Maryborough Water Supply Strategy 2010

WIDE BAY WATER CORPORATION

29-31 Ellengowan St Hervey Bay QLD 4655
PO Box 5499 Hervey Bay QLD 4655
Phone 1300 808 888 | Fax (07) 4125 5118

www.widebaywater.qld.gov.au

TABLE OF CONTENTS

1.0 INTRODUCTION

This Water Supply Strategy's main objective is to evaluate the existing water supply's capacity to meet projected population and water consumption forecasts and to identify infrastructure requirements to satisfactorily manage these demands to the year 2031.

The primary objectives of this Report are to:

- Assess the existing water supply demand based on recent flow data under the current demand management regimes;
- Assess the projected demand to 2031 based on population projections that are consistent with Office of Economic and Statistical Research (OESR) projections;
- Identify the capacity of the existing raw water sources and determine the most appropriate method of augmentation to meet community and demand growth if required;
- Consider the impacts of climate change on potential raw water supplies;
- Identify the future water treatment requirements for the Maryborough area and determine the most appropriate method of supply for treated water to the community;
- Evaluate the impacts that the revised population projections and development sequencing will have on the major water supply infrastructure components (e.g. treatment plants, pump stations, reservoirs, trunk mains);
- Allocate the revised water supply demands to an hydraulic model, identify where the system 'fails' and determine the most efficient options for augmentation;
- Identify the additional water supply infrastructure options and appropriate construction timing required to deliver the desired Standards of Service (SOS) to Wide Bay Water Corporation customers;
- Establish a preferred strategy from the options proposed for water supply infrastructure planning up to 2031;
- Identify any areas that require further investigation.

1.1 Study Area

The study area incorporates all reticulated water supply networks located within the former Maryborough City Council and Tiaro Shire Council local government areas, as controlled by Wide Bay Water Corporation. The study area consists of Maryborough City and its environs and the town of Tiaro.

2.0 OBJECTIVES

2.1 Objectives of the Study

The aim of the investigation was to review existing and projected population projections and water consumption within the study area. This will enable the development of a strategic infrastructure plan and associated capital works program with a 20 year planning horizon to the year 2031.

Underpinning the work required to achieve these aims, a population model and a detailed water network model have been prepared. These models will allow Wide Bay Water Corporation to periodically undertake system analyses on the water supply system to verify and amend the 20 year works program as necessary.

The principal objectives of the study were to:

- **build** a population model, which is capable of determining existing equivalent dwelling (ED) population and predicting future populations for nominated development or planning horizons;

- **review** the performance of the existing water supply scheme and identify areas which do not provide the adopted Standards of Service to consumers;

- **develop** water network models for the existing water supply system and for each of the five (5) year planning steps to the year 2031 system;

- **produce** a 20 year capital works program based on the results of the hydraulic modelling and determine the capital requirements associated with the various augmentation options developed;

2.2 Standards of Service

A Statement of Corporate Intent has been adopted between Fraser Coast Regional Council and Wide Bay Water Corporation to identify the commercial relationship between the two entities and to ensure an acceptable standard of service is provided to all customers. This document sets the quantity, quality and reliability requirements of the scheme. The main requirements that affect the preparation of this report are as follows:

- the number of permissible hours of water discontinuity – maximum 5 hours;
- 99% of all premises will have water pressure of 20 metres or greater for 90% of the year;
- all premises will have a flow available of 20 L/min or greater for 90% of the year; and
- the quality of water at the point of delivery is to meet NHMRC guidelines for 95% of the time.
- Wide Bay Water also aims to satisfy the following standards of service contained within the QWRC Guidelines, commonly known as the "DNR Guidelines":
    - maximum residual pressure should not exceed 80 metres;
    - the reticulation network shall be capable of providing a fire flow in residential areas during the peak demand period of 15 L/s while maintaining a minimum residual pressure of 12 metres; and
    - the reticulation network shall be capable of providing a fire flow in commercial areas during the peak demand period of 30 L/s while maintaining a minimum residual pressure of 12 metres.

3.0 EXISTING SYSTEM

3.1 System Overview

The City's existing raw water supply is sourced from Tinana Creek, a tributary of the Mary River, where two storages have been constructed; Teddington and Tallegalla Weirs.

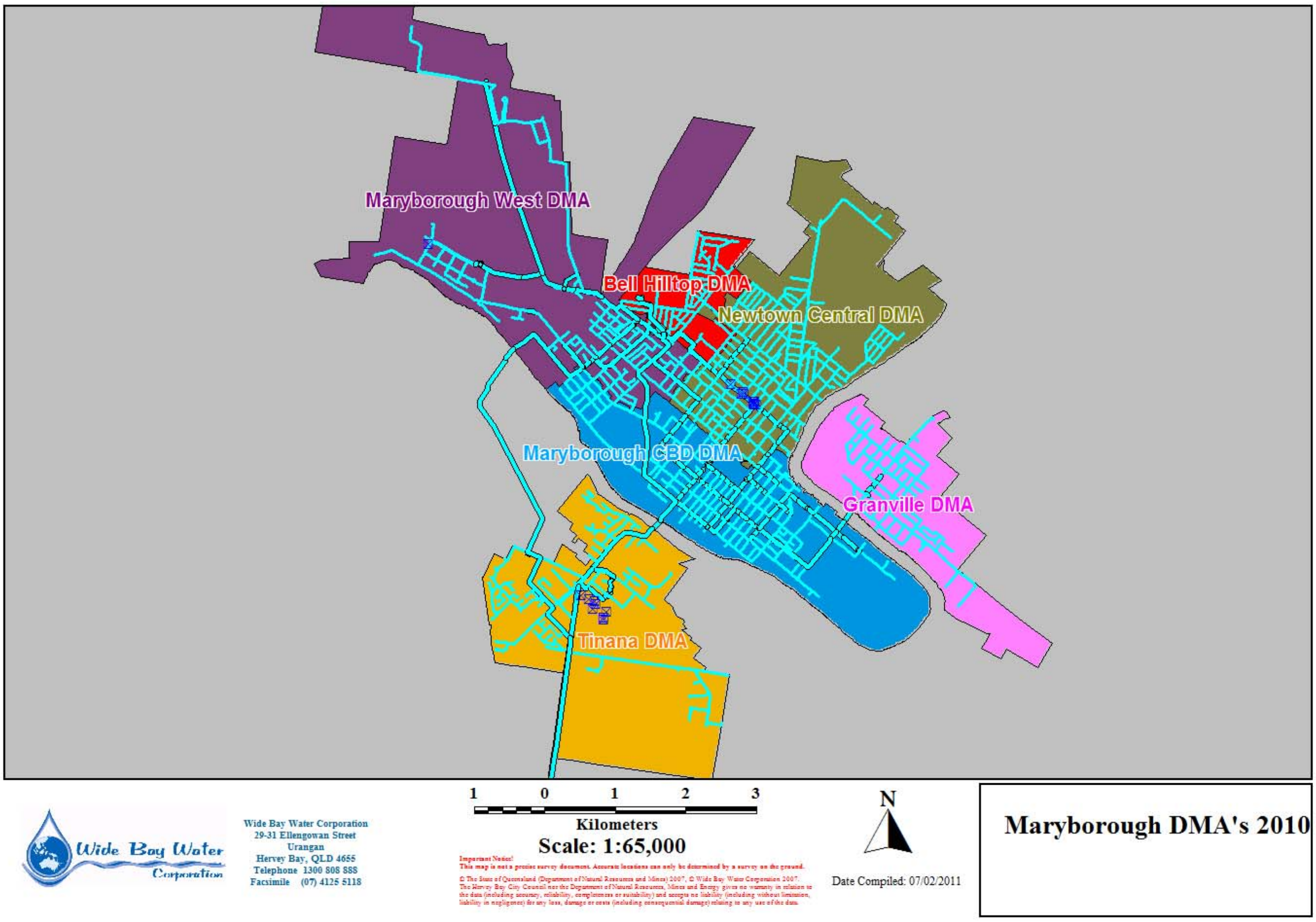
Teddington Weir is located approximately 16 km south of the city and has a full supply volume of 3,710 ML at 8.66 m AHD. Tallegalla Weir is approximately 22km south of Teddington Weir and has a full supply volume of 400 ML. Following amalgamation Teddington and Tallegalla Weirs are now owned by Fraser Coast Regional Council and are under the control of WBWC. WBWC has an annual High Priority Allocation of 6,819 ML/annum from DERM to draw raw water from Teddington Weir to supply Maryborough and its environs.

Teddington Weir also provides irrigation water to farmers located adjacent to Tinana Creek upstream of the Weir. There are 21 irrigation licences on the Weir with a total water allocation of 2798 ML. Sugar cane is the primary land use around the Maryborough district and is the biggest user of water from Tinana Creek. Plans to increase the area under cane cultivation are dependent on the availability of irrigation water. The capacity of Teddington Weir is expected to be adequate until well after the 2031 planning horizon assuming the current low growth in Maryborough continues.

Raw water is drawn from Teddington Weir and is treated at the Teddington WTP located adjacent to the weir. The treated water is transferred from Teddington WTP via DN600 and DN525 transmission mains to Maryborough where it is distributed to town reservoirs at 2 Mile Reservoir (4.5ML), Aberdeen Ave Reservoir (4.5ML), Anne St Reservoir (4.5ML) and Boys Ave Reservoirs (10ML and 9.1ML).

While most of the customers are supplied through reticulation pipework, there are a number of customers that are connected directly to transmission mains.

To regulate the flow of water throughout the reticulation network, Maryborough has established six (6) separate demand management areas (DMA). The original DMA's were created to regulate pressures within the separate zones and more recently have been used for demand management and to monitor and reduce system leakage. Despite the introduction of these DMA's Maryborough has approximately 150L/connection/day (114 L/ED/day) of unaccounted for water. This equates to approximately 17% of total water usage in Maryborough.



Additional storages are located at the Mary River Barrage on the Mary River upstream from Maryborough (full supply = 4770ML) and on Tinana Creek downstream from Teddington Weir. These storages are owned and operated by SunWater Projects (SWP) as part of the Lower Mary River Irrigation Scheme (LMRIS). The LMRIS supplies water to farmers within the Maryborough City area and those rural areas that were within the former Shires of Woocoo and Tiaro. Under this scheme water is transferred via open channel and pipeline from the pondage behind the Mary River Barrage to Tinana Creek Barrage for delivery to farmers in the Walkers Point, Bidwill and the Maryborough City areas. In 1993 a pipeline was installed to transfer Mary River water directly to Teddington Weir via the Owanyilla channel to augment irrigation allocations from Teddingtom Weir and to increase the reliability of Council's raw water source. These allocations provide 2500 ML/annum of Medium Priority water for irrigation and 1000 ML/annum of High Priority water for the Maryborough City area.

Cyanobacteria (blue-green algae) and attendant water quality and health problems have become one of the region's key issues in water resource management, urban and irrigation water supply. While acknowledging irrigation needs for water, there are concerns over potential threats to the town water supply from cyanobacterial blooms and impacts on the water quality of Teddington Weir by potential transfers of algal laden waters from the Mary River. During transfers through the Owanyilla Channel from the Mary River to Tinana Creek, continuous monitoring of water quality is undertaken to ensure the potential for algal blooms to impact on the Tinana Creek catchment is minimised.

The main differences in water quality between the Mary River and Tinana Creek waters are that the Mary River has:

- alkalinity levels greater than 100 mg/L (as $CaCO_3$) compared with 20 mg/L (as $CaCO_3$) in Tinana Creek;
- lower apparent and true colour;
- higher conductivity and hence dissolved solids;
- higher hardness associated with higher levels of calcium and magnesium;
- higher pH;

- lower iron and manganese.

The biodiversity of the Teddington Weir pool is expected to change with the introduction of Mary River water. Changes that can be expected are an increased level of algae in the weir pool due to increased levels of alkalinity and reduced levels of colour. This is likely to result in higher levels of transmittance of UV light in the water body and produce conditions favourable for algal production.

The prevalence of water weed in the catchments contributes to the high level of organic matter within the Tinana Creek. Work is currently in progress to remove blankets of hyacinth and salvinia weeds from the water storage. This is to minimise the levels of decomposing organic material that needs to be removed during the water treatment process.

Officers of the former Maryborough City Council had developed operating rules for the Teddington Weir based on releases from Tallegalla Weir (Hunter Water Australia) and the implementation of staged water restrictions. Council's consulting engineer in 1998 developed operating rules for water transfers from the Mary River to Teddington Weir based on cyanobacteria levels in the Mary River. A blue-green algae (cyanobacterial) contingency plan was also developed for Teddington Weir (update of a contingency plan previously developed in 1993 (Simmonds and Bristow).

Another major problem with the Teddington storage is the incidence of higher than desirable levels of iron and manganese in the water which ultimately results in water discolouration problems in Maryborough. An artificial destratification system was installed in the Teddington Weir pool in 1995 to reduce peaks of iron and manganese in the raw water. This system is providing lower, more consistent levels of iron and manganese although problems still occur occasionally with stratification.

As part of a review of water discolouration problems (SKM, 1998) the former Maryborough City Council commissioned a consulting engineer to evaluate the performance of the destratification system. The review concluded that:

- the installed diffuser arrangement did not address the issue of protecting the intake structure from drawing un-aerated water;
- the diffuser holes appear larger and too close together to develop mixing;
- the air flow rate is in the appropriate range; and
- the destratification system requires modification (cost estimate - $10,000 for modelling and design and $10,000 for construction). This activity is included in the 10 year Capital Works Program.

Water quality and quantity issues in the Lower Mary River Area are increasingly being addressed in a more catchment-wide regional basis involving the major stakeholders. WBWC has been involved with the Mary Basin Water Resource Plan which, in part, forms the basis for future licence conditions;

The allocation of water is divided into high priority users including WBWC's water use for public water supplies. Irrigation users are categorised as medium priority users meaning that their allocation is reduced or ceased when certain predetermined weir level triggers are met.

Furthermore the introduction of announced allocations specified in licences will dictate the percentage of allocation allowed in any particular year. This announced allocation is calculated using a formula and takes into account factors including usable volume available, high priority demands, environmental release requirements and losses.

3.2 Bulk Supply System

The bulk supply system consists of the following assets:

1. A pump station facility (owned by SunWater Projects) that extracts water from the Mary River and pumps into Teddington Weir.
2. Teddington and Tallegalla Weirs.

3. Teddington Water Treatment Plant (WTP), clear water storage and raw and treated water pumping stations.
4. Bulk treated water delivery mains 2 x DN525 to Two Mile Reservoir thereafter consisting of a DN525 and DN600 to the town reservoirs.
5. Two Mile Reservoir with a volume of 4.5ML.
6. Tinana pump station and elevated reservoir with a capacity of 0.5ML.
7. A DN525 transmission main to Aberdeen Reservoir with a volume of 4.5ML and associated

   - low level pump station and elevated reservoir with a capacity of 0.45ML.
   - high level pump station and elevated reservoir with a capacity of 0.45ML. This also supplies a 1ML elevated storage at the Showgrounds.

8. 2 x DN600 Transmission mains to Boys Ave Reservoirs No. 1 and No. 2 with volumes of 10 ML and 9.1 ML respectively.
9. A DN300 transmission main to Anne Street reservoir with a capacity of 4.5ML and associated PS and Elevated reservoir with a capacity of 0.45ML.

Table : Length (km) of Bulk Supply mains in Maryborough by material and diameter

Material Type		***AC***	***CI***	***DICL***	***PVC***	***uPVC***	***MS***	***FRC***	***TOTAL***
Diameter (mm)	**500**	-	-	2.0	-	-	-	-	2.0
	525	-	-	10.8	-	-	15.9	-	26.7
	600	-	0.2	14.8	-	-	0.7	0.7	16.4

3.3 Distribution System

In this report, the distribution system has been defined as that infrastructure that delivers water from the bulk supply assets to the individual water districts. These mains are typically required to deliver the maximum hour demands throughout the system.

Table : Length (km) of distribution pipe in Maryborough by material and diameter

Material Type		***AC***	***CI***	***DICL***	***PVC***	***uPVC***	***MS***	***FRC***	***TOTAL***
Diameter (mm)	**300**	3.9	10.1	1.6	2.1	-	-	-	17.7
	375	-	-	2.2	-	-	-	-	2.2
	450	0.6	3.0	1.4	-	-	1.4	-	6.4

3.4 Reticulation Network

The network's reticulation system comprises DN100, DN150, DN200, DN 225 and DN250 water mains to which the majority of service connections are made. These mains are required to provide both maximum hour demands and fire fighting flows. The distribution of water mains is shown in the table below by size and by material type.

Table : Length (km) of reticulation pipe in Maryborough by material and diameter

Material Type		***AC***	***CI***	***DICL***	***PVC***	***uPVC***	***MS***	***FRC***	***TOTAL***
Diameter (mm)	**100**	40.5	40.3	-	36.5	0.2	-	-	117.5
	150	11.6	14.4	1.2	18.1	0.1	-	-	45.4
	200	5.2	1.3	0.1	5.0	1.0	-	-	12.6
	225	3.1	1.9	0.6	0.7	-	-	-	6.3

	250	1.1	3.9	2.1	-	-	-	-	7.1

4.0 POPULATION PROJECTIONS AND WATER DEMAND

4.1 Existing ED Demand

Maryborough City had a residential population of approximately 27,217 in 2006 (Census Data), and based on the Queensland Treasury's Office of Economic and Statistical Research (OESR) Urban Centre and Locality (UCL) estimates that will rise to 29023 in 2011. OESR growth forecasts going forward are that Maryborough will continue to grow at 0.8% per annum which is consistent with previous PIFU Medium Series Growth Projections. This growth forecast has been used throughout this report.

Wide Bay Water has carried out a number of consumption analyses based on consumption data from residential property water meters. From this analysis it has been determined that the current average daily demand for a residential property or Equivalent Dwelling (ED) in Maryborough is 680 L/ED/day. This average demand includes an allowance of approximately 17% for unaccounted water and system leakage and is considered to be an appropriate demand to be used as the basis for future planning purposes in Maryborough. Leakage and unaccounted for water has been determined to be 114L/ED/day (150 L/connection/day) in Maryborough. Further work on leakage management and water usage has the potential to significantly reduce the current level of unaccounted for water.

4.2 Future ED Demand

For modelling purposes the estimated consumption per ED has been assumed to remain at 680 L/ED/day although the distribution of demands will change with changing population and development density.

