Water Supply Planning Report
Moura and Banana

Banana Shire Council

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The quantities and cost estimates presented in this report are an indicative engineering estimate. They are based on Cordell's and Rawlinsons' cost data and our engineering experience on similar projects. These quantities and cost estimates are not Quantity Surveyor quantities or estimates. Cardno do not warrant the accuracy of these quantities or estimates in any way and they should only be used for indicative budgeting purposes.

1.0 EXECUTIVE SUMMARY

Water supply for the townships of Moura and Banana is extracted from the Dawson River under the Dawson Valley Water Supply Scheme. Water is treated to a potable standard at the Moura water treatment plant and distributed via reticulated infrastructure to service the townships. Details of existing infrastructure were extracted from Banana Shire Council GIS data and 'As Constructed' engineering drawings.

The water supply design criteria were determined in accordance with the Banana Shire Council Planning Scheme and the Department of Natural Resources and Mines Planning Guidelines for Water and Sewerage (DNR&M Guidelines).

An Equivalent Person (EP) population model was constructed for Moura and Banana based on metered water consumption records. Projections were made in accordance with the EP population model at existing (2006), intermediate (2011) and ultimate (2026) horizons for Moura and Banana.

An H_2OMAP model was constructed to assess capability of the water supply infrastructure to adequately supply the projected population of Moura and Banana. The model was constructed using the projected EP demands. Pressure and flow verifications were made based on observed SCADA data and hydrant tests.

A number of model scenarios were created to reflect the existing, intermediate and ultimate projection scenarios. For many scenarios it was necessary to consider a number of augmentation strategies. Proposed augmentation strategies were modeled to analyse their impact on the level of service provision.

Following the procedures set out in the Department of Natural Resources and Mines Water Supply and Sewerage Planning Guidelines, the model scenarios were run for a 9 day period consisting of 3 days at AD, 3 days at MDMM and 3 days at PD. Fire flow analyses were conducted at the maximum demand section of the diurnal flow curve for the third PD.

Modelling results were presented in the form of Peak Hour service pressure with and without fire-flows, and the reservoir volume and pump station operation over time. The H_2OMAP water supply analysis model compliments the presented modelling results.

A works schedule was developed to provide a summary of the presented augmentation strategies, and to provide a reference on which direct comparisons between scenarios at the existing, intermediate and ultimate horizons can be made. A summary of the works schedule is shown on Tables 1.1, 1.2 and 1.3.

Table 1.1 – Summary of augmentations for 2006 development

Scenario	Augmentation Required	Units	Unit Cost ($/unit)	Sub-Total	Total
1 - Nominal Population Growth	200kL Elevated Reservoir at Banana	1	$220,000	$220,000	$220,000
2 - Nominal Population Growth plus 50 lot development at Banana	200kL Elevated Reservoir at Banana	1	$220,000	$220,000	$220,000
3 - Nominal Population Growth plus 250 lot development at Banana	200kL Elevated Reservoir at Banana	1	$220,000	$220,000	$220,000

Table 1.2 – Summary of augmentations for 2011 development

Scenario	Augmentation Required	Units	Unit Cost ($/unit)	Sub-total	Total
1 - Nominal Population Growth	N/A	N/A	N/A	N/A	0
2 - Nominal Population Growth plus 50 lot development at Banana	N/A	N/A	N/A	N/A	0
3 - Nominal Population Growth plus 250 lot development at Banana	Increase capacity of Moura rising main	5,200	$317	$1,648,400	$6,055,000
	Increase capacity of Banana rising main	20,100	$216	$4,341,600	
	Increase capacity of elevated reservoir to 250 kL	1	$65,000	$65,000	

Table 1.3 – Summary of augmentations for 2026 development

Scenario	Augmentation Required	Units	Unit Cost ($/unit)	Sub-Total	Total
1 - Nominal Population Growth	Increase capacity of Moura rising main	5,200	$317	$1,648,400	$2,098,400
	Increase capacity of clear water storage to 2.04 ML	1	$450,000	$450,000	
2 - Nominal Population Growth plus 50 lot development at Banana	Increase capacity of Moura rising main	5,200	$317	$1,648,400	$6,440,000
	Increase capacity Banana rising main	20,100	$216	$4,341,600	
	Increase capacity of clear water storage to 2.04 ML	1	$450,000	$450,000	
3 - Nominal Population Growth plus 250 lot development at Banana	Increase capacity of clear water storage to 2.04 ML	1	$450,000	$450,000	$670,000
	Increase capacity of elevated reservior to 400 kL	1	$220,000	$220,000	

2.0 INTRODUCTION

Water supply for the townships of Moura and Banana is extracted from the Dawson River under the Dawson Valley Water Supply Scheme. Water is treated to a potable standard at the Moura water treatment plant and distributed via reticulated infrastructure to service both townships.

The purpose of this report is to detail the process undertaken to:

- Determine the desired standards of service and design criteria for water supply;
- Determine demand and population projections for Moura and Banana;
- Construct a water supply reticulation model;
- Assess the water supply reticulation at Moura and Banana, and
- Determine augmentation strategies to ensure future demands are met.

3.0 EXISTING WATER SUPPLY INFRASTRUCTURE

The townships of Moura and Banana are supplied with potable water from the Dawson River via the Moura water treatment plant and reticulated infrastructure. A water supply reticulation overview is given on Figures 3.1, 3.2 and 3.3. The intake pumping infrastructure consists of four Grundfos SP95-8 submersible pumps (two duty and two standby). Raw water is pumped in a north to north-westerly direction through a 5.1km, DN225 rising main to the Moura water treatment plant. According to operating charts, the plant has a capacity of 70 L/s. The clear water storage consists of two reservoirs with a total storage capacity of 1.02 ML.

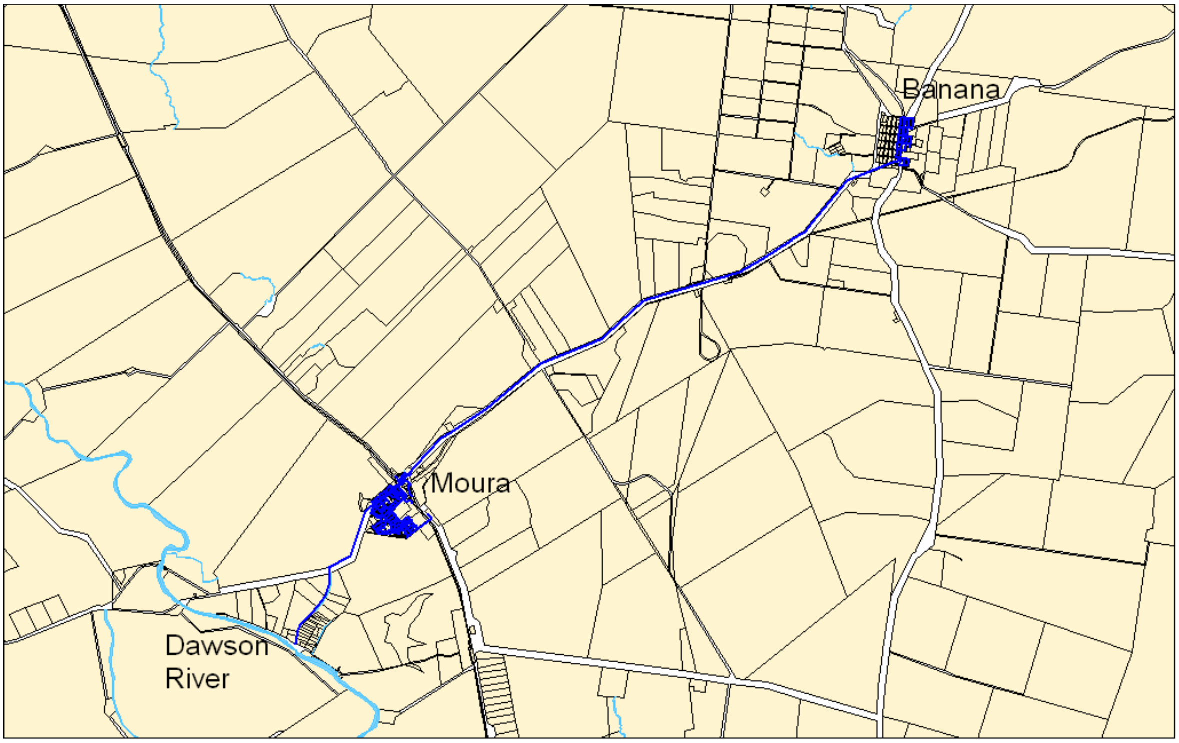


Figure 3.1 – Water Supply Reticulation Overview for Moura and Banana

A set of five variable speed Grundfos CR90-4 pumps are installed on site at the Moura water treatment plant. The pumps are controlled by system demand and provide service pressure for the reticulation in Moura.

A set of four variable speed Grundfos CRE16-20 booster pumps are located on the Dawson Highway opposite Moura-Bindaree Rd. The head is delivered to a 19.1 km, DN150 rising main to Banana. The pumps are controlled by demand at Banana.

There are two storage reservoirs within the system. The first is located adjacent to Burnham St and has a storage volume of 0.17 ML, with a top water level of 166 mAHD. A second is located adjacent to the Dawson Hwy at the Banana pumping station site with a storage volume of 0.49 ML and a top water level of 159 mAHD. It is understood that the variable speed pumps at the Moura water treatment plant and the Banana pump station were installed such that the reticulation is independent of both the Burnham St and Dawson Hwy reservoirs.

The minor reticulation consists of DN100 to DN150 AC mains. There is one reported DN50 AC main leading to the Moura cemetery. The total reticulation length, including trunk infrastructure is approximately 58 km.

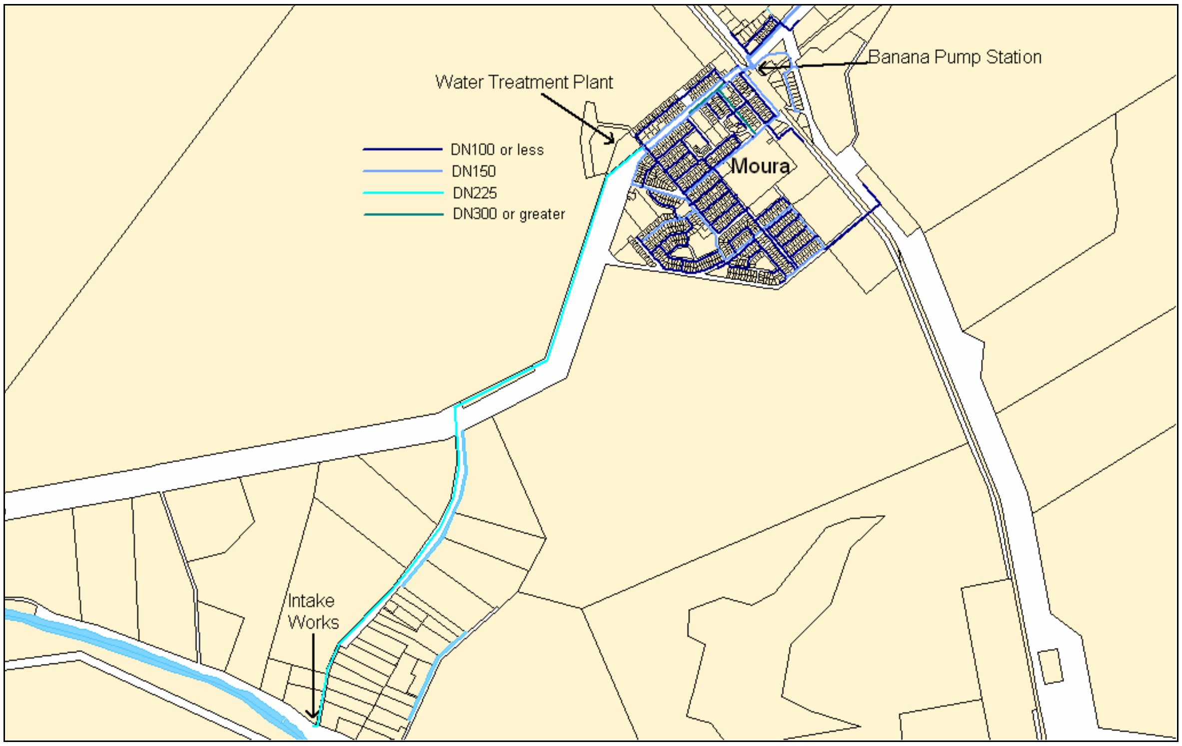


Figure 3.2 – Water Supply Reticulation Overview for Moura

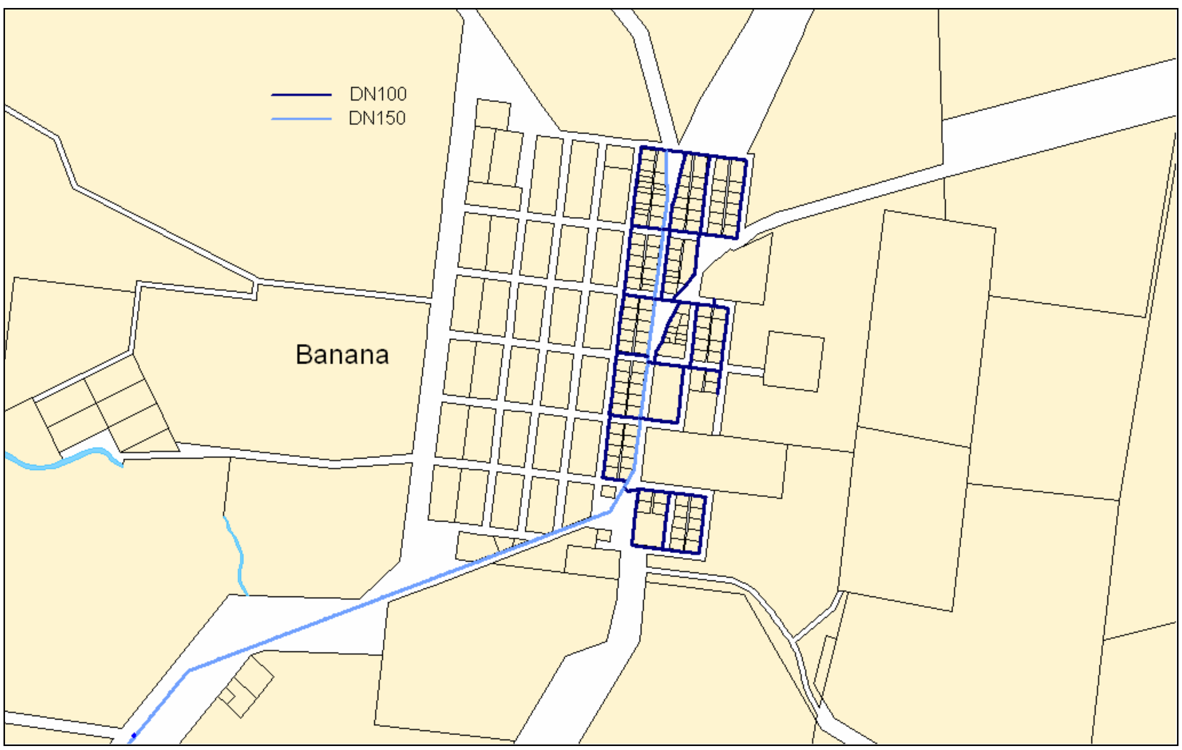


Figure 3.3 – Water Supply Reticulation Overview for Banana

4.0 DESIGN CRITERIA AND STANDARDS OF SERVICE

The water supply design criteria were determined in accordance with the Banana Shire Council Planning Scheme and the Department of Natural Resources and Mines Planning Guidelines for Water and Sewerage (DNR&M Guidelines). The following criteria were adopted for this study:

4.1 DEMAND AND PEAKING FACTORS

Average Day Demand, AD	=	600	L/EP/day
Mean Day Maximum Month, MDMM	=	780	L/EP/day
Peak Day Demand, PD	=	1150	L/EP/day
Peak Hour Demand, PH	=	95	L/EP/hour

MDMM:AD	=	1.3
PD:AD	=	1.91
PH:PD	=	1/12

4.2 RESIDUAL PRESSURES

Minimum Residual Pressure	=	22	m
Maximum Residual Pressure	=	80	m

4.3 FIRE-FIGHTING REQUIREMENTS

Fire Flow Demand (residential)	=	15	L/s for 2 hours
Fire Flow Demand (commercial)	=	30	L/s for 4 hours
Minimum Critical Pressure	=	12	m

4.4 MINIMUM RESERVOIR STORAGE CAPACITY

Ground Level Reservoir	=	3*(PD - MDMM) + fire-flow
Elevated Reservoir	=	6*(PH - MDMM/12) + fire-flow

- Reservoirs to have a positive net inflow at the end of each MDMM
- No reservoir is to fail during the analysis

4.5 MINIMUM PUMP FLOW RATE

Reticulation Mains	=	PH + fire-flow
Raw Water Pumps	=	MDMM over 20 hours
Pumps Feeding Elevated Reservoir	=	(6*PH - Operating Volume)/21600

- Reservoir Operating Volume in Litres

4.6 DIURNAL DEMANDS

The diurnal pattern was extracted from the Banana Shire Council telemetry data. The pattern for residential, commercial and industrial was normalised to produce daily demands consistent with AD. It is understood that the Moura Single Person Quarters

(SPQ) has a peak demand of 1.3 L/s, and that this demand is allowable only during night flow periods. The diurnal pattern for the Moura SPQ was adjusted accordingly.

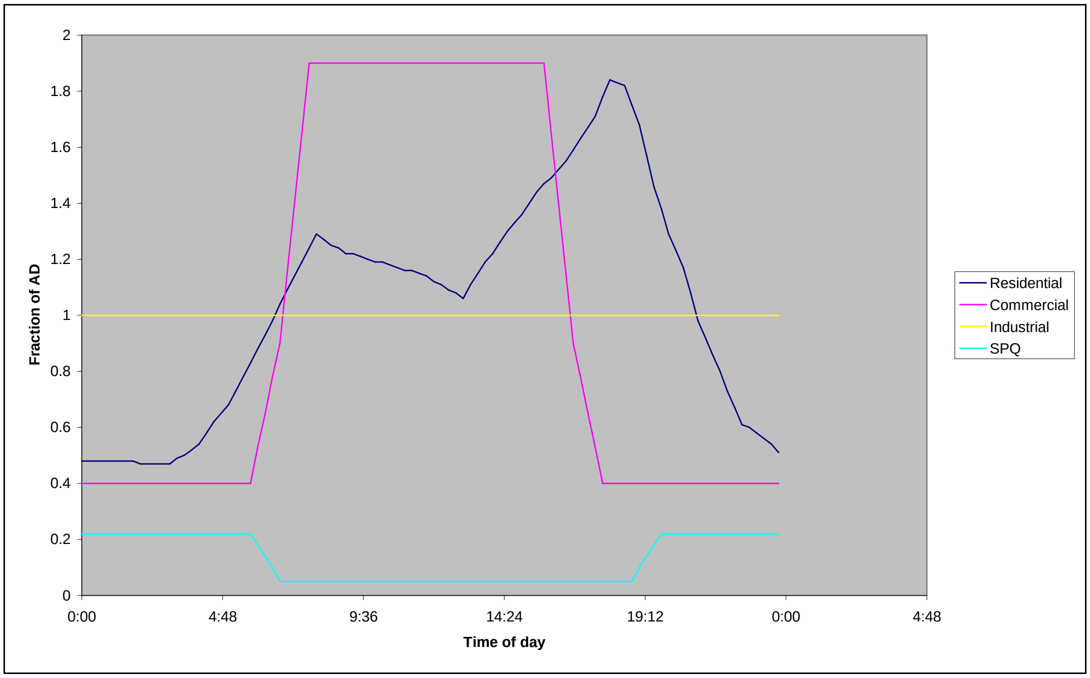


Figure 4.1 Diurnal consumption pattern for Moura and Banana

5.0 DEMAND AND POPULATION PROJECTIONS

The current population at Moura and Banana was determined through correlation of the Banana Shire Council Integrated Population Model on the basis of Equivalent Person populations. Historical population data was extracted from census counts presented in the Banana Shire Council Comparative Profile, and the Planning Information and Forecasting Unit (PIFU).

Based on metered consumption and the number of connections it was determined that the 2006 occupancy ratio at Moura is 3 EP/detached residential dwelling, and at Banana is 2.6 EP/detached residential dwelling. By following methods prescribed in the Department of Natural Resources and Mines Water and Sewerage Planning Guidelines (DNR&M Guidelines), the average day consumption was found to be 450 L/EP/Day. However, the AD = 600 L/EP/Day was adopted in accordance with the Banana Shire Council Planning Scheme.

The demand parameters shown in Table 5.1 were determined in accordance with the DNR&M Guidelines, and based on metered consumption for all (excluding detached residential) land use categories.

Table 5.1 – Equivalent demand parameters for various land use types

	EP	
Land Use Type	Moura	Banana
Caravan Park	22	*n/a*
Child Care	4.5	*n/a*
Church	4.4	*n/a*
Community Protection	3.7	*n/a*
School	42	11.4
Hotel	50	16.7
Light Industry	2.4	0.5
Outbuildings	0.5	0.5
Pre School	13.6	*n/a*
Professional Offices	1.5	*n/a*
Residential Dwelling	3	2.6
Service Station	1.8	*n/a*
Shop	3.8	*n/a*
Sports Club & Facilities	5.9	*n/a*
Transport Facility	0.8	*n/a*
Warehouse & Bulk Store	5	*n/a*

In order to determine the impact of future development on the Moura and Banana water supply infrastructure it was considered necessary to make assessments at existing, intermediate and ultimate horizons. The following sections document the manner in which the population for Moura and Banana was projected.

5.1 MOURA

It is understood that the Moura SPQ is currently at ultimate development of 470 EP. This level of development is assumed to remain static for the duration of the analysis period.

5.1.1 Existing - 2006

The current service population for Moura was projected from 2001 census counts. A nominal growth rate of 2 % p.a. was adopted after a startup meeting with the Banana Shire Council Water Supply and Sewerage Manager. In addition to the current development at Moura, the following approved developments were included in the projection:

- Stages 1, 2 and 3 of the Herzog St. subdivision, providing 130 lots (390 EP);
- Open space adjacent to Elliot and Widderick Sts, providing 8 lots (24 EP); and
- Moura Hotel accommodation expanded, providing 20 additional rooms (20 EP).

The total current equivalent population of Moura (including SPQ) was projected to 3600 EP.

5.1.2 Intermediate - 2011

The intermediate population was projected by applying a 2% p.a. nominal growth rate on the 2006 service population, and adding the final stage of the Herzog St development providing and additional 14 lots (42 EP).

The 2011 equivalent population of Moura (including SPQ) was projected to 4000 EP.

5.1.3 Ultimate - 2026

The service population for the ultimate horizon was projected by applying a 2% p.a. nominal growth rate on the 2011 service population. The 2026 equivalent population of Moura (including SPQ) was projected to 5000 EP. The ultimate housing capacity of Moura was determined through inspection of metered water usage data, and in accordance with the Banana Shire Council strategic development plan.

Table 5.2 – Housing Capacity at Moura

	Units	Population
Vacant Residential Lots	100	300
Single Unit Dwelling	710	2130
Multi Unit Dwelling	22	132
Proposed Herzog St subdivision	144	432
Elliot St Development	8	24
TOTAL	1006	3018

Assuming the occupancy ratio remains constant, the ultimate population of Moura will have a shortfall of 660 houses. It is considered that future subdivisions will be planned to cater for this need.

5.2 BANANA

5.2.1 Existing - 2006

The current service population of Banana was projected based on annual consumption, the unit water demand and the occupancy ratio. Projections were verified to be consistent with the census data for Banana Shire. In addition to the current resident population the following developments were included in the projection:

- Open space adjacent to Moriarty and Gregory Sts, providing an additional 14 lots (42 EP);
- The subdivision of Lot 2/B4910, providing a total of 4 lots (10.4 EP); and
- Single developments on Lots 1/RP835040 and 104/B4919 (5.2 EP).

The total current equivalent population of Moura was projected to 215 EP.

5.2.2 Intermediate - 2011

The intermediate population projection was derived by applying a 2% p.a. nominal growth rate on the 2006 service population. A number of development scenarios were identified:

• *Scenario 1* – Nominal growth on 2006 base population only.
• *Scenario 2* – Nominal growth on 2006 base population, plus a 50 lot (130 EP) development in the open space to the west.
• *Scenario 3* – Nominal growth on 2006 base population, plus a 50 lot (130 EP) development in the open space to the west, plus a 200 lot (520 EP) development to the north-west.

The Equivalent Population for the above scenarios are outlined in Table 5.3.

Table 5.3 – Total Equivalent Population for Banana

	Scenario 1	Scenario 2	Scenario 3
EP	235	360	750

5.2.3 Ultimate - 2026

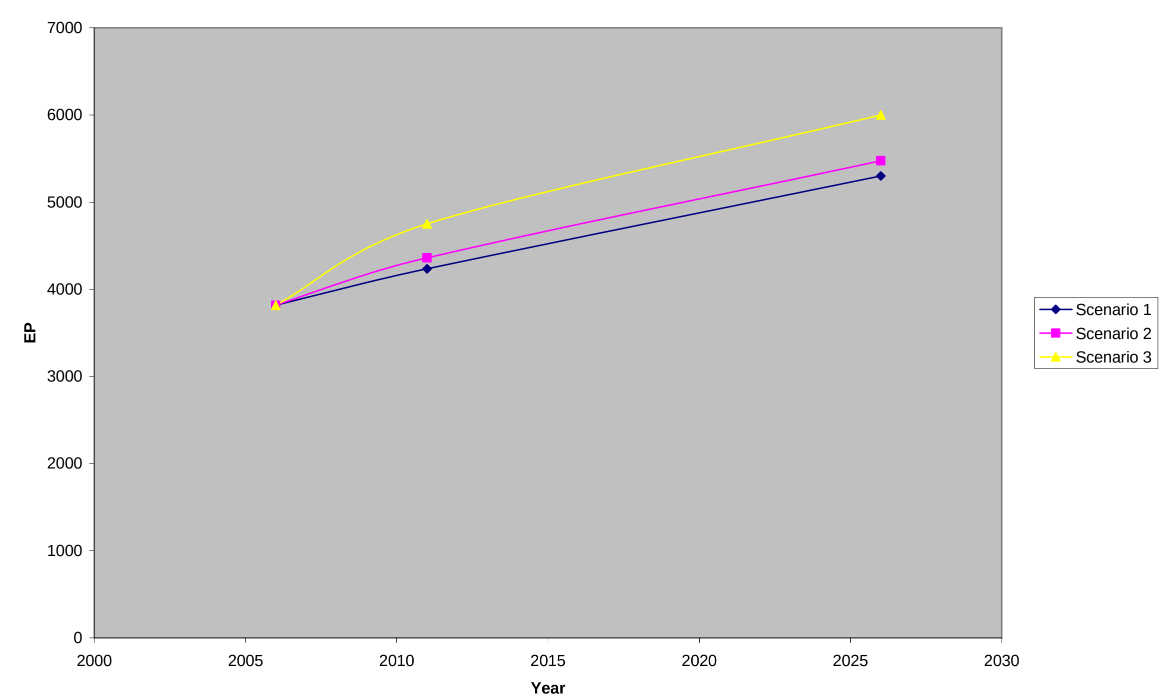
The ultimate service population, outlined in Table 5.4, was projected by applying a 2% p.a. nominal growth rate on the respective intermediate scenarios.

Table 5.4 – Total Equivalent Population for Banana

	Scenario 1	Scenario 2	Scenario 3
EP	300	475	1000

5.3 SUMMARY

The total projected service population of Moura and Banana, Scenarios 1, 2 and 3 is outlined on Figure 5.1.



		Moura EP	Banana EP	Total EP
Existing (2006)		3600	215	3815
Intermediate (2011)	Scenario 1	4000	235	4235
	Scenario 2		360	4360
	Scenario 3		750	4750
Ultimate (2026)	Scenario 1	5000	300	5300
	Scenario 2		475	5475
	Scenario 3		1000	6000

Figure 5.1 – Equivalent Person Projection

The system demand from each scenario is outlined in Table 5.4. Data was tabulated based on Total EP and the adopted peaking factors.

Table 5.4 – Projected System Demand

		EP	AD (L/s)	MDMM (L/s)	PD (L/s)	PH (L/s)
Scenario 1	Existing	3815	26.5	34.4	50.8	100.7
	Intermediate	4235	29.4	38.2	56.4	111.8
	Ultimate	5300	36.8	47.8	70.5	139.9
Scenario 2	Existing	3815	26.5	34.4	50.8	100.7
	Intermediate	4360	30.3	39.4	58.0	115.1
	Ultimate	5475	38.0	49.4	72.9	144.5
Scenario 3	Existing	3815	26.5	34.4	50.8	100.7
	Intermediate	4750	33.0	42.9	63.2	125.3
	Ultimate	6000	41.7	54.2	79.9	158.3

Previous planning reports (Parsons Brinckerhoff, 2005; Ullman & Nolan, 1992) have reported the allowable peak hour demand (PH) from Moura and Banana to be 140 L/s, based on treatment plant capacity and number of EP. It is noted that the ultimate PH for Scenario 1 (nominal population growth only) is consistent with the previous studies.

6.0 WATER SUPPLY RETICULATION MODEL

6.1 MODEL CONSTRUCTION

An H_2OMAP model was constructed to assess the capability of the water supply infrastructure to adequately supply the projected population of Moura and Banana.

6.1.1 Pumps

It was reported that the Dawson River exhibits a head of 104.6 mAHD at the submersible pumps. This value was adopted as the static boundary condition for the model. Consistent with the duty/standby nature of the raw water transfer pumps, the model was constructed with two duty pumps and assigned the curve given on Figure 6.1, extracted from the manufacturer's online catalogue.

Rule based controls were assigned such that the duty pumps were modelled to close when the Moura water treatment plant clear water storage tanks reached 98% of capacity, and open when the clear water storage tanks fell to 90% capacity.

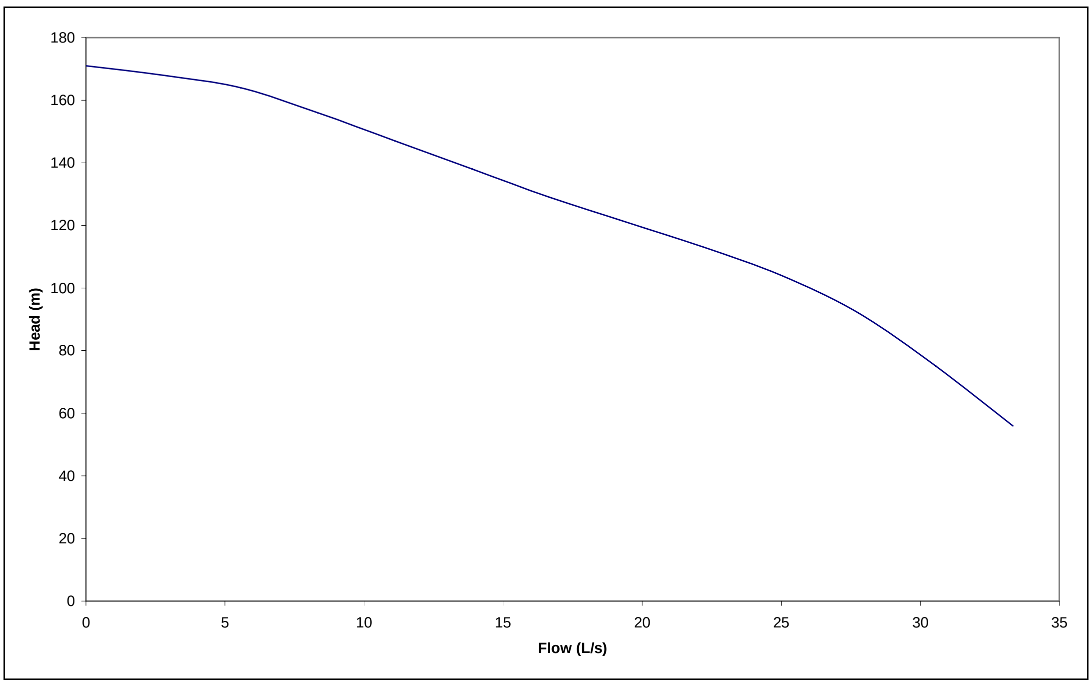


Figure 6.1 – Submersible Pump Curve

The Moura booster pump station was modelled as a set of five variable speed pumps with the pump curve on Figure 6.2 extracted from the manufacturer's online catalogue. Rule based controls were assigned to maintain a constant pressure calibrated to pressure observations made during the Okano St hydrant test.

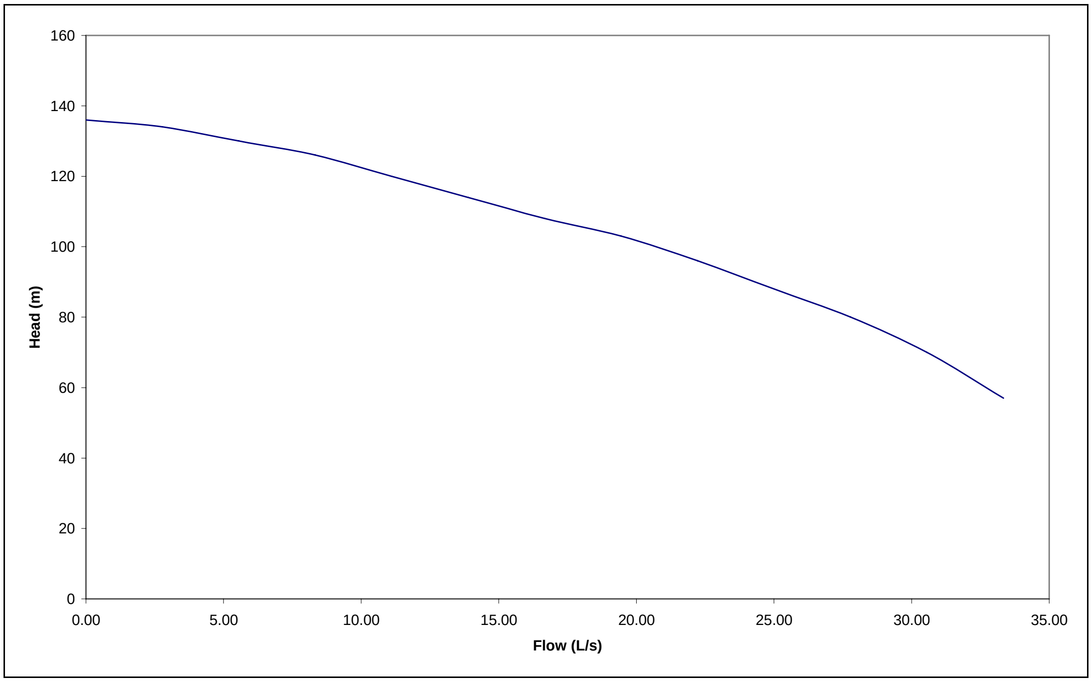


Figure 6.2 – Moura booster pump curve

The Banana booster pump station was modelled as a set of four variable speed pumps each with a duty point of 4.5 L/s at 83.3 m in accordance with Banana Shire Council 'As Constructed' drawings. Rule based controls were assigned to maintain a constant pressure at Banana in accordance with Banana Shire Council SCADA readings.

6.1.2 Reservoirs

The clear water storage at Moura consists of two tanks with respective storage capacities of 0.9 and 0.12 ML, modelled as a single tank with the following details:

Elevation	=	130.9	mAHD
Minimum Level	=	0	mRL
Maximum Level	=	3	mRL
Initial Level	=	2.7	mRL
Diameter	=	20.81	m

The recommendations of a report prepared by Boyd Water Services included the construction of an 800 kL ground level service reservoir adjacent to Herzog St in order to supply the 144 lot subdivision. The reservoir was modelled with the following details:

Elevation	=	138	mAHD
Minimum Level	=	0	mRL
Maximum Level	=	3	mRL
Initial Level	=	2.7	mRL
Diameter	=	18.43	m

6.1.3 Nodes

Nodes were placed at strategic points within the reticulation. Elevations were assigned based on topographic plots. Nodal demands were assigned as number of EP in accordance with the values derived in the preceding chapter (Table 5.1). The global demand multiplier was set to produce AD flows of 600 L/EP/day. Fire-flow demands of

30 L/s (commercial) and 15 L/s (residential) were assigned to respective model precincts in accordance with the Banana Shire Council Planning Scheme (Zoning Maps are shown in Appendix B), and remained constant throughout the model simulations.

6.1.4 Pipes

The pipe layout was input to H_2OMAP from GIS data. The pipe diameters were read in directly and were used for the model simulations. Inconsistencies were checked for and corrected as necessary. The H_2OMAP model was scaled to coincide with actual pipe lengths.

Hazen-Williams coefficients were entered as follows:

Diameter 150mm or less	=	100
Diameter 200mm to 300mm	=	110
Diameter 375mm or greater	=	120

6.1.5 Overview

An overview of the water supply reticulation model is shown on Figures 6.3 and 6.4

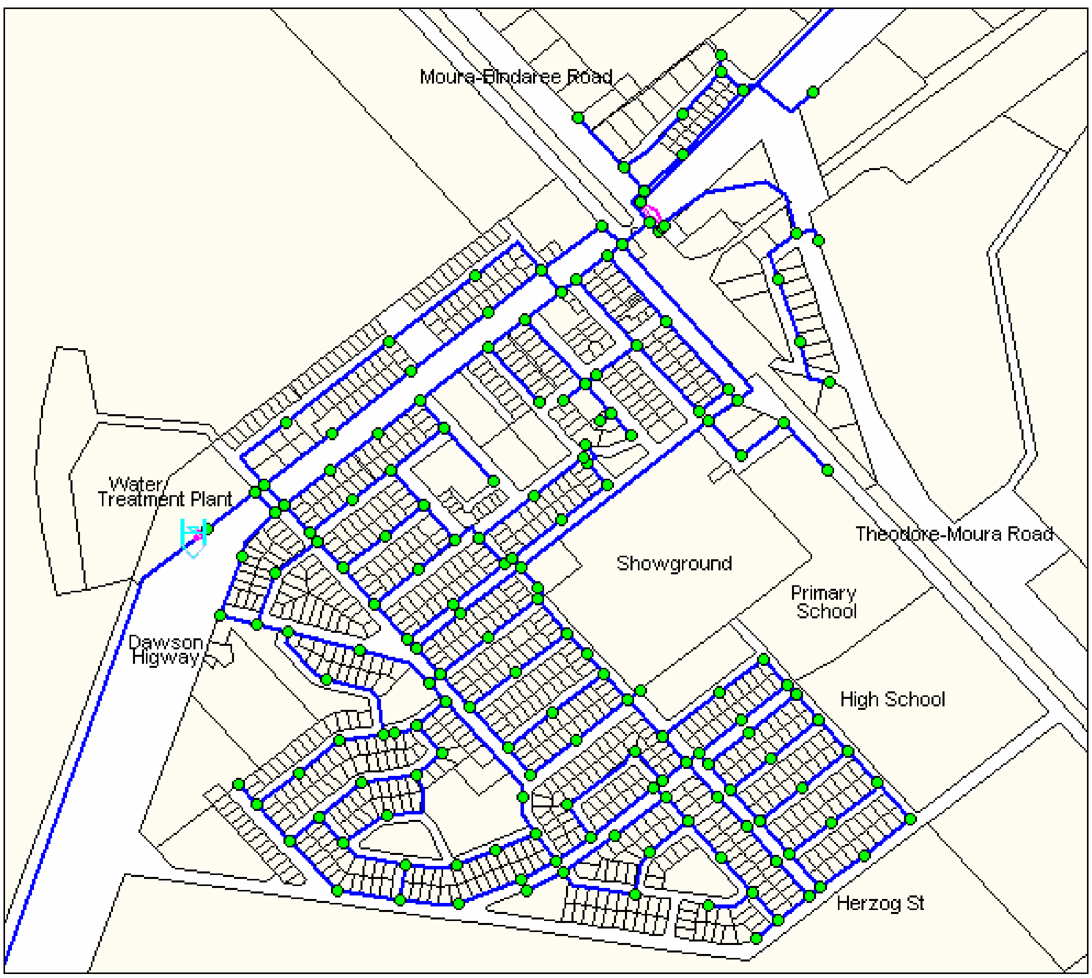


Figure 6.3 – Overview of water supply reticulation model for Moura

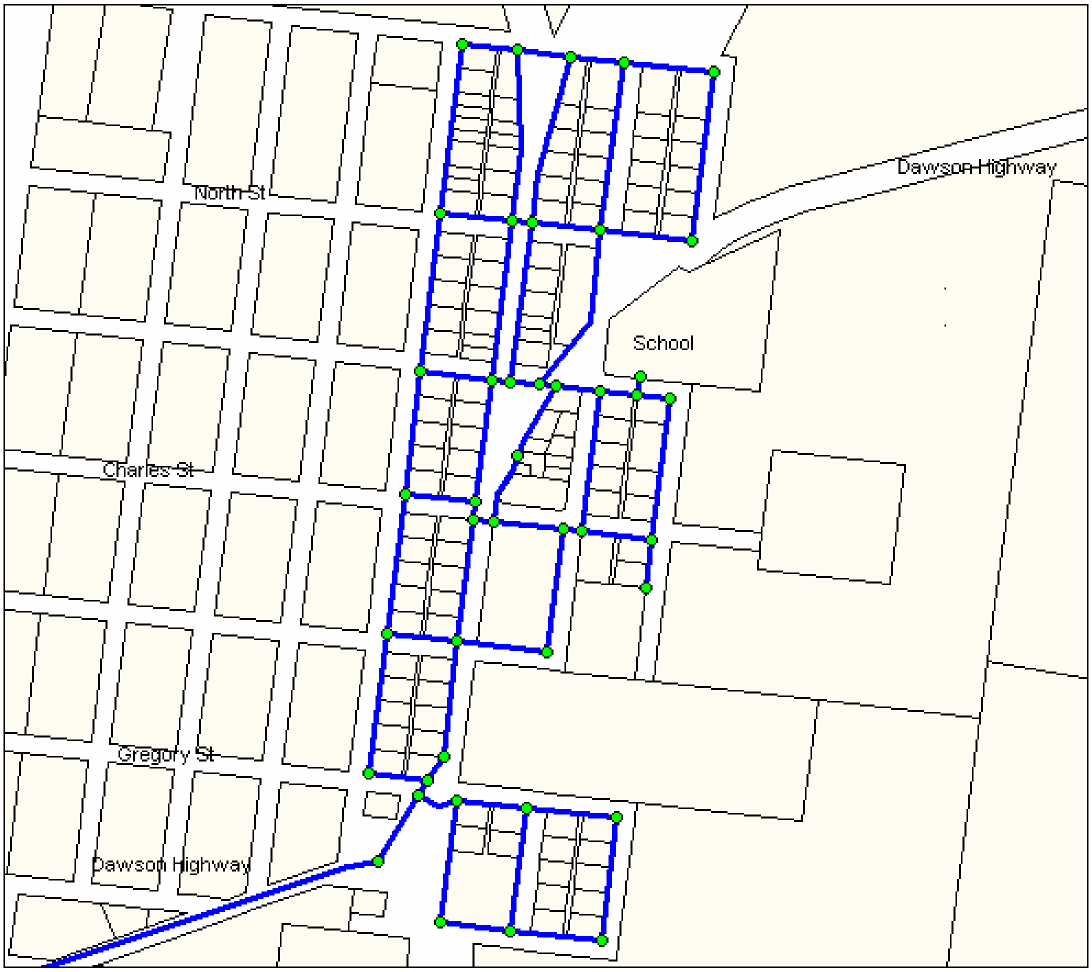


Figure 6.4 – Overview of water supply reticulation model for Banana

Following the procedures set out in the Department of Natural Resources and Mines Water Supply and Sewerage Planning Guidelines, the model was run for a 9 day period consisting of 3 days at AD, 3 days at MDMM and 3 days at PD. Fire flow analyses were conducted at the maximum demand section of the diurnal flow curve for the third PD.

