AQUIS RESORT AT THE GREAT BARRIER REEF PTY LTD

ENVIRONMENTAL IMPACT STATEMENT

VOLUME 4

CHAPTER 25

INFRASTRUCTURE

25. INFRASTRUCTURE

25.1 WATER SUPPLY

CRC Water and Waste (CRCWW) is responsible for the provision of water supply across the Cairns Region. The supply chain for provision of potable water to consumers is supported by five principal water infrastructure elements:

Potable Water

- Bulk Water Supply
- Treatment
- Trunk Distribution
- Reservoir Storage
- Trunk Reticulation.

Reuse Water is produced at the Marlin Coast WWTP which is also operated by CRCWW. The supply of reuse water to customers is delivered through the waste water treatment facilities at the treatment plant and a dedicated reticulation system.

25.1.1 Existing Situation

a) Potable Water Supply

Reference is made to the *Overall Water Supply Strategy for Cairns*, planning report by CRC Water & Waste of May 2009. The report reflects Council's current position on planning for potable water supply infrastructure upgrade for Cairns Urban Area into the future.

This report provides a planning horizon through to 2044 that takes into account predicted population growth of the region and the required supply infrastructure to meet these projections. It should be noted that Council has recently established a Water Security Panel, which has been established to review water supply strategy and to consider water supply demands arising from potential growth opportunities for Cairns.

The *Far North Queensland, Draft Regional Water Supply Strategy* was delivered by the Queensland Government in 2007. This report is a foundation to Councils report and provides overarching guidance to future population growth and infrastructure needs.

<u>Existing Bulk Water Infrastructure</u>

The Cairns Urban Area raw water supply is sourced from the Behana Creek and Copperlode Falls Dam producing a safe yield of 28,283 ML/a. (The safe yield is the threshold where there is no probability of the dam volume falling below 40% of capacity.)

The Council planning report indicates the current demands exceed safe yields from Behana Creek and Copperlode Falls Dam and thus upgrading and/or new sources are required to meet current and future demands.

<u>Predicted Bulk Water Demands</u>

CRCWW has prepared demand forecasts at five year intervals to be serviced by the bulk water sources. These figures have been adopted for the purpose of establishing current planned bulk water demands for the Cairns Region and are presented in **Table 25-1**.

TABLE 25-1 BULK WATER DEMANDS FOR CAIRNS URBAN AREA

Year	2009	2014	2019	2024	2029	2034	2039	2044
Total (ML/a)	26 274	28 664	31 165	33 790	36 451	39 120	41 789	44 477

Figure 4-1 illustrates the predicted bulk water demands and the current safe yield for the period of 2015 to 2034.

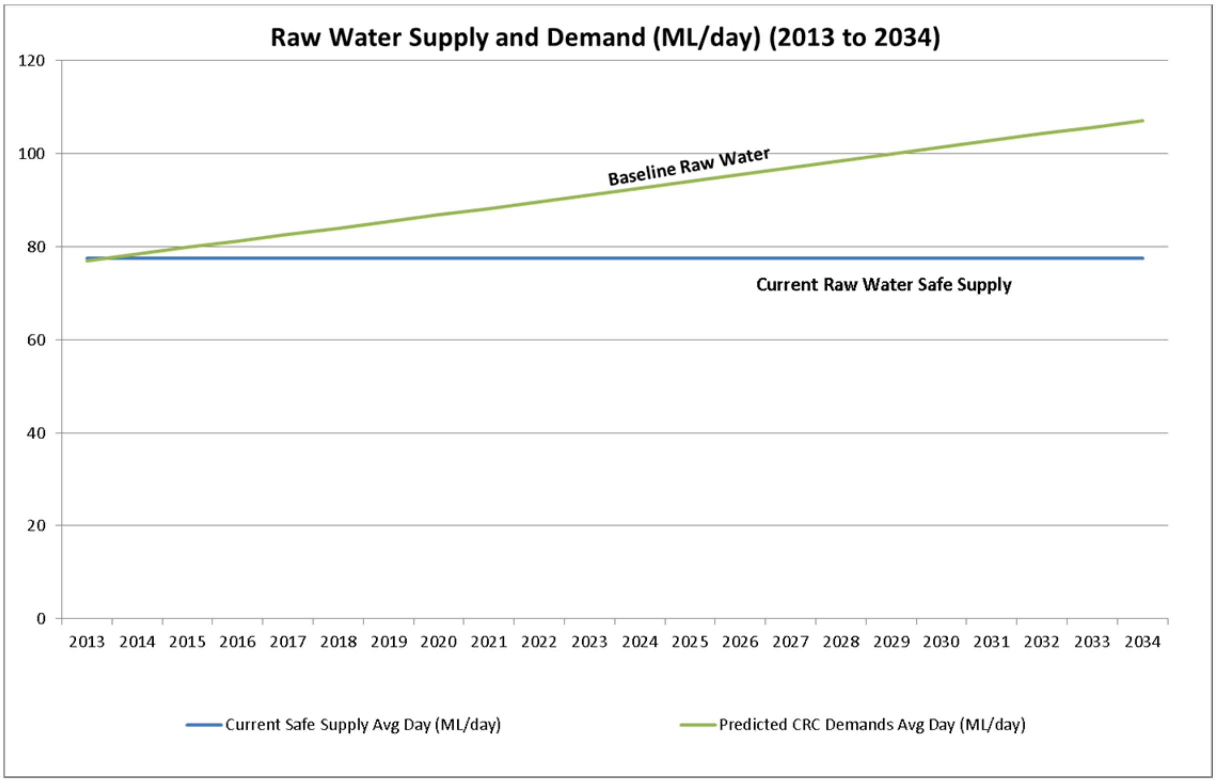

Figure 25-1 CRC forecast raw water demands and safe yield.

The figure demonstrates Cairns raw water supply sources are at safe yield threshold and new bulk water sources are required as a priority.

The *Overall Water Supply Strategy for Cairns,* planning report investigated options for augmentation of existing or new bulk water supply sources. The report found upgrading the current bulk water sources to be unfeasible and that the ***Mulgrave Aquifer*** and the ***Barron River*** are two potential sources that are suitable for future needs.

The aquifer source requires groundwater extraction from the Mulgrave Aquifer near Aloomba and is proposed to be established in two stages. The estimated source volumes are:

- Stage 1: 5475 ML/a
- Stage 2: 9125 ML/a
- Total: 14 600 ML/a

The location of the Mulgrave Aquifer stages is illustrated in **Figure 25-2**.

Figure 25-2 Locations of proposed Mulgrave aquifers.

Surface water extraction from the Barron River is situated at Lake Placid and requires a new intake and associated delivery infrastructure including a new Water Treatment Plant. The potential source volume is:

- Stage 1: 9125 ML/a
- Stage 2: 9125 ML/a
- Total: 18 250 ML/a

The location of the Barron River source is illustrated in **Figure 25-3**.

Figure 25-3 Proposed location of Barron River source.

The *Overall Water Supply Strategy for Cairns* planning report identifies that there are two preferred options for the staged implementation of these bulk water sources and these are summarised in **Table 25-2.**

TABLE 25-2 BULK WATER SOURCE PREFERRED OPTIONS

Option	Staging	Description	Proposed Timing for Implementation	Net Safe Yield ML/a
Option 1	Stage 1	Barron River Stage 1 including Kamerunga WTP	2009	34 364
	Stage 2	Barron River Stage 2	2025	43 440
	Stage 3	Mulgrave Aquifer Stage 1	2042	46 112
Option 2	Stage 1	Mulgrave Aquifer Stage 1	2009	28 224
	Stage 2	Barron River Stage 1 including KWTP	2013	37 033
	Stage 3	Barron River Stage 2	2030	46 112

The *Overall Water Supply Strategy for Cairns* planning report recommends Option 2 as the preferred strategy. Noting the proposed timing for implementation of Stage 1 of each option is for 2009, Council are yet to act on the recommendations.

CRCWW Officers have advised it is preferred to implement a 15 ML/day stage of the Mulgrave Aquifer as a short term augmentation which allows time to further explore implementation of other options including a staged Barron River source.

Figure 25-4 demonstrates the augmented capacity of the bulk water supply based upon implementation of the 15 ML/day from the Mulgrave Aquifer in 2019 and 25 ML/day from the Barron River in 2023.

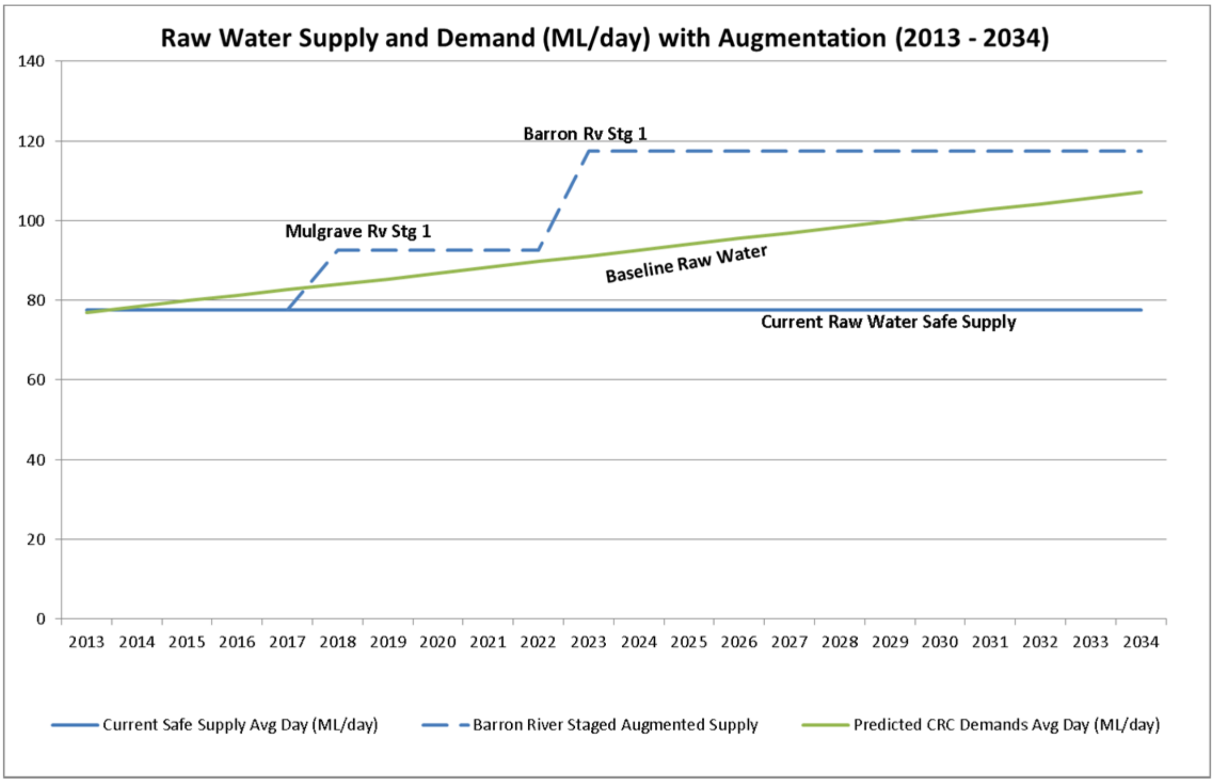

Figure 25-4 Staged commissioning of Mulgrave aquifer and Barron River sources.

The solid blue line represents the current safe bulk water supply from the Behana Gorge and Copperlode Dam sources. The sold green line is the baseline bulk water demand predicted by CRC and the dashed blue line is an option for a bulk water supply augmentation regime. Staged implementation of the Mulgrave Aquifer and Barron River supply (or similar strategy) would meet current base line growth to beyond 2034.

<u>Key Approvals</u>

CRC will be the agency responsible for the procurement of permits and licencing associated with the sourcing of new raw water sources at the Mulgrave Aquifer and the Barron River.

For the Mulgrave Aquifer, environmental licences, permits and approvals that may be required for the Mulgrave River Aquifer are summarised in the draft *Approvals and Regulation Management Plan* prepared by GHD. The report provides an overview of legislative approvals that may be required by Council for the development of a borefield to abstract and collect up to 15 ML/d and the establishment of a new Southern Water Treatment Plant (WTP).

Advice from CRCWW states that '*Council currently holds a licence to take groundwater from the Mulgrave River Alluvium with a nominal entitlement of 15,000 ML per annum. However, Council does not hold any licences or permits to authorise the construction of any infrastructure to activate the licence by way of taking groundwater'.*

In relation to the Barron River source Council also advise that 'the Department of Natural Resources and Mines (DNRM) is the licensing authority responsible for un-supplemented surface water diversion and groundwater extractions within the Barron River catchment. DNRM develop and manage the Water Resource Plans (WRP) and Resource Operations Plan (ROP).

For the Barron River catchment, the ROP has allocated a reserved water allocation of 4,000 ML/d for the Cairns City Town Water Supply. In order to release the allocation, Council is required to satisfy a number of requirements as set out in the Barron ROP to the satisfaction of DNRM.

In 2005, a submission was provided to DNRM in support of releasing the allocation. In 2006, DNRM provided a comprehensive request for further information in support of the submission. The major items included:

- An offer price per ML for the water released: The ROP establishes a water trading scheme with the price for water being based on market prices. The allocated water is however un-supplemented which is unreliable and essentially run of river.
- Investigation of the Mulgrave River Aquifer: It was necessary for Council to demonstrate a commitment to investigating alternative sources of water, including the Mulgrave River Aquifer. Council has since invested heavily into investigating the Mulgrave River Aquifer as indicated in relevant references.

The former Cairns City Council applied to the Wet Tropics Management Authority (WTMA) for a permit to construct a water extraction facility and associated pipeline at Lake Placid in 2000. This application was approved in 2001 subject to conditions. One condition of this approval is the development of a Monitoring and Impact Mitigation Management Program (MIMMP) to establish baseline conditions of the site. This has not been undertaken to date nor discussed in detail with WTMA and may extend over a period of one to two years to establish baseline conditions.

A Deed of Agreement under the Nature Conservation Act 1992 has been made between former Cairns City Council and the Chief Executive of the former Environment Protection Agency in August 2001. The Deed of Agreement authorises Cairns City Council to use an area within Barron Gorge National Park for the purpose of constructing, using and maintaining approved facilities for the extraction of not more than 50 ML/day from Lake Placid in accordance with the terms and conditions as set out in the Deed.

A referral under the Environmental Protection and Biodiversity Conservation Act 1999 was made to the then Department of Environment and Heritage (now Department of Sustainability, Environment, Water, Population and Communities) to allow the construction of a raw water pump station, intake and associated pipework and to abstract up to 50 ML/day. Department advised that the construction of the raw water pump station, intake and associated pipework and the abstraction of up to 50 ML/day did not trigger any further action.

Notwithstanding the above, this Act has not been looked at in recent times and any reactivation of the Barron River scheme may require referral to SEWPAC. Prior experience with SEWPAC in relation to the Mulgrave River Aquifer scheme indicate the Act has gone through a number of amendments, and such amendments may impact on their response to referring the action now.'

Water Treatment

Water from the Copperlode Falls Dam is treated by the Freshwater Creek Water Treatment Plant (WTP). The Freshwater Creek WTP is rated to process 120ML/d, however CRCWW has adopted a maximum treatment capacity of 110ML/d to take into account water losses in backwashing and some minor daily downtime for maintenance. The bulk water sourced from Behana Gorge is treated by screening only.

Figure 25-5 illustrates the predicted demands and water treatment capacity for Cairns from 2013 to 2034. The predicted demands are derived from treatment data presented in the CRC Water Supply Strategy Report.

