5.2.2 Lower Mgeni System

Description

The Lower Mgeni System (**Figure 5.7** and **Figure 5.8**) serves the greater eThekwini Municipal area from lower Pinetown/KwaDabeka in the west, to Phoenix/Inanda/Verulam in the north, to the Durban seaboard in the east and to Amanzimtoti/KwaMakuta in the south. It also provides water to the northern coastal areas of Ugu District Municipality. The system derives its water resources from the uMngeni River, being fed from Nagle and Inanda Dams, which are supported by Albert Falls Dam, Midmar Dam and the MMTS.

Water is treated at Umgeni Water's Durban Heights WTP (**Table 5.24**) located in Westville, Wiggins WTP (**Table 5.25**) located in Cato Manor and Maphephethwa WTP (**Table 5.26**) located in the Inanda Dam area. Umgeni Water sells water to eThekwini Municipality "at the fence" of these WTPs and thus does not own nor operate the bulk distribution pipelines downstream of these WTPs. However, operational and infrastructure changes within the eThekwini Municipality's system, which is served by these WTPs, have a profound influence on the WTPs operational and infrastructure requirements.

In recent years considerable effort (Umgeni Water in collaboration with eThekwini Municipality) has gone into optimising the overall efficiency of the distribution system to share the load better between the two WTPs. One of these initiatives has involved the transfer of demand from areas previously supplied from Durban Heights WTP onto Wiggins WTP. This demand transfer commenced in January 2005 and involved the transfer of 40 - 60 Mℓ/day onto Wiggins WTP.

Table 5.24 Characteristics of the Durban Heights WTP.

WTP Name:	Durban Heights WTP
System:	Lower Mgeni System
Maximum Design Capacity:	615 Mℓ/day
Current Utilisation:	490.84 Mℓ/day
Raw Water Storage Capacity:	0 Mℓ
Raw Water Supply Capacity:	710 Mℓ/day
Pre-Oxidation Type:	Prechlorination
Primary Water Pre-Treatment Chemical:	Polymeric Coagulant
Total Coagulant Dosing Capacity:	Other
Rapid Mixing Method:	Hydraulic Jump
Clarifier Type:	Pulsator Clarifier
Number of Clarifiers:	18
Total Area of all Clarifiers:	6580 m^2
Total Capacity of Clarifiers:	611 Mℓ/day
Filter Type:	Constant Rate Rapid Gravity Filters
Number of Filters:	100
Filter Floor Type	Plate Design
Total Filtration Area of all Filters	6227 m^2
Total Filtration Design Capacity of all Filters:	615 Mℓ/day
Total Capacity of Backwash Water Tanks:	2326 m^3
Total Capacity of Sludge Treatment Plant:	30 000 kg/day of thin sludge
Capacity of Used Washwater System:	25.2 Mℓ/day
Primary Post Disinfection Type:	Chlorine gas
Disinfection Dosing Capacity:	
Disinfectant Storage Capacity:	24 ton
Total Treated Water Storage Capacity:	506 Mℓ

Table 5.25 Characteristics of the Wiggins WTP.

WTP Name:	Wiggins WTP
System:	Lower Mgeni System
Maximum Design Capacity:	350 Mℓ/day
Current Utilisation:	238.03 Mℓ/day
Raw Water Storage Capacity:	0 Mℓ
Raw Water Supply Capacity:	350 Mℓ/day
Pre-Oxidation Type:	Ozone
Primary Water Pre-Treatment Chemical:	Polymeric Coagulant
Total Coagulant Dosing Capacity:	Polymeric Coagulant
Rapid Mixing Method:	Hydraulic Jump
Clarifier Type:	Pulsator Clarifier
Number of Clarifiers:	4
Total Area of all Clarifiers:	3980 m^2
Total Capacity of Clarifiers:	360 Mℓ/day
Filter Type:	Constant Rate Rapid Gravity Filters
Number of Filters:	24
Filter Floor Type	Monolithic
Total Filtration Area of all Filters	6688 m^2
Total Filtration Design Capacity of all Filters:	350.16 Mℓ/day
Total Capacity of Backwash Water Tanks:	
Total Capacity of Sludge Treatment Plant:	
Capacity of Used Washwater System:	2.78 Mℓ/day
Primary Post Disinfection Type:	Hypochlorite
Disinfection Dosing Capacity:	240 l/hr
Disinfectant Storage Capacity:	
Total Treated Water Storage Capacity:	248 Mℓ

Table 5.26 Characteristics of the Maphephethwa WTP.

