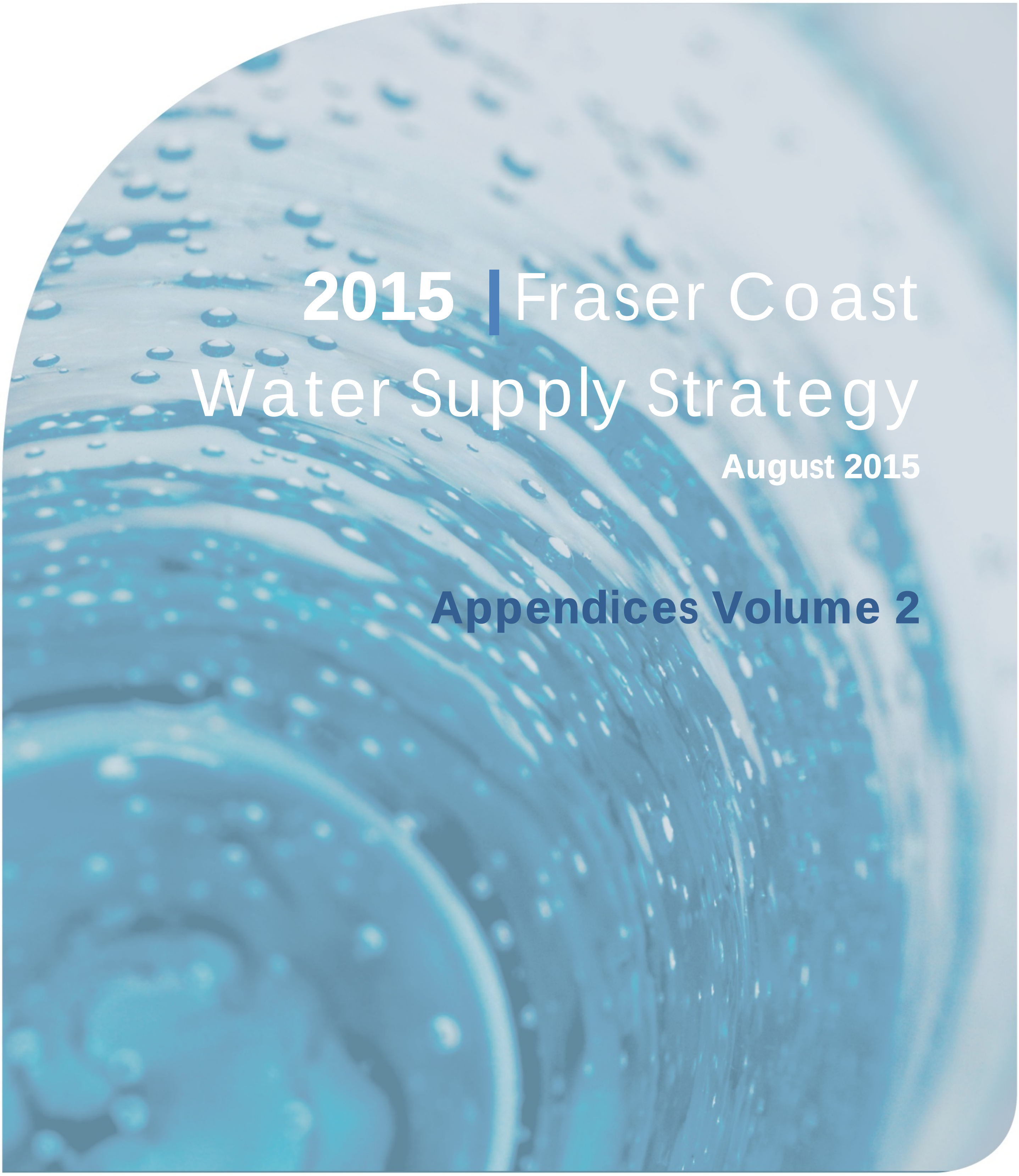
WIDE BAY water
CORPORATION



2015 | Fraser Coast Water Supply Strategy

August 2015

Appendices Volume 2

APPENDIX 4 – TREATMENT

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4A - Burgowan WTP

Burgowan Clear Water Pump replacement

The clear water pumps are theoretically capable of producing approximately 400L/s, however in practice they only produce 320L/s. Clear Water Pump Replacement. This project is for the replacement of the Clearwater pumps. It is estimated that the cost of replacing the pumps with a new pump station with a duty of 600L/s would be approximately $600k.

Mechanical replacement of clear water pumps for growth is notionally required in 2021/2022 and is provided for information only.

An investigation is required into the causes of poor performing pumps at Burgowan. This has the potential to defer capital expenditure if it proves to be a network issue causing the reduction in performance. The investigation needs to consider;

- Network factors leading to poor performance
- Pump factors leading to poor performance
- Recommendation on whether new pumps are required now or whether system configuration could rectify the issues.

It is envisaged that this investigation can be undertaken in-house with the use of operational and engineering staff. It is estimated that this investigation would cost approximately $10k.

Burgowan Disinfection upgrade

The current disinfection system is through hypo dosing at the plant. The hypochlorite system is not operating optimally at this point in time. An estimated cost to upgrade the hypo system is approximately $40k.

Sodium Hypochlorite systems require regular replacement of chemicals and therefore have higher operational costs compared with chlorine. Gaseous chlorine has high safety issues and hence has high establishment costs, but its ongoing costs are considerably lower and gas tanks can be stored on site going bad. The cost to install a gas system at Burgowan is estimated to be $395k.

An investigation into the advantages and disadvantages of Hypochlorite vs Gaseous chlorine is required. It is estimated that this report would cost approximately $5k.

4B - TEDDINGTON WTP UPGRADES

Raw Water Pipeline from SunWater pipeline directly to Teddington Weir

While most of the water allocation for the Maryborough township is obtained from the Tinana Creek catchment, WBWC does have an allocation available from the Mary River. This allocation is currently transferred through combined channel and pipeline infrastructure owned and operated by Sun Water.

It has been proposed that WBWC install a new pipe which connects the existing pipeline and channel system from the Mary River directly to Teddington WTP as a way of reducing cross contamination between the two sources of water and enable better treatment efficiency.

This involves the installation of approximately 300m of DN375 water main from the existing SunWater pipeline to the Teddington WTP.

It is estimated that this work would cost approximately$155,000.

Raw Water Pump Station

Replacement of the weir intake structure and raw water pumps is currently being designed and expected to be completed in 2015. This upgrade will improve the ability to draw water from various depths in the weir, allowing maximum operational flexibility. Although the bottom draw off has been allowed for in the design it will be capped due to uncertainties in water quality. If this draw off point is ever required it can be commissioned relatively easily.

As part of the upgrade a new pump pit will be constructed and pumps installed.

Table 1: Raw Water Pump Station Upgrade

Item	Description	Size	Year Proposed	Capital Cost approx.
1	Replace pumps	Match Plant Capacity	2015	$330,000
TOTAL				**$330,000**

Ozone / BAC Treatment Upgrade

Some treatment issues have been identified at Teddington WTP and these include:

- High manganese levels.
- High DOC (dissolved organic carbon) which results in THM formation.
- High THM (Trihalomethane's) levels which is a result of chlorine disinfection and high DOC.
- Sludge management, for both liquid and solids disposal.

- Water stabilisation; the water is currently corrosive.
- Inlet structure located on the weir, the design poses a risk to supply continuity and accessibility is a WH&S issue.
- Raw water pumps rationalisation.
- Lack of critical alarm generation due to aged or non-existent SCADA.

The installation of ozone and BAC treatment could address these issues but the capital expense is quite high as shown in the table below.

Table 2: Treatment Upgrade Costs

Component	***Est. Cost $1000's***
Ozone/BAC	600
Electrical works	120
Ozone Contact Tank	300
Filters	1,000
Contingency 30%	606
Total	**2,626**

It is therefore proposed that alternative methods of treatment be examine and trialled before committing to this expense.

The other options to exhaust firstly are;

- Potassium Permanganate to oxidise the magnesium and
- CO_2 / lime to stabilise the water quality from the plant.

Potassium Permanganate (KMnO4) Treatment Upgrade

In order to precipitate the manganese from the water supply, potassium permanganate is a strong oxidiser suitable for this purpose. Potassium permanganate trials are being undertaken. If these are successful then this would be implemented in the Teddington Water Treatment process. The estimated cost to install a treatment system adequate for the capacity of the Teddington WTP is estimated at $200k.

APPENDIX 5 – WATER RETICULATION

Table 1 - Length (km) of reticulation pipe in Hervey Bay by Material and Diameter

	Material Type															
Dia (mm)	**AC**	**CI**	**CICL**	**CU**	**DICL**	**GRP**	**HDPE**	**MDPE**	**mPVC**	**MSCL**	**oPVC**	**PE**	**PVC**	**SS**	**uPVC**	**Grand Total**
25				2			164					71			54	291
32							3	357				1520				1880
40								237				307				544
50							242					1023			1165	2430
63					12		2224	15973	85			18659				36954
80	360	11		13	6						4	0	4179		1	4574
90								40								40
100	175910	2168	599		7249		183	7209	8966	3	5675	607	895	11	162923	372397
110							24	988								1013
125								46								46
150	50886	618	123		5950		19	209	5215		4600		1640		81260	150519
200	8809	4444	201		3552		64	0	3022		5063	309	686		25807	51957
225	964	908													7	1879
250	1944	5045			3548				220		1260				9975	21991
300	17111	3896			2688		45		347		3792	1182			14015	43077
375	10074				16053	21			2454		17		369		4754	33741
400							260									260
450	25038	1			6268	1			574		2					31883
500		4			16789											16794
600	28	4			8642	14051				2359						25083
660										165						165
750					992											992
Grand Total	**291124**	**17099**	**923**	**15**	**71747**	**14073**	**3229**	**25059**	**20883**	**2527**	**20413**	**23679**	**7769**	**11**	**299959**	**798509**

Table 2 - Length (km) of reticulation pipe in Maryborough by Material and Diameter

Material type														
Diameter (mm)	**AC**	**CI**	**CICL**	**DICL**	**GRP**	**HDPE**	**MDPE**	**mPVC**	**MSCL**	**oPVC**	**PE**	**PVC**	**uPVC**	**Grand Total**
32							21							21
63						102	150				3022			3274
80				8						6				14
90										1				1
100	40871	24549	726	1073				547		6136		44982	1171	120056
150	13797	9377	26	3014		109	177			9072		19990	184	55747
180						113	362							475
200	7593	7		993				426		457		4616	251	14344
225	2456	425	721	262						32		398	767	5062
250	1069	2388	1636	1876						15		1103		8086
300	3923	6200	285	6583	3	88	222	1628	64	1412		661		21069
375			16	2283					5					2304
450	400			2806	636				746					4587
500				3104										3104
525				7					20224					20231
600	169			10035	674				5508					16387
Grand Total	**70278**	**42947**	**3411**	**32043**	**1313**	**412**	**932**	**2601**	**26547**	**17132**	**3022**	**71750**	**2374**	**274762**

Table 3 - Length (km) of reticulation pipe in Tiaro by Material and Diameter

Material Type										
Diameter (mm)	**AC**	**CU**	**DICL**	**HDPE**	**MDPE**	**oPVC**	**PE**	**PVC**	**uPVC**	**Grand Total**
63					189		976			1166
80		3								3
100	3350		0			13		4286	209	7859
150	3		76			87		537	384	1087
180				49						49
200						0		822		822
Grand Total	**3353**	**3**	**77**	**49**	**189**	**101**	**976**	**5645**	**593**	**10986**

5B - MB Creation of the Bell Hilltop DMA/Zone

The Bell Hilltop DMA is separately metered from the Maryborough West DMA, it is however, part of the same network and thus the Showgrounds elevated reservoir and the High zone Elevated reservoir float on the Maryborough West and Bell Hilltop DMA's. Because the Top Water Level (TWL) of at the Showground elevated reservoir is approximately 4m higher than the High zone elevated tank. This effectively causes the high level elevated tank to remain full.

It is proposed that the High Level Elevated tank be used exclusively for the Bell hilltop DMA by floating the tank off this zone and isolating the zone from other areas. This will allow elevated tanks in both zones to cycle and will improve water quality in the tanks.

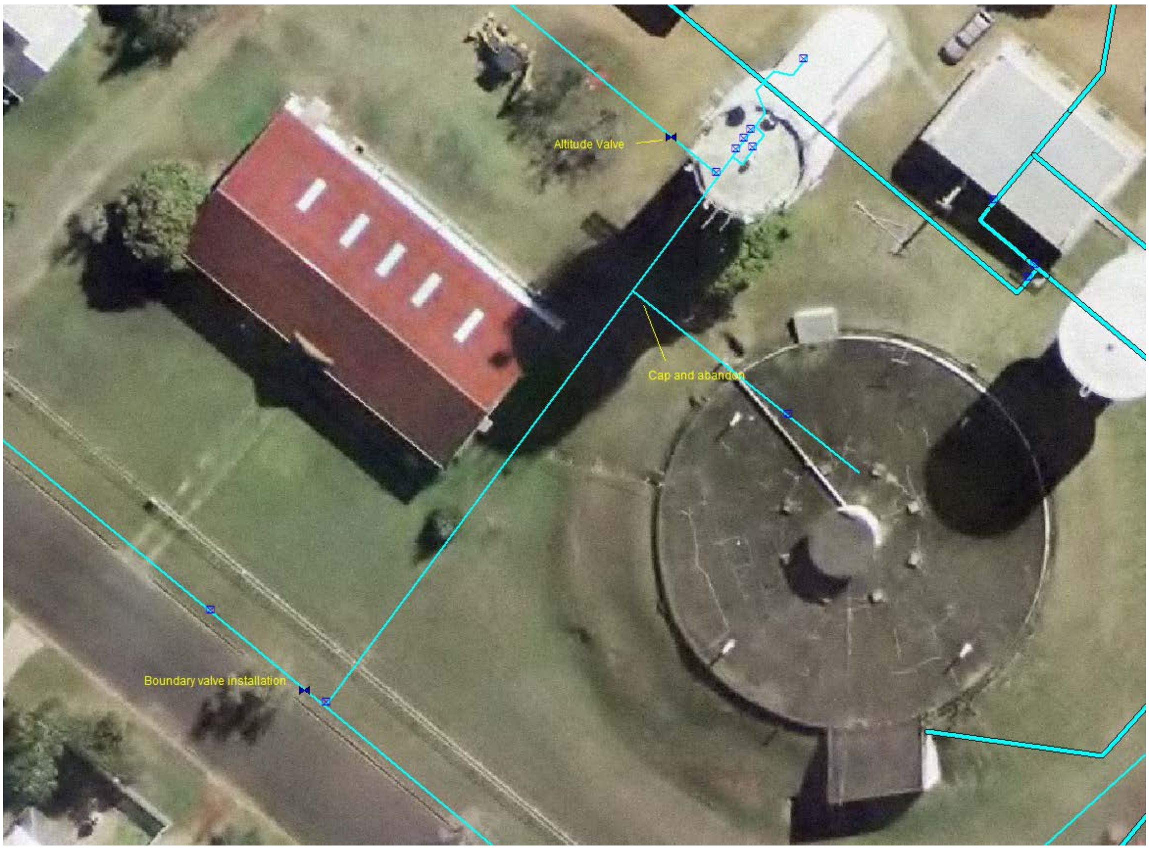


Figure 1 - Bell Hilltop configuration of DMA

This project requires the installation of a boundary valve and some controls for the altitude valve and is estimated at $25,000.

5C - MB Creation of Ann Street DMA/Zone

The Low level elevated reservoir currently services the entire Newtown Central, Granville and CBD DMA's. It does this in conjunction with the Ann St Elevated Reservoir which has a TWL approximately 1.5m below the TWL of the low level elevated reservoir.

It is proposed to recommission the ground level reservoir at Ann St and upgrade the pump station in the facility so that previous noise issues are reduced.

While the energy savings will be minimal for this proposal, there are operational benefits to creating this zone including;

- Providing dedicated storage to the CBD and Granville area.
- Additional security for low level and high level zones if a Pump Station is out of order or power supply to Aberdeen facility is interrupted for a period of time.
- Ann Street reservoir could be back fed to Tinana as security of supply if Two Mile Reservoir is offline.
- Ann Street could feed Newtown Central zone if required

The costs associated with this project are

Table 4 - Costs associated with setting up Ann St Zone

Component	Yr Req	Cost
Reservoir reinstatement	2015	$300,000
Pump Station	2018	$81,000
Generator	2018	$50,000
Total		**$431,000**

Creation of the zone will require 3 boundary valve installations on DN300 mains. These are estimated to cost $20,000 each.

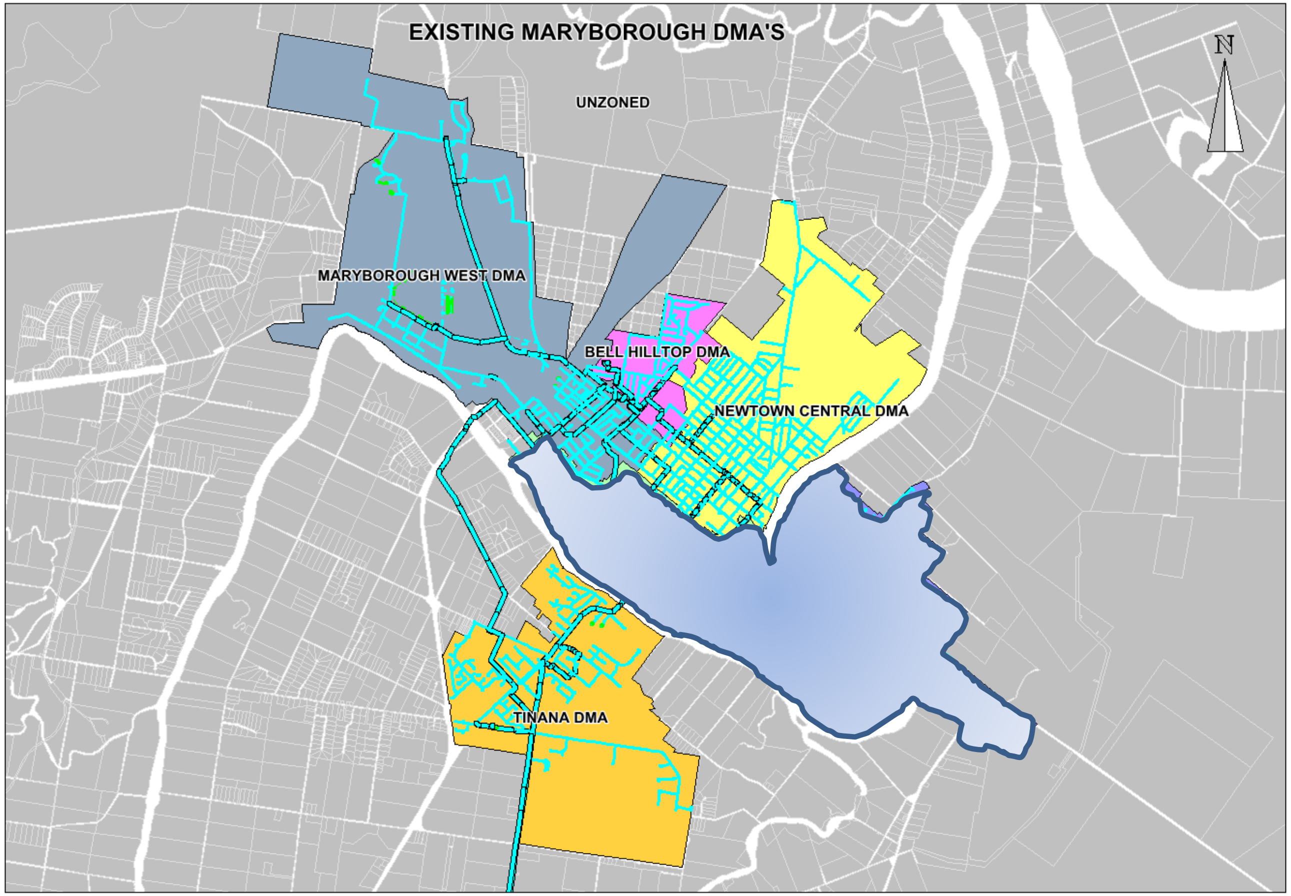


Figure 2 - CBD Zone Creation

5D - MB Proposed New Boundary between CBD Zone and High level Zone

Fire flow modelling indicated service level 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 places this area in the CBD Zone (Low Zone) and hence has lower pressures. Relocation of the DMA boundary in this area will re-establish service levels by placing this area in the High Zone which has higher pressures. Some minor capital works is required achieve this. This requires the boundary to be moved to Neptune Street. Pipework was constructed to allow for this modification to the DMA boundary in 2013, but the boundary was not implemented because of failure issues due to the high level pump operation. These pumps have now been installed with VFD's and it has been demonstrated that the failures that previously occurred are no longer an issue. The DMA boundary should be moved to improve Fire flow to the pocket of residential area.

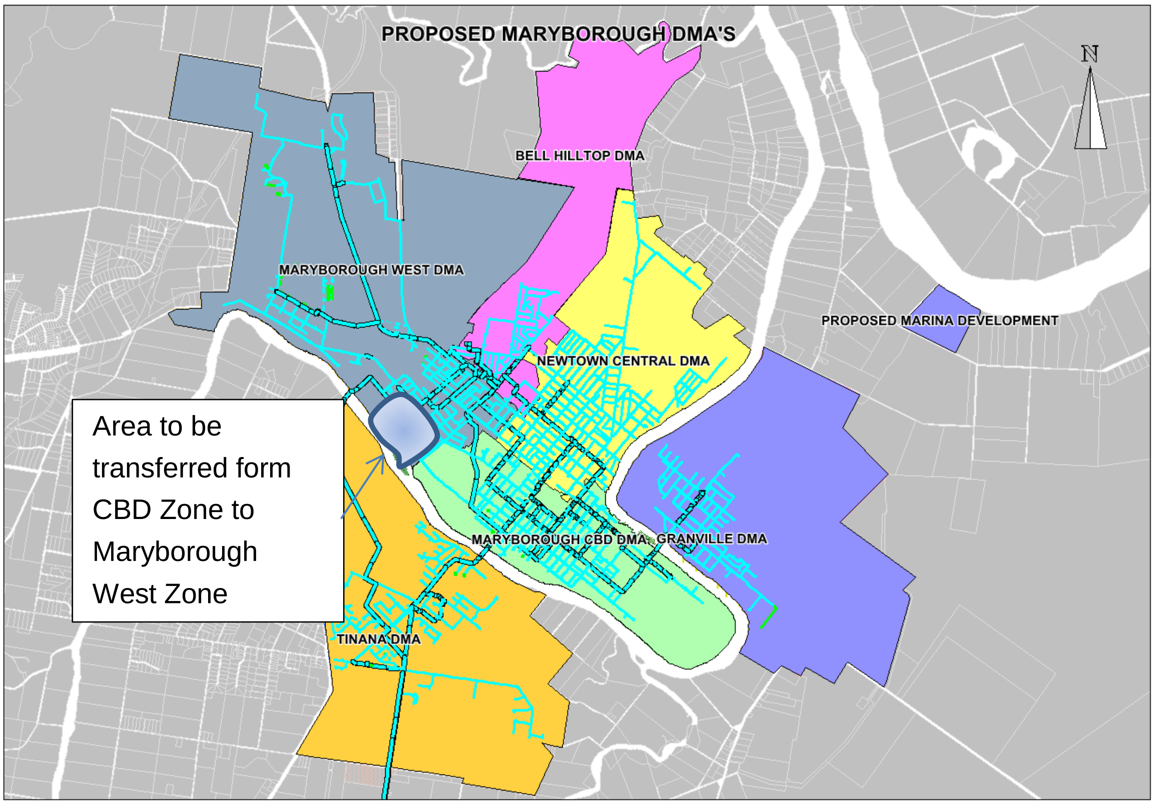


Figure 3 - Changes to the Boundary between CBD and Maryborough West Zones

5E - Pipeline Replacement Program

Pipes are generally designed to have a life of in excess of 80 years. There are many factors which influence the life of a pipeline including;

- Material type and quality
- Quality of installation
- Environmental conditions
- Cyclic loading

No failure assessment has been carried out on the pipeline set. Normally the assessment would investigate the failure mechanisms, lifespans and material types for each pipe that has been replaced or failed historically. It should not include pipes that have been upgraded purely for capacity. A detailed assessment of pipe life and failure mode should be undertaken to determine likely life expectancy of pipes within the reticulation system.

A brief assessment of installation dates has been undertaken for the various pipe materials used in the Fraser Coast. The results are shown in the graph below.

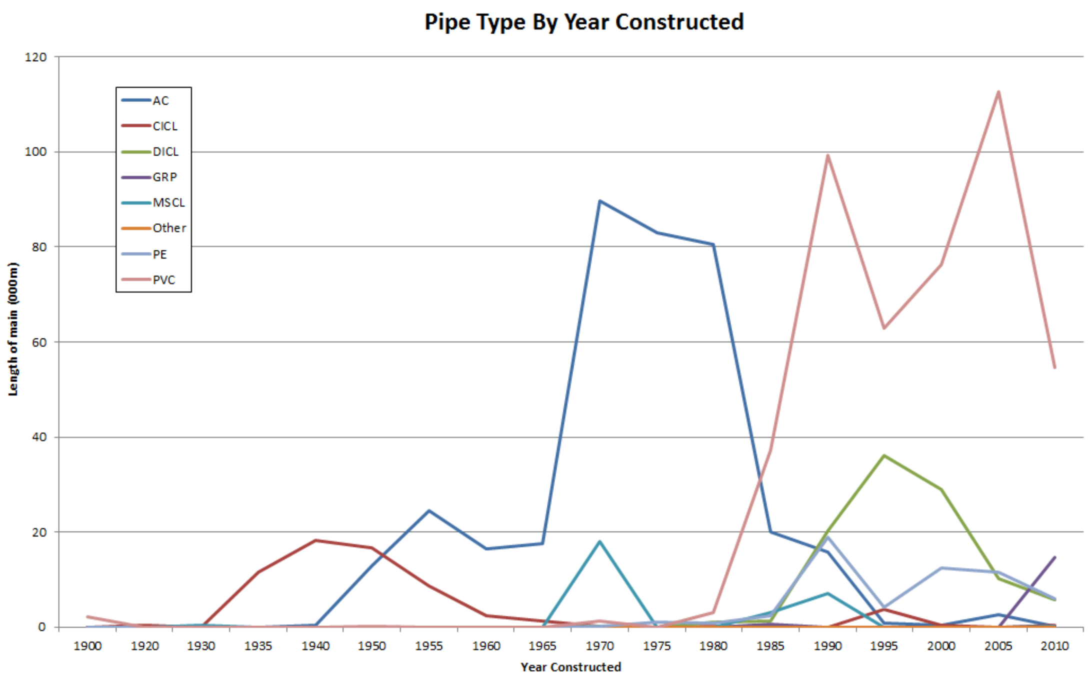


Figure 4 - Length of Pipe Type by Age

If we assume that pipes have a useful life of 80 years, it can be seen that CICL pipe laid between 1930 and 1965 will reach its end of its useful life between 2010 and 2045. The length of pipe and expected replacement over the period to 2031 are shown in the table below.

Table 5 - Length of mains due for Replacement

Replacement due (Assumed 80 year pipe life)	Sum of Length (m)
2000	376
2013	449
2015	11637
2020	18531
2030	1563
2031	140
Total	**33108**

It can be seen that over the planning horizon there is approximately 33 km of pipeline that needs to be replaced. The majority of these are cast iron pipelines installed in Maryborough in 1930 through to 1960. Pipelines in Hervey Bay did not commence being installed til 195 according to WBWC GIS records. A breakdown of the costs is provided in the following table.

Table 6 - Potential Cost of Mains Replacement

Cost of Mains ($000's)								
	Diameter							
Year	100	150	200	225	250	300	450	Total
2000	32	35				3		70
2013							253	253
2015	608	173	2		661	1746		3190
2020	1987	1034		48	207	142		3418
2030	236	20						256
2031	23							23
Total	**2886**	**1262**	**2**	**48**	**868**	**1891**	**253**	**7210**

5F - Condition of Reticulation Assessment

Figure 5 - Typical pipe corroded from exterior

The modelling conducted for this report has assumed that the reticulation network is in reasonable condition and the roughness coefficients are those typically used for similar aged pipelines. This means that there is no allowance made for severely tuberculate pipes in the capacity assessment.

Turburculated pipes are a major operational issue and require replacement. A program of replacement was established in 2010 based on maintenance records, local knowledge and GIS data. The program was for the replacement of all of the corroded CI pipes within a ten year program. The original program batched the working in order of priority meaning that the most severely corroded pipes were undertaken first and the least affected pipes carried out in year ten. In 2012, this priority schedule was replaced with a priority based on geographical region. This provides greater synergies between projects, focuses operational crews in particular areas at a time and allows more cost effective designs to be undertaken.

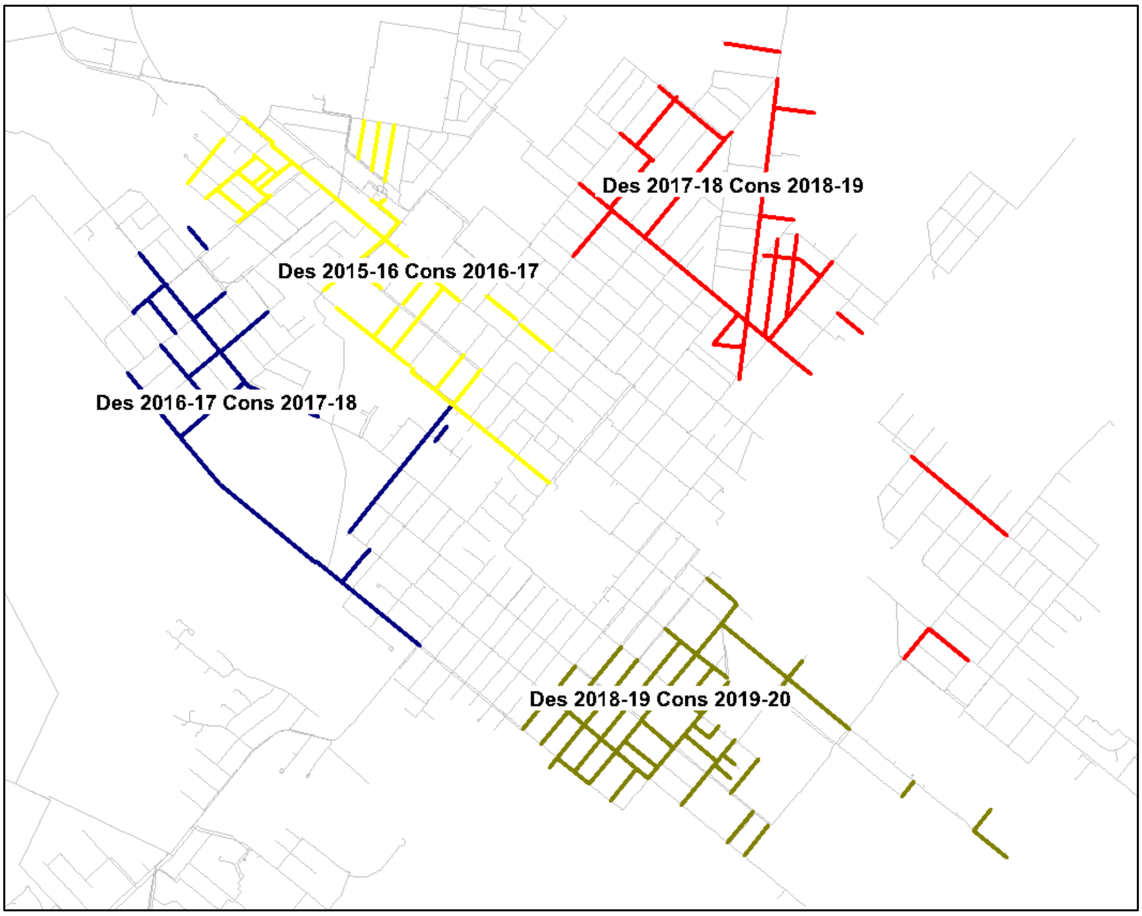


Figure 6 – Maryborough Condition Replacement Program

The estimated cash flows for each of the years are reported in the table below.

Table 7 - Cost of Replacements

Year Design/Year Construct	Cost of works ($000's)
Des 2015-16 cons 2016-17	1,264
Des 2016-17 cons 2017-18	1,293
Des 2017-18 cons 2018-19	2,293
Des 2018-19 cons 2019-20	2,215
Total	**7,065**

Figure 7 - Pipe showing signs of Carbonisation

The general principle of the program is to investigate the pipelines in the year prior to design to ensure that the pipelines require replacement and that their condition extends the entire length of the main and not limited to fittings only. Where the pipe barrels are found to have an estimated life in excess of 10 years, the mains replacement are deferred and the scope of works is changed to a fittings replacement project. It has been found that in most cases the smaller pipelines (DN100 and DN150) are in reasonable condition internally; however there is a high level of carbonisation which is evident by dark discolouration through the cross section of the pipe material. The design phase is carried out the year prior to program construction. This is to ensure that the works can be constructed and completed in the appropriate financial year.

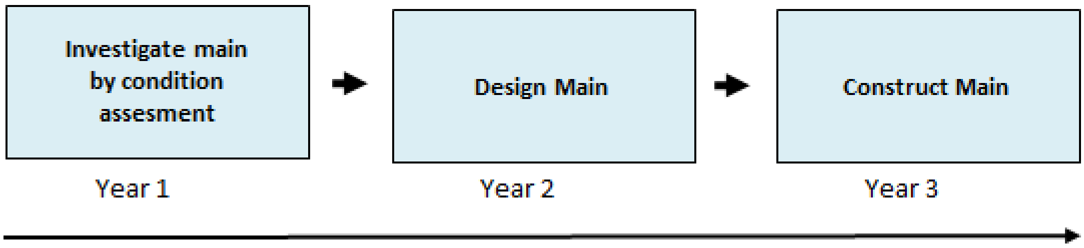


Figure 8 - Flow Chart for Condition Assessment

5G - Fittings Replacement Program

Many of the cast iron (CI) fittings installed prior to 1980 in the Fraser Coast are unlined. The fittings include hydrant tees, bends, and valves. Many of these fittings are severely deteriorated through tuberculation which is a by-product of corrosion which deposits on the pipe surface severely reducing pipe line capacity by increasing roughness. It is not evidenced during normal domestic demands but the reduction in capacity is extremely evident during fire flows where the demands are high. Hydrant testing is an easy way of identifying where the mains may have tuberculised fittings. Generally one would expect about 20L/s from a hydrant in an average scenario. When the fittings are tuberculised, the tested flows can be as little as 1 or 2L/s.

Table 8 - Fittings Installations Years (prior to 1980)

	Hervey Bay	Maryborough	Total	Total in system	Percentage (%)	Cost per Fitting ($)	Total (000's)
Hydrants	1064	439	1503	8492	18%	2000	3006
Valves	716	405	1121	7038	16%	3000	3363
Tees and Crosses	859	473	1332	10272	13%	2000	2664
Totals	**2639**	**1317**	**3956**				**9033**

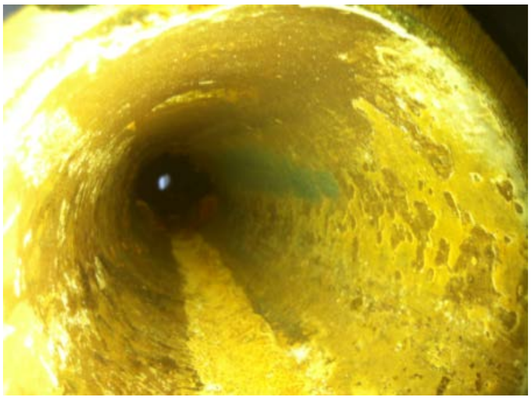


Figure 9: Fitting showing Internal Tuberculation

Currently about $250,000 is budgeted annually for the replacement of fittings in Hervey Bay and $200,000 in Maryborough. At this rate it is estimated that the fittings will be completed in approximately 20 years. A strategy for the replacement of fittings incorporated with the pipeline replacement project will focus the replacement in similar area and hence improve the overall benefit from the programs as a whole. This is a reoccurring project and has not been included in this reports capex program. It is however to be added into the budget.

5H - Leak Detection

To monitor the flow of water throughout the reticulation network, Wide Bay Water has established 15 separate demand management areas (DMA) in Hervey Bay. Each of these demand areas are supplied via a single distribution main that is metered constantly. The water demand area metering system is one part of Wide Bay Water's extensive leak detection program. It aims to identify areas with high night time flows which can indicate leaks in the water infrastructure.

The identification of zones with leakage problems enables the Corporation to allocate capital and resources more efficiently and effectively. These demand management areas are also used for

5I - NPV Urraween Zone Water Supply Concept

OPTION 1 – NEW PUMP STATION (now) AND INSTALL 20ML RESERVOIR (2031)

OPTION 1	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Capital costs		1,400,000									
Maintenance	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000	20,000
Operating Costs (Power)	511,219	521,443	531,872	542,509	553,359	564,427	575,715	587,229	598,974	610,953	623,173
Total (ops and maintenance)	180,481	541,443	541,443	541,443	541,443	541,443	541,443	541,443	541,443	541,443	541,443
Total	180,481	1,941,443	541,443	541,443	541,443	541,443	541,443	541,443	541,443	541,443	541,443
Cumulative Total	180,481	2,121,924	2,663,367	3,204,810	3,746,253	4,287,696	4,829,138	5,370,581	5,912,024	6,453,467	6,994,910

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Capital costs										
Maintenance	20,000	20,000	20,000	20,000	20,000	30,000	30,000	30,000	30,000	30,000
Operating Costs (Power)	635,636	648,349	661,316	674,542	688,033	701,794	715,829	730,146	744,749	759,644
Total (ops and maintenance)	541,443	541,443	541,443	541,443	541,443	541,443	541,443	541,443	541,443	541,443
Total	541,443	541,443	541,443	541,443	541,443	3,601,443	541,443	541,443	541,443	541,443
Cumulative Total	7,536,353	8,077,796	8,619,239	9,160,682	9,702,125	13,303,568	13,845,010	14,386,453	14,927,896	15,469,339

NPV
$8,229,964.81

Notes;

- WACC = 6.25%
- Assumptions

  20hr pump run per day

  2% growth per annum used to determine increase in demand

5I – NPV Urraween Zone Water Supply Concept

OPTION 2 - UPGRADE EXISTING PUMP STATION (now)

OPTION 2	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Capital costs		700,000									
Maintenance	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Operating Costs (Power)	740,302	755,108	770,211	785,615	801,327	817,354	833,701	850,375	867,382	884,730	902,424
Total (ops and maintenance)	255,036	765,108	780,211	795,615	811,327	827,354	843,701	860,375	877,382	894,730	912,424
Total	255,036	1,465,108	780,211	795,615	811,327	827,354	843,701	860,375	877,382	894,730	912,424
Cumulative Total	255,036	1,720,144	2,500,355	3,295,970	4,107,297	4,934,650	5,778,351	6,638,726	7,516,108	8,410,838	9,323,262

	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Capital costs										
Maintenance	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Operating Costs (Power)	920,473	938,882	957,660	976,813	996,349	1,016,276	1,036,602	1,057,334	1,078,481	1,100,050
Total (ops and maintenance)	930,473	948,882	967,660	986,813	1,006,349	1,026,276	1,046,602	1,067,334	1,088,481	1,110,050
Total	930,473	948,882	967,660	986,813	1,006,349	1,026,276	1,046,602	1,067,334	1,088,481	1,110,050
Cumulative Total	10,253,735	11,202,617	12,170,277	13,157,091	14,163,440	15,189,716	16,236,318	17,303,652	18,392,133	19,502,183

NPV
$10,296,802.19

623

Notes;

- WACC = 6.25%
- Assumptions

  20hr pump run per day

  2% growth per annum used to determine increase in demand

OPTION 1 - PAYBACK PERIOD ASSESSMENT

5I – NPV Urraween Zone Water Supply Concept

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
	2,015	**2,016**	**2,017**	**2,018**	**2,019**	**2,020**	**2,021**	**2,022**	**2,023**	**2,024**	**2,025**
OPTION 1 Cumulative Costs	180,481	2,121,924	2,663,367	3,204,810	3,746,253	4,287,696	4,829,138	5,370,581	5,912,024	6,453,467	6,994,910
OPTION 2 Cumulative Costs	255,036	1,720,144	2,500,355	3,295,970	4,107,297	4,934,650	5,778,351	6,638,726	7,516,108	8,410,838	9,323,262
Cumulative Savings	74,555	-401,779	-163,012	91,160	361,044	646,955	949,213	1,268,144	1,604,084	1,957,371	2,328,352
Payback period									Payback	Payback	Payback

	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
	2,026	**2,027**	**2,028**	**2,029**	**2,030**	**2,031**	**2,032**	**2,033**	**2,034**	**2,035**
OPTION 1 Cumulative Costs	7,536,353	8,077,796	8,619,239	9,160,682	9,702,125	13,303,568	13,845,010	14,386,453	14,927,896	15,469,339
OPTION 2 Cumulative Costs	10,253,735	11,202,617	12,170,277	13,157,091	14,163,440	15,189,716	16,236,318	17,303,652	18,392,133	19,502,183
Cumulative Savings	2,717,382	3,124,821	3,551,038	3,996,409	4,461,315	1,886,149	2,391,308	2,917,199	3,464,237	4,032,844
Payback period	Payback	Payback	Payback	Payback	Payback	Payback	Payback	Payback	Payback	Payback

5J – Water Pump Station Details

Table 9 - Water Pump Station Details

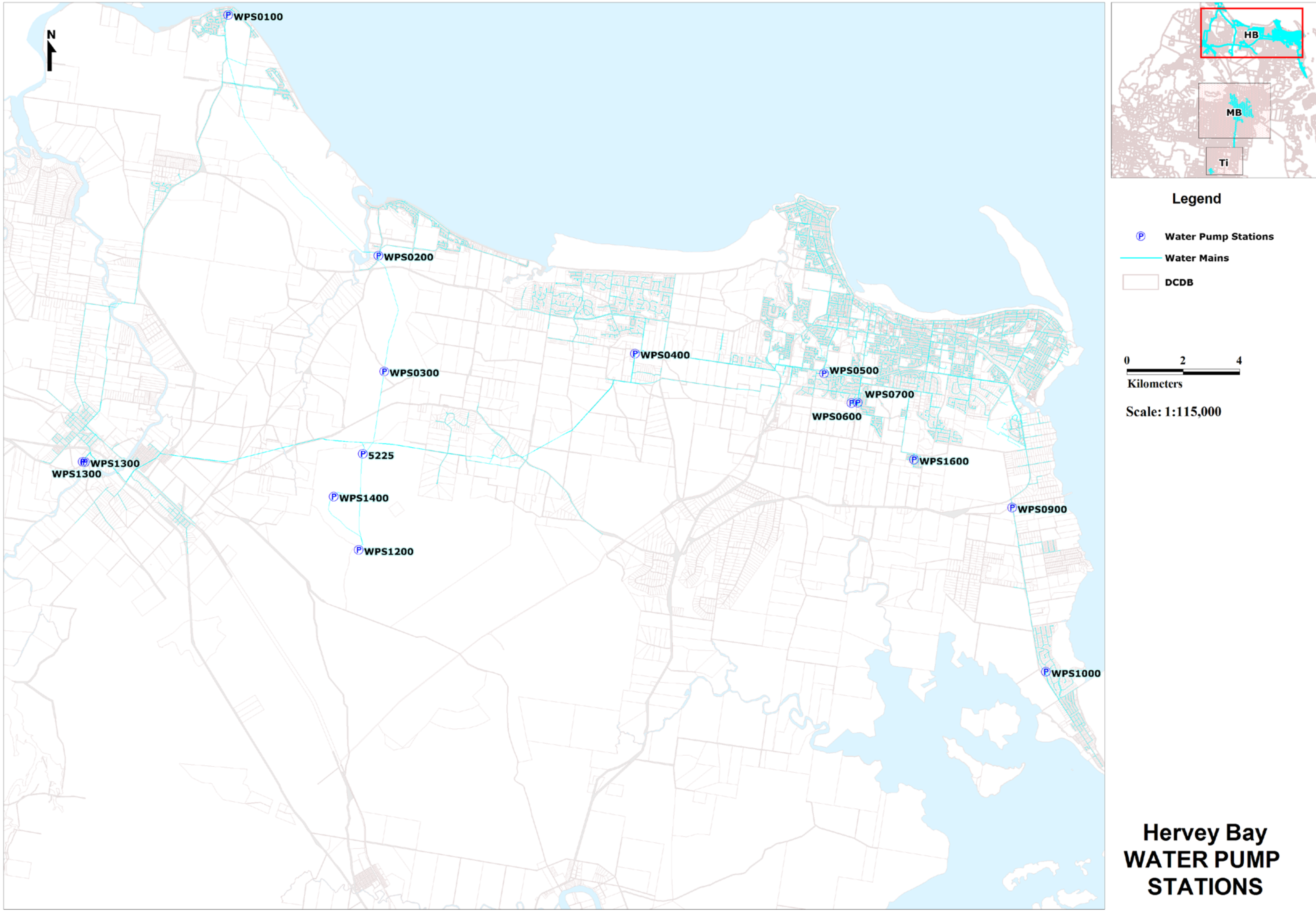
	PS Name	PS No.	No of Pumps	Fixed / Variable Speed	Duty (Current)	PS Duty (2031)	Description/Purpose	Pumping Regime
HB	Burrum Weir (New) raw water PS	WPS1318	2	Fixed	278L/s@63m head	n/a	This pump station is used to transfer raw water from Burrum Weir to Burgowan WTP.	MDMM
HB	Burrum Weir (Orig) raw water PS	WPS1300	2	Fixed	250L/s@38m head	n/a	This pump station is used to transfer raw water from Burrum Weir to Burgowan WTP.	MDMM
HB	Cassava No.1 raw water PS	WPS1200	2	Vacuum		n/a	This pump station is used to transfer raw water from Cassava 1 to Burgowan WTP.	MDMM
HB	Cassava No.2 raw water PS	WPS1400	1	Vacuum		n/a	This pump station is used to transfer raw water from Cassava 2 to Burgowan WTP.	MDMM
HB	Burgowan Clear Water PS	5225	2	Fixed	517L/s@58.4m head 326L/s@77m head	600L/s@75m head	This pump station is used to transfer treated water from Burgowan WTP to the Hervey Bay System.	MDMM
HB	Toogoom Bush PS	WPS0300	2	Variable	20.3L/s@68.8m head	n/a	This pump station is used to transfer treated water from Burgowan PS to the Toogoom reservoir and is used when the HGL from Burgowan is insufficient to fill the Toogoom Reservoir.	MDMM
HB	Toogoom Rd PS	WPS0200	2	Fixed	27L/s@ 91m head	n/a	This pump station is used to transfer treated water from the Toogoom network to the Burrum Heads network. It is only used in emergencies as the rising main is in poor condition.	Emergency supply only
HB	Burrum Heads Standpipe PS	WPS0100	1	Fixed	Not in use	n/a	This pump station was used to transfer treated water from the Burrum Standpipe into the Burrum network. The standpipe is no longer in use and nor is this pump station.	PH
HB	Dundowran PS	WPS0400	2	Variable	50L/s@20m head	61L/s@48m head	This pump station is used to transfer treated water from the Burgowan PS to the Dundowran area. While simultaneously supplying the reticulation and the Bayrise reservoir (300kl).	PH
HB	Dundowran – Apex Close	n/a	2	Variable	n/a	17L/s@20m head	This pump station is proposed to be use to elevate the pressures to the Apex close area without necessitating raised pressures throughout Dundowran	PH
HB	Urraween No 1 PS	WPS0500	3	Variable	150L/s@65m head	n/a	This pump station is used to transfer treated water from Urraween reservoir to Ghost Hill No 1 and 2 reservoirs. It also provides water directly into the distribution system if required.	MDMM/PD/PH

5J – Water Pump Station Details

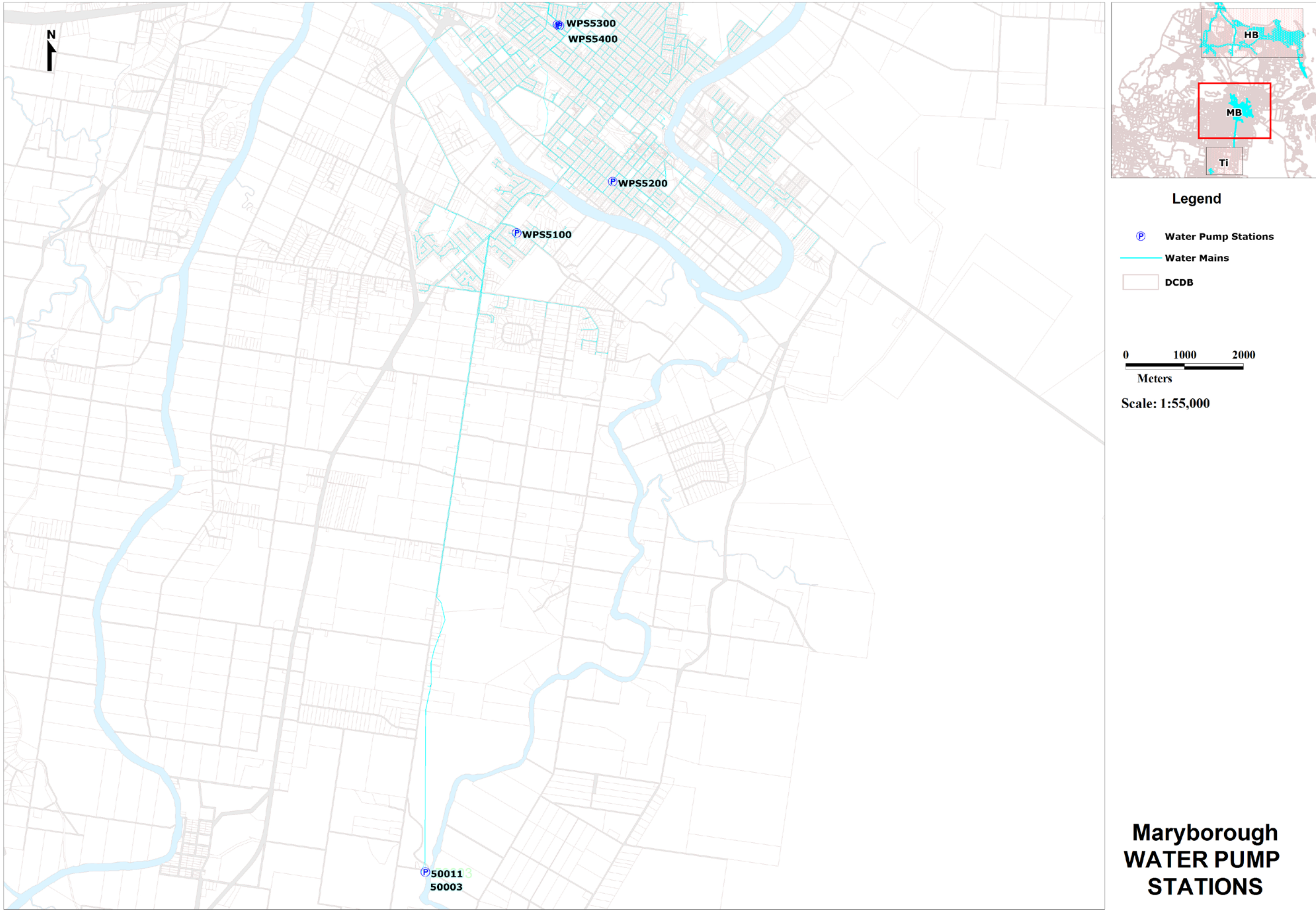
	PS Name	PS No.	No of Pumps	Fixed / Variable Speed	Duty (Current)	PS Duty (2031)	Description/Purpose	Pumping Regime
HB	Madsen Rd PS	n/a	2	Variable	n/a	620L/s@53m head	This pump station is proposed used to transfer treated water from the Burgowan transmission mains to Ghost Hill No 1 reservoir. It also provides water directly into the distribution system if required.	MDMM
HB	Ghost Hill Res No.2 HLZ PS	WPS0600	4 1	Variable	25L/s@30.3m head 10L/s@30m head	n/a	This pump station is used to transfer treated water from Ghost Hill No 2 reservoir into the reticulation system on the Kawungan ridge. It is also capable of providing water to future areas of Nikenbah and River Heads.	PH
HB	Ghost Hill No 1 PS	WPS0700	not currently used	Fixed		n/a	This pump station is used to transfer treated water from Ghost Hill No 1 reservoir to Ghost Hill No. 2 reservoir.	MDMM
HB	Parklands Estate	WPS1600	3 1	Variable	2.8L/s@31.9m head 18L/s@30.9m head	32.6L/s@ 13.6m head	This pump station is used to boost pressure to the Parklands estate.	PH
HB	Booral PS	WPS0900	2	Variable	13L/s@32m head 15L/s@31.9m head	35L/s@40m head	This pump station is used to boost the transfer of treated water to River Heads reservoir.	MDMM/Partially PH
HB	River Heads HLZ PS	WPS1000	3	Variable	5L/s@43m head	35L/s@34.4m head	This pump station is used to transfer treated water from River Heads reservoir into the River Heads High Zone reticulation network.	PH
MB	Teddington Raw Water PS	50003	2	Variable		n/a	This pump station is used to transfer raw water from Teddington Weir to the Teddington WTP.	MDMM
MB	Teddington Clear Water PS	50011	4	Variable	240L/s@m head	n/a	This pump station is used to transfer treated water from Teddington WTP to Two Mile reservoir.	MDMM
MB	Tinana Water PS	WPS5100	2	Variable	48.2L/s@36.5m head	n/a	This pump station is used to transfer treated water into the reticulation system of Tinana while simultaneously recharging the elevated reservoir in Tinana.	PH
MB	High Zone PS	WPS5300	2	Variable	285L/s@ 50.7m head	n/a	This pump station is used to transfer treated water into the reticulation system of Maryborough West while simultaneously recharging the the High Zone and showgrounds ET’s.	PH
MB	Low Zone PS	WPS5400	2	Variable	227L/s@21.3m head	n/a	This pump station is used to transfer treated water into the reticulation system of Newtown Central while simultaneously recharging the Low Zone ET. Currently it also recharges the Ann Street elevated reservoir and supplys the CBD and Granville also.	PH
MB	Ann Street PS	WPS5200	not in	Fixed		n/a	This pump station is proposed to be used to transfer treated water	PH

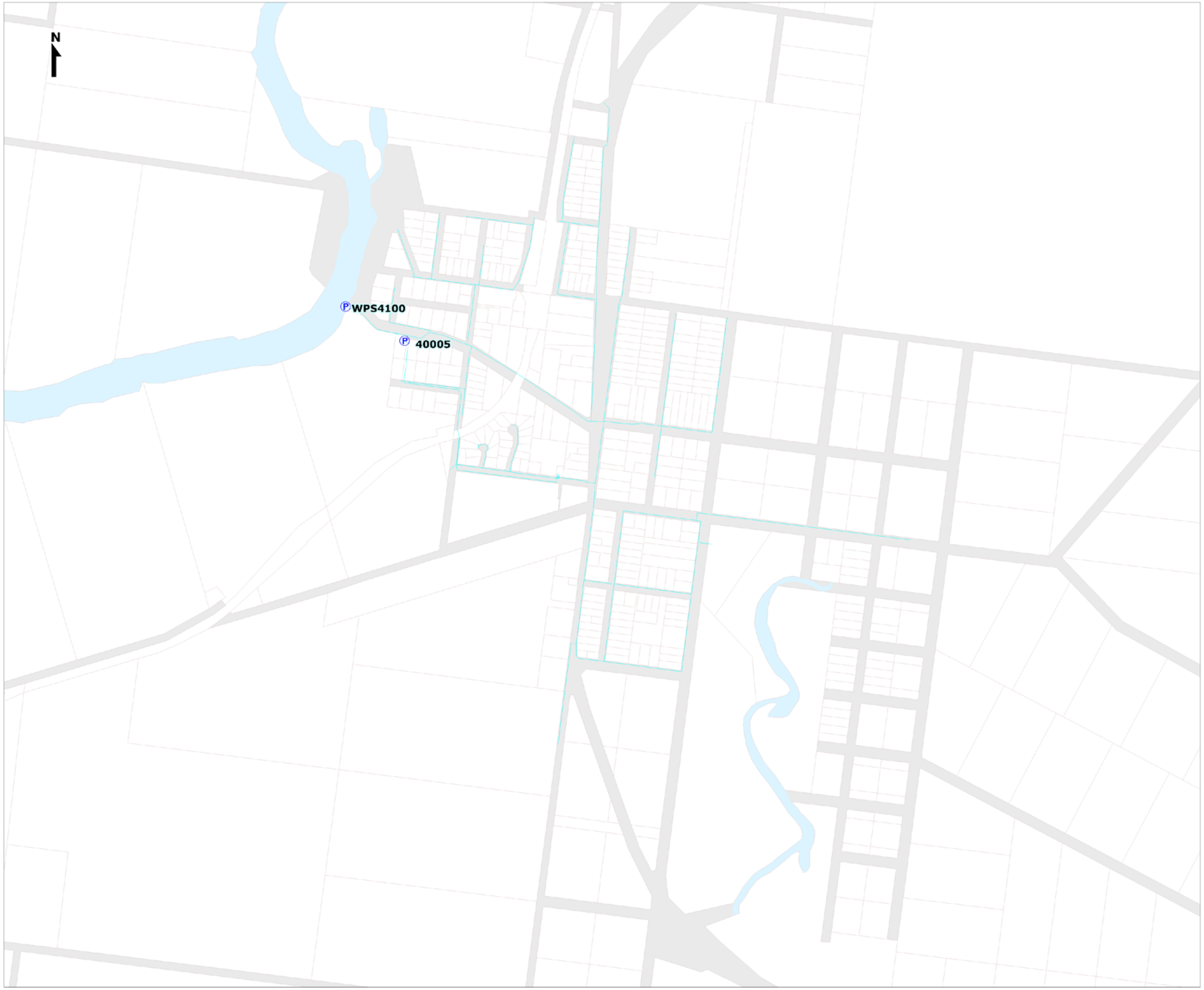
5J – Water Pump Station Details

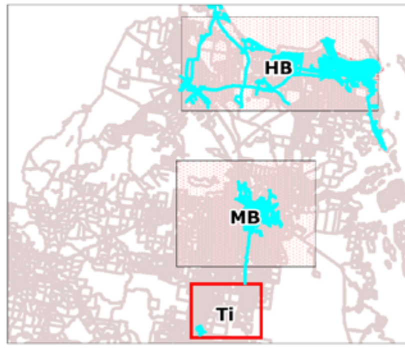
	PS Name	PS No.	No of Pumps	Fixed / Variable Speed	Duty (Current)	PS Duty (2031)	Description/Purpose	Pumping Regime
			use				into the reticulation system of Granville and CBD while simultaneously recharging the Ann St ET.	
MB	Granville Water Pump Station	n/a	3	Variable	n/a	20L/s@20m head	This pump station will provide minimum residual pressures to the highest elevated areas in Granville.	PH
TIA	Tiaro Raw Water PS	WPS4100	2	Fixed	12.5L/s@60m head	n/a	This pump station is used to transfer raw water from the Mary River to the Tiaro WTP.	MDMM
TIA	Tiaro Clear Water PS	40005	2		25L/s@75m head	n/a	This pump station is used to transfer treated water from the Tiaro WTP to the Tiaro ET..	PH



Hervey Bay
WATER PUMP
STATIONS


N
WPS5300
WPS5400
WPS5200
WPS5100
50011
50003
HB
MB
Ti
Legend
Water Pump Stations
Water Mains
DCDB
0
1000
2000
Meters
Scale: 1:55,000
Maryborough
WATER PUMP
STATIONS


