement
Environment Protection and Biodiversity Conservation Act 1999 (Cwth)	EPBC Act	Department of the Environment	EPBC Act	Not required as there is no significant impact to a matter of national environmental significance
Rights in Water and Irrigation Act 1914	RIWI Act	DoW	5C licence to construct wells 26D licence to take water	The Water Corporation is not required to obtain either a Section 5C or Section 26D licence. The power given to the Water Corporation by Section 139(2)(a) of the *Water Services Act 2012* overrides the generic requirements of Sections 5C and 26D of the RIWI Act and therefore the Water Corporation is exempt from the requirement to obtain a dewatering license.
Wildlife Conservation Act 1950	WC Act	DPaW	Licence to take flora and fauna	Unlikely to be required
Environmental Protection Act 1986	EP Act	OEPA & EPA	Part IV approval	Part IV approval is required if the EPA formally assess the proposal.
	Clearing Regulations	DER	Clearing permit under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*	A clearing permit will be required for the proposed works unless the proposal is assessed by the EPA.
Aboriginal Heritage Act 1972	AH Act	DAA	Section 18 “consent to disturb”	Not required as there are no registered sites.
Planning and Development Act 2005	PD Act	WAPC/City of Armadale	Development Approval	A development approval is required under the Town Planning Scheme to develop the proposal
Biosecurity and Agriculture Management Act 2007	BAM Act	Department of Agriculture and Food		Management of declared pests (Arum Lily and One Leaf Cape Tulip)

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5.0 Principles of Environmental Protection

5.1 Principles of Environmental Protection

Table 4 describes how the Principles of Environmental Protection have been addressed in this proposal.

Table 4 Principles of Environmental Protection

Principle	Consideration given in this Proposal
1. Precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, decisions should be guided by: - Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment. - An assessment of the risk-weighted consequences of various options.	- WC has conducted scientific studies to understand the project area and the potential risks to the environment - The proposal has sought to avoid environmental impacts by using existing degraded areas - WC has conducted a risk weighted assessment of the consequences of each option to determine that this proposal is appropriate - WC acknowledges the sensitivity of BF 342 and is proposing to use trenchless technology to avoid and minimise environmental degradation.
2. Intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	- The WC proposal meets the principle of intergenerational equity by providing adequate health services for future generations, whilst minimising any impacts on the environment
3. Conservation of biological diversity and ecological integrity. Conservation of biological diversity and ecological integrity should be a fundamental consideration.	- The proposed use of EcoPlough technology is intended to avoid impacts to biological diversity.
4. Improved valuation, pricing and incentive mechanisms - Environmental factors should be included in the valuation of assets and services. - The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. - The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes. - Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentives structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.	- Environmental factors were considered when evaluating options - WC has acknowledged that the proposed alignment has a number of environmental constraints, but is the best option for the viability of the sewerage network - The proposed construction methodology for the pressure main through Bush Forever Site 342 is more expensive than standard construction methodology
5. Waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	- Minimise the risk of sewage overflow by ensuring the system has sufficient capacity - Reducing the generation of odour at existing PS

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6.0 Environmental Aspects and Impacts

6.1 Summary of Environmental Aspects and Impacts

6.1.1 Identification of Relevant Factors and Objectives – EAG 8

Environmental Assessment Guideline 8 (EAG 8) describes an environmental factor as the part of the environment that may be impacted upon by an aspect of the Project. There are 14 environmental factors that have been selected to be relevant and practical to the EIA process. In addition, there are two integrating factors – rehabilitation and closure and offsets, which are important considerations in determining the environmental acceptability of proposals.

Based on the scale and nature of the Proposal, Table 5 identifies the key environmental factors which may be relevant to the proposal.

Table 5 Environmental factors and objectives – EPA EAG 8.

Factor	Objective	Relevance to Proposal
Sea		
Benthic Communities and Habitat	To maintain the structure, function, diversity, distribution and viability of benthic communities and habitats at local and regional scales.	**Not relevant** – No proximity to marine or coastal environments.
Coastal Processes	To maintain the morphology of the subtidal, intertidal and supratidal zones and the local geophysical processes that shape them.	
Marine Environmental Quality	To maintain the quality of water, sediment and biota so that the environmental values, both ecological and social, are protected.	
Marine Fauna	To maintain the diversity, geographic distribution and viability of fauna at the species and population levels.	
Land		
Flora and Vegetation	To maintain representation, diversity, viability and ecological function at the species, population and community level.	**Relevant** – Section 6.2
Landforms	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils.	**Minor Relevance** – Section 6.3
Subterranean Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	**Not relevant** – Proposal will not result in any significant impact.
Terrestrial Environmental Quality	To maintain the quality of land and soils so that the environment values, both ecological and social, are protected.	**Minor Relevance** – Section 6.3 & 6.4
Terrestrial Fauna	To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.	**Minor Relevance** – direct mortality during construction and up to 0.1 ha of habitat loss.
Water		
Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.	**Relevant** – Section 6.5 & 6.6
Inland Waters Environmental Quality	To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected.	**Relevant** – Section 6.5 & 6.6

Factor	Objective	Relevance to Proposal
Air		
Air Quality	To maintain air quality for the protection of the environment and human health and amenity.	**Minor relevance** – Proposal will not result in any significant air or dust emissions.
People		
Amenity	To ensure that impacts to amenity are reduced as low as reasonably practicable.	**Minor relevance** – Proposal will not result in any significant impacts.
Heritage	To ensure that historical and cultural associations are not adversely affected.	**Minor relevance** – Proposal will not result in any significant impacts.
Human Health	To ensure that human health is not adversely affected.	**Not Relevant** – there are potentially significant human health impacts if the proposal is not implemented
Integrating Factors		
Offsets	To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.	**Not Relevant** – there will not be any significant residual environmental impacts.
Rehabilitation and Closure	To ensure that premises are closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the State.	**Minor relevance** – all areas impacted by the proposal will be rehabilitated to pre-existing state, except where required for access tracks and infrastructure.

6.1.2 Significance Framework – EAG 9

In EAG 9 *Environmental Assessment Guideline for Application of a significance framework in the environmental impact assessment process Focussing on the key environmental factors*, the OEPA detail that it only intends to assess projects with impacts on key environmental factors. Key environmental factors are those where the EPA's objectives may be met, but there is a lack of confidence, data or conditions related to implementation. If there is early confidence that none of the factors are key factors or that another regulatory process can ensure that the EPA objective can be met then that factor will receive no further consideration by the EPA. The proponent is only required to carry out further necessary studies for the preliminary key environmental factors. Refer to Section 8.0.

6.1.3 Summary of Environmental Aspects and Impacts

A summary of the environmental aspects and impacts relevant to this proposal and considering the guidance in EAG 8 and EAG 9 is provided in Table 6.

Table 6 Summary of Environmental Aspects and Impacts

Aspect/Factor	Evaluation of Potential Impacts
Hydrological Processes and Inland Water Quality	- no dewatering will occur in the vicinity of native vegetation within BF 342 - potential to expose ASS (managed in accordance with the ASSDMP) - the pipe will not impede groundwater flow within BF 342 due to the extent of the aquifer - there may be a small rise in groundwater upstream of the pipe of the order of 45 mm
Flora and Vegetation	- Disturbance of up to 0.1 ha of native vegetation within BF 342 - 94 flora taxa were identified within the proposal area - No threatened flora within proposal area - Priority 3 *Jacksonia gracillima* was recorded at 8 locations within Bush Forever 342 - one TEC has been recorded within the BF 342 area but will not be directly impacted - two PEC's have been recorded within BF 342 and up to 0.04 ha of these PEC's may be pruned or trampled
Terrestrial Fauna	- direct mortality during construction - minor loss of habitat (up to 0.1 ha)
Landforms	- mixing of soil layers (to a depth of 1.5 m)
Heritage	- two registered Aboriginal heritage sites are within close proximity to the proposal but will not be impacted
Amenity	- minor impacts on residents adjacent to the proposal area during construction due to dust and noise - minor impacts to visual amenity during construction - readily manageable through standard construction techniques
Terrestrial Environmental Quality	- no contaminated sites within proposal area - potential to expose ASS (managed in accordance with the ASSDMP)
Closure and rehabilitation	- areas of disturbance requiring rehabilitation at end of construction

6.2 Flora and Vegetation

6.2.1 EPA Theme, Factor and Objective

Theme	Factor	Objective
Land	Flora and Vegetation	To maintain representation, diversity, viability and ecological function at the species, population and community level.

6.2.2 Existing Environment

Mapping of the Swan region vegetation of Western Australia was completed on a broad scale (1:250,000) by Heddle et al. (1980). Heddle et al (1980) describe one vegetation complex within the proposal area:

- Southern River Complex – Open woodland of *Corymbia calophylla* – *Eucalyptus marginata* – *Banksia* spp. with fringing woodlands of *E. rudis* – *Melaleuca rhaphiophylla* along creek beds.

The Southern River Complex has been extensively cleared since European settlement. The Southern River Complex has a current extent of 11,254.99 ha remaining or 19.69% of its pre-European extent (57,171.55 ha) remaining (Local Biodiversity Program, 2013). Of the remaining extent, 2,513.31 ha are within bush forever sites.

A target of 30% or more of the pre-European extent of each ecological community is considered necessary to preserve biodiversity.

A Level 2 flora and vegetation assessment was conducted by ENV Australia Pty Ltd on 12 October 2012 (Appendix D). The survey identified 94 flora taxa, from 76 genera and 30 families (ENV, 2013). On average 18.1 species were recorded in each 100 m^2 quadrat.

No Threatened species listed under the EPBC Act or the WC Act were recorded in the survey. One species of priority flora (*Jacksonia gracillima* P3) was recorded from eight locations within the proposal area (ENV, 2013). Database searches identified 26 conservation significant taxa as potentially occurring in the proposal area (Table 7).

Table 7 Conservation significant flora species (threatened and priority flora) potentially occurring within the proposal area (ENV, 2013)

Species	Conservation Status EPBC	Conservation Status WA	Likelihood of occurrence
Caladenia huegelii	Endangered	Threatened	Likely
Diuris purdiei	Endangered	Threatened	Likely
Drakaea elastica	Endangered	Threatened	Likely
Drakaea micrantha	Vulnerable	Threatened	Likely
Lepidosperma rostratum		Threatened	Likely
Verticordia plumosa var. pleiobotrya	Endangered	Threatened	Likely
Acacia lasiocarpa var. bracteolata long peduncle variant (G.J Keighery 5026)		P1	Likely
Austrostipa jacobsiana		P1	Likely
Eremaea asterocarpa subsp. brachyclada		P1	Likely
Schoenus pennisetis		P1	Likely
Acacia benthamii		P2	Likely
Byblis gigantea		P3	Likely
Eryngium pinnatifidum subsp. palustre		P3	Not known
Jacksonia gracillima		P3	Recorded
Schoenus capillifolius		P3	Likely
Stylidium longitubum		P3	Likely
Aponogeton hexatepalus		P4	Likely
Dodonaea hackettiana		P4	Possible
Drosera occidentalis subsp. occidentalis		P4	Likely
Grevillea thelemanniana subsp. thelemanniana		P4	Unlikely
Jacksonia sericea		P4	Likely
Microtis quadrata		P4	Possible
Ornduffia submersa		P4	Likely
Thysanotus glaucus		P4	Likely
Tripterococcus paniculatus		P4	Likely
Verticordia lindleyi subsp. lindleyi		P4	Likely

Three vegetation communities were identified and described within the proposal area. Of the total area surveyed (2.12 ha), 1.3 ha (61.1%) was mapped as cleared and is devoid of native vegetation. ENV (2013) inferred Floristic Community Types (FCT) from these vegetation communities based on Gibson et al (1994). Vegetation association Ba is likely to represent FCT SCP21c-Low lying *Banksia attenuata* woodlands or shrublands. This community is listed as a Priority 3 Priority Ecological Community (PEC). The vegetation descriptions and inferred FCT is listed in Table 8 and illustrated in Figure 2.

