WASTEWATER TREATMENT PLANT FACILITIES PLAN CITY OF SHELBY, OHIO

January 2015

Prepared for:

Shelby OHIO EST. 1834

1433401

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Acronyms and Abbreviations

ADF	Average Daily Flow
CDBG	Community Development Block Grant
DWAF	Drinking Water Assistance Fund
EDMR	Effluent Discharge Monitoring Report
gpd	Gallons per Day
gpm	Gallons per Minute
GWR	Ground Water Rule
LF	Linear Foot
MCL	Maximum Contaminant Level
MDF	Maximum Daily Flow
MGD	Millions of Gallons Per Day
mg/L	Milligrams per Liter
MHI	Median Household Income
MORs	Monthly Operations Reports
NPDES	National Pollution Discharge Elimination System
OAC	Ohio Administrative Code
ODOD	Ohio Department of Development
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
OM&R	Operation, Maintenance, and Repair
OPWC	Ohio Public Works Commission
OSHA	Occupational Safety and Health Administration
OWDA	Ohio Water Development Authority
SDWA	Safe Drinking Water Act
s.f.	Square Feet
ug/L	Micrograms per liter
US	United States
USDA	United States Department of Agriculture
VFD	Variable Frequency Drive
WSRLA	Water Supply Revolving Loan Account
WWTP	Wastewater Treatment Plant

1.0 EXECUTIVE SUMMARY

The purpose of the Facility Plan report is to determine the extent of the existing service area in order to handle current and 20-year design flows from the City and the upgrades required in order to consistently achieve compliance of the current and upcoming NPDES effluent parameters. The current situation in the study area is characterized based on its physical area, population dynamics and wastewater generation rates, and by evaluating the current condition of the wastewater treatment plant. This Facility Plan report is intended to provide the City of Shelby guidance in selecting the wastewater treatment improvements with respect to their flow handling capacity, operating condition, and any deficiencies in final effluent parameters being discharged recently.

Another element that the report will provide is a discussion on implementation schedule and a description of financing options that will render the project affordable to city residents. Specifically, the purpose of this Facility Plan report is to develop a wastewater management program for the facilities planning area so that it is cost-effective, environmentally sound, implementable and manageable.

In order to come up with future flow projection and the corresponding sizing of the treatment equipment, historic Census data was used. For the City of Shelby WWTP, the average daily flow is calculated to be 2.17 MGD based on 2010 – 2013 flow data. Design flow is not expected to change in the future because (a) there is a reducing trend in the population, and (b) no new areas are expected to be connected to the WWTP in the near future.

1. Areas in WWTP where improvements are recommended
    - Grinder/Screen building
    - Stormwater pumping and retention basins
    - Influent pumping
    - Primary Clarifier
    - Aeration Blowers and air controls
    - Aeration tank
    - Final clarifiers

- Solids handling
- Aerated grit thickener
- Disinfection and post aeration
- PLC system, plant control and monitoring
- General site improvements
- Office space and amenities

2. Public areas in sanitary sewer where improvements are recommended:
   - Manholes
   - Storm sewer connections
   - Sewer lines

3. Private areas in sanitary sewer where improvements are recommended:
   - Laterals
   - Yard drains

From the recommended treatment plant improvements, those selected by the City of Shelby will have an estimated project cost of $6,482,642 for the year 2014. Preliminary cost estimate from F. E. Krocka & Associates for sanitary flow improvements to overcome infiltration and inflow (I/I) indicates a project cost of $11,870,000. By comparing the costs of the above two projects, it is clear that it is more economical to undertake WWTP improvement project over the sanitary sewer improvement project.

2.0 INTRODUCTION

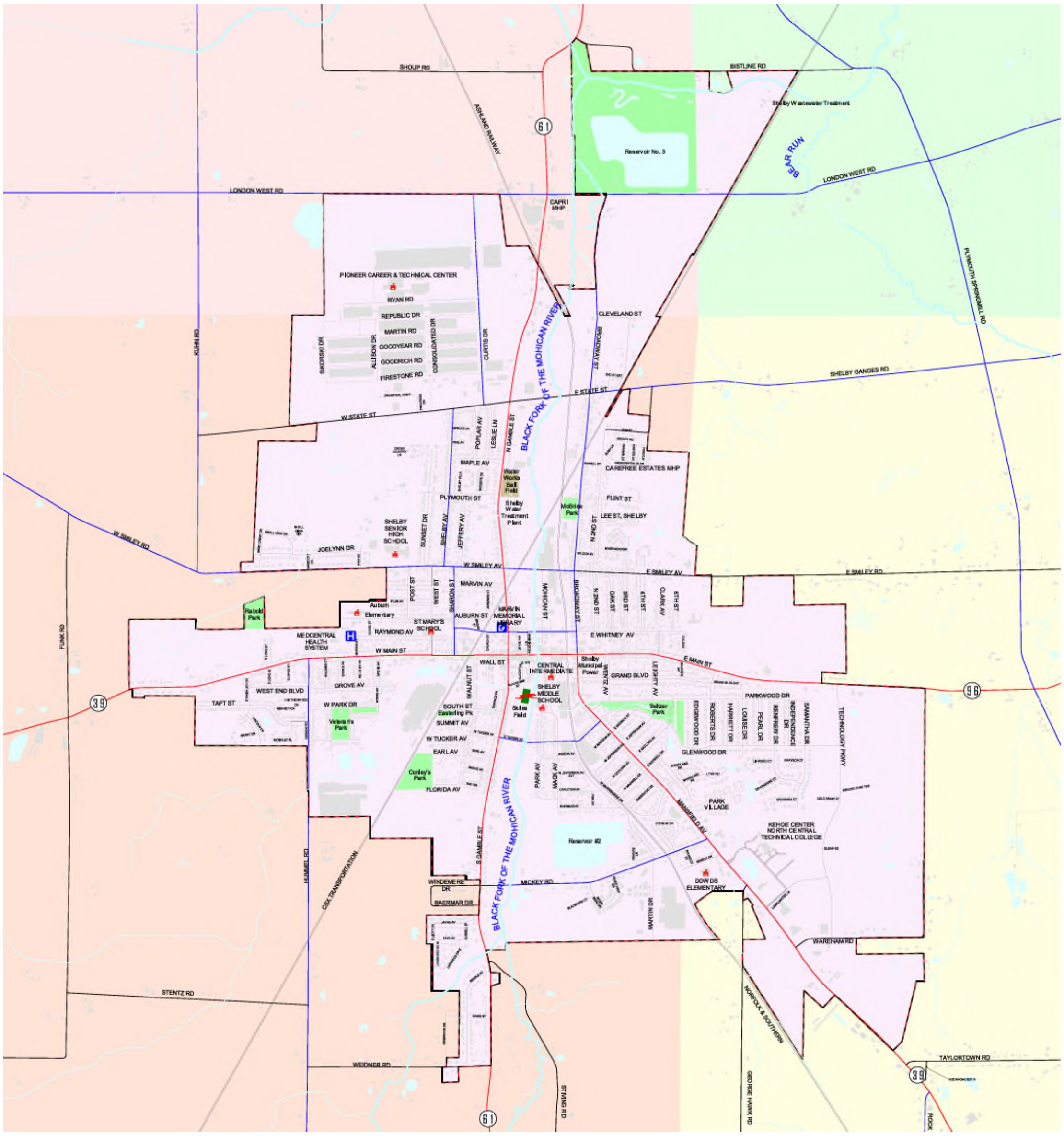
In July 16, 2014 the City of Shelby contracted with CT Consultants Inc to complete a Facilities Plan to evaluate options for an upgrade to the existing Wastewater Treatment Plant (WWTP) based on existing and projected flow rates, treatment process requirements, and cost analysis.

2.1 CURRENT SITUATION

The City of Shelby is located at the northwest part of Richland County, Ohio. United States (US) Routes 39 and 96 run together across the City from West to East, and intersects with Route 61 at the heart of the City.

According to the Census report of 2010 and the earlier decades, the City had been experiencing a decreasing trend in population. Upon extrapolation from the past population data, the estimated population for the year 2040 will be 8,920. The average number of people per household is 2.38 as per the 2010 Census. The City currently has 4,066 wastewater service taps. A location map is shown in the next page.

At Shelby WWTP, the maximum daily flow (MDF) occurs during Spring season due to seasonal rainfall, increasing infiltration in the collection system. The treatment plant has been designed to treat an average daily flow of 2.5 MGD, and a maximum daily flow of 5.0 MGD. There are two (2) storage basins; the primary basin holds 2 million gallons and the secondary basin holds 18 million gallons. With the plant reaching its design life along with the intense maintenance needed to keep the plant operating to meet regulatory standards, the need for an upgrade has been addressed in this report.



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CITY OF SHELBY, OHIO
LOCATION MAP

2.2 POPULATION ANALYSIS

The City of Shelby population data was collected from the US Census Bureau which included the new 2010 census population statistics along with historical trends for the area.

Upon performing population analysis of the City of Shelby, it is evident that the population in the recent years has been on the decline (Table 1). Population of Richland County, in which the City of Shelby is located, has also decreased overall in the past four decades (Table 2), although at a lower rate than the City of Shelby (Figure 1).

Table No.1:
Population of the City of Shelby from 1970 up until 2040

Year	Population	% Change
1970	9,847	
1980	9,646	-2.04%
1990	9,564	-0.85%
2000	9,821	-2.69%
2010	9,317	-5.13%
2020	9,185	-1.42%
2030	9,052	-1.44%
2040	8,920	-1.46%

Table No.2:
Population of Richland County from 1970 up until 2040

Year	Population	% Change
1970	129,880	
1980	131,205	1.02%
1990	129,160	-1.56%
2000	128,797	-0.28%
2010	124,175	-3.59%
2020	122,749	-1.15%
2030	121,323	-1.16%
2040	119,896	-1.18%

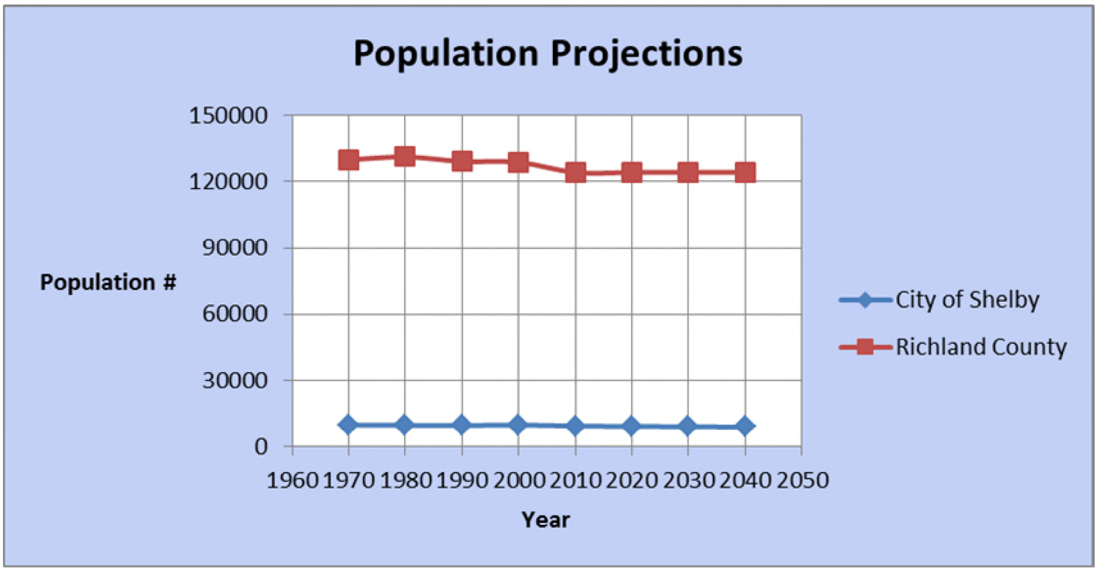

Figure 1: The population of the City of Shelby and Richland County showing the growth trend.

2.3 FUTURE SERVICE AREAS AND BUSINESSES SERVED

The population growth for the City of Shelby has been on the decline for the last four decades. As a result, there is no anticipated increase in the number of customers to Shelby WWTP. According to Shelby WWTP superintendent, there are no plans for any neighborhood towns to establish contract to discharge wastewater to this facility. A discussion of projected flows follows:

2.3.1 Rumpke Landfill Projection

Leachate from Rumpke Landfill has been delivered to the City's WWTP for the past several years. During the last three years, 359,000 to 556,000 gallons of leachate have been accepted per month by the City of Shelby. Based on the information provided, it is not possible to project flow estimates in the future. Volume of leachate to be generated by landfill facilities depends on the amount of precipitation received during any given year. Net change expected in the number of landfill cells at the Rumpke landfill facilities in the neighborhood is not known.

Primary pollutants of concern in the leachate from Rumpke landfill are ammonia and total dissolved solids (TDS). Based on the available data from the past 4 years, the concentration of ammonia ranged from 400 to 750 mg/L and TDS from 3,000 to 9,900 mg/L. No hazardous chemicals have been detected at significant concentrations.

A detailed report on the characteristics of leachate from Rumpke landfill and wastewater to Shelby WWTP has been prepared (Appendix E).

2.3.2. Liberty Fluid Company

Shelby WWTP is currently accepting waste products from this package plant. The amount of waste accepted is 8,000 gallons per month. Future changes in the quantity of septage to be discharged to Shelby WWTP are unknown. It is our understanding that the package plant treats wastewater from restaurants, and that their waste sludge is hauled to Shelby WWTP for disposal.

Overall, additional volume of wastewater from businesses to the WWTP is not significant.

2.4 FLOW CHARACTERISTICS ANALYSIS

Based on effluent discharge monitoring report (EDMR) data provided by Shelby WWTP Superintendent for the years 2010 to 2013, the average daily flow to the plant is 2,170,000 gallons per day, or 2.17 million gallons per day (MGD). Figure 2 and Figure 3 show the average daily flow and maximum daily flow, respectively, for the past four years.

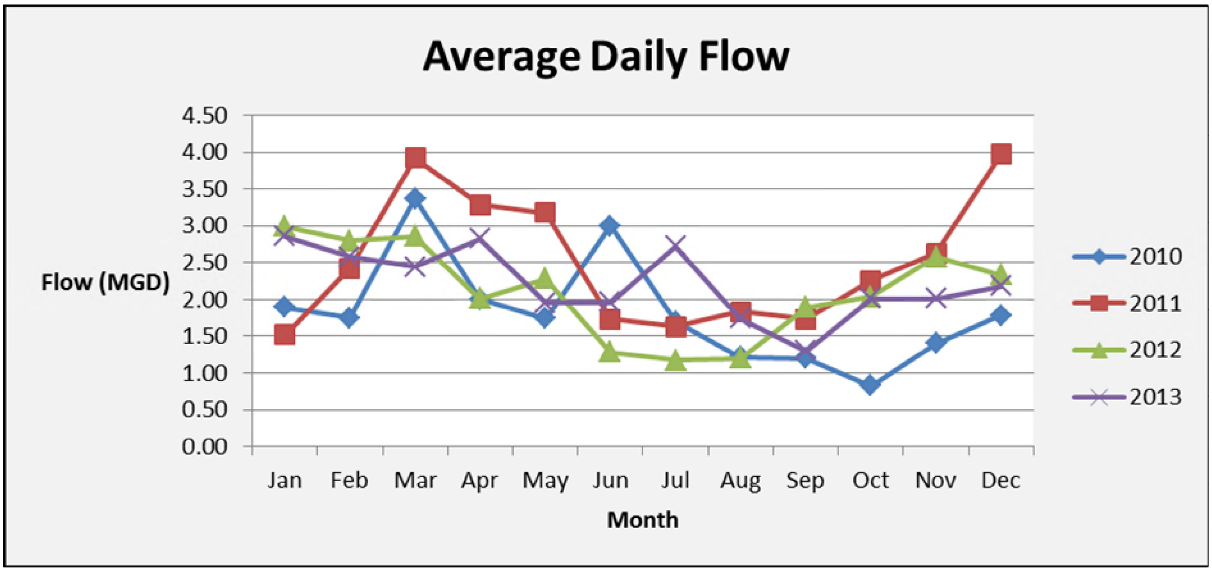

Figure 2: Average Daily Flow over the past four years collected from the EDMR data provided by the WWTP Superintendent

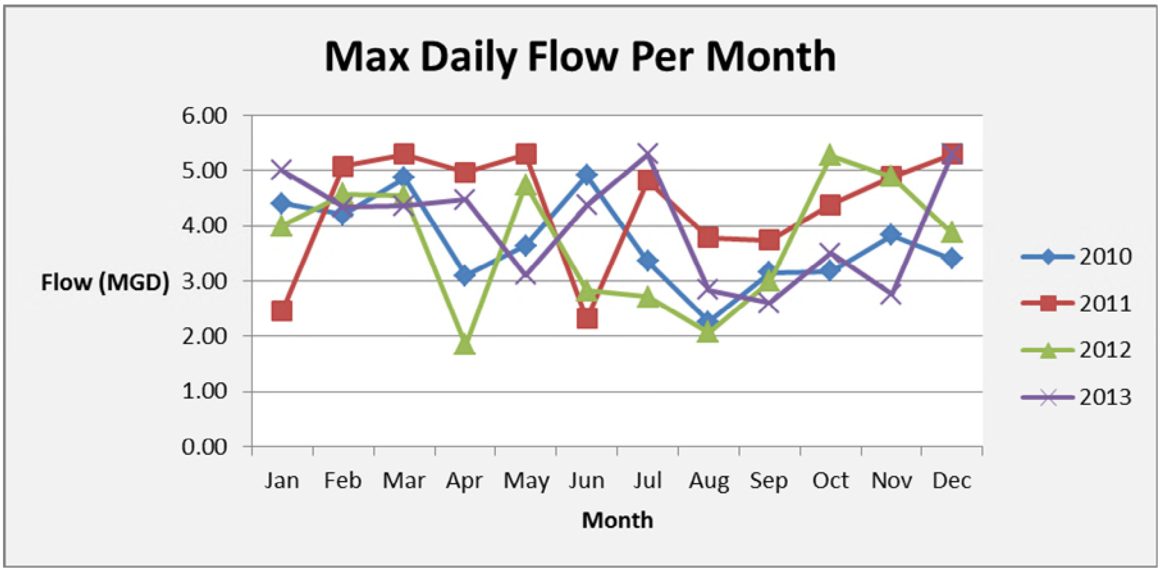

Figure 3: Comparison of maximum daily flows per month per year from EDMR data

The daily flow data from the four year period from January 2010 through December 2013 was entered into a Microsoft Excel spreadsheet and statistical analysis performed. Using built-in Excel spreadsheet formulas, the resulting mean was 2,166,563 gpd with a standard deviation of 720,952 gpd and a 95% confidence interval of +/- 209,343 gpd, resulting in an upper 95% confidence estimate of 2.38 MGD.