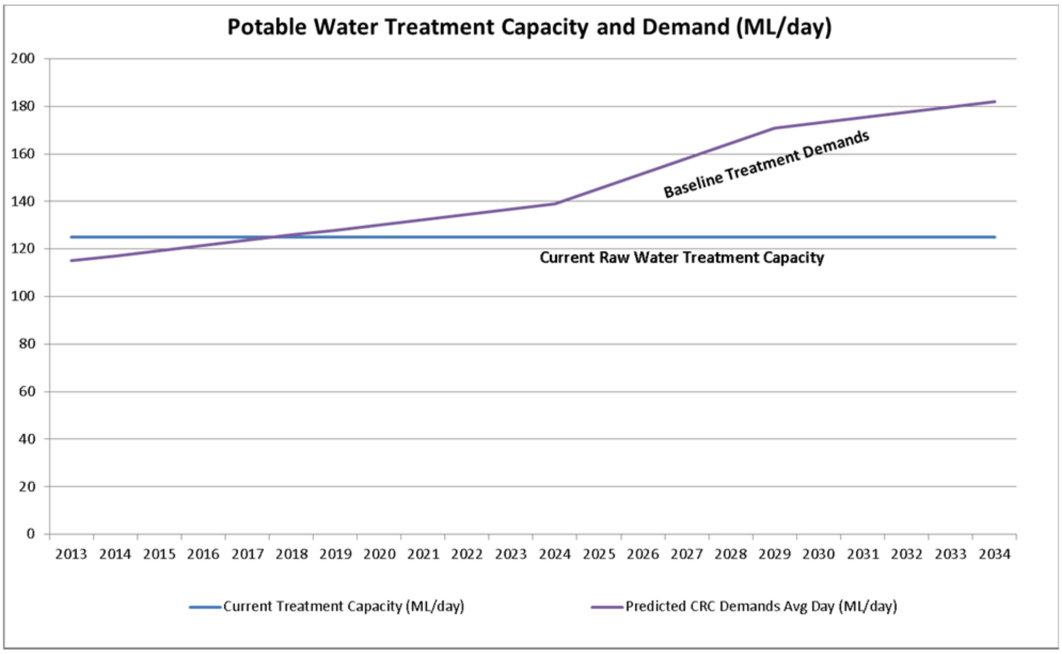

Figure 25-5 Cairns Water Treatment Capacity and Demand

The solid blue line represents the current water treatment capacity including the screened Behana Gorge source. The solid purple line represents the current and predicted treated water demands forecast by CRCWW.

Table 5.8 of Chapter 7 of the DERM Planning Guidelines for Water Supply and Sewerage identifies that the capacity of Water Treatment Plants should be based on the 'delivery flow rate from the source (over 20 hours)'. In this instance the MDMM delivered over 20 hours has been adopted to define the Treatment Plant demands.

The Freshwater WTP is approaching capacity over the next three to four years, and there is a need for augmentation or additional WTP facilities.

CRCWW are planning for a Southern WTP and Kamerunga WTP to meet future needs. The 'Overall Water Supply Strategy for Cairns', Planning Report indicates the Southern WTP is a priority and planning is to have the plant operating by 2015. Council have advised it is more likely now to extend beyond 2015 and timing will be better understood when Council complete the review of the water supply strategy in 2014.

The Southern WTP will treat water from the existing Behana Creek source and reticulate potable water to meet the demands of the Gordonvale and the Mount Peter areas. The Southern WTP is proposed to be rated to treat 60ML/day (implemented in stages) and is to be located on Draper Road, Gordonvale adjacent to the existing bulk water storage reservoir.

The Southern WTP will take demand off the Freshwater Creek WTP. In the absence of bringing additional raw water sources on line, there will be a marginal reduction in the safe yield due to further water losses from backwashing and maintenance at the second WTP. CRCWW expect the corresponding safe yield will be 26 010 ML/a, reducing from the current 28 283 ML/a. As such, commissioning the Southern WTP without further raw water sources in place will reduce the safe yield.

The Kamerunga WTP would treat the new raw water source at the Barron River. The Kamerunga WTP would be staged for commissioning and upgrade to align with the Barron River source.

Based upon commissioning the Southern WTP (25 ML/day) in 2017 and the Kamerunga WTP(50ML/day) in 2025, the net water treatment capacity is demonstrated in **Figure 25-6**.

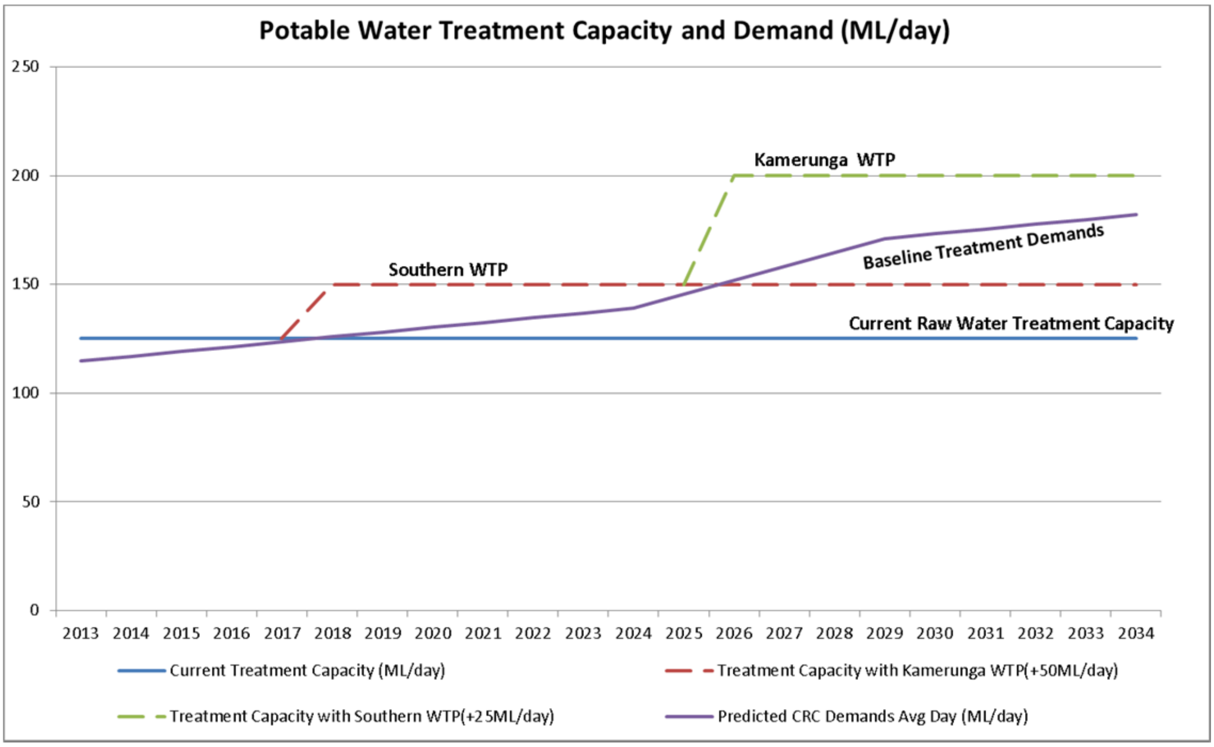

Figure 25-6 - Water treatment capacity and demands with Southern and Kamerunga WTPs.

This proposed regime of augmentation of treatment capacity would meet Cairns current needs to beyond 2034.

Trunk Reticulation

A trunk delivery pipeline network delivers treated water from the Freshwater Water Treatment Plant to the Northern Beaches reservoirs.

This network comprises a DN525mm trunk main that feeds the northern reservoirs of Redlynch and University, a DN475mm trunk main to Moore Road reservoir and DN300mm main to the Palm Cove reservoir.

This main is generally aligned within the corridors of the Western Arterial Road and the Captain Cook Highway from the Freshwater WTP terminating at the northern reservoir at Palm Cove.

CRCWW advise the distribution network has adequate capacity until the Kamerunga WTP is put into service. Upgrade of the trunk delivery network is planned to be initiated at that time and is described in **Table 25-3**.

TABLE 25-3 TRUNK DISTRIBUTION UPGRADE TRIGGERED BY KAMERUNGA WTP

Pipeline section	**Augmentation**
Tunnel Hill Treatment Plant to Raw Water Valve Pit	0.3 km of DN 600 mm
Raw Water Valve Pit to Northern Bypass Valve Pit	0.3 km of DN 750 mm
Northern Bypass Valve Pit to Christies Drive	0.4 km of DN 750 mm
Christies Drive to Shaws Access Road	1 km of DN 750 mm
Shaws Access Road to Kamerunga Road	2 km of DN 750 mm
Kamerunga WTP to Kamerunga Bridge	0.8 km of DN 600 mm
Kamerunga Pump	166 L/s @ 12 m head

Reservoir Storage

CRCWW has a series of water storage reservoirs located across the network to buffer peak demands on water supply, provide emergency supply and maintain reticulation pressures.

The Aquis Resort site is within the catchment supplied by University Reservoir (20 ML). CRCWW advises that the capacity of University Reservoir is committed to existing demands and any additional demands generated for storage would trigger the need for additional storage to be provided.

CRCWW proposes that a clearwater storage reservoir will be constructed as part of the proposed Kamerunga WTP. This reservoir will distribute to the southern end of is the area currently serviced by the University reservoir. This will take demand off the University reservoir; however the reduction of demand has not been quantified at this time.

Network Connection

A DN600 mm trunk main pipes water from the JCU Reservoir, under the Captain Cook Highway and distributes into the Smithfield reticulation network.

A DN 250mm AC main located within the Yorkeys Knob Road corridor, connects to the DN 525 mm bulk water main in the Captain Cook Highway corridor and services the Yorkeys Knob township.

Figure 25-7 illustrates the current capacity and demands over time on the Yorkeys Knob water main.

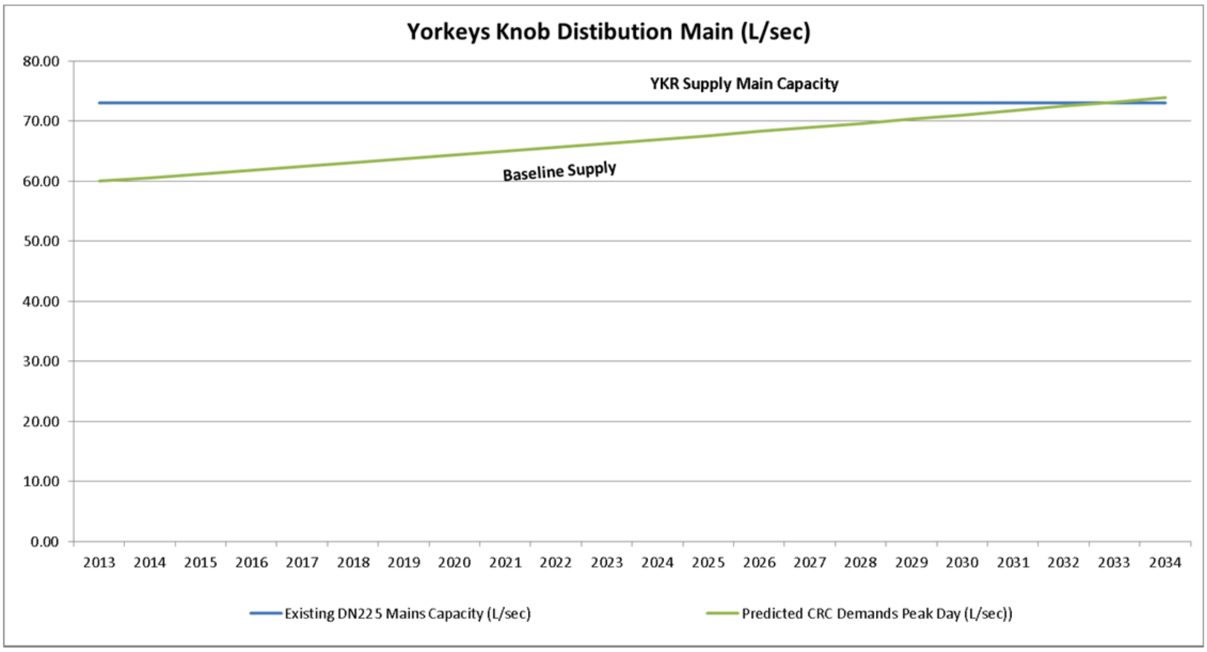

Figure 25-7 Yorkeys Knob baseline supply main capacity and predicted capacity consumption.

The main has capacity to meet the needs of Yorkeys Knob residents to 2034. There are no plans for upgrade of the distribution main in Yorkeys Knob Road.

b) Re-Use Water

The Marlin Coast Waste Water Treatment Plant (Marlin Coast WWTP) produces Class C and Class A treated reuse water. The plant currently supplies to the Paradise Palms and Half Moon Bay Golf Courses. Other potential users are the James Cook University (JCU), Bluewater Estate and Smithfield Village.

The Marlin Coast WWTP is planned to be upgraded to achieve Class A+ recycled water, which is capable of being used for unrestricted non-potable uses.

The Marlin Coast Recycled Water Scheme will take A and C class quality recycled water from the upgraded Marlin Coast WWTP and deliver a portion of it to nearby schools and golf courses for irrigation purposes. The remaining A class quality recycled water will be further treated to an A+ class standard to be used for toilet flushing and outdoor water use, through residential dual reticulation networks.

The infrastructure to make up the Marlin Coast Recycled Water Scheme will include a water reclamation plant (to produce the A+ quality recycled water), trunk supply pipelines and the re-commissioning of a disused storage reservoir. The design of the trunk supply pipelines and work required to re-commission the currently disused storage reservoir at Earl Hill has been completed. Finalisation of the design and the award of the contract for the construction of the water reclamation plant were planned by Council to be completed by late 2012 however this has been deferred.

A constraint on the quantum of recycled water available for resale is the volume of sewage processed at the treatment plant. Currently 6.2 ML/d average dry weather flow (ADWF) of sewage is treated at the Marlin Coast WWTP with a total treatment capacity of 8.3M L/d ADWF. CRCWW advises that the plant has the capacity to produce 6.2 ML/day of Class A reuse water at full sewage load. CRCWW currently is committed to supplying 2.8 ML/day to Yorkeys Knob and Paradise Palms Golf Clubs. Thus there is surplus capacity of 3.4 ML/day ADWF of reuse water production.

Figure 25-8 shows the capacity and demand over time for re-use water from the Marlin Coast WWTP.

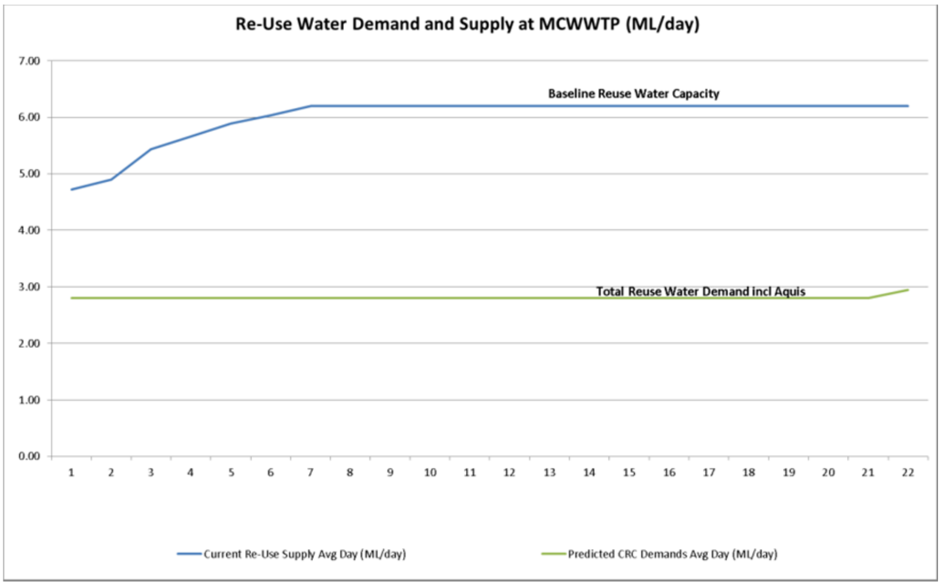

Figure 25-8 Marlin Coast WWTP current reuse water supply and demand.

At this time there is significant over supply of reuse water available from the Marlin Coast WWTP which will increase as the base load of waste water treatment increases over time to peak at the plant's capacity.

Reticulation of the reuse water to existing customers is undertaken using private rising mains, and as such no trunk reuse water mains are in service.

25.1.2 Impacts

a) Impact Mitigation

Given the value of water as a resource to the community of Cairns and the potential impacts that Aquis will have on the supply resource and network capacity, the following initiatives will be adopted in the design of the Aquis Resort:

Reduce Consumption by Various Conservation Measures

Water-wise initiatives will be implemented to reduce demands on potable water supply. These initiatives include the following:

- Taps and hand wash basins:
  - Install flow regulated taps with aerators.
  - Periodically check taps for leaks.
  - Adopt where possible cisterns with integrated hand basins. These systems allow the water usage from the hand basin to fill the cistern.
- Showers:
  - Install shower heads limiting the water flow to 9 L/minute.
  - Select spa baths that have pressure jets located low in the bath to allow it to be operated with minimal water.

