MWH

BUILDING A BETTER WORLD

REPORT

Water Supply Strategic Infrastructure Plan - Agnes Water Supply Scheme

Prepared for Gladstone Regional Council

February 2015

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
John Ciccotelli	Phillip Hall

PREPARED BY		
Phillip Hall / Anjila Finan	.....	...../...../.....
CHECKED BY		
Hayden Knight	.....	...../...../.....
REVIEWED BY		
Phillip Hall	.....	...../...../.....
APPROVED FOR ISSUE BY		
John Ciccotelli	.....	...../...../.....

BRISBANE
Level 3 35 Boundary Street, PO Box 3602, South Brisbane, QLD 4101
TEL +61 7 3029 5000, FAX +61 7 3029 5050

REVISION SCHEDULE

Rev No	Date	Description	Signature or Typed Name (documentation on file).			
			Prepared by	Checked by	Reviewed by	Approved by

Executive Summary

MWH were engaged by Gladstone Regional Council in 2014 to develop water supply and sewerage strategic infrastructure plans for the Gladstone and Agnes Water networks. As part of this engagement 4 individual reports were produced as follows:

- Water Supply Strategic Infrastructure Plan – Gladstone Water Supply Scheme
- Water Supply Strategic Infrastructure Plan – Agnes Water Water Supply Scheme
- Sewerage Strategic Infrastructure Plan – Gladstone City Area
- Sewerage Strategic Infrastructure Plan – Agnes Water

This report represents the water supply strategic infrastructure plan for the Agnes Water water supply scheme and documents the inputs, methodology, assumptions and approach adopted along with the water supply infrastructure outcomes.

All above listed reports have been prepared for the joint purpose of supporting Gladstone Regional Council's submission of the Local Government Infrastructure Plan (LGIP) for which updated water supply and sewerage infrastructure planning was required in the Gladstone City and Agnes Water networks.

Based on the outcomes of this study the following is concluded:

1. A demand model for Agnes Water water supply area was developed and allocated to the H2OMAP hydraulic model for use in existing and future performance assessment and the identification of augmentation requirements. A summary of the project demands per Ultimate water zones is provided within **Table ES-1**. The current demand of the Agnes Water water supply network of 1,087 ET was identified with an Ultimate demand of 4,543 ET.

Table ES-1: Total ET per Ultimate Supply Zones

Water Zone	Total ET						
	2014	2016	2021	2026	2031	2036	Ultimate
Booster Zone	62	62	62	62	62	62	62
High Level Zone	465	604	688	795	850	950	2,048
Low Level Zone	560	630	804	944	1,152	1,347	2,433
Total	**1,087**	**1,297**	**1,554**	**1,801**	**2,064**	**2,359**	**4,543**

2. An assessment of current storage capacities based on current zoning identified that current reservoir storage is sufficient until the 2036 planning horizon. The ET trigger for storage upgrade is 2,150 ET which will occur in approximately 2033 based on the current growth projections.

3. Due to capacity and operational issues with the existing 150 mm diameter supply main from the Agnes Water WTP to the Seaspray Drive reservoirs a new dedicated 375 mm diameter reservoir supply main is proposed (**WTM_AW_002** and **WTM_AW_003**). The new main will be of sufficient capacity to deliver required flows to the network up to and including the Ultimate planning horizon. Additionally, pressure fluctuations currently being experienced by customers in the network due to the current inlet/outlet operation of the reservoir supply main will be removed. A flow controlled connection to the proposed low level reservoir (**WRS_AW_700**) at 2036 from this dedicated inlet main is proposed.

4. Driven by high pressures being experienced by customers within the low lying areas in the east of Agnes Water, a rezoning strategy for the Agnes Water water supply network has been developed. This strategy is summarised as follows:

    a. Establish a low level zone consisting of low elevation properties primarily located to the east of Captain Cook Drive. The low level zone will initially be supplied via a pressure reduced connection from the high level zone located on the 150 mm diameter main at the southern end of Captain Cook Drive. Upon construction of the Evans Court low level reservoir (**WRS_AW_700**) and 375 mm diameter low level reservoir outlet main (**WTM_AW_009**), the PRV can be removed and the low level zone can be supplied directly from this new reservoir.

    b. Supply to the 1770 water supply network must continue to be supplied from the HGL of the Seaspray Drive resevoirs for standards of service to be maintained in both Agnes Water and 1770 water supply networks. A number of upgrades to the network are required for both bypassing the low level zone and providing sufficient capacity for future supply to 1770. These upgrades are as follows:

        - 2014 Augmentations:
            - **ATM_AW_001** – Dedicated 1770 supply main in Captain Cook Drive (200 mm diameter)
            - **WRM_AW_010** - Capacity upgrade from Starfish Street to Banksia Drive – (200 mm diameter)
        - 2016 Augmentations
            - **WRM_AW_026** - Woodrow Drive and Solander Close – (200 mm diameter)
        - Ultimate Augmentations:
            - **WRM_AW_018** - Connection Sunlover Avenue to Discovery Drive – (200 mm diameter)
            - **WRM_AW_028** - Seaspray Dive reservoirs to Sunlover Avenue – (200 mm diameter)
            - **WRM_AW_027** - Discovery Drive – (200 mm diameter).

5. The existing reservoir is of sufficient capacity to service the proposed HLZ at ultimate demands as illustrated in **Table 6-3**. 5.6 ML is proposed as the size for the Evans Court low level reservoir in order meet Ultimate demand requirements.
6. Upon establishment of the Ultimate zoning strategy, network deficiencies under maximum hour and fire flow demands were identified and resolved through more augmentation works. Significant maximum hour Augmentations are proposed within the low level zone along Captain Cook Drive:
    - **WTM_AW_004** – 2021 – Captain Cook Drive duplication from Round Hill Road to Thomson Street (300 mm diameter)
    - **WTM_AW_006** – 2036 – Captain Cook Drive duplication from Thomson Street to Lady Musgrave Drive (300 mm diameter)
    - **WTM_AW_005** – 2036 – Captain Cook Drive duplication from Lady Musgrave Drive to Waterfront Drive (250 mm diameter)
7. Cost estimation for proposed infrastructure was undertaken. The total cost estimate for proposed water supply infrastructure is **$10.15 Million** based on the adopted methodology. **Table ES-2** summarises the cost estimates for all water supply infrastructure identified within this study (LGIP and IPP combined). Further breakdown of cost estimates are available in Section 10 and within Appendix D.

Table ES-2: Agnes Water Augmentations – All Augmentations

Augmentation Type	Planning Horizon							
	2014	2016	2021	2026	2031	2036	Ultimate	Total
Water Mains								
Water Main Augmentations	$410,000	$3,650,000	$460,000			$1,420,000	$800,000	**$6,740,000**
Fire Flow Augmentations	$130,000		$30,000			$60,000	$80,000	**$300,000**
Pump Stations								
Spring Street Pump Station Upgrade							$1,090,000	**$1,090,000**
1770 Booster Pump Station			$150,000					**$150,000**
Reservoirs								
Evans Court Low Level Reservoir						$1,870,000		**$1,870,000**
Total	**$540,000**	**$3,650,000**	**$640,000**	**$0**	**$0**	**$3,350,000**	**$1,970,000**	**$10,150,000**

8. Some potential limitations related to this study were identified and are provided as follows:

- The demand model adopted within this study was developed based on a number of assumptions. Although based upon the best available information at the time the demand model will not be accurate in its development projections, land use and timing for all properties within the study area. The development methodology is provided within Section 4 of the report and the document - 'Gladstone Regional Council Demand Model Development Technical Memo (MWH, July 2014)'.
- With the exception of the supply strategy to 1770 no optioneering of solutions has been undertaken within this study. Therefore, preferred or alternative solutions may be available.
- Cost estimates have been developed at a unit rate level only. The cost estimates have not considered individual alignments and site conditions, or infrastructure for which trenchless construction methods will be required.
- The feasibility and practical constructability of proposed assets has generally not been assessed within this study. There may be some proposed assets that require alternative solutions to be developed based on future site and environmental constraints.
- The timing of proposed infrastructure matches the 5 year planning horizons assessed within this study. For construction of "just in time" infrastructure these 5 year planning horizons may not be suitable to GRC and future assessment into timing may be required.
- Zone boundary updates have been proposed within this study without assessment of valve localities.
- Fire flow demand allocation was informed by the developed demand model. As the land uses within the demand model are not accurate for all parcels, the allocation of fire flows may be incorrect in places.

Report outcomes should be viewed with consideration to the above limitations.

Based on the conclusions of this study the following is recommended:

1. The outcomes of this report are viewed as the best and most up-to-date water supply planning for the Agnes Water water supply network. The outcomes, should however, be viewed with consideration to the identified limitations.

2. GRC consider the following opportunities for improving the outcomes of future planning studies in the Agnes Water water network. The following opportunities will also assist in ensuring the most prudent and efficient infrastructure solutions are identified for delivery. Opportunities:

    - Future update of the demand model developed for input into this water supply master planning study. As new information becomes available relating to land uses, development timing and sequencing, and state growth projections, it is envisaged that benefits will be identified by GRC in updating the demand model for input into future and ongoing infrastructure planning studies.
    - Prior to delivering major infrastructure items identified within this report it is recommended that specific detailed planning and feasibility studies be undertaken to ensure the preferred and most efficient solutions are being delivered. The detailed planning studies may also be used to assess the 'just in time' delivery of infrastructure, and develop more detailed/accurate cost estimates.
    - The assessment within this report was undertaken based on the GRC adopted standards of service. It has been identified across other Queensland water authorities and councils that a review of service standards in respect to appropriate levels of conservatism can result in significant capital cost savings on infrastructure delivery. GRC may see benefit in undertaking a review of the planning based standards of service currently adopted. Activities involved would include a demand tracking assessment for review of unit planning demand and peaking factors, and a risk based approach to reviewing performance based standards of service.

Gladstone Regional Council

Water Supply Strategic Infrastructure Plan - Agnes Water Supply Scheme

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1 Introduction

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- Sewerage Strategic Infrastructure Plan – Agnes Water

This report represents the water supply strategic infrastructure plan for the Agnes Water water supply scheme and documents the inputs, methodology, assumptions and approach adopted along with the water supply infrastructure outcomes.

All above listed reports have been prepared for the joint purpose of supporting Gladstone Regional Council's submission of the Local Government Infrastructure Plan (LGIP) for which updated water supply and sewerage infrastructure planning was required in the Gladstone City and Agnes Water networks.

Within this study, infrastructure solutions have been developed for both pre-existing performance issues and future performance issues resulting from proposed development. Infrastructure solutions have been separated into two categories within this study as follows:

1. LGIP Infrastructure – Trunk water supply infrastructure requirements as a result of development or network rezoning driven by development. The LGIP timeframe is for planned trunk infrastructure up to and including the 2031 planning horizon.

2. Internal Project Planning (IPP) Only Infrastructure – Any infrastructure not categorised as LGIP infrastructure (i.e. reticulation infrastructure, infrastructure proposed for resolution of pre-existing performance issues, or infrastructure proposed as required beyond the LGIP timeframe).

1.1 Background

Gladstone Regional Council (GRC) was formed in 2008 from the amalgamation of Calliope Shire Council, Gladstone City Council and Miriam Vale Shire Council. GRC is drafting a planning scheme for the whole of Gladstone Region, to replace the individual planning schemes for the three former shires. As part of GRC's submission of the draft planning scheme for its first State Interest Review in August 2014, one of the submission requirements is to prepare a Local Government Infrastructure Plan (LGIP), formerly known as a Priority Infrastructure Plan (PIP).

The LGIP outlines the necessary infrastructure required to service the next 10 to 15 years of growth outlined within the planning scheme. The LGIP outlines the local government's plans for providing trunk infrastructure to service urban development growth in a coordinated, efficient and orderly way. Trunk infrastructure is generally defined as 'higher order' infrastructure that is shared between developments, whereas non-trunk infrastructure is 'lower order' and is internal to developments which connects to 'higher order' trunk infrastructure.

To achieve this, the LGIP outlines the following infrastructure types:

- Water supply
- Sewerage
- Stormwater

- Transport
- Public parks and land for community facilities.

GRC engaged MWH to prepare a Water Supply Strategic Infrastructure Plan to enable the water supply component of the LGIP to be completed. The preparation of strategic infrastructure plans is in accordance with the *Sustainable Planning Act 2009,* Department of Local Government and Planning: Statutory Guideline 01/11 – Priority Infrastructure Plans, Queensland Planning Provisions (QPP) and the State Planning Regulatory Provision (SPRP).

1.1.1 Terms of Reference

The Local Government Infrastructure Plan (LGIP) is structured as follows:

- *Planning Assumptions*, which clearly outlines the type, scale, location and timing of future development and growth and how these align with the local government's preferred land use pattern.
- *Priority Infrastructure Area* (PIA), which defines the parts of a local government area intended to accommodate the next 10-15 years growth for urban purposes.
- *Desired Standard of Service* (DSS), which details the applicable design and service standards to the respective trunk and non-trunk infrastructure networks.
- *Plans for Trunk Infrastructure* (PFTI), which identifies the existing and future trunk infrastructure to service urban development within the PIA.

The Water Strategic Infrastructure Plan supports the *Plans for Water Infrastructure* component of the LGIP. The terms of reference to prepare the Water Strategic Infrastructure Plan require the following tasks:

- Outline the development and growth factors affecting the need for additional water supply assets for the amalgamated GRC.
- Outline the desired water supply conditions to accommodate the region's needs.
- Identify water supply initiatives from previously prepared Priority Infrastructure Plans (PIPs).
- Provide a high level of assessment on the initiatives to determine their relative priority and year of implementation need.
- Deliver the water supply Strategic Infrastructure Plan to support the development of GRC's LGIP.

1.1.2 Previous Studies

There have been two planning studies for the Agnes Water water supply network in recent years. These studies are listed as follows:

- Agnes Water and Seventeen Seventy Water Supply & Sewerage Infrastructure (Strategic Plan for PIP) -(Coleridge Water Engineers, September 2008); and
- Miriam Vale Council Water Supply Planning Report - Report for Agnes Water/Town of 1770 (GHD, August 2008)

The drivers behind undertaking an updated water supply strategic planning study for the Gladstone City area are as follows:

- The need for an updated infrastructure assessment based a newly developed demand model. The demand model was developed as part of this study and aligns with projected state populations projections developed by Office of Economic and Statistical.

- Assessment of water supply infrastructure requirements following adjustments to the proposed water supply zoning strategy.
- Assessment of water supply infrastructure using an updated hydraulic model for performance assessment and augmentation identification.

1.2 Project Scope

The primary objective of the Water Supply Strategic Infrastructure Plan is to identify the water supply infrastructure required to service the existing and future service area demands in accordance with the Desired Standards of Service (DSS).

In order to achieve the purpose of this study, the key tasks required are:

- Review previous reports and strategic servicing plans
- Define and confirm current network operation through initial stakeholder workshops
- Update the current hydraulic Agnes Water hydraulic water supply model in H20MAP Water
- Within the same model, develop scenarios for planning horizons; 2014 (Current), 2016, 2021, 2026, 2031, 2036 and Ultimate.
- Allocate loading in the model for all planning horizons based on the latest GIS based demand model
- Assess the performance of the network at each planning horizon against GRC desired standards of service (DSS) to identify current and future capacity shortfalls.
- Develop infrastructure and/or non-infrastructure solutions to ensure DSS requirements are achieved over all planning horizons. Solutions will generally align with strategic direction informed by GRC.
- Provide capital cost estimates for proposed infrastructure solutions.
- Prepare water supply infrastructure planning report with associated infrastructure plans

1.3 Assessment Assumptions

The following assumption, both general and technical, has been adopted for the purposes of this assessment:

- A demand model was developed concurrently to this study to align with state Office of Economics and Statistical Research (OESR) population projections. This demand model was adopted for the purposes of infrastructure assessment in this study. The demand model was developed based on a number of assumptions. These assumptions are detailed within Section 4 of this report and within the technical memorandum 'Gladstone Regional Council Demand Model Development Technical Memo (MWH, July 2014)'
- The base hydraulic model for use within this study was provided by GRC. The following was assumed correct within the hydraulic model:
    - Controls assigned to active assets
    - Sizes and attributes of existing assets represented within the model
    - Setup of existing zone boundaries and other closed network valves (reviewed as part of the model update exercise undertaken and described within Section 5 of this report)
- The current GRC demand and performance based desired standards of service (DSS) were adopted in this study. No review or re-assessment of these standards of service was undertaken.

- An infrastructure assessment for the Seventeen Seventy water supply network has not been undertaken as part of this study. However, infrastructure requirements to maintain supply to the Seventeen Seventy reservoir has been assessed.

As stated is Section 1, within this study, infrastructure solutions have been developed for both pre-existing performance issues and future performance issues resulting from proposed development. Infrastructure solutions have been separated into two categories within this study as follows:

- LGIP Infrastructure – Trunk water supply infrastructure requirements as a result of development or network rezoning driven by development. The LGIP timeframe is for planned trunk infrastructure up to and including the 2031 planning horizon.

- Internal Project Planning (IPP) Only Infrastructure – Any infrastructure not categorised as LGIP infrastructure (i.e. reticulation infrastructure, infrastructure proposed for resolution of pre-existing performance issues, or infrastructure proposed as required beyond the LGIP timeframe).

2 Standards of Service

Water network performance analysis was undertaken in line with the Gladstone Regional Council's Water and Wastewater Master Planning Guideline (2014) and through other standards confirmed through discussion with GRC. This section describes the desired standards of service (DSS) applied in this study.

2.1 Demand Based Standards

The GRC Desired Standards of Service specify an Average Day (AD) water usage of 1,170 L/ET for Agnes Water and Seventeen Seventy.

The Maximum Day (MD) diurnal demand profiles for Residential, Commercial, Industrial, Park and School end uses are provided in the guideline were applied in this assessment. The Maximum Day and Peak Hour (PH) to Average Day peaking factors shown in **Table 2-1** are inherent in these profiles. The Mean Day Maximum Month (MDMM) to Average Day peaking factors were supplied by GRC.

Table 2-1: Agnes Water – Water Demand Peaking Factors

Demand Type	MDMM/AD	MD/AD	PH/AD
Residential	1.5	2	4.3
Commercial	1.0	1.3	2.6
Industrial	1.0	1.2	1.6
Park	1.0	1.3	2.0
School	1.0	1.2	2.4

The firefighting capacity assessment was based on the following firefighting demands:

- 15 L/s for residential properties three (3) storeys or less
- 30 L/s for all commercial properties (including residential accommodation facilities with commercial kitchens) and residential properties of four (4) or more storeys.

Within this study fire flow assessment was undertaken assuming a peak hour background demand and assuming the full fire flow requirement is delivered through a single hydrant. Hydrants locations were not accurately represented in the network hydraulic model at all locations. Fire flow demands were allocated to model junctions and if failure was identified the "realness" of the fire flow capacity issue was assessed based on location to the nearest hydrant. If fire flow failure was identified to occur at a location at which no hydrant was present (i.e. at the end of a small diameter property connection main) these failures were discounted from solution development.

2.2 Performance Based Standards

The modelled water network must achieve desired standards of service for both operational and firefighting scenarios. The water network performance standards of service for the performance assessment of the Agnes Water water supply network are summarised in **Table 2-2** below.

Table 2-2: Agnes Water - Water Supply Desired Standards of Service

Parameter	Guideline Standard	Notes
Network Performance		
Minimum	25 m	Under operational Peak Hour

Parameter	Guideline Standard	Notes
Operational Pressure		demands
Minimum Residual Pressure (Fire Flow)	12 m at the fire node and 6 m elsewhere in the system.	Under firefighting demands with Peak Hour background demand
Maximum head loss per km	5 m/km	Under operational Peak Hour demands (Applied for sizing of new infrastructure. This criteria has not been adopted within this study for triggering the upgrade of existing infrastructure except in instances were high head losses are identified to result in low pressure or create operational issues such as high head gain requirements from pump stations).
Maximum Velocity	2.5 m/s	Under operational Peak Hour demands
Water Pump Stations		
Servicing Ground Level Reservoirs	Supply of MDMM Demand over 20 hours	
Direct Booster Pump Stations	Peak Hour demand + Fire flow capacity	
Storage Reservoirs		
Reservoir Storage	3 Minimum Days (0.6xAD) + Firefighting Storage	
Additional Allowance for Pumped Reservoir with Gravity Reservoir Downstream	Difference in inflow and outflow rates = 4 hours @ MDMM Demands	Adopted 4 hours assumes pumping 20 hour/day and gravity feed 24 hour/day for MDMM
Firefighting Storage – mixed use service area	4 hours @ 30 L/s	432 kL

3 System Description

3.1 Network Overview

The existing Agnes Water water supply network including the trunk supply main to the 1770 township is shown within **Figure 1**. **Figure 2** provides a more detailed map showing the Agnes Water existing water supply network.

Water supply for the entire Agnes Water and 1770 water supply network is sourced from the Agnes Water Desalination Treatment Plant located at Springs Road. It is understood the capacity of this WTP is 1.5 ML/day.

A pump station located at the desalination plant delivers supply to the Agnes Water Seaspray Drive reservoir facility. The Seaspray Drive reservoir facility consists of 3 reservoirs with a total capacity of 4.98 ML (1 x 4 ML + 2 x 0.49 ML tanks). Connections exist off the 150 mm diameter supply main from the WTP to Seaspray Drive through which supply is delivered into the Agnes Water network concurrently with the filling of the reservoirs. At high water levels in the Seaspray Drive reservoir, the WTP turn off and water gravitates from the reservoirs to supply the demand of the zone. It is understood the combined inlet outlet pumped supply main is currently creating problems with pressure fluctuations and transients being experienced by customers. Additionally, the 150 mm diameter pumped supply main is of insufficient diameter to enable efficient ongoing use in this arrangement.

