Fly Creek Pumping Station

Inspection

Raisin Region
Conservation Authority

January 30, 2019

Final Report

Abstract

The Fly Creek flood control system comprises a pumping station; 300,000 m^3 retention pond and overflow structure; 3000 m of concrete box culvert; 2000 m of open channel, and numerous gabion structures. The system provides flooding protection for approximately 25% of the City of Cornwall (population 46,000).

An inspection was undertaken in 2018 to note deficiencies and prioritize maintenance activities.

The following items were recommended for action:

1. Continue / implement overall maintenance and inspection program of all components.
2. Refurbish Pump #1.
3. Refurbish Pump #2.
4. Monitor gasket leak of Pump #3.
5. Replace Soleplates for Pump #1, Pump #2, Pump #3.
6. Clean motor windings for Motor #1, Motor #2, Motor #3.
7. Overhaul Motor #3.
8. Repair hour meters on Pump #2 and Pump #3 motor control cabinets.
9. Retrieve dewatering pump and service / repair.
10. Reinstate wetland valve/pump actuator.
11. Repair seepage issue with wetland.
12. Repair automatic transfer switch (not turning off diesel engine upon restored power).
13. Implement human control interface on SCADA system.
14. Implement alarm notifications on SCADA system.
15. Calibrate ultrasonic depth transmitter.
16. Repair flashing on main air inlet.
17. Repair or replace surveillance camera; install interior monitoring cameras.
18. Recondition the pond overflow to ensure proper operation.

Suggested Citation

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Primary Author(s): Phil Barnes.

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MNRF - Ontario Ministry of Natural Resources and Forestry
MCC - Motor Control Centre
RRCA - Raisin Region Conservation Authority
WECI - Water and Erosion Control Infrastructure

Acknowledgements

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Introduction

The Fly Creek flood control system comprises a pumping station, 300,000 m^3 stormwater retention pond and overflow structure, 3000 m of concrete box culvert, 2000 m of open channel and numerous gabion structures. The system provides flooding protection for approximately 25% of the City of Cornwall (population 46,000).

The RRCA is responsible for the entire Fly Creek flood control system. This includes all inlets, a syphon structure near Ontario Street, and fencing near Fennel Crescent residential area. The RRCA is also responsible for the entire open channel upstream and downstream of the pumping station up to the outlet at the Donihee Drain which includes gabion structures, culverts, and overflow structures. The complete infrastructure is integral to the flood control project.

The Fly Creek flood control system was a phased construction project throughout the 1980s and 1990s. The total cost was around $20 Million. The project was made possible through heavy investment from the province and the municipality. The system is estimated to save annual flood damages in the range of $0.5 Million to $2.0 Million (in 2018 dollars, updated from TSH 1991[1]).

In recent years, operation costs have increased due to failing components (pumps, motors, control system) as well as maintenance requirements on channels and inlet structures.

A complete operations and maintenance procedures review was undertaken. The results of which will minimize overall expenditures through pro-actively identifying faults in the system and addressing them before catastrophic failure occurs. The review included all electrical systems, pumping systems, backup generating system, operating procedures, pond maintenance, channel maintenance and an assessment of provincial compliance approval conformity.

System Components

For the purposes of this inspection, the following components were inspected:

- Motor Control Centre
- Primary Pumping System (Pumps, Motors, Control Panels)
- Dewatering Pump
- Wetland (Valve Actuator, Fountain Head, Wetland embankment)
- Emergency Power System (Diesel Engine, Generator Set, Transfer Switch)
- Fuel Storage System
- SCADA System
- Vents and Exhaust Components
- Surveillance Camera
- Inlet Screen
- Outlet Channel

[1] Fly Creek Flood Damage Update, City of Cornwall, Totten Simms Hubicki Associates, January 1991