N
WPS4100
40005

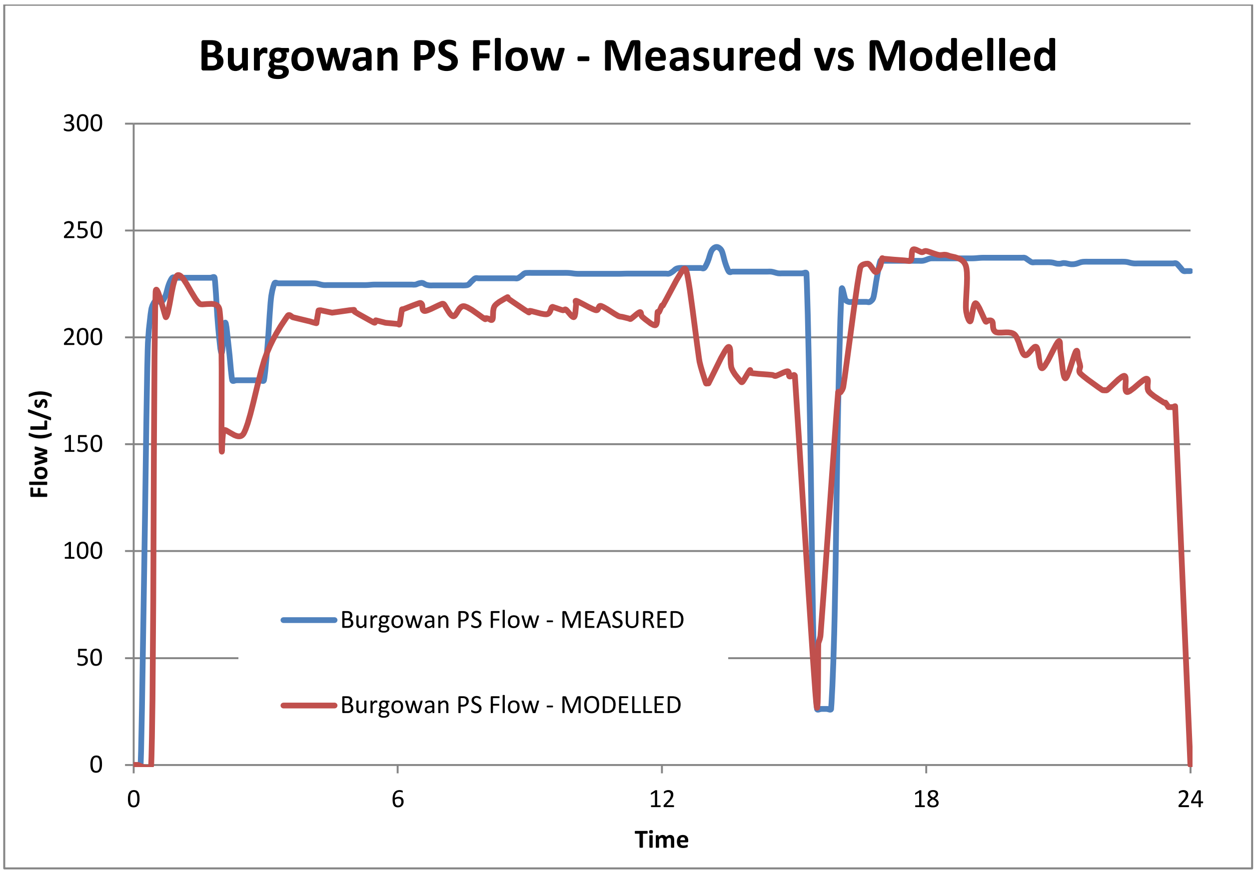

HB
MB
Ti

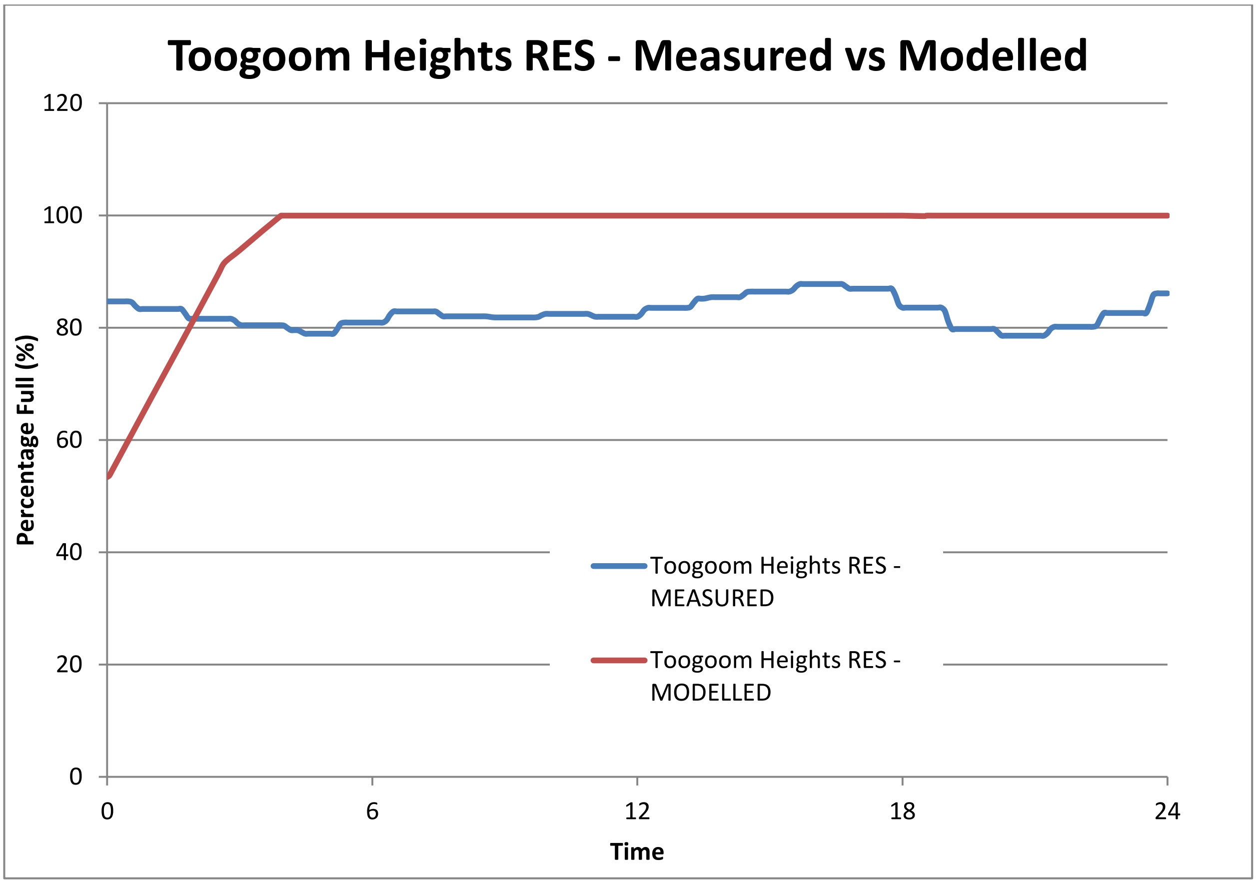
Legend
Water Pump Stations
Water Mains
DCDB
0 200 400
Meters
Scale: 1:10,000
Tiaro
WATER PUMP
STATIONS

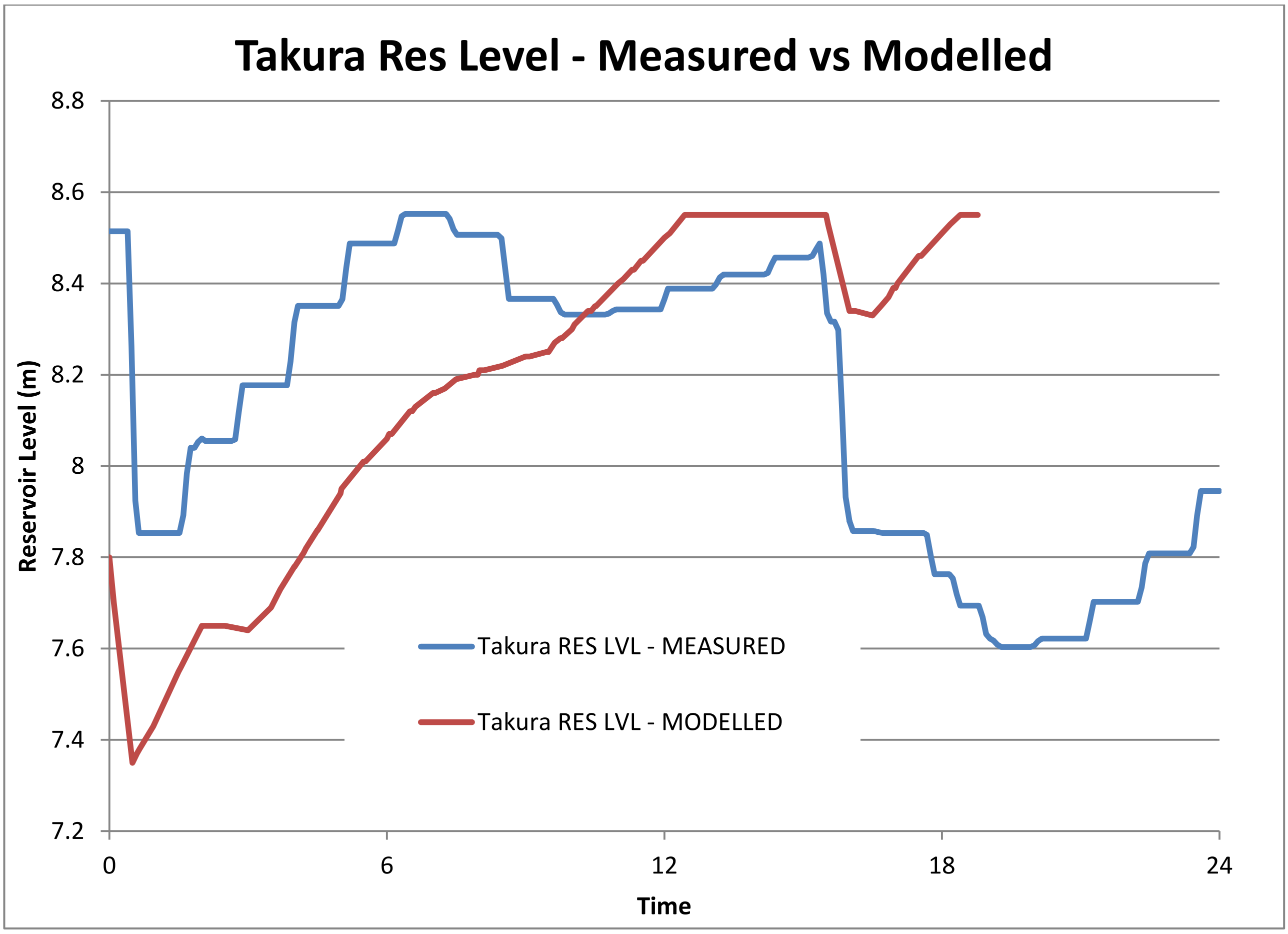
APPENDIX 6 – WATER QUALITY

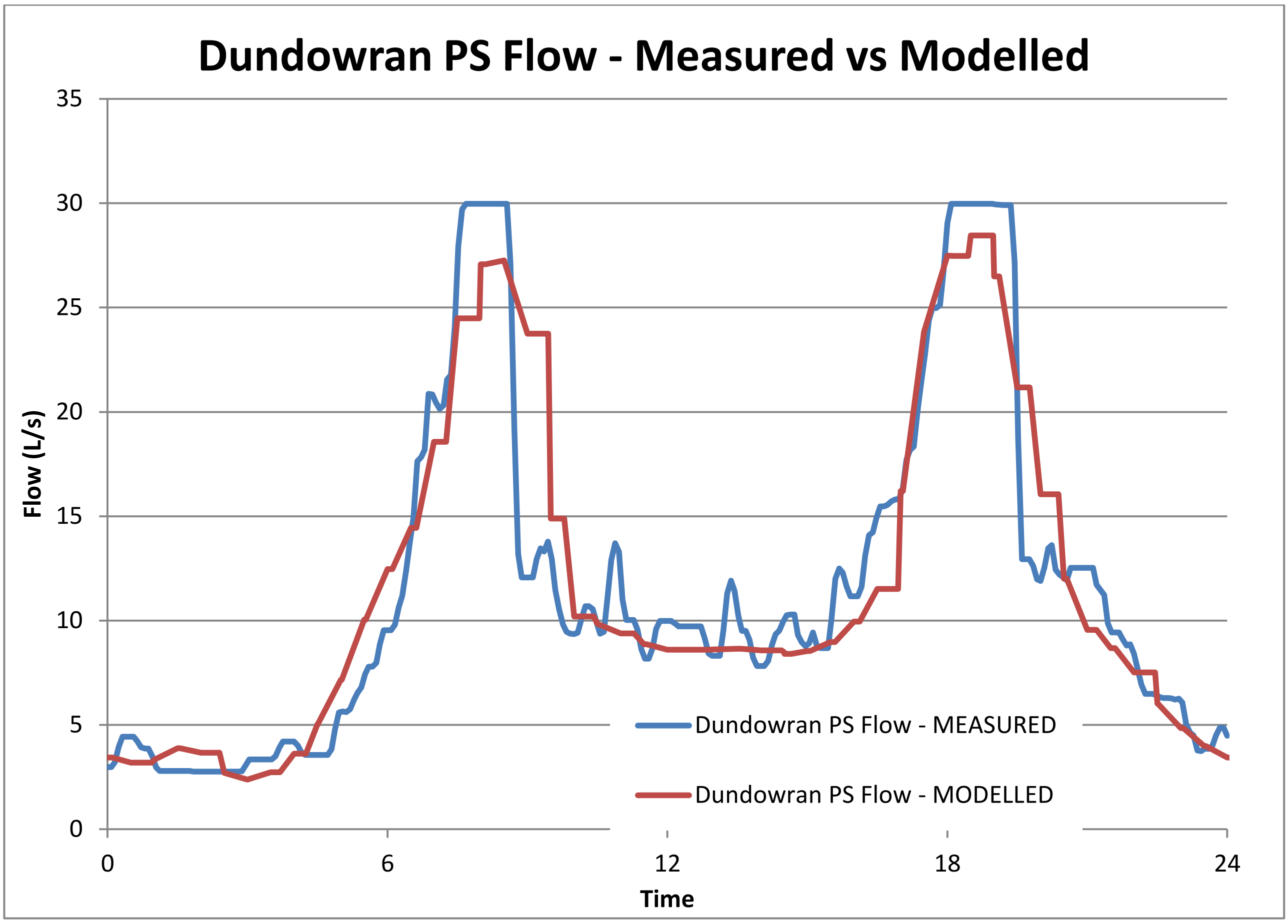
Table of Contents

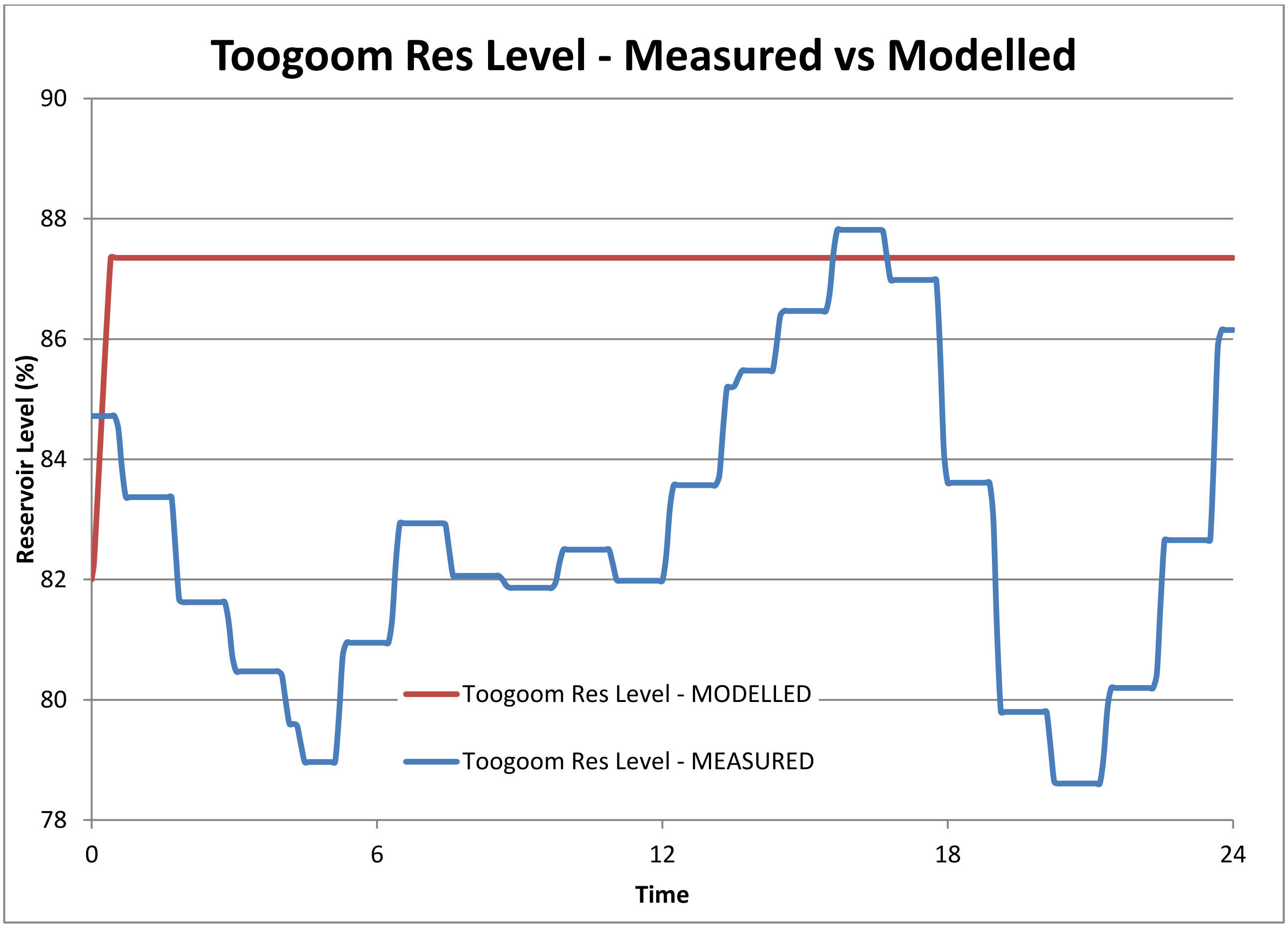
6A - Hervey Bay Water Quality Model Calibration

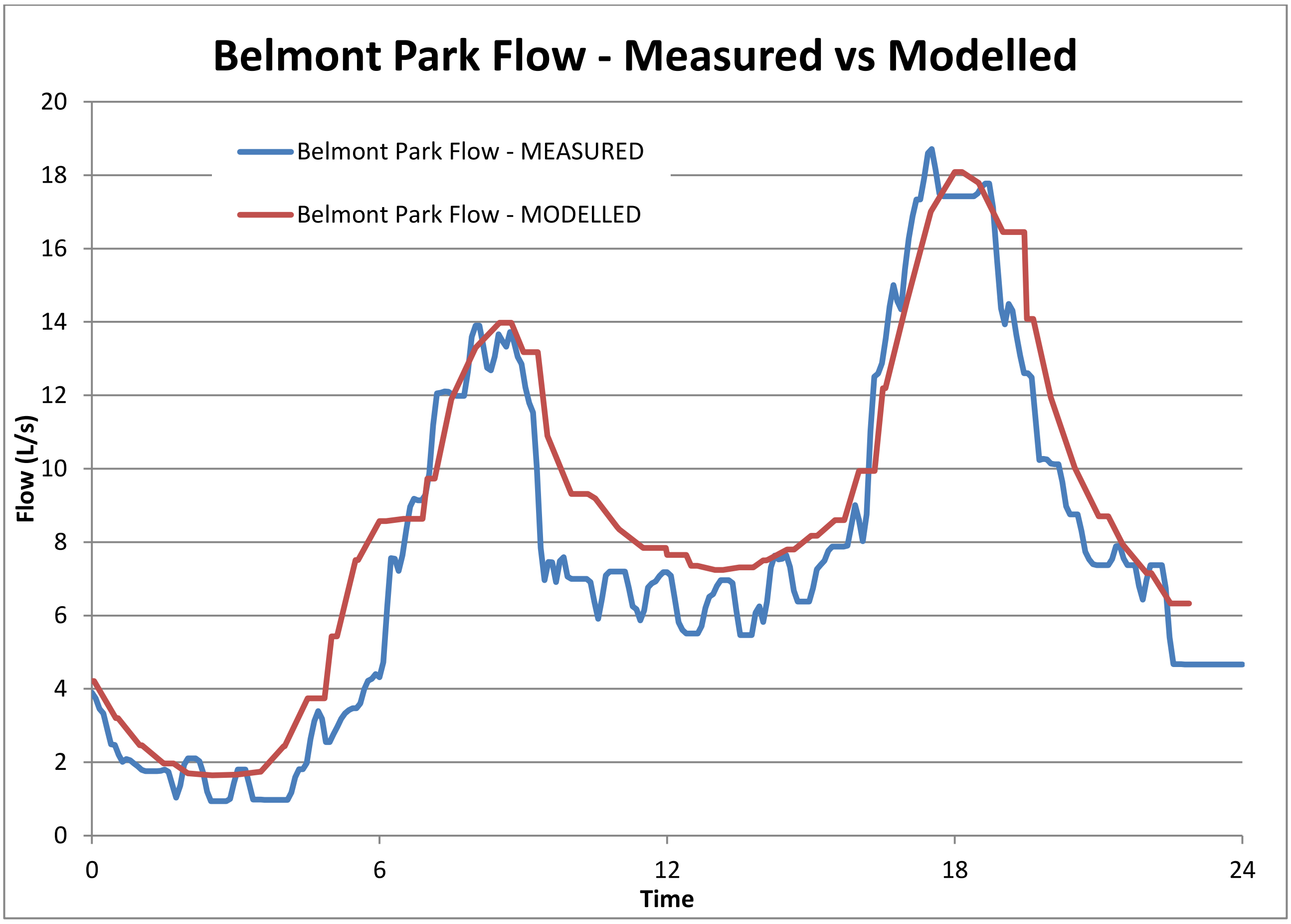


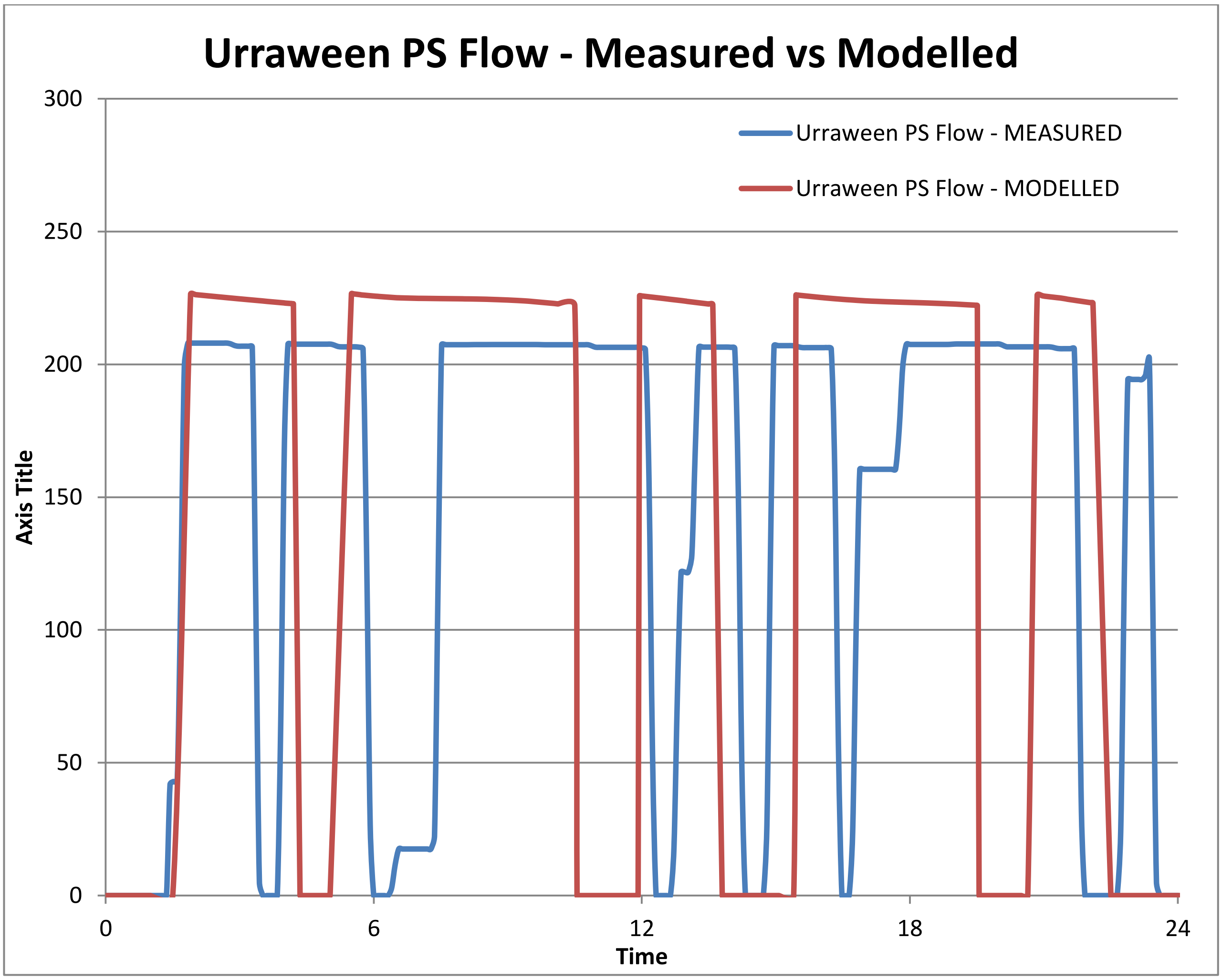


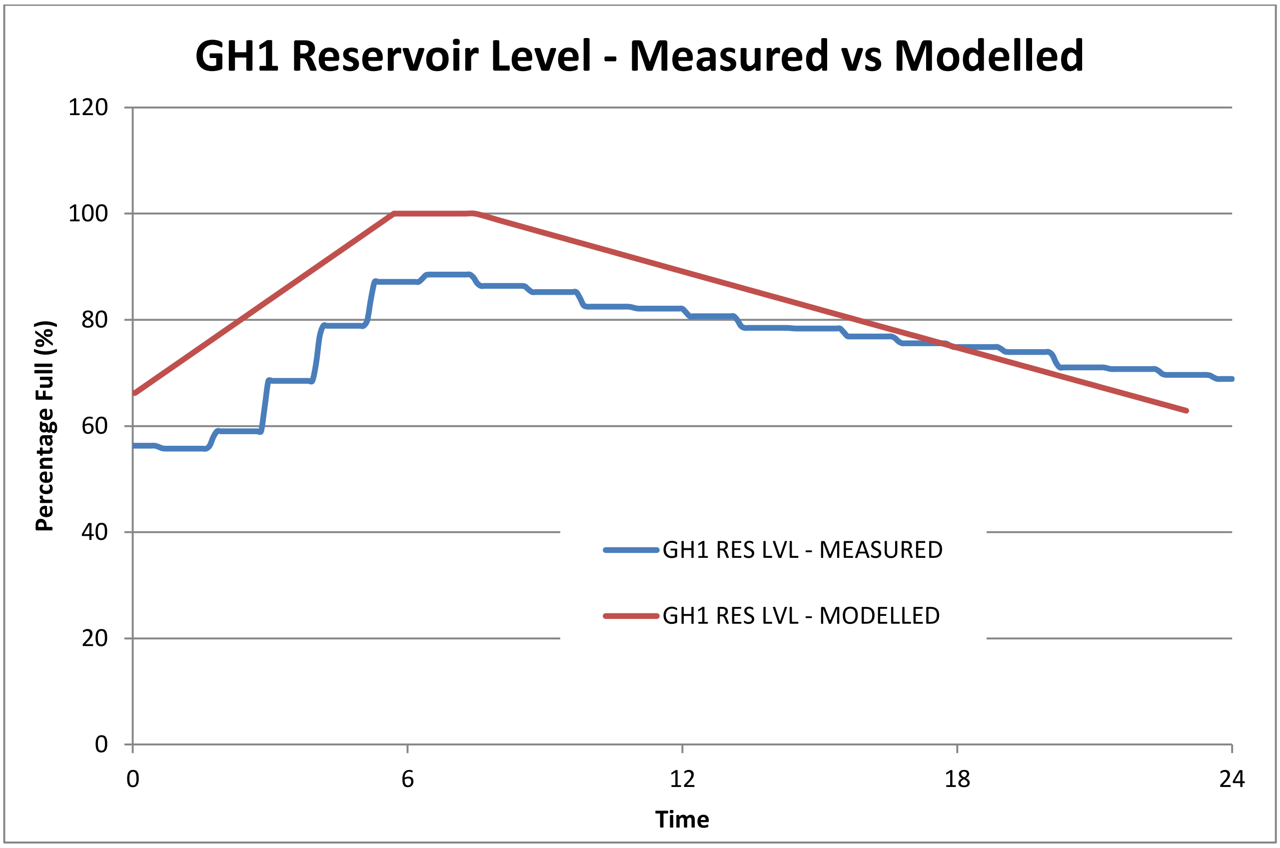

Takura Res Level - Measured vs Modelled
8.8
8.6
8.4
8.2
8
7.8
7.6
7.4
7.2
Reservoir Level (m)
0
6
12
18
24
Time
Takura RES LVL - MEASURED
Takura RES LVL - MODELLED

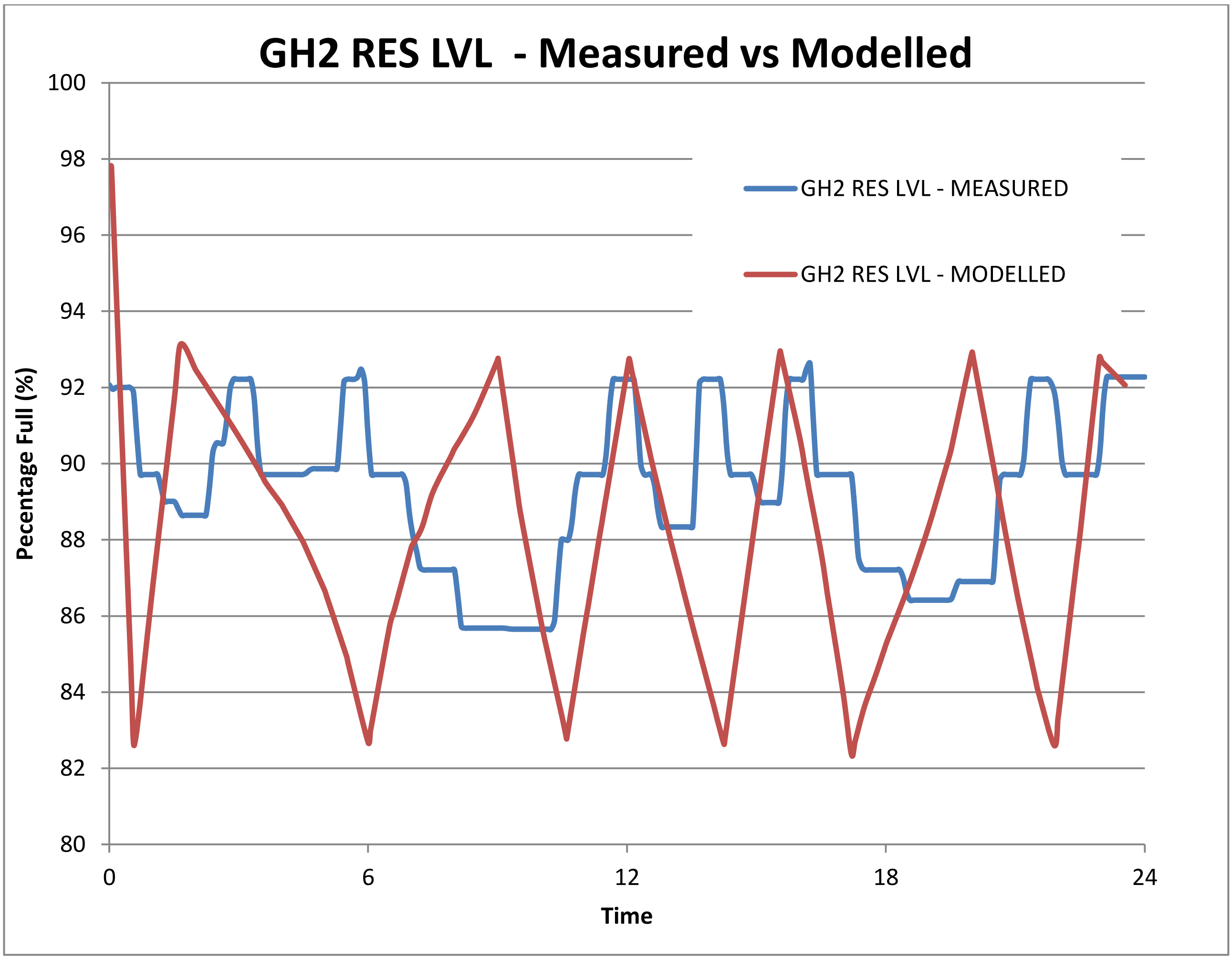

Dundowran PS Flow - Measured vs Modelled
35
30
25
20
15
10
5
0
Flow (L/s)
0
6
12
18
24
Time
Dundowran PS Flow - MEASURED
Dundowran PS Flow - MODELLED

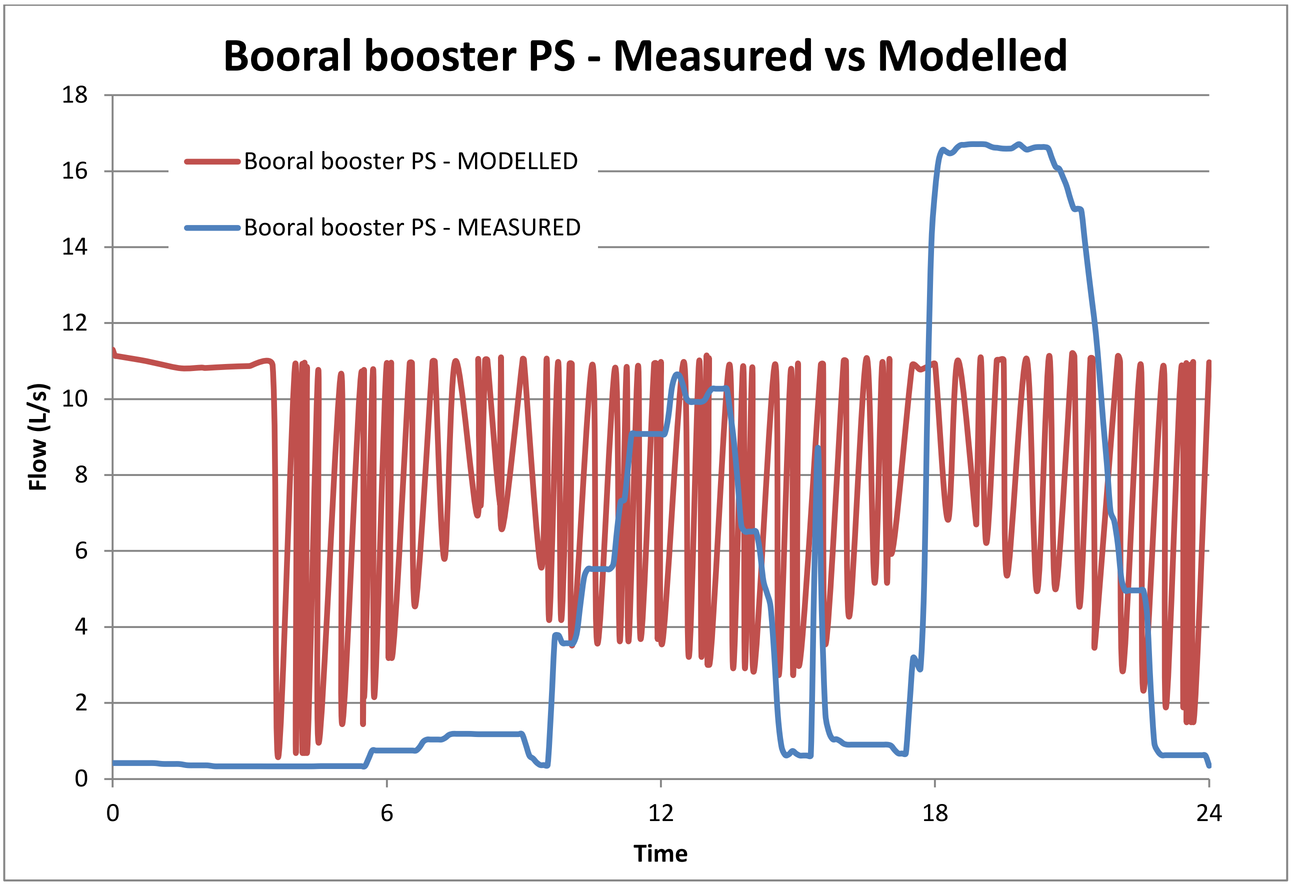

Toogoom Res Level - Measured vs Modelled
Reservoir Level (%)
90
88
86
84
82
80
78
0
6
12
18
24
Time
Toogoom Res Level - MODELLED
Toogoom Res Level - MEASURED

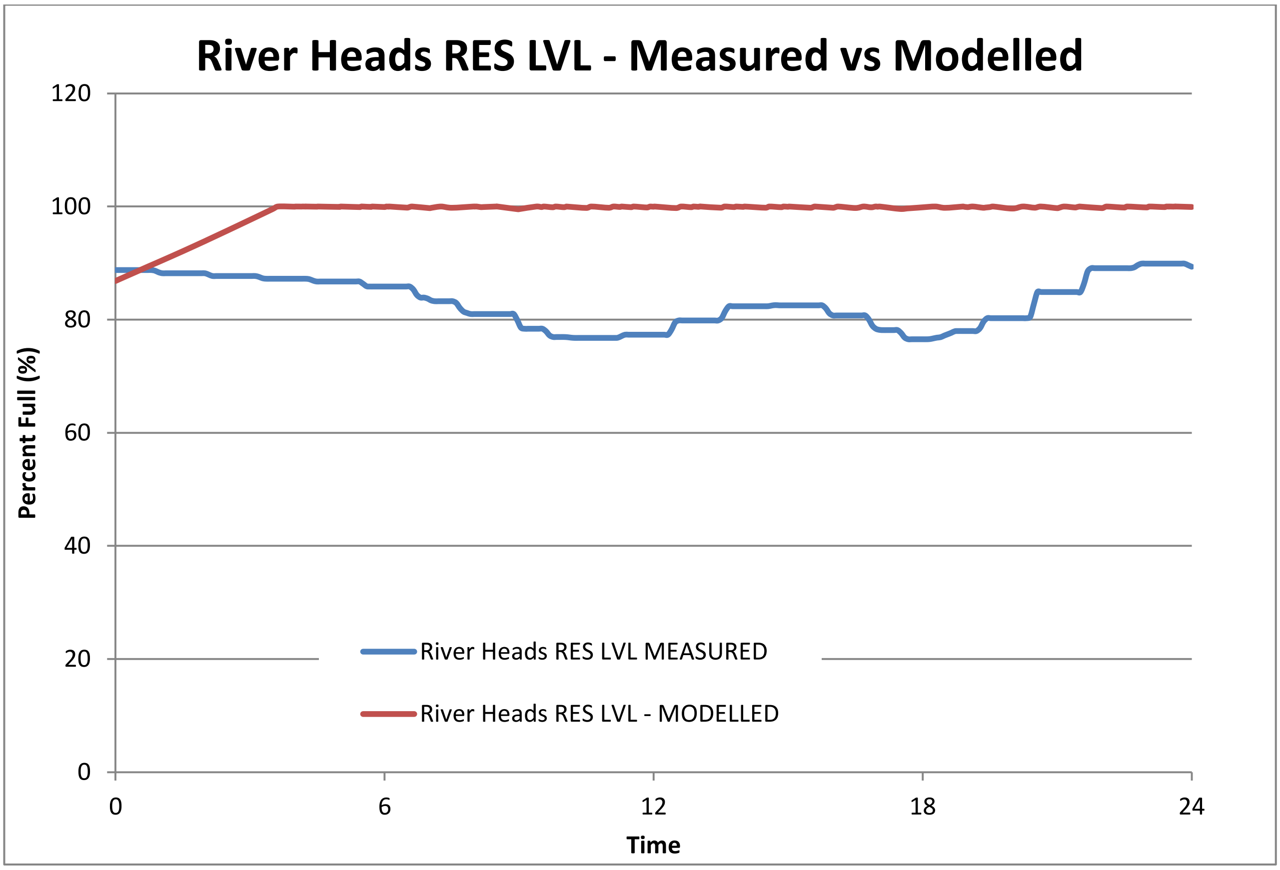

Belmont Park Flow - Measured vs Modelled
Flow (L/s)
20
18
16
14
12
10
8
6
4
2
0
0
6
12
18
24
Time
Belmont Park Flow - MEASURED
Belmont Park Flow - MODELLED

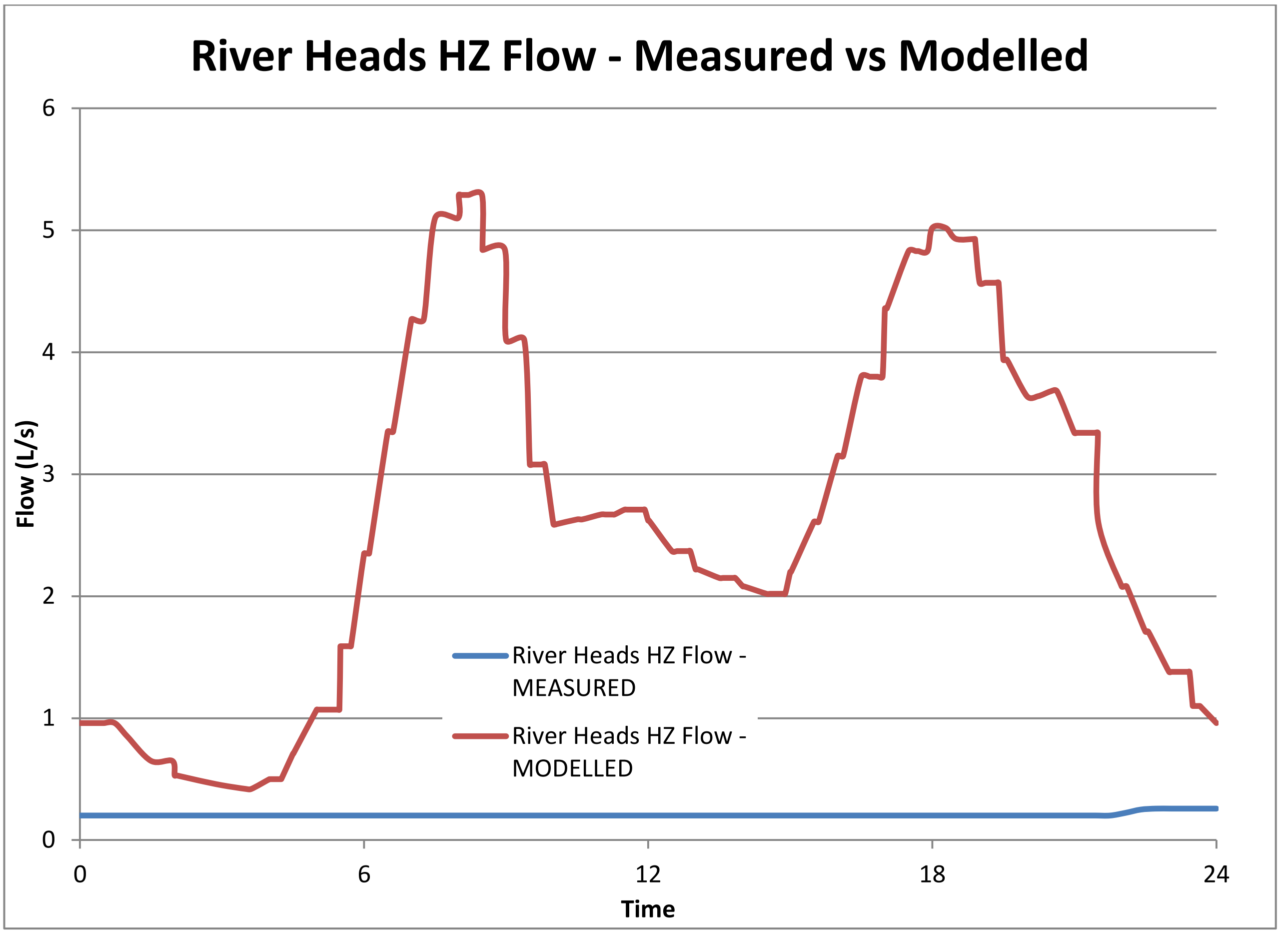

Urraween PS Flow - Measured vs Modelled
300
250
200
150
100
50
0
Axis Title
Urraween PS Flow - MEASURED
Urraween PS Flow - MODELLED
0
6
12
18
24
Time

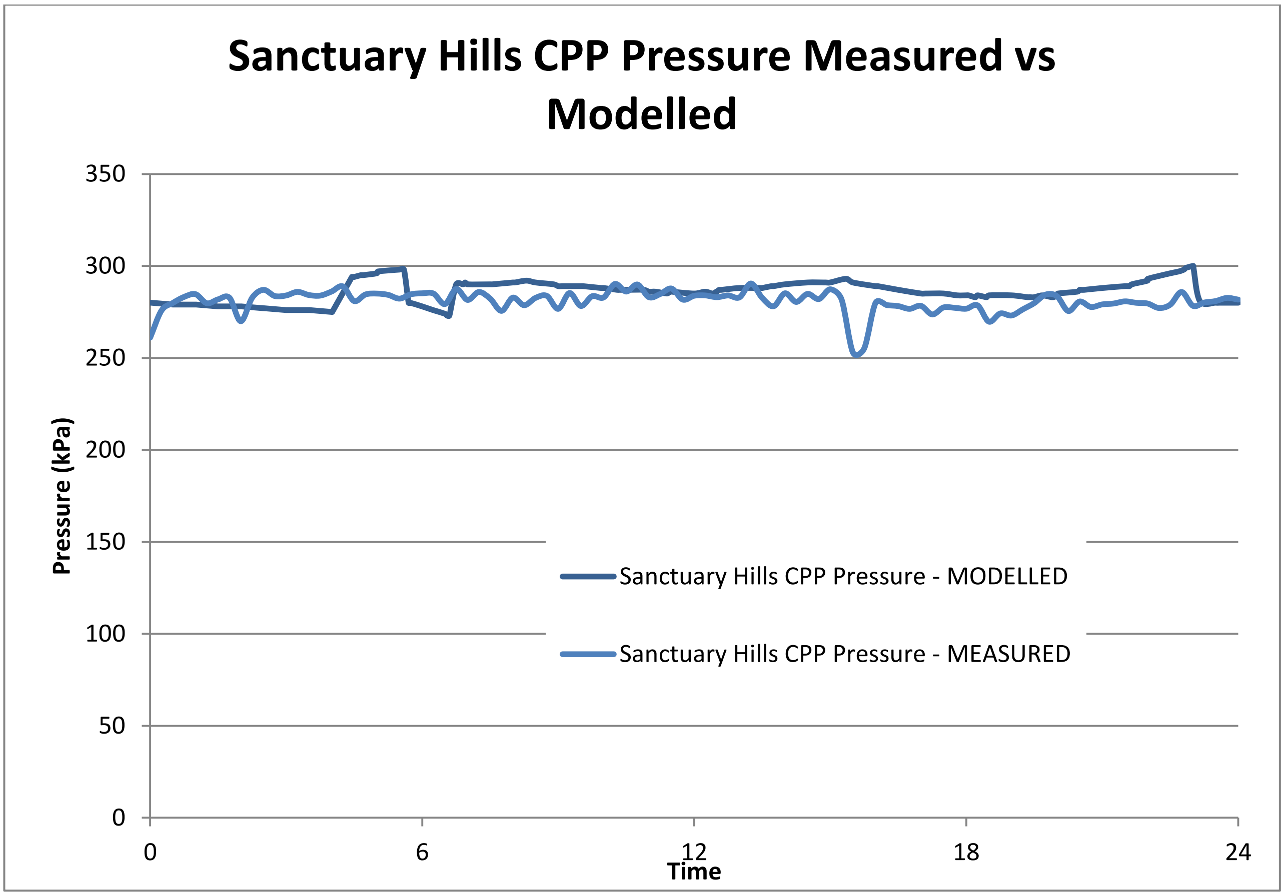

GH1 Reservoir Level - Measured vs Modelled
120
100
80
60
40
20
0
Percentage Full (%)
GH1 RES LVL - MEASURED
GH1 RES LVL - MODELLED
0
6
12
18
24
Time

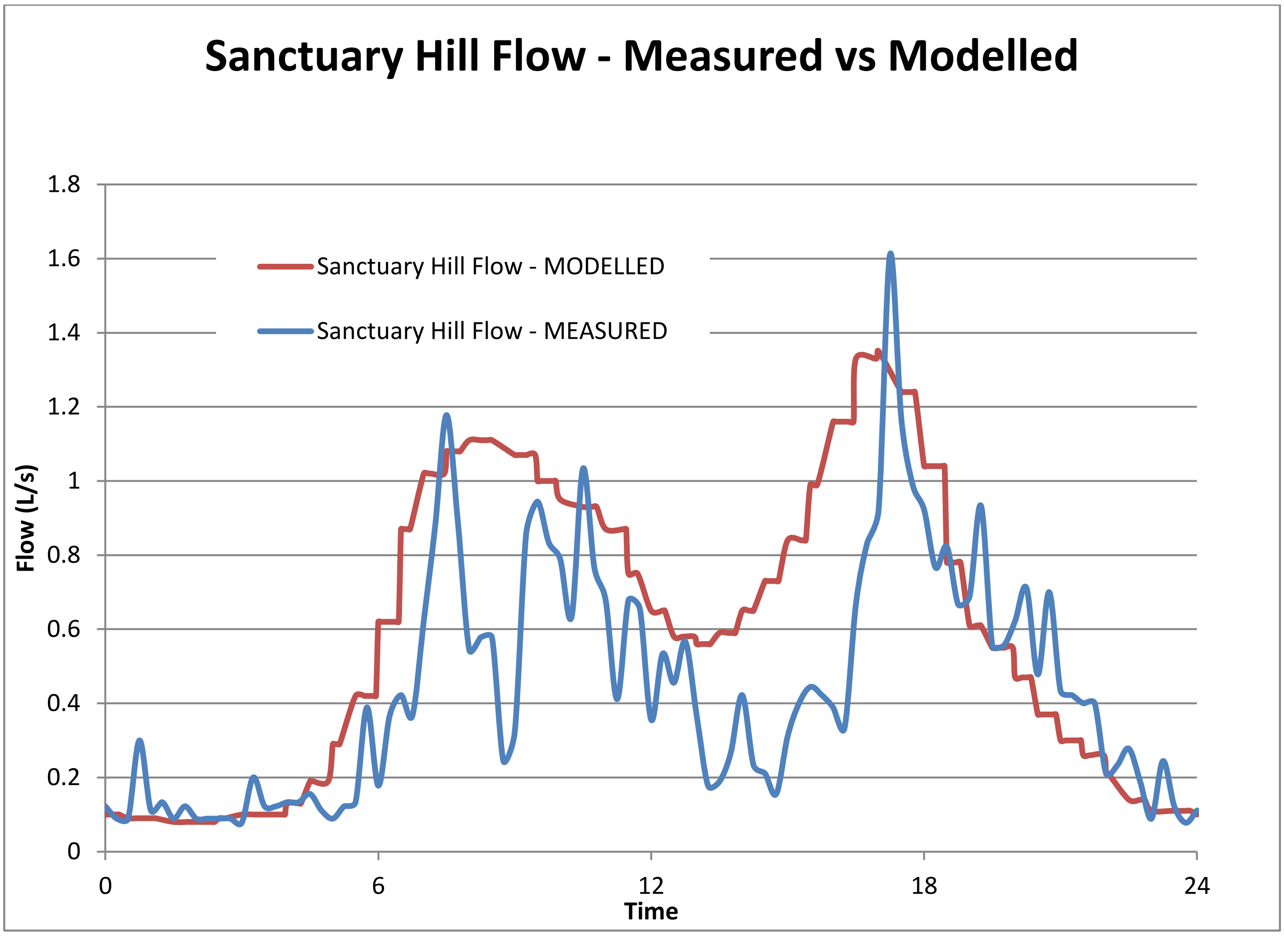

GH2 RES LVL - Measured vs Modelled
GH2 RES LVL - MEASURED
GH2 RES LVL - MODELLED
Pecentage Full (%)
100
98
96
94
92
90
88
86
84
82
80
0
6
12
18
24
Time

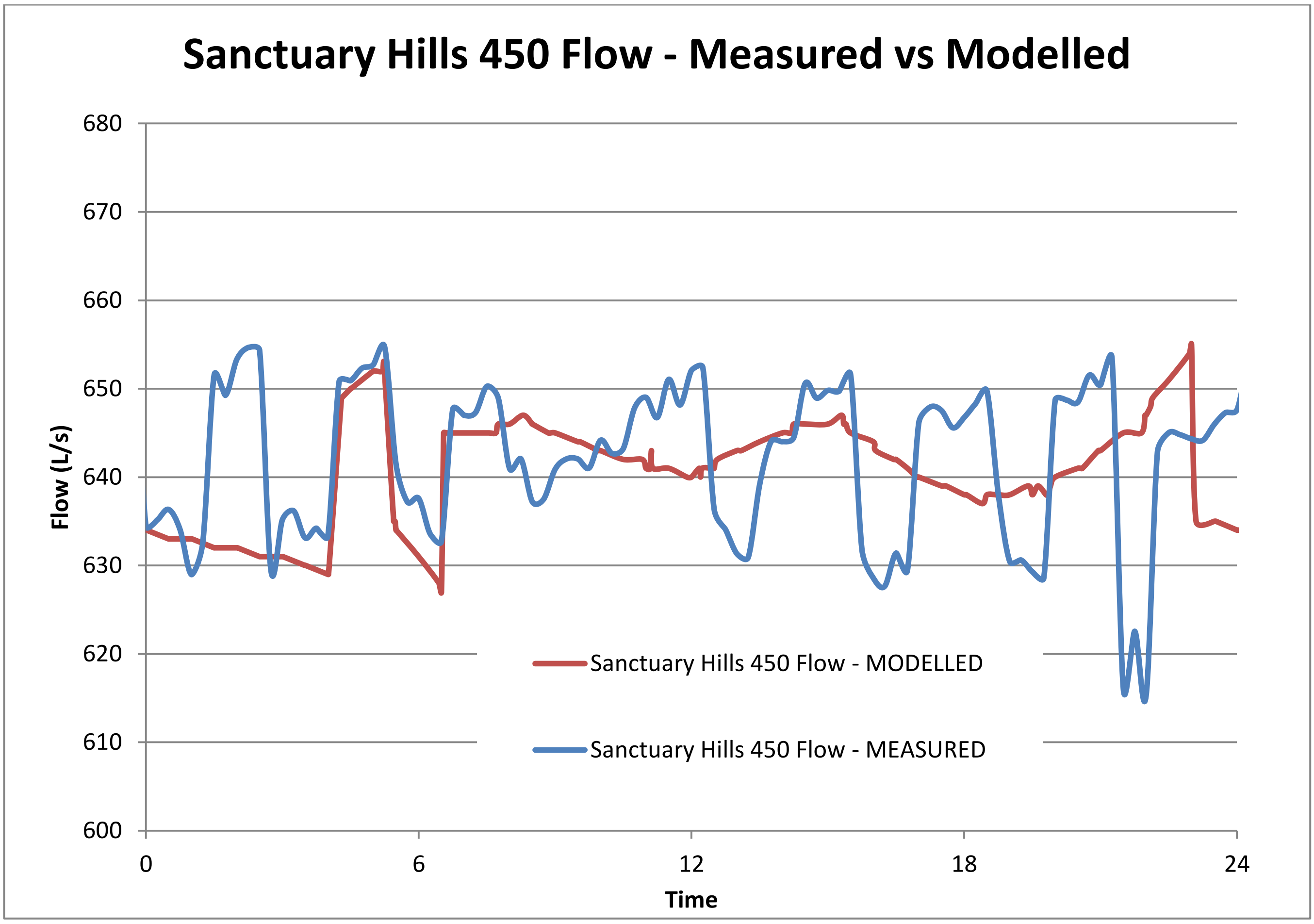

Booral booster PS - Measured vs Modelled
Booral booster PS - MODELLED
Booral booster PS - MEASURED
Flow (L/s)
18
16
14
12
10
8
6
4
2
0
0
6
12
18
24
Time

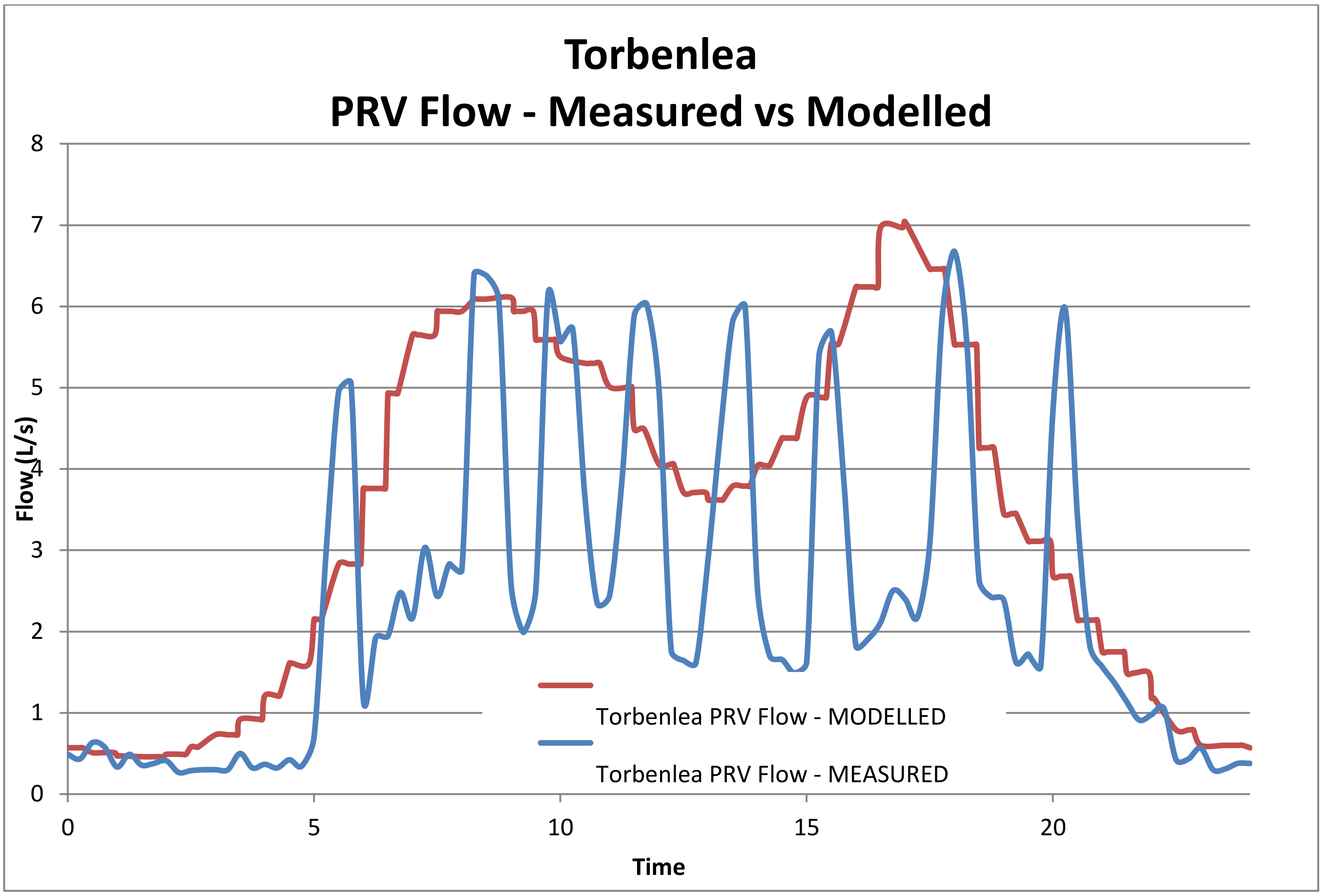

River Heads RES LVL - Measured vs Modelled
120
100
80
60
40
20
0
Percent Full (%)
River Heads RES LVL MEASURED
River Heads RES LVL - MODELLED
0
6
12
18
24
Time

