Appendix Q

Concept design peer review

Googong Township water cycle project

Environmental Assesment

November 2010

BLACK & VEATCH
Building a world of difference.

Mr Craig Harris
Assistant Project Director
Googong Integrated Water Cycle Management Strategy

B&V Project 166660

13 January 2010

Canberra Investment Corporation Limited
Level 3, 64 Allara Street
Canberra, ACT 2601

Subject: Technical Review of Googong Integrated Water Cycle Management Strategy: Water & Wastewater Concept Design

Dear Mr Harris:

I have technically reviewed a number of documents related to the proposed Googong New Town development to be located south of Queanbeyan in NSW specifically related to the Integrated Water Cycle Management Strategy.

My queries and comments are presented in a report (Technical Review of Googong Integrated Water Cycle Management Strategy: Water & Wastewater Concept Design), broken down in separable portions, viz:

- Separable Portion 1 (SP1): Process and Treatment Details;
- Separable Portion 2 (SP2): Potable Water;
- Separable Portion 3 (SP3): Sewage Pump Stations and Rising Mains; and
- Separable Portion 4 (SP4): Recycled Water.

Whilst I had a number of technical queries and comments as well as suggestions for future consideration, I found the work that has been done technically sound. There are areas that could use revision to strengthen the conclusions drawn and as well as clarify the selections made.

Regards,

BLACK & VEATCH

Dr Brace H Boyden
Senior Technical & Process Specialist

cc: Alan Potter

TECHNICAL REVIEW OF THE GOOGONG INTEGRATED WATER CYCLE MANAGEMENT STRATEGY: WATER & WASTEWATER CONCEPT DESIGN

Study prepared by Montgomery Watson Harza (MWH)
for Canberra Investment Corporation (CIC)

Technical Review by:
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North Sydney, NSW 2060

FINAL
13 January 2010

TECHNICAL REVIEW OF THE GOOGONG INTEGRATED WATER CYCLE MANAGEMENT STRATEGY: WATER & WASTEWATER CONCEPT DESIGN

Executive Summary

A technical review of the Googong Integrated Water Cycle Management Strategy, Water and Wastewater Concept Design report was conducted along with related ancillary documents. The Concept Design for a new proposed residential development to be located south of Queanbeyan in NSW was put together by the consultants Montgomery Watson Harza (MWH) for the Canberra Investment Corporation Limited (CIC).

The technical review was carried out in four Separable Portions (SP), including SP1 (Process & Treatment Details), SP2 (Potable Water & Bulk Distribution), SP3 (Sewage Pump Stations and Rising Mains) and SP4 (Recycled Water & Bulk Distribution). A number of queries were generated, which were put to MWH and discussed at two meetings on 08 Dec 09 and 17 Dec 09. All writen responses received by the technical reviewer were included herein.

SP1: Process & Treatment Details

WRP Estimated Loads

The estimated loads to the Water Reclamation Plant (WRP) were based on typical per capita loadings, with per capita sewage production estimated at 180 L/EP/d. Future flows to the plant were projected in accordance with population ingress into the development. This methodology was a good "first cut" but will need some refinement in the detailed design. The sewage flows likely will be less than estimated.

WRP Discharge Criteria

The Concept Design report employed the superseded May 1993 *NSW Guidelines for Urban & Residential Re-use of Reclaimed Water* for determining "recycled water" quality (i.e. what quality the WRP has to achieve) in lieu of the latest guidelines, the 2006 *Australian Guidelines for Water Recycling*. The 2006 guidelines are a non-prescriptive, risk based approach that was recommended in the report to be adopted / implemented prior to the detailed design. It is recommended by the technical reviewer that the latest guidelines be used and that the risk exercise should be done at the Concept Design level, as part of this study, rather than base the whole concept design, including the process selection, on superseded guidelines.

Selection of Preferred Process

It is the opinion of the reviewer that the ultimate process selection in the Concept Design was apparently driven by achieving zero nitrate in the effluent via a Biowin simulation and rather isolated from practicality as evidenced by the estimated effluent quality of zero nitrate.

The removal of phosphorus in the Concept Design preferred process relies on the addition of the salt ferric sulphate, which adds significantly to the TDS of the WRP effluent or recycled water. Appendix 6 (Salt Balance) of the Concept Design report indicates that *"The results of the mass balance show that land application* [of TDS] *is below 700 mg/L on an average basis throughout the year…This has been taken as a daily time series from the volumes generated within this report over 41 years…The* [TDS] *discharge from the treatment plant is high at over 1000 mg/L".*

A significant reduction in TDS in the WRP effluent could be achieved by altering the preferred process (from that nominated) to one that reduces the amount of ferric sulphate and alkalinity addition used for the treatment of sewage. This can be illustrated by considering that proposed WRP effluent, with an estimated TDS of 1059 mg/L, must be diluted with potable water/rain water with a TDS of 100 mg/L in the proportion of 723 L of potable/rain water for every 1,000 L of WRP effluent to achieve an irrigation quality water quality with a TDS of 655 mg/L.

Reducing the TDS in the WRP effluent by only 100 mg/L (say to 959 mg/L, by 100 kg salt/ML, by using less ferric sulphate or alkalinity at the WRP) needs 548 L of potable/rain water (180 L less/ML WRP effluent) to achieve an irrigation water quality of 655 mg/L, and so forth.

A preferred process that involves full biological nutrient removal (BNR) for nitrogen and phosphorus could achieve a significant reduction in the TDS of the WRP effluent. Using the estimated influent quality to the WRP in the Concept Design, the COD / P ratio was sufficient to suggest that significant P removal could be achieved with minimal use of iron salts. A quick Biowin 3.1 modelling of a full BNR process with an MBR confirmed these initial thoughts with P levels being reduced well below 1 mg/L without iron but with methanol ahead of the aerobic systems to help with nitrate reduction. A final pH of about 6.9 was estimated without alkalinity addition.

Alkalinity addition may in the end be necessary for the ultimate BNR treatment process as will a metal dosing system (for achieving very low P levels), but a proper BNR process would greatly reduce the TDS of the effluent, reduce the sludge quantity and would make the P in the biosolids more bio-available for plant uptake.

In addition to using a full BNR process, another consideration should be the potential staged use of modular treatment plants such as modular RBC units (rotating biological contactors), which can be configured anaerobic, anoxic or aerobic and easily enclosed for odour control (with likely a smaller odour control system than what is currently proposed). They have a low operating cost and can be added in modules to suit the needs of the development. As a Stage 1 process issue it is important to have process redundancy from day 1, such that not all is dependent on a sole process train as has been proposed in the Concept Design.

Treatment of Solids

The Concept Design proposes running a 20 day solids retention time (SRT) in the MBR and sending the waste activated solids (WAS) to an aerobic digester for additional treatment before dewatering and the solids being recycled by an external contractor. It is the opinion of the reviewer that the aerobic digester can be omitted from the process with a 20 day SRT. The MBR solids are sufficiently stable for off site management.

Odour Control

It is recognised that the WRP is within 200 m of the housing development and that control of odour is paramount. However, the proposed design of the odour control system seems overly conservative.

The use of ferric sulphate for odour control introduces more sulphate (and potential malodour downstream) and would seem counter productive in the long run. If ferric chloride is to be avoided as suggested by the soil scientists (because of the recycled water system), the use of alum should be explored as a substitute for ferric sulphate.

WRP Layout

Use of common walls needs further exploration for process tanks where possible to reduce civil costs. Staging of some civil works as suggested in the Concept Design such as the blower rooms may be less expensive at first but will be more expensive in the long term.

The overall layout of the WRP can be improved such that biological treatment tanks are in an area not so distant from the inlet works. The odour control facility can be located anywhere as long as there is truck access and the pipework is minimised. The bioreactors could be put together with three common walls. The office needs to remain near the entrance. The space allocated for the Flow Control Facility is in a site low spot, which is appropriate, but can be moved for the sake of a more efficient layout.

Staging

The staging of various aspects of the WRP have been determined from a viewpoint of saving capital costs only. The use of a modular biological treatment approach could simplify the staging considerably, thus reducing initial cost. From an operations and risk perspective, having an initial single biological process train should be avoided.

SP2: Potable Water & Bulk Distribution

Potable Water Quality

The quality of potable water from either the Googong WTP and [particularly] the Stromlo WTP was stated as "*could be mildly corrosive*" to metal pipes [such as copper] as evidenced by a Langelier Saturation Index (LSI) of around -1.23 for the Googong WTP. However, if one uses another indice such as Ryznar Stability Index (RSI = pHs – LSI), one can back out of Table 57 (Appendix 3) an RSI (max) = 9.43-(-1.23) = 10.7, which is indicative of **highly corrosive** waters. Regardless, the selection of concrete lining (although monitoring for excessive calcium may be necessary) or plastic pipes is appropriate but copper pipes for individual houses could conceivably suffer significant corrosion.

It is recommended that this issue be taken up directly with ACTEW or perhaps there is existing data [from ACTEW AGL] that these waters will not appreciably corrode copper pipes.

It should be noted that alkalinity can be increased in water with minimum pH increase with $NaHCO_3$ (sodium bicarbonate) or Na_2CO_3 (soda ash), although these two chemicals will increase the sodicity of the water. Adding alkalinity in the raw water will assist with the sustainability of householders copper pipes as well as improve conditions at the WRP for the removal of nitrogen.

Location of Water and Recycled Water Reservoirs

The Concept Design proposes co-locating the water and recycled reservoirs some 5 km from the main development to achieve the 20 m of static head. This arrangement involves a lot of pumping, particularly for the recycled water (RW) system. It is recommended that consideration be given to locating at least the RW reservoir(s) closer to the WRP and the town with pumping (coupled with possibly elevation) to achieve the desired minimum of 20 m of static head.

Potable Water Delivery Main

The nominated pipe size in a 5 km long pipe will yield a velocity of 0.49 m/s in Stage 1 (157 LPS) and 0.98 m/s for the ultimate at 278 LPS, lower than the minimum recommended by WSA 03. Moreover, the chlorine residual for water entering the BWPS is stated to be low before the 5 km pipeline.

In the early stages of the development, the velocity in the water main will be almost nil, particularly during those periods outside the diurnal cycle of usage. Whilst the use of concrete lining is recognised because of the water quality, there is some danger that the water could become quite high in calcium. These issues should be considered further in the detailed design.

A rechlorination station should also be considered at the BWPS to prevent the possible buildup of slime and a reduction of water quality. This will of course increase the TDS of the water but this needs to be weighed against risk reduction.

Dual Power Supply

No dual power supply is proposed for the reservoir site but rather an emergency generator is proposed to be sourced to power the pumps in the event of a power outage. The generator will be connected into the MCC via an external connection. Sufficient reserve storage of an absolute minimum of 2 hours of maximum hour peak day demand is to be maintained in the reservoirs.

Note that every power outage will have the operators scrambling to get a generator. It is recommended that either a dual power supply be provided or that a resident backup generator be provided.

Remote Sites

In Section 3.8.2 it is not proposed that the potable and recycled water pumps be housed in a building. It is further stated that it is possible that a small shed or similar might be required for noise or security reasons.

It is the opinion of the technical reviewer that all pumps be housed in a simple building, (e.g. besser blocks and iron roof with sound attenuation as needed as a minimum) to moderate noise from that higher elevation to the surrounding community and particularly for security reasons (juveniles will likely invade this remote site).

SP3: Sewage Pump Stations (SPS) and Rising Mains

Pace of Growth in Development

It is noted that until a 550 equivalent population (EP) is reached in the development (99 kL sewage/d), SPS1 or SPS2 will not operate but rather sewage will be tankered away to Queanbeyan or Fyshwick STPs.

The current preferred design for the WRP requires this initial management approach for the sewage. It should be noted, however, that a modular treatment plant would more likely to be able to accommodate the lower initial sewage flows and could be to (i.e. its capacity increased) as is necessary.

Emergency Storage in SPS1 and SPS2

It is recommended that the use of mixers be considered for use in the emergency storage areas, particularly during the early phases of development. There will be additional grit because of the new construction and the mixing could help minimise septicity related issues with the sewage.

The design emergency storage areas should be such that tankers can use the existing pumps to empty the volumes into their trucks through camlock couplings.

SP4: Recycled Water & Bulk Distribution

Water Modelling

It is recognised that significant work and optimisation went into the water modelling to predict water recycling as a function of various scenarios and the numbers appear reasonable (I cannot comment further without getting into the models themselves). However, as a general comment for consideration, these models do not produce absolute numbers; particularly as multiple models were used, with the output of one model being used for the input of another. The generated numbers likely have at least a 10% error (or more). The reader is left to make up their own mind as to the validity of any particular comparison.

Whilst most people will accept the numbers as they are, there will be a portion of people who will recognise the lack of a proper error analysis such that a comparison between 67% reuse [with rainwater tanks] as opposed to 75% reuse [without rain water tanks] for NH1A means little if the error is at least 10%.

The technical reviewer recommends that proper error analysis be done before the generated numbers are used for decision making.

Contribution of Proposed Development to Environmental Water Quality

The outputs from a series of "MUSIC" models was analysed to determine the change in pollutant loads to the Quenbeyan River as a result of the development (again no error analysis, although inadequacy of the data set is acknowledged). Conclusions were drawn on the difference in SS, TN, and TP to before and after development that the parameters do not meet ANZECC guidelines for TN and it meets the ACT Water Quality but exceeds ANZECC guidelines for TP.

It should be noted that whilst TP and TN are definitely important as stress triggers for aquatic ecosystems, it should not be forgotten that the proposed development will also contribute other chemicals to the river aside from the nutrient load, which Section 4 Googong New Town Concept Design, Site Water Balance Assessment (Dec 09) is silent on.

Googong Land Capability Assessment Report, dated 13 Dec 2009

Section 1.1 stated that "*Unlike conventional potable water supplies, recycled water contains* ***significant*** *concentrations of nitrogen and phosphorus and other substances such as chlorine, sodium and chloride that could be potentially harmful to garden plants, ….*".

The use of the word "*significant*" is misleading. With what were these levels compared? The WRP in this case will be producing an effluent with ΣN from about 3 to 5 mg/L and ΣP of about 0.1 mg/L. These are not "significant" concentrations for these nutrients in the opinion of the reviewer. Section 1.1 needs to be rewritten.

