CAPACITY, MANAGEMENT, OPERATION AND MAINTENANCE (CMOM) PLAN

CITY OF CORPUS CHRISTI
DATE: JULY 20, 2020
REVISION NO 6

This CMOM Plan is a reference document for current and planned procedures and practices within the Water Utilities Department. The document should be reviewed by staff at least every two years and updated as procedures or processes change. Revisions should be logged and distributed to all staff, internal or contracted, who are responsible for implementing the plan or conducting tasks outlined by the plan.

Document Update Log

Rev. No.	Date	Section/Page	Description
1	11/6/2017	CMOM Plan	Rev. 1
2	12/7/2017	CMOM Plan	Rev. 2
3	9/7/2018	CMOM Plan	Rev. 3
4	9/19/2018	CMOM Plan	Rev. 4
5	6/7/2019	CMOM Plan	Rev. 5
6	7/20/2020	CMOM Plan	Rev. 6
7			
8			
9			
10			
11			
12			
13			
14			
15			

Contents

1. Background

The City of Corpus Christi (at times referred to as the City), the United States of America and the State of Texas have entered into a Consent Decree regarding the City's wastewater collection and treatment system (WCTS). The Capacity, Management, Operation and Maintenance (CMOM) Plan (at times referred to as the Plan) was prepared pursuant to the terms of the Consent Decree. A copy of the Consent Decree is available at www.cctexas.com. In the event of any conflict between the terms and provisions of the Plan and the Consent Decree, the terms and provisions of the Consent Decree shall prevail. The CMOM Plan is intended to be an ongoing program and will be used to manage the City's sanitary sewer collection system both during and after the Consent Decree term.

The City has prepared this document to describe the programs that comprise the CMOM Plan for the City's WCTS. The City referenced the U.S. Environmental Protection Agency (USEPA) Guidance document, *Guide for Evaluating Capacity, Management, Operation and Maintenance Programs at Sanitary Sewer Collection Systems (2005)*, to develop applicable programs designed around the City's organization, staff responsibilities, and current program status. The various programs presented, including the CMOM Plan itself, will continue to evolve through time to reflect lessons learned from on-the-ground developments and adaptive management principles.

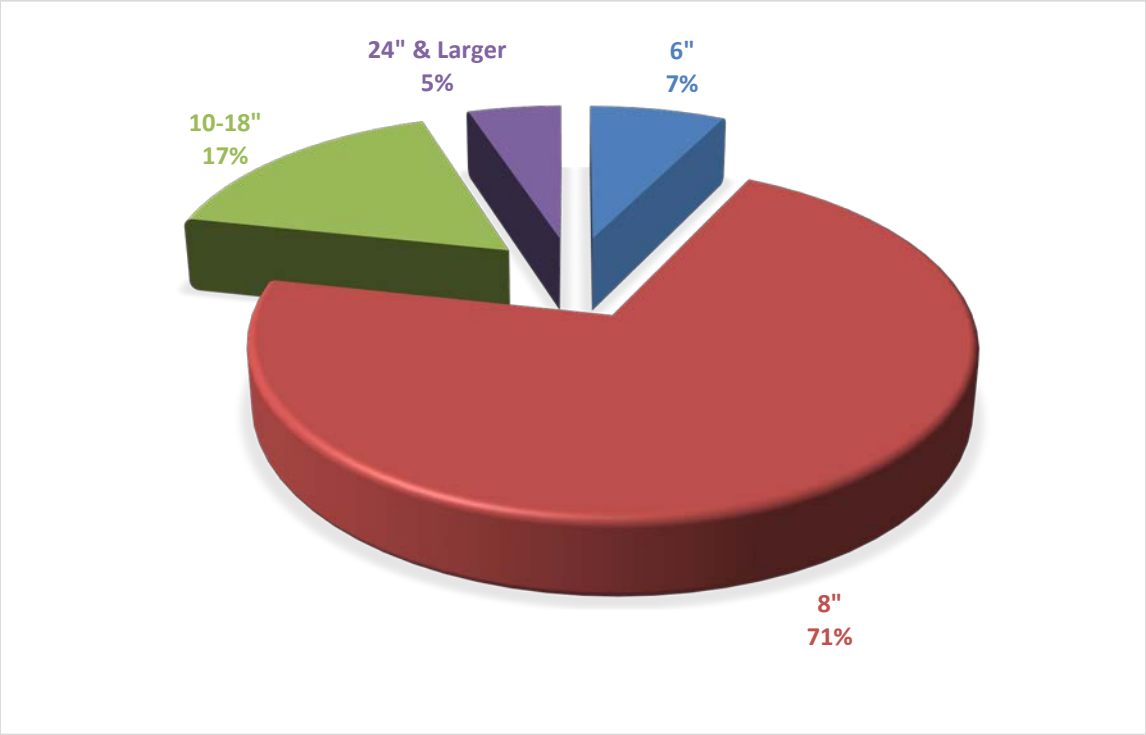
It is important that the CMOM Plan and associated programs be reviewed on a regular, biennial basis. Updating and reviewing the effectiveness of each program element will provide staff input on where resources need to be concentrated to maximize system performance. Regular review will allow written revisions (refer to Document Update Log) to the CMOM Plan to be implemented to address new concerns or priorities, and will provide a sustainable resource for future supervisors and management.

The City of Corpus Christi has no satellite communities that discharge into the collection system. The sewer collection system consists of 1,282 miles of gravity sewer mains and 102 lift stations. Figure 1 presents a summary of the Corpus Christi sewer mains by pipe diameter.

Figure 1

Sewer Collection System Inventory by Pipe Size

(Data Source: City of Corpus Christi GIS)



2. City's Mission and Plan Goals

As stated on the City's website, the Water Utilities Department mission is as follows:

> "*To protect and/or improve the health, welfare and quality of life for the citizens of Corpus Christi by providing for the collection, treatment, and disposal of wastewater in accordance with all federal, state, and local regulations in the most cost-effective manner possible*."

The City's CMOM Plan and associated programs support this mission. The overall purpose is to provide for the proper operation and maintenance (O&M) of assets while minimizing failures, malfunctions, and blockages that could contribute to sanitary sewer overflows (SSOs), including spills as defined by the Texas Commission on Environmental Quality (TCEQ). For purposes of the CMOM Plan, a TCEQ-defined accidental discharge or spill is an SSO that has a different reporting requirement as provided in the Sanitary Sewer Overflow Response Plan (SSORP).

The City currently has practices in place that meet CMOM expectations, and continues to standardize and refine documentation and data related to CMOM programs. Specific components and goals of the City's CMOM programs are presented in Table 1.

Table 1
CMOM Program Goals

Components	Major Goals
Goals	• Properly manage and operate the collection system • Provide capacity to convey peak flows • Minimize the frequency of prohibited SSOs • Mitigate the impact of SSOs
Organization	• Identify personnel responsible for implementing, managing, and updating CMOM • Chain of communication for reporting SSOs and spills
Legal Authority	• Design and construction • Installation, testing and inspection
Measures and Activities	• Collection system map • Manage Infiltration/Inflow(I/I) • Resources and budget • Prioritized preventive maintenance • Scheduled inspection and condition assessment • Contingency equipment and replacement inventories • Training • Education of homeowners and businesses • Outreach to plumbers and building contractors
Design and Construction Standards	• Standards for installation, rehabilitation and repair • Standards for inspection and testing

3. Organizational Structure

The City's organizational structure, including department descriptions and responsibilities, can change over time as management implement new programs or consolidate work functions. Figure 2 presents the current organization chart for the Water Utilities Department. The organization chart shown presents those City staff responsible for implementing, managing, and updating the CMOM Plan.

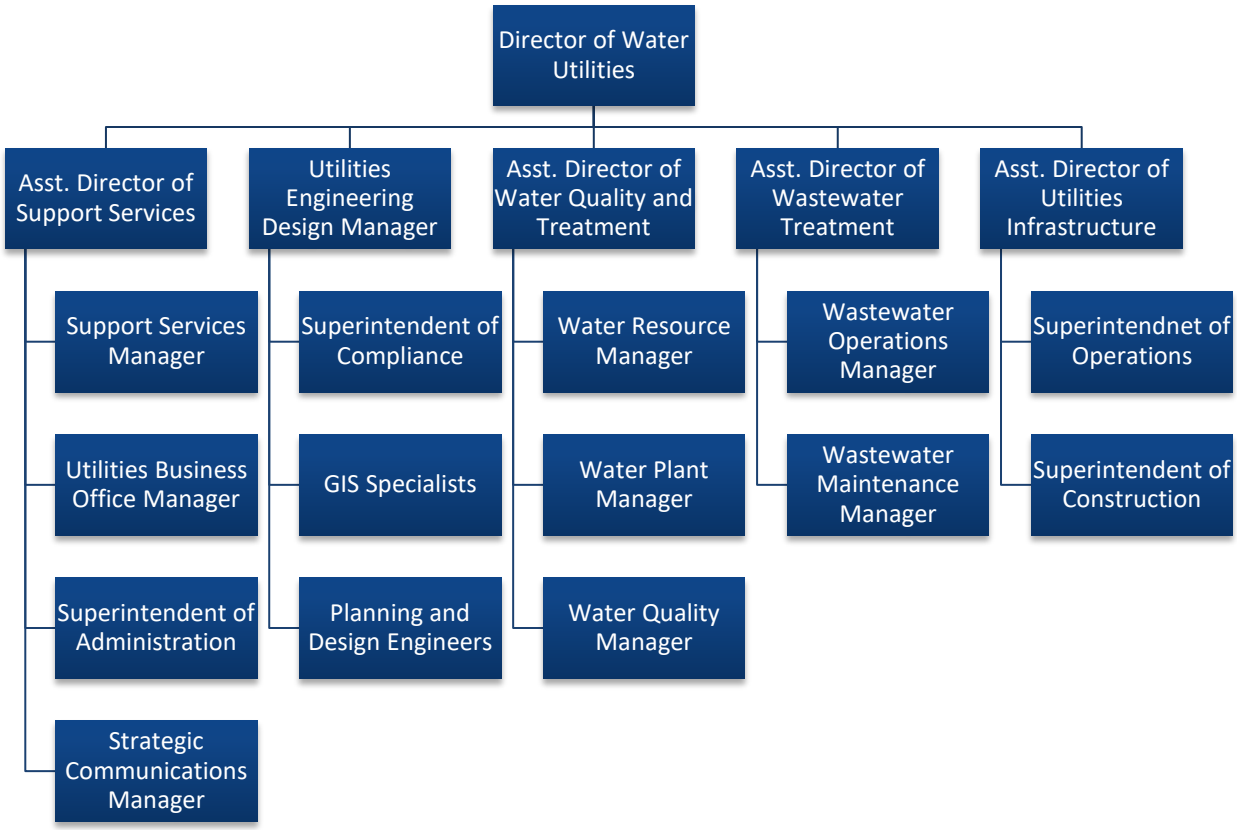
Directors and Assistant Directors– Establish department policy, planning, lead staff, allocate resources, delegate responsibility, authorize outside contractors to perform services and may serve as public information officer, prepare sewer collection system planning documents, manage capital improvement delivery system, prepare itemized budgets, and coordinate development and implementation of various water and sewer programs.

Managers and Superintendents – Manage field operations and maintenance activities, provide relevant information to management, prepare and implement contingency plans, lead emergency response, investigate and reports SSOs, oversee field crew training and scheduling, provide oversight, establish priorities and goals of sewer maintenance and sewer repair crews, review performance indicators, and maintain sewer lift stations and telemetry systems.

Field Crew – Performs maintenance activities, mobilizes and responds to notification of stoppages and SSOs, inspects and tests manholes and sewer mains for infiltration/inflow, and performs sewer repairs. Note: condition and capacity assessments may be performed by in-house staff or outsourced to consulting engineers.

Figure 2

CMOM Implementation Organizational Chart



4. CMOM Plan Components

4.1 Cleaning Program

The City currently employs a risk-based sewer cleaning program to remove debris from the sewers and to prevent blockages and potential sewer backups or SSOs. The program consists of hot spot cleaning on a site with specific frequency along with a comprehensive risk-based cleaning of all small diameter sewer mains within the collection system. The comprehensive sewer cleaning plan prioritizes those areas associated with SSOs. The City may update the small diameter neighborhood inspection order as new information becomes available that suggests reordering of priorities is warranted. Based on the results of the cleaning, the re-cleaning cycle may be revised resulting in some assets cleaned at a more frequent or less frequent cycle than other adjacent assets.

Predominate cleaning methods include jetting and jet-vacuum. Other methods include manual rodding, bucket winching and root cutting. The method usually is determined in advance and is normally contingent on the pipe type and size and on the conditions expected in the pipe. The cleaning program presented in Appendix A presents the process flow diagram used by the City of Corpus Christi and is summarized below:

A. Small Diameter Cleaning (Less than 24-inch Diameter)

All small diameter pipe is scheduled for cleaning (normally jet or jet/vac) within 10 years of the effective date of the consent decree using the prioritization method described in the Program Prioritization section. A review of cleaning and inspection results will determine the next cleaning frequency. The goal will be to clean all pipe on a 10-year cycle unless other data such as CCTV or other inspection technology demonstrates the cleaning cycle should be adjusted. Small diameter cleaning will occur by priority neighborhoods and generally be performed from the upstream portions of the neighborhood to the downstream where feasible.

