LASALLE SOUTH WATER SUPPLY

WATER SERVICING ALTERNATIVES REVIEW

FINAL REPORT (R1)

Prepared for:
City of Winnipeg
Water & Waste Department

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0.0 INTRODUCTION

Cochrane Engineering has been retained by the City of Winnipeg to investigate alternative means of implementing piped water delivery to the residential area in south St. Norbert. The area is bordered by the La Salle River to the north and west, the City of Winnipeg boundary to the south, and the Red River to the east.

Currently, the 65 existing homeowners in this area rely upon trucked water, delivered to cisterns at each house. For this study, it is assumed that there will be a maximum of 110 homes that will be accommodated in this area.

The purpose of the study is to provide a comparison between servicing this area with a watermain system in accordance with the City's servicing standards, and a watermain system in accordance with the servicing standards that are generally used in rural locations in Manitoba.

1.0 BACKGROUND

Through discussions with the City of Winnipeg's Water and Waste Department, the following parameters are to be followed in order to provide a comparison between the City's servicing standards and those used in rural communities.

- The tie-in for the source of water is the existing 200mm diameter watermain at Pembina Highway and Rue Des Trappistes.
- A 300mm diameter watermain is required for the tie-in and is to extend south across the La Salle River.
- The watermains are to be designed to handle domestic use only (no fire flows).
- A minimum watermain size of 100mm diameter shall be used for the City of Winnipeg servicing standard.
- The area is relatively flat with the ground elevation at the south City boundary assumed to be approximately 2.0 metres higher than the ground elevation at the watermain tie-in at Pembina Highway and Rue Des Trappistes.

The rural standards and practices that will be discussed are not from any one source, but a combination of information that is based on the standards used by the Manitoba Water Services Board (MWSB) and Cochrane Engineering's experiences from having worked in over 100 Manitoba municipalities and communities, particularly in the adjacent Municipalities of Ritchot and Macdonald.

The option of using a trickle system was reviewed as a part of this study. A trickle system is a scenario in which a piped municipal water system is used to supply water directly to individual cisterns located on each residential lot. The homeowner then supplies all piping and pumps required to pressurise and distribute the water throughout the home. This type of system was not considered viable and therefore was not investigated further. Details of the review of trickle systems were prepared as Technical Memorandum No. 1 and is included as Appendix 'A' of this report.

2.0 OPTION ASSESSMENT

The potential servicing of the LaSalle South area with domestic water may be accomplished with various scenarios. As this area is under the jurisdiction of the City of Winnipeg, there is merit to using the City's standards for design, materials, and construction methods. However, although this area is within the City's boundaries, the appearance is far from a typical new subdivision, and is more of a rural setting with large lots, open ditches, and no municipal sewer system. Therefore, the idea of using rural standards similar to those implemented in the neighbouring Rural Municipalities of Ritchot and Macdonald, are also an option. This Section will address the major similarities and differences between the City of Winnipeg servicing standards, and those implemented in rural areas.

Figure 2.1 is included at the end of this Section, which presents a comparison between the servicing standards used by the City of Winnipeg and those used in rural communities in Manitoba.

2.1 WATERMAIN SIZE

The City of Winnipeg uses a minimum watermain size of 150mm diameter. This minimum size is generally required to accommodate fire flow conditions, but since the La Salle South area will not be serviced with hydrants for fire fighting purposes, a minimum size of 100mm diameter will be used for the purpose of this study. In rural areas, a minimum main size of 50mm diameter is used to service multiple homes when no fire protection is provided.

2.2 WATERMAIN DEPTH

Minimum depth of watermains in the City of Winnipeg is 2.44 metres from the crown of the pipe to the finished road centerline grade. The Manitoba Water Services Board specifies a minimum bury depth to invert of 2.75 metres in urban areas, and a 2.4 metre depth in rural areas, with a minimum 3.0 metre depth below roads. The reason for the shallower depth in rural areas is to take advantage of the additional snow cover which acts as insulation since these mains would generally be located in ditches.

2.3 WATERMAIN PIPE

The City of Winnipeg specifies that watermains shall be PVC C900 Class 150 (DR 18). The MWSB specifications accept PVC C900, PVC Series 160, and HDPE DR 17 for watermains.

2.4 VALVE SPACING

Main line distribution valves are required to provide adequate shutdown capabilities to accommodate repairs and maintenance. In part, the City's requirements for valve spacing is a maximum of 152 metres, and a maximum of 20 services between valves. Standards for rural pipelines will also generally specify a maximum of 20 services between valves, but due to low population densities, it may be several kilometres before 20 services are encountered, and therefore a typical rural specification may call for a maximum valve spacing of approximately 3.2 kilometres.

2.5 DESIGN PRESSURE

Design pressures for watermain systems are similar between City standards and rural standards. The City specifies a minimum static pressure of 207 kPa (30 psi) in street laterals during the maximum hour demand, while rural standards will generally allow a minimum pressure of 172 kPa (25 psi). The City also requires a minimum of 138 kPa (20 psi) at the hydrant during the maximum day demand plus fire demand loading. Rural standards will usually have this same requirement, if fire protection is provided.

2.6 ALIGNMENT

The City has adopted a set offset for the installation of watermains, based on the width of the right-of-way in which they are located (i.e. 4.5 metre offset on 18.0 metre right-of-way, 5.0 metre offset on 40.0 metre right-of-way). These offsets were developed to provide clearances between all utilities that may be located within an urban right-of-way. In rural areas, there is no defined offset for infrastructure since there are fewer utilities likely to be located in a right-of-way and therefore fewer conflicts with clearances. The location of these items are usually at the discretion of individual utilities at the time of construction.

2.7 TEST PRESSURE

The City of Winnipeg and most rural watermain specifications will stipulate a test pressure of 1000 kPa (145 psi) when the main is used to supply water for fire protection. When a waterline is used to supply potable water to rural residents, and no fire protection is provided, the test pressure is usually stipulated at 700 kPa (102 psi). The specified duration and specified allowable leakage for rural systems may vary slightly depending on the design engineer's preferences and the type of watermain being installed.

2.8 WATER SERVICE PIPE SIZE

The City has a standard residential water service line size of 19mm, however, for the LaSalle South area, it may not be practical. Because houses are set back further from the property line in rural settings such as this, a 25mm service line has been used for the City Standards scenario to reduce the headloss in the long service lines. Service lines in rural Manitoba will generally vary between 19mm in urban centers, and 38mm for service lines on rural pipelines, such as the LaSalle South area.

2.9 WATER SERVICE PIPE TYPE

The City's standard residential water service pipe is Type 'K' copper. Rural locations will accept service pipe such as copper, HDPE DR 17, and LDPE Series 100, although the LDPE is typically allowed only on rural (non-community) pipelines, and is not as widely used as the other two for water services.

2.10 AIR RELEASE FACILITIES

In the City of Winnipeg, fire hydrants are generally located at high points which allows for an access location for the manual release of accumulated air. Where a manual release is not sufficient, air release valves are installed in chambers. In rural situations, designers will use hydrants or manual air releases for the release of isolated pockets of accumulated air in watermains. The manual air release is typically a small diameter line (25mm) that will connect to the top of a watermain and then to a curb stop, and then to the ground surface. The curb stop is normally closed, but is opened occasionally to release air. The pipe to the surface is drained after use to prevent freezing. Automatic air release chambers are also installed on rural waterlines when the topography warrants the need, and a manual air release is not sufficient.

2.11 FLUSHING / SWABBING

Access to City watermains for flushing and swabbing purposes are usually provided through hydrants. Rural watermains are similarly flushed and swabbed through hydrants, where provided, but post hydrants (small diameter standpipes) are also used to flush small diameter lines (50mm and 75mm), and flushouts are also used to flush and swab larger diameter lines (100mm and larger). Flushouts are generally valved PVC standpipes that come to the surface and are capped with a blind flange. On many rural pipelines, hydrants are used exclusively as flushouts and not for fire fighting purposes. In these cases, they are either painted a different colour from other fire fighting hydrants in the area, or there is posted signage to designate their intended use.

2.12 CHLORINE CONCENTRATIONS

Since 2001, the residual chlorine level in the watermain at Pembina Highway and Ducharme Avenue has been an average of 0.35 mg/L, based on information supplied by the Water and Waste Department. However, the data reveals several occasions where the level is listed as 0.1 mg/L, and as low as 0.08 mg/L. Under normal circumstances, the residual chlorine level in the existing City watermain system should be sufficient to provide an acceptable level of chlorine residual in this new servicing area. However, the low readings near the tie-in indicate that there are fluctuations and the chlorine levels in any extensions should be monitored.

Figure 2.1
City of Winnipeg Standards vs. Rural Standards for Watermains

Item	City of Winnipeg Servicing Standard	Rural Servicing Standard
Minimum Watermain Size	- 150 mm - 100 mm (domestic use only - no fire flow)	- 50 mm
Watermain Depth	- 2.44 m (depth to crown below street centreline)	- 2.75 m (Urban) - 2.40 m (Rural) - 3.00 m (below roads)
Watermain Pipe	- PVC C900 Class 150	- PVC C900 - PVC Series 160 - HDPE DR 17
Valve Spacing	- Max. – 152 m - Max. – 20 services between valves	- Max. 3200 m - Max. 20 services between valves
Design Pressure	- Min. – 207 kPa (30 psi) at Street at max. hour - Min. – 138 kPa (20 psi) at hydrant at max. day plus fire demand	- Min. – 172 kPa (25 psi) at street at max. hour - Min. – 138 kPa (20 psi) at hydrant at max. day plus fire demand (if any)
Alignments	- Varies with right-of-way width	- As required
Test Pressure	- 1000 kPa (150 psi)	- 1000 kPa (150 psi) – watermains with fire flows - 700 kPa (100 psi) – watermains without fire flows
Water Service Size	- 19 mm - 25 mm for LaSalle South	- 38 mm
Water Service Pipe	- Type ‘K’ copper	- Type ‘K’ copper - HDPE DR 17 - LDPE Series 100 - Composite water service tubing
Air Release Facilities	- Hydrants - Air Release Chambers	- Hydrants - Manual Air Release - Air Release Chambers
Access for Flushing/Swabbing	- Hydrants	- Hydrants - Post Hydrants - Flushouts

3.0 SERVICING STANDARDS REVIEW

This Section will provide a review of materials and practices used in rural Manitoba and how they may be integrated into the watermain servicing for the La Salle South area.