6.2 MODEL VERIFICATION

The calibration scenario was included in order to make comparisons of observed data versus modelling results. The scenario demands include only the existing level of development at Moura and Banana. The two-staged verification process involves both pressure and flow comparisons.

6.2.1 Pressure Verification

Recent pressure observations were made during a hydrant test at Okano St, Moura. Figure 6.5 shows the observed pressure from the hydrant test and the simulated model pressure. It is shown that the discrepancy is less than 10%. For the purpose of this report the model is considered to be calibrated.

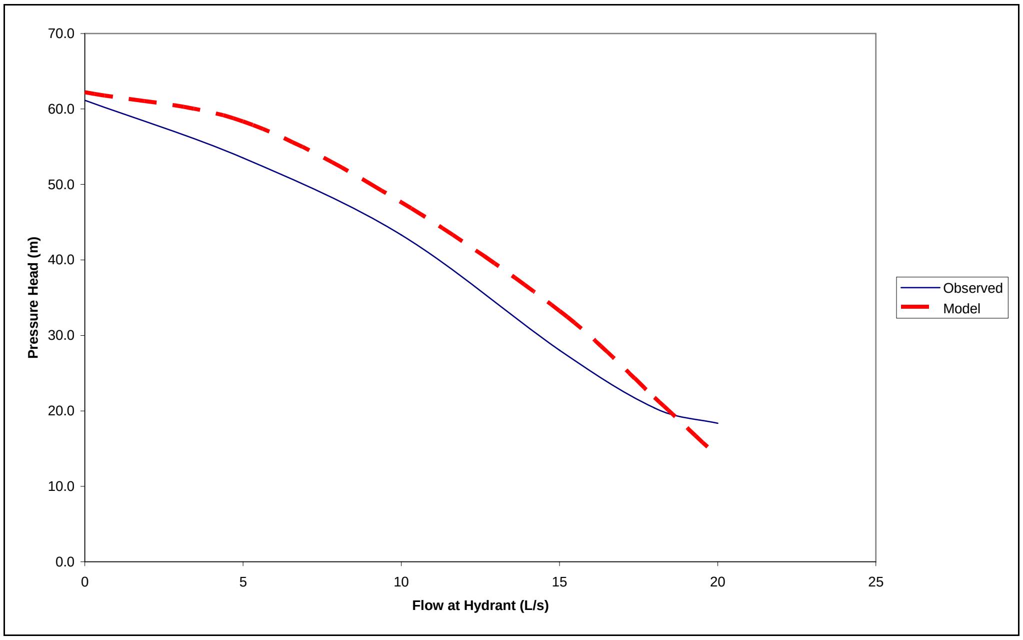


Figure 6.5 – Model Pressure Verification

6.2.2 Flow Verification

The average diurnal system demand pattern was extracted from Banana Shire Council telemetry data. It is shown on Figure 6.6 that the model produces flows which are closely correlated with observed SCADA readings.

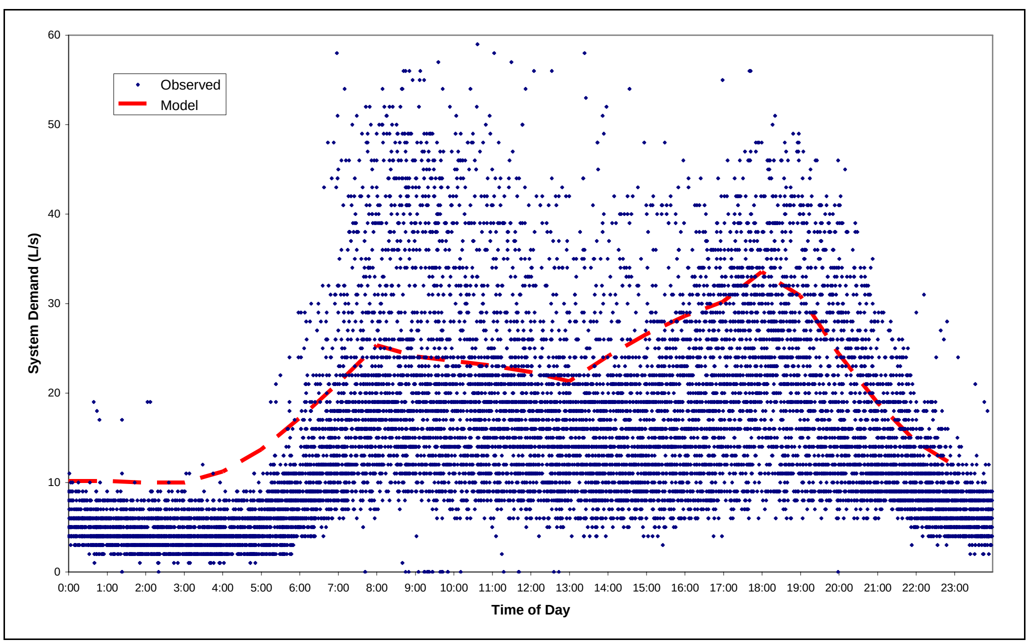


Figure 6.6 – Flow Verification

6.3 MODEL SCENARIOS

A number of H_2OMAP model scenarios were created to reflect the population projections given in Chapter 5. The model scenario tree is outlined in Table 6.1 below. For many scenarios it was necessary to consider a number of augmentation strategies. A shorthand description of the proposed augmentation strategy is shown in italics. Further detail is presented in Chapters 7, 8 and 9.

Table 6.1 – Scenario Tree for Moura and Banana Water Supply Reticulation Model

2006, EXISTING HORIZON		
	CALIBRATION	
	EXISTING: With Proposed Demands	
		OPTION A: *Proposed Augmentation - Banana Elevated Reservoir*
		OPTION B: *Proposed Augmentation - Banana Rising Main*
2011, INTERMEDIATE HORIZON		
	INTERMEDIATE SCENARIO 1: Nominal Population Growth (2006) at Moura and Banana	
	INTERMEDIATE SCENARIO 2: Nominal Population Growth (2006) at Moura and Banana, Additional 50 lots at Banana	
	INTERMEDIATE SCENARIO 3: Nominal Population Growth (2006) at Moura and Banana, Additional 200 lots at Banana	
		INTERMEDIATE SCENARIO 3A: *Moura and Banana rising mains augmented; 250 kL elev res.*
2026, ULTIMATE HORIZON		
	ULTIMATE SCENARIO 1: Nominal Population Growth on Intermediate Scenario 1	
		ULTIMATE SCENARIO 1A: *Moura WTP Clear Water Storage Augmented*
		ULTIMATE SCENARIO 1B: *River pumps and Moura rising main augmented*
		ULTIMATE SCENARIO 1C: *Moura RM + River Pumps + clear water storage augmented; 250 kL elev res*
	ULTIMATE SCENARIO 2: Nominal Population Growth on Intermediate Scenario 2	
		ULTIMATE SCENARIO 2A: *Moura clear water storage augmented; 400 kL elev res.*
		ULTIMATE SCENARIO 2B: *Dawson Rr RM + River Pumps augmented*
	ULTIMATE SCENARIO 3: Nominal Population Growth on Intermediate Scenario 3	
		ULTIMATE SCENARIO 3A: *Moura WTP Clear Water Storage Augmented; 1000kL elev res*
		ULTIMATE SCENARIO 3B: *Moura WTP CW Storage + Banana RM Augmented; 400kL elev res*

7.0 MODELLING ANALYSIS – EXISTING HORIZON

7.1 PRELIMINARY MODELLING

The model was run with the 2006 projected population in order to determine the level of service provision afforded by the current water supply infrastructure, including the Herzog St service reservoir. Model pipe diameters are shown on the schematic, Figures 7.1 and 7.2.

The corresponding model scenario is "EXISTING, With Projected Demands". The model diameters are shown on Figures 7.1 and 7.2. The PEAK HOUR service pressure at Moura and Banana is shown on Figures 7.3 and 7.4.

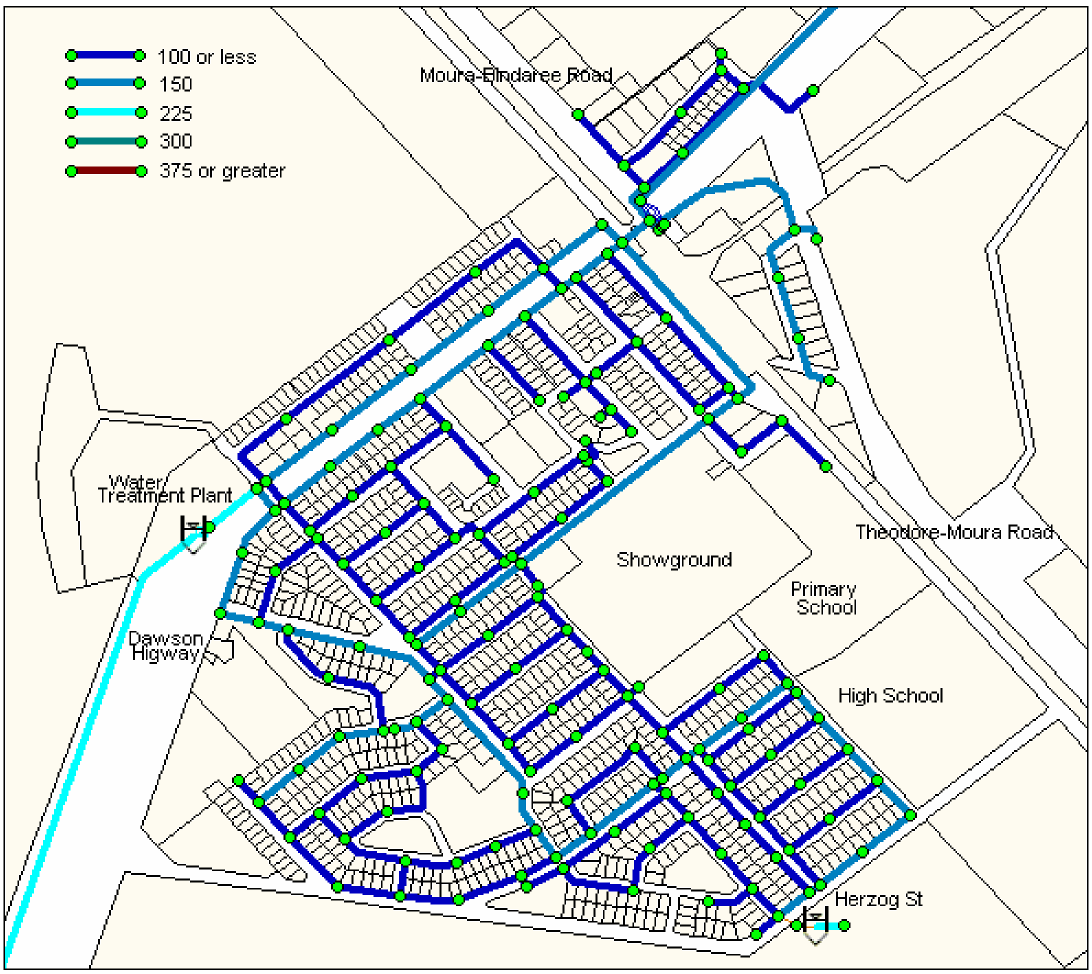


Figure 7.1 – Model Schematic (Moura), Existing Scenario

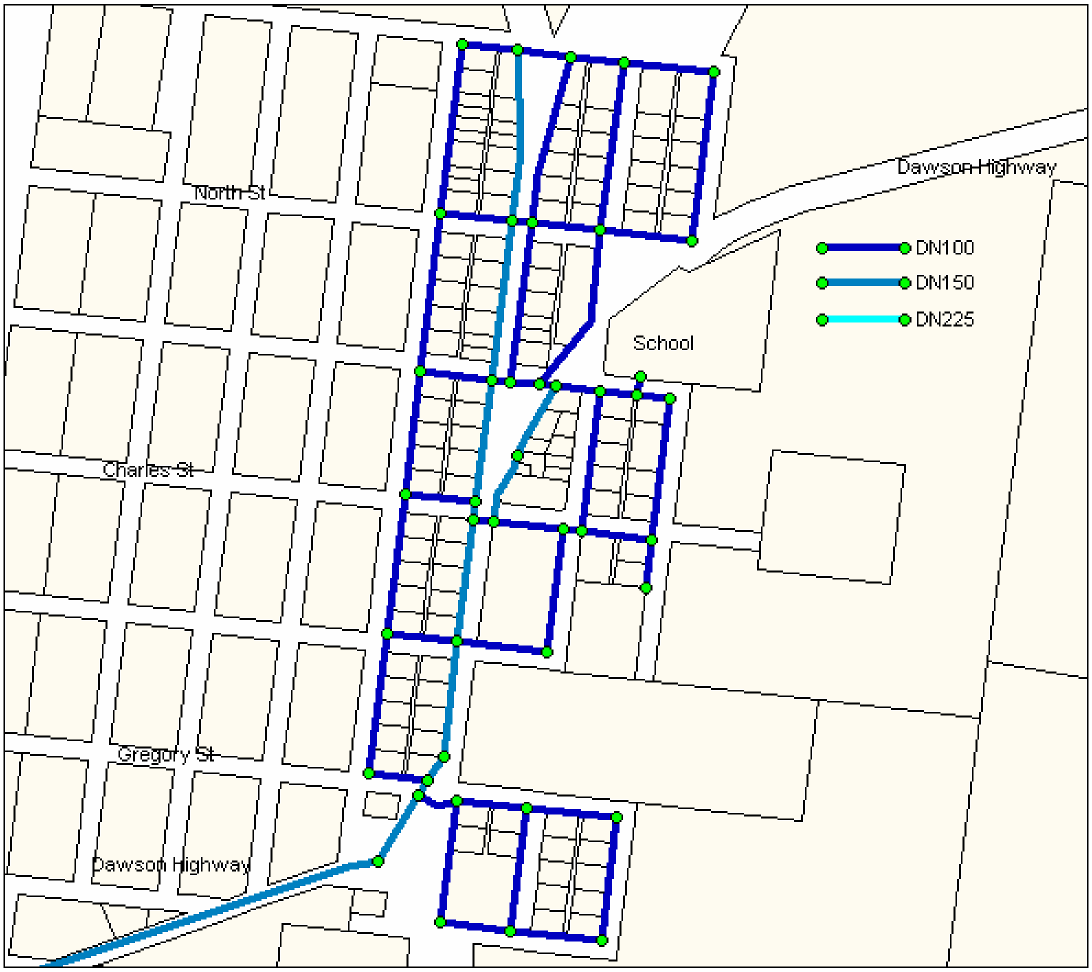


Figure 7.2 – Model Schematic (Banana), Existing Scenario

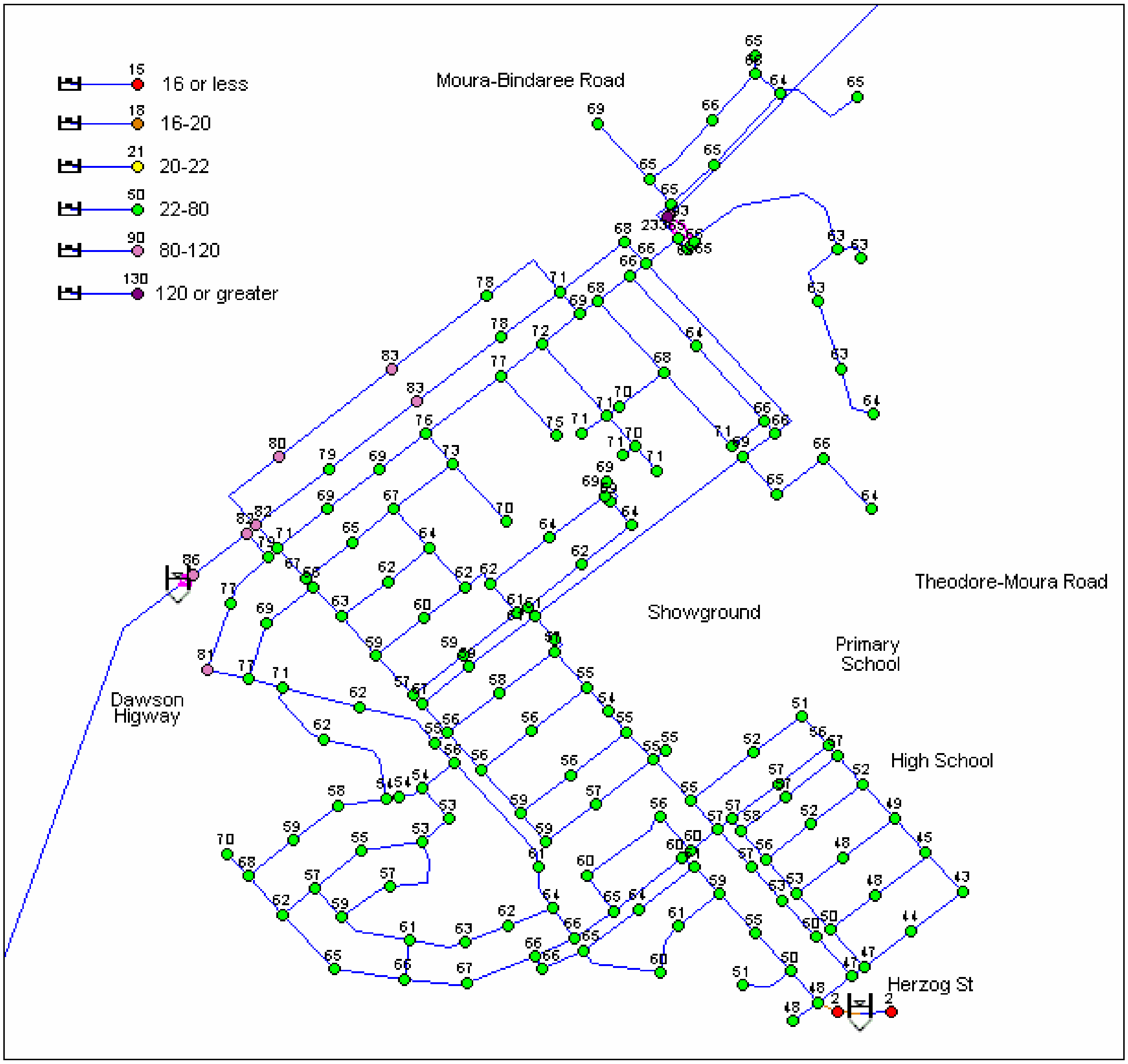


Figure 7.3 – PH pressure (m) at Moura

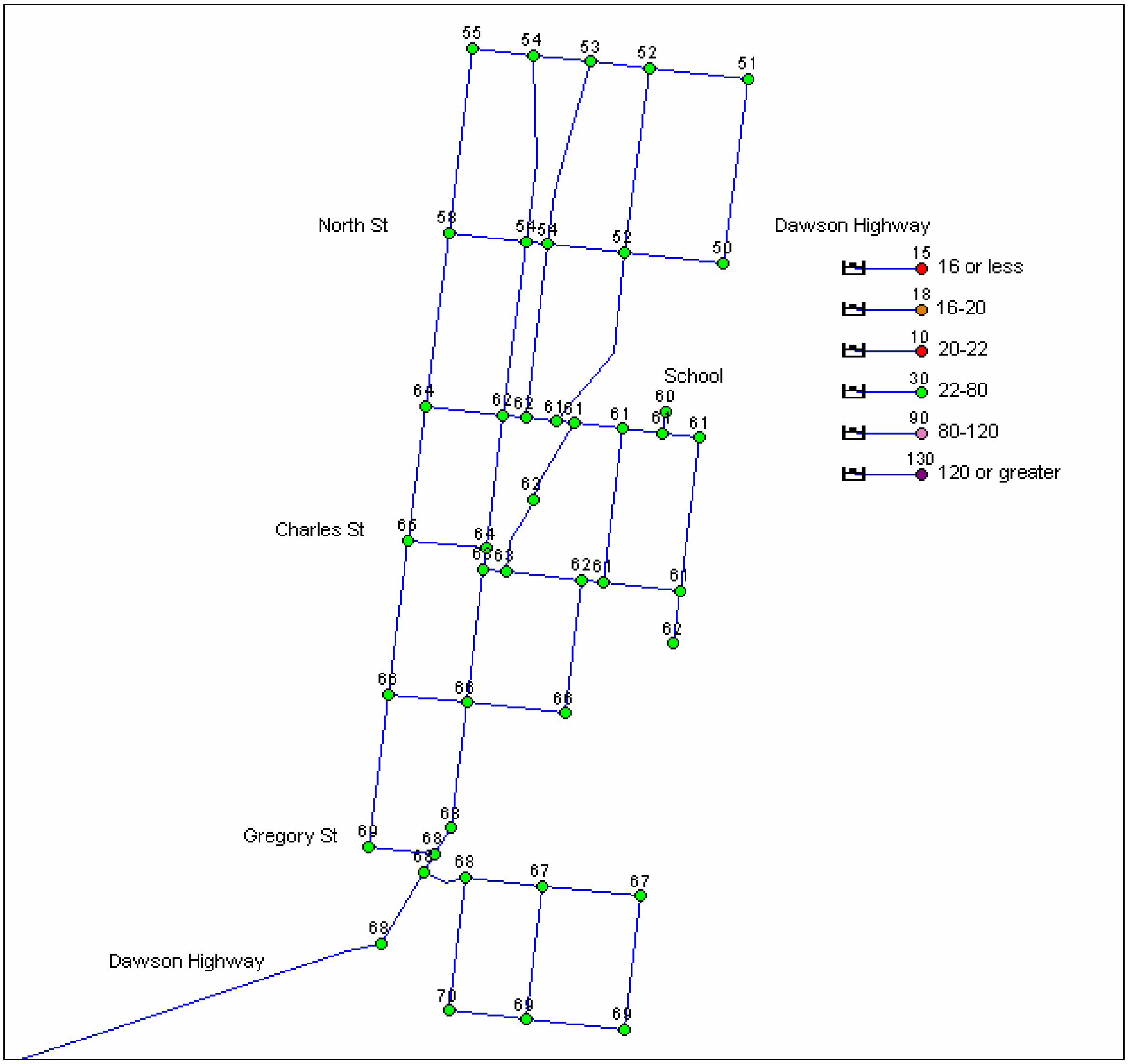


Figure 7.4 – PH pressure (m) at Banana

The model indicates that the minimum PH pressure ranges from 43-82m at Moura and 51-70m at Banana. Thus the design criterion for residual service pressure at Moura and Banana are met.

A fire-flow analysis was undertaken in accordance with the DNR&M Guidelines. The critical design flow shown on Figures 7.5 and 7.6 is a measure of the maximum flow available at the current node such that the pressure in the reticulation does not drop below the design pressure of 12m.

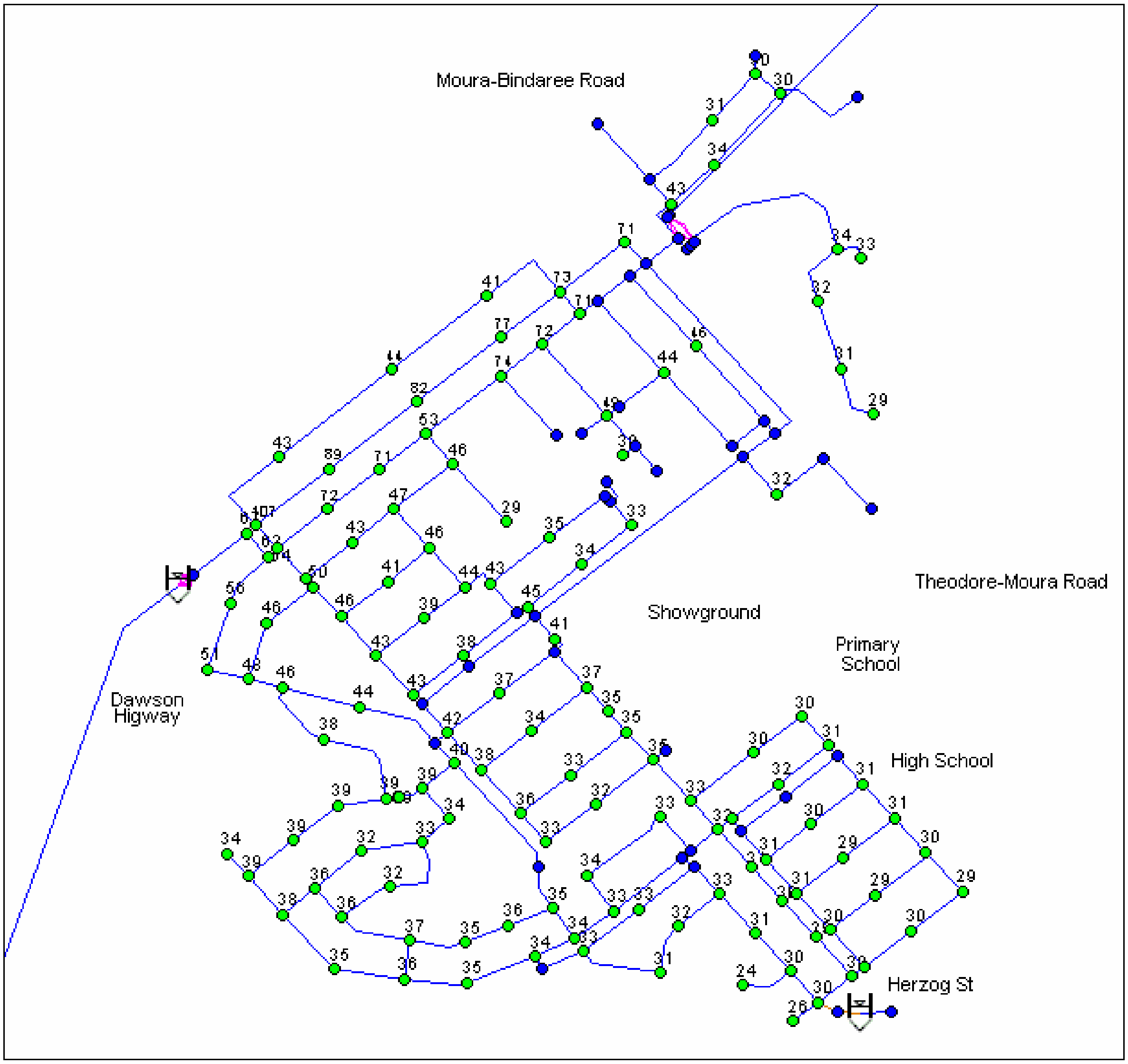


Figure 7.5 – Critical design flow (L/s) at Moura

Nodes denoted in green indicate that the fire-flow provisions are met in accordance with the DNR&M Guidelines. Blue nodes are non-demand nodes, and thus excluded from the analyses. The model indicates that the minimum critical design flow of 15 L/s (residential) and 30 L/s (commercial) is met at Moura.

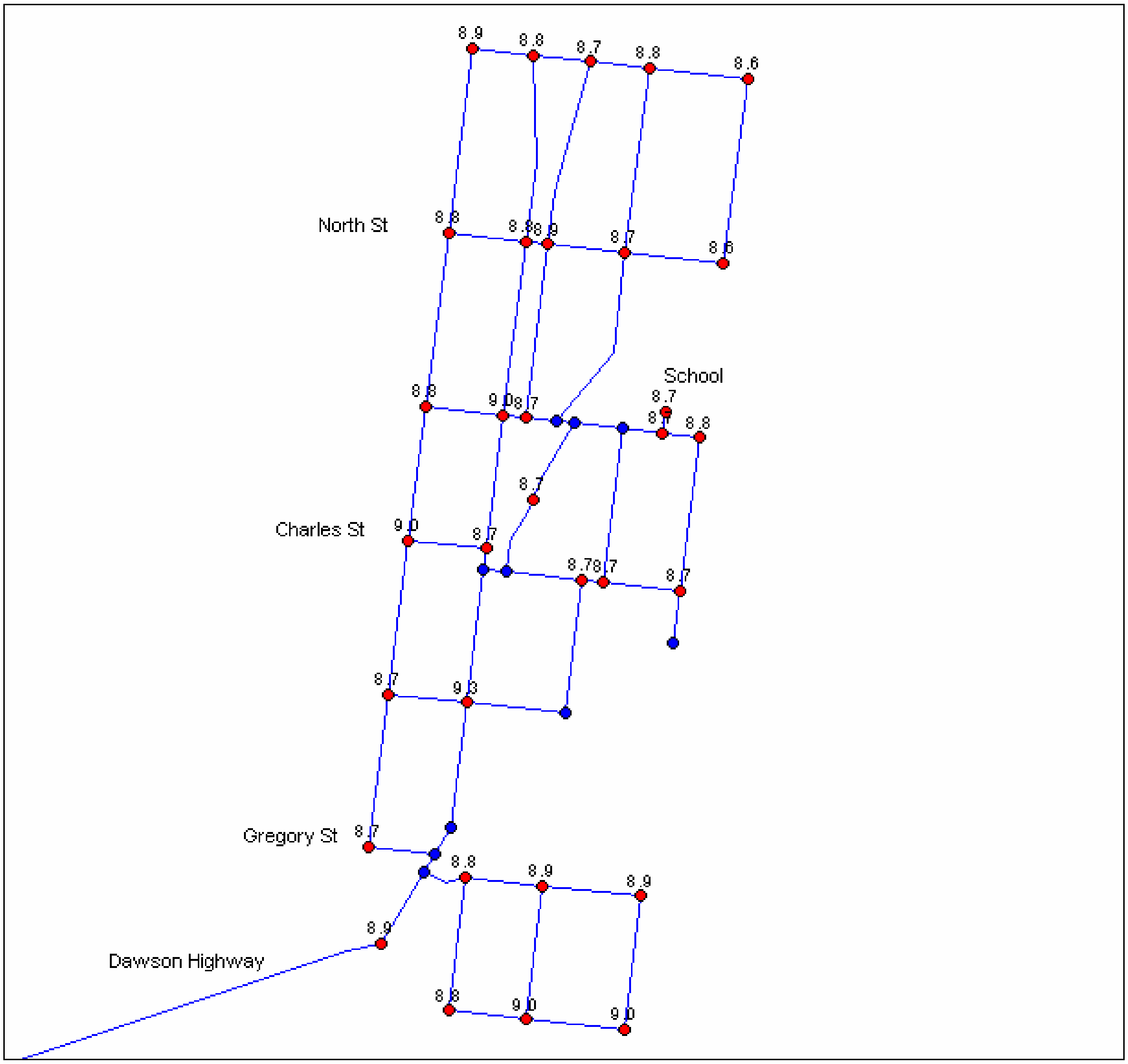


Figure 7.6 – Critical design flow (L/s) at Banana

The critical design flow at Banana is some 8-9 L/s which is lower than the 15 L/s recommended by the DNR&M Guidelines. Augmentation of existing infrastructure is considered necessary in order to satisfy the design criteria with respect to fire-flow at Banana.

7.2 AUGMENTATION STRATEGY

The augmentation strategies considered include the construction of an elevated reservoir at Banana and the augmentation of the Banana rising main. The preliminary modelling scenario was used to define the following set of critical pressure points, which were used to assess the impact of the proposed augmentations.

Table 7.1 - Critical pressure points within Moura and Banana

Node ID	Comment	Location	Average Service Pressure (m)	Critical Node Pressure (m)	Critcal Design Flow (L/s)
15	Burnham St Reservior	Moura	62	50	39.0
73	Cnr Herzog and McRae Sts	Moura	59	44	29.3
131	Cnr Young and Master Sts	Moura	65	55	32.1
158	Cnr King and Shean Sts	Moura	78	52	48.4
177	Okano St	Moura	63	27	34.6
187	Cnr Stuart and Moriarty Sts	Banana	67	0	9.0
222	Cnr Leichhardt Hwy and Moriarty Sts	Banana	49	0	8.6

7.2.1 Option A – Banana Elevated Reservoir

An elevated storage reservoir was modelled at a nominal high point in Banana, adjacent to the Dawson Hwy and Moriarty St. The reservoir was modelled with a storage capacity of 200 kL in accordance with the DNR&M Guidelines. The variable speed drives (VSD) were removed from the Banana pump station – the pumps were modelled as two duty and two standby each delivering 2.5 L/s at 13.5 m, producing maximum downstream pressure of 82 m. The resultant flow is above the minimum recommended rate of 1.9 L/s defined by the DNR&M Guidelines. H_2OMAP rule controls were assigned such that the pumps closed when the level in the proposed elevated reservoir reached 98%, and opened when the level in the reservoir fell to 90% of capacity.

The model was run with the above augmentation, and as outlined on the model schematic, Figure 7.7. The minimum PH service pressure at Moura and Banana is shown on Figures 7.8 and 7.9.

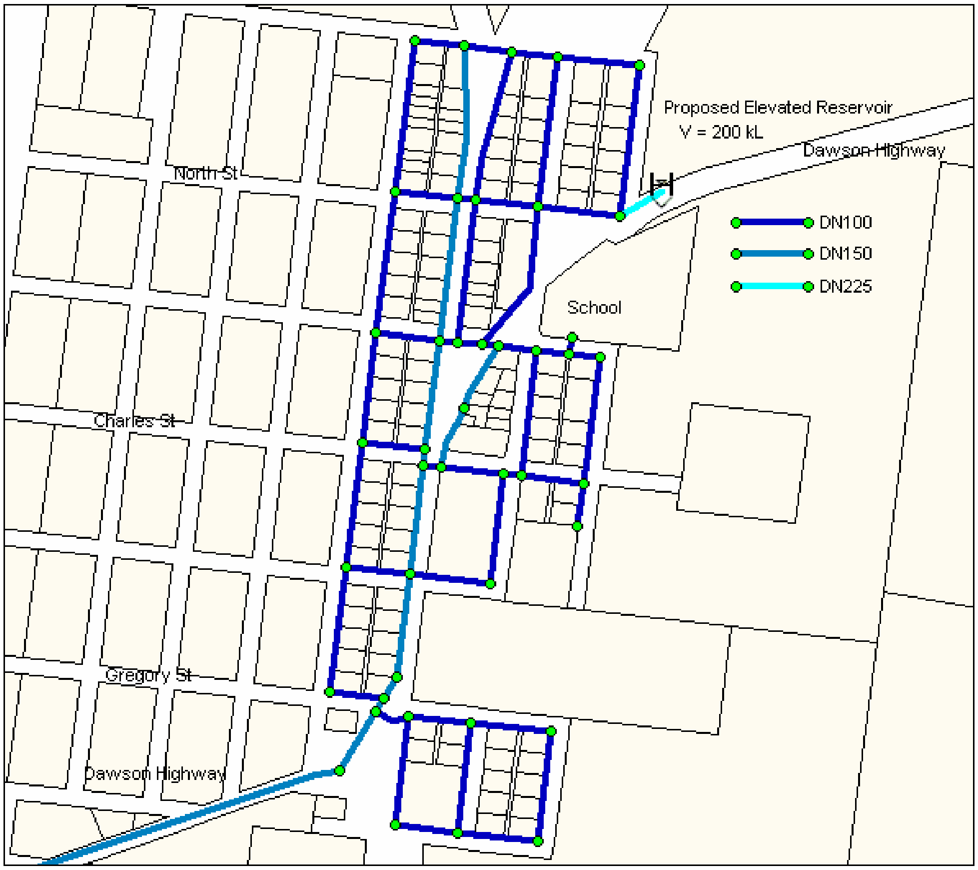


Figure 7.7 – Model Schematic (Banana), Existing Scenario, Option A

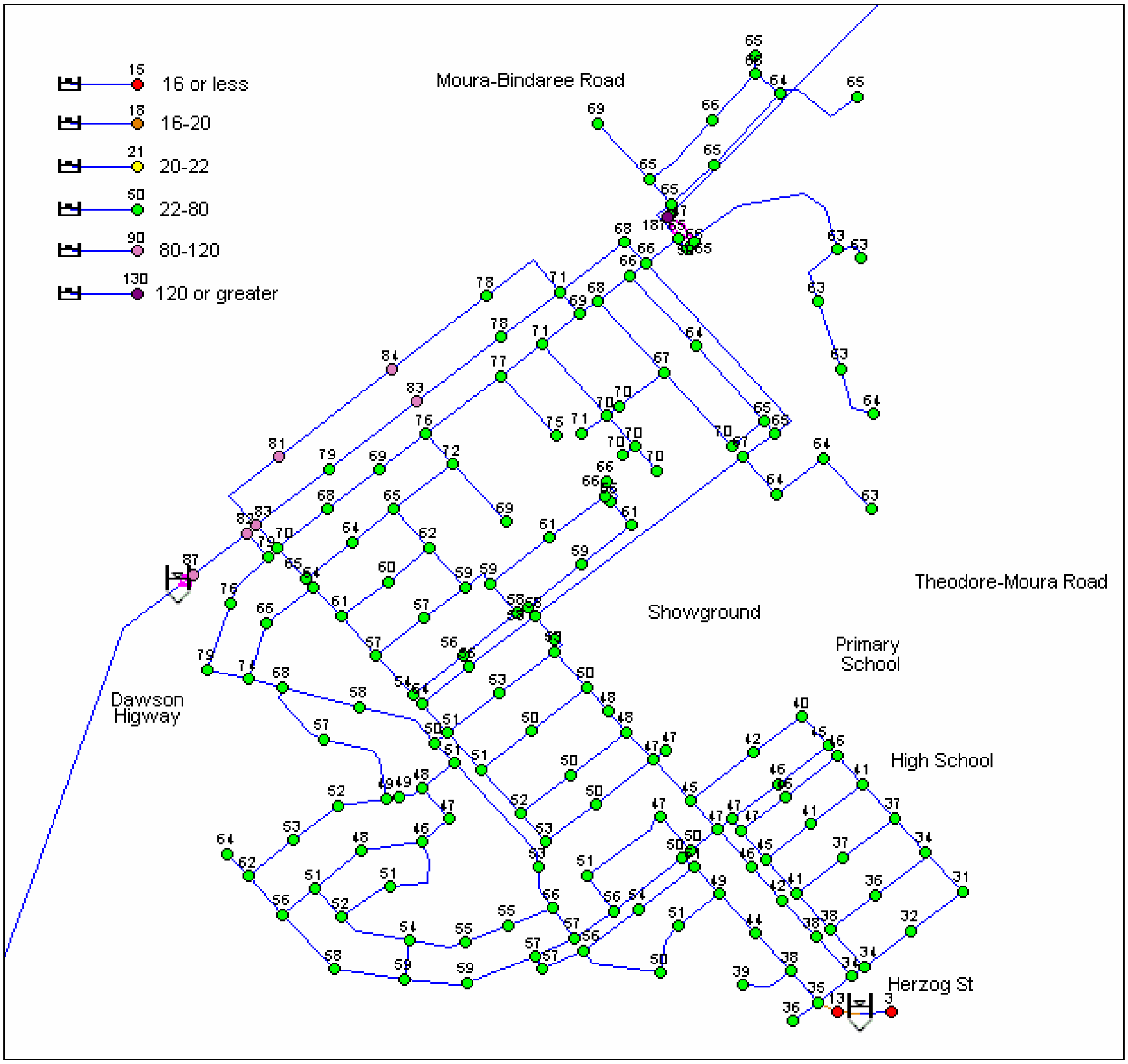


Figure 7.8 – PH service pressure (m) at Moura

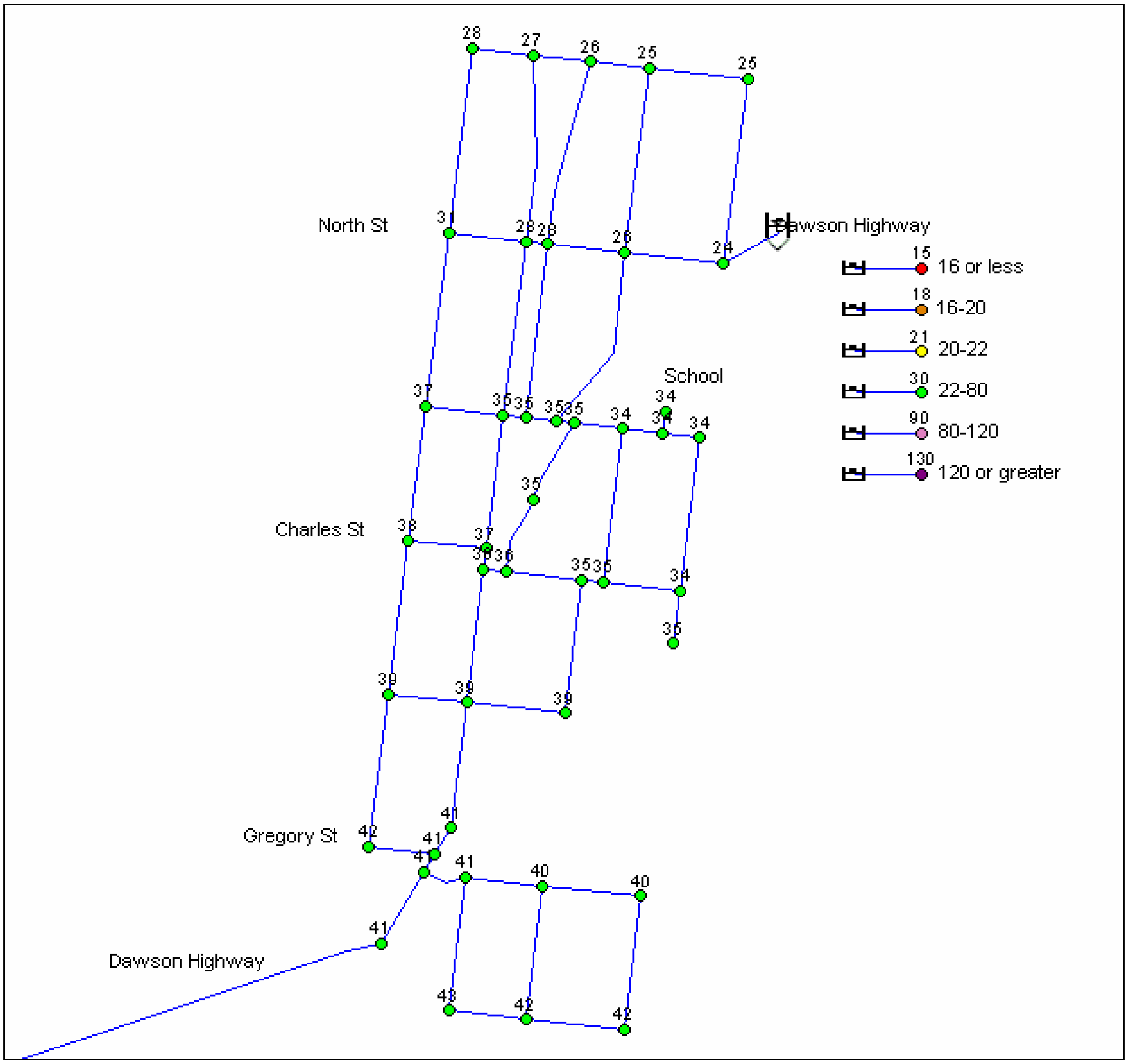


Figure 7.9 – PH service pressure (m) at Banana

The model indicates that the PH service pressure ranges from 31-84m at Moura and from 24-43m at Banana, thus the design criteria for residual service pressure at Moura and Banana are met.