Compliance with the Director General's Requirements (DGRs) for Part 3A Concept Plan and Stage 1 Project Application

Waterway and land effluent discharge requirements identified in the Environmental Assessment Report (EAR), currently in draft form

In the Director Generals Requirements (DGRs), the key issues under "Water Quality and Hydrology" were broken down and individually assessed as to whether the Preliminary Environmental Assessment Report (not the Environmental Assessment Report) properly addressed them.

Most topics were considered "Adequately Covered" with the below exceptions:

- *Operation details of the disinfection systems and the quality of the recycled water must be provided*: The water recycling plant will be designed to meet the requirements of the Australian Guidelines for Water Recycling (NRMMC, 2008) and its proposed effluent discharge licencing conditions and will include unit processes for disinfection.

  Operational details of the proposed disinfection systems were not specifically given for the UV irradiation and chlorine systems. Quality of the recycled water given.

  By the strict letter of the DG requirements, this criterion was **Partially Covered**.

- *Wet weather effluent storage requirements, the location of infrastructure within riparian areas and details of any dry and wet weather sewage overflows, including the predicted frequency of overflows and contingency measures to minimise infiltration:* A reduced infiltration sewerage system (RISS) is proposed, a stormwater management strategy will be developed to mitigate the potential impacts of the development to: (i) reduce 1-in-3 month stormwater peak runoff flow to pre-development levels with release of captured flow over a period of 1–3 days, (ii) reduce five year ARI and 100 year ARI stormwater peak run off flows to predevelopment levels, (iii) ensure that residential land is flood free for the 100 year ARI storm event and provide safe, evacuation routes, a full risk assessment will identify hazards associated with operations such as accidental spills and sewerage overflows, the NH1A development to have four large detention basins to control the flows from the development site (two basins in NH1A to be located within open space areas), and riparian buffer zones will be incorporated into the design of water cycle management for NH1A to protect water bodies.

Again by the strict wording the "*predicted frequency of overflows*" was not directly addressed so this criterion was **Partially Covered.**

Odour and noise requirements (also identified in the draft EAR)

In the Director Generals Requirements (DGRs), the key issues under "Air Quality" and "Noise and Vibration" were broken down and individually assessed as to whether the Preliminary Environmental Assessment Report (not the Environmental Assessment Report) properly addressed them.

Most topics were considered "Adequately Covered" with the below exceptions:

- Assessment under nominated Guidelines ***Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*** *(DEC, 2005),* ***Assessment and Management of Odour from Stationary Sources in NSW*** *(DEC, 2001) and* ***Technical Notes: Draft Policy: Assessment and Management of Odour from Stationary Sources in NSW*** *(DEC, 2001):* Air quality modelling will be carried out to assess proposed emissions for the water cycle infrastructure (odours from infrastructure), along with mitigation and management recommendations for infrastructure design, but I did not see these guidelines specifically mentioned even in the Reference list.

  In the technical reviewer's opinion, this criterion was **Partially Covered.**

- Assessment under nominated Guidelines ***Environmental Noise Control Manual*** *(EPA, 1994),* ***Environmental Criteria for Road Traffic Noise*** *(EPA, 1999),* ***Industrial Noise Policy*** *(EPA, 2000) and* ***Assessing Vibration: A Technical Guideline*** *(DECC, 2006):* A construction and operational noise and vibration assessment would be undertaken for the project that would specifically include modelling and predictions of noise levels but I did not see these guidelines particularly mentioned even in the Reference list.

  In the technical reviewer's opinion, this criterion was **Partially Covered.**

Recycled water production – volume and quantity (identified in the draft EAR, Water Balance Report and Land Capability Report)

It is stated in the Preliminary Environmental Assessment Report that the "*water reuse and savings that will target reductions in potable water use of 60–70 per cent compared to traditional developments*" and that a number of scenarios were considered for complete integration of the water cycle management to achieve at least a 50 per cent reduction in potable water demand and target up to 70 per cent reduction via the preferred option, which will (i) mandate low flow showerheads, (ii) mandate flow controls on taps, (iii) landscaping controls, (iv) mandate water efficient clothes washers, (v) use rainwater tanks for all residential development, (vi) use rainwater tanks for all non-residential development, (vii) use recycled water to residential development, (viii) use recycled water to non-residential development and (ix) employ water sensitive urban design.

The Googong New Town Concept Design, Site Water Balance Assessment (Dec 09) report states that at full development, the recycled water system will use between 71 and 73% of the wastewater generated in the new town for the case where rainwater tanks are adopted and that the recycled water system will use approximately 62 to 65% of the wastewater generated in the new town. Eliminating the use of rainwater tanks as a substitute for some water uses in preference to the use of recycled water will increase the volume of wastewater recycled in the new town to 80% at the same time as decreasing water demand reductions to approximately 55%.

The two reports are consistent in the numbers they present and the methodologies used to extract the numbers (i.e. the use of the various models) were considered reasonable. The only point that the reviewer found problematic was the lack of an error analysis. The value of these numbers is diminished by not giving the reader an idea of the error bounds.

If the error analysis were introduced, it may be that rainwater tanks could be easily dispensed with as they may not be justified.

TECHNICAL REVIEW OF THE GOOGONG INTEGRATED WATER CYCLE MANAGEMENT STRATEGY: WATER & WASTEWATER CONCEPT DESIGN

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TECHNICAL REVIEW OF THE GOOGONG INTEGRATED WATER CYCLE MANAGEMENT STRATEGY: WATER & WASTEWATER CONCEPT DESIGN

Table of Contents

Summary of Possible Cost Saving Measures

1. As a general comment to CIC, alternate designs to the proposed Concept Design for the treatment of sewage could lessen the overall project cost, improve the plant operability, improve the sustainable reuse of by-products and improve project staging.

   One thought along these lines (and there are others) was the staged use of modular BNR treatment plants such as modular RBC units (rotating biological contactors), which can be configured anaerobic, anoxic or aerobic and easily enclosed for odour control (with likely a smaller odour control system than what is proposed). They have a low operating cost and can be added in modules to suit the needs of the development. As a Stage 1 process issue it is important to have process redundancy from day 1, such that not all is dependent on a sole process train as has been proposed in the Concept Design.

2. The use of a full BNR process for both nitrogen and phosphorus would reduce chemical usage, decrease the TDS of the RW and reduce the sludge volume.

3. The aerobic digester can be eliminated. The biological reactor already produces a twenty day SRT. The WAS should be directly dewatered for subsequent off-site management.

4. The design of the odour control system seems overly conservative and likely will be optimised during the tender design/detailed design. A modular sewage treatment plant could reduce the cost of this component.

5. Moving the RW water storage tanks closer to the development with pumped instead head of static head will save capital costs.

6. Greater use of pressurised sewerage (in certain areas particularly) may have price advantages over traditional gravity.

7. The addition of alkalinity to the potable water is apparently needed (to be confirmed) to make the water less aggressive to copper pipes. Alkalinity addition by ACTEW AGL may be possible at their water treatment sites. This would potentially reduce the addition of alkalinity at the WRP for the recycled water system.

Background

Canberra Investment Corporation (CIC) is proposing a new residential community development at Googong, located south of Queanbeyan in NSW (the 'Googong Development'). The community will contain approximately 6,000 residences, supported by retail, commercial and community services. Throughout the development, CIC intends to employ a number of innovative water cycle management measures. These measures are intended to:

- Reduce the volume of potable water use through a series of water conservation, recycling and rainwater use initiatives;
- Improve the quality of runoff into the adjacent Queanbeyan River through the retention of stormwater on site through rainwater use and a series of Water Sensitive Urban Design (WSUD) measures; and
- Minimise the discharge of wastewater to the environment through the use of recycled water for toilet flushing and irrigation.

In addition, CIC intends to create a visually green and leafy town with landscaping and planting established in advance of the subdivision.

An Integrated Water Cycle Management Strategy (IWCMS) was prepared by Montgomery Watson Harza (MWH).

The Integrated Water Cycle included all elements associated with the supply of potable water, the collection of and treatment of sewage flows and the transfer of treated flows into the recycled water system for re-use.

The IWCMS is intended to reduce potable water consumption per capita by more than 60% over ACT 2003 levels, and to recycle up to 80% of the potable water consumed. Recycled water will be provided to residents of the development for use in irrigation, washing machines and to flush toilets. Recycled water will also be used to irrigate open spaces. Any excess recycled water would be released into the river.

Due to the sensitive nature of the receiving environment and the requirement for recycled water as a non-potable water supply, the new plant is required to achieve high effluent quality standards. In particular, for total nitrogen (TN) and total phosphorus (TP) for which values of 5 mg/L and 0.2 mg/L, respectively, have been specified.

To achieve these standards, an enhanced biological nutrient removal (BNR) process is required

MBR package plant technology was ruled out as an appropriate solution as it is not designed to achieve the required Total N and P removal. To do so, would require significant modifications, making the 'package plant' element obsolete.

The recommended secondary treatment option is a BNR process employing MBR technology. This was chosen using the following multi-criteria analysis parameters: Land take, Technical, Approvals, Costs (both capital and operating), Program and the vision of the development.

The following aspects of the draft CDR were requested to be the focus of this review:

- Biological water reclamation system with specific emphasis on:
  1. Assumptions used for loads and effluent requirements;
  2. Process selection and chemical P removal;
  3. Assumptions used in process size selection;
  4. Additional carbon requirements;
  5. Additional alkalinity addition;
  6. Proposed odour system;
  7. Salt addition for P removal;
  8. Layout and optimisation of phase 1;
  9. Staging of the system; and
  10. Potential value engineering initiatives, which may reduce whole-of-life costs.
- Potable water system and bulk distribution.
- Sewage pumping stations and rising mains.
- Recycled water system and bulk distribution.

The technical review was also to consider whether the proposed design *conforms with the Director General's Requirements (DGRs) for Part 3A Concept Plan and Stage 1 Project Application*, in particular compliance with:

- Waterway and land effluent discharge requirements identified in the Environmental Assessment Report (EAR), currently in draft form;
- Odour and noise requirements (also identified in the draft EAR);
- Recycled water production – volume and quantity (identified in the draft EAR, Water Balance Report and Land Capability Report)

In addition, the technical reviewer was to *review and comment on the projected potable water savings and recycled water use* (referring to the Water Balance Report and Land Capability Report).

This report summarises the technical review of the IWCMS by Black & Veatch. The Review consisted of four separable portions, plus sections as mentioned above:

- **Separable Portion 1 (SP1)**: Process and Treatment Details;
- **Separable Portion 2 (SP2)**: Potable Water;
- **Separable Portion 3 (SP3)**: Sewage Pump Stations and Rising Mains;
- **Separable Portion 4 (SP4)**: Recycled Water; and
- **Confirmation to DGR Requirements,** specifically (i) Waterway and land effluent discharge requirements, (ii) Odour and noise requirements and (iii) Recycled water production – volume and quantity.

Introduction

This report was written as a series of queries put forth to MWH, the consultants in charge of the Water and Wastewater Concept Design, on four Separable Portions: SP1: Process & Treatment Details; SP2: Potable Water & Bulk Distribution; SP3: Sewage Pump Stations and Rising Mains; and SP4: Recycled Water & Bulk Distribution).

The answers received by the date of the report writing were also included.

The reports reviewed included:

1) Water & Wastewater Concept Design (30 Oct 2009, Revision 0)

2) Appendix 1, Drawings

3) Appendix 2, Key Correspondence

4) Appendix 3, Water Quality Analysis

5) Appendix 4, Commissioning

6) Appendix 5, Design Sewage Flow Calculation

7) Appendix 6, Salt Balance

8) Appendix 7, Standards

9) Appendix 8, WRT Odour Control Options

10) Site Water Balance Assessment (Dec 2009)

11) Site Water Balance Assessment (Sept 2009)

12) Options Report

13) Preliminary Environmental Assessment Report, December 2008

14) Recycled Water Irrigation Land Capability Assessment (July 2009)

15) Recycled Water Irrigation Land Capability Assessment (Sept 2009)

16) Recycled Water Irrigation Land Capability Assessment (13 Dec 09)

In addition two meetings were attended with MWH, CIC and Evans & Peck on

1) 08 Dec 09 at office of Evans & Peck in Chateswood to address queries regarding SP1 and
2) 17 Dec 09 at MWH office in the city to address queries regarding SP2, SP3, and SP4.

SP1: Process & Treatment Details

General

1. Can you briefly explain what ESD principles were followed / applied for the design of the process for the WRP?
2. There is inconsistency in the writeup in Section 5.6 between the use of "zone" and "tank". Zone usually refers to a designated region within a tank.

   MWH Response: Replaced zone with tank.
3. The glossary of acronyms is incomplete.

   MWH Response: To be completed in the final report.
4. "nr" is not an abbreviation for number; "no" is usually used. (minor comment)
5. Peer review should be appended to the CDR.

   MWH Response: Agreed.

Assumptions used for loads and effluent requirements

6. The influent loads in Table 6 (see similar below) are written to be "approximated" with typical domestic EP or per capita sewage loads. Whilst I don't necessarily disagree with the numbers, no reference was given as to where they originated. It would have made more sense to use numbers from the Canberra area (ACTEW) and/or a similar development [in a similar location] in Australia already in existence. Rouse Hill comes readily to mind as one development with some history of sewage production, recycle water use, and EP nutrient production.

	Per capita (L/d/EP)	COD (g/d/EP)	BOD (g/d/EP)	SS (g/d/EP)	NH4 (g/d/EP)	TKN (g/d/EP)	P (g/d/EP)
	180	120	60	65	10	13	2.5
Year		1	5	10	15	20	25
Population		912	4562	9125	13687	18250	18849
ADWF (kL/d) or (kg/d)		164	821	1643	2464	3285	3393
COD (mg/L) or (kg/d)	667	109	547	1095	1642	2190	2262
BOD (mg/L) or (kg/d)	333	55	274	548	821	1095	1131
COD/BOD	2.0						
SS (mg/L) or (kg/d)	361	59	297	593	890	1186	1225
NH4-N (mg/L) or (kg/d)	56	9	46	91	137	183	188
TKN (mg/L) or (kg/d)	72	12	59	119	178	237	245
P (mg/L) or (kg/d)	13.9	2	11	23	34	46	47

   MWH Response: References were added below the Table (Table 6).

