Office of the Mayor
Chokwe Lumumba, Mayor

219 South President Street
Post Office Box 17
Jackson, Mississippi 39205-0017
Telephone: 601-960-1084
Facsimile: 601-960-2193

March 6, 2014

Chief, Environmental Enforcement Section
Environment and National Resources Division
U. S. Department of Justice
Box 7611 Ben Franklin Station
Washington, DC 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., S. W.
Atlanta, GA 30303

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

RE: City of Jackson
EPA Consent Decree
Sewershed Evaluation Plan

Dear Gentlemen:

Attached, please find the City of Jackson's Sewershed Evaluation Plan. This plan was developed and submitted by the City of Jackson in accordance with the EPA Consent Decree dated March 1, 2013. Paragraph 26 of the Consent Decree requires the City to submit to EPA for review and approval a sewershed evaluation 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 gathered and evaluated the information submitted. Based on my inquiry of the 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,

Charles H. Tillman, Acting Mayor
City of Jackson Mississippi

Cc: Les Herrington, P.E., Mississippi Department of Environmental Quality
Kwame Kenyatta, Deputy Chief Administrative Officer, City of Jackson
Gail Lowery, City Attorney, City of Jackson
Willie Bell, Interim Public Works Director, City of Jackson
Mary D. Carter, Public Works Deputy Director, City of Jackson
Public Depository, Eudora Welty Public Library

The City of JACKSON

Sewershed Evaluation Plan

Department of Public Works
Wastewater Infrastructure Redevelopment Program

February 28, 2014

WAGGONER
WEI/AJA, LLC

City of Jackson
Wastewater Infrastructure Redevelopment Program

Sewershed Evaluation Plan

February 28, 2014

Prepared for:

City of Jackson
Department of Public Works
P.O. Box 17
Jackson, MS 39205-0017

Prepared by:

WEI/AJA LLC
143A LeFleurs Square
Jackson, MS 39211

City of Jackson, Mississippi
Sewershed Evaluation 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.

Willie C. Bell, Jr., Interim Director
Department of Public Works

2/28/14
Date

Sewershed Evaluation Plan

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Appendix

1.0 Introduction

The City of Jackson entered into a Consent Decree with U.S. EPA on March 1, 2013 to address inadequacies of the City's wastewater collection and transportation system (WCTS). This ***Sewershed Evaluation Plan*** fulfills the requirements set forth in Consent Decree §IV-2. It describes the methodology the City will use to evaluate the sewersheds, and describes the plan for determining the rehabilitative and corrective actions needed to meet the objectives of the Consent Decree. Required corrective actions will be defined in an Evaluation Report and Rehabilitation Plan developed for each sewershed.

1.1 Consent Decree Requirements

As stated in the Consent Decree, the Sewershed Evaluation Plan shall contain the following, at a minimum:

1. Sanitary Sewer Evaluation Survey. The Sewershed Evaluation Plan shall provide for the City to characterize and address the structural integrity of the WCTS and to identify means to improve WCTS capacity and eliminate SSOs and Prohibited Bypasses at the WWTPs, including the identification and reduction of I/I, by conducting a Sanitary Sewer Evaluation Survey for the Sewershed. The Sanitary Sewer Evaluation Survey component of the Sewershed Evaluation Plan shall include, at a minimum, the following:

    1) The criteria that the City will use for establishing the location of flow and rainfall monitoring equipment installation for the Sewershed evaluations, and for determining whether the City will install the flow and rainfall monitoring equipment either permanently or temporarily, in order to adequately characterize flow in the Sewershed.
    2) A map showing the location of each permanent and temporary flow and rainfall monitoring site established in the WCTS.
    3) A description of the data management system that will organize, analyze, and report flow and rainfall data collected from the WCTS.
    4) A description of the quality assurance and quality control program the City will follow to ensure the accuracy and reliability of flow and rainfall data collected from the WCTS.
    5) Procedures to identify and evaluate I/I in the Sewersheds (including, without limitation, Private Laterals).
    6) Dry weather monitoring to characterize base flows and wet weather monitoring following events of sufficient duration and intensity to characterize peak flows.
    7) Techniques for reducing Infiltration.
    8) A program to eliminate sources of Inflow (including legal mechanisms and enforcement programs).
    9) A program to identify and eliminate cross connections between the WCTS and the City's municipal separate storm sewer system.
    10) Methodologies to evaluate the success of items (5) through (9) above.

11) A review of the legal authority in the current sewer use ordinance to require that the owner of an illegal stormwater connection to the WCTS take all appropriate steps necessary to eliminate the connection.
12) If the review of the legal authority indicates a need to amend the legal authority in order to assume better control over illegal stormwater connections to the WCTS, the Plan shall include the proposed revisions to the ordinance with a schedule for proposing the draft ordinance to the City Council for adoption.
13) Decision-making criteria, procedures, and protocols for prioritization of the evaluation and rehabilitation of Gravity Sewer Lines and associated manholes.
14) Decision-making criteria, procedures, and protocols to determine the need for, and the conduct of, internal condition inspection of Gravity Sewer Lines and associated manholes.
15) Decision-making criteria, procedures, and protocols to determine the need for, and the conduct of, grouting in Gravity Sewer Lines and associated manholes (e.g., leakage rate for application of grout).
16) Decision-making criteria, procedures, and protocols used to determine the need for, and the conduct of, smoke testing.
17) Decision-making criteria, procedures, and protocols used to determine the need for, and the conduct of, dye testing.
18) Decision-making criteria, procedures, and protocols used to determine the need for, and the conduct of, point repair(s), slip lining or line replacement.
19) Decision-making criteria, procedures, and protocols to determine whether I/I from a Private Lateral is excessive and needs to be addressed.
20) Decision-making criteria, procedures, and protocols to determine the need for, and the conduct of, flow isolation of Gravity Sewer Lines and associated manholes.
21) Guidelines for conducting a cost-effectiveness analysis to consider the rehabilitation costs for I/I sources and rainfall-induced I/I source eliminations versus the costs of transportation, storage, and treatment.
22) Documentation of the basis and criteria for rehabilitation, transportation, storage, and treatment costs.

2. Pump Station Evaluations. The Sewershed Evaluation Plan shall provide for the City to evaluate the design capacity, current effective capacity, equipment condition, and operational redundancy in its Pump Stations in the Sewersheds. This evaluation shall include, at a minimum, the following criteria:

1) Adequacy of station capacity.
2) Critical response time, defined as the time interval between activation of the high wet well level alarm and the first SSO, under peak flow conditions.
3) Adequacy of station condition, based upon both physical inspection and any available operating and mechanical failure history during at least the past five (5) years preceding the lodging date of the Consent Decree.
4) Adequacy of station design and equipment, including redundancy of pumps and electrical power supply (including whether emergency or back-up power is available on a portable or fixed basis), and other equipment installed, based upon

the most current edition of MDEQ's *Guidance for the Design of Publicly Owned Wastewater Facilities*.

5) The ability of maintenance personnel to take corrective action within the critical response time calculated for each Pump Station.

1.2 Evaluation Plan Elements

The report includes an overview of the City of Jackson WCTS in Section 2 and identifies the individual sewersheds. The plan for wastewater flow characterization in the sewersheds is discussed in Section 3. The required work scope for subsequent Sewer System Evaluation Surveys of the sewersheds is addressed in Section 4. Sewer rehabilitation and infiltration/inflow reduction measures are discussed in Sections 5 and 6. The scope of work for evaluation of pump stations within the sewersheds is described in Section 7. The report concludes with the proposed plan and schedule for implementing the ***Sewershed Evaluation Plan*** in Section 8.

2.0 Wastewater System Overview

The City of Jackson WCTS consists of approximately 5.3 million feet of gravity sewer, which includes 69,400 feet (13.1 miles) of the West Bank Interceptor (WBI). The WBI runs along the west side of the Pearl River and receives flow from most of the sewersheds. It is the major north-south interceptor pipe that conveys wastewater to the Savanna Street Wastewater Treatment Plant (WWTP). The WCTS also include 98 pump stations and their associated force mains.

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 System	Presidential Hills
15	**Bakers Creek**	Lynch Creek System	Savanna

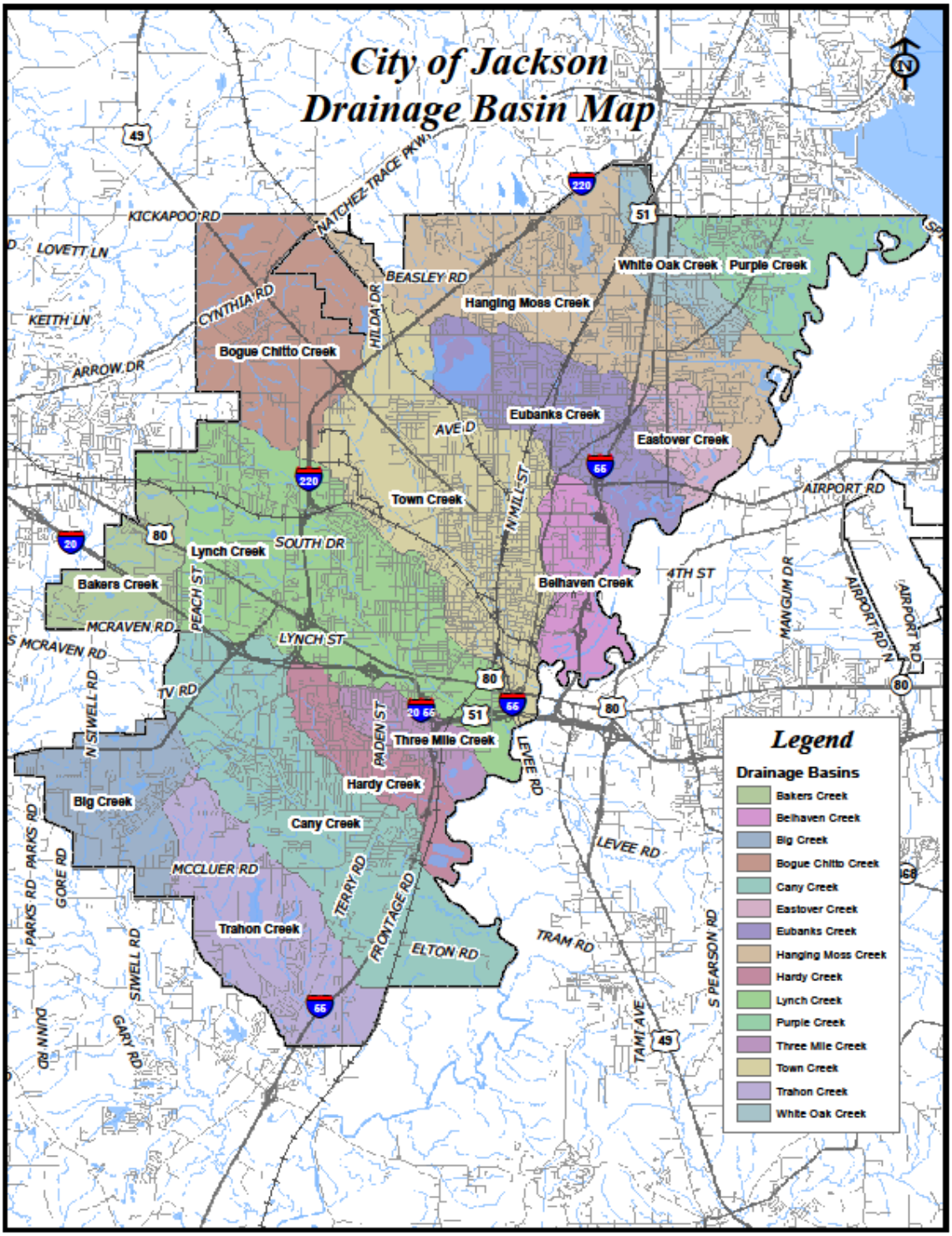
As used in this report, "sewershed" is defined as a portion of the wastewater collection system contained within a single drainage basin. Wastewater from Sewersheds 1-11 flow into the West Bank Interceptor and then to the Savanna Street WWTP in South Jackson which discharges to the Pearl River. The Trahon 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**.

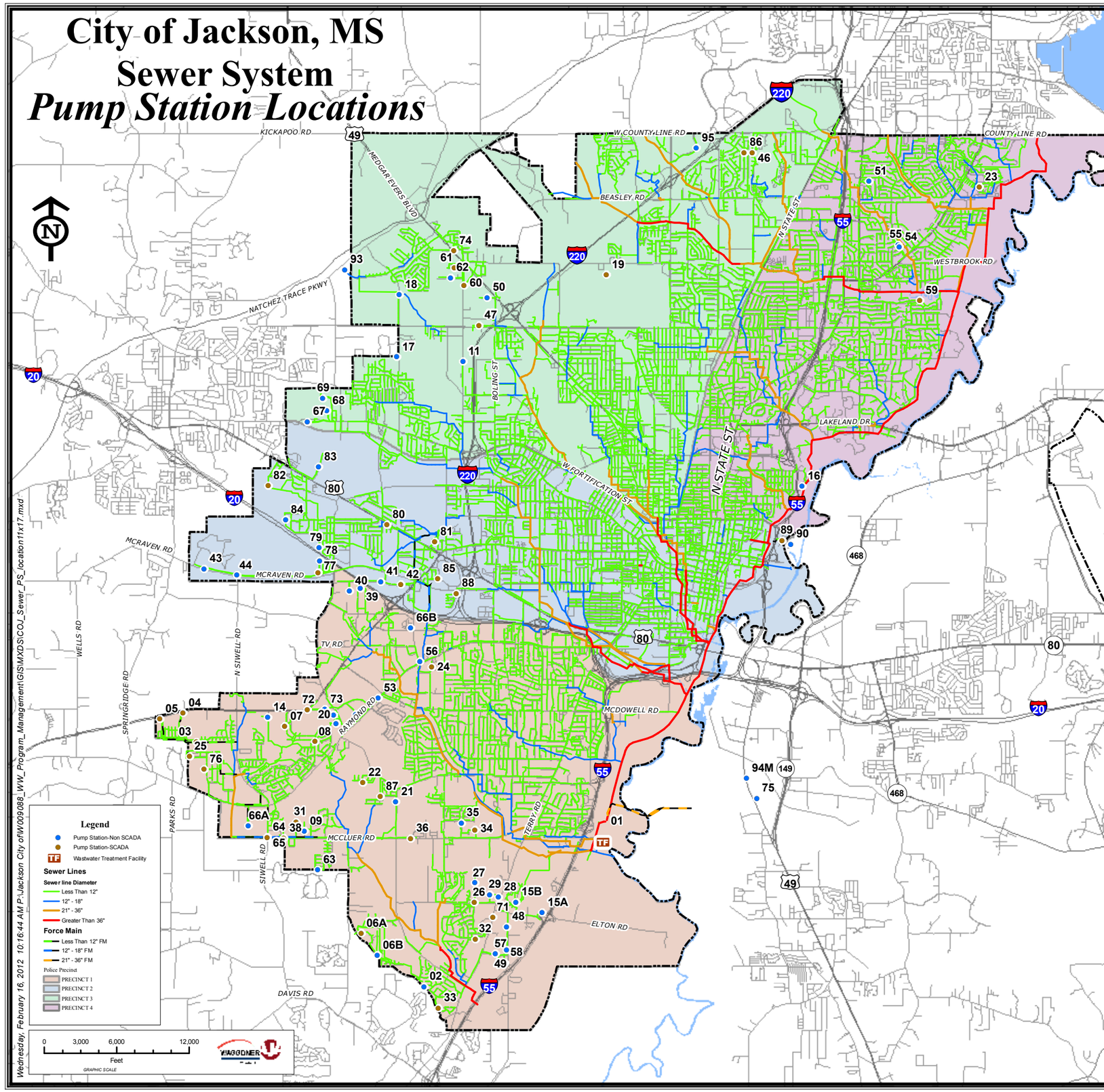
2.2 Pump Stations

The WCTS contains 98 pump stations consisting of 29 large pump stations and 69 small pump stations. Large pump stations are defined as those with pump motors ≥ 7.5 HP, the largest being 50 HP. Small pump stations are those with pump motor sizes ranging from 1.5 to 5 HP. Force main sizes vary from 2-in to 16-in diameter. A location map of the WCTS pump stations is shown on **Figure 2-2**.