The following basic design data (Table 3) summarizes the existing design flows.

Table No.3
Existing Design Flow Summary

Average Daily Flow (ADF)	2.17 MGD
Maximum Daily Flow (MDF)	3.94 MGD
Peak Hourly Flow (PHF)	7 MGD (> 5 MGD sent to Retention Basins)

Ratio of the existing maximum daily flow (MDF) to average daily flow (ADF) is 1.82. This value is within the Ten States Standards peak factor (PF) for a community of this size (ratio of hourly peak flow to average design flow for a population of 10,000 is shown to be around 3.0). The peak flow value for the WWTP could be as high as 7 MGD according to Shelby WWTP's O&M Manual prepared in 2009. Peaking factor value based on the ratio of this peak flow to the average design flow of 2.5 MGD is 2.8.

The peaking factor values discussed above does not seem to suggest infiltration and inflow (I&I). However, wastewater generated per capita is very high (Figure 4). Over the last four years, the average per-capita wastewater discharged to Shelby WWTP was 230 gallons per capita per day (gpcd). The per-capita flow rates presented in the plot do not include flow contributions from Rumpke landfill (average of 556,000 gallons per month), Huron County landfill (average of 20,000 gallons per month), Richland County landfill (average of 32,000 gallons per month), and Liberty Fluid packaged wastewater treatment plant (average of 8,000 gallons per month). Per-capita wastewater generation value for Shelby WWTP is much higher than Ten State Standards typical value of 100 gpcd. The high flow per-capita is attributed to I&I.

Figure 4: Wastewater Generation Per Capita for Shelby WWTP

2.5 SANITARY SEWER OVERFLOWS

Based on the Smoke Testing performed in 2009 by Underground Utility Services Inc. in 2009, there are two (2) known sanitary sewer overflows (SSO) in the Shelby sanitary sewer system. This is the key priority, and the overflow points need to be confirmed by dye testing. Further, based on their four years of rainfall data analysis, it was reported that there is a high probability of an overflow event when three (3) contiguous days of 3+ inches of rainfall occur. Besides the sanitary sewer overflow points, the most significant problems found were in sewer laterals, storm sewer cross connections, and manhole castings.

Based on the smoke test results, a total of 581 structures have been identified to have problems in the sanitary sewer collection system. Of these, 49% were identified in public property (manhole structures, storm sewers, etc.) and the remaining 51% in residential and other private properties. (Laterals, yard drains, etc.)

According to a personal communication notes from Mr. Charlton Brown (Shelby WWTP Superintendent) in 2014, there has been no water-in-basement (WIB) incidences reported in the last four years.

2.5.1 Efforts to Reduce I/I

The City hired Underground Utility Services Inc. and performed Smoke Test in November 2009. The City has committed to the Northwest District Office of Ohio EPA to submit a schedule describing the City's efforts to comply with identified action items and to submit a plan for eliminating the SSOs. It is expected that the plan will result in eliminating the SSOs in the near future.

A summary of bypass events that occurred during the last three years is presented in Table 4. According to this data, 11 bypasses occurred in the year 2011 and three events in 2013.
Inspection reports from Ohio EPA indicate that bypass events occurred in February and April 2014.

According to the City of Shelby infiltration/inflow (I/I) reduction program report, I/I problems have been identified with the City's sewer collection system. In 2009, the City has performed Smoke

Testing of their Sanitary Sewer/Collection network, covering an area roughly 6.6 square miles. The sanitary system consists of 51 miles of main line, of which 46 miles include vitrified clay pipe.

In the year 2015, the City of Shelby will perform the West Main Street I/I Reduction Project (budget $198,000) which will replace approximately 770 LF of sanitary sewer. Replacement will be a combination of 8-inch and 6-inch sanitary sewer pipes.

In the year 2015 and beyond, engineering efforts towards investigating critical I/I removal project needs and developing preliminary design has been allocated a budget of $110,000

2.5.2 Contingency Plan

The City's primary goal is to eliminate the SSOs by identifying and eliminating sources of I/I in order to decrease wet weather flows. If, however, the I/I reduction effort is not successful or it is determined that the proximate cause of the SSO is a downstream bottleneck, it is possible that the SSO elimination will result in increased flows to the WWTP. The possible amount of increased flow is not known at this time. The City's investigations will continue throughout the proposed WWTP improvement design period. Any possible increase in flow to the WWTP will be quantified prior to submission of the Permit-to-Install application for the proposed WWTP improvements.

The Contingency Plan for handling possible increased flows at the WWTP due to SSO elimination includes:
(a) Utilizing the capacity of the existing Retention Basins;
(b) Utilizing the additional peak flow capacity due to the proposed improvements; or,
(c) Possibly constructing an additional Retention Basin if necessary.

As a supplement to plan (a), this report recommends installation of channels from both the Retention Basins to direct flow to the standby Aeration Tank. This arrangement will minimize bypass events when both the Basins are full.

Table No.4
Bypass Events in the City of Shelby WWTP

DATE	RAINFALL (inch)	DURATION OF BYPASS(2) (HRS)	TOTAL BYPASS(3) (MG)	INFLUENT PEAK (MGD)	TSS (mg/L)	BOD (mg/L)	RETENTION BASIN DEPTH(1) (ft)
2/1/2011	0.75	24	0.9	1.3	7	73	FULL
2/28/2011	2.3	24	1	5.3	7	37	FULL
3/5/2011	1.6	24	1.8	5.3	53	40	FULL
3/6/2011	1.6	24	1.8	5.3	14	27	FULL
3/10/2011	1.1	24	1.5	5.3	12	73	FULL
3/11/2011	0.3	8	0.4	5.3	7	37	FULL
5/26/2011	1.85	24	1.5	5.3	45	28	FULL
11/29/2011	1.5	2	0.1	4.6	38	35	FULL
12/5/2011	2.3	24	1.8	4.2	53	44	FULL
12/6/2011	0.8	24	1.4	5.3	36	62	FULL
12/23/2011	0.75	24	1.5	5.3	12	40	FULL
4/12/2013	1.8	24	0.6	4.4	32	63	FULL
7/10/2013	1.98	37	2.3	5.3	18	66	FULL
12/19/2013	1.99	32	2.8	3.4	36	33	FULL

Notes:

1. During each bypass event, both the retention basins (18 MG and 1.8 MG) were full.
2. When both the retention basins were full and the plant flow meter records 5.3 MGD, wastewater is bypassed.
3. There is no flow meter for the by-pass valve. All events are estimated. Volumes are probably greater.

The WWTP currently has a combined 20 million gallon Retention Basins. Records indicate that both the Retention Basins have filled up completely several times. This includes the bypass events summarized in Table 5.

There are two high flow relief options at the plant. One option is to open and close valves to direct the force main that goes to the Retention Basins. The other option is to utilize the bypass valve which allows influent to go directly into the bypass outfall.

Typically Shelby WWTP utilizes the fourth raw sewage pump to pump wastewater to Grit Chamber during rain events. When the flow exceeds 4.5 MGD, operating three pumps cannot keep up with the incoming flow.

2.6 TREATMENT ANALYSIS

The Shelby WWTP has obtained a new National Pollution Discharge Elimination System (NPDES) discharge permit (2PD00036*MD) that will be in effect through January 31, 2017. Authorized by the Ohio Environmental Protection Agency, this permit limits their effluent discharge to the Black Fork Mohican River. These limits consist of pH ranging from 6.5 to 9.0 and a Fecal Coliform limit of 1000 to 2000 #/ 100 ml for 30-day and daily limits, respectively. The CBOD has a daily limit of 15 mg/l and a 30-day limit of 10 mg/l during summer, and a daily limit of 23 mg/l and a 30-day limit of 15 mg/l during winter. The TSS has a daily limit of 18 mg/l and a 30-day limit of 12 mg/l during summer, and a daily limit of 27 mg/l and a 30-day limit of 18 mg/l during winter. The ammonia has a daily limit of 3.5 mg/l and a 30-day limit of 2.0 mg/l during summer, and a daily limit of 10.0 mg/l and a 30-day limit of 7.0 mg/l during winter. As for the current analysis of the plant it can be seen that there have been occasional excedence of effluent ammonia during summer months over the last three years.

The following data was obtained from the Shelby WWTP from their EDMR reports which were analyzed and presented in Tables 5 and 6.

Table No.5

Influent and Effluent TSS and BOD loading rate averages from the past four years of MOR Data showing current percent removal rates

Year	Influent			Effluent			% Removed		
	Avg. TSS (mg/l)	Avg. NH_3-N (mg/L)	Avg. BOD (mg/l)	Avg. TSS (mg/l)	Avg. NH_3-N (mg/L)	Avg. BOD (mg/l)	Avg. TSS	Avg. NH_3-N	Avg. BOD
2010	154	14.3	250	5.6	3.1	3.7	96.4	78.3	98.5
2011	134	11.9	238	7	2.4	3.5	94.8	79.8	98.5
2012	148	14.8	252	10	3	5	93.2	79.7	98.0
2013	102	15.6	244	8.8	2.4	4.3	91.4	84.6	98.2

Table No.6

Average Flow Characteristics from effluent samples over the past four years of MOR Data

Effluent	2010	2011	2012	2013
Avg Daily Flow (mgd)	1.80	2.51	2.11	2.21
Avg TSS (mg/l)	5.6	7.0	10.0	8.8
Avg NH_3-N (mg/l)	3.1	2.4	3.0	2.4
Avg CBOD (mg/l)	3.7	3.5	5.0	4.3
Avg Rainfall (inch)	3.5	5.0	3.6	3.9

Based on past discussions with Ohio EPA it can be expect that nutrient removal will likely be imposed sometime within the next several NPDES permit cycles.

According to the Ohio River Valley Water Sanitation Commission (ORSANCO), there is “nothing planned for nutrients”. There is also no total maximum daily load (TMDL) study completed at this point. The Ohio EPA’s Draft Nutrient Reduction Strategy Framework for Ohio Waters (“Draft Strategy”) includes the potential for a phosphorus limit. The Draft Strategy does not call for nitrogen limits at this time. Table 21 from the report is extracted and shown below.

Table 21. Guidelines for assigning phosphorus WLAs in TMDLs, POTWs discharging 1 MGD per day or more. If no effluent data available to estimate load, use a concentration of 3 mg/l.

	Condition of Water	WLA and NPDES Permit Content
Lake Erie Basin	Not impaired for nutrients	1.0 mg/l at design flow, per long-standing Lake Erie policy
	Impaired for nutrients; this source is predominant contributor to impairment	When new WQS (including TIC analysis) in place: Allocate as low as 0.5 mg/l (with compliance schedule, trading option, habitat fixes)
		Until new WQS in place: Allocate the lower of 1.0 mg/l at design flow or existing load* (with trading option, habitat fixes).
	Impaired for nutrients; this source is one of multiple contributors to impairment	When new WQS (including TIC analysis) in place: Allocate as low as 0.5 mg/l (with compliance schedule, trading option, habitat fixes)
		Until new WQS in place: Allocate at 1.0 mg/l at design flow*
Ohio River Basin	Not impaired for nutrients	Include existing effluent load in WLA in TMDL. No phosphorus permit limit; monitoring per guidance
	Impaired for nutrients; this source is predominant contributor to impairment	When new WQS (including TIC analysis) in place: Allocate as low as 0.5 mg/l (with compliance schedule, trading option, habitat fixes)
		Until new WQS in place: Allocate the lower of 1.0 mg/l at design flow or existing load*(with trading option, habitat fixes).
	Impaired for nutrients; this source is one of multiple contributors to impairment	When new WQS (including TIC analysis) in place: Allocate as low as 0.5 mg/l (with compliance schedule, trading option, habitat fixes)
		Until new WQS in place: Allocate at 1.0 mg/l at design flow* (with compliance schedule, trading option, habitat fixes)

* However, if rigorous, calibrated model that simulates instream processes indicates need: Allocate as low as 0.5 mg/l at design flow (with compliance schedule, trading option, habitat fixes).

At this point, without a TMDL, the Ohio River would be classified as "Not impaired for nutrients" and there would be no phosphorus permit limit. Once a TMDL is completed, on the assumption that the Shelby WPCF would not be the predominant contributor to impairment, if the Ohio River is deemed to be impaired and the WPCF is a deemed to be a contributor, then the limit would be 1.0 mg/L at design flow but possibly set as low as 0.5 mg/L if a new water quality standard (WQS) is established.

3.0 EXISTING TREATMENT

The City's original WWTP was constructed in 1953. The plant was expanded in 1988 (elimination of sanitary bypass and a 1.8 million gallon retention pond) to its current capacity of 2.5 MGD average design flow and 5 MGD peak daily flow. In 2007, a new 18 million gallon retention pond, and a grinder and screen building were added.

The influent to the plant enters the Grinder/Screen house via a 48-inch diameter sewer. When flow exceeds 5 MGD such as during wet weather, up to three storm water pumps divert flow to a retention basin of 2 million gallon capacity. When this retention basin is full, water overflows to another retention basin of 18 million gallons. When the wastewater flow rate returns to normal, water from retention ponds gradually drains into the sewer main via a drain pit. Overflow from the retention pond flows into the sewer line via another drain pit before being pumped to the grit tank. From this second drain pit, excess flow is diverted as bypass stream to the receiving Mohican River. Wastewater that is not bypassed gets pumped to aerated grit chamber. After grit removal, wastewater flows to the primary settling tanks.

Settled primary solids, along with waste activated sludge from final clarifiers are transferred to the primary digester. The primary settling tank effluent flows by gravity to the head of the aeration tanks. The final clarifiers following the aeration tanks provide for biosolids to settle. Clear effluent proceeds to the chlorine contact tanks for disinfection before being discharged into the Mohican Black Fork River. See Figure 5 for a process flow schematic.

The primary sludge digester receives the settled solids from the primary clarifiers and waste activated sludge from secondary clarifiers. Here the solids are subjected to anaerobic digestion. The primary digester is heated with methane gas. A Perth gas mixer was part of the original design to keep the sludge mixed. However, the mixer is no longer in service and therefore no mixing is provided for sludge at present. Once withdrawn from the primary digester, the sludge is pumped to the secondary digester where the function of this digester to allow the sludge to settle and thicken. Supernatant from secondary digester is pumped back to the primary tanks and the sludge is pumped to the sludge holding tank.

Digested and thickened sludge is hauled off site for land application. The remaining sludge dries into a sludge cake and is hauled to the landfill or land applied. Sludge drying beds are no longer operated due to backing up of Mohican river water into the drying bed during high flow periods.

During storm events, water level in the screen building has been reported to rise well above the top of the channel in which the drum screen and grinder are placed. Detailed hydraulic analysis will be performed during the design phase to determine the reason for the flooding, and a solution to rectify this condition will be developed.

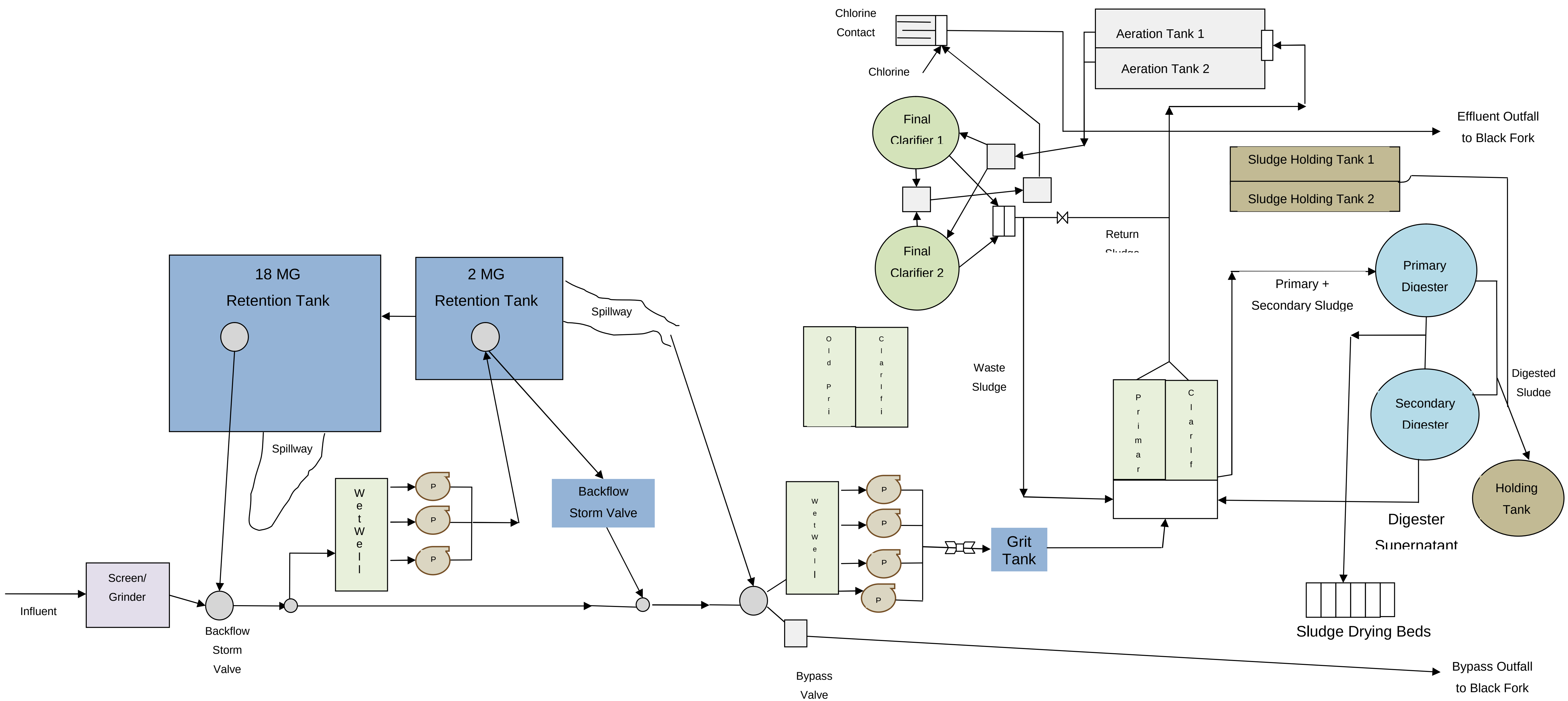

Figure 5

Existing Water Pollution Control Facility

Process Flow Schematic

Legend

New flow meter

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3.1 PRELIMINARY TREATMENT

3.1.1 Grinder/Screen

Wastewater enters the grinder/screening building in a 48-inch diameter sewer. The grinder/screening equipment consists of two rotating drums (12 MGD capacity) that feed a grinder. The grinder grinds the particles and feed a screw auger that lifts the screenings to a dumpster for removal by an overhead crane system.