The planning scheme for Maryborough allows for expansion of residential areas in Tinana, and some infill in Maryborough Central and Granville. Growth in non-residential development has been provided for in the North Maryborough area and limited areas in Tinana and Granville. These non-residential areas have been assumed to grow at the same rate as Residential growth over the planning period to 2031.

Total ED projections for each of the 5 year design horizons from the year 2010 to the year 2031 are detailed below.

Table : Equivalent Dwelling (ED) Projections

Year	Residential Demand	Non-Residential Demand	Total Demand
2010	9990	2781	**12772**
2011	10172	2796	**12968**
2016	11014	2869	**13883**
2021	11559	2944	**14503**
2026	12119	3021	**15140**
2031	12665	3100	**15766**

Table : Equivalent Dwelling (ED) Figures per DMA

Year	Granville	Newtown Central	Maryborough CBD	Tinana	Bell Hilltop	Maryborough West
2010	1252	3451	3557	1666	780	2003
2011	1268	3457	3562	1818	782	2019
2016	1362	3531	3617	2447	798	2065
2021	1421	3622	3670	2787	817	2122
2026	1461	3715	3722	3120	840	2218
2031	1517	3845	3781	3383	859	2316

Table : Estimated Daily Water Requirements (ML/Day)

Year	Average Day	Mean Day Maximum Month	Peak Day
2010	8.7	12.2	16.5
2011	8.8	12.3	16.8
2016	9.4	13.2	17.9
2021	9.9	13.8	18.7
2026	10.3	14.4	19.6
2031	10.7	15.0	20.4

4.3 Demand Allocation

Demand allocation is dependent upon the number of equivalent dwellings (ED's) either existing or permitted under the planning scheme for a particular site. Over the twenty year strategy the amount of residential and non-residential development will increase.

The number persons/dwelling was obtained from the Australian Bureau of Statistics data from 2006 which indicated a population density of 2.8 persons/dwelling.

4.4 Demand Types

For modelling purposes demand types have been simplified into two categories, residential and non-residential:

(i) Residential demand encompasses all residential development including low, medium and high density residential development;

(II) Non-residential development includes commercial, industrial, educational, sporting, recreational and health related premises.

The relative percentage of each demand type within each Demand Management Area varies throughout Maryborough. Areas that have a high percentage of residential demand include Tinana, Maryborough CBD and Newtown Central. Maryborough West, and the Maryborough CBD have a high percentage of non-residential demands.

4.5 Peaking Factors

Peaking factors for the Average Day (AD), Mean Day Maximum Month (MDMM), Peak Day (PD) and Peak Hour (PH) hydraulic analyses were derived from an analysis of water production and consumption data.

A report by Cardno (2009) which was based on water production data prior to 2005 indicated that the PD and the MDMM factors should be 1.9 and 1.4 respectively. A more recent review of the water production figures from 2008 through to 2010 (post introduction of water meters) indicates that the PD and MNMM factors are 1.7 and 1.3 respectively.

The lower factors may be attributable to water restrictions, the drought in 2008-09 and a particularly wet year during 2009-10. At this early stage it is uncertain whether the lower factors are sustainable into the future. Therefore the figures proposed by Cardno (2009) have been adopted for modelling purposes.

Average Day Demand is equal to the total consumption recorded for the year divided by the number of days in the year.

Average Day (AD) = 680 L/ED/D x Number of Equivalent Dwellings(ED)

Peak Day Demand is the maximum demand expected to occur on one day (usually in summer) every year. It is calculated by multiplying Average Day demand by 1.9.

Peak Day (PD) = Average Day x 1.9 (Peaking Factor)

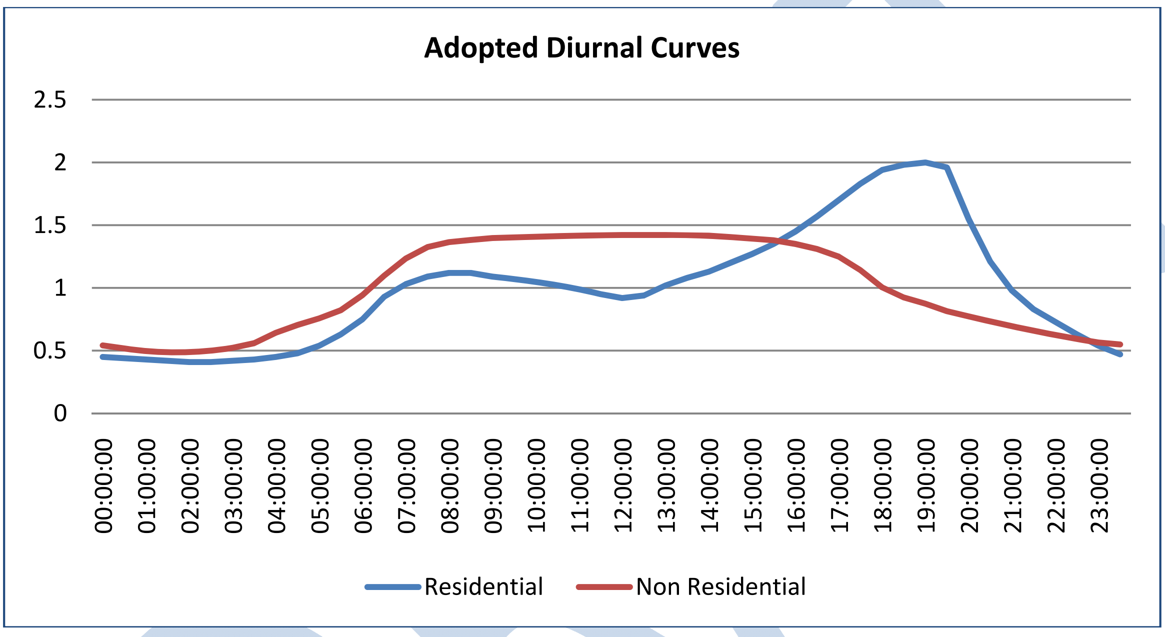
Mean Day Maximum Month Demand is the average daily demand expected to be experienced over the maximum month of the year. Mean day maximum month for domestic connections is calculated by multiplying average day demand by 1.4. This ratio is representative of the Maryborough City water consumption data.

Mean Day Maximum Month (MDMM) = Average Day x 1.4 (Peaking Factor)

4.6 Diurnal Profiles

Diurnal profiles are used to account for variations of demand for different land uses throughout the day. In the model, the profiles apply diurnal factors on an hourly basis to establish a snapshot of the flow rate at any given time.

Figure: Residential and Non Residential Diurnal Curves



The peaking factors for Peak Day and Mean Day Maximum Month were applied to these curves to estimate demand. Based on the estimated design horizon populations and the demand criteria detailed above, the average day, mean day maximum month, and maximum day demands have been plotted and compared at each 5-year time interval.

Figure: Average Day Demand per Year

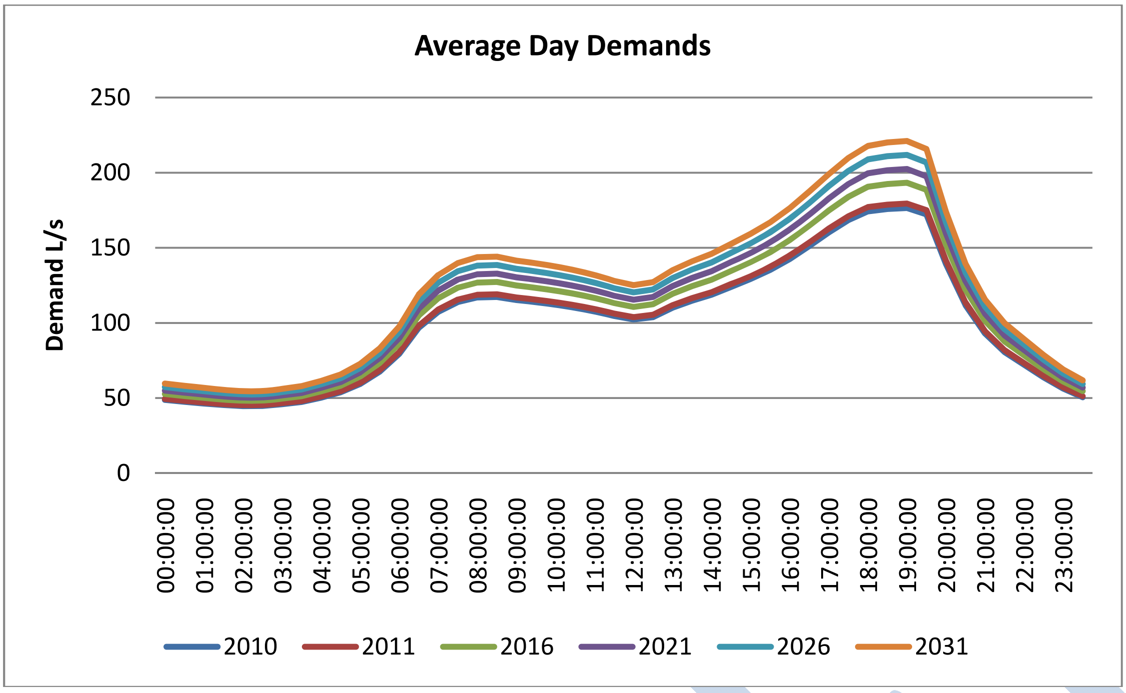


Figure: Mean Day Maximum Month Demand

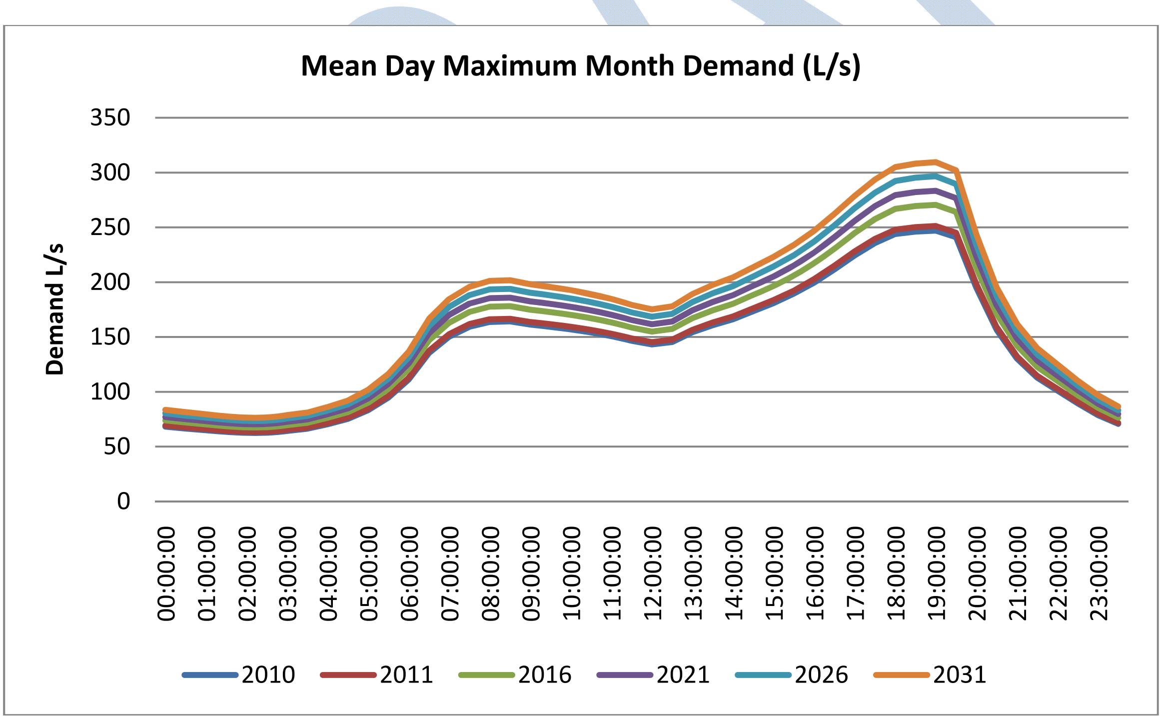
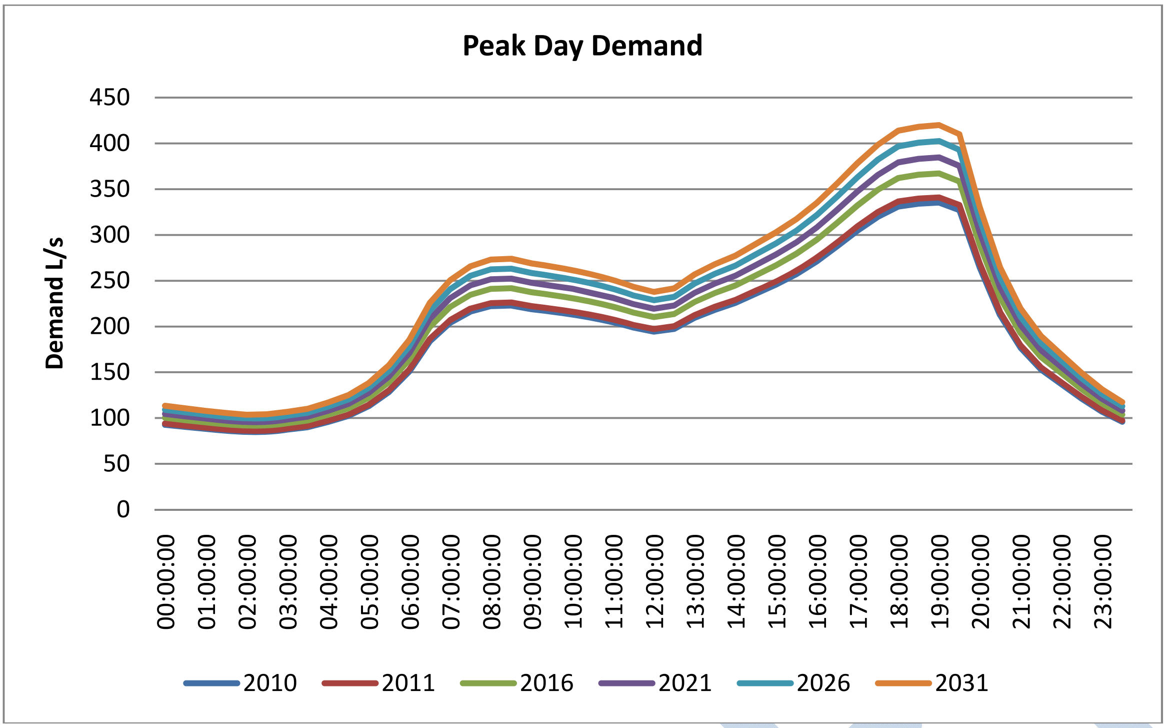


Figure: Peak Day Demand



5.0 RAW WATER SOURCE

WBWC has an annual High Priority Allocation of 6,819 ML to draw raw water from Teddington Weir. An additional High Priority allocation of 1000 ML is also available from Teddington Weir although this is a transfer from the Mary River. Teddington Weir has an Historical No Failure Yield of 4120 ML. The draft Resource Operating Licence for the Mary River provides for the transfer of the additional 1000ML of High Priority water allocation from the Mary River and to date has only been used as a critical water supply supplement in times of drought.

Total annual demand has reduced significantly since 2002 due in part to the drought and also the introduction of water meters around 2004. Assuming this demand reduction is sustainable through pricing structures and demand management iniatives, total annual demand is forecast to rise from a low of 3170 ML in 2010 to 4589 ML in 2051. The previous highest annual demand was 4769 ML in 2001.

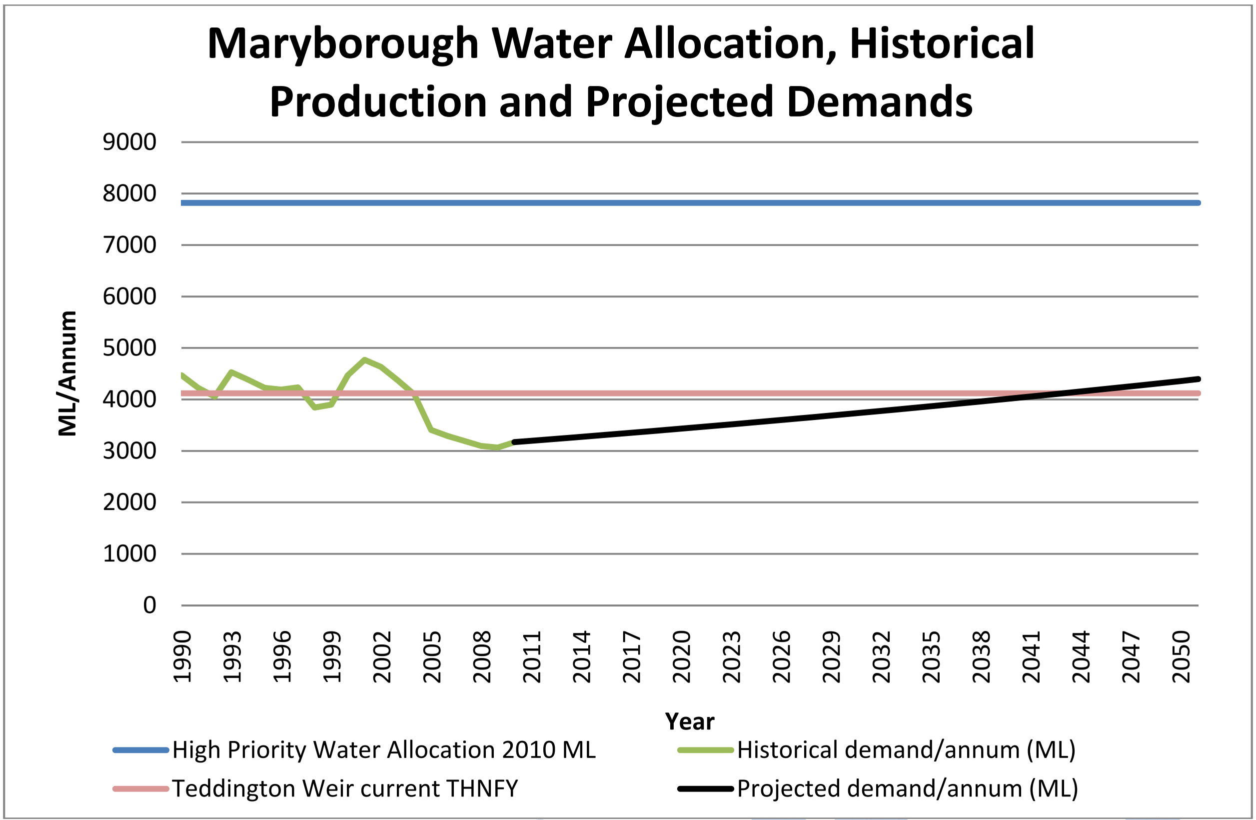
The following table summarises the annual treated water requirement determined from the Average Day Demand, and the graph below shows historical and projected total annual demand in Maryborough.

