BAY CITY

MINUTES • AUGUST 11, 2016

Council Chambers	Special Meeting	5:00 PM

1901 5TH STREET
BAY CITY, TX 77414

1. CALL TO ORDER & CERTIFICATION OF QUUORUM

Attendee Name	Title	Status	Arrived
Mark Bricker	Mayor	Present	
Chrystal Folse	Mayor Pro-Tem	Present	
William Cornman	Councilman	Present	
Julie Estlinbaum	Councilwoman	Late	5:02 PM
Steven Johnson	Councilman	Present	
Carolyn Thames	Councilwoman	Late	5:36 PM

2. REGULAR ITEMS FOR DISCUSSION, CONSIDERATION AND/OR APPROVAL:

1. Report

RECEIVE, DISCUSS, AND CONSIDER A PRESENTATION FROM JONES & CARTER ENGINEERING ON THE DRAFT REPORT OF THE CITY OF BAY CITY SANITARY SEWER SYSTEM ANALYSIS AND MASTER PLAN, AND THE SEWER PLANT TCEQ PERMIT RENEWAL, AND DIRECT STAFF AS NECESSARY.

Barry Calhoun, Director of Public Works & Matt Breazeale, P.E., Jones | Carter Engineering
Mr. Calhoun introduced Matt Breazeale. He added that they would provide an update on the TCEQ permit.

Mr. Breazeale informed Mayor and Council that the last time a Water analysis for the City took place was in 1981. He stated that they had to build off of the 1981 model. There was not a lot of data to work with. It was backfilled with the water meter data and lowered by 15%. Mr. Breazeale stated that they created an itemized task list and worked off of that to be able to create the analysis. He added that there is 108 miles of water lines, with 10% being Force Main and 90% being Gravity. Mr. Breazeale informed Mayor and council that 10% of the City's system had been rehabbed and the other 90% was the original infrastructure.

Mr. Breazeale moved on to provide an overview of the WWTP and its operations. He stated that the best they could tell the plant was built prior to 1967. He stated that it was probably built in the 40s or 50s. Mr. Breazeale went on to add that the latest improvements were in 1991,a dn that the WWTP is rated at 4.3 million gallons.

Mr. Breazeale explained that the CBOD went from a 10 to a 7, and that this was happening all over the State. He added that the hydraulic was not a problem unless there was a rain event. Mr. Breazeale stated that the City has seen the CBOD at a 6, at least three (3) times a year. He pointed out that the concern was where the number would increase to as the flow increased. Councilman Johnson asked if the influx of flow from the plant caused it to increase to 12. Mr. Breazeale stated that his concern was that it could increase above what is allowed. Councilman Johnson asked what would happen, and Mr. Breazeale stated that the City would be in violation of its permit and TCEQ could fine and/or assess a fine. Mr. Breazeale pointed out that the important issue was the aeration basin. Where the City is today is at 3.35 million gallons a day, he did not think it is a 4.3 million gallon plant. The increase in rain water increases the amount of the influx.

Mr. Breazeale provided Council with a Flow Diagram. He went on to state that the above ground items do not concern him as much, but it was the below ground and electrical that concerned him. The City has 27 lift stations, the oldest being built in 1957 and the newest, not considering the Tenaris lift station, was built in 1991. Mr. Breazeale explained that they completed a scoring system on the lift stations and the average score 17 out of 35. Three (3) of the lift stations were up to or close to capacity.

Mr. Breazeale explained the two options for the WWTP. Option was would be to rehab the current plant and make the modifications at a cost of $4.5 million. Option 2 would be to build a plant at a cost of $10 million.

There were discussions between Mayor, Council, Mr. Breazeale and Mr. Calhoun regarding the options. It was the consensus of Council to begin on the engineering and proceed with requesting an extension from TCEQ.

3. ITEMS / COMMENTS & MAYOR AND COUNCIL MEMBERS

4. ADJOURNMENT

AGENDA NOTICES:

Action by Council Authorized:
The City Council may vote and/or act upon any item within this Agenda. The Council reserves the right to retire into executive session concerning any of the items listed on this Agenda, pursuant to and in accordance with Texas Government Code Section 551.071, to seek the advice of its attorney about pending or contemplated litigation, settlement offer or on a matter in which the duty of the attorney to the governmental body under the Texas Disciplinary Rules of Professional Conduct of the State Bar of Texas conflict with the Open Meetings Act and may invoke this right where the City Attorney, the Mayor or a majority of the Governing Body deems an executive session is necessary to allow privileged consultation between the City Attorney and the governing body, if considered necessary and legally justified under the Open Meetings Act. The City Attorney may appear in person, or appear in executive session by conference call in accordance with applicable state law.

Attendance By Other Elected or Appointed Officials:
It is anticipated that members of other city board, commissions and/or committees may attend the meeting in numbers that may constitute a quorum of the other city boards, commissions and/or committees. Notice is hereby given that the meeting, to the extent required by law, is also noticed as a meeting of the other boards, commissions and/or committees of the City, whose members may be Agenda City Council August 8, 2013 in attendance. The members of the boards, commissions and/or committees may participate in discussions on the same items listed on the agenda, which occur at the meeting, but no action will be taken by such in attendance unless such item and action is specifically provided for on an agenda for that board, commission or committee subject to the Texas Open Meetings Act.

Executive Sessions Authorized:
This agenda has been reviewed and approved by the City's legal counsel and the presence of any subject in any Executive Session portion of the agenda constitutes a written interpretation of Texas Government Code Chapter 551 by legal counsel for the governmental body and constitutes an opinion by the attorney that the items discussed therein may be legally discussed in the closed portion of the meeting considering available opinions of a court of record and opinions of the Texas Attorney General

known to the attorney. This provision has been added to this agenda with the intent to meet all elements necessary to satisfy Texas Government Code Chapter 551.144(c) and the meeting is conducted by all participants in reliance on this opinion.

This is to certify that the above notice of a Workshop Meeting was posted on the front window of the City Hall of the City of Bay City, Texas on Thursday, August 4, 2016 before 5:00 p.m. Any questions concerning the above items, please contact Mayor Mark A. Bricker at (979) 245-2137.

____

Rhonda Clegg
City Secretary

City Council
1901 5Th Street
Bay City, TX 77414

SCHEDULED

Meeting: 08/11/16 05:00 PM
Department: Public Works
Category: Report
Prepared By: Barry Calhoun
Initiator: Barry Calhoun
Sponsors:
DOC ID: 2381

DISCUSSION ITEM (ID # 2381)

RECEIVE, DISCUSS, AND CONSIDER A PRESENTATION FROM JONES & CARTER ENGINEERING ON THE DRAFT REPORT OF THE CITY OF BAY CITY SANITARY SEWER SYSTEM ANALYSIS AND MASTER PLAN, AND THE SEWER PLANT TCEQ PERMIT RENEWAL, AND DIRECT STAFF AS NECESSARY.

The City of Bay City authorized Jones | Carter Engineering to perform a sewer model for the City's entire sanitary sewer system and perform the necessary tasks to renew our TCEQ permit for the City's wastewater treatment plant. The purpose of the Sanitary Sewer System Analysis and Master Plan is to provide an assessment and evaluation of the City of Bay City’s entire wastewater system and detail a Master Plan for the City’s use. The Sanitary Sewer System Analysis evaluates the City’s current wastewater collection and treatment system, identifies critical areas for improvements, and assesses potential areas of growth and the necessary improvements to serve these areas. The Master Plan will help City staff plan for capital projects necessary to meet growing wastewater collection and treatment needs and expansion of the City system's infrastructure. This Sanitary Sewer System Analysis and Master Plan will also analyze the City's compliance with TCEQ Rules and Regulations for Domestic Wastewater Systems. This report is in draft format for the purpose of presenting to City Council for their review and comments.

2016 SANITARY SEWER SYSTEM ANALYSIS & MASTER PLAN

FOR

THE CITY OF BAY CITY

MATAGORDA COUNTY, TEXAS

INTERIM REVIEW

Not intended for construction, bidding or permit purposes.

Engineer: KYLE H. KASPAR, P.E.

P.E. Serial No.: 114352

Date: AUGUST 2016

AUGUST 2016

JC Job No. R0017-0037-00

JONES | CARTER

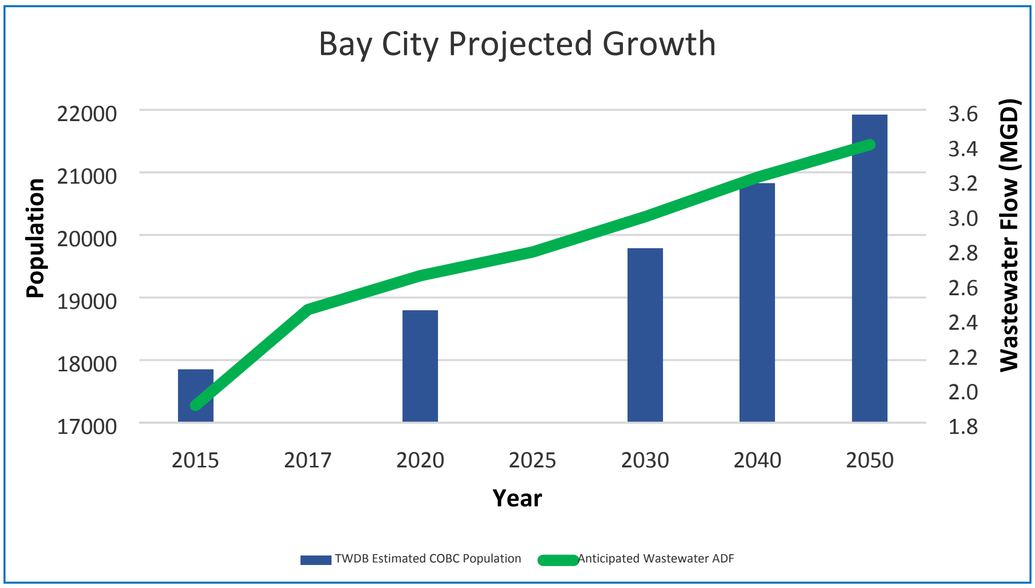
Texas Board of Professional Engineers Registration No. F-439

6330 West Loop South, Suite 150 • Bellaire, TX 77401 • 713.777.5337

EXECUTIVE SUMMARY

This City of Bay City 2016 Sanitary Sewer System Analysis and Master Plan evaluates the current 2016 wastewater system, the projected 2017 through 2050 wastewater system, proposed Capital Projects, and includes recommendations for the City of Bay City wastewater system.

The City of Bay City (the City) encompasses approximately 8.5 square miles and is expected to increase in population from 17,614 (based on the 2010 census) to approximately 21,923 by 2050. The anticipated daily wastewater contribution or Average Daily Flow (ADF) is expected to increase from approximately 1.9 million gallons per day (MGD) in 2015 to approximately 2.5 MGD in 2017, a 30% increase in system flow. This near term increase is largely from non-residential flow contributions, specifically the addition of the Tenaris Steel Manufacturing Facility and the Dunn Heat Exchangers Manufacturing Facility. The anticipated wastewater flow is expected to continue to increase by 5% to 10% every year through 2050 based on other known developments and the anticipated population growth to an ultimate ADF of 3.4 MGD as shown in the figure below.



The City has one existing Wastewater Treatment Plant (WWTP) located at 4511 Starling Drive, Bay City, Texas. The WWTP was constructed prior to 1967 and the site is permitted to discharge 4.3 MGD per TPDES Permit No. WQ0010123004. The effluent limits in the renewed permit issued on September 25, 2015 have changed from 10 mg/l CBOD, 15 mg/l TSS, 3 mg/l NH3-N, and 126 cfu/100 ml *E. coli* at the beginning of the permit to 7 mg/l CBOD, 15 mg/l TSS, 2 mg/l NH3-N, and 126 cfu/100 ml *E. coli*. The City is required to comply with the revised permit limit within 3 years from the date the permit was issued. These lower limits required by this renewed permit will be more difficult to achieve as the WWTP begins to receive increasing amounts of wastewater flow throughout the coming years.

The City's existing sanitary sewer collection and treatment system does not comply with Texas Commission on Environmental Quality (TCEQ) TAC 30 §217 minimum requirements. There are significant deficiencies with the ability of the system to store, convey, and treat wastewater during wet weather and power outage events. Based on the data collected, the City has significant inflow and infiltration issues.

Additionally, there are considerable accessibility, safety, and security concerns with many of the City's facilities.

In order to meet the expected growth in ADF in the coming years, the City will have to engage in an extensive infrastructure design and construction program to improve the existing system and expand the system to accommodate future flows. See Exhibit A for the Existing Sanitary Sewer System Layout and Exhibits D and E for the Future Development and Proposed Improvements. To meet these needs, we recommend the Capital Projects (CPs) detailed in *Section 4.1* of this report be completed by the City as soon as fiscally feasible.

Capital Project Nos. 1-3 are critical projects and are needed to ensure the City can provide adequate wastewater to developing areas or remedy deficient areas in the system. These projects total approximately $10M. We recommend the City proceed with CPs 1-3 as soon as fiscally possible.

Capital Project Nos. 5a-11a are gravity sewer extensions that could result in the ability to abandon or demolish a total of seven out of the City's twenty-seven lift stations. These projects require additional investigation (on the ground survey) to ensure they are all feasible. If even a few of the projects are feasible and the City can discontinue operation of these lift stations, it will result in significant long-term savings of Operations and Maintenance Costs.

The 30 Capital Projects listed in this Report total just over $28M in permitting, engineering, and construction costs. These are the top 30 Capital Projects identified as needed before 2020. Additional projects will be necessary and can be identified as these are completed. As these projects and City wide development progresses, the Master Plan needs to be re-evaluated to determine additional Capital Projects to aid the City in better serving their wastewater system users.

In addition to the CPs identified, we recommend the City complete Operations and Maintenance (O&M) projects detailed in *Section 4.2* as soon as fiscally feasible. O&Ms 1-4 are necessary to address current deficiencies caused by aging infrastructure. These four projects total $3.3M. We recommend the City proceed with O&Ms 1-4 as soon as fiscally possible.

The remaining O&M projects listed are recommended to ensure the City can continue to operate and maintain a functioning wastewater system. The sum of the 7 O&M Projects listed in this Report totals over $70M. These are the top O&M Projects identified as needed before 2020. As these projects and City wide development progresses, the Master Plan needs to be re-evaluated and updated to determine additional O&M Projects to aid the City in better serving their wastewater system users. Other maintenance costs not listed as projects but which still need to be budgeted for are: collection system repairs, facility and infrastructure inspections, lift station and wastewater treatment plant consumables, electrical, motor and pump repairs or replacements, service line extensions, meter replacement, and other annual recurring items.

Based on the projects listed, the City needs to invest a minimum of $30M over the next five to ten years to bring the system into compliance with TCEQ minimum requirements. Additionally, the City should budget for a total of $100M prior to 2050. We recommend the City seek any and all funding mechanisms available to them to plan for the projects laid out in this report and all other future projects.

TABLE OF CONTENTS

LIST OF EXHIBITS

LIST OF ATTACHMENTS

1.0 INTRODUCTION

1.1 Purpose

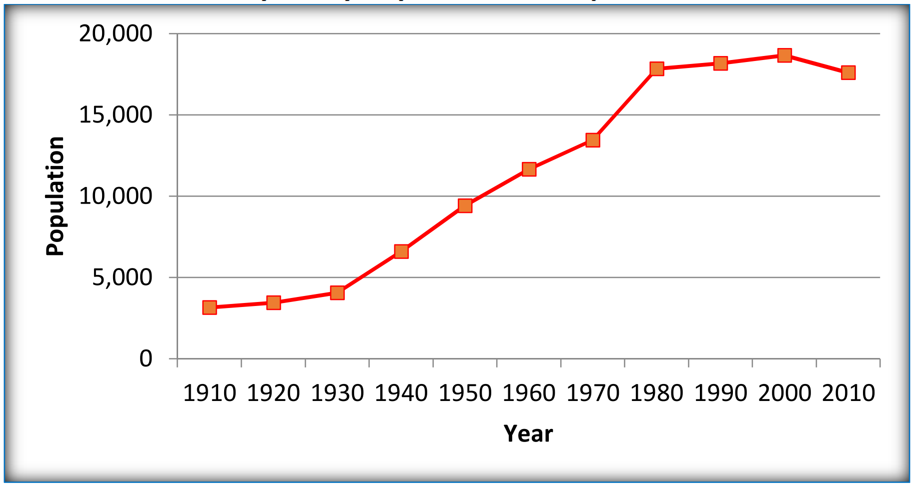
The purpose of this 2016 Sanitary Sewer System Analysis and Master Plan is to provide an assessment and evaluation of the City of Bay City's wastewater system and detail a Master Plan for the City's use. The Sanitary Sewer System Analysis evaluates the City's current wastewater collection and treatment system, identifies critical areas for improvements, and assesses potential areas of growth and the necessary improvements to serve these areas. The Master Plan will help city staff plan for capital projects necessary to meet growing wastewater collection and treatment needs and expansion of the City system's infrastructure. This Sanitary Sewer System Analysis and Master Plan also analyzes the City's compliance with 30 TAC §217 Texas Commission on Environmental Quality's (TCEQ) Design Criteria for Domestic Wastewater Systems.

1.2 Background Information

Jones|Carter (JC) was authorized by the City of Bay City (the City) to perform a Sanitary Sewer System Analysis and develop a Sanitary Sewer System Master Plan for the City in 2016. JC serves as the City's Primary Consulting Engineer and collected records of the City's existing system to generate this analysis and report.