3.1 MATERIALS

The City's present specification for watermains stipulates the use of PVC C900 pipe, however HDPE has been used for water crossings, and will be used for the crossing of the La Salle river in this project. In the Servicing Options section of this report, we have prepared a scenario that utilizes HDPE DR 17 for all watermains less than 150mm. HDPE has been used for watermains in rural Manitoba for several decades, and although HDPE and PVC are similar in hydraulic characteristics and their nature of responses to stress loadings, there are differences with regards to pressure ratings, soil loads, surges, and buckling resistance. However, with the soils, anticipated pressures, and bury depths that will be encountered in the La Salle South area, HDPE would be suitable.

We have assumed a HDPE DR 17 would be used, even though a DR 11 would have a more directly comparable pressure rating to the PVC C900. Because of the relatively low velocities and pressures that are expected in this area, and because the mains are not required to handle fire flows, the HDPE DR 17 would meet the requirements. It may be noted that MWSB Standards do permit the use of HDPE DR 17 in community water systems providing fire protection. HDPE is typically joined together using a thermal butt fusion method, or electrofusion. Flanged connections are used to connect the pipe to various appurtenances such as valves and existing piping systems. Electrofusion tapping sleeves are typically used for service connections.

The City's standard for water service pipe is Type 'K' copper, and although this is also widely used in rural Manitoba, the use of polyethylene and composite water service tubing is increasing. The cost is comparable to copper, depending on the length and location of where it is being installed, and it has the added advantage of being more resistant to most acids, salt solutions, and soils with high alkali concentrations. As an example, the communities of Stonewall and Steinbach no longer install copper services for this reason.

Many of the products stipulated in the City specifications are standardized to reduce the inventory required to service, repair and maintain the watermains in the city. New products will often require additional fittings, connectors, gaskets, and tools that are to be kept on hand for future servicing. The requirements necessary to accommodate new materials are not addressed in this study, but is an issue that should be addressed by the City.

3.2 PIPE SIZING

As the City standard for watermains is PVC C900, the minimum size available is 100mm. In the Servicing Options section of this report, the scenario depicting rural standards and HDPE watermains utilizes mains as small as 50mm. Because of the relatively small demands, and no fire flow requirements, the use of HDPE allows for smaller, and less costly mains to be installed.

3.3 INSTALLATION

Watermains installed in the City are usually accomplished by either open cut using excavators, or directional drilling methods. Watermains in rural areas are similarly installed by these methods, but chain trenchers are also utilized, particularly when there is minimal conflict with existing infrastructure, and there are minimal service connections. However, because there are approximately 65 existing homes with driveways, watermain installation by chain trencher is not likely an option for this area.

Installation by directional drilling is becoming increasingly popular for water installations as the equipment is becoming more sophisticated, versatile, and cost-effective for contractors to own and operate. The most significant advantage to this method is the reduction in restoration that is required. When construction occurs in an established area, restoration costs are significant, and therefore the additional cost for directional drilling may offset the cost of restoration required if the work was accomplished by open cut methods. Even if installation costs were greater when directional drilling methods were specified, it may still be beneficial to specify this method to minimize the disruption and inconvenience to the local residents.

3.4 BURY DEPTHS

The bury depths specified in the City standards are similar to those used in rural specifications, and therefore whichever specification is used, there would be a minimal effect on installation cost, maintenance, or long term reliability.

3.5 ALIGNMENT

Although the City standards specify an offset alignment based on the width of the right-of-way, a more practical offset for installation in an existing area should be determined during the design phase of this project. This offset would be based on the location of existing infrastructure, and a location that would provide an ease of installation and maintenance.

A suggested alignment along Pembina Highway would be closer towards the west property line, and closer towards the east property line along Turnbull Drive. A cursory review indicates that these would minimize the number of road crossings that would be required for the service connections.

3.6 HIGHWAY CROSSINGS

Preliminary information provided by the City of Winnipeg indicates that the right-of-way along Pembina Highway is under the jurisdiction of the City. However, the City does work cooperatively with Manitoba Transportation and Government Services (Highways) in this area, and their input would be solicited prior to any work in the right-of-way. Under Highways' specifications, an encasement pipe is required for every watermain and service line that would be installed under the Pembina Highway pavement. For the purposes of this report, it is assumed that Highways' standards will be adopted, but the City should consider the ramifications before any final decision is reached.

As some of the service connections may become quite lengthy, and costly, there should be a consideration during the design phase to install a small diameter main (50mm) across Pembina Highway in selected locations to service small clusters of homes. The cost for this second 'main' would likely be offset by the cost of individual service lines, and corresponding encasement pipes, crossing the highway for each individual service.

3.7 AIR RELEASE CHAMBERS / FLUSHOUTS

Due to the relatively flat topography on the area, the accumulation of air in the lines should not be a major factor in this watermain, as isolated high points should be minimal and infrequent. Manual air releases should be considered at select locations. The crossing of the La Salle River, however, is a location where an automatic air release valve / chamber may be required, due to the probable accumulation of air on the north side where the watermain depth increases significantly before crossing under the river.

Access to the mains for flushing and swabbing should also be supplied, particularly at dead end locations. These may take the form of specially designated hydrants, or valved stand pipes, depending on the preference of governing bodies. Because a large number will not likely be required, the difference in cost will not be significant based on the total scope of work that will be required for this project.

4.0 HYDRAULIC MODEL

The preceding section provides a comprehensive comparison of the water system design and construction standards used by the City of Winnipeg versus those used by the Manitoba Water Services Board for rural settings. This section compares the design standards with respect to water demands and presents the results of computer modeling of the proposed system for the different design standards.

4.1 WATER DEMANDS

The intended use of the proposed water system extensions do not include supply for fire protection or commercial/industrial uses. The water demands of this supply system are therefore limited to domestic usage.

The first method used for estimating domestic demand used the fixture unit method described in the AWWA Manual of Water Supply Practices, (AWWA M22). With an estimated 42 fixture units for each of the 110 houses on the system, the combined fixture units are 4,620, corresponding to a total peak demand of approximately 14.2 L/s (225 USgpm), (Figure 4.5, AWWA M22). Each house, therefore has an estimated peak demand of 0.13 L/s (2.1 USgpm). No indication is given for the peak hour demands with this method, but for the purposes of modeling the case of fire flow boundary conditions, a peak day demand of 7.1 L/s is assumed (i.e. half that of the peak demand).

The design of large systems or smaller systems with sufficient looping typically involves an estimate of average-day per capita consumption and the use of peaking factors to estimate peak day and peak hour demands. For the purposes of this study, the City of Winnipeg has requested we assume an average per capita consumption of 300 litres per capita day . With a population of 336 people, (i.e. 110 houses with an average of 3.05 residents), the estimated peaking factor for peak hour demands is 4.1 (Harman Equation) and the peak day peaking factor is often taken as half that of peak hour (i.e. 2.1). With these criteria, the peak day and peak hour demands for the entire system extension are 2.4 and 4.8 L/s, respectively. Manitoba Water Services Board does not typically account for peak instantaneous demands in the design of rural water systems. For comparison and discussion purposes, however, a peak instantaneous demand is estimated to be 9.0

times the average-day demand, yielding a total system demand of 10.8 L/s. This is to reflect the large lots and houses within the community and the possibility that many connections could be using large quantities of water simultaneously, such as for watering lawns. Additionally, the Manitoba Water Services Board typically restricts the maximum instantaneous water use to 0.23 L/s (3.0 Igpm) per residence. This maximum residential demand is discussed further in Section 4.4.

Because the proposed system does not include any looping and because the residents could be prone to larger water consumption, the system demands estimated using the AWWA method has been chosen for the purposes of this study as it provides the more conservative estimates.

4.2 SYSTEM BOUNDARY CONDITIONS

The City of Winnipeg has provided the following boundary conditions for the modeling of the system. These are the conditions estimated in the existing system, without the added demand of the proposed system, at the corner of Pembina Highway and Rue Des Trappistes. Peak day and peak hour peaking factors of 1.6 and 2.5, respectively, were used by the City of Winnipeg to derive these estimates for the boundary conditions. The ground elevation at this location is approximately 232.7 m.

Table 4.1
Boundary Conditions Without Extension Demands

Demand Condition	City Demand (ML/day)	Pressure (kPa)	Pressure (psi)
Existing - Average Day	225	476	69
Existing – Peak Day	360	462	67
Existing – Peak Hour	563	469	63
Future – Average Day	351	n/a	68
Future – Peak Day	562	434	63
Future – Peak Hour	878	386	56
Future – Peak Day with Fire Conditions	562	282	41

The City of Winnipeg has also provided related modeling results in order to provide some insight into the system pressure response to flow. This has been used to modify the boundary conditions to account for the added demands from the proposed extension. Figure 4.2 illustrates the pressures at the connection point as a function of demand. The figure reveals a very strong polynomial relationship. The boundary conditions for peak hour and peak day with fire conditions are indicated in the figure as well as the incremental increase to the demand from the proposed system extension. The drop in boundary pressure for each demand scenario is evident. Table 4.3 lists the City demands described above, along with the corresponding demands in the proposed extension, and the resulting boundary condition modifications using the relationship in Figure 4.2.

