April 1, 2024

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Mr. Roger Nesbitt, CAO
City of Dryden
30 Van Horne Avenue
Dryden, Ontario P8N 2A7

via email only

D-536.02

Dear Mr. Nesbitt,

Re: Mario Milanese Subdivision - Stage 3 – Pre-Design Report

1.0 INTRODUCTION

JR Cousin Consultants Ltd. (JRCC) was retained by the City of Dryden (the City) to complete the preliminary design for the Stage 3 extension of the Mario Milanese Subdivision. The Mario Milanese Subdivision is located in the south portion of Dryden. Stage 3 development includes a total area of approximately 4.46 ha (11 acres), including extension of Mario Milanese Place, a south extension of Elvis Avenue, and proposed lots along Sandy Beach Road beginning at Sandy Beach Mews and extending eastward toward Milanese's Lakes.

Other than the existing Sandy Beach Road, the land is mostly undeveloped. The legal plan of the subdivision has been established. Therefore, the surveyed and registered layout of the lots and right of ways are retained with minimal alterations. There are some existing watermain (WM), sanitary sewer (WWS), and land drainage sewer (LDS) underground pipe utilities constructed to previous development plans, and some existing drainage infrastructure along Sandy Beach Road. The existing infrastructure is incorporated into the preliminary design wherever feasible.

2.0 SUBDIVISION BACKGROUND AND PLANNING

JRCC reviewed the original Design Brief for Stage 3 of the Milanese Subdivision (Design Brief, 7709-5), previous design drawings, and all available as-built record information, JRCC has incorporated the City's criteria and standards for water and sewer mainlines, the preferred locations of underground utilities, lot servicing, lot grading and drainage, roads, and active transportation paths and walkways in the preliminary design drawings, located in Appendix A. Thus, the subdivision preliminary design meets the City's vision and the City of Dryden, City of Thunder Bay, and OPSS / MOE standards and specifications.

The current JRCC preliminary design includes a total of 42 single family lots, which includes the amalgamation of the original lot layout's Lot 76 (Block 15) into lots 77, 78, and 79.

The design population estimate for the subdivision extension is based on City of Thunder Bay Standards residential single family dwelling population density of 37 persons per hectare. The area of the proposed 42 lots is 4.19 hectares. Therefore, the design population used for Stage 3 is 155. With 42 lots, the population density is further calculated to be 3.69 persons per single family dwelling or lot. Additional future development is incorporated into the WWS design with an estimated additional 24 lots along Sandy Beach Road to the east of Stage 3.

Proposed vehicle and pedestrian access is provided from Sandy Beach Road and St. Charles Drive via reconstruction of approximately 220 m of Sandy Beach Road, extensions of Elvis Avenue and Mario Milanese Place, and proposed walking pathway and recreational activity trails.

It is anticipated that when the final design for Stage 3 extension of the Mario Milanese Subdivision is complete, the City will proceed with the subdivision approval process in preparation for tendering of the project.

3.0 WATER DISTRIBUTION

JRCC preliminary design plans of the proposed underground infrastructure are included in Appendix A, Plans ML1 to ML6. The water distribution system will be connected to existing watermains on Mario Milanese Place, Elvis Avenue, and Sandy Beach Road. Watermain looping is designed within the subdivision to efficiently provide the required system design flows and pressures.

Based on the City's standards, unless noted otherwise, the following are the criteria used for the preliminary design of the water distribution system:

1. The watermain will be constructed of PVC C-900 pipe.
2. Fire hydrants will be Clow Brigadier model M-67.
3. City of Thunder Bay Standards specify minimum and maximum operation pressures of 350 kPa (35.7 m of water) and 700 kPa (71.4m). The standard states homes subjected pressure exceeding 550 kPa (56.1 m) shall be equipped with a pressure regulating device to maintain water pressure in the home at less than 550kPa. The Design Brief assumed operating pressures of the existing system between 350 to 385 kPa (59.5 m).
4. City of Thunder Bay Standards for design domestic water demands and pressures are as follows:
    a. It is assumed the proposed connections to the existing system can supply at least 350 kPa to the proposed extension.
    b. Average daily demand is 400 L/p/d.
    c. The maximum day water demand factor for population up to 500 is 3.00, or 1200 L/p/d.
    d. The peak rate factor for population up to 500 is 4.50. Therefore, the maximum hourly peak demand is 1800 L/p/d.
    e. Under maximum hourly demand, the minimum system pressure shall not be less than 275 kPa (28.0 m).
5. City of Thunder Bay Standards design with fire flow assumptions and requirements are:
    a. The minimum fire flow required is 4550 L/minute, or 76 Liters per second.
    b. The minimum residual pressure at any location in the system is 140 kPa (14.3 m), with the design maximum daily demand and a design fire flow located at the most critical location.
6. The minimum size of watermain is 150 mm.
7. JRCC design follows The City of Thunder Bay maximum fire hydrant spacing, using a 75 m maximum radius circular zone coverage and maximum 150 m line spacing.
8. The maximum spacing of watermain valves is 240 m. The maximum number of services affected by shutting off any proposed segment of WM is 14.
9. Following The City of Thunder Bay Standards, the design WM cover is 2.15 m to 2.75 m. The cover for service lines is from 2.15 m to 2.5 m.
10. JRCC has designed the watermains offset from the right of way lines as shown on the plans.
11. The JRCC design for proposed mainlines is based on typical offsets from right of way lines for both watermain and sewermain, with horizontal separation being the remainder of the width of the right of ways.
12. Watermain valves and hydrants are to include anode protection in accordance with City of Thunder Bay Standards.
13. City of Thunder Bay Standards recommend 1.0 m preferred and minimum 0.5 m vertical separation between watermains and sewermains.

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14. Water service connections will use stainless steel 19 mm service saddle clamps, corporation stops, and curb stops.
15. The water service lines will be Municipex 19 mm. The service lines will be capped at the property line.
16. The service lines will include a minimum fourteen (14) gauge TWH solid copper light coloured plastic coated tracer wire for all non-metallic water connections and fire service mains.

Following the above criteria, the subdivision water distribution system hydraulic properties were modelled using the software EPA Net version 2.2; using the Hazen-Williams friction loss equation to determine pressure losses in the system. The EPA Net model diagrams are included in Appendix B. Pipe roughness coefficients, "C", used in the model, follow City of Thunder Bay Standards:

- 150 mm and smaller pipe uses a C of 100,
- 200 to300 mm diameters use a C of 110,
- and pipe 300 mm and larger use a C of 120.

The model uses proposed 150 mm WM pipe throughout. The model also assumes the existing City water distribution system supplies 350 kPa and the required peak hour demands and the combined maximum day demands and fire flow rates. The City of Thunder Bay Standards state with the peak hourly demand, system pressures shall not be less than 275 KPa. The model returns a minimum lowest peak hour demand system operating pressure of 35.70 m, or 350.2 kPa, at the intersection of Sandy Beach Road and Memorial Avenue; model node n129.

A fire flow of 76 liters per second was applied at various proposed subdivision fire hydrant locations, combined with the maximum day demands, to determine the critical fire location. The water distribution system must maintain a minimum of 140 kPa with the design maximum daily demand and a design fire flow located at the most critical fire hydrant location. Table 1: Water Distribution System Pressure with Fire Flow below lists the critical node and minimum system pressure.

Table 1: Water Distribution System Pressure with Maximum Day Demand and Critical Fire Flow

Critical FH node 76 L/s	System Node with Lowest Pressure	Head (m)	Head (kPa)
FHn136	FHn136	23.25	228

Based on the EPA net model analysis, PVC C-900 DR-18 pipe with 150 mm diameter are sufficient for the proposed watermains. The watermain will be installed with 2.15 m to 2.75 m of ground cover.

Service lines will extend to the property line with a curb stop installed 0.3 m from the road allowance. In accordance with City of Dryden recommendations, a 19 mm diameter Municipex service line pipe will be used for housing lots with 2.15 m to 2.5 m of ground cover.

WM construction is to be in accordance with City of Dryden, City of Thunder Bay, and OPSS specifications and standards.

4.0 WASTEWATER COLLECTION

Stage 3 of the Mario Milanese Subdivision will be serviced with a gravity wastewater sewer collection system, which will discharge to an existing lift station location on Sandy Beach Road. The lift station is currently non-operational and

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requires pumps and pipe upgrades to accommodate the sewage design flows. See section 8.0 for more information on the lift station and forcemain.