Figure 1: Fly Creek Drainage Area

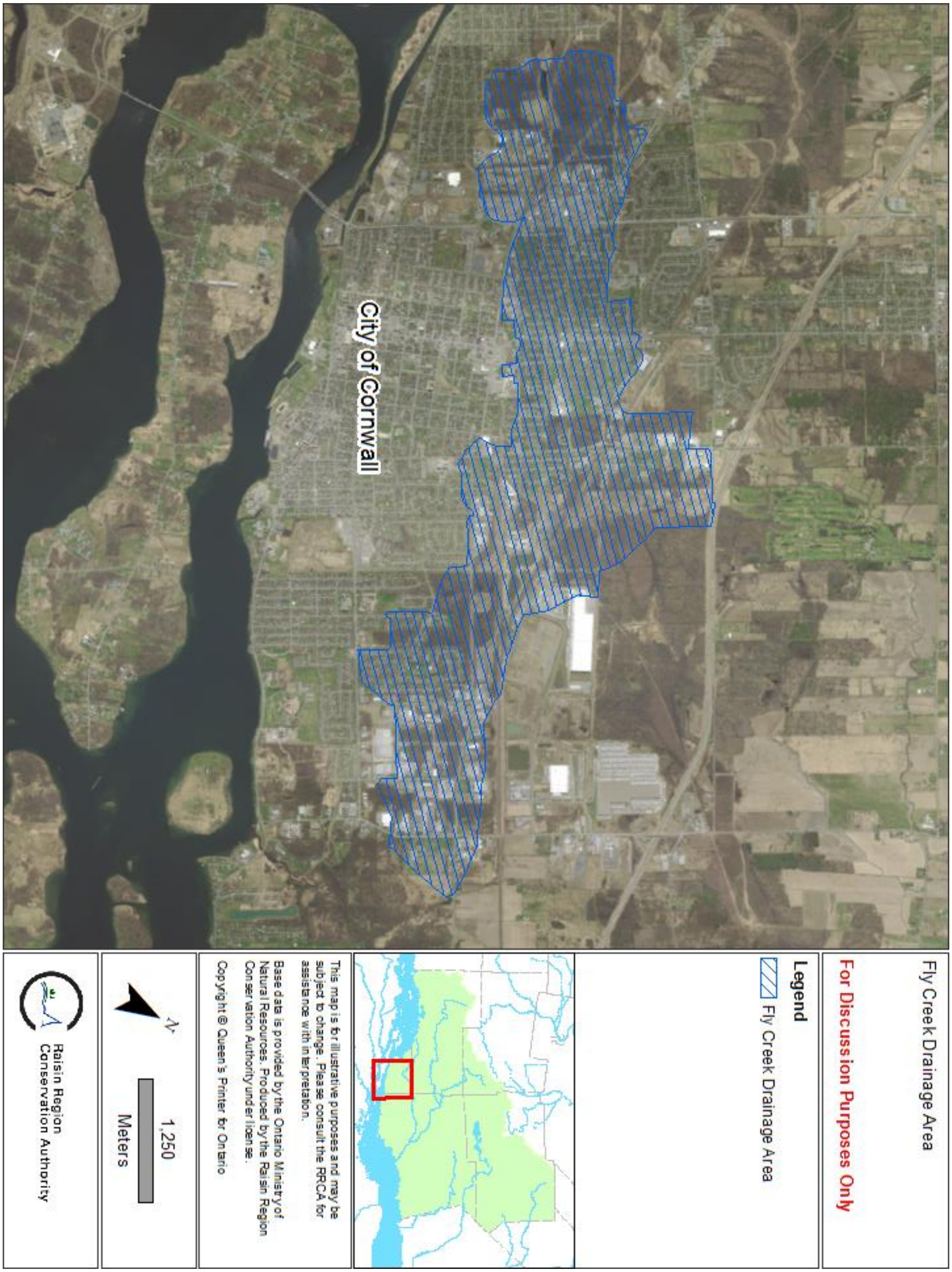
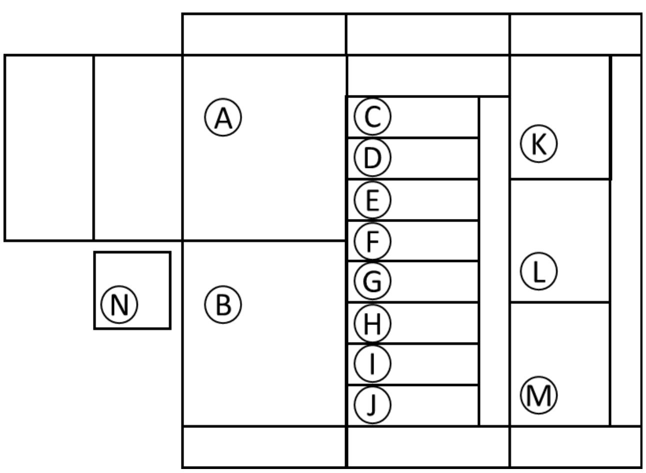


Figure 2: Fly Creek Facility

Motor Control Centre

Figure 3: Motor Control Centre Layout



A	Metering Transformer Compartment
B	Main Breaker
C	Heater #UH1, 20A C.B.
D	Heater #UH2, 20A C.B.
E	Lighting Transformer, 10 KVA
F	Exhaust Fan, #EF2
G	Exhaust Fan, #EF3
H	De-watering Pump
I	Fountain Pump
J	Exhaust Fan, #EF1
K	Pump #1
L	Pump #2
M	Pump #3
N	Telecom Ottawa Fiber Optic Input

The motor control centre is comprised of a Klockner-Moeller Series 200 MCC unit, which is rated for 600 Volts with bus ratings of 600 Amps (Vertical) and 300 Amps (Horizontal). The three main breakers (buckets) for the three main pumps were replaced in 2017.

