Office of the Mayor
Chokwe Lumumba, Mayor

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Chief, Environmental Enforcement Section
Environment and National Resources Division
U.S. Department of Justice
Box 7611 Ben Franklin Station
Washington, D.C. 20044-7611
Re: DOJ No. 90-5-1-1-09841

Brad Ammons
Environmental Engineer
Clean Water Enforcement Branch
Municipal & Industrial Enforcement Section
U.S. EPA Region 4
61 Forsyth St., SW
Atlanta, GA 30303

Karl Fingerhood
Environmental Enforcement Section
U.S. Department of Justice
Box 7611 Ben Franklin Station
Washington, D.C. 20044-7611

September 30, 2013

RE: City of Jackson
EPA Consent Decree
1st Semi-Annual Report, March – August 2013 and Sewershed Prioritization Work Plan

Dear Gentlemen,

Enclosed please find the Semi-Annual Report for the period of March through August 2013. The report was developed and submitted by the City in accordance with the EPA Consent Decree dated March 1, 2013 and your correspondence of May 31, 2013. Also enclosed is Sewershed Prioritization Work Plan prepared pursuant to the Consent Decree.

Finally, enclosed is an executed copy of the Supplemental Environmental Project Escrow Agreement and the Account Statement showing the first deposit in the amount of $175,000.00 made on August 30, 2013.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering such information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sincerely,

Chokwe Lumumba
Mayor

cc: Les Herrington, P.E., Mississippi Department of Environmental Quality
Pieter Teeuwissen, City Attorney
Dan Gaillet, P.E., Director, Department of Public Works
Public Depository, Eudora Welty Public Library

The City of JACKSON

SEWERSHED PRIORITIZATION WORK PLAN

Department of Public Works
Wastewater Infrastructure Redevelopment Program

WAGGONER
WEI/AJA, LLC

SEPTEMBER 30, 2013

City of Jackson, Mississippi
Sewershed Prioritization Work Plan

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering such information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Dan Gaillet, Public Works Director

9-26-13

Date

Sewershed Prioritization
Work Plan

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Appendix

1.0 Introduction

A requirement of the EPA Consent Decree is to quantify Infiltration/Inflow (I/I) within the City of Jackson sewersheds and establish priorities for their further evaluation and rehabilitation. This ***Sewershed Prioritization Work Plan*** was developed to serve as a guide to characterization of the wastewater system, assessment of I/I, and prioritization of the individual sewersheds for further evaluation. The Work Plan is provided to establish the framework for conducting the required evaluation activities.

1.1 Consent Decree Requirements

As stated in the Consent Decree, the Sewershed Prioritization Work Plan (SSPWP) shall contain the following, at a minimum:

1. The methodologies and procedures the City will implement to estimate the severity of I/I within each Sewershed.

2. The methodologies and procedures the City will implement for the development of a computerized digital mapping system for each Sewershed that shall include, and have the ability to display, the West Bank Interceptor, all Gravity Sewer Lines, Force Mains, Pump Stations, manholes, inverts, siphons, WWTP locations, diversion valves, outfall locations, and all other appurtenances relating to the City's Sewer System. The mapping system does not need to include Private Laterals. The mapping system shall have the capability to store, update, and display information in a manner that will aid City personnel in the development and implementation of a Hydraulic Model, the Sanitary Sewer Evaluation Survey and the proper operation and maintenance of the Sewer System.

3. The methodologies and procedures the City will implement for assessing the capacity of the WCTS including the West Bank Interceptor, all Pump Stations, all Major Sewer Gravity Lines, all Force Mains and siphons and their respective related appurtenances, all known SSO locations, and any other portions of each Sewershed. The capacity assessment shall include the WCTS that must be assessed so as to allow a technically-sound evaluation of the causes of SSOs and Prohibited Bypasses at the WWTPs. The capacity assessment shall specifically identify, at a minimum, the hydraulic capacities of the WCTS, and compare those capacities to existing and future projected average and peak flows in dry and wet weather. This assessment shall identify those portions of the WCTS that are expected to cause or contribute to SSOs and/or Prohibited Bypasses at the WWTPs under existing and future projected average and peak flows in dry and wet weather, and the degree to which those portions experience or cause, under current or projected future conditions, SSOs and/or Prohibited Bypasses at the WWTPs. As part of the capacity assessment, the City shall use the information it is required to develop to assess existing and future projected capacity of the WCTS and the ability of the WCTS to transmit peak flows experienced by and predicted for the WCTS.

4. The methodologies and procedures the City will implement to develop a computerized Hydraulic Model of the WCTS within each Sewershed using a hydraulic modeling software package. The City shall use the Hydraulic Model in the assessment of the hydraulic capacity of the WCTS in that Sewershed and in the identification of appropriate rehabilitative and corrective actions to address all capacity and condition limitations identified in that Sewershed's WCTS. The City shall develop the Hydraulic Model to provide a detailed understanding of the response of the WCTS to wet weather events and an evaluation of the impacts of proposed remedial measures and removal of I/I flow. The City shall configure the Hydraulic Model to accurately represent the City's WCTS, in accordance with currently accepted engineering practice. The City may model its WCTS in different levels of detail, as necessary to identify the causes of all known SSOs and to assess proposed remedial measures with the goal of eliminating those SSOs.

   The City's Hydraulic Model shall include at a minimum the West Bank Interceptor, all Major Gravity Lines and associated manholes, and all Pump Stations and associated Force Mains. The City shall configure the Hydraulic Model using adequate, accurate, and sufficiently current physical data (e.g., invert and ground elevations, pipe diameters, slopes, pipe run lengths, Manning roughness factors, manhole sizes and configurations, Pump Station performance factors) for its WCTS. In particular, the City shall field verify the physical data to allow calibration and verification of the model. The City shall calibrate and verify the Hydraulic Model using appropriate rainfall data, actual hydrographs, and WCTS flow data. The City shall use at least three separate data sets each for calibration and verification. As part of the calibration process, the City shall either use existing sensitivity analyses for the selected model, or carry out its own sensitivity analyses, such that calibration effectiveness is maximized. The Hydraulic Model shall, at a minimum, include:

   1) A description of the Hydraulic Model that includes the criteria set forth above;
   2) Specific attributes, characteristics, and limitations of the Hydraulic Model;
   3) Identification of all input parameters, constants, assumed values, and expected outputs;
   4) Digitized map(s) and schematics that identify and characterize the portions (including the specific Gravity Sewer Lines) of the WCTS that shall be included in the Hydraulic Model;
   5) Identification of input data to be used;
   6) Configuration of the Hydraulic Model;
   7) Procedures and protocols for performance of sensitivity analyses (*i.e.*, how the Hydraulic Model responds to changes in input parameters and variables including the use of various design storms of varying durations and intensities);
   8) Procedures for calibrating the Hydraulic Model to account for values representative of the WCTS and WWTPs using actual system and WWTP data (*e.g.*, flow data); and
   9) Procedures to verify the Hydraulic Model's performance using additional, independent actual Sewer System data (*e.g.*, flow data).

5. The methodology and criteria for prioritizing Sewersheds or groups of Sewersheds in order to conduct the phased evaluation and rehabilitation of the WCTS in each Sewershed as required by this Consent Decree. The criteria for prioritizing Sewersheds shall include, at a minimum, the following:

    1) The severity of the estimated I/I in the Sewersheds;
    2) The frequency, volume and location of SSOs in the Sewersheds;
    3) The relative potential impact of SSOs in the Sewersheds to human health and the environment;
    4) The average age of Gravity Sewer Lines within each Sewershed;
    5) The pipe material used within each Sewershed; and
    6) Any ongoing rehabilitation or corrective action work in the Sewersheds including detailed information on the current status and completion dates for such work.

6. The methodologies, procedures and criteria for developing proposed schedules for implementing and completing the evaluation and rehabilitation of the WCTS in each Sewershed or groups of Sewersheds as required by this Consent Decree.

This Work Plan was developed to fulfill the requirements of Section VI ¶ (B) 24 set forth in the Consent Decree.

1.2 Work Plan Elements

Described in subsequent sections are the specific requirements for developing the digital mapping system of the City of Jackson wastewater collection and transportation system (WCTS) together with information on the hydraulic computer model that will be used to simulate system response to dry and wet weather flows. This is followed by a discussion of the methods that will be used in assessing capacity and evaluating I/I in the system. Finally, the criteria to be employed in prioritizing the individual sewersheds for further evaluation are described, together with the plan for implementing the sewershed characterization activities.

2.0 Digital Mapping and Modeling

A digital mapping system will be developed to display and simulate the City of Jackson sewer system as an aid in implementing the various collection system programs required by the Consent Decree. The methodologies and procedures that are being used to develop the computerized digital mapping system are described in this section.

