Recycled Water Flow Release Protocol

Googong Township Integrated Water Cycle Project

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Project No.: 15009
Version: 11.0
Date: May 2016

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 final 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 consistency review undertaken for increased design capacity from 3,600 EP to 4,700EP	Rob Salisbury	Rob Salisbury	24 May 2016

APPROVAL FOR ISSUE

Name	Signature	Date
Rob Salisbury		24 May 2016

Contents

C1 Background 1
C2 Purpose 2
C3 Recycled water discharge 3
C3.1 Overview 3
C3.2 Discharge Point 1 – interim recycled water reservoir 6
C3.3 Discharge Point 3 – Beltana Park outlet (Googong Creek) 10
C3.4 Water quality monitoring 17
C4 Review procedures 18
C4.1 Overview 18
C4.2 Review process 18
C5 References 19

Tables

Table 1 Conditions of Approval 2
Table 2 Overview of recycled water discharges 3
Table 3 Review procedures for the recycled water quality protocol 18

Figures

Figure 1 Discharge locations for Stage 1 of the IWC Project 4
Figure 2 Schematic showing recycled water discharge during operation 5
Figure 3 Design drawings - interim reservoir site general arrangement 7
Figure 4 Design drawings - interim reservoir detailed pipe layout 8
Figure 5 Average recycled water discharge at Discharge Point 1 for a population of approximately 4,700 EP 10
Figure 6 Design drawings - Drainage structure Beltana Park outlet (Sheet 1) 12
Figure 7 Design drawings - Drainage structure Beltana Park outlet (Sheet 2) 13
Figure 8 Design drawings - Drainage structure Beltana Park outlet (Sheet 3) 14
Figure 9 Average recycled water discharge at Discharge Point 3 up until a population of approximately 4,700 EP is reached 16

Terms and Abbreviations

CCP	Critical control point
CoA	Condition of Approval
EDT	Emergency Discharge Tank
EP	Equivalent population
EPA	Environment Protection Authority
EPL	Environment Protection Licence
GTPL	Googong Township Proprietary Limited
IWC	Integrated water cycle
kL	Kilolitres
ML	Megalitres
mm	Millimetres
NSW	New South Wales
Operator	GTPL (during process commissioning and verification) or QCC (during ongoing operation)
OSWT	Off-Spec Water Tank
Protocol	Recycled Water Flow Release Protocol
QCC	Queanbeyan City Council
RWFRP	Recycled Water Flow Release Protocol
RWQMP	Essential Sewage and Recycled Water Quality Management Plan
SoC	Statement of Commitments
SQID	Stormwater Quality Improvement Devices
SWAEMP	Surface Water (and Aquatic Ecology) Monitoring Program
TDS	Total dissolved solids
TN	Total nitrogen
TP	Total phosphorous
TSS	Total suspended solids
WMP	Water Management Plan
WRP	Water Recycling Plant

C1 Background

Recycled water that is not used by the Googong Township for non-potable household use or open space irrigation will be discharged to the environment.

As outlined in Section 4.2 of the Water Management Plan (WMP), excess recycled water that meets effluent criteria listed in the Essential Sewage and Recycled Water Quality Management Plan (RWQMP) will be discharged (following dechlorination) from the interim recycled water reservoir to the stormwater management system, which 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 Water Recycling Plant (WRP), or during the failure of a critical control point (CCP) during operation) will be discharged into Googong Creek via an existing chamber and outlet structure on Googong Creek immediately downstream of the pond in Beltana Park.

C2 Purpose

This Recycled Water Flow Release Protocol (the 'Protocol') forms an appendix to the WMP that seeks to identify and manage potential impacts on surface water and groundwater resulting from the operation of the IWC Project.

Specifically, this Protocol describes the discharge arrangements for excess recycled water released to the environment and provides a procedure for the review of such discharges based on the outcomes of the monitoring required by other parts of the WMP, Conditions of Approval (CoA) and Statement of Commitments (SoC).

This Protocol also fulfils the requirements of CoA D5 and D8 (c), as shown in Table 1.

Table 1 Conditions of Approval

<table>
<tr><th>CoA No.</th><th>Requirement</th><th>Reference/ Comments</th></tr>
<tr><td>D5</td><td>The recycled water discharged to the environment shall not exceed the water quality parameters identified in Table D1 below. 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.</td><td>OEMPs
WMP Appendix A</td></tr>
<tr><td></td><td>Table D1: Effluent Quality Limits
<table>
<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>
<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>
</table></td><td></td></tr>
<tr><td>D8</td><td>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:</td><td>This Protocol forms an appendix to the WMP.</td></tr>
<tr><td></td><td>1. a Recycled Water Flow Release Protocol, including:</td><td>This Protocol</td></tr>
<tr><td></td><td>A. recommended discharge rates based on baseline data of receiving waterways and meteorological conditions;</td><td>Section C3</td></tr>
<tr><td></td><td>B. the detailed design and operation specifications for the discharge structure/s;</td><td>Section C3</td></tr>
<tr><td></td><td>C. procedures for the review and amendment of flow release protocols based on the outcomes of monitoring;</td><td>Section C4</td></tr>
<tr><td></td><td>The Water Management Plan and sub-plans shall be prepared in consultation with OEH, NOW, NSW Health and DTIRIS (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.</td><td>WMP Section 1.4</td></tr>
</table>

C3 Recycled water discharge

C3.1 Overview

There are three discharge points for Stage 1 of the IWC Project that have been included in the Part 3A Project Approval, or the Project Modification dated 9 July 2014. These are shown in Figure 1, and are as follows:

- Discharge Point 1 – Interim recycled water reservoir.
- Discharge Point 2 – Emergency discharge at Montgomery Creek.
- Discharge Point 3 – Beltana Park outlet structure (Googong Creek).

Discharge point 2 will only be used in emergency scenarios, and therefore is not covered by this Protocol. Similarly, it is not licensed under Environment Protection Licence (EPL) 20188. To this effect, the Beltana Park outlet structure discharge point (Discharge Point 3 under the Project Approval) is licensed as Discharge Point 2 in the EPL.

Three types of discharge will occur at the interim recycled water reservoir and the Beltana Park outlet structure:

- Recycled water in excess of township demand (Discharge Point 1).
- Discharge during process verification (Discharge Point 3).
- Discharge as a result of critical control point failure at the WRP (Discharge Point 3).

These scenarios are described in more detail in the following sections, while a schematic of the discharge process during operation is shown in Figure 2.

Table 2 provides an overview of the discharges to the environment that may occur during Stage 1 of the IWC Project.