Figure 4: Motor Pan 2 (Open)

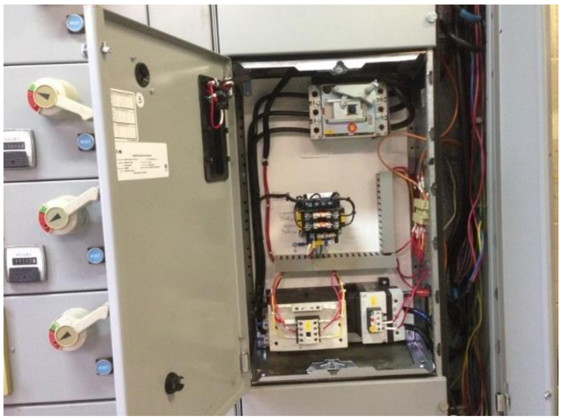


Figure 5: Infrared Scan - Motor Panel 1

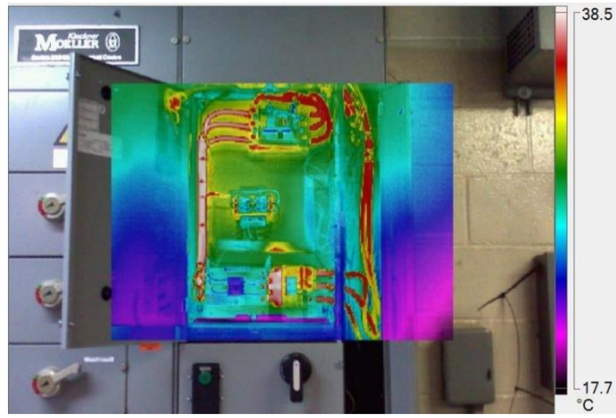


Figure 6: Infrared Scan - Motor Panel 2

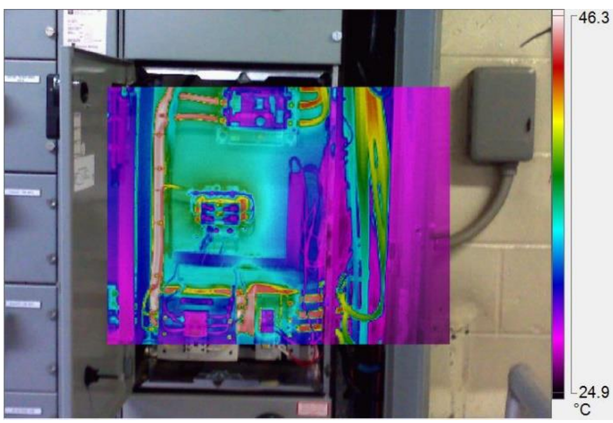
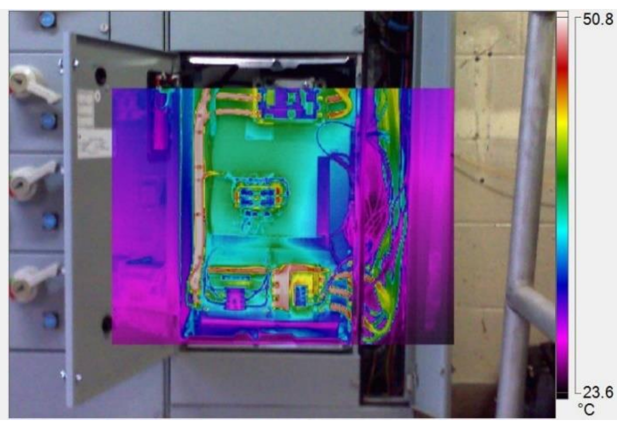


Figure 7: Infrared Scan - Motor Panel 3



Motor Control Centre Assessment

An infrared inspection was performed on all three buckets with a pump in service. The results indicated that the wiring was in good shape and that operating temperatures were within normal ranges. All electrical components within the motor control centre are properly working and fully operational.

Primary Pumping System

The primary pumping system includes three WDM Model 24 Vertical Axial Flow Pumps. These pumps are each driven by a U.S. Electric, 100 hp, 3/60/575 Volt, 900 rpm vertical hollow shaft motor with non-reverse ratchet. The motors are self-contained units with a separate control panel and are all air cooled. Each pump is rated for 700 L/second capacity. The motors were installed in 1991 and the pumps were replaced in 1999.

Pump #2 was overhauled in 2004, Pump #3 had a bent shaft repair in 2006 and an overhaul in 2017. Motor #3 underwent a balancing operation in 2018 as a result of the inspection.

Figure 8: Main Pumps and Motors

Primary Pumping System Assessment

In May of 2018, an inspection of the pumps and motors was undertaken by ASL Roteq.

Pump #1 had been experiencing rough start-ups and would often cause the breaker to trip. The observed start-up issues on this pump strongly suggest some initial wear has occurred on this pump’s lower column bearing / bushing. This is likely resulting in some propeller – column contact at initial start-up that stabilizes on the pump comes up to speed. It was disconnected and removed for inspection. It was determined that the pump was in poor condition and severely pitted. Additionally, the soleplate was noted to be severely corroded. It was agreed not to reconnect Pump 1 and to take it out of service until it can be refurbished.

