174 MAITLAND DRIVE RESIDENTIAL DEVELOPMENT

Preliminary Watermain Design Brief

September 2020

AINLEY GRAHAM & ASSOCIATES

CONSULTING ENGINEERS AND PLANNERS
COLLINGWOOD · BARRIE · BELLEVILLE · KINGSTON · OTTAWA

File No. 19628-1

Ainley GROUP CONSULTING ENGINEERS PLANNERS

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1.0 INTRODUCTION

1.1 General

Ainley Group has been retained to undertake engineering services necessary for the completion of a watermain design brief to support the proposed Draft Plan of Subdivision application for 174 Maitland Drive within the Municipality of the City of Belleville.

The proposed development is bounded to the west by existing residential development (Deerfield Park Subdivision), to the north by Maitland Drive, to the south by Lowe's Home Improvement Centre, and to the east by vacant partially treed land. The development site is represented in **Figure 1**.

The proposal will incorporate the development of thirty-six (36) single family residential lots, and sixty-one (61) townhouse units.

1.2 Criteria

This report has been prepared with consideration of the following documents and guidelines;

- Form 1 – Record of Watermains Authorized as a Future Alteration,
- Ministry of the Environment publication 'Watermain Design Criteria for Future Alterations Authorized under a Drinking Water Works Permit – June 2012',
- Ministry of the Environment publication 'Design Guidelines for Drinking Water Systems, 2008',
- Fire Underwriters Survey 'Water Supply for Public Protection (1999)', and
- The Corporation of the City of Belleville 'Manual of Standard Specifications'.

2.0 PROPOSED WATERMAIN WORKS

The proposed works will include the connection to the existing 400mm diameter PVC watermain located within Maitland Drive. For the proposed development, the approximate length of new 200mm diameter PVC watermain is 771 m. **Figure 2** outlines the proposed watermain layout.

3.0 EXISTING CONDITIONS

Fire hydrant flow test results were provided by the City of Belleville Water Distribution and Service Department for an existing fire hydrant located Maitland Drive and the western intersection with Street 'A' (Intersection A). The results indicated a static pressure of 60 psi. A copy of the test results are enclosed in **Appendix A**.

4.0 WATER DEMAND EVALUATION

4.1 Domestic Water Demand

An evaluation of the anticipated water demand has been prepared using the guidelines set out in the Ministry of the Environment publication 'Design Guidelines for Drinking Water Systems, 2008'.

Based on the proposed development unit count, the anticipated demands are;

- Average Day – 1.18 l/s,
- Maximum Day – 4.34 l/s,
- Minimum Hour – 0.22 l/s,
- Peak Hour – 6.51 l/s.

Supporting calculations included in **Appendix B**.

4.2 Fire Flow

Fire flow requirements have been evaluated based on the Fire Underwriters Survey 'Water Supply for Public Protection (1999)'.

The resulting Fire Flow + Maximum Day requirement has been determined to be 148.71 L/s.

Supporting calculations are included in **Appendix B**.

4.3 Transient Pressure

The proposed 200 mm diameter PVC Class 150 DR 18 pipe has been designed by the manufacturer to withstand pressures up to 150 psi, which is higher than the maximum operating pressure (100 psi) plus any transient pressure it may be subjected to.

The proposed pipes and joints have also been designed to withstand the maximum operating pressure plus the surge pressure that would be created by stopping a water column moving 0.6 m/s. The transient pressure surge in a PVC Class 150 DR 18 pipe with a 0.6 m/s water column is 35 psi.

5.0 HYDRAULIC EVALUATION

The MOE Design Guidelines for Drinking Water Systems (2008) state that the normal operating pressures in the water distribution system should be approximately 50 to 70 psi. The maximum pressure in the system should not exceed 100 psi, and the minimum pressure in the system should be no lower than 40 psi; however, in the case of fire flows, the pressure may drop to a level no lower than 20 psi.

An EPANET model was created to model the watermain pressures for the development. The water source used in the model is based off of the hydrant testing carried out at Maitland Drive (**Appendix A**). Inputs into the model included the hydrant pressure and flow data; pipe lengths, friction factors, and diameters; pipe junction elevations; and demand flows. The data input into

the model are included in **Appendix C** along with the output generated from the model. The model node used to test the normal demand and fire flow demand flows was node 7, which was considered to be located in the "worst case" position, as it is located at the end of the townhouse block.

