SEWPCC Upgrading/Expansion
Conceptual Design Report

SECTION 12 - Outfall and Yard Piping

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12.0 Outfall and Yard Piping

12.1 INTRODUCTION

This section looks at the realignment of the existing onsite watermains and wastewater sewers infrastructure in order to accommodate the proposed SEWPCC expansion. The section also provides recommendations on the issue of increasing the hydraulic capacity of the outfall via a bypass/secondary outfall and the requirement by Manitoba Conservation to provide continuous flow and quality monitoring of the effluent leaving the plant.

12.2 REALIGNMENT OF THE "ON-SITE" WATERMAINS AND WASTEWATER SEWERS TO ACCCOMODATE THE SEWPCC EXPANSION

12.2.1 Watermains

It can be seen in Figure 12.1 that the proposed expansion of the SEWPCC facility results in some of the new structures being constructed near or on top of some of the existing onsite watermains. It is therefore required that some of the existing watermain be abandoned and or replaced to accommodate the proposed expansion. The proposed modifications to the onsite watermain system are shown in Figure 12.2.

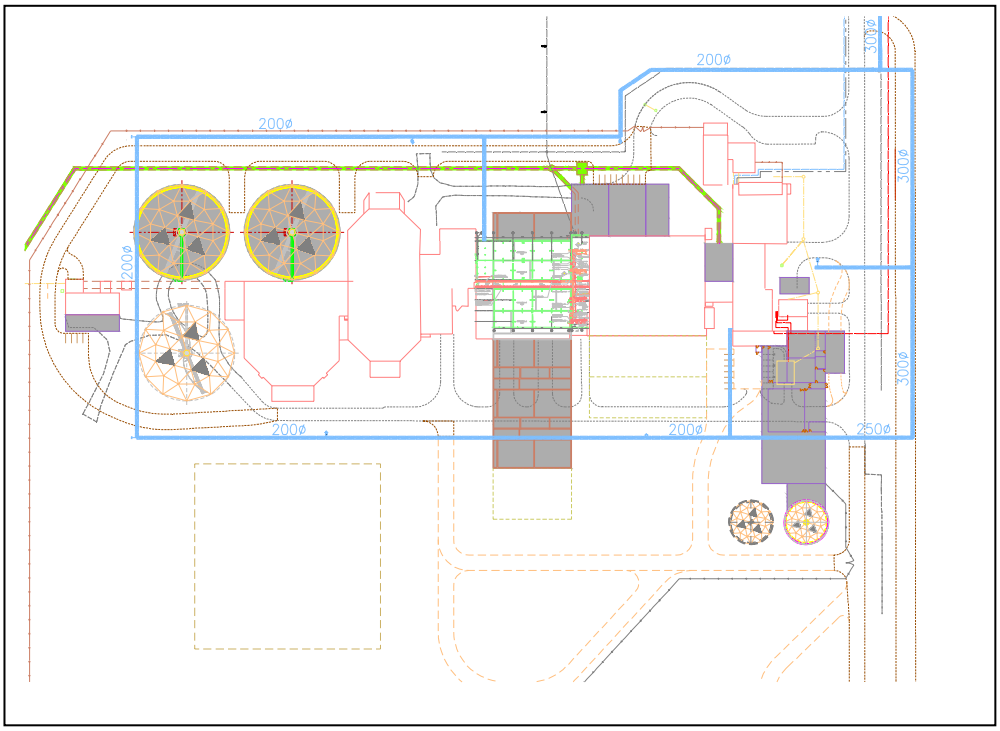


Figure 12.1: Existing "On-Site Watermains

The modifications include:

- Abandoning the north/south 200 mm watermain on the west side of the site and extending the watermain loop to the west side of the UV disinfection building.
- Abandoning a portion of the east / west 200 mm watermain on the south side of the site and extending the watermain loop to the south side of the proposed perimeter roadway.