B. Large Diameter Cleaning (Equal or greater than 24-inch Diameter)

Large diameter sewer, 24 inch or greater, is cleaned by Sewershed based on factors including SSO history, condition history, coordination with potential WWTP consolidation projects and coordination with other infrastructure improvements such as water or street projects. The City has prioritized the large diameter inspection and cleaning by Sewershed instead of the neighborhood-based approach described above for small diameter mains, as follows:

1. Oso
2. Broadway
3. Greenwood
4. Laguna Madre
5. Allison
6. Whitecap

As part of each manhole inspection, the City will measure the depth of debris in the associated large diameter gravity sewer main. Inspections will generally be completed in an upstream to downstream direction. The City shall clean each large diameter gravity sewer where the depth of debris exceeds twenty (20) percent of the pipe diameter at either the upstream or downstream manhole. Any large diameter gravity sewer main found to have a measured depth of debris that exceeds twenty (20) percent of the pipe diameter shall be re-inspected within five (5) years of the date that main is cleaned.

The re-inspection frequency for manholes associated with large diameter gravity sewer mains will be on a 10-year cycle, and the resulting data will be used to determine

cleaning needs for the associated large diameter sewer mains. The City may update the Sewershed inspection order of individual large diameter mains as new information becomes available to suggest reordering of priorities is warranted.

C. Lift Station Wet Wells

Lift station wet wells are monitored during scheduled maintenance inspections. Observed floating or settled debris will generally be scheduled and removed by jet-vac, as needed.

D. Hot Spot Cleaning

Certain line segments are more susceptible to blockages and may be put on the city trouble-spot cleaning list as a proactive measure. The frequency of cleaning is determined based on observed conditions. Additionally, segments may be added or removed from the list based on field observations and findings. For example, if the cleaning crews notice that little to no debris is being removed from a line segment on a three-month cleaning frequency, then the supervisor may recommend the line segment be placed on a less frequent cleaning cycle. The frequency of trouble-spot cleaning will vary based on local observations. The City's computerized maintenance management system (CMMS) is used to manage planned maintenance cycles for the cleaning crews.

E. Referral of Gravity Sewer Mains for CCTV Inspection

When cleaning activities indicate that any gravity sewer main may have a significant structural defect, each such gravity sewer main shall be inspected using CCTV and assessed in accordance with CMOM Appendix B (Condition Assessment). The conditions that may indicate significant defects include:

1. a cleaning tool cannot be passed through the pipe;
2. one or more pieces of broken pipe is observed at the downstream manhole; or
3. a significant quantity of recently infiltrated soil is observed at the downstream manhole.

F. Cleaning Documentation

Collection System cleaning is accomplished through the implementation of a work order based system which provides staff with information regarding which sewer mains need to be cleaned. After a sewer main has been cleaned, collections crews complete a cleaning record which includes the following information:

- Date and time of cleaning
- Method of cleaning
- Names of collections workers

- Location and cause of any blockage
- Observations
- Number of passes
- Type of solids encountered
- Debris level
- Recommendation of necessary further actions

The CMMS is the primary tool for maintaining history of field activities and cleaning records as well as preventive maintenance scheduling.

4.2 Sanitary Sewer Overflow Response Plan (SSORP)

The City developed a Sanitary Sewer Overflow Response Plan (SSORP) designed to ensure that reports of suspected overflows are confirmed then addressed, so the impact of the overflow can be minimized with respect to public health, adverse effects on water quality and customer service. The SSORP Manual is a standalone document prepared to detail the City's response to suspected SSOs. The manual will be used by staff to inform, train, and provide direction for SSO reporting and follow-up procedures to maintain compliance with Federal and State regulations including appropriate notification to local, state, and federal authorities.

The SSORP will be reviewed regularly and updated as needed to adapt to changing conditions, address new concerns, address regulatory changes, and implement new or revised standard operating procedures. Any amendments are approved by the Director of Water Utilities, or assigned designee, and incorporated into the plan.

4.3 Lift Station Outage Response Plan (LSORP)

The City of Corpus Christi is dependent on the normal operation of more than 100 wastewater lift stations within the collection system. A failure of a lift station may result in customer service being disrupted and lead to an SSO if it takes an extended period to return the lift station to service. Failures may be attributed to power outages, mechanical failure, lift station control failure, pump blockage, vandalism, severe storm damage, etc. For these reasons, the City has operating personnel and procedures in place to address such events to minimize the impact on customers and potential for SSOs. The detailed Lift Station Outage Response Plan (LSORP) is included in Appendix B of the Sanitary Sewer Overflow Response Plan (SSORP).

To minimize failures, City crews make routine scheduled visits to each lift station. A team of master electricians and mechanical repair staff are responsible for troubleshooting failures and performing those measures necessary to resolve failure events. Every lift station within Corpus Christi is remotely monitored with alarming capability. When an alarm is received and verified, crews are dispatched to resolve the issue. The SSORP details procedures used to address those

situations where an SSO occurs as a result of a lift station failure. The outage plan, detailed in the manual, presents the process used to restore service taking into consideration the lift station capabilities, nature of the outage, and the estimated system detention time before the outage results in an SSO.

4.4 Fats, Oils and Grease (FOG) Program

To keep the sewer collection system functioning properly and minimize blockages in the sewer mains that may cause or contribute to SSOs, the City has implemented a Fats, Oils, and Grease (FOG) Control Program. The detailed FOG program is presented in a standalone FOG Program Manual and is the primary reference document to be used by staff for implementing the FOG portion of the CMOM Plan.

The various components of the FOG Control Program include:

- Public and Commercial Education and Outreach
- Provisions for proper FOG disposal
- Legal Authority to Prohibit Discharges
- Requirements to install and maintain Grease Removal Devices (GRDs)
- Development and implementation of source control measures
- Coordination with Utilities Infrastructure staff on FOG related problems

Key program elements outlined in the FOG manual include permits and ordinances, inspections, FOG requirements, FOG haulers, education and outreach, enforcement, and FOG program performance indicators. The FOG Program Manual will be reviewed during the scheduled CMOM Plan review.

4.5 Ongoing Condition Assessment

Condition assessment programs for the collection system are critical elements to properly operate and maintain the collection system and to provide recommendations for future projects. The City has historically inspected and cleaned sewers and manholes on a routine basis. These inspection programs are necessary to determine structural integrity, root problems, etc. The City has the following on-going inspection programs:

- Pipeline Inspection
- Inspection of Manholes
- Code Compliance
- Sewer Cleaning
- Smoke Testing
- Dye Water Flooding

- Lift Station, Force Main and Air Release Valve (ARV)

Refer to Appendix B for the condition assessment process, inspection methods and category ratings used by the City.

A. Pipeline Inspection

The initial sewer inspection program will be prioritized (see Section 5. Program Prioritization) and scheduled to be completed within 10 years from the effective date of the Consent Decree. From the results of these inspections, the next inspection cycle may be revised using the pipeline condition rating established during the "Monitoring Analysis" task in Appendix B of the CMOM. In general, those pipelines with condition ratings of A and B will be inspected on a 20-year frequency, and C rating on a 10 year frequency. Professional judgement may be used to determine if these general frequencies are appropriate on a case-by-case basis for specific assets or in general based on trends that are identified over the course of the condition assessment program. In special instances, a D rated pipe that was not remediated will be placed on a 5-year frequency. During the course of sewer cleaning activities, observed conditions indicating potentially significant structural defects will be inspected using CCTV in accordance with CMOM Appendix B (Condition Assessment). In addition, "Maintenance Analysis" will occur per Appendix B to determine if O&M defects (i.e. roots or grease) or lack thereof were observed to an extent that may warrant increasing or decreasing the maintenance (cleaning) frequency for that pipe. Professional judgement, along with the defect data, current maintenance frequency, etc. may be used to determine the need for such a frequency modification. All sewer pipeline inspections are documented electronically. The City uses the NASSCO PACP defect rating system in support of the condition assessment ranking protocol. Based on the condition assessment findings, recommendations are made for future inspections, repairs, rehabilitation or replacement.

During a gravity sewer main inspection, if a visible defect is observed on the wastewater lower lateral and may significantly contribute to an SSO, then the City will take appropriate action to resolve the defect. During a gravity sewer main inspection, if a visible defect is observed on the wastewater lower lateral and the defect is unlikely to significantly contribute to an SSO, the City will monitor the wastewater lateral under the CMOM Plan.

B. Manhole Inspection

The City collects manhole condition data consistent with industry standards and guidelines. The City uses elements from a variety of standards including manuals of practice published by the Water Environment Federation, American Society of Civil Engineers, National Association of Sewer Service Companies, etc. The manhole

condition assessment form developed for the City of Corpus Christi is presented in Appendix B along with the A through E condition rating system used by staff to categorize manhole condition.

Observed defects will be reviewed and prioritized. Those manholes with defects which would result in a categorization of D or E will be reviewed first, followed by those manholes with defects which would result in manhole categorizations of A, B or C. Manholes with a rating of D or E undergo additional analysis that considers remedial measures. Based on the condition assessment, a recommendation may be made for future inspection, rehabilitation, or replacement. Such determinations occur during the "alternatives analysis" and "Monitoring Analysis" tasks as identified in Appendix B of the CMOM Plan. In general, the frequency of inspection will be 20 years for category A and B ratings and 10 years for category C ratings. Professional judgement may be used to determine if these general frequencies are appropriate on a case-by-case basis for specific assets or in general based on trends.

C. Closed-circuit Television (CCTV) Inspection

Closed-circuit Television cameras are used to visually establish the pipeline conditions as the camera is propelled through the sewer main. Any structural defects, defects contributing to Infiltration/Inflow (I/I), maintenance defects, or construction defects are recorded along with a detailed log. Internal inspection of specific sewer mains will help engineers determine the best repair options which in time will optimize overall project costs. Field documentation and digital video are used to record all findings. CCTV inspections may be performed by in-house staff and/or outsourced to contractors.

All CCTV crews conducting inspections of sewer lines for the City of Corpus Christi are required to provide the video, inspection logs and database files or data in a format that complies with the Pipeline Assessment Certification Program (PACP). Videos are provided on DVD and/or hard drives for ease of storage and use. All contractors performing CCTV inspection for new or existing sewer are required to provide the data in the PACP formats. Appendix B presents the process used for mainline condition assessment including CCTV inspection.

D. Smoke Testing

Smoke testing is another tool that the City uses to identify sources of I/I and potential defects. Areas to be smoke tested may be determined based on Infiltration/Inflow Analysis, hydraulic modeling and alternatives analysis. Study area maps are generated in GIS and notification of residents is initiated generally through the use of door hangers. The City Police Department and Fire Department and area residents are notified when performing smoke testing. Defects are documented and repair recommendations and

costs established. This testing is not performed when the ground is wet as it impacts the ability to locate and identify defects. Normally one line segment upstream and downstream of the manhole is tested at a time. Smoke testing will identify inflow sources and most restrictive conditions within sewer lines.

Field documentation of the defects includes sketches of each system defect along with pertinent information for prioritizing the defects. Data documentation will be sufficient to establish the exact location of each defect and determine the best repair method. Color photographs will be taken to document each defect during the smoke test. The location of the defect will be determined by measurement from permanent objects (corner of house, power pole, etc.). Additionally, smoke testing information may be used to generate a list of sewer mains that require internal TV inspection.

E. Dye Testing

Dye water flooding is another element that the City uses to identify sources of I/I, trace flows within the system to update system mapping, identify illicit connections and identify exact location of individual defects. Dye water flooding will be used on an as-needed basis and will generally be performed in conjunction with CCTV inspection.

F. Lift Station, Force Main, and ARV Inspections

The lift stations, although monitored continuously via SCADA and inspected during routine maintenance, require periodic in-depth condition assessment inspections to maintain reliability, to identify maintenance needs and to establish the overall condition of these critical system components. Appendix B includes the detailed Lift Station Condition Assessment Checklist used by the City. Since lift station are continually monitored and have scheduled maintenance inspections, the frequency of the more detailed condition assessment will be established by staff after the initial assessments are performed on each lift station in compliance with the Consent Decree. Factors that may be used to establish the frequency for the next condition assessment will be findings from the initial assessment, age, work order history and criticality.

Force mains convey the wastewater flows under pressure and represent about 10% of the City's wastewater system. Force mains typically consist of materials that are less commonly used in gravity sewer collection systems such as ductile iron (DI), cast iron (CI), steel, and plastic (PVC and HDPE) pressure pipe and fittings. The metal materials are susceptible to both internal corrosion from the wastewater flow and hydrogen sulfide gases, as well as external corrosion due to the environment in which the pipe is buried. Even when a force main consists of a non-ferrous pipe material such as PVC, ductile iron (DI) fittings and valves are naturally installed along the pipe length and are at a higher risk of developing a leak over time. Design standards require air release valves (ARV's) to be

installed at the high points along the line and due to corrosion, these ARVs can fail to function as originally intended.

Regular condition assessments are scheduled to be completed on force main and ARVs within 2 years of the effective date of the Consent Decree. Based on the findings, repairs may be initiated or inspection frequency changed to monitor the asset on a more frequent basis.

4.6 Ongoing Capacity Assessment

The City is committed to having sufficient capacity during dry and wet weather. To manage the system capacity requires collecting system hydraulic data and performing analysis to isolate areas of the collection system where capacity constraints exist. This includes identifying areas where, during wet weather events, excess flow from rainfall dependent infiltration/inflow (RDII) may make it difficult to transport peak flow rates.

A. Hydraulic Modeling and Master Planning

Hydraulic wastewater system models provide the tools for analyzing system conveyance capacities, bottlenecks, and potential overflow locations. The hydraulic model helps facilitate system analysis, aids in development of system improvements, produces informational maps and exhibits, and predicts the system's response to future improvements. This enables the City to assess and predict capacity requirements and develop least cost strategies to optimize system performance. Data generated from the hydraulic model provides the necessary information to ensure adequate capacity to transport and treat wastewater flows now and into the future.

