2016 Annual Report

Sioux Lookout Water Pollution Control Plant

Prepared for: The Corporation of the Municipality of Sioux Lookout

Prepared by: Northern Waterworks Incorporated

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1 Introduction

The Sioux Lookout Water Pollution Control Plant (WPCP) is regulated by the terms and conditions within Certificate of Approval Number 3-0250-92-006 (the Certificate). This Annual Report has been prepared in accordance with Condition 17 of the Certificate, and it shall summarize the system's performance over the previous calendar year (January 1 to December 31, 2016).

This Report is intended (1) to provide a performance record for future references, (2) to ensure that the Ministry of the Environment and Climate Change (MOECC) is made aware of problems as they arise, and (3) to provide a compliance record for the terms and conditions outlined in the Certificate. This report must contain, but shall not be limited to, the following information:

(a) A summary of all monitoring and compliance reports submitted in the reporting period, including an overview of the success and adequacy of the sewage treatment program (section 8);

(b) A comprehensive interpretation of all monitoring data and analytical data collected relative to the works during the reporting period and a comparison to the effluent quality and quantity criteria (sections 3.2 & 4);

(c) A summary of any effluent quality assurance or control measures undertaken during the reporting period (section 3.1);

(d) A summary of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the Works (section 6.1);

(e) A description of any operating problems encountered and corrective actions taken during the reporting period (section 7);

(f) A summary of any proposed alteration, extension or replacement in the process or operation of the Works to be completed over the next reporting period which may require approval under the *Ontario Water Resources Act* (section 6.3);

(g) A tabulation of the volume of sludge generated in the reporting period and an outline of anticipated volumes to be generated over the next reporting period (section 5);

(h) An outline of the sludge handling methods and disposal areas to be utilized over the next reporting period (section 5);

(i) An evaluation of the calibration and maintenance procedures conducted on all monitoring equipment (section 6.2); and,

(j) An evaluation for the need for modifications to the Works to improve performance and reliability and to minimize upsets and bypasses (section 6.4).

2 System Description

The Sioux Lookout sewage works consist of sanitary sewers, sewage pumping stations and associated force-mains, and an extended aeration water pollution control plant. Sanitary sewers collect wastewater and direct it to multiple pumping stations located throughout the community, which in turn deliver the wastewater to the Robert Street Sewage Pumping Station. This pumping station includes an underground wet well and two variable speed submersible pumps for transferring wastewater via force-main to the Sioux Lookout WPCP for treatment.

Designed for the treatment and disposal of sewage, the Sioux Lookout WPCP has a hydraulic rated capacity of 2,840 m^3/day (average daily flow) with a peak flow rated capacity of 9,230 m^3/day. The facility includes a mechanical and stationary bar screen for the removal of large particles, a grit removal system, two circular treatment units each containing an aeration tank, clarifier, and aerobic digester, a chlorine contact chamber, and an outfall sewer discharging final effluent to Pelican Lake. The facility also includes a sludge dewatering system and a control building housing a laboratory, a gas chlorination system, an emergency diesel generator set, air supply equipment, control and metering systems, and piping, heating and ventilation systems. The Sioux Lookout WPCP is owned by the Corporation of the Municipality of Sioux Lookout and was operated by Northern Waterworks Incorporated (NWI) for the duration of the reporting period.

3 Water Quality

3.1 Monitoring Programs

Samples are collected by licenced operators and submitted to an accredited laboratory for analysis on a biweekly basis (once every two weeks) for influent (raw sewage) and effluent parameters. Minimum requirements concerning the sampling and testing of raw sewage and final effluent parameters are provided in Condition 15 (Monitoring and Recording) of the Certificate. Additionally, the sampling program has been designed to comply with the federal *Wastewater Systems Effluent Regulations* (WSER). Table 1 summarizes the sampling program employed at the Sioux Lookout WPCP.

Licenced operators also conduct in-house testing to determine the operational performance of the various stages of the treatment process and for quality assurance purposes as it concerns final effluent parameters. Table 2 summarizes those parameters that were routinely tested for operational control or quality assurance purposes during the reporting period. This table is intended to provide a summary of effluent quality assurance measures undertaken in the reporting period as required by Condition 17(c) of the Certificate. Typical control measures that may be implemented in response to test results include altering the rate of return activated sludge flow, affecting the volume of solids removed from the treatment process (i.e. waste activated sludge), modifying chlorine dosages to optimize disinfection, modifying the operation of air supply equipment, and conducting plant cleaning and maintenance.

Table 1: Sampling program summary

Parameter	Sample Type[1]
Influent Monitoring (Once every two weeks)	
BOD5	Composite
Total Suspended Solids	Composite
Total Phosphorus	Composite
Total Kjeldahl Nitrogen	Composite
Chemical Oxygen Demand[2]	Composite
Volatile Organic Acids[2]	Composite
pH[2]	Grab
Field Temperature[2]	Grab
Effluent Monitoring (Once every two weeks)	
BOD5	Composite
CBOD5[3]	Composite
Total Suspended Solids	Composite
Total Phosphorus	Composite
Total Kjeldahl Nitrogen	Composite
Total Ammonia Nitrogen	Composite
Nitrate	Composite
Nitrite	Composite
Orthophosphate, Dissolved[2]	Composite
Chemical Oxygen Demand[2]	Composite
Volatile Organic Acids[2]	Composite
pH	Grab
Field Temperature[2]	Grab
Field Total Residual Chlorine[4]	Grab
E. coli	Grab

1. A composite sample is a sample that is collected over a time period of at least 24 consecutive hours. The sample consists of at least 24 discrete samples taken approximately one hour apart, with the volume of each sample being proportional to the sewage flow at the time the discrete sample is taken. A grab sample refers to an individual sample of sufficient size collected at a randomly selected time.
2. These parameters are not a component of the mandatory sampling program required by the Certificate.
3. The final effluent parameter CBOD5 is not a component of the mandatory sampling program required by the Certificate. However, effluent CBOD5 must be tested on a monthly basis in accordance with the federal *Wastewater Systems Effluent Regulations*.
4. Regulatory testing for effluent total residual chlorine (TRC) is achieved through the in-house testing program. TRC is typically tested on a daily basis, and is also tested coincident with E. coli sample collection.

Table 2: Testing program summary[1]

Parameter
Influent Monitoring
Dissolved Oxygen
Temperature
Effluent Monitoring
Dissolved Oxygen
Temperature
Free Residual Chlorine
Total Residual Chlorine
Total Suspended Solids (per CTU[2])
Process Monitoring[3]
Aeration 30 Minute Sludge Settling
Aeration Dissolved Oxygen
Aeration pH
Aeration Total Suspended Solids
Return Activated Sludge TSS[2]
Clarifier Sludge Depth
Clarifier Dissolved Oxygen
Clarifier Temperature

1. Refers to all in-house tests conducted for purposes related to operational control and quality assurance. All samples collected for the in-house testing program are grab samples.
2. CTU = combined treatment unit; TSS = total suspended solids.
3. All process monitoring tests are conducted on each of the aeration tanks and secondary clarifiers associated with the two combined treatment units.

3.2 Monitoring Results

In accordance with Condition 17(b) of the Certificate, this report must provide a comprehensive interpretation of all monitoring and analytical data collected relative to the facility during the reporting period, complete with a comparison to the effluent quality criteria. Table 3 summarizes effluent monitoring results and compares them to the relevant objectives and compliance limits for all regulated parameters.

Table 3: Effluent monitoring results summary and comparison with performance criteria[1]

Month	BOD5		TSS		TRC	E. coli[4]
	MAC[2] (mg/L)	MAL[3] (kg/d)	MAC (mg/L)	MAL (kg/d)	MAC (mg/L)	MGMD (MPN/100 mL)
Objective	**10**	**28.4**	**10**	**28.4**	**0.50**	**150**
Limit	**25**	**71.0**	**25**	**71.0**	**1.20**	**200**
Jan	5.1	9.2	11.0	19.9	0.44	10
Feb	2.9	5.1	8.4	15.0	0.48	2
Mar	2.3	4.3	6.4	12.2	0.50	12
Apr	3.5	7.4	6.5	13.8	0.37	52
May	4.3	8.8	8.9	18.4	0.31	50
Jun	3.4	6.8	8.6	17.2	0.44	7
Jul	2.2	4.8	8.9	19.7	0.44	24
Aug	5.8	12.1	9.0	18.8	0.41	417
Sep	1.6	3.0	5.0	9.7	0.45	25
Oct	1.0	2.0	6.4	12.7	0.49	2
Nov	1.8	3.9	7.9	16.7	0.46	20
Dec	2.0	3.7	8.3	15.7	0.43	16

1. BOD5 = five-day total biochemical oxygen demand; TSS = total suspended solids; TRC = total residual chlorine; MAC = monthly average concentration; MAL = monthly average loading; MGMD = monthly geometric mean density.
2. Monthly average concentration is defined as the arithmetic mean of the daily concentrations of a contaminant in the effluent sampled or measured, or both, during a calendar month. For determinations related to monthly average concentrations, individual sample results that are below a lower detection limit are assigned a value of half the detection limit. For example, the lower detection limit for the parameter is BOD5 is 2.0 mg/L; any result reported as <2.0 mg/L for BOD5 would be assigned a value of 1.0 mg/L for the purposes of determining monthly average concentrations.
3. Monthly average loading is defined as the value obtained by multiplying the monthly average concentration of a contaminant by the monthly average daily flow over the same calendar month.
4. For determinations related to monthly geometric mean densities, individual sample results that are below or above a detection or reportable limit are assigned a value equivalent to that limit. For example, any result for the parameter E. coli reported as <1 MPN/100 mL would be assigned a value of 1 MPN/100 mL for the purposes of determining monthly geometric mean densities.

Effluent limits are summarized in Condition 12 (Non-Compliance) of the Certificate, and any exceedance constitutes non-compliance. Limits are expressed as monthly average concentrations and monthly average loadings for the parameters BOD5 and total suspended solids, as a monthly average concentration for the parameter total residual chlorine, and as a monthly geometric mean density for the parameter E. coli.

Effluent objectives are summarized in Condition 11 of the Certificate, and the facility must be designed, constructed, and operated to achieve the effluent objectives. Objectives are set at more stringent values than compliance limits, and they are expressed as monthly average concentrations and monthly average loadings for the parameters BOD5 and total suspended solids, as a monthly average concentration for the parameter total residual chlorine, and as a monthly geometric mean density for the parameter E. coli.

Effluent results were below the compliance limits for the entire reporting period with the exception of an exceedance for the parameter E. coli in the month of August. Effluent results were also below the objectives for the entire reporting period with the exception of the E. coli exceedance in the month of August and an exceedance for the parameter total suspended solids in the month of January. Refer to section 7.1 for more information concerning effluent limit and objective exceedances.

4 Flow Monitoring

Condition 13(a) of the Certificate states that the sewage works are approved to treat sewage at an average flow of 2,840 m^3/day, with a peak flow rate of 9,230 m^3/day. Condition 13(b) states that the introduction of sewage flows in excess of the peak flow rate is not approved under the Certificate. Additionally, Condition 13(c) states that the introduction of sewage flows in excess of the average daily flow for any consecutive period of time greater than one year is not approved.

Table 4 summarizes influent flow monitoring results. Throughout the reporting period, 755,800 m^3 of influent was introduced to the facility. On an average day 2,065 m^3 of influent was introduced, representing 73% of the average daily rated capacity. The maximum amount of influent introduced to the facility on a given day in 2016 was 2,900 m^3, representing 31% of the peak flow rate of the facility.

Table 4: Influent wastewater flows - 2016

Month	Total Volume (m^3)	Daily Flows (m^3/day)	
		Average	Maximum
Jan	55,400	1,787	2,000
Feb	50,700	1,748	2,000
Mar	61,600	1,987	2,500
Apr	65,200	2,173	2,900
May	62,400	2,013	2,800
Jun	63,500	2,117	2,500
Jul	72,300	2,332	2,800
Aug	69,700	2,248	2,600
Sep	63,300	2,110	2,500
Oct	63,400	2,045	2,400
Nov	66,300	2,210	2,400
Dec	62,000	2,000	2,300
Total	755,800	---	---
Avg	62,983	2,065	---

5 Solids Management

In accordance with Condition 17(h) of the Certificate, this report must provide an outline of the sludge handling methods and disposal areas that will be utilized over the next reporting period. The volume of solids in the treatment process is controlled by directing activated sludge (i.e. waste activated sludge) to the respective aerobic digesters at the Sioux Lookout WPCP. Sludge is then transferred to a dewatering system for further processing, such that the solids are concentrated and much of the water present is removed and returned to the influent works. Dewatered sludge is then hauled by trailer to the Hidden Lake Landfill, where it is mixed with sand and used as cover for the site. Sludge management methods and disposal areas to be utilized over the next reporting period are not expected to change.

Table 5: Solids management summary

Month	Dewatered Sludge Volume Generated (m^3)
Jan	85
Feb	159
Mar	122
Apr	78
May	128
Jun	108
Jul	101
Aug	88
Sep	34
Oct	93
Nov	93
Dec	93
Total	1,182

In accordance with Condition 17(g) of the Certificate, this report must provide a tabulation of the volume of sludge generated in the reporting period, in addition to providing an outline of anticipated volumes to be generated over the next reporting period. A tabulation of the amount of sludge generated in the reporting period is provided in Table 5. Approximately 1,182 m^3 of dewatered solids were removed from the facility in 2016, which was the result of dewatering 7,264 m^3 of waste activated sludge. The amount of dewatered sludge generated and removed from the facility in 2017 is anticipated to be between 900 m^3 and 1,400 m^3.

6 Maintenance and Modifications

6.1 Planned Maintenance & Modifications

In accordance with Condition 17(d) of the ECA, this report must include a summary of all maintenance carried out on any major structure, equipment, apparatus, mechanism or thing forming part of the Works. The Sioux Lookout WPCP employs a planned maintenance program that ensures that the sewage works and related equipment that are installed or used to achieve compliance are properly operated and maintained. Licenced Operators perform routine maintenance on all equipment including pumps, air supply equipment, chemical feed systems, monitoring equipment, alarm systems, safety equipment, and other treatment components. Both routine and non-routine (emergency) maintenance activities are conducted in accordance with manufacturers' instructions.

Additional significant planned inspection, maintenance, rehabilitation, and renewal activities that occurred during the reporting period are summarized below. Maintenance activities associated with equipment failures are summarized in section 7.2.

- On June 20, the generator at the Sioux Lookout WPCP was inspected and load tested.

- On July 19, repairs to the generator exhaust system were completed. The exhaust system was previously damaged by falling ice.

- Between August 14 and August 19, treatment unit no. 1 was taken out of service for inspection and cleaning. Between September 1 and 9, treatment unit no. 2 and the chlorine contact chamber were taken out of service for inspection and cleaning. Sludge deposits were removed and structures and equipment were inspected and serviced. Deficient air disc diffusers were also replaced. This maintenance activity had previously been suggested as a modification to improve the performance and reliability of the sewage treatment program.

- On September 1, influent and effluent flow measuring devices passed annual inspection and calibration verification.

- On September 29, the Municipality excavated and repaired a portion of the outfall sewer. The outfall sewer had been previously inspected with a camera subsequent to the collapse of another portion in late 2015. The inspection indicated that another 30 m may be on the verge of collapse. Effluent was bypassed around the repaired section through a temporary connection between the chlorine contact chamber and a downstream manhole.

6.2 Monitoring Equipment Calibration and Maintenance

Condition 13(d) of the Certificate requires the installation, maintenance, and operation of a sufficient number of flow measurement devices. These devices must be calibrated at regular intervals not exceeding one year to ensure their accuracy within ± 5% of the full scale reading. Flow meters are required to measure a) the quantity of sewage being conveyed to and through the sewage treatment plant and b) the quantity of untreated sewage being bypassed to the disinfection facility.

Flow monitoring equipment indicated in the Certificate includes one (1) 229 mm throat dimension Parshall flume at the influent works and one (1) V-notch weir for measuring plant effluent flow. Additional monitoring equipment includes a handheld colorimeter for measuring chlorine residuals and a portable meter used for determining pH, temperature and dissolved oxygen concentrations. A summary of planned calibration and maintenance activities conducted on monitoring equipment is provided in Table 6.

Table 6: Summary of monitoring equipment calibration and maintenance activities

Equipment	Calibration & Maintenance Activities
Flow Measuring Devices (Influent & Effluent)	Daily inspection; annual calibration verification; calibration as required.
Handheld Colorimeter (Free and Total Chlorine)	Daily (weekdays) inspection; monthly quality assurance; calibration as required.
Portable Multi-Parameter Meter (Dissolved Oxygen, pH, Temperature)	Weekly (minimum) inspection; calibration and maintenance as required.

In accordance with Condition 17(i) of the Certificate, this report must include an evaluation of the calibration and maintenance procedures conducted on all monitoring equipment. Current planned calibration and maintenance procedures are considered to be adequate for all monitoring equipment.

6.3 Summary of Proposed Alterations, Extensions, or Replacements

In accordance with Condition 17(f) of the Certificate, this report must provide a summary of any proposed alteration, extension, or replacement in the process or operation of the works to be completed over the next reporting period which may require approval under the *Ontario Water Resources Act*.

There are no anticipated alterations, extensions, or replacements in the process or operation of the works to be completed over the next reporting period which may require approval under the *Ontario Water Resources Act*.

6.4 Modifications to Improve Performance and Reliability

In accordance with Condition 17(j) of the Certificate, this report must provide an evaluation for the need for modifications to the sewage works to improve performance and reliability and to minimize upsets and bypasses. For the purposes of this report, modifications intended to improve performance may include major and minor capital and operational projects planned for future reporting periods.

Modifications that may improve the performance and reliability of the sewage treatment program include:

- Effluent total residual chlorine (TRC) at the facility is greater than the prospective federal effluent TRC water quality standard of less than 0.02 mg/L. This standard will come into force on January 1, 2021, and the Sioux Lookout WPCP will be required to either switch to an alternative disinfectant or to install a dechlorination chemical feed system. This work will also result in the issuance of an updated Approval for the facility prior to the installation of required equipment.

- While an effluent limit for pH is not currently included in the Certificate of Approval for the Sioux Lookout WPCP, any updated Approval would likely include a pH effluent limit range of between 6.0 and 9.5. The facility would not be able to consistently achieve this effluent limit, and consideration may be given to the installation of a pH adjustment chemical feed system. Such a system would also help to control effluent total ammonia nitrogen, which is likely to be included as a regulated effluent parameter in an updated Approval.

7 Operating Problems

In accordance with Condition 17(e) of the Certificate, this report must provide a description of any operating problems encountered and corrective actions taken during the reporting period. For the purposes of this report, operating problems may be indicated by effluent limit and objectives exceedances, equipment, infrastructure and process failures, by-passes, overflows, spills, and abnormal discharge events.

7.1 Effluent Limit and Objective Exceedances

7.1.1 E. coli

In August, the monthly geometric mean density for effluent E. coli was 417 MPN/100 mL, which is greater than the effluent limit and objective of 200 MPN/100mL and 150 MPN/100 mL, respectively. The exceedance has been attributed to a single result (E. coli >2420 MPN/100mL) from a sample collected on August 23 during the start-up period of treatment unit 1. The treatment unit had previously been cleaned and inspected between August 14 and August 19. The subsequent monthly geometric mean density result was 25 MPN/100 mL, and there were no other exceedances for the reporting period.

7.1.2 Total Suspended Solids

In January, the monthly average concentration for effluent total suspended solids was 11.0 mg/L, which is greater than the effluent objective of 10.0 mg/L. The exceedance has been attributed to a failure of the clarifier drive assembly on treatment unit no. 1. There were no other objective exceedances for the reporting period.

7.2 Equipment, Infrastructure and Process Failures

Operating problems associated with significant equipment, infrastructure and process failures that occurred during the reporting period include the following:

- On January 12, the clarifier drive associated with treatment unit no. 1 failed. The drive motor and helical gearbox were repaired and the drive was placed back into service.

- There were various operating problems with dewatering equipment during the reporting period. Specifically, the press belt had to be replaced, bearings had to be replaced in the rollers, and the conveyor belt had to be replaced. A spare drive and motor were also ordered for the dewatering equipment in the event that these components fail.

- On September 12, the scum arm associated with treatment unit no. 2 failed and was repaired.

7.3 Bypasses, Overflows, Spills and Abnormal Discharge Events

A by-pass refers to the diversion of sewage around one or more unit processes within the treatment facility, whereby diverted sewage flows are returned to the treatment facility upstream of the final effluent sampling location and are discharged to the environment through the plant outfall. By-passes are prohibited except in certain situations, and may be planned (i.e. for maintenance or research purposes) or unplanned (i.e. emergency situations or high flow conditions). A plant overflow means a discharge to the environment from the sewage treatment facility at a location other than the plant outfall or into the plant outfall downstream of the final effluent sampling location. Overflows are prohibited except in certain situations, and special reporting, sampling, and recording requirements apply in the event of an overflow. Spills are releases of pollutants into the natural environment from or out of a structure, vehicle or other container that is abnormal in quality or quantity in light of all the circumstances of the discharge. Abnormal discharge events include any other abnormal events not otherwise classified as a bypass, overflow, or spill.

There were no bypasses, overflows or spills during the reporting period for the Sioux Lookout WPCP.

8 Conclusion

In accordance with Condition 17(a) of the Certificate, this report must provide a summary of all monitoring and compliance reports submitted in the reporting period, including an overview of the success and adequacy of the sewage treatment program. All owners of mechanical sewage treatment plants are encouraged to submit Municipal Utility Monitoring Program forms to the Ministry of the Environment and Climate Change (MOECC). These forms summarize monitoring data and are completed for every calendar month. All such forms were completed and submitted to the MOECC for the entire reporting period.

Analytical and flow monitoring data suggest a successful and adequate sewage treatment program. With the exception of a single compliance limit exceedance, the Sioux Lookout WPCP was capable of consistently meeting all compliance limits for the final effluent parameters biochemical oxygen demand, total suspended solids, total residual chlorine, and E. coli. Additionally, all flows to the sewage works during the reporting period were below the maximum hydraulic capacity of the facility, and the annual average daily flow was below the rated capacity.

The stated goals of the sewage treatment program for 2016 were (1) to maintain or improve system performance with respect to achieving the objectives for effluent total suspended solids and (2) to stabilize and reduce effluent TRC in order to reduce the number of objective failures. The improved performance with respect to the total number of effluent limit and objective exceedances across all parameters is summarized in Table 7. The goals of the sewage treatment program in 2017 include maintaining and improving upon the level of performance achieved in 2016.

Table 7: Compliance history – total number of effluent limit and objective exceedances[1,2]

Year	No. of Limit Exceedances				No. of Objective Exceedances				Total
	BOD5	TSS	TRC	EC	BOD5	TSS	TRC	EC	
2013	0	0	0	0	0	4	12	0	16
2014	0	0	0	1	0	12	10	0	23
2015	0	0	0	1	0	4	3	0	8
2016	0	0	0	1	0	1	0	0	2

1. BOD5 = total biochemical oxygen demand; TSS = total suspended solids; TRC = total residual chlorine; EC = Escherichia coli.
2. Limit and objective exceedances are treated as mutually exclusive.