



Water Management Plan

Googong Township Integrated Water Cycle Project

Prepared by:

RPS MANIDIS ROBERTS PTY LTD

Level 9, 17 York Street,
Sydney NSW 2000

T: 02 9248 9800
F: 02 9248 9810
E: infrastructure-solutions@rpsgroup.com.au

Prepared by: Katharine Bond
Reviewed: Rob Salisbury
Approved: Rob Salisbury
Project No.: 15009
Version: 11.0
Date: May 2016

Prepared for:

GOOGONG TOWNSHIP PTY LTD


Level 3, 64 Allara Street
Canberra ACT 2600

T: 02 6230 0800
F: 02 6230 0811
W: www.googong.net

DOCUMENT STATUS

Version	Purpose of Document	Approved by	Reviewed by	Review Date
5.0	Interim WMP - approved by DP&E	Rob Salisbury	Chontelle Perucich	18 December 2013
6.0	Updated following completion of baseline monitoring – for GTPL and QCC review	Rob Salisbury	Rob Salisbury	9 April 2015
7.0	Updated to reflect GTPL and QCC comments – for consultation	Rob Salisbury	Rob Salisbury	15 May 2015
8.0	Updated following agency review – for GTPL and QCC review	Rob Salisbury	Rob Salisbury	6 July 2015
9.0	Updated following GTPL and QCC review	Rob Salisbury	Rob Salisbury	25 September 2015
10.0	Final for DP&E approval	Rob Salisbury	Rob Salisbury	8 October 2015
11.0	Minor updates post DP&E approval following additional EPA comments and incorporation of additional baseline monitoring reports	Rob Salisbury	Rob Salisbury	24 May 2016

APPROVAL FOR ISSUE

Name	Signature	Date
Rob Salisbury		24 May 2016

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Terms and Abbreviations

AGWG	<i>Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1)</i> (National Resource Management Ministerial Council, Environment Protection and Heritage Council and Australian Health Ministers' Conference 2006)
BoB Group	Bush on Boundary Group
CCP	Critical control point
CEMP	Construction Environmental Management Plan
CIC	Canberra Investment Corporation
CoA	Condition of Approval
DP&E	Department of Planning and Environment
DP&I	Department of Planning and Infrastructure
EA	Environmental Assessment
EP	Equivalent population
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
EPA	Environment Protection Authority
GTPL	Googong Township Proprietary Limited
GWMP	Groundwater Monitoring Program
IMP	Irrigation Management Plan
IWC	Integrated water cycle
NH1A	Neighbourhood 1A
NOW	NSW Office of Water
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
OEMP	Operational Environmental Management Plan
Operator	GTPL (during process commissioning and verification) or QCC (during ongoing operation)
QCC	Queanbeyan City Council
RWFRP	Recycled Water Flow Release Protocol
RWQMP	Essential Sewage and Recycled Water Quality Management Plan
SGWRP	Surface and Ground Water Response Plan
SoC	Statement of Commitments
SWAEMP	Surface Water (and Aquatic Ecology) Monitoring Program
WMP	Water Management Plan
WRP	Water Recycling Plant

1 Introduction

1.1 Background

Googong Township Proprietary Limited (GTPL), a partnership between Canberra Investment Corporation (CIC) and Mirvac, is responsible for the development of the Googong Township that will be located in the Canberra region, approximately 7 km south of Queanbeyan in NSW. The Googong Township will be home to approximately 18,000 people and developed over the next 25 years.

The township is designed around an integrated water cycle (IWC), with a dedicated Water Recycling Plant (WRP) that will reduce the consumption of potable water in the community by approximately 60 per cent and recycle the township's water for non-potable use.

The Googong Township Water Cycle Project Environmental Assessment (November, 2010) (EA) was prepared under (the now repealed) Part 3A of the *NSW Environmental Planning and Assessment Act 1979* (EP&A Act) to assess the impacts of construction and operation of infrastructure for the potable water, recycled water and sewage system required to service the township.

Concept Approval for the ultimate development (Stage 1 and Stage 2) and a Project Approval for Stage 1 of the Googong Township IWC Project were granted by the NSW Planning Assessment Commission, under delegation from the Minister for Planning and Infrastructure on 24 November 2011.

GTPL assessed the impacts of construction and operation of the IWC Project on water quality and hydrology, and groundwater in Sections 6 and 10 of the EA, respectively. Aquatic ecology, which is related to water quality, was assessed in Section 11 of the EA. Detailed studies were conducted for the EA to address the Director-General's Requirements issued by the Department of Planning and Infrastructure (DP&I). The following appendices of the EA relate to water management:

- Appendix B – *Googong Integrated Water Cycle, Water and Wastewater Concept Design*, October 2010 (MWH).
- Appendix D – *Googong Residential Community Recycled Water Irrigation and Capability Assessment*, August 2010 (Agsol Pty Ltd).
- Appendix E – *Groundwater Assessment – Googong NSW*, September 2010 (CM Jewell & Associates).
- Appendix N – *Googong Township Irrigation Strategy*, May 2010 (Brown Consulting).

A subsequent concept design report supplement was prepared in September 2013 (MWH 2013), while further specialist baseline studies have been completed to assist in the preparation of this Water Management Plan (WMP). These baseline study reports are listed in Section 4.1.

1.2 Context

The Googong Township is being constructed and operated in stages to ensure the infrastructure is correctly sized to meet the incremental level of demand. Stage 1 of the IWC Project comprises the following infrastructure:

- WRP.
- Temporary (interim) reservoirs for recycled and potable water.
- Pumping stations for sewage, recycled water and potable water.

- Mains pipework (including rising and distribution mains) for sewage, recycled water and potable water to connect to Neighbourhood 1A (NH1A).
- Structures for the discharge of excess recycled water to the stormwater management system at the interim reservoirs, as well as at Beltana Park (developed as part of the Googong Township).
- Structure for the discharge of emergency overflows to Montgomery Creek at the WRP.

Figure 1 outlines the components of Stage 1 of the IWC Project. This figure also shows the proposed operational stages for Stage 1 (Stage A – Network, Stage AB WRP and Stage B – Network).

GTPL, Queanbeyan City Council (QCC) and Icon Water are responsible for the operation of Stage A – Network. Following completion of the WRP, Icon Water and QCC will own and operate the network and WRP.

Accordingly, any Construction Environmental Management Plan (CEMP) and/or Operational Environmental Management Plan (OEMP) will be prepared and implemented to reflect the different stages of the Project's development and address the relevant requirements of the Conditions of Approval (CoA), the Statement of Commitments (SoC), the EA, Submissions Report and all applicable legislation.

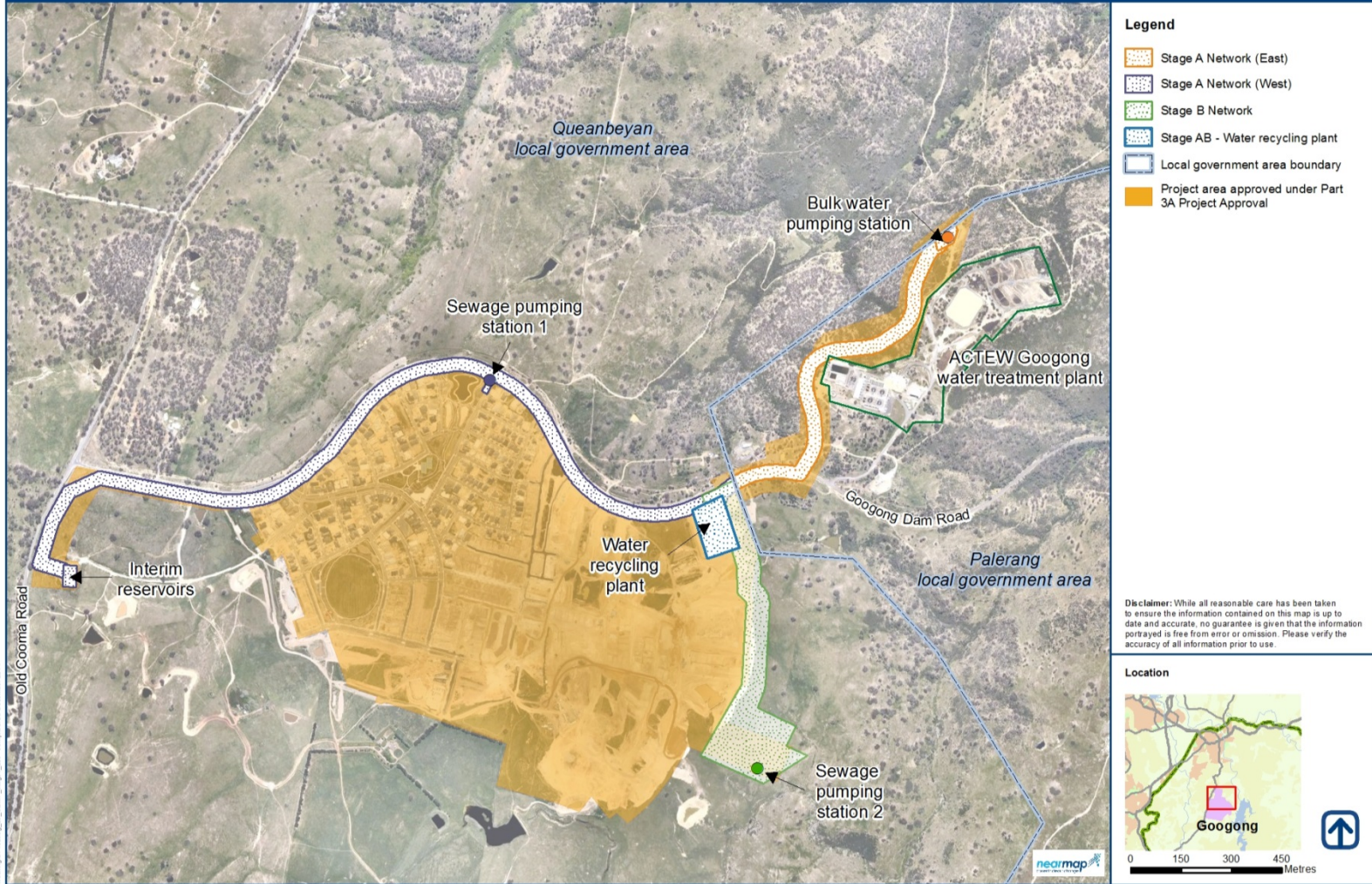
The next section outlines the staging of OEMPs required for the IWC Project. It is important to note that this Water Management Plan (WMP or Plan) will be implemented in conjunction with the OEMP/s (and associated documents) relevant to that stage.

