Oconee Joint Regional Sewer Authority

Comprehensive Management Plan:

Operations, Maintenance, and Management

Appendices of this plan have been removed as they have been updated or are not relevant to the *OJRSA Development Policy*. Contact OJRSA with any questions regarding the CMOM.

SEPTEMBER 2022

Prepared for:
Oconee Joint Regional Sewer Authority
623 Return Church Road
Seneca, South Carolina 29678

SOUTH CAROLINA
W.K. DICKSON & COMPANY, INC.
No. C00177
CERTIFICATE OF AUTHORIZATION

SOUTH CAROLINA
LICENSED PROFESSIONAL ENGINEER
No. 35236
STEVEN J. BARBIAN

Digitally signed by Steven J. Barbian
Date: 2022.09.23 16:04:50-04'00'

Prepared by:
WK Dickson & Co., Inc.
5 Legacy Park Road, Suite A
Greenville, South Carolina 29607
WKD # 20210552.00.GV

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1. Introduction

The Capacity, Management, Operations, and Maintenance (CMOM) Program outlined in this report was developed in response to Consent Order No. 21-025-W. The intent is to provide a process for the documentation of the condition of assets within the conveyance system and water reclamation facility (WRF) as well as prioritization of needed repairs.

1.1. Definitions

Basin – A smaller subset of the sanitary sewer system bounded by natural topography or sewer connectivity. By portioning off smaller subsets the utility can better monitor the condition of the sanitary sewer system and the performance of each basin.

Bypass – The intentional diversion of waste streams from any portion of a treatment facility.

Capacity Related Overflow – An overflow that occurs when a system is not able to convey all the wastewater to the treatment plant because of insufficient grade, pipe size, wet well size, pump capacity, force main size, or a design flaw and the overflow cannot be corrected through proper operation and maintenance.

Closed Circuit Television (CCTV) – used to identify and locate defects and other factors affecting the condition of the sanitary sewer system components.

Collection System – See definition for Conveyance System.

Combination Cleaners – Equipment that is most frequently used to flush and suction clean gravity sewer lines and manholes; often used to clear or collect wastewater and related debris from the sanitary sewer system.

Computerized Maintenance Management System (CMMS) – A workforce management system, that includes desktop management for dispatchers and GPS for crew location. Work orders may be directly sent to field crews through electronic communication to reduce response time. It also provides a place to input, store, and look up conditions of each portion of the sanitary sewer system.

Conveyance System – The network of gravity pipes, manholes, pumping stations, force mains, valves, and appurtenances associated with the transportation of wastewater to the publicly owned treatment works (POTW). The conveyance system is considered to be a component of the POTW.

Corrosion – The deterioration of a material due to chemical reactions with its environment.

Critical Part – Any part of the utility's collection, transmission, or treatment system for which the time required to acquire a replacement part would result in, or extend, a permit violation or a sanitary sewer overflow, including an un - permitted discharge. The replacement for a critical part is called a critical spare part.

Customer Service Program – The Utility's program for responding to customer complaints which include a database program that electronically files customer complaints.

Discharge – Any release of untreated, partially treated, or treated wastewater or wastewater that is combined with stormwater or excessive I/I at any location other than the designated wastewater treatment plant discharge location.

Disruption of Service – Any damage, blockage, or repair work that results in an interruption of sanitary sewer service to a customer.

Dry Weather SSO – An SSO that is caused by flow restrictions or system disruptions, typically these occur in dry weather but can also be caused during wet weather conditions.

Emergency Standard Operating Procedures – The Utility's procedure for responding to and mitigating SSOs.

Environmental Protection Agency (EPA) – United States Environmental Protection Agency.

Force Mains – A sanitary sewer line that is pressurized in order to convey wastewater from the pump station into a gravity main, or another pump station and force main.

Geographic Information System (GIS) – a software system that provides mapping services of the utility's sanitary sewer system and other utility information.

Gravity Lines – The portion of the Utility's sanitary sewer system that uses changes in elevation to convey wastewater.

Impacted Areas – Areas that have been affected by an SSO or discharge.

Infiltration – Water other than wastewater that enters a sewer system (including sewer service connections and foundation drains) from the ground through such means as defective pipes, pipe joints, connections, or manholes.

Inflow – Water other than wastewater that enters a sewer system (including sewer service connections) from sources such as, but not limited to, roof leaders, cellar drains, yard drains, area drains, drains from springs and swampy areas, manhole covers, cross connections between storm sewers and sanitary sewers, catch basins, cooling towers, storm waters, surface runoff, street wash waters, or drainage.

Inflow and Infiltration (I/I) – A summation of inflow and infiltration that has no distinction.

Manhole Assessment Certification Program (MACP) – A standardized manhole inspection procedure and form provided by NASSCO.

Manhole – The main access point to the sanitary sewer system as well as a point of connection for gravity lines, private laterals, or force mains.

Member City or Member Cities – Municipalities that are parties as included in the "Inter-Municipal Agreement and Joint Resolution Creating a Joint Authority Water and Sewer System" as filed with the Clerk of Court of Oconee County as of October 31, 2007, which are the cities of Seneca, Walhalla, and Westminster.

Monitored Locations – The location of installed flow monitors meant to identify wet weather problems, SSOs, and general flow conditions in the area.

Municipal or Municipality – A city, town, borough, county, parish, regional district, nonprofit, association, or other public body created by or under state law and having jurisdiction over disposal of sewage, industrial wastes, or other wastes, or an Indian tribe or Indian Tribal organization, or a designated and approved management agency under section 1288 of the CWA (33 U.S.C. § 1362 (4) and 40 CRF 122.2).

NASSCO – National Association of Sewer Service Companies.

OJRSA – Oconee Joint Regional Sewer Authority.

Operations and Maintenance Related Overflow – An overflow that occurs when an adequately designed and sized system that is well operated is not able to convey all the wastewater to the treatment plant because of poor maintenance. An overflow that occurs when an adequately designed and sized system that is well maintained is not able to convey all the wastewater to the treatment plant because of poor operation.

Pipeline Assessment and Certification Program (PACP) – Standard inspection and documentation procedure for pipelines.

Pump Station – A mechanical method of conveying wastewater to higher elevations.

Rainfall-Derived Infiltration and Inflow (RDII) is the increased portion of water flow in a sanitary sewer system that occurs during and after a rainfall as a source of operating problems in sanitary sewer systems. RDII is the main cause of sanitary sewer overflows (SSO) to basements, streets, or nearby receiving waters.

Rainfall Induced Infiltration (RII) – The portion of the infiltration (flows coming from infiltration sources) that enters the sewage system during and immediately after rainfall events. Rainfall induced infiltration does not include inflow.

Regional Collection and/ or Treatment System – A collection system or treatment system that accepts wastewaters from satellite collection systems. The OJRSA is a Regional Collection and/or Treatment System.

Sanitary Sewer – A conduit intended to carry wastewater from residences, commercial buildings, industrial plants, and institutions together with minor quantities of ground, storm, and surface waters that are not admitted intentionally, to wastewater treatment facilities.

Sanitary Sewer Overflow (SSO) – A sanitary sewer overflow is an overflow, spill, release, or diversion of wastewater from a sanitary sewer system. Sanitary sewer overflows include overflows or releases of wastewater that reach navigable waters, overflows or releases of wastewater that do not reach navigable waters, wastewater backups into buildings that are caused by blockages of flow conditions in a sanitary sewer other than a building lateral. Wastewater backups into buildings caused by a blockage or other malfunction of a building lateral that is privately owned is not a sanitary sewer overflow.

Sanitary Sewer System – An infrastructure system including private laterals, gravity mains, manholes, pump stations, force mains, and wastewater treatment plants that collect, convey, transmit, and treat residential, commercial, and industrial wastewater.

Satellite Collection System – A collection system that is owned and operated by one entity that discharges to a regional collection and/or treatment system that is owned and operated by a different entity. Satellite collection systems can be publicly or privately owned and depend on a separate entity for wastewater treatment and discharge. Such systems *may* be issued a Satellite Sewer System permit by SCDHEC. Examples of publicly owned satellite sewer collection systems served by the OJRSA include the municipalities of Seneca, Walhalla, Westminster, West Union, and Oconee County. Privately owned examples are Royal Acres Mobile Home Park and Pelham Creek Apartments.

SCADA – Supervisory Control and Data Acquisition, which is a system of software or other such applications that allow for controlling and monitoring treatment and collection system processes remotely.

SCDHEC – South Carolina Department of Health and Environmental Control

SOP – Standard Operating Procedure- Steps defined by the organization that are to be followed by trained personnel in order to successfully complete an operating activity or task.

Structural Sanitary Sewer Overflows – Overflows that are a result of structural failures such as collapses of force mains, gravity sewers, and manholes.

Suspicious Substance – Any substance or material not normally found in a wastewater system including but not limited to caustic substances or fuel.

Unpermitted Discharge – The discharge of wastewater containing pollutants to the navigable waters directly or by way of the storm drainage without obtaining a proper NPDES Permit.

Utility – Oconee Joint Regional Sewer Authority

Wet Weather SSO – A discharge of untreated wastewater that has mixed with excessive amounts of I/I to cause an overflow of the sanitary sewer system.

1.2. Utility Information

The Utility provides services to five municipal satellite collection system customers—Seneca, Walhalla, Westminster, West Union, and Oconee County—as well as several privately owned satellite collection systems. The majority of flow treated at the Coneross Creek Water Reclamation Facility (WRF) is conveyed through transmission lines from the three satellite collection systems. Most of the collection systems are owned and operated by each of the municipalities that are served by the satellite systems.

OJRSA owns roughly 71 miles of conveyance mains with 56 miles of gravity sewer and 15 miles of force mains being served by 16 pump stations. These conveyance mains convey the wastewater from each of the satellite collection systems to the wastewater treatment plant which currently has capacity to treat 7.8 million gallons per day (MGD).

The Utility will soon begin operating a retail sewer collection system in the southern portion of Oconee County that will serve the Interstate 85 corridor and Fair Play community.

