

Wastewater Treatment Evaluation for the City of Wikonac, Wisconsin

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April 18, 2005

This report presents an analysis of the current wastewater treatment system in the City of Wikonac, Wisconsin, for use in preparation of the Infiltration/Inflow Analysis. The report begins by evaluating the system in its current condition. The report then identifies and addresses three specific problem areas found upon inspection of the individual system components. The report further offers explanations for incorrect water level data found in the tables provided. Finally, the report concludes by reconfirming the findings and providing recommendations based on the current evaluation of the system and the problems identified.

April 18, 2005

Any Street
Madison, Wisconsin 53562

Dear Mr. Carlson:

RE: Wastewater Treatment Project for Wikonac, Wisconsin

The following is the report requested regarding the results of my evaluation of the wastewater treatment plant and municipal sewer system in Wikonac, Wisconsin.

As you can see from the report, three problem areas were identified during my inspection of the facilities. These problems require only minor repairs or maintenance to resolve. A fourth and potentially larger problem was found to be the result of an improperly calibrated meter which created the appearance of excessive wastewater.

As we discussed over the phone, with the meter issue identified, the data recorded by that meter has been adjusted and losses were found to be within acceptable ranges for a properly maintained facility. Consequently, the Sewer System Evaluation Survey will not be required. The City was relieved to find there was a simple explanation for the losses and is currently in the process of properly calibrating the meter in question.

Thank you for providing me with the data and background information. This information assisted me in identifying the meter issue and providing guidance to the City of Wikonac.

Please contact me if you have any questions regarding the report.

Sincerely,

Peyton M. Creadick
Project Engineer

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EXECUTIVE SUMMARY

The Wikonac Sewer System is made up of three major subsystems. The original facilities were built around the turn of the century with additions to the system made in 1938. The age of the system increased that the system would require advanced repairs. In preparation for the Inflow/Infiltration Analysis which is to be prepared by Robert Carlson, Project Manager, a thorough visual inspection of the facilities including all potential overflow points and pumping stations, in addition to an examination of available water data (pumped and returned), was necessary. Through this inspection, as indicated in the following report, it can be safely determined that the Sewer System Analysis report will not be necessary.

The report is divided into three major sections. The first major section is the introduction. It covers the scope of the evaluation. The second section, divided into three subsections, addresses the overall conditions of Wikonac's facilities, provides background information on the sewers, problems found, and analysis of water data (including lake levels) itemized in four tables.

The overall condition of the facilities is good, especially considering their age. Inspection of the Wikonac sewer system and wastewater treatment facilities revealed only three problems requiring repairs. These three problems are addressed in the Evaluations section of the report and are as follows:

- Dry Weather Overflow at Manholes 23 and 27 caused by sand build-up in the sewers.
- Inflow at manhole 9 caused by deteriorated boards on the wooden weir.
- Water entering the sewers during high lake levels at the L Street box sewer caused by a low steel plate on the box sewer.

A fourth problem was identified involving a meter requiring recalibration. Data provided by that meter is unreliable. The wastewater returned is under-reported. By manually measuring the water flow and comparing this data to the meter, the error rate was determined and used to correct and explain the data in the report. After correcting this data, the water losses were found to be within normal ranges for a properly maintained facility.

The final section of the report contains conclusions and recommendations for resolving these problems. The recommendations include cleaning the sewers regularly to prevent further build-up of sand and other surface matter in the sewers, replacing the deteriorated boards at the wooden weir, raising the steel plate on the box sewer, and professionally calibrating the wastewater-flow meter.

As previously stated, due to the data provided and minimal repairs necessary, the Sewer System Evaluation Survey will not be necessary.

INTRODUCTION

Overview of Project

In order to identify whether or not a Sewer System Evaluation Survey would be required for the City of Wikonac, Wisconsin, it was necessary to make a visual inspection of Wikonac's wastewater treatment facility and sewer system. It was also necessary to inspect all of Wikonac's recorded data for any inconsistencies or potential trouble indicators.