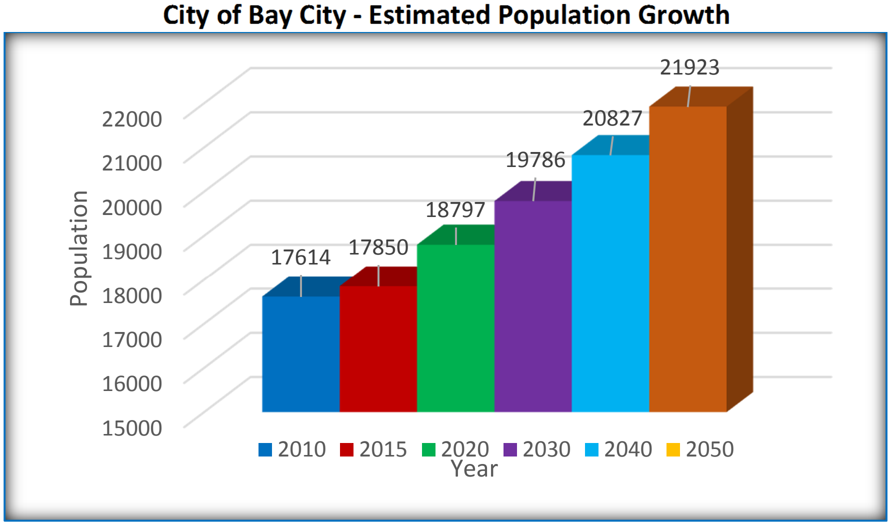
The City of Bay City was established in 1894 when it was dedicated as the County Seat for Matagorda County. In 1904 the City was incorporated and in 1914 the City's Municipal Waterworks Department was founded. Throughout the early 1900's the City served as a central point for three (3) railroads and saw consistent growth. From the 1930's to the 1960's, the City became an agricultural and manufacturing hub for Matagorda County. In the 1960's an airport and a canal connecting the City to the Intercostal Waterway were completed which led to continued growth in manufacturing and industrial facilities throughout the 1960's to 1970's. With the completion of the South Texas Nuclear Project in 1976 and the Celanese and Occidental Chemical Company's facilities nearby, the City continued to see growth into the 1980's. Beginning in the late 1980's through the 2000's, population growth began to stagnate and with the Census of 2010, the City actually saw a drop in total population. Figure No. 1 presents the historical population of the City over the last 100 years based on information provided by the United States Census Bureau.

Figure No. 1
City of Bay City – Historical Population



As described in the City's Comprehensive Plan, *Vision 2040*, based on information provided by the Texas Water Development Board (TWBD), the population of the City is expected to grow at a rate of 1% per year through 2020 and 0.5% per year thereafter. As shown in Figure No. 2, the City is expected to have a total estimated population of 21,923 by 2050.

Figure No. 2
City of Bay City - Estimated Population Growth



The City's 2015 sanitary sewer flow information was collected from City staff. The City has a maximum 30-day Average Daily Flow (ADF) of 2.47 Million Gallons per Day (MGD) at the WWTP. As of January 2016, the City serves 10,057 active water and sewer connections per 30 TAC §290.38(16) (see *Section 2.4* for the details and definitions of connections and detailed analysis of the current flow conditions). This equates to a unit flow rate of 245 gallons per day (gpd) per connection, which is slightly lower than the TCEQ 30 TAC §217 required design value of 300 gpd per connection.

The City's Comprehensive Plan, *Vision 2040*, completed in 2014, detailed numerous different approaches to City planning necessary to guide decisions for maintaining and developing infrastructure to serve the citizens of Bay City. One recommendation of this Comprehensive Plan was to develop and implement a Sanitary Sewer System Master Plan. Additionally, recent large developments such as the Tenaris Steel Manufacturing Facility and the Dunn Heat Exchangers Manufacturing Facility, which have higher wastewater flows compared to residential connections, have prompted the need for additional planning of the City's sanitary sewer system.

The TCEQ revised the City's WWTP effluent limits in their most recent permit renewal, dated September 2015. These new limits require a reduction of effluent criteria from 10 mg/l CBOD, 15 mg/l TSS, 3 mg/l NH3-N, and 126 cfu/100 ml *E. coli* to 7 mg/l CBOD, 15 mg/l TSS, 2 mg/l NH3-N, and 126 cfu/100 ml *E. coli*. The City is required to comply with these reduced limits within 3 years of the permit date.

1.3 Evaluation Criteria

One purpose of this Sanitary Sewer System Analysis and Master Plan is to analyze the City's compliance with 30 TAC §217 TCEQ's Design Criteria for Domestic Wastewater Systems. Based on the TCEQ's regulations, the system was analyzed for three conditions: wastewater flow during average dry weather flow, dry weather peak flow, and peak flow with inflow and infiltration.

Inflow consists of storm water that enters sanitary sewer systems at points of direct connection to the system. This usually includes items such as roof drain connections, driveway drains, illegal or poorly constructed taps, and faulty manhole rims and lift station lids. Infiltration consists of groundwater that enters sanitary sewer systems through cracks or leaks in the sanitary sewer pipes. Collectively, inflow and infiltration are commonly known as I & I.

In order to assess the TCEQ requirements, JC analyzed items such as collection area flows, velocity in the pipes, lift station storage volume, pump capacity, pump run times, pump cycles, and general system efficiency.

The normal means of data collection and preliminary evaluation for a system of this size is the Lift Station Pump Run Times. The information available for Lift Station Run Times was collected from the City's Operations Staff and is presented in *Section 2.4*. Lift Station Pump Run Times provide a starting point for determining how much flow is being conveyed in the system. Each area that a Lift Station collects is presented as a Gravity Service Area (GSA) and the defined GSA's for this system are detailed in *Section 2.2*.

The lift station run time data provided by City staff has significant gaps in the recordings varying from a few days to over a month due to faulty equipment and limited manpower. This was identified during the process of creation of this report and it has been requested of City Staff to attempt to collect more regular data. For this report, water meter billing data was primarily used in distributing and analyzing flows across the system in lieu of these lift station pump run times. See *Section 2.4* for more details.

More detailed evaluation of the entire wastewater collection and treatment system could be provided if more specific data was collected. Examples of more detailed data collection include daily or hourly pump reads, SCADA run-time data collection and organization for all of the lift stations, installing flow monitors, and meters. Additionally, projects such as performing cleaning and televising of the existing gravity sanitary sewers and force mains can aid in confirming line size, grade, orientation and condition for proper assessment of velocity and flow conditions.

1.4 Master Plan Criteria

This Sanitary Sewer System Master Plan was prepared to provide guidance on how best to meet the projected growth while maintaining adequate system capacity within the range of minimum and maximum velocities in the sanitary sewers, for multiple phases of development within the City.

The City has already planned several Capital Projects (CPs). This master plan includes a unified analysis of the existing wastewater system, the previously planned CPs, additional CPs identified during this analysis, and their ability to supply the proposed development in order to evaluate each CP's effectiveness. Each CP is detailed in Se*ction 3.2* and they are presented by number in order of relative importance. The order of the CPs can be modified as necessary based on outside factors such as property or easement acquisition, access to appropriate funding, or bidding projects together to ensure competitive prices, any of which may alter the delivery schedule. The proposed implementation order was determined based on each project's ability to improve the existing system's capacity, increase redundancy within the system, increase efficiency in the system, and provide the capacity for future development. Additional parameters included safety concerns, inadequate pumping capacity, and compliance with TCEQ §217 rules and regulations. Table No. 10 outlines each CPs purpose and cost.

2.0 EXISTING WASTEWATER SYSTEM

2.1 System Overview

The City of Bay City's Municipal Waterworks was founded in 1914 and the details of the City's wastewater collection system are incomplete. Some sections of the system are known to be between 50-years and 100-years old. Schematics of the City's wastewater collection infrastructure from the 1940s through the early 2000's were used as the basis of the Sanitary Sewer System Model.

The existing sanitary sewer system consists of twenty-seven Public lift stations, one wastewater treatment plant, approximately 570,000 linear feet (LF) of sanitary sewer pipe (gravity sewer and force mains), and over 1,500 manholes. The Wastewater Treatment Plant (WWTP) is located in the southeast area of the City and is accessible from Avenue F at Palm Village Boulevard. See *Section 2.3* for more details regarding the wastewater facilities. The City's existing wastewater system is shown in Exhibit A.

The system conveys and treats an annual average daily flow (ADF) of approximately 1.9 million gallons per day (MGD) based on 16-months of influent data collected at the WWTP from January 2015 through April 2016. The wastewater facilities are currently able to collect and treat dry weather, average daily flow for all users with minimal issues. Most of the collection system and various lift stations pump to Lift Station No. 14 (Cottonwood) in the center of the system, which is then re-pumped to Lift Station No. 1 on the WWTP site. Additionally, several lift stations serve only one or two small developments and run for an hour or less a day. Several other lift stations and gravity service areas were identified to have significant I&I problems. The lift stations are presented in detail in *Section 2.3*.

2.2 Existing Collection System

The collection system is comprised of sanitary sewer lines of varying ages, diameters, and materials. The unplanned development of areas of the City over the years has limited the efficiency of the wastewater system. The current network of over 514,000 LF (97.5 miles) of gravity sewer also has many pipes under or immediately adjacent to pavement. Table No. 1 shows the existing collection system inventory of the system by pipe size. Additional facilities may exist which were not shown in the records collected.

Table No. 1
Existing Collection System Pipe Inventory

Size & Type	Length (ft)(1)
6-inch (or less) Gravity Sanitary Sewer	160,000
8-inch Gravity Sanitary Sewer	180,000
10-inch Gravity Sanitary Sewer	62,000
12-inch Gravity Sanitary Sewer	68,000
15-Inch Gravity Sanitary Sewer	9,000
18-Inch Gravity Sanitary Sewer	11,000
21-Inch Gravity Sanitary Sewer	2,000
24-Inch Gravity Sanitary Sewer	11,000
27-Inch Gravity Sanitary Sewer	5,000
30-Inch Gravity Sanitary Sewer	2,000
36-Inch Gravity Sanitary Sewer	3,000
42 to 48-inch Gravity Sanitary Sewer	1,000
Total Gravity Sewer	**514,000**
4-Inch (or less) Force Main	4,000
6-Inch Force Main	12,000
8-inch Force Main	15,000
10 to 12-inch Force Main	9,000
16-inch Force Main	9,000
24-inch Force Main	7,000
Total Force Main	**56,000**
GRAND TOTAL SANITARY SEWER PIPE =	**570,000**

Note: (1) All values rounded to the nearest thousand.

Based on conversations with City staff, the main collection lines in the City's system have high levels of corrosion, and significant I&I issues. The City's largest collection lines (42-inch (42"), 36-inch (36"), and 30-inch (30") gravity sanitary sewers) along Sycamore Street to the WWTP were built in 1966. It is our understanding that these gravity lines have not been rehabilitated in recent history, and based on conversations with the City, portions of these lines are failing. The 15-inch (15") to 27-inch (27") gravity line along Moore Avenue and Lloyd Avenue, the major collection line for the Cottonwood regional lift station, was built in 1960. Portions of the 15-inch (15") to 27-inch (27") gravity line along Moore Avenue were rehabilitated in 2011. The service areas in the northern portion of the City also have I&I problems.

The lift stations for these service areas often reach their high level alarms, especially during rain events. The 24-inch (24") gravity line along Hedge Rose Lane and Areca Drive to the WWTP was built in 1950. According to drawings, this sewer was rehabilitated in 1994. Various rehabilitation projects on smaller lines (6-inch through 12-inch gravity sewers) were completed throughout the 1990s and 2000s. These rehabilitation projects focused primarily on the northwest areas of the City. Based on research of drawings and records, approximately 10% of the City's existing collection system has been rehabilitated in the last 20 years.

In order to accurately assess the system, JC split the collection system into twenty-nine (29) Gravity Service Areas (GSAs), based on gravity mains and major lift station service areas. Exhibit B – Lift Station Flow Diagram presents a schematic of how flow from each GSA is collected and sent to the WWTP. Exhibit C – Gravity Service Areas presents an overall map of these GSAs. See *Section 2.3* for details regarding the lift stations and the WWTP detailed in the following GSA breakdowns.

Gravity Service Area 1 North (GSA 1N) is located along Sycamore Avenue from the WWTP to the railroad track, and Sparks Road from Sycamore Avenue to Krumholz Road. GSA 1N encompasses approximately 340 acres and serves mostly single family residential areas and a few commercial developments. GSA 1N is collected by a 42-inch (42") gravity sewer along Sycamore Street that flows north to south into LS 1 at the WWTP. The service area also receives flow from LSs 4, 17, 27, and 15.

Gravity Service Area 1 Central (GSA 1C) is located around SH 60 and Palm Village Boulevard and extends from the Meadow Chase Apartments to the Nile Valley Canal, and SH 60 to the WWTP. GSA 1C encompasses approximately 420 acres west of the WWTP and serves a mix of single family residential, apartments, and some commercial tracts along SH 60. GSA 1C is collected by a 24-inch (24") gravity sewer within side lot easements, Areca Drive, and back lot easements that flow west to east into LS 1 at the WWTP. The service area also receives flow from LSs 12 and 13.

Gravity Service Area 2 (GSA 2) is located along 12th Street, from Avenue F to Highland Drive, extends north to Ross Street and south to 8th Street. GSA 2 encompasses approximately 340 acres and serves a mix of single family residential, commercial, the Bay City Junior High School, Middle School, and Elementary School. The service area is collected by 10-inch (10") and 12-inch (12") gravity sewer along 12th Street, and 18-inch (18") gravity sewer along Avenue I that flows east to west and north to south into LS 2. The service area also receives flow from LSs 5 and 16.

Gravity Service Area 3 (GSA 3) is located along Doris Street, from Short Street to Longhorn Avenue, and along Old Van Vleck Road from Rice Avenue to SH 35. GSA 3 encompasses approximately 110 acres and serves primarily single family residential and the First Christian Church. The area is collected by 12-inch (12") gravity sewer along Doris Street that flows from multiple directions into LS 3. No other LSs pump into GSA 3.

Gravity Service Area 4 (GSA 4) is located along Buck's Bayou Drive, from the Dry Creek crossing to Glen Haven Drive. GSA 4 encompasses approximately 50 acres and serves primarily single family residential. The service area is collected by 10-inch (10") gravity sewer along Holly Glen Drive that flows from southeast to northwest into LS 4. The service area also receives flow from LS 9.

Gravity Service Area 5 (GSA 5) is located along Ross Street from Avenue J to Cottonwood Creek and Cedarvale Road from Golden Avenue to Cottonwood Creek. GSA 5 encompasses approximately 290 acres and serves a mix of single family residential and commercial. The service area is collected by 10-inch (10") gravity sewer along Cedarvale Road and 12-inch gravity sewer along Live Oak Drive that flows north to south and east to west into LS 5. The service area also receives flow from LS 20.

Gravity Service Area 6 (GSA 6) is located along SH 60 from Adams Road to Pine Knoll Road, and extends west to Avenue I. GSA 6 encompasses approximately 150 acres and serves mostly commercial and some industrial. The service area is collected by 10-inch (10") gravity sewer along SH 60 that flows north to south into LS 6. The service area also receives flow from LS 7.

Gravity Service Area 7 (GSA 7) is located along SH 60 from Pine Knoll Road to South Industrial Road. GSA 7 encompasses approximately 110 acres and serves primarily commercial and industrial. The service area is collected by 8-inch (8") gravity sewer that flows north to south into LS 7. The area also receives flow from LS 22.

Gravity Service Area 8 (GSA 8) is located along Tepeyac Avenue and Old River Road. GSA 8 encompasses approximately 60 acres and serves primarily single family residential. The service area is collected by 8-inch (8") gravity sewer that flows southwest to northeast into LS 8. No other LSs pump into GSA 8.

Gravity Service Area 9 (GSA 9) is located along Glen Haven Drive and Glen Meadow Drive. GSA 9 encompasses approximately 30 acres and serves primarily single family residential. The service area is collected by 8-inch (8") gravity sewer along Glen Haven Drive that flows north to south, and by 10-inch (10") gravity service area along Bucks Bayou Road that flows east to west into LS 9. No other LSs pump into GSA 9.

Gravity Service Area 10 (GSA 10) is located along Hamman Road and extends south to Bordeaux Drive. GSA 10 encompasses approximately 120 acres and serves primarily single family residential. The service area is collected by 12-inch (12") gravity sewer along Hamman Road that flows west to east, and 10-inch (10") gravity sewer along Hamman Road that flows east to west into LS 10. No other LSs pump into GSA 10.

Gravity Service Area 11 (GSA 11) is located south of SH 60 and Spruce Street. GSA 11 encompasses approximately 5 acres and serves a few single family residences along Spruce Street. The service area is collected by an 8-inch (8") gravity sewer along Spruce Street that flows east to west into LS 11. No other LSs pump into GSA 11.

Gravity Service Area 12 (GSA 12) is located along Thompson Drive and Stingray Drive. GSA 12 encompasses approximately 140 acres and serves primarily single family residential. The service area is collected by 12-inch (12") gravity sewer along Thompson Drive that flows west to east, and 10-inch (10") gravity sewer along Stingray Drive that flows south to north into LS 12. No other LSs pump into GSA 12.

Gravity Service Area 13 (GSA 13) is located along SH 60 and Bay Ridge Blvd. GSA 13 encompasses approximately 60 acres and serves primarily single family residential. The service area is collected by a 10-inch (10") gravity sewer along Bay Ridge Blvd that flows west to east, and SH 60 that flows south to north into LS 13. The service area also receives flow from LS 11.

Gravity Service Area 14 West (GSA 14W) is located on the western edge of the central part of town, along Moore Road and within easements from 2nd Street to Brasfield Avenue. GSA 14W encompasses approximately 600 acres and serves a mix of single family residential and commercial including the Legacy Retirement Community and the Linnie Roberts Elementary School. The service area is collected by a 27-inch (27") gravity sewer along Whitson Street that flows west to east into LS 14. The service area also receives flow from LSs 6, 8, 18, 24, 25, and 26.

Gravity Service Area 14 Central (GSA 14C) is located along Avenue F from Austin Street to Golden Avenue, and along 3rd Street from Avenue B to Nichols Avenue. GSA 14C encompasses approximately 1,060 acres and serves a mix of single family residential, commercial and industrial including Matagorda County Court House, Tenie Homes Elementary School, H-E-B, and the county jail. The service area is collected by a 15-inch (15") gravity sewer along Avenue H that flows north to south, and an 18-inch (18") gravity sewer that flows northeast to southwest across Cottonwood Creek into LS 14. The service area also receives from LS 19.

Gravity Service Area 15 (GSA 15) is located along 7th Street from Nichols Avenue to Norvell Avenue and along Clover Avenue, Svletlik Avenue, and Andrea Drive. GSA 15 encompasses approximately 240 acres and serves a mix of commercial and single family residential. The service area is collected by a 15-inch (15") gravity sewer along back lot easements between 5th Street and 6th Street that flows east to west into LS 15. No other LSs pump to GSA 15.

Gravity Service Area 16 (GSA 16) is located along El Camino Street from El Centro Street to La Vista Avenue. GSA 16 encompasses approximately 30 acres and serves single family residential. The service area is collected by a 10-inch (10") gravity sewer along El Camino Street that flows west to east into LS 16. No other LSs pump to GSA 16.