- Toilets:
  - Install 4 star WELS dual flush systems.
  - Utilise cisterns with integrated hand basins.
- Kitchens, restaurants and bars
  - Minimise the need for hosing of floors.
  - Install pedal-operated or sensor tap controllers to ensure valves are closed when not in use.
  - Operate full dishwashers.
  - Install waterless urinals.
- Laundry Facilities:
  - Encourage guest re-use of linen and towels.
  - Operate washing machines when fully loaded.
  - Minimum four-star water efficiency rating for all washing machines.
- Pools, spas and water features:
  - Divert filtered backwash for re-use on landscaping etc.
  - Install drainage barriers around pools to collect overflows or splashes and re-use.
- Hotel grounds
  - Mow grass to less than one-third of its original height.
  - Use Xeriscape (low water) gardens including selecting local natives or other water wise plants and lawn grass.
  - Add compost or mulch to increase moisture retention.
  - Install rain and/or soil moisture sensors that monitor and control the levels of irrigation. Install sprinklers with efficient watering patterns and droplet sizes which encourage soil penetration.
  - Incorporate stormwater collection and re-use into the landscaping.
- Golf Course:
  - Use a grass that is suitable for the region.
  - Irrigate at night and avoid irrigating during high winds.
  - Incorporate stormwater collection and re-use into the golf course layout.
  - Utilise efficient irrigation and sprinkler systems with soil moisture monitoring and control to prevent over-watering.

A Total Water Management Plan will be developed during detailed design to address this issue in an integrated manner.

Sources of Alternative Water

Not all of the total water demand needs to be of potable quality. Some typical uses where non-potable water will be suitable are:

- toilet flushing
- non-consumption uses
- external and equipment wash-down
- other non-contact uses
- irrigation
- construction processes including dust control, earthworks and concrete manufacture.

By utilising reuse or harvested water wherever possible, the demand on the Council system is reduced and overall sustainability is increased.

Sources of non-potable water available for the Aquis development are:

- effluent re-use water (recycled water)
- rainwater harvesting from rooftops
- stormwater runoff harvesting (car parks and public spaces).

An integrated non-potable water supply strategy is proposed that will rely upon these sources in the following order of preference:

- Roof Water: Captured in the roof plumbing system and piped to the non-potable water storage system
- Runoff Water: Captured, screened and plumbed to the non-potable water storage system
- Re-Use Water: Piped from the Marlin Coast waste water treatment plant to the non-potable water storage system.

b) Water Supply Task

<u>Operations</u>

The unique nature of the development recognises that significant opportunities exist for the reduction of water demand by the use of water reduction devices, water saving management practices and substitution of potable for non-potable sources. A first principles analysis of water demand for Aquis has been undertaken reflecting proposed 'smart water management' strategy for the development.

Table 4-1 provides a summary of the predicted water demands based upon anticipated sources, uses and quantity per use for guests, staff and day visitors.

TABLE 25-4 FIRST PRINCIPLES WATER USE ASSESSMENTS

User	Use	Qty/Use	Unit	Frequency	Daily Use	Source
Guest						
	Half Flush	6	litre	4	24	Reuse
	Full Flush	9	litre	2	18	Reuse
	Meals	25	litre	3	75	Potable
	Showers	90	litre	2	180	Potable
	Drinking	0.25	litre	8	2	Potable
	Hygiene	8	litre	2	16	Potable
	Laundry	35	litre	0.35	12	Potable
	Miscellaneous	10	litre	1	10	Potable
Staff						
	Half Flush	6	litre	2	12	Reuse
	Full Flush	9	litre	1	9	Reuse
	Meals	20	litre	1	20	Potable
	Showers	90	litre	0.1	9	Potable
	Drinking	0.25	litre	4	1	Potable

User	Use	Qty/Use	Unit	Frequency	Daily Use	Source
	Hygiene	2	litre	1	2	Potable
	Laundry	9	litre	1	9	Potable
	Miscellaneous	5	litre	1	5	Potable
Day Visitors						
	Half Flush	6	litre	2	12	Reuse
	Full Flush	9	litre	1	9	Reuse
	Meals	25	litre	1	25	Potable
	Hygiene	2	litre	1	2	Potable
	Miscellaneous	2	litre	1	2	Potable

The average water demand per person per day is summarised as follows:

- Potable Water Use / Guest: 295 L
- Reuse Water / Guest: 42 L
- Potable Water Use / Visitor: 29 L
- Reuse Water / Visitor: 21 L
- Potable Water Use / Staff: 46 L
- Reuse Water / Staff: 21 L.

A seasonal analysis of guest occupancy across an operating calendar year was undertaken recognising that the typical seasonal peak is during the dry season from May to October, peaking in July to September. This analysis was used to define and quantify the design criteria used to size the various elements of the water supply chain.

Raw water supply requirements is defined by the average use per day (ML/day) (or consumption over a year (ML/a)), treatment plant treatment capacity is defined by the quantum of water to be used on the mean day of the maximum month (ML/day), water storage needs is quantified as three times the difference between the peak day usage and the mean day maximum month (ML) and reticulation is sized by the peak hour demand of the facility(L/sec).

CRC publishes design guidelines to quantify each of the design criteria, which are defined based upon analysis of historic data and empirical relationships between the criteria. Utilisation of these guidelines is a conservative approach and does not reflect the nature of water use of Aquis. Hence a first principles analysis of water demands for Aquis was utilised to redefine the design criteria to be applied for sizing of infrastructure.

The design criteria for sizing of water supply infrastructure were defined as follows:

- Mean Day Maximum Month (MDMM): Average daily demand in the high demand period
- Average Day (AD): Average daily demand across the entire year
- Peak Day (PD): Average day at 90% occupancy x 1.125
- Maximum Day (MD): Average day at 100% occupancy x 1.125.

Utilising these definitions the water supply design criteria for the ultimate operation of Aquis Resort (excluding irrigation) is quantified in **Table 25-5**.

TABLE 25-5 WATER SUPPLY DESIGN CRITERIA

Design Criteria	Source	Water Demand (ML/Day)	Source	Water Demand (ML/Day)
MDMM	Potable	4.45	Reuse	0.92
AD	Potable	3.88	Reuse	0.81
PD	Potable	4.37	Reuse	0.91
MD	Potable	4.85	Reuse	1.01

Reuse water and harvested rainwater will be used for irrigating lawns, the golf course and wash down of outdoor areas. A first principles calculation of irrigation demand was undertaken utilising a methodology prescribed by *Efficient Irrigation: A Reference Manual for Turf and Landscape*' by Geoff Connellan.

Average re-use water demand for irrigation of Stage 1 is 3.35 ML/day in the dry season and 1.67 ML/day in the wet season. For ultimate development the dry and wet season average demands are 3.10 ML/day and 1.55 ML/day respectively. (The irrigation demand for Stage 1 is higher than for the ultimate as there is more landscaped space to maintain. Stage 2 will convert some of this space to built form, thus reducing irrigation demand.)

Total average demand for water per day in the seasonal peak is 8.04 ML/day. This will comprise of 3.88 ML/day of potable supply and 4.16 ML/day of reuse or harvested rainwater.

By way of comparison, utilising traditional empirical EP calculations at the rate of 500 L/EP/day, the Aquis Resort would have a demand of 18.4 ML/day. By utilising best practice water saving devices and management practices reflected in the first principles water supply analysis, the average total water demand has been reduced by 10.4 ML/day and the average potable water demand reduced a further 4.16 ML/day.

<u>Construction</u>

For construction, water demands have been established based upon the requirements of the construction workforce and the construction processes to be employed that will generate a demand for water use.

Construction workers average demand for water has been estimated to be 38 L/day which translates to the following demands in Stage 1 and Stage 2 of construction where peak workforce population is 3750 and 3500 respectively:

Stage 1 Construction

- MDMM: 0.04 ML/day
- Average Day: 0.04 ML/day
- Peak Day: 0.05 ML/day
- Maximum Day: 0.05ML/day.

Stage 2 Construction

- MDMM: 0.04 ML/day
- Average Day: 0.04 ML/day
- Peak Day: 0.04 ML/day
- Maximum Day: 0.05ML/day.

Construction processes (e.g. concrete production and earthworks placement and dust control) are the more significant uses of water during the construction phases. Construction water uses were derived based upon anticipated moisture contents required to mix and place concrete, quarry materials and earthworks and an average rate of coverage to the site footprint for dust control over the life of the construction phases. The average construction water demands at peak construction activity were quantified as follows:

Stage 1 Construction

- MDMM: 3.84 ML/day
- Average Day: 3.84 ML/day
- Peak Day: 4.6 ML/day
- Maximum Day: 4.61ML/day.

Stage 2 Construction

- MDMM: 0.8 ML/day
- Average Day: 0.8 ML/day
- Peak Day: 0.96 ML/day
- Maximum Day: 0.96ML/day.

The relatively higher demands for water for stage 1 is reflected by the fact the majority of the earthworks activities will be undertaken during that stage. Stage 2 is principally focused on building construction which is less water hungry.

c) Potable Water Supply Impacts

Impacts on Raw Water Supply

Figure 25-9 illustrates the raw water supply demands generated by Aquis for the period of 2013 to 2034 overlaid onto the current predicted baseline needs for Cairns relative to the current supply with the planned supply upgrade at the Mulgrave Aquifer and Barron River.

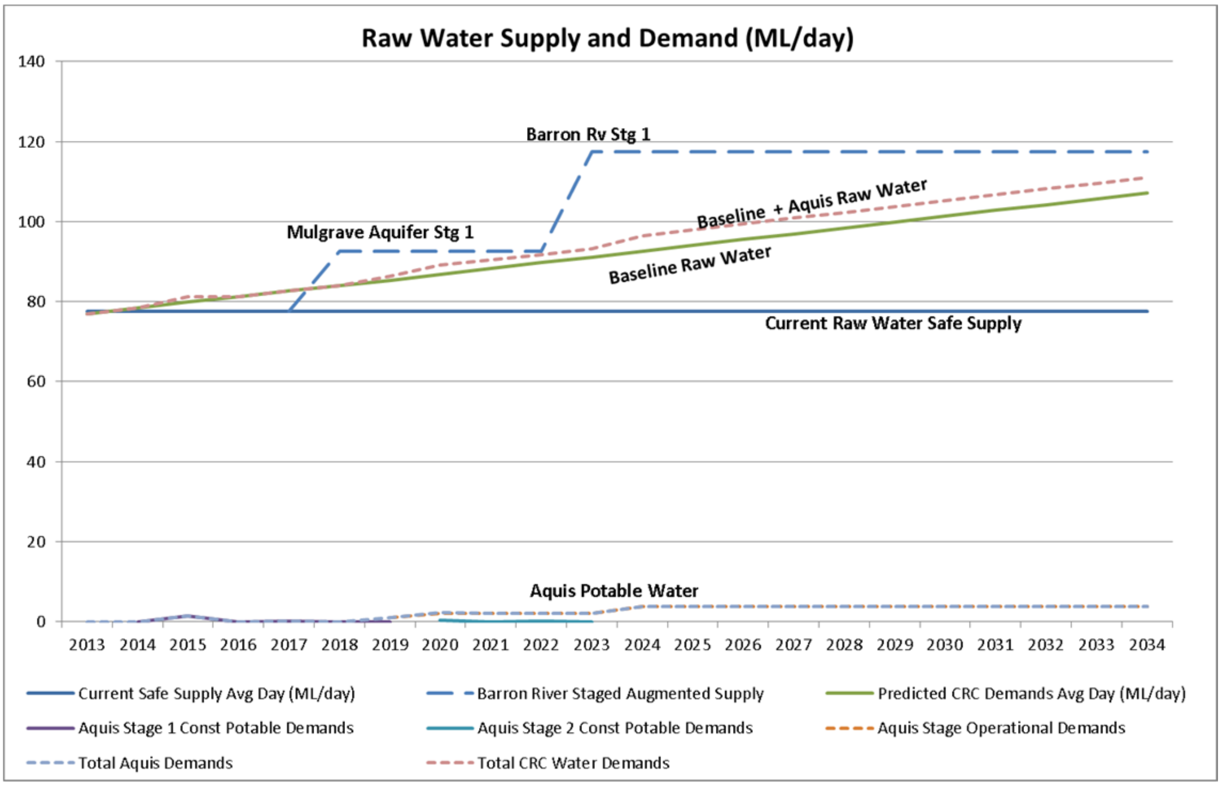

Figure 25-9 Aquis raw water demands.

The Aquis potable water demands for the construction and operational phases are shown at the base of the plot. The dotted pink line is the cumulative demand for raw water supply for Cairns and Aquis. The planned raw water source augmentation with the Mulgrave River Aquifer (15ML/day) followed by the Barron River Stage 1 (25ML/day) would be sufficient to meet potable raw water demands for Cairns and Aquis to beyond 2034.

<u>Aquis Impacts on Water Treatment</u>

Based upon the design parameters developed and discussed above, **Figure 25-10** demonstrates the treated water supply demands overlaid onto the predicted baseline demands relative to the current raw water capacity and planned commissioning of the Southern WTP and the Kamerunga WTP.

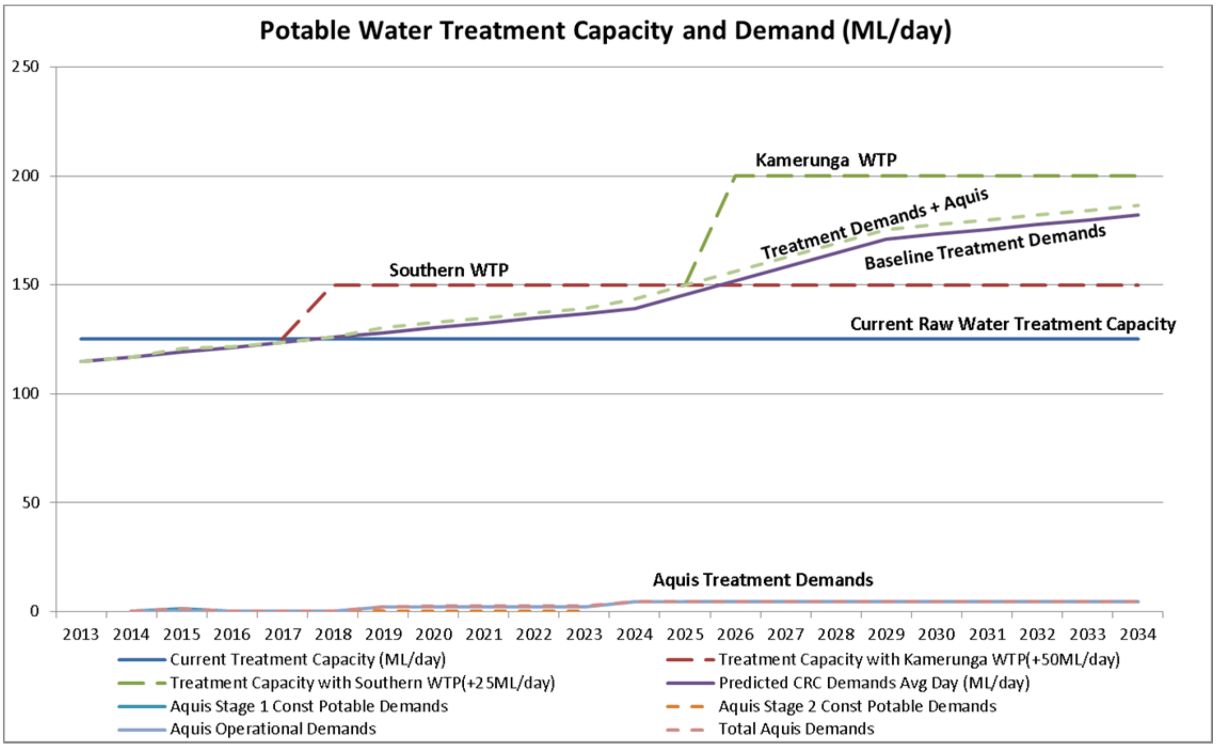

Figure 25-10 Water teatment capacity and demands with Southern and Kamerunga WTPs including Aquis Resort.

The light green dotted line shows the cumulative treated water demands of the Aquis Resort overlaid onto the baseline demands. In the context of the total water treatment demands for the region, Aquis' needs for treated water supply is relatively small. The planned regime of commissioning the Southern WTP (25 ML/day) in 2017 and the Kamerunga WTP (50 ML/day) in 2025 would be sufficient to meet these needs.

Impacts on Trunk Distribution

Council advise that the proposed planned upgrade of the trunk distribution network triggered by the implementation of the Kamerunga WTP will not have sufficient capacity to cater for the additional demands generated by Aquis and will require further 'up sizing'.

Impacts on Reservoirs

As noted previously, the University Reservoir is at capacity and will require augmentation or a new storage to meet the requirements generated by Aquis.

Impacts on Network Connection

Figure 25-11 illustrates the impacts of placing Aquis supply needs on the existing main in Yorkeys Knob Road.