The JRCC mainline gravity wastewater sewer preliminary design criteria is based on the City of Dryden and City of Thunder Bay Standards:

1. The minimum wastewater sewermain diameter is 200 mm.
2. The City of Thunder Bay Standards minimum pipe slope is 0.3%, with 0.5% preferable, as used for Stage 3.
3. The City of Thunder Bay Standards specify a wastewater sewer residential flow rate of 400 L/p/d, and an infiltration rate used for design of sanitary sewers of 0.26 L/s/ha. Further, the maximum allowable infiltration rate is not to exceed 0.075 L/hour/mm of pipe diameter/each 100 m of pipe. The largest infiltration rate calculated by the two criteria above will be used in the design of the sewer system.
4. Weeping tile connections to the wastewater sewer system are not allowed.
5. No roof drain connections are allowed.
6. Wastewater sewermain pipe is to be SDR-35 PVC.
7. City of Thunder Bay Standards minimum ground cover over sanitary sewers is followed, and is 2.5 m, with 2.75 m preferable.
8. City of Thunder Bay Standards recommend manholes to be spaced a maximum of 110 m apart, with 100 m recommended.
9. The City of Thunder Bay Standards for the additional vertical fall in manholes based on the degree of bend of the flow will be followed.
10. All service line pipe is to be a minimum of 150 mm SDR-21 PVC.
11. The minimum slope of service lines is to be 1%.
12. Service lines will be plugged at the front lot property line.

In general, when sizing sewer trunk lines, the maximum recommended flow depth is 70% of the internal diameter of the pipe. When sizing sewer lateral branches, the maximum recommended flow depth is 50% of the internal diameter of the pipe. Flow capacity is calculated using a Mannings roughness factor "n" of 0.013. All sections of pipe have been designed to maintain a minimum 0.6 m/s scour velocity during peak hour flow to prevent buildup of debris with the system.

Table 2: Pipe Flow Rate Capacity at Minimum and Recommended Pipe Slopes

Diameter	Min % Slope	Flow Rate at 50% Flow Depth	Flow Velocity (m/s)	Flow Rate at 70% Flow Depth	Flow Velocity (m/s)
200	0.30	8.98 L/s	0.57	15.0 L/s	0.74
200	0.50	11.6 L/s	0.64	19.4 L/s	0.83

Using City of Thunder Bay infiltration design rate of 0.26 L/s/ha, with an estimated area of 7.36 ha contributing to infiltration, the total flow is 1.9136 L/s for Stage 3. Further, this criteria's infiltration rate can be calculated as 0.0456 L/s per lot. Using the City of Thunder Bay maximum allowable infiltration rate of 0.075 L/hour/mm of pipe diameter/100 m of pipe, the total infiltration rate is 2.1515 L/s, or 0.0512 L/s per lot. For sizing the Stage 3 WWS pipe, the 2.1515 L/s infiltration rate is used.

City of Thunder Bay peak sewage flow rate factors are calculated based on system population using the Harmon equation:

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$1 + (14 / (4+(P/1000)^{0.5}))$, where P is the total population.

The 42 lot Stage 3 development design population is 155. Additionally, the proposed sewer system will collect sewage diverted from 30 existing houses on Mario Milanese Place (design population of 111), and another 24 future development lots east of Stage 3 along Sandy Beach Road (design population of 89). Therefore, the Harmon peak hour factor is 4.046. Peak design sewage flow, based on a total population of 355, 400 L/p/d, and the peak hour factor, is calculated to be 6.65 L/s. Adding the maximum allowable infiltration, the entire network was analyzed to have sufficient design capacity for 8.80 L/s. The proposed development wastewater sewer is shown on Appendix A, ML1 to ML6. The table below shows the pipe slope and expected flow rates for several key system locations.

Table 3: Sewer Pipe Peak Flow Rates

Upstream Manhole	Downstream Manhole	Diameter	% Slope	Expected Flow Rate	Velocity (m/s)
MH1A	MH1B	200	3.37	2.73 L/s	0.96
MH1B	MH2	200	1.71	2.87 L/s	0.78
MH6	MH8	250	0.68	4.31 L/s	0.63
MH8	MH9	200	6.26	5.17 L/s	1.46

In summary, the proposed 200mm SDR-35 PVC wastewater sewermain pipes will have sufficient capacity. The proposed manholes have been spaced to a maximum of 100 m, and the depth of the sewer will maintain minimum 2.75 m cover.