Table 2 Overview of recycled water discharges

Discharge point	Discharge type	Average discharge flow	Maximum discharge flow	Discharge quality
Discharge point 1	Recycled water in excess of township demand.	<500 kL/day Dependent on total population of the township (refer to Section C3.2.2).	3 ML/day	RWQMP criteria (dechlorinated). Effluent discharge limits to environment (CoA D5, Table D1).
Discharge Point 3[1]	Discharge during process verification.	240 kL/day[2]	3 ML/day[3]	Effluent discharge limits to environment (CoA D5, Table D1).
Discharge Point 3[1]	Discharge as a result of critical control point failure at the WRP.	<800 kL/day Dependent on total population of the township (refer to Section C3.3.3).	3 ML/day	Effluent discharge limits to environment (CoA D5, Table D1).

1. Licensed as Discharge Point 2 in EPL 20188.

2. Based on dry weather conditions.

3. Based on wet weather conditions.

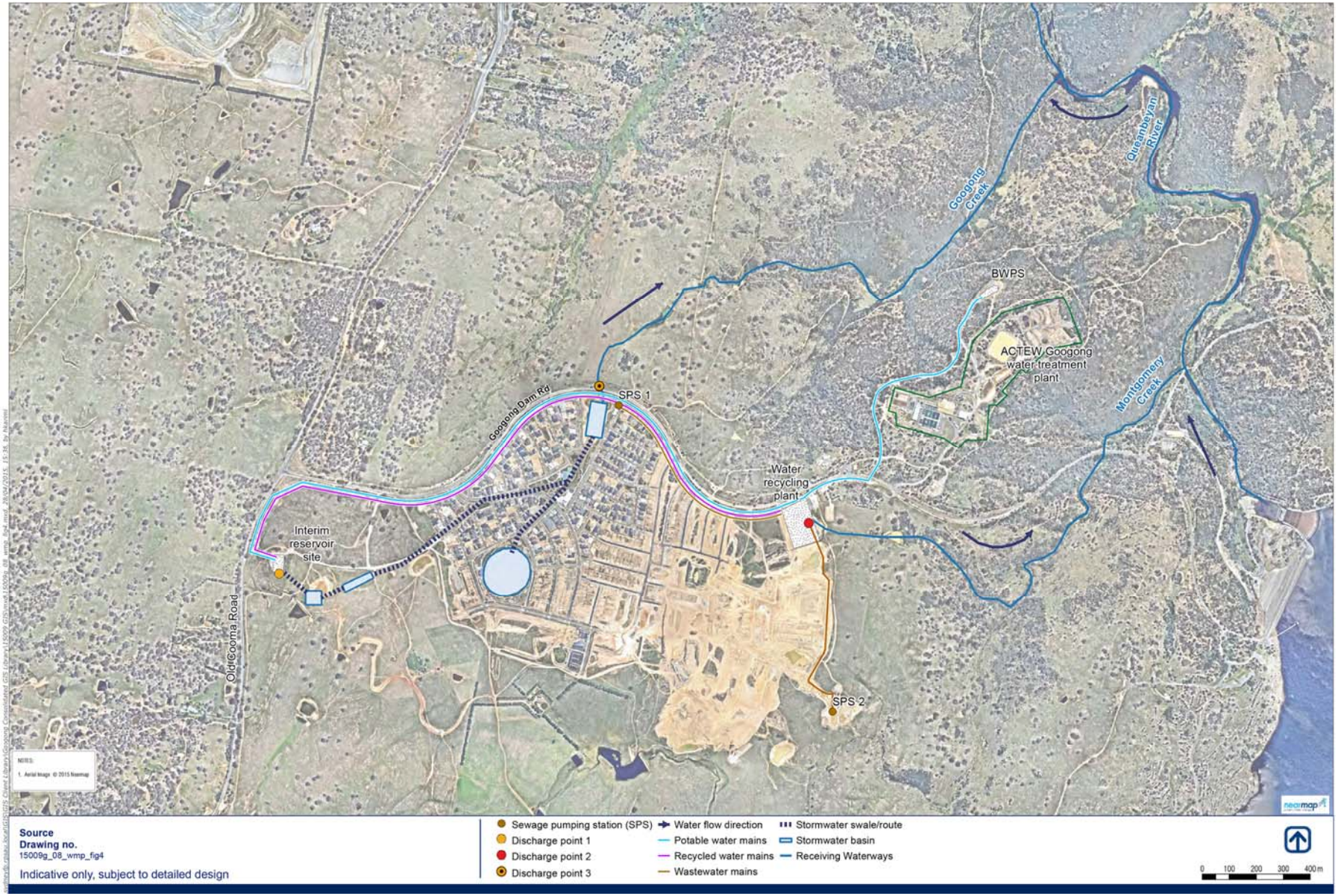


Figure 1 Discharge locations for Stage 1 of the IWC Project

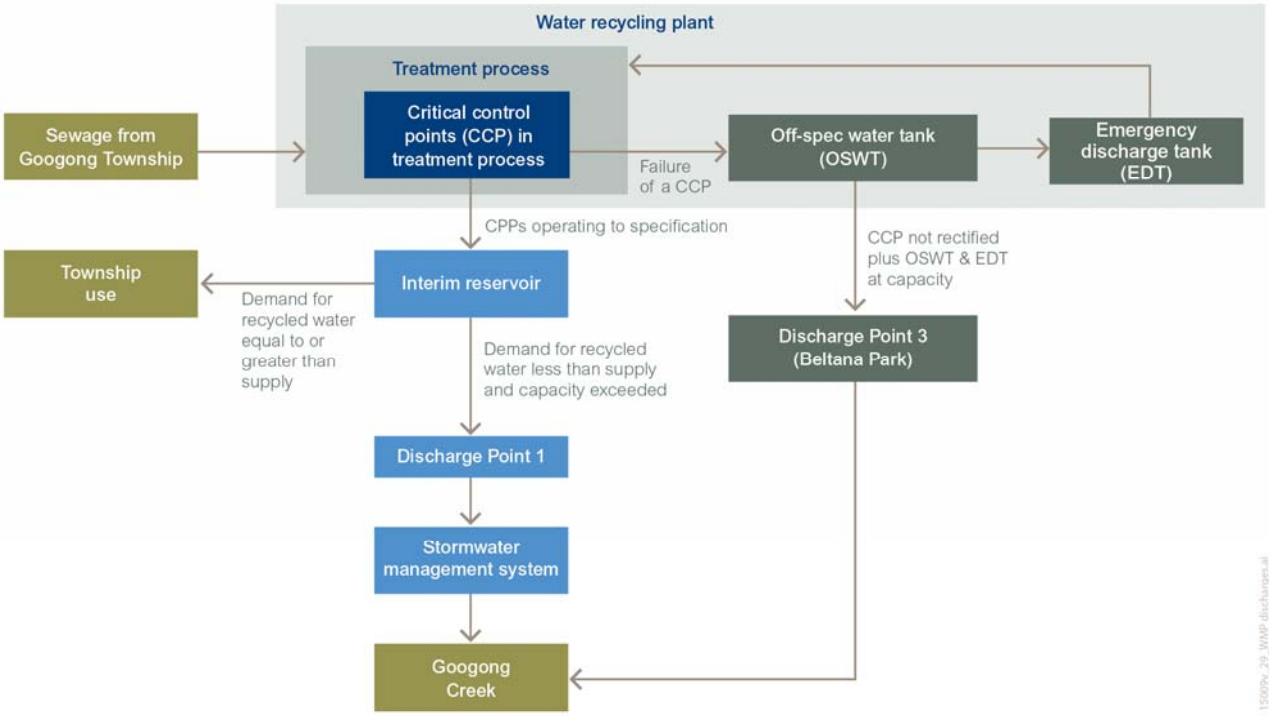


Figure 2 Schematic showing recycled water discharge during operation

C3.2 Discharge Point 1 – interim recycled water reservoir

C3.2.1 Discharge structure

Once operational, the WRP will pump recycled water (that has been fully treated and meets the RWQMP criteria) to the interim recycled water reservoir adjacent to Old Cooma Road, near Googong Dam Road (Discharge Point 1 in Figure 1).