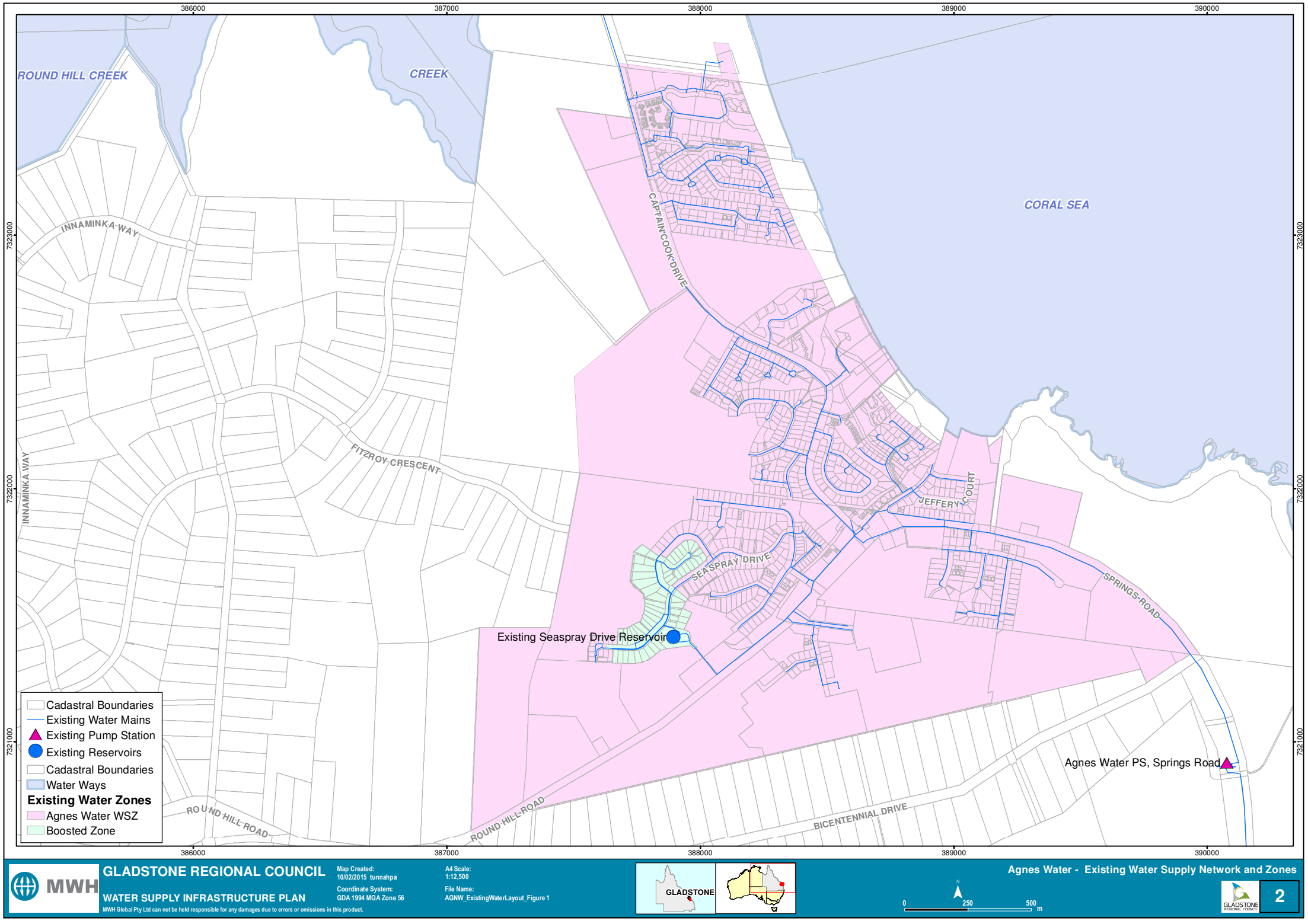
With the exception of a small boosted zone for the supply of elevated properties in the vicinity of the Seaspray Drive reservoirs, the Agnes Water water supply network is comprised of a single pressure zone operating off the level of the Seaspray Drive reservoirs (TWL: 89 m). High pressures are experienced in the low lying areas along the coast to the east of Captain Cook Drive. PRVs have previously been installed to manage the high pressures in the areas of Beaches Village Circuit and Agnes Street areas. It is understood that GRC is seeking a more holistic and longer term strategy for managing these low pressures.

A 150 / 250 mm diameter water main runs through Agnes Water from south to north along Captain Cook Drive. This main continue north from the extent of the Agnes Water network at Beaches Village Circuit and delivers supply to 1770.

3.1.1 Supply to Seventeen Seventy (1770).

A 1.5 ML reservoir exists at 1770 (TWL 80.9 m) and provides the storage for the water supply network. As mentioned above 1770 and its reservoir receive supply from the Agnes Water water supply network. There is a difference in TWL between the Seaspray Drive reservoirs and the 1770 reservoir of approximately 8m. This relatively small difference in TWL limits the capacity and flow rate to supply the 1770 from Agnes Water.

Figure 1: Agnes Water and 1770 Supply Water Supply Network Overview



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WATER SUPPLY INFRASTRUCTURE PLAN

MWH Global Pty Ltd can not be held responsible for any damages due to errors or omissions in this product.

Map Created: 10/02/2015 tunnahpa

Coordinate System: GDA 1994 MGA Zone 56

A4 Scale: 1:12,500

File Name: AGNW_ExistingWaterLayout_Figure 1

GLADSTONE

N

0 250 500 m

Agnes Water - Existing Water Supply Network and Zones

GLADSTONE REGIONAL COUNCIL

2

3.2 Asset Overview

3.2.1 Reservoirs

Currently there are 3 reservoirs servicing Agnes Water and one servicing 1770. The operation of these reservoirs is discussed above in Section 3.1. **Table 3-1** summarises the dimensions and the water supply zones serviced by the existing reservoirs within Agnes Water/1770.

Table 3-1: Agnes Water/1770 Reservoir Details

Reservoir Name	Description	Model ID	Zone Serviced	Dia (m)	TWL (m)	BWL (m)	Vol (ML)
Agnes Water HLZ Reservoirs	1 x 4ML & 2 x 0.486ML Reservoirs at Seaspray Drive – modelled as a single reservoir	WS0068	Combined Agnes Water Network	39.8	89.0	85.0	4.97
1770 Reservoir	1 x 1.5 ML Reservoir at Bargara	TSS01	1770	23.3	72.5	75.9	1.5

3.2.2 Pump Stations

There are currently only two operational pump stations within the Agnes Water supply network - The Spring Street WTP pump station delivering supply to the network, and the booster pump station at Seaspray Drive servicing the local booster zone consisting of elevated properties.

Table 3-2 summarises the pump stations within the Agnes Water supply network.

Table 3-2: Agnes Water Pump Station Details

Pump Station	Model ID	Pump Duty (L/s)	Capacity (L/s)
Agnes Water WSZ PS	HL1 & HL2	25 L/s	70 L/s
Agnes Water Booster PS (3 booster pumps + 1 jockey)	PU1-1, PU1-2, PU1-3 & PU1-3	~4 L/s	20 L/s (fire pump)

3.2.3 Pipe Assets

There are approximately 25 km of mains in the Agnes Water water supply network. **Table 3-3** summarises the size distribution of these mains.

Table 3-3: Summary of Diameter of Water Main

Pipe Diameter (mm)	Total Length of Modelled Water Main (m)	Percentage by Length (%)
<100	268	1.1%
100	10,654	40.9%
150	10,597	41.7%
200	1,497	5.9%
225	389	1.5%
250	2,202	8.7%

Pipe Diameter (mm)	Total Length of Modelled Water Main (m)	Percentage by Length (%)
300	59	0.2%
375	18	0.1%
Total	**25,415**	**100%**

4 Demand Development and Outcomes

4.1 Demand Development

The development of the GIS based demand model for the current and future demand horizons is described in detail in the 'Gladstone Regional Council Demand Model Development Technical Memo (MWH, July 2014)'. The methodology detailed within this report is summarised as follows:

1. The demand model was based on the future ultimate development GIS cadastre file supplied by GRC;

2. Each lot was designated a lot based land use as follows:
    a. The land uses were simplified and mapped to the model diurnal demand profile categories as shown in **Table 4-1** below;
    b. Any areas outside of the study area or not serviced by water or sewerage currently and into the future were designated with a RURAL land use type to indicate this;

Table 4-1: Land Use Code Mapping

GRC Land Use	Diurnal Pattern Profile
Single Family Residential	Residential
Multi-Family Residential	Residential
Commercial	Commercial
Mixed	Residential & Commercial
Industrial	Industrial
Community	Commercial
Public Open Space	Park
Schools	School

    c. The GRC existing customer accounts were used to identify whether an existing residential lot was single family residential (RES) or multi-family residential (RES-M);
    d. For multi-family residential and mixed use blocks, the GIS cadastre file contains a polygon for each individual residence and at least one for the lot area. To avoid over allocation of demand the lot polygons were designated a Land Use 'BLOCK';
    e. The land use for future development lots was determined from future development information supplied by GRC;

3. Existing (2014) Demand Development:
    a. For residential lots the following Equivalent Tenement (ET) ratios were adopted for existing lots in line with the GRC's Water and Wastewater Master Planning Guidelines;
        Single Family Residential = 1 ET/dwelling; and
        Multi-family Residential = 0.8125 ET/dwelling
    For the current horizon, demand was only allocated to lots with existing accounts.

b. For existing non-residential lots ET was determined from the ET data provided by GRC. This ET had been determined from 2012/13 consumption data and ET derived using the average day water usage of 1,170 L/ET/day.

4. The demand model was extended to 2016, 2021, 2026, 2031, 2036 and Ultimate growth horizons.
   a. The future residential demand was grown in-line with the published Office of Economic and Statistical Research (OESR) population growth figures for the Agnes Water – Miriam Vale SA2 zone. It was assumed that 95% of all future growth for the SA2 zone was within the Agnes Water water supply area and all growth would be serviced.
   b. The future non-residential demand was grown in line with the Gladstone Priority Infrastructure Plan (PIP) employment projections.

5. Information on all future identified development locations and was provided by GRC along with an order of expected development. ET demand was provided for a number of these parcels by GRC. For others ET was assigned based on an ET/ha development density derived with support of GRC and the standard demand ratios contained within the GRC Water and Wastewater Master Planning Guidelines. Developments were bought online in the demand model in priority order to match the demand growth profile determined above.

6. The demands adopted to assess the supply to 1770 were derived from current and Ultimate ET loading provided by GRC. Growth rates were applied in line with the OSER growth rate for Agnes Water – Miriam Vale SA2 area and demands developed for the 2016, 2021, 2026, 2031, 2036 and Ultimate growth horizons.

4.2 Summary of Demand Outcomes

Table 4-2 shows the demand model ET for each ultimate water supply zone. **Table 4-3** to **Table 4-5** show the average day, mean day maximum month and maximum day demands for each demand horizon in litres per second based on the average day demand figure of 1,170 L/ET/day as specified in the GRC Standards of Service.

Table 4-2: Total ET per WSZ

Water Zone	Total ET						
	2014	2016	2021	2026	2031	2036	Ultimate
Booster Zone	62	62	62	62	62	62	62
High Level Zone	465	604	688	795	850	950	2,048
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Total	**1,087**	**1,297**	**1,554**	**1,801**	**2,064**	**2,359**	**4,543**

Table 4-3: Average Day Demands

Water Zone	Average Day Demand (L/s)						
	2014	2016	2021	2026	2031	2036	Ultimate
Booster Zone	0.8	0.8	0.8	0.8	0.8	0.8	0.8

Water Zone	Average Day Demand (L/s)						
	2014	2016	2021	2026	2031	2036	Ultimate
High Level Zone	6.3	8.2	9.3	10.8	11.5	12.9	27.7
Low Level Zone	7.6	8.5	10.9	12.8	15.6	18.2	32.9
Total	**14.7**	**17.6**	**21.0**	**24.4**	**28.0**	**31.9**	**61.5**

Table 4-4: Mean Day Max Month Demands

Water Zone	Mean Day Max Month Demand (L/s)						
	2014	2016	2021	2026	2031	2036	Ultimate
Booster Zone	1.3	1.3	1.3	1.3	1.3	1.3	1.3
High Level Zone	9.4	12.3	14.0	16.1	17.3	19.3	41.6
Low Level Zone	11.4	12.8	16.3	19.2	23.4	27.4	49.4
Total	**22.1**	**26.3**	**31.6**	**36.6**	**41.9**	**47.9**	**92.3**

Table 4-5: Maximum Day Demands

Water Zone	Maximum Day Demand (L/s)						
	2014	2016	2021	2026	2031	2036	Ultimate
Booster Zone	1.7	1.7	1.7	1.7	1.7	1.7	1.7
High Level Zone	12.8	16.7	19.0	21.9	23.4	26.2	56.5
Low Level Zone	15.4	17.4	22.2	26.0	31.8	37.2	67.1
Total	**30.0**	**35.7**	**42.9**	**49.7**	**56.9**	**65.1**	**125.3**

The ET and demands adopted for supply to 1770 are shown in **Table 4-6**. Demands for 1770 are also based on the average day demand figure of 1,170 L/ET/day as specified in the GRC Standards of Service.

Table 4-6: Seventeen Seventy ET and Demands

Water Zone	2014	2016	2021	2026	2031	2036	Ultimate
ET	268	278	302	326	351	376	476
Average Day Demand (L/s)	3.6	3.8	4.1	4.4	4.8	5.1	6.4
Mean Day Max Month Demand (L/s)	4.5	4.7	5.1	5.5	5.9	6.3	7.7
Maximum Day Demand (L/s)	5.9	6.2	6.7	7.2	7.8	8.3	10.2

5 Model Update

A review and update of the Agnes Water water supply model was undertaken to include the latest known infrastructure in the model so that the model best reflects current operation of the network and so that the model aligns with the requirements of the GRC Standards of Service.

5.1 GIS Infrastructure Review

Existing infrastructure within the H2OMAP hydraulic model was compared against the following GIS files:

- WaterMainsAssetData.TAB
- GRCWaterRetic.TAB

The file "WaterMainsAssetData.TAB" contained asset attribute data for all pipes but did not include recently installed water mains. For Agnes Water the GRCWaterRetic.TAB included only a small number of additional reticulation pipes hence, the inconsistencies were not significant and no further action was taken.

The WaterMainsAssetData.TAB file was used to review the sizing of existing infrastructure in the model. From review it was identified that the extent of the infrastructure within the existing model covered the extent of this GIS layer. Where inconsistencies between the GIS and the model were identified, the attribute information in the GIS was assumed correct and the model was updated to reflect the GIS.

5.2 Roughness Coefficient and Internal Diameter Review

Where sufficient information on pipe material was available the hydraulic diameters of the pipes represented within the model were updated to align with **Table 5-1** taken from the GRC Water and Wastewater Planning Guideline. Where existing pipes were outside of the categories provided within **Table 5-1** the internal diameters and applied roughness coefficients were generally assumed correct.

Table 5-1: Pipe hydraulic attributes for model update

Pipeline Nominal Diameter	AS4130:2003 PE100 PN16, blue-line		AS1477:2006 uPVC Series 2 PN16 RRJ		AS2280:2004 DICL PN35 RRJ	
	Mean Internal Diameter (mm)	Hz-W "C" Coefficient (Roughness)	Mean Internal Diameter (mm)	Hz-W "C" Coefficient (Roughness)	Mean Internal Diameter (mm)	Hz-W "C" Coefficient (Roughness)
50	40.4	120				
63	51	120				
75	61	120				
100			104.3	100		
150			152	100		
200			202.3	110		
250			249.2	110		
300					322	110
375					401	120
450					480	120
600					636	120
750					790	125

5.3 Controls and Active Asset Review

The operation of the Spring Street pump station was reviewed within the model to ensure alignment with the field setup. No other significant active assets exist within the Agnes Water water supply network.

5.4 Scenario Setup

A scenario structure was created within the Agnes Water hydraulic model to facilitate the assessment of performance at each planning horizon. This scenario structure is provided within **Table 5-2**.

Table 5-2: Agnes Water H2OMAP Model Scenario Structure

Scenario Level	Scenarion Name	Description
1	Existing	Header Scenario
1.1	Existing_AD	2014 AD demand, existing assets, no network upgrades
1.1	Existing_MDMM	2014 MDMM demand, existing assets, no network upgrades
1.1	Existing_MD	2014 MD demand, existing assets, no network upgrades
1	2014	Header Scenario
1.1	2014_AD	2014 AD demand, existing assets and network upgrades and controls changes to achieve DSS at 2014
1.1	2014_MDMM	2014 MDMM demand, existing assets and network upgrades and controls changes to achieve DSS at 2014
1.1	2014_MD	2014 MD demand, existing assets and network upgrades and controls changes to achieve DSS at 2014
1	2016	Header Scenario
1.1	2016_AD	2016 AD demand, existing assets and network upgrades and controls changes to achieve DSS at 2016
1.1	2016_MDMM	2016 MDMM demand, existing assets and network upgrades and controls changes to achieve DSS at 2016
1.1	2016_MD	2016 MD demand, existing assets and network upgrades and controls changes to achieve DSS at 2016
1	2021	Header Scenario
1.1	2021_AD	2021 AD demand, existing assets and network upgrades and controls changes to achieve DSS at 2021
1.1	2021_MDMM	2021 MDMM demand, existing assets and network upgrades and controls changes to achieve DSS at 2021
1.1	2021_MD	2021 MD demand, existing assets and network upgrades and controls changes to achieve DSS at 2021
1	2026	Header Scenario
1.1	2026_AD	2026 AD demand, existing assets and network upgrades and controls changes to achieve DSS at 2026
1.1	2026_MDMM	2026 MDMM demand, existing assets and network upgrades and controls changes to achieve DSS at 2026
1.1	2026_MD	2026 MD demand, existing assets and network upgrades and controls changes to achieve DSS at 2026
1	2031	Header Scenario
1.1	2031_AD	2031 AD demand, existing assets and network upgrades and controls changes to achieve DSS at 2031
1.1	2031_MDMM	2031 MDMM demand, existing assets and network upgrades and controls changes to achieve DSS at 2031
1.1	2031_MD	2031 MD demand, existing assets and network upgrades and controls changes to achieve DSS at 2031
1	2036	Header Scenario
1.1	2036_AD	2036 AD demand, existing assets and network upgrades and controls changes to achieve DSS at 2036
1.1	2036_MDMM	2036 MDMM demand, existing assets and network upgrades and controls changes to achieve DSS at 2036
1.1	2036_MD	2036 MD demand, existing assets and network upgrades and controls changes to achieve DSS at 2036
1	Ultimate	Header Scenario
1.1	Ultimate_AD	Ultimate AD demand, existing assets and network upgrades and controls changes to achieve DSS at Ultimate
1.1	Ultimate_MDMM	Ultimate MDMM demand, existing assets and network upgrades and controls changes to achieve DSS at Ultimate
1.1	Ultimate_MD	Ultimate MD demand, existing assets and network upgrades and controls changes to achieve DSS at Ultimate

The development of scenarios is summarised as follows:

- Unique data sets were created and assigned for each planning horizon for the following:
  - Demand sets
  - Control sets
  - Fire flow sets
- AD, MDMM and MD operation sets containing associated diurnal profiles were created and assigned to the corresponding scenarios
- Planning horizon attribute information fields (Existing through to Ultimate) were created and populated for all link elements (pipes, pumps and valve). Query sets were created based on these planning horizons information fields for activation of each asset (existing and proposed) in the correct scenarios.
- Within the model setup. Auto node inclusion was activated such that query sets acted based on link assets alone.

5.5 Model Demand Allocation and Handling

The parcel based demand model developed and discussed in **Section 4** was allocated to the Agnes Water hydraulic model using the H2OMAP demand allocation tool and a closest pipe to closest junction allocation routine. The demand sets created for each planning horizon were allocated to the hydraulic model as shown in **Table 5-3**.

Table 5-3: Demand Type Allocation and Diurnal Pattern Assignment

Demand Type	H2OMAP Demand Field	Pattern Name
Detached Residential	1	SFR
Attached Residential	2	MFR
Commercial	3	COM
Industrial	4	IND
Community	5	PUB
Schools	6	SCH
Public Open Space and Parks	7	POS

The allocated demand in ET was converted to L/s through the global demand multiplier. A multiplier of 0.013542 was required for the conversion of 1,170 L/ET/day to a L/s demand. Diurnal profiles in line with the GRC Standards of Service were assigned to the model to reflect AD, MDMM and MD demands in the appropriate scenarios. Diurnal patterns were created based on a half hourly time step.

5.6 Modelling of Supply to 1770

The reticulation network for 1770 was not assessed as part of this study. However, in order to assess the impact of 1770 demands on the Agnes Water water supply network, a skeletonised version of the 1770 supply infrastructure was included in the model up to and including the 1770 Reservoir.

Demands for 1770 were represented as a single point demand from the 1770 Reservoir. The derivation of demands in ET for each planning horizon is discussed in **Section 4**. ET was converted to L/s through the global demand multiplier in the model. A multiplier of 0.013542 was required for the conversion of 1,170 L/ET/day to a L/s demand. As above, diurnal profiles in line with the GRC Standards of Service were assigned to the 1770 demands to reflect AD, MDMM and MD demands in the appropriate scenarios

6 Bulk Supply Performance Assessment

Infrastructure schedules for the augmentation solutions discussed in this section (along with sections 7 and 8) are provided within Appendix D. Infrastructure maps are provided within Appendix A.

6.1 Existing Storage & Pump Capacity Assessment

6.1.1 Existing Storage Assessment

An assessment of the available reservoir storage for the Agnes Water water supply zone network was initially undertaken. From this assessment future projected deficiencies in reservoir storage could be identified.

The reservoir storage requirement for Agnes Water has been assessed using the GRC Standards of Service value of:

3 x Minimum Day Storage + Firefighting Allowance

Where the firefighting allowance = 4 hours at 30 L/s.

Results of this assessment are provided in **Table 6-1**. It can be seen that current volume of storage at Seaspray Drive reservoirs is expected to be insufficient by the 2036 planning horizon. The ET trigger for storage upgrade is 2,150 ET which will occur in approximately 2033 based on the current growth projections.

Table 6-1: Reservoir Storage Assessment – Current Zoning

Planning Horizon	Existing Storage (ML)	Required Operational Storage (ML)	Excess / Deficiency (ML)
Current	4.97	2.72	2.25
2016	4.97	3.16	1.81
2021	4.97	3.70	1.27
2026	4.97	4.22	0.75
2031	4.97	4.78	0.19
2036	4.97	5.40	-0.43
Ultimate	4.97	10.00	-5.03

6.1.2 Existing Pump Capacity Assessment

An assessment of the existing pump capacity at the Spring Street WTP was undertaken. From this assessment future deficiencies in pump capacity could be identified.

The pumping requirement for Agnes Water has been assessed using the GRC Standards of Service value of MDMM demand over 20 hrs.

Results of this assessment are provided in **Table 6-2**. It can be seen that current capacity of this pump station is expected to be insufficient at the Ultimate planning horizon based on the current growth projections. The ET trigger for pump station upgrade is 3,100 ET.