Gravity Service Area 17 (GSA 17) is located east along SH 35 from Old Van Vleck Road to the Walmart. GSA 17 encompasses approximately 70 acres and serves primarily commercial, including Walmart. The service area is collected by a 12-inch (12") gravity sewer along SH 35 that flows northeast to southwest into LS 17. The service area also receives flow from LSs 3 and 21.

Gravity Service Area 18 (GSA 18) is located along SH 35 at Nile Valley Road. GSA 18 encompasses approximately 10 acres and serves a mobile home park. The service area is collected by 8-inch (8") gravity sewer that flows west to east into LS 18. No other LSs pump to GSA 18.

Gravity Service Area 19 (GSA 19) is located along Cottonwood Creek between Lee Street and Cottonwood Avenue. GSA 19 serves the home located at 2720 Cottonwood Avenue and encompasses approximately 1 acre. No other LSs pump to GSA 19.

Gravity Service Area 20 (GSA 20) is located along Pine Knoll Road and Lindsey Avenue. GSA 20 encompasses approximately 40 acres and serves single family residential. The service area is collected by a 12-inch (12") gravity sewer along Pine Knoll Road that flows west to east into LS 20. The service area also receives from LS 23.

Gravity Service Area 21 (GSA 21) is located along SH 35 from the Walmart to McCrosky Road, and along Bayou Drive and North Drive. GSA 21 encompasses approximately 270 acres and serves primarily commercial with some single family residential. The service area is collected by a 10-inch (10") gravity sewer along SH 35 that flows west to east, and a 10-inch (10") gravity sewer along SH 35 that flows from east to west, both into LS 21. The service area also receives flow from LS 27.

Gravity Service Area 22 (GSA 22) is located north along FM 3156. GSA 22 encompasses approximately 5 acres and serves the homes and businesses along FM 3156. No other LSs pump to GSA 22.

Gravity Service Area 23 (GSA 23) is located north along Eagles Road. GSA 23 encompasses 3 acres and serves the Eagles Dance Hall, located along Eagles Road. No other LSs pump to GSA 23.

Gravity Service Area 24 (GSA 24) is located along 12th Street on the west side of town. GSA 24 encompasses approximately 1 acre and serves the Hardeman Park located along 12th Street, adjacent to the Legacy Retirement Home. No other LSs pump to GSA 24.

Gravity Service Area 25 (GSA 25) is located along 2nd Street Spur at 2nd Street. GSA 25 encompasses approximately 50 acres and serves the existing home and future homes along 2nd Street south of Bay City High School. The service area is collected by an 8-inch (8") gravity sewer along 2nd Street that flows east to west into LS 25. No other LSs pump to GSA 25.

Gravity Service Area 26 (GSA 26) is located at the Bay City High School. GSA 26 encompasses approximately 80 acres and serves Bay City High School. The service area is collected by a 12-inch (12") gravity sewer that flows west to east into LS 26. No other LSs pump to GSA 26.

Gravity Service Area 27 (GSA 27) is located along SH 35, east of McCrosky Road. GSA 27 is currently undefined, but could potentially encompass over 200 acres. GSA 27 will serve the Tenaris steel manufacturing plant and future development along SH 35. Currently no gravity lines extend along this service area, a single 10-inch force main is extended into LS 27 from the Tenaris plant.

2.3 Existing Wastewater Facilities

The current wastewater facilities consist of twenty-seven public lift stations, four private lift stations, and one WWTP. For the purposes of this report, only the public facilities were assessed and are presented in the report. Attached Exhibit B - Lift Station Flow Diagram presents a flow diagram of the system's collection areas and the sequence of lift station flows.

2.3.1 Existing Wastewater Treatment Plant

The WWTP is located at 4511 Starling Drive, east of SH 60 and Palm Village Boulevard. The existing WWTP treats by way of a conventional activated sludge process and includes a wet pit/dry pit lift station, equalization basin, fine screen, fine bubble aeration basins, hydraulic suction clarifiers, chlorine contact basin with chlorine and sulfur dioxide gas feed systems, aerobic digesters, and gravity dewatering in either drying beds or filter boxes. The WWTP is permitted for 4.3 MGD average daily flow (ADF) and 17.20 MGD 2-Hour Peak Flow per TPDES Permit No. WQ0010123004. *Attachment A* is a copy of the WWTP Permit. JC performed a visual inspection of this WWTP and all of the lift stations as part of this Master Plan. *Attachment B* presents a few photos from each facility.

The date of the construction of the original WWTP could not be found. The earliest construction drawings are dated 1967. Facilities that are currently in use that pre-date 1967 include the lift station and aerobic digesters. Later improvements that JC was able to document include:

- 1967 – Aeration Basin No. 1 and influent junction box (re-purposed from original screen / grit removal tank.
- 1981 – Sludge Dewatering Facilities
- 1982 – Retention Pond
- 1988 – WWTP LS Improvements, Equalization basin
- 1991 – Headworks, final clarifiers, aerobic digesters (re-purposed from original main process unit), chlorine contact basin, chemical feed building, influent junction box (re-purposed headworks)
- 1995 – Control Building
- 1996 – Maintenance Building
- 2014 – Mechanical screen, high efficiency blower, fine bubble diffusers and dewatering equipment.

The effluent limits in the renewed permit issued on September 25, 2015 have changed from 10 mg/l CBOD, 15 mg/l TSS, 3 mg/l NH3-N, and 126 cfu/100 ml *E. coli* at the beginning of the permit to 7 mg/l CBOD, 15 mg/l TSS, 2 mg/l NH3-N, and 126 cfu/100 ml *E. coli*. The City is required to begin meeting these revised effluent limits within 3 years from the date the permit is issued. Table No. 2 presents the influent characteristics for data available at the WWTP. The WWTP is designed on the premise of reducing the influent characteristics to meet the desired effluent characteristics. The data provided and used in this analysis is based on random sampling. The City should collect flow-weighted influent samples for BOD, TSS, ammonia, and phosphorus once per week for a year to aid in quantifying the basis of design for future process modifications.

Table No. 2: Influent Characteristics

	Permitted		Design Influent Characteristics(1)		
Current Flow (MGD)	Average Flow (MGD)	Peak Flow (MGD)	BOD (mg/L)	TSS (mg/L)	NH_3-N (mg/L)
1.9 ADF	4.30	17.20	287	287	50

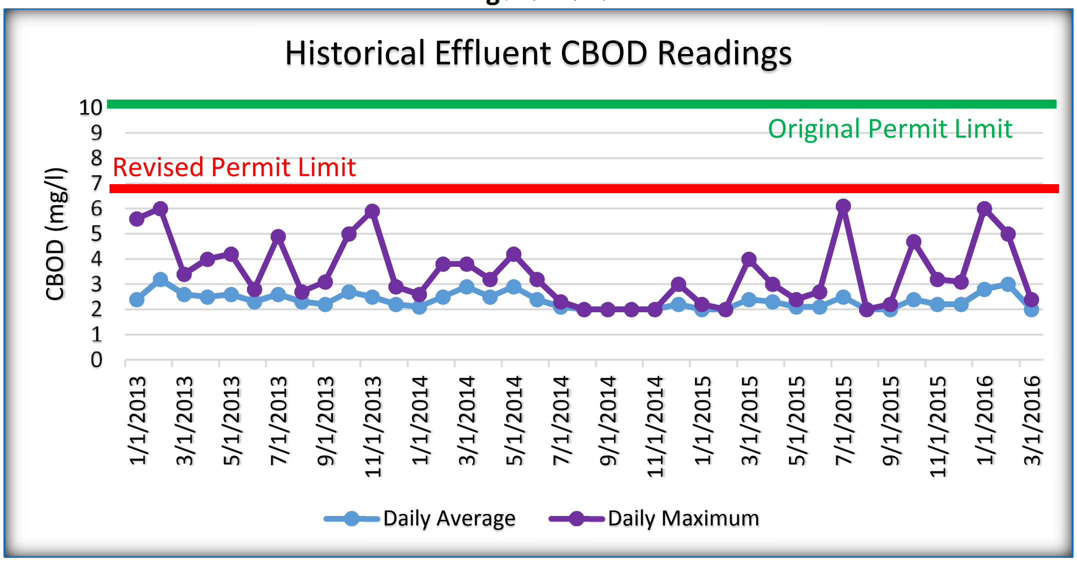
Notes:

(1) The BOD and TSS values used for analyzing the existing WWTP are based on the maximum value recorded from 2015.

(2) The NH3-N (ammonia) values of 50 mg/l is assumed since data has not been collected for this parameter.

Figure No. 3 is a graph of the City's historical effluent data. Over the last 3 years, the WWTP has been near, at, or over 6 mg/l with CBOD 4 times. These events have taken place when the WWTP has received an ADF of at or less than 2 MGD. Based on the revised permit, the WWTP is supposed to be able to treat more than double this amount (4.3 MGD) and maintain a limit of under 7 mg/l CBOD.

Figure No. 3



Based on the new effluent limits, and the design characteristics presented in Table No. 2, the plant capacity was evaluated. JC determined that the existing volume for the aeration basins, secondary clarifiers, and digesters were insufficient to treat the ADF of 4.3 MGD based on the revised standards. The estimated flow that can be treated with the existing tankage and the required additional volume to treat the permitted flow are presented in Table No. 3.

Table No. 3: Available and Required Treatment Capacities for Proposed Effluent Limits

Treatment Unit	Total Existing Basin Volume/Area	Available Treatment Capacity	Required Total Volume/Area to Treat 4.3 MGD
Aeration Basins	210,100 cubic feet	3.35 MGD	269,000 cubic feet
Secondary Clarifiers	14,800 square feet	3.70 MGD	17,000 square feet
Digesters	112,800 cubic feet	2.35 MGD	204,000 cubic feet(1)

(1) Required volume calculated based on 28 day sludge storage per Chapter 217.

As can be seen from Table No. 3, the existing aeration basins, secondary clarifiers, and digesters do not have sufficient volume to treat the permitted flow of 4.3 MGD.

The existing wastewater treatment plant was designed prior to August 2008 under now obsolete rules and regulations. If this plant is modified by a change in capacity, the plant will need to be re-evaluated under the new TAC 30 §217 rules and requirements. The changes between these rules are significant and evaluation of the WWTP may reveal that its capacity needs to be re-rated to a lower total flow value and major improvements or over-expansions may be required to achieve the original design flow rate. In addition, the new aeration requirements in §217 require a minimum dissolved oxygen concentration of 2.0 mg/l throughout the basin at the maximum diurnal organic loading rate with the largest blower out of service. This will require the addition of a second, high capacity blower to match the largest existing blower. The existing digesters were designed and constructed under TAC Chapter 317 rules which only required 15 days of sludge storage. Improvements to the digester will require updating the digester volume to meet TAC 30 §217 rules which requires 28 days of sludge storage.

Currently, the WWTP receives an average annual ADF of 1.9 MGD based on provided 2015 data. As described in *Section 3.1*, future flow to the WWTP is not expected to exceed 3.4 MGD ADF. Down-rating the plant's permitted flow to 3.4 MGD from the current permit of 4.3 MGD is a viable alternative. See *Section 3.2.1* for details regarding the WWTP options available to the City, including details regarding this re-rating.

2.3.2 Lift Stations

The City operates and maintains twenty-seven (27) public lift stations. The lift stations were inspected during a site visit conducted June 13, 2016. From the site visit, each lift station was graded on the condition of seven (7) different elements: Accessibility, Security, Pumps, Wet Well Piping, Pump Discharge Piping, Structural Condition, and Electrical Equipment. For each element, the lift station was given a score from 0-5, with 0 being demolish and replace and 5 being great condition, no work necessary. A total score of 35 means the lift station is in great condition, while a total score of 0 means the lift station needs to be demolished and replaced. The Lift Station Assessment Summary can be seen in Attachment C. A summary of all of the lift station data collected by JC and the City is detailed in Attachment D.

Lift Station No. 1 (LS 1) is located at the WWTP and is included in the WWTP assessment. See *Section 2.3.1* for details regarding the WWTP.

Lift Station No. 2 (LS 2), also known as 11th & Avenue I, is located at 1704 Avenue I. LS 2 has a 15-foot (15') x 12-foot (12') rectangular wet well, is approximately 23-feet (23') deep and was constructed in 1992. Record drawings and information provided by the City show LS 2 utilizes three (3) 1,300 gpm Flygt pumps. LS 2 collects flow from GSA 2 and LS 2 pumps via approximately 8,800 LF of 16-inch (16") force main to Lift Station 14 (Cottonwood). From the JC site visit conducted, LS 2 received a score of 13 out of 35 with the wet well piping, pump discharge piping, and electrical equipment in poor condition.

Lift Station No. 3 (LS 3), also known as Doris, is located at 3903 Doris Street. LS 3 is a 6-foot (6') diameter, 18-foot (18') deep lift station constructed in 1957. Pump sizes and design head were estimated for LS 3 based upon record drawings, and pump manufacturer information provided by the City. The pumps for LS 3 are estimated to be two (2) 460 gpm Gorman-Rupp pumps. LS 3 collects flow from GSA 3 and pumps via 3,500 LF of 8-inch (8") force main to Lift Station 17. From the JC site visit conducted, LS 3 received a score of 17 out of 35 with the structural integrity and electrical equipment in poor condition.

Lift Station No. 4 (LS 4), also known as Bucks Bayou, is located at 3611 Bucks Bayou Road. LS 4 has a 7-foot (7') diameter wet well and is approximately 18-foot (18') deep. Construction drawings were not available for LS 4 at the time of this report. Pump sizes and design head were estimated for LS 4 based upon force main conditions, pump manufacturer information provided by the City. The pumps for LS 4 are estimated to be two (2) 600 gpm Flygt pumps. LS 4 collects flow from GSA 4 and pumps via 900 LF of 8-inch force main to GSA 1N. From the JC site visit conducted, LS 4 received a score of 23 out of 35 with lower scores for accessibility and pumps.

Lift Station No. 5 (LS 5), also known as Ross, is located at 2301 Ross Street. LS 5 has a 8-foot (8') x 10-foot (10') rectangular wet well that is approximately 21-feet (21') deep and was constructed in 1992. Record drawings and information provided by the City shows LS 5 utilizes two (2) 550 gpm Flygt pumps. LS 5 collects flow from GSA 5 and pumps via 4,100 LF of 10-inch (10") force main to Lift Station 11. From the JC site visit conducted, LS 5 received a score of 16 out of 35, with the wet well piping, pump discharge piping and electrical equipment in poor condition.

Lift Station No. 6 (LS 6), also known as Avenue C, is located at 825 Avenue C. LS 6 is an 8-foot (8') diameter, approximately 21-feet (21') deep lift station constructed in 1976. Pump sizes and design head were estimated for LS 6 based upon record drawings and pump information provided by the City. The pumps for LS 6 are estimated to be two (2) 400 gpm Gorman Rupp pumps with space for a third pump. LS 6 collects flow from GSA 6 and pumps via 50 LF of 6-inch (6") force main to GSA 14W. From the JC site visit conducted, LS 6 received a score of 22 out of 35, with the electrical equipment in poor condition.

Lift Station No. 7 (LS 7), also known as North 60, is located at 400 Avenue F North. LS 7 is an 8-foot (8') diameter, approximately 20-feet (20') deep lift station constructed in 1976. Pump sizes and design head were estimated for LS 7 based upon record drawings and pump information provided by the City. The pumps for LS 7 are estimated to be two (2) 325 gpm Gorman Rupp pumps with space for a third pump. LS 7 collects flow from GSA 7 and pumps via 200 LF of 6-inch (6") force main to GSA 6. From the JC site visit conducted, LS 7 received a score of 18 out of 35, with the electrical equipment and pump discharge piping in poor condition.

Lift Station No. 8 (LS 8), also known as Grace, is located at 707 Grace Street. LS 8 is an 8-foot (8') diameter, approximately 20-feet (20') deep lift station constructed in 1979. LS 8 utilizes two (2) 220 gpm Flygt Pumps, according to record drawings. LS 8 collects flow from GSA 8, and pumps via 100 LF of 4-inch (4") force main to GSA 14W. From the JC site visit conducted, LS 8 received a score of 15 out of 35, with accessibility issues, and the wet well piping and pump discharge piping in poor condition.

Lift Station No. 9 (LS 9), also known as McDonald Meadows, is located at 4000 Holly Glenn. LS 9 is a 7-foot (7') diameter and approximately 10-foot (10') deep lift station. Pump sizes and design head were estimated for LS 9 based on pump information provided by the City, force main conditions and pump curves. The pumps for LS 9 are estimated to be two (2) 180 gpm Flygt pumps. LS 9 collects flow from GSA 9 and pumps via 500 LF of 4-inch (4") force main to GSA 4. From the JC site visit conducted, LS 9 received a score of 18 out of 35, with the pump discharge piping and wet well piping in poor condition.

Lift Station No. 10 (LS 10), also known as Hamman, is located at 2501 Hamman Road. LS 10 is an 8-foot (8') diameter and approximately 18-foot (18') deep lift station constructed in 1976. The lift station has two (2) pumps, one (1) 300 gpm Flygt pump and one (1) 600 gpm Flygt pump pump per record drawings. LS 10 collects flow from GSA 10 and pumps via 600 LF of 10-inch (10") force main to an 18-inch (18") gravity sewer that flows directly to LS 1 at the WWTP. From the JC site visit conducted, LS 10 received a score of 17 out of 35, with accessibility issues and lack of adequate security features.

Lift Station No. 11 (LS 11), also known as Baybrook, is located at 5001A Avenue F. LS 11 is a 5.5-foot (5.5') diameter, approximately 13-foot (13') deep lift station constructed in 1975. The lift station has two (2) pumps, but the pump sizes could not be determined for LS 11 due to not having record drawings or pump information at the time of this report. LS 11 collects flow from GSA 11 and pumps via 700 LF of 4-inch (4") force main to GSA 13. From the JC site visit conducted, LS 11 received a score of 13 out of 35, with the pumps, pump discharge piping, wet well piping, and electrical equipment all in poor condition.

Lift Station No. 12 (LS 12), also known as Thompson, is located at 1100 Thompson Drive. LS 12 is an 8-foot (8') diameter, approximately 18-foot (18') deep lift station constructed in 1978. The lift station has two (2) 300 gpm Flygt pumps, per record drawings. LS 12 collects flow from GSA 12 and pumps via 1,300 LF of 6-inch (6") force main to GSA 1C. From the JC site visit conducted, LS 12 received a score of 21 out of 35 with lower scores for accessibility, pumps, and wet well piping condition.