When Pump #3 was re-installed it was noted too that the soleplate was corroded and requires replacement as it is not likely to provide a stable base for operation. The motor was also found to be out of balance. It was rebalanced; however, vibration analysis indicates that there is likely a bearing defect in the motor that requires immediate attention. There is some minor leaking on at the discharge gasket of this pump which should be monitored.

Pump #2 was tested for vibration and found to be operating within tolerances. A decision was made not to disconnect the pump for inspection at this time. It is suspected to be in poor condition and require refurbishing like Pump #1 and Pump #3. The soleplate is also expected to require replacing.

Previous infrared testing on the motors indicates that (other than motor 3 having a vibration issue) the motors are generally in good condition. However, it is suspected that they are drawing excess current on Startup and as a result occasionally tripping their breakers. This is likely because the motor windings are dirty. It was recommended that the motor windings be cleaned.

The hour meters on pump motor control panel #2 and #3 are currently not working.

Figure 9: Pump 1 - Removal

Figure 10: Soleplate 1 - Corrosion

Figure 11: Pump 1 - Pitted Suction Bell

Figure 12: Pump 1 - Corroded Impeller

Figure 13: Pump 3 – Pump Case Cavitated

Figure 14: Pump 3 – Case wear from cavitation

Figure 15: Pump 3 – Worn shaft sleeve

Figure 16: Pump 3 – Pump bearings severely worn

Figure 17: Pump 3 - Worn shaft couplings and bolts

Figure 18: Pump 3 - Deep shaft wear near impeller

Figure 19: Pump 3 - Reinstallation

Figure 20: Pump 3 - Soleplate Corrosion

Figure 21: Pump 3 - Casing Re-install

Figure 22: Pump 3 - Motor Re-install

Figure 23: Motor 1

Figure 24: Motor 1 – Thermal Scan

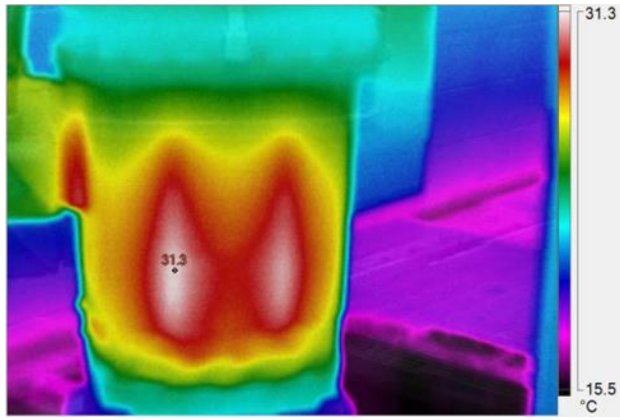


Figure 25: Motor 2

Figure 26: Motor 2 – Thermal Scan

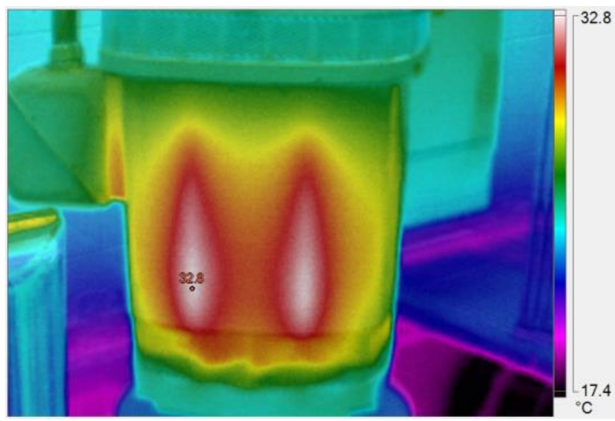
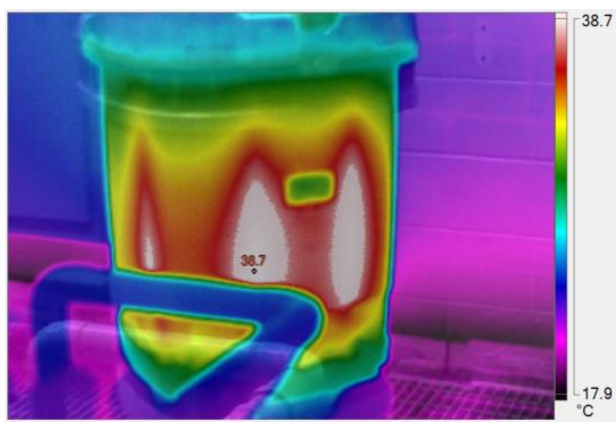


Figure 27: Motor 3

Figure 28: Motor 3 – Thermal Scan



Dewatering Pump

A dewatering pump is used to lower the water level below the main pump shutoff of 49.000m. to an elevation of 47.550m. It can be run continuously overnight to remove the water remaining in the pond well. The dewatering pump is a 10 HP Flygt 3126 and is rated for 33 L/s.