Enviroworks (2012) conducted a flora and vegetation survey of the proposal area for the City of Armadale's Keane Road Strategic Link Public Environmental Review. This survey identified a Threatened Ecological Community (TEC) in the south east corner of Bush Forever Site 342, just north of the intersection of this proposal with Anstey Road. This TEC is identified as:

FCT type SCP10a Shrublands on Dry Clay Flats – species rich community dominated by low heathland shrubs and species of Restionacaea and Cyperaceae. It is typified by the absence of a tree layer and the presence of *Banksia telmatiaea, Hakea varia, Verticordia densiflora var. densiflora* and *Chaetanthus aristatus.*

SCP 10a is listed as Endangered under WA TEC criteria and Critically Endangered under the EPBC Act (as "Clay Pans of the Swan Coastal Plain").

The ENV (2013) survey did not identify this TEC (SCP 10a) within the proposal area.

Table 8 Vegetation communities in the project area (ENV Australia, 2013)

Map reference	Vegetation community	Inferred Floristic Community Type
MpMr	Low Open Woodland of *Melaleuca preissiana, Melaleuca rhaphiophylla* over *Regelia ciliata, Kunzea glabrescens, Acacia pulchella* and *Hypolaena exsulca.*	SCP4 – *Melaleuca preissiana* damplands
Kg	Tall Open Scrub of *Kunzea glabrescens* with *Regelia ciliata, Melaleuca viminea, Hypolaena exsulca, Baumea juncea* and *Acacia pulchella* with scattered *Melaleuca preissiana.*	SCP5 – Mixed Shrub damplands
Ba	Woodland of *Banksia attenuata* and *Banksia ilicifolia* over *Kunzea glabrescens*, *Hibbertia subvaginata*, *Melaleuca thymoides, Dasypogon bromeliifolius, Lyginia imberbis* and *Phlebocarya ciliata*.	SCP21c – Low lying *Banksia attenuata* woodlands or shrublands (Priority 3 Priority Ecological Community)
Cleared		

Vegetation condition ranged from completely degraded to excellent. Vegetation clearing for access tracks and fire breaks, recreational vehicle access, urban development and weeds within and adjacent to the study area were the most frequently observed impacts on native vegetation (ENV, 2013). The entire area is dissected by an access track which has contributed to disturbance and introduction of weeds into adjacent vegetation, reducing condition.

The proposal area has been surveyed for dieback several times and results suggest it is dieback free and protectable (Enviroworks, 2009).

Fifteen species of weeds (introduced flora) were recorded during the ENV (2013) survey. One species of Declared Pest was recorded (Arum Lily - **Zantedeschia aethiopica*) within the project area. One Leaf Cape Tulip (**Moraea flaccida*) was also recorded from within the proposal area and is a Declared Pest in many parts of WA, but not within the City of Armadale. Several other highly invasive species were also recorded in the survey.

6.2.3 Potential Impacts on Flora and Vegetation

The clearing of native vegetation will be avoided as much as possible during the construction of the BWPM. The use of the EcoPlough will enable the pipeline to follow the existing fire access track through Bush Forever Site 342. The fire access track is sufficiently wide in most locations to accommodate the EcoPlough's 4 m required installation width. Where the track is not wide enough, vegetation will be pruned back and there will be some trampling of vegetation on the edge of the track. An area of up to 0.1 ha of clearing (including pruning and trampling) is anticipated to be the maximum impact to flora and vegetation from this proposal.

The proposal will involve the clearing of up to 0.1 ha of vegetation belonging to the Southern River Complex. This is a total of 0.0002% of the pre-European extent and 0.001% of current extent of this complex. The loss of 0.1 ha of the Southern River complex is not considered significant.

Jacksonia gracillima P3 is unlikely to be impacted by the proposal. If pruning of vegetation is required in the vicinity of any individuals of *Jacksonia gracillima*, the pruning will be conducted on the opposite side of the fire access track. (Note ENV (2013) did not find *Jacksonia gracillima* on both sides of the track at the same location)

The P3 PEC (SCP21c – represented by vegetation type 'Ba') may be impacted by pruning and trampling. The fire access track is at its narrowest as it passes through vegetation type 'Ba'.

The TEC SCP 10a will not be impacted by clearing or pruning. The fire access track is considerably wider at the eastern end of the Bush Forever site.

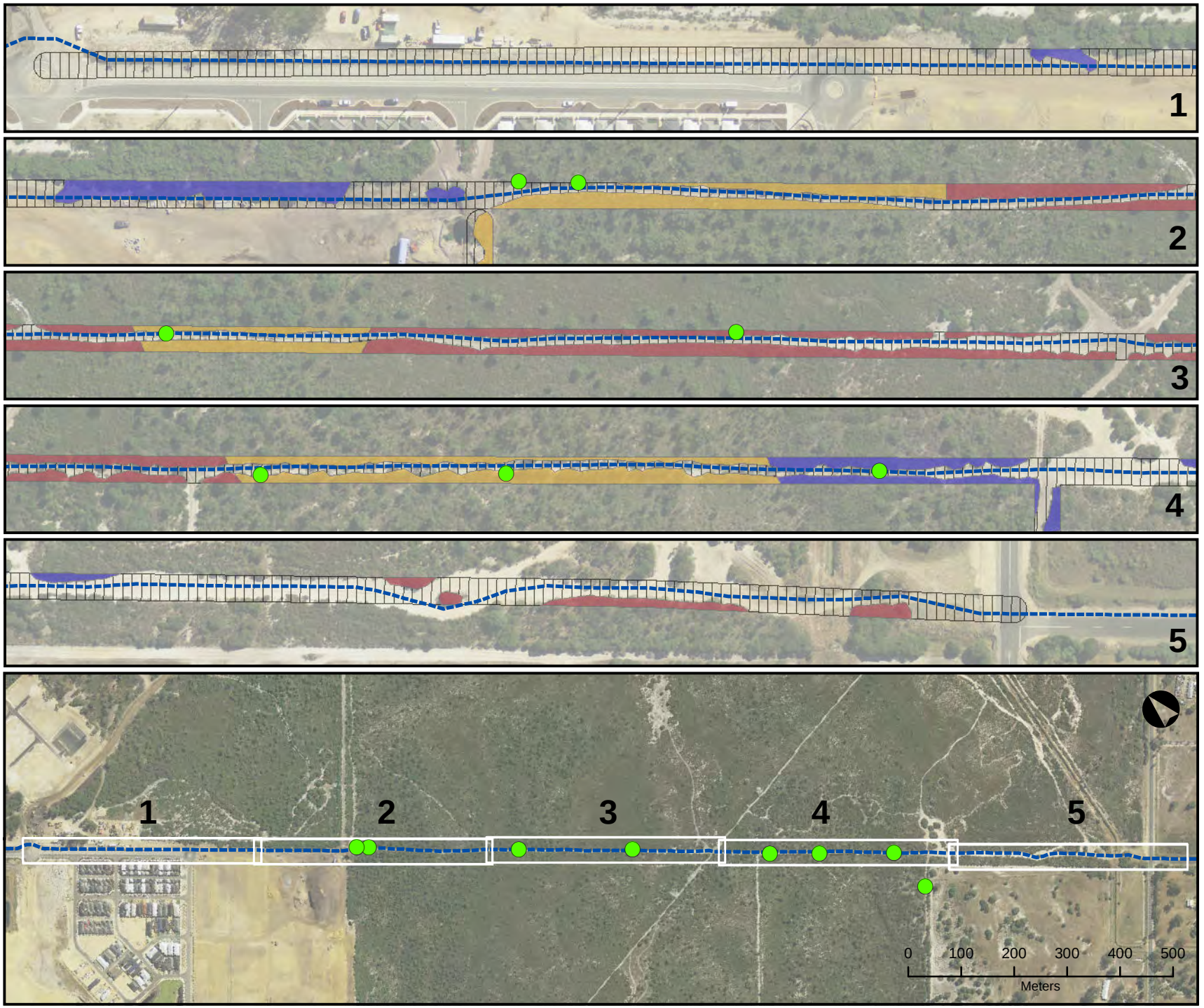
During construction there is an increased risk of ignition and bush fire from machinery operating in the area. This risk is increased by the fact that construction will occur during the summer months in order to reduce the chance of intercepting the water table. Welding of pipe sections also increases the risk of ignition.

Construction work has the potential to introduce or spread weeds and diseases such as dieback. However there is currently uncontrolled access to the area by recreational vehicles and horses which are also likely vectors for weeds and disease.

6.2.4 Proposed Management and Mitigation

Proposed management and mitigation of impacts on flora and vegetation include:

- use of the EcoPlough within Bush Forever Site 342 to avoid impacts associated with conventional trenching technology and avoid or minimise the clearing of native vegetation
- marking and avoiding all individuals of *Jacksonia gracillima*
- avoiding the clearing of any vegetation within the boundary of TEC SCP 10a
- minimise the clearing of native vegetation within vegetation type 'Ba' (PEC SCP21c)
- hygiene measures, including updated dieback mapping, to prevent the introduction and/or spread of weeds and disease into Bush Forever Site 342
- all plant and machinery will be restricted to the confines of the existing fire access track
- all plant and machinery will be fitted with appropriate spark arrestors on exhausts
- no lighting of fires or smoking will be permitted on site
- liaise with the Department of Fire and Emergency Services prior to the commencement of works and remain up to date with the daily fire ban status
- no hot works within the Bush Forever site
- firefighting equipment is to be on site during all work activities.



Vegetation Mapping

Balannup Pressure Main

Figure 2

0 10 20 30 40 50
Metres
1:2,000 (A4)

Coordinate System: GDA 1994 MGA Zone 50

LEGEND

- Pressure Main

Priority Flora

- P3 - *Jacksonia gracillima*

Vegetation Comunities

- Ba (P3 PEC - SCP 21c)
- Cleared
- Kg
- MpMr
- Mv

AECOM

6.3 Soils

6.3.1 EPA Theme, Factor and Objective

Theme	Factor	Objective
Land	Landforms	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils.

6.3.2 Existing Environment

The landform and soils of the proposal area are of the Southern River unit of the Bassendean Dunes (Churchward and McArthur, 1980). The Southern River unit is described as being formed from aeolian deposition, but is generally sand deposited over alluvial soils. The Southern River unit of the Bassendean Dunes is described as a sandplain with low dunes and many intervening wetlands, iron and humus podzols, peats and clays (Churchward and McArthur, 1980).

The Southern River unit is a transition between the deep aeolian sands of the Bassendean Dunes and the alluvial soils of the Guildford formation. The Southern River unit varies from the Bassendean unit of the Bassendean Dunes by the nature of the wetlands associated within each unit. Within the Bassendean unit, wetlands are generally peaty podzols, where in the Southern River unit the wetlands have a clay base (Churchward and McArthur, 1980).

Northcote *et al* (1960-1968) described the soil type in the proposal area as:

Cb38 – Sandy dunes with intervening sandy and clayey swamp flats: chief soils are leached sands (Uc2.33) and (Uc2.21), sometimes with a clay D horizon below 1.5 m, on the dunes and sandy swamps. Associated are various soils in the clayey swamps, such as (Ug6.4) and some (Dy) and (Dg) soils.

Geological mapping of the Perth Metropolitan Region as part of the 1:50,000 Geological Series, has identified the soils of the proposal area as belonging to the following units (GSWA 1986):

- (Sp1) Peaty Sand - grey to black, fine to medium-grained, moderately sorted quartz sand, slightly peaty of lacustrine origin.
- (Sp8) Sand - white to pale grey at surface, yellow at depth, fine to medium-grained, moderately sorted, subangular to subrounded, minor heavy minerals.
- (Sp10) Sand: as S8 over sandy clay to clayey sand of the Guildford formation, of aeolian origin.

The proposal area is predominantly underlain by fine to medium grained quartz sand of aeolian origin, associated with the Bassendean Sand unit (GHD, 2014a). A thin layer of friable variably cemented iron and/or organic rich sands colloquially known as coffee rock is commonly encountered within the vicinity of the water table. Coffee rock forms by the precipitation of humates and iron from groundwater, mainly in the zone of water table fluctuations, and may vary between bright orange, orange brown and dark brown to black. Coffee rock horizons contain stored potential acidity in a number of forms. They may contain inorganic sulfides, including di-sulfides (pyrites) and iron monosulfides as well as potential acidity stored in poorly crystalline and easily hydrolysable iron and manganese oxides (acid sulfate soils are addressed in Section 6.4 below).

