SINCLAIR KNIGHT MERZ

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Banana Shire Council

Biloela Water Supply Planning Report

- Rev 0
- 2 May 2006

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Executive Summary

Existing Water Supply System

The Biloela water supply system receives bulk water from Callide Dam, from bores in the Callide Valley Aquifer and from CS Energy (supplied to Callide Dam from Awonga Dam under nominated conditions). The maximum allocation from these sources is 2,587ML/yr.

Water is treated at the water treatment plant off Calvale Road which services Callide Town, the Callide Power Station to the east and Biloela and Thangool to the west. Water is delivered to two ground level reservoirs (off State Farm Road) in Biloela via a gravity main.

There are two water supply zones in Biloela - a High Level and a Low Level Zone. Water is pumped from the Ground Level reservoirs to elevated tanks for each zone. Water is pumped to Thangool from Booster pumps off the Burnett Highway which are connected to the Biloela High Level Zone.

There are six production bores which currently supply 26L/s to the water supply system. Water from the bores is blended with treated water at the ground level reservoirs.

Population Projections

The 2001 population of Biloela was 5,485 people. The projected 2031 population, based on a 1.2% annual growth rate, is 7,904. A planning population of 8000 has been adopted for this study.

There are currently 2,340 developed lots in Biloela and 441 ha of undeveloped land allocated to residential, rural residential, industrial or commercial development under the existing Draft IPA Banana Shire Planning Scheme. This is equivalent to an additional 990 lots based on the densities of existing development applications.

The projected water demands for the Biloela Water Supply system are shown in the table below.

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- **Demand Summary**

Category	Existing System Demands		Full Development System Demands	
	(ML/yr)	AD (ML/d)	(ML/yr)	AD (ML/d)
Residential	972	2.66	1285	3.52
Rural Residential	118	0.32	381	1.04
Industrial	25	0.07	52	0.14
Commercial	83	0.23	89	0.24
Agricultural	5	0.01	5	0.01
Parks and Gardens	125	0.34	125	0.34
Individual Consumers	288	0.79	288	0.79
Total Biloela	**1,615**	**4.42**	**2225**	**6.10**
Thangool	70	0.19	92	0.25
Callide Town	15	0.04	15	0.04
TOTAL	**1,700**	**4.66**	**2332**	**6.39**

Analysis of Existing Water Supply System Performance

Modelling indicated that there are several areas in Biloela where Max Hour (MH) residual pressures are less than Council's Standards of Service target of 22m head. These are;

- The end of Lawrence St and Kothmann Ct where pressures are about 17.5 m
- Along Ebony Way and the cul-de-sacs off of it where the residual pressures are about 18 m
- An area at the corner of Tiamby St and State Farm Road where pressures are about 21.7m.

Modelling also indicated that MH residual pressures in the HLZ are very sensitive to the level of the Earlsfield St Elevated Tank.

The MH pressures in Thangool and Callide Town all met the service target of 22m.

A fire flow analysis was undertaken using 15L/s (residential) and 30L/s (Commercial) demands at both MH and 2/3 MH.

The model indicated that there are areas in Biloela with limited fire fighting capacity. Dead end mains are a problem with Diane Ct and Ebony Way being particularly weak locations.

There is limited fire fighting capacity in Thangool (at the airport and at the end of the town supply main) and at Callide Town. The head loss through the supply main to Callide Town is the major reason for the deficiencies.

Even when 2/3 MH is adopted (as the design fire fighting condition) there are deficiencies in the water supply systems. These deficiencies are largely due to the head losses in the (numerous) 100mm dia mains.

The ability of the Fire Brigade to fight fires is affected by the availability of water which varies during the day. The above analyses are for high demand conditions and the systems will have better performance at other times of the day.

Council should discuss the fire fighting capabilities with the local Fire Brigade (and possibly undertake trials) to determine if additional upgrade works are required (in the short term) to improve the fire fighting capabilities.

Analysis of Full Development System Performance

In order to provide sufficient water to the town to meet the increase in demand and to meet Council's standard of service pressures, it is proposed to augment the system as follows:

- Upgrade the WTP to Stage 1A capacity of 160L/s.
- Construct a booster pump on the existing 300mm diameter water main feeding Biloela. The booster pump would be located on Calvale Road downstream of the Callide off-take and would include a 300mm dia bypass with a non-return valve to allow non-peak demands to be supplied without pumping.
- Upgrade the LLZ booster pumps from 20kw to 30kw.
- Construct 1.2 km of 200mm diameter main from the LLZ elevated tank, down Melton St and along Kroombit St to Barrett Street.
- Construct 500 m of 150mm diameter water main to connect the Hills Avenue water main to Joe Kooyman Drive.

When the above augmentations are included in the model, all future development areas except the high level areas near the Earlsfield Street Reservoir meet the 22m standard of service pressure during MH on MD. Pressures in this area range from 18.8m to 21.6m. Pressures are above 22m at MH when the AD scenario is run in the model. Given that they are in an isolated elevated area the slightly lower pressures obtained on peak days are considered acceptable.

In order to provide sufficient pressures to the new development near Earlsfield Street Tank a 300 mm diameter trunk main is needed from the reservoir to the connection at the end of Valley

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View Drive. As this main is required for all new development in the area its construction could be funded by "headworks charges".

The Washpool Gully area has an off-take directly from the 300mm dia treated water main. As a result there are excessive pressures in the system (when the WTP reservoir is not being filled and the booster pump is off). To prevent excessive pressures during low demand periods a PRV has been included in the model set at a pressure of 30m. This PRV should be provided by the Washpool Gully area developer.

Pressures in the system are all below 80m during low flow periods.

Even with the above augmentations there are still several areas which do not meet the Council's fire fighting standard of service of 15L/s (residential) and 30L/s (Commercial) at MH. These areas are:

- Hills Avenue
- Valentine Plains Rd
- The Burnett Highway (near Countryman's Motel)
- Commercial and industrial area near Readon Avenue and Dawson Highway
- End of Oxley St
- Eastern end of Dee St (near the zone valve)
- End of State Farm Rd past the Council Depot
- Earlsfield Res New Development
- Thangool
- Callide Town

Additional augmentations are required to provide the nominated standard of service in these areas.

Augmentation Works and Costs

A summary of the augmentation requirements and their associated costs are included in the table below. The rates include a 30% allowance for contingencies, survey, planning, design, construction supervision and contract administration.

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Augmentation and Cost Summary

Item	Description	Qty	Unit	Rate*	Amount
1.	**Delivery and Water Treatment Plant Infrastructure All New Development**				
	Upgrade WTP to Stage 1A				
	Replace Filter Media	1	item	60000	$60 000
	Inlet inline mixer modification	1	item	7000	$7 000
	Inlet control valve settings	1	item	3000	$3 000
	Flash Mixer weirs	1	item	5000	$5 000
	Clarifier down pipes	1	item	20000	$20 000
	Sub-Total				$95 000
	Construct a 20kW booster pump on Calvale Road with bypass and NRV (duty & standby)	1	item	209000	$209 000
	Total say				**$300 000**
2.	**Delivery Infrastructure - LLZ development**				
	Upgrade LLZ Booster Pumps from 20kW to 30kW	1	item	198000	$198 000
	Construct 200mm dia main from LLZ elevated tank	1200	m	198	$237 600
	Total say				**$440 000**
3.	**Delivery Infrastructure - HLZ development**				
	Construct 300 mm dia main through the new high level zone development	1500	m	304	$456 000
	Total say				**$460 000**
4.	**Council Reticulation Upgrade**				
	Construct 150mm dia main between Hills Avenue and Joe Kooyman Drive	500	m	176	$88 000
	Total say				**$90 000**
5.	**Council Fire Fighting Upgrades**				
	Hills Avenue - 100 mm dia	60	m	133	$7 980
	Valentine Plains Road - 150 mm dia	170	m	176	$29 920
	Commercial and Industrial Area - 200 mm dia	800	m	198	$158 400
	End of Oxley St - 100mm dia	440	m	133	$58 520
	Near Oxley St - 100 mm dia	320	m	133	$42 560
	Dee St - 100mm dia	50	m	133	$6 650
	End State Farm Road - 150mm dia	200	m	176	$35 200
	Earlsifield Rd New Development (Needs to be included in development plan)	-	-	-	-
	Thangool - 200mm dia	1350	m	198	$267 300
	Thangool - 150mm dia	1150	m	176	$202 400
	Callide Town - 150mm dia	2000	m	176	$352 000
	Total say				**$1 160 000**

*June 2004 dollars plus 10%

Infrastructure Cost Recovery

The water supply infrastructure costs calculated on a per lot basis can be summarised as follows.

- **Delivery and Treatment Cost Distribution – Water Supply**

Description	All Development	HLZ Development	LLZ Development
Delivery & WTP infrastructure	$300 000	$460 000	$440 000
Less 40% state govt subsidy	$120 000	n/a	n/a
Net cost	$180 000	$460 000	$440 000
Lots	990	622	424[(1)]
Cost per lot	$182	$740	$1 037
Total Cost Per Lot	**-**	**$922**	**$1 219**

Note: (1) Council's LLZ extension (127 lots), plus new LLZ development (140 lots) plus Thangool (157 lots)

The developer contribution for the LLZ (low level zone) i.e. 140lots will be about $145 000. The remaining $295 000 is for upgrading the service to existing lots and the cost will need to be met by Council.

Fire fighting augmentations total $1 160 000. This includes $340 000 for Biloela, $470 000 for Thangool and $350 000 for Callide Town. These are Council costs.

It is assumed that developers will provide all water supply mains less than 300mm diameter in their development areas as part of their development costs.

Trunk water mains (i.e. 300mm diameter and larger) plus the water treatment plant augmentation that services more than one development and their cost can be apportioned between the developments.

In this respect it has been assumed that these costs could be apportioned on a per lot basis.

Council will need to develop the formal mechanisms for infrastructure cost recovery under IPA legislation - these include a priority infrastructure plan (PIP) and an infrastructure charges schedule (ICS).

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1 Introduction

Banana Shire Council commissioned Sinclair Knight Merz on 25 January 2005 to undertake a water network analysis and to prepare a planning report for the Biloela water supply scheme.

The network analysis and planning report examines the following.

(a) historical and future population growth

(b) historical, current and future water demands (including presently un-metered parks reserves, medians etc)

(c) bulk water requirements and capacity of existing sources

(d) capacity of the raw water infrastructure from the intake to the water treatment plant (including key water treatment plant components, storage and pumping capacity).

(e) Capacity of the reticulation network for existing, future and fire fighting demands (including identification of deficiencies and augmentation requirements).

Drafts of various sections of the planning report were submitted to Council for comment in February, April, July and October 2005 and in January 2006.

Council staff (particularly Mr Anthony Lipsys and Mr Michael Baker) have provided valuable information and comments to assist with understanding of the existing system and with achieving Council's objectives for this investigation.

2 Existing Water Supply Scheme

2.1 Water Sources and Availability

Biloela's urban water is drawn from the Callide Valley groundwater aquifer and from Callide Dam.

The Callide Valley aquifers are reported to have a safe yield of approximately 23 000 ML/yr however there is currently approximately 43 000 ML/yr in allocations.

Callide Dam is located at AMTD 80.1 km on Callide Creek. It has a crest level at 216.18m AHD and has a full storage capacity of 127 000 ML. The storage is normally maintained at approximately 25 000 ML (20% capacity, with a water level at approximately 202m AHD) by flow from the Awoonga Pipeline. Approximately 14 000 ML/yr of water is pumped in the pipeline but 9000 ML/yr is delivered to Callide Dam to ensure adequate supply to the Callide power station. Any storage in excess of the 20% capacity is normally released to recharge the Callide Valley aquifers.

Banana Shire Council has the following allocations for Biloela and Thangool.

- 1200 ML/annum allocation from Callide Dam;
- 987 ML/annum nominal allocation from the Callide Valley aquifer. This allocation is classified as "medium priority" water and is subject to reduction due to over allocation of water drawn from Callide Valley aquifer. Recent allocations have been reduced as follows;
    - 2004/05 – reduced to 80%
    - 2005/06 – reduced to 75%
- CS Energy is obligated to provide an additional 400ML/yr to Banana Shire Council, when needed, under the Callide Power Station infrastructure agreement. The water is pumped to Callide Dam from Awonga Dam.

The water availability for Biloela is summarised in the table below.

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Table 2.1 – Bulk Water Availability

Source	Annual	Average Daily
Callide Dam	1 200 ML	3.3
Callide Valley Aquifer	740 ML(1)	2.0
CS Energy	400 ML	1.1
Total	**2 340 ML**	**6.4 ML/d**

Note: (1) Assumes 75% allocation delivered

2.1.1 Borefield

Bore water is drawn from 6 production bores (Nos, 4, 5, 8, 9,10 & 11) that are approximately 20m deep and normally have water levels varying from 2m to 6m below the surface.

Bores No.4 & 5 are at the Gladstone Rd site and bores Nos. 8, 9, 10 & 11 are at the Dakenbar Rd site as shown on **Figure 2.1**. Flow yield from each bore is primarily determined by the aquifer level and can vary from 12 to 30 L/s depending on the aquifer water level. Effective flow from all the bores has typically been around 45 L/s (3.24ML over 20 hrs). The recent drought and resulting lowering of the ground water table has effectively reduced this to around 26L/s.

Record low water levels in the Callide Valley aquifer in late 1995 and early 1996 caused the complete failure of bores Nos. 10 & 11 and restricted the flow from the remaining bores.

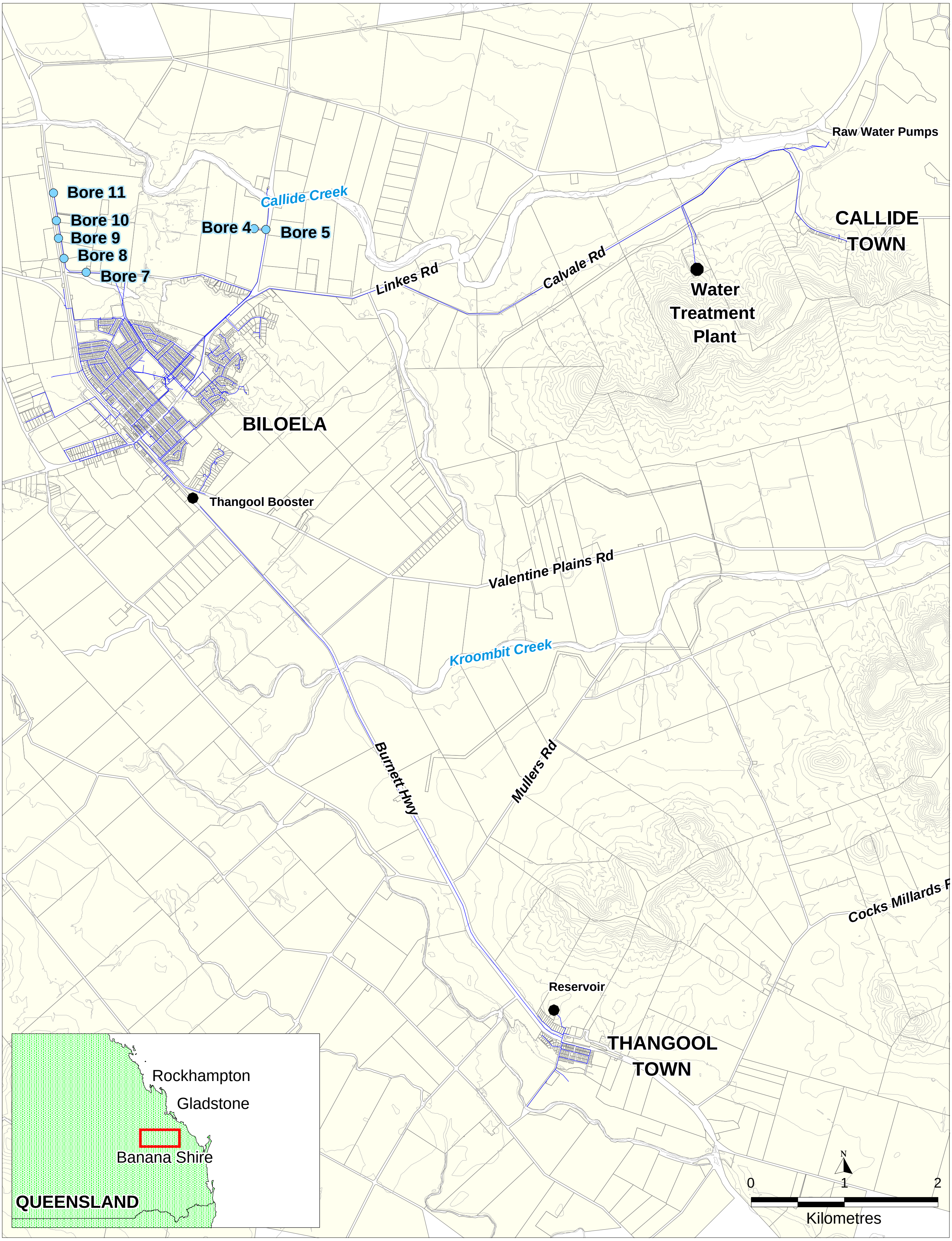
The bore water from both bore fields is pumped to the Ground Level Reservoirs No.1 & 2 at State Farm Rd via two 200mm dia rising mains. The water is not treated, but is blended with the treated water from the Water Treatment Plant and then chlorinated prior to distribution.