Figure 29: Sample installation of Dewatering Pump

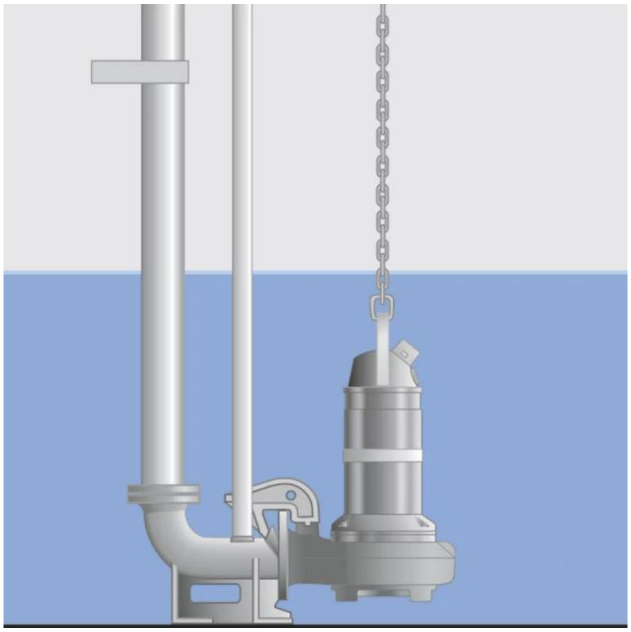


Figure 30: Replacement dewatering pump

Dewatering Pump Assessment

The dewatering pump was known to be acting up in recent years and would cause the breaker to trip immediately on start up. It was uncertain if there was a mechanical problem with the pump or an electrical problem. During the inspection, the pump was being hoisted by it's connected chain, which snapped (due to corrosion) and the pump fell to the bottom of the pond well.

It is recommended that the pump be retrieved by a qualified person (confined space, diver); and inspected for repairs. A suitable chain should be selected for securing the pump

A replacement pump was purchased in 2006. The model number is Flygt 3127. This pump could possibly be used to replace the original pump.

Wetland

In 2003, the Fly Creek system was modified to include a wetland to enhance water quality through the pond particularly during low flow condition by diverting a portion of the flow through the proposed wetland pond. The wetland is not hydraulically connected to the system other than through a low flow pump. Flow from the existing dewatering pump was diverted through a Rotork valve control device to provide water to the wetland.

Figure 31: Wetland Diversion Actuator

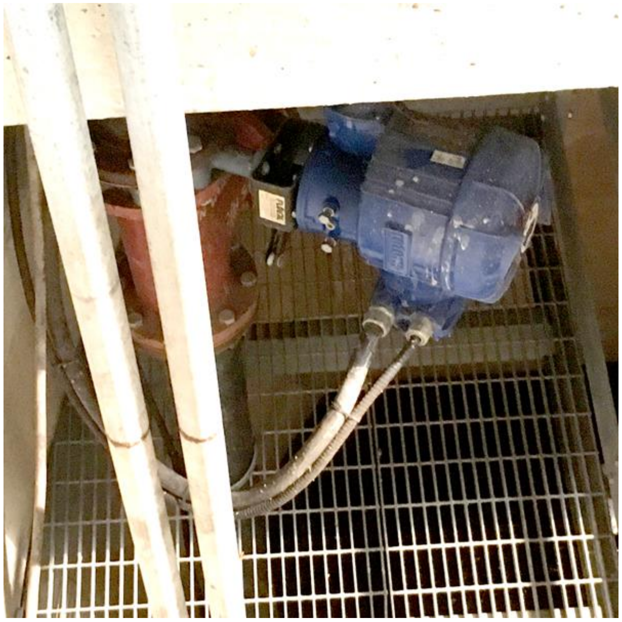


Figure 32: Wetland Fountain Head

Wetland Assessment

The diversion actuator appears to be in good physical condition; however, at the time of inspection it was not possible to check the operation due to the controls having been removed during the last SCADA system update. Moreover, as the dewatering pump has not been working as of late, it is not possible to check the flow to the wetland. The wetland fountain head, which is to be removed for the winter, appears to still be in good condition. The wetland itself has seen some significant seepage in the past few years and may be compromised through rodent burying.

It is recommended that the actuator controls be reinstated and tested, and that that the wetland embankments be examined and repaired.

Emergency Power System

The emergency power system consists of an Onan/Cummins model #350 DFCC diesel generator set and control panel incorporating an automatic transfer switch. This system provides continuous standby service for the pumping station electrical equipment.

A Westinghouse Robonic type II model R03600 transfer switch senses complete loss of normal power on any phase, and after a time delay, designed to prevent unnecessary starting during a temporary power/phase failure, signals the emergency generating set to start. When the emergency power attains rated speed and voltage, the transfer switch automatically transfers the load to emergency power. When normal power returns, the automatic transfer switch sense this and retransfers the load from emergency power to normal power and signals the emergency source to stop. The generator set continues to run after transfer to enable a 10-minute shut down sequence to occur. If the emergency source shall malfunction while furnishing power to the load, the transfer switch automatically disconnects the load from emergency power to allow restarting the emergency source with no connected load. After restarting the emergency source and attaining rated speed and voltage, the transfer switch automatically reconnects the load to emergency power.