2.1 Jackson Sewersheds

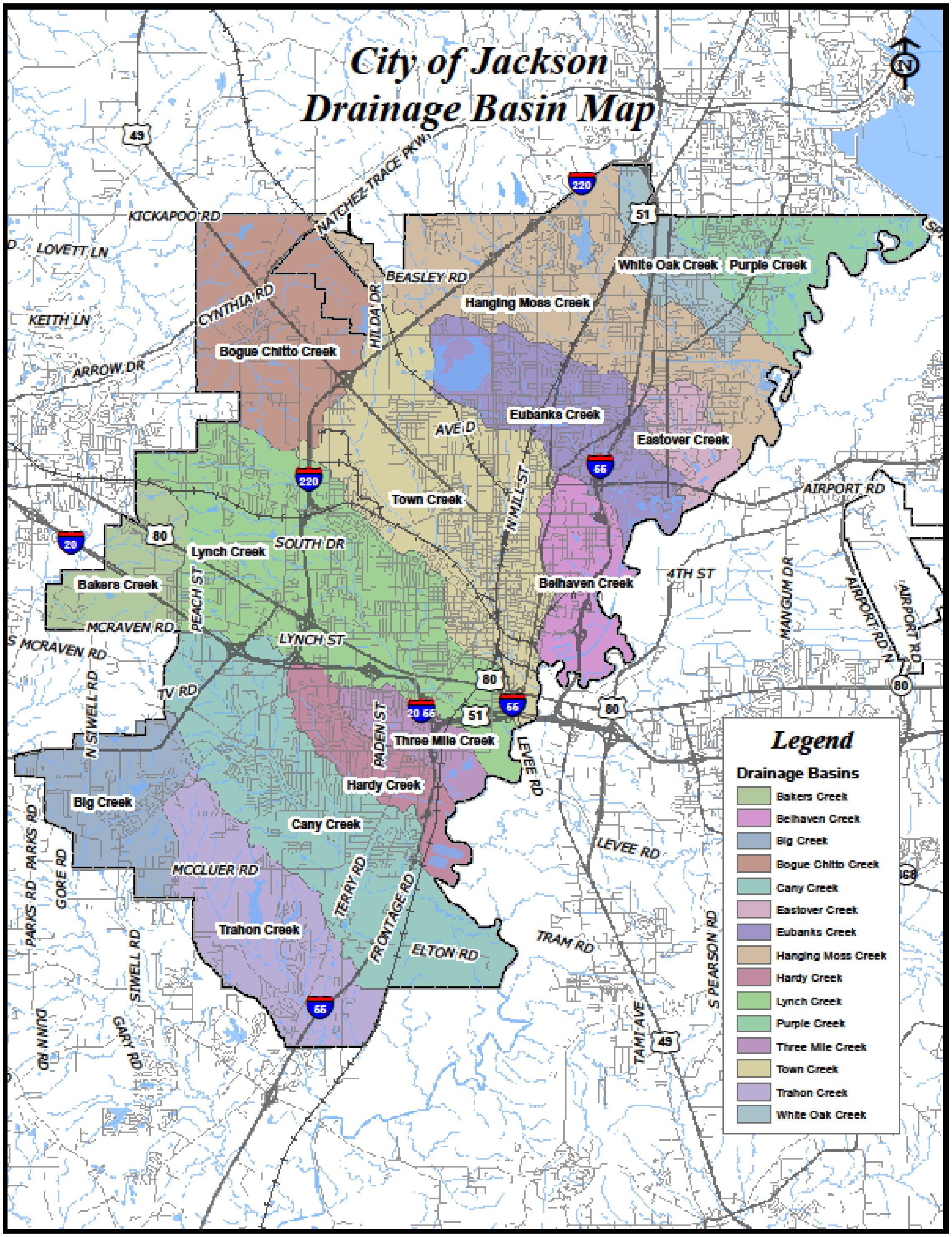
The topography of the area around the City of Jackson is interesting in that a ridge on the west side of Jackson diverts general surface water drainage to either the Big Black River, which flows to the Mississippi River, or the Pearl River, which flows to the Gulf of Mexico. Within the City of Jackson, most surface streams flow in a general southeast direction to the Pearl River. A list of the Jackson sewersheds and drainage points is provided on **Table 2-1**.

Table 2-1
City of Jackson Sewersheds

Sewershed		Discharge Point	Treatment Plant
1	Purple Creek	West Bank Interceptor	Savanna
2	White Oak Creek	West Bank Interceptor	Savanna
3	Hanging Moss Creek	West Bank Interceptor	Savanna
4	Eastover Creek	West Bank Interceptor	Savanna
5	Eubanks Creek	West Bank Interceptor	Savanna
6	Belhaven Creek	West Bank Interceptor	Savanna
7	Town Creek	West Bank Interceptor	Savanna
8	Lynch Creek	West Bank Interceptor	Savanna
9	Three Mile Creek	West Bank Interceptor	Savanna
10	Hardy Creek	West Bank Interceptor	Savanna
11	Caney Creek	West Bank Interceptor	Savanna
12	Trahon Creek	West Bank Interceptor	Trahon
13	Big Creek	West Bank Interceptor	Trahon
14	Bogue Chitto Creek	Big Black River	Presidential Hills
15	Bakers Creek	Lynch Creek	Savanna

Wastewater from Sewersheds 1-11 flow into the West Bank Interceptor and then to the Savanna Wastewater Treatment Plant (WWTP) in South Jackson which discharges to the Pearl River. The Trahon and Big Creek sewersheds flow to the Trahon WWTP which discharges into the Pearl River further south. Two westerly Jackson drainage basins, Bogue Chitto Creek and Bakers Creek, drain to the Big Black River. The Bogue Chitto sewershed is served by the Presidential Hills WWTP. Bakers Creek sewershed flows are pumped into the Lynch Creek basin and then flow to the West Bank Interceptor. A map of the sewersheds is shown on **Figure 2-1**.

Figure 2-1
City of Jackson Sewersheds



2.2 Digital Mapping

ArcMap 9.3 digital mapping software from ESRI will be used to develop, simulate, and display the City of Jackson wastewater collection system components and attributes. ArcMap is the main component of the ESRI ArcGIS suite of geospatial processing programs. It is used primarily to view, edit, create, and analyze geospatial data, and is a common and highly capable computer mapping platform. ArcMap allows the user to explore data within a data set, symbolize features accordingly, capture attributes associated with geospatial points and features, and create customized maps. It will also interface with most hydraulic modeling software programs, and will support management of data generated from Sanitary Sewer Evaluation Surveys. Once developed, the digital sewer mapping system will be used by the City in the performance of ongoing O&M activities on the collection system.

To develop digital maps of the Jackson wastewater collection and transportation system (WCTS), boundaries will first be defined for each sewershed. All pipes 12-in diameter and larger, additional pipes required for the hydraulic model, manholes associated with these pipes, and all pump stations will be entered into the geodatabase. Manholes will be located using field GPS coordinates, and pipes will be snapped (connected) to the individual manholes. Next, topology verification will be performed on the manholes and pipes to correct any connectivity errors. Pipes that do not have a diameter value will be further examined to determine if diameter can be deduced from the connecting pipe(s). If not, further evaluation of existing sewer maps or verification by City maintenance staff will be performed. When all attribute data is entered and verified for each sewershed, the individual sewersheds will be compared to ensure that adjacent basins connect and flow properly. Finally, the City's 98 pump stations will be checked for proper system connectivity. After a final quality check, the mapping system will be ready for interface with the hydraulic modeling software.

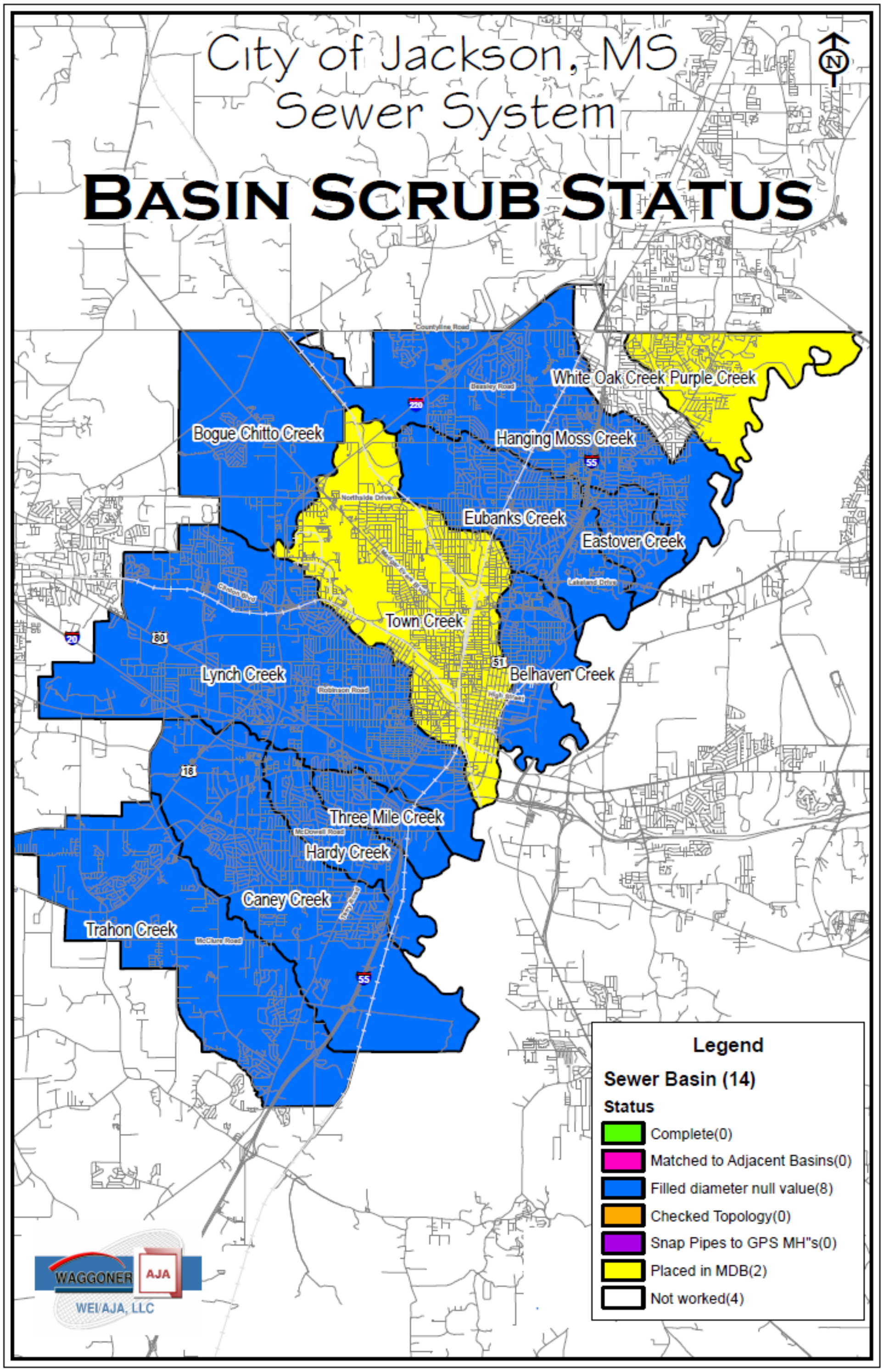
Digital mapping of the Jackson WCTS is currently underway. Approximate status of the City-wide map development is shown on **Figure 2-2**, which also indicates the sequential steps used by the GIS analysts to create maps of the entire system.