Figure : Summary of Treated Water Demand (ML)

Year	Average Day	Peak Day	MDMM	Annual Requirement (ML/Annum)
2010	8.7	16.5	12.2	**3170**
2011	8.8	16.8	12.3	**3219**
2016	9.4	17.9	13.2	**3446**
2021	9.9	18.7	13.8	**3600**
2026	10.3	19.6	14.4	**3758**
2031	10.7	20.4	15.0	**3913**
2036	11.2	21.2	15.6	**4072**
2041	11.6	22.1	16.3	**4238**
2046	12.1	23.0	16.9	**4410**
2051	12.6	23.9	17.6	**4589**

Based on these projections the current allocations are adequate for the foreseeable future.

Graph needs tidying up.



Maryborough Water Allocation, Historical Production and Projected Demands
ML/Annum
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1990
1993
1996
1999
2002
2005
2008
2011
2014
2017
2020
2023
2026
2029
2032
2035
2038
2041
2044
2047
2050
Year
High Priority Water Allocation 2010 ML
Historical demand/annum (ML)
Teddington Weir current THNFY
Projected demand/annum (ML)

6.0 TREATMENT

6.1 Teddington Water Treatment Plant - Overview

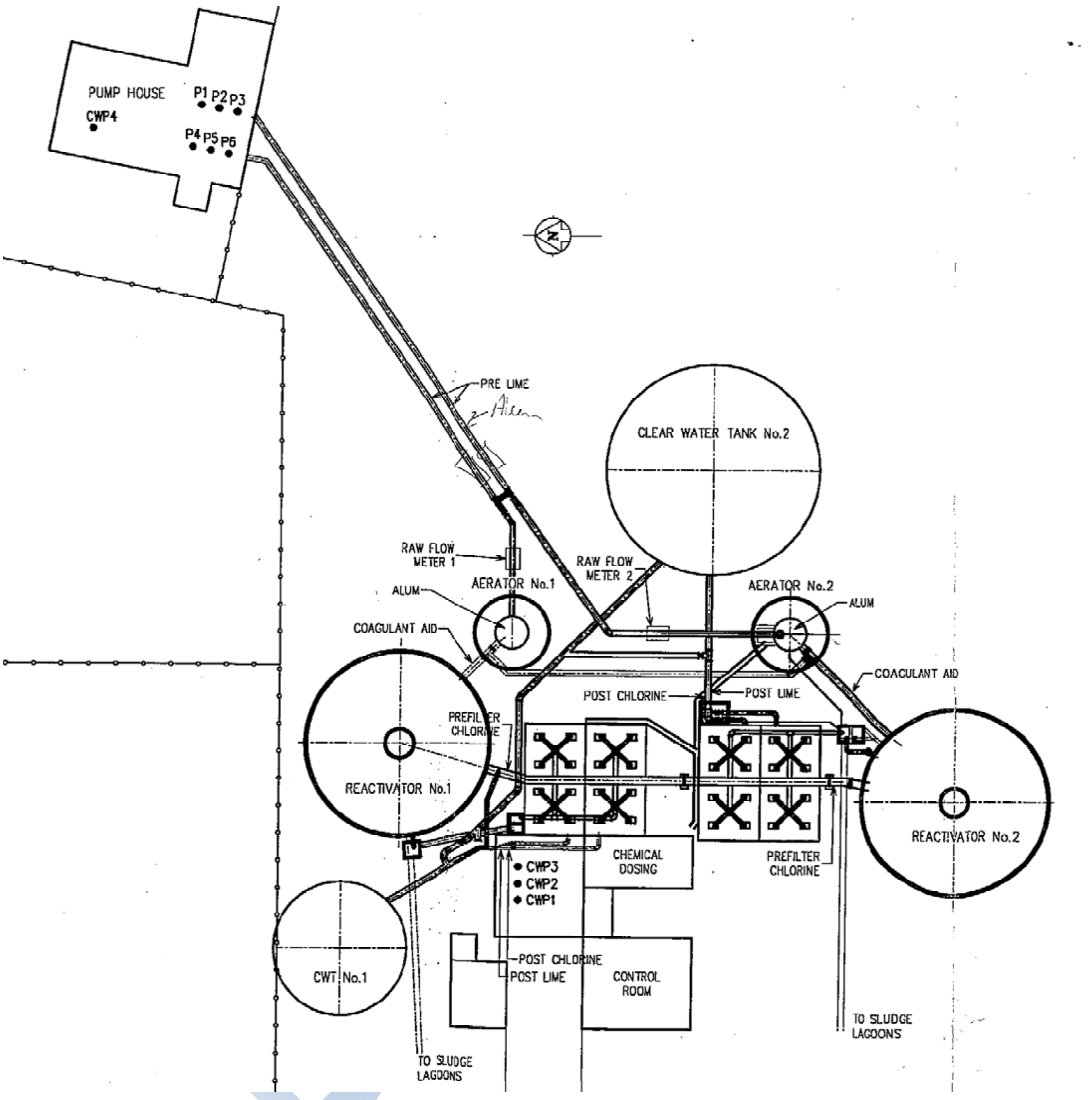
The Teddington Water Treatment Plant (WTP) is located at Teddington Weir, a weir pool on Tinana Creek. The plant consists of two identical conventional treatment processes providing aeration, coagulation, clarification, filtration, pH correction and disinfection. Raw water supply to the plant is pumped from the weir via one of two available pumping configurations depending on which process stream is to be used. The plant is hydraulically capable of treating 460L/s which is equivalent to 36ML/day per day for a 22 hr operating day, however treated water demand has historically reached only a maximum of approximately 22ML/day prior to 2008 and there are significant issues with treated water quality at higher production rates.

Raw water is firstly dosed with lime and then alum is added at the top of the aerator. The dosed water is then fed to a reactivator type clarification process where a coagulant aid polymer is dosed to improve settling. Supernatant from the clarifier then flows into two sand pressure filters consisting of eight cells per filter. The plant has been upgraded to include facilities for PAC dosing and the pre-chlorination coated media process for manganese removal. Filtered water is dosed with lime and chlorine before flowing into either of two treated water storage tanks on site prior to being pumped into the distribution system.

In October 2002, Maryborough City Council (MCC) requested Hunter Water Australia (HWA) to perform a chemical dosing review of its Teddington WTP to determine if the treatment process could be improved in terms of treated water quality, plant operability and operating costs. The main issues of concern were the costs associated with the use of both hydrated lime and aluminium sulphate (alum) which are both delivered to the plant dry in 25kg bags.

Delivery of these chemicals in bulk would offer reduced annual chemical expenditure, minimise manual handling and provide both time savings and improved safety. Further improvements could be also achieved if the coagulant and alkali used at the plant were in liquid form as this simplifies the dosing systems required saving on capital expenditure and maintenance costs.

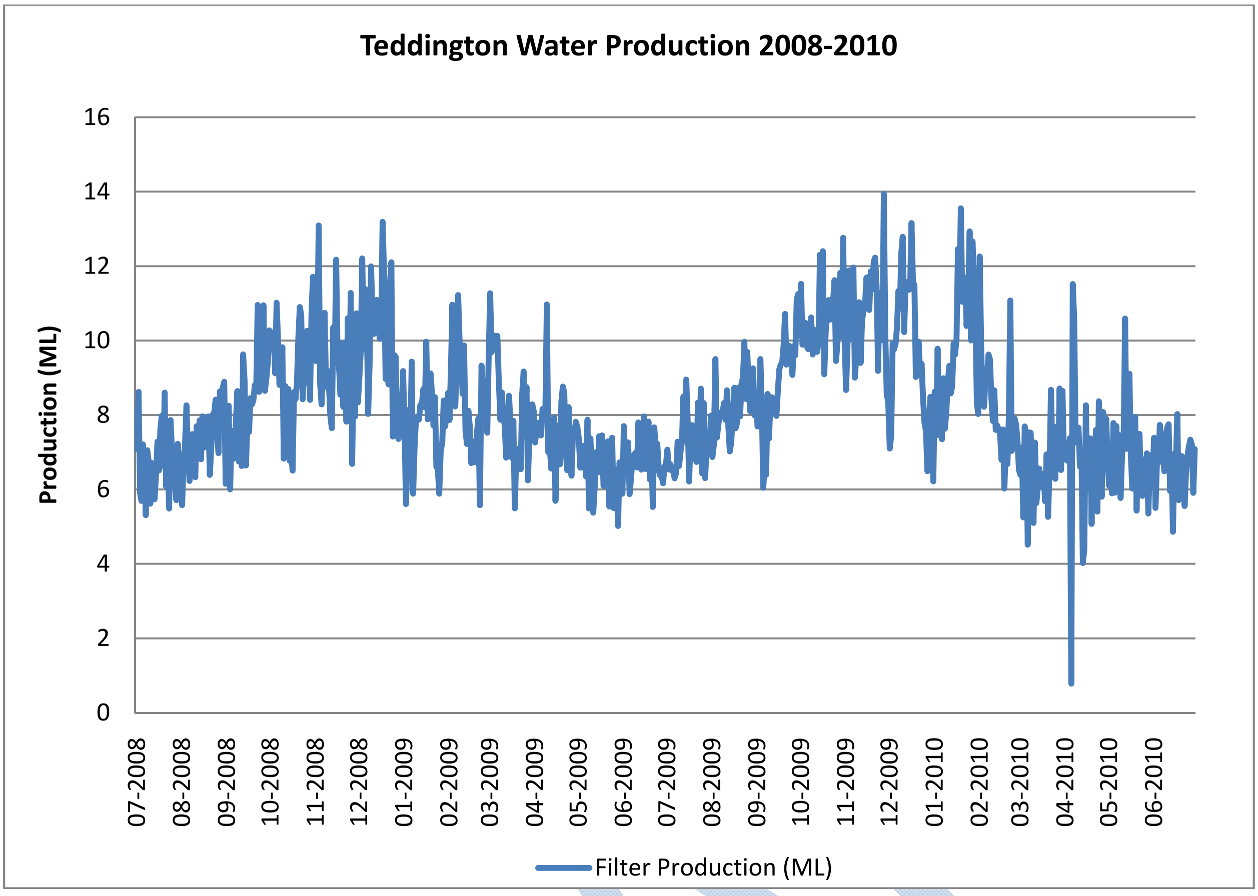
Figure : Teddington Water Treatment Plant Process Plan



Improvement in water quality from the plant can be achieved through optimisation of the existing processes. New control systems will be required to achieve this outcome. In the longer term, additional processes will also be required to meet water quality standards and increased production rates.

Subsequent to the introduction of water meters and consumption based charges in Maryborough, water consumption has dropped significantly. The treated water production between 2008 and 2010 ranges between 5 and 15ML/day in line with seasonal fluctuations. The following graph shows the recent production figures from the Teddington WTP.

Figure: Treated Water Production Teddington WTP



7.0 TRUNK DISTRIBUTION

7.1 Pump Stations

Teddington WTP Clearwater Pumpstation

Located at Teddington WTP, this pump station has the capacity to supply in excess of 400L/s into the Maryborough Township. These pumps are manually activated to supply and fill Two Mile Reservoir. They automatically shut down once the reservoir is full. The pump station consists of four pumps each with individual capacities shown in the table below.

Table: Teddington Clearwater Pumpstation

Pump	*Elevation*	*Output L/s*	*Operation*
Pump 1	20	110	Manual on Auto off
Pump 2	20	110	Manual on Auto off
Pump 3	20	277	Manual on Auto off
Pump 4	20	225	Manual on Auto off

Tinana Pump Station
These pumps provide water directly to the suburb of Tinana. There are two pumps installed in this pump station and each pump has a capacity of 48L/s at a head of 36.5m. The pump station supplies water directly into the reticulation, but also supplies water to the Tinana elevated reservoir. This pump station services approximately 1300 customers.

This pump station will require upgrading in 2016 with the projected water demand increases.

Aberdeen Avenue Low Level Pump Station
This pump station located at Aberdeen Avenue services the Newtown Central DMA and Bell Hilltop DMA. This pump station consists of 3 pumps and each has a capacity of 227L/s at 21.3m head. This area services approximately 4000 customers. Water is pumped directly to the system and the Aberdeen Avenue low level elevated tank with a capacity of 0.45ML.

Aberdeen Avenue High Level Pump Station
This pump station located at Aberdeen Avenue services the Maryborough West DMA. It also provides water to the Showgrounds elevated reservoir. This pump station consists of 2 pumps and has a capacity of 285L/s at 50.7m head. This area services approximately 1700 customers. Water is pumped directly to the system and to the high level elevated tank with a capacity of 0.45ML.

Anne Street Pump Station
This pump station services the Maryborough CBD DMA and also supplies water to the Granville DMA. This pump station consists of 2 pumps and each has a capacity of 115L/s at a head of 31.6m. The pump station services approximately 3500 customers.

The pumps supply water directly to the reticulation and to the Anne Street Elevated Reservoir (0.45ML). This pump station had previously provided water to the Granville elevated reservoir (0.05ML). Since the Granville reservoir has been decommissioned (November 2010) water supply reliability to that DMA needs to be improved.

It is understood that the Anne Street Pump station is not currently being used due to noise issues and damage to mains when it is operated. There are also reported leakage issues with the Anne St reservoir. The decommissioning of Granville Elevated reservoir may intensify any issue of over pressurising the system mains and variable speed drives fitted to the pumps may be required to reduce damage to the reticulation. This pump station and the Anne

Street Facility are essential components in the Maryborough Strategy and it is recommended that this pump station be recommissioned as soon as practical.

7.2 Reservoirs

Ground level Reservoirs:

The existing ground level reservoirs are detailed in the following table.

Table - Ground Level Reservoirs

Reservoir	*Construction Year*	*Storage Volume (ML)*	*Top Water Level (mAHD)*	*Bottom Water Level (mAHD)*
Two Mile		4.5	48.0	no information
Aberdeen Avenue	1933	4.5	31.95	25.85
Anne Street	1998	4.5	30.3	24.05
Boys Avenue No. 1	1969	9.1	30.52	24.57
Boys Avenue No. 2	1983	10	30.8	24.8
Total		32.6		

For the purposes of this report, Maryborough can be separated into three zones defined by the Mary River and Tinana Creek.

Maryborough zone is the area bordered by the Mary River to the south and east and contains the greatest portion of Maryborough. It is also the location of four of the five ground level reservoirs, including Boys Avenue reservoirs 1 and 2, Ann Street reservoir and Aberdeen Avenue Reservoir. These have a combined storage volume of 28.1ML.

The area bordered by the Mary River to the north and Tinana Creek to the east is Tinana zone. This area is supplied directly from 2 Mile Reservoir from the existing DN525 trunk mains. This zone includes 2 Mile reservoir with a storage capacity of 4.5ML.

The area bordered by the Mary River to the west and south is Granville which relies on supply from the Maryborough area via a single water main across the Mary River. The Granville zone does not have a dedicated reservoir located within the zone.

Table: Storage requirements for Major Zones by Projected Planning Horizon

Reservoir	*Type*	*Storage Volume (ML)*	*Zone Capacity (ML)*	*Storage Required (ML)*					
				2010	*2011*	*2016*	*2021*	*2026*	*2031*
Whole of town	Ground Level	32.60	32.60	21.27	21.60	23.13	24.16	25.22	26.26
Maryborough Zone	Ground Level	28.10	28.10	12.97	13.00	13.24	13.51	13.79	14.14
Granville	Ground Level	0.00	0.00	**2.09**	**2.11**	**2.27**	**2.37**	**2.43**	**2.53**
Tinana	Ground Level	4.50	4.50	2.97	3.13	4.18	**4.75**	**5.08**	**5.74**

It can be seen that if considering Maryborough as a whole the town storage is adequate to meet the overall demand projections to beyond 2031. However, if we consider each individual zone then the shaded areas indicate where the existing storage is deficient within the zone.

Granville has no existing storage and only a single supply main into the zone. This presents a risk to the corporation should failure of this supply main occur.

Likewise Tinana is separated from the Maryborough storage by the Mary River and requires additional storage augmentation by 2021.

Elevated Reservoirs:

Maryborough has five elevated reservoirs which provide limited storage to the Maryborough water supply system. The elevated reservoirs are;

- Aberdeen Avenue High and Low level elevated reservoirs which are supplied from the Aberdeen, Boys Avenue 1 and 2 ground level reservoirs;
- Anne Street elevated reservoir which is supplied from the Anne Street ground Level reservoir;
- Tinana elevated reservoir which is supplied from the Two Mile ground level reservoir.

Granville elevated reservoir was decommissioned in November 2010. While the capacity of this reservoir was only 50kL, it provided a small amount of security of supply to the Granville area.

The elevated reservoir at the Showgrounds, while being the largest elevated reservoir in Maryborough, is located on the periphery of the town and therefore has limited benefit until growth occurs in that area.