1.3. Program Elements

The Utility's CMOM Program has ten main components:

- Financial Plan,
- Personnel Evaluation,
- Pump Station Inspection and Maintenance Program,
- Sewer Inspection and Cleaning Program,
- Inflow and Infiltration Evaluation Program,
- Manhole Inspection Program,
- Documentation and Records,
- Easement/ROW Maintenance Program,
- Sewer Use and Grease Regulation, and
- Spare Parts and Equipment Inventory.

Each of these programs utilize specific tools and methods to assess the condition of the respective attribute. The results of these assessments are then entered into the Utility Cloud and used to develop a list of priorities for repairs, rehabilitations, replacements, and capital improvement projects.

1.4. List of Priorities

The CMOM Program incorporates system wide information into the list of priorities for repair, rehabilitation, replacement, and capital improvement projects based on the following factors:

- Extent of damage or defect,
- Consequences of potential failure,
- Proximity to other defects,
- Relation to pipe segments in the Predictive Cleaning Program,
- Potential to contribute to SSO, and
- Number of odor complaints.

These factors will be used to rank each asset with the most dramatic defects and the most severe consequences of failure receiving the highest priority. Each year the priorities should be reassigned based on updated information collected from the previous year's assessments and inspections. Supporting information for the list of priorities comes from assessments, inspections, and evaluations completed as part of the Pump Station Inspection and Maintenance Program, Sewer Inspection and Cleaning Program, Inflow and Infiltration Evaluation Program, Manhole Inspection Program, as well as any other maintenance and repair history.

1.5. Performance Goals

The goal of the CMOM is to monitor and document the conditions of the various components of the sanitary sewer system and assign priorities to necessary repairs, rehabilitation, replacement, and capital improvement projects to transfer the maintenance efforts from reactive to proactive. The goal is to keep the list of priorities updated, including inspecting manholes and gravity sewers at least once every ten years, pump stations once every year, and force mains at least once every five years, while checking all potential corrosion defect areas annually. Information should be entered directly into a tracking database, so that at any point a report may be generated detailing the progress towards those goals.

1.6. Resources

The CMOM will require the use of many internal and some external resources. A complete list of resources that are available is included in Appendix A. These resources include manhole inspections, smoke testing, dye testing, CCTV inspections, gravity system defect analysis, corrosion defect analysis, pump station inspections, flow monitoring, and SL-RAT assessment. These tests, inspections, and assessments are part of the Utility's efforts to proactively address conveyance system issues before they result in SSOs.

In some instances, it may be more beneficial for the Utility to hire a third party to conduct asset inspections to allow the Utility's personnel more time to address other aspects of the CMOM Program. Any party internal or external conducting asset tests, inspections, or assessments on behalf of the Utility is expected to perform to the standards described herein.

End of Section

2. Financial Plan

Oconee Joint Regional Sewer Authority owns and operates a collection system that receives its flow solely from satellite collection systems. Their user rates are not based on a cost per volume of wastewater treated but based proportional to flow received, which is referred to as the "pro rata share" revenue model. The user rates are the primary source of revenue for the Utility.

The annual budget is developed by both the Executive Director and Department Heads for Administration, Systems Operations, Reclamation Facility, Pretreatment, Laboratory, Contract Operations, and Capital Improvements. The Department heads develop a budget for their department based on the previous year's operational budget and adding and subtracting one-time expenses as necessary. One-time expenses may include major equipment purchases, training events, conferences, and capital improvement projects. Once budget negotiations between the Department Heads and Executive Director are complete, the Executive Director submits the budget to the Board of Commissioners for approval.

Once the budget is approved, the user fees are developed using a pro rata share – meaning that the annual budget is divided among the satellite collections systems based on the proportion of the total flow received at the Coneross Creek Wastewater Treatment Facility. If a satellite system contributes 45% of the flow to the WRF, then they will be billed for 45% of the annual budget. The annual rate is distributed evenly across a 12 month calendar.

Because the annual budget is the basis for the next year's budget and user fees, it is important to ensure that the expenses throughout the year are tracked and are used in conjunction with what was originally budgeted. This assessment has both an operational and budgetary benefit. By comparing the original budget to actual expenses each department may become aware of the changing trends which may indicate aging infrastructure, change in the wastewater characteristics, increase in chemical usage. The budgetary benefit is that the Department Head will keep in touch with current cost trends and how well each department operates within their budget.

It was recommended by Willdan Financial Services and First Tryon Financial Advisors in 2021 to raise rates by February 1, 2022 and implement additional 20% rate increases over the next four fiscal years.[1] A 20% rate increase was implemented by the Board on March 1, 2022 but one was not approved for Fiscal Year 2023 (beginning July 1, 2022).

End of Section

[1] OJRSA Finance & Administration Committee Meeting minutes, December 13, 2021.

3. Personnel Evaluation

The Utility is responsible for the operations and maintenance of the conveyance system and the Coneross Creek WRF. The EPA provides guidelines[2] for the number and type of personnel a utility should keep on staff in order to best maintain their assets; however, the OJRSA is unlike most other wastewater providers because it operates. These recommendations are based on several factors including:

- Population served
- Treatment capacity
- Number and types of equipment

3.1. Frequency and Type of Evaluation

We recommend that utility staffing requirements are re-evaluated as capacity changes, and as technology improves for remote monitoring and control. Having the appropriately trained and appropriate number of staff on hand ensures that maintenance is kept up while also being able to safely respond to emergencies.

Three types of evaluations may need to be conducted: one for the office/administrative staff, one for the conveyance system, and one for the WRF. Each will depend on the recent changes that need to be accounted for in a potential change in staffing.

OJRSA has competed a comprehensive review of the staff and estimated tasks needing completed. The full matrix of the assessment is included in Appendix B. OJRSA is in the process of adding additional remote, retail customers to the system. The staffing needs for that expansion is included in this analysis.

3.2. Evaluation for Office and Administrative Staff

OJRSA currently has four office staff. There are an estimated 11,325 man-hours of work that need completed by office and administrative staff. Each OJRSA staff is schedule for 1,800 hours per year after holidays, sick time, and personal time off. This equates to needing 6 full time staff in these roles.

The largest tasks that are not fully covered are Fats, Oils, and Grease (FOG) inspections and engineering oversight for the planned retail sewer expansion. These tasks will be covered by the two new positions of Engineering Project Manager and FOG and

[2] "Estimating Staffing for Municipal Wastewater Treatment Facilities" as published by US EPA, March 1973.

Engineering Inspector. The office and administrative staffing breakdown is summarized in Table 3-1 below.

Table 3-1 Office and Administrative Staff

Position	Current	Needed
Executive Director	1	1
Operations Director	1	1
Engineer/Project Manager	0	1
FOG and Engineering Inspector	0	1
Office Manager	1	1
Records Clerk	1	1
Total	**4**	**6**

3.3. Evaluation for Conveyance System Staff

OJRSA currently has seven conveyance system staff. There are an estimated 17,629 man-hours of work that need completed by conveyance system staff. Each OJRSA staff is schedule for 1,800 hours per year after holidays, sick time, and personal time off. This equates to needing 9-to-10 full time staff in these roles. The additional staffing will include a Conveyance System Supervisor, a Senior Maintenance Technician, and another Maintenance Technician. The maintenance department covers both the pump station maintenance as well as the maintenance needs at the WRF. The conveyance system staffing breakdown is summarized in Table 3-2 below.

Table 3-2 Office and Administrative Staff

Position	Current	Needed
Conveyance System Supervisor	0	1
Conveyance System Crew Leader (Tech III)	0	1
Conveyance System Tech II/I	2	1-to-2
Maintenance Supervisor	1	1
Maintenance Senior Tech (Tech III)	0	1
Maintenance Tech II/I	4	4
Total	**7**	**9-to-10**

3.4. Evaluation for Wastewater Treatment Plant Staff

OJRSA currently has five wastewater treatment plant staff. There are an estimated 10,247 man-hours of work that need completed by treatment plant staff. Each OJRSA staff is schedule for 1,800 hours per year after holidays, sick time, and personal time off. This equates to needing 5.5 full time staff in these roles. It is anticipated with the implementation of increased automated controls through SCADA software at the WRF, some of the tasks may be reduced in the near future. OJRSA may be able to maintain the current staffing level of five staff.

The lab analysis work is subcontracted out and not performed by OJRSA staff at this time; however, the Utility has a fully functional laboratory that can be used to perform these functions internally for the agency with the proper staffing. The maintenance at the treatment plant is performed by the conveyance system staff. The water reclamation facility staffing breakdown is summarized in Table 3-3 below.

Table 3-3 Office and Administrative Staff

Position	Current	Needed
Water Reclamation Supervisor	1	1
WRF Senior Operator	2	2
WRF Operator II/I	2	2
Maintenance Tech II/I	0	1
Lab Analyst[3]	0	1
Total	**5**	**7**

End of Section

[3] The OJRSA began contracting out lab services on July 1, 2022; however, they retained the position and agency administration have elected not to fill it at this time. If the Utility decides in the future to bring laboratory services inhouse once again, they should assess their needs based on parameters listed in their NPDES permit and process control functions. Before performing any compliance sampling for reporting to SCDHEC, they will need to have their lab recertified for the necessary parameters prior to submitting analysis reports.

4. Pump Station Inspection and Maintenance

A Pump Station Inspection and Maintenance Program (PSIMP) is a crucial component to the success of a wastewater collection system. The PSIMP has several primary responsibilities:

- Ensures all pump stations are maintained in a reliable and ready condition,
- Outlines a routine inspection and preventive maintenance schedule, and
- Provides the appropriate checklist or form for pump station inspection or preventive maintenance.

4.1. Previous OJRSA Pump Station Inspection Procedure

Oconee Joint Regional Sewer Authority (OJRSA) operates and maintains sixteen (16) sanitary sewer pump stations throughout Oconee County. OJRSA performs pump station inspections on a weekly, monthly, quarterly, and annual basis. The frequency and type of inspections needed at each pump station is determined on a station-by-station basis that considers such factors as age, operating history, size and potential for negative environmental impact. Operations Department personnel perform inspections and the majority of the preventive and minor corrective maintenance tasks. Major electrical, mechanical and instrumental maintenance is contracted out as needed.