WTP Name:	Maphephetwa WTP (existing)	Maphwphetwa WTP (upgrade)
System:	Lower Mgeni System	Lower Mgeni System
Maximum Design Capacity:	1.2 Mℓ/day	5 Mℓ/day
Current Utilisation:	1.75 Mℓ/day	
Raw Water Storage Capacity:	None	None
Raw Water Supply Capacity:	2 Mℓ/day	5 Mℓ/day
Pre-Oxidation Type:	None	Chlorine
Primary Water Pre-Treatment Chemical:	None for slow sand filters, Aluminium Sulphate	Aluminium Sulphate
Total Coagulant Dosing Capacity:	None	250 kg/day at 50 mg/l (maximum)
Rapid Mixing Method:	In line mixing	Flow over weirs
Clarifier Type:	None	circular clarifiers with mechanical sludge scrapers
Number of Clarifiers:		2
Total Area of all Clarifiers:		226 m2
Total Capacity of Clarifiers:		5 Mℓ/day
Filter Type:	Slow Sand Filters	Rapid Gravity Filters
Number of Filters:	4	4
Filter Floor Type	PVC piping	Monolithic
Total Filtration Area of all Filters	Slow Sand filters: 523 m2	50 m2
Total Filtration Design Capacity of all Filters:	Slow Sand filters: 0.75 Mℓ/day AVGFs: 0.5 Mℓ/day	5 Mℓ/day
Total Capacity of Backwash Water Tanks:	N/A (Slow sand filters do not backwash)	195 m3
Total Capacity of Sludge Treatment Plant:	None	5 Mℓ/day
Capacity of Used Washwater System:	N/A	11.7 m3/day
Primary Post Disinfection Type:	Gaseous Chlorine	Gaseous Chlorine
Disinfection Dosing Capacity:		1.5 kg/hr
Disinfectant Storage Capacity:	70 kg cylinders	70 kg cylinders with automatic changeover
Total Treated Water Storage Capacity:	1 Mℓ	2.5 Mℓ

Status Quo and Limitations

Durban Heights Water Treatment Plant

Of major concern at Durban Heights WTP is the Northern Aqueduct which serves as a key bulk water main supplying eThekwini Municipality. Currently the aqueduct conveys approximately 260Mℓ/day of the total volume sold to eThekwini Municipality and it serves the major northern growth areas of Newlands, KwaMashu, Ntuzuma, Phoenix, Durban North and Umhlanga.

With the increasing growth in demand in the supply areas of the Northern Aqueduct over the past two years, particular branch nodes off the system experience low residual pressures. At eThekwini Municipality's request, Umgeni Water has commissioned the Durban Heights Booster Pump Station immediately downstream of Durban Heights Reservoir 3. This pump station ensures that a minimum pressure of 272 mASL is maintained at all of Reservoir 3 sales points, whilst Reservoir 3 is allowed to operate within reasonable levels. However, hydraulic analysis suggest that this measure may not prevent the problematic downstream reservoirs from running empty, as eThekwini Municipality's secondary booster pump stations and pipelines serving these areas (e.g. Ntuzuma NR2 Reservoir, Durban North High Level Reservoir and Umhlanga 2 Reservoir) are currently undersized. Other alternatives may also have to be investigated in the future.

Compounding this problem is the fact that eThekwini Municipality anticipates water demand growth along the Northern Aqueduct to accelerate considerably with the Dube Tradeport and the King Shaka International Airport acting as catalysts (**Section 3.3.1**). eThekwini Municipality has identified this area as a major growth area and is making contingency plans to augment the supply in the Northern Aqueduct System. However, due to urban development along the route of the aqueduct, there are now severe space constraints, and it will be difficult to construct a second pipeline along the same route.