Table - Elevated Reservoirs

Reservoir	*Construction Year*	*Storage Volume (ML)*	*Top Water Level (mAHD)*	*Bottom Water Level (mAHD)*
Aberdeen Ave Low	1970	0.45	50.60	43.74
Aberdeen Ave High	1971	0.45	57.00	50.14
Anne Street	1970	0.45	49.10	42.24
Show Grounds	1991	1.00	61.00	53.00
Tinana	1981	0.5	62.00	54.78
Granville Tank*		0.05	42.73	38.16
Total		2.85		

**Granville Tank was decommissioned in November 2010*

The NRM standards for the sizing of service reservoirs, has been used to determine the future storage requirements. An analysis of the required reservoir capacities for the projected demands is summarised below:

Table - Storage requirements for Elevated Reservoirs by Projected Planning Horizon

Reservoir	*Type*	*Storage Volume (ML)*	*Zone Capacity (ML)*	*Storage Required (ML)*					
				2010	2011	2016	2021	2026	2031
Aberdeen Ave Low	Elevated	0.45	0.45	**1.09**	**1.09**	**1.10**	**1.12**	**1.14**	**1.16**
Aberdeen Ave High	Elevated	0.45							
Show Grounds	Elevated	1							
		1.45	1.45	0.69	0.69	0.70	0.70	0.71	0.72
Anne Street	Elevated	0.45	0.45	**0.78**	**0.78**	**0.78**	**0.79**	**0.80**	**0.81**
Tinana	Elevated	0.5	0.50	**0.70**	**0.73**	**0.83**	**0.89**	**0.94**	**0.99**
Granville*	Elevated	0.05	0.05	**0.64**	**0.64**	**0.65**	**0.66**	**0.67**	**0.68**

**Granville Tank was decommissioned in November 2010*

The shaded cells in the table above indicate the elevated reservoirs that fail when compared with the NRM guidelines which include allowances for fire fighting and/or emergency. It appears that the elevated reservoirs in Maryborough have been sized to store fire fighting flows only and make no allowance for the domestic storage component. However provision of additional elevated storage to meet the NRM guidelines is deemed uneconomical and an alternative option has been investigated.

The elevated reservoirs in Maryborough "float" on the system, meaning that pump stations pump directly into the reticulation system and the elevated reservoirs which serve to ensure that pressures are not excessive by buffering pressure surges. These reservoirs also provide limited storage at a suitable pressure should maintenance of the pump station be required.

Proposed Developments:
Major new development is expected in the Tinana area. Depending on transport access to the Granville area, this may also be an area of high growth. The remaining areas of Maryborough are mainly infill development and development of existing vacant lots.

Maryborough Demand Management Areas (DMA's)

- Maryborough CBD DMA
- Bell Hilltop DMA
- Granville DMA
- Maryborough West DMA
- Tinana DMA
- Newtown Central DMA – Currently being assessed as a potential future DMA

Of the above DMA's, a number are predicted to have a significant increase in population as a result of new development (e.g. Tinana and Granville) or densification of the existing development areas (e.g. Maryborough CBD and Maryborough West). This additional demand on the water supply system will necessitate upgrades to the network and may affect the DMA boundaries.

Generally the DMA's are isolated from one another by the installation of boundary valves which can be manually opened in times of emergency. Because Maryborough is relatively flat, the primary operational use of the DMA's is to provide isolated sections of network where leak detection and monitoring can occur on a permanent basis.

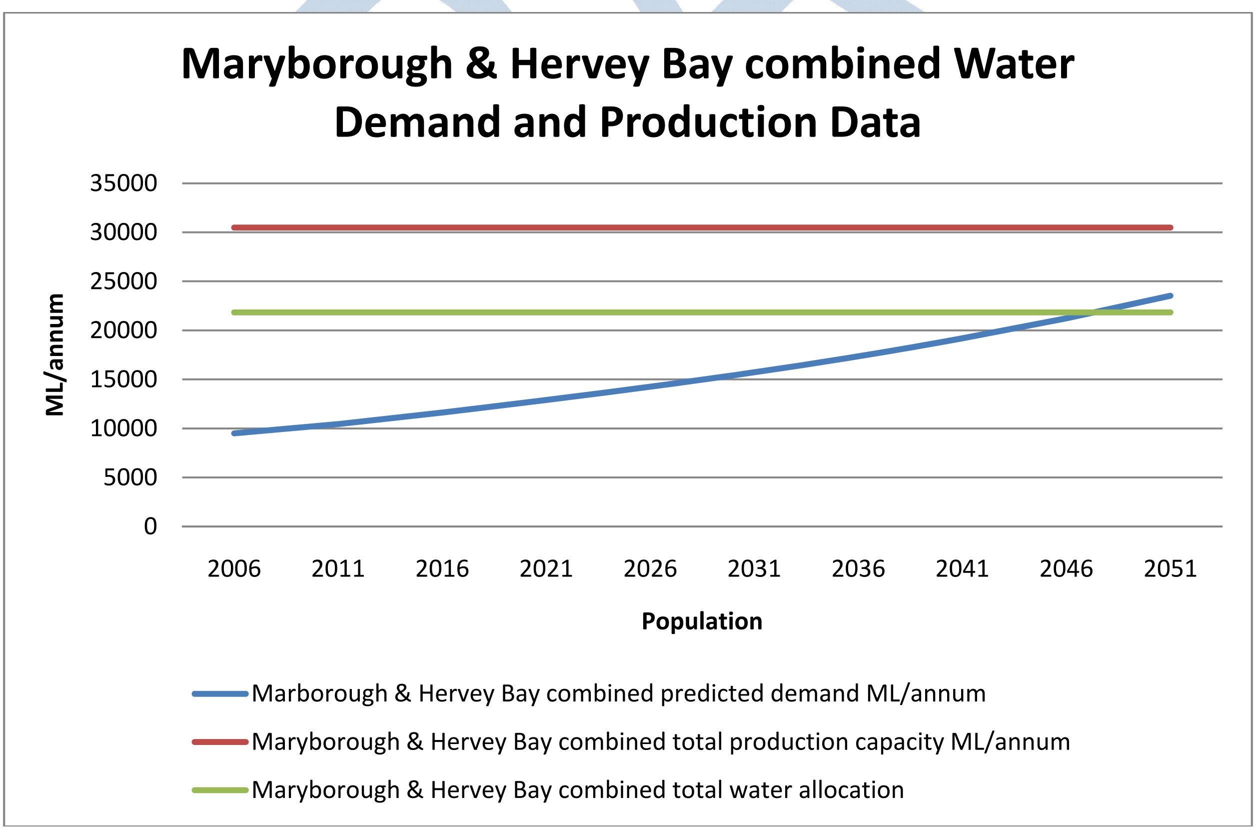
8.0 DISCUSSION

Now that Wide Bay Water has the responsibility for both the Maryborough and Hervey Bay systems an opportunity exists to look at the benefits of a water grid servicing both systems. Transfer of treated water and/or raw water between the two systems should be considered to maximise the use of existing assets such as water treatment plants. A water grid also has the potential to offer water source security to both systems and deferred capital expenditure on major infrastructure assets. Options for upgrading the Teddington Water Treatment Plant should therefore be considered on a regional basis rather than simply for the Maryborough community. For this reason this report will be recommending that an investigation be undertaken into the benefits of a water grid before any decisions are taken on additional process stream units and design plant capacity at Teddington.

Utilisation of some of the available water allocation from the Mary River to supply Hervey Bay is consistent with the outcomes of the Hervey Bay Strategy Report where a supply from the Mary River is identified as the preferred option for future water supply.

Connection of the Maryborough and Hervey Bay systems would provide increased supply capacity in Hervey Bay for the future and also improved reliability of supply to both the townships. Currently both townships rely on a single source of water supply. Contamination or other source failure issues could mean isolation of the source and subsequently Maryborough would only have a limited amount of storage (1-2 days) in its storage reservoirs to rectify the problem.

The graph below indicates the combined system capacity if a water grid were to be established. This option could utilise the available capacity at Teddington WTP and transfer treated water to Hervey Bay via Burgowan, or conversely to transfer treated water from Burgowan WTP to Maryborough. Linking the two systems will require some major transmission infrastructure including approximately 30km of transmission main which could cost in the order of $30m depending upon size and route. (The Hervey Bay Strategy Report indicated that a pipeline to transfer 7800 ML/annum of raw water from the Mary River to Burgowan WTP would cost $38.35m.)



8.1 Raw Water Pump station

Vertical line-shaft pumps transfer water from the weir to the Teddington WTP. These shaft driven pumps are nearing the end of their useful life. It is proposed that the 6 existing pumps be replaced with fewer but more efficient pumps that meet the design capacity and operating regime of the Teddington Water Treatment Plant.

Table: Raw Water Pump Station Upgrade

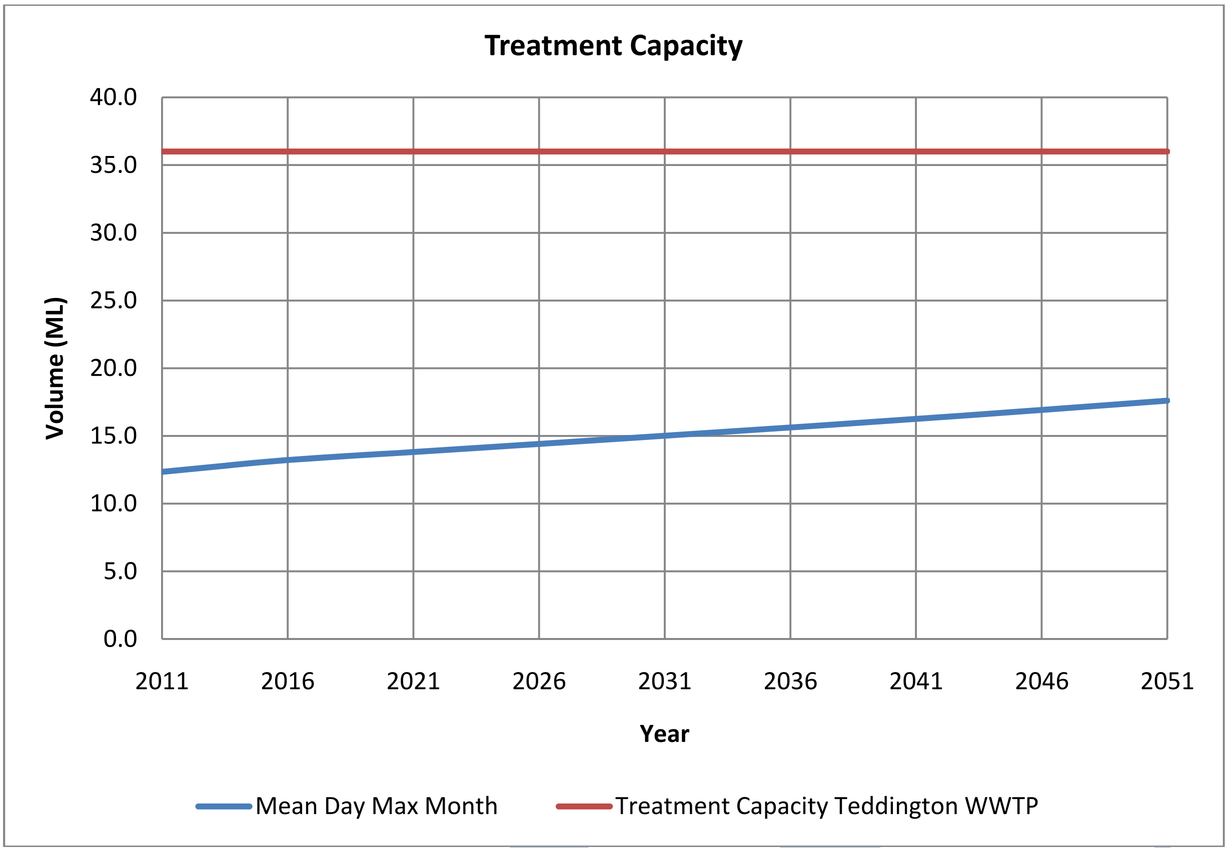
Item	Description	Size	Year Proposed	Capital Cost approx
1	Replace pumps	Match Plant Capacity	2012	$330,000
TOTAL				$330,000

8.2 Clear Water Pump Station Upgrade

Operating procedures and control systems for the clear water pumps need further investigation. The pumps are currently manually activated by the operators with automatic shut-off. Options include variable frequency drives and and/or improved control systems. It is proposed to allow for a planning report in 2011 to review water transfer arrangements throughout Maryborough to determine the best option. An allowance has been included for budget purposes in 2012 for the installation of VFD's although the final configuration will be dependant upon the outcome of the Planning Report.

8.3 Treatment Capacity

The MDMM is forecast to increase from 12.2ML/day to 15.0ML/day in 2031. The nominal capacity of the treatment plant at Teddington is 36ML/day. However, there are severe limitations on plant production capacity due to deteriorating water quality with increased production rates. In order to produce 36 ML/day significant upgrades will be required at the plant. These improvements are not required to meet the projected demand in Maryborough but need to be assessed as part of a regional approach to water supply. This is beyond the scope of this report and forms one of the recommendations.



Issues have been identified at Teddington WTP and these include:

1. High manganese levels.
2. High DOC (dissolved organic carbon) which results in THM formation.
3. High THM (trihalomethanes) levels which is a result of chlorine disinfection and high DOC.
4. Sludge management, for both liquid and solids disposal.
5. Water stabilisation; the water is currently corrosive.
6. Inlet structure located on the weir, the design poses a risk to supply continuity and accessibility is a WH&S issue.
7. Raw water pumps rationalisation.
8. Lack of critical alarm generation due to aged or non-existent SCADA.

More detailed Information can be found in the Teddington WWTP, Asset Report (January 2011) in Appendix .

Consideration of a regional approach to water supply is necessary before a decision can be made on the scale of augmentation of the Teddington Water Treatment Plant.

8.4 Trunk Distribution

8.4.1 Granville Security of Supply

Granville is isolated from the remainder of the Maryborough network by the Mary River. The sole supply main (DN450) to Granville crosses the existing Tiger Street Bridge.

An elevated reservoir of 50kL has recently been decommissioned because of its poor condition. This storage was well under the capacity required for the area that it serviced.

Several options are available for the improvement of security of supply to Granville.

OPTION A1 - New reservoirs

To improve the security of supply to this area one option is to install a new ground level reservoir and associated pump station to this area (and possibly a new elevated reservoir). This option would provide limited volume of water to the Granville area should the DN450 main remain out of service for an extended period, say by failure of either the main or the bridge during a major flood event. The sizing of the ground level and elevated reservoirs (under NRM guidelines) would be 3.2ML and 0.8ML respectively.

The estimated costs are:

Table: Granville DMA Water Supply Infrastructure – Option A1 – New Reservoirs and PS

Item	Description	Size	Unit Rate	Length/Size	Year Proposed	Capital Cost approx
1	Granville GL Reservoir	3.2 ML	-	-		$1,350,000
2	Granville Elevated Reservoir	0.8ML	-	-		$2,210,000*
3	Local MH Booster Pump Station	56 L/s	-	-		$700,000
TOTAL						$4,300,000

** Cost extrapolated from cost database*

OPTION A2 – New River Crossing

An alternate supply main to Granville crossing the Mary River had previously been considered by Maryborough City Council and is a more economical option. The alternative feed across the Mary River would also provide security of supply should the DN450 feed be inoperable. The alternative feed should be a minimum of DN300 the sizing being dependent upon the future growth and development in Granville.

The estimated costs are;

Table: Granville DMA Water Supply Infrastructure – Option A2 – New Water Supply Main

Item	Description	Size	Unit Rate	Length/Size	Year Proposed	Capital Cost
1	DN300 bored main under Mary River	DN300	$3572/m	300m		$1,080,000
2	DN300 from Lennox Street to Odessa St (excluding river crossing)	DN300	$317/m	1450m		$530,000*
TOTAL						$1,610,000

** includes a compensation factor of 1.15 for poor soil (High WT) in urban areas*

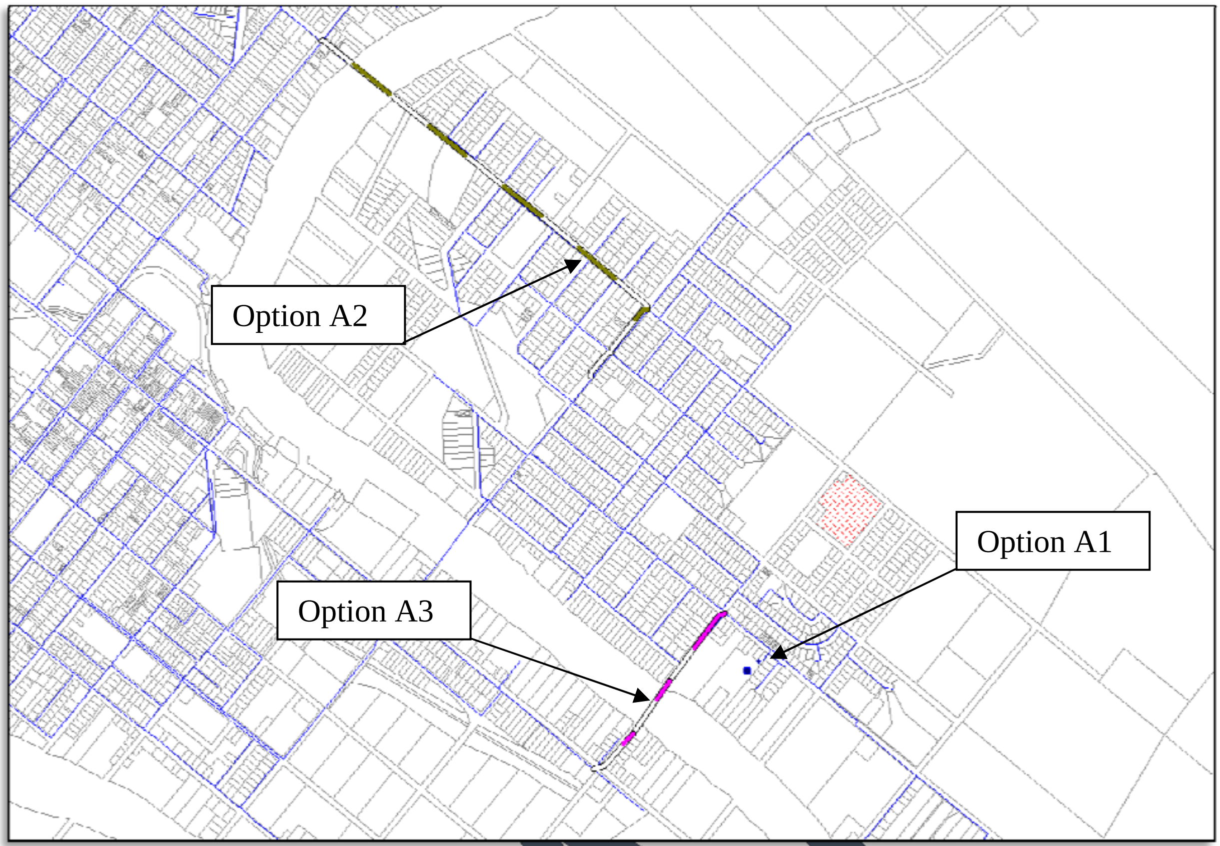
OPTION A3 – Alternate site for River Crossing

An alternative route for a river crossing is upstream from the Tiger Street Bridge from Kent Street via Ajax and Hoffmann Streets and offers potential cost advantages over Option A2. This route is considerably shorter and has the advantage of supplying water close to the highest area of Granville. Preliminary costs for this proposal are shown below:-

Table: Granville DMA Water Supply Infrastructure – Option A2 – New Water Supply Main

Item	Description	Size	Unit Rate	Length/Size	Year Proposed	Capital Cost
1	DN300 bored main under Mary River	DN300	$3572/m	300m		$1,080,000
2	DN300 from Kent Street to Cambridge	DN300	$317/m	405m		$150,000*
TOTAL						$1,230,000

** includes a compensation factor of 1.15 for poor soil (High WT) in urban areas*



8.4.2 Storage in Tinana DMA

Tinana is currently the high growth area in Maryborough and is likely to remain so in the foreseeable future. Improved access through construction of a second river crossing may well be the limiting factor on growth in Granville. The Tinana area is supplied directly from the transmission mains from 2 Mile Reservoir. While the Two Mile Reservoir services the entire Maryborough area it has been assumed for modelling purposes that it provides water storage for the Tinana area.