2.3 Hydraulic Modeling

A computer-based hydraulic model of the Jackson wastewater collection system will be developed for use as a tool for:

- Evaluating system condition.
- Determining rehabilitation needs.
- Identifying required capacity increases.
- Estimating and allocating sewer loadings.
- Predicting and quantifying surcharge conditions and sewer overflows.
- Understanding the system response to wet weather events.

Figure 2-2
Jackson WCTS GIS Mapping Status



The City of Jackson is currently assessing two hydraulic modeling packages to use in evaluating the collection system. These are:

1. SewerGEMS by Bentley Systems, Inc. – The City has a WaterGEMS model so the companion SewerGEMS would make a logical addition.

2. InfoWorks CS by Inovyze – The City has previously purchased a license for InfoWorks, now expired, and is evaluating the merits of renewing it.

A decision will be made on the hydraulic modeling software package that best meets the needs of the City of Jackson by the end of third quarter 2013. Funds for purchase of the selected model will be included in the 2014 budget.

The selected hydraulic modeling program will provide the ability to analyze, design, and simulate sanitary sewer system operations using built-in hydraulic and hydrology tools, and a variety of wet-weather calibration methods. Both software packages are Windows-based and use Arc GIS for GIS integration, thematic mapping, and publishing. They also support AutoCAD for engineering design environments and CAD layouts.

The following components of the wastewater collection and transportation system will be incorporated into the hydraulic computer model:

- West Bank Interceptor
- Major gravity sewers (12-in diameter and greater, all manholes, and any pipe connecting to a pump station)
- All pump stations
- All force mains

Two requirements of the hydraulic model are that it must identify capacity issues and it must include all major gravity lines. For the City of Jackson, major gravity lines are considered those 12-in diameter and larger. Problems that occur with the smaller lines are primarily maintenance related as opposed to capacity related. When capacity issues are resolved in the 12-in and larger lines, then most of the capacity related problems in the system will be addressed. And, since the smaller lines represent about 75% of the collection system, then only about 25% of the system needs to be modeled to identify the capacity issues.

For model development, a physical survey is being performed to determine an accurate location, top elevation, and invert elevations of each manhole and to verify the configuration of the sewer network. The verified physical attribute data will be used as input to the hydraulic model and reflected accurately on the GIS maps. Model calibration will be performed as described in Section 4.

2.4 GIS Interface Design

Hydraulic modeling results will be displayed using the ArcMap GIS mapping software. The GIS interface will be used to present the sanitary sewer data in its spatial relationships among various map features. The main function of the GIS interface is to enable the user to visualize the sewer system characteristics on the map and to query the system. The GIS interface allows users to point at map features (e.g., manholes and sewer lines) and retrieve sewer information from the database. It also allows users to run a set of pre-defined queries and to display query results or reports.

A useful feature of the GIS interface is to present and analyze the spatial relationships among map features. Examples of these relationships include adjacency (i.e., manholes in a specific area), connectivity (e.g., sewer lines connected to specific manholes) and containment (e.g., manholes and sewer lines contained in a specific area). An important function of GIS interface is to produce graphics on the screen or on paper that convey results of analysis to the engineers who make decisions about maintenance and improvement work. Graphical representation of the sewer system characteristics (e.g., I/I sources) can be generated and allow system users to visualize and understand the sewer data and the analysis of potential events.

2.5 GIS Specific Modeling Functions

The sewer modeling program will be capable of providing an array of tools for displaying, querying, and analyzing maps and databases. The engineers and technicians will be able to access a number of customized functions through the sewer modeling program. These include:

- Find manholes by street name.
- Display manholes by cover inflow.
- Find manholes by depth.
- List manhole covers by type.
- View manhole inspection reports/photos.
- Identify TV-inspected mains.
- Display images of TV-inspected mains.
- Select TV-inspected mains or smoke-test locations.
- Display TV Line Information.
- Display smoke-test results.

When completed, the results of the digital mapping and hydraulic modeling efforts will be used to assess the capacity of wastewater collectors and interceptors and to evaluate severity of infiltration and inflow within each major sewer reach. The capacity assessment methodology that will be used is described in the following section.

3.0 Capacity Assessment

An essential component of sewershed evaluation is assessing the capacity of the major wastewater collector and interceptor sewers within each sewershed. The methodology that will be used to assess the capacity of major sewers, pump stations, and force mains is described in this section. The methodology used to assess capacity of the West Bank Interceptor, the major trunk sewer on the west side of the Pearl River that serves most of the City's sewersheds, was previously presented in the ***West Bank Interceptor Work Plan*** and is not included in the discussion below.

3.1 Capacity Assessment Methodology

The Capacity Assessment of sewers within the sewersheds will be performed following a sequential process that includes the following steps:

- Identification of the physical attributes and characteristics of pipes, manholes, pump stations, and force mains within the sewershed.
- Development of a geographic information system (GIS) representation of the collection network together with land use data and other relevant information.
- Review and analysis of previous SSO reports, maintenance history, and pipe network configuration within the sewershed to identify critical or strategic pipes where flow monitoring should be performed.
- Measurement of sewage flows at the selected strategic locations within the sewershed using continuous flow meters.
- Deployment and monitoring of continuously-recording rainfall gauges at multiple locations within the city.
- Development of a dynamic computer model of the collection system hydraulics calibrated with flow and rainfall monitoring data.
- Generation of computer simulations of the collection system operation under the design storm conditions and determination of collection system capacities based on the modeling results.
- Evaluation of the capacities of pump stations and force mains.
- Capacity assessment documentation and reporting.

3.2 Design Storm

The design condition for evaluation of sewer capacity will be the peak wet weather flow experienced by the system. The design rainfall event used to calculate the peak wet weather flow will be the 2-year, 24-hour storm. This storm event has a probability of occurring in any given year of 50%, which is the annual probability of a 2-year average return interval. This design storm is consistent with the Consent Decree, where a 2-year, 24-hour storm is cited as the basis for peak flow determination to be used in capacity assurance planning. Additionally, this storm frequency is used as the basis for determining sewer rehabilitation needs in a number of other cities within EPA Region IV.

3.3 Future Average and Peak Flows

As required by the Consent Decree, the design basis for sewer rehabilitation planning will be the future dry weather flow and peak wet weather flow experienced by the system. The future dry weather flow will be determined based on estimates of future population growth within the sewershed. Population projections for the City of Jackson will be obtained from the City of Jackson Department of Planning and Development and/or other sources. A minimum planning horizon of 20 years will be used. A disaggregation algorithm will be developed to distribute future population growth to individual sewersheds on a reasonable and representative basis. Using this future population growth and the historical per capita wastewater flow contribution in Jackson, the future dry weather flow will be determined. Peak dry weather flow is the projected or measured diurnal peak flow that occurs on dry weather days. Normally, the future wet weather flow will control rehabilitation decision making, except where the future dry weather flow is determined to be excessive compared to the sewer capacity, as further discussed below.

The peak wet weather flows will be determined using the hydraulic model of the system calibrated with flow monitoring data for the 2-year, 24-hour storm. Future wet weather flows will generally be equivalent to the current wet weather flow quantity. Where appropriate future increases in peak wet weather flows will be included, for example in sewersheds with expected growth and corresponding sewer system enlargement. In actuality, future peak wet weather flow rates should actually decrease compared to current rates as rehabilitation measures are completed.

3.4 Capacity Assessment Criteria

Described below is the capacity assessment process that will be used to analyze available hydraulic capacity and system performance under design flow conditions. In general, capacity assessment of the sewers will be performed based on guidance provided in Section 6.3 of *Computer Tools for Sanitary Sewer System Capacity Analysis and Planning* (EPA/600/R-07/111, October 2007).

Gravity Sewers

Major gravity lines will be analyzed using the hydraulic model. Flows into the system will be represented by hydrographs developed from dry and wet weather flow conditions. The model will be capable of computing the hydraulic grade line at various flow conditions and comparing it to available capacity. Capacity of the gravity sewer system pipes will be evaluated on the basis of flows that do not result in surcharging of the hydraulic grade line beyond 24-inches above top of pipe at any location, or to within three feet of a manhole rim elevation, based on 1-hour peak flow conditions for both existing and projected future flows. Exceptions will be made for locations where the collection or transmission system is specifically designed and constructed to operate under surcharge conditions. These locations include siphons and flat sections such as highway or railroad crossings in carrier pipes. This definition is consistent with the Consent Decree.

Gravity sewers to be evaluated will include all major interceptors and collectors, pipe segments where modeling indicates that 25% or less of available capacity and/or depth remains, and manholes associated with these pipes.

Pump Stations and Force Mains

The available total capacity of individual pump stations and force mains will be compared to existing and future peak flows for the design storm conditions to determine if sufficient capacity exists for each condition. The maximum capacity of pump stations will be defined as the total pumping capacity with all pumps in service, and with wetwell conditions that do not cause a surcharge condition in the influent sewer(s) that exceeds the maximum surcharge condition described above for gravity sewers. For pump stations, the maximum 3-hour peak flow expected to occur as a result of the 2-year 24-hour storm will be used for capacity assessment, since wet wells will provide flow attenuation.