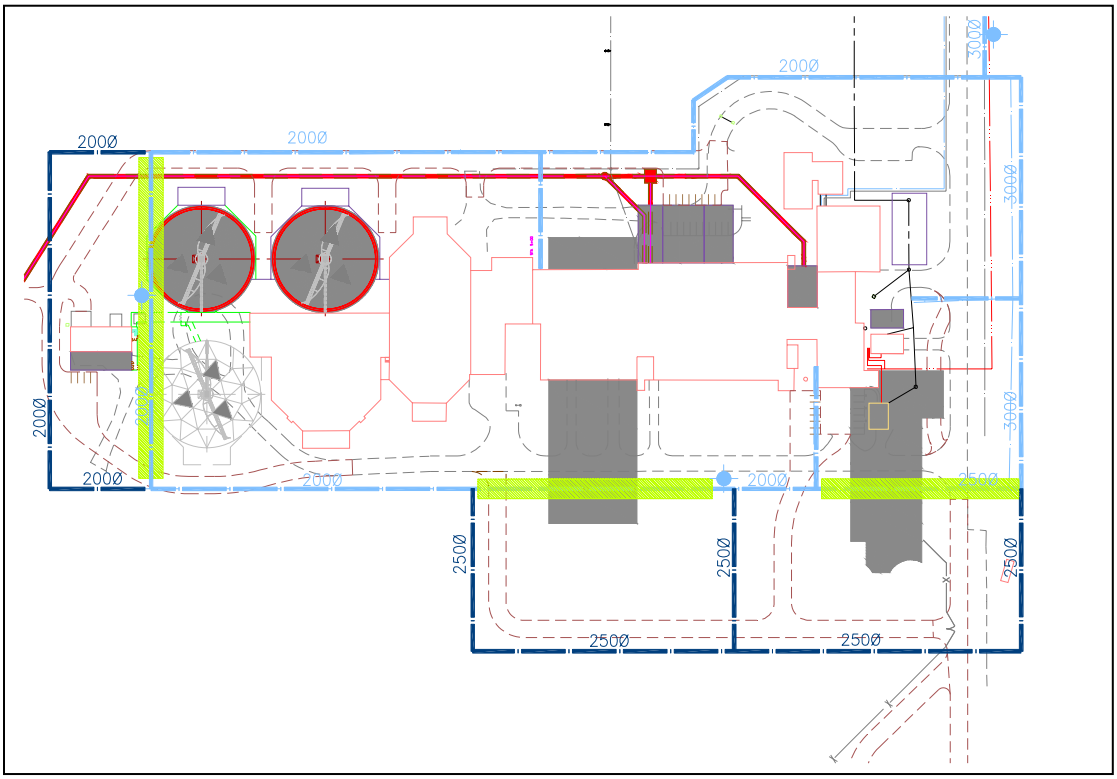


Figure 12.2: Revisions to "On-Site Proposed Watermain

Fire Flow is described as the flow rate of a water supply, measured at 20 pounds per square inch (psi) (1381 KPa) residual pressure, that is available for fire fighting[1]. Figure 12.3 shows the maximum fire flows available from the existing watermain system. These values are based on the simulated hydrant flows produced by the City of Winnipeg's Water and Waste Department.

It can be seen that the available fire flows range from (180 l/s) 2853 USGPM to (258 l/s) 4089 USGPM. This amount of available fire flow at the plant is fairly significant considering the plant is located at the southern edge of the City of Winnipeg's water distribution system.

[1] 2003 International Fire Code - Appendix B - Fire Flow Requirements for buildings.

A calculation of the required fire flow for the SEWPCC building with the proposed expansion was performed using the Fire Underwriter's Survey criteria. This resulted in a calculated fire flow requirement of 5,811 USGPM (367 l/s). In general a flow of 5,811 USGPM (367 l/s) would be extremely hard to achieve from the City of Winnipeg's water distribution system, if not impossible.

The Fire Underwriters criteria states that in cases where the resultant fire flows are grossly overstated, "the properties should preferably be modified in hazard to reduce the required flow as part of a coordinated community fire protection system". The resultant fire flows noted above corresponds with this case and therefore should be reduced.

The SEWPCC building is constructed out of mainly non-combustible materials (concrete and brick), the main contents of the building are treated and non-treated sewage, and there are very few people in the building at any time.

Considering that the flows delivered to the SEWPCC are in the upper range of what any municipal water distribution system is capable of delivering (260 l/s), the existing flows delivered to the SEWPCC are acceptable and no upgrades to the water distribution system are recommended.

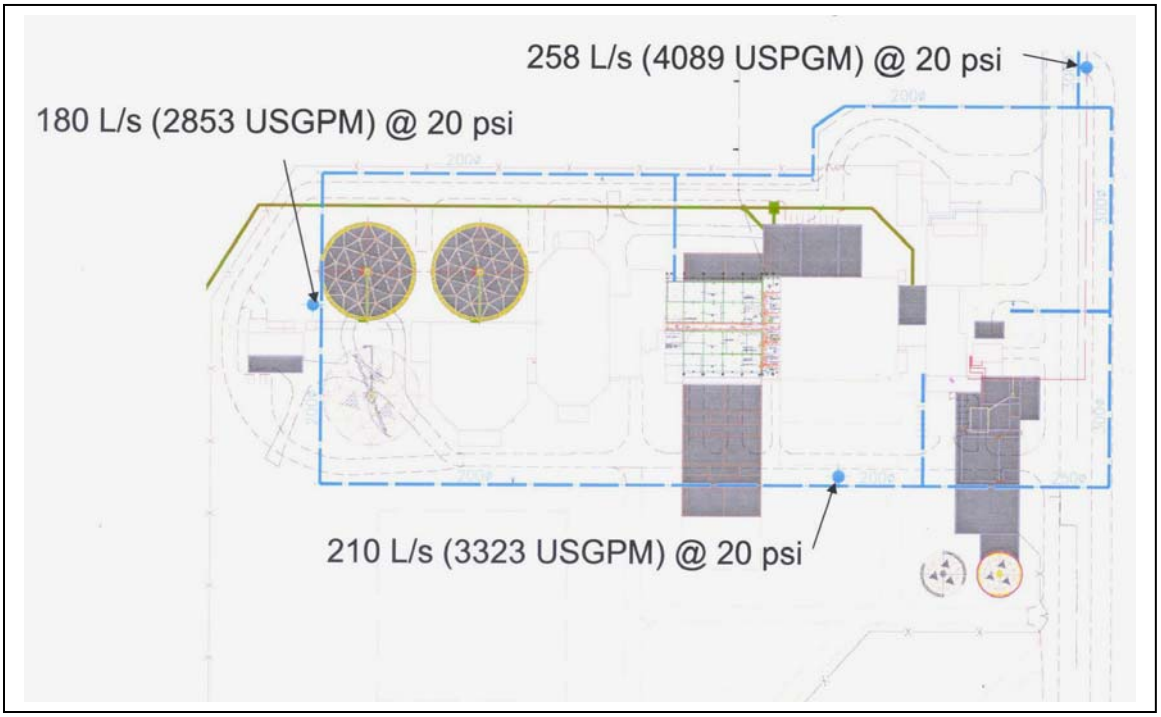


Figure 12.3: Available Fire Flow

Figure 12.4 shows the hydrant spacing for the proposed expansion. Four (4) hydrants were added to provide complete hydrant coverage around the building. Both the existing fire hydrants and the proposed fire hydrants are located next to the perimeter access road and are easily accessible by the Winnipeg Fire Department.