Tinana can also be supplied from the elevated reservoirs at Aberdeen Ave, but this is a more expensive alternative. Additional storage in the area of Two Mile Reservoir (or at Tinana Pump station site) south of the Mary River is required to meet demand. A 1.5ML storage at either the Tinana PS site (Option B1) or the existing Two Mile Reservoir site (Option B2) is estimated to cost approximately $1,100,000. Utilisation of the existing decommissioned ground level reservoir at Two Mile Reservoir should be considered in evaluation of the options available to provide additional storage for Tinana.

Table: Tinana DMA Water Supply Infrastructure

Item	Description	Size	Unit Rate	Length/Size	Year Proposed	Capital Cost
1	Tinana GL Reservoir	1.5 ML	-	-		$1,100,000
TOTAL						**$1,100,000**

8.4.3 Elevated tanks in Maryborough

Analysis shows that the elevated storages in Maryborough do not meet the DNR guidelines. Most tanks are sized at 0.45ML with the exception being the showground elevated tank at 1.0 ML (the 0.05 ML Granville elevated reservoir has been decommissioned). The 0.45ML elevated reservoirs appear to be sized to provide storage for fire flows and do not make sufficient allowance for domestic storage requirements.

It is uneconomical to upgrade the elevated tanks. If pump failure occurs, the tanks' current capacities will provide limited storage to meet domestic demands. It should be noted that existing storage equates to no more than a peak hour's flow.

To meet fire fighting and domestic demands it is proposed that the fire fighting capacity be included in the ground level reservoirs in each zone. When fire flows are required the existing pumps will ramp up and pump directly into the system to meet the required demand.

To facilitate this it is required that the pump stations be made reliable by:-

- providing backup power supply to each of the pump stations by way of a standby generator set, and,
- providing standby pumps in all stations.

8.5 Reticulation

Hydraulic Network Models were developed for each 5 year increment from 2011 (base position) through to 2031 taking into account:

- Average Water demand of 680L/ED/day;
- Population growth as defined in Section 4.0 of this document. Growth was allocated across the city where current zoning under the Maryborough City Plan permitted.
- Peaking factors and diurnal profiles as defined in section 4.0 of this document;
- Existing network operating procedures (pump start/ stop, reservoir levels etc.);
- No failure scenario of 3 consecutive days of maximum day demand (i.e. Average day x 1.9);
- Fire Flow allowance of 15 L/s (residential)and 30L/s (commercial) at peak hour demand at each node in the in accordance with zonings indicated in the Maryborough City Plan.

Where a pipeline failed under the above scenarios during any 5 year time step, that pipeline was identified and an additional (or replacement) pipeline provided to that area. Failure of a pipeline was due either to excessively high velocities or head losses resulting in failure to meet the levels of service specified within the service agreement.

Where a pump station failed to meet the required demand or a reservoir ran out of water, additional pumping capacity or storage was provided.

Modelling was carried out for the ultimate development anticipated by the planning scheme and for intermediate timesteps in 5 year intervals to 2031. Growth rates used in the underlying demand model are consistent with those outlined in section 4, and development sequencing has favoured the Tinana area with infill development throughout the city.

As a starting point, the reticulation layout for the ultimate planning horizon was adopted from the Cardno (2009) Report. This pipeline layout was verified with the demands determined in section 4. Two analyses were carried out, one to meet domestic supply requirements and one to meet fireflow requirements. Any pipes that were determined unnecessary in the ultimate model were removed from the ultimate scenario.

Modelling was conducted in three stages. Demands appropriate to the time step were applied to the reticulation network and the results of the model run were analysed to identify any level of service deficiencies. Where areas failed to meet level of service requirements, pipes were placed consistent with the ultimate scenario. Where additional pump(s) or storage were required, these were placed at the appropriate timestep. The scenario was then re-run to ensure that the required levels of service were achieved.

Residential and commercial fire flow runs were then conducted and any additional deficiencies in system capacity were identified and rectified before moving on to the next time step.

IT was assumed throughout the fire flow analyses that commercial fire flows (30 L/s) would only be provided within the Commercial, Industrial, High and Medium Density Residential Zones within the City of Maryborough. All other hydrants were tested for residential fire flows (15 L/s). Whilst there are a small number of hydrants that do not meet the desired standards, they are generally located on 100mm diameter or smaller dead end mains, in courts, or at DMA boundaries on 100mm diameter mains where flow is only available to the hydrant from one direction. Failure of a hydrant does not mean that water is not available from the hydrant; it simply means that the hydrant does not meet the standards and in some cases could fail to meet them by less than 1.0 L/s. In most cases a solution was offered in terms of pipeline upgrades to rectify the deficiency.

Provision has been made within the forward capital works program to upgrade those mains that fail due to fire flow deficiency. It should be noted that there is no legal requirement for WBWC to provide water for fire fighting purposes nor does WBWC guarantee that water will be available from a hydrant that has been provided in a particular location.

The results of the modelling are qualified to the extent that the condition of the network has been considered to be reasonable. There is insufficient pressure and flow data available at the moment to reach any conclusions about the internal condition of the network. Isolated flow restrictions from internally corroded valves and fittings due to the aggressive water from the Teddington WTP are not possible to model. Nor is it possible to assume internal pipe roughness values that will account for the variations throughout the network due to the random nature of the restrictions. As more data becomes available the level of confidence in the model will be able to be improved.

Three main areas of the reticulation require attention;

- Fire fighting standards are not achievable in areas of the system, even under current demands. These have been identified as being required immediately, however they may be programmed for rectification over a number of years.
- Augmentation of the reticulation system is required in some areas to meet projected growth. It is intended that any mains augmentations required as a result of development be funded from developer contributions. Fraser Coast Regional council is seeking to implement a Regulated Infrastructure Charge in the short term and to prepare a Priority Infrastructure Plan (PIP) for the Council area. It is likely that the PIP will provide for full cost recovery of growth related capital works.
- Security of supply issues were identified in Granville and Tinana. These have been discussed in the section on Trunk Distribution.

The majority of the Maryborough water supply system has network mains able to meet all design parameters. In fact with the exception of some cul-de-sacs and some small areas of development the reticulation system is sized with the capability for sustaining projected future infill growth with minimal upgrades.
Any upgrades required were tabulated and cost estimates based on the unit rates in Appendix 4 were used to prepare the forward Capital Works Program

8.6 DMA Boundaries

Fireflow modelling indicated failure of the water supply system around the area enclosed by Neptune, Russell, Queen and Alice Streets. The cause of this failure is the current location of the DMA boundary which disrupts the main supply line into this area. Relocation of the DMA boundary in this area re-established service levels and with some minor capital works has reduced the overall need for upgrades in the reticulation.

Currently operators are required to manually operate valves if there is a need to provide additional water into a particular DMA. The installation of a few strategically placed stepdown PRV's between the high and low pressure zones would reduce the requirement for manual operation of valves and provide a second feed into DMA's under routine operating conditions. For security of supply reasons each DMA should have a minimum of two feeds. Further modelling needs to be done to refine this proposal.

8.7 Operational Issues

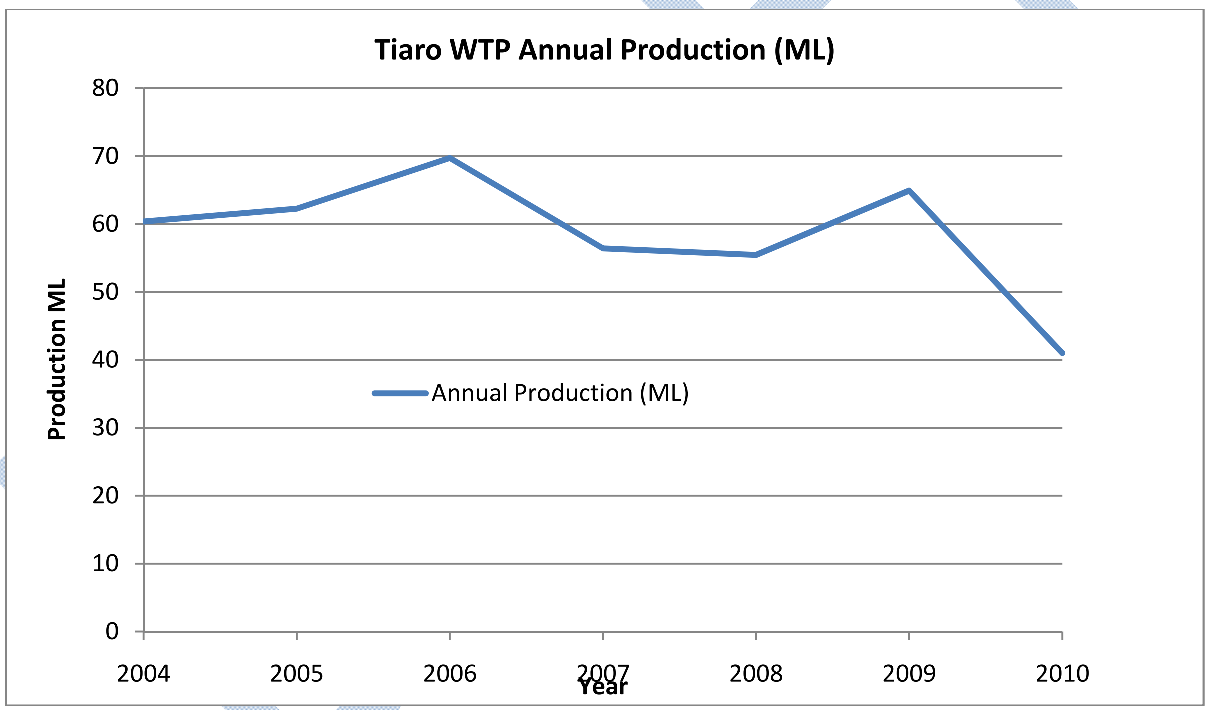
Operational and maintenance issues are beyond the scope of this Report. However, it is understood that many of the cast iron (CI) fittings in Maryborough are tuberculated due to the highly corrosive water, and unlined pipe and fittings have been used in the past for maintenance purposes. Modelling conducted for this report has assumed that the reticulation network is in reasonable condition because the extent of this problem is unknown at this stage.

9.0 TIARO OVERVIEW

Tiaro is a small community located south of Maryborough. The Tiaro Shire was amalgamated in 2008 into the Fraser Coast Regional Council, and henceforth become the responsibility of WBWC. Raw water is sourced from the Mary River and transferred to the Tiaro Water Treatment Plant. WBWC has a High Priority allocation in the Mary Basin Draft Resource Operations Plan of 120 ML for Tiaro.

The treatment plant consists of a combined DAF and filtration plant. From the treatment plant treated water is pumped to a ground level storage (approx 1.25ML) at the same site. From there treated water is pumped directly into the reticulation system. An existing elevated tank (approx 100kL) on Forgan Terrace provides pressure to the network when the pumps are not operating.

Historical annual demand in Tiaro is shown in the following graph. Unfortunately there is limited metered consumption data available due to the recent introduction of water meters. The available consumption data covers the period of dramatic reduction in demand and demand/ED may therefore be underestimated. For modelling purposes the actual metered consumption data has been used but this needs to be reviewed when more data is available. It is recommended that as an interim measure 590 L/ED/day be used as the basis for future planning in Tiaro which is consistent with demand forecasts in Hervey Bay. (Maryborough's current ED demand of 680 L/ED/day has not been used because of excessive unaccounted for water and/or system losses)



A water demand model was developed for Tiaro based on OESR population growth forecasts. In preparing the model it was found that there were some asset information gaps that needed to be addressed, and insufficient metered consumption data was available to be conclusive in demand forecasting. A copy of the Tiaro Water Supply Report is included in Appendix 2, and the results are summarised below;

- Current water demand is estimated at 464L/ED/Day although there is little metered consumption data available. For planning purposes 590 L/ED/day is recommended to be used as an interim measure until more consumption data becomes available.
- The current High Priority allocation of 120 ML in the Draft Mary Basin Resource Operations Plan is adequate for projected growth in Tiaro beyond 2051.
- Losses through the treatment plant are approximately 11.2% of total production.
- Modelling shows that for growth consistent with OESR forecasts, the existing infrastructure is capable of sustaining the projected water demand until 2031.
- Asset and GIS data on the Tiaro water supply system is incomplete and needs to be addressed from an asset management perspective.
- Commercial (non-residential) fire flow conditions (30L/s) cannot be sustained by the existing infrastructure, and augmentations will be required to provide this level of service.
- Residential fire flow conditions (15 L/s) can generally be sustained with augmentations to remove dead ends.

10.0 20 YEAR CAPITAL WORKS PROGRAM

Detailed below is the 20 year capital works program developed from the hydraulic modelling. The program takes into account the adopted standards of service and the operation strategies discussed previously.

10.1 Unit Rates for Water Mains

Contained in the table below are the water main unit rates adopted for calculating the capital costs of the proposed augmentations. The unit rates are based on an analysis of tendered construction rates for projects in South East Queensland. They have been factored to include on-costs such as design, survey, construction supervision and corporate overheads. The rates do not have an allowance for GST.

TABLE: Augmentation Unit Rates

Diameter (mm)	Unit Cost ($/m)
100	$139
150	$184
200	$207
225	$262
250	$278
300	$317
375	$461
400	$480
450	$503
500	$558
525	$603
600	$707
660	$775
675	$820
700	$849
750	$935

The rates above are based on good soil conditions in an urban area. Appropriate multiplication factors are applied to allow for different soil conditions and localities i.e. rural, urban, CBD. Refer to Appendix 3 for further details.

10.2 Proposed Capital Works Programme

The Total Estimated Cost for the 20 Year Capital Works Programme is approximately $17 Million. Location and sequencing of the proposed works are shown in the following diagrams and details of the works are included in Appendix 1.

The year that an item appears is the projected year in which the infrastructure will be required based upon the assumed growth rates and distribution across the network. Changes in development patterns, growth rates and consumption patterns will affect the forward sequencing of the proposed works.

Wide Bay Water Corporation
29-31 Ellengowan Street
Urangan
Hervey Bay, QLD 4655
Telephone 1300 808 888
Facsimile (07) 4125 5118

Important Notice!
This map is not a precise survey document. Accurate locations can only be determined by a survey on the ground.

N

600 0 600 1200 1800
Meters
Scale: 1:30,000

Date Compiled: 12/01/2011

MARYBOROUGH WATER SUPPLY STRATEGY

Stage 2011

Wide Bay Water Corporation

Wide Bay Water Corporation
29-31 Ellengowan Street
Urangan
Hervey Bay, QLD 4655
Telephone 1300 808 888
Facsimile (07) 4125 5118

Important Notice!
This map is not a precise survey document. Accurate locations can only be determined by a survey on the ground.

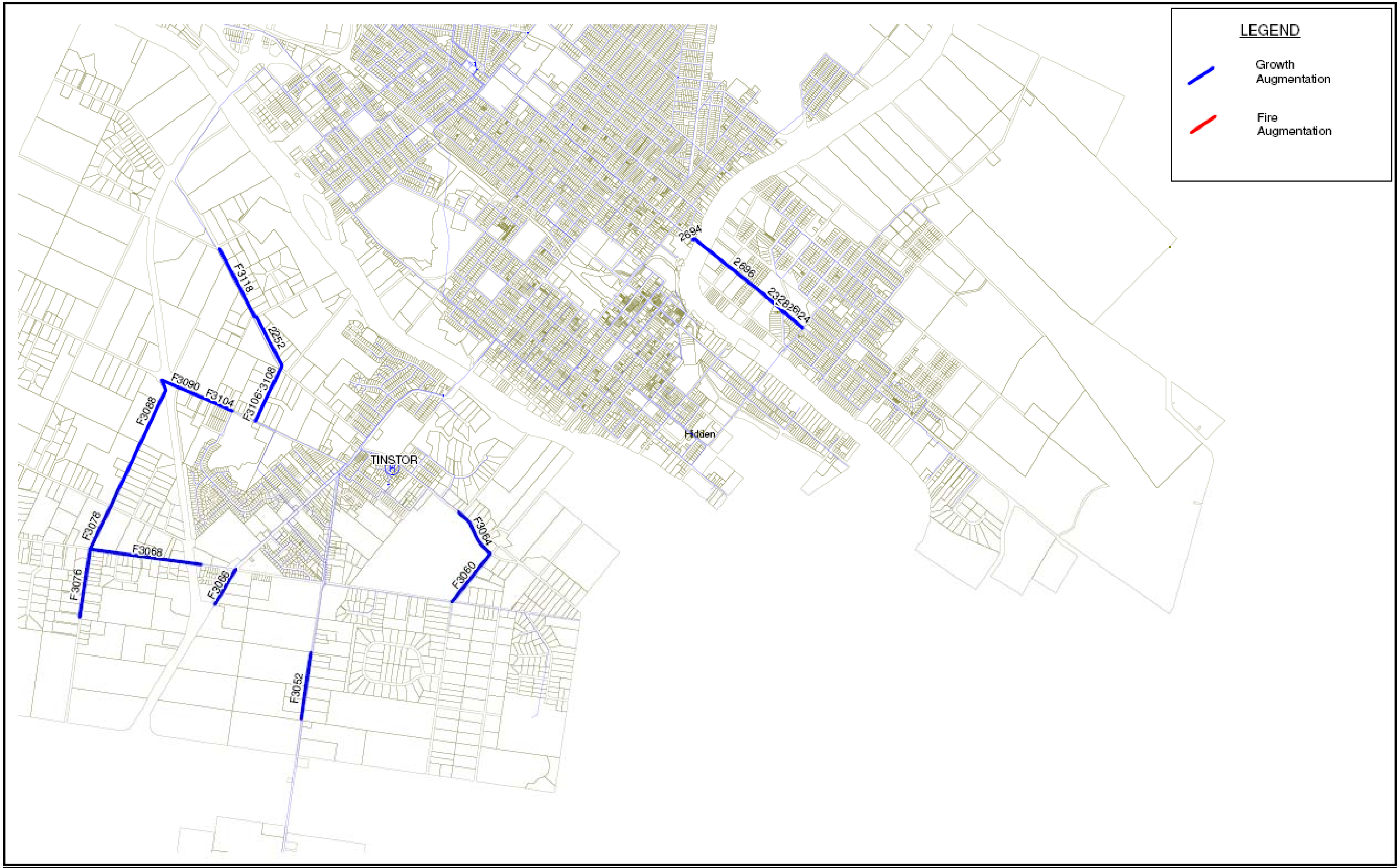
N

600 0 600 1200 1800
Meters
Scale: 1:30,000

Date Compiled: 12/01/2011

MARYBOROUGH WATER SUPPLY STRATEGY

Stage 2016



Wide Bay Water Corporation

Wide Bay Water Corporation
29-31 Ellengowan Street
Urangan
Hervey Bay, QLD 4655
Telephone 1300 808 888
Facsimile (07) 4125 5118

Important Notice!
This map is not a precise survey document. Accurate locations can only be determined by a survey on the ground.

