Table of Contents

APPENDICES

1. Introduction

The Water Corporation proposes to construct a 1.5km section of pressure main within an existing fire access track along the southern boundary of Bush Forever site 342 in the City of Armadale. The proposed alignment traverses the Anstey-Keane Dampland and is located adjacent to a mapped Threatened Ecological Community (TEC) listed as critically endangered under the *Environment Protection Biodiversity Act, 1999* (Figure 1). The adjacent TEC (SCP 10a) is described as 'Shrublands on dry clay flats'

The Water Corporation incorporated avoidance and mitigation measures into the design phase of the proposal to ensure the proposal meets the Environmental Protection Authorities objective in relation to Hydrological Processes, which is to

'Maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance, are protected'

Due to the potential for the installation of the pipeline to result in localised changes to hydrological processes and as a result potentially impact the adjacent TEC, the Water Corporation, in consultation with the Office of Environmental Protection Authority (OEPA) and the Department of Parks and Wildlife (DPaW) engaged GHD to undertake further investigations to increase the understanding of;

- The hydrological functioning of the dampland and the respective interactions with local surface water and groundwater systems and the regional superficial aquifer; and
- The impacts (if any) that the installation of the proposed pressure main may have on the hydrological functioning of the dampland.

This report presents a summary of the findings of the additional investigations undertaken and an assessment of the potential environmental impacts of the Water Corporation's proposal specifically;

- Mitigation of potential environmental impacts
- Summary and conclusions of the additional investigations undertaken
- Potential environmental impacts associated with the installation of the pressure main (specifically related to impacts to hydrological processes and the potential impact to the SCP10a)
- Proposed post-installation monitoring program

2. Mitigation of potential environmental impacts

During the design phase of the proposal the Water Corporation considered numerous alignments and construction methodologies to mitigate potential environmental impacts.

It was decided to install the proposed pressure main utilising a trenchless construction methodology known as the Ecoplough. Using trenchless technology allows the pipeline to be installed;

- Within an existing 4m wide fire access track (with a maximum of 0.1ha of clearing);
- Without the excavation of Acid Sulfate Soils; and
- Without the need for dewatering

2.1 Alternative Pipeline Alignments

Three alternative pipeline alignments were considered to connect Collared Street Pump Station to Waterworks Road Pump Station. Two of the options skirted around the Bush Forever site. These alignments were considered unsuitable during the selection process due to the following:

- They were substantially longer routes resulting in significantly higher costs both in construction and throughout the life of the asset.
- Hydraulically impractical due to the longer distances and increased head losses from bends potentially requiring additional pumping stations and/or discharge towers.
- Impacted private properties or did not avoid impact to Bush Forever site 342.
- Presents safety risks to Water Corporation employees both during construction and in operation due to the intersection of major transport routes.
- Alternate routes investigated are highly congested with existing underground services already in place including water, drainage, gas and sewer which represent a high level of risk for construction and maintenance.

2.2 Realignment of proposed route

In a meeting between the Water Corporation, Chairman of the EPA and members of OEPA the option of realigning the pressure main to Lot 101 to avoid Bush Forever site 342 was discussed. The Corporation has since assessed the possibility of realigning the pipeline and concluded it is not practicable due to the following;

- Land Owner Support
  - The Water Corporation approached the land owner of Lot 101 to the south of Bush Forever site 342 (Cedar Woods) to discuss locating the pipeline and associated easement within their boundary. Cedar Woods advised they would

not support the establishment of an easement due to the impact it would have on the development potential of the land. Cedar Woods also advised the Water Corporation they similarly did not support the City of Armadale's proposal for Keane Rd to deviate onto their land and in fact only became aware of the proposal at a public forum which they attended.

- In the event the landowner is unsupportive, as a last option the Water Corporation can pursue compulsory acquisition, however this process can take a significant amount of time (sometimes years) to come to a suitable arrangement. To enable the Water Corporation to deliver adequate wastewater services within the Balannup Catchment the construction of the proposal is required to be completed by 2017, due to the timeframes associated with the land acquisition process it is envisaged the pipeline will not be operational when it is required.

In summary, this option was considered and was rejected when significant difficulties with the landowner were revealed.

- Environmental considerations
  - In the unlikely event the landowner approval issue is able to be resolved; re-aligning the pipeline into Lot 101 will require additional clearing. The Ecoplough installation method is a low-impact installation technique with a minimum turning radius of 70m, meaning creating an additional bend in the pipeline to re-align the pipeline alignment into Lot 101 will require additional clearing which negates the advantage of designing the pipeline within the existing cleared fire access track specifically to avoid clearing.
  - The Water Corporation has assessed the clearing area required to divert the pressure main alignment into Cedarwoods property. It is predicted approximately 720m^2 of native vegetation is required to be cleared to install the re-aligned pressure main (Appendix B)
  - GHD have advised that moving the pipeline alignment into the Cedar Woods property would have no mitigating effect on the potential impact of the pipeline on the Bush Forever land and nearby TEC.

3. Potential impacts to hydrological processes and SCP10a

In consultation with OEPA and DPaW the Corporation engaged GHD to undertake further site investigations to increase the understanding of the how the wetland functions and any potential impacts installing the pressure main may have on hydrological processes and associated vegetation communities (Attachment 1).

GHD's site investigations indicate that an ephemeral aquifer system forms within the Bassendean Sands in the vicinity of the TEC, which is perched on the confining Guildford Formation clayey sands. This perched system aligns reasonably well with the mapped extent of the TEC. The different groundwater chemistries and the increase in salinity with depth indicate that the perched system and the underlying confined aquifer are distinct groundwater systems with limited hydraulic connectivity.