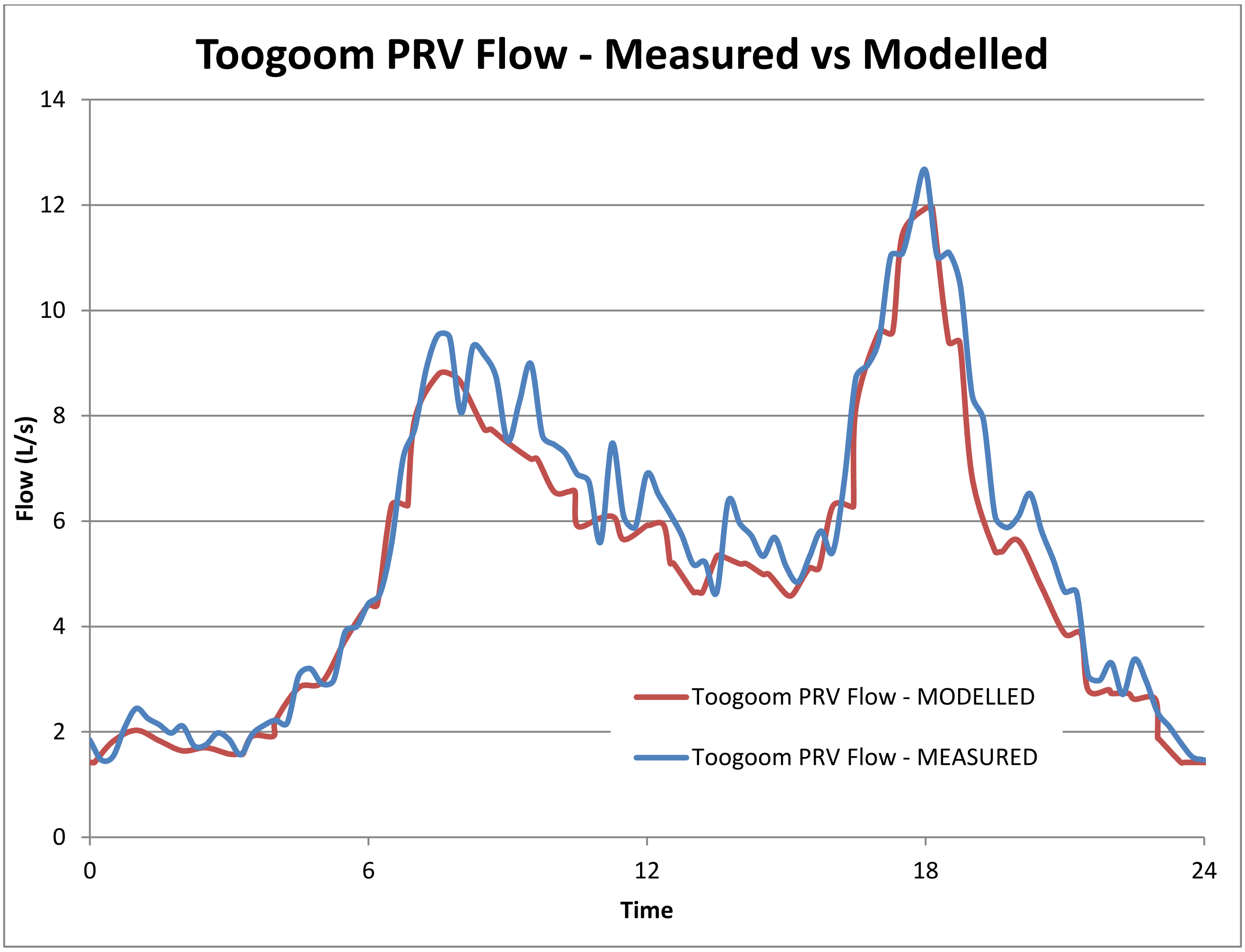

River Heads HZ Flow - Measured vs Modelled
6
5
4
3
2
1
0
Flow (L/s)
River Heads HZ Flow - MEASURED
River Heads HZ Flow - MODELLED
0
6
12
18
24
Time

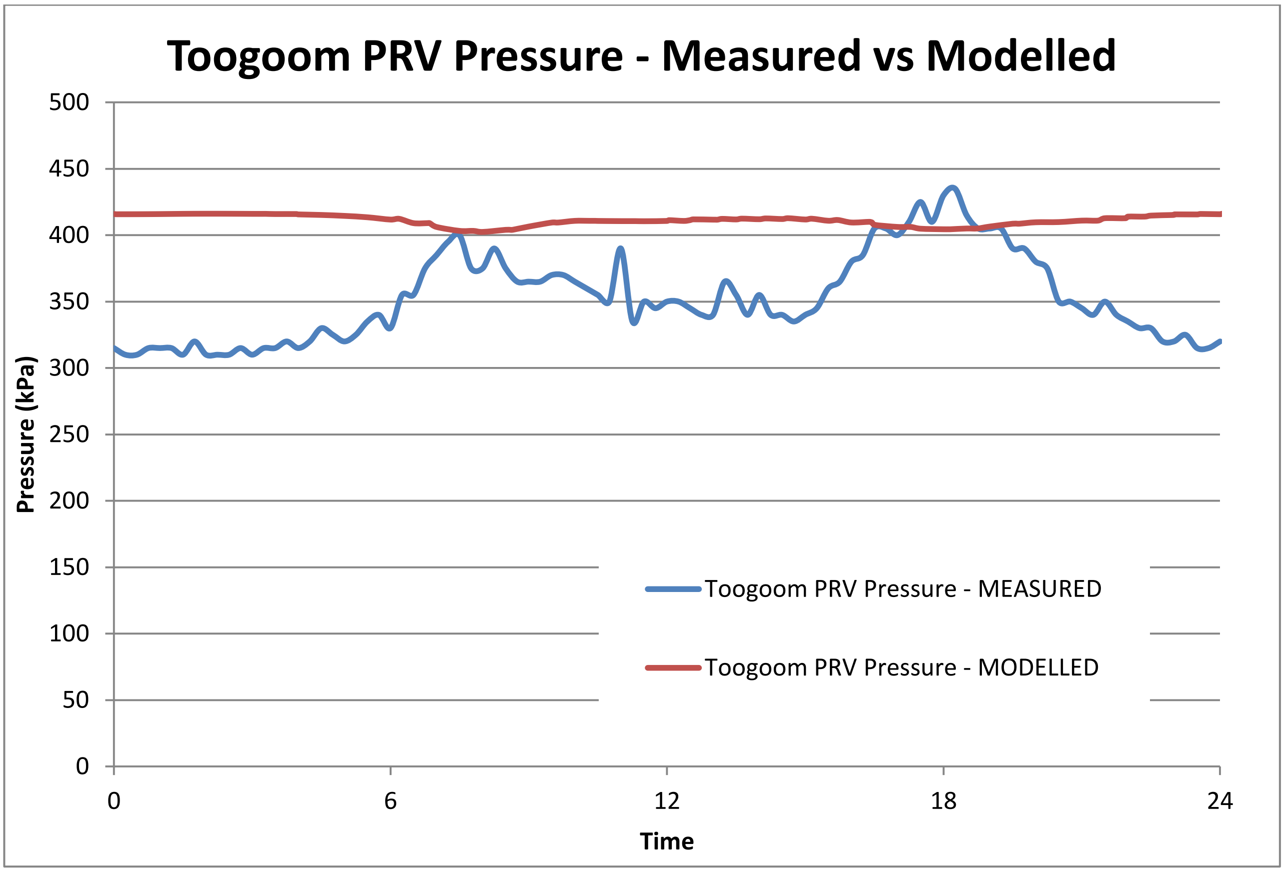

Sanctuary Hills CPP Pressure Measured vs Modelled
Pressure (kPa)
350
300
250
200
150
100
50
0
0
6
12
18
24
Time
Sanctuary Hills CPP Pressure - MODELLED
Sanctuary Hills CPP Pressure - MEASURED

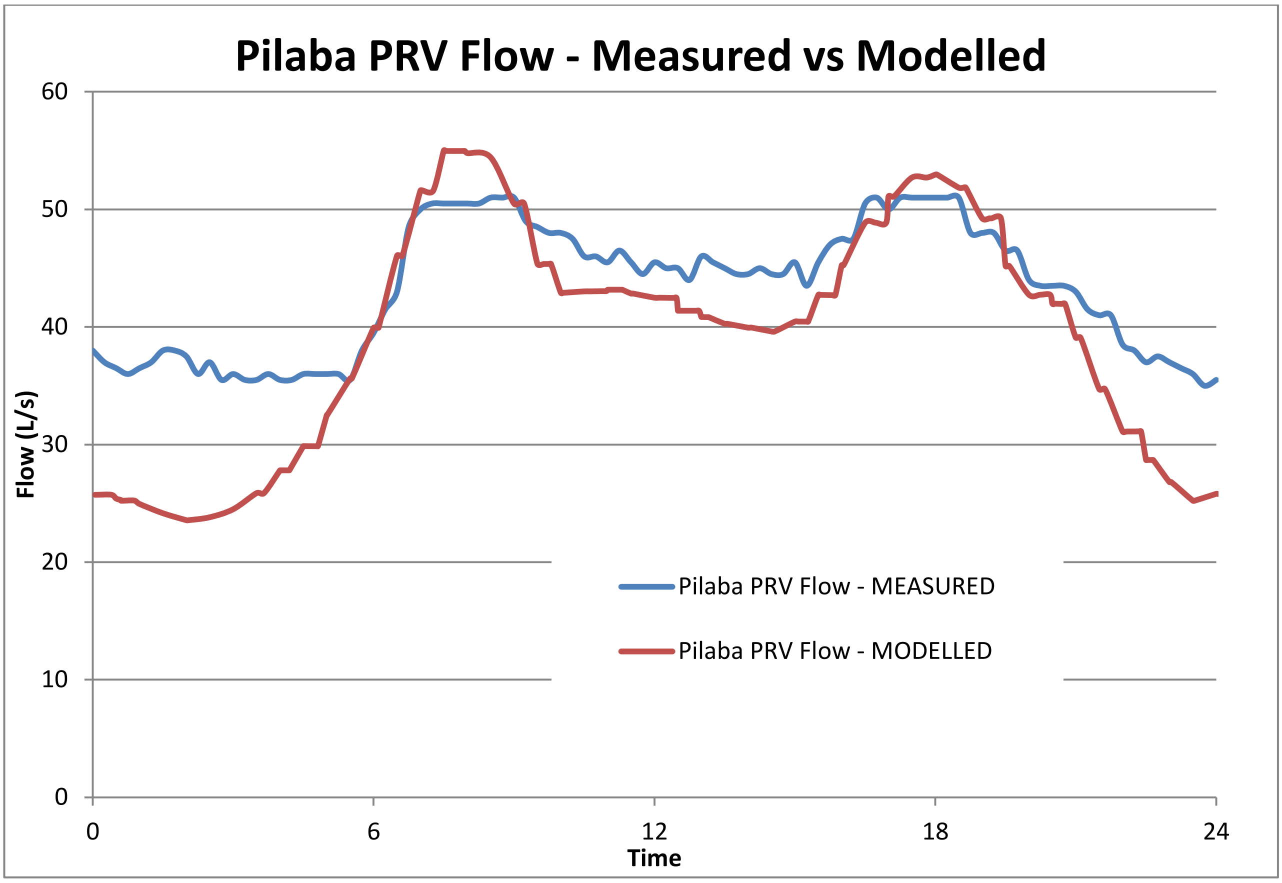

Sanctuary Hill Flow - Measured vs Modelled
Flow (L/s)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
6
12
18
24
Time
Sanctuary Hill Flow - MODELLED
Sanctuary Hill Flow - MEASURED

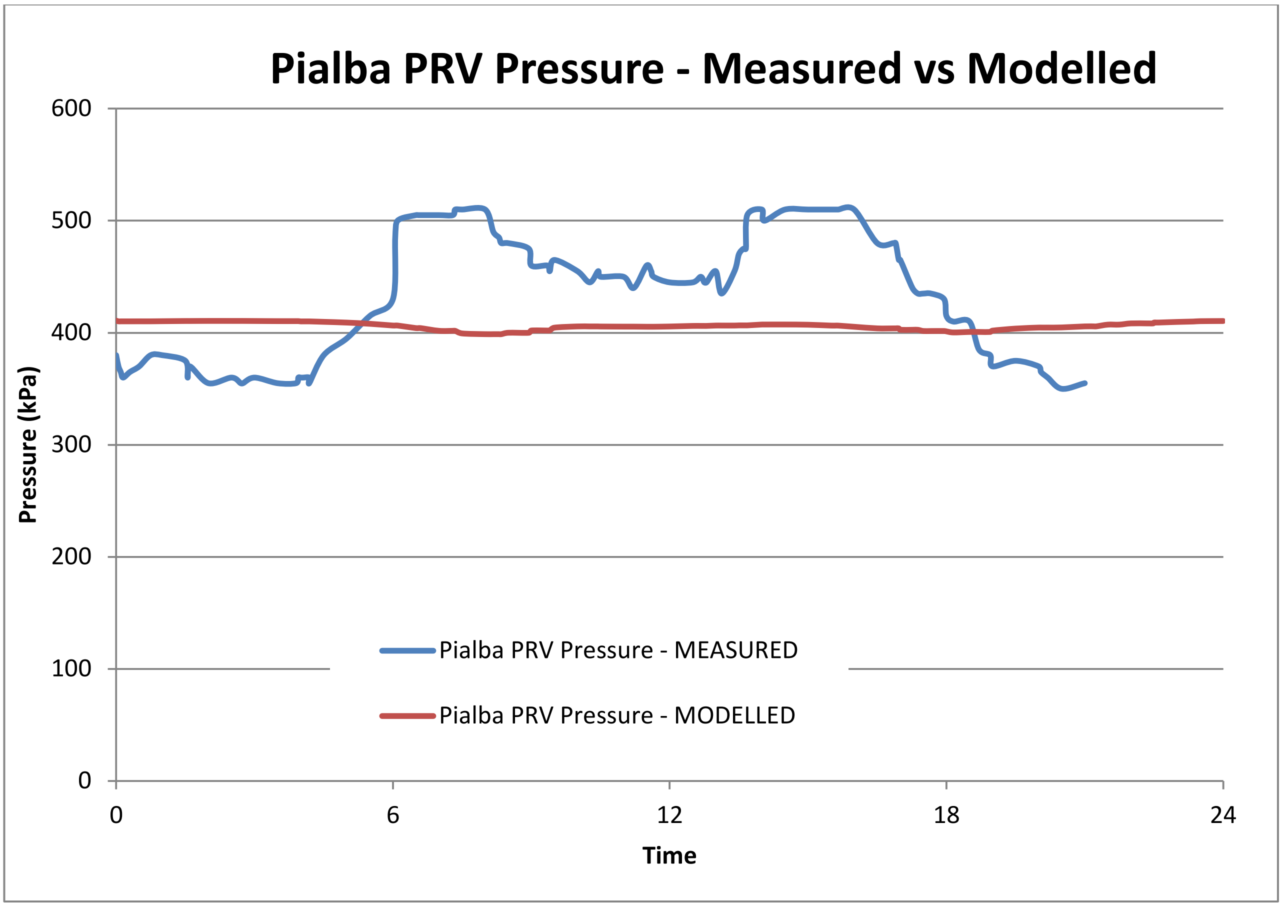

Sanctuary Hills 450 Flow - Measured vs Modelled
680
670
660
650
640
630
620
610
600
Flow (L/s)
0
6
12
18
24
Time
Sanctuary Hills 450 Flow - MODELLED
Sanctuary Hills 450 Flow - MEASURED

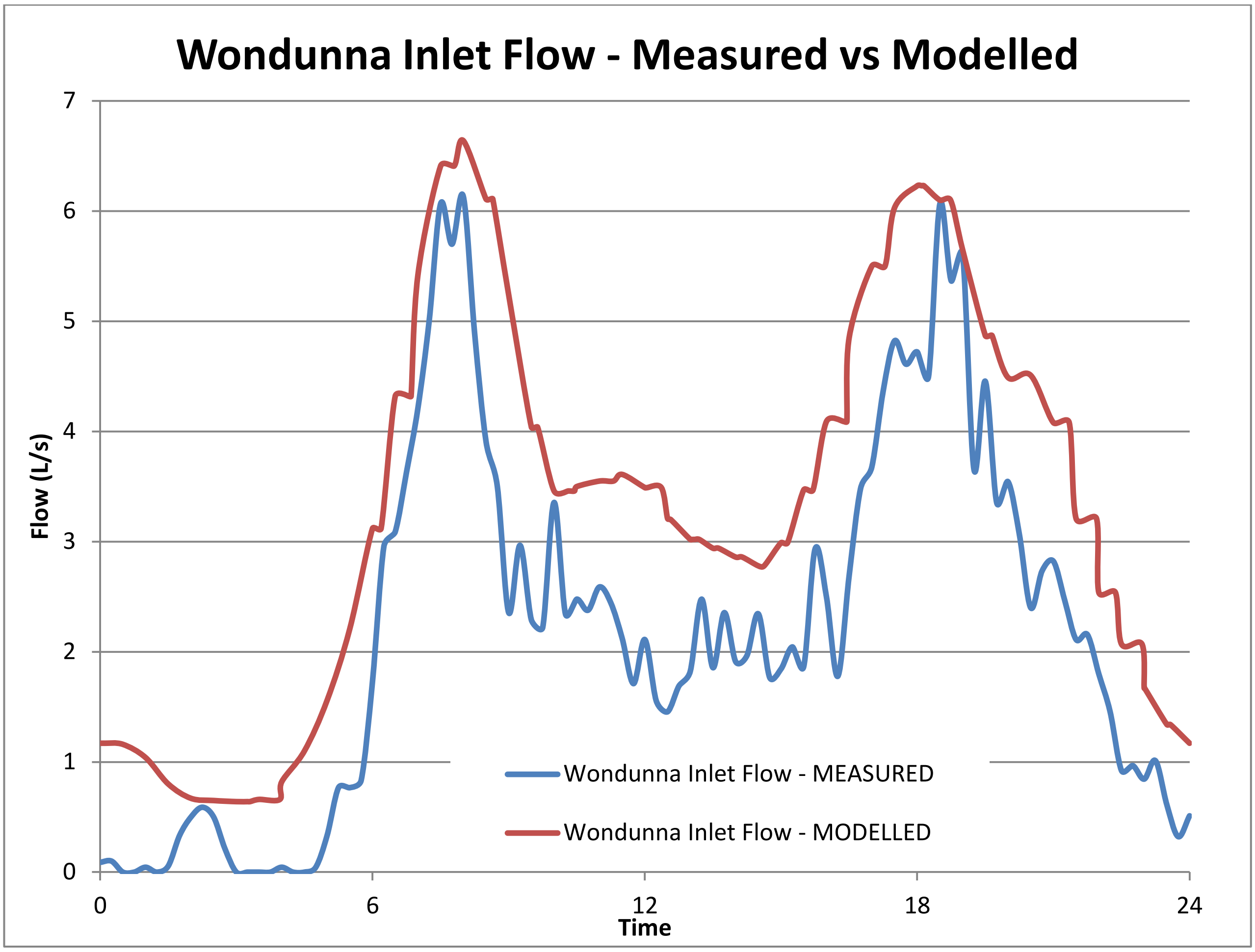

Torbenlea
PRV Flow - Measured vs Modelled
8
7
6
5
4
3
2
1
0
Flow (L/s)
0
5
10
15
20
Time
Torbenlea PRV Flow - MODELLED
Torbenlea PRV Flow - MEASURED

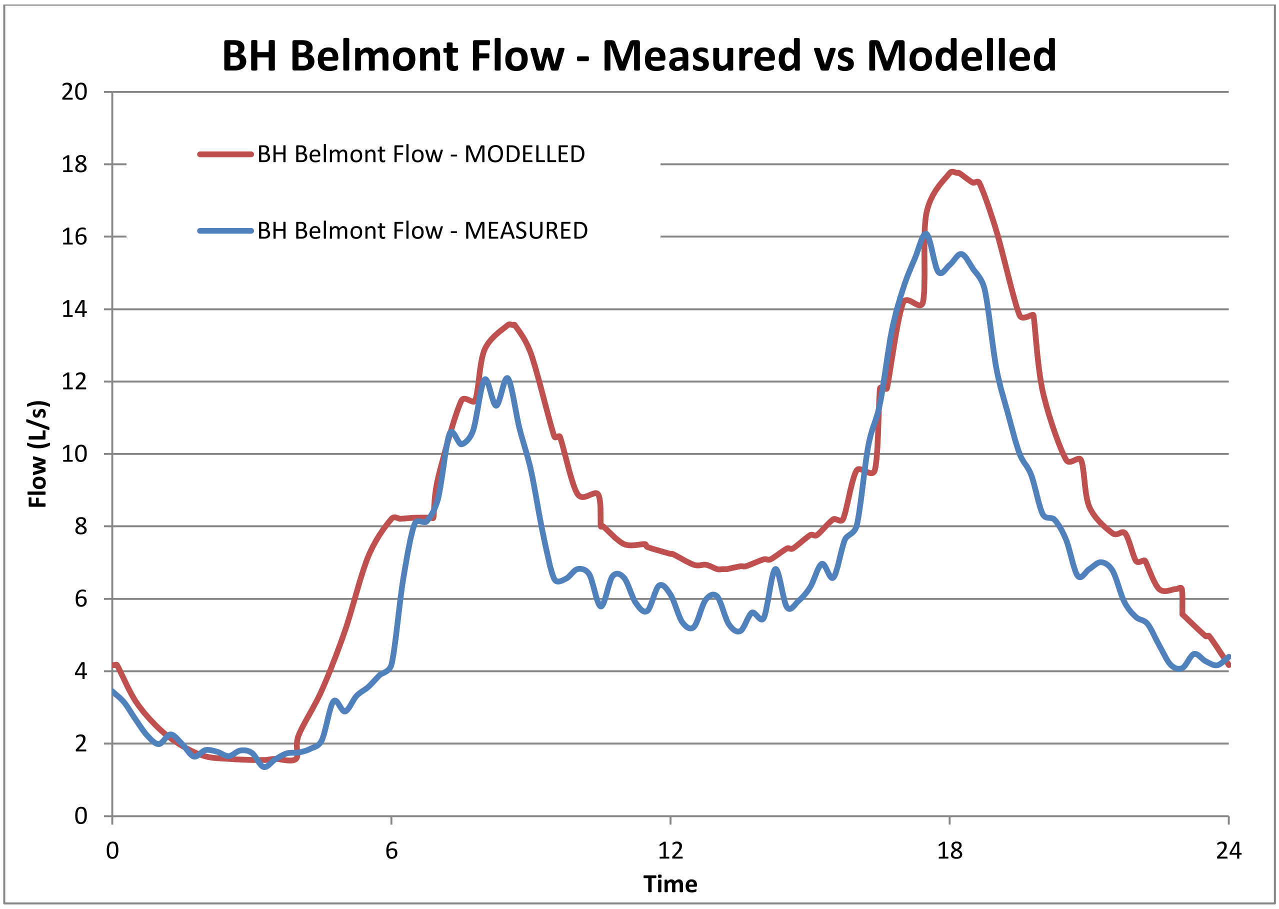

Toogoom PRV Flow - Measured vs Modelled
Flow (L/s)
0
2
4
6
8
10
12
14
0
6
12
18
24
Time
Toogoom PRV Flow - MODELLED
Toogoom PRV Flow - MEASURED

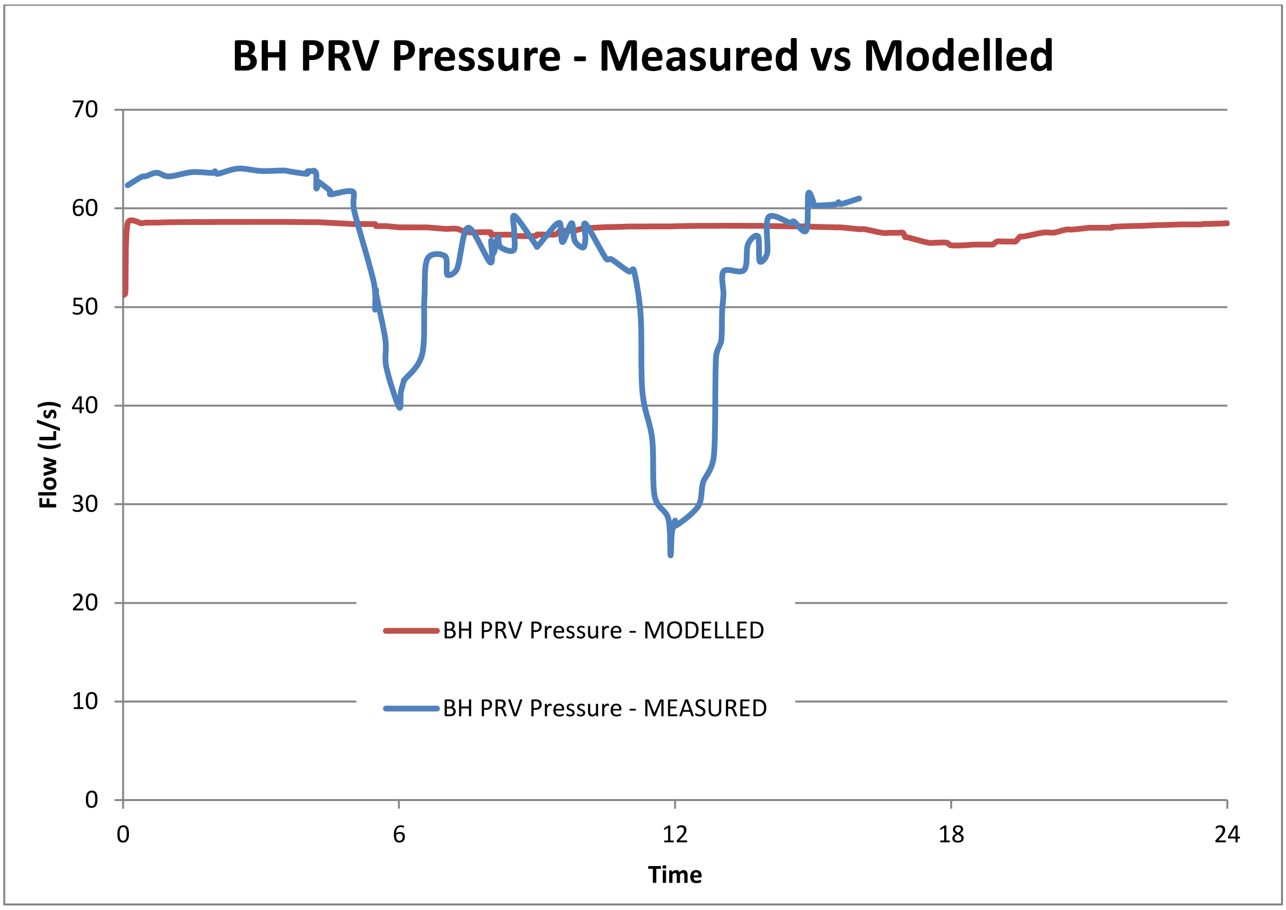

Toogoom PRV Pressure - Measured vs Modelled
Pressure (kPa)
0
50
100
150
200
250
300
350
400
450
500
0
6
12
18
24
Time
Toogoom PRV Pressure - MEASURED
Toogoom PRV Pressure - MODELLED

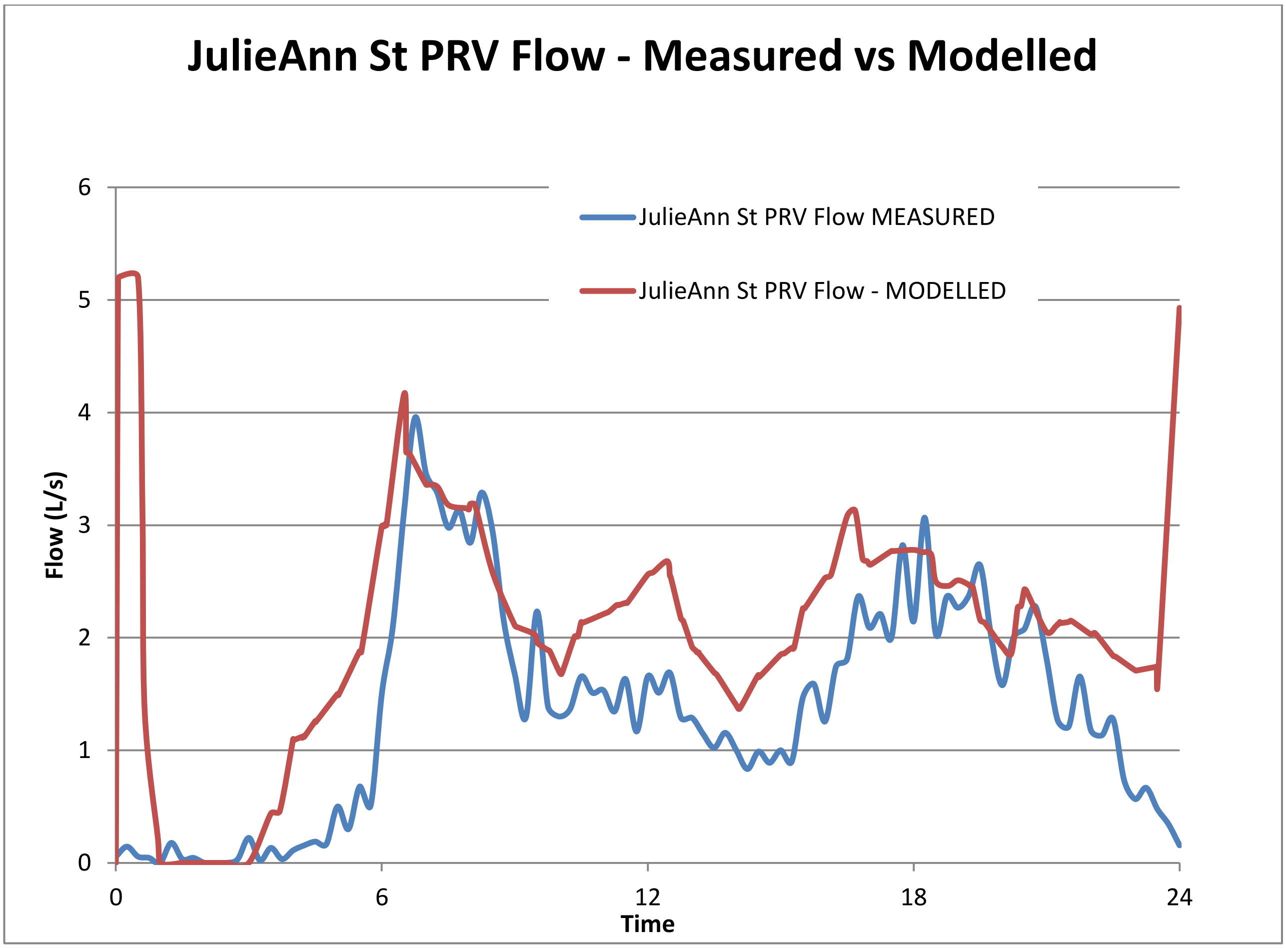

Pilaba PRV Flow - Measured vs Modelled
Flow (L/s)
0
10
20
30
40
50
60
0
6
12
18
24
Time
Pilaba PRV Flow - MEASURED
Pilaba PRV Flow - MODELLED

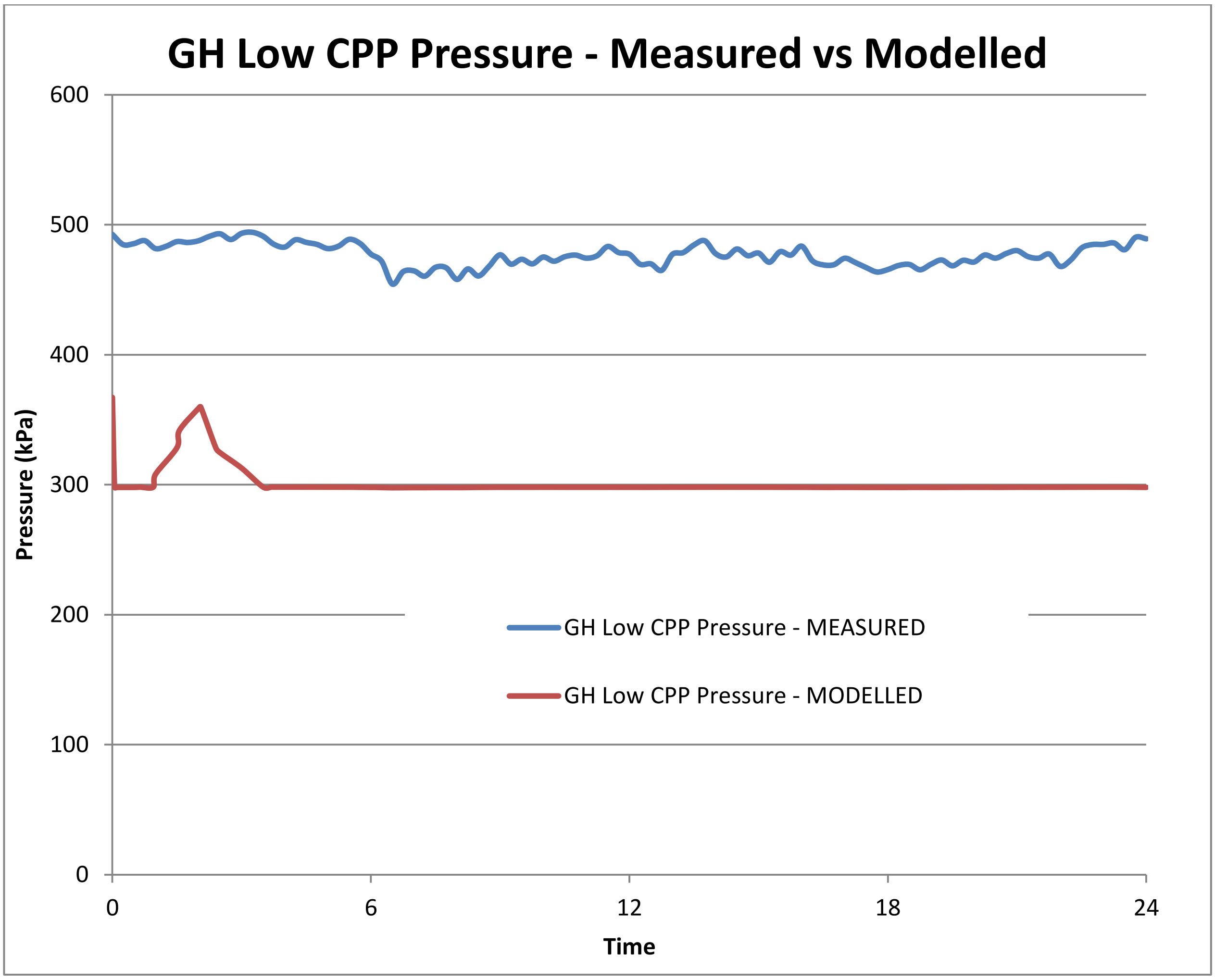

Pialba PRV Pressure - Measured vs Modelled
Pressure (kPa)
0
100
200
300
400
500
600
0
6
12
18
24
Time
Pialba PRV Pressure - MEASURED
Pialba PRV Pressure - MODELLED

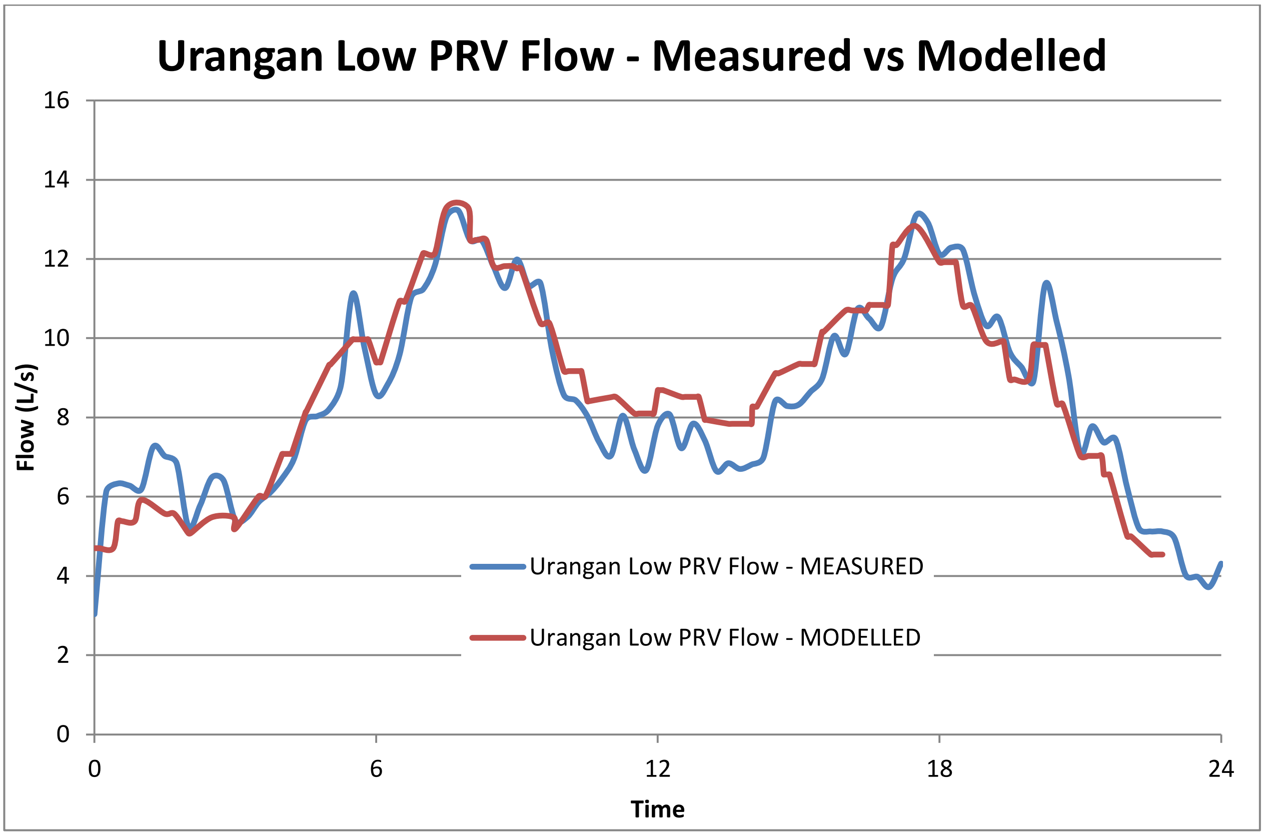

Wondunna Inlet Flow - Measured vs Modelled
7
6
5
4
3
2
1
0
Flow (L/s)
0
6
12
18
24
Time
Wondunna Inlet Flow - MEASURED
Wondunna Inlet Flow - MODELLED

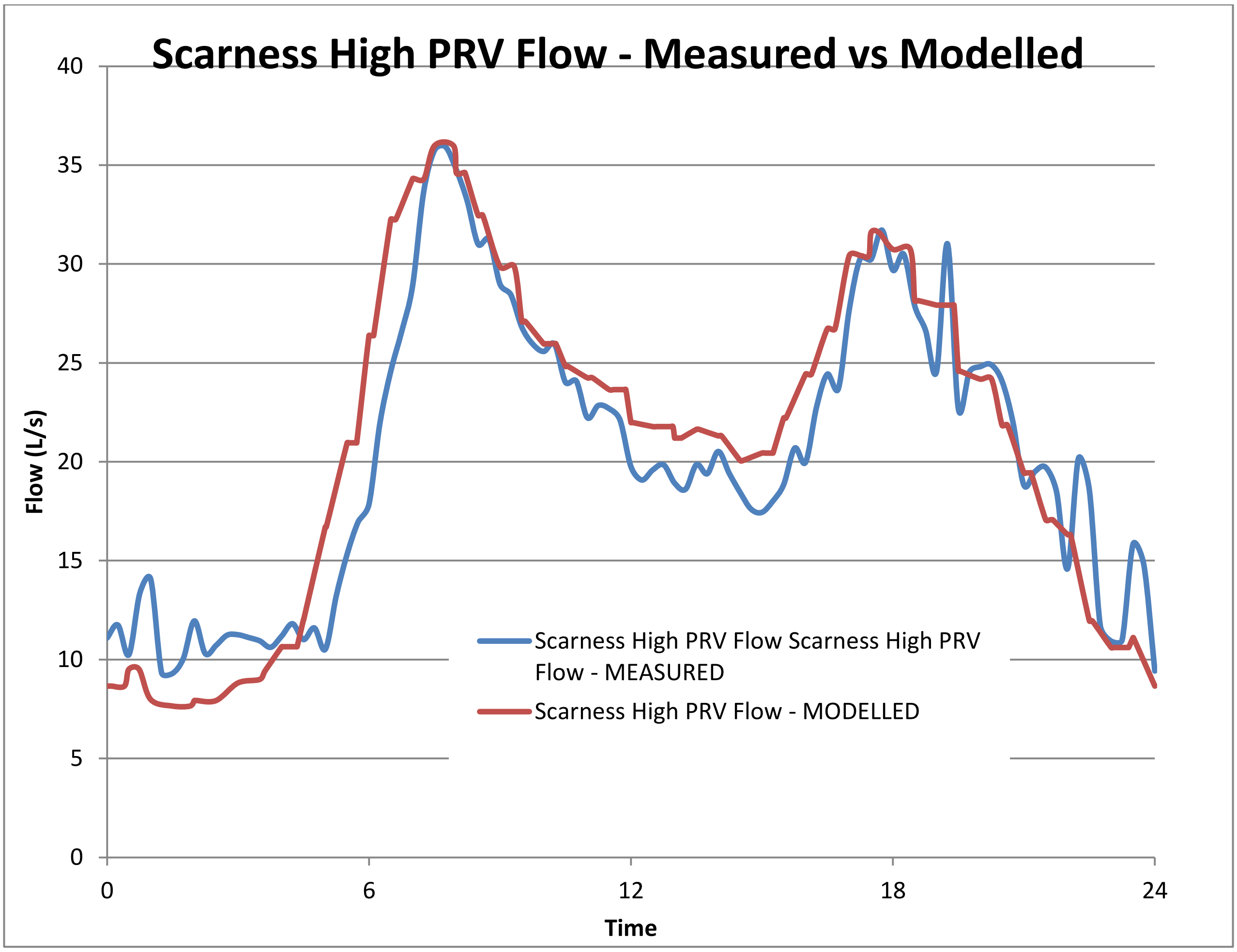

BH Belmont Flow - Measured vs Modelled
BH Belmont Flow - MODELLED
BH Belmont Flow - MEASURED
Flow (L/s)
Time
0
2
4
6
8
10
12
14
16
18
20
24

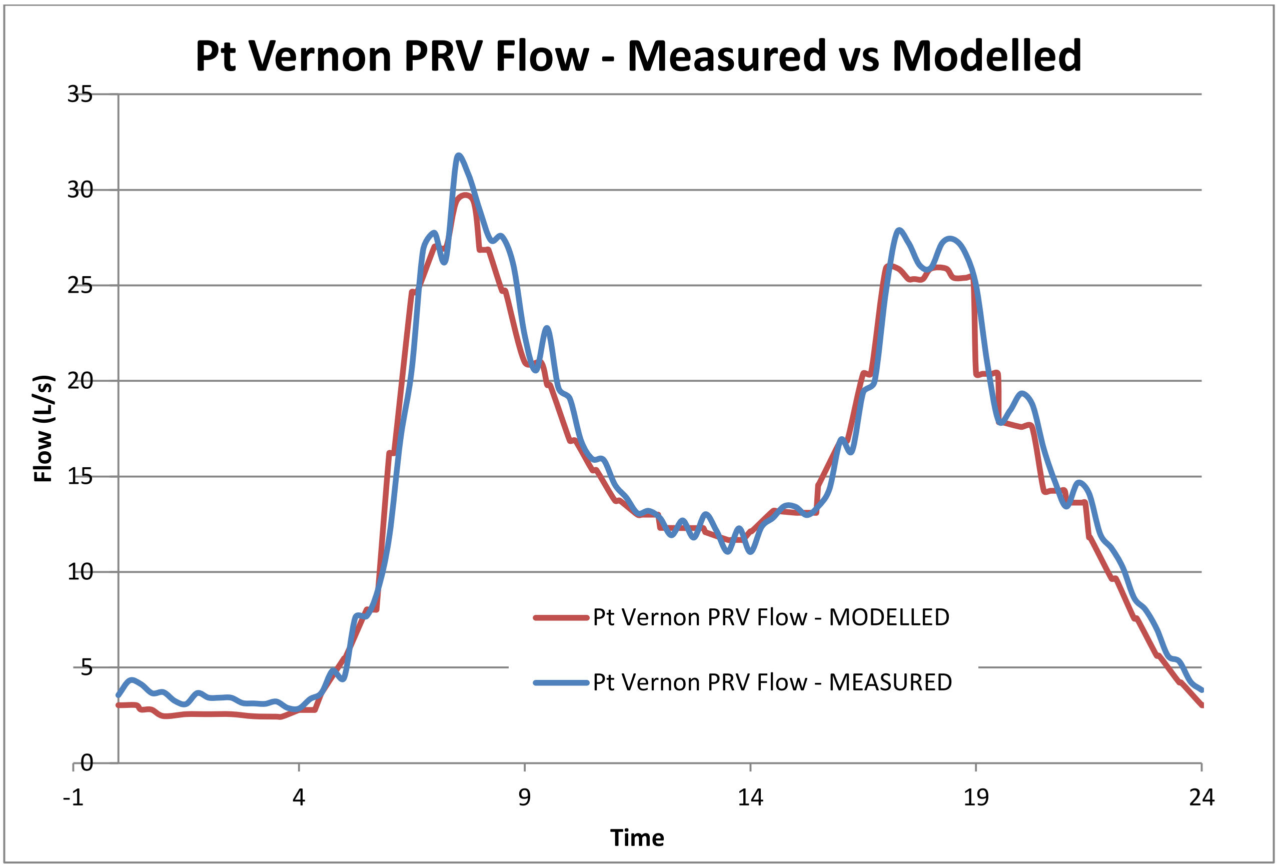

BH PRV Pressure - Measured vs Modelled
BH PRV Pressure - MODELLED
BH PRV Pressure - MEASURED
Flow (L/s)
Time
0
10
20
30
40
50
60
70
6
12
18
24

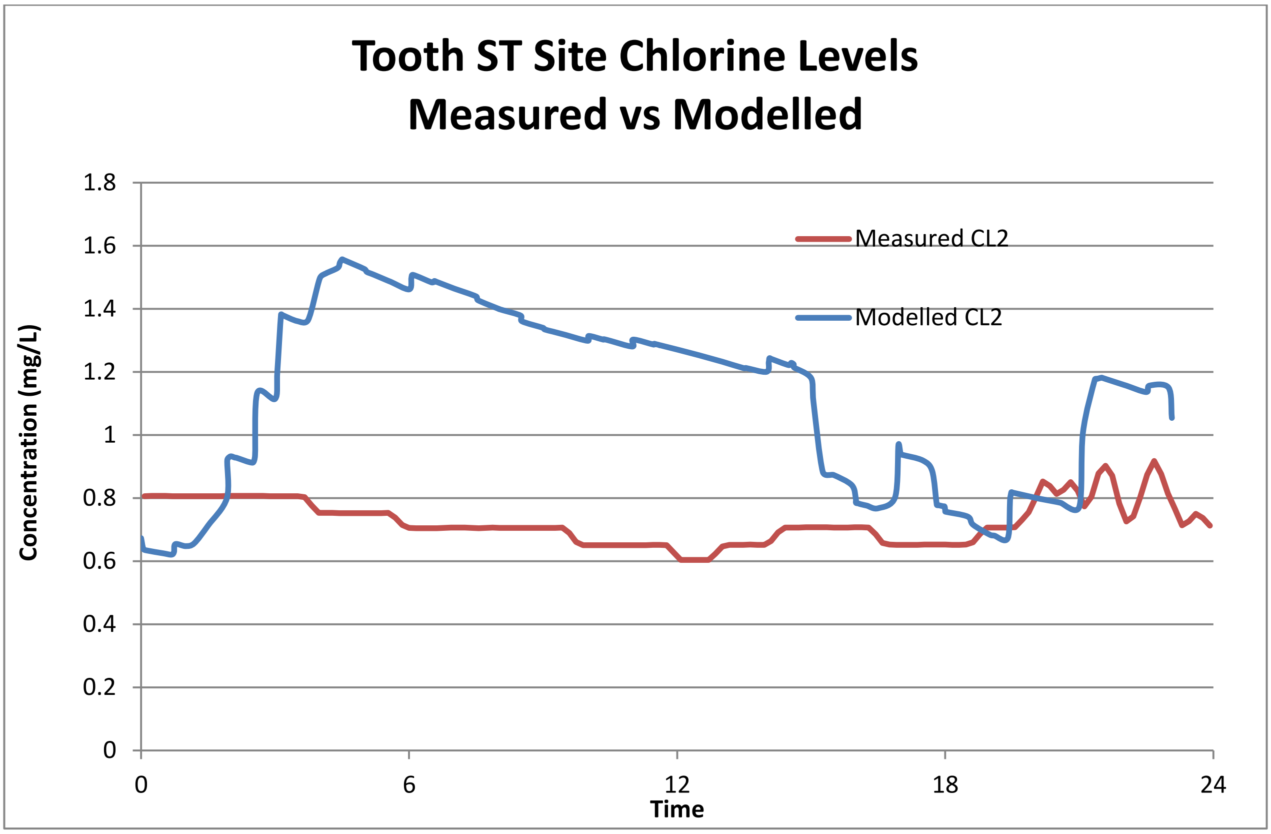

JulieAnn St PRV Flow - Measured vs Modelled
Flow (L/s)
Time
0
1
2
3
4
5
6
0
6
12
18
24
JulieAnn St PRV Flow MEASURED
JulieAnn St PRV Flow - MODELLED

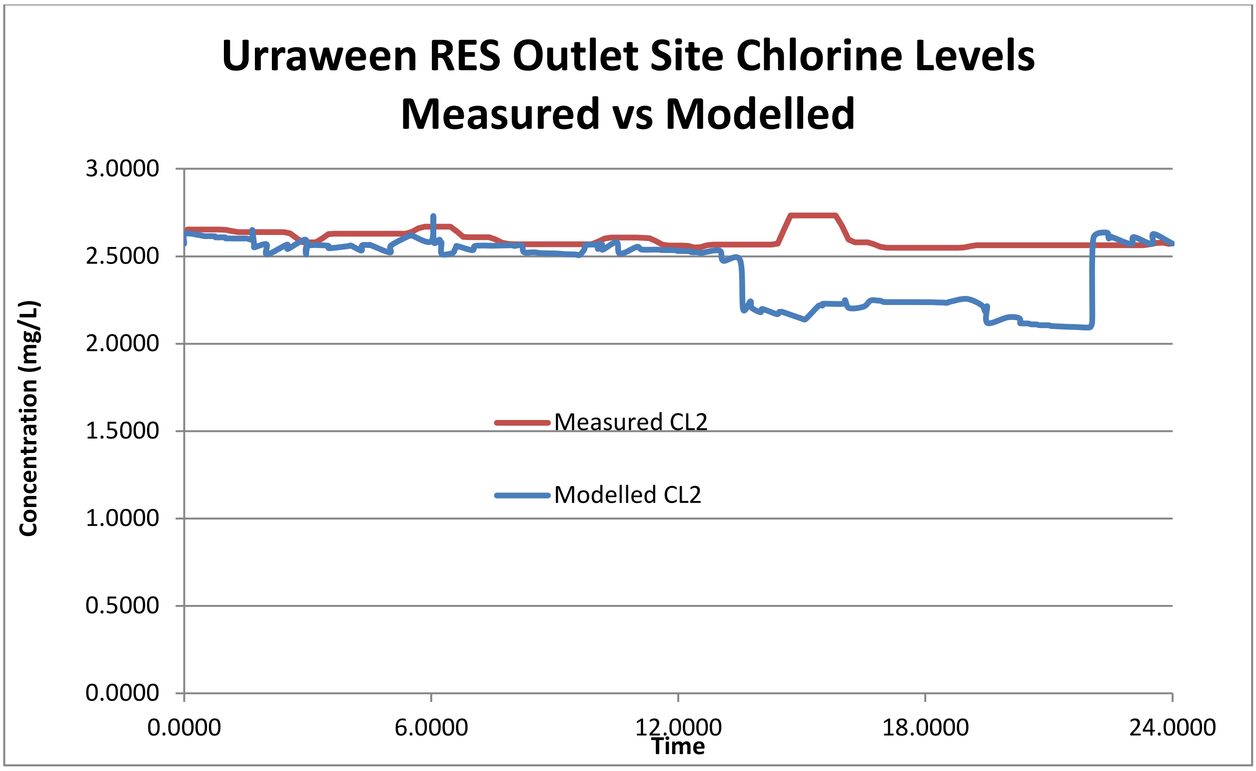

GH Low CPP Pressure - Measured vs Modelled
600
500
400
300
200
100
0
Pressure (kPa)
0
6
12
18
24
Time
GH Low CPP Pressure - MEASURED
GH Low CPP Pressure - MODELLED

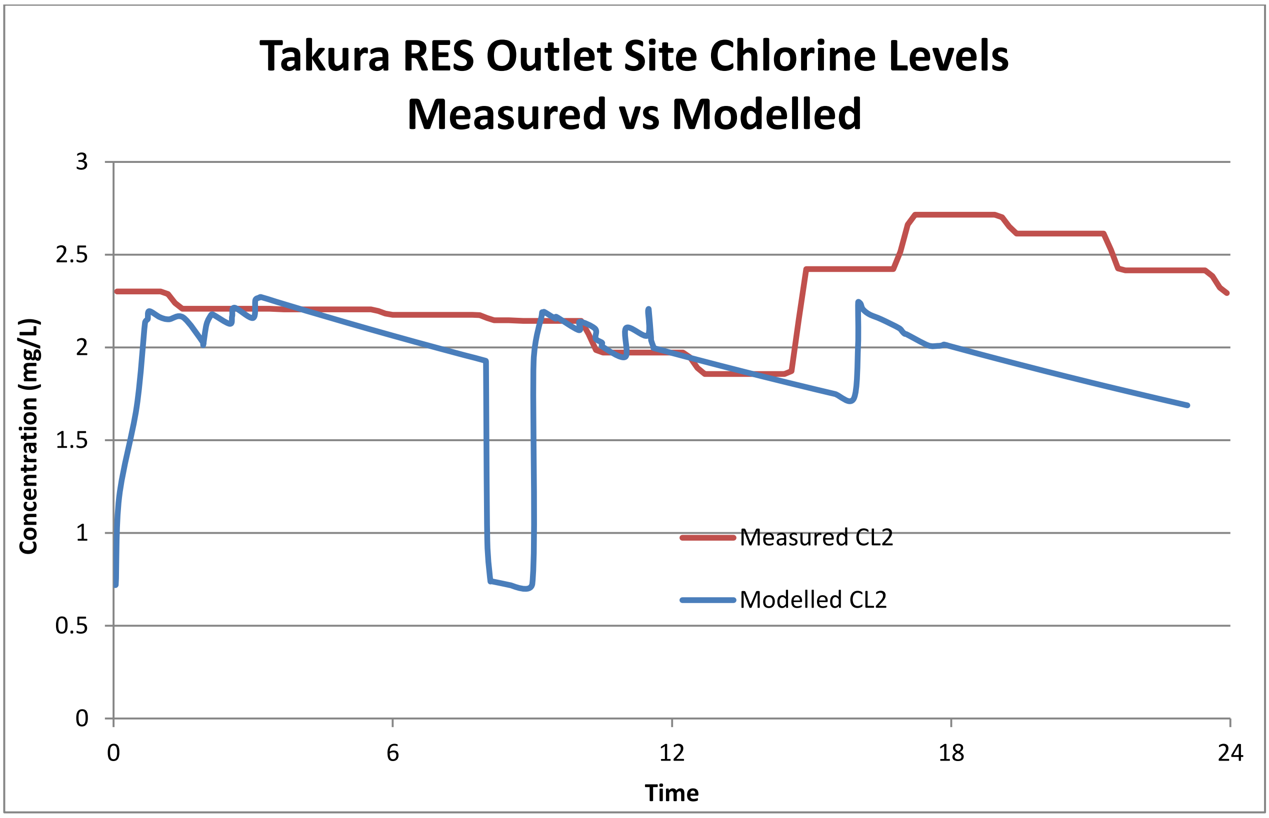

Urangan Low PRV Flow - Measured vs Modelled
16
14
12
10
8
6
4
2
0
Flow (L/s)
0
6
12
18
24
Time
Urangan Low PRV Flow - MEASURED
Urangan Low PRV Flow - MODELLED

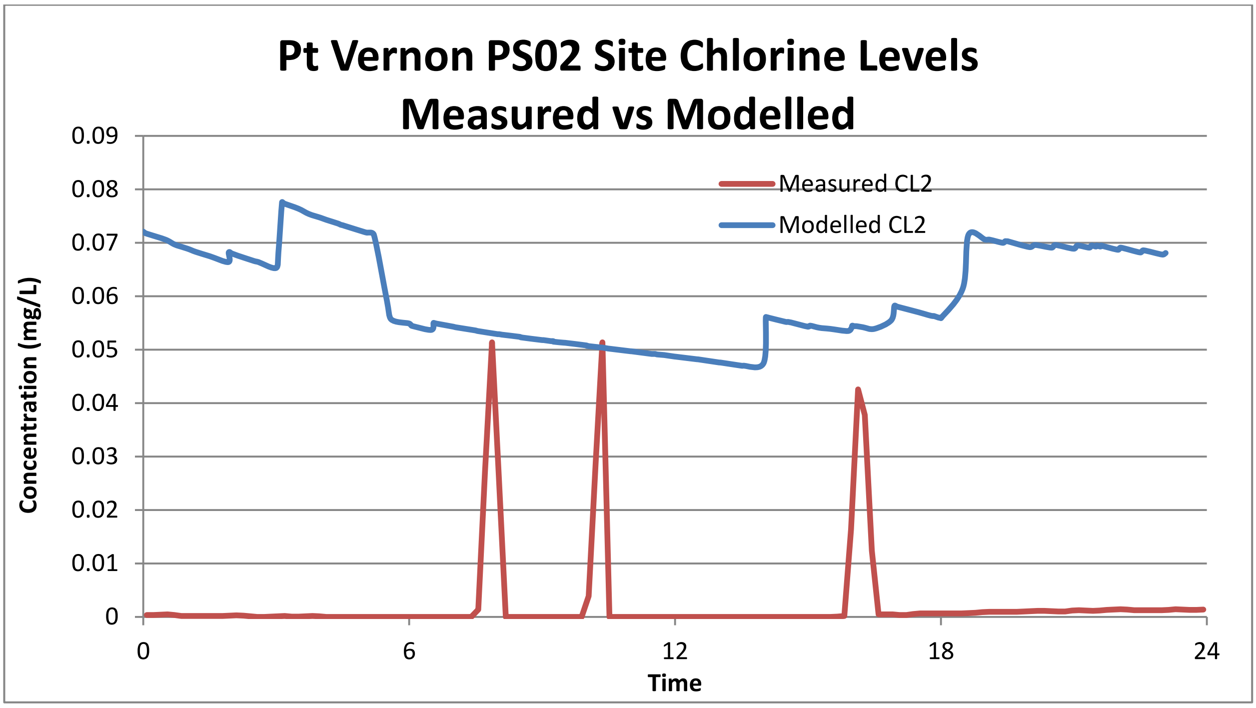

Scarness High PRV Flow - Measured vs Modelled
Flow (L/s)
40
35
30
25
20
15
10
5
0
0
6
12
18
24
Time
Scarness High PRV Flow Scarness High PRV Flow - MEASURED
Scarness High PRV Flow - MODELLED