The model shows that during Maximum Day Flows (normal demand conditions), the minimum pressure in the system will be 61.23 psi (43.06 m head), whereas during the Maximum Day + Fire Flow demand, the minimum pressure in the system will be 43.38 psi (30.51 m head). Two other flows were analyzed for quality control / confidence checks: 1) at 100 l/s, the pressure at the fire flow node will be 53.59 psi (37.69 m head), and 2) the flow that will cause 20 psi pressure (14.06 m head) at the fire flow demand node was determined to be 232.69 l/s. Supporting calculations are included in **Appendix C**. As such, the EPANET model shows that the watermain pressures conform to the guidelines for normal operating pressures and fire flow pressures.

6.0 DESIGN CONSIDERATIONS

Notwithstanding the following the Guidelines outlined in The Corporation of the City of Belleville 'Manual of Standard Specification' shall apply. The following outlines the design considerations to be applied for the hydraulic evaluation and design layout;

Pipe Diameters
The distribution system shall require fire flow throughout; therefore, the minimum pipe diameter shall be 150mm.

Friction Factors
For all watermain 200mm in diameter – 120
For all watermain 400mm in diameter – 120

Pipe Material
All watermain pipe 100mm to 300mm in diameter shall be PVC DR18 (or lower) and be manufactured in accordance with AWWA C900 and certified to NSF/ANSI 61 and to CSA B137.3.

The pressure class of all pipes shall be a minimum of 235psi.

System Pressure

Normal pressures in the distribution system should not go above 100 psi or below 40 psi during normal demand periods. In the case of fire flows, it may be acceptable to allow the pressure in the system to drop to a level no lower than 20 psi.

Service Pipe
Service piping shall be a minimum diameter of 19mm and of copper or polyethylene.

Copper services shall be type K soft copper with an internal working pressure of 175psi and

conform to ASTM B88 and be certified to NSF/ANSI 61.

Polyethylene services shall have a standard DR of 11.0 or lower with a pressure class of 160psi or greater and shall conform to AWWA C901 and be certified to NSF/ANSI 61.

Fire Hydrants
Hydrants should be installed at locations agreed to through consultation with the Municipality during the review process.

Hydrants shall conform to AWWA Standard C502: Dry Barrel Fire Hydrants.

Fire hydrant drain holes are anticipated to be at least 1.0 m above the water table at all proposed hydrant locations.

Valves
Valves shall be installed at each intersection (2 at a 'T', 3 at a 'cross') and at minimum separations as requested by the Municipality during detailed design.

All valves shall conform to AWWA standards.

Chambers
There are no chambers proposed in this development.

Depth
All watermain shall be a minimum of 1.8m in depth.

Dead Ends
All locations where a watermain terminates (temporary or permanent) a plug and blow off shall be installed.

Restraints
All joints (at fittings, hydrants, valves and bends greater than 11.25^{o}) shall be mechanically restrained.

Separation Distances
- Horizontal – 2.5m clear,
- Vertical – 0.5m clear.

Utility Crossings
When a watermain crosses over or under a utility (other than sanitary or storm) a separation of 0.3m shall be provided.

Permeation by Organic Compounds
There are no know soil contamination concerns on the subject lands, accordingly no consideration for permeation has been considered.

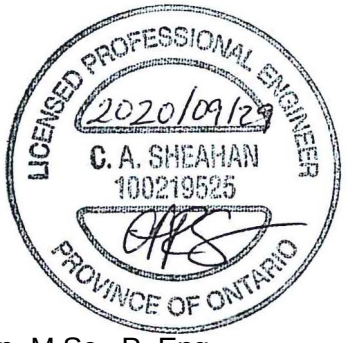
Pipe Encasement
There are no encasement requirements in this development.

7.0 CONCLUSIONS

- The proposed watermain works are anticipated to meet the minimum required 20 psi under maximum day demand plus fire flow.
- Under normal demand conditions, the proposed watermain works are anticipated to meet the minimum required 40 psi. The proposed works are not anticipated to exceed the maximum 100 psi.
- The design layout should conform to the criteria outlined in section 6 of this brief.