Lift Station No. 13 (LS 13), also known as Bayridge, is located at 4612 Avenue F. LS 13 is an 8-foot (8') diameter, approximately 20-foot (20') deep lift station constructed in 1971. The pump sizes could not be determined due to not having record drawings or pump information at the time of this report. LS 13 collects flow from GSA 13 and pumps via 500 LF of 8-inch (8") force main to GSA 12. From the JC site visit conducted, LS 13 received a score of 15 out of 35 with the electrical equipment in poor condition and lower scores for accessibility, pumps, pump discharge piping, wet well piping and structural conditions.

Lift Station No. 14 (LS 14), also known as Cottonwood, is located at 2000 Lloyd. LS 14 serves as the regional lift station for the majority of the City, with a 24-foot (24') diameter, approximately 21-foot (21') deep wet well, constructed in 1986. The lift station has four (4) pumps, one (1) 4,150 gpm Flygt pump, one (1) one (1) 2,125 gpm Flygt pump, and two (2) 1,260 Flygt gpm pump, according to pump submittals. LS 14 collects flow from GSA 14C and GSA 14W and directly from LS 2. LS 14 pumps via 6,900 LF of 24-inch (24") force main to the WWTP. LS 14 appears to have an auxiliary force main that could pump via 16-inch (16") force main to the 36-inch gravity sanitary sewer in GSA 1N. From the JC site visit conducted, LS 14 received a score of 19 out of 35 with the wet well piping and structural in poor condition.

Lift Station No. 15 (LS 15), also known as Bell, is located at 2212 Gloria Avenue. LS 15 is a 9.5-foot (9'-6") x 10-foot (10') rectangular wet well that is approximately 14-foot (14') deep. Pump sizes and design head were estimated for the lift station based on force main condition and pump information. The lift station has two (2) Gorman Rupp pumps estimated to be 400 gpm each. LS 15 collects flow from GSA 15 and pumps via 100 LF of 6-inch (6") force main to GSA 1N. From the JC site visit conducted, LS 15 received a score of 16 out of 35 with the electrical equipment in poor condition, and the accessibility, pumps, pump discharge piping, and wet well piping receiving lower scores.

Lift Station No. 16 (LS 16), also known as Del Norte, is located at 3200 A El Camino Street. LS 16 is a 6-foot (6') diameter, approximately 16-foot (16') deep lift station constructed before 1981. Pump sizes and design head were estimated for the lift station based on force main condition and pump information. The lift station has two (2) Flygt pumps estimated to be 125 gpm each. LS 16 collects flow from GSA 16 and pumps via 1,300 LF of 4-inch force main to GSA 5. From the JC site visit conducted, LS 16 received a score of 12 out of 35, with the pump discharge piping and electrical equipment in poor condition.

Lift Station No. 17 (LS 17), also known as FM 457, is located at 4125 FM 457. LS 17 is a 9-foot (9') diameter, approximately 22-foot (22') deep lift station constructed in 1989. The lift station has two (2) 400 gpm Flygt pumps, according to record drawings. LS 17 collects flow from GSA 17 and directly from LS 3 and pumps via 5,800 LF of 8-inch (8") force main to GSA 1N. From the JC site visit conducted, LS 17 received a score of 14 out of 35 with all criteria receiving lower scores.

Lift Station No. 18 (LS 18), also known as Fiesta, is located at 205 12th Street. LS 18 is a 4-foot (4') diameter, approximately 11-foot (11') deep lift station constructed in 1980. The lift station has two (2) 200 gpm Flygt pumps, according to pump submittals. LS 18 collects flow from GSA 18 and pumps via 2,200 LF of 6-inch (6") force main to GSA 14W. From the JC site visit conducted, LS 18 received a score of 11 out of 35, with difficult accessibility, pumps, pump discharge piping, electrical equipment and structural integrity all in poor condition.

Lift Station No. 19 (LS 19), also known as Little Cottonwood, is located at 2718 Cottonwood. LS 19 is a 3-foot (3') diameter and approximately 6-foot (6') deep lift station. The lift station has one (1) pump, but the pump size could not be determined due to not having record drawings or pump information at the time of this report. LS 19 serves a single house along Cottonwood Avenue, and pumps via approximately 300 LF of 1.5-inch (1 ½") force main to GSA 14C. From the JC site visit conducted, LS 19 received a score of 13 out of 35, with difficult accessibility, pumps, pump discharge piping and wet well discharge piping all in poor condition.

Lift Station No. 20 (LS 20), also known as Elliott, is located at 2000 Pine Knoll Road. LS 20 is a 6-foot (6') diameter, 19-foot (19') deep lift station constructed in 1993. The lift station has two (2) 290 gpm Flygt pumps according to record drawings. LS 20 collects flow from GSA 20 and pumps via 1,900 LF of 6-inch (6") force main to GSA 5. From the JC site visit conducted, LS 20 received a score of 21 out of 35 with difficult accessibility.

Lift Station No. 21 (LS 21), also known as SH 35, is located at 5920 7th Street. LS 21 is a 6-foot (6') diameter, approximately 19-foot (19') deep lift station constructed in 1993. The lift station has two (2) 400 gpm Flygt pumps, according to record drawings. LS 21 collects flow from GSA 21 and pumps via 4,500 LF of 8-inch (8") force main to GSA 17. From the JC site visit conducted, LS 21 received a score of 21 out of 35 with pumps and wet well piping in poor condition.

Lift Station No. 22 (LS 22), also known as FM 3156, is located at 2050 FM 3156. LS 22 is a 4-foot (4') diameter, approximately 8-foot (8') deep lift station. Pump sizes and design head were estimated for the lift station based on force main condition and pump information. The lift station has two (2) Zoeller pumps estimated to be 30 gpm each. LS 22 collects flow from GSA 22 and pumps via 800 LF of 2-inch (2") force main to GSA 7. From the JC site visit conducted, LS 22 received a score of 16 out of 35 with accessibility difficulty, pumps, and pump discharge piping in poor condition.

Lift Station No. 23 (LS 23), also known as Eagles, is located at 1815 Eagles Road. LS 23 is a 3.5-foot (3'-6") diameter, approximately 10-foot (10') deep lift station. The lift station has 2 pumps, but the pump sizes could not be determined due to not having record drawings or pump information at the time of this report. LS 23 collects flow from GSA 23 and pumps via approximately 350 LF of 2-inch (2") force main to GSA 20. From the JC site visit conducted, LS 23 received a score of 18 out of 35 with the pump discharge piping in poor condition.

Lift Station No. 24 (LS 24), also known as Hardeman, is located at 616 12th Street. LS 24 is a 4-foot (4') diameter, approximately 8-foot (8') deep lift station. The lift station has one (1) pump, but the pump size could not be determined due to not having record drawings or pump information at the time of this report. LS 24 collects flow from GSA 24 and pumps via approximately 1,150 LF of 2-inch (2") force main to GSA 14W. From the JC site visit conducted, LS 24 received a score of 13 out of 35 with the pump, pump discharge piping and wet well piping in poor condition.

Lift Station No. 25 (LS 25), also known as Blackcat, is located at 2709 Charles Haley Drive. LS 25 is a 5-foot (5') diameter, approximately 12-foot (12') deep lift station. The lift station has one (1) pump, but the pump size could not be determined due to not having record drawings or pump information at the time of this report. LS 25 collects flow from GSA 25 and pumps via 2,200 LF of 2-inch (2") force main to GSA 14W. From the JC site visit conducted, LS 25 received a score of 14 out of 35 with the pumps and pump discharge piping in poor condition.

Lift Station No. 26 (LS 26), also known as the High School lift station, is located at 416 7th Street. LS 26 is a 7-foot (7') diameter, approximately 15-foot (15') deep lift station. The lift station has two (2) pumps, but the pump sizes could not be determined due to not having record drawings or pump information at the time of this report. LS 26 collects flow from GSA 26 and pumps via 1,300 LF of 6-inch (6") force main to GSA 14W. From the JC site visit conducted, LS 26 received a score of 17 out of 35 with lower scores for accessibility, pumps, pump discharge piping, wet well piping and structural condition.

Lift Station No. 27 (LS 27), also known as Tenaris, is located along SH 35 and the LCRA Canal. LS 27 is a 16-foot (16'), 29-foot (29') deep lift station constructed in 2015 to serve the new Tenaris steel manufacturing plant. The lift station has two (2) 500 gpm Flygt pumps, and can alternatively pump via either 4,000 LF to GSA 21 or via 14,000 LF of 10-inch (10") force main to GSA 1N.

In general, the lift stations need various improvements to bring them into compliance with TCEQ §217. Each lift station needs signage, an all-weather driveway for access, access hatch safety (fall protection), internal piping coating or replacements, wet well coatings, and assessment of pumping conditions to determine appropriate force main velocities. These improvements as well as pump replacements, Lift Station Rehabilitation, Expansion, or Abandonment are addressed further in *Sections 3.2, 4.1, and 4.2*.

There are currently emergency generators installed at the WWTP and LSs 14 and 27. In order to provide service during a power outage, it is recommended that these generators be placed on a regular maintenance schedule to ensure they are always fueled and operational. Additionally, it is recommended that all of the public lift stations be assessed to determine if there is a viable emergency condition operation consideration. Options for providing emergency condition service include a permanent generator, electrical modifications for a quick connect for a temporary generator (generator on a trailer), auxiliary pumps, or gravity overflows. A number of the existing lift stations have gravity overflow pipes installed. These overflows need to be checked to determine if they are functional, and the impact they have on their service areas in order to function properly.

JC and the City of Bay City updated the *City of Bay City Lift Station Design Guidelines* in 2015. The Guidelines present necessary design standards of a lift station to meet TCEQ §217. It is recommended the existing lift stations be evaluated against the updated *Design Guidelines*, and for necessary improvements to be made to correct any deficiencies.

2.4 Sanitary Sewer Flow

In order to provide adequate comparison of water to wastewater facilities and needs, the sanitary sewer flow was evaluated on flow contribution (whether by gallons per minute (gpm), gallons per day (gpd), or million gallons per day (MGD)) and on a *connection* basis. Based on billing data provided, the City has 8,143 physical connections as of 2016. 30 TAC §217 (Wastewater) does not address the definition of a connection. Per 30 TAC §290.38(16) (Water) a connection is a single family residential unit, each commercial or industrial establishment, and for apartment complexes, the individual apartment units are considered a connection. The existing billed physical connections in the City are made up of several types of uses, including single family residential, multi-family residential, commercial, schools, and city connections. The City currently has 10,057 connections based on the §290.38(16) definition of a connection.

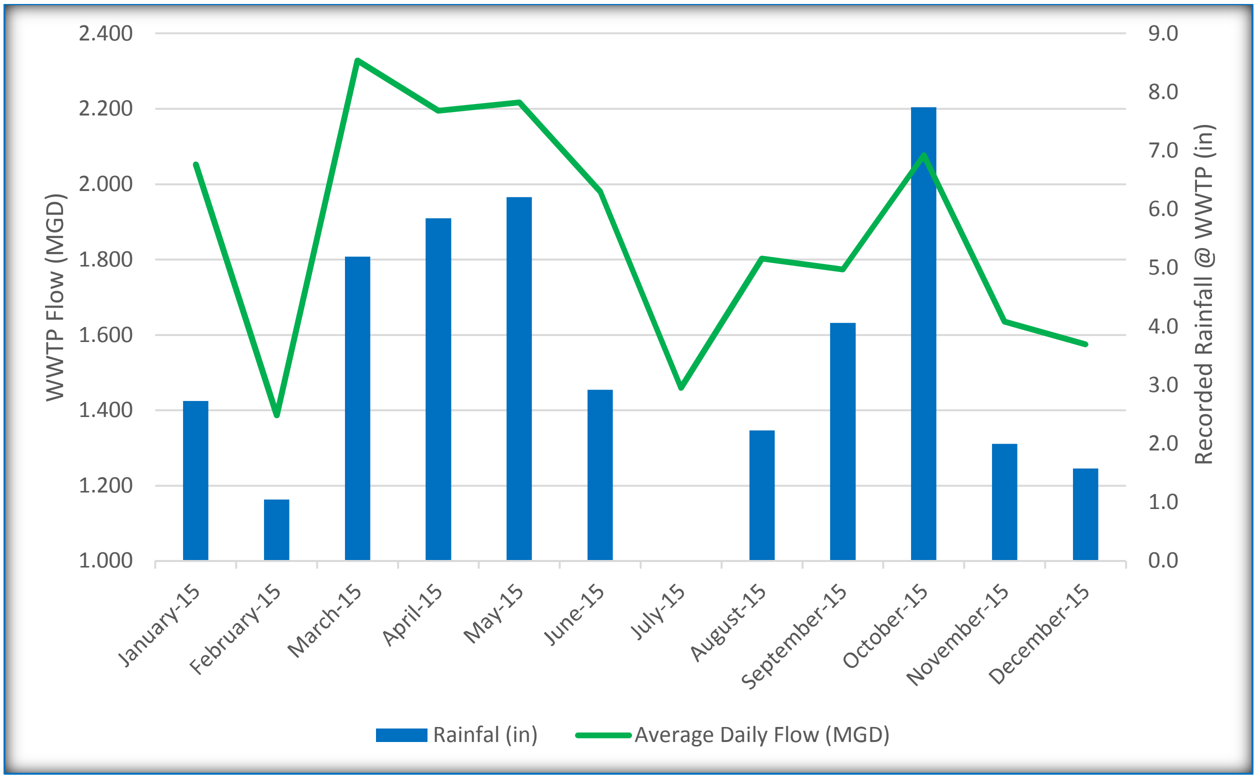
The wastewater system annual Average Daily Flow (ADF) was determined from 16 months of influent flow data at the WWTP provided by City staff. Sixteen months of data is not a long enough time period to provide a formal evaluation in accordance with 30 TAC §217, but can serve as a basis for general assessment. Based on this collected data, the system has a wastewater annual ADF of 1.89 MGD for the period of January 2015 to April 2016. As a comparison, the water system ADF was 2.22 MGD for 2015.

Per TAC 30 §217.34(1)(A), when an existing wastewater facility is to be re-rated or altered, the design must utilize the **maximum monthly average day flow**. The 2015 maximum month ADF, or the maximum 30-day average, for the influent at the WWTP was 2.47 MGD. This higher flow took place during the time period of mid-April to mid-May of 2015. As a comparison, water produced at the water plants for the same time period in mid-April to mid-May of 2015 was 2.3 MGD ADF.

April and May of 2015 recorded some significantly high rainfall. Based on the data at the WWTP, this totaled 7-inches over a 30-day period. The fact that the wastewater treated average flow throughout the 30-day maximum ADF exceeded the water produced from the water plants clearly shows that the system has some significant I&I issues.

Based on the City's 10,057 physical connections and a maximum 30-day ADF of 2.47 MGD, the City currently has a wastewater unit flowrate of 245 gpd/conn. TCEQ §217 design parameters assume a flow of 300 gpd/conn when better historical data is not available. Figure No. 4 presents the monthly sanitary sewer flow received at the WWTP from January to December of 2015 as well as the monthly rainfall totals during this same time period at the CoBC WWTP.

Figure No. 4
CoBC Wastewater Treatment Plant Flow Data



As shown in Figure No. 4 above, there is clear correlation between high WWTP flow months and high rainfall months. The WWTP flow increasing when there are high rainfall days reinforces the assessment that there are significant I&I issues throughout the collection system.

Pump run time data was provided by City Staff for each lift station as described in *Section 2.3*. The run times summarize how long the pump was running during a given period of time. The run times are normally collected daily, to measure how many hours the pump runs during the day, to determine a true average day flow and 2-hour Peak Flow condition. The data provided for the City's lift station run times includes significant gaps in time from a few days to an entire month. There are three significant hindrances to collecting daily data for twenty-seven (27) lift stations: equipment malfunctions, manpower, and time. Many of the pump meters were also defective or broken during the period of run time data collected, resulting in errant data that had to be disregarded for the purposes of this report.

The Gravity Service Area wastewater flows were calculated based on the 2015 water meter data as provided in the *City of Bay City 2016 Water System Analysis & Master Plan.* A factor of 85% was applied to the water demands to obtain the sanitary sewer ADF, based on the ratio of the average 2015 WWTP metered influent to the average 2015 water demand (1.89 MGD / 2.22 MGD = 85%). The TCEQ also recommends, in lack of sufficient historical data, using a water demand of 360 gpd per connection and wastewater contribution of 300 gpd per connection. Using these TCEQ recommended flows results in a water to wastewater ratio of 83%. Overall, the City's water to wastewater ADF ratio is within reason.

Based on the data provided by the City, the WWTP recorded a single maximum day event of 10.03 MGD during 2015. This results in a maximum day peak factor of 5.3*Q (10.03 MGD / 1.89 MGD = 5.3). The TCEQ requires the design of wastewater facilities to consider the 2-Hour Peak Flow, which in lieu of historical data, is a minimum of 4*Q. Hourly data for the City was not available at the time of this report and was likely higher 5.3*Q for the 2-Hour Peak on this day. Based on the fact that the maximum day peak factor is already higher than normal design parameters (5.3 versus 4), it was assumed that the 2-Hour Peak Flow (PF) would be a minimum of 5.3*Q for the purposes of this analysis and report. Additional *hourly* data should be collected and this report should be updated to re-assess the capacity of lift stations and gravity lines accordingly. The lift station pump sizes, design capacities, existing flow conditions, force main sizes, and gravity sanitary sewers are described in detail in *Sections 2.2 and 2.3* and on Exhibits B and C.

In order to properly assess the sewer system's flow conditions, it would be preferable for one year of consistent, complete daily and hourly data to be collected. This should include at a *minimum, daily* reads at the critical lift stations (LSs 1, 2, 4, 6, 10, 12, 13, 14, and 17) and preferably daily reads for all of the lift stations. These lift stations are critical because they collect multiple other lift stations, flow directly to the WWTP, or are along waterways that would need analysis to accurately assess I&I. Hourly data needs to be collected at the WWTP and LSs to more accurately define the 2-Hour Peak Flow. Additionally, other means of data collection could be utilized such as influent manhole flow monitoring, force main metering, or pump run-time SCADA connection of all of the lift stations to more accurately analyze the entire wastewater system.

Lift station run times were not available for LSs 2, 6, 13, 17, 18, 19, 22, 24, and 25 because a run time meter has not been installed or is malfunctioning. Lift station run times were not available for LS 27, because the lift station was not yet receiving flow as of June 2016. Pump sizes were not available at the time of the report for LSs 1, 6, 7, 9, 11, 12, 13, 14, 19, 22, 23, 24, 25, and 26, so the pump sizes were estimated based on discharge conditions, pump information, and diameter of the wet well, when available for each lift station.