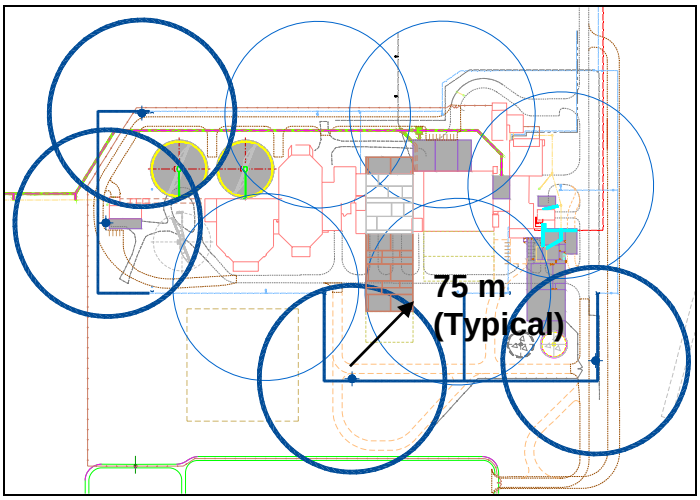


Figure 12.4: Existing and Proposed Fire Hydrant Spacing

12.2.2 Wastewater Sewer

It can be seen in Figure 12.5 that the proposed expansion to the SEWPCC site results in some of the new structures being constructed near or on top of some of the existing onsite wastewater sewers. It therefore will be a requirement that some of the existing wastewater sewers be abandoned and/or replaced to accommodate the construction of the new buildings.

Figure 12.5 also shows the proposed changes to the wastewater sewers that will allow the expansion.

These changes include removing 25 m of the 200 mm PVC sewer that serviced the “Chemical Storage Building” and removing and realigning the 150 mm sewer service to the “Service Building”. Figure 12.5 also shows the natural gas lines that would be required to be removed to accommodate the construction of the proposed electrical/odor building.

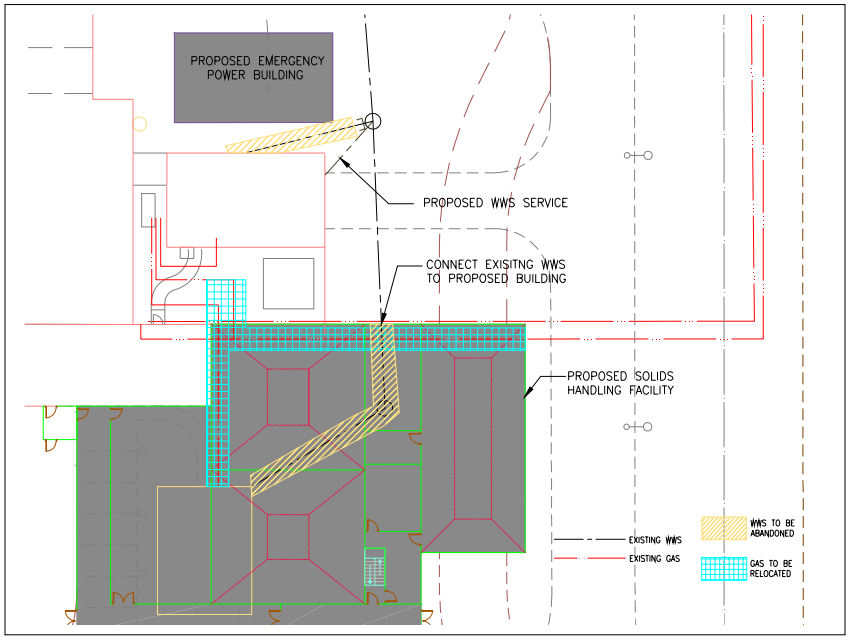


Figure 12.5: Existing Wastewater Sewer and Proposed Wastewater Sewer Realignments

12.2.3 Summary

A summary of the work required to realign the existing onsite watermain and wastewater infrastructure to accommodate the proposed SEWPCC expansion can be found in the Table 12.1.

Table 12.1 - Required Watermain and Wastewater Work

Total length of Watermain abandoned	320 m
Total length of new Watermain to be installed	665 m
New Hydrants added	4
Total length of new Wastewater Sewer to be removed	40 m
Total length of new Wastewater Sewer to be installed	15 m

The total cost for the proposed watermain realignments is $489,000. This includes the following markups – 10% for contingencies, 15% for engineering, 30% for an estimating allowance and 20% for inflation.

The total cost for the proposed wastewater sewer realignments is $35,000. This includes the following markups – 10% for contingencies, 15% for engineering, 30% for an estimating allowance and 20% for inflation.

12.3 OUTFALL BYPASS PIPE

12.3.1 Background

The capacity of the outfall needs to be large enough to convey the recommended total plant pumping capacity of 415 MLD to the river. Complicating this is Manitoba Conservation's requirement in the SEWPCC licence that UV Disinfection for up to 175 MLD of flow must be maintained at all times.

High river levels decrease the capacity of the existing outfall by decreasing the amount of available hydraulic head between the river and the plant. In the PDR it was recommended that a 2100 mm Diameter "Twinned" Outfall pipe be constructed in order to maintain operation of the UV Disinfection Facility during high river levels and high flows from the plant.

Section 7 - Headworks provides details on how high flows (415 MLD) are handled at the SEWPCC. A summary is as follows:

1. At the total pumping capacity of 415 MLD, 215 MLD of flow will be diverted to the proposed 2100 mm diameter bypass pipe following primary treatment by a vortex grit removal system and fine screen.

2. At a point approximately 50 metre downstream of the start of the bypass pipe, 100 MLD of effluent will flow out of the bypass pipe and into the bioreactor, 10 metres downstream of this point 125 MLD will flow back in to the bypass pipe from the primary settling tank (PST).

This results in a net flow of 240 MLD of effluent flowing through the remaining length of the bypass pipe until it connects back into the original outfall pipe.

12.3.2 Outfall Model

The performance of the existing outfall pipe and the bypass proposed in the PDR was modelled using the modelling software InfoWorks® 9.0 CS. Refer to Section 3.4 for modelling assumptions.