The existing rotating drums do not provide perfect capture of the debris, since the drums cannot be in contact with the grinder. Coarse material attaches to the drum but is not picked up by the grinder and as a result passes downstream due to drum's rotation. The material will pass by the screw auger and not be captured. According to the Jones and Henry report, this flaw was later rectified by the manufacturer.

3.1.2 Raw Sewage Pumps

There are a total of four 850 to 1,500 gpm raw sewage pumps. They are located in a 27 ft x 6 ft x 9 ft WD wet well. These pumps pump the raw influent to the grit tanks. These pumps can deliver a peak flow of 5 MGD.

The raw sewage pumps discharge into a 14-inch line, through a venturi-style flow meter before entering the grit tanks.

3.1.3 Storm Water Pumping and Retention Basins

Two storm water retention basins serve the WWTP to store storm water during rain events. At a preset level in the wet well of the storm water pump station, the first storm pump (total three, each with a combined 2,800 gpm capacity) will begin filling the first basin (2 million gallons capacity). As the level rises in the pump station, the second and third pumps turn on.

When the first basin fills completely, it will overflow to the second basin (18.5 million gallons capacity). If the first basin does not fill completely, it is manually drained back through the inlet pipe by opening the 16-inch sluice gate at the basin outlet chamber. If the second basin is either partially or completely filled, it is drained through its 12-inch drain line and electric valve.

The electric valve is opened manually to return 1 MGD to the WWTP. At this rate, when both the retention basins are full, they will take up to 20 days to drain completely.

If both the retention basins fill during a storm event, they overflow out their spill ways in the bypass to the Black Fork Mohican River.

3.1.4 Aerated Grit Tanks

Influent flow enters the aerated grit tanks via a 14-inch force main. Grit chamber is 30-ft long x 13-ft wide x 18.5-ft WD, with 42,300 gallons of process volume. Wastewater flows into the tank by gravity and discharges over a weir to a 24-inch gravity discharge line. A weir maintains the water level in the grit tank.

The grit tank is aerated using two set of swing arm assembly, each with eight coarse bubble diffusers. Air flows from aeration tank blowers via 6-inch feed line to the grit tank, and is adjusted manually. Typical air flow rate observed is 3 to 8 CFM per foot, and 180 to 240 CFM per foot is reported to be required. Peak wastewater flow at 5 minutes detention time is 12.2 MGD.

Grit that is collected in the grit tank is removed by vacuum truck.

3.2 PRIMARY TREATMENT

3.2.1 Primary Clarifiers

Effluent from the grit tank flows by gravity via a splitter box (currently not functioning) to two primary clarifiers. The clarifier tanks are 50-ft long x 20-ft wide x 9-ft SWD. At the design surface overflow rate of 1,200 gpd/ft^2, each clarifier can handle 1.2 MGD flow. This results in a combined design flow of only 2.4 MGD possible. Wastewater flows over a weir and through a 20-inch pipe to the clarifier influent trough (1.5-ft wide). The influent trough feeds two 24-inch x 48-inch slide gates which in turn feed each primary tank inlet channel. Each inlet channel is 1.5-ft wide with six 6-in x 8-in ports and a 1.5-ft x 2.25-ft opening at the end of each inlet channel for overflow relief.

Sludge is moved to the inlet end of the tanks by a chain and flight scraper. Each tank has three sludge pits. Sludge is withdrawn with telescoping valves which are manually dropped for each sludge pit to allow discharge into the sludge holding well for that tank. Sludge from the holding wells is in turn transferred to the digester by 150 gpm pumps in the basement of the digester building. Withdrawal from the sludge pit is performed manually by utilizing a start/stop operation from either the push buttons at the sludge pit or within the digester building.

Scum and grease are withdrawn from the tanks using a 12-inch rotating scum pipe in each tank. Scum removal from the primary tanks is a manual operation. Scum can only be discharged into the scum box adjacent each primary tank and is removed by vacuum truck.

3.3 SECONDARY TREATMENT

3.3.1 Aeration Tanks and Blowers

Primary clarifier effluent flows by gravity to the head of the aeration tanks via a 30-inch diameter pipe. Each of the two aeration tanks is 150-ft x 30-ft x 13.3-ft SWD, with a capacity of 448,000 gallons (5.25 hours HRT). An 8-inch line taps into the 30-inch pipe prior to the aeration tanks to mix the return activated sludge into the primary effluent.

At the influent chamber to the aeration tanks, a slide gate permits utilization of either one of the tanks. A 6-inch line bringing digester supernatant also enters the influent chamber. Typically the plant utilizes one aeration tank at any given time.

Air flow to the biological treatment system is controlled by the number of blowers in service. There are five turbine blowers (four available), each with 1,100 CFM capacity. Proportional delivery of air to the tanks is achieved by adjusting manual valves provided on drop legs to the diffusers. Each tank is provided with 586 Weiss fine bubble diffusers. Target dissolved oxygen (D.O.) concentration to be maintained is 2 mg/L. D.O. level in the system is measured manually by taking mixed liquor samples and reading with laboratory D.O. meter.

3.3.2 Final Clarifiers

Mixed liquor from the aeration tank flows by gravity via a 30-inch pipe to the final clarifier splitter box where the flow is distributed uniformly to the two clarifiers. Each clarifier is 50-ft in diameter

(1,963 ft^2) with 13.5-ft SWD. From the splitter box, two 20-inch pipes carry mixed liquor to the clarifiers. Clarified effluent discharges over the weirs to the effluent troughs and combines together. Clarified effluent flows to the chlorine contact tank.

Settled sludge is withdrawn by lowering the 8-inch telescoping valves which feed the return sludge wet well with three return activated sludge (RAS) pumps (450 – 600 gpm submersible type). RAS pumps operate via floats and on on/off and lead/lag operation to maintain flow rate equivalent to 50 – 150% of design average flow of 1,700 gpm.

At the surface overflow rate of 1,000 gpd/ft^2 at design hourly peak flow, each clarifier can handle 1.96 MGD flow.

3.4 DISINFECTION AND POST-AERATION

3.4.1 Chlorine Contact and Post Aeration Tank

Secondary clarifier effluent flows by gravity in a 30-inch pipe to the inlet of the chlorine contact tank (53,400 gallons, with baffle arrangement of four channels each 33-ft x 5-ft x 11-ft SWD). In the inlet channel a diffuser dispenses chlorine (chlorine gas from one ton cylinders) into the incoming flow. After contact, the effluent passes through the baffled contact tank.

At the end of the tank, the effluent is aerated with diffusers (air from the aeration blower via 40 diffusers to meet the dissolved oxygen requirement for the final effluent). Sodium metabisulfite is also added as a dechlorinating agent. After dechlorination, the final effluent flows over the outlet weir to the outfall in the Black Fork of the Mohican River.

There are no controls available for chlorine and sodium metabisulfite addition. Chlorination, dechlorination and post aeration are being performed manually and visually controlled.

3.5 SOLIDS HANDLING

3.5.1 Primary Digester

Co-settled primary sludge and waste activated sludge are pumped to the primary digester (40-ft diameter x 23-ft SWD, 216,000 gallons capacity). Primary digester has a floating cover. Sludge temperature in primary digester is maintained with a heat exchanger. Heat exchanger is circulated with hot water from a boiler, which runs on methane gas.

3.5.2 Secondary Digester

After digestion in the primary digester, sludge is transferred to secondary digester provided with a gas holder cover (40-ft diameter x 23-ft SWD, 216,000 gallons capacity). Digested supernatant is returned to the primary tanks.

3.5.3 Digested Sludge Storage Tank

Digested Sludge Storage tank is comprised of one 40-ft diameter x 23-ft SWD tank and two previous aeration tanks at 90-ft x 25-ft x 14.5-ft SWD (total volume of 704,000 gallons).

3.5.4 Sludge Drying Bed

Operationally there were 15 sludge drying beds of 100-ft x 20-ft x 1-ft SWD. Currently ten are decommissioned. The remaining five are used for grit storage prior to landfill disposal. At present, digested sludge is hauled off site in liquid form.

3.6 ADDITIONAL ELEMENTS

3.6.1 Plant Drainage

There are two submersible drainage pumps at 250/350 gpm with floats, and a 6-ft diameter manhole. These pumps handle drainage from sludge loading line, sludge drying beds, grit tank drains, primary tank drains, splitter box, and the old drain manhole adjacent to the sludge holding tanks (which were previously aeration tanks).

The existing control panel electronics are reported to be in poor condition and needs to be replaced.

3.6.2 Electrical, Instrumentation and Control

Overall, control system for this plant is inadequate. Most of the equipment are operated manually. As a result, the response time to changes in incoming wastewater has not been rapid enough.

3.6.3 Office/Laboratory/Break Room

More office space is required. Laboratory is cramped. Need for additional space for personnel is strongly recommended.

4.0 NEED FOR THE PROJECT

In determining the need for the project upgrade there were three primary factors that make the current WWTP operation inadequate for projected operations.

4.1 AGED EQUIPMENT

The first major factor to be considered is that the plant has reached the 20 year design life on the existing equipment. As summarized above, most of the existing equipment has been well maintained but it is wearing out and in need of more frequent repair. Add to this that spare parts are harder to locate, rendering the concerned equipment inefficient. To ensure that the plant will operate consistently, efficiently, and without significant maintenance issues for the next 20 years and beyond, most of the existing equipment needs to be replaced.

4.2 INCREASED POLLUTANT LOAD

The City of Shelby is interested in continuing to accept landfill leachate from Rumpke's Nobel Road Landfill and two other landfill facilities in the neighborhood, and septage from package plants for treatment in their WWTP. Revenues from these landfills are a good source of income for the City. There is potential for Shelby WWTP to receive effluent from minor dischargers. There are 49 minor dischargers with NPDES permit that are listed in Richland County (http://wwwapp.epa.ohio.gov/dsw/permits/permit_list.php). However, the WWTP has been experiencing difficulty in complying with the permitted discharge limits. Therefore it is necessary to make sure that this WWTP plant has adequate capacity to process leachate and commercial effluent without any discharge violations, especially effluent ammonia.

4.3 OVERFLOW

Periodical bypass events have been reported by the City of Shelby WWTP following wet weather. According to Ohio EPA, bypass from wastewater treatment plants is considered to be in violation of the terms and conditions of the NPDES permit. The agency requires that the City should be actively involved in removing I/I incidences from the sanitary sewer collection system.

The sanitary sewer system was designed to handle significant flows by including sewer pipes of 24-inch to 48-inch diameter, it is understood that the system was not a combined sewer system. Both the Retention Basins with a combined capacity of 21 million gallons get filled up when heavy rains occur. Under these situations, the City is forced to bypass excess flows that the WWTP cannot handle.

5.0 EVALUATION AND OPTIONS FOR IMPROVEMENTS

The following discussion focuses on I/I and wastewater treatment plant improvements to meet current and future discharge limits, including their capital cost, operation and maintenance costs and probable construction cost.

5.1 NO ACTION ALTERNATIVE

A "No Action" alternative should always be evaluated as a means to document the necessity of a given project. The flow data presented in the earlier sections show that increased flow capacity is needed at the facility. Also, as discussed in the "Need for Project" section above, the equipment at the facility has reached or exceeded its useful life.

Action is required because the City has been experiencing bypass events and permit violations. Also, much of the equipment in the plant is beyond its expected service life and in need of upgrade or replacement. Action is needed now to prevent declining performance and increased maintenance efforts.

5.2 INFILTRATION / INFLOW (I/I) IMPROVEMENTS

Based on the Smoke Testing results on the sanitary sewer (Appendix F), it was found that a total of 581 problem points exist. Of this, 51% were identified in private property and the remaining in public property. The most significant problems identified were sewer laterals, storm sewer cross connections, and manhole casting. Further, two potential sanitary sewer overflow points have been found.

5.3 COMMON IMPROVEMENTS

Based on the deficiencies identified in the WWTP and discussed in the earlier sections, the following improvements are recommended:

1. Grinder/Screen Building: (a) replace existing screen with a new screen and compactor to discharge screenings at grade; (b) isolate electrical gear and ensure that the entire building is explosion proofed; and (c) upgrade HVAC and repaint interior.

2. Stormwater Pumping and Retention Basins: (a) Replace three stormwater pumps; (b) overflow from retention basins to aerations tanks with telescoping valves; (c) install flow meters in the return lines from the retention basins and in the bypass line; (c) install overflow monitor in the retention basins and connect the SCADA; and (d) upgrade to mix contents during emptying.
3. Influent Pumping: (a) replace influent pumps with higher capacity and VFD; (b) install flow meter on the influent line to grit chamber; and (c) replace control panel.
4. Primary Clarifier: (a) install scum pump and replace scum pipes and accessories so that the scum box is not filled too quickly; (b) install flow meter in the influent line to the aeration tanks; and, (c) automate sludge withdrawal instead of the existing manual operation.
5. Aeration Blowers and Air Controls: (a) replace three of the oldest blowers and install VFDs with DO based control; (b) replace leaking airline; and, (c) install new influent gates for higher influent levels (at present, influent flows over into the unused aeration tank).
6. Aeration Tanks: (a) install pH, DO and ORP analyzers to monitor biological system. This is necessary to ensure compliance of effluent parameters such as ammonia.
7. Final Clarifiers, RAS, and WAS Pumps: (a) construct a new 50-ft diameter final clarifier (clarifier #3) and modify the splitter chamber accordingly in order to handle flows greater than 3.9 MGD; (b) replace sludge collector mechanisms and WAS/RAS pumps; and, (c) automate sludge wasting using a new flow meter to measure return sludge flow rate.
8. Solids Handling: (a) Add an external mixing pump to primary digester; (b) for the old aeration tanks that have been modified into sludge storage tanks, install sludge feed piping and supernatant removal equipment/piping; (b) replace boiler/heat exchanger, gas handling equipment, and valves in digester buildings; (d) install additional piping and valves from digester mixing pump; and (e) upgrade gravity thickener.
9. Aerated Grit Thickener: (a) Install piping to connect to vacuum truck.

10. Disinfection and Post Aeration: (a) replace chlorination/dechlorination system with UV system; (b) install new electrical building for the proposed UV equipment; and, (c) install effluent flow meter and post aeration chamber.
11. General Site Improvements: (a) demolish unused tanks, backfill, and landscape; (b) review and modify stormwater collection system; (c) replace yard hydrants; (d) install security camera and additional lighting on site.
12. Office Space and Amenities: (a) block breezeway; and, (b) modify chlorine building with lockers and showers.