Figure 4.2 System Response at Proposed Connection Point

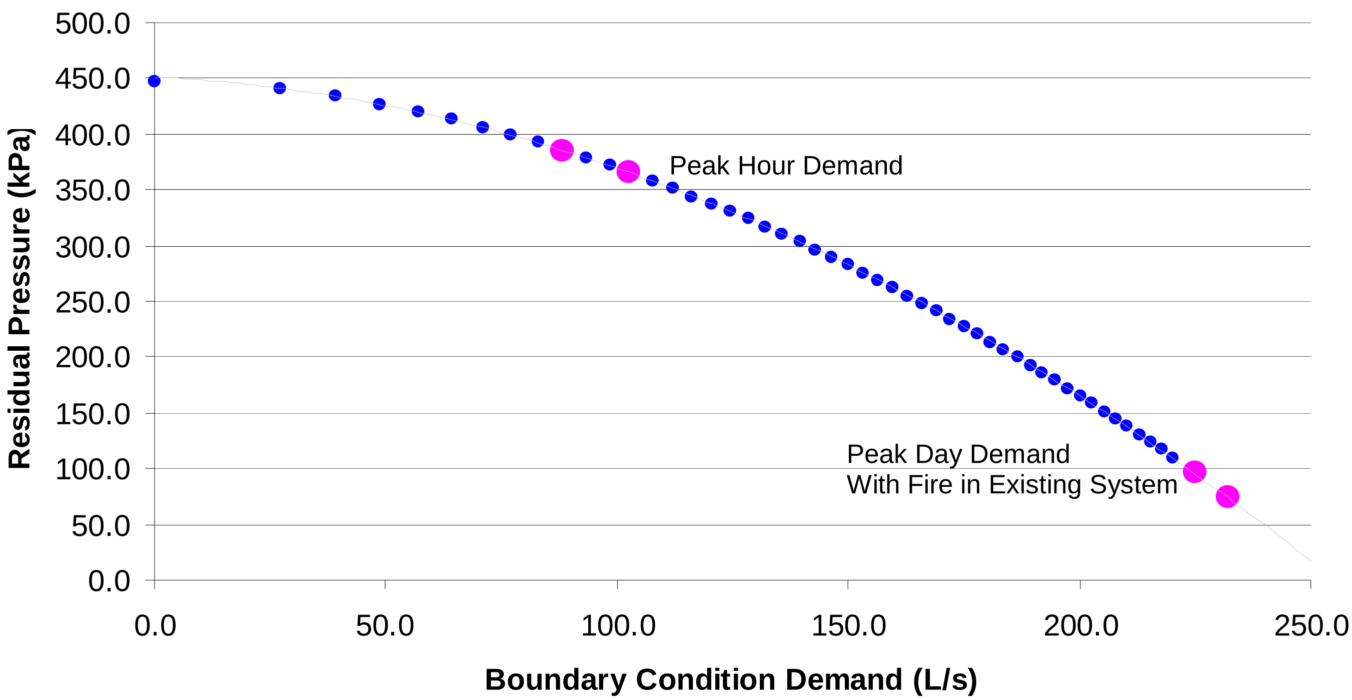


Table 4.3
Boundary Condition Corrections for Added Extension Demand

Demand Condition	Boundary Condition Demand (L/s)	Added Extension Demands (L/s)	Residual Pressure Drop (kPa)
Future – Peak Hour	88.2	14.2	19.4
Future – Peak Day with Fire	225	7.1	21.2

Table 4.4 lists the "corrected" boundary condition pressures, accounting for the increased demand that would result from the proposed system extension.

Table 4.4
Boundary Condition Pressures For Modeling

Demand Condition	Future Connection Pressure (Without Proposed System) (kPa)/(psi)	Connection Pressure Correction (kPa)/(psi)	Connection Pressure (With Proposed System (kPa)/(psi)
Future – Peak Hour	386 / 56	-19.4 / 2.8	367 / 53
Future – Peak Day with Fire Conditions	282 / 41	-21.2 / 3.1	261 / 38

4.3 PIPE MATERIALS

As mentioned in the previous section, the City of Winnipeg specifies that watermains shall be PVC and MWSB specifications accept PVC and HDPE for watermains. In a new condition, these materials exhibit very low roughness characteristics, with "C" factors as high as 150. For the purposes of providing a conservative design approach, a "C" factor of 130 has been used for modeling, to account for deterioration and fouling of the pipes with age, as well as to accommodate minor losses in the proposed pipe system.

The modeling of the system utilizes PVC C900, DR 18 for City Standards and both PVC C900 and HDPE DR17 (IPS size) for rural standards. The HDPE pipe is only used for those diameters below the City of Winnipeg minimum pipe size of 150 mm. Table 4.5 lists the inside diameters used for modeling the range of nominal pipe sizes used.

Table 4.5
Pipe Inside Diameters

Nominal Pipe Size	Inside Diameter (mm)	
	PVC C900, DR 18	HDPE DR17
50	N/a	53
75	N/a	78
100	108	100
150	155	147
300	297	283

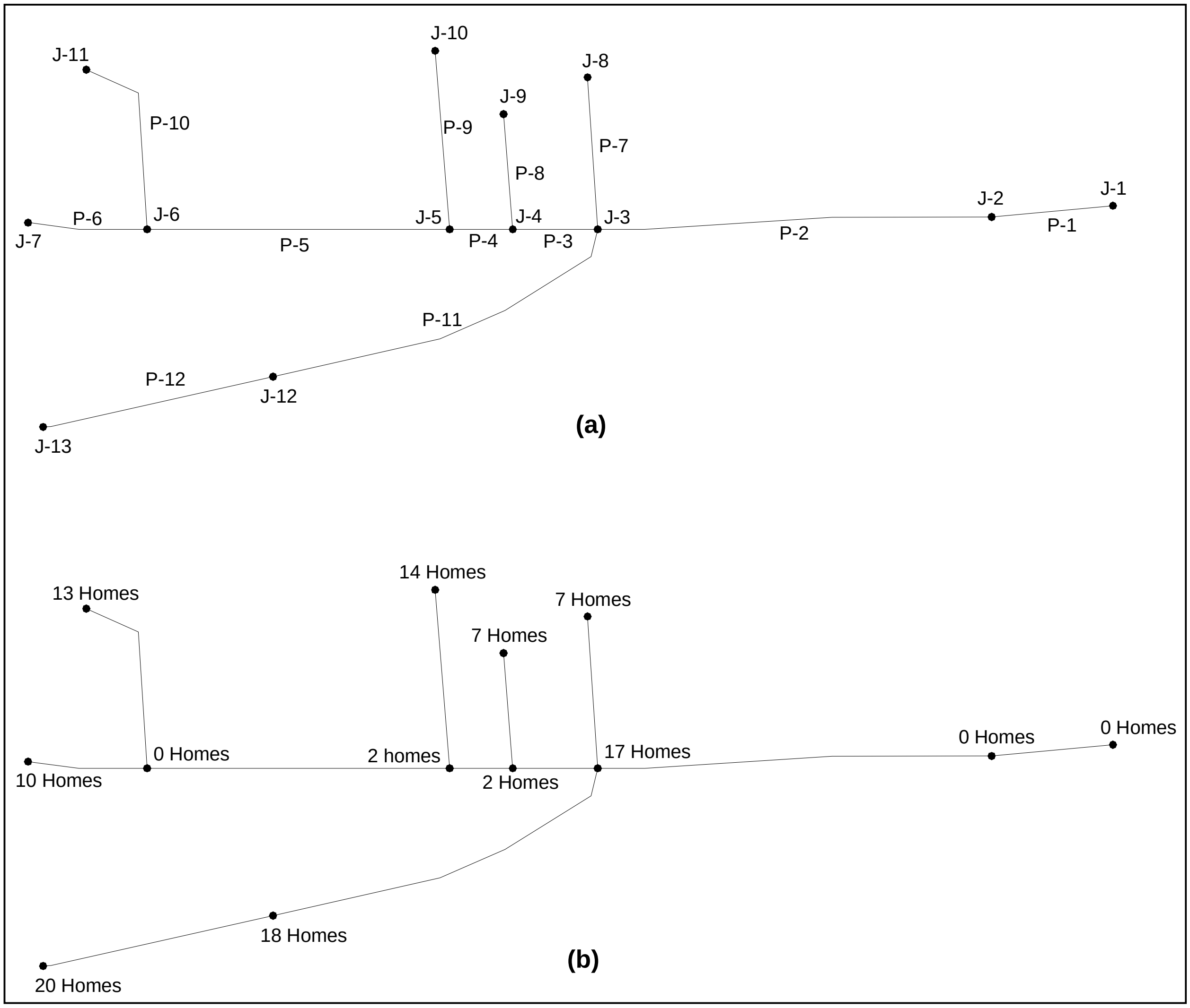
4.4 SYSTEM MODELING

The proposed network extension was modeled using the preceding design criteria and assumptions for pipe materials, demands and boundary conditions. Two design alternatives have been developed using a variety of modeling scenarios. Modeling scenarios were developed for both City (design alternative 1) and rural standards (design alternative 2) to cover peak hour conditions and peak day with fire flow conditions at the connection point. For each scenario, the network pipes were sized to accommodate the appropriate minimum pressure requirements. This was done using the respective inside diameters listed in Table 4.5. Figure 4.6 illustrates the base model, indicating the pipe and junction labels as well as the number of homes represented by each model node. It has been assumed that there are 3.05 people residing in each home, the figure suggested by the City of Winnipeg.

