Cleveland Heights
Sanitary Sewer Evaluation Survey
(SSES)
Work Plan

Final

February 3, 2018

WadeTrim Team

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 Introduction

In 2017, the City of Cleveland Heights entered into a Partial Consent Decree (CD) with the U.S. Environmental Protection Agency (USEPA) and the U.S. Department of Justice (DOJ). The CD requires Cleveland Heights to complete a Sewer System Evaluation Survey (SSES) as described in the CD *Appendix A: Integrated Overflow Control Master Plan (IOCMP) Development Process*. Appendix A describes a two-phased SSES to support development of the IOCMP.

The SSES has been split into two phases and spread over nearly four years to help minimize cost and rate increases to Cleveland Heights sewer customers. Spreading the investigation work over the longer period will allow Cleveland Heights staff to complete much of the investigation, thereby reducing the cost of using outside contractors. The Phase 1 SSES will complete investigation of at least 50% of the system, including the most problematic portions, by November 1, 2019. Phase 2 will complete investigations in the remaining areas by June 30, 2021. Both phases will complete SSES reports to document findings.

1.1 Purpose of Plan

The two-phase SSES will characterize sanitary sewer system flow response to precipitation, and identify the types and locations of infiltration/inflow (I/I) sources and system structural problems that may cause SSOs and/or basement flooding. This plan describes:

- How the sewer system evaluation will be broken down into two phases and how the information will be used for planning
- Field activities and data collection previously performed during the Northeast Ohio Regional Sewer District's (NEORSD, District) Heights Hilltop Interceptor Local SSES (HHI-LSSES) project
- Field activities to be used by Cleveland Heights and/or their contractors to perform the two-phased SSES required under the Consent Decree
- Data collection and QA/QC procedures and how data will be stored for project and subsequent use
- Reporting requirements and how the information gathered during the SSES will support the upcoming System Characterization, Capacity Assessment and Integrated Overflow Control Master Plan (IOCMP).

2.0 SSES Phases 1 and 2 Investigation Areas

The SSES Phase 1 will focus on the worst-performing portions of the system, including all known, active SSOs and their associated tributary areas, common trench (including over/under) sewers, and those portions believed to have the highest I/I rates. This preliminary understanding of the existing system is being developed based on NEORSD's ongoing HHI-LSSES scheduled for completion in July 2018. The HHI-LSSES is conducting targeted field investigations, monitoring, modeling, problem identification and alternatives analysis in Cleveland Heights and the 15 other communities tributary to the District's HHI sewer system.

The Phase 1 area investigations will start with the HHI-LSSES information and findings, and extend the field investigations in more detail to provide the primary information needed to develop the IOCMP. Phase 1 SSES information will be used to characterize the entire Cleveland Heights system based on monitoring, modeling and capacity assessment throughout the entire system. The Phase 2 SSES will then be completed in parallel with development of the IOCMP, and Phase 2 information will be used to update the IOCMP assumptions and findings as appropriate. The proposed Phase 1 SSES area map is shown in **Figure 1.** The map updates and slightly expands the area previously indicated to USEPA.

The Cleveland Heights sewered service area includes approximately 5,200 acres. The proposed Phase 1 SSES target area is approximately 2,700 acres. The known SSOs shown on the map are green, red or black based on 2016 electronic flow monitoring performed during the HHI-LSSES project. Green SSOs were not observed to overflow during the 2016 monitoring period. Red SSOs did overflow at least once, while the black SSOs were not observed in 2016 due to the Fairmount Boulevard SSO Relief Sewer construction that was underway during the monitoring period. The proposed Phase 1 SSES investigation area will include all known Cleveland Heights SSOs except CH-52, which is projected to be controlled up to at least the 10-year rainfall, and CH-14, which has been confirmed by field check to be physically eliminated. The Phase 1 area may continue to be adjusted based on results from the ongoing HHI-LSSES project, but the proposed investigation activities and proportion of total area are expected to remain essentially unchanged.