All bores are radio telemetry controlled by a float switch in the GL Reservoir No.1 at State Farm Rd.

2.1.2 Biloela WTP

Water treatment plants and raw water supply systems are normally designed to deliver MDMM demands in 20 hours.

Raw dam water is drawn from the Callide Dam manifold outlet to the raw water pump station's two centrifugal pumps (duty/standby, invert at 190.2m AHD), which are rated at 180 L/s (12.96 ML over 20 hrs) but have variable frequency drives (VFDs) controlled to 120 L/s (8.64 ML over 20 hrs)



Legend

	Cadastre		Existing Water Network
	Bore Location		10m Contour

Figure 2.1

Water Network Extent

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The raw water pumps are controlled by a float switch in the Clear Water Tank at the WTP which sends a signal to the WTP switchboard radio. The WTP radio telemetry sends a signal to start/stop the raw water pumps.

The raw water is pumped via a 3.5 km 375mm diameter asbestos cement (AC) rising main to the water treatment plant (inlet TWL 264.3m AHD). Water treatment involves: chemical coagulation, flocculation, sedimentation, filtration, chemical correction and disinfection.

Treated water gravitates from the WTP Clear Water Tank (2 ML, TWL 260.0m AHD) to the Callide Power Station's Treated Water Reservoir (0.1 ML, TWL 249m AHD), the Biloela Ground Level Reservoirs No.1 & 2 at State Farm Rd and to Callide Town. The trunk mains are 300mm diameter AC.

Council has an infrastructure agreement to provide 2.5 ML/d (29L/s over 24hrs) of treated water to the Callide Power Station. Flow to the Callide Power Station is normally about 33 L/s but at times instantaneous flows of 65 L/s have been recorded.

Flow to the State Farm Road GL Reservoir No.1 is radio telemetry controlled and is approximately 55 L/s (3.96ML over 20hrs). This flow is varied at times to achieve optimum blending with the available bore water flow.

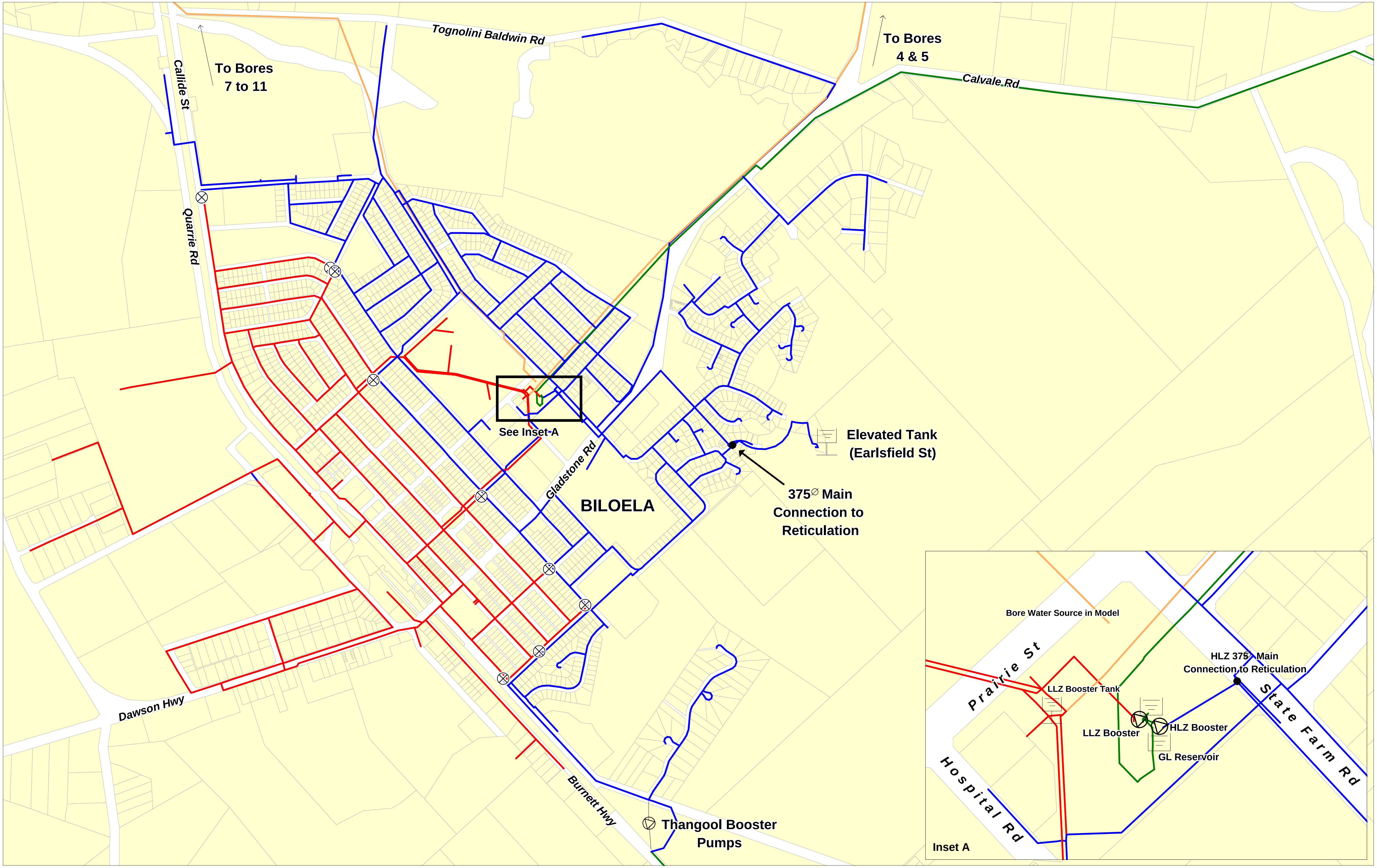
2.2 Pumps, Trunk Mains and Reservoirs

As described previously, dedicated mains from the borefields and WTP feed the two ground level reservoirs at State Farm Road. The two waters (bore and WTP) are blended in a flash mixing chamber on the side of Reservoir No.1 (9 ML). Ground Level Reservoir No.2 (1.5 ML) is connected to GL Reservoir No.1. Both reservoirs have a TWL of 194.9m AHD and operate as a single reservoir (State Farm Road GL Reservoirs).

Ground level reservoirs are normally designed with a capacity of 3 times the difference between MD and MDMM demands.

There are two water supply pressure zones in Biloela ie a high level and a low level water supply zone. These are serviced by two separate elevated tanks, one at the State Farm Road and the other off Earlsfield Street. The State Farm Road Tank (1.36 ML, TWL 214.2m AHD) services the low level zone and the Earlsfield Street Tank (1.95 ML, TWL 234.1m AHD) services the high level zone.

The areas included in each of the zones are shown on **Figure 2.2**.



Legend

- Cadastre
- Biloela HLZ
- Biloela LLZ
- Supply Rising And Gravity Main
- Pipework Not Included in Model
- Elevated Tank
- Reservoir
- Zone Valve
- Booster Pump/s

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0 0.5 1 Kilometres

Figure 2.2

Biloela Water Supply Scheme

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All water supplied into the reticulation system is a blend of untreated bore and treated dam water. The blended water is chlorinated at the Ground Level Reservoirs. Previously the blended water was fluoridated but Council has discontinued this practice. The chlorination and (unused) fluoridation equipment is located in the High Lift Pump station.

Thangool is currently supplied by four Gundfos CR16 pumps located near Hills Avenue. There is an existing 0.34 ML abandoned reservoir at Thangool that is being refurbished for use. The reservoir will be re-commissioned shortly so it has been included in the existing system model.

2.3 Pressure Zones and Reticulation

Final water is drawn from the State Farm Road GL Reservoirs into the High Lift Pump Station at the State Farm Rd site. The High Lift pump station includes both the high level and the low level zone pumps as follow.

Low Level Zone

The Low Level Zone (LLZ) High Lift pumps (1 duty/ 1 standby) are nominally rated at 150L/s. The pumps are controlled by the water level in the Low Level Zone Elevated Tank at the State Farm Rd site.

Low Level Zone

The High Level Zone (HLZ) High Lift pumps (1 duty/1 standby) are rated at 94L/s. The pumps are controlled by the water level in the High Zone Elevated Tank off Earlsfield St. The main from the HLZ pumps to the Earlsfield Elevated tank is 375 mm diameter.

2.4 Water Hammer

Council has received some complaints regarding pressure surges in the water reticulation. A recent complaint was on Tognalini Road. All complaints have been located in the HLZ and are likely to be from the Earlsfield Reservoir Booster pumps stops and starts.

The 375mm diameter delivery main from the booster pumps to the reservoir is connected to the reticulation (rather than being a dedicated main) and this is likely to be the major source of the pressure surges in the network. The system was modelled with the 375mm delivery main as a dedicated rising main to the reservoir (i.e. without connection to the network) but the residual pressures in the network were then too low so the delivery main needs to remain connected to the reticulation.

Water hammer has not been modelled as part of this study because special software is needed and that work was outside the study scope.

To be able to undertake a specific pressure transients study of the Biloela system Council would need to collect information about the transients (for model calibration). This information would include locations that experience the worst transients; measured pressures at these locations and details of pump operations etc at these times.

It might then be possible to model the performance and develop cost effective suppression solutions.

2.5 Residual Chlorine

Some chlorine residual readings were taken by Council from the Biloela Water Supply System on 6 April 2005. The results of the testing are listed below. The minimum target for chlorine residual in a reticulation system is 0.7 mg/L (QWRC Guidelines, 1989).

Biloela

Town Pump Station	0.6 mg/L
Earlsfield Reservoir	0.2 mg/L
Spier St Park	0.15 mg/L
Ebony Way	0.2 mg/L
Joe Kooyman Dr	0.2 mg/L
RSL Park	0.2 mg/L

Thangool

Rising Main	0.2 mg/L
Town Park	0.2 mg/L
Airport	0.0 mg/L

Callide Dam

Random house tap	0.0 mg/L

Clearly some of these results are less than desirable but they are for only one point in time and the areas may have receive effective disinfection at other times during the day/s the measurements were taken.

Because chlorine residuals vary with system demands, dose rate, water quality, time of the day, condition of the pipes etc it is very difficult to develop a model which reflects real situations. Large amounts of data collected over extended periods of time are required to calibrate a residual chlorine model. If there is insufficient calibration data the output from the model is of little value.

Council should first try to optimise disinfection performance by controlled experimentation. This will at least provide a dataset for later modelling if that proves necessary. With controlled experimentation Council would develop a plan for increasing dose rates and measuring the results at various locations over the day. Often complaints about high chlorine residuals occur when the dose rate is increased and the easiest solution is often to inject low chlorine doses at a number of locations.

3 Land Use and Demography

3.1 Population Projections

3.1.1 Population Data

Population data from the Australian Bureau of Statistics from 1933 to 2001 are included in **Table 3.1** and shown graphically on **Figure 3.1**.

- **Table 3.1 – Historical Census Data**

Year	Total Population	Average Inter-Census Annual Growth (% pa)	Occupied Dwellings	Average Occupancy
1933(1)	429	-	94	4.56
1947(1)	940	5.8	217	4.33
1954(1)	1399	5.8	339	4.13
1961(1)	2048	5.6	481	4.26
1966(1)	3537	11.5	863	4.10
1971(1)	4034	2.7	1032	3.91
1976(1)	4586	2.6	1277	3.59
1981	4643	0.2	1405	3.30
1986(2)	-	-	-	-
1991	5051(3)	-	1665	3.03
1996	5161(3)	0.4	1855	2.78
2001	5485(3)	1.2	1978	2.77

Note: (1) Data was obtained from the *Revised Report on Augmentation of Biloela Water Supply Storage and Reticulation,* 1981.

(2) Data obtained stated that the population in1986 was 1974 this is clearly incorrect and has not been used.

(3) Sourced from Table B01 – 2001 Census Data for Biloela. The population data includes non-private dwellings.

The data shows a sharp increase in population from 1961 to 1966, as a result of the Callide Dam and Power Station Projects. From 1966 to 1976 the average annual increase in population dropped to about 2.6%. Although the 1986 data are missing, **Figure 3.1** clearly shows a decline in population growth rate from 1976 to 1996 with an annual growth rate of only 0.2% from 1976 to 1981 and 0.4% from 1991 to 1996. The population growth from 1996 to 2001 again increased at a rate of 1.2% pa.

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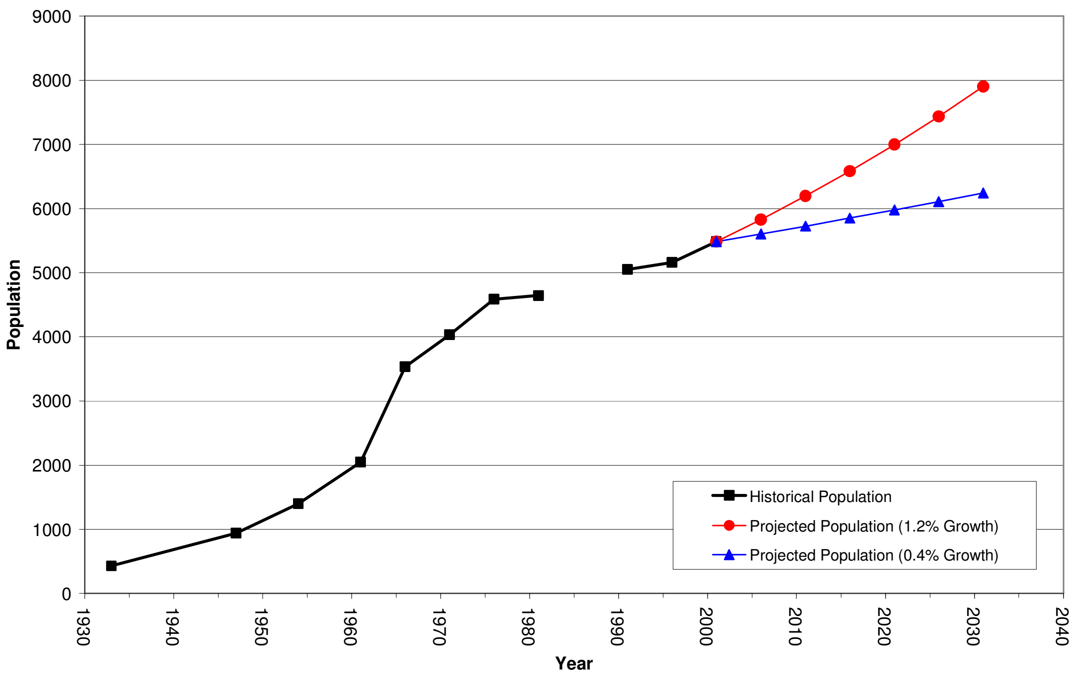
Figure 3.1 – Historical and Projected Populations



A review of the Census collector district maps for Biloela in 1996 and 2001 confirmed that there were no changes which would have a significant impact on the population counts. The collector districts used to collect the 2001 population data are shown graphically in **Appendix A.** A review of an aerial photo (taken in 2004) indicates that there are only about a dozen dwellings included in the Census which are outside the water supply area. This will not affect the outcomes of this study.