Figure 2-1
City of Jackson Sewersheds



City of Jackson, MS
Sewer System
Pump Station Locations



Pump Stations

I.D.	Site	Site Address	Potential Overflow Site	SCADA	Facility
1	SAVANNAH STREET WWTF	15 SOUTH	IT0043	YES	WWTF
2	AMANDA LANE	AMANDA LANE	TR0046	NO	PS
3	BROOKHOLLOW #2	BROOKHOLLOW DRIVE L 160	AT STATION	YES	PS
4	BROOKHOLLOW #3	6675 HWY 18	TR1516	YES	PS
5	BROOKHOLLOW #4	2102 THOUSAND OAK	AT STATION	YES	PS
6A	BROOKWOOD ESTATES	ROBWAY COVE	AT STATION	YES	PS
6B	BROOKWOOD PLACE	4811 BROOKWOOD PLACE	AT STATION	NO	PS
7	CEDAR HILLS #1	461 GREENMOUNT DRIVE	AT STATION	YES	PS
8	CEDAR HILLS #3	201 CEDARWOOD DRIVE	TR1407	YES	PS
9	CHASEWOOD	140 CHASEWOOD AVENUE	AT STATION	NO	PS
10	COLE ROAD	COLE ROAD		NO	PS
11	COUNTRY CLUB #1	1452 COUNTRY CLUB DRIVE	TN3299	NO	PS
12	DELRAY	125 DELRAY AVE	CY1395	NO	PS
13	DURANVILLE	185 DURANVILLE DRIVE	TR0861	YES	PS
14	EDEN DOWNS	553 EDEN DOWNS	AT STATION	NO	PS
15A	I-55 FRONTAGE ROAD	I-55 FRONTAGE ROAD	AT STATION	NO	PS
15B	ELTON ROAD	207 ELTON ROAD	AT STATION	NO	PS
16	FEWELL WATER PLANT	I-55 WATER PLANT	AT STATION	NO	PS
17	FLAG CHAPEL #1	717 FLAG CHAPEL ROAD	AT STATION	NO	PS
18	FLAG CHAPEL #2	992 FLAG CHAPEL ROAD	BC0341	NO	PS
19	FOREST AVENUE	1851 FOREST AVENUE	HM0991	YES	PS
20	FOREST HILL #1	155 FOREST HILL DRIVE	AT STATION	NO	PS
21	FOREST HILL #2	3557 FOREST HILL ROAD	AT STATION	NO	PS
22	FOREST PARK	PARK CIRCLE	AT STATION	YES	PS
23	GREENWING	GREENWING COURT	PL0326	YES	PS
24	HICKEY DRIVE	2130 HICKORY DRIVE	CY1650	YES	PS
25	HILL DALE	561 HILLANDALE DRIVE	TR1192	YES	PS
26	LAKESHORE "B"	174 LAKESHOR ROAD	TR0473	YES	PS
27	LAKESHORE "C"	4058 VENUS AVENUE	TR0557	NO	PS
28	LAKESHORE "D"	4395 TERRY ROAD	AT STATION	NO	PS
29	LAKESHORE "E"	201 RED HILL DRIVE	TR0501	NO	PS
30	J.R. LYNCH (NOT IN SERVICE)	4280 LYNCH STREET		NO	PS
31	MARCHALL AVENUE	160 MARSHALL AVENUE	TR0767	YES	PS
32	MAYFAIR #1	HOLLY HILLS DRIVE	TR0275	YES	PS
33	MAYFAIR #3	ROBINWOOD DRIVE	TR0004	YES	PS
34	McCLUER #1	500 McCLUER ROAD	CY0179	YES	PS
35	McCLUER #2	3890 McCLUER ROAD	AT STATION	NO	PS
36	McCLUER #3	887 McCLUER ROAD	TR0710	YES	PS
37	McCLUER #4	1077 McCLUER ROAD	TR0691	YES	PS
38	McCLUER #5	1665 McCLUER ROAD	TR0733	YES	PS
39	McRAVEN #1	2694 MOORE DRIVE	CY1928	NO	PS
40	McRAVEN #2	155 HILLVIEW	CY1919	NO	PS
41	McRAVEN #3	4813 McRAVEN ROAD	LY0918	NO	PS
42	McRAVEN #4	4650 McRAVEN ROAD	LY0838	YES	PS
43	McRAVEN #5	6186 McRAVEN ROAD	LY0951	NO	PS
44	McRAVEN #5	6100 McRAVEN ROAD	AT STATION	NO	PS
45	MULE JAIL	6510 OLD CANTON ROAD @ COUNTY LINE	PL1045	YES	PS
46	NORTH COLONY	6112 FLORAL DRIVE	HM2315	YES	PS
47	NORTHSIDE DRIVE	3700 W. NORTHSIDE DRIVE	TN3658	YES	PS
48	OLD BYRAM ROAD #1	4837 OLD BYRAM ROAD	TR0223	NO	PS
49	OLD BYRAM ROAD #2	4681 OLD BYRAM ROAD	AT STATION	NO	PS
50	PATANN	PATANN STREET	TN3688	NO	PS
51	PLANTATION COURT	PLANTATION COURT	PL0409	NO	PS
52	PORTWOOD	155 PORTWOOD DRIVE	AT STATION	NO	PS
53	RAYMOND ROAD	2108 RAYMOND ROAD	CY1545	NO	PS
54	RIVER THAMES #1	5440 RIVER THAMES ROAD	AT STATION	NO	PS
55	RIVER THAMES #2	5407 RIVER THAMES ROAD	AT STATION	NO	PS
56	ROBINSON ROAD	5297 ROBINSON ROAD	AT STATION	NO	PS
57	SCOTTDALE #1	112 SCOTTDALE DRIVE	TR0196	NO	PS
58	SCOTTDALE #2	10 ROB LANE	TR0162	NO	PS
59	SHEFFIELD	2238 SHEFFIELD DRIVE	HM0575	YES	PS
60	SHELL ROCK "A"	6340 COUNTRY CLUB	AT STATION	YES	PS
61	SHELL ROCK "B"	255 S. SHELLROCK	BC0194	YES	PS
62	SHELL ROCK "C"	3458 DIXION SYLES ROAD	AT STATION	NO	PS
63	SHORT AVENUE	1465 SHORT AVENUE	AT STATION	NO	PS
64	SIWELL ROAD #1	4095 SIWELL ROAD	AT STATION	YES	PS
65	SIWELL ROAD #2	4071 SIWELL ROAD	AT STATION	NO	PS
66A	STRATFORD	139 STRATFORD DRIVE	TR0808	NO	PS
66B	SUMMER PARK	GREENWAY DRIVE	AT STATION	NO	PS
67	SYLVAN #1	6065 CLINTON BLVD.	AT STATION	NO	PS
68	SYLVAN #2	151 SYLVAN TRAIL	AT STATION	NO	PS
69	SYLVAN #3	351 SYLVAN TRAIL	AT STATION	NO	PS
70	SYLVAN #4	498 SYLVAN TRAIL	AT STATION	NO	PS
71	TERRY ROAD	4640 TERRY ROAD	TR0446	YES	PS
72	TIMBERLAWN #1	6115 HWY. 18	CY1439	YES	PS
73	TIMBERLAWN #2	132 TIMBERLAWN ROAD	CY1445	NO	PS
74	US HWY. 49 NORTH	6159 US HWY. 49 NORTH	AT STATION	YES	PS
75	WEST RANKIN PUMPSTATION	620 OLD HWY. 49 SOUTH		NO	PS
76	WESTERN HILLS #1	WESTERN HILLS DRIVE	AT STATION	YES	PS
77	WESTSIDE #1	1900 WALLACE STREET	LY1033	YES	PS
78	WESTSIDE #2	1790 WALLACE STREET	LY1252	NO	PS
79	WESTSIDE #3	1651 WALLACE STREET	AT STATION	NO	PS
80	WESTSIDE #4	1914 US HWY. 80 WEST	AT STATION	YES	PS
81	WESTSIDE #5	4210 CHURCH CIRCLE	LY1685	YES	PS
82	WESTSIDE #6	600 E. BROWNING DRIVE	LY2536	YES	PS
83	WESTSIDE #7	1238 ZEPHYR STREET	LY2735	NO	PS
84	WESTSIDE #8	6325 YARBROUGH STREET	LY2036	NO	PS
85	WHITEHALL	4180 WHITEHALL ROAD	AT STATION	YES	PS
86	WHITESTONE	WHITESTONE ROAD	HM2365	YES	PS
87	WINDSOR FOREST #1	SHANNONDALE DRIVE	CY0598	YES	PS
88	YARBO	3855 YARBRO	AT STATION	YES	PS
89	YMCA #1	E. RIVER PLACE	AT STATION	YES	PS
90	YMCA #2	OLD RIVER PLACE	IT0058	NO	PS
91	TRAHON WWTP	APACHE ROAD #1	AT STATION	NO	WWTF
92	TRAHON LIFT STATION	APACHE ROAD #2	AT STATION	NO	PS
93	PRESIDENTIAL HILLS LAGOON	PRESIDENTIAL HILLS	BC0251	NO	WWTF
94M	RICHLAND (WEST RANKIN)	620 OLD HWY. 49 SOUTH		NO	PS
95	ECHELON	1235 ECHELON PARKWAY	AT STATION	NO	PS

Data Source: City of Jackson & Severn Trent Services January 2005

SCADA SITES

NOT IN SERVICE OR OWNED BY OTHER CITIES

3.0 Wastewater Flow Characterization

For the sewersheds identified as major contributors of infiltration and inflow (I/I), a detailed Sewer System Evaluation Survey (SSES) will be performed. The purpose of the SSES will be to identify sources of excess I/I, evaluate the structural condition of the major collectors within the defined area of evaluation, determine sewer rehabilitation requirements and costs, and develop a rehabilitation plan based on cost effectiveness and other criteria. The basic SSES work scope that will be applied to the City of Jackson sewersheds is described below.

3.1 Sewershed Prioritization

Comprehensive flow monitoring is currently underway along the City's West Bank Interceptor. A total of 29 flow meters are being used to measure flows along the WBI together with the flow entering from each contributing sewershed. Additional flow monitoring will be performed in 2014 within the major sewersheds to further identify the relative severity of I/I, including the three sewersheds that do not discharge into the WBI. The flow monitoring results from the WBI and the major sewersheds will be used to develop the ***Sewershed Prioritization Report*** to be submitted by September 1, 2016. Based on the relative level of I/I detected, the sewersheds will be classified into the following groups:

Group 1 Sewersheds

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

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.

Based on the above classification and preliminary sewershed flow monitoring results, the objectives and boundaries for required Sanitary Sewer Evaluation Studies will be established for the Group 1 and Group 2 sewersheds. The proposed scope of work for the SSES studies is described in the following sections. The preliminary Scope of Work proposed to be used for SSES contractor procurement is included in **Appendix A**.

For each SSES study, existing wastewater flow regimes will be established for the sewershed. Wastewater flow characterization will include the following:

- Flow and rainfall monitoring

- Flow and rainfall data analysis
- I/I assessment

The general SSES work scope pertaining to these steps is described below. It is the City's intention to use qualified professional services firms experienced in sewer evaluation studies, including installing and operating flow and rainfall monitoring equipment, to perform each SSES.

3.2 Flow and Rainfall Monitoring

Flow and rainfall monitoring is being performed on the City of Jackson WCTS in three phases. These are:

Phase 1 – West Bank Interceptor Flow Monitoring

Currently underway, a series of 29 flow meters and 4 rain gauges are being used to measure flows within the 13 mile long West Bank Interceptor and from the contributing sewersheds. This information will assist in identifying and prioritizing the sewersheds in terms of relative contribution of I/I. The location of the Phase I flow meters is shown on **Figure 3-1**. The four rain gauges are widely distributed within the WCTS so that they can be used for calibration of the hydraulic computer model of the entire system.

Phase II – Preliminary Sewershed Flow Monitoring

Additional flow monitoring will be performed in 2014 within the sewersheds to provide a better understanding of the quantity, severity, and distribution of I/I being contributed. Included in Phase II is measurement of flows from sewersheds that do not discharge into the West Bank Interceptor. This information will be used to finalize sewershed prioritization into groupings based on I/I severity, and used as the basis for the ***Sewershed Prioritization Report*** due to EPA on September 1, 2016. The preliminary sewershed flow monitoring results together with the WBI flow monitoring results will also be used to calibrate the hydraulic computer model of the WCTS. Flow meters will be located at strategic locations within the sewersheds such as the terminus of trunk sewers and at pump stations. Preliminary locations of Phase II flow meters are also shown on **Figure 3-1**. The proposed sewershed flow meters are listed on **Table 3-1**.

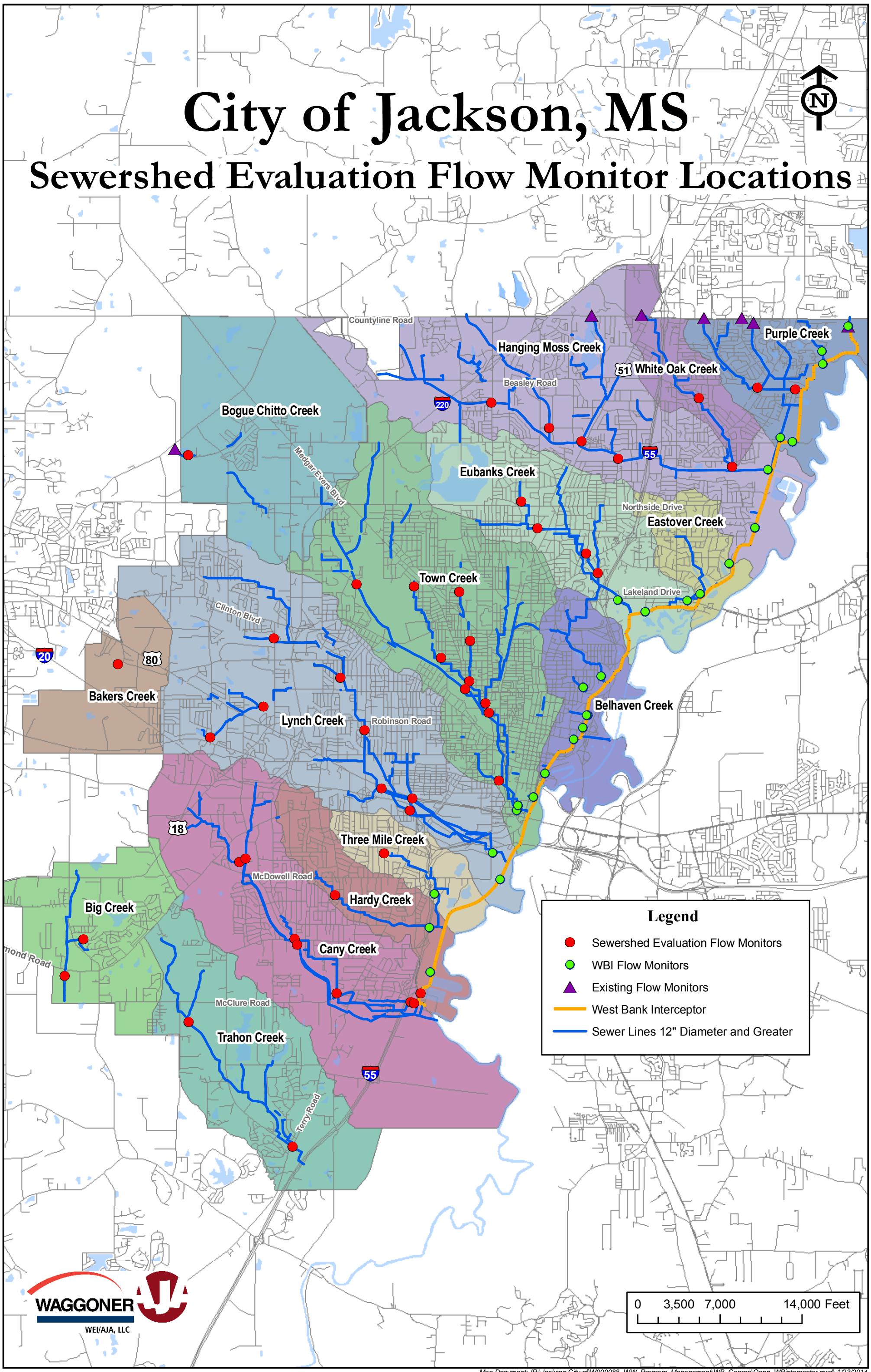
Phase III – SSES Flow Monitoring

SSES studies will subsequently be scheduled for Group I and Group II sewersheds. Based on the results of the SSES, a Rehabilitation Plan will be developed and implemented for each sewershed. After rehabilitation activities are completed, post-rehab flow monitoring will be performed where needed to verify or document I/I reduction.

A schematic of I/I analysis process is summarized on **Figure 3-2**.