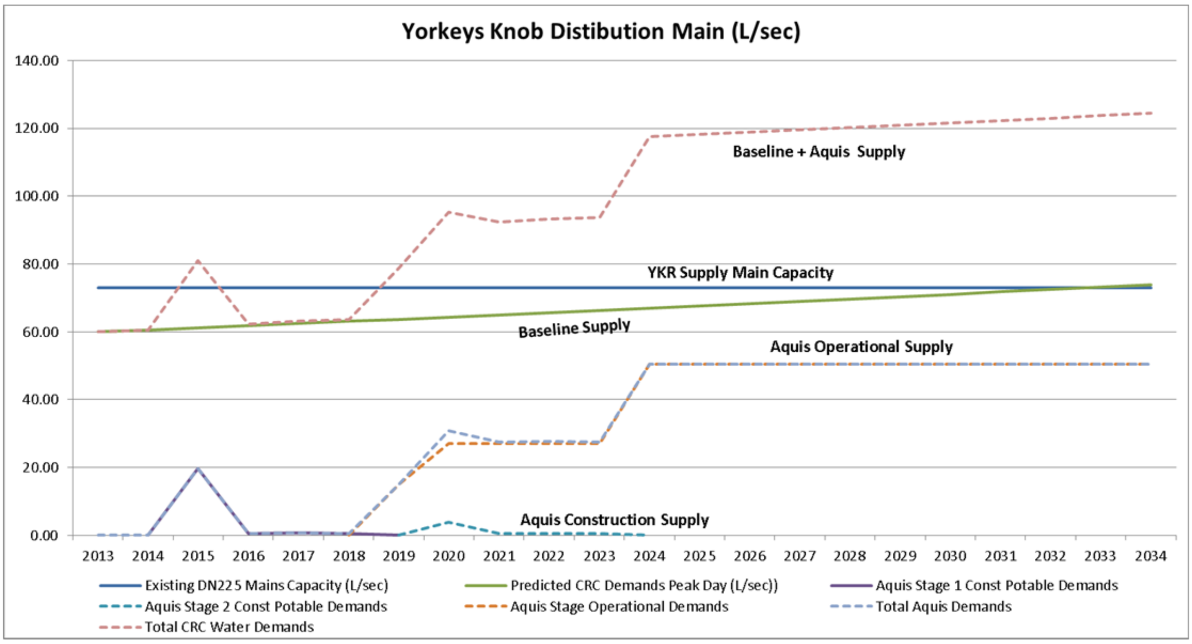

Figure 25-11 Yorkeys Knob Baseline Supply Main Capacity and augmentation required for Aquis.

Aquis will generate a peak flow of approximately 50l/sec which will exceed the latent capacity in the Yorkeys Knob Supply Main. The capacity of the main will be exceeded in Stage 1 of the construction phase and at commencement of operation.

d) Reuse Water

The availability of reuse water is a function of the turnover of wastewater through the Marlin Coast WWTP. The Marlin Coast WWTP has surplus supply of 3.4ML/day ADWF of reuse water when operating at full load. The Stage 1 construction of Aquis is where the greatest construction reuse water demand exists as the site earthworks is being built during this time.

Estimated peak demand for reuse water during construction is 4ML/day. Based on current sewage loads and current reuse water commitments to existing customers, the Marlin Coast WWTP can produce 2ML/day of Class A reuse water for use by Aquis during construction. The construction contractor will be required to manage the construction water demand by providing on-site storage of potable supplies to buffer demands.

Peak period average reuse water demand generated by Aquis Resort during operations will be 4.2ML/day. The Aquis Resort will exceed the current uncommitted reuse water production capacity of the plant. Aquis however will also be a source of wastewater to the Marlin Coast WWTP, thereby generating further wastewater volume for reuse water production. The Marlin Coast WWTP will require upgrading to cater for the additional sewage load and additional reuse water demand.

e) Water Balance

At ultimate full operation Aquis water demands and reuse water generation opportunity through the Marlin Coast Waste Water Treatment Plant is summarised as follows:

- Potable Water Peak Season Average Day : 3.88 ML/day
- Reuse Water Peak Season Average Day : 4.16 ML/day
- Reuse Water Generation Peak Season Average Day: 4.23 ML/day

At full operations Aquis will generate sufficient reuse water through the Marlin Coast WWTP to meet its own demands.

f) Regional Implications

The regional implications on the water supply network arising from the Aquis development are important in the context of maintaining reliable and secure supply to the Cairns Region. The Far North Queensland Regional Water Supply Strategy (FNQRWSS) is the current water supply planning document that sets out the management strategies for water supply for the next 50 years for Cairns.

The FNQRWSS outlines options for managing Far North Queensland's water supply requirements. The strategy seeks to achieve optimal environmental, social and economic outcomes and to advance solutions for the region's future urban, rural and industrial water needs.

The FNQRWSS provides recommendations in relation to water supply into the future which are provided below. After each recommendation is a statement relating to how Aquis aligns with the recommendations:

- ***Assessments to date support the need to undertake an early augmentation of supply for Cairns.*** The need for early augmentation of supply for Cairns exists and the need amplified 2019 when Aquis commences operation. Council has identified the Mulgrave River Aquifer Bore Fields and the Barron River as two alternative viable sources for raw water supply. There are two options which comprise a combination of staged implementation of these sources which will provide secure supply to beyond 2044. The implementation of these options is currently under review by CRC.
- ***A long-term water supply plan based on a LoS assessment on water supply security is required.*** A Water Supply Strategy was prepared by CRC in 2009 and the findings are still largely relevant. Council is currently undertaking a full review of the water supply strategy. This will include stochastic modelling of water demands.
- **Even with substantially improved demand management measures a shortfall of approximately 20 000 ML per annum is predicted by 2055 should no augmentation of supplies occur**. This is consistent with the current planning reports for water supply for Cairns. An augmentation of supply is required.
- **Residential water use target for Cairns City of 225 litres per person per day by 2025**. Aquis plans to meet this goal through design and operational management initiatives.

The shortfall is expected to be reduced by:

- ***Demand management strategies that target a reduction in per capita consumption.*** Aquis will employ water use reduction strategies that will reduce potable demand by substitution with non-potable supplies (e.g. toilet flushing and irrigation). In addition, water wise initiatives shall be employed at the design phase that will reduce water demands. Such initiates include low flow showerheads and taps, water efficient commercial appliances, waterless urinals and operations management strategies for reduction in water use.
- ***The development of groundwater resources such as the Mulgrave River Aquifer.*** Development of alternative raw water sources is a priority for CRC as current supplies are at minimum secure supply thresholds.

- ***Alternative water sources such as desalination and fit-for-purpose recycled water and stormwater re-use.*** The use of recycled water and harvesting of rainwater is a key aspect of the water supply strategy for Aquis. Approximately 60% of the water supply needs will be derived from these sources through use of Class A re-use water from Marlin Coast Waste Water Treatment Plant and the capture and storage of rainfall runoff from roofs and public spaces.
- Barron River at Lake Placid:
  - ***Access reserved water (4000 ML) available from the Water Resource (Barron) Plan 2002.*** The Barron River source has been identified by Council as one of the preferred raw water supply sources for Cairns. Council are currently undertaking a review of raw water supply options.
  - ***Purchase supplemented water from the Mareeba Dimbulah Water Supply Scheme***.
  - ***Further investigation of additional storage sites.*** Further investigation of additional storage sites (such as Nullinga Dam) will be considered after a portfolio of demand and supply side options, designed to meet the future urban water requirements of Cairns, have been exhausted.

Aquis will create a water supply demand that sits within the Far North Queensland Regional Water Supply Strategy framework.

25.1.3 Augmentation

a) Potable Water Supply

Upgrade of the Bulk Water Supply

CRC has a current need to upgrade the bulk water supply for Cairns which can be achieved through the implementation of the Mulgrave Aquifer and the Barron River schemes. The Aquis demands for potable water supply can be met through these schemes.

Upgrade of Water Treatment Capacity

CRC has plans to commission the new Southern Water Treatment Plant by 2015/16 and also bring the Kamerunga Water Treatment Plant on line in parallel with the Barron River raw water source. Implementation of these planned upgrades in water treatment capacity will accommodate the demands generated by Aquis.

Augmentation of the Distribution Network

CRC advise Aquis will result in the need for the proposed distribution network upgrade associated with the implementation of the Kamerunga WTP to be upsized to cater for the additional demand. **Table 25-6** describes the estimated incremental increases in sizing required to respond to the Aquis impacts.

TABLE 25-6 TRUNK DISTRIBUTION UPGRADE TRIGGERED BY KAMERUNGA WTP AND AQUIS

Pipeline section	Augmentation	Augmentation with Aquis Resort
Tunnel Hill Treatment Plant to Raw Water Valve Pit	0.3 km of DN 600 mm	0.3 km of DN 750 mm
Raw Water Valve Pit to Northern Bypass Valve Pit	0.3 km of DN 750 mm	0.3 km of DN 825 mm
Northern Bypass Valve Pit to Christies Drive	0.4 km of DN 750 mm	0.4 km of DN 825 mm
Christies Drive to Shaws Access Road	1 km of DN 750 mm	1 km of DN 825 mm
Shaws Access Road to Kamerunga Road	2 km of DN 750 mm	No change
Kamerunga WTP to Kamerunga Bridge	0.8 km of DN 600 mm	0.8 km of DN 720 mm
Kamerunga Pump	166 L/s @ 12 m head	166 L/s @ 12 m head

The upsizing triggered by Aquis for this planned upgrade are relatively incremental and would be met through the infrastructure charging regime. Refinement of the upsizing needs will be undertaken during the concept design phase of the project.

Augmentation of Water Storage

Augmentation of potable water storage capacity is required to meet Aquis Resort demands. Provision of an additional 10ML of potable water storage will be required. It is proposed the storage be provided on-site to meet resort demands and provide emergency supply in the event of the water supply network being disabled.

Upgrade the Water Network Connection

Given the capacity of the existing trunk main connection to Yorkeys Knob is insufficient to meet Aquis needs, a DN300 dedicated main is proposed. To provide redundancy a DN200 secondary supply main is proposed to connect the existing trunk main network in Macgregor Road via Dunne Road. It is proposed to have the DN300 dedicated main in place by 2016 to meet water supply needs for the construction of the project.

Figure 25-12 demonstrates how the new dedicated DN300 main will meet Aquis requirements for a water network connection.

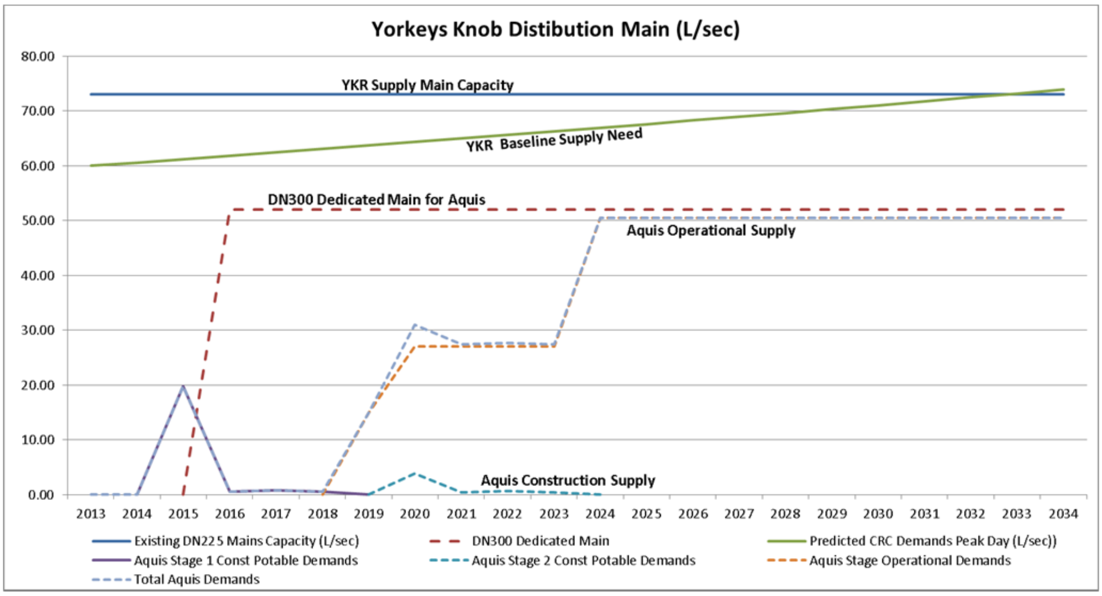

Figure 25-12 Yorkeys Knob baseline supply main capacity and augmentation required for Aquis.

Figure 25-13 shows the proposed alignment for the dedicated DN300 water main connection from the Captain Cook Highway and the DN200 secondary main from MacGregor Road.

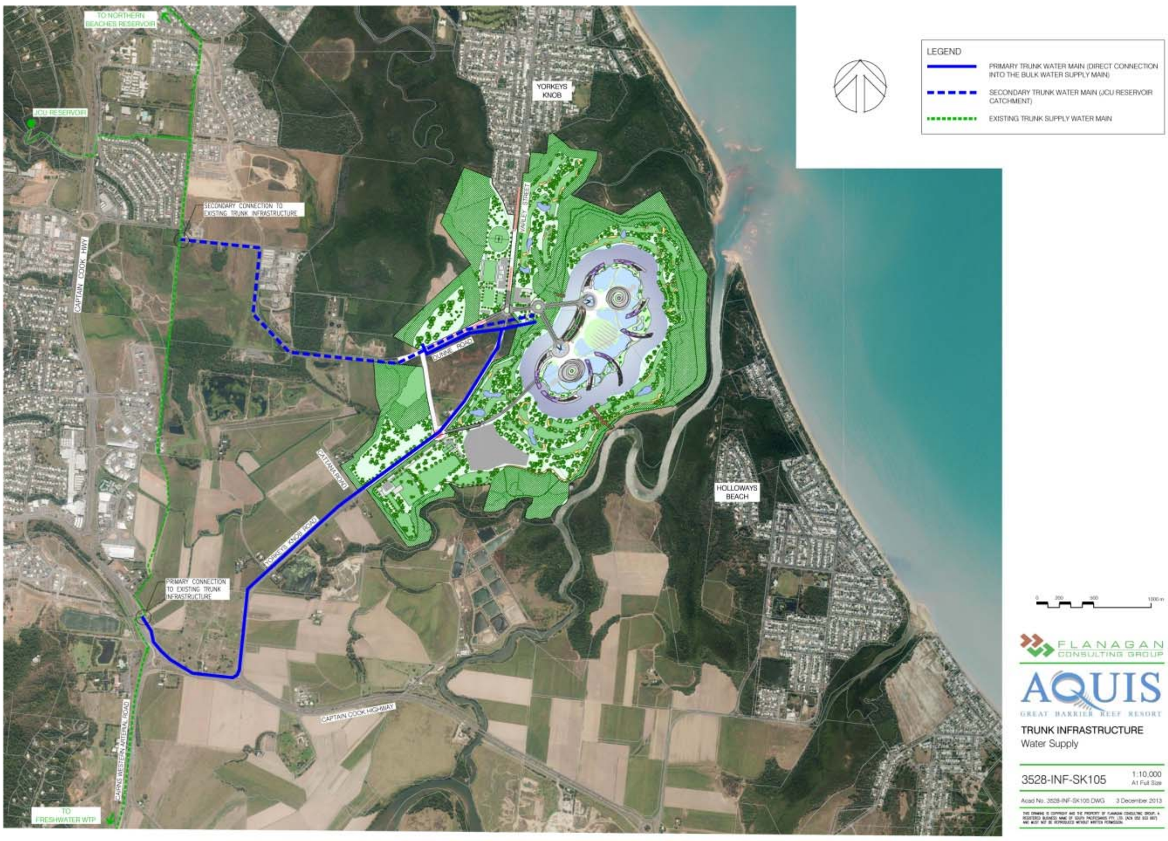

Figure 25-13 DN300 and DN200 dedicated mains to Aquis Resort.

b) Reuse Water

Of the 4.2 ML/day of reuse water demand, 3.88 ML/day is to service irrigation needs and the balance is for toilet flushing. DERM guidelines allow Class A reuse water to be used for irrigation with appropriate dripper and ground level sprinkler systems and Class A+ is to be used for toilet flushing. Hence there are options to either supply all 4.2 ML/day as Class A+ with a significant upgrade of the reuse water treatment plant or split the Class A and A+ supplies with a smaller augmentation for Class A+ at the Marlin Coast WWTP and with dual supply lines and storages at Aquis. These options are to be further explored with Council in the concept design phase.