The Bassendean Sand is underlain at variable depth by alluvial clayey, silty and sandy soils of the Guildford Formation. To the east of the site, in the vicinity of the Waterworks Road PS the Bassendean Sand extends to depth. Small pockets of peaty sand associated with swamps subject to seasonal flooding are likely to be encountered at or near surface to the south east of Skeet Road (GHD, 2014a).

Bassendean Sand is described as a fine to medium grained quartz sand which is very pale grey at the surface becoming yellow at depth. The Guildford Formation consists of clay, sand and gravel and is variably laterised and podsolised. The Peaty Sand found in this region is formed from swamp deposits and is described as grey to black, fine to medium grained, moderately sorted quartz sand, slightly peaty and of lacustrine origin.

GHD (2014a) conducted bore sampling along the entire proposed alignment and described two distinct geological areas within Bush Forever Site 342. The first section is from Skeet Road to 320 m east and the second from 320 m east of Skeet Road to Anstey Road. The first section from Skeet Road predominately consists of loose Bassendean Sand to 2.5 m, overlaying a layer of medium dense to dense silty sand. A thin layer of coffee rock (less than 0.5 m) was intersected at depths between 2.5 m and 3.5 m. The coffee rock is described as very dense, weakly cemented silty sand (GHD, 2014a).

The second geological area within Bush Forever Site 342 typically consists of a thin layer Bassendean Sand (0.5-2.0 m) overlaying sandy clay/clayey sand (Figure 3). The top sand layer becomes shallower towards the east. The sandy clay/clayey sand layer is typically grey/brown in colour but red, yellow or green layers were also encountered (GHD, 2014a).

Outside of the Bush Forever site, the ground conditions were highly variable due in part to disturbance of soils for development. GHD (2014a) noted that the area west of Skeet Road contains strongly cemented coffee. East of Anstey Road there may be sections of the pressure main that intersect strongly cemented clayey sand, particularly around Waterworks Road PS. However much of this layer may be below the depth of excavation.

6.3.3 Potential Impacts to Soils

To the west of Skeet Road and to the east of Anstey Road it is unlikely that there will be any impact on soils or soils structure. In these locations the soil structure has already been altered by existing development, with the installation of services and roads. Trenching and installing a pressure main will have no further impact on the soil structure in these previously disturbed areas.

At the western end of Bush Forever Site 342 (from Skeet Road to 320 m east) it is unlikely that the proposed trenchless technology of the EcoPlough will impact upon soil structure. In this section the Bassendean Sand layer extends to 2.5 m deep, with a thin layer of coffee rock beneath this layer. The EcoPlough will only plough to a depth of 1.5 m deep to install the pressure main and will therefore not disturb the coffee rock or denser silty sand beneath.

At the eastern end of Bush Forever Site 342, it is likely that the EcoPlough will penetrate beneath the Bassendean Sand layer into the layer of sandy clay/clayey sand. The Bassendean Sand layer is only 0.5-2.0 m thick. Any impact to soil structure is likely to be minimal, as the sandy clay/clayey sand layer extends to depth below and it will not be penetrated by the EcoPlough. Soil displaced during ripping and ploughing will be returned soon after ploughing and compacted to achieve pre-construction compaction levels (+/- 20%).

6.3.4 Proposed Management

The primary mitigation measure to manage the potential impacts to soils (excluding ASS) will be the use of the EcoPlough through Bush Forever Site 342. Conventional trenching technology will be used to install the pressure main west of Skeet Road and east of Anstey Road.

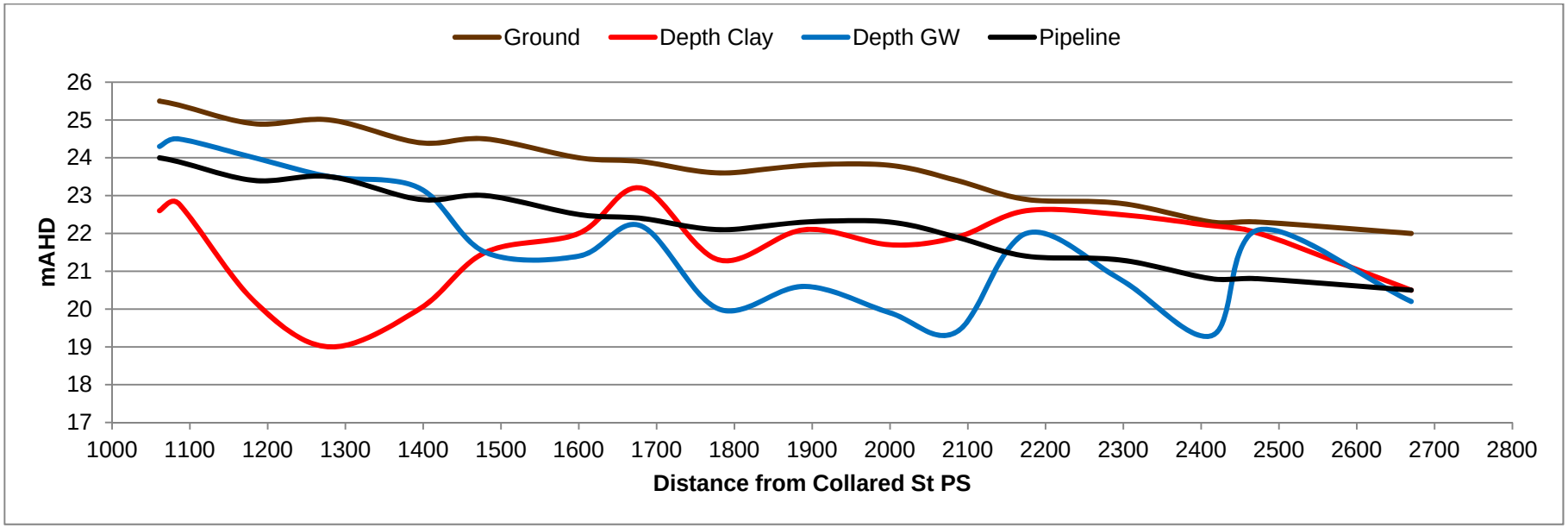


Figure 3 **Graphical representation of the cross section through Bush Forever site 342** showing ground level, depth to clay, depth to groundwater and the depth of the BWPM (Skeet Street is at 1080 m from Collared St and Skeet Rd is 2600 m). Depths extrapolated from GHD (2014a).

6.4 Acid Sulfate Soils

6.4.1 EPA Theme, Factor and Objective

Theme	Factor	Objective
Land	Landforms	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils.
Land	Terrestrial Environmental Quality	To maintain the quality of land and soils so that the environmental values, both ecological and social, are protected.
Water	Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.
Water	Inland Waters Environmental Quality	To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected.

6.4.2 Existing Environment

ASS includes both actual ASS and potential ASS. Actual ASS are soils that are currently generating acidity, whilst potential ASS are soils that are yet to generate acidity but have the capacity to do so. ASS are naturally occurring soils, sediment and peats that contain metal sulfides formed under anoxic conditions. Under anoxic conditions, these soils remain benign and do not pose a risk to the environment (potential ASS). However exposing potential ASS to oxygen has the potential to cause significant environmental impacts including:

- loss of biodiversity in wetlands
- contamination of groundwater resources by acid, arsenic, heavy metals and other contaminants.

A review of the Department of Environment Regulation (DER), ASS risk mapping available through the Landgate Shared Land Information Portal (SLIP) indicates that the majority of the alignment overlies an area of 'Moderate to low risk of ASS occurring within 3 m of natural soil surface but high to moderate risk of ASS beyond 3 m of natural soil surface'. There are three small areas of 'High to moderate risk of ASS occurring within 3 m of natural surface soil'. These areas are described below and shown in Figure 4:

- a 130 m long section within Bush Forever Site 342, approximately 500 m east of Skeet Road
- a 220 m long section in the vicinity of the Keane Road and Anstey Road intersection
- a 100 m long section between Allen Road and Armadale Road.

These areas are associated with peaty clay sediments as depicted on the published geological information and were targeted during the site investigation.

In consideration of the moderate risk of ASS, visual assessment and site investigation was undertaken in conjunction with the geotechnical investigation (GHD, 2014b).

The site investigation was undertaken in conjunction with the geotechnical and contamination investigation in June and July 2013 to establish the ASS risk within the footprint of the proposed works and the risk associated with potential dewatering operations associated with construction.

ASS was identified in samples collected from fifteen (15) of the twenty eight (28) push probing locations drilled during the site investigation. Potential ASS material is associated with the black silty sands, grey silty/clayey sands, black/brown sandy silt and coffee rock horizons, generally at or below the water table.

The maximum inferred RL of PASS encountered during the investigation was 23.5 m AHD within the brown silty sand horizon at BH15, located within the Bush Forever section.

Based on the proposed pipeline invert levels, it is likely that ASS material will be disturbed as part of the construction works. GHD (2014b) is a draft Acid Sulfate Soil Management Plan (ASSDMP) and it will be updated and finalised following final design (Appendix E).

Based on the ASS laboratory results, GHD (2014b) defined a number of ASS management areas within the proposal area. Note – no ASS was found in the topsoil (top 300 mm of the soil profile).

Table 9 below defines the areas within the proposal area which are deemed to be ASS by GHD (2014b). Any soil material excavated from the areas defined in Table 9 requires ASS management and treatment.

Table 9 Defined ASS areas and estimated volumes requiring treatment (GHD, 2014b).

Location Description	ASS	Lithological Description	Estimated volume of ASS material
Exchange Ave to Skeet Road	All material below 24 m AHD or approximately 1.0 to 1.5 m below ground level	Guildford Formation	650 m^3
Bush Forever Site 342	All material regardless of depth	Bassendean Sand underlain by Guildford Formation	Material disturbed but not excavated
South of Armadale Road to east side of Tonkin Hwy	All material below 21.75 m AHD, or approximately 2.0 m to 3.0 m below ground level	Guildford Formation	1750 m^3

6.4.3 Potential Impacts from ASS

ASS are benign when in a waterlogged or anoxic state. However when these soils are exposed to oxygen, the iron sulfides oxidise rapidly producing sulfuric acid. The acidity mobilises many metals and other contaminants that would otherwise be locked in soil sediments. Disturbing ASS and exposing it to oxygen has the potential to cause significant environmental impacts including:

- soil acidification
- adverse changes to the quality of soil and water
- loss of biodiversity in wetlands
- invasion and dominance of wetlands by acid tolerant plants and plankton species
- contamination of groundwater resources by acid, arsenic, heavy metals and other contaminants.

Appropriate management of ASS will prevent the potential impacts of disturbing ASS from occurring.