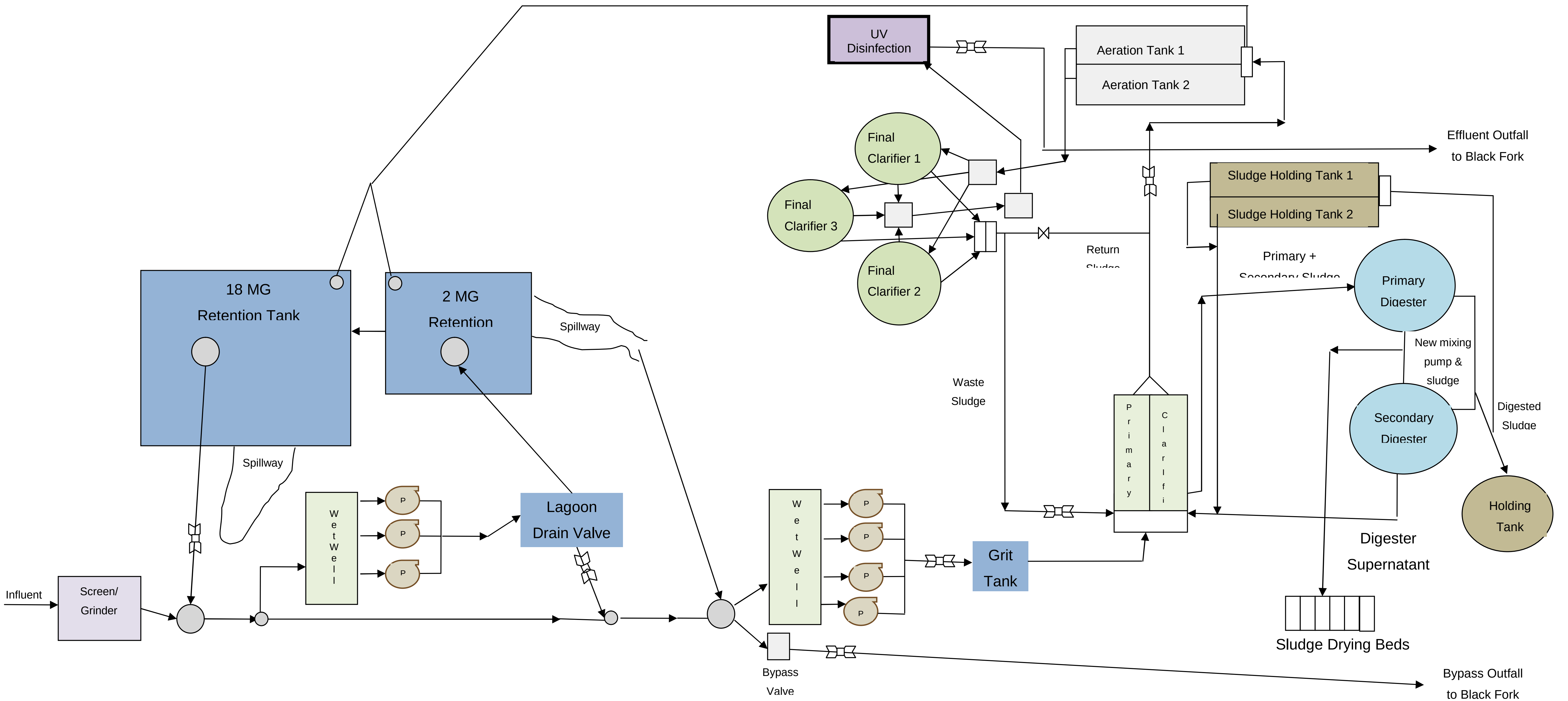

Figure 6

Plant Improvement Recommendations

Process Flow Schematic

5.4 PRELIMINARY COST ESTIMATES

There are recommended improvements to the wastewater collection system and wastewater treatment plant. It is recommended, however, that the City continue to undertake projects to reduce infiltration and inflow (I/I) over and beyond the recommendations provided.

Preliminary construction cost estimates have been prepared to give an economical perspective to the WWTP upgrades and I/I elimination recommendations. The WWTP facility improvement cost estimates have been included in Appendix A, and I/I elimination cost estimates in Appendix B. Project costs include engineering design, bidding, inspection, construction administration, permitting, advertising, legal fees, interest during construction, and other project related costs.

5.5 PRESENT WORTH ANALYSIS

The present worth cost of an item is the amount of money that would be needed today in order to cover all costs associated with the improvement (O&M and debt service costs) over the life of the project. Design life for the WWTP equipment is 20 years. Table No. 7 presents the results of the present worth analysis for the WWTP upgrades and I/I elimination activities.

Basis for the estimation of the yearly additional OM&R for WWTP improvement plan, as shown in Table No.7 is explained in Table No.8. From Table No.7, it is apparent that it will be more economical to carry out WWTP improvement project when compared to I/I elimination project. Also, WWTP improvement tasks cannot be avoided even if I/I elimination is accomplished.

Table No.7

Present Worth for Shelby WWTP and I/I Improvement Plan

	Improvement	
	WWTP	**I/I**
Construction Costs	$ 5,187,087	$ 9,891,886
Contingency - 10%	$ 520,000	$989,200
Engineering Costs - 15%	$ 792,040	$ 1,483,783
Sub-Total Project Costs	**$ 6,499,127**	**$ 12,364,869**
Potential Grants	$ 0	$ 0
Sub-Total Loan Amount	**$ 6,499,127**	**$ 12,364,869**
Annual Loan Payment	$251,830	$ 479,115
Interest Paid on 1% Loan	$1,026,231	$1,952,441
Total Paid	**$7,525,382**	**$14,317,309**
Yearly Additional OM&R	$48,523	$ 0
OM&R Present Worth	$875,624	$ 0
Total Present Worth	**$8,401,006**	**$14,317,309**

Table No.8

Annual OM&R Cost Estimate Associated With The Improvement Plan

AREA	UNITS	EXISTING	NEW
stormwater pumping	HP	210	430
	kW	157	321
	# pumps	2	2
	hours/yr	250	250
	Annual cost ($)	5,481	11,223
	Difference ($)		5,742
UV Units	kW/lamp		0.25
	# lamp/mod		8
	# modules		8
	kW (equip)		1
	hours/yr		8,760
	Annual cost ($)		10,424
Digester mixing pump	HP		30
	kW		22
	# pumps		2
	hours/yr		8,760
	Annual cost ($)		27,436
Chlorine building (will be eliminated)	kW	22.5	
	hours/yr	8760	
	Annual cost ($)	-13,797	
Additional lighting	HP		30
	kW		22
	hours/yr		8760
	Annual cost ($)		13,718
Total additional annual power cost:			$43,523
Assumed additional repair cost:			$5,000
Total OM&R Cost:			$48,523

Note:

1. Power cost assumed is $0.07/kW-h

5.6 ADVANTAGES AND DISADVANTAGES

5.6.1 Costs

Cost estimate for the improvements based on Jones & Henry report and the preferences of the City of Shelby are presented in Appendix A. Cost estimate for I/I elimination is presented in Appendix B. Project cost for improving the condition of the WWTP ($6.5 million) is significantly less than the cost estimate for addressing I/I problems ($11.8 million).

5.6.2 Effluent Quality

The proposed improvements are aimed at meeting the effluent discharge standard consistently. Replacement of old blowers and enabling operators to deciding the number of blowers in operation based on DO analyzers in the aeration tank should eliminate effluent ammonia violations. Installation of the third secondary clarifier unit will prevent effluent TSS concentrations from exceeding the discharge limit during high flow conditions.

5.6.3 Operability and Safety

The plan includes replacement of worn and outdated equipment throughout the plant which will lead to reduced OM&R efforts.

Replacement of the existing screen with new screen/compactor will greatly reduce maintenance efforts associated with inert materials such as rags and other debris passing through the plant.

For final clarifiers there is no significant incremental increased electrical cost for an additional unit. From a practical view, O&M and balancing flows is actually easier with identically sized units as opposed to variable sized units. Hydraulic splits are much easier to achieve and taking units in and out of service for maintenance is easier to accomplish.

The plan includes conversion to UV disinfection which will result in reduced man-hours and eliminate risks associated with handling chlorine.

The design includes modernization of the plant's electrical instrumentation and controls. All data will be routed to a centralized control room which will allow for convenient monitoring of plant performance and equipment operation.

6.0 PROPOSED PROJECT

6.1 PROPOSED TREATMENT PROCESS

In the proposed project, an additional secondary (final) clarifier of the same size as the existing clarifiers will be included. This addition will provide the necessary sedimentation during wet weather flows and will result in effluent suspended solids in compliance with the effluent discharge limit. Both the retention basins will overflow directly to the aeration tank on standby. The chlorine disinfection will be changed to UV disinfection to reduce man hours and eliminate safety precautions of handling the chlorine. See Figure 6 above for a flow schematic of this treatment scheme.

6.2 CONSTRUCTION COST ESTIMATE

The opinion of probable construction cost for the selected project is $5,187,100. With contingency and project costs, the total project cost is anticipated to be $6,499,200. See Appendix A for a detailed cost estimate.

6.3 ENVIRONMENTAL IMPACTS

The environmental impact of this project will be minimal. There will be no land acquisition outside of the WWT facility and no effect on fish and wildlife. Any vegetation that is disturbed will be subject to erosion control methods and will be reseeded to prevent erosion sedimentation. There will be no effect on the geology, soil, air, or mineral resources. This project should have minimal impact on the water resources or hydrology.

Best management practices for erosion and sedimentation control will be utilized during construction activities to prevent downstream water quality impacts. These best practices will include silt fences, ditch checks, and catch basin bags. The project specifications will require the construction General Contractor to prepare and follow a sediment and erosion control plan during construction of the project. A storm water pollution prevention plan will be prepared prior to construction if required.

No wetlands are present on the property. This is already a fully developed site. Any necessary environmental reviews will be completed during the design phase prior to the construction loan award.

Some parts of Shelby WWTP property are located within the 100 year flood plain of the Mohican River (Appendices C and D). Any proposed new structure or modifications to the existing structures will be evaluated with respect to their location relative to the 100-year flood plain during the design phase of this project.

6.4 CONSTRUCTION CONCERNS

There are no unusual construction concerns anticipated for this project. The majority of the treatment plant property is located within the 100 year flood plain of the Mohican Black Fork River, and design and construction will need to account for this flood elevation.

6.5 OWNERSHIP

The City of Shelby will maintain legal authority for all financial, institutional, and managerial mechanisms necessary to design, finance, construct, own and operate the wastewater treatment facilities for the community. The City will determine the user rate system and collect all revenues.

6.6 USER RATES

In September 2014, a Sanitary Sewer Capital Improvements Surcharge section (1044.07) has been amended to the Sewer Charges chapter (1044) of Shelby City Council. According to this amendment:

(a) Residential customers shall pay a capital improvement surcharge of $7.67 per month;
(b) Senior citizen residential customers shall pay a capital improvement surcharge of $3.50 per month;
(c) Commercial customers shall pay a capital improvement surcharge of $9.18 per month; and,
(d) Industrial customers shall pay a capital improvement surcharge of $10.70 per month.

Current Sewer and Water rates for the City of Shelby is shown in Appendix G.

6.7 PUBLIC INVOLVEMENT

The City will involve the public in the process of this project. Discussions regarding planning, financing, design, and permitting will be held at the City Council meetings, which are open to the public and meeting minutes available to the public. The City website will also be utilized to provide the public with updated information during the process.

6.8 RECOMMENDATIONS

CT Consultants, Inc. recommends that the City of Shelby:

1. Submit this report to the Ohio EPA Division of Environmental and Financial Assistance (DEFA) and any other relevant funding agencies.
2. In conjunction with CT Consultants, meet with Ohio EPA DEFA to discuss the requirements, scope, and goals of the new WWTP system.
3. Upon agreement with Ohio EPA DEFA, review and revise the proposed WWTP design data and proceed with the design and preparation of detailed plans, specifications and contract documents for the proposed project.
4. Coordinate with Ohio EPA to complete the anti-degradation process to revise the NPDES discharge permit for the higher flows and thus enabling additional loadings to the Black Fork Mohican River. Complete this revision in parallel with final design ahead of the Permit-to-Install (PTI) application in order to expedite this project.
5. Upon completion of the design, submit the plans and specifications along with a Permit-to-Install (PTI) application to Ohio EPA for their approval to proceed with construction of the proposed facility.
6. Upon receipt of a PTI from Ohio EPA, proceed with bidding and constructing the proposed facilities.

6.9 IMPLEMENTATION SCHEDULE

The following is a projected schedule for implementation of this project:

Design loan by	June 1, 2015
Preliminary Design	June 2015 – September 2015
Final Design	September 2015 – January 2016
PTI Submission by	December 31, 2015
Bidding and Award	May 2016 – June 2016
Construction	July 2016 – June 2017

6.10 FINANCING

The following typical benchmarks (Table 9) are used by the various funding agencies to determine eligibility for grants or low interest loans:

Table No.9
Eligibility Criteria for Grants and Low Interest Loans

	City of Shelby Current Situation	**Benchmarks to Qualifying Funding**
Median household income	\$39,371[1]	Varies
Low to moderate income ratio after survey	39.7%[2]	
Population	9,414[1]	Less than 10,000
Number of households	3,911[4]	
Sewer rate	Sewer = 1.05% of MHI \$415 annual[3]	

Notes:

(1) 2007 – 2011 American Community Survey

(2) 2000 US census

(3) 2010 Annual residential sewer rates (based on 7,756 gal./mo. Or 1,037 c.f./mo.)

(4) https://suburbanstats.org/population/ohio/how-many-people-live-in-shelby

The City has the following potential funding sources available for this project.

6.10.1 Ohio Public Works Commission (Issue I)

The Ohio Public Works Commission (OPWC) has established a program for the purpose of providing financing to public entities for capital improvement projects. Local subdivisions (cities, villages, townships, counties, etc.) in Ohio are eligible for funding through this program. The financial assistance can be in the form of a grant or loan.

The City would be eligible for up to a $500,000 grant. The grant application is due in the fall and requires an Engineer's cost estimate. In addition, the credit enhancement program can pay for interest during the year of construction and the first year of operation.

6.10.2 Ohio EPA Division of Environmental and Financial Assistance (DEFA) Water Pollution Control Loan Fund (WPCLF)

Through USEPA grant monies and matching funds provided by the Ohio Water Development Authority, the WPCLF can provide financial assistance to public water systems.

Some of the program goals are:

- Provide below market rate loans to eligible systems
- Target technical assistance to public systems serving populations of 10,000 or fewer
- Promote development of technical, managerial, and financial capacity of public systems to achieve and maintain compliance
- Support compliance with state and federal operator certification requirements

Based on the current year's program, the City would be pre-qualified for a 1% hardship loan and a potential recipient of principal forgiveness. The application is due in the fall, and it will be determined what the qualifications will be for next year's program, as well as the availability of principal forgiveness funds.

6.10.3 Ohio Water Development Authority

The Ohio Water Development Authority (OWDA) offers a loan program to finance the planning, design and construction of water and wastewater projects. The payback period for construction loans can be for up to 30 years. Interest rates are approximately equal to current market ratio. The current OWDA interest rate is 3.86% and changes every quarter. An interest rate discount is available down to 2.00% if sewer rates at 4,500 gallons of usage are at least 1.5% of the median household income (MHI). The City would have to raise their sewer rates for customers inside the City in order to meet this requirement.

6.10.4 United States Department of Agriculture Rural Development

The United States Department of Agriculture (USDA) Rural Development Services (formerly Farmers Home Administration) provides financing to small rural communities for water and wastewater projects. The financing terms are dependent on the Median Household Income (MHI) of the community. Loans can be made for up to 40 years with an annual interest rate dependent on the Median Household Income.

Rural Development awards a combination of grant and loan funding to reduce debt service costs for residential sized customers to where the monthly user charge per household is considered reasonable.

APPENDIX A Shelby WWTP – Improvement Cost Estimates from J&H and City Of Shelby Preferences

APPENDIX 6-1: SHELBY WWTP - IMPROVEMENT COST FROM J&H AND CITY OF SHELBY PREFERENCES

AREA	2012 COST (J&H)		2014 COST (J&H)		2014 COST (SHELBY SCOPE)		COMMENTS
	COST	AREA COST TOTAL	COST	AREA COST TOTAL	COST	AREA COST TOTAL	
DISINFECTION AND POST AERATION		$580,000		$613,248		$613,248	
- Replace chlorination/dechlorination w/ UV disinfection	$420,000		$444,076		$444,076		
- New electrical building for UV equipment	$130,000		$137,452		$137,452		
- Install effluent flow meter and chamber	$30,000		$31,720		$31,720		
FINAL CLARIFIERS, RAS AND WAS PUMPS		$1,370,000		$1,448,534		$1,448,534	
- Construct 50' dia. Final clarifier and modify splitter chamber	$860,000		$909,298		$909,298		
- Replace mechanisms	$330,000		$348,917		$348,917		
- Install sludge flow meter and replace pumps	$100,000		$105,732		$105,732		
- Automation of sludge wasting	$80,000		$84,586		$84,586		
PLC SYSTEM, PLANT CONTROL AND MONITORING		$600,000		$634,394		$150,000	
- Replace MCC	--		--		--		No details available on MCC
- Provide SCADA system	$600,000		$634,394		$150,000		
GRINDER / SCREENING		$440,000		$465,222		$470,906	
- Isolate electrical gear and explosion proof upgrades	$75,000		$79,299		$79,299		
- Upgrade HVAC and repaint interior	$45,000		$47,580		$47,580		
- New Screen with compactor to discharge screenings at grade	$320,000		$338,344		$344,027		
STORMWATER PUMPING AND RETENTION BASINS		$767,500		$811,496		$629,989	
- Replace 3 storm pumps	$515,000		$544,522		$363,014		City of Shelby considers replacing 2 storm pumps instead of 3
- Upgrade to mix contents during emptying	$70,000		$74,013		$74,013		
- Overflows from retention basin to aeration tanks	$100,000		$105,732		$105,732		
- Install flow meters on 12" and 16" return lines	$50,000		$52,866		$52,866		
- Install overflow monitor and connect to SCADA	$7,500		$7,930		$7,930		
- Install flow meter on plant bypass line	$25,000		$26,433		$26,433		
INFLUENT PUMPING		$315,000		$333,057		$333,057	
- Replace influent pumps	$225,000		$237,898		$237,898		
- Install VFD on each pump	$60,000		$63,439		$63,439		
- Replace control panel	$30,000		$31,720		$31,720		
PRIMARY CLARIFIERS		$340,000		$359,490		$264,331	
- Automate sludge withdrawl	$70,000		$74,013		$74,013		
- Install flow meter influent line to the aeration tank	$25,000		$26,433		--		City not considering this recommendation
- Install scum pump	$65,000		$68,726		--		City not considering this recommendation
- Replace scum pipes and mechanisms	$180,000		$190,318		$190,318		
AERATION BLOWERS AND AIR CONTROLS		$440,000		$465,222		$465,222	Besides the items listed by J&H and the City, CT recommends
- Install new gates for higher influent levels	$20,000		$21,146		$21,146		the following for energy conservation and effluent NH3 control:
- Replace leaking air line	$20,000		$21,146		$21,146		1. VFDs for aeration blowers, 1 per 2 blowers (2): $31,720
- Replace three oldest blowers	$400,000		$422,930		$422,930		2. pH and DO analyzers and connect to SCADA: $10,000
SOLIDS HANDLING		$520,000		$549,808		$549,808	
- Add external digester mixing pump	$90,000		$95,159		$95,159		
- Install sludge feed piping, sludge pumps/piping, supernatant equipment/piping	$150,000		$158,599		$158,599		
- Replace boiler/heat exchanger	$160,000		$169,172		$169,172		
- Replace gas handling equipment	$80,000		$84,586		$84,586		
- Replace valves in digester building	$15,000		$15,860		$15,860		
- Install additional piping and valves from digester mixing pump	$25,000		$26,433		$26,433		
- Gravity thickener upgrades			$0		$0		No details available on gravity thickener
AERATED GRIT TANK		$15,000		$15,860		--	City of Shelby has eliminated clam shell bucket; status of
- Replace clamshell bucket and install piping for acces to vac truck	$15,000		$15,860		--		piping uncertain
GENERAL SITE		$185,000		$195,605		$111,019	
- Demolish tanks, backfill and landscape	$65,000		$68,726		--		City not considering this recommendation
- Review and modify stormwater collection system	$60,000		$63,439		$63,439		