The historical data shows the variation that can occur in population growth for a small town like Biloela. It is therefore difficult to predict the future population growth for the town.

The projected populations for growth rates of 0.4% and 1.2% (the growth rates from the last two Census) are shown in **Table 3.2**. The difference between the projected 2031 population is about 1660 for these growth rates. Given the amount of proposed future developments currently submitted to Council and adopting a conservative approach (in terms of water supply) the higher growth rate of 1.2% will be adopted for this study. The projected 2031 population of 7900 is only 300 higher than the 2005 population projected in the 1981 water supply study (Ullman & Nolan Pty Ltd, 1981). This demonstrates the difficulty in projecting future populations and the effect of large projects on the population of small towns.

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- **Table 3.2 – Projected Population**

Year	Projected Population	
	0.4% annual growth	1.2% annual growth
2006	5604	5829
2011	5727	6195
2016	5851	6584
2021	5979	6998
2026	6109	7437
2031	6242	7904

A planning population of 8000 will be adopted for this study. This is a 46% increase from the 2001 census population.

3.1.2 Occupancy Ratios

Table 3.1 shows a decline in average occupancy (persons per occupied dwelling) from 4.56 in 1933 to 2.78 in 1996. This reflects the change in social structure of families over time.

The average occupancy remained stable from 1996 to 2001 with a ratio of 2.77 at 2001. This is consistent with the occupancy ratio for Queensland in 2001 which was 2.79 (2001 ABS Census Data). Note that the occupancy ratios shown in **Table 3.1** are higher than the “true” occupancy ratio as the calculation uses private dwellings only. Dwellings such as the retirement village and hotels are not included in the dwelling count.

The national average persons per household has remained stable at 2.6 from 1994 to 2000 (it was not stated if this was based on private or total dwellings). (ABS, Australian Social Trends 2002, Housing – National Summary Tables).

A break up of the 2001 occupancy ratios for Queensland and Biloela is shown in **Table 3.3**. **Table 3.3** shows that the occupancy ratio of a Separate House is consistent with the average occupancy ratio calculated in **Table 3.1** while the total average occupancy ratio (for all dwelling types) is reduced to 2.57 persons per dwelling.

This is also consistent with the Queensland occupancy ratio and appears to be consistent with the Australian average (assuming the ratio is based on total occupied dwellings).

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Table 3.3 – 2001 Occupancy Ratio Break Up

	Queensland			Biloela		
Dwelling Type	**Dwellings**	**Persons**	**Occ. Ratio**	**Dwellings**	**Persons**	**Occ. Ratio**
Separate house	1 045 137	2 914 780	2.79	1 640	4 539	2.77
Semi-detached, row or terrace house, townhouse etc.	91 979	178 993	1.95	59	102	1.73
Flat, unit or apartment:	164 424	273 692	1.66	143	226	1.58
Other dwellings						
Caravan, cabin, houseboat	34 199	59 071	1.73	102	156	1.53
Improvised home, tent, sleepers out	3 932	7 019	1.79	3	3	1.00
House or flat attached to a shop, office, etc.	3 697	8 436	2.28	12	30	2.50
Not stated	12 245	26 320		21	42	
Unoccupied private dwellings	127 299	n.a.	n.a.	192	n.a.	n.a.
Total	1 482 912	3 468 311	n.a.	2 172	5 098	n.a.
Total occupied	**1 355 613**	**3 468 311**	**2.56**	**1980**	**5 098**	**2.57**

Source: Table B18 – 2001 Census data for Queensland and Biloela – Private dwellings and persons in occupied private dwellings.

Future occupancy ratios are difficult to predict. The occupancy ratios appear to have stabilised from 1996 to 2001 so it will be assumed that the ratio will not change in the future. This is a conservative assumption because if a change did occur it would most likely be to reduce the ratio further.

An occupancy ratio of 2.77 (say 2.8) for individual residential dwellings will be adopted for this study.

3.2 Land Use

The zoning of Biloela is described in the Draft IPA Banana Shire Planning Scheme and is represented on **Figure 3.2**. The figure shows that the town zone is made up of ten Town Precincts, all of these except rural are listed in **Table 3.4.**

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Table 3.4 – Biloela Town Precincts

Town Precinct	Current Development			Undeveloped Areas(1)		Full Development	
	No. Lots	Area (ha)	Average Lot Size (m^2)	Area (ha)	Estimated No. Lots	Total Area (ha)	Estimated Lots
Residential	1353	127.1	820	185	552(2)	312.1	1905
Residential Accommodation	474	39.3	829	-	-	39.3	474
Rural Residential	134	75.8	5657	189.9	348(2)	265.7	482
Commercial	94	8.3	883	-	-	8.3	94
Community	56	88.6	15821	-	-	88.6	56
Highway	27	8.82	3267	3.4	5(3)	12.2	37
Industrial	146	40.4	2767	46.9	85(3)	87.3	315
Recreation	31	205.4	66258	-	-	205.4	31
Tourism	25	15.8	6320	-	-	15.8	25
Total	**2340**	**609.5**	**-**	**525.2**	**990**	**1034.7**	**3419**

Note: (1) As shown on **Figure 3.2**

(2) Based on existing development applications

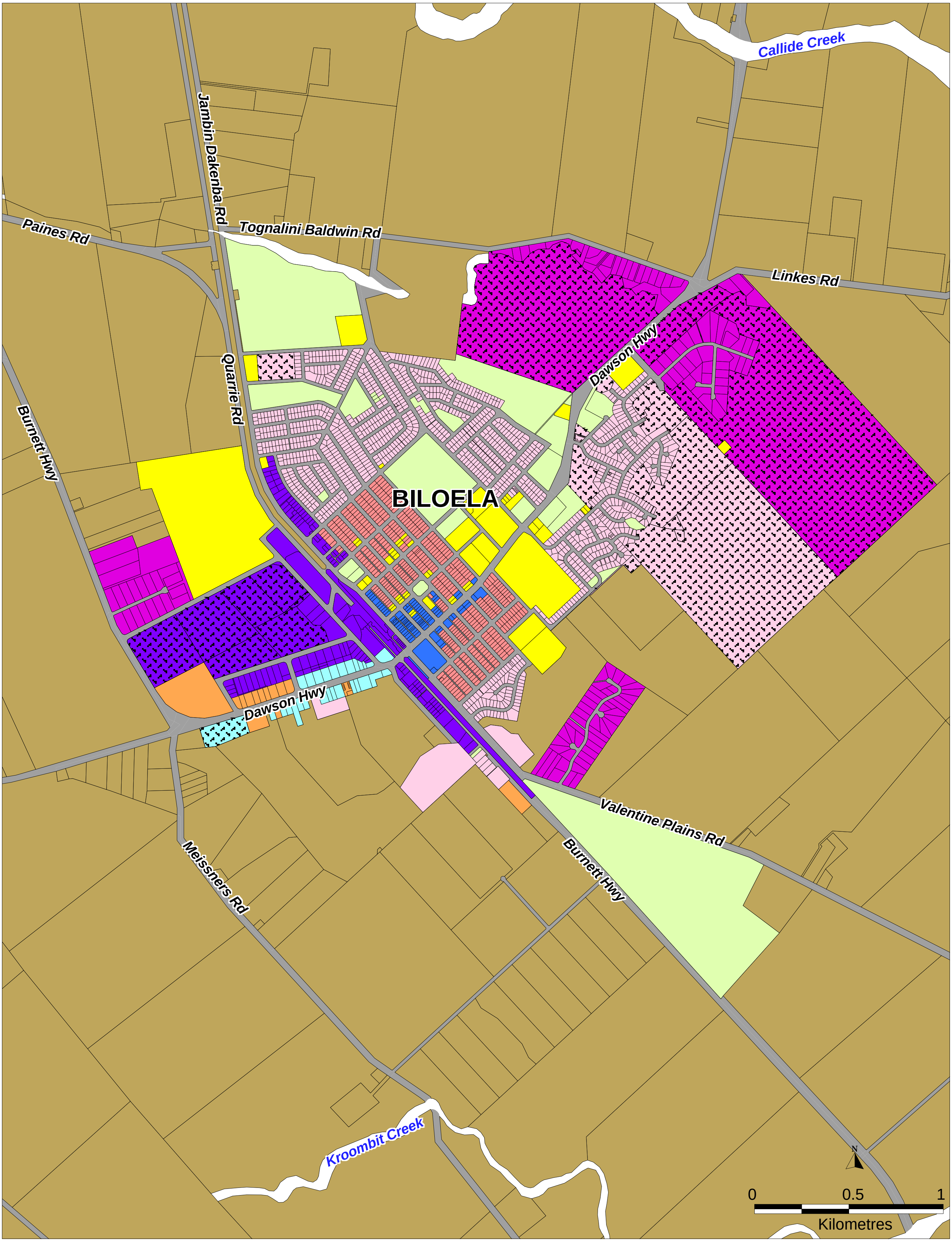
(3) Some land is state government owned and some is freehold. The lots adopted are based on the expected size of future lots.

The total number of lots included in the Residential, Residential Accommodation and Rural Residential at full development is 2 861. Based on an Occupancy Ratio of 2.8 this is equivalent to a population of 8 010. This shows that Biloela has sufficient undeveloped land allocated under the town plan to accommodate the projected 2031 population.

The number of lots included in each of the proposed development areas is summarised below:

Table 3.5 –Development Lots

Sub-Division	Lot Type	Number of Lots
Washpool Gully	Rural Residential	198
Auburn Street	Residential	10
HLZ off the Dawson Highway	Residential	20
Earlsfield HLZ	Residential	472
Earlsfield HLZ	Rural Residential	150
LLZ near Earlsfield Reservoir	Residential	50
Between Quarrie Rd and Burnett Hwy	Industrial/Commercial	90
	Total	**990**



Legend

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Town Zoning

- Commercial
- Community
- Highway
- Industrial
- Recreation
- Rural
- Residential
- Residential Accommodation
- Rural Residential
- Tourism
- Undeveloped Land

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Figure 3.2

Draft Banana Shire Town Planning Scheme

QE09210

Biloela Water Supply Planning Report

4 Water Demands

4.1 Water Production

The 2004 annual production of the Biloela Water Treatment Plant (WTP) is shown in **Table 4.1**.

- **Table 4.1 – Biloela Water Treatment Plant Production 2004**

Month	Raw Water (ML)	Supernatant Water (ML)	Treated Water (ML)
January	88.72	n/a	91.18
February	80.42	n/a	79.10
March	91.07	n/a	89.95
April	116.23	n/a	114.61
May	115.48	n/a	112.63
June	107.87	n/a	105.56
July	112.44	n/a	110.51
August	130.14	n/a	127.99
September	104.36	n/a	102.62
October	155.30	4.77	152.53
November	115.18	3.71	115.01
December	116.28	4.86	124.02
Total	**1 333.49**	**46.55**(1)	**1 325.71**

n/a – Not Available due to meter fault

Note: (1) Assumes the supernatant is 3.5% of raw water

The total of the supernatant and treated water is approximately 1 373 ML. This is a 1% difference from the raw water usage of 1333ML. A 1% difference is considered to be a very good correlation given the general accuracy of water meters.

Not all of the treated water goes to Biloela, a break up of the distribution of treated water is included in **Table 4.2**.

- **Table 4.2 – Biloela Water Treatment Plant Treated Water Break Up 2004**

Month	Backwash Water (ML)	Callide Power Station (ML)	Callide Township (ML)	Biloela & Thangool (ML)	Total (ML)
January	4.32	30.07	0.88	54.96	90.23
February	4.08	27.89	0.87	45.21	78.06
March	4.08	32.24	1.22	51.04	88.58
April	5.25	34.76	1.49	67.99	109.48
May	5.78	42.48	1.53	67.13	116.92
June	0.48	39.60	1.35	60.00	101.44

Month	Backwash Water (ML)	Callide Power Station (ML)	Callide Township (ML)	Biloela & Thangool (ML)	Total (ML)
July	4.84	38.98	1.53	65.63	110.99
August	5.09	43.16	1.66	78.63	128.54
September	4.36	29.66	1.09	69.70	104.81
October	6.28	54.74	1.24	90.22	152.49
November	5.09	45.83	0.99	63.38	115.28
December	5.60	47.27	1.59	72.06(1)	126.52
Total	**55.25**	**466.68**	**15.44**	**785.95**	**1323.35**

n/a – Not Available

Note: (1) The meter was reading erratically

The data shows that there is an excellent correlation between the treated water meter reading (1326 ML) and the sum of the individual bulk meter readings (1323 ML). This indicates that the water production data is reliable.

- **Table 4.3 –Water Distributed to Biloela and Thangool 2004**

Month	Bore Water (ML)	WTP to Biloela and Thangool (ML)	Total (ML)	(Less) Thangool (ML)	Biloela (ML)
January	81.3	55.0	136.3	6.8	129.5
February	77.9	45.2	123.1	n/a	116.2
March	86.6	51.0	137.7	7.0	130.7
April	106.7	68.0	174.7	8.3	166.4
May	95.6	67.1	162.7	6.4	156.3
June	84.4	60.0	144.4	6.9	137.5
July	80.3	65.6	145.9	6.2	139.7
August	89.2	78.6	167.8	6.2	161.6
September	70.0	69.7	139.7	5.7	134.0
October	79.0	90.2	169.2	6.9	162.3
November	60.5	63.4	123.9	4.6	119.3
December	71.5	72.1	143.6	7.2	136.4
Total	**983**	**785.9**	**1769**	**79.1**	**1689.9**

n/a – Not Available

Note (1) – Adopted October value for February

There were 2213 connections at Biloela in 2003/04. The annual water production rate for Biloela is therefore equal to;

- 764kL/con/yr or 2 092L/con/day
- 804 L/person/day (based on a projected population of 5759 for 2004)

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The Water Resource Commission, Guidelines for Planning and Design of Urban Water Supply Schemes includes water supply statistics for Biloela from 1983 to 1987. This data is listed below;

- 1983 – 2 029 L/con/day
- 1984 – 1 952 L/con/day
- 1985 – 2 901 L/con/day
- 1986 – 2 718 L/con/day
- 1987 – 2 427 L/con/day

The data for 2003/04 is closest to that for 1983 and 1984. There is a significant increase from 1985-1987. The 2003/04 water production rate probably reflects constrained water availability (possibly even drought).

4.2 Existing Metered Water Usage

4.2.1 Council's Water Charging Policy

In 2004/05 Council charged water on an allocation basis. Each user had a water entitlement charged at $0.67/kL (ie for a residential lot: 600kL x $0.67= $402 per annum). Any usage over the allocation was at $1.50/kL. The 2004/05 water allocation schedule is included in **Appendix B**.

A new system has been adopted from 2005/06. Water Charges for Biloela/Thangool/Callide Dam for 2005/06 have been set and apply from 1 July 05.

The access charge will be charged half yearly with the Council rate notice. For a residence in Biloela, Thangool and Callide Dam the charge is $132 per half year. The consumption charges will be issued quarterly with water meters now being read at the end of September, December, March and June each year.

The consumption charges for Biloela, Thangool and Callide Dam are 70 cents per kilolitre for usage up to 400 kilolitres and 95 cents per kilolitre for all usage above 400 kilolitres. The normal early payment discount will not apply to the consumption charges.

To calculate the usage for the different development categories in Biloela existing water rating data has been used for the financial years from 1999/2000 to 2003/2004. Council has distributed these data against 56 different land types.

The land use types have been grouped into seven water supply categories as follows;

- Residential
- Rural Residential
- Commercial
- Industrial

- Agricultural
- Council Parks and Gardens
- Individual (Large water users have been identified separately)

The land use types included in each of the above water supply categories are listed in **Appendix C**.