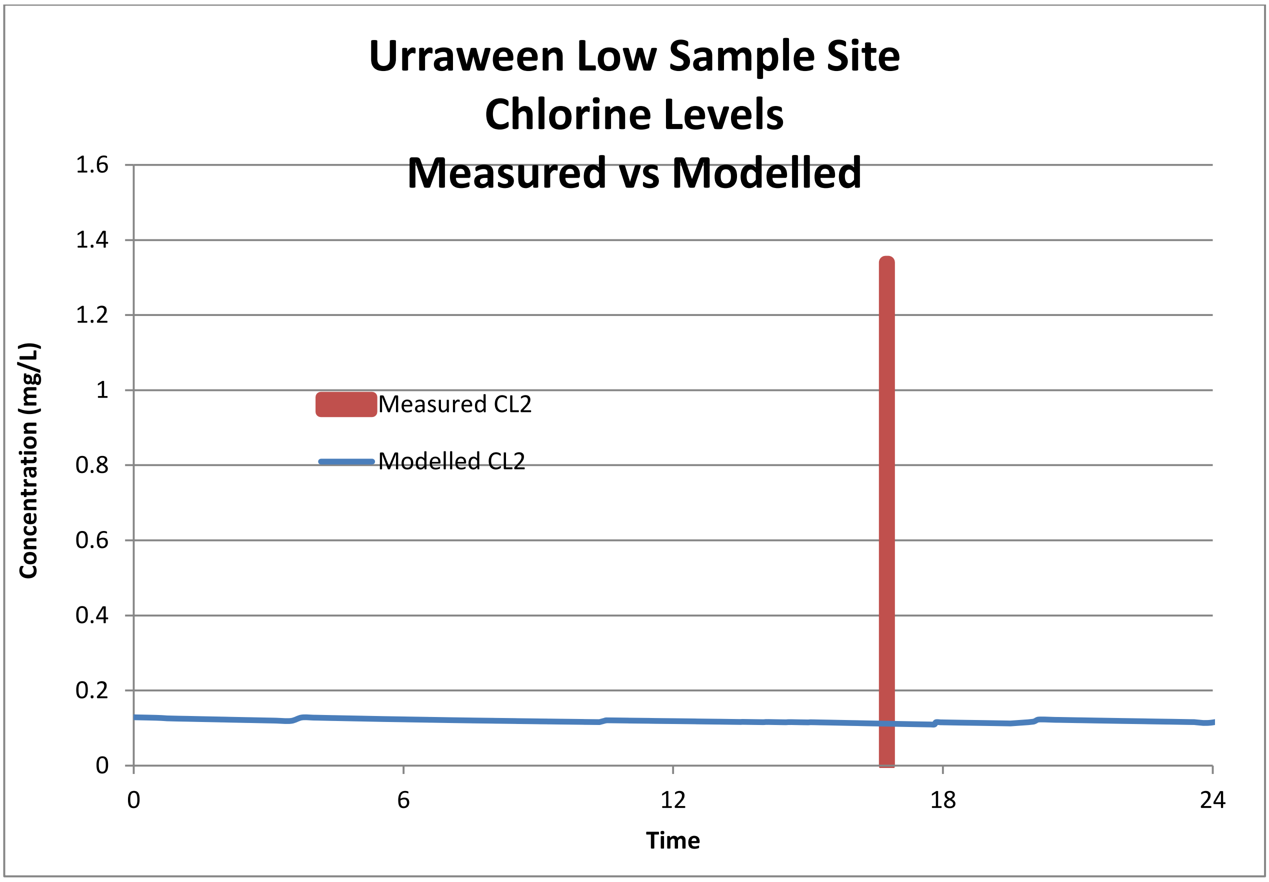

Pt Vernon PRV Flow - Measured vs Modelled
Flow (L/s)
35
30
25
20
15
10
5
0
-1
4
9
14
19
24
Time
Pt Vernon PRV Flow - MODELLED
Pt Vernon PRV Flow - MEASURED

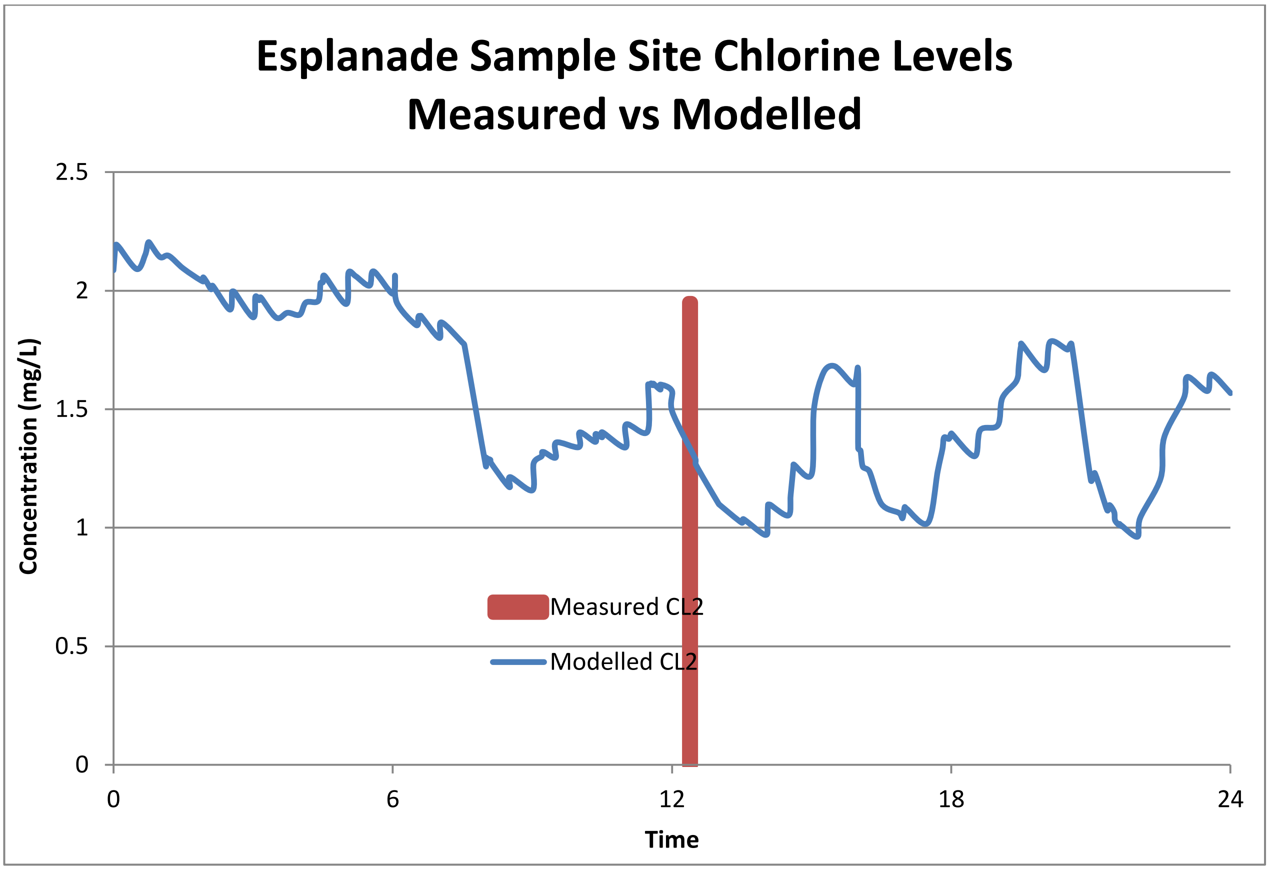

Tooth ST Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
6
12
18
24
Time
Measured CL2
Modelled CL2

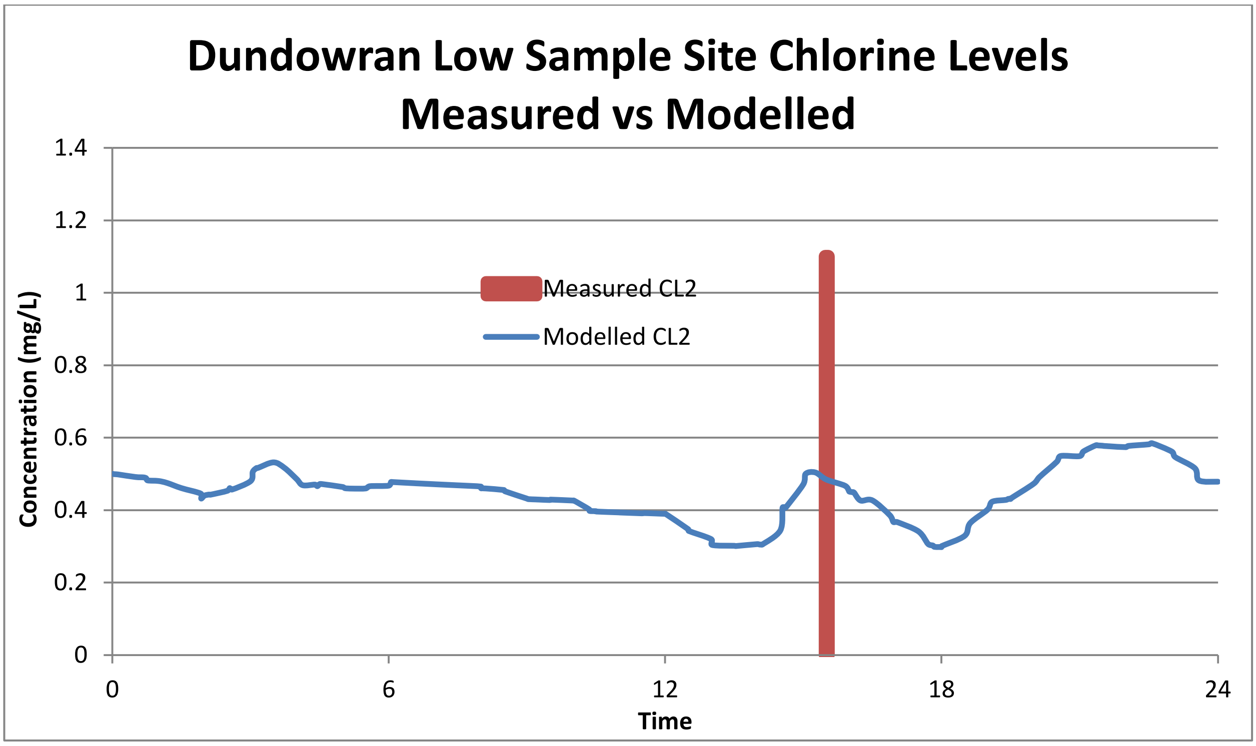

Urraween RES Outlet Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
3.0000
2.5000
2.0000
1.5000
1.0000
0.5000
0.0000
0.0000
6.0000
12.0000
18.0000
24.0000
Time
Measured CL2
Modelled CL2

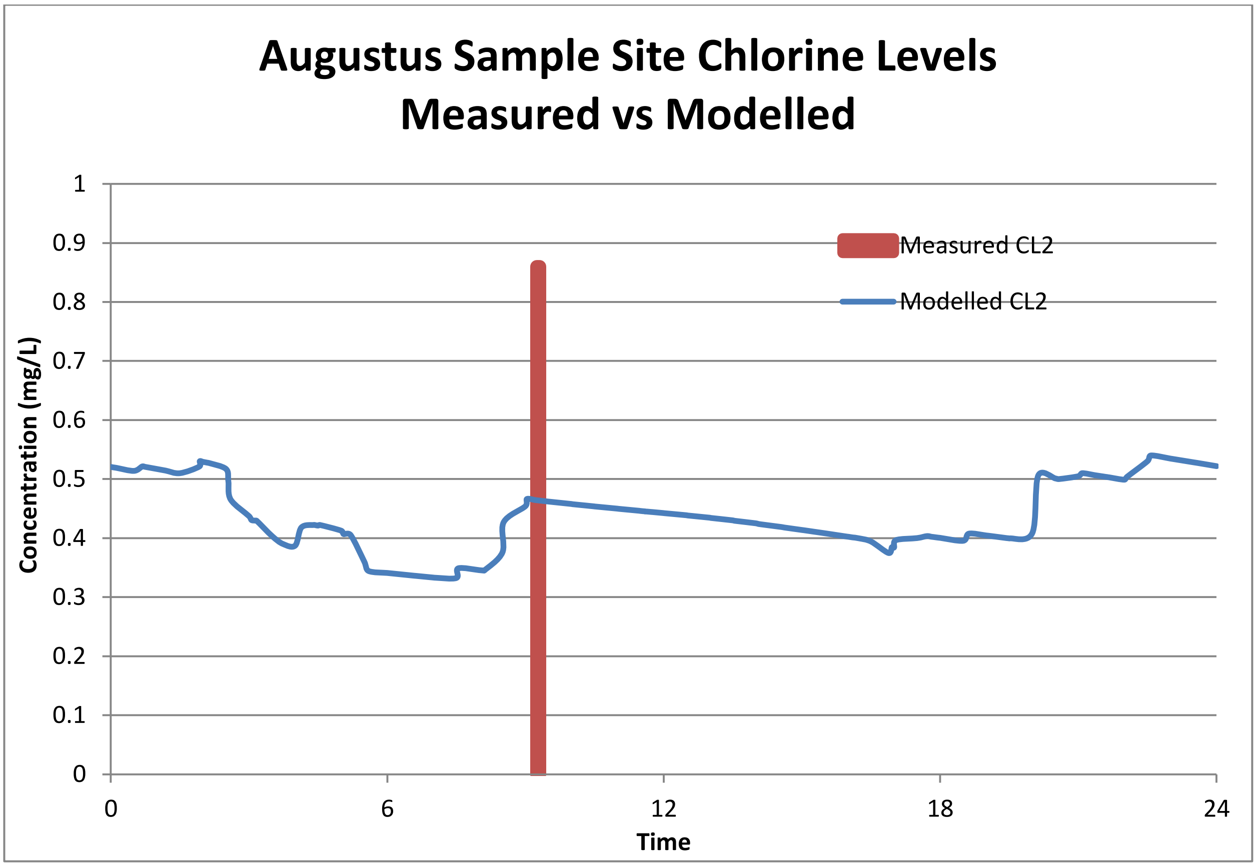

Takura RES Outlet Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
0
6
12
18
24
Time
Measured CL2
Modelled CL2

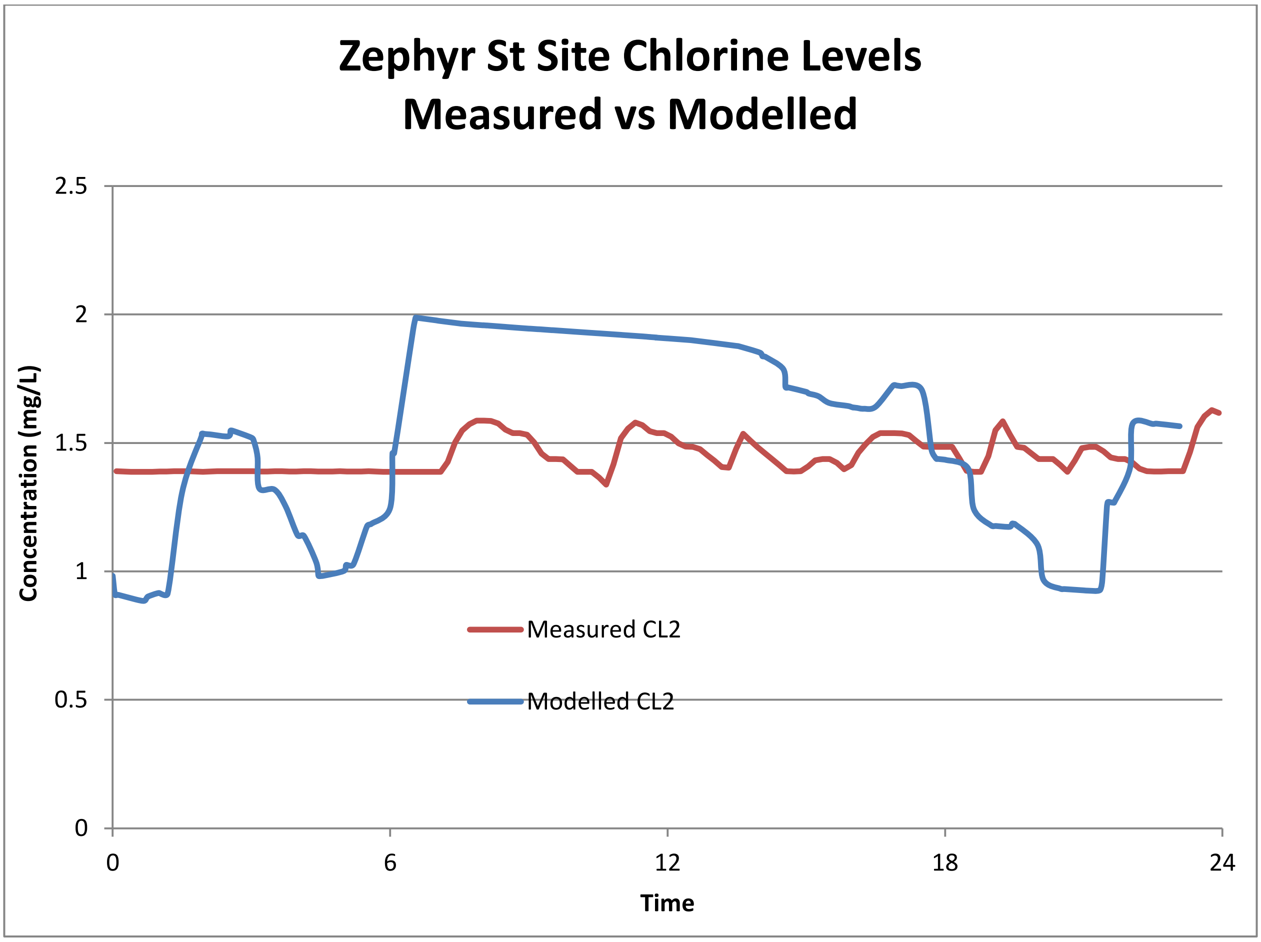

Pt Vernon PS02 Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
6
12
18
24
Time
Measured CL2
Modelled CL2

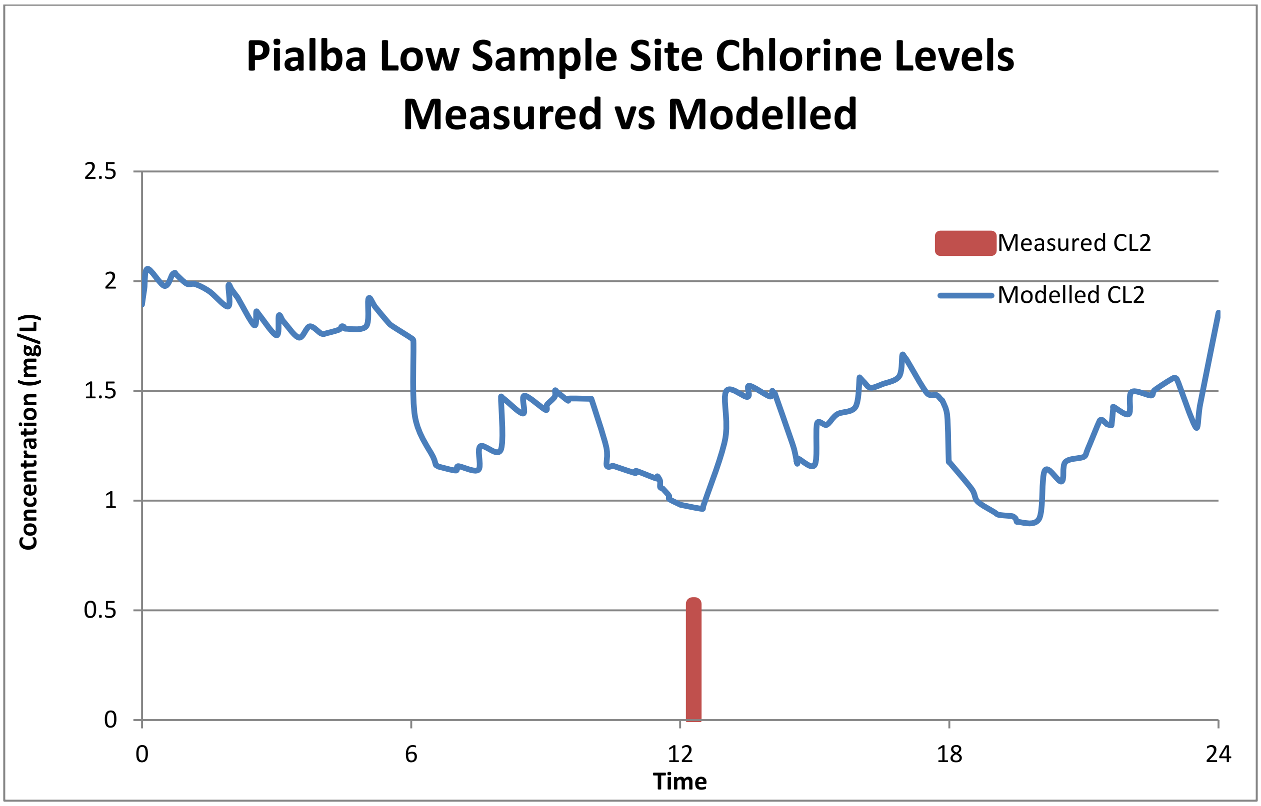

Urraween Low Sample Site
Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

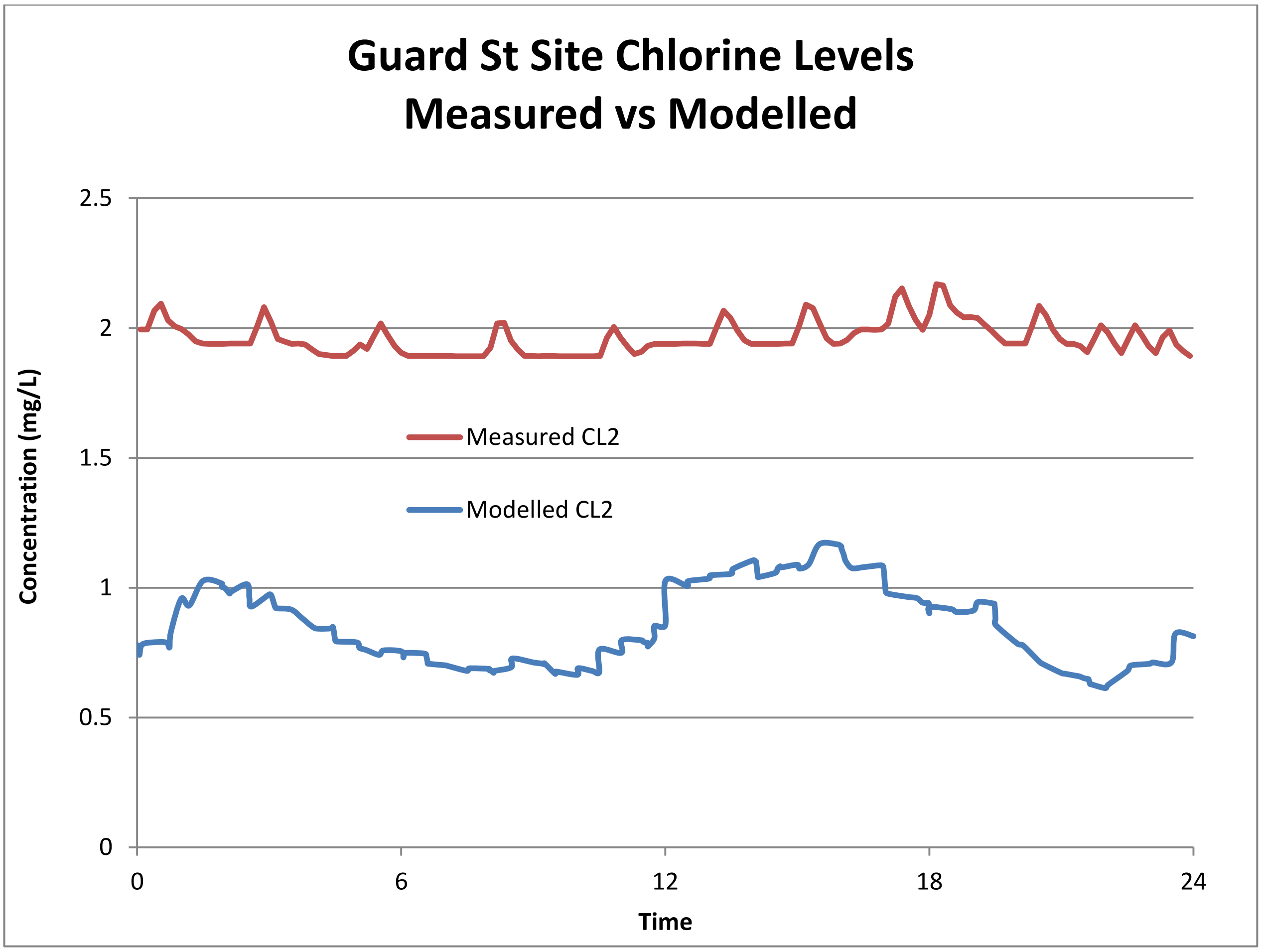

Esplanade Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

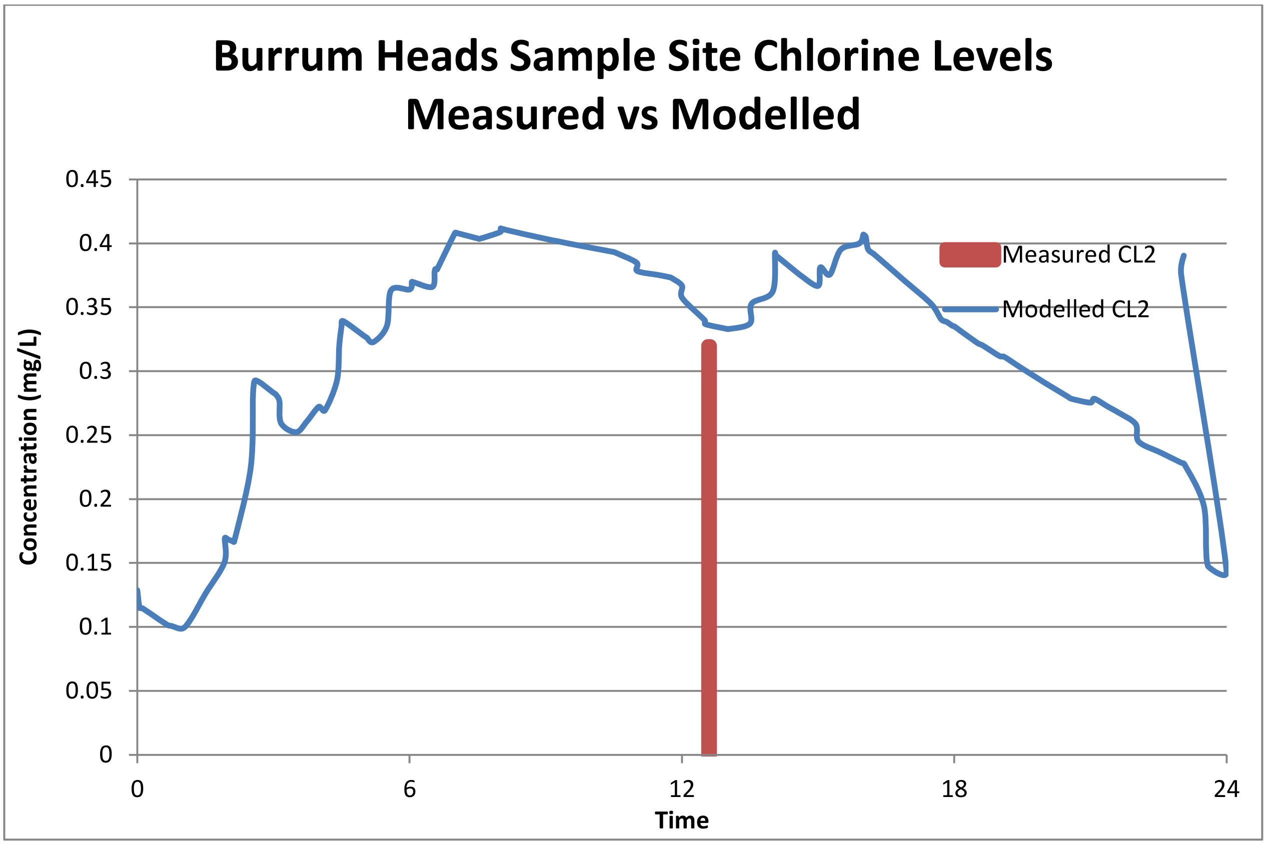

Dundowran Low Sample Site Chlorine Levels
Measured vs Modelled
Measured CL2
Modelled CL2
Concentration (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
6
12
18
24
Time

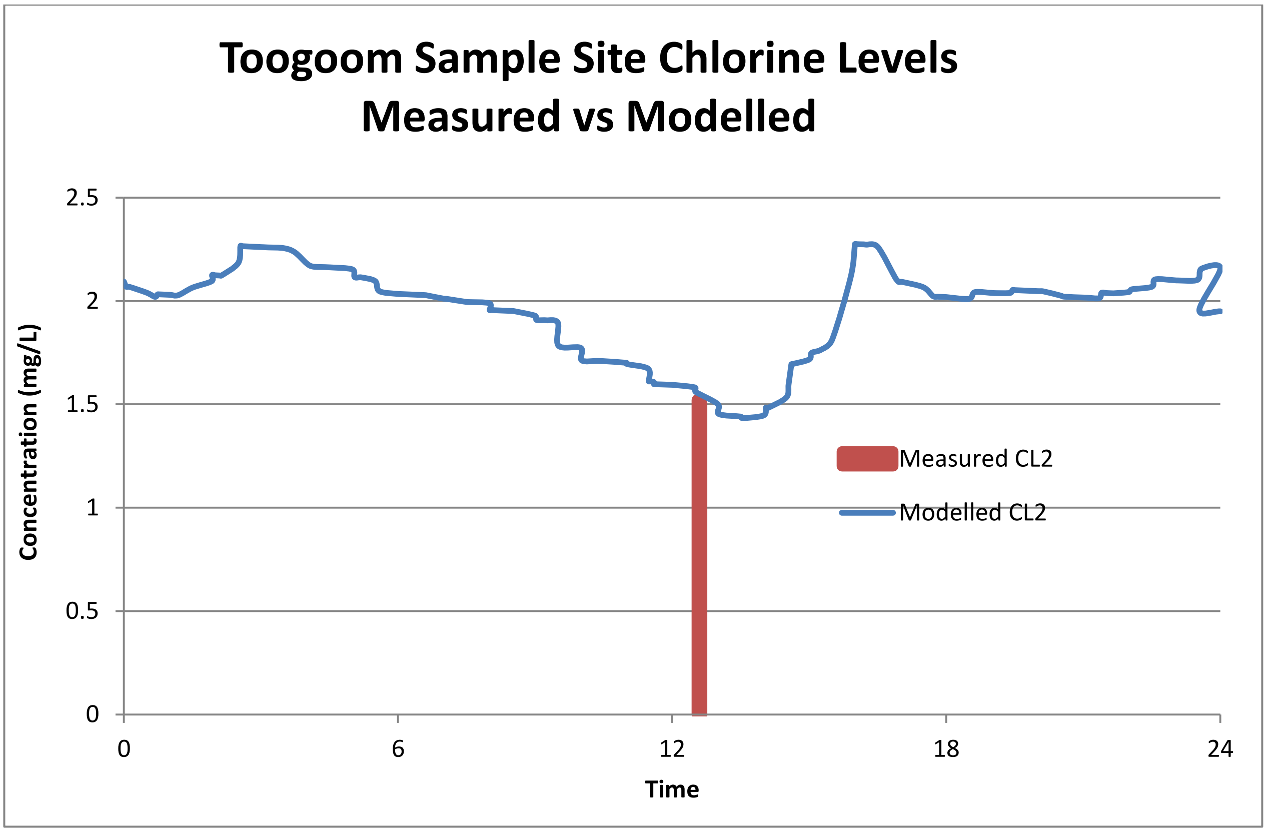

Augustus Sample Site Chlorine Levels
Measured vs Modelled
Measured CL2
Modelled CL2
Concentration (mg/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
6
12
18
24
Time

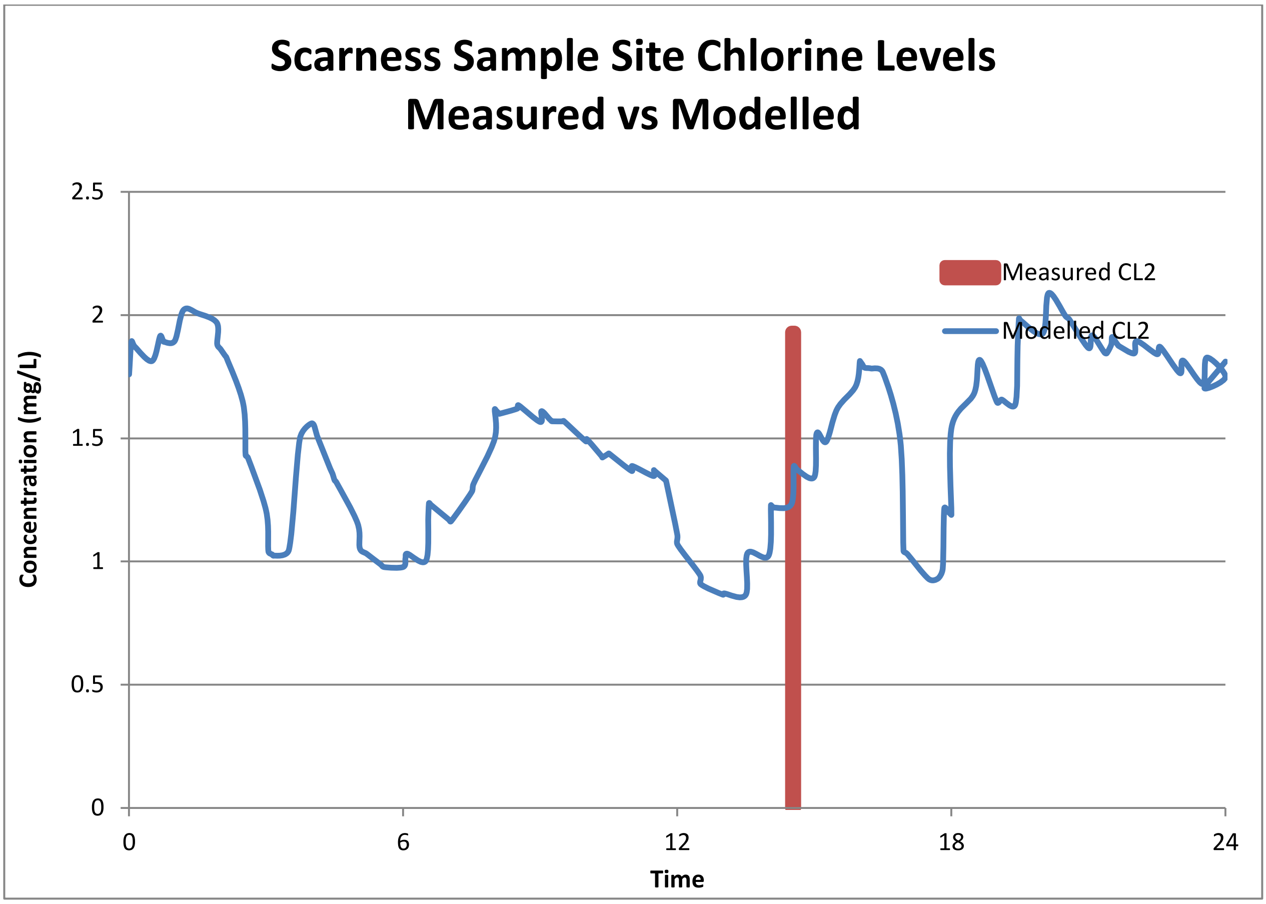

Zephyr St Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

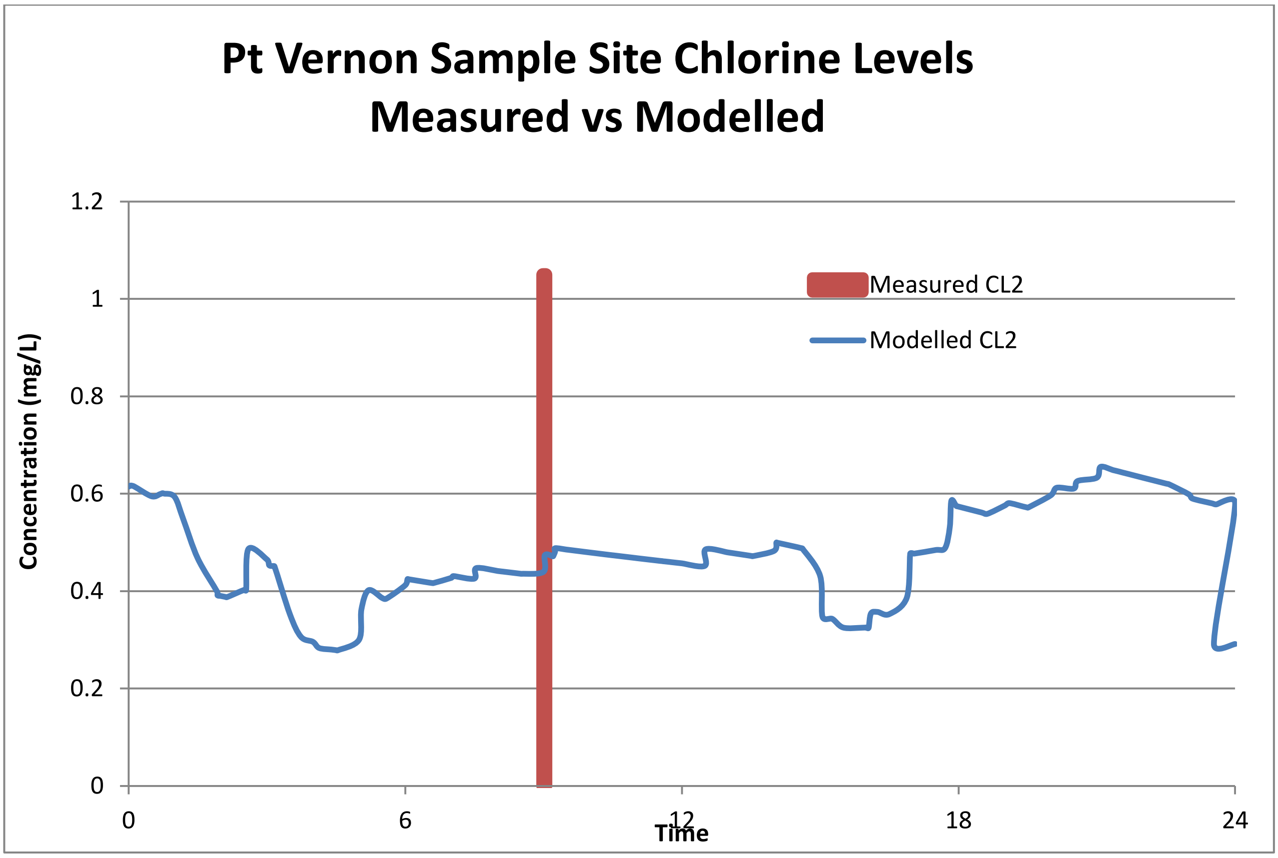

Pialba Low Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

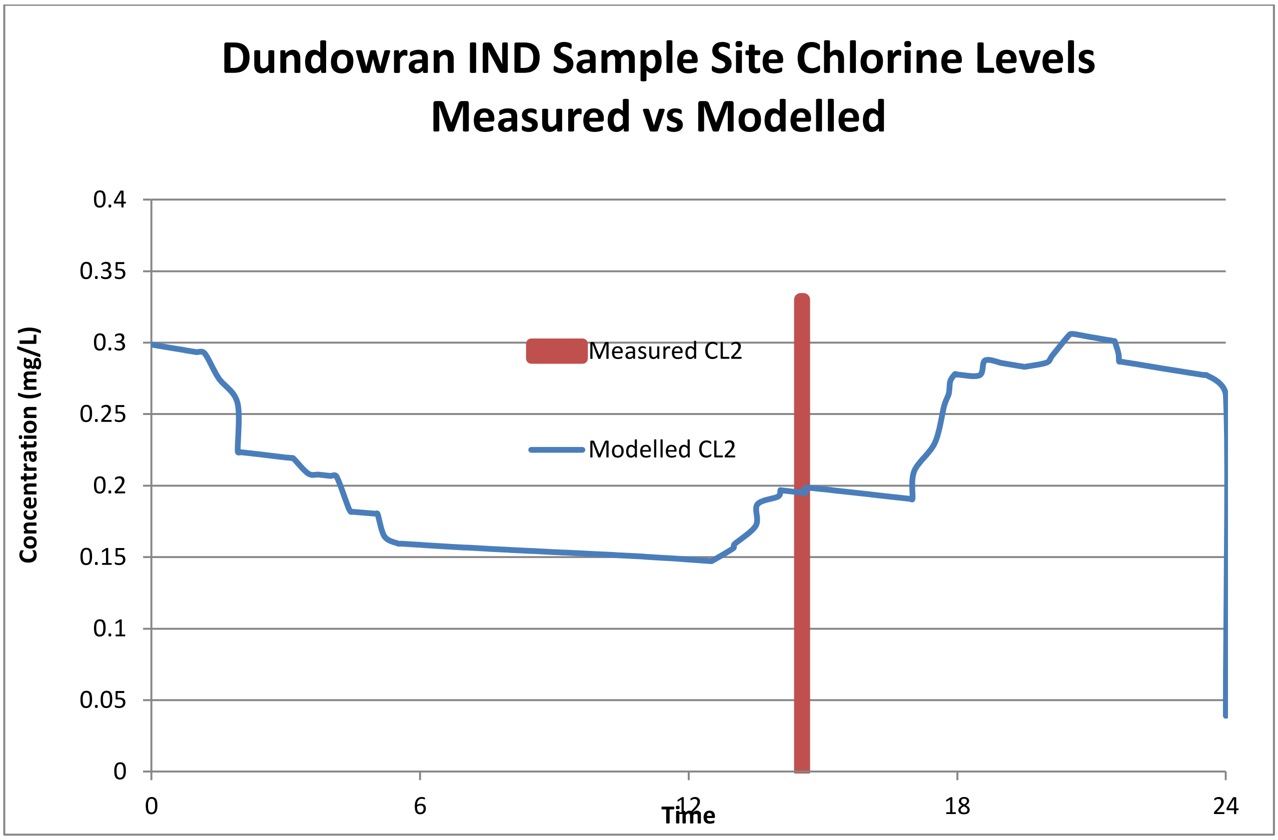

Guard St Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

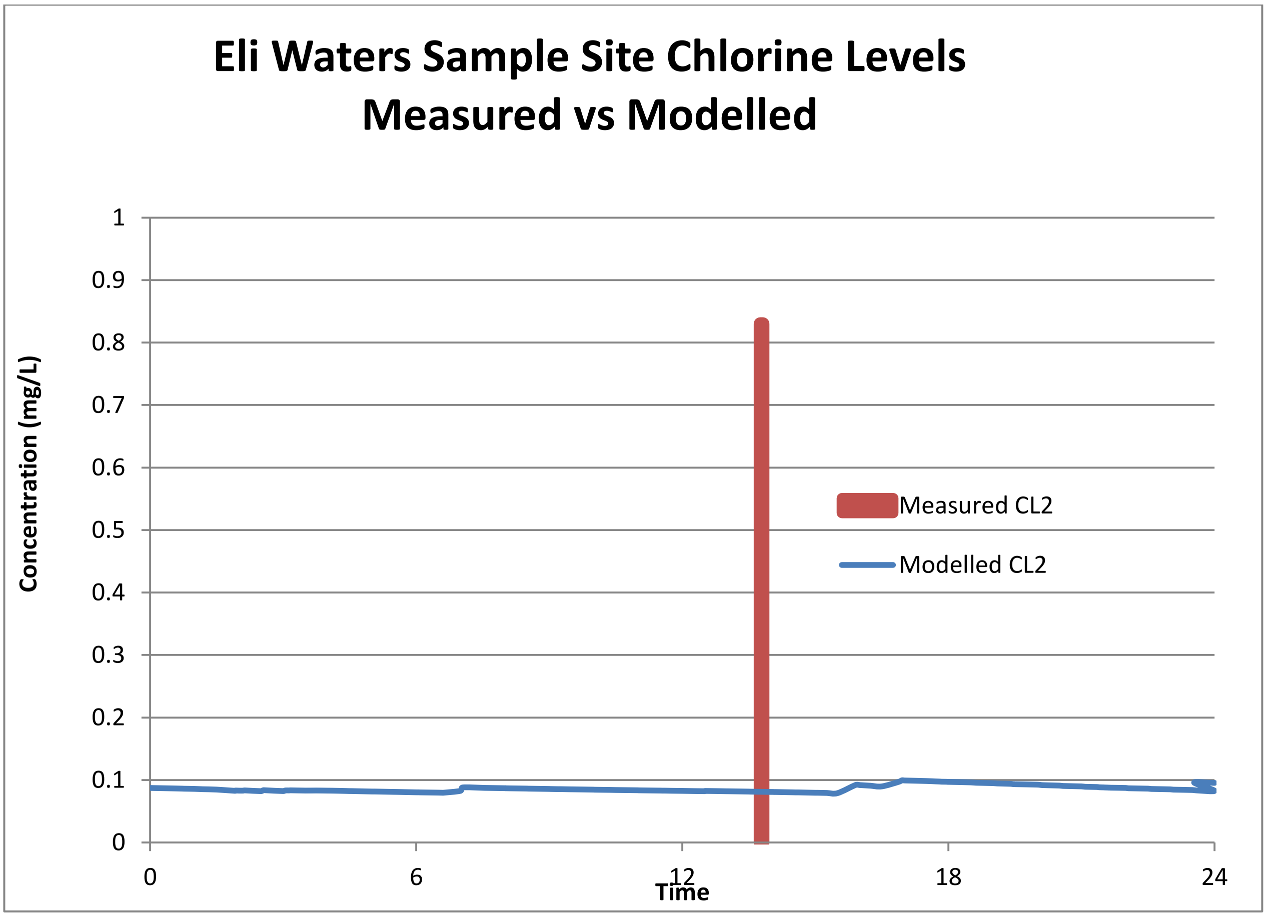

Burrum Heads Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

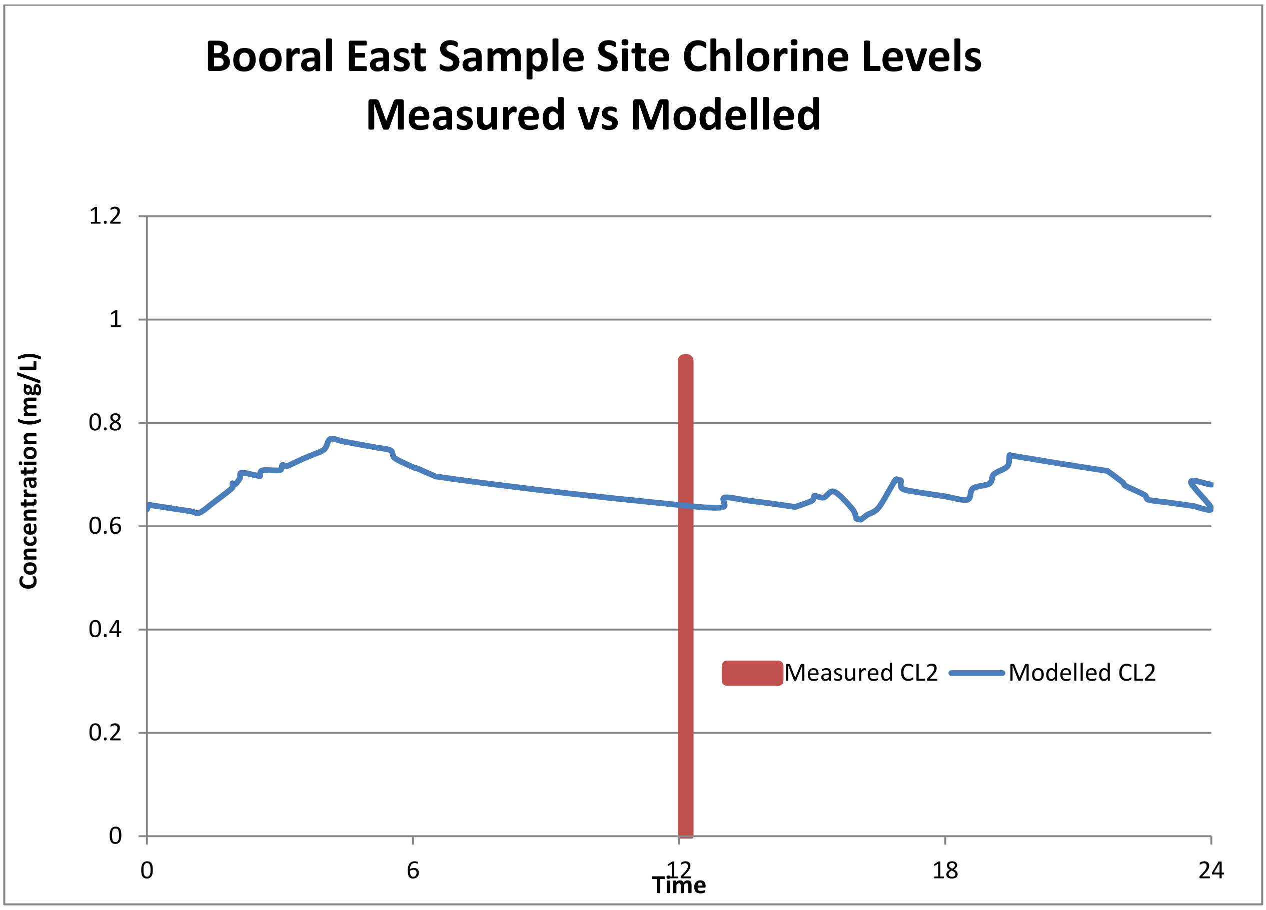

Toogoom Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
0
6
12
18
24
Time
Measured CL2
Modelled CL2

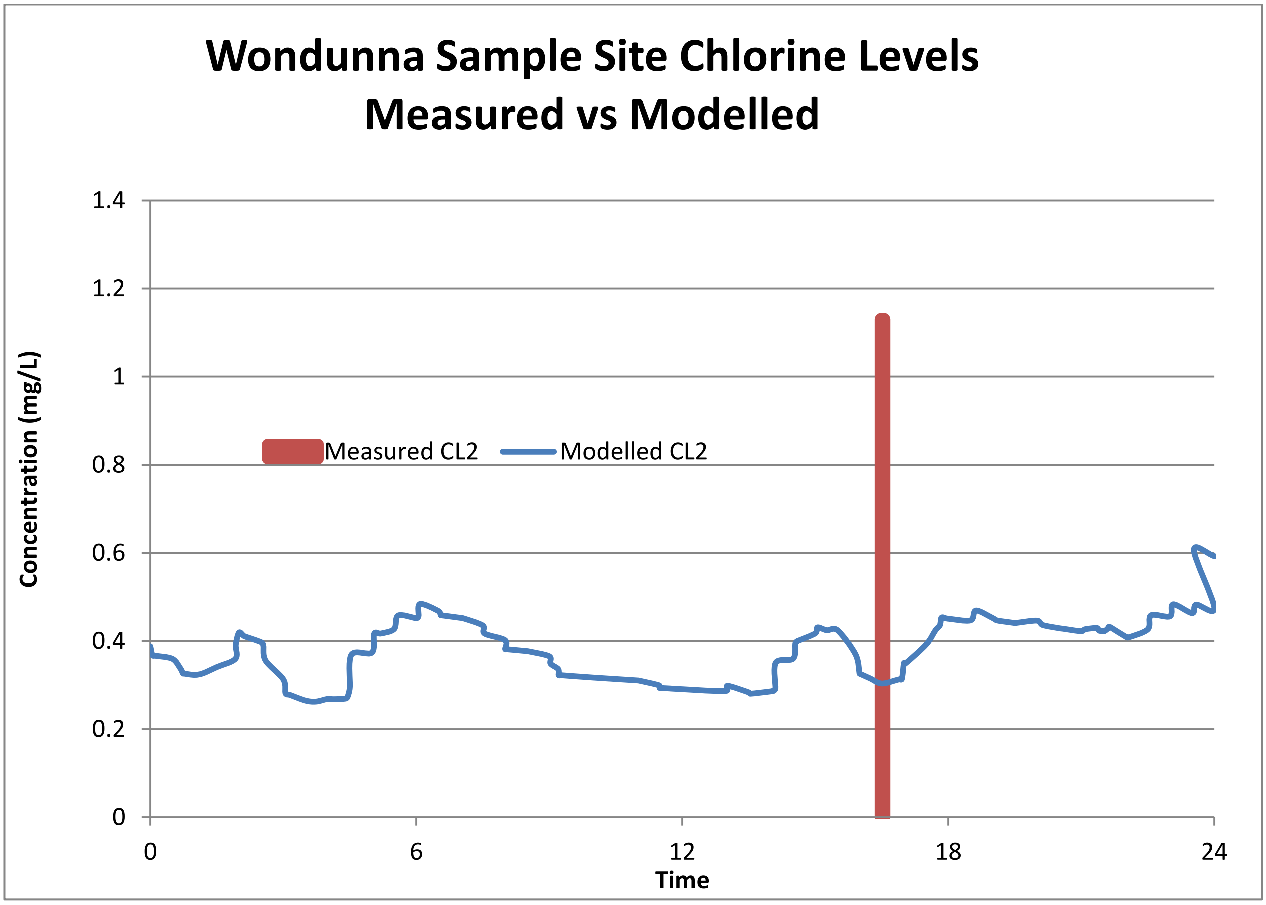

Scarness Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
0
6
12
18
24
Time
Measured CL2
Modelled CL2

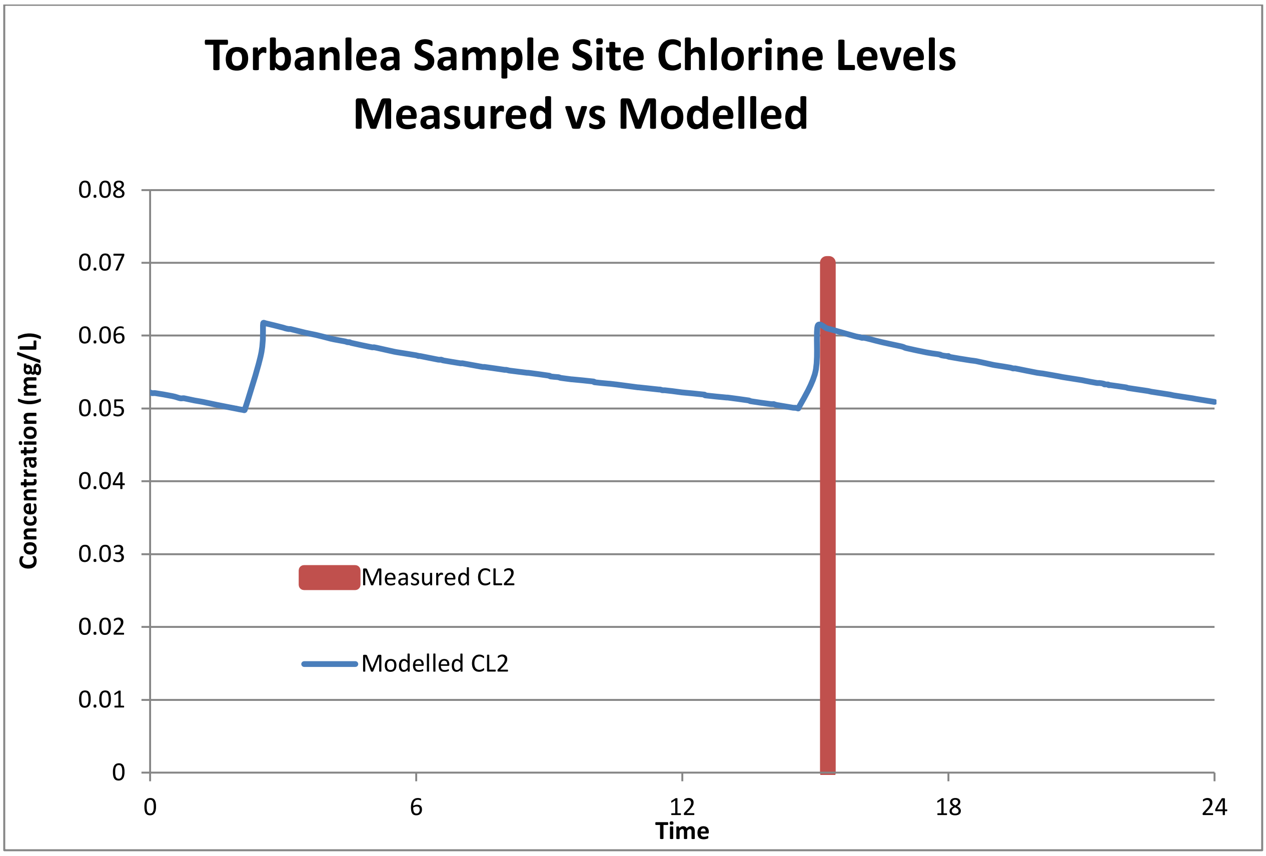

Pt Vernon Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
0
6
12
18
24
Time
Measured CL2
Modelled CL2