2.1 Development of IOCMP based on Phase 1 SSES Investigations

The ongoing HHI-LSSES has found that SSOs and leaky common trench sewers are the two primary problems to be solved in Cleveland Heights. In addition, private property I/I may be significant in some areas developed before WWII, and less so in newer areas. The approaches used to solve these problems will include relatively common sewer system rehabilitation such as cured-in-place-pipe (CIPP) lining, reconstruction of sewers and service laterals, and relief sewer piping. The optimal blend of proposed improvements required to achieve the desired performance in the most cost-effective manner will be estimated during development of the IOCMP, and refined during implementation as post-construction performance is assessed using flow monitoring and modeling analysis. New sewer rehabilitation technologies, such as flood grouting (e.g. Sanipor), may also become available locally to address leaky common trench systems.

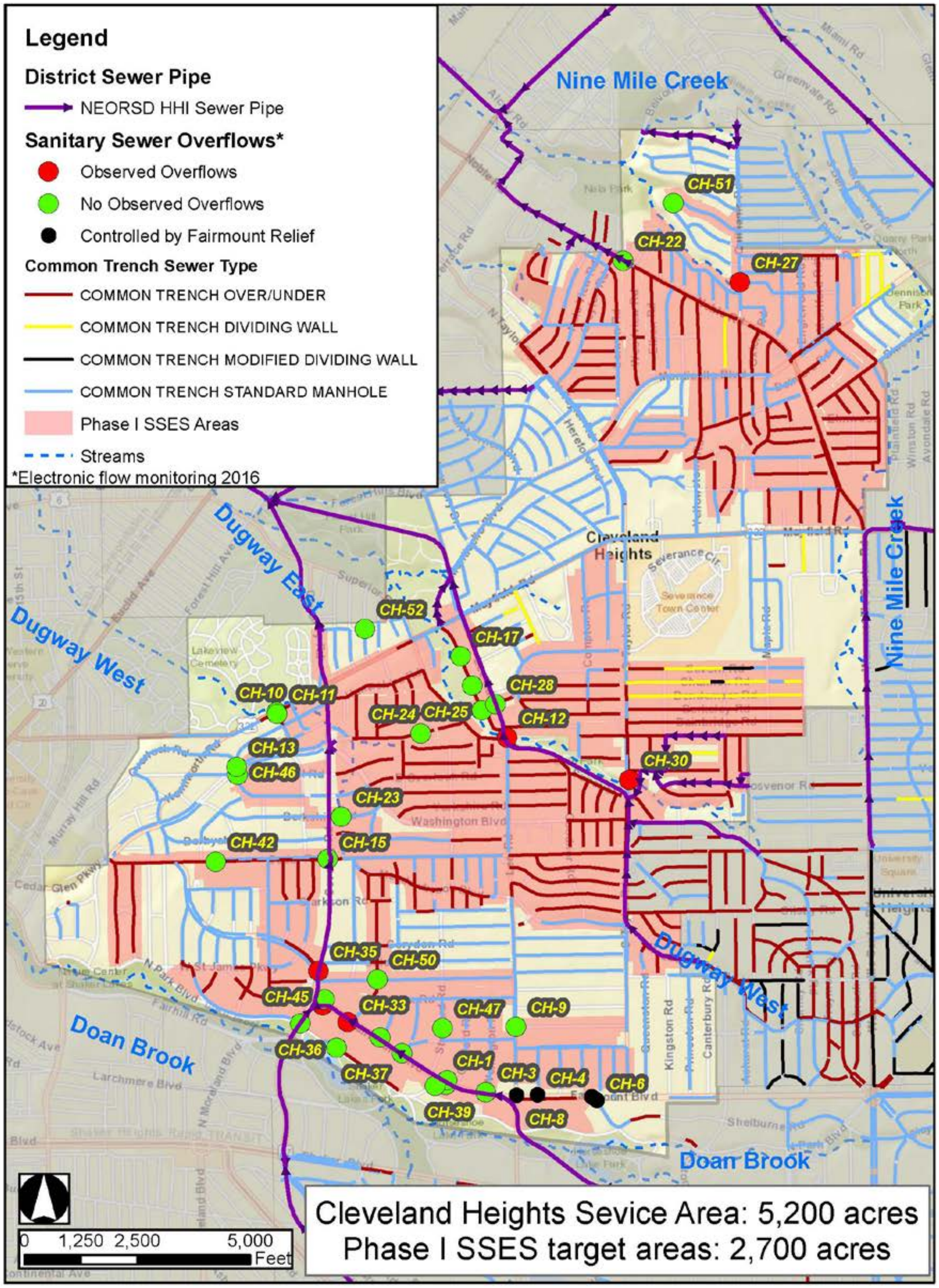
The Phase 1 SSES investigations will provide the required information to estimate the scope and cost of the IOCMP based on the following:

- Manhole investigations to include the entire system, and further define the boundaries of the various trench types in Cleveland Heights
- Flow and rainfall monitoring to characterize the entire system
- Model update, extension and calibration into neighborhood areas as required to further define problem extents
- Detailed Closed Circuit Televising (CCTV) and National Association of Sewer Service Companies (NASSCO) inspection and I/I testing in at least 50% of the service area to further define system existing conditions and extent/nature of rehabilitation and/or new infrastructure required
- Private property I/I testing in sample areas, if acceptable to Cleveland Heights, to further define the contribution of I/I from private property.

- This information will be extrapolated across the Cleveland Heights service area to develop the IOCMP scope schedule and budget for the entire program. As this is being completed, the remainder of the service area investigation will be completed in the Phase

2 SSES to confirm the extrapolation and proposed work. Any significant new information from Phase 2 would then be used to update the final IOCMP as required per the schedule in the CD.

Figure 1. Proposed SSES Phase 1 Investigation Areas



3.0 Heights Hilltop LSSES Information

NEORSD's HHI-LSSES project has completed field activities that will supplement Cleveland Heights Phase 1 SSES activities including more than 43,000 linear feet (LF) of CCTV inspection coded by NASSCO PACP ratings, 49,000 LF of dyed water flood testing, 33,000 LF of smoke testing, and Manhole Assessment Certification Program (MACP) inspections at all known SSO structures. This information will be incorporated into the City's Geographic Information System (GIS) as described in Section 4, and is also available in reporting from NEORSD.

A list of Field Work Orders performed during the HHI-LSSES project is included in **Table 1**. Detailed field work planning for the Cleveland Heights SSES will review the information available from the HHI-LSSES project to optimize SSES efforts for Phases 1 and 2. Sewer televising, NASSCO ratings, manhole inspections and dyed water flood testing completed during the HHI-LSSES, or other efforts within the past few years, need not be repeated.

Table 1. HHI-LSSES Field Work Orders Completed in Cleveland Heights

Work Order No.	Streets	Activity	Approximate Quantities	Description
1	Various	MACP Inspections	48 Manholes	Invert plate status and connectivity will be checked
2	Various	MACP Inspections	55 Manholes	Inspection of SSO
3	Various	SSO Invest, PACP	TBD	Connectivity investigations
4	Elmwood Rd., Navahoe Rd., Edgehill Rd., Overlook Rd.	Dye testing	8,470 LF	Dye Testing of storm sewers in Cleveland Heights
7A	Various	Divider Wall	35 Manholes	
16	Northvale Blvd., Rutherford Rd., Carver Rd., Brandon Rd., Stuart Rd.	Smoke Testing	5,300 LF	Smoke testing in Cleveland Heights
17	Fairfax Rd., Guilford Rd.	Dye testing	2,260 LF	Dye Testing in Cleveland Heights
19	Various	MACP Inspections	9 Manholes	Inspection of SSO structures
20	Monmouth Rd., Wellington Rd., Exeter Rd., Idlewood Rd., Shaker Rd.	Dye testing	3,200 LF	Dye Testing in Cleveland Heights
24A	Various	Divider Wall		Divider wall inspection and measure downs
26	Berkeley Rd, Sylvanhurst Rd, Henderson Rd, Woodmere Dr, S Overlook Dr	Dye testing	11,700 LF	Dye testing with catch basin and lateral launch (over/under)