Table 6-2: Spring Street WTP Pump Station Capacity Assessment

Planning Horizon	Total ET	Required Pump Capacity (L/s)	Existing Pump Capacity (L/s)	Excess / Deficiency (L/s)
Current	1,354	30.8	70	39.2
2016	1,575	36.1	70	33.9
2021	1,856	42.8	70	27.2
2026	2,127	49.2	70	20.8
2031	2,415	56.0	70	14.0
2036	2,735	63.6	70	6.4
Ultimate	5,019	118.5	70	-48.5

6.2 Ultimate Storage and Zoning Solution Summary

An overall network strategy to resolve future storage deficiencies and high pressure issues to low lying properties within Agnes Water was developed. This strategy was based upon the zoning strategy developed by GRC and provided to MWH upon project start-up. A number of servicing alternatives were assessed for both cost effectiveness and operational benefits. The following was considered when developing the preferred servicing strategy:

- Ensuring high pressure issues in the low lying coastal areas to the east of the zone were alleviated;
- Available new reservoir sites and storage timing requirements:
    - A new reservoir site located south of Donohue Drive at Evans Court has been identified for provision of future storage.
    - The elevation of this site is approximately 54 m meaning a TWL of around 59 m is like for a new reservoir of ~ 5 to 6 ML in volume.
- The condition of the existing Agnes Water reservoirs at Seaspray Drive;
- Any operational or re-zoning issues created by a continued operation of the network with combined inlet/outlet arrangement to the Sea Spray Drive reservoirs.
- Opportunities for the continued supply to the 1770 water supply network.

The proposed ultimate storage and zoning strategy is summarised below. The proposed changes have been developed to make best use of existing infrastructure connectivity. Each element is described in more detail in Sections 6.2.1 to 6.3. Appendix A provides the proposed strategy geographically.

- It is proposed that an Agnes Water low level zone is created, initially supplied via a PRV at the southern end of Captain Cook Drive. Ultimately the low level zone will be supply via the new Evans Court reservoir once storage levels trigger the construction of this reservoir. The proposed low level zone extent is shown geographically with **Appendix A** maps and within Figure B2 of **Appendix B**.
- A new dedicated reservoir inlet supply main from the Agnes Waters WTP to ultimately supply both the Seaspray Drive (high level) and Evans Court (low level) reservoirs is proposed. Prior to the construction of the Evans Court reservoir this new main will provide dedicated supply to the Seaspray Drive reservoirs alone. A dedicated inlet main will remove the current capacity issues associated with the current 150 mm supply main from the WTP. Additionally the operational and customer service concerns associated with the fluctuating pressure occurring under the current network arrangement will be removed.

- The existing reservoir complex at Seaspray Drive will be retained as the Ultimate storage for the Agnes Water high level zone. Prior to the construction of the new Agnes Water low level reservoir in Evans Court, the Seaspray Drive reservoirs will also provide storage to the Agnes Water low level zone, which will be supplied via a PRV connecting from the HLZ network.
- The extent of the proposed low level zone extends north to the Beaches Village area incorporating the existing mains in Captain Cook Drive. 1770 is currently supplied from the main Captain Cook Drive from the north of Beaches Village Circuit. The reduced HGL of the low level and the pressure failure predicted to occur, prevent the supply to 1770 from LLZ pressure. A dedicated supply from the Agnes Water HLZ to the water main in Captain Cook Drive north of 1770 is proposed to enable the 1770 network and reservoir to continue to receive supply from HLZ pressure.

The identification of available valving for establishing the proposed zoning has not been undertaken within the scope of this study. GRC may wish to undertake further assessments to optimise the proposed boundaries based on available valving. The Ultimate proposed zoning derived from this assessment is shown geographically in Appendix A.

Existing and Ultimate water supply zoning maps excluding infrastructure are provided within **Appendix B**.

6.2.1 Ultimate Storage Infrastructure Requirements

The proposed extent of the new Low Level and High Level Zones is shown geographically in Appendix A.

The existing reservoirs at Seaspray Drive will ultimately be used to service the new Agnes Water HLZ. The existing reservoir is of sufficient capacity to service customers within the proposed HLZ at ultimate demands as illustrated in **Table 6-3**. 5.6 ML of storage at Evans Court is required to service the ultimate demand of the proposed Low Level Zone.

Table 6-3: Reservoir Storage Assessment – Ultimate

	High Level Zone	Low Level Zone
Ultimate ET	2,110 ET	2,433 ET
Existing Storage	4.97 ML	0 ML
Required Operational Storage	4.88 ML	5.56 ML
Additional Storage Requirement	No Additional Storage Required	5.56 ML

6.2.2 Ultimate Pump Station Infrastructure Requirements

From the assessment of pump station capacity provided above in Table 6.2 it was identified that upgrade of the pump station at the Spring Street WTP to 120 L/s is required at Ultimate (50 L/s capacity increase).

6.2.2.1 1770 Supply pumping requirement

As only 8 m of HGL differential is available to drive flow from the Seaspray Drive reservoirs to the 1770 reservoirs the available flow rate is limited to approximately 5 L/s. As demand increases in the 1770 network the available flow under gravity is not sufficient to maintain levels within the 1770 reservoir. Reservoir levels show decline from 2016 under

consecutive maximum day demand periods. At 2026 reservoir performance modelling indicates significantly reduced levels.

Based on maintaining supply within the Agnes Water reservoir over 3 consecutive days construction of a booster pump station on the 250 mm diameter main in Captain Cook Drive north of Beaches Village Circuit is proposed at 2026. However, due to declining levels being observed from 2016 and the potential impact of commercial fire flow (e.g. at Marina ~ 4 hours @ 30 L/s ~ 0.43 ML) to further drain reservoirs levels, GRC may wish to considered construction of the booster pump station at the 2016 planning horizon to mitigate risk.

A booster pump station with duty of 15 L/s is proposed with equivalent standby for the purposes of maintaining reservoirs levels over 3 consecutive days of maximum day demand at Ultimate.

6.2.3 Ultimate Zoning Infrastructure Requirements.

The following section details the infrastructure requirements for establishment of the new Agnes Water zoning. Infrastructure maps are provided within **Appendix A**. These along with **Figure B1** of **Appendix B** provide the proposed zone boundaries.

6.2.3.1 New Dedicated Inlet Main to Agnes Water Reservoirs

To alleviate the issues associated with the current 150 mm diameter supply main from the Agnes Water WTP, a dedicated 375 mm diameter reservoir inlet main is proposed and sized for carrying ultimate flows delivered by the upgraded WTP pump station (120 L/s). The proposed dedicated reservoir inlet main (**WTM_AW_002** and **WTM_AW_003**), will ultimately supply both the Seaspray Drive reservoirs (high level) and the Evans Court reservoirs (low level). As the Evans Court low level reservoir will not be constructed at the time of delivering the dedicated 375 mm diameter reservoir inlet main, it is recommended a blank connection point is provided at this location for future connection.

Once the Evans Court reservoir is online a control valve will be required at the reservoir inlet to manage the filling rate of the reservoir. If the Evans Court reservoir was allowed to fill at its natural hydraulic rate, due to the elevation of this reservoir being lower than the Seaspray Drive reservoirs, the Evans Court reservoir would fill preferentially and potentially cause inefficiencies with pump operation and the available flow rate to the Seaspray Drive reservoirs.

6.2.3.2 Agnes Water High Level Zone

The Agnes Water high level zone will consist primarily of properties to the west of Captain Cook Drive. No new augmentations are required to establish this high level zone other than those associated with supporting supply to 1770.

1770 Supply

A number of options for supply to 1770 have been assessed. A dedicated supply main from to 1770 starting at the Seaspray Drive reservoir was initially identified as the preferred option within previous report versions. However, since this time GRC have advised of issues with securing an easement through the private land that this main dedicated main would cross. An agreed strategy of supplying 1770 through HLZ infrastructure before connecting to a dedicated 1770 supply main in Captain Cook Drive at Discovery Drive (**ATM_AW_001**) has been adopted. Technical memorandums, emails and drawings are provided in **Appendix C** documenting the assessments undertaken and the discussions had in coming to an agreed supply strategy for 1770.

To support supply through the Agnes Water HLZ to 1770 a number of other augmentations are proposed in a staged approach. These augmentations are listed as follows:

- 2014 Augmentations:
    - **WRM_AW_010** - Capacity upgrade from Starfish Street to Banksia Drive – (200 mm diameter)

- 2016 Augmentations
    - **WRM_AW_026** - Woodrow Drive and Solander Close – (200 mm diameter)
- Ultimate Augmentations:
    - **WRM_AW_018** - Connection Sunlover Avenue to Discovery Drive – (200 mm diameter)
    - **WRM_AW_028** - Seaspray Dive reservoirs to Sunlover Avenue – (200 mm diameter)
    - **WRM_AW_027** - Discovery Drive – (200 mm diameter).

  Please see Appendix C for a detailed description of options, performance and the benefits of adopting the agreed strategy for supply to 1770.

The proposed high level zone extent is to include the elevated area south east of the Captain Cook Drive and Round Hill Road intersection in the vicinity of Donohue Drive and Evans Court. Prior to the construction of the Evans Court low level reservoir in 2036, this section of the network can continue to be supplied from the high level zone using existing infrastructure. However, upon construction of the low level reservoir a new low level reservoir outlet main is proposed (see 6.2.3.3 below). At this time, some of the water mains in the vicinity of Round Hill Road, previously operating on the high level zone will be utilised within the low level zone. Therefore a new 200 mm diameter high level connecting main (**WTM_AW_007**) is required to maintain supply from the high level zone to the Donohue Drive and Evans Court area.

6.2.3.3 Agnes Water Low Level Zone

Supply to the new low level zone will ultimately be sourced from the proposed 5.6 ML reservoir (WRS_AW_700) at Evans Court. Reservoir inlet infrastructure is discussed previously in Section 6.2.3.1 and Section 6.2.

At construction of the reservoir in 2036 a 375 mm diameter reservoir outlet main is proposed to deliver supply to the established low level zone (**WTM_AW_009**). As discussed previously a pressure reduced inlet connecting from the high level zone will provide supply to the low level zone prior to the construction of the Evans Court reservoir. A setting of the PRV matching the TWL of the Evans Court reservoir is proposed. GRC may wish to considered operating the PRV at a higher setting for the purposes of deferring capital expenditure on augmentations within the proposed low level zone.

Establishment of the low level zone resolves high pressure issues experienced by low lying properties near to the coast, most notably in the Agnes Street and Jeffrey Court area and up at Beaches Village. However, significant development and growth is expected in these areas in the future. The section of Captain Cook Drive water main between Round Hill Road and Lady Musgrave Court which provides the main path of supply within the low level zone is 150mm diameter. High head loss is experienced within this main with as demand in Agnes Water increases in line with the projections. Hydraulic modelling identified that without augmentation of the Captain Cook Drive water main, pressure failure within the north of the low level zone is expected to occur by 2021 with significant further failure anticipated by 2036.

To resolve the future capacity issues associated with the Captain Cook Drive water main, the following Augmentations are proposed:

- **WTM_AW_004** – 2021 – Captain Cook Drive duplication from Round Hill Road to Thomson Street (300 mm diameter)
- **WTM_AW_006** – 2036 – Captain Cook Drive duplication from Thomson Street to Lady Musgrave Drive (300 mm diameter)
- **WTM_AW_005** – 2036 – Captain Cook Drive duplication from Lady Musgrave Drive to Waterfront Drive (250 mm diameter).

7 Maximum Hour Network Performance and Augmentation Assessment

In addition to the zone bulk supply, zone establishment and trunk capacity augmentations identified within **Section 6**, a number of augmentations were identified as required to resolve localised minimum pressures below desired standards of service under maximum hour demands. Theses maximum hour augmentation upgrades are listed and discussed within this section. Infrastructure maps are provided within Appendix A.

The following localised maximum hour augmentations were identified:

- Following the construction of the dedicated Seaspray Drive reservoir inlet, the existing inlet/outlet will be used as a reservoir outlet main only. To increase outlet flow paths from the Seaspray Drive reservoirs and improve the capacity of the high level zone network a connection from the water main in the southwest of Starfish Street to this reservoir outlet is proposed through the following augmentations:
    - **WRM_AW_017** – 2016 - Connection from the reservoir outlet to Starfish Street for network connectivity and supply to future development (150 mm diameter)
    - **WRM_AW_016** – 2016 - Interconnection of reservoir outlet to extension of Startfish Street for connectivity and supply to future development (150 mm diameter)
- Existing localised low pressures are currently experienced under maximum day demands at the elevated area in the vicinity of Evans Court. The following augmentations were proposed to resolve these pressure failures:
    - **WRM_AW_013** – 2014 - Donohue Drive and Webster Court (150 mm diameter)
    - **WRM_AW_014** – 2014 - Donohue Drive and Webster Court (150 mm diameter)
    - **WRM_AW_015** – 2014 - Webster Court to Evans Court (150 mm diameter)
- Rezone of the area in the vicinity of Joseph Banks Boulevard to the low level zone has been proposed to alleviate high pressures experiences during low demands. By 2036 pressure failures were identified within this rezoned area under high demands, however, during evenings high pressures were still experienced. A 150 mm diameter connection main from Captain Cook Drive, through an easement, to Joseph Banks Boulevard is proposed to resolve the identified pressure failures (**WRM_AW_019**).

Infrastructure schedules for the augmentation solutions discussed in this section (along with sections 6 and 8) are provided within Appendix D. Infrastructure maps are provided within Appendix A.

8 Fire Flow Performance Assessment

Infrastructure schedules for the augmentation solutions discussed in this section (along with sections 6 and 7) are provided within Appendix D. Infrastructure maps are provided within Appendix A.

8.1 Fire Flow Assessment Methodology

The firefighting capacity assessment was undertaken based on the following firefighting demands:

- 15 L/s for residential properties three (3) storeys or less
- 30 L/s for all commercial properties (including residential accommodation facilities with commercial kitchens) and residential properties of four (4) or more storeys.

Within this study fire flow assessment was undertaken assuming a peak hour background demand and assuming the full fire flow requirement is delivered through a single hydrant. Hydrant locations were not accurately represented in the network hydraulic model at all locations. Fire flow demands were allocated to model junctions and if failure was identified the "realness" of the fire flow capacity issue was assessed based on location to the nearest hydrant. If fire flow failure was identified to occur at a location at which no hydrant was present (i.e. at the end of a small diameter property connection main) these failures were discounted from solution development.

Allocation of fire flow demand to junctions within the hydraulic model was based on land uses within the developed demand model. As there are some limitations to the demand model land uses, it is a possibility that not all junctions are allocated the appropriate fire flow demands. Within this study no further verification of fire flow demand allocation was undertaken through the use of aerial photography, Google street view or other means.

8.2 Fire Flow Augmentation Outcomes Summary

A total of 5 augmentations are proposed as part of this study to resolve fire flow deficiencies within the Agnes Water water supply network as identified within the hydraulic model. Two of these augmentations were identified as required within the 2014 planning horizon. An additional three fire flow augmentations were identified as required between 2021 and 2040 as detailed in **Table 8-1** below.

Table 8-1: Proposed Agnes Water Fire Flow Augmentations

Water Mains						
ID	**Planning Horizon**	**Dia (mm)**	**Length (m)**	**Address**	**Commentary**	**ET Trigger and Commentary**
WRM_AW_FF_021	2014	100	34	Tavern Road	FF interconnection for Tavern Road	Fire flow upgrade 2014
WRM_AW_FF_022	2014	150	342	Donohue Drive	FF Upgrade for School in Donohue Drive	Fire flow upgrade 2014
WRM_AW_FF_023	2021	100	91	Panorama Close	FF Upgrade for Panorama Close	Fire flow upgrade 2021
WRM_AW_FF_024	2036	150	150	Beach Houses Estate Road	FF Upgrade for failure in Beach Houses Estate Road	Fire flow upgrade 2036
WRM_AW_FF_025	2040	150	208	Atlantis Boulevard to The Promenade	FF Upgrade for failures in The Promenade	Fire flow upgrade 2040

It is also noted that a small fire flow deficiency was identified within The Crescent, bordering the boosted zone. Within draft deliverables, this fire flow deficiency was addressed through a new main from the end of Shady Lane to The Crescent. Comments received from GRC on the draft deliverables directed this main to be removed from the

infrastructure plan due to constructability issues. It was agreed that an alternative solution would not be developed as GRC were aware of the issue.

9 Infrastructure Schedules

Staged schedules for the water supply infrastructure proposed to maintain standards of service within the Agnes Water water supply network up to and including the Ultimate planning horizon as detailed within **Section 6** to **Section 8** are provided within **Appendix D**. These augmentations are shown geographically within the **Appendix A** maps and can be cross referenced through unique IDs.

Appendix D infrastructure schedules:

- **Table D1** – Water main augmentations
- **Table D2** – Fire flow augmentations
- **Table D3** – Reservoir augmentations
- **Table D4** – Pump stations augmentations

As stated is Section 1, within this study, infrastructure solutions have been developed for both pre-existing performance issues and future performance issues resulting from proposed development. Infrastructure solutions have been separated into two categories within this study as follows:

- LGIP Infrastructure – Trunk water supply infrastructure requirements as a result of development or network rezoning driven by development. The LGIP timeframe is for planned trunk infrastructure up to and including the 2031 planning horizon.

- Internal Project Planning (IPP) Only Infrastructure – Any infrastructure not categorised as LGIP infrastructure (i.e. reticulation infrastructure, infrastructure proposed for resolution of pre-existing performance issues, or infrastructure proposed as required beyond the LGIP timeframe).

10 Cost Estimation

10.1 Cost Estimation Methodology

Cost estimates for augmentations proposed within this report have been developed based on the following assumptions:

- Unit rates contained within the Harrison Grierson Unit Rates Report 2010 were adopted.
- Rates were indexed to 2014 rates (11% increase)
- No geology assessment was undertaken for soil factor multipliers in this study (unavailable). A clay soil factor was assumed for all augmentations. Harrison Grierson Unit Rates Report 2010 recommends the following multipliers based on soil type:

Hard Rock	1.36
Soft Rock	1.1
Clay	1
Sand	0.88

- The cost estimates contain no contingency based on advice within Harrison Grierson Report.
- No assessment of geology at reservoir sites was undertaken. Therefore hard rock multipliers were not included for any site.
- Where water main construction within greenfield areas was assumed no allowance for road and pavement reinstatement has been allowed. The additional rate for road and pavement construction has been allowed for water mains considered within developed/urban areas.
- Cost Estimates for pump stations are developed using unit rates per kW. A pump efficiency of 70% is assumed to calculate the pump station power requirement.

In water main cost estimates no assessment or allowance for trenchless construction requirements has been undertaken. As no contingency has been included within the cost estimates, there is a risk that the cost of delivery of some mains has been underestimated.

10.2 Summary Cost Estimation Outcomes

Individual cost estimation outcomes for each proposed infrastructure item are provided within the **Appendix D**.

Table 10-1 provides total infrastructure cost estimation per asset type and planning horizon including all augmentations identified within this study. Total estimated capital expenditure is $10.2 Million using the adopted cost estimation methodology.

Table 10-2 and **Table 10-3** provide infrastructure cost estimation summaries for LGIP and IPP infrastructure respectively.

Table 10-1: Agnes Water Augmentations – All Augmentations

Augmentation Type	Planning Horizon							
	2014	2016	2021	2026	2031	2036	Ultimate	Total
Water Mains								
Water Main Augmentations	$410,000	$3,650,000	$460,000			$1,420,000	$800,000	**$6,740,000**
Fire Flow Augmentations	$130,000		$30,000			$60,000	$80,000	**$300,000**
Pump Stations								
Spring Street Pump Station Upgrade							$1,090,000	**$1,090,000**
1770 Booster Pump Station			$150,000					**$150,000**
Reservoirs								
Evans Court Low Level Reservoir						$1,870,000		**$1,870,000**
Total	**$540,000**	**$3,650,000**	**$640,000**	**$0**	**$0**	**$3,350,000**	**$1,970,000**	**$10,150,000**

Table 10-2: Agnes Water Augmentations – LGIP Augmentations

Augmentation Type	Planning Horizon							
	2014	2016	2021	2026	2031	2036	Ultimate	Total
Water Mains								
Water Main Augmentations	$190,000	$3,600,000	$460,000					**$4,250,000**
Fire Flow Augmentations								**$0**
Pump Stations								
Spring Street Pump Station Upgrade								**$0**
1770 Booster Pump Station			$150,000					**$150,000**
Reservoirs								
Evans Court Low Level Reservoir								**$0**
Total	**$190,000**	**$3,600,000**	**$610,000**	**$0**	**$0**	**$0**	**$0**	**$4,400,000**

Table 10-3: Agnes Water Augmentations – IPP Augmentations

Augmentation Type	Planning Horizon							
	2014	2016	2021	2026	2031	2036	Ultimate	Total
Water Mains								
Water Main Augmentations	$220,000	$50,000				$1,420,000	$800,000	**$2,490,000**
Fire Flow Augmentations	$130,000		$30,000			$60,000	$80,000	**$300,000**
Pump Stations								
Spring Street Pump Station Upgrade							$1,090,000	**$1,090,000**
1770 Booster Pump Station								**$0**

Augmentation Type	Planning Horizon							
	2014	2016	2021	2026	2031	2036	Ultimate	Total
Reservoirs								
Evans Court Low Level Reservoir						$1,870,000		**$1,870,000**
Total	**$350,000**	**$50,000**	**$30,000**	**$0**	**$0**	**$3,350,000**	**$1,970,000**	**$5,750,000**

11 Discussion

The limitations, future opportunities and parked items identified through this assessment are noted within this section of the report.

11.1 Limitations

This report reflects a high level strategic planning study. Due to scope, time constraints and available information, there are a number of potential limitations associated with the outcomes of this study. These potential limitations are provided as follows:

- The demand model adopted within this study was developed based on a number of assumptions. Although based upon the best available information at the time the demand model will not be accurate in its development projections, land use and timing for all properties within the study area. The development methodology is provided within **Section 4** of the report and the document - 'Gladstone Regional Council Demand Model Development Technical Memo (MWH, July 2014)'.
- With the exception of the 1770 supply strategy, no optioneering of solutions has been undertaken within this study. Therefore, preferred or alternative solutions may be available.
- Cost estimates have been developed at a unit rate level only. The cost estimates have not considered individual alignments and site conditions, or infrastructure for which trenchless construction methods will be required.
- The feasibility and practical constructability of proposed assets has generally not been assessed within this study. There may be some proposed assets that require alternative solutions to be developed based on future site and environmental constraints.
- The timing of proposed infrastructure matches the 5 year planning horizons assessed within this study. For construction of "just in time" infrastructure these 5 year planning horizons may not be suitable to GRC and future assessment into timing may be required.
- Zone boundary updates have been proposed within this study without assessment of valve localities.
- Fire flow demand allocation was informed by the developed demand model. As the land uses within the demand model are not accurate for all parcels, the allocation of fire flows may be incorrect in places.

