Memo

To: Northfield Township Board

From: Howard Fink

Date: 8/18/2016

Re: Equalization Basin

Dear Township Board,

Attached in your packet is the equalization study completed by Tetra Tech. Soil Borings have come back indicating there is no issues. Brian Rubel will be on hand for any questions.

Respectfully Submitted,

Howard Fink, Township Manager

NORTHFIELD TOWNSHIP

Wastewater Treatment Plant

Wet Weather Storage Tank Preliminary Design Report

March 21, 2016

Table of Contents

INTRODUCTION 1
TANK SIZING 2
TANK MATERIAL 4
Concrete Tank 4
Bolted Steel Tank 5
TANK DIMENSIONS 7
TANK, VALVE AND METER VAULT LOCATION 8
TANK OPERATION 9
Filling 9
Maintenance 10
Draining/Overflows 10
Tank Cleaning 11
Instrumentation and Control 12
Temporary Facilities 13
PUMP STATIONS 14
8 Mile Pump Station 14
Woodland Center Correctional Facility Pump Station 15
COST OPINION 16
SCHEDULE 17
RECOMMENDATIONS 18
Soil Borings 18
Funding Sources 18
Final Recommendation 18

Appendix A - Tank Sizing Reports
Appendix B - Drawing Figures
Appendix C – Cost Opinion
Appendix D –Soil Boring Proposal

INTRODUCTION

Northfield Township owns and operates a Wastewater Treatment Plant (WWTP) and sanitary collection system. The WWTP is located at 1150 Lemen Road, Whitmore Lake, Michigan 48189. As with most older sewer systems, the wastewater flow rates increase with rainfall. This makes operating the WWTP challenging. As early as 1988, the Township evaluated construction of a Wet Weather Storage (WWS) tank to manage the wet weather flow. However, the WWS tank was never constructed. Operational challenges from recent wet weather flow and inquiries regarding adding new development have led to this preliminary design report for a WWS tank at the Northfield WWTP.

TANK SIZING

The WWTP's current average flow is 0.7 MGD and can be as high as 0.9 MGD during spring months (May generally being the peak month). The current WWTP capacity is 1.3 MGD. The Township's NPDES permit allows expansion up to 3 MGD. In 2002, Northfield, Green Oak, and Hamburg Township entered into a consent order that called for the WWTP to expand to 2.25 MGD. However the economy stalled and this expansion did not proceed.

In March 2015, as part of the Sanitary Sewer Capacity Inventory Report, Tetra Tech completed an analysis which resulted in a preliminary tank size of 1.7 MG to prevent overflows up to the 25-year, 24-hour design storm in accordance with the Michigan's sanitary sewer overflow (SSO) policy. The design storm hydrograph was based on several years of metered data from the WWTP's influent meter. This storage volume would allow the current plant to be used without other major improvements until the average dry weather flow during the spring reached 1.1 MGD, which is 85 percent of the WWTP's treatment capacity. Expansion of the WWTP would be required once average flows reached this magnitude.

As part of this preliminary design a second, but more data intensive analysis (a long-term simulation), was completed to take advantage of the portion of the State's SSO Policy. This allows communities to demonstrate that there will be no more than one overflow in ten years from the system instead of using the 25-year, 24-hour design storm. This approach can substantially reduce the amount of storage required to meet the State's SSO Policy relative to the design storm.

The long-term simulation was completed using EPA SWMM. Flows in response to rainfall are predicted by the model using a unit hydrograph method based on the response to rainfall recorded at the WWTP's influent meter and 54 years of hourly rainfall data. The model also uses a seasonally varying dry weather flow pattern to represent the higher dry weather flows measured in the spring season.

For the 54-year simulation, the minimum tank size that meets the State's SSO Policy will have a volume that is just larger than the sixth largest volume required, and will allow roughly one overflow every ten years on average. This volume was determined to be 1.3 MG.

Due to uncertainties in modeling, it is prudent to plan for a slightly larger storage tank than the analysis projects. For instance, it may be wise to plan on a 1.5 MG tank. The model predicts a 1.5 MG tank will have two overflows in the 54-year model simulation.

Further discussion of preliminary sizing of the WW tank and discussion of the long-term simulation in more detail are provided in Appendix A.

TANK MATERIAL

Two types of tank materials were considered as part of the evaluation. One type of tank considered is a below grade concrete storage tank and the other type of tank considered is an above ground bolted steel storage tank.

