PROCESS CONTROL NARRATIVE – Issued for Tender

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1. General

1.1 Introduction

The Blind River Water Treatment Plant (WTP) is located at 47 Murray Street in the Town of Blind River, Ontario. The WTP was previously supplied with raw water from five wells located in a well field approximately 500m north of the WTP. The raw water provided by these wells is classified as groundwater under the direct influence of surface water (GUDI).

Due to history of decline in performance and water quality from these wells, a new surface water intake and associated low lift pumping station (LLPS) will be constructed to provide a higher quality source of raw water and allow the decommissioning of the existing well field.
The purpose of this process control narrative (PCN) is to provide a guide for the programming and operation of the process control system of the new raw water intake system and LLPS. This includes the following process components:

- Raw Water Intake, including:
  - Raw Water Sampling
  - Air Backwash system for intake (blockage from debris, ice)
- Low-Lift Pumping System
- Sodium Hypochlorite Feed to intake (invasive mussel control)

Manual processes such as fine screens in the screen wells within the LLPS and accompanying valves/gates are provided for reference only.
An overview and description of emergency standby power operation is included. Sections contained herein describe each piece of process equipment, the different operating modes, and fault responses.

1.2 Process Overview

Raw water will be supplied from Lake Huron to the LLPS via a 400mm diameter HDPE raw water intake pipe. The intake pipe will extend approximately 410m into the lake. Onshore, the pipe will extend an additional 30m to connect to the LLPS. The intake pipe will be designed for an ultimate flow of 6,800m^3/day. The intake screen structure will be located at a depth of approximately 4.0m and designed to maintain an entry velocity below 75mm/s through the screen.

The intake will be equipped with a sodium hypochlorite dosing line for invasive mussel control, an air backwash system, and a raw water sampling line.

Raw water will flow by hydrostatic pressure from the intake screen through the intake pipe to the raw water intake well located just outside the LLPS. The raw water will then pass through manual screens to remove any remaining debris, prior to reaching the screened water well and low lift wet wells.

The LLPS will be initially equipped with two (2) low lift pumps, each rated for 3,400m^3/day at 32.1m TDH, operating in duty/standby configuration. Each pump will be equipped with a VFD. There will be provision for the future installation of two additional pumps, with the same rating as the existing pumps. The low lift pumps will be controlled to maintain the required water level in the flocculated water conduit at the Blind River WTP (LIT 0301).

2. Control Philosophy and SCADA Monitoring

2.1 Control Hierarchy

The control hierarchy to be implemented is based upon the following control standards and hierarchy (Table 2-1).

An upgraded control system to the Blind River Wastewater Treatment Plant (WWTP), which is more recent to the WTP, will be installed. This system will utilize Factory Talk Version 12.00.00 with Panelview Plus 1000 HMI/OIT screen.

Table 2-1: Control Modes

Level	Description
LOCAL	The selection of LOCAL or REMOTE mode of operation is typically made by an operator at the device, MCC, or area control panel by means of a selector switch. In LOCAL mode, the device is to be controlled through the use of field devices.
REMOTE MODE	The REMOTE-control mode can be broken down into REMOTE-AUTO and REMOTE-MAN, which can be selected from SCADA while a device's selector switch has been set to the REMOTE Mode position. Switching from LOCAL to REMOTE may cause the device to operate if the device is in REMOTE-AUTO and required to start/stop by the PLC automatic device logic. The selection between REMOTE-MAN and REMOTE-AUTO is based upon the last selection made at any of the workstations (HMI) in the SCADA system or the local OIT.
REMOTE-AUTO	When in REMOTE-AUTO mode, the device will be controlled by automatic logic from the PLC, and the operator may adjust control variables and setpoints of some aspects of operation from a remote location.
REMOTE-MAN	During REMOTE-MAN mode, the device is controlled remotely through HMI or OIT by the operator, without control from automatic logic. Following a power failure, a device in REMOTE-MAN will require operator intervention for it to resume its previous operating state again.
BUMPLESS TRANSFER	Switching from REMOTE-AUTO to REMOTE-MAN will provide a bumpless transfer of the device operation. A bumpless transfer means that if that specific device was running in REMOTE-AUTO and the operator switched it to REMOTE-MAN, the device will continue to run without requiring a re-start. Switching from REMOTE-MAN to REMOTE-AUTO, however, may cause the device to operate if the device is required to start/stop by the PLC automatic control logic.
OUT-OF-SERVICE	While in REMOTE mode, operator has the option to place a device in OUT-OF-SERVICE mode. The device will maintain its last state when OUT-OF-SERVICE is enabled.

2.2 Statistical Calculations

2.2.1 Analog Signals

A selection of the following calculations is completed for each analog signal, depending on the specific type of analog instrument. For example, if the instrument is a flow reading, the totals are an

applicable statistical reading. If the instrument is a pressure reading or from a water quality analyzer, the totals are not an applicable calculation.

- Total Today
- Total Yesterday
- Total This Month
- Total Last Month
- Continuous Total

2.3 Trends

Unless noted otherwise, historical datalogging and trending will be provided for **analog** signals including but not limited to:

- Water quality analyzers (turbidity, temperature, pH, chlorine residual);
- Level transmitters;
- Flow transmitters, and;
- Pressure transmitters.

2.4 Device Virtual Points

Unless noted otherwise, the following virtual points will be provided for each device that is controlled through the PLC.

2.4.1 Motor (Device)

- REMOTE-AUTO Status
- REMOTE-MAN Status
- Mode Request
- REMOTE-MAN Start Request
- REMOTE-MAN Stop Request
- REMOTE-AUTO Start Request
- REMOTE-AUTO Stop Request
- OUT-OF-SERVICE Enabled
- Available Status
- Alarm Reset
- Runtime Reset
- Runtime
- REMOTE-AUTO Speed Setpoint
- REMOTE-MAN Speed Setpoint
- Speed Feedback

2.4.2 Device Runtime

A device may require a Continuous Runtime counter to track the service life of the equipment. The Runtime counters are resettable and a “Yes/No” confirmation is required at the HMI.

3. Raw Water Intake System

3.1 Overview

The raw water intake crib will be located in Lake Huron, approximately 410m offshore, and at a maximum depth of approximately 4 m. The intake pipe will be a 400mm diameter HDPE pipe, extending to reach the intake assembly, and approximately 30m onshore to connect to the LLPS. Raw water will flow by hydrostatic pressure through the intake structure and intake pipe into the LLPS intake well.

The raw water intake pipe will be fitted with a Z-alloy intake screen to prevent debris from entering the intake pipe and LLPS. The LLPS and intake will also be equipped with an air backwash system, which provides bursts of compressed air to the intake screen through a pipe running along the length of the intake pipe. These bursts of air will allow for remote removal of frazil ice, mussels or other debris from the screen as needed. These bursts can be triggered remotely, and the system will also include a programmable timer to deliver automatic air bursts for times of the year when frazil ice formation is likely. The system will include an air compressor, vertical air receiver, and complete control panel with enclosure.

3.2 Equipment and Instrumentation Lists

Table 3-1: Equipment and Valve List associated with Raw Water Intake

Tag Name	Location	Description	Range
Control Equipment			
SP-0111	Sampling Pump	Sampling Pump	0 – 60 L/h
AC-0101	Air Compressor	Air Compressor	0 – 175 psi
AR-0101	Air Receiver Discharge Line	Compressed Air Valve	Open/Closed

Table 3-2: Raw Water Intake Instrumentation List

Tag Name	Location	Description	Range
TIT-0101	Sampling Pump Discharge	Temperature Analyzer Transmitter	0 – 50°C
AIT-0101	Sampling Pump Discharge	pH Analyzer Transmitter	5 – 10
AIT-0102	Sampling Pump Discharge	Turbidity Analyzer Transmitter	0 – 100 NTU
AIT-0103	Sampling Pump Discharge	Chlorine Residual Analyzer Transmitter	0 – 5 mg/L

3.3 Modes of Operation

The sampling pump will operate constantly to enable continuous functioning of the analyzers at all times.

3.4 Fault Response Operation

Raw Water Sampling Pump

Upon failure, the sampling pump will shut down and be inhibited from starting until all faults are cleared and the pump has been reset. An alarm will be annunciated on SCADA. Operators may take manual samples or revert to water quality analysers at the WTP until the sampling pump has been brought back online

Temperature & Turbidity Meter, pH and chlorine residual Analyzer

During a signal error alarm, the signal will continue to be read and the scan status of the instrument will remain ON. An alarm will be annunciated on SCADA.

Power Failure Response

The LLPS standby generator will provide backup power to the entire LLPS and intake facility in the event of utility power failure.

When a utility power failure occurs, the standby generator will provide power for the sampling pump to maintain flow. The SCADA workstation will display the event on the alarm banner advising that a power failure has occurred. Pump alarms will be ignored during a power failure event in order to avoid alarms such as "Uncommanded Stop".

If both the utility power and standby generator fail, the equipment will restart after power is restored, according to the equipment's individual relay logic circuit.

3.5 Control Setpoints

Control set point for the invasive mussel control/sodium hypochlorite is described under the sodium hypochlorite system in Section 5.

3.6 Datalog Requirements

Table 3-3: Raw Water sample and Wells Data Collection

3.7 Analogue Alarms

Low and high alarms will be reviewed with Operations staff, confirmed and finalized in the final version.

Table 3-4: Analogue Alarms

Description	Tag Name	Low Low		Low		High		High High		Security Level
		DEF	PRI	DEF	PRI	DEF	PRI	DEF	PRI	
Raw Water Temperature	TIT-0101									
Raw Water pH	AIT-0101									
Raw Water Turbidity	AIT-0102									
Raw Water Chlorine Residual	AIT-0103									

Note: DEF = Default Value, PRI = Alarm Priority

4. Low-Lift Pumping System

From the intake well, raw water will flow through a sluice gate into one of the two screen wells. Each screen well will be equipped with a stainless steel wire mesh screen panel. These panels are designed for manual cleaning with a water hose upon removal. Each screen well is rated for phase 2 capacity of the intake and LLPS (i.e., 6,800m^3/day).

From the screen wells, raw water will then pass through sluice gates to reach the screened water wells, which will be able to permit cross-flow through a connecting sluice gate. Finally, raw water will flow through a sluice gate into the low lift wet wells, which will be interconnected by a sluice gate.

Each low lift wet well will be equipped with one (1) vertical turbine pump, for a total of two (2) low lift pumps. Each low lift well will have provision for the one additional pump of equal rating to the existing pumps. Each low lift pump will be equipped with a VFD. The specifications of these pumps are provided in Table 4-1.

Table 4-1: Low Lift Pump Specifications

Tag Name	Design Flow (m^3/day)	TDH (m)	Motor Size (hp)	Power (kW)	VFD
Low Lift Pump 1	3,400	25	25	18.75	Yes
Low Lift Pump 2	3,400	25	25	18.75	Yes
Low Lift Pump 3 (future)	3,400	25	25	18.75	Yes
Low Lift Pump 4 (future)	3,400	25	25	18.75	Yes

4.1 Equipment and Instrumentation List

Each low lift pump will be equipped with a VFD, allowing the output of the duty pump to be continually adjusted to maintain the level in the flocculated water conduit at the Blind River WTP. The discharge of each low lift pump will also be fitted with a motorized butterfly valve, to be closed when the pump is not in service.

Each discharge watermain from the LLPS will be fitted with flow and pressure transmitters.

Table 4-2: Low Lift Pumping System Equipment List

Tag Name	Location	Description	Range
Control Equipment			
LLP-0111	Low Lift Pump 1	Low Lift Pump 1	0.00 – 39.25 L/s
LLP-0121	Low Lift Pump 2	Low Lift Pump 2	0.00 – 39.25 L/s
V-0112	Low Lift Pump 1 Discharge	Low Lift Pump 1 Discharge Valve	Open/Closed
V-0122	Low Lift Pump 2 Discharge	Low Lift Pump 2 Discharge Valve	Open/Closed

Table 4-3: Low Lift Pumping Station Instrumentation List

Tag Name	Location	Description	Range
FIT-0111	Discharge Header	Flow Transmitter	0 – 100 L/s
PIT-0111	Discharge Header	Pressure Transmitter	0 – 1000 kPa
FIT-0121	Discharge Header	Flow Transmitter	0 – 100 L/s
PIT-0121	Discharge Header	Pressure Transmitter	0 – 1000 kPa

4.2 Control Details

The plant-wide remote system control is available from the SCADA HMI. REMOTE system control of equipment will be carried out from SCADA, and LOCAL control will be carried out from pushbuttons, panels, or other control devices located on or near the actual equipment, the operator has the ability to run the equipment as well as monitor the status of the instrumentation. For a detailed explanation of the control philosophy, refer to Section 4.

The REMOTE control mode can be further broken down to REMOTE-AUTO and REMOTE-MANUAL, which can be selected from SCADA while a device's selector switch has been set to REMOTE control mode. During REMOTE-AUTO mode, the device will be controlled by automatic logic from the PLC, and the operator may adjust control variables and setpoints of some aspects of operation from a remote location. During REMOTE-MANUAL mode, the device is controlled remotely by the operator, without control from automatic logic. A description of the control hierarchy is provided in the following table.

Table 4-4: Low Lift Pumping System Control Mode Overview

Level	Selection	Control Type	Selection	Operator Input
REMOTE	Local 2-way selector switch	REMOTE-AUTO	From HMI	Setpoints
		REMOTE-MANUAL	From HMI	Required
LOCAL	Local 2-way selector switch	LOCAL-MANUAL	N/A	Required

4.3 Modes of Operation

REMOTE-AUTO

In this mode, the low lift pumps will be controlled to maintain the required water level in the flocculated water conduit at the Blind River WTP. The pump speed will be adjusted (VFD) to minimize fluctuations of the water level in the flocculation tanks. The pumps will operate in alternate duty/standby mode based on an operator adjustable period (e.g. 24 hours).

The low lift pumps have a start level setpoint and a target level setpoint. Once the level in the flocculated water conduit drops below the start level setpoint, the duty pump is requested to start after an operator adjustable time delay. Once the flow drops below the stop flow setpoint and the level is confirmed to be above the target level setpoint, the duty pump is requested to stop after an operator adjustable time delay. The duty pump will modulate its speed following a control loop that reduces flow prior to reaching the water level setpoint.

The actuated butterfly valves (V-0112 and V-0122) on each pump discharge will remain closed while the pumps are not in operation. When the pump is requested to start, the motorized valve will open prior to the pump starting after an operator adjustable time delay. When the pump is requested to stop, the motorized valve will close after the pump has stopped.

When the discharge pressure is high enough to activate the physical pressure trigger in the surge relief valve (not by PLC), the surge relief valve SRV-0111 will open, and the open status will be displayed on SCADA. Once the pressure has been released through the surge valve and the valve is physically triggered to close (not by PLC), the closed status of the valve will be displayed on SCADA.

If the level in a low lift well is too low for continued safe operation, the duty pump will be requested to stop after an operator adjustable time delay and an alarm will be generated.

The duty low lift pump will automatically rotate after an operator adjustable operating period. The duty pump will also automatically switch in the event of pump failure.

When the two future low lift pumps are installed, it is intended that there will be one additional duty pump. The second duty pump will be requested to start if the level in the flocculated water conduit continues to fall below a second setpoint after the first duty pump has started. The future low lift pumps will also be equipped with VFD, and the speed of the duty pumps will be equal while the second duty pump is in operation. The second duty pump will be requested to stop once the total flow drops below a second stop flow setpoint and the level is confirmed to be above a second target level setpoint. Under normal operating conditions, there will be one duty pump per low lift well, and the duty low lift pumps will automatically rotate after an operator adjustable operating period. This control scheme will be reviewed and detailed at the time of upgrade.

REMOTE-MANUAL

In this mode, the operator can initiate remote start/stop of the low-lift pumps as well as duty alternation, from SCADA. This mode also permits manual adjustment of the level setpoints and pump speed.

This control mode supersedes and locks out the auto mode.

LOCAL-MANUAL

In this mode, the operator may manually start and stop the low lift pumps from the local controls on-site. Local START-STOP push buttons are provided at the nearby MCC, as well as a knob to adjust the VFD speed.

This control mode supersedes and locks out the REMOTE modes, overriding time delays between starts, maximum/minimum VFD speed settings, and pump lock-outs for low level.

4.4 Fault Response Operation

Low Lift Pump

Upon failure, the low lift pump will shut down and be inhibited from starting until all faults are cleared and the pump has been reset. An alarm will be annunciated on SCADA.

Level and Pressure Transmitters

During a signal error alarm, the signal will continue to be read and the scan status of the instrument will remain ON. An alarm will be annunciated on SCADA.

Power Failure Response

For power failure response, refer to Section 4.8

4.5 Control Setpoints

The table below identifies any security settings that apply to the SCADA/operator interface for the setpoint. For all shutdowns, if a reading has reached the shutdown setpoint or is in exceedance, a timer will begin based on the operator adjustable delay setpoint. Once the timer has expired, the booster station will shut down.

Table 4-5: Low Lift Pumping System Control Setpoints

Control Setpoint	Tag Name	Data Type	Significant Digits	Input Range (Min/Max)	Default	Security Level
Low Lift Pump Start Level		REAL	3	LWL in Flocculation tanks (TBA)		Operator
Low Lift Pump Stop Level		REAL	3	HWL in Flocculation tanks (TBA)		Operator
Low Lift Pump Start Delay		DINT	3	0 – 999 s	300 s	Operator
Low lift Pump Stop Delay		DINT	3	0 – 999 s	30 s	Operator
Low Lift Pump Discharge Valve Open Delay		DINT	3	0 – 999 s	30 s	Operator
Low Lift Pump VFD Minimum Speed		REAL	3			Operator
Low Lift Pump VFD Maximum Speed		REAL	3			Operator
Low Lift Well Shutdown Level (Low)		REAL	3	0 – 2 m	1.0 m	Operator
Low Lift Well Shutdown Delay		DINT	3	0 – 999 s	30 s	Operator

4.6 Datalog Requirements

Table 4-6: Low Lift Pumping System Data Collection

Description	Tag Name	Historian Collection Required	Historian Collection Intervals	PLC Datalogging Required	PLC Datalogging Intervals	PLC Datalogging Duration
Intake Well 1 Level	LIT-0111	Yes	2 mins	No	N/A	N/A
Screen Well 1 Level	LIT-0112	Yes	2 mins	No	N/A	N/A
Low Lift Well 1 Level	LIT-0113	Yes	2 mins	No	N/A	N/A
Intake Well 2 Level	LIT-0121	Yes	2 mins	No	N/A	N/A
Screen Well 2 Level	LIT-0122	Yes	2 mins	No	N/A	N/A
Low Lift Well 2 Level	LIT-0123	Yes	2 mins	No	N/A	N/A
Discharge Header 1 Flow	FIT-0111	Yes	2 mins	No	N/A	N/A
Discharge Header 1 Pressure	PIT-0111	Yes	2 mins	No	N/A	N/A
Discharge Header 2 Flow	FIT-0121	Yes	2 mins	No	N/A	N/A
Discharge Header 2 Pressure	PIT-0121	Yes	2 mins	No	N/A	N/A
Low Lift Pump 1 Speed	LLP-0111	Yes	2 mins	No	N/A	N/A
Low Lift Pump 2 Speed	LLP-0121	Yes	2 mins	No	N/A	N/A

4.7 Analogue Alarms

Table 4-7: Low Lift Pumping System Analogue Alarms

Description	Tag Name	Low Low		Low		High		High High		Security Level
		DEF	PRI	DEF	PRI	DEF	PRI	DEF	PRI	
Intake Well 1 Level	LIT-0111									
Screen Well 1 Level	LIT-0112									
Low Lift Well 1 Level	LIT-0113									
Intake Well 2 Level	LIT-0121									
Screen Well 2 Level	LIT-0122									
Low Lift Well 2 Level	LIT-0123									
Discharge Header 1 Flow	FIT-0111									
Discharge Header 1 Pressure	PIT-0111									
Discharge Header 2 Flow	FIT-0121									
Discharge Header 2 Pressure	PIT-0121									

Note: DEF = Default Value, PRI = Alarm Priority

4.8 Power Failure Response (Standby Generator)

The LLPS standby diesel generator provides backup power to entire facility loads in the event of utility power failure.

When a utility power failure occurs, the standby diesel generator will provide power for the low lift pumps to maintain flow to the WTP. The SCADA workstation will display the event on the alarm banner advising them that a power failure has occurred. Pump alarms are ignored during a power failure event in order to avoid alarms such as “Uncommanded Stop”.

If the LLPS power (hydro and standby generator) fails completely, the equipment will restart after power is restored, according to the equipment’s individual relay logic circuit.

5. Sodium Hypochlorite Feed System

A sodium hypochlorite chemical feed system is provided for control of invasive mussels. It allows for the injection of 10.36% sodium hypochlorite to the intake pipe via a diffuser mounted at the mouth of the intake structure. This system only operates seasonally.

The sodium hypochlorite feed system consists of two positive displacement dosing pumps, operating in duty/standby configuration. At present, the pumps are each rated for 3 L/h, the required chlorine dose at maximum flow (3,400 m^3/day).

The speed of the duty pump is paced to provide a dose of chlorine proportional to the low-lift discharge flowrate (as measured by FIT-0111), so as to prevent the discharge of excess chlorine into the lake. An online chlorine residual analyzer (AE-0103) monitors the chlorine residual concentration in the raw water (sample pump) to enable the operator to optimize and control the chlorine dosage for mussel control.

A chlorine residual of 0.5 mg/L is targeted for mussel control. An alarm will be sounded if the chlorine residual drops below that level. The design dosage of the feed system is 1.5mg/L, targeting a 0.5 mg/L residual. The sodium hypochlorite solution is stored in a 1,360L storage tank, which is filled directly from vendor chemical totes.

5.1 Equipment List

Table 5-1: Sodium Hypochlorite Feed System Equipment List

Tag Name	Location	Description	Range
Control Equipment and Instrumentations			
DP-0901	Dosing Pump 1	Dosing Pump 1	0.0 – 3.0 L/h
DP-0902	Dosing Pump 2	Dosing Pump 2	0.0 – 3.0 L/h

Table 5-2: Sodium Hypochlorite Feed System Instrumentation List

Tag Name	Location	Description	Range
LSH-0901	Sodium Hypochlorite Storage Tank Containment Area	Spill Detector	Not Detected/Detected
LIT-0901	Sodium Hypochlorite Storage Tank	Ultrasonic Level Transmitter	0 - 2 m

5.2 Control Details

Refer to section 4.2.

5.3 Modes of Operation

Refer to section 4.3.

5.4 Fault Response Operation

Dosing Pumps

Upon failure, the dosing pump will shut down and be inhibited from starting until all faults are cleared and the pump has been reset. An alarm will be annunciated on SCADA. The standby pump will be started.

Storage Tank Level Transmitter

During a signal error alarm, the signal will continue to be read and the scan status of the instrument will remain ON. An alarm will be annunciated on SCADA.

Spill Detection

An alarm will sound if a spill is detected in the containment area. During a signal error alarm, the signal will continue to be read and the scan status of the instrument will remain ON. An alarm will be annunciated on SCADA.

Power Failure Response

When a utility power failure occurs, the standby generator will provide power for the dosing pumps to maintain sodium hypochlorite flow. The SCADA workstation will display the event on the alarm banner advising them that a power failure has occurred. Pump alarms are ignored during a power failure event in order to avoid alarms such as “Uncommanded Stop”.

If both the utility power and standby generator fail, the equipment will restart after power is restored, according to the equipment’s individual relay logic circuit.

5.5 Control Setpoints

The table below identifies any security settings that apply to the SCADA/operator interface for the setpoint. For all shutdowns, if a reading has reached the shutdown setpoint or is in exceedance, a timer will begin based on the operator adjustable delay setpoint. Once the timer has expired, the booster station will shut down.

Table 5-3: Low Lift Pumping System Control Setpoints

Control Setpoint	Tag Name	Data Type	Significant Digits	Input Range (Min/Max)	Default	Security Level
Ratio of chlorine dose to raw water flowrate	AIT0103_AI	REAL	4	0 – 5 mg/L	0.5 mg/L	Operator
Dosing Pump Speed	DP0901_SI / DP0902_SI	REAL	3	0 – 3 L/h	120 spm	Operator
Storage Tank Shutdown Level (Low)	LIT0901_LE	REAL	3	0 – 2 m	0 m	Operator