The proposed wastewater sewers are to be construction in accordance with City, the City of Thunder Bay, and OPSS specifications and standards.

5.0 LOT GRADING AND DRAINAGE

The existing topography is relatively level ground in at the west end of the proposed Stage 3 development. This area requires maximum lot grades of 5%. However, the east side topography drops off steeply toward Milanese's Lakes with slopes of more than 25%.

Previous conceptual design plans used back to front or front to back lot drainage schemes. This lot grading scheme was adopted for the preliminary JRCC proposed lot grading design. However, the east side lots along Elvis Avenue would have to include slopes up to 25% over the entire depth of the lots. In order to reduce the steep front and rear grades of these lots to a 7% maximum, JRCC recommended a walk out basement lot grading scheme for the east side of Elvis Avenue. The walk out lots proposed by JRCC have been accepted by the City.

To ensure the runoff from higher elevation lots will not drain onto adjacent lots, rear lot drainage swales with easements divide the lots along shared rear property lines and direct runoff onto the roadway drainage system. At the lots on the south side of Sandy Beach Road, a proposed perimeter drainage ditch and easement conveys runoff to a short section of LDS under Sandy Beach Road, discharging to Milanese's Lakes.

Final lot grading has not been included in the cost estimate.

6.0 ROADS AND DRAINAGE

The development will be serviced with a network of asphalt paved roads. The road design includes 4.43 m driving lanes, matching the existing roads, and 0.6 m wide concrete curbs and gutters. All roads will have a 3% cross fall and minimum 0.5% longitudinal grade.

Based on the City of Thunder Bay Standards and Specifications:

- The road pavement structure will have:
  - a pavement structure of 80 mm asphalt in two 40 mm lifts,
  - 150 mm A-base,
  - 500 mm B-base,
  - and non-woven geotextile.
- The driveway pavement structure will have:
  - 80 mm asphalt,
  - 150 mm A-base,
  - 200 mm B-base,
  - and non-woven geotextile.
- The 1.5 m and 4.0 m wide development active transportation sidewalks will be designed with:
  - 80mm asphalt,
  - 350 mm A-base,
  - and non-woven geotextile.

All topsoil within the ROW will be stripped prior to construction. Seeding and topsoil has been included for the area between the edge of road and the property line.

Following City of Thunder Bay Standards, minimum intersection curb radii are 8.0 m. Curb and gutter grades will be minimum 0.5%. The maximum road gutter grade is 8%. The maximum sidewalk slope is 5%, with a minimum 2% cross slope. The roadway structures will be constructed over a compacted subgrade free of organic or frost susceptible soil. Minimum boulevard grades of 2% are to be used wherever feasible.

Subdivision drainage throughout the proposed development will be provided using concrete curb and gutter roads for all roadways fronting residential lots. The existing and proposed LDS networks described in section 7.0 will convey the curb and gutter flows to the Milanese's Lakes, and side roadway ditches will be used for drainage of the eastern portion of Sandy Beach Road. All roadway drainage will be located within the proposed road ROW.

7.0 LAND DRAINAGE SEWER

There is an existing LDS in the Mario Milanese Place and Elvis Avenue extensions, including some catch basin inlets along the proposed routes of Mario Milanese Place and Elvis Avenue, discharging to Milanese's Lakes east of Mario Milanese Place. The existing LDS requires adjustment of the catch basin elevations to match with the proposed roadway.

Following the City's standards, the LDS will be PVC SDR-35 pipe with 250 mm to 450 mm diameters. When sizing the LDS pipes, the maximum flow depth is 97% of the internal diameter of the pipe. Flow capacity is calculated using a Mannings roughness factor "n" of 0.013 for smooth wall pipe and 0.025 for corrugated metal pipe. All sections of pipe have been designed to maintain a minimum 0.6 m/s scour velocity during peak hour flow to prevent buildup of debris with the

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system. The minimum pipe gradient is 0.5%, and the pipes are sized based on a maximum flow depth of 97%. The LDS will be installed with a minimum of 1.8 m of ground cover.