SewerGEMS™ developed by Bentley Software is used for analysis of the City of Corpus Christi's sewer collection system. This software was chosen for its capabilities of analyzing systems that have complicated pumping and pressure sewers with multiple lift stations. Rainfall dependent inflow and infiltration (RDII) is computed using defined contributing areas and inflow parameters for volume and rate as determined through model calibration compared to observed rainfall and field collected flow data.

The City-wide hydraulic model consists of six (one for each treatment plant service area) individual models:

1. Oso Wastewater Treatment Plant Service Area
2. Greenwood Wastewater Treatment Plant Service Area
3. Broadway Wastewater Treatment Plant Service Area
4. Laguna Madre Wastewater Treatment Plant Service Area
5. Allison Wastewater Treatment Plant Service Area
6. Whitecap Wastewater Treatment Plant Service Area

Each is an all pipes model where each pipe, lift station and manhole within the service area is represented. Those sewer lines ten (10) inch and larger (and smaller critical sewers) are modeled using field obtained survey data. All other sewer lines smaller than 10 inches are also modeled using TCEQ minimum slope criteria. The model attribute data is periodically updated with additional field survey information that is collected and system expansion data due to new construction. This section in conjunction with Appendix C details the hydraulic model development and use for capacity assessment and assurance activities.

Modeling Benefits and Objectives

The master planning effort incorporates the hydraulic model to address the following CMOM objectives:

1. Develop a short and long-term plan that determines wastewater infrastructure modifications/improvements that ensure adequate collection system conveyance capacity.
2. Develop a management tool to improve decision making ability.
3. Generate a prioritized capital improvement program (CIP).
4. Model integration with the wastewater GIS database.

Modeling helps to identify "potential capacity constraints" under current and future conditions and to estimate the cost of predicted potential improvements needed to mitigate these deficiencies. Note that the model predicts "potential capacity constraints" that are confirmed through a more site specific, detailed field investigation.

The development of a hydraulic model for the City collection system ensures consistent assessment of future growth, maintenance, and system capital requirements for current and future conditions. Furthermore, hydraulic modeling provides the staff with pertinent data to assess system impacts from various wet weather events and will further enable the modeler to test cost effective repair strategies and alternatives. Modeling allows staff to simulate a series of possible scenarios that will help determine least cost solutions to identified hydraulic needs.

The CMOM on-going capacity assurance plan addresses short and long-term capacity issues. Short-term capacity analysis may be required to address new development while long-term capacity analysis includes future population growth. The hydraulic model is the primary tool used for performing preliminary evaluations for capacity assurance and alternatives analysis. The hydraulic model is a tool that will continue to undergo revision and recalibration as the collection system geometry changes through growth, pipeline rehabilitation or other remedial measures such as flow balancing, diversion, storage, etc.

Areas of the City that are built-out are expected to require less re-calibration. In general, the need for model re-calibration will be assessed approximately every five years.

B. Field Verification Investigation

The field verification process is presented in Appendix C along with the capacity assessment flow chart. Where the hydraulic model predicts a potential capacity constraint (PCC), then the City will investigate these PCCs in more detail which may include additional flow monitoring, physical inspection, surveying, etc. to confirm the model prediction (Confirmed Capacity Constraint) or remove the PCC from further analysis. Field verification, using various flow metering tools, is dependent on obtaining adequate rainfall data.

Should inadequate rainfall occur during the field verification monitoring period, then those PCCs under investigation will continue to be monitored by extended temporary flow monitoring, use of permanent lift station monitors, temporary surcharge event monitoring or flow level monitoring until adequate rainfall (refer to Appendix C) is obtained.

Modifications and enhancements to the field verification process should be noted during each CMOM review and Appendix C updated to document the most current procedures and flow monitoring methods being utilized.

C. Flow Monitoring

Wastewater flow monitoring establishes both the dry and wet weather hydraulic characteristics of the system. The flow monitoring data are used to establish the areas of the collection system that contribute to excessive rainfall dependent infiltration/inflow (RDII), provide data for calibration of the city-wide hydraulic model, and provide data for the engineering design. Periodic flow monitoring will continue to be performed to maintain the hydraulic model calibration and master planning efforts, verify potential capacity constraints within the collection system, and provide engineering data for specific project design.

4.7 Preventative Maintenance (PM)

The Water Utilities Infrastructure Division and Wastewater Treatment Mechanical and Electrical Maintenance team are responsible for the City's preventative maintenance activities for the WCTS. The City's CMMS generates scheduled PM work orders with a summary of work tasks to be performed. Standard Operating Procedures (SOP) are used to supplement the work order to provide details on PM activities such as Closed-Circuit Television and Gravity Main Cleaning (reference Appendix F and G respectively). The City's Condition Assessment Program provides details on additional PM activities such as air

relief valve inspections, lift station inspections, manhole inspections, and force main inspections (reference appendix B, *Condition Assessment*). Work activity results are stored electronically within the CMMS and additional work orders may be generated based on the results. Reports on activities, issues, results, and other items can then be generated through the CMMS.

5. Program Prioritization

Early year projects are generally associated with gravity sewer mains, force mains, and lift stations that require priority condition remedial measures because they have caused an SSO or are likely to cause an SSO before the submission of the Condition Remedial Measures Plan ("Priority Projects"). These assets and associated projects are expedited by the City due to their high risk. The majority of system assets will undergo cleaning and condition assessment activities using the following prioritization approach.

The City of Corpus Christi developed a risk-based cleaning and condition assessment work plan that addresses the elevated-risk portions of the City sooner in the program to mitigate the number and impact of SSOs.

Using the City GIS mapping system, historical data and asset databases, staff identified approximately 1,700 individual subdivisions that comprise the entire sewer collection system. In general, each subdivision was constructed during a relatively short time period making the asset materials, method of construction, design, soil conditions, and age similar. Sewer assets within each area have very similar characteristics with a defined downstream terminus.

The cleaning and condition assessment plan prioritizes those assets associated with historical SSOs and directs resources to address these locations early in the city-wide program. These assets with historical SSOs are grouped by subdivision and are sometimes referred to as priority neighborhoods and are addressed no later than the first four (4) years of the Consent Decree using the process and rating criteria presented in Appendix B.

The remaining neighborhoods (by subdivision) with no history of SSOs are referred to as performing neighborhoods. The performing neighborhoods program will begin on or before four (4) years after the Consent Decree Effective Date and continue until all condition remedial measures are completed. As part of the performing neighborhoods program, the City will undertake the following:

a. inspect and assess, in accordance with the rating criteria in CMOM Appendix B, gravity sewer mains and manholes not subject to either the early year or the priority neighborhood subdivisions;

b. analyze and assess, using the techniques presented in Appendix B, then select condition related remedial measures that may consider the long-term performance of the asset; the consequences of failure of the asset; the life-cycle cost for maintaining the asset; the type and severity of the defect(s); the past performance of similar assets; and the historical operation and maintenance of the asset;
c. schedule and complete condition remedial measures for all assets identified as requiring remedial action as part of the performing neighborhood program within the time designated by the Consent Decree.

City of Corpus Christi has implemented comprehensive cleaning, condition, and capacity assessment programs. As these programs are revised or updated, the most current plan and schedule will be added to the appropriate appendix.

6. CMOM Resources and Supporting Activities

The City currently has several resources and supporting activities that will require integration into the overall framework of the CMOM Plan. The following have been identified as necessary tools or functions:

6.1 Geographic Information System (GIS)

The City's Environmental Systems Research Institute (ESRI) Enterprise GIS database is a crucial tool used for asset management, analysis, planning, maps, and reporting. For decades, the City has built and maintained a GIS database of critical City infrastructure such as parcel data, zoning boundaries, utility infrastructure, and much more. New City infrastructure is added to the GIS database where it is given a unique asset identifier and then shared with other City databases and reporting systems such as the City's Computerized Maintenance Management System – MAXIMO. Tracking infrastructure with a GIS system provides an efficient way to organize, communicate, understand, and query City data. When combined with other databases, GIS technology is used by the City to produce numerous reports related to forecasting, monitoring, and asset management.

6.2 Computerized Maintenance Management System (CMMS)

The City has configured and implemented a work order and asset management system called MAXIMO. This software integrates GIS, work order management, and asset management into a comprehensive system that is supported and updated in-house and with help from outside consultants. This system has been fully implemented by the Water Utilities Department and is widely used by other city departments. The MAXIMO CMMS provides a database of information about the City's maintenance operations. MAXIMO helps organize and schedule work and provides reporting tools for documenting completed work.

The following are characteristics of the MAXIMO asset management system:

a. Each asset within the collection system has a unique identifier in MAXIMO called the asset number.
b. Collection system assets in MAXIMO include data on location, materials of construction, length, depth, and the Wastewater Treatment Plant (WWTP) associated with the asset.
c. Work order history is maintained in MAXIMO by creating work orders for specific assets. The work orders include the asset data and records of material and labor. Work orders also include log entries documenting work details, and records of problems, causes, and remedies.
d. Condition meters are utilized for many assets in MAXIMO. For example, sewer pipe cleaning provides fields for documenting details of cleaning that include debris levels, types of debris, and the number of passes required to clean the pipes.
e. Performance standards are established for operations staff that can be reported from MAXIMO. Examples of performance standards include: 1) linear feet cleaned per day, 2) manifest for debris quantity disposed; 3) number of blockages cleared per day; 4) number of repairs per day or week; etc.

6.3 Customer Service Requests

Each City department currently manages service requests and work orders using the City's CMMS. Service requests can be generated either through customer calls into the City's Customer Call Center, or requests from within any City department. City staff may communicate with residents in person, by phone or email, or through various social media. The following are information retrieval methods or communication options available to customers:

1. Customer Call Center: Telephone number 361-826-CITY (2489) is used to receive calls from the public. This number is posted on the City website and publications and provided to the media.
2. Online Service: The City website www.cctexas.com provides information on each department, frequently asked questions, and notification numbers (including the Customer Call Center).
3. Smart Phone App: CCMobile is a smart phone application that can be downloaded from the City website and is primarily used for residents to notify the City of immediate problems. Photos can be uploaded to show the specific issue to be addressed.
4. Social media accounts are used by various City departments to keep citizens informed on current issues that may affect their commute or services.
5. Email Alerts: Email notifications are routed to residents who sign-up for alerts regarding police activity, weather alerts, etc.

6.4 Engineering Standard Design, Construction, and Inspection

The City Engineering and Development Services Departments maintain record drawings and provide the design manuals for regulating construction within the City. The Standard Specifications and Detail Sheets are available for download from the City web site: http://www.cctexas.com/services/construction-and-property-services/architects-and-engineering-firms

The Engineering Service Department provides support to the Water Utilities Department. The City Engineer sets the design standards for all manners of public works construction including sanitary sewer, produces design documents for standard detail drawings and specific projects, and provides construction management for various Capital Improvement Plan projects. Support functions for the wastewater group include:

a. Standard Design Criteria - Maintaining standard design criteria and construction details for public and private sewers, streets, drainage, water distribution, treatment plants, etc.
b. Design Review - New construction review process that includes input from wastewater utilities staff.
c. Construction inspection - City performs construction inspection to ensure compliance with design plans and specifications. The city inspection group tracks warranty periods and performs follow-up warrantee inspections. New construction is inspected, as appropriate, prior to initiating the warranty period and if needed inspected again prior to expiration of the warrantee. Construction of wastewater infrastructure is verified by the inspector for compliance with procedural and materials standards.
d. As-Built Plans - As-built plans are maintained by the City Engineer and are used by the Water Utilities Department to update the collection system maps within the GIS mapping system.
e. Asset Inventory - The Water Utilities Department maintains an inventory of collection system assets within GIS and MAXIMO. Attribute data fields are defined in the database for ease of sorting data. For example, pipe size and pipe material type are in separate fields that can be tagged to facilitate sorting. All assets have unique identifiers. Newly constructed assets have unique identifiers assigned after acceptance testing or when the warranty period ends.
f. Sewer Collection System Maps - Staff relies heavily on maps for dispatching crews, performing maintenance and tracking performance. Currently, maps are maintained in GIS. It is important that the City staff continue to assign the proper asset number to work orders (manhole, pipeline, pump station, etc.) to track repair history and quantify work performed by asset type.

g. Sewer Design - The design of City initiated gravity sewer and sewer force main projects is primarily performed by the Engineering Department under the supervision of the City Engineer. Some projects involving specialized engineering expertise are outsourced to consulting firms with experience in those areas. The City has standard design specifications, detail drawings, approved materials lists and design criteria to assist staff in the design of gravity sewer and force main projects. New sewer design uses the published TCEQ Chapter 217 Design Criteria for Domestic Wastewater Systems.
h. Hydraulic Model - City staff analyzes capacity availability for new development, taking into account information and results from the City's hydraulic model.
i. Capacity Assurance - A capacity assurance plan was developed through a dynamic hydraulic model of the collection system calibrated to flow and rainfall data recorded at several locations within the collection system. The model predicts potential capacity constraints within the collection system and future possible potential capacity constraints that may develop as the system expands. The model will be updated periodically to include changes in the system inventory, land use, population, and I/I rates (if warranted).

6.5 Budgeting and Accounting Procedures

The City maintains a robust Budget and Strategic Management Department. Accounting looks backward in time and deals with financial transactions that have already occurred. Budgeting looks forward in time and attempts to predict what will occur financially. Budget and Strategic Management maintains the financial integrity of the city and provides financial management and policies, administration, audit and support services to city departments and other customers. In addition, it provides an annual budget, long-term strategic plan and analysis of financial and performance information to city departments, management and City Council to facilitate informed decisions in a manner consistent with generally accepted purchasing practices and legally mandated federal, state and local statues, ordinances and codes.