Whilst eThekwini Municipality plan to transfer the current demands of KwaDabeka and the NR2 (Inanda) supply zones off Durban Heights WTP and onto the proposed Western Aqueduct, the approximate 70 Mℓ/day that will initially be freed up may be required to meet the increasing demands of other nodes in the northern areas. These include the demands of new housing developments in the Verulam/Tongaat area, Grange and that of the proposed Dube Tradeport.

An analysis of historical production for the Durban Heights WTP (December 2011 to November 2012) is presented in **Figure 5.22**, and shows that for 39% of the time the WTP was being operated above the optimal operating capacity (80% of design capacity) and 0% of the time the WTP was operated at above design capacity. The previous year Durban Heights WTP was operating above the optimal operating capacity for 46% of the time and 1% of the time above the design capacity. This indicates that the demand off the WTP has been decreasing.

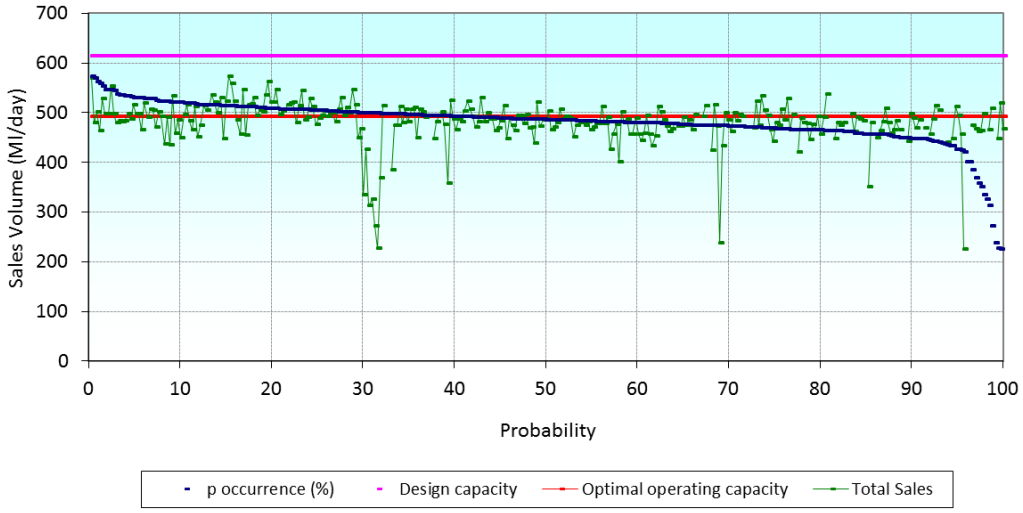

Figure 5.22 Analysis of historical production at Durban Heights WTP from December 2011 to November 2012.

Over the past 48 months, eThekwini Municipality have made significant investments in various water loss reduction projects, with further spending planned in the future. Among their 16 dedicated interventions for curtailing water loss is the Asbestos Cement Pipe Replacement Programme. A new pressure management system and improved customer billing have also been introduced. The reduction in water purchases from Umgeni Water has become evident in the 2011/2012 financial year. This is noted in the downward trend of the 12-month moving average in **Figure 5.23**.

