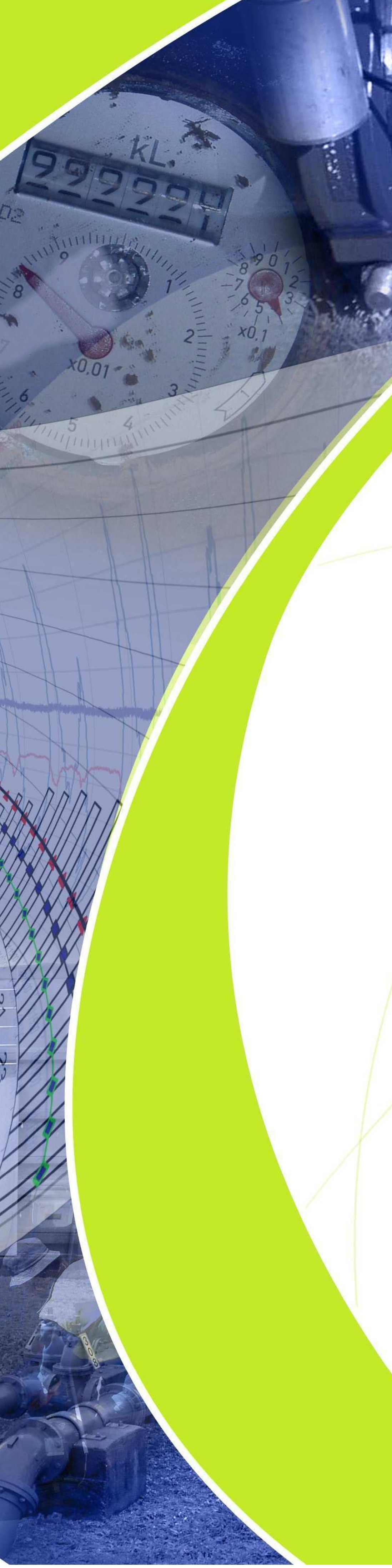

Tiaro Water Supply 2010

Supplement to Maryborough Water Supply Strategy 2010

WIDE BAY WATER CORPORATION

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1 BACKGROUND

Prior to amalgamation, Tiaro Shire was an area of 2196 sq km, immediately south of Maryborough. The majority of the Shire was amalgamated with Maryborough City, Hervey Bay City and Woocoo Shire in 2008 to form Fraser Coast Regional Council. Tiaro is a small community with a population of 363 (2001).

2 SYSTEM OVERVIEW

Raw water is sourced from the Mary River through a submersible pump which transfers raw water to the Tiaro Water Treatment Plant through a 100mm main.

The treatment plant consists of a combined DAF and filtration plant. From the treatment plant, water is pumped to the onsite ground level storage (approx 1.25ML). Treated water is pumped directly into the reticulation system. An existing elevated tank (approx 100kL) on Forgan Terrace floats on the system.

Limited documented information has been able to be obtained on the water supply system in Tiaro.

Figure 1: System overview of intake and treatment plant at Tiaro

3 RETICULATION SYSTEM

3.1 Tanks

There are two main storages in the Tiaro system. One ground level reservoir located at the water treatment plant and an elevated reservoir located at Forgan Terrace. Tank sizes are estimated from site inspections.

Forgan Terrace Elevated Reservoir:

Height of stand = 20m
Diameter of tank = 6m
Height of tank = 3.5m
Estimated capacity of this tank is 100kL.

Table 1: Forgan Terrace Elevated Reservoir Details

Parameter	*Value*
TWL	23.5m
BWL	20.0m
Initial level	22.5m
Ground level at tank	49.2m

Water Treatment Plant Ground Level Reservoir:

Height of reservoir = 4m
Diameter of reservoir = 20m
Estimated capacity of this reservoir is 1.25ML.

Table 2: Tiaro WTP Ground Level Reservoir Details

Parameter	*Value*
TWL	4.0m
BWL	0.0m
Initial level	3.0m
Ground level at tank	32.0m

3.2 Pipes

Pipe data was obtained from the GIS records for Tiaro.

Table 3: Length of Mains by Material Type

Material	*Length (m)*
PVC	7618.2
AC	3354.3
MDPE	1158
uPVC	201.2

3.3 Pumps

There are three pump stations in the Tiaro system.

Table 4: Pump Station Details

Pump	***Type***	***Duty***		***Power (kW)***
		Head (m)	**Flow (L/s)**	
Extraction Pump (WPS4100)	Grundfos submersible SP 46-07	60	12.5	11
Transfer Pump 1 & 2	TEFC NM100-65 200/200	11	14	30
Clearwater Pump (CWPS)	Premier 100-65 200/250	75	25	37

3.3.1 Pump Controls

Controls for the pump stations were not available. The assumed controls are:

- All pumps are controlled by reservoirs
- All reservoirs are to be maintained at almost full (0.5m below full level)

The resulting control settings used in the model are.

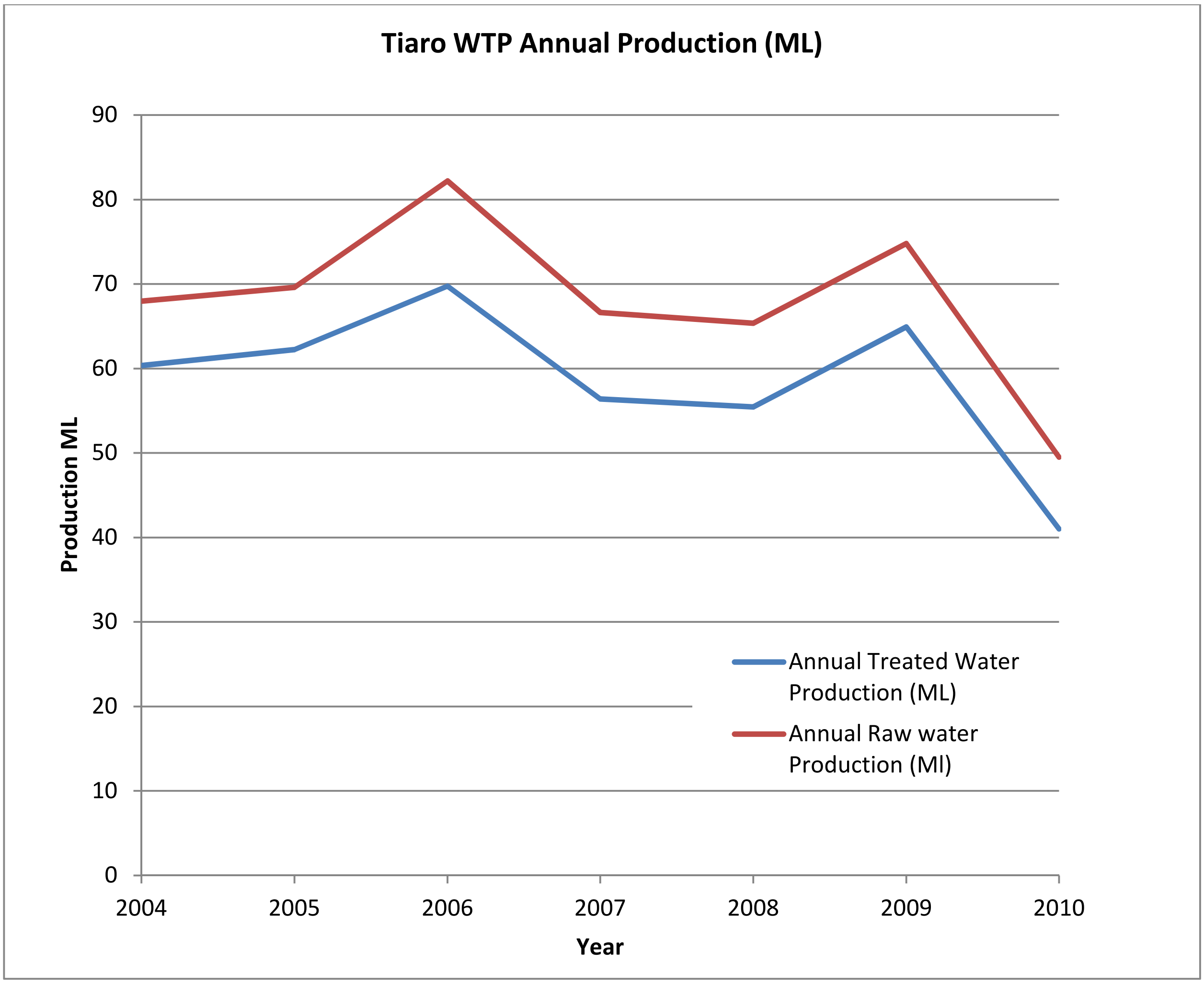
Table 5: Assumed Pump Station Control Details

Pump Station	*Controlled by*	*Pump start level*	*Pump stop level*
Extraction Pump	TWTP	3	3.7
Transfer Pump #1	Tiaro Ground Level Reservoir (TGLR)	3	3.7
Transfer Pump #2	Tiaro Ground Level Reservoir (TGLR)	3	3.7
Clearwater Pump	Tiaro Elevated Reservoir	22.5	23.4

4 WATER DEMAND

4.1 Existing Production

The annual production of water at Tiaro shows a downward trend. The data available is limited and reliable conclusions cannot be made without additional historical data.



4.2 Average Day Demand Allocation

Metered water consumption data was obtained from Water Billing. Less than 2 years of data was available, as water meters have only recently been installed. 2009 production data resulted in total consumption at 65 ML per annum, however this significantly reduced in 2010. There is no definitive explanation for this decrease (for example the installation of water meters or drought restrictions). However, with such a small community and volume of consumption, fluctuations of this degree are possible.

A system and demand review was undertaken with this data.

Table 6: Average Day Demand for Tiaro in Litres

	Connections	*Occupied Lots (Connections with demand>20L/day)*	*Average Consumption per Development Type*	*Average Total Daily Demand*	*Average Consumption inc. Water losses (estimated 35%)*
Residential	219	204	422	86161	570
Non-Residential	59	46	615	28284	830
Total	278	250		114445	

Based in the limited available data the analysis suggests that the average residential demand in Tiaro is similar residential demand in Hervey Bay.

Table 7: Comparison of Residential Water Demands per Equivalent Dwelling.

Town	*L/ED/day*
Maryborough	680
Hervey Bay	590
Tiaro	570

Using these figures there are 219 Residential connections in Tiaro and 59 Non-Residential connections. Of these some 7% are considered vacant (demand less than 20L/day). The Average ED consumption based on residential demand is 570L/ED.

4.3 Peaking Factors

4.3.1 Mean Day Maximum Month Factor

Mean Day Maximum Month factor = 1.35

4.3.2 Peak Day Factor

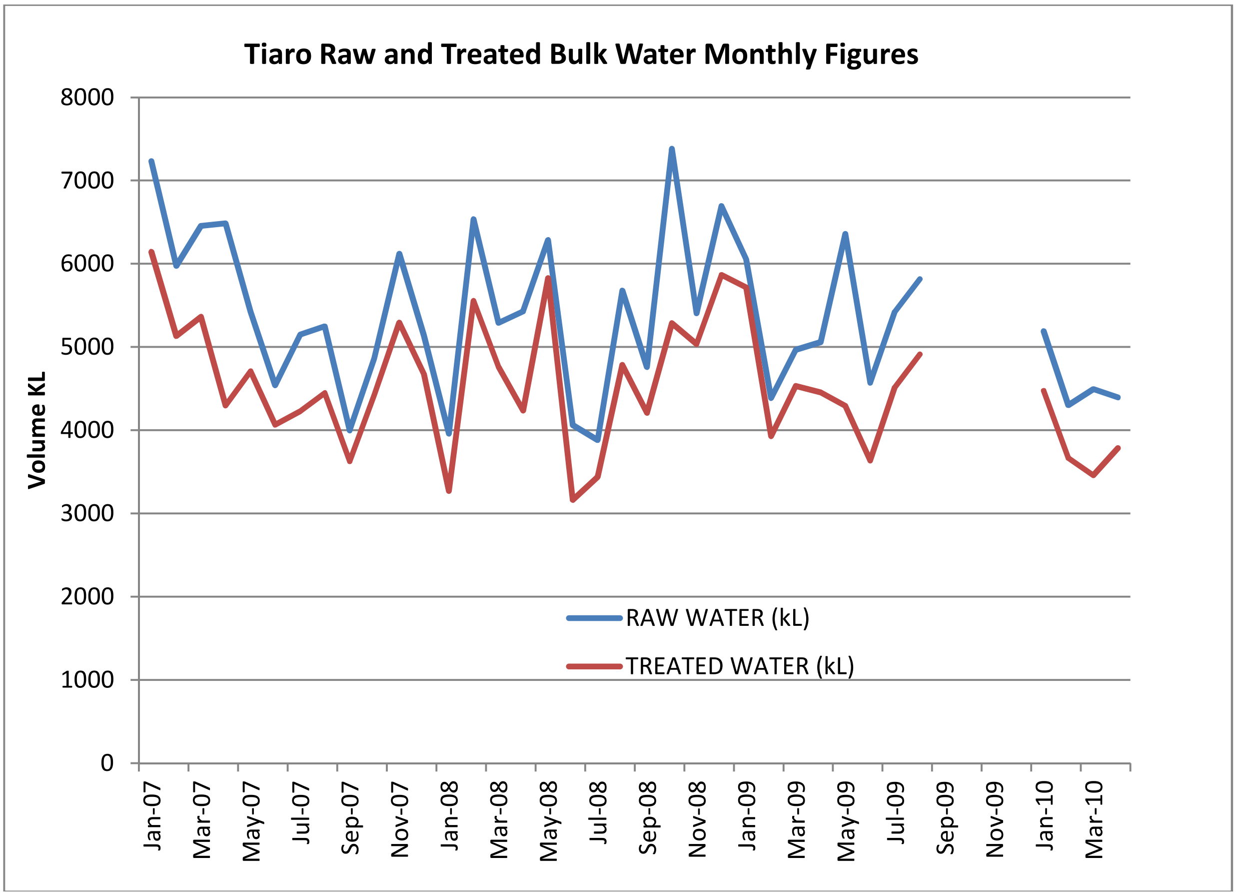
Peak day factor = 2

NB: The factors were compared with the WSAA code for water supply and compared favourably with peaking factors used in Maryborough. Maryborough had a MDMM from historical data of 1.4 compared with 1.35 at Tiaro, and a PD factor on 1.9 compared with 2.0 in Tiaro. The assumption of 2.0 for Tiaro is reasonable as higher peaking factors in smaller communities is expected.

4.4 Unaccounted Water

The losses through the treatment plant are approximately 14.9% (from 2008-2010 bulk water readings). These losses could be attributed to normal operation of the Water Treatment Plant like backwashing filters and disposal of DAF by-products.

Figure 2: Raw and Treated Bulk Water at Tiaro WTP.



These losses are included when sizing headworks infrastructure from the source to the treatment plant, but not considered when sizing infrastructure downstream of the treatment plant.

Unaccounted for water is generally determined as the difference between the production water and the consumption water. These losses can be made up of several components including:

- Inaccurate meter recording – generally as the meter ages they err on the low side;
- Water leakage through joints and fittings. These are generally targeted as part of normal routine maintenance of a system;
- Water theft – For examples might be tankers filling up at hydrants without approval or bypassing water meter;
- Operational losses including water for fighting fires, flushing of hydrants, emptying of mains, disinfection etc.

There is a large discrepancy between production data and total metered consumption in Tiaro. For 2008 and 2009 the unaccounted water is in order of 30-40% of the total average daily production. However this reduces in 2010 when the consumption volume decreases. No conclusion can be drawn on the percentage of unaccounted for water without further data.

The assumption of 35% is high when compared with other water utilities around Australia and further investigation of this volume of unaccounted for water needs to be undertaken.

4.5 Diurnal Curves

The diurnal curves for the Tiaro area were adopted from the Maryborough and Hervey Bay water models as no data for Tiaro was available.

4.6 Future Demand Forecasts

Regional growth data is available and this was used for the purposes of determining the percentage increase in water demand. It is assumed that water demand growth will be proportional to population growth. For small communities this is a reasonable assumption where there are no major agricultural, commercial or industrial ventures.

The Office of Economic and Statistical Research (OESR) gives a regional average annual growth rate at approximately 2.1% however the actual annual growth rate varies slightly for each time period.

Figure 3: Historical ED and Projected Growth for Tiaro 2004 - 2031

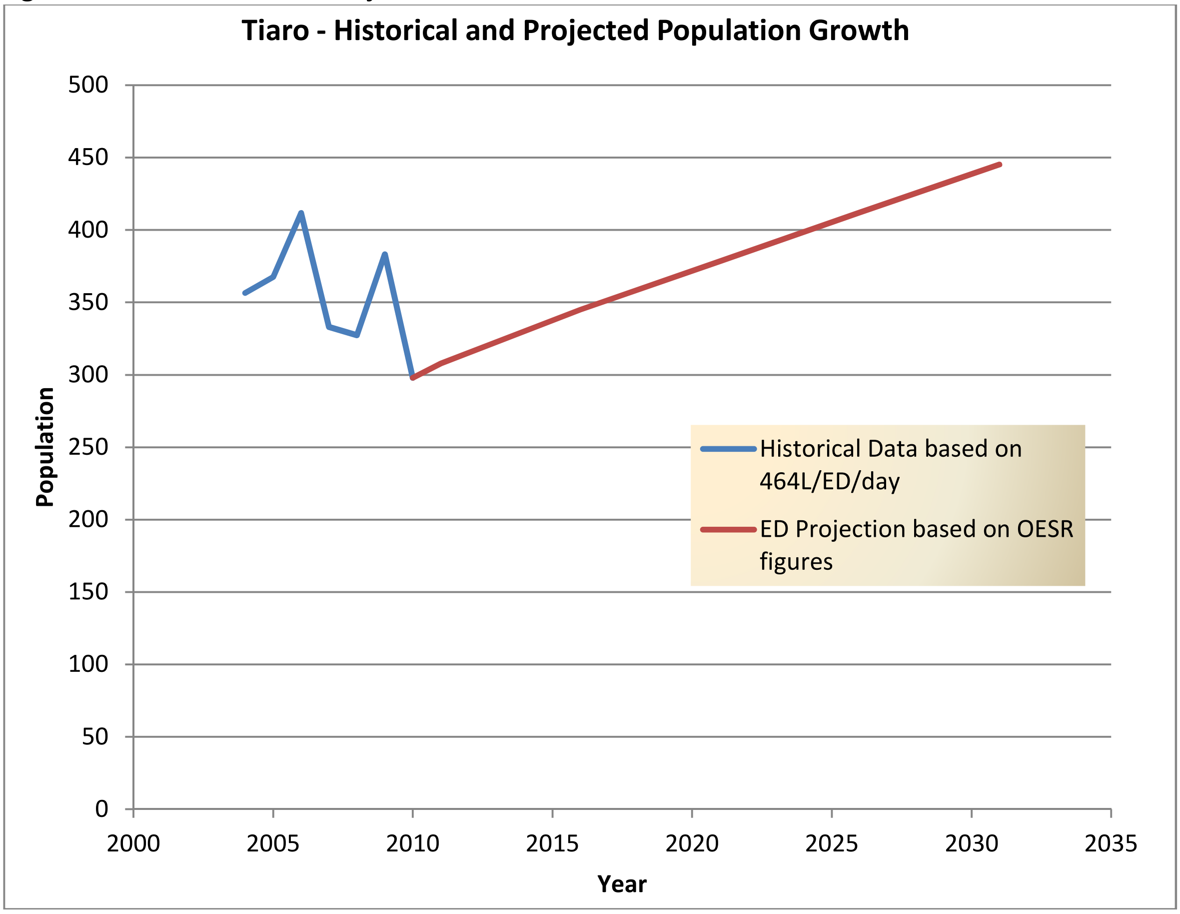


Table 8: Forecasted Growth using OESR data

Forecasted Year	*Regional growth rates adopted from OESR (%)*	*Projected ED's*
Current	Existing ED's +10% for losses	298
2011	3.3%	308
2016	12.1%	345
2021	9.7%	378
2026	8.8%	412
2031	8.1%	445

Note: the addition of a single house equates to a growth rate of approximately 0.5%.

5 WATER QUALITY

Typical analyses for Raw Water and Treated Water are included in Appendix 1.

6 WATER MODEL

6.1 Modelling Criteria

Standards of Service applicable in Hervey Bay and Maryborough were used for the purposes of this study.

Fire flow for domestic areas is 15L/s with a minimum residual pressure of 12m during peak hour flow. In commercial areas the fire fighting requirement is 30L/s with a minimum residual pressure of 12m. Domestic demand requires that the residual pressure not fall below 20m residual pressure during peak hour flow.

6.2 Modelling Scenarios

Due to time and resource limitations verification of this model against field data was not possible. Two current scenarios were created for Average Day demands and for Peak Day demands:

1. ADCURR, Current Average Day Demand (35% greater than billed meter flows to allow for losses).
2. PDCURR, Peak Day Demand Current (200% increase over ADCURR).

Future demand modelling was conducted to be consistent with OESR predictions in 5 years time steps to 2031. Demand growth allocations:

- Peak Day Demand 2011 (3.3% increase over PD)
- Peak Day Demand 2016 (12.1% increase over PD2011)
- Peak Day Demand 2021 (9.7% increase over PD2016)
- Peak Day Demand 2026 (8.8% increase over PD2021)
- Peak Day Demand 2031 (8.1% increase over PD2026)

6.3 Model Output

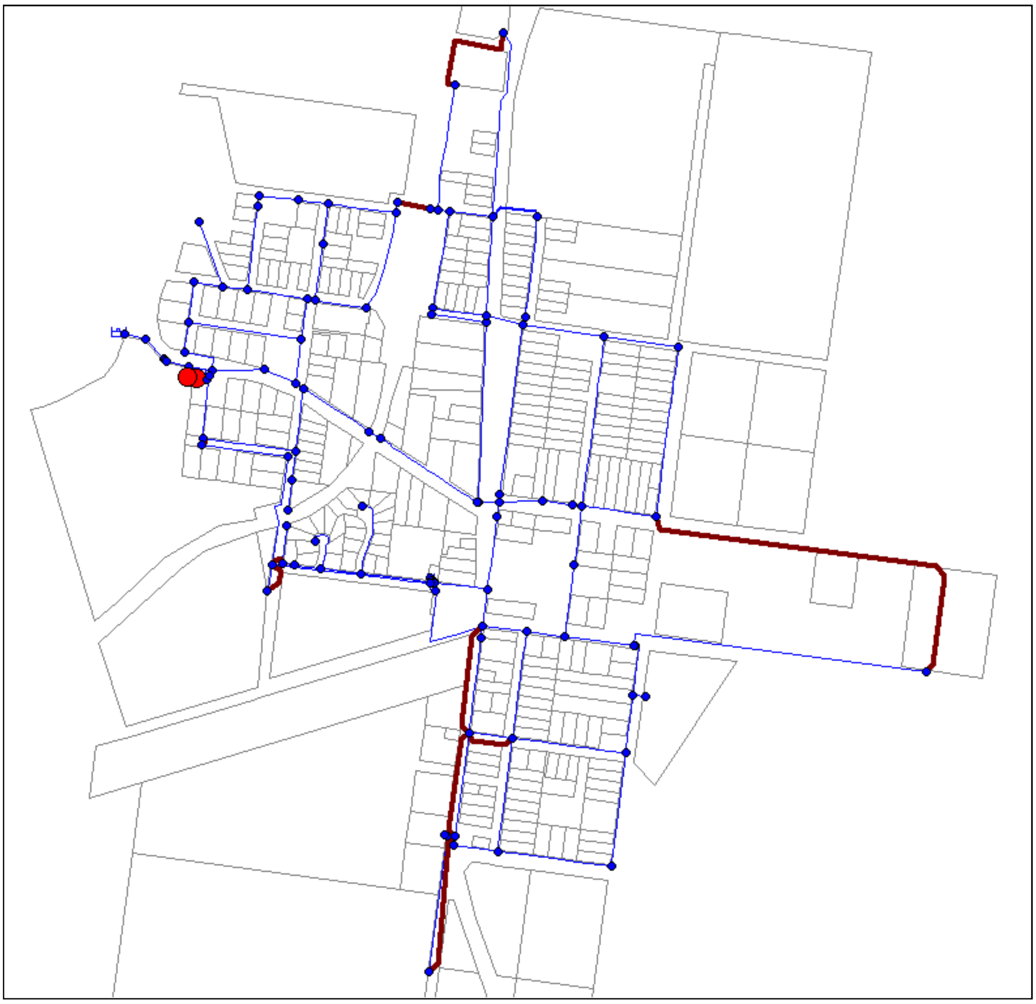
The demand model shows the existing infrastructure was capable of sustaining the projected water demand till 2031.

Fire flow modelling showed that the existing infrastructure is generally capable of sustaining future growth under domestic fire flow conditions (15L/s).

Commercial (non-residential) fire flow conditions (30L/s) cannot be sustained by the existing infrastructure. The Corporation is not required to guarantee fire fighting flows. A decision to undertake upgrading of existing pipework for fire fighting purposes sets a good example to developers and the community.

The network upgrades required to rectify these fire flow issues are shown below in red. The augmentations will also remove the majority of dead end mains from the network

Figure 4: Upgrade works required for fire flow.



6.4 Headworks

6.4.1 Rising Main and Raw Water Pumps

The raw water pumping system supplying the treatment plant was analysed separately as it incorporates treatment plant losses not incurred by the remainder of the system. On the basis of the available information the existing pumps and rising main deliver approximately 10L/s to the WTP.

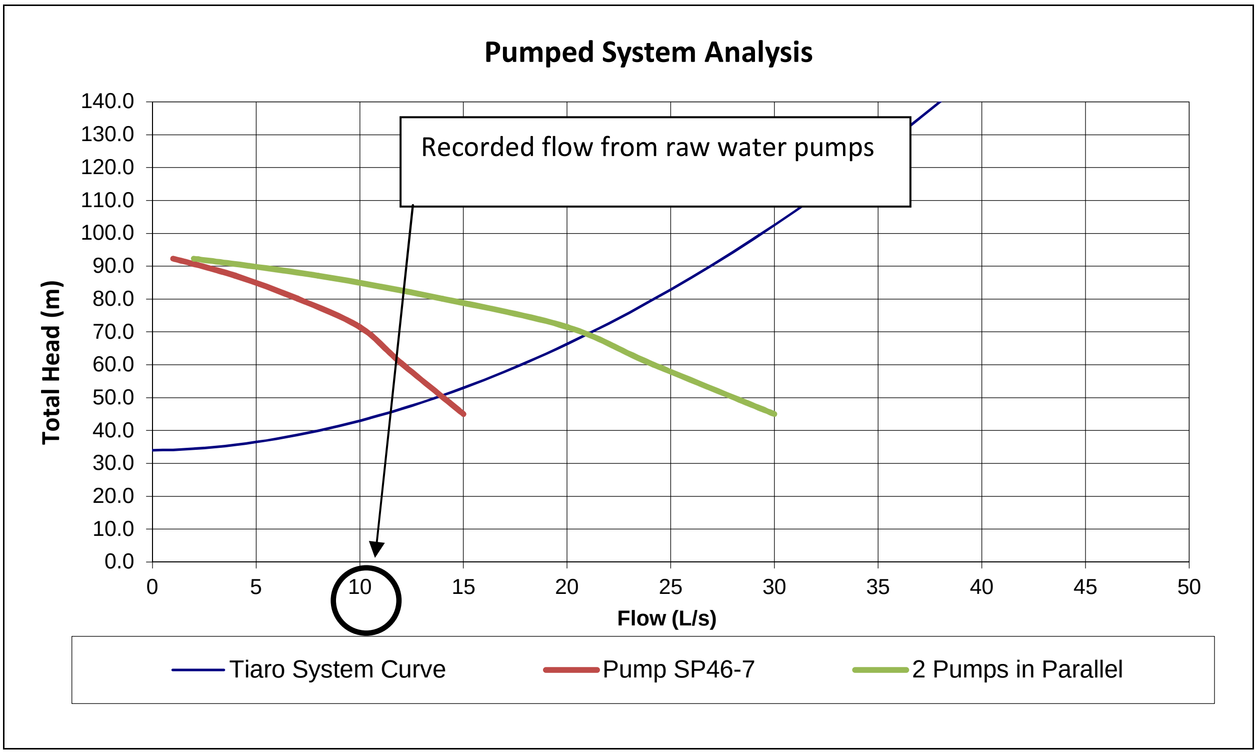
The Tiaro system requires the following projected flows to meet demand.

Table 9: Required Flows to meet Peak Daily Demand at Headworks

Peak Daily Demand	*Required Flow (L/s) to meet PD demand**
2010 (Average Daily)	1.84
2010	3.69
2011	3.81
2016	4.27
2021	4.68
2026	5.09
2031	5.51

**Including 14.9% losses for treatment plant*

Figure 5: System Performance Curve for Tiaro



Records indicate that the pumps at the Mary River intake are Grundfos submersible pumps (model no SP46-07). Clearly these pumps are capable of sustaining the flows required into the future. Unfortunately there is insufficient information on the pumps and rising main to accurately determine system characteristics and as a result the pumps appear to have capacity beyond their current performance. Some possible explanations are that the pump impeller/pump curve information is incorrect, the rising main details may be incorrect or that valves on the rising main may be throttled or corroded.

6.4.2 Storage Reservoirs

Table 10: Reservoir Analysis

Tank		***Storage Volume (ML)***	***Required Storage Vol***				
			2011	**2016**	**2021**	**2026**	**2031**
Ground Level Reservoir	**RES4100**	1.25	0.71	0.74	0.78	0.81	0.84
Elevated Tank	**RES4000**	0.1	0.05	0.05	0.06	0.06	0.07

The analysis above shows that the storages in Tiaro are sufficient to meet future requirements.

It should be noted that the analysis of the elevated reservoir is based on domestic storage requirements only. No allowance has been made for fire fighting in the elevated tank. Due to the high cost of elevated storage, the preferred method for handling fire fighting is to provide storage in the ground level reservoir and direct pump into the system at the required peak hour flow and fire fighting flows. This means that some modification is required to the existing pump station including:

- Adequate sizing of the pumps to meet peak hour and fire fighting requirements;
- Ideally, the provision of a generator to provide adequate power supply should there be a power failure;
- Automatic closure of the elevated tank to provide flow and pressure directly into the system.

7 CONCLUSIONS

This report forms the basis for strategic capital expenditure at Tiaro over the forecast 20 year planning horizon to the year 2031.

With exception of existing fire fighting inadequacies it can be concluded that the reticulation system in Tiaro is adequate to meet the future projected demands.

This report should be read in conjunction with the Maryborough Water Supply Strategy.

8 RECOMMENDATIONS

It is recommended that;

1. An investigation is undertaken to verify the asset and operation data underlying this report.
2. This report forms the basis for the 20 year capital works programme for Tiaro.
3. The investigation into unaccounted water losses is continued as more data is collated.

APPENDIX 1: RAW AND FINAL WATER QUALITY TIARO WTP

Job Description	Reg. Date	pH	Turbidity	True Colour	Fluoride by ISE	Total Alkalinity	Total Hardness	Ammonia as N by FIA	Phosphate as P by FIA	Oxides of Nitrogen	Nitrite as N by FIA	Nitrate as N by FIA	Copper - AAS	Zinc - AAS	Iron - AAS	Manganese - AAS	Escherichia coli by DST
			NTU	PtCo Units	mg/L	mgCaCO3/L	mgCaCO3/L	mgNH3-N/L	mgPO4-P/L	mgTON-N/L	mgNO2-N/L	mgNO3-N/L	mg/L	mg/L	mg/L	mg/L	MPN/100mL
		<0.01	<0.1	<5	<0.09	<1.2	<0.6	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.005	<0.01	<0.005	<<1
Tiaro WTP Raw Water	5/10/2010	7.9	22	<5	0.44	99	149	0.007	0.053	0.266	0.011	0.254	<0.01	<0.005	0.315	0.04	520
Tiaro WTP Raw Water	13/10/2010	7	202	59	0.34	26	38	0.035	0.03	0.177	0.008	0.169	<0.01	0.013	2.217	0.471	>2400
Tiaro WTP Raw Water	20/10/2010	7.4	55.5	36	0.28	55	76	0.019	0.032	0.202	0.006	0.196	<0.01	0.014	0.821	0.063	140
Tiaro WTP Raw Water	27/10/2010	7.2	54.4	55	0.16	69	99	0.019	0.022	0.255	0.007	0.248	<0.01	0.015	0.605	0.051	550
Tiaro WTP Raw Water	3/11/2010	7.8	11.9	13	0.24	95	104	0.025	0.041	0.295	0.014	0.281	<0.01	<0.005	0.236	0.026	41
Tiaro WTP Raw Water	9/11/2010	7.4	7.8	6	0.2	97	106	0.006	0.034	0.143	0.009	0.134	<0.01	0.013	0.185	<0.005	13
Tiaro WTP Raw Water	17/11/2010	8.3	5.9	20	0.46	107	117	0.002	0.018	0.008	0.008	<0.001	<0.01	<0.005	0.108	0.015	4
Tiaro WTP Raw Water	24/11/2010	8	7.1	16	0.36	110	66	0.004	0.02	0.028	0.005	0.023	<0.01	<0.005	0.122	0.038	4
Tiaro WTP Raw Water	1/12/2010	8	4.83	6	0.36	120	126	<0.001	0.018	0.012	0.003	0.009	<0.01	<0.005	0.118	0.035	10
Tiaro WTP Raw Water	8/12/2010	7.4	95.8	157	0.32	96	56	0.074	0.012	0.207	0.007	0.2	<0.01	<0.005	<0.01	0.198	340
Tiaro WTP Raw Water	15/12/2010	7.3	74	91	0.28	42	35	0.013	0.031	0.054	0.01	0.045	<0.01	0.028	0.823	0.095	210
Tiaro WTP Raw Water	22/12/2010	7.1	93.4	95	0.34	23	19	0.031	0.031	0.049	0.01	0.039	<0.01	0.023	1.35	0.118	290

Job Description	Reg. Date	pH	Conductivity	Total Dissolved Salts	Free Chlorine	Fluoride by ISE	Turbidity	True Colour	Total Alkalinity	Total Hardness	Calcium Hardness	Langelier Index	Aluminum - FIA	Iron - AAS	Manganese - AAS	Total Coliforms by DST	Escherichia coli by DST
			uS/cm	ppm	mg/L	mg/L	NTU	PtCo Units	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$		mg/L	mg/L	mg/L	MPN/100mL	MPN/100mL
		<0.01	<0.01	<1	<0.02	<0.09	<0.1	<5	<1.2	<0.6	<0.8		<0.01	<0.01	<0.005	<<1	<<1
Tiaro WTP Finish Water	5/10/2010	7.7	637	433	0.03	0.33	0.34	<5	87	118	51	-0.607	0.06	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	13/10/2010	7.5	609	414	0.11	0.33	0.21	<5	93	109	46	-0.82	0.068	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	20/10/2010	7.6	520	354	0.06	0.24	0.28	<5	74	104	43	-0.842	0.038	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	27/10/2010	7.2	450	306	0.52	0.15	0.17	<5	56	111	58	-1.227	0.052	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	3/11/2010	7.7	519	353	0.17	0.18	0.2	<5	78	92	50	-0.654	0.083	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	9/11/2010	7.7	495	337	1.11	0.13	0.16	<5	94	95	46	-1.22	0.051	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	17/11/2010	8.4	503	342	0.57	0.41	0.15	<5	90	103	40	0.072	0.048	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	24/11/2010	8.5	585	398	12.1	0.42	0.27	<5	114	42	57	0.363	0.095	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	1/12/2010	7.9	515	350	0.65	0.29	0.12	<5	99	116	43	-0.415	0.046	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	8/12/2010	7.8	530	360	0.52	0.26	0.12	<5	52	120	44	-0.786	0.033	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	15/12/2010	8	475	323	0.13	0.36	0.18	<5	83	91	71	-0.171	0.073	<0.01	<0.005	<1	<1
Tiaro WTP Finish Water	22/12/2010	8.3	462	314	3.5	0.32	0.29	<5	85	75	39	-0.119	0.064	<0.01	<0.005	<1	<1

APPENDIX 2: ISSUES ENCOUNTERED IN SYSTEM MODELLING

The work undertaken for this report and the development of the demand model encountered several issues. These are detailed below with suggested actions to rectify the issues.

Issue	*Action*
Basic field data in GIS is incomplete.	Data needs to be verified and fields populated including – BWL, TWL, Overflow level, bottom of tank, diameter, construction material. Pump details are incomplete.
Pipes are not always split at tees/tapers and changes in diameters and materials	This is not best practice drafting. It is recommended that a set of business rules be formulated for the drafting of assets on GIS.
Some data fields required for modelling are not included in the data set.	Include these fields in the data set – including roughness, upstream and downstream nodes
There is no link between the Proclaim billing system and the cadastral (DCDB) data.	Creating a common identifier in both these tables will allow the tables to be linked.
Subdivisional changes and consolidation are not tracked in DCDB.	Create a parent parcel field which identifies the parent parcel prior to subdivisional changes.

APPENDIX 3: COST ESTIMATE FORMULA

Unit costs were derived from the following table.

Table 1: 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

These rates apply to good soil conditions. Since the soil conditions at Tiaro are largely unknown including the distribution of rock, a factor of 1.42 (used for poor soil conditions) is applied to these rates.

Table 2: 20 Year Capital Plan

ID	LENGTH	DIAMETER	RATE ($/M)	RATE FACTOR	COST ($)	TYPE	YEAR	DESCRIPTION	RELATED PROJECT
W37	30	150	$184.00	1.42	$ 7,867.22	Fire	2011/12	INTERCONNECTOR CRN FORGAN TCE AND LARNER ST	TIA003
W39	17	150	$184.00	1.42	$ 4,519.23	Fire	2011/12	INTERCONNECTOR BROWN ST	TIA003
			unit		$ 30,000.00	Investigation	2011/12	INVESTIGATION AND VERIFICATION OF SITE DATA AND MODEL CALIBRATION	
W27	64	200	$642.88		$ 41,416.72	Fire	2012/13	PROPOSED RAIL WAY CROSSING BETWEEN RIVER ST AND HOPPER ST	TIA002
W31	216	150	$184.00	1.42	$ 56,403.82	Fire	2014/15	DUPLICATION MAYNE ST BTWN GRENFELL AND EATON ST	TIA001
W35	222	150	$184.00	1.42	$ 57,946.89	Fire	2014/15	DUPLICATION MAYNE ST BTWN GRENFELL AND INMAN ST	TIA001
W41	103	150	$184.00	1.42	$ 26,833.93	Fire	2014/15	DUPLICATION GRENFELL ST BTWN MAYNE AND COPPERHAGEN ST	TIA001
W33	228	150	$184.00	1.42	$ 59,443.42	Fire	2015/16	LOOP ALONG JACOBSEN ST BTWN MAYNE ST AND RAILWAY	TIA004
W43	73	150	$184.00	1.42	$ 19,054.15	Fire	2015/16	LOOP LARNER ST STH OF FORGAN TCE	TIA005
W45	277	150	$184.00	1.42	$ 72,363.27	Fire	2015/16	LOOP NETHERBY RD STH OF EATON ST	TIA005
W49	789	150	$184.00	1.42	$ 206,248.06	Fire	2015/16	LOOP FROM CRN INMAN AND GUTCHY ST TO JOHN AND TIARO ST	TIA004
RES4000		130kl ET	unit		$ 278,570.00	Growth	2018/19	TIARO ELEVATED TANK UPGRADE	TIA006
WPS4100			unit		$ 30,000.00	Efficiency		UPGRADE PS AT MARY RIVER INTAKE	TIA007
CWPS		PS gen set	unit		$ 50,000.00	Fire		GENSET FOR TIARO CLEAR WATER PUMP STATION	TIA008