1.2.1 OEMPs required for the IWC Project

It is intended that OEMPs will be prepared for the following stages of operation for the IWC Project:

- Stage A – Network OEMP: required for the interim operation of Stage A – Network prior to operation of the WRP where sewage will be tankered off site (the Stage A – Network OEMP was approved by DP&I in October 2013 and has now been superseded).
- Stage AB – Network OEMP: required for the operation of Stage AB – Network during process commissioning and verification of the WRP (the Stage AB – Network OEMP was approved by DP&E in August 2015).
- Stage AB – WRP (process commissioning and verification) OEMP: required for the operation of Stage AB WRP during process commissioning and verification of the WRP (i.e. before sewage is received and recycled water is discharged to the environment). The Stage AB – WRP (process commissioning and verification) OEMP was approved by DP&E in August 2015.
- Combined Stage 1 OEMP: will be developed by QCC for Stage A + B – Network and Stage AB WRP prior to handover and operation of the WRP.

Googong Integrated Water Cycle Project Stage 1



Source:
 1. GIS datasets as supplied from Brown Consulting
 2. Aerial imagery from Nearmap (2014)

Figure 1 Stage 1 (Stages A and B) of the IWC Project

1.2.2 Need for the WMP

The EA identified potential impacts on the existing surface and groundwater environment as a result of recycled water being used within the township and excess recycled water discharged to the Queanbeyan River catchment.

A range of mitigation measures, including the preparation of this WMP were recommended to manage risks to surface water and groundwater quality, aquatic ecology, soil and plants. Impacts and compliance with water quality discharge criteria (as stipulated in CoA D5) will be monitored via programs outlined in this Plan.

1.2.3 Previous version of the WMP

An interim version of the WMP (and sub-plans) was developed in the absence of established baseline data for environmental components like soil, surface water and groundwater characteristics. It prescribed the methodology and requirements for the baseline survey. The interim WMP was written in December 2013, and was approved for use by the Department of Planning and Environment (DP&E). It was considered appropriate for commencement of monitoring but required update and amendments following completion of 12-months of baseline data.

Accordingly, this Plan (and sub-plans) has been reviewed, updated and provided to DP&E for approval following the undertaking of the baseline monitoring. Final approval of the WMP is required prior to operation of the WRP and the reuse of recycled water and/or discharge of excess recycled water to the environment.

1.3 Environmental management systems overview

The overall Environmental Management System and approach to managing operational environmental impacts is described in the OEMPs for the IWC Project. This WMP forms part of the environmental management framework for the IWC Project, as described in the OEMPs associated with the IWC Project.

In accordance with CoA D8, this Plan has been developed in consultation with the NSW Office of Environment and Heritage (OEH), NSW Environment Protection Authority (EPA), NSW Office of Water (NOW), NSW Health and the NSW Department of Primary Industries (Fishing and Aquaculture).

This WMP includes sub-plans focused around surface, soil and groundwater quality that are appended to this plan, they are:

- Surface Water (and Aquatic Ecology) Monitoring Program (SWAEMP) – Appendix A.
- Groundwater Monitoring Program (GWMP) – Appendix B.
- Recycled Water Flow Release Protocol (RWFRP) – Appendix C.
- Surface and Ground Water Response Plan (SGWRP) – Appendix D.
- Irrigation Management Plan (IMP) – Appendix E.

The SWAEMP and the GWMP establish a monitoring program for surface and groundwater impacts such as:

- Surface water flows and quality.
- Impacts on water users.
- Stream health and habitat.
- Channel stability.
- Impacts on groundwater supply of potentially affected landowners.

- Impacts on any groundwater dependent ecosystems and riparian vegetation.

The development of the updated SWAEMP and GWMP has involved the collation of at least 12 months of baseline monitoring data for surface water, aquatic ecology and groundwater. These baseline monitoring programs have assisted in setting trigger levels to identify any potentially adverse impacts, following commencement of the WRP operation.

The results of the baseline monitoring programs have fed into complementary documents, primarily the RWFRP and the SGWRP, which have used the collected data to provide recommended discharge rates and a response protocol to be implemented if any assessment criterion is exceeded. Given that these sub-plans rely on the data being collected from the monitoring program, it is proposed that they will be regularly updated as additional data is collected. Refer to Section 7.2 for further information regarding plan updates and amendments.

Baseline monitoring data for the soil and groundwater properties in relation to irrigation areas (including salinity levels and a nutrient budget) has been gathered to enable the updating of the IMP. The outputs of the IMP are a program to monitor areas that are subject to irrigation and a protocol for the use of recycled effluent (including application rates and restrictions).

The outputs from the RWFRP, SGWRP and IMP will be fed-back into the relevant monitoring programs to ensure that the correct trigger levels and rates are being used, as well as back into the relevant OEMP to ensure that operational environmental impacts are minimised and managed. Figure 2 demonstrates how the sub-plans in the WMP interrelate with one-another.

Another key document, which relates to the quality of recycled water and its use, is the *Googong Township Essential Sewage and Recycled Water Quality Management Plan (RWQMP)*, which has been prepared by QCC to support applications for the construction and operation of the WRP, under Section 60 of the *Local Government Act 1993*. The RWQMP (QCC 2013) addresses the 12 Elements of the *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) (AGWR)* (National Resource Management Ministerial Council, Environment Protection and Heritage Council and Australian Health Ministers' Conference 2006) (refer Section C.3).

The WMP and RWQMP should be read and used in conjunction with each other. Please contact QCC directly for the current version of the RWQMP.

1.4 Consultation

This Plan and its appendices have been developed in consultation with the following government agencies and stakeholders:

- DP&E.
- OEH.
- NSW EPA.
- Department of Primary Industries (Fishing and Aquaculture) (DPI).
- NSW Health.
- NOW.
- QCC.
- Icon Water.
- Googong Bush on Boundary (BoB) group that includes representatives of local environmental groups and residents.

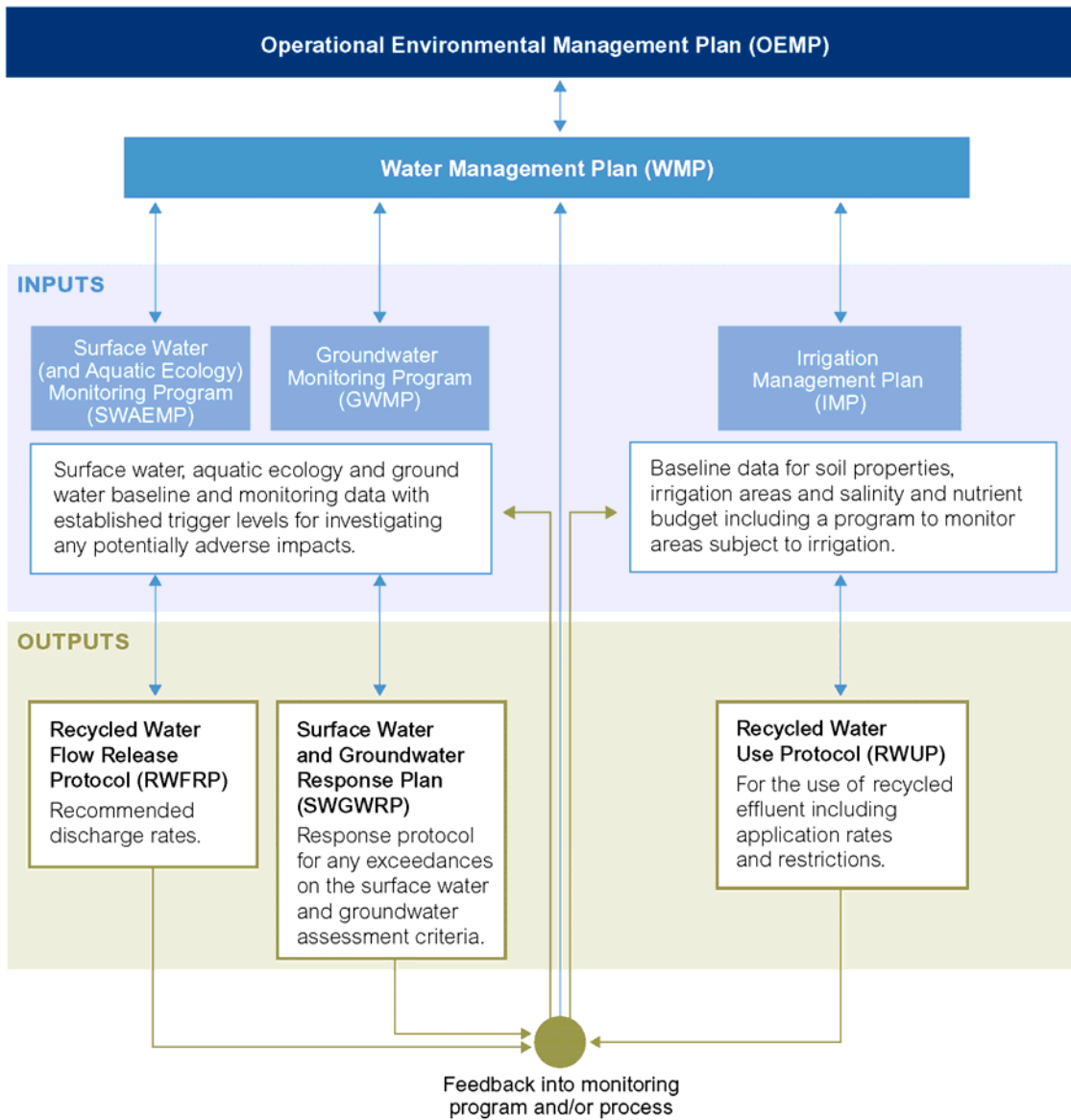


Figure 2 Water Management Plan sub-plan overview

2 Purpose and objectives

2.1 Purpose

The purpose of this Plan is to describe how the IWC Project's operator will manage and protect water quality and aquatic ecology throughout the operational life of the IWC Project, in accordance with the relevant regulatory and other requirements.