As mentioned previously, pipes were modeled using the Hazen-Williams equation with a pipe roughness of “C” = 130. Although the proposed pipe materials typically have higher “C” factors, this lower value was used to accommodate minor losses and potential for pipe deterioration and fouling.

A cursory review of the topography of the area indicates that the relief does not exceed roughly 2.0 m along the proposed route. For this reason, and for simplicity, all nodes are modeled with an elevation equal to 2.0 m above the connection point elevation.

Figure 4.6
Base Model with
(a) Junction And Pipe Labels, and
(b) The Number of Houses Represented by Each Model Node



The modeled scenarios are described briefly below.

<u>**Design Alternative 1 – City of Winnipeg Design Standards**</u>

Scenario 1 - City of Winnipeg Design Standards, Fire Flow with Peak Day Demand

- Pipe Material: C900 PVC, inside diameters as in Table 4.5
- Connection Point Pressure: 261 kPa (38 psi)
- Minimum Pressure Requirement: 138 kPa (20 psi) at the street
- Domestic Demand: 0.0212 L/s per person (7.1 L/s Total)

Scenario 2 – City of Winnipeg Design Standards, Peak Hour Demand

- Pipe Material: C900 PVC, Inside diameters as in Table 4.5
- Connection Point Pressure: 367 kPa (53 psi)
- Minimum Pressure Requirement: 207 kPa (30 psi) at the street
- Domestic Demand: 0.0423 L/s per person (14.2 L/s Total)

<u>Design Alternative 2 – Rural Design Standards</u>

Scenario 3 – Rural Design Standards, Fire Flow with Peak Day Demand

- Pipe Material: DR17 HDPE, Inside diameters as in Table 4.5
- Connection Point Pressure: 261 kPa (38 psi)
- Minimum Pressure Requirement: 138 kPa (20 psi) at the street
- Domestic Demand: 0.0212 L/s per person (7.1 L/s Total)

Scenario 4 – Rural Design Standards, Peak Hour Demand

- Pipe Material: DR17 HDPE, Inside diameters as in Table 4.5
- Connection Point Pressure: 367 kPa (53 psi)
- Minimum Pressure Requirement: 172 kPa (25 psi) at the street
- Domestic Demand: 0.0423 L/s per person (14.2 L/s Total)

As mentioned above, each scenario was modeled to determine the required pipe sizes to satisfy the minimum pressure requirements for the respective domestic demands. The resulting nominal pipe sizes for each scenario are listed in Table 4.7 below. Note that the bracketed diameters refer to the minimum pipe size required by the City of Winnipeg Standards. The corresponding node pressures are listed in Table 4.8.

Table 4.7
Summary of Required Pipe Sizes

Pipe	Pipe Length (m)	Pipe Diameters / Lengths			
		Design Alternative 1		Design Alternative 2	
		Scenario 1 (mm)	Scenario 2 (mm)	Scenario 3 (mm)	Scenario 4 (mm)
P-1	304	300	300	300	300
P-2	985	150	150	150	150
P-3	212	75 (100)	100	75	100
P-4	158	75 (100)	100	75	75
P-5	756	75 (100)	100	75	75
P-6	299	50 (100)	50 (100)	50	50
P-7	379	50 (100)	50 (100)	50	50
P-8	287	50 (100)	50 (100)	50	50
P-9	446	50 (100)	75 (100)	50	50
P-10	482	50 (100)	75 (100)	50	75
P-11	929	75 (100)	100	75	100
P-12	588	75 (100)	75 (100)	50	75

Note: Bracketed numbers indicate the required pipe size due to City of Winnipeg minimum pipe standards.

Table 4.8
Summary of Model Pressures

Node	Node Pressures							
	Design Alternative 1				Design Alternative 2			
	Scenario 1		Scenario 2		Scenario 3		Scenario 4	
	(kPa)	(psi)	(kPa)	(psi)	(kPa)	(psi)	(kPa)	(psi)
J-1	262	38	372	54	275	40	379	55
J-2	242	35	352	51	255	37	359	52
J-3	230	33	310	45	212	35	326	46
J-4	215	31	294	43	198	33	293	44
J-5	208	30	285	41	191	32	277	40
J-6	194	28	271	39	179	30	247	32
J-7	186	27	243	35	178	29	230	28
J-8	225	33	292	42	211	35	315	43
J-9	211	31	280	41	198	33	285	42
J-10	186	27	274	40	189	29	230	28
J-11	174	25	260	38	177	27	203	31
J-12	187	27	264	38	174	29	233	39
J-13	179	26	234	34	166	21	215	35

As was discussed in Section 1.1, the Manitoba Water Services Board restricts the maximum consumption rate per residence to 0.23 L/s (3.0 Igpm). Each model scenario was further tested using this value. This was accomplished by systematically applying this demand to each node in turn, similar to a fire flow analysis. This would reflect the system response to absolute peak demands at each residence. Although the results of this are not shown, the modeled scenarios were found to generally accommodate this additional demand.

The following sections of this report present the two design alternatives and discuss the costs and benefits of each. These two alternatives were found to be model scenarios 2 and 4, which represent the worst case scenarios (i.e. largest required pipe sizes) for the City design standards (design alternative 1) and the rural design standards (design alternative 2), respectively. It is important to note that the other modeled scenarios (i.e. scenarios 1 and 3 are not viable designs as they only represent the required pipe sizes for the specific conditions modeled. For example, scenario 3 represents the conditions where peak day demand is required while a fire is being experienced near the connection point in the existing City water network. It is shown, however, that these pipe sizes are not adequate for peak instantaneous demands (i.e. scenario 4). Recall that the design must meet both design conditions; i) peak instantaneous demand, and ii) peak day demand with fire flow boundary conditions.

Additional information is provided in Appendix 'B', which includes maps (in Watercad V6.0 Model Figures) showing each modeling scenario.

5.0 SERVICING OPTIONS

With regards to financial and technical issues, two options are being reviewed for the servicing of this area. One is a watermain system designed and constructed in accordance with City of Winnipeg servicing standards, and the other is for a system conforming to rural servicing standards. The general layout plan of these systems are provided at the end of Section 6 as Figures 6.3 and 6.4.

5.1 OPTION LAYOUT

The general layout for the watermain servicing is consistent for both Options. A watermain is installed in the right-of-ways of Turnbull Drive and Pembina Highway, and connect to the existing City of Winnipeg watermain system at Pembina Highway and Rue Des Trappistes. Lateral branches are connected off the two mains to service present and future streets and cul-de-sacs. For the purpose of estimating capital costs, it is assumed that service lines are connected to the mains and terminate at the front lot line with a curb stop for each lot with a present home, or a potential home. Any costs associated with extending a water service from the curb stop and into the plumbing system of a house is assumed to be the responsibility of the home owner.

5.2 OPTION COMPARISONS

An estimated capital cost for the design and construction of a watermain system in accordance with City of Winnipeg servicing standards is $1,407,250.00, while a system in accordance with rural standards is $1,176,820.00. A detailed breakdown of these costs is included in Section 6.0 of this report.

The servicing for both options takes into account an increase in growth for this area. There are presently 65 homes located in the study area. Although it is not possible to foresee every possible configuration of future development and subdivision comparison, a cursory review of the area, which maintains a minimum of 2 acre lots, reveals an ultimate of 110 residential lots. This figure was used for the preliminary sizing of the lines for both options.

Both options include servicing to the south boundary of the City of Winnipeg on both Pembina Highway and Turnbull Drive. If there are any future extensions further south, the lines may not be adequately sized to handle such a scenario. An additional line between the Pembina Highway mains and the Turnbull Drive main to "loop" the system would provide some potential for southern expansion, but this has not been included in the scope of work of this study. In any case, areas to the south of the current City boundary are already served by the Ritchot municipal water system.

From a hydraulic standpoint, our computer modeling that was undertaken for this study reveals that the pipe sizes we have indicated for both Options will satisfy the water demand scenarios that we have outlined. The major difference between the two options is the use of PVC pipe versus HDPE. Technically, both piping systems are capable of handling the conditions stated in this report. Both systems have been in use for water distribution throughout Manitoba, and North America, for several decades. The decision for a community to use one material over another is generally a personal preference that is based on cost, established inventory, maintenance, adaptation to future and existing systems, and past experiences. One system cannot be considered "superior" over the other.

6.0 CAPITAL COSTS

6.1 CAPITAL COST FOR SERVICING OPTIONS

The capital costs have been estimated for the installation of services using both City of Winnipeg servicing standards and rural standards. The estimated unit prices for main line piping was derived by soliciting informal pricing from three local contractors. To account for any unforeseen variables, the unit prices used were an average of the two highest prices received. The unit price for piping was then increased by 15% to account for fittings, valves, hydrants, flushouts, manual air release valves, encasement pipes, etc. A 15% allowance was also included for both contingencies and engineering.

The total estimated capital cost for installation using City of Winnipeg standards is $1,407,250.00, while the estimated capital cost for installation using rural servicing standards is $1,176,820.00. A detailed breakdown of these costs are provided in this Section as Figures 6.1 and 6.2 respectively. A general layout of these services showing the proposed pipe sizes for both options are provided as Figures 6.3 and 6.4.

6.2 WATER COST

An analysis has been completed to compare the current cost between water rates in the City of Winnipeg, the Rural Municipality of Ritchot, and the cost of hauling water to fill cisterns.

The following assumptions are being used for all 3 scenarios:

- Average demand is 300 litres/person/day
- Average house serves 3.05 persons
- Average quarterly water use per house is 83.5 cubic metres
- Average annual water use per house is 334 cubic metres

City of Winnipeg

The City of Winnipeg charges $2.75 per 100 cubic feet of water used, plus a quarterly charge of $12.10 for a 5/8" meter.

