ENGINEERING REPORT

HIGHWAY 70 SEWER LIFT STATION

Prepared For: City of McEwen, Tennessee

File: 33543-12
August 2016

BWSC BARGE WAGGONER SUMNER & CANNON, INC.

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FIGURES

1.0 INTRODUCTION

The City of McEwen, Tennessee was served with a Commissioner's Order and Assessment (WPC 12-0113) from the Tennessee Department of Environment and Conservation (TDEC) on June 11, 2013. The Order cited 'numerous violations and deficiencies found related to the collection system, wastewater treatment plant (WWTP), and the self-monitoring program'. Violations included but were not limited to:

- Failed to meet effluent limits
- Discharged untreated wastewater from the collection system or before treatment at the WWTP
- Caused a condition of pollution and a threat to public health and the environment

As a result of this Order, the City of McEwen has enacted a program to meet the requirements of the Order. One aspect of this program is the replacement of the Highway 70 Sewer Lift Station (SLS). The pump station at Highway 70 has experienced operational issues with vibration of the pumps since it was put into service. Multiple attempts have been made to address the vibrational issues which continue to plague the station. However, none of these attempts have been successful and the station continues to malfunction, contributing to the frequent overflows at the site. This report details the design associated with the replacement of the Highway 70 SLS.

2.0 CAPACITY ANALYSIS

The Highway 70 SLS is the largest station in the collection system and serves the largest portion of the collection system other than the area that gravity feeds to the wastewater treatment plant. The station receives flow from the Pine Thicket SLS and serves a mix of industrial, residential, and some commercial customers.

A combination of the monthly operating reports (MOR) and rainfall data from January 2012 to March 2014 is used to determine an estimated average daily flow (ADF) and total flow within the wastewater system. In addition to this data, a GIS platform is used to divide the system into various sub-basins according to the four (4) SLS's and the treatment plant. This analysis results in an influent base flow to the Highway 70 SLS of approximately 42,000 gallons per day (GPD) and a 2-year, 24-hour flow of approximately 331,500 GPD.

The design capacity of the replacement Highway 70 station is based on the 2-year, 24-hour flow. This flow is increased by 2.4%, corresponding to the 20-year projected population growth for the City of McEwen, to be approximately 340,000 GPD. In order to provide a slightly higher pumping capacity as compared to the expected influent flow, the proposed Highway 70 SLS is designed to pump 275 gallons per minute (396,000 GPD) or 14% more than the projected 20-year influent flow.

3.0 DESIGN

3.1 Force Main Modifications

The existing Highway 70 SLS pumps wastewater through a 6-inch force main a total of 8,300 linear feet. The force main discharges into a manhole located in the City of McEwen at the intersection of Wilkie Street and Long Street West. The flow is then carried to the headworks of the WWTP by the gravity sewer system.

During the research and analysis of the existing SLS and force main, it was identified that there are no air release valves anywhere along the pipeline. Given the profile and intermediate high points along the route, this project proposes the installation of eight (8) 2-inch air release valves on the existing force main.

3.2 Highway 70 SLS

The existing Highway 70 SLS is a wet well mounted, Smith and Loveless, suction lift station. It is currently located on the easement of a residential property. The station is not protected or surrounded by a fence and has historically been the location of multiple sanitary sewer overflows. The City of McEwen has decided to relocate the station to an adjacent property, which the City is currently in the process of purchasing. The relocation will allow the City to convert the existing wet well into a standard manhole, not significantly affecting the hydraulics of the system while providing a secure location for the station.

The proposed Highway 70 SLS will be comprised of submersible pumps and a 14.5 foot deep wet well. The station discharge piping and associated valves will be constructed above ground with insulation and heat tracing. The submersible pumps will be driven by adjustable frequency drives located in a central pump control panel. The pumps will operate in a standard duty/standby sequence and will alternate pumps based on each pump-down cycle. Finally, depending on the available funds and construction bids, the station will be equipped with a standby generator.

The bottom elevation of the wet well will be 735.5 feet and the top elevation will be 750.0 feet. The force main high point is located at an elevation of 836.9 feet and is located just upstream of the discharge manhole. Assuming the centerline of the submersible pumps is 10-inches above the bottom of the wet well, the static head of the system is 100.5 feet. Given a pumping capacity of 275 gpm through the 8,300 foot, 6-inch force main with a C factor of 110 and 130, the friction head of the system is 57.5 feet and 41.5 feet, respectively. This results in a total dynamic head of 158 feet at C equal to 110 and 143 feet at C equal to 130.

Figure 3.2 below depicts the system curves at both C factors and three submersible pump options: (1) ABS, (2) Flygt and (3) Wilo.

