HUMMOCK HILL SUPPLEMENTARY EIS

Response to Water and Sewerage Issues

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1. INTRODUCTION

1.1 Purpose

Cardno were previously engaged to undertake a feasibility investigation into the provision of water and sewerage services to the proposed Hummock Hill Island Development. The *Hummock Hill Feasibility Investigation* (Cardno, 2007) formed part of an overall Environmental Impact Statement (EIS) for the development, which was advertised for public comment in December 2007.

During the advertising period, several submissions were received from interested parties with comments on the various components of the EIS. Consequently, a Supplementary EIS is to be prepared which addresses the matters raised in the submissions.

In completing this report, Cardno have explored the issues raised in relation to the EIS and have prepared a supplementary report in response to the issues. The main issues raised in the submissions which are covered in this report relate to:

- Overall Water Management Strategy – this is addressed in section 3.1
- Impacts of sewage overflows – addressed in section 5.3;
- Technology proposed for desalination and sewage treatment plants – refer to sections 3.2.1, 4.1 and 5.1;
- Other potential water supply solutions – addressed in section 3.1.2; and
- Sustainability of irrigation with recycled water –addressed in section 5.2.

1.2 Abbreviations

AD	Average Day
ADWF	Average Dry Weather Flow
DNRM	Department of Natural Resources & Mines (now DNRW)
DNRW	Department of Natural Resources & Water
EP	Equivalent Person
ET	Equivalent Tenement
kL	Kilolitre
L/EP/day	Litres per equivalent person per day
L/hh/d	Litres per household per day
L/p/d	Litres per person per day
MD	Maximum Day
MDMM	Mean Day Maximum Month
MH	Maximum Hour
ML	Megalitre
NPV	Net Present Value
RWTP	Recycled Water Treatment Plant
STP	Sewage Treatment Plant
WTP	Water Treatment Plant

2. BACKGROUND

Hummock Hill Island is located in Rodds Bay, 30km south of Gladstone and 500km north of Brisbane. It is within the newly formed Gladstone Regional Council.

Eaton Place Pty Ltd holds a development lease over approximately 1,200 hectares of the island and proposes to develop about one third of this area for a community of approximately 4,500 visitors and residents. The development comprises over 2000 lots, with properties ranging from large, seaside lots to golf course properties and apartments.

In addition to the holiday and permanent residential lots, the proposed Hummock Hill Island Development will comprise a golf course, two hotels, a conference centre, education campus, town centre, marine centre, Caravan Park, school recreational camp ground and an airstrip.

Development is planned to proceed in an environmentally sensitive manner, considering the principles of sustainable development. As such, a number of water cycle design objectives have been identified. These were previously detailed in the *Hummock Hill Island Development Master Plan* (SKM, March 2005) and are restated below:

- Limited reliance on water resources from the mainland;
- Sustainable utilisation of on-island water resources to ensure that groundwater and wetland resources are not depleted or degraded;
- Maximisation of site based water management including roof catchment collection and reuse of greywater;
- Provision of a safe potable water supply that meets Australian Drinking Water Quality guidelines;
- Maintenance of human health and in particular avoidance of exposure to pathogens and coliforms;
- Maintenance of a reliable water supply for fire fighting; and
- Minimisation of discharges of treated water to natural systems, with no discharge in dry weather.

3. WATER CYCLE MANAGEMENT

3.1 Scheme Concept

The preferred scheme identified for the development includes the following key components:

- The provision of a potable (drinking) water supply from a desalination plant (or mainland supply if more appropriate);
- Rainwater tanks on each property for capture of roofwater for internal, non-potable uses (eg laundry, hot water, shower, etc);
- Reticulation of recycled water to households for toilet flushing and external irrigation;
- An on-site sewage and recycled water treatment plant; and
- A wet weather storage to balance recycled water production and demand.

It should be noted that rainwater is NOT intended for potable supply purposes.

By utilising a range of water sources, water supply for the development is not reliant on only a single source of supply. This provides additional security and ensures a robust yet flexible water cycle solution. The overall solution is also based on a “no discharge” philosophy. Therefore reuse of treated wastewater along with alternative disposal methods for both solid and liquid waste streams from the STP and WTP have been considered.

Each of the elements of the proposed scheme are discussed further below.