Routine pump station inspections are conducted by Operations Department personnel to check station operation. Inspection functions include looking and listening for malfunctioning equipment, observing wear/tear and checking standard operation. Care functions performed during inspections include cleaning, lubrication, exercising, and adjusting equipment.

The following is a narrative description of the Sewage Pump Station Inspection system as outlined in the OJRSA flow chart presented in Figure 3-1:

1. The Maintenance Supervisor schedules pump station inspection teams and determines assignments. If applicable, after initial assignment, inspection scheduling can be handled by OJRSA's chosen computerized maintenance management system (CMMS).

2. The inspection teams utilize the appropriate inspection form based on the type of inspection they are doing:
    a. Weekly / Monthly / Quarterly / Annual inspection of an aboveground pump station
    b. Weekly / Monthly / Quarterly / Annual inspection of generator at an aboveground pump station
    c. Weekly / Monthly / Quarterly / Annual inspection of a belowground pump station with generator
3. Each team performs the tasks and inspections applicable to their specific pump stations. The inspectors are responsible for filling the inspection forms.
4. If immediate action is required, the inspector notifies the Operations Director and Maintenance Supervisor. If applicable, the appropriate measures can be taken within OJRSA's CMMS to note what actions were taken to solve the problem.
5. Before leaving the pump station, the inspectors record station information on the inspection form and in the station logbook including: observations, action taken, and station elapsed time meter readings.
6. The inspection form is routed to the appropriate supervisor for review and logged in the CMMS.
7. If additional maintenance is required as a result of the findings of the inspection, the Maintenance Supervisor or his/her designee will generate the appropriate work orders. If applicable, work orders can be generated and maintained within OJRSA's CMMS.
8. If the maintenance items can wait until the next scheduled preventive maintenance date, or if a work order to address the item is already open, the Operations Director or Maintenance Supervisor cross-references the maintenance item noted in the inspection with the existing work order.

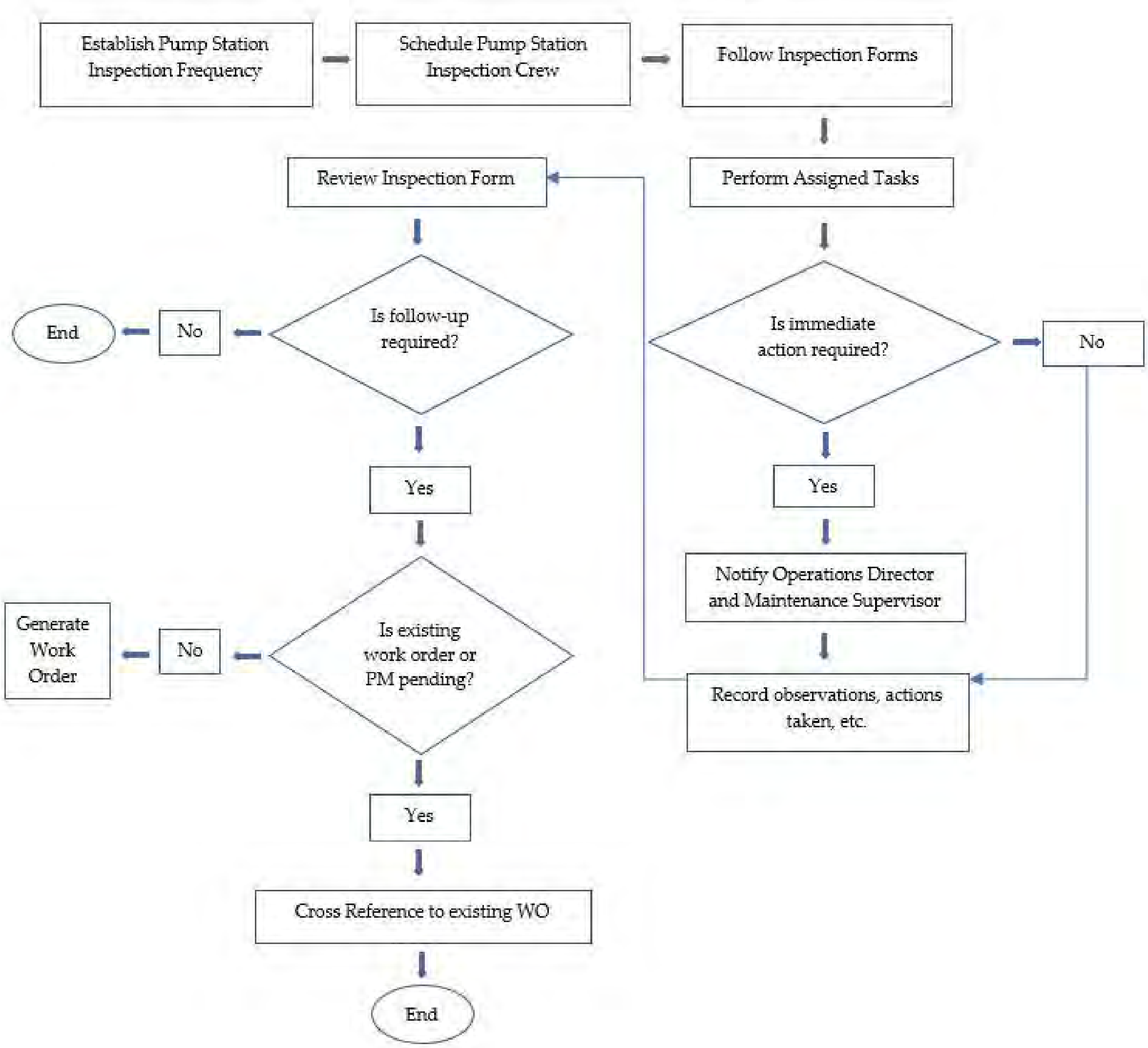

Figure 3-1 Operations Department Pump Station Inspection Flow Chart

Pump station maintenance inspectors follow a comprehensive checklist on an inspection form that is included in Appendix C.

The following is an outline of the general inspection tasks that should be performed and documented. Not all of these tasks are included on the inspection forms, but they should each be performed according to the schedule below.

Weekly:

- Visually inspect the access road and station for vandalism,
- Clean up trash and debris material,
- Record pump hours for each pump,
- Inspect and wash down wet well,
- Place pump controls back into auto position prior to leaving station,
- Visually inspect generator for fuel and ability to operate properly, and
- Complete all required paperwork/inspection forms.

Monthly:

- Operate pumps during generator operation to test load on generator,
- Hose/clean dry/well, if available,
- Transfer stand-by generator,
- Check and lube pressure relief valve,
- Operate and exercise all valves,
- Check emergency lighting,
- Check grass and cut,
- Clean battery tops and remove fill caps (wear eye protection and keep acid off hands and clothing),
- Maintain and clean rain gauges,
- Service battery cells with water, and
- Complete all required paperwork/inspection forms.

Quarterly:

- Lubricate pump bearings,
- Lubricate exhaust fan bearings,
- Lubricate U-joint, if available,
- Exercise all valves, and
- Complete all required paperwork/inspection forms.

Annually:

- Lubricate electric pump motors,
- Change generator oil,
- Perform a pump drawdown test, and
- Complete all required paperwork/inspection forms.

It is also important to keep detailed records of pump station visits and to file these records in an easily accessible location. Each inspection should be recorded in the logbook of the appropriate pump station and the associated report should be filed within OJRSA's CMMS, or an organized, hardcopy filing system.

4.2. Pump Station Preventive Maintenance

Preventive Maintenance (PM) is scheduled inspection and work performed to prevent equipment breakdown, reduce wear, improve efficiency, and extend the life of the equipment. The key to successful preventive maintenance is proper scheduling.

A schedule listing the PM and inspection frequency should be maintained at each pump station, as well as within OJRSA's CMMS. If applicable, the CMMS could also notify OJRSA when preventive maintenance is due based on programmed characteristics within the software.

PM should include both inspection and care activities and should be done in addition to the functions performed in pump station inspections. The preventive maintenance schedule should be based on manufacturers O&M manuals, pump station performance history, and corrective maintenance issues identified. PM activities typically include, but are not limited to the following:

- Visual inspection,
- General equipment inspection, cleaning, and lubrication as needed, and
- Check wet wells for floatables, grease, grit, and properly performing sensors/alarms.

4.3. Safety Considerations

It is important that all OJRSA staff conduct day-to-day tasks and activities safely through a combination of knowledge and awareness. Multiple hazards exist in the performance of an employee's routine daily tasks and work assignments. Far more dangers prevail when conducting inspections and maintenance on sewage pump stations.

The following are some of the more common hazards to consider:

- Slips/falls,
- Strains/ruptures,
- Falling objects,
- Poisonous or toxic gases,
- Infections and infectious diseases,
- Confined space entry procedures and permit requirements, and
- Electrical shock and arc flash.

To combat these known risks and be prepared for unknown dangers, OJRSA should ensure the following:

- A minimum two-man crew should be utilized to conduct pump station inspection and maintenance, including during afterhours responses to emergencies;
- Employees entering a confined space must be trained and follow proper protocols including atmospheric monitoring and obtaining an entry permit;
- Wear appropriate Personal Protective Equipment (PPE) – hardhats, safety shoes, vests, gloves, ear plugs, harnesses, monitoring equipment, etc.; and
- Operation and maintenance activities on electrical equipment must be performed by a qualified electrician.

End of Section

5. Sewer Inspection and Cleaning Program

A Sewer Inspection and Cleaning Program (SICP) keeps a wastewater collection system operating efficiently by:

- Determining the condition of the sewer so lines can be repaired or replaced as necessary,
- Helping prevent blockages and backups, and
- Removing built-up debris, such as tree roots, grease, grit and sand.

5.1. Sewer Cleaning

Sewer system cleaning is used to remove accumulated material from the sewer. Cleaning helps to prevent blockages and is also used to prepare the sewer for inspections. Sewer cleaning is a process that is more often used on gravity lines. There are two main explanations for the lack of cleaning in force mains: 1) it is not usually practical to take a force main out of service; and 2) because force mains operate under pressure, they are less likely to experience buildup and blockages. In order to be proactive, however, both force mains and gravity mains will be cleaned on a routine basis as part of the SICP.