For force mains, the 1-hour peak flow will be used for capacity assessment for both existing and future projected flows. The maximum capacity of force mains will generally be based on the flow capacity at a velocity of 7.0 feet per second to minimize friction head on the pumps. However, velocities of up to 10.0 feet per second are acceptable in certain applications. Therefore, force main capacity will be evaluated on a case by case basis.

3.5 Correlation with SSO Locations, Severity and Causes

As discussed above, capacity assessment will be performed on major interceptors and collectors, and on gravity sewers indicated by the hydraulic model to have limited capacity. Additionally, as part of the capacity assessment process, the location of identified components where capacity evaluation is required will be correlated with locations of known SSOs. This in turn may require additional sewer system components to be added to the evaluation.

Locations with known SSOs will require a more intensive capacity assessment to evaluate the severity of the SSOs and determine their causes. This will include locations with a previous history of wet weather related SSOs. Any other areas expected to cause or contribute to SSOs, or prohibited bypasses at the WWTP, under existing or future average and peak flows will also be identified using the hydraulic model and included in the capacity assessment. This evaluation will include a determination of SSO or bypass severity, which may be defined as the degree of risk these areas can be expected to cause or contribute to SSOs or prohibited bypasses.

3.6 Capacity Evaluation

As described above, data collected as part of the Capacity Assessment process will be analyzed to establish the conveyance capacities of the major interceptors, gravity sewers, pump stations, and force mains. In parallel, the existing and future capacity required for each major sewer segment or pump station will be determined. The capacities required for dry weather flows will be derived from existing population data and future population projections. The capacities required for peak wet weather flows will be derived from hydraulic modeling of the collection system with appropriate adjustments for future conditions. The capacities required will then be compared to the capacity available for all of the WCTS components analyzed. From this comparison, the ability of the collection system to transmit existing and future peak flows will be established, and an itemized list of WCTS components that require capacity improvements will be developed. Together with the structural condition assessment, the capacity improvement needs will be used to define the rehabilitation measures that will be implemented for each major sewer component.

4.0 Infiltration and Inflow Evaluation

City of Jackson sewersheds will be evaluated to determine the severity of infiltration and inflow (I/I) within each sewershed. The methodology that will be used to perform the evaluations and characterize the level of I/I is described in this Section.

4.1 Wastewater Flow Characterization

Wastewater flow components include the baseline dry weather flow and the peak wet weather flow resulting from rain events, as further discussed below.

Infiltration/Inflow

Inflow is defined as the component of wastewater consisting of extraneous water that is discharged into a sewer system from sources such as sump pumps, roof leaders, cellar/foundation drains, drains from springs and swampy areas, manhole covers, catch basins, cross-connections from storm drains, cooling water discharges, and other inlets. Inflow differs from infiltration in that it is the result of direct connections of extraneous flow sources into the collection system and, generally, is not linked to fluctuations in the groundwater table. Inflow is largely the result of wet weather (stormwater) influences on the sewer system. During dry weather, the quantity of inflow is generally expected to approach zero. During storm events, inflow may rapidly impact the sewer system causing the wastewater flow to increase. The increase in wastewater flow due to inflow may terminate a short time after the storm event or it may influence the sewer system for a prolonged period depending on the type of inflow sources which exist in the system. It is not uncommon for inflow to elevate wastewater flows for a number of days.

Infiltration, in contrast, is water that enters the system through structural defects. One aspect of the Program will be to evaluate the relative contribution of inflow vs. infiltration to the extent practicable. The I/I variability will also be assessed. Consistent with the requirements of the Consent Decree, the criterion for "Source of Excessive I/I" will be developed based on reasonable interpretation of the observed data. I/I sources that are deemed excessive will be targeted for remediation.

Flow Characterization

As described in Section 5, limited flow monitoring will be conducted within the sewersheds to provide data for calibrating the hydraulic computer model. The flow monitoring data will also be used to characterize and evaluate the relative degree of I/I within each sewershed.

Dry Weather Flows

For each flow monitoring site, a dry weather period will be established to show its normal hydraulic behavior. Based on the rainfall data, the interval during a period of little or no rainfall, and after all flow monitoring sites return to normal flow levels following a previous rainfall event, will be used to determine average and peak dry weather flows.

Wet Weather Flows

There are two aspects to wet Weather Analysis. The first aspect of the wet weather analysis is carried out in the same manner as that for the dry weather period. The response of the monitoring sites to rainfall in terms of observed peak flow rate and flow depth will be described and compared to the observed peak flow rate and flow depth for the dry weather period, and the peak wet weather flow value will be determined. The second aspect of the analysis quantifies the rainfall-dependent inflow/infiltration (RDI/I) observed at each monitoring site.

In determining the wet weather response of a site, all rain events during a monitoring period will be reviewed. The rain event that will be selected as representative will be determined based on the response of each rain gauge and the relationship to the flow monitoring site. Any increase of flow over the dry weather average at each site in response to wet weather will be noted as rainfall-derived infiltration/inflow.

4.2 Flow Monitoring Site Selection

Flow monitoring will consist of installing a series of flow meters at strategic locations within the sewershed together with a series of rain gauges located in various points within the contributing collection system. The number of meters needed is dependent on the size of the system and the configuration of the sewershed. The strategic location for the flow meters will be determined through a detailed review of the City's GIS sewer maps.

Each potential metering site will be investigated in the field. Field investigations allow the City to adequately confirm the feasibility of installing the flow meter. Field investigation also ensures that each site is hydraulic suitable for flow monitoring. Selected flow monitoring sites should have a minimum amount of turbulence. Each site will be evaluated for specific installation and operational conditions of access, safety, traffic control, structural condition, hydraulic suitability, and level of flow.

The City will employ a qualified specialty contractor to install and operate the flow and rainfall monitoring equipment. The contractor may use a variety of metering technologies, and each location will be evaluated to determine the meter best suited for that location. The contractor will be required to follow a set of standard procedures for installation, maintenance, and calibration of the metering equipment based on the manufacturers' recommended practices. The following criteria will be used in selecting flow meter types at specific locations:

- Pipe size
- Flow ranges
- Hydraulic conditions
- Telemetry method
- Operating principle
- Accuracy
- Monitoring period duration

- Data management
- Cost

The Specifications for the City's Flow and Rainfall Monitoring Program are provided in **Appendix A.**

4.3 Flow Monitoring Data Analysis

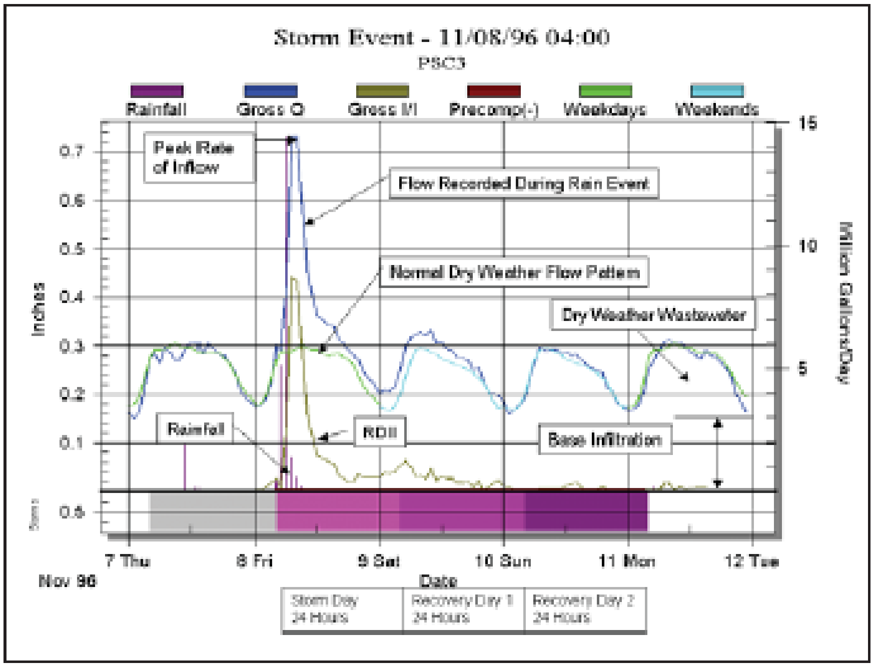
Data collected by the limited flow monitoring program conducted within the sewersheds will be adequate for screening the sewersheds based on relative level of I/I. The flow monitoring analysis methodology that will be used is described below.

Data Interpretation

Data to be generated by the flow monitoring program will include hydrographs, data plots, and scattergraphs. Flow hydrographs and depth and velocity data plots will be used to review the consistency and reliability of the measured data under wet weather conditions. An example flow hydrograph is shown on **Figure 4-1**. Analysts will first observe how a meter responds to the rainfall event and note the magnitude of peak flows and the shape of the generated hydrographs. A pattern between wet weather response and the total rainfall is then determined. The depth and velocity data plot also provides information regarding sewer system behavior under various wet weather conditions. Analysts will establish the hydraulic pattern at a specific meter site based on depth and velocity relationships and look for consistent behavior during various rainfall events. If a portion of the data being reviewed is out of character, the analyst will alert field crews to investigate.