As shown in Table No. 4, based on the data collected, three (3) of the existing lift stations have Peak Flows over the design capacity of the lift station. The other remaining twenty-four (24) lift stations have sufficient design capacity to handle the existing flows. Many of the lift stations are actually significantly oversized for their currently defined service areas.

Lift Station Nos. 14, 15, and 16 are estimated to be receiving wastewater over their current pump capacity. It is recommended these lift stations be investigated further over the next year to determine if pump improvements are necessary.

Table No. 4 - Exist Lift Station Capacity Summary

Lift Station No.	Lift Station Name	Diameter (ft)	No. Pumps	Pump Size (gpm)	Lift Station Design Capacity (gpm)(2)	Maximum Flow to Lift Station (gpm)(3)	% of Capacity Used(3)
LS 1	WWTP	8				7,000	
LS 2	11th & Ave I	15x12	3	1,300	2,600	986	38%
LS 3	Doris	6	2	460(1)	460	133	29%
LS 4	Bucks Bayou	7	2	600	600	203	34%
LS 5	Ross	8x10.67	2	550	550	77	14%
LS 6	Ave C	8	3	400(1)	800	229	29%
LS 7	North 60	8	3	325(1)	650	54	8%
LS 8	Grace	8	2	2204)	220	63	29%
LS 9	McDonald Meadows	7	2	180(1)	180	51	28%
LS 10	Hamman	8	3	300, 600, 900	900	424	47%
LS 11	Baybrook	5.5	2	--(4)	--(4)	50	N/A
LS 12	Thompson	8	2	300	300	127	42%
LS 13	Bayridge	8	2	--(4)	--(4)	113	N/A
LS 14	Cottonwood	24	3	4,150, 1,260, 2,125	3,385	3,919	116%
LS 15	Bell	9.5x10	2	400(1)	400	783	196%
LS 16	Del Norte	6	2	125	125	126	101%
LS 17	FM 457	9	2	475	475	417	88%
LS 18	Fiesta	4	2	200	200	13	7%
LS 19	Little Cottonwood	3	1	--(4)	--(4)	1	N/A
LS 20	Elliott	6	2	290	290	34	12%
LS 21	SH35	6	2	400	400	193	48%
LS 22	FM 3156	4	1	30(1)	30	3	9%
LS 23	Eagles	3.5	2	--(4)	--(4)	1	N/A
LS 24	Hardeman	4	1	--(4)	--(4)	1	N/A
LS 25	Blackcat	5	1	--(4)	--(4)	2	N/A
LS 26	High School	7	2	--(4)	--(4)	40	N/A
LS 27	Tenaris	16	2	500	500	N/A	N/A

Notes:

(1) Pump Size is estimated based upon force main conditions, construction plans, and pump curves, whichever were available for each lift station at the time of the report.

(2) Lift Station Design Capacity is based on the provided pump size (gpm) with the largest pump out of service per TAC 30 §217.

(3) The Maximum 30-Day Average (Q) was calculated based on data from the sewer model for the given services areas.The 2 Hour Peak Flowarate is Q times the determined Maximum Day Factor (5.3) from the WWTP Influent Data. Actual re-design would require determination of the 2-Hour Peak Flowrate with hourly data from the City for each lift station, which is likely to be in excess of these values.

(4) No data available.

2.5 Model Creation

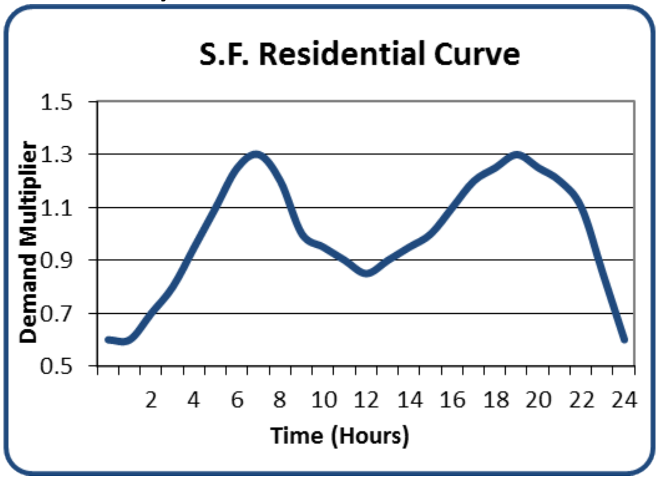
A sanitary sewer model was created in SewerGEMS V8i Edition by Bentley Systems, Inc. This model is a tool to analyze performance and predict future behavior of the sanitary sewer system. The purpose was to develop a fully dynamic computer model of the City's wastewater system that calculates flows, velocities, and depths within the system over extended periods of time. The existing condition sanitary sewer model was created with information provided by the City's existing GIS database coupled with record drawings and information of the existing gravity sanitary sewers, manholes, sanitary sewer force mains, and lift stations provided by the City as presented in the previous sections. The model includes all known wastewater collection, storage, and pump facilities in the City.

Wastewater flows are input into the model at manholes by associating them with sanitary flow data from adjacent development. The flow is then simulated to the downstream lift station and transmitted by the lift station pumps into force mains that discharge into gravity wastewater lines that then flow to the next lift station and ultimately the wastewater treatment plant. The lift station pump sizes, configurations and controls used for the model are based on record drawings when available. The wastewater treatment plant is not included in the model and simulations as the software is not intended to model treatment facilities.

The loading for the sanitary sewer model was created by utilizing the previously developed regional demand distribution from the *City of Bay City Water System Analysis*. The water demand flows were adjusted to sanitary sewer loading and applied to locations throughout the system by assigning the sanitary sewer flow to the nearest manhole. There are approximately 770 manholes (51% of the system) throughout the City with loading. I&I within the model was assessed by multiplying the ADF times 5.3 in order to simulate the MDF the City's WWTP has received in the last year. This multiplier was placed on all of the sanitary sewer flow contributions resulting in an even spread of the modeled I&I. In reality, certain areas of the system may be larger contributors to I&I than other areas. SewerGEMs has the ability to model storm event based I&I by creating drainage areas and assigning variable percentage of I&I to certain locations. This type of Storm Event based modeling was not utilized at this time due to the lack of detailed data available. Seen *Section 2.6 Model Calibration* for further discussion on this topic.

The base sanitary sewer loading of 1.9 MGD ADF as used for the model is presented in *Section 2.4 Sanitary Sewer Flow.* The system was evaluated under average and maximum daily flow conditions, including a 2-Hour Peak Flow condition. The 2-Hour Peak Flow Condition was determined by applying a diurnal usage to each flow contribution type. Standard weekday residential diurnal curves were assumed for the model to appropriately represent the peak hour flow. Figure No. 5 presents an example diurnal curve used for a single-family flow contribution. Over a 24-hour period residential flow peaks from 6:30 AM to 7:30 AM and 6:00 PM to 8:00 PM time range. These curves are based on the diurnal curves developed during the creation of the water model and master plan.

Figure No. 5
Sanitary Sewer Contribution Diurnal Curve



2.6 Model Calibration

The model was built using the best available data from research and coordination with City staff. The model was compared to all record drawings, collected lift station run times (when available), known conditions of lift stations, collected water meter data, and any and all other information provided by City staff to make it as accurate as possible. Unlike the water distribution system, we are unable to collect system pressure data and flows within the force mains and gravity lines. Therefore, the sanitary sewer model created was not field calibrated at this time.

A true calibration would consist of real time data collection such as flow monitoring, pump run-time SCADA connection of all of the Lift Stations, rainfall monitoring, field testing and evaluation of all pumps and facilities to confirm their operating conditions. We would recommend flow monitoring, pump testing, and daily Lift Station meter data for at least one full year if a calibrated model is desired.

The benefits of a calibrated model would enable JC to more accurately predict inflow and infiltration per each lift station area and determine which areas of the City have the greatest need for sanitary sewer rehabilitation. This would be very beneficial to aid with prioritizing Capital Projects. A calibrated model can also be used to analyze pump cycles and lift station efficiency to determine desired pump and impellor sizes. Additionally, a calibrated model can be used to determine bottlenecks and high risk areas within the system in order to assess and predict new gravity and force main alignments and their impacts to the system.

2.7 Model Scenarios and Results

Two system scenarios were evaluated for the existing 2016 flow conditions. The average daily and peak daily scenarios were analyzed for the system during a 24-hour period through an extended period simulation (EPS). The two scenarios and their results for the existing system are as follows:

Average Daily Flow - This scenario consists of a modeled 2016 Average Day Flow condition of approximately 1,900,000 flow (ADF) run over a 24-hour extended period simulation (EPS). The two-hour peak flow modeled during this time period was approximately 625 gpm.

Maximum Daily Flow - This scenario consists of a modeled 2016 Maximum Day Flow condition of approximately 10,070,000 gpd (5.3 x ADF) run over a 24-hour extended period simulation (EPS). The two-hour peak flow modeled during this time period was approximately 3,400 gpm.

Based on the results of the model, during ADF conditions, approximately 15% of the gravity collection system is fully submerged at some point during the day. During the modeled MDF condition, this percentage of submerged lines increases to over 60%. Table No. 5 presents the maximum flowrate and velocity of the gravity collection system in the model as well as these values of amount of pipe submerged. Table No. 6 presents a summary of the force main conditions in the model. Desirable force main velocities are greater than 2.0 ft/s and less than 6.0 ft/s. The system currently maintains below 6.0 ft/s, but does not maintain above 2.0 ft/s.

Table No. 5
2016 Model Results – Gravity Collection System

Scenario	Max Gravity Flow (gpm)	Max Gravity Velocity (fps)	Gravity Lines (LF of) Submerged
2016 ADF	919(1)	2.4(2)	72,491(3)
2016 MDF	4,549(1)	3.4(4)	305,802(4)

Notes:
(1) Location is in the 48-inch gravity line into the WWTP LS.
(2) Location is in the 12-inch gravity line approximately 450-feet north of LS No. 2.
(3) Approximately 15% of the entire system is submerged at various points throughout the day.
(4) Location is in the 12-inch gravity line at the intersection of Avenue I and 12th Street.
(5) Approximately 60% of the entire system is submerged at various points throughout the day.

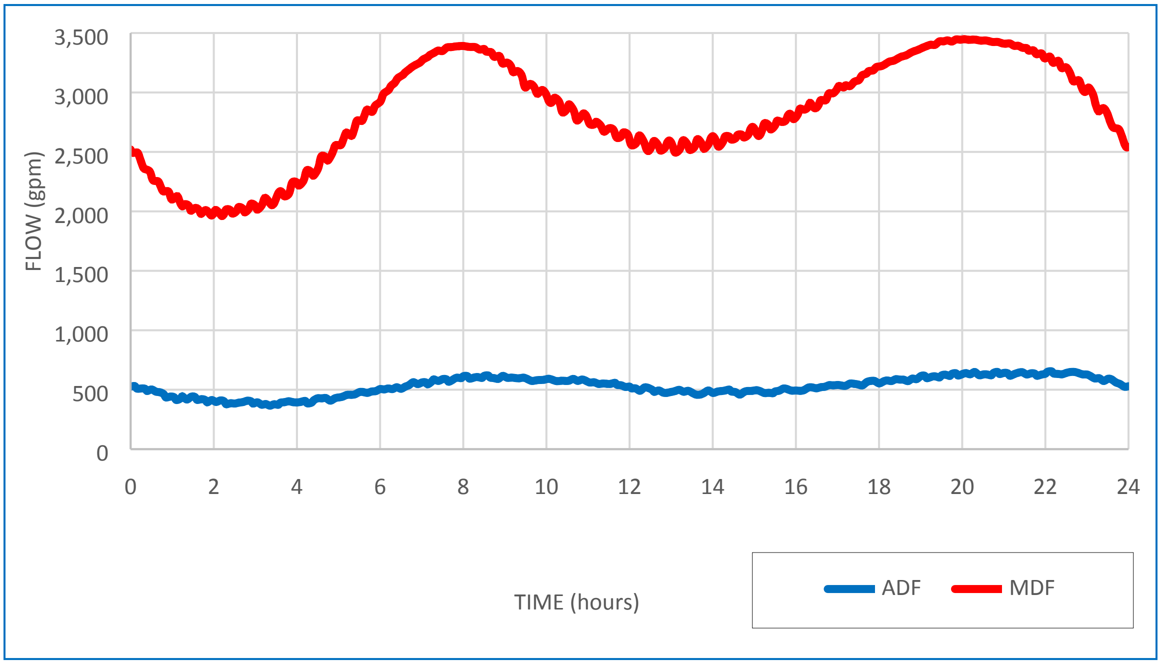
Table No. 6
2016 Model Results – Force Mains

Scenario	Max Force Main Flow (gpm)	Min Force Main Flow (gpm)	Max Force Main Velocity (fps)	Min Force Main Velocity (fps)
2016 ADF	4,802(2)	15(3)	5.4(4)	0.2(3)
2016 MDF	6,190(2)	15(3)	5.8(5)	0.2(3)

Notes:
(1) Results only include off-site force main results. Onsite piping is not reported on.
(2) Location is the 24-inch force main from the Cottonwood Lift Station to the WWTP.
(3) Location is the 1.5-inch force main from the Little Cottonwood Lift Station.
(4) Location is the 6-inch force main from the Bucks Bayou Lift Station.
(5) Location is the 10-inch force main from the Hamman Lift Station.

The model is able to calculate and graph flows for any pipe in the system. Figure No. 6 illustrates the typical flow pattern of wastewater into the WWTP.

Figure No. 6
Flow Pattern of 48-Inch Line into WWTP
During an ADF (Blue) and MDF (Red)



As shown in the Figure No. 6, the flow in the gravity sewer just outside of the WWTP peaks at approximately 9 AM and 9 PM. There is approximately a 2-hour delay from when peak flow enters the system to when the peak flow arrives at the WWTP. This delay is due to travel time in the gravity sewer lines and detention time in the lift stations. To determine exact loading times and delays, a calibrated model would be required.

The model is able to graph the flow lines and paths of the gravity sewer pipes, lift stations, and force mains. The following Figure Nos. 7 through 9 illustrate various flow paths of the system.

Figure No. 7
Hydraulic Profile of Lindsey Ave to LS 20 to LS 5 to LS 2 to LS 14 to WWTP LS

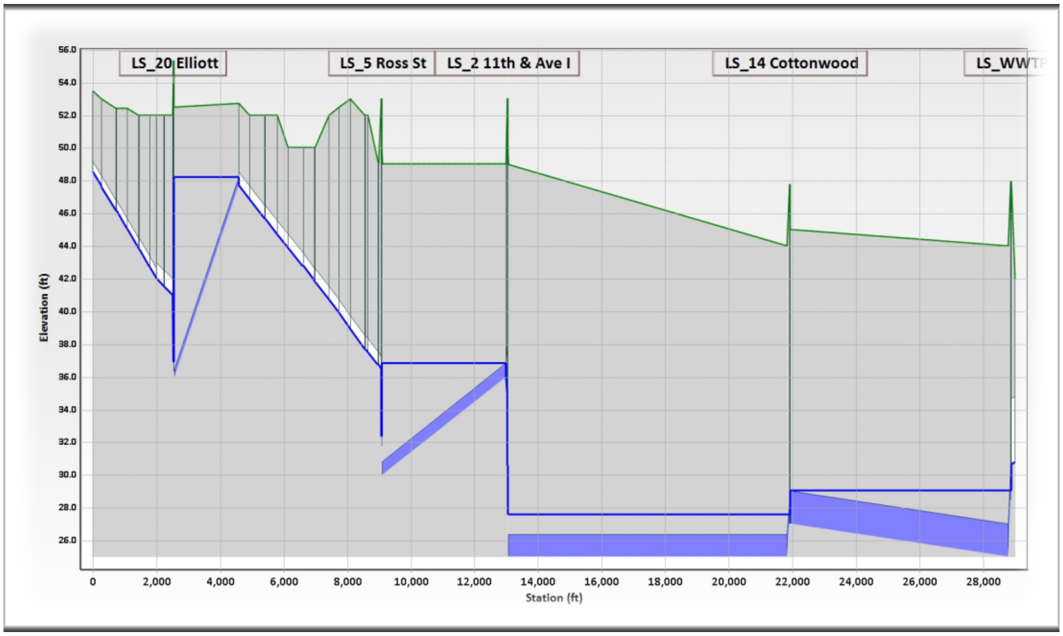


Figure No. 8
Hydraulic Profile of Fiesta Gardens to LS 18 to LS 14 to WWTP LS

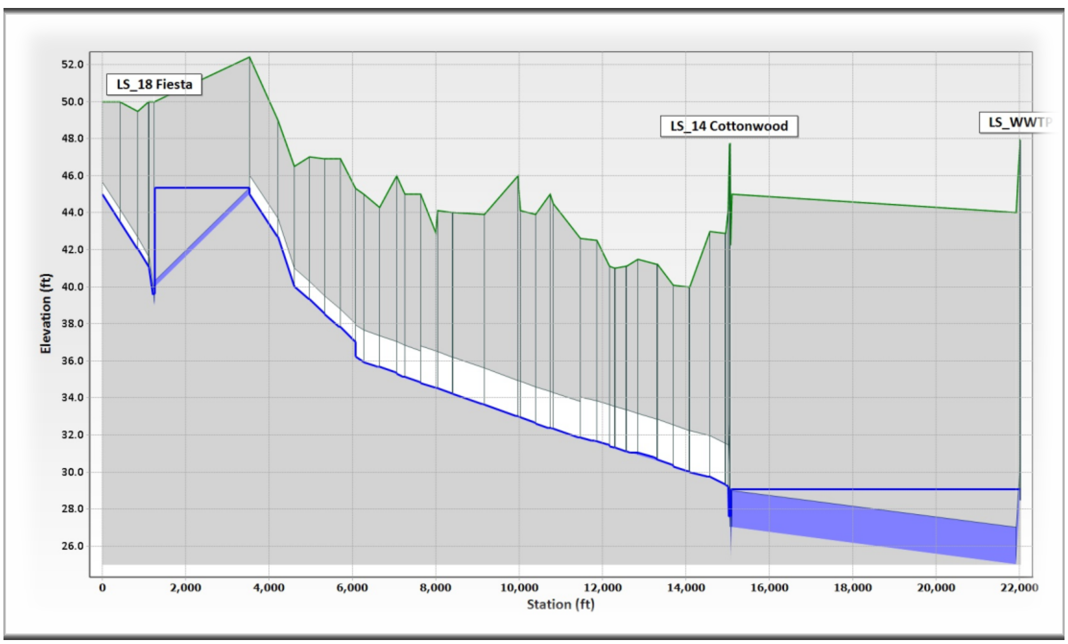
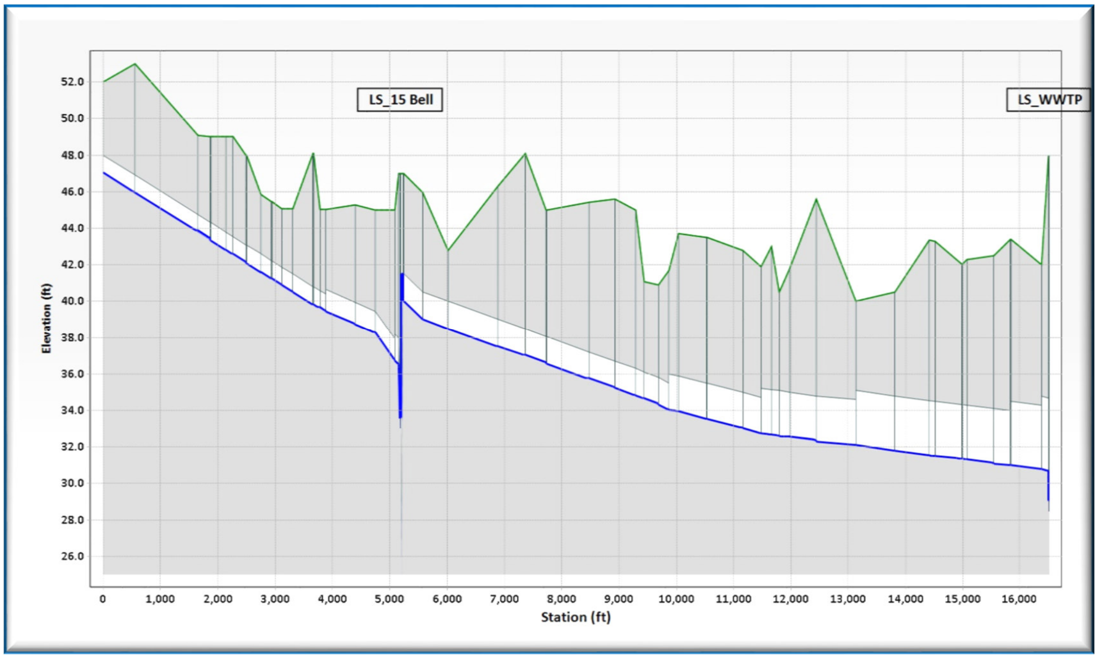