It is recommended that the outcomes of this report be viewed as the best and most up-to-date water supply planning for the Agnes Water water supply network. The outcomes, should however, be viewed with consideration to the above limitations.

11.2 Future Opportunities

A number of opportunities were identified which may assist GRC in improving the outcomes of ongoing and future planning studies associated with the Agnes Water water supply network. Potential opportunities include:

- Future update of the demand model developed for input into this water supply master planning study. As new information becomes available relating to land uses, development timing and sequencing, and state growth projections, it is envisaged that benefits will be identified by GRC in updating the demand model for input into future and ongoing infrastructure planning studies.
- Prior to delivering major infrastructure items identified within this report it is recommended that specific detailed planning and feasibility studies be undertaken to ensure the preferred and most efficient solutions are being delivered. The detailed planning studies may also be used to assess the 'just in time' delivery of infrastructure, and develop more detailed/accurate cost estimates.

- The assessment within this report was undertaken based on the GRC adopted standards of service. It has been identified across other Queensland water authorities and councils that a review of service standards in respect to appropriate levels of conservatism can result in significant capital cost savings on infrastructure delivery. GRC may see benefit in undertaking a review of the planning based standards of service currently adopted. Activities involved would include a demand tracking assessment for review of unit planning demand and peaking factors, and a risk based approach to reviewing performance based standards of service.

12 Conclusions

Based on the outcomes of this study the following is concluded:

1. A demand model for Agnes Water water supply area was developed and allocated to the H2OMAP hydraulic model for use in existing and future performance assessment and the identification of augmentation requirements. A summary of the project demands per Ultimate water zones is provided within **Table 12-1**. The current demand of the Agnes Water water supply network of 1,087 ET was identified with an Ultimate demand of 4,543 ET.

Table 12-1: Total ET per Ultimate Supply Zones

Water Zone	Total ET						
	2014	2016	2021	2026	2031	2036	Ultimate
Booster Zone	62	62	62	62	62	62	62
High Level Zone	465	604	688	795	850	950	2,048
Low Level Zone	560	630	804	944	1,152	1,347	2,433
Total	**1,087**	**1,297**	**1,554**	**1,801**	**2,064**	**2,359**	**4,543**

2. An assessment of current storage capacities based on current zoning identified that current reservoir storage is sufficient until the 2036 planning horizon. The ET trigger for storage upgrade is 2,150 ET which will occur in approximately 2033 based on the current growth projections.

3. Due to capacity and operational issues with the existing 150 mm diameter supply main from the Agnes Water WTP to the Seaspray Drive reservoirs a new dedicated 375 mm diameter reservoir supply main is proposed (**WTM_AW_002** and **WTM_AW_003**). The new main will be of sufficient capacity to deliver required flows to the network up to and including the Ultimate planning horizon. Additionally, pressure fluctuations currently being experienced by customers in the network due to the current inlet/outlet operation of the reservoir supply main will be removed. A flow controlled connection to the proposed low level reservoir (**WRS_AW_700**) at 2036 from this dedicated inlet main is proposed.

4. Driven by high pressures being experienced by customers within the low lying areas in the east of Agnes Water, a rezoning strategy for the Agnes Water water supply network has been developed. This strategy is summarised as follows:

    a. Establish a low level zone consisting of low elevation properties primarily located to the east of Captain Cook Drive. The low level zone will initially be supplied via a pressure reduced connection from the high level zone located on the 150 mm diameter main at the southern end of Captain Cook Drive. Upon construction of the Evans Court low level reservoir (**WRS_AW_700**) and 375 mm diameter low level reservoir outlet main (**WTM_AW_009**), the PRV can be removed and the low level zone can be supplied directly from this new reservoir.

    b. Supply to the 1770 water supply network must continue to be supplied from the HGL of the Seaspray Drive resevoirs for standards of service to be maintained in both Agnes Water and 1770 water supply networks. A number of upgrades to the network are required for both bypassing

the low level zone and providing sufficient capacity for future supply to 1770. These upgrades are as follows:

- 2014 Augmentations:
  - **ATM_AW_001** – Dedicated 1770 supply main in Captain Cook Drive (200 mm diameter)
  - **WRM_AW_010** - Capacity upgrade from Starfish Street to Banksia Drive – (200 mm diameter)
- 2016 Augmentations
  - **WRM_AW_026** - Woodrow Drive and Solander Close – (200 mm diameter)
- Ultimate Augmentations:
  - **WRM_AW_018** - Connection Sunlover Avenue to Discovery Drive – (200 mm diameter)
  - **WRM_AW_028** - Seaspray Dive reservoirs to Sunlover Avenue – (200 mm diameter)
  - **WRM_AW_027** - Discovery Drive – (200 mm diameter).

5. The existing reservoir is of sufficient capacity to service the proposed HLZ at ultimate demands as illustrated in **Table 6-3**. 5.6 ML is proposed as the size for the Evans Court low level reservoir in order meet Ultimate demand requirements.
6. Upon establishment of the Ultimate zoning strategy, network deficiencies under maximum hour and fire flow demands were identified and resolved through more augmentation works. Significant maximum hour Augmentations are proposed within the low level zone along Captain Cook Drive:
   - **WTM_AW_004** – 2021 – Captain Cook Drive duplication from Round Hill Road to Thomson Street (300 mm diameter)
   - **WTM_AW_006** – 2036 – Captain Cook Drive duplication from Thomson Street to Lady Musgrave Drive (300 mm diameter)
   - **WTM_AW_005** – 2036 – Captain Cook Drive duplication from Lady Musgrave Drive to Waterfront Drive (250 mm diameter)
7. Cost estimation for proposed infrastructure was undertaken. The total cost estimate for proposed water supply infrastructure is **$10.15 Million** based on the adopted methodology. **Table 12-2** summarises the cost estimates for all water supply infrastructure identified within this study (LGIP and IPP combined). Further breakdown of cost estimates are available in Section 10 and within Appendix D.

Table 12-2: Agnes Water Augmentations – All Augmentations

Augmentation Type	Planning Horizon							
	2014	2016	2021	2026	2031	2036	Ultimate	Total
Water Mains								
Water Main Augmentations	$410,000	$3,650,000	$460,000			$1,420,000	$800,000	**$6,740,000**
Fire Flow Augmentations	$130,000		$30,000			$60,000	$80,000	**$300,000**
Pump Stations								
Spring Street Pump Station Upgrade							$1,090,000	**$1,090,000**

Augmentation Type	Planning Horizon							
	2014	2016	2021	2026	2031	2036	Ultimate	Total
1770 Booster Pump Station			$150,000					**$150,000**
Reservoirs								
Evans Court Low Level Reservoir						$1,870,000		**$1,870,000**
Total	**$540,000**	**$3,650,000**	**$640,000**	**$0**	**$0**	**$3,350,000**	**$1,970,000**	**$10,150,000**

8. Some potential limitations related to this study were identified and are provided as follows:

- The demand model adopted within this study was developed based on a number of assumptions. Although based upon the best available information at the time the demand model will not be accurate in its development projections, land use and timing for all properties within the study area. The development methodology is provided within Section 4 of the report and the document - 'Gladstone Regional Council Demand Model Development Technical Memo (MWH, July 2014)'.
- With the exception of the supply strategy to 1770 no optioneering of solutions has been undertaken within this study. Therefore, preferred or alternative solutions may be available.
- Cost estimates have been developed at a unit rate level only. The cost estimates have not considered individual alignments and site conditions, or infrastructure for which trenchless construction methods will be required.
- The feasibility and practical constructability of proposed assets has generally not been assessed within this study. There may be some proposed assets that require alternative solutions to be developed based on future site and environmental constraints.
- The timing of proposed infrastructure matches the 5 year planning horizons assessed within this study. For construction of "just in time" infrastructure these 5 year planning horizons may not be suitable to GRC and future assessment into timing may be required.
- Zone boundary updates have been proposed within this study without assessment of valve localities.
- Fire flow demand allocation was informed by the developed demand model. As the land uses within the demand model are not accurate for all parcels, the allocation of fire flows may be incorrect in places.

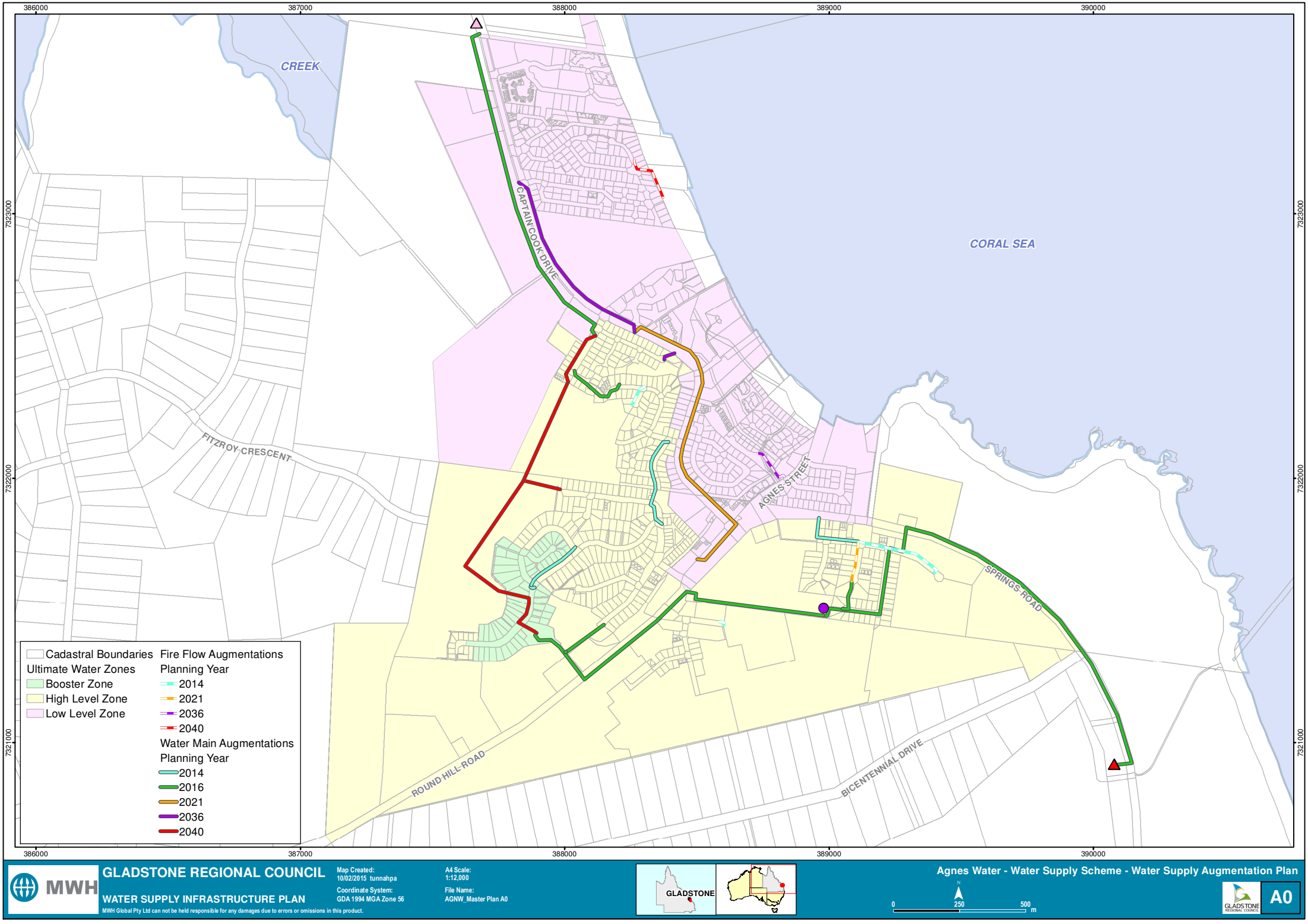
Report outcomes should be viewed with consideration to the above limitations.

13 Recommendations

Based on the conclusions of this study the following is recommended:

1. The outcomes of this report are viewed as the best and most up-to-date water supply planning for the Agnes Water water supply network. The outcomes, should however, be viewed with consideration to the identified limitations.
2. GRC consider the following opportunities for improving the outcomes of future planning studies in the Agnes Water water network. The following opportunities will also assist in ensuring the most prudent and efficient infrastructure solutions are identified for delivery. Opportunities:
    - Future update of the demand model developed for input into this water supply master planning study. As new information becomes available relating to land uses, development timing and sequencing, and state growth projections, it is envisaged that benefits will be identified by GRC in updating the demand model for input into future and ongoing infrastructure planning studies.
    - Prior to delivering major infrastructure items identified within this report it is recommended that specific detailed planning and feasibility studies be undertaken to ensure the preferred and most efficient solutions are being delivered. The detailed planning studies may also be used to assess the 'just in time' delivery of infrastructure, and develop more detailed/accurate cost estimates.
    - The assessment within this report was undertaken based on the GRC adopted standards of service. It has been identified across other Queensland water authorities and councils that a review of service standards in respect to appropriate levels of conservatism can result in significant capital cost savings on infrastructure delivery. GRC may see benefit in undertaking a review of the planning based standards of service currently adopted. Activities involved would include a demand tracking assessment for review of unit planning demand and peaking factors, and a risk based approach to reviewing performance based standards of service.

Appendix A Augmentations Maps



MWH

GLADSTONE REGIONAL COUNCIL

WATER SUPPLY INFRASTRUCTURE PLAN

MWH Global Pty Ltd can not be held responsible for any damages due to errors or omissions in this product.

Map Created: 10/02/2015 tunnahpa

Coordinate System: GDA 1994 MGA Zone 56

A4 Scale: 1:12,000

File Name: AGNW_Master Plan A0

GLADSTONE

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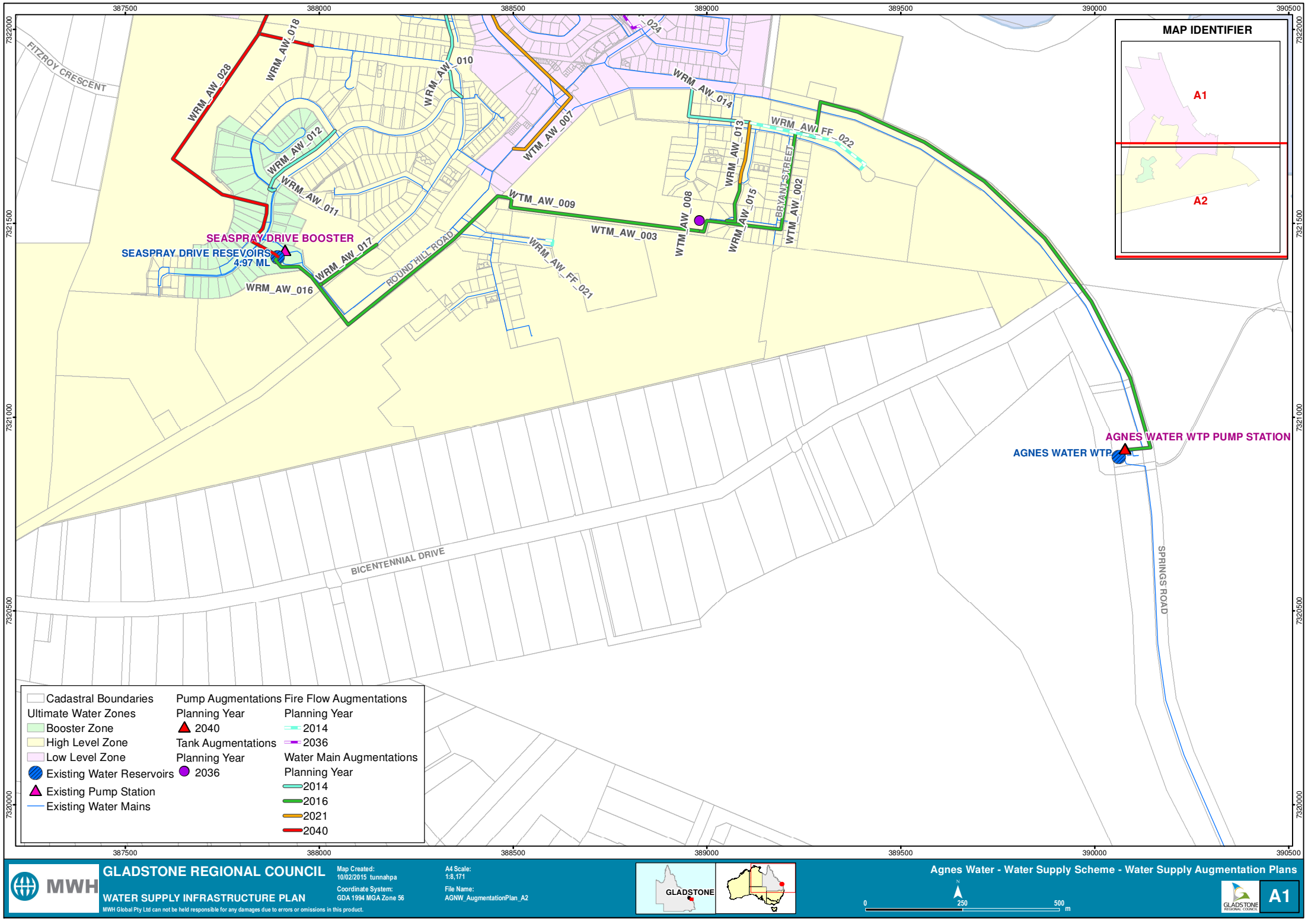
Agnes Water - Water Supply Scheme - Water Supply Augmentation Plan

GLADSTONE REGIONAL COUNCIL

A0



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WATER SUPPLY INFRASTRUCTURE PLAN

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Map Created: 10/02/2015 tunnahpa

Coordinate System: GDA 1994 MGA Zone 56

A4 Scale: 1:8,171

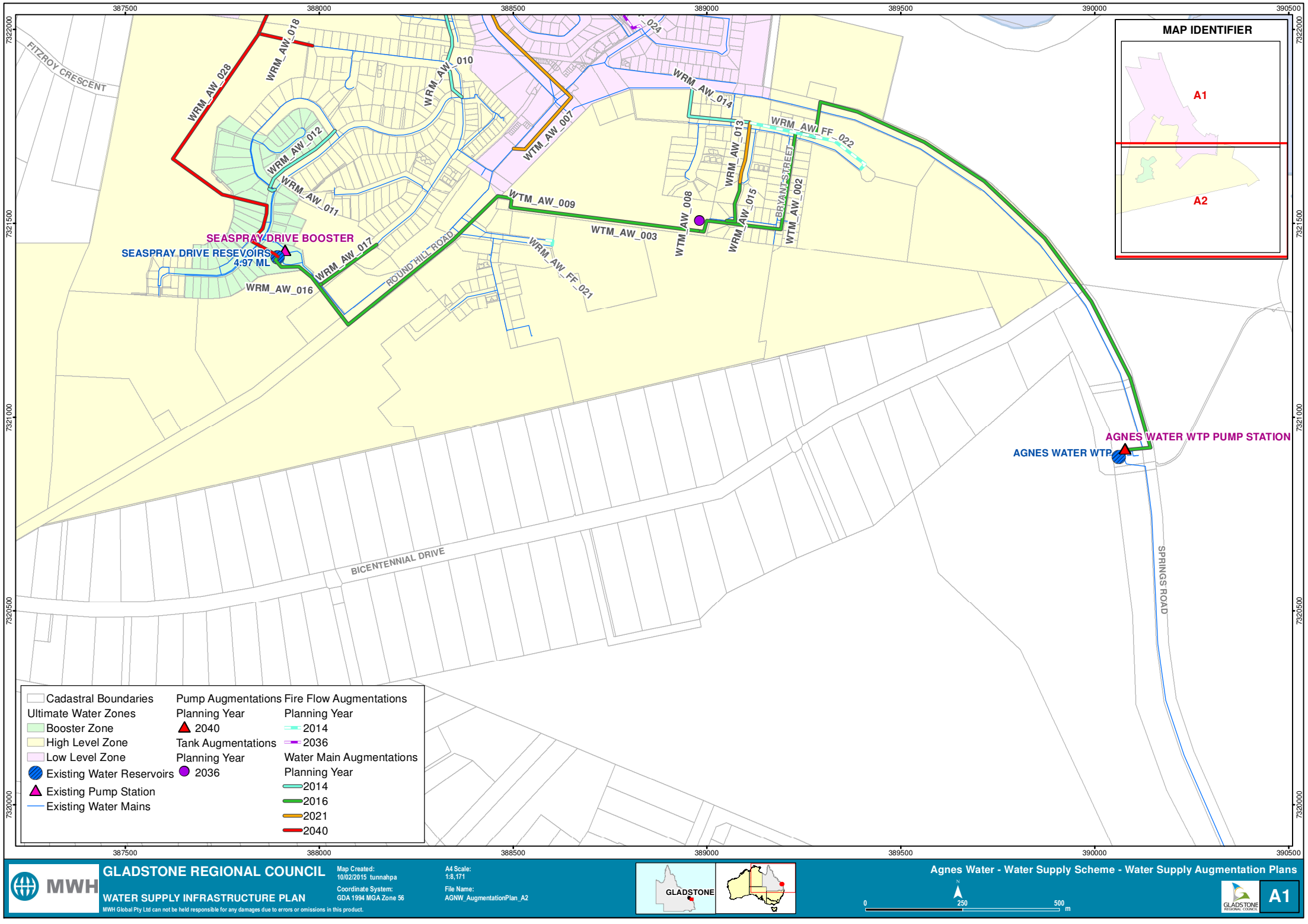
File Name: AGNW_AugmentationPlan_A2

GLADSTONE

Agnes Water - Water Supply Scheme - Water Supply Augmentation Plans

0 250 500 m

A1



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WATER SUPPLY INFRASTRUCTURE PLAN

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Map Created: 10/02/2015 tunnahpa