3.1.1 Water Balance

The following household water balance was adopted for the development:

Location		**Typical Uses**	**Consumption**	
			L/p/d	**L/hh/d** [1]
Internal	Kitchen	Drinking, cooking	13	29
	Bathroom	Washing hands, cleaning teeth, shower	55	121
	Toilets	Toilet flushing	24	53
	Laundry	Washing Machine, hand clothes washing	27	59
	Hot Water	Shower, Dishwashing, hand basins	58	128
External	Garden	Garden irrigation		175
	Other	Car washing, etc		25
Total Household Use			**177**	**589**

For comparison, we can apply the above water balance to a standard residential property. Based on an estimated occupancy of 2.7persons per household, the total household demand becomes 678L/d (177 x 2.7 + 200), which is around 15% lower than the current demand of approximately 800L/p/d in say the Tannum / Boyne area. This is reasonable, particularly considering the improvements in water efficient appliances and fittings, and the increased awareness of water conservation in the community. This also equates to 250L/p/d (total demand) which is just above the "Target 230" included within the Draft *South East Queensland Regional Water Strategy* (QWC, March 2008).

3.1.2 Water Supply

Two options were considered to provide a supply of potable water to the development - a desalination plant and a pipeline from the mainland supply.

Preliminary analysis indicated that cost of either option was quite similar. The desalination plant was suggested as the preferred option for the following reasons:

- Alignment with the desired objectives for the development by ensuring that it is not reliant on a water supply from the mainland;
- Desalination is a non climate dependent source and so provides long term security of supply; and
- The plants are modular in nature and as such the final capacity of the plant can be determined when better information on consumption trends for the development become known.

Other suitable options for the supply of water can be considered during detailed planning and design for the development.

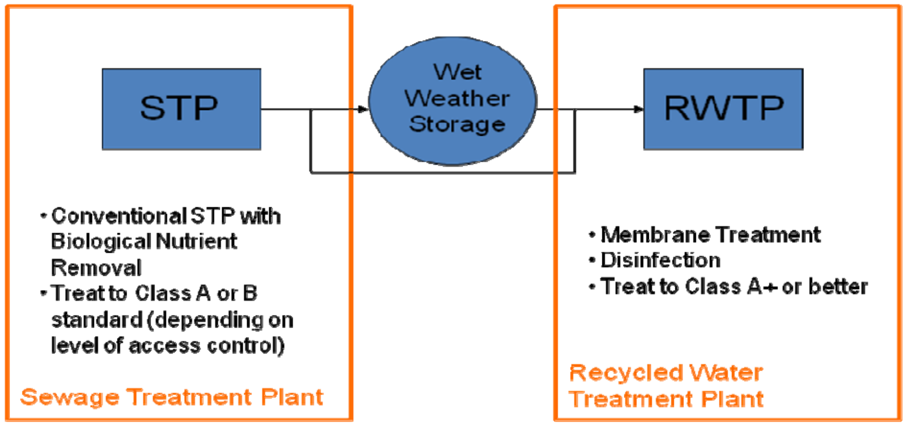
A pipeline from Awoonga Dam to Agnes Waters / 1770 is currently under consideration and may also provide a viable alternative.

Further detailed analysis and consultation with Gladstone Area Water Board (GAWB) and Gladstone Regional Council will be required to ensure that the proposed solution is consistent with their long term supply strategy for the area.

3.1.3 Sewage

An on-site sewage treatment plant will be constructed to service the development. The plant will produce highly treated recycled water (Class A+ standard), suitable for reticulation to individual households for external use and toilet flushing.

The concept for the treatment process is noted below. Note that whilst the Sewage Treatment and Recycled Water Treatment Plants are schematically indicated to be separate plants, they will likely be a single plant, with specific treatment trains to meet the quality requirements for each component.



The Sewage Treatment Plant (STP) will treat the influent to Class A or B standard – suitable for irrigation of the golf course and air strip. The Recycled Water Treatment Plant (RWTP) will further polish the water to Class A+ standards – which is suitable for reticulation to households.

As recycled water demand will not exactly match sewage generation rates, a wet weather storage will be constructed. Preliminary calculations suggest that this storage will be approx 100ML however this will need to be confirmed during detailed planning. Due to the size of the open storage, it will contain Class B effluent only, and be used to supply a Class A+ recycled water plant for reticulation around the development. Quality of the effluent will be maintained in accordance with the Recycled Water Management Plan developed for the site.