Figure No. 9
Hydraulic Profile of Andrea Drive to LS 15 to WWTP LS



As shown in Figures Nos. 7 through 9, there are multiples paths the sanitary sewer system takes throughout the City. Some sections of the City flow directly into the WWTP via gravity, while other sections must utilize multiple lift stations in order for the flow to arrive at the WWTP. It is normally preferable to minimize the number of lift stations the flow must go through to arrive at the WWTP, as this limits overall . With the model we can predict the complete path from any new or existing Lift Station to the WWTP. This can assist the City staff with planning location of future lift stations and force mains.

Additionally, are at several dozen pipes in the system that act as emergency overflows, either directly adjacent to a lift station or in the middle of the system. While many of these overflows are rarely used, they do provide system redundancy in the scenario of a lift station failure. With a calibrated model JC would be able to model a lift station going offline for 24-48 hours and the response of the rest of the system due to these overflows.

3.0 FUTURE WASTEWATER SYSTEM

3.1 Population and Flow Contribution Growth

The resident population of the City of Bay City is 17,614 people according to the 2010 census. Based on information provided by the TWBD and presented in the *Vision 2040* report, the City of Bay City is expected to grow at a rate of 1% per year through 2020 and 0.5% per year thereafter. As shown in Table No. 7, the City is expected to have a total estimated population of 21,923 by 2050.

Table No. 7
Annual Population Estimates

Year	Population
2010	17,614
2015	17,850
2020	18,797
2030	19,786
2040	20,827
2050	21,923

The growth in sanitary sewer flow is projected to come from industrial, commercial, single-family residential, and multi-family residential. The projected industrial, commercial and multi-family flow contribution is anticipated to be primarily along State Highway 35 and State Highway 60. The projected single-family residential flow contribution is anticipated to be on the East and North sides of the City, on future roads that will extend from State Highway 35 and State Highway 60.

Based on the conditions outlined in the *Vision 2040 Comprehensive Plan* and information provided by City staff, this analysis assesses the growth of the City in population and development for 2017, 2020, 2030, 2040, and 2050 and its impact on projected wastewater flows. The projected wastewater contribution based on anticipated development is shown in Table No. 8. It is assumed the City will not look to expand the City limits or the wastewater system service area significantly. It is anticipated development will be either scattered throughout the system or concentrated along Highway 35 and Highway 60. All development will be within the City limits and the City needs to ensure proper wastewater collection and treatment is going to be provided to these developments.

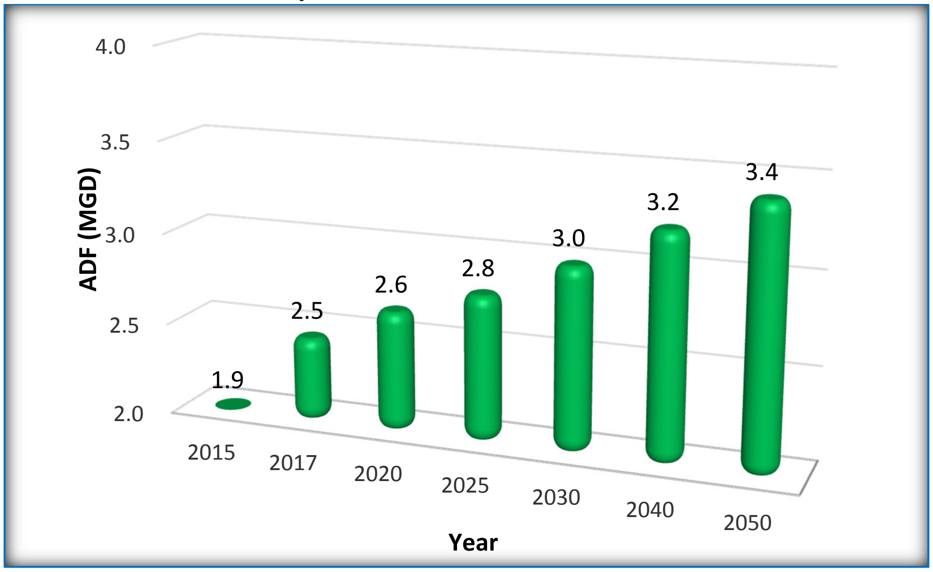
Table No. 8
Anticipated Development

Map ID	Development Description	Est. Conns	Development Category	Year	Average Daily Flow Contribution
A	Tenaris – Phase II	1	Industrial	2017	340,000 gpd
B	Dunn Heat – Phase II	1	Industrial	2017	68,000 gpd
C	9ers Grille	1	Commercial	2017	4,300 gpd
D	Candlewood Suites	1	Hotels/Motels	2017	4,300 gpd
E	Fairfield Inn	1	Hotels/Motels	2017	4,300 gpd
F	Best Western	1	Hotels/Motels	2017	4,300 gpd
G	Bay Tex Hotel (30 beds)	1	Hotels/Motels	2017	4,300 gpd
H	Misc. Hotels (2 @ 100 beds each)	2	Hotels/Motels	2017	8,600 gpd
J	North-East Development (12th Street)	109	Residential	2017	15,400 gpd
K	Indigo Park 30 Ac. Development	182	Residential	2020	25,700 gpd
L	Theater (McCrosky)	1	Commercial	2020	8,500 gpd
M	Retail (McCrosky)	10	Commercial	2020	43,000 gpd
N	New (DT) Apartments (200 units)	200	Multi-Family	2020	18,000 gpd
O	FEMA Safe Dome	1	Government	2020	8,500 gpd
P	250 Ac. Master Plan Development (N. SH 60)	2,273	Residential	2025	320,500 gpd
Q	Indigo Park 10 Ac. Apartments	571	Multi-Family	2030	51,400 gpd
S	20 Ac. Residential Development (East)	303	Residential	2030	42,700 gpd
	TOTAL	**3,659**			**971,800 gpd**

The projected wastewater flow contributions are based on the known future uses of the land within the City of Bay City limits. It was assumed that all projected growth takes place with the listed developments from Table No. 8. After the known Developments through 2030, a 1% growth in residential connections per year was assumed to account for the expected general population increase in the City. Exhibit D attached presents the known developments through 2030 and their expected locations within the City's wastewater service area. Additional large contributors such as Tenaris and Dunn Heat are not anticipated at this time. If another large contributor such as this desires to be served by the City, this analysis and report should be re-evaluated on a case-by-case basis to determine if service is feasible and the impact to existing facilities to convey and treat wastewater.

Attachment E presents a detailed breakdown of the estimated wastewater contribution over time with the outlined developments through 2050. Based on these developments and a 1% continued growth, it is estimated the City will need sanitary sewer collection and treatment capabilities to serve 3.4 MGD ADF of wastewater by 2050. Figure No. 10 depicts the anticipated increase in wastewater flow through 2050.

Figure No. 10
Anticipated Growth of Wastewater Flow



3.2 2017 Capital Projects

According to the collected data, the City's wastewater system has many deficiencies in meeting the required level of service in TAC 30 §217 rules. The City is also expected to add approximately 1.5 MGD ADF by 2050 for a total annual ADF of 3.4 MGD. We recommend the following 30 Capital Projects (CPs) to improve the existing system and lay the needed infrastructure foundation for future flows. Using the data, we have evaluated the following CPs and their impact on the City's current and future wastewater collection and treatment facilities. The following CPs are intended to be completed in the order described by their number. If there are obstacles preventing this order we recommend re-assessing the proposed system to ensure the desired results will be met.

One goal of this report was to determine and present the options the City has to meet the revised limits in the 2015 WWTP Permit. For treatment, these options consisted of Option A - rehabilitating and utilizing the existing WWTP to meet all of the City's wastewater treatment needs or Option B constructing a second WWTP to meet some of the City's wastewater treatment needs and utilizing the existing WWTP to meet the remaining wastewater treatment needs. CPs 1a and 1b are presented in *Section 3.2.1*. It was determined early during the process of this Analysis that Option B is not a viable alternative due to the Capital and Operating and Maintenance costs associated with splitting flow in the City and maintaining two (2) WWTPs. The 2nd WWTP portion of Option B is presented, but additional facilities such as an additional Lift Station to send one-third of the flow from the middle of town east to the new WWTP, or the improvements that would still be required at the existing WWTP, were not analyzed further after it was deemed too costly of an option. Option B would also result in significant additional operational and maintenance costs with a 2nd WWTP and a 28th public lift station.

3.2.1 2017 Wastewater Treatment Facility Projects

Capital Project No. 1a (CP 1a) consists of the rehabilitation and replacement of structures and mechanical and electrical equipment at the WWTP. CP1a proposes to rehabilitate the existing WWTP to bring it into compliance with §217 rules and regulations, correct mechanical and electrical issues, and replace equipment as necessary to ensure a properly functioning WWTP.

As described in *Section 2.4*, the WWTP currently receives an average annual ADF of approximately 1.9 MGD. As described in *Section 3.1,* future flow to the WWTP is not expected to exceed 3.4 MGD ADF. Down-rating the plant's permitted flow to 3.4 MGD is required for implementation of CP1a.

Re-rating the existing WWTP requires collection, organization and analyzing 5-years of influent data for the WWTP and comparing it to the capacities and abilities of the WWTP. The existing WWTP was designed and constructed under TAC §317 rules. The change in capacity will require meeting the TCEQ Chapter 217 rules. Upon completion of collection, organizing, and analyzing this data, it must be presented to the TCEQ for review and approval.

The required aeration basins, secondary clarifiers, and digesters volume to treat 3.4 MGD are presented in Table No. 9.

Table No. 9: Required Basin Volume to Treat 3.4 MGD

Treatment Unit	Total Existing Basin Volume/Area	Available Treatment Capacity	Additional Required Volume/Area to Treat 3.4 MGD
Aeration Basins	210,100 cubic feet	3.35 MGD	0 (1)
Secondary Clarifiers	14,800 square feet	3.70 MGD	0
Digesters	112,800 cubic feet	2.35 MGD	161,000 cubic feet (2)

Notes:

(1) – Based on an MLSS concentration of 3,300 mg/L. Field verification of all dimensions will be required to confirm volumes.

(2) – Includes replacement of both existing digesters due to poor concrete condition.

The aeration basins and secondary clarifiers are adequately sized to treat 3.4 MGD. However, an additional basin volume of over 48,000 cubic feet is needed for the digesters to meet TCEQ requirements.

An additional blower is recommended to meet §217 rules and bi-furcation of the existing air piping is recommended to ensure proper air distribution throughout the WWTP. The digesters are generally in poor condition with severe structural concrete cracking. We recommend demolition of the existing digesters and replacement with a new 2 stage digester with a total volume of 161,000 cubic feet.

JC evaluated the condition of the current WWTP facilities based on a site visit on June 13, 2016. Significant findings include the following:

1. Poor (structural) condition of influent junction box and lift station.
2. Equalization basin is not operational.
3. Lack of operational gates cause flow imbalance between aeration basins.
4. Mal-distribution of air among multiple process units.
5. Inability to control return activated sludge rates inhibits process control and contributes to air mal-distribution.
6. Lack of operational gates cause flow imbalance between secondary clarifiers.
7. The single chlorine contact basin cannot be isolated, drained, and cleaned. It has no mixing capabilities.
8. Restrictions on dewatering and disposal of sludge with filter boxes inhibit process control.
9. Concrete structure for both digesters is unsound. Digesters have no means of decanting.
10. The plant does not have emergency power for process equipment.

Recommended improvements were prioritized based on need, regulatory compliance, and safety. JC also considered long term improvements that are necessary for ongoing functionality, reliability, and economy. These improvements do not consider any additional change in permit limits. Potentially, total phosphorous limits may be added or new industrial contributors may result in additional metals limits in the WWTP's discharge permit.

The total estimated cost of improvements over the next 20 years for this WWTP is approximately $13M. These improvements have been spread out over three major improvements projects over a 15 year time period and are described as CP 1a, CP 29, and CP 30.

CP 1a would allow the City to continue to operate a single WWTP and provide for the future capacity of the City's projected sanitary sewer flow needs. CP 1a is estimated to cost $5,700,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2017.

Capital Project No. 1b (CP 1b) consists of the construction of a second WWTP on the east side of town. Completion of this project would not alleviate the need for rehabilitation and replacement of structures and mechanical and electrical equipment at the existing WWTP. CP1b proposes to design and construct a new WWTP on SH 35 to serve approximate 1.2 MGD and the remaining 2.2 MGD of the ultimate 3.4 MGD would continue to go to the existing WWTP.

The proposed WWTP, located at a new site to be determined near the Tenaris Lift Station would be designed for an average flow of 1.2 MGD and a peak flow of 4.8 MGD. The site lies approximately 4,000 feet north-east of the intersection of Highway 35 and 7th Street. The surrounding land area is mostly undeveloped with some commercial and industrial development.

Implementation of this option will require obtaining a second effluent discharge permit from the TCEQ.

Raw wastewater will be conveyed to the proposed WWTP from the existing Tenaris Lift Station via a 10-inch force main. An SBR was selected for this proposed WWTP due to the process' simplicity and low cost. SBRs require minimal footprint as equalization, primary clarification, biological treatment, and secondary clarification can be achieved in a single reactor. Also, potential capital cost savings can be achieved by eliminating clarifiers and other equipment. The process train is described below, and a proposed layout is depicted in Exhibit F.

Proposed Second WWTP Process Train:

A. Headworks

The headworks will consist of an elevated structure with a mechanical fine screen that effectively removes debris such as rags, wood, cans, and personal products such as condoms from the influent wastewater.

B. SBR

As opposed to conventional activated sludge, SBRs achieve both organic removal and settling in the same reactor, thus reducing the footprint of a SBR system. To achieve nutrient removal, ammonia nitrogen (NH_3-N), the proposed SBR will have dedicated aerobic and anoxic cycles within the same tank. This system will comprise of four basins, each 60 feet long by 60 feet wide.

C. Digesters

TCEQ §217 regulations require a solids retention time of 28 days. To meet this criteria, the proposed plant will have two digester basins, each 40 feet long by 30 feet wide. The solids produced will be hauled off-site either to WWTP No. 1 or to a landfill, and the supernatant will be sent back to the SBRs for further treatment.

D. Chlorine Contact Basin

A chlorine contact basin (CCB) will disinfect the wastewater from the SBRs. To meet the TCEQ §217.281(a)(1) regulations of a minimum detention time of twenty (20) minutes, the basin will have two trains, with internal baffle walls to create a serpentine flow pattern with a 40:1 aspect ratio, measuring 50 feet long by 25 feet wide.

E. Effluent Filters

The proposed WWTP will have tertiary disk filters to provide additional removal of suspended solids and a reduction in BOD from secondary effluent. Removal of solids also improves the efficacy of subsequent disinfection. The plant is proposed to have two filters with four (4) disks each.

F. Disinfection

The purpose of disinfection is to control pathogenic organisms. The proposed WWTP will include two fiber-reinforced plastic (FRP) bleach tanks and two sodium bisulfite tanks. The use of bleach and bisulfite is a much safer approach compared to the use of chlorine and sulfur dioxide gas ton containers under pressure.

CP 1b would require the City to operate two WWTPs to provide for the future Capacity of the City's projected sanitary sewer flow needs. CP1b would also require the construction of a new regional lift station to collect approximately 0.8 MGD from the center of the City to send back to the Tenaris LS, which would be modified to send flow to the new WWTP. Additionally, rehabilitation and improvements at the existing WWTP would still be necessary to enable it to continue to operate properly to its new ultimate flow of 2.2 MGD.

CP 1b is estimated to cost $10,000,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018.

Capital Project No. 29 (CP 29) consists of the rehabilitation and replacement of structures and mechanical and electrical equipment at the WWTP. CP 29 is planned to rehabilitate the existing WWTP to replace aging equipment, recoat piping and structures, and perform general cleaning and maintenance as necessary to continue to ensure a functioning WWTP. CP 19 is estimated to cost $5,500,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2025.