The maximum total pumping capacity of 415 MLD of the plant was the governing flow to determine how the existing outfall pipe and proposed bypass performed under high river levels.

The 415 MLD flow was split into 240 MLD coming from the proposed 2100 mm bypass pipe and the remaining 175 MLD of flow coming from the UV Disinfection Facility into the original 1800

mm outfall. The 2100 mm bypass connects back into the 1800 mm pipe approximately 600 meters west of the UV Building. Figure 12.6 shows a schematic of the proposed outfall bypass.

The proposed UV Disinfection Facility expansion was included in the InfoWorks® outfall model. The limiting factor for the maximum amount of flow through the outfall is the depth of flow at the UV Disinfection Facility. In the existing facility, the UV equipment can not operate when the (HGL) Hydraulic Grade Line downstream of the UV weir is higher than 230.26 m.

As there is a requirement to maintain the UV treatment of secondary flows year round, the HGL downstream of the UV weir was used as the critical upstream water elevation.

Trojan Technologies is the company that supplied the original UV equipment and is the preferred supplier for the UV facility expansion. Trojan was contacted to see if the operation of the UV facility could be adjusted to allow for a higher HGL downstream. Trojan responded that the maximum downstream HGL could be raised to 230.55 with some adjustments to their system. These adjustments are described in the Section 11 - Effluent Disinfection.

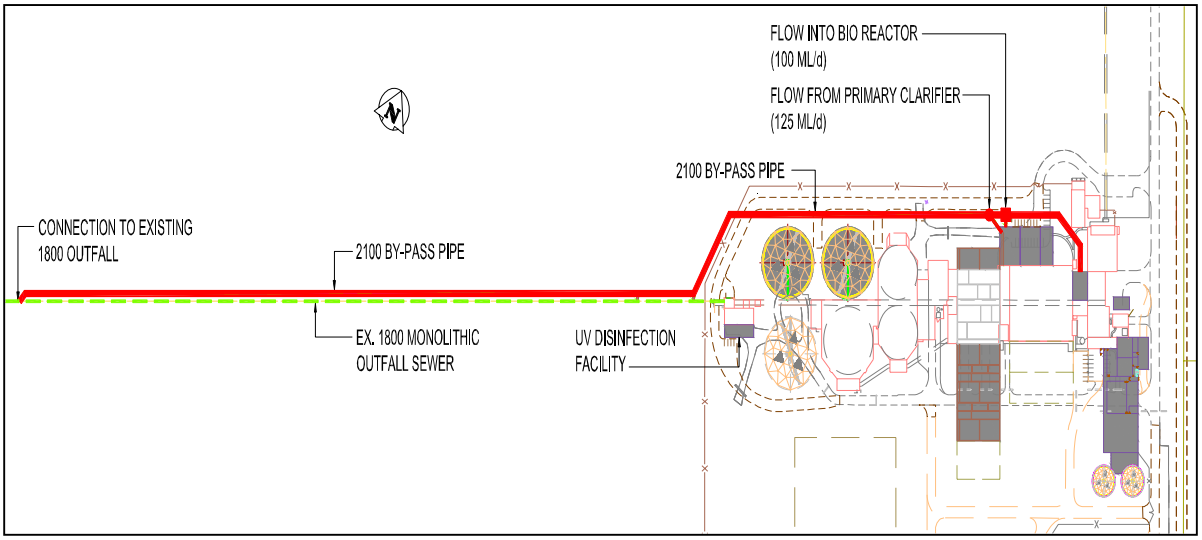


Figure 12.6: Proposed Outfall Bypass

12.3.3 Red River Levels

As stated earlier in this report one of the major factors affecting the capacity of the outfall is the level of the Red River at the outfall. Table 12.2 shows the Red River water levels at the SEWPCC for the various spring return periods and for the 14 ft. James “Rule 4 “summer level (Manitoba Water Stewardship, Memorandum, November 19, 2004). The Floodway summer operations Rule 4 stipulates that the water level at James Avenue has to be at the 14 ft. (James Avenue datum) and rainfall has to be imminent prior to operation of the Floodway.

Table 12.2 - River Flood Elevations in South End Area

Return Period	James Ave.	Bishop Grandin Bridge	St Mary's Outfall	SEWPCC Outfall	Comment
	(Ft above datum)	Spring Events Water Level Elevations in m ASL			
5	18.9	227.8	227.9	228.1	
10	19.7	228.1	228.2	228.4	
20	19.8	228.1	228.2	228.4	
33	22.6	228.3	228.5	228.7	
50	24.6	229.4	229.5	229.8	
100+	23.9	230.8	230.9	231.2	Close to 1997 Event
Event type	Summer Events Water Level Elevations in m ASL				
NORMAL	7	223.6	223.7	223.7	
14 Ft James	14	226.9	227.0	227.2	Rule 4 Trigger
26-Jul-75	15.9	227.5	227.6	227.8	
16-Aug-93	17.0	227.9	228.0	228.2	
6-Jun-04	15.0	227.3	227.4	227.6	
3-Jul-05	20.7	229.1	229.3	229.4	