Figure 33: Cummins Diesel Engine

Figure 34: Onan Generator

Figure 35: Automatic Transfer Switch

Figure 36: Transfer Switch Gauges

Figure 37: Transfer Switch Gauges

Emergency Power System Assessment

The diesel engine and generator set have been shown to be in good working order. Startup and operation work as intended. The automatic transfer switch has shown a recent deficiency in that it does not properly signal the generator to turn off when power is restored. This has caused the engine to run until it runs out of fuel.

Fuel Storage System

Fuel for the standby power diesel engine generating set is supplied from a 905 L aboveground steel tank. The tank is enclosed within a thick concrete secondary containment holding cell.

Figure 38: Diesel Fuel Tank

Fuel Storage System Assessment

This current fuel system replaced a 9000L outside underground fibreglass tank and 450L inside day tank in 2006. The fuel storage tank has a manufacturing date of November 2006. The fuel lines were repaired in September of 2015. The tank was also fully inspected at that time. The tank, being located inside, is protected from the elements and is still in good condition and shows no evidence of corrosion or leakage. The secondary containment cell is adequately sized, it is clean and in good condition.

SCADA System

The current SCADA system (Supervisory Control and Data Acquisition) was implemented in 2015 and replaced an older Bristol Babcock analog system (circa 1990) which was at "end of life" for hardware and software support and had been operating erratically. The current system consists of Allen Bradley digital components. The SCADA receives the water level depth signal from a Milltronics MultiRanger ultrasonic sensor. Pumping station outlet flow is recorded by a Greyline Instruments AVFM-II Area Velocity Flow Meter.

The original SCADA system also included a tipping bucket raingauge and turbidity meter. These measurement devices have since been abandoned.

Figure 39: SCADA System (Panel open, with wiring exposed)

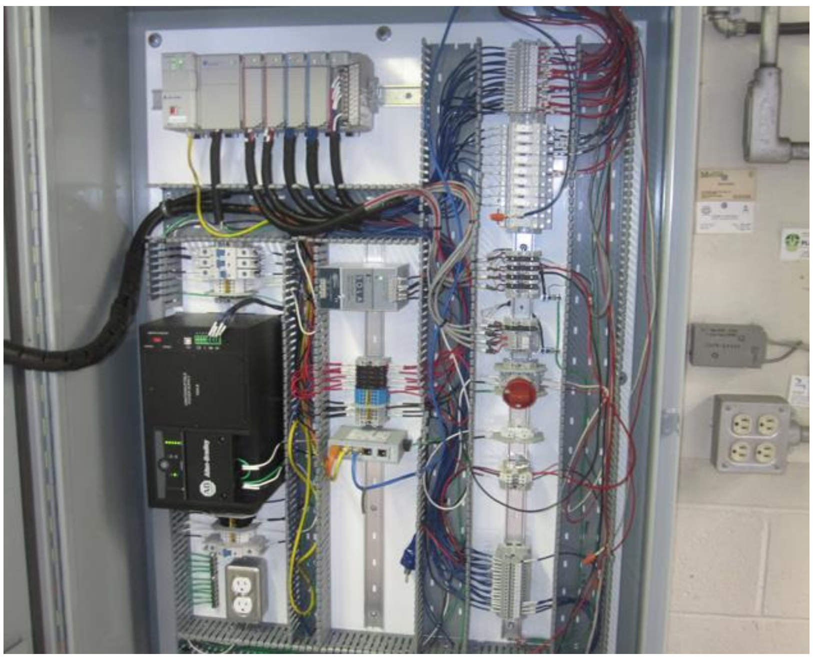


Figure 40: Sample SCADA Screen

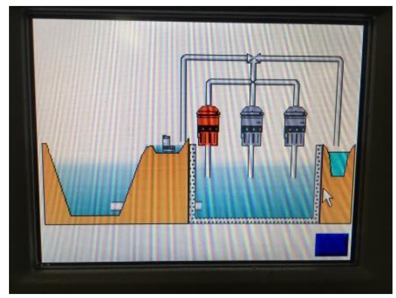


Figure 41: Sample SCADA Screen

Figure 42: Depth and Flow measurement devices

SCADA System Assessment

The current SCADA system is working as intended, in that the pumps are properly activating and deactivating at the pre-set water levels. The SCADA system interface as it is currently programmed does not permit easy modifications to operating rules. Additionally, there is no alarm mechanism implemented to alert of system malfunction or high-water level events. It is recommended that the SCADA system be modified to enable the human machine interface features to be accessible to operators for easier programing of features (i.e. adding/removing pumps from service); and, that suitable alarm routines be implemented.

The Milltronics Multiranger appears to be operating correctly; however, it should be verified and calibrate to ensure proper operation of the pumps. The Greyline flow meter is currently not working. This is not integral to the operation of the system, but it's proper operation could help provide insight into operations.

The abandoned raingauge, while not integral to the operation of the system, could be refurbished as it could provide additional context to the operations and flow output of the pumping station.