2.2 Objectives

The key objective of the WMP is to manage potential impacts on surface water and groundwater systems during operation of the IWC Project. To realise this objective the following will be undertaken:

- Ensure appropriate measures are implemented to address the relevant CoA and SoC, and safeguards detailed in the EA and submissions report (refer Sections 3.3 and 3.4).
- Ensure appropriate measures are implemented to comply with all relevant legislation and other requirements (refer Section 3).
- Ensure appropriate controls and procedures are implemented during the operation of the IWC Project to avoid or minimise potential adverse impacts to receiving waters and surrounding landscapes (refer Sections 4 and 5).

3 Environmental requirements

3.1 Relevant legislation

The OEMPs (Section 3) associated with the IWC Project identify the legal and other requirements applicable to the IWC Project during the operational phase of the IWC Project.

In particular, the NSW Office of Water has advised that the construction of monitoring bores is an aquifer interference activity under the *Water Management Act 2000*. As provisions of this Act relating to Aquifer Interference approvals have not commenced, a Part 5 licence under the *Water Act 1912* is still required for this activity. A Part 5 groundwater licence has been obtained by GTPL from NOW prior to any sinking of new wells for groundwater monitoring as part of this program (refer Appendix B).

In addition, it is proposed to establish two monitoring stations along the Queanbeyan River to continuously monitor certain parameters. GTPL will obtain a Controlled Activity Approval under Part 3, Chapter 3 of the *Water Management Act 2000* from the NOW prior to establishing any water monitoring stations (refer Appendix A).

3.2 Relevant guidelines

The following guidelines and documents have been reviewed and addressed during the preparation of this Plan:

- *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC & ARMCANZ 2000) particularly Volume 1, Chapter 5: Guidelines for Recreational Water Quality and Aesthetics and Volume 2, section 8.2.3: Aquatic Ecosystems.
- *Environmental Guidelines: Use of Effluent by Irrigation* (DEC 2004).
- *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks* (National Resource Management Ministerial Council, Environment Protection and Heritage Council and Australian Health Ministers' Conference 2006).

3.3 Minister's Condition of Approval

The CoA relevant to this Plan is listed in Table 1. A document reference is also included to indicate where in the WMP or other management documents the CoA are addressed.

Table 1 Conditions of Approval relevant to water management

CoA No.	Condition requirements	Document reference																																			
B3	<p>The Proponent shall provide a compensatory water supply to any land owner whose water entitlements are adversely impacted (other than an impact that is negligible) as a result of the project, in accordance with the criteria established in the Water Management Plan in condition D8.</p> <p>The compensatory water supply measures shall provide an alternate water supply for the duration of the impact attributed to the project. The alternate water supply shall at least be of an equivalent quality and quantity to the affected supply and be provided within 24 hours of the loss being identified, or as otherwise agreed by the affected resident/land owner.</p> <p>If the Proponent is unable to provide an alternative supply of water, then it shall provide reasonable alternative compensation in consultation with the affected land owner. If the Proponent and the land owner cannot agree on the measures to be implemented, or there is a dispute about the implementation of these measures, then either party may refer the matter to the Director-General for resolution.</p>	Section D8																																			
D5	<p>The recycled water discharged to the environment shall not exceed the water quality parameters identified in Table D1 below.</p> <p><i>Table D1: Effluent Quality Limits</i></p> <table border="1"> <thead> <tr> <th rowspan="2">Parameter</th> <th colspan="2">Effluent discharge limits to environment</th> </tr> <tr> <th>Units</th> <th>90th Percentile</th> </tr> </thead> <tbody> <tr> <td>BOD</td> <td>mg/L</td> <td>10</td> </tr> <tr> <td>Suspended Solids</td> <td>mg/L</td> <td>10</td> </tr> <tr> <td>TN</td> <td>mg/L</td> <td>10</td> </tr> <tr> <td>TP</td> <td>mg/L</td> <td>0.5</td> </tr> <tr> <td>TDS</td> <td>mg/L</td> <td>700</td> </tr> <tr> <td>Faecal Coliforms</td> <td>cfu/100mL</td> <td>150</td> </tr> <tr> <td>pH</td> <td></td> <td>6.5-8.0</td> </tr> <tr> <td>Free Chlorine (residual)</td> <td>mg/L</td> <td>0.1</td> </tr> <tr> <td>Nitrogen – Ammonia</td> <td>mg/L</td> <td>2</td> </tr> <tr> <td>Oil & Grease</td> <td>mg/L</td> <td>2</td> </tr> </tbody> </table> <p>If the results of the water quality monitoring undertaken in accordance with the Water Management Plan in condition D8 indicates that the downstream ambient water quality criteria of the Queanbeyan River is exceeded as a result of the project, then the project shall be adjusted to reduce the concentration of the relevant parameters in the recycled water discharged to the environment.</p>	Parameter	Effluent discharge limits to environment		Units	90 th Percentile	BOD	mg/L	10	Suspended Solids	mg/L	10	TN	mg/L	10	TP	mg/L	0.5	TDS	mg/L	700	Faecal Coliforms	cfu/100mL	150	pH		6.5-8.0	Free Chlorine (residual)	mg/L	0.1	Nitrogen – Ammonia	mg/L	2	Oil & Grease	mg/L	2	<p>Appendices A and B</p> <p>Also refer to OEMPs</p>
Parameter	Effluent discharge limits to environment																																				
	Units	90 th Percentile																																			
BOD	mg/L	10																																			
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TP	mg/L	0.5																																			
TDS	mg/L	700																																			
Faecal Coliforms	cfu/100mL	150																																			
pH		6.5-8.0																																			
Free Chlorine (residual)	mg/L	0.1																																			
Nitrogen – Ammonia	mg/L	2																																			
Oil & Grease	mg/L	2																																			
D6	No recycled water shall be discharged to the environment until at least 12 months of baseline data for the receiving waterways has been obtained and the flow release protocol has been established, in accordance with the approved Water Management Plan in condition D8.	Appendices A, B and E outline the methodology for baseline data collection.																																			
D8	The Proponent shall prepare and implement a Water Management Plan for the project to manage potential impacts on surface water and groundwater systems during operation of the project. The plan must be prepared in accordance with Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMCANZ, 2000), particularly Volume 1, Chapter 5: Guidelines for Recreational Water Quality and Aesthetics and Volume 2, section 8.2.3: Aquatic Ecosystems, and include:	This Plan																																			
	Surface Water Monitoring Program , including:	Appendix A																																			
	1. procedures to obtain detailed baseline data on surface water flows and quality in creeks and other water bodies that could potentially be affected by the project, including relevant parameters and monitoring locations;	Section A2.1																																			

CoA No.	Condition requirements	Document reference
	2. surface water and stream health impact assessment criteria including trigger levels for investigating any potentially adverse surface water impacts and for the supply of compensatory water;	Section A3
	3. a program to monitor and assess: <ul style="list-style-type: none"> A. surface water flows and quality; B. impacts on water users; C. stream health and habitat; and D. channel stability 	Section A4
	a Groundwater Monitoring Program , including:	Appendix B
	1. detailed baseline data of groundwater levels, yield and quality in the region, and privately-owned groundwater bores, that could be affected by the project;	Section B2
	2. groundwater impact assessment criteria including trigger levels for investigating any potentially adverse groundwater impacts;	Section B4
	3. a program to monitor and assess: <ul style="list-style-type: none"> A. impacts on the groundwater supply of potentially affected landowners; B. impacts on any groundwater dependent ecosystems and riparian vegetation; 	Sections B3 and B5 Appendix A
	a Recycled Water Flow Release Protocol , including:	Appendix C
	1. recommended discharge rates based on baseline data of receiving waterways and meteorological conditions;	Section C3
	2. the detailed design and operation specifications for the discharge structure/s; and	Section C3
	3. procedures for the review and amendment of flow release protocols based on the outcomes of monitoring;	Section C4
	a Surface and Ground Water Response Plan , including:	Appendix D
	1. a response protocol for any exceedances of the surface water and groundwater assessment criteria;	Sections D4 and D5
	2. measures to notify and compensate landowners of privately-owned land whose water supply is adversely affected by the project; and	Section D8
	3. measures to mitigate and/or offset any adverse impacts on waterways, groundwater dependent ecosystems and/or riparian vegetation; and	Section D4
	an Irrigation Management Plan prepared in accordance with the relevant guidelines including <i>Environmental Guidelines: Use of Effluent by Irrigation (DEC 2004)</i> and <i>Australian Guidelines for Water Recycling: Managing Health and Environmental Risks</i> (National Resource Management Ministerial Council, Environment Protection and Heritage Council and Australian Health Ministers' Conference 2006) which must:	Appendix E
	1. include detailed baseline data of the soil properties of the proposed irrigation areas, including salinity levels and a nutrient budget;	Section E4

CoA No.	Condition requirements	Document reference
	2. identify any potential off-site risks and impacts and describe measures to minimise any environmental impacts;	Sections E5, E7 and E8
	3. include a protocol for the use of recycled effluent for irrigation including application rates and restrictions; and	Sections E7, E8 and E9
	4. include a program to monitor areas subject to irrigation.	Section E10
	The Water Management Plan and sub-plans shall be prepared in consultation with OEH, NOW, NSW Health and DTRIS (Fisheries), and be submitted to the Director-General for approval by the end of June 2012 and prior to commencing operation of the project, unless otherwise agreed by the Director General.	Section 1.4

3.4 Statement of Commitments

The SoC relevant to this Plan are listed in Table 2. A document reference is also included to indicate where in the WMP or other management documents the SoC are addressed.