7. It is noted from the Concept Report (paragraph above Table 29) that the superseded May 1993 *NSW Guidelines for Urban & Residential Re-use of Reclaimed Water* were used for determining "recycled water" quality in lieu of the

latest guidelines, the 2006 *Australian Guidelines for Water Recycling*. The 2006 guidelines are a non-prescriptive, risk based approach that was recommended to be adopted / implemented prior to the detailed design.

Table 29 does not indicate any proposed Consent Conditions for recycled water (aside from *Faecal coliforms* to be < 1 CFU/100 mL) but only for the quality for discharge to the environment.

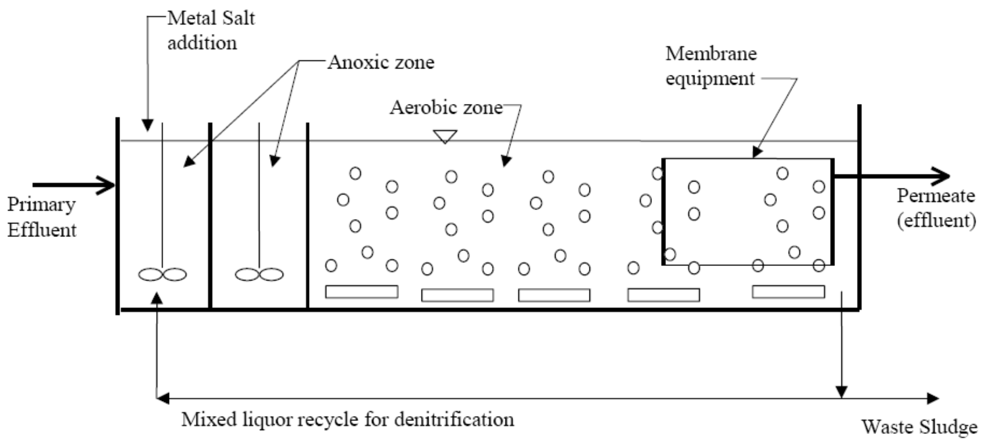
It would seem more efficacious if the risk exercise would have been done at the Concept Design level, as part of this study, rather than base the whole concept design, including the process selection, on superseded guidelines.

MWH Response: Risk Assessment will be done - organisation in process.

Process selection and chemical P removal

8. A MLE process has in the past been selected when chemical P removal is proposed with an MBR. There are several examples around the world and Australia currently in operation. Victor Harbour MBR WWTP is one example that comes to mind put in by Tenix. This MBR is shown below and was designed for a 3.6 MLD ADWF with an ultimate peak wet weather flow of 11.2 MLD. Effluent in this case is reused for local irrigation and to provide environmental flows.

Often the submerged membranes are included at the end of the tank (as shown above and below), rather than a separate membrane tank, which lowers both capital and operating costs (no extra pumps). In other cases pressure membranes are external to the bioreactor.



What is the rationale for:

a) Selection of the preferred process over the MLE (perhaps the MLE was modelled and could not meet the nitrogen limits?) and

b) Use of a separate membrane tanks, which requires pumping into?

Note: The ultimate process selection in the Concept Design was apparently driven by achieving zero nitrate in the effluent and rather isolated from practicality as evidenced by the estimated effluent quality:

Average Effluent Nutrient Concentrations		
COD	48	mg/L
BOD	5	mg/L
Ammonia	0.3	mg/L
TKN	3.0	mg/L
Nitrate	0.00	mg/L
Total Nitrogen	3.3	mg/L
NFR	2	mg/L

MWH Response: Refer to the Options report. Membranes have been put outside the tank as no decision has been made on the type of membranes and to decrease the opportunity for ammonia breakthrough (conservative approach on the basis that no membranes have been selected but we know some units require a separate tank. This will be re-examined by detailed designers.

BV Response: The Options Report was not given as part of the original review material. A copy was later forwarded to the reviewer.

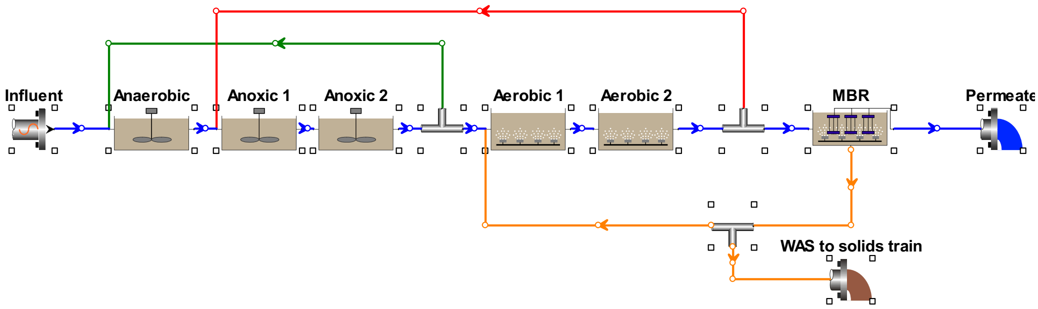
9. Was the use of biological P removal ever considered to:

a) Reduce operating plant costs (i.e. reduce the use of iron and alkalinity consumption),
b) Decrease the amount of salinity, and
c) To make the P in the biosolids more accessible for plants?

The COD/P = 48 with the report numbers; a value > 35 is normally considered well on the way to an effluent total phosphorus concentration of ca 1 mg/L or less (Randall et al. 1992).

Add an upfront anaerobic tank to the preferred process (with proper recycle streams) and process reconfiguration, you could have a Johannesburg Configuration (for instance).

Biowin 3.1 now has the MBR for BNR selection as an option (this would require some "twigging" of course). I was able to reduce phosphorus to well below 1 mg/L (without iron) using the numbers from the Concept Design report by adding some methanol ahead of the aerobic systems. This also helped with the nitrate and the pH was about 6.9. This process would require more "twigging" but it does seem possible.



Note: Alkalinity addition may in the end be necessary for the ultimate treatment process but a proper BNR process could substantially reduce the amount required. Moreover, the sludge quantity would be less and the P in the biosolids more bio-available for plant uptake.

The Land Capability Assessment report in Table S10, Section 1.8, suggested that even though the proposed recycled water is likely to have an average phosphorus concentration of 0.2 mg/L, much higher levels of P (and N for that matter) could be tolerated if it can be demonstrated that there is no impact on discharges to receiving waters. A full BNR plant may provide the level of nutrient removal required with chemicals only as a backup.

The Land Capability Assessment report in Section 1.10.7 itself recommended the "The proposed RWP should be designed to minimise the need for additions of chemicals for phosphorus removal such as ferrous chloride. Aluminium sulphate is likely to have less impact on the salinity of the effluent."

MWH Response: Will be included as an opportunity in Section 7. This will be dependent on the operations personnel selected and associated philosophy.

BV Response: Considering the ramifications of reducing salinity in the RW (by reducing chemical use) as well as sludge production and the fact that preliminary modelling shows it to work, it makes sense to consider it.

MWH Response: Susan Kitching to respond.

BV Response: No response received at the time of this writing.

10. Was price the major consideration for the selection of ferric sulphate instead of ferric chloride for P removal and odour control? The process downside of introducing more sulphate into the system would seemingly outweigh the cost upside. Reduction of sulphate in low redox conditions of course leads to hydrogen sulphide.

    Note: The use of ferric sulphate for odour control would seem to be counter productive. In the lower redox areas of the plant, e.g. anoxic or anaerobic areas, sulphate would reduce to hydrogen sulphide. Given the lack of a buffer area between the WRP and houses, this only increases the size of the odour control system.

    MWH Response: Ferric Sulphate was considered as opposed to a chloride compound due to feedback from the soil analysts. Other chemicals listed as an opportunity in Section 7 (as with all chemicals) will be dependent on operator preference

    BV Response: It is still not obvious to the technical reviewer that this was well thought out.

11. Were alternatives to iron considered for P removal such as lime and alum? If so, what were the reasons for precluding them? The use of iron results in additional solids (around 30%) due to the formation of $Fe(OH)_3$. Moreover, iron complicates downstream UV irradiation as iron precipitates on the bulbs

    Note: I understand the use of iron but was a process gone through to preclude lime and alum? The use of iron sulphate is questionable considering the emphasis put on odour control.

    (See response to question 10)

12. Was salt balance modelling done with the current process, with and without environmental discharge? The addition of ferric salts and alkalinity correction would only accelerate a salt buildup, particularly during drier months with potential water rationing (which Canberra has been known to have) when discharge to the environment could be zero.

    Note: This needs closer scrutiny but it may be that the scheme has to have a minimum discharge to the environment to prevent a salt buildup.

MWH Response: See Appendix 6.

BV Response: Appendix 6 is ever brief on such an important issue.

13. What is the rationale behind using the more expensive Mg $(OH)_2$ instead of NaOH?

    I am presuming that this selection is to decrease the possible sodicity of the water in manipulation of the SAR (sodium absorption ratio) = Na / $[(Ca + Mg) / 2]^{1/2}$, which would make the water more useful for irrigation.

    Note: The question comes back to the aforementioned salt balance. Is the use of Mg $(OH)_2$ really necessary? How is the sodicity of the WRP effluent to change with time from season to season when environmental discharge lessens?

    MWH Response: See response for 12 above.

    BV Response: Response could have been more informative.

14. The paragraph at the end of Section 5.11.1, viz "Waste activated sludge from the bioreactors will be treated to achieve a stabilisation Grade B. It is assumed that there will be no major contaminants in the catchment which would affect this contaminant grading" needs correction. The proposed process should produce a Grade A contaminant grading and a Grade B stabilisation grading.

15. The proposed new development at Googong is being created premised on water recycling, stormwater control, water sensitive urban design and creating a visually green and leafy town with landscaping and planting. Yet biosolids are simply to be for "*…collection and off-site disposal.*"

    Was upgrading the biosolids to Grade A Stability considered such that they would have unrestricted use around the Googong site to help achieve the "visually green and leafy town"?

    MWH Response: Appendix added on different Biosolids strategies and some example process trains. This will be developed with the operators and local disposal sites. The least risk option for disposal has been developed (that being Grade B) commercial agreements will be developed with the operator during detailed design.

    BV Response: The thinking still cannot seem to get past the word "disposal" instead of reuse. Biosolids are a resource just as recycled water.

16. Further to the biosolids issue, was consideration ever given to composting or the use of CaO (quick lime, like an RDP process for example) to achieve stabilisation to get Grade A for the WAS without additional aerobic digestion? The WAS already has a SRT of 20 days from the bioreactor.

MWH Response: See above response.

17. Were anaerobic digesters considered to allow electrical generation on site?

    MWH Response: As the sludge will be stable after 20 days aeration the gas production in anaerobic digestion will be minimal. Co-generation is generally only used on sites where the gas production is substantial to get a benefit over the inefficiencies of the machine.

    BV Response: All makes good sense, why then have aerobic digesters at all?

    MWH Response: Susan Kitching to respond.

    BV Response: No response received at the time of this writing.

18. The paragraph at the end of Section 5.11.1 needs correction (confusion between contaminant & stability grading).

    MWH Response: Changed.

19. Consider gravity flow throughout the plant to limit pumping.

    MWH Response: Need to discuss with WRP civil designer who is on leave until 14/12

    BV Response: Noted.

Assumptions used in process size selection

Please refer to Table I and each line number.

Table I Line 1. Influent Q = 3,390 m3/d; at ultimate size

Table I Line 2. No Trains = 4

Table I Line 3.

Table I Line 4.

Table I Line 5.

Table I Line 6.

Table I Line 7. CODo = 667 mg/L; arises out of 2 x 60 mgBOD/EP/day, likely high but acceptable estimate

Table I Line 8. TKN = 72 mg/L; arises out of 13 mgTKN/EP/day

Table I Line 9.

Table I Line 10. TP = 14 mg/L; arises out of 2.5 mgTP/EP/day

Table I Line 11.

Table I Line 12. F_{up} = 0.2; Biowin default is 0.13, reference for this “typical” Australian value?

Table I Line 13. F_{bs} = 0.27; Biowin default is 0.16, reference for this “typical” Australian value?

Table I Line 14. COD/VSS = 1.48

Table I Line 15. Acetate addition as COD = 89 mg/L

Table I Line 16.

Table I Line 17.

Table I Line 18.

Table I Line 19.

Table I Line 20.

Table I Line 21.

Table I Line 22.

Table I Line 23. Y_H = 0.45; any specific MWH experience?

Table I Line 24.

Table I Line 25.

Table I Line 26.

Table I Line 27. Secondary Effluent TSS Concentration = 15 mg/L

Table I Line 28. MLSS = 8000 mg/L; conservative but acceptable

Table I Line 29.

Table I Line 30.

Table I Line 31.

Table I Line 32.

Table I Line 33.

Table I Line 34.

Table I Line 35.

Table I Line 36.

Table I Line 37.

Table I Line 38.

Table I Line 39.

Table I Line 40.

Table I Line 41.

Table I Line 42.

Table I Line 43.

Table I Line 44.

Table I Line 45.

Table I Line 46.

Table I Line 47.

Table I Line 48. Sludge Age = 20 days

Table I Line 49. ΣMass Chem P sludge =1957 kg TSS/day/train

Table I Line 50.

Table I Line 51.

Table I Line 52.

Table I Line 53. Recycle Ratio = 6

Table I Line 54.

Table I Line 55.

Table I Line 56.

Table I Line 57.

Table I Line 58. COD/VSS = 1.48; consistent with Ekama et al. (1984)

Table I Line 59.

Table I Line 60.

Table I Line 61.

Table I Line 62.

Table I Line 63.

Table I Line 64. Diffuser Fouling Factor = 0.9; based on what experience with MBR plants?

Table I Line 65. Site elevation = 480 m

Table I Line 66. Pressure at site elevation = 101.2 kPa; doesn't seem to match with above

Table I Line 67.

Table I Line 68.

Table I Line 69.

Table I Line 70.

Table I Line 71.

MWH Response: Typical Australian figures, backed up by site data from the Sydney area. Those fractions used within Biowin are typical North American figures.

BV Response: The reviewer is well aware of the origin of the Biowin parameters. What was the reference for these "typical Australian figures"? Is it MWH experience? If so no problem.

MWH Response: Based on MWH experience.

BV Response: Response is sufficient.