A critical node fire-flow analysis was undertaken in accordance with the DNR&M Guidelines. The critical node pressure is defined as the minimum pressure in the critical node search area when the node in question is loaded with the total (base + fire-flow) demand.

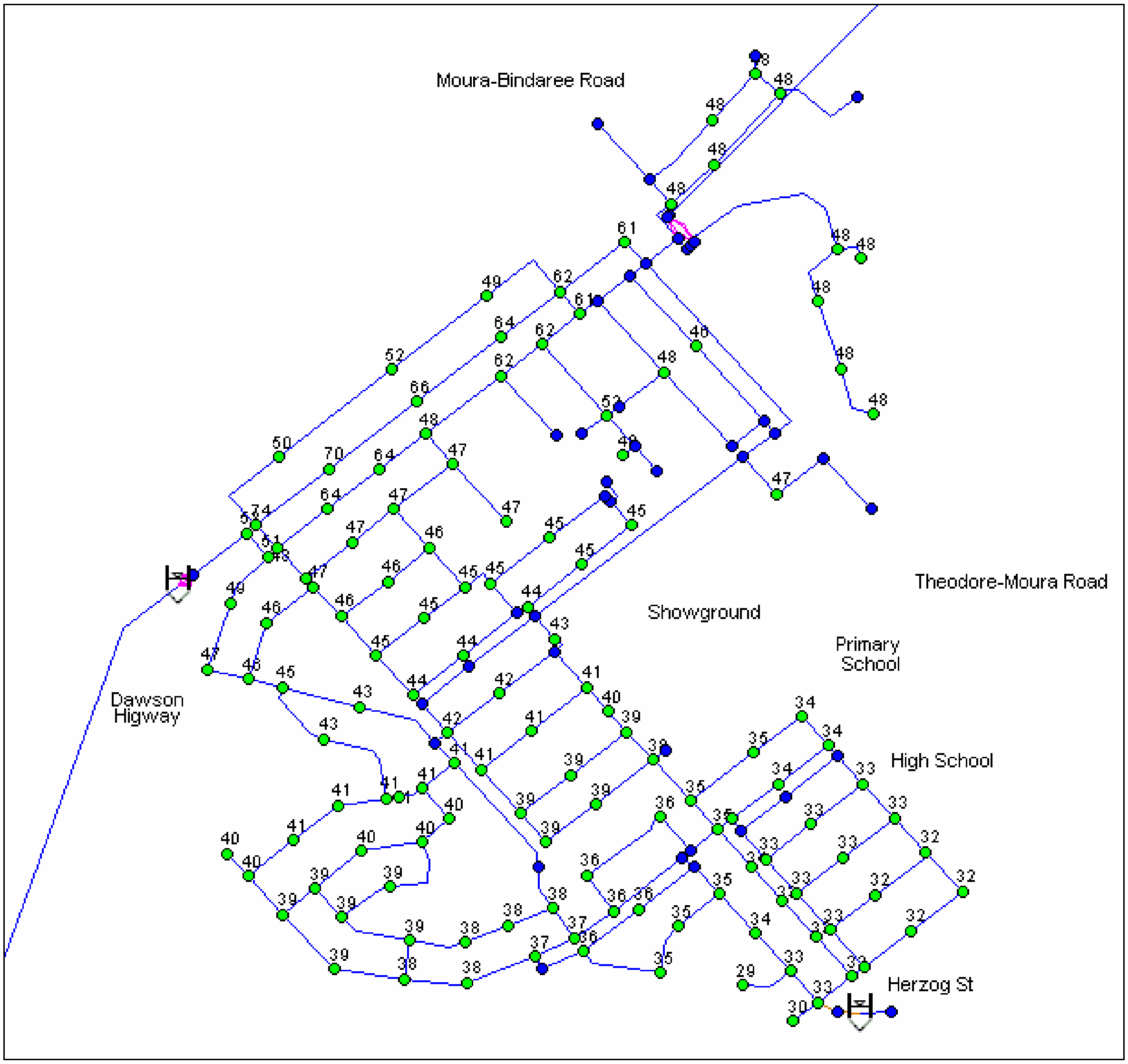


Figure 7.10 Critical Node Pressure (m) at Moura

The minimum critical node pressure of 30m occurs in the southern vicinity of Moura. This is in accordance with the DNR&M Guidelines.

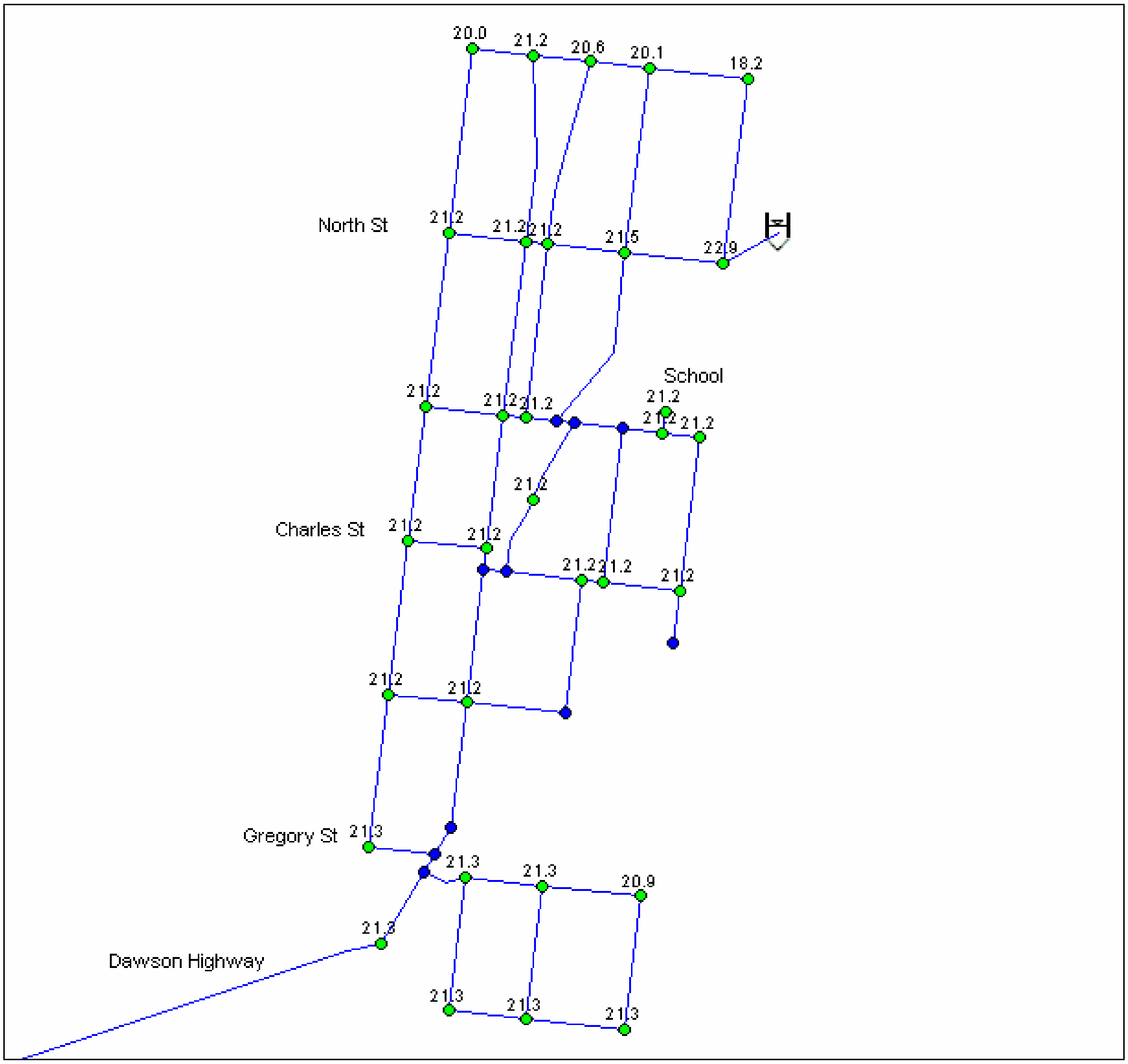


Figure 7.11 – Critical Node Pressure (m) at Banana

The minimum critical node pressure at Banana is 18.2 m, which is above the minimum recommended pressure as defined by the DNR&M Guidelines.

The critical pressure point comparisons outlined on Table 7.2 confirm that the design criteria for average service pressure and fire-flows are met.

Table 7.2 – Critical Pressure Point Comparison

	Average Service Pressure (m)		Critical Node Pressure (m)		Critical Design Flow (L/s)	
Node ID	Pre-augmentation	Post-augmentation	Pre-augmentation	Post-augmentation	Pre-augmentation	Post-augmentation
15	62	63	50	41	39.0	32.5
73	59	59	44	32	29.3	23.3
131	65	66	55	47	32.1	31.0
158	78	79	52	52	48.4	43.5
177	63	64	27	27	34.6	34.7
187	67	43	0	21	8.5	19.0

221	49	24	0	18	8.1	22.3

In order to analyse reservoir volumes and pump station operation over time, fire-flow demands were modeled at respective commercial and residential nodes. A fire-flow demand of 30 L/s was modeled at commercial node 177 for a duration of 4 hours to analyse the level in the Moura water storage reservoir and the Dawson River pump station operation. The results are shown on Figure 7.12. Likewise, a fire-flow demand of 15 L/s was modeled at residential node 187 at Banana for a duration of 2 hours to analyse the level in the proposed elevated reservoir and the Banana booster pump operation. The results are shown on Figure 7.13.

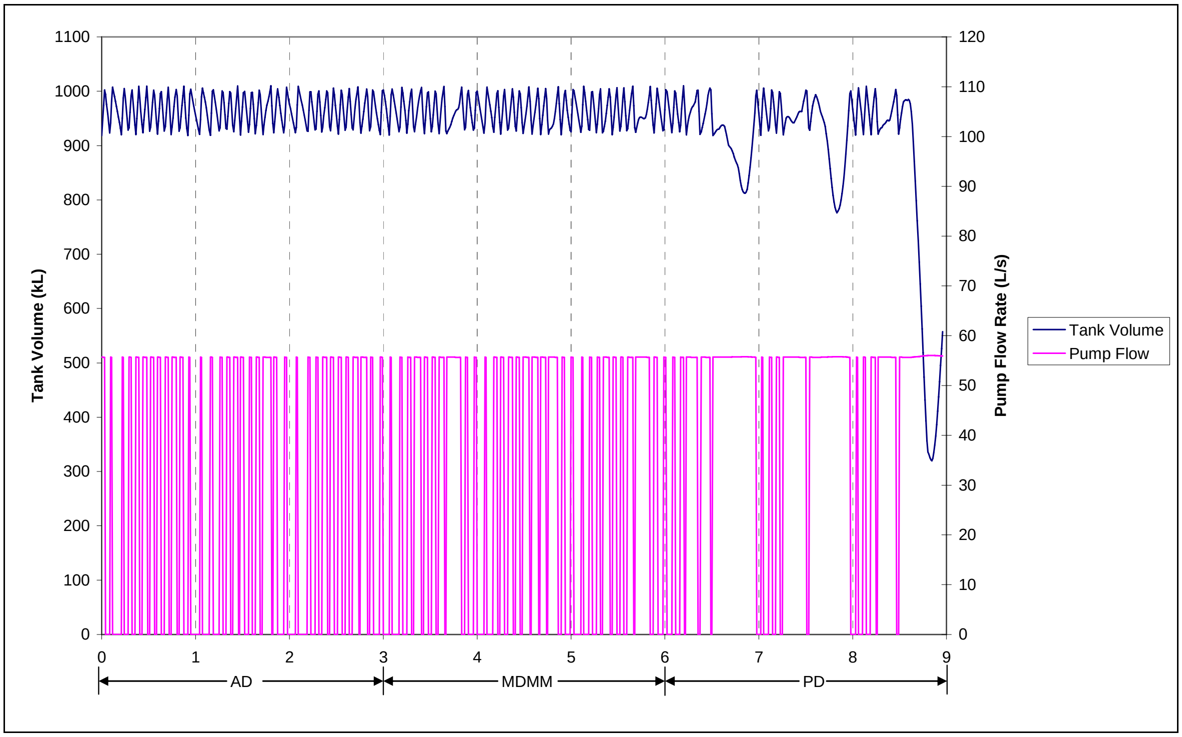


Figure 7.12 – Clear water storage volume and river pump station operation over analysis period

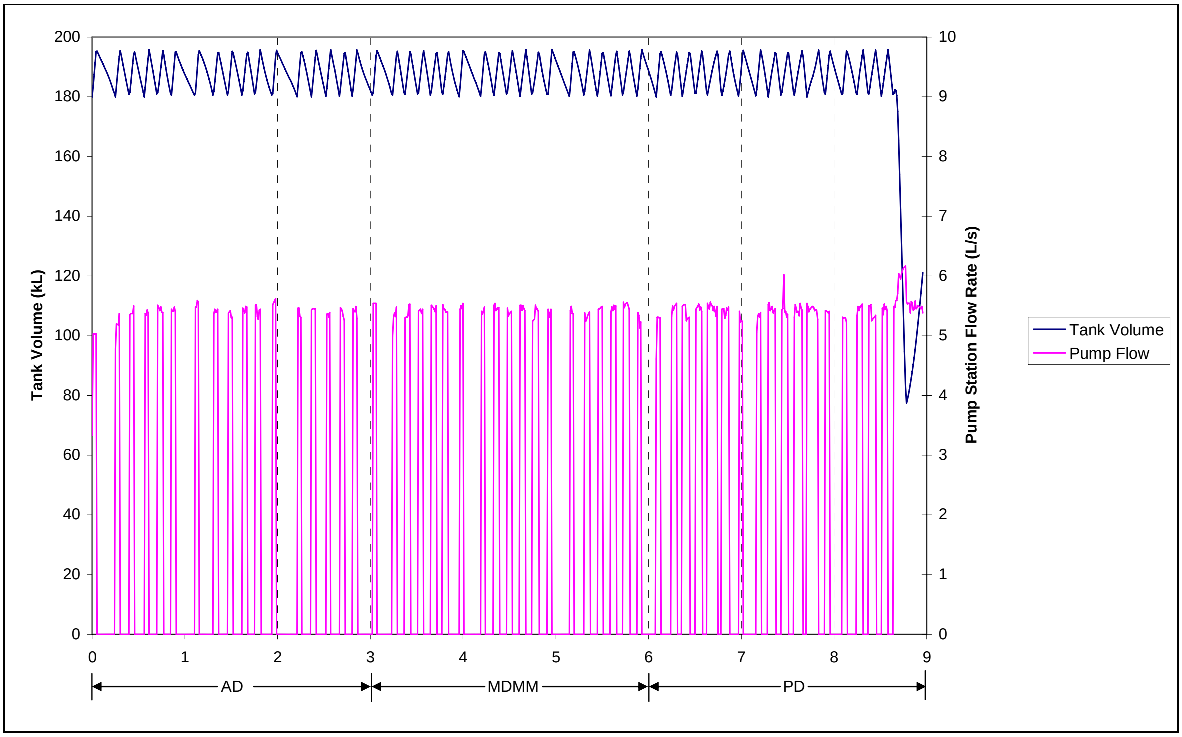


Figure 7.13 – Proposed elevated reservoir volume and Banana booster pump station operation over analysis period

Defined by the DNR&M Guidelines, the minimum delivery flow rate for the Moura rising main and the Banana rising main is 41 L/s and 3.2 L/s respectively. It is seen that these minimum flow rates are met. Furthermore, it is seen that the reservoirs have a net positive inflow at the end of each MDMM, and that neither reservoir has failed during the analysis period. Thus the design criterion for reservoir storage and pump station operation are met.

7.2.2 Option B – Banana Rising Main Augmentation

The modelling was undertaken with the Banana rising main augmented from the existing DN150 to a DN225. The model diameters are outlined on the model schematics, Figure 7.14. The VSD pumping arrangement in the Banana pump station was retained, controlled by the demand at Banana.

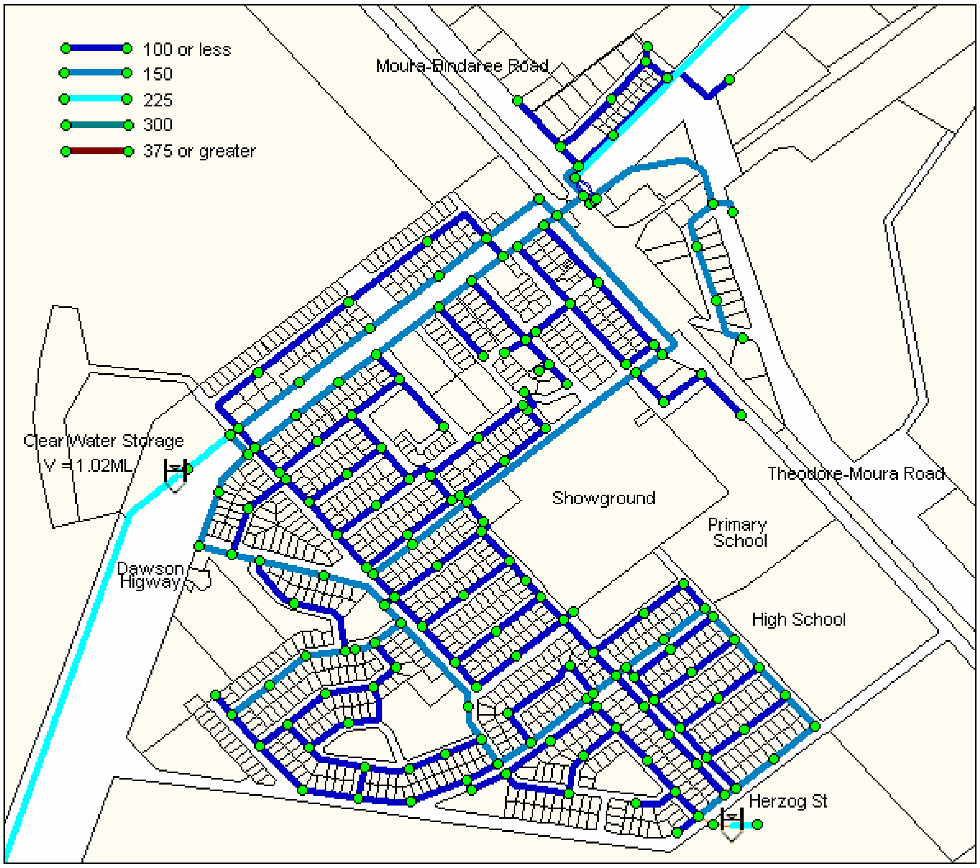


Figure 7.14a – Model Schematic (Moura), Existing Scenario, Option B

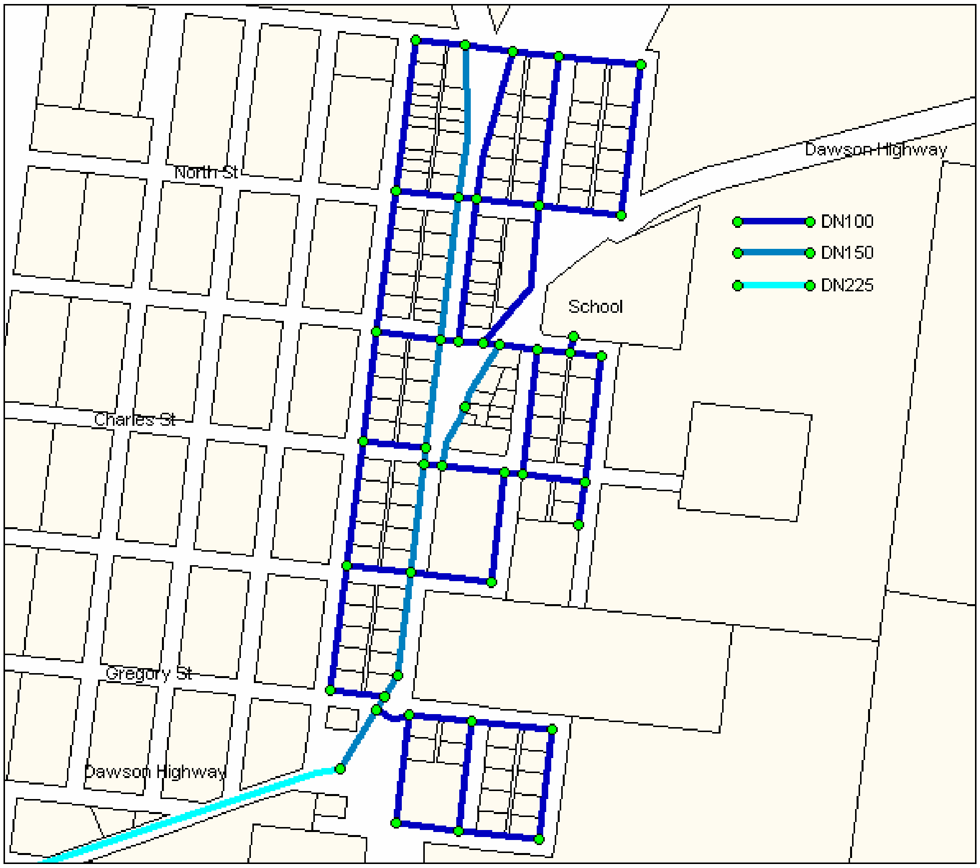


Figure 7.14b – Model Schematic (Banana), Existing Scenario, Option B

The PH service pressure at Moura and Banana is shown on Figures 7.15 and 7.16.

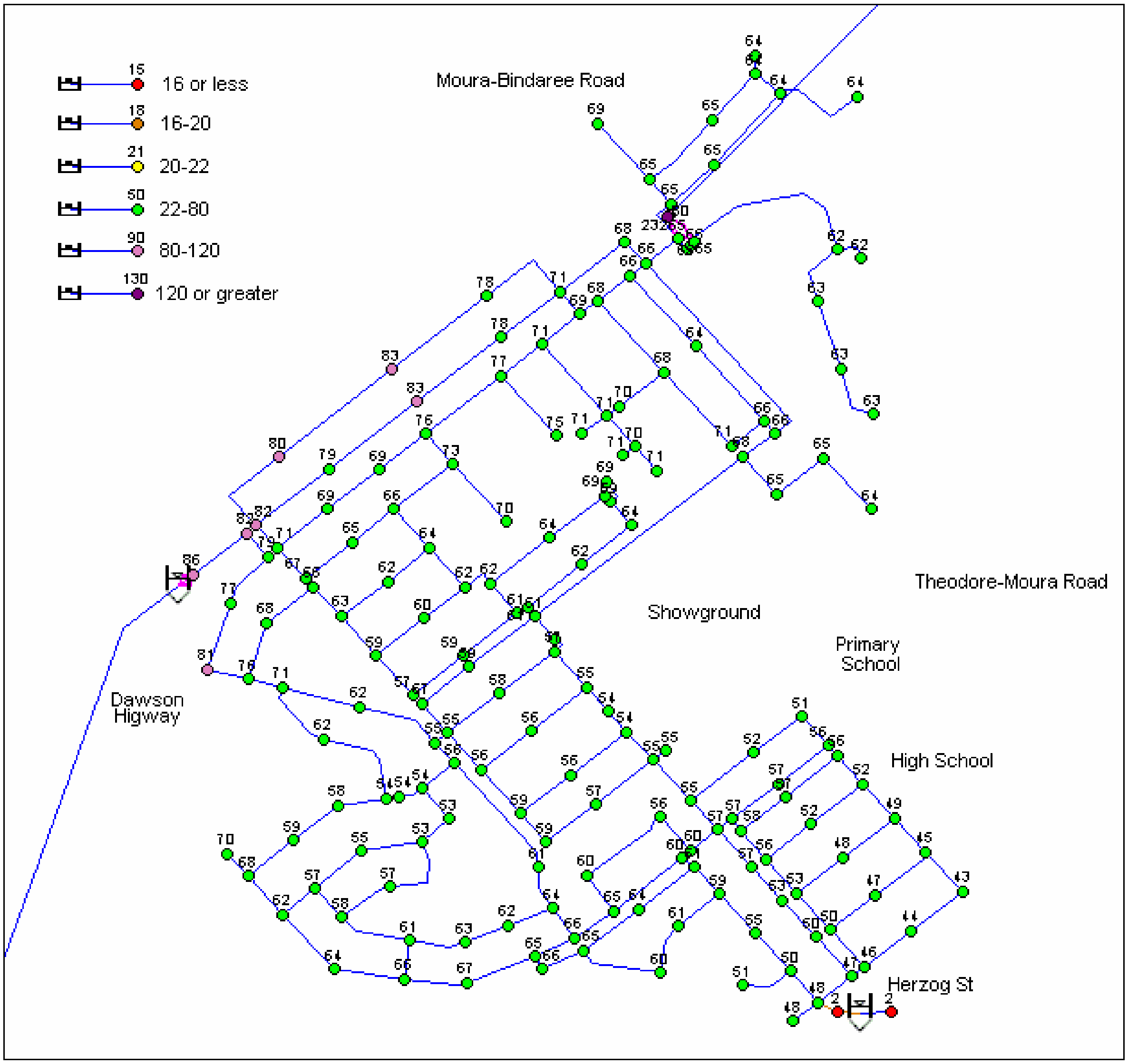


Figure 7.15 – PH service pressure (m) at Moura

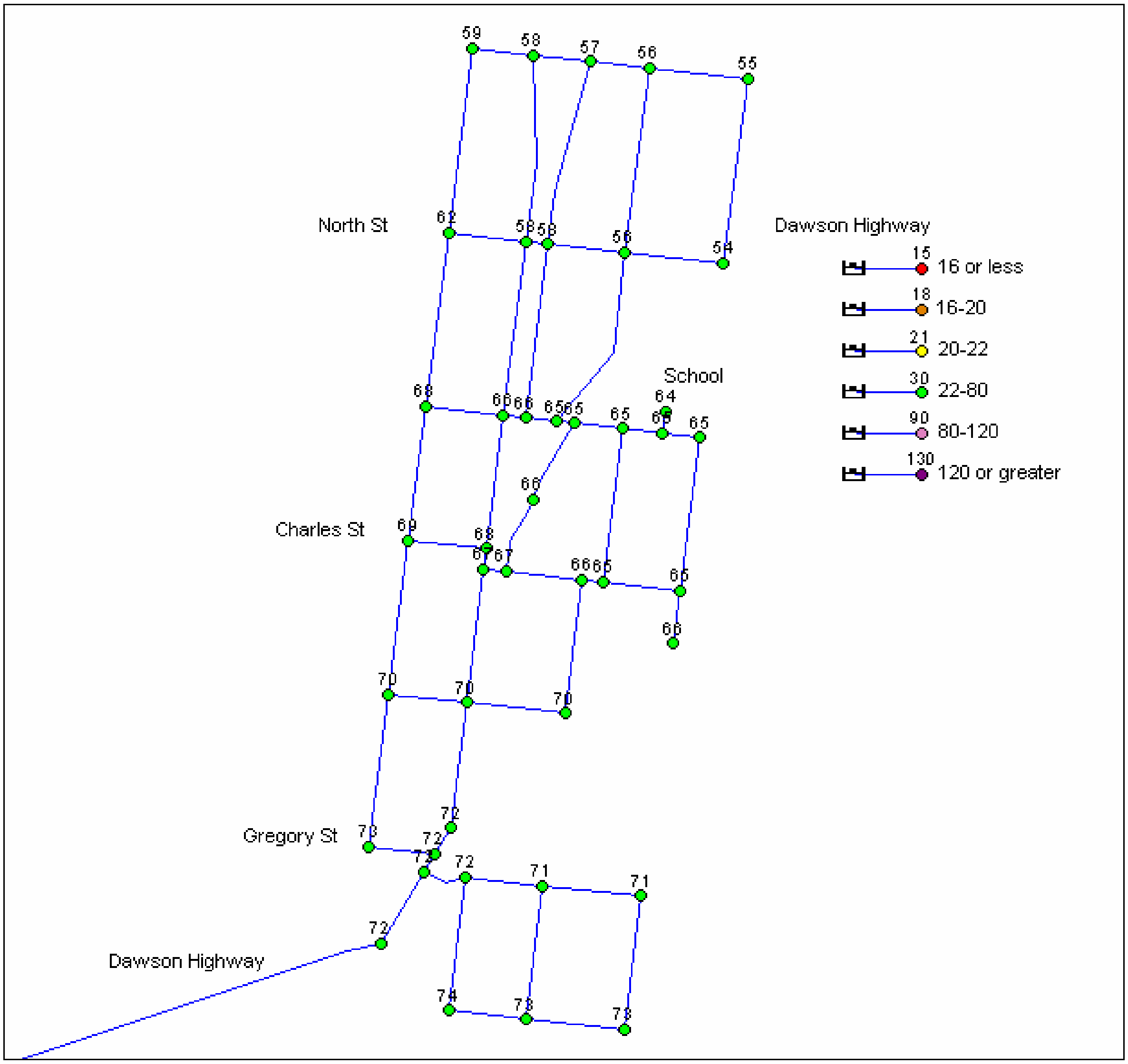


Figure 7.16 – PH service pressure (m) at Banana

The model indicates that the minimum PH service pressure ranges from 43-83m at Moura and from 54-74m at Banana, thus the design criteria for residual service pressure at Moura and Banana are met.

A critical node analysis was undertaken in accordance with thew DNR&M Guidelines. The critical node pressure for Moura and Banana is shown on Figures 7.17 and 7.18.

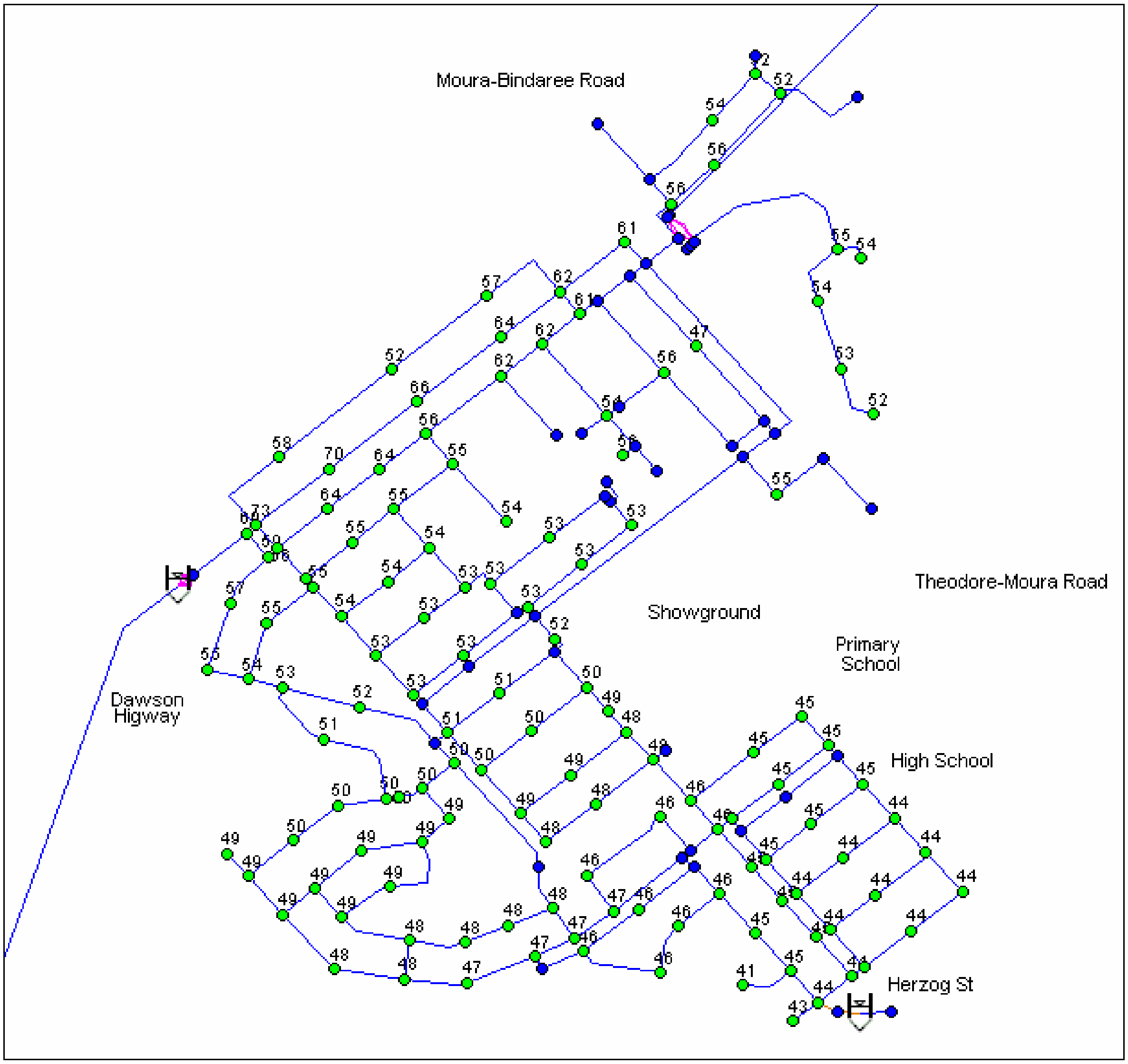


Figure 7.17 – Critical node pressure (m) at Moura

The minimum critical node pressure at Moura is 41m, which is in accordance with the DNR&M Guidelines.

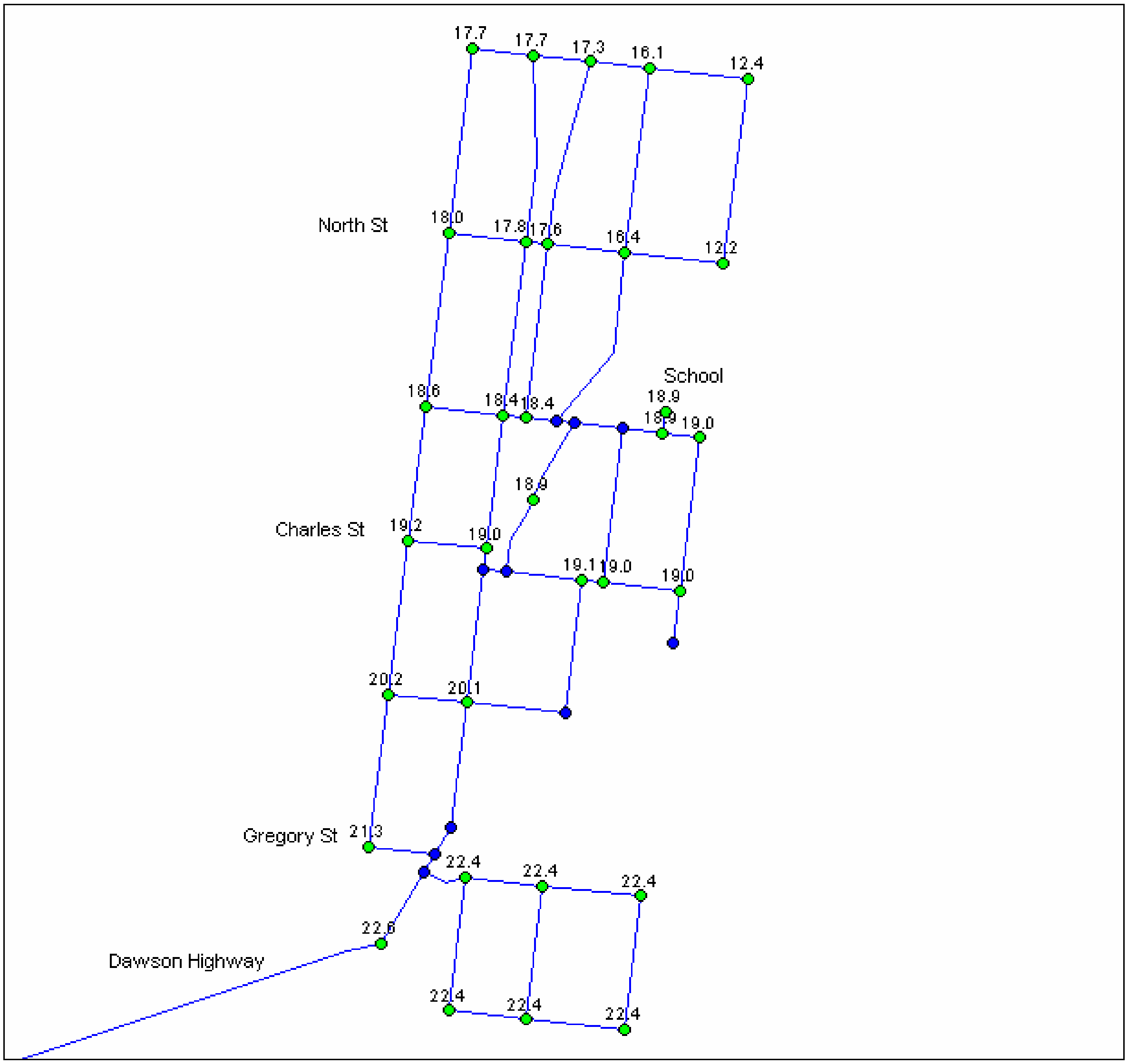


Figure 7.18 – Critical node pressure (m) at Banana

The minimum critical node pressure at Banana is 12.2m, which is above the minimum recommended pressure as defined by the DNR&M Guidelines.

The critical node pressure comparisons outlined on Table 7.3 confirm that the design criteria for average service pressure and fire-flows are met.

Table 7.3 – Critical Pressure Point Comparison

	Average Service Pressure (m)		Critical Node Pressure (m)		Critical Design Flow (m)	
Node ID	Pre-augmentation	Post-augmentation	Pre-augmentation	Post-augmentation	Pre-augmentation	Post-augmentation
15	62	62	50	50	39.0	39.0
73	59	59	44	44	29.3	29.3
131	65	65	55	55	32.1	32.1
158	78	78	52	52	48.4	43.4
177	63	63	27	27	34.6	34.6
187	67	71	0	34	8.5	17.0
221	49	53	0	24	8.1	15.9

In order to analyse the reservoir level and pump station operation over time, a fire-flow demand of 30 L/s was included at commercial node 177 for a duration of 4 hours. The Dawson River pump station and clear water storage operation is shown on Figure 7.19.

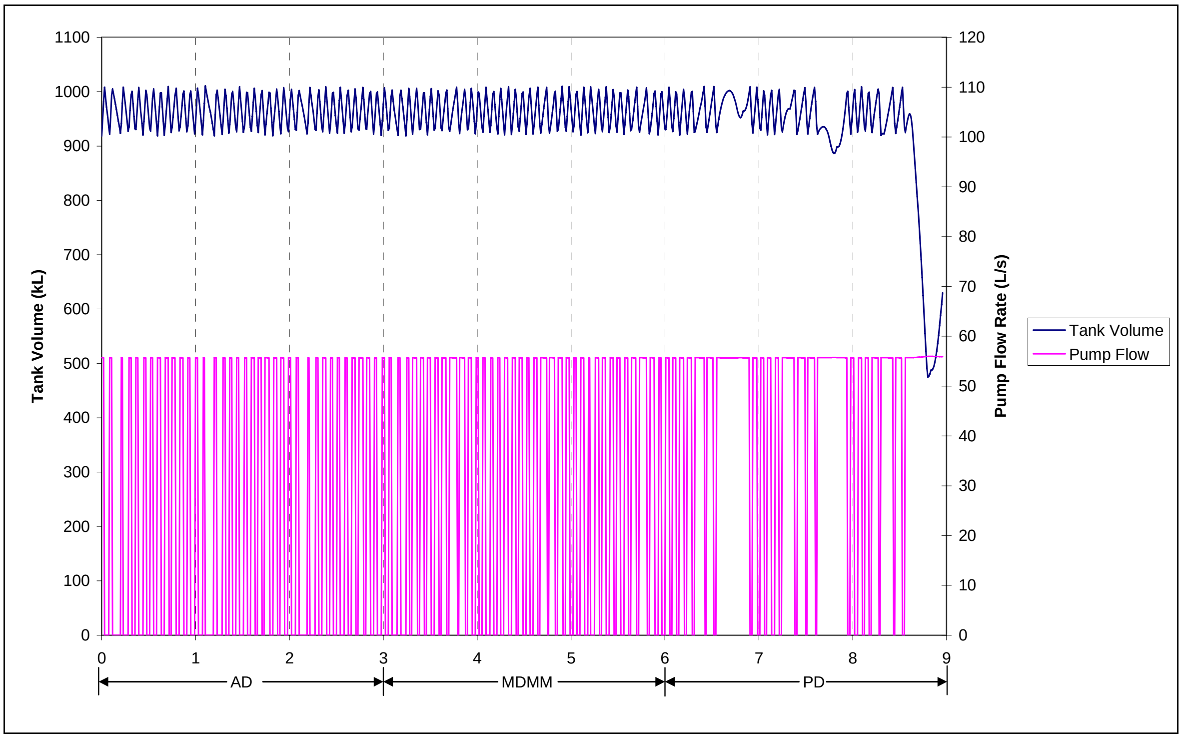


Figure 7.19 - Clear water storage volume and Dawson River pump operation over analysis period

It is seen that the reservoir has a net positive inflow at the end of each MDMM and that the reservoir has not failed during the analysis. Furthermore, the delivery flow rate of 56L/s is above the minimum recommended flow rate of 41 L/s in accordance with the DNR&M Guidelines. Thus the design criterion for reservoir storage and pump station capacity are met.