If recycled water production exceeds usage in the township then the recycled water reservoir will overflow via an overflow pipe and dechlorination unit to a discharge structure, where water will then be discharged to the stormwater system, through a series of ponds and eventually into Googong Creek.

The process involves the following:

- Rising main from the WRP to the interim reservoir.
- Interim recycled water reservoir with a capacity of approximately 2.3 ML.
- Bell-mouth overflows from reservoir to an overflow main leading to discharge structure.
- Sodium bisulphite dosing point (for de-chlorination).
- Flow meters.

The discharge structure will help to dissipate the energy from the resulting flows and prevent scouring. It consists of the following:

- A scour and overflow outlet held in place with an anchor block.
- Two layers of boulders (minimum diameter 200 mm) placed on a slope extending for approximately 11 m, and about three to four metres in width.
- Two gabion baskets placed as weirs, at three and ten metres from the overflow outlet.

Design drawings and photos of the discharge structure at the interim recycled water reservoirs are shown in Figures 3 and 4, and Plates 1 and 2, respectively.

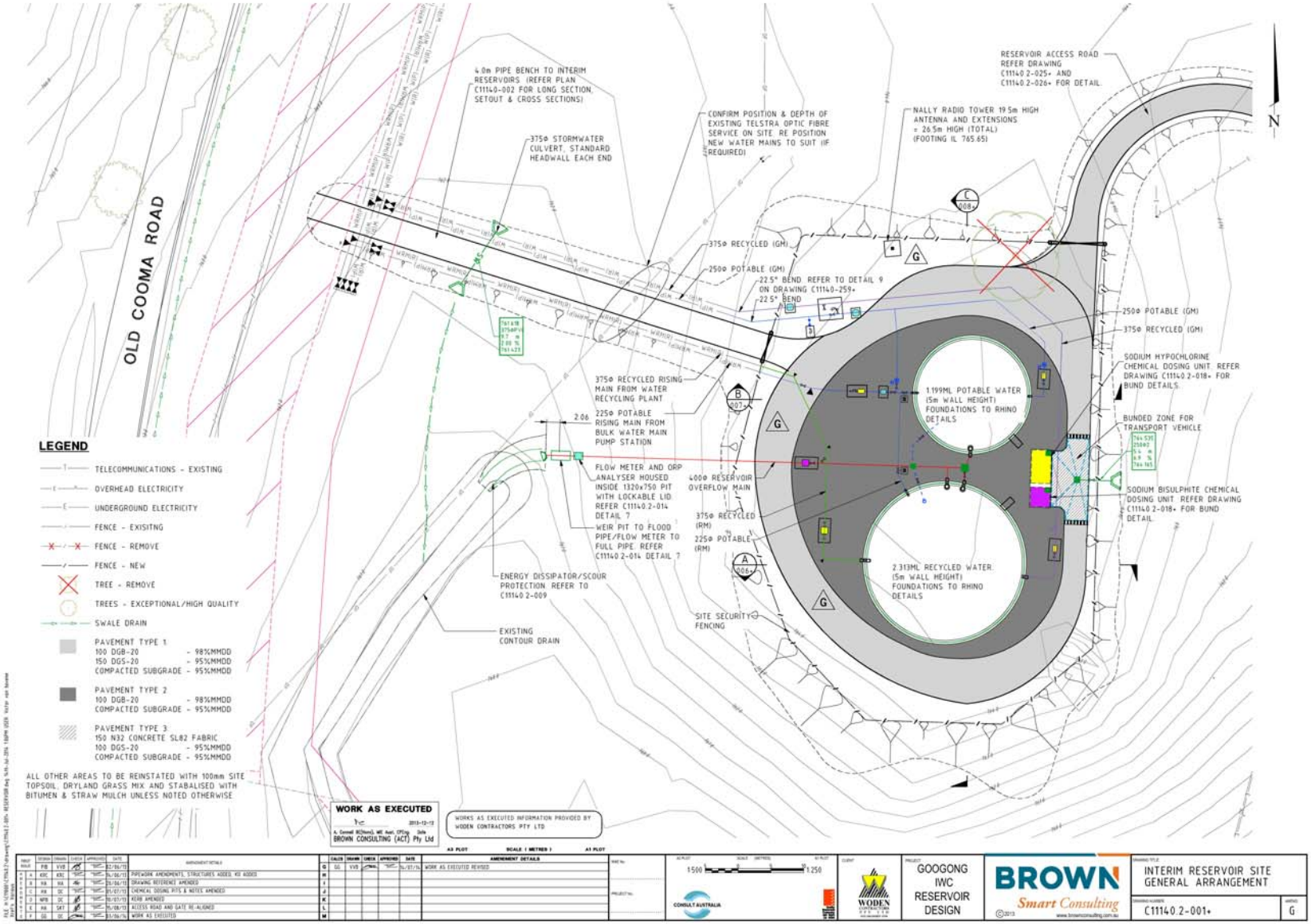
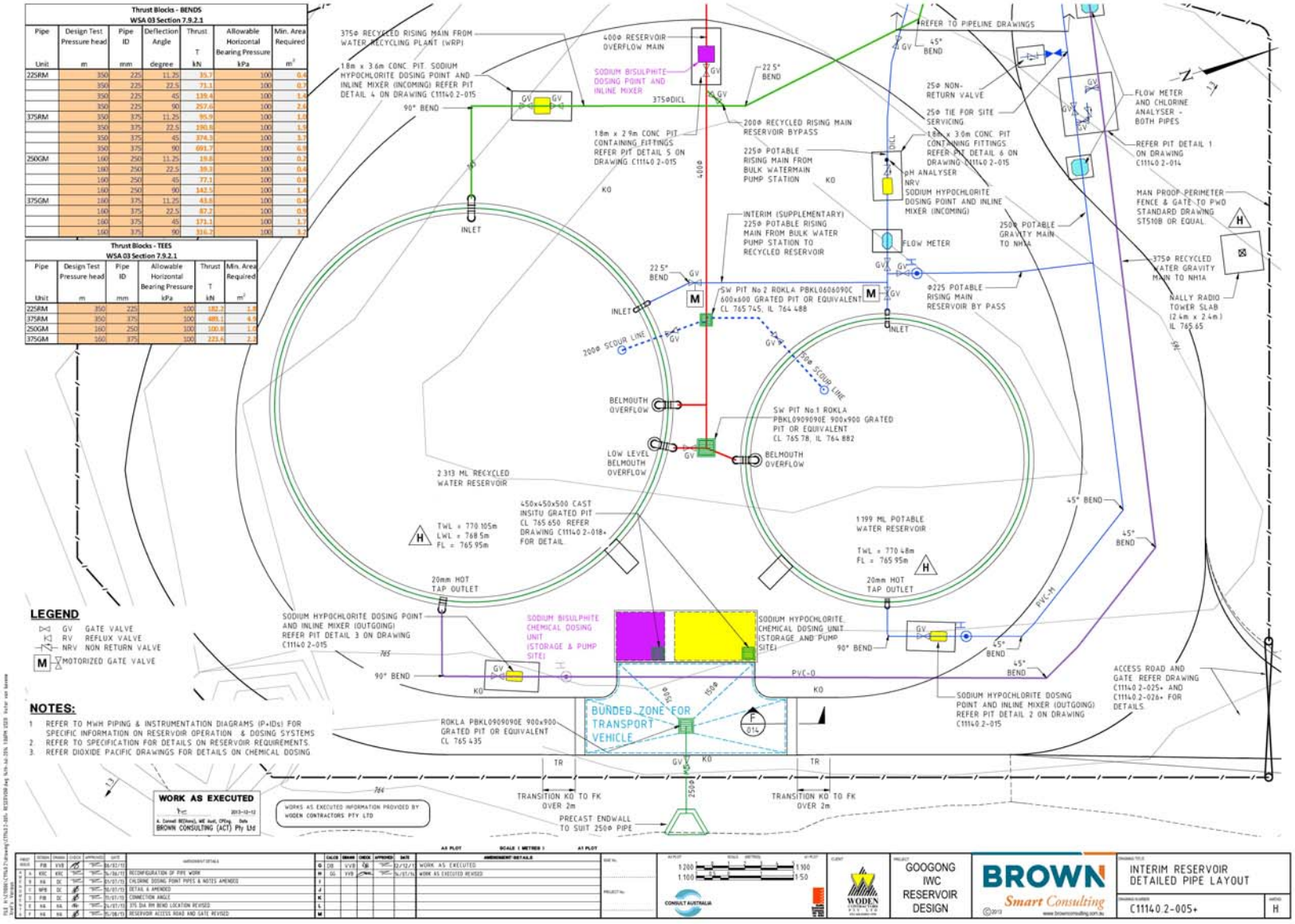