Line No	Googong WRP Design		Total			
1	Total Influent Flow (ADWF)	Q	3.39	ML/d		
2	Number of Trains		4			
3			Per Bioreactor			
4			Raw Wastewater	Return Streams		
5	Flowrate	Q	0.85	0.04	ML/d	
6				0.0368		
7	Total COD Concentration	Sti	667	0	mg/L	
8	Influent Total Kjeldahal Nitrogen Concentration	Nti	72	27	mgN/L	
9				27		
10	Influent phosphorous		14	26	mgP/L	
11	Unbiodegradable soluble COD fraction with respect to total COD	fus	0.05			*Biowin default, Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 2-4 recommends between 0.04 -0.10 (use specifier)*
12	Unbiodegradable particulate COD fraction with respect to total COD	fup	0.2			*Typical Australian value - should be determined from influent specifier*
13	Readily biodegradable COD fraction with respect to biodegradable COD	fbs	0.27			*Typical Australian value - should be determined from influent specifier*
14	COD/VSS Ratio	fcv	1.48		mgCOD/mgVSS	*Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 2-2*
15	Acetate addition as COD		89		mg/L	*COD addition from COD source (Acetic Acid or Liquid sugar etc)*
16						
17	Ammonia fraction of the influent TKN	fna	0.66			*Biowin default, Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 2-4 recommends between 0.6 -0.8 (use specifier)*
18	Unbiodegradable soluble organic nitrogen fraction	fnu	0.02			*Biowin default, Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 2-4 recommends between 0.00 - 0.04 (use specifier)*
19	Nitrogen fraction of the influent biodegradable volatile particulate material	fn	0.1		mgN / mg Xii	
20	Maximum s-recycle as a function of Influent	S	6			
21	DO concentration of a recycle	Oa	2		mg/L	
22	DO concentration of s recycle	Os	1		mg/L	
23	Hetrotrophic Yield Coefficient	Yh	0.45		mg VSS / mg COD	*Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 4-3 / Biowin (0.66mgCOD/mgCOD)*
24	Specific Yield Coefficient of Nitrosomonas	Yn	0.1		mg VSS / mg COD	*Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 5-10 / Biowin*
25	Endogenous Residue	f	0.2		mg VSS / mg VSS	*Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 4-3 / Biowin (0.66mgCOD/mgCOD)*
26	MLVSS/MLSS ratio of the sludge Excluding Chemical P removal	fi	0.75		mgVSS/mgTSS	
27	Secondary Effluent Total Solids Concentration	Xtf	15		mg/L	
28	Mixed Liquor Suspended Solids Concentration	Xt	8000		mg/L	*Input design value*
29	Bioreactor pH	pH	7.2			*Input based on influent data*
30	Bioreactor Dissolved oxygen concentration	O	2		mg/L	*Input design value*
31	Oxygen half saturation constant	Ko	1		mg/L	*Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 5-10 / Biowin*

Table I. MWH Biowin Design Process Parameters (continued)

Line No	Googong WRP Design (Continued)			θ	Tmin	Tmax	Units	
32					15	24		
33	Endogenous respiration rate at 20 °C	bh_{20}	0.24	1.029	0.21	0.27	/d	*Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 4-3 / Biowin (0.66mgCOD/mgCOD)*
34	Specific endogenous mass loss rate for Nitrosomonas at 20 °C	bn_{20}	0.17	1.029	0.147	0.191	mg/mg.d	*Biowin (up-dated value from Theory, Design and Operation of Nutrient Removal Activated Sludge Processes)*
35								
36	*Calculation of specific growth rate - Monod equation*							
37								
38								
39	$$\mu_{n(T_{\min})} = \mu_{\max} e^{0.095(T_{\min}-15)} \frac{[NH_4^+]_E}{K_{N(15)} e^{0.118(T_{\min}-15)} + [NH_4^+]_E} \times \frac{[DO]}{K_O + [DO]} \times [1 - 0.833(pH_{opt} - pH)]$$							
40								
41								
42	Maximum Specific Growth Rate at 20 °C	Unm_{20}	0.9	1.072	0.64	1.19	mg(NH_3-N)/mg(NH_3-N).d	*Biowin (up-dated value from Theory, Design and Operation of Nutrient Removal Activated Sludge Processes)*
43	Ammonia half saturation constant at 20 °C	Kn_{20}	0.7	1.00	0.70	0.70	mg(NH_3-N)/L	*Biowin (up-dated value from Theory, Design and Operation of Nutrient Removal Activated Sludge Processes)*
44	Kinetic Constant for Degredation of Organic Nitrogen	Kr	0.015	1.029	0.01	0.02	mg/mg.d	*Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 5-14*
45	Denitrification Rate Constant 1	K_{1T}	0.72	1.2	0.29	1.49	mgNO_3-N/mgVASS.d	*Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 6-17*
46	Denitrification Rate Constant 2	K_{2T}	0.10	1.08	0.07	0.14	mgNO_3-N/mgVASS.d	*Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 6-17*
47	Denitrification Rate Constant 3	K_{3T}	0.07	1.029	0.06	0.08	mgNO_3-N/mgVASS.d	*Theory, Design and Operation of Nutrient Removal Activated Sludge Processes - pg 6-17*
48	Design Sludge Age	Rsd	20.0				days	
49	Total Mass of sludge due to Chemical P Removal	M(Xcp)	1957				kg TSS / Train	*N.B. Chemical sludge produced from ferric sulphate addition for odour control and for phosphorous removal.*
50								*Chemical sludge generated predominantly from ferric sulphides, ferric hydroxides and ferric phosphates*
51	Total mass of Chemical Sludge	M(ΔXChem)	98				kg TSS/day.Train	
52								
53	Selected Optimum a recycle ratio	a	6					
54								
55	Design mass fraction of sludge in Secondary anoxic zone at selected a Recycle ratio	fx3d	0.22					
56	Heterotrophic Endogenous respiration rate @ T˚C		0.21				d-1	
57	Hetrotrophic Yield Coefficient		0.45				gVSS/gCOD	
58	COD/VSS ratio		1.48				gCOD/gVSS	
59	Endogenous residue Coefficient		0.2				gVSS/gVSS	
60	Heterotrophic Endogenous respiration rate @ 20˚C		0.24				d-1	
61	wastewater to clean water Oxygen transfer coefficient Ratio (alpha factor: oxyger		0.5					
62	wastewater to clean water dissolved oxygen saturation concentration Ratio (Beta		0.95					
63	Temperature correction co-efficient (Theta factor)		1.02					
64	Fouling factor (accounts for internal and external fouling of diffusers)		0.9					
65	Site elevation above see level (Altitude)		480				m	
66	Pressure at Site Elevation		101.2				kPa	
67	Pressure at Site Elevation		759.2				mmHg	
68	Maximum water temperature		24				C	
69	Wastewater Depth		5				m	
70	Diffuser height		0.25				m	
71	SOTE		5				%/m	

Additional carbon requirements

With the influent parameters used, the TKN/COD ratio equals about 0.11. Complete denitrification can only be achieved for TKN/COD ratios < 0.08 without the addition of an external energy source (Ekama et al 1984).

This was confirmed by a steady state simulation of the Concept Design (CD) process with NO additional carbon as shown by the excess nitrate in the below table.

Average Effluent Nutrient Concentrations	CD	Tech Check (no carbon)	Units
COD	48	34	mg/L
BOD	5	0.8	mg/L
Ammonia	0.3	0.2	mg/L
TKN	3.0	2.7	mg/L
Nitrate	0.00	4.6	mg/L
Total Nitrogen	3.3	7.3	mg/L
NFR	2	--	mg/L

Additional alkalinity addition

The source waters from Googong WTP and particularly Stromlo WTP are by their nature alkaline deficient as evidenced by Langelier Saturation Index (LSI) that is -1.23. Moreover, alkalinity consumption by iron addition for P removal is significant and does require alkalinity addition as was confirmed in a steady state simulation of the CD process to keep the pH above 7.0.

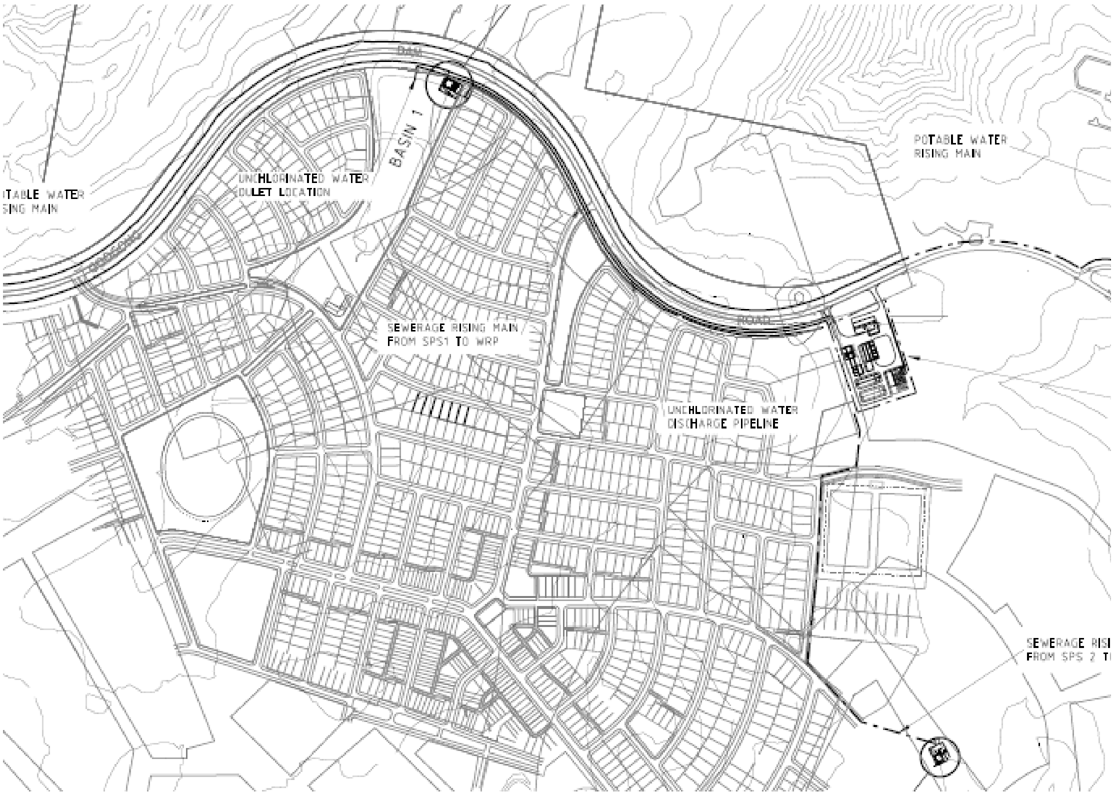
A properly designed [full] BNR plant can biologically remove a good share of the phosphorus as was also shown in the aforementioned "MBR for BNR" simulation but the requirement for alkalinity addition is still likely.

Proposed odour system

Odour control is to be provided in the form of carbon filters and chemical dosing for the sewerage system. The WRP is to be equipped with a centralised Odour Control Facility, comprising two (2) biological trickling filters (3 m ϕ x 13 m H), 2 activated carbon filters (3 m ϕ x 5 m H, 35 m^3 each), two extraction fans and associated ductwork and ancillary works. Treated air will be discharged via a 15 m high exhaust stack.

The column sizes bring to mind the odour control structure at Subiaco, a 62 MLD sewage treatment plant (as shown in the below picture), which uses NaOCl for odour control, and suffers from residences close by.

The majority of the gas extraction comes from the Bioreactor and Membrane Tanks in Stage 1 and in the Ultimate development. Many odour control facilities do not extract "odour" from the aerated sections of the tankage but the close location of the WRP to housing (as close as 100 m from the drawing below) makes this understandable.



The current odour control system in the opinion of the technical reviewer could be reduced through more optimisation after the final process is selected.

20. What alternative odour scenarios were modelled to eventually determine that bioreactor tank and membrane tanks had to be covered and gas extracted to comply with the odour threshold at the plant boundary?

21. Was the use of a NaOCl scrubbing tower [similar to that at Subiaco WWTP] ever considered and why was it eventually precluded? I am presuming because it is less "green" than a trickling filter.

    Note: The proposed extraction of 20 to 25 air changes per hour for the inlet works would seem to be on the high side unless someone is in there all the time. There could of course be a switch to increase extraction when personnel do enter the area. The proposed odour control system is large for such a small plant but the WRP is only ca 100 m from the nearest housing. This is a concept design and this design will need some optimisation of the odour system.

22. How were the gas extraction rates for the Biological and Membrane tanks determined?

23. How were the numbers determined for Tables 42 and 43?

24. How often will the activated carbon need replacement and how will it be physically accomplished?

    Note: Having more of a buffer zone would lower the odour control costs.

MWH Response (21 to 24): Refer to the Odour Dispersion Modelling Report

BV Response: This report was not amongst the original material included for review.

25. Explain in more detail how storm water will be treated on site and what amount will be treated by the plant. Membrane installation might be staged to save capital cost.

    MWH Response: Refer to drawing A1081402-SK401 for flow control tank space.

Salt addition for P removal

Covered above.

Layout and optimisation of phase 1

26. Comment was given in the Concept Design that two bioreactors should be built in Stage 1 as opposed to a single reactor. The other two reactors (total of 4) are to built for the ultimate development.

    Why not build the reactors such that common walls are used to reduce the overall cost?

    MWH Response: Need to discuss with WRP civil designer who is on leave until 14/12

    BV Response: Noted.

27. Is it feasible to construct the ultimate chlorine contact tank in Phase 1 (see notes below)?

    MWH Response: Need to discuss with WRP civil designer who is on leave until 14/12

    BV Response: Noted.

28. Why not construct the whole blower room in Stage 1 rather than adding the room later?

    MWH Response: Need to discuss with WRP civil designer who is on leave until 14/12

    BV Response: Noted.

29. Why are the inlet works and the biological reactors so far from one another? I note that the proposed aerobic digester, rotary drum thickener and flocculation tanks close to the inlet works but distant from the biological treatment tanks.

    I note the site from Drwg A1081402-SK401 slopes from bottom (SW) to top (NE) by some 7 m and from left (NW) to right (SE) by 4 m. The lowest corner of the site is where the tertiary treatment facility is proposed, which is appropriate.

It appears more logical to have the biological treatment tanks in the area not so distant from the inlet works. The odour control facility can be located anywhere as long as there is truck access and the pipework is minimised. The bioreactors could be put together with three common walls. The office needs to remain near the entrance. The space allocated for the Flow Control Facility is in a low spot, which is appropriate.