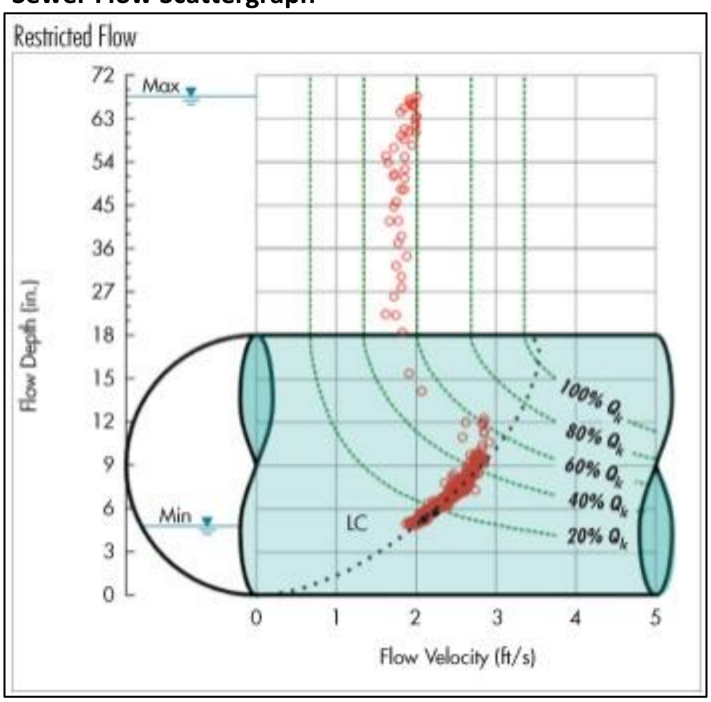
A scattergraph is a graphical tool that depicts a relationship between velocity and flow depth. An example is shown on **Figure 4-2**. This graph will be used to characterize flows upstream and downstream of the monitoring sites. The graph is also used to interpret hydraulic conditions and assess sewer capacity. This type of flow monitoring analysis provides information regarding the reaction of the wastewater sewer system during storm events and helps identify system deficiencies.

Figure 4-1
Sewer Flow Hydrograph



Courtesy ADS

Figure 4-2
Sewer Flow Scattergraph



Courtesy ADS

Flow Monitoring Results Reporting

The City's flow monitoring contractor will be required to furnish a Flow Monitoring Program Report on a monthly basis. The monthly report will include site reports for each station (per meter). The report will also be required to include the following information:

- Purpose of flow monitoring, location and type of flow meters used.
- Dry weather analysis (including calculated base flows and diurnal patterns).
- Wet weather analysis (including locations impacted by I/I and to what degree).
- Determination whether data can be used for capacity assessment.
- Tables and figures necessary to explain the results and findings.
- Conclusions and recommendations.
- Hydrographs and tabular data for each station for the monitoring period.
- Frequency of flow meter inspection, service, and calibration.
- Frequency of downloading flow monitoring data.
- Base groundwater infiltration.
- RDI/I.
- Surcharged pipes.
- Capacity restrictions.
- Sanitary sewer overflows (SSOs).

Performance trends will be evaluated to decide what actions are necessary to maintain system performance within controllable limits and to determine whether system performance is operating within predicable limits.

Flow and Rainfall Data Analysis

Multiple rain events of varying intensities will be monitored to accurately assess the inflow response of the system for each event. Information obtained during the monitoring period will be used to determine the following:

- Average Dry Weather Flow (ADWF) and Peak Dry Weather Flow (PDWF).
- Average Wet Weather Flow (AWWF) and Peak Wet Weather Flow (PWWF).
- Peak inflow rates.
- Total I/I volume.

In addition, not all wet season storm events will furnish the necessary I/I data to measure and model the system responses to significant rainfall events. In dry winters, it may be necessary to extend flow monitoring activities for a longer time period.

Data Acquisition and Review

During daily data analysis, an engineer or technician trained and experienced in flow and rainfall monitoring techniques will determine the quality of the data by observing the flow monitoring data over time and confirming the observed data with results of field calibrations. Computer software will be used for more accurate analysis and to generate a detailed report. Rain data for each month will also be compared to the calibration sheet to determine if the sensor is malfunctioning.

Flow level and velocity data will be obtained by the flow meter on 15-minute intervals during the monitoring period. Data may be captured at 5-minute intervals due to high flow variability or possible other reasons. Data will be downloaded from the meters remotely via telemetry to a central data storage system. Downloaded data will be reviewed for data quality. Sensor failures or damage and/or suspected loss of data quality will be documented in a log and corrective measures will be taken (e.g., replace meter, sensor, batteries, or take other actions as needed).

4.4 I/I Evaluation Results

Flow meter and rain gauge data will be used to estimate the amount of I/I entering the system using the procedures set forth above. Flow and rainfall monitoring data will be used to develop Rainfall Dependent Inflow and Infiltration parameters and hydrographs for analysis. The RDI/I parameters and hydrographs will be used to calibrate the hydraulic modeling program. The data will also be used to assess capacity availability in the sewer system and to define the need for more detailed sanitary sewer evaluation studies.

The City will utilize the flow and rainfall monitoring data to established baseline flow quantities, to estimate the volume of I/I entering various sewer segments/sewersheds, to assess capacity availability in various sewer segments, and to prioritize sanitary sewersheds into the appropriate rehabilitation groups. The sewershed prioritization methodology that will be used is described in the following section.

5.0 Sewershed Prioritization

The Consent Decree requires the City of Jackson to evaluate sanitary sewer overflow locations and identify the causes and severity of the SSOs as well as causes and severity of any prohibited bypasses that occur at the wastewater treatment plants. Within each sewershed, those components that contribute to SSOs or prohibited bypasses will be the focus for more detailed assessment. This section describes the methodology and criteria that will be used to prioritize the sewersheds for further evaluation and rehabilitation.

5.1 Prioritization Methodology

The purpose of sewershed prioritization is to provide a process for identifying and correcting, in a cost effective manner, problems and limitations within the WCTS in the order of priority of their impact and risk to surface waters and the public. The sewer system evaluations will be performed following the procedures described in *Sewer System Infrastructure Analysis and Rehabilitation*, EPA/625/6-91/030. **Figure 5-1** depicts the approach to conducting sewer system evaluations in accordance with this Handbook.

Preliminary Survey

The screening process used to prioritize the sewersheds will be based on a preliminary survey of the sewershed conditions together with results of flow monitoring. The preliminary survey will consist of a review of existing information about the sewershed including:

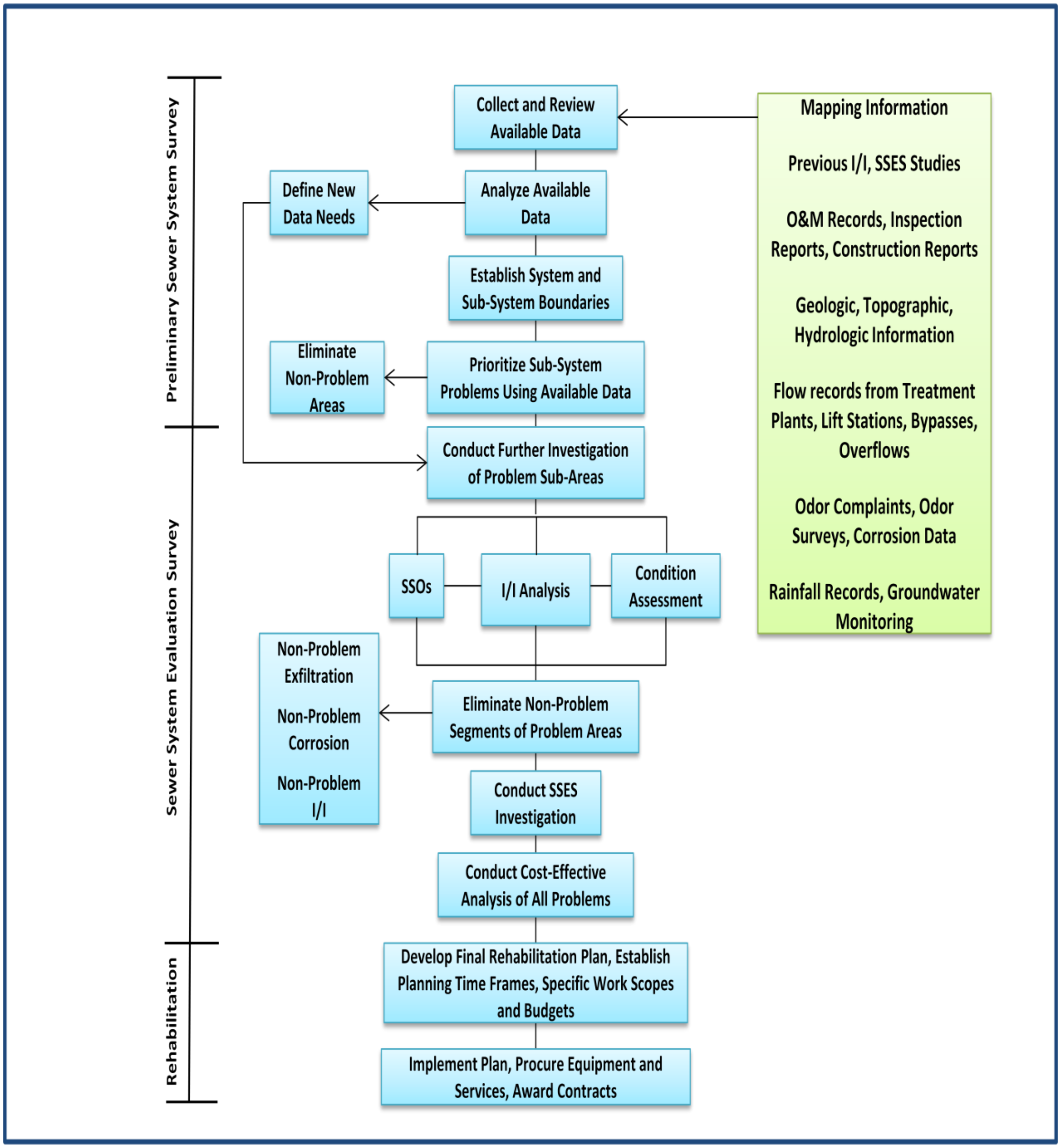
- Known physical damage to the sewer infrastructure.
- Known capacity limitations.
- Areas with frequent blockages.
- Rate and degree of deterioration.
- Delineation of areas with minimal sewer problems.
- Presence of excessive I/I.