Table 2 Statement of Commitments relevant to water management

Objective	Ref. No.	Commitment	Document reference
Ensure comprehensive monitoring of operation of the water cycle	OP1	<p>Establishment and location details for monitoring sites will be in accordance with WQ4. Results of all monitoring programs that form part of these Statement of Commitments will be considered in terms of overall environmental impact on a regular basis, including:</p> <ul style="list-style-type: none"> ▪ The trade-off between potable water savings, reduction in stormwater discharges and increased recycled water discharges. ▪ Relative impacts of excess recycled water discharges compared to impacts on soil and groundwater from recycled water uses. ▪ The timeframe for relative comparisons of impacts components of the water cycle will be determined in consultation with the relevant government agencies. ▪ The ability to feedback results for further stages of Googong township. 	Appendix A
Adaptive management	OP3	<p>Management plans will be reviewed with consideration of the outcomes of monitoring programs:</p> <ul style="list-style-type: none"> ▪ Additional management and mitigation measures will be implemented, should monitoring identify that the water cycle systems is operating outside of modelled or expected parameters. 	Section 7

Objective	Ref. No.	Commitment	Document reference
Monitor impacts on waterways	WQ4	<p>A monitoring program to assess the potential impacts of the Project on the Queanbeyan River (including water quality, flow, fish migration, macrophytes and macro invertebrate communities) will be undertaken.</p> <ul style="list-style-type: none"> ▪ Details of the monitoring program will be determined in consultation with relevant government authorities/stakeholders (including the OEH, DPI and potentially Icon Water). Such consultation will ensure the sharing of available data for the Queanbeyan River for comparative and impacts assessment purposes. ▪ A new monitoring site within the Queanbeyan River is proposed to measure water quality and aquatic ecology impacts over the medium term. This site will be located near the confluence of Googong Creek and Queanbeyan River (and will be sited to enable comparison with data collected from upstream and downstream sites). ▪ Monitoring will commence approximately 12 months prior to commissioning the water recycling plant. 	Appendix A
	WQ5	The operation environmental management plan (OEMP) will outline erosion and sediment control measures to protect buffer and riparian vegetation zones, in general in accordance with Statement Of Commitment WQ3.	Addressed in the OEMPs
Ensure minimal impact on soil salinity and groundwater quality	S5 ¹	Early stages of Googong township will be used as a trial to better understand the movement of salt in the landscape. It will involve the installation of carefully located piezometers and the monitoring of results, as well as monitoring the effectiveness of pre-emptive measures such as any subsurface drainage system. The results will be used to improve strategies for ensuing stages.	Appendices B and E
Monitor groundwater quality to avoid adverse impacts	G3	<p>Develop a groundwater monitoring program for the Project in consultation with relevant stakeholders. The program will address the following:</p> <ul style="list-style-type: none"> ▪ The salt levels in groundwater will be regularly monitored during and after Stage 1 of the Project. ▪ Groundwater samples will be collected from both the shallow and regional aquifers, and soil conductivity (that is, salt) mapping will be carried out where possible in areas of inferred impact. ▪ The monitoring of salt levels in the receiving waters will be indicative of the effectiveness of the stormwater system. 	Appendix B
Minimise salinity impacts on soil and plant growth	G7	<p>Soil monitoring in low-lying areas, where salt is likely to accumulate, will be undertaken. If salt levels were shown to be increasing, engineered drainage structures to nearby creek lines will be constructed.</p> <p>As a preventative measure, to avoid future bare soil patches and erosion, salt-tolerant landscaping will be used in low-lying areas.</p>	Appendix E

¹Other components of SoC S5 not relating to operation have not been included, as they have been captured in other stages or documents.

Objective	Ref. No.	Commitment	Document reference
Further investigate the groundwater environment, potential changes to recharge, and likelihood of long-term impacts	G8	Undertake the groundwater monitoring program as outlined in Table 12 of this report ² .	Appendix B
Avoid impacts on and monitor changes to aquatic ecology	A1 ³	Aquatic ecology impacts are considered under WQ4. A water quality and aquatic ecology monitoring program will be developed to monitor construction and operation impacts of the Project on waterways (refer to WQ4 for further details). The monitoring program will include siting of the aquatic ecology monitoring location to ensure viable comparison with historical and other recent river ecology data.	Appendix A

² "Table 12: Recommended scope of works and timing for future groundwater monitoring program" was included in the submissions reports and is reproduced in Appendix A of this WMP.

³ Other components of A1 not relevant to the WMP have not been included, as they have been captured in the other stages or documents.

4 Environmental aspects and impacts

4.1 Existing environment

As outlined in Section 1.2.3, this Plan and associated sub-plans (Appendices A to E) have been updated upon review of the following baseline surface water, groundwater and soil monitoring:

- *Googong Aquatic Ecology – Annual Baseline Report* (Hydrobiology, February 2015).
- *Googong Hydrogeological Services – Annual Groundwater Monitoring Report* (SMEC, January 2015a).
- *Results of Additional February 2015 Monitoring Round and Recommendations* (letter report) (SMEC, March 2015b).
- *Googong Hydrogeological Services – June 2015 Progress Report* (SMEC, July 2015c).
- *Results of March 2016 Geophysical Survey* (letter report) (SMEC, May 2016).
- *Googong Township Stage 1 Irrigation Management Plan* (Agsol, March 2015a).
- *Googong Soil Monitoring Program Report* (Agsol, March 2015b).
- *Soil Monitoring Programme Googong Township* (supplementary report) (Agsol, April 2016).

4.1.1 Surface water environment

Drainage in the area consists of a number of small ephemeral and semi-permanent creeks, farm dams and depressions, shown in Figure 3. Records show that the area has a mean annual rainfall of just less than 600 mm, with summer thunderstorms and drought as common features. There are four main catchments in the area:

- Googong Creek catchment.
- Jerrabomberra Creek catchment.
- Montgomery Creek catchment.
- Googong Dam catchment.

These are all sub-catchments of the Queanbeyan River catchment.

Baseline data stemming from the surface water and aquatic ecology monitoring completed by Sentinel and Hydrobiology from November 2013 to December 2014 is provided in Section A2.1.7 of the SWAEMP (Appendix A). It outlines details of:

- Habitat (including macrophytes).
- Surface water quality.
- Aquatic ecology (diatoms, macro invertebrates, fish and other aquatic fauna).