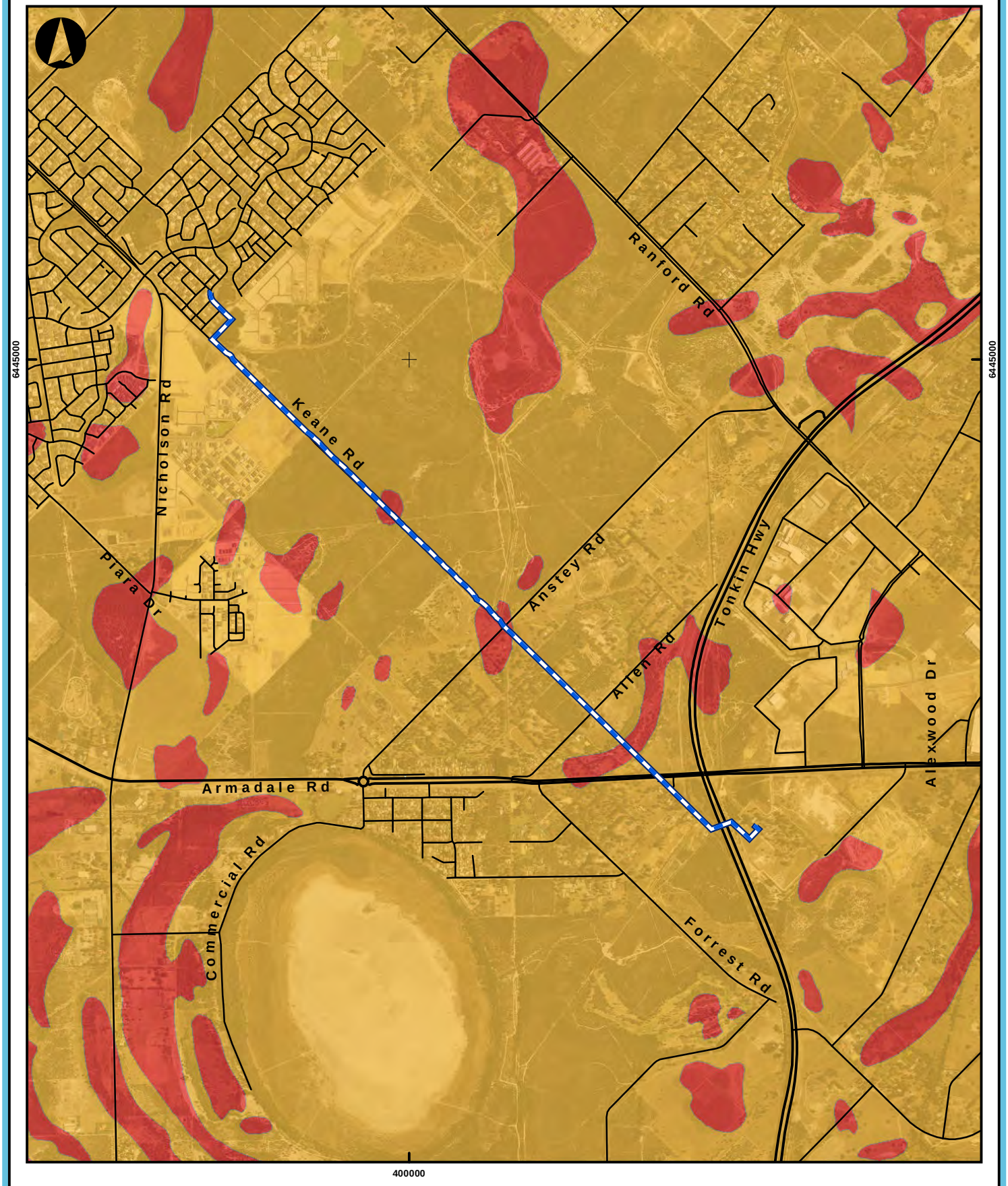
6.4.4 Proposed Management of ASS

ASS will be managed in accordance with the draft ASSDMP, DER ASS guidelines (DEC 2013) and the Water Corporation Acid Sulfate Soil and Dewatering Management Strategy' (Water Corporation 2007). The draft ASSDMP will be finalised when the final design is completed for areas outside of Bush Forever Site 342.

ASS management within Bush Forever Site 342 will consist of:

- following the initial ripping, a layer of lime will be applied to the furrow at a rate of 11 kg per linear metre (this rate is based on the maximum net acidity encountered during investigations)
- the pipe will then be inserted and soil backfilled (including the blended lime)
- no material will be removed from site during installation
- an inspection (including photographs) will be undertaken every 250 m to verify the application and successful blending.

The addition of Aglime is not expected to result in any risk to groundwater quality (Appendix G).



Acid Sulfate Soils

Balannup Pressure Main

Figure 4

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000

Meters

1:28,000 (A4)

LEGEND

Pressure Main

Acid Sulfate Soils

Risk Category

- High to moderate risk
- Moderate to low risk

AECOM

6.5 Groundwater

6.5.1 EPA Theme, Factor and Objective

Theme	Factor	Objective
Water	Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.
Water	Inland Waters Environmental Quality	To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected.

6.5.2 Existing Environment

The Hydrogeological Atlas of Western Australia indicates three aquifers in the area, Perth Superficial Swan Aquifer, the Leederville Aquifer and the Yarragadee Aquifer. The Bassendean Sand geological units make up the superficial aquifer within the study area. The Leederville Aquifer and the Yarragadee Aquifer are deep relative to the proposed construction and are not considered relevant to this proposal.

The BWPM lies within the Forrestdale Main Drain catchment within the Perth Proclaimed Groundwater Area. The watertable lies close to the surface throughout the proposal area, with depth to groundwater typically around 2 m below ground level (bgl) and often less following rain (DoW, 2014). Groundwater levels fluctuate by 1.2 m to 2 m over the course of the year depending on rainfall quantity in a given year (DoW, 2009). Groundwater within the proposal area flows in a south-easterly direction.

A review of DoW's Perth Groundwater Atlas provides information in regards to the groundwater level in May, 2003 and the historical maximum groundwater levels for the pressure main alignment. GHD (2014a) recorded groundwater levels through the proposal area in June and July 2013. Table 10 below summarises this information.

Table 10 Historical groundwater levels within the proposal area (DoW, 2014 & GHD, 2014a).

Section	May 2003 (mAHD)	Historical Maximum (mAHD)	Historical Maximum (m bgl)	June/July 2013 (mAHD)	June/July 2013 (m bgl)
Exchange Ave to Skeet Road	23.5 to 22.5	25.5 to 24.5	0.2 to 1.75	23.5 to 25.2	0.9 to 3.3
Bush Forever Site 342	23.0 to 21.0	25.0 to 23.0	-0.5 to 0.5	19.5 to 24	0.2 to 4
South of Armadale Road to east side of Tonkin Hwy	21.0 to 22.0	23.0 to 25.0	-0.5 to 1.6	20 to 23.2	1.2 to 3.9

6.5.3 Potential Impacts on Groundwater

There are three potential impacts on groundwater by the proposed BWPM – dewatering during construction, obstruction of groundwater flow and impacts on groundwater quality due to spills and leaks. These potential impacts are described in more detail below:

Dewatering

No dewatering will be conducted within Bush Forever Site 342, to ensure there are no drawdown impacts on groundwater dependent vegetation. No dewatering is proposed within the Bush Forever Site 342, as the EcoPlough technology does not require dewatering for construction. Any dewatering outside of the Bush Forever site is highly unlikely to cause a drawdown impact on vegetation within the Bush Forever site due to the late summer construction timing.

Dewatering is expected to be required in discrete locations along the proposed BWPM alignment outside Bush Forever Site 342 to facilitate construction. Due to seasonal fluctuations of groundwater, and year to year variations dependent on annual rainfall, it is not possible to definitively identify where dewatering will be required. The methodology employed to dewater the trench will be dependent on a number of factors. In cohesive soils, where only minor lowering of the groundwater table is required or where the rate of seepage into the trench is limited, pumping from sumps located within the trench will be sufficient. This method is not expected to be suitable for rapid inflow. In sands and high permeability soils, dewatering by spears will be the most effective option (GHD, 2014b).

Dewatering has the potential to impact groundwater dependent vegetation through groundwater drawdown. Several factors influence the amount of groundwater drawdown experienced by groundwater dependent flora, and the extent of dewatering impact (cone of depression) due to dewatering. These include:

- permeability of the soil
- the depth of trench
- time of year that construction is undertaken
- subsurface conditions present
- duration trench is open
- length of trench that is opened at one time.

The impact of dewatering by this proposal on groundwater drawdown will not be significant, primarily because dewatering will not occur in any areas adjacent to intact native vegetation. GHD (2014b) estimates that a drawdown of 1.5 m (0.5 m below the bottom of the trench) will have a flow rate of 12 L/s and a cone of depression of between 29-41 m, depending on the hydraulic conductivity of the soil. Further, only 100 m of trench will be opened at any time. Any excavated trench will typically be backfilled the same day it is opened and groundwater drawdown will be of a limited duration.

Dewatering water discharged without adequate management may impact on surface and groundwater quality. Discharge without retention may cause iron hydroxides to precipitate out where effluent is discharged into surface water bodies in particular. The chemical reactions that ensue may release large quantities of acid and cause the deoxygenation of the water body. These reactions will also decrease the local buffering capacity and increase the chance of acidification where buffer levels are already low. Depending on the management level required, dewatering effluent will be retained prior to discharge in accordance with the Water Corporation Acid Sulfate Soil and Dewatering Management Strategy (Water Corporation, 2007). Where retention is not required, dewatering effluent will be treated and infiltrated back over the excavated trench.

Obstruction of Groundwater Flow

The pressure main will not cause an obstruction to groundwater flow or adversely impact flora once installed. The considerable thickness and overall transmissivity of the underlying aquifer will allow the aquifer to easily transmit groundwater under the pipe without a significant increase in groundwater levels upstream. Groundwater on the upstream side of the pipe may rise by between 1-10% of the diameter of the pipe (Mannos & Kavvadas 1996). For the proposed 450 mm pipe this would mean a maximum rise in groundwater of 45 mm upstream.

In addition to the above reference RPS undertook groundwater modelling to predict potential groundwater impacts associated with the pressure main installation. The results of the modelling concluded that the pressure main will not have significant direct or indirect impacts on the subsurface flows at the project site (Appendix G).

Leaks and Spills

A consistent concern raised through stakeholder consultation was the chance of a leak or spill of hydrocarbons during construction or sewage during operation within a sensitive area such as Bush Forever Site 342. A hydrocarbon spill may result in contamination of the wetland and groundwater. A sewage leak or spill would increase the level of nutrients within the wetlands, potentially leading to eutrophication, and also release pathogens that maybe harmful to human health.

In response to these concerns, the pressure main through Bush Forever Site 342 has been "over engineered" to minimise the potential for leaks or spills. Instead of a standard 375 mm PVC pipe, Water Corporation will install a continuous 450 mm High Density Polyethylene (HDPE) pipe. The Water Corporation design standards for this pressure main specify a nominated pressure rating of PN12, or 40 m pressure head, which incorporates a safety factor of x1.5. The HDPE pipe has a nominated pressure head of PN16, or 160 m pressure head. This is four times the required design standard. The HDPE pipe is designed for much higher pressures than it will be exposed to for this pressure main and is suited to the proposed trenchless installation technology. No weak points such as air or scour valves will be installed within Bush Forever Site 342.

Hydrocarbon spills are a risk during construction. To lower the risk of hydrocarbon spills contaminating soil and groundwater the following measures will be employed:

- no refuelling will occur within the Bush Forever site
- chemicals, including fuel, will not be stored within 100 m of the Bush Forever site
- fuel and chemicals will be stored in an appropriately bunded compound or facility and in accordance with relevant legislation
- spill response kits will be available at any chemical or fuel storage location, at refuelling points and for any works within sensitive areas.

6.5.4 Proposed Management of Groundwater Impacts

Impacts on groundwater will be avoided, minimised or managed through the following actions:

- developing a final ASSDMP just prior to construction in accordance with the Water Corporation Acid Sulfate Soil and Dewatering Management Strategy (Water Corporation, 2007)
- use of trenchless technology (EcoPlough) through Bush Forever Site 342. The EcoPlough will remove any requirement to dewater or excavate ASS in this section
- construction of the pressure main is proposed to occur in summer when the water table is lower to reduce the amount of dewatering required, or avoid dewatering altogether
- duration of trench being open. A section of trench (outside the Bush Forever area) will typically be open for no longer than a day. The impacts of dewatering on surrounding vegetation will be limited to a very short period of time.
- limiting the length of trench open at any time. This management action ties in with the duration a trench will be open. The length of section of trench open at one time will typically be of the order of 100 m, as this is the amount of pipe that can be installed in a day. A shorter length of trench requiring dewatering reduces the area of impact and the volume of water required to be disposed or, at any particular point in time
- "over engineering" the pressure main through the Bush Forever site by using a 450 mm HDPE pipe with a pressure rating of PN16, which is able to withstand four times the pressure that the Water Corporation's design standard requires for this pressure main
- no air or scour valves will be installed within the Bush Forever site as these may weaken the integrity of the pipe, it also means there is no requirement to enter the Bush Forever site during the operation of the pressure main or to scour water within the Bush Forever site.

6.6 Wetlands

6.6.1 EPA Theme, Factors and Objectives

Theme	Factor	Objective
Land	Landforms	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils.
Water	Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected.
Water	Inland Waters Environmental Quality	To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected.