Figure 3 Design drawings - interim reservoir site general arrangement



Thrust Blocks - BENDS WSA 03 Section 7.9.2.1						
Pipe Unit	Design Test Pressure head m	Pipe ID mm	Deflection Angle degree	Thrust T kN	Allowable Horizontal Bearing Pressure kPa	Min. Area Required m^2
225RM	350	225	11.25	35.7	100	0.4
	350	225	22.5	71.1	100	0.7
	350	225	45	139.4	100	1.4
	350	225	90	257.6	100	2.6
375RM	350	375	11.25	95.9	100	1.0
	350	375	22.5	190.9	100	1.9
	350	375	45	374.9	100	3.7
	350	375	90	691.7	100	6.9
250GM	160	250	11.25	19.6	100	0.2
	160	250	22.5	39.3	100	0.4
	160	250	45	77.1	100	0.8
	160	250	90	142.5	100	1.4
375GM	160	375	11.25	43.6	100	0.4
	160	375	22.5	87.2	100	0.9
	160	375	45	171.1	100	1.7
	160	375	90	316.2	100	3.2

Thrust Blocks - TEES WSA 03 Section 7.9.2.1					
Pipe Unit	Design Test Pressure head m	Pipe ID mm	Allowable Horizontal Bearing Pressure kPa	Thrust T kN	Min. Area Required m^2
225RM	350	225	100	182.2	1.8
375RM	350	375	100	489.1	4.9
250GM	160	250	100	100.8	1.0
375GM	160	375	100	223.6	2.2

Figure 4 Design drawings - interim reservoir detailed pipe layout

Plate 2 Energy dissipater/scour protection at interim reservoir discharge point

Plate 1 Flow meter and ORP analyser, housed inside pit (foreground) with weir pit to full pipe in mid-ground

C3.2.2 Discharge of excess recycled water

Average discharge rates for excess recycled water at Discharge Point 1 are dependent on the population of the township at the time and seasonal variability. Figure 5 presents indicative average discharge rates over a year (days 1 to 365) for a population of approximately 4,700 equivalent population (EP), based on 40 years of meteorological data. It therefore represents the upper end of the average recycled water discharge rates during Stage 1 of the IWC Project. The graph indicates that discharge will vary across the year, depending on recycled water demand in the township. For example, during summer there is more demand for recycled water to undertake irrigation and watering of gardens, therefore there will be less excess water to discharge.

The recycled water will flow into the stormwater network and be subject to treatment via the Stormwater Quality Improvement Devices (SQIDs), the largest being the Beltana Park Wetland and Pond, prior to entering Googong Creek. The SQIDs will reduce the potential impact of the recycled water flows on the Googong Creek and Queanbeyan River catchments by providing treatment via sedimentation, filtration and biological processes.

Discharge rates at the interim recycled water reservoir will be regularly reviewed during operation of the WRP, as outlined in Section C4.