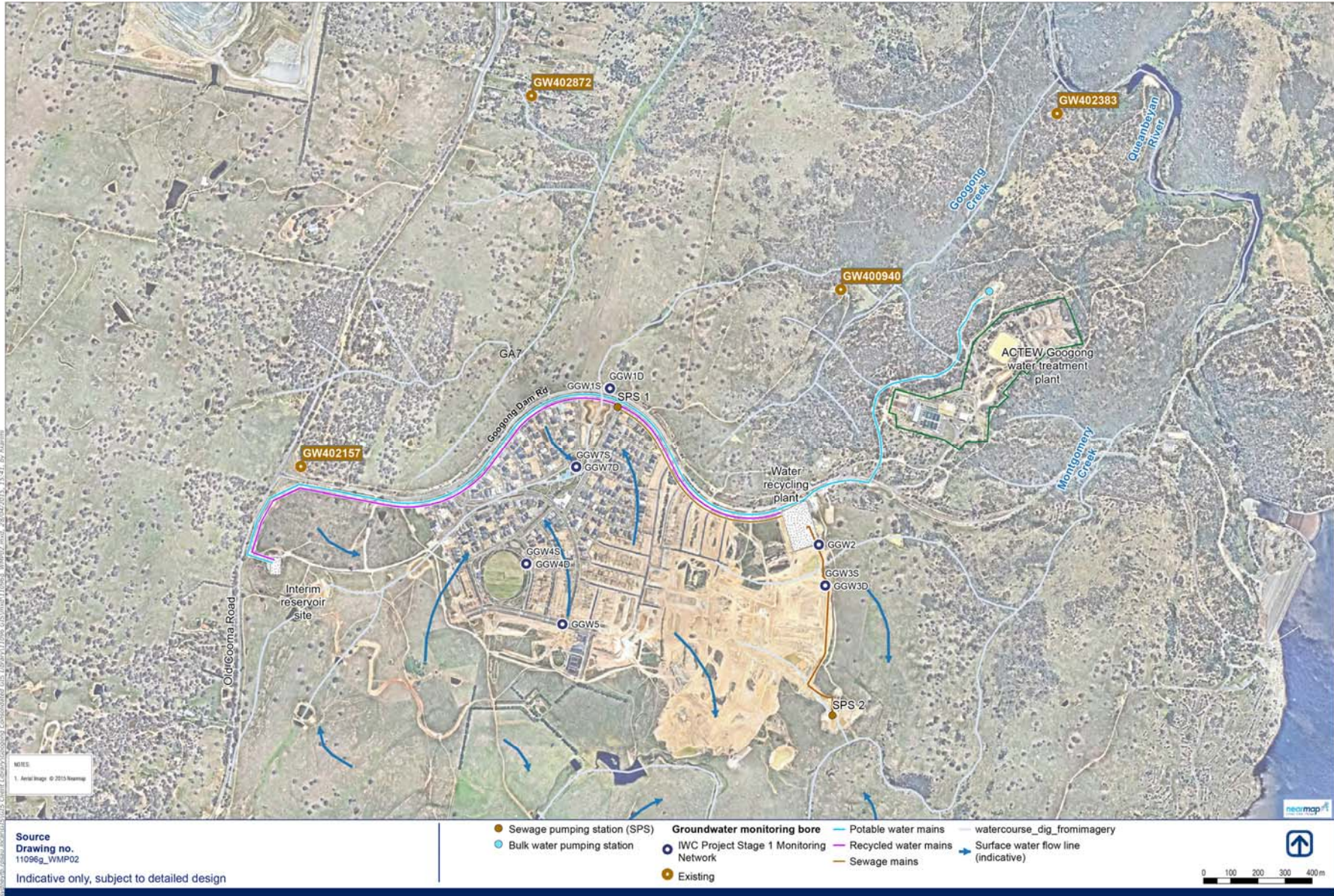


Figure 3 Existing surface and groundwater features

4.1.2 Groundwater environment

According to SMEC (2015a), groundwater is hosted in a regionally extensive fractured-rock aquifer. Minor alluvial aquifers are located along the alignments of locally significant waterways, but these are expected to have minimal storage and not to be of significance to the assessment of the potential groundwater impacts of the IWC Project. The depth to bedrock across much of the site is expected to be between about one to two metres, with fresh bedrock encountered at shallower depths at higher elevations, and marked changes of slope. Shallow groundwater is expected to migrate along the interface between the soil horizons and relatively fresh bedrock, and to discharge to surface water streams across the site.

Baseline data stemming from the groundwater monitoring completed by SMEC from September 2013 to September 2014 is provided in Section B2.3 of the GWMP (Appendix B). It outlines details of:

- Bore yields and aquifer parameters.
- Standing water levels, groundwater flow and gradients.
- Groundwater quality.
- Groundwater recharge and discharge.

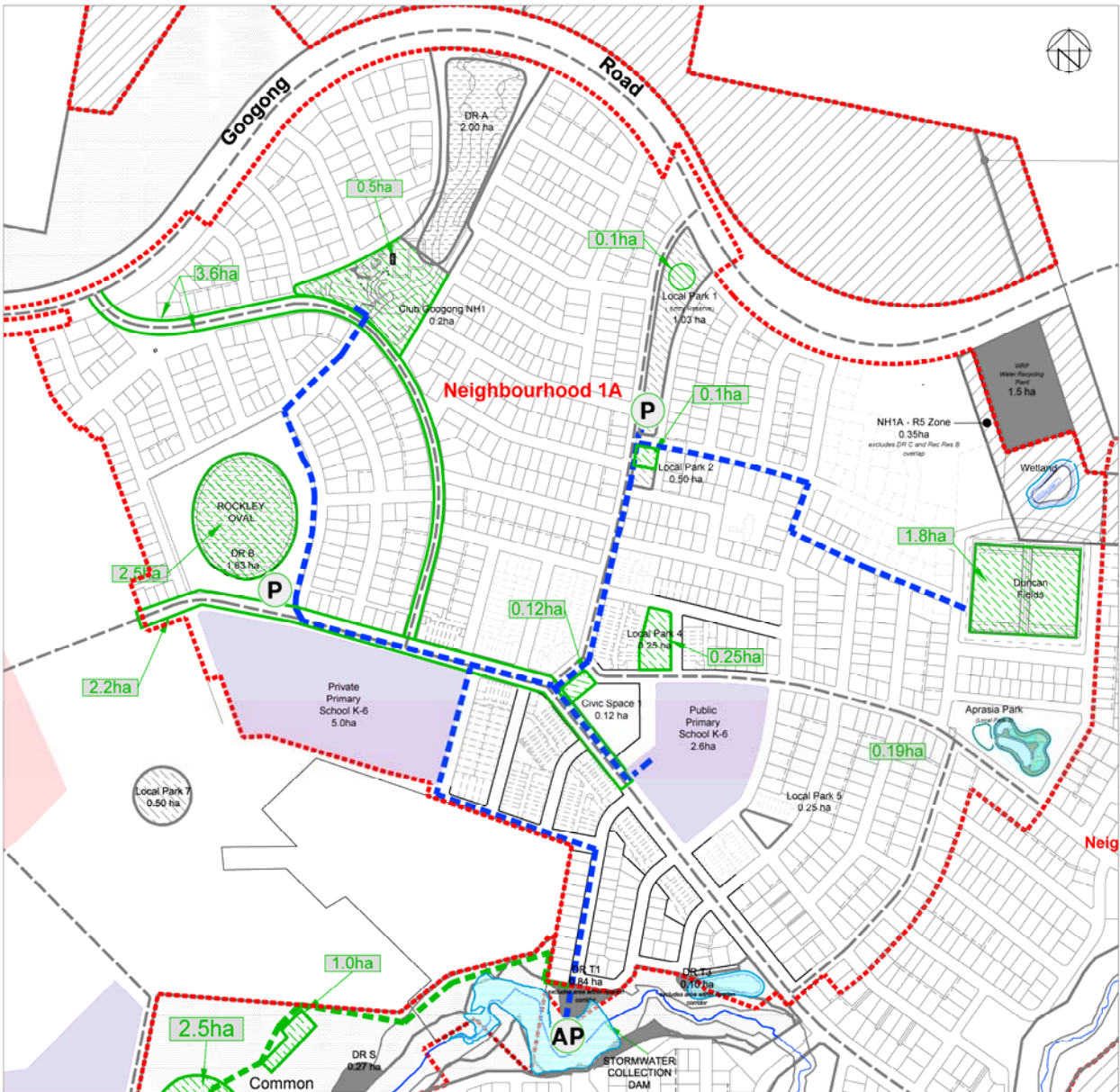
4.1.3 Soil landscape suitability for irrigation with recycled water

The EA included collection of soil samples across the pre-development Googong Township area. Their properties were tested and analysed in relation to the sustainability of recycled water re-use. The likely area of irrigation was identified using the layout of lots and playing fields and included a potential 12.83 ha of open space to be irrigated for the IWC Project. These areas were targeted whilst conducting initial soil suitability analyses. Figure 4 shows the irrigation areas in the Googong Township during Stage 1 of the IWC Project.

The soils tested were not found to be saline or sodic and generally indicated good water and nutrient holding capacity. The EA concluded that the soils within the Googong Township area would also be an effective barrier to any potential contaminants accessing any sensitive groundwater table due to the good water and nutrient holding capacity of the soils.

The suitability of soils within the Googong Township area for irrigation can be determined using two topographic and soil suitability tables (DEC 2004).

Table 3 shows the results of the topographic suitability assessment for irrigation with recycled water within the Googong Township area undertaken in 2010 by Agsol Pty Ltd. It showed that there were no significant topographic limitations to irrigation.



- LEGEND**
- PERMANENT IRRIGATION AREAS
 - 4.18ha
 - IRRIGATION PUMP
 - AERATION PUMP DAM
 - AS CONSTRUCTED IRRIGATION MAINS (RISING)
 - FUTURE IRRIGATION MAINS (RISING)
 - SCHOOLS
 - MIXED USE URBAN CORE
 - PUBLIC OPEN SPACE
- NOTE:**
1. ALL IRRIGATION WATER SUPPLIED BY THE RECYCLED WATER NETWORK TO IRRIGATION TANKS AND ASSOCIATED PUMPS.

Figure 4 Irrigation areas in the Googong Township (Stage 1 of the IWC Project)

Table 3 Topographic suitability assessments for recycled water irrigation (DEC 2004)

Feature	Details of this scheme	Limitation rating for the study area
Slope gradient (%)	<10% Areas where slopes exceed 10% have generally been excluded from the proposed housing development and irrigated open space areas.	Slight (for spray irrigation)
Flooding	Areas affected by flooding have been excluded from the proposed housing development. However, they may be included in proposed irrigated landscape areas.	Slight
Landform element	Hill slopes and ridges. Home sites and some active playing fields would be modified to make them more suitable for irrigation.	Slight
Surface rock outcrop	This feature is significant in some locations, but is not necessarily a concern for irrigated home gardens or passive recreational areas. Rocks would be removed or covered in playing fields.	Moderate

Source: Table 6.4 Googong Land Capability Study, Agsol (Appendix D of the Environmental Assessment)

Table 4 details the soil suitability assessment results from within the Googong Township area in relation to the DEC 2004 suitability tables. Agsol (2010) concluded that the results relating to the suitability of the soil landscape for irrigation suggests there are no significant limitations to irrigating with recycled water.