Concrete Tank

This type of tank would be a buried below grade concrete storage tank with a concrete cover. Considerations with this type of tank include:

- Considerable excavation and backfill would be required.
- Fitting the concrete tank onsite in an ideal location within the property lines will be challenging.
- A valve and meter vault would be required to divert flow from the 8 Mile Pump Station into the storage tank.
- A pump station would be required for draining the tank. These pumps would be used very infrequently and be another maintenance item for plant staff.
- The concrete tank would most likely have a concrete cover to contain odors. A concrete cover is not ideal since hydrogen sulfide can build up in the tank and deteriorate the concrete.
- A typical design life would be 50 to 100 years.
- Approximate cost of $3 per gallon of storage

Bolted Steel Tank

This type of tank would be an above-ground bolted steel storage tank with access stairs, platform, and a dome cover. Considerations with this type of tank include:

- Fill would need to be brought on site to raise the tank high enough for the tank to drain by gravity to the Grit and Screen Building. This eliminates the need for a pump station to drain the tank. Proper compaction methods would need to be followed to control tank settling.
- A valve and meter vault would be required to divert flow from the 8 Mile Pump Station into the storage tank.
- The same valve and meter vault would be used for draining the tank back to the Grit and Screen Building. Since draining the tank can be done by gravity, a pump station would not be required. This will provide one less maintenance item for the WWTP staff as compared to the concrete tank.
- Access stairs would be provided to the top of the tank with a platform for access into the tank at the top of the stairs.
- A dome cover would be located over the top of the tank to contain odors.
- The steel will be glass lined to control corrosion.
- A typical design life is at least 50 years.
- Approximate cost of $2 per gallon of storage

Based on review with plant staff it was decided to proceed with designing the bolted steel storage tank with the main reason that the bolted steel tank would be considerably less expensive than the concrete tank with a similar design life. Additional reasons for the bolted steel tank is that it will fit on site, a pump station is not required, and the tank and equipment will have minimal maintenance. From this point in the report only the bolted steel storage tank is discussed.

TANK DIMENSIONS

Bolted steel tanks can be obtained in numerous combinations of height and diameter. For this project, we have identified a 100 feet diameter by 26.5 feet tank height as a reasonable combination to provide the 1.5 MG of storage. The floor elevation of the tank will be at elevation 915.00 which places the tank higher than the expected high water level at maximum flow in the Grit and Screen Building as shown on Figure 2 in Appendix B. This will allow the tank to be drained by gravity. The final tank diameter and tank height may be slightly adjusted during design of the tank.

TANK, VALVE AND METER VAULT LOCATION

The WWS tank will be located directly south of the Grit and Screen Building. This location requires the least amount of fill to be brought on site for raising the floor of the WWS tank to allow gravity draining of the tank. This location also leaves the area to the south and east clear for future plant expansion. The location for the WWS tank is shown on Figure 3 in Appendix B.

A valve and meter vault will be located just south of the Grit and Screen Building and north of the WWS tank. The valve and meter vault will have throttling valves, open-close motor-actuated valves, open-close manual valves, magnetic flow meter, and sump pump. The vault will be located at the existing 90 degree bend on the 12-inch force main from the 8 Mile Pump Station to the Grit and Screen Building. This 90 degree bend will be replaced with the piping and valves shown on Figure 1 in Appendix B. The 90 degree bend and a small portion of the 14" Raw Sewage (RS) pipe from the Grit and Screen Building to the Primary Flow Split Structure will need to be relocated to move this pipe further away from the valve and meter vault perimeter. This piping is shown on Figure 5 in Appendix B.

The elevations of the WWS tank, valve and meter vault, and piping are shown on Figure 2 in Appendix B.

TANK OPERATION

Filling

The primary method to fill the WWS tank is through the 12-inch force main from 8 Mile Pump Station. A throttling valve will be installed on the 12-inch force main to control the flow rate to the Grit and Screen Building (perhaps to typically limit flows to less than the 2.5 mgd peak capacity of the WWTP). This throttling valve will be located in the valve and meter vault. The remaining pumped flow will go to the WWS Tank through the open motor-actuated plug valve and a flow meter located in the valve and meter vault. The influent flow to the WWTP will be measured by the existing Parshall Flume in the Grit and Screen Building and the influent flow the WWS tank will be measured by the new magnetic flow meter.