The water balance for the site is based on a "no discharge" philosophy. It is anticipated that reuse of recycled water at the household level will utilise a large proportion of the recycled water, with any additional water used for irrigation of open space, the golf course, and the airstrip. Analysis has indicated that there will be a shortfall of recycled water to meet the anticipated demand across the development, which will be supplemented from the potable supply. Thus, by utilising the storage to balance demand, there should be no discharge from the site during normal operating conditions.

The only foreseeable causes for discharge from the site are extreme weather events and/or catastrophic plant failure. To mitigate the risk of this storage will be provided both within the network and at the STP to cater for above average flows and it is anticipated that the wet weather storage could be also used as an emergency bypass for the plant (with the water passing through the plant again for treatment prior to reuse or irrigation) in the event of plant failure. Further, the water cycle strategy for the development has maximised the use of recycled water and design of the sewerage system will be such that infiltration will be minimised, and as such the emergency discharge point would be utilised during extreme events only.

Whilst the above measures provide a robust mechanism to cater for a range of events, it is still prudent to allow for an emergency overflow point for extreme weather events or catastrophic plant failure. This discharge point will be above HAT on the non-tidal area of the island and as such will not impact on the declared Colosseum Fish Habitat Area.

The plant will be located in the utility area, away from residents. Appropriate buffer distances and/or treatment measures will be required to ensure that the plant meets EPA requirements for noise and odour. This is likely to involve provision of acoustic covers for equipment and ensuring that some components of the STP (eg inlet works) are covered and the air scrubbed prior to release. The wet weather storage can either be located adjacent to the utility area, or within the golf course precinct. As the water would be Class B (and thus not suitable for human contact) a storage located within the golf course precinct would need to have restricted access to manage any potential human health or environmental impacts.

3.1.4 Rainwater Tanks

Rainwater tanks will be used to supplement supply to households. The collected roofwater will be used for internal, *non-potable* uses such as laundry and hot water.

Rainwater tank modelling has indicated that a yield of around 120L/d could be obtained from a 22kL tank, while a 45kL tank would provide 215L/d. The analysis was based on a 50 year daily rainfall record and an occupancy of 2.5 persons per household. If necessary, the rainwater tanks could be topped up with potable water (or potentially recycled water should regulations change in the future).

3.1.5 Recycled Water

As a proposed Island community, Hummock Hill faces two key challenges from a water cycle perspective – securing a sustainable supply of water and managing treated wastewater. One method to assist in managing both of these issues as well as attaining the water cycle objectives noted in section 2 is to use recycled water as a supplementary source of supply.

The *Queensland Water Recycling Guidelines* (December 2005) nominate a range of appropriate uses for varying recycled water qualities. Within the urban context, Class A+ recycled water is required for reticulation to householders, and is considered suitable for toilet flushing and external uses (such as garden irrigation). The quality parameters for Class A+ are listed below:

Parameter	Value
Chlorine	>0.5mg/L in 95% of samples
Clostridium perfringens	<1 cfu/100 mL in 95% of samples
E.coli	<1 cfu/100 mL in 95% of samples
F-RNA bacteriophages	<1 pfu/100 mL in 95% of samples
Somatic coliphages	<1 pfu/100 mL in 95% of samples
Turbidity	<2 NTU in 95% of samples

In addition to the above, the *Draft Water Quality Guidelines for Recycled Water Schemes* (June, 2008) sets out the specific log reductions required for Class A+ recycled water. The treatment train needs to be adequate to achieve a 5 log reduction in Bacteria, Protozoa and Helminths and a 6.5 log reduction of viruses.

On July 1st, 2008 the *Water Supply (Safety and Reliability) Act 2008* (the Act) came into effect in Queensland, administered by the Queensland Department of Natural Resources and Water (DNRW). The Act supersedes the previous *Queensland Water Recycling Guidelines*, December 2005 which were regulated by the EPA. The Act includes provisions for recycled water with the aim of:

- Protecting public health
- For critical recycled water schemes, ensuring continuity of operation to meet essential water supply needs.

For schemes commencing supply after 1 July 2009 an approved Recycled Water Management Plan (RWMP) (or exemption) must be in place before supply of recycled water commences. A RWMP is a documented risk based system for managing production and supply of recycled water. The steps involved in preparation of a RWMP are:

1. Assemble Risk Assessment Team
2. Document description the treatment system (including source water), uses, recycled water quality and levels of exposure
3. Identify hazards and assess risks
4. Determine Critical Control Points, Quality Control Points and control measures
5. Establish critical limits for each control measure
6. Establish monitoring, validation and verification programs
7. Prepare management procedures and corrective actions

Steps 1-5 take a HACCP approach to the management of risks and will be undertaken during the detailed planning and design of the scheme. Validation and verification of the scheme are newer concepts and will need further discussion and liaison with DNRW to determine the specific requirements for each scheme.