City of Jackson, MS

Sewershed Evaluation Flow Monitor Locations



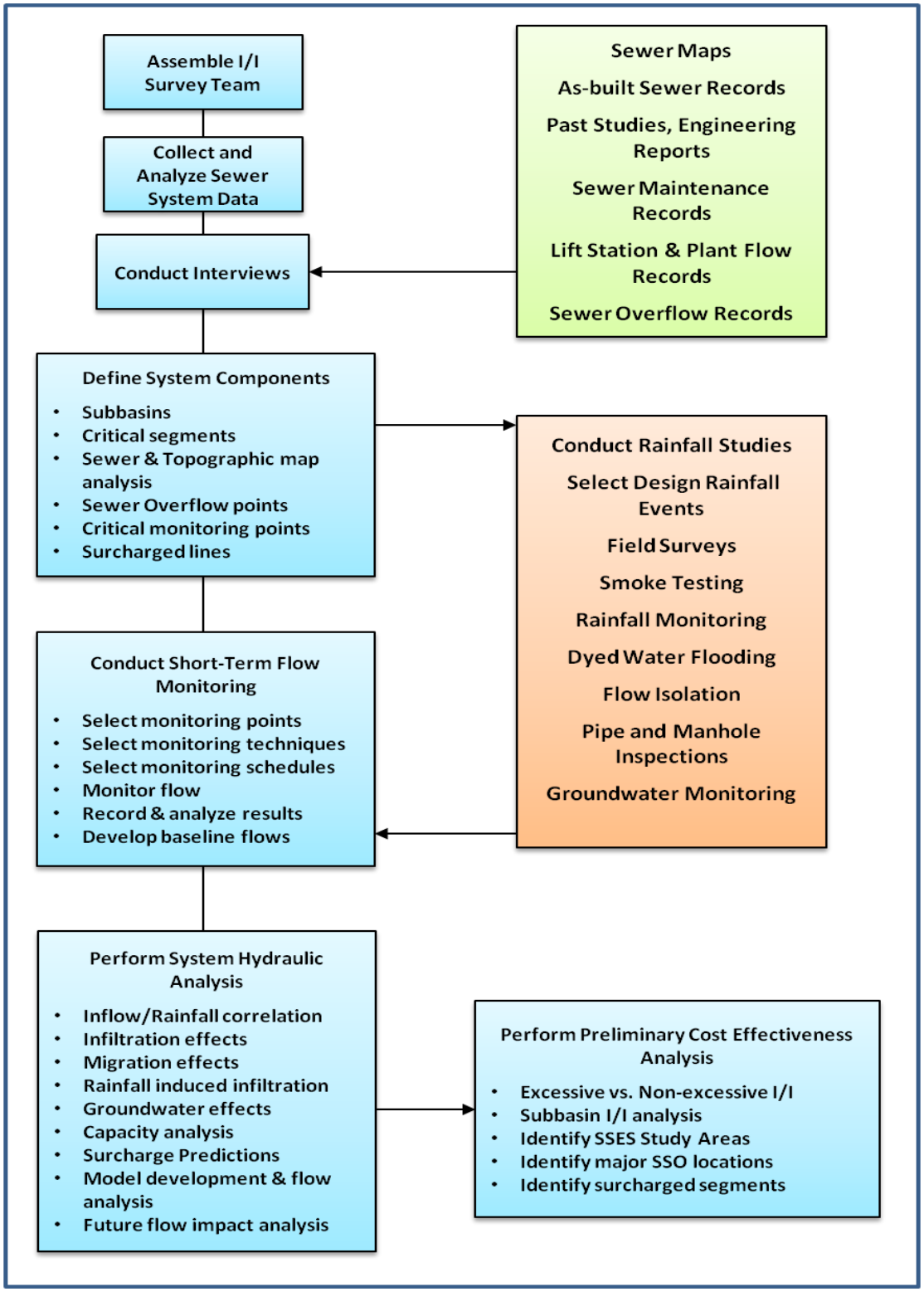
Map Document: (P:\Jackson City of\W009088_WW_Program_Management\WB_George\Qann_WBinterceptor.mxd) 1/23/2014

Table 3-1

Sewershed Flow Meter Sites

	Manhole ID	Pipe Diameter, in	MH Depth	Location
1	BC0270	16	11	Gate End of Franklin Roosevelt
2	CY0159	30	17	Entrance Road to WWTP
3	CY0180	12	5	Entrance Road to WWTP
4	CY0277	15	11	3865 Meadow Lane
5	CY0280	42	19	Entrance Road to WWTP
6	CY0810	30	15	Oak Forest at Cooper Street
7	CY0899	17	9	Oak Forest at Cooper Street
8	CY1548	24	11	5537 Robinson Road
9	CY1567	18	8	Robinson Road/Colony Square
10	EU0262	15	14	3574 Crane Boulevard
11	EU0396	24	17	3910 Oak Ridge Street
12	EU0708	21	13	MeadowBrook Road
13	EU1030	12	15	3934 Meadow Lane
14	HC0323	15	13	2746 Shannon Drive
15	HM0632	24	17	5005 Meadow Oak Park Drive
16	HM0710	36	22	Manhattan
17	HM0988	36	14	Highland Street
18	HM1223	30	15	Meadow Road
19	HM1602	36	16	Watkins Road
20	LY0277	31	14	Valley Street
21	LY0392	18	9	Parking Lot of Holiday Motel
22	LY0496	30	11	Parking Log off of Hwy 80
23	LY1169	12	10	West Haven
24	LY1291	30	15	Ellis Avenue
25	LY1759	21	17	Dixie Road
26	LY2311	18	3	3755 Jayne Street
27	LY2502	10	10	Easement Access off of Browning
28	LY2767	12	10	Dixon Road
29	PL0167	30	12	End of Deer Trail
30	PL0173			
31	TM0229	10	9	Glen Road
32	TN4206	18	18	Roach Street at RR Tracks
33	TN1041	36	6	Gallatin Street
34	TN40378	15	10	Cohea Steet at Bailey Street
35	TN1305	36	23	Fortification Street
36	TN1413	27	11	692 Rondo Street
37	TN1736	22	7	939 Mobile Street
38	TN1940	24	15	Rondo Street at Vardaman Street
39	TN2550	18	8	End of Lerida
40	TN2640	19	9	3340 Center Street
41	TN2673	27	15	Field South of Ford
42	TR0050	42	22	Terry Road at Forest Road
43	TR0646	27	21	Henderson at Private Drive
44	TR0860	24	16	Raymond Road
45	TR1076	10	6	116 Pine Cove
46	WO0220	24	19	5528 Marblehead Drive

Figure 3-2
I/I Analysis Flow Chart



3.3 Flow Monitoring Site Selection

Flow metering sites are identified within the sewersheds based upon a review of the WCTS structure using GIS system sewer maps. Criteria used for selection of flow monitoring sites, and for evaluating the feasibility of each selected site for flow meter installation, are described below.

Site Selection Criteria

Flow monitoring sites will be selected on the basis of:

- Key sewer junctures as required to calibrate system hydraulic model
- Based on model calibration, additional capacity limited sites for further I/I assessment
- Locations of known SSOs
- Knowledge and experience of sewer maintenance staff
- Other selected locations based on best engineering judgment

A sufficient number of flow monitors will be installed within the sewersheds to permit accurate grouping of sewersheds and delineation of SSES study areas within the priority sewersheds.

Site Evaluation

Each potential metering site will be further investigated in the field. 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 purpose of the field investigation will be to:

- Confirm the feasibility of installing the flow meter within the selected manhole.
- Ensure that the sewer and manhole arrangement at each site is hydraulically suitable for flow monitoring.
- Verify that the site does not have an excessive amount of turbulence.

The City will employ a qualified specialty contractor to install and operate the flow and rainfall monitoring equipment for all three flow monitoring phases. 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

At this time the sewershed flow meters are planned to be temporary. However, several may subsequently be determined to be sufficiently useful to be left in place as permanent meters for use in management of the collection system. Additionally, several of the meters installed on the West Bank Interceptor will be designated as permanent flow meters.

3.4 Flow and Rainfall Monitoring Data Analysis

Data collected by the flow monitoring programs in the sewersheds will be managed in a similar manner as the flow data obtained from the West Bank Interceptor. This will insure consistency in data collection and analysis throughout the wastewater infrastructure improvements program. 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 3-3**. 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, together with the relative quantity of inflow and infiltration. 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 3-4**. 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 sewer system during storm events and will help to identify system deficiencies.

Figure 3-3
Sewer Flow Hydrograph

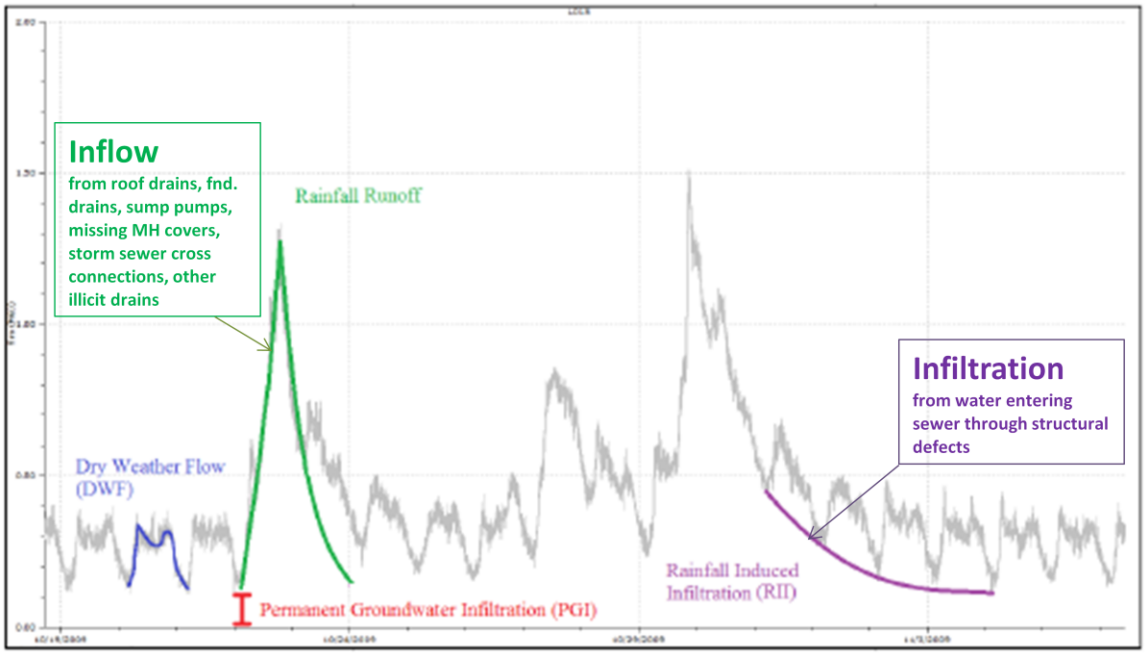
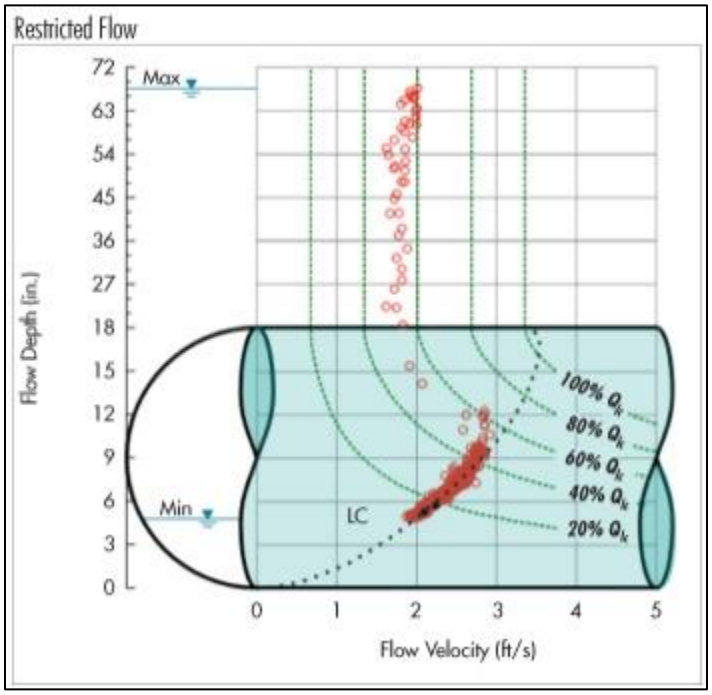


Figure 3-4
Sewer Flow Scattergraph



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).

Currently, the City of Jackson's flow monitoring contractor is using the Telog for Windows® software platform by Telog Instruments, Inc. for data analysis and reporting. It is anticipated that this software will continue to be used in the future. A description of the Telog software capabilities is provided in **Appendix B**.

3.5 Quality Assurance

An overview of the City's quality assurance/quality control process pertaining to flow and rainfall monitoring data is provided below.

QA/QC Program

The City of Jackson Flow and Rainfall Monitoring Program will incorporate formal quality control/quality assurance procedures. The integrity of the data is important whether for billing, capacity analysis or I/I investigations. To maintain the flow meters in proper operation, the QA/QC checks include periodic procedures to demonstrate that readings produced by the monitors can be validated. The lack of proper QA/QC procedures, limited on-site data reviews, and lack of proper and detailed field verifications often results in lower-quality data as well as data losses. Therefore, QA/QC checks will be performed throughout the program. A well-designed flow monitoring approach will provide for the collection of quality data to successfully apply to hydraulic modeling. The selected calibration and verification rainfall events will be developed from the flow and rainfall monitoring data.

Site Inspection and Maintenance

Field verification is an important activity in collecting accurate data and assuring minimum loss of data due to malfunctioning equipment or accumulation of debris at the monitoring site. Field inspections will be conducted at least monthly or more frequently if needed. Meter calibration will be confirmed on site with measurements taken using an independent device. Meter maintenance requirements are extremely site sensitive. Some sites will

require minimal maintenance visits, while others will be continually affected by silt and debris build-up.

The flow meters and rain gauges will be maintained in the field per the manufacture's and City's guidelines and as needed to ensure that the meters are properly functioning and recording quality data. Meter maintenance may include cleaning and/or adjustment of sensors, and replacement of batteries, desiccant or other equipment components as needed.

Calibration Procedures

Field calibration is the process of independent verification of the flow meters. Field calibration of all meters will be conducted to verify the accuracy and repeatability of the recorded data. Field calibration includes entry into the meter manhole and measurement of the flow depth and flow velocity (using a portable velocity meter). Field calibration will be completed approximately monthly, or as necessary based on data review and diagnostics. Field calibration measurements gathered throughout the monitoring period will be used to perform any adjustments to meter recorded depth or velocity data.

QA/QC checks of the data and site visits will be immediately conducted if problems are observed with erratic data or unexplained changes in the data values. In sum, quality assurance will be a continuous process designed to insure ongoing data validity throughout the project.

3.6 Infiltration/Inflow Evaluation

Flow meter and rain gauge data will be used to identify and evaluate the amount of I/I entering the system using the procedures outlined below.

Flow Data Analysis

Flow data will be analyzed on a site by site basis. Analysis of each site will be performed using the flow calculated by the continuity equation:

$$Q = V * A$$

Where:

Q = Flow

V = Velocity

A = Cross sectional flow area

If the continuity equation is not applicable, then flow will be calculated using the open channel Manning flow equation:

$$Q = 1.49/n\ R^{2/3}\ S^{1/2}\ A$$

Where:

Q = Flow

n = Pipe roughness

R = Hydraulic radius

S = Hydraulic grade Line

A = Cross sectional flow area

Dry Weather Analysis

A dry weather period will be established for each site 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 characterize dry weather flows and determine the ADWF and PDWF.

Wet Weather Analysis

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 PWWF 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 RDI/I.

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 (storm water) 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. Areas with I/I sources that are deemed excessive will be targeted for an SSES study for more detailed evaluation and development of a rehabilitation plan.

The RDI/I parameters and hydrographs will also be used to calibrate the hydraulic modeling program. The hydraulic model will be used to assess capacity availability in the sewer system and, based on relative levels of system I/I observed, to aid in defining the need for more detailed sanitary sewer evaluation studies.

In summary, 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, to prioritize sanitary sewersheds into the appropriate rehabilitation groups, and to further identify specific areas within the sewersheds where detailed SSES studies are required to determine rehabilitation needs. Methods that will be used to reduce I/I are described in the following section.

4.0 SSES Guidelines

SSES studies will be performed in the Group I sewersheds (containing at least 30% of total system I/I) and Group II sewersheds (with at least 40% of total system I/I) as defined in the ***Sewershed Prioritization Report***. The techniques that the SSES consultants will be required to use to evaluate I/I sources and develop rehabilitation plans are described in this section. Included are the decision-making criteria, procedures, and protocols to determine the need for, and the conduct of, I/I evaluation techniques to be used in the program.

4.1 SSES Approach

The City intends to engage a series of qualified professional services firms to perform the Sewer System Evaluation Survey (SSES) studies within sewersheds with the most I/I as determined from flow monitoring. Beginning with Group I, the sewersheds will be further prioritized through additional Phase III flow monitoring. This detailed flow monitoring will be performed within selected areas of the sewershed to further identify and characterize the I/I severity, and define the specific areas where SSES studies are required. These areas will be further prioritized based on relative I/I contribution to develop a schedule for performing the SSES studies and subsequent rehabilitation.

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. This 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 sewersheds will be prioritized using the criteria established in the ***Sewershed Prioritization Work Plan***. The criteria are:

- SSO severity
- I/I volume
- Environmental risk
- Failure risk
- Results of current rehab activities
- Maintenance history
- Future development
- Sewer characteristics

The ***Sewershed Prioritization Report*** will document the arrangement of the 15 City of Jackson sewersheds into the respective grouping based on their relative I/I contribution. 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 procedure described in Section 4-3.

4.2 I/I Evaluation and Structural Condition Assessment

The SSES study elements anticipated to be employed to further evaluate I/I together with the structural condition of the sewers are discussed below. Described are the decision-making criteria, procedures, and protocols that will be used to determine the need for each evaluation method. Detailed procedures for the conduct of each method are included in the technical specifications provided in **Appendix A**.