Table 4.4 –Metered Water Usage for each Water Supply Category

Category	2003/ 2004	2002/ 2003	2001/ 2002	2000/ 2001	1999/ 2000	Average
Residential						
Total Usage (kL/yr)(1)	809540	535824	708832	819272	689077	
Number of connections(1)	1731	1648	1608	1491	1444	
Average Usage (kL/Con/yr)	468	325	441	**549**	477	452
Rural Residential						
Total Usage (kL/yr) (1)	97716	66405	87867	97575	78963	
Number of connections(1)	157	154	146	132	127	
Average Usage (kL/Con/yr)	622	431	602	**739**	622	603
Industrial						
Total Usage (kL/yr) (1)	21380	20204	21211	26152	22631	
Number of connections(1)	79	73	77	74	72	
Average Usage (kL/Con/yr)	271	277	275	**353**	314	298
Commercial						
Total Usage (kL/yr) (1)	69111	51850	61121	67785	69639	
Number of connections(1)	127	126	124	120	111	
Average Usage (kL/Con/yr)	544	412	493	565	**627**	528
Agricultural						
Total Usage (kL/yr) (1)	4251	4111	6048	5372	5073	
Number of connections(1)	8	7	7	6	6	
Average Usage (kL/Con/yr)	531	587	864	**895**	846	745

Note: Only connections which had a water usage have been included in the calculation. Council has advised that where a series of consecutive years usage is zero in the historical rating data, the water meter was changed during that period. Council's rate data base does not keep historical meter reading data once a new meter has been installed.

The data in **Table 4.4** shows that (with the exception of the commercial development) the highest consumption occurred in 2000/01. For this study, the highest annual average per connection consumption will be adopted for estimating water demands. This is the most conservative approach. It is likely that 2000/01 was a particularly dry period, which would explain why the commercial demands were not affected as much as the other categories.

Table 4.5 provides water usage data for the large consumers.

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▪ Table 4.5 – Metered water usage for Individual Large Consumers

Development	Usage (kL/yr)					
	2003/ 2004	2002/ 2003	2001/ 2002	2000/ 2001	1999/ 2000	Max
Pre-School (Auburn St)	1595	1031	2101	2777	**2572**	2572
Show Grounds (Callide St)	1693	469	2692	**5526**	4032	5526
Aged Persons Home (Kariboe St)	738	743	1120	**1817**	-	1817
Myola Caravan Pk (Valentine Plains Rd)	17998	14168	**22546**	21907	21906	22546
Shopping Centre (2-16 Gladstone Rd)	**10143**	5672	8796	8199	4373	10143
Kindergarten (Kariboe St)	**802**	287	676	780	790	802
Child Care Centre (Grevillia St)	992	586	**1341**	1238	1173	1341
Civic Centre (Rainbow St)	4906	387	3377	**7513**	6049	7531
Private School (Catholic Primary) (Rainbow St)	5749	2802	8162	**9629**	7130	9629
Lutheran School (Collard St)	**6194**	2606	4044	5369	4419	6194
State Primary School (Gladstone Rd)	11956	4954	14887	**18880**	12350	18880
Hospital (Hospital Rd)	15294	4225	14004	**20648**	15924	20648
Bowls Club (Gladstone Rd)	4628	4851	4634	6061	**5037**	5037
State High School (Gladstone Rd)	**38453**	7690	22875	21926	15342	35453
Cooinda Kindy (Lawrence St)	**1654**	839	804	-	-	1654
Child Care Centre (Heaton St)	2063	2275	1465	1679	**2492**	2492
Sports Club (Squash Court) (Dawson Highway)	306	494	681	1035	**1060**	1060
Settlers Inn (Dawson Highway)	5697	8649	10950	18904	**20486**	20486
Boomerang Caravan Park (Dunn St)	3937	3209	4007	4489	**4645**	4645
Retirement Village/Aged Care complex (Lutheran Church – Burnett Highway)	**6245**	-	-	-	-	6245
Biloela Sewage Treatment Plant	**15135**	14207	14850	4560	875	15135
Magavalis Ovals (Valantine Plains Rd)	4879	1292	**6242**	6055	8835	6242
Callide Valley Rugby League	7784	5130	**14227**	701	-	14227
Biloela Senior Soccer Club	**9450**	1420	-	-	-	9450
Biloela Junior Rugby League Club	**1513**	-	-	-	-	1513
Biloela Junior Soccer Club	4429	1258	2786	**6316**	4879	6316
Callide Valley Touch Football Club	**10985**	1958	-	-	-	10985
Biloela Heavies Junior Soccer	9079	1818	5619	**10611**	10276	10611
Hotel (Kariboe St)	3403	**3606**	605	-	-	3606
Service Station (Dawson Highway)	1952	1859	2410	3009	**4056**	4056
Retail Warehouse (Dawson Highway)	2484	2786	2070	**2941**	2264	2941
Motel (Burnett Highway)	5827	**6257**	5887	5815	5490	6257
Laundry/Drycleaners (13 Callide St)	**11465**	10170	1806	-	-	11465

Development	Usage (kL/yr)					
	2003/ 2004	2002/ 2003	2001/ 2002	2000/ 2001	1999/ 2000	Max
Anzac Memorial Club (Callide St)	1510	1983	1754	2296	**11925**	11925
Hotel (58-62 Callide St)	**9097**	5526	-	-	-	9097
Total	**240035**	**125207**	**187418**	**200681**	**178380**	**308527**

The water used on Council's parks and gardens is shown separately so the water use can be estimated for the non-metered connections. The Tom Dawson Park has been metered since the 1999/2000 financial year. The annual consumptions are as follows;

- 1999/2000 – 2 043 kL
- 2000/2001 – 2 222 kL
- 2001/2002 – 1 935 kL
- 2002/2003 – 259 kL
- 2003/2004 – 2 043 kL

The average annual consumption at Tom Dawson Park is 1 761kL/annum and the mown area of the park is 1.24 ha. The average water usage is therefore 1 409 kL/ha. Council have advised that this park is one of the most watered parks. The usage will therefore be adopted for the remaining parks in Biloela, as a conservative estimate of water used.

The total mown area of the 39 watered parks in Biloela is 73.5 ha. The annual water usage on parks is therefore estimated to be 104 ML/yr.

The total metered water usage, including an estimate for Parks and Gardens, in Biloela is shown in **Table 4.6**.

- **Table 4.6 – Total Metered Water Usage in Biloela**

	2003/04 %	Usage (kL/yr)				
		2003/ 2004	2002/ 2003	2001/ 2002	2000/ 2001	1999/ 2000
Residential	60.1	809 540	535 824	708 832	819 272	689 077
Rural Residential	7.3	97 716	66 405	87 867	97 575	78 963
Industrial	1.6	21 380	20 204	21 211	26 152	22 631
Commercial	5.2	69 111	51 850	61 121	67 785	69 639
Agricultural	0.3	4 251	4 111	6 048	5 372	5 073
Individual Large Consumers	17.8	240 035	125 207	187 418	200 681	178 380
Parks and Gardens	7.7	104 000	-	-	-	-

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	2003/04 %	Usage (kL/yr)				
		2003/ 2004	2002/ 2003	2001/ 2002	2000/ 2001	1999/ 2000
Total	**100**	**1 346 033**	**803 601**	**1 072 497**	**1 216 837**	**1 043 763**
Plus Thangool	n/a	57 514	36 176	53 417	66 222	52 760
Total	**n/a**	**1 403 547**	**839 777**	**1 125 914**	**1 283 059**	**1 096 523**

The total water production and usage for Thangool and Biloela is summarised below.

- **Table 4.7 –Water production and usage for Biloela and Thangool**

Township	Production (2004) ML	Usage (03/04) ML	Misclose
Biloela	1 690	1 404	1.2 (20%)
Thangool	79	58	1.36 (36%)

System losses of 17%, while high, are consistent with losses in other towns in Queensland. The water loss of 26% for Thangool is considered high. It is recommended that Council investigate the high water losses in Thangool. Many Councils in Queensland are implementing strategies to reduce water losses. Banana Shire Council may also wish to consider implementing some water loss reduction strategies.

4.3 Peaking Factors

The Mean Day and Max Day data for 2002 to 2004 are shown in **Table 4.8**. The data has been provided by Banana Shire Council.

- **Table 4.8 – Mean Day and Max Day Data**

	2002		2003		2004	
Month	Mean Day (ML)	Max Day (ML)	Mean Day (ML)	Max Day (ML)	Mean Day (ML)	Max Day (ML)
January	5.2	7.0	3.2	4.6	4.4	6.2
February	6.4	7.5	2.6	3.6	4.2	5.5
March	4.3	6.4	2.8	3.1	4.4	5.6
April	3.4	3.8	3.0	3.5	5.9	5.5
May	2.9	3.9	3.7	4.5	5.2	6.0
June	2.2	2.5	4.0	5.8	4.8	5.0
July	2.6	2.8	3.1	3.7	4.7	5.3
August	2.5	2.9	3.3	4.2	5.4	6.1
September	2.8	4.1	4.6	7.2	4.6	5.8

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Month	2002		2003		2004	
	Mean Day (ML)	Max Day (ML)	Mean Day (ML)	Max Day (ML)	Mean Day (ML)	Max Day (ML)
October	3.4	4.1	3.7	5.4	5.5	6.7
November	2.9	3.7	5.5	6.3	4.1	6.6
December	3.1	3.3	3.6	6.8	4.6	6.6
MDMM	**6.4**	**-**	**5.5**	**-**	**5.9**	**-**
Max Day	**-**	**7.5**	**-**	**7.2**	**-**	**6.7**
Average Day	**3.5**	**-**	**3.6**		**4.8**	

Note: The 2004 average day data does not match the WTP production data of 4.6ML/d.

The demand ratios based on the above data are shown in **Table 4.9**.

- **Table 4.9 – Demand Ratios**

Year	AD (ML)	MDMM	MD
2002	3.5	1.8AD	1.2MDMM 2.1AD
2003	3.6	1.5AD	1.3MDMM 2AD
2004	4.8	1.2AD	1.1MDMM 1.4AD
Water Resources Commission Guidelines (1989)	-	1.5AD	1.5MDMM 2.25AD

For this study the WRC Guideline values have been adopted.

4.4 Demand Summary

4.4.1 Existing Demands

As discussed in **Section 4.1** the 2003/04 annual production was 2 092 L/con/day (based on total production and total connections). The data from 1983 to 1987 ranged from 1 952 L/con/day to 2 901 L/con/day.

The 2003/04 production rate of 2 092 L/con/day is at the lower end of the range of the historical data. It is therefore considered appropriate (given demand management initiatives such as user pays), and has been adopted for this study.

Given the misclose between production and Metered usage, the metered data will need to be factored up. The factored increase is shown in **Table 4.10**.

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- **Table 4.10 –Metered Water Increase Factor**

Township	Actual Production (2004) ML	Metered Usage (03/04) ML	Increase Factor for Metered Usage
Biloela	1 690	1 404	1.20
Thangool	79	58	1.36
Callide Town	15	n/a	n/a

n/a – Not available

The average daily water demands that have been adopted, for the existing system model, are included in **Table 4.12**. The areas are based on the Land Use areas in the Banana Shire Council Planning Scheme. The average demand per hectare rates developed from the existing demands (**Table 4.12**) were used to develop the full development demands (**Table 4.13**). The scheme precincts have been grouped as follows;

- **Table 4.11 – Zoning Precincts and Water Supply Category**

Water Supply Model Category	Zoning Precincts Included
Residential	Residential Residential Accommodation
Rural Residential	Rural Residential
Commercial	Commercial Highway Tourism
Industrial	Industrial

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- **Table 4.12 – Adopted Biloela Demands (Existing)**

Category	Connections	2003/04 Metered Usage (ML/yr)	Adopted Demands (ML/yr)	AD Demand (L/Con/s)	Land Use Area[1] (ha)	Average Demand (ML/ha/yr)
Residential	1731	810	972	0.018	150	6.5
Rural Residential	157	98	118	0.024	76	1.6
Industrial	79	21	25	0.010	40	0.6
Commercial	69	69	83	0.038	32.9	2.5
Agricultural	8	4	5	0.020	-[2]	-[2]
Parks and Gardens	-	104	125	-	-[2]	-[2]
Individual Consumers	-	240	288	-	-[2]	-[2]
Total Biloela	**-**	**1346**	**1615**	-	-	-
Thangool	118	58	70	0.019	-	-
Callide Town	30	n/a	15	0.016	-	-
TOTAL	**-**	**1404**	**1700**	-	-	-

Note: (1) Based on the Land Use areas in the town planning scheme.
(2) Not required as the same demands will be adopted for the existing and fully developed scenario

4.4.2 Full Development Demands

The projected full development demands are shown in **Table 4.13**.

- **Table 4.13 – Adopted Biloela Demands (Full Development)**

Category	Existing System Demands (ML/yr)	Additional Development (Connections)	AD Demand (L/con/s)	Additional Demands (ML/yr)	Full Development System Demands (ML/yr)
Residential	972	552	0.018	313	1285
Rural Residential	118	348	0.024	263	381
Industrial	25	85	0.010	27	52
Commercial	83	5	0.038	6	89
Agricultural	5	Nil	-	-	5
Parks and Gardens	125	Nil	-	-	125
Individual Consumers	288	Nil	-	-	288
Total Biloela	**1615**				**2225**
Thangool	70	39[1]	0.018[3]	22	92
Callide Town	15	-[2]	-	-	15
TOTAL	**1700**				**2332**

Note: (1) Assuming the development rate for Thangool is the same as for Biloela
(2) Assuming no additional development in Callide Township
(3) For consistency the Biloela value has been adopted.

4.4.3 Demand Summary

The adopted demands for the water supply study are summarised below.

- **Table 4.14 – Adopted Biloela Demand Summary**

Category	Existing System Demands		Full Development System Demands	
	(ML/yr)	AD (ML/d)	(ML/yr)	AD (ML/d)
Residential	972	2.66	1285	3.52
Rural Residential	118	0.32	381	1.04
Industrial	25	0.07	52	0.14
Commercial	83	0.23	89	0.24
Agricultural	5	0.01	5	0.01
Parks and Gardens	125	0.34	125	0.34
Individual Consumers	288	0.79	288	0.79
Total Biloela	**1615**	**4.42**	**2225**	**6.10**
Thangool	70	0.19	92	0.25
Callide Town	15	0.04	15	0.04
TOTAL	**1700**	**4.66**	**2332**	**6.39**

This indicates that the Bulk Water Availability will be fully committed to the Full Development system demands (see Table 2.1). Additional water sources will be required to expand beyond this level of development and there may well be short term deficiencies (due to ground water restrictions).

5 Biloela Water Treatment Plant

The Biloela WTP is located off Calvale Road and treats water pumped from the Callide Dam. The plant was designed and built by NEI John Thompson (Australia) in 1983/84.

5.1 Water Quality

The most important water quality parameters are colour, turbidity, iron and manganese. The target design values for these parameters were:

Turbidity (NTU)	<1
Colour (Pt units)	<5
Iron (mg/L)	<0.1
Manganese (mg/L)	<0.5
Residual chlorine (mg/L)	0.5
Fluoride (mg/L)	0.7

Council's operator advises that the raw water contains very little colour and turbidity. Tastes and odours (possibly from organic matter in Callide Dam) are said to be the main water quality problem.

5.2 Raw Water Pumping

Raw water is pumped to the WTP from a raw water pump station at Callide Dam. The raw water pumps have a capacity of 180L/s but are controlled to deliver 120L/s by telemetry control of the variable speed drive units. The raw water pipeline is 375mm dia and 3.5 km long.

Chlorine is dosed into the raw water pipeline (from a one tonne drum) to control tastes and odours.

5.3 Treatment Process

5.3.1 Inlet and Flash Mixer

The design flow rate for the WTP is 120L/s. This rate can be modulated by adjusting the set point in the control system. The primary coagulant (for removing colour and turbidity) is Alum and this is dosed into the raw water pipeline upstream of a three-stage inline mixer and the flash mixer tank. The Alum dose is typically 20-30mg/L. Polymer is also added to improve coagulation. Lime can be pre-dosed at this location for pH/alkalinity control.