Staging of the system

Comments are included in the below table.

Process Unit	Stage 1	Ultimate	Comments
6mm screens	All built in Stage 1		
1mm screens	All built in Stage 1		
Grit removal	1 tank	2 tanks	
Bioreactors	1 tank	4 tanks	2 tanks should be built in Stage 1 for redundancy
Bioreactor aeration	3 blowers	6 blowers	Why not construct the whole blower room in Stage 1 instead of adding the room later?
Membrane tanks	2 tanks	4 tanks	Do the membrane tanks have to be separate from the bioreactors?
UV disinfection	1 module	4 modules	2 modules for Stage 1 for redundancy
Chlorine contact tank	1 tank	2 tanks	Building it all in Stage 1 would have the added benefit of more "C x t" and possibly less Cl_2 usage.
Chemical storage and dosing	All built in Stage 1		
Odour control	1 biotrickling filter 2 carbon filters	2 biotrickling filters 3 carbon units	The piping for odour extraction should be designed for the ultimate.
First flush system	All built in Stage 1		
Service water system	All built in Stage 1		
Sludge thickeners	1 unit	2 units	
Aerobic digesters	1 tank	2 tanks	
Centrifuges	2 units		

Potential value engineering initiatives, which may reduce whole-of-life costs.

- Use of a full BNR design to reduce chemical usage, particularly the use of ferric sulphate which will significantly increases the TDS of the RW (see Appendix 6)
- Elimination of the aerobic digester. The biological reactor already produces a twenty day sludge age. The WAS should be directly dewatered for subsequent management.
- The use of the proposed design or similar should consider the use of common walls to reduce capital costs and required land take between Stage 1 and the Ultimate development. This would be directly applicable to the construction of bioreactors and possibly the membrane tanks.

  Could it also be feasible to construct the chlorine contact for the ultimate development in Stage 1? Initially the tank would be too large but chlorine disinfection is always gauged against a C x T (chlorine concentration x time) number. With a larger tank, less chlorine would be necessary at first. As the development grows the HRT (hydraulic residence time) decreases and the chlorine dosage would have to be increased to maintain the desired CT.

- The design of the odour control system seems overly conservative and likely will be optimised during the tender design/detailed design.

  Consideration should be given to the use of the aerobic reactor (if the final design suits) for a majority of odour control via running the malodourous air through the aeration system. This would certainly save pipework to the OCF as well as potentially reduce the size of the whole OCF. A signoff of the final proposed use of the air blowers should be sought from the blower manufacturer.

- I believe it probably would be less costly in the long run to construct the whole blower room in Stage 1 instead of adding the room later.

- Serious consideration should be given to the use of staged modular treatment plants such as modular RBC units (rotating biological contactors), which can be configured with anaerobic, anoxic or aerobic volumes to suit a full BNR process and easily enclosed for odour control (with likely a smaller odour control system than what is proposed). Significant capital savings are thought possible as well as lower operating costs. Moreover, the system can be augmented in modules to suit the population growth of the development.

SP2: Potable Water & Bulk Distribution

General

1. Can you briefly explain what ESD principles were followed / applied for the design of the Potable Water & Bulk Distribution System.

2. Discussion from Appendix 3: LSI was not intended as an indicator of corrosivity towards mild steel or other metals of construction as acknowledged in the writing that "*there is a potentially poor correlation between the LSI and the rate of corrosion*". The Googong water reaching a LSI maximum (Table 57) of -1.23 is stated as "*could be mildly corrosive*". However, if one uses another indice such as Ryznar Stability Index (RSI = pHs – LSI), one can back out of Table 57 an RSI (max) = 9.43-(-1.23) = 10.7, which is indicative of **highly corrosive** waters. Regardless, the selection of concrete lining or plastic pipes is appropriate but copper pipes for individual houses could conceivably suffer significant corrosion.

   MWH Response: Noted.

   BV Response: This was raised as an issue to be taken up directly with ACTEW AGL or perhaps there is existing data [from ACTEW AGL] that these waters will not appreciably corrode copper pipes?

3. Alkalinity can be increased in water with minimum pH increase (the two are not directly proportional). I note the statement "*alkalinity will need addressed at Stromlo WTP, as it cannot be properly corrected in the network*".

   a) Was the addition of $NaHCO_3$ (sodium bicarbonate) or Na_2CO_3 (soda ash) ever considered to make the water from Googong WTP and particularly Stromlo WTP less aggressive to metal pipes or
   b) Were discussions ever held with ACTEW AGL regarding this matter? I did not see relating correspondence.

   Note: It is recognised that both of these chemicals contribute to water sodicity but having a water that is less aggressive to metals pipes (eg copper) as well as requiring less alkalinity addition at the WRP could be overall beneficial.

   MWH Response: Susan Kitching to respond.

   BV Response: No response at the time of this writing.

Proposed System

4. Was a single pump station ever considered, viz just the BWPRS, to supply both the High Level and Low Level reservoirs? What was the rationale for excluding this option?

   MWH Response: This would not be preferred due to the inefficiency of the approach & potential difficulty with controls. The high level tank has less than 1 day storage & failure of a single PS would result in non-availability of supply.

BV Response: Something still worth considering in the detailed design.

5. "*To manage the risk associated with actual demands exceeding design assumptions, the sizing of the critical infrastructure with potential future constraints has been increased in the conceptual design. BWPS delivery main will be constructed in Stage 1 and sized to meet combined potable and non-potable maximum day demands over a 20 hour period.*"

   a. What design provisions were made for fire fighting, particularly to cope with the bush fire threats as seen in the past?

      MWH Response: The technical reviewer was told at the review meeting on 17Dec09 that checks were done around the proposed city and that sufficient capacity was available.

      BV Response: Would prefer to have response in writing.

   b. "*Reservoirs sized at maximum day demand volume + 25%.*" On what basis were these volumes determined?

      MWH Response: This has now been superseded. Design is based on WSAA03 & Googong Design figures.

      BV Response: Response is sufficient.

6. Were other locations and design approaches considered for the storage reservoirs, even **separate** locations for potable and recycled water?

   It is recognised that the current position of the reservoirs provide 20 m of residual head; however, the potable water will flow least 2 km before it reaches the outskirts of the development in the west and longer to the east. A portion of the dirty water will in Phase I be pumped to the WRP via SPS 1 (over a 1 km) and SPS2 (0.75 km) to the WRP, which will treat the water. Another SPS in the WRP will pump the treated (recycled) water 4+ km for storage.

   MWH Response: Earlier studies considered the location of the storage reservoirs. We can discuss further at the review meeting.

   BV Response: Mention was made at the meeting on 17Dec09 that a member of Council was particularly against "non-traditional" designs where the 20 m of pressure was achieved with other than with a static head.

   Incorporation of this consideration would naturally constrain the design process and could be changed during detailed design.

7. There are two proposed *Low Level* potable water reservoirs, PW1 at 1,000 kL and PW2 at 2,000 kL, supplied by BWPS. It is stated that PW2 "*will be required*

prior to ultimate development". It is proposed that a one day maximum usage storage will be provided

a. What is the background for selecting the minimum storage for potable and recycled water? Comment: 24 hours at maximum usage does not give much buffer for repair issues nor for use in the case of a bush fire (which we have all seen can be serious in Canberra).

b. Was a single tank ever considered as opposed to two small tanks in two stages, eg with Present Value evaluation of alternatives? The larger tank would be less expensive per unit volume and would give additional storage volume over the single maximum total (point a above).

   MWH Response: Two small tanks allow for a staged approach to be adopted which reduces the risks associated with the development rates. In addition, a staged approach allows demand assumptions to be verified during the initial stage.

   BV Response: Mention was also made at the meeting about the importance of saving initial capital costs. Response is sufficient.

8. In the Concept Design there are High Level potable & recycle water reservoirs of about 80 kL to service 830 dwellings by gravity feed within the NH2, NH3 and NH4 areas. These reservoirs would be supplied from a second pump station (PWHL), pumping from the low-level reservoirs. These reservoirs are proposed to be constructed again in two stages.

   Was a single tank ever considered as opposed to two small tanks in two stages, e.g. with Present Value evaluation of alternatives?

   BV Response: See above.

9. *"Due to possible low residual pressures in the Googong WTP to Stromlo WTP transfer pipeline, it will be necessary to place the pumps below ground."* How were the low pressures verified?

   MWH Response: Pressures were advised by ACTEW.

   BV Response: This will need to be verified before detailed design.

10. *"The provision of the larger diameter pipeline will lead to lower pumping station energy costs, a pipeline with a lower embodied energy with improved sustainability outcome."* How does a larger diameter pipe by itself have lower embodied energy than a smaller equivalent?

    MWH Response: If a larger diameter pipe is adopted then it results in lower pressures & a thinner pipe wall thickness is acceptable.

    BV Response: Minor point only.

11. *"This size a pipeline will yield a velocity of 0.49 m/s in Stage 1 (157 LPS) and 0.98 m/s for the ultimate at 278 LPS. These velocities are lower than the minimum recommended by WSA 03. This coupled with the low Cl_2 residual may lead to bacterial re-growth within the delivery main. A flushing cycle is recommended."* As the proposed 600 DN delivery main is almost 5 km long and the above issues exist, was a rechlorination station ever considered at the BWPS?

    MWH Response: Susan Kitching to comment.

    BV Response: Comment not received at the time of this writing.

12. No dual power supply will be provided to the reservoir site but rather an emergency generator will be sourced to power the pumps. The generator will be connected into the MCC via an external connection. Sufficient reserve storage of an absolute minimum of 2 hours of max hour peak day demand is to be maintained in the reservoirs. What was the rationale for this arrangement over a dual power supply or even a resident backup generator?

    Note: every power outage will have the operators scrambling to get a generator.

    MWH Response:

    BV Response: At the meeting, MWH is apparently looking into this issue further but no written response was received by the date of this writing.

13. Section 3.8.2. "*It is not proposed that the potable and recycled water pumps be housed in a building. It is possible that a small shed or similar might be required for noise or security reasons*." Comment: All pumps should be housed in a simple building, (eg besser blocks and iron roof with sound attenuation as needed as a minimum) to moderate noise from that higher elevation to the surrounding community and particularly for security reasons (juveniles will likely invade this remote site).

    MWH Response: This could be considered as a potential enhancement.

    BV Response: This should not be an enhancement but rather a minimum design.

14. Section 3.9.2.3 The NaOCl plant is regarded as critical equipment and backup power or dual supply is required. This needs to be consistent with Section 3.8.2.3 where an emergency generator is to be brought in event of a power failure.

    MWH Response: Dual power would be preferred - need to discus with Tony Connell (Brown) whether this will be available.

    BV Response: Dual power or an onsite backup would be recommended.

SP3: Sewage Pump Stations and Rising Mains

General

1. Can you briefly explain what ESD principles were followed / applied for the design of the Sewage Pump Stations and Rising Mains System.

Proposed System

2. Until a 550 EP is reached in the development (99 kL sewage/d), SPS1 or SPS2 will not operate but rather sewage will be tankered away to Queanbeyan or Fyshwick STPs; up to 5 trips per day are possible prior to Stage 1. Presumably the odour control system will be functional at SPS1 and SPS2 during this early time?

   MWH Response: Yes

   BV Response: Response is sufficient.

3. Was the use of mixers inside the emergency storage areas in SPS1 and SPS2 considered to reduce septic-derived issues between truck pumpouts in the time before 550 EP is achieved? I understand the ability to dose $Fe_2(SO_4)_2$ at the storages if desired.

   MWH Response: No. Mixers were not considered. This could be considered as an enhancement to the design.

   BV Response: Response is sufficient.

4. What is the anticipated operating procedure for operation of the SPS1 and SPS2 when population does meet 550 EP to minimise solids deposition? I note your mention of a tanker and suction hose for the scour valves in Section 4.7.2.

   MWH Response: No specific measures are proposed. Manual washdown will be required at the time of tanker visit.

   BV Response: During the early stages of the development grit will be significant due to the new construction. This should be noted and become part of the management plan.

5. Perhaps I have missed it but it was not obvious how the septic trucks will pump out SPS1 and SPS2 during the period before 550 EP is achieved in the development.

   MWH Response: Until there is sufficient population, flows will be removed via a tanker & suction hose. A camlock coupling will be available for direct connection to the tanker

   BV Response: I was referring to how the septic trucks connect into the storage well. This is a detail certainly but needs consideration.

6. Typo in Section 4.3.1, second paragraph.

7. Section 4.4.2.2.2. "*The concrete roof of the wet well / emergency storage pumping station will protrude 200 mm above ground level across the length and breadth of the storage to reduce the potential for surface water inundating the structure.*" Will the PS be a waterproof structure, considering since the station is below ground? I note in Table 21 that the 1:100, 1:20 flood levels were not given.

   MWH Response: The PS will be designed as a water retaining structure. The structure is assumed to be above 1:100 year flood level but this is subject to subject to review/confirmation.

   BV Response: At the meeting I was told that the roof level would be above the 1:20 year flood level but this has not been confirmed in writing.

8. Are there duty/standby carbon units provided for the SPSs or is the carbon easily and quickly changed? How long does the carbon unit have to be off line during carbon changeover?

   MWH Response: Changeover is quick - approximately 10 minutes. Duty/standby arrangements have not been considered at this stage.

   BV Response: Response is sufficient.

SP4: Recycled Water & Bulk Distribution

General

1. Can you briefly explain what ESD principles were followed / applied for the design of the Recycled Water & Bulk Distribution System.

Water Balance

2. Googong New Town Concept Design, Site Water Balance Assessment (Dec 09)

   a. As a general comment the practice is this report of presenting numbers from model runs without any kind of error bounds can be misleading. The numbers were presented as absolute and likely contain substantial error, particularly as considering the number of models used, with the outputs of one as inputs to another. There was for instance disagreement between the WATHNET and PURRS models for the volume of water saved with rainwater tanks of at least 4%, attributed only to the shorter time step of PURRS.

      "At full development, the recycled water system will use between 71 and 73% of the wastewater generated in the new town for the case where rainwater tanks are adopted." Comment: A proper error analysis should have been conducted to allow the reader to fully appreciate the significance of the numbers generated. There is likely that the error could be at least +/- 10%, which makes the comparison of alternatives in this study more circumspect.