- Quarterly cost - $93.23
- Annual cost - $372.92

Rural Municipality of Ritchot

The R.M. of Ritchot has a quarterly minimum charge of $30.00, which includes 3000 imperial gallons. Any additional water that is used is charged at $7.00 per 1000 imperial gallon.

- Quarterly cost - $137.80
- Annual cost - $551.20

Bulk Water Hauling for Cisterns

An average cost for hauling of water is $28.00 per 1000 imperial gallons.

- Quarterly cost - $515.20
- Annual cost - $2060.80

Figure 6.1
City of Winnipeg Servicing Standards
Opinion of Probable Cost

	Description of Work	Unit	Quantity	Unit Price	Amount
1.	300 mm WM (LaSalle Crossing)	l.m.	305	$210.00	$64,050.00
2.	Connect to Existing WM	each	1	$2,500.00	$2,500.00
3.	Air Release Chamber	each	1	$15,000.00	$15,000.00
4.	150 WM (includes 15% for appurtenances)	l.m.	985	$165.00	$162,525.00
5.	100 WM (includes 15% for appurtenances)	l.m.	4535	$135.00	$612,225.00
6.	25 mm Corp Stop / Curb Stop / Curb Stop Box	each	110	$700.00	$77,000.00
7.	25 mm Water Service (Class 4 Backfill)	l.m.	1340	$45.00	$60,300.00
8.	25 mm Water Service (Augered)	l.m	1270	$70.00	$88,900.00
	Subtotal				$1,082,500.00
	15% Engineering				$162,375.00
	15% Contingency				$162,375.00
	TOTAL				**$1,407,250.00**

Figure 6.2
Rural Servicing Standards
Opinion of Probable Cost

	Description of Work	Unit	Quantity	Unit Price	Amount
1.	300 mm WM (LaSalle Crossing)	l.m.	305	$210.00	$64,050.00
2.	Connect to Existing WM	each	1	$2,500.00	$2,500.00
3.	Air Release Chamber	each	1	$15,000.00	$15,000.00
4.	150 WM (includes 15% for appurtenances)	l.m.	985	$165.00	$162,525.00
5.	100 WM (includes 15% for appurtenances)	l.m.	1140	$100.00	$114,000
5.	75 WM (includes 15% for appurtenances)	l.m.	1985	$95.00	$188,575.00
6.	50 WM (includes 15% for appurtenances)	l.m.	1410	$90.00	$126,900.00
7.	38 mm Corp Stop / Curb Stop / Curb Stop Box	each	110	$750.00	$82,500.00
8.	38 mm Water Service (Class 4 Backfill)	l.m.	1340	$45.00	$60,300.00
9.	38 mm Water Service (Augered)	l.m	1270	$70.00	$88,900.00
	Subtotal				$905,250.00
	15% Engineering				$135,785.00
	15% Contingency				$135,785.00
	TOTAL				**$1,176,820.00**

6.3 COST/BENEFIT OF PROJECT

Based upon provision of water distribution to prevailing City standards the effective total cost to existing consumers in the district has be calculated as follows:

Project Cost:	$1,407,250
Annual Amortization (20 years, 8%):	$143,330
Annual Payment for each homeowner	
(110 potential connections):	$1,303
Annual Cost of Hauling Water:	$2,060
Total Annual Cost of Piped Water	
(110 connections) $373 + $1,303=	$1,676

If the property owners pay cash for this project ($12,795 each based on 110 potential connections), they would recoup the capital investment in about nine years. This is based upon an annual "operating cost" saving of $1,362, representing the difference of hauled water cost ($2,060) and piped water cost ($373), minus the property tax credit* ($325), divided into $12,795.

* The residents of the district currently receive an annual $325 property tax credit in compensation for lack of City water service. This tax credit will not be available if water service is extended to the district.

If the rural servicing standards are used, the above costs would be reduced by 16%; the initial capital cost would be repaid by savings on water purchases in only eight years.

6.4 MISCELLANEOUS COSTS

The foregoing does not include the cost of installing service piping from the property line into the home. These costs will vary significantly between properties depending on the relative placement of the home. However, the current cost of purchasing water hauled by tanker, doesn't include maintenance, power consumption and replacement costs for the pump, pressure switch, pressure tank and cistern for which each home owner is currently responsible. The relative costs of service lines on private property and ongoing maintenance of private tank/pumping systems should be in the same order of magnitude.

There is an additional cost issue. The City imposes a $0.65 levy per frontage foot for all property within the area served by water, in order to fund on-going watermain renewal programs. The La Salle South district would be subject to this levy as well.

7.0 RECOMMENDATIONS

Based on the estimated total capital costs, the option of servicing the La Salle South area by using rural servicing standards is a more financially viable alternative, and is therefore recommended for this location. However, as mentioned earlier in this report, implementing a change in the City's servicing criteria by adding products that are not used anywhere else in the City will likely impact inventory and maintenance procedures. The cost of this impact was not a part of this study, and is therefore not known. However, it should be investigated before any decision is made to proceed with any of the two servicing options identified in this report.

Respectfully submitted:

Cochrane Engineering Ltd.

Prepared by : Michael Matview, C.E.T.
Devon Danielson, M.Sc., P.Eng.

Reviewed by: W.H. (Bill) Brant, P. Eng.
Senior Water Supply Specialist

PROVINCE OF MANITOBA
W. H.
BRANT
2004 05 26
REGISTERED PROFESSIONAL ENGINEER

APEGM
Certificate of Authorization
Cochrane Engineering Ltd.
No. 227 Expiry: April 30, 2004

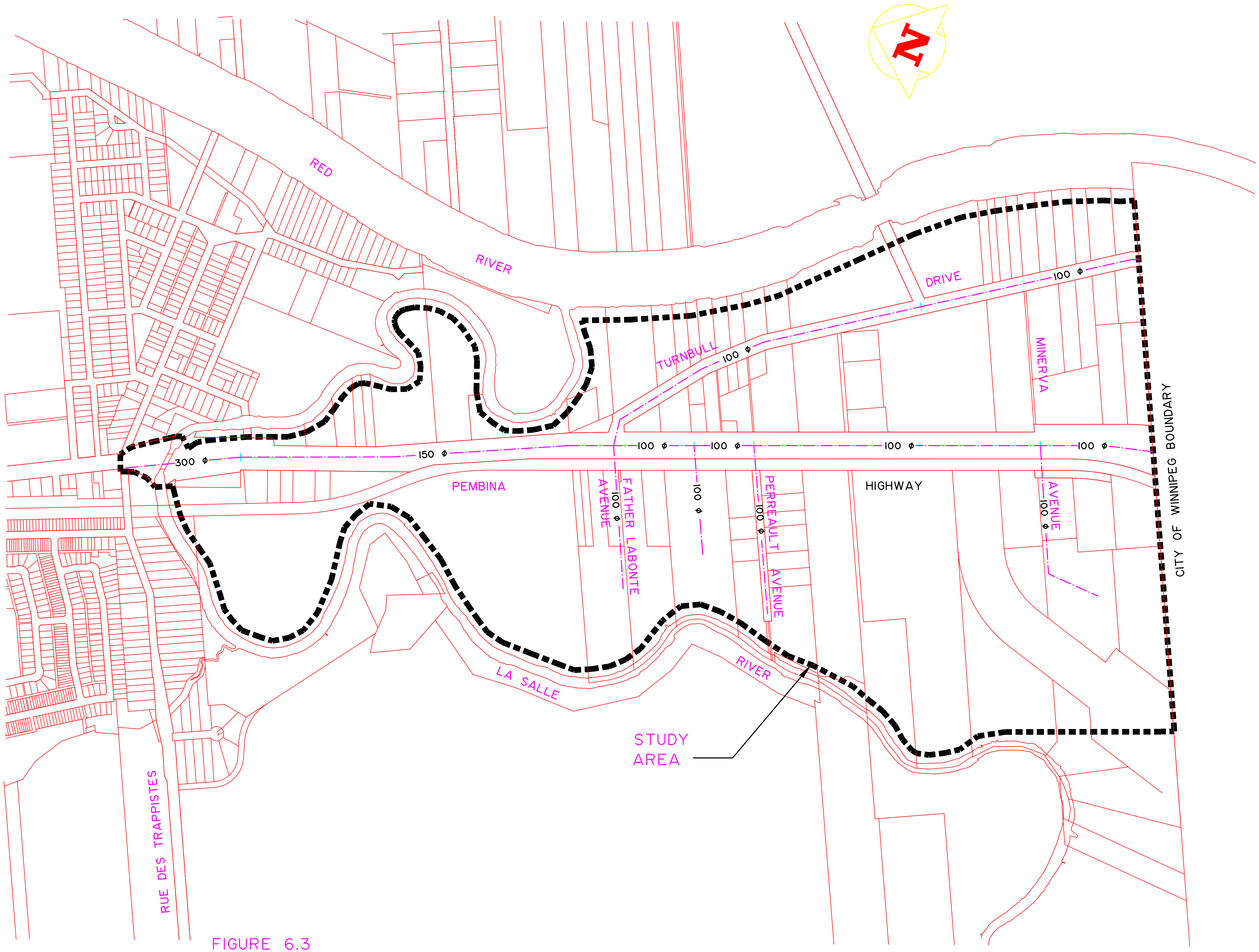


FIGURE 6.3

SERVICING ALTERNATIVE USING CITY OF WINNIPEG SERVICING STANDARDS

COCHRANE ENGINEERING LTD.
#600 – 5 DONALD STREET
WINNIPEG, MANITOBA, R3L 2T4
TEL: (204) 477-6650
FAX: (204) 474-2864

ENGINEERS • PLANNERS • SCIENTISTS • PROJECT MANAGERS
VANCOUVER, CALGARY, REGINA,
SASKATOON, WINNIPEG, BURLINGTON, TORONTO