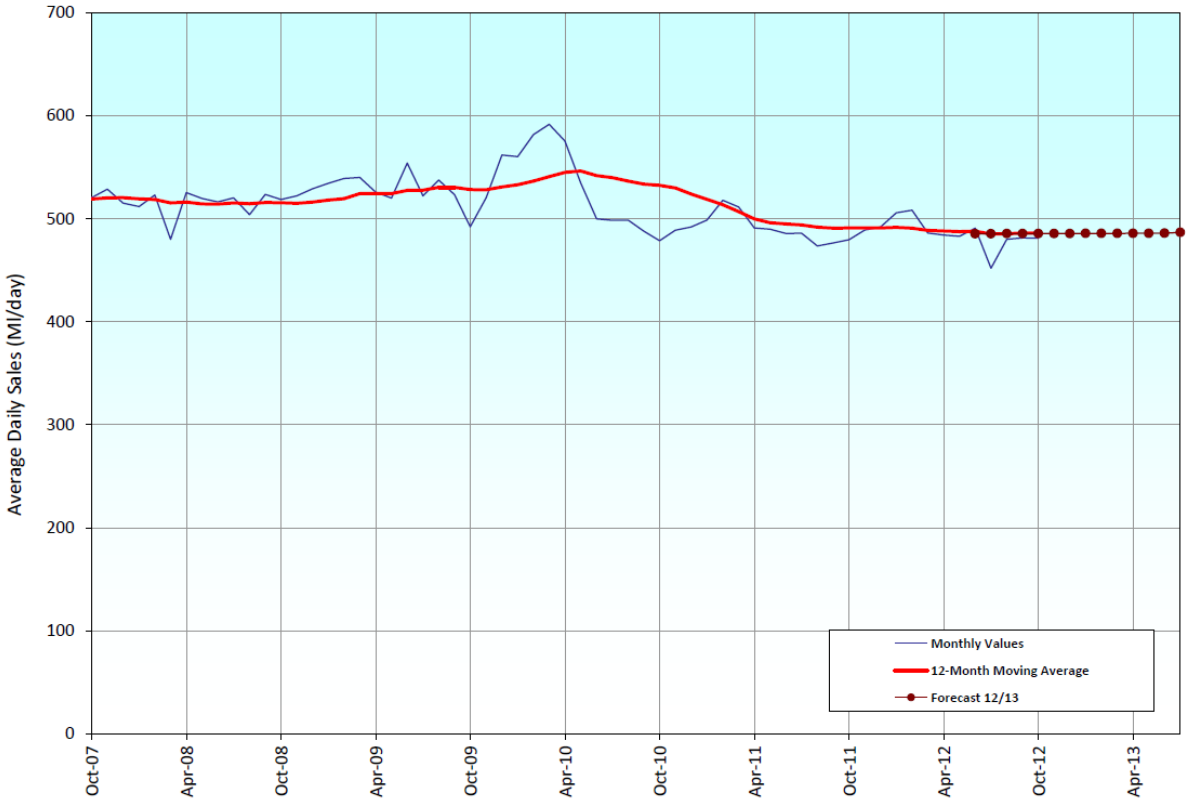

Figure 5.23 Historical demand curve for Durban Heights WTP.

Wiggins Water Treatment Plant

Wiggins WTP supplies the Amanzimtoti/KwaMakuta areas located in the southern portion of eThekwini Municipality. Due to water resource constraints at Nugwane Dam (**Section 4.4.5**) and the limited capacity of Amanzimtoti WTP, it is necessary to augment the supply to areas downstream of the Amanzimtoti WTP with flows from Wiggins WTP via the South Coast Augmentation (SCA) Pipeline. This will be required until such time as a new regional bulk water supply system is developed on the lower reaches of the Mkomazi River (**Sections 4.4.6** and **7.2**). In the interim, the Wiggins WTP sub-system should have sufficient treatment and distribution capacity to meet the long-term demands of Amanzimtoti and the South Coast Pipeline (SCP).

Figure 5.24 shows the current configuration of the existing SCA pumped supply infrastructure linking the Wiggins WTP sub-system to Amanzimtoti WTP. This system has certain operational capacity constraints that still have to be rectified to ensure that the Wiggins WTP system continues as the point of supply for Amanzimtoti and the SCP in the future.