In summary, the pre-development soil survey confirmed that the typical soils within the study area are not saline or sodic and soils have good water and nutrient holding capacity to about 50 cm. The soils also have a high capacity to absorb phosphorus. The typically well-drained soils over much of the area lower the potential risk of concentrating salts within or near irrigation areas. Furthermore, the modification of gardens should have a positive impact through the addition of topsoil mulches etc.

Table 4 Soil suitability assessments for recycled water irrigation

Soil characteristic	Typical soil result	Limitation rating for the study area
pH topsoil	5.0–7.8	Slight
Exchangeable sodium percentage (0–40 cm)	<5 %	Slight
Exchangeable sodium percentage (40–100 cm)	<10 %	Slight
Electrical Conductivity (0–20 cm)	<1 dS/m	Slight
Electrical Conductivity (20–100 cm)	<4 dS/m	Slight
Cation exchange capacity (0–40 cm)	<12 meq/100 g	Slight to moderate
Depth to seasonal water table	>3m on hill slopes and crests. May rise to within 1m in low lying areas.	Slight
Depth to hardpan or bedrock	50cm–1m	Slight to moderate
Hydraulic conductivity – surface	80mm/hr	Slight
Hydraulic conductivity – subsoil	<5mm/hr	Moderate
Available water holding capacity	100 mm/mm	Slight
Emerson Aggregate Test (0–100 cm)	3(1)	Slight
P sorption	Good	–

Source: Table 6.5 Googong Land Capability Study, Agsol (Appendix D of the Environmental Assessment)

The suitability assessments for recycled water irrigation provided above should be used as a guide only, as soil baseline data has been collected for irrigation areas within the newly established terrain. The results of this baseline data are discussed in Section E4 of the IMP (Appendix E).

4.1.4 Geophysical investigation

An ongoing geophysical investigation program for mapping salinity (soil and/or groundwater) has been undertaken to assess potential salinity variations pre- and post-irrigation practices.

Electromagnetic surveying is a key tool to identify the variability in soil characteristics. The technology is routinely used to identify the variability in soil characteristics by measuring the soil's apparent conductivity. It is influenced by soil porosity, soil moisture, the concentration of dissolved salts and the amount and type of clay within the soil profile.

Under normal conditions, the highest conductivity readings will represent soils with the highest overall clay content and lowest drainage, indicating potentially saline conditions; the lowest conductivity readings indicate relatively coarse textured soils with lower electrolyte levels and typically having increased relative drainage characteristics.

Figure 5 shows the electromagnetic survey results as outlined in the EA. Generally, the conductivity readings were low to very low over the site, which is consistent with non-saline and well-drained soils. The lowest readings are in areas dominated by rocky soil. The higher readings generally occur along the drainage lines and may be an indicator of deeper or damp soil.

This electromagnetic survey should be used as a guide only, as additional geophysical baseline data has been collected within the newly established terrain within the Township. The results of this baseline data are discussed in Section B2.3 of the GWMP (Appendix B).

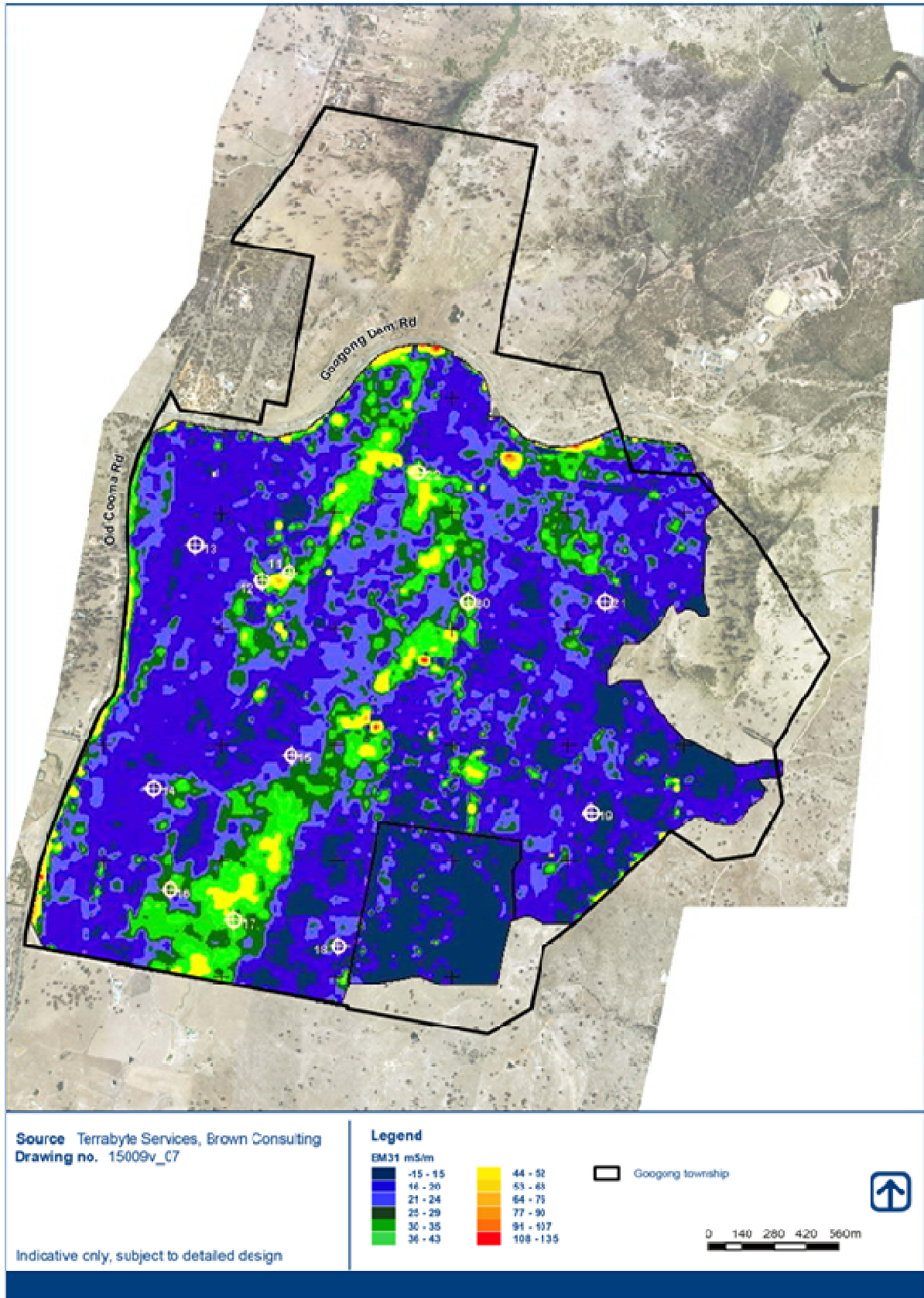


Figure 5 Electromagnetic survey results

4.2 Use of recycled water and discharge points from the IWC Project

A draft version of the RWQMP was prepared by QCC in 2013. The RWQMP will be finalised by QCC following input of results obtained during WRP process verification and prior to operation. It describes how recycled water from the WRP will be used in the township:

- Toilet flushing within residences and commercial premises.
- **Irrigation of key public domain elements (seven sports fields, five neighbourhood parks; and verges for main roads).**
- **Residential garden use.**
- **Residential car washing.**
- **Fire fighting.**

Bold font indicates uses that are relevant to the WMP, as they pose a risk to surface water and/or groundwater quality, aquatic ecology, soil or plants.

In addition to these uses, excess recycled water that meets effluent criteria listed in the RWQMP will be discharged from the interim recycled water reservoir to the stormwater management system that discharges to Googong Creek. Excess recycled water that does not meet the RWQMP criteria (i.e. during the process verification phase in commissioning of the WRP before it is approved for use in the Township, or during the failure of a Critical Control Point (CCP) during operation) will be discharged into Googong Creek via the existing chamber and outlet structure at Beltana Park.

4.2.1 Health risks associated with the use of recycled water

The recycled water system would supply water to a standard fit for the intended uses in accordance with the AGWR.

The central principle of the AGWR is that all recycled water schemes require a risk management plan. For the Googong Township, a RWQMP has been developed by QCC, and provides a detailed assessment of the sewage treatment process and water recycling scheme and identifies the monitoring and controls necessary to produce water of an appropriate quality for its intended end use (QCC 2013). The RWQMP will be continuously evaluated and reviewed to assure safety and sustainability throughout the IWC Project lifecycle.

The RWQMP includes an assessment of the recycled water system, identifying the following means to which people may be exposed to recycled water:

- Contact with skin (people being sprayed during irrigation, car washing, etc.).
- Inhalation (inhaled during irrigation, car washing, cleaning inside the home, etc.).
- Ingestion (accidental potable use).

Additionally it identified the following activities that would not be suitable for recycled water use:

- Filling or topping-up of swimming pools.
- Consumption (i.e. drinking, cooking).
- Cross-connections (resulting to recycled water being piped to taps supplying potable water).
- Open access water features (i.e. children playing in water features).

Through the identification of health risks associated with the use of recycled water, preventative measures will be developed in the RWQMP and have been used in the development of this WMP (and sub-plans), particularly in relation to uses associated with irrigation.

4.2.2 Discharge locations

The discharge location for excess recycled water that meets effluent criteria listed in the RWQMP for the IWC Project is at the interim reservoir site, which flows into Googong Creek via the stormwater management system. This discharge location is marked as 'Discharge Point 1' in Figure 6. The recycled water will be de-chlorinated (at the reservoirs) and discharged into the first of the stormwater ponds, it will then flow through the stormwater management system (including Beltana Pond) and into Googong Creek.