6.6.2 Existing Environment

The proposal area lies within part of the regionally significant Anstey/Keane wetlands and the nationally significant Gibbs Road Swamp System and is one of the largest remaining areas of dampland of high conservation value on the Swan Coastal Plain (DPaW 2014a) (Figure 5).

The Gibbs Road Swamp System comprises of a series of wetlands on the east slope of the Jandakot mound. It covers an area of around 5,800 ha, roughly bounded by the Kwinana Freeway to the west, Tonkin Highway to the east, Rowley Road to the south and Ranford Road to the north. The wetlands to the west of the system are at the top of the Jandakot groundwater mound and potentially contribute to its recharge. The proposal area lies towards the eastern end of the system.

The Anstey/Keane wetlands are a series of damplands, evaluated as Conservation Category Wetlands (CCW), lying within Bush Forever Site 342 with relatively intact remnant vegetation. Outside of the Bush Forever site, most of these damplands have been classified as Multiple Use (MU) and have been cleared for agriculture and other development. Some damplands towards Armadale Road have been evaluated as Resource Enhancement (RE). The damplands are seasonally waterlogged, with occasional periods of inundation.

CCW are relatively undisturbed wetlands that retain high ecological values. Approximately 20% of the wetlands remaining in the Swan Coastal Plain are considered to be CCW (DPaW, 2014b). The disturbance of a CCW through construction activities has the potential to further degrade the wetland and damage habitat vital to flora and fauna species.

The wetlands within the proposal area are part of Southern River unit (Churchward and McArthur, 1980). The wetlands of the Southern River unit are typically aeolian deposits of sand overlying clays and differ from wetlands further west in the Bassendean Dunes due to the clay layer. Where soils in wetlands in the Bassendean unit are generally peaty podzols, wetlands within the Southern River unit have occurred where sand has blown over the alluvial soils and wetlands often have a clay base (Churchward and McArthur, 1980).

Table 11 Wetlands intersecting the proposed BWPM alignment.

Unique Feature Identifier (UFI)	Classification	Evaluation
15425	Dampland	MU
14167	Dampland	CCW
14891	Dampland	CCW
15427	Dampland	CCW
14937	Dampland	CCW
15183	Dampland	CCW
15428	Dampland	CCW
14876	Dampland	CCW
14170	Dampland	CCW
14897	Dampland	MU
14883	Dampland	MU
15832	Not Assessed	RE
7525	Dampland	RE
14342	Dampland	RE
15837	Dampland	MU
15838	Dampland	RE

6.6.3 Potential Impacts on Wetlands

There are a number of potential impacts on wetlands from the proposal. However it is unlikely that any impacts will be significant. Potential impacts include:

- dewatering drawdown (Section 6.5.3)
- dewatering discharge (Section 6.5.3)
- obstruction of groundwater flow (Section 6.5.3)
- pipe burst during operation (Section 6.5.3)
- damage to soil structure (Section 6.3.3)
- ASS (Section 6.4.3)
- clearing of native vegetation (Section 6.2).

These impacts have been addressed in other sections as listed above.

The area of wetlands within the construction envelope of this proposal is:

- CCW – 0.52 ha
- RE – 0.78 ha
- MU – 11.6 ha

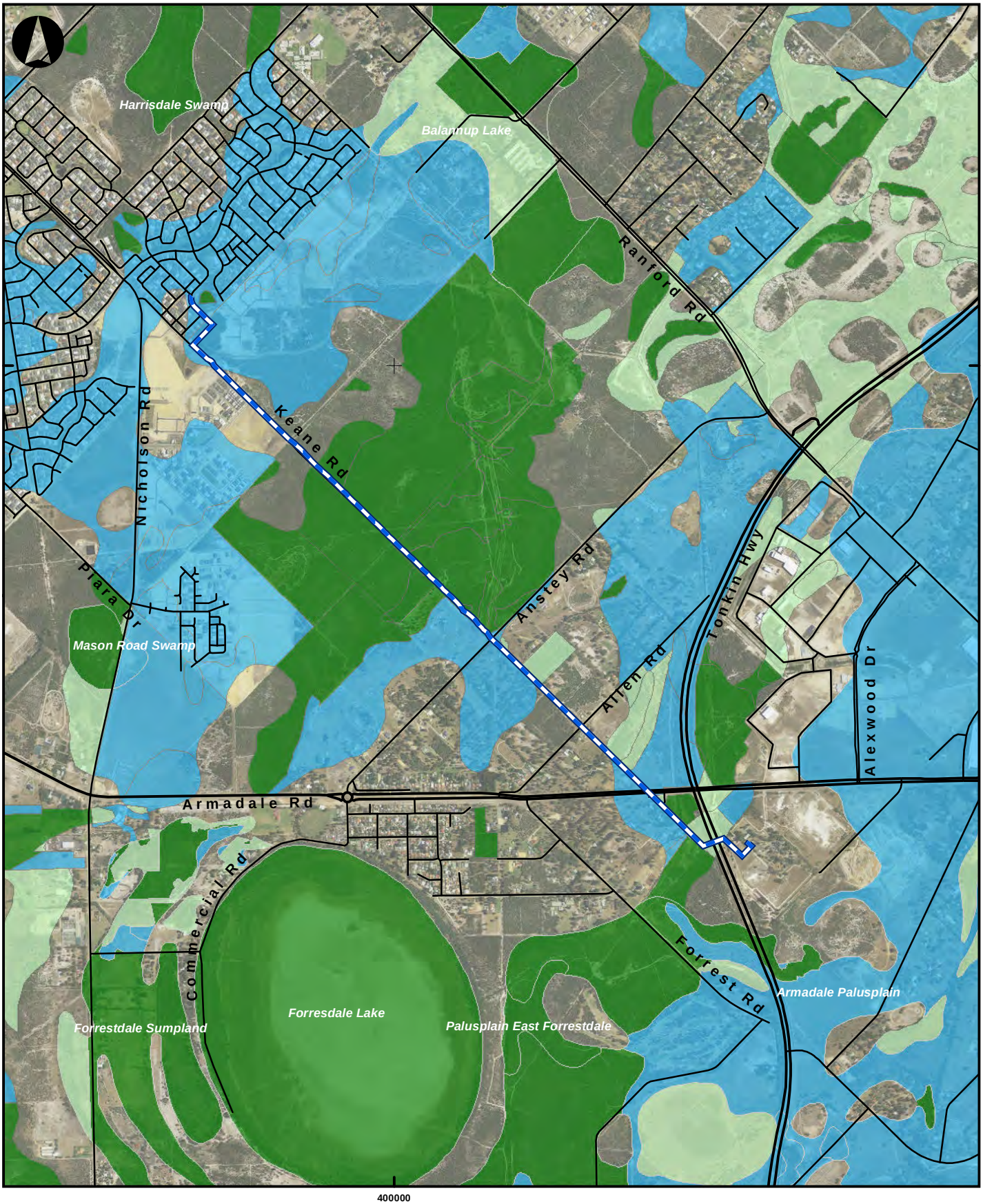
The CCW wetland at the intersection of Armadale Road and Tonkin Highway (UFI 15,547) will not be impacted by this proposal.

It is unlikely that the construction and operation of a pressure main will have any significant impact upon the water quality, groundwater availability, soil structure or biodiversity of wetlands within the proposal area.

6.6.4 Proposed Management

In order to avoid and minimise impacts on wetlands, the Water Corporation proposes to implement the following management actions:

- EcoPlough within Bush Forever Site 342 to minimise clearing and avoid any requirement to dewater or excavate ASS.
- for sites outside of Bush Forever Site 342, the reinjection of dewatering effluent close to source in accordance with the Water Corporation Acid Sulfate Soil and Dewatering Management Strategy (Water Corporation, 2007)
- timing of construction to minimise the requirement to dewater
- “over engineering” the pressure main through the Bush Forever site to a 450 mm HDPE pipe (normal pressure main 375 mm PVC pipe)
- no air/scour valves within the Bush Forever section of the pressure main.



Geomorphic Wetlands

Balannup Pressure Main

Figure 5

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000

Meters

1:28,000 (A4)

LEGEND

- Pressure Main
- Conservation
- Resource Enhancement
- Multiple Use

AECOM

6.7 Conservation Estate

6.7.1 EPA Theme, Factor and Objective

Theme	Factor	Objective
Land	Landforms	To maintain the variety, integrity, ecological functions and environmental values of landforms and soils.
Land	Terrestrial Environmental Quality	To maintain the quality of land and soils so that the environmental values, both ecological and social are protected.

6.7.2 Existing Environment

Bush Forever is a State Government Policy and program that identifies 51,200 ha of regionally significant vegetation for protection, covering 26 vegetation complexes (Government of Western Australia 2000a; 2000b). This amounts to approximately 18% of the original vegetation on the SCP portion of the Perth metropolitan area (Government of Western Australia 2000a; 2000b).

Regionally significant vegetation has been identified based on criteria relating to its conservation value. Important criteria in the identification process include the achievement, where possible, of a comprehensive representation of all the ecological communities originally occurring in the region, principally through protecting a target of at least 10% of each vegetation complex in the Bush Forever project boundary (Government of Western Australia 2000a; 2000b). The proposal intersects both Bush Forever Site 342 and the Anstey-Keane block of the Jandakot Regional Park, between Skeet Road and Anstey Road (Figure 6).

A portion of Bush Forever Site 342, also known as Anstey/Keane Dampland and Adjacent Bushland, Forrestdale, is intersected by the proposal area. The entire Bush Forever Site 342 is 311.6 ha, with approximately 296 ha of bushland. Approximately 200 ha of the Bush Forever is zoned “Parks and Recreation” under the Metropolitan Regional Scheme (MRS) and this includes the proposal area.

The Anstey-Keane block of the Jandakot Regional Park is approximately 200 ha in size. It sits within Bush Forever Site 342 and excludes those parts of the bush forever site that are not zoned “Parks and Recreation”. The Jandakot Regional Park is a mosaic of land parcels from 17 -34 km south east of Perth, with a total area of 2,362 ha. The park is grouped into six roughly contiguous land areas (estates), with the Anstey-Keane block being a part of the Anstey Estate.

A management plan has been developed for the Jandakot Regional Park and it identifies management priorities for each area of the park. The Anstey-Keane block is designated as a “conservation and protection” management zone (CCWA, 2010). The management emphasis within the conservation and protection management zones of the Jandakot Regional Park is to protect and enhance (where possible) the conservation and landscape qualities of the park. Crown land within the Jandakot Regional Park reserved for required utilities and services will retain the existing reserve purpose and tenure arrangements.

This proposal is consistent with State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region, as:

- it is consistent with the overall purpose of existing planning commitments along the Keane Road Reserve
- the proposal can be reasonably justified with regard to wider environmental, social and economic considerations and all reasonable alternatives have been considered
- impacts will be minimised to as low as possible through the use of an existing cleared track as the alignment for the pipeline
- innovative trenchless technique will reduce clearing footprint to 0.1 ha of native vegetation
- once operational, the pipe will not need to be maintained or disturbed.

6.7.3 Potential Impacts to the Conservation Estate

It is unlikely that the proposed BWPM will significantly impact Bush Forever Site 342 or the Jandakot Regional Park. The pressure main will be installed along an existing fire access track, with minimal clearing other than pruning and trampling impacting upon approximately 0.1 ha of conservation significant vegetation. Once constructed, the pressure main will not be visible, will not require operational access or maintenance and will not have any adverse impacts on the values of the conservation estate it sits within.

6.7.4 Proposed Management

The Water Corporation has used the EPA's mitigation hierarchy and proposes to use innovative construction techniques to avoid or minimise impacts to Bush Forever Site 342 and the Jandakot Regional Park. Subject to approval, the pressure main will be constructed along an existing fire access track to avoid the clearing of native vegetation. The use of the trenchless EcoPlough technology will ensure no significant impact to the Bush Forever site, beyond the extent of temporary disturbance of the existing track.