Capital Project No. 30 (CP 30) consists of the rehabilitation and replacement of structures and mechanical and electrical equipment at the WWTP. CP 30 is planned to rehabilitate the existing WWTP to replace aging equipment, recoat piping and structures, and perform general cleaning and maintenance as necessary to continue to ensure a functioning WWTP. CP 19 is estimated to cost $2,000,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2030.

3.2.2 2017 Lift Station Projects

It was evaluated during collection and analysis of the existing sanitary sewer infrastructure that there are seven (7) lift stations that the City currently operates and maintains that could potentially be served by larger gravity sewer extensions that would allow the City to abandon or demolish these lift stations. The money spent on these capital projects essentially pays for itself over time by not having to continue to pay for operation and maintenance costs of these lift stations. See *Section 3.2.4* for Collection System Capital Projects that could result in the abandonment of Lift Station Nos. 9, 11, 18, 19, 23, 24, and 25. Prior to any lift station capacity improvements, the lift station should be metered hourly to determine the influent flow. Pump sizes and depth of the lift station should also be verified.

Capital Project No. 3 (CP 3) consists of the rehabilitation of Lift Station No. 14. As identified in *Section 2.3.2*, LS 14 has accessibility issues, and its pumps, pump discharge piping, wet well piping and structural integrity are in poor condition. LS 14 is the primary regional lift station that serves approximately half the City. LS 14 is also located near a major waterway, Cottonwood Creek. CP 3 is estimated to cost $700,000, with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018.

Capital Project No. 5b (CP 5b) consists of the replacement of Lift Station No. 19. As identified in *Section 2.3.2*, LS 19 has accessibility issues, and its pumps, pump discharge piping and wet well piping are in poor condition. LS 19 has only one pump. Based on the City's and TCEQ's lift station design criteria, the City should completely replace this lift station in lieu of rehabilitation. CP 5b is estimated to cost $150,000, with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018. See *Section 3.2.4* for CP 5a.

Capital Project No. 6b (CP 6b) consists of the rehabilitation of Lift Station No. 23. As identified in *Section 2.3.2*, LS 23's pump discharge piping is in poor condition. CP 5b is estimated to cost $100,000 construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018. See *Section 3.2.4* for CP 6a.

Capital Project No. 7b (CP 7b) consists of the replacement of Lift Station No. 24. As identified in *Section 2.3.2*, LS 24's pump, pump discharge piping, and wet well piping are in poor condition. LS 24 has only one pump. Based on the City's and TCEQ's lift station design criteria, the City should completely replace this lift station in lieu of rehabilitation. CP 7b is estimated to cost $160,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018. See *Section 3.2.4* for CP 7a.

Capital Project No. 8b (CP 8b) consists of the rehabilitation of Lift Station No. 18. As identified in *Section 2.3.2*, LS 18 has accessibility issues, and its pumps, pump discharge piping, electrical equipment, and structural integrity are all in poor condition. CP 8b is estimated to cost $160,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018. See *Section 3.2.4* for CP 8a.

Capital Project No. 9b (CP 9b) consists of the replacement of Lift Station No. 25. As identified in *Section 2.3.2*, LS 25's pumps and pump discharge piping are in poor condition. LS 25 has only one pump. Based on the City's and TCEQ's lift station design criteria, the City should completely replace this lift station in lieu of rehabilitation. CP 9b is estimated to cost $150,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018. See *Section 3.2.4* for CP 9a.

Capital Project No. 10b (CP 10b) consists of the rehabilitation of Lift Station No. 9. As identified in *Section 2.3.2*, LS 9's pump discharge piping and wet well piping are all in poor condition. CP 10b is estimated to cost $240,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018. See *Section 3.2.4* for CP 10a.

Capital Project No. 11b (CP 11b) consists of the rehabilitation of Lift Station No. 11. As identified in *Section 2.3.2*, LS 11's pumps, pump discharge piping, wet well piping, and electrical equipment are all in poor condition. CP 11b is estimated to cost $260,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018. See *Section 3.2.4* for CP 11a.

Capital Project No. 12 (CP 12) consists of the rehabilitation of Lift Station No. 16. As identified in *Section 2.3.2*, LS 16 has accessibility issues, and its pumps, pump discharge piping, wet well piping and electrical equipment are in poor condition. CP 12 is estimated to cost $290,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 13 (CP 13) consists of the rehabilitation of Lift Station No. 2. As identified in *Section 2.3.2*, LS2's wet well piping, pump discharge piping and electrical equipment are in poor condition. CP 13 is estimated to cost $300,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 14 (CP 14) consists of the rehabilitation of Lift Station No. 17. As identified in *Section 2.3.2*, LS17 has accessibility and security issues, and its pumps, pump discharge piping, wet well piping and electrical equipment are in poor condition. CP 14 is estimated to cost $290,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 15 (CP 15) consists of the rehabilitation of Lift Station No. 8. As identified in *Section 2.3.2*, LS8's wet well has accessibility issues, and wet well piping and pump discharge piping are in poor condition. CP 15 is estimated to cost $230,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 16 (CP 16) consists of the rehabilitation of Lift Station No. 13. As identified in *Section 2.3.2*, LS13 has accessibility issues, and its pumps, pump discharge piping, wet well piping, structural integrity and electrical equipment are in poor condition. CP 16 is estimated to cost $290,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 17 (CP 17) consists of the rehabilitation of Lift Station No. 5. As identified in *Section 2.3.2*, LS5's structural integrity and electrical equipment are in poor condition. CP 17 is estimated to cost $270,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 18 (CP 18) consists of the rehabilitation of Lift Station No. 15. As identified in *Section 2.3.2*, LS15 has accessibility issues, and its pumps, pump discharge piping, wet well piping and electrical equipment are in poor condition. CP 18 is estimated to cost $260,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 19 (CP 19) consists of the rehabilitation of Lift Station No. 22. As identified in *Section 2.3.2*, LS22 has accessibility issues, its pumps, pump discharge piping and wet well piping are in poor condition. CP 19 is estimated to cost $160,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 20 (CP 20) consists of the rehabilitation of Lift Station No. 3. As identified in *Section 2.3.2*, LS3's structural integrity and electrical equipment are in poor condition. CP 20 is estimated to cost $160,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 21 (CP 21) consists of the rehabilitation of Lift Station No. 10. As identified in *Section 2.3.2*, LS10 has accessibility and security issues, and its pumps and structural integrity are in poor condition. CP 21 is estimated to cost $150,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 22 (CP 22) consists of the rehabilitation of Lift Station No. 26. As identified in *Section 2.3.2*, LS26 has accessibility issues, its pumps, pump discharge piping, wet well piping and structural integrity are in poor condition. CP 22 is estimated to cost $270,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 23 (CP 23) consists of the rehabilitation of Lift Station No. 7. As identified in *Section 2.3.2*, LS7's electrical equipment and pump discharge piping are in poor condition. CP 23 is estimated to cost $240,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 24 (CP 24) consists of the rehabilitation of Lift Station No. 12. As identified in *Section 2.3.2*, LS12 has accessibility issues and its pump and wet well piping are in poor condition. CP 25 is estimated to cost $130,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 25 (CP 25) consists of the rehabilitation of Lift Station No. 20. As identified in *Section 2.3.2*, LS20 has accessibility issues, and its pumps are in poor condition. CP 25 is estimated to cost $170,000, with 15% contingencies, inflation, and engineering. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 26 (CP 26) consists of the rehabilitation of Lift Station No. 21. As identified in *Section 2.3.2*, LS21's pumps and wet well piping are in poor condition. CP 26 is estimated to cost $160,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 27 (CP 27) consists of the rehabilitation of Lift Station No. 6. As identified in *Section 2.3.2*, LS6's electrical equipment is in poor condition. CP 27 is estimated to cost $140,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

Capital Project No. 28 (CP 28) consists of the rehabilitation of Lift Station No. 4. As identified in *Section 2.3.2*, LS4's pumps are in poor condition and the site has accessibility problems. CP 28 is estimated to cost $150,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020.

3.2.3 2017 Force Main Projects

At the time of this report, no force main re-routes or extensions were identified that would benefit the City.

It was identified during analysis of the lift stations that the majority of the City's force mains appear to be over-sized. Over-sizing of force mains leads to lower than desired velocities. TAC 30 §217 recommends 3.0 feet per second (ft/s) for lift stations with two or less pumps and 2.0 ft/s for the first pump in lift stations that have three or more pumps with a daily flush of 5.0 ft/s. See *Section 4.2* for more details regarding the condition of and recommendations for the City's force mains.

3.2.4 2017 Collection Systems

Capital Project No. 2 (CP 2) consists of rehabilitation by Cured-in-Place Pipe (CIPP) of approximately 1,300 LF of 30-inch (30"), 2,500 LF of 36-inch (36"), and 1,300 LF of 42-inch (42") gravity sanitary sewer that flows north to south along Sycamore Avenue to the WWTP. The existing gravity line was constructed in 1966 and is in need of rehabilitation. The project is estimated to cost $3,600,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs.

Capital Project No. 4 (CP 4) consists of rehabilitation by Cured-in-Place Pipe (CIPP) of approximately 3,600 LF of 27-inch (27") gravity sewer along Lloyd Street, Avenue F, and Whitson Street, approximately 1,500 LF of 24-inch (24") gravity sewer along Moore Avenue, from Whitson Street to Austin Street, and approximately 500 LF of 24-inch (24") gravity sewer along Moore Avenue from Rugeley Street to 1st Street. The existing gravity lines were constructed in 1960 and in need of rehabilitation. The 24-inch (24") gravity sewer along Moore Avenue from Austin Street to Whitson Street and from Rugeley Street to 1st Street was not included in the recent *2011 CDBG Sanitary Sewer Improvements*. The project is estimated to cost $2,100,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs.

Capital Project No. 5a (CP 5a) consists of the installation of approximately 500 LF of 8-inch (8") gravity sanitary sewer from LS 19 northwest along the Drainage Channel to an existing manhole in order to **abandon LS 19**. LS 19 currently serves one property. A gravity sanitary sewer project in 2014 extended a sewer nearby that could have the necessary depth to serve this property without needing LS 19. LS 19 could be abandoned or removed and this would save the City significant operation and maintenance costs through 2050. CP 5a as currently described is estimated to cost $150,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018. Further investigation is necessary to confirm the depths are adequate for this project. There are also other (more costly) alternatives to abandoning this lift station including extending approximately 2,000 LF of 12-inch (12") gravity sanitary sewer south and east along the drainage ditch or along Matthews Street to the 18-inch (18") gravity sanitary sewer along Sycamore Ave.

Capital Project No. 6a (CP 6a) consists of the installation of approximately 1,500 linear feet of 12-inch (12") gravity sanitary sewer from LS 23 southwest along Eagles Road to a 10-inch (10") gravity sanitary sewer along SH 60 in order to **abandon LS 23**. LS 23 currently serves one property. The existing gravity sanitary sewer along SH 60 could have the necessary depth to serve this property without LS 23. LS 23 could be abandoned or removed and this would save the City significant operation and maintenance costs through 2050. CP 6a is estimated to cost $300,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2018. Further investigation is necessary to confirm the depths are adequate for this project.

Capital Project No. 7a (CP 7a) consists of the installation of approximately 1,500 linear feet of 12-inch (12") gravity sanitary sewer from LS 24 south and east along drainage ditches to an existing 24-inch (24") along Moore Avenue in order to **abandon LS 24**. LS 24 currently serves one property. The existing gravity sanitary sewer along Moore Avenue could have the necessary depth to serve the current properties. LS 24 could be abandoned or removed and this would save the City significant operation and maintenance costs through 2050. CP 7a is estimated to cost $300,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2019. Further investigation is necessary to confirm the depths are adequate for this project. There is also another (potentially less costly) alternative to abandoning this lift station by extending approximately 1,500 LF of 12-inch (12") gravity sanitary sewer east along 12th Street Street to the 18-inch (18") gravity sanitary sewer along Moore Avenue.

Capital Project No. 8a (CP 8a) consists of the installation of approximately 5,000 linear feet of 18-inch (18") gravity sanitary sewer from LS 18 north and east along drainage ditches in order to **abandon LS 18**. LS 18 currently serves several properties as described in GSA 18. The existing 21-inch (21") gravity sanitary sewer along Moore Avenue could have the necessary depth to serve this property without LS 18 by extending this larger gravity sewer. LS 18 could be abandoned or removed and this would save the City significant operation and maintenance costs through 2050. CP 8a is estimated to cost $1,200,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2019. Further investigation is necessary to confirm the depths are adequate for this project. There is also another (potentially less costly) alternative to abandoning this lift station by extending approximately 4,000 LF of 18-inch (18") gravity sanitary sewer south to the High School Lift Station (LS 26).

Capital Project No. 9a (CP 9a) consists of the installation of approximately 2,400 linear feet of 12-inch (12") gravity sanitary sewer from LS 25 north and east along access roads to the High School Lift Station (LS 26) in order to **abandon Lift Station No. 25**. LS 25 currently serves several residential properties. LS 26 could have the necessary depth to serve this property without LS 25. LS 25 could be abandoned or removed and this would save the City significant operation and maintenance costs through 2050. CP 9a is estimated to cost $400,000 with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 20xx. Further investigation is necessary to confirm the depths are adequate for this project. There is also another (potentially more costly) alternative to abandoning this lift station by extending approximately 4,000 LF of 15-inch (15") gravity sanitary sewer east along 2nd Street to the 24-inch (24") gravity sanitary sewer along Moore Avenue.

Capital Project No. 10a (CP 10a) consists of the installation of approximately 2,000 linear feet of 15-inch (15") gravity sanitary sewer from LS 9 northwest along Bucks Bayou Road in order to **abandon Lift Station No. 9**. LS 9 currently serves several residential streets as described in GSA 9. LS 4 could have the necessary depth to serve this property without LS 9 by extending this larger gravity sewer directly to LS 4. LS 9 could be abandoned or removed and this would save the City significant operation and maintenance costs through 2050. CP 10a is estimated to cost $450,000, with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020. Further investigation is necessary to confirm the depths are adequate for this project.

Capital Project No. 11a (CP 11a) consists of the installation of approximately 3,500 linear feet of 18-inch (18") gravity sanitary sewer from LS 11 north and east along Spruce Street and Mulberry Street in order to **abandon Lift Station No. 11**. LS 11 currently serves several properties as described in GSA 11. The existing 24-inch (24") gravity sanitary sewer north of Hedgerose Lane could have the necessary depth to serve this property without LS 11 by extending this larger gravity sewer. This project may also require reconfiguration of some of the existing sanitary sewer through the Bay Brook Apartments Complex parking lot. LS 11 could be abandoned or removed and this would save the City significant operation and maintenance costs through 2050. CP 11a is estimated to cost $1,000,000, with construction, 15% contingencies, inflation, and engineering, surveying, and construction management costs. The estimate is based on an assumed construction contract year of 2020. Further investigation is necessary to confirm the depths are adequate for this project. There is also another (potentially more costly) alternative to abandoning this lift station by extending approximately 4,000 LF of 18-inch (18") gravity sanitary sewer east to the 18-inch (18") that flows north to the WWTP.

3.3 2017 Projected System Model Results

Based on the projects outlined within this report, it is not anticipated there will be any major collection system improvements by 2017. All of the projects outlined are large enough that they require approximately six months to one year for design and six months to one year for construction. See *Section 2.7* for Existing Model Results. If desired, the City can request certain scenarios to be modeled to determine the impact of particular planned improvements.

3.4 2020-2050 Projected System Model(s)

Due to the size of the area modeled, the variability of existing sanitary sewer lines that may be replaced, rehabilitated, relocated or up-sized, and the uncertainty of future development, additional scenarios other than the presented Capital Projects and the increase in flow contributions for 2017 were not presented. Computer models have been setup for future use for each iteration from 2020, 2030, 2040, and 2050. If desired, the City can request certain scenarios to be modeled to determine the impact of particular planned improvements.

4.0 RECOMMENDATIONS

4.1 Capital Projects Summary

In order to meet the expected growth in wastewater flow in the coming years as outlined in *Section 3.1,* the City will have to engage in an extensive infrastructure design and construction program to improve the existing system and lay the needed infrastructure foundation for future users. Table No. 10 presents the summary list of all of the Capital Projects (CPs) outlined throughout *Section 3* of this report. The projects are listed in order of precedence based on overall system need and their impact in correcting major system wide deficiencies. We recommend all of these CPs be implemented by the City as soon as fiscally possible. See *Section 3.2.1, 3.2.2* and *3.2.4* for detailed descriptions of the CPs. The costs presented are based on a construction cost, 15% contingencies, inflation for the anticipated construction contract year presented, engineering, surveying and construction management costs.

There are two options regarding the WWTP serving the ultimate needs of the City. Option A is to rehabilitate, expand, and modify the existing WWTP as well as re-rate to serve 3.4 MGD. Option B is to construct a 2nd WWTP, divert approximately one-third of the City's wastewater flow to this WWTP and rehabilitate and re-rate the existing WWTP to serve 2.2 MGD.

Option A is anticipated to cost approximately $6M with all permitting, engineering, construction, 15% contingencies, and inflation. Option B is anticipated to cost in excess of $15M with all permitting, engineering, construction, 15% contingencies, and inflation (including CP 1b and additional un-defined projects of a new regional lift station and limited repairs to the existing WWTP). Based on the scope and costs of the projects required to send and treat flow at a 2nd WWTP, as well as the additional operational and maintenance costs associated with a second WWTP, Option A is recommended.

CPs 5-11 are all presented with options *a* and *b*. For each of these lift stations, the City should investigate the feasibility of installing gravity sanitary sewers in order to abandon or remove the Lift Station. While some of the option *a* projects may have a larger up-front capital cost, the investment could potentially pay for itself by way of significantly reduced operating and maintenance costs.

CPs 1-3 are critical projects necessary to bring the system into compliance with §217 rules, meet the recent changes in regulatory requirements and ensure the City is able to convey and treat the anticipated 2017 wastewater flows. These projects total approximately $10M. We recommend the City proceed with Capital Project Nos. 1-3 as soon as fiscally possible.