6.6 Safety and Training

Staff safety assurance and training activities are monitored by department supervisors as well as the City's Risk Management Department. The Risk Management Department serves as a resource to all City departments by providing training, education, safety seminars, etc. Each department has specialized safety concerns that are addressed during safety meetings, and formal classroom or informal on-the-job discussions.

The purpose of the training program is to provide personnel with the proper training, skills, and equipment to complete job requirements safely and in compliance with regulatory requirements. Additionally, the program defines principles under which work is accomplished, provides awareness of safe working procedures to employees, and

establishes and enforces specific regulations and procedures. Safety training is documented and maintained by the department conducting the training. The Water Utilities Department provides safety training to all staff, including office personnel. Safety training topics include lockout/tagout, understanding and accessing Safety Data Sheets, chemical handling, confined space permitting and entry, trenching and excavations, bloodborne pathogens, traffic control and work site safety, electrical and mechanical systems, pneumatic and hydraulic systems, and emergency response.

Each department is responsible for establishing job-specific training requirements. The Water Utilities Department offers on-the-job training for topics such as customer service conflict resolution and communication, the City's CMMS, computer software (Microsoft Word, Excel, etc.), and detailed tasks specific to the various programs the department oversees.

The training program provides a mechanism for educating employees and establishing technical competence through external training partners and programs such as the Texas Rural Water Association (TRWA), Texas A&M Engineering Extension Service (TEEX), Texas Water Utilities Association (TWUA), Water Environment Association of Texas (WEAT), National Association of Sewer Service Companies (NASSCO), or other certification programs. The City utilizes a combination of in-house skills training and the purchase of specialized training through state and national associations, conferences and vendor programs to enhance skills for performing daily work duties, and provides certified operators continuing education hours to maintain licensing.

Courses or training offered by the City conducted either by City personnel or through training partners include but are not limited to: basic wastewater, calculations, collection system, customer service inspector, management, Pipeline Assessment Certification Program (PACP), pumps and pumping, safety, wastewater treatment, wastewater lab, Manhole Assessment Certification Program (MACP), lift station inspections, and sanitary sewer overflow response. Courses that are eligible for continuing education credit through TCEQ are maintained electronically through the TCEQ licensing website.

7. **Key Performance Indicators**

The City defined key performance indicators that can be used for monitoring the effectiveness of the CMOM program elements. Appendix D summarizes the key performance indicators the City uses to monitor the CMOM program elements and establish operational related trends.

The City reviews the key performance indicators on an annual basis to determine operational trends and evaluate possible reorganization of program resources. As the CMOM Plan is implemented, the trends should become stable and outliers can be further evaluated to determine if changes to various CMOM programs are warranted to address specific concerns. For example, if SSOs associated with grease trend upward, then FOG inspections and public outreach may be increased to address the grease issue. This trending analysis is also a tool to monitor the CMOM Plan effectiveness in reducing SSO frequency and volume.

8. **CMOM Review Updates**

The CMOM Plan provides the framework and documentation to implement the programs that the City feels will best serve its customers and residents. This Plan is meant to be a working document and will be updated on a two-year cycle, based on the City's ongoing review. Revisions to the CMOM Plan should be recorded on the Document Update Log. The following could be anticipated during the life of the CMOM:

1. Review the CMOM Plan protocols and program elements for applicability and relevance
2. Review CMOM budget for adequacy to meet recommendations
3. Monitor performance indicators and interpret results
4. Determine if goals remain applicable to the City
5. Provide recommended changes to the Plan
6. Update the CMOM Plan
7. Prepare summary reports on annual review of key performance indicators
8. Prepare Annual CMOM Report in compliance with Consent Decree

9. Program Guidance and Sources

Texas Secretary of State. (accessed 2020, July). *Texas Administrative Code Title 30, Part 1, Chapter 217 Design Criteria for Domestic Wastewater Systems.*

United States Environmental Protection Agency. (2005, January). *Guide for Evaluating Capacity, Management, Operation, and Maintenance (CMOM) Programs at Sanitary Sewer Collection Systems.*

Appendix A

Corpus Christi System-Wide Cleaning Program Process and Guidelines

Appendix A

Corpus Christi System-Wide Cleaning Program Process and Guidelines

This appendix is meant to illustrate the requirements of Section V.C of the Consent Decreee ("CD"). Significant detail exists in the CD that is not in this Appendix. To the extent that this Appendix and the CD are inconsistent, the CD controls.

Small Diameter (SD) Gravity Sewer Mains – Less than 24-inches in Diameter
CD Section V.B, Paragraphs 14, 15 and 17

Plan, Schedule, and Conduct System Wide SD Cleaning and Visual Inspection Program

Implement System-wide SD Gravity Sewer Main Cleaning and Visual Inspection Activities
CD Paragraphs 14 and 15.c and e

- Clean SD Gravity Sewer within 10 years of the Effective Date.
- Annually clean a minimum of 12% of the total SD Gravity Sewer Main miles. Repeat "Hot Spot" cleaning miles may be counted towards the 12% annual minimum.

Implement Repeat "Hot Spot" Gravity Sewer Cleaning and Visual Inspection Activities
CD Paragraphs 15.d

- Gravity Sewer Mains will be selected for repeat cleaning and cleaning frequencies will be determined as warranted based on Cleaning Findings, including:
- City best professional judgment
- SSO root cause information
- CCTV findings
- Previous sewer cleaning findings

Assess Visual Inspection Data

- Evaluate whether pipe should be referred for a more detailed inspection

Refer for CCTV inspection if warranted

- *CD Paragraph 17*
  Guidelines for referral include:
  - Cleaning Tools will not pass through pipe
  - Pieces of broken pipe
  - Significant quantities of soil observed at downstream manhole

Evaluate Cleaning Findings

Guidelines for evaluation of gravity sewer cleaning findings

Pipes Included in Hot Spot Program:	Pipes Not in the "Hot Spot" Program:
• Minor – Reduce Frequency • Moderate – Keep at Current Frequency • Heavy – Increase Frequency	• Heavy – Add Pipe to the "Hot Spot" Program

Note: These are recommendations based on business logic that a person reviews to accept, reject, or revise.

Review and Implement Cleaning Frequency Changes

- Manually review recommendations:
  - Accept recommendation
  - Reject recommendation
  - Revise recommendation
- Update the Preventive Maintenance Cleaning module in CMMS with Accepted changes

Appendix A
Corpus Christi System-Wide Cleaning Program Process and Guidelines

Large Diameter (LD) Gravity Sewer Mains – Greater than or Equal to 24-inch Diameter
CD Section V.B, Paragraphs 14, 16 and 17

Plan, Schedule, and Conduct Initial LD Inspection Activities
Paragraph 16.a

Inspect manholes associated with LD Gravity Sewer Mains within 4 years of the Effective Date. Measure the depth of debris in the associated LD Gravity Sewer Main via the upstream and the downstream manholes.

Clean LD Gravity Mains
Paragraph 16.b

Inspection Data Evaluation Guidelines to Determine Cleaning Needs

The City shall clean each LD Gravity Sewer Main segment where the depth of debris in the LD Gravity Sewer Main, as measured in such LD Gravity Sewer Main at either the upstream or downstream manhole, exceeds twenty (20) percent of the pipe's diameter. The following LD cleaning milestones shall be reached from the Effective Date: at least 30% will occur within 6 years; at least 60% will occur within 8 years; 100% will occur within 10 years.

Re-inspection Frequency
Paragraph 16.c

Any LD Gravity Sewer Main found to have a depth of debris, as measured in the pipe at either the upstream or downstream manhole, that exceeds twenty (20) percent of the pipe diameter shall be re-inspected within five (5) years of the date that main is inspected, unless main is cleaned within that five (5) year period, in which case it will be re-inspected within five (5) years of the date that the main is cleaned. Re-cleaning and re-inspection frequencies for all other Large Diameter Gravity Mains will be determined as part of the CMOM program.

Refer for CCTV inspection if warranted
CD Paragraph 17

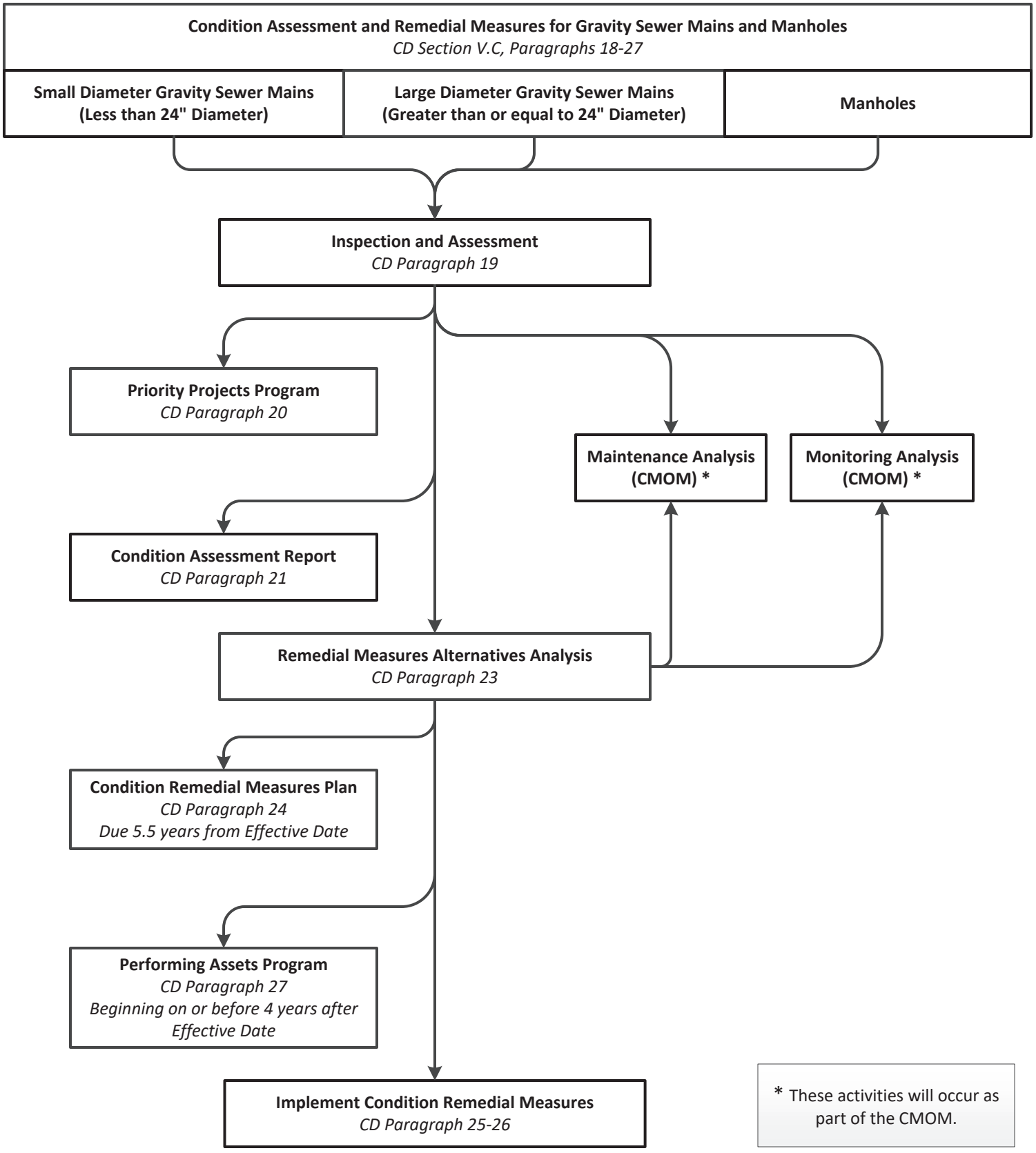
- Guidelines for referral include:
  - Cleaning Tools will not pass through pipe
  - Pieces of broken pipe
  - Significant quantities of recently infiltrated soil observed at downstream manhole

Appendix B

Condition Assessment and Remedial Measures Approach

Appendix B
Condition Assessment and Remedial Measures Approach

This appendix is meant to illustrate the requirements of Section V.C of the Consent Decree ("CD"). Significant Detail exists in the CD that is not in this Appendix. To the extent that this Appendix and the CD are inconsistent, the CD controls.



Appendix B
Condition Assessment and Remedial Measures Approach

Plan, Schedule, and Conduct System Wide Inspection Activities

Small Diameter Gravity Sewer Mains (Less than 24" Diameter)
CD Paragraphs 19.a and 19.a.ii

Inspection methods

- For non-PVC pipes as described in Paragraph 19.a.ii.1. and non-PVC pipes in the Performing Assets Program Subdivisions installed before 1974 as described in Paragraph 19.a.ii.2:
  - CCTV
- For performing Assets Program pipe installed between 1974 and 1982):
  - CCTV or pole camera
- For remaining pipes, including PVC and Performing Assets Program pipes installed between 1983 and the date ten years prior to the Effective Date:
  - CCTV, or
  - sewer cleaning findings; or
  - pole camera inspections; or
  - mechanical proofing; or
  - smoke testing; or
  - dye testing; or
  - other techniques as they become available commonly utilized by other sewer management agencies.

Prioritize pipes for inspection

- Prioritize pipes per the Prioritization Approach Appendix C
- Additional inspections as needed for investigations

Schedule and conduct inspection activities

- Generally, schedule inspection activities in conjunction with small diameter gravity sewer main cleaning

Large Diameter Gravity Sewer Mains (Greater than or equal to 24" Diameter)
CD Paragraphs 17, 19.a and 19.a.i

Inspection method

- For all pipes referred in accordance with Paragraph 17:
  - CCTV; or
  - other full length internal visual inspection.
- For all other pipes (CD Paragraph 19):
  - CCTV; or
  - Sonar; or
  - 360-degree video; or
  - laser imaging; or
  - visual inspection; or
  - physical entry; or
  - other techniques as they become available commonly utilized by other sewer management agencies.