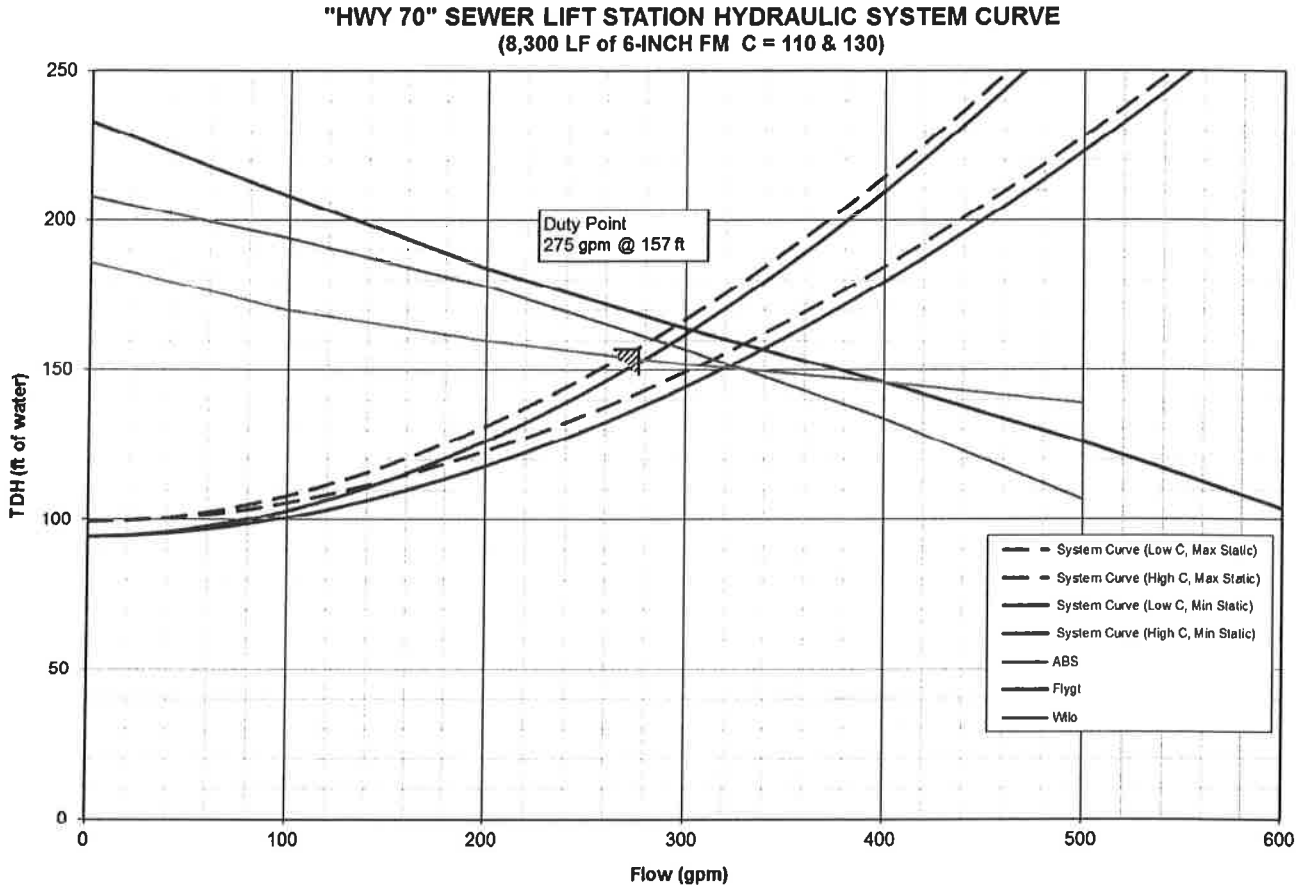

Figure 3.2 – System and Pump Curves

4.0 SUMMARY

As a part of the City of McEwen's program to address the Commissioner's Order and Assessment (WPC 12-0113) of June 2013, the Highway 70 SLS will be replaced. The station will be relocated to an adjacent property, properly secured by fencing. The proposed station will be a submersible station with adjustable frequency drives for increased operational flexibility. Depending on the available funds and construction bids, the station will also be equipped with a standby generator. In addition to the replacement of the SLS, there will be eight (8) air valves installed on the existing force main.

WPN16-0694

ENGINEERING REPORT - **ADDENDA**

HIGHWAY 70 SEWER LIFT STATION

Prepared For: City of McEwen, Tennessee

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September 2016

BWSC Barge Waggoner Sumner & Cannon, Inc.

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FIGURES

Appendices

1.0 INTRODUCTION

The following information is provided in response to comments received on September 22, 2016 from the Tennessee Department of Environment & Conservation (TDEC).