Seals

Consultants

ISS.	REV.	DATE	APP.	DESCRIPTION

CITY OF WINNIPEG
LASALLE SOUTH
WATER SUPPLY

WINNIPEG MANITOBA

CIVIL

SERVICING ALTERNATIVES
PIPE SIZES USING CITY OF
WINNIPEG STANDARDS

DESIGNED	M.P.M.	APPROVED	W.H.B.
DRAWN	M.P.M.	SCALE	N.T.S.
CHECKED	W.H.B.	DATE	03/02/04

PROJECT NO.	DRAWING NO.	REV
WE04021	FIG. 6.3	0

ACAD No. 04021FIG6.3

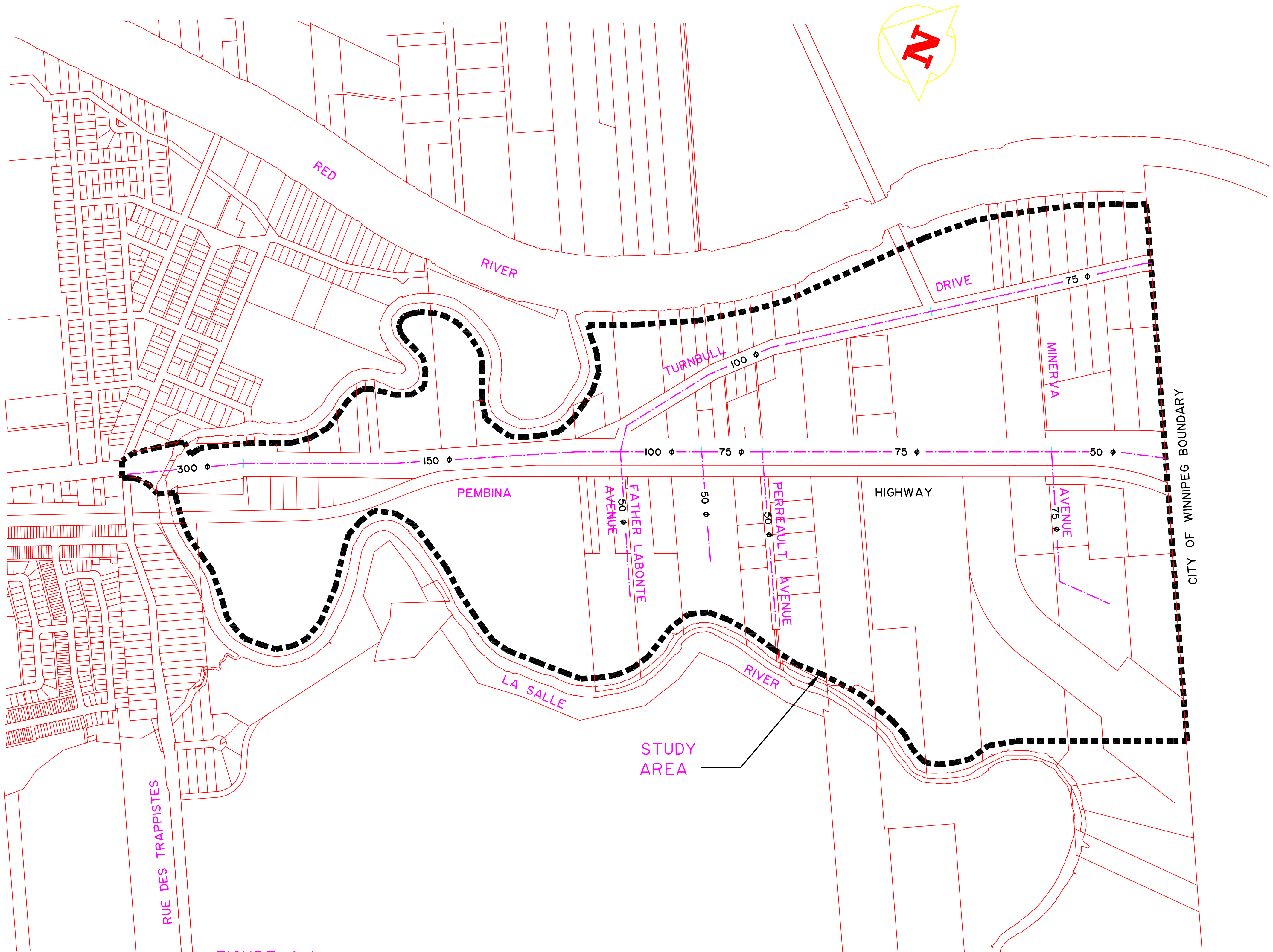


FIGURE 6.4

SERVICING ALTERNATIVE USING RURAL SERVICING STANDARDS

COCHRANE ENGINEERING LTD.
600 – 5 DONALD STREET
WINNIPEG, MANITOBA, R3L 2T4
TEL: (204) 477-6650
FAX: (204) 474-2864
ENGINEERS • PLANNERS • SCIENTISTS • PROJECT MANAGERS
VANCOUVER, CALGARY, REGINA, SASKATOON, WINNIPEG, BURLINGTON, TORONTO

Seals

Consultants

ISS.	REV.	DATE	APP.	DESCRIPTION

CITY OF WINNIPEG
LASALLE SOUTH
WATER SUPPLY

WINNIPEG MANITOBA

CIVIL

SERVICING ALTERNATIVES
PIPE SIZES USING
RURAL STANDARDS

DESIGNED	M.P.M.	APPROVED	W.H.B.
DRAWN	M.P.M.	SCALE	N.T.S.
CHECKED	W.H.B.	DATE	03/02/04
PROJECT NO.	WE04021	DRAWING NO. FIG. 6.4	REV 1

ACAD No. 04021FIG6.4

APPENDIX A

LaSalle South Water Supply
Tech. Memo #1 (R2)
Trickle Systems

LASALLE SOUTH WATER SUPPLY

TECHNICAL MEMORANDUM NO. 1 (R2)

TRICKLE SYSTEMS

Prepared for:
City of Winnipeg
Water & Waste Department

Project No: WE 04 021 00 WE

March, 2004

COCHRANE ENGINEERING LTD.

600 – 5 DONALD STREET
WINNIPEG, MB R3L 2T4

ENGINEERS, PLANNERS, SCIENTISTS & PROJECT MANAGERS

TABLE OF CONTENTS

0.0 INTRODUCTION

Cochrane Engineering has been authorised by the City of Winnipeg to investigate alternative means of implementing piped water delivery to the portion of the St. Norbert community which is south of the LaSalle River. A plan of the proposed service area is shown in Figure 1.

Currently, the homeowners in this area rely upon trucked water, delivered to cisterns at each house. Many residents of the district have requested that the City provide piped water service from the City distribution system. Preliminary cost figures were previously provided for conventional distribution works to the prevailing City Standard. Some residents have deemed this to be too costly, and as an alternative, they have proposed that a "trickle feed" –type piped water distribution system be considered.

This technical memorandum presents an overview of the trickle feed concept. A description of such systems follows in Section 1 of this report. The information herein is based primarily on the standards and practices of the Manitoba Water Services Board (MWSB), and on the requirements of the Office of Drinking Water (ODW). MWSB is a provincial agency which has several mandates, including facilitating development of rural piped water distribution systems. ODW is the provincial agency with the responsibility of enforcing the provisions of the Drinking Water Safety Act. Both agencies were recently incorporated into the new provincial Department of Water Stewardship.

1.0 BACKGROUND

1.1 TRUCKED WATER DELIVERY

The rural region southwest of the City of Winnipeg has not had the benefit of being able to draw on groundwater as a supply source for residences and farms. This is due to the prevailing saline water in the fractured limestone aquifer which underlies the predominant clay and clay till overburden of the region. In the absence of any other water source, residents of the area have relied upon water hauled by tanker trucks from standpipes on urban water distribution systems.

Each home served by tanker truck has a concrete or fibreglass cistern (water storage tank), typically storing 5 – 10,000 litres, and located either in the home's basement or buried in the ground adjacent to the home, similar to a septic tank.

Each home also has a pressure system to convey water from the cistern to the home plumbing. Such systems typically consist of a centrifugal pump in the basement, or submersible pump in the cistern, with an air-cushion pressure tank and pressure switch to regulate pump operation.

Like the rest of the region southwest of Winnipeg, the City's LaSalle South district has relied upon the truck-filled cistern supply methodology for many years.

1.2 RURAL PIPED WATER SYSTEMS

In the 1980s, a trend developed in the municipalities southwest of Winnipeg, toward construction of small diameter piped water distribution systems, to serve both rural residents and farms. The small pipe diameters were the consequence of cost limitations driven by low population densities, which are as low as one or two connections per kilometre.

The low available flows and pressures – limited to about 0.2 L/sec and 170 kPa – led to development of "trickle feed systems". For the purposes of this document, a "trickle feed system" is a piped public water distribution system where water is delivered at relatively low flow and pressure, into a cistern, through a float controlled valve, similar to that in a toilet tank, to regulate the water level. Water is delivered into the home plumbing by means of the same pump system used in cisterns receiving water by tanker truck. The homeowner retains ownership and responsibility for maintenance of the tank and pressure system, and for the sanitary condition of the works.

In conventional urban water distribution systems, the utility provides adequate flow volume and pressure for direct supply to operate domestic appliances and plumbing fixtures. With the low capacity of the trickle feed system, the homeowner's pump must satisfy the demand, causing the cistern level to drop. The cistern refills over time, predominantly in low demand periods.