Table 4: LDS Gravity Pipe Flow at 0.1% Gradient

Diameter	Min % Slope	Flow Rate at 97% Flow Depth
250	0.50	44.81 L/s
300	0.50	72.87 L/s
375	0.50	123.13 L/s
450	0.50	214.85 L/s

Extension of the existing Sandy Beach Road LDS is required, which will discharge into Milanese's Lakes. The proposed LDS pipes are sized in accordance with City of Thunder Bay Standards and Ministry of Transportation (MTO) guidelines to accommodate a 1 in 10-year return storm with a duration of 60 minutes for urban and rural local road LDS pipes and structures. Based on storm intensity, duration, and frequency data from the nearest available rainfall recording station at Rawson Lake Ontario, the 1 in 10-year 60-minute duration storm intensity used is 40 mm per hour.

The estimation of the design flow of the existing LDS pipe on Sandy Beach Road was determined as the maximum capacity of the existing 400 mm diameter pipe at 97% full and 1.45% grade; which is 267.26 L/s. The Stage 3 Subdivision layout along Sandy Beach Road was divided into catchment areas contributing additional runoff to the proposed LDS extension, based on proposed locations of catch basin inlets. The Rational Method was used to calculate peak storm water flow rates, with an assumed post development runoff coefficient of 0.5; which is typical for residential subdivision development.

The layout of the proposed LDS is shown on Plans ML4 and ML5, Appendix A. The table below shows the pipe slope and expected flow rates and velocities for key locations.

Table 5: Proposed LDS Pipe Flow Rates

Upstream LDS CB / Manhole	Downstream LDS Manhole	Diameter	% Slope	Catchment Area (m^2)	Expected 10 Year Return Flow Rate	Flow Depth	Velocity (m/s)
TIE-IN	CB1	400	1.45	N/A	267.26 L/s	97%	2.15
CB1	CB2	450	2.86	6,099.0	301.14 L/s	58%	3.21
CB2	LDS OUTLET	450	7.57	17,594.6	398.89 L/s	51%	4.97

The LDS will be construction is to be in accordance with City of Dryden, City of Thunder Bay, and OPSS specifications and standards.

Various approvals are required (DFO, MNRF, LRCA), with reference to City of Thunder Bay section 2. 2.3.3 and OPSS for the proposed LDS design and construction requirements.

8.0 LIFT STATION AND FORCEMAIN

The existing lift station location on Sandy Beach Road was installed around 1995 but was never commissioned. The Lift station was complete with internal metal piping and a 150 mm diameter PVC C900 forcemain. The internal piping has corroded and will be replaced with new stainless-steel piping and valves. The valves will have their operating rods extended through the lift station lid, to allow operation from the surface.

It is proposed to install 4 hp submersible pumps, with each pump capable of pumping 9.5 L/s at 17.8 m of head. This would meet the peak wet weather flow of 8.8 L/s. Together, both pumps would produce 15.2 L/s at 19.9 m of head.

The existing forcemain is 150 mm diameter PVC C-900 pipe with an inside diameter of 154.7 mm. At the single pump flow of 9.5 L/s, the velocity in the existing forcemain will be 0.50 m/s. This is less than the recommended cleaning velocity of 0.6 m/s from the *Recommended Standards for Wastewater Facilities (Ten State Standards), 2014*. Therefore, the pump control panel will be programmed to run both pumps periodically to achieve cleaning velocities. When both pumps run the velocity in the forcemain will be 0.81 m/s.

Based on measurements of the existing lift station cover, the proposed pumps would fit through the pump hatch. Several modifications to the existing lift station lid are required, including coring holes for the plug valve operators, installing a davit for a pump lifting hoist. A fiberglass platform and fiberglass ladders will be installed in the lift station for maintenance access.

It is assumed that the electrical service will be 600V, three phase, as that was used in the original lift station and forcemain project. The voltage and size of the service will be confirmed prior to finishing detailed design.

9.0 COST ESTIMATE

An itemized budget class "A" cost estimate of construction and non-construction costs is presented in Appendix B. The following is a summarization of the capital costs for each area of required works for a 2024 construction season. The costs for each year after this projection period should be inflated per prevailing inflation and market conditions.

Table 6 - Class C Cost Estimate – Mario Milanese Subdivision Stage 3

Description	Total
Mobilization, Insurance, and Bonding	$184,000.00
Water Works	$706,250.00
Sanitary Sewer Works	$1,027,050.00
Road Works and Drainage	$1,934,568.00
Subtotal Construction	**$3,851,868.00**
Contingency (5%)	$192,593.40
Engineering (8%)	$308,149.44
HST (13%)	$500,742.84
Total	**$4,853,353.68**

Yours truly,

JR Cousin Consultants Ltd.