2.0 HYDRAULIC PROFILE

The hydraulic profile below is based on a pump flow rate of 275gpm, existing force main C-factor of 110 and a total dynamic head of 156 feet.

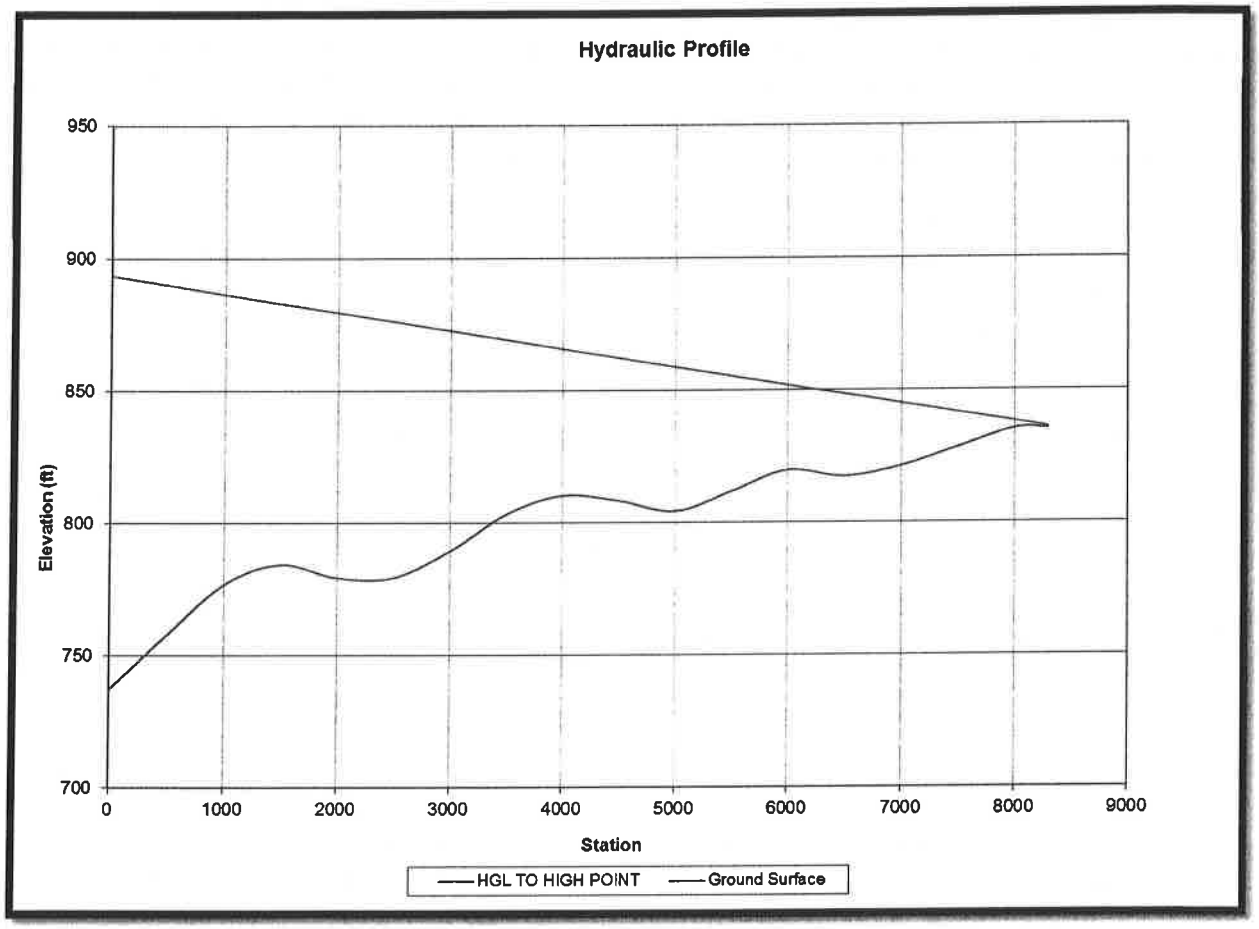

Figure 1 - Hydraulic Profile

3.0 AREA MAP

The map located in Appendix A depicts the area served by the pump station as a part of the overall collection system.

4.0 DOWNSTREAM CAPACITIES AND OVERFLOWS

The City of McEwen is actively engaged in projects to address the aging wastewater treatment plant (WWTP) and significant RDI&I experienced within the collection system. The WWTP improvements are

currently being designed with construction completion anticipated for 2018. A gravity system rehabilitation project is also in design with construction projected to begin in the spring of 2017. Due to issues with the condition of the existing lift station, it is critical the new station is constructed as soon as feasible. Due to the schedules for the completion of the rehab and wastewater treatment plant projects, the new station will come online with hydraulic restrictions during wet weather conditions. This scenario was anticipated which is why measures were included in the design to mitigate the system conditions until the rehabilitation and plant projects are completed.