AREA	2012 COST (J&H)		2014 COST (J&H)		2014 COST (SHELBY SCOPE)		COMMENTS
	COST	AREA COST TOTAL	COST	AREA COST TOTAL	COST	AREA COST TOTAL	
- Replace yard hydrants	$15,000		$15,860		--		City not considering this recommendation
- Install security and camera	$25,000		$26,433		$26,433		
- Add site lighting	$20,000		$21,146		$21,146		
OFFICE SPACE, LOCKERS, AND SHOWERS		$230,000		$243,184		$150,000	
- Block in breezeway, convert chlorine building with lockers and showers	$230,000		$243,184		$150,000		
TOTAL CONSTRUCTION COST		$5,802,500		$6,135,121		$5,186,113	
CONTINGENCY RANGE (10%)		$580,250		$613,512		$520,311.34	
ENGINEERING RANGE (15%)		$870,375		$920,268		$792,702.01	
TOTAL PROJECT COST		$7,253,125		$7,668,901		$6,499,127	

APPENDIX B City Of Shelby – I/I Elimination Cost Estimate

APPENDIX 6-2: CITY OF SHELBY - I/I ELIMINATION COST ESTIMATE

AREA	# UNITS	2013 COST		2014 COST		2015 COST		2016 COST		NOTES
		COST	AREA COST TOTAL	COST	AREA COST TOTAL	COST	AREA COST TOTAL	COST	AREA COST TOTAL	
PUBLIC PROPERTY PROBLEMS										
1. EASILY ACCOMPLISHED ITEMS			$270,000		$277,631		$285,478		$293,546	
- Replace Manhole castings	83	$80,000		$82,261		$84,586		$86,977		Do not accomplish significant
- Install Chimney Seals in Manholes	23	$10,000		$10,283		$10,573		$10,872		I/I elimination
- Replace Manholes	29	$180,000		$185,087		$190,318		$195,697		
2. ELIMINATE STORM SEWER CONNECTIONS			$3,700,000		$3,804,571		$3,912,098		$4,022,664	
- Direct Connections	34	$1,700,000		$1,748,046		$1,797,450		$1,848,251		Will eliminate most of the I/I
- Indirect Connections	40	$2,000,000		$2,056,525		$2,114,648		$2,174,413		problems
3. REPLACE SANITARY SEWERS			$4,200,000		$4,318,703		$4,440,760		$4,566,267	
- Leaking Sewer Line	38	$2,128,000		$2,188,143		$2,249,985		$2,313,575		
- Blocked Sewer Line	37	$2,072,000		$2,130,560		$2,190,775		$2,252,692		
PRIVATE PROPERTY PROBLEMS										
1. REPLACE LATERALS			$1,300,001		$1,336,742		$1,374,522		$1,413,369	
- Replace Laterals	113	$1,300,001		$1,336,742		$1,374,522		$1,413,369		
2. DISCONNECT YARD DRAINS			$150,000		$154,239		$158,599		$163,081	
- Disconnect Yard Drains	20	$150,000		$154,239		$158,599		$163,081		
TOTAL CONSTRUCTION COST			$9,620,001		$9,891,886		$10,171,456		$10,458,926	
CONTINGENCY (5%)			$481,000		$494,594		$508,573		$522,946	
ENGINEERING (15%)			$1,443,000		$1,483,783		$1,525,718		$1,568,839	
TOTAL PROJECT COST			**$11,544,001**		**$11,870,264**		**$12,205,747**		**$12,550,712**	

Notes:
- Values based on the preliminary estimates provided by F. E. Krocka & Associates, Inc. on April 2013
- Projections based on ~2.8% increase in cost every year

APPENDIX C Shelby WWTP Map with Contours

200 feet
Shelby
0636600104000
D.V.117,P.574
D.V.118,P.317
0636600105000
D.V.900,P.124
211.35
502
284.56
482
374.01
216.81
29.1
1067
1065.5
1067.5
1068.5
1072.5
1073
1071
1071.5
1063
1077.5
1073.1
1058.5
1061
1059.5
1059
1070
1060

APPENDIX D Shelby WWTP Map with Flood Plain and Contours

200 feet
0636600104000
D.V.117,P.574
D.V.118,P.317
Shelby
0636600105000
D.V.900,P.124
211.35
502
284.56
482
216.81
374.01
1073
1071
1071.5
1068.5
1081
1067

APPENDIX E Wastewater Characterization Study Report

WASTEWATER CHARACTERIZATION STUDY FOR THE CITY OF SHELBY'S WASTEWATER TREATMENT PLANT

October 2014

Prepared for:

Shelby OHIO EST. 1834

14334

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1.0 INTRODUCTION

1.1 BACKGROUND

The City of Shelby, Ohio is planning to design and construct improvements to their wastewater treatment plant (WWTP). The project objectives are:

1. Eliminate WWTP wet weather bypassing events;
2. Increase process capacity and control to maintain compliance with discharge permit limits; and,
3. Improve treatment process efficiency and performance by replacing obsolete and worn-out equipment with the goal of reducing energy and maintenance costs.

In addition to the above objectives, the City is also interested in continuing to accept landfill leachate from Rumpke's Noble Road Landfill and septage from package plants (treating restaurant wastewater) for treatment in their WWTP. However, the client has been experiencing difficulty in complying with permitted discharge limits. Under this situation, it becomes necessary to make sure that the leachate discharge does not contribute to discharge violations, especially for effluent ammonia.

The 2.5 MGD capacity WWTP is a conventional activated sludge treatment system with screening, grit removal, primary treatment, and secondary treatment consisting of two aeration tanks (58,500 cubic feet each) and two clarifiers for treating BOD and nitrogen loads. To accommodate effluent ammonia limits, the plant is designed for nitrification. However, the plant does not have process instrumentation to measure dissolved oxygen (DO), pH, temperature, etc. in a field representative and real-time manner.

Based on the historic data provided by the client, CT has performed analysis of the background and leachate loads to the WWTP, theoretical design capabilities, and attempted correlation between possible effluent violations and periods during leachate discharge.

1.2 EXISTING WASTEWATER TREATMENT PLANT (WWTP)

A comprehensive description of the existing WWTP is contained in the Jones and Henry report. A brief statement is provided herein. Average daily flows (ADF) during June 2014 (test period) were 2.0 MGD. The daily peaking factor is 2.3 (4.8 MGD) and monthly peaking factor is 1.6 (3.4 MGD). Minimum daily flow was 0.98 MGD and minimum monthly of 1.27 MGD. The facility includes screen, grit chamber, and two primary clarifiers for primary treatment, and conventional activated sludge aeration tanks (two, each of 437,580 gallons), five aeration blowers of 1,100 cfm capacity each, and two secondary clarifiers for secondary treatment, and a chlorine contact tank. Aerobic digester is also in operation for stabilizing primary sludge and waste activated sludge. Biosolids are aerobically digested and hauled off site to landfill.

Average influent and effluent values for June 2014 are shown in Table 1.

TABLE NO. 1

Average Influent and Effluent Parameters on days when no leachate was accepted by the Plant

PARAMETERS	UNITS	INFLUENT	EFFLUENT	NPDES LIMIT (SUMMER)
pH	s.u.	7.2	7.3	6.5 – 9.0
CBOD	mg/L	140	4	15 (7-Day); 10 (30-Day)
TSS	mg/L	86	2.4	18 (7-Day); 12 (30-Day)
NH_3-N	mg/L	14	0.1	3.5 (7-Day); 2 (30-Day)
TDS	mg/L	650	730	

1.3 LEACHATE RECEIVING

Leachate from Rumpke landfill is delivered to the City's WWTP in tank trucks of 6,200-gallon capacity. Initially, leachate was directly discharged at the WWTP's Headworks facility. In April 2014, upon recognizing the possibility of shock loads to biological treatment processes at the WWTP, the City required that leachate be discharged into the sewer system upstream of the plant to allow mixing and dilution with domestic sewage. Leachate collected in holding tanks at the landfill is loaded into tank trucks and transported to a manhole 4.1 miles upstream of the WWTP (Figure 1). Typically, it takes approximately 15 minutes to unload a 6,200 gallon tank truck. This results in approximately 30% dilution (413 gpm of leachate (6,200gallon/15 minutes) to 1,375 gpm (2.0 MGD ADF) of total influent wastewater. On the days of leachate delivery, one to five truckloads (6,200 – 31,000 gallons) of leachate are discharged to the system during regular business hours. Generally, leachate is delivered during or soon after the occurrence of a wet weather event. Multiple truck loads arrive in approximately 2 hour intervals.

During June and July of 2012 and during the first half of May 2013, there were 10 violations of NPDES permit limits for ammonia. Since then, there have been no NPDES permit violations with respect to ammonia. Four miles of sewer pipe (2 miles of 4-feet diameter and 2.1 miles of pipes of assorted sizes) provide up to 24 hours of detention time for the influent mixture.

1.4 NEED FOR WASTEWATER CHARACTERIZATION

While the City desires to continue accepting leachate from Rumpke's Noble Rd Landfill, it is recognized that its typical variability and potential toxicity still poses a potential risk to biological treatment processes and ultimately permit compliance. The City believes any additional provisions needed to accommodate continual acceptance of leachate while reducing the risk to the City's plant, then Rumpke should be expected to provide appropriate funding. Since wastewater characteristics are relatively undefined with respect to leachate, WWTP influent and the effects on WWTP effluent, it is difficult to indicate whether any provisions are warranted and what they might entail. Therefore, the City authorized a special wastewater characterization study to provide additional data so a determination could be made regarding impacts and the need for special provisions. This report summarizes the findings of the wastewater characterization study as well as potential impacts to the existing WWTP.

2.0 WASTEWATER CHARACTERIZATION

2.1 LEACHATE TOXICITY

Leachate toxicity is addressed by reviewing annual propriety pollutant analyses provided by the landfill. A copy of laboratory reports from 2009 through 2013 is included as Appendix A. A summary of the results are shown in Table No. A-1, also included in Appendix A. In addition, the City collected independent samples on July 7, 2011, and December 16, 2013. Results are included in Table No. A. General Observations from the data are as follows:

1. Volatile organics and heavy metals are not present in sufficient concentrations to cause alarm for the biological activity at Shelby's WWTP. For instance, although potentially toxic chemicals such benzene (<10 ug/L), toluene (<0.3 mg/L), butanone (up to 2 mg/L) and chloroethane (0.35 mg/L) were detected in the leachate, their concentrations were well below their inhibitory levels to biological treatment. They are expected to be biodegraded. Mercury was also not detected, but the detection limit is not the lowest.

2. Presence of barium at 1 – 3 mg/L in the leachate does not pose any scale formation risk to the sewer pipe line after dilution with the influent wastewater.

3. Acetone was detected the most frequently and sometimes at elevated concentrations. But the volatility and biodegradability of acetone should not pose a concern at the concentrations detected (0.02 – 1.7 mg/L) in leachate to the Shelby WWTP.

4. PCBs have not been detected since 2009. Pesticides in 2013 were also not detected.

5. Due to inconsistency in detected organic compounds and concentrations, the City should continue to receive annual reports. Shelby should also consider collecting a duplicate or separate sample and analyzing it for priority pollutants as a quality control check. A different laboratory shall be used than the one used for the landfill.

6. Ammonia and Total Dissolved Solids (TDS) are the primary compounds with sufficiently elevated concentrations that warrant monitoring and further study. Over the period, ammonia ranged between 400-750 mg/l. TDS ranged between 3,000 mg/l and 9,900 mg/l though the latter value may be an anomaly. Primary constituents of TDS appear to be sodium, chloride and alkalinity (carbonates and bicarbonates). With ammonia already an NPDES permit limit and TDS a likely future limit, these compounds should be closely monitored.

   See Appendix A and Table No. A-1 for further details regarding results. A graphical sketch is also included showing increasing ammonia-N and TDS trends since 2009.

2.2 STUDY AND RESULTS

Grab samples of leachate were taken from the holding tanks located at the Rumpke Noble Road Landfill on the days when trucks were delivering leachate to the plant. It is reported that samples were taken when the holding tanks were ¼ to ¾ full. For the raw influent and final effluent, composite of samples taken between 9:00 a.m. and 7:00 p.m. at two-hour intervals was obtained every day (Monday to Friday). Samples of raw influent are taken before primary tank, and for final effluent, before discharge to Black Fork River. Data for the leachate, combined influent, and final effluent is given in Table No. 2.

TABLE NO. 2

Key Study Results
June 2014 Characterization Study

	09-Jun-14			11-Jun-14		
	Leachate	Influent	Final	Leachate	Influent	Final
BOD, mg/l	67	75	4.5	<120	NA (1)	NA
COD, mg/l	1400	250	28	900	NA	NA
TSS, mg/l	16	68	4.6	38	NA	NA
Oil & Grease, mg/l	<5.2	9.4	<5.0	<5.4	NA	NA

NH_3-N, mg/l	998	28	0.30	568	NA	NA
Phosphorus, mg/l	1.18	2.09	1.09	1.06	NA	NA
Copper, ug/l	49	16	<10	21	NA	NA
Mercury, ug/l	<0.2	<0.2	<0.2	<0.2	NA	NA
TDS, mg/l	4500	770	580	3900	NA	NA

		16-Jun-14			18-Jun-14	
	Leachate	Influent	Final	Leachate	Influent	Final
BOD, mg/l	220	150	<4.0	55	140	<4.0
COD, mg/l	1500	370	20	990	360	26
TSS, mg/l	35	92	2.4	26	86	2.4
Oil & Grease, mg/l	<5.2	22	<5.0	<5.3	<5.0	**32** (2)
NH_3-N, mg/l	648	18	0.16	458	29.9	0.12
Phosphorus, mg/l	1.01	4.16	1.45	0.80	4.09	1.69
Copper, ug/l	25	38	<10	38	30	<10
Mercury, ug/l	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
TDS, mg/l	5100	630	730	3700	650	610

		19-Jun-14			23-Jun-14	
	Leachate	Influent	Final	Leachate	Influent	Final
BOD, mg/l	110	150	10.0	NA	180	5.2
COD, mg/l	1600	270	36	NA	480	24
TSS, mg/l	30	140	8.2	NA	110	4.2
Oil & Grease, mg/l	<5.3	<10	6.1	NA	33	8.2
NH_3-N, mg/l	655	5.88	1.42	NA	22.6	0.31
Phosphorus, mg/l	1.06	2.35	1.08	NA	2.91	0.56
Copper, ug/l	13	44	<10	NA	30	<10
Mercury, ug/l	<0.2	<0.2	<0.2	NA	<0.2	<0.2
TDS, mg/l	5200	460	510	NA	690	600

(1) NA = Not Analyzed
(2) Suspected sampling/analysis anomaly

Based on 5 grab samples of leachate analyzed by Alloway Labs, ammonia concentration averaged 665 mg/l. By the time 24-hour composite samples were collected for the plant influent, average ammonia concentration had been diluted to 20.1 mg/l. Average effluent concentration was 0.46 mg/l.

For comparison, plant personnel independently analyzed daily samples of the influent for the month of June and analyzed samples for 14 days when leachate was discharged to the influent sewer 4.1 miles upstream from the WWTP. Leachate was sampled directly from delivery trucks. Monthly, average leachate concentration was 663 mg/l and average influent concentration was 22.2 mg/l. Effluent averaged 0.54 mg/l. Table No. 3 summarizes the results.

Values shown between the two databases are consistent. Results also demonstrate that the upstream leachate discharge point is appropriate. Ammonia concentrations are sufficiently diluted by the time it reaches the plant (from 665 mg/L to 20 mg/L). In addition, there is little advance impact to treatment process performance. Adequate nitrification is occurring with the existing plant. Increase in nitrate/nitrite from <1 mg/L in the influent to 10 mg/L after biological treatment indicates the role of biological processes to remove influent ammonia of around 20 mg/l to < 1 mg/l. Table Nos. 2 and 3 summarize the analytical results of key parameters and Appendix A contains a copy of the Alloway reports.