7.3 SUMMARY OF OPTIONS

The 2006 projected demands presented in Section 5 were included in the modelling. The model indicated that augmentation of existing infrastructure was necessary in order to adequately meet the standards of service at Moura and Banana. The augmentation strategies that were modelled include the construction of an elevated reservoir at Banana and the augmentation of the Banana rising main.

Both augmentation strategies considered are capable of meeting the minimum service pressure, reservoir and pump station requirements at Moura and Banana. However, the augmentation of the Banana rising main (Section 7.2.2) will result in pressures in excess of 140m immediately downstream of the VSD pump station. As such, Option A that involves the construction of an elevated reservoir at Banana is considered the most feasible strategy for augmentation.

8.0 MODELLING ANALYSIS – INTERMEDIATE HORIZON

The reticulation was assessed at the intermediate horizon, 2011. The projected demands from Sections 5.1.2 (Moura) and 5.2.2 (Banana, Scenarios 1, 2 and 3) were included in the model.

8.1 INTERMEDIATE SCENARIO 1

The model was run with the Scenario 1 projected demands in order to determine the level of service provision afforded by the water supply infrastructure; existing pipe diameters were used, the 200kL reservoir at Banana was included. The model schematic (Figure 8.1) outlines the water supply infrastructure as modelled. The corresponding model scenario is "INTERMEDIATESC1, Banana Scenario 1 – Nominal Population Growth".

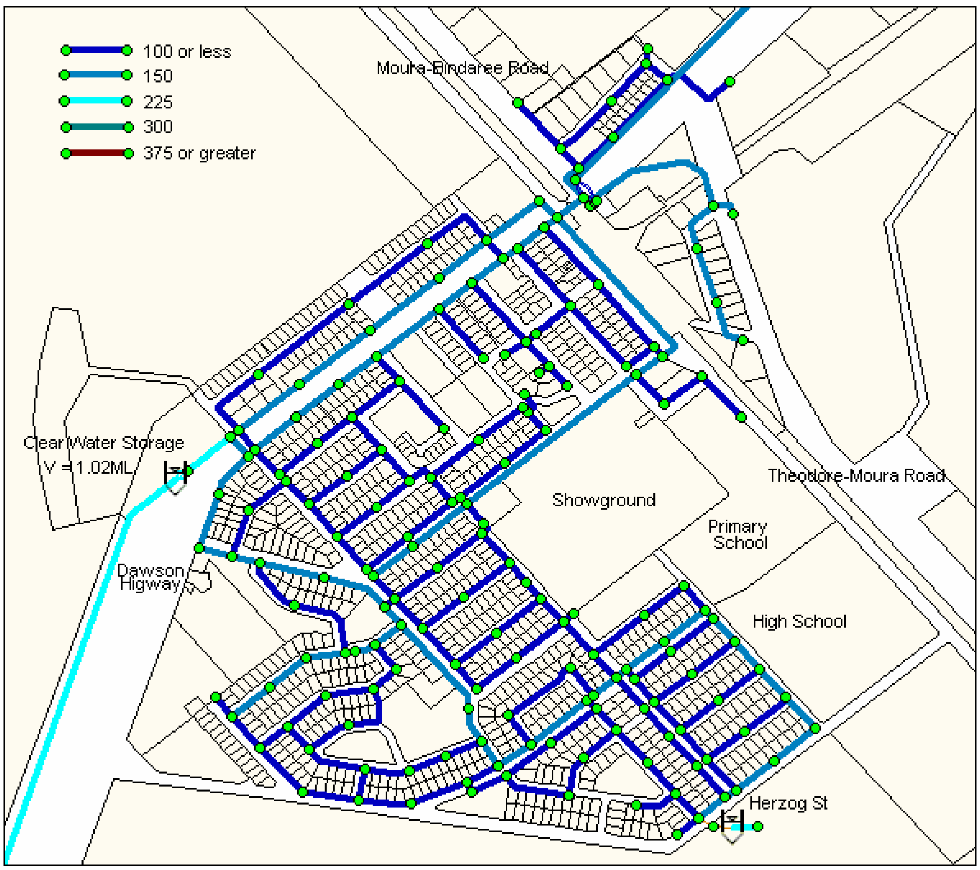


Figure 8.1a – Model Schematic (Moura), Intermediate Scenario 1.

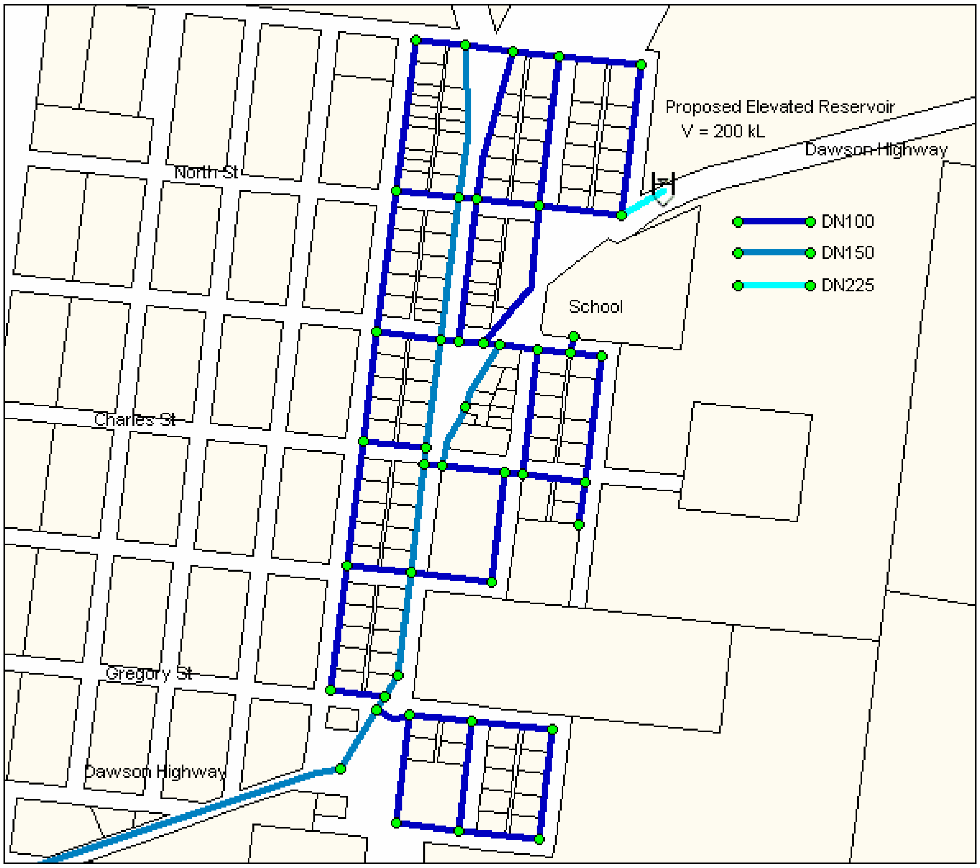


Figure 8.1b – Model Schematic (Banana), Intermediate Scenario 1.

The Peak Hour service pressure at Moura and Banana is shown on Figures 8.2 and 8.3.

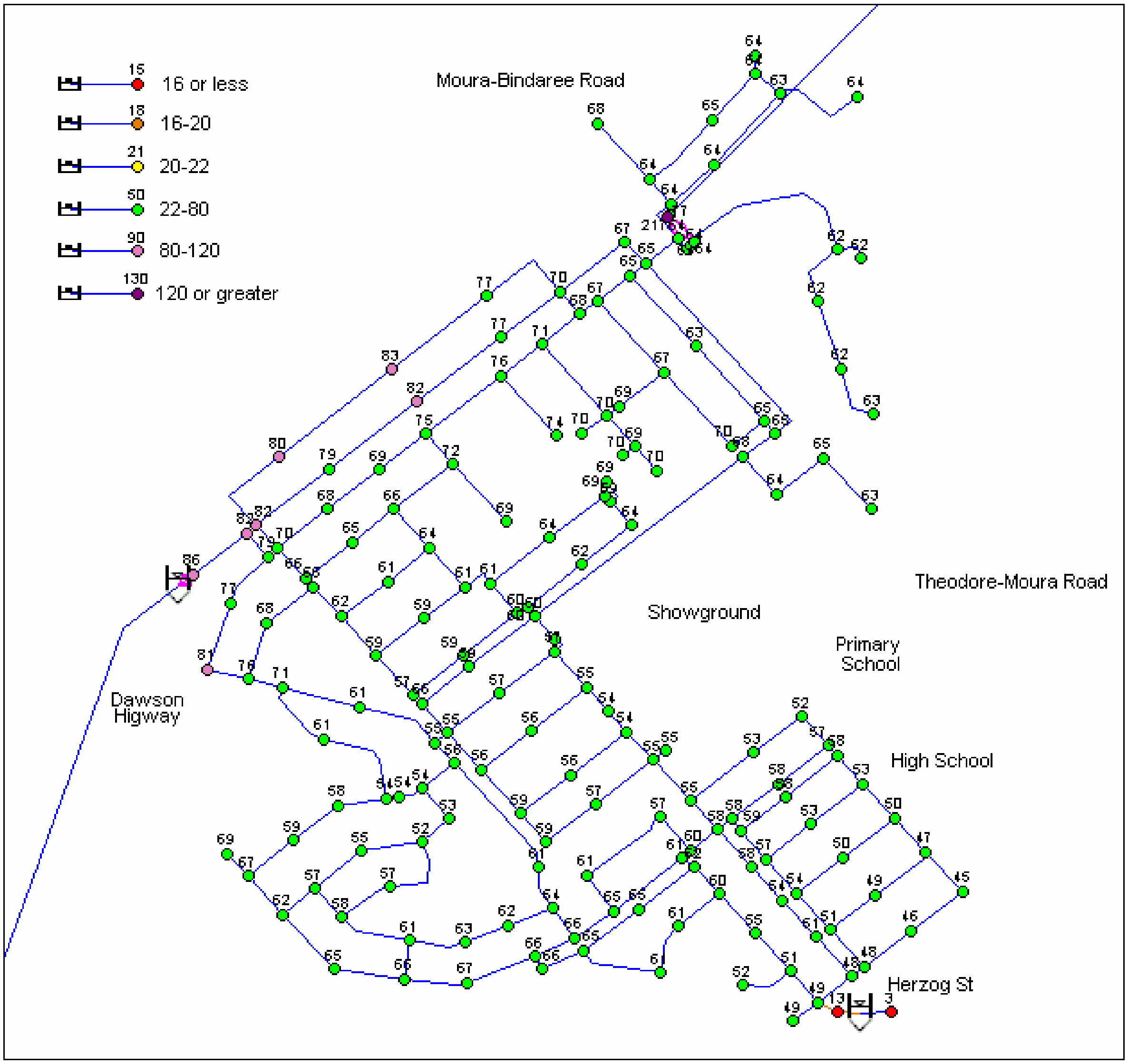


Figure 8.2 – PH service pressure (m) at Moura

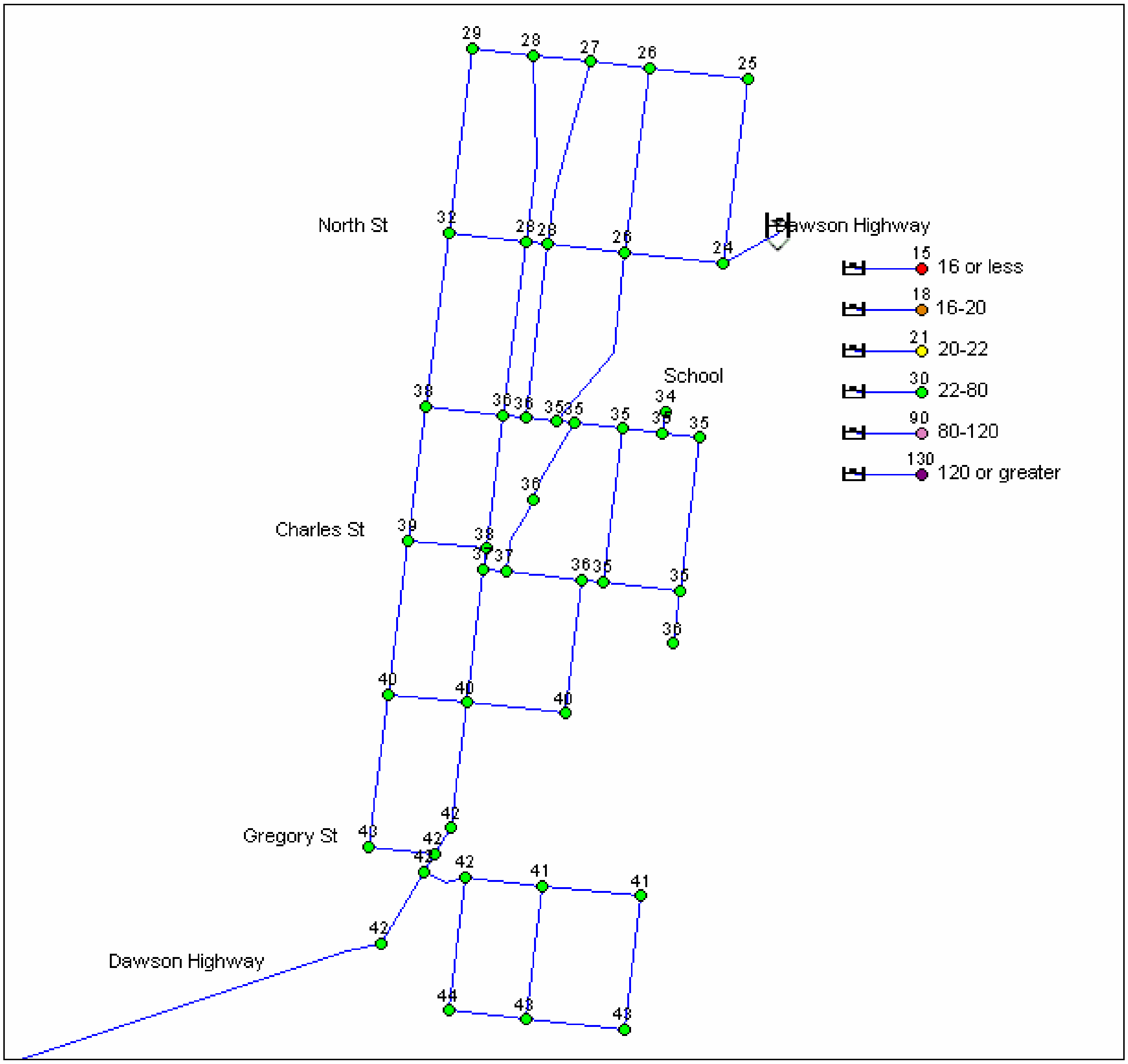


Figure 8.3 – PH service pressure (m) at Banana

The model indicates that the minimum PH service pressure ranges from 45-83m at Moura and from 24-44m at Banana, thus the design criteria for residual service pressure at Moura and Banana are met.

A critical node fire-flow analysis was undertaken in accordance with the DNR&M Guidelines. The critical node pressure for Moura and Banana is shown on Figures 8.4 and 8.5.

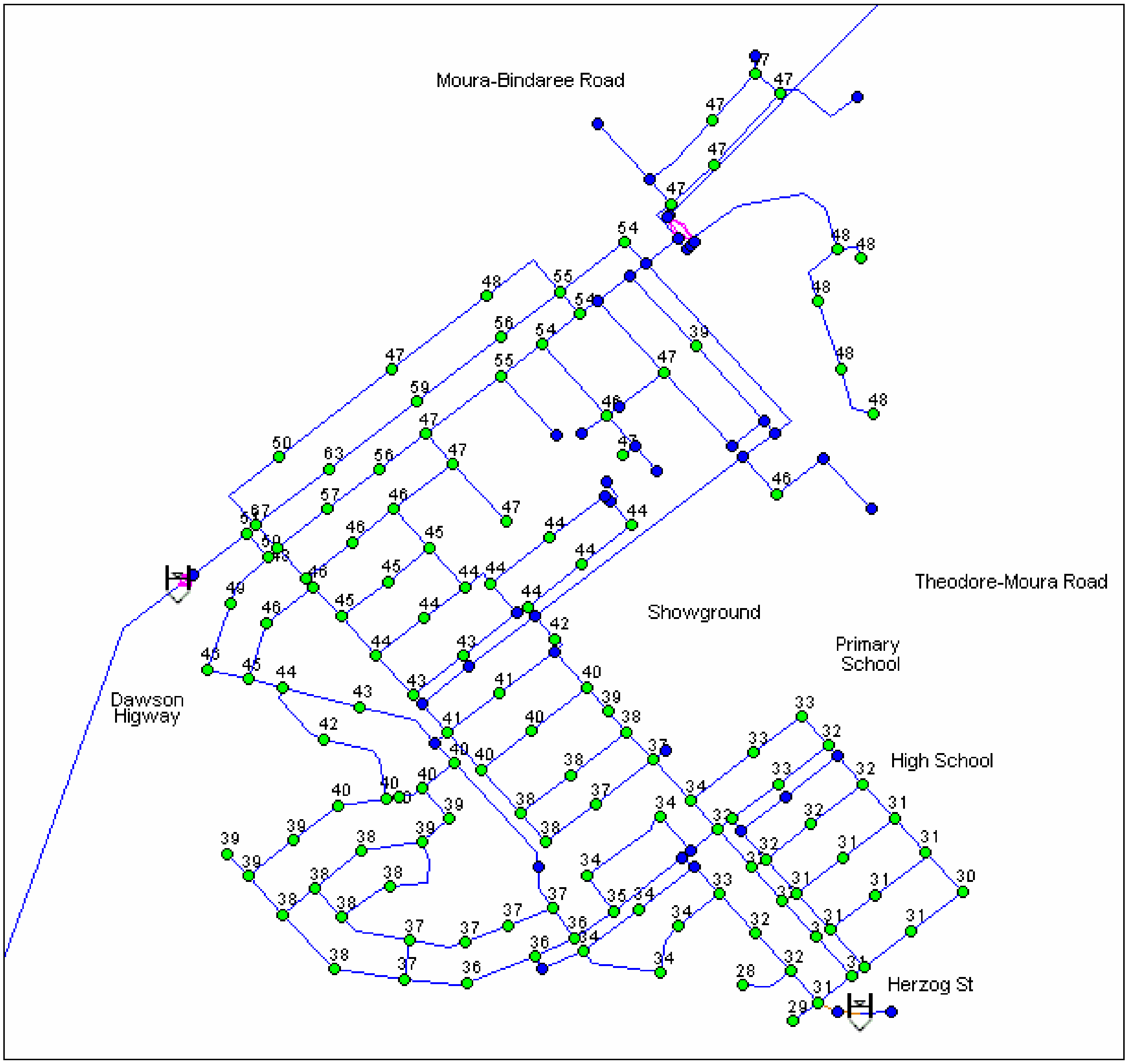


Figure 8.4 – Critical node pressure (m) at Moura

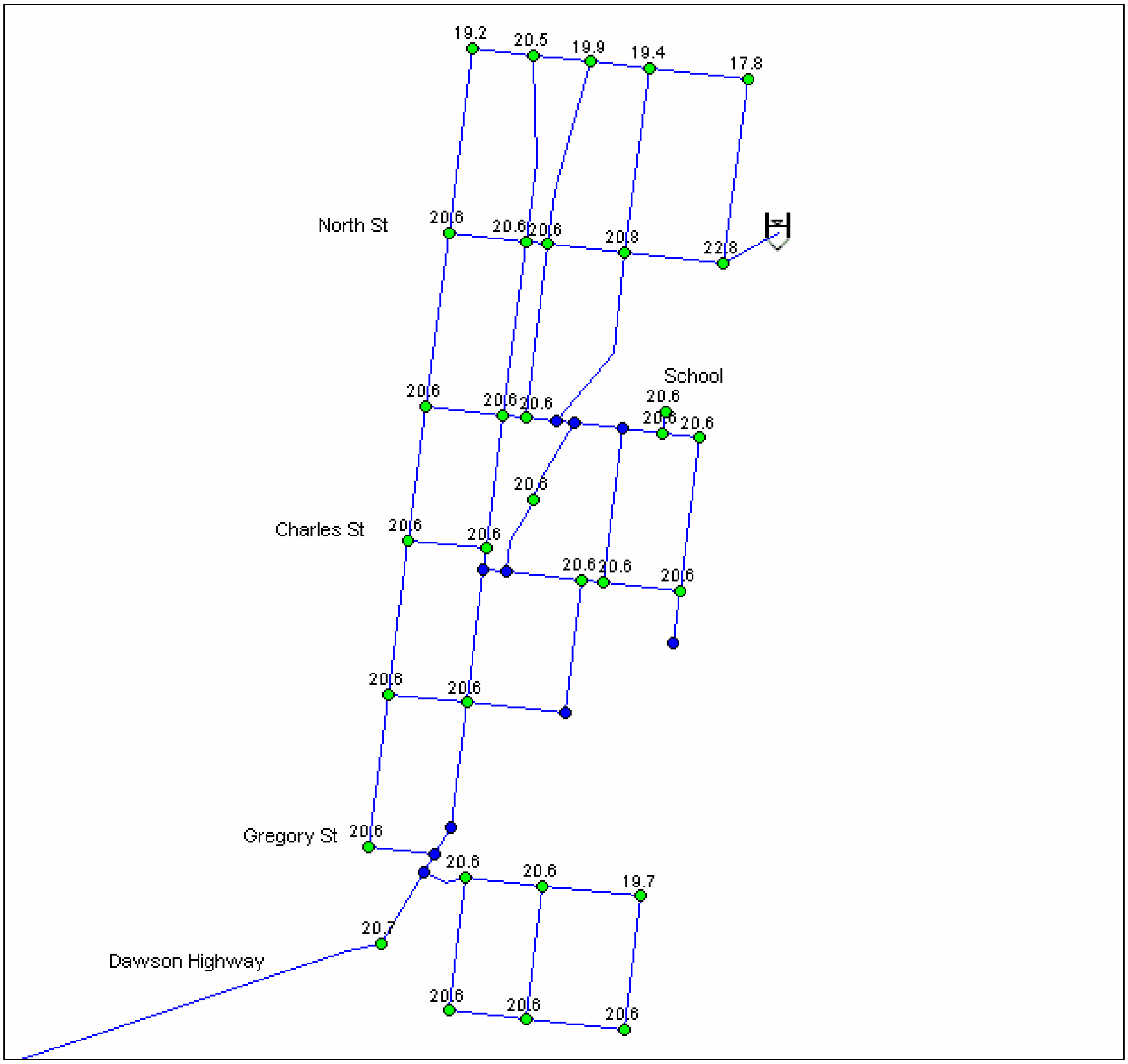


Figure 8.5 – Critical node pressure (m) at Banana

The model indicates that the minimum critical node pressure is 29m at Moura and 17.8m at Banana, thus the minimum fire-flow pressure of 12m is provided in accordance with the DNR&M Guidelines.

In order to analyse the clear water storage and river pump operation, a commercial fire-flow demand was modeled at Moura. The modelling results are shown on Figure 8.6. Likewise, a residential fire-flow demand was modeled at Banana to analyse the elevated reservoir and Banana pump station operation, shown on Figure 8.7.

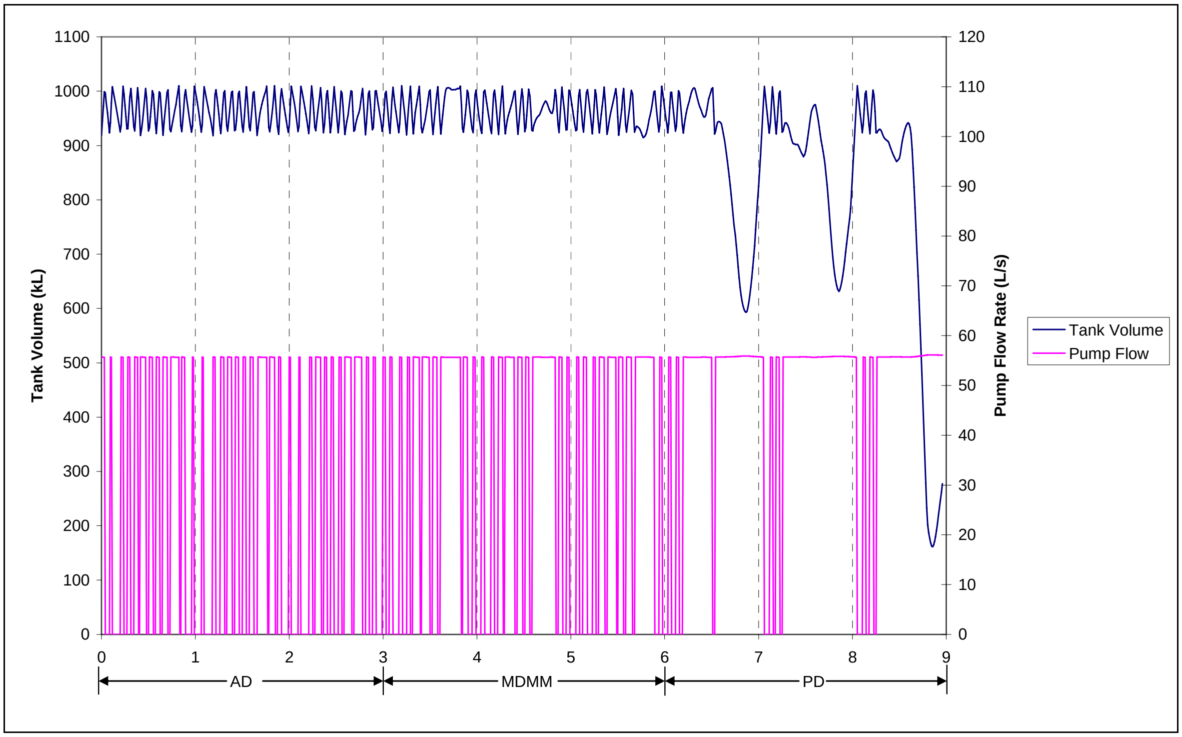


Figure 8.6 - Clear water storage volume and Dawson River pump operation over analysis period

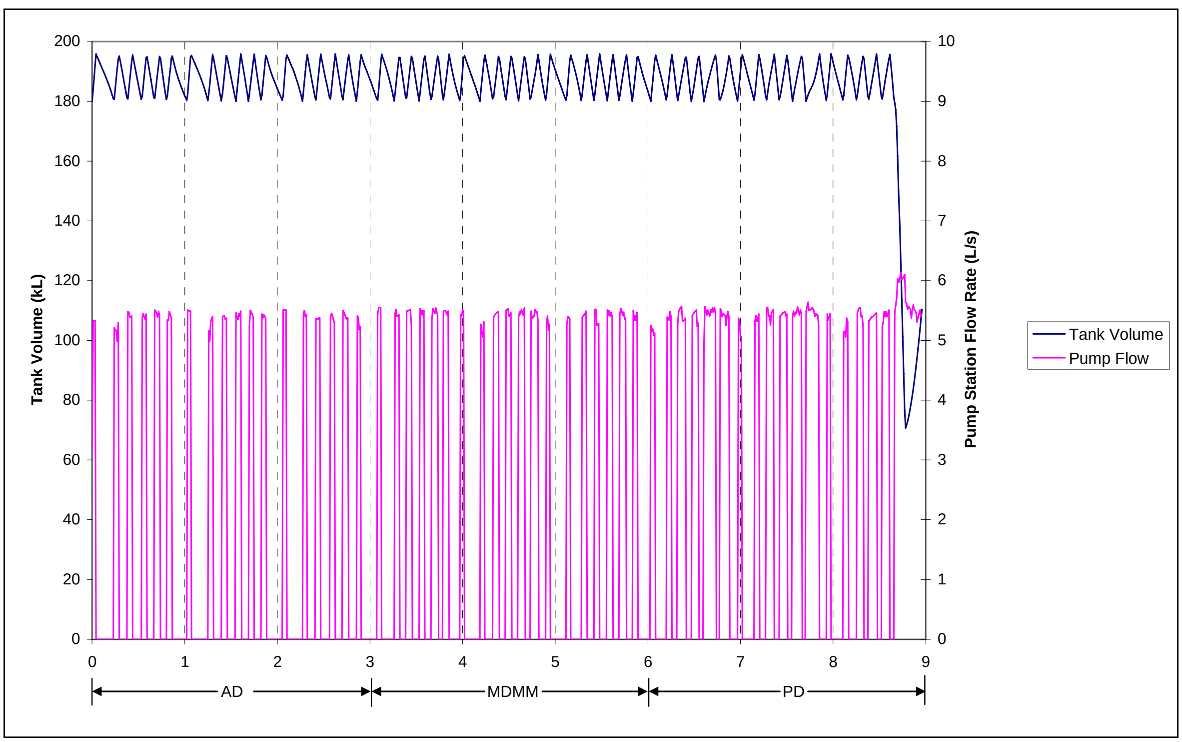


Figure 8.7 - Proposed elevated reservoir volume and Banana booster pump station operation over analysis period

Defined by the DNR&M Guidelines, the minimum delivery flow rate for the Moura rising main and the Banana rising main is 46 L/s and 3.7 L/s respectively. It is seen that these minimum flow rates are met. Furthermore, it is seen that the reservoirs have a net positive inflow at the end of each MDMM, and that neither reservoir has failed during the analysis period. Thus the design criterion for reservoir storage and pump station operation are met.

8.2 INTERMEDIATE SCENARIO 2

The model was run with the Scenario 2 projected demands in order to determine the level of service provision afforded by the water supply infrastructure; existing pipe diameters were used, the 200 kL elevated reservoir was included. The model schematic (Figure 8.8) outlines the water supply infrastructure as modelled. The corresponding model scenario is “INTERMEDIATESC2, Banana Scenario 2 – Nominal Population Growth + 50 lot development”.

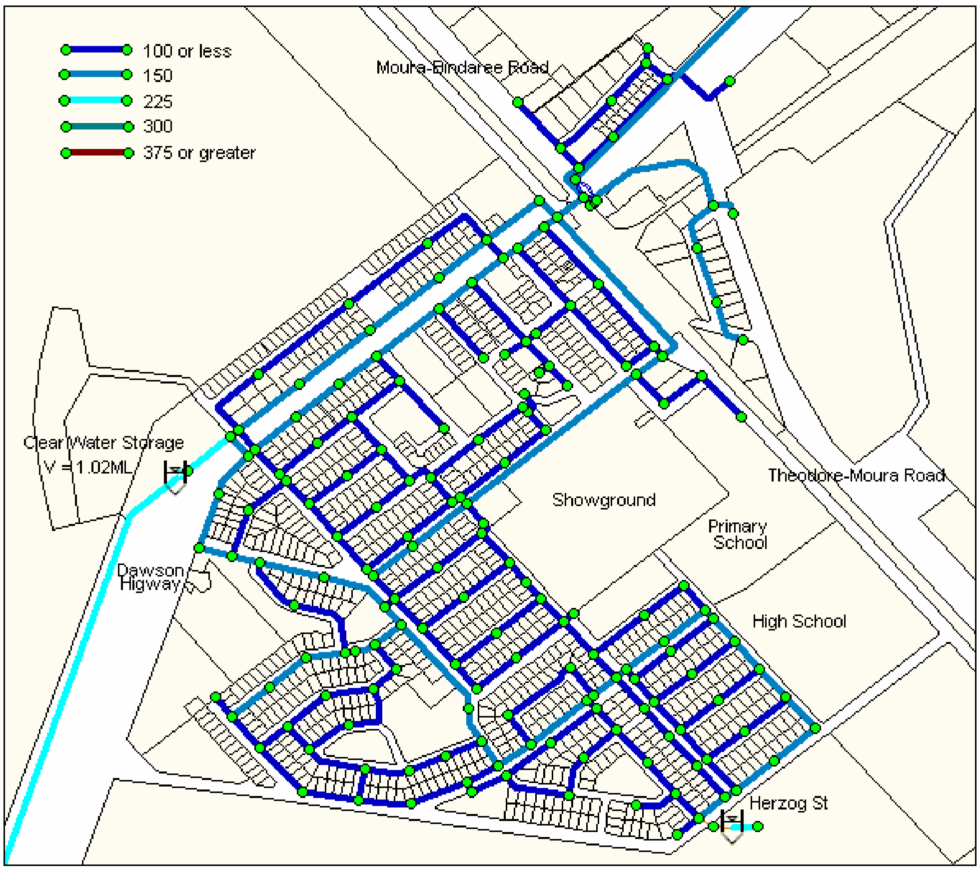


Figure 8.8a – Model Schematic (Moura), Intermediate Scenario 2.

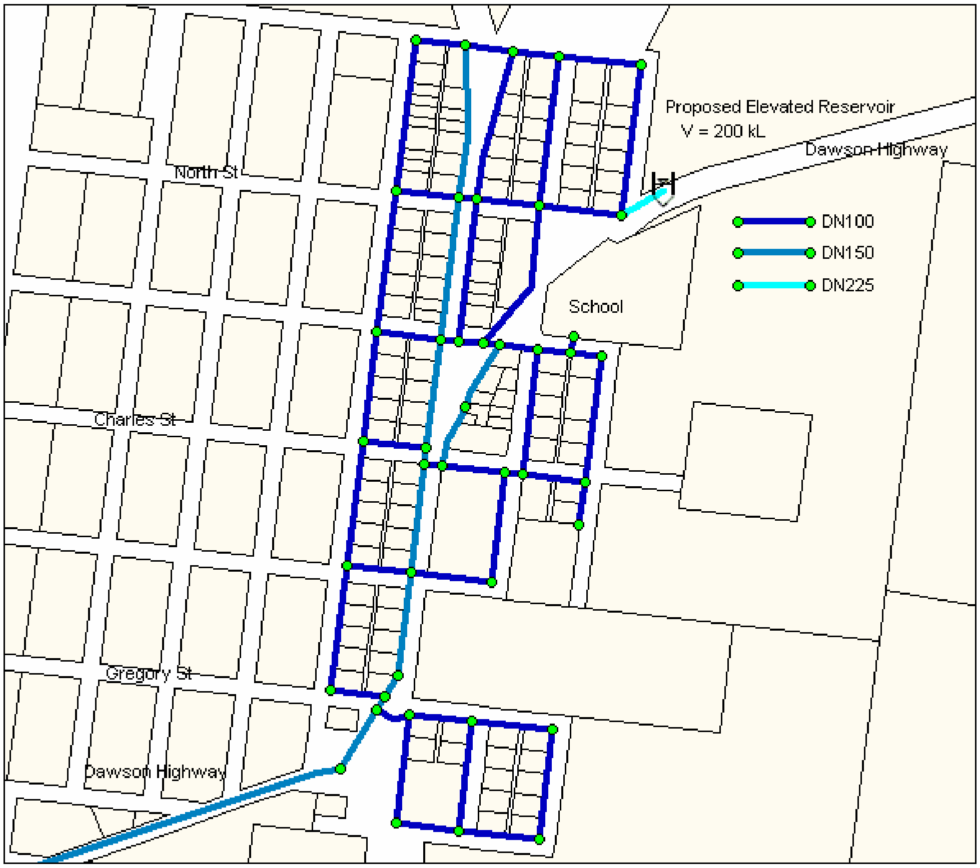


Figure 8.8b – Model Schematic (Banana), Intermediate Scenario 2.

The Peak Hour service pressure at Moura and Banana is shown on Figures 8.9 and 8.10.

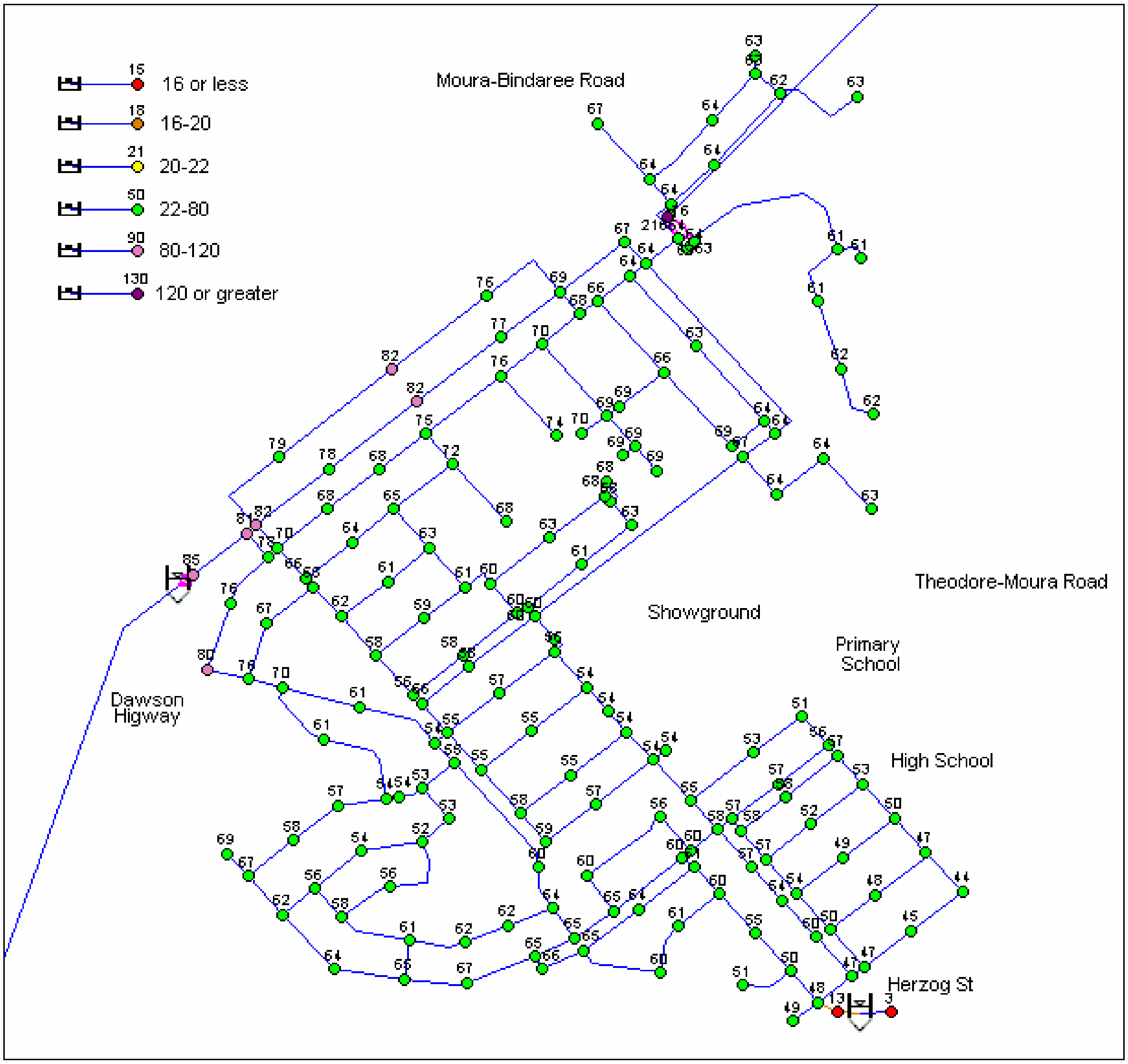


Figure 8.9 – PH service Pressure at Moura

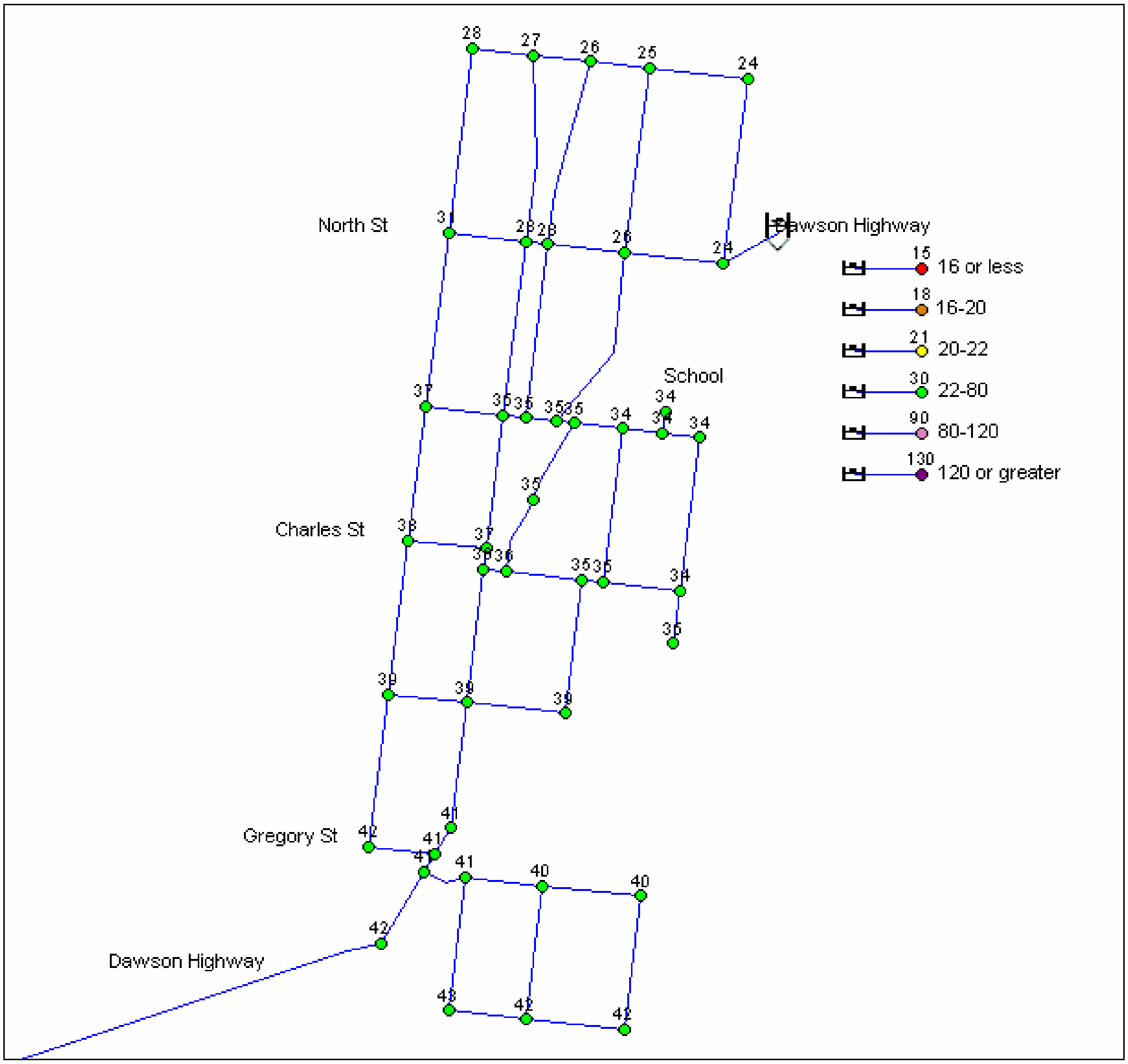


Figure 8.10 – PH service Pressure at Banana

The model indicates that the minimum PH service pressure ranges from 44-82m at Moura and from 24-43m at Banana, thus the design criteria for residual service pressure at Moura and Banana are met.