      <u>MWH Response</u>:

      <u>BV Response</u>: Nothing received in writing but at the meeting on 17 Dec 09 there was some movement on procuring a proper error analysis.

   b. The outputs from a series of "MUSIC" models was analysed to determine the change in pollutant loads to the Quenbeyan River as a result of the development. Again, with no error parameters on the numbers shown in Table 4-1 (although inadequacy of data set was acknowledged), conclusions were drawn on the difference in SS, TN, and TP to before and after development that the parameters do not meet ANZECC guidelines for TN and it meets the ACT Water Quality but exceeds ANZECC guidelines for TP. Comment: TP and TN are definitely important as stress triggers for aquatic ecosystems (which the Quenbeyan River is); however, it should not be forgotten that the proposed development will also contribute other chemicals to the river aside from the nutrient load, which Section 4 is silent on.

   c. How do the findings from the *Site Water Balance Assessment* feed into the numbers used in *Water and Wastewater Concept Design*, particularly estimating the maximum potable and recycled water demands? I did not recognise a lot of cross correlation?

3. Googong New Town Concept Design, Site Water Balance Assessment (Dec 09) Version 4, Received on 15 Dec 09.
   New Results Given:
   a. The range of water cycle management measures to be employed in the Googong New Town will result in a reduction in demand of approximately 60%;
   b. The recycled water system will use approximately 62 to 65% of the wastewater generated in the new town; and
   c. Eliminating the use of rainwater tanks as a substitute for some water uses in preference to the use of recycled water will increase the volume of wastewater recycled in the new town to 80% at the same time as decreasing water demand reductions to approximately 55%.

4. H2OMap software was used to confirm the potable and non-potable system configurations. Extended period model runs, incorporating maximum daily demands were made to assess reservoir recovery, reservoir operation levels and pump operation. Please confirm that this include provisions for fire fighting and briefly explain what these were.

5. Appendix 6 Salt Balance. *"The results of the mass balance show that land application is below 700 mg/L on an average basis throughout the year…This has been taken as a daily time series from the volumes generated within this report over 41 years…The discharge from the treatment plant is high at over 1000 mg/L "* (1059 mg/L actually). Comment: a significant reduction in TDS in the WRP effluent could be achieved by reducing the amount of ferric sulphate and alkalinity addition used. Can you describe what the worst case scenario that was modelled with respect to the salt balance, eg low rain fall, high RW use, low river discharge and for what duration and what TDS?

6. Appendix 6 Salt Balance. Comment: If the results from Table 62 are used such that the potable water/rain water is assumed to have a TDS of 100 mg/L and the WRP discharge is assumed to have a TDS of 1059 mg/L, to produce irrigation quality water quality with a TDS of 655 mg/L implies that for every 1,000 L of WRP effluent, one would need dilution of 723 L of potable/rain water. Reducing the TDS in the WRP effluent by 100 mg/L (say to 959 mg/L, by 100 kg salt/ML, by using less ferric sulphate or alkalinity at the WRP) needs 548 L of potable/rain water (180 L less) to achieve an irrigation water quality of 655 mg/L, and so forth. Reducing the salinity in the WRP effluent goes a long way to making the whole process more sustainable, particularly for irrigation. Note the comment in the Googong Land Capability Assessment Report "*The increased salt load that is allowed to move through the landscape in surface or subsurface waters, may adversely affect remnant natural areas such as bushland, wetlands, rivers and creeks*". The AWM 2009 report showed that there was no risk of plant foliar damage when recycled water contained a salt concentration of 500 mg TDS /L (or less) but with 700 TDS mg/L, the risks were appreciably greater with highly-sensitive species. The combination of rainwater tanks and lowering the salinity produced through the WRP would be a more sustainable management strategy.

7. In the final Googong Land Capability Assessment Report, dated 13 Dec 2009 (by Agsol Pty Ltd), Section 1.1 "*Unlike conventional potable water supplies, recycled water contains significant concentrations of nitrogen and phosphorus and other substances such as chlorine, sodium and chloride that could be potentially harmful to garden plants,….*", the use of the word "significant" is misleading. With what are these levels being compared? The WRP in this case will be producing an effluent with ΣN from about 3 to 5 mg/L and ΣP of about 0.1 mg/L. These are not "significant" concentrations for these nutrients in the opinion of the technical reviewer and the writing should reflect this.

   I might again add that the presentation of projected reuse percentages as a function of the various scenarios in this report (eg Table S3) is not very meaningful without error bounds. The statement just under Table S3 "*In the NH1A Stage the level of reuse of recycled water was 67% with rainwater tanks and 75% without tanks*" means little if the error bounds are + / - 10%.

8. I would concur with the recommendations from the Googong Land Capability Assessment Report that the use of low phosphorus low sodium and salt detergents by householders should be [strongly] encouraged to help reduce TDS accumulation.

9. Googong Land Capability Assessment Report (Draft 14 July 09). Table 8.12 and analysis.

Scenario	Reuse (%)			Discharge (ML/yr)		
	1/10-dry	Median	1/10-wet	1/10-dry	Median	1/10-wet
1	61	52	45	442	544	626
2	69	58	48	348	485	601
3	68	61	55	367	439	520
4	78	70	62	245	338	435

"The median reuse with rainwater tanks was within the 52-58% range depending on how the distribution storage was managed. Less recycled water was used for irrigation when rainwater was available for household use (scenarios 1 & 2), and the median reuse in these scenarios was 9-12 percentage points less than with the corresponding scenarios without rainwater tanks.

For all scenarios, the level of reuse increased by 7-11 percentage points above the median in very dry years and decreased by 6-10 percentage points below the median in very wet years. The level of reuse would be greater in very extreme years."

Comment: No error analysis accompanied the results presented in Table 8.12.

It is acknowledged that the numbers changed significantly from the draft to the final report but still no error analysis.

Table S3 in the 13 Dec 09 Recycled Water Irrigation Land Capability Assessment report, which is a summary of the mean reuse and irrigation for the two scenarios for NH1A:

Component	Class	Scenario	
		With rain water tanks	Without rain water tanks
Reuse (%)	Recycled water	67	75
Discharge (ML/yr)	Recycled water	78	60
Irrigation (ML/yr)	Rain water	24	0
	Recycled water	57	58
	Potable water	52	75
	Total	133	133

shows that the models produce absolute numbers. These are not absolute numbers and the levels quoted in the analyses could likely fall within a plus or minus 10% error or more. The reader is left to make up their own mind as to the validity of the comparison between the various scenarios (1 to 4).

General

10. "*A level of redundancy of equipment has been assumed*" but this did not specifically detailed. What was it, please elaborate?

System Design

11. Recycled Water Irrigation Land Capability Assessment Report. "*A distribution storage (or storages) will receive the daily flow of recycled water from the proposed RWP and two alternative management options for these storages were explored (1) At the end of each day, any surplus recycled water was discharged and (2) Discharges only occurred when the distribution storage filled to capacity.. This was done because of the uncertainty regarding how much recycled water could be held in the storage on a day to day basis without having an unacceptable deterioration in water quality…..*" Was data from Rouse Hill or other existing "third pipe" developments unavailable from which to get some idea of the stability of recycled water?

    Note in the final draft of the report (page 81) this dilemma was resolved by concentrating on (1) only in that "*Distribution storage (or storages also known* *as reservoirs) received the daily flow of recycled water from the proposed WRP. At the end of each day, any surplus recycled water was discharged*".

12. There is potential to refine the overall system configuration, including ultimate bulk water pumping station capacity and low-level reservoir size following confirmation of water usage behaviour and system management preferences. What is the likelihood that the concept design will require substantial modification?

13. Section 6.2: A second recycled water pumping station will be constructed at the WRP to enable a pumped discharge of non-chlorinated water to stormwater basin 1 to occur. Why not directly to river discharge?

14. For Stage 1 the largest estimated sewage flow will be 0.99 MLD, whilst Table 50 anticipates a RW maximum daily demand of 5.3 MLD (a deficit of 4.3 MLD or >440%); at the ultimate development there will be an estimated sewage flow of 3.4 MLD with an anticipated RW maximum daily demand of 17.5 MLD (a deficit of 14.1 MLD or >400%). How much of these deficits will be supplied by potable water and how much by the rainwater tanks?

15. A minimum of one-third maximum daily demand as reserve storage for the low level reservoirs and 2 hours of maximum demand for the high level reservoir was allowed in the Concept Design. How were these numbers selected? Was fire fighting part of this assessment?

16. Was a comparison(s) done between providing the minimum residual water pressure of 20 m at closer locations to the development but with less static elevation (such that the head would be provided by pumping), particularly for the recycled water system? Note the distance from the WRP to the low level reservoirs is almost 5 km.

    MWH Response: None received at the time of this writing.

    BV Response: At the meeting on 17 Dec 09 it was indicated that the design process with respect to this particular point was somewhat constrained by a Council member who was against any design that did not provide 20 m of static head for pressure.

Compliance with the Director General's Requirements (DGRs) for Part 3A Concept Plan and Stage 1 Project Application

The technical reviewer has gone through the Preliminary Environmental Report (not the Environmental Assessment Report as nominated below), forwarded on 15 Dec 09 and excerpted portions (i.e. "cherry picked") from the report (or other relevant documents) that are directly relevant to the various aspects of the Director General Requirements (DGR) for Part 3A Concept Plan and Stage 1 Project Application. The DGRs are included as a nested file in Attachment B in the back of this report.

Perceived compliance of the Preliminary Environmental Assessment Report with addressing the various Director General Requirements is the professional opinion of the technical reviewer. Assessments were given as "Adequately Covered" or "Partially Covered" under "BV Comments". A "Partially Covered" status was given when a particular aspect may not have been specifically mentioned in the Preliminary Environmental Report.

Waterway and land effluent discharge requirements identified in the Environmental Assessment Report (EAR), currently in draft form

DG Requirements

Under Key Issues "Water Quality and Hydrology" it is stated "*the EA shall include an assessment of water quality impacts arising from the construction and operation of the project. With respect to construction, risks associated with laying pipelines, including across watercourses, erosion and sedimentation controls and management of any discharges from the project to prevent impacts to nearby watercourses must be addressed. With respect to operation, details of the disinfection systems and the quality of the recycled water must be provided. Details on the proposed use(s) of the recycled water and how this will be managed, particularly with respect to runoff into waterways and the need for buffer zones, must be provided. Details of the impacts and management of wastewater and infrastructure must be provided, including impacts from discharges for the recycled water plant (both wastewater and surplus treated water). Where relevant, wet weather effluent storage requirements, the location of infrastructure within riparian areas and details of any dry and wet weather sewage overflows must be provided. These details must include the predicted frequency of overflows and contingency measures to minimise infiltration. Consideration must also be given to water cycle management plans for the area.*"

Preliminary Environmental Report Treatment

If these requirements are broken down individually, they will be easier to address from the Preliminary Environmental Assessment report.

A. Assessment of water quality impacts arising from the construction and operation of the project:

1. No development will occur in the Googong Dam catchment.
2. Ecowise Environmental Consultants (Ecowise, 2008) has conducted a preliminary assessment of the current status of water quality in the Queanbeyan River at three locations. The sites are: (i) Upstream of the location of the proposed discharge, below the Googong Dam, (ii)

Immediately downstream of Wickerslack Lane, and (iii) Some distance further downstream of the Wickerslack Lane Site.

Total Nitrogen (TN) concentrations have tended to be significantly above ANZECC guideline (2000) values at both sites below Googong Dam. Historical data shows this to be a consistent trend for TN in the Queanbeyan River. Total Phosphorus (TP) concentrations have also tended to be above or very close to the ANZECC guideline (2000) values (Ecowise, 2008).

Cyanobacterial blooms, exceeding the guidelines (ANZECC, 2000) for recreational water were recorded at the Googong Dam site upstream of the proposed discharge point during the summer of 2002–03 (December 2002 and January 2003) and again in December 2003.

3. A desktop review of groundwater conditions has been undertaken by C. M. Jewell and Assoc (Jewell, 2004). Groundwater within the area is contained within fractured-rock aquifers and the majority of bores in the area tap into these.

4. The water recycling plant will be designed to meet the requirements of the Australian Guidelines for Water Recycling (NRMMC, 2008) and its proposed effluent discharge licencing conditions and will have unit processes for first flush containment.

5. During the construction reduced water quality in the surrounding catchments could result from: (i) Sediment laden runoff from earthworks such as the pipeline installation, etc, (ii) Direct impacts on drainage lines (such as bank destabilisation) and (iii) Direct spills of pollutants (oil, grease, concrete to water courses).

6. During operation of the sewerage and recycled water systems (plant, pipes and pumping stations) potential impacts on surface water quality may include: (i) Reduced water quality in the unnamed creek and the Queanbeyan River due to the release of recycled water discharge, (ii) Reduced water quality due to failure of the treatment process, (iii) Accidental overflows from the system (malfunctions, pump failure, breakage etc), (iv) Increased flows to the unnamed creek and hence Queanbeyan River – a change in the water regime in the creek from mostly dry to mostly wet is likely to impact on the creek morphology and the flora and fauna associated with the creek, (v) Spills of pollutants connected to the operations (chemicals, fuels etc) and (vi) Untreated stormwater discharge to water bodies. Stormwater from urban areas is generally of poor quality and has diffuse sources of pollutants.

7. A water quality monitoring program for both surface and groundwater would be developed and employed before and after commissioning to ensure that surface water quality impacts are minimised and risks are managed appropriately.

B. *Construction risks associated with laying pipelines, including across watercourses, erosion and sedimentation controls and management of any discharges from the project to prevent impacts to nearby watercourses must be addressed:*

1. A water cycle management plan will be prepared for the area. This will take into consideration construction and operational impacts associated with the proposal at the concept level. The water cycle management plan will examine the following: (i) Stormwater management across the site, including stormwater quality, treatment and proposed uses, (ii) Construction impacts on waterways due to runoff and discharges (eg from the laying of pipelines and placement of infrastructure) and (iii) Operational impacts of the proposed water cycle management system, including: (a) Proposed recycled water quality (and treatment processes to achieve this quality), (b) Proposed uses of recycled water, the management and monitoring of these uses, and any potential impacts associated with such uses, (c) Proposed recycled water discharges and (d) Wastewater management practices.