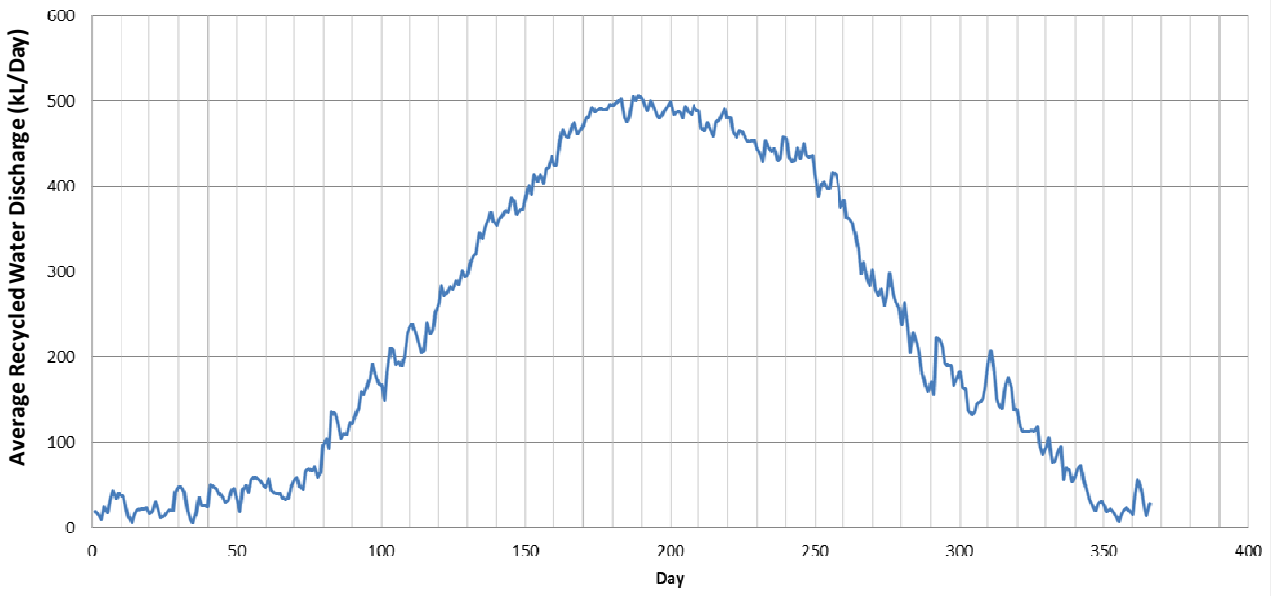


Figure 5 Average recycled water discharge at Discharge Point 1 for a population of approximately 4,700 EP

C3.3 Discharge Point 3 – Beltana Park outlet (Googong Creek)

C3.3.1 Discharge structure

During process verification or due to the failure of a CCP during operation, recycled water produced by the WRP that does not meet the RWQMP criteria will be diverted to the 30 kL Off-Spec Water Tank (OSWT) and then pumped through a pipeline along Googong Dam Road. The recycled water will then be discharged into Googong Creek via the existing discharge chamber, immediately downstream of the pond at Beltana Park (Discharge Point 3 in Figure 1).

Level and flow monitoring sensors are installed at the OSWT and its associated pumping station. To allow for recycled water to be pumped to Discharge Point 3, two additional pumps and associated valves, including a scour valve for maintenance have been provided.

A rising main, connected to a gravity main, links the OSWT to the existing outlet structure at Beltana Park.

The recycled water will be directed to an underground reinforced concrete chamber and then discharged to Googong Creek via two 1650 mm diameter reinforced concrete pipes that extend under Googong Dam Road.

Design drawings and photos of the discharge structure at Beltana Park are shown in Figures 6 to 8, and Plates 3 and 4, respectively.

C3.3.2 Discharge during process verification

During the process verification stage, which will extend for approximately 140 days, all recycled water produced by the WRP will be pumped via a pipeline to Discharge Point 3 at Beltana Park (licenced as EPA Point 2 under EPL 20188), as the recycled water will not yet have been approved for use in the township. The recycled water will be dechlorinated at the WRP prior to discharge at Discharge Point 3. Temporary sediment controls, in the form of hay bales, will be present downstream of the outlet structure during this time. These will help dissipate the energy of the flows down the drainage line.

During process verification it has been estimated that an average of 184 kL/day of recycled water will be discharged to the environment during dry weather. The total volume likely to be discharged during this stage is approximately 26 ML.

Discharge Point 3 is located within the Googong Creek catchment, which flows into the Queanbeyan River. As stated in Section 4.1.1 of the WMP, Googong Creek is an ephemeral system, which is regularly dry. The upstream landscape of the creek continues to gently slope within the first 300 metres of the creek, before the creek narrows into a series of sharply winding gullies, which head down to the river.

Stormwater modelling by Brown Consulting indicates that discharging treated recycled water during process verification is likely to marginally increase the concentration of total suspended solids (TSS) within Googong Creek and Queanbeyan River. It is also likely to moderately increase the concentration of total nitrogen (TN) and total phosphorous (TP) within these waterways. A detailed water quality model for Queanbeyan River was not prepared however based on the significantly larger catchment it is expected that the increases in TN and TP pollutants in the river will be minimal further downstream.

Any changes will be for a relatively short period (20 weeks) and still be relatively minor compared with annual pollutant loads that would otherwise flow down Googong Creek towards the Queanbeyan River. As outlined in Table 5, Section A2.1.7 of the Surface Water (and Aquatic Ecology) Monitoring Program (SWAEMP), total nitrogen is already elevated within the Googong Creek and Queanbeyan River system. Similarly, TP and TSS are also elevated in Googong Creek. These parameters will be monitored throughout process verification, as part of the ongoing surface water (and aquatic ecology) monitoring program outlined in Appendix A.

During a year of average rainfall, the Beltana Park catchment could be expected to receive just less than 600 ML/year of runoff. The total estimated discharge volume during process verification will be approximately 26 ML. This represents a relatively small increase of 4.3 per cent when compared with an average year of rainfall runoff. This percentage increase is considered insignificant when compared to the variability of rainfall patterns, and therefore a minimal impact due to scour from the discharge of process verification flows is anticipated.

Discharge rates at the interim recycled water reservoir will be regularly reviewed during operation of the WRP, as outlined in Section C4.