Prioritize pipes for inspection

- Prioritize pipes per the Prioritization Approach Appendix C.
- Additional inspections as needed for investigations.

Schedule and conduct inspection activities

Manholes
CD Paragraph 19.b

Inspection Methods

- Visual

Schedule and conduct inspection activities

- Inspections of manholes associated with Small Diameter Gravity Lines Mains shall generally be conducted on the same schedule used for the inspection of the associated Gravity Sewer Main, or sooner.
- Inspections of manholes associated with Large Diameter Gravity Sewer Mains shall generally be completed within four (4) years of the Effective Date.

Gravity Sewer Main Condition Assessment

The City shall perform assessments of Gravity Sewer Mains in accordance with the requirements of Section V.C of this Decree, and using the following guidelines:

1. Prioritize the review of inspection data based on the severity of findings. For Example, prioritize review of Gravity Sewer Mains using PACP Quick Ratings. In general, review pipes with grade 5 and 4 defects first, followed by pipes with grade 3, 2, or 1 defects.
2. Categorize all inspected Gravity Sewer Mains using the following table:

Category	Example Structural Conditions	Likely Outcome
E - Very Poor Condition	Structural collapse, which has or could likely cause SSO; or collapse imminent	Alternatives Analysis
D - Poor Condition	Significant missing material or broken material, severe corrosion with exposed pipe wall reinforcement, or pipe wall deformation greater than 25% from structural deterioration combined with hinge fractures.	Alternatives Analysis
C - Fair Condition	Pipe wall deformation less than 25% from structural deterioration combined with hinge cracks, displaced fractures, or moderate corrosion - but no pipe wall reinforcement visible.	Monitoring Analysis or Maintenance Analysis under CMOM
B - Good Condition	Pipe wall deformation from construction impacts or less than 10% of diameter from structural deterioration, minor corrosion, slightly open non-displaced fractures, or other moderate material degradation.	Maintenance Analysis under CMOM
A - Very Good Condition	Mild defects which may include tight non-displaced cracks or other mild material degradation.	Maintenance Analysis under CMOM

- Perform analysis on inspection data and consider appropriate criteria which may include factors such as the following:
  - Type and severity of structural defects, long-term performance of asset, the life-cycle cost, and consequence of failure
  - Historical operation and maintenance data: overflows, inspections, cleaning findings, cleaning frequency, previous remediation, customer complaints, and other unique circumstances for each individual asset
  - Site conditions: Property rights, access for maintenance and construction, depth, soil type, environmental sensitivity, surface restoration requirements, and other unique circumstances for each individual asset

See Page 3

Appendix B
Condition Assessment and Remedial Measures Approach

See Page 2

Manhole Condition Assessment

The City shall perform assessments of manholes in accordance with the requirements of Section V.C of this Decree, and using the following guidelines:

- Prioritize the review of inspection data based on the severity of findings. For example, prioritize review of manhole inspections using the worst defect(s) and its location. Those manholes with defects which would result in a categorization of D or E would be reviewed first, followed by those manholes with defects which would result in manhole categorizations of A, B or C.
- Manhole I/I observations will be considered in the Capacity Remedial Measures Alternatives Analysis process identified in Paragraph 28.i of the Consent Decree and the Capacity Remedial Measures Alternatives Analysis box in Appendix D (see page 4 of 4) for confirmed capacity constraints that may be candidates for an inflow and/or infiltration reduction remedial measure project.
- Categorize all inspected Gravity Sewer Manholes using the following table:

Category	Example Structural Conditions	Likely Outcome
E - Very Poor Condition	Manhole collapse or collapse imminent, or other significant defect that has caused or could likely cause an SSO. -Such structural defects indicating potential structural failure may include: missing bricks, casting failure, severe corrosion in the wall and/or base and broken/missing cover and frame.	Alternatives Analysis
D - Poor Condition	Severe corrosion, large open cracks, and significant missing bricks or broken walls, castings, covers, frames, or other significant defect that has caused or could likely cause an SSO –Such structural defects may include: one or more large, open cracks,separated casting, adjustment failure significant damaged cover and frame, significant corrosion of metal surfaces, significant deterioration of concrete mortar between bricks, and significant deterioration of precast wall sections and precast joint defects.	Alternatives Analysis
C - Fair Condition	Moderate structural defects including moderate cracks, corrosion, and deterioration of walls, castings, covers, and frames. Such defects may include two or more closed cracks, loose casting, loose bricks, moderate corrosion of metal surfaces, and moderate deterioration of concrete mortar between bricks.	Monitoring Analysis under CMOM
B - Good Condition	Minor structural defects including small cracks, minor deterioration of walls, castings, covers, and frames. No moderate or severe structural defects. Single closed crack, minor frame/cover defects, minor manhole corrosion.	Maintenance Analysis under CMOM
A - Very Good Condition	No defects or cosmetic defects such as non-displaced cracks. A manhole with no minor, moderate or severe structural defects, only cosmetic defects observed, if any.	Maintenance Analysis under CMOM

See Page 4

Appendix B
Condition Assessment and Remedial Measures Approach

See Page 3

Condition Assessment Report
CD Paragraph 21
See Condition Assessment Report Template in Appendix F

Condition Remedial Measures Alternatives Analysis
CD Paragraph 23

Analyze and assess the techniques available to address condition-related defects identified in the Sewer Collection System that were not remediated as part of the Early Year Program. Select Condition Remedial Measures for all assets identified as requiring remedial action based upon criteria including the likely long-term performance of the asset; the consequence of failure of the asset; cost; the type and severity of the defects(s); past performance of similar assets; and the historical operation and maintenance of the asset (e.g. overflows, inspections, cleaning findings, cleaning frequency, previous remediation, customer complaints, and other unique circumstances for each individual asset). Such solutions and techniques may include, but are not limited to:

Gravity Sewer Mains:

- Point Repairs: Spot repairs or remediation of a portion of the pipe segment using trenchless or open-trench remediation.
- Pipe Rehabilitation: Trenchless sewer remediation from manhole to manhole such as lining or grouting
- Pipe Replacement: Replacing the sewer from manhole to manhole including pipe bursting, cured-in-place pipe, or slip-lining
- Other remediation techniques (such as new technologies or methods that become available)
- Monitoring Analysis or Maintenance Analysis (performed as part of CMOM)

Manholes

- Manhole Repair or Rehabilitation: Poured in place liners, Cured in place liners, Cementitious coating, Polymer coating, Mechanical seals and insert replacement, Ring or Cover replacement, Manhole frame adjustment and resealing, Bench/Pipe/Chimney/Joint seals
- Manhole Replacement: Manhole removed and new structure installed
- Other remediation techniques (such as new technologies or methods that become available)
- Monitoring Analysis or Maintenance Analysis (performed as part of CMOM)

Maintenance Analysis (CMOM) *
Adjust maintenance type or frequency as warranted.

Monitoring Analysis (CMOM) *
Update inspection method and schedule next inspection date as warranted.

* These activities will occur as part of the CMOM.

Implement Condition Remedial Measures
CD Paragraphs 25-26

- Implement Condition Remedial Measures
- City may implement Condition Remedial Measures generated consistent with this appendix prior to submittal of the Condition Remedial Measures Report and this work shall be credited towards compliance

Condition Remedial Measures Plan
CD Paragraph 24

- See Condition Remedial Measures Report Template in Appendix H
- Schedule and prioritizations shall be based on: the severity of defects identified; frequency and history of SSOs; pipe size, age and material; maintenance history; appropriate grouping of Sewer Collection System assets for bid packages and neighborhood disruption reduction; scheduling practicalities; coordination with Capacity Remedial Measures; and other appropriate factors.

Performing Assets Program
CD Paragraph 27

Beginning on or before 4 years after Effective Date implement a program of inspection, assessment and remediation of Gravity Sewer Mains and manholes associated with Small Diameter Gravity Sewer Mains, not subject to either the Early Year Program or the Condition Remedial Measures Plan.

City of Corpus Christi - Lift Station Assessment Form

Lift Station Name _____ **Type** _____

Location/Address _____

Lift Station Asset ID _____ **Number of Pumps** _____

Firm Capacity in GPM (all pumps operating) _____

Firm Capacity in GPM (largest pump out of service) _____

Inspector _____ **Date** _____

* For purposes of this Lift Station Assessment Form, unless marked with an asterisk (*), all "Poor" ratings signify defects likely to cause or contribute to an SSO. Where an asterisk (*) is provided next to a category, a "poor" rating in that category shall not result in evaluation under the Condition Remedial Measures Alternative Analysis of the Corpus Christi Consent Decree with the U.S. Environmental Protection Agency and Texas Commission on Environmental Quality.

** Refer to CMOM Plan

Building and Grounds

			Good	Fair	Poor	N/A
***Building Structure**		Type: _____				
	*Building Roof/Ceiling		◯	◯	◯	◯
	*Building Finishes		◯	◯	◯	◯
	*Building Doors and Windows		◯	◯	◯	◯
	*Building HVAC	Type: _____	◯	◯	◯	◯
***Fencing**		Type: _____	◯	◯	◯	◯
	*Gates	Type: _____	◯	◯	◯	◯
***Site/Grounds**		Size: _____	◯	◯	◯	◯
	*Lighting		◯	◯	◯	◯
***Pavement (Driving)**		Type: _____	◯	◯	◯	◯
***Drainage**		Type: _____	◯	◯	◯	◯
***Odor**	Comment: _____		◯	◯	◯	◯
	Odor Control System	Type: _____	◯	◯	◯	◯
	Odor Control Mechanical		◯	◯	◯	◯
	Odor Control Media	Type: _____	◯	◯	◯	◯
***Noise**			◯	◯	◯	◯
***Overall Site Appearance**			◯	◯	◯	◯

Comments _____

Structural

				Good	Fair	Poor	N/A
Wet Well		Size:					
	**Debris			○	○	○	○
	**Fats, oils, and grease			○	○	○	○
	*Ventilation			○	○	○	○
	Walls	Material:		○	○	○	○
	*Coatings	Type:		○	○	○	○
	*Access Hatches	Number:		○	○	○	○
	*Slab			○	○	○	○
Dry Well/Valve Vault							
	Walls	Material:		○	○	○	○
	*Coatings	Type:		○	○	○	○
	*Grating/Hatching	Number:		○	○	○	○
	*Stairway/Ladder	Material:		○	○	○	○
	Sump/Pump	Number:		○	○	○	○
	*Ventilation	Type:		○	○	○	○

Comments _____

Mechanical

					Good	Fair	Poor	N/A
Quick Connect	(Circle)	YES	/	NO				
Piping and Valves								
	Suction Valve	Number:			○	○	○	○
	Check Valve	Number:			○	○	○	○
	Discharge Valve	Number:			○	○	○	○

			Good	Fair	Poor	N/A
Riser Piping	Material:		◯	◯	◯	◯
Discharge Piping	Material:		◯	◯	◯	◯
Fittings	Material:		◯	◯	◯	◯

Comments

Pumps

Pump 1

Asset ID _____ Make _____ Model _____

Capacity _____ GPM

Impeller Dia./Code _____ Horsepower _____

	Good	Fair	Poor	N/A
Pump	◯	◯	◯	◯
Seals	◯	◯	◯	◯
Motor	◯	◯	◯	◯
Shaft	◯	◯	◯	◯
Electrical Cable	◯	◯	◯	◯
*Noise	◯	◯	◯	◯
*Vibration/Heat	◯	◯	◯	◯

Pump 1 *The following components are to be inspected during pump disassembly*

	Good	Fair	Poor	N/A
*Oil	◯	◯	◯	◯
Impeller	◯	◯	◯	◯
Packing Rings	◯	◯	◯	◯
Internal Seals	◯	◯	◯	◯

Pump 2 Asset ID _____ Make _____ Model _____

Capacity _____ GPM

Impeller Dia./Code _____ Horsepower _____

	Good	Fair	Poor	N/A
Pump	◯	◯	◯	◯
Seals	◯	◯	◯	◯
Motor	◯	◯	◯	◯
Shaft	◯	◯	◯	◯
Electrical Cable	◯	◯	◯	◯
*Noise	◯	◯	◯	◯
*Vibration/Heat	◯	◯	◯	◯

Pump 2 *The following components are to be inspected during pump disassembly*

*Oil	◯	◯	◯	◯
Impeller	◯	◯	◯	◯
Packing Rings	◯	◯	◯	◯
Internal Seals	◯	◯	◯	◯

Pump 3 Asset ID _____ Make _____ Model _____

Capacity _____ GPM

Impeller Dia./Code _____ Horsepower _____

	Good	Fair	Poor	N/A
Pump	◯	◯	◯	◯
Seals	◯	◯	◯	◯
Motor	◯	◯	◯	◯
Shaft	◯	◯	◯	◯
Electrical Cable	◯	◯	◯	◯
*Noise	◯	◯	◯	◯
*Vibration/Heat	◯	◯	◯	◯

Pump 3 *The following components are to be inspected during pump disassembly*

	Good	Fair	Poor	N/A
*Oil	◯	◯	◯	◯
Impeller	◯	◯	◯	◯
Packing Rings	◯	◯	◯	◯
Internal Seals	◯	◯	◯	◯

