# SEWER MAPPING PROGRAM

## FOR

## CITY OF GREENVILLE
## GREENVILLE, MS



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# Table of Contents

## Acronyms

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|---|---|
| CAD | Computer Aided Drafting |
| CCTV | Closed Circuit Television |
| CMOM | Capacity, Management, Operations, and Maintenance |
| EPA | U.S. Environmental Protection Agency |
| ESRI® | Environmental Systems Research Institute |
| FSE | Food Service Establishment |
| GCE | Grease Control Equipment |
| GIS | Geographical Information System |
| GPS | Global Positioning System |
| ID | Identification |
| IMS | Information Management System |
| IT | Information Technology |
| LACP | Lateral assessment Certification Program |
| MACP | Manhole Assessment Certification Program |
| MDEQ | Mississippi Department of Environmental Quality |
| NASSCO | National Association of Sewer Service Companies |
| OSSER | Ongoing Sanitary Sewer Evaluation & Rehabilitation |
| PACP | Pipeline Assessment Certification Program |
| PCD | Partial Consent Decree |
| SCADA | Supervisory Control and Data Acquisition |
| SOP | Standard Operating Procedure |
| SSER | Sanitary Sewer Evaluation & Rehabilitation |
| SSO | Sanitary Sewer Overflow |
| WCTS | Wastewater Collection & Treatment System |

# 1.0 Introduction

## 1.1 Purpose/Goal

On April 4, 2016, a Partial Consent Decree (PCD), issued by the United States of America on behalf of the United States Environmental Protection Agency (EPA) to the City of Greenville, Mississippi (CITY), was executed. The PCD cited the CITY for violations to both their National Pollutant Discharge Elimination System (NPDES) Permit and the Clean Water Act (CWA). The PCD, among other things, required the CITY to develop and implement a Capacity, Management, Operation and Maintenance (CMOM) Program with one of the major sub-programs being the Sewer Mapping Program.

The Sewer Mapping Program builds on and expands the City's pre-existing sewer mapping efforts. The City currently has the ability to produce maps using GIS technology, produce and share maps on ArcGIS Online for use by all sewer system operation staff, consultants, and contractors, and identify and track problems such as SSO's and service interruptions geographically. The City has constantly worked to improve its sewer mapping capabilities starting in the late 1980's with digitizing county tax maps with water and sewer asset layers. Then in the early 2000's with the acquisition of Survey Grade GPS equipment, enabling the sub-inch accuracy mapping of water and sewer assets. More recent Sewer Mapping tasks were conducted as part of the SSER programs in Group 1 and Group 2 mini-systems as part of the requirements of the Partial Consent Decree (PCD).

The purpose of the Sewer Mapping Program is to provide an integrated system to map, inventory, and depict system assets. One goal of Sewer Mapping is to provide an efficient means for data evaluation and record keeping. Another goal is to provide and maintain a comprehensive inventory of system components and assets including relevant attributes and characteristics catalogued by mini-system, sewershed and/or lift station. This is consistent with the City's overall goal to use GIS to provide real-time, visual information for planning and scheduling system maintenance and improvements.

## 1.2 Program Activities

The City of Greenville's Sewer Mapping Program uses Global Positioning System (GPS) equipment to update sewer system GIS maps and asset inventory of the wastewater collection and treatment system (WCTS).

The following are key aspects of, or functions included in, the Sewer Mapping Program:

- Producing maps using GIS technology.

- Producing maps showing the locations of all sanitary sewer manholes, gravity sewer pipes, lift stations, force mains, valves, and wastewater treatment facilities.

- Producing maps capable of electronically integrating the locations of sewer service connections in pipes that have been televised and for which such electronic data identifying the precise GIS locations of the connections are provided. The context for gathering this electronic data shall be through Sanitary Sewer Evaluation and Rehabilitation Programs (SSER) 1,2,3,4,5 and 6 required in the Partial Consent Decree (PCD), and the Ongoing Sanitary Sewer Evaluation and Rehabilitation Program (OSSER). All non-emergency CCTV work done under SSER 1,2,3,4,5 and 6, and OSSER will provide this data, which will be integrated in the GIS system.

- Producing maps that include attribute data for the wastewater collection and transmission system (WCTS) including, but not limited to, size, material, estimated age or age range, condition, slope, invert elevation, and rim elevation.

- Producing maps that delineate the spatial boundaries of sewer mini-systems and sewersheds.

- Producing maps that show the NASSCO Maintenance Index rating, or NASSCO Structural Index rating of sewer line segments color-coded to indicate the NASSCO condition rating from 0 to 5.

- Producing maps that depict Sewers in easements with NASSCO Maintenance Index ratings color-coded to indicate the NASSCO condition rating from 0 to 5.

- Producing maps that can electronically integrate available maps, showing the location of surface streets and street addresses, surface water bodies, and political boundaries.

- Producing maps in a manner that will allow use by all sewer system operation and maintenance crew leaders and contractors in the field.