The new Highway 70 Sewer Lift Station (SLS) should not create any additional sanitary sewer overflows (SSO's) than what the City of McEwen currently experiences. Although the new SLS will have more pumping capacity than the existing station, variable speed drives (VFD) will be used, in conjunction with the discharge flow meter, to maintain a pumping rate compatible to the existing station. Also, additional storage has been designed in the system by converting the existing wet well into a manhole which could help reduce the periodicity of overflows at the station.

It is expected that upon the completion of the *both* the rehabilitation project and WWTP improvements project, the capacity of the system downstream of the Highway 70 SLS will be increased resulting in the reduction of SSO's in this area. It will not be until this milestone that the Highway 70 SLS pump rate would be incrementally increased to its design point of 275gpm.

Finally, if construction funds are available, the VFD's programmable logic controller (PLC) will be used to determine the inflow rate at the station. Given the level instrumentation and flow meter already designed as a part of the new station, the PLC will have the capability to calculate the inflow rate, display the rate via the VFD's screen, and data log the information for retrieval and historical trending.

5.0 PUMP CYCLE TIME

The calculations for the cycle time of the HWY 70 SLS pump station are provided in Appendix B.

6.0 ELECTRICAL RELIABILITY

The base design of the Highway 70 SLS will provide a service entrance rated, automatic transfer switch (ATS). The ATS will have the capacity to transfer power from the primary electrical source to a secondary or standby source. If construction funds are available above the base bid, a permanent standby generator and corresponding equipment pad will be installed. The permanent standby generator would be fueled by diesel and would be capable of providing a minimum of 48-hours of full-load power (both lead and lag pumps operational) to the SLS. If construction funds are not available, the permanent standby generator will be considered for a future project. Given the base design includes the ATS, during a power outage without the permanent generator, the owner would have the capability to connect a portable secondary power source to operate the station until the primary power source is restored.

In addition, all electrical components will be installed above the calculated 500-year flood elevation of 752.0 feet.

Appendix A

Map

0 0.175 0.35 0.7 Miles

Tennessee State Plane, Feet
North American Datum 1983

N

Overall Sewer System Map

CITY OF McEWEN

Humphreys County, Tennessee

Manholes
Lift Stations
Gravity
Force Main
Sewer Basins
Hwy 70 SLS Basin

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Date: 26 September 201

Appendix B

Pump Cycle Time Calculations

LIFT STATION DESIGN

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WET WELL DESIGN

1. Compute the Wet Well Volume Based on a 10 Minute Cycle Time.

T = Time for one cycle (min.)	[redacted]
Ve = Effective volume of wet well (gal.)	
Q = Pumping rate (gpm)	275
S = 1/2 peak flow (gpm)	138
Ve = T/((1/Q-S)+(1/S))	687.50

2. Plot Cycle Time versus Flow In.

Tr = Desirable Running Time (min.)	[redacted]
Vr = Effective volume of wet well (gal.)	
Vr = Tr(Q) - Tr(S)	687.50

VOLUME GIVEN CYCLE TIME AND FLOWS

t = V/Qpump-Qin + V/Qin

Cycle Time t, min.	Qin	Qpump	Flow Units	Conversion to gpm	Volume (cu.ft.)	Volume (gal)
10	138	275	[redacted]		91.91	687.50

MINIMUM VOLUME GIVEN CYCLE TIME IN MINUTES

t = 4V/Qout

Cycle Time t, min.	Qpump	Flow Units	Conversion to gpm	Volume cu. ft.	Volume (gal)
10	275	[redacted]		91.91	687.50

CYCLE TIME GIVEN VOLUME AND FLOW

t = V/Qpump-Qin + V/Qin

Volume (cu.ft.)	Qin	Qpump	Flow Units	Conversion to gpm	Fill Time	Empty Time	Cycle Time
91.9	137.5	275	[redacted]		5.00	5.00	10.00

LIFT STATION DESIGN
Barge, Waggoner, Sumner and Cannon, Inc.

TABLE OF CYCLE TIME VERSUS INFLUENT FLOW

Volume (cu.ft.)	Qpump	Flow Units	Conversion to gpm
91.9	275	gpm	1.00

Qin	Fill Time	Empty Time	Cycle Time
27.5	25.00	2.78	27.78
55	12.50	3.13	15.63
82.5	8.33	3.57	11.90
110	6.25	4.17	10.42
137.5	5.00	5.00	10.00
165	4.17	6.25	10.42
192.5	3.57	8.33	11.90
220	3.13	12.50	15.63
247.5	2.78	25.00	27.78