Scope of Evaluation

The system consists of three sewer subsystems: sanitary sewers, storm sewers, and combined sewers. There are a large number of manholes and seven pumping stations to be inspected. The interceptor sewer has potential overflow points created when combined wastewater and storm-water runoff overflow during times of rain or heavy snow.

After assessing the system, the following steps were deemed necessary in making a full evaluation of Wikonac's facilities.

- Interview necessary Wikonac personnel
- Inspect the seven pumping stations.
- Identify and inspect overflow points on the interceptor sewer.
- Identify potential inflow sources.
- Analyze recorded data to determine any inflow/losses.
- Identify any problems and the repairs needed to resolve the problem.

This report contains the results of that assessment. Three main problems were identified during the visual inspection. A secondary problem was identified using data in the tables provided, as well as manual testing of the wastewater returning to the system.

Report Format

This report is divided into two sections. The first section contains three sub-sections. The first sub-section is an overall evaluation of the systems. The second sub-section addresses specific problems identified. The third sub-section addresses data analysis of pumped water, wastewater, and flow recorded. The second section of the report presents conclusions and recommendations based upon the data presented in the report.

EVALUATION

Wikonac System

The Wikonac System was built around the turn of the century with combined sewers for discharge into Lake Michigan and the Gull River. In 1938, the City constructed a primary wastewater treatment plant and an interceptor sewer designed for dry weather flow. Diversion overflow structures were also installed along the interceptor for rain as well as melting snow. The city has three large bodies of water impacting its sewer system and wastewater treatment facility: Lake Michigan, Lake Nebagamon, and the Gull River.

The total population of Wikonac, Wisconsin, combined with estimations of additional users comes to approximately 12,000 people. Of this population, the industrial use market is made up of schools, motels, one supermarket, a few small firms, Wisconsin Tool, St. Anne Hospital, and Beta Chemical. Of these industrial users, the latter three are the largest. Wisconsin Tool and Beta Chemical are the largest users. St. Anne Hospital does not use water but does discharge into the system. Beta Chemical does not discharge into the system.

The system consists of three sewer subsystems. There are 10,170 feet of sanitary sewers, 12,090 feet of storm sewers, and 167,020 combined sewers. In addition, there are 625 manholes and seven plumbing stations. The interceptor sewer has 23 potential overflow points where combined wastewater and storm-water runoff could overflow when it rains. These 23 points were inspected along with the seven pumping stations and certain key manholes identified when the records of the plant were reviewed.

Problem Areas

Upon inspection of the previously mentioned facilities, three problem areas were identified. Two of the three problem areas were found near three of the diversion structures. The first diversion structure problem was found to be related to dry weather overflow. The second was found to be related to inflow. A third problem, not related to the diversion structures, was identified with a steel-plate overflow device.

Dry Weather Overflow

Overall, the diversion structures appear to be in functioning properly; however, during dry weather some water overflow does occur. This overflow has been identified at two of the diversion structures. The structures are located at manholes 23 and 27. Upon further inspection, the source of this problem has been identified as a maintenance issue. The upstream sewers have not had regular cleanings. Without these cleanings, sand from winter road sanding has

built-up in the upstream sewers causing the overflow. Vic Ling of the Department of Public Works is aware of this sand build-up and intends to have the issue addressed.

Inflow at the Wooden Weir

Near the diversion structure at manhole 9, sanitary sewage has been identified. This sewage is the result of inflow and appears to occur when the lake is high and the Gull River rises. The result is that the river backs up into the pumping station. When the river water returns to the north side of the river channel, it takes with it the diluted sewage. The source of this problem has been identified upon inspection of the top boards of the wooden weir. These boards were found to have deteriorated to the point where they permit the previously mentioned river water back-up. Replacing these boards will resolve the inflow.