A critical node fire-flow analysis was undertaken in accordance with the DNR&M Guidelines. The critical node pressure at Moura and Banana is shown on Figures 8.11 and 8.12.

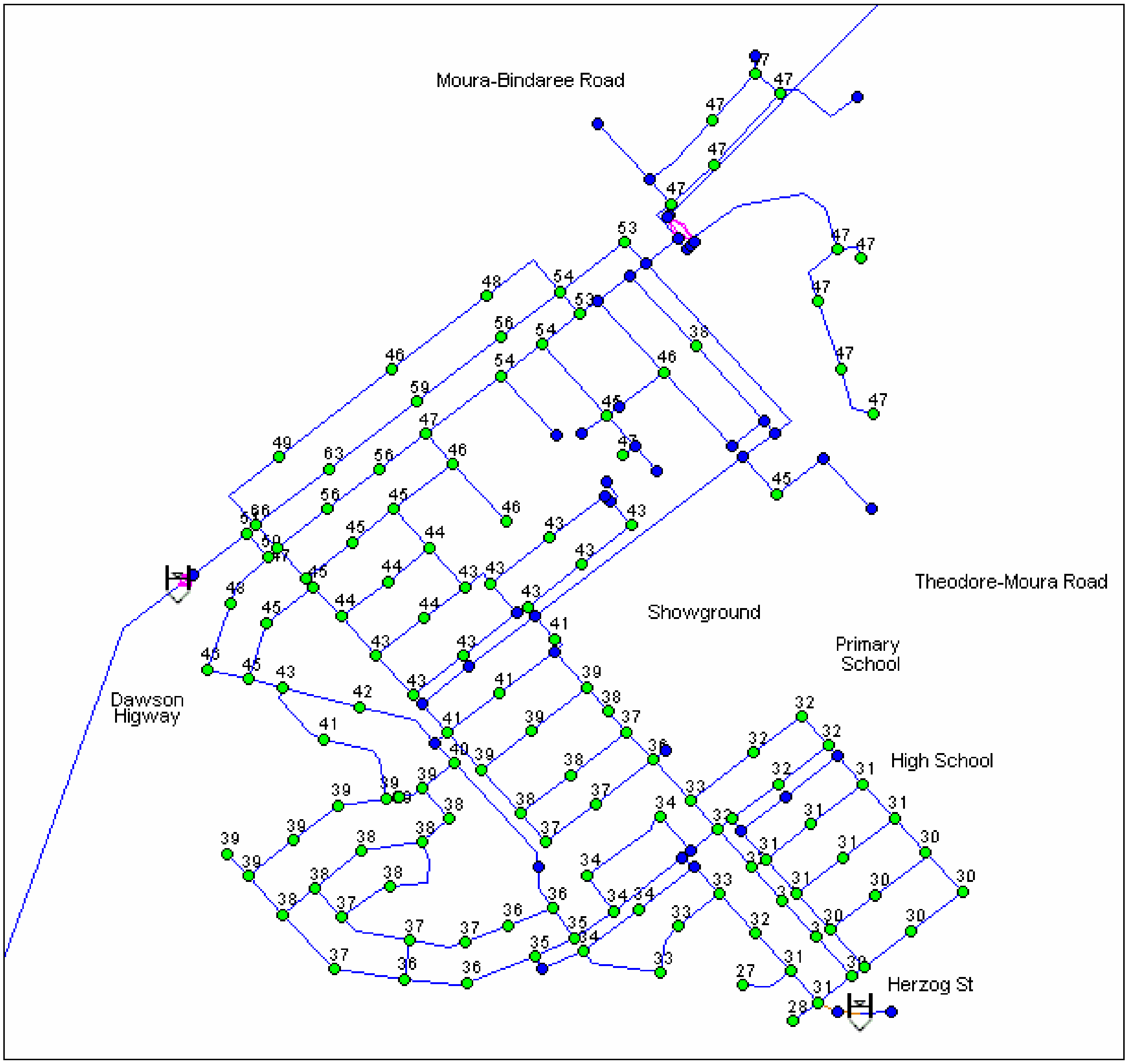


Figure 8.11 – Critical Node Pressure at Moura

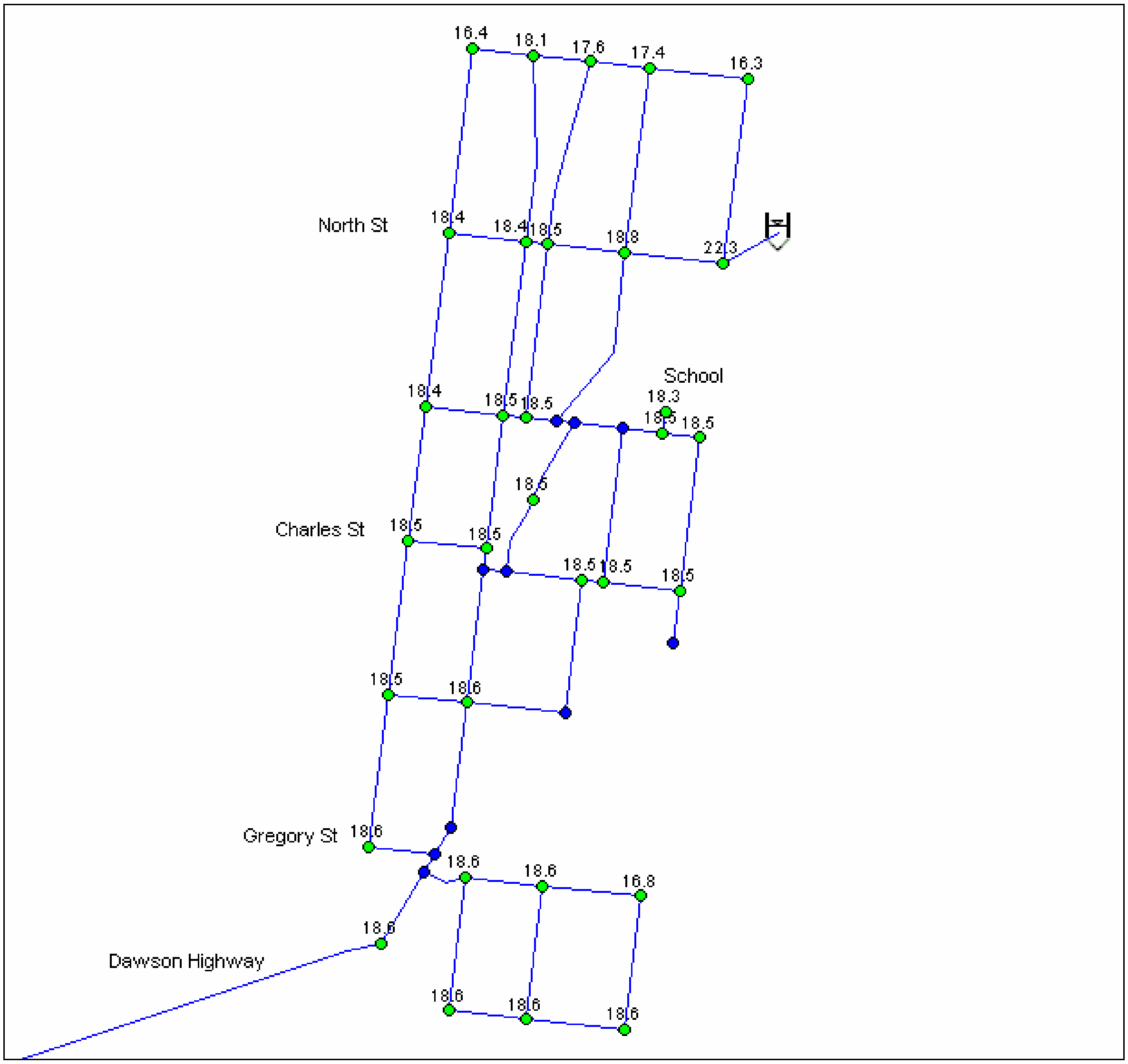


Figure 8.12 – Critical Node Pressure at Banana

The model indicates that the minimum critical node pressure is 28m Moura and 16.3m at Banana, thus providing the minimum fire-flow pressure of 12m in accordance with the DNR&M Guidelines.

In order to analyse the clear water storage and river pump operation, a commercial fire-flow demand was modelled at Moura. The modelling results are shown on Figure 8.13. Likewise, a residential fire-flow demand was modelled at Banana in order to analyse the elevated reservoir and Banana pump station operation, shown on Figure 8.14.

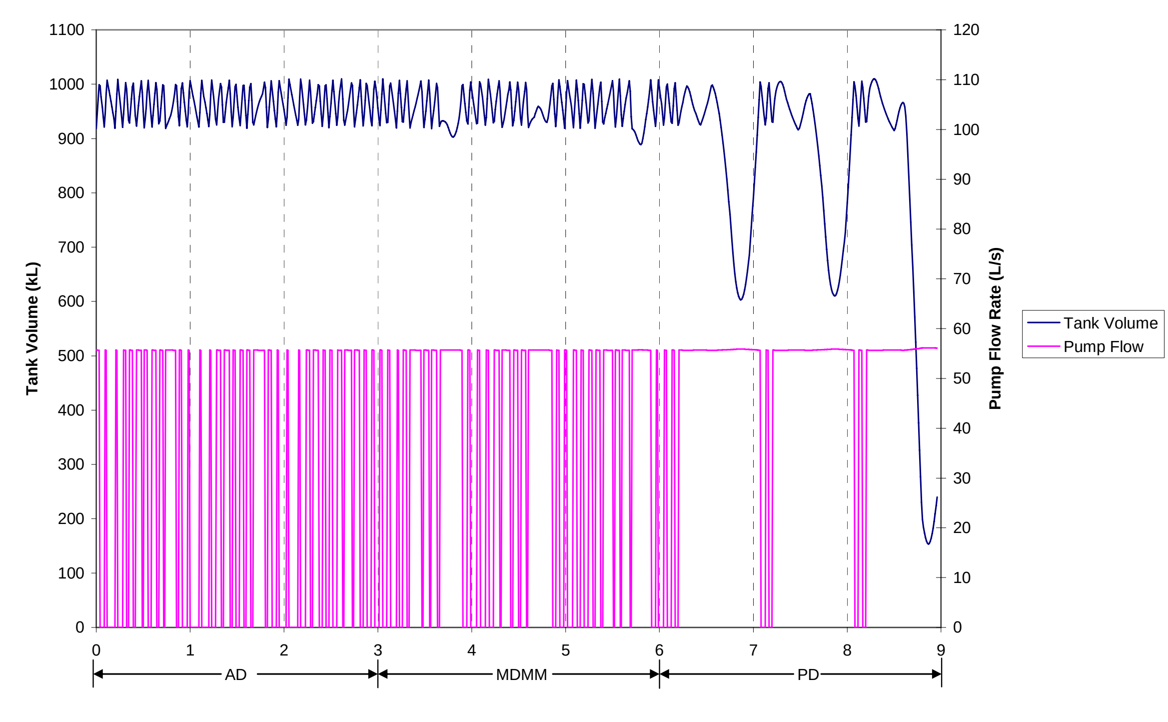


Figure 8.13 – Clear water storage volume and Dawson River pump operation over analysis period

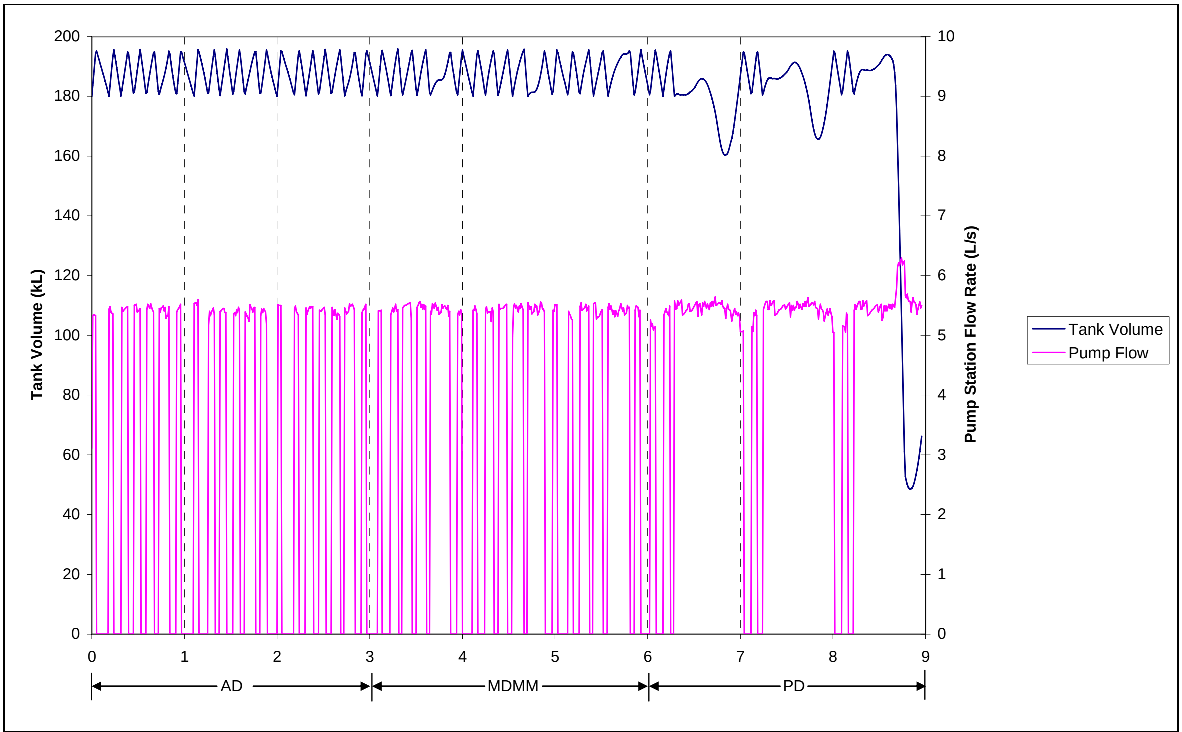


Figure 8.14 – Proposed elevated reservoir volume and Banana booster pump station operation over analysis period

Defined by the DNR&M Guidelines, the minimum delivery flow rate for the Moura rising main and the Banana rising main is 47 L/s and 7 L/s respectively. The flow rate in the

Banana rising main is slightly lower than the recommended minimum. However, both reservoirs have a net positive inflow at the end of each MDMM and neither reservoir has failed during the analysis. Thus the design criterion for reservoir storage and pump station operation are effectively met.

8.3 INTERMEDIATE SCENARIO 3

The model was run with the Scenario 3 projected demands in order to determine the level of service provision afforded by the water supply infrastructure. The storage capacity of the proposed elevated reservoir was increased from 200kL to 250 kL to meet the minimum requirements in accordance with the DNR&M Guidelines. However, the model did not compile due to the clear water storage and the Banana elevated reservoir failing during fire-flow demand. Further augmentations are considered necessary in order to satisfy the design criteria.

An additional H_2OMAP model scenario was created in order to model the proposed augmentation strategy, outlined in the following section.

8.3.1 Augmentation of Moura and Banana rising mains

The existing DN225 rising main from the Dawson River to the Moura water treatment plant (approx 5.2km) was upgraded to a DN300. The existing DN150 rising main from Moura to Banana (approx 20km) was upgraded to a DN225.

The Banana booster pump station was modelled with two duty and two standby pumps, each delivering 5.25 L/s at 15.5 m, producing a downstream pressure of 79 m. Rule based controls were assigned such that the pumps closed when the level in the proposed elevated reservoir at Banana reached 98%, and opened when the level in the reservoir fell to 90% of capacity.

The corresponding model scenario is “INTS3A, Moura + Banana RMs augmented; 250kL elev. res.”. The model schematic (Figure 8.15) outlines the proposed augmentations.

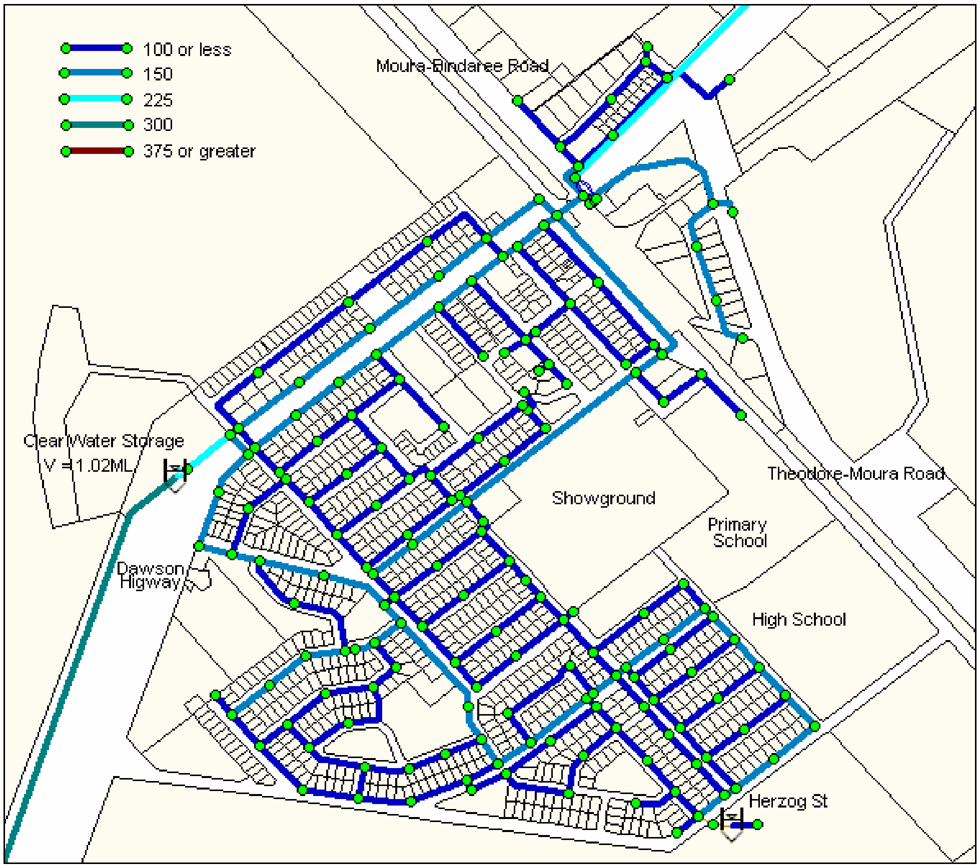


Figure 8.15a – Model Schematic (Moura), Intermediate Scenario 3, Augmentation A.

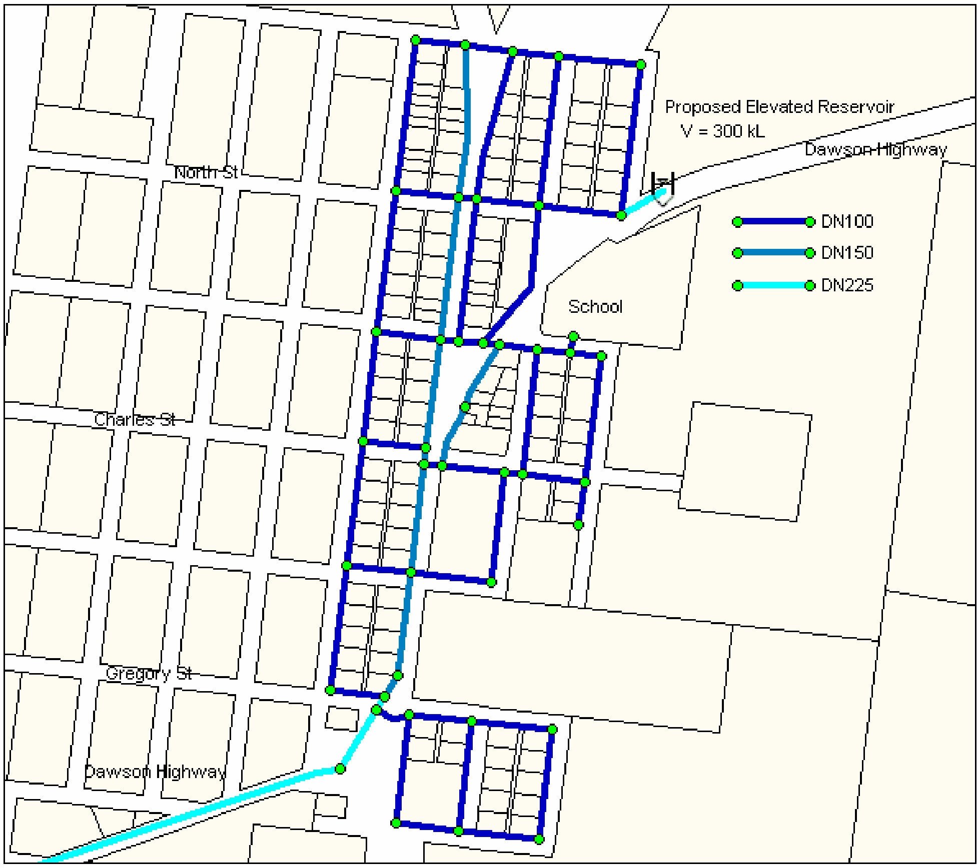


Figure 8.15b – Model Schematic (Banana), Intermediate Scenario 3, Augmentation A.

The Peak Hour service pressure at Moura and Banana is shown on Figures 8.16 and 8.17.

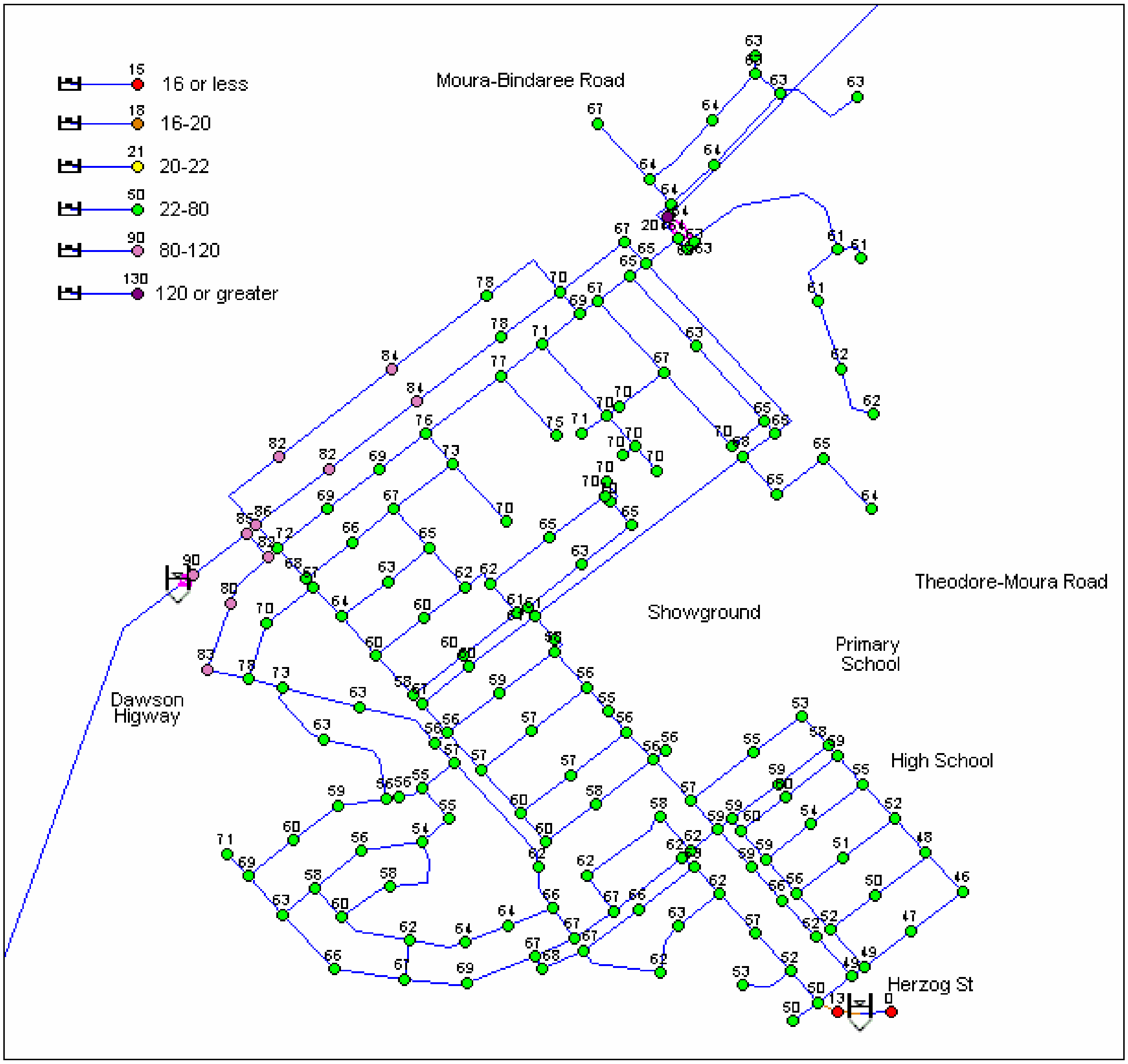


Figure 8.16 – PH service pressure (m) at Moura

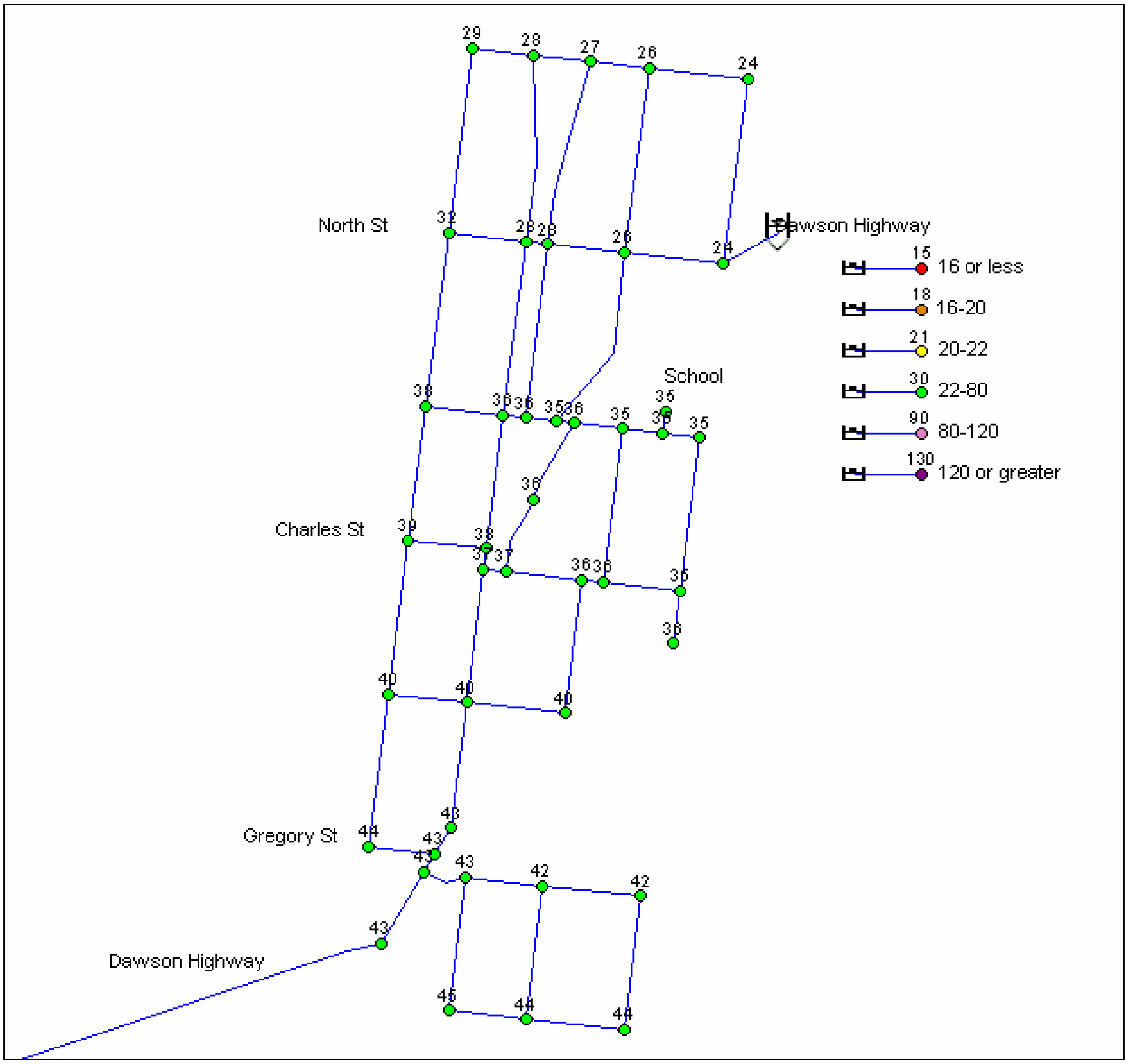


Figure 8.17 – PH service pressure (m) at Banana

The model indicates that the minimum PH service pressure ranges from 46-84m at Moura and from 24-45m at Banana, thus the design criteria for residual pressure at Moura and Banana are met.

A critical node fire-flow analysis was undertaken in accordance with the DNR&M Guidelines. The critical node pressure for Moura and Banana is shown on Figures 8.18 and 8.19.

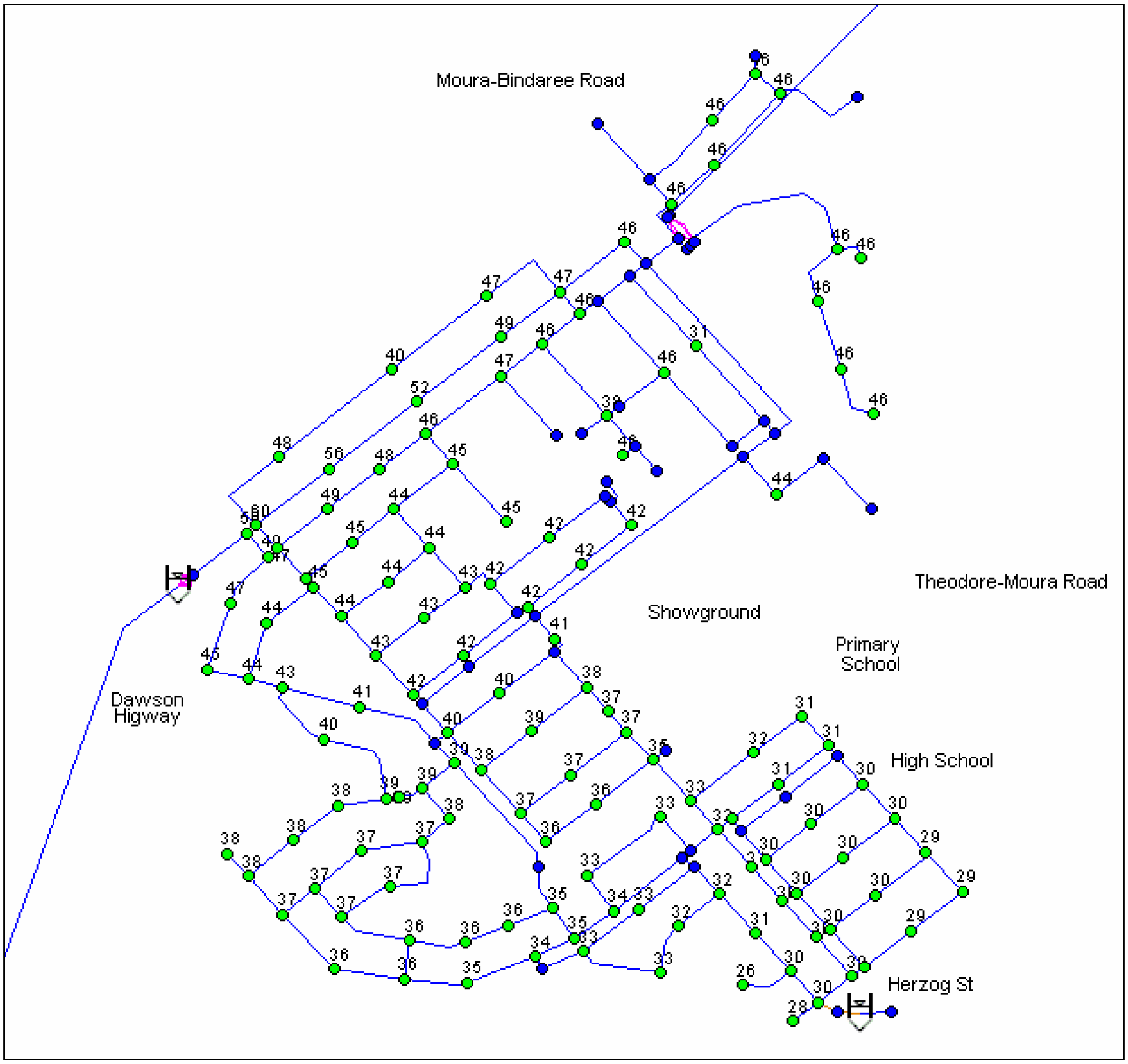


Figure 8.18 – Critical node pressure (m) at Moura

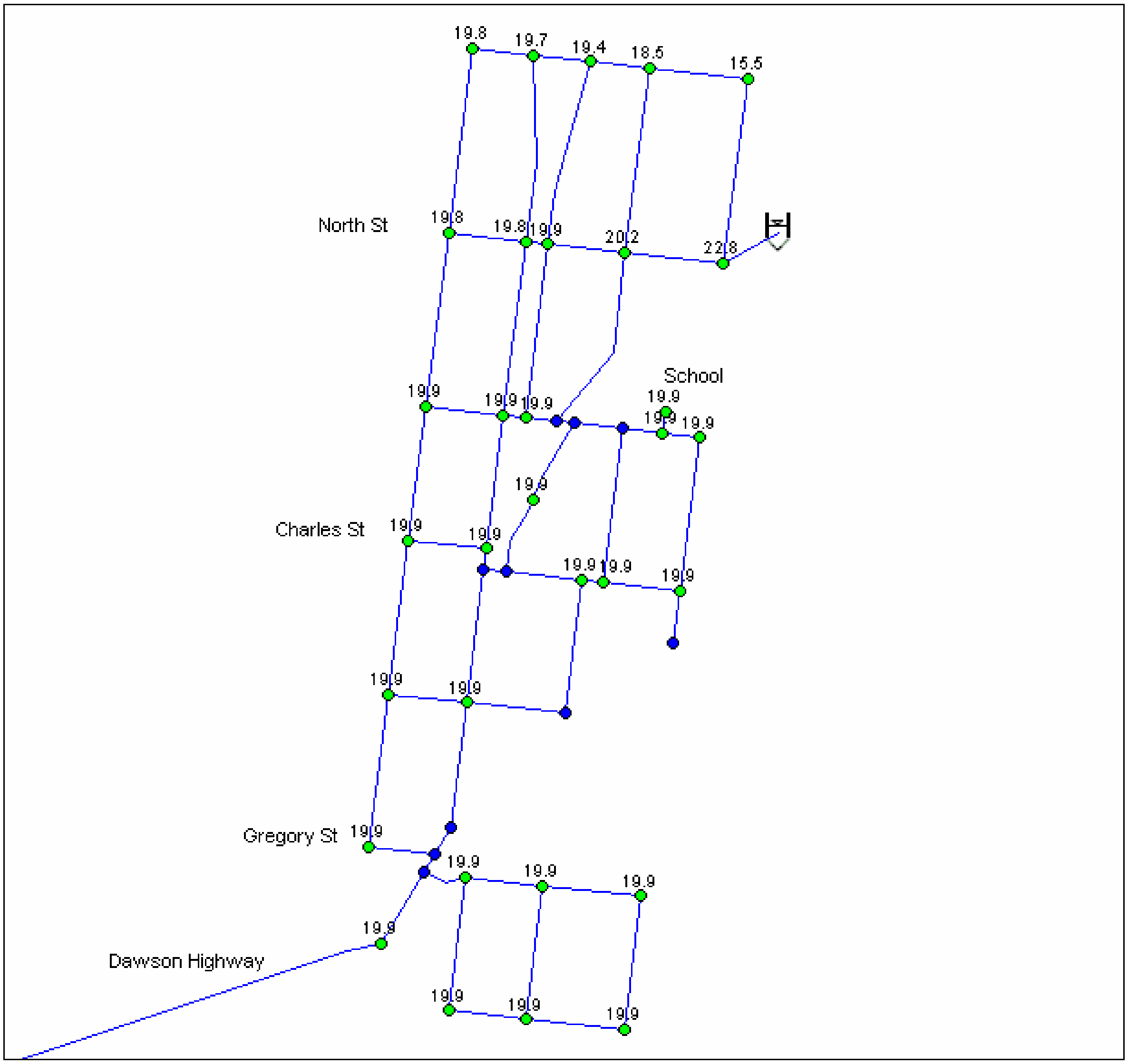


Figure 8.19 – Critical node pressure (m) at Banana

The modelling indicates that the minimum critical node pressure is 28m Moura and 15.5m at Banana, thus meeting the design criteria for residual fire-flow pressure.

In order to analyse the clear water storage and river pump operation, a commercial fire-flow demand was modelled at Moura. The modelling results are shown on Figure 8.20. Likewise, a residential fire-flow demand was modelled at Banana in order to analyse the elevated reservoir and Banana pump station operation, shown on Figure 8.21.

Defined by the DNR&M Guidelines, the minimum delivery flow rate for the Moura rising main and the Banana rising main is 51 L/s and 16 L/s respectively. The flow rate in the Banana rising main is slightly lower than the recommended minimum. However, both reservoirs have a net positive inflow at the end of each MDMM and neither reservoir has failed during the analysis. Thus the design criterion for reservoir storage and pump station operation are effectively met.

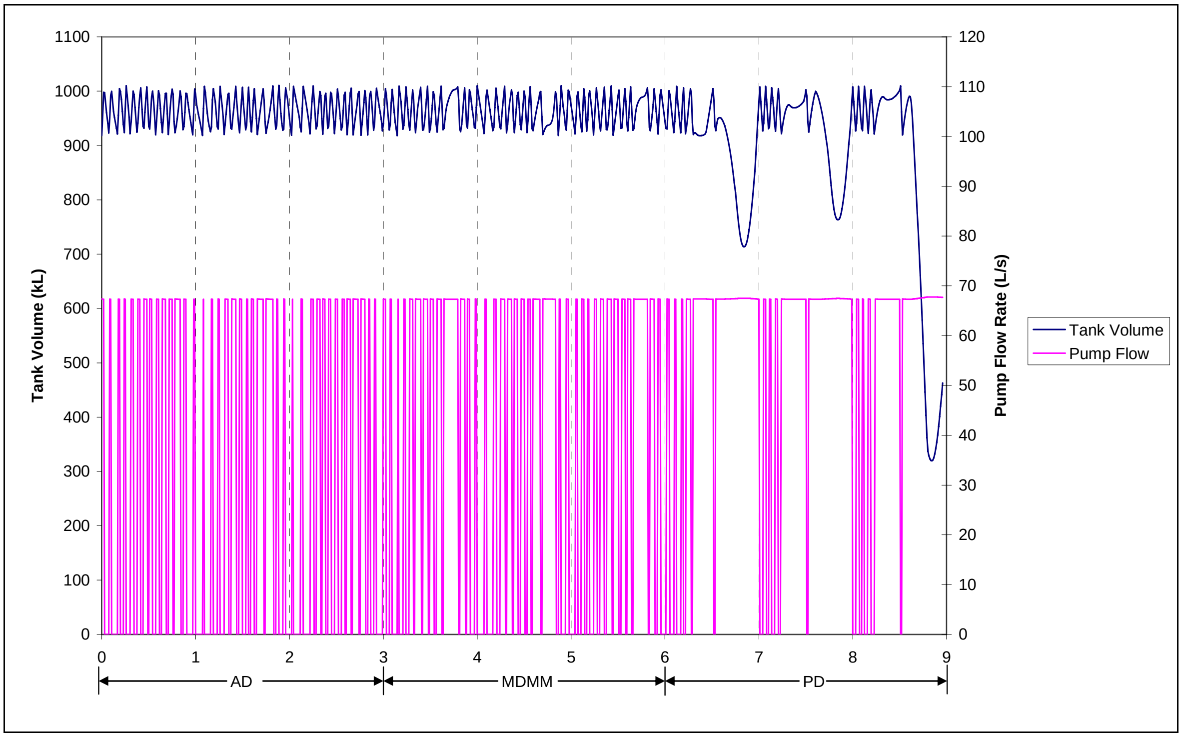


Figure 8.20 – Clear water storage volume and Dawson River pump operation over analysis period

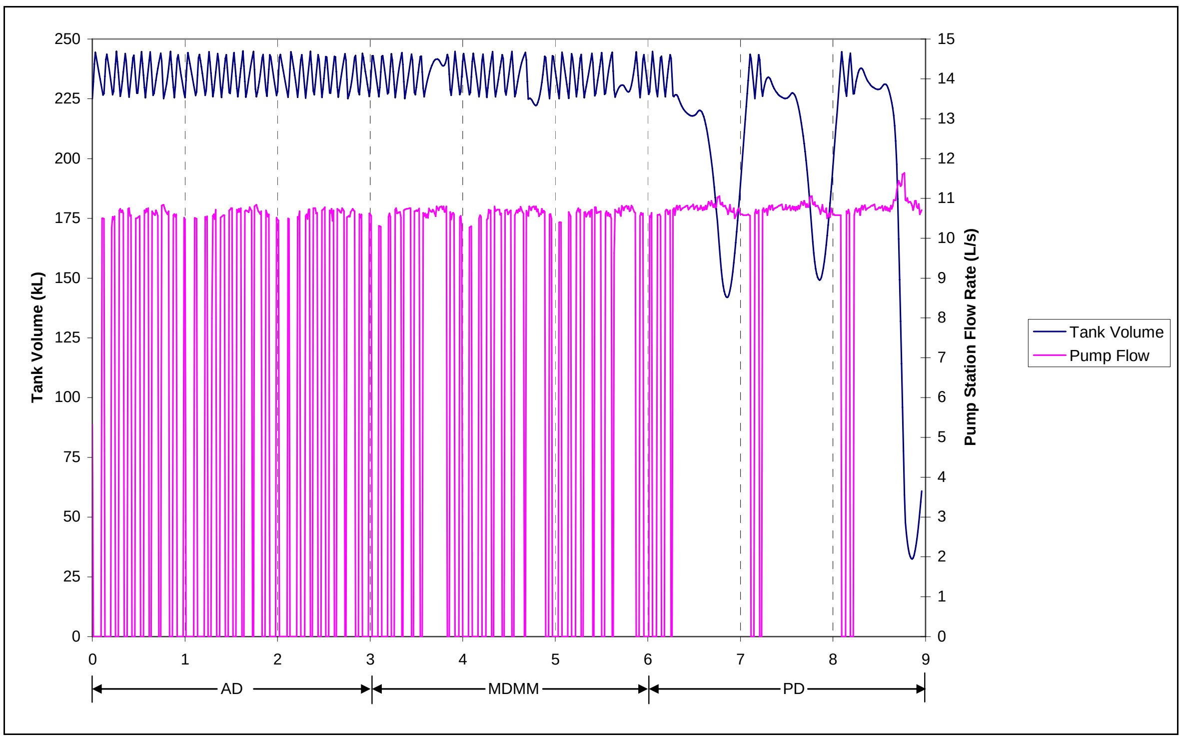


Figure 8.21 - Proposed elevated reservoir volume and Banana booster pump station operation over analysis period

9.0 MODELLING ANALYSIS – ULTIMATE HORIZON

The reticulation was assessed at the ultimate horizon, 2026. The projected demands from Sections 5.1.3 (Moura) and 5.2.3 (Banana, Scenarios 1, 2 and 3) were included in the model.