We trust that the above meets your guidelines and ask that you contact the undersigned, should you have any queries.

Sincerely,
AINLEY GRAHAM & ASSOCIATES LIMITED



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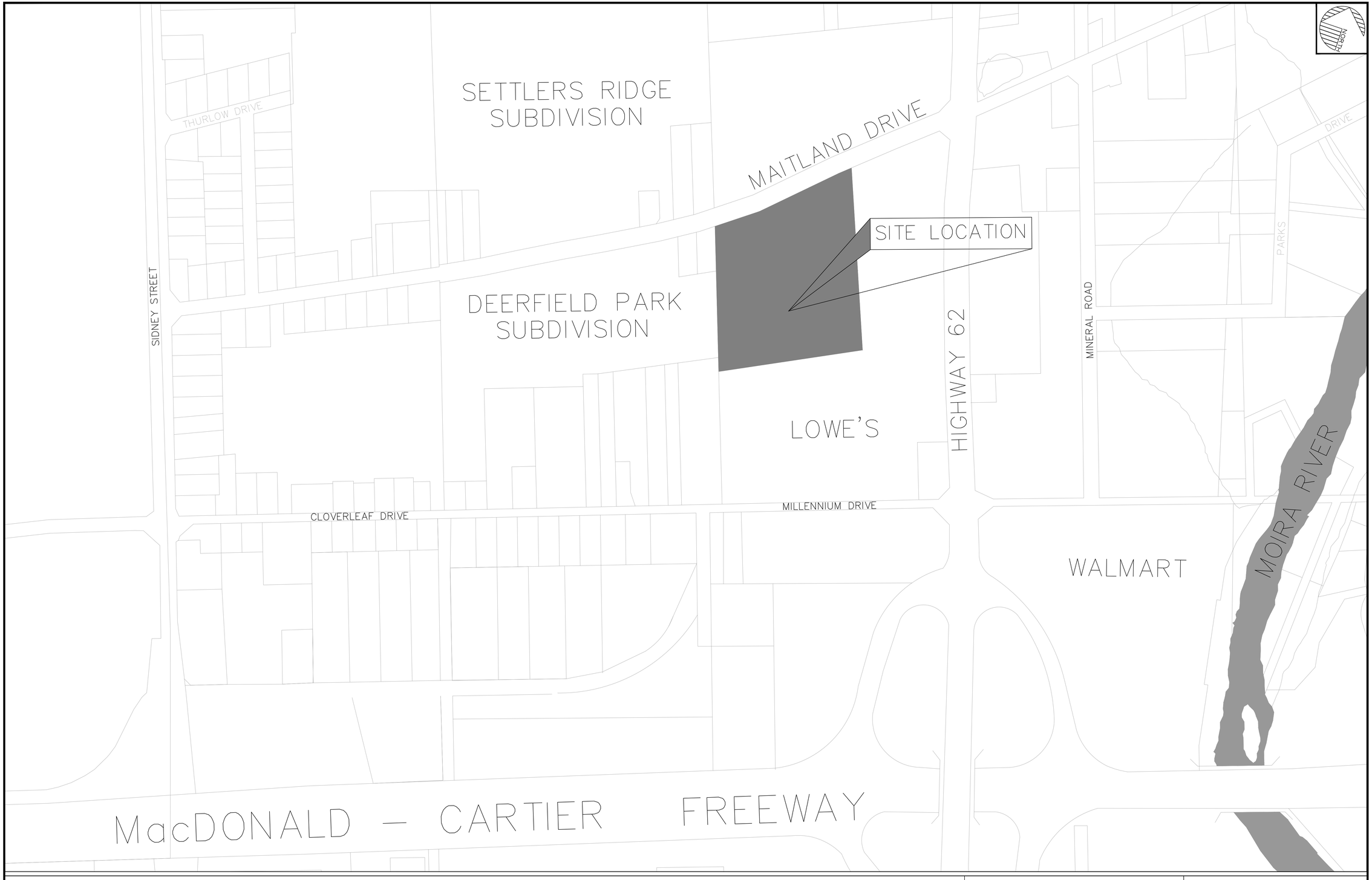