A variety of I/I and structural condition evaluation tools are available that can be employed as an SSES study component. A summary of the evaluation methods that may be used in the conduct of the Jackson SSES work is shown on **Table 4-1.**

Table 4-1
Sewer System Testing and Inspection Methods

Method		Application
1	**CCTV/Multi-Sensor Inspection**	Primary internal inspection technique for I/I point source identification and structural condition assessment.
2	**Electrode Scanning Leak Detection**	Used to identify pipe defects not detected by CCTV methods. Applicable to pipes ≤20" diameter.
3	**Manhole Inspection**	Primary method to evaluate manhole I/I leaks and structural condition
4	**Smoke Testing**	Most common routine source detection method to identify I/I.
5	**Dye Testing**	Rainfall simulation technique used after smoke testing to confirm suspected inflow connections.
6	**Lateral Testing**	Used where smoke testing indicates major defects in private laterals
7	**Building Plumbing Inspection**	Used where smoke testing indicates inflow from roof leaders and foundation drains
8	**Flow Isolation**	Used where smoke testing indicates major infiltration sources or infiltration areas.

The following sections describe the application of the above evaluation techniques.

CCTV/Multi-Sensor Inspection

Description

A method of internal inspection of sewer lines using remotely operated television cameras and other instruments.

Decision Making Criteria

Will generally be used on all sewer lines within the defined SSES study area, except those areas that were determined not to have I/I problems.

Procedures/Protocols

The interior of pipes will be inspected using closed circuit television (CCTV), laser imaging, and/or sonar. These instruments are typically mounted on a remotely operated self-propelled robotic platform that is propelled through the pipe. The instruments map the complete interior both above and below the waterline to provide a full 360° quantitative view of the pipeline. The CCTV provides a visual indication of pipe defects, which are coded by trained technicians to PACP[1] standards. The laser device maps the true inside diameter and measures wall thickness loss due to corrosion. The sonar measures sediment buildup on the pipe bottom to evaluate cleaning needs. Sensors may also be installed to measure hydrogen sulfide gas concentration, temperature, and pipe slope.

Multi-Sensor Sewer Inspection Robot

Courtesy RedZone Robotics, Inc.

[1] Defects are coded in accordance with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP).

Electrode Scanning Leak Detection

Description

A method of accurately locating pipe defects and estimating corresponding infiltration.

Decision Making Criteria

May be used in selected areas where I/I is deemed excessive and conventional CCTV and related methods are inconclusive. Applicable to sewer lines 20-in diameter and smaller. Pipe must be suitable for isolation and flooding to perform test.

Procedures/Protocols

Another sewer defect evaluation technique that may be used in some areas is electrode scanning. This recently developed technique involves measuring electricity flow from a probe that is pulled through the pipe. The electricity flows through defects in the pipe wall to a probe on the surface, presenting a relatively accurate map of the location and size (and, hence, rate of infiltration) of the defect. This occurs because most sewer pipes are poor conductors of electricity. The pipe must be full of water at the probe location. Electricity is conducted through the water, pipe defect, and soil to the probe. Electrode scanning is generally used on pipes less than 20-in diameter, although probes have been recently introduced for larger pipes. This technology is available from Electro Scan Inc. and Vivax-Metrotech Corporation. ASTM F2550-06 describes the standard practice for locating leaks in sewer lines using electrode scanning. A schematic of the electrode scanning technology is shown on **Figure 4-1**.

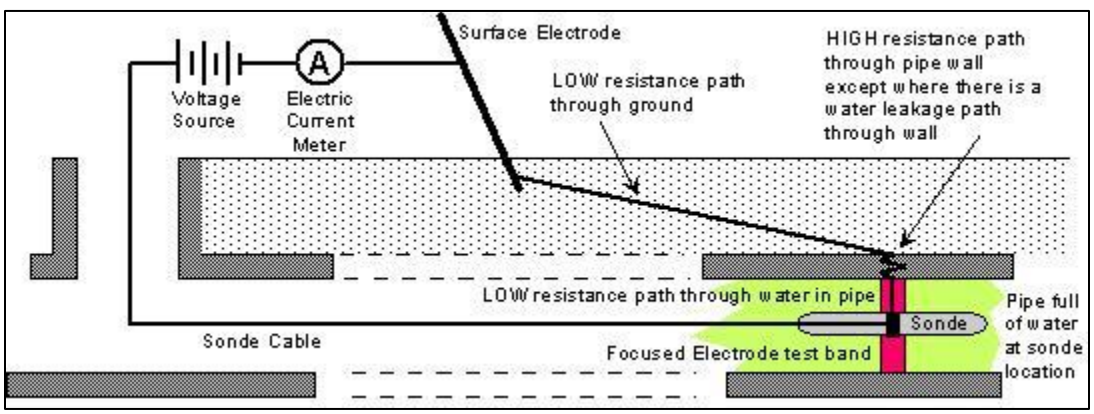


Figure 4-1
Electrode Pipe Defect Scanning Schematic
Courtesy Electro Scan Inc.

Smoke Testing

Description

A common I/I detection method that will identify many but not all pipe defects. Smoke is forced through the main sewer line and contributing pipe laterals by a blower. By plugging the downstream line, smoke is forced under pressure through pipe defects to the surface, where it can be observed.

Decision Making Criteria

Used where there is a need to rapidly evaluate areas with known high inflow based on flow monitoring or flow isolation, and to identify defects.

Smoke testing can be used in areas where:

- Sewers are shallow
- Sewers and laterals are not covered by impervious paving (residential areas, generally)
- Sewers are 18-in diameter and smaller

Smoke testing should not be used:

- During periods when soil is wet
- When groundwater levels are high
- During windy weather conditions
- When sewers contain sags or are flowing full.

Procedures/Protocols

Smoke testing is used to further define results observed from CCTV inspection and other assessment activities to identify potential locations of defects allowing the entry of I/I. Smoke testing is effective on both public and private property (laterals) and can locate cross connections or other illicit connections. Smoke testing is often used to identify inflow sources, or direct connections, from roofs or from the ground surface to the sanitary sewer system. Typically, these connections are pipes from roof drains, cross connections from storm sewer systems, open cleanouts, holes in the sewer pipe that are connected to the ground surface, or submerged manholes. Smoke testing is done by blowing low-pressure, non-toxic, non-staining vapor or "smoke" into a section of the sewer line through the manholes. During the SSES, locations where emerging smoke is observed are recorded, together with the estimated leak severity, leak type, leak source, and surface conditions. Digital photographs are also taken of each observed source.

Dye Testing

Description

A method of simulating rainfall to locate sources of inflow by flooding the pipe or area being tested with water containing a bright colored dye. Using general observation and CCTV, the path of the dye can be determined and defects can be located. This method is applicable to identifying mainline defects, cross-connections, connected roof drains and area drains, and infiltrating manholes.

Decision Making Criteria

Used when additional investigation is needed to further pinpoint and quantify leaks identified from previous CCTV, smoke testing, or other I/I evaluation techniques.

Procedures/Protocols

Dye testing consists of flooding a defined area with dyed water or adding dyed water to a suspected inflow source, such as a rain gutter. It is a rainfall simulation technique used in conjunction with CCTV, smoke testing, and manhole inspection to determine whether or not a smoke exit point is directly or indirectly connected to the sewer system. Dyed water testing is also used to investigate building sewer system connectivity. Dye testing is typically used to confirm surface connections or cross connections that may not be identifiable by smoke testing. A liquid fluorescent dye is introduced at the upstream point of suspected inflow, such as a roof leader, catch basin, abandoned building connection, or tank. It may also be employed by flooding a localized area with water containing dye. A downstream point, usually a manhole, is monitored during the test to detect the presence of dye and confirm the inflow path. Dye testing is also useful in verifying whether a service connection to the main line is active.

Flow Isolation

Description

A method used to determine the relative quantity of ground water infiltration (during dry weather) or rainfall derived infiltration (during wet weather). Generally performed at night by plugging the upstream manhole and monitoring flow at a downstream manhole of the selected pipe segment(s).

Decision Making Criteria

Used in further classifying and prioritizing localized sewers within subbasins that are significant sources of infiltration. Performed in areas with excessive infiltration based upon flow monitoring results, experience of sewer maintenance crews, and/or other assessment means. Results of flow isolation are not meant to quantify I/I, but are used to determine if infiltration rates are high enough to warrant more detailed investigation.

Procedures/Protocols

Flow isolation involves measuring flows at a designated manhole downstream of the area isolated for survey. This technique is generally performed on 1,000-ft to 3,000-ft segments within a sewer basin. Inflatable plugs are normally used in the upstream sewer to temporarily block flows generated above the monitoring zone, although sandbags can be used on small sewers. For sewers 18-in diameter and less, flow measurement during the flow isolation period is generally performed by constructing a weir at the downstream manhole. For larger diameter pipes, a flow meter or depth and velocity measurements are normally required. The flow isolation results are reviewed to determine if the area being studied contributes infiltration severe enough to warrant further investigation by CCTV or multi-sensor inspection.

Manhole Condition Assessment

Description

Visual inspection of manholes performed to identify sources of inflow and infiltration. Visual inspection provides a means to identify undocumented connections, as well as the structural, construction, and operational defects present in the structure.

Decision Making Criteria

Standard inspection procedures will be used to assess the structural condition and I/I severity of manholes. All manholes within defined SSES study areas will receive a detailed field inspection and condition assessment.

Procedures/Protocols

Manhole condition assessment technologies are performed primarily using visual or camera imaging. The inspection will normally record the following information for each manhole on an inspection form:

- Manhole identification
- Manhole location
- Manhole depth
- Wastewater flow status
- Surface cover around manhole
- Indication of ponding
- Type of cover
- Manhole construction materials
- Condition rating of various manhole components
- Observations of active infiltration and/or inflow locations and severity
- Digital photographs

Manhole inspection can be performed from the surface or by physical entry depending on the desired level of precision of the collected data. Entering the manholes requires proper confined space entry procedure that generally includes a safety harness, emergency retrieval equipment, gas detection, and forced-air ventilators. Digital cameras are used to document defects. Observed manhole defects are coded and condition grades assigned by trained technicians to MACP[2] standards. The condition grades are used in classifying I/I severity and serve as a benchmark for future assessments. I/I severity together with the overall condition of the manhole is used to determine the rehabilitation approach.

Vacuum testing techniques are also available for manhole assessment, although these techniques are not anticipated to be used for Jackson WCTS manhole assessments.

[2] Defects are coded in accordance with the National Association of Sewer Service Companies (NASSCO) Manhole Assessment and Certification Program (MACP).

Private Laterals Evaluation

Description

Assessment of I/I contribution from private laterals. Private lateral evaluation methods that may be used are CCTV, smoke testing, and dye testing.

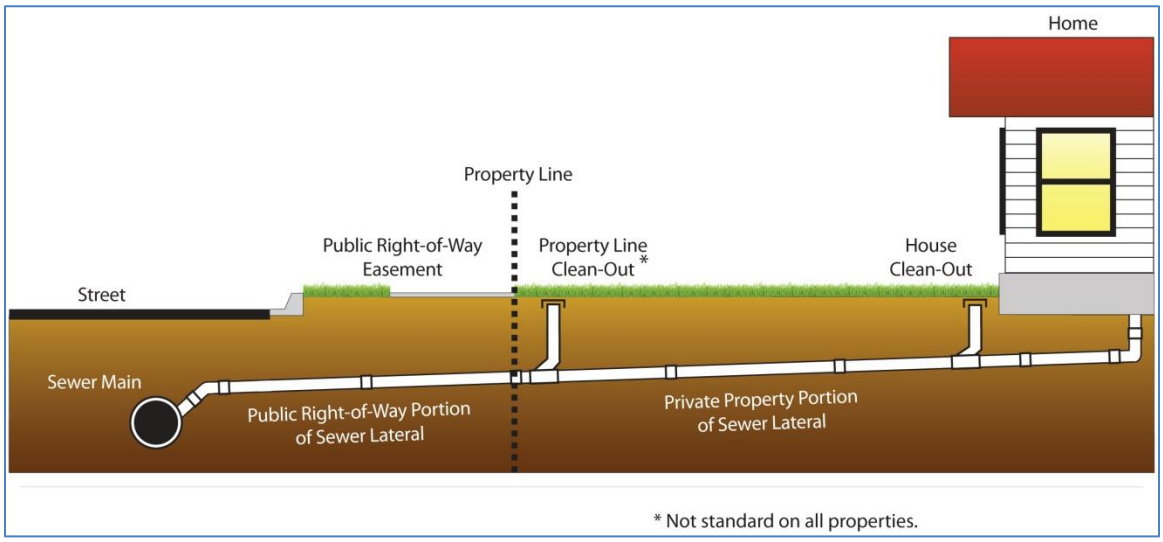
Decision Making Criteria

Used where previous I/I evaluation activities have identified private laterals as a likely major I/I contributor. Effective rehabilitation and I/I abatement in these areas generally requires a comprehensive approach that includes private lateral assessment and rehabilitation.

Procedures/Protocols

Private laterals can be inspected using a combination of technologies, the selection of which depends on site conditions and access. Access onto private property to confirm or gather defect data is generally a voluntary program requiring the property owner's permission. Smoke testing is the most commonly applied private lateral I/I evaluation method. Also used is CCTV of private laterals with camera entry from the main line, or mini-cams launched from cleanouts on private property. Dyed water flooding of downspouts, area drains, or other suspected inflow entry points is also an effective evaluation technique.

Private lateral defects are coded and condition grades assigned by qualified technicians to rate I/I severity and to serve as a quantifiable benchmark for future assessments. This information is then used to determine the rehabilitation approach required for the private laterals.



4.3 SSES Procedure

Some combination of the evaluative tools and programs described above will be selected and utilized for each SSES based on the system size and specific characteristics of the study area. The most efficient combination of evaluative tools and programs will be used to assess the priority areas. The selection of the most effective tools and programs, or combinations thereof, will ultimately be made on a case by case basis considering the specific conditions of the SSES study area and data available at the time the assessment is performed.

The sewer system evaluations will be performed following the procedures described in *Sewer System Infrastructure Analysis and Rehabilitation*, EPA/625/6-91/030. **Figure 4-2** depicts the approach to conducting sewer system evaluations in accordance with this Handbook.

Results of the SSES Studies will provide detailed information on the sources and quantities of I/I within each study area, together with information on the structural condition and location of defects. A Rehabilitation Plan will then be prepared to correct the excessive I/I sources and repair the structural defects. Development of the Rehabilitation Plan and the potential rehabilitation measures that may be used are described in the following section.

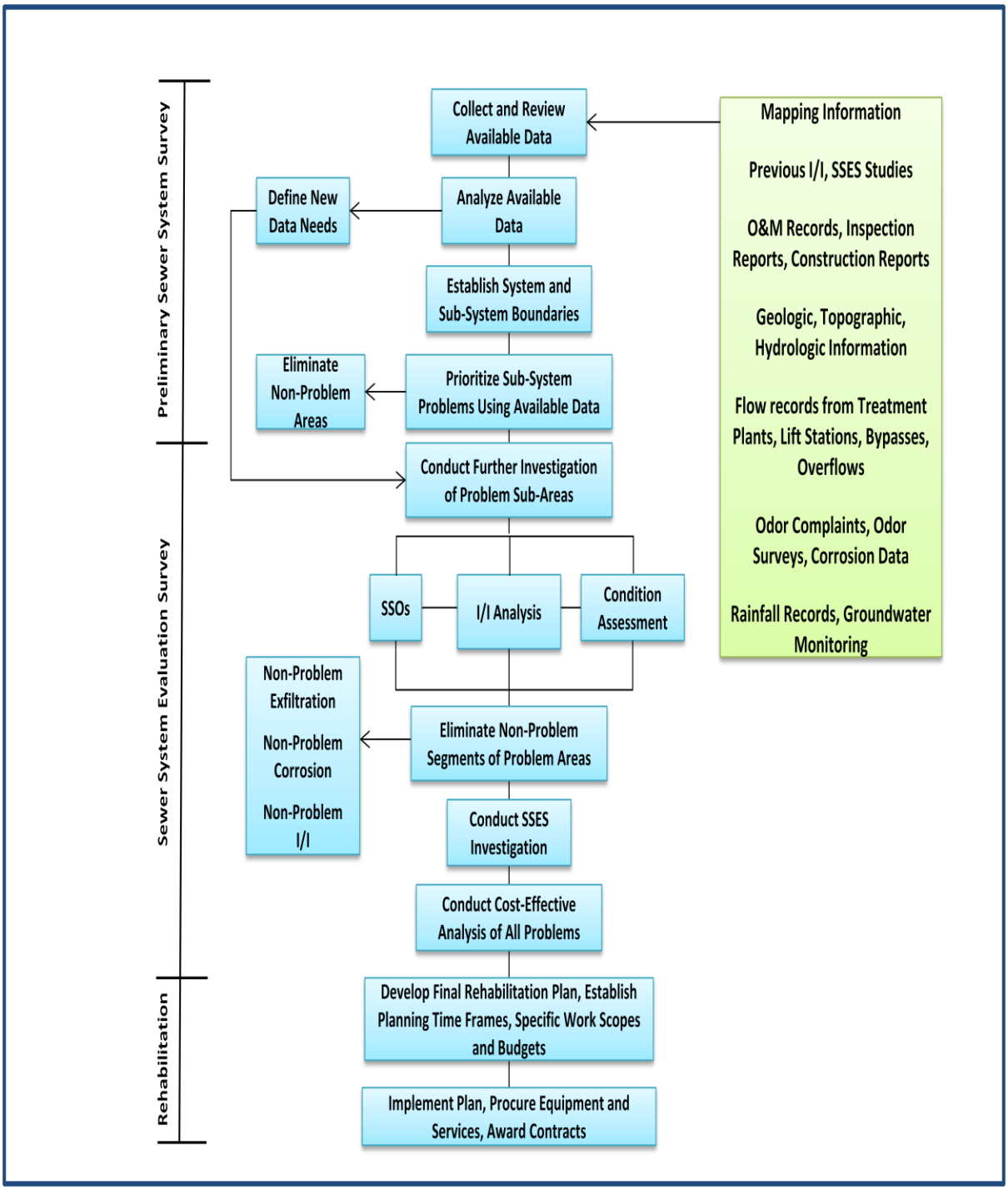


Figure 4-2
Approach to Conducting Sewer System Evaluations

5.0 Sewer Rehabilitation

The flow and rainfall monitoring data will be used to identify areas within the collection system with excessive I/I. Detailed SSES studies will then be performed within these areas to identify the source and cause of the excessive I/I and to develop a rehabilitation plan to remove the excessive I/I from the system. This section describes the pipe rehabilitation planning methodology and the rehabilitation techniques that will be employed to remove excessive I/I. Rehabilitation methods will be included in the Rehabilitation Plans based on a cost effectiveness evaluation, which is also described.