Pump 4 Asset ID _____ Make _____ Model _____

Capacity _____ GPM

Impeller Dia./Code _____ Horsepower _____

	Good	Fair	Poor	N/A
Pump	◯	◯	◯	◯
Seals	◯	◯	◯	◯
Motor	◯	◯	◯	◯
Shaft	◯	◯	◯	◯
Electrical Cable	◯	◯	◯	◯
*Noise	◯	◯	◯	◯
*Vibration/Heat	◯	◯	◯	◯

Pump 4 *The following components are to be inspected during pump disassembly*

*Oil	◯	◯	◯	◯
Impeller	◯	◯	◯	◯
Packing Rings	◯	◯	◯	◯
Internal Seals	◯	◯	◯	◯

Pump 5 Asset ID _____ Make _____ Model _____

Capacity _____ GPM

Impeller Dia./Code _____ Horsepower _____

	Good	Fair	Poor	N/A
Pump	◯	◯	◯	◯
Seals	◯	◯	◯	◯
Motor	◯	◯	◯	◯
Shaft	◯	◯	◯	◯
Electrical Cable	◯	◯	◯	◯
*Noise	◯	◯	◯	◯
*Vibration/Heat	◯	◯	◯	◯

Pump 5 *The following components are to be inspected during pump disassembly*

*Oil	◯	◯	◯	◯
Impeller	◯	◯	◯	◯
Packing Rings	◯	◯	◯	◯
Internal Seals	◯	◯	◯	◯

Pump 6 Asset ID _____ Make _____ Model _____

Capacity _____ GPM

Impeller Dia./Code _____ Horsepower _____

	Good	Fair	Poor	N/A
Pump	◯	◯	◯	◯
Seals	◯	◯	◯	◯
Motor	◯	◯	◯	◯
Shaft	◯	◯	◯	◯
Electrical Cable	◯	◯	◯	◯
*Noise	◯	◯	◯	◯
*Vibration/Heat	◯	◯	◯	◯

Pump 6 *The following components are to be inspected during pump disassembly*

	Good	Fair	Poor	N/A
*Oil	◯	◯	◯	◯
Impeller	◯	◯	◯	◯
Packing Rings	◯	◯	◯	◯
Internal Seals	◯	◯	◯	◯

Electrical System

					Good	Fair	Poor	N/A
Electrical System Power	Volt/Phase:							
Panel/Enclosures	NEMA4X	YES	NO		◯	◯	◯	◯
Transformers (AEP)					◯	◯	◯	◯
Disconnect	Type:				◯	◯	◯	◯
Generator	KW				◯	◯	◯	◯
Transfer Switch					◯	◯	◯	◯
Electrical System Control								
Breakers	Type:				◯	◯	◯	◯
Speed control/VFD	Type:				◯	◯	◯	◯
Starters	Type:				◯	◯	◯	◯
Control Relays	Type:				◯	◯	◯	◯

Comments

Instrumentation/SCADA

				Good	Fair	Poor	N/A
Panel	NEMA4X	YES	NO	◯	◯	◯	◯
Instrumentation							
Level	Type:			◯	◯	◯	◯
Flow	Type:			◯	◯	◯	◯

Instrumentation/SCADA (continued)				Good	Fair	Poor	N/A
	PLC	Type:		◯	◯	◯	◯
SCADA				◯	◯	◯	◯
	RTU	Type:		◯	◯	◯	◯
	Radio/Antenna	Type:		◯	◯	◯	◯

Comments

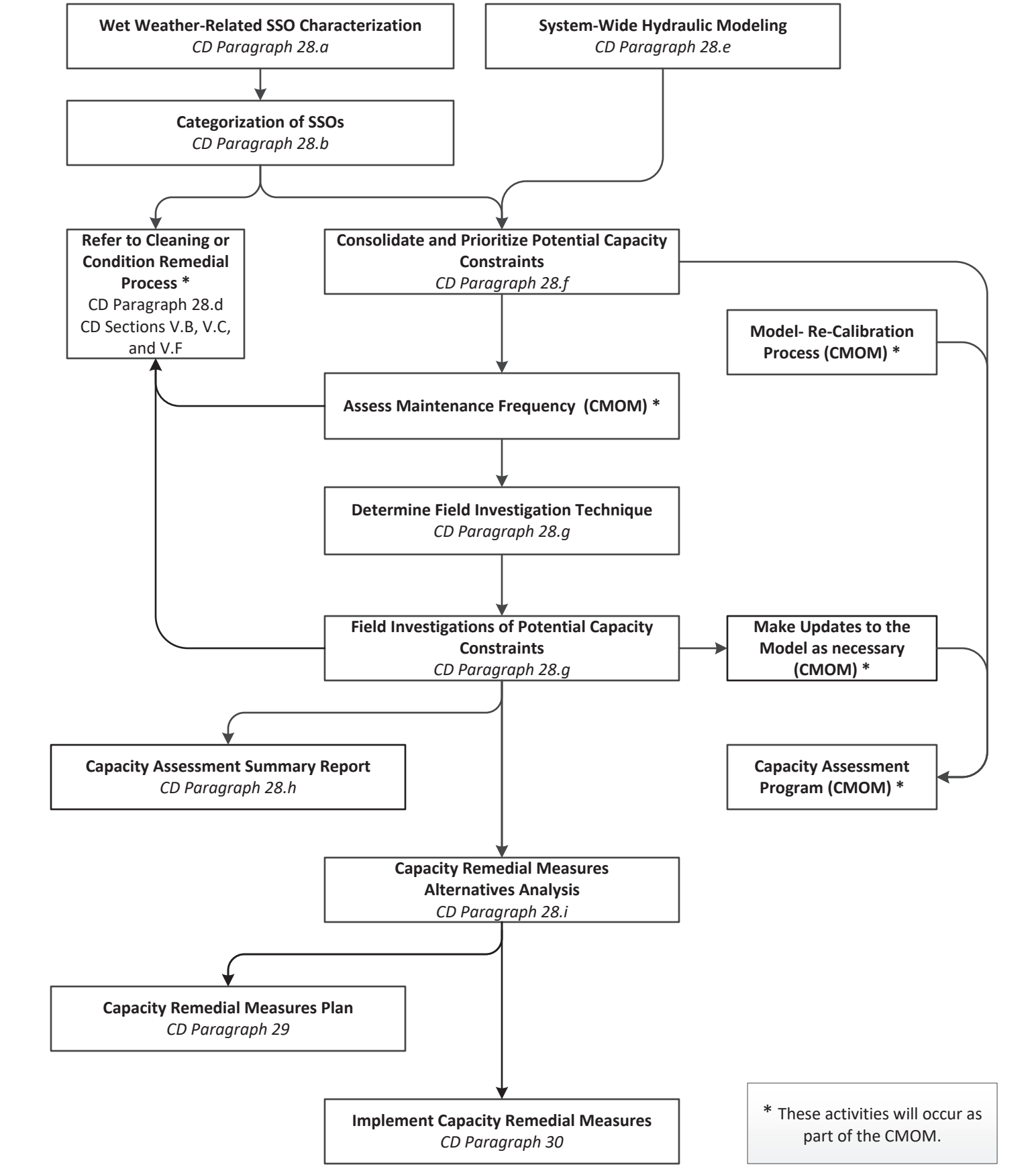
Appendix C

Capacity Assessment and Remedial Measures Approach

Appendix C

Capacity Assessment and Remedial Measures Approach

This appendix is meant to illustrate the requirements of Section V.D of the Consent Decree ("CD"). Significant detail exists in the CD that is not in this Appendix. To the extent that this Appendix and the CD are inconsistent, the CD controls.



Appendix C

Capacity Assessment and Remedial Measures Approach

Wet Weather-Related SSO Characterization *CD Paragraph 28.a*

- Evaluate SSOs during wet weather events 4 years before and 3 years after Effective Date
- Activities may include as appropriate, but are not limited to:
  - Review available records
  - Talk to staff that performed the post-SSO investigation
  - Consult with cleaning and repair crews
- *Wet weather events are rain events that exceed 1-inch over a 24-hour period*

Categorization of SSOs *CD Paragraphs 28.b*

A) Most likely a capacity-related SSO. Existing data indicate that there does not appear to be a history of maintenance or structural issues that may have led to the SSO.

B) Most likely maintenance related or condition related. Existing data indicate that the cause is most likely a maintenance-related cause such as FOG, roots, or debris, or a condition-related cause, such as a protruding lateral or an offset joint, but there may also be a Capacity Constraint at the SSO location.

C) Not a capacity-related SSO. Existing data indicate that the SSO was not capacity related. Examples include isolated events such as pool or colling towers being drained into the sewer system or cleaning maintenance related issues such as significant FOG, roots, or debris.

System-Wide Hydraulic Modeling

CD Paragraph 28.e

- Corpus Christi will use a 5-year, 24-hour assessment storm at existing population scenario in the model as the assessment parameters to identify discrete system components that result in a Priority 1 through 5 categorization as described in the "Consolidate and Prioritize Potential Capacity Constraints" box below.
- Identify Priority 1 through 5 potential Capacity Constraints.

Refer to Cleaning or Condition Remedial Process *

CD Paragraph 28.d

CD Section V.B

CD Section V.C

CD Section V.F

Consolidate and Prioritize Potential Capacity Constraints *CD Paragraph 28.f*

Priority 1 - Category A SSO and the Hydraulic Model also predicts SSO within the assessment parameters.

Priority 2 - Where Hydraulic Model predicts SSO within the assessment parameters, but with no observed SSO. Category A SSO, but the Hydraulic Model does not predict SSO within the assessment parameters.

Priority 3 - The Hydraulic Model predicts hydraulic grade line (HGL) near ground elevation within the assessment parameters.

Priority 4 - Category B SSO.

Priority 5 - The Hydraulic Model predicts that pipe design capacity is exceeded for sustained 60 minutes or more but the HGL is not near the ground elevation within the assessment parameters.

Notes

- *The list above represents criteria for use by City in prioritizing the potential Capacity Constraints that may warrant Field Investigation. The City will prioritize field investigations by, in general, starting at the top of the list, with Priority 1 taking the highest priority and Priority 5 taking the lowest priority. In general, the City shall start with Priority 1 and work towards lower priorities as higher priority field investigations are concluded. Corpus Christi may reprioritize potential Capacity Constraints as new information becomes available or adjustments to the model are made.*
- *Priorities 1-4 are more likely than 5's to warrant field investigation, though this shall be determined based upon a case-by-case engineering assessment (for example, such as inverted siphons which are intentionally operated submerged with HGL above pipe crown).*
- *Priority 5's shall be kept on a monitoring list or go to field investigation as warranted based upon a case-by case engineering assessment. Priority 5's that do not go to field investigation shall be kept on the potential Capacity Constraint list and monitored as updates are made to the model.*

* These activities will occur as part of the CMOM.

Assess Maintenance Frequency Data (CMOM) *

Evaluate, and modify as needed, the maintenance frequency for each pipe under investigation to prevent blockages that would significantly reduce design capacity during the investigation

See Page 3, Determine Field Investigation Technique

Model Re-calibration Process (CMOM) *

- Collect additional flow metering data over time
- Collect additional rain gauge data over time
- Apply appropriate observed storm events to model
- Calibrate the model to match measured flows (for both dry and wet weather flows)
- Assess calibration anomalies and adjust model

Notes

- *This process is currently planned to occur as needed in the future depending on system growth/change rate or other factors.*
- *If needed, model re-calibration will be performed as part of CMOM*

See Page 3, Make Model Updates as Necessary

Appendix C

Capacity Assessment and Remedial Measures Approach

See Page 2

See Page 2

Determine Field Investigation Technique

CD Paragraph 28.g

Determine which Field Investigation Technique is most appropriate for each identified potential Capacity Constraint

- Flow measurement
- Level measurement
- Visual inspection
- Other (specify)

Field Investigations of Potential Capacity Constraints *CD Paragraph 28.g*

City shall implement selected field investigation technique at each location with a priority 1-4 potential Capacity Constraint until a significant wet weather event occurs in order to determine whether there is a significant wet weather response. In performing field investigations, the City shall adhere to the following guidelines:

- Significant wet weather events are rain events that exceed 1-inch over a 24-hour period.
- The assessment storm is a 5-year, 24-hour storm at existing population scenario.
- If the HGL is at or near ground surface elevation during a wet weather event less than 1-inch over a 24 hour period, identify as a Verified Capacity Constraint and refer for remedial measures alternatives analysis.
- For significant wet weather events that are less than the assessment storm, the following guidelines apply:
  - Apply observed storm to Hydraulic Model and determine predicted HGL at the potential capacity constraint location. Compare predicted HGL from Hydraulic Model to observed HGL. Corpus Christi will use its best professional judgment to adjust the Hydraulic Model if appropriate.
  - If observed HGL is at or above the Hydraulic Model's predicted HGL at the observed storm:
    a. For Priority 1, 2 and 3: identify as a Verified Capacity Constraint and refer for alternatives analysis, as appropriate
    b. For Priority 4 and 5: evaluate on a case-by-case basis and refer to alternatives analysis, as appropriate
  - If observed HGL is less than the Hydraulic Model's predicted HGL at the observed storm:
    a. For Priority 1 and 2:
      i. If Hydraulic Model predicts an overflow at the assessment storm, evaluate on a case-by-case basis and refer for remedial measures alternatives analysis, as appropriate.
      ii. If Hydraulic Model does not predict an overflow at the assessment storm, remove these sites from the field investigation program as appropriate. The City will continue to monitor these sites as part of CMOM.
    b. For Priority 3, 4, and 5: remove the site from the field investigation program as appropriate. The City will continue to monitor these sites as part of CMOM.
- *The City will determine that no capacity constraint exists at a site when a wet weather event occurs that is approximately equal to or exceeds the assessment storm, and no overflow takes place. Any such sites will be removed from the field investigation program and monitored in the future as part of CMOM*
- *Where no significant wet weather response occurs, the City will remove a location from the field investigation program*

Make Updates to the Model as Necessary (CMOM) *

- Such updates may include calibration opportunities based on flow meter data, updates to attributes found during the field investigation, accounting for debris loading, or other relevant new data

Notes

- *Updates will be performed as part of CMOM*

See Page 4

Capacity Assessment Summary Report

(CD Paragraph 28.h)

See Capacity Assessment Report Template in Appendix I.