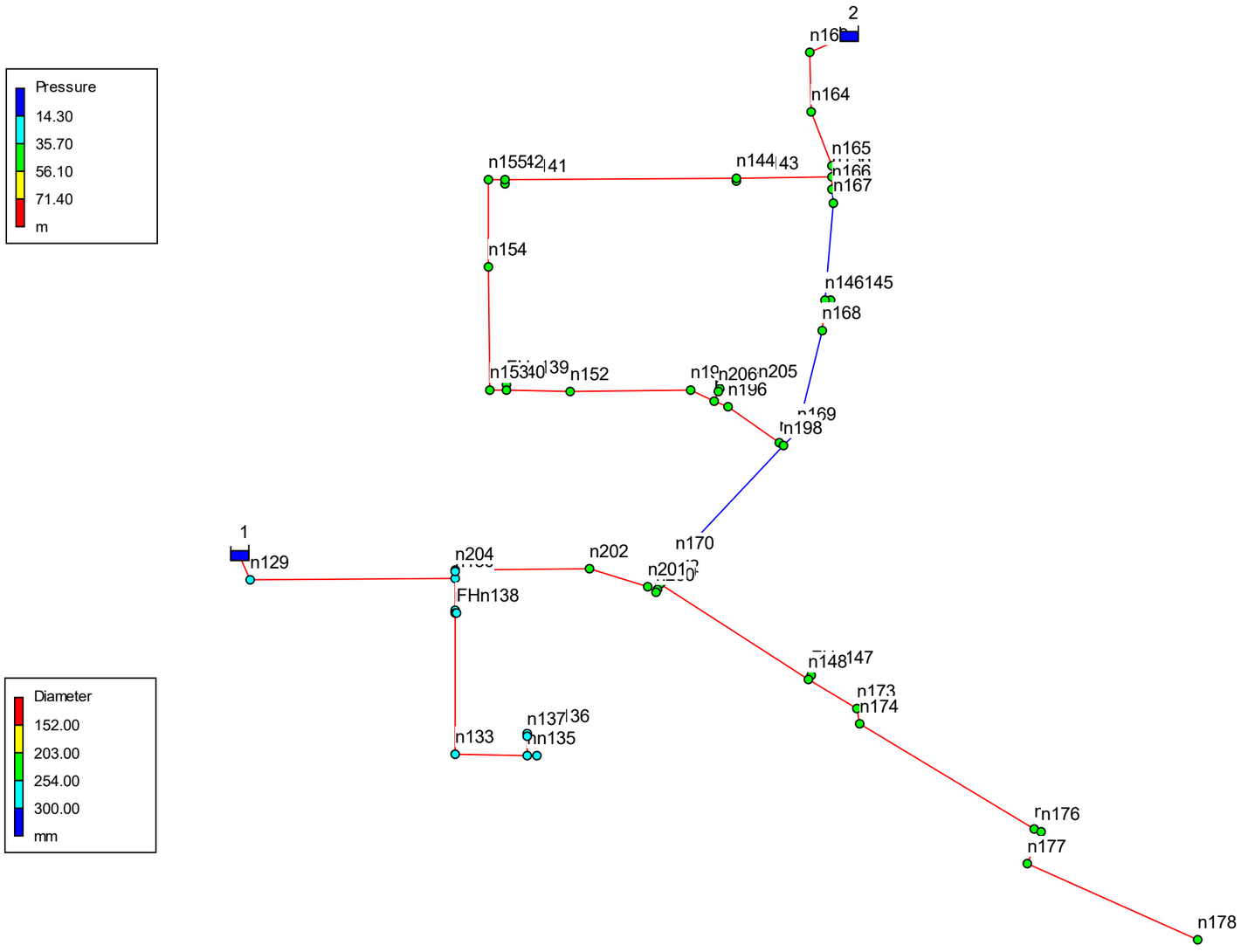
Scott Blonski, P. Eng.
Municipal Engineer

Matt Fisher, P. Eng.
Senior Municipal Engineer

APPENDIX B

D-536.02 Mario Milanese Stage III

Day 1, 12:00 AM



EPANET 2.2 - Max Day Demand

D-536.02 Mario Milanese

Day 1, 12:00 AM