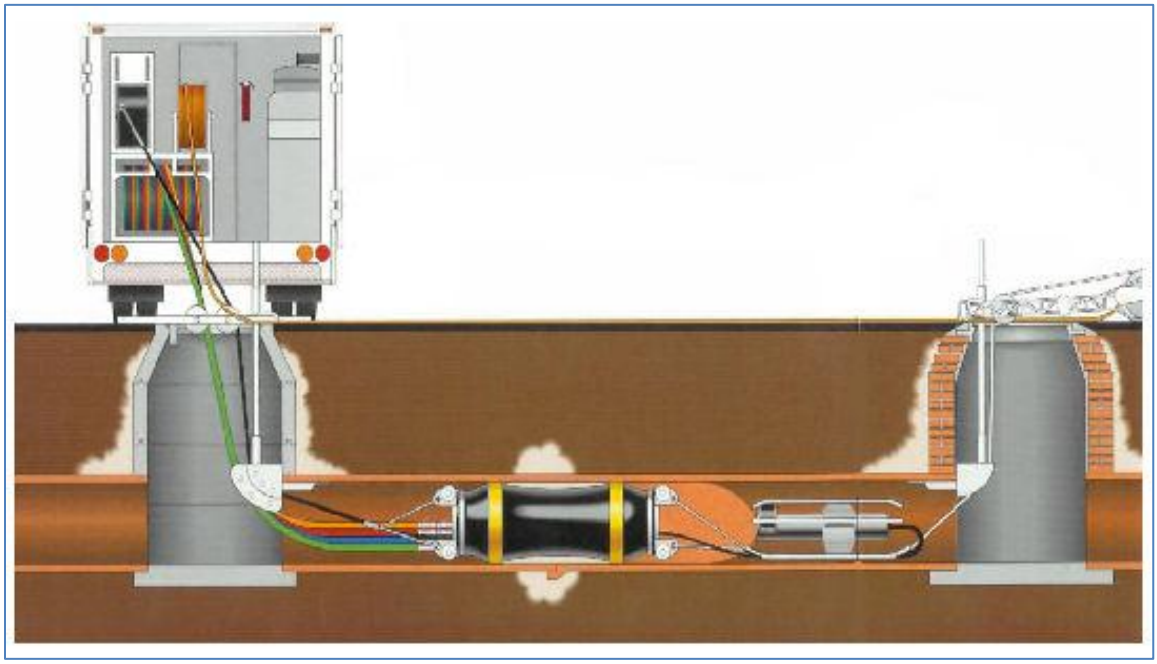
5.1 Rehabilitation Measures

Sewer rehabilitation to correct structural defects and reduce I/I may consist of one or more repair methods. The decision-making criteria, procedures, and protocols to determine the need and application of each repair technique are outlined below. The actual conduct of the repair methods will be defined in detailed technical specifications that will be developed for each rehabilitation project. Prior to performing any rehabilitation measure, sewer line cleaning to remove debris and deposits will be performed as may be required for the selected rehabilitation method.

Grouting

Description

A method of sealing cracks and joints in sewer pipe and manholes by pumping chemical grout into and beyond individual voids, which then hardens to provide a seal.



Chemical Grouting

Decision Making Criteria

Grouting will be used in localized areas where comprehensive rehabilitation is not cost effective, but some pipe repair is necessary. It will also be widely used for sealing of cracks and voids in manholes. Grouting, which includes chemical sealing, is the default manhole repair method. Each pipe and manhole location where grouting is determined to be suitable must be evaluated independently to insure the proper grout composition is selected.

Procedures/Protocols

Grouting is a technology used primarily for spot repairs to seal joints and non-structural cracks. Applied properly, it reduces or stops infiltration and exfiltration from the sewer. The chemical grout builds up an external, flexible, and impermeable mass in the soil surrounding the repair location. This method can be used to seal cracks in pipe walls, holes, and leaky joints. Grouting can generally be performed while the sewer line remains in service. For Jackson, grout sealing included in sewershed Rehabilitation Plans would be performed by a qualified private contractor. The grout sealing activities would be required to adhere to the technical specifications included in **Appendix B**.

Point Repairs

Description

Point repairs refers to the practice of sealing observed pipe defects individually to reduce or eliminate I/I. Point repair techniques include:

- Open cut repairs
- Joint sealing
- Segment relining
- Pointing (for brick or masonry sewers)

Decision Making Criteria

Point repairs are normally employed only for short reaches such as one or two pipe joints. These types of repairs are most often conducted by City maintenance crews in response to pipe failures. Point repairs may be included as a component of sewershed rehabilitation plans in certain limited areas where structural and/or corrosion problems have been identified but grouting and/or relining is not warranted.

Procedures/Protocols

<u>Open Cut Repairs</u> – Open cut repairs consist of excavation of the damaged pipe, removal of the damaged segment(s), and installation of one or two new joints together with repair sleeves. Depending on the pipe material, special adapters may be necessary to rejoin the pipe. For smaller breaks, a repair clamp can be used around the damaged section which does not require removal of the damaged pipe. A wide variety of repair clamps are available.

Joint Sealing – Leaky pipe joints can be sealed internally using rubber sleeves that bridge over the leaking joint. The rubber sleeve is then compressed and sealed against the adjacent pipe wall by expanding steel compression rings. These sleeves can also be used to seal a radial crack in a pipe wall or transition between two different pipe materials. The internal rubber joint seals are typically used in large pressurized pipes, such as force mains. Bypass pumping and manned entry of the pipe is generally necessary to install internal seals. For smaller pipes, robotic platforms are available that can seal joints, as well as wall cracks or other defects, with an epoxy material.

Segment Relining – Short sections of a cured-in-place pipe (CIPP) liner can be installed within a section of pipe that requires repair. To be effective, the CIPP liner must adhere to the pipe and prevent water from migrating between the liner and the pipe wall. Installation and curing methods are modified to accommodate the shorter point repair length. CIPP for point repairs can be used for lengths between 3 and 60 feet.

Pointing – Conventional repointing techniques may be used in brick or masonry sewers and manholes to reduce infiltration or replace deteriorated mortar. These types of sewers and manholes are not present in Jackson except in a few localized areas.

Point Repair

Relining/Sliplining

Description

This rehab classification applies to a variety of systems for restoring the interior of damaged, corroded, or weakened pipe. Restoration may be accomplished by installing a new interior liner within the pipe (relining), or inserting a new pipe within the old pipe (sliplining).

Decision Making Criteria

Relining and sliplining are very effective sewer rehabilitation methods; however, they are also among the most expensive. For Jackson, relining and/or sliplining will be used in most applications where extensive pipe damage or corrosion has been confirmed and the pipe requires renewal. In certain areas where pipe damage or corrosion is determined to be limited, other techniques such as point repairs may be used in lieu of complete relining. Also, if the structural condition of the existing pipe is beyond feasible repair or the hydraulic capacity is inadequate, complete replacement may be required in some cases. Otherwise, relining/sliplining will serve as the default method of sewer rehab for the City of Jackson.

Procedures/Protocols

Relining – The life of existing sewers lines can be extended by installing a new close-fit corrosion resistant internal liner. Several different lining technologies are available including:

- CIPP – A felt tube impregnated with resin is inserted in the existing pipe and heated to create a new cured-in-place pipe (CIPP).

- Fold-and-Form Pipe – A folded thermoplastic liner is inserted in the existing pipe and then expanded to a circular shape through pressure, heat, or mechanical means.

- Spiral-Wound Pipe – A continuous PVC-ribbed strip with interlocking edges is inserted into the existing pipe to create a new spiral-wound pipe. The annulus between the old and new pipe is filled with grout.

- Panel systems – For pipe 30-in in diameter and larger, FRP or PVC-ribbed panels with interlocking edges are installed within the pipe and joined together to create a watertight seal. The annulus is then filled with grout.

- Spray-on linings – A variety of spray-on lining systems are available for pressure pipes (force mains). These systems are also used for manhole sealing and corrosion protection.

Sliplining – Old sewers can be renewed by inserting a smaller diameter pipe within the existing pipe. Insertion is performed from an access pit using a winch and cable system (small pipes) or jacking equipment (large pipes). The annulus between the new and old pipe

is grouted to provide additional strength to resist soil loads and groundwater pressure. Available sliplining systems include:

- Continuous Pipe – Small diameter HDPE pipes are assembled into a continuous length and then inserted into the existing pipe using a winch and cable.

- Segmental Pipe – Large diameter pipe segments are joined in the trench and jacked or pushed into place. Pipe materials include HDPE, PVC, FRP and others.

- Rolldown and Swageline Pipe – New HDPE pipe is reduced in diameter using rollers or a compression machine, inserted into the existing pipe, and pressurized to expand the new pipe within the old pipe.

Sliplining will reduce the existing internal diameter of the sewer. However, the plastic pipe materials typically used for sliplining usually have less friction than the existing pipe so the hydraulic capacity may not be adversely affected.

Technical specifications that outline the procedures and protocols for pipe relining/sliplining in detail are included in **Appendix B**.

Sliplining

Line Replacement

Description

Complete replacement of an existing sewer line with a new pipe.

Decision Making Criteria

Line replacement will be selected as the required rehab measure when:

(1) Problems with the structural condition, alignment, or grade of the existing sewer are too severe to repair.

(2) The existing sewer has inadequate hydraulic capacity and continued reliance on the capacity available is unacceptable.

The pipe replacement method will be selected considering the required replacement length, number/density of contributing laterals, traffic and safety concerns, presence of other buried infrastructure, required construction time, and related factors including costs.

Procedures/Protocols

Pipe replacement, when required, will be performed using one of a variety of acceptable techniques. For any line replacement method except relief sewers, temporary bypass pumping throughout construction will be required. Pipe replacement methods include:

- Open cut – Excavate and remove the existing pipe; install a new pipe with the required capacity.

- Pipe bursting – A technique where the existing pipe is mechanically fragmented and a new pipe of equal or larger diameter is inserted into the enlarged hole.

- Relief sewer – Construction of a new parallel sewer in an adjacent or nearby alignment. This method allows the existing sewer to remain in service during construction. The relief sewer can be installed using either open cut or trenchless methods. Trenchless methods include microtunneling, horizontal directional drilling, and jack-and-bore tunneling.

Pipe Replacement

Private Lateral Repair

Description

Recognizing that private laterals are a significant source of I/I into the collection system, sewer rehabilitation in most cases must also address private laterals in order to achieve I/I reduction goals. Private lateral repair may involve both a public and private responsibility, depending on the City's jurisdiction. The private lateral connection point to the sewer main must also be addressed as part of the rehabilitation evaluation and repaired if necessary.

Decision Making Criteria

The SSES studies will identify areas with significant private lateral I/I contributions and delineate the areas where private lateral rehabilitation is necessary. Responsibility for much of the required private lateral repair will therefore fall on local property owners. In anticipation of the need for repairing defective private laterals, and to avoid potential conflicts with property owners pertaining to City-mandated repair directives, the City of Jackson has established a Supplemental Environmental Project (SEP) under the terms of the Consent Decree to provide funding assistance for some lateral repairs on private property. Using funds allocated to the SEP, defective private laterals identified as requiring repair will be included in the respective sewershed rehabilitation plans, and will be repaired using the procedures and protocols outlined below.

Procedures/Protocols

Laterals – Common private lateral repair methods include grout sealing, as discussed above, relining, and complete replacement. Several different grouting methods are available, and can be performed from the sewer main or from cleanouts. Relining may include epoxy injection by a remotely operated robot or installation of a CIPP liner. Replacement may be accomplished by a variety of methods including open-cut or pipe bursting.

Cleaning will often be required prior to performing lateral repairs. Root growths will require removal either mechanically or chemically. Rodding and jetting with appropriately sized equipment may also be options depending on the nature and extent of cleaning required.

Service Connections –The service connection point at the main line may also be a significant source of I/I. Repair of service connections may be accomplished using the point repair methods discussed above or by relining. Repair techniques could include grouting, open-cut repair or thimble/saddle replacement, epoxy sealing using a sewer robot, or relining with CIPP.

Lateral Repair

Manhole Rehabilitation

Description

Renewal of damaged or corroded manholes by structural repair, applying a protective coating, installing a manhole liner, or by complete replacement of the manhole.

Decision Making Criteria

Upon conclusion of an SSES, all manholes found to have structural damage, corrosion, active or previous infiltration, or other problems will be scheduled for rehabilitation and identified in the Rehabilitation Plan. The rehab method(s) to be employed will vary depending on the severity of the problems encountered. Generally, selection of the appropriate rehab method(s) will be the responsibility of the engineer directing the rehab plan development.

Procedures/Protocols

Manhole renewal techniques to be employed will consist of the following, where required:

- Protective Coatings – A number of coating systems are available that will provide a corrosion-resistant barrier and/or enhance the structural integrity of the manhole. After proper cleaning and surface preparation, the coating system may be sprayed on or hand applied. Coating systems may be cement mortar, epoxy, polyurethane, or other lining materials.

- Lining Systems – Lining systems are available that will restore the structural integrity of the manhole and eliminate infiltration through the walls. Lining methods include poured-in-place or formed-in-place concrete, prefabricated fiberglass, and spray-applied systems. Concrete liners are often combined with epoxy coating or a plastic liner (HDPE, PVC or FRP) for corrosion protection. HDPE or PVC liners have T-lock ribs that become embedded in the concrete liner. FRP liners are smooth and require filling the annular space with poured-in-place concrete.

Manhole Repair

- Bench and Channels – Together with the manhole walls, the lower bench and flow channels may also require rehabilitation. Some liner systems can incorporate the bench and channel walls, or they may be rebuilt using cementitious products or epoxy, nonshrink grouts. Wastewater flow diversion is required to achieve the proper cure time.

- Manhole Replacement – New manholes may sometimes be required as part of rehabilitation activities when the existing structure has experienced collapse or is highly unstable, or when a new manhole must be added into the network. New manholes may be constructed using precast manhole segments, cast-in-place concrete, or a combination. New manholes should be equipped with a non-corrosive liner. HDPE or FRP manholes may also be an option where flotation is not a concern.

5.2 Rehabilitation Plan Development

Flow monitoring, hydraulic modeling and SSESs conducted in sewershed sub-basins will result in the identification and quantification of capacity limited sewers, sources of excessive I/I, and structural defects. For each sub-basin, a Rehabilitation Plan will be developed to address these problems and outline the corrective action required. The rehabilitation measures selected for implementation will be based on a cost effectiveness evaluation. The approach to Rehabilitation Plan development is described below.

Rehabilitation Plan

Sewer segments identified as requiring rehabilitation will be evaluated individually to select the most appropriate rehabilitation methods such as those described in Section 5.1. In general, selection of an appropriate rehabilitation method will include consideration of:

- Potential construction impacts
- Local availability
- Sewer depth
- Number of connected service laterals
- Surface conditions

General rehabilitation decision making criteria that will be applied are summarized on **Figure 5-1**.

Cost Effectiveness Evaluation

Detailed cost effectiveness criteria will be developed and used in evaluating rehabilitation measures. The cost effectiveness criteria will allow comparison of the cost of possible solutions and combinations of solutions, including treatment plant enlargement, capacity enlargement, offline storage, and I/I abatement through rehabilitation or pipe replacement. The results of this evaluation step will allow accurate comparison of the cost of conveyance and treatment vs. the cost of rehabilitation and I/I reduction.