Report to be reviewed and commented upon by EPA.

* These activities will occur as part of the CMOM.

Appendix C

Capacity Assessment and Remedial Measures Approach

See Page 3

Capacity Remedial Measures Alternatives Analysis

As required by Paragraph 28.i, the City shall complete an analysis of the available remedial measures to address Verified Capacity Constraints. As part of this process, the City shall:

- Utilize existing data and collect any necessary additional field data such as:
  - Smoke testing
  - Dye testing
  - Flow metering
  - CCTV
  - Survey information
  - Manhole inspection data
  - Other data as needed
- Use engineering analysis to determine which solution is most likely to resolve the constraint at the lowest possible cost considering both long-term performance and life-cycle cost. Possible measures include: (1) re-routing a portion of upstream wastewater flows, (2) Reducing flows entering the WCTS from customers, (3) reducing inflow, (4) reducing infiltration, (5) Increase conveyance capacity of WCTS, (6) building upstream flow detention facilities, (7) continued monitoring, or (8) other engineering solutions.
- Apply the design parameters and TCEQ required growth projection to determine appropriate pipe sizing, as needed.
- For convey and treat projects, the City shall evaluate potential downstream impacts including the ability of the WWTP to handle the flow.

Implement Capacity Remedial Measures (CD Paragraph 30)

- Prioritize remedial measures and periodically evaluate priorities
  - Generally, review severity of Capacity Constraints identified during inspections, frequency and history of capacity-related SSOs, pipe size, age and material, maintenance history, relationship of Capacity Constraint areas of the WCTS to growth-related improvements and/or condition-related improvements, practical planning considerations and other criteria determined to be appropriate by Corpus Christi.
- Coordinate with condition remedial measures as needed
- Allocate budget
- Design as needed
- Implement remedial measures

Capacity Remedial Measures Plan
(CD Paragraph 29)

- See Capacity Remedial Measures Plan Template in Appendix J
- Plan reviewed and approved by EPA.

Appendix D
Key Performance Indicators

The following presents the metrics that will be used to monitor the CMOM Program. The performance indicators may change over time as better metrics and methods to measure progress are developed.

Key Performance Indicators

Key Performance Indicators	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
1) Annual Number of SSOs:										
Fats, Oil, and Grease										
Capacity or I/I										
Roots										
Debris										
Lift Station Failure										
Structural Failure										
other										
Total Volume of SSOs:										
2) Annual Number of TCEQ Spills:										
Fats, Oil, and Grease										
Capacity or I/I										
Roots										
Debris										
Lift Station Failure										
Structural Failure										
other										
Total Volume of TCEQ Spills:										
3) Public SSO Notification Reports Issued										
4) Total Number of Food Service Establishments										
a. Number of Inspections										
b. Number of Issued Citations and Violations										
5) Total Sewer Cleaned [1]										
a. Small Diameter										
b. Large Diameter										
6) Total Sewer CCTV										
a. Small Diameter										
b. Large Diameter										
7) Total Manhole Inspections										
8) Total Force Main Inspections										
9) Total ARV Inspections										
10) Total Lift Station Inspections										

Note 1: Miles cleaned includes hot spot cleaning

	City of Corpus Christi Utilities – Maintenance of Lines Standard Operating Procedure **First Responders**	**MOL-SOP-011**	
		Rev:	**2.0**
		Date:	**11 / 2019**
		Page:	**1 / 4**

REVISION HISTORY

Rev.	Date	Author	Description of Change
1.0	April, 2013	Bruce Short	Initial Release
1.1	April 2014	Bruce Short	Recertified – No Revision
2.0	November 2019	Anna Richardson	Major Re-write; New Number System

PURPOSE AND APPLICABILITY

PURPOSE: To establish a uniform procedure for City of Corpus Christi Utilities First Responders

APPLIES TO: City of Corpus Christi Utilities – Maintenance of Lines

DESCRIPTION OF SYSTEM

The City of Corpus Christi Water Utilities Department is responsible for responding to reports of problems or damage to Water Utilities group which includes; water distribution, wastewater collection, and storm water collection. In order to quickly respond and accurately address these reports, the department employs utility first responders. A first responder is dispatched to the reported address to evaluate the issue and direct the proper response.

SAFETY WARNINGS

Technicians performing this function are to follow all the safety procedures set forth by the city and department. Water utilities department requires all technicians to wear safety boots, reflective safety vest, hard hat, protective gloves, safety glasses at a minimum. The correct safety signage and traffic control equipment must be in place before any work is performed. Traffic control must adhere to the Texas Manuel on Uniform Traffic Control Devises, TMUTCD.

PROCEDURE

The first responders work is driven by reports of problems or damage to the water utilities systems. These reports usually come from citizens who observe problem and report them to the city help line at 361-826-CITY (2489). Once a problem is reported, a work order is generated in Maximo CMMS (Computerized Maintenance Management System). The work order typically includes an address and description of the issue that was observed. New work orders are assigned to the first responders for response.

After hours first responders are called out and receive work orders thru the city dispatchers 361-885-6942 located in the city gas department. First responders will receive and respond to all calls for water leaks, no water, flooding, wastewater backups/spills/ overflows, cave-ins, missing lids or manhole covers. Additionally issues that may not be water utilities but will need to be investigated.

1. First responders are to check in at the beginning of their shift with the shift foreman and will receive their assigned work orders through Maximo on their assigned Ipad / Tablet.
    a. There are three rotating shifts.
        i. Day shift works 8-hour days from 7:00 am to 3:30 pm and ½ hour lunch.
        ii. Afternoon shift works 8-hour days from 11:30 am to 8:00 pm and ½ hour lunch.
        iii. Evening shift works 10-hour days from 1:30 pm to 12:00 midnight and ½ hour lunch.
        iv. On-call shift is from 12:00 midnight to 7:00 am.
    b. On-call responder will be called out to respond to high priority issues after hours as needed.
2. After receiving assigned work order, responders will place themselves in progress on Maximo using their assigned Ipad / Tablet and proceed to the location.
    a. Secure your personal safety. Park your vehicle safely per Risk Management Procedure *R8.0 Driving Rules and Regulations.*
    b. Secure the site to ensure the safety of the general public. Use traffic cones to mark hazards. Use traffic control barriers as needed to protect vehicle and pedestrian traffic around the site.
    c. Secure City Infrastructure and property.
3. Evaluate the site and determine if utility is affecting critical or sensitive services such as medical facilities, multi-unit residential properties, single resident or businesses that have critical needs. Properly document and record this in Maximo.
4. For water distribution system related calls:
    a. Determine if leak is on the main, main to meter, meter, fire hydrant or a customer leak.
    b. Determine where the leak is; in the street, between curb and sidewalk, ditch line, side or rear easement.
    c. If leak is on the customer side, note approximate location, document in Maximo and notify the customer.
    d. If water leak can be repaired on the spot, make the repair, complete the Maximo work order and notify the customer.
    e. Report main leaks (flooding or causing damage), no water issues and any other major issues that need immediate attention to the appropriate crew foreman.
    f. Mark area of excavation with white paint and/or stakes.
    g. Call in emergency line locates for the affected area per MOL-SOP-017 *Utility Line Locations*.
    h. Document in detail your findings, any actions taken, and the Emergency Line Locations # in the Maximo work order logs.

i. Take photographs of leak and area, save to Maximo.

j. Notify the customer of issue and what is being done to restore service.

5. For wastewater calls for clogged services or backups:

   a. Determine extent of issue, main line or service blockage. Start by checking the up-stream manhole. If down and flowing, route or jet service lateral to restore service.

   b. After providing service, Document in detail your findings and actions taken, complete the Maximo work order and notify the customer.

   c. Create follow up work order to inspect to determine cause of backup.

   d. If unable to provide service or the wastewater main line system is blocked or surcharged, document in detail all findings and actions taken in the work order logs. Notify the customer. Mitigate work order to the vactor crew. The vactor crew will take possession of the work order and any follow up work.

6. For wastewater calls for Collapsed Gravity Mains:

   a. Notify the Response Foreman of the collapse and its severity.

      i. A **Minor** collapse will not adversely impact public safety or cause major service disruptions. An example of a minor collapse would be one that is in a rear easement and on a main smaller than 12" diameter.

      ii. A **Major** collapse may adversely impact public safety and/or cause major service disruptions. An example of a major collapse would be one that is in a public right of way (road, sidewalk, etc.) and/or on a main 12" or larger.

   b. Secure the area to protect public safety.

   c. Mobilize Vactor Trucks as required.

   d. Response Foreman will notify the Repair Foreman, and coordinate with the Work Coordinator to determine the need for a by-pass.

   e. Repair Foreman will take over security for the site, initiate any necessary by-pass to maintain service, and coordinate the repair.

   f. If contractors are needed to assist with repairs, notify the Construction General Foreman to coordinate assistance from contractors. Contractors will take ownership of all job sites and tasks for which they are contracted.

7. For wastewater calls for Force Main Breaks:

   a. Locate the break and determine which Lift Station powers the force main.

   b. Secure the area to protect public safety.

   c. Notify the Response Foreman. The Response Foreman will estimate the time frame for repairs and consult with the Work Coordinator to determine if the lift station can be maintained by in-house forces or require contractor assistance for a by-pass.

   d. Contact wastewater Major Maintenance to deactivate the Lift Station.

e. Notify the Repair Foreman. The Repair Foreman will take over site security, make repairs, and/or coordinate assistance from contractors for by-pass operations if necessary.

f. If contractors are needed to assist with repairs, notify the Construction General Foreman to coordinate assistance from contractors. Contractors will take ownership of all job sites and tasks for which they are contracted.

First responders will investigate and troubleshoot all work orders that are assigned and either resolve the issue or mitigate the work to the appropriate department. First responders are to ensure all work orders are properly completed or mitigated in Maximo and that all required staff notifications are made. All work sites or issues that require further work shall be secured for public safety.

QUALITY ASSURANCE AND QUALITY CONTROL

The shift Foreman will evaluate all first responders work orders to ensure they were properly escalated and / or completed in Maximo. Shift foreman will verify that all required documentation is logged, uploaded and work order is properly coded. First responders are often viewed as the face of the water utilities department and must always maintain a professional appearance and treat customers with respect. Our goal is to always provide excellent customer service while interacting with our customers and to maintain the excellent reputation of the City of Corpus Christi Water Utilities Department.

First Responders should provide as much detail as possible on the First Responders form, and on the Maximo work order. Describe the site evaluation, safety devices left, repairs made, and any repairs needed with enough detail that repair crews know what is needed before they arrive to make repairs. Avoid using jargon or abbreviations in the Maximo Logs.

First Responders are often viewed as the face of the Water Department when on site evaluating problems and leaks. Maintain a professional appearance at all times. Always treat customers with respect. Strive to provide excellent customer service any time you interact with our customers to maintain the excellent reputation of the City of Corpus Christi Utilities Department.

APPROVALS

Technical Review		Administrative Review	
Name:	Aaron Richardson	Name:	Tom LaVake
Title:	Utilities Sys Manager	Title:	Operations Superintendent
Signature:	Aaron Richardson	Signature:	
Date:	11-05-2019	Date:	11-6-19

	City of Corpus Christi Utilities – Maintenance of Lines Standard Operating Procedure **Inspecting Wastewater Lines - CCTV**	**MOL-SOP-032**	
		Rev:	**1.0**
		Date:	**05/2020**
		Page:	**1 / 3**

REVISION HISTORY

Rev.	Date	Author	Description of Change
1.0	May 2020	Jimmy Torres	Initial Release

PURPOSE AND APPLICABILITY

PURPOSE: To define a routine procedure for inspecting wastewater lines using Closed Circuit Television (CCTV)

APPLIES TO: All City of Corpus Christi Utilities – Maintenance of Lines Technicians

DESCRIPTION OF SYSTEM

The City of Corpus Christi Utilities – Maintenance of Lines division maintains the wastewater collections system. An important component of the maintenance is to inspect the lines by televising. Inspections are conducted on newly installed lines to verify that the installation was done properly, and on existing lines to identify structural failures or defects. CCTV is the primary tool for these inspections.

The city uses commercial trucks with a combination of high-pressure water jetting and a high flow vacuum to clean existing mains and remove debris prior to CCTV inspections. These trucks are commonly referred to as “Vactor Trucks” because the manufacturer of most of the trucks in the fleet is Vactor®. Detailed instructions on cleaning wastewater lines using a Vactor can be found in MOL-SOP-007 *Wastewater Collection System Maintenance – Vactor Trucks.*

The CCTV trucks used to televise the lines are self-contained box trucks that have all the necessary equipment onboard to conduct the inspections. The main components of the inspection system are a cable reel and winch, fiber optic cable, a robotic crawler with lights and cameras, a controller, and a computer with Wincan pipeline inspection software.

SAFETY WARNINGS

Contact with raw sewage is a potential health hazard. Care should be taken to prevent contamination of uniform, skin, and tools by using the appropriate personal protective equipment (PPE).