174 MAITLAND DRIVE
CITY OF BELLEVILLE

FIGURE 1
KEY MAP

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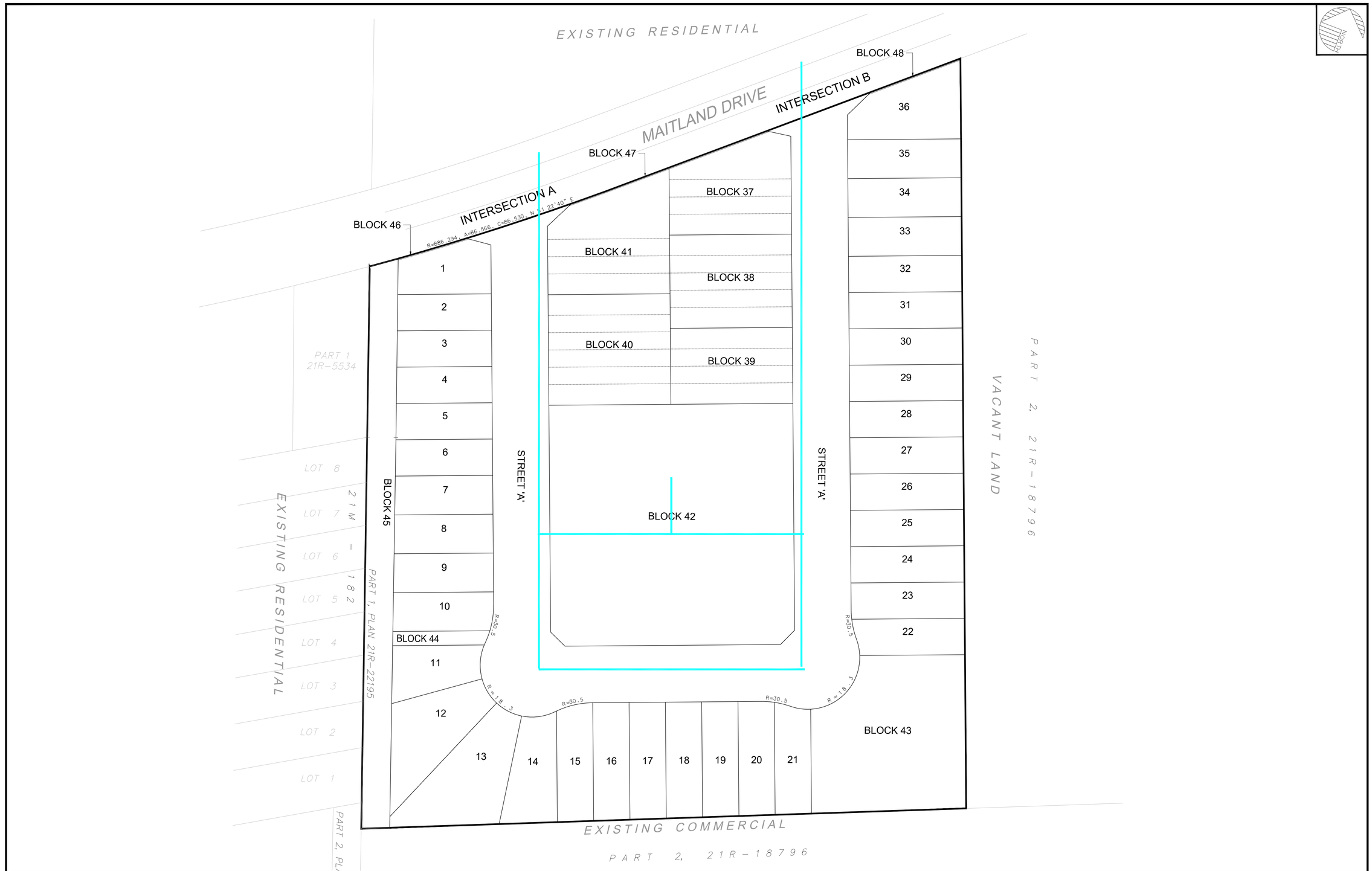