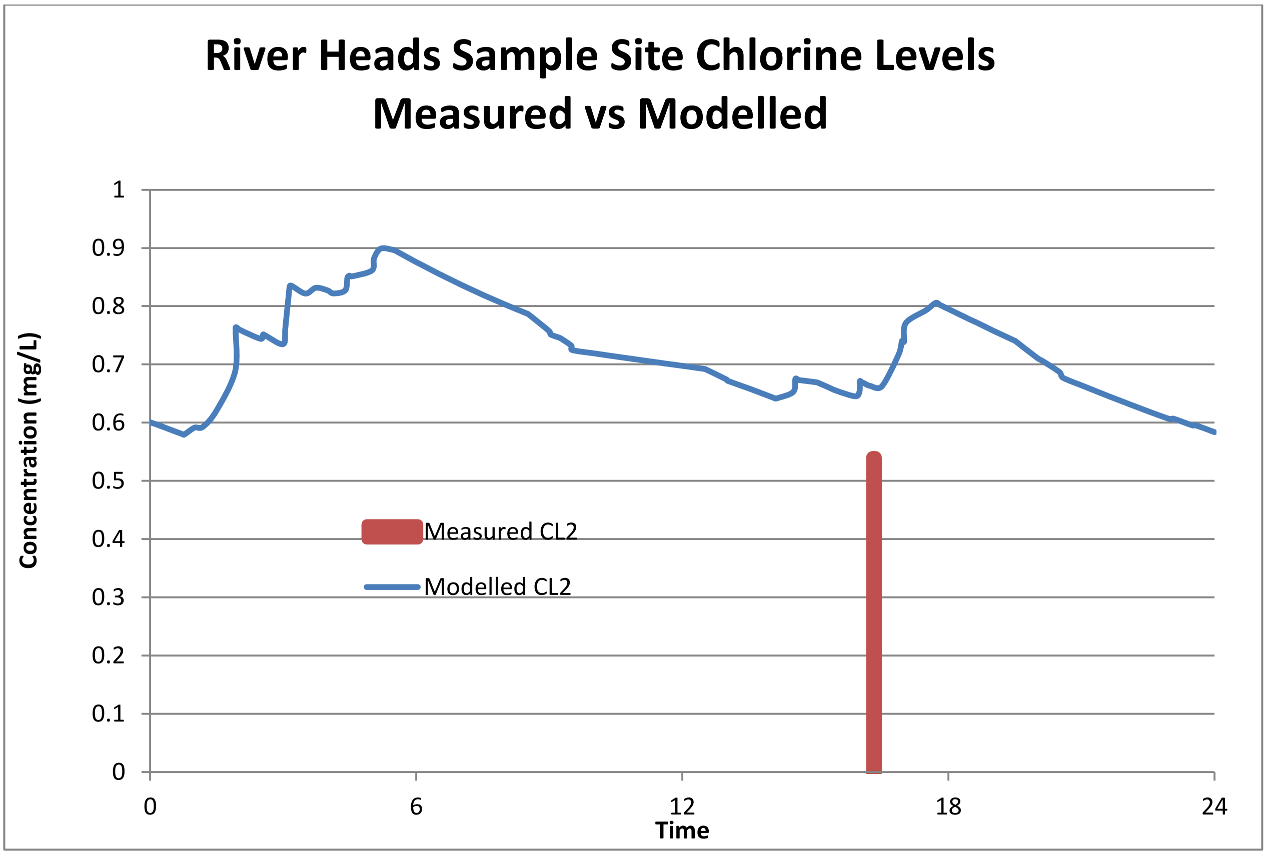

Dundowran IND Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
6
12
18
24
Time
Measured CL2
Modelled CL2

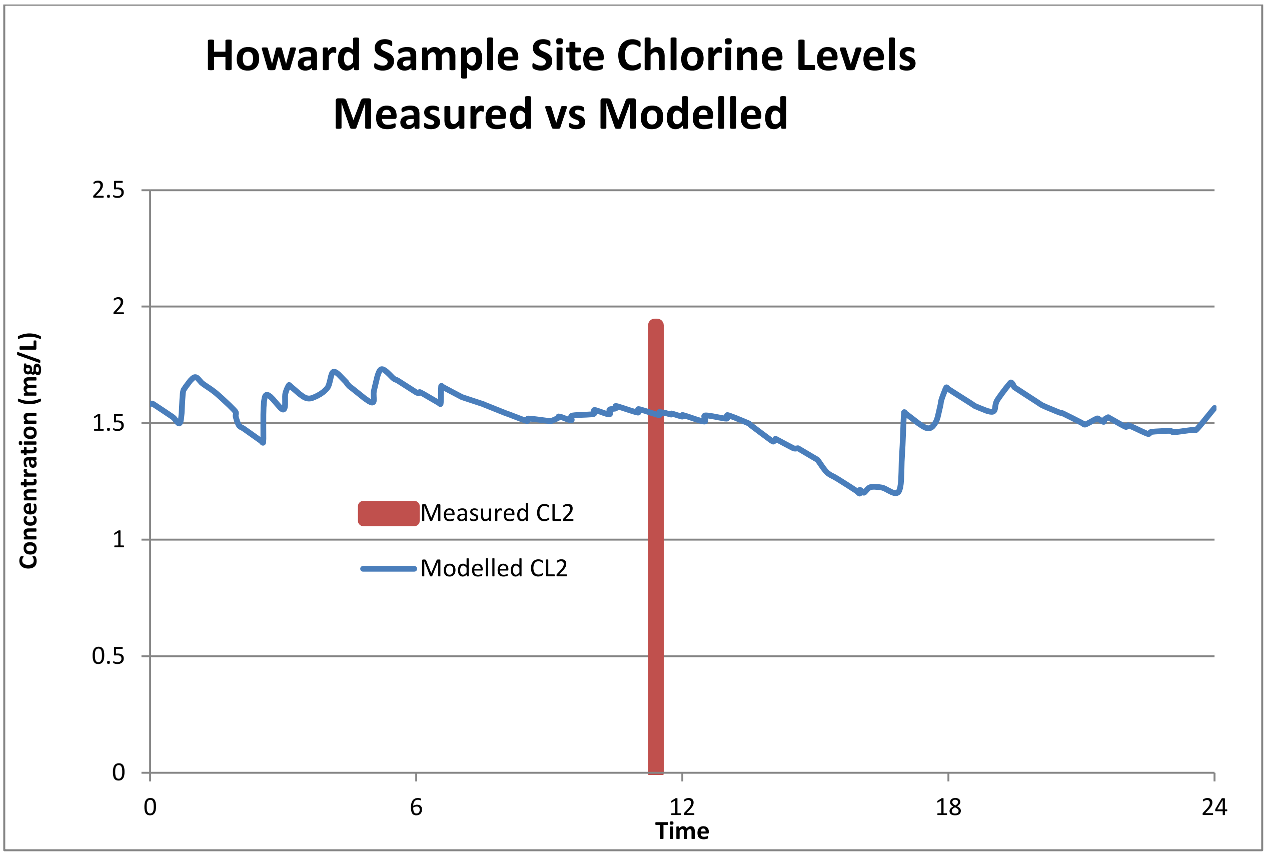

Eli Waters Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

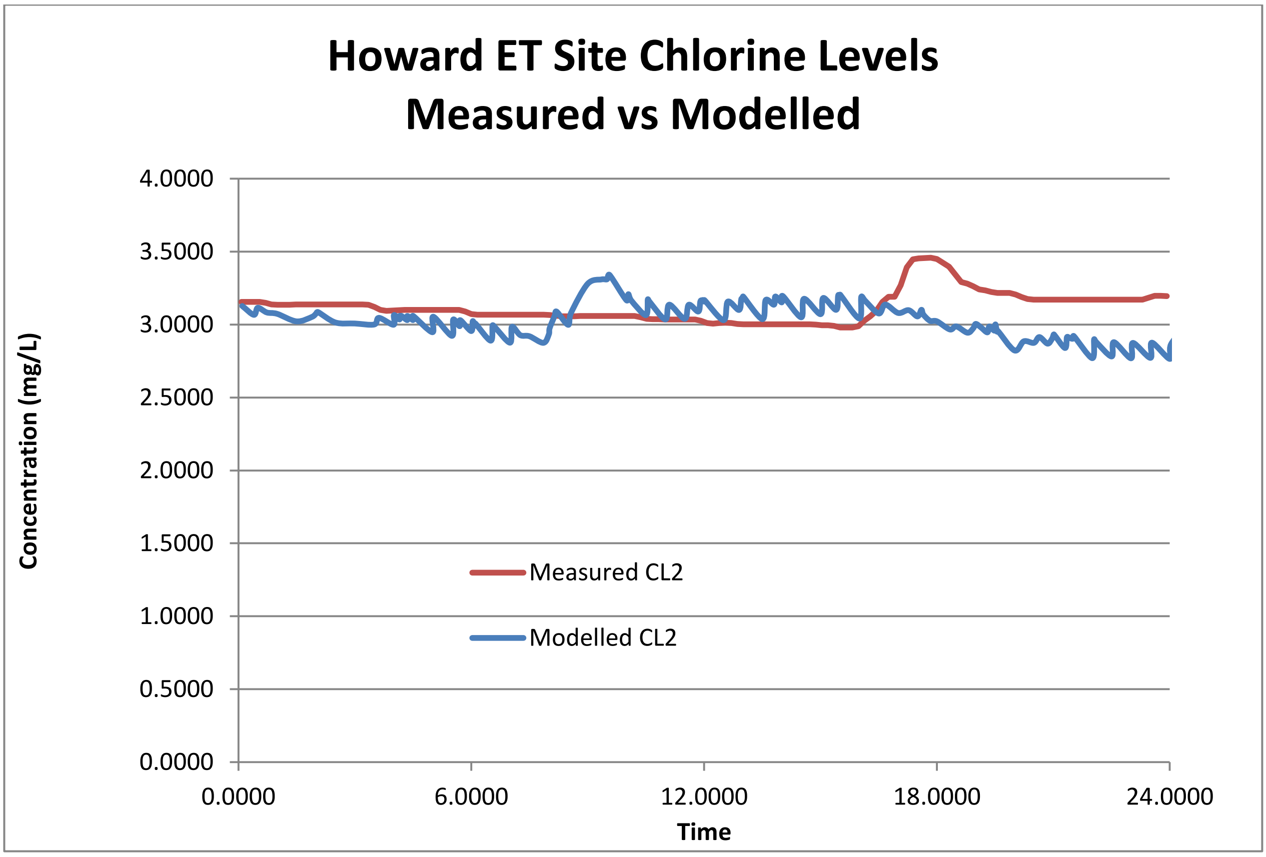

Booral East Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

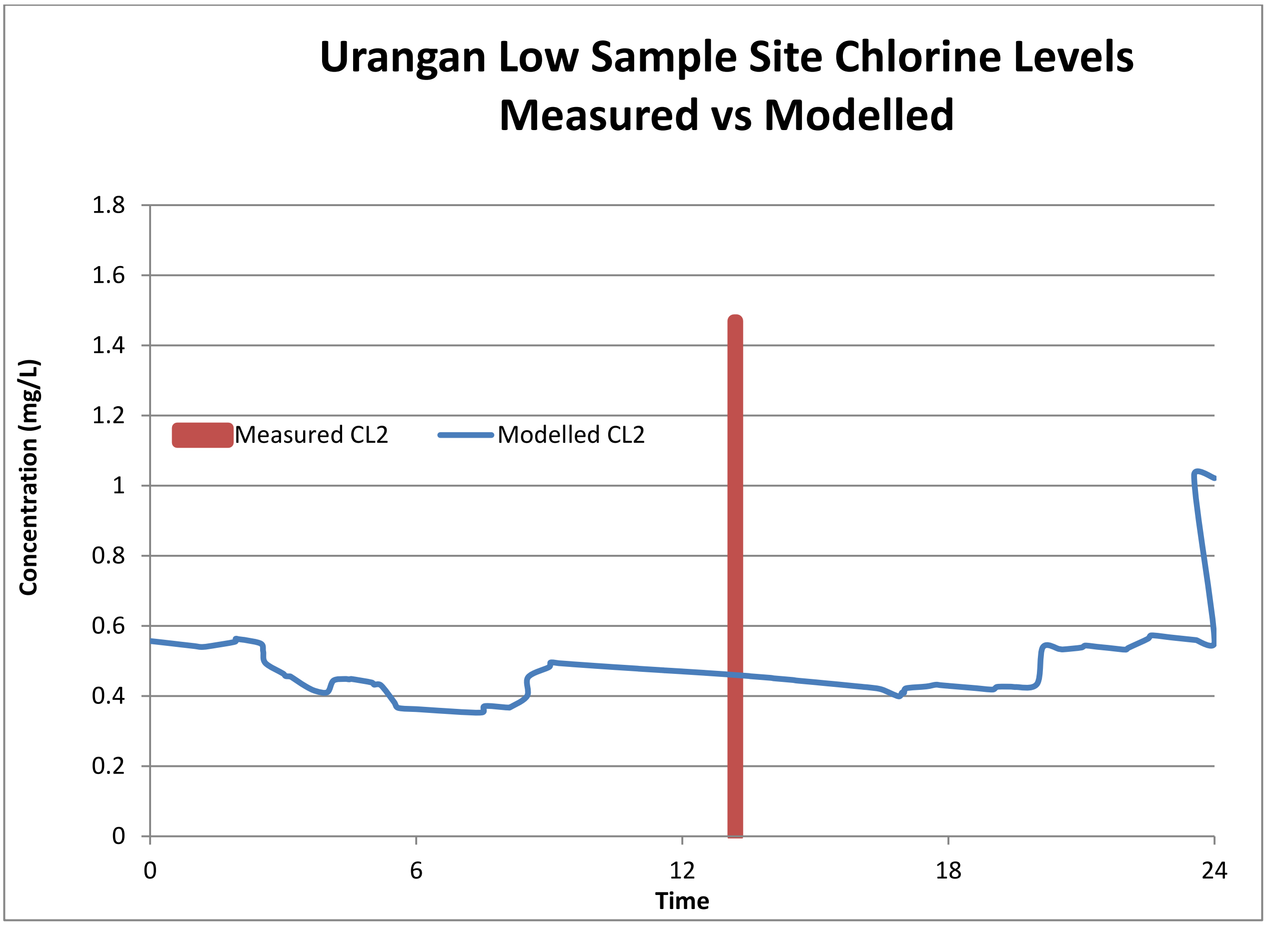

Wondunna Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

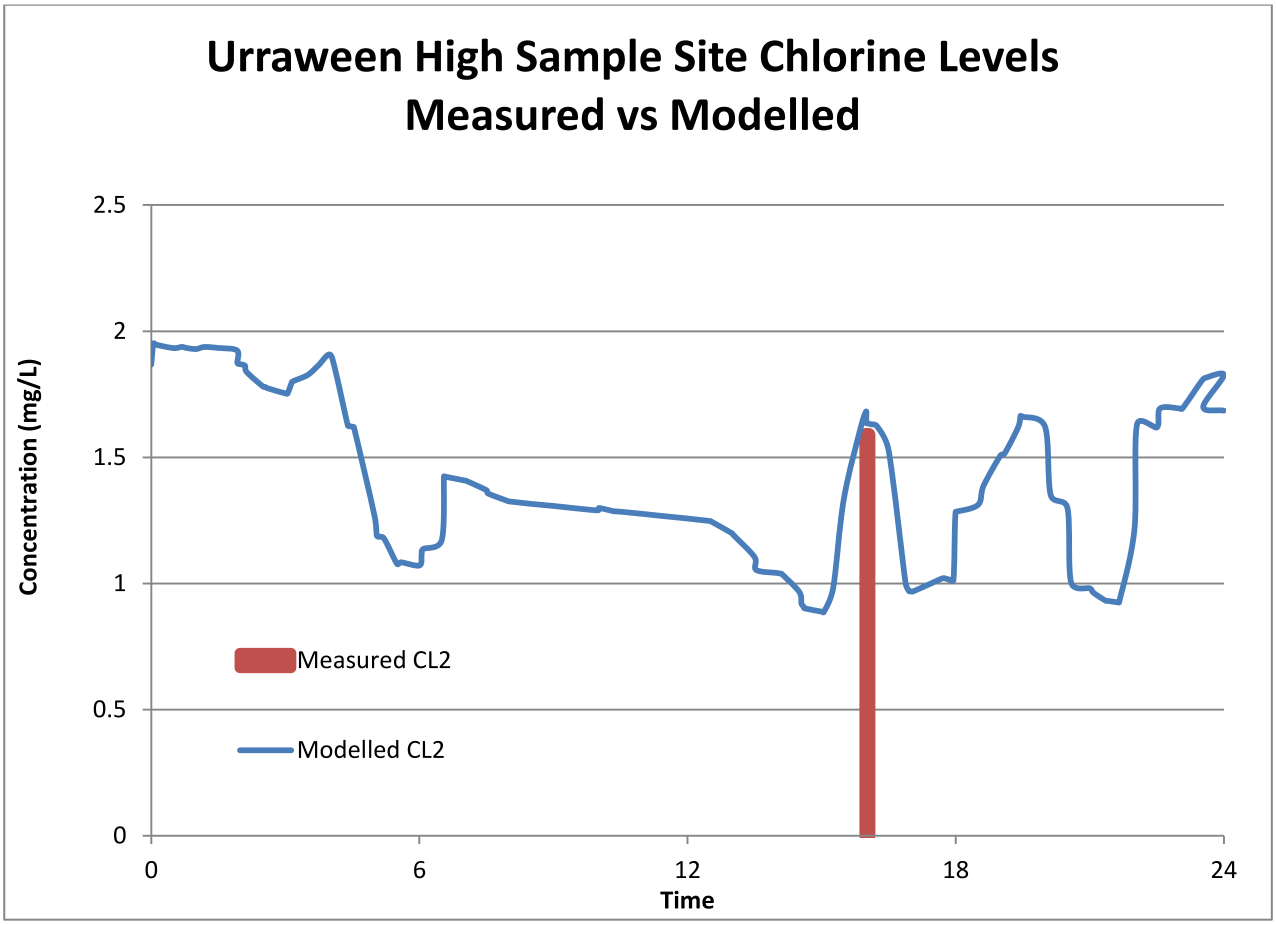

Torbanlea Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

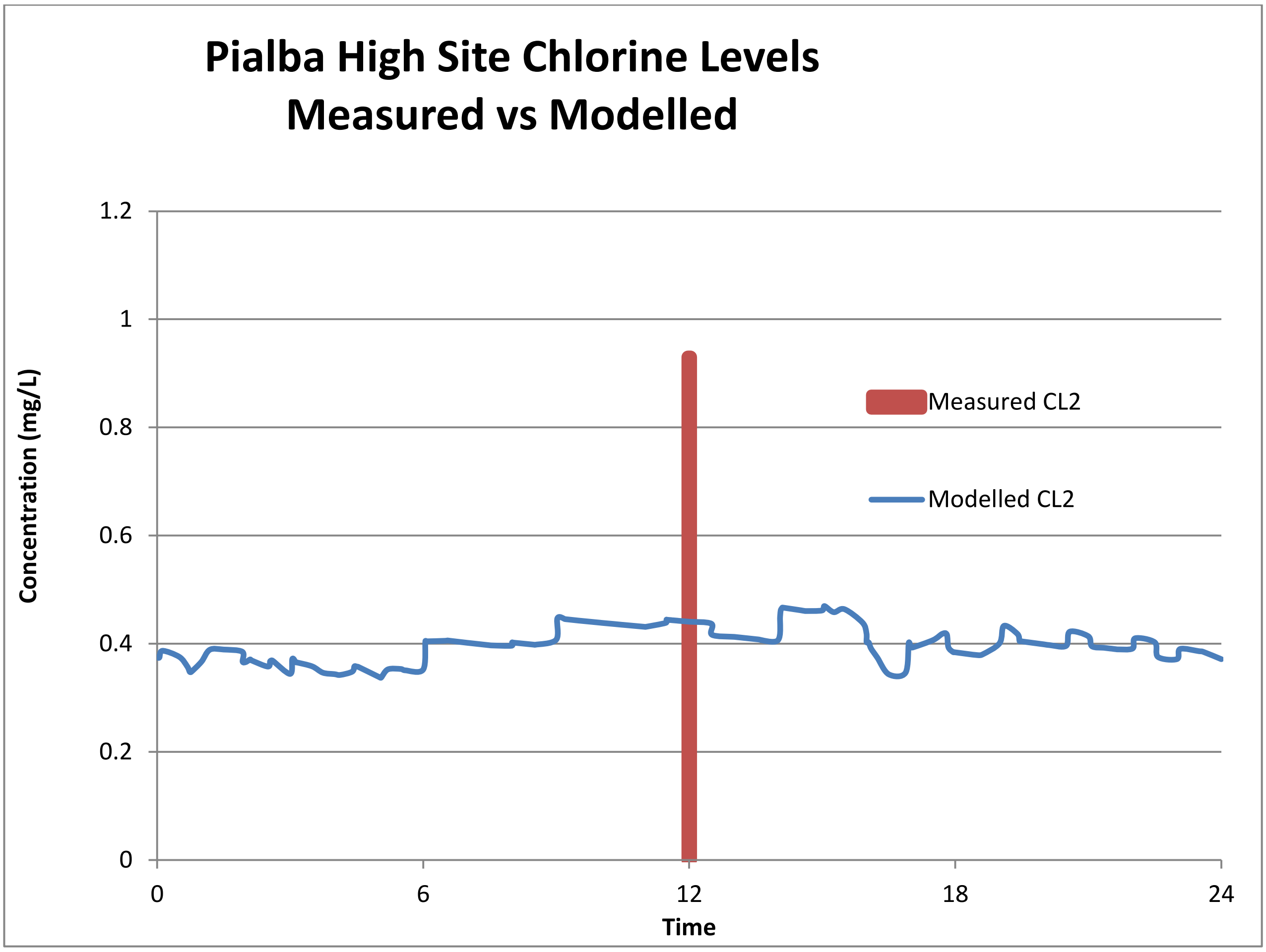

River Heads Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

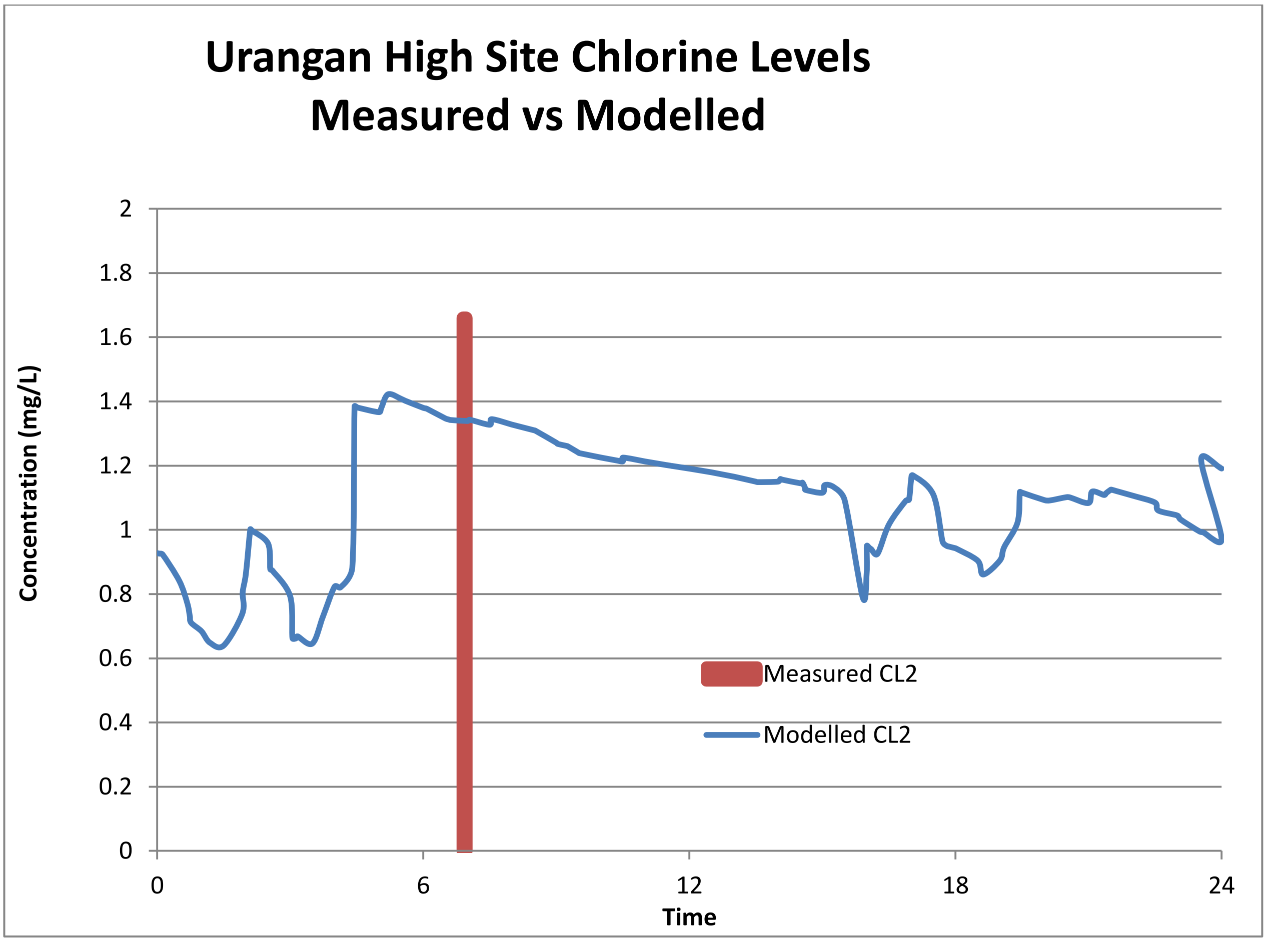

Howard Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

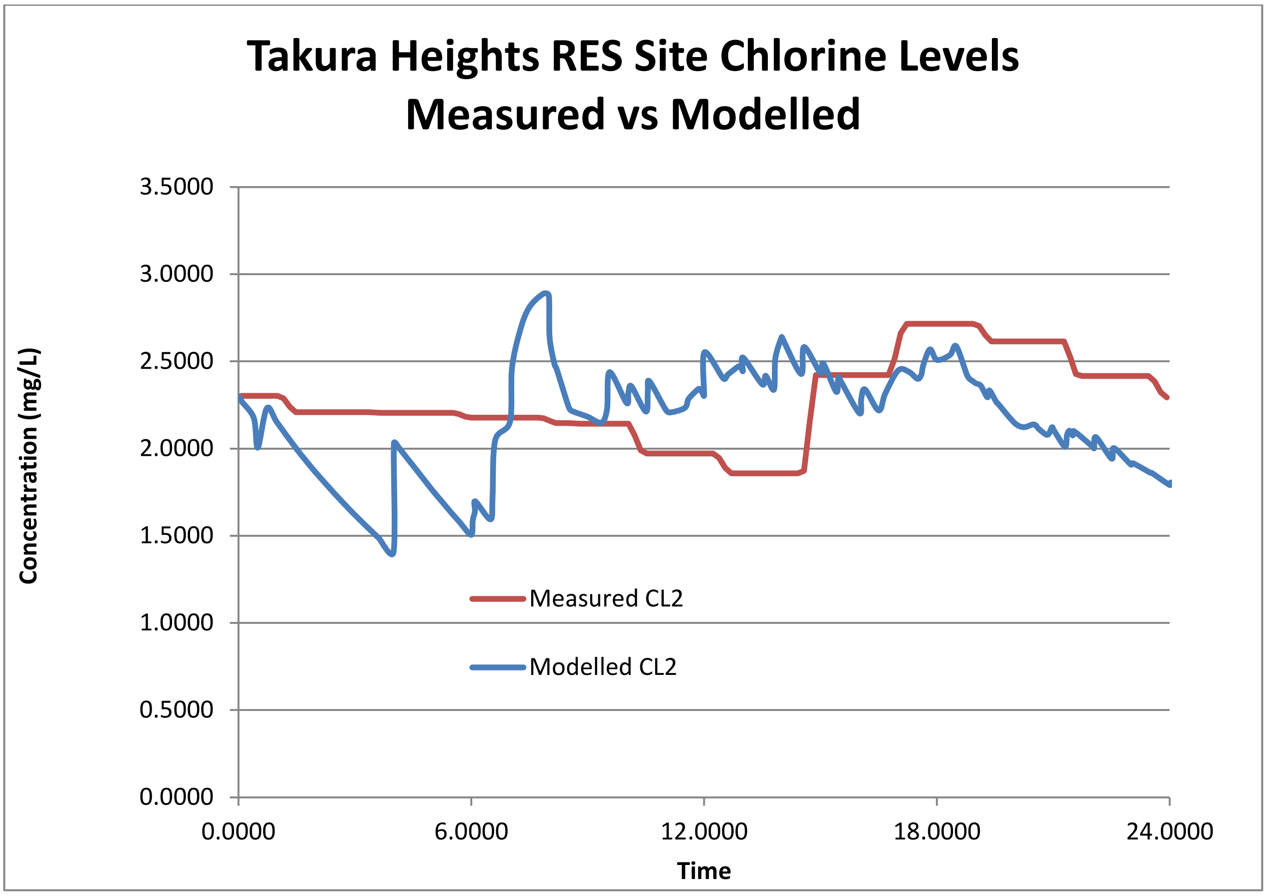

Howard ET Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
4.0000
3.5000
3.0000
2.5000
2.0000
1.5000
1.0000
0.5000
0.0000
Measured CL2
Modelled CL2
0.0000
6.0000
12.0000
18.0000
24.0000
Time

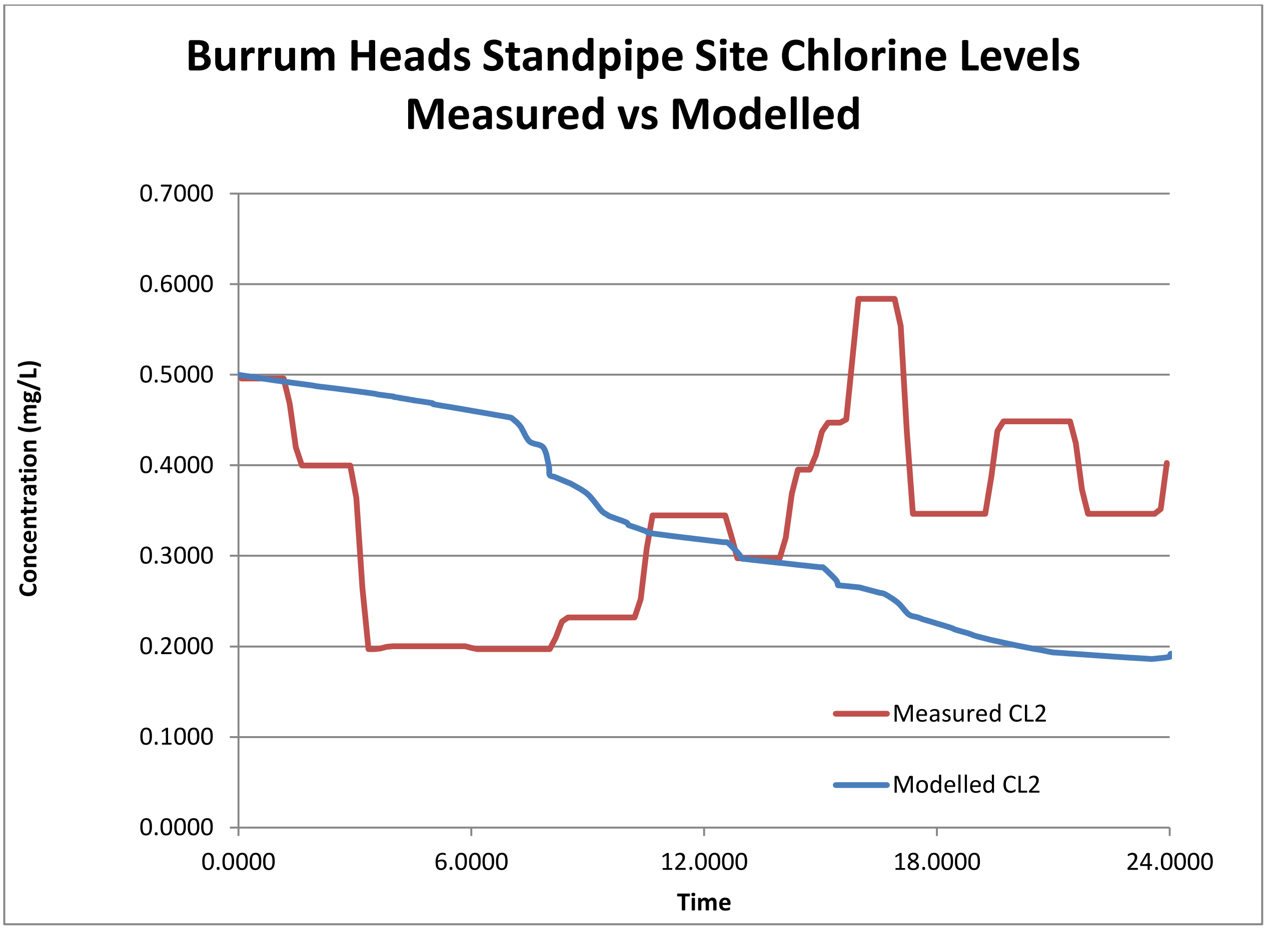

Urangan Low Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

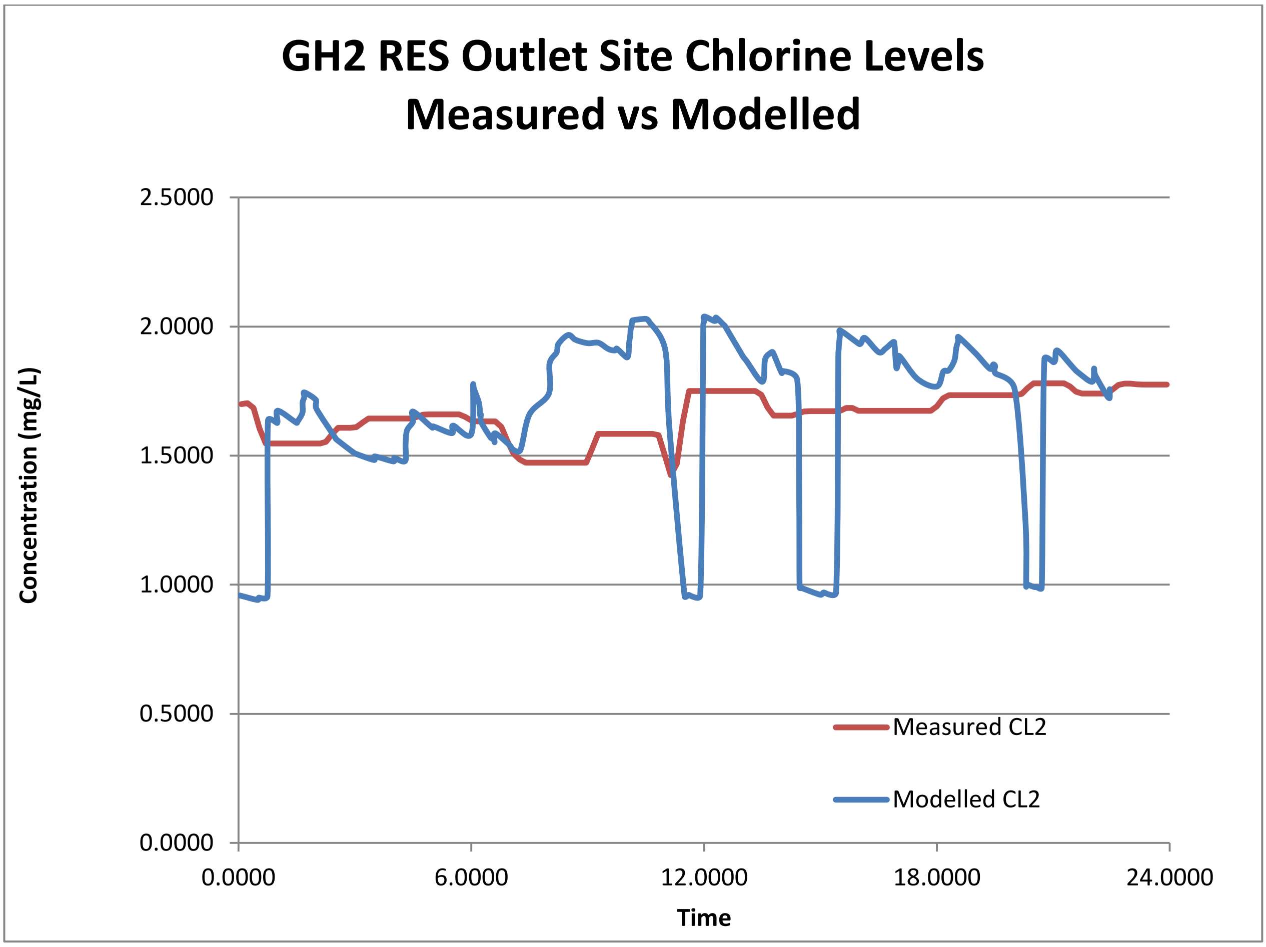

Urraween High Sample Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time


Pialba High Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
1.2
1
0.8
0.6
0.4
0.2
0
Measured CL2
Modelled CL2
0
6
12
18
24
Time

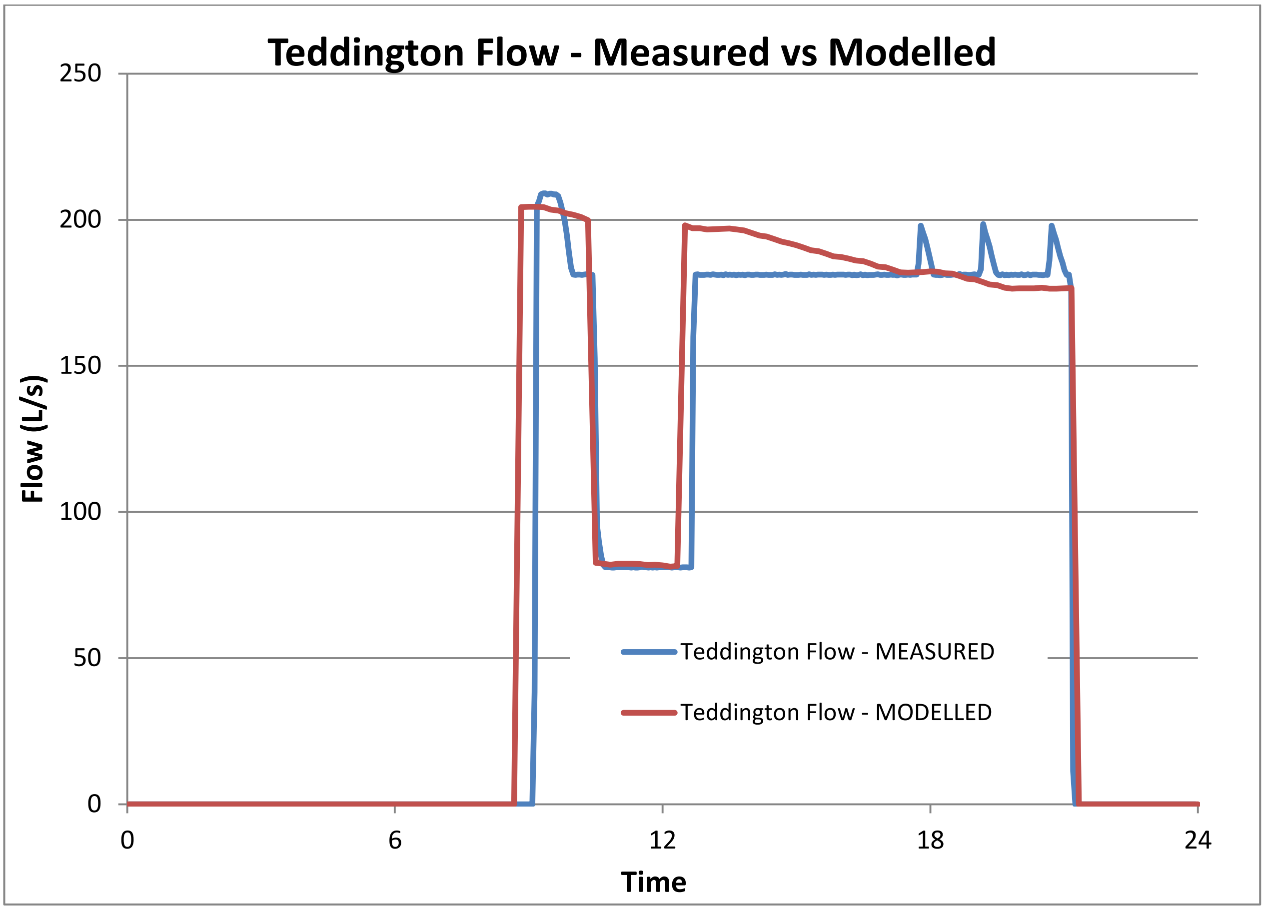

Urangan High Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
6
12
18
24
Time
Measured CL2
Modelled CL2

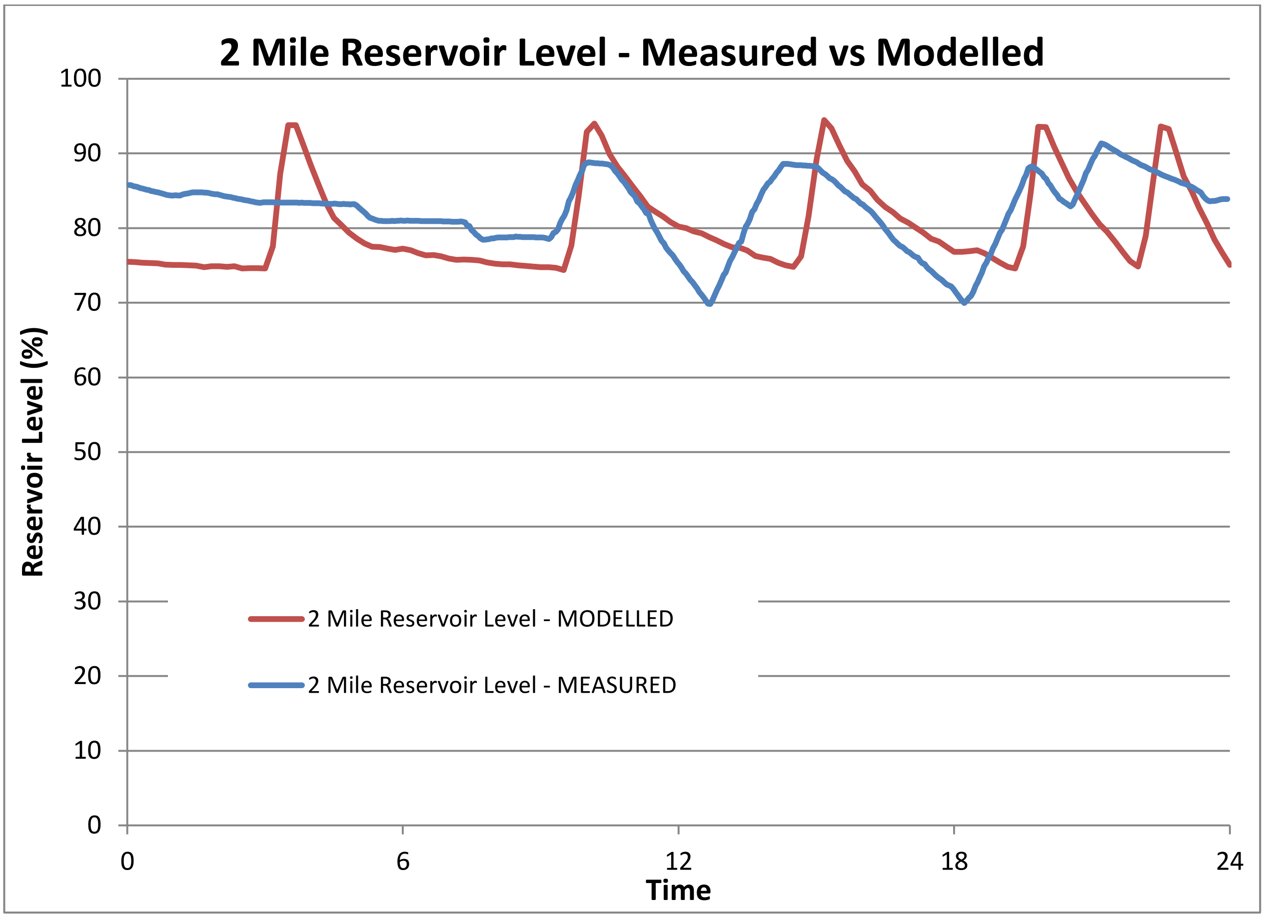

Takura Heights RES Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
3.5000
3.0000
2.5000
2.0000
1.5000
1.0000
0.5000
0.0000
0.0000
6.0000
12.0000
18.0000
24.0000
Time
Measured CL2
Modelled CL2

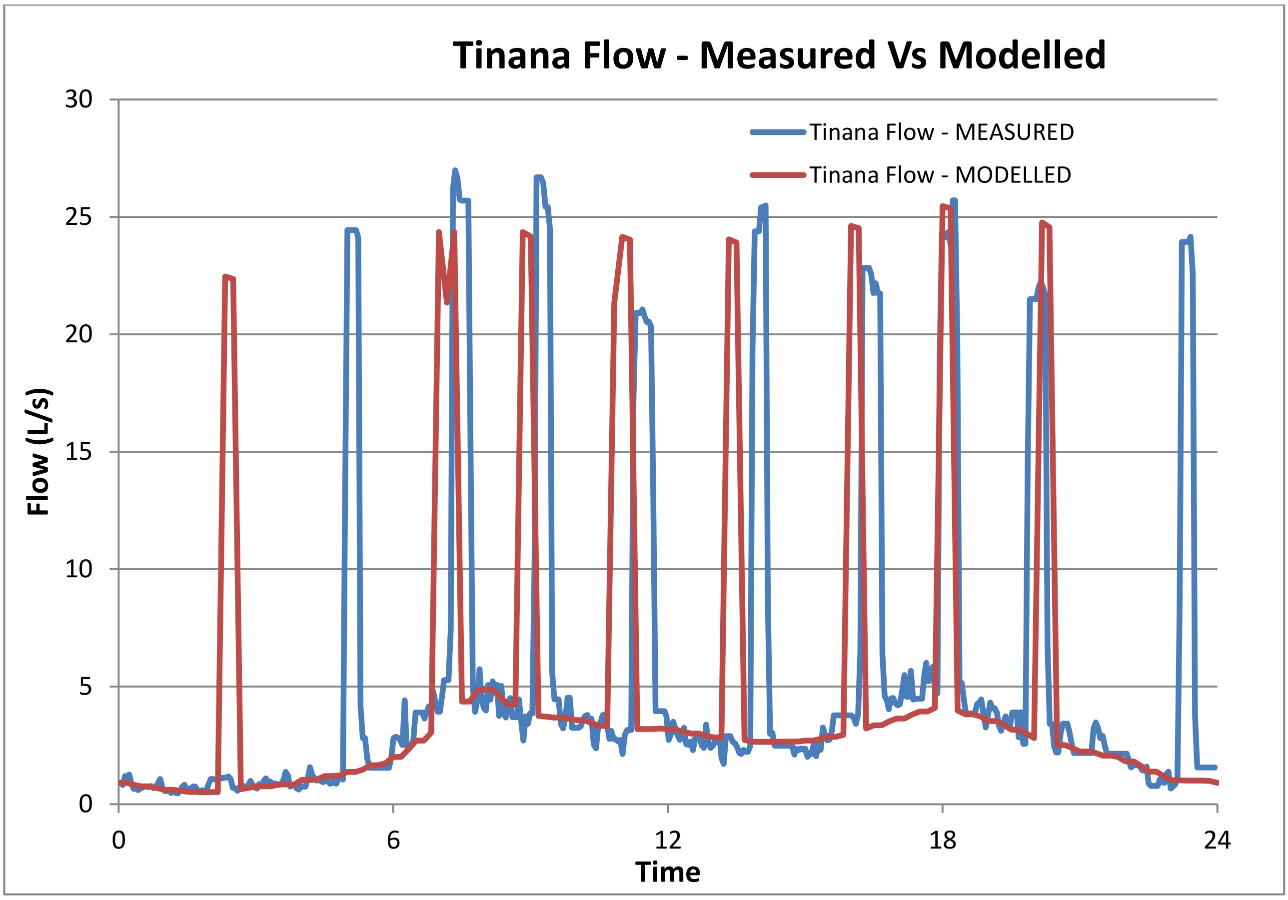

Burrum Heads Standpipe Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
0.7000
0.6000
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
0.0000
6.0000
12.0000
18.0000
24.0000
Time
Measured CL2
Modelled CL2

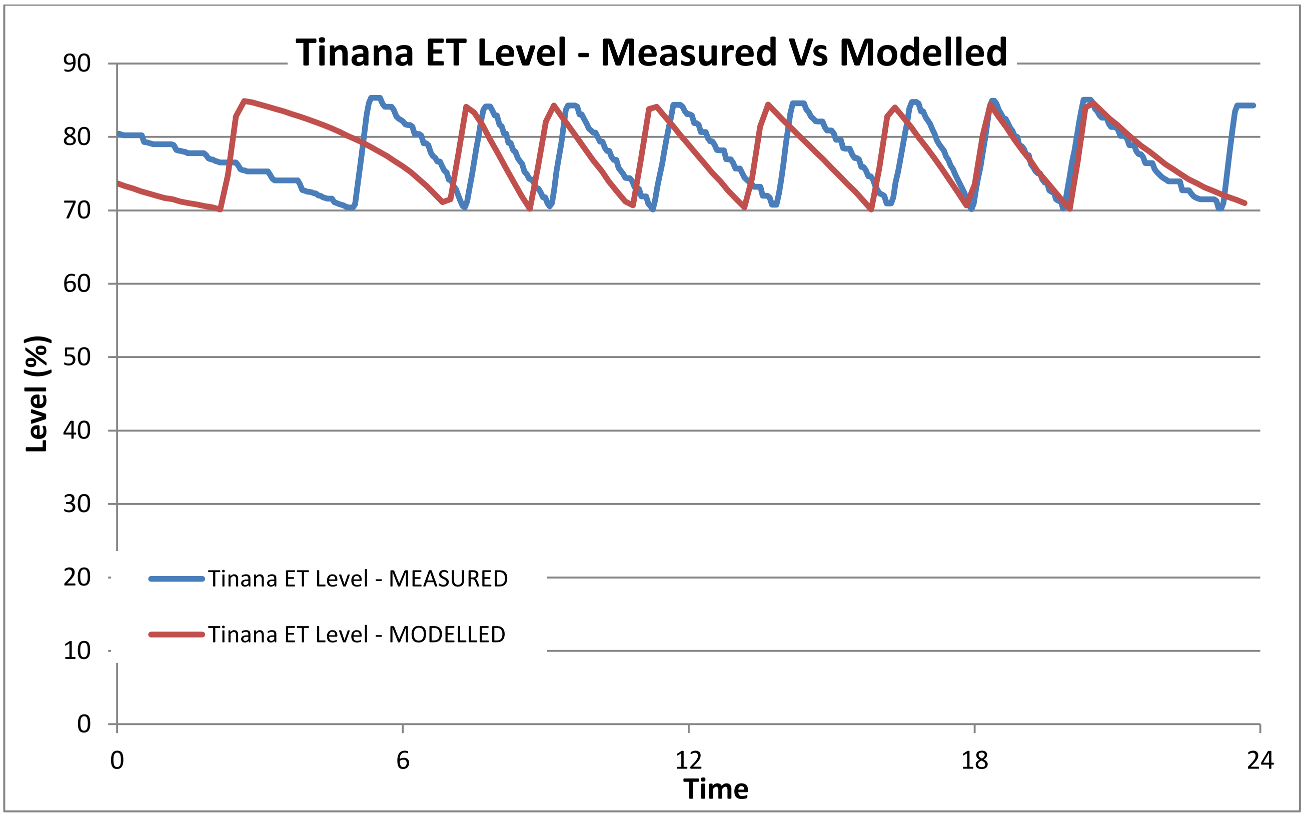

GH2 RES Outlet Site Chlorine Levels
Measured vs Modelled
Concentration (mg/L)
2.5000
2.0000
1.5000
1.0000
0.5000
0.0000
0.0000
6.0000
12.0000
18.0000
24.0000
Time
Measured CL2
Modelled CL2

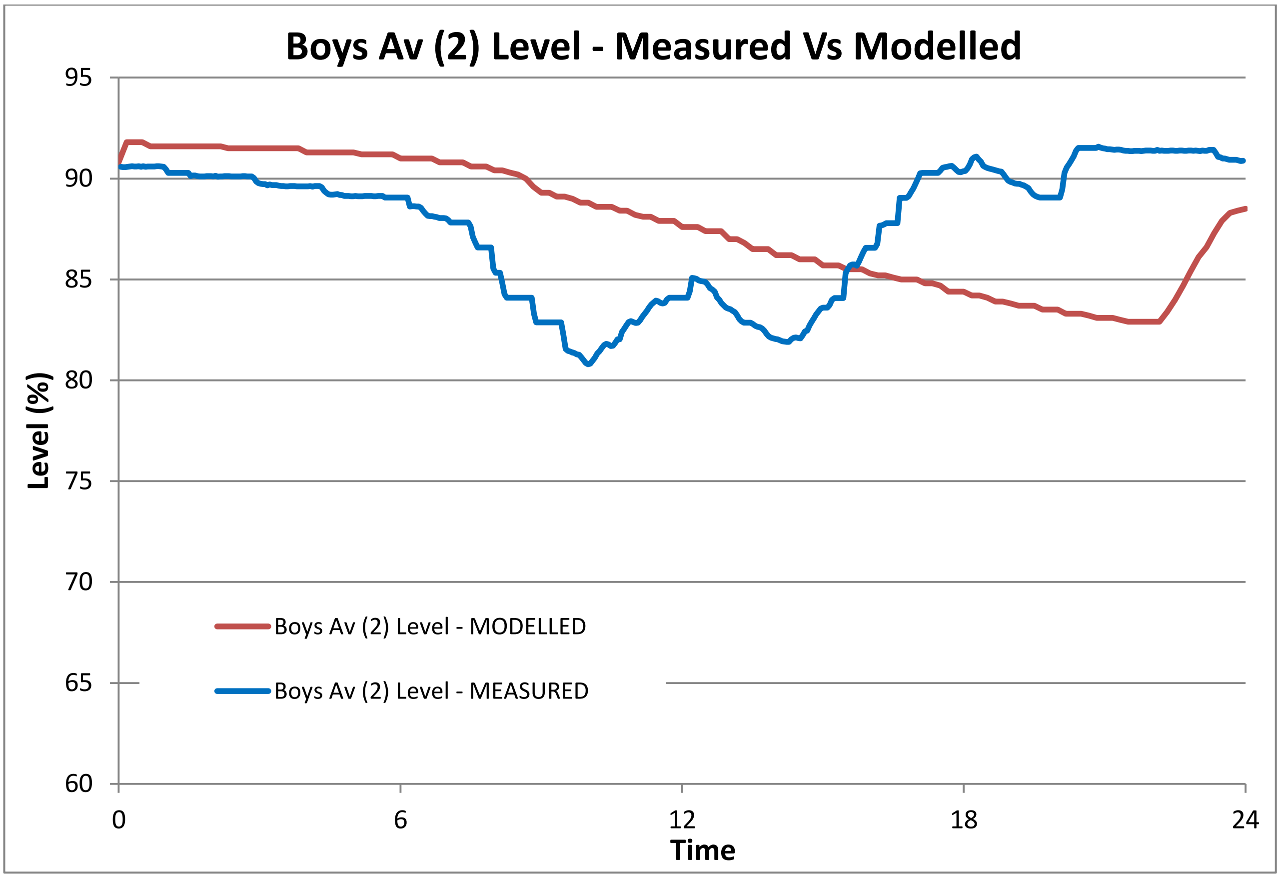
Maryborough Water Quality Model Calibration

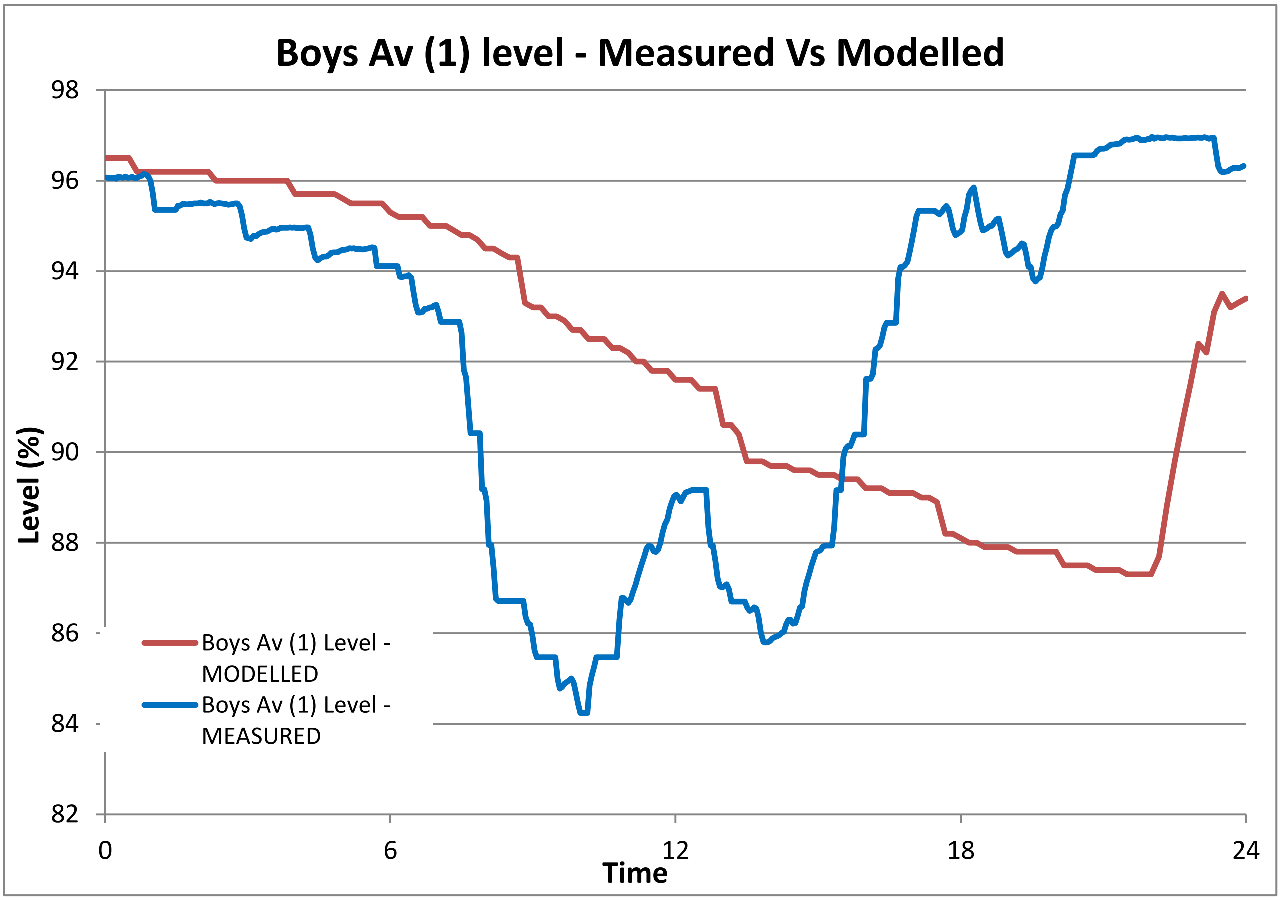


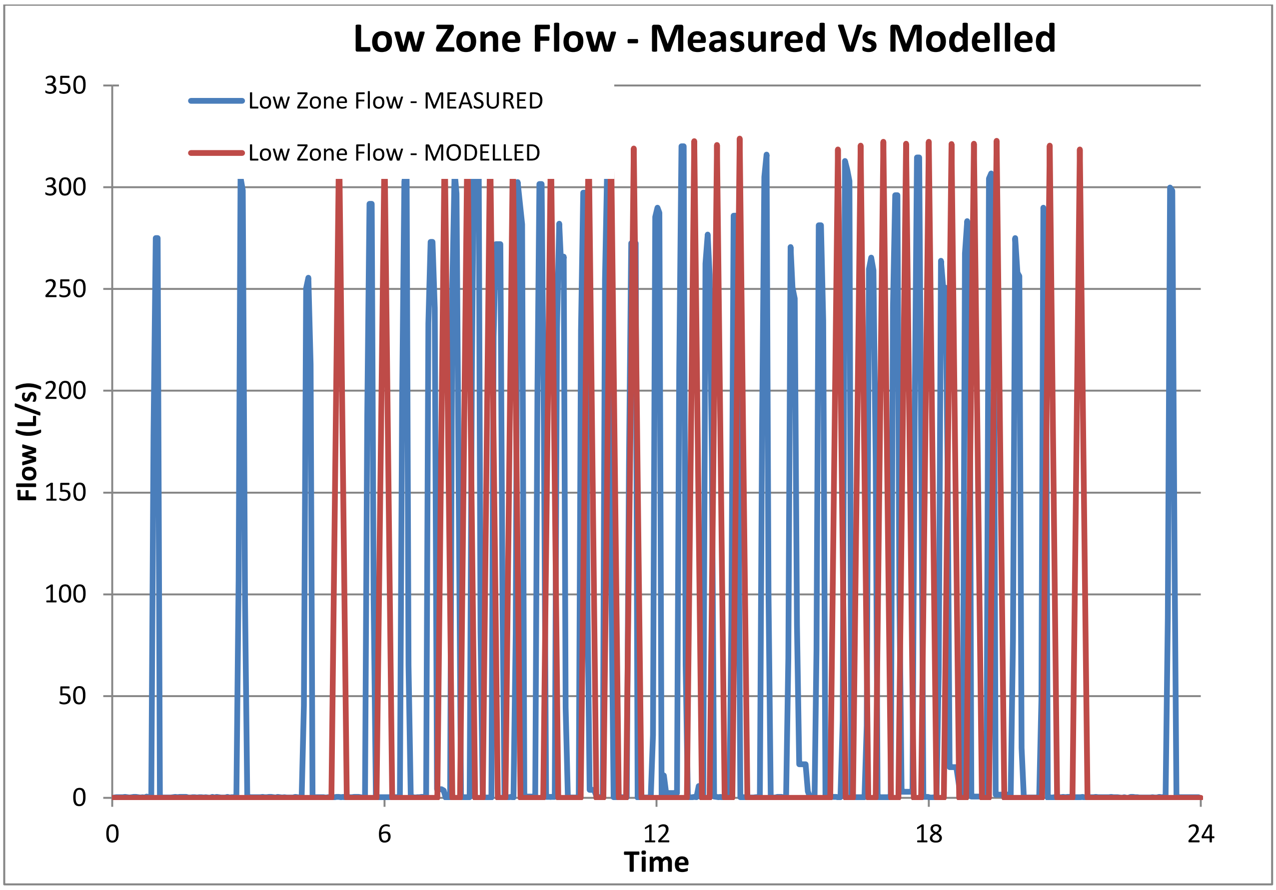


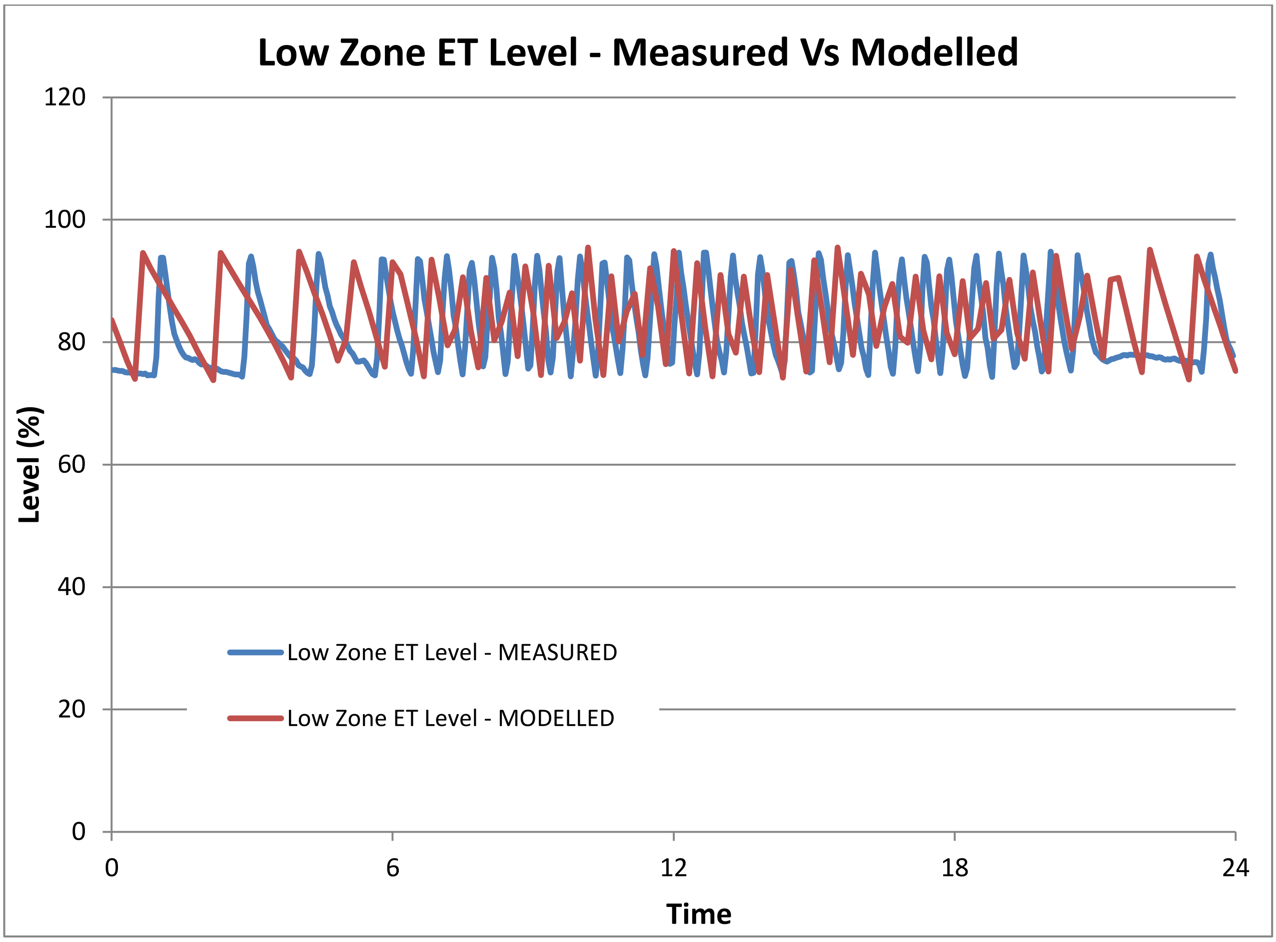

Tinana Flow - Measured Vs Modelled
Flow (L/s)
Time
Tinana Flow - MEASURED
Tinana Flow - MODELLED
0
5
10
15
20
25
30
0
6
12
18
24