DPaW Managed Lands, Bush Forever & Regional Parks

Balannup Pressure Main

Figure 6

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000

Metres

LEGEND

- Pressure Main
- Regional Park
- Bush Forever Sites
- Crown Freehold - Dept Interest
- Nature Reserve

AECOM

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7.0 Stakeholder Consultation

7.1 Identified Stakeholders

Water Corporation has conducted extensive consultation with stakeholders in the development of this proposal. Consultation has included:

- Government agencies
- Members of Parliament
- Local government (City of Armadale)
- Community groups.

Stakeholder consultation undertaken to date is detailed in Table 12.

During proposal development, public feedback has been invited via the project web site: www.watercorporation.com.au/water-supply-and-services/ongoing-works/balannup-wastewater-main

Water Corporation will continue to consult with relevant stakeholders during the environmental impact assessment process and during implementation of the proposal.

7.2 Stakeholder Concerns

The main environmental issues raised during the stakeholder consultation have been summarised below and addressed in more detail in Table 13:

- Impacts to a Bush Forever (BF) site (Section 6.7)
    - Presumption against clearing of BF on the eastern side of the Swan Coastal Plain
    - BF is for conservation not infrastructure
- What other options exist and why weren't these undertaken? (Section 3.0).
- Why is Water Corporation taking a reactive approach to development? Why wasn't this considered prior to the development being required? (Table 13).
- Impacts and management of environmental impacts including:
    - Threatened Ecological Communities (Section 6.2)
    - Clearing of native vegetation (Section 6.2)
    - Wetlands (Section 6.6)
    - Hydrology – impeding groundwater flow (Section 6.5)
    - Soil structure (Section 6.3)
    - Acid Sulfate Soils (Section 6.4)
    - Dewatering (Section 6.5)
    - Dieback management (Section 6.2)
    - Offsets (Table 13)

- How are these impacts manageable? (Section 6.0).
- What are the chances of the pipe leaking? (Section 6.5.3).
- The ploughing methodology is untried, how does Water Corporation know it will work? (Appendix B).
- Concerns around Water Corporation's environmental management record (Table 13).
- Boring and drilling studies failed to show the presence of ferricrete (Appendix E).
- Cannot commence this activity until the Keane Road Strategic Link (KRSL) Public Environmental Review (PER) is complete (Table 13).

Table 12 Stakeholder consultation conducted as part of the Balannup Wastewater Pressure Main

Consultation method and date	Stakeholder	Issue/Comment
Meeting 21.11.2013	**Office of the Environmental Protection Authority**	- Please ensure that prior to referral to the EPA you have consulted with all relevant parties, and please ensure that this consultation involves the City of Armadale (James Robinson Manager - Strategic Planning is the key contact for the Keane Road Strategic Link). - Early indications are that the proposal is likely to be given a Not Assessed – Managed under Part V Level of Assessment, however, as per all projects this will be subject to the Chairman's final determination. - Regarding meeting with the Chairman, we would like to arrange for this to occur once the proposal has been referred to us. - Possible interested parties: • **Community Groups** ▪ Friends of Forrestdale ▪ Urban Bushland Council ▪ Conservation Council of Western Australia ▪ Wildflower Society ▪ Jandakot Regional Park Advisory Committee • **Government Departments** ▪ Department of Parks and Wildlife ▪ Department of Water (letter sent 16 June 2014 inviting comment) ▪ Department of Aboriginal Affairs (letter sent to South West Aboriginal Land and Sea Council inviting comment on 23 June 2014) ▪ Conservation Commission of Western Australia (letter sent 16 June 2014 inviting comment via DPaW's Environmental Management Branch) ▪ Department of Planning – Bush Forever Office (letter sent 16 June 2014 inviting comment)
Letter 19.12.2013 Briefing 28.01.2014	**City of Armadale**	- Briefing with City of Armadale to introduce the proposal

Consultation method and date	Stakeholder	Issue/Comment
Letter 20.12.2013 Briefing 28.01.2014	Dr Tony Buti MLA **Member for Armadale**	- Acknowledged severe congestion of services already present with route alternatives (Options 2 & 3). - Concerned about development in Armadale and the clearing of remnant bushland. - Recognised that the proposal provides the opportunity to minimise environmental impact while ensuring development was appropriately serviced. - Acknowledged that development pressure and WC obligation to service this had triggered WC proposal. - Stated that he had not been approached by CoA with details of its proposal and expressed appreciation for WC efforts to ensure he was informed about the pressure main proposal. - Indicated that SE Regional Centre for Urban Landcare (http://www.sercul.org.au/committee.html) chairperson and former CoA Councillor Pat Hart was very concerned about local environmental and water issues, so may be interested in WC proposal. - Accepted that the pressure main needs to be established and if clearing is minimised, the proposal appeared reasonable .
Letter 20.12.2013 Briefing 29.01.2014	Mr Chris Tallentire MLA **Member for Gosnells**	General project briefing, with several issues raised: - Would the demonstrable WC community engagement have a bearing on the environmental regulator's decision to formally assess or not assess the proposal. - Local environment groups contacting him were concerned about potential construction of the KRSL and the associated urbanisation of BF 342, which, in his view, was a function of the KRSL proponent's failure to engage with the community. - Was a WC easement required in BF 342, or could the pressure main be installed and 'forgotten about'. - Raised concern that illegal off-road activity was a potential threat to the integrity of WC infrastructure. - Local community groups were also very concerned about illegal rubbish dumping in the area. - He was not convinced of the merits of avoiding formal EPA assessment, which provided opportunities for structured consultation. - Expressed appreciation of WC's rationale in the selection of the Option 1 alignment to advance the proposal, as well as its selection of what appeared to be the best technology to minimise impact. - Queried whether there would be any requirement for environmental offsets, given the limited nature of impacts currently anticipated.

Consultation method and date	Stakeholder	Issue/Comment
		- Confirmed his view that the area's Bush Forever status meant that offsets appeared to be appropriate. - Iterated view that marginally successful efforts of local community groups to protect the area presented an opportunity for WC to support those groups to better manage BF 342. - Iterated view that community concern about increasing urbanisation of the surrounding area would result in further development pressure on BF 342. Therefore, ongoing and effective management of BF 342 – not necessarily driven by WC, but with the support of WC – would seem appropriate. - Confirmed intention to advise concerned community groups that he had been briefed by WC. - Confirmed intention to redirect to the WC any community queries received to ensure they are appropriately addressed. - Queried proximity of proposed pressure main to the KRSL alignment. - Acknowledged that WC was not in a position to await approvals for the KRSL proposal.
Letter 19.12.2013 Briefing 31.01.2014	Tony Simpson MLA **Member for Darling Range**	- Expressed appreciation for WC requirement to progress proposal, given the 'huge' development pressure being experienced within the electorate. - Noted that demand for sewer service in Forrestdale Business Park precinct (Stage 1 & 2) would become very significant by 2017. - Noted awareness of odour issues associated with interim configuration in Piara Waters. - Expressed unequivocal support for the Option 1 alignment preferred by WC. - Queried entire cost of pressure main development. - Queried timeframe for pressure main development, given that the City of Armadale had its own KRSL proposal currently under consideration by regulators. - Acknowledged that uncertainty regarding KRSL approvals left WC in a difficult position and again expressed unequivocal support for WC proposal. - Expressed appreciation of WC commitment to engage stakeholders and community groups to ensure any concerns were appropriately addressed.
Briefing 04.02.2014 Letter (WC to DPaW) 16.06.2014 Email (DPaW to WC)	**Department of Parks & Wildlife (Swan Region and Environmental Management Branch)**	- Provided a summary of the proposal. - DPaW require Water Corporation to consider • The impacts on the TEC (Dewatering/Drawdown)

Consultation method and date	Stakeholder	Issue/Comment
18.07.2014		• Dieback • Appropriate offset proposal - Sought further comments from DPaW and provided extra information regarding stakeholder engagement and details of the proposal. - DPaW (Swan Region) responded via email on the 18.07.2014 advising that DPaW will provide detailed comments when the project is referred to the EPA.
Letter 19.12.2013 Briefing 05.02.2014	Don Randall MP **Federal Member for Canning**	- General briefing of project, studies being conducted and stakeholder concerns. - Expressed appreciation for briefing, acknowledged the importance of the proposal, confirmed his support for the proposal.
Letter 09.01.2014 Meeting 11.02.2014	**Anstey-Keane Management Group** **Convenor:** DPaW Community Bushland Coordinator, Urban Nature **Members:** - DPaW - City of Armadale - Water Corporation - Friends of Forrestdale President - WAPC (Apology) - Western Power (Apology)	- Introduction of Anstey-Keane Management Group (AKMG) membership (Friends of Forrestdale, WA Planning Commission, Western Power, City of Armadale, Department of Parks and Wildlife, Water Corporation). - AKMG interest in receiving a briefing relates to potential implications of the WC proposal regarding management and restoration practices in the publicly-owned dampland areas managed by the group, rather than fulfilment of WC's community engagement plan. - Noted that there is a long history of issues at the Waterworks Road PS – formerly Cleanaway site and known to be contaminated. - Acknowledged that development pressure on WC to cater for wastewater management requirements was "…getting greater by the day…" - General concerns about alignment choice: • Alternative pressure main routes • Was Option 3 achievable? • Could the alignment follow the firebreak on the southern boundary of BF 342? - Would the proposal impact the movement of bandicoots and kangaroos? - Agreed that standard trenchless technologies across the entire BF 342 area would be inappropriate from a DPaW perspective.

Consultation method and date	Stakeholder	Issue/Comment
		- The pipe material would be flexible HDPE pipe material. - How would pipe lengths be joined? - Can the ploughing technique be accommodated entirely within the 3 m firebreak? - How many machinery passes are required to install pipeline? - Development pressure exerted on the WC was acknowledged. - Acknowledged the in-built contingencies in WC's wastewater conveyance scheme, citing previous spills into the Southern River, via drainage facilities, following power failures at the Waterworks Road PS. - Friends of Forrestdale was against the CoA's KRSL proposal and that position naturally extended to the WC proposal, as FoF do not wish to see any development-related activity within BF 342. - Could the proposed pressure main withstand the pressure of a road being constructed above it. - FoF understanding of the EP Act is that no other proposal affecting the same site can be considered while the KRSL PER is underway. - Dieback is a concern for the AKMG. - What is the potential for the pipe to burst or leak? - Noted that the proposed installation depth was unlikely to trigger acid sulfate soils. - Would WC install along the KRSL alignment if the CoA alignment was approved. - Advised by WC that the pressure main was on the critical path for construction and the schedule required construction in 2015. - Is this the first time the ploughing technology has been used by WC? - What would WC do if KRSL and this proposal were both rejected by the EPA.
Telephone 07.02.2014 Email 18.02.2014 Letter 25.02.2014 Email 04.03.2014	**Urban Bushland Council**	- UBC stated their opposition to the proposal and that no development proposal within BF 342 was acceptable. - Cited concern about WC past environmental management within BF 342. - Advised that any briefing offers to UBC affiliates including SERCUL, The Friends of Forrestdale and The Wildflower Society would not be accepted as "our position will not change and the other peak groups will support us in our stance"

Consultation method and date	Stakeholder	Issue/Comment
Meeting 14.03.2014 Meeting 22.03.2014		- Provided written advice to WC to formalise UBC's position. - Issues raised at 14 March 2014 meeting include: • BF 342 should not be impacted now or ever • Bush Forever policy has a presumption against clearing on the eastern side of the Swan Coastal Plain • Alternatives to the west, away from the Pinjarra Plain should have been considered • The alignment through BF 342 and conservation category wetlands is a fatal flaw • There is a high acid sulfate soil risk posed by construction that will cause irreversible degradation • Old and complex soil structure • Highly complex hydrology • Ploughing will irrevocably disrupt the natural soil sequence and is a fatal flaw • The pipe will disrupt hydrology and cause a "dam wall" effect to groundwater • Risk of untried technique (ploughing) • Why has Water Corporation's position of placing underground pipes outside of this BF site changed? • Degradation of the Anstey-Keane wetlands would cause significant reputational damage to the Water Corporation - Main points from second meeting on 22 March 2014: • UBC affronted by Water Corporation's lack of appreciation of their expertise and efforts provided in good spirit and the public interest • Concerned that WC did not consider Bush Forever sites as areas set aside for conservation only • A pipeline through BF342 will have a series of irreversible effects on wetland function, conservation values and flora and fauna • Option 1 (through BF 342) has a series of fatal flaws, that WC refuse to acknowledge • Can WC categorically state that Option 1 will never need an additional pumping station in the future? • WC could not substantiate claim that impacts are manageable