Work Order No.	Streets	Activity	Approximate Quantities	Description
27	Navaho Rd, Elmwood Rd, Rosemond Rd, Ardmore Rd, Sylvania Rd	Catch basin connectivity	44 CB, 24 MH	Dye testing catch basins and MACP inspections
36	East Scarborough, Clarendon Rd, South Taylor Rd	Smoke Testing and Dyed Water Flooding	3,500 LF, 2,400 LF	3500 LF smoke testing, 2400 LF dye testing
37	Superior, South Taylor, Staunton, Raymont, Stratford	System Investigation	3 days	Invert plate checks, connectivity investigation and dye testing to confirm system configuration
38	Scarborough and Lamberton	Connectivity	4 days	Connectivity investigation of CSO area
39	Woodbridge, St. Albans, Boynton, Radcliffe, Castleton, Forest Hills, Chelsea, Hollister, Seaton, Rumson	Smoke Testing	12,000 LF	Smoke testing in Cleveland Heights
46	Coleridge	Dye Water Flooding	1,500 LF	Dye Testing in Cleveland Heights
53	Fairmount, Coventry, Cedar, Meadowbrook	Connectivity Investigation	2 days	Connectivity investigation of CSO area
53A	Coventry, Cedar	Connectivity	1 day	
54	Derbyshire, Demington, Clarkson	Dye water flooding	3,000 LF; 20 CBs	Dye testing with catch basin in Cleveland Heights
60	Pembrook, Pennfield	Smoke testing, Dye testing with catch basin	2,500 LF; 5,500 LF	Smoke testing and Dye testing with catch basin in Cleveland Heights
61	Quilliams, Lowell	CCTV, Dye testing with catch basin	600 LF, 780 LF	CCTV, dye testing with catch basin in Cleveland Heights

Work Order No.	Streets	Activity	Approximate Quantities	Description
62	Edgehill, North Park, Coventry, Fairmount	Smoke testing	6,400 LF; 4,000 LF	Smoke testing, dye testing with catch basin
74	South Taylor, Clarendon, Chelsea, Seaton, Castleton, Haselton, Radcliff, St Albans, Brandon, Rutherford, Fairmount	Dye Flood Testing with Catch Basin, CCTV	4,973 LF; 873 LF	Smoke Testing follow up

4.0 SSES Field Activities

Field investigations for the Cleveland Heights SSES will confirm sewer system layout, locations and elevations as required, connectivity, trench type, structural condition and watertightness to support system characterization. Typical investigations and associated activities will include visual inspection, pole camera inspection, manhole entries, micromonitoring, smoke testing, dyed water testing, pump station inspection, elevation/location survey, and sewer system cleaning and CCTV inspection. The breakdown of work between Cleveland Heights staff and outside contractors will be developed in detail as the field work gets started in 2018. The City is planning to perform as much of the effort as possible.