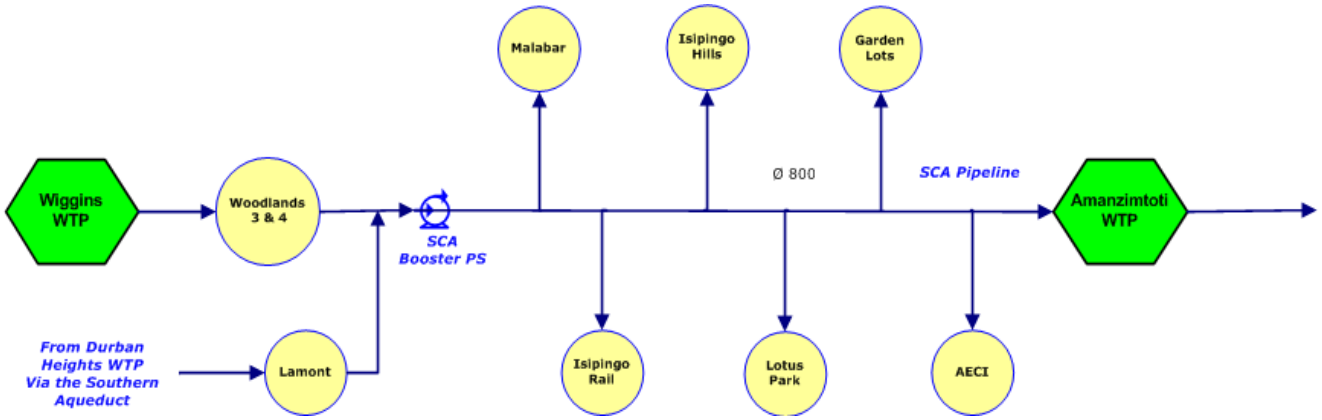

Figure 5.24 Extent of the South Coast Augmentation Scheme.

Hydraulic analysis has revealed that the existing SCA Pipeline has adequate capacity to meet current and projected demands up to the year 2020, provided that a new in-line booster pump station is installed along the SCA Pipeline to replace the existing Umlazi Pump Station. The new SCA Booster Pump Station is complete, and is in the process of commissioning, to address these constraints. This will serve as a medium-term infrastructure development strategy to meet current and projected demands off the SCA Pipeline up to the year 2020.

An analysis of historical production at the Wiggins WTP (December 2011 to November 2012) is presented in **Figure 5.25** and shows that for 20% of the time the WTP was being operated above the optimal operating capacity (80% of design capacity) and 0% of the time the WTP was operated at above design capacity. The previous year Wiggins WTP was operating above the optimal operating capacity for 6% of the time and 0% of the time above the design capacity. This indicates a significant increase in demand on Wiggins WTP over the last year. One factor is the load-shedding off Durban Heights WTP onto Wiggins WTP.

A concern is the unusual peaks that have been transposed onto the Wiggins WTP over the past year. This had a significant effect on the operation of the plant with fluctuating chemical dosing and stringent level controls, which is not sound operating practice for a WTP.

A study is currently being conducted by Umgeni Water to identify the cause of the peak loads and to investigate measures to minimise the effect of these peak loads on the WTP.

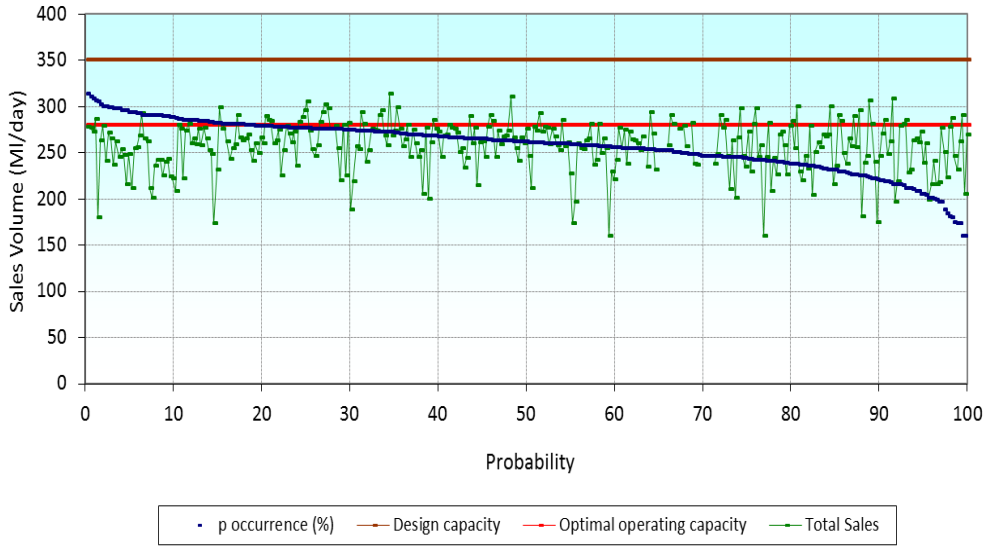

Figure 5.25 Analysis of historical production at Wiggins WTP from December 2011 to November 2012.