Fire Fighting

The Queensland Fire and Rescue Service (QFRS) have endorsed the use of Class A+ recycled water for fire fighting. Within the Hummock Hill development, it is proposed that the fire fighting capacity is included within the recycled water network and storages. This will include a recycled water tank (approx 1.5ML capacity, co-located with the potable water tank) and a pressurised reticulation network. Through the detailed design phase, network analysis will be undertaken to size the water and recycled water mains to ensure that adequate flow and pressure are able to be provided.

Where necessary for commercial / industrial uses (eg the airstrip), dedicated fire tanks will be provided.

3.2 Other Considerations

As with any future development scenario, it is important to ensure that proposed solutions are compatible with the future context. The proposed solution for Hummock Hill Island is sufficiently flexible that a range of future events could be incorporated into the final solution.

3.2.1 Technology changes

Further detailed analysis and design will be required before any solution is accepted by regulatory authorities and ultimately constructed on the island. To establish the feasibility of the development, comments have been made within the EIS (and this supplementary report) regarding possible technology options for Desalination and Sewage / Recycled Water Treatment. These technologies are considered to be suitable options for the development, however, it should be noted that the Proponent has not committed to one particular technology. There are many other viable solutions which can be considered. For example, Membrane Bioreactors (MBRs), Sequencing Batch reactors (SBRs) with Ultra filtration, or other proprietary package systems would be suitable for the STP / RWTP.

The new *Water Supply (Safety and Reliability) Act 2008* requires any proposed plants to undergo a “Pre-Commissioning” phase whereby the performance of the plant in relation to water quality and log removals of pathogens and viruses are established during design. For established technologies, a series of agreed parameters can be used to demonstrate that adequate disinfection is achieved, however unproven technologies will require a more rigorous assessment. This provides a robust process to ensure that public health is protected.

At this feasibility level it is most important to ensure that the objectives and principles for water cycle management on the island are clear. The most appropriate solution to meet these objectives can be identified and developed in the future to provide a sustainable water cycle management solution. New technologies can then be considered (once proven) to ensure that the most appropriate technology is selected at the time of establishment.

It should also be noted that treatment technologies (eg the desalination plant and sewage treatment plant) are quite scaleable, and thus can be constructed in several stages. The staging of the plants will allow for periodic review of the key parameters for the design and the evaluation of alternative technologies should they prove suitable.

3.2.2 Purified Recycled Water (PRW)

Over the past 2 years, there has been significant change in community attitudes towards recycled water. In particular, Purified Recycled Water (highly treated recycled water suitable for discharge into a drinking water storage dam) has gained increasing public support, to the extent the Western Corridor Water Recycling Project will now deliver PRW to Wivenhoe Dam to supplement drinking water supplies in South East Queensland. Without the benefit of a surface water storage for drinking water on the Island, the use of PRW for this purpose on Hummock Hill Island is not feasible.

However, it is conceivable in this context that future regulations may allow for the direct discharge of recycled water into the drinking water network – termed direct potable reuse. Whilst this has not been explicitly allowed for on Hummock Hill Island (or in any existing regulations), it could be incorporated within the proposed solution should regulations and community attitudes allow this in the future.

4. WATER SUPPLY

4.1 Desalination Plant

A supply of potable water is proposed to be provided from a Desalination plant on the Island. Desalination technology is particularly suitable for island communities such as Hummock Hill Island. As noted in *the SEQ Regional Drought Strategy* (WaterForever, 2005), "There are at least 20 desalination plants in Queensland. Ten of these are seawater desalination plants, including five on the Torres Strait islands and one on Hamilton Island."

As discussed in Section 3.1.2, desalination is one of several possible options for supplying water to the island, however at this stage is considered to be the most favourable option. Further detailed analysis (including analysis of ocean impacts) will be required to confirm this. Several additional approvals (eg ERA) will also be required prior to construction of the plant, and these will require extensive studies and analysis to be completed.

It is proposed that seawater will be extracted from Boyne Channel via a seawater intake pump located on the northern (island side) pier of the bridge. The pump will be programmed to pump seawater during the upper half of the tidal cycle to ensure a consistent quality of raw water. A stainless steel submersible pump will be screened to prevent the ingress of debris and organisms into the pipeline. Flows in the pump will be quite low compared to current in the Boyne Channel and are not expected to entrap marine organisms. Detailed hydrodynamic modelling will be required to confirm the suitability of this location.