2. The water cycle management plan will accommodate requirements for water recycling plant operations (e.g. consideration of the seasonal timing of any proposed discharges to minimise potential impacts) and for maintenance of water cycle infrastructure.

   For recycled water use, the relevant national standards will be taken into account to assess the risks to the environment and human health, with attention paid to recycled water exposure pathways. Furthermore, state guidelines for sewage treatment systems will be considered in the environmental assessment and will guide infrastructure design, placement of infrastructure and mitigation and management of measures.

   With respect to stormwater management, drainage and stormwater design will incorporate water sensitive urban design principles for the development site, such as subsurface infiltration zones, drainage swales, bio-retention basins/trenches and permeable paving. The existing groundwater quality and pathways will be examined.

   Consideration will also be given to cumulative impacts on the receiving waters. An ongoing water quality monitoring program will be developed and implemented before and after commissioning to ensure that all risks are managed appropriately.

3. A stormwater management strategy utilising the principles of water sensitive urban design, will be developed that mitigates the potential impacts of the development such as: (i) Stormwater quality, (ii) Riparian zones, (iii) Water balance and stream forming flows, (iv) Stormwater peak flows and flood risk and (v) Construction phase impacts.

4. Construction management plans will be developed to address any water quality impacts that may result from construction activities, including drainage and stormwater runoff.

5. The pumping station will be located within the existing Googong Water Treatment Plant boundary. The pipeline to the residential development will follow the access road to the plant. The existing uses of this area mean that impacts associated within Googong water cycle management are likely to be minimal.

6. There will be no direct impact on the Googong Dam Catchment from the development. The small southeast corner of the Googong site that currently drains toward the dam will not be developed; hence there will be no discharges to the dam. The inward recreational focus of the masterplan will discourage human activity in the area that could impact on the water cycle.

7. Nine potential areas of concern in regard to soil contamination have been identified within the development site (Coffey, 2004). These areas are most likely to require remediation prior to proceeding with development. Given the isolated locations of the sites and the nature of their contamination, it has been concluded that they are likely to be able to be remediated to a level to accommodate development (Willana, 2007).

8. Several of the watercourses within the Googong area contain steeply sloping banks and are more densely vegetated than the surrounding farmland. These areas act as wildlife corridors accommodating many varieties of native animals. These areas are considered both visually and environmentally sensitive. A number of these watercourses have been identified by DWE as requiring preservation within a riparian buffer zone. The width of the buffer zone will generally be an average of 20 meters from the bank to the watercourse. More major watercourses such as the unnamed creek on the eastern side of Cooma Road, which flows beneath Googong Dam Road, may require a wider buffer zone, especially because of the increased steepness of the terrain on either side of the watercourse (Don Fox, 2001 cited in Willana, 2007).

C. *Operation details of the disinfection systems and the quality of the recycled water must be provided:*

1. Staging will need to take into account several factors including: (i) Initial low flows unable to support biological treatment processes and (ii) The anticipated population growth rate.

2. For the life of NH1A (this may be up to 10 years depending on lot sales rate), and depending on effluent discharge standards, the water recycling plant bioreactor may take the form of either: (i) An intermittent process design or (ii) A continuous process design.

3. Where economically advantageous and where capable of meeting the effluent discharge standards, proprietary package systems may be employed for either process design. Where proprietary package systems cannot securely produce the effluent discharge quality required under the water recycling plant's discharge licence, or where not financially viable, stage 1 of the ultimate plant's bioreactor design will be constructed.

4. Similarly, for the initial years of the development and depending on effluent discharge standards, the plant's filter system may take the form of either: (i) A proprietary package system or (ii) Stage 1 of the plant's ultimate filtration system.

5. The water recycling plant will be designed to meet the requirements of the Australian Guidelines for Water Recycling (NRMMC, 2008) and its proposed effluent discharge licencing conditions and will include unit processes for disinfection.

D. *Details on the proposed use(s) of the recycled water and how this will be managed, particularly with respect to runoff into waterways and the need for buffer zones:*

1. It is proposed that recycled water be directly employed for: (i) Irrigation of sporting fields and public spaces and (ii) Toilet flushing and washing machines.

2. Rainwater tanks are to be used for household irrigation and as a cold water source for washing machines.

3. During periods of high water demand, the potable water supply will be used as a 'top-up' source for the recycled water supply system. Water sensitive urban design will provide further water demand reductions reducing irrigation water needs by retaining runoff within the development area.

4. Water sensitive urban design stormwater control features such as drainage swales, porous paving and retention of natural drainage paths and streams will be employed.

5. Further investigation of overland stormwater capture will be conducted as part of the stormwater management plan.

6. The water recycling plant will be designed to meet the requirements of the Australian Guidelines for Water Recycling (NRMMC, 2008) and its proposed effluent discharge licencing conditions and will unit processes for first flush containment.

7. A licence under the Protection of the Environment Operations Act 1997 is likely to be required for any proposed releases of recycled water into receiving waters, which will be considered in the environmental assessment.

E. *Details of the impacts and management of wastewater and infrastructure, including impacts from discharges for the recycled water plant (both wastewater and surplus treated water):*

1. The ephemeral creeks proposed as options for discharge of excess recycled water are located in the northern parts of the development area adjacent to the proposed water recycling plant location. Both creeks eventually discharge to the Queanbeyan River below Googong Dam to the north of the Googong Dam Road causeway.
2. Concept infrastructure facilities are detailed in Figures 3 and 4, for water and wastewater management respectively.
3. The preferred integrated water cycle management option for Googong comprises the following key elements: (i) Water recycling plant, (ii) Potable and recycled water distribution system, (iii) Wastewater collection system, (iv) Stormwater management system, (v) Water pumping stations, (vi) Sewage pumping stations and (vii) Potable water and recycled water reservoirs.
4. Infrastructure for the integrated water cycle management strategy will be staged over time to meet the needs of the development as the development grows. Components of the infrastructure will be provided in stages to meet population growth within the development. Such infrastructure includes: (i) Bulk potable water pumping station and rising main, (ii) Potable water distribution system, (iii) Potable water reservoirs (including potable water chlorination and pH adjustment chemical dosing equipment), (iv) Water recycling plant, (v) Recycled water distribution system, (vi) Recycled water pumping station, odour control system and rising mains, (vii) Recycled water reservoirs, (viii) Wastewater collection system and (ix) Wastewater pumping stations and rising mains.
5. The ANZECC Water Quality Guidelines for aquatic ecosystems (ANZECC, 2000) will be considered in design of the water recycling plant with respect to any necessary discharges of recycled water during times of low recycled water demand. Indicative trigger values for some parameters include (i) TP = 20 µm, (ii) FRP= 15 µm, (iii) TN= 250 µm, (iv) NOx= 15 µm, (v) NH4= 13 µm, (vi) DO= 90 to 110% saturation and (vii) $6.5 \leq pH \leq 7.5$. If discharges to receiving environments are considered necessary, water recycling plant design requirements will also consider the known ambient receiving water quality.
6. The design of the potable and recycled water systems will be based primarily on the guidelines published by the Water Services Association (WSA) of Australia with due consideration of the water consumption minimisation measures to be adopted in the development control plans created for the development.

F. *Wet weather effluent storage requirements, the location of infrastructure within riparian areas and details of any dry and wet weather sewage overflows, including the predicted frequency of overflows and contingency measures to minimise infiltration:*

1. The wastewater collection system will be a modified gravity sewerage system, which will be modified to reduce infiltration. This type of system is a recent development in the delivery of wastewater collection services in Queensland (any new area in the Gold Coast) and NSW (Mulgoa, Wallacia, Silverdale, Upper Blue Mountains) and are commonly termed: smart sewers, reduced infiltration gravity sewers (RIGS), reduced infiltration sewerage systems (RISS) or modified gravity sewerage systems.

   RISS aims to minimise the potential for rain and ground water infiltration, and the potential for sewage exfiltration, and therefore has a number of sustainability and environmental benefits.

2. A stormwater management strategy utilising the principles of water sensitive urban design, will be developed that mitigates the potential impacts of the development such as: (i) Stormwater quality, (ii) Riparian zones, (iii) Water balance and stream forming flows, (iv) Stormwater peak flows and flood risk and (v) Construction phase impacts.

3. The key objectives of the strategy will be developed to achieve the following performance: (i) A reduction of 1-in-3 month stormwater peak runoff flow to pre-development levels with release of captured flow over a period of 1–3 days, (ii) A reduction of five year ARI and 100 year ARI stormwater peak run off flows to predevelopment levels, (iii) To ensure that residential land is flood free for the 100 year ARI storm event and provide safe, evacuation routes, (iv) Maintaining the existing hydrological regime for stream forming flows, with respect to peak flows and duration of flow, (v) Compared to predevelopment, a reduction in average annual stormwater pollutant export load of:

   • Gross pollutants (>5mm) by 90 per cent,

   • Suspended solids by 85 per cent,

   • Total phosphorus by 65 per cent,

   • Total nitrogen by 45 per cent, and

   (vi) To maximise the efficient use of land by integrating stormwater management strategies into public open space and roadways.

4. The proposed stormwater management strategy incorporates the following measures to manage and mitigate the impacts of the proposed development: (i) Stormwater treatment facilities such as GPT's, bio-retention swales and basins, (ii) Stormwater detention systems, (iii) Roof water run-off collection and re-use for non-potable

water uses, (iv) Flood risk management using flood planning levels, (v) Construction phase management provisions, which include implementation of erosion and sediment control strategies and (vi) Possible inclusion of overland stormwater storage and reuse.

5. A full risk assessment will identify hazards associated with operations such as accidental spills and sewerage overflows. Mitigation measures will be included in the statement of commitments and will be outlined in CEMP and OEMP.

6. Within NH1A and other development areas within the same broad catchment, it is proposed to provide four large detention basins to control the flows from the development site. There will be two basins in NH1A to be located within open space areas. These basins would be connected via a series of open channels and swales at the development site, and would be adopted in conjunction with tree pits.

7. The approach to water cycle management will affect the potential impacts on aquatic biodiversity. A desktop assessment will be undertaken to inform the current state of aquatic biodiversity and to identify any information gaps. If a physical assessment is deemed necessary it will be undertaken for the purpose of the environmental assessment. Baseline data gathered will be used to gauge the effectiveness of mitigation measures. The assessment will include examination of options for the water management system such as seasonal timing of flows for the release of recycled water to the water courses. The approach to the design and operation of the system will include consideration of treatment options for wastewater to produce the required recycled water quality, and of potential impacts on waterways due to recycled water discharges. Recommendations made with respect to sites for discharge, operational pumping and discharge regimes will be based on mitigating the impacts on aquatic biodiversity (as well as on water quality and hydrology).

   Riparian buffer zones will be incorporated into the design of water cycle management for NH1A to protect water bodies.

G. *Water cycle management plans for the area:*

1. The proposed water cycle infrastructure under this project application will provide complete water and wastewater services to the NH1A development.

2. The preferred option incorporated the following features: (i) Mandated low flow showerheads, (ii) Mandated flow controls on taps, (iii) Landscaping controls, (iv) Mandated water efficient clothes washers, (v) Rainwater tanks for all residential development, (vi) Rainwater tanks for all non-residential development, (vii) Recycled water to residential development, (viii) Recycled water to non-residential development and (ix) Water sensitive urban design.

3. Further detailed investigations were then completed on the preferred option with the expectation that this option reduces the amount of potable water imported to service the new development by **62 per cent** compared to that required for a conventional development (BASIX proxy measurement).
4. See also D1 to D4.
5. See also F5.
6. The Googong water cycle project is in pursuance of the capture of wastewater and supply of water and treated water to the new town residents of Googong, NSW…

BV Comments

- Part A, *Assessment of water quality impacts arising from the construction and operation of the project*: Baseline studies have been done, WRP will meet Australian Guidelines for Water Recycling (NRMMC, 2008), risks of construction and operation identified, and a Water Quality Monitoring Programme for both surface and groundwater would be developed and employed before and after commissioning.

  In the opinion of the technical reviewer, this topic has been Adequately Covered

- Part B, *Construction risks associated with laying pipelines, including across watercourses, erosion and sedimentation controls and management of any discharges from the project to prevent impacts to nearby watercourses must be addressed:* A water cycle management plan will be prepared for the area for stormwater management, construction impacts to waterways (such as pipelines), operational impacts of the proposed water cycle management system that will include impacts from proposed uses of RW and proposed RW discharges, construction management plans will be developed to address any water quality impacts from construction activities, no direct impact upon the Googong Dam Catchment, potential existing contaminated areas identified, and water courses identified for buffer and riparian zones.

  In the opinion of the technical reviewer, this topic has been Adequately Covered.

- Part C, *Operation details of the disinfection systems and the quality of the recycled water must be provided:* The water recycling plant will be designed to meet the requirements of the Australian Guidelines for Water Recycling (NRMMC, 2008) and its proposed effluent discharge licencing conditions and will include unit processes for disinfection.

  Operational details of the proposed disinfection systems were not specifically given for the UV irradiation and chlorine systems. Quality of the recycled water was given.

  By the strict letter of the DG requirements, this criterion was **Partially Covered.**

- Part D, *Details on the proposed use(s) of the recycled water and how this will be managed, particularly with respect to runoff into waterways and the need for buffer zones:* Details of proposed uses given, high demand periods will be topped with potable water, use of water sensitive urban design, to retain runoff within development, further investigation of overland stormwater capture to be conducted as part of the stormwater management plan and buffer zones were addressed in Part B.
  In the opinion of the technical reviewer, this topic has been Adequately Covered.

- Part E, *Details of the impacts and management of wastewater and infrastructure, including impacts from discharges for the recycled water plant (both wastewater and surplus treated water):* Potential discharge points to eventuate into the Queanbeyan River below Googong Dam, concept infrastructure facilities are detailed in Figures 3 and 4, for water and wastewater management respectively, preferred integrated water cycle management option identified that could reduce substantially reduce potable usage over traditional approaches, infrastructure for the integrated water cycle management strategy to be staged over time to meet the needs of the development such as bulk water PS, potable water distribution system, etc, ANZECC Water Quality Guidelines for aquatic ecosystems (ANZECC, 2000) to be considered in design of the water recycling plant and the design of the potable and recycled water systems will be based primarily on the guidelines published by the Water Services Association (WSA) of Australia, environmental baselines established, and a Water Quality Monitoring Programme for both surface and groundwater would be developed and employed before and after commissioning.