As the recycled water passes through the stormwater management system, the likelihood of mosquitoes or algal blooms in waterways is greatly reduced, if not eliminated.

Bio-retention basins, vegetated swale and wetland elements are designed to capture, reduce and in some instances remove pollution caused by nitrogen and phosphorous. By reducing these elements to acceptable levels the chance or occurrence of algal blooms is greatly reduced and most probably eliminated.

In addition, to reduce mosquito breeding the availability of stagnant or standing water is minimised. Beltana Pond has been designed so that passive water flow is directed to flow through the wetland and into the pond via the longest route possible. In addition to this a recirculation pump has been provided to ensure water in the pond is regularly passed through the wetland to increase oxygenation and retreat for pollutants.

Emergency discharges from the WRP will discharge into Montgomery Creek and is marked as 'Discharge Point 2' in Figure 6. This discharge point would only be used in emergency events. Emergency discharges into Montgomery Creek would contain de-gritted and screened sewage. In the extremely unlikely event that the pumps at the sewage pumping stations were running at flood head (i.e. nominally wet weather in excess of 1:10 years) and the manual screen in the inlet works was blocked, the sewage would be de-gritted only.

Excess recycled water produced by the WRP that does not meet the RWQMP criteria (i.e. during the process verification phase in commissioning before it is approved for use in the Township, or during the failure of a CCP during operation) will be diverted to an Off-Spec Water Tank at the WRP and then pumped along a separate pipeline along Googong Dam Road. The recycled water will be dechlorinated at the WRP prior to entering the pipeline. The recycled water will then be discharged into the ephemeral Googong Creek via the existing chamber and outlet structure at Beltana Park, immediately downstream of Beltana Pond. This discharge location is marked as 'Discharge Point 3' in Figure 6. It is an EPA-licenced discharge point and recycled water discharged at this location will be required to meet the effluent criteria in CoA D5 and the other relevant conditions of the Environment Protection Licence.

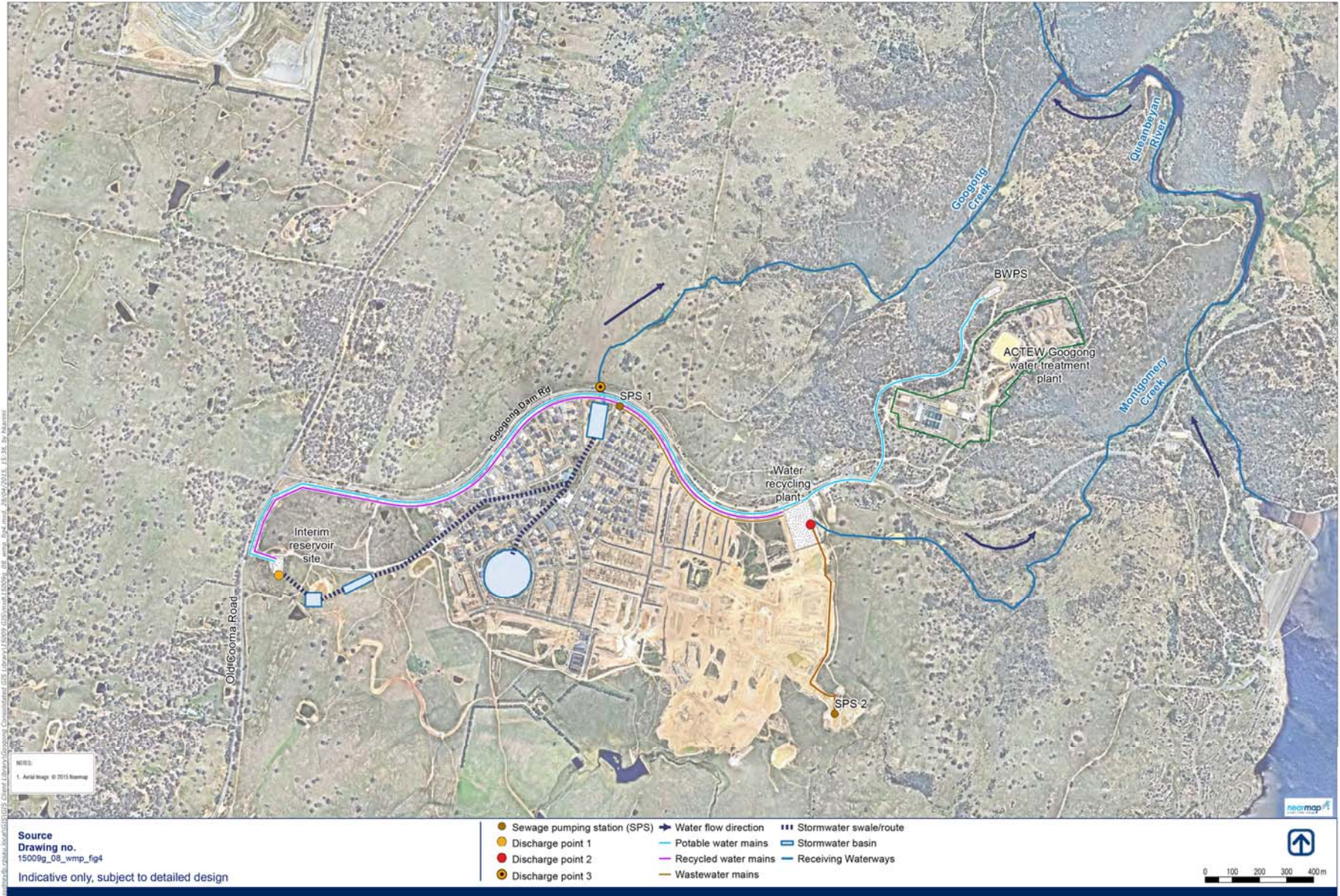


Figure 6 Discharge locations for Stage 1 of the IWC Project

4.3 Environmental impacts

The EA identified that the potential impacts associated with using recycled water primarily relate to:

- The introduction of salt (salinity) into the landscape and receiving waters as a result of recycled water uses. In home gardens, the risks to the soil may include adverse physical and/or chemical changes, which could lead to a reduction in fertility and the soils' potential to grow turf or garden. The primary risk would be from irrigation leading to extra water logging, a rise in water tables and/or soil salinity increases.

However, Agsol's report (2010) concluded that while there is a potential risk of increased soil salinity, the IWC Project is not likely to result in significant impacts to soil salinity and there would be no significant limitations to irrigating with recycled water. A range of measures (refer Appendix E, Section E.5) has been proposed in the IMP to address any potential increases in soil salinity detected through ongoing monitoring. Such measures will include control mechanisms at the WRP, controlling chemical amounts for reticulation and education programs for residents.

- Potential impacts of any changes in flow regimes and/or water quality on aquatic flora and fauna due to irrigation and discharge to the environment; and the risk that these activities may generate significantly more runoff and/or percolation, leading to a change in catchment hydrology and/or soil erosion.

The sporting fields within NH1A that will be irrigated with recycled water were analysed in more detail as part of the baseline soil investigation undertaken by Agsol in February 2015. This analysis highlighted a further potential impact associated with the risk of 'over-application' of recycled water or fertilisers. Due to the limited buffering capacity of the soil, and hence poor nutrient holding capacity, there is an increased risk of excess nutrients from the recycled water or fertilisers leaving the site in drainage waters. These risks will be managed appropriately through the implementation of the IMP, provided at Appendix E. In particular, the scheduling of irrigation and application of fertiliser will be undertaken in a manner that will mitigate these risks.

This Plan has been developed to identify and manage impacts to surface water and groundwater quality, aquatic ecology, soil and plants.

5 Environmental control measures

The following sub-plans document the monitoring and response plans to identify and manage potential impacts on surface, groundwater, aquatic ecology, soils and landscapes:

- Surface Water (and Aquatic Ecology) Monitoring Program (SWAEMP) – Appendix A.
- Groundwater Monitoring Program (GWMP) – Appendix B.
- Recycled Water Flow Release Protocol (RWFRP) – Appendix C.
- Surface and Ground Water Response Plan (SGWRP) – Appendix D.
- Irrigation Management Plan (IMP) – Appendix E.

6 Compliance management

6.1 Roles and responsibilities

The IWC Project team's roles and responsibilities during operation are outlined in Section 4 of the OEMPs associated with the IWC Project. Specific responsibilities for the implementation of environmental controls, including monitoring, are detailed in Table 5 below and relevant sub-plans of this WMP (Appendices A to E).

6.2 Training

Personnel working in relevant operational areas of the IWC Project will undergo site induction training outlined in Section 5 of the OEMPs associated with the IWC Project. The induction training will address elements related to water management including:

- The objectives and requirements of this Plan and sub-plans.
- Relevant legislation.

6.3 Monitoring

Monitoring programs are detailed in each of the respective sub-plans of this WMP (Appendix A, B and E).

Table 5 provides a summary of the surface water, aquatic ecology, groundwater and soil monitoring requirements for the IWC Project pre-operation and during the first year of operation of the WRP. The results from the monitoring programs will input into reports that will be produced annually as outlined in Section 6.5.

6.4 Auditing

Audits will be undertaken to assess the effectiveness of environmental controls, compliance with this Plan and sub-plans, CoA, SoC and other relevant approvals, licenses and guidelines.

Internal auditing of the WMP will be undertaken generally on a yearly basis and will be co-ordinated by the operator. The purpose of auditing is to verify compliance with:

- This WMP and sub-plans.
- Approval requirements (CoAs, SoCs).
- Any relevant legal and other requirements (e.g. licenses, permits, regulations).

Additional audit requirements relating to the operation of the IWC Project are detailed in Section 8 of the OEMPs.