Coordinate System: GDA 1994 MGA Zone 56

A4 Scale: 1:8,171

File Name: AGNW_AugmentationPlan_A2

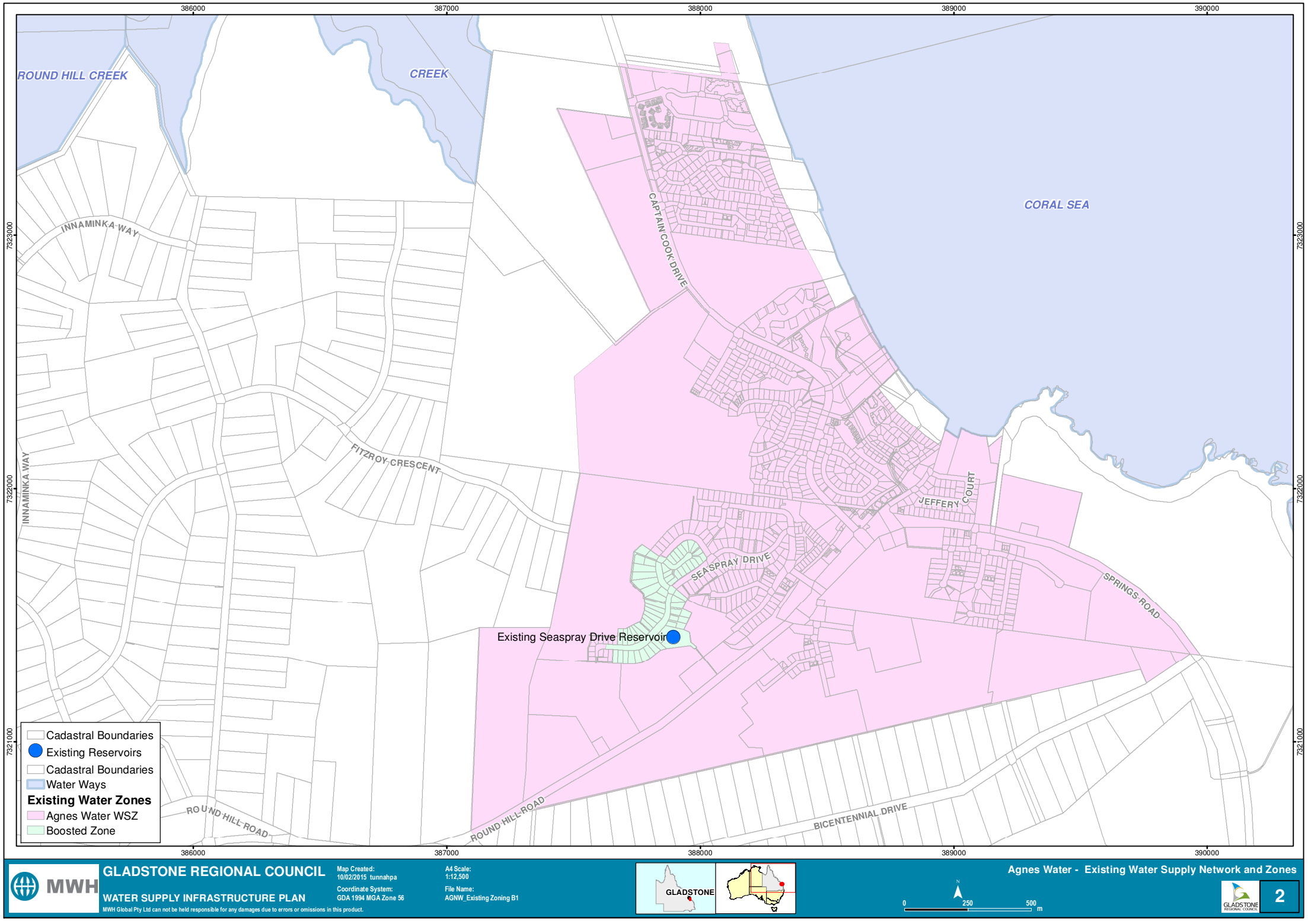
GLADSTONE

Agnes Water - Water Supply Scheme - Water Supply Augmentation Plans

0 250 500 m

A1

Appendix B Zoning Maps



MWH

GLADSTONE REGIONAL COUNCIL

WATER SUPPLY INFRASTRUCTURE PLAN

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Map Created: 10/02/2015 tunnahpa

Coordinate System: GDA 1994 MGA Zone 56

A4 Scale: 1:12,500

File Name: AGNW_Existing Zoning B1

GLADSTONE

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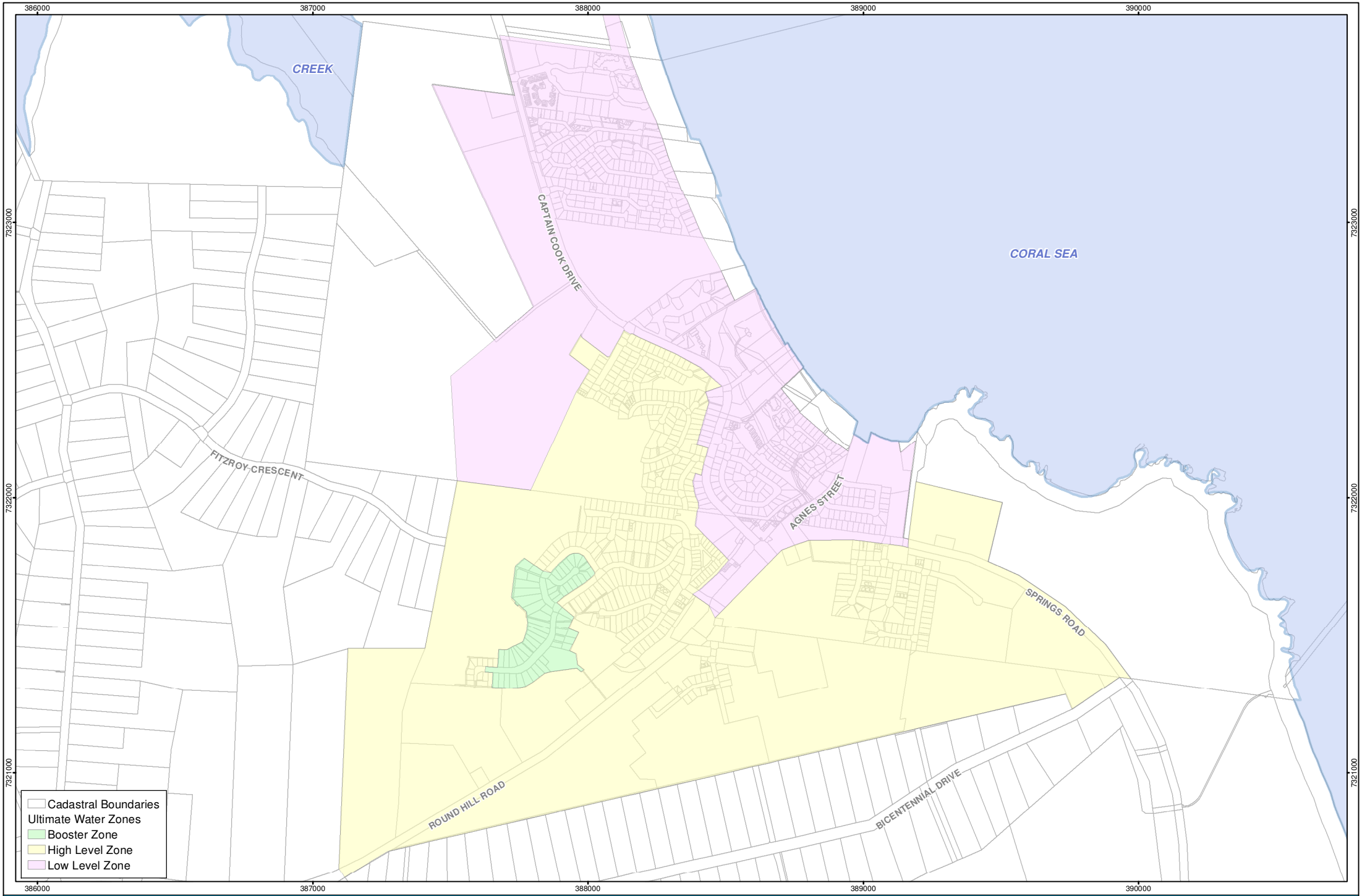
0 250 500 m

Agnes Water - Existing Water Supply Network and Zones

GLADSTONE REGIONAL COUNCIL

2



MWH

GLADSTONE REGIONAL COUNCIL

WATER SUPPLY INFRASTRUCTURE PLAN

Map Created: 10/02/2015 tunnahpa

Coordinate System: GDA 1994 MGA Zone 56

A4 Scale: 1:12,000

File Name: AGNW_Ultimate Zoning B2

GLADSTONE

0 250 500 m

Agnes Water - Water Supply Scheme - Water Supply Augmentation Plan

GLADSTONE REGIONAL COUNCIL

B2

Appendix C GRC Correspondence

Phillip Hall

Subject: FW: Agnes Water/1770 water strategic plan
Attachments: Agnes Water - Interim Low Level Zoning requirements.pdf

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From: Phillip Hall
Sent: Monday, 19 January 2015 2:57 PM
To: 'Ashleigh Tomkins'
Cc: Emma Hamilton; Technical Services (Mailbox)
Subject: RE: Agnes Water/1770 water strategic plan

Hello Ashleigh

Please find the attached map and commentary proposing initial infrastructure requirements for establishment the Agnes Water low level zone and to maintain sufficient supply to 1770 and the 1770 reservoir.

The main features of the proposed strategy are summarised in the attached and proposed infrastructure for this interim solution avoids the undeveloped land parcels. A higher fixed PRV setting is proposed for the interim period to avoid some augmentations. Bring forward of the 1770 booster supply pump station is proposed to 2016, however, reservoir levels were marginal so there could be an opportunity to defer this pump station through risk based decision.

Please do not hesitate to call should you have any questions. I'll call tomorrow to go through once you've had a chance to review.

Best Regards
Phil

From: Ashleigh Tomkins [mailto:AshleighT@gladstonerc.qld.gov.au]
Sent: Friday, 16 January 2015 1:17 PM
To: Phillip Hall
Cc: Emma Hamilton; Technical Services (Mailbox)
Subject: RE: Agnes Water/1770 water strategic plan

Phil,

We have a meeting to discuss Agnes upgrades at 1 on Tuesday. Any advice you could provide before then would be greatly appreciated, however I know these thing will take as long as they take.

We are also looking at some stuff in Gladstone sewer which I'll forward under separate cover.

We probably need to catch up and collate any outstanding queries you require from us and I'll get started on actioning these.

Ashleigh Tomkins
Engineer - Development
GLADSTONE REGIONAL COUNCIL

From: Phillip Hall [mailto:Phillip.T.Hall@mwhglobal.com]
Sent: Friday, 16 January 2015 10:33 AM
To: Ashleigh Tomkins
Cc: Emma Hamilton; Technical Services (Mailbox)
Subject: RE: Agnes Water/1770 water strategic plan

Hello Ashleigh

After getting started on this assessment today, there is a bit more analysis required than I had initially thought. The end of today timeframe I suggested below is a bit optimistic. Instead I will provide you with a response early next week (Monday or Tuesday).

Please do hesitate to be in contact if this delay creates any issues.

Hope you have a great weekend.

Best Regards
Phil.

From: Phillip Hall
Sent: Thursday, 15 January 2015 11:49 AM
To: 'Ashleigh Tomkins'
Cc: Emma Hamilton; Technical Services (Mailbox)
Subject: RE: Agnes Water/1770 water strategic plan

Hi Ashleigh

Happy belated new year to you and Emma. Hope you are both well and wish you all the best for 2015.

I will look to get you an answer on the below before the end of the week. I'll give you a call at the time of providing the answer as well around finalising the strategic planning reports.

Will be in contact soon

Regards
Phil

From: Ashleigh Tomkins [mailto:AshleighT@gladstonerc.qld.gov.au]
Sent: Thursday, 15 January 2015 11:30 AM
To: Phillip Hall
Cc: Emma Hamilton; Technical Services (Mailbox)
Subject: FW: Agnes Water/1770 water strategic plan

Phil,

How are you? I hope you had a good end of year break?

For Agnes Water water, I've been having discussions with our operations guys and they're pretty keen to move on installing the zone separation. This being said we aren't sure how quickly we can sort out the issues associated with providing a dedicated 1770 feed across the undeveloped parcels.

Is it feasible at all to provide a dedicated 1770 feed from the high lift zone with only upgrades on captain cook drive (plus those through the existing banksia drive starfish area)?

An alternate option might be to do the 1770 feed from the low level zone. Will this option require any extra upgrades or oversizing compared to option 1? How much more head would be required from the 1770 booster pumps (compared to say option 1)?

Happy to use 2016 demands for this check. Give me a call if you would like to discuss further.

Thanks,

Ashleigh Tomkins
Engineer - Development
GLADSTONE REGIONAL COUNCIL
PO Box 29 Gladstone Qld 4680
Phone 07 4975 8170 I Fax 07 4975 8500
Email: ashleight@gladstonerc.qld.gov.au I Website: www.gladstone.qld.gov.au

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From: Phillip Hall [mailto:Phillip.T.Hall@mwhglobal.com]
Sent: Tuesday, 21 October 2014 4:20 PM
To: Ashleigh Tomkins
Cc: Emma Hamilton; Anjila Finan
Subject: RE: Gladstone W&S strategic plans

Hello Ashleigh

Following the request below, please find the attached memo involving assessment of the Agnes Water supply to 1770 and a proposed strategy. Following our assessment, Option 1 involving a dedicated supply to 1770 is proposed. Option 1 has the lowest overall cost along with some other benefits.

Could you please confirm you are happy with us to adopting and developing Option 1 within the Strategic Infrastructure Planning Report.

Thank you. Please give me a call if you would like to discuss.

Regards

Phil

From: Ashleigh Tomkins [mailto:AshleighT@gladstonerc.qld.gov.au]
Sent: Thursday, 4 September 2014 2:26 PM
To: Phillip Hall
Cc: Emma Hamilton; Ian Munro
Subject: RE: Gladstone W&S strategic plans

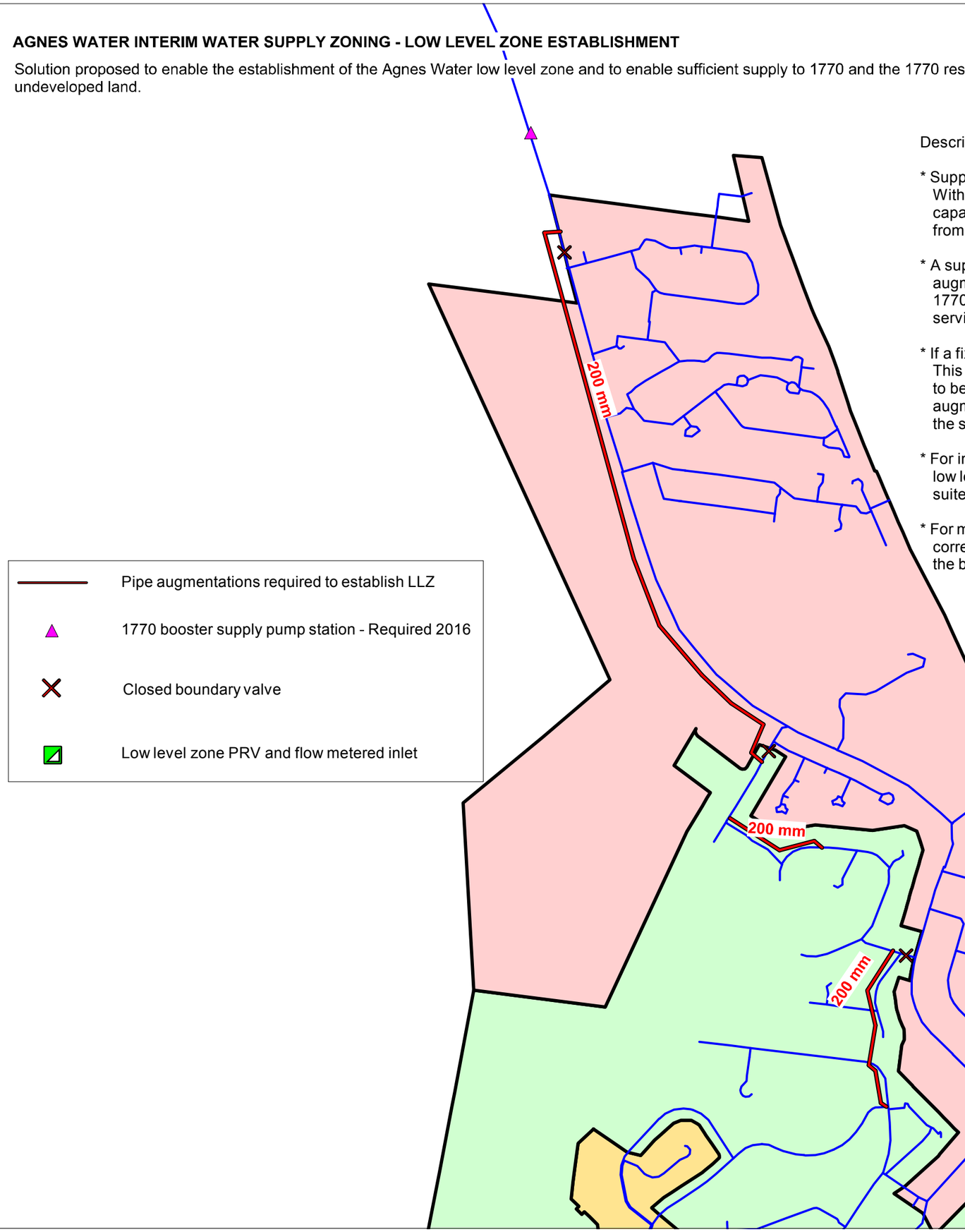
Phil,

Sorry about the delays getting this info to you its been a bit hectic up here. As you may be aware Phil Boshoff has recently resigned from Council.

For the Agnes Water water network we're going to need to add in the 1770 bulk water network and a point demand at the 1770 reservoir. I've put the 1770 demand up on sharepoint Celisa developed this when we first built the 1770 system. I've put the as cons for the 1770 water network and the res up on sharepoint in "information requests/MWH - Water and Sewer/1770 water network". From this point we'll be in a better position to determine what will work and what won't. At the moment I'm proposing we assess three scenarios servicing by gravity with interconnection, servicing by gravity with dedicated feed and servicing with pump feed.

AGNES WATER INTERIM WATER SUPPLY ZONING - LOW LEVEL ZONE ESTABLISHMENT

Solution proposed to enable the establishment of the Agnes Water low level zone and to enable sufficient supply to 1770 and the 1770 reservoir without contruction of a dedicated supply to 1770 from the Seaspray Drive reservoirs through private and undeveloped land.



Description / Summary

* Supply to 1770 via the LLZ to prevent the need for the 200 mm dia HLZ main in Captain Cook Dr was trialled With the additional 1770 demand on the low level zone the existing mains in Captain Cook Drive were of insufficient capacity to maintain pressure and fire flow desired standards of service within the low level zone. Supply to 1770 from the high level zone is therefore necessary

* A supply path to the 1770 network from the HLZ is required. It is proposed this is established by the pipe augmentations shown. Pipe augmentations are propsoed as 200 mm such that a 200 mm dia supply path to 1770 can be completed in the future if requried to meet Ultimate demands and maintain desired standards of service in the high level zone.

* If a fixed head PRV is selected a setting of 70 m HGL (pressure ~ 64 m) is proposed for the initial interim period. This wll allow desired standards of service with in the low level zone under both peak hour and fire flow demands to be met without the requirement for any low level zone augmentations. As demand in the low level zone grows augmentation of the 150 mm diameter main in Captain Cook drive is required (at 2021) with this upgrade installed the setting of the PRV can be lower to match the HGL of the future Agnes Water low level resevoir (~ 59 m).

* For improved pressure and non-revenue water reduction GRC may wish to consider a flow modulating PRV at the low level zone inlet. During low demands the zone has the potential for a significantly reduced PRV setting and is suited well to flow modulated pressure reduction.

* For maintaining levels in the 1770 reservoir a booster supply pump station has been proposed in previous correspondence at 2021. Without the opportunity to initially construct a dedicated supply to 1770, constuction of the booster pump stations requires bring forward to 2016 to maintain standards of service and levels in the 1770 res.

Assumptions:

- Requirements are based on GRC standards of service.
- The 2016 plannnig horizon and demand projections have been used in assessment
- No assessment of current actual demand trends have been undertaken

- There could be opportunities for GRC to defer construction of the 1770 booster pump station beyond 2016 following a risk based decision should current actual demands and peaking factors be below those contained within the GRC desired standard of service.

- If flow modulation of the PRV inlet is to be considered by GRC futher field and modelling assessemnt is recommended.

21 October 2014

Gladstone Regional Council
Via Email

Dear

Agnes Water / 1770 Water Supply Network Strategy Assessment

This Technical Note has been prepared in response to the email received from Ashleigh Tomkins entitled Agnes Water water network (08 July 2014). This email detailed a number of requests for further assessment of the Agnes Water network. Results from this assessment are provided within this report along with a recommended strategy. The correspondence chain is included as an attachment to this letter (Appendix A).

We request feedback from Gladstone Regional Council stakeholders to confirm the proposed strategy. The confirmed approach with then be adopted within the Agnes Water Strategic Water Supply Infrastructure Plan being developed concurrently.

Background

In March 2014 MWH were engaged by GRC to undertake water supply and sewerage strategic infrastructure planning studies for the Gladstone City and Agnes Water networks. A servicing plan for Agnes Water, pre-developed by GRC, was provided to MWH at project start-up with instruction to adopt for the purposes of defining draft PIP inputs within available time frames. Draft PIP inputs have been delivered with the adoption of this provided servicing plan. The feedback provided in the above mentioned correspondence requests the investigation of servicing alternatives that may provide both cost and operational benefits.

Implementation of an Agnes Water low level zone has been identified as a priority and is currently being implemented in a limited form. The infrastructure required for the rezoning of the Agnes Water water supply system has been detailed in a prior Technical Note entitled **Agnes Water / 1770 Water Supply Network Strategy Assessment (24 July 2014)**.

This report is an addendum to the Technical Note (24 July 2014) and discusses alternative servicing options for 1770 only.

Scope

Implementation of an Agnes Water low level zone has been identified as a priority and is currently being implemented in a limited form. The purpose of this assessment is to assess options for supply to 1770.