Vents and Exhaust Components

Several vents, exhaust fans, and automated louvre opening systems are used throughout the pumping station. The fans dissipate heat, vent diesel exhaust, inlet fresh air, and are also used to evacuate noxious gases that could build up in the wet well.

Figure 43: Exhaust Fan Unit

Figure 44: Fresh Air Louvres

Figure 45: Wet Well Air Blower

Vents and Exhaust Components Assessment

The vents and exhaust components are all performing properly. It has been noted that the flashing around the main fresh air louvres is separating from the building and should be repaired.

Surveillance Camera

An Axis 213 PTZ Network Camera is installed outside near the entrance door of the pumping station. The single camera is configurable to present real-time viewing of various points of interest around the facility (i.e. full view of the pond, zoom in of access road between pond cells, view of front door etc.). A VPN (Virtual Private Network) allows remote viewing of the camera feed through any compatible device connected to the internet.

Figure 46: Surveillance Camera (Mfr. Photo)

Figure 47: Outside Camera Dome (Mfr. Photo)

Surveillance Camera Assessment

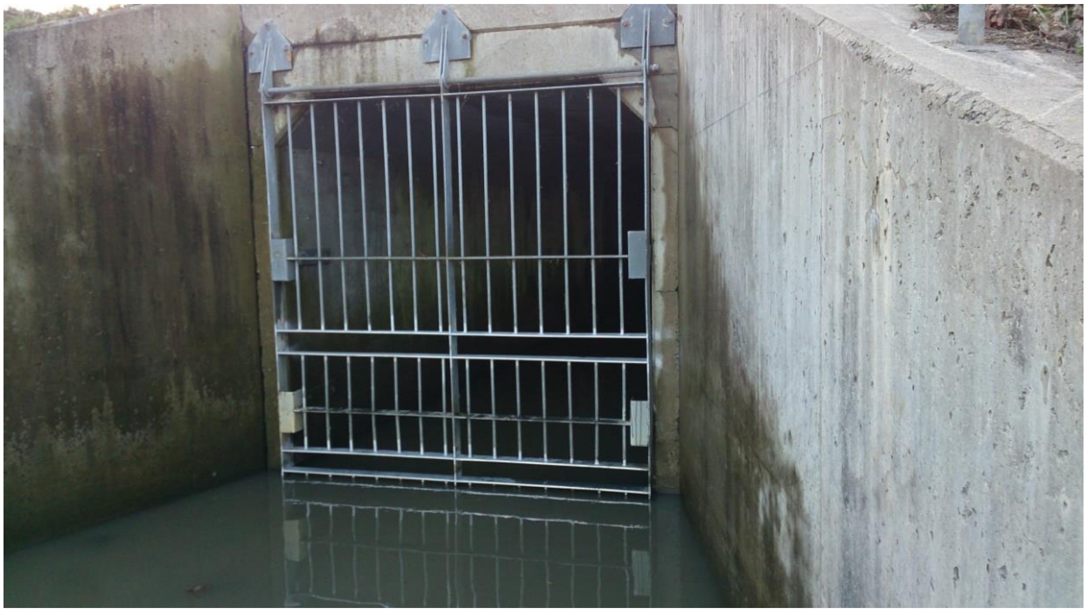
The current surveillance camera is non-functional, and the VPN connection has been disconnected. The camera is not critical to pumping station operation; however, it is an extremely useful tool. For example, an operator can make a quick visual check of water levels in the pond and make a remote assessment as to the proper operation of the pumping station. It is recommended that the camera be replaced or repaired immediately.

It would also be recommended that a security camera system be installed within the pumping station too. For a relatively low expense, this would enable the operations staff to review and possibly trouble shoot alarms remotely. It would enable staff add additional monitoring without the expense of physically visiting the pumping station.

Inlet Screen

All water flowing into the Fly Creek retention pond enters through a metal grate, or inlet screen. The screen has vertical slats spaced 6 inches apart. The screen is intended to capture large debris and prevent it from entering the system. The screen also acts as a safety device in the event someone was to fall into the channel. The inlet screen was modified in 2014 by introducing a horizontal opening at the bottom. The opening allows small items to pass through and prevents the accumulation of debris build up that would previously create blockages from time to time.