The presence of excessive I/I will be determined by flow monitoring within the West Bank Interceptor and the contributing sewersheds, as further described below.

West Bank Interceptor Flow Monitoring

Detailed flow monitoring will be conducted over the entire 15-mile length of the WBI as described in the ***West Bank Interceptor Work Plan*** submitted August 1, 2013. The WBI flow monitoring program will include measurement of flows from all eleven major sewersheds that discharge into the WBI. The sewershed flow monitoring results will allow

Figure 5-1
Approach to Conducting Sewer System Evaluation



identification and ranking of sewersheds according to the relative contribution of I/I. With this information, sewersheds will be selected for additional flow monitoring to further screen the sewersheds and allow them to be classified according to the following groups:

Group 1 Sewersheds

Sewersheds with severe I/I problems that collectively contribute at least 30% of the total I/I in the entire system.

Group 2 Sewersheds

Sewersheds with significant I/I problems that collectively contribute at least 40% of total system I/I.

Group 3 Sewersheds

Sewersheds with the least I/I problems that collectively contribute no more than 30% of total system I/I.

Preliminary Flow Monitoring in Sewersheds

Based on the above classification, additional flow monitoring will be performed in the sewersheds to further refine and quantify I/I sources and severity. Results of this preliminary sewershed flow monitoring will be used to establish objectives and boundaries for subsequent Sanitary Sewer Evaluation Studies (SSESs). The preliminary flow monitoring within the sewersheds will also be used to provide data for calibration of the hydraulic computer model of the WCTS.

The preliminary sewershed survey results, WBI flow monitoring data, and preliminary sewershed flow monitoring data will be used to identify the severity of rehabilitation needs of individual sewersheds. The sewersheds will then be further prioritized for evaluation using the criteria described below. Results will be used to develop detailed work scopes for the subsequent detailed SSES studies. The required SSES work will be further defined in the ***Sewershed Evaluation Plan*** that will be submitted by March 1, 2014.

5.2 Prioritization Criteria

Upon review of the critical factors that enter into decision making regarding sewer rehabilitation, the City of Jackson selected the following criteria to use for sewershed prioritization. A brief explanation of each criterion is also provided. The criteria, in order of priority, are:

1. **SSO Severity** – A measure of the frequency, volume, and location of capacity related SSOs within the sewershed. The SSO measure will be calculated as the number of SSOs over the monitoring period x average diameter of overflowing sewers / total miles of sewer within the sewershed.

2. **I/I Volume** – The relative quantity of I/I occurring in the sewershed based on flow monitoring results. Rated as high, medium, or low.

3. **Environmental Risk** – The degree of risk to public health, surface waters, and the environment posed by the sewershed due to SSOs and/or physical vulnerability. Rated as high, medium, or low.

4. **Failure Risk** – A measure of the potential impact of structural failures of critical sewers to the residents, institutions, and businesses within the sewershed. Rated as high, medium, or low.

5. **Current Rehab Activities** –Expected results of ongoing or scheduled rehabilitation projects or other corrective action work within the sewershed. Rated as positive or neutral.

6. **Maintenance History** – Frequency and severity of previous repairs within the sewershed as experienced by Jackson Public Works Department staff. These include point repairs, blockages, and known structural defects. Rated as high, medium, or low.

7. **Future Development** – The potential or plans for future development and growth within the sewershed. Rated as positive or neutral.

8. **Sewer Characteristics** – A general measure of the condition of sewers within the sewershed based on age and/or pipe material. Rated as favorable, neutral, or unfavorable.

5.3 Sewershed Ranking

For each sewershed, ratings will be developed for each of the eight prioritization criteria. These will then be compared and the sewersheds will be ranked in order of priority, with No. 1 being the sewershed with the overall worst problems. After ranking, the Group 1 and Group 2 sewersheds will be defined.

In prioritizing the sewersheds, techniques involving imprecise criticality ratings and/or subjective weighting factors will not be used. Instead, prioritization will be based on a broad review of all pertinent information on the sewersheds, including the prioritization criteria ratings, by a qualified engineering review team. Sewershed prioritization will then be based on the results of this review together with best engineering judgment.

5.4 Work Plan Implementation

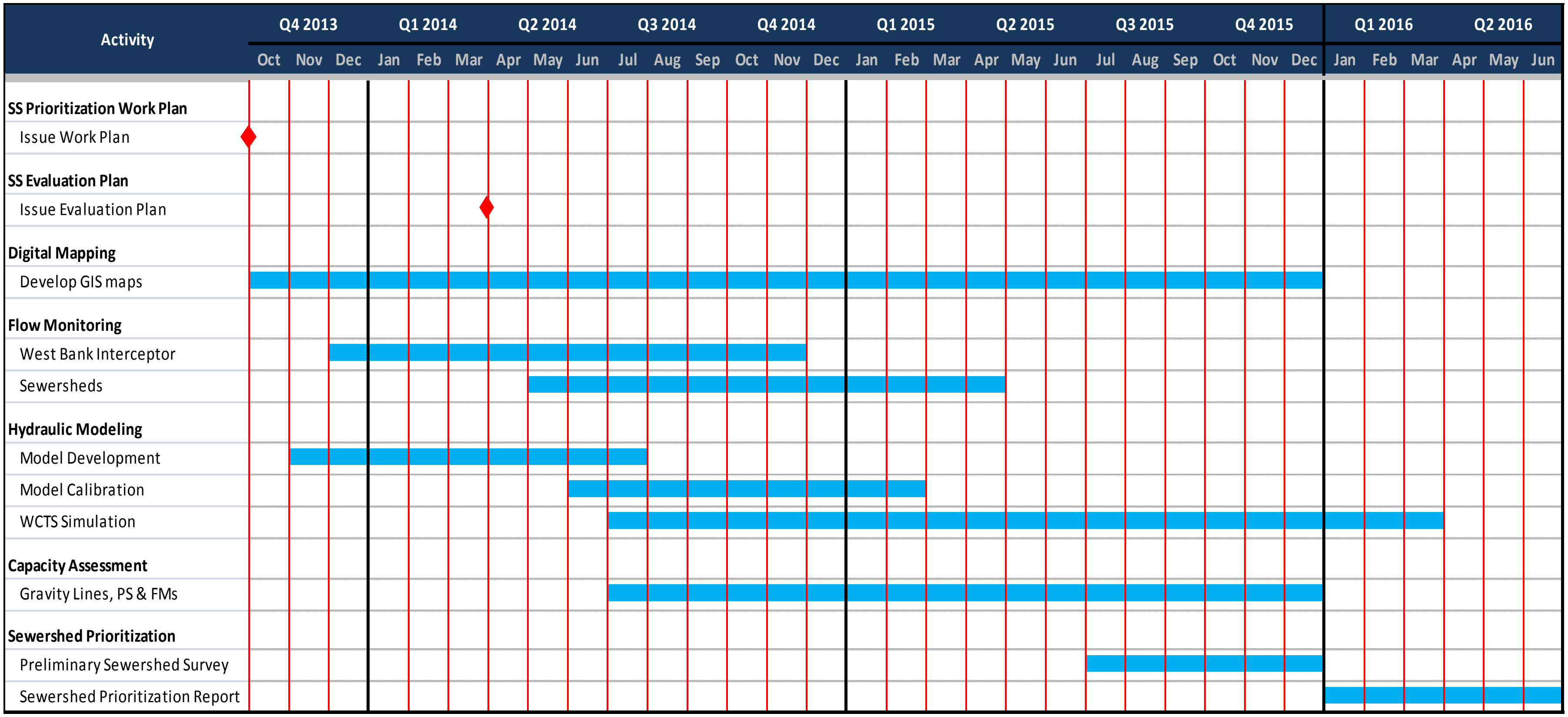
The preliminary survey performed on the individual sewersheds and the flow monitoring results will be used to define the objectives, cost, and schedule for implementing the SSES investigations necessary for a complete analysis of the wastewater infrastructure. The SSES studies to be performed will be described in the ***Sewershed Evaluation Plan***. In general, the SSES work within each sewershed may include the following activities:

- Above-ground right-of-way inspection
- Sewershed evaluation flow monitoring
- Manhole inspection
- Sewer inspection (CCTV or multi-sensor)
- Smoke testing
- Dyed water flooding

The SSES results will be used to determine rehabilitation needs, prepare cost effectiveness evaluations of repair methods, and select the appropriate rehabilitation plan.

The schedule for implementing the Sewershed Prioritization Work Plan is shown on **Figure 5-2**.

Figure 5-2
Sewershed Prioritization Work Plan
Implementation Schedule



Appendix A

Flow and Rainfall Monitoring System

Specifications

SECTION 40 91 23

FLOW AND RAINFALL MONITORING SYSTEM

Table of Contents

SECTION 41 91 23

FLOW AND RAINFALL MONITORING SYSTEM

PART 1: GENERAL REQUIREMENTS

1.01 Purpose

A. The water/sewer division of the City of Jackson, Mississippi, herein referred to as the Owner, has determined that it will be necessary to perform ongoing permanent flow monitoring to address specific needs of the wastewater collection system management.

1.02 Network Overview and Scope

A. Wastewater Flow Monitors

1. The Owner will have new wastewater flow monitors installed within the collection system at twenty-nine (29) locations. Each of the flow monitors will be networked into a system and provide the Owner with vital information on the hydraulic performance of the wastewater system as indicated in Section 3.

2. The Owner will contract with a Service Provider to deliver, install, and maintain flow monitors for the aforementioned flow monitoring program. The Service Provider shall supply all hardware for each flow monitoring location consisting of hardware as specified in Section 4.