1.3 EVOLUTION OF RURAL PIPED SYSTEMS

Early rural water systems frequently used materials which were unknown in conventional waterworks design, such as low density polyethylene pipe with joints consisting of nylon inserts and gear clamps. Such piping was rated at 515 kPa ("75 psi"), far less than conventional waterworks materials, which are rated for 1035 kPa working pressure. Use of such materials limited the working pressure of the early rural systems.

When rural systems began to proliferate 15 years ago, MWSB design philosophy evolved. High density fusion welded polyethylene and PVC piping (manufactured to CSA Specification B.137.3, and rated at 1100 kPa) became the standard. System operating pressures rose to as much as 550 kPa. The MWSB approach also included continued installation of flow restrictors at the meter in the home, which limited discharge to 0.23 L/sec. The design objective was to deliver 175 kPa minimum residual pressure throughout the systems, although static pressure could exceed 500 kPa.

Most rural residents found that they had adequate direct line pressure without need of repumping at each home. The residents generally did not want the responsibility of maintaining tanks and pumps. In addition, MWSB perceived the public health risks of using cisterns (Sec. 2.0). Consequently, the cistern was no longer a part of the water delivery system, with the one exception being for livestock operations (Sec. 3.0).

2.0 PUBLIC HEALTH CONCERNS

Trickle fed systems have presented limitations of service and imposed on-going maintenance responsibilities on homeowners. However, of greater concern was the public health risk of such systems. While the integrity of potable water quality could be maintained to the end of the pipe filling the cistern, quality could be assured no further than that. The cisterns have manholes to provide access for inspection and cleaning. They are not truly air or water tight. Similarly, joints between the precast concrete or fibreglass sections are not pressure rated. Entry of vermin (rodents, insects, etc.), dust, soil, runoff, groundwater, and other deleterious material can not be entirely prevented. The cisterns also tend to accumulate sediment over time, with consequential impact on quality. Chlorine residuals are essential to maintain microbiological quality, but the residual dissipates in tanks which are not sealed against the atmosphere.

In the light of this, MWSB has not incorporated trickle feeds on the domestic (i.e. non-livestock) portions of their rural water projects for many years. The risks of contamination and the uncertainty of appropriate homeowner maintenance and sanitary measures, have been deemed too great a threat from a public health perspective.

3.0 TRICKLE SYSTEMS FOR LIVESTOCK OPERATIONS

Where a rural water system serves livestock operations (cattle, hogs, etc.) the water consumption is far greater than for a residence. Peak demand could be several litres per second, far beyond the 0.23 L/sec capacity of a typical rural system, which over a 24 hour day results in 20,000 litres of water being delivered. This is adequate for a herd of 100 dairy cattle; 200 head of beef cattle or 300 sows in a "farrow-to-finish" hog operation. Where larger operations are served, the water system is designed with greater delivery capacity, as would be the case where a village is served. In all cases - villages or intensive livestock operations - reservoirs with pumping equipment are normally provided for equalisation storage and repressurisation. Community reservoirs are always provided with rechlorination systems.

MWSB uses single check "backflow" preventors on all rural services, installed along with the flow restrictors at the meter. For the cisterns at livestock operations, reduced pressure double-check backflow preventors are used. The water pumped out of the cistern does not provide service to the farmhouse, or for any potable use. This again reflects the inability of the water system to maintain integrity of quality "from source to tap" where cisterns are involved.

4.0 PUBLIC HEALTH POLICY IN MANITOBA

Discussions on February 5, with David Shwaluk, P. Eng., Chief Engineer, MWSB, indicated that MWSB is very conscious of the fact that cisterns cannot assure integrity of water quality. As noted previously, vermin (including rodents and insects), dust, soil, rain, run off, groundwater and all manners of contaminants could find their way into a cistern. Consequently, cisterns cannot be used for piped potable water delivery in systems, built under MWSB's program. This policy was echoed in discussions on February 19 with Don Rocan, P. Eng., of the Office of Drinking Water, which views the use of trickle feed systems as being contrary to the "source to tap" protection now demanded by the newly proclaimed provincial "Drinking Water Safety Act".

5.0 SASKATCHEWAN PRACTICE

It has been suggested that Saskatchewan is still implementing the trickle feed concept, specifically in a region near Regina, to which the City was apparently supplying water to 150 rural homes through small diameter lines feeding tanks. Discussions with our Regina office indicated that this is a reality.

The project is question is being undertaken by a federal agency, PFRA, as part of their farm water supply assistance program. The system is exempted from the new Saskatchewan drinking water regulations, and is not under the jurisdiction of Saskatchewan's Department of Environment and Resource Management. Through a regulatory loophole (intentional or otherwise), the system is not classified as a public water system, but rather each farm or rural residence is deemed still to have an individual water source, analogous to having an individual well.

In Manitoba, the new Drinking Water Safety Act has no such loophole, and any piped water distribution system with 15 or more connections is designated as a "public water system", which by law must conform to all regulatory requirements. As stated previously, the Office of Drinking Water will not approve the "trickle-feed" concept for public systems because of the inability to provide "source-to-tap" assurance of quality.

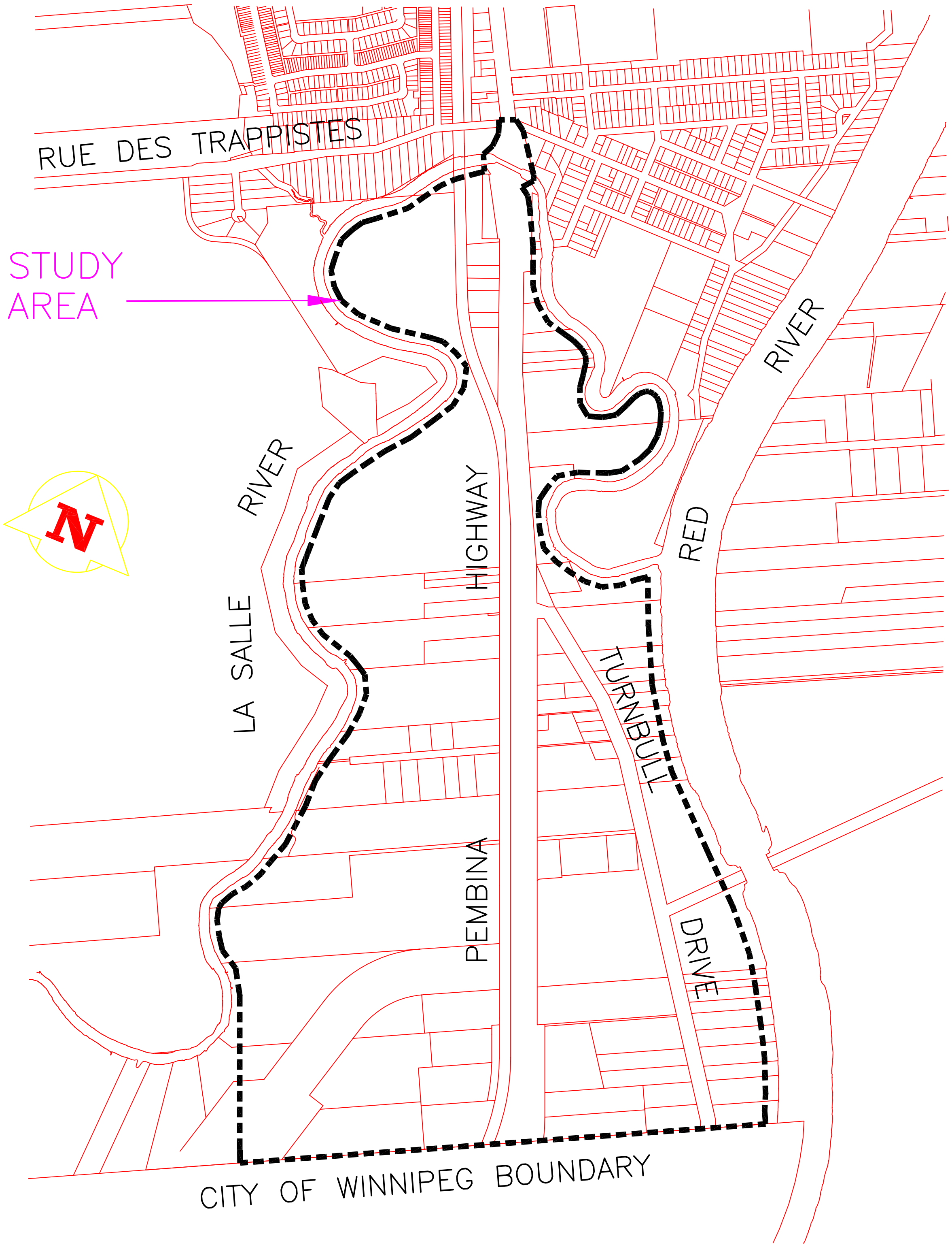
6.0 RECOMMENDATIONS

As a consequence, of the public health concerns and regulatory considerations, the use of trickle feed systems is not an option for servicing the district south of the La Salle River. It is recommended that only two piped water supply alternatives be considered for potential implementation, namely conventional urban water distribution to City standards, and rural-type piped water service to MWSB standards. These will be explored further in the summary report being prepared under this project.

Respectfully submitted:

Cochrane Engineering Ltd.