- Mapping of work orders to identify and track problems geographically, such as stoppages, service interruptions, infiltration, and SSOs, to assist in the planning, scheduling, and prioritization of maintenance. Data from the IMS system will be added to the GIS System monthly and a new map generated and shared online for all Sewer Maintenance personnel to utilize.

## 1.3 Program Resources

City personnel, in addition to consultants and contractors, support the Sewer Mapping Program. City personnel utilize the GIS system daily, while consultants, contractors and/or city personnel are mostly relied upon to collect the information for mapping and inventorying of the system, and building the attribute tables, maps, etc. that consitute the GIS system.

Equipment includes smartphones, computers, office equipment, and software programs. The City uses state of the art software for mapping/GIS work (via ESRI® ArcGIS®, Softdesk AutoCAD). The city uses state of the art computer hardware to create maps and store the data that makes up the maps and printers to create hardcopy maps when necessary.

The city utilizes a variety of servers to store and share the data that makes up the GIS System. A local onsite server is utilized to store all the SSES, GPS, and map data. Online servers are utilized to share data to field crews, consultants, and contractors.

## 1.4     Mapping Process

The City of Greenville uses the services of consultants and contractors to conduct the field mapping and inventory activities. Data collection for the mapping program is scheduled by mini-system and sewershed. Mini-system SSER priorities were established during formulation of the PCD.

SSER crews locate each manhole and utilize established manhole identification (ID) numbers. The goal is to reference this unique ID number in all data systems containing information on manholes. They then record the orientation of all pipes and pipe diameters and measure invert depths, manhole material, condition, and manhole dimensions. All manhole inspections are conducted by NASSCO Certified personnel (MACP) utilizing NASSCO developed coding schema to uniformly rate the condition of the manholes. This data is used to build attribute tables on manholes in the GIS system.

Inventory, survey, and draw down data of lift stations are also utilized in this program. SSER crews are responsible for sewer lift station inventory and inspection, including the number of pumps, size, type, motor sizes and other name plate data such as serial numbers and year of installation. Wet wells are measured, location by street address, subdivision, and drainage mini-system and sewershed. They record horizontal and vertical coordinates of manholes, lift stations, and system property boundaries. This data is used to build attribute tables on lift stations in the GIS system.

SSER crews clean, perform a video assessment of gravity lines utilizing NASSCO certified personnel (PACP), with NASSCO approved Software, follow NASSCO approved coding Schema to uniformly rate the condition of gravity sewers. This data is used to build attribute tables on gravity sewers in the GIS system. Smoke testing of the gravity sewer system is also conducted. Points where smoke appears are mapped with GPS equipment, physically measured from two or more fixed objects, photographed with an identification board marked with a unique id number for the leak and the address where the leak is occurring. All this data is then input into an Access database. It is then used to build an attribute table of system leaks in the GIS system.

As the SSER crews complete the survey of each mini-system, they deliver a Microsoft® Access® (Access) database containing the records, videos, photos of all assets surveyed to the consulting engineer. The consulting engineer then reviews the data for accuracy and completeness, after which it is delivered to the GIS Technician. The City of Greenville uses ESRI® ArcGIS® for mapping, and Microsoft Access™ databases for system inventory. Data is received from the consulting engineer by the GIS Technician and imported into these software systems, as applicable. Video survey files, and photo survey files are stored on a local file server, but GIS hyperlinks are directed to offsite servers for field crew, consultant, and contractor review. In addition, the GIS technician imports feature locations and attributes from the Access database into the GIS.

6

SSER data is integrated into the GIS System as soon as it is made available to the GIS Technician, after review by the consulting engineer for accuracy and completeness.

Data submission for new development sewer assets are incorporated into the GIS based on digital submission standards contained in Section 1.8 required for developer/engineer plans and specifications.

Attributes that could not be directly obtained through field survey will be completed by processing the data obtained in the field and historical records by contractors or staff, for example date and type of rehabilitation will be completed based on City's records. Pipe slope will be determined based on the upstream and downstream pipe inverts and pipe length (by field surveyed upstream and downstream manhole coordinates); pipe age will be estimated based on either the recorded subdivision plat or original sewer construction card.

In addition to data from the system mapping and inventory survey, data updates to the system will derive from new developments that are depicted on a final plat or as-built (survey data), system changes that have been reported by City personnel in the regular course of business, and system changes that have been reported by SSER crews. All City personnel have access to all GIS maps. Any map errors noted are reported to the GIS technician for immediate GIS map revisions.