The scope of this assessment is as broken into the following tasks:

1. Assess supply to 1770 upon implementation of a low level zone. Identify the preferred augmentation requirements for both maintaining standards of service within the high and low level zone providing supply to 1770 via the high level zone.
2. Review requirements and configuration of supply to 1770, investigating benefits of:
    a. a dedicated supply; and
    b. the creation of looped supply through the high level zone.

MWH Australia Pty Ltd
Level 3 35 Boundary Street
PO Box 3602
South Brisbane, QLD 4101

TEL +61 7 3029 5000
FAX +61 7 3029 5050
www.mwhglobal.com
ABN: 17 007 820 322

3. Compare performance and costs of the alternative options.

In order to meet the scope requirements, the model has been extended to include the 1770 reservoir and supply main and 1770 demands at each planning horizon. The following options have been investigated

- **Option 1** - A dedicated supply to 1770 from the HLZ Reservoir at Seaspray Drive joining the existing 150 mm diameter 1770 supply main north of Beaches Village Circuit
- **Option 2** - Creation of a supply to 1770 connected to the HLZ.
- **Option 3** - Creation of a supply to 1770 connected to the HLZ with the addition of a connection from the 1770 supply main to the low level zone via a PRV to provide maximum day support to resolve low maximum hour pressures in the Beaches Village Circuit area.

Proposed Zoning

The proposed low level zone boundary identified in original planning was adopted as the basis for this assessment (see Figure 1). A PRV is proposed at the inlet to the low level zone on the 150 mm diameter main in Captain Cook Drive immediately north of the intersection with Round Hill Road. The PRV was initially set to delivery 57 m HGL to match a standard operating level in the future low level reservoir which will ultimately supply this zone.

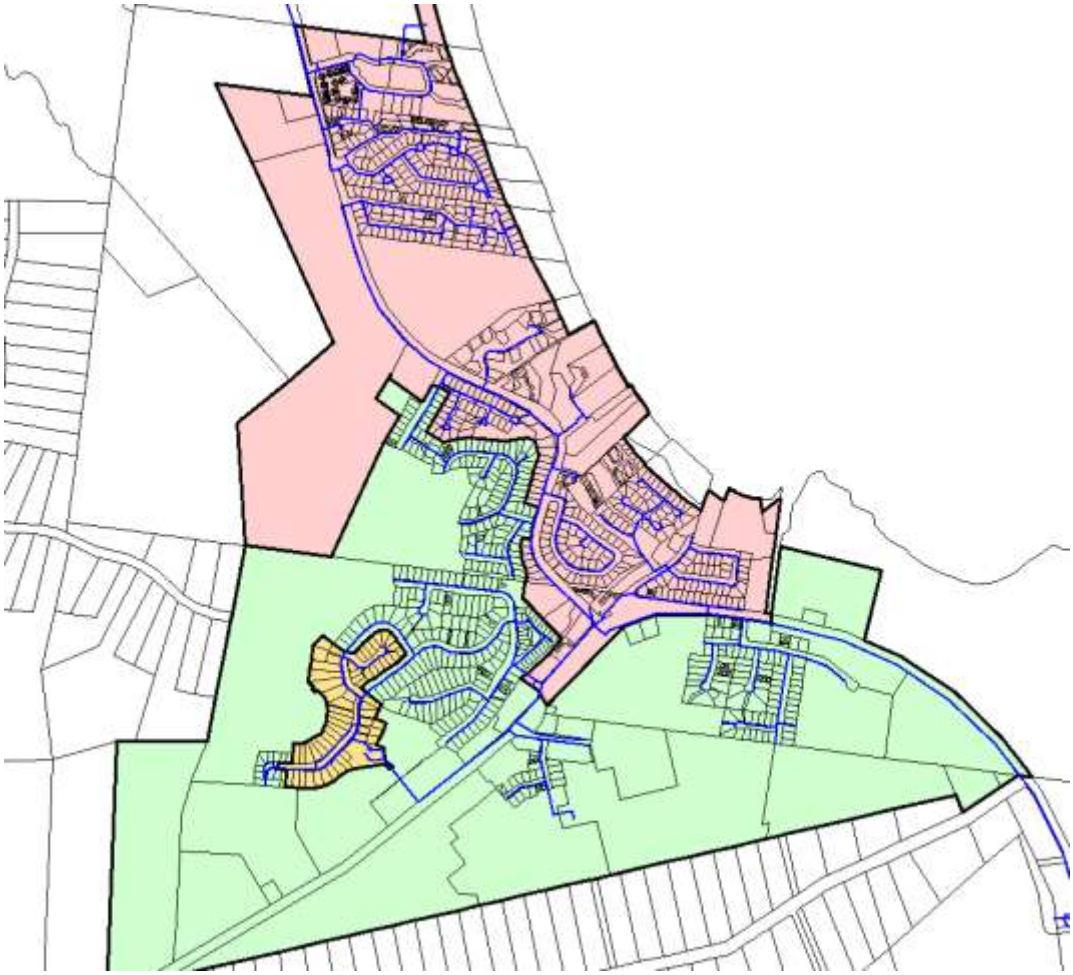


Figure 1: Agnes Water Proposed Zoning – Pink = Low Level Zone, Green = High Level Zone

1770 Demands

The demands adopted to assess the 1770 supply were derived from current and Ultimate ET loading provided by GRC. Growth rates were applied in line with the OSER growth rate for Agnes Water – Miriam Vale SA2 area. Table 1 summarises the resultant ET and demands for each planning horizon.

Table 1: Seventeen Seventy ET and Demands

Water Zone	2014	2016	2021	2026	2031	2036	Ultimate
ET	268	278	302	326	351	376	476
Average Day Demand (L/s)	3.6	3.8	4.1	4.4	4.8	5.1	6.4
Mean Day Max Month Demand (L/s)	4.5	4.7	5.1	5.5	5.9	6.3	7.7
Maximum Day Demand (L/s)	5.9	6.2	6.7	7.2	7.8	8.3	10.2

Option Description and Infrastructure Requirements

Option 1 – A Dedicated Supply to 1770 Reservoir from the Agnes Water HLZ Supply

A dedicated Supply to the 1770 reservoir was investigated under the new zoning regime. Figure 2 shows the adopted main routing and the required infrastructure to support supply to 1770 and maintain supply within the Agnes Water high and low level zones. The infrastructure timing and requirements are detailed below, they have been split into augmentations required to service 1770 and other capacity upgrade requirements.

1770 Supply Augmentations

- **2016** – Construction of a new 200 mm diameter dedicated supply main for 1770. This main is routed directly from the high level supply connecting to the existing 150 mm diameter 1770 supply main to the north of Beaches Village Circuit (See Figure 2).
- **2021** – Additional boosting is required (5 kW pump) at maximum day demands to assist supply to the 1770 Reservoir. The booster station has been located to the north of Beaches Village Circuit at the start of the existing 150 mm diameter 1770 supply main.

Maximum Hour and Fire Flow Pressure Capacity Upgrades

1. **2016** – 200 mm diameter capacity upgrade from Starfish Street to Banksia Drive required due to rezoning of Joseph Banks Boulevard area to the Low Level Zone
2. **2021** – 300 mm diameter capacity upgrade in Captain Cook Drive from Round Hill Road to Thomson Street (Section 1 in Figure 2) required to resolve low pressures in northern Agnes Water Low Level Zone

3. **2036** – 300 mm diameter capacity upgrade in Captain Cook Drive from Thomson Street to Waterfront Drive (Section 2 and Section 3 in Figure 2) required to resolve low pressures in northern Agnes Water Low Level Zone
4. Ultimate 200 mm diameter capacity upgrade in Beaches Village Circuit (see Figure 2) required to resolve low pressures in in Beaches Village Circuit area

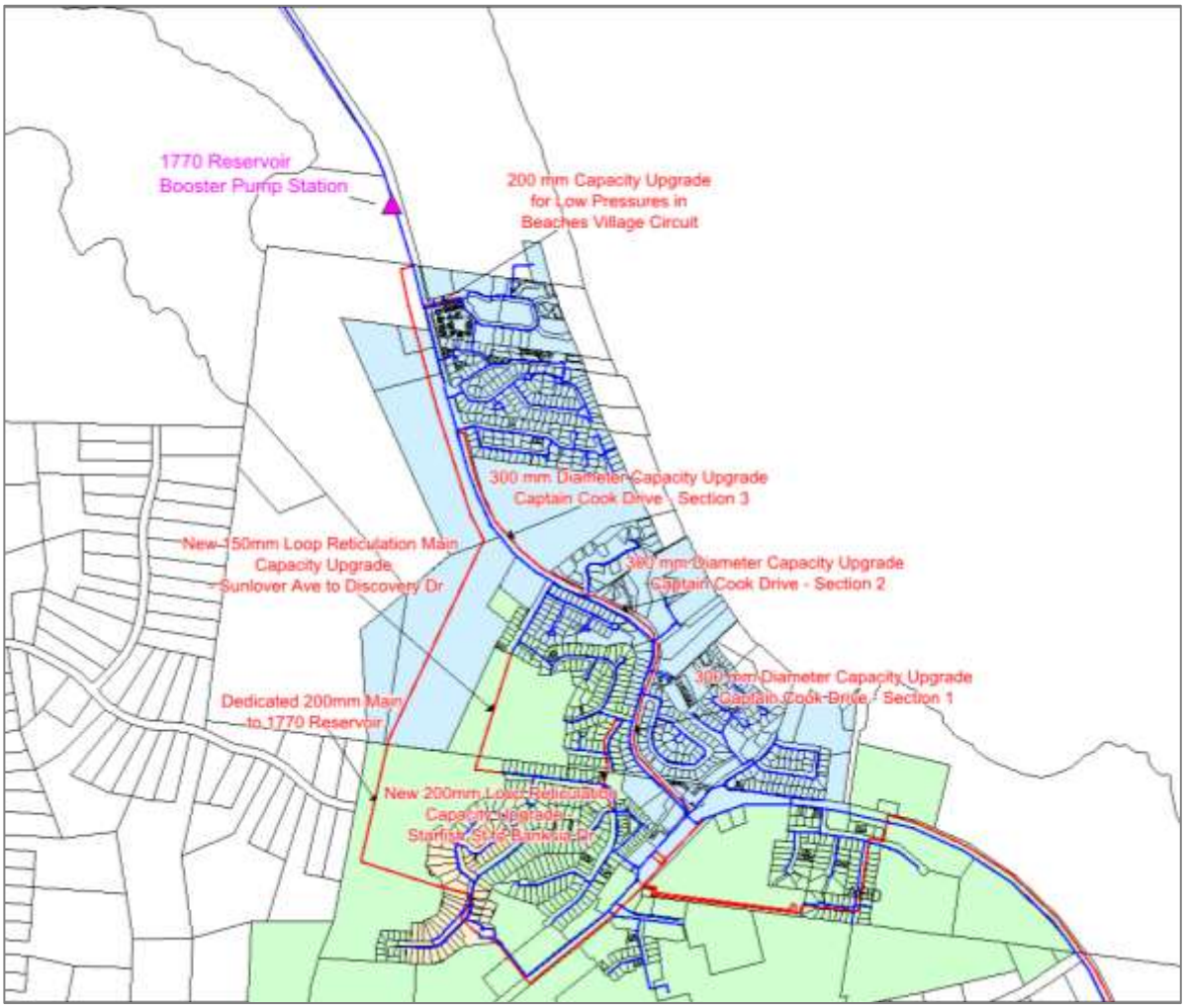


Figure 2: Option 1 Augmentations

<u>Option 2 – Creation of supply to 1770 Reservoir connected via Agnes Water HLZ</u>

A supply to the 1770 reservoir connected to the Agnes Water HLZ was investigated under the new zoning regime to identify if the use of capacity in existing HLZ infrastructure contained benefits. Figure 3 shows the adopted main routing and the required infrastructure to support supply to 1770 and maintain supply within the Agnes Water high and low level zones. The existing 250 mm main in Captain Cook drive was utilised and augmented to support this option. The infrastructure timing and requirements are detailed below and have been split into augmentations required to service 1770 and other capacity upgrade requirements.

1770 Supply Augmentations

Augmentations required to create a looped supply to the 1770 reservoir

- **2016** – Construction of a new 200 mm diameter supply main directly from the high level supply connecting into the existing 250 mm main in Captain Cook Drive (See Figure 3).
- **2021** – Additional boosting is required (5 kW pump) at maximum day demands to augment supply to the 1770 Reservoir. The booster station has been located to the north of Beaches Village Circuit at the start of the existing 150 mm diameter 1770 supply main.
- **2016** – 300 mm diameter capacity upgrade in Captain Cook Drive from Lady Musgrave Court to Waterfront Drive (Section 3 in Figure 3) required to maintain supply to northern Agnes Water Low Level Zone due to dedication of existing 250 mm main to 1770 Reservoir supply.
- **2016** – 200 mm diameter capacity upgrade in Captain Cook Drive from Lady Waterfront Drive to Beaches Village Circuit (Section 4 in Figure 3) required for dedicated 1770 Reservoir supply.
- **2016** – 200 mm diameter loop main to connect the existing 150 mm diameter main in Discovery Drive to the existing 250 mm in Captain Cook Drive (see Figure 3).

Maximum Hour and Fire Flow Pressure Capacity Upgrades

5. **2016** – 200 mm diameter capacity upgrade from Starfish Street to Banksia Drive required due to rezoning of Joseph Banks Boulevard area to the Low Level Zone
6. **2016** – 300 mm diameter capacity upgrade in Captain Cook Drive from Thomson Street to Lady Musgrave Court (Section 2 in Figure 3) required to resolve low pressures in northern Agnes Water Low Level Zone
7. **2021** – 300 mm diameter capacity upgrade in Captain Cook Drive from Round Hill Road to Thomson Street (Section 1 in Figure 3) required to resolve low pressures in northern Agnes Water Low Level Zone

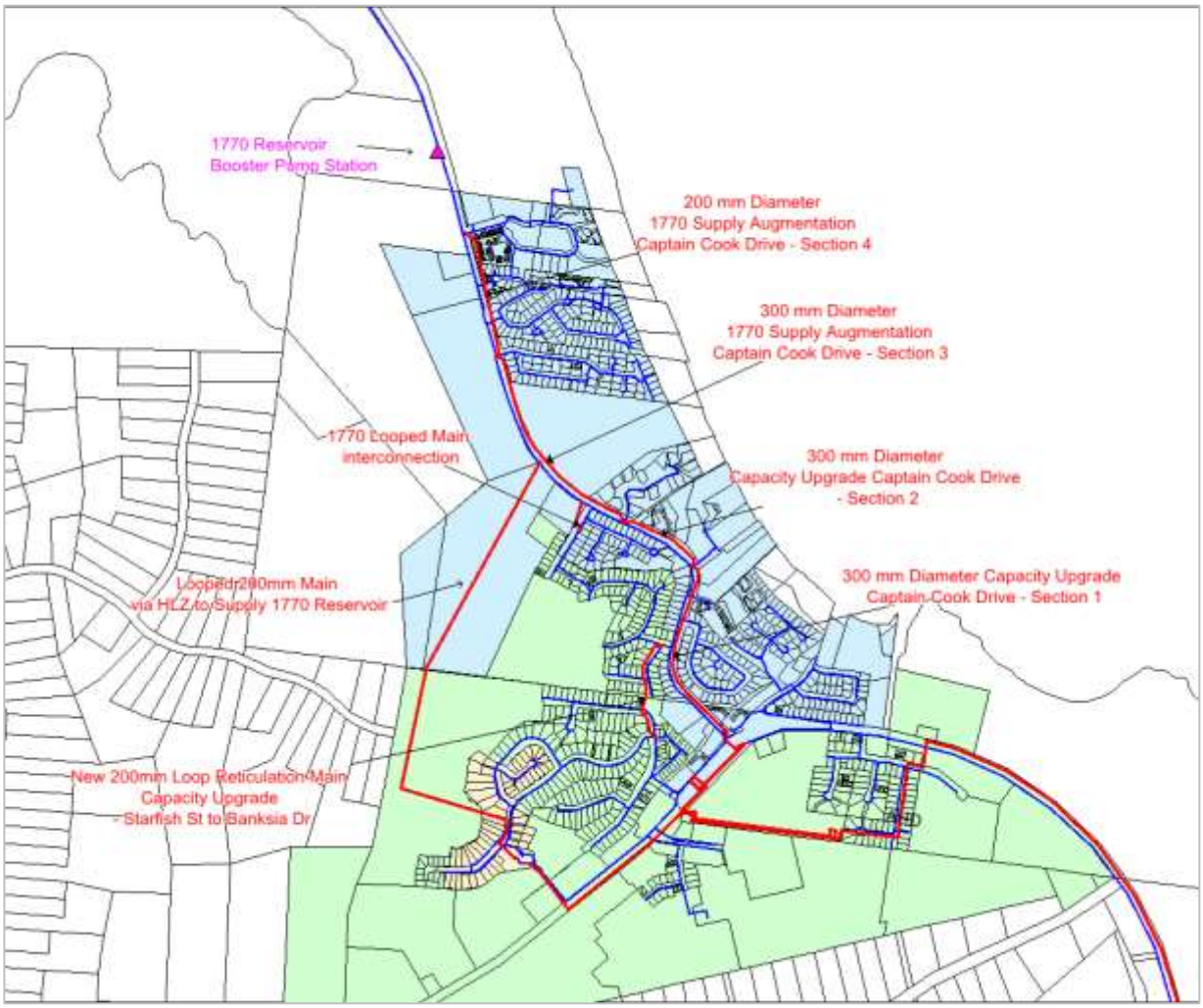


Figure 3: Option 2 Augmentations

<u>Option 3 – Creation of supply to 1770 Reservoir connected to the Agnes Water HLZ Supply with a PRV connection to the LLZ from the HLZ to resolve low pressures in Beaches Village Circuit area</u>

A looped supply to the 1770 reservoir was investigated under the new zoning regime. Figure 4 shows the adopted main routing and the required infrastructure to support supply to 1770 and maintain supply within the Agnes Water high and low level zones. The existing 250 mm main in Captain Cook drive was utilised and augmented to support this option with the addition of a PRV on the existing 150 mm diameter main at the entrance to Beaches Village Circuit. The infrastructure timing and requirements are detailed below and have been split into augmentations required to service 1770 and other capacity upgrade requirements.

1770 Supply Augmentations

Augmentations required to create a looped supply to the 1770 reservoir

1770 Supply Augmentations

Augmentations required to create a looped supply to the 1770 reservoir

- **2016** – Construction of a new 375 mm diameter supply main directly from the high level supply connecting into the existing 250 mm main in Captain Cook Drive (See Figure 4).
- **2016** – 300 mm diameter capacity upgrade in Captain Cook Drive from Lady Musgrave Court to Waterfront Drive (Section 3 in Figure 4) required to maintain supply to northern Agnes Water Low Level Zone due to dedication of existing 250 mm main to 1770 Reservoir supply.
- **2016** – 200 mm diameter capacity upgrade in Captain Cook Drive from Lady Waterfront Drive to Beaches Village Circuit (Section 4 in Figure 4) required for dedicated 1770 Reservoir supply.
- **2016** – 200 mm diameter loop main to connect the existing 150 mm diameter main in Discovery Drive to the existing 250 mm in Captain Cook Drive (see Figure 4).
- **2016** – PRV set at 40 m to allow maximum hour supply to Beaches Village Circuit area to be supported by the 1770 Reservoir supply.
- **2021** – Additional boosting is required (5 kW pump) at maximum day demands to augment supply to the 1770 Reservoir. The booster station has been located to the north of Beaches Village Circuit at the start of the existing 150 mm diameter 1770 supply main.

Maximum Hour and Fire Flow Pressure Capacity Upgrades

8. **2016** – 200 mm diameter capacity upgrade from Starfish Street to Banksia Drive required due to rezoning of Joseph Banks Boulevard area to the Low Level Zone

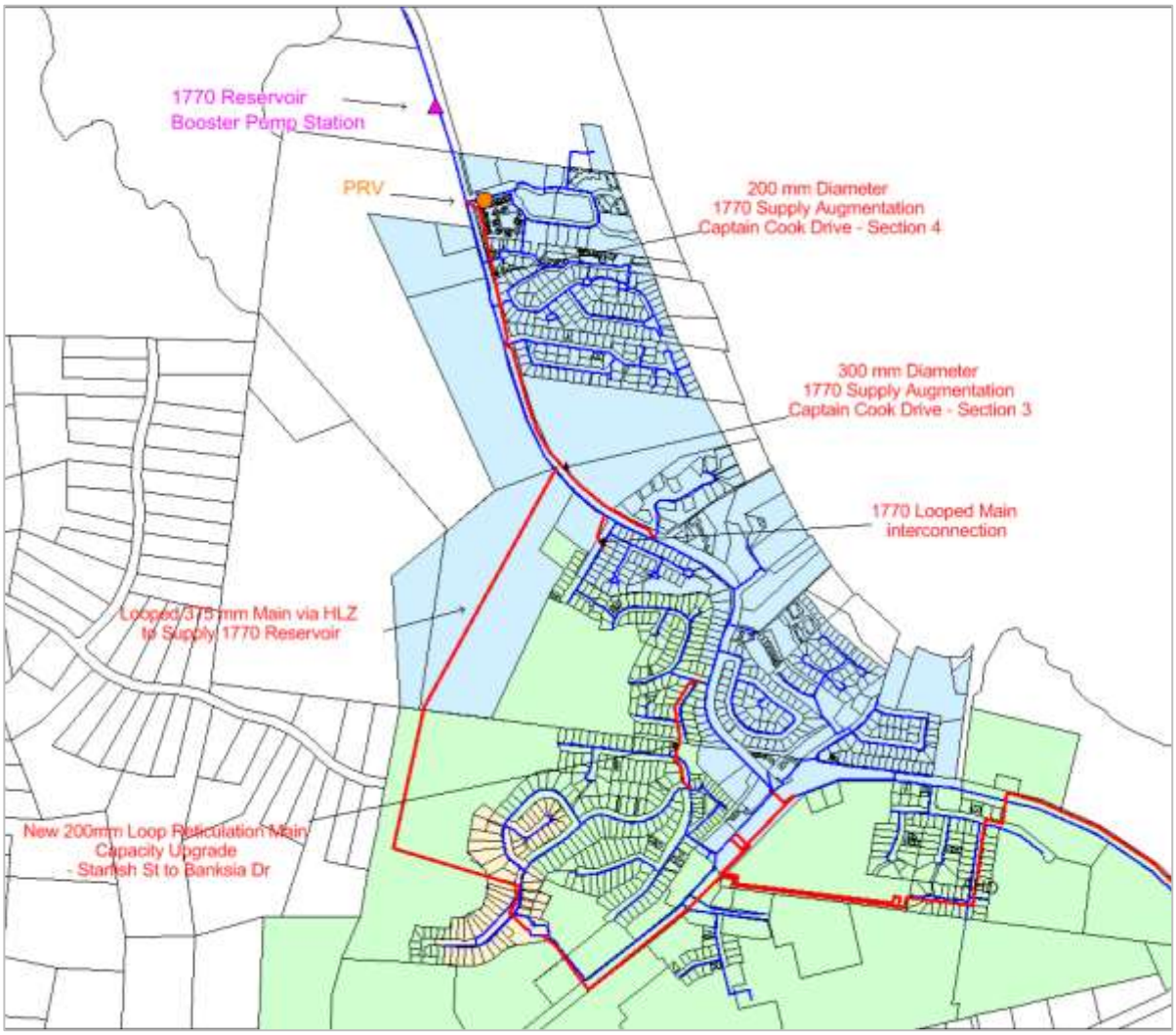


Figure 4: Option 3 Augmentations

Assessment Results and Costs

Assessment of the performance of the 3 options and the resultant infrastructure timing and costs are discussed below:

1. Under all 3 scenarios there is a requirement for additional pumping to enable supply to the 1770 reservoir by 2021 as reservoir levels cannot be maintained at healthy levels over 3 consecutive days of maximum day demand in the 1770 reservoir without pumping. Figure 5 below shows the three Max Day profile for 2021 without pumping for the 1770 Reservoir (Figure 5 shows results for Option 1 however, the profile is very similar for Options 2 and 3). This illustrates that by 2021 reservoir levels could be falling to <20% without pumping under peak demands.