9.1 ULTIMATE SCENARIO 1

The model was run with the Scenario 1 projected demands in order to determine the level of service provision afforded by the water supply infrastructure; existing pipe diameters were used, the proposed 200kL reservoir at Banana was included. The model was run but did not compile due to the Moura clear water storage reservoir failing during PD demand.

Further augmentations are considered necessary in order to meet the desired standards of service. Additional H_2OMAP model scenarios were created in order to model the proposed augmentation strategies, outlined in the following sections.

9.1.1 Augmentation of clear water storage capacity

The model clear water storage was augmented with a proposed 3.7 ML reservoir, providing a total storage capacity of 4.72 ML. Existing pipe diameters were retained. The corresponding model scenario is "ULTS1A, Moura WTP Clear Water Storage Augmented". The model schematic (Figure 9.1) shows the proposed augmentation.

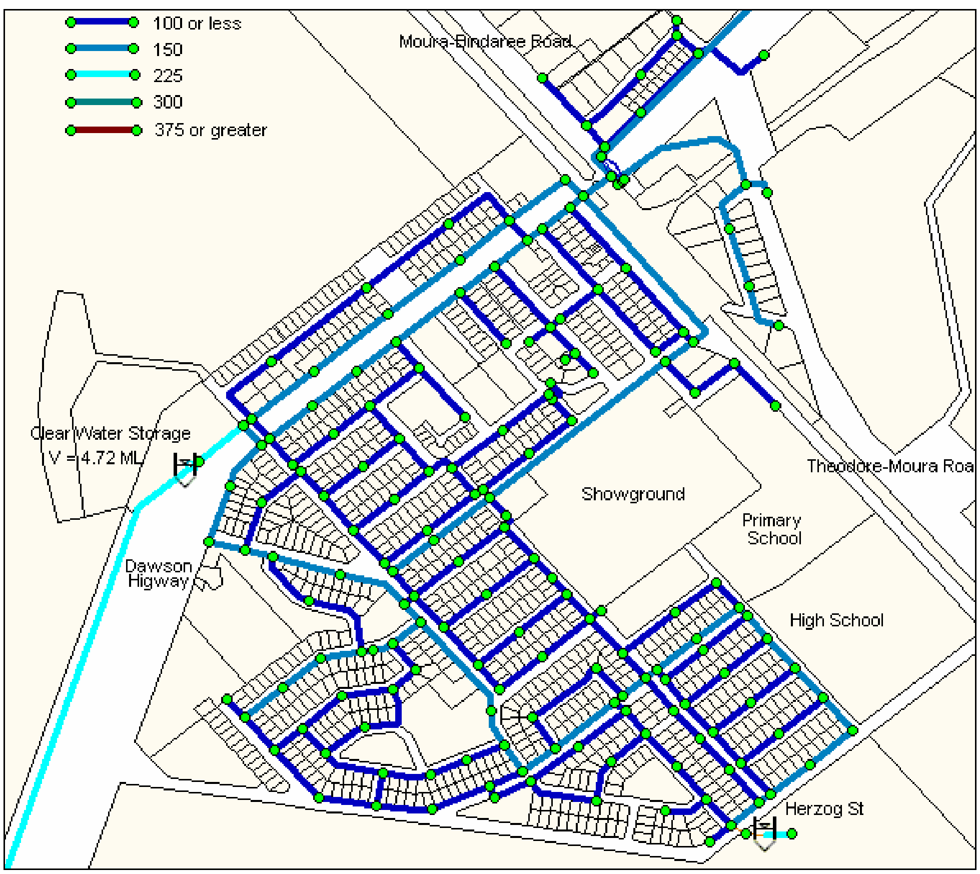


Figure 9.1 – Model Schematic (Moura), Ultimate Scenario 1, Augmentation A.

A 30 L/s commercial fire-flow demand was included. Figure 9.2 shows that the volume of clear water storage becomes significantly depleted during PD. The Dawson River pump station is noted to have continuous operating periods of up to 70 hours. As such, increasing the clear water storage alone is not considered a feasible augmentation strategy.

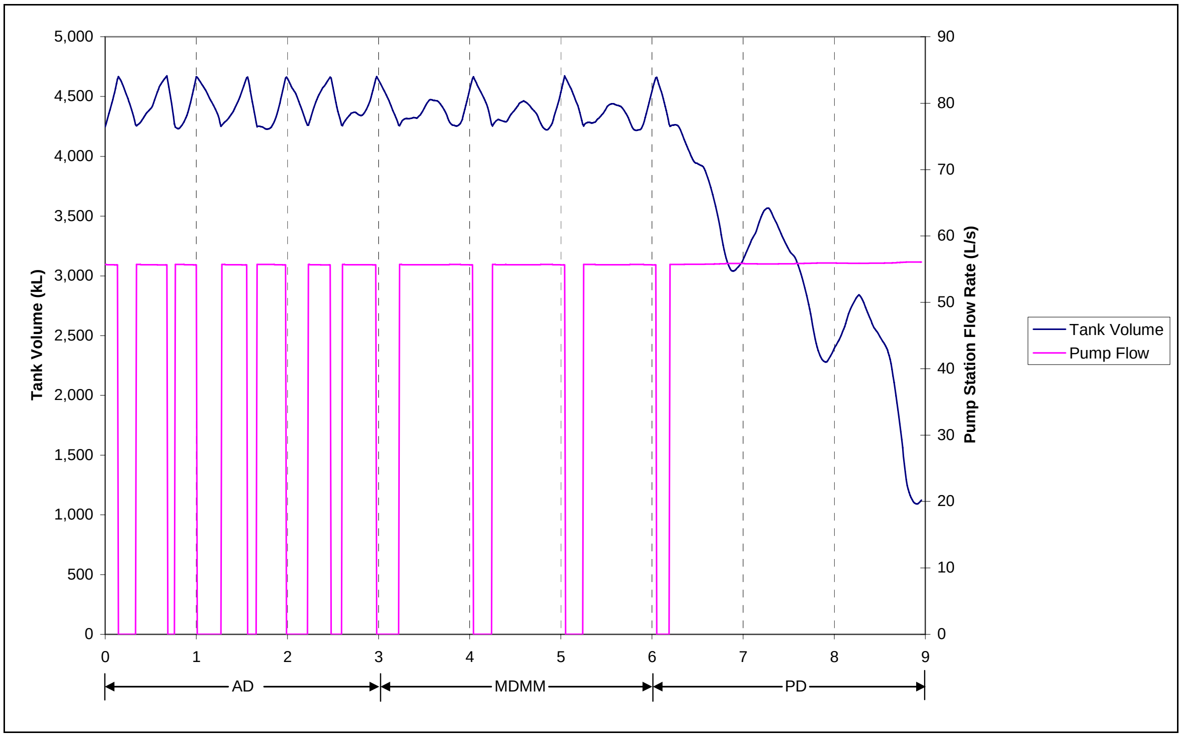


Figure 9.2 - Clear water storage volume and Dawson River pump operation over analysis period

9.1.2 Increase raw water delivery and treatment plant capacity

The delivery flow rate was increased in order to prevent the clear water storage from becoming depleted during PD. To achieve this, the river pumps were augmented by bringing a third duty pump on line. The existing DN225 rising main between the Dawson River and the Moura water treatment plant (approx 5.2km) was upgraded to a DN300 to cater for the extra flow. The design capacity of the treatment plant was increased by some 25 L/s to 93 L/s.

The proposed augmentations are illustrated on the model schematic, Figure 9.3.

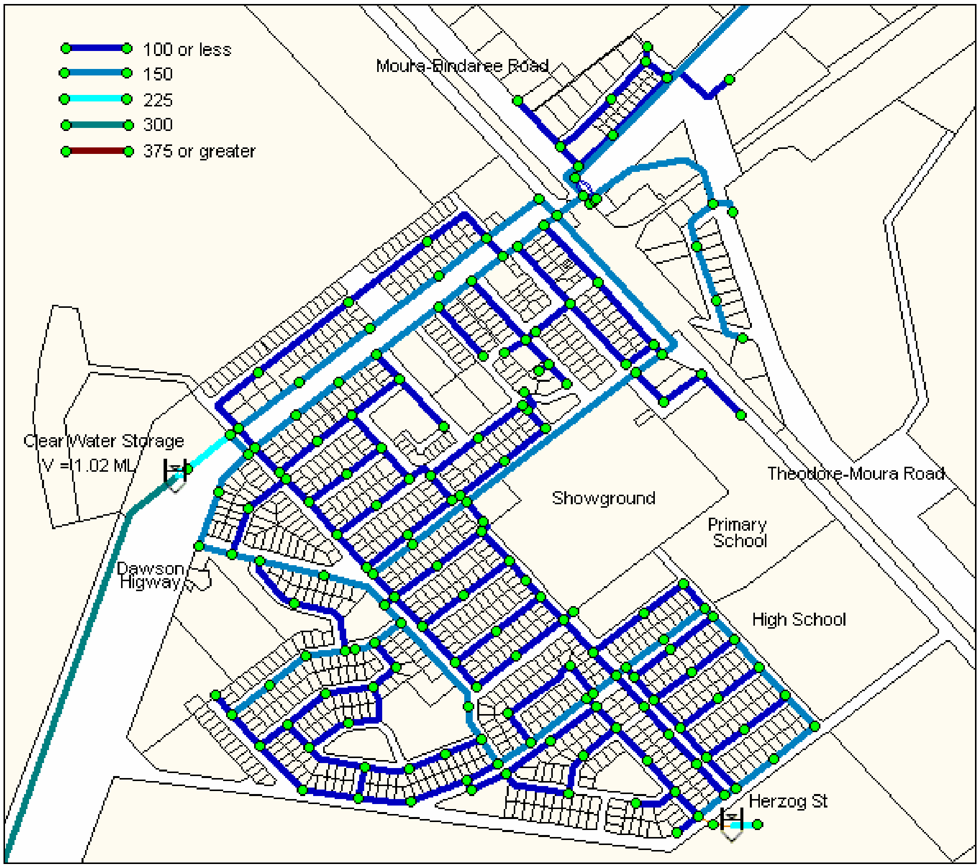


Figure 9.3 – Model Schematic (Moura), Ultimate Scenario 1, Augmentation B.

The clear water storage volume and the Dawson River pump station operation is shown on Figure 9.4. It is noted that whilst the clear water storage no longer becomes significantly depleted, the Dawson River pumps are subject to 18 stop/starts during AD. As such, the augmentation strategy that involves increasing the delivery flow rates and the water treatment plant capacity is not considered feasible.

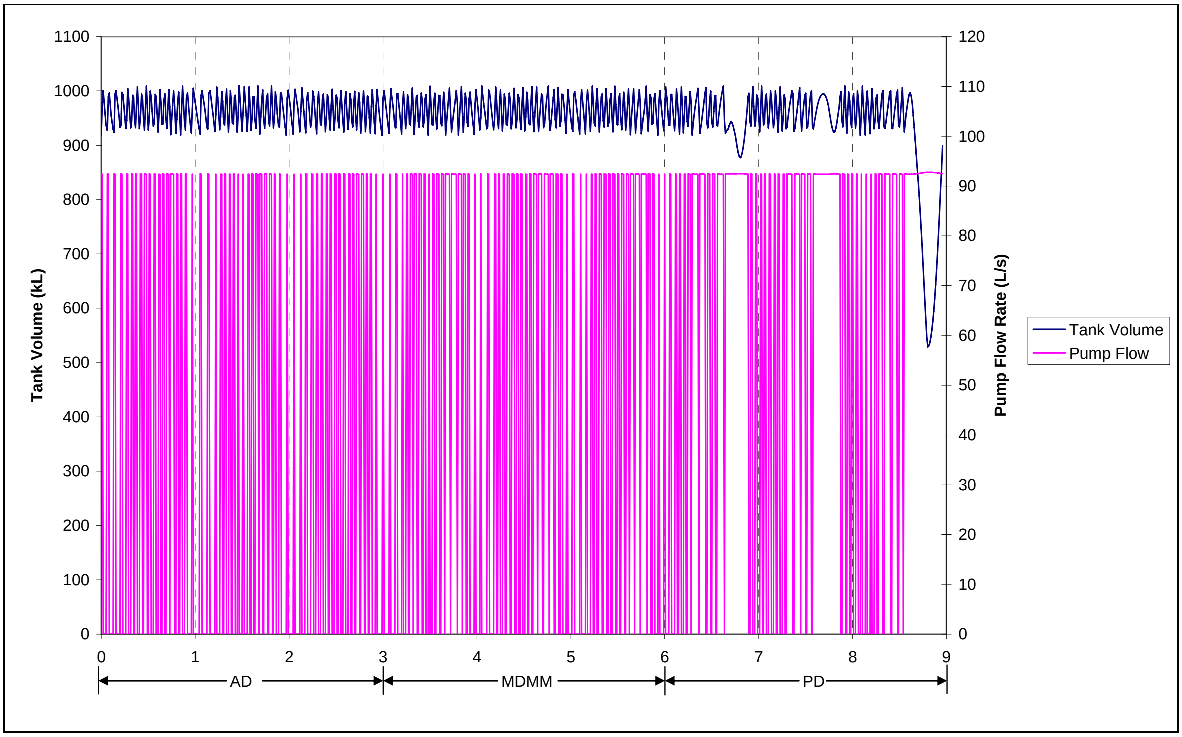


Figure 9.4 – Reservoir storage and pump operation over analysis period

9.1.3 Augmentation of Moura rising main and clear water storage

The clear water storage capacity was augmented by doubling the reservoir volume, providing a total proposed storage of 2.04 ML. The existing DN225 rising main between the Dawson River and the Moura water treatment plant (approx 5.2km) was upgraded with a DN300 in order to reduce the magnitude of the friction losses. The resulting flow rate is increased by some 15 L/s, meeting the treatment plant design capacity of 68 L/s.

The proposed augmentations are outlined on Figure 9.5.

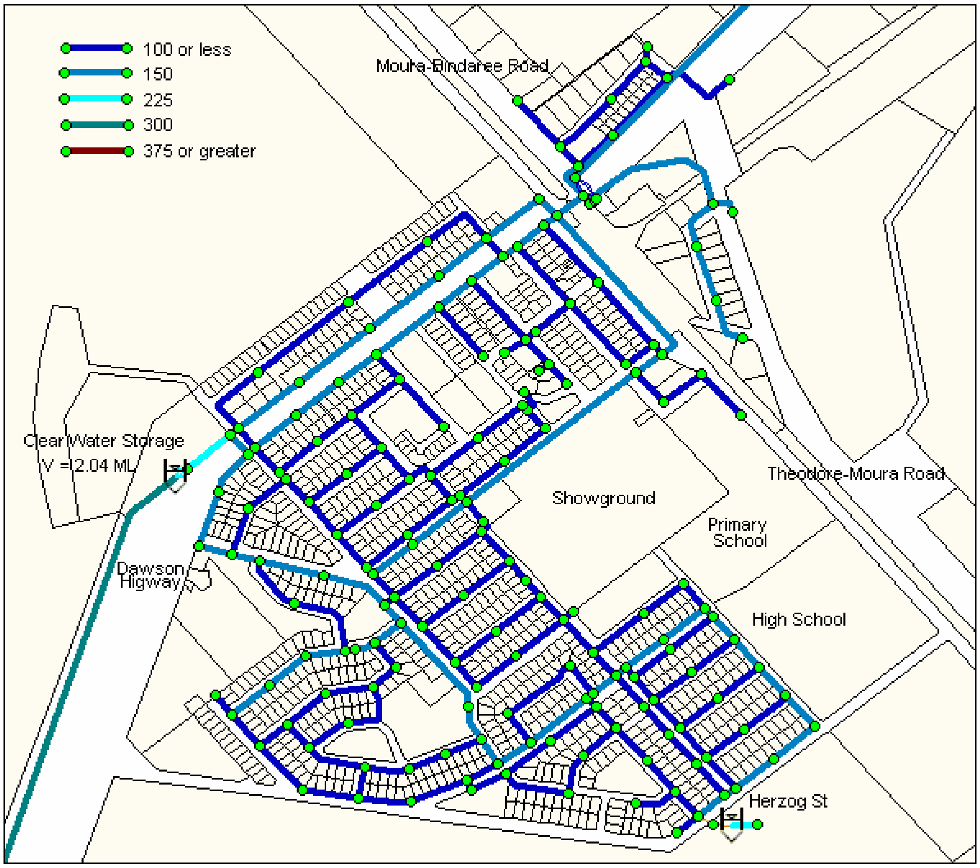


Figure 9.5 – Model Schematic (Moura), Ultimate Scenario 1, Augmentation C.

The clear water storage volume and the Dawson River pump station operation is shown on Figure 9.6. The model indicated that the clear water storage does not fail during the analysis period, and that the raw water pumps are subject to 7 stop/starts per AD. As such, the augmentation of the clear water storage from 1.02 ML to 2.04 ML, and the upgrading of the existing 5.2km DN225 raw water delivery main to a DN300, is considered the most feasible augmentation strategy.

The level in the proposed Banana service reservoir and the delivery flow rate in the Banana rising main is shown on Figure 9.7. The model shows that an adequate level of emergency storage is available during a 15 L/s fire-flow demand in Banana.

Defined by the DNR&M Guidelines, the minimum delivery flow rate for the Moura rising main and the Banana rising main is 57 L/s and 5.4 L/s respectively. It is seen that these minimum flow rates are met. Furthermore, it is seen that the reservoirs have a net positive inflow at the end of each MDMM, and that neither reservoir has failed during the analysis period. Thus the design criterion for reservoir storage and pump station operation are met.

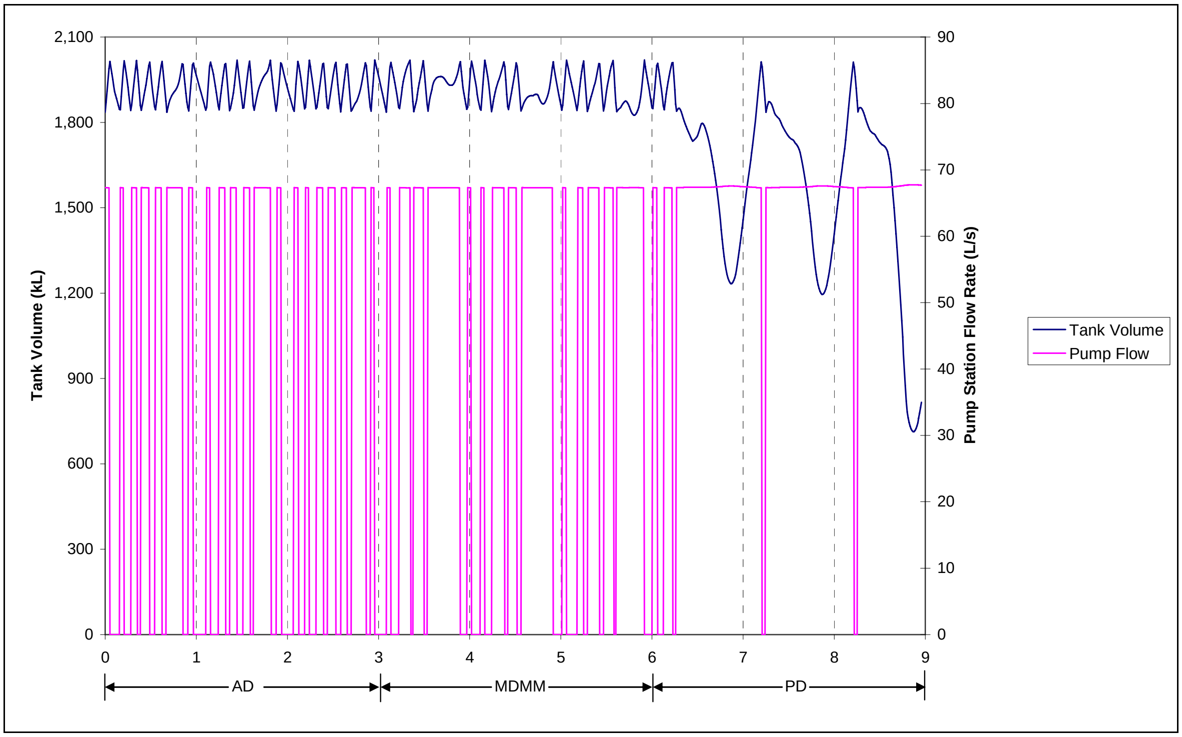


Figure 9.6 – Reservoir storage and pump operation over analysis period

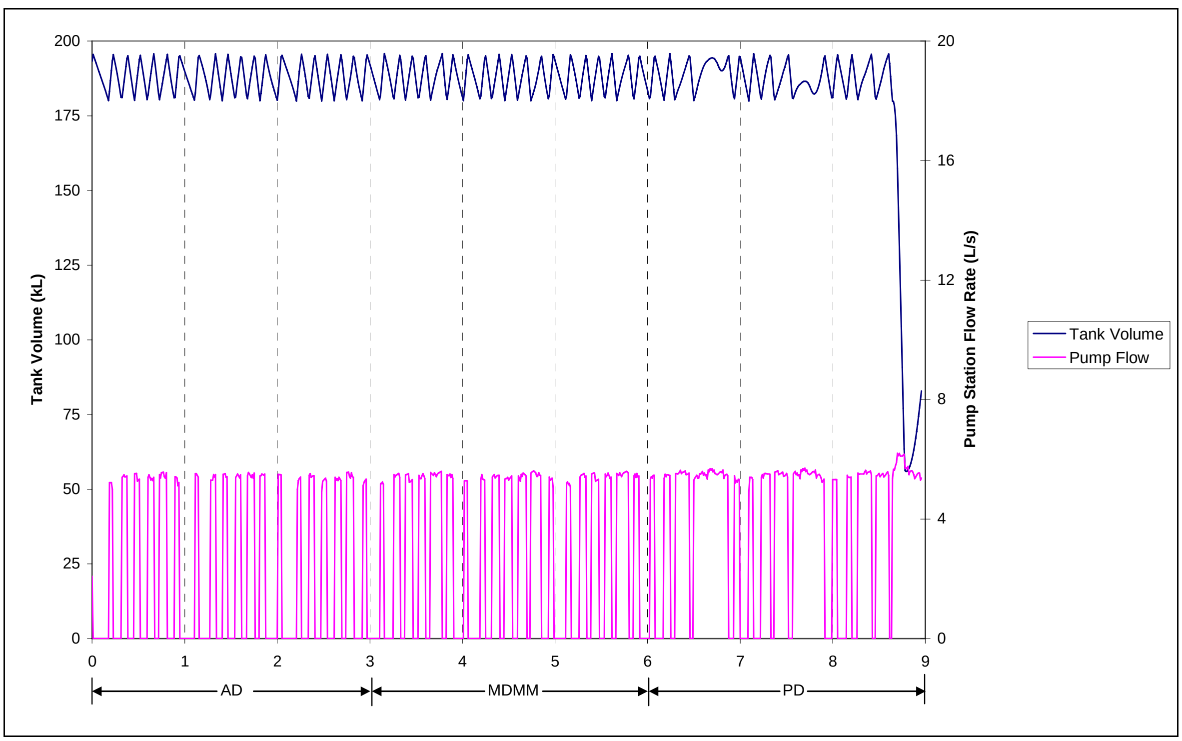


Figure 9.7 - Proposed elevated reservoir volume and Banana booster pump station operation over analysis period

The Peak Hour service pressure at Moura and Banana is shown on Figures 9.8 and 9.9.

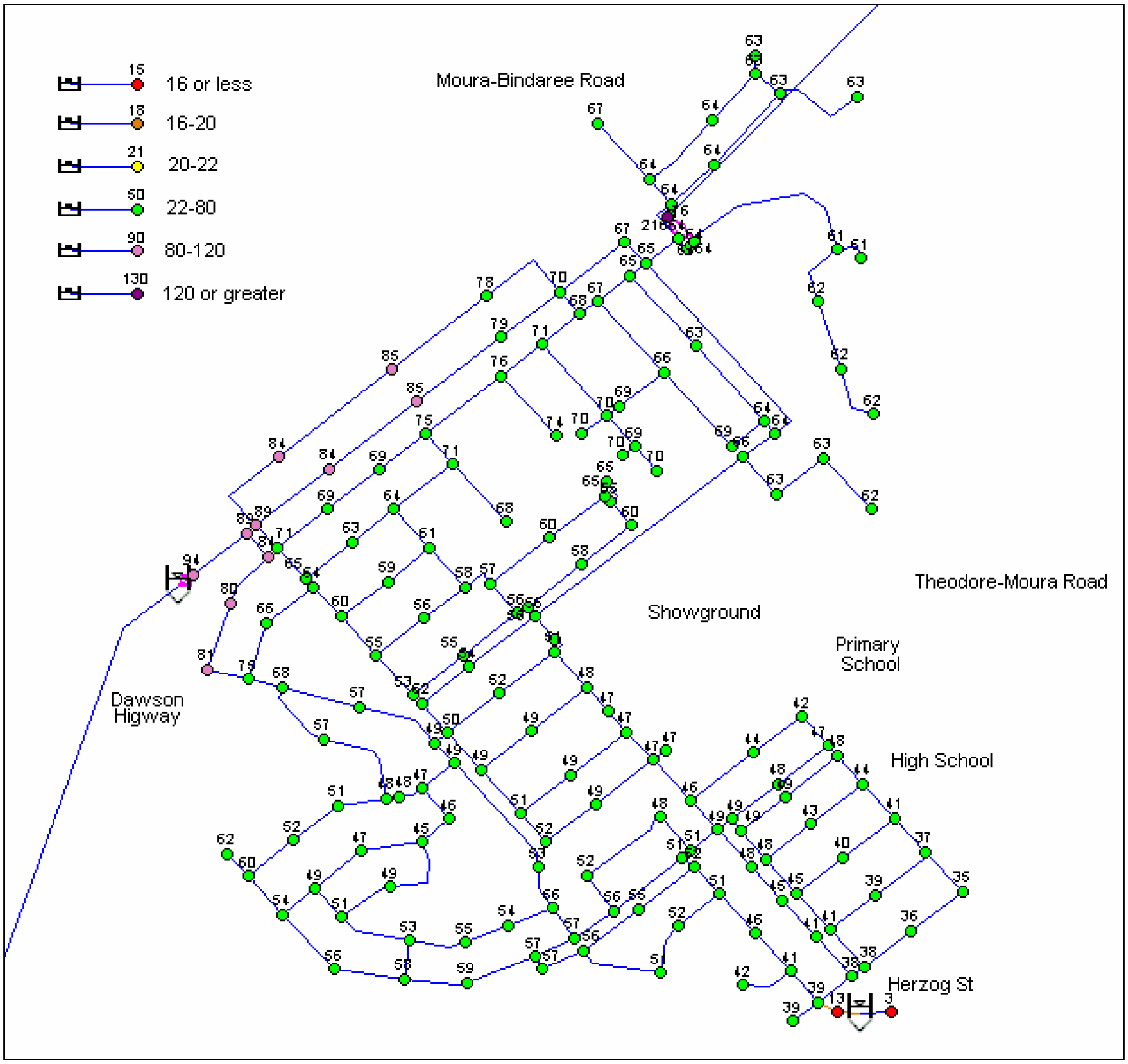


Figure 9.8 – PH service pressure (m) at Moura

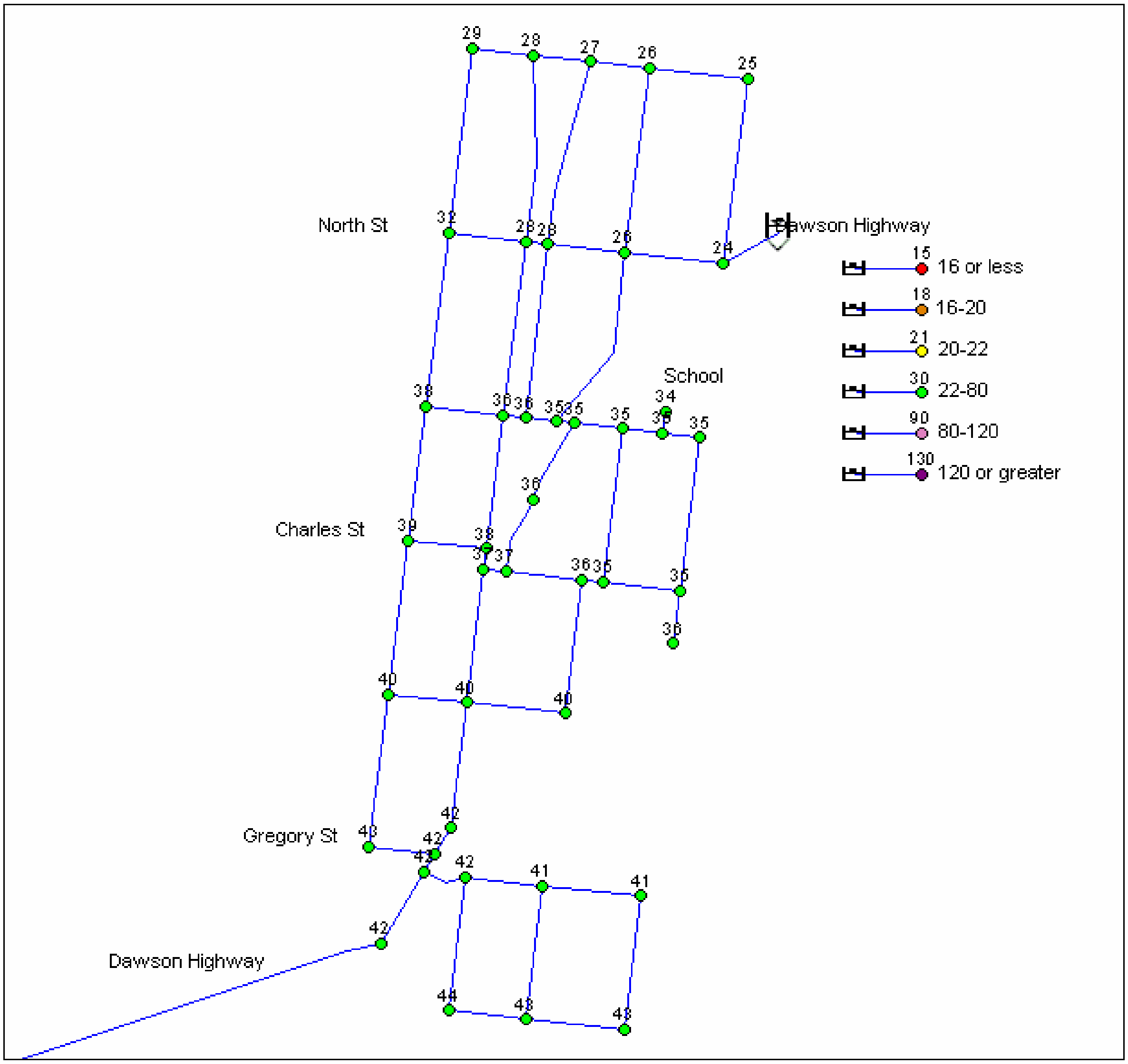


Figure 9.9 – PH service pressure (m) at Banana

The model indicates that the minimum PH service pressure ranges from 35-85 m at Moura and from 24-44m at Banana, thus the design criteria for residual service pressure at Moura and Banana are met.

A critical node fire-flow analysis was undertaken in accordance with the DNR&M Guidelines. The critical node pressure for Moura and Banana is shown on Figures 9.10 and 9.11.

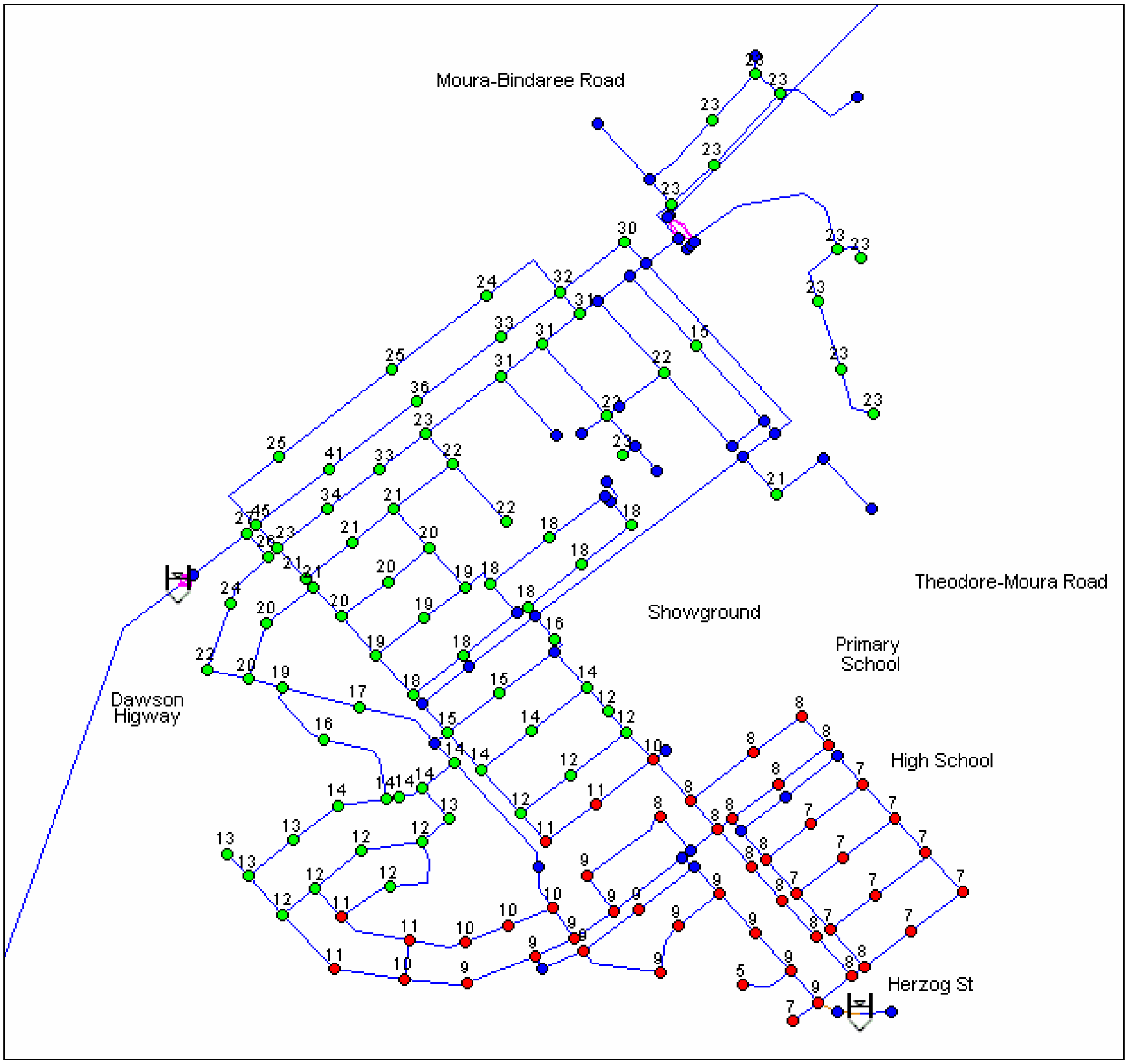


Figure 9.10 – Critical node pressure (m) at Moura

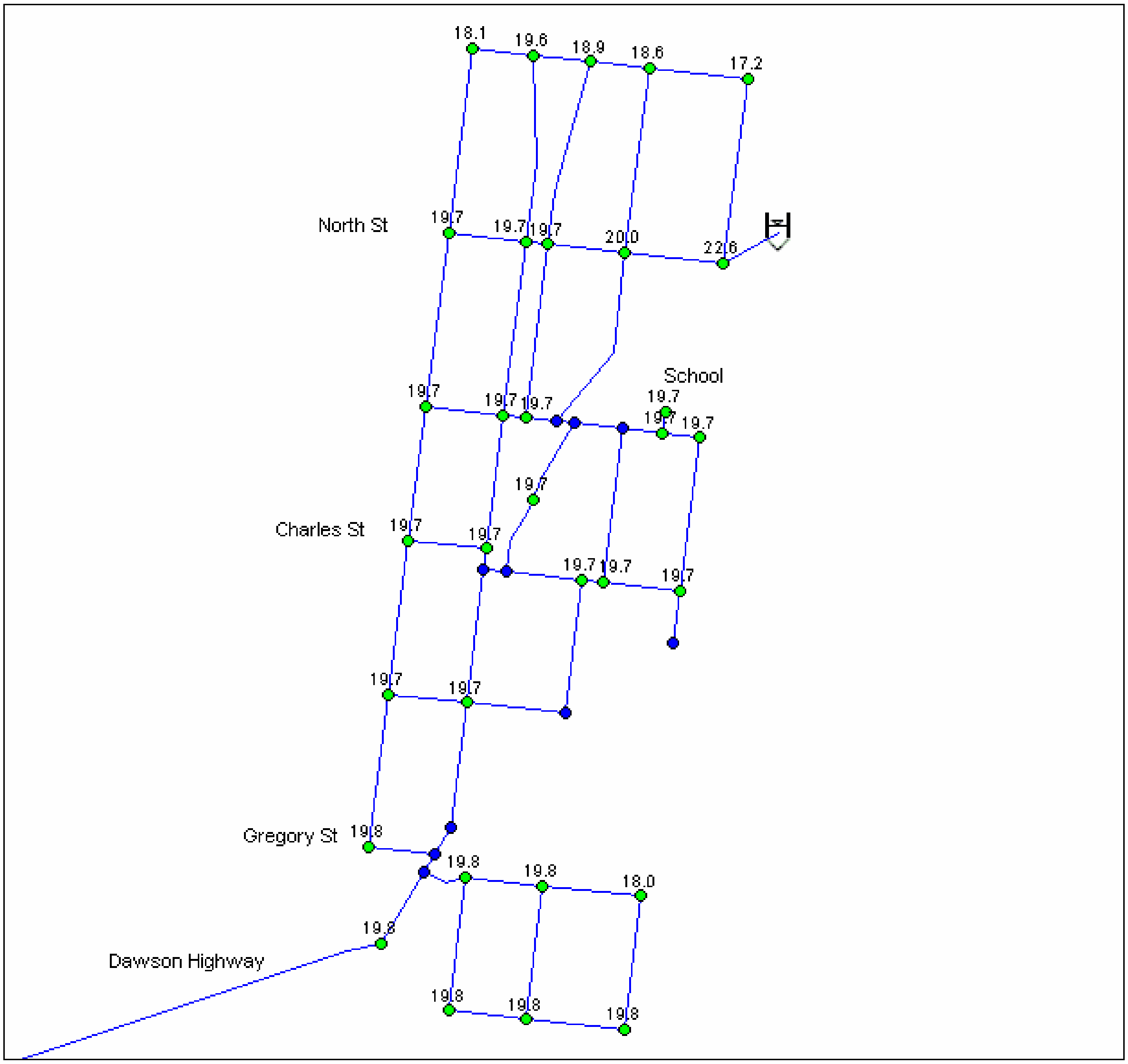


Figure 9.11 – Critical node pressure (m) at Banana

The model indicates that the minimum desired critical node pressure of 12m is not met in the southern vicinity of Moura. It is considered that the minimum pressures can be increased by partitioning the town into separate water supply zones in accordance with the Banana Shire Council strategic water supply plan, or by placing restrictions on the Herzog St development for example by allowing water to be extracted only during off peak periods.

The minimum critical node pressure at Banana is 17.2m which is consistent with the adopted design criteria.

9.2 ULTIMATE SCENARIO 2

The model was run with the Scenario 2 projected demands in order to determine the level of service provision afforded by the water supply infrastructure; existing pipe diameters were used, the proposed 200kL service reservoir was included as 'existing infrastructure'. The model was run but did not compile due to the Moura clear water storage and the Banana elevated reservoir failing during PD demand.

Further augmentations are considered necessary in order to meet the desired standards of service. Additional H_2OMAP model scenarios were created in order to model the proposed augmentation strategies, outlined in the following sections.

9.2.1 Augmentation of clear water storage and elevated reservoir

The clear water storage was augmented with a proposed 3.7 ML reservoir, providing a total proposed storage capacity of 4.72 ML. The Banana elevated reservoir was modelled with an internal storage capacity of 400 kL. Existing pipe diameters were retained. The model schematic (Figure 9.12) outlines the proposed augmentation strategy.

Figures 9.13 and 9.14 show that both reservoirs become significantly depleted during PD. Again, up to 70 hours continuous pump station operation is experienced. As such, increasing the reservoir storage capacity alone is not considered a feasible augmentation strategy.