Consultation method and date	Stakeholder	Issue/Comment
		• UBC requested other alignments outside this sewer district, or along Nicholson and Armadale Roads are pursued • UBC claimed that they are presenting the scientific facts and expert advice, second to no other and WC has dismissed their advice • No one from WC was present at the two meetings with the appropriate environmental expertise and knowledge of eastern side of the Swan Coastal Plain • WC dismissive attitude is unacceptable to UBC and failure to acknowledge and take into account the facts presented by UBC is a failure of governance • UBC conclusions: ▪ The UBC, as the peak community association for urban bushland conservation and protection, calls upon WC to withdraw its option one, and any modification of this proposal within BF 342, for construction of the Balannup Pressure Main ▪ Please note the summary of points from the 14 March 2014 meeting (above) and note these issues remain ▪ Representatives of the UBC again request a meeting with the CEO Ms Sue Murphy concerning these matters - Other issues raised at second meeting 22 March 2014: • "Why is consideration of this post-development and not pre-development?" • Why don't you take a pre-emptive approach? You can't do proper environmental planning if the development is allowed and then you want to retrofit the pipeline required to service it • Bush Forever was built on the premise that, if it's not a major road reserve, it is a road reserve that should never be developed. "That was an understanding signed on to by all the government agencies, including the water authority…" • The road reserve (Keane Road) should have been deleted 12 years ago • The Bush Forever Policy states that these areas have been set aside for conservation, not infrastructure • WC had an established precedent in avoiding this BF site when it developed a main from the Forrestfield [Nicholson Road] Desalination PS to storage facilities in the hills without impacting this Bush Forever site, as it was placed down the middle of Anstey Road

Consultation method and date	Stakeholder	Issue/Comment
		• UBC did not question the justification for the pressure main, their main concern is that WC's planning is faulty and Bush Forever came before the approvals for the sub-division • WC should justify why they have not gone with Option 2 (along Nicholson & Armadale Roads) • Could WC simply upgrade the Collared Street pumping station? • Option 3 appears to be more suitable for servicing additional new development in the area • UBC shocked that dewatering required for Option 3, as their understanding was that dewatering was not necessary for pipeline development • Do other sewer districts have the capacity required? • Can WC guarantee that an additional pumping station will never be needed for option 1? • Concerned that geotechnical investigations did not find ferricrete • Edge effects from the pipeline, even if there is no clearing – it is ecology 101 • For WC to consider that any Bush Forever site is available for infrastructure is totally wrong • WC has a lot of options for this pipeline, but they have only presented those options that address WC's engineering and cost concerns
Email 09.01.2014 Briefing 25.02.2014	**Jandakot Regional Park Community Advisory Committee (JRPCAC)** **Convenor:** DPaW A/Community Liaison Officer, Regional Parks Unit - Swan Region **Agency Attendees** DPAW City of Cockburn Jandakot Airport Holdings **JRPCAC Community Reps**	- General briefing of proposal. - Friends of Forrestdale stated their objection to the proposal and that they would oppose it throughout • They consider that WC must find an alternative route, regardless of their engineering and cost issues • If the proposal was to go ahead, it would set a bad precedent for other services within a bush forever site - Other JRPCAC members agreed that it was a bad precedent, but applauded WC for their innovation in minimising environmental impacts and the time required to construct. - Raised concerns about ASS impacting water quality. - Dieback management

Consultation method and date	Stakeholder	Issue/Comment
Letter 13.6.2014 (from Water Corporation) Letter 30.06.2014 (from DoW)	**Department of Water**	- The Water Corporation sought comments on and provided preliminary information regarding the proposal. - The DoW responded on the 30th June advising they had no comments and recommended that the Water Corporation liaise with the Department of Parks and Wildlife.
Briefing 11.06.2014	**Bushcare and Environmental Working Group** **Convenor:** CoA Environmental Officer **Chair:** SE Regional Centre for Urban Landcare chairperson **BEWG Membership:** Not disclosed by CoA - Privacy Includes Friends of Forrestdale President	- General briefing of proposal - Issues raised • Has WC considered adjusting alignment into private land at eastern end, as per KRSL proposal? • Concerns regarding environmental management and adhering to environmental management plans referred to another non Water Corporation construction project as an example. • Concerns regarding the impact of the pipeline on groundwater flow • Noted that using the proposed machinery would lead to some compaction of soil • Asked if an environmental officer would be present while construction works were being undertaken within the Bush Forever site • Requested that the priority 3 species are tagged and retained and if this is not possible advised there are ways to relocate the individual species • Will the installation of the pipeline leave enough space for the proposed fauna underpasses in the KRSL? • Will the Water Corporation consider undertaking revegetation in the areas impacted? • Will audit reports on the implementation of management plans be publicly available? • Outlined negative environmental management of government agencies in the past and queried if this proposal will be the same • It seems to be a low environmental impact…that Water Corporation are committing to stay primarily within the confines of the track…there appears to be a lot of positives • How can you assure us that you would not spread dieback or ASS along the whole alignment? • Does the Water Corporation have a contingency plan if the technology does not work?
Letter 23.06.2014	**South West Aboriginal Land and Sea**	- Water Corporation provided preliminary information and sought comments.

Consultation method and date	Stakeholder	Issue/Comment
Email 23.06.2014	**Council**	- SWALASC acknowledged receipt of the letter and did not provide any comments.
Letter 16.06.2014 (from Water Corporation to Department of Planning) Briefing 5.08.2014 Letter from WAPC to Water Corporation 15.8.2014	**Department of Planning and the Western Australian Planning Commission**	- Provision of preliminary information and briefing - WAPC as the landowner advised the Water Corporation of their support of the proposal (Appendix F) - The Water Corporation will meet WAPC's conditions for their support of this proposal by: • The Water Corporation will continue to liaise with WAPC with regards to management • The EcoPlough will be used to minimise impacts of pipeline installation • Vegetation likely to be impacted during pipeline installation will be pruned or trimmed to minimise breakage and weakening of the plants • No rubbish will be left within the Bush Forever site during or after construction • The firebreak will be compacted to pre-installation ground compaction levels (+ /– 20%) • The Water Corporation will not seek an easement over the pipeline alignment

Table 13 Description of primary stakeholder concerns reference this proposal and how Water Corporation is proposing to manage the concern.

Stakeholder Concern	Explanation of Concern	Proposed management or response
- Impacts to a Bush Forever (BF) site	- BF sites have been listed for conservation of regionally significant remnant vegetation in and around the Perth Metropolitan Area - BF policy was agreed by all government agencies in 2003 - BF sites should not be disturbed for infrastructure development - Presumption against clearing of vegetation on the eastern side of the Swan Coastal Plain - BF is for conservation not infrastructure	- WC consider that this proposal is consistent with the aims of BF and State Planning Policy 2.8 *Bushland Policy for the Perth Metropolitan Region* (SPP 2.8) - SPP 2.8 seeks to protect BF areas as a priority except where: • a proposal is consistent with the overall purpose of an existing planning commitment, in particular existing reserves for roads (regional or local), pipelines, water or drainage services, with any impacts minimised and managed in accordance with existing environmental management plan best practice requirements or • A proposal can be reasonably justified with regard to wider environmental, social and economic considerations (in particular future road (regional or local) requirements) and all reasonable alternatives have been considered to avoid or minimise any direct loss of regionally significant bushland - SPP 2.8 states existing cleared or developed areas with BF areas are not intended for protection, however any significant indirect impact to bushland may be subject to environmental controls. - SPP 2.8 provides an impact assessment process for BF areas. - This proposal is consistent with SPP 2.8, as it is consistent with the overall purpose of existing planning commitments along Keane Road. - The proposal can be reasonably justified with regard to wider environmental, social and economic considerations and all reasonable alternatives have been considered. - Impacts will be minimised to as low as possible through the use of an existing cleared track as the alignment for the pipeline. - Innovative trenchless technique will reduce clearing footprint to 0.1 ha of native vegetation. - Once laid, the pipe will not need to be maintained or disturbed.

Stakeholder Concern	Explanation of Concern	Proposed management or response
		- Referral of this proposal to the EPA is consistent with the impact assessment process of SPP 2.8. - Refer to Section 6.7 for more detail.
- What other options exist and why weren't these undertaken? - Why is Water Corporation taking a reactive approach to development? Why wasn't this considered prior to the development being required?	- Why does the connection have to be made to Waterworks PS - WC should have planned for this development - Ensured that through proper planning, BF wouldn't be impacted - Could other sewerage districts west or south take the load?	- There is no infrastructure to the north or north east of the Collared Street pump station which can be considered for the Collared Street PS to discharge. This is due in part to the existence of the Jandakot Water Mound protection zone. - For a more detailed explanation see Section 2.2.
- Impacts and management of environmental impacts including:		
• Threatened Ecological Communities	- The proposal will impact a TEC (FCT SCP10a)	- The proposal will not directly impact any TEC vegetation. The fire access track proposed for the alignment is very wide at this location and no clearing will be required (See Section 6.2).
• Clearing	- Presumption against clearing of BF on the eastern side of the Swan Coastal Plain - Clearing should not occur within a BF site - Clearing should not occur within a conservation category wetland	- Clearing of vegetation has been avoided and minimised to the maximum extent possible through the use of an existing fire access track for the alignment and innovative construction techniques (EcoPlough). - See Section 6.2 and Appendix A for more information on the potential impacts and the evaluation of trenchless technologies to avoid clearing impacts.
• Wetlands	- Nationally significant Anstey-Keane wetland should not be impacted - There is a presumption against impacts and clearing of CCW and their buffers in EPA guidance	- There will be less than 0.1 ha of native vegetation impacted by this proposal within the wetland area. - Most of the vegetation impacted will be 'temporary' clearing – for example the pruning of branches to allow a large enough envelope for the EcoPlough.

Stakeholder Concern	Explanation of Concern	Proposed management or response
		- There will be no impact to the hydrology of the wetlands. - See Section 6.5 for more detailed information.
• Hydrology	- Impeding groundwater flow - The pressure main will cause a barrier to groundwater flow like a dam wall	- Groundwater will not be impeded by the pressure main. - Groundwater will find its own path and flow around the pipe. - Refer to Section 6.5.
• Soil structure	- Irreparable damage to ancient soil structures by ploughing - Will affect wetland hydrology and flora composition	- The EcoPlough will minimise mixing of soil layers. - The wetlands of the Southern River unit (including the wetlands within the proposal area) are underlain by a clay layer and the hydrology will not be impacted by the EcoPlough. - See Section 6.3.
• Acid Sulfate Soils (ASS)	- ASS will ruin the wetlands - ASS will cause irreparable damage - Lake Gwelup – poorly managed ASS - Potential impacts to humans drawing on the groundwater as potable water	- If ASS is not managed correctly it has the potential to cause adverse impacts to the wetlands. - However ASS can be readily managed. The Water Corporation has significant practical experience in managing ASS as a common risk associated with its projects - WC has conducted an ASS investigation and developed a draft ASS management plan (Appendix E). - A final ASS management plan will be developed prior to construction. - See Section and Appendix E for more information.
• Dewatering	- Why is dewatering even required? - Dewatering will impact vegetation adjacent to pipeline.	- No dewatering is required within BF 342. - Dewatering will possibly be required in areas where traditional trenching construction methodologies are used. - The EcoPlough technique will not require dewatering. - Construction is proposed in late summer/early autumn to take advantage of the lowest groundwater levels and potentially avoid any dewatering. - There is no native vegetation adjacent to the pressure main where dewatering may occur.