Steel-Plate Overflow Device

Water is entering the Wikonac system at a steel-plate overflow device located at the 5 ½-foot box sewer in L Street between 14th and 15th Avenues. The source of the water appears to be a small inland lake called Lake Nebagamom. Water is entering the sewers at high lake levels. This is contributing to abnormally high wastewater flow data as indicated in Table 3: Wastewater Flow Recorded. It has been determined that raising the steel plate on the box sewer should resolve the overflow issue.

Data Analysis

It is important to point out that a fourth potential problem was identified upon inspection of the water data provided by the City of Wikonac. This data shows high water losses for the years 1981 and 1982. Much more water was pumped into the system than was recorded being returned to the system. Upon further inspection, it was determined through direct measurements that the meter is reporting 0.3 mgd (approximately 29 %) less than is actually flowing through the system. Given the 0.3 mgd error measurement, it can be discerned that the reported wastewater flow is approximately 300,000 gallons less per day than the actual wastewater flow. Upon speaking to Vic Ling, it was determined that the wastewater flow meter had been recalibrated between 1979 and 1981.

Though, the exact date has not been determined, the recalibration marks the beginning of the under-reported wastewater flow. The reason for the inaccuracy of these readings is incorrect placement of the meter during recalibration. The meter was placed directly at the weir instead of being positioned to measure the water upstream at its highest point.

With the wastewater flow data being inaccurate, any water loss calculations would also be inaccurate. To determine accurate loss levels, two data samples have been provided below. They have been taken from weeks in February when

there was little or no runoff or lake inflow to affect readings. In addition, the 29 % error rate has been increased to 31 % to account for lower flows at night. Additional adjustments have been made to account for the discharge into the system by St. Anne's Hospital and the water usage by Beta Chemical. It must be noted that St. Anne's Hospital has its own water supply, and Beta Chemical does not discharge wastewater due to pollution regulations (see Table 2 for recorded usage data for Beta Chemical).

The following calculations provide accurate percentages of water loss for the Wikonac system:

Feb 15-19 1982 – 1st Case.

Waste-Water Flow (See Table 3)

714,000 gal/day + 31 % (221,340) = 935,340 – 33,000 (St. Anne's) =
902,340 gal/day

Water Pumped (See Table 1)

1,254,400 gal/day - 256,138 (used by Beta Chem but not discharged) =
998,262 gal/day

Water Loss

7.65 % (based on recorded water pumped)

Feb 13-17 1984 – 2nd Case

Waste-Water Flow

796,000 gal/day + 31 % (246,760) = 1,042,760 – 33,000 (St. Anne's) =
1,009,760 gal/day

Water Pumped

1,314,200 gal/day – 282,714 (Beta Chem) = 1,031,486

Water Loss

1.65 %

The example losses are 1.65 % and 7.65 % respectively. Acceptable loss for a well-managed system is anything up to 10 %. With this data, it can be safely assumed that the system has no hidden water loss. With that information and the sources of inflow having been identified in this report, it can be determined that the Sewer System Evaluation Survey will not be necessary.

The following page contains the data used to determine water losses and inflow into the Wikonac system.

TABLE 1: Pumped Water to the City of Wikonac (mgd)

	1981	1982	1983	1984
January	1.22	1.22	1.16	1.33
February	1.40	1.19	1.53	1.29
March	1.20	1.24	1.23	1.34
April	1.33	1.26	1.19	1.20
May	1.30	1.40	1.45	1.26
June	1.64	2.12	1.68	1.52
July	1.79	2.23	1.58	1.61
August	1.93	1.78	1.40	1.70
September	1.31	1.60	1.35	1.44
October	1.11	1.24	1.26	1.25
November	1.22	1.22	1.26	1.18
December	1.10	1.16	1.32	1.18
Average (year)	1.38	1.47	1.37	1.36
Max. day	2.96	2.88	2.44	2.29
Min. day	0.84	0.74	0.91	0.98

Table 2 represents water used by Beta Chemical which was not returned to the sewer due to pollution regulations.