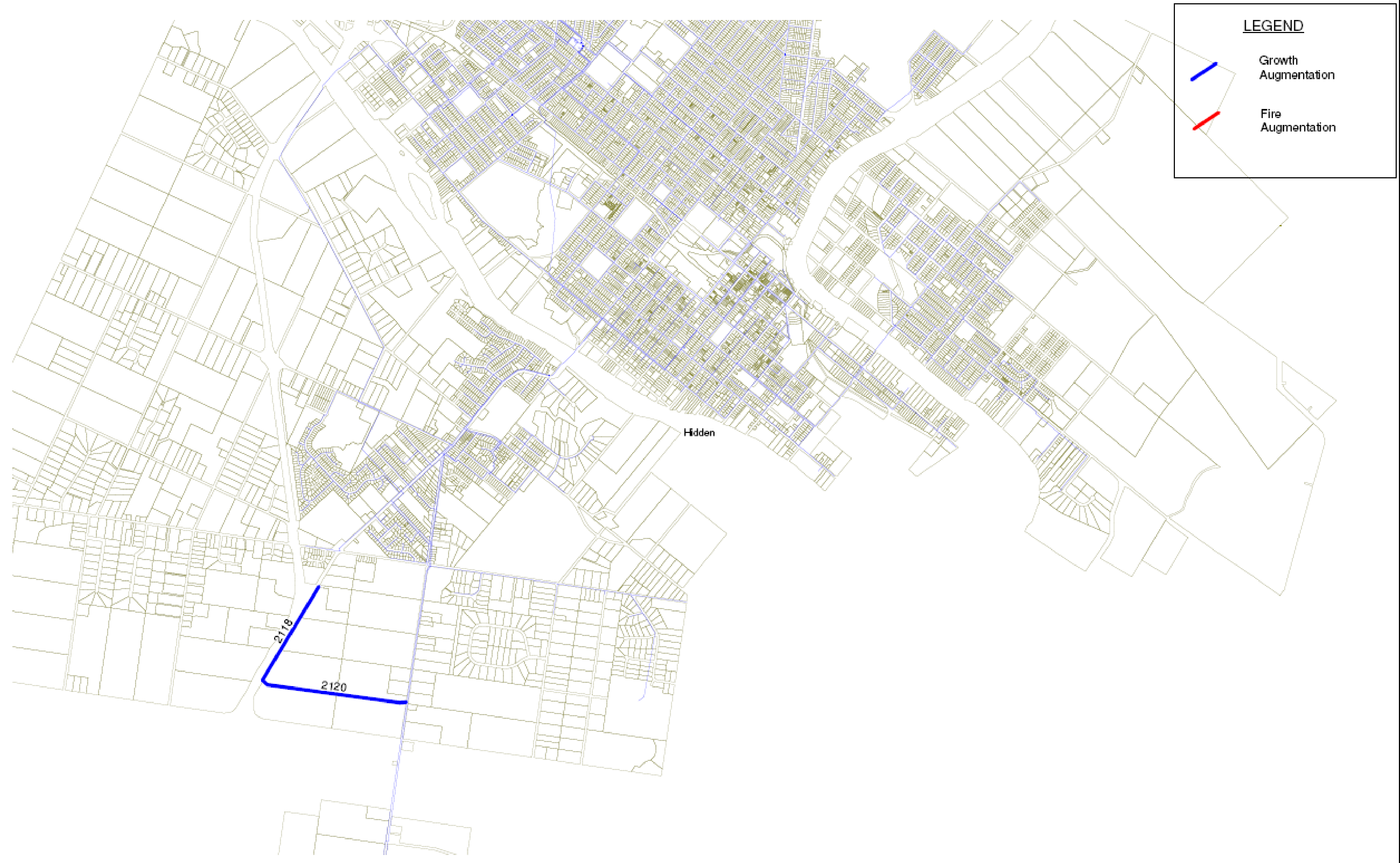
N

600 0 600 1200 1800
Meters
Scale: 1:30,000

Date Compiled: 12/01/2011

MARYBOROUGH WATER SUPPLY STRATEGY

Stage 2021



Wide Bay Water Corporation
29-31 Ellengowan Street
Urangan
Hervey Bay, QLD 4655
Telephone 1300 808 888
Facsimile (07) 4125 5118

Important Notice!
This map is not a precise survey document. Accurate locations can only be determined by a survey on the ground.

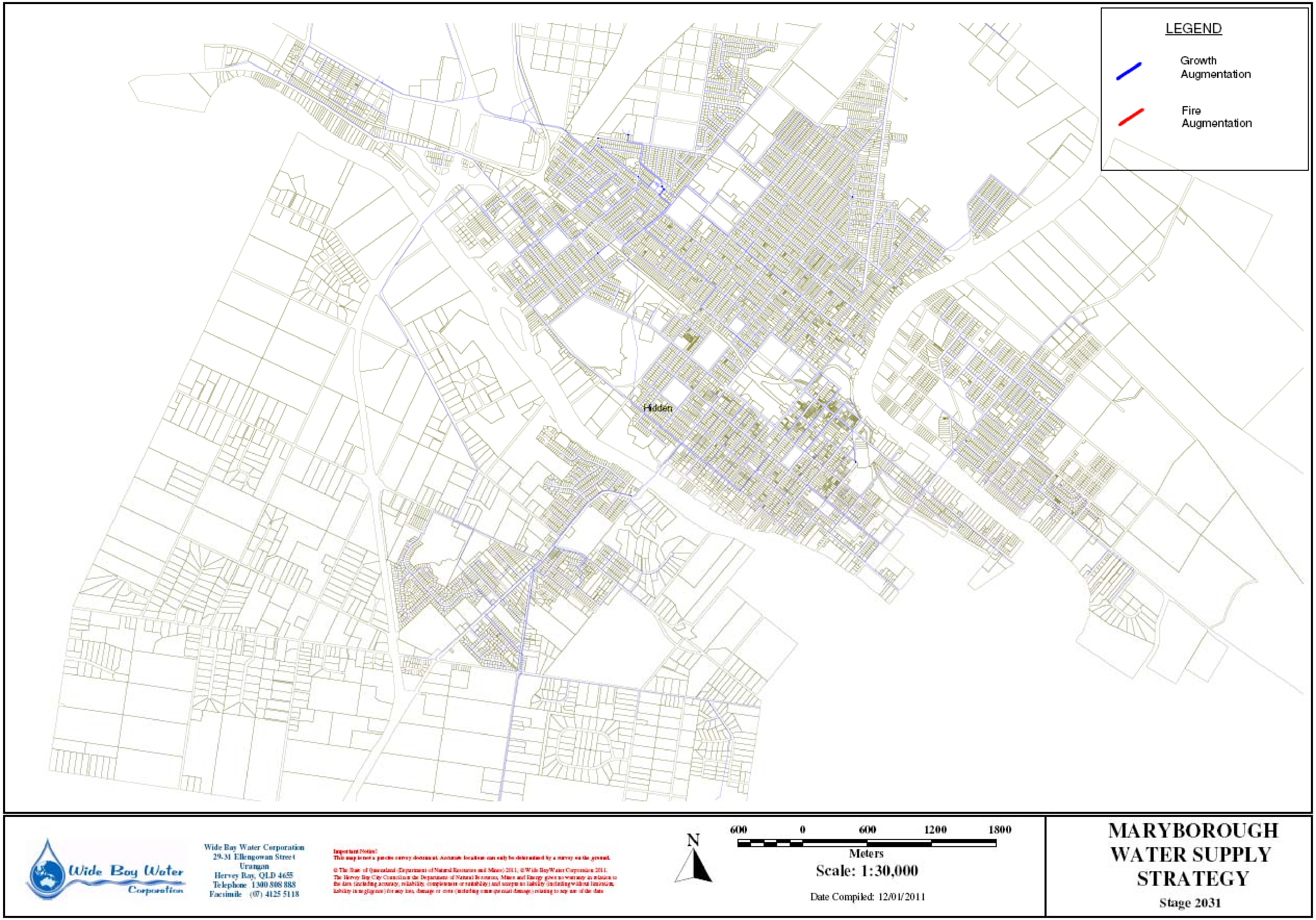
N

600 0 600 1200 1800
Meters
Scale: 1:30,000

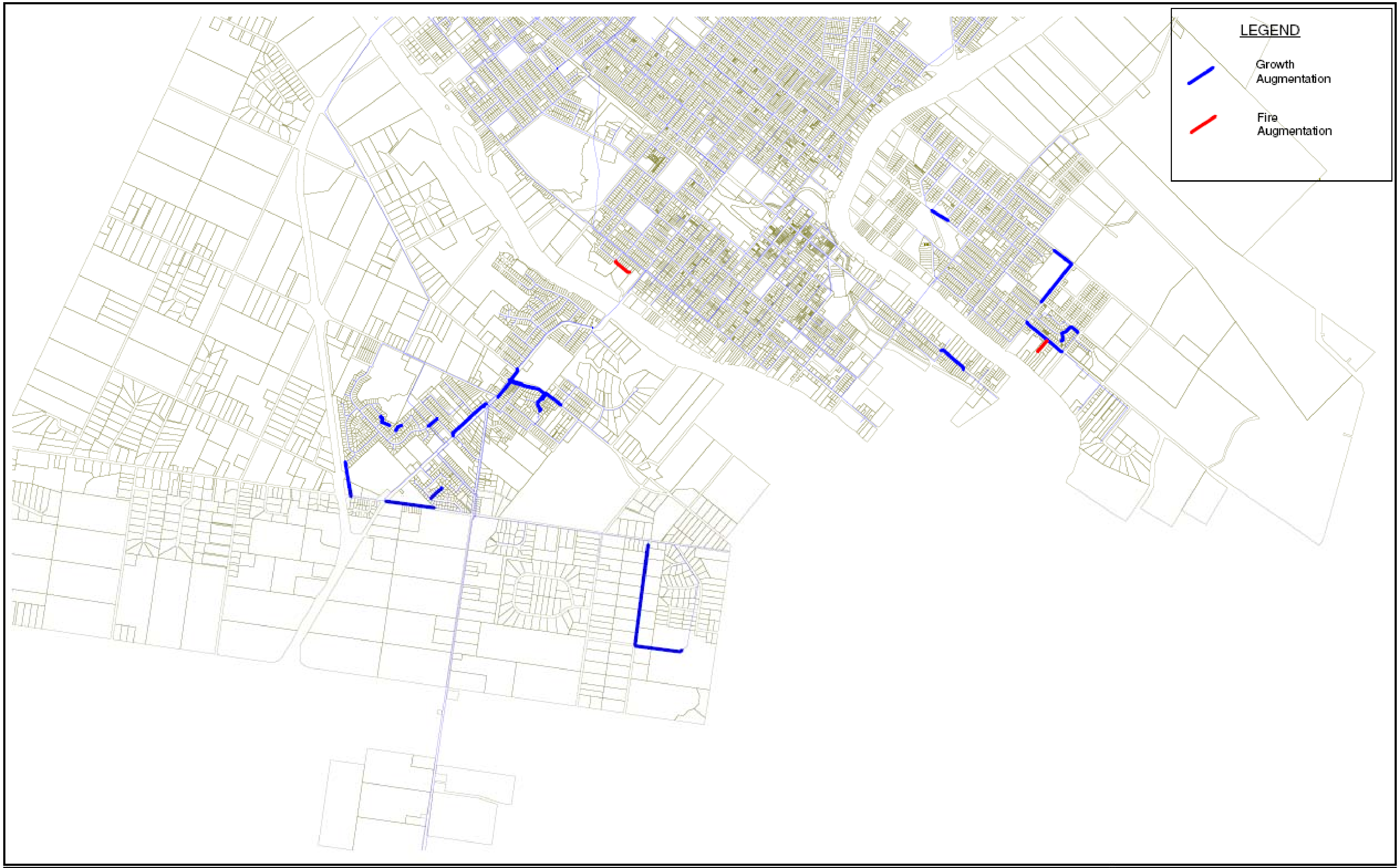
Date Compiled: 12/01/2011

MARYBOROUGH WATER SUPPLY STRATEGY

Stage 2026



LEGEND
Growth Augmentation
Fire Augmentation
Hidden
Wide Bay Water Corporation
Wide Bay Water Corporation
29-31 Ellengowan Street
Urangan
Hervey Bay, QLD 4655
Telephone 1300 808 888
Facsimile (07) 4125 5118
Important Notice!
This map is not a precise survey document. Accurate locations can only be determined by a survey on the ground.
© The State of Queensland (Department of Natural Resources and Mines) 2011, © Wide Bay Water Corporation 2011.
The Hervey Bay City Council nor the Department of Natural Resources, Mines and Energy gives no warranty in relation to the data (including accuracy, reliability, completeness or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data
N
600 0 600 1200 1800
Meters
Scale: 1:30,000
Date Compiled: 12/01/2011
MARYBOROUGH WATER SUPPLY STRATEGY
Stage 2031



Wide Bay Water Corporation

Wide Bay Water Corporation
29-31 Ellengowan Street
Urangan
Hervey Bay, QLD 4655
Telephone 1300 808 888
Facsimile (07) 4125 5118

Important Notice!
This map is not a precise survey document. Accurate locations can only be determined by a survey on the ground.

MARYBOROUGH WATER SUPPLY STRATEGY

Stage Ultimate (post 2031)

11.0 CONCLUSION

This Water Supply Strategy Report for Maryborough provides the basis of a capital development programme untill 2031. It provides for growth rates consistent with OESR forecasts within the urban footprint of Maryborough. Higher growth is expected to occur in Tinana and to a lesser extent in Granville, with infill development occurring throughout the city.

A capital development programme valued at approximately $17 million will be required over the next 20 years to address capacity problems within the existing network and to meet projected growth. This program makes no provision for the replacement of old or truberculated pipes, valves and fittings, and modelling has been conducted on the assumption that the network is in reasonable condition. Higher expenditure is scheduled in the earlier part of the programme to address backlog issues predominantly associated with inadequate provision for fire flows within the current network.

A number of assumptions have been made which include the sequencing of development in Maryborough. Estimated growth rates used in the document will need to be monitored and the Water Supply Strategy adjusted should changes to the assumptions be encountered.

A number of areas have been identified for further investigation including a regional water grid, the capacity requirements of the Teddington WTP and security of supply to Tinana and Granville.

Providing the High Priority allocations in the Draft Mary Basin Resource Operations Plan are available there is adequate water available for projected growth in Maryborough throughout the planning period.

12.0 Recommendations

The following recommendations are made with respect to this report:

1. That the Board adopts the Maryborough Water Supply Strategy Report 2010 as the basis for development of a Capital Works Programme for the period to 2031.

2. That this Report be reviewed every five years, as a minimum, to address any changes to water demand, population growth rates and development sequencing.

3. That a report be prepared to assess the benefits of a regional water grid for Maryborough and Hervey Bay. Any decision on capacity upgrade of the Teddington WTP should be deferred until the results of the regional water grid study have been reported.

4. That an investigation of the scope and severity of corroded valves and fittings in the Maryborough water supply system is commenced, and a program for replacement be developed for inclusion in future budgets.

5. That planning studies are conducted in the 2011/12 financial year to address the following;

    a. Security of supply to the Granville area.
    b. Provision for Fire Fighting storage and delivery.
    c. Storage options for future growth in Tinana.
    d. Recommissioning the Anne Street pumpstation and storages.