EXISTING 400mm DIAMETER WATERMAIN

PROPOSED 200mm DIAMTER WATERMAIN

174 MAITLAND DRIVE
CITY OF BELLEVILLE

FIGURE 2
CONCEPT PLAN

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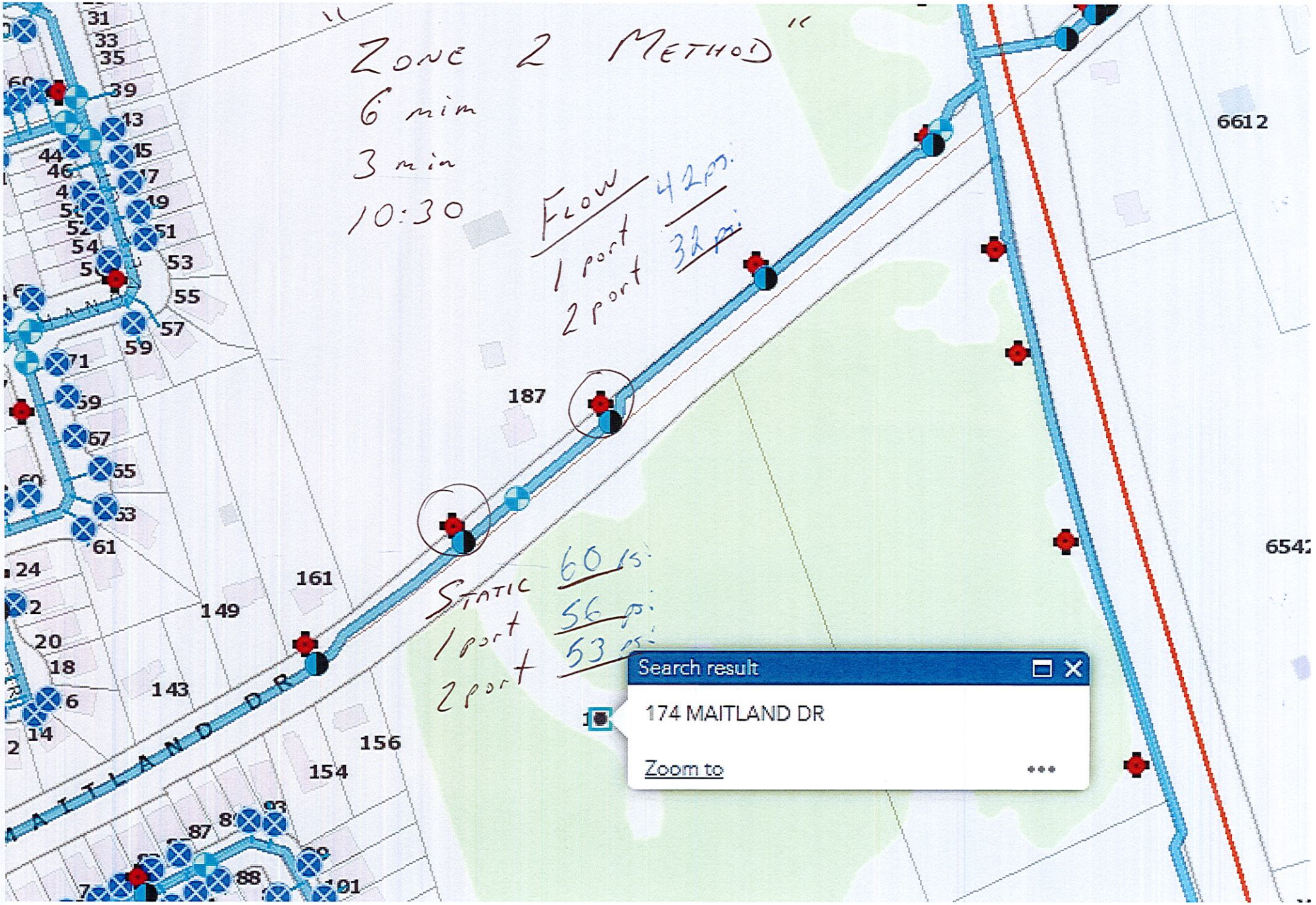
APPENDIX A