Source: Grant Mohr, July 17, 2006

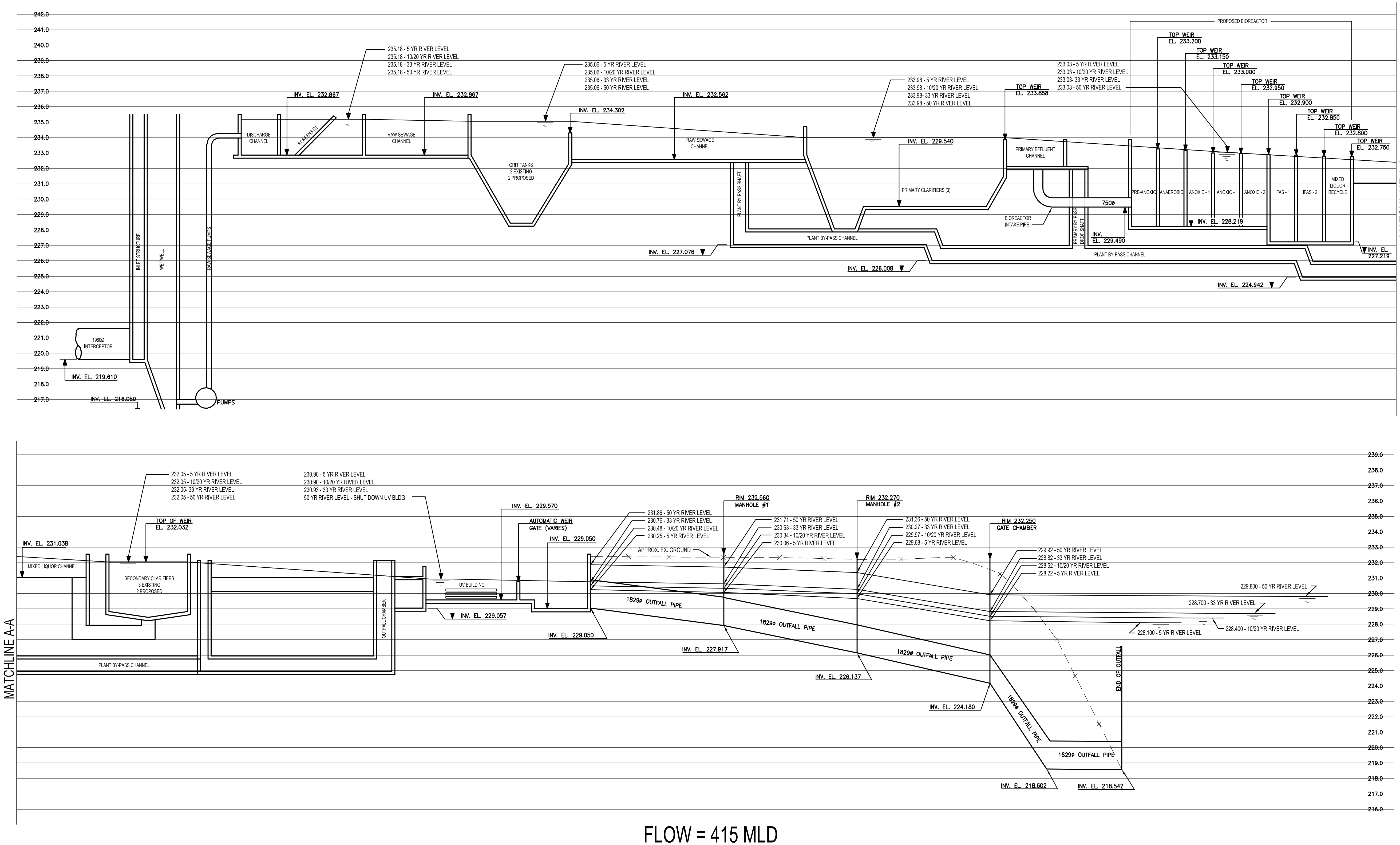
12.3.4 Simulation Results

The InfoWorks® model of the twinned outfall was run with various river levels at the maximum pumping capacity of 415 MLD to determine what the maximum river level can be while maintaining operation of the UV Disinfection facility.

Table 12.3 shows the HGL at the UV Building at the maximum flow of 415 MLD and at various river levels. Figure 12.7 shows the HGL at various river levels at the maximum plant pumping capacity of 415 MLD. At a river level greater than a 50 year return period, there would be potential for the HGL to be higher than the ground elevation. The use of sealed manhole lids to prevent effluent from surcharging on to the surface would be implemented.

Table 12.3 - Outfall Capacities for Various River Levels

Flow (MLD)	River Level (m)	HGL @ UV Bldg. (m)	River Return Period	Comments
415 (175 UV)	227.85	230.26	Less than a 5 year	Original Trojan UV criteria
365 (175 UV)	228.4	230.26	20 year	Original Trojan UV criteria
415 (175 UV)	228.4	230.55	20 year	Modified Trojan UV criteria



FLOW = 415 MLD

NOTES:
1. NEW VORTEX GRIT CHAMBERS NOT SHOWN, FOR CLARIRITY.
2. NEW BY-PASS CONDUITS ARE NOT SHOWN FOR CLARITY

APEGM
Certificate of Authorization
Stantec Consulting Ltd.
No. 1301 Expiry: April 30, 2009

LOCATION APPROVED
UNDERGROUND STRUCTURES

SUPV. U/G STRUCTURES COMMITTEE | DATE

NOTE:
LOCATION OF UNDERGROUND STRUCTURES AS SHOWN ARE BASED ON THE BEST INFORMATION AVAILABLE BUT NO GUARANTEE IS GIVEN THAT ALL EXISTING UTILITIES ARE SHOWN OR THAT THE GIVEN LOCATIONS ARE EXACT. CONFIRMATION OF EXISTENCE AND EXACT LOCATION OF ALL SERVICES MUST BE OBTAINED FROM THE INDIVIDUAL UTILITIES BEFORE PROCEEDING WITH CONSTRUCTION.

B.M. ELEV.

NO.	REVISIONS	DATE	BY

Stantec Consulting Ltd.
905 Waverley Street, Winnipeg, Manitoba
Tel 204-489-5900 Fax 204-453-9012

DESIGNED BY	–	CHECKED BY	–
DRAWN BY	–	APPROVED BY	–
HOR. SCALE: VERTICAL:	–	RELEASED FOR CONSTRUCTION:	
DATE	08/11/26	DATE	

ENGINEER'S SEAL

TENDER NO. 2007-

Winnipeg

THE CITY OF WINNIPEG
WATER AND WASTE DEPARTMENT

SOUTH END WATER POLLUTION CONTROL CENTRE

H.G.L. FOR VARIOUS RIVER LEVELS
AT A PLANT FLOW RATE OF 415 MLD

CITY DRAWING NUMBER: FIGURE 12.7

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Table 12.3 shows that the outfall with the proposed bypass, can convey a maximum flow of 415 ML/day while maintaining and the UV Disinfection process operating at the existing UV downstream HGL of 230.26 m up until a river level of 227.85 m. This is equivalent to less than a 5 year River Return Period.