Blockages in gravity sewers are usually caused by a structural defect, poor design, poor construction, an accumulation of material in the pipe (especially grease), or root intrusion. Additionally, if the flow is less than 2 feet per second, grit and solids can accumulate leading to potential blockages.

Most operational defects, such as roots, sediment, fats, oils, and grease, reduce the hydraulic capacity of the pipe. Sewer cleaning and source control activities are directed toward preventing or reducing the impacts of operational defects on the collection system. Preventive cleaning is a better approach than reactive cleaning, and routine, planned sewer cleaning is crucial to maintaining clear lines and preventing potential blockages from occurring.

There are two key components to the cleaning portion of the SICP: The Predictive Cleaning (PC) Program and the Comprehensive Cleaning Program.

5.1.1. Predictive Cleaning (PC) Program

The Predictive Cleaning (PC) Program is an asset specific preventative maintenance approach for proactively addressing known operational issues. Line segments are added to the PC Program when they require more frequent cleaning than the other line segments in the collection system in order to maintain hydraulic capacity. Information from SSO records and CMOM inspection, tests, and assessments need to be used to determine which pipe segments will be added to the PC Program and which ones will continue to be included. This information may include a list of SSOs or Building Backup locations, and notes from condition assessment of gravity lines. Once the need for more frequent cleanings is reduced and the cause of previous blockages is removed, the line segments can be removed from the Predictive Cleaning Program and cleaned according to the schedule within the Comprehensive Cleaning Program.

While in the PC Program, lines will be cleaned using the same methods outlined in the Comprehensive Cleaning Program. Each line segment included in the program will be evaluated, and the appropriate cleaning method will be applied to address the operational issues at hand.

5.1.2. Comprehensive Cleaning Program

The Comprehensive Cleaning Program will utilize scheduled cleaning to maximize the operational capacity of the wastewater collection system by reducing debris buildup, grease, and root intrusion. The cleaning done as part of this program will be completed in addition to any cleaning performed by the Predictive Cleaning Program and will be executed as outlined in Table 5-1.

Table 5-1 Comprehensive Cleaning Schedule

Description	Frequency
Comprehensive Cleaning	Entire system cleaned in 10 years (maximum) then repeat process beginning with the first portion of system cleaned. The Comprehensive Cleaning process is to be performed and repeated indefinitely.
Mechanical Root Abatement	As determined by inspection/condition assessment
Chemical Root Abatement	As determined by inspection/condition assessment

Predictive Cleaning	As determined by inspection/condition assessment and outlined in the PC Program

As shown in Table 5-1, there are several methods that can be utilized for sewer cleaning:

1. Hydraulic Cleaning (flushing) – any application of pressurized water to clean the pipe.
2. Mechanical Cleaning – use of a physical device to scrape, cut, or pull material from the sewer.
3. Chemical Cleaning – use of a chemical additive to facilitate the control of odors, grease buildup, root growth, corrosion, and insect and rodent infestation.

Hydraulic cleaning will be the primary method utilized by OJRSA in their scheduled cleanings. OJRSA will employ a crew to conduct routine cleanings of each segment according to the 10-year schedule. It typically takes a minimum of 3 staff to perform cleaning functions; however, it is best performed with 4.

Mechanical and chemical cleaning will be performed on an as-needed basis dependent on the findings of routine system inspections. Segments that are subject to more extensive root intrusion and grease buildup will be treated with the appropriate cleaning method to resolve the operational issue/ defect. ***IMPORTANT NOTE: Chemical cleaning should be done with care and in conjunction with the Operations Director and Water Reclamation Supervisor. There are many chemicals that can be extremely toxic to the biological processes performed at the water reclamation facility, which can lead to permit violations and environmental harm!***

Regardless of the method of cleaning performed, specific information will be documented. Cleaning forms, or records, will at a minimum include the following information:

- Date of cleaning,
- Location and identification of line cleaned,
- Pipe size and material,
- Name of personnel performing cleaning,
- Distance cleaned,

- Any obstacles encountered during cleaning, and
- How many passes were needed to properly clean the pipe.

Proper, in-depth documentation of cleanings will allow OJRSA to ensure that they are following the cleaning schedule set forth within this SCIP. Detailed documentation will also aid OJRSA in recognizing trends that may warrant adding a pipe segment to the PC Program.

5.2. Sewer Inspection

In addition to sewer cleaning, sewer inspection is a key component of a wastewater collection system operating successfully. Sewer inspection can range from visual checks to flow monitoring, to closed circuit television (CCTV).

Visual inspection of manholes and sewer lines are the first line of defense in the identification of existing or potential problem areas. Visual inspections can be performed on manholes and on above grade (or exposed) force mains and gravity mains. These inspections should take place on both a scheduled basis and as part of any preventive or corrective maintenance activities.

In addition to exterior visual inspections, there are a number of inspection techniques that may be employed to inspect the interior of a sewer system. Regardless of the technique chosen, it is important that inspection records contain key characteristics and information, including but not limited to the following:

- Location and identification of line being inspected,
- Pipe size and material,
- Name of personnel performing inspection,
- Distance inspected,
- Cleanliness of the line,
- Pipe defects identified from starting point to ending point of inspection, and
- Results of inspection, including estimates of I/I.

5.2.1. Gravity Main Inspection

Every segment of gravity sewer will be inspected at *least once every ten years* by CCTV inspections in accordance with NASSCO's Pipeline Assessment

Certification Program (PACP), which should be performed in conjunction with the Comprehensive Cleaning Program. While the PACP inspection focuses on the results of CCTV, additional assessments may include flow monitoring, smoke testing, dye testing, and SL-RAT inspections.

Flow monitoring results may be used to assess flow conditions and identify large sources of I/I. Smoke testing of sewer lines can also identify a range of I/I sources and can be conducted simultaneously with smoke testing of manholes and private laterals. Dye testing is typically a follow-up test to sources of I/I identified by smoke testing. In these cases, it is used to confirm a source as I/I. Once a source of I/I is confirmed by dye testing, it is inspected with CCTV to determine the extent of the problem.

It is important to note, however, that regardless of any identified problems, defects, or damages, or the lack thereof, all gravity sewer lines should be inspected by CCTV *at least once every ten years*.

5.2.1.1. Flow Monitoring

Flow monitoring is an important tool in the management of wastewater flows. Data collected from flow monitoring is analyzed for the following uses:

- Determining dry and wet weather flows,
- Prioritizing areas for rehabilitation,
- Determining the adequacy of the system to support both dry and wet weather flows,
- Determining available hydraulic capacity in the conveyance system,
- Quantifying the reduction of I/I in rehabilitated areas, and
- Providing data for development/calibration of the system hydraulic model and for flow trend analysis.

Flow monitoring can be categorized as permanent (long-term) or temporary (short-term). Permanent flow monitoring is used to monitor the effectiveness of sewer maintenance and rehabilitation programs and to provide long-term I/I data. Temporary flow monitoring uses portable equipment to capture data over a specified period of time, with 60 days being the usual minimum period.

Currently, OJRSA utilizes three (3) permanent flow monitors for the purpose of billing their Member Cities. Additionally, OJRSA recently deployed 18 temporary flow monitors (for a 4 month period) to gain a better understanding on their system, and specifically areas of their system that may be contributing to excessive I/I. For such an assessment, accurate rain data is also necessary. This data is supplied by six (6) rain gauges located throughout the collection system. When needed, existing rainfall data is supplemented with Doppler data.

After the flow monitoring data and rainfall data are collected, the data is analyzed for the purpose of billing, updating a hydraulic model, and prioritizing areas within the collection system that may need cleaning, inspection, and/or rehabilitation.

It is recommended to install rain gauges throughout the system as the amount and intensity of rainfall during storms can vary greatly across a system.

5.2.1.2. Smoke Testing

Smoke testing is conducted to help identify I/I sources, cross-connections, and unauthorized connections. Excessive amounts of I/I can contribute to a significant amount of flow to the sanitary sewer system that the system may not be prepared to handle. The extent of I/I will vary from system to system, although it has been recommended by engineers the OJRSA use the following formula to determine excessive I/I[4]:

> *2,000 gpd * [(Miles of 8-inch diameter pipe * 8) + (Miles of 10-inch diameter pipe * 10) + (Miles of 12-inch diameter pipe *12) … + (Miles of X-inch diameter *X)]*[5]

[4] Formula is based on one referenced in the "Quick Guide for Estimating Inflow and Infiltration" as published by US EPA, June 2014; however, the US EPA's formula uses 1,500 gpd instead of 2,000 gpd. Recommendation provided by Weston & Sampson, Inc. and WK Dickson & Co., Inc.

[5] Where "*X*" represents each diameter pipe in the sewer system.

Excessive I/I frequently causes SSOs; therefore, it is important to keep I/I at a minimum in the sanitary sewer system.

Smoke testing begins by placing a blower over a manhole and allowing it to channel non-toxic smoke into the sanitary sewer system. The smoke will travel through the manholes, gravity sewers, and private laterals and will penetrate any hole or opening along the way. As smoke rises it will work its way to the surface thus identifying the sources and / or locations of I/I. The largest sources of I/I are typically direct and indirect connections with stormwater infrastructure, although these connections may be minimal in number. The following are more common sources of I/I:

- Leaks in mainlines from cracks, holes, and even deformed pipe segments,
- Leaks in manholes,
- Cracked or vented manhole lids,
- Connected roof leaders and cellar drains,
- Abandoned service lines, and
- Broken or missing cleanout caps.

Results of smoke testing will be logged into OJRSA's CMMS as the test is being conducted. Once the smoke has entered the sanitary sewer system, crew members will look for smoke surfacing from catch basins, cracks in the roadway, along the side of the roads, through manhole lids, roof leaders, uncapped cleanouts, and roof sewer vents. There are even times when smoke can be seen emanating from what appears to be solid surfaces, such as the ground, which warrants further investigation. When crews have spotted a smoke source that indicates an I/I source they need to immediately take a picture to capture the smoke source and enter the geographic location in the CMMS. Then they need to complete the smoke test form to document details of the smoke source. Paper copies of the smoke test form need to be kept on hand in the event of technical difficulties. A copy of the smoke test form is in Appendix D.