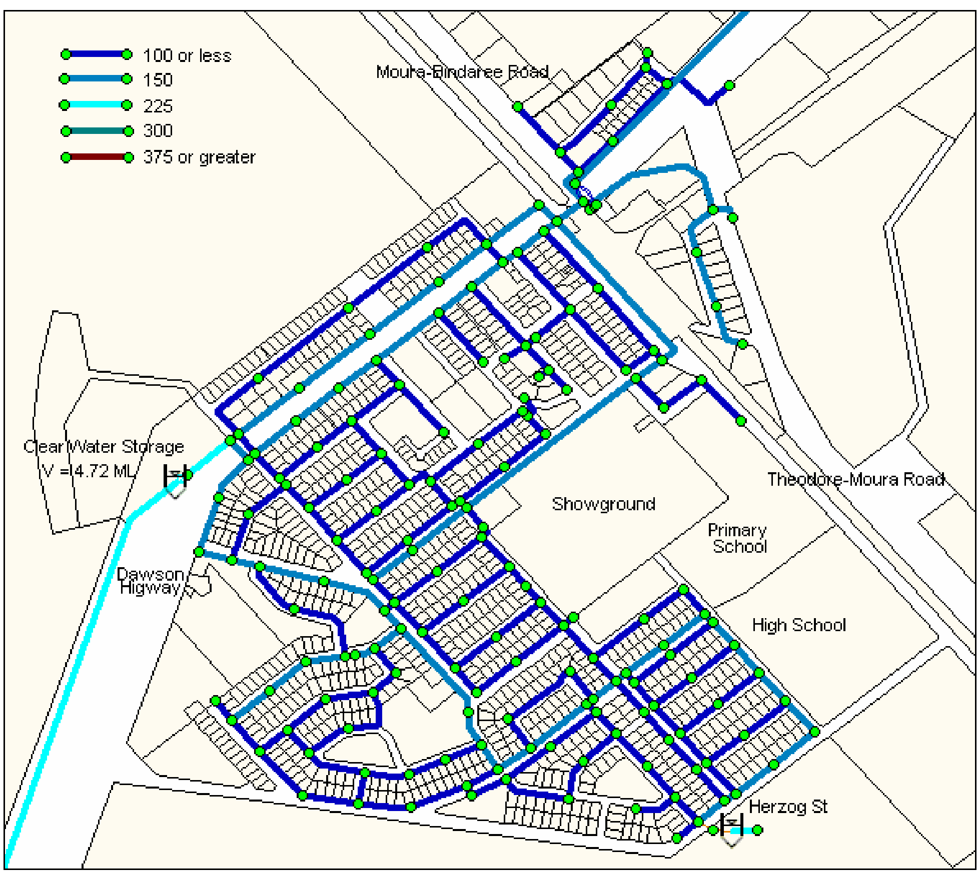


Figure 9.12a – Model Schematic (Moura), Ultimate Scenario 2, Augmentation A

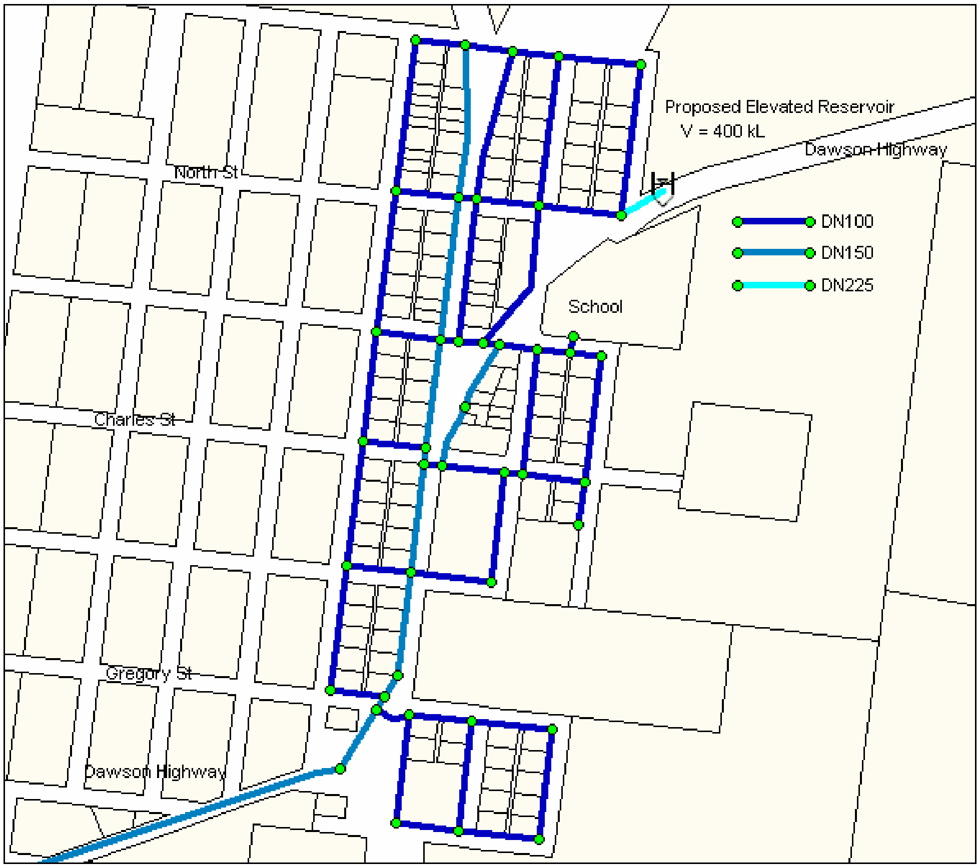


Figure 9.12b – Model Schematic (Banana), Ultimate Scenario 2, Augmentation A

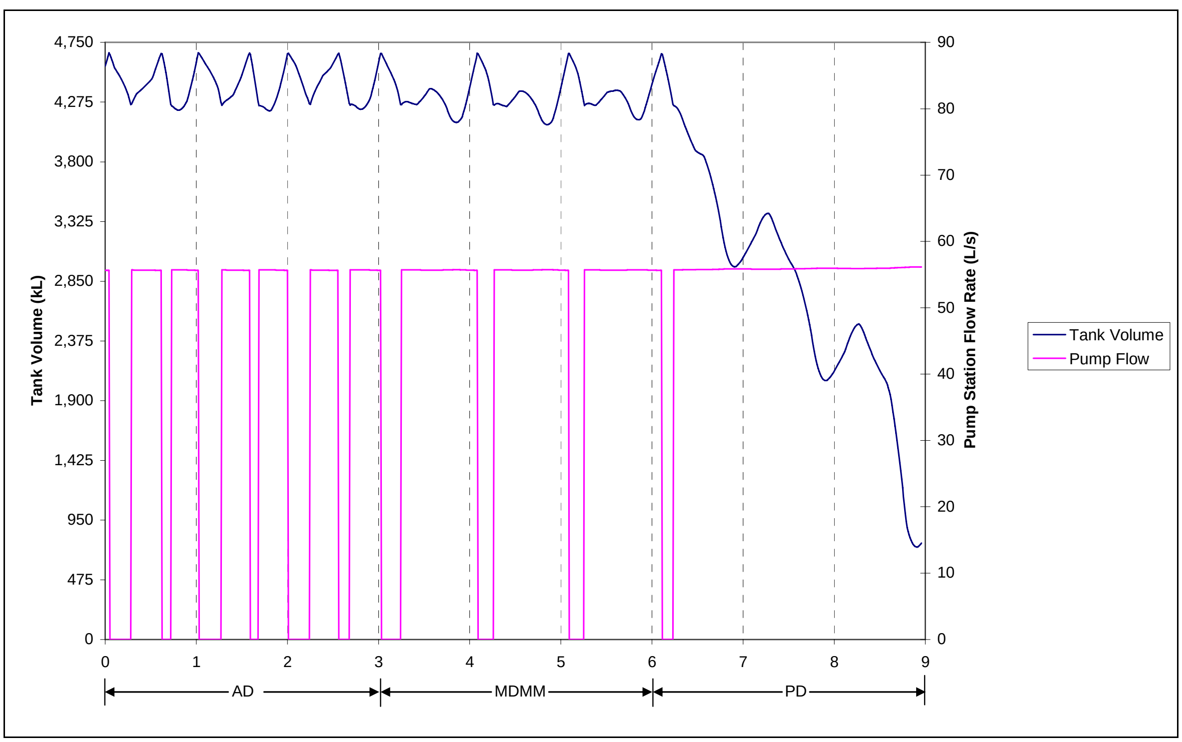


Figure 9.13 – Clear water storage volume and Dawson River pump operation over analysis period

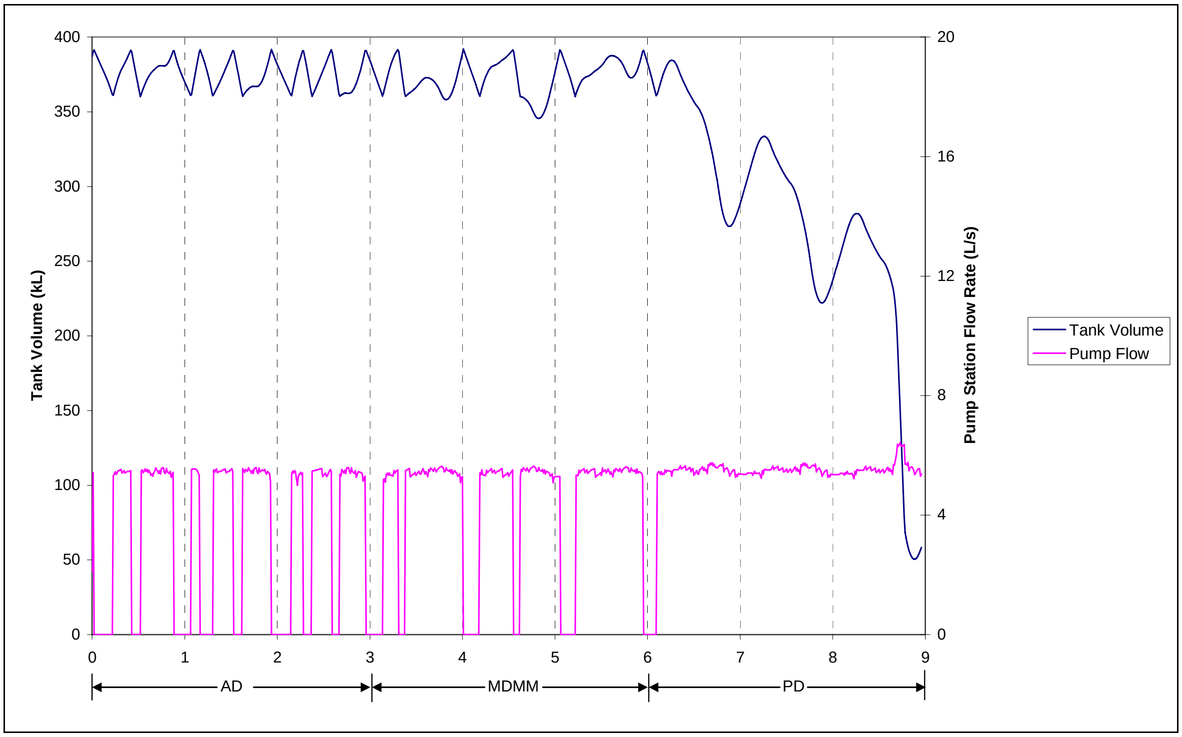


Figure 9.14 – Proposed elevated reservoir volume and Banana booster pump station operation over analysis period

9.2.2 Augmentation of Moura and Banana rising mains and clear water storage

The clear water storage was augmented by doubling the reservoir volume, providing a total proposed storage volume of 2.04 ML. The existing DN225 rising main between the Dawson River and the water treatment plant was upgraded to DN300, increasing the design flow to 68 L/s.

The Banana pump station was modelled with 2 duty and 2 standby pumps, each delivering 4 L/s. The existing DN150 Banana rising main was upgraded to a DN225 to cater for the extra flow.

The proposed augmentations are outlined on Figure 9.15. The corresponding model scenario is “ULTSC2B, Moura RM + CWS augmented”.

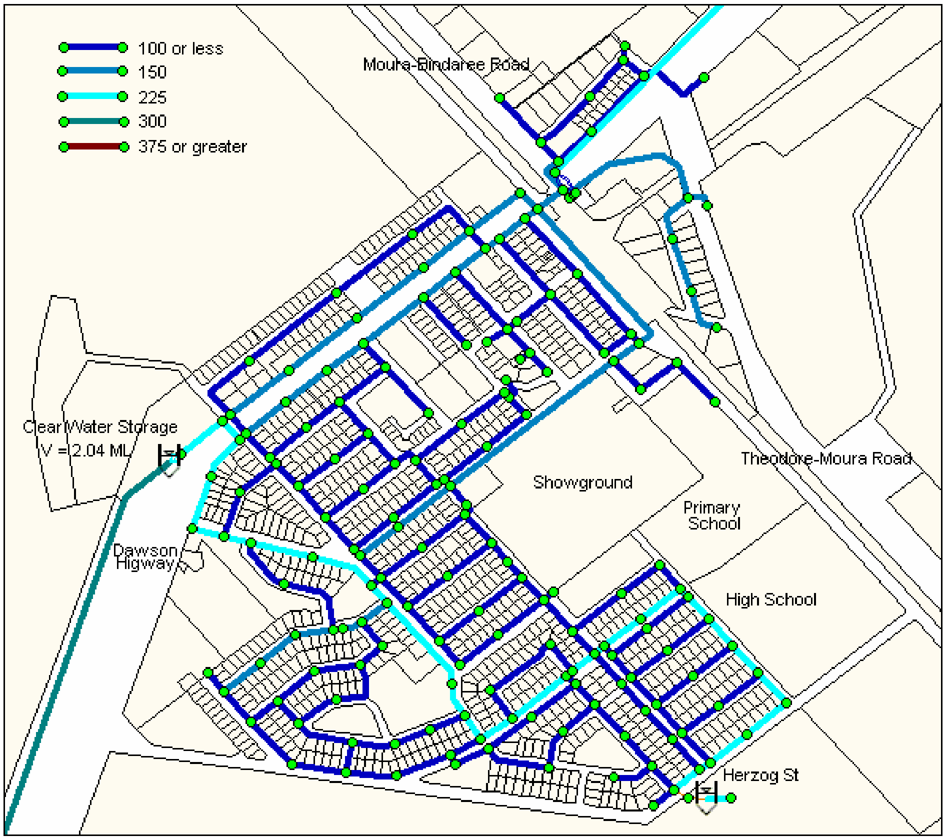


Figure 9.15a – Model Schematic (Moura), Scenario 2, Augmentation B

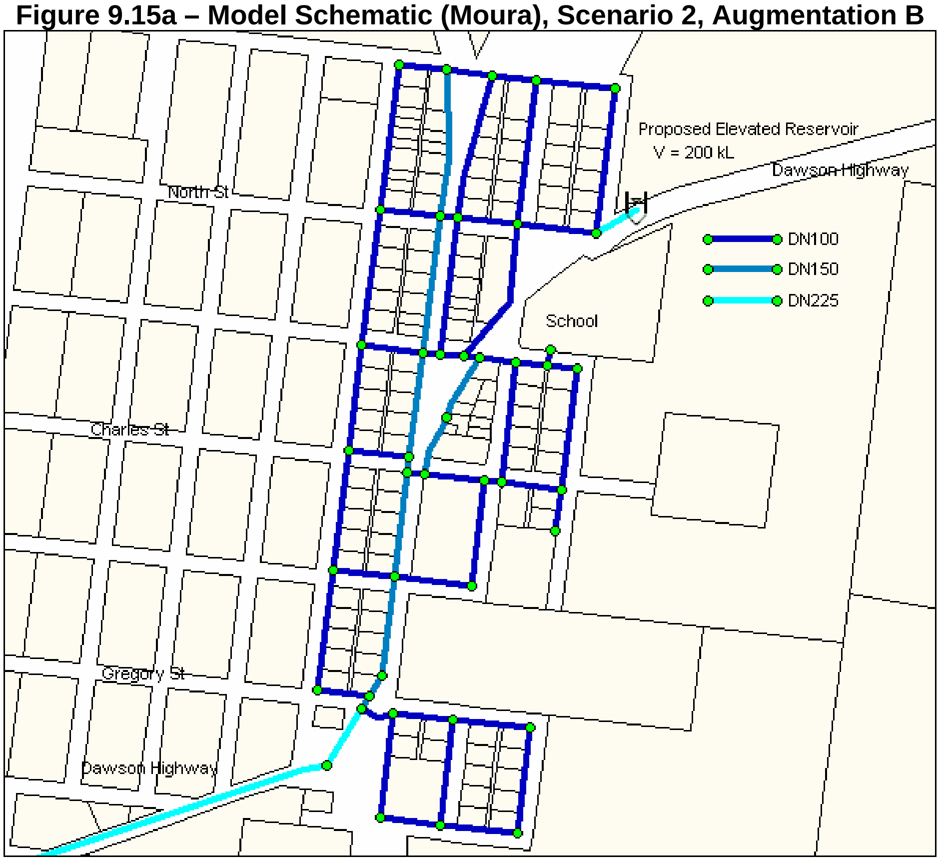


Figure 9.15b – Model Schematic (Banana), Scenario 2, Augmentation B

The Peak Hour service pressure for Moura and Banana is shown on Figures 9.16 and 9.17.

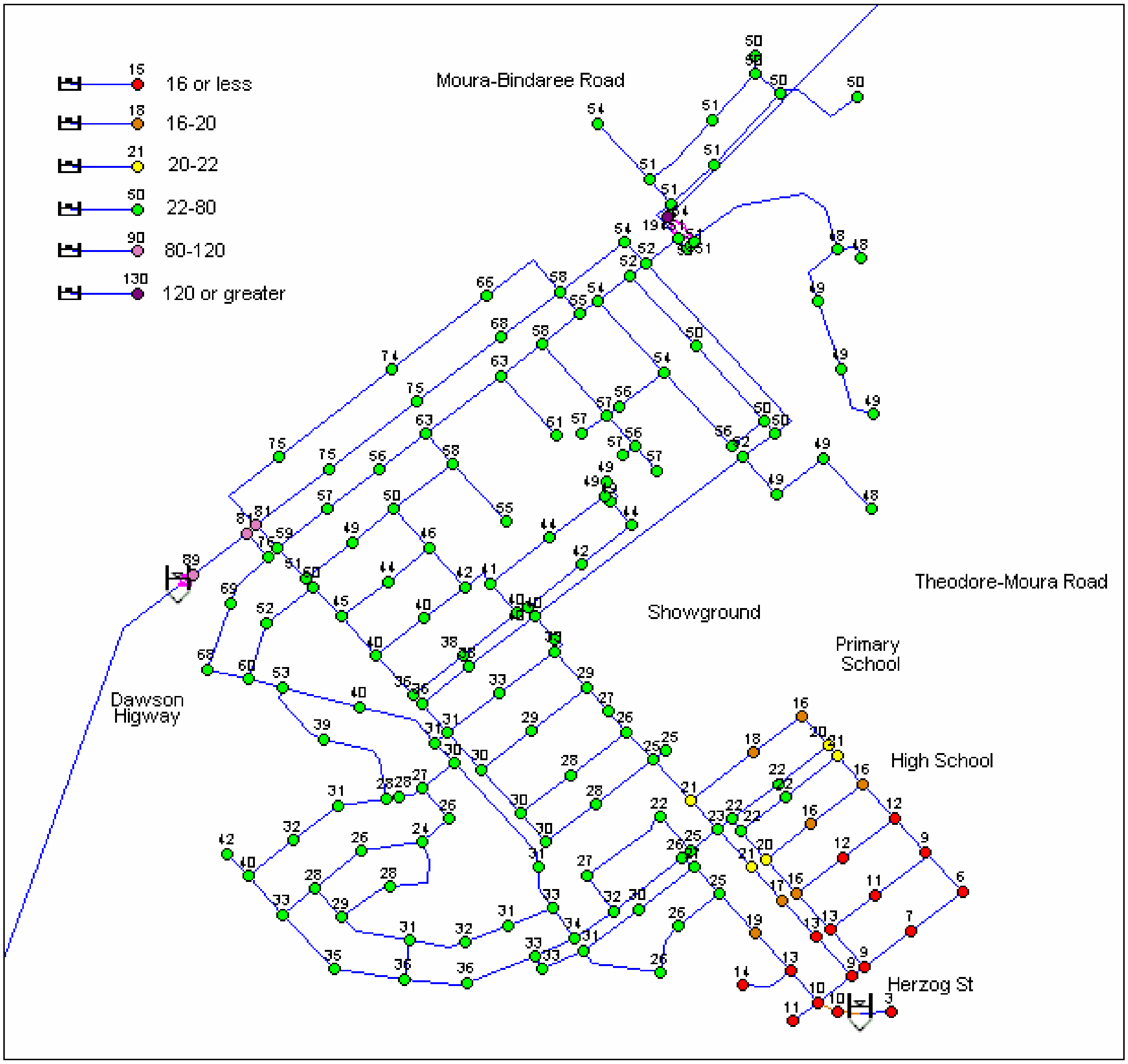


Figure 9.16 – PH service pressure (m) at Moura

System modelling suggests that the Peak Hour service pressure drops significantly in the south-eastern parts of Moura. It is anticipated that such problems be overcome with the introduction of separate water supply zones or by imposing PH flow restrictions on the southern developments.

As shown on Figure 9.17, the PH service pressure at Banana is maintained within appropriate design levels.

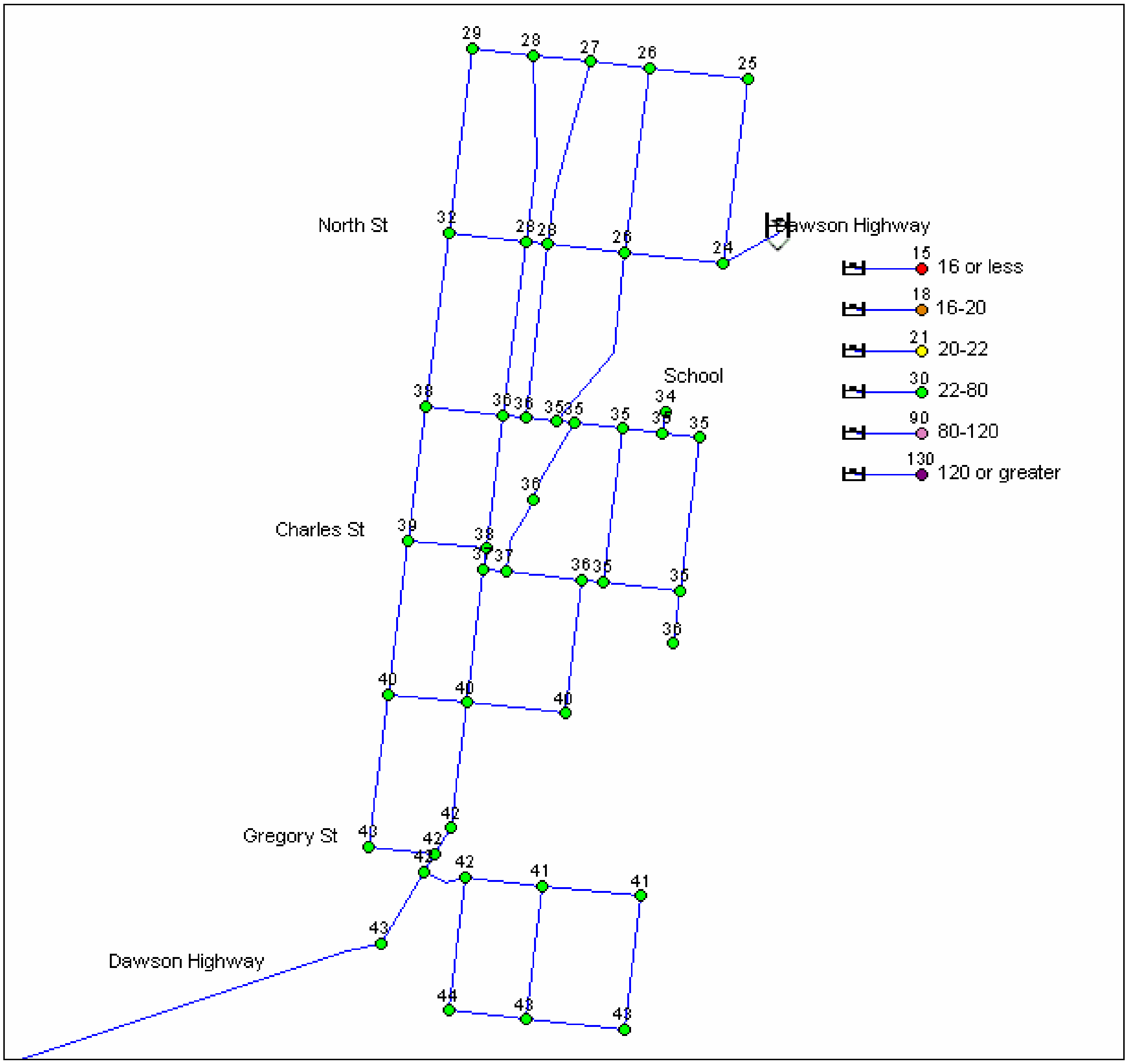


Figure 9.17 – PH service pressure (m) at Banana

A critical node fire-flow analysis was undertaken in accordance with the DNR&M Guidelines. The critical node pressure at Moura and Banana is shown on Figures 9.18 and 9.19.

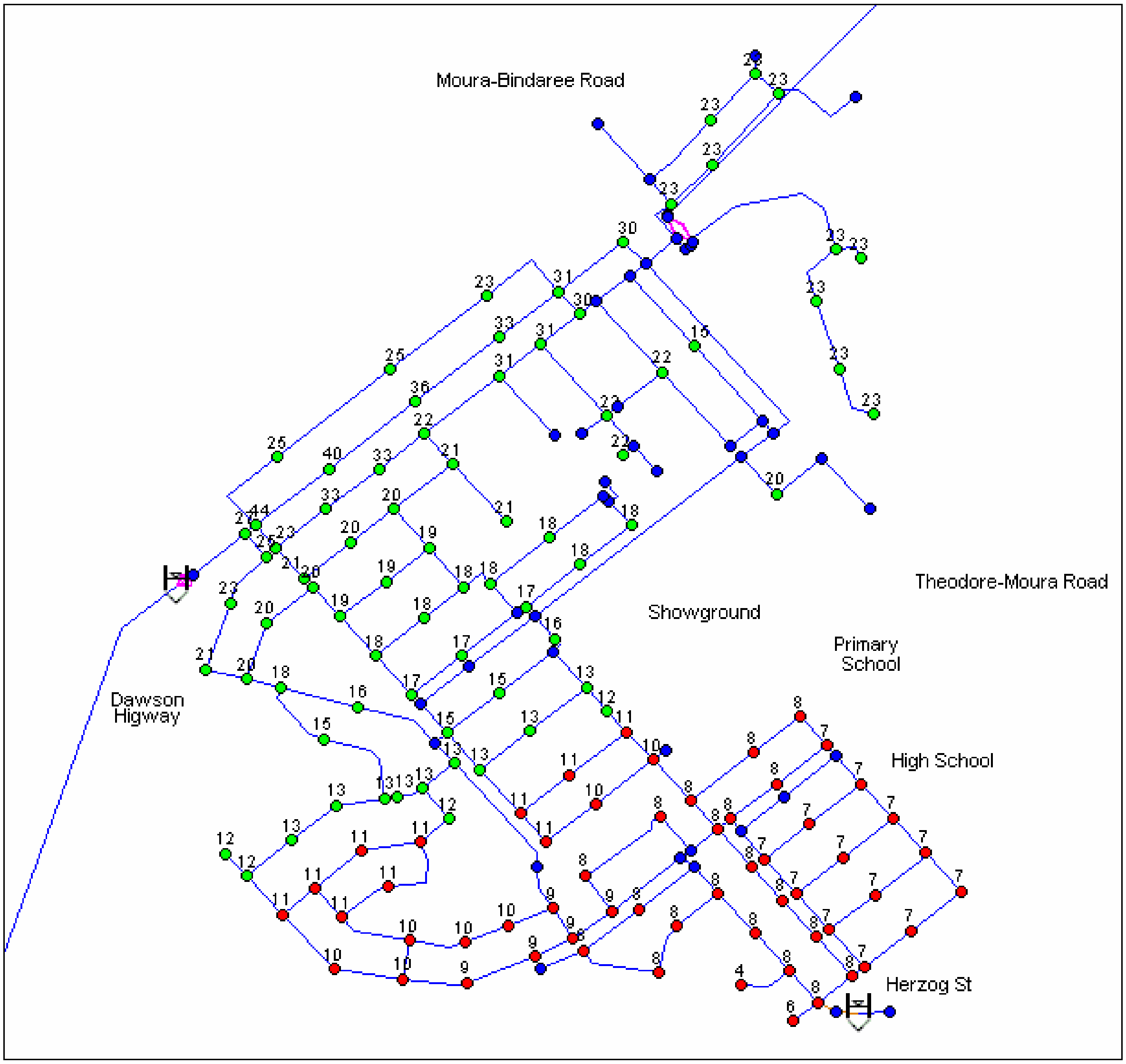


Figure 9.18– Critical node pressure (m) at Moura

With regard to the minimum pressures, similar problems occur in the southern vicinity of Moura. However, it is expected that the critical node pressure may be increased by the division of water supply zones or PH flow restrictions, as previously alluded to.

Shown on Figure 9.19, the minimum critical node pressure at Banana is 17.5m, which is in accordance with the DNR&M Guidelines.

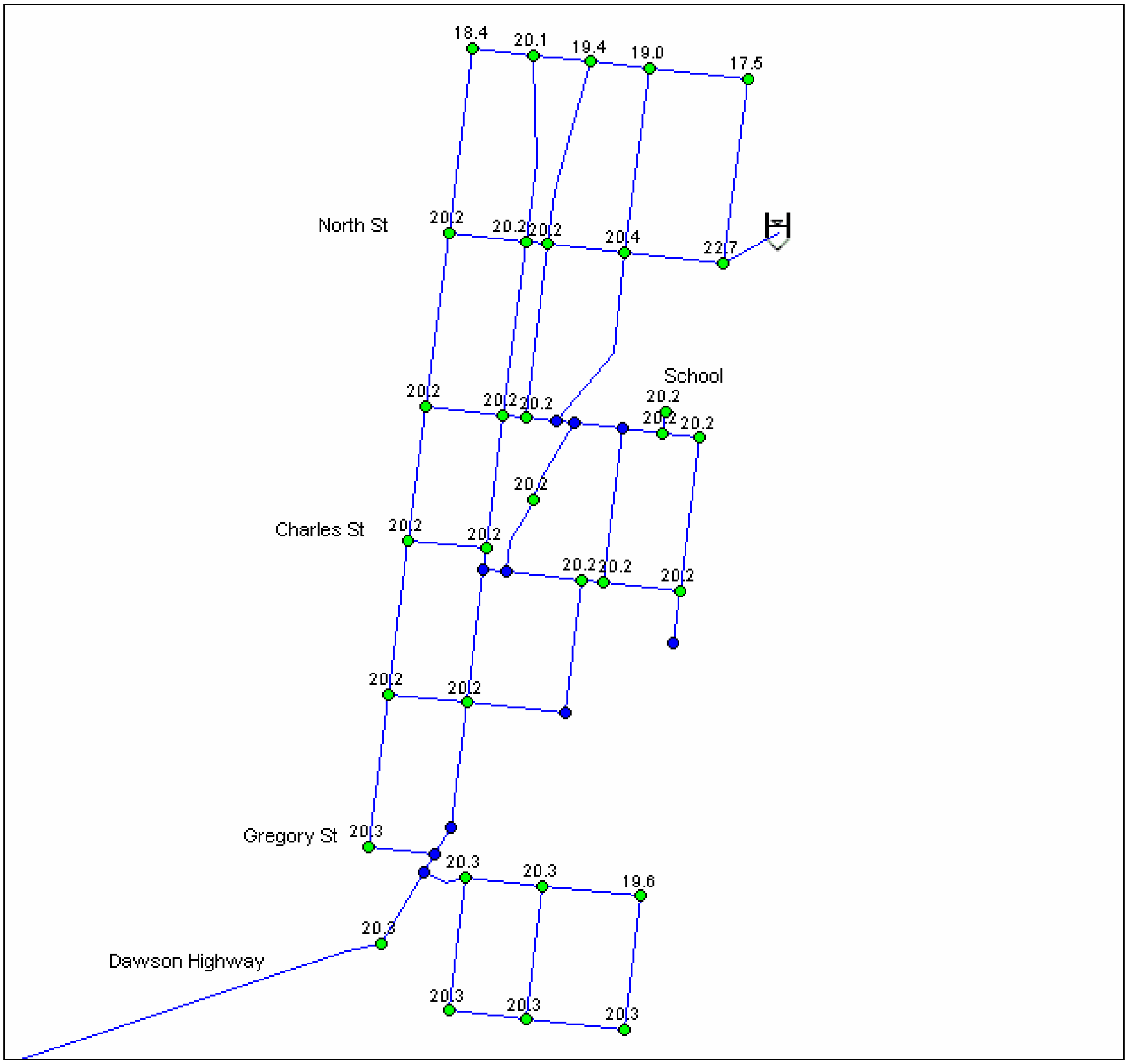


Figure 9.19 – Critical node pressure (m) at Banana

In order to analyse the clear water storage and river pump operation, a commercial fire-flow demand was modelled at Moura. The modelling results are shown on Figure 9.20 Likewise, a residential fire-flow demand was modelled at Banana in order to analyse the elevated reservoir and Banana pump station operation, shown on Figure 9.21.

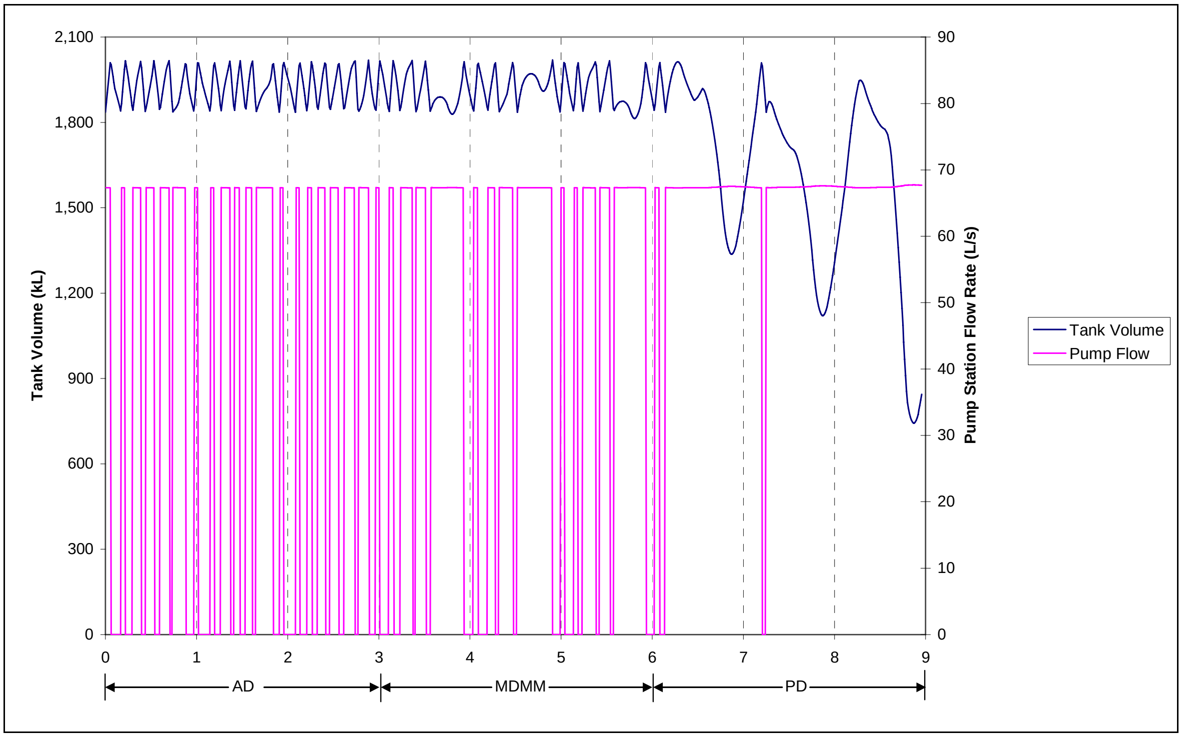


Figure 9.20 – Clear water storage volume and Dawson River pump operation over analysis period

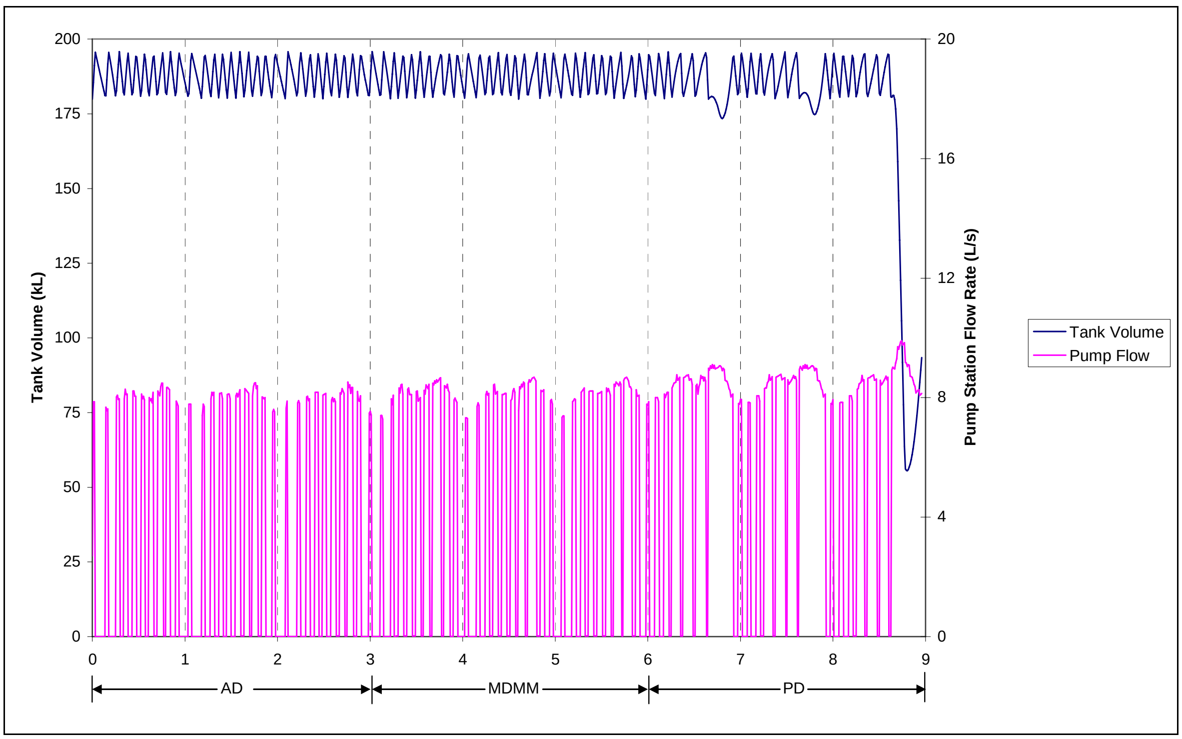


Figure 9.21 – Proposed elevated reservoir volume and Banana booster pump station operation over analysis period

Defined by the DNR&M Guidelines, the minimum delivery flow rate for the Moura rising main and the Banana rising main is 59 L/s and 10 L/s respectively. The flow rate in the Banana rising main is slightly lower than the recommended minimum. However, both reservoirs have a net positive inflow at the end of each MDMM and neither reservoir has failed during the analysis. Thus the design criterion for reservoir storage and pump station operation are effectively met.

9.3 ULTIMATE SCENARIO 3

The model was run with the Scenario 3 projected demands in order to determine the level of service provision afforded by the water supply infrastructure. The corresponding model scenario is "ULTIMATESC3, Banana Scenario 3 – Nominal Population Growth + 250 lot development".

The initial model infrastructure components included the existing infrastructure plus the proposed augmentations for the third intermediate scenario, that is, an elevated reservoir at Banana and the Moura and Banana rising mains upgraded to DN300 and DN225 respectively. The storage capacity of the Banana elevated reservoir was increased to 300 kL to meet the minimum requirements in accordance with the DNR&M Guidelines. However, the model did not compile due to the clear water storage and the Banana elevated reservoir failing during fire-flow demand. Further augmentations are considered necessary in order to satisfy the design criteria.

9.3.1 Augmentation of clear water storage and elevated reservoir

The model clear water storage was augmented with a proposed 3.7 ML reservoir, providing a total storage capacity of 4.72ML. The proposed Banana elevated reservoir was modelled with a nominal storage capacity of 1 ML. The model schematic on Figure 9.22 outlines the proposed augmentations. The corresponding model scenario is "ULTS3A, Moura CWS + Banana elev. res. augmented".

Figures 9.23 and 9.24 show that both reservoirs become significantly depleted during PD. Extensive pump station operation periods are required to refill the reservoirs. As such, increasing the reservoir storage capacity alone is not considered a feasible augmentation strategy.