Table No. 10 - Capital Projects Summary

No.	Capital Projects	Cost	Ant. Const. Year
1a	WWTP Rehabilitation	$ 5,700,000	2018
1b	WWTP No. 2	$10,000,000	2018
2	42-inch to 30-inch Gravity Sewer Rehabilitation	$ 3,600,000	2018
3	LS 14 Rehabilitation	$ 700,000	2018
4	27-inch to 24-inch Gravity Sewer Rehabilitation	$ 2,100,000	2018
5a	Gravity Sewer Extension to Abandon LS 19	$ 150,000	2018
5b	LS 19 Replacement	$ 150,000	2018
6a	Gravity Sewer Extension to Abandon LS 23	$ 300,000	2018
6b	LS 23 Rehabilitation	$ 100,000	2018
7a	Gravity Sewer Extension to Abandon LS 24	$ 300,000	2019
7b	LS 24 Replacement	$ 160,000	2019
8a	Gravity Sewer Extension to Abandon LS 18	$ 1,200,000	2019
8b	LS 18 Rehabilitation	$ 160,000	2019
9a	Gravity Sewer Extension to Abandon LS 25	$ 400,000	2020
9b	LS 25 Replacement	$ 150,000	2020
10a	Gravity Sewer Extension to Abandon LS 9	$ 450,000	2020
10b	LS 9 Rehabilitation	$ 240,000	2020
11a	Gravity Sewer Extension to Abandon LS 11	$ 1,000,000	2020
11b	LS 11 Rehabilitation	$ 260,000	2020
12	LS 16 Rehabilitation	$ 290,000	2020
13	LS 2 Rehabilitation	$ 300,000	2020
14	LS 17 Rehabilitation	$ 290,000	2020
15	LS 8 Rehabilitation	$ 230,000	2020
16	LS 13 Rehabilitation	$ 290,000	2020
17	LS 5 Rehabilitation	$ 270,000	2020
18	LS 15 Rehabilitation	$ 260,000	2020
19	LS 22 Rehabilitation	$ 160,000	2020
20	LS 3 Rehabilitation	$ 160,000	2020
21	LS 10 Rehabilitation	$ 150,000	2020
22	LS 26 Rehabilitation	$ 270,000	2020
23	LS 7 Rehabilitation	$ 240,000	2020
24	LS 12 Rehabilitation	$ 130,000	2020
25	LS 20 Rehabilitation	$ 170,000	2020
26	LS 21 Rehabilitation	$ 160,000	2020
27	LS 6 Rehabilitation	$ 140,000	2020
28	LS 4 Rehabilitation	$ 150,000	2020
29	WWTP Improvements – 2025	$ 6,200,000	2025
30	WWTP Improvements – 2035	$ 2,400,000	2030

Totaling over $28M, these are the top 30 Capital Projects identified as needed before 2030. As these projects and City wide development progresses, the Master Plan can be re-evaluated to determine additional Capital Projects to aid the City in better serving their water system customers. Exhibit E attached presents the locations of these Capital Projects.

4.2 Operations & Maintenance Projects

Regular, efficient, effective maintenance is a vital step to achieving long term financial sustainability for the City's Sanitary Sewer System. The City should set aside increasing amounts of money each year to bring the sanitary sewer system up to the highest quality. Steps can include data collection of problem areas with logging of main breaks, regular pressure testing of portions of the City system, assessment projects such as Cleaning & Televising (C&TV), Manhole Surveys, smoke testing and dye testing, and yearly inspections of all major facilities with City administrative and operational staff and the Engineer present. The City should perform regular maintenance on all electrical facilities and backup power generators. This regular maintenance should conform to NFPA 110 requirements.

Much of the existing infrastructure in downtown is over 50 years old. City staff currently respond to any sewer backups or overflows and repair them as needed. These repairs are time-critical and require immediate attention in order to restore service. The City should consider compiling maintenance records of existing sanitary sewers to identify sections of the City that require frequent repairs or have frequent complaints. The City can then replace entire sections of older sanitary sewer instead of responding to single point locations. This can be done as one large project or phased out over years when funding is available.

The City should consider budgeting in order to replace a certain percentage of the sanitary sewer system each year. While the annual expenses may vary depending on the project sizes, a goal of replacing 4% of the system each year is a good baseline as this provides for a 25-year complete rehabilitation or replacement. After all the older lines are replaced, the City can decrease the percentage of line rehabilitation per year. Moving forward, the City should utilize implementation of GIS based repair tracking. This will allow the City to identify problem areas of the system to plan for large scale replacement projects and prioritize those sections that break often.

Additionally, there are various projects that are necessary to ensure the City maintains a robust and reliable system. The following projects are identified as Operations and Maintenance (O&M) projects and should be completed as soon as fiscally feasible.

Table No. 11
O&M Projects Summary

No.	O&M Projects	Cost	Ant. Year
1	Cleaning & Televising GSAs 6 and 7	$100,000	2017
2	Rehabilitation of GSAs 6 and 7	$1,400,000	2017
3	Force Main Assessment	$600,000	2018
4	Lift Station Generator Project	$1,200,000	2018
5	Sanitary Sewer Manhole Rehabilitation	$3,300,000	2018
6	Collection System C&TV	$1,100,000	2018
7	Collection System Rehabilitation	$64,000,000	Phased 2020-2050

O&M Project No. 1 (O&M 1) consists of cleaning and televising GSAs 6 and 7. Based on discussions with the City's staff, LSs 6 and 7 and the northern gravity service areas experience tremendous I&I. Cleaning and televising will allow the City to identify potential areas to be rehabilitated and point repairs to reduce I&I in the system. Table No. 12 below presents the linear footages of pipes by size in GSAs 6 and 7.

Table No. 12

GSA 6	
Exist Pipe Size	**Linear Footage**
10-inch	6,100
8-Inch	5,900
6-Inch	3,300
GSA 7	
Exist Pipe Size	**Linear Footage**
8-Inch	7,000

The project is estimated to cost $100,000 with construction, 15% contingencies, surveying, engineering, and construction management costs.

O&M Project No. 2 (O&M 2) consists of the rehabilitation within GSAs 6 and 7 after completion of O&M 1. GSA 6 serves commercial development, single family and multi-family residential with approximately 150 connections. GSA 7 serves mostly commercial developments along SH 60 and single family residential homes with approximately 100 connections. For the purposes of budgeting, it is assumed all pipes within these GSAs will need to be pipe-bursted size on size. The project is estimated to cost $1,400,000 with construction, 15% contingencies, surveying, engineering, and construction management costs.

O&M Project No. 3 (O&M 3) consists of the investigation and assessment of all of the City's force mains (approximately 56,000 LF). As discussed in *Section 3.2.3,* the majority of the City's force mains operate at lower than desired velocities. This can lead to build-up in the pipelines which can cause pumps to operate inefficiently, plug up the force mains, or result in "slugs" of more concentrated wastewater discharging into the gravity sewer system and intermittently getting to the WWTP. This project would propose to use SmartBall© technology to analyze and assess the existing force mains. This technology allows the force mains to remain in operation during assessment. The project is estimated to cost $600,000 with construction, 15% contingencies, surveying, engineering, and construction management costs.

O&M Project No. 4 (O&M 4) consists of the modification of all of the City's public lift stations to utilize some form of emergency condition operation. It is recommended that all of the public lift stations be assessed to determine if there is a viable emergency condition operation consideration. Options for providing emergency condition service include a permanent generator, electrical modifications for a quick connect for a temporary generator (generator on a trailer), auxiliary pumps, or gravity overflows. For the purpose of budgeting, we have proposed O&M 4 with significant long term improvements. Additional investigation could be undergone to determine if cheaper options are viable.

For proposed O&M 4, it is recommended that any Lift Station that is proposed to serve a 2-Hour Peak Flow over 700 gpm or is adjacent to a major water way needs a permanent generator. Eight (8) lift stations have been identified as meeting this criteria for a permanent on-site generator: LSs 2, 4, 6, 10, 14, 15, 17, & 22. Currently, only LS 27 (Tenaris) has a generator. As a part of this project, it is proposed for the City to purchase three (3) portable generators on trailers to use for the remaining lift stations (17) during emergency situations. These Portable Generators can then also be used by the City for other facilities or special events.

This project is estimated to cost $1,200,000, with construction, 15% contingencies, surveying, engineering, and construction management costs.

O&M Project No. 5 (O&M 5) consists of rehabilitation of all sanitary sewer manholes in the City's system (approximately 1,500 manholes). Sanitary sewer manholes are a common point of large I&I that is often overlooked. Many of the City's manholes are over 30 years old and are most likely constructed with bricks. More recent manholes were likely constructed with concrete, but concrete can corrode and crack and allow I&I as well. A complete manhole C&TV package or a Manhole inventory project can be utilized to identify the true need or value of a manhole rehabilitation project. See *Section 4.3.2* for more details regarding Infrastructure Assessment and Documentation.

It is recommended to rehabilitate existing manholes that are more than 20 years old by pressure cleaning, re-establishment of benches and inverts with cement, coating of the entire manhole with a minimum of 1-inch of cement and 80-120 mils of an epoxy, polyurethane, or polyurea. There are also other coating systems that are one product systems such as Spectrashield or SewperCoat. Any of these systems will provide better protection against I&I than just the brick or concrete manhole alone.

The project should also include evaluation and determination of the replacement of cones, rims and covers as necessary for any manholes that are corroded or damaged. Additionally, measures such as bolting down the cover if the top of rim is below the flood plain, adding vent pipes, housekeeping pads, or Inflow Protectors are options to limit Inflow. This project is estimated to cost $3,300,000 with construction, 15% contingencies, surveying, engineering, and construction management costs.

O&M Project No. 6 (O&M 6) consists of Cleaning and Televising (C&TV) of the City's collection system, approximately 550,000 LF. The existing condition of the majority of the City's collection system is unknown. A large portion of the gravity sewers were constructed over 50 years ago. C&TV is the most effective, non-intrusive way to determine the actual condition of the existing collection system. This

JONES | CARTER

project is estimated to cost $1,100,000 with construction, 15% contingencies, surveying, engineering, and construction management costs.

O&M Project No. 7 (O&M 7) consists of rehabilitation of the City's entire collection system, approximately 550,000 LF. There are several means of rehabilitating existing sanitary sewers including Cured-In-Place Pipe (CIPP), Pipe-Bursting, or conventional removal and replacement. In order to minimize impact on the existing community we recommend utilizing construction methods that minimize open excavation such as pipe bursting or CIPP. We recommend the replacement projects are bundled into larger projects in excess of $200,000 in order to get competitive pricing. The line quantities, sizes and estimated costs to rehabilitate are shown in Table No. 13.

Table No. 13
Cost of Gravity Sanitary Sewer Rehabilitation

Size	Linear Feet	Cost per LF to Rehabilitate(1)	Cost to Rehab All(2)
6-inch (or less)	160,000	$ 80	$12,800,000
8-inch	180,000	$ 80	$14,400,000
10-inch	62,000	$ 85	$5,300,000
12-inch	68,000	$ 95	$6,500,000
15-inch to 18-inch	20,000	$ 120	$24,000,000
21-inch to 30-inch	7,000(3)	$ 150	$1,100,000(3)
36-inch	Included in Capital Projects due to Impact to System I&I		
42-inch (or larger)	Included in Capital Projects due to Impact to System I&I		
Totals			**$64,100,000**

Notes:
(1) Assumes all-in cost for sanitary sewer rehabilitation, with construction, 15% contingences and engineering, and if completed within the next five (5) years. Costs are based on worst case, pipe-burst method of rehabilitation, assuming size on size pipe bursting. Costs also include service reconnections with double strap tapping saddles and replacement of service leads within 5-feet (5') of main line, including all bends and fittings. Certain areas may need to be evaluated to determine if up-sizing of the existing sewers or down-sizing by means of slip-lining would better serve the City's long term needs. Prices will vary if Cured-in-Place Pipe (CIPP) can be utilized and if services are in moderate to good condition.
(2) Rounded to the nearest one-hundred thousand dollars.
(3) Does not include the approximately 12,700 LF of 24-inch (24") to 30-inch (30") gravity sewer included in Capital Projects.

Operations & Maintenance Project Nos. 1-4 are critical projects and are needed to resolve aging infrastructure problems. The remaining O&M projects listed are recommended to ensure the City can continue to operate and maintain an optimum water system. As these projects and City wide development progresses, the Master Plan can be re-evaluated to determine additional Capital Projects to aid the City in better serving their wastewater system customers. Other maintenance costs not listed in this section include; collection system repairs, facility and infrastructure inspections, wastewater plant consumables, electrical, motor and pump repairs or replacements, service line extensions, meter replacement, etc.

4.3 Non-Capital Projects Improvements

As various developments begin construction, there will be a need to extend sanitary sewers to serve the new development. An important step during this process is to evaluate the future expectations of the area along with the immediate needs. The City should also consider if regional improvements should be required to serve the development and, if practical, work with the developer to construct the larger line.

An option for a future project or projects that the City may be interested in is a Reclaimed Water System. The TCEQ's TAC 30 §210 provides the requirements for the City to design and construct facilities that treat wastewater to a level that it is permissible for re-use by the City or other users, including for wholesale purposes to public and private users. If a Reclaimed Water System is desired, the City should invest in a study by Planners and Engineers to determine the functional and financial feasibility of such a system.

Additionally, the rules and regulations that cover wastewater collection and treatment are updated regularly. There are projects that may be required in the future to cover these changing regulations such as sludge dewatering, nutrient removal, and phosphorous removal, to name a few. These projects were not covered in the scope of this Master Plan and funding should be collected and maintained as best as possible to ensure the City is ready for future regulatory requirements with wastewater collection and treatment.

4.4 Non-Construction Projects

In addition to the CP and O&M Projects listed, there are many non-construction related projects that can aid the City with future planning and asset allocation. Non-construction projects that should be planned and budgeted for include Policy Revisions, Maintenance Programs, and Infrastructure Assessment and Documentation.

4.4.1 Policy Revisions

We recommend creating a Sanitary Sewer System Criteria Manual to ensure the City has greater control over development as it relates to the wastewater system. Goals for policy should include guidelines for design criteria, line sizing in order to support regional development from the public sanitary sewer lines, minimum criteria, material requirements and restrictions, construction standards, and outlining options for future partnership agreements with other entities for providing wastewater treatment and/or reclamation of wastewater. Examples of design criteria include items such as requiring minimum pipe sizes based on projected flow conditions, manhole spacing requirements, or implementing *Development Impact Fees* to offset the cost of new users on an existing system.

JC and the City of Bay City updated the *City of Bay City Lift Station Design Guidelines* in 2015. These guidelines are a good start, but do not cover gravity sewers, connection to City facilities, or requirements of discharge to the City's sanitary sewer system.

4.4.2 Maintenance Programs

We recommend the City develop an official Wastewater Facilities Maintenance Program. Preventative Maintenance is key to ensure the City is maintaining the investment made in these facilities so many years ago. The City should plan to have lift station pumps pulled and rehabilitated regularly. This can aid in preventing an unplanned failure that could lead to Sanitary Sewer Overflows (SSOs) and costly last minute pump replacements.

4.4.3 Infrastructure Assessment & Documentation

Many of the City's manholes are in good condition and do not require any maintenance. However, while performing work in Bay City and collecting information we observed several manholes with corrosion issues, damaged rims and covers, lift stations and manholes that are too small for access, and some manholes that did not exist in the City's databases. In order to determine the condition of all the City's manholes we recommend a complete manhole inspection and inventory. We recommend the results be published on maps and distributed to the City and integrated online with GIS for future updates and modifications. A detailed manhole inspection program by JC can range from $100,000 to $250,000 based on the number of manholes and the type of deliverable desired.

4.5 Budgeting & Funding

As discussed in *Sections 3 and 4,* CP Nos. 1 through 3 are critical to serving the projected 2017 wastewater needs or to meet new regulatory requirements. In order to construct CPs 1 through 3, the City will need to budget for approximately $10M. We recommend the City immediately start these projects when financially able.

We recommend the City complete the top CPs and O&M Projects by 2030 totaling $28M and $8M, respectively, as presented on Table Nos. 10 & 11. These summary costs include construction, contingencies, inflation, and surveying, engineering, and construction management services. These costs do not include soft costs, such as interest or fees associated with obtaining bonds, loans, grants or other funding mechanisms.

With all of the projects mentioned in this report, the City of Bay City needs to plan for approximately $100M through 2050 for their sanitary sewer system.

The following are options available to the City for obtaining funding:

1. *Sewer Rate Increases*: The City should consider an updated Rate Order analysis to review their current sewer rates compared to similar Public Wastewater Systems of this size and age. The Rate Analysis will also review current sewer operational and maintenance costs to ensure the City is passing these costs on to the user(s) fairly and appropriately.

2. *Tax Increases*: The City should consider reviewing their current tax system to determine if there is a fair and appropriate way to collect funds for wastewater system maintenance and improvements.

3. *Grants or Low Impact Loans*: The City should investigate any and all options for Grants or Loans by local or Federal Agencies, such as the Texas Water Development Board (TWBD), Clean Water State Revolving Fund (CWSRF) Economically Distressed Areas Program (EDAP), State Water Implementation Fund for Texas (SWIFT), Texas Community Development Block Grant Program (TxCDBG), etc.

4. *Bonds*: If needed the City can explore selling bonds in order to fund the needed improvements.

The City should consider any and all funding mechanisms available to them. We recommend the City maintain budgeted cash reserves to replace wastewater facilities or collection lines in the case of unexpected failure.

5.0 SUMMARY

The City of Bay City anticipates significant growth in development, population, and wastewater flows. The implementation of sanitary sewer system improvements is critical to ensure adequate collection, storage, distribution, and treatment is available to meet the projected wastewater flows.

The City's existing sanitary sewer collection and treatment system has significant deficiencies with the ability to provide collection and treatment of flow per Texas Commission on Environmental Quality (TCEQ) TAC 30 §217 minimum requirements. In order to meet projected 2020 wastewater flows the City will have to engage in aggressive infrastructure projects to improve the existing system. See Exhibit A for the Existing Sanitary Sewer System Layout and Exhibits D and E for the Future Development and Proposed Improvements.

Additionally, the City received a revised WWTP permit in September 2015 that requires compliance within 3 years of the permit date. This revised permit has more stringent water quality thresholds that will require significant improvements to the existing WWTP facilities in order to comply with the City's current and anticipated ultimate wastewater flows.

We recommend the implementation of all Capital Projects and Operations and Maintenance Projects as identified in *Sections 4.1 , 4.2, and 4.3* of this report. These projects will total approximately $100M through 2030 based on the estimated construction costs, contingencies, inflation, and engineering, surveying, and construction management costs associated with them.

We recommend regular updates to this Sanitary Sewer System Master Plan every 5 years, or if significant changes to development are anticipated. The sanitary sewer model can be utilized in the interim with the assistance of JC to ensure any changes or additions in development are properly taken into account.