Before smoke testing begins, a thorough explanation needs to be made to local emergency responders, particularly fire fighters, so that they are aware of the situation. Additionally, customers need to be made aware of the smoke testing in advance to reduce confusion and concern. Customers should be notified with door hangers indicating the approximate dates and areas to be smoke tested. An example door hanger is located in Appendix E. This is important, as from time to time, smoke can enter homes through leaky or unused plumbing and give the illusion of a fire.

A safety data sheet (SDS) for the chemical used to produce the smoke should be readily available for customers to review if they have any concerns.

5.2.1.3. Dye Testing / Dyed Water Flooding

Dye testing is used to identify I/I sources as well as to confirm sanitary sewer connectivity. Dye testing is often the first follow-up test in response to positive smoke testing results and visual investigation. In cases where dye testing is not possible or practical, a follow up inspection would likely include CCTV. Additionally, dyed water flooding can be used to identify sources of infiltration by dying the suspected source and then locating the point of entry of the dyed water in the downstream piping.

The use of dye testing for confirming connectivity of the pipes and appurtenances may be used to clarify current connections of roof leaders, storm drains, and other suspected sources of I/I as well as wastewater pathways.

The results of each dye test needs to be captured on the dye test form. A copy is included in Appendix F.

5.2.1.4. Sewer Line Rapid Assessment Tool

The Sewer Line Rapid Assessment Tool (SL-RAT) uses an audio signal to assess flow path within a pipe segment. This process will generate a number, ranging from zero (0) to ten (10), with zero (0) representing a completely blocked structure, and ten (10) indicating a clear, open pipe available for wastewater flow.

SL-RAT uses acoustic technology to transmit sounds of varying frequencies through gravity sewer pipe segments. The SL-RAT comes in two pieces: the sound generating piece and the listening piece. Each piece is placed on a manhole at either end of the gravity sewer segment to evaluate the relative blockage of the line in question. It takes roughly three minutes to complete a transmission between two manholes.

SL-RAT evaluations should be conducted on each gravity sewer line at least once every two years. While the SL-RAT locates potential trouble areas, it does not identify the problem, the extent or location of the problem, or provide solutions to the problem. Therefore, areas receiving low SL-RAT scores should be followed up with CCTV to gather all necessary information for developing a solution to the problem.

SL-RAT evaluations can even be useful to identify sags in the pipe, which can detrimentally impact the system's hydraulic capacity.

All pipe segments receiving a score of five (5) or less will be followed up with cleaning or CCTV inspection to clear the obstruction or identify the location of the blockage. Once the cause is identified, the crew leader will initiate a work order to address the problem. In situations where a score of zero is indicated, meaning a total blockage, or no apparent flow downstream, it may be more prudent to immediately notify the Operations Director so that actions can be taken to immediately mitigate a potential SSO.

5.2.1.5. Closed Circuit Television Inspection

Closed Circuit Television (CCTV) inspections involve crew members lowering a self-propelled remote-control camera into a manhole to navigate the sanitary sewer system. Crew members are able to view the inside of the pipe segments and log the location and extent of defects.

All CCTV inspections for OJRSA will be documented according to NASSCO's PACP standards including video recording of the line segments, still photos of defects, and a written record using the standard code for the description and location of the defects. By using NASSCO's standard code, information between crews and external parties may be shared more accurately and concisely with internal staff as well as external consultants, such as engineers and contractors. Additionally, it helps OJRSA to categorize the severity of each defect and then prioritize corresponding maintenance, rehabilitation, and repair projects.

An information management software compatible with the camera hardware will be used to collect the CCTV video and log of defects. This database will be linked to OJRSA's CMMS so that crews making the repairs can access the CCTV video for reference if necessary.

CCTV inspections are most effective when they are conducted within a week of having the sewer lines cleaned, reducing the amount of debris or accumulation in the sewers that would otherwise interfere with visual inspection. Therefore, it is recommended that all lines that are CCTV inspected should be cleaned within one week prior of inspection.

If a full line blockage or complete structural collapse is identified by OJRSA while conducting CCTV inspections, OJRSA will restore functionality immediately to avoid additional adverse effects, such as a sanitary sewer overflow.

5.2.2. Force Main Inspection

Force mains can generally be more difficult to inspect due to limited access, small pipe diameter, and difficulty in taking out of service. Because of this, inspections need to be done in a manner that consider both probability of failure and consequence of failure. This simultaneous consideration constitutes a risk-based investigation (RBI). With this in mind, specific factors that will be considered when prioritizing pipes for inspection, include:

- Age of the force main,
- Location, especially if adjacent to roadways or waterways,
- Environmental impacts of a failure,
- Diameter,
- Leak history,
- Accessibility, and

- ♦ Time since last inspection.

Additionally, areas that are susceptible to corrosion will be routinely monitored to better schedule preventative maintenance. Early detection is key to preventing potential failures.

Force mains will be assessed for their condition at least once every five (5) years and annually for known corrosion defects.

Force main inspections should include the following items:

- Visual inspection of force main route. The inspection should look for any visible wastewater leaking to the surface, sags in the ground to indicate a collapsed pipe.
- Pump flow tests. The annual pump flow tests done with the pump station assessment will help determine if the force main is adding any additional head to the system.
- Pigging the line. Pigging a force main involves connecting a pig launcher to the force main and flushing a mechanical "pig" through the line. The pig will clean the line by dislodging any blockages. It also has a GPS unit to located any blockages too big to be cleaned internally. Any large blockages should be excavated, opened, and cleaned.

5.2.3. Air Release Valve (ARV) Inspection

Air release valves (ARVs) provide protection to the force mains and pump stations where they are installed. ARVs allow excess air to be discharged from the pump station as the force main fills with pump sewage. Other ARVs can also allow air back into the force main to prevent a siphon or vacuum effect on the force main and pumps. Due to their protective nature and mechanical components, ARVs should be inspected every year.

There are three types of ARVs on the market. These are:

- Air Release Valve: Include slow air release function only. These are typically placed at intermediate high points along the force main.
- Air Vacuum Valve: These valves include vacuum breaking and high-volume air release. This type of valve is located typically at absolute high

points where the HGL drops below the pipe and air must enter to eliminate vacuum conditions. It is also placed along force mains to facilitate proper filling.

- Combination Air Valve: It contains both small air release orifice and larger air/vacuum port in one assembly. It is commonly recommended for use in wastewater main force.

5.2.3.1. ARV Operation and Maintenance (O&M) Problems

Those functions described in earlier section make ARVs essential to many pressure systems. However, there are operation and maintenance (O&M) problems that can occur even if the valves are functioning properly. Following are examples of some of the problems that can occur:

Corrosion - Internal corrosion of a metallic pipe can occur when a vacuum breaking ARV introduces air into the pipe. For this reason, metallic FMs should use air release only ARVs wherever possible. Additionally, external corrosion can occur inside the ARV vault as the air from the pipe is released. If the air contains hydrogen sulfide, the external wall of the pipe, the ARV itself, the saddle and isolation valve attaching the ARV to the pipe, the vault, and the vault cover may all become corroded over time.

Surge - The sudden closure of an ARV after it rapidly releases air can create a surge event. This can be caused when the orifice is oversized. A too large orifice will increase the rate of flow of the air and reduce the time between its opening and closing. ARVs often are not effective surge control devices either because they do not react fast enough to allow air in to prevent vapor cavity formation or because they become plugged with grease and debris and fail to open.

Odor and noise - ARVs can be a nuisance to nearby residents if they emit odor or cause a whistling as the air is released from the FM (due to improper orifice sizing).

Siphoning - While this typically does not present a problem, flow can siphon over high points along a force main that are higher in elevation than the discharge. This may be a complete siphon or, more commonly, a partial siphon that reduces the effective static head on the pumps. This becomes a problem if it causes the pumps to operate too far right on their curve (runout condition).

When selecting and/or replacing an ARV, the actual orifice diameters and optional features of the ARV should be selected for the specific conditions of that installation, which may be different even from other ARVs on the same FM. In order to ensure appropriate equipment replacements and spare parts inventory, the actual orifice diameters and optional features of each ARV should be documented at the time of installation.

Another consideration to note is that if ARVs are closed, particularly at intermediate high points along the force main, air binding may develop in the force main. Thus, if any ARVs are turned off, Operations should be certain to monitor the pumping capacity, pump run times and pump discharge pressures to identify any signs of air binding. Also, if an unexplained reduction in pumping capacity is observed-especially if this corresponds with an increased discharge pressure, any ARVs along the force main should be inspected for air binding.

5.2.3.2. ARV Inspection

Air valves shall be inspected annually assuming the initial inspection does not reveal significant problems. If significant problems are found, the valve shall be inspected every 6 months. Valves should be disassembled, cleaned and returned to service. A quick check of the need for back flushing would be to open the bottom drain valve on the side of the valve body. If sewage drains out easily, back flushing may not be required. The valve should still be disassembled and cleaned as grease or other debris may have accumulated in the top portion of the valve. If sewage does not drain out, the valve may need back flushing. It is highly recommended that distribution system potable water not be used as the flushing water source. Instead, clear water from a portable water tank and pump should be used as the flushing water source thus protecting against potential backflow.

Air valves with cast iron bodies should be removed, cleaned, corrosion removed, primed and painted at least every five years or more often depending on inspection and need. Install a spare air valve to replace the removed valve. After the removed air valve has been rehabilitated, it should be placed in inventory.

Air valves with either stainless steel or plastic bodies should be removed, cleaned, and inspected at least every five years or more often depending on inspection and need. Install a spare air valve to replace the removed valve.

Always isolate and drain the valve and depressurize the valve before opening the cover/body or removing the valve.