The table also shows that at a 20 year River Level (228.4 m) and the UV Disinfection process operating with the existing UV downstream HGL of 230.26 m the outfall has a capacity of 365 MLD.

However, with the downstream HGL at the UV facility raised to 230.55 the capacity of the outfall while maintaining UV Disinfection increases to 415 MLD at a 20 year River Level of 228.4 m. This is the recommended configuration. Refer to Section 13 - Hydraulic Profile for further modeling results of various flow scenarios.

12.3.5 Construction of the 2100 mm Bypass Pipe

The 2100 mm bypass pipe is proposed to be a Class 3 – Reinforced Concrete Pipe with a maximum depth of bury of the pipe of 5.5 m. The soil investigations performed for this expansion as well as the soils investigation performed for the construction of the original 1800 mm outfall pipe indicated a minimum depth of 9.0 m of clay along the proposed bypass alignment. Figure 12.8 shows a summary of the depth of clay in the area based on the two soil investigations.

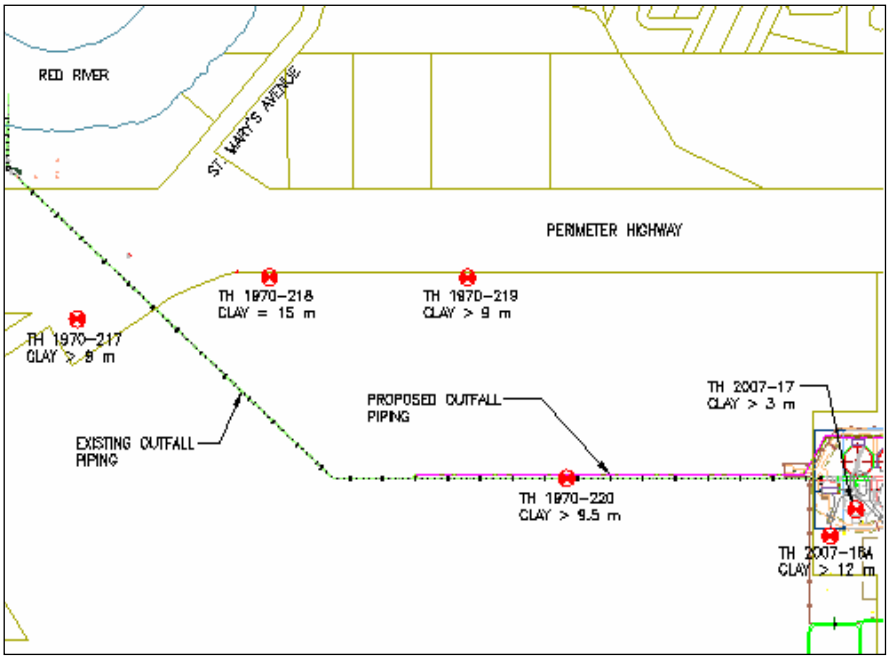

Figure 12.8: Summary of Clay Depths

The outfall pipe would be constructed by open cut methods. The maximum manhole spacing is recommended to be 250 metres.

The total cost for the proposed 2100 mm bypass/outfall pipe is $8,950,000 this includes the following markups – 10% for contingencies, 15% for engineering, 30% for an estimating allowance and 20% for inflation.

12.4 OUTFALL - FLOW AND QUALITY MONITORING

In accordance with License No. 2716 issued March 3, 2006, there is a requirement by Manitoba Conservation to obtain effluent flow and quality data from the SEWPCC outfall. The sampled effluent flow must represent the flow entering the river and thus must be the blended effluent flow from both the bypass pipe and the UV Disinfection facility.

To accommodate this requirement a monitoring station building is required. The building must be secure, heated and direct access to the outfall line must be provided to the Manitoba Conservation Environment Officer. Effluent flows ranging from 22 MLD to 415 MLD must be measured and the sampling device must be flow-proportional. Manitoba Conservation will provide the ISCO sampler while the City of Winnipeg must provide the flow measurement device.

To achieve the Manitoba Conservation requirements, the final effluent and bypass flows must be combined in a single pipe for a length adequate to obtain accurate flow measurements. This will require modifications to the existing outfall. Figure 12.9 is a schematic that shows the proposed modifications to the outfall / bypass outfall.

The changes would include the connection of the existing 1800 mm outfall and the proposed 2100 mm outfall west of the UV disinfection facility via a pair of cast in place concrete chambers. The chambers would each have a pair of sluice gates. The sluice gates or stop logs would be used to divert the combined flow from the 1800 mm pipe and 2100 mm pipe into the 2100 mm pipe for a distance of 50 metres. Following the downstream chamber the flow would find a natural hydraulic balance between the two pipes. At a point approximately 600 meters west of the UV building where the pipes would connect into the single 1800 mm pipe. The Inflow modeling of the outfall and the proposed bypass has shown that the total length of bypass pipe west of the UV building can be reduced from the original 1000 meters stated in the Preliminary Design Report while still achieving the required reduction in hydraulic head loss.

The sluice gates or stop logs between the two chambers on the 1800 mm pipe would be closed during normal operations but would make this pipe available during maintenance procedures on the monitoring station.