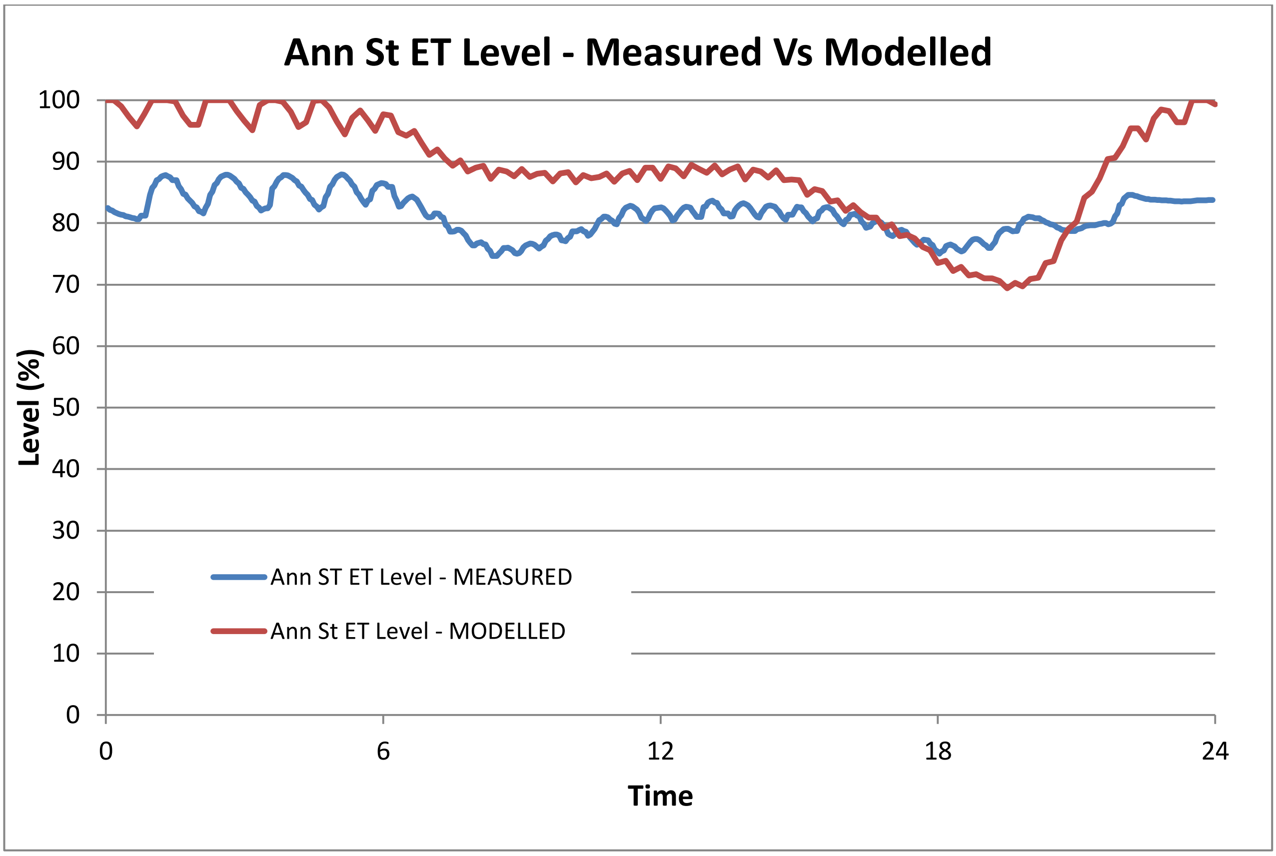

Tinana ET Level - Measured Vs Modelled
Level (%)
Time
Tinana ET Level - MEASURED
Tinana ET Level - MODELLED
0
10
20
30
40
50
60
70
80
90
0
6
12
18
24

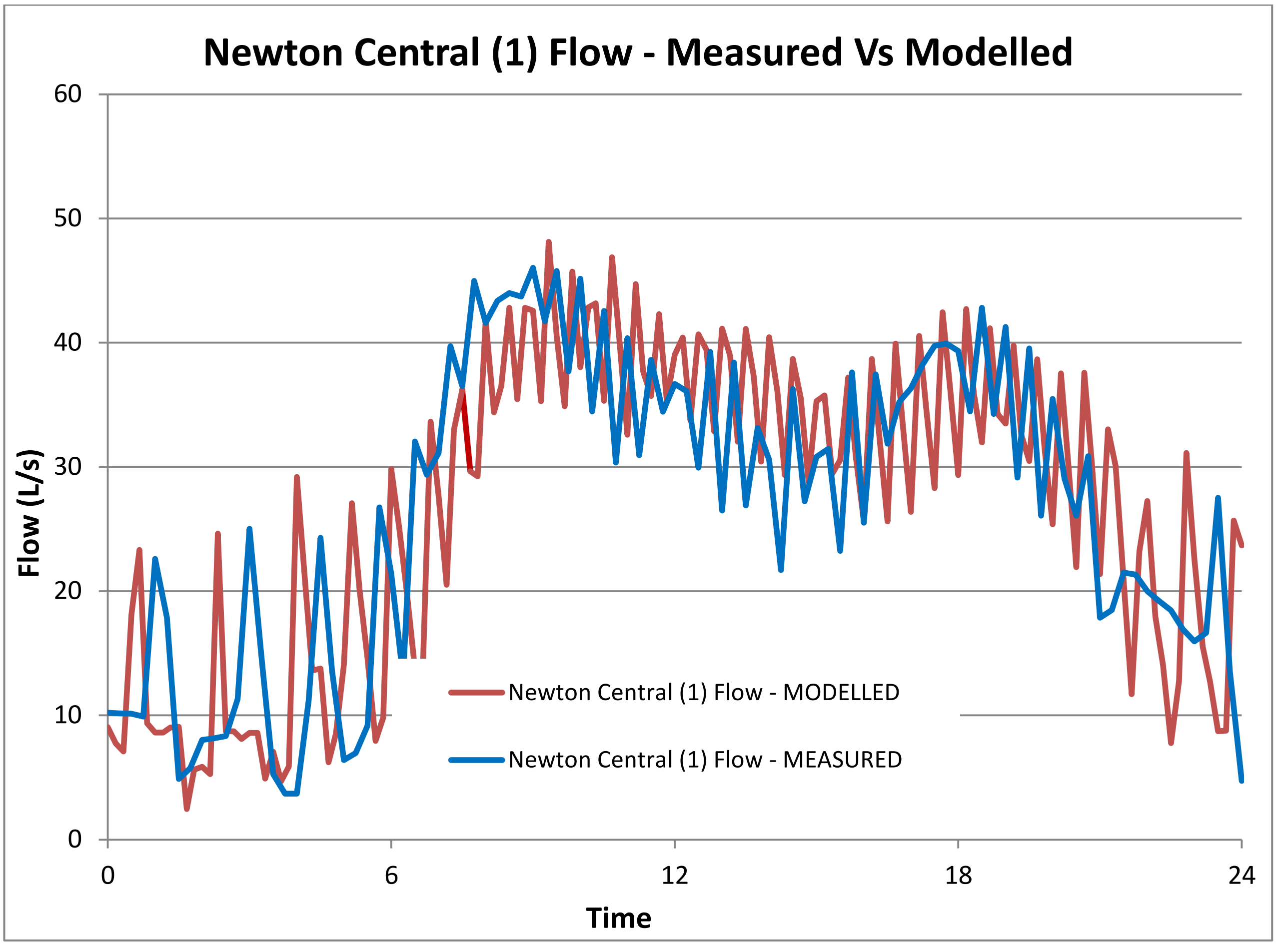

Boys Av (2) Level - Measured Vs Modelled
Level (%)
95
90
85
80
75
70
65
60
0
6
12
18
24
Time
Boys Av (2) Level - MODELLED
Boys Av (2) Level - MEASURED

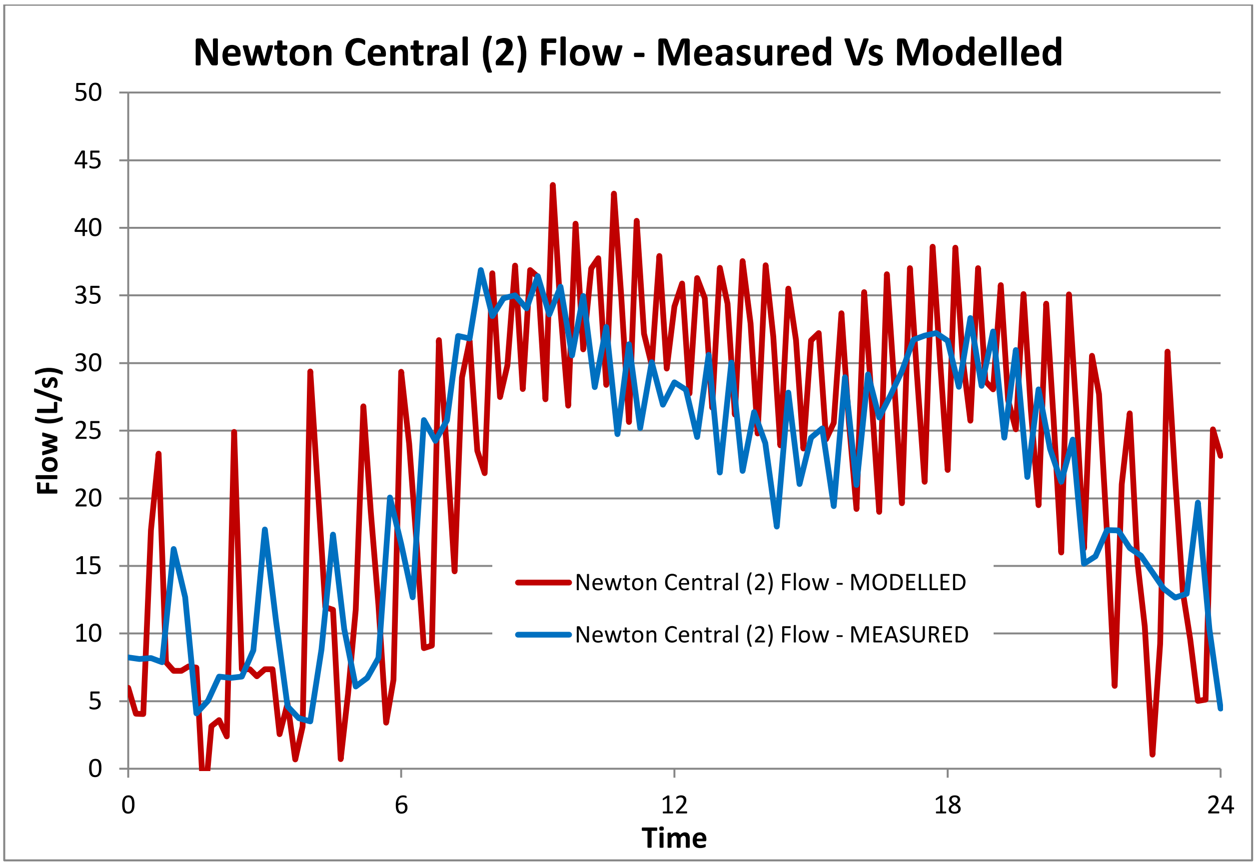

Boys Av (1) level - Measured Vs Modelled
Level (%)
98
96
94
92
90
88
86
84
82
0
6
12
18
24
Time
Boys Av (1) Level - MODELLED
Boys Av (1) Level - MEASURED

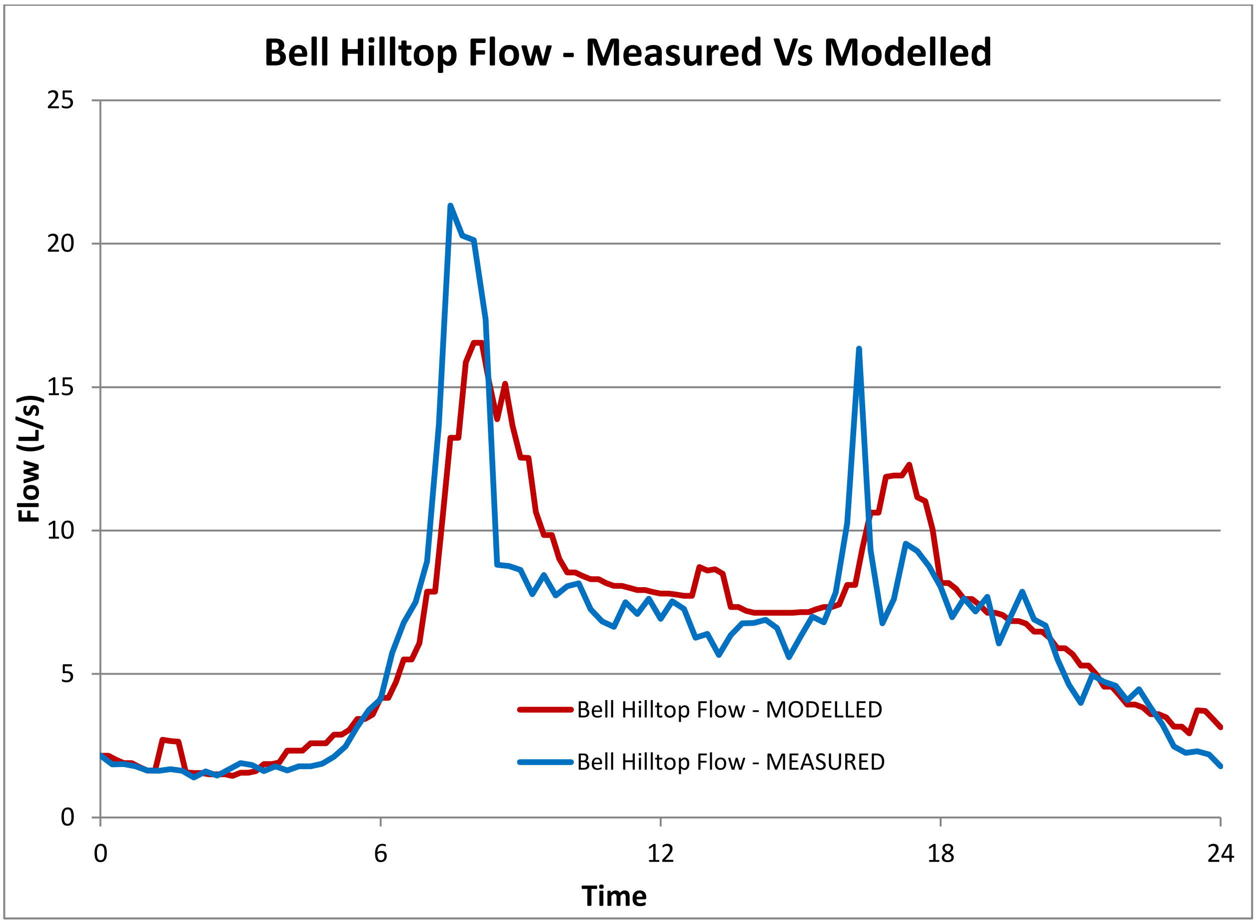

Low Zone Flow - Measured Vs Modelled
Low Zone Flow - MEASURED
Low Zone Flow - MODELLED
Flow (L/s)
350
300
250
200
150
100
50
0
0
6
12
18
24
Time

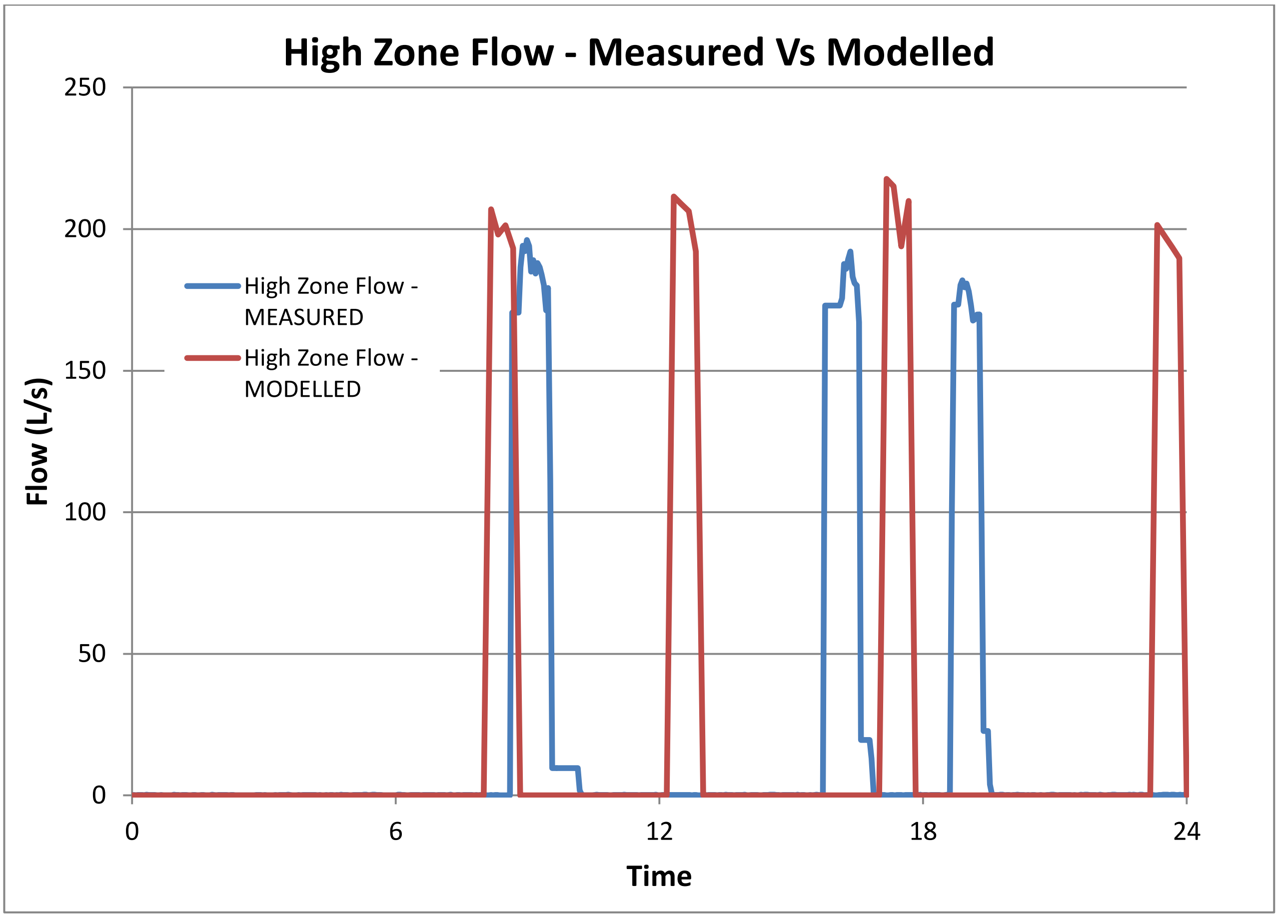

Low Zone ET Level - Measured Vs Modelled
Level (%)
120
100
80
60
40
20
0
Low Zone ET Level - MEASURED
Low Zone ET Level - MODELLED
0
6
12
18
24
Time

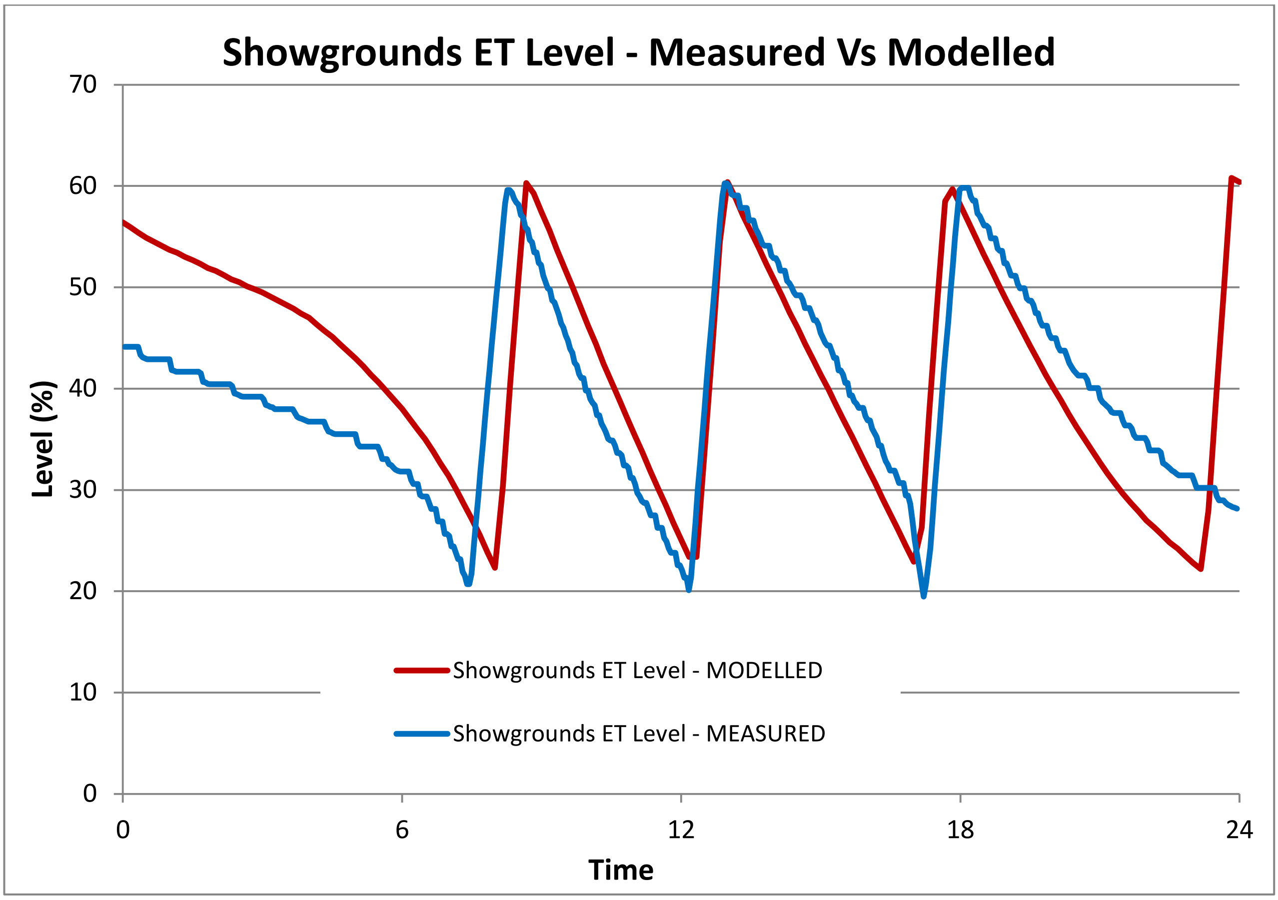

Ann St ET Level - Measured Vs Modelled
Level (%)
100
90
80
70
60
50
40
30
20
10
0
0
6
12
18
24
Time
Ann ST ET Level - MEASURED
Ann St ET Level - MODELLED

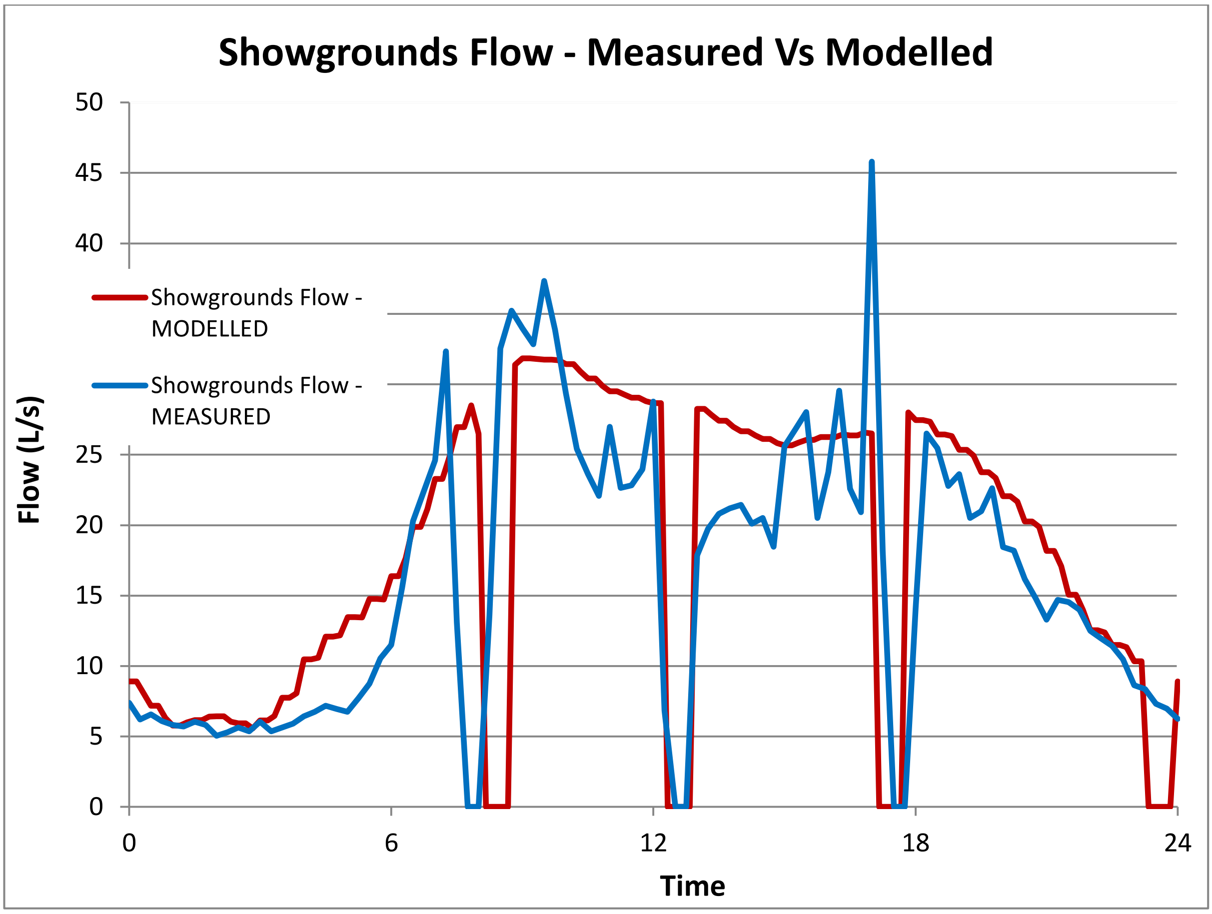

Newton Central (1) Flow - Measured Vs Modelled
Flow (L/s)
60
50
40
30
20
10
0
0
6
12
18
24
Time
Newton Central (1) Flow - MODELLED
Newton Central (1) Flow - MEASURED

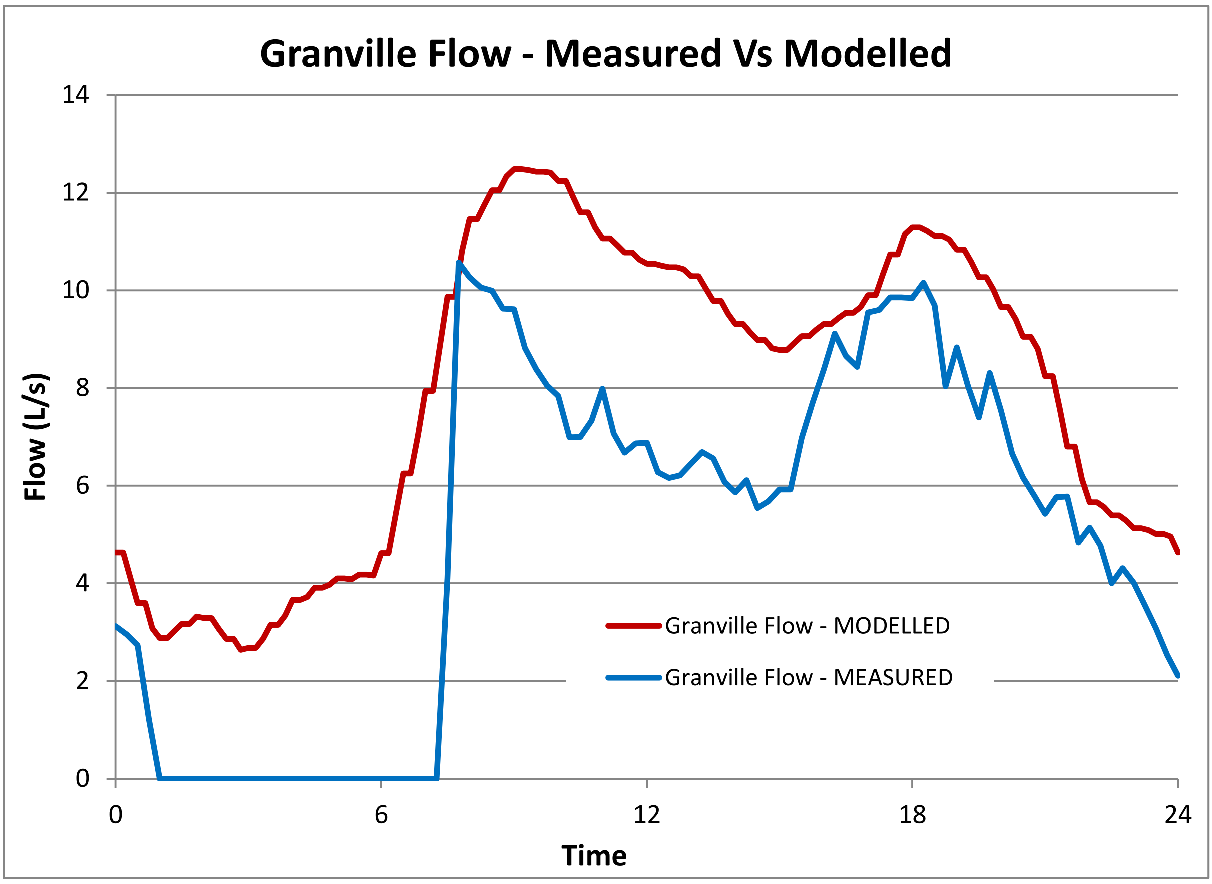

Newton Central (2) Flow - Measured Vs Modelled
Flow (L/s)
50
45
40
35
30
25
20
15
10
5
0
0
6
12
18
24
Time
Newton Central (2) Flow - MODELLED
Newton Central (2) Flow - MEASURED

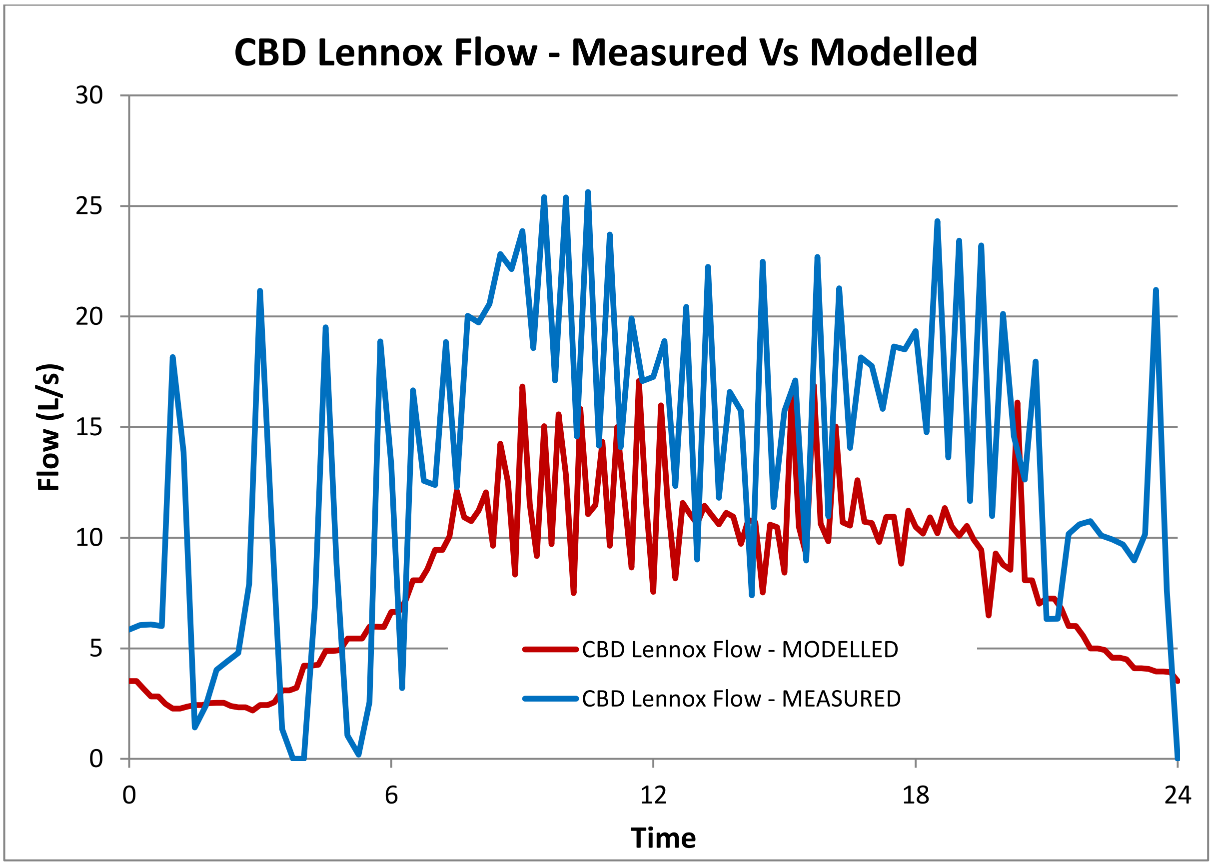

Bell Hilltop Flow - Measured Vs Modelled
Flow (L/s)
25
20
15
10
5
0
0
6
12
18
24
Time
Bell Hilltop Flow - MODELLED
Bell Hilltop Flow - MEASURED


High Zone Flow - Measured Vs Modelled
Flow (L/s)
250
200
150
100
50
0
High Zone Flow - MEASURED
High Zone Flow - MODELLED
0
6
12
18
24
Time

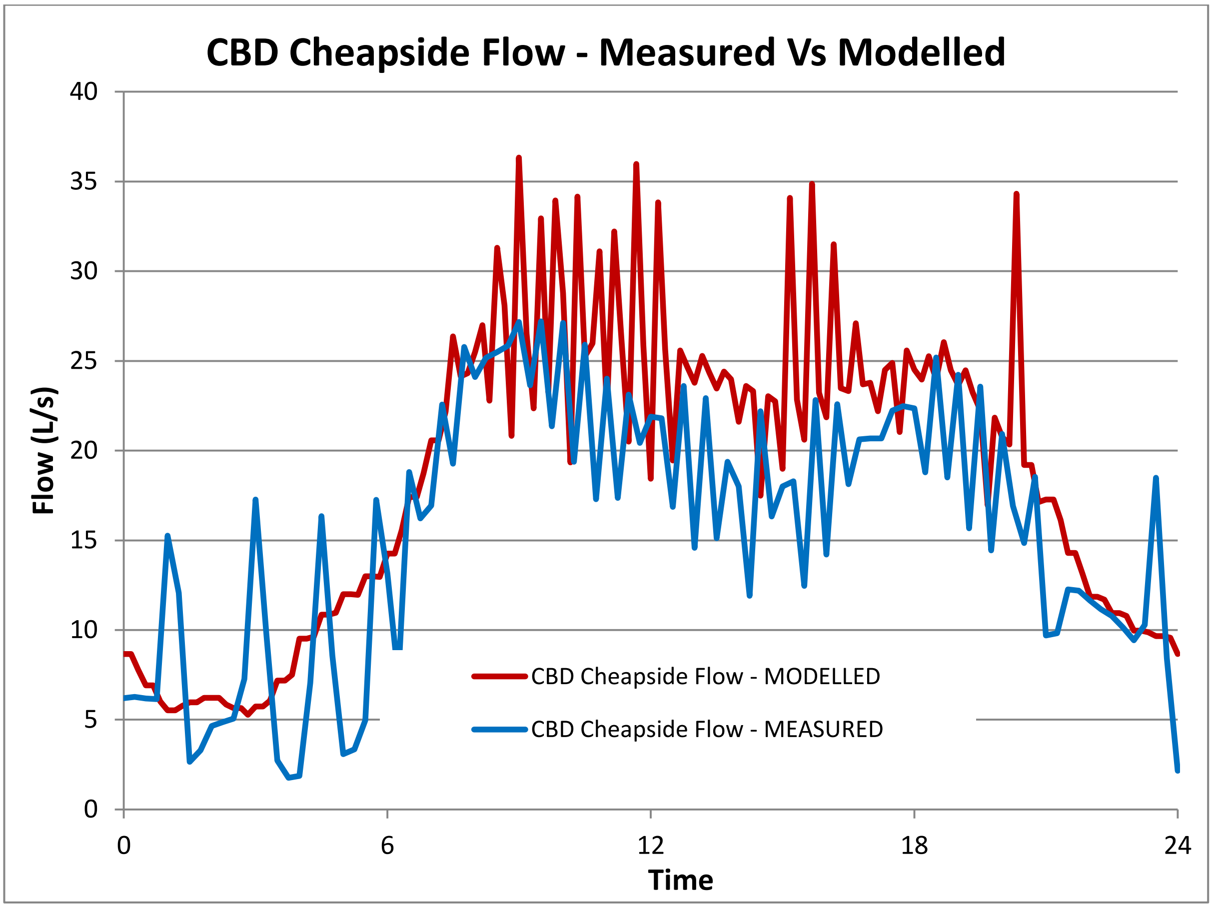

Showgrounds ET Level - Measured Vs Modelled
Level (%)
70
60
50
40
30
20
10
0
Showgrounds ET Level - MODELLED
Showgrounds ET Level - MEASURED
0
6
12
18
24
Time


Showgrounds Flow - Measured Vs Modelled
Flow (L/s)
50
45
40
25
20
15
10
5
0
Showgrounds Flow - MODELLED
Showgrounds Flow - MEASURED
0
6
12
18
24
Time

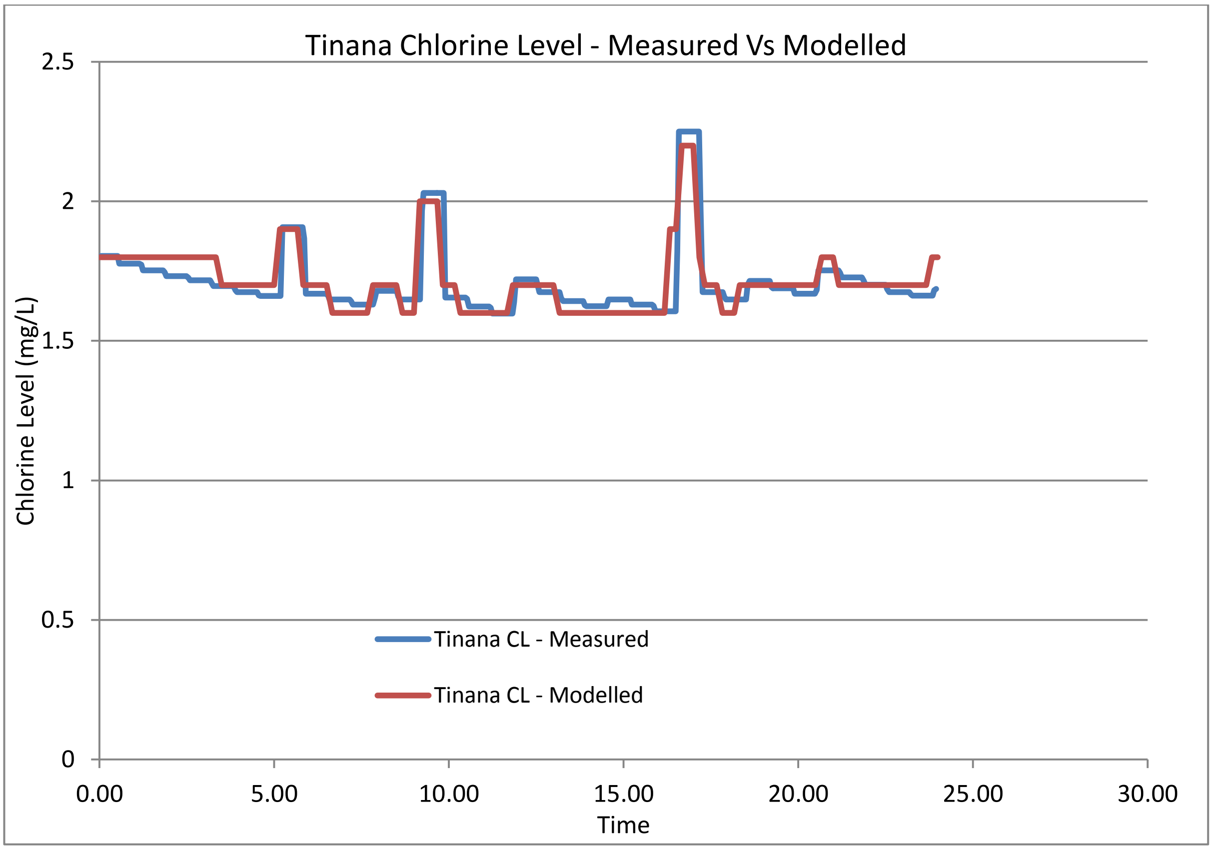

Granville Flow - Measured Vs Modelled
Flow (L/s)
14
12
10
8
6
4
2
0
Granville Flow - MODELLED
Granville Flow - MEASURED
0
6
12
18
24
Time

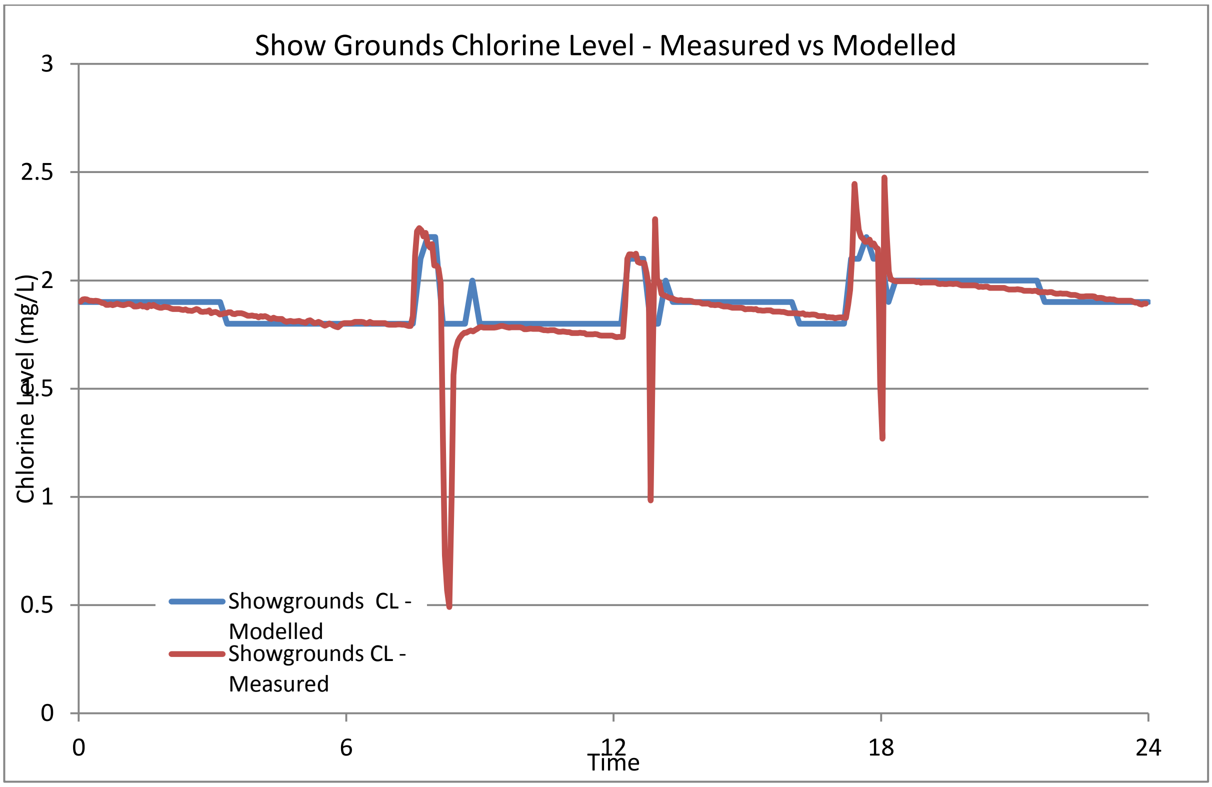


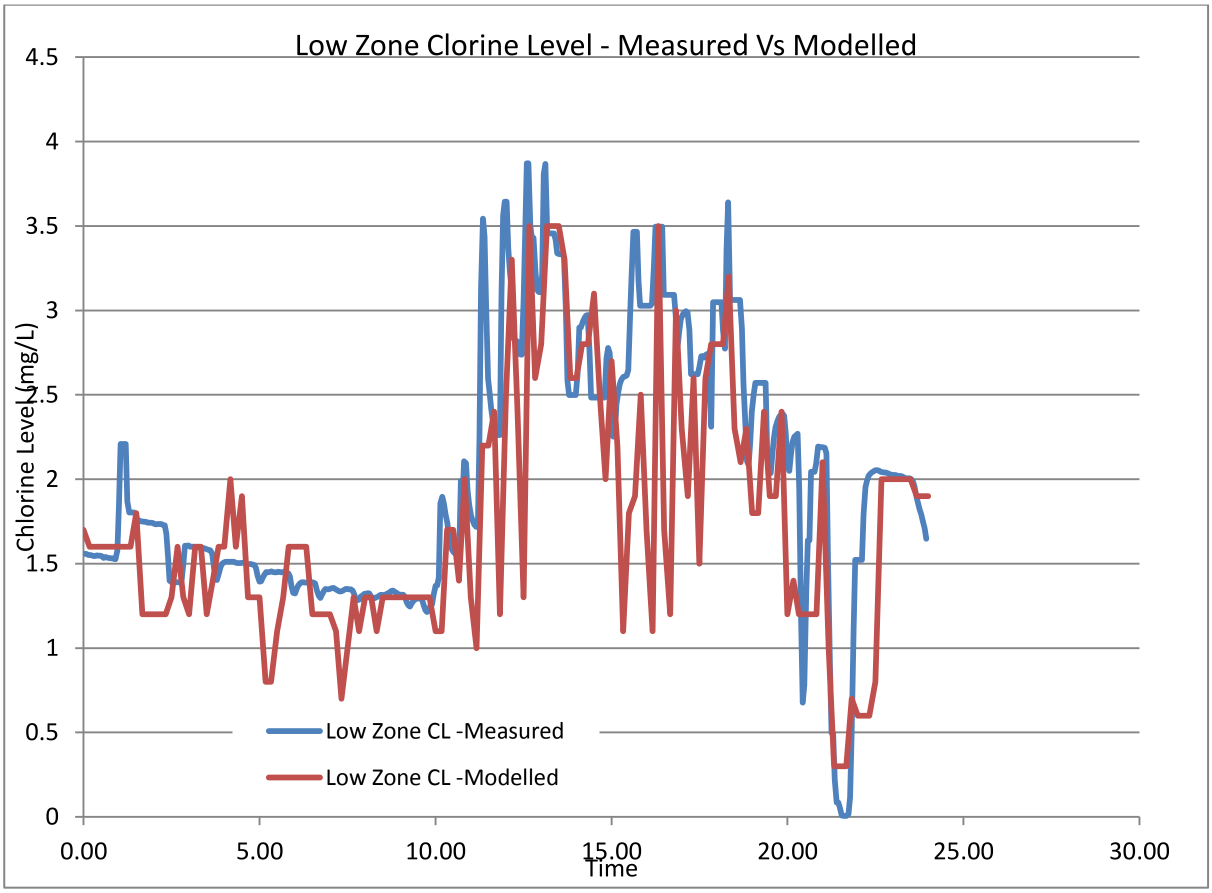
CBD Lennox Flow - Measured Vs Modelled
Flow (L/s)
30
25
20
15
10
5
0
0
6
12
18
24
Time
CBD Lennox Flow - MODELLED
CBD Lennox Flow - MEASURED

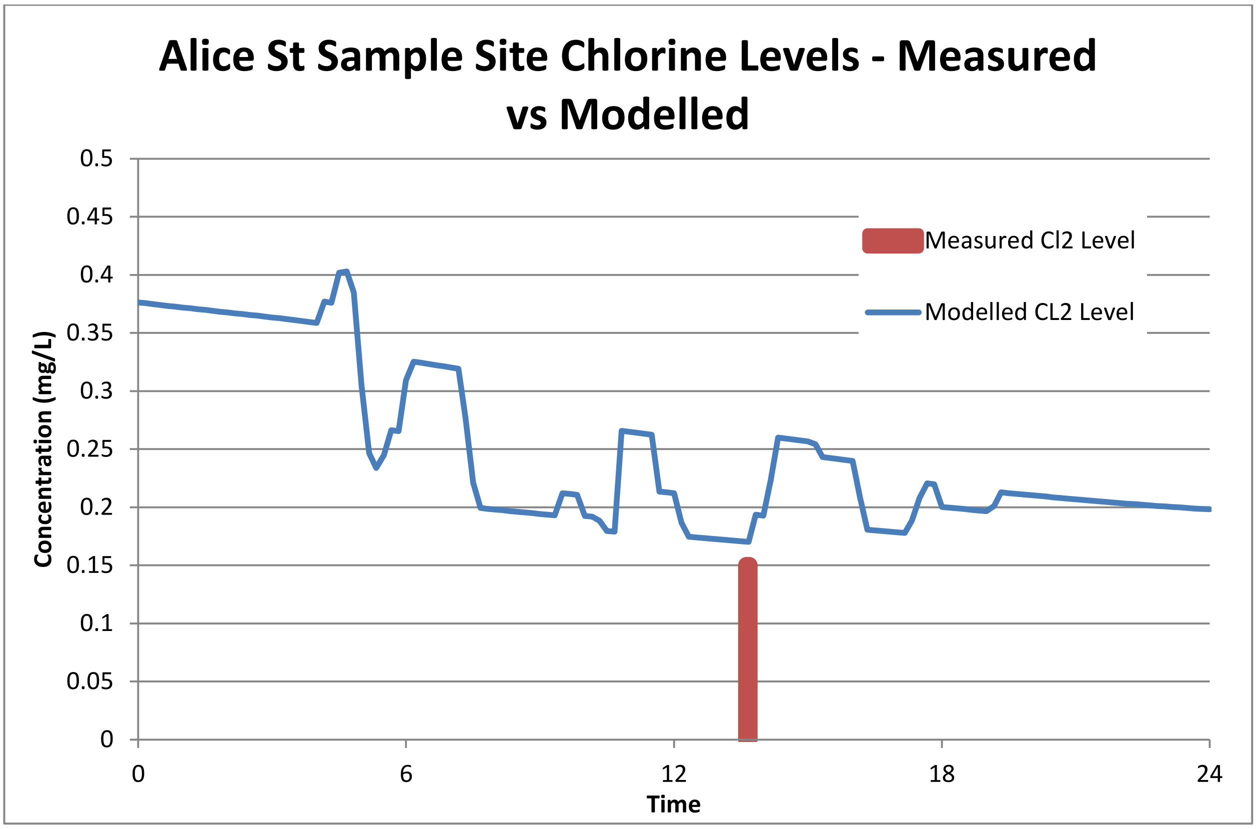


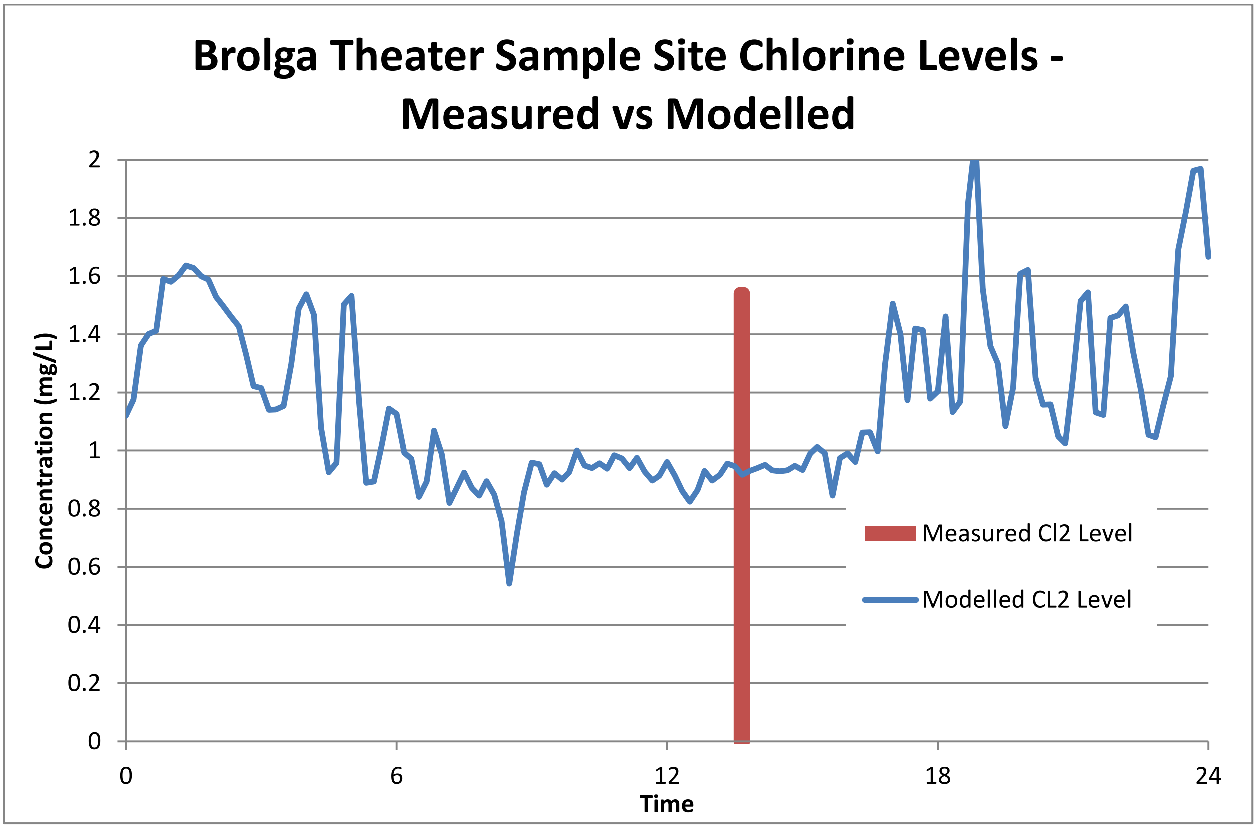
CBD Cheapside Flow - Measured Vs Modelled
Flow (L/s)
40
35
30
25
20
15
10
5
0
0
6
12
18
24
Time
CBD Cheapside Flow - MODELLED
CBD Cheapside Flow - MEASURED