  In the opinion of the technical reviewer, this topic has been Adequately Covered.

- Part F, *Wet weather effluent storage requirements, the location of infrastructure within riparian areas and details of any dry and wet weather sewage overflows, including the predicted frequency of overflows and contingency measures to minimise infiltration:* A reduced infiltration sewerage system (RISS) is proposed, a stormwater management strategy will be developed to mitigate the potential impacts of the development to: (i) reduce 1-in-3 month stormwater peak runoff flow to pre-development levels with release of captured flow over a period of 1–3 days, (ii) reduce five year ARI and 100 year ARI stormwater peak run off flows to predevelopment levels, (iii) ensure that residential land is flood free for the 100 year ARI storm event and provide safe, evacuation routes, a full risk assessment will identify hazards associated with operations such as accidental spills and sewerage overflows, the NH1A development to have four large detention basins to control the flows from the development site (two basins in NH1A to be located within open space areas), and riparian buffer zones will be incorporated into the design of water cycle management for NH1A to protect water bodies.

  By the strict wording the "*predicted frequency of overflows*" was not directly addressed so this criterion is considered by the technical reviewer to be **Partially Covered.**

- Part G, *Water cycle management plans for the area:* The proposed water cycle infrastructure under this project application will provide complete water and wastewater services to the NH1A development, the PEA covered the features of the preferred option and it is stated that "The Googong water cycle project is in pursuance of the capture of wastewater and supply of water and treated water to the new town residents of Googong, NSW"

  In the opinion of the technical reviewer, this topic has been Adequately Covered.

Odour and noise requirements (also identified in the draft EAR)

DG Requirements

Under Key Issues "Air Quality" it is stated "*the EA shall include an assessment of the air quality impacts associated with the project prepared in accordance with the **Approved Methods for the Modelling and Assessment of Air Pollutants in NSW** (DEC, 2005), **Assessment and Management of Odour from Stationary Sources in NSW** (DEC, 2001) and **Technical Notes: Draft Policy: Assessment and Management of Odour from Stationary Sources in NSW** (DEC, 2001). This assessment must consider any potential impacts on nearby sensitive receptors, including future residential receptors associated with the Googong urban development area.*

Under Key Issues "Noise and Vibration" it is stated "*the EA shall include an assessment of noise and vibration impacts during construction and operation and in the context of planned urban development in the area. Construction traffic noise must also be addressed. The assessment must take into account the following guidelines as relevant: **Environmental Noise Control Manual** (EPA, 1994), **Environmental Criteria for Road Traffic Noise** (EPA, 1999), **Industrial Noise Policy** (EPA, 2000) and **Assessing Vibration: A Technical Guideline** (DECC, 2006).*

Preliminary Environmental Report Treatment

Air Quality

A. Assessment under nominated Guidelines:

1. (i) Existing local air quality would need to be determined, project emissions predicted (for construction and operation), and potential impacts assessed. Greenhouse gas emissions for the construction of the project will be in line with government guidelines (such as the NSW Greenhouse Plan 2005), (ii) Air quality modelling will be carried out to assess proposed emissions for the water cycle infrastructure (odours from infrastructure), along with mitigation and management recommendations for infrastructure design, (iii) Standard soil and water mitigation measures for water infrastructure construction would be adopted, (iv) Dust control measures will be used during construction as required, for example on excavation sites and dirt roads and (v) All measures will be included in the statement of commitments and outlined in the CEMP and Operation Environmental Management Plan (OEMP).

B. *Assessment of potential impacts on nearby sensitive receptors, including future residential receptors associated with the Googong urban development area*:

1. Reduced air quality within the study area associated with rural-residential land uses are likely to occur on an occasional basis only, and may stem from dust or particulates generated from farming activities during dry periods and from smoke and ash released during controlled burning and bushfires.
2. The Cooma Road Quarry presents a potential source of air pollution for the study area. Blasting, crushing and other quarrying activities, vehicle movements on unsealed surfaces and windborne particles picked up from exposed surfaces, may generate dust pollution.
3. The water recycling plant will be located within the northeast corner of the development area… The location of the plant has been selected to minimise the potential impact on residents and optimise the use of Googong Dam Road as a maintenance and service vehicle corridor, consolidating maintenance and service vehicle movements for the development with similar movements for the existing Googong Water Treatment Plant.
4. The water recycling plant will be designed to meet the requirements of the Australian Guidelines for Water Recycling (NRMMC, 2008) and its proposed effluent discharge licencing conditions and will contain unit processes for odour control.
5. It is proposed that parts of the plant be located within 200m of the proposed residential development. A number of issues will need to be carefully considered during the detail design to minimise the impact of the plant on future nearby residents and achieve an environmentally viable 200m buffer. These issues include impacts associated with lighting, noise, odour, vehicle movements and visual amenity.
6. The large part of the pumping stations will be below ground with the roof slab, access lids, vent shaft, odour control facility and switchboard being visible above ground.

<u>Noise</u>

A. Assessment under nominated Guidelines:

1. A construction and operational noise and vibration assessment would be undertaken for the project (focussing on the impact of traffic noise for future dwellings). Specific potential impacts of water cycle infrastructure will be considered. This would involve: (i) Identification of all noise sensitive receivers, (ii) Noise monitoring for baseline noise levels, (iii) Modelling and predictions of noise levels, (iv) The potential impacts will be minimised by the design and siting of the infrastructure within the development, (v) Activities would be organised so that noise and vibration impacts are minimised during

construction and operation, (vi) Construction activities that could potentially produce significant noise and vibration levels would be scheduled during practicable hours and (vii) Measures will be included in the statement of commitments and outlined in CEMP and OEMP.

B. *Assessment of noise and vibration impacts during construction and operation and in the context of planned urban development in the area:*

1. See A1 above.

C. *Construction traffic noise must also be addressed*:

1. A construction and operational noise and vibration assessment would be undertaken for the project (focussing on the impact of traffic noise for future dwellings).

BV Comments

Air Quality

- Part A, Assessment under nominated Guidelines ***Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*** *(DEC, 2005),* ***Assessment and Management of Odour from Stationary Sources in NSW*** *(DEC, 2001) and* ***Technical Notes: Draft Policy: Assessment and Management of Odour from Stationary Sources in NSW*** *(DEC, 2001):* Air quality modelling will be carried out to assess proposed emissions for the water cycle infrastructure (odours from infrastructure), along with mitigation and management recommendations for infrastructure design, but I did not see these guidelines specifically mentioned (perhaps I missed it?), even in the Reference list.

  In the technical reviewer's opinion, this criterion was **Partially Covered.**
- Part B, *Assessment of potential impacts on nearby sensitive receptors, including future residential receptors associated with the Googong urban development area*: Present air quality issues and sources were identified, the location of the WRP has been located to minimise impact on residents, WRT is to be designed to meet the requirements of the Australian Guidelines for Water Recycling (NRMMC, 2008) and its proposed effluent discharge licencing conditions and will contain unit processes for odour control, during the detail design of the WRP a number of considerations are proposed to achieve an environmentally viable 200m buffer (including impacts associated with lighting, noise, odour, vehicle movements and visual amenity), and pump stations will be below ground with the roof slab, access lids, vent shaft, and odour control facility.

  In the technical reviewer's opinion, this topic has been Adequately Covered.

Noise

- Part A, Assessment under nominated Guidelines ***Environmental Noise Control Manual*** *(EPA, 1994),* ***Environmental Criteria for Road Traffic Noise*** *(EPA, 1999),* ***Industrial Noise Policy*** *(EPA, 2000) and* ***Assessing Vibration: A Technical Guideline*** *(DECC, 2006):* A construction and operational noise and vibration assessment would be undertaken for the project that would specifically include modelling and predictions of noise levels but I did not see these guidelines particularly mentioned (perhaps I missed it?), even in the Reference list.

In the technical reviewer's opinion, this criterion was **Partially Covered.**

- Part B, *Assessment of noise and vibration impacts during construction and operation and in the context of planned urban development in the area:* A construction and operational noise and vibration assessment would be undertaken for the project (focussing on the impact of traffic noise for future dwellings). Specific potential impacts of water cycle infrastructure will be considered. This is to involve: (i) identification of all noise sensitive receivers, (ii) noise monitoring for baseline noise levels, (iii) modelling and predictions of noise levels, (iv) the potential impacts will be minimised by the design and location of the infrastructure within the development, (v) activities would be organised so that noise and vibration impacts are minimised during construction and operation, (vi) construction activities that could potentially produce significant noise and vibration levels would be scheduled during practicable hours and (vii) measures will be included in the statement of commitments and outlined in CEMP and OEMP.

  In the opinion of the technical reviewer, this topic has been Adequately Covered.

- *Part C, Construction traffic noise must also be addressed*: A construction and operational noise and vibration assessment would be undertaken for the project (focussing on the impact of traffic noise for future dwellings).

  In the opinion of the technical reviewer, this topic has been Adequately Covered.

Recycled water production – volume and quantity (identified in the draft EAR, Water Balance Report and Land Capability Report)

DG Requirements

None were specifically stated.

Preliminary Environmental Report

1. The proposed new town will utilise contemporary environmental and social sustainability processes, incorporating a host of major initiatives ranging from walkable neighbourhoods and energy efficiency to water reuse and savings that will target reductions in potable water use of 60–70 per cent compared to traditional developments.
2. A number of scenarios have been considered for the complete integrated water cycle management of Googong new town. The preferred scenario was selected with consideration of the following project objectives and water sustainability criteria: (i) Achieve at least a 50 per cent reduction in potable water demand and target up to 70 per cent reduction, (ii) Gain stakeholder endorsement, (iii) Protection of Googong Dam, and (iv) Be economically feasible.
3. The preferred option incorporated the following features: (i) Mandated low flow showerheads, (ii) Mandated flow controls on taps, (iii) Landscaping controls, (iv) Mandated water efficient clothes washers, (v) Rainwater tanks for all residential development, (vi) Rainwater tanks for all non-residential

development, (vii) Recycled water to residential development, (viii) Recycled water to non-residential development and (ix) Water sensitive urban design.

4. Googong New Town Concept Design, Site Water Balance Assessment (Dec 09). At full development, the recycled water system will use between 71 and 73% of the wastewater generated in the new town for the case where rainwater tanks are adopted.

   The recycled water system will use approximately 62 to 65% of the wastewater generated in the new town. Eliminating the use of rainwater tanks as a substitute for some water uses in preference to the use of recycled water will increase the volume of wastewater recycled in the new town to 80% at the same time as decreasing water demand reductions to approximately 55%.

BV Comments

1. *Googong New Town Concept Design, Site Water Balance Assessment (Dec 09).* A proper error analysis should have been conducted to allow the reader to fully appreciate the significance of the numbers generated. It is likely the error in the analyses could be at least +/- 10%, which makes the comparison of alternatives in this study more circumspect.

2. *Googong Land Capability Assessment Report, dated 13 Dec 2009.* The statement just under Table S3

Component	Class	Scenario	
		With rain water tanks	Without rain water tanks
Reuse (%)	Recycled water	67	75
Discharge (ML/yr)	Recycled water	78	60
Irrigation (ML/yr)	Rain water	24	0
	Recycled water	57	58
	Potable water	52	75
	Total	133	133

   "*In the NH1A Stage the level of reuse of recycled water was 67% with rainwater tanks and 75% without tanks*" means little if the error bounds are + / - 10%.

3. The recycled water production – volume and quantity can only be adequately assessed if accompanied with a proper error analysis.

Attachment A: Scope of Review (as per proposal)

Separable Portion (SP) 1: Process & Treatment Details

Tasks	Separable Portion 1 Process & Treatment Details Tasks
1	Review of all Assumptions (as related to the overall process design)
2	Review of Process Selection (includes primary, secondary and tertiary treatment processes)
3 to 7	Preliminary check of biological design with spreadsheet
6	Review of odour system methodology and equipment (does not include odour modelling)
8	Review of Plant Layout (assumes site plans are made available)
9	Review of Proposed Staging (assumes growth projection data is made available)
10	Value Engineering (includes review of equipment selection, particularly those pieces that contribute heavily to O&M; comment only on GHG emissions and carbon footprint; assumes all equipment spec are made available)
11a	Checking whether CDR conforms with DG Part 3a Concept Plan and Stage 1 Project Application (bullet points as given in RFP)
11b	Review and comment on the projected potable water savings and recycled water use (referring to Water Balance Report and Land Capability Report)
12	Writing of Report (Memo style report has been assumed)

Separable Portion (SP) 2: Potable Water & Bulk Distribution

Task No	Separable Portion 2 Potable Water
1	**Potable Pump and Storage Facilities** (Inc review of hydraulic design to check pump sizing and storage volumes; assumes all detail is given to do this, eg pump specification, valve specs, tank size(s) and overall layout of distribution system; does not incl
2	Distribution System (as in Task 1)
3	Other
4	Report (allows for a memo type report)

Separable Portion (SP) 3: Sewage Pump Stations and Rising Mains

Task No	Separable Portion 3 SPS and Rising Main Tasks
1	**Sewage PS and Storage** (Inc review of hydraulic design to check pump sizing; assumes all detail is given to do this, eg pump specification, valve specs, and overall layout of sewerage system; does not include complete hydraulic model)
2	**Rising Mains** (part of Task 1 above but will also include pipe sizes and layout of sewerage)
3	Other
4	Report (allows for a memo type report)

Separable Portion (SP) 4: Recycled Water & Bulk Distribution

Task No	Separable Portion 4 Recycled Water Tasks
1	**Recycled Water PS and Storage** (Inc review of hydraulic design to check pump sizing; assumes all detail is given to do this, eg pump specification, valve specs, and overall layout of pipework)
2	**Distribution System** (part of Task 1 above but will also include pipe sizes and layout of the grid)
3	Other
4	Report (allows for a memo type report)

Attachment B: Director Generals Requirements

Note that the attached nested file (on the right) from Chris Wilson, Executive Director, Major Project Assessments (delegate of the Director-General) to Mr Mark Attiwill, Project Director, Canberra Investment Corporation (undated, but reference S08/01819) that contains the Director General's requirements (DGR) prepared following the Planning Focus Meeting held on 11 Dec 08 and in consultation with the relevant government agencies.

DGR given to BV

This document was used to assess whether the Preliminary Environmental Assessment complied in the areas nominated in the original project brief.