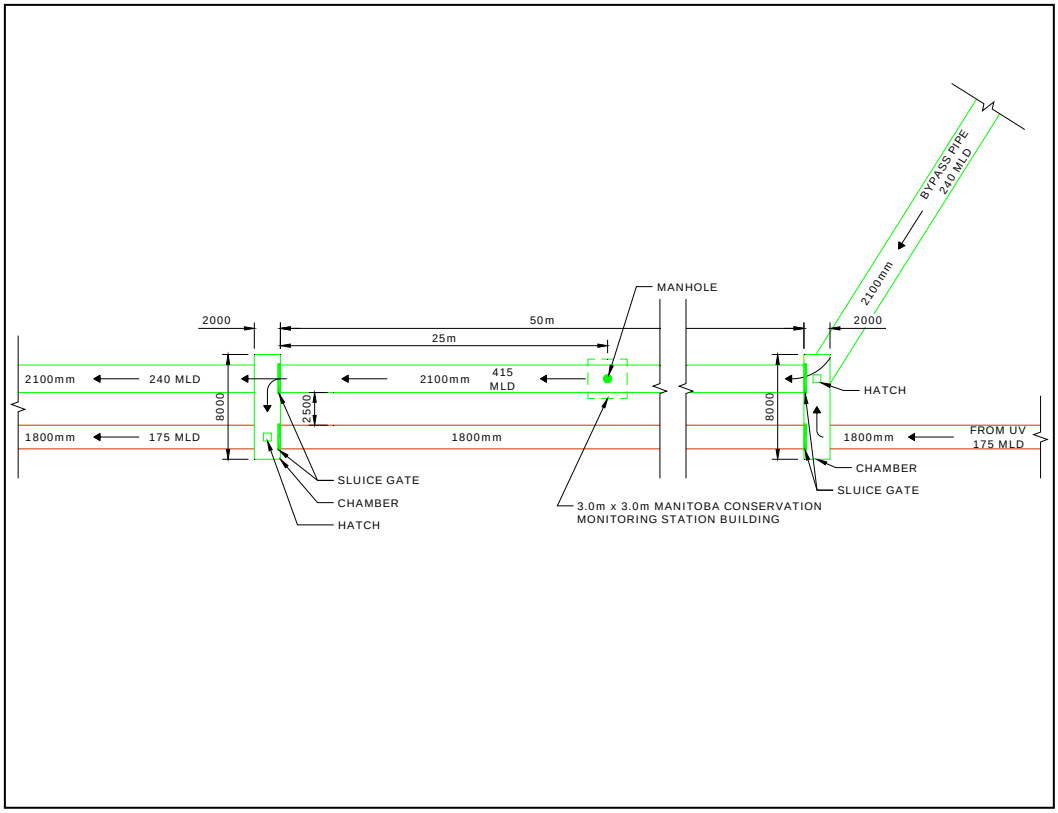

Figure 12.9: Schematic Showing Proposed Modifications to Allow Manitoba Conservation Monitoring

12.5 PROPOSED MONITORING STATION DETAILS

The proposed monitoring station would be approximately 3 m x 3 m in size and would be built to provide a secure, heated building with direct access to the outfall line for the Manitoba Conservation Environment Officer. This is also where the City Environmental Standards Division would obtain their daily samples.

The building construction is proposed to be concrete block complete with a limestone exterior. The building will have general heating, venting and electrical service. A flow measurement interface module and sampler would be located in the building. The building would be located over a pipe access manhole. The proposed plant fencing would be modified to include the monitoring station, driveway and parking area within the plant's boundary.

Figure 12.10 shows a schematic of the proposed site plan for the monitoring station

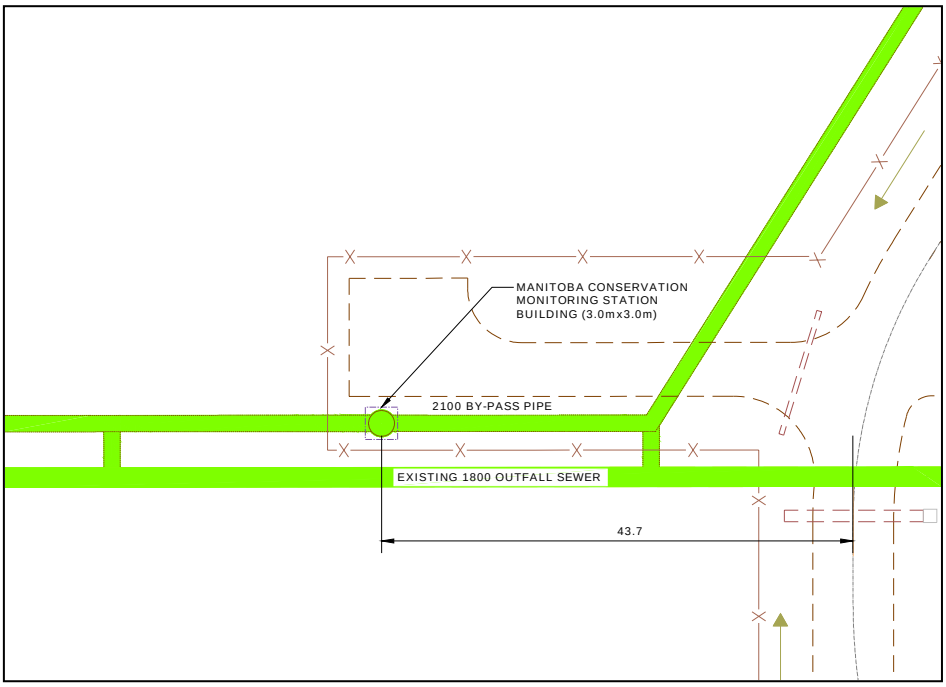

Figure 12.10: Proposed Monitoring Station Site Plan

12.6 FLOW METER

Manitoba Conservation requires that the flow measurement be accurate within two (2) percent. Manitoba Conservation also requires that the flow meter be calibrated every two (2) years.