5.2.3.3. ARV Common Issues and Possible Solutions

The following is a listing of common problems with Air Valves and possible solutions for resolution:

- Leakage at Inlet Connection: Tighten valve threaded connection or flange bolts. If leaks persist, remove valve and re-seal the threads with pipe sealant/tape, or reattach with new bolts and tighten as necessary. Check that the valve's actual operating pressure does not exceed its design Working Pressure as stamped on the valve's nameplate.
- Leakage at Cover/Body joint: Tighten bolts per the manufacturer's recommendations. It may be advisable to replace the cover/body gasket first. Check that the valve's actual operating pressure does not exceed its design Working Pressure as stamped on the valve's nameplate.
- Orifice not Releasing Air Under Pressure: Check that the valve's actual operating pressure does not exceed its design Working Pressure as stamped on the valve's nameplate. If the valve is operating within its design pressure range, isolate, drain and depressurize the valve for inspection and cleaning. Open the isolation valve and allow the ARV to refill. Once the valve is again pressurized, test the valve for proper operation by injecting air (with compressor) into the bottom drain connection line and see if the valve releases the injected air. If the valve does not release the injected air, the valve needs to be repaired or replaced.
- Liquid Leakage through Air Blow Off: Isolate valve from main line, and depressurize valve through bottom drain connection. Check for gravel or

other debris in the outlet at the top of the valve; clean as needed. Back flush the valve to remove debris. If back flushing is not effective, disassemble and inspect the internal seat, orifices, float and float guide for debris, wear, or damage. Replace as needed with a float kit or seat kit from the manufacturer. Check that the valve's actual operating pressure does not exceed its design Working Pressure as stamped on the valve's nameplate. Check that the valve's minimum operating pressure (typically 3-7 psi) is not less than the actual operating pressure of the line. If the minimum pressure is not met, leakage will occur until the valve is modified to seal better. Contact the ARV manufacturer on a case-by-case basis.

- Always isolate and drain the valve and depressurize the valve before opening the cover/body or removing the valve.
- Replace all valves as necessary that cannot be repaired in the field. Ensure replacement valves are provided with same functionality and orifice sizing as the original valves (unless an appropriate evaluation is performed to confirm suitability of another valve type and/or size).

End of Section

6. Inflow and Infiltration Evaluation Program

The term "inflow and infiltration" refers to stormwater runoff and groundwater that enters into the sanitary sewer system through holes in the infrastructure and stormwater infrastructure that is connected to the sanitary sewer system and thereby the conveyance system.

It is important to remove both sources of inflow and infiltration from the conveyance system and at the wastewater treatment plant when they are identified. It is especially important to remove connections form stormwater infrastructure as they are often large sources of inflow. Stormwater should not be discharged to the sanitary sewer system, because it typically does not require treatment and it adds to the surge of wastewater seen throughout the conveyance system and at the wastewater treatment plant. This surge of wastewater often creates capacity and treatment difficulties, and has led to significant SSOs on the OJRSA system in recent years.

Locating sources of inflow and infiltration can be achieved through flow monitoring as described in Section 6.1. By establishing a baseline of flow rates during dry conditions for a specific area and comparing them against the surge of flow during wet weather over the same specific area, one can derive a peaking factor. Areas with the highest peaking factors have more inflow and infiltration entering the collection system anywhere upstream of that point. Flow monitoring is the main component to any inflow and infiltration evaluation program.

Flow monitoring can be conducted with one or more flow monitors. The more monitors there are, the more beneficial and informative the results will be.

The following strategic factors will be considered:

6.1 Type of Flow Monitors

Both permanent and temporary flow monitors may be used to obtain a complete picture of the flow conditions in the sanitary sewer system.

6.1.1. Permanent Flow Monitors

Permanent monitors are used to gather baseline flow data over a long period of time to calibrate new flow monitors, identify and document new problems and the success of projects in the sanitary sewer system. Typically, data from permanent flow monitors can be used to measure the long-term effects of rehabilitation and I/I source reduction. Once they are mounted, they are not typically moved. Permanent flow monitors are often mounted in strategic locations including where two sewer systems/districts merge and where two basins or sub-basins merge.

6.1.2. Temporary Flow Monitors

Temporary flow monitors are usually in place for 60 days or more and are located to collect data from specific projects or areas.

Typical flow monitoring programs will incorporate both permanent and temporary flow monitors to evaluate the volume of wastewater passing through key locations. The data will be stored so that it may be retrieved and reviewed if necessary.

In addition to collecting sewer flow data, collecting rainfall data will improve the usefulness of the data collected by estimating the amount of I/I entering the system during various wet weather events. A diagram depicting the different steps to be taken for effective flow monitoring can be found in Figure 6-1.

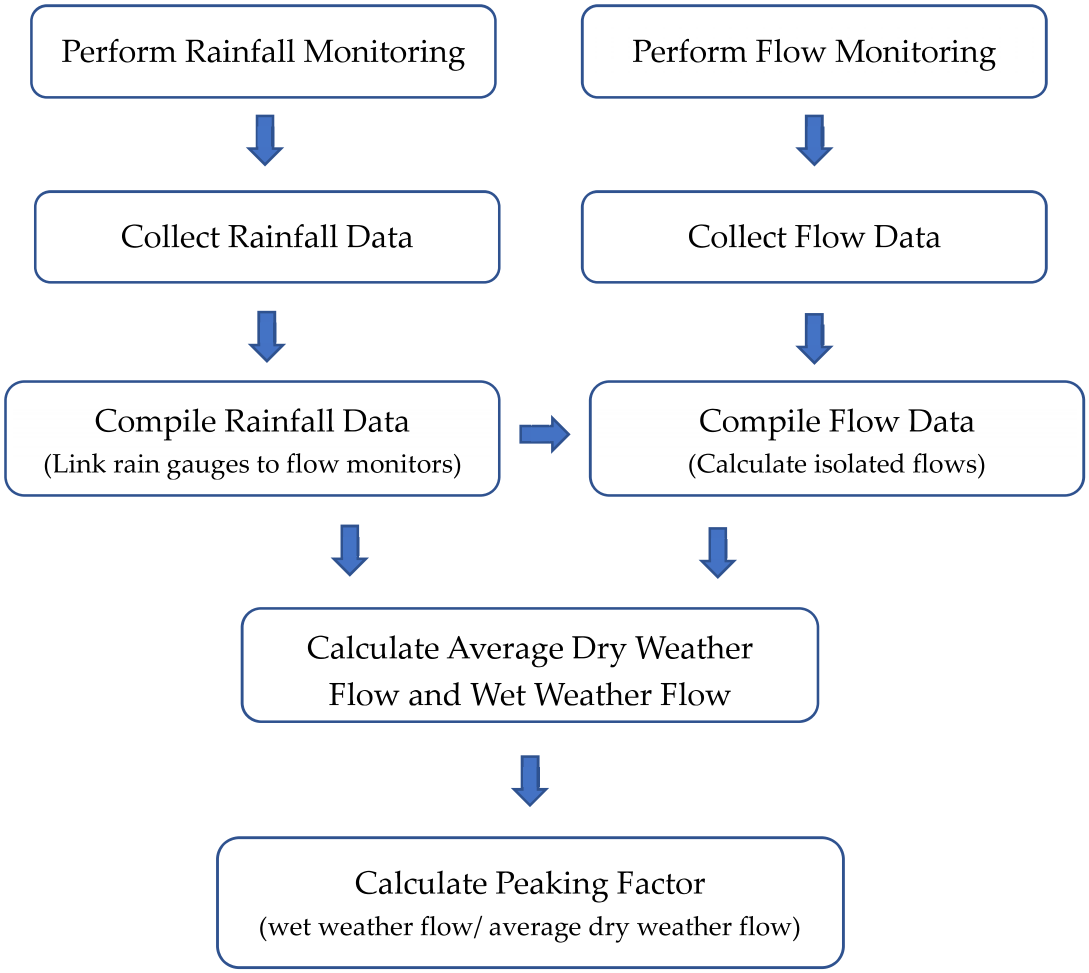

Figure 6.1 Flow Monitor Data Analysis

Both permanent and temporary flow monitors should be placed throughout the sanitary sewer system to collect flow rates at strategic points.

6.2. Data Quality Review

Once the data is collected, it should be analyzed to be sure that only quality data is used. The flow data should be plotted over time with rainfall data as a quality check. An increase in base flow should correspond to an increase in rainfall data, any other changes in the base flow should be given careful consideration before using. The flow rates should also be checked to be sure they are within the range of accurate measuring for the flow monitors.

Successful flow monitoring programs collect and review data weekly. The more frequently the data is collected and analyzed, the more quickly responses could be made to the data. Such responses may include prevention of potential SSOs or flow monitors in need of calibration. In cases where the data collected indicates that a downstream blockage may exist, the data should be verified as accurate. Upon verification the Conveyance System Supervisor should be notified, and a corresponding work order should be initiated to mitigate any SSO. In the case of inaccurate data, the flow monitors may need to be moved to sites that have better hydraulic conditions. The sooner they are identified the sooner they can be corrected.

6.3. Average Dry Weather Flow

After the flow monitoring and rainfall data are collected, the average dry weather flow is calculated. The average dry weather flow should be based on the flow from at least 5 dry weather days. Dry weather days should be verified with rainfall collection data. It is also important to wait until flow conditions return to normal after a wet weather event for use in calculating average dry weather flow.

6.4. Identifying Wet Weather Flow

A wet weather event is identified as the flow that occurs during and after the time periods the rain gauge measures precipitation. Typically, there is a delay between the time the rain gauge indicates wet weather and the increase in the wastewater flow. Depending on the intensity and duration of a wet weather event, the wastewater flow rates may remain elevated for more than 24 hours after the precipitation ceases. It is possible to measure a notable wet weather event but no increase in wastewater flow. This may indicate that there is not enough precipitation to infiltrate the sanitary sewer system. For that reason, only the most substantial rain events should be considered wet weather events and at least three wet weather events should be recorded to ensure a representative result.

Once the time frame for each wet weather event is identified, the wastewater flow rates over the same time periods will be measured. It is important that the same time frame for all flow monitors is used for each wet weather event.