3. The Service Provider will administer each flow meter site during the terms of the contract. Site administration consists of provision of all operation, maintenance, telemetering, and data confirmation services as set forth in PART 3.

B. Rain Gauges

1. The Owner will have new rain gauge monitors installed at four (4) locations relative to the flow monitors in the collection system. Each of the rain gauges will be networked into the system and, in conjunction with the flow monitoring network, provide the wastewater division with critical information correlating rainfall with system-wide sewer flow as indicated in Section 3.

2. The Owner will contract with a Service Provider to deliver, install, and maintain rain gauge monitors for the aforementioned flow monitoring program. The Service Provider shall supply all hardware for each rain monitoring location consisting of hardware as specified in Section 4. At the conclusion of the project the rain gauge monitors will become the property of the City.

3. The Service Provider will administer each rain gauge during the terms of the contract. Site administration consists of provision of all operation, maintenance, telemetering, and data confirmation services as set forth in PART 3.

C. Equipment Ownership

1. The flow meters and rain gauges furnished under this project will become the property of the OWNER. Title to the equipment will pass to the OWNER when the Service Provider's invoice for the equipment is paid whether after installation or as stored materials. The Service Provider will continue to operate and maintain the flow metering equipment until the conclusion of the project.

D. Uptime

1. The Owner understands that data is critical and that any loss of data may negatively impact the Owner. Therefore, the Service Provider shall meet minimum criteria for system-wide Uptime as specified in Section 3.

E. Data Analysis

1. The Owner understands that flow data collected from a wastewater environment requires review for accuracy, issuing of work orders to maintain equipment, and identification and editing of data irregularities.

2. The Service Provider shall use the specifications for Data Analysis indicated in PART 3.6.

3. The Service Provider shall provide reports as specified in PART 5.

F. Software

1. The Service Provider shall deliver a means to interrogate the flow monitoring data, including generating graphs and accessing reports prepared by the Service Provider.

2. The Service Provider shall provide evidence that the software to be delivered will meet or currently meets the specifications in Section 6.

G. Service Provider Qualifications

1. The flow monitoring Service Provider shall meet the qualifications as listed in PART 2.

PART 2: SERVICE PROVIDER QUALIFICATION AND PROPOSAL REQUIREMENTS

2.01 Service Provider Evidence of Certification

A. Quality Management System

1. The Service Provider shall design and produce product according to a documented Quality Management System of procedures and work instructions.

B. The Service Provider shall include specific evidence that the current certification was performed on each area required under the scope of services:

1. Manufacture – If the Service Provider is not the manufacturer of the equipment, evidence of the manufacturer's current certification for quality manufacturing processes shall be provided.

2. Equipment Installation and Maintenance procedures – The Service Provider shall provide evidence that they maintain and enforce quality processes and safety standards for all field service work.

3. Data Analysis procedures – The Service Provider shall provide evidence that they maintain and enforce a quality process for ensuring data integrity in all data analysis.

4. Software Development process – The Service Provider shall provide evidence that they maintain and enforce a quality process for customer requirements, software design, testing, deployment, and support for all software to be provided.

5. Customer Service / Support – The Service Provider shall provide evidence that they maintain and enforce a quality process for handling customer service, problem resolution, and feedback.

C. Service Provider Obligations – The flow monitoring and rain gauge service provider shall be responsible for providing evidence of the following:

1. Availability of Parts, Warranties, and Service

   a. If the Service Provider is not also the manufacturer of the equipment, then the Service Provider shall provide a letter or other proof of ability to do business with the manufacturer of the hardware to be installed.

   b. The Service Provider shall be responsible for providing all equipment and materials necessary to perform the work specified.

2. The Service Provider shall provide proof of availability and training of labor and services required to properly install and place into operation the integrated sewer flow monitoring network, including:

   a. Evidence of being able to supply the services of factory trained service and installation personnel to troubleshoot and maintain the equipment.

   b. Evidence of qualifications for personnel who will install all components of the permanent network and perform all electronic, electrical, start-up and field optimization procedures required to place the complete system in fully acceptable operation.

2.02 Detailed Technical Submittals

A. A complete technical submittal, with descriptive brochures and engineering data covering the items of equipment offered, shall be submitted with the proposal. The Technical Submittals shall describe in detail how the service provider's system complies with each specification requirement of this document.

B. Copies of typical charts, hydrographs, tabulations and reports from projects of similar scope and complexity shall be included. Any deviations from the specifications must be noted in the Deviations from Specifications section.

2.03 Service Provider Resumes

A. The flow-monitoring service provider shall submit resumes of the proposed project managers, engineers, instrument technicians and other key personnel in his employ who would perform the proposed work.

B. Each resume shall reflect the competency of staff for this permanent network project, noting past experience of similar scope and complexity.

2.04 Service Provider Experience

A. The Owner acknowledges that the wastewater system, consisting of sewer lines and manholes, is a hostile environment for collecting flow information requiring a manufacturer with extensive knowledge and expertise.

B. Responding firms shall demonstrate qualifications by providing references of five (5) other flow monitoring projects:

1. Which service provider has commissioned telemetered flow monitoring and rain gauge equipment comparable in design, construction and use to the units specified.

2. At least three (3) of which have a similar number of networked flow monitors.

C. For each project submitted as a reference the number of units, the year installed and accepted, and the current status (active, partially active, or inactive) must be specified.

D. Service Provider shall have a minimum of five (5) years of successful, documented experience in the assembly and installation of networked telemetered flow monitoring and rain gauge equipment, and in gravity sewer flow monitoring applications.

E. The references shall consist of names, titles, addresses, and telephone numbers of individuals who have responsibility for operation of flow monitoring equipment that has been manufactured by the service provider and is comparable in design, construction and use to the units specified that the service provider has furnished.

3.05 Other Service Provider Qualifications

A. Manufacturer's Qualifications – The Service Provider shall submit satisfactory evidence of having adequate plant, equipment and technical experience to furnish the equipment and services expeditiously, and of having the financial capability to meet obligations incident to the work.

B. Operations and Maintenance Qualifications – The Service Provider shall submit satisfactory evidence of having the manpower, facilities, equipment and a program to offer the operations and data processing services required by this specification.

C. Patent and Hold Harmless Certifications – The Service Provider shall submit certification that they hold or have license to all applicable patents and shall indemnify and save harmless the Owner from all liabilities, judgments, costs, damages and expenses which may result from the infringement of any patents, trademarks, and copyrights by reason of the use of any proprietary materials, devices, equipment or processes incorporated in or used in the performance of the work under this contract.

D. Safety Qualifications – The Service Provider shall certify compliance with 20 CFR 1910.146 (OSHA confined space safety regulations) and all safety requirements involved with the project. The service provider shall submit a copy of his confined space entry procedures and safety procedures.

1. The service provider shall be responsible for taking all necessary safety precautions in the performance of its services. Due to the requirement to enter active sewer lines to fulfill this contract, the service provider is advised that the sewer and manhole environment may be oxygen deficient and may contain toxic and/or explosive gas vapors and liquids, as well as the health hazards associated with contact with raw wastewater.

2. The service provider is further advised that night activities may be associated where minimum flow levels are involved.

4. The service provider shall follow all applicable Federal, State, local and OSHA Regulations for manhole work and confined space entry.

PART 3: SCOPE OF SERVICES

3.01 Site Selection and Installation

A. The Owner has selected sites for the installation of all equipment.

B. The Service Provider shall install equipment in optimum locations for best accuracy and reliability results. Prior to the installation of equipment each site will be inspected and documented.

C. Each site will be inspected to determine hydraulic suitability. This shall require descending the manhole to ensure adequate inspection.

1. The Service Provider may recommend that a designated monitoring location be changed to take advantage of more favorable hydraulics at upstream or downstream locations.

2. Site inspection shall include the accurate measurement of pipe or channel geometry, silt, and the location of installed equipment for use in flow calculations. The service provider shall not rely on as-built drawings for the determination of pipe geometry or slopes.

3.02 Telemetered Access

A. The Owner understands that the immediate use of flow data is important to uptime, rapid identification of data irregularities, and maintenance.

B. The Service Provider shall provide a method for remote (telemetry) access the flow monitors. The Service Provider shall install all telemetry equipment and ensure it is operational.

C. The Service Provider may use any third party telemetry service, such as local phone service provider and shall be responsible for all charges for phone, cellular or other telemetry directly.

D. The Service Provider shall provide software to communicate with the equipment as specified in Section 6.

3.03 Confirmation of Data Accuracy

A. On Location Confirmation of Accuracy

1. Confirmation of accuracy must be measured in the Owner’s sewers at every site to ensure reliability of monitored data at that location.

2. The Owner will not accept any options or proposals from the service provider to waive confirmations.

3. Number of confirmations – the Owner will require the service provider to perform a minimum of two (2) manual depth and velocity measurements at every site in order to confirm that the sensors are actually measuring accurate depths and accurate velocities.

4. Calibrations will be conducted at each site monthly to ensure accuracy. Calibration includes verification using portable velocity meter at each site.

B. Method of confirmation

1. Initial confirmation of the flow meters shall involve a minimum of two (2) in-manhole measurements taken on different days. Confirmation will compare manual readings to sensor readings for all depth and velocity sensors. Attempts shall be made to have these measurements done at flow levels that span typical dry daily flows.

2. The confirmation checks shall be summarized in depth-to-discharge format on tables. Each confirmation shall consist of an instantaneous depth of flow and velocity measurement.

3.04 Operations and Maintenance Services

A. The Service Provider shall provide all spare parts at the Service Providers expense to maintain the equipment. Price proposals which do not include an adequate spare parts budget will not be considered.

B. The Service Provider shall provide a fixed price for twelve (12) months of complete maintenance of the network with options for yearly extensions.