Recycled supernatant from the sludge lagoons is returned to the WTP at the flash mixer.

The flash mixer is sized to achieve four minutes contact time (at 120 L/s inflow) to thoroughly mix the coagulant chemicals and to generate "pin" floc prior to entry to the clarifiers.

An overflow is provided at the flash mixer to protect the WTP process from excess flows.

5.3.2 Clarifiers

The clarifiers are sludge blanket contact clarifiers. Flocculation is enhanced by directing the dosed raw water into the settling sludge blanket in the hopper bases of the clarifiers. Each clarifier has four hopper bases - the dosed raw water is distributed evenly between the hoppers and injected at a rate of 1.0m/sec.

The heavier flocs are retained in the sludge blanket. Lighter flocs rise into the 60^0 tube settlers where they agglomerate to form heavier flocs that settle to the sludge blanket.

Clarified water passes through the settling tubes and into the filter inlet channel.

The clarifier sludge blanket depth is maintained by intermittent timed sludge withdrawals. Currently 90 second sludge withdrawals are separated by 15 minute settling intervals.

5.3.3 Filters

Clarified water is split evenly between the four sand filters. Filtered water is collected in the under drainage system and delivered to the Outlet Filter Well. Modulating values are used to achieve "constant rate" or "rising head filtration" operation.

The filter underdrain system comprises "concreted – in" ABS rectangular laterals, nozzle bolts and polypropylene filter hoods with air control bolt stems. The system is designed to collect filtered water and to distribute backwash water and air scour evenly.

Accumulation of floc in the filter increases the head loss and causes the filter inlet level to rise. Backwashing is required when the inlet level reaches the design level.

The backwashing sequence is air scour (typically 3 minutes); combined air scour and low backwash (typically 3 minutes) and high backwash (5 minutes). Backwashing is carried out manually by the operator when the high level condition is indicated by a level switch alarm.

5.3.4 Treated Water Storage

Filtered water is dosed at the Filter Outlet Well with lime (for pH connection) and chlorine and then flows by gravity to the Treated Water Storage. Fluoride was previously added also but this practice has been abandoned.

5.4 Chemical Dosing

Storage for 8 tonnes of lime and 30 tonnes of Alum is provided in the Chemical Storage room on the upper level of the main plant building.

5.4.1 Alum and Lime Dosing

The alum and lime hoppers are manually loaded with bags. The hoppers have a dust extraction system.

There are three identical solution feeders – one for alum, one for lime and a common standby. The alum hopper has a 40 hour capacity (at 100mg/L dose rate) while the lime hopper has a 24 hour capacity (at 50mg/L pre and 69mg/L post dose rates). Generally little or no pre-dosing is required because of the high natural alkalinity of the raw water.

5.4.2 Chlorine Dosing

Provision has been made for pre-dosing of chlorine to the clarifier inlets but this is rarely required (because of the chlorine dosing in the raw water pipeline).

Chlorine is dosed to the filtered water line upstream of the Treated Water Storage at a rate to achieve 0.5mg/L residual after 30 minutes.

Gaseous chlorine is drawn from a one tonne drum (with a 70kg cylinder standby) to the chlorinators where it is dissolved in a service water stream.

5.4.3 Fluoride Dosing

Sodium fluoride was previously prepared in a 1500L batch tank at 2.5% giving two days capacity. Partially softened water is required to batch the dry sodium fluoride.

Fluoride was injected at a rate to achieve 0.7mg/L concentration.

5.4.4 Polymer Dosing

Polymer is batched for injection to the raw water. An anionic Magnafloc polymer is used at a rate of 1-2mg/L.

5.4.5 Powdered Activated Carbon Dosing

A PAC system has been provided for responding to blue green algae toxin events in Callide Dam.

5.5 Washwater Recovery System

Water from the filter backwashes and from clarifier desludging gravitates to the Wastewater Collection Surge Tank. This tank attenuates the flow rate to the sludge lagoons. The Surge Tank can accommodate two successive backwashes (60m^3 each) received over 20 minutes and six clarifier desludges within the same period. The Surge Tank is designed to scour any accumulated sludge and discharge slightly faster than the plant's wastewater production rate. There is an overflow for unanticipated events.

5.5.1 Sludge Lagoons

There are three sludge lagoons – each is designed to receive six months sludge from the plant. The design approach was to have one lagoon in service and two drying.

After several months drying dried sludge is removed by a loader.

The main issue with the sludge lagoons arises from organics in the sludge that become malodorous and return tastes and odours to the WTP (with the supernatant stream).

5.5.2 Supernatant Recovery

Supernatant from the sludge lagoons is pumped to the WTP inlet.

5.6 Control

The WTP is controlled from a central control panel that interacts with field mounted controllers and control consoles. The control philosophy is that the WTP starts and stops automatically based on levels in the treated water storage. Chemical dosing starts simultaneously with the plant. Filter backwash is controlled manually from field mounted filter backwash control consoles.

5.7 Main Building

The upper floor of the Main Building comprises the Chemical Store (and loading hoppers), Foyer, M/F toilets, Control Room, Laboratory, Office and Filter Operating Gallery. The lower floor includes Chemical Feeder Room, Polymer Store and Filter Pipe Gallery.

5.8 WTP Capacity and Upgrading

Council's operator advises that the existing WTP operates for only 12 – 13 hrs /d during peak demand periods.

The designer suggested the following capacities and upgrading strategy.

- **Table 5.1 – Designer Recommended Capacities and Upgrading Strategy**

	Present	Stage 1A	Stage 2
Minimum Flow	60 L/s	-	120 L/s
Maximum Design Flow	120 L/s	160 L/s	240 L/s
Maximum Hydraulic Capacity	140 L/s	-	280 L/s

The Stage 1A augmentation approach comprises increasing the existing clarifier rating (to a rise rate of 5.1m/hr) and replacing the filter sand with mixed media (to increase the filtration rate to 11.5 m/hr). Trials were recommended to confirm that the clarifier performance at this higher rating is satisfactory.

Modifications would also be required to the raw water pumping rate, the inlet inline mixer, the inlet control valves, the flash mixer weirs and the clarifier downpipes diameter would need to be increased.

The Stage 2 augmentation approach would follow Stage 1A and comprise a new clarifier and two new mixed media filters. Modifications would also be required to the raw water pumping system (i.e. new pumps), the inlet inline mixer, the inlet control valves and the flash mixer to new clarifier pipework.

The Alum storage hopper capacity reduces to 20 hours (at 100mg/L dose rate), the lime storage hopper capacity reduces to 20 hours (at 69mg/L post dosing rate). The sodium fluoride batch tank capacity is sized to provide one day capacity at Stage 2 design flow. An extra supernatant return pump is required (i.e. to provide two 50% duty pumps and one standby).

5.9 Water Treatment Plant Issues

Blue green algae toxins and disinfection by-products are issues that Council needs to consider at Biloela.

The existing PAC dosing approach is a crude response to potential toxin concerns. Council needs to undertake monitoring (when there is bloom in the Callide dam) and if toxins are a persistent problem consideration should be given to adding Ozone/BAC to the plant.

The existing pre-chlorination and organic matter in the raw water raises the potential for disinfection by-product formation. Council should monitor the treated water for disinfection by-products and if the concentrations are excessive Council should discontinue the practice. This will make water treatment more difficult and additional oxidation eg by ozone may need to be added.

6 Design Criteria

6.1 Demand Ratios

As discussed in **Section 4.3** the adopted Demand Ratios are;

MDMM = 1.5AD

MD = 1.5MDMM

MD = 2.25AD

These demand ratios have been used in this study for nominal sizing of water supply infrastructure. These sizes have been checked by a 3 MDMM plus 3 MD dynamic network analysis.

6.2 Residual Pressures

Council's Standards of Service (BSC, 2004) for residual pressures at the property boundary are:

- Maximum design pressure of 80m
- Minimum design pressure of 22m provided during maximum hour

The Queensland Water Resource Commission guidelines (QWRC, 1989) recommended minimum residual pressures as follows:

- Minimum design pressure of 22m provided during maximum hour
- Minimum design pressure of 16 m provided during maximum hour in small isolated or elevated areas.

The QLD WRC Guidelines have recently been superseded with the latest Queensland Planning Guidelines for Water Supply and Sewerage (DNRM, 2005) which recommend pressures at the property boundary of:

- Maximum – 80m
- Minimum Residential – 20 to 25m
- Minimum Industrial/commercial – 25m

6.3 Fire Fighting Demands

Council's Standards of Service (BSC, 2004) for fire fighting are:

- MH plus 15L/s residential with a residual pressure of 12m
- MH plus 30L/s commercial with a residual pressure of 12m

The Queensland Water Resource Commission guidelines (QWRC, 1989) recommended fire fighting criteria of;

- 2/3 MH plus 15L/s residential with a residual pressure of 12m
- 2/3 MH plus 30L/s commercial with a residual pressure of 12m

The latest Queensland Water Supply and Sewerage Guidelines (DNRM, 2005) recommend that for schemes servicing more than 3000 people the static fire fighting criteria is the same as the Council Standards of Service described above. Where the population is less than 2000 people 2/3MH is accepted instead of MH demands. The guidelines also recommend that the system can operate at 15L/s (residential) for 2 hours and 30L/s (commercial) for 4 hours.

The DNRM (2005) Guidelines also include the need for concurrent fire fighting ability, where the population is greater than 5000 people, when sizing trunk mains. These requirements include a simultaneous residential fire (15L/s for 2 hours) with a commercial fire of (30L/s for 4 hours).

In this study 15L/s (residential) and 30L/s (Commercial) fire fighting flows have been located at critical nodes at both MH and 2/3MH demands.

6.4 Storages and Pumps

The Queensland Water Resource Commission Guidelines (QWRC, 1989) recommended the following reservoir sizing criteria;

Ground Level Storage = 3 (MD-MDMM)

> This criterion implies that a ground level reservoir should not be emptied during a 3MD demand period.
>
> The recommended pump capacity for supplying ground level storages is MDMM over 20 hours.

Elevated Storage Volume = 6(MH-MDMM/12) + fire fighting reserve

> The fire fighting reserve is usually taken at 150kL (2hrs 40 minutes @ 15L/s) but smaller provisions are considered adequate for smaller schemes. Where a smaller fire fighting reserve is adopted an increase in pumping rate is usually provided to compensate ie;
>
> Pump/mains capacity (L/s) = (6MH – operating capacity)/6x3600
> The operating capacity of the elevated storage is taken as the total volume less fire fighting reserve.

The latest Queensland Water Supply and Sewerage Guidelines (DNRM, 2005) recommend the storage requirement as shown in **Table 6.1**.

- **Table 6.1 – DNRM Reservoir Capacity Requirements**

Scenario	Required Performance Criteria	Comment
1. 3 days at Mean Day Maximum Month	All reservoirs to have a positive net inflow at the end of each day	Commence reservoir level at 90% full at midnight (ie start of day 1)
2. Scenario 1 to be followed by 3 peak days	No reservoir should have failed during period of analysis	Scenarios 1&2 could be run using Peak Week if historical data available, rather than 3 peak days

Source: DNRM, 2005

For this study a 3MDMM plus 3MD dynamic network analysis has been used to confirm the sizing and operation of water infrastructure components.

6.5 Water Treatment

The QWRC guidelines (QWRC, 1989) recommended daily flow capacity for a water treatment plant is MDMM. For water treatment with a pumped raw water feed (like Biloela) this implies a treatment capacity of MDMM in 20hrs.

The latest guidelines do not include a treatment capacity recommendation, so the QWRC guidelines will be adopted.

7 Existing System Model

A network model of the Biloela water supply system has been set up using H_2OMap Water (Suite 6, Update No.2). The model includes Biloela, Callide Town, Thangool, raw water supply to the Water Treatment Plant and bore supplies.

7.1 Existing System

7.1.1 Pipes

There are approximately 580 pipes in the existing system model. There is approximately 74.3 km of reticulation mains in Biloela, Thangool and Callide Townships and 18.8 km of dedicated gravity and rising mains for bore and treated water delivery.

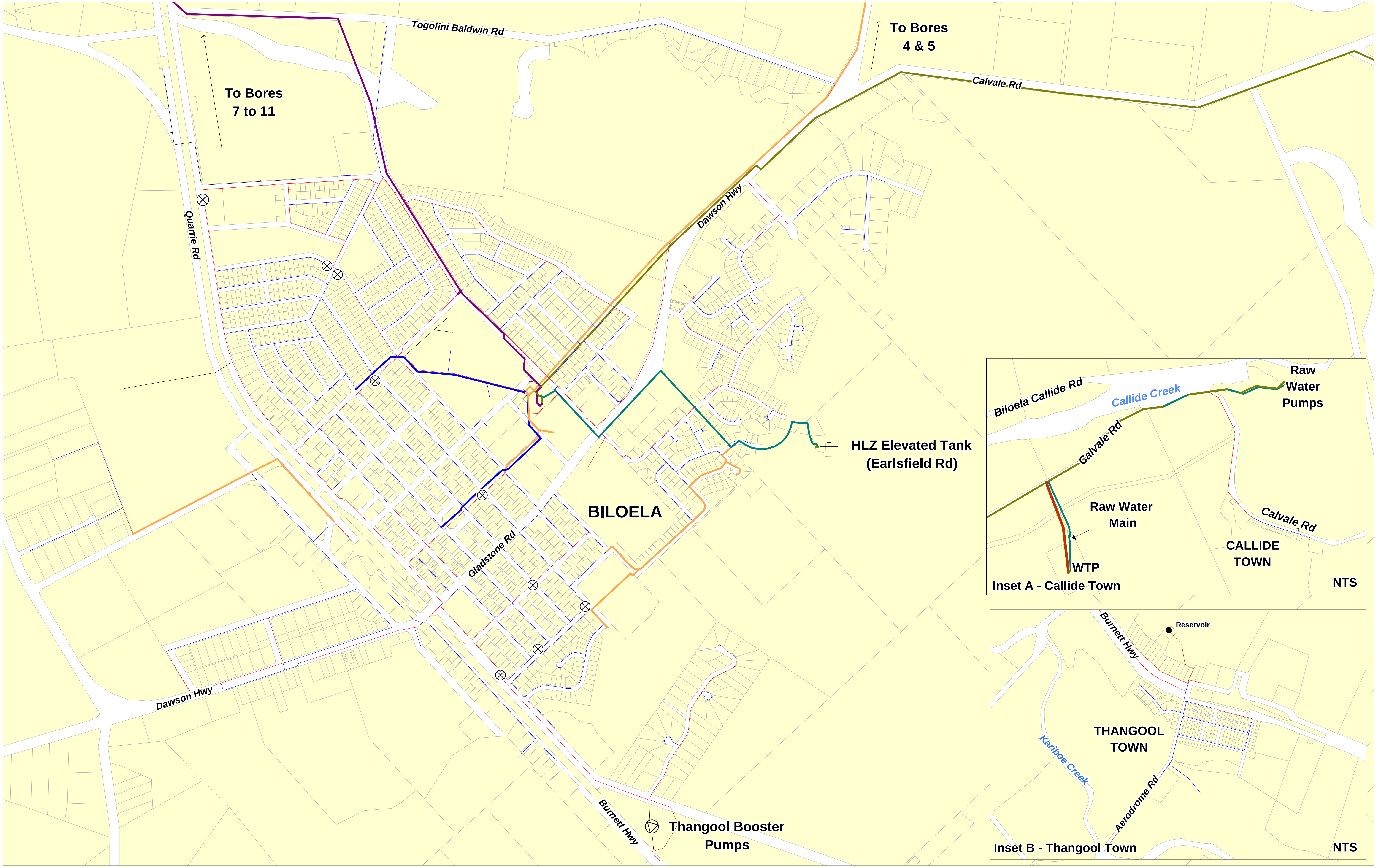
The pipe sizes range from 30 mm in diameter for small local off-takes to 375mm in diameter for trunk mains.

The adopted Hazen Williams coefficients are as follows;

- Pipes ≤ 200 mm diameter – C=110
- Pipes > 200 mm diameter – C=120

Nominal diameters have been adopted in the model for all types of pipes.