The process proposed in the EIS is a MVC Desalination Process (refer section 3.4.1.4 of the EIS). The process is a commercially available technology which is capable of producing high quality desalinated water from a range of operating environments and is considered to be an appropriate technology for Hummock Hill Island. Further details of the technology are provided in the MPI report included as part of the EIS.

It should be noted that the MVC process is only one potentially viable technology; a range of suitable technologies will be considered during the detailed planning and design phases to ensure that the most appropriate technology is utilised.

The water provided by the desalination plant will meet the requirements of the *Australian Drinking Water Guidelines* (2004) and the *Water Supply (Safety and Reliability) Act 2008*. Comprehensive HACCP and Drinking Water Quality Plans will be developed to ensure that any potential human health impacts are managed throughout the design and operation of the plant.

4.2 Evaporation Ponds

As part of the concept identified for the desalination plant, the EIS proposed that evaporation ponds would be used to manage the brine waste from the desalination plant.

As noted above, desalination is a potential option for the supply of water to the development. Should this prove the most appropriate option, further detailed analysis would be required to confirm the sizing, location and dimensions of the ponds. Preliminary analysis has indicated that 4 ponds, each 65m x 65m would 4 required to manage the brine stream.

The sizing has allowed for containment of a 1 in 100 year storm event. However provision will also be made for the monitoring of the salinity in the ponds during wet weather events. Should the salinity in the ponds be less than seawater, excess water can be discharged to the ocean. If the salinity is greater than seawater (and there is a potential for overflow of the ponds) the water can be blended with either seawater or recycled water prior to discharge.

It is anticipated that the ponds would be lined with either clay or a geotextile, typically with permeability less than 0.01mm/day. Specific measures such as the need for screening of the ponds and the potential for mosquito breeding would also be considered in more detail during the design phase.

5. SEWAGE TREATMENT

5.1 Treatment Technology

As part of the EIS the use of High Velocity Sonic Disintegrator (HVSD) technology has been proposed for the production of recycled water. This technology is currently used (in conjunction with other biological and chemical processes) for the *Sunrise at 1770* development.

The HVSD technology has been identified as a potentially feasible technology which could be used within in the treatment train to achieve the desired water quality. However, many other treatment technologies would also be suitable. It is difficult to specify the most appropriate technology at this point in time. It is likely tenders for the construction of the Sewage & Recycled Water treatment plants would be undertaken on a performance based specification. This means that a particular technology would not be identified upfront, but rather, the market would be asked to respond to a tender on the basis of the most suitable technologies available at the time that could produce the desired effluent quality.

Several additional approvals (including an ERA) would be required and would evaluate the proposed technology. A verification process (as noted in 3.1.5) would also be required to ensure that the plant is capable of consistently producing Class A+ recycled water.

5.2 Irrigation / Recycled Water Management Plan

As noted in section 3.1.5, a Recycled Water Management Plan will be required to manage the production and supply of recycled water. Irrigation with recycled water will therefore be managed via this mechanism. Specific plans would be required for large users such as the Golf Course and the air strip, however a broader community based management plan would need to be developed to cover the reticulated supply.

A MEDLI model (which analyses the ability of the soil to manage quantities of effluent) was prepared for the feasibility study. It identified that irrigation with recycled water could be managed at a sustainable level on the island. Further MEDLI modelling will be required as in input to the formulation of Recycled Water Management Plans to provide for the sustainable use of the Recycled Water.

5.3 Sewage Overflows

By their nature, sewerage systems are typically quite ‘leaky’. Therefore, in addition to being designed to carry sewage from properties, they also include an allowance for water infiltration into the system. Cracks in pipes, joints and illegal connections to the system are significant contributors of additional water to the sewerage network.

The additional water that enters the system during rainfall events can cause the system to overflow. Typically this sewage would be extremely dilute and historically has been discharged to a local waterway via controlled overflow structures. Increasingly, environmental regulations are tightening up on this practice and therefore mechanisms to reduce or eliminate the number of overflows from the system need to be investigated.

To reduce the frequency and extent of overflows, two main courses of action can be undertaken:

- Reduce infiltration into the sewers; and
- Provide additional storage in the system.