6.5. Calculating Maximum Peaking Factor

The peaking factor is a comparison of the average dry weather flow and the wet weather flow. It is calculated by dividing the wet weather flow by the average dry weather flow. In a perfect system with no I/I, the peaking factor will be one. The closer the peaking factor is to one, the less I/I there is upstream of the flow monitor. To calculate the maximum peaking factor, the wet weather event that measured the most flow during the event is divided by the average dry weather flow. This would be the same as calculating the peaking factor for all wet weather events for a given flow monitor and then selecting the highest value as the maximum peaking factor.

This maximum peaking factor will reflect the conditions of all the sanitary sewer system upstream unless another flow monitor is located upstream to isolate the flow conditions between the monitors. This may be done by subtracting the average dry weather flow of the upstream flow monitor from the downstream flow monitors average dry weather flow. The same thing should be done for each of the wet weather flows to obtain the isolated wet weather flow rates. The technique of measuring isolated flow rates can be used to identify areas where there are a lot of I/I sources or a large I/I source.

The March 2022 Preliminary Engineering Report (PER) done by WK Dickson determined that a wet weather peaking factor of 2.8 is high for the OJRSA system. Any area with a peak factor over 2.8 should be targeted for further investigation.

Once flow monitoring has been completed and target areas have been identified, OJRSA should further inspect for I/I. A comprehensive approach to locating defects involves inspecting all aspects of a collection system, including manholes, sewer mains and laterals. All inspections need to be conducted in accordance with the National Association of Sewer Service Companies (NASSCO). Manholes, sewer mains and laterals need to be inspected in accordance with the Manhole Assessment Certification Program (MACP), Pipeline Assessment Certification Program (PACP) and Lateral Assessment Certification Program (LACP), respectively. For further details on how to properly inspect manholes, sewer lines and laterals, refer to the Manhole Inspection Program (MIP) and the Sewer Inspection and Cleaning Program (SICP), located in Sections 7 and 5, respectively.

Sometimes the number, size, and type of defects observed through visual or video inspection will not justify the amount of I/I identified in flow monitoring. When this is the case, other methods may need to be employed to identify additional defects. Below are additional inspection methods that may prove beneficial:

Sewer Scanning Evaluation Technology (SSET) – Produces a 360- degree visual scan so that the entire surface of the pipe to be observed can be seen in flat view. This allows an engineer to measure joints and cracks and check for stains and deposits.

Electrical Leak Location – Identifies pipe defects by measuring the electrical resistance of the pipe wall. Most sewer pipes are electrical insulators and have high resistance to electrical currents. A defect in the pipe that leaks water will also leak electrical current, even if there is no visible infiltration.

Acoustic/Sonar Detection – Uses sensors to detect vibrations and sound wave variations caused by defects and leaks. Acoustic sensors can provide real-time verification of defects or problems.

Once sources and locations of I/I are confirmed, they will need to be mitigated or repaired. This can be accomplished through pipe replacement or rehabilitation on a case-by-case basis.

End of Section

7. Manhole Inspection Program

Manhole inspections are routinely conducted to identify manhole defects and potential safety hazards. Each manhole should be inspected once every ten (10) years *at a minimum*. These inspections should be performed in conjunction with the gravity main inspection program as described in 5.2.1. The purpose of the formal manhole inspection program is to collect the data on manhole conditions, check on manhole locations, pipe connectivity, and flow conditions in the area. Manholes are the primary access point to the conveyance system to check the flow conditions in the area. Therefore, manholes must be kept safe for the use of Utility Personnel.

Manhole inspections and inspection forms need to be conducted in accordance with the National Association of Sewer Service Companies' (NASSCO's) Manhole Assessment Certification Program (MACP). MACP inspections include removing the manhole lid and conducting a visual inspection of the internal components of each manhole. Inspections may often be conducted visually from the surface or with the use of a pole camera (perform a NASSCO MACP Level 1 inspection). Depending on manhole conditions and depths the inspector may need to enter the manhole to collect all necessary information (perform a NASSCO MACP Level 2 inspection. Manhole inspections are aided by regular cleaning, therefore, it maximizes the effectiveness of manhole inspections to clean them concurrently.

The inspection should be recorded at the time of the inspection and should include notes, an area picture, a picture looking straight down in the manhole, a picture zoomed in on the bottom of the manhole, at least one zoomed-in picture for each connection, and at least one zoomed-in picture for each defect found. The area picture can be used to help locate the manhole and should show house numbers, streets signs, or other identifying landmarks with the manhole lid clearly visible or marked with flagging. Another photo of the manhole lid with the manhole ID clearly labeled should also be added to the file. The picture looking into the manhole will give an overall look at the inside of the manhole and help piece together the zoomed-in photos of the bottom of the manhole, the connection points, and the defects.

Each manhole inspection should be recorded as it occurs. However, paper copies of the form should be available to inspection crews in the event that the network cannot be reached.

The crew leader conducting the manhole inspection will initiate a work order for each defect found. For infrastructure that does not appear in the field as it does in GIS (missing, incorrectly located, mislabeled, incorrect size, incorrect material, etc.) the collection system supervisor needs to be contacted to verify conditions, and coordinate a GIS update. Additionally, if any surcharged manholes are encountered, the Conveyance System Crew needs to be contacted to mitigate the situation and the information should be entered into the Predictive Cleaning Program for a follow up visit. If a defect or potential failure of the manhole is immediately imminent and likely to cause an SSO then the Crew Leader needs to initiate a work order to remediate the problem and involve the Conveyance System Crew if necessary, to avoid an SSO.

End of Section

8. Documentation and Records

It is important to maintain a variety of records, such as assets, evaluations, maintenance tasks, repairs and replacements, customer complaints, and work orders. These records will be maintained in a Computer Maintenance Management System (CMMS) for ease of use. This will allow for efficient evaluations, record keeping, search functions, and record recall. The software selected are recommended to be GIS-based to geographically view these records. For additional recommendations regarding the CMMS software recommendations, please refer to Appendix H, Computer Maintenance Management System Software Checklist.

All personnel responsible for issuing work orders, scheduling crews, and completing work orders in the field should have access to the CMMS in the field with mobile access devices.

For each work order issued and completed a record in the CMMS should be generated to document the work completed. At a minimum, each task requires the input of:

- Date and Time,
- Crew member performing work,
- ID Number of asset being evaluated, maintained, or repaired/replaced, and
- Condition information collected during inspection.

For each action there needs to be a specific form in IMMS that can prompt crews in the field to fill in the specific information necessary and relevant to that task. Each crew needs to keep hard copies of each form so that the work may continue regardless of any technical difficulties.

8.1. Record of Assets

It is important to maintain records of assets:

- Type of asset (pipe, manhole, gravity or force main, pump station),
- Installation date, material type, size and capacity,
- Unique ID, location, and basin information, and
- Make and model, and serial numbers of each asset, where applicable.

A benefit of maintaining these records is finding trends of premature failures of particular materials at a higher than expected failure rate. This allows for these materials to be proactively repaired or replaced.

8.2. Record of Evaluations

A variety of evaluation types should be occurring on regular intervals. Sometimes these evaluations are also considered inspections, or assessments. Results of all inspections, assessments, and evaluations should also be maintained in a CMMS including:

- Sewer Line – Rapid Assessment Tool (SL-RAT),
- Smoke Testing,
- Dye Testing,
- CCTV Inspections,
- Manhole Inspections,
- Pump Station Inspections,
- Lateral Connection Inspections, and
- High Priority Assets.

These records are important to maintain to ensure that each asset is evaluated according to schedule and evaluation type. For instance, each sewer line should be SL-RAT assessed once a year and CCTV inspected at *least once every 10 years*. Refer to Section 5.2.1 for further detail. The evaluation records should be used to ensure each asset is evaluated according to schedule and that no assets are overlooked. Assets that are overlooked can become liabilities to the Utility as defects go unnoticed and unaddressed.

Sometimes equipment used to evaluate assets comes with its own software to document the evaluation and its results. This is especially true for CCTV Inspections where gravity main inspections are facilitated using a camera and footage counter mounted on a small robot. This software needs to be NASSCO and PACP certified, fully conform to PACP standard data format and export and import guidelines as established by NASSCO. The software will provide a tabular space to input the footage, defect code, and photo link. It may also limit the number of errors by only allowing standard PACP defect codes to be entered, which may expedite field reviews. The software should also automatically enter condition ratings based on the defect code for each pipe segment.

A field review should be conducted for accuracy once the data has been collected from the field. A secondary review should be made to ensure that all necessary information has been collected, that follow-up inspections are not needed to further identify the cause of any problems, and any work orders necessary are issued in order address any identified problems. Once it is determined that the CCTV inspection information is accurate and complete, it should be uploaded to the CMMS.

8.3. Record of Maintenance

There are many aspects of collection system maintenance that are required in order to keep it in good condition. Maintenance assets include:

- Manholes,
- Gravity Mains,
- Pump Stations,
- Force Mains and Air Release Valves (ARVs), and
- Easements.

The maintenance of these assets may include quick visual inspections to verify flow conditions, remove debris, roots, and FOG (fats, oil, and grease), lubricate mechanical components, and recalibrate instrumentation as necessary.

It is important to keep record of maintenance tasks to ensure that the schedule of proactive and reactive maintenance is maintained. Assets that routinely require reactive maintenance may need to be considered for more thorough evaluations to ensure it is appropriately designed for the current conditions.

8.4. Record of Repair or Replacement

All repairs should be recorded. This includes records of rehabilitation, point repairs, and replacements. These records should be reviewed on a regular basis to:

- Evaluate the effectiveness of recent rehabilitation efforts,
- Determine the need for future replacements, and
- Look for patterns in assets that require premature or overly frequent rehabilitation.

Specific assets that fail repeatedly despite adequate maintenance and repairs should be reviewed to determine the root cause of the problem. The root cause should be documented in the CMMS for future reference and work orders should be issued to address the cause.

8.5. Record of Customer Complaints

Most customer complains center around odors and sanitary sewer overflows. Both of these complains should be addressed as quickly as possible. Odor complaints are usually a sign of either an overflow or corrosive conditions in the sanitary sewer and should be considered a precursor to the failure of an asset if not addressed. Additionally, sanitary sewer overflows should be responded to in accordance with the Utilities' sewer overflow response program.