Fire Hydrant Flow Test Data


ZONE 2 METHOD
6 min
3 min
10:30
FLOW
1 port 42 psi
2 port 32 psi
STATIC 60 psi
1 port 56 psi
2 port 53 psi
Search result
174 MAITLAND DR
Zoom to
MAITLAND DR
187
161
149
143
156
154
6612

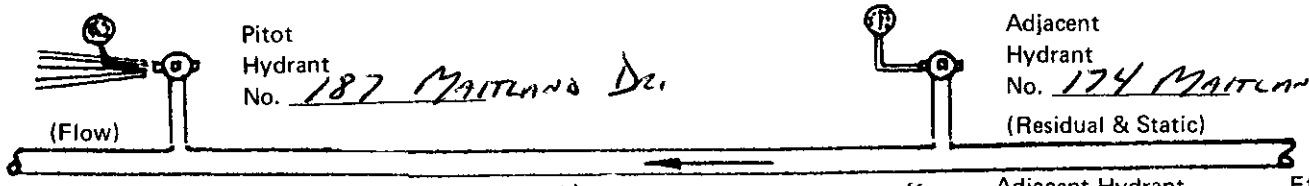
Routing

White - 1. Op. Mgr. 2. Draft. 3. FF bk.
Pink - File 842
Canary - Originator

Belleville Utilities Commission
459 SIDNEY STREET
P.O. BOX 939
BELLEVILLE, ONT., K8N 5B6
(613) 966-3651

Date: Dec. 16/19
Time: 10:30
Performed by ...TS., CM
File: 842

FIRE HYDRANT FLOW TEST



Pitot Hydrant No. 187 MAITLAND DR.

Adjacent Hydrant No. 174 MAITLAND DR.
(Residual & Static)

Adjacent Hydrant _____ Ft.
Above or Below Pitot Hydrant

"ZONE 2 METHOD"

Street Name MAITLAND DR.

Location on St.
or name of Bldg. _____

Provide Four Pressure Readings: Select outlets to give 10 psi drop at adjacent hydrant if possible		OUTLETS one - 1"	one - 1 1/8"	one - 1½"	one - 2½" (10:36)	two - 2½" (10:39)	
Step One -	Adjacent Hydrant	_____	_____	(10:30)	60	60	psi (static)
Step Two -	Pitot Hydrant	_____	_____	_____	42	32	psi (flow)
Step Three -	Adjacent Hydrant	_____	_____	_____	56	53	psi (residual)
Step Four -	Adjacent Hydrant	_____	_____	_____	60	60	psi (static check)

low with 20 psi residual at adjacent hydrant
= measured flow $\left(\frac{\text{available drop}}{\text{test drop}}\right)^{.54}$