Stakeholder Concern	Explanation of Concern	Proposed management or response
		- See Section 6.5.3 and Appendix E for an explanation of the potential impacts and mitigation of dewatering.
• Dieback management	- The proposal will introduce and/or spread dieback within the BF 342 site	- WC propose to conduct dieback surveys prior to construction. - A dieback management plan will be developed and implemented in consultation with DPaW. - It should be noted that the fire access track through BF 342 is unmanaged and uncontrollable, so the risk of dieback and weed spread is present. - Refer to Section 6.2.
• Offsets	- Would offsets be required? - No possible offsets to manage the impacts are available	- WC is not proposing any offsets at this stage. - Offsets (if required) will be determined in accordance with the Water Corporations state-wide clearing permit and in consultation with relevant regulators.
- How are these impacts manageable?	- Concerns that constructing the pressure main will cause irreparable damage that will not be able to be mitigated or managed	- The ploughing technique proposed through the BF 342 site will be the least intrusive method of construction possible. - The pressure main alignment is using an existing cleared area within BF 342.
- What are the chances of the pipe leaking?	- WC policy allows discharge of sewage during pipe failure to prevent toilets from backing up - How well are the pipe segments secured? What is the chance of a join failing - If sewerage was to be discharged into the wetland area it is likely to cause irreparable damage	- There will be no discharge of sewage into the wetland areas. - The pressure main through BF 342 will have no air/scour valves and therefore will not be able to discharge sewage. - The HDPE pipe material negates the potential for leaks and is over-engineered for this particular task (it is able to withstand four times the required pressure rating). The pipe material was selected due to concerns about the significance of a potential burst within BF 342. - WC requirements will ensure that electrofusion pipe joins would follow stringent processes. - See Section 6.5.3.
- The ploughing methodology is untried, how does Water Corporation	- There is no evidence that this technology has been used to lay 450 mm pipes	- A trial using a 450 mm HTPE pipe was conducted on 17 July 2014 and confirmed that the technique is viable.

Stakeholder Concern	Explanation of Concern	Proposed management or response
know it will work	before - The unknowns surrounding this untried technique are of high concern. - The high potential risk of failure of this untried technique increases the follow-on risk of changing the pipe installation technique to some other process, such as trenching which is equally unsuitable in this conservation wetland	- Senior management at WC have approved the application of this technique. - Other projects are considering this technique, but are unlikely to be implemented before this proposal. - The risks of the technique are acceptable when considering the minimal vegetation clearance required. - WC will be able to clear almost no vegetation (0.1 ha) through the BF 342 site using this technique. - Refer to Section 3.1 and Appendix A & B for more information. - A video of the EcoPlough demonstration can be viewed on the Water Corporation project website at www.watercorporation.com.au/balannup and going to the “background information” tab.
- Concerns around Water Corporation’s environmental management record.	- Concerns about the existing main drain within BF 342 and the lack of weed control by WC	- WC has taken steps to address the weed issues at this location.
- Boring and drilling studies failed to show the presence of ferricrete	- Stakeholders stated that ferricrete (coffee rock) was present on the site and should have been found by any drilling program	- Ferricrete was found in several locations along the proposed alignment - At only one location (borehole 15) was ferricrete found at the same level or higher than the pipeline is proposed to be laid (GHD 2014a). - Many of the wetlands in this area are underlain by clay, rather than peaty soils and coffee rock. It is the clay layer that perches water in these wetlands. The clay layer will be impacted, but not severed and there will be no impact on the water holding capacity of the wetlands. - See Section 6.3.
- Can not commence this activity until the Keane Road Strategic Link (KRSL) Public Environmental Review is complete	- Stakeholders asked how WC could refer and construct this proposal until the KRSL PER had been completed	- PER is complete and KRSL has been found by the EPA to be environmentally unacceptable. - The pressure main has been specifically excluded from the KRSL proposal by the City of Armadale and therefore WC are not “co-proponents” of the KRSL PER. - This proposal is a completely separate, different proposal to KRSL.

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8.0 Application of Significance Framework – EAG 9

The EPA uses a 'Significance Framework' to determine the likely significance of a proposal and to make decisions throughout the EIA process – from its decision on whether or not to assess a proposal, through to its recommendations to the Minister for Environment on whether or not a proposal should be implemented, and the recommended implementation conditions.

Where EPA objectives for a factor can be met, then the proposal is considered unlikely to have a significant impact on the environment. Where a proposal may or may not meet one or more of the EPA objectives, then the proposal is likely to have a significant impact on the environment.

As outlined in Section 6.0, the preliminary key environmental factors identified as likely to be impacted by the proposal are as follows:

- hydrological processes
- inland waters environmental quality
- flora and vegetation

For referred proposals, the OEPA conducts a significance assessment in line with the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012* to determine whether the potential impacts on environmental factors will require formal assessment under the EP Act. The criteria considered in this significance assessment were applied to the Project to determine the need for a referral to the OEPA (Table 14).

Table 14 Assessment of the Significance of the Project against the OEPA significance criteria

EPA Significance Criteria	Assessment of Proposal
Values, sensitivity and quality of the environment which is likely to be impacted	- Vegetation outside the area of impact is above the 10% critical threshold for constrained areas. - Maximum impact to Southern River vegetation complex is only 0.001 % of remaining extent. - The Southern River vegetation complex has 19.69 % of its pre-European extent remaining. - The extent of vegetation to be cleared (0.1 ha) is not significant and represents 0.001% of the remaining extent of the Southern River complex. - Priority Flora are well represented outside of the proposal area and will not be directly impacted. - TEC will not be directly impacted - Minor impact to PEC (400 m^2). - Minor (<5 cm) localised impacts on groundwater.
Extent (intensity, duration, magnitude and geographic footprint) of the likely impacts	The proposal requires a disturbance of 4.5 ha over its 4.5 km length. This includes: - Disturbance of 0.6 ha of land within Bush Forever Site 342 including 0.5 hectares of an already degraded access track. - Maximum clearing of 0.1 ha of native vegetation. - 2400 m^3 of ASS to be remediated. - No dewatering or excavation of ASS within Bush Forever Site 342.
Consequence of the likely impacts (or change)	- Disturbance is not likely to result in any reduction in the local and regional availability of habitat and extent of significance species and vegetation. - Disturbance is not likely to result in a reduction in groundwater availability.

EPA Significance Criteria	Assessment of Proposal
Resilience of the environment to cope with the impacts or change	- Most of the Proposal area is already significantly disturbed, with the exception of Bush Forever Site 342. - The Proposal will follow an existing fire access track within Bush Forever Site 342.
Cumulative impact with other projects	As the total impact of this Proposal on flora and fauna is minor, it is not likely to result in any cumulative impacts.
Level of confidence in the prediction of impacts and the success of proposed mitigation	- Water Corporation has undertaken sufficient investigations to understand the nature of flora, fauna, groundwater and sub-surface geology and the potential impacts on these factors. - Trials of the EcoPlough technology using a 450 mm pipe have been undertaken to ensure that the technique is viable.
Objects of the Act, policies, guidelines, procedures and standards against which a proposal can be assessed	All relevant policies, guidelines, procedures and standards have been considered in the assessment of the environmental value of the area.
Presence of strategic planning policy framework	Not Relevant. The Project is not a Strategic Proposal.
Presence of other statutory decision-making processes which regulate the mitigation of the potential effects on the environment to meet the EPA's objectives and principles for EIA	Aspects of the Project able to be appropriately assessed and managed through the following regulatory mechanisms: - Clearing impacts – Part V of the EP Act. - Impacts of groundwater extraction and ASS – Water Corporation ASS and Dewatering Management Strategy.
Public concern about the likely effect of the proposal, if implemented, on the environment.	Key Community Stakeholder and Agency consultation has been undertaken. It is likely that there will be a level of concern from some community groups if the proposal is implemented.

9.0 References

Churchward H.M. & McArthur W.M. (1980). 'Landforms and soils of the Darling System Western Australia', in Department of Conservation and Environment, Atlas of Natural Resources Darling System Western Australia, Explanatory Text.

Conservation Commission of Western Australia (2010). *Jandakot Regional Park Management Plan 2010.* A report prepared by the Conservation Commission of Western Australia, the Department of Environment and Conservation, City of Cockburn, City of Armadale and the Town of Kwinana.

Department of Environment and Conservation (2013). *Identification and investigation of acid sulfate soils and acidic landscapes,* Department of Environment and Conservation, Government of Western Australia, Acid Sulfate Soils Guideline Series, March 2013.

Department of Water. (2009). *Forrestdale Main Drain: Arterial Drainage Strategy.* Government of Western Australia. Perth, WA: Government of Western Australia.

Department of Water (2014). *Perth Groundwater Atlas* [on line]. Viewed 3 June 2014, http://www.water.wa.gov.au/idelve/gwa/.

Enviroworks (2012). *Keane Road Strategic Link: Level 2 Vegetation and Flora Assessment.* Report by Enviroworks Consulting for the City of Armadale.

Enviroworks (2009). *Keane Road Strategic Link. Dieback Assessment and Management Plan.* Report by Enviroworks Consulting for the City of Armadale.

ENV Australia Pty Ltd (2013). *Flora, Vegetation and Fauna Assessment, Keane Road.* Report prepared by ENV Australia Pty Ltd for Water Corporation.

Geological Survey of Western Australia [GSWA]. (1986). *Geology of the 1:50 000 mapsheet PERTH (20342), first edition* [Data set]. East Perth.

Gibson, N., Keighery, B., Keighery, G., Burbidge, A., and Lyons, M. (1994). *A Floristic Survey of the Southern Swan Coastal Plain.* Unpublished report for the Australian Heritage Commission. Western Australia: Department of Conservation and Land Management and the Western Australian Conservation Council of Western Australia.

GHD (2013). *Trenchless Construction Techniques Analysis. Balannup Pressure Main.* Unpublished report by GHD Pty Ltd for Water Corporation.

GHD (2014a). *Engineering Summary Report. Balannup Pump Station A (Collared St) M&E Upgrade and New Pressure Main (Keane Road) Water Corporation Project Number: C-S01249. Revision C.* Unpublished report by GHD Pty Ltd for Water Corporation.

GHD (2014b). *Keane Road Pressure Main, Balannup. Draft Acid Sulfate Soil and Dewatering Management Plan.* Unpublished report by GHD Pty Ltd for Water Corporation.

Government of Western Australia. (2000a). *Bush Forever: Volume 1: Policies, Principles and Processes.* Perth: Department of Environmental Protection.

Government of Western Australia. (2000b). *Bush Forever: Volume 2: Directory of Bush Forever Sites.* Perth: Department of Environmental Protection

Government of Western Australia (2014). *Contaminated Sites Database.* WA Department of Environment Regulation, Perth, Western Australia. Available online from: https://secure.dec.wa.gov.au/idelve/css/ Accessed 27 May 2014.

Heddle, E. M., Loneragan, O. W., and Havel, J. J. (1980). 'Vegetation complexes of the Darling System, Western Australia' [Explanatory Text and Map]. In: *Atlas of Natural Resources Darling System Western Australia*. Perth: Department of Conservation and Land Management.

Local Biodiversity Program (2013). *2013 Native Vegetation extent by Vegetation complexes on the Swan Coastal Plain south of Moore River.* Accessed 6 June 2014 at http://pbp.walga.asn.au/Portals/1/Templates/docs/SCP%202013%20remnant%20veg.pdf.

Mannos, P.G. & Kavvadas, M. (1996). 'Rise of the groundwater table when flow is obstructed by shallow tunnels', *Ingegneria Geologia delgi Acquiferi,* vol 7, 3-6.

Northcote, K.H. with Beckmann, G.G., Bettenay, E., Churchward, H.M., Van Dijk, D.C., Dimmock, G.M., Hubble, G.D., Isbell, R.F., McArthur, W.M., Murtha, G.G., Nicolls, K.D., Paton, T.R., Thompson, C.H., Webb, A.A. and Wright, M.J. (1960-1968). Atlas of Australian Soils, Sheets 1 to 10. With explanatory data (CSIRO Aust. and Melbourne University Press: Melbourne).

Utility Providers Services Committee (2010). *Utility Providers Code of Practice for Western Australia.* Code of Practice produced by the Utility Providers Services Committee.

Water Corporation (2007). *Water Corporation Acid Sulfate Soil and Dewatering Management Strategy*. Report by Parsons Brinckerhoff for Water Corporation, July 2007.