Both the customer complaint and the work orders issued to address the complains should be documented in CMMS. These records can be helpful in determining the location and extent of a problem area and the conditions that have caused a problem to arise. Records of the work orders issued to address the complaint provide a way to determine what has historically been most effective at addressing the problem.

8.6. Record of Work Orders

Once a work order is issued, a record of the work order should be automatically generated in the CMMS. The record should be updated as it progresses from being assigned to a crew, to being investigated, and then addressed. Follow-up work orders should be issued in such a way that they can be tracked as follow-ups to the original work order. Records of these work orders can be used to evaluate the performance of assets, ability to maintain maintenance schedules, effectiveness of repairs, and response to customer complaints.

The use of a compatible CMMS will greatly reduce the amount of work required to make, maintain, and use the records described in this section.

End of Section

9. Easement/ROW Maintenance Program

Easements and Right-of-Ways are crucial components of the conveyance system by providing access to the conveyance system to perform maintenance. It is necessary to maintain these easements to ensure ease of locating and accessing them and that the assets located within the easement are operating properly.

Easements should be maintained *at least once every year*. Maintenance is necessary to remove any trees, shrubs, brush, and other obstacles that may:

1. Obstruct Vehicular Traffic – Inspection and maintenance equipment need to be able to access each of the assets in order to keep the assets in good condition. Any obstacles that reduce vehicular access to a sanitary sewer system asset should be removed. Often times these may include sheds, fences, carports, playhouses, doghouses, vegetation and landscaping, yard art.
2. Remove Roots – Wastewater that leaks from pipes is sought out by roots that can enter the pipes and create blockages that reduce the pipe's hydraulic capacity. Therefore, it is important to keep trees, large shrubs, other brush at a distance to reduce the potential of roots entering the pipes and reducing hydraulic capacity.

Upon discovering trees, shrubs, brush, and other obstacles located in the Easement the Utility will create work orders to have them removed from the easement. Where it is within the legal authority of the Utility, the Utility will have the trees, shrubs, and brushes removed promptly.

In the case where the obstacles appear to be property of the homeowner, like sheds, doghouses, and fences, the Utility will need to work with the homeowner to have them moved.[6] The Utility should work with the homeowner to help them understand the importance of maintaining access to the easements in order to reduce future recurrences. Especially since sometime these obstacles are the results of attempts to hide or disguise sanitary sewer system assets. This is especially true for assets that are visible above grade or are in prominent locations.

Easements that contained personal property that has a higher likelihood of being returned to its original location should be added to next year's list of easement inspections for a follow-up visit. Annual follow-up visits should continue until no personal property is found in the easement.

End of Section

[6] An alternate remedy, if acceptable to the OJRSA, would be to have the property owner install a wide "drive-through" gate on the fences crossing the Easements. The OJRSA should have their own lock on the gate so they can gain access without having to cut another's lock from the gate.

10. Sewer Use and Grease Regulation

Oconee Joint Regional Sewer Authority (OJRSA) developed a Sewer Use Regulation that became effective March 1, 2019. These Regulations present the requirements to discharge to the publicly owned treatment works (POTW) and allow OJRSA to comply with all applicable State and Federal laws and the Pretreatment Regulations (40 CFR Part 403 and R61-9 Part 403).

The Regulations include a Fats, Oils, and Grease (FOG) Control Program in Appendix H. The purpose of that document is to provide regulation of the collection, control, and transportation of non-hazardous FOG generated by users that derives from animal or vegetable products.

Each Member City has their own Sewer Use Regulation (SUR) and it must be at least as stringent as the SCDHEC-approved SUR of the OJRSA. Additionally, each Member City either has a FOG program or utilizes OJRSA's FOG program as their own. Furthermore, there is a memorandum of agreement between the Member Cities and OJRSA to comply with OJRSA's Sewer Use Regulation and FOG Program.[7] This enables OJRSA and the satellite collection systems to operate under a set of uniform regulations for consistency in how they enforce and handle violations of the rules.

10.1. Sewer Use Regulations

Sewer Use Regulations are one of the most important documents that a sanitary sewer collection and treatment system can have. They lay the framework for what discharges are allowed and how they should be discharged to avoid disrupting the operation of the POTW or contaminate the resulting wastewater disposal system.

OJRSA is in the process of revising the Sewer Use Regulations. The revisions have the following goals:

1. To strengthen the FOG program,
2. Address deficiencies in the Enforcement Response Guide (ERG),

[7] These agreements were executed by the Member Cities, Oconee County, and West Union on the following dates. There was no "sunset" date to the agreements, and they are automatically adopted by each municipality upon approved revision by the OJRSA Board of Commissioners. Seneca approved: December 10, 2019. Walhalla approved: November 15, 2019. Westminster approved: November 14, 2019. Oconee County approved: February 19, 2020. West Union approved: November 12, 2019.

3. Improve the hauled waste acceptance requirements,
4. Address excessive Inflow and Infiltration matters from upstream users.

Additionally, some items will be pulled from the Sewer Use Regulations to become stand alone policies. The stand alone policies will allow for easier updating of the policies by the OJRSA Board. The policies to be pulled from the Sewer Use Regulations include:

1. Schedule of Fees
2. Standard Design and Details

WKD recommends that the Member Cities continue to further align their SURs with OJRSA's as they go through periodic updates to reduce potential conflicts within the documents.

10.2. Fats, Oils, and Grease Control Program

A FOG Program is essential for a collection system to regulate substances that could be potentially harmful to the system. For OJRSA and its Member Cities specifically, as industrial and commercial growth continues, a strong FOG program will decrease the potential for sanitary sewer overflows (SSOs) due to clogs from regulated byproducts.

The following are recommended to be added to the FOG program to aid in enforcement/compliance:

1. Develop design standards for grease control equipment.
2. Add record keeping requirements of FOG device maintenance.
3. Add requirements for recorded employee training.
4. Add periodic effluent flow requirements.
5. Add requirements for non-Food Service Establishment FOG permits. (These would be for car washes, car repair garages, and laundromats).

End of Section

11. Spare Parts and Equipment Inventory

It is important to keep a current inventory of the tools, spare parts, and equipment available to the Utility's employees. The inventory should be stocked according to equipment manufacturer's recommendations, updated records of maintenance and equipment needs, any components with long lead times, and any critical component that does not have a backup or work around option. To reduce the Utility's risk and improve resiliency, it is key to keep critical components in stock. If failure of a component occurs and there is no replacement in stock, a long down-time or period of inefficient operation will occur.

11.1. Inventory

A current inventory will account for all items at the warehouse and will ensure crews have access to adequate tools and equipment. A system should be set up to sign out tools and equipment and to ensure accountability.

The inventory should document:

- Type, age, and description of the tool, spare part, or equipment,
- Manufacturer, model number, and serial number (if applicable),
- Fuel type or electrical connection requirements (if applicable),
- Repair history and operating costs,
- Storage location (if more than one storage location is used), and
- Presence of Operation and Maintenance Manual.

Tools and equipment should be inspected routinely and before each use. When tools are found to have reached the end of their useful service life, they should be replaced. The consistent replacement of worn out tools, equipment, and replacement of spare parts should be addressed in the annual budget.

11.2. Warehouse Location

An easily accessible and conveniently located warehouse should be maintained to store the tools, equipment, and spare parts where crews are dispatched. If the warehouse is shared with other departments or utilities, it should be clearly noted which tools, equipment, and spare parts are available to each group. Inventory logs should not include tools, equipment, and spare parts that are not available to the Utility.

11.3. Tools, Equipment, and Spare Parts

11.3.1. Tools

A set of tools are provided to Operators on a daily basis in order aid in the completion of work tasks. Over time as these tools become worn or otherwise need replacing, it is the Operator's responsibility to inform the Supervisor that the tool needs to be replaced. The tool should be replaced from inventory as soon as possible and the stock supply should be replenished.

For tools not routinely available, the Operator should check out the tool from the warehouse via the tool inventory tracking system. The tool should be returned as specified to the warehouse. If the tool was damaged, its current condition should be noted on the tracking form.

11.3.2 Equipment

Larger tools and equipment should be stored in the warehouse. These items may include portable generators, bypass pumps, and CCTV equipment. Adequate supply of each should be determined based on:

- Consequence of not having immediate access to equipment,
- Current access to this equipment,
- Potential for simultaneous need of this equipment throughout the collection system, and
- Available alternatives to having these equipment items including on call contractors and promptness of their response times.

Like the tools, a tracking system should be implemented to provide accountability, maintain an inventory list, condition of equipment, and adequate quantity.

11.3.3. Spare Parts

Spare parts should be kept in a clean, protected stock room.

When determining which spare parts to include the following factors should be considered as a minimum:

- Recommendations from manufacturer' manual aids,
- Frequency of usage of the part,

- Criticality of the part and of the equipment,
- Difficulty in obtaining the part, and
- Available equipment redundancies and bypass equipment or other work arounds.

Critical parts are those that are essential to the operation of the collection system. A list of critical spare parts should be kept with adequate quantities. A tracking system should be used to determine how frequently certain spare parts are needed and where they are needed to maintain adequate supply. The tracking system for the use of spare parts can also be used to determine if certain assets need an additional evaluation, are reaching the end of their service life, or need upgrading to a higher capacity. All utility staff should have access to the list of critical spare parts and be able to find and identify them in the warehouse.

11.4. Procurement

Having a well-established and well understood procurement policy, sometimes called a Purchasing Policy, serves as a backup plan for maintaining a spare parts and tools inventory. Sometimes during emergencies unexpected situations arise resulting in a need to quickly purchase additional materials. Having an established Purchasing Policy that is well understood and specifically outlines emergency purchases can make this process easier.

A Procurement Policy's purpose is to help balance value with price and to protect the utility from waste and abuse. A copy of the Oconee Joint Regional Sewer Authority's Purchasing Policy is included in Appendix I. This policy includes procedures for regular purchases, emergency purchases, purchasing contracts, cash purchases, and routine small purchase orders. This policy was reviewed and approved by the Oconee Joint Regional Sewer Authority.

It is recommended that Procurement Policies be reviewed on a routine basis to ensure that outlined procedures and established monetary limits are practical for the current environment.

End of Section