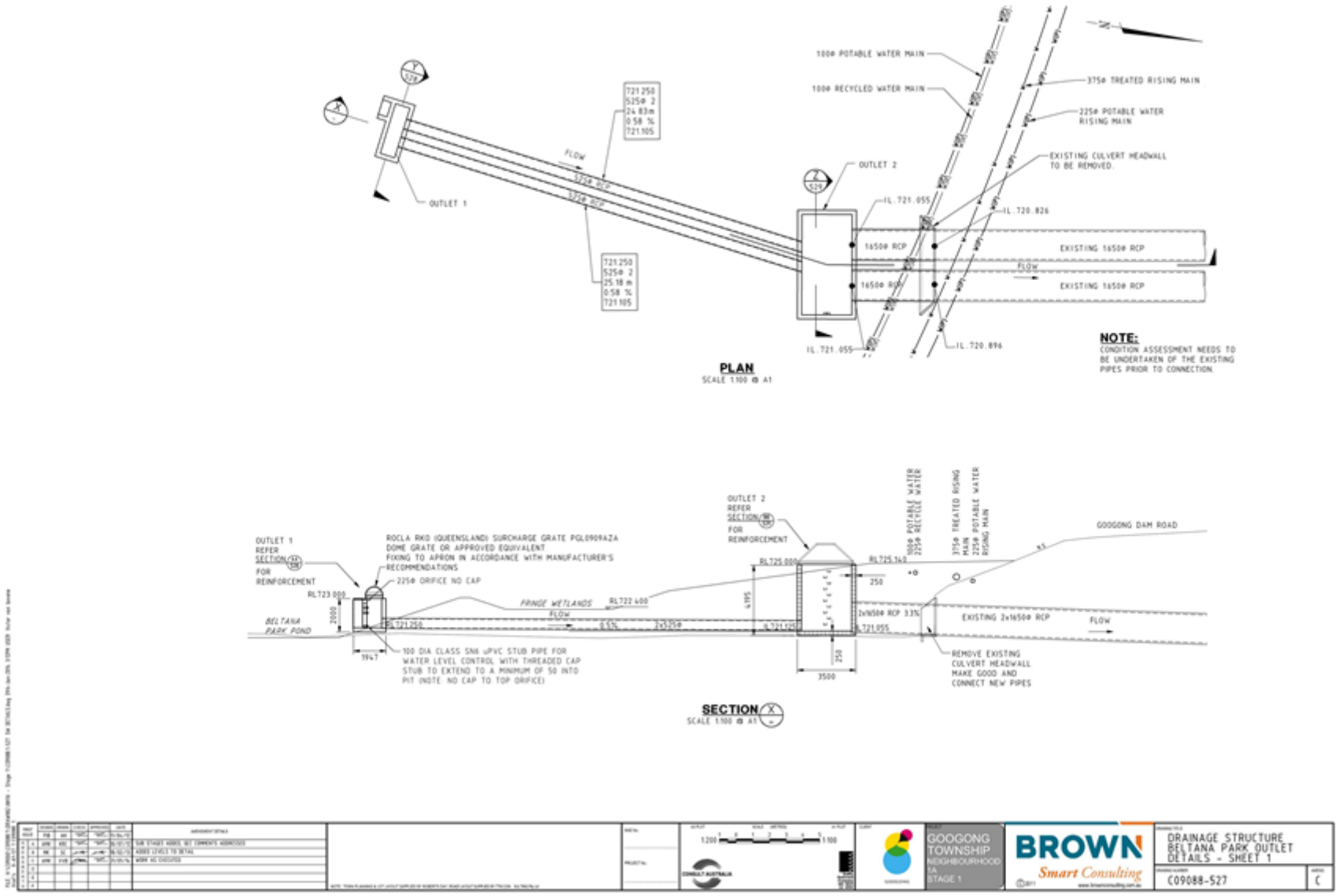


Figure 6 Design drawings - Drainage structure Beltana Park outlet (Sheet 1)

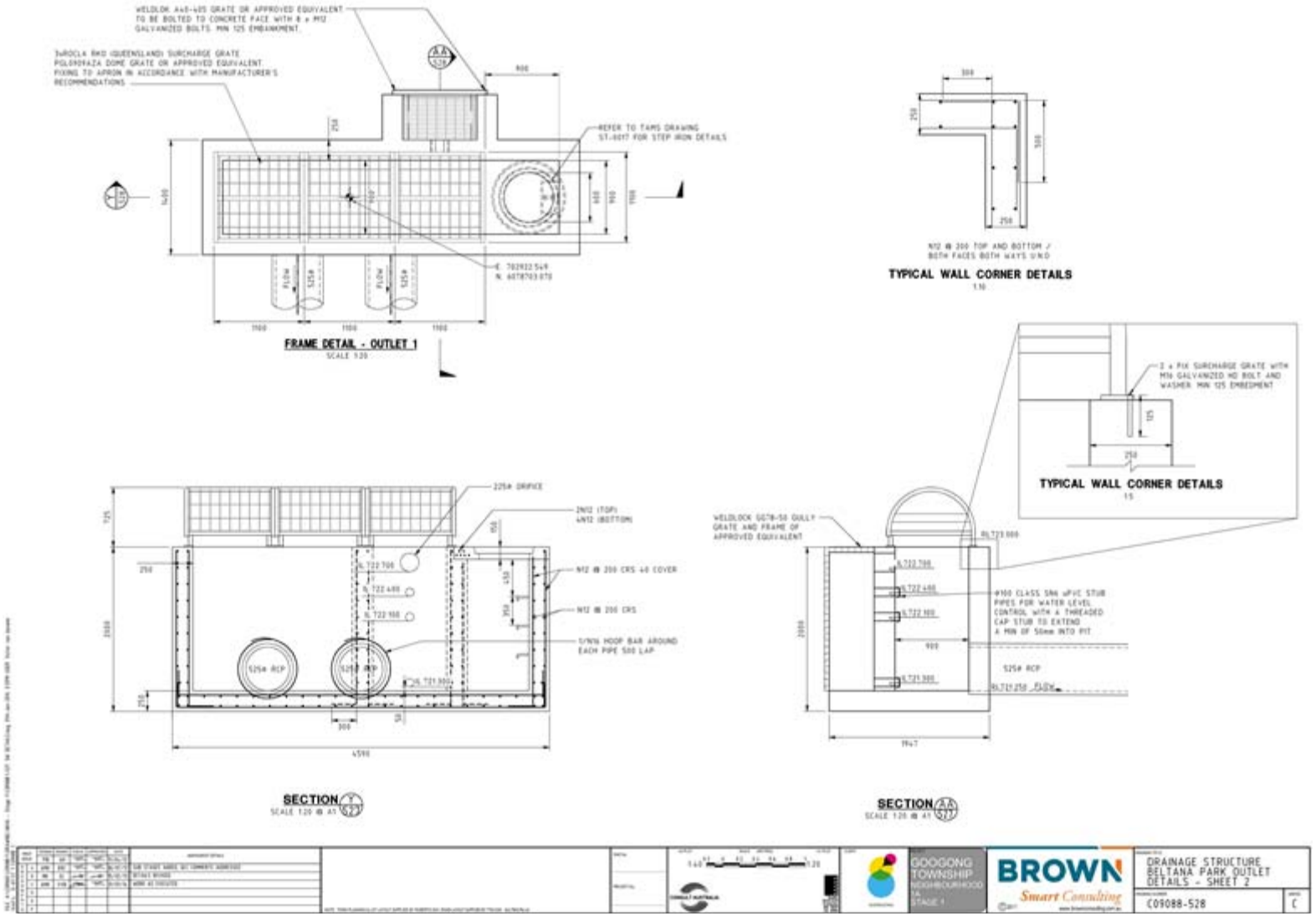


Figure 7 Design drawings - Drainage structure Beltana Park outlet (Sheet 2)