Figure 25-14 illustrates the expected demands over time for reuse water by Aquis Resort and associated capacity upgrade proposed for Marlin Coast WWTP to supply Class A and A+ reuse water.

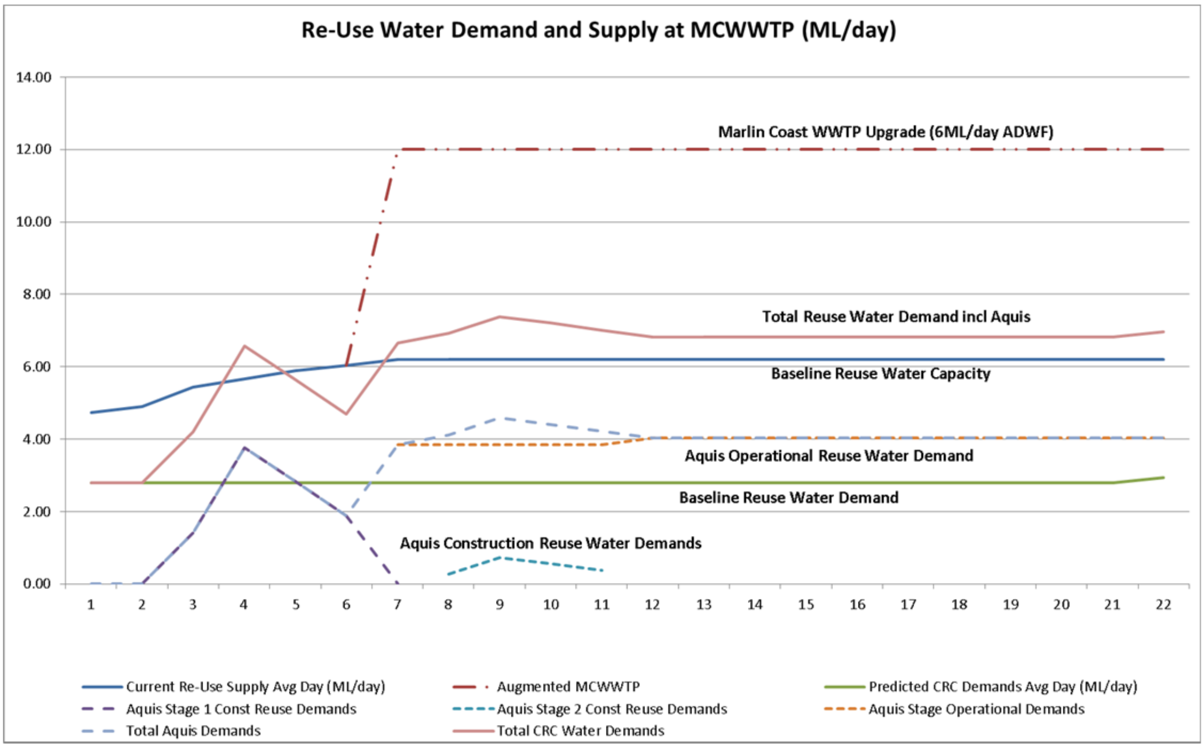

Figure 25-14 Marlin Coast WWTP current reuse water supply and demand with Aquis demands.

Staged upgrade of the Marlin Coast WWTP to receive the increased waste water load and associated increased capacity to process a further 6 ML/day (ADWF) of reuse water would be sufficient to meet the local catchment needs.

It is proposed to provide for storage of the reuse water supply on-site. This would be used to buffer peak demands for reuse water supply and to meet minimum resort reuse water needs in the event of system failure. Reuse water storage of 4ML is proposed.

A DN250 dedicated reuse water trunk main is proposed to provide connection for supply of reuse water from the Marlin Coast WWTP.

Figure 25-15 shows the proposed alignment for the dedicated DN250 reuse water main connection from the Marlin Coast WWTP to the Aquis Resort via the Dunne Road corridor.

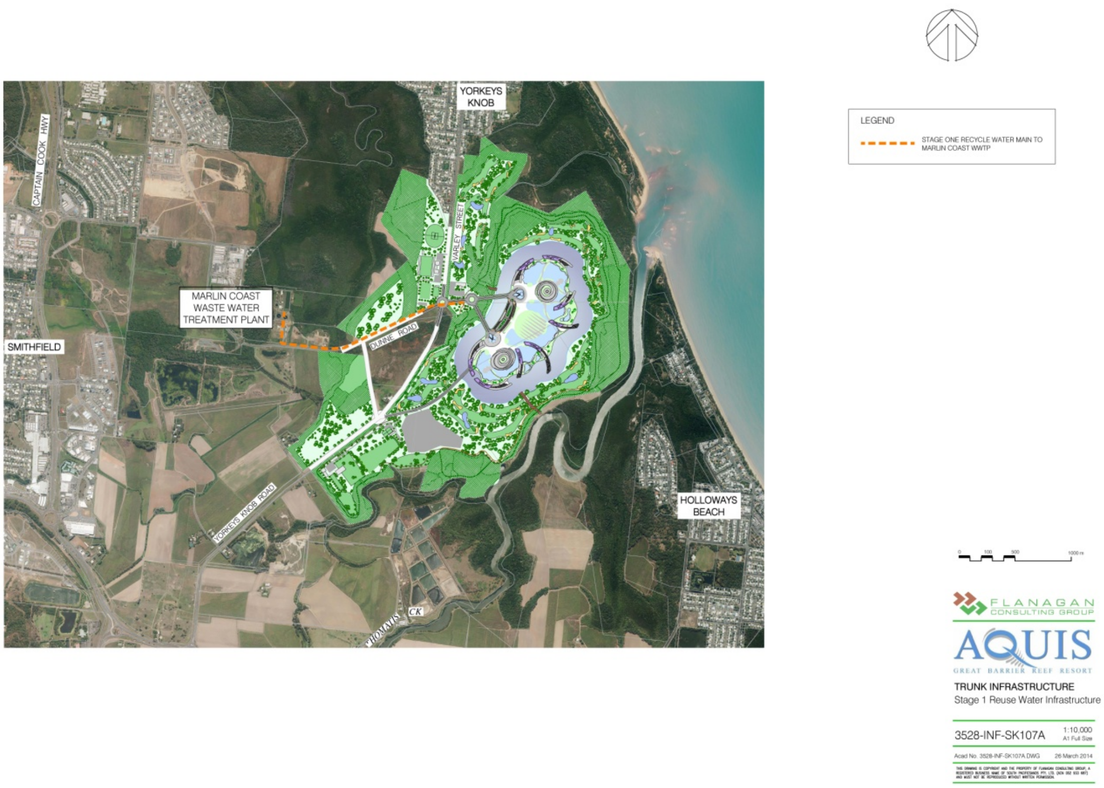

Figure 25-15 DN200 dedicated reuse water main to Aquis Resort.

Figure 25-16 illustrates the service corridor type sections proposed for Yorkeys Knob and Dunne Road. These would be subject to confirmation when final existing services locations are established.

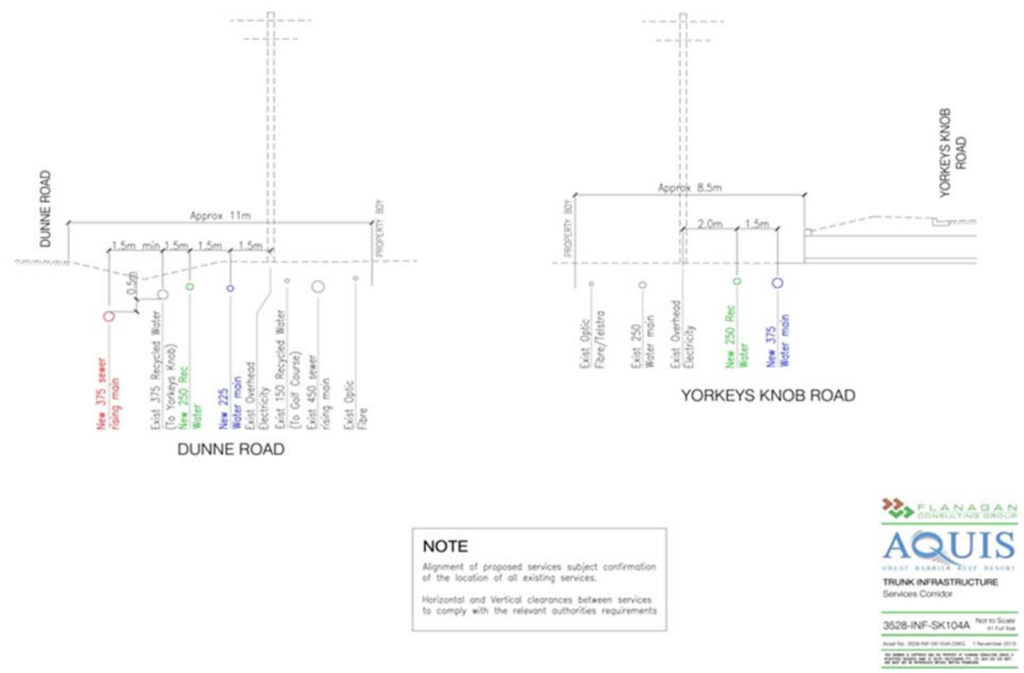

Figure 25-16 Services type sections.

No master planning or network modelling of the internal water network has been undertaken as yet. This process will be undertaken in support of the Material Change of Use application to be made to CRC and is considered premature for the Environmental Impact Statement.

c) Emergency Response and Storage Needs

The emergency action strategy for Aquis in the case of a failure of the main water supply reflects standards that would be adopted for a small urban community.

Recognising that loss of supply is most likely to occur during a natural disaster, such as a cyclone or flooding event, the site based water supply management plan would initiate a regime of water demand reduction to reflect a priority of use to conserve available supplies.

A natural disaster resulting in loss of supply is likely to occur during the wet season when the resort would be at low season average occupancy, and the need for irrigation and other related uses can be eliminated. Hence the total water demand for Aquis in such circumstances would be 3.99ML/day of potable water and 0.34 ML/day of Class A+ reuse water.

In the event of a cyclonic, storm surge or flood warning being initiated management procedures will be implemented to ensure the storages are filled.

For further redundancy in the system the potable water storage will be reticulated to the non-potable storage (with non-reverse flow devices) to provide for emergency filling of the non-potable system. This will ensure that in the event of protracted loss of supply of the non-potable source, functions like toilet flushing can be maintained.

Details of the emergency response and associated infrastructure requirements would be developed with CRC as part of a whole of network water security risk management strategy that would dovetail into Councils natural disaster emergency response plans.

d) Infrastructure Agreement

The proposed development is located outside the Priority Infrastructure Area (PIA) and is inside the charging catchment for Infrastructure Charges for water infrastructure.

The proposed development will result in:

- Infrastructure that has not been included current planning and that would be wholly attributable to the proposed development, and
- Future infrastructure that is currently planned that would need to be brought forward in time to accommodate the proposed development.

The proponent proposes that it enter into an Infrastructure Agreement with Council on the basis that:

- the development is considered as separate to and independent of the Council Trunk Infrastructure Contribution Policy
- the cost of dedicated trunk infrastructure to connect the development to the existing water supply network where it has capacity is met by the proponent
- the proponent will contribute its proportionate share of the cost of the upgrades to the transport network
- cost sharing arrangements would be identified for shared trunk infrastructure.

An estimate of the trunk water supply infrastructure charges is as follows:

- Calculated average potable water demand is 3.88 ML/day.
- Based upon 500 L/EP and 3.1 EP/EDU this is equates to 2504 EDU.
- Trunk water infrastructure charge per EDU (2013 charge)= $4802.00 (Approx.)

Water Infrastructure Charge = 2504 x $4802 = $12,240,208

25.2 WASTE WATER

Waste water generated by Aquis will be treated at the Marlin Coast Waste Water Treatment Plant (WWTP) which is situated on Dunne Road adjacent to the development site.

25.2.1 Existing Situation

a) Marlin Coast Waste Water Treatment Plant

The capacity of the Marlin Coast WWTP is 8.3 ML/day (Average Dry Weather Flow) and currently treats 6.3 ML/day of wastewater. There is a latent capacity of 2 ML/day ADWF to cater for growth.

Figure 25-17 demonstrates the predicted demands for the Marlin Coast WWTP catchment and the plant capacity. The predicted demands are based upon the GHD technical planning reports prepared for CRC on the Marlin Coast WWTP.

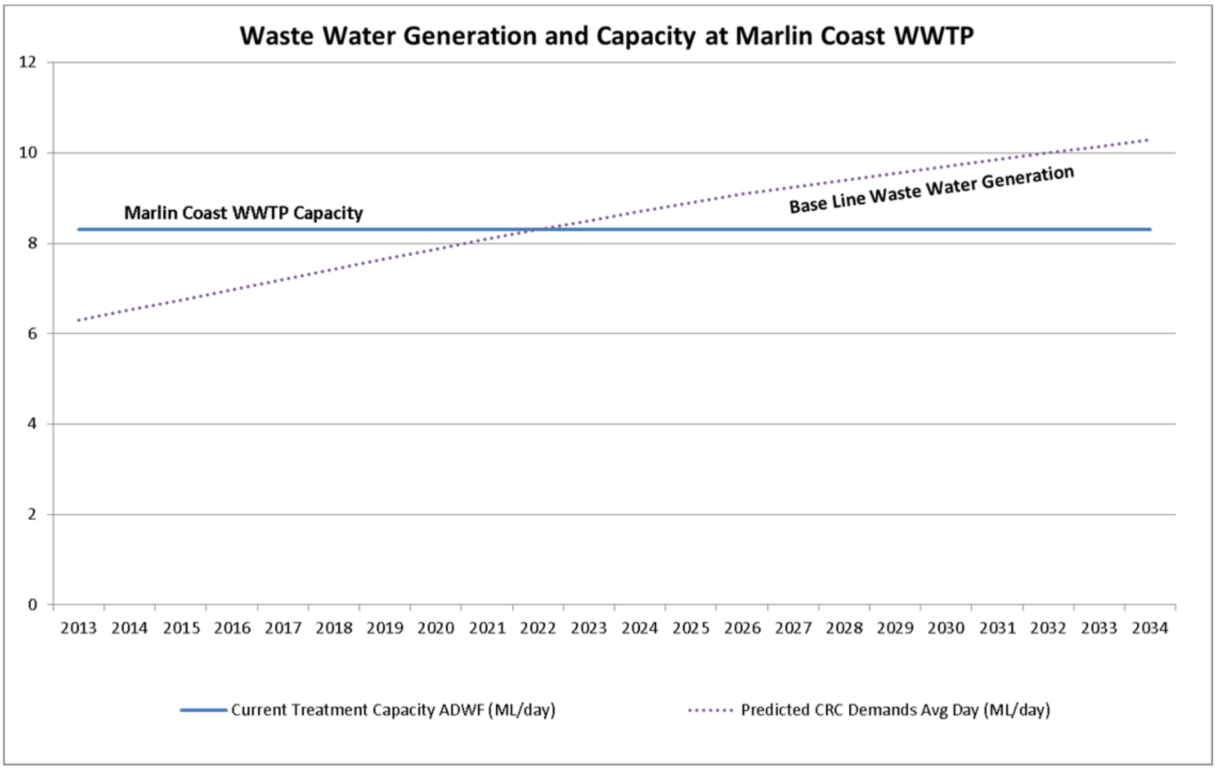

Figure 25-17 Marlin Coast WWTP catchment predicted generation.

The waste water generation for the catchment is predicted to exceed capacity of the Marlin Coast WWTP by 2021.

b) Network Connection

The Marlin Coast WWTP receives waste water from the Eastern Major Catchment which encompasses the Yorkeys Knob urban area.

The DN450 YK1 rising main receives the combined flows from all of the Yorkeys Knob pump stations and conveys the wastewater via Yorkeys Knob and Dunne Road to the Marlin Coast WWTP.

Figure 25-18 plots the predicted peak wet weather flows in the YK1 rising main and capacity to 2034.