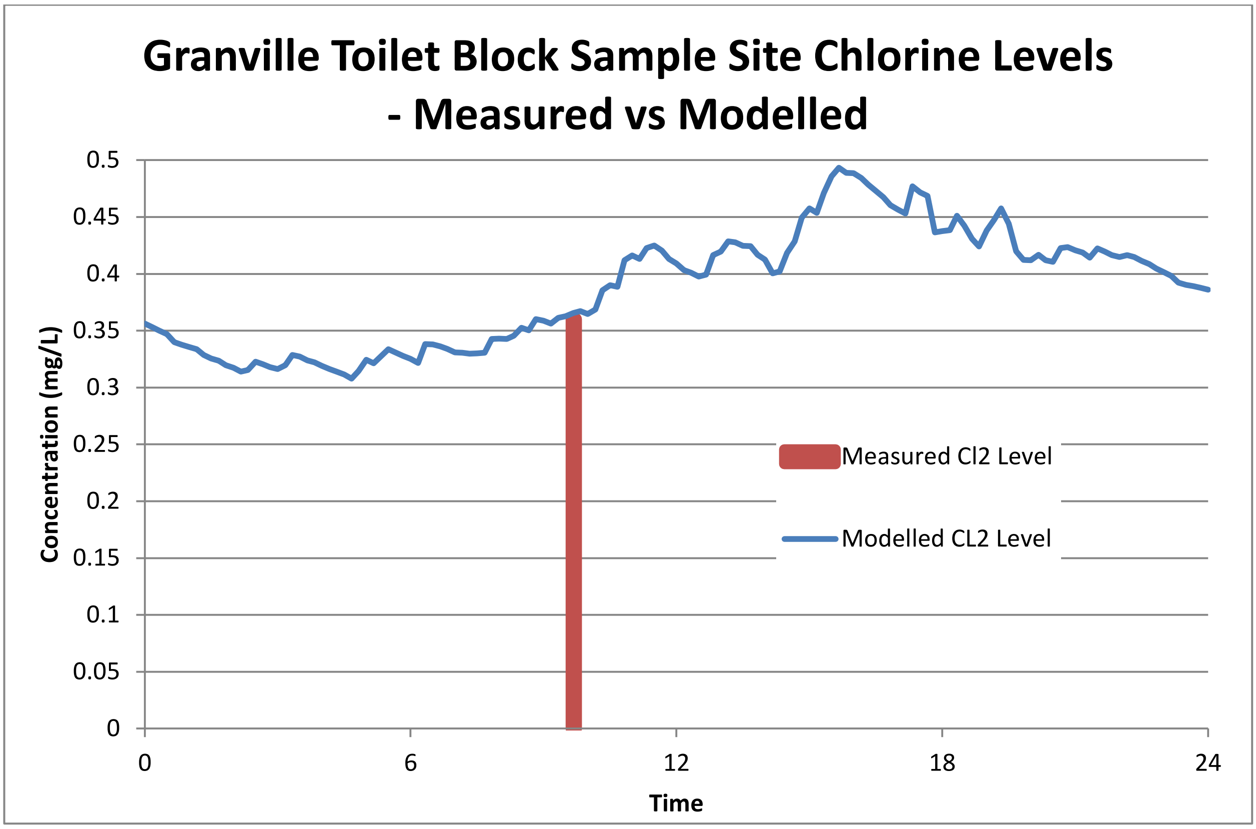

Tinana Chlorine Level - Measured Vs Modelled
Chlorine Level (mg/L)
2.5
2
1.5
1
0.5
0
0.00
5.00
10.00
15.00
20.00
25.00
30.00
Time
Tinana CL - Measured
Tinana CL - Modelled

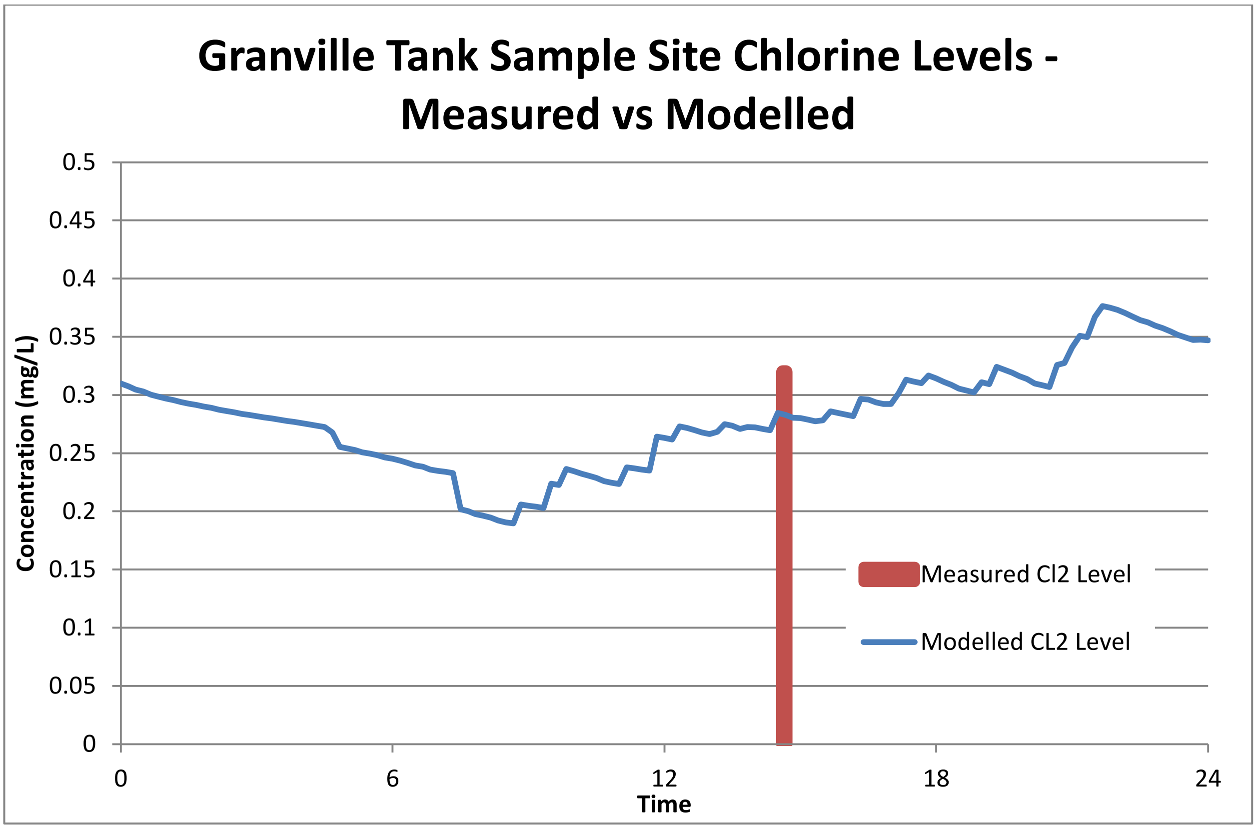

Show Grounds Chlorine Level - Measured vs Modelled
Chlorine Level (mg/L)
3
2.5
2
1.5
1
0.5
0
0
6
12
18
24
Time
Showgrounds CL - Modelled
Showgrounds CL - Measured

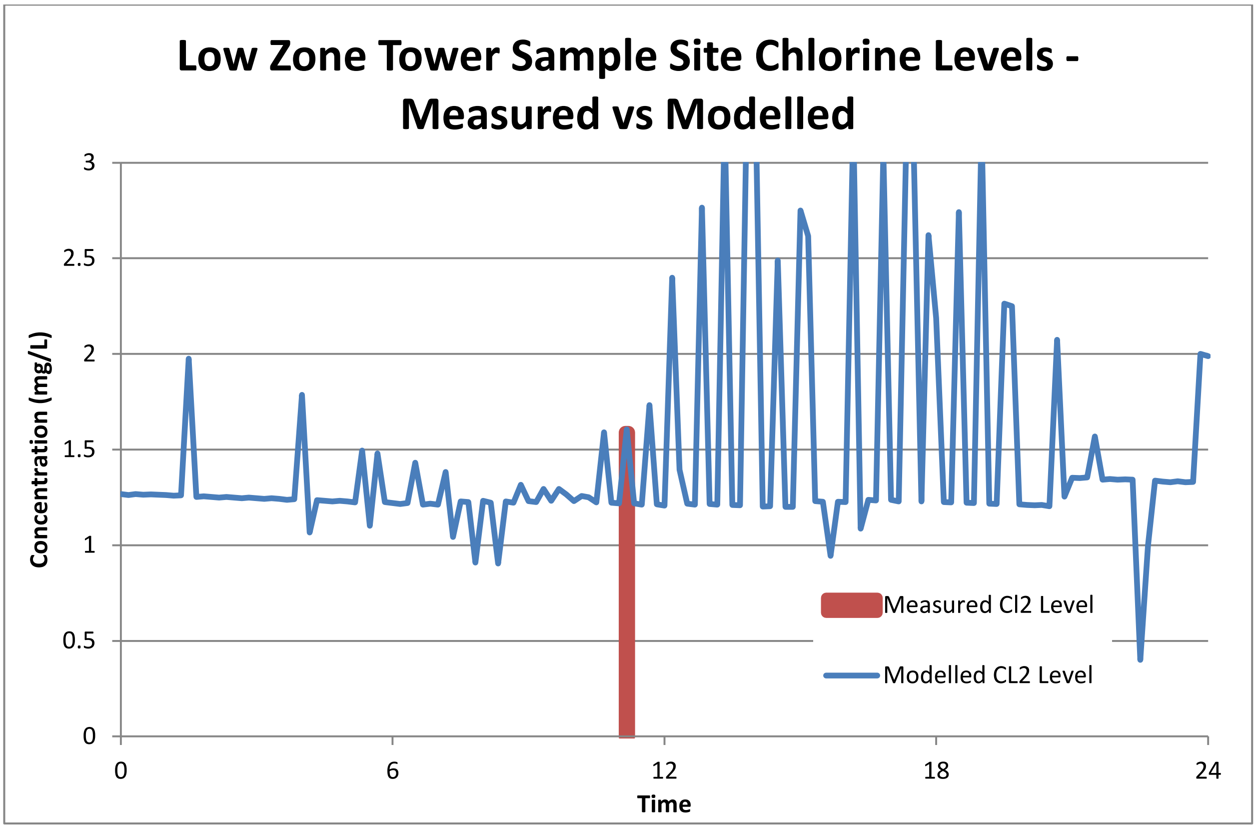

Low Zone Clorine Level - Measured Vs Modelled
Chlorine Level (mg/L)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.00
5.00
10.00
15.00
20.00
25.00
30.00
Time
Low Zone CL -Measured
Low Zone CL -Modelled

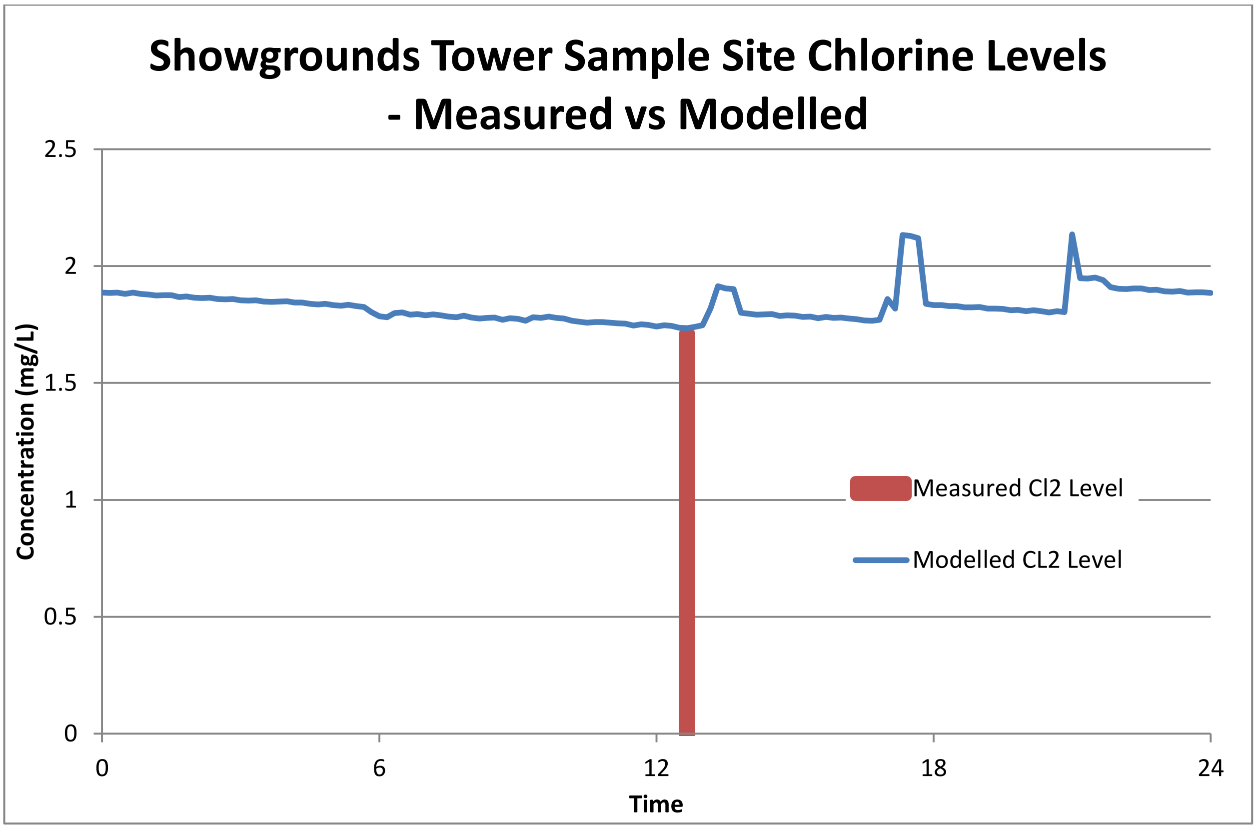

Alice St Sample Site Chlorine Levels - Measured vs Modelled
Concentration (mg/L)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
6
12
18
24
Time
Measured Cl2 Level
Modelled CL2 Level

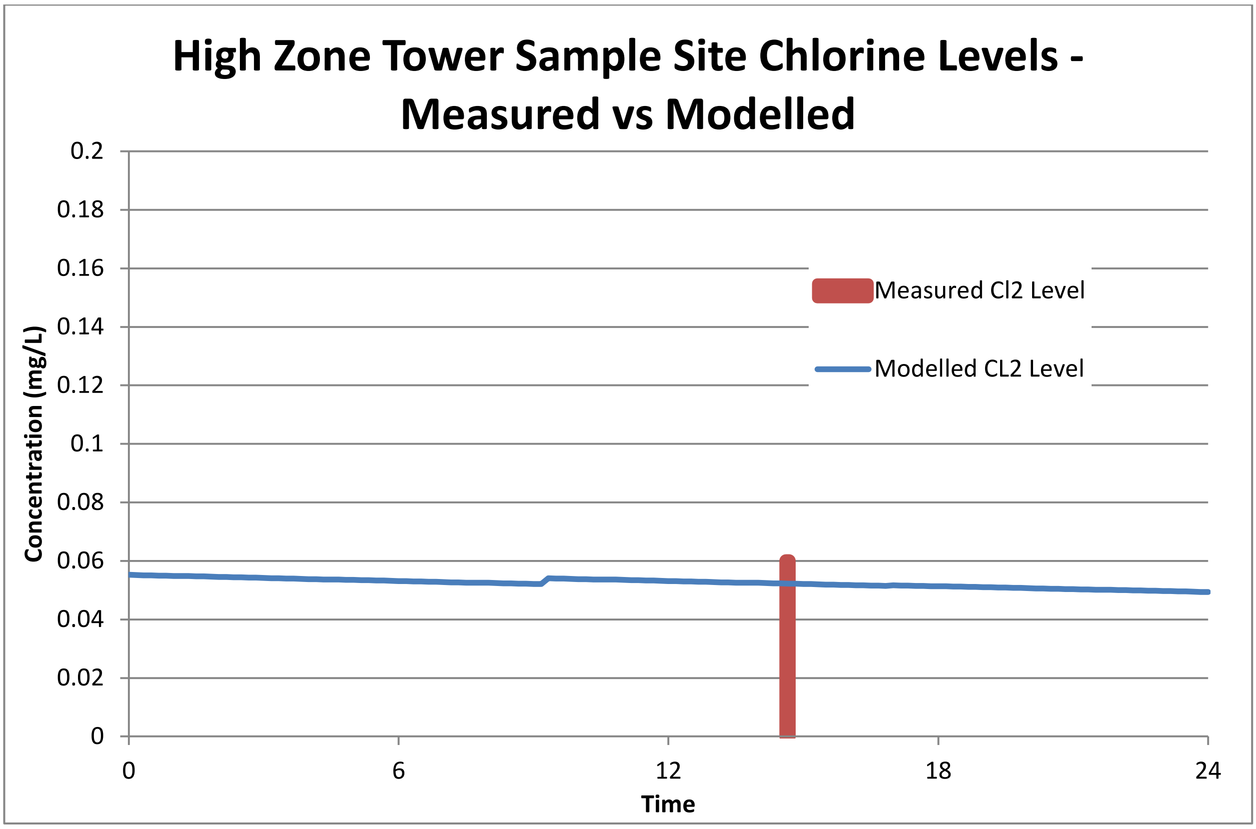

Brolga Theater Sample Site Chlorine Levels - Measured vs Modelled
Concentration (mg/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
6
12
18
24
Time
Measured Cl2 Level
Modelled CL2 Level

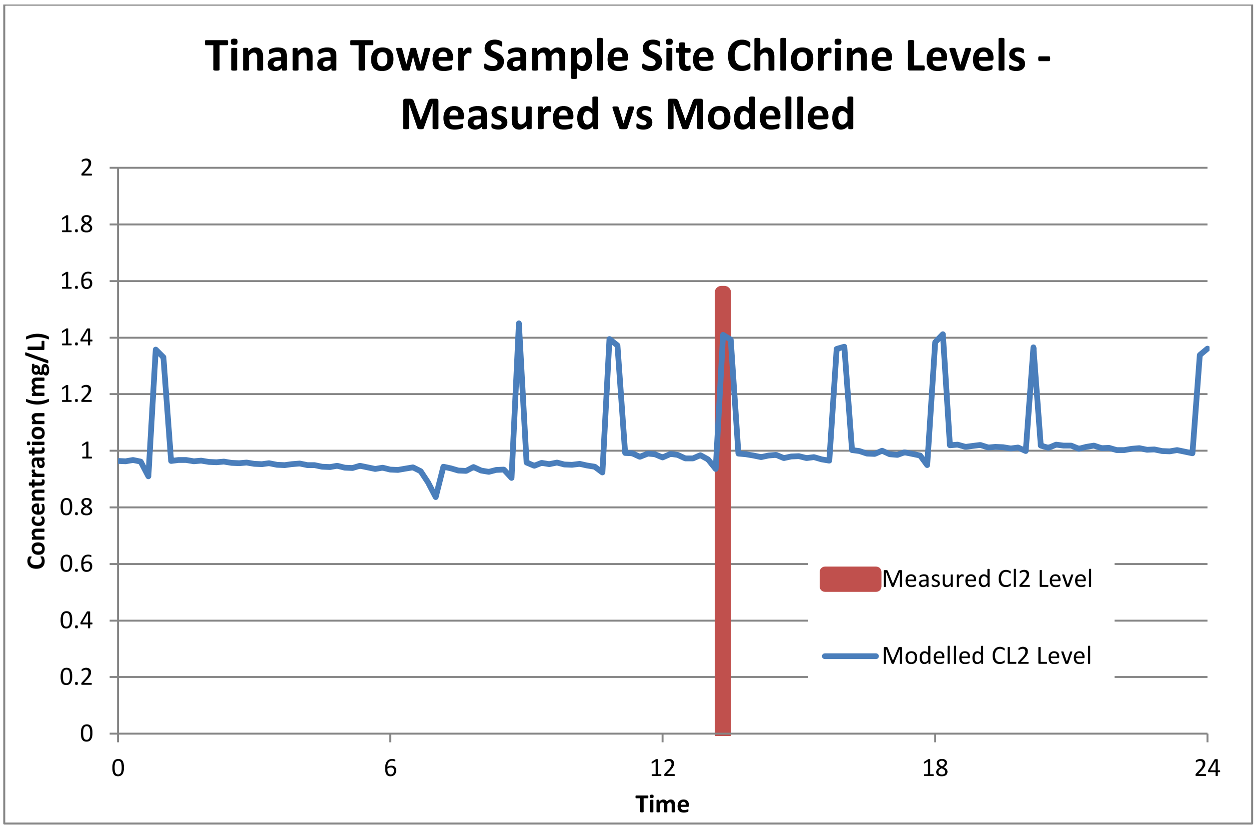

Granville Toilet Block Sample Site Chlorine Levels - Measured vs Modelled
Concentration (mg/L)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
6
12
18
24
Time
Measured Cl2 Level
Modelled CL2 Level

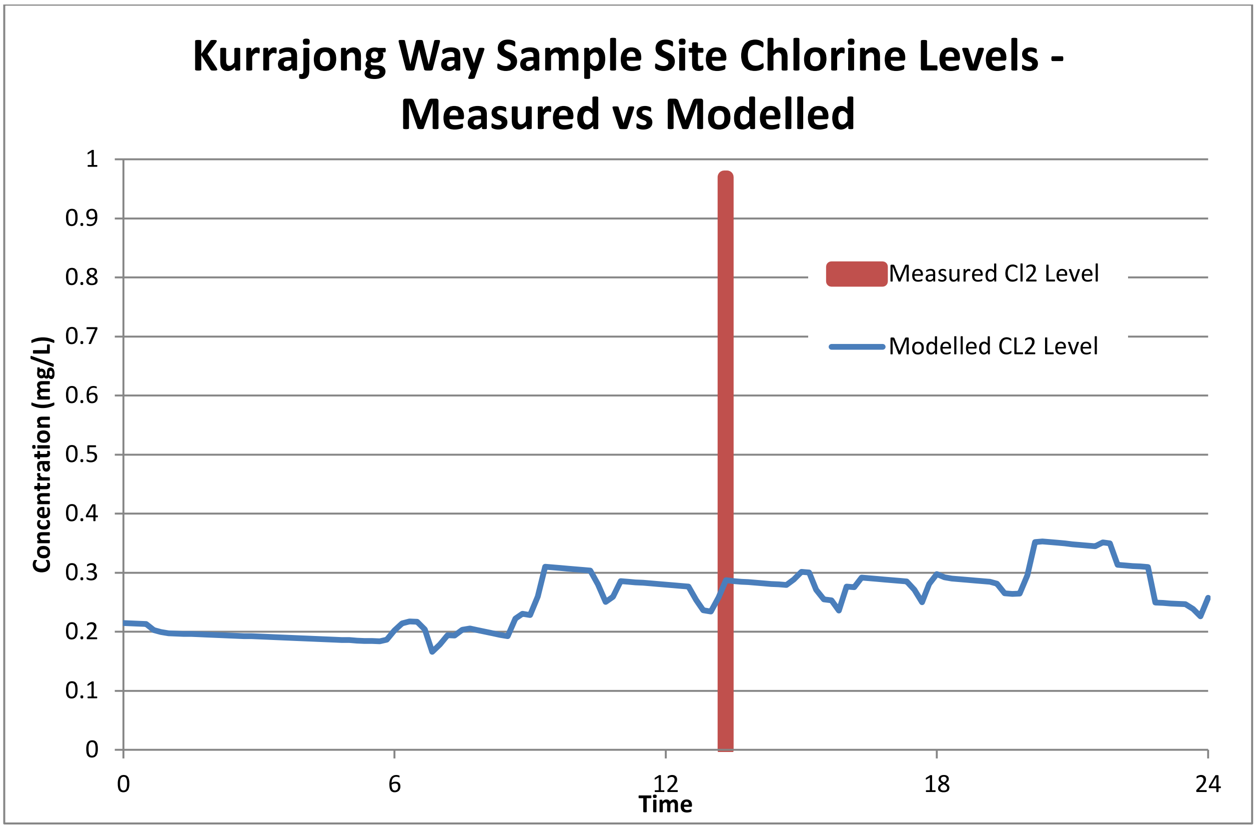

Granville Tank Sample Site Chlorine Levels - Measured vs Modelled
Concentration (mg/L)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
6
12
18
24
Time
Measured Cl2 Level
Modelled CL2 Level

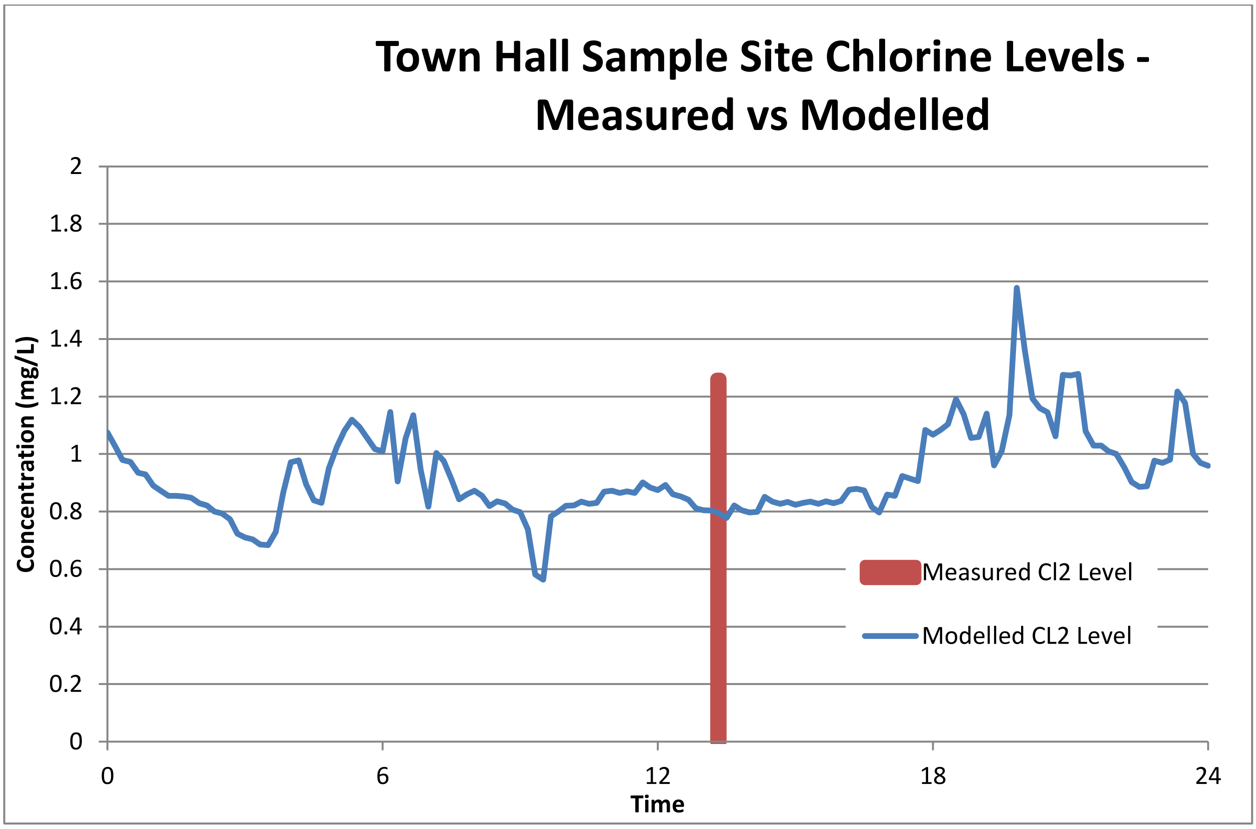

Low Zone Tower Sample Site Chlorine Levels - Measured vs Modelled
Concentration (mg/L)
3
2.5
2
1.5
1
0.5
0
0
6
12
18
24
Time
Measured Cl2 Level
Modelled CL2 Level


Showgrounds Tower Sample Site Chlorine Levels - Measured vs Modelled
Concentration (mg/L)
2.5
2
1.5
1
0.5
0
0
6
12
18
24
Time
Measured Cl2 Level
Modelled CL2 Level


High Zone Tower Sample Site Chlorine Levels - Measured vs Modelled
Concentration (mg/L)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
6
12
18
24
Time
Measured Cl2 Level
Modelled CL2 Level


Tinana Tower Sample Site Chlorine Levels - Measured vs Modelled
Concentration (mg/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
6
12
18
24
Time
Measured Cl2 Level
Modelled CL2 Level


Kurrajong Way Sample Site Chlorine Levels - Measured vs Modelled
Concentration (mg/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
6
12
18
24
Time
Measured Cl2 Level
Modelled CL2 Level


Town Hall Sample Site Chlorine Levels - Measured vs Modelled
Concentration (mg/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
6
12
18
24
Time
Measured Cl2 Level
Modelled CL2 Level

6B - Bulk and Wall Decay Coefficients Determination

Background

There are two decay rate coefficients used in first order Chlorine Modelling. These are;

Bulk coefficient which relates to the decay of chorine as a result of the source water quality

Wall Coefficient which relates to the decay of chlorine as a result of biofilms attached to the inner pipe walls.

Two experiments have been undertaken to determine these coefficients the methodology and finding are presented this report.

Bulk Rate Coefficient Determination

Aim

To determine the bulk coefficient of the water supply systems in Hervey Bay and Maryborough.

Methodology

1. Collect six raw water samples from Burgowan and Teddington. The water should be collected prechlorination.

2. Clearly mark the samples with the location and date.

3. Place known concentrations of 1, 2 and 3 mg/L of chlorine into raw water samples. 2 samples for each concentration.

4. Maintain 3 samples (1, 2, 3mg/L) sample in a water bath at 24 degrees Celsius and the other at 2 degrees Celsius to give an indication of the effect of temperature on the decay rate.

5. Measure the chlorine concentration of each sample at the following times. Consistent time spacing may not be possible so a range of times is acceptable.

   2-24min
   30-48min
   1.5-2 hr
   6hr
   24hr
   36hr
   48hr
   72hr

6. Graph the results

7. Determine the Bulk Coefficient (k_b)

Bulk Decay Results

Table 1 - Bulk Decay Results

Site	Teddington RW (unspiked = 0.09 mg/L)						Burgowan RW (unspiked = 0 mg/L)									
														Teddington Finish	Burgowan Finish	
Temperature	24 degrees			1-2 degrees			24 degrees			1-2 degrees						
Concentration	1mg/L	2mg/L	3mg/l	1mg/L	2mg/L	3mg/l	1mg/L	2mg/L	3mg/l	1mg/L	2mg/L	3mg/l		Ambient		
Bottle No.	1	2	3	4	5	6	1	2	3	4	5	6	Time	Cl2	Cl2	
Test Time	11:32	11:43	11:52	11:36	11:44	11:55	11:37	11:46	11:57	11:40	11:48	11:59	9:02		2.74	3/06/15
0min	0.99	1.71	2.24	0.96	1.54	2.58	0.16	1.23	2.24	0.35	1.20	2.04	10:00	1.9		
Test Time	12:00	12:09	12:15	12:04	12:11	12:17	12:07	12:12		12:08	12:13	12:18	11:15	1.82	2.38	(In Lab)
10min	0.97	1.63	2.74	0.94	1.57	2.62	0.39	1.00		0.37	1.04	1.96	14:15	1.51	1.9	
Test Time	13:13	13:22	13:29	13:16	13:23	13:31	13:18	13:25	13:33	13:20	13:27	13:35	15:15	1.47	2.00	
30min	0.83	1.32	2.70	0.73	1.45	2.60	0.20	0.75	2.00	0.19	0.77	1.82	16:25	1.42	1.97	
Test Time	17:27	17:30	17:31	17:38	17:40	17:42	17:32	17:35	17:37	17:44	17:45	17:46	17:15	1.37	1.98	
6hr	0.49	1.11	2.10	0.58	1.22	2.42	0.01	0.30	1.29	0.04	0.48	1.33	12:16	0.83	1.06	4/06/15
Test Time	12:06	12:08	12:10	12:20	12:21	12:23		12:12	12:14	12:24	12:26	12:28	11:45	0.41	0.52	5/06/15
24hr	0.05	0.47	1.41	0.35	0.95	2.10		0.01	0.35	0.02	0.23	1.00	8:05	<0.01	<0.01	9/06/15
Test Time	11:55	11:57	12:00	12:08	12:10	12:12			12:05		12:13	12:15				
48hr	0.02	0.09	0.93	0.26	0.82	1.82			0.01		0.08	0.92				
Test Time			8:13	8:17	8:19	8:21					8:23	8:25				
9/06/2015			0.12	0.07	0.58	1.56					<0.01	0.50				

A stock Free Chlorine reagent was made by determining the Free Chlorine available from White King bleach solution (34000 mg/L) and diluting this 1in 100 to provide a 340mg/L Stock.
The stock was prepared on the 2/6/15, the vessel wrapped in Alfoil to stop light deterioration and refrigerated overnight. The stock was brought to ambient temperature at 9am in anticipation of sample delivery.
Dilutions were calculated to provide 1, 2 and 3 mg/L spiked additions as per the template.

$$\frac{\text{Conc required x Final Volume (1000mL)}}{\text{Stock Conc}}$$

1 mg/L spike to 1000mL = 2.94 mL stock

All spikes we added at the same time as soon as the sample volumes were corrected to approx 1 Lt after delivery to the lab.

2 mg/L spike to 1000mL = 5.88 mL stock
3 mg/L spike to 1000mL = 8.82 mL stock

Please note that refrigerated sample aliquots for testing needed to be returned to room temperature for analysis.
The DPD reagent works best at ambient and the glass cells do not have light transmission interfered with by condensation from cold samples.
Testing at 0, 10 and 30 mins was conducted by Ryan Catling
Testing for subsequent time frames was conducted by Glynis Stewart
Testing of Free Chlorine over time on the Finish Waters from Burgowan and Teddington was requested by Ryan Catling on the 2/6/15

Discussion

The bulk coefficient is determined from the decay formulae

$$C = C_o e^{-k_b t_d}$$

Where;

C = Concentration of Chlorine (mg/L)

C_o = Initial Concentration of Chlorine (mg/L)

k_b = bulk Coefficient (min^{-1})

t_d = time (min)

rearranging the formulae we get to solve for k_b.

$$k_b = -\frac{ln\left(\frac{C}{C_o}\right)}{t_d}$$

Excel was used to determine the k_b value by applying an exponential line of best fit to the data.

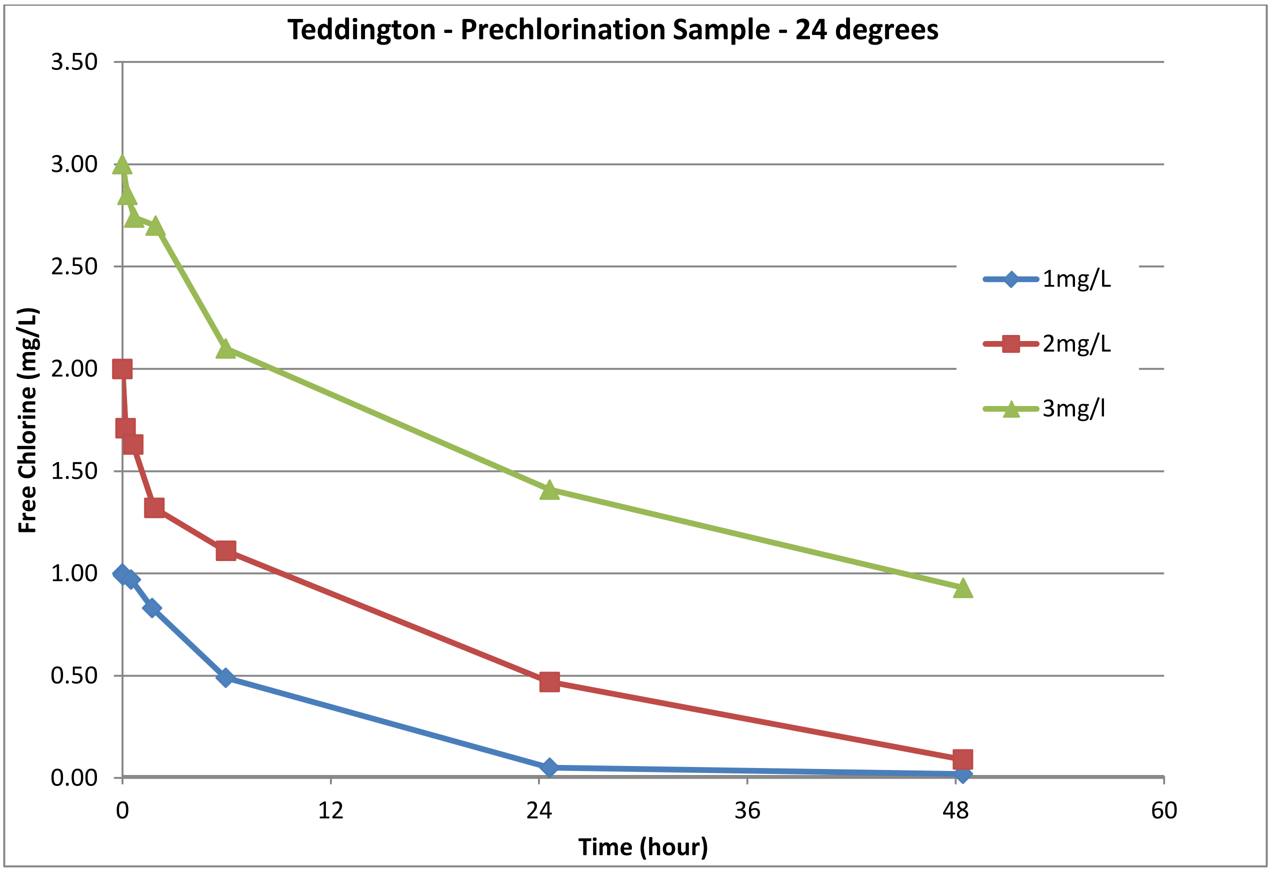


Figure 1 - Teddington Chlorine Decay Results

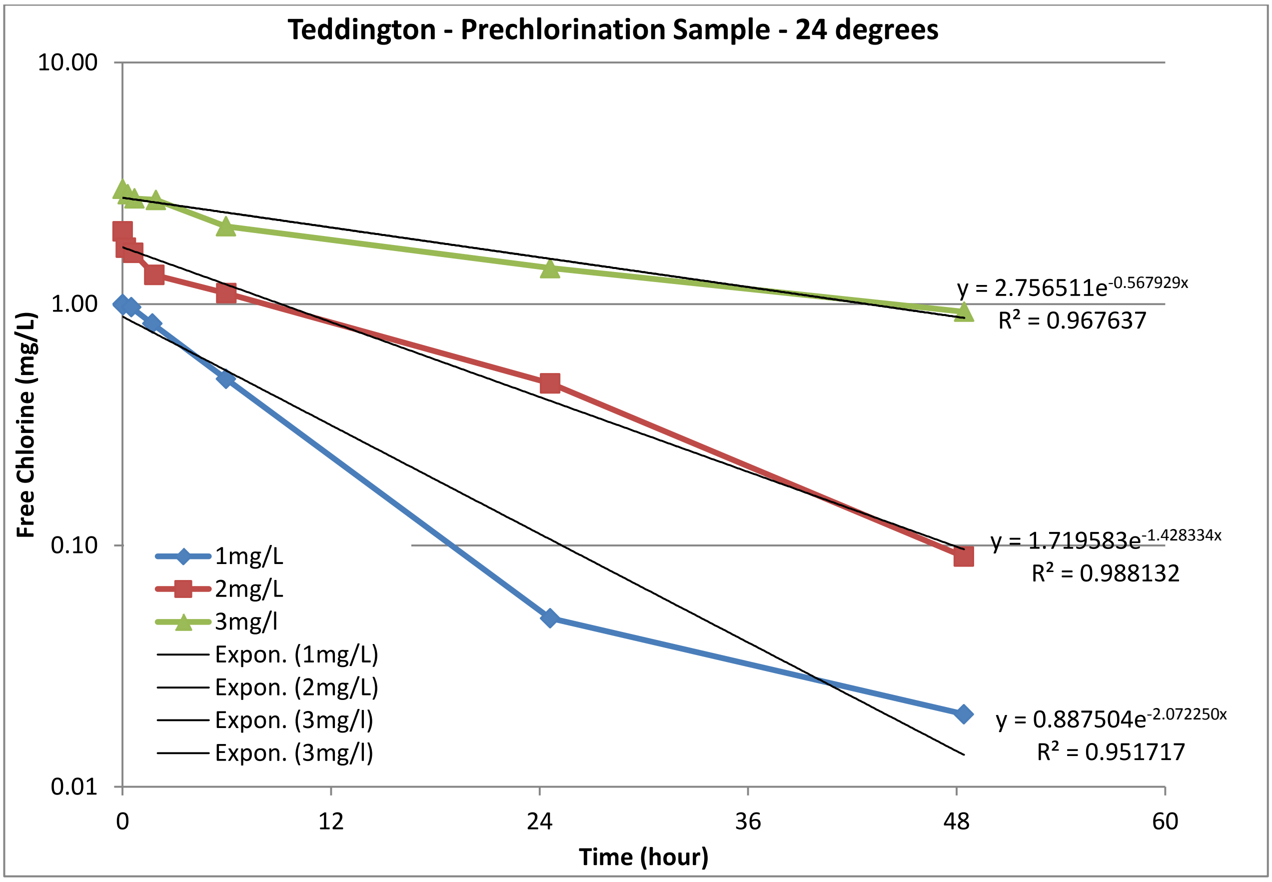


Figure 2 Decay Curve Teddington 24 degree Sample

The results using this method were mixed. Good correlation was obtained from the 2mg/L sample (R^2>0.98). While the 1mg/L and 3mg/L samples showed good correlation only if the last data point in each set was removed.

Table 2 - Results for Teddington Raw Water

Sample	**k_b (day^{-1})**
1mg/L	2.0723
2mg/L	1.4283
3mg/L	0.5679
Post Chlorination Sample	0.869

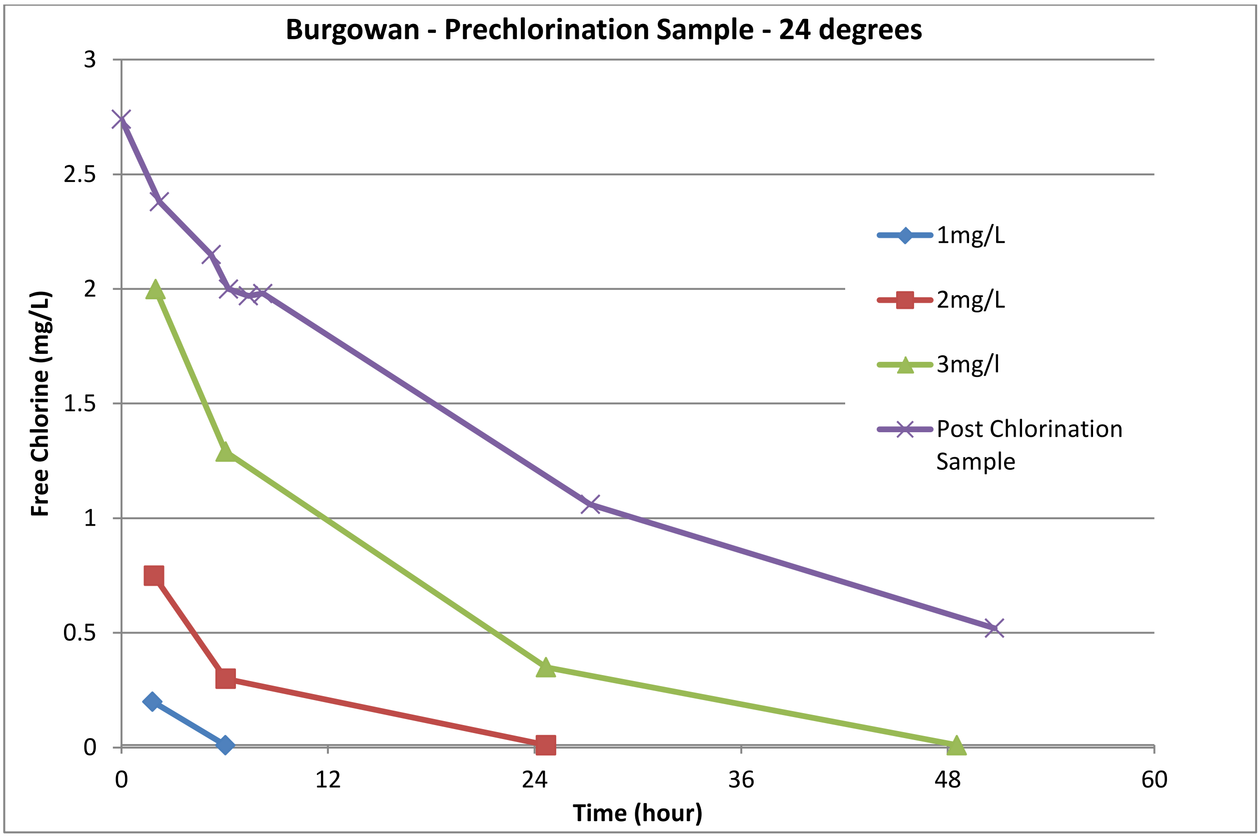


Figure 3 - Burgowan Chlorine Decay Results

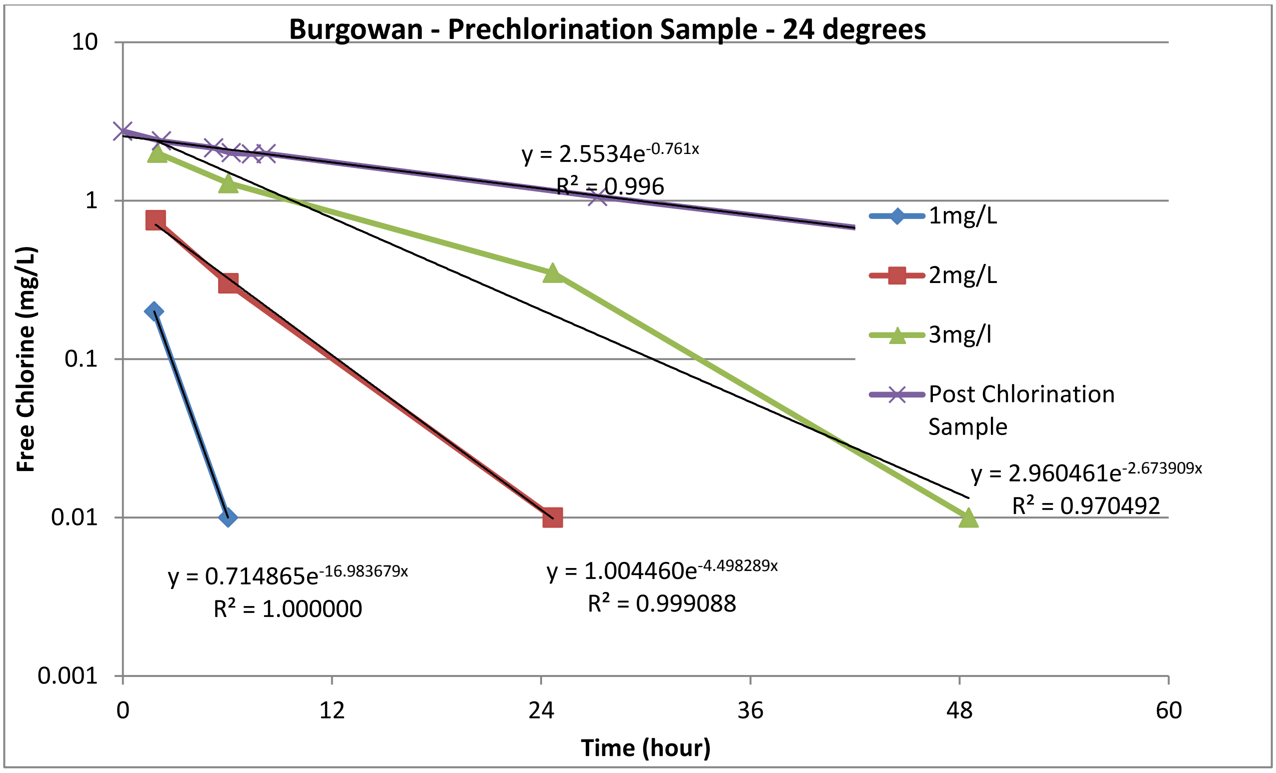


Figure 4 - Decay Curve Burgowan 24 degree sample

This method demonstrated good correlation in all the samples (R^2 >0.97 in all cases).

Table 3 - Results for Burgowan Raw Water

Sample	k_b (day^{-1})
1mg/L	17.445
2mg/L	4.7972
3mg/L	2.6128
Post Chlorination Sample	0.808

The pre-chlorination samples yielded similar results for Teddington and Burgowan at 0.864/day and 0.808/day respectively. These are significantly lower than the other results which are influenced by the higher occurrence of organic material to react with.

Since, typically the water in the first few hours of contact with chlorine remains in the water treatment plant and is generally stored in clear water reservoirs to achieve minimum chlorine contact times, it is deemed more realistic that the decay constant applicable to the later time periods in the curve are more appropriate for use in the chlorine decay modelling.

Table 4- Adopted Bulk Coefficients

Location	k_b (day^{-1})
Teddington	0.869
Burgowan	0.808

Wall Reaction Rate Coefficient Determination

Aim

To determine the wall coefficient of the water supply systems in Hervey Bay and Maryborough.

Methodology

1. Determine locations where measurements will be undertaken. The sites provide a range of pipe sizes and material types, but generally they have been chosen because they are areas located at the extremity of the water supply network.

2. Each site selected must meet the following criteria.

    a. has unidirectional flow. This can be achieved through closing valves where site is not a dead end

    b. has a hydrant at each end for measuring flows and chlorine levels

    c. ideally 300-400m in length (between start and end hydrants)

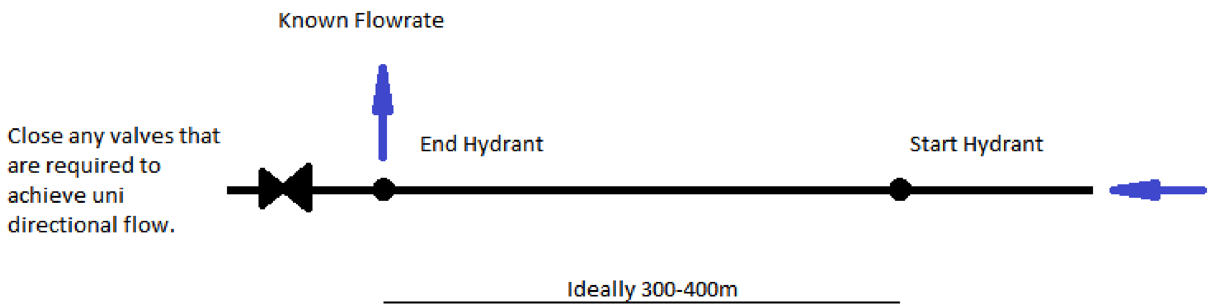


Figure 5 - Test Setup Procedure

3. At a known flowrate determine the time it will take water to travel from the start hydrant to the end hydrant.

4. On site, open the end hydrant to the known flowrate as decided in Step 3.

5. Measure and record the chlorine level at the start hydrant (C_o). Repeat this step 4 times at regular time intervals. Keep note of intervals used.

6. Wait the required detention time as calculated in Step 3 (t_d).

7. Measure and record the chlorine level at the end hydrant. Repeat chlorine measurement 4 times at the intervals used in Step 5.

8. Close the hydrant and reopen any valves that were shut.

9. Determine the wall coefficient from the data collected.

Results

Table 5- Field Locations Summary

Site	Street	Location	Diameter (mm)	Material	Length (m)	Volume (m3)	flow (L/s)	time (t_d) (min)
1	Totness Rd	Denman Camp Rd to Tavistock St	200	AC	301.8	9.5	10	16
2	Emerald Park Way	Jewel Crt to end of main	200	mPVC	273.3	8.6	10	14
3	Limpus St	Drummond St to past Boat Harbour Drv	100	AC	270.1	2.1	4	12
4	Seafarer Drv	Cove Blv 400m up the road (hyd 2781)	100	uPVC	489	3.8	5	12
5	Long St	Corser St to Wattle St	200	CI	325	10.2	15	18
6	Lower Mountain Rd	Citrus Drv to Scrub Hill Rd	250	DICL	220.4	10.8	15	13
7	Oregean Creek Rd	to end of main	100	uPVC	557	4.4	10	12
8	River view Drv	Bulleen Way to Traviston Way	100	AC	262.5	2.1	4	11
9	Queen St	Neptune St to Cheapside St	100	CI	703	5.5	10	13
10	Odessa/Water Point Rd	Ross St to Range St	100	PVC	365.7	2.9	5	12
11	Cheapside St	Alice St to Kent St	300	CI	206	14.6	15	17
12	Koala Cres	to end of main	100	PVC	303	2.4	5	15

Table 6 - Field Results for Wall Coefficients

Notes	Site		Reading 1	Reading 2	Reading 3	Reading 4	Reading 5
	1	m1	2.3	2.4	2.3	2.4	1.9
		m2	2.4	2.3	2.2	2.3	2.2
		time (min)	16				
	2	m1	2.5	2.4	2.5		
		m2	1.96	2.2	2.2	2.5	2.4
		time (min)	14				
	3	m1	1.27	1.91	2	1.88	2
		m2	1.68	2	1.66	1.87	1.73
		time (min)	12				
	4	m1	0.12	0.17	0.08	0.16	0.1
		m2	0.08	0.09	0.08	0.07	0.09
		time (min)	12				
	5	m1	1.44	1.4	1.54	1.35	1.45
		m2	0.78	1.21	1.21	1.23	1.23
		time (min)	18				
Readings were extremely erratic - Closed valve didn't prevent backflow. Need to redo test	6	m1	0.73	1.09	1.16	1.21	1.32
		m2	0.4	0.46	0.53	0.68	0.99
		time (min)	13				
The apparent linear progression from these readings could possibly be explained by water nearer to the end of the main being older and hence less chlorinated.	7	m1	0.03	0.11	0.15	0.18	0.21
		m2	0.16	0.09	0.17	0.19	0.2
		time (min)	12				
	8	m1	0.42	0.43	0.35	0.35	0.38
		m2	0.3	0.35	0.29	0.35	0.43
		time (min)	11				
	9	m1	0.24	0.19	0.94	1.74	1.13
		m2	2.2	1.16	0.98	1.14	1.36
		time (min)	13				
	10	m1	1.48	1.61	1.55	1.51	1.52
		m2	1.34	1.5	1.49	1.42	1.51
		time (min)	12				
The valve here was extremely hard to close and jammed before it could close completely, hence no reliable test results have been obtained here	11	m1					
		m2					
		time (min)	17				
	12	m1	1.56	1.84	1.93	2	1.97
		m2	1.79	1.87	1.91	2	1.94
		time (min)	16				
	13		2.1	1.75	2	2	2
			1.23	1.81	2	1.95	1.99
		time (min)	15				

Discussion

Some of the difficulties arising from the methodology were;

- the uncertainty of whether the flow rates in the pipelines were accurate or not. Due to leaking valves, customer take off points etc. The flow measurement device was also only accurate to +/- 0.5L/s.
- the accuracy of the sampling. At times the samples yielded different concentrations, possibly due to the water sample, testing technique, human or machine error or fluctuations in chlorine levels.

These are potential reasons that led to readings obtained in the field that were not consistent. To overcome this issue an adopted m1 and m2 figure was used which removed any outliers and spurious data.

Using these adopted m1 and m2 figures allowed the calculation of the wall decay coefficient using the formula below.

The wall coefficient is determine from the decay formulae

$$C = C_o e^{-R_w t_d}$$

Where;

C = Concentration of Chlorine (mg/L)

C_o = Initial Concentration of Chlorine (mg/L)

R_w = Rate of Reaction (day^{-1})

t_d = time (day)

$$R_w = -\frac{ln\left(\frac{C}{C_o}\right)}{t_d}$$

And

$$R_w = \left({}^{A}/_{V}\right) k_w C^n$$

A = Surface Area (m2)

V = unit volume (m3)

k_w = Wall Coefficient (day^{-1})

C = concentration (mg/L)

n = wall reaction order

rearranging the formulae we get to solve for k_w.

$$k_w = \frac{R_w\left({}^{V}\!/_{A}\right)}{C^n}$$

The results are tabulated below.

Table 7- Adopted m1 and m2 Figures and Calculated k_w Figures

Site	Street	Location	Diameter (mm)	Material	time (t_d) (day)	Adopted m1 (mg/L)	Adopted m2 (mg/L)	Calculated k_w (m/day)
1	Totness Rd	Denman Camp Rd to Tavistock St	200	AC	0.0111	2.35	2.25	0.4501
2	Emerald Park Way	Jewel Crt to end of main	200	mPVC	0.0097	2.467	2.252	0.3683
3	Limpus St	Drummond St to past Boat Harbour Drv	100	AC	0.0083	1.9475	1.788	0.1596
4	Seafarer Drv	Cove Blv 400m up the road (hyd 2781)	100	uPVC	0.0083	0.126	0.082	0.0447
5	Long St	Corser St to Wattle St	200	CI	0.0125	1.436	1.22	0.2886
6	Lower Mountain Rd	Citrus Drv to Scrub Hill Rd	250	DICL	0.0090	1.102	0.612	1.1632
7	Oregean Creek Rd	to end of main	100	uPVC	0.0083	0.1625	0.162	0.0000
8	Riverview Drv	Bulleen Way to Traviston Way	100	AC	0.0076	0.386	0.344	0.0459
9	Queen St	Neptune St to Cheapside St	100	CI	0.0090	1.27	1.16	0.1016
10	Odessa/Water Point Rd	Ross St to Range St	100	PVC	0.0083	1.534	1.452	0.0820
11	Cheapside St	Alice St to Kent St	300	CI				No result
12	Koala Cres	to end of main	100	PVC	0.0111	1.935	1.902	0.0248
13	North St	Cheapside to Pallas	300	CICL	0.0104	2.025	1.9375	0.2100

The calculated k_w factor varied significantly with the location, age, size and material of pipe chosen.

The graphical representation shows that the majority of the k_w values are between 0 and 0.0105 with a some higher readings at the extremities of the reticulation system.