The pipe information was provided by Council in MapInfo and hardcopy format. The diameters of the reticulation network are shown graphically on **Figure 7.1**.



Legend

Cadastre
Zone Valve
Elevated Tank

Existing Water Network Pipe Diameters (mm)

Less than 80
100
150
200
225
250
300
375
450

N

0 0.5 1
Kilometres

Figure 7.1

Water Network Diameters

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7.1.2 Nodes

There are approximately 520 nodes in the existing system model. The elevations have been interpolated using H20Map from contour information provided by BSC. The elevations range from 165 m AHD in Biloela to 254 m AHD at the WTP.

7.1.3 Reservoirs

The model includes three reservoir and two elevated tanks (standpipes). The details included for each are;

Water Treatment Plant Clear Water Storage:

Elevation = 255.15m
Minimum Level = 1 m (RL = 256.15 m)
Maximum Level = 4.85 m (RL = 260.0 m)
Initial Level = 90% (4.37 m)
Diameter = 46.18m
Capacity = 2ML

State Farm Road Ground Level Reservoirs (No1 & 2):

Elevation = 188.63m
Minimum Level = 1 m (RL = 189.63 m)
Maximum Level = 6.27 m (RL = 194.9 m)
Initial Level = 90% (5.64 m)
Diameter = 46.18m
Capacity = 10.5 ML

Thangool Ground Level Reservoir

Elevation = 223m
Minimum Level = 0.5 m (RL = 223.5 m)
Maximum Level = 3 m (RL = 226 m)
Initial Level = 90% (2.7 m)
Diameter = 12 m
Capacity = 340 kL

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State Farm Road Elevated Tank:
Elevation = 189.4m
Minimum Level = 0 m (RL = 189.4 m)
Maximum Level = 24.8 m (RL = 214.2 m)
Initial Level = 90% (22.32 m)
Diameter = 7.93 m
Capacity = 1.36ML

Earlsfield Street Elevated Tank:
Elevation = 204.13m
Minimum Level = 0 m (RL = 204.13 m)
Maximum Level = 29.97 m (RL = 234.1 m)
Initial Level = 90% (26.97 m)
Diameter = 9.7 m
Capacity = 1.95 ML

7.1.4 Water Sources

The model includes two water sources, the bores and the WTP. The flow from the bore field has been modelled at 26L/s and the flow from the water treatment plant into the WTP clear water storage has been modelled at 120L/s. The model includes the gravity treated water main from the clear water storage to both Callide Town and Biloela. A flow control valve has been included so that the flow to Biloela is limited to 55L/s.

The settings to start and stop the bore and WTP sources are as follows:

WTP Clear Water Storage – WTP Source
Open: Water Level = 72%, 3.5 m (RL = 258.65 m)
Closed: Water Level = 86% 4.15 m (RL= 259.3 m)

State Farm Road Ground Level Reservoirs –Biloela Bores and Treated Water Control Valve:
Open both sources: Water Level = 90% 5.64 m (RL=194.27 m)
Close both sources: Water Level = 100%, 6.27 m (RL = 194.9 m)

7.1.5 Pumps & Rising Mains

Three pumps have been included in the Biloela Water Supply Model as described below.

State Farm Road Booster Pump (LLZ Pumps)

The State Farm Road Booster Pumps are 1967 Harland Uniglide pumps. A pump curve is not available for these pumps but the design duty point is said to be:

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1235gallons/minute at 66.5 ft head (ie 93.4L/s at 20.27 m head)

When this single duty point was included in the model there was insufficient head and flow to fill the Earlsfield Rd Tank because the model developed an inappropriate pump curve for that duty. However if a constant power input of 20kW is used the pump performance was as expected.

Only one pump operates at any given time.

The pumps are controlled by the level in the State Farm Road Elevated Tank as follows;
On: Water Level = 90%, 22.32 m (RL= 211.72 m)
Off: Water Level = 99%, 24.55 m (RL = 213.95 m)

The State Farm Road Boosters are connected to a 300 mm which reduces to a 200mm diameter main prior to connecting into the low level pressure zone reticulation just before the elevated tank.

Earlsfield Street Booster Pump (HLZ Pumps)
The Earlsfield Street Booster Pumps are both Uniflow UFC 8/8 pumps. The performance curve for these pumps is included in **Appendix E**. Only one pump operates at any given time.

The pumps are controlled by the level in the Earlsfield Street Elevated Tank as follows;
On: Water Level = 90%, 26.97 m (RL= 231.31 m)
Off: Water Level = 99%, 29.67 m (RL = 234.08 m)

The Earlsfield Street Boosters are connected to a 375mm diameter rising main which connects into the high level pressure zone reticulation at two locations as follows;
- To the 100mm diameter main near the GL Reservoirs along State Farm Road
- To the 200mm diameter main in Earlsfield Street.

The location of the connections is shown on **Figure 2.2.**

Thangool Booster Pumps
There are four Grundfos CR16-40U pumps which supply flow to Thangool. The reservoir at Thangool is currently out of service as it leaks. However the reservoir is in the process of being fixed so for the purposes of this study it has been assumed it is operating. The pumps are controlled by the levels in the Thangool reservoir as follows:

On: Water Level = 67%, 2 m (RL= 225 m)
Off: Water Level = 100%, 3 m (RL = 226 m)

The pumps connect to 11.6 km of 150 mm diameter main which connects to Thangool. Two booster pumps operating simultaneously have been included in the model.

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The booster pump performance curve is included in **Appendix E**.

7.1.6 Zones & Valves

The HLZ and LLZ areas in Biloela are separated by 13 closed zone valves. H2OMap does not include a gate valve as an option, it only allows you to open and close pipes. As a result the zone valves have been modelled as pressure reducing valves set to close. This is so the closed pipes can be seen visually within the model (closed pipes can not be easily identified).

Figure 2.2 shows the Biloela HLZ, LLZ and the location of the zone valves.

7.1.7 Demands

The adopted demands for the existing water supply system are as shown in **Table 4.12 – Adopted Biloela Demands (Existing).** These are summarised in **Table 7.1** below.

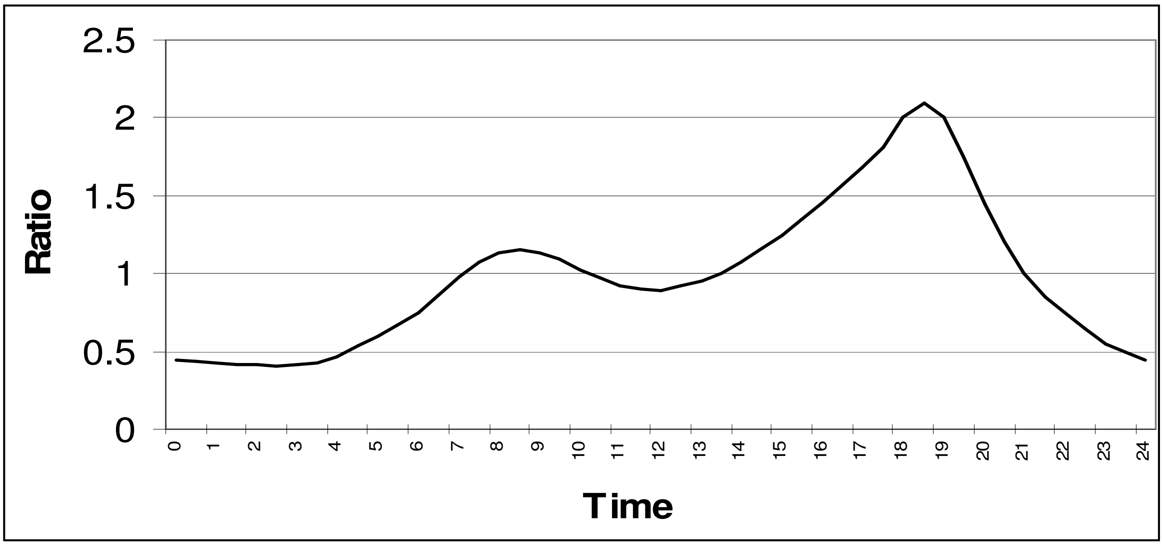
- **Table 7.1 – Adopted Biloela Demands (Existing System Model)**

Category	Adopted Demands (ML/yr)	Adopted Demand Curve	AD (L/s)	MD (L/s)	MH[(1)] (L/s)
Residential	972	Residential	30.82	69.35	145.62
Rural Residential	118	Residential	3.75	8.44	17.72
Industrial	25	Non-Domestic	0.79	1.78	1.94
Commercial	83	Non-Domestic	2.63	5.92	6.45
Parks and Gardens & Agricultural	43[(2)]	Non-Domestic	1.36	3.06	3.34
Individual Consumers	288	Non-Domestic	9.13	20.54	22.39
Total Biloela	**1615**	**-**	**48.48**	**109.08**	**197.46**
Thangool	70	Residential	2.22	5.00	10.49
Callide Town	15	Residential	0.48	1.08	2.27
TOTAL	**1700**	**-**	**51.18**	**115.16**	**210.22**
Total Demand in Model	**-**	**-**	**51.01**	**114.77**	**209.84**

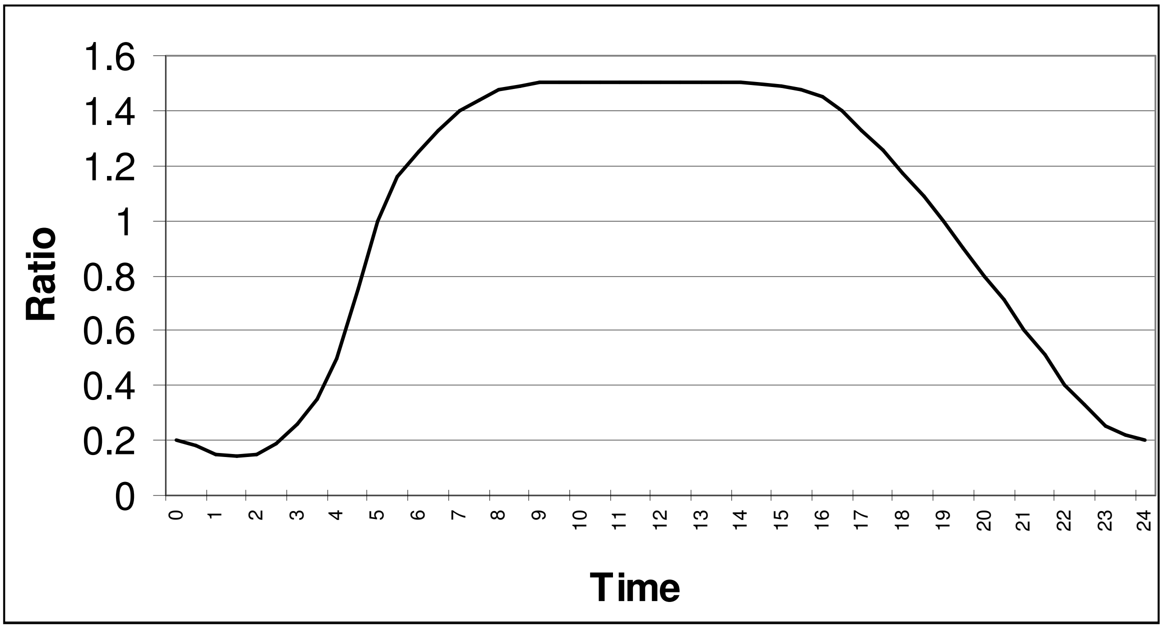
Note: (1) MH is 18:30 when the peaking factors are: Residential is 2.1 and Non-Domestic 1.09.
(2) Demand is 1/3 of total demand as not all parks would be irrigated the same day.

H_2OMap does not have standard demand curves. The adopted curves are from the WATSYS water supply modelling software. The curves are diurnal curves and are shown graphically in **Figure 7.2** and **Figure 7.3**.

- **Figure 7.2 – Residential Diurnal Demand Curve**



- **Figure 7.3 – Non-Domestic Diurnal Demand Curve**



8 Existing System Model Results

8.1 Verification

There is limited data available to verify the existing system model. Council has provided RADTEL data (for 2004) for the Thangool Booster Pumps, the Earlsfield Street Elevated Tank and the WTP Clear Water Storage. As shown in **Table 4.2** the month with the maximum flow from the water treatment plant was October 2004. A review of the data provided showed that October 14 was the Maximum Day for 2004.

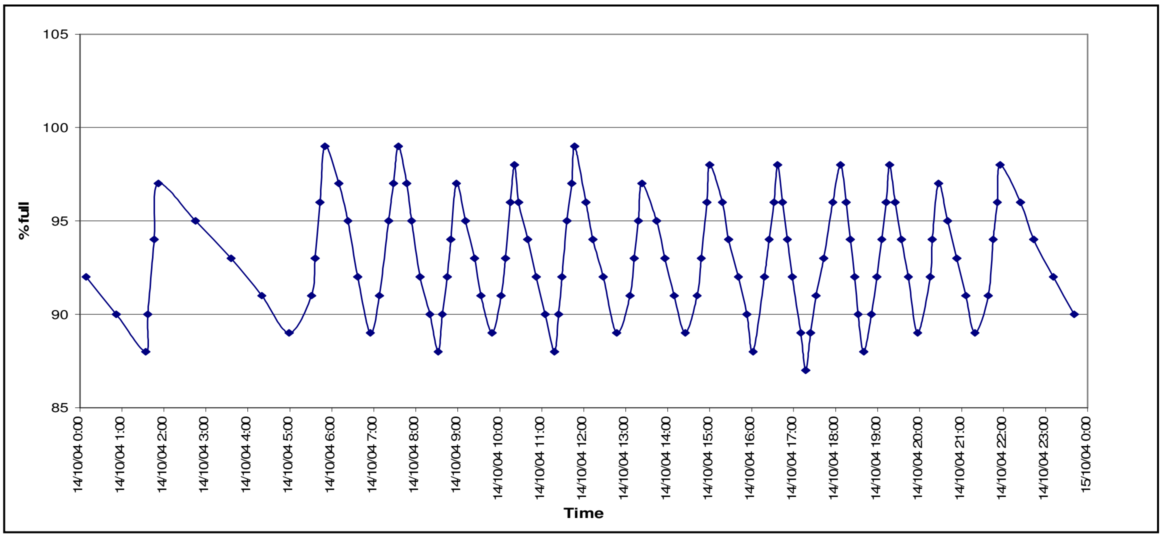
8.1.1 Thangool Booster Pumps

The data provided for the Thangool Booster pump can not be used for verification of the model. This is because there is a reservoir modelled for Thangool which is currently not in place.