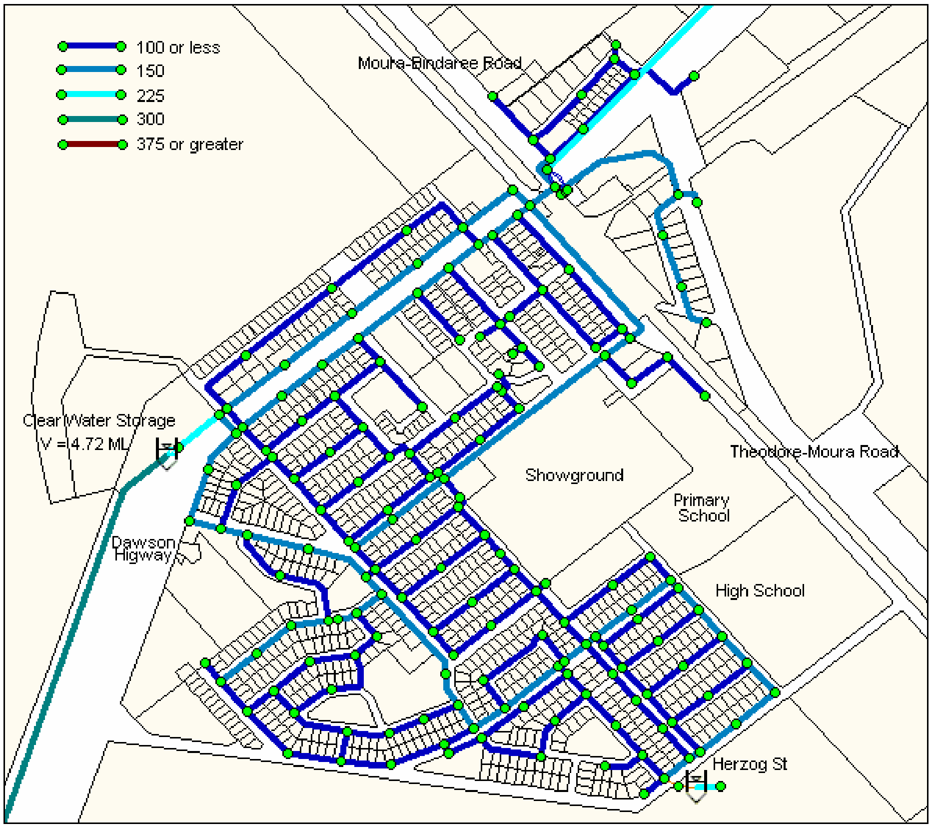


Figure 9.22a – Model Schematic (Moura), Ultimate Scenario 3, Augmentation A

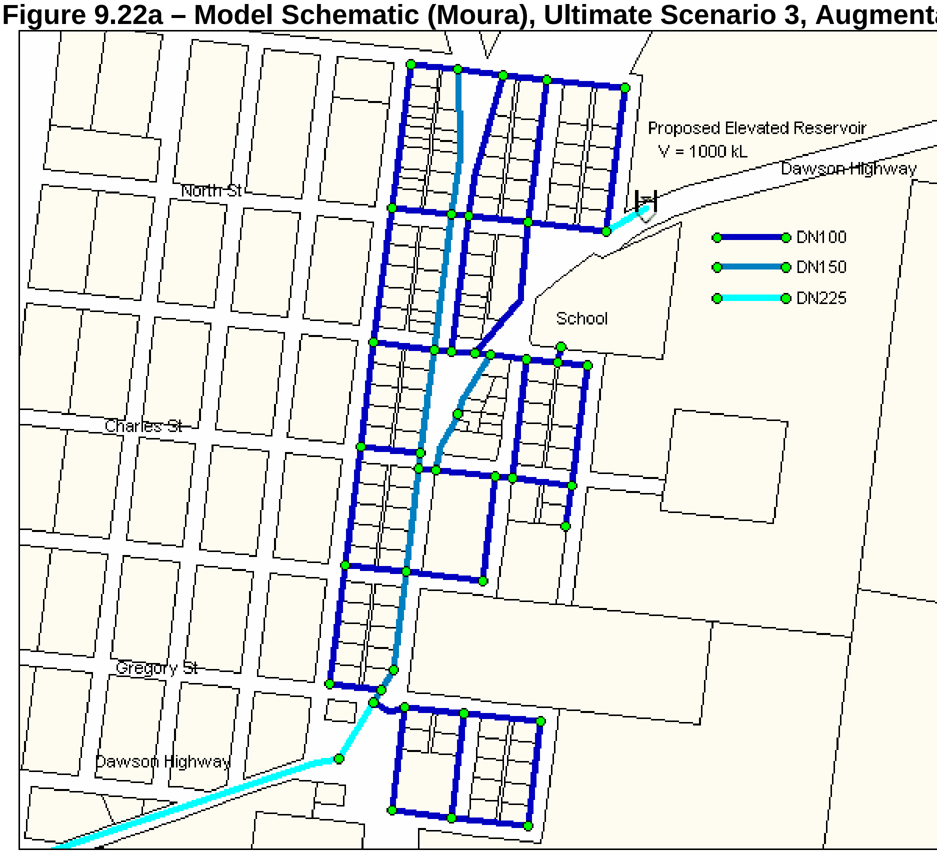


Figure 9.22b – Model Schematic (Banana), Ultimate Scenario 3, Augmentation A

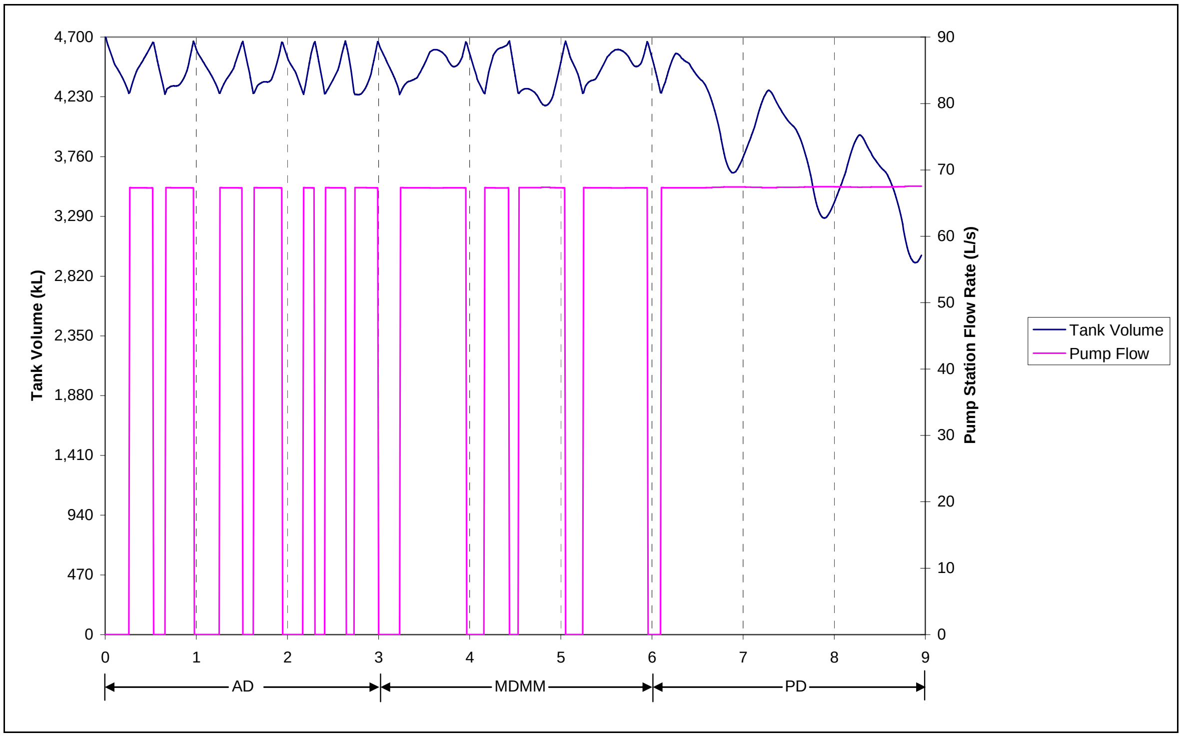


Figure 9.23 – Clear water storage volume and Dawson River pump operation over analysis period

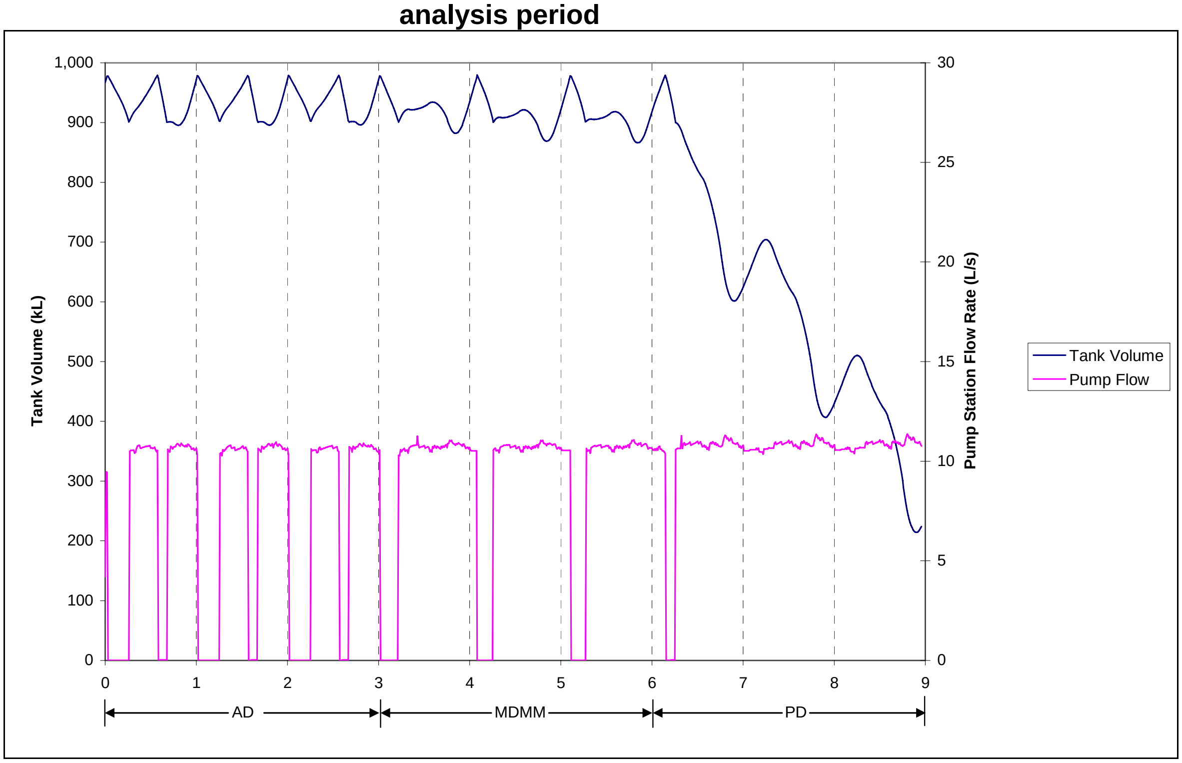


Figure 9.24 – Proposed elevated reservoir volume and Banana booster pump station operation over analysis period

9.3.2 Intake Pumps, clear water storage and Banana reservoir augmented

The clear water storage was augmented by doubling the reservoir volume, providing a proposed storage capacity of 2.04 ML. The proposed elevated reservoir was modelled with a nominal capacity of 400 kL. The Banana booster pump station was modelled with two duty and two standby pumps, each delivering 6.5 L/s at 30m, producing a downstream pressure of 91m. In order to increase the raw water delivery rate, a third duty pump was brought online at the Dawson River intake.

The proposed augmentations are outlined on Figure 9.25. The corresponding mode scenario is "ULTSC3B – Moura + Banana RMs Augmented; 400kL elev res.".

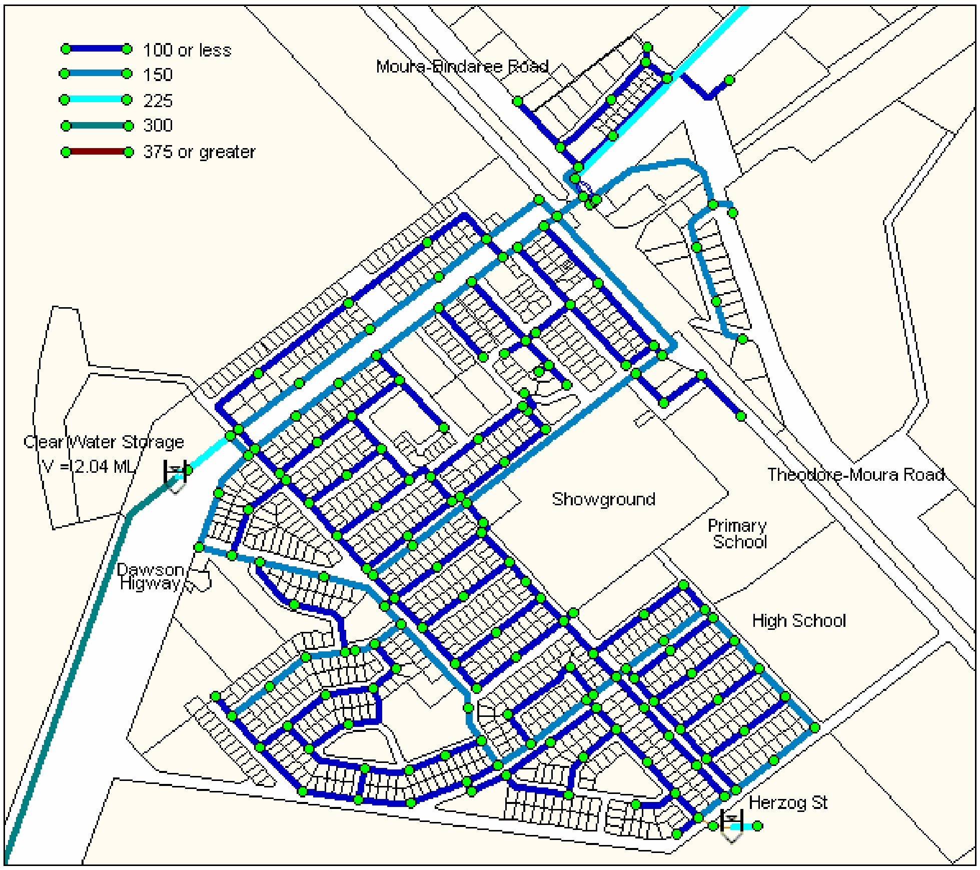


Figure 9.25a – Model Schematic (Moura), Ultimate Scenario 3, Augmentation B

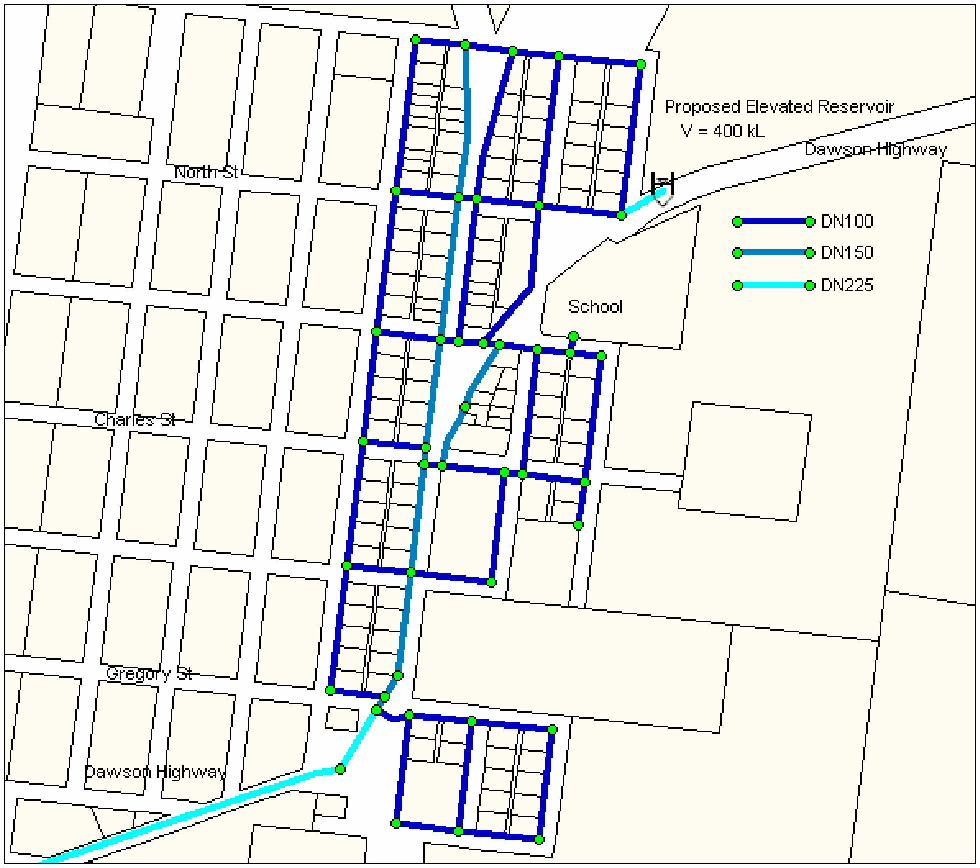


Figure 9.25b – Model Schemtic (Banana), Ultimate Scenario 3, Augmentation B

The Peak Hour service pressure for Moura and Banana is shown on Figures 9.26 and 9.27.

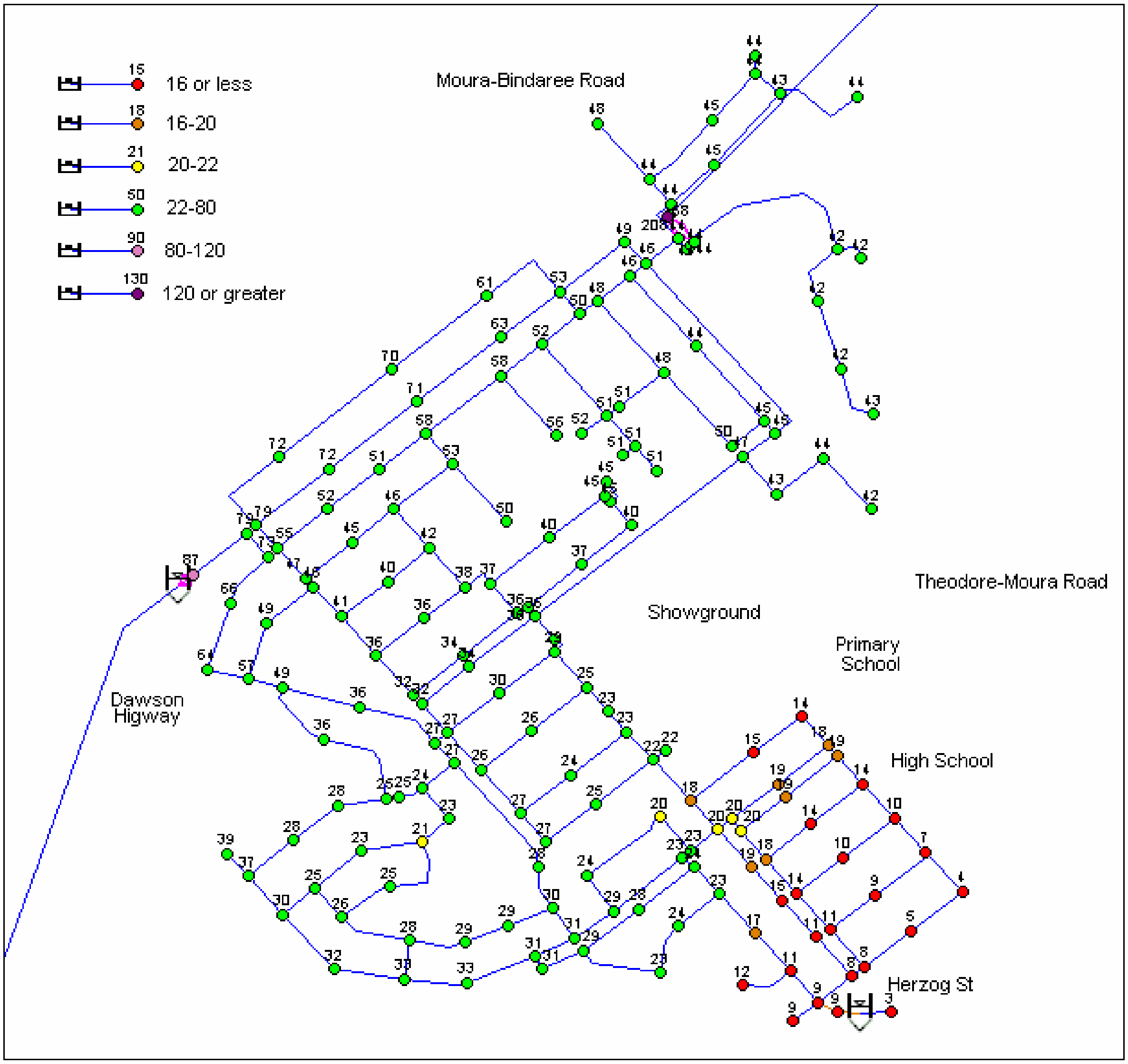


Figure 9.26 – PH service pressure (m) at Moura

As with the first two 2026 scenarios, the PH pressure drops below the desired minimum. As previously mentioned, the low pressure problems may be eliminated by careful strategic planning should this development scenario eventuate.

As seen on Figure 9.27, the PH service pressure at Banana ranges from 24-44m, which satisfies the adopted design criteria.

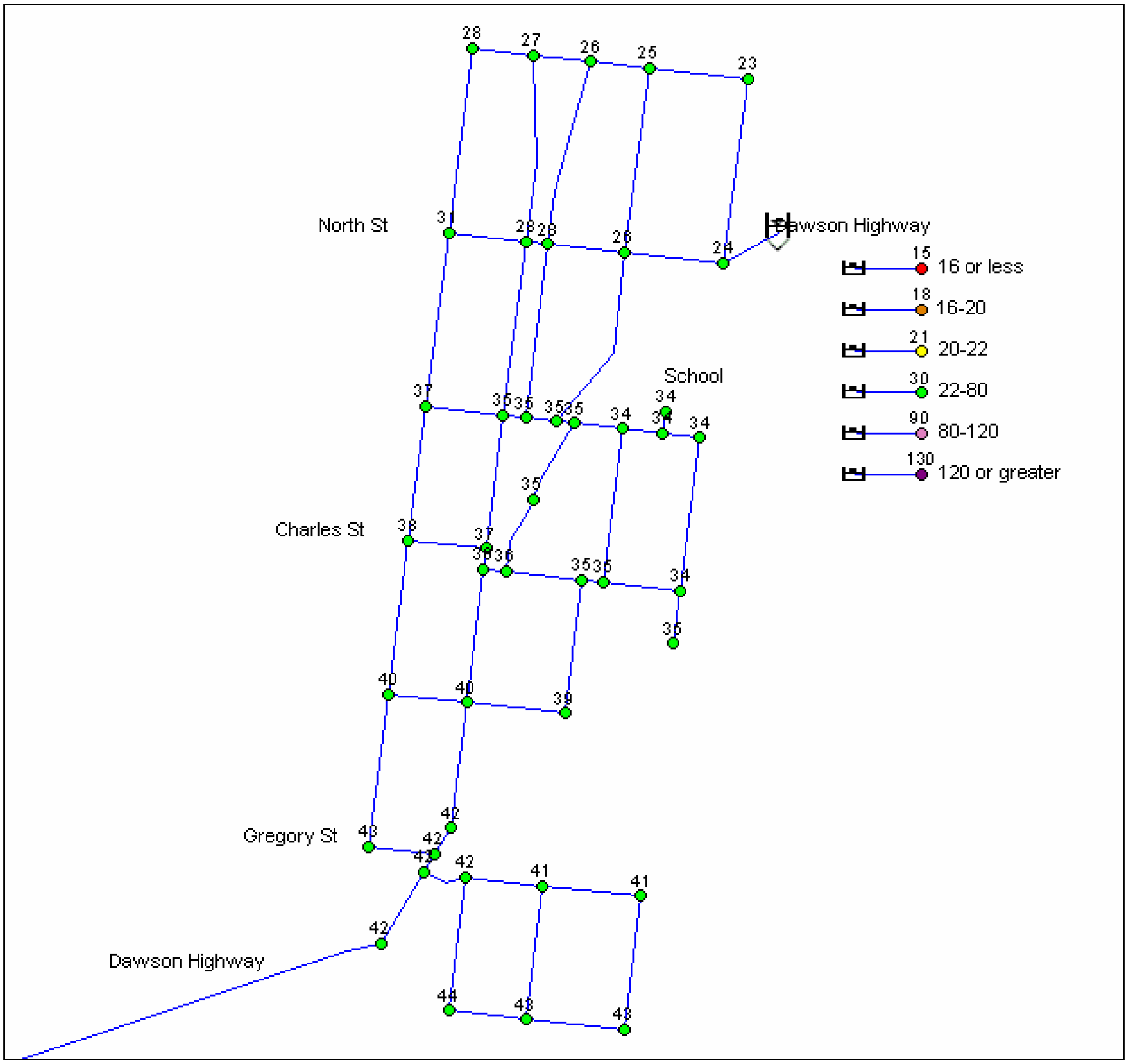


Figure 9.27 – PH service pressure (m) at Banana

A critical node fire-flow analysis was undertaken in accordance with the DNR&M Guidelines. The critical node pressure for Moura and Banana is shown on Figures 9.28 and 9.29.

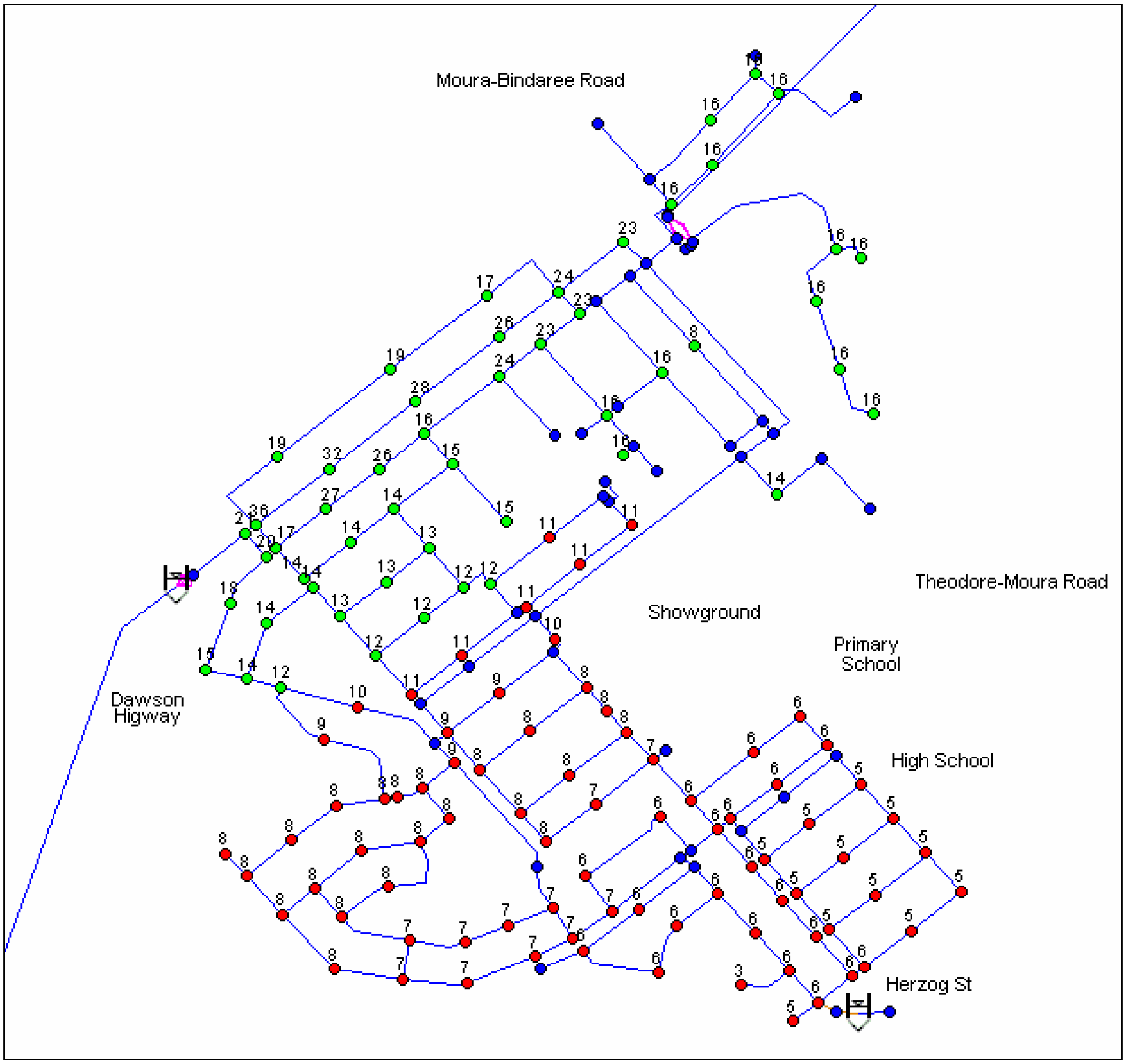


Figure 9.28 – Critical node pressure (m) at Moura

Compared with the previous two scenarios, the low critical node pressure problems are encroaching towards the north of Moura. Again, it is anticipated that the low pressures can be increased by partitioning the township into separate water supply zones, or by restricting flow to the southern development.

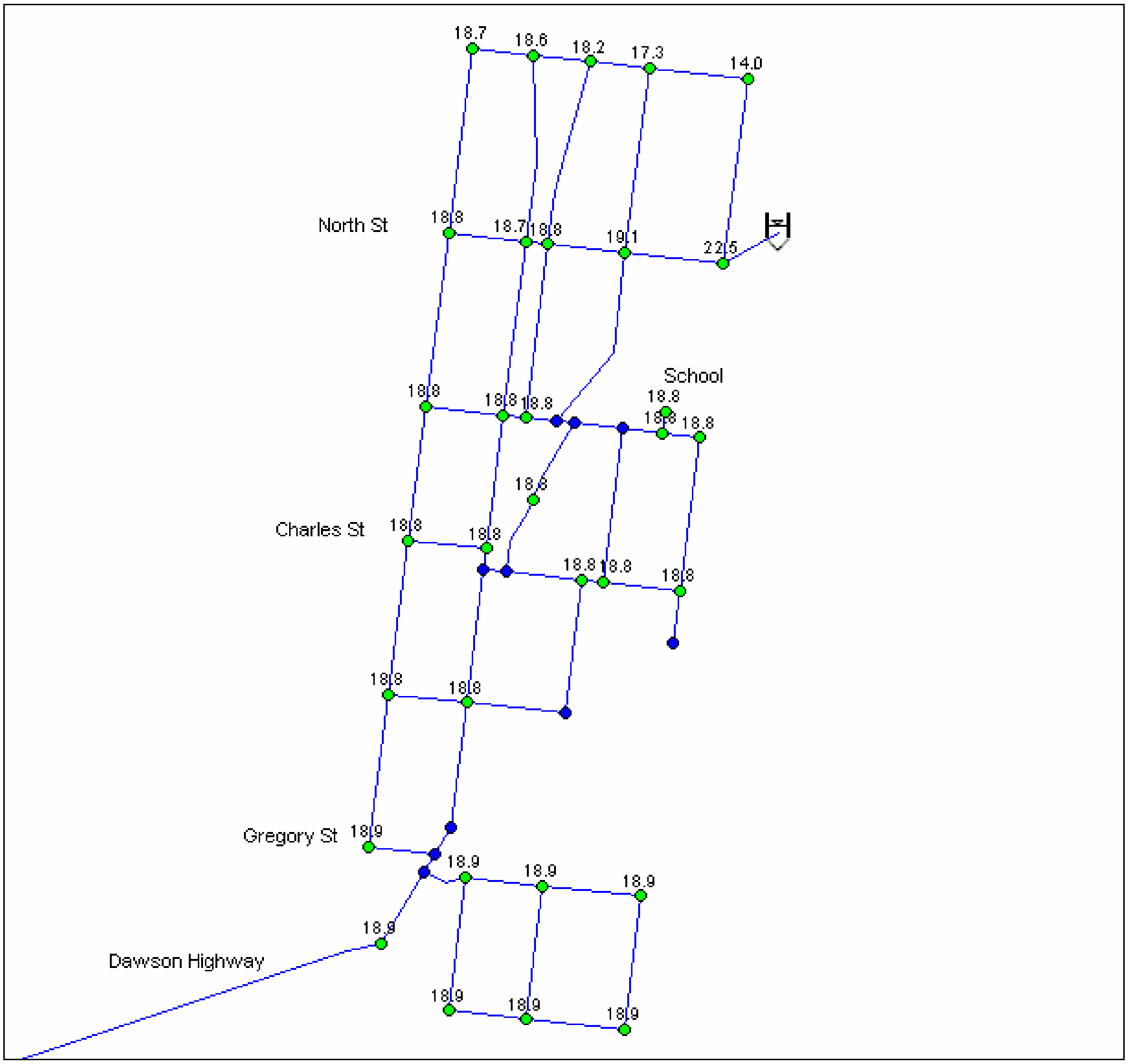


Figure 9.29 – Critical node pressure (m) at Banana

In order to analyse the clear water storage and river pump operation, a commercial fire-flow demand was modelled at Moura. The modelling results are shown on Figure 9.30. Likewise, a residential fire-flow demand was modelled at Banana in order to analyse the elevated reservoir and Banana pump station operation, shown on Figure 9.31.

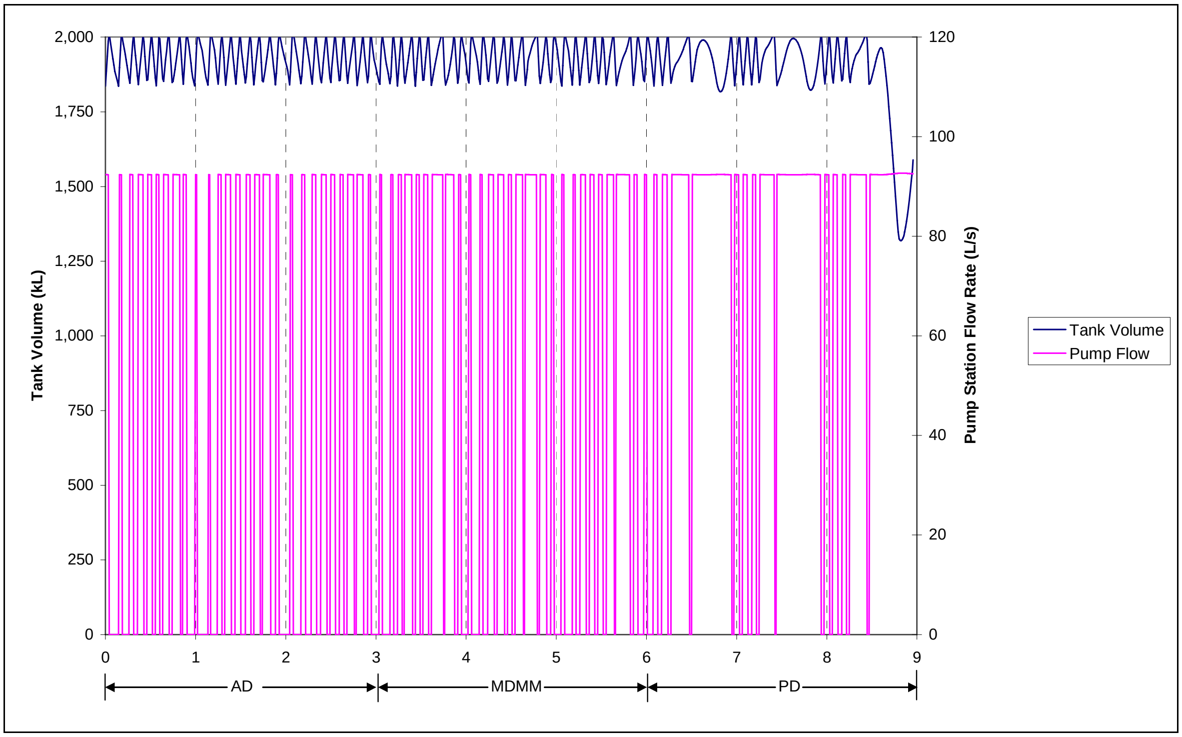


Figure 9.30 – Clear water storage volume and Dawson River pump operation over analysis period

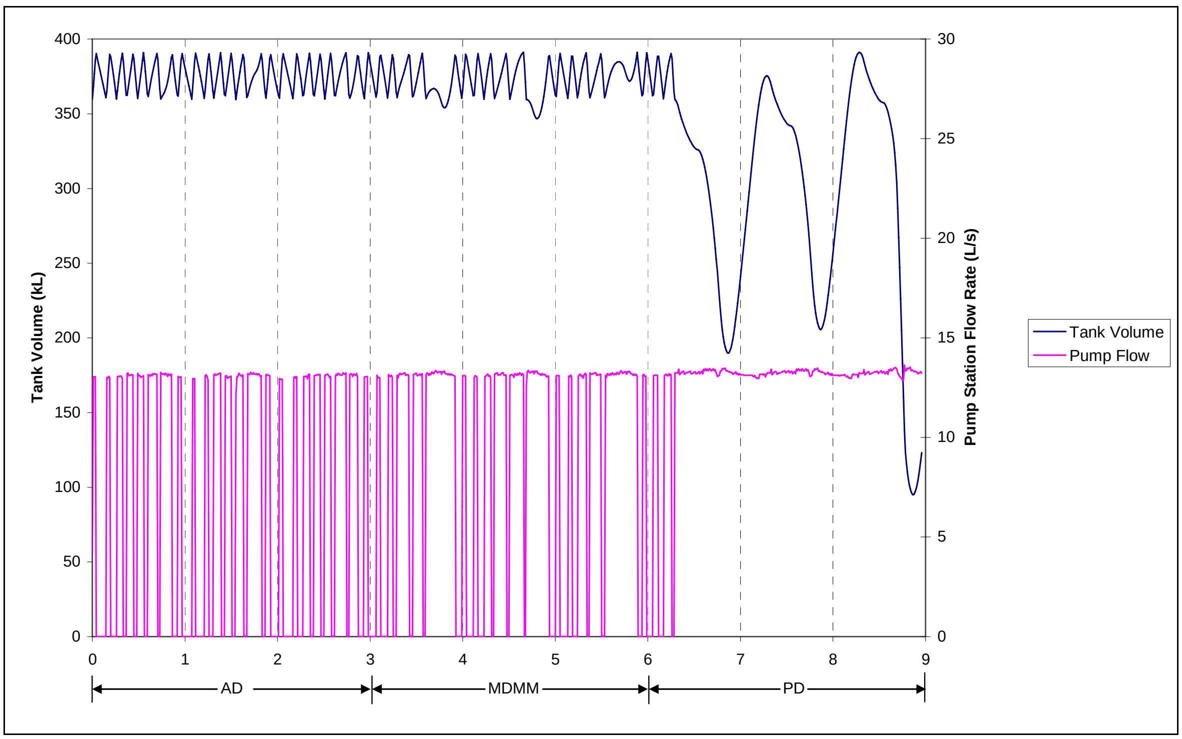


Figure 9.31 - Proposed elevated reservoir volume and Banana booster pump station operation over analysis period

Defined by the DNR&M Guidelines, the minimum delivery flow rate for the Moura rising main and the Banana rising main is 65 L/s and 22 L/s respectively. The flow rate through the Banana rising main is 9 L/s lower than the minimum recommended flow rate.

However, due to the critical node pressure problems in the vicinity of the pump station, it is not considered feasible to further increase the flow.

10.0 SCHEDULE OF WORKS

This chapter provides a summary of the proposed augmentation strategies.

10.1 EXISTING HORIZON

System modelling has shown that the construction of an elevated reservoir at Banana is the most effective augmentation ensuring that the desired standards of service are met. A nominal internal reservoir capacity of 200 kL was found to be adequate to service the township in accordance with the DNR&M Guidelines.

Table 10.1 – Summary of augmentations for 2006 development

Scenario	Augmentation Required	Units	Unit Cost ($/unit)	Sub-Total	Total
1 - Nominal Population Growth	200kL Elevated Reservoir at Banana	1	$220,000	$220,000	$220,000
2 - Nominal Population Growth plus 50 lot development at Banana	200kL Elevated Reservoir at Banana	1	$220,000	$220,000	$220,000
3 - Nominal Population Growth plus 250 lot development at Banana	200kL Elevated Reservoir at Banana	1	$220,000	$220,000	$220,000

10.2 INTERMEDIATE HORIZON

The model indicated that the water supply infrastructure including the proposed elevated reservoir was capable of meeting the service standards for Scenarios 1 and 2. However, further augmentations were shown to be necessary for Scenario 3. Augmentation to the Moura and Banana rising mains ensured the flow was increased, and the augmentation of the proposed elevated reservoir to 250 kL ensured that minimum reservoir levels were met. Thus the desired standards of service were met in accordance with the DNR&M Guidelines.

Table 10.2 – Summary of augmentations for 2011 development

Scenario	Augmentation Required	Units	Unit Cost ($/unit)	Sub-total	Total
1 - Nominal Population Growth	N/A	N/A	N/A	N/A	0
2 - Nominal Population Growth plus 50 lot development at Banana	N/A	N/A	N/A	N/A	0
3 - Nominal Population Growth plus 250 lot development at Banana	Increase capacity of Moura rising main	5,200	$317	$1,648,400	$6,055,000
	Increase capacity of Banana rising main	20,100	$216	$4,341,600	
	Increase capacity of elevated reservoir to 250 kL	1	$65,000	$65,000	

10.3 ULTIMATE HORIZON

System modelling indicated that all scenarios require further augmentations in order to meet the desired standards of service. The proposed augmentations are summarised on Table 10.3.

Table 10.3 – Summary of augmentations for 2026 development

<table>
<tr><th>Scenario</th><th>Augmentation Required</th><th>Units</th><th>Unit Cost ($/unit)</th><th>Sub-Total</th><th>Total</th></tr>
<tr><td rowspan="2">1 - Nominal Population Growth</td><td>Increase capacity of Moura rising main</td><td>5,200</td><td>$317</td><td>$1,648,400</td><td rowspan="2">$2,098,400</td></tr>
<tr><td>Increase capacity of clear water storage to 2.04 ML</td><td>1</td><td>$450,000</td><td>$450,000</td></tr>
<tr><td rowspan="3">2 - Nominal Population Growth plus 50 lot development at Banana</td><td>Increase capacity of Moura rising main</td><td>5,200</td><td>$317</td><td>$1,648,400</td><td rowspan="3">$6,440,000</td></tr>
<tr><td>Increase capacity Banana rising main</td><td>20,100</td><td>$216</td><td>$4,341,600</td></tr>
<tr><td>Increase capacity of clear water storage to 2.04 ML</td><td>1</td><td>$450,000</td><td>$450,000</td></tr>
<tr><td rowspan="2">3 - Nominal Population Growth plus 250 lot development at Banana</td><td>Increase capacity of clear water storage to 2.04 ML</td><td>1</td><td>$450,000</td><td>$450,000</td><td rowspan="2">$670,000</td></tr>
<tr><td>Increase capacity of elevated reservior to 400 kL</td><td>1</td><td>$220,000</td><td>$220,000</td></tr>
</table>

11.0 CONCLUSIONS AND RECOMMENDATIONS

An H_2OMAP model was constructed to assess the Moura and Banana water supply reticulation. The model was constructed in accordance with Banana Shire Council GIS data and engineering drawings. The model demands were determined through correlation of the Banana Shire Council Equivalent Person Population model.

The water supply design criteria were determined in accordance with the Banana Shire Council Planning Scheme and the Department of Natural Resources and Mines Planning Guidelines for Water and Sewerage (DNR&M Guidelines), and used for the model simulations.

The water supply reticulation was assessed at the existing (2006), intermediate (2011) and ultimate (2026) horizons. The water supply reticulation model was used to assess the impact of the population projections, to determine whether further augmentations are required, and to analyse the impact of such augmentations.

It is understood that a number of development applications have recently been submitted for Banana, resulting in a high likelihood of extensive development at Banana, should it not be curbed by water supply among other factors. However, system modelling has shown that minimum standards of service with regard to fire-flow pressure may not be met if the extensive development entailed in Scenario 3 is allowed to proceed. As such, Scenario 2 for projected development, which includes an additional 50 lots at Banana, is considered the most probable scenario.

The proposed augmentation strategy for Scenario 2 includes the construction of a 200 kL elevated reservoir at Banana to meet the desired standards of service for the existing population. Further augmentations will be required to the Moura rising main and treatment plant, and the Banana rising main by 2026.

12.0 REFERENCES

Augmentation of Reticulation – Moura Water Supply, Ullman & Nolan (1992)

Moura Township Water Network Analysis Report for Moura and Kotti Doon Single Persons Quarters, Parsons Brinckerhoff (2005)

Planning Guidelines for Water Supply and Sewerage, The Department of Natural Resources and Mines (2005)

Planning Scheme for Banana Shire, Banana Shire Council (2005)

Water Supply Network Analysis and Planning Report, Boyd Water Services (2006)

APPENDIX A

Overview

Figure A1 – Aerial Photograph of Moura

Figure A2 – Aerial Photograph of Banana

Figure A3 – Overview of Moura water treatment plant clear water storage tanks

Figure A4 – Overview of Moura SPQ clear water storage

APPENDIX B

Zoning Maps