The flow meter that best meets the performance requirements for flow ranges from 22 MLD to 415 MLD is the ADFM® Pro20 Velocity Profiler Flow Meter by Teledyne Isco shown in Figure 12.11. This flow meter is permanently mounted in the bottom of the pipe and can measure full or partially full pipe flow. The meter calculates the flow based on four (4) Pulse-Doppler velocity measures and one (1) ultrasonic depth sensor. A schematic of the meter setup in the pipe is shown in Figure 12.12. The meter provides two (2) percent accuracy and has a digital / analog interface that provides an Ethernet connection. The meter can be calibrated in one day using dye testing.

This flow meter requires a minimum of 225 mm of liquid in the pipe to operate. A pressure sensor will be added to provide flow readings at levels less than 225 mm using an algorithm.

The InfoWorks® model shows that at the minimum flow of 22 MLD of flow there is a depth of flow of 270 mm in the 2100 mm pipe.

Figure 12.11: ADFM® Pro20 Velocity Profiler Flow Meter by Teledyne Isco

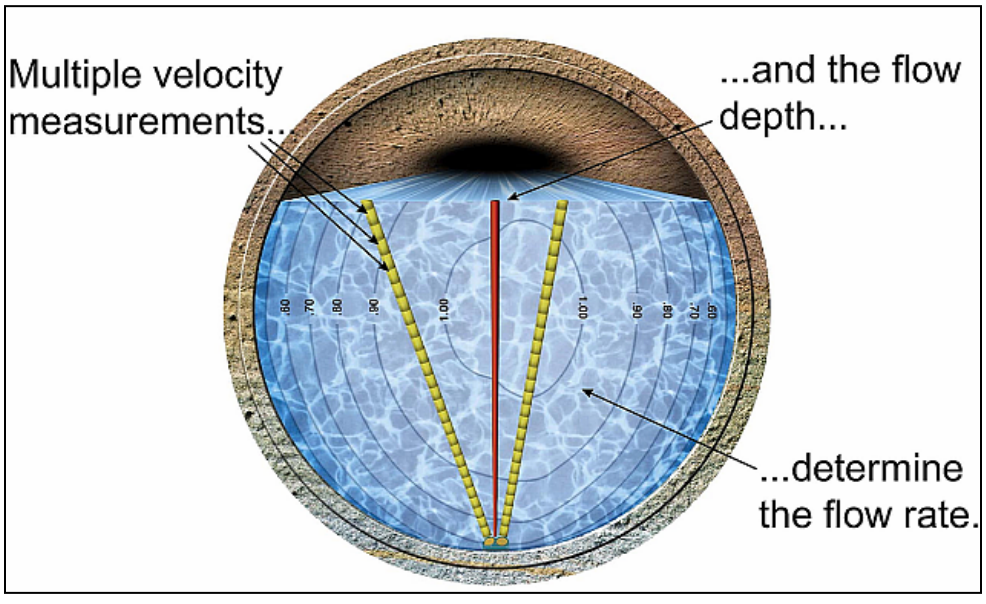

Figure 12.12: Flow Meter Set Up Inside Pipe

12.7 SUMMARY AND RECOMMENDATIONS

12.7.1 Watermain and Wastewater Sewer Realignment

The proposed expansion to the SEWPCC site results in some of the new structures being constructed near or on top of some of the existing onsite watermains and wastewater sewers. It is therefore recommended that some of the existing watermain and wastewater sewer be abandoned and or replaced to accommodate the proposed expansion.

The estimated total cost for the proposed watermain realignments is $489,000 and for the proposed wastewater sewer realignments is $35,000. This includes the following markups – 10% for contingencies, 15% for engineering, 30% for an estimating allowance and 20% for inflation.

12.7.2 Outfall Bypass

It is recommended that 1000 metres of 2100 mm Diameter “Twinned” Outfall / Bypass pipe be constructed in order to maintain operation of the UV Disinfection Facility during high river levels and high flows from the plant.

This will allow 415 MLD of flow to be conveyed to the river while maintaining operation of the UV Disinfection Facility using the revised Trojan operating criteria at a 20 year River Level of 228.4 m.

The total cost for the proposed 2100 bypass/outfall pipe is $8,950,000 this includes the following markups – 10% for contingencies, 15% for engineering, 30% for an estimating allowance and 20% for inflation.

12.7.3 Outfall - Flow and Quality Monitoring

In order to comply with the Manitoba Conservation license an outfall effluent monitoring station must be added to the SEWPCC expansion.

The sampled effluent flow must represent the flow entering the river and thus must be the blended effluent flow from both the bypass pipe and the UV treated flow. Therefore, it is recommended that bypass outfall be modified by the connection of the existing 1800 mm outfall and the proposed 2100 mm outfall west of the UV disinfection facility via a pair of cast in place concrete chambers. The chambers would each have a pair of sluice gates. The sluice gates would be used to divert the flow from the 1800 mm pipe and the 2100 bypass pipe into the 2100 mm for 50 metres and then back to the 1800 mm and the 2100 mm bypass pipe.

A monitoring station consisting of a wood frame building with a limestone exterior that would match the UV building. The building would be designed to include heating, venting and electrical. A flow measurement interface module and sampler would be located in the building.

The building would be located over the pipe access manhole. The proposed plant fencing would be modified to include the monitoring station, driveway and parking area.

The flow meter selected that best meets the performance requirements is the ADFM® Pro20 Velocity Profiler Flow Meter by Teledyne Isco. This flow meter is permanently mounted in the bottom of the pipe and can measure full or partially full pipe flows from 22 MLD up to 415 MLD.

The total cost for the proposed Monitoring Building complete with flow meter, the two (2) outfall bypass diversion chambers and a gravel driveway and parking area is $1,200,000 this includes the following mark-ups – 10% for contingencies, 15% for engineering, 30% for an estimating allowance and 20% for inflation.