   The available head at model node 182 (at the start of the existing 150 mm diameter 1770 supply main north of Beaches Village Circuit) is not sufficient to drive adequate flow to the 1770 reservoir

without pump beyond 2021. This includes the additional augmentations proposed between 2016 and 2021 for all options.

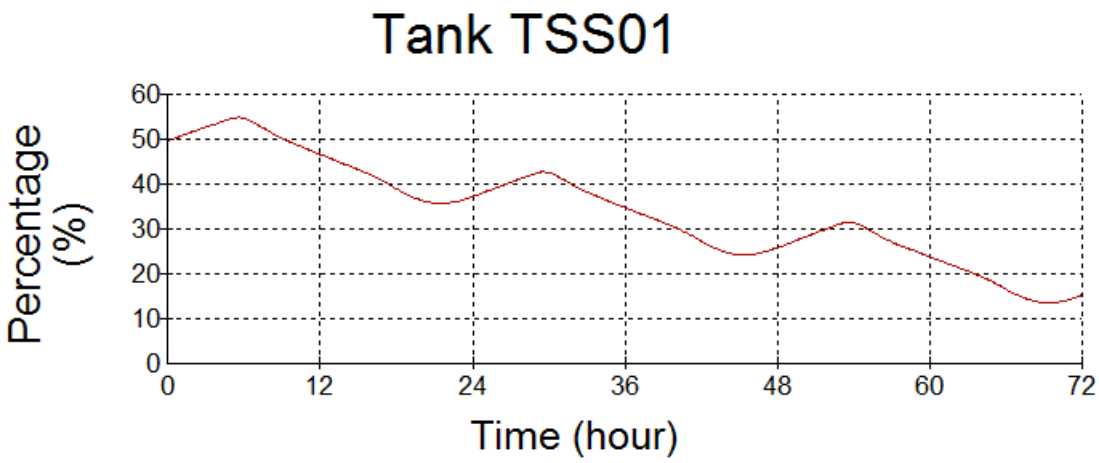


Figure 4: 2021 PercentageFull Profile for 1770 Reservoir (Option 1)

The HGL values for 2016 for each option at model node 182 (at the start of the existing 150 mm diameter 1770 supply main north of Beaches Village Circuit) are shown below in Table 2 without the addition of pumping. The 1770 has an elevation of 79.2 m illustrating that there is limited available driving HGL to provide MDMM demands.

The available head at model node 182 is not sufficient to drive adequate flow to the 1770 reservoir without pumping at or beyond 2021.

Table 2: 2021 HGL at North of LLZ without pumping

Option	2016 Minimum HGL (m) At Node 182
Option 1	83.2
Option 2	82.7
Option 3	85.0

2. Table 3 to Table 5 below summarise the infrastructure timing, costs and net present value (NPV) at 5% for each option.
    - The dedicated main option (Option 1) has a slightly lower NPV costs than the Option 2 looped main. This is because there is a requirement to augment the existing 250 mm main in Captain Cook Drive north of Lady Musgrave Drive in Option 2 and this is roughly equivalent to additional length of main required to by-pass the northern section of the LLZ with a dedicated main in Option 1. A dedicated main also allows delay of some capacity upgrades.

- Option 3 returned the highest costs. The installation of a PRV to support maximum day pressures in the Beaches Village Circuit removes the need for augmentation off the existing 250 mm diameter main in Captain Cook Drive between Round Hill Road and Lady Musgrave Court. However, these savings are offset by the requirement to upsize the proposed main from the HLZ reservoir to Captain Cook Drive to 375 mm to support the peak hour flows in the north of the Low Level Zone.

Table 3: Option 1 Infrastructure Costs and Net Present Value

ID	Diameter (mm)	Length (m)	Planning Horizon	Cost Estimate (%)	NPV @ 5%
Mains					
Captain Cook Drive – Section 3	300	766	2036	$510,000	$166,041
Captain Cook Drive – Section 2	300	316	2036	$210,000	$68,370
Captain Cook Drive – Section 1	300	685	2021	$460,000	$311,346
Dedicated 1770 Main	200	2,724	2016	$1,350,000	$1,166,181
Sunlover Ave Capacity Upgrade	150	512	2026	$180,000	$95,458
Banksia Dr Capacity Upgrade	200	368	2016	$190,000	$164,129
Pump					
1770 Booster			2021	$148,740	$100,673
Total					**$2,072,198**

Table 4: Option 2 Infrastructure Costs and Net Present Value

ID	Diameter (mm)	Length (m)	Planning Horizon	Cost Estimate (%)	NPV @ 5%
Mains					
Captain Cook Drive – Section 4	200	437	2016	$220,000	$190,044
Captain Cook Drive – Section 3	300	766	2016	$510,000	$440,557
Captain Cook Drive – Section 2	300	316	2016	$210,000	$181,406
Captain Cook Drive – Section 1	300	685	2021	$460,000	$311,346
1770 Looped Main via HLZ	200	1,793	2016	$890,000	$768,815
Loop Main Interconnection	150	89	2016	$40,000	$34,554
Banksia Dr Capacity Upgrade	200	368	2016	$190,000	$164,129
Pump					
1770 Booster			2021	$148,740	$100,673
Total					**$2,191,525**

Table 5: Option 3 Infrastructure Costs and Net Present Value

ID	Diameter (mm)	Length (m)	Planning Horizon	Cost Estimate	NPV @ 5%

				(%)	
Mains					
Captain Cook Drive – Section 4	200	437	2016	$220,000	$190,044
Captain Cook Drive – Section 3	300	766	2016	$510,000	$440,557
1770 Looped Main via HLZ	375	1,793	2016	$1,480,000	$1,278,480
Loop Main Interconnection	150	89	2016	$40,000	$34,554
Banksia Dr Capacity Upgrade	200	368	2016	$190,000	$164,129
					Pump
1770 Booster			2021	$148,740	$100,673
Total					**$2,208,437**

Summary

We propose Option 1 involving the dedicated supply main to 1770 as the preferred Option as it provides the lowest whole of life costs (NPV). The solution also provides three clean and separate zones allowing the cleanest flow metering and management of the three options. Additionally it likely provides the simplest solution in terms of implementation with more construction in greenfield areas compared to construction in Captain Cook Drive.

Yours sincerely

Philip Hall

MWH Australia Pty Ltd

Appendix A – GRC Correspondence

From: Ashleigh Tomkins [mailto:AshleighT@gladstonerc.qld.gov.au]
Sent: Tuesday, 8 July 2014 6:53 PM
To: Phillip Hall
Cc: Phil Boshoff; Emma Hamilton; Ian Munro; Ben Heinrich
Subject: Agnes Water water network

Phil,

Phil B would like you to look into some things as part of the Agnes Water water strategic plan.

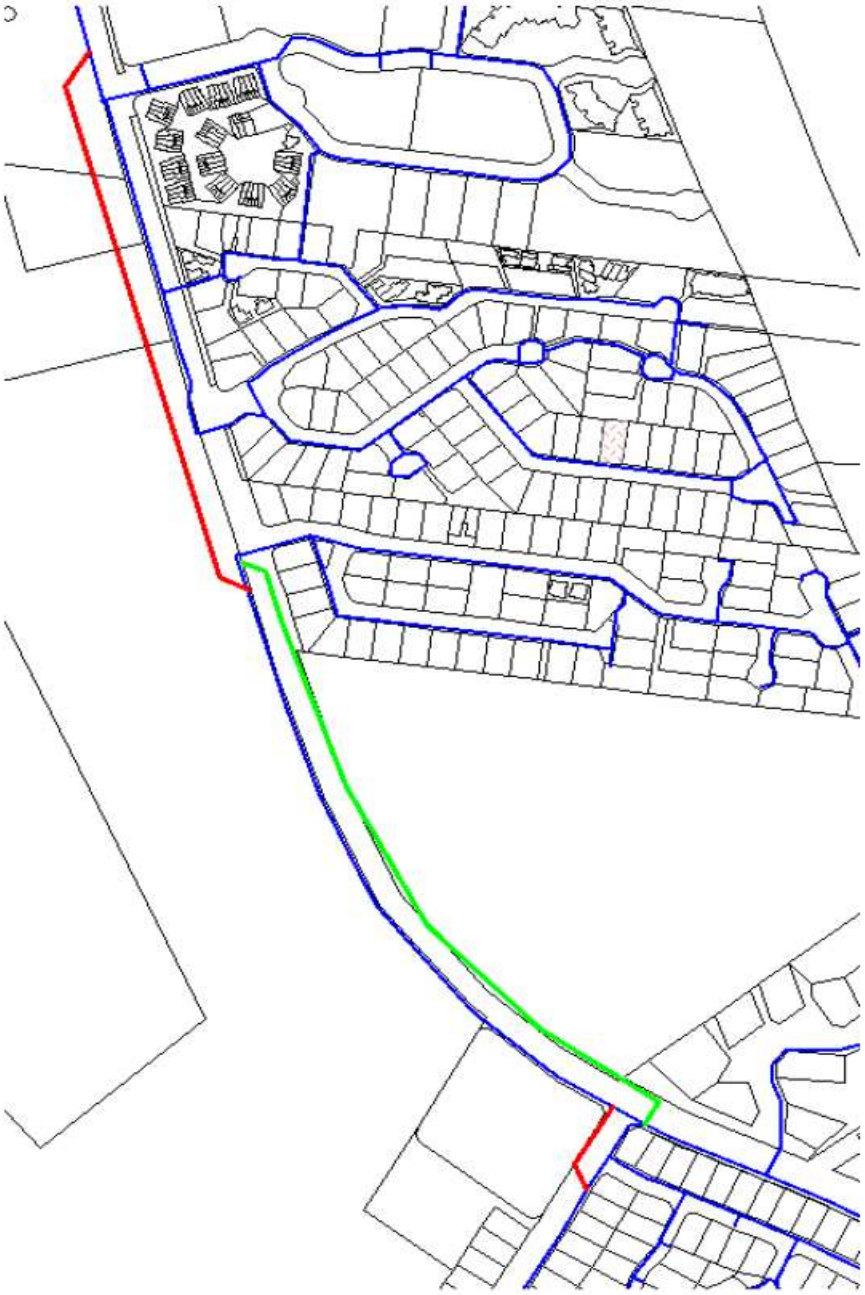
First off he's looking at implementing the high/low separation in a reduced form in the next year or so. He's proposing a PRV be provided in the location shown with the red dot on the attached map. The other zoning separations will be as per your ultimately proposed zones.
This will require some works to feed 1770 from the high level zone. He would like to investigate what happens if the section of water main along captain cook drive (shown in red) is delivered as a first stage. Can you please identify what the available flow rate is (without compromising ff or operational pressures or velocities (2.5m/s), happy to accept high headloss):

- With the 200 upgrade shown in pink (in line with your modelling)
- With the link shown in yellow (can we look at this one instead as well as in conjunction with the upgrade in banksia drive (pink), I think this may avoid issues with the 100NB in Solander Close)

Can you provide a head at the end of the network (node 182) for each of these please.

Can you please also identify what upgrades to the existing network are triggered by the low level rezoning?

Are there any efficiencies to be gained by using the existing 250NB (from discovery drive to the northern end of Agnes) as the new feed to 1770 (in the high zone) and providing a new low zone main through to Beaches Village Circuit (incorporating the 2040 identified upgrade) (first image below). Or a new feed to the southern end of this area with a new high level main between waterfront drive and beaches village circuit (second image below)?
Possible options (red high level upgrades, green low level upgrades)



Phil would also like to look into if there is any efficiencies to be gained from looping the 1770 feed (green) to the general network instead of having it as a dedicated feed.

There are also concerns over high pressures in the area circled in blue. I believe this may be somewhat solved by provision of the dedicated feed. Can you please provide the maximum model pressures in this area with and without the dedicated feed. If the maximum pressure with the dedicated feed is >85m we may need to look into other pressure reduction steps.

While he was looking at this Phil has identified that the fire fighting augmentation identified at the end of Shady Lane (in the pumped area) isn't practical onsite. Can we just remove this, if we're concerned in the future we can look at upping the head of the fire fighting booster pumps or upgrade the 100NB down shady lane.

I'm on leave for 3 weeks from Thursday so if you have any questions please get in contact with Emma and if its something modelling related she'll get me to give you a call.

Thanks,

Ashleigh Tomkins
Engineer - Development
GLADSTONE REGIONAL COUNCIL
PO Box 29 Gladstone Qld 4680
Phone 07 4975 8170 I Fax 07 4975 8760
Email: ashleight@gladstonerc.qld.gov.au I Website: www.gladstone.qld.gov.au

MWH

BUILDING A BETTER WORLD

24 July 2014

Gladstone Regional Council
Via Email

Attention: Emma Hamilton

Dear Emma

Agnes Water / 1770 Water Supply Network Strategy Assessment

This letter report has been prepared in response to the email received from Ashleigh Tomkins titled Agnes Water water network (8 July 2014). The received email contained a number of requests for further assessment of the Agnes Water network. Results from the assessment are provided within this report along with a recommended strategy. We request feedback from Gladstone Regional Council stakeholders to confirm the proposed strategy. The confirmed approach with then be adopted within the Agnes Water Strategic Water Supply Infrastructure Plan being developed concurrently.

The above mentioned email is included as an attachment to this letter.

Background

In March 2014 MWH were engaged by GRC to undertake water supply and sewerage strategic infrastructure planning studies for the Gladstone City and Agnes Water networks. A servicing plan for Agnes Water, pre-developed by GRC, was provided to MWH at project start-up with instruction to adopt for the purposes of defining draft PIP inputs within available time frames. Draft PIP inputs have been delivered with the adoption of this provided servicing plan. The feedback provided in the above mentioned email provides requests for investigation of servicing alternative that may provide both cost and operational benefits.

Scope

The scope of this assessment of the Agnes Water water supply network is as broken into the following tasks:

1. Assess the implementation of an Agnes Water low level zone in the short term through a PRV installation. Identify augmentation requirements (new and/or bring forward) to meet standards of service.
2. Assess supply to 1770 upon implementation of a low level zone. Identify the preferred augmentation requirements for both maintaining standards of service within the high level zone providing supply to 1770 via the high level zone.
3. Review requirements and configuration of the previously proposed dedicated supply to 1770, investigating benefits of different connection points and the creation of looped supply through the high level zone.
4. Review maximum pressure performance in the vicinity of Tate Street and Donohue Drive.

MWH Australia Pty Ltd
Level 3 35 Boundary Street
PO Box 3602
South Brisbane, QLD 4101

TEL +61 7 3029 5000
FAX +61 7 3029 5050
www.mwhglobal.com
ABN: 17 007 820 322

Performance Assessment and Results

Scope Item 1 – Low Level Zone Assessment

Low lying properties in the east of Agnes Water area currently experiencing high maximum pressures. Under the submitted planning these will not be addressed until the time of the new reservoir construction in 2036. GRC have requested the installation of a PRV to reduce pressure to these areas be investigated along with an understanding of the network augmentations required as a result of the pressure reduced supply.

- The Agnes Water water model loaded with 2016 demand was used for assessment of existing performance given low level implementation is anticipated in 2015.
- The proposed low level zone boundary identified in original planning was adopted (see Figure 1).
- A PRV is proposed at the inlet to the low level zone on the 150 mm diameter main in Captain Cook Drive immediately north of the intersection with Round Hill Road
- The PRV was initially set to delivery 57 m HGL to match a standard operating level in the future low level reservoir which will ultimately supply this zone.

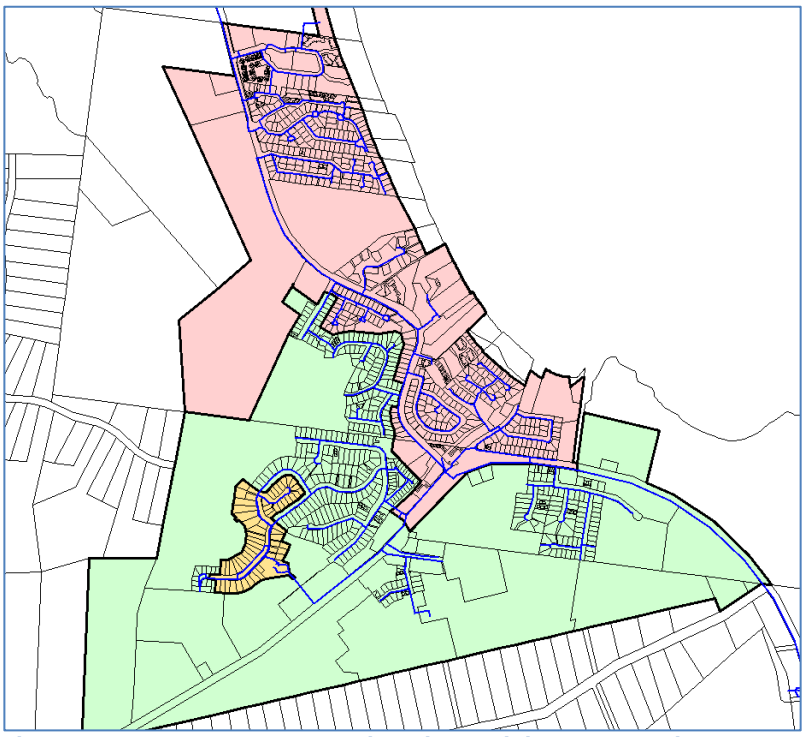


Figure 1: Agnes Water Proposed Zoning – Pink = Low Level Zone, Green = High Level Zone

Maximum Hour and Fire Flow Pressure Assessment

- 2016 – with the installed PRV limiting HGL to 57 m pressure failure in the Beaches Village Circuit area is experience without network augmentation. Raising the PRV setting to 62 m HGL was identified to resolve these maximum hour pressure failures. However under fire flow conditions widespread fire flow deficiencies were identified in the north of the Agnes Water network. Fire flow failures are a result of high head loss through the 150 mm diameter main in Captain Cook Drive. To resolve these fire flow failures, augmentation of the 150 mm diameter main in Captain Cook

Drive with a 300 mm diameter main (Ultimate sizing) from the proposed PRV inlet to Thomson Street is proposed.

- 2021 – Requires the extension of the 300 mm diameter augmentation north along Captain Cook Drive to the start of the 250 mm diameter main in Captain Cook Drive.
- Ultimate – The new reservoir is required by 2036. At this time the PRV can be bypassed by a new main connecting from the reservoir outlet, and running along Round Hill Road and into Captain Cook Drive. A number of other augmentations (both maximum hour and FF) are required to this zone at Ultimate but their timing is not impacted as a result of bring forward of the low level zone establishment.

Assessment identified that the 250 mm diameter main that currently supplies the Beaches Village Circuit area between the end of the existing 150 mm diameter main in Captain Cook Drive and Waterfront Drive requires upgrade at Ultimate to resolve both maximum hour and fire flow augmentation. A parallel 200 mm diameter main is sufficient. However, as a high level main will also be required along this Captain Cook alignment to supply 1770, to prevent the need for 3 water mains, it is proposed that the existing 250 mm diameter main be used as the high level supply to 1770 up to Waterfront Drive and a 300 mm diameter main be constructed for supply to the north of the low level zone. The Existing 250 mm diameter main north of Waterfront drive is of sufficient diameter for supply to the low level properties and does not require augmentation. The proposed size for a dedicated HLZ main from Waterfront Drive to the Agnes Water network is 200 mm. These works will be required at the time of establishing the Low Level zone.

Other mains configurations were trialled for supply to 1770 from the high level zone and the Beaches Village Circuit area from the Low Level Zone. The above arrangement was identified as the most efficient arrangement in terms of total capital infrastructure. Table 1 provides a summary of the options assessed and their infrastructure requirements. The options provided within Table 1 are as follows:

- Option 1 (recommended) :
    - Section 1 – Utilise existing 250 mm diameter main for the high level supply to 1770 and construct a new 300 mm diameter main for supply to north of the low level zone
    - Section 2 – Construct a new 200 mm diameter main for supply to 1770 and utilise the existing 250 mm diameter main for supply to north of the low level zone.

- Option 2:
    - Section 1 – Construct a new 200 mm diameter main for the high level supply to 1770 and utilise the existing 250 mm diameter main for supply to the north of the low level zone as well as constructing a new 200 mm diameter low level main at Ultimate
    - Section 2 – Construct a new 200 mm diameter main for supply to 1770 and utilise the existing 250 mm diameter main for supply to north of the low level zone.

- Option 2:
    - Section 1 – Utilise existing 250 mm diameter main for the high level supply to 1770 and construct a new 300 mm diameter main for supply to north of the low level zone
    - Section 2 – Utilise the existing 250 mm diameter main for high level supply to 1770 and construct a new 250 mm diameter main for supply to the north of the low level zone.