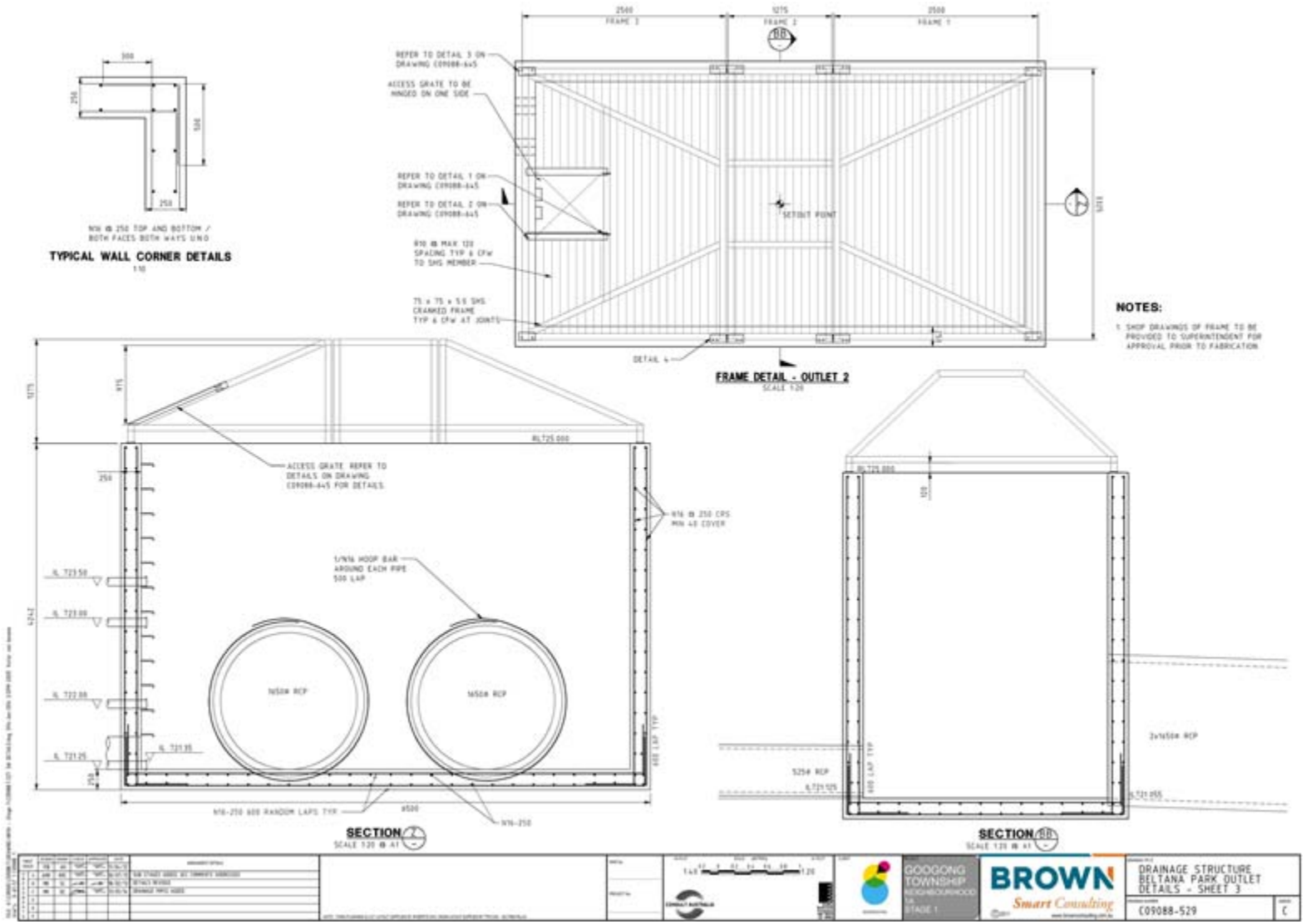


Figure 8 Design drawings - Drainage structure Beltana Park outlet (Sheet 3)

Plate 3 Outlet structure at Beltana Park

Plate 4 Inside of outlet structure, showing 1650 mm diameter reinforced concrete pipes that transfers recycled water to Googong Creek

C3.3.3 Discharge as result of critical control point failure

In the event of failure of a CCP during operation, the recycled water will be diverted to the OSWT and then to an Emergency Discharge Tank (EDT) that has a capacity of 330 kL, which is typically eight hours of available storage (for average dry weather flows for the 4,700 EP capacity of Stage 1 of the IWC Project). If the CCP failure is rectified before the capacity of the EDT is exceeded, then the recycled water will be returned to the inlet works of the WRP for treatment and no discharge will be required.

If the CCP failure has not been rectified by the time the capacity of the EDT is reached then the incoming flows from the WRP will be treated and directed to the OSWT and then pumped along the discharge pipeline to be released to the environment. The recycled water will be dechlorinated at the WRP prior to discharge at Discharge Point 3.

It is difficult to estimate the frequency and volume of recycled water discharged in the event of a failure of one of the CCPs during operation, as such scenarios are dependent on the operation of the WRP. However for most CCP failures, the problem is likely to be able to be rectified within an eight-hour period, which is the typical storage capacity at the WRP. This means that the stored water in the EDT can be re-processed at the WRP and discharge will not occur. The RWQMP considers the CCPs and appropriate mitigation measures to minimise such occurrences.

Similar to excess recycled water discharged at the interim reservoirs, average discharge rates at Discharge Point 3 as a result of CCP failure will be dependent on the population of the township at the time. The discharge rates provided in Figure 9 represent the upper averages up until a total population of 4,700 EP is reached.