8.1.2 Earlsfield Street Elevated Tank

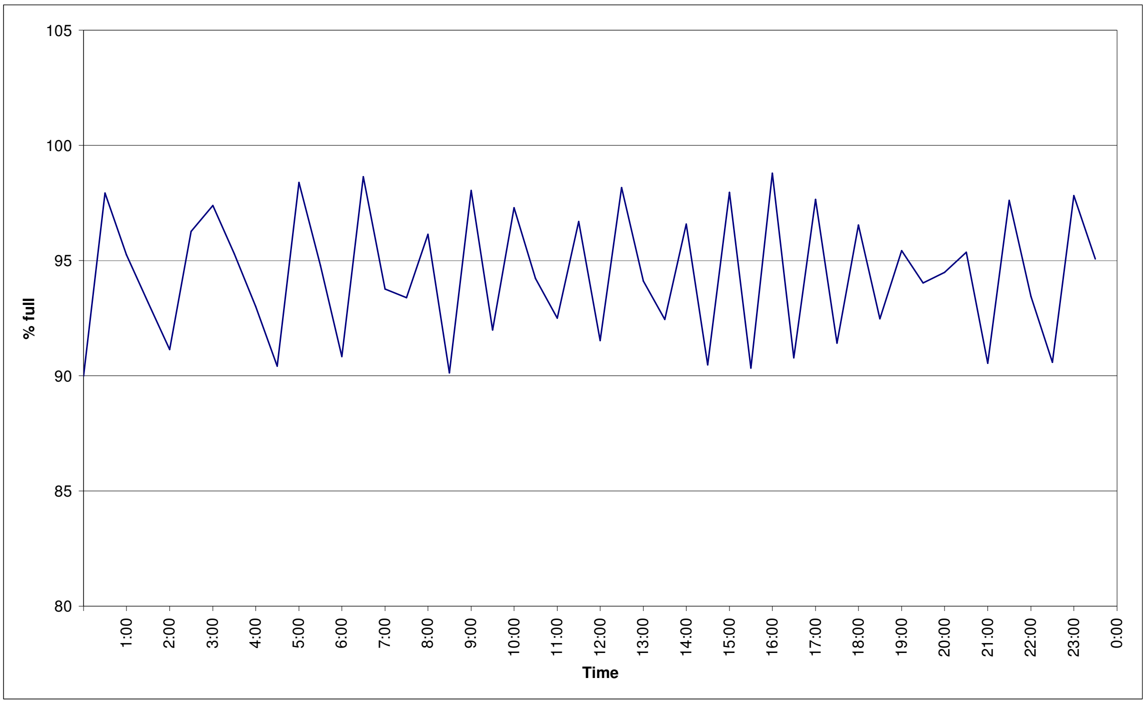
The water level data provided by Council for the Earlsfield Street Elevated Tank is relatively consistent and considered suitable for use. This data for 14 October 2004 is similar to the majority of the data provided for 2004. There were just two days (29 February and 19 October 2004) when levels in the reservoir dropped significantly to 54% and 42% respectively (both at approximately 7:00 am). Given that both large drops occurred during low demand periods it is likely that they happened as a result of an operation or maintenance incident, so the data for these periods have not been considered further. The water levels for 14 October 2004 are shown graphically in **Figure 8.1**.

- **Figure 8.1 – RADTEL Data Earlsfield Elevated Tank (14 October 2004)**



The modelled operation of the Earlsfield Elevated Tank is shown in **Figure 8.2**. The figure shows quite a good correlation between the RADTEL data and the model output.

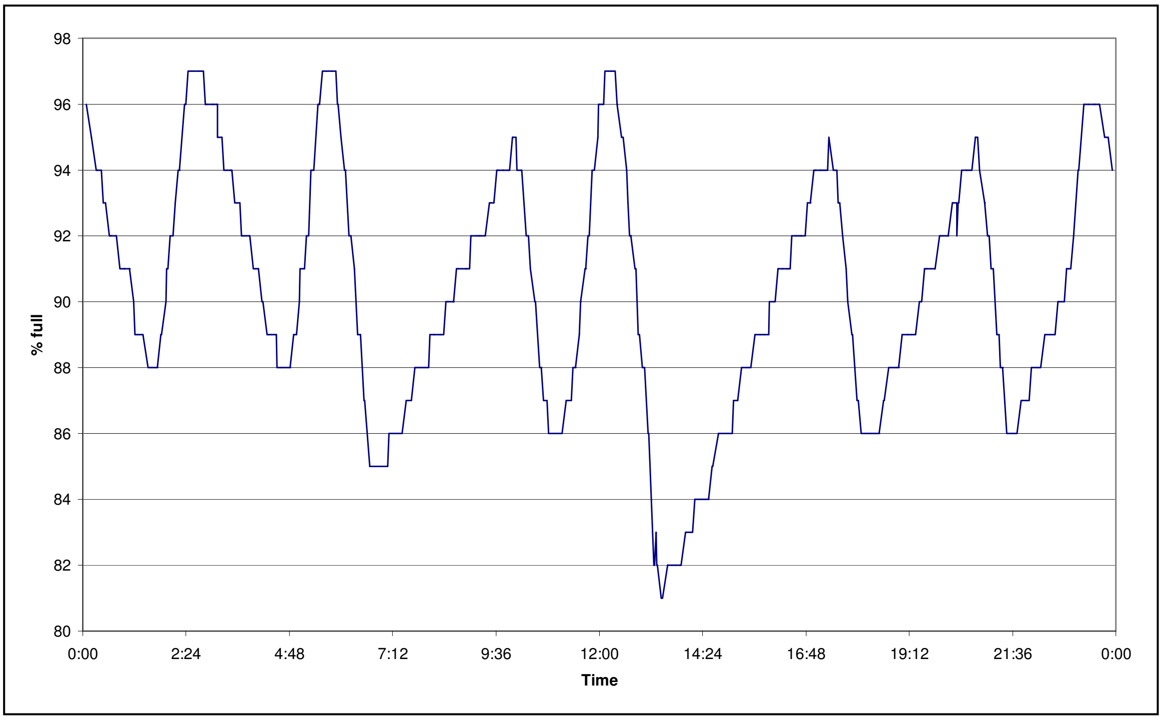
- **Figure 8.2 – Earlsfield Elevated Tank Model MD output**



8.1.3 WTP Clear Water Storage

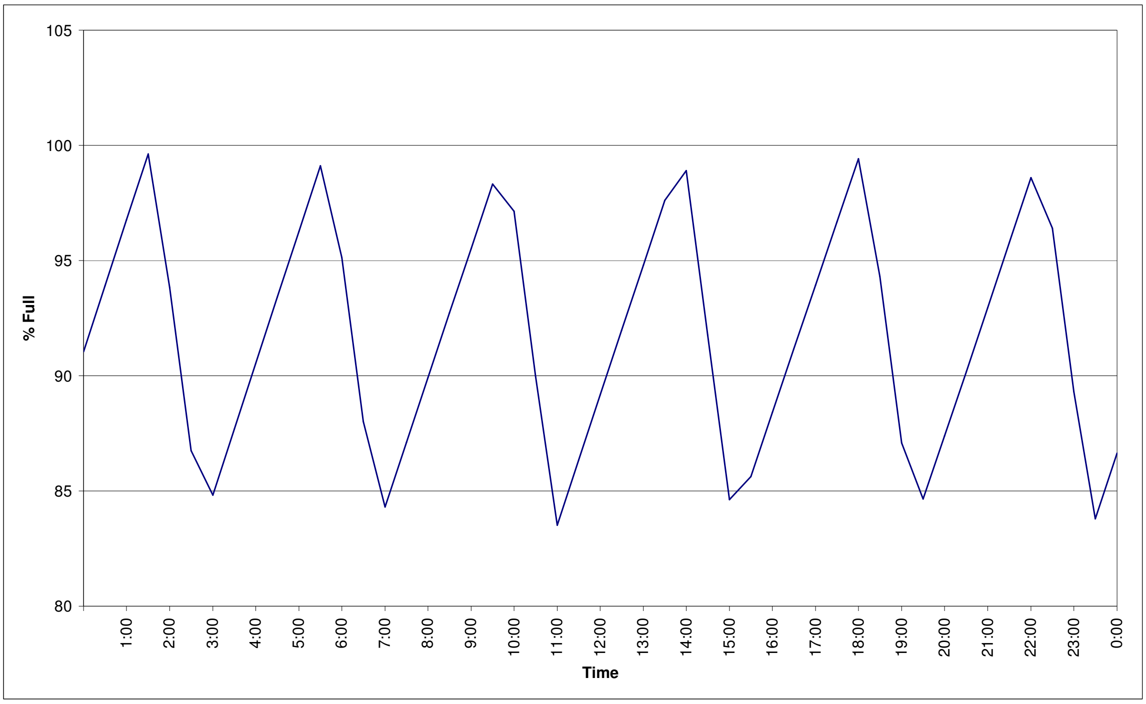
As for the Earlsfield Reservoir 14 October 2004 data, has been adopted for model verification purposes. The water level data provided by Council are shown graphically in **Figure 8.3**.

- **Figure 8.3 – RADTEL Data WTP Clear Water Storage (14 October 2004)**



The modelled operation of the WTP Clear Water Storage is shown in **Figure 8.4**. The figure shows quite a good correlation between the RADTEL data and the model output.

- **Figure 8.4 – WTP Clear Water Storage Model MD output**



8.2 Hydraulic Analysis

8.2.1 Residual Pressures

The topography of Biloela, Thangool and Callide is shown on **Figure 8.5 – Biloela Topography** and **Figure 8.6 – Thangool and Callide Town Topography**.

Legend

5m Index Contour

1m Intermediate Contour

SINCLAIR KNIGHT MERZ

SKM

0 0.5 1

Kilometres

N

Figure 8.5

Biloela Topography

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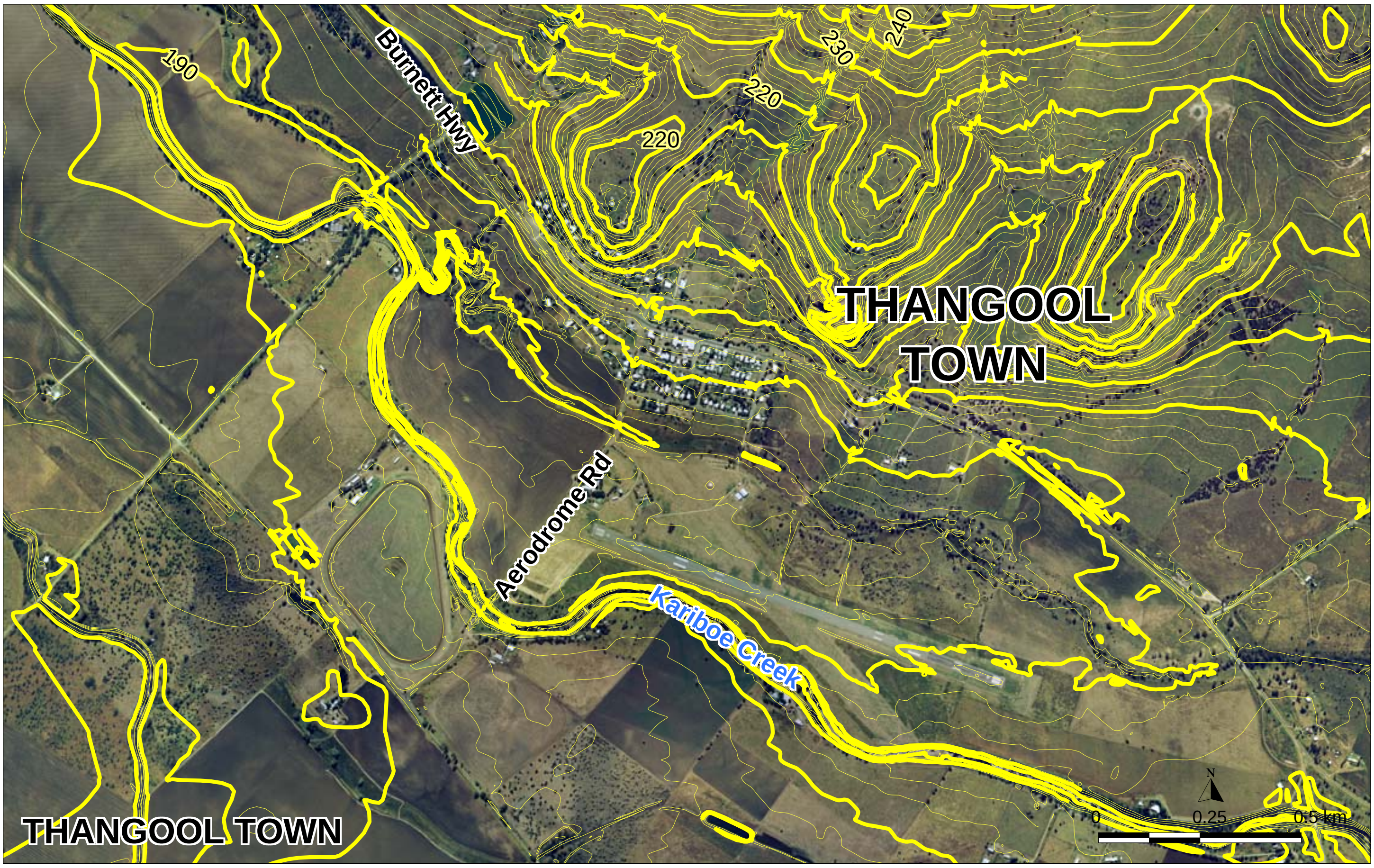

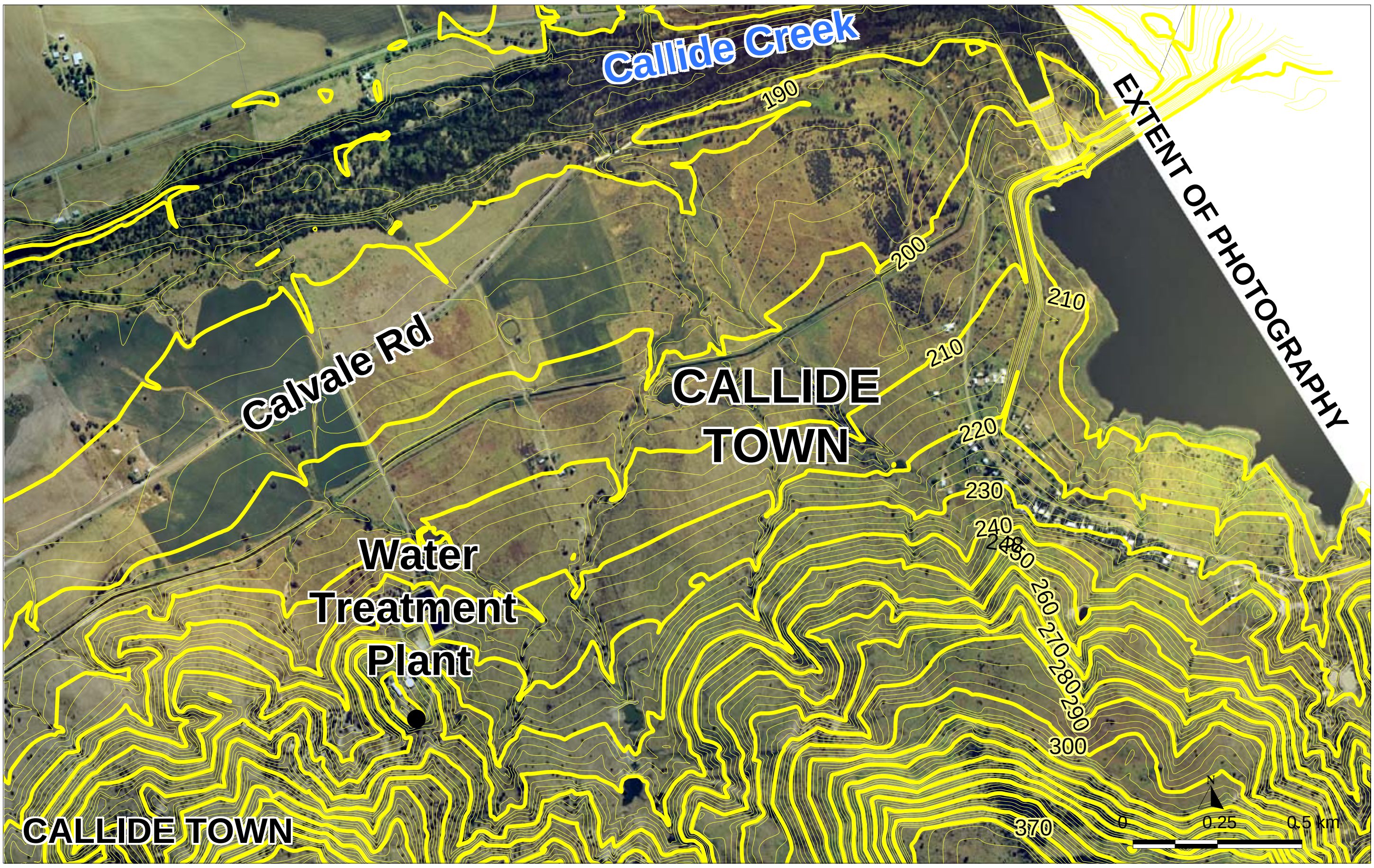

Legend

- 5m Index Contour
- 1m Intermediate Contour

SINCLAIR KNIGHT MERZ
SKM

Figure 8.6

Thangool & Callide Town Topography

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8.2.1.1 Biloela

The ranges of residual pressures at MH for Biloela Town, when the HLZ Booster Pump and Thangool Booster Pumps are off, are shown in **Figure 8.7**.