Normally the flow from the Woodland Center Correctional Facility Pump Station will be to the Grit and Screen Building. If the Grit and Screen Building needs to be temporarily taken out of service the flow from the 8-inch force main from Woodland Center Correctional Facility Pump Station can be sent to the WWS tank. The ground-buried valve to the Grit and Screen Building will be closed and the ground buried valve to the WWS tank will be opened.

See Figure 1 for the flow schematic and Figure 5 for the yard piping showing the piping arrangement. These figures are located in Appendix B.

Maintenance

To allow for maintenance on the throttling valves and the flow meter, normally-open plug valves are located upstream and downstream of each piece of equipment. These are shown on Figure 1 in Appendix B.

These valves will also allow an alternate flow path from 8 Mile Pump Station to the Grit and Screen Building if the throttling valve to the Grit and Screen Building is out of service or requires maintenance. Flow from the 8 Mile Pump Station will be through the motor-actuated plug valve located in the valve and meter vault. The 12-inch valve located upstream of the 12-inch throttling valve will be closed. The 12-inch valve in the yard to the WWS tank will be closed. The flow will be routed through the valve and meter vault and the 10-inch pipe to the Grit and Screen Building.

Draining/Overflows

The WWS tank will be drained by gravity to the Grit and Screen Building. The draining flow rate will be controlled by the new throttling valve in the valve and meter vault and existing Parshall flume at the Grit and Screen Building. The motor-actuated plug valve in the valve and meter vault to the 12-Inch 8 Mile Pump Station force main will be closed.

The WWS tank will also have an overflow pipe that will route flow to the influent of the Chlorine Contact Tank. Therefore, in extreme conditions, the tank could overflow wastewater to the chlorine contact tank for disinfection before discharging from the WWTP. This overflow pipe is shown on Figure 1 flow schematic and the overflow pipe elevation 940.50 is shown on Figure 2 which are both in Appendix B. The overflow piping will be routed along the south edge of the existing WWTP structures to the Chlorine Contact Tank. This pipe routing is shown on Figures 5 and 6 in Appendix B.

All of the pipe sizes shown are preliminary and the final sizes will be determined during design.

Tank Cleaning

Cleaning of the tank will be done with a flexible flushing hose located on the platform at the top of the WWS tank. A new 6-inch potable water (PW) pipe will be installed from the existing 6-inch PW pipe near the existing hydrant located to the east of the Service Building to a new hydrant located near the northeast corner of the Grit and Screen Building. A new 2-inch pipe will be installed from the 6-inch PW into the Grit and Screen Building to replace the existing 2-inch copper pipe. At the WWS tank a 2-inch hose connection will be located at the top and bottom of the tank and a 2-inch pipe will be provided up the side of the tank. When the tank needs to be cleaned WWTP staff will connect a flexible hose from the new hydrant to the 2-inch pipe connection at the bottom of the tank. At the top of the tank WWTP staff will connect a flexible hose to the 2-inch pipe connection and will hose down the tank from the platform. The PW pipe route is shown on Figure 5 in Appendix B.

At the existing hydrant located east of the Service Building, recently Township fire department staff opened the fittings on the hydrant and measured in flow stream from the 2.25-inch fitting to be 9 psi. When the 1.5-inch fitting was opened, 24 psi was measured in the flow stream. The Township has stated this corresponds to approximately 550 gpm. The static pressure was not able to be measured which makes projecting these observations to the higher tank and the farther point quite challenging. However, it appears that it is likely that that this hose stream is sufficient to clean all or part of the new tank. An entry may need to be made into the tank for complete flushing on the far side of the tank.

Flushing hose connections will be located at various points on the piping in the valve and meter vault to clean the pipe when not in use. Flexible hoses from the fire hydrant can be connected to these flushing hose connections. These flushing connections will be required to clean the pipe after the tank has been drained since the elevation of the pipe will be below the normal water level in the Grit and Screen Building. This pipe will always be full of water.

Instrumentation and Control

Influent flow to the Grit and Screen Building will continue to be measured by the existing Parshall Flume in the Grit and Screen Building. The throttling valve on the 12-inch 8 Mile force main will throttle the flow to the WWTP and send the excess flow to the WWS tank if influent flow to the WWTP is above an operator entered flow rate in SCADA.