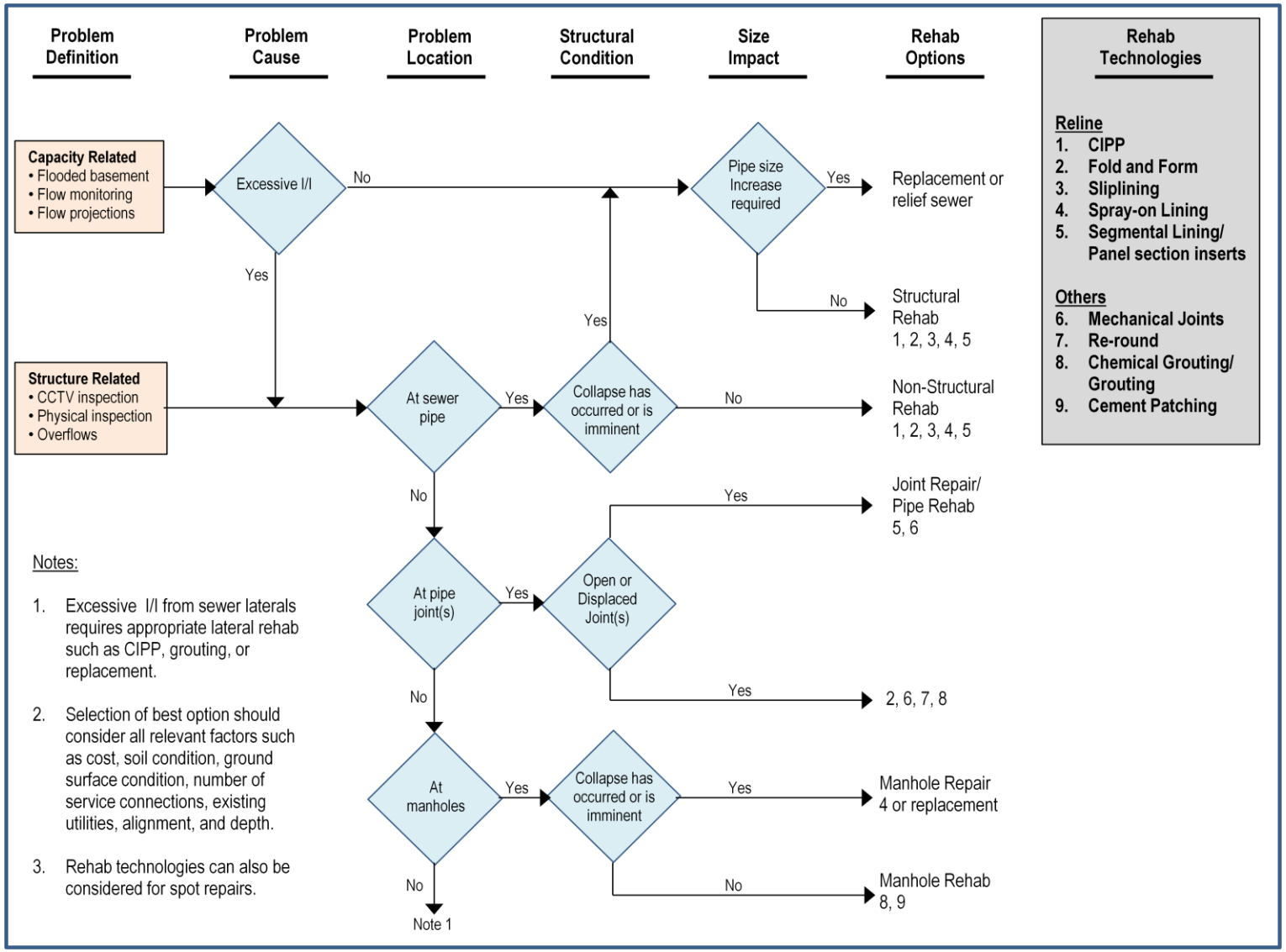


Figure 5-1
Wastewater System Rehabilitation Options

The objective will be to determine the most cost effective solution that provides the greatest return for the required financial outlay. The estimated cost of ongoing maintenance and/or increased maintenance attributed to defects not eliminated will be included in the evaluation, as well as the cost of continued deterioration of the system due to existing defects. The improvements selected will represent the least cost combination of conveyance improvements, treatment plant peak flow capacity improvements, and sewer rehabilitation measures.

Cost Effectiveness Guidelines

The cost effectiveness evaluation methodology used in developing Rehabilitation Plans will be based on the procedure presented in *Sewer System Infrastructure Evaluation and Rehabilitation*, EPA/625/6-91/030. The basic procedure consists of:

1. Determine the total cost for correcting each I/I source, the amount of I/I eliminated, and the repair cost per unit of flow.

2. Plot cost of rehabilitation vs. I/I reduced (gallons per day).

3. Determine the total cost for excess wet weather flow conveyance and treatment on a per-gallon basis.

4. Plot cost of conveyance and treatment vs. I/I reduced.

5. Sum the curves to derive a composite curve for rehab cost vs. I/I reduced. The low point of the curve will indicate the optimum quantity of I/I that can be cost effectively removed. The cost corresponding to this quantity represents the total cost needed for the corrective actions.

Rehab Planning Cost Basis

To apply the cost effectiveness guidelines, representative costs are required for rehabilitation, conveyance, storage, and treatment. For purposes of the cost effectiveness analysis, sewer rehabilitation will generally be assumed to consist of either relining with CIPP or complete replacement by open-cut trenching. Sewers identified for rehab in each sub-basin will be reviewed individually to determine which method is most appropriate. General rule-of-thumb costs based on sewer diameter will be applied to determine the rehab or replacement cost. For all sewers identified for CIPP rehab, it will be further assumed that 3% of the total length will require point repair. It is also assumed that all manholes within the rehabilitation zone require repair by application of a protective coating based on a manhole depth of 8-ft.

Table 5-1 lists representative costs that are proposed to be used for installation of a CIPP liner within an existing sewer. **Table 5-2** lists a similar cost basis for sewer pipe replacement. Sewer replacement costs will be further increased to account for trenchless road and stream crossings that are required in each sub-basin. The cost tables will be updated in the future using the current construction index at the time the rehabilitation plan is prepared.

Capacity upgrades may also be required for some pump stations to convey the required peak wet weather flows or to prevent overflows upstream of the pump station. In some cases new larger force mains may also be required. These improvements will normally be necessary irrespective of cost effectiveness considerations, and are therefore not a component of the rehabilitation planning cost effectiveness evaluation.

Costs for wastewater conveyance and treatment will be based on the current annual O&M cost for the treatment plant that receives the flow. If any off-line storage options appear feasible, other than the existing equalization basins at the Savanna Street WWTP, costs will be developed during rehab plan development using actual characteristics of the proposed storage site and required volume derived from hydraulic modeling.

Table 5-1
Gravity Sewer CIPP Relining Cost

Rehab Item	Unit	Unit Cost
CIPP Liner		
8-in diameter	**LF**	**$65**
10-in diameter	**LF**	**$75**
12-in diameter	**LF**	**$90**
16-in diameter	**LF**	**$125**
20-in diameter	**LF**	**$165**
24-in diameter	**LF**	**$215**
30-in diameter	**LF**	**$260**
36-in diameter	**LF**	**$345**
42-in diameter	**LF**	**$500**
48-in diameter	**LF**	**$600**
Point Repair	LF	**$615**
Manhole Lining	VF	**$250**

Table 5-2
Gravity Sewer Replacement Cost

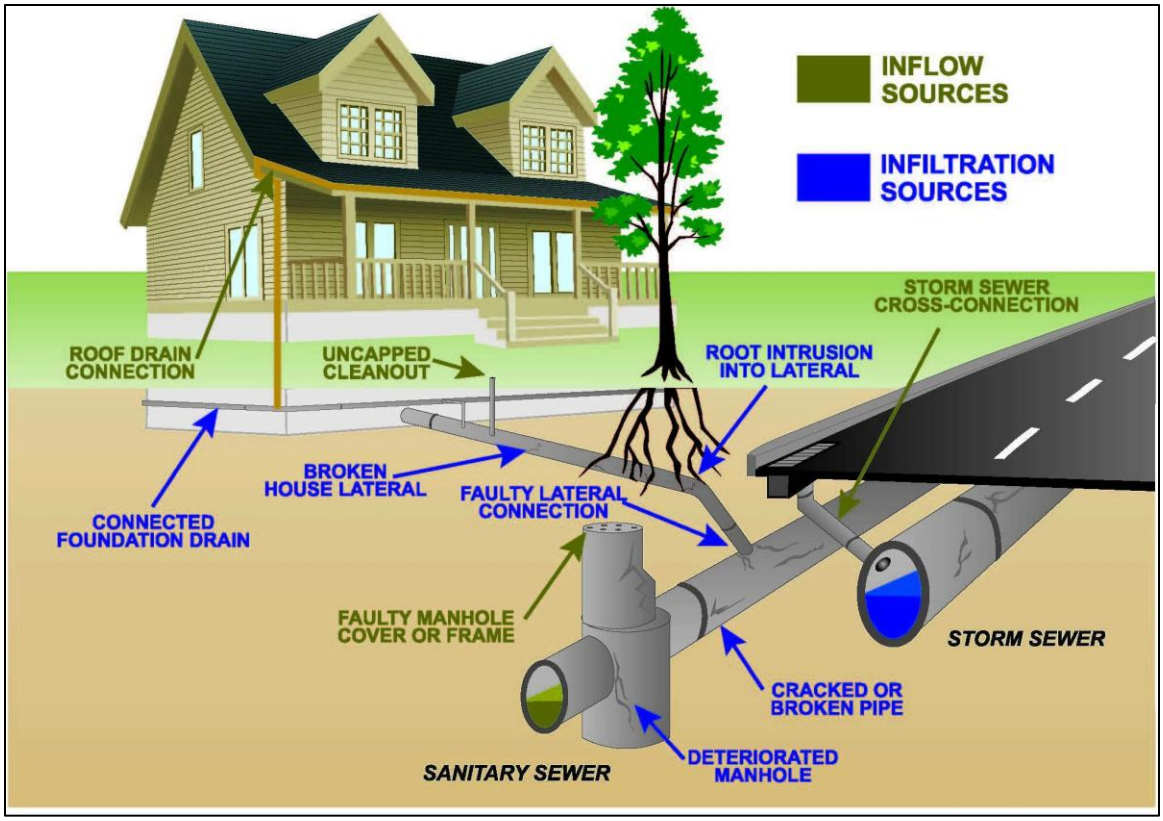
	Cost ($/LF)	
Diameter (in)	0-12 ft Depth	12-20 ft Depth
8	**$160**	**$245**
12	**$190**	**$290**
16	**$250**	**$325**
18	**$275**	**$365**
24	**$375**	**$450**
30	**$490**	**$515**
36	**$600**	**$675**

6.0 Infiltration/Inflow Abatement

This section summarized the techniques that will be employed to reduce infiltration into the collection system, eliminate sources of inflow, and to identify and eliminate cross connections between the storm and sanitary sewer systems. Also included are the methodologies for evaluating the success of the I/I reduction efforts, and results of a review of the City of Jackson legal authority pertaining to sanitary sewer illicit connections.

An illustration depicting the differences between infiltration and inflow is shown on **Figure 6-1**.

Figure 6-1
Sources of Infiltration and Inflow



6.1 Infiltration Reduction Techniques

Infiltration consists of groundwater that enters the sewer through structural defects. As described in Section 5, infiltration reduction will be accomplished by identifying and quantifying excessive infiltration through flow monitoring and SSES studies, development of a cost effective rehabilitation plan, and implementation of the selected rehabilitation measures. These infiltration rehab measures consist of:

- Grouting
- Point repairs
- Relining/sliplining
- Line replacement
- Private lateral repair
- Manhole sealing

Properly executed, all of the above techniques will be effective in repairing defects that cause infiltration. More critical is conducting the proper rehab planning within the sewershed to allow development of a comprehensive infiltration reduction program. A comprehensive program is one that includes all major sources of excess infiltration together with a plan for addressing them. It is the intent of the City of Jackson to develop a comprehensive infiltration reduction program as described in Section 4.

6.2 Inflow Reduction Programs

Inflow consists of surface water that enters the sewer through illicit connections, missing manhole covers, or other means. Measures to reduce inflow into the collection system will vary depending on the specific nature of the inflow source. Some typical inflow control measures include:

- Elevating manhole rims above the flood elevation, where feasible, or providing water tight bolted covers.
- Replacing missing manhole or cleanout covers.
- Elimination of storm sewer cross connections.
- Elimination of building drain and downspout cross connections.

The first two inflow reduction elements are a normal part of routine sanitary sewer design and sewer maintenance procedures practiced by the City of Jackson. The latter two items are part of the City's cross connection control policy, which is described below.

6.3 Cross Connection Control

The City of Jackson has separate sanitary sewer and stormwater conveyance systems, so cross connections between the two systems are uncommon. Additionally, most houses in Jackson do not have basements that would require sump pumps. Cross connection may consist of building roof and basement drains and landscaping area drains that were connected to the sanitary sewer at a time when the plumbing code was not strictly enforced. Because sanitary and storm sewer cross connections do not appear to be a significant problem in Jackson, a formal cross connection control program is not required. Cross connections are typically identified as part of sewershed evaluation activities, such as smoke testing. The detailed SSES studies planned for Jackson sewersheds, as described in

Section 4, will identify any remaining cross connections within Sewer Groups 1 and 2. The City has adequate legal authority to require property owners to remove the cross connection as documented in Section 6.5.

6.4 I/I Reduction Verification

I/I reduction verification will be performed using post-rehabilitation flow monitoring within each sewershed where rehab has been completed. As part of the overall WCTS rehabilitation effort required by the Consent Decree, the City of Jackson is installing a series of permanent and temporary meters that will measure wastewater flow from each sewershed, as well as within the sewersheds. Additionally, the City has 98 pump stations within the WCTS. Pump station run times before and after rehabilitation will also be compared and used as a measure of I/I reduction success. Where warranted by post-rehab flow and pump station monitoring, additional rehabilitation measures will be planned and implemented to achieve the City's I/I reduction goals.

6.5 Legal Authority Review

City regulations for use and operation of the sanitary sewer system are defined in Chapter 122 of the City of Jackson Code of Ordinances. The city ordinances provide the necessary legal authority to prohibit illicit connections to the sewer system and adequate enforcement mechanisms to require removal of any illicit connections identified.

Article II, Sewage Disposal Standards, Section 122-141 pertaining to roof downspouts and exterior drains states:

> No person shall make connection of roof downspouts, exterior foundation drains, areaway drains, or other sources of surface runoff or groundwater to a building sewer or building drain which in turn is connected directly or indirectly to a public sanitary sewer.

Section 122-166 pertaining to discharge of stormwater and surface water states:

> No person shall discharge or cause to be discharged any stormwater, surface water, groundwater, roof runoff, subsurface drainage, uncontaminated cooling water, or unpolluted industrial process waters to any sanitary sewer.

Section 122-82 pertaining to violations of the ordinance states:

> (a) Any person found to be violating any provision of this article....shall be served by the city with written notice stating the nature of the violation and providing a reasonable time limit for the satisfactory correction of such violation. The offender shall, within the period of time stated in such notice, permanently cease all violations. Any person who shall continue any violation beyond such time limit shall be deemed guilty of a misdemeanor.
>
> (b) Any person violating any of the provisions of this article shall become liable to the city for any expense, loss, or damage occasioned by the city by reason of such violation.

Chapter 1 of the Jackson Code of Ordinances contains penalties for violations of city ordinances. The City may impose fines up to $1000, and/or imprisonment as allowed by

state law, for each day the violation occurs. Additional legal authority is also provided through the City's adopted building codes.

7.0 Pump Station Evaluations

Evaluation of the sewersheds will include pump stations as well as the wastewater collectors. Evaluation of pipes within the sewersheds is described in the preceding sections. The companion pump station evaluations that will be performed are described in this section.

7.1 Pump Station Evaluation Requirements

The main purpose of the pump station evaluations is to assess the design capacity, current effective capacity, equipment condition, and operational redundancy of all pumping facilities within the sewersheds. As required by the Consent Decree, the City of Jackson will include the following criteria in performing the pump station evaluations:

- Adequacy of station capacity
- Critical response time
- Station condition
- Station design
- Maintenance response time

In general, the pump station evaluations will be performed separately from the Sewershed Evaluation Surveys to be completed within the prioritized Group 1 and Group 2 sewersheds. The City's approach to each evaluation criterion is discussed below.

7.2 Adequacy of Station Capacity

Physical attribute data and design criteria for the City's 98 pump stations are being compiled for input to the hydraulic computer model being developed for the WCTS. Upon calibration of the model, wastewater flows within the collection system will be simulated under dry weather and wet weather flow conditions and used to assess adequacy of pump station capacities.

Design Storm

The design condition for evaluation of pump station 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. However, 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.

Pump Station and Force Main Capacity

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 design maximum surcharge allowance.[1] A comparison of the total available pump station capacity to the maximum required capacity will result in the identification of any necessary station enlargement requirements.

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.

7.3 Critical Response Time

Pump station critical response time is defined as the time interval between activation of the high wet well level alarm and the first SSO under peak flow conditions. Wet well volume and high water level alarm elevation will be physical attributes compiled and included in the hydraulic model, together with upstream manhole elevation data. The hydraulic model will then be used to calculate the pump station critical response times based on the peak flow condition.

To avoid an SSO, maintenance personnel must respond to a high water alarm and take corrective action within the critical response time limit for each pump station. The critical response time for each as calculated above will constitute the standard for required maintenance response actions. These critical response times will be incorporated into the emergency operations program developed for each pump station as part of the CMOM Pump Station Operations Program.

7.4 Station Condition

Evaluations to assess adequacy of pump station conditions are performed annually by the City's contract operator, United Water Services Mississippi, LLC. Results of the most recent evaluation are included in the ***Pump Station Preventative Maintenance Programs*** and the

[1] As defined in the *Sewershed Prioritization Work Plan* (September 2013), these are 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.