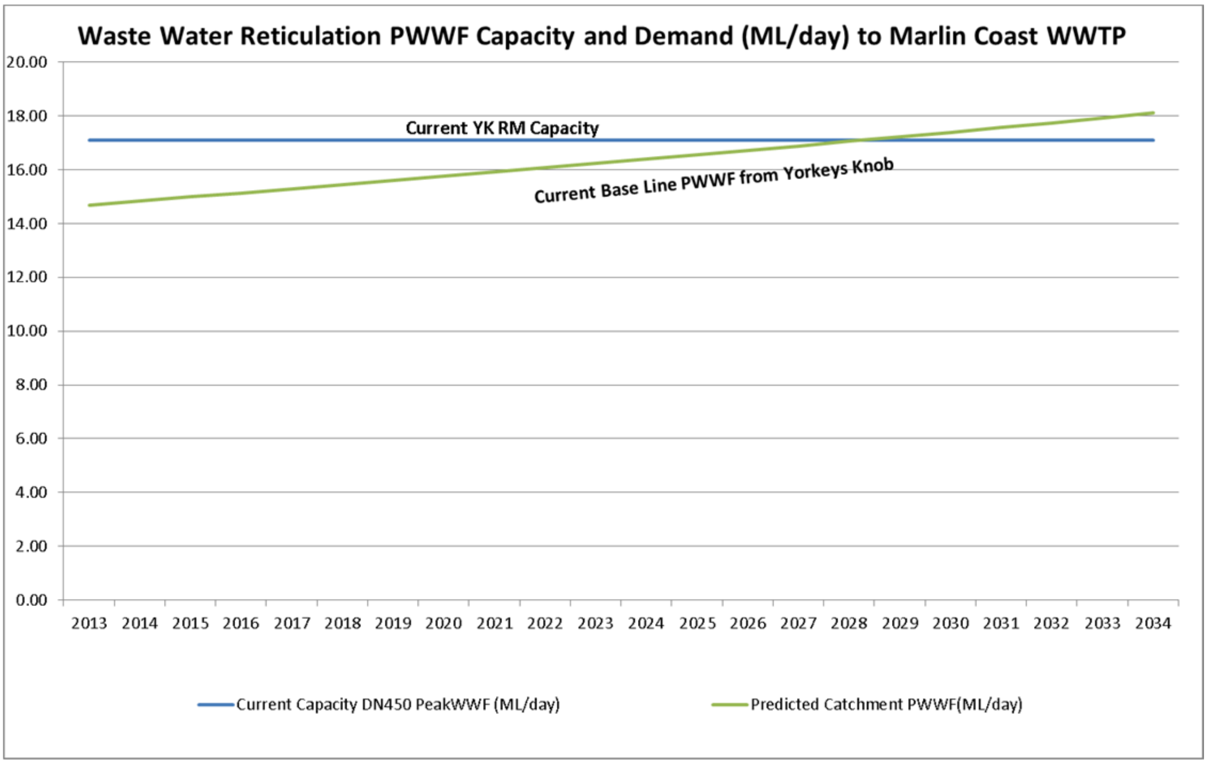

Figure 25-18 Capacity and demands on the existing Yorkeys Knob waste water rising main.

It is anticipated the existing rising main will require upgrading by 2028 to cater for background growth in waste water generation from Yorkeys Knob. Council have no plans for upgrading of the main, and propose to implement some minor upgrades of pump stations in Yorkeys Knob.

25.2.2 Impacts

a) Waste Water Generation

The first principles calculation to derive water demands for the Aquis Resort has been used as the basis for determining waste water generation. The seasonal analysis of guest occupancy across an operating calendar year was undertaken recognising that the typical tourist high season is during May to October, peaking in July to September.

The anticipated average waste water generation derived for guests, staff, construction workers and day visitors is as follows:

- Guests: 354 L/day
- Visitor: 53 L/day
- Staff: 70 L/day
- Construction Workers: 41 L/day.

Waste water treatment infrastructure design parameters are defined by the average dry weather flow (ML/day) for the waste water treatment plant treatment capacity and peak flow for the sizing of reticulation and trunk mains. The peak flows cater for infiltration of ground water into the reticulation system.

CRC publish design guidelines used to quantify each of the design criteria which are derived based upon analysis of historic data and empirical relationships between the criteria. Utilisation of these guidelines is a conservative approach and does not reflect the nature of waste water generation by Aquis. Hence the first principles analysis of waste water generation by Aquis was utilised to redefine the design criteria to be applied and how they would be derived.

From this analysis the design criteria for waste water treatment infrastructure were defined as follows:

- Average Dry Weather Flow (ADWF) = Average waste water generation calculated in the high tourist season
- Peak Flow : 4 x ADWF@ seasonal peak (CRC have agreed to a factor of 4 based upon the expectation the site will be reticulated by vacuum type systems)

Utilising these definitions the waste water design criteria is shown in **Table 25-7.**

TABLE 25-7 WASTE WATER GENERATION DESIGN PARAMETERS

Construction / Operational Phase	ADWF (ML/day)	Peak Flow (ML/day)
Stage 1 Construction	0.15	0.60
Stage 2 Construction	0.14	0.56
Stage 1 Operations	3.02	12.08
Ultimate Operations	5.64	22.56

b) Impacts on Waste Water Treatment

Figure 25-19 shows the predicted waste water generation by Aquis for the period of 2013 to 2034 and the anticipated total combined Aquis and predicted background catchment flows are shown.

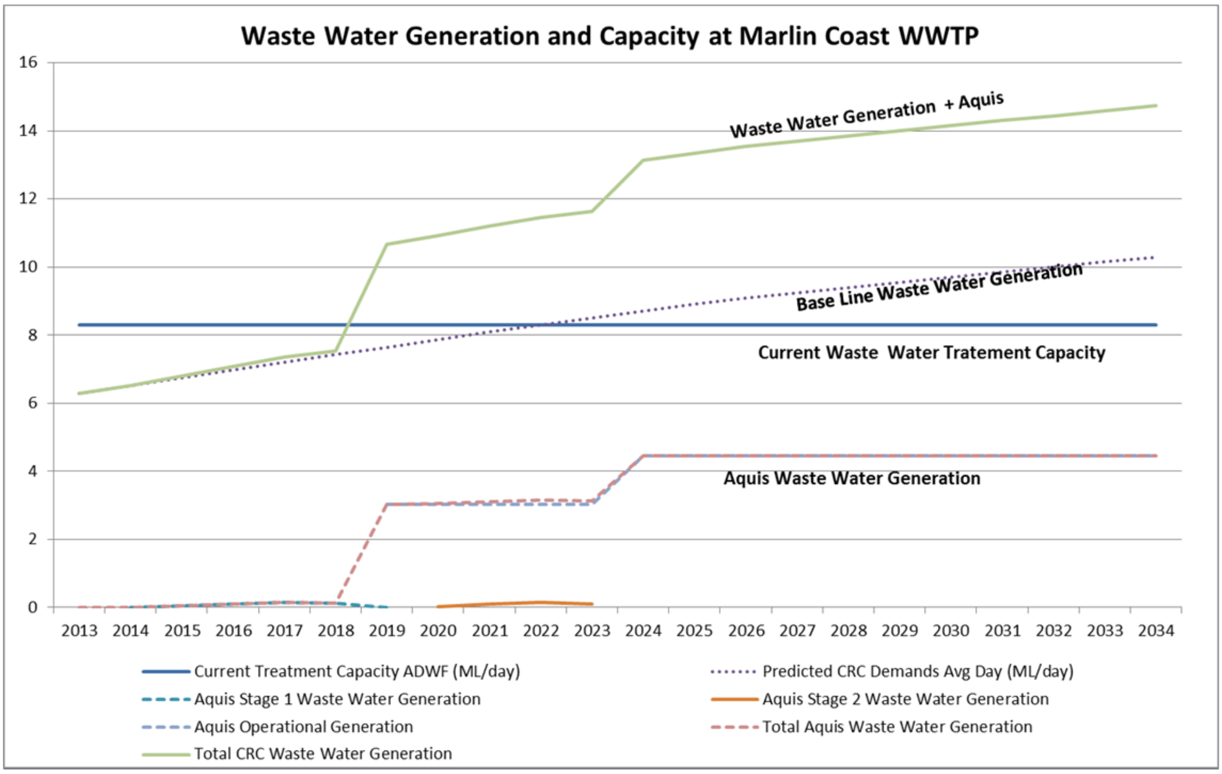

Figure 25-19 Aquis waste water generation and Marlin Coast WWTP treatment capacity.

The figure demonstrates the latent capacity of the Marlin Coast WWTP is consumed by the Aquis Resort by the start of the Stage 1 operations in 2019 and therefore will require upgrading. Council plan to upgrade the plant over time to 17ML/day ADWF capacity to meet planned catchment demands and would be bought forward by 4 to 5 years to accommodate the needs of Aquis.

c) Impacts on Waste Water Connection

The Aquis Resort will generate waste water that will exceed the capacity of the existing Yorkeys Knob rising main.

Figure 25-20 shows the peak wet weather flow from Aquis and how this demand will exceed capacity of the existing rising main.

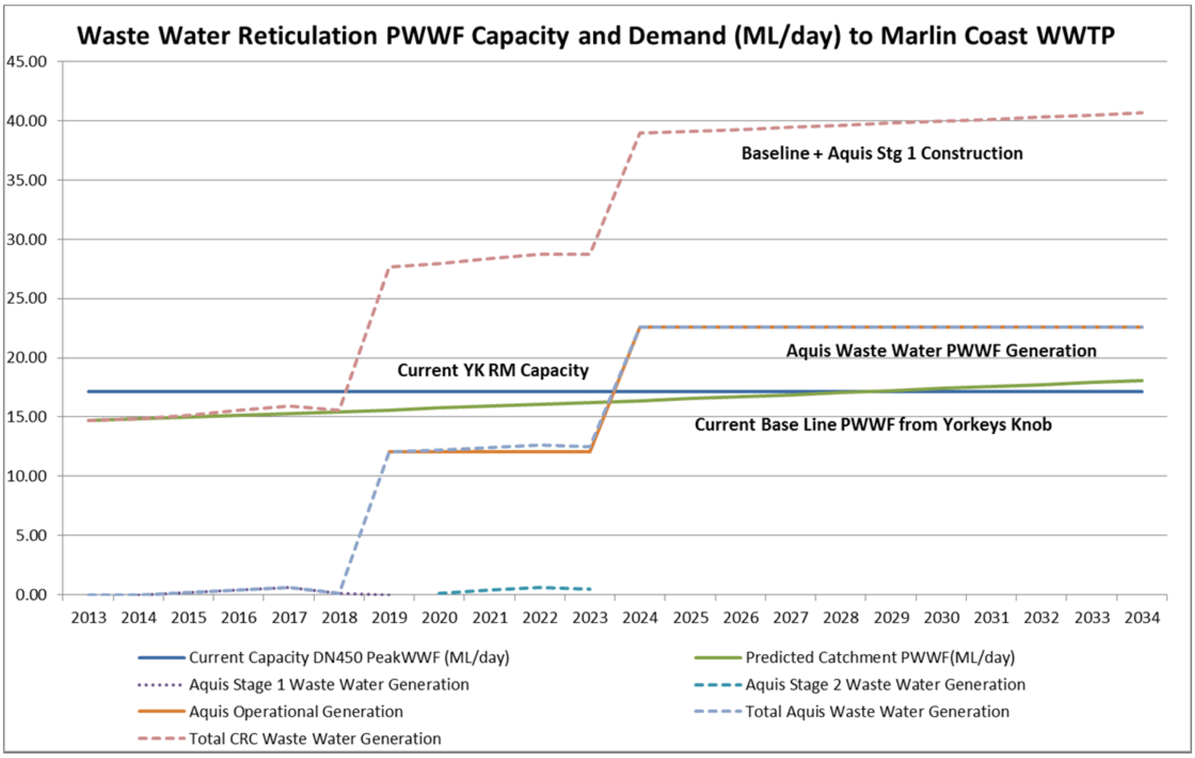

Figure 25-20 Aquis Waste water generation and dedicated rising main capacity.

25.2.3 Augmentation

a) Mitigation Measures and Management

Waste water generation mitigation and management strategies will contribute significantly to minimising the quantum of discharge and thus the ability of the trunk network to receive and treat the waste water flows from Aquis. Below are a number of strategies that will be employed to manage and mitigate waste water flows.

<u>Waste Water Mitigation by Design</u>

The design of the waste water reticulation system will be based upon using 'smart' sewerage system which will further reduce loads on external infrastructure by:

Minimising inflow and infiltration

- Utilisation of vacuum sewage systems which are recognised to reduce infiltration opportunity.
- Monitoring of flows throughout the network to establish potential inflows and repair opportunities.

Balancing of Discharge of Peak Flows

- Sewage buffer tanks will be utilised for the storage of peak flows to regulate and manage discharge to the network and Marlin Coast Water Treatment Plant.
- Emergency storage will be provided to cater for up to three days storage at peak sewage generation flows to cater for circumstances involving loss of the network or treatment plant (e.g. major flooding or cyclone events). The emergency storage will form part of the buffer tank system.

- Telemetry will be utilised to link the sewerage pump stations to the Marlin Coast WWTP to automate and regulate discharge from the pump stations as a function of flows being received by the WWTP.

Design Practices

Aquis will implement measures consistent with design and operational requirements defined by the CRC FNQROC development design guidelines. These measures will include:

- Lids of sewerage manholes will be sealed and anchored to avoid over flow and ingress.
- Sewage pump stations will be placed above the Q100 + climate change levels to avoid ingress in major flood events.
- Sewage pump stations will have stand-by power supply provided by diesel powered power generators.
- Emergency storage at each of the pump stations will be sized to cater for six hours of average dry weather flow (ADWF) to cater for routine maintenance.
- Emergency storage will be provided on-site to cater for extenuating circumstances where there is an extreme natural event. The storage would be sized to cater for three days of average dry weather flows. (Given in this circumstance the occupancy will likely be low this quantum of storage is considered appropriate.) Management procedures would also be put in place to arrange for storages to be pumped out and transported by tanker to operational waste water treatment plants.

Managing Discharge of Sewerage Strengths

There are elements of the development that will require application to Council for Trade Waste permits to allow discharge into the council sewerage system as follows:

- *Swimming Lagoon*: There will be on-site treatment and chlorination required of the water used for the swimming lagoon at the main resort. The treatment will include filtering and associated backwash of the filter system as a maintenance regime. The backwash water is to be discharged into the sewerage system under a trade waste permit. Due to likely high chlorine levels in the backwash water it is envisaged this will need storage and pre-treatment on-site to strip out chlorine.
- *Aquarium:* The aquarium will also require filtering and treatment of the source salt water as it enters the aquarium and then associated filtering of the water during operation. Like the lagoon, the filter system will require backwashing and as a consequence create backwash water which is to be discharged into the sewerage system under a trade waste permit. This waste will like have high salt and chloride levels and will need on-site treatment and storage prior to discharge into the sewerage system.

Proprietary systems (e.g. Amiad Water Systems) for the filtration of pool / aquarium and backwash water are available on the market. Treatment of high chlorination contents is undertaken using Kinetico Hydrus Carbon filters and high salt contents are treated using a reverse osmosis membrane system and dilution. The back wash waters will be tanked, tested and monitored for water quality prior to discharge into the sewer system and would be discharged at a slow continuous rate so as to maximise opportunity for dilution with sewage flows.

b) Upgrade of Marlin Coast WWTP

CRC plan to upgrade the Marlin Coast WWTP to 17 ML/day (ADWF) capacity. This may be implemented in single or multiple stages and the implementation of Aquis would result in bring forward of upgrade by four to five years. **Figure 25-21** illustrates options for a single or staged upgrade that would meet Cairns requirements including Aquis.