TABLE NO.3

Characterization Study Results for Ammonia - N

			Influent	Leachate			Influent	Effluent	
	Flow Rate	Rainfall	NH_3-N w/o leachate	VOLUME	NH_3-N Landfill Holding Tank	NH_3-N Delivery Truck	NH_3-N w/leachate	NH_3-N	
Date	(mgd)	(in.)	(mg/L)	(gal)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	Notes
01-Jun-14	1.354								
02-Jun-14	1.480	0.32		18,600		691	24.7	0.274	
03-Jun-14	1.483		20					0.941	(3)
04-Jun-14	3.189	1.1		12,400		741	38.9	0.116	
05-Jun-14	2.081		10						
06-Jun-14	1.808			18,600		806	16.6		
07-Jun-14	1.585		12.3						
08-Jun-14	3.268	0.89	8.2						
09-Jun-14	2.002			18,600	998	741	24.4	0.078	
10-Jun-14	1.695	0.05		6,200		542	15.6	0.168	(3)
11-Jun-14	1.684	0.06	17.7		568			0.095	
12-Jun-14	1.556			18,600		660	23.8		

			Influent	Leachate			Influent	Effluent	
	Flow Rate	Rainfall	NH_3-N w/o leachate	VOLUME	NH_3-N Landfill Holding Tank	NH_3-N Delivery Truck	NH_3-N w/leachate	NH_3-N	
Date	(mgd)	(in.)	(mg/L)	(gal)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	Notes
13-Jun-14	1.419	0.03	21						
14-Jun-14	1.314		28.4						
15-Jun-14	1.304		24.3						
16-Jun-14	1.402			18,600	648	663	39.5	0.286	
17-Jun-14	1.289		21.6					3.61	(1)
18-Jun-14	1.806	1.40		18,600	458	291	23.9	0.312	
19-Jun-14	2.764		8.1		655				
20-Jun-14	2.510	0.20		24,800		801	29.6		
21-Jun-14	2.126	0.02		24,800		800	4.1		(2)
22-Jun-14	1.696		9.5						
23-Jun-14	1.777	0.30		24,800		780	29.1	0.152	
24-Jun-14	2.869	2.15		31,000		577	26.6	0.068	
25-Jun-14	3.645			31,000		623	3.2	0.110	(2)
26-Jun-14	2.583		5.9						
27-Jun-14	2.160		9.7						
28-Jun-14	1.898		10.6						
29-Jun-14	2.046	0.16	5.7						
30-Jun-14	1.917	0.08		18,600		569	24.1		

Count	30	13	15	14	5	14	14	12	
Average	2.0	0.4	14.8	21418.2	665.4	663.2	22.2	0.542	
Minimum	1.3	0.0	5.7	6200.0	458.0	291.0	3.2	0.068	
Maximum	3.6	2.2	28.4	31000.0	998.0	806.0	39.5	3.610	
Total		6.76		285,200					

Notes:

(1) Higher effluent value is attributable to digester supernatant returned to the head of the plant.

(2) Low influent values are indicative of a sampling/analysis anomaly.

The NPDES discharge permit limits for Shelby WWTP is given in Table No. 4.

TABLE NO.4

Final Effluent Limits (Permit Number: 2PD00036*MD; Public Notice Date: November 16, 2012) and Monitoring Requirements for Shelby WWTP Outfall 001

PARAMETER	UNIT	EFFLUENT LIMITS			
		30 DAY AVERAGE CONC (mg/L)	MAXIMUM (mg/L)	30 DAY LOAD (Kg/d)	DAILY MAXIMUM (Kg/d)
Temperature	°C	----------------------Monitor--------------------------------------			
Dissolved O_2					
- Summer	mg/L	---------------------7.0--			
- Winter	mg/L	----------------------5.0--			
TSS					
- Summer		12	18	115	170
- Winter		18	27	170	255
Ammonia					
- Summer		2	3.5	19	33
- Winter		7	10	66	95
Oil & Grease	mg/L	-----------------------10 maximum------------------------			

A special observation is the elevated effluent concentration on June 17, 2014. The value of 3.61 mg/l is attributable, per plant personnel, to the return of anaerobic digester supernatant. It is an order of magnitude greater than typical daily values and consequently the probable cause of periodic ammonia limit exceedences.

3.0 WASTEWATER TREATMENT PLANT EVALUATION

Data collected by the WWTP operator during the one month (June 2014) test period was provided to CT. During the test period, only one (1) aeration tank was operated with two (2) blowers in operation. For this period, Table 6 represents concentration and load values for ammonia-N to the WWTP under conditions of with and without leachate addition, and during days of wet weather and dry weather.

Overall, there was a 47% (no rain) to 125% (during rainy days) increase in ammonia-N load to the plant when leachate was accepted by the plant, when compared to load from raw wastewater only. Relative increase in hydraulic load with (2 MGD) and without (1.98 MGD) leachate is not significant. Therefore, it was determined necessary to assess the capacity of the existing aeration tank for its ability to handle BOD and nitrogen loads under background (no leachate) and leachate loading conditions.

3.1 EVALUATION OF PLANT CAPACITY

Influent wastewater parameters and WWTP capacity were analyzed based on the methods presented in Ontario Water and Wastewater Operators Association publication for evaluating nitrogen and carbon removal in a single sludge system (such as the one in Shelby Plant). This analysis was done in order to determine if effluent discharge limits can be achieved under both "raw wastewater only" and "combined raw wastewater and leachate" input conditions. Results of the findings are summarized in Table No. 5.

Effluent ammonia concentration from the days when leachate was added is shown in Figure 2. Analysis by plant is shown in blue line, from DMR provided for this period. Data from the external lab is shown in green line and tick marks There appears to be no correlation between the number of truckloads of leachate brought to the plant and the combined ammonia load (Figure 3) because there is also a wide deviation in the daily ammonia load from the raw waste.

In the design analysis, the following conditions and assumptions apply:

1. Analytical parameters from the external lab were used for the purpose of data analysis.
2. Volume of one aeration tank (58,500 cu. Ft) was used;
3. Primary clarifier could remove 25% of total BOD coming in;
4. For every unit of BOD removed, 3% of NH3-N was used for metabolism;
5. Overall dissolved oxygen for the entire volume of aeration plant was 1.5 mg/L, and half saturation constant of oxygen for nitrifiers was 1.3 mg/L;
6. The specific oxygen transfer efficiency of Fine bubble diffusers for supplying air was 21%;
7. Activated sludge uses 1.1 lb oxygen per lb BOD, and 4.6 lb oxygen per lb NH_3-N degraded;
8. A safety factor of 1.5 was used when calculating the mass of oxygen needed for BOD and ammonia removal; and
9. To be conservative, target effluent ammonia-N was set at a more stringent level of 1.75 mg/L. This is 50% of NPDES summer time limit of 3.5 mg/L.

Findings from Data during Test Period:

1. Based on the sludge wasting data provided, there is more than adequate aeration solids retention time available for both "raw wastewater" as well as "raw wastewater + leachate" conditions (8.3 and 8.5 days respectively);

2. On an average of 2 MGD flow rate (ADF), hydraulic retention time (HRT) for one aeration tank is 5 hours and 15 minutes and air provided by two blowers is 2,200 CFM. These operational parameters are required to achieve the effluent discharge limits (Table No. 4) when the treatment plant receives raw wastewater only.

3. Return activated sludge (RAS) flow rates during "raw wastewater" and "raw wastewater with leachate" operations were 43% and 37% of the respective influent flow rates. It is possible to increase ammonia removal by raising the RAS pump flow rate resulting in reduced F/M ratio. The maximum recommended operation level of the RAS pump is 150% of the influent rate (City of Shelby WWWTP O&M manual, 2009).

4. The change in BOD load with the addition of leachate to wastewater is assumed to be negligible. The maximum ammonia concentration that one aeration tank (in addition to the BOD load) with the available two aeration blowers can process 20.6 mg/L or 343 lb/d at a steady rate at 2 MGD. This corresponds to daily leachate acceptance of 18,030 gal or 2.9 truckloads with an average NH_3-N concentration of 665 mg/L.

5. When three truckloads of leachate are added, 2,398 CFM of air is required to achieve effluent compliance for NH_3-N and BOD. This means that in addition to the total air delivered from two aeration blowers, 198 CFM will be required.

6. Summary of operational values calculated for various numbers of truckloads of leachate addition is shown in Table 6.

7. In the past when leachate was directly added to the plant headworks, addition of 6,200 gallons of leachate to influent in 15 minutes increased the ammonia load to the plant by 13.4 folds (from 0.18 lb/min to 2.46 lb/min). This corresponds to a combined influent ammonia-N concentration of 163 mg/L (Figure 4). The 2.46 lb/min load is a shock load, because the maximum load the plant can handle any time is 0.24 lb/min (20.6 mg/L). Under this condition, nitrifying bacteria cannot multiply quickly enough to handle shock loads that come in short spikes of 15 minutes.

8. The shock load situation has been overcome by moving the point of leachate discharge 4 miles upstream in the sewer line (Figure 1). About 23 hours of detention time is provided by the sewer line to the wastewater + leachate mixture before entering the treatment plant.

9. Aeration capacity of the two blowers provided (1,100 cfm each) barely meets the average aeration needs when only raw waste comes in. Based on the calculations, it is not sufficient when average leachate load is added (1,223 cfm will be needed to achieve compliance of effluent standards).

3.2 IMPLICATIONS OF AERATION REQUIREMENT CALCULATIONS

During the test period, since both aeration tanks were operating with a total of four blowers working, no effluent ammonia violation occurred. However, it is not economical to run both the aeration tanks and four blowers all the time. The second aeration tank was meant to be used only during flood events by the WWTP. Further, there is a risk of effluent ammonia violations when feeding leachate to the plant with single aeration tank and two blowers in operation. Therefore, a strategy must be identified to operate the WWTP with one aeration tank in service and distribute leachate load in in such a way that its capacity is not exceeded with shock loads or peak loads.

4.0 SUMMARY AND RECOMMENDATIONS

- Based on the analysis and calculations presented above, it is possible to treat intake of up to 17,980 gallons (nearly three truck loads) of leachate with 665 mg/L ammonia-N and 140 mg/L CBOD with one aeration tank and two existing blowers in operation, assuming the leachate is added uniformly to the plant.

- To treat up to 8 truckloads of leachate, one aeration tank and three aeration blowers in operation is sufficient.

- If nine to twelve truckloads were to be accepted per day for many consecutive days, two aeration tanks and three blowers will be needed in service to ensure effluent compliance.

- If 13 to 23 truckloads of leachate were to be accepted per day for many consecutive days, two aeration tanks and four blowers need to be operated to ensure compliance.

- Maximum number of truckloads of leachate that can be accepted per day for many consecutive days is 23. Beyond that, there is not enough HRT available while both the aeration tanks are in operation.

- It is our understanding that the aeration blowers are past their prime age and therefore needs to be replaced in the near future. When the WWTP management decides to replace aeration blowers, units with 1,250 CFM capacity should be considered with VFD in order to be able to deliver optimum amount of air during peak load conditions.

- RAS flow rate shall be increased to enhance NH_3-N removal when there is an increase in leachate load to the influent or when there is a risk of effluent ammonia exceeding the discharge limit.

- Based on the available effluent data from Shelby WWTP, it is understood that it has operated satisfactorily for majority of the time (about five violations per year for ammonia-N). In order to ensure that the treatment plant effluent complies with discharge limits consistently, the above mentioned guidelines shall be incorporated into the operations routine.

- Perform sampling and analysis of ammonia regarding digester supernatant return to characterize this wastewater and corresponding impacts to WWTP performance, similar to the leachate characterization study. Possibly consider hauling supernatant to the leachate discharge manhole and evaluate whether the mixing and dilution effects allow for better assimilation of loadings.

TABLE NO.5

Theoretical and Existing Capacity for Shelby Plant With and Without Leachate Load

PARAMETERS	UNITS	RAW WASTEWATER		RAW WW + LEACHATE	
		EXISTING[e]	CALCULATED[d]	EXISTING[e]	CALCULATED[d]
Average Flow	MGD	1.98		2.00	
Avg. BOD_5 Influent	mg/L	139		139	
Avg. BOD_5 Effluent	mg/L	4		6.6	
Avg. NH_3-N Influent	mg/L	14.8		22.2	
Avg. NH_3-N Effluent	mg/L	0.1		0.7	
MLSS	mg/L	3,238		3,265	
MLVSS	mg/L	2,266		2,285	
N Assimilated	mg/L		3		3
N Nitrified	mg/L		10.8		18.2
Nitrifier Fraction	$\frac{g\ Nitrifiers}{g\ MLVSS}$		0.025		0.042
Minimum SRT	d		2.73		2.11
Design SRT[a]	d	8.3	5.45	8.5	4.21
Nitrifier Biomass	mg/L		61		61 transient
					100 steady state
Nitrifier doubling time	Hr.		1.5		1.5
Aerobic HRT	Hr	3.3	2.4	3.3	3.89 transient[f]
					3.29 transient[g]
					2.0 steady state
Std. Oxygen Req.	lb/d		12,076		13,843
Air Requirement[b]	Cfm		2,134		2,446
Size of Each Blower[c]	Cfm	1,100	1,067	1,100	1,223

Note:

(a) Calculated with a safety factor of 2

(b) With fine bubble diffusers having 21% std. O_2 transfer efficiency

(c) Assuming two blowers operated at a time

(d) Needed in order to achieve effluent discharge compliance

(e) Based on existing operational parameters

(f) Aerobic SRT needed at average influent NH3-N concentration of 22.2 mg/L

(g) Aerobic SRT needed at average influent NH3-N concentration of 20.6 mg/L

TABLE NO.6

Aeration Tank and Blower Air Requirements for Adding Various Truckloads of Landfill Leachate to Shelby WWTP

Number of Truckloads	NH_3-N Load from leachate (lb/d)	Air Requirement (CFM)	Number of Blowers[(a)]	HRT Requirement (Hours)	# Aeration Tank Required
3	369	2,398	2 + 1	3.37	1
4	404	2,490	2 + 1	3.71	1
5	438	2,588	2 + 1	4.05	1
6	472	2,684	2 + 1	4.39	1
8	541	2,874	2 + 1	5.08	1
9	575.6	2,970	2 +1	5.42	2
12	678.85	3,256	2 + 1	6.44	2
13	713	3,348	3 + 1	6.78	2
23	1,057	4,304	3 + 1	10.19	2
24	816	4,396	3 + 1	10.53	3[(b)]

Note:

(a) Additional blower shall be run on VFD to deliver just enough air to the aeration tank

(b) Not possible to operate at this condition, because only two aeration tanks are present with a combined HRT of 10.50 hours