Table 5 Monitoring requirements for the IWC Project - pre-operation and first year of WRP operation

Project phase	Frequency of sampling	Monitoring requirements	Responsibility
Pre-operation of the WRP (12 months minimum) - COMPLETED	Various (refer to Appendix A, Section A2)	Monitoring of fish, habitat (including macrophytes), diatoms, macro invertebrate and water quality was undertaken to gain a suitable database for characterising the baseline surface water and aquatic ecology conditions at the site in accordance with Appendix A, Section A2.1. Two continuous water monitoring stations were installed along the Queanbeyan River. These will measure conductivity and pH.	GTPL
	Quarterly	Groundwater samples to gain a suitable database for characterising the baseline groundwater conditions for the IWC Project. These baseline samples were analysed for a relatively broad range of inorganic and organic determinants outlined in Appendix B, Table 5.	GTPL
	One off	Soil samples to determine baseline soil conditions for the constituents outlined in Appendix E, Section E4.1.3.	GTPL
First year of WRP operation	Continuous	Groundwater - shallow bore loggers Parameters: groundwater levels and EC	GTPL (during process verification) QCC (ongoing operation)
		Irrigation CCP - recycled water quality delivered to the irrigation reservoirs (measurable chlorine residual) Methodology: chlorine analyser	
		Irrigation CCP - recycled water quality delivered to the irrigation reservoirs (turbidity measurement) Methodology: turbidity analyser	
	Automated sensor or daily observations	Irrigation CCP - spray drift (cessation based on wind speed) Methodology: automated sensor or daily observations.	QCC
	Daily	Irrigation CCP - time of irrigation (cessation prior to use) Parameter: staff to check before event	QCC
Irrigation CCP - weather station (rainfall) Methodology: automated or manual.			
Irrigation CCP - irrigation system scheduling (soil moisture deficiency) Soil moisture monitors and/or manual moisture probes.			

Project phase	Frequency of sampling	Monitoring requirements	Responsibility
		Irrigation CCP - irrigation system scheduling (soil moisture buffer) Visual observation (e.g. no puddles after irrigation). Soil moisture monitors and/or manual moisture probes.	
	Regularly ongoing	Surface water - flow monitoring Method: review of gauge data for flows in the Queanbeyan River at Wickerslack Lane (QBN703) and at the Googong Dam spillway (if available) in conjunction with recycled water discharge data.	GTPL (during process verification) QCC (ongoing operation)
	Monthly	Surface water - water quality Parameters for laboratory testing: total nitrogen; oxides of nitrogen; ammonia; total phosphorus; microbiological faecal coliforms; total algae (only October-March); cyanobacteria; biochemical oxygen demand (BOD); suspended solids; total dissolved solids; free chlorine; oil and grease; alkalinity; E. coli and enterococci. Parameters for in situ field monitoring: total chlorine, pH, temperature and dissolved oxygen.	GTPL (during process verification) QCC (ongoing operation)
		Irrigation CCP - recycled water quality Parameter: nitrogen, phosphorous, pH, TDS Methodology: sampled at irrigation reservoir.	QCC
	After 3 and 6 months of irrigation with recycled water from WRP, and then as required.	Groundwater - geophysical surveys Method: FEM survey and associated soil sampling.	QCC
	Quarterly	Surface water - diatoms Method: one composite sample collected at each site.	GTPL (during process verification) QCC (ongoing operation)
	Bi-annually (6 monthly)	Surface water - macro invertebrates (spring and autumn) Method: riffle habitat sampling generally in accordance with <i>Australian River Assessment System (AusRivas) Sampling and Processing Manual</i> .	GTPL (during process verification) QCC (ongoing operation)
		Surface water - habitat assessment (spring and autumn) Method: Recording of site characteristics and photos.	

Project phase	Frequency of sampling	Monitoring requirements	Responsibility
		<p>Surface water - channel stability (spring and autumn) Method: Photopoint monitoring at a defined location within each survey site.</p> <p>Groundwater - water quality Parameters for laboratory testing: sodium, potassium, magnesium, calcium, sulphate, chloride, bicarbonate, total dissolved solids (TDS), nitrate, ammonia, Total Kjeldahl nitrogen, reactive phosphorous, copper, cadmium, chromium, lead, nickel, zinc, total iron, total manganese. Parameters for <i>in situ</i> field monitoring: pH, temperature, EC.</p>	
	Annually	<p>Surface water - fish survey Method: in accordance with the Guidelines for detecting fish listed as threatened under the <i>Environment Protection and Biodiversity Conservation Act 1999</i>.</p> <p>Irrigation area monitoring - soil quality (from start 2016) Parameters: pH; electrical conductivity; nitrate; total nitrogen; available phosphorus; total phosphorus; exchangeable sodium percentage; heavy metals and pesticides; phosphorus sorption capacity.</p> <p>Soils in low lying areas - soil quality (from start 2017) Parameters: pH; electrical conductivity; nitrate; total nitrogen; available phosphorus; total phosphorus; exchangeable sodium percentage; heavy metals and pesticides; phosphorus sorption capacity.</p>	QCC
	Whenever plumbing works are undertaken at irrigation sites.	<p>Irrigation CCP - potable water supply lines (cross connections) Methodology: Sample all potable water outlets after plumbing works.</p>	GTPL (during process verification) QCC (ongoing operation)

6.5 Reporting

GTPL/QCC will prepare a report annually depending upon who has operational responsibility for the IWC Project (i.e. GTPL prior to handover of the WRP).

The WMP annual report will include the results and analysis of the monitoring required by this Plan; recommendations for any management plan updates; as well as any actions taken to correct any non-conformances in order to ensure compliance with the relevant conditions of approval. The reporting requirements are detailed further in the OEMPs.

Upon finalisation, this annual report will be made available by QCC to the agencies listed in Section 1.4 for their reference. QCC will also make the annual reports publically available on their website in a timely manner.

Table 6 provides a summary of the reporting requirements relating to the monitoring programs that support the WMP for the IWC Project pre-operation and during the first year of operation of the WRP.

Table 6 Reporting requirements for the IWC Project monitoring programs

Project phase	Frequency of sampling	Reporting requirement	Responsibility
Pre-operation of the WRP (12 months minimum) - COMPLETED	At the completion of the one year of baseline monitoring	<p>Baseline reports detailing the results of one year of baseline data for surface, aquatic ecology, groundwater and soil conditions.</p> <p>These reports will input into a review of the following:</p> <ul style="list-style-type: none"> ▪ The monitoring program and trigger levels for surface water, aquatic ecology and groundwater during the first year of operation. ▪ The RWFRP. ▪ The IMP. 	GTPL
WRP operation	Annually	<p>Surface water and aquatic ecology</p> <p>Update and refine surface water and aquatic ecology monitoring program with regard to data collected on fish, macro invertebrate, diatoms, habitat and water quality in consultation with the regulators and in accordance with Appendix A, Section A4.3.</p>	QCC
		<p>Groundwater</p> <p>Update and refine groundwater monitoring program with regard to data collected to date in consultation with the regulators and in accordance with Appendix B, Section B5.5.</p>	
		<p>Irrigation and soil management</p> <p>Update and refine irrigation management and soil monitoring program with regard to data collected in consultation with the regulators and in accordance with Appendix E, Section E11.5.</p>	

7 Review and improvement

7.1 Non-conformance and adaptive management

The OEMPs (Section 8) associated with the IWC Project outline the process for adaptive management, including the procedure for identifying, reporting, recording and reviewing non-conformances. In relation to this Plan, non-conformances may include:

- Failure to implement required monitoring programs, or components of required monitoring programs.
- Exceedences of water or soil quality criteria identified through monitoring.
- Potential or actual impacts to surface water, aquatic ecology, groundwater, soils and landscapes or adjacent water users.

Adaptive management will ensure that the monitoring data is reviewed and analysed to determine the effectiveness of the management system and evaluate the need for change. This will ensure continual improvement.

Accordingly this Plan should be implemented in conjunction with the OEMPs for the IWC Project.

7.2 Management plan update and amendment

GTPL will co-ordinate the review and distribution, as appropriate of the WMP for the IWC Project until IWC assets are handed over to QCC for operation. At that point, the WMP and responsibility for its review will also be transferred over to QCC.

Revision of the WMP may be triggered by findings of the monitoring programs, annual reporting and non-conformance register (prescribed in Section 8 of the OEMP). The review may result in changes to protocols or programs outlined in the sub-plans, to mitigation measures or monitoring/reporting requirements or other updates to the WMP.

For the revision of the WMP, the operator will ensure that documentation is:

- Developed in consultation with relevant stakeholders identified in Section 1.4, reviewed and approved prior to issue.
- Issued for use.
- Controlled and stored for the legally required timeframe.
- Removed from use and archived when superseded or obsolete.

The operator will endorse minor changes to the WMP. Minor changes would typically include those that:

- Are editorial.
- Do not increase the extent of environmental impacts when considered individually or cumulatively.
- Do not restrict the project's ability to meet all CoA and environmental obligations.

Where the operator determines that a change is not minor, the revised WMP will be sent to DP&E for approval.

A register will identify the current revision of particular documents. Revised documents will be distributed to controlled copyholders, as identified in Section 1.4.

Refer also to Appendix A (Section A4), Appendix B (Section B5) and Appendix (Section E10) for details on the process of review for specific monitoring programs.

8 References

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Appendix A

Surface Water (and Aquatic Ecology) Monitoring Program

Appendix B

Groundwater Monitoring Program

Appendix C

Recycled Water Flow Release Protocol

Appendix D

Surface and Groundwater Response Plan

Appendix E

Irrigation Management Plan