4.1 Gravity Sewer Assessment

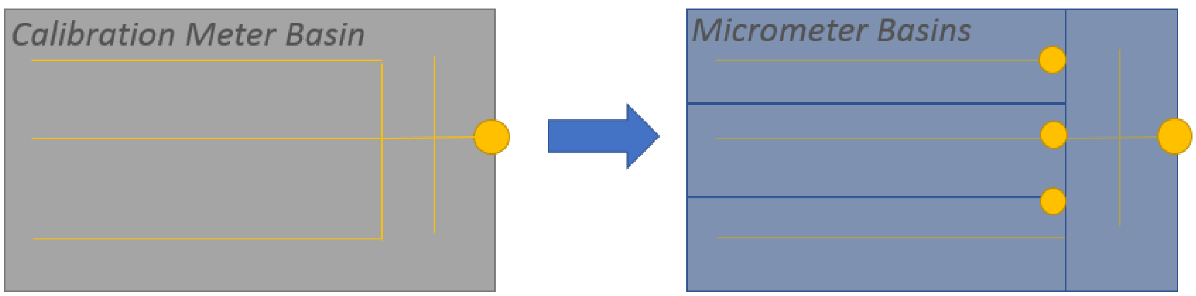
Gravity sewer assessment will follow procedures used during the HHI-LSSES, as well as USEPA guidance materials, sound industry and engineering practices, and Appendix A, Section II of the Consent Decree. The primary assessment tools used will be CCTV and manhole inspection. All assessments will follow NASSCO guidelines and rating procedures. Cleveland Heights has seven employees that are certified in NASSCO standards, and any subcontractors performing inspection work will also be required to be certified. The primary investigative tools to be used for I/I source identification and location include micromonitoring, smoke testing and dyed water testing. Due to the large amount of common trench sewer in Cleveland Heights, dyed water flood testing may be more commonly used than smoke testing, as the common trench systems have frequently been too leaky to get meaningful information from smoke testing. Cleveland Heights has adopted attribute data and names from NEORSD to allow consistent data collection through field activities for the SSES. The following sections describe information that will be captured by each field activity and resources that will be used for each.

4.1.1 Micromonitoring

Micromonitoring is a field screening tool used to check wet weather flow response and screen suspected problem and high I/I areas with short-term flow monitoring typically in place for only one or two significant rainfalls. Permanent NEORSD gauges and temporary SSES rain gauges will be used to record rainfalls electronically during the project. NEORSD radar rainfall data will also be available for modeling analysis. These will be described in the System Characterization

Monitoring Plan due March 2, 2018. Micromonitoring uses the same depth/velocity meters used for calibration monitoring, but with reduced data quality review requirements to speed up deployment to successive locations. Calibration and micrometer basin areas typically average approximately 100 acres and 25 acres, respectively. **Figure 2** illustrates how calibration meter basins can be divided into smaller micrometer basins. Detailed planning for potential micromonitoring locations will accompany planning for system characterization monitoring. The System Characterization Monitoring Work Plan is due to USEPA by March 2, 2018.

Figure 2. Calibration and Micrometer Basins Illustration



4.1.2 CCTV and PACP Assessment

The two-phase SSES requires a system-wide inspection and assessment of all gravity sanitary sewer segments using CCTV to identify pipe structural degradation, illicit discharges, cross connections, and non-stormwater discharges to the Municipal Separate Storm Sewer System (MS4). The Cleveland Heights collection system consists of approximately 670,000 LF of sanitary sewer, and a slightly lesser length of storm sewer. Selected portions of the storm sewer system will also be televised to assess condition and confirm any suspected illicit discharges. The project will use a combination of internal and contracted resources to complete this task. Cleveland Heights is currently in the process of purchasing new Vactor/Cleaning and CCTV trucks the will allow staff to perform cleaning and CCTV inspection starting in the spring/summer of 2018.

CCTV inspection will assess the structural and O&M condition of the collection system using NASSCO PACP standards to identify degradation that may contribute to SSOs. It will also be used, along with dye flood testing of storm sewers, to assess I/I sources and cross filtration between storm and sanitary sewers, particularly in common trench areas. The inspections will also help confirm pipe attribute and other system information in the Cleveland Heights GIS including:

- Location, size and configuration of all sewers, manholes, overflow points
- Sewer trench types including over/under sewers
- Locations of suspected cross connections between the sanitary sewer system and the MS4

4.1.3 Manhole Inspection and MACP Assessment

The SSES will internally inspect each manhole in the collection system with emphasis on identifying potential cross-connections between the sanitary and the MS4, and to identify all over/under (invert plate) manholes to document the status of invert plate manholes. Additional investigation techniques may be used including dye testing, lamping and CCTV, if suspected cross-connections cannot be confirmed visually. Missing/displaced invert plates will be documented and replaced or reinstalled where feasible based on existing manhole conditions. If existing conditions preclude replacement or reinstallation within 30 days, Cleveland Heights will develop a plan to replace the invert plate, and will conduct tethered block monitoring if feasible based on sewer configuration under the Real Time Monitoring Program until the missing plate is replaced, or otherwise mitigated.