Based on the conclusions of the GHD investigation detailed in the report installation of the pipeline is highly unlikely to have an adverse impact on the TEC based on the following conclusions contained in the GHD report:

- Rainfall is likely to be the dominant mechanism and water source for recharge and maintenance of the perched aquifer. Accordingly, no impacts on the recharge of the perched ephemeral aquifer system resulting are anticipated from the installation of the sewer main.
- The sewer main is aligned along an existing fire access track. This track forms a catchment divide with surplus surface water shedding onto the areas adjacent to the track and flowing southeast to the low lying remnant wetland in the vicinity of the Anstey Rd and Keane Rd intersection. Installation of the sewer main will not change the catchment divide and will not interrupt surface water flow paths in the vicinity of the TEC.
- The sewer main is to be installed within a ridge of elevated Guildford Formation clayey sand along the existing fire access track at the southern extent of the ephemeral perched aquifer system. In the unlikely event that that there is horizontal drainage towards the perched system in the vicinity of the TEC, this will be at a very low rate and installing the sewer main within this material of low permeability is highly unlikely to have any influence on this drainage.
- The thickness of the underlying clayey sands along the sewer main alignment appears to be in the order of ~6 m. Installing the sewer main into the top ~1.5 m of this material should still result in sufficient residual thickness to maintain the hydraulic integrity of the perched aquifer system. Given the alignment and installed depth of the sewer main in relation to the ephemeral perched aquifer system associated with the TEC, this is unlikely to pose a risk of increased hydraulic connectivity between the perched aquifer system within the TEC and the underlying confined aquifer system.

Taking into consideration the comprehensive investigations undertaken by GHD and the review of all existing data, the installation of the pipeline is highly unlikely to impact on the current existing hydrological processes occurring in the Anstey-Keane Damplands. Accordingly, there are not expected to be any impacts to TEC SCP10a mapped adjacent to the Pipeline alignment.

4. Scope of Hydrological Impact Assessment Report (GHD)

Water Corporation considered DPaW's recommendation to develop a numerical groundwater model to simulate the site water balance and to assess any potential changes to flow directions and fluxes resulting from the installation of the sewer main. In a meeting held between oEPA, DPaW and the Water Corporation, DPaW suggested the numerical model should be based on the conceptual groundwater model developed by GHD and the supporting data from the investigations. The Corporation has considered including a numerical water balance in the scope of the impact assessment work however based on the following reasons considers the conceptual model and supporting data are sufficient to assess the potential hydrogeological impacts.

- Considering the conceptual model and the assessed impacts resulting from the installation of the sewer main along the ridge of clayey sand at the south-western extremity of the TEC, GHD is of the opinion a numerical model is unlikely to demonstrate any tangible change in the water balance or flow directions.
- a key unknown for the water balance will be the evapotranspiration associated with the wetland, for which there are no site measurements and very little data available from other sites.

5. Recommendations and Post-installation monitoring program

In addition to the project specific management actions which will be implemented the Corporation has considered the recommendations from the OEPA and GHD and commits to undertaking the following;

5.1 Rising the invert of the pipeline

In the investigation report GHD advised that the alignment of the sewer main at the installed depth of ~1.5 mBGL is in close proximity to a pocket of more sandy material which, if intersected, could further reduce the effective residual thickness of the aquitard (i.e. Guildford Formation clayey sand Although the current design does not intersect these lenses GHD advised that raising the invert of the pressure main to avoid the pockets of more sandy material within the Guildford Formation clayey sand at ~2.5 mBGL would provide an increased factor of safety to ensure vertical drainage is not affected.

Accordingly, the Water Corporation commits to raising the pipeline by 300mm within the bush forever area to increase the distance above the pockets of more sandy material within the Guilford Formation clayey sand. While this level of cover (600mm) is shallower than Water Corporations design standard requirements it can be accommodated by using a stronger pipe and because of the lower risk associated with non-Water Corporation works impacting the pipe given its location within a Bush Forever land holding.

5.2 Post-installation monitoring program

Although the environmental impact assessment undertaken to date has deemed it highly unlikely the installation of the pressure main will impact on hydrological processes, it is very important for future proposals to build an understanding of any potential impact the pressure main has on hydrological processes and the adjacent TEC following installation. Accordingly, the Water Corporation is committed to collecting, analysing and sharing post-installation monitoring data with, relevant stakeholders such as DoW and DPaW to;

- Allow the Water Corporation to gain an understanding of the potential impacts of pipeline infrastructure within environmentally sensitive areas such as wetlands and TEC's.
- Increase the understanding of the hydrological processes associated with the Anstey-Keane Damplands.

As such following the installation of the pipeline the Water Corporation commits to undertaking routine monitoring of the groundwater systems prior to, during and following construction for a period of two years including:

- Installing loggers in boreholes A01D, A01S, A05D, A05S, A07, A11, A15, GHD13-BH06S, GHD13-BH25, Hyd2o-BHAR5 Hyd2o-BHAR6 and taking samples from Baileys Brach Drain (Figure 2);
- Retrieving and analysing water quality samples for the analytes detailed in in Section **Error! Reference source not found.** (GHD, 2015) as well as for potential contaminants that could emanate through construction and operation of the sewer main.
- The data collected will be reviewed, analysed and shared with interested parties (including DPaW, DoW and community stakeholder groups).

Ensuring all relevant stakeholders including community groups, DPaW and DoW collaboratively work together to build this understanding. This allows the Water Corporation to utilise the expertise within these stakeholder groups which will ensure the exercise is valuable.