The historical and projected water demand from the Wiggins WTP is presented in **Figure 5.26.**

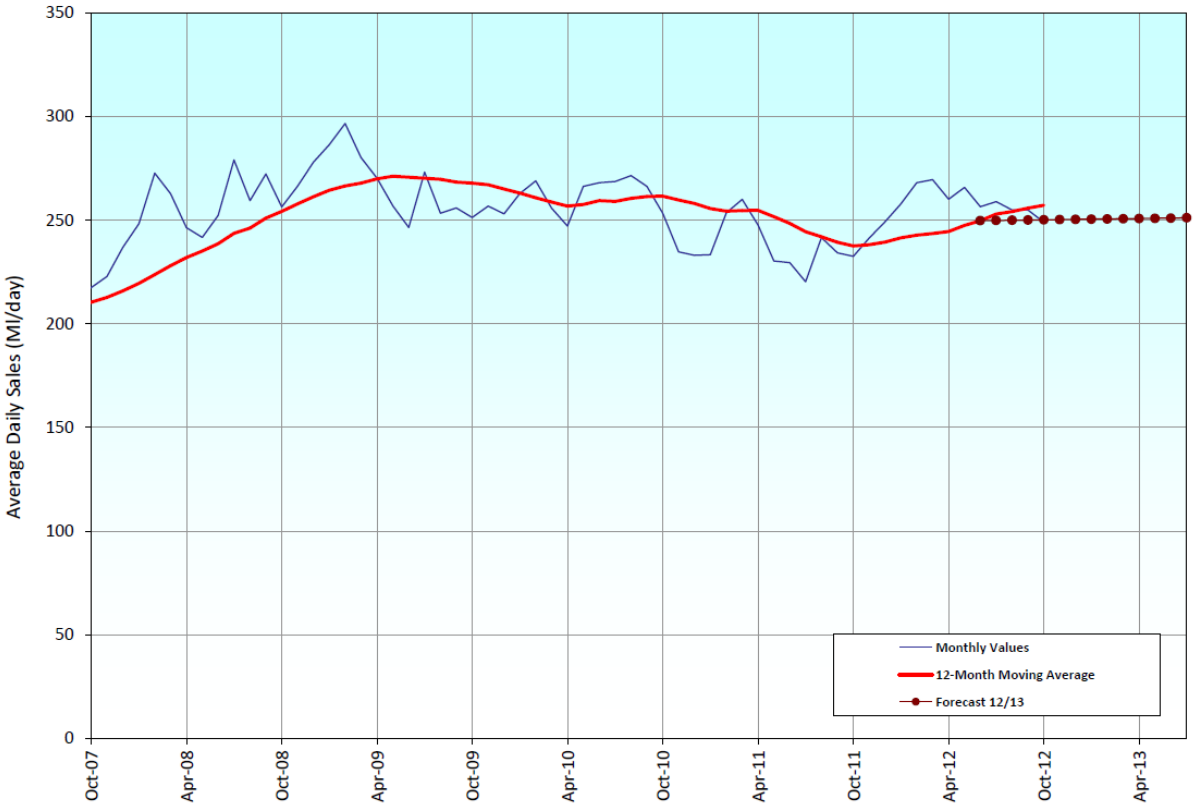

Figure 5.26 Historical demand curve for Wiggins WTP.

Maphephethwa Water Treatment Plant

Maphephethwa WTP (**Table 5.26**, **Figure 5.27**) was originally commissioned as a rural scheme under a turnkey contract. The works is located in the Inanda Dam area and draws water off one of the Nagle Dam raw water aqueducts supplying Durban Heights WTP. The raw water is filtered through a set of four Slow Sand Filters. The filtered water is chlorinated and supplied into a 1 Mℓ on-site storage/distribution reservoir. The original works occupies approximately 800 m^2 and had an initial treatment capacity of 0.75 Mℓ/day.