Note: Section 1 = Captain Cook Drive from Discovery Drive to Waterfront Drive
Section 2 = Captain Cook Drive from Waterfront Drive to north of Beaches Village Circuit.
Shown in Figure 2.

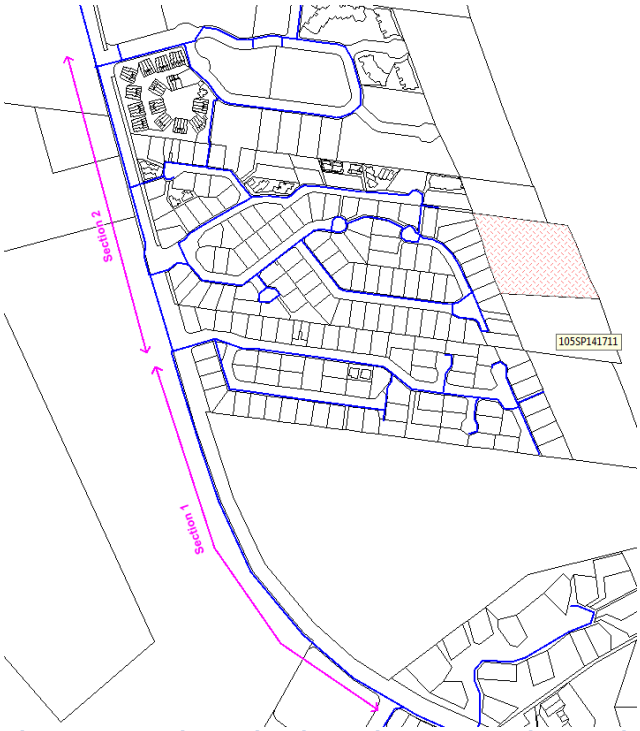


Figure 2: Captain Cook Drive Main Augmentation Sections

Table 1: high level and low level infrastructure requirements in Captain Cook Drive.

Option	Section 1 Diameters (mm) (upto Waterfront Drive)			Section 2 Diameters (mm) (beyond Waterfront Drive)	
	HL main	LL main 1	LL main 2	HL main	LL main 1
Option 1	250 (existing)	300 (new)	N/A	200 (new)	250 (existing)
Option 2	200 (new)	250 (existing)	200 (new)	200 (new)	250 (existing)
Option 3	250 (existing)	300 (new)	N/A	250 (existing)	250 (new)

A 4th option for GRC to consider is similar to option 2 above, however, instead of constructing a 200 mm low level augmentation of the 250 mm diameter main in section 1, GRC could consider a PRV boundary valve between the high level and low level network. The PRV boundary would be installed with the intention of opening and allowing supply from the high level main to the low level network once pressures in the low level network are experienced below 25 m. This would provide a secondary or emergency feed to the low level zone and remove the need for the 200 mm augmentation mentioned above. Although, likely the most cost effective option, this has not been proposed, as we currently don't know the preference of GRC operations staff. The PRV arrangement may create the risk of failing to properly operate when required such as under fire flow demands.

Scope Item 2 – High level zone assessment with supply to 1770

Hydraulic modelling has identified that for supply to 1770 from a new high level zone two internal network augmentations are required along with the dedicated high level 1770 supply in Captain Cook Drive discussed above. At least one of these augmentations is required to provide connectivity of the high level zone to the north. The two internal augmentations are as follows:

- 200 mm diameter augmentation from the 200 mm main in Starfish Street to down Banksia Drive to Redgum Drive.
- 150 mm diameter augmentation from Sunlover Avenue to Discovery Drive.

When assessing performance with Banksia Drive augmentation alone, fire flow failures were identified in Discovery Drive.

When assessing performance with the Sunlover Avenue to Discovery Drive augmentation alone pressure failures were identified at the top of Panorama Close.

Table 2 provides the minimum HGL supplied to the 1770 network under each of the internal augmentation options under 2016 demand. Table 2 also provides a local network performance summary. The required HGL for delivery to 1770 is not confirmed. GRC will have an understanding of this HGL requirement for 1770 and will be able to assess the suitability of available HGL provided within this letter.

Table 2: High level zone performance with supply to 1770

Internal Augmentation Options	HGL at start of 1770 network (m)	Performance Comments
Banksia Drive	62.6	Fire flow failure at Discovery Drive
Sunlover Ave to Discovery Drive	63.4	Pressure failure at Panorama Close
Both (Recommended)	74.6	No network failure.

With modelling undertaken using Ultimate demand projections, and with both internal augmentation options implemented the minimum available HGL to 1770 was identified as **61.8 m**. This HGL is available under the 2016 supply arrangement which does not include a new main to support supply to 1770 directly from the Seaspray Drive reservoirs (without green main as provided in drawing accompanying the email request).

<u>Scope Item 3 – Configuration of previously proposed dedicated 1770 main from Seaspray Drive reservoirs.</u>

In scope item 1 it was identified that to establish a low level zone in the short term a dedicated high level main in Captain Cook Drive from Discovery Drive to the 1770 network is required.

The original proposed arrangement was to have a dedicated 1770 supply main the whole distance from Seaspray Drive to the 1770 network, this would keep supply to 1770 separate from the Agnes Water high level zone.

The section of dedicated main from Seaspray Drive to 1770 may not be required given that assessment in Scope Item 2 identified that at Ultimate 61.8 m HGL can still be delivered to 1770 without the length from Seaspray Drive reservoirs to Captain Cook Drive, provided the augmentations in Banksia Drive and from Sunlover Avenue to Discovery Drive are constructed. Without the dedicated 1770 supply main from Seaspray Drive reservoirs to Captain Cook Drive, 1770 is supplied via the high level zone rather than through a dedicated feed. No obvious negatives were identified in having 1770 supplied via the Agnes Water high level zone opposed to having a 100% dedicated supply to 1770.

As growth occurs through the vacant greenfield areas to the west of the Agnes Water network, having 1770 supplied via the high level zone and not as an isolated (unconnected) supply may have benefits. If a new main from Seaspray Drive reservoirs was to be built and looped back into the high level network at Captain

Cook Drive, this main could be used supply customers through the greenfield areas that this main will run through. However, if this main was to be 100% dedicated to 1770 no connection to the main would be allowable and servicing these future Greenfield areas may require additional infrastructure to connect and may not carry the same level of supply security that a large supply main passing through the site and looping back to the network would provide.

Within our study we will propose to include the 200 mm diameter supply main from the Sea Spray Drive reservoirs and connecting back into the high level network at Captain Cook Drive at the time when development of the Greenfield areas begins to occur. The greenfield development is expected to begin in 2036 according to the demand models developed.

With inclusion of this 200 mm diameter main from Seaspray Drive reservoirs to the high level main in Captain Cook Drive at 2036, the minimum HGL delivered to 1770 was modelled to increase from **61.8 m** HGL at Ultimate to **79.6 m** HGL.

We request GRC feedback on whether we are to include this section on 200 mm diameter main, as there is no standards of service driver for it, unless a HGL in supply to 1770 of **61.8 m** is too low.

Scope Item 4 – High Pressure Review in the Vicinity of Tate Street and Donohue Drive.

Once the dedicated reservoir supply main is constructed as proposed for 2016, maximum residual pressures experienced within this part of the network were identified as <80 m. Previous pressure fluctuations and transients created by the operation of the WTP pump station will be removed, and no rapid changes in pressure are expected. Pressure reduction measures within this area will be problematic as nearby elevations in Webster Court, Bryant Street and Evans Court increase quickly from the low properties in Tate Street and Donohue Drive. Network augmentations have been proposed in Webster Court, Bryant Street and Evans Street to resolve low pressures and the proposed augmentations may be compromised by any pressure reduction measures in the area.

Conclusions

The proposed infrastructure plan and timing assessed within with report are provided within Figure A1.

Other conclusions are as follows:

- Creation of an Agnes Water low level zone to manage high pressures can be implemented in the short term through a PRV on the 150 mm diameter main at the southern end of Captain Cook Drive and augmentation of the 150 mm diameter main in Captain Cook Drive.
- A parallel of the 250 mm diameter main in Captain Cook Drive is required to enable high level zone supply to 1770. Three options for this supply were assessed. The preferred option was identified as Option 1:
    - Section 1 – Utilise existing 250 mm diameter main for the high level supply to 1770 and construct a new 300 mm diameter main for supply to north of the low level zone
    - Section 2 – Construct a new 200 mm diameter main for supply to 1770 and utilise the existing 250 mm diameter main for supply to north of the low level zone.
    - Where:
        - Section 1 = Captain Cook Drive from Discovery Drive to Waterfront Drive
        - Section 2 = Captain Cook Drive from Waterfront Drive to north of Beaches Village Circuit.
- To supply 1770 from the high level zone the following internal network augmentations are required to maintain standards of service within the high level network.

    - 200 mm diameter augmentation from the 200 mm main in Starfish Street to down Banksia Drive to Redgum Drive.
    - 150 mm diameter augmentation from Sunlover Avenue to Discovery Drive.
- On commencement of greenfield development to the west of the Agnes Water network a 200 mm diameter high level zone main is proposed from the Seaspray Drive reservoirs to the high level main in Captain Cook Drive. We request GRC feedback on whether we are to include this section on 200 mm diameter main, as there is no standards of service driver for it, unless a HGL in supply to 1770 of **61.8 m** is too low.
- Pressure management in the vicinity of Tate Street and Donohue Drive is not proposed.

I trust this letter report is to your requirements and we look forward to receiving you feedback and confirmation of preferred options for inclusion in the infrastructure plans.

Please give me a call should you wish to discuss any aspect of this assessment.

Yours sincerely

Phillip Hall
Planning Leader QLD
MWH Australia Pty Ltd

mains_strategy by YR_INST
2,016 (7)
2,021 (1)
2,036 (1)

Closed Valve

dia 200
dia 250
dia 300
dia 200
dia 300
dia 300
dia 200
dia 150
dia 200
Proposed PRV

* Red (2016) mains are required upon implementatino of the low level zone
* Proposed PRV setting of 57 m HGL
* No DSS need for the blue main (2036) from Seapray Drive Reservoirs to Captain Cook Drive was identified. However, it does provide some benefits. Inclusion in the Infrastructure plans is to be confirmed by GRC
* This map is to be viewed and interpreted through reading associated letter report

While he was looking at this Phil has identified that the fire fighting augmentation identified at the end of Shady Lane (in the pumped area) isn't practical onsite. Can we just remove this, if we're concerned in the future we can look at upping the head of the fire fighting booster pumps or upgrade the 100NB down shady lane.

I'm on leave for 3 weeks from Thursday so if you have any questions please get in contact with Emma and if its something modelling related she'll get me to give you a call.

Thanks,

Ashleigh Tomkins
Engineer - Development
GLADSTONE REGIONAL COUNCIL
PO Box 29 Gladstone Qld 4680
Phone 07 4975 8170 I Fax 07 4975 8760
Email: ashleight@gladstonerc.qld.gov.au I Website: www.gladstone.qld.gov.au

Appendix D Proposed Infrastructure Schedules

Table D1: Water Mains Augmentations

ID	Planning Horizon	LGIP/IPP	Water Supply Scheme	Water Supply Zone	Upgrade Type	Diameter (mm)	Length (m)	Address	Commentary	ET Trigger and Commentary	Geology	Landuse (Rural/Urban)	Unit Rate ($/m)	Item Cost Estimate ($)	Contingency	Cost Estimate including contingency (%)
WTM_AW_001	2016	LGIP	Agnes Water	1770/AW	Trunk	200	1,300	Captain Cook Drive from Discovery Drive to north of Beaches Village	1770 Supply Main	Proposed at 2016 when rezoning of Agnes Water is proposed. Limited capacity in the existing network results in low pressure issues in the north of Agnes Water requires a dedicated supply to 1770 at this time. AW Zone ET > 1,250 ET	Clay	Urban	495.06	$ 650,000	$ -	$ 650,000
WTM_AW_002	2016	LGIP	Agnes Water	AW	Trunk	375	2,001	Springs Road	WTP dedicated reservoir supply - WTP to LL Reserovir	Required at 2016 once headlosses within the 150 mm diameter main from the WTP limit the capacity of the WTP pump station and their ability to maintain levels in the Seaspray Drive reservoirs. AW Zone ET > 1,250 ET	Clay	Urban	821.4	$ 1,650,000	$ -	$ 1,650,000
WTM_AW_003	2016	LGIP	Agnes Water	AW	Trunk	375	1,333	Evans Court to Seaspray Drive via Round Hill Road	WTP dedicated reservoir supply - LL to HL Reservoir	Required at 2016 once headlosses within the 150 mm diameter main from the WTP limit the capacity of the WTP pump station and their ability to maintain levels in the Seaspray Drive reservoirs. AW Zone ET > 1,250 ET	Clay	Urban	821.4	$ 1,100,000	$ -	$ 1,100,000
WTM_AW_004	2021	LGIP	Agnes Water	AW	Trunk	300	685	Captain Cook Drive	Required to resolve low pressures in northern Agnes Water	Proposed at 2021 to resolve pressure failures within the north of the Agnes Water network. AW Zone ET > 1,450 ET	Clay	Urban	658.23	$ 460,000	$ -	$ 460,000
WTM_AW_005	2036	LGIP	Agnes Water	AW	Trunk	250	756	Captain Cook Drive	Required to resolve low pressures in northern Agnes Water	Proposed at 2036 to resolve pressure failures within the north of the Agnes Water network. AW Zone ET > 2,350 ET	Clay	Urban	570.54	$ 440,000	$ -	$ 440,000
WTM_AW_006	2036	LGIP	Agnes Water	AW	Trunk	300	316	Captain Cook Drive	Required to resolve low pressures in northern Agnes Water	Proposed at 2036 to resolve pressure failures within the north of the Agnes Water network. AW Zone ET > 2,350 ET	Clay	Urban	658.23	$ 210,000	$ -	$ 210,000
WTM_AW_007	2033	LGIP	Agnes Water	AW	Trunk	200	235	Road Hill Road	Interconnection of high level mains	Required by 2033 concurrent with the future Low Level Reservoir. The trigger is when existing storage becomes insufficient to supply the entire zone. AW Zone ET > 2,150 ET	Clay	Urban	495.06	$ 120,000	$ -	$ 120,000
WTM_AW_008	2033	LGIP	Agnes Water	AW	Trunk	300	27	Back of Evans Court	Future low Level resevoir inlet	Required by 2033 concurrent with the future Low Level Reservoir. The trigger is when existing storage becomes insufficient to supply the entire zone. AW Zone ET > 2,150 ET	Clay	Urban	658.23	$ 20,000	$ -	$ 20,000
WTM_AW_009	2033	LGIP	Agnes Water	AW	Trunk	375	735	Low level reservoir site to Round Hill Road	Low Level reservoir outlet	Required by 2033 concurrent with the future Low Level Reservoir. The trigger is when existing storage becomes insufficient to supply the entire zone. AW Zone ET > 2,150 ET	Clay	Urban	821.4	$ 610,000	$ -	$ 610,000
WRM_AW_010	2014	LGIP	Agnes Water	AW	Reticulation	200	368	Banksia Drive	Capacity upgrade from Starfish Street to Banksia Drive	Capacity upgrade required at 2014. AW Zone ET > 1,086 ET	Clay	Urban	495.06	$ 190,000	$ -	$ 190,000
WRM_AW_011	2014	IPP	Agnes Water	AW	Reticulation	100	24	Intersetion of Seaspray Drive and The Crescent	Inteconnection for Boosted Zone Extension	Required for the rezone of properties to the seaspray drive boosted zone at 2014 to resolve current low pressures. AW Zone ET > 1,086 ET	Clay	Urban	246.42	$ 10,000	$ -	$ 10,000
WRM_AW_012	2014	IPP	Agnes Water	AW	Reticulation	100	223	Seaspray Drive	For boosted zone extension	Required for the rezone of properties to the seaspray drive boosted zone at 2014 to resolve current low pressures. AW Zone ET > 1,086 ET	Clay	Urban	246.42	$ 60,000	$ -	$ 60,000
WRM_AW_013	2014	IPP	Agnes Water	AW	Reticulation	150	156	Donohue Drive and Webster Court	For resolving low pressures in Evans Court	Capacity upgrade required at 2014. AW Zone ET > 1,086 ET	Clay	Urban	341.88	$ 60,000	$ -	$ 60,000
WRM_AW_014	2014	IPP	Agnes Water	AW	Reticulation	150	235	Donohue Drive and Webster Court	For resolving low pressures in Evans Court	Capacity upgrade required at 2014. AW Zone ET > 1,086 ET	Clay	Urban	341.88	$ 90,000	$ -	$ 90,000
WRM_AW_015	2016	IPP	Agnes Water	AW	Reticulation	150	127	Webster Court to Evans Court	For resolving low pressures in Evans Court	Capacity upgrade required at 2016. AW Zone ET > 1,250 ET	Clay	Urban	341.88	$ 50,000	$ -	$ 50,000
WRM_AW_016	2016	LGIP	Agnes Water	AW	Reticulation	200	3	Starfish Street	Interconnection of resevoir outlet to extension of Startfish	Proposed at 2016. AW Zone ET > 1,250 ET	Clay	Urban	495.06	$ 10,000	$ -	$ 10,000
WRM_AW_017	2016	LGIP	Agnes Water	AW	Reticulation	150	176	Connection from reservoir outlet to Starfish Street	For network connectivity and supply to future development	Proposed at 2016. AW Zone ET > 1,250 ET	Clay	Urban	341.88	$ 70,000	$ -	$ 70,000
WRM_AW_018	2040	IPP	Agnes Water	AW	Trunk	200	512	Connection Sunlover Avenue to Discovery Drive	Capacity upgrade from Sunlover Avenue to Discovery Drive to support supply through the high level zone to 1770	Proposed at Ultimate	Clay	Urban	495.06	$ 260,000	$ -	$ 260,000
WRM_AW_019	2036	IPP	Agnes Water	AW	Reticulation	150	50	Joseph Banks Boulevard	Connection between Joseph Banks Blvd and Captain Cook Drive	Interconnection for connection of properties with Joseph Banks Boulevard to the proposed low level zone for resolving high pressures. At the time of low level zone establishment (2036)	Clay	Urban	341.88	$ 20,000	$ -	$ 20,000
WRM_AW_026	2016	LGIP	Agnes Water	AW	Trunk	200	240	Woodrow Drive and Solander Close	Capacity upgrade of the 100 mm diameter main to support initial supply through the HLZ to 1770	Proposed at 2016 when rezoning of Agnes Water is proposed. Limited capacity in the existing network results in low pressure issues in the north of Agnes Water requires supply to 1770 from the HLZ at this time. AW Zone ET > 1,250 ET	Clay	Urban	495.06	$ 120,000	$ -	$ 120,000
WRM_AW_027	2040	IPP	Agnes Water	AW	Trunk	200	220	Discovery Drive	Capacity upgrade of the 150 mm diameter main to support Ultimate supply through to 1770	Proposed at Ultimate	Clay	Urban	495.06	$ 110,000	$ -	$ 110,000

Table D2: Fire Flow Augmentations

ID	Planning Horizon	LGIP/IPP	Water Supply Scheme	Water Supply Zone	Upgrade Type	Diameter (mm)	Length (m)	Address	Commentary	ET Trigger and Commentary	Geology	Landuse (Rural/Urban)	Unit Rate ($/m)	Item Cost Estimate ($)	Contingency	Cost Estimate including contingency (%)
WRM_AW_FF_021	2014	IPP	Agnes Water	AW	FF	100	34	Tavern Road	FF interconnection for Tavern Road	Fire flow upgrade 2014	Clay	Urban	246.42	$ 10,000	$ -	$ 10,000
WRM_AW_FF_022	2014	IPP	Agnes Water	AW	FF	150	342	Donohue Drive	FF Upgrade for School in Donohue Drive	Fire flow upgrade 2014	Clay	Urban	341.88	$ 120,000	$ -	$ 120,000
WRM_AW_FF_023	2021	IPP	Agnes Water	AW	FF	100	91	Panarama Close	FF Upgrade for Panarama Close	Fire flow upgrade 2021	Clay	Urban	246.42	$ 30,000	$ -	$ 30,000
WRM_AW_FF_024	2036	IPP	Agnes Water	AW	FF	150	150	Beach Houses Estate Road	FF Upgrade for failure in Beach Houses Estate Road	Fire flow upgrade 2036	Clay	Urban	341.88	$ 60,000	$ -	$ 60,000
WRM_AW_FF_025	2040	IPP	Agnes Water	AW	FF	150	208	Atlantis Boulevard to The Promenade	FF Upgrade for failures in The Promenade	Fire flow upgrade 2040	Clay	Urban	341.88	$ 80,000	$ -	$ 80,000

Table D3: Reservoir Augmentation Table

ID	Planning Horizon	Water Supply Scheme	Water Supply Zone	Upgrade Type	Owner	Volume (ML)	TWL (m)	Address	Commentary	ET Trigger and Commentary	Hard Rock Uplift	Item Cost Estimate ($)	Contingency ($)	Cost Estimate including contingency (%)
WRS_AW_700	2036	Agnes Water	AW	Trunk	GRC	5.6	61	Future Evans Court reservoir site	Agnes Water Low Level reservoir	Required at 2036 when the capacity of the existing Agnes Water storage is exceeded by the demand of the zone. AW Zone ET > 2,150 ET	1	$ 1,870,000	$ -	$ 1,870,000

Table D4: Pump Station Augmentation Table

ID	Planning Horizon	Water Supply Scheme	Water Supply Zone	Upgrade Type	Owner	Duty Flow (L/s)	Duty Head (m)	Power (kW)	Address	Commentary	ET Trigger and Commentary	Item Cost Estimate ($)	Contingency ($)	Cost Estimate including contingency (%)
WPS_AW_600	2040	Agnes Water	AW	Trunk	GRC	120	130	218.5	Agnes Water WTP, Springs Road	Pump station upgrade	Pump station upgrade required at Ultimate when capacity of the existing pump station is exceeded. AW Zone ET > 3,100 ET	$ 1,090,000	$ -	$ 1,090,000
WPS_AW_601	2026	Agnes Water	1770	Trunk	GRC	15	20	4.2	North of Beaches Village Circuit	Maximum Day Booster Pump for supply to 1770 if required under maximum day and fire flow demands.	Booster Pump Station required at 2026 when headloss in existing 1770 supply main inhibits maintainance of levels in the 1770 reservoir under maximum day demands without pumping to a reasonable level of risk.	$ 150,000	$ -	$ 150,000