Available drop is static less 20
Test drop is static less residual

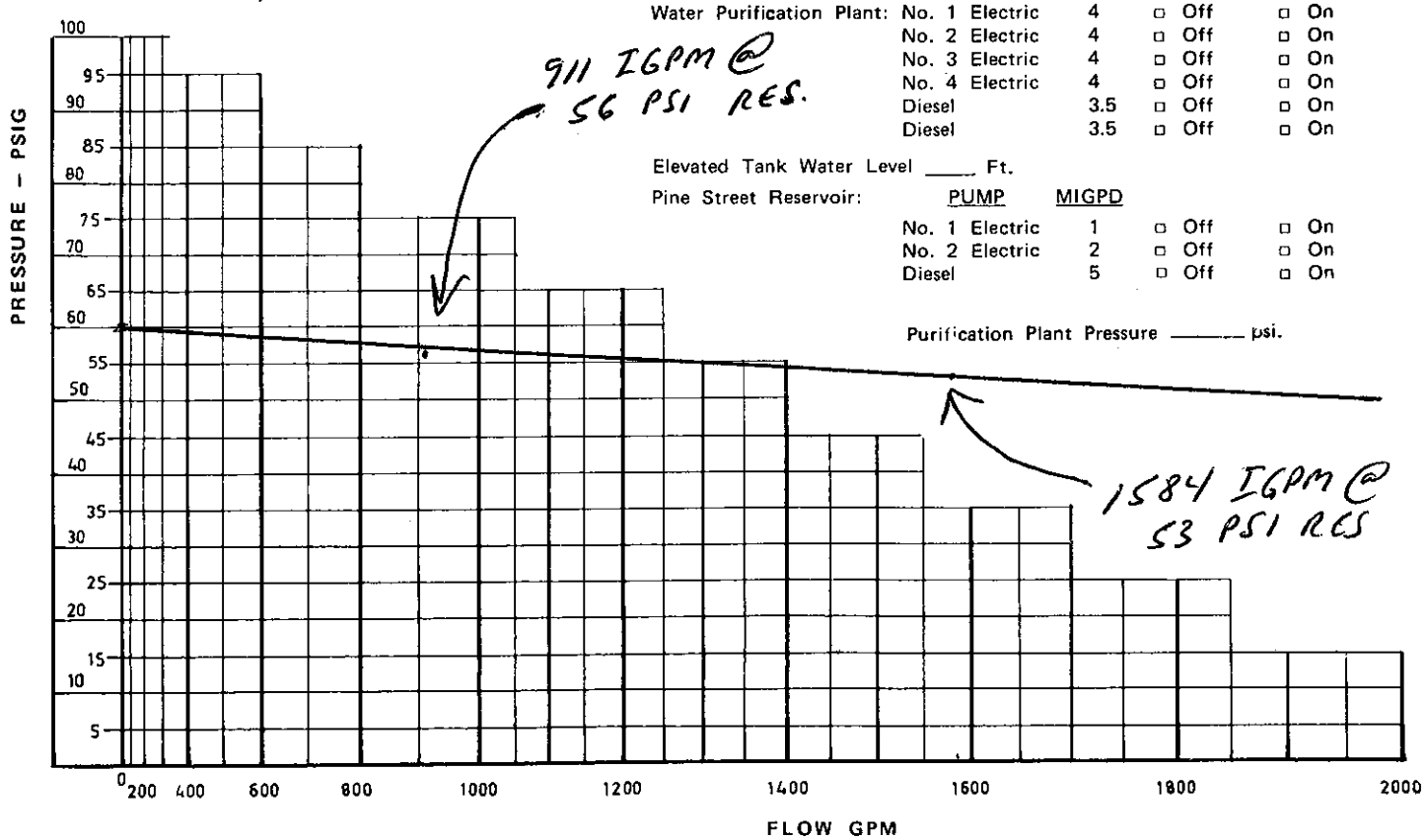
Information below can be obtained at a later date from records at Water Purification Plant.

		PUMP	MIGPD		
Water Purification Plant:	No. 1	Electric	4	☐ Off	☐ On
	No. 2	Electric	4	☐ Off	☐ On
	No. 3	Electric	4	☐ Off	☐ On
	No. 4	Electric	4	☐ Off	☐ On
		Diesel	3.5	☐ Off	☐ On
		Diesel	3.5	☐ Off	☐ On

Elevated Tank Water Level ____ Ft.

Pine Street Reservoir:	PUMP	MIGPD		
	No. 1 Electric	1	☐ Off	☐ On
	No. 2 Electric	2	☐ Off	☐ On
	Diesel	5	☐ Off	☐ On

Purification Plant Pressure _____ psi.



Fm. 109A

APPENDIX B

Water Demand Calculations

Maitland Drive
Evaluation of Water Demand

Population

#units	97	
pop/unit	3	assumed
# people	291	

Average Day Flow

L/cap*d	350		assumed
ADF	101850	l/d	
	1.18	l/s	

Maximum Day Flow

factor	3.68		MOE Table 3.3
L/cap*d	350		
MDF	374808	l/d	
	4.34	l/s	

Minimum Hour

factor	0.19		MOE Table 3.3
ADF	1.18	l/d	
	0.22	l/s	

Peak Hour

factor	5.52		MOE Table 3.3
ADF	1.18	l/d	
	6.51	l/s	

Fire Flow - Single Family Units

*Water Supply for Public Fire protection - Guide for Determination of Reguired Fire flow - Fire Underwriters Survey (1999)