Figure 48: Inlet Screen



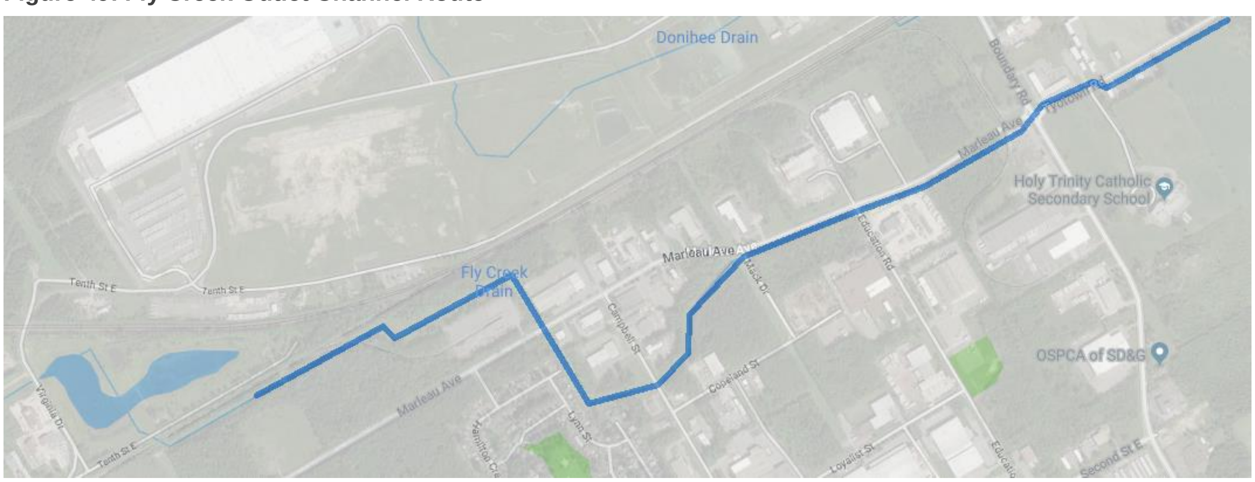
Inlet Screen Assessment

The inlet screen is firmly attached and is functioning as designed.

Outlet Channel

Water pumped from Fly Creek is sent through a force main to the discharge channel. The channel runs west from the pond, then heads south crossing Marleau Avenue, east crossing Campbell Street, and then north to run parallel to Marleau Avenue through Mack Drive and Education Road. The channel crosses Boundary Road and runs parallel to Tyotown Road before joining the Donihee Drain. The Donihee Drain empties into Gray's Creek approximately 1 km downstream of Fly Creek confluence. In turn, Gray's Creek discharges into the St. Lawrence River at Gray's Creek Marina approximately 1.5 km downstream of the Donihee confluence.

Figure 49: Fly Creek Outlet Channel Route



Outlet Channel Assessment

The channel is prone to becoming overgrown. It last saw a major clean out in 2014. In 2018 a beaver dam blockage was removed. The culvert under Campbell Street was replaced by the City of Cornwall in 2018. The channel could see flows in the order of 2100 L/second – it is imperative that regular maintenance and inspection be performed to ensure proper operation. The current condition is assessed as adequate.

The pond overflow requires maintenance as a silt accumulation is possibly impeding proper operation. This should be remedied.

Recommendations

Most of the components within the pumping station are 20 to 30 years old. It is essential that a routine maintenance program be implemented to ensure the longevity of the system. Moreover, routine inspection and maintenance can identify components that should be repaired or replaced prior to failure.

The table below summarizes the components inspected, their current condition and the recommended action.

Table 1: Recommended Actions

Component	Condition	Recommended Action
Motor Control Center	Good	Implement bi-annual thermal imaging
Pump 1	Severely pitted bell and impeller	Refurbish immediately
Pump 2	Vibration analysis suggests okay. Likely pitted bell and impeller similar to Pump 1 and 3.	Refurbish short term
Pump 3	Good, recently refurbished	No immediate action required, implement regular maintenance
Soleplate 1	Significant corrosion	Replace
Soleplate 2	Significant corrosion	Replace
Soleplate 3	Significant corrosion	Replace
Motor 1	No operational deficiencies noted. However, motor windings are dirty.	Clean motor windings, implement regular maintenance and cleaning.
Motor 2	No operational deficiencies noted. However, motor windings are dirty.	Clean motor windings, implement regular maintenance and cleaning.
Motor 3	Vibration signature indicates bearing defect in the motor bearings.	Overhaul motor.
Motor Control Cabinets	Good. Duty hour meters not working for pump #2 and #3.	Repair hour meters for pump #2 and pump #3
Dewatering Pump	Non-functional, unattached to chain.	Retrieve pump, and service or replace
Wetland	Pump/valve actuator not in use, seepage noted a wetland.	Reinstate valve actuator and test. Repair wetland embankments.
Diesel Engine and Generator Set	Good	No immediate action required, implement regular maintenance
Transfer Switch	Defect with switch when power returns	Repair immediately
Fuel Storage System	Good	Continue regular maintenance program.
SCADA System	Works as programmed, interface prevents easy modifications to process. No alarm systems/processes activated.	Implement better human machine interface and alarm notification system. Milltronics depth measurement device should be calibrated. Raingauge and flow meter could be returned to service.
Vents and Exhaust Component	Good. Flashing damaged around main air inlet.	Continue regular maintenance program. Repair flashing on main air inlet.
Surveillance Camera	Broken	Replace or repair immediately. Recommend installing additional camera system inside the pumping station for remote monitoring.
Inlet Screen	Good	Continue regular maintenance program.
Outlet Channel	Good. Pond overflow has silt accumulation.	Continue regular maintenance program. Recondition overflow as required.