The works has recently been upgraded to a design capacity of 5 Mℓ/day. Partial commissioning of the works has been completed to a capacity of 3 Ml/day. Raw water to the works is drawn from Aqueduct No. 2, which delivers water to Durban Heights Waterworks, via a 160mm internal diameter PVC pipeline. The off-take point of the Aqueduct is located 260 m from the works. The raw water supply pipeline to the WTP is fitted with a pre-chlorination unit, flow meter and a flow control valve.

Figure 5.27 Maphephethwa Water Treatment Plant.

Figure 5.28 shows that there has been increased demand from the WTP in recent years and the works currently produces an average of 2.7 Mℓ/day as at the end of December 2012.

It is envisaged that the demand will grow as soon as the commissioning of the upgrade is complete and the plant is fully operational as shown in **Figure 5.28**.

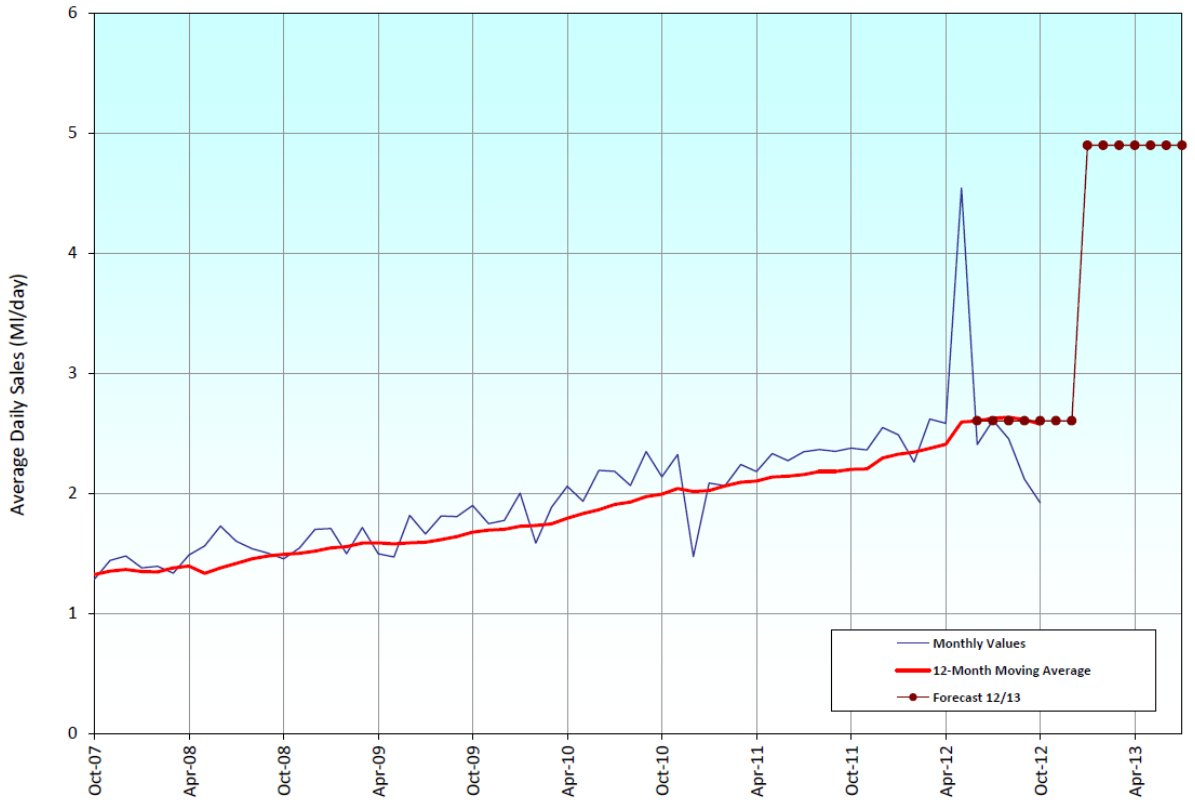

Figure 5.28 Historical demand curve and projections for Maphephethwa WTP.

Recommendations

Figure 5.29 illustrates schematically the demands on the Lower Mgeni System in its current configuration.