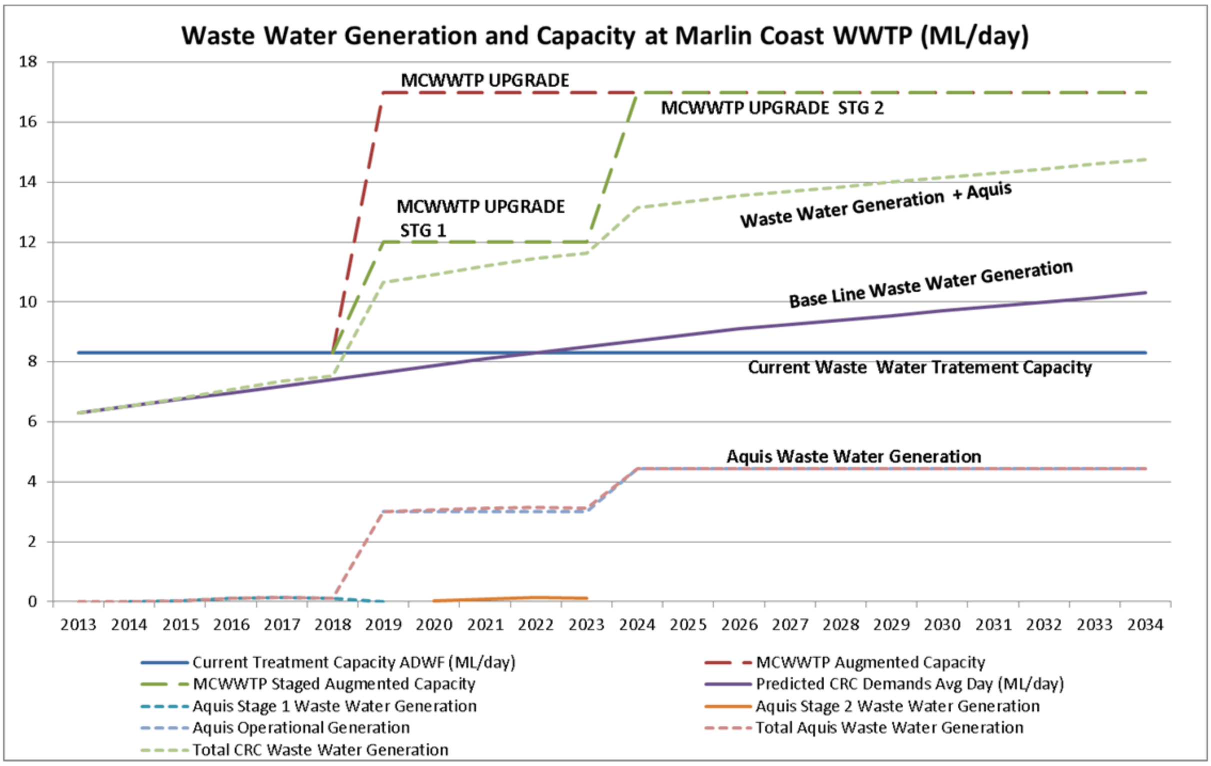

Figure 25-21 Aquis waste water generation and Marlin Coast WWTP treatment capacity.

c) Dedicated Waste Water Rising Main

A dedicated DN500 rising main will be utilised to pipe waste water flows from the Aquis Resort to the Marlin Coast WWTP. A large pump station will be situated adjacent to the development to pump waste water to the Marlin Coast WWTP. **Figure 25-22** illustrates the benefits of the dedicated waste water rising main.

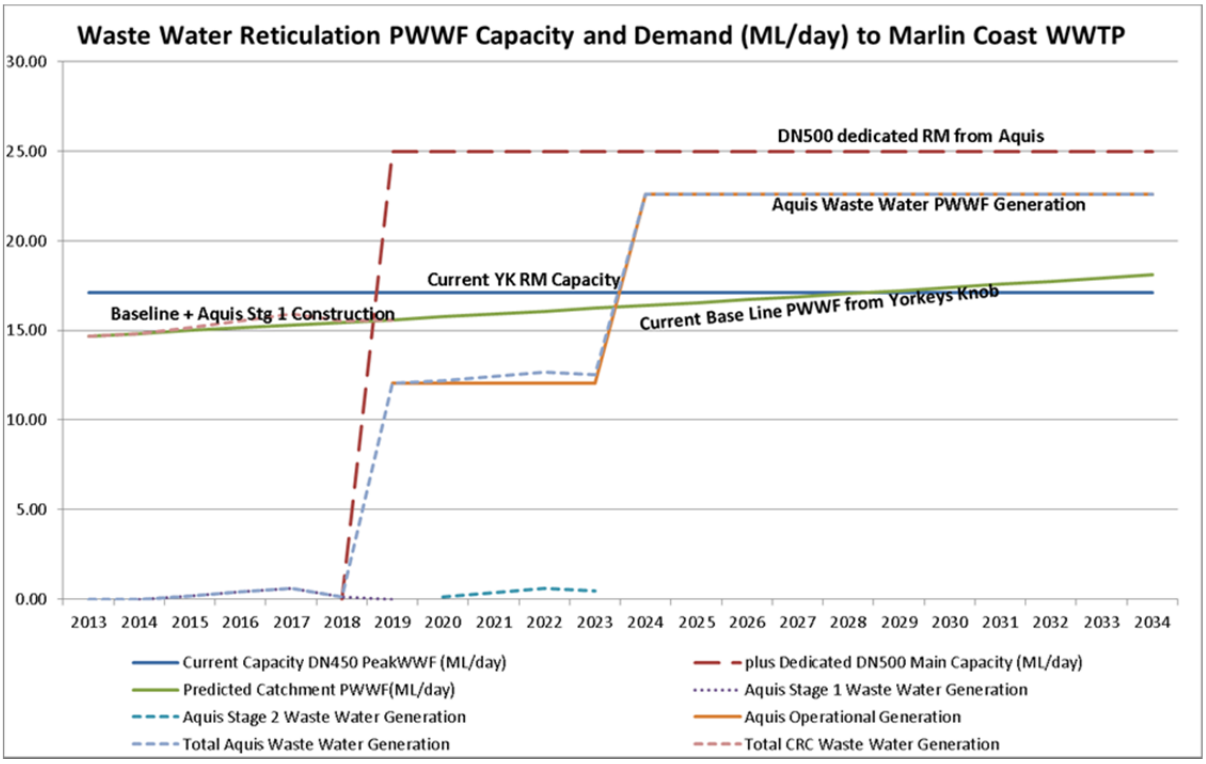

Figure 25-22 Aquis waste water generation and dedicated rising main capacity.

The red dashed line represents the commissioning of the dedicated DN500 waste water rising main at 2019. Waste water flow generated during the stage 1 construction phase can be accommodated by the existing Yorkeys Knob Rising Main. It is proposed a temporary pump station would be established for Stage 1 construction which would direct inject into the existing Yorkeys Knob rising main.

Figure 25-23 provides details of the proposed alignment for the DN500 waste water rising main to the Marlin Coast WWTP.

Figure 25-23 Proposed DN500 waste water rising main to the Marlin Coast WWTP.

Figure 25-24 provides detail of the proposed services type sections within Yorkeys Knob Road and Dunne Road.

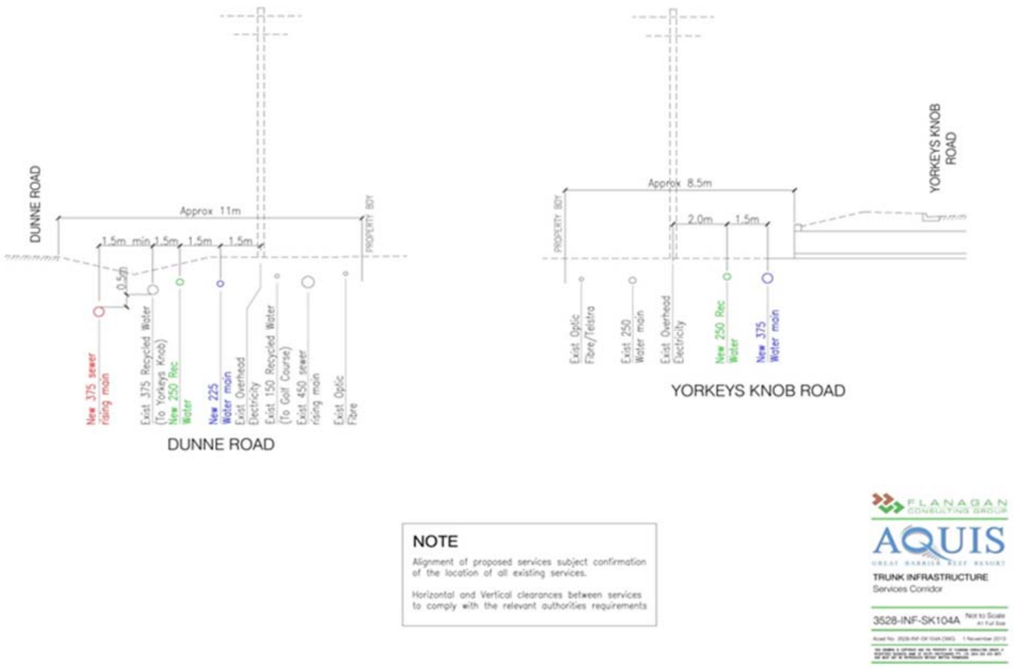

Figure 25-24 Services type sections.

The type sections will be further refined as the concept design is developed for the trunk services.

No master planning or network modelling of the internal waste water network has been undertaken as yet. This process will be undertaken in support of the Material Change of Use application to be made to CRC and is considered premature for the Environmental Impact Statement.

d) Key Approvals

In relation to the upgrade of the Marlin Coast WWTP, CRCWW have sought advice from DEHP and have been advised that:

'CRC (CRC) may upgrade its WWTPs as necessary provided the conditions of the approval can be achieved and you remain within the relevant ERA threshold. If this can be achieved then there would be no amendment or new application required. For example of particular relevance to this case, CRC should consider any upgrades and the ability to meet, on an ongoing basis, the maximum release on any one dry weather day of 21.3 ML and daily mass loads for TN of 57 kg/day and TP of 11.4 kg/day.'

Council advises that it has no issues with meeting the TN and TP mass loads, and from the information to hand, and assuming all sewage from Aquis is treated at the Marlin Coast WWTP, CRCWW do not consider there is any significant risk of the WWTP exceeding the maximum release of 21.3 ML/d for any dry day, throughout the design horizon of the plant, i.e. through to 2026.

e) Infrastructure Agreement

The proposed development is located outside the Priority Infrastructure Area (PIA) and is inside the charging catchment for Infrastructure Charges for waste water infrastructure.

The proposed development will result in:

- Infrastructure that has not been included current planning and that would be wholly attributable to the proposed development, and
- Future infrastructure that is currently planned that would need to be brought forward in time to accommodate the proposed development.

The proponent proposes that it enter into an Infrastructure Agreement with Council on the basis that:

- the development is considered as separate to and independent of the Council Trunk Infrastructure Contribution Policy
- the cost of dedicated trunk infrastructure to connect the development to the existing water supply network where it has capacity is met by the proponent
- the proponent will contribute its proportionate share of the cost of the upgrades to the transport network
- cost sharing arrangements would be identified for shared trunk infrastructure.

As the Aquis development will be funding in full the trunk reticulation to the Marlin Coast WWTP, it is proposed that the development would contribute that component of the headworks charge related to the WWTP. An estimate of the WWTP portion of the standard charge is 46%.

Estimated Headworks Charges = 5300 EDU @ $3988/EDU x 0.46 = $9 722 744.

25.3 ENERGY AND COMMUNICATIONS

25.3.1 Existing Situation

a) Energy

To cater for load growth on the Cairns Northern Beaches region, Ergon Energy (EE) has proposed that a new Smithfield 132/22 kV Zone Substation be developed in McGregor Rd, Smithfield, around 2024/2025. This is based on current load forecasting and risk management methodologies, current estimates of commercial and residential activity in the area, current estimates of load growth and demand management activities. Ergon Energy (EE) have acquired the land and completed only preliminary stage planning for this facility.

The Smithfield substation will be developed as a 132/22 kV hybrid indoor/outdoor substation with two transformers of approximately 60MVA each, supplied by 2 x 132 kV overhead /underground feeders installed from the Powerlink Kamerunga substation, and with a 3 bussection 22 kV indoor switchboard.

Some augmentation of the Kamerunga substation will be required to fit a further two HV bays to provide a connection point for the two new feeders serving the Smithfield substation.

The planning, design and construction timeframe required by EE to construct this major new substation in the Smithfield area is in the order of four to five years. As part of the Federal Australian Energy Regulator (AER) guidelines for network operators, EE is required to undertake a Regulatory Investment Test - Distribution (RIT-D) process whenever they assess that network augmentation works over a value of $5 m are required on their network. It is estimated that this process adds at least six months to a substation development process, but would be catered for in the four to five year timeframe mentioned above.

The 2 x 132 kV feeders will be installed along the Cairns Western Arterial Road reserve, and as a result will not have any redundancy in location. From the Caravonica roundabout, to the Smithfield substation location, it is possible to separate the cables via two independent cable routes to provide added security, by utilizing a new road relocation reserve being progressed by DTMR.

The Yorkeys Knob Township is currently serviced via a single 22 kV feeder which has limited spare capacity (approximately 1 MVA).

b) Communications

Telstra's network includes fixed line, broadband services and mobile coverage to the Yorkeys Knob community. All of these networks are supported by an optic fibre cable on a standard alignment along Yorkeys Knob Rd and the Captain Cook Highway to the Freshwater exchange to the south.

At Yorkeys Knob the fixed services originate from a telephone exchange located in Wattle Street. The existing conduit and cable reticulation towards the proposed site would be insufficient for even minor construction work communications.

Mobile services are currently provided via antennas on a small tower adjacent the exchange.

Similar to Ergon, the planning for any augmentation of the Telstra Network to the Yorkeys Knob area has been significantly delayed due to a lack of customer demand. With the slow rate of organic growth in the area the existing Telstra infrastructure is capable of catering for the current and medium term demand. This also delays the introduction and support of higher bandwidth services like ADSL 2+ etc.

There is currently no NBN Co infrastructure in the Yorkeys Knob Area. The current roll-out plan has services to be installed in the area in the next three years. Similar to Telstra, any major band-wide upgrade would require new optic fibre run from the Freshwater Exchange.

25.3.2 Impacts

a) Energy

The energy demand for the development including equivalent electrical power requirements to provide lighting, general power, air conditioning, cooking, hot water production etc. has been assessed in consideration of the area and anticipated use of the proposed development.

To confirm if there are more efficient methods of satisfying this energy demand, alternative energy sources have been assessed. For example cooking and water heating could be provided by gas appliances. This would require the reticulation of gas throughout the site, but will provide a reduction of ~15% in the electrical power demand. Our preliminary estimates indicate that there would be a saving of approximately $7K / day based on occupancy of 11 000 people. The reduction in electrical energy demand saved by using gas is estimated at 4 MVA, which is equivalent to half the capacity of a fully loaded 22 kV Ergon feeder.

Similarly, energy savings can be realised in centralising the production of chilled water with reticulation throughout the district for air-conditioning use.

District Cooling Systems (DCS) with Central Energy Plants (CEP) typically comprises of a dedicated plant building that houses multiple large High Voltage chillers, primary and secondary chilled water circulating pumps, cooling towers and condenser water pumps.

The CEP building is typically located away from public and acoustically sensitive areas. CEPs can effectively replace most of the refrigeration plant in new buildings. They serve to lower noise levels in the occupied parts of the site and reduce building area requirements to house plant. They are expandable to accommodate growth in demand and generally employ higher efficiency equipment than distributed plant. The chilled water is distributed throughout the district though a piped chilled water network.

Most importantly, centralising the production of the bulk of the chilled water throughout the site:

- provides a substantial saving in electrical power reticulation within each facility
- reduces the plant area burden on each individual building thereby reducing building capital cost
- provides the opportunity to incorporate Thermal Energy Storage (TES).
- enables the centralisation of redundant chilled water plant thereby improving infrastructure utilisation.

In conventional systems, the refrigeration plant must operate whenever the building requires cooling. This generally occurs during the day time when ambient temperatures are high and electrical demand from other sources is at its highest.

In a Thermal Energy Storage System, the refrigeration plant is operated at optimal chiller efficiency with storage tanks acting as a buffer for variances in the demand. This provides significant cost savings in peak demand charges for electrical demand, despite the equivalent electrical energy being consumed to produce the stored chilled water.

Stage 1 of the Aquis Development requires the supply of approximately 14MW with the total development requiring 29 MW from the Ergon Energy (EE) electricity network in the Yorkeys Knob / Smithfield area. Currently, Ergon Energy is not able to supply this amount of energy from its existing network. Ergon Energy have advised that the closest 132/22 kV Zone Substation at Kamerunga, does not have this capacity available in the transformers or 22 kV feeders to supply the additional 29 MVA.

b) Communications

The telecommunication requirements of the Aquis Resort for landlines, mobile and broadband / optical fibre coverage will far exceed the capacity of the existing copper infrastructure. A significant upgrade will be required to meet the development needs.

25.3.3 Augmentation

a) Energy

Ergon Energy (EE) has proposed that a new Smithfield 132/22 kV Zone Substation be developed in McGregor Rd, Smithfield, around 2024/25 based on current load forecasting, risk management methodologies, current estimates of commercial and residential activity in the area, current estimates of load growth and demand management activities. Ergon Energy has acquired the land and completed preliminary stage planning for this facility. Ergon Energy will be required to bring forward the construction date of this Smithfield substation based on the load required by the Aquis Resort.

EE is likely to contract out the design and construction of the feeder and substation work to reputable external contractors. This will allow a more rapid deployment than would otherwise be the case. We expect this will bring the development of the major power infrastructure more in line with the proposed Aquis Development timeline.

EE will require the developer to enter into a connection agreement for the required energy supply for the entire development.

For construction phase power demands the options are to make each contracting firm responsible for their power generation or provide a hybrid of Ergon and centrally generated power which could be sold to the contracting firms throughout the site.