Note J - Single Family Dwellings - short Method Applicable

Step

A	Construction type	Wood Frame			
B	Floor Area	130 m^2			
C	Height	2 storey max typ.			
			C	1.5	
			A	260	
D	F=220CsqrtA		F	5321.09	l/min
E	Hazard Adjustment	low (-25%)		-1330.27	l/min
		adjusted		3990.82	
F	Sprinkler Adjustment			NA	
G	Exposure Adjustment***	75%		2993.11	l/min
H	Total			**6983.93**	l/min
				116.40	l/s

****(sides = 2x25%, front = 10% and rear = 15%)*

Fire Flow - Townhouse Units

*Water Supply for Public Fire protection - Guide for Determination of Reguired Fire flow - Fire Underwriters Survey (1999)

Step

A	Construction type	Wood Frame			
B	Floor Area	400 m^2			
C	Height	1 storey			
			C	1.5	
			A	400	
D	F=220CsqrtA		F	6600.00	l/min
E	Hazard Adjustment	low (-25%)		-1650.00	l/min
		adjusted		4950.00	
F	Sprinkler Adjustment			NA	
G	Exposure Adjustment***	75%		3712.50	l/min
H	Total			**8662.50**	l/min
				144.38	l/s

****(sides = 2x25%, front = 10% and rear = 15%)*

Max Day + Fire Flow **148.71** l/s

APPENDIX C

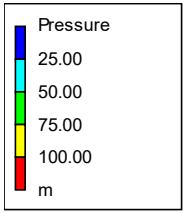
Hydraulic Calculations

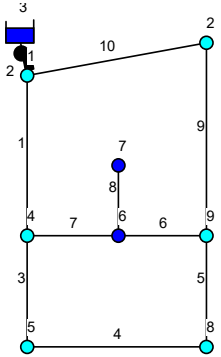
Pump Curve - Maitland Drive (Elevation 111m)

Flow (L/s)	Head (m)
0	42.2
78.5	39.4
134.26	37.3

Equation: Head = 42.2-0.02968(Flow)^1.04

Note: Curve Flow (L/s) and Head (m) values taken from Hydrant Testing and Converted from IGPM and PSI (Appendix B)


Pressure
25.00
50.00
75.00
100.00
m


3
2
10
1
2
9
1
7
8
4
7
6
6
9
3
5
5
4
8

Network Table - Links

Link ID	Length m	Diameter mm	Roughness
Pipe 1	130	200	120
Pipe 3	53	200	120
Pipe 4	107	200	120
Pipe 5	53	200	120
Pipe 6	54	200	120
Pipe 7	54	200	120
Pipe 8	35	200	120
Pipe 9	170	200	120
Pipe 10	115	400	120
Pump 2	#N/A	#N/A	#N/A

Maximum Day Flow

Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Pressure m
Junc 1	110	0	43.06
Junc 2	110	0	43.06
Junc 4	107	0	46.06
Junc 5	105	0	48.06
Junc 6	106	0	47.05
Junc 7	107	4.34	46.05
Junc 8	104	0	49.06
Junc 9	105	0	48.06
Resvr 3	111	#N/A	0.00

Maximum Day Flow + Fire Flow

Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Pressure m
Junc 1	110	0	37.75
Junc 2	110	0	37.65
Junc 4	107	0	36.13
Junc 5	105	0	38.12
Junc 6	106	0	35.43
Junc 7	107	148.71	30.51
Junc 8	104	0	39.10
Junc 9	105	0	38.09
Resvr 3	111	#N/A	0.00

Flow Creating 20 PSI (14.06 m Head)

Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Pressure m
Junc 1	110	0	34.51
Junc 2	110	0	34.27
Junc 4	107	0	26.93
Junc 5	105	0	28.90
Junc 6	106	0	24.04
Junc 7	107	232.69	14.06
Junc 8	104	0	29.85
Junc 9	105	0	28.82
Resvr 3	111	#N/A	0.00

100 LPS Base Demand

Network Table - Nodes

Node ID	Elevation m	Base Demand LPS	Pressure m
Junc 1	110	0	39.60
Junc 2	110	0	39.55
Junc 4	107	0	40.38
Junc 5	105	0	42.38
Junc 6	106	0	40.57
Junc 7	107	100	37.69
Junc 8	104	0	43.37
Junc 9	105	0	42.36
Resvr 3	111	#N/A	0.00