Cleveland Heights has approximately 3,000 manholes in the sanitary collection system based on updated GIS information. As with the CCTV, the Sewer Department plans to use a combination of internal staff and private contractors to complete manhole inspections using either manned entry or pole cameras. All inspection information will be entered real-time into the ArcGIS Online (AGOL) system.

Manhole inspections will be used to evaluate the general condition of the manhole structure and its component parts: cover, frame, chimney, cone, walls, bench/channel, and connecting conduits. Manhole inspection data shall be compliant with NASSCO MACP Version 6.0.1 Level 1, or more recent version.

4.1.4 Gravity Sewer Dyed Water Testing

Dyed water testing will be used to perform leak investigations, test manhole connections and locate cross connections between sanitary and storm sewer systems similar to testing completed for the HHI-LSSES project. This information will be used to characterize the system and support development of the IOCMP.

Dyed water testing will be conducted by flooding the ground surface or a storm sewer segment with dyed water to simulate a stormwater runoff condition. Flooding will typically be performed in conjunction with CCTV inspection in the sanitary sewer to observe I/I locations and classify levels of infiltration. Dye testing will typically be done in the public right-of-way. Private property investigations may also benefit from dyed water testing to determine frequency and magnitude of private I/I sources.

4.1.5 Gravity Sewer Smoke Testing

Smoke testing of sanitary sewer is a proven method to quickly screen large areas for the presence of I/I sources. The HHI-LSSES project has found that smoke testing is not well suited for use in leaky common trench areas because the smoke transfers rapidly from sanitary to storm sewers, and obscures individual source locations. Due to the relatively small length of separate trench sewers in Cleveland Heights, smoke testing may be useful on only a limited basis for investigation in the SSES. Some common standard manhole areas may also be candidates for smoke testing if the systems are in relatively good condition.

4.2 Pump Station and Force Main Assessment

The Cleveland Heights sewer system includes two small pump stations and less than one mile of force main. The pump stations are located on Woodview Road and at Forest Hills Park. The Woodview Pump Station serves an area of approximately 20 households and the pumps were refurbished in 2007. The Forest Hills Park Pump Station is only used seasonally since it serves the public park area. The Forest Hills Park electrical system was replaced in 2016. As a requirement of the CMOM program, the pump stations are checked monthly and inspected twice annually. The CMOM inspections will be performed and documented in the SSES reports. Along with the routine inspection reports, the SSES will consider mechanical reliability issues, capacities, pump redundancy and alterative power sources.

The force main from Forest Hills Pump Station can be inspected off season using CCTV equipment during the SSES project. The Woodview Road Pump Station system will be reviewed for potential force main televising as well.

5.0 Data Collection and Storage

The NEORSD ArcGIS Online (AGOL) system hosts maps that allow editing of GIS data by authorized users. Esri (Environmental Systems Research Institute) publishes a mobile app (for Windows, iOS, and Android devices) called Collector that can be used to view and edit map content published in ArcGIS Online. Cleveland Heights field crews will use Collector to capture deliverable project datasets using mobile devices and synchronize those datasets into NEORSD's enterprise geodatabase via ArcGIS Online.

5.1 NEORSD AGOL

The main dataset categories that will be used from ArcGIS Online are:

- Cleveland Heights collection system GIS layers
- SSES project-specific GIS layers (manhole inspections, pipe inspections etc.)
- Collection system mapping changes

Esri's ArcGIS Online is a cloud-based platform for publishing and viewing GIS data. NEORSD has an ArcGIS Online organizational account included with their Esri Enterprise License Agreement that allows for use of remote collectors to enter data real time into the system. Cleveland Heights does not have that capability. Because of this, data collection will be completed through the District's AGOL site. Periodic data exports from the District GIS will allow Cleveland Heights to update its GIS internally while allowing for continued real time field data collection. ArcGIS Online will be used on the Cleveland Heights SSES project for:

- Providing Cleveland Heights access to NEORSD enterprise GIS layers - NEORSD and local collection system and basemap layers are published as feature services in ArcGIS Online.
- Aggregating field data collected using Esri apps on mobile devices - ArcGIS Collector on mobile devices will sync field data collected real time in the field to ArcGIS Online.
- Tracking progress of field activities - Fieldwork status GIS layers indicating crew, date, photo attachments, and inspection/ installation report attachment will be updated regularly by the project team as field work progresses for:
  - Pipe inspections
  - Manhole inspections
  - Smoke/dye testing results
  - O&M issues discovered by field crews

A screenshot example of AGOL map showing data collected is shown in **Figure 3**.

Figure 3. AGOL Screenshot of SSES Data Collection

5.2 Cleveland Heights GIS

Cleveland Heights recently installed Esri ArcGIS on the City's computer system. This program will help maintain digital records of the collection system, and will be frequently updated from the NEORSD AGOL system. The Cleveland Heights Sewer Department has imported the collection system layers from NEORSD and adopted the asset naming system currently used by the District to ease the transfer of data between Cleveland Heights and NEORSD.

6.0 Reporting

Following each phase of the SSES, Cleveland Heights will prepare an SSES report summarizing findings from field work. This report will provide detailed condition assessment of pipes and manholes, significant O&M findings, and propose potential improvements to be considered in development of the IOCMP. The SSES will include comprehensive review of all known data concerning SSOs to support the system analysis and formulation of the IOCMP.

The Phase 1 SSES will be conducted concurrent with system characterization flow monitoring and the update and recalibration of the system model. The information developed will be used to formulate the IOCMP due by June 1, 2021. The Phase 2 SSES field work will be completed in parallel with the IOCMP, and used to update IOCMP recommendations as needed.

6.1 Quality Control

A combination of internal staff and private contractors will conduct investigations and collect data for the SSES and subsequent IOCMP analysis. A quality control plan is being developed with detailed work planning to ensure data collection is consistent. The following guidelines provide an overview of the quality control procedures for the SSES:

1. All crews will use the same inspection and data collection procedures and forms. The inspection and data collection standards and protocols will be adapted for the Cleveland Heights SSES from the HHI-LSSES project and other successful SSES projects.
2. Inspection forms used by contractor crews will be checked by Cleveland Heights, or their engineer, for errors and omissions and corrected as required.

3. Contractor submittals will include a cover letter with a statement that verifies that all data has undergone a thorough QA/QC check, and that the information is accurate and reliable.
4. All original inspection forms will be filed for future reference. Any potential paper forms or notes/sketches will be scanned to pdf format and linked to the respective asset ID. Scanned forms shall be retained for five years with redundant electronic back-up.
5. Errors or omissions noted by the GIS Analyst will be flagged and reported to the Sewer Department Supervisor or private contractor's project manager for resolution.

7.0 SSES Schedule

Table 2 shows relevant requirements from Appendix D of the 2017 Partial Consent Decree related to SSES activities. Field activities for SSES Phase 1 are expected to begin in the Spring of 2018.

Table 2. Schedule of Consent Decree Requirements for SSES Activities

Partial Consent Decree Requirement and Appendix D Item No.		Citation	Submit for Review and Approval
10	Submit SSES work plan for 2 phased approach	CD Main Text Section V.B Paragraph 17	December 4, 2017
15	Complete Phase 1 SSES, satisfying Section II of CD Appendix A	CD Main Text Section V.B Paragraph 18	November 1, 2019
16	Submit Phase 1 SSES report to EPA	CD Main Text Section V.B Paragraph 18	February 3, 2020
18	Submit Integrated Overflow Control Master Plan	CD Main Text Section V.F Paragraph 30	June 1, 2021
19	Complete Phase 2 of the SSES	CD Main Text Section V.B Paragraph 19	June 30, 2021
21	Submit SSES Phase 2 report to EPA	CD Main Text Section V.B Paragraph 19	September 30, 2021