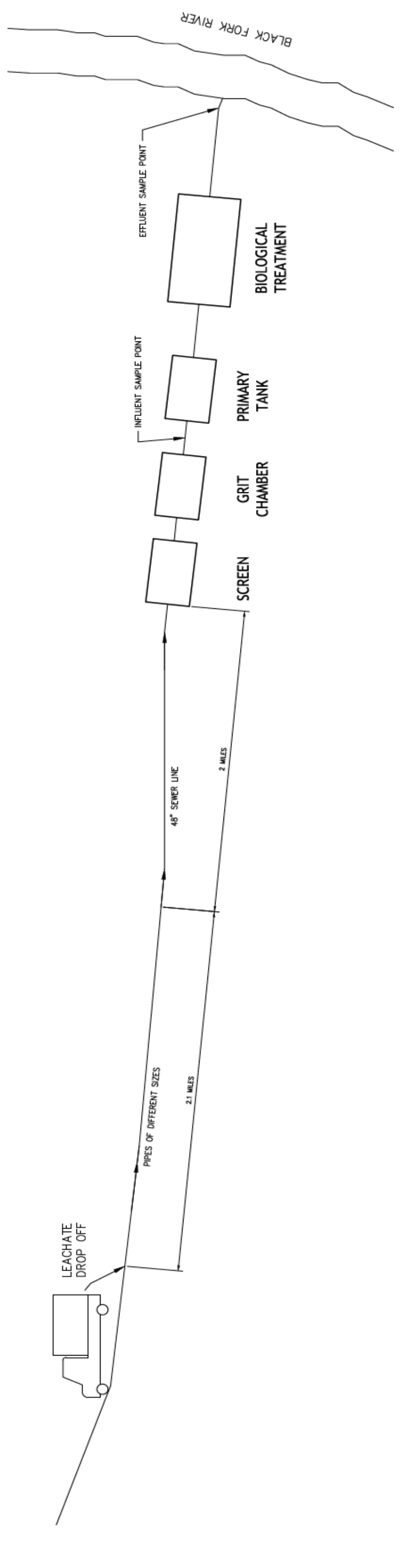

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FIGURE 1. FLOW SCHEMATIC FOR THE TREATMENT PLANT

FIGURE 2. EFFLUENT AMMONIA CONCENTRATION DURING TEST PERIOD

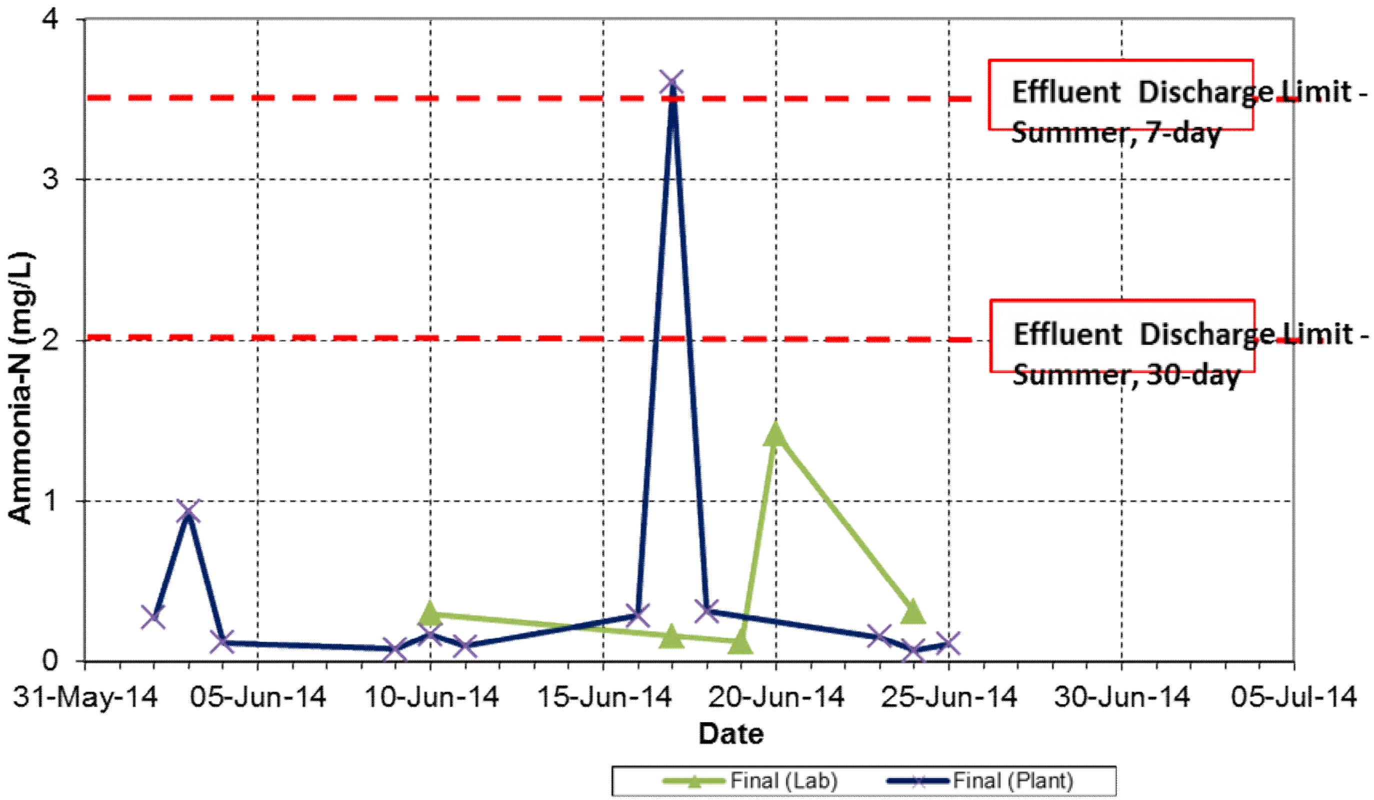

FIGURE 3. AMMONIA-N LOAD TO PLANT AS A FUNCTION OF THE NUMBER OF TRUCK LOADS

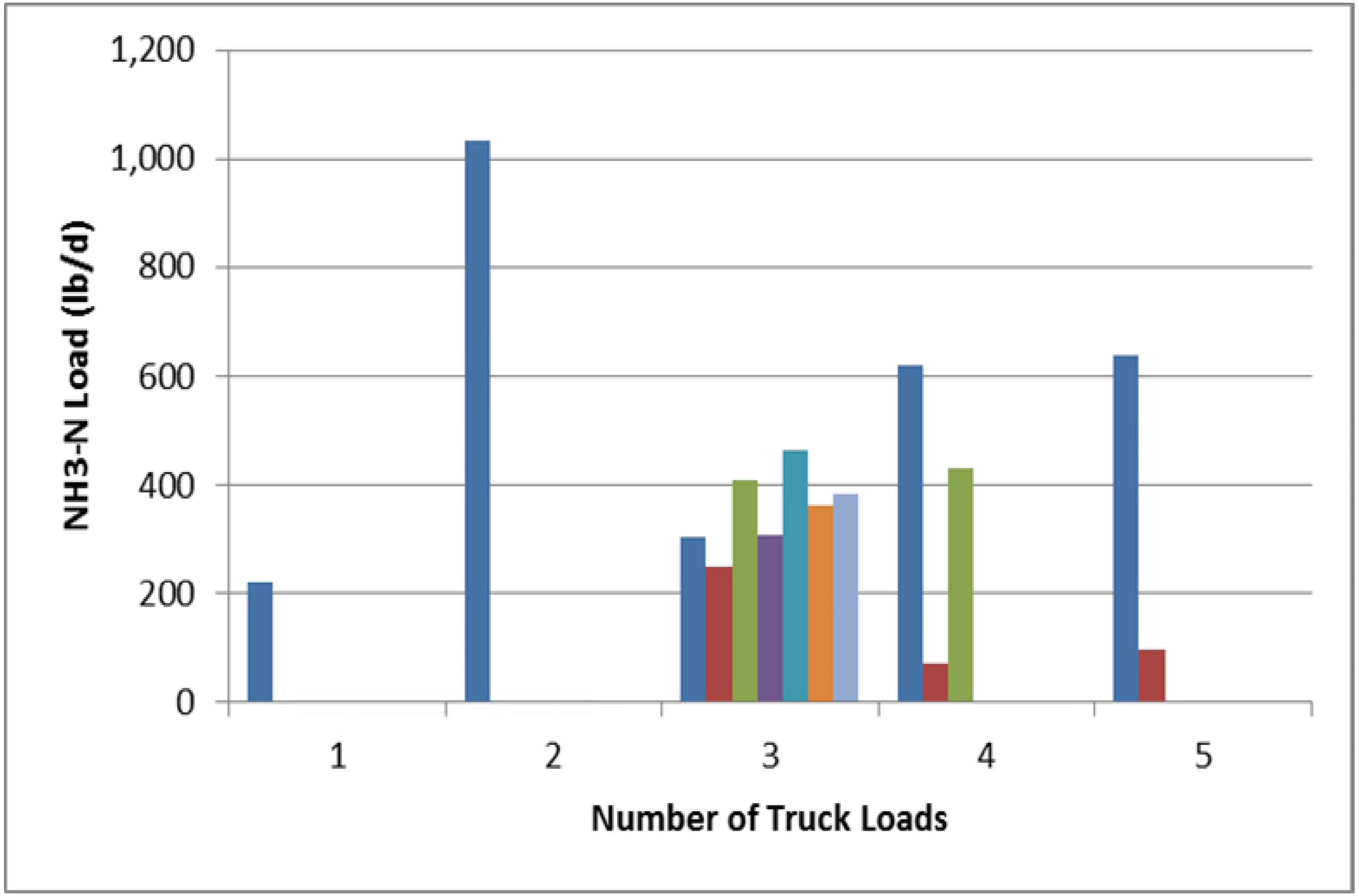

Figure 4. AMMONIA LOAD TO PLANT WITH AND WITHOUT LEACHATE

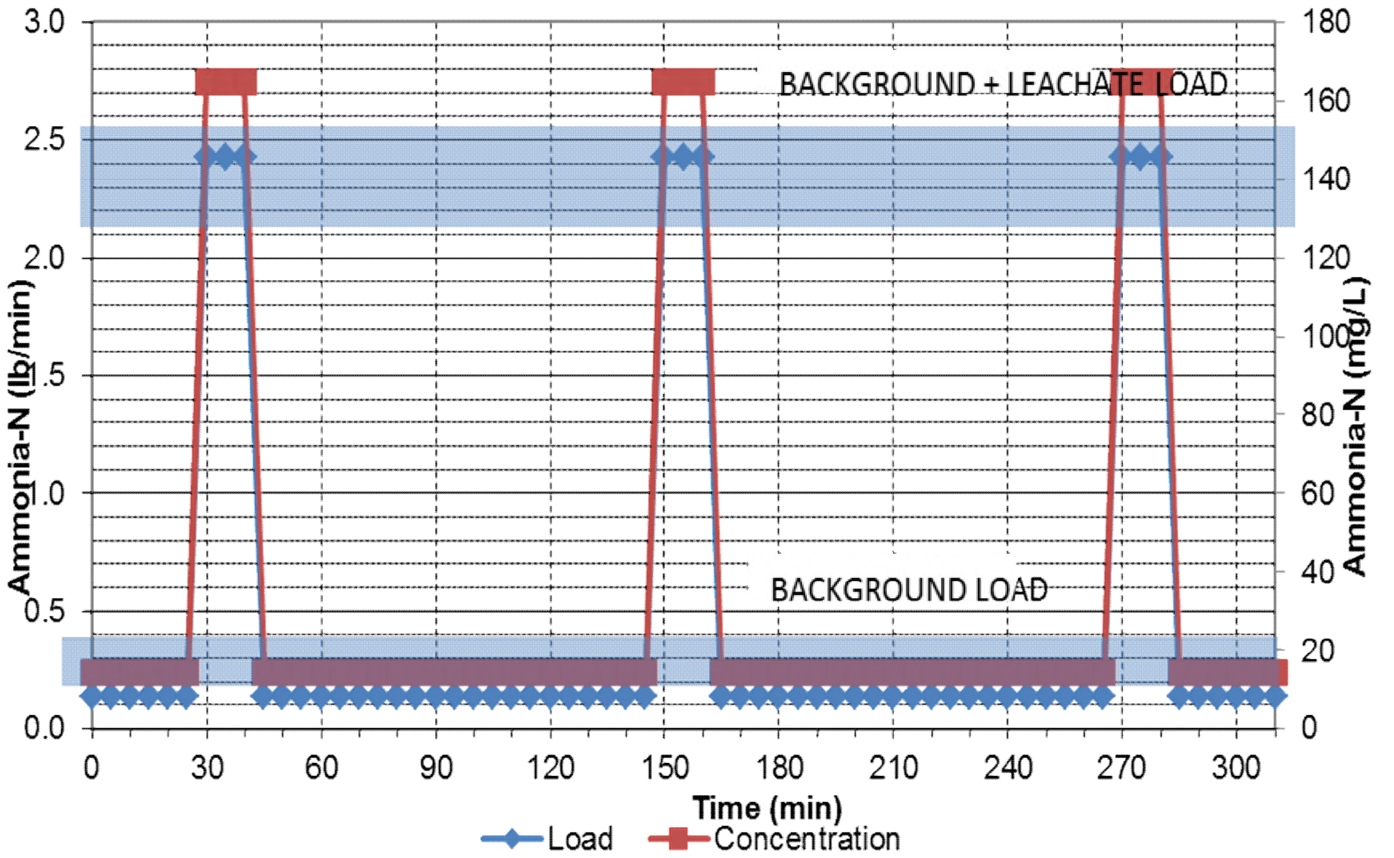

Table No. A-1
Noble Rd Landfill Leachate
Results of Laboratory Analysis

	11/11/2009	11/9/2010	7/7/2011	11/8/2011	11/14/2012	11/11/2013	12/16/2013	Comments
Conventional Pollutants	(Landfill)	(Landfill)	(Landfill)	(Landfill)	(Landfill)	(Landfill)	(Landfill)	
COD	NA	NA	NA	NA	NA	NA	6890 mg/l	Values considered to be a high strength industrial
BOD	NA	NA	NA	NA	NA	NA	1600 mg/l	waste with COD/BOD ratio of 4.5/1 trending toward
TSS	NA	NA	NA	NA	NA	NA	320 mg/l	difficulty in biodegradability.
TOC	NA	NA	157 mg/l	NA	NA	NA	2170 mg/l	
Oil and Grease	NA	NA	11.0 mg/l	NA	NA	NA	ND mg/l	
Field PH	7.44 SU	7.67 SU	NA	8.63 SU	NA	NA	7.8 SU	slightly alkaline but not corrosive
Field Temperature	16.7 ^{o}C	17.4 ^{o}C	NA	17.4 ^{o}C	NA	NA	NA	
Surfactants (MBAS)	NA	NA	NA	NA	NA	NA	1.72 mg/l	
Turbidity	NA	22.3 NTU	NA	NA	NA	NA	NA	
Nutients								
Ammonia- N	594 mg/l	418 mg/l	520 mg/l	499 mg/l	562 mg/l	757 mg/l	NA	Ammonia loading trending higher which should be
Nitrate/Nitrite-N	ND mg/l	ND mg/l	21.5 mg/l	0.18 mg/l	0.023 mg/l	0.089 mg/l	NA	monitored.
Phosphorus	NA	NA	0.63 mg/l	NA	NA	NA	NA	
Total Dissolved Solids	2970 mg/l	4460 mg/l	NA	3730 mg/l	3900 mg/l	9910 mg/l [2]	NA	TDS trending higher although many parameters for
Calcium	77.3 mg/l	78 mg/l	NA	139 mg/l	50.5 mg/l	424 mg/l [2]	NA	the 11/11/13 sampling event are orders of
Magnesium	146 mg/l	179 mg/l	NA	85 mg/l	78.7 mg/l	375 mg/l [2]	NA	magnitude higher than previous values. TDS is a
Potasium	215 mg/l	250 mg/l	NA	219 mg/l	243 mg/l	311 mg/l	NA	parameter of concern for OEPA and may involve a
Sodium	855 mg/l	1100 mg/l	NA	1120 mg/l	1150 mg/l	1180 mg/l	NA	future permit limit. This should be monitored.
Chloride	986 mg/l	1330 mg/l	NA	1310 mg/l	1190 mg/l	1340 mg/l	NA	Sodium, chloride and alkalinity (carbonates and
Sulfate	3.26 mg/l	ND mg/l	NA	79.5 mg/l	41.7 mg/l	10.7 mg/l	NA	bicarbonates are primary constituents)
Alkalinity	3,050 mg/l	3540 mg/l	NA	2670 mg/l	3080 mg/l	4730 mg/l	NA	
Volatile Organics								
1,4 Dichlorobenzene	7.0 ug/l	ND ug/l	NA	ND ug/l	6.5 ug/l	ND ug/l	ND ug/l	
2-Butanone (MEK)	360 ug/l	2100 ug/l	NA	ND ug/l	15 ug/l	20000 ug/l [2]	NA ?	Organic loadings are not considered as
4-Methyl-2-								problematic. Volatile compounds are readily
pentanone (MIBK)	26 ug/l	40 ug/l	NA	ND ug/l	57 ug/l	410 ug/l [2]	NA ?	biodegradable.
Acetone	200 ug/l	1700 ug/l	NA	60 ug/l	29 ug/l	20000 ug/l [2]	NA ?	
Benzene	8.0 ug/l	5.2 ug/l	NA	ND ug/l	5.8 ug/l	ND ug/l	ND ug/l	
Chlorobenzene	ND ug/l	ND ug/l	NA	ND ug/l	ND ug/l [1]	ND ug/l	ND ug/l	
Chloroethane	ND ug/l	ND ug/l	NA	ND ug/l	ND ug/l	ND ug/l	353 ug/l [2]	
Chloroform	ND ug/l	ND ug/l	NA	4.5 ug/l	ND ug/l	ND ug/l	ND ug/l	
Ethylbenzene	15 ug/l	ND ug/l	NA	ND ug/l	16 ug/l	ND ug/l	ND ug/l	
Toluene	25 ug/l	ND ug/l	NA	ND ug/l	5.7 ug/l	110 ug/l [2]	303 ug/l [2]	
Xylenes	18 ug/l	11 ug/l	NA	ND ug/l	21 ug/l	ND ug/l	ND ug/l	

Table No. A-1 Continued
Noble Rd Landfill Leachate
Results of Laboratory Analysis

	11/11/2009	11/9/2010	7/7/2011	11/8/2011	11/14/2012	11/11/2013	12/16/2013	Comments
Other Organics	(Landfill)	(Landfill)	(City)	(Landfill)	(Landfill)	(Landfill)	(City)	
1,2-Dibromo-3-								
chloroethane							353 ug/l	
chloropropane	ND ug/l	0.11 ug/l	NA	ND ug/l	ND ug/l	ND ug/l	NA	
Diethyl phthlate	NA	NA	NA	NA	NA	NA	34.6 ug/l	
PCBs	ND ug/l	ND ug/l	NA	ND ug/l	ND ug/l	ND ug/l	ND ug/l	
Pesticides	NA	NA	NA	NA	NA	NA	ND ug/l	
Phenolics	NA	NA	<0.25 mg/l	NA	NA	NA	2.53 mg/l [3]	Readily biodegradable.
Toluene							303 ug/l	
Heavy Metals								
Arsenic	0.092 mg/l	0.111 mg/l	0.077 mg/l	0.67 mg/l	0.15 mg/l	0.18 mg/l	ND mg/l	
Cadmium	ND mg/l	ND mg/l [1]	ND mg/l	0.0003 mg/l	ND mg/l	0.0024 mg/l	0.009 mg/l	
Chromium	0.018 mg/l	0.025 mg/l	0.017 mg/l	0.073 mg/l	0.027 mg/l	0.035 mg/l	0.043 mg/l	Concentrations are not considered as
Copper	0.007 mg/l	0.008 mg/l	ND mg/l	0.052 mg/l	ND mg/l	0.032 mg/l	0.022 mg/l	problematic
Lead	ND mg/l [1]	ND mg/l [1]	0.01 mg/l	0.017 mg/l	ND mg/l [1]	0.027 mg/l	0.028 mg/l	
Mercury	NA	NA	ND mg/l	NA	NA	NA	ND mg/l	
Molybdenum			0.026 mg/l					
Nickel	0.156 mg/l	0.297 mg/l	0.287 mg/l	0.46 mg/l	0.27 mg/l	0.54 mg/l	0.585 mg/l	
Silver	ND mg/l	ND mg/l [1]	ND mg/l	ND mg/l	NA mg/l	ND mg/l	ND mg/l	
Zinc	0.401 mg/l	0.307 mg/l	0.69 mg/l	8.9 mg/l	0.016 mg/l	0.88 mg/l	1.03 mg/l	
Cyanide	NA	NA	ND mg/l	NA	NA	NA mg/l	0.02 mg/l	
Other Metals								
Antimony	0.006 mg/l	0.005 mg/l	NA	0.007 mg/l	0.002 mg/l	0.011 mg/l	NA	
Barium	1.01 mg/l	1.38 mg/l	NA	3.2 mg/l	1.6 mg/l	2.2 mg/l	NA	Concentrations are not considered as
Beryllium	ND mg/l [1]	ND mg/l	NA	ND mg/l [1]	ND mg/l	ND mg/l	NA	problematic
Cobalt	0.006 mg/l	0.009 mg/l	NA	0.074 mg/l	0.008 mg/l	0.033 mg/l	NA	
Molybdenum	NA	NA	0.026 mg/l	NA	NA	0.033 mg/l	ND mg/l	
Selenium	ND mg/l	ND mg/l	ND mg/l	0.037 mg/l	ND mg/l	0.006 mg/l	ND mg/l	
Thallium	ND mg/l [1]	ND mg/l [1]	NA	0.003 mg/l	ND mg/l	ND mg/l	NA	
Vanadium	0.004 mg/l	ND mg/l [1]	NA	0.02 mg/l	0.007 mg/l	0.018 mg/l	NA	
Iron	6.03 mg/l	5.4 mg/l	NA	377 mg/l [2]	4.5 mg/l	80.7 mg/l	NA	
Manganese	0.107 mg/l	0.126 mg/l	NA	6.7 mg/l [2]	0.75 mg/l	6.8 mg/l [2]	NA	

NOTES:

1. Values reported but below the PQL therefore interpreted to be ND for this table
2. Order of magnitude higher than previous, presumed sampling, analysis or reporting error
3. most prominent consituent is phenol at 549 ug/l
4. NA = Not analyzed; ND = Not detected

APPENDIX F Smoke Testing Report

UNDERGROUND UTILITY SERVICES INC.