Having each contracting firm provide their own power could become problematic in regulating fuel storage, noise and general electrical safety. Alternatively, as part of a future central energy plant an early part of the large scale generation could be provided with the ability to synchronise to the Ergon network and supplement it during high load conditions. During the low load conditions the site could be run totally off the Ergon Energy supply

Figure 25-25 provides a concept arrangement for the proposed electricity reticulation provisions to and through the Aquis Resort site.

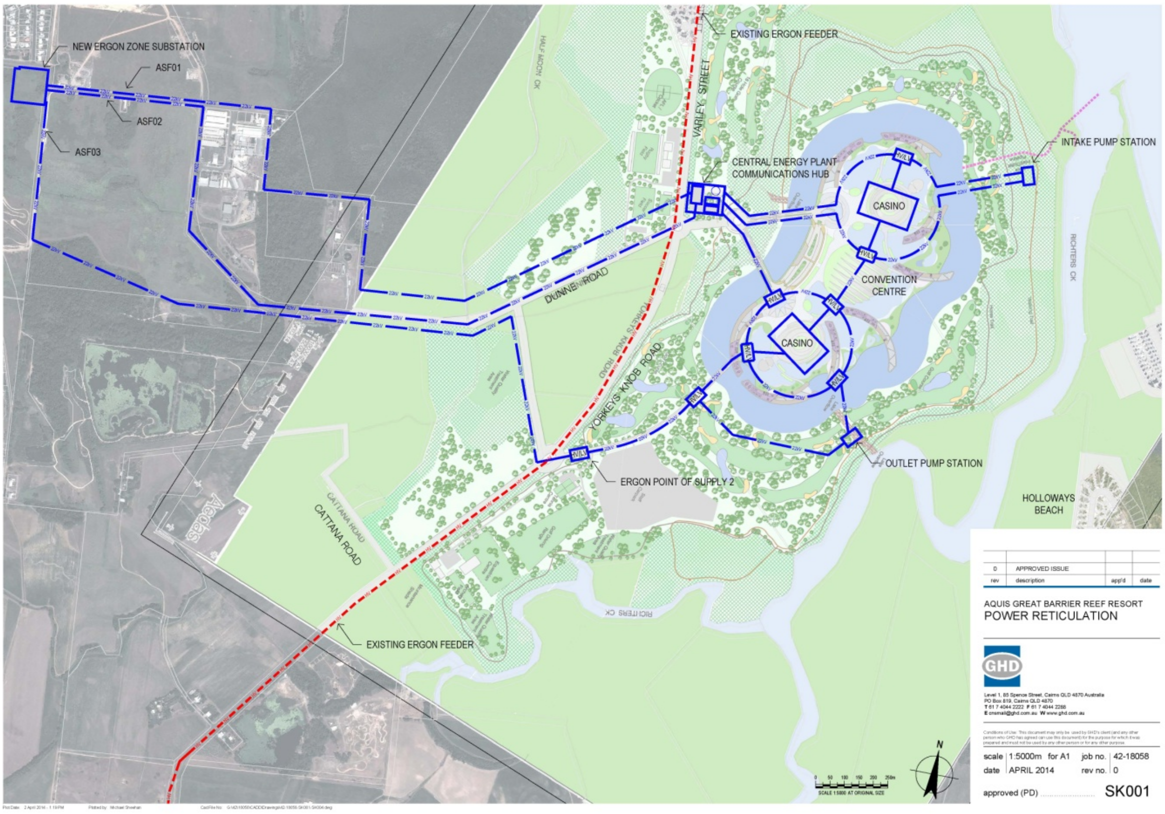

Figure 25-25 Proposed power reticulation scheme.

b) Telecommunications

<u>Fixed and Wideband Services</u>

With the introduction of the Aquis development, Telstra would need to upgrade its back haul bandwidth to cater for the development. This would require the installation of new optic fibre cables back to the Freshwater exchange and the provision of a communications centre (exchange) adjacent the proposed Central Energy Plant.

Reticulation throughout the site would require an optic fibre network installed in the common service trench as indicated on the communication drawings. At each building communication equipment would be required to provide connection to the fixed and wideband services network.

<u>Mobile Services</u>

The provision of mobile phone coverage in the hotels, convention centre and casino post construction is a separate activity and will require detailed analysis and costing for a final solution, based on the size of the development and the number of staff expected that will be on-site will trigger the need for a new facility.

- The site will need to be located within the development area to provide an efficient layer of coverage.
- Easy access to mains power and optic fibre will be required.

- Council approval will be required for any structure Telstra installs; Telstra will manage this as part of its process. For such sites Council approval can add up to six months to the lead time of building a facility.

<u>NBN Co Infrastructure</u>

Within the next three years NBN Co is expected to provide a fully reticulated network in the Yorkeys Knob area. The Aquis Development would simply be an accelerated portion of the expected organic growth in the area.

Figure 25-26 provides a concept arrangement for the proposed telecommunications provisions through the Aquis Resort site.

Figure 25-26 Proposed telecommunications reticulation.

25.4 INFRASTRUCTURE ALTERNATIVES

25.4.1 ESD Justification

The National Strategy for Ecological Sustainable Development (ESD) notes that the three core objectives (Department of the Environment 2013):

- to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations
- to provide for equity within and between generations
- to protect biological diversity and maintain essential ecological processes and life-support systems.

The discussion also notes that the Aquis approach is to consider a raft of sustainability initiatives to reduce energy consumption, conserve water, reduce waste, and re-use materials where possible via a *Sustainability Strategy*. Relevant aspects that strategy are:

- water use (use of re-cycled water from the WWTP, use minimisation initiatives)
- energy efficiency (centralised chilled water storage, possible use of reticulated gas, solar, motion sensors for lighting, energy efficient lighting, training staff in energy efficiency specific to their roles)
- purchase grid electricity from renewable sources such as wind or solar
- maximise use of natural lighting and ventilation in design of buildings
- undertake energy audits and track carbon
- waste management (including WSUD and its role in reducing export of water-borne pollutants, as well as a whole range of solid waste minimisation initiatives)
- greenhouse gas emissions (a design matter covering a wide range of design disciplines).

25.4.2 Water

a) Options for Water Supply

The quantum and security of supply of water supply is a significant issue when considering potential alternatives for supply of water to Aquis. There were several potential water sources considered for Aquis and these are discussed below:

- **Reticulated Potable Supply from CRC.** Given the location of the site within the urban fabric of Cairns, and its close proximity to existing water network infrastructure of Cairns, the connection of Aquis to the network makes for a prudent and feasible solution. The quantum of potable water required to service Aquis will place further demand on an existing raw water supply that currently requires upgrading, hence the development has sought to minimise demands on potable water supply by maximising the opportunity for use of recycled treated effluent and adopting water-wise management practices and devices across the resort.
- **Recycled Re-Use Water from CRC.** Analysis has established that up to 50% of the water demands of the development can be met through the use of recycled water sourced from the Marlin Coast and the Northern Cains WWTPs. This Class A and Class A+ water can be used for irrigation and toilet flushing uses. Re-use water represents a valuable sustainable resource that is currently created in volumes that are significantly under-utilised. It is a cost-effective and prudent and feasible alternative to using potable water for certain uses.
- **Harvesting of Rainwater.** Harvesting of rainwater by capture of roof runoff and storage in basement tanks is an effective means of maintaining a non-potable supply that can be utilised for toilet flushing and the like. It is also part of the stormwater drainage strategy previously described.
- **Groundwater.** Given the proximity of the site to the sea and the known transmissivity of the soils, the quality of groundwater in the upper aquifer will be at best brackish and most likely saline The groundwater report (**Appendix Q**) notes that extraction from this upper aquifer may be practical for construction but not on any sustained basis for the operational phase. Extraction of groundwater from the lower, semi-confined aquifer to support the construction and operation has the potential to move the existing freshwater/saline groundwater interface that could result in the loss of this resource both within and adjacent to the site boundaries. Detailed investigations and modelling are likely to be necessary to assess the suitability of extracting groundwater from the semi-confined aquifer and to estimate the available resource and possible pumping rates. The design decision to quarantine the lake from local groundwater makes the extraction of this resource more feasible but sustainability will need to be demonstrated before this can take place.

- **Sea Water.** Sea water sourced from the adjacent creek system or from an ocean intake off Yorkeys Knob and processed through a desalination plant represents a potential potable water alternative. However, desalination plants are very costly to build and operate and consume large amounts of energy. (Energy costs account for one-third to one-half of the total cost of producing desalinated water.) The process of desalination requires pre-treatment and cleaning chemicals, which are added to water before desalination to make the treatment more efficient. These chemicals include chlorine, hydrochloric acid and hydrogen peroxide, and they can be used for only a limited amount of time. Once they have lost their ability to clean the water, these chemicals are disposed of and this requires appropriate disposal facilities. Brine is the by-product of desalination and this hypersaline water must be disposed of. Most desalination plants pump brine back into the ocean, which presents environmental concerns given the proximity to the Great Barrier Reef WHA. Ocean species are not equipped to adjust to the immediate change in salinity caused by the release of brine into the area. The discharge of hypersaline water also decreases oxygen levels in the water which can create conditions for fish kill.

In summary, alternatives that are considered to be prudent and feasible are:

- connection to the Council supply network for potable and non-potable water
- use of treated effluent and harvested rainwater for non-potable water.

Alternatives that are not considered to be prudent and feasible are:

- use of groundwater (for other than short term use during construction)
- use of sea water via a desalination plant.

b) Options for Treated Effluent

Production of suitable treated effluent can involve two possible alternative infrastructure solutions as discussed below:

- Marlin Coast WWTP: The Marlin Coast WWTP is located less than 1 km from Aquis on Dunne Road. The plant currently services the sewerage catchment within which the development is situated. The plant will require upgrading to meet the sewage generation demands of the development and Council are also planning to augment the plant to produce Class A+ treated effluent which would be reticulated back to the development for non-potable uses. A dedicated main would be installed to connect a proposed major sewage pump station to the treatment plant. The Marlin Coast WWTP meets the licensing requirements for treatment and discharge of treated effluent and it is planned to upgrade the plant from the current 8.3 ML/day capacity to 17 ML/day.
- On-site treatment and disposal: On-site treatment and disposal of wastewater would require a treatment plant of significant size and scale to meet the demands of Aquis. On-site waste water treatment plant technology is typically designed to service remote sites where there is no existing sewage treatment capacity or the demand is generated for a relatively short period of time, for example a mining camp or the like. In this case Aquis is situated in very close proximity to the Marlin Coast WWTP and will be creating demand for an indefinite period. A dedicated sewage treatment plant would require permits and licensing for processing and disposal of treated sewage that would in effect duplicate those that are currently in place for the Marlin Coast WWTP. The placement of a second WWTP on the Aquis site, in such close proximity to an existing facility that can be readily upgraded to cater for the demand, is not an appropriate solution in the context of management, permitting and licensing, cost-effectiveness, or environmental risk.

In summary:

- alternatives that are considered to be prudent and feasible are:
  - reticulation of treated effluent from the Marlin Coast WWTP (and the Northern WWTP) to the site
- alternatives that are not considered to be prudent and feasible are:
  - on-site treatment of sewage.

25.4.3 Energy and Communications

The project has a number of management options available to meet this high load and these include:

- conventional on-site generation (standby and load balancing)
- energy efficiency (especially regarding air conditioning)
- reticulated ga
- alternative energy sources.

a) On-site Generation

The provision of back-up power will be critical to a significant portion of this development during both construction and operation. Demands include the buildings, pools, and other facilities as well as the lake infrastructure which has ongoing power demands for pumping and circulation.

Construction

Generation during construction will need to cater for very low load condition (at night) and substantial load conditions during the day, including crane power and potentially large compressor units. It is proposed that a transfer-parallel arrangement be considered to cater for these extreme load conditions. Under this arrangement the central plant could only use Ergon power from the Yorkeys Knob feeder during low load conditions and provide generator power operating in parallel on a common low voltage (415 V) bus during high load demand times.

Operation

Within the buildings, the back-up power may be provided by either diesel or gas power generator units. However the external essential services will require installation of a central power plant. The provision of a significant power plant as required to provide construction power could be re-configured following construction to provide part of the long term power back-up to the development.

When the development is operational, a similar arrangement could be implemented to provide the following functionality:

- generator power to supply essential loads during a loss of power event
- parallel/transfer arrangement to assist with peak power demand management
- parallel/transfer arrangement also enables periodic testing of the generators without affecting the connecting load or the need to use expensive load banks.

To improve the overall efficiency of the power and air conditioning delivery to the development, consideration should be given to using high voltage chillers and generators in the central energy plant. This involves a mismatch between the necessary operating voltage and that normally supplied and there are certain technical solutions that need to be explored.

b) Air Conditioning

The air conditioning load constitutes 40% of the estimated peak load demand of 29 MW and the use of a centralised chilled water system has the potential to assist with this. This involves a large scale district cooling system, with centralised production of chilled water via high efficiency central energy plant in conjunction with a thermal energy storage tank. The centralisation of chilled water production would facilitate the reduction of plant room sizes and eliminate the need for cooling towers in each of the buildings in the development. It will also significantly reduce the amount of electrical energy required at each building, therefore reducing the electrical reticulation infrastructure.

Although the development will have a relatively ‘flat’ site cooling load profile (i.e. few peaks and throughs that permit load balancing, a system of this scale provides an opportunity for reduction in peak demand through chilled water thermal energy storage. It is estimated that the diversified site cooling load would draw approximately 12 MW of power and this could be reduced by up to 4 MW.

c) Gas Infrastructure

Cooking and water heating could be provided by gas appliances. This would require the reticulation of gas throughout the site, but will provide a significant reduction in the electrical power demand.

Preliminary estimates indicate that there would be a saving of approximately $7K / day based on occupancy of 11,000 people. The total electrical energy saving by using gas is estimated at 4 MVA, which is equivalent to half the capacity of a fully loaded 22 kV Ergon feeder. This would also provide significant savings in the high voltage power reticulation network.

The only existing reticulated gas systems in the Cairns area are located in the Cairns CBD and in parts of Palm Cove. Origin Energy operates this infrastructure and would therefore be capable of establishing and operating a similar reticulated gas system for the Aquis development. These systems are based on a localised mass storage cylinder and reticulated gas pipe networks to each building or load centre.

d) Renewable Energy

<u>Solar Power Generation</u>

The introduction of solar power generation for this scale of development would be feasible provided that a solution to install the panels on the roof of the major structures could be incorporated. An initial calculation suggests up to 5 MW of energy or 20% of the total daytime resort demand could be supplied by solar energy, representing total energy saving of 12.5% for sunny days. This excludes allowance for roof areas on the rectangular stadium.

Further investigation would be required when the final building roof structure is confirmed to determine the total available roof space and therefore the expected yield of solar energy. The pay-back period is approximately five years irrespective of the initial investment.

<u>Wind Power Generation</u>

Based on previous studies on wind generation in this area, this form of power generation is not considered viable. The wind in this location is very erratic and generally yields would be small/ insignificant. When considering the required investment there would be more efficient solutions to provide energy savings to offset traditional power generation.

<u>Tidal Power Generation</u>

The use of tidal power generation located in Thomatis Creek adjacent the development could be investigated. There would be significant environmental considerations to work through with this form of generation and while the yields may make it a viable option, the feasibility would be subject to further investigation.

Co-generation from Waste

While there are no current waste co-generation opportunities for power that have been identified with the development, Aquis Resort is also committed to exploring any opportunities that may be identified during the detailed project planning and design stages.

e) Communications

The provision of the necessary communications within the resort is a detailed design issue, with a number of issues needing consideration:

- allowance for new technology (i.e. the National Broadband Network (NBN) will be available in the area before construction is completed)
- changes in consumer use of voice, text and data services
- communications required during an emergency when the public system could be inoperable (this was raised as an important issue during consultation with emergency services personnel.

25.4.4 Resource and Energy Efficiency

The proponent has made a commitment to achieve the highest possible standards in terms of energy efficiency and overall sustainability and is targeting a six star rating for all buildings. This will require careful attention to all aspects of energy efficiency including siting and orientation of buildings, passive cooling options, the use of alternative energy, and the wise use of other resources.

In order to do justice to this issue requires a major study in its own right and this is planned as part of the Sustainability Strategy.

Some initial discussion is provided in this EIS on the issue of resource efficiency, for example:

- recommendations for energy savings by the use of reticulated chilled water, gas, and solar power, as well as possible use of power co-generated from waste
- use of treated effluent from local sewerage treatment plant for non-potable uses (this has benefits in reducing pollutant discharge to the GBR lagoon
- a raft of waste management strategies.