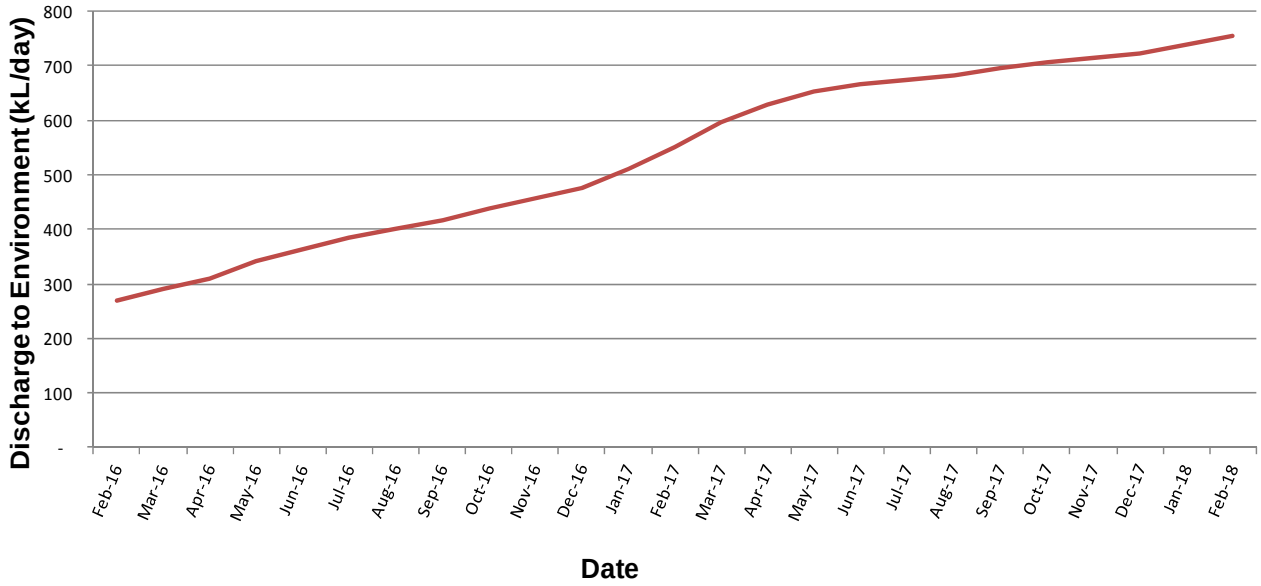


Figure 9 Average recycled water discharge at Discharge Point 3 up until a population of approximately 4,700 EP is reached

Based on modeling by Brown Consulting, the estimated increase in pollutants during a CPP failure are expected to be insignificant when compared to typical annual pollutants from the catchment due to rainfall, and given the rare circumstance where a 72-hour discharge would be required, the impacts to Googong Creek and Queanbeyan River are considered to be insignificant. Potential pollutants, including TN, TP and TSS will continue to be monitored throughout operation of the WRP, as part of the ongoing surface water (and aquatic ecology) monitoring program outlined in Appendix A.

Brown Consulting (2014) also noted that the estimated flows when compared with annual rainfall represents a relatively small increase which would be insignificant when compared to the variability of rainfall patterns. Therefore negligible scour impacts are anticipated.

C3.4 Water quality monitoring

A key concern around the discharge of recycled water is around water quality. CoA D5 prescribes the water quality limits for the recycled water discharged to the environment (refer Table 1).

The WRP has been designed in order that recycled water discharges meet the water quality limits outlined in CoA D5. EPL 20188, issued by the NSW Environment Protection Authority (EPA) to Googong Township Pty Ltd (GTPL) to undertake construction and testing of the WRP permits the discharge of recycled water at the Beltana Park discharge point during process verification. The EPL includes these water quality limits under condition L2.4, while requirements to monitor these pollutants of concern during discharge are provided under condition M2.

The water quality limits will also be a requirement of the operational EPL for the WRP, to be obtained by Queanbeyan City Council (QCC). In addition to the monitoring of the recycled water discharged at Beltana Park, the recycled water being supplied to the interim reservoir will be monitored for its quality at the WRP, prior to pumping. Monitoring will include:

- Online parameters such as pH, conductivity (or TDS), turbidity (inferring TSS) and CCPs for disinfection processes (inferring faecal coliforms).
- Routine weekly testing of other parameters (BOD, TSS, TN, TP, ammonia, oil & grease).

Water monitoring of receiving waterways is outlined in more detail in the SWAEMP (see WMP Appendix A). The results of the SWAEMP will be considered as part of the review of discharge rates (refer Section C4 of this Protocol).

SMEC (2015) determined that:

- release of recycled water at the Beltana Park discharge point is not expected to have an impact on groundwater quality as the outlet is at the top of the incised Googong Creek and a groundwater discharge area is located below the discharge point.
- releases of recycled water at the interim reservoirs are not considered to pose an issue to the groundwater system as the connection between Beltana Pond and the groundwater table is limited.

C4 Review procedures

C4.1 Overview

The operator (and their contractors) will prepare reports summarising monitoring results on an annual basis.

The operator will review the Protocol and discharge rates, taking into consideration results from the following ongoing monitoring:

- Surface water and aquatic ecology.
- Groundwater.
- Telemetry data for WRP and other IWC infrastructure.

Should monitoring data identify impacts to the environment, options to alter discharge volumes to reduce water impacts or change other operational/infrastructure aspects while maintaining operational integrity will be considered.

C4.2 Review process

Once the WRP is operational, the discharge rates outlined in this Protocol will be reviewed on an annual basis.

This Protocol will also be reviewed on an annual basis to ensure that the details and procedures described within provide an effective method for the review of discharge rates.

For example, the operator may require additional monitoring and reporting for certain parameters should the effectiveness of an operational change need to be ascertained before the next formal review process. Such changes would need to be documented in this Protocol and the WMP, where applicable.

Review procedures for the Protocol that are to be undertaken by the operator are outlined in Table 3. Implementation of actions outlined in the procedure will be the responsibility of the operator.

Table 3 Review procedures for the recycled water quality protocol

No	Action
1a	Undertake monitoring as per the programs detailed in the WMP relating to surface water, aquatic ecology, groundwater and soils.
1b	Prepare an annual report that summarises data and identifies exceedances of water criteria or other areas for concern.
2	Obtain all relevant telemetry data for the WRP and other IWC infrastructure.
3	Consider results of monitoring, specialist recommendations and whether any operational changes are required.
4	If actions to address impacts are required – consider options to alter operations and discharge flows along with an assessment of the expected changes to impacts. Discuss with monitoring contractors where necessary.
5	Select preferred option and arrange for consultation with relevant agencies on updated management plans.
6	Implement preferred option.
7	Review and update the Protocol.

C5 References

Brown Consulting (2014). *Googong IWC - Discharge of treated effluent during Process Verification and Critical Control Point failure*. Letter report prepared for GTPL, dated 11 February 2014.

SMEC (2015). *Googong Hydrogeological Services – Annual Groundwater Monitoring Report.* Prepared for GTPL.