Providing Professional Services to Public Utilities,
Commercial, Industry and Contractors
throughout the Midwest.

City of Shelby, Ohio 2009 Sanitary Sewer Smoke Testing Report

The City of Shelby hired Underground Utility Services Inc. to perform sanitary sewer smoke testing for the entire City. The testing was started September 2009. Compilation of the data was performed and report submitted in November 2009. The weather was extremely dry prior to the testing and during the testing. This provided excellent testing conditions.

Summary

A total of 581 problems in the sanitary sewer collection system were identified during the smoke testing. A total of 295 or 51% of all problems are identified as private issues or individual property owner’s responsibility to repair. The remaining 286 or 49% of the total were identified as public problems. In the City of Shelby, the property owner is responsible for maintaining the sewer lateral from the building to the right of way or easement. The most significant problems found were sewer laterals, storm sewer cross connections and manhole casting. In addition we found what may be 2 sanitary sewer overflow points. These points need to be confirmed by dye testing.

As part of this report, we have provided a series of recommendations which we believe will assist the City in correcting the problems found in our report. Each problem found is provided in the individual problem site report. We have provided a follow up repair form on the back of each site report to allow the City to document the repair or action taken.

Report Details

Smoke testing consists of isolating sections of the sanitary sewer system using sandbags and blowing smoke into the isolated section. The smoke is observed flowing out of the ground from various defects found in the sewer system, which are documented and presented in this report. When smoke did not flow through the main pipe we categorized this as a “No smoke through Main” problem. There were 37 sections of the sewer that are categorized as this. In these sections there can undiscovered problems.

P.O. Box 835 Marion, Ohio 43301-0835	***- Waterline Leak Detection - Water Distribution online Monitoring/alarm system - Utility Locating/Map/GIS***	***- Sewer Televising/Flow Metering/Smoke/Dye Test - Specialized equipment Sales & Service***	**800-490-5325 Fax 740-389-6883 On the web at WWW.UUSINC.com**

Each source of I/I is listed as an individual problem as well as no smoke through sewer main. In many of the problems found we grouped a number of sources that are interconnected, such as several downspouts for a particular building or a group of interconnected storm sewer catch basins as a single problem.

The sanitary sewer system is shown on the provided map with symbols representing each category of problem and the problem number. The base map sewer lines and manholes were provided by the City of Shelby. A DVD of the map and report were provided for any additional copies.

Each type of problem is categorized. A description of the category and a table of the number of problems found by category are shown below. We have further broken the categories into Private Property Problems and Public Problems. Public problems are associated with main lines and manholes. Private problems are from the main line to the property.

QTY.	CATEGORY	DESCRIPTION
PRIVATE PROPERTY PROBLEMS		
18	Clean out, no cap	Describes a sewer clean out with no cap and surface water enters the clean out. Clean outs above grade were not considered
18	Clean out, leak around	Is a sewer clean out, where smoke was observed leaking around the outside of the pipe, thus a leak is located somewhere below grade
48	Foundation	Smoke was observed rising around the building foundation, thus indicating the foundation drain is tied into the sanitary sewer
113	Lateral	Smoke was observed coming up out of the ground in a long path following what appears to be the sewer lateral.
47	Downspouts	Where smoke was observed rising out of the building's downspouts
4	Downspouts(a)	Where smoke was observed coming out of the ground or pipe where the downspouts discharge to
19	Hole in yard	Where smoke was observed flowing out of a hole in the yard.
20	Yard Drain	Were smoke was observed rising out of a drainage tile located on private property
PUBLIC PROBLEMS		
81	Manhole casting	Where smoke is observed rising out of the ground along the outside of casting
2	Manhole lid vented	Where smoke is observed rising out of the ventilation holes in the lid and where a significant amount of inflow could occur.
23	Manhole Chimney	Where smoke was observed from an area outside the casting area, thus indicating a leaking MH chimney
29	Manhole walls	Where smoke was observed from an area located further out than described above, thus indicating a leaking manhole walls at a greater depth
38	Main pipe	Where smoke is observed rising above the sewer main
37	No smoke thru main	Smoke could not flow through the main due to a belly in the line or blockage. Pressurized smoke was applied to both sides of the area.
34	Storm Sewer	Where smoke is observed immediately flowing from a catch basin upon starting the test, thus probably a direct connection.
40	Storm Sewer(a)	Where smoke is observed flowing from a catch basin, but it took a while before it occurred, thus indicating that it is probably not a direct connection
2	Possible Overflow points	Not yet confirmed points were the sanitary sewer system can overflow into the receiving stream.

Review of the City of Shelby's Sanitary Sewer Collection System

The City of Shelby sanitary sewer system is a gravity sewer system and has no lift stations. The area is subject to flooding and a significant amount of the system is within the flood plain. The oldest portions of the system are estimated to be 100 years old. The sewer system is comprised of over an estimated 70 miles of main pipe and over 1,300 manholes that were accounted for through GPS locating by the City.

The majority of the system is comprised of clay pipe and concrete. All recent sewer replacements and new construction is PVC pipe. For the size of Shelby, there is a significant amount of large pipe. The largest is 48" with a significant amount of 24" and larger pipe. It appears that the system was designed for significant flows. However from conversations with the City staff, the system was not a combined sewer system.

The wastewater treatment plant (WWTP) has currently an average dry weather flow of 1.7 million gallons per day (mgd). The WWTP is designed for a peak flow of 5.0 mgd and has an off line storage tank of 3 million gallons. At a later date an additional 18 million gallon storage pond was added. A total of 21 million gallons of off-line storage for flows exceeding the WWTP's 5 mgd peak flow rate is available. In 2008, the WWTP flow exceeding the peak flow rate and overflowed the off line storage system for 3 days in February. Shelby also received a significant rainfall/flooding event in August of 2007 where off line storage overflowing occurred.

Rainfall Analysis

We have provided you 4 years of rainfall analysis, as measured at the Mansfield Airport. Rainfall and sanitary sewer I/I are directly related to one another, they are dependent upon the frequency, duration and intensity. The purpose of this analysis is to determine the overall probability of reoccurring overflow events. The Rainfall Analysis graph uses a 3 day moving (forward) daily total rainfall and counting the number of days where there where events greater than 1", 1.5" & 2" allows us to predict the potential number of overflow events within the collection system in its present condition. The second graph provides the top 20 – 3 day events from 2005 through 2008. The two reported overflow events occurred on 8/07 and 2/08 and are highlighted in red. This would indicate a high probability of an overflow event when the 3 day contiguous days of rain exceed 3 inches that an overflow would occur. This however this does not include overflow points that were unknown at that time.

Recommendations

From both visual observations and smoke testing the entire system, there appears to be a past management philosophy of increasing pipe size and building larger storage tanks and not addressing the root cause of the I/I problem. Increasing the sewer system's hydraulic capacity and storage can only address the intermittent problems. I/I will not improve with age, it only gets worse. A simplistic view of it is to think of the Grand Canyon which took millions of years to form to what it is today. I/I is similar in the fact that rain water erodes its way into the sanitary sewer system and overtime the pathway increases in size and thus the flow capacity to inflow/infiltrate the sanitary sewer system with rain water.

The overall objective of a well maintained sewer collection system is to:

1. Have a trouble free system for your customers, which means no interruption in service or sewer back up problems.
2. Minimal I/I into the system ensures the capacity to:
   - 2.1. Service your existing customer base
   - 2.2. Service potential new customers
   - 2.3. Maximizes the useful life of the collection system and WWTP thus minimizing future capital costs
   - 2.4. Minimal impact on other infrastructure, such as roads, water lines, storm sewers, etc.
3. That quality material, workmanship, testing and inspection is used in all new construction, repairs or rehabilitation work. The life span of this infrastructure is forever. The cost to go back and fix problems the second time is extremely expensive.

A sewer system is a relatively simple system comprising of main lines, manholes and laterals. I/I enters into the system through all 3 of these points. Addressing only the public side of the system (mains and manholes) will only have limited success in I/I removal. Thus at some point, the private side (laterals) will need to be addressed by developing an overall strategy and plan.

Sanitary sewer smoke testing is an effective means of identifying problem areas. It does not however identify the actual problem or solution(s). This requires additional investigation work by televising in conjunction with dye testing.

The key priority is to minimize sanitary sewer overflows and customer service interruption. We recommend addressing the following types of problems found in our smoke testing listed below and develop a long-term strategy of maintaining the sanitary sewer collection system. This strategy needs to ensure that the system is improving at a rate greater than the rate of the existing system's degradation.

Priority	Qty Found	Description of Problem
1	2	Possible Overflows – Need to confirm if they are overflow points by dye testing. This could significantly change the present number of actual overflow occurrences
2	34	Storm Sewer – This is a significant source of additional I/I and can be additional overflow points to the receiving stream
3	40	Storm Sewer(a) – Again significant source of I/I
4	38	Main pipe – This is a significant source of I/I and an indication of possible sewer collapse and interruption in customer service.
5	37	No smoke thru main – This can be a possible sewer back up or collapsed line, leading to service interruption
6	135	Manhole problems – Specifically address those manholes located in the flood plain area.

Typically there is not enough funding to address all the problems, all at once. This means allocating enough funding to address a portion of the prioritized problems each year. The key to the overall success of any program is persistence. This is not a one fix problem, there are many problems and there will continue to be additional problems in the future as the system ages. What we are addressing here is maintenance issues; maintain what you have now, not replacement, increasing system capacity or new development.

The infrastructure to be maintained is a forever issue and should not be left to future generations. This is not a replacement program; you cannot afford to replace your existing infrastructure. Today there are many methods of maintaining / repairing existing infrastructure using trenchless technologies, that minimize cost (compared to replacement), customer inconveniences and limit their impact on other infrastructure (i.e. roads other buried infrastructure). There may be times where replacement may be the most cost effective means of addressing a specific type of problem.

Our recommended outline of a sewer maintenance rehabilitation program would consist of the following steps shown in the tables below for year one, year two and beyond.

Year 1

Step	Process	Description
1	Planning	This would consist of developing an annual budget, prioritizing problems, updating your existing maps and create a data base of information for documenting the problems, investigation, repairs, overflow events and service interruptions. In addition, review of new construction methods and existing maintenance practices.
2	Measure Success	Implement a method of measuring rainfall and flow at WWTP and off-line storage tanks. Derive total I/I per rainfall event. In addition, the number of service interruptions need to be collected and the type of problem(s) encountered.
3	Investigate & Derive solutions	Investigate those problems selected from your planning stage and derive solutions for each problem. This consists of televising the line and dye testing to define the problem. Each problem will have its own solution and a project number. You will have multiple projects from which you can select which ones to implement this year or in the future depending upon priority and budget
4	Maintenance Contracts	Develop maintenance contracts based on the type of problems found in step 3. Typically this would be for sewer lining, grouting, root control, manhole rehabilitation and point repairs. These are annual renewable type contracts that allow for estimating repairs costs.
5	Implement Repairs	Based on the contract bid items and quantity of repairs select those repairs that will stay within your budget and issue purchase orders for the work to be completed.
6	Inspection / Testing	Perform inspection / testing for each of the maintenance contractor to ensure quality work and material are used. Evaluate each contractor and their overall performance.
7	Constant process improvement	This consist of annually reviewing the investigative work, solutions applied, projects completed, measured flow difference (before & after) and implement improvements to the overall process.
8	Annual Report	Put together annually a summary of all the above items completed that year and proposed process improvements for next year.

Year 2 & beyond

Step	Process	Description
1	Planning	Develop a list of problems for the year to investigate and implement proposed process improvements from the previous year.
2	Measure Success	Continue to quantify service interruptions, I/I and rain events. This is a critical item to measure and quantify success.
3	Investigate & Derive solutions	Investigate those problems selected from your planning stage and derive solutions for each problem. With maintenance contracts in place, cost estimates can be easily derived for each problem / project.
4	Maintenance Contracts	Renew those contracts that have worked well and re-bid out those that have not. In addition, add additional contracts for other process as deemed beneficial.
5	Implement Repairs	Based on the contract bid items and quantity of repairs select those repairs that will stay within your budget and issue purchase orders for the work to be completed. This can be from projects derived the previous year(s) or the current year.
6	Inspection / Testing	Perform inspection / testing for each of the maintenance contractor to ensure quality work and material are used. Evaluate each contractor, method and their overall performance.
7	Constant process improvement	This consist of annually reviewing the investigative work, solutions applied, projects completed, measured flow difference (before & after) and implement improvements to the overall process. Investigate other methods of rehabilitation as deemed beneficial
8	Annual Report	Put together annually a summary of all the above items completed that year and proposed process improvements for next year.

APPENDIX G Sanitary Sewer Capital Improvement Surcharges - 2014

AMENDED ORDINANCE NO. 17 -2014
(Sponsor – Councilmembers Schag and Martin)

AMENDING SECTION 1044.07 (SANITARY SEWER CAPITAL IMPROVEMENTS SURCHARGE) OF CHAPTER 1044 (SEWER CHARGES) OF THE CODIFIED ORDINANCES OF THE CITY OF SHELBY.

WHEREAS, Ordinance No. 28-2003 was passed on August 4, 2003, creating a sanitary sewer capital improvement surcharge for users of the municipal sanitary sewer system of the City of Shelby, Ohio; and

WHEREAS, there is currently an administrative surcharge in effect from August1, 2014 through December 31, 2014 and the City desires to extend said surcharge for the purpose of financing of debt to remodel the wastewater treatment plant and also capital expenditures for equipment and maintenance of the plant; and

WHEREAS, it is in the interest of the public health, safety, morals, and general welfare of the citizens of the City of Shelby that Section 1044.07 (Sanitary Sewer Capital Improvements Surcharge) of Chapter 1044 (Sewer Charges) be amended so that any inequity associated with the surcharge is resolved.

NOW, THEREFORE, BE IT ORDAINED BY THE COUNCIL OF THE CITY OF SHELBY, OHIO, A MAJORITY ELECTED THERETO CONCURRING:

Section 1: That Section 1044.07 (Sanitary Sewer Capital Improvements Surcharge) of Chapter 1044 (Sewer Charges) shall be amended so as to read as follows:

1044.07 SANITARY SEWER CAPITAL IMPROVEMENTS SURCHARGE.

(a) "Residential" customers who are billed in accordance with the terms of this chapter shall pay a surcharge of Seven and 67/100 Dollars ($7.67) per month. This charge shall be shown on the billing statement sand shall be designated for the Sanitary Sewer Capital Improvement Fund.

(b) "Senior citizen residential" customers who are billed in accordance with the terms of this chapter shall pay a surcharge of Three and 50/100 Dollars ($3.50) per month. This charge shall be shown on the billing statement and shall be designated for the Sanitary Sewer Capital Improvement Fund.

(c) "Commercial" customers who are billed in accordance with the terms of this chapter shall pay a surcharge of Nine and 18/100 Dollars ($9.18) per month. This charge shall be shown on the billing statement and shall be designated for the Sanitary Sewer Capital Improvement Fund.

(d) "Industrial customers who are billed in accordance with the terms of this chapter shall pay a surcharge of Ten and 70/100 Dollars ($10.70) per month. This charge shall be shown on the billing statement and shall be designated for the Sanitary Sewer Capital Improvement Fund.

(e) Any individual or business entity that is using the Municipal Sanitary Sewer System of the City of Shelby, Ohio, shall be billed for the Sanitary Sewer Capital Improvement Fund surcharge in accordance with the terms of divisions (a) through (d) of this section. In the case of individuals or business entities whose sanitary sewer usage or consumption is not separately metered and who, therefore, receive no sanitary sewer billings, the appropriate charge for the Sanitary Sewer Capital Improvement Fund shall be added to their utility bill, unless their water service has been shut off by the city, and where there is only one water meter in a structure with multiple living units, the main water meter will have to be shut off to receive no bill for the separate living units.

(f) Monies shall be collected for a maximum of Twenty (20) years (January 1, 2015 to December 31, 2034) and will be reviewed annually by Shelby City Council to determine the continued need for collection. The new rates will begin with the January, 2015 bills and will be shown on the February, 2015 billing.

Section 2: All remaining sections of Chapter 1044 (Sewer Charges) shall remain in full force and effect.

Section 3: That all meetings and hearings concerning the adoption of this Ordinance have been in compliance with Codified Ordinance 220.01, Ohio Revised Code Section 121.22, and the Charter of the City of Shelby, Ohio.

Section 4: That this Ordinance shall be in full force and effect from and after its passage, approval by the Mayor, and the earliest period allowed by law.

PASSED: October 6, 2014

Steven L. Schag
Vice President of Council

APPROVED:

ATTEST: Robert A. Lafferty
Clerk of Council

Marilyn S. John
Mayor

Prepared by:

Gordon M. Eyster
Director of Law