Pump Stations Operation Program reports prepared to fulfill the WCTS Capacity, Management, Operation and Maintenance (CMOM) requirements of the Consent Decree. These assessments include a physical inspection of each pump station together with a review of the operating and mechanical failure history of the station, to the extent available. The City's current Pump Station Preventative Maintenance Program conducted by United Water includes the identification, prioritization, scheduling, and repair of all pump stations found to have physical, mechanical, or electrical repair needs.

7.5 Station Design

In addition to physical condition, the design of each pump station will be evaluated to determine if the station complies with good engineering design practice as outlined in *Guidance for the Design of Publicly Owned Wastewater Facilities*, MDEQ NPELF40. Design elements to be evaluated include:

- Flood protection
- Station and equipment accessibility
- Pump redundancy
- Electric power supply
- Corrosion protection
- Alarms
- Controls
- Valves
- Ventilation
- Flow measurement
- Emergency operations

When the required pump station capacity is determined upon completion of the hydraulic model, each station will be evaluated for design adequacy. Required pump station upgrades or replacements identified by the design evaluation will then be planned and constructed consistent with the sewer rehabilitation schedule. This schedule will be developed as part of the rehabilitation plan for each sewershed as described in Section 5.

7.6 Pump Station Evaluation Summary

In summary, pump station evaluations required by the Consent Decree are being completed in a multi-step process. These consist of:

- Ongoing annual inspections of station condition, and scheduling of needed repairs or equipment replacements.

- Determination of required station capacity and calculation of the O&M critical response time using the hydraulic computer model.

- Evaluation of design adequacy will be performed after the required capacity has been determined, and will be completed concurrent with development of Rehabilitation Plans for each sewershed. Necessary capacity increases or pump station upgrades will then be planned and completed consistent with the sewer rehabilitation activities to be performed within the designated sewersheds.

The hydraulic modeling and pump station design adequacy evaluations will be completed as shown in the Sewershed Evaluation Schedule included in the following section.

8.0 Sewershed Evaluation Schedule

The ***Sewershed Evaluation Plan*** is developed to serve as a guide in performing Sewershed Evaluation Survey (SSES) studies within each Group 1 and Group 2 sewershed. Information derived from the SSES work will be used to identify the major sources of infiltration/inflow and development of a rehabilitation plan to remove the I/I sources. Evaluation of the pump station design adequacy will also be performed concurrent with the SSESs.

The Group 1 and Group 2 sewersheds are defined as follows:

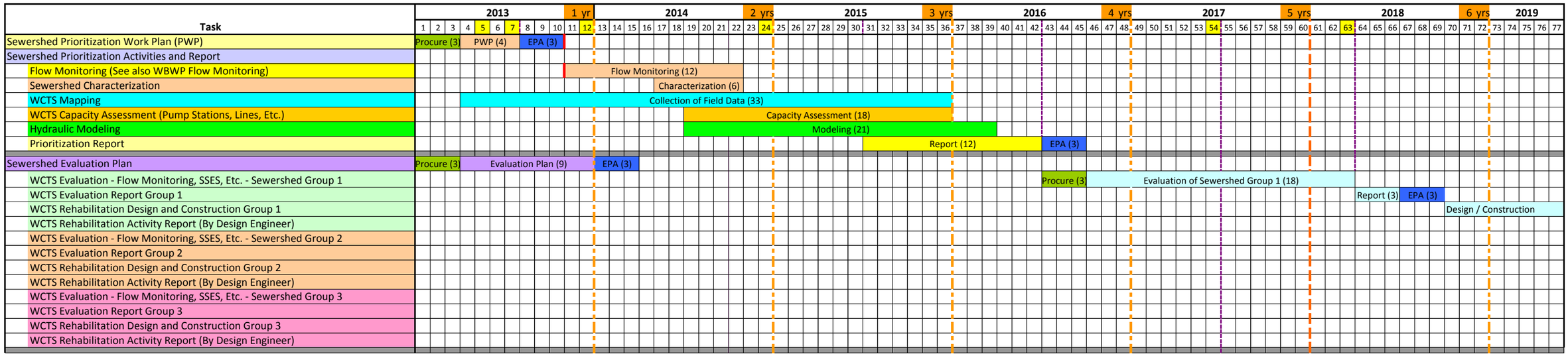
- Group 1 sewersheds are those with severe Infiltration/Inflow (I/I) that collectively contribute at least 30% of the total I/I in the entire system.

- Group 2 sewersheds are those with significant I/I that collectively contribute at least 40% of total system I/I.

The remaining sewersheds are those with the least I/I problems that collectively contribute no more than 30% of total system I/I.

The City of Jackson sewershed evaluation work will be performed over a nine year period as set forth in the Consent Decree. The schedule for the Group 1 and Group 2 sewershed evaluation activities is shown on **Figure 8-1**.

Figure 8-1
City of Jackson, Mississippi
DEQ Agreed Order / EPA Consent Decree
Sewershed Rehabilitation
17.5 Year Schedule



Note:
Sewershed Group 1 Completion by January 1, 2024
Sewershed Group 2 Completion by July 1, 2030
Sewershed Group 3 Rehabilitation not required

Appendix A

Sewer System Evaluation Survey Procedures

1. SSES Scope of Work
2. Smoke and Dye Testing Specifications
3. Condition Assessment and CCTV Specifications

Sewer System Evaluation Survey
Scope of Work

1.0 Introduction

The City of Jackson, Mississippi is soliciting proposals from qualified firms to conduct a Sewer System Evaluation Survey (SSES) of a portion of the Sanitary Sewer Collection system designated on **Exhibit A** and to plan, design, and manage required sewer rehabilitation construction within the study area. The selected firm will:

1. Identify and determine the specific locations and estimated flow rates for all sources of Infiltration and Inflow (I/I) in the study area;

2. Prepare a report documenting I/I findings;

3. Evaluate methods of rehabilitation, develop a rehabilitation plan, and estimate costs of rehabilitation for each identified source of I/I;

4. Develop drawings and specifications for the required rehabilitation activities, and

5. Provide bidding and construction administration services for the rehabilitation work.

This project will be managed on behalf of the City of Jackson by its Program Manager for the ongoing wastewater infrastructure redevelopment program.

2.0 Study Area Description

The project area consists of the entire sanitary sewer collection system within the boundaries denoted on Exhibit A. The sanitary sewer collection system within the Study Area consists of approximately _____ linear feet of sewer mains and approximately ___ sewer manholes. It also contains ____ pump stations and force mains. The pump stations and force mains are being evaluated under a separate project.

3.0 Scope of Work

The required scope of work shall include three (3) phases:

1. Conduct a Sewer System Evaluation Survey (SSES), prepare an SSES Report, and develop a Sewer Rehabilitation Plan;

2. Develop drawings, specifications, and contract documents for sewer rehabilitation by a private contractor; and

3. Furnish customary bidding, construction administration, and project closeout services during the rehabilitation phase of the project.

4.0 Sewer System Evaluation Survey

The Consultant shall perform a comprehensive Sanitary Sewer Evaluation Survey (SSES) that will include following tasks:

4.1 Project Management

In addition to general project management and administrative activities, the Consultant shall identify a project manager who will be the contact person for this project. The Project Manager will be required to conduct a minimum of five (5) monthly job meetings to be held at City offices. The Project Manager and the Consultant shall attend any and all meetings as directed by the City. The Project Manager will also be responsible for making two status presentations at project milestone dates to be specified by the Program Manager.

Measurement and Payment: This work will not be measured. This work shall be paid for as part of the lump sum prices for "Sewer System Evaluation Survey," including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

Preparation of Permits: The Consultant shall prepare and obtain any necessary state and local permits if required for execution of the SSES.

Measurement and Payment: This work will not be measured. This work shall be paid for as part of the lump sum prices for "Sewer System Evaluation Survey," including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.2 Rainfall Monitoring

One continuous recording tipping bucket rain gauge shall be installed and monitored within the study area. In addition, other less-site-specific rainfall data shall be obtained and evaluated. Rainfall monitoring data collection shall be performed for the duration of the project. At least two major storm events shall be recorded. Rainfall monitoring shall be conducted in accordance with the Specifications.

Measurement and Payment: This work will not be measured. This work shall be paid for as part of the lump sum prices for "Sewer System Evaluation Survey," including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.3 Flow Monitoring (including Flow Isolation Monitoring)

Consultant shall provide, install, and monitor at least three continuous flow monitors. Flow monitoring shall be conducted in accordance with the Specifications.

Measurement and Payment: This work will not be measured. This work shall be paid for as part of the lump sum prices for "Sewer System Evaluation Survey," including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.4 Manhole Inspection

All manholes within the study area shall be inspected in conformance with the Specifications. All manholes that are identified as "buried" or not visible at the ground surface shall be reported to the Program Manager. If the City is able to uncover such manholes to provide access, all such manholes shall be included within the SSES. All Manhole Inspections shall include an estimation of groundwater level by the "wet-ring" method as described in the Specfications. Estimated groundwater depth shall be reported both on the individual manhole inspection form and summarized in the SSES report. The SSES report shall also provide an analysis of the groundwater monitoring results.

All Manhole inspections and deliverables shall be performed in conformance with the National Association of Sewer Service Companies (NASSCO) Manhole Assessment and Certification Program (MACP) as applicable. The Consultant shall provide digital records of all manhole inspections including color photographs. The digital records and viewing software shall be compatible for installation and use on a personal computer with a Windows 7 operation system. These inspections will be supplemented by the following;

1. Location of manhole structures based on various map source documents of varying quality.

2. Gathering of sub-meter Global Positioning System (GPS) coordinates for each manhole cover, and;

3. The use of a pole camera inspection to digitally document the manhole defects, and;

4. Perform pole camera zoom video inspections of selected manholes for each adjacent pipe connection and pipe attached to the manhole (incoming and outgoing).

Measurement and Payment – Manhole Inspection shall be measured as each manhole actually inspected per this scope of work. This work shall be paid for as the unit price bid item for "MANHOLE INSPECTION," including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.5 Smoke Testing

All Sewer Mains in the Project Area shall be smoke tested in accordance with the Specifications and the NASSCO Pipeline Assessment and Certification Program (PACP) as applicable.

Coordinate field operations with the City and Program Manager and conduct customer outreach prior to the execution of smoke-testing and subsequent dyed water flooding of selected smoke release points of the designated portions of the wastewater collection system. Confirmed smoke release locations from the collection system on both public and private property will be documented with digital, written records and sub-meter GPS coordinates of the smoke release location.

Measurement and Payment - Smoke Testing shall be measured as the horizontal distance (in linear feet) as measured between the centers of the two manholes of the sewer main actually smoke tested . This work shall be paid for as the unit price bid item for "SMOKE TESTING SEWER MAINS,", including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.6 Rainfall Simulation: Dyed Water Testing

All identified and suspected possible inflow sources shall be tested in accordance with the Specifications. The use of closed circuit television shall be utilized to facilitate this task.

Measurement and Payment –Dyed Water Testing shall be measured per each identified and/or suspected inflow source actually tested per this scope of work. This work shall be paid for as the unit price bid item for "DYED WATER TESTING,", including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.7 Rainfall Simulation: Dyed Water Flooding

Identified and suspected possible inflow sources shall be tested in accordance with the Specifications, as directed by the Program Manager. The use of closed circuit television shall be utilized to facilitate this task.

Measurement and Payment –Dyed Water Flooding shall be measured as the horizontal distance (in linear feet) of the sewer actually tested . This work shall be paid for as the unit price bid item for "DYED WATER FLOODING,", including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.8 Internal Building Inspections

Consultant shall perform inspections in conformance with the Specifications.

Measurement and Payment –Internal Home Inspections shall be measured per each building actually inspected per this scope of work. This work shall be paid for as the unit price bid item for "INTERNAL BUILDING INSPECTIONS," including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.9 Flow Data Evaluation and Analysis

This item shall be conducted in conformance with the Specifications.

Measurement and Payment: This work item will not be measured for payment. This work shall be paid for as part of the lump sum prices for "Sewer System Evaluation Survey," including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.10 CCTV Inspections: Sewer Mains and Sewer Laterals

Perform light cleaning preceding CCTV inspections conducted in accordance with NASSCO's

All Sewer Mains in the Project Area shall be cleaned and inspected by closed circuit television accordance with the Specifications and NASSCO PACP and MACP as applicable. If directed by Program Manager, perform selected larger diameter sanitary sewer inspections using optional multi-sensor sonar/radar/CCTV. In addition, all sewer laterals (from the sewer main to the building) shall be inspected in conformance with the Specifications and NASSCO PACP as applicable utilizing a CUES LAMPII lateral and mainline probe (or similar acceptable to the Program Manager) televising device capable of being deployed into lateral pipes and through Y connection(s) if necessary. In addition, Television Inspection shall be utilized as necessary in conjunction with other SSES study tasks as necessary to facilitate the project purpose which is identify and determine the specific locations and estimated flow rates for all sources of Infiltration and Inflow (I/I) in the study area. The Consultant shall provide digital records of all televising and viewing software in a format in conformance with NASSCO PACP and MACP. The digital records and viewing software shall be compatible for installation and use on a personal computer with Windows 7 operating system.

Measurement and Payment – Closed Circuit Television Inspection shall be measured as the horizontal distance (in linear feet) as measured between the centers of the two manholes of the sewer main actually inspected. This work shall be paid for as the applicable unit price bid item for either "Closed Circuit Television Inspection: Sewer Mains" or "Closed Circuit Television Inspection: Sewer Laterals,", including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.11 Traffic Control

Consultant shall prepare and implement all required maintenance and movement of traffic (MMOT) plans as required by state and local agencies. The Consultant shall be responsible for furnishing all materials and manpower (including traffic officers if required) necessary to execute the required MMOT plan.

Measurement and Payment: This work item will not be measured for payment. This work shall be paid for as part of the lump sum prices for "Sewer System Evaluation Survey," including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

4.12 Preparation of Report

The Consultant shall prepare a report in conformance with the Specifications. The report shall include separate sections for each above SSES work task, as well as summaries and appendices as appropriate. In addition to the reporting requirements specified above, the report shall include clear, concise maps as necessary to illustrate the findings of the SSES. Maps shall be prepared utilizing Autodesk software, version 2007 or newer. The Consultant shall furnish five (5) hard copies of the report as well as an electronic copy in Adobe .pdf format. All report maps shall also be furnished to the Program Manager electronically in Autodesk format.

The Report shall include a Rehabilitation Plan to correct the defects that are cost effective to perform. The Consultant shall provide detailed mitigation recommendations for each I/I

defect identified in the SSES. The recommendations shall describe detailed, specific rehabilitation measures to resolve each I/I defect. Each I/I defect for which rehabilitation is proposed shall be ranked according to severity of defect. The Consultant's opinion of cost shall be furnished for all proposed rehabilitation items. Prospective bidders shall submit a recent sample of an engineering report for a similar project with their bid.

Measurement and Payment: This work will not be measured. This work shall be paid for as part of the lump sum prices for "Sewer System Evaluation Survey," including all products, materials, equipment, tools, labor and incidentals thereto, complete and accepted by the Program Manager.

4.13 Other Project Information

The Consultant shall incorporate the following considerations:

1. Underground utilities mapping information provided by the Program Manager does not show all underground utilities. The Consultant is responsible for identifying underground utilities not shown Mississippi One-Call 811 72 hours prior to the commencement of any work causing subsurface disturbance that may be associated with conducting SSES operations.

2. The Program Manager has mapped the sewer collection system within the study area and city-wide. The Program Manager will provide the Consultant with existing mapping and currently available "as-built" sewer plans. The consultant shall verify the collection system configuration and report any discrepancies. If discrepancies are encountered, Consultant shall determine actual system configuration and provide sketch of correct system configuration. Consultant shall identify and locate any system components not shown on the City's existing system mapping, including identifying and locating all manholes not visible at the ground surface.

3. The Water system within the study area is owned and operated by the City of Jackson. The Consultant shall coordinate with the Department of Public Works for all water use required to properly conduct the SSES. Water usage required to conduct the SSES will be paid for by the City.

4. The Consultant shall be responsible for light cleaning of pipes, structures, and other collection system components as necessary to properly conduct the SSES. The Consultant shall also be responsible for the proper disposal of waste and/or debris resulting from cleaning operations. Heavy cleaning of any pipe segment requires pre-approval by the Program Manager. Heavy cleaning is required when debris accumulation is greater than 25% of the pipe diameter.

5. Coordination with Local Residents – The Consultant shall be responsible for obtaining permission from all property owners for all tasks requiring entry onto or in to private property. The Consultant shall be responsible for contacting property owners to schedule entry to properties. Repeated contact of property owners shall be required if necessary by the consultant until a property entry is scheduled and conducted. The

Consultant shall be available outside normal business hours if necessary to facilitate property owner's schedules as it relates to their availability to provide property access to the Consultant.

The Consultant shall coordinate access with private property owners prior to work that will restrict access or use of property to property occupants.

6. All studies to determine infiltration shall be performed during a period of high groundwater conditions and in conformance with the Specifications.