Naturally, one of the best ways to reduce the additional load in the sewerage network is to stop it getting there in the first place. More recent technologies such as “smart sewers” have been introduced to reduce infiltration into sewers. These systems are well sealed from the external environment and thus minimise the amount of water that enters the sewerage network.

A conventional sewerage system is typically designed to carry 5 times the average flow, or around 2.5 times the expected peak daily flow. For smart sewers, design factors are reduced to around 3-4 times the average flow, or 1.5 times the peak daily flow.

Other solutions such as pressure or vacuum sewers which also typically have low infiltration could also be considered during the detailed planning and design processes.

As can be seen from the factors noted above, whilst the amount of infiltration into the network can be reduced it is very difficult (or impossible) to eliminate it entirely. Therefore to protect sensitive environments, additional storage can be included within the network. This would typically occur at sewage pump stations and at the sewage treatment plant – where additional flow from a wet weather event is detained and released again after the event has ceased.

Design criteria for the sewerage system will need to be agreed with Council but are likely to include the following:

- Use of ‘smart sewers’ to reduce infiltration in to the system;
- Sewers designed to carry PWWF = 4 x ADWF;
- Sewage Treatment Plant to treat 3 x ADWF;
- 4hrs emergency storage to be provided at pump station and STP to cater for plant and equipment failure;
- A ‘fail safe’ emergency bypass at STP to divert flows to storage lagoons.

Any emergency overflow point will be licenced by EPA and will require further analysis to evaluate the impact on the receiving environment.

5.4 Sludge Treatment / Handling

The solid waste streams from both the sewage treatment plant and recycled water plant will require further treatment and/or disposal. Sewage sludge can be processed for beneficial uses, however the production of a suitable biosolids product is typically quite expensive – prohibitively so for small scale plants.

The most viable option for Hummock Hill Island is for the sludge to be trucked off the site and transported to Calliope River STP where it can be stabilised and disposed of in a secure landfill. Ultimately it can be incorporated into any future plans for beneficial use of the biosolids. To reduce sludge transport costs dewatering of sludge at Hummock Hill treatment facilities should be incorporated into the design.

6. NEXT STEPS

The concepts noted in the *Hummock Hill Feasibility Investigation* (Cardno, 2007) and included within the EIS are feasible options only. A range of additional studies will be required to confirm the most appropriate technology and configuration for the water cycle infrastructure on the island.

It is anticipated that the next steps in progressing these concepts are:

- Detailed planning studies
  - Evaluation of most suitable water supply source (pipeline options vs desalination)
  - Concept design for desalination plant (if appropriate – to consider available technologies)
  - Concept design of sewage and recycled water treatment plants and development of performance based specification
  - Specification (and signoff by stakeholders) on key design parameters for infrastructure on the Island
- Obtain environmental and regulatory approvals for infrastructure. This includes:
  - ERA for STP & RWTP
  - ERA for Desalination plant

  Note: Whilst not required for the construction phase DNRW approval of the scheme will ultimately be required. Discussions with DNRW during the design phase are strongly recommended to ensure the proposed scheme will comply with regulatory requirements.
- Detailed design of infrastructure components
  - Trunk sewers and water pipelines
  - Water and recycled water reservoirs
  - Sewage pump stations

All of the above will also require extensive liaison with Council regarding ownership arrangements, system design and ongoing operation and maintenance costs. This study is intended to illustrate that there are feasible options available to service the Hummock Hill Island development with water cycle infrastructure. Decisions regarding the specific components are intended to be made in close consultation with Council and based on triple bottom line evaluation criteria.

7. COMMITMENTS/OBJECTIVES

Time is an important factor in determining the most appropriate option from a water cycle perspective (particularly when it comes to technology). Therefore it is more appropriate that detailed planning and design is undertaken close to when the development proceeds. At this stage of the process, key objectives and commitments are of most value and will ensure that the principles are upheld, without having to lock in particular technology solutions.

The following commitments / objectives are recommended for inclusion in any development conditions resulting from the EIS.

- Water conservation is an integral part of the development. The proponent will demonstrate that the proposed solution provides substantial savings in potable water demand.
- In evaluating proposals for water cycle infrastructure on the Island, the proponent will consider the sustainability of the solution as well as the ongoing operational and maintenance costs for the proposals. Extensive liaison will be undertaken with Council to obtain their endorsement of the proposed solutions.

The Proponent is committed to the sustainable management of water on the island and will work closely with Council and regulatory agencies throughout the detailed planning and design phases of the project.