1. Minimum PPE includes hardhat, steel toe boots, safety glasses or face shield, reflective safety vest, hand sanitizer, and hearing protection. Rubber gloves shall be worn when handling equipment that contacts raw sewage.
2. Practice safe lifting when carrying cameras and equipment.
3. Secure the jobsite with proper traffic control devices before beginning work.
4. Always use a manhole cover lifter bar and follow safe lifting procedures when lifting and moving manhole covers.
5. Secure the work site prior to leaving. Never leave an active work site or open manholes unattended.

PROCEDURE

CCTV video Inspection of the wastewater collection infrastructure is conducted on designated sectioned areas as assigned by maximo. The CCTV inspection crew should video inspect, on average, 1000 feet daily. The CCTV inspection crew is to conduct inspections on assigned main line segments and record pipe integrity of existing and new wastewater main lines per department needs and requirements.

VEHICLE INSPECTION / MAINTENANCE

Daily, weekly, and monthly inspection and maintenance is required for personnel safety and vehicle performance. Conduct manufacturer recommended inspections and maintenance accordingly on both the Vactor and CCTV trucks in accordance with the Maximo PM work orders.

NEW MAINLINE INSPECTION PROCEDURES

1. Conduct job site inspection:
    a. Contact inspector.
    b. Set inspection date.
    c. Create Maximo work order.
2. Position the CCTV truck at selected manhole, secure the site with proper traffic control.
3. Remove manhole cover to perform the CCTV inspection.
4. Have vactor truck add water to the upstream manhole.
5. Set up CCTV Wincan program and enter the engineering plan information.
6. Make sure camera has appropriate air to keep water out.
7. Slide tiger tail over cable before attaching camera to protect cable wiring.
8. Set up the camera according to pipe size, place camera inside manhole, and adjust camera start footage count.
9. While operating the camera, do not exceed 30 ft/min. speed.
10. Conduct and record the inspection. Enter pipe condition information as needed.
11. Wash and clean camera after removing the camera from the manhole.
12. Complete the inspection followed by completing the report on Wincan.
13. Replace manhole cover, pick up traffic control devices, and continue to the next segment for inspection.
14. After the inspection is complete, notify the city inspector and utilities engineering group.
15. Enter information in Maximo and complete work order.

EXISTING MAINLINE INSPECTION

1. Use the Maximo work order to verify asset locations.
2. Clean and prepare the main line using a Vactor per MOL-SOP-0007.

3. Position the CCTV truck at selected manhole, secure the site with proper traffic control.
4. Open and remove manhole cover and conduct a visual inspection.
5. Set up CCTV Wincan program and enter the engineering plan information.
6. Make sure camera has appropriate air to keep water out.
7. Slide tiger tail over cable before attaching camera to protect cable wiring.
8. Set up the camera according to pipe size place camera inside manhole and adjust camera start footage count.
9. While operating the camera, do not exceed 30 ft/min. speed.
10. Conduct and record the inspection. Enter pipe condition information as needed.
11. Wash and clean camera after removing the camera from the manhole.
12. Complete the inspection report on Wincan.
13. Replace manhole cover, pick up traffic control devices, and continue to the next segment for inspection.
14. Enter information in Maximo and complete work order. Create child work orders for any structural failures or defects found during the inspection.

QUALITY ASSURANCE AND QUALITY CONTROL

Shift foreman will verify that all required documentation is logged, uploaded, and the work orders are properly coded. City technicians are often viewed as the face of the water utilities department and must always maintain a professional appearance and treat customers with respect. Our goal is to always provide excellent customer service while interacting with our customers and to maintain the excellent reputation of the City of Corpus Christi Water Utilities Department.

TRAINING

1. PCAP Training
2. Minimum Class 1 Wastewater Collections Operator License

APPROVALS

Technical Review		**Administrative Review**	
Name:	_____	Name:	_____
Title:	_____	Title:	_____
Signature:	_____	Signature:	_____
Date:	_____	Date:	_____

	City of Corpus Christi Utilities – Maintenance of Lines Standard Operating Procedure **Wastewater Collection System Maintenance Vactor Truck**	**MOL-SOP-007**	
		Rev:	**2.1**
		Date:	**07/2019**
		Page:	**1 / 5**

REVISION HISTORY

Rev.	Date	Author	Description of Change
1.0	January 2019	Bruce Short	Initial Release
2.0	May 2019	Bruce Short	Add Maintenance and Inspections
2.1	July 2019	Bruce Short	Revise SOP Number

PURPOSE AND APPLICABILITY

PURPOSE: To define a routine procedure for maintaining wastewater collection system gravity mains using a Vactor truck

APPLIES TO: All City of Corpus Christi Utilities – Maintenance of Lines Technicians

DESCRIPTION OF SYSTEM

The City of Corpus Christi Utilities - Maintenance of Lines division maintains the wastewater collection system. Maintenance activity is performed to remove blockages from wastewater lines and for routine preventative maintenance.

Blockages in collection mains are usually caused by an accumulation of material in the pipe, or by structural failures or defects. Accumulated material includes fats, oil, grease, gravel, silt, or sediment. Structural failures can include broken or collapsed pipes, or separation of pipe joints. Defects such as protruding taps may catch debris and cause a buildup of solids that block the main. Root intrusion through structural defects is also a major contributor to blockages.

The city uses commercial trucks with a combination of high pressure water jetting and a high flow vacuum to unclog collection mains and remove debris. These trucks are commonly referred to as “Vactor Trucks” because the manufacturer of most of the trucks in the fleet is Vactor®. High pressure water flows through a nozzle to propel the nozzle and loosen debris. The high flow vacuum removes loosened debris from the main. Vactor Trucks are deployed to clear backups in mains. The trucks are also used in a preventive maintenance program that targets problem mains to prevent overflows from occurring.

SAFETY WARNINGS

Contact with raw sewage is a potential health hazard. Care should be taken to prevent contamination of uniform, skin, and tools by using the appropriate personal protective equipment (PPE).

1. Minimum PPE includes hardhat, steel toe boots, safety glasses or face shield, reflective safety vest, hand sanitizer, and hearing protection. Rubber gloves shall be worn when handling equipment that contacts raw sewage.
2. Wastewater collection manholes are considered confined spaces. Never enter a manhole without first notifying a supervisor and following confined space entry procedures.

3. Secure the jobsite with proper traffic control devices before beginning work.
4. Always use a manhole cover lifter bar and follow safe lifting procedures when lifting and moving manhole covers.
5. Vactor Truck operation requires at least 2 Technicians.
6. Use caution when moving the vacuum boom around employees, power lines and trees.
7. Secure the work site prior to leaving. Never leave an active work site or open manholes unattended.

PROCEDURE

VEHICLE INSPECTION / MAINTENANCE

Daily, weekly, and monthly inspection and maintenance is required for personnel safety and vehicle performance. Conduct manufacturer recommended inspections and maintenance accordingly.

1. Manufacturer and department daily vehicle inspection must be performed daily and to include:
    a. Daily House Keeping. Remove all trash and debris.
        i. Cab
        ii. Tool boxes
        iii. Work area
    b. Drain daily
        i. Cyclone debris box
        ii. Air tanks for brake system
    c. Sludge tank and seal
        i. Clean and inspect at the end of every shift
        ii. Inspect and flush sludge tank drain valve
    d. Jetter hose and reel
        i. Inspect prior to and during every use
    e. Hydraulic gauge
        i. Inspect hydraulic fluid level
    f. Water tank air gap
        i. Inspect and remove any debris

TROUBLE CALLS

Trouble calls come in from citizens reporting backups in homes or businesses, or wastewater overflows to the ground or street. Utility First Responders respond to these calls and determine whether the backup is in the service or the main. If the backup is in the main a Vactor Truck crew is called in to service the main.

1. Determine the extent and location of the backup. Jet the section of pipe between the free flowing and backed up manholes.
    a. Open the manhole nearest the address of the complaint to see if wastewater is backed up in the main. Be sure to close the manhole after checking.
    b. Continue opening manholes moving downstream until a free-flowing main is found. Be sure to close each manhole after checking. Do not leave open manholes unattended. Open service line cleanouts near or at the mainline blockage. The blockage will be downstream of the full manhole.
    c. Use department approved nozzles with the rating of 60 gpm at 2,000 psi.
2. Position the truck at the downstream manhole, secure the job site with proper traffic control, and remove the manhole cover.
3. Assemble a nozzle jet and tiger tail to the hose. **Use a nozzle jet type that reduces the chances for blowing toilets such as the Softblaster®**. Push the hose/jet into the manhole and direct the jet toward the upstream section of pipe.
4. Assemble the vacuum tube extensions. Align the vacuum boom with the manhole and insert the vacuum tube into the manhole. **Note: Use of the vacuum will be at the discretion of the crew leader. In situations where there is poor access or when the manhole is in an unsafe location, clogs may be jetted clear without vacuuming the debris.**
5. Use department approved nozzles with the rating of 60 gpm at 2000 psi. Jet water toward the upstream manhole using minimal pressure while simultaneously vacuuming any dislodged debris.
    a. Start at 600 psi and work toward the blockage.
    b. Increase pressure incrementally as required to clear the blockage.
    c. Maximum target pressure should be 1500 psi.
    d. Notify a supervisor before exceeding 1500 psi. Pressure should never exceed the maximum nozzle operating pressure of 2000 psi.
6. If necessary, retrieve the jet and repeat the process until the clog is cleared. It may be necessary to change the jet for different types of clogs.
7. If the Softblaster® type nozzle does not resolve the issue, another department approved nozzle may be used following the same procedure.
8. Vacuum debris during both directions of jetting.
9. When the clog is clear, wind the hose and jet back downstream with minimal jet pressure. Throttle the jet down as it reaches the first manhole.
10. For blockages that cannot be cleared:
    a. Note the position of the hose when it reaches the blockage with a piece of tape.
    b. Retrieve the hose and then extend it above ground in the direction of the main to pin-point the location of the blockage using the tape mark on the hose. Remember to account for the manhole depth.
    c. Mark the location of the blockage on the surface using white paint.

d. Create a repair Work Order to excavate the main and remove the blockage. Notify a supervisor that the blockage could not be cleared.

11. Monitor the flow in the main long enough to verify that the clog remains cleared.
12. Replace manhole covers and secure the worksite. Conduct a walk-around of the truck and job site before leaving the site.
13. If the Trouble Call came from a home or business, return to the address, verify that their service is down and flowing, and notify the customer.
14. Clean and dump the back tank at the end of each daily shift. Conduct a walk-around of the truck before leaving the dump site.

PREVENTIVE MAINTENANCE CALLS

Preventive maintenance calls (PMs) are conducted on previously identified sections of main. Unlike trouble calls, the section of main to be serviced is known at the start of the job. Vactor Truck crews conduct PMs on known sections of main to prevent overflows from occurring.

1. Position the truck at the downstream manhole, secure the job site with proper traffic control, and remove the manhole cover.
2. Assemble a nozzle jet and tiger tail to the hose. **Use a nozzle jet type that reduces the chances for blowing toilets such as the Softblaster®**. Push the hose/jet into the manhole and direct the jet toward the upstream section of pipe.
3. Assemble the vacuum tube extensions. Align the vacuum boom with the manhole and insert the vacuum tube into the manhole. **Note: Use of the vacuum will be at the discretion of the crew leader. In situations where there is poor access or when the manhole is in an unsafe location, lines may be maintained without vacuuming the debris.**
4. Jet water toward the upstream manhole using minimal pressure while simultaneously vacuuming any dislodged debris.
    a. Start at 600 psi and work toward the blockage.
    b. Increase pressure incrementally as required to clear the blockage.
    c. Maximum target pressure should be 1500 psi.
    d. Notify a supervisor before exceeding 1500 psi. Pressure should never exceed the maximum nozzle operating pressure of 2000 psi.
5. Repeat the jetting process until all debris is cleared.
6. Vacuum debris during both directions of jetting.
7. If the Softblaster® type nozzle does not resolve the issue, another department approved nozzle may be used following the same procedure.
8. When the line is clean wind the hose and jet back downstream with minimal jet pressure. Throttle the jet down as it reaches the first manhole.
9. For blockages that cannot be passed:
    a. Note the position of the hose when it reaches the blockage with a piece of tape.

b. Retrieve the hose and then extend it above ground in the direction of the main to pin-point the location of the blockage using the tape mark on the hose. Remember to account for the manhole depth.

c. Mark the location of the blockage on the surface using white paint.

d. Create a repair Work Order to excavate the main and remove the blockage. Notify a supervisor that the blockage could not be cleared.

10. Clean all spills and overspray with the vacuum.
11. Replace manhole covers and secure the worksite. Conduct a walk-around of the truck and job site before leaving the site.
12. Note the type and amount of debris removed on the field logs.
13. Clean and dump the back tank at the end of each daily shift. Conduct a walk-around of the truck before leaving the dump site.

END OF SHIFT DAILY CHECKS

At the end of each daily shift perform the following tasks:

1. Remove all trash and debris from inside the cab.
2. Inspect hydraulic fluid level gauge in sight glass.
3. Inspect and flush drain valve on sludge tank.
4. Inspect and remove any debris from tank air gap'
5. Open petcock valve to drain air and condensation from air brake tanks. Close valve when complete.

QUALITY ASSURANCE AND QUALITY CONTROL

Knowledge of the type of past blockages is useful in determining the type of nozzle to use for preventive maintenance. Include as much information as possible in the PM work order to assist crews in choosing the correct nozzle type. Record all equipment used, personnel, and locations maintained on the printed copy of the work order. Transcribe the actuals into Maximo after the work is complete.

APPROVALS

Technical Review	**Administrative Review**
Name: _____	Name: _____
Title: _____	Title: _____
Signature: _____	Signature: _____
Date: _____	Date: _____