7. Regulatory Compliance – All equipment operators and inspectors shall be trained and licensed per NASSCO PACP and MACP as appropriate. All required licenses for work being performed shall be in the possession of the person(s) while performing the work. The Consultant shall provide a 'Competent Person', as defined by OSHA on location for all applicable work. The Consultant shall be solely responsible to conduct their operations in a manner that meets all applicable local, state, and federal regulations including RIDEM, CRMC, USEPA, OSHA and labor and equipment licenses. Contractor shall also comply with all permits, if any, issued for this project.

8. The City will not reimburse the Consultant separately for travel costs. All travel costs attributable to this project shall be incorporated into the Lump Sum fee.

9. The Consultant shall provide the Program Manager with a criminal history check (from the MS Attorney General's office) for any employee whom may be assigned to work involving entry on to private property. The City or Program Manager reserves the right to disallow any employee with an unacceptable criminal history.

Measurement and Payment: This work will not be measured. The above stated OTHER work shall be paid for as part of the lump sum prices for "Sewer System Evaluation Survey," including all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

The Program Manager Shall Provide the Consultant with the following:

1. System drawings in hard copy and electronic (Autodesk) formats.

2. Assistance locating manholes (on an as-needed basis).

3. Pavement cutting and/or excavation necessary to access manholes that are not currently visible at the ground surface, as may be necessary to properly conduct the SSES.

4. Providing copies of record plans or sanitary sewer system components.

5. Provide Consultant with copy of 2000 I/I study, where available.

6. Provide the Consultant with water use records and Pump Station equipment data and run times.

7. Accompany Consultant as necessary at internal home inspections.

5.0 Prepare Rehabilitation Contract Documents

Upon authorization by the City and the Program Manager, Consultant will prepare contract documents including drawings and specifications to complete the selected sewer rehabilitation activities. The Contract Documents will be complete and suitable for public bidding of the repair and rehabilitation work.

Measurement and Payment: This work shall be paid based on a Scope of Work and Lump Sum Fee as subsequently agreed to between the City/Program Manager and Consultant. The Scope of Work and Fee shall be developed upon completion of the Rehabilitation Plan. The lump sum fee shall include all products, materials, equipment, tools, labor, and incidentals thereto, complete and accepted by the Program Manager.

6.0 Bidding and Construction Services

Bid Phase

During the advertising and bidding phase for the proposed sewer system rehabilitation activities, Consultant shall attend the pre-bid conference, answer questions from prospective bidders, issue addenda as necessary, assist in evaluating bids that are received, and providing a written bid evaluation and recommendation for an award of a construction contract.

Construction Phase

The Consultant shall provide customary services during construction of the rehabilitation improvements. This work will generally include the following:

1. Review of shop drawings, catalog cuts, and product submittals for conformity with the construction contract documents;

2. Review of applications for payment and change orders, and written recommendations for same;

3. Attend periodic job meetings to monitor and report on the construction progress and to provide interpretations as to the intent of the construction contract documents;

4. Provide field inspection services as necessary to ensure contract compliance with the construction contract documents;

5. Prepare and issue as-built drawings (paper and electronic).

Measurement and Payment: This work shall be paid based on a Scope of Work and Fee as subsequently agreed to between the City/Program Manager and Consultant. The Scope of Work and Fee shall be developed concurrent with the Scope and Fee developed for the design phase activities described in Section 5.

7.0 Qualifications

1. All work is to be performed by firms or individuals within firms having at least ten (10) years' experience in conducting Sewer System Evaluation Surveys. Firms and/or individuals must have detailed and relevant experience with the applicable Federal and State regulations and programs, as well as professional organization standards and criteria.

2. A Statement of Qualifications must be submitted as a part of the respondent's proposal, including a listing of key personnel to be assigned to this project (organizational chart and resumes), relevant experience of the firm and the key personnel, and other pertinent information which identifies the respondent's ability to perform the work elements listed. A separate list of all intended sub-consultants must also be provided, identifying the tasks for the subconsultant and the (proposed) relationship between the respondent and the sub-consultant (i.e. joint venture, straight sub-consultant basis, etc.). Similar qualifications information is to be supplied for each proposed sub-consultant.

TECHNICAL SPECIFICATIONS FOR SMOKE AND DYE TESTING
OF GRAVITY PIPELINES

1.00 PART I – GENERAL

1.01 OVERVIEW

A. Scope of Work – The scope of work shall include the furnishing of all labor, materials, equipment, tools, and services required to perform and complete all work necessary to document, by means of smoke testing, dye testing, and digitally-recorded CCTV inspection, all identifiable sources of inflow and infiltration (I&I) to the designated sanitary sewer system from prohibited connections and defective pipes. The locations of project sites are in the City of Jackson and are listed in Appendix B and shown on the site drawings in Appendix C.

B. Authority of Program Manager – The Program Manager is the City's designated representative for this project. However, the City Engineer shall remain as the final authority.

C. Ambiguities – Whenever the provided documents or these Special Provisions do not provide sufficient information or clarity for the Consultant to understand the intent, or whenever the Consultant feels that the information provided is inconsistent with "industry standards", the Consultant shall bring this to the attention of the City, through their Program Manager as their designated representative, and ask for clarification, before taking any action.

C. Reference Documents

1. CCTV Inspections shall be performed in accordance with "Technical Specifications for the Inspection and Evaluation of Gravity Pipelines."

1.02 REQUIRED SUBMITTALS

1. Copies of insurance and workers' compensation policies, certificates and/or binders
2. Documentation of smoke products, including MSDS
3. Documentation of dye products, including MSDS
4. Documentation of smoke testing equipment for both mainlines and laterals.
5. Draft Schedule showing which segments will be done in each week
6. Initial draft of Initial Notification Letter to be distributed prior to commencing work, which will inform affected residents of what will be done during the test and how to prepare for it (the Program Manager will work with the Consultant to produce an approved final draft).
7. Draft Door Hanger for smoke testing
8. List of proposed employees and copies of any relevant certifications (i.e., NASSCO)
9. Typical Traffic Control Plans

10. Proposed field logs and reports
11. Proposed configuration of digital database
12. Monthly update of the digital database (electronically conveyed)

1.03 SCHEDULE

A. Schedule – Due to the need to coordinate closely with the residents who will be affected by this work, maintaining a reliable Schedule is critically important. Prior to beginning of work, the Consultant shall submit to the Program Manager a proposed Schedule showing the dates for specific neighborhoods. The Notice to Proceed shall not be issued until the Schedule has been received, reviewed and accepted by the Program Manager. Development and maintenance of the Schedule are the responsibility of the Consultant. In addition, the Consultant shall provide a two (2) week lookahead schedule to the Program Manager by Friday of every week showing in detail the location of work and any other relevant project activities during that period. Failure of the Consultant to comply with the requirements of this section shall be grounds for determination by the Program Manager that work shall not proceed until a reasonable Schedule or Revised Schedule is submitted and accepted, and the Consultant is in compliance.

B. Commencement of Work – Work shall begin **no later than the 10th day after the Notice to Proceed** is issued by the City.

C. Continuous Prosecution of the Project

1. Because timing of the work after notification of the affected residents is of such importance, and because the nature of the work requires that it be completed during dry weather when the ground is not saturated, failure of the Consultant to maintain adequate progress or to adhere to the approve Schedule shall be grounds for termination of this Contract.

2. If the City terminates the Contract for non-performance, the City shall have the work completed by other means, using funds that would have been paid to the Consultant. Therefore, no further payment will be made to the Consultant until the work has been completed. At that time, the Consultant may be paid for the work that they had done, only to whatever extent there remains an unspent balance in the Contract amount.

1.04 WORKING HOURS

A. All work performed by the Consultant shall be accomplished between the hours of 8:00 a.m. and 5:00 p.m. Monday through Friday, except City holidays, unless authorized in advance, in writing by the Program Manager.

1.05 PROJECT MEETINGS

A. Initial Meetings – Prior to issuance of the Notice to Proceed, one or more meetings of the Consultant's representative(s) and the Program Manager will be held to discuss in detail certain procedural aspects of the work including, at least:

1. Administrative procedures for transmittals, approvals, change orders, and similar items;
2. Review of the method of application for payment, progress payments, retention, and final payment;
3. Review of emergency procedures;
4. Review of traffic control procedures and general safety procedures
5. Development of the project Schedule;
6. Notifications to residents affected by the project, and communications with the City's emergency service providers and Public Works crews;
7. Review of the documentation to be generated during the course of the project (field records and digital database)
8. Basis for determination that follow-up on-site smoke testing or dye testing is needed.

B. Progress Meetings – Meetings among the City Public Works staff, the Program Manager, and the Consultant's project manager shall be conducted to discuss project progress. The Progress Meetings will be held weekly at first, and at longer intervals when satisfactory progress is being made.

1.06 COOPERATION WITH OTHER WORK

A. The City reserves the right to perform, or have performed, other and additional work at any time, by contract or otherwise, at or near the sites included in this project. Should work be underway or be subsequently undertaken within or adjacent to this project, the Consultant shall cooperate with all other contractors or other forces, including garbage and recycling forces, and shall conduct this work so that the operations of both suffer the least interference and delay. If there should be any disagreement between contractors, or the Consultant and the City as to the manner and order of performing work, such disagreement will be resolved by the City Engineer, and his determination shall be final.

1.07 CONSULTANT'S USE OF PUBLIC PREMISES

A. Overnight storage of materials or parking of Consultant's vehicles on City streets will only be allowed in an area specified in writing by the Program Manager. All spillage or mud tracking or tracking of other materials on streets, gutters and driveways shall be removed or cleared immediately.

B. The Consultant shall not allow the locations of the work to become littered with trash or waste material. The Program Manager shall have the right to determine what is or

is not waste material or rubbish, and shall have the right to determine the place and manner of disposal.

C. The Consultant shall provide portable toilet facilities and personnel wash area for his/her personnel and subcontractors.

1.08 ACCESS TO PRIVATE PROPERTIES

A. The City of Jackson Municipal Code provides that the City's employees or agents are to be allowed access over private properties to access sewer facilities, including private laterals.

B. If the Consultant's crew is unable to enter a property for any reason, the Program Manager will attempt to arrange for entry. This may require the Consultant to schedule a subsequent trip to that site.

C. The Consultant's crews shall treat residents with courtesy and respect, and shall politely answer brief, simple questions, but they should refer the residents to the emergency telephone number and the Town's website for more information. See elsewhere in these Special Provisions for requirements pertaining to avoiding damage to private property.

D. The Consultant shall immediately notify the Program Manager of any hostile contacts with residents, particularly if the Consultant's personnel are ejected from, or refused entry to, a property.

1.09 PRESERVATION AND RESTORATION OF PROPERTY

A. The Consultant must attempt to avoid causing damage to landscaping and private improvements overlying public facilities and private laterals being worked on. If a manhole or cleanout within or at the edge of an easement needs to be cleared, the Consultant will make reasonable efforts to restore the surrounding landscaping and improvements upon completion of the work, except that manholes or cleanouts shall not be covered or concealed. If a public manhole or cleanout has been covered by paving or hardscape materials it shall not be disturbed until the Program Manager has been notified.

B. Full compensation for protecting and repairing property as specified herein and all payments for the protection, repair or restoration of existing improvements and utilities shall be considered as included in the price paid for other items of work and no additional compensation will be allowed thereof.

C. The Consultant shall minimize disruption, noise and dust nuisance arising from their operations.

D. If any backflow prevention devices (BPD's) are encountered on sewer laterals, they shall be removed with care and restored to operable condition after the work is

completed at that site. If the backflow device cannot be removed or replaced without damage, or if it is in inoperable condition, the property owner shall be immediately notified. The Consultant's crews shall carefully document their handling of – and particularly their replacement of – any BPD's. If a BPD cannot be removed without damaging it, the smoke shall be introduced into the lateral farther upstream.

1.10 PUBLIC UTILITIES

A. The Consultant shall not interrupt any of the other public utilities or private service lines unless approved by the City.

1.11 GENERAL SAFETY

A. The Consultant shall perform all the work in accordance with applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and working with hazardous materials, as applicable. The Consultant is fully responsible for the safety of personnel conducting the work as well as well as the safety of the affected residents and the general public.

1.12 MAINTAINING ACCESS AND TRAFFIC CONTROL

A. Provisions must be made to allow resident and businesses reasonable access to their properties during the work.

B. Traffic shall be maintained at all times in both directions (at least alternating direction) on the streets affected by the work. If the Consultant's vehicles or safety precautions around an open manhole cannot maintain a clear travel-way of at least 20 feet in width (or the full paved width in streets narrower than 20 feet), it must be presumed that opposing traffic cannot pass safely at that point, and traffic control will be required.

C. Where two 10' lanes cannot be maintained on a two-way street, a full-time dedicated flagger shall be provided, whose full attention shall be on traffic and no other tasks. All costs for providing flaggers shall be borne by the Consultant and be included in the compensation paid for the work.

D. The Consultant shall provide markers, signs, delineators, and barricades as necessary to control traffic and protect the work area in the vicinity of the project.

E. The Consultant shall submit a set of Traffic Control Plans (TCPs), for typical situations anticipated to be encountered, for the Program Manager's approval. They shall address: full and partial lane closures, flagging, advanced warning signage, cones, barricades or other devices, and maintaining vehicle and pedestrian access. They shall show the manhole relative to the sides and centerline of the roadway, the position of the Consultant's equipment, and the positions of traffic control devices being used. The positions of existing permanent traffic controls and approximate

distance measurements must be shown. Simply copying standard plans from MDOT shall not be sufficient, although the TCPs produced must be consistent with those standards. Traffic Control Plans shall be submitted a minimum of ten (10) days prior to the anticipated start date, and may have to be revised at the Program Manager's direction. Work within public streets cannot be commenced without an approved Traffic Control Plan applicable to the particular situation.

F. The Consultant shall post temporary "No Parking" signs needed for construction or traffic control at least forty eight (48) hours prior to when they are needed in order for them to be enforced by Town of Hillsborough Police Department.

1.13 WATER SUPPLY

A. Water is available from City fire hydrants for use on this project. The Consultant shall obtain a hydrant meter from the City of Jackson Water Department. A refundable deposit is required for return of the meter. There will be no cost for water usage.

1.14 PERSONNEL QUALIFICATIONS

A. All employees working directly for the Consultant, or for any firm that performs subcontract work for the Consultant, shall be properly trained and thoroughly experienced in any type of work they perform, including the use of tools, equipment and materials used in the work. They shall be appropriately supervised, and the Consultant shall be responsible for the behavior of all workers, including those of subcontractors as well.

B. The Consultant, and each firm that performs subcontract work for the Consultant, shall provide a list to the Program Manager of all employees that will conduct field work within the City. The list must include full names, as well as copies of each employee's Driver's License, and must show the employees' individual qualifications for the work they perform.

C. The Program Manager will provide photo ID cards to the Consultant for all employees conducting field work within the City. The ID cards must be displayed prominently while work is being done and must be presented to residents when entering private property.

D. Although it is not anticipated that employees will enter the manholes, if that should become necessary (for placement or retrieval of plugs, or any other reason) the employees must observe approved Confined Space Entry protocols and strictly follow all required safety procedures. Only employees with documented training in Confined Space Entry may be permitted to participate in that activity.

E. The City reserves the right to eject any employee of the Consultant or any subcontractor, and to forbid them from any further work within the City.

Notwithstanding, this shall not affect the Consultant's requirement to continue the work without slowdown or delay.

1.15 OTHER REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The following references are part of this Specification. In any case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Specification shall prevail. In any case of conflict between the requirements of the other documents listed, the precedence of the documents will be in the order in which they are listed below, with the highest precedence listed first. The latest versions of the following references shall be used, except as noted.

1. Occupational Safety and Health Administration (OSHA) Standards
2. The City of Jackson Municipal Codes and Standard Specifications
3. Mississippi Department of Transportation Standard Specifications
4. The National Association of Sewer Service Companies (NASSCO) Pipeline Assessment & Certification Program (PACP) and Lateral Assessment & Certification Program (LACP)

1.16 PROJECT RECORD DOCUMENTS

A. Record Plans – The set of Plot Plans showing individual lots and blocks provided by to the Consultant by the Program Manager shall be neatly marked-up as the project proceeds. These are to be the Record Plans for the work.

B. Digital Database

1. The Consultant's digital database shall be set up to be compatible with the City's ArcGIS system so that the data and links can be imported intact without requiring translation or conversion. It shall provide separate records for each sewer main segment and for each property. The individual records shall include active links to the accompanying Plot Plans, photographs, videos and notes.

2. For presentation to the City, placement of the data into Microsoft Excel spreadsheet format, which can be imported into the Program Manager's project management system, is preferred.

3. Field notes, photographs and videos shall be entered into the Consultant's digital database daily and shall be available for the Program Manager to review within 24 hour of any request. The updated database shall be conveyed to the Program Manager for review with each Application for Payment. Title to all materials will transfer to the City of Jackson.

4. The digital database, along with the files related to it, shall be conveyed to the Program Manager on a portable external hard-drive, formatted in FAT32 or NTFS to be readable on computers with Microsoft Windows operating systems.

C. Final Report

1. Consultant shall submit a Draft Final Report to the Program Manager for review upon completion of the project. The report shall include samples of marked-up Plot Plans, photographs and narrative notes from the smoke testing, and samples of the paper reports generated during the video inspections, and it will refer to the digital database, which will accompany it, that will include the complete records for each sewer main segment and each property.

2. The Draft