W.H. (Bill) Brant, P. Eng.
Senior Water Supply Specialist



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TITLE **LASALLE SOUTH WATER SUPPLY STUDY AREA**

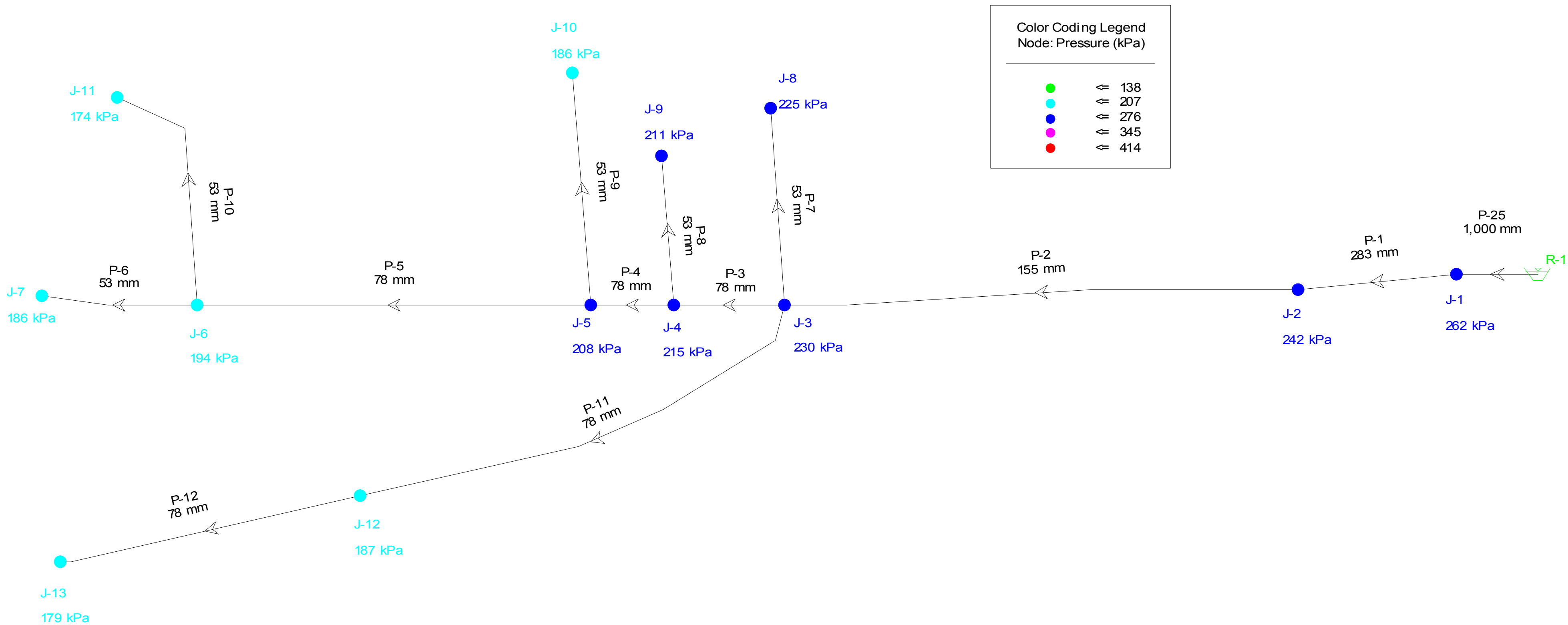
DATE 03/02/04 DWG No. WE04021 **FIGURE 1**

ACAD No. 04021FIG1

APPENDIX B

WaterCAD V.6.0
Model Figures

Scenario: Scenario 1



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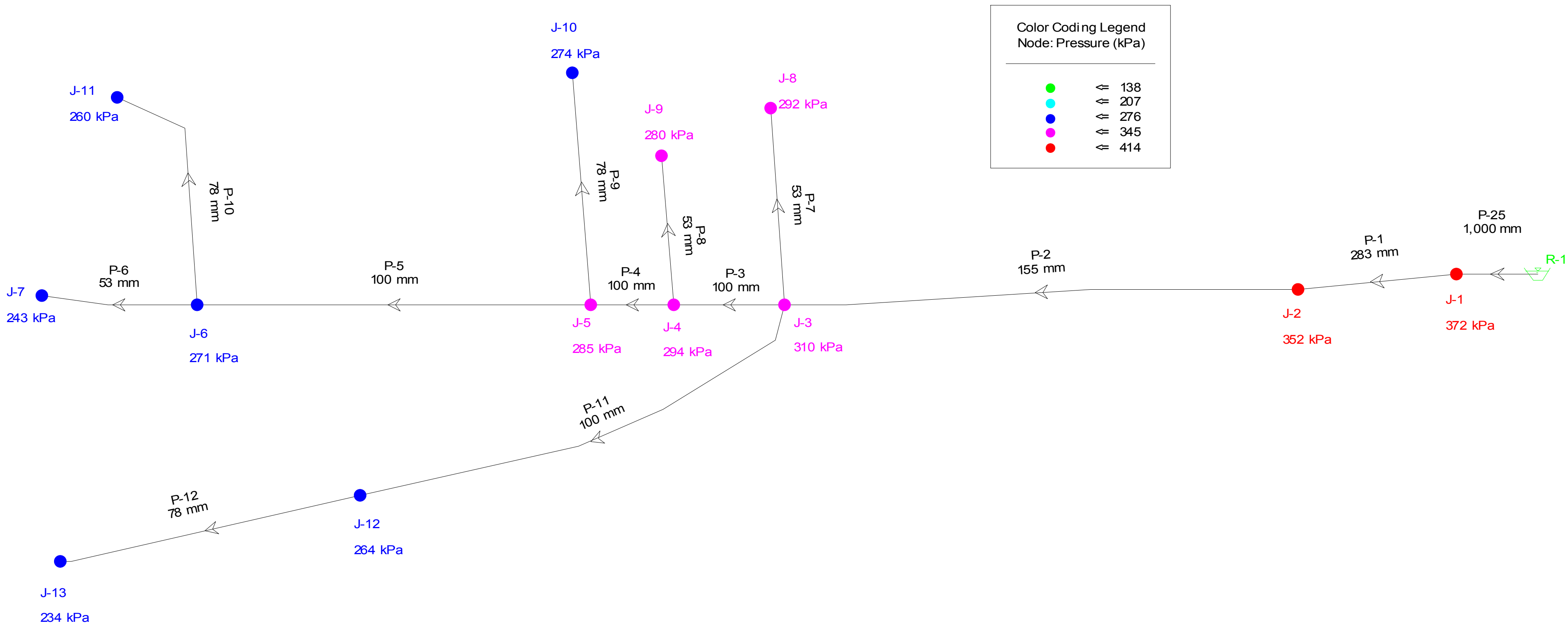

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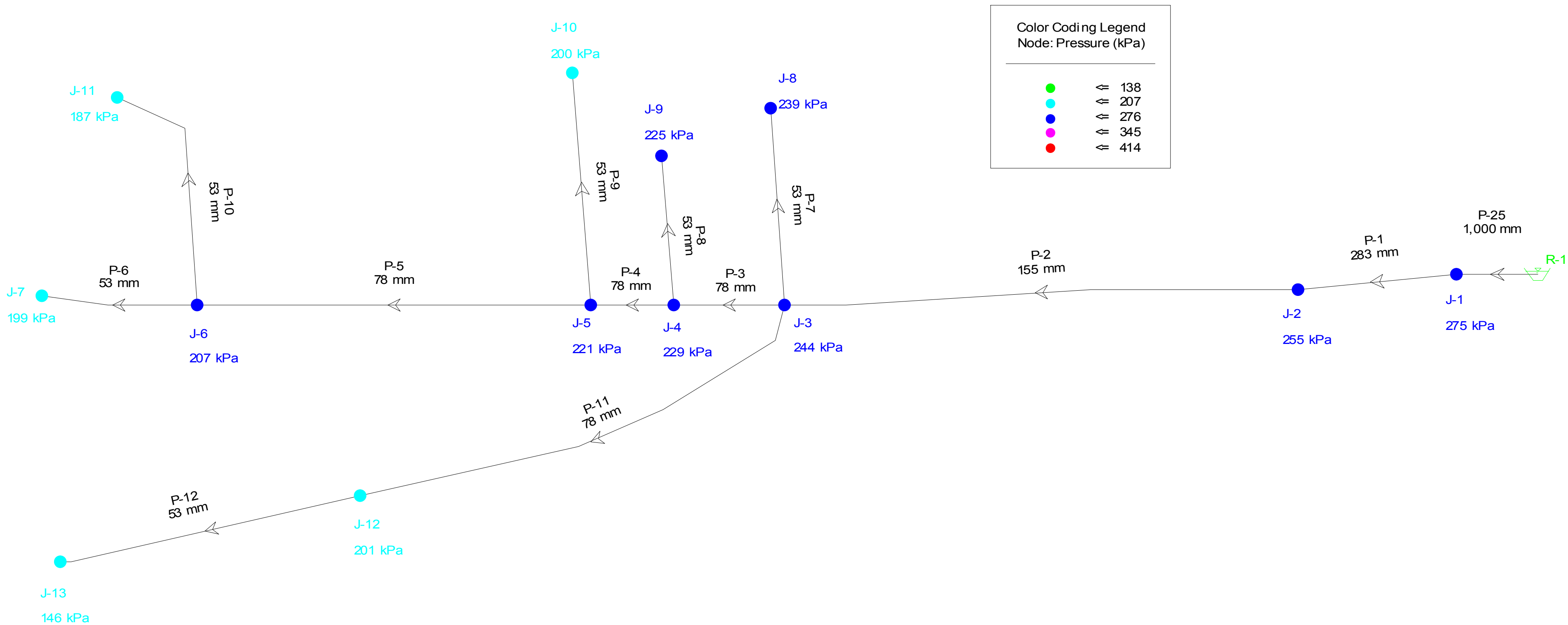

Scenario: Scenario 4