A magnetic flow meter will be located on the pipe to the WWS tank. This meter will measure the pumped flow from 8 Mile Pump Station into the WWS tank. This meter can also be used to measure the total volume pumped to the WWS tank and to estimate any volume that may overflow the tank. This measured overflow will be recorded and used for reporting overflow events to the DEQ. The existing Parshall flume and new throttling valve will be used to control the flow rate drained from the tank to the Grit and Screen Building.

An ultrasonic level sensor will be located in the tank to monitor the level in the tank.

Temporary Facilities

Temporary facilities will be required to control the wastewater flow when the tie-in is made on the 12-inch force main from 8 Mile Pump Station, when the tie-in is made to the 8-inch force main from Woodland Center Correctional Facility Pump Station, and when the small section of 14-inch RS to the Primary Flow Split Structure is relocated. Options for temporary operations include taps on the existing piping and temporary piping from these taps to the Primary Influent Flow Split Structure or to the Grit and Screen Building if temporary bulkheads are placed over the pump station force main influent pipes. Tanker/vactor trucks could also be used at the pump stations. This work would be done during low flow periods.

PUMP STATIONS

8 Mile Pump Station

The station consists of two Flygt dry pit submersible pumps with variable frequency drives. The duty point of the pumps are 1,750 gpm at 90 feet of total dynamic head. These pumps have recently been installed. The station also has two older pumps with variable frequency drives that are rarely used.

To fill the WWS tank, the existing pumps will need additional head to fill the tank to the overflow elevation 940.50. This will add approximately 26 feet of additional static head to these pumps. This assumes the original pumps were sized to pump to the high water elevation 914.72 in the Grit and Screen Building. The additional head does not account for dynamic losses in the piping system. These loses will be calculated as part of the design project. The additional head will reduce the capacity of the pumps by about 500 gpm when the tank is near the over flow elevation.

As part of this project it is recommended to remove the two old pumps in the pump station and to replace with two new Flygt dry pit submersible pumps with variable frequency drives. The new pumps will have approximately 30 feet of additional head at the design flow. This will add additional capacity to the pump station and reliability to the pump station as well. Additional electrical upgrades will be required as part of this work.

Woodland Center Correctional Facility Pump Station

The station consists of two submersible pumps located in the wet well of the pump station. The duty point of these pumps appear to be 400 gpm at 63 feet total dynamic head based on the literature provided by the facility. These pumps are currently in process of having the variable frequency drives installed on the pumps. The shut off head of these pumps is 82 feet based on the literature provided and looking at the maximum curve for the pumps. These pumps will not pump to the overflow elevation in the tank and will only pump to a mid-level elevation. This most likely will not be a problem since as stated previously in the report these pumps will only pump to the WWS Tank if the Grit and Screen Building is temporarily out of service. WWTP staff will need to be aware of the limitations with this pumping system. These pumps could be replaced with higher head pumps. The cost opinion assumes these pumps will not be replaced.

COST OPINION

The project cost opinion is $2.8 million dollars. The cost opinion is included in Appendix C.

SCHEDULE

A sample project schedule is below:

- Final Design 3 to 5 months
- Bidding and Award 2 to 3 months
- Construction 12 months

The total duration until completion will be 17 to 20 months from initiation of final design. However, the funding source chosen by the Township may impose additional constraints.

RECOMMENDATIONS

Soil Borings

It is recommended to have soil borings done in the location of the WWS tank and the valve and meter vault to verify that the soils are adequate for locating those structures. We have contacted TTL Associates, Inc. for budget pricing and recommended number of soils borings and locations. The budget price for four soil borings, laboratory testing, engineering analysis and report is $8,285. The proposal from TTL Associates is included in Appendix D.

Funding Sources

The Township should consult with its financial advisor on funding recommendations. The Township may choose to borrow funds for this Revolving Fund Loan (or SRF). While the SRF loan will probably consist of a lower interest rate, the SRF loan also requires an extensive set of studies to demonstrate that the proposed equalization tank is the cost effective solution to the wet weather. These studies will take approximately two years to complete and likely will cost $200,000 to $400,000. The cost of these studies may negate the savings from the lower interest rate.

Final Recommendation

The final recommendation is to install a 1.5 MG above grade, bolted steel, WWS tank, the valve and meter vault, and associated piping. It is also recommended to replace the two existing pumps at the 8 Mile Pump Station.