The figure shows that there are several areas in Biloela where residual pressures are less than Council's Standard of Service target of 22m head. These are;

- The end of Lawrence St and Kothmann Ct where pressures are about 17.5 m
- Along Ebony Way and the cul-de-sacs off of it where the residual pressures are about 18 m
- An area at the corner of Tiamby St and State Farm Road also has pressures of about 21.7m.

The residual pressures provided in the HLZ are sensitive to the level of the Earlsfield St Elevated Tank. The above pressures occur when the depth in the Earlsfield Reservoir is 27.45m (91.6% full) - changes in the level of the reservoir result in an equivalent change in pressures in the HLZ.

If the Earlsfield Street booster pump is operational, pressures throughout the high level zone are all above 22m at MH.

If the Thangool booster pumps are "on" the pressures in Hills Avenue area drop to about 12m at MH and are below 22m from 17:30 to 19:30 on MD.

The pressures in the three areas listed above also drop an additional 1.5m if the Thangool Booster pumps are on at MH.

The minimum pressure recommended by the DNRM Guidelines (DNRM,2005) is 20m. The QWRC Guidelines (QWRC, 1989) recommend a minimum of 16m for elevated or isolated areas.

8.2.1.2 Thangool

The model results show that there are no pressure problems in Thangool which has minimum residual pressures at MH of 22.7 m.

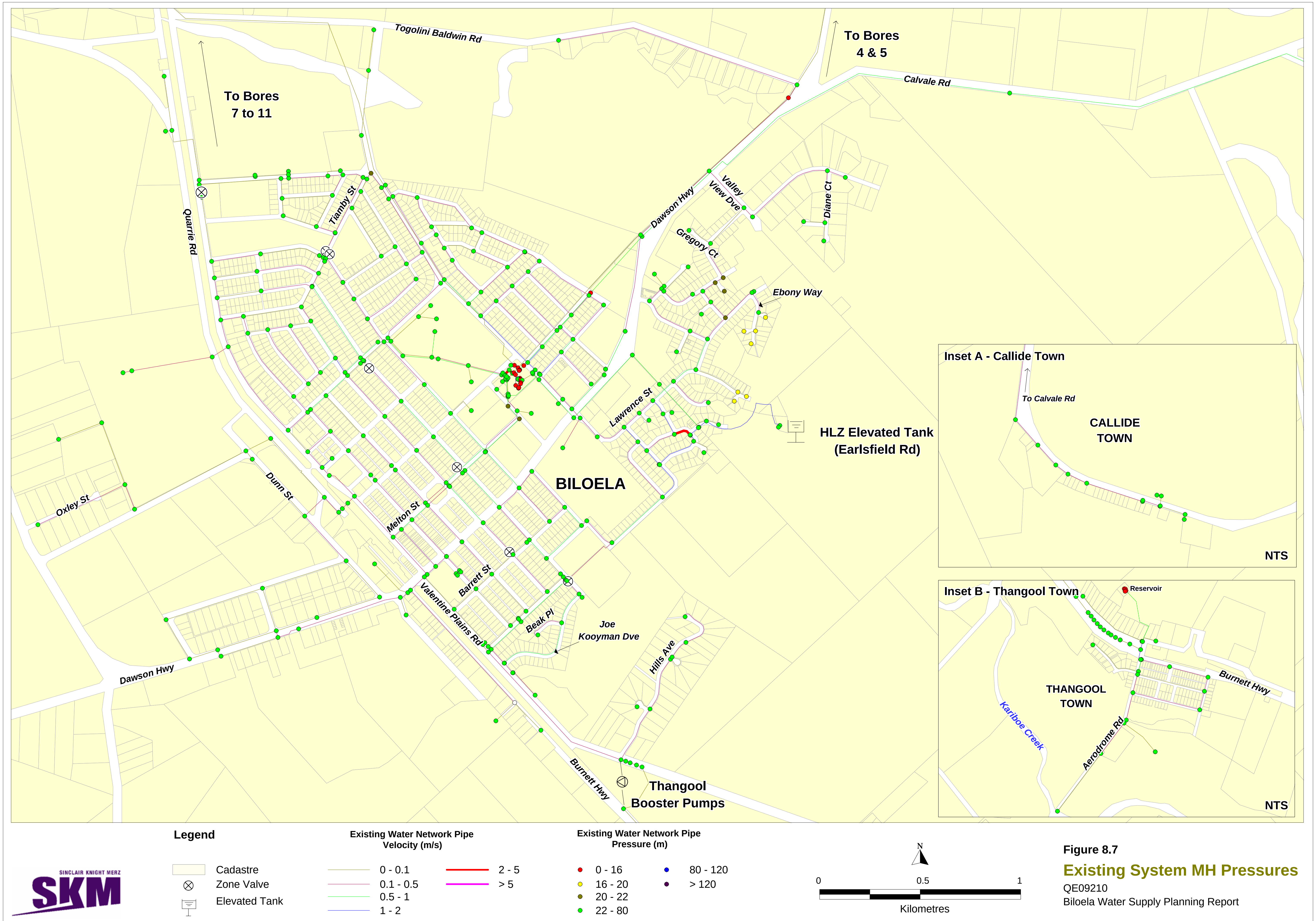

Figure 8.7

Existing System MH Pressures

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8.2.1.3 Callide Town

The residual pressures at MH for Callide Town are all above 22m with a minimum pressure of 25m at the end of the system. This occurs when the Callide Power Station demands are a constant 33 L/s. If demands from the power station increase Council may need to consider limiting the rate of flow (with a flow control valve) to avoid low pressures in Callide Town.

8.2.2 Reservoir and Booster Pump Sizing

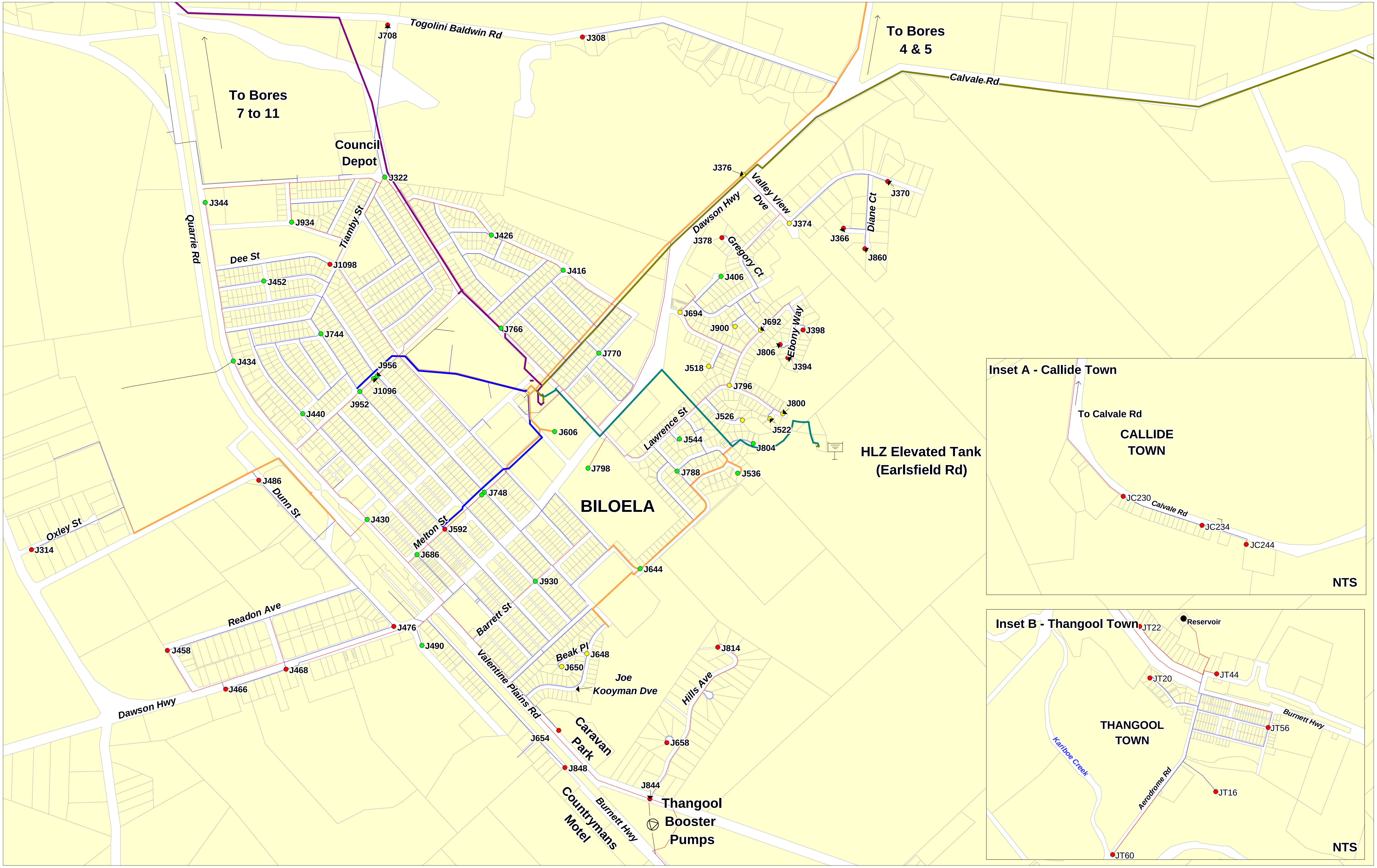
Based on the latest DNRM Guidelines (DNRM, 2005), all storages should not fail when running 3 MDMM (initial water levels at 90%) followed by 3MD. This analysis was completed for the existing system and all booster pumps and storages are considered to be appropriately sized for existing demands. The reservoir levels for the six day demand period are included in **Appendix F**.

8.2.3 Fire Flow Analysis

Fire demands of MH plus 15L/s and 30 L/s (for residential and commercial properties respectively) were placed through out the water supply network on nodes which are likely to be critical. The location of the selected nodes is shown on **Figure 8.8**.

Given the system would have been designed to the original QWRC Guidelines (QWRC, 1989) an analysis has also been completed using 2/3 MH demands.

The complete results of the analysis are attached in **Appendix G**.



Legend

Cadastre	
Zone Valve	
Elevated Tank	

Fire fighting demand locations

- Able to provide fire flow
- Unable to provide Fire Flows at 2/3 MH
- Unable to provide Fire Flows at MH

Existing Water Network Pipe Diameters (mm)

Less than 80	225
100	250
150	300
200	375

N

0 0.5 1

Kilometres

Figure 8.8

Fire Fighting Demand Locations

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SKM

8.2.3.1 Biloela

A summary of the results for Biloela is included in **Table 8.1**.

- **Table 8.1 – Biloela Existing System Fire Fighting Demand Model Results**

Critical Area	Nodes[(1)]	MH + Fire Fighting Demands			2/3 MH + Fire Fighting demands		
		Total Demand (L/s)	Head with Fire Flow (m)	Available Flow (L/s) @ 12m head	Total Demand (L/s)	Head with Fire Flow (m)	Available Flow (L/s) @ 12m head
Hills Avenue	J814	19.2	-ve	13.1	17.8	6.5	16.3
	J658	15.0	-ve	9.2	15.0	6.9	13.6
	J844	15.0	-ve	10.6	-	OK	OK
Valentine Plains Rd	J654	16.7	-ve	13.1	-	OK	OK
The Bruce Highway (near Countryman's Motel)	J848	30.5	-ve	8.4	30.4	-ve	9.5
Commercial and industrial area near Readon Avenue and Dawson Highway	J458	30.3	-ve	21.2	30.2	2.2	24.9
	J466	30.5	-ve	21.5	30.4	3.3	25.3
	J468	30.5	2.9	24.2	30.3	9.8	28.8
	J476	30.2	-ve	17.5	30.2	-ve	20.6
End of Oxley St	J314	16.2	3.3	14.0	15.8	9.4	15.1
End of Dunn Street	J486	30.0	-ve	14.0	30.0	-ve	15.5
Eastern end of Dee St (near the zone valve)	J1098	15.0	-ve	11.0	15.0	2.6	12.5
End of State Farm Rd past the Council Depot	J708	15.0	-ve	11.5	15.0	8.9	14.4
Crn State Farm Rd and Auburn St	J322	15.4	11.6	14.9	-	OK	OK
End Tognolini Baldwin Drive	J308	16.4	-ve	8.6	15.9	-ve	10.3
Hospital	J606	31.4	6.8	23.5	-	OK	OK
End of Heaton St	J406	15.4	0.8	9.6	-	OK	OK
End of Gregory Court	J378	15.4	8.5	11.8	-	OK	OK
Annandale Ct	J544	15.3	11.4	14.0	-	OK	OK
Meeting of Coreen and Dresdon Sts	J934	15.4	11.9	15.2	-	OK	OK
Diane Ct	J370	15.9	-ve	6.5	15.6	-ve	10.8
	J366	15.6	-ve	5.3	15.4	-ve	9.4
	J860	15.5	-ve	5.0	15.3	-ve	8.4
Ebony Way	J398	15.4	-ve	6.8	15.3	8.5	13.5
	J806	15.4	-ve	6.3	15.3	3.7	11.9
	J394	15.0	-ve	5.0	15.0	1.2	10.7

Critical Area	Nodes[1]	MH + Fire Fighting Demands			2/3 MH + Fire Fighting demands		
		Total Demand (L/s)	Head with Fire Flow (m)	Available Flow (L/s) @ 12m head	Total Demand (L/s)	Head with Fire Flow (m)	Available Flow (L/s) @ 12m head
The area after the Crn Dawson Hwy and Valley View Drive.	J374	16.1	8.3	13.3	-	OK	OK
	J376	15.6	9.3	12.6	-	OK	OK
The high level area after the corner of Lawrence St and Carige Ct	J518	15.4	5.0	11.0	-	OK	OK
	J522	15.4	2.6	7.3	-	OK	OK
	J526	15.8	0.8	9.75	15.5	11.6	15.3
	J692	15.0	6.2	8.3	-	OK	OK
	J694	15.8	7.1	9.7	-	OK	OK
	J796	16.6	7.5	10.4	-	OK	OK
	J800	15.3	5.3	8.0	-	OK	OK
	J900	15.4	4.7	10.8	-	OK	OK

Note: (1) Only nodes with fire fighting demands are included here

The table shows that there are areas in Biloela with limited fire fighting capacity. Dead end mains are a problem, Diane Ct and Ebony Way are particularly week areas.

8.2.3.2 Thangool and Callide

A summary of the results for Thangool and Callide are included in **Table 8.2**.

- **Table 8.2 – Callide & Thangool Existing System Fire Fighting Demand Model Results**

Critical Area	Nodes[1]	MH + Fire Fighting Demands			2/3 MH + Fire Fighting demands		
		Total Demand (L/s)	Head with Fire Flow (m)	Available Flow (L/s) @ 12m head	Total Demand (L/s)	Head with Fire Flow (m)	Available Flow (L/s) @ 12m head
Thangool	JT56	15.6	-ve	9.5	15.4	6.4	12.1
	JT60	15.6	-ve	7.0	15.4	-ve	8.5
Callide Town	JC230	15.2	9.3	13.5	-	OK	OK
	JC234	15.2	-ve	7.8	15.2	-ve	8.7
	JC244	15.2	-ve	6.7	15.2	-ve	7.4

The table shows that there is limited fire fighting capacity in Thangool at the airport and at the end of the town supply.

There is also limited fire fighting capability at Callide Town. The losses through the main to Callide Town are the major reason.

8.2.3.3 Conclusions

The results show that there is a significant difference between the results using MH and 2/3 MH as the design criteria.

Even when 2/3 MH is adopted there are still deficiencies in the system. These deficiencies are largely due to the head losses in 100mm diameter mains. As with most towns many of the water mains are 100mm diameter.

The ability of the fire brigade to fight fires is affected by the availability of water which varies during the day. The above analyses are "stringent" tests and the system will have better performance at other times of the day.

Council should discuss the fire fighting capabilities with the local fire brigade (and possibly undertake trials) to determine if additional upgrade works are required in the short term to improve the fire fighting capabilities.