The projects recommended to address the above-identified issues are listed below:

- Undertake an investigation study for the augmentation of the Wiggins High Lift Pump Station to meet existing and projected demand.
- Study to be undertaken to optimise the shared demand between the proposed Western Aqueduct and Durban Heights WTP to ensure the optimal operation of Durban Heights WTP.

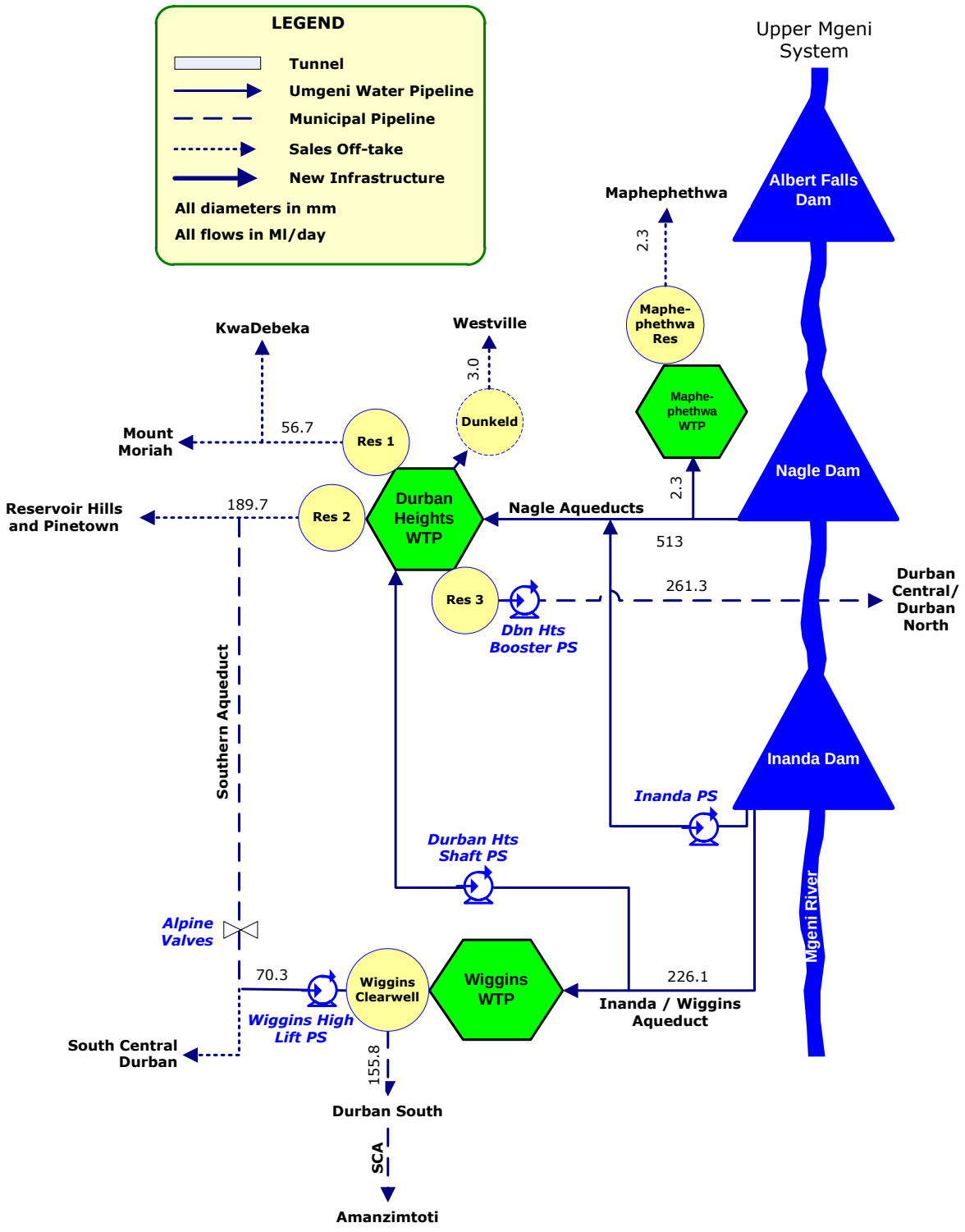

Figure 5.29 Schematic of the Lower Mgeni System.