3.05 Data Uptime

A. Each flow monitor and rain gauge site shall be maintained to assure a minimum up-time of ninety percent (90%).

B. The Service Provider shall provide at least three references of projects similar in size and scope where a minimum of 90% system-wide Uptime was achieved.

3.06 Data Analysis

A. Qualifications – The Service Provider shall provide at least three references of projects similar in size and scope where data analysis was performed.

B. The Service Provider shall review all collected data monthly for the purpose of identification and editing of data irregularities.

C. Backup copies of raw data shall be maintained by the Service Provider for the duration of the contract.

D. Review of the data editing shall be performed by an analyst with a minimum of 3 years of experience with the specified equipment.

E. Weekly Data Review shall be performed by the Service Provider to ensure that the equipment is operational and properly logging data. The Service Provider shall be responsible for issuing maintenance work orders based on this review.

F. Finalization of data shall be completed according to the specification for Information Deliverables in Section 5.

PART 4: DETAILED EQUIPMENT SPECIFICATIONS

4.01 Flow Monitoring Equipment

A. Minimum Flow Monitor Requirements

1. A data logger and programmable sensor command unit installed at the sewer manhole location with enough memory to ensure that adequate data at 15 minute intervals can be stored. The data logger shall support a circular buffer with the oldest data only being written over once the memory is filled.

2. Clock – Unit shall have battery-backed crystal controlled hardware real-time clock/calendar.

3. A communications device to allow for remote communications via telephone or wireless media.

4. On-Site Communications – Shall be capable of being configured to support on-site RS232 serial communications or a telephone line simulator.

5. Temperature Range – Shall function within specifications between 0 and 60^0 C.

6. Connectors – All sensor connector cables will be fitted with U.S. Mil Spec gold plated contacts for environmental sealing.

7. An ultrasonic depth sensor with cable connection to the data logger should have capability of accurately measuring a minimum depth of 0.75 inches in 0.02 inch increments.

   a. Temperature Compensation - Range readings must be compensated for the changes of the speed of sound in air. Sensor temperature readings must be available to user for both diagnostic as well as logging purposes.

8. A velocity sensor with cable connection to the data logger capable of accurately measuring velocity from -5 to 20 feet per second (fps).

   a. Range - -5.0 to +20 feet per second (fps)

   b. Resolution - 0.04 fps

   c. Accuracy - +/- 0.8% Full Scale – 0.0 to 5.0 fps, +/- 1.2% Full Scale – 5.0 to 10.0 fps, +/- 2.8% Full Scale 10.0 to 15.0 fps

9. A pressure sensor with cable connection to the data logger capable of accurately measuring depth in surcharge conditions for standard sewer pipes.

4.02 Rain Gauge

A. The aforementioned data logger shall be able to accept data from an industry standard rain tipping bucket.

B. The equipment shall be able to measure 0.1 inches (1mm) per tip of bucket.

C. The tipping bucket shall be a corrosion resistant funnel collector with tipping bucket assembly.

4.03 Sampler Interface

A. The equipment housing shall be a waterproof, NEMA 6, IP67, pressurized marine grade aluminum cylinder to ensure that the electronics are protected from the harsh sewer environment.

B. Power

1. Battery – The equipment shall be able to use non-rechargeable alkaline batteries with a minimum life of one year at 15-minute sample rate (logging depth and velocity).

2. External Power – The equipment shall have capability of being powered by an external DC power input.

3. Electronics – Shall utilize low power (CMOS) logic.

C. Error Checking

1. The equipment shall measure and record internal temperature and voltage.

2. Data Security – A remote unit shall not respond unless the correct identification is transmitted

3. Data Reliability – All information shall be transmitted with parity and check digits.

4. Data Integrity - All communications shall have adequate error detection and correction to ensure that no data from the logger is corrupted or lost during communications.

5. Transmission Error – Parity bits and check digits shall be transmitted with each block of data. Acknowledgements shall be required for every transmission, with retransmissions if errors are detected.

D. Lightning Protection – If standard voice-grade telephone communication is provided, then the equipment shall have transient suppressors installed on the incoming telephone line to protect the logger against nominal lightning surges.

4.04 Equipment Programmable Settings and Data Validation

A. The equipment shall have a programmable Data Recording Interval at standard intervals of 1, 2, 2.5, 5, 15, and 30 minutes or 1, 2, 12, or 24 hours.

B. The equipment shall support the configuration of the data logger switching into a faster data sampling and recording interval once a user-defined trigger has been exceeded.

C. The equipment shall have programmable options to control samplers and rain totaling.

D. The equipment shall include the ability to cross-reference pressure sensor readings with ultrasonic sensor readings to ensure pressure sensor accuracy. The equipment shall also be able to provide a composite depth during surcharged conditions.

E. The equipment shall include the ability to establish a depth to velocity relationship against which to reference all depth and velocity readings. Data points that do not match the established depth to velocity relationship shall not be logged in memory until a second or third re-firing of the sensors confirms the legitimacy of the data point.

F. The equipment shall support advanced software filtering to help compensate for adverse monitoring conditions such as waves, foam, noise, etc.

PART 5: FLOW INFORMATION DELIVERABLES

5.01 Monthly Report

A. Service Provider will attend monthly progress meeting with client.

B. Service provider will submit monthly reports to the Client presenting the data collected during each monthly flow-monitoring period.

C. Monthly reports shall consist of a graphical presentation of flow depth, velocity and quantity data for each monitoring location. Graphical presentations shall include a scattergraph presentation of flow depth and velocity data as well as a hydrograph presentation of flow depth, velocity, and quantity data, along with available rainfall data.

D. Monthly reports shall consist of a tabular summary of flow depth, velocity, and quantity data for each monitoring location. Tabular summaries shall include minimum, average, and maximum values for flow depth, velocity and quantity data, along with flow quantity and rainfall totals for the monthly reporting period.

E. Monthly reports shall consist of a narrative summary of observed flow conditions at each monitoring location.

F. Monthly reports shall include flow depth, velocity, and quantity data, along with associated rainfall data from each monitoring location in a format compatible with Microsoft® Excel.

G. Monthly report shall be provided to the client no later than 15 days following the conclusion of each month.

H. Monthly report shall be provided on recordable CD-Rom or other electronic medium approved by the Client in a format compatible with Microsoft® Office or Adobe® Acrobat® Reader.

5.02 Flow Analysis Report

A. Service provider will assist the Client with I/I analysis and reporting.

B. Service provider will assist with Summary of RDII (Rainfall Dependent Inflow / Infiltration) precipitation events for each flow monitored location.

PART 6: SOFTWARE

6.01 General

A. The Service Provider shall install and maintain all software required for the scope of services.

B. Because the Owner does not want to be limited by operating system requirements, the Service Provider shall provide software accessible using Internet Explorer and available to any personnel requiring access.

C. The Service Provider shall be responsible for purchasing any computers, purchasing any third party software licenses, hosting the application, maintaining physical system, ensuring network security, and providing reliable access to the system.

D. The Service Provider shall be responsible for all system maintenance, data uploads, database maintenance, and software defect repairs.

E. The Service Provider shall provide at least three references of other users of the proposed software.

6.02 User Permissions and Security

A. The Software shall have secure access by password and user name for authorized personnel.

B. The Software shall support per-user permissions to ensure that the Owner can restrict certain features to authorized users. Specifically, the Software shall support restrictions for (at a minimum):

1. Alarm acknowledgement
2. Raw data access (Vs. processed data)

6.03 Geographical Information

A. Owner will provide a collection system map derived from GIS data and including geographic information the Owner requires to be displayed.

B. Each monitoring location shall be represented on the map. The Software shall provide a method to navigate to data for any location from the map.

C. The software shall provide an indication on a map of the alarming location.

6.04 Web Accessible Data

A. The Service Provider shall provide access to the data via a password protected website.

B. The website shall have the capability to generate scattergraphs for data at each monitored location.

C. The website shall have the capability to generate hydrographs for data at each monitored location.

D. The website shall have the capability to generate data files in the (*.csv) file format.

E. The software shall be able to contain attached information deliverables for each location in the system. The Service Provider shall attach these information deliverables and ensure they are available.

6.05 Telemetry

F. The software shall have the capability of remotely communicating with the equipment specified in Section 4.

G. The Owner shall have the ability to issue a data collection command in order to obtain data in near real time.

6.06 Alarm and Event Reporting

A. The software shall be able to receive event notification actions generated by the equipment specified in Section 4.

1. Supported events (minimum)

   a. Proportional Flow Loss

   b. High Depth

   c. High-high Depth

   d. Battery low voltage warnings

   e. Sensor failure warnings

2. The software shall provide an audible indication that an alarm condition is active.

B. Alarm Response

1. The software shall maintain a log of all historical alarms.

2. The software shall provide a method for the Owner to acknowledge alarms, and shall provide restrictions to ensure that only those users who have been granted permission to do so may acknowledge an alarm.

3. The Software shall provide a method for flexible alarm escalation. The System shall notify via phone, email, or email compatible pager those personnel specified for the alarming location if an alarm has not been acknowledged after a specified period of time.

C. The Service Provider shall provide with their submittal an approach to minimize false alarms.

1. The submittal shall include a method of Automatic Data Processing which minimizes flow data irregularities in the data to allow for identification of real flow events.

2. The submittal shall include a method of “smart” alarming to minimize false alarms and account for changing diurnal flow patterns.

3. The submittal shall include a detailed description of the Service Provider’s staffed support center’s procedure for assisting the Owner’s personnel in identification and resolution of alarm issues. This shall include, at a minimum:

   a. Maximum allowable response time for open issues.

   b. Method for issuing field service directives for maintenance.

6.07 Training and Support

A. The Service Provider shall provide training on the use of the software to the Owner.

B. The Service Provider shall provide telephone support to the Owner using personnel experienced in troubleshooting problems with the specified software.

END OF SECTION

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