## 1.5 Updating the GIS Inventory

All work on the sewer system, including but not limited to OSSER, mini-system rehabilitations, point repairs, manhole repair or replacement, lift station rehabilitation, new developments, etc. will utilize existing identification schemas for manholes, line segments, etc. All sewer system rehabilitation work will require post-rehab documentation utilizing NASSCO approved methods and will include ID, address if applicable, GPS coordinates, poll-cam photos of manholes, video of new or rehabbed gravity sewer segments, photos of lift station rehab, as-built drawings of mainline replacements, lift station rehabs, updated condition assessment of rehabbed gravity sewers, etc. All post-rehab inspection data will be incorporated into the GIS system as soon as it is delivered to the GIS Technician. All mapping corrections and/or updates provided to the GIS technician should be in Mississippi-West State Plane Coordinate System. All revisions and additions to the GIS Inventory from the above will be made within ninety (90) days of completion of the rehabilitation, repair, replacement or acquisition of assets. All data associated with the rehabilitation, repair, replacement or acquisition of assets will follow the digital submission standards in Section 1.8. All data will be delivered to the GIS Technician via email, Dropbox, or courier. All courier delivered submissions should include a signed, dated Letter of Transmittal.

## 1.6 Food Service Establishment Mapping

Food Service Establishments have been preliminarily mapped utilizing privilege license data from the City Clerk's office. As the initial inspections by the FOG Control Personnel are carried out, the GIS Technician will make any additions or deletions to the FSE mapping data as soon as the information is provided by the FOG Control Personnel.

Existing, if any, Grease Control Equipment (GCE) will be delineated on a sewer system map change form. GCE location in relation to structures, interior dimensions if practicable, as well as cleanouts and access points will be delineated on the form. Photos of existing equipment will be taken showing the relationship to structures, access points, etc. Completed sewer system map change forms will be copied and sent to the GIS Technician to be incorporated into the GIS Inventory the same day.

## 1.7 Using the GIS Inventory

The City of Greenville maintains a Geographic Information System (GIS) inventory of its sanitary sewer collection system for use by City Employees, Contractors, and Consultants. Employees can access the GIS inventory through the ESRI website (ArcGIS.com), or the ArcGIS app. However, employees have different permission levels to access the GIS inventory based on their job type and level of responsibility.

The levels of GIS interaction are technician and viewer.

a. The GIS Technician manages the ESRI server and the files located there. This individual has ArcGIS server software or software licenses. They are responsible for managing the data on the server and maintaining the data as a whole. They resolve errors or software problems and are responsible for posting, or uploading, changes to the GIS system after edits have been made. The Technician creates datasets and geo-databases whenever a new type of data is produced. Most of their time is spent adding data to the various feature sets and databases. They are able to query the data and do analyses as requested. They are able to change the way the map is presented and are able to print custom maps. They can create subsets of data based on location or attribute data. They are constantly maintaining the data as updates and additions are delivered. Examples of the data constantly added to the GIS include; service request entries in the IMS, SSER data, and additions/deletions to the cities infrastructure.

b. Viewers have only the ability to view the data, print maps, and turn layers on or off. Viewers can access the GIS through the internet via Apple or Android apps, and the ESRI server via their personal computers. They have the ability to search for an address, make measurements on the map, add text or draw on the map, and print what is shown on the screen, but not save changes to the GIS System.

## 1.8 Digital Submission Requirements

As part of the SSER, OSSER, additions, rehabilitations, repairs, maintenance, etc. the data collected must be incorporated into the GIS System. In order to efficiently incorporate all system changes and SSER data into the GIS System, it is important that the following digital submission standards be followed:
- Photographs must be submitted as JPEG files
- As-built or record plans must be submitted as PDF documents

- SSER data must be submitted as Microsoft ACCESS files
- Video files associated with SSER, OSSER, and post rehabilitation work must be submitted as WMV or MP4 files.

## 1.9 Updating the GIS Software

The software programs currently being utilized by the City of Greenville include ESRI ArcGIS Standard Edition v10.6, Softdesk AutoCAD v2013 Civil 3D, Microsoft Office Home/Business 2016. These software packages are maintained by Greenville's Information Technology Department/Consultant and are housed on servers in the City Drafting Department. The City uses these software programs to update, maintain, and manage the sanitary sewer GIS inventory databases.

The procedure for updating the software is coordinated through the City's Information Technology (IT) Department/Consultant as follows:

1) The end user (primarily the GIS Technician) typically gets a notification from the vendor that a patch, new version, or upgrade is available. The GIS Technician and IT will evaluate the need for this patch, new version, or upgrade based on need.

2) The basis of need examples include:
   a) Significant application enhancements from the current version. For example, if the new version of the software could drastically improve the performance compared to the current version, or the new patches could eliminate more bugs, etc.
   b) Software technical specifications. For example, if the new version has the latest operating system, better Geographical User Interface (GUI), or is more compatible with other hardware and/or software that is currently used.
   c) Technical support expiring for the current version. The vendor has a timeline to provide technical support to the current version, or if free technical support and training are offered for the upgraded version, etc.

3) The GIS Technician submits a request to the Public Works Manager that initiates the purchasing process.

4) IT evaluates the software changes to see what would be impacted.

5) If IT concurs on the upgrade, the Public Works Manager makes a formal request during the budget process if the upgrade involves a capital expenditure or increase in annual license fees.

6) If the upgrade is an incremental no cost upgrade, the Public Works Manager can approve immediately once IT concurs on the upgrade.

7) An internal training session takes place during the upgrade process. The software vendor or a consultant either provides training.