6. The Tiaro Water Supply 2010 report in attachment 2 form part of the Maryborough Area Water Strategy Plan.

13.0 REFERENCES

1. Cardno and Davies, 1998, "Maryborough City - Water Supply System Water Supply Planning Report - Final Draft", Cardno and Davies, QLD
2. Cardno and Davies, 1999, "Maryborough City Council – Fire Flow Investigation", Cardno and Davies, QLD
3. Cardno, 2009, "Maryborough – Water Supply Planning Report", Cardno, QLD
4. DNR&M, 2005, Letter regarding groundwater investigations around Maryborough, Natural Resources and Mines , QLD
5. WSAA, 2002, "WSA 03 – 2002 - Water Supply Code of Australia", Water Services Association of Australia, 2002
6. DNRM, 2005, "Planning Guidelines for Water Supply and Sewerage", Department of Natural Resources and Mines, March 2005
7. HWA, 2003, "Review of Chemical Dosing Systems – Teddington WTP", Hunter Water Australia, 2003
8. WBWC, ?, "Process Review – Maryborough Water Treatment Plant"

APPENDIX 1 – CAPITAL EXPENDITURE PROGRAMME

Budget Year	Unique ID	Town	Description	Size	Req	LENGTH (m)	Estimated Cost (2010 $'s)	Related projects
2011-12	2354	MBH	DUPLICATE WINSTON NOBLE DRV	150	Fire	375	$ 82,078.36	MBH004
2011-12	2710	MBH	MAIN ALONG NORTH STREET NORTH ST FROM AMITY ST TO 3M20369	150	Fire	124	$ 27,231.25	MBH004
2011-12	2390	MBH	DUPLICATION COMET ST FROM HARWOOD ST	150	Fire	54	$ 11,765.29	MBH004
2011-12	2462	MBH	MAIN ALONG SEARLE ST BETWEEN RD AND 1SP114242	150	Fire	129	$ 28,239.76	MBH004
2011-12	2682	MBH	MAIN ALONG FRANK ST FROM FRANK ST TO NEPTUNE STREET	200	Fire	313	$ 77,181.48	MBH004
2011-12	2686	MBH	MAIN ALONG FRANK ST FROM ARIADNE ST	200	Fire	316	$ 77,909.67	MBH004
2011-12	2382	MBH	LOOP ALONG SOUTH ST BETWEEN FERRY ST AND FERRY LANE	150	Fire	136	$ 29,733.38	MBH004
2011-12	2356	MBH	LOOP AT CHURCHILL ST	200	Fire	61	$ 18,064.68	MBH004
2011-12	2388	MBH	DUPLICATION ALONG HARWOOD ST FROM ALICE TO COMET ST	150	Fire	135	$ 29,622.17	MBH004
2011-12	AHETPSUG	MBH	ABERDEEN HIGH ZONE PUMP STATION UPGRADE NEW GENSET FOR FF		Fire	0	$ 100,000.00	MBH004
2011-12	ALETPSUG	MBH	ABERDEEN LOW ZONE PUMP STATION UPGRADE NEW GENSET FOR FF		Fire	0	$ 100,000.00	MBH004
2011-12	ASPSUG	MBH	ANNE ST PUMP STATION UPGRADE NEW GENSET FOR FF		Fire	0	$ 100,000.00	MBH004
2011-12	KentPipe	MBH	300MM ALONG KENT STREET BETWEEN GUAVA AND MARCH ST	300	growth	467	$ 170,448.57	MBH006
2011-12	GuavaPipe	MBH	ALONG GUAVA ST BETWEEN KENT AND MARY ST	300	growth	119	$ 43,373.16	MBH006
2011-12	MaryPipe	MBH	ALONG MARY ST BETWEEN TIGER AND GUAVA ST	300	growth	414	$ 151,283.42	MBH006
2011-12	2452	MBH	MAIN ALONG ROAD BETWEEN SEARLE AND BRYANT ST	150	growth	443	$ 115,659.80	MBH007
2011-12		MBH	INVESTIGATION/PLANNING REPORT - WATER -OPTIONS STUDY - GRANVILLE SECURITY OF SUPPLY		Investigation		$ 30,000.00	
2011-12		MBH	INVESTIGATION/PLANNING REPORT - WATER - Anne Street PS		Investigation		$ 30,000.00	
2011-12		MBH	INVESTIGATION/PLANNING REPORT - WATER - OPTIONS STUDY - TINANA WATER SUPPLY STORAGE OPTIONS		Investigation		$ 30,000.00	

2011-12		MBH	INVESTIGATION/PLANNING REPORT - WATER - FIRE STORAGE		Investigation		$	30,000.00	
2011-12		MBH	INVESTIGATION/PLANNING REPORT - WATER - OPTION STUDY -FUTURE WATER SOURCES MARYBOROUGH/HERVEY BAY		Investigation		$	50,000.00	
2011-12	TRWPS	MBH	TEDDINGTON RAW WATER PS UPGRADE		growth		$	330,000.00	MBH020
2011-12	TCWPS	MBH	TEDDINGTON VFD UPGRADE TO CLEARWATER PUMP STATION		growth		$	100,000.00	MBH021
2011-12	W37	TIA	INTERCONNECTOR CRN FORGAN TCE AND LARNER ST	150	Fire	184	$	7,867.22	TIA003
2011-12	W39	TIA	INTERCONNECTOR BROWN ST	150	Fire	184	$	4,519.23	TIA003
2011-12		TIA	INVESTIGATION AND VERIFICATION OF SITE DATA AND MODEL CALIBRATION		Investigation		$	30,000.00	
2011-12	WPS4100	TIA	UPGRADE PS AT MARY RIVER INTAKE		Efficiency		$	30,000.00	TIA007
2011-12	CWPS	TIA	GENSET FOR TIARO CLEAR WATER PUMP STATION		Fire		$	50,000.00	TIA008
2011-12							**$**	**1,884,977.45**	
2012-13									
2012-13	2626	MBH	DUPLICATE CAMPBELL ST BETWEEN NEPTUNE AND TANNER	150	Fire	239	$	52,250.97	MBH004
2012-13	2378	MBH	DUPLICATION WARRY ST	200	Fire	107	$	26,454.28	MBH004
2012-13	2672	MBH	MAIN ALONG GOLDSMITH ST TO JUPITER ST	200	Fire	188	$	46,292.04	MBH004
2012-13	2318	MBH	BANANA ST - WORLSELEY AND ADMIRAL	150	Fire	134	$	29,232.06	MBH004
2012-13	2440	MBH	LOOP BETWEEN QUARRY AND CHARLEMONT	150	Fire	160	$	35,107.77	MBH004
2012-13	2444	MBH	DUPLICATE SUNBURY ST	150	Fire	111	$	24,227.22	MBH004
2012-13	2370	MBH	GUAVA ST NORTH OF KENT ST	150	Fire	115	$	25,141.27	MBH004
2012-13	2618	MBH	LOOP BETWEEN QUEEN ST AND KATHERINE ST	150	Fire	181	$	39,595.74	MBH004
2012-13	2662	MBH	LOOP BETWEEN CRAN AND MCGREGOR ST	150	Fire	291	$	63,679.51	MBH004
2012-13	2624	MBH	NEPTUNE ST BETWEEN ALICE ST AND QUEEN ST	150	DMA	451	$	117,934.98	MBH005
2012-13	2172	MBH	MAIN ALONG RANGE AND CARDIGAN	150	growth	268	$	70,069.45	MBH008

2012-13	2174	MBH	MAIN ALONG CARDIGAN ST	150	growth	230	$	60,102.63	MBH008
2012-13	2180	MBH	MAIN ALONG CARDIGAN ST	150	growth	170	$	44,339.30	MBH008
2012-13	2676	MBH	MAIN ALONG NEPTUNE ST CONNECTING INTO KENT STREET	200	growth	119	$	29,288.65	MBH007
2012-13	W27	TIA	PROPOSED RAIL WAY CROSSING BETWEEN RIVER ST AND HOPPER ST	200	Fire	643	$	41,416.72	TIA002
2012-13							**$**	**705,132.59**	
2013-14	2374	MBH	DUPLICATE KENT ST STH EAST AJAX ST	150	Fire	229	$	50,233.78	MBH004
2013-14	2376	MBH	DUPLICATION ON CYPRESS AV FROM THOMAS TO DOUGLAS PL	150	Fire	53	$	11,618.43	MBH004
2013-14	2668	MBH	LOOP BETWEEN OBRIEN ST AND ADMIRAL STREET	200	Fire	297	$	73,271.14	MBH004
2013-14	2698	MBH	MAIN ALONG YARALLA ST	200	Fire	77	$	18,976.27	MBH004
2013-14	2442	MBH	DUPLICATE ORMOND ST BETWEEN GAYNDAH AND SUNBURY	150	Fire	134	$	29,311.23	MBH004
2013-14	2360	MBH	MAIN ALONG YARALLA ST FROM WALKER STREET TO 46M20151	150	Fire	74	$	16,209.03	MBH004
2013-14	2372	MBH	DUPLICATE AJAX ST NORTH OF KENT ST	150	Fire	143	$	31,238.13	MBH004
2013-14	2664	MBH	MAIN ALONG FERRY LANE TO SOUTH ST	150	Fire	137	$	29,917.54	MBH004
2013-14	2344	MBH	DUPLICATE ISLAND PLANTATION SAMS	200	Fire	633	$	155,863.41	MBH004
2013-14	2420	MBH	DUPLICATE ON KELVIN GROVE ST	150	Fire	249	$	54,485.98	MBH004
2013-14	2666	MBH	LOOP BETWEEN HILLCREST AV AND CARDIGAN STREET	150	Fire	241	$	52,798.98	MBH004
2013-14	2670	MBH	LOOP BETWEEN CAMBRIDGE ST AND ARNAUD ST	200	Fire	351	$	86,439.18	MBH004
2013-14	2680	MBH	CONTINUE MAIN ALONG AVON ST INTO ALDRIDGE ST	150	Fire	85	$	18,608.47	MBH004
2013-14	2688	MBH	MAIN ALONG ARIADNE ST BETWEEN SYDNEY ST TO MARYBOROUGH URANGAN RD	200	Fire	963	$	237,097.91	MBH004
2013-14	2704	MBH	LOOP ON GEORGE STREET	150	Fire	49	$	10,788.40	MBH004
2013-14	2706	MBH	LOOP BETWEEN FERRY LANE AND FORT ST	150	Fire	111	$	24,258.03	MBH004
2013-14	2684	MBH	LOOP FROM BOX ST TO STAFFORD STREET AND CRESCENT ST	150	Fire	163	$	35,662.30	MBH004
2013-14	2366	MBH	KENT ST BETWEEN FERRY ST AND JOHN ST	150	growth	207	$	53,968.14	MBH012

2013-14							**$**	**990,746.33**	
2014-15	www		MAIN ALONG ODESSA BETWEEN DUNDAS AND CAMBRIDGE	300	growth	210			
2014-15	2426		DUPLICATE MELALEUCA CL	150	Fire	134	$	29,354.77	MBH004
2014-15	2202		DUPLICATION GILBERT ST	150	Fire	225	$	49,214.48	MBH004
2014-15	2304		DUPLICATION KINGHORN ST	150	Fire	305	$	66,780.34	MBH004
2014-15	2332		DUPLICATE ERROL ST TO BOOKER	150	Fire	169	$	36,948.75	MBH004
2014-15	2334		DUPLICATE BOOKER SMITH TO ERROL	150	Fire	107	$	23,485.00	MBH004
2014-15	2392		DUPLICATE ALONG QUEEN ST BETWEEN PLEASANT ST AND LIONS DRV	150	Fire	195	$	42,684.12	MBH004
2014-15	2702	MBH	LOOP BETWEEN KOALA CR AND TEDDINGTON RD	150	Fire	345	$	75,603.18	MBH004
2014-15	2396	MBH	DUPLICATE JAY ST FROM CARLISLE ST	150	Fire	114	$	25,030.12	MBH004
2014-15	2362	MBH	100MM INTERCONNECTOR KENT ST ADJ 1RP3477	150	Fire	9	$	1,887.00	MBH004
2014-15	2306	MBH	LOOP GREVILLEA DR AND BOONOROO	150	Fire	358	$	78,378.36	MBH004
2014-15	FTIN	MBH	TINANA PUMP STATION UPGRADE (150KW)	250L/s@36.5m	growth		$	878,811.25	MBH010
2014-15	P2012		MAIN ALONG ODESSA ST FROM STEINDL ST TO 19RP70096	300	growth	113	$	41,374.39	MBH009
2014-15	4017		MAIN ALONG ADESSA ST BETWEEN BANANA ST AND STEINDL STBANANA ST	300	growth	200	$	72,933.31	MBH009
2014-15	W31	TIA	DUPLICATION MAYNE ST BTWN GRENFELL AND EATON ST	150	Fire	184	$	56,403.82	TIA001
2014-15	W35	TIA	DUPLICATION MAYNE ST BTWN GRENFELL AND INMAN ST	150	Fire	184	$	57,946.89	TIA001
2014-15	W41	TIA	DUPLICATION GRENFELL ST BTWN MAYNE AND COPPERHAGEN ST	150	Fire	184	$	26,833.93	TIA001
2014-15							**$**	**1,563,669.71**	
2015-16	F3254	MBH	MAIN ALONG ADELAIDE AND ALBERT	450	growth	621	$	382,000.00	
2015-16	GRANSTOR	MBH	STORAGE RESERVOIR AT GRANVILLE (FOR SECURITY OF SUPPLY) 3.2ML	3.2Ml	growth		$	1,338,595.65	MBH002

2015-16	F3114	MBH	MAIN ALONG EATON VALE RD	250	growth	73	$	24,026.93	MBH003
2015-16	F3112	MBH	MAIN ALONG EATON VALE RD	250	growth	289	$	95,730.95	MBH003
2015-16	F3110	MBH	MAIN ALONG EATON VALE RD	250	growth	455	$	150,651.22	MBH003
2015-16	2242	MBH	MAIN ALONG EATON VALE RD FROM GYMPIE RD TO 51RP32909	250	growth	154	$	51,136.23	MBH003
2015-16	W33	TIA	LOOP ALONG JACOBSEN ST BTWN MAYNE ST AND RAILWAY	150	Fire	184	$	59,443.42	TIA004
2015-16	W43	TIA	LOOP LARNER ST STH OF FORGAN TCE	150	Fire	184	$	19,054.15	TIA005
2015-16	W45	TIA	LOOP NETHERBY RD STH OF EATON ST	150	Fire	184	$	72,363.27	TIA005
2015-16	W49	TIA	LOOP FROM CRN INMAN AND GUTCHY ST TO JOHN AND TIARO ST	150	Fire	184	$	206,248.06	TIA004
2015-16							**$**	**2,017,249.89**	
2016-17									
2016-17	GRANPS	MBH	PS FOR GRANVILLE (40KW)	60L/s @ 36m	growth		$	697,182.00	MBH002
2016-17	GRANELEVSTOR	MBH	ELEVATED STORAGE RESERVOIR AT GRANVILLE (FOR SECURITY OF SUPPLY)	0.8Ml	growth		$	2,210,000.00	MBH002
2016-17							**$**	**2,907,182.00**	
2017-18									
2017-18	TINSTOR		2 MILE STORAGE RESERVOIR AUGMENTATION (STORAGE FOR TINANA)	1.5Ml	growth		$	985,759.38	MBH017
2017-18	2690	MBH	MAIN ALONG LENNOX ST BETWEEN WALKER STREET AND NORTH STREET	300	growth	257	$	93,785.97	MBH001
2017-18	2692	MBH	MAIN ALONG NORTH STREET BETWEEN LENNOX ST 3RP105121	300	growth	217	$	79,124.50	MBH001
2017-18	F3048	MBH	MAIN ALONG TEDDINGTON RD BTEWEEN IINDAH RD AND 183WBAR636	300	growth	626	$	228,580.27	MBH011
2017-18							**$**	**1,387,250.12**	

2018-19									
2018-19	2694	MBH	MARY RIVER CROSSING NORTH STREET TO CAMBRIDGE STREET	300	growth	212	$	755,617.31	MBH001
2018-19	2696	MBH	MAIN ALONG CAMBRIDGE ST FROM MARY RIVER TO RAGLAN ST	300	growth	618	$	225,747.14	MBH001
2018-19	2324	MBH	ALONG CAMBRIDGE ST BTWN GRANVILLE TCE AND ODESSA ST	300	growth	229	$	83,548.55	MBH001
2018-19	2326	MBH	ALONG CAMBRIDGE ST GRANVILLE TCE CROSSING	300	growth	36	$	13,033.06	MBH001
2018-19	2328	MBH	ALONG CAMBRIDGE ST BTWN RAGLAN AND GRANVILLE TCE	300	growth	170	$	62,128.84	MBH001
2018-19	RES4000	TIA	TIARO ELEVATED TANK UPGRADE	130kl ET	Growth		$	278,570.00	TIA006
2018-19							**$**	**1,418,644.91**	
2019-20									
2019-20	F3108		MAIN ALONG OCONNOR RD BETWEEN EATON VALE RD AND 5RP819391	150	growth	296	$	64,853.07	MBH016
2019-20	F3106		MAIN ALONG OCONNOR RD BETWEEN 5RP819391 AND CENTRAL RD	150	growth	226	$	49,377.68	MBH016
2019-20	F3118	MBH	MAIN ALONG EATON VALE RD BETWEEN BUCHANNAN ST ROSEHILL RD	250	growth	666	$	220,523.73	MBH018
2019-20	2252	MBH	MAIN ALONG EATON VALE RD BETWEEN O'CONNOR RD AND BUCHANNAN ST	200	growth	504	$	124,174.95	MBH018
2019-20							**$**	**458,929.44**	
2020-21									
2020-21	F3052	MBH	MAIN ALONG TEDDINGTON RD BETWEEN 183WBAR636 AND 187WBAR636	300	growth	592	$	216,174.24	MBH011
2020-21	F3066	MBH	MAIN ALONG GYMPIE RD BETWEEN IINDAH RD W AND BRUCE HIGHWAY	300	growth	356	$	130,125.62	MBH013
2020-21	F3068	MBH	MAIN ALONG IINDAH RD W BETWEEN HARDIE ST AND BRUCE HIGHWAY	225	growth	978	$	305,209.96	MBH014
2020-21	F3090	MBH	MAIN ALONG CENTRAL RD BETWEEN BRUCE HIGHWAY AND 1RP154769	225	growth	394	$	122,840.87	MBH014
2020-21	F3104	MBH	MAIN ALONG CENTRAL RD BETWEEN 1RP154769 TULIPWOOD DRV	225	growth	280	$	87,439.16	MBH014

2020-21							**$**	**861,789.85**	
2021-26									
2021-26	2118	MBH	MAIN ALONG BRUCE HIGHWAY BETWEEN GYMPIE RD AND THREE MILE RD	150	growth	950	$	207,998.73	MBH019
2021-26	2120	MBH	MAIN ALONG THREE MILE RD BETWEEN TEDDINGTON RD AND THE BRUCE HIGHWAY	150	growth	1273	$	278,759.38	MBH019
2021-26	F3088	MBH	MAIN ALONG GLENRICH RD BETWEEN BLUEBELL RD W AND THE BRUCE HIGHWAY	150	growth	1219	$	266,976.58	MBH014
2021-26	F3078	MBH	MAIN ALONG GLENRICH RD BETWEEN BLUEBELL RD W AND IINDAH RD	100	growth	414	$	68,585.55	MBH014
2021-26	F3076	MBH	MAIN ALONG HARDIE ST FROM INDAH RD W TO 2RP192555	150	growth	600	$	131,312.50	MBH014
2021-26	F3064	MBH	MAIN FROM WOONGOOL RD TO SPRINGVALE RD	225	growth	466	$	145,331.39	MBH015
2021-26	F3060	MBH	MAIN ALONG SPRINGVALE RD FROM WOONGOOL RD TO IINDAH RD E	225	growth	540	$	168,403.37	MBH015
2021-26							**$**	**1,267,367.49**	
Post 2031	F3044	MBH	IINDAH RD W	300	growth	429	$	156,551.97	
Post 2031	F3058	MBH	YANGOORA AV	150	growth	882	$	193,198.55	
Post 2031	F3200	MBH	HOFFMANN ST	250	growth	411	$	135,977.96	
Post 2031	2116	MBH	YANGOORA AV	150	growth	423	$	92,685.35	
Post 2031	2168	MBH	ARNAUD ST	150	growth	429	$	93,875.15	
Post 2031	2170	MBH	BANANA ST	150	growth	196	$	42,817.82	
Post 2031	2226	MBH	WOONGOOL RD	375	growth	394	$	209,005.40	
Post 2031	2234	MBH	YURUGA PL	375	growth	122	$	64,842.53	
Post 2031	2254	MBH	NATHAN ST	300	growth	72	$	26,339.12	

Post 2031	2260	MBH	WOONGOOL RD	300	growth	92	$	33,540.77
Post 2031	2262	MBH	WOONGOOL RD	200	growth	193	$	47,556.47
Post 2031	2266	MBH	WOONGOOL RD	375	growth	10	$	5,419.90
Post 2031	2268	MBH	NATHAN ST	200	growth	171	$	42,043.60
Post 2031	2310	MBH	JULIAN CT	150	growth	78	$	17,025.95
Post 2031	2320	MBH	REGENT ST	150	growth	170	$	37,179.41
Post 2031	2428	MBH	ROSEWOOD CT	150	growth	81	$	17,742.33
Post 2031	2430	MBH	JACARANDA AV	150	growth	146	$	31,974.78
Post 2031	2478	MBH	ARNAUD ST	150	growth	87	$	19,127.88
Post 2031	2480	MBH	JOCELYN PDE	150	growth	100	$	21,952.59
Post 2031	2636	MBH	EATON VALE RD	200	growth	124	$	30,554.77
Post 2031	2638	MBH	CEDAR CT	250	growth	309	$	102,277.39
Post 2031	2640	MBH	NORWAY ST	200	growth	269	$	66,198.47
Post 2031	2642	MBH	GYMPIE RD	200	growth	42	$	10,259.64
Post 2031	2644	MBH	BERTRAM ST	200	growth	391	$	96,204.19
Post 2031	2648	MBH	WALWORTH ST	200	growth	103	$	25,416.99
Post 2031	2658	MBH	POINCIANNA CT	150	growth	145	$	31,749.20
Post 2031	2308	MBH	0	150	growth	133	$	29,172.85
Post 2031	2700	MBH	WARRY ST	150	growth	169	$	37,069.93
Post 2031							**$**	**1,717,760.97**

APPENDIX 2: TEDDINGTON WATER TREATMENT PLANT PROCESS REVIEW

N:\Planning\Teddington THM\Teddington Process Review

APPENDIX 2 – TIARO WATER SUPPLY 2010 REPORT

N:\Planning\Tiaro\Water Strategy 2010\Final\....rev1

APPENDIX 3 – WATER SOURCES

1. Future Surface Water Sources

Consideration of further water sources has not been considered further in this report because the existing supply allocation is adequate for the future needs of Maryborough for the planning horizon to 2051. It should be noted that the Hervey Bay Water Supply Strategy requires an additional water supply source into the future and that the Mary River is the preferred option.

It important to diversify water sources where possible. Maryborough relies solely on surface water for its water supply. Diversification of water supplies along with demand management may provide a more sustainable water supply and reduce the impact during periods of drought. For this reason a review of studies into possible future ground water supplies in the region, desalination and recycled water options (some of which were included in the WBWC (2009) Hervey Bay Water Supply Strategy) is also included here.

2. Groundwater

In 2005, the Maryborough City Council requested a review of the assessments undertaken for the Maryborough area. A summarized report was provided by the Department of Natural Resources and Mines. This report identified the following;

That the Maryborough to Hervey Bay area consists geologically of a series of older predominantly sedimentary and volcanic basement formations (Tiaro Coal Measures, Grahams Creek Formation, Maryborough Formation, and Burrum Coal Measures) extensively overlain by;

- thin sequences of Tertiary age Elliott Formation and minor basalts; and
- young alluvial and dune sand / marine deposits adjacent to major *rivers* and The Great Sandy Strait.

Regional assessment of ground water supply in the Maryborough City Council area was undertaken by the State in the late 1960's to late 1970's, mainly in search of agricultural supplies. Groundwater work was also undertaken in the late 1980's as part of salinity investigations. The investigations used and a summary of the results are outlined below.

Maryborough Area Drilling Results **(Geological Survey of Queensland, Ellis?, 1968).**
Drilling and assessment of 45 investigation bores were carried out between Tiaro in the southwest, north to Burrum River in the north and then east to the coast. Results of this investigation showed that potable bores are low yielding in Tertiary or alluvial aquifers with generally increasing salinity with increasing yield in basement aquifers;

- 8 bores <1 OOOµS/cm but yielding < 1 L/s;
- 10 bores 1OOOµS/cm to 3000µS/cm, yields up to 2.5L/s;
- Remainder generally 1000µS/cm to 5000µS/cm (up to 34800µS/cm) generally yielding up to 6L/s but with a max of 10L/s)

Mary Valley Groundwater Investigations - Hydrogeological Report on Area between Tiaro and Pialba **(Geological Survey of Queensland, Laycock, 1969).**

Drilling and assessment of 59 investigation bores showed that formations with potable quality supply reported yields <1.25L/s with the exception of Tertiary basalts in Nikenbah area where yields between 3.75L/s and 6.25L/s were encountered. Alluvial aquifers potentially suitable for small scale irrigation were identified, but were generally unsuitable for human consumption. Follow up investigations are recommended on Nikenbah basalts and Maryborough-Boonooroo Tertiary (Elliott) sediments.

Mary Valley Groundwater Investigations - Drilling and Testing Sand-Gravel Aquifer Boonooroo Area **(Geological Survey of Queensland, Laycock, 1975).**
Drilling and assessment of 18 investigation bores including 4 pumping tests between the northern Tuan State Forest and Boonooroo showed that the aquifer is widespread with good water quality (usually <1000µS/cm), but generally thin and low yielding. Test production bores were drilled at the 4 best investigation sites and were test pumped yielding between 0.5L/s and 4.5L/s. The report identified potential higher yielding paleochannel but concluded that the aquifer was extremely variable and did not recommend additional investigation.

Groundwater Resources of Queensland **(Geological Survey of Queensland, 1973)**.
Carried out Statewide for identification of groundwater potential. Results were that "The Maryborough Formation...and the Burrum Coal Measures... yield small supplies of groundwater ... often brackish in quality. The poorly consolidated sediments of the Elliott Formation of Tertiary age, occurring between Maryborough and Booonooroo, *have* potential for supplies of good quality water <1000 ppm), with yields in excess of 1000 gph (1.25L/s)."

Lower Mary Irrigation Area Groundwater Salinity and Airborne Multispectral Scanner Investigations **(Queensland Water Resources Commission, Pearce, 1988).**
Drilling and assessment of 29 investigation bores and numerous private bores from Tiaro to Maryborough were performed. The summary of these results were that 'With the exception of groundwater contained within the Tertiary Elliott Formation most of the remaining groundwater located in the area are of poor quality and unsuitable for irrigation."

Based on the results from the above investigations it is apparent that the prospects for significant yields of good quality groundwater in the Maryborough City Council area are poor. Although numerous private bores have been added to NR&M's groundwater database since these investigations, the data supports these original conclusions. The only potential target is the Tertiary Elliott Formation in the area to the north of, and within the northern Tuan State Forest; *however* conditions indicated to date suggest that extensive investigation would be required to locate sufficient productive sites and to assess the sustainability of such a supply.

3. Desalination

Desalination is the process of removing dissolved salts from saline or brackish water to make it fit for human consumption. Water desalination technology has been in use worldwide for decades and is rapidly advancing, in particular for potable water supplies. A number of desalination plants have been constructed in Australia in recent years with a number planned by various water service providers, predominantly in higher population areas such as Perth, Melbourne and SE Queensland.

There are two recognised desalination technologies utilised for potable supplies:

1. Thermal (evaporation)
2. Membrane filtration

Membrane filtration is the most common system utilised in Australia with membrane development and system operation improving at a rapid pace. Reverse Osmosis processes have recently been constructed in Queensland with the largest being on the Gold Coast (125 Ml/day) suppling the South East Queensland region.

WBWC Engineering Staff commenced a review of desalination options last year as a method of providing supply to our more remote communities (Burrum and River Heads) while reducing demand on our existing infrastructure. The following comments were provided in the review report:

Process:
Reverse Osmoses (RO) involves more than just a RO membrane, it requires feed water that is of very high quality so as not to deposit any particles or particulates within the membrane that would be impossible to remove at a later date. This involves passing the water through a very fine sand filter, or to achieve better water quality through another membrane treatment system which will produce water of very high quality suitable for the RO plant. After passing through the RO membrane the salt content of the raw water will be reduced by 98 - 99%. This treated water is very pure but highly aggressive to pipes and fittings. Extra chemicals are added at the end of the process to provide additional alkalinity and minerals, to balance the water delivered to our customers.

Considerations:
Energy
Reverse Osmoses treatment plants traditionally use a large amount of power in order to reach the pressures required to remove the salts from the water. These costs are being reduced as the technology is improving. Currently costs are approximately $1.25 per KL of water produced. This break down encompasses, Power Cost = $ 0.82, Chemical Cost = $ 0.13, Membrane Replacement costs = $ 0.15, Maintenance costs = $ 0.15 (per m^3 permeate).

Resource
Extraction would ideally be from a location where the water is collected through sand, providing an initial barrier to particulates and organic material.. From initial consultation with the EPA with regard to the construction of a desalination plant, they have indicated that they will form a special team to decide on whether such a project is feasible from their point of view. Extraction of water from the waters around Hervey Bay and return of concentrated brine may have some impact on the existing environmental conditions and indications are that DERM may be opposed to such a development.

Maintenance
An R.O. treatment plant does not require any more maintenance than a conventional plant; it has a far smaller footprint and has no issues associated with blowers and large mechanical works but it does have high pressure pumps and anti-scaling dosing facilities which ideally should not require any special maintenance. The design life of an R.O. plant is approximately 20 - 25 years, though the membranes (as with any membrane plant) will require replacement at 5-year intervals.
The costs involved with maintenance have been integrated into the above costing figures. All manufacturers offer a service contract with immediate response to ensure the integrity of the treatment systems, and will require negotiation during the contract period or at tendering.

Chemicals.
The following chemicals may be used in treatment processes in a desalination plant but their use will depend on trials and treatability studies.

Chemical	Issue	Measurement
Coagulant	Enhance flocculation in pretreatment filtration	Total Suspended Solids (TSS) Iron (mg/L)

Chlorine	Microbiological growth in pretreatment	Total Organic Carbon (TOC)
Sodium Metabisulfite	Remove chlorine prior to RO membranes	Total Chlorine – ppm Oxidation Reduction Potential (ORP) – mV
Antiscalant	Scale formation on membrane elements	Stiff-Davis Saturation Index (SDSI) Langelier Saturation Index (LSI)
Acid or Caustic	Feed pH – boron rejection, permeate pH	pH
Calcite Mineral	Product Water corrosion potential	Hardness (mg/L)

Cost

Reports developed by GHD in 2003 and by AWA in 2008 identify the cost of development and operation of seawater desalination plants. As with most water or wastewater treatment facilities, economies of scale come into effect as plants increase in size and development and operation costs go down. The following is a potential option for WBWC:

Option	Capacity (ML/d)	Capital Cost	Annual O&M Cost	O&M Cost per kL
Construct a single 20 ML/d Plant (Location to be determined)	20.0	$74.3m	$8.95m	$1.23

Notes:

- No additional treatment is needed at each site;
- The 20 ML/d plant will require a pipeline to existing reservoir storages;
- Potential sites include:
    - River Heads
    - Booral

While these sites are approximately 30km from Maryborough, they would provide a consistent and reliable water source.

4. Indirect Potable Reuse

Recycled Water has been identified in the Regional Water Supply Strategy (RWSS) as a potential opportunity to reduce demand on potable water supplies in the event of an extreme drought. The RWSS defines Recycled Water as:

- Sewage or treated sewage
- Greywater, and
- Wastewater (Queensland Government 2008)

From July 2008, recycled water is regulated under the *Water Supply (Safety and Reliability) Act 2008.* This act defines a regulatory framework for both recycled and drinking water in Queensland.

Recycled water is available in different quantities, reflecting source water and level of treatment. There are two broad categories defined under the Act:

1. Recycled water that is used for potable reuse (augmented drinking water supplies, also known as purified recycled water (PRW);
2. Recycled water for non potable reuse.

For the purpose of this report, we are dealing with treated recycled water through an IPR process to reduce demand on the existing potable supplies.

The recently constructed Nikenbah WWTP was designed to provide a high quality treated effluent and for that effluent to be piped to the Cassava Dams and then retreated to reduce demand on potable supplies from the Burrum River system. Additional State Government subsidies were forthcoming on that project for that purpose and it met State requirements current at that point in time.

Purified Recycled Water (PRW) is wastewater that has been treated to the highest standard through a seven-barrier process (*Water Supply (Safety and Reliability) Act 2008).*

The seven barriers are:

1. Residential/ source control
2. Wastewater treatment plants
3. Microfiltration
4. Reverse osmosis
5. Advanced oxidation
6. Blending of water into a natural reservoir, such as a dam
7. Water treatment plant.

Public perception of such a scheme has not been determined although the Corporation has always been very clear in the potential use of treated effluent as a water supply source in the event of a major drought.

APPENDIX 4 – WATER INFRASTRUCTURE

Table: Water Main Cost factors for various construction conditions

DEPTH	*LEVEL OF DEVELOPMENT*	*SOIL TYPE*	*COST ADJ ID*	*WATER MAIN*	
				WMN 150 to <300mm	WMN 300 to <600mm
Min. depth	Urban	Sand	Min. depth/Urban/Sand	1.34	1.24
Min. depth	Urban	Good Soil	Min. depth/Urban/Good Soil	1.00	1.00
Min. depth	Urban	Poor Soil (High WT areas)	Min. depth/Urban/Poor Soil (High WT areas)	1.42	1.31
Min. depth	Urban	ASS areas	Min. depth/Urban/ASS areas	1.45	1.33
Min. depth	Urban	Soft Rock	Min. depth/Urban/Soft Rock	1.18	1.15
Min. depth	Urban	Hard Rock	Min. depth/Urban/Hard Rock	1.47	1.40
Min. depth	Urban	Underwater	Min. depth/Urban/Underwater	2.49	1.80

1.0 Rates for other Water Infrastructure

Rates for ground level and elevated reservoirs and pump stations were adopted from the WBWC estimating spreadsheet. For reservoirs the costs vary in accordance with the storage volume and the material type. It was assumed for the purposes of this report that the material type for ground level and elevated reservoirs was concrete and steel respectively. The costs for pump stations vary with the kW rating of the pump station.

Table – Pump Stations

Total Station kW	***Civil***	***Pipework and Equipment***	***Mechanical***	***Electrical***	***Total Cost***
10	$33,089	$26,102	$23,385	$42,639	$125,215
20	$63,851	$43,231	$37,546	$61,385	$206,013
30	$92,409	$58,073	$49,529	$75,968	$275,978
40	$118,879	$71,600	$60,285	$88,372	$339,135
50	$143,374	$84,227	$70,211	$99,370	$397,182
75	$196,649	$113,143	$92,618	$122,978	$525,388
100	$222,071	$139,500	$112,730	$143,057	$617,357
150	$262,689	$187,391	$148,707	$177,044	$775,828
200	$291,507	$231,042	$180,999	$205,949	$909,496
250	$313,860	$271,789	$210,802	$231,582	$1,028,033
300	$332,125	$310,362	$238,761	$254,877	$1,136,123
350	$347,567	$347,215	$265,273	$276,391	$1,236,447
400	$360,942	$382,658	$290,608	$296,491	$1,330,700

450	$372,741	$416,913	$314,956	$315,429	$1,420,040
500	$383,296	$450,145	$338,460	$333,393	$1,505,294
600	$401,560	$514,029	$383,350	$366,929	$1,665,869
700	$417,003	$575,067	$425,919	$397,902	$1,815,890
800	$430,379	$633,768	$466,596	$426,837	$1,957,582
900	$442,178	$690,501	$505,690	$454,102	$2,092,471
1000	$452,732	$745,542	$543,427	$479,963	$2,221,663
1050	$457,620	$772,494	$561,843	$492,433	$2,284,391
1100	$462,280	$799,101	$579,984	$504,625	$2,345,989
1150	$466,733	$825,379	$597,865	$516,555	$2,406,533
1200	$470,996	$851,350	$615,502	$528,242	$2,466,090
1250	$475,086	$877,026	$632,907	$539,702	$2,524,720
1300	$479,015	$902,425	$650,093	$550,944	$2,582,477
1350	$482,795	$927,559	$667,070	$561,984	$2,639,410
1400	$486,439	$952,442	$683,850	$572,832	$2,695,562
1450	$489,954	$977,083	$700,440	$583,497	$2,750,975
1500	$493,350	$1,001,495	$716,850	$593,990	$2,805,685

Table : Ground Level Reservoir costs

Capacity (ML)	***Total Cost***
0.1	$138,580
1	$531,984
5	$1,362,187
10	$2,042,201
15	$2,588,039
20	$3,061,682
25	$3,487,988
30	$3,880,008
35	$4,245,638
40	$4,590,097
45	$4,917,056
50	$5,229,217
55	$5,528,640

Table : Elevated Reservoir costs

Capacity (ML)	***Total***
0.1	$213,883
0.2	$343,257
0.3	$622,130
0.4	$1,050,505
0.5	$1,628,379
0.8	$2,100,000
3.0	$6,000,000*
4.0	$8,000,000*

*Extrapolated figures