TABLE 2: Pumped Water Not Returned to the Sewer (mgd)

	1981	1982	1983	1984
January	Data	0.30	0.32	0.41
February		0.22	0.26	0.44
March	Not	0.19	0.25	0.40
April		0.26	0.30	0.20
May	Avail.	0.28	0.23	0.18
June		0.22	0.30	0.06
July		0.33	0.45	0.82
August		0.14	0.38	0.29
September		0.25	0.41	0.27
October		0.25	0.33	0.23
November		0.28	0.37	0.22
December		0.24	0.37	0.34
Average		0.25	0.33	0.32

Table 3 contains the previously mentioned data collected by the incorrectly calibrated wastewater-flow meter. This data must be modified for proper interpretation.

TABLE 3: Wastewater Flow Recorded (mgd)

	1981	1982	1983	1984
January	0.54	0.86	0.90	1.08
February	0.55	0.80	0.78	0.89
March	0.59	1.07	0.99	1.45
April	0.54	0.86	1.03	1.23
May	0.54	0.89	0.94	2.31
June	0.54	0.88	0.95	3.46
July	0.56	0.96	1.07	2.72
August	0.65	0.99	1.35	1.97
September	0.89	0.99	1.33	1.66
October	0.86	0.86	1.13	1.50
November	0.90	0.85	1.00	0.95
December	0.97	0.93	1.01	0.92
Average (year)	0.68	0.91	1.04	1.68
Max. day	1.10	1.41	2.20	5.42
Min. day	0.40	0.57	0.54	0.61

The second problem indicated by the data was a drastic increase in wastewater flow in 1984. The increase initially appeared to be caused by excessive infiltration into the sewers. High lake levels as shown in Table 4 appear to be causing lake and river water inflow into the system. After discovering the incorrectly reported data displayed in Table 3, it has been determined that the increase in wastewater is higher than initially shown.

TABLE 4: Lake Michigan Water Levels

	1981	1982	1983	1984
January	578.69	578.81	579.1	579.89
February	578.55	578.69	578.9	579.92
March	578.49	578.97	578.9	580.02
April	578.63	579.24	579.1	580.38
May	578.99	579.55	579.6	580.65
June	579.26	579.80	579.8	580.98
July	579.35	579.91	580.0	580.99
August	missing	579.86	580.2	580.96
September	579.21	579.70	580.3	580.68
October	579.08	579.47	580.2	580.44
November	578.99	579.22	580.02	580.12
December	578.92	579.1	579.87	579.97

As seen in table 4, Lake Michigan's water levels have been rising. With the identification of the 0.3 mgd average error in the recorded wastewater flow, the wastewater flow is not only indicative of inflow but that the inflow is 29-31% higher than recorded. However, the sources of the inflow have been identified, and the repairs of the previously mentioned problems found with Wikonac's system in the previous sub-section will resolve the inflow issues.

CONCLUSION

Overall, the Wikonac system is in good shape for a system of its age. Three problem areas and their respective solutions have been identified. The primary issues involve needed cleaning and some relatively minor repairs to prevent inflows from the lakes, especially Lake Michigan, when the lake levels are high. It must be noted that all wastewater flow records for the City of Wikonac between the years of 1979 and 1984 should be considered inaccurate. The year 1979 is included due to the inability to determine the precise date of the faulty meter calibration. This data will need to be adjusted when used for calculations or as consideration for repairs or maintenance.

RECOMMENDATIONS

Given the age of the sewer and wastewater treatment facilities, the minimal repairs necessary are a credit to those who maintain the facilities. The following are the recommendations for increasing the efficiency and accuracy of the system:

- Clean sewers to prevent build-up of sand or other debris.
- Replace deteriorated boards at manhole 9.
- Raise the steel plate on the L Street box sewer.
- Recalibrate the wastewater-flow meter on a regular basis (annually or bi-annually). A professional technician should be contracted to perform this recalibration.