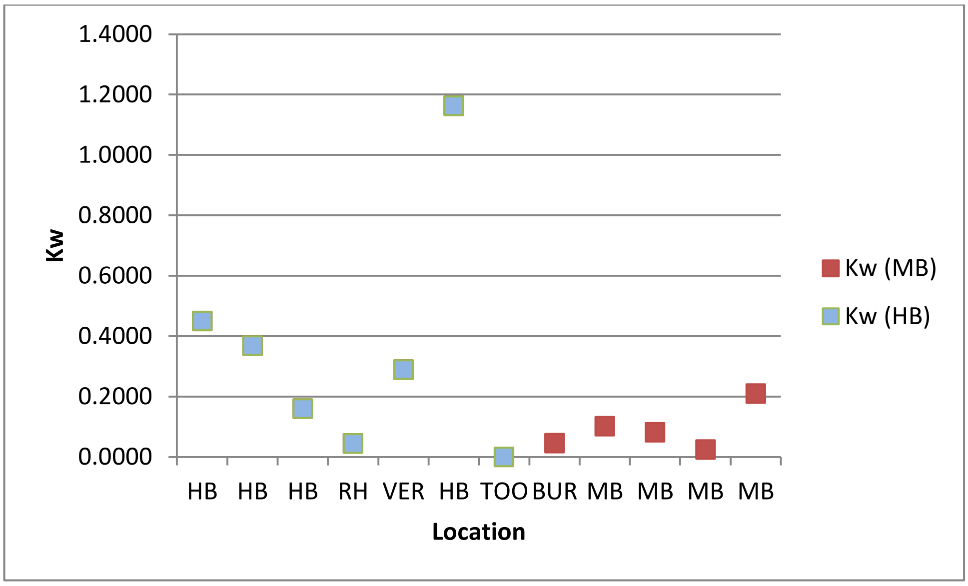


Figure 6 - Graphical Representation of k_w Figures Obtained

A summary of the results are shown below

Table 8 - Adopted k_w Figures

Location	**K_w (m/day)**
Hervey Bay	0.1596 – 0.4501
Lower Mountain Rd	1.1632
River Heads	0.0447
Toogoom	0.0001
Point Vernon	0.2886
Maryborough	0.0248 - 0.1016
Tinana	0.21

Conclusions

There are many variables that can affect the k value including age, size, material and roughness which all affect the decay rate. Since it is not possible to correlate kw with these factors due to a limited sample size, it is prudent to adopt a location based method for applying k_w coefficients.

The k_w figures in Table are to be adopted for those areas indicated.

Attachment A - Site Locations

Site	Street	Location	diameter (mm)	Material	Length (m)	Vol (m3)	flow (L/s)	time (min)
1	Totness Rd	Denman Camp to Tavistock St 	200	AC	301.8	9.5	10	16
2	Emerald Park Way	Jewel Crt to end of main 	200	mPVC	273.3	8.6	10	14

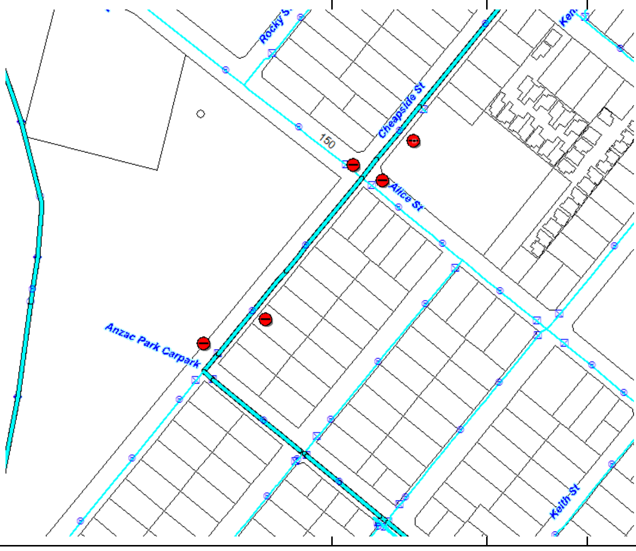
Site	Street	Location	diameter (mm)	Material	Length (m)	Vol (m3)	flow (L/s)	time (min)
3	Limpus St	Drummond St to past Boat Harbour Drv 	100	AC	270.1	2.1	4	9
4	Seafarer Drv	Cove Blv to 400m up the road (hyd 2781) 	100	uPVC	489	3.8	5	13
5	Long St	Corser St to Wattle St 	200	CI	325	10.2	15	11

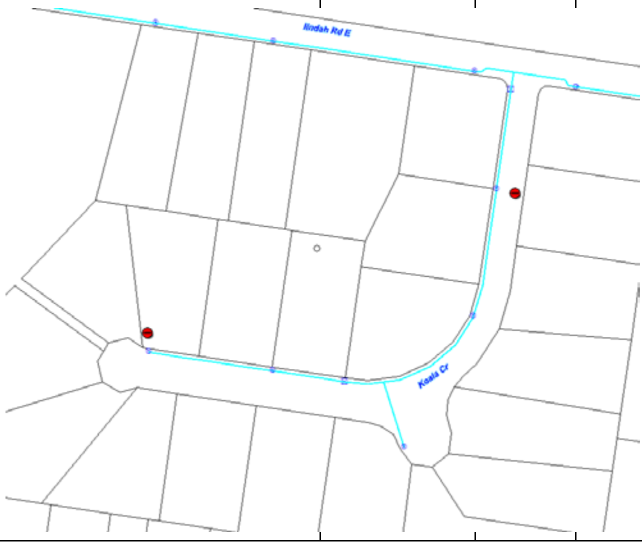
Site	Street	Location	diameter (mm)	Material	Length (m)	Vol (m3)	flow (L/s)	time (min)
6	Lower Mountain Rd	Citrus Drv to Scrub Hill Rd 	250	DICL	220.4	10.8	15	12
7	Oregean Creek Rd	to end of main 	100	uPVC	557	4.4	10	7
8	Riverview Drv	Bulleen Way to Traviston Way 	100	AC	262.5	2.1	4	9

Site	Street	Location	diameter (mm)	Material	Length (m)	Vol (m3)	flow (L/s)	time (min)
9	Queen St	Neptune St to Cheapside St	100	CI	703	5.5	10	9

Site	Street	Location	diameter (mm)	Material	Length (m)	Vol (m3)	flow (L/s)	time (min)
10	Odessa/Water Point Rd	Ross St to Range St	100	PVC	365.7	2.9	5	10

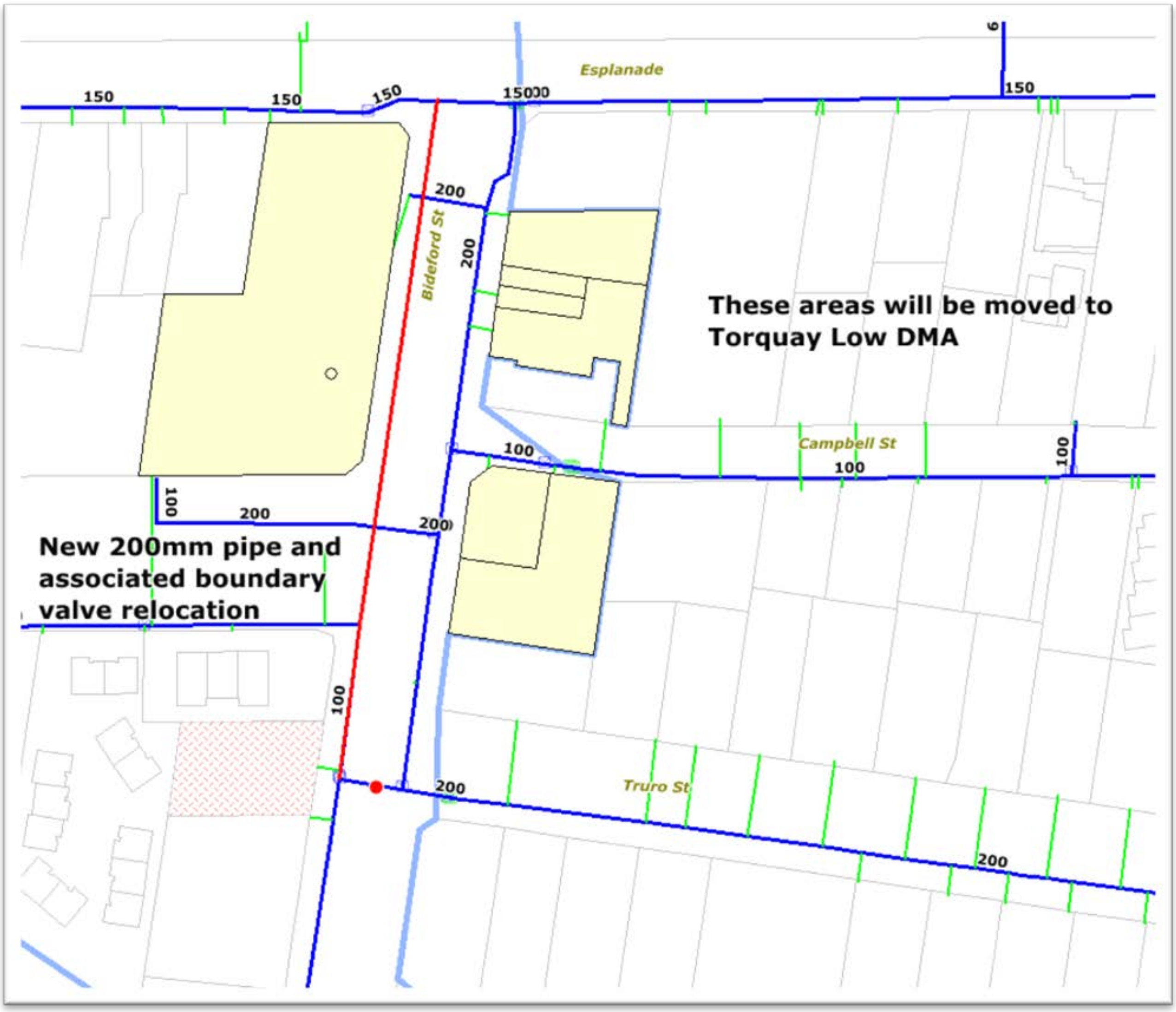
Site	Street	Location	diameter (mm)	Material	Length (m)	Vol (m3)	flow (L/s)	time (min)
11	Cheapside St	Alice St to Kent St	300	CI	206	14.6	15	16



Site	Street	Location	diameter (mm)	Mate rial	Length (m)	Vol (m3)	flow (L/s)	time (min)
12	Koala Cres	To end of main 	100	PVC	303	2.4	5	8

6C – Water Quality Improvement Projects

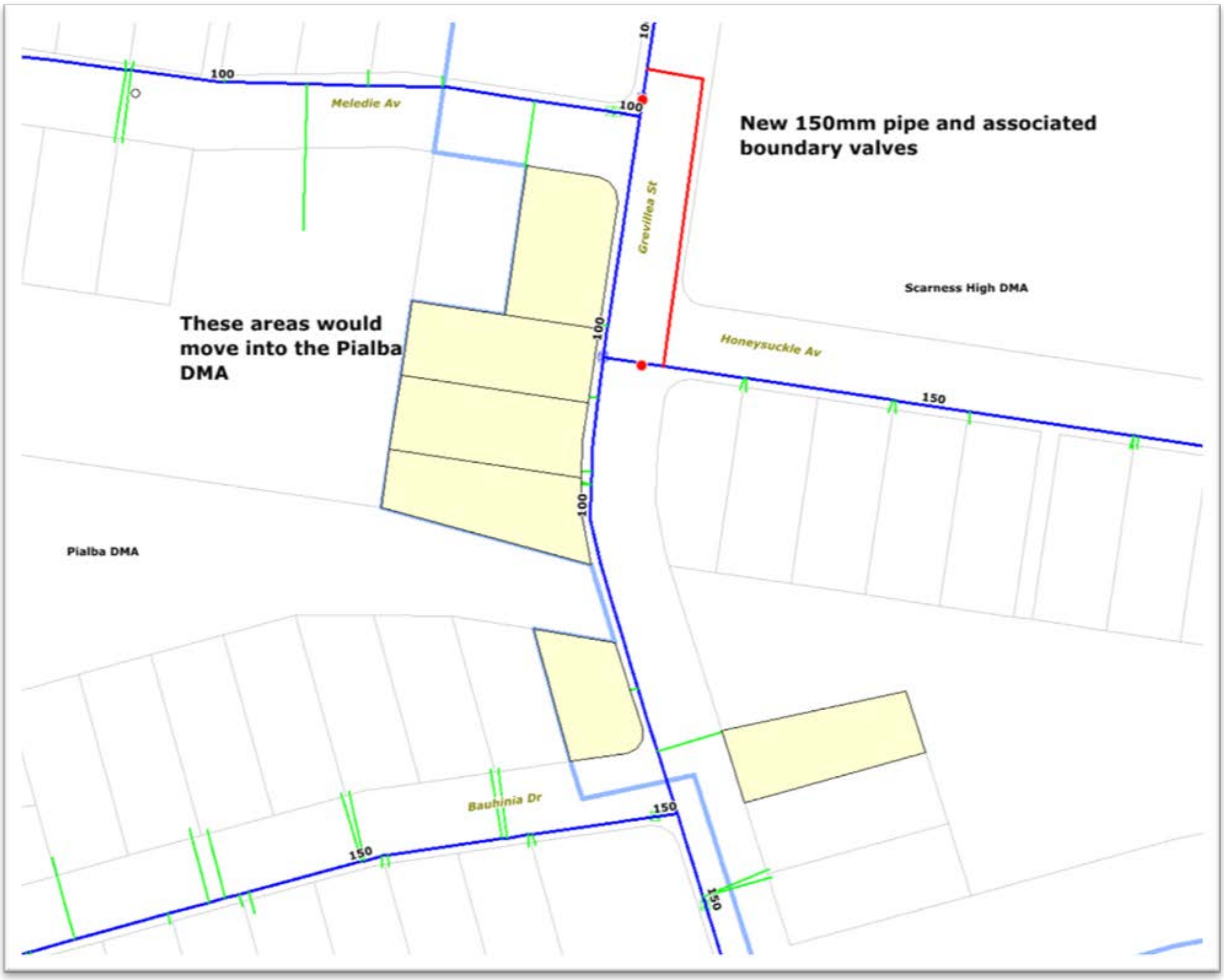
Item HB1 – Bideford St – Truro St to Esplanade



Cost estimate

1 x boundary valves	= $5,000
190m of 200mm water main	= $100,000
Total	**= $105,000**

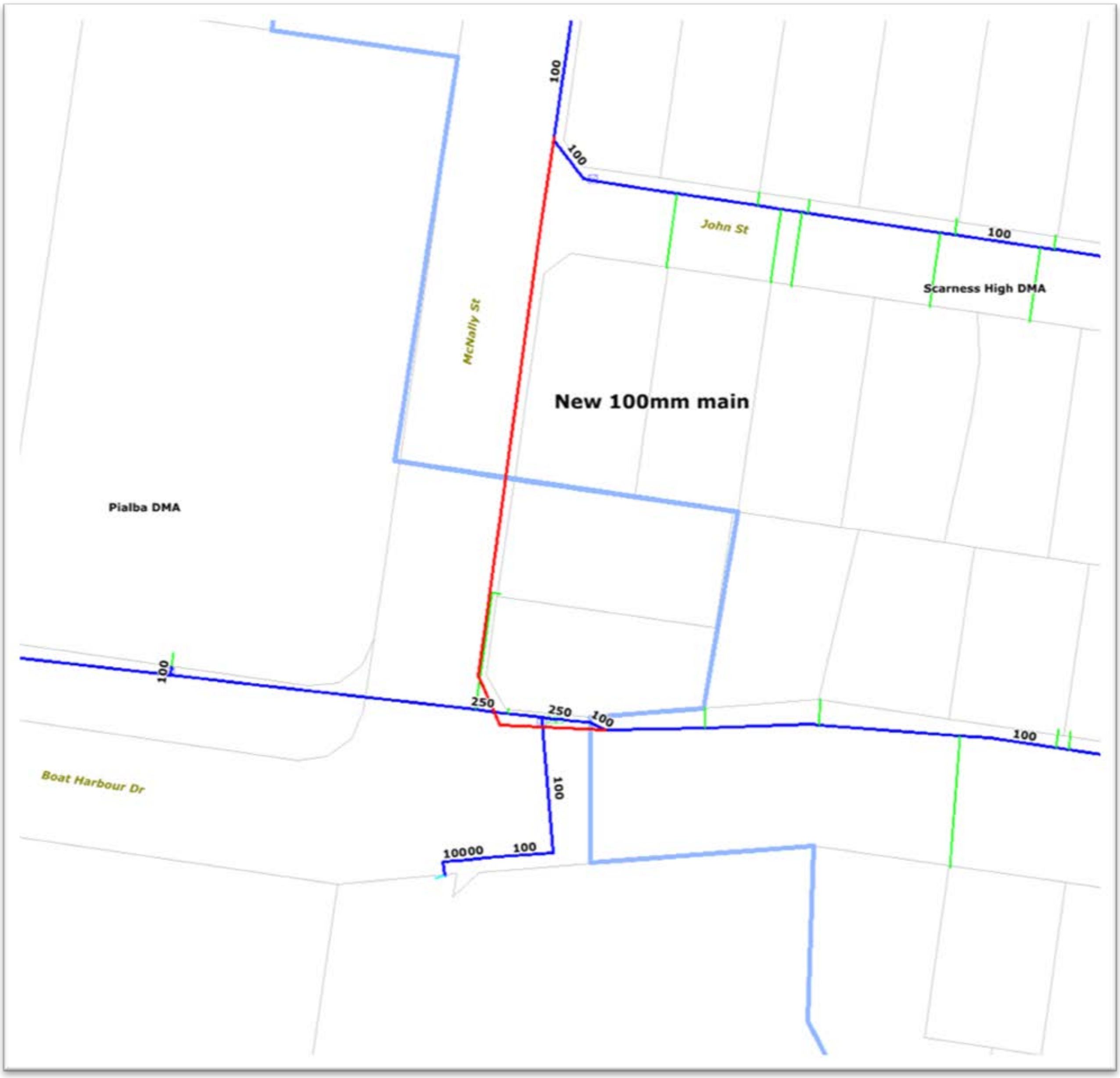
Item HB2 – Grevillea St – Honeysuckle Av to Meledie Av



Cost estimate

2 x boundary valves	= $10,000
100m of 150mm water main	= $40,000
Total	**= $50,000**

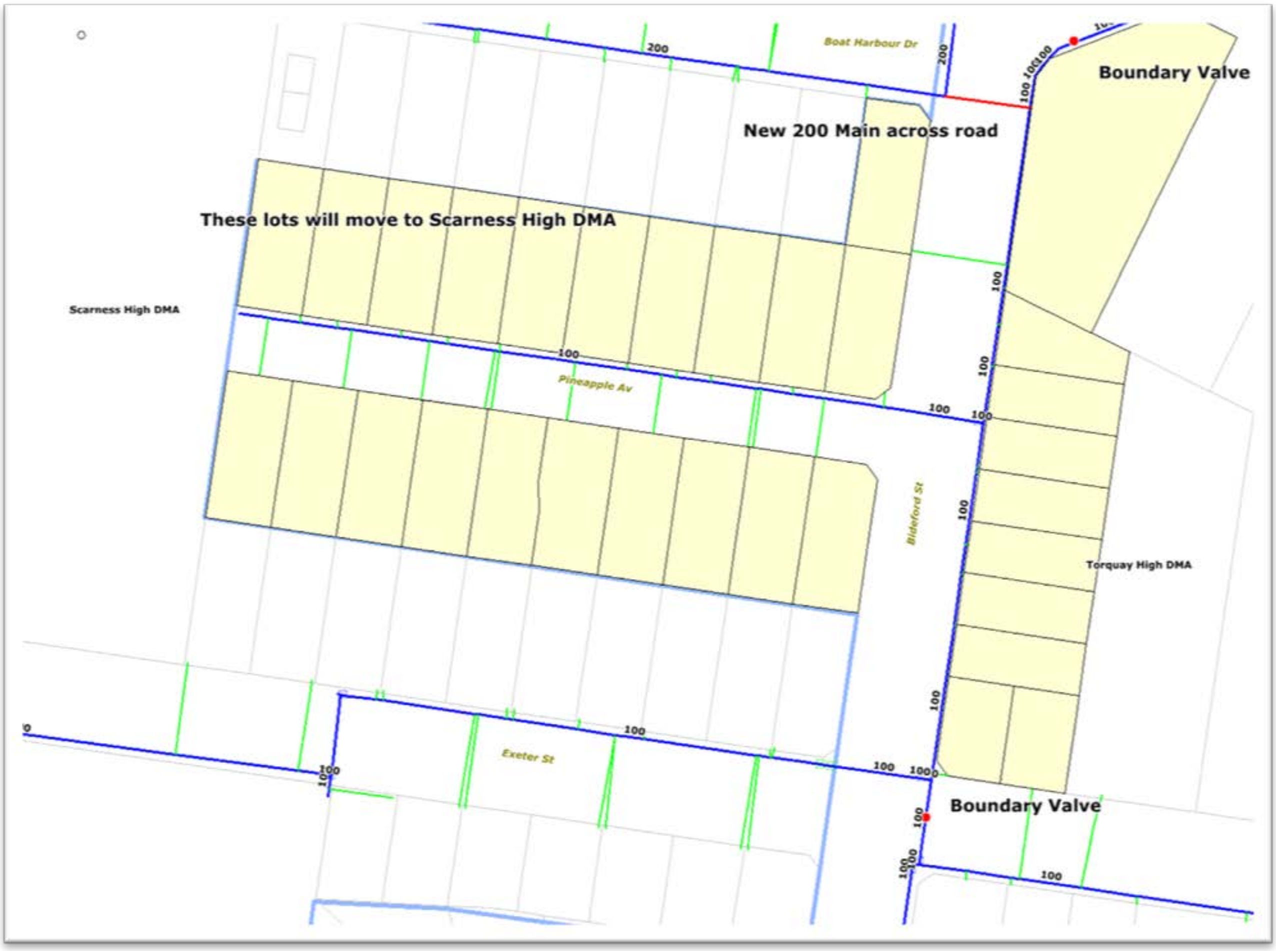
Item HB3 – McNally St – Boat Harbour Drive to John St



Cost estimate

125m of 100mm water main	= $30,000
Total	**= $30,000**

Item HB4 – Bideford and Boat Harbour Drive Interconnection



Cost estimate

2 x boundary valves	= $10,000
200mm interconnector main	= $30,000
Total	**= $40,000**

Item HB5 – Sandpiper St – Curlew Tce to Turnstone Bvd

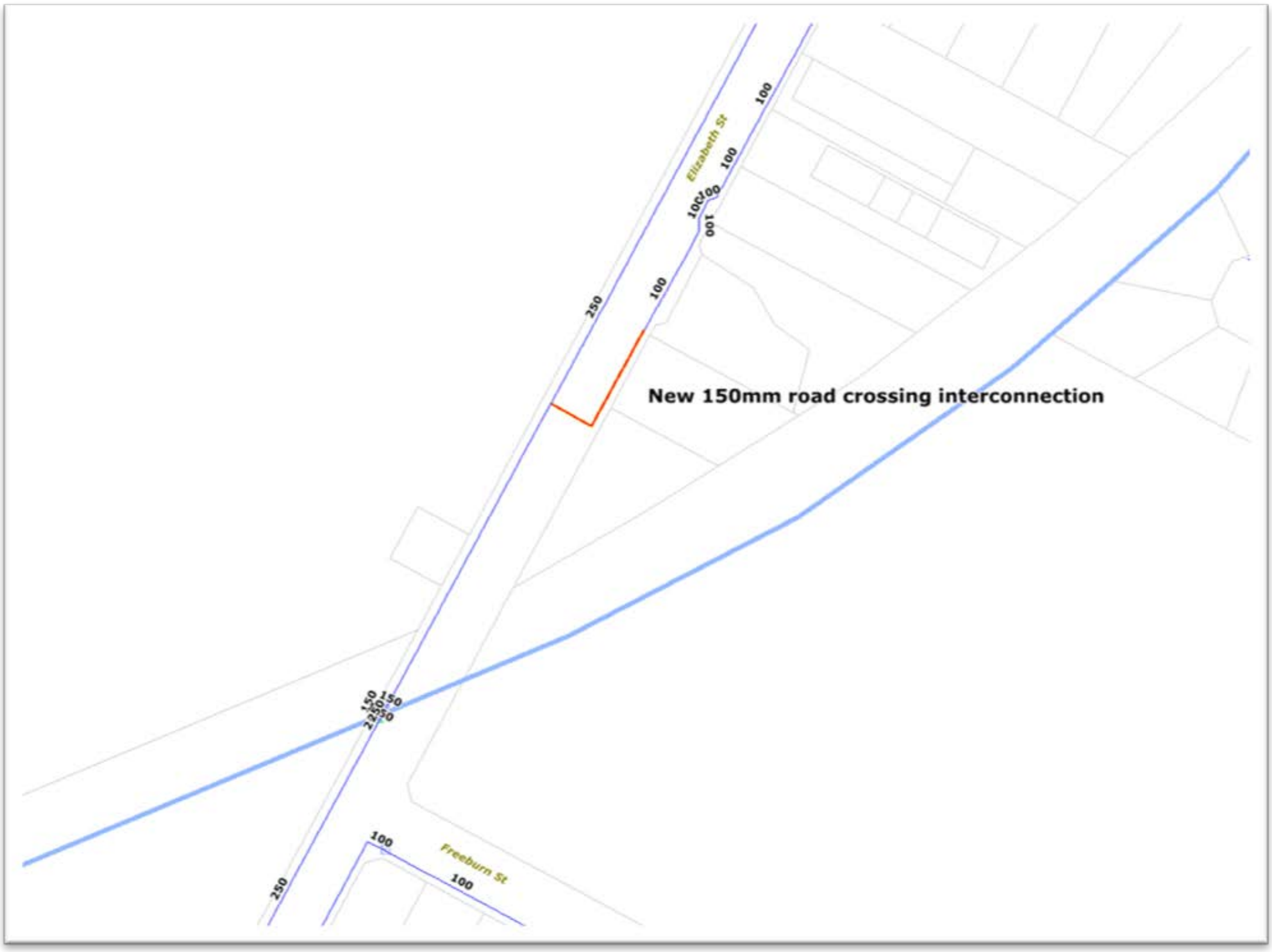
Cost estimate

2 x boundary valves = $10,000

90m 100mm water main = $20,000

Total = $30,000

Item HB6 – Elizabeth Street Interconnection



Cost estimate

150mm water main interconnection = $25,000

Total = $25,000

HB7 – Bergin to Colyon St Interconnection

Cost estimate

100mm water main interconnection	= $15,000
Total	**= $15,000**

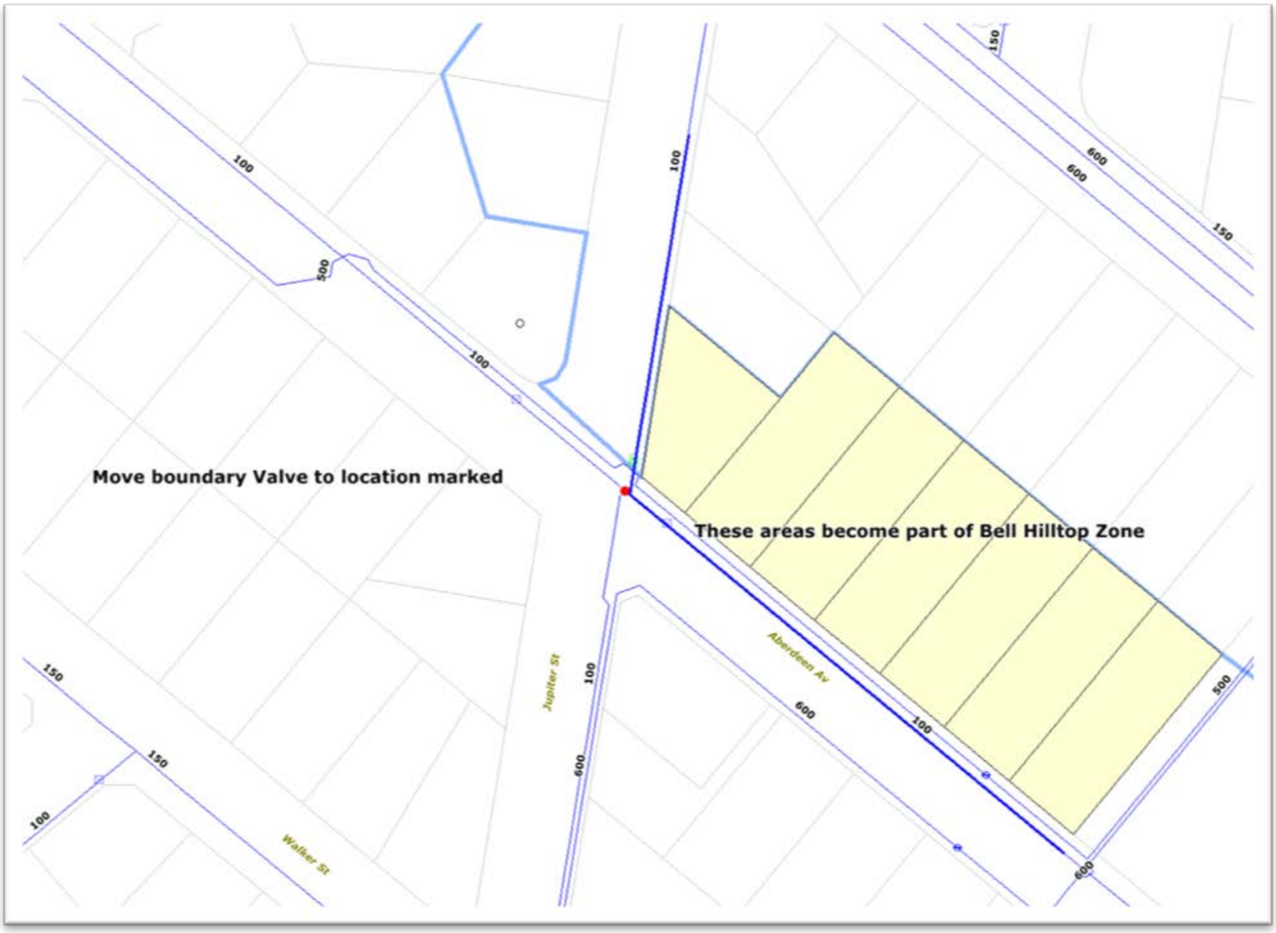
Item HB8 – Booral Rd, Urangan - Beck Rd and Don Adams Dr

Cost estimate

150mm 740m water main interconnection = $154,000

Total = $154,000

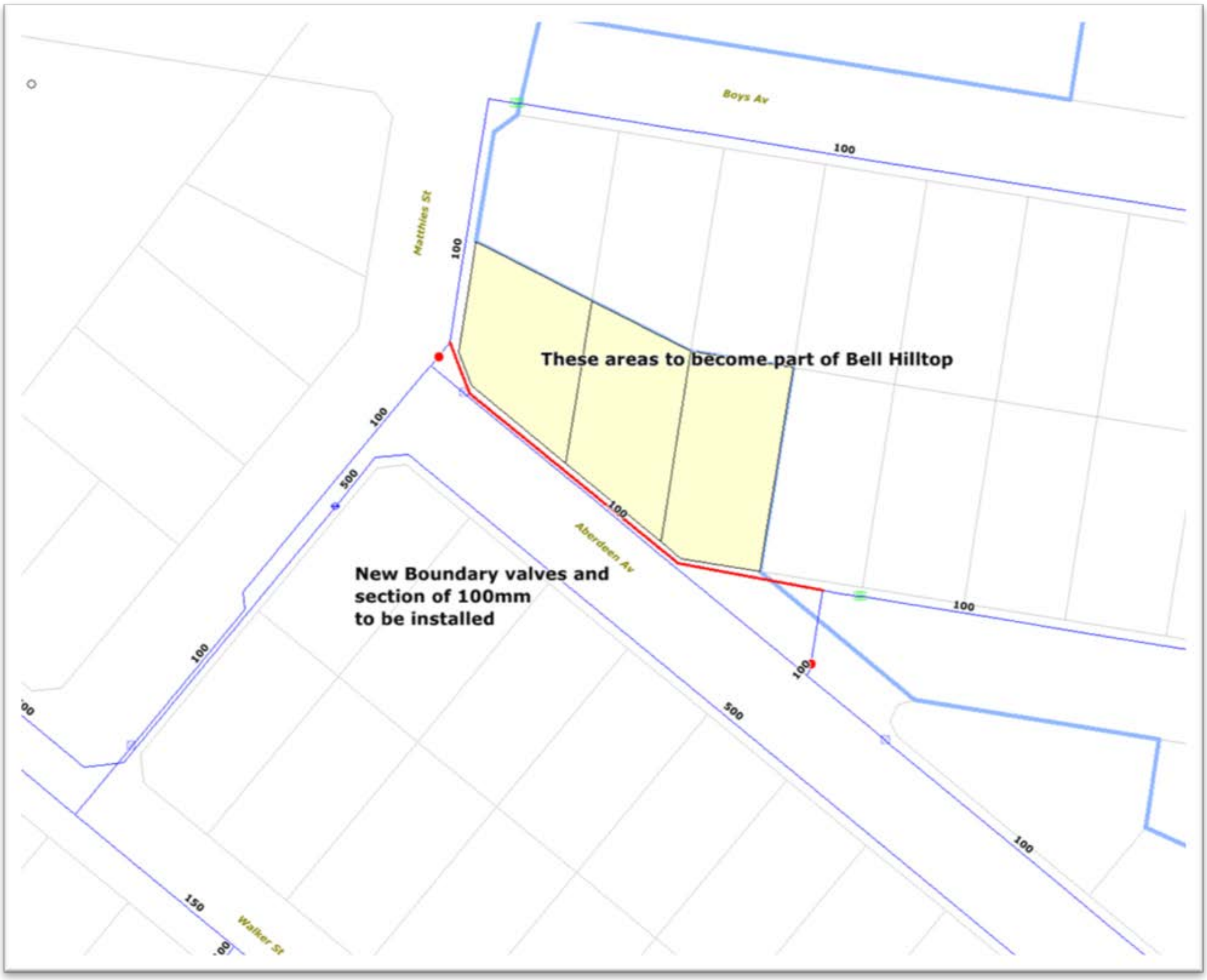
Item MB1 – Jupiter St and Aberdeen Av Boundary Valve Relocation



Cost estimate

1 x boundary valve = $10000

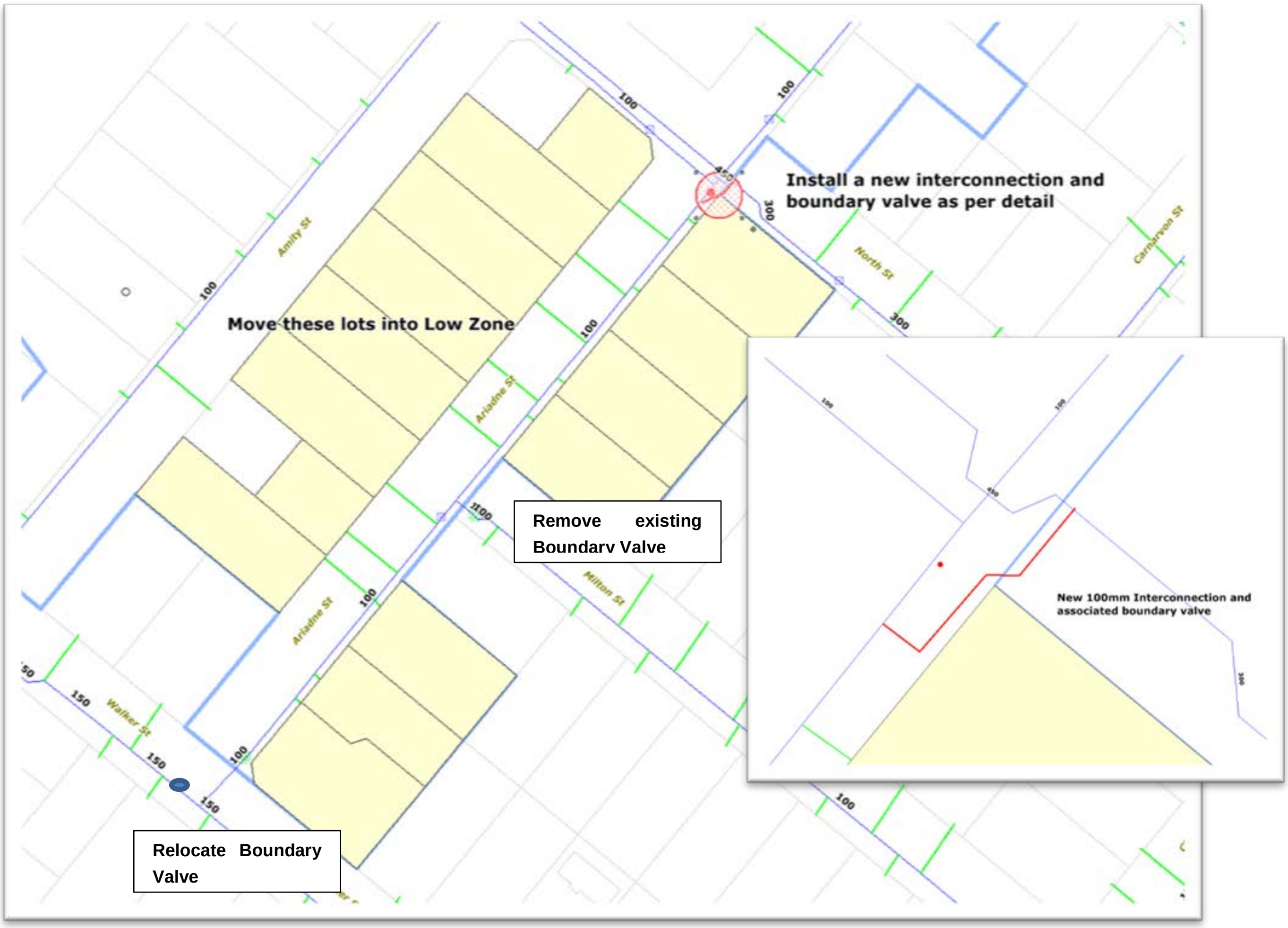
Item MB2 – Aberdeen Av – Matthies St to Connolly St and associated boundary valves



Cost estimate

2 x boundary valves	= $10,000
92m of 100mm water main	= $20,000
Total	**= $30,000**

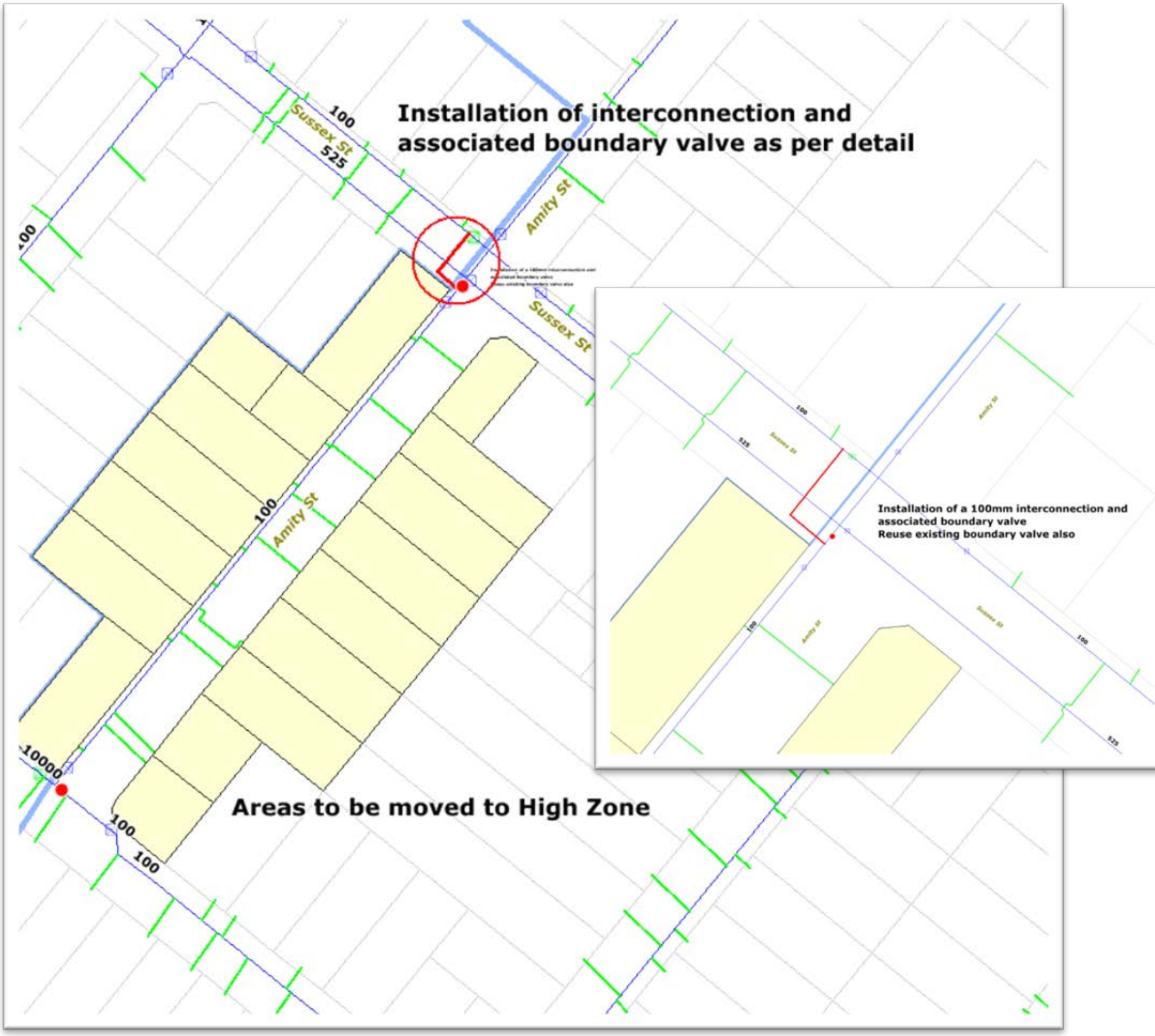
Item MB3 – Interconnection between Ariadne St and North St



Cost estimate

2 x boundary valves	= $10,000
Remove existing Boundary	= $5,000
100mm interconnector main	= $15,000
Total	**= $30,000**

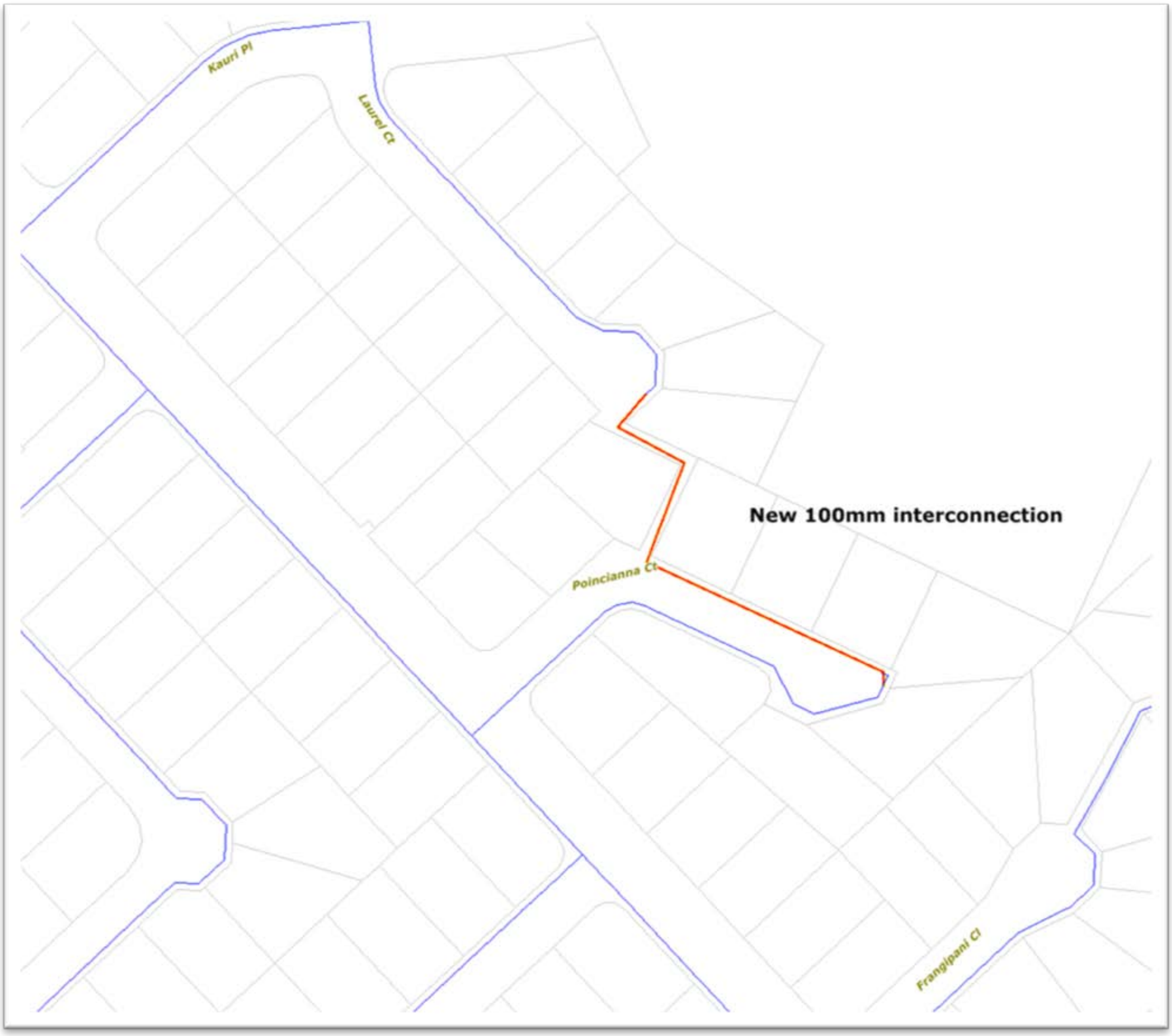
Item MB4 – Sussex St and Amity St Interconnector



Cost estimate

2 x boundary valves	= $10,000
100mm interconnection main and road crossing	= $20,000
Total	**= $30,000**

Item MB5 - Poinciana Ct and Laurel Ct interconnection



Cost estimate

100mm interconnection main	= $24,000
Total	**= $24,000**

Item MB6 – Kent St, MBH - Ferry to inline with Fort St

Cost estimate

100mm interconnection main	= $36,000
Total	**= $36,000**

Item T1 – Gee St to River St

Cost estimate

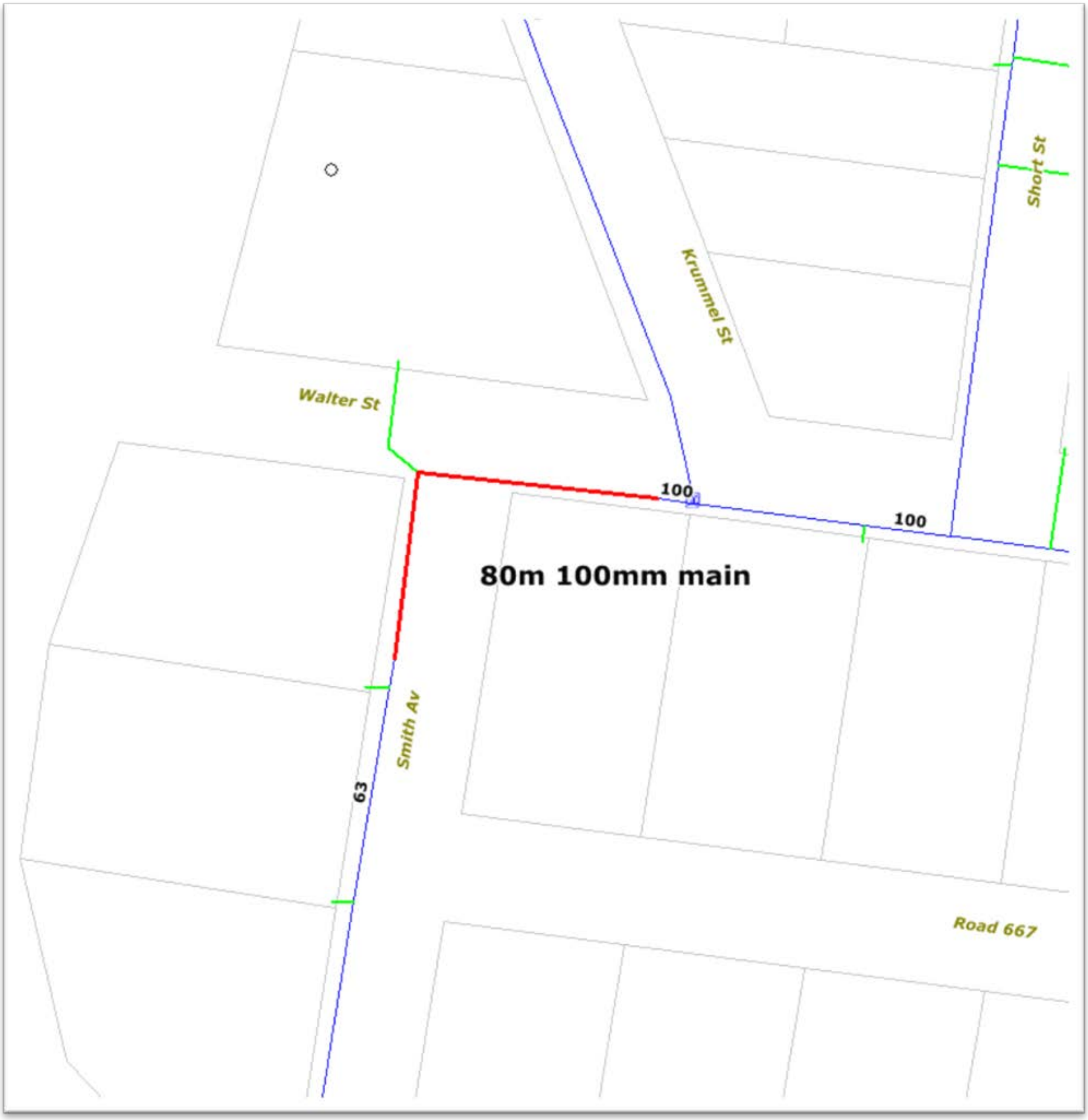
75m of 100mm water main	= $25,000
Total	**= $25,000**

Item T2 – River St to Short St

Cost estimate

75m of 100mm water main	= $25,000
Total	**= $25,000**

Item T3 – Smith Av and Walter St Interconnection



Cost estimate

80m of 100mm water main	= $25,000
Total	**= $25,000**

Item T4 – Burgess St – Tiaro St to Bruce Highway

Cost estimate

310m of 100mm water main = $70,000

Total = $70,000

Boys Avenue Reservoirs

The Boys Avenue reservoirs are the main ground level storages for Maryborough along with the future recommissioning of the Ann St reservoir.

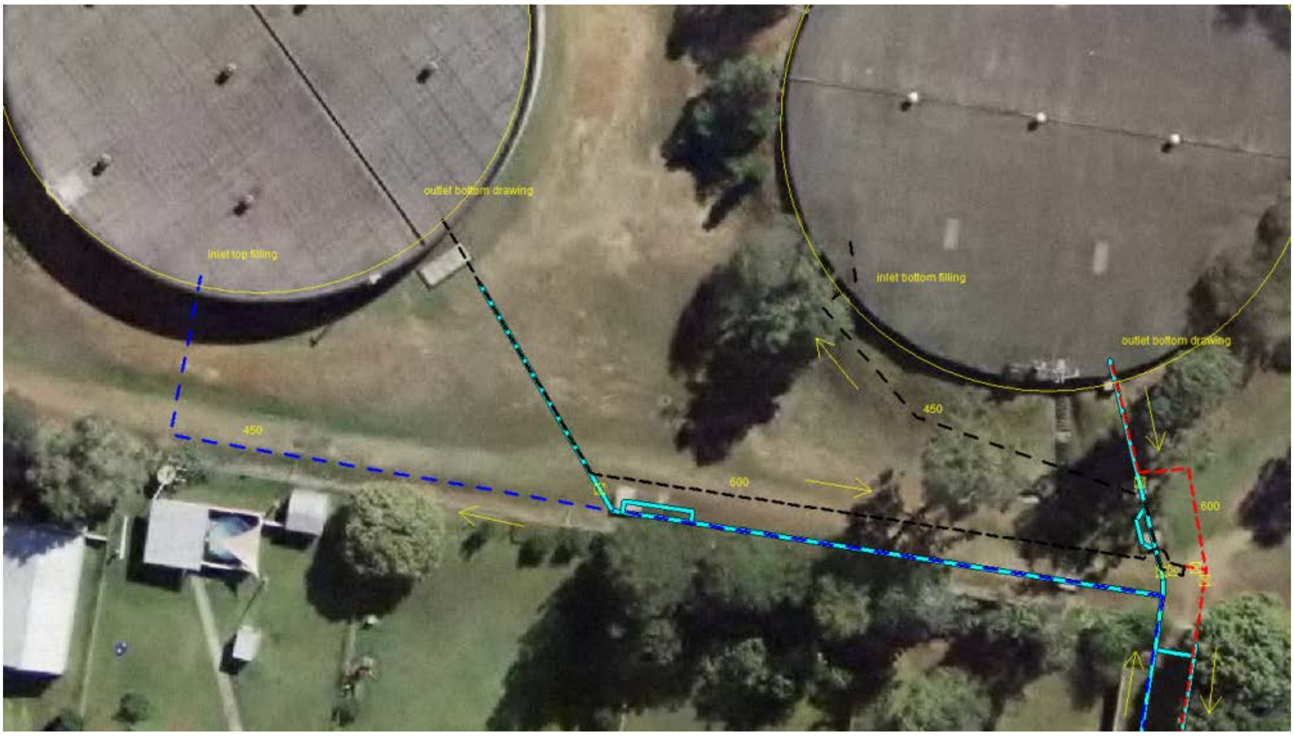


Figure 7 - Boys Ave Pipework Reconfiguration

To effectively use the Boys Avenue reservoirs, some pipeline reconfiguration is required. This reconfiguration maximises the water quality by attempting to create a First in First out (FIFO) system where there are little or no dead areas and the reservoir is changed over regularly. It also allows for the lead reservoir to be used for aeration and removal of any formed THM's. This concept pipe layout is included. Functionally the concept is as shown in the following flowchart.

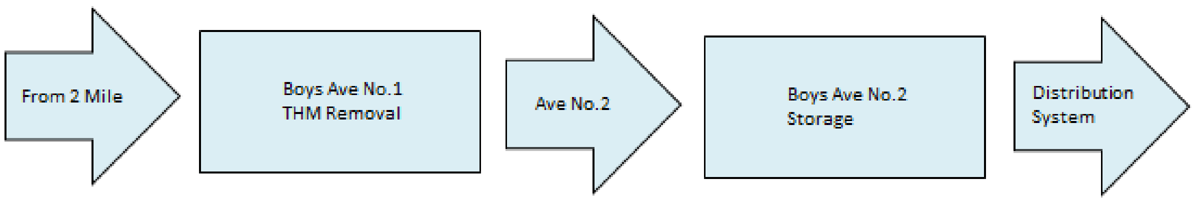


Figure 8 – Boys Ave Concept Flowchart

MB Aberdeen Reconfiguration

The condition of the ground level reservoir at Aberdeen requires costly repair to its roof structure. The total storage available in the Maryborough system allowed the Aberdeen reservoir to be decommissioned without detriment to the overall system security over the 20 year planning horizon. Without this reservoir in service the main control was switched over to the Boys Avenue Reservoirs.

To optimise the operation of the Boys Avenue, some pipework modifications are required to introduce a dedicated feed from 2 Mile to the Boys Avenue reservoirs and a dedicated feed from the Boys Avenue reservoirs to the high and low zone pump stations. The proposed 600mm main (shown in dashed blue line) will allow this to occur.

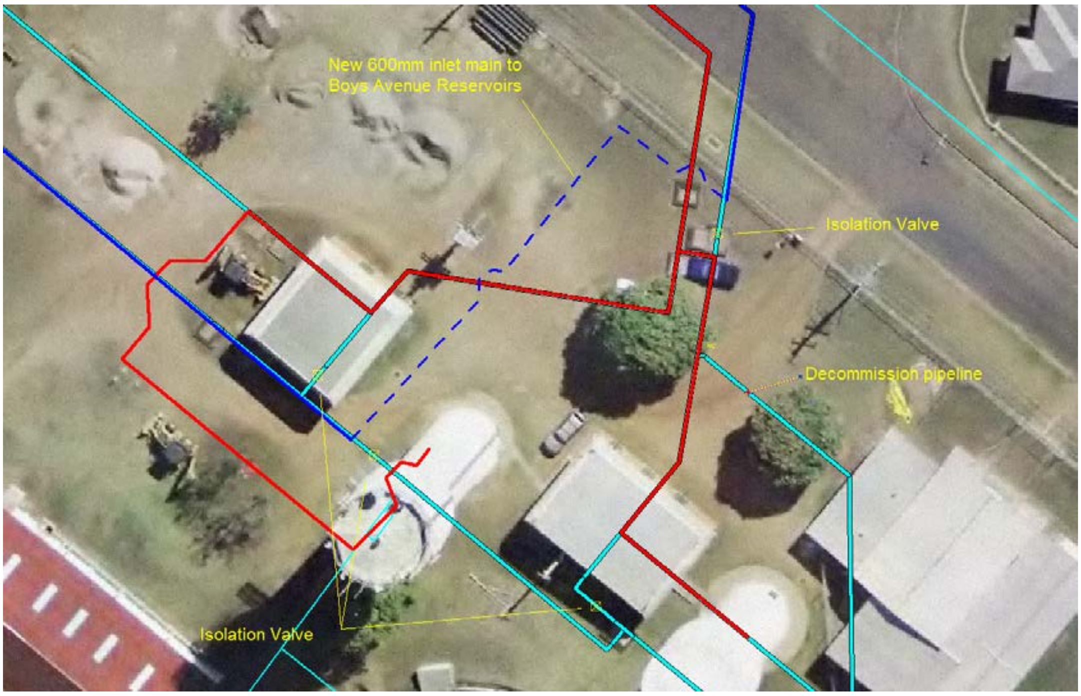


Figure 9 - Aberdeen Reconfiguration of Pipework

APPENDIX 7: UNIT COST RATES

Contained in the tables below is the water main unit rates adopted for calculating the capital costs of the proposed augmentations. The unit rates below are based on an extensive 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 1: Augmentation Unit Rates (Water)

Diameter	Base Cost ($/m)
63	$ 107
100	$ 168
150	$ 212
200	$ 264
225	$ 299
250	$ 329
300	$ 391
375	$ 807
400	N/A
450	$ 957
500	$ 1,163
525	N/A
600	$ 1,342
660	$ 2,211
675	$ 2,233
700	$ 2,272
750	$ 2,349
800	$ 2,651
825	$ 2,692
900	$ 2,816

The rates above are based on sand in an urban area and have had appropriate multiplication factors applied to allow for different soil conditions and different locations i.e. rural, urban, CBD.

Table 2: Cost Multiplication Factors

Level of Development	Soil Type		Pipe Size			
			100mm-300mm	400mm -< 600mm	660mm - < 900mm	960mm -< 2100mm
RURAL	Sand	S	1.05	0.87	0.79	0.81
	Good Soil	GS	0.85	0.81	0.8	0.82
	Poor Soil (High WT areas)	HWT	1.11	1.05	1	1.03
	ASS areas	ASS	1.11	1.05	1	1.03
	Soft Rock	SR	1.08	1.04	0.96	0.99
	Hard Rock	HR	1.31	1.3	1.17	1.24
URBAN	Sand	S	1.26	1.08	0.98	0.98
	Good Soil	GS	1	1	1	1
	Poor Soil (High WT areas)	HWT	1.27	1.24	1.2	1.21
	ASS areas	ASS	1.27	1.24	1.2	1.21
	Soft Rock	SR	1.23	1.23	1.15	1.17
	Hard Rock	HR	1.47	1.49	1.36	1.42
HIGH DENSITY URBAN	Sand	S	2.45	2.04	1.79	1.71
	Good Soil	GS	1.72	1.8	1.8	1.71
	Poor Soil (High WT areas)	HWT	2.03	2.07	2.01	1.94
	ASS areas	ASS	2.03	2.07	2.01	1.94
	Soft Rock	SR	1.99	2.06	1.91	1.86
	Hard Rock	HR	2.24	2.33	2.15	2.14
CBD	Sand	S	2.45	2.04	1.79	1.71
	Good Soil	GS	1.72	1.8	1.8	1.71
	Poor Soil (High WT areas)	HWT	2.03	2.07	2.01	1.94
	ASS areas	ASS	2.03	2.07	2.01	1.94
	Soft Rock	SR	1.99	20.6	1.91	1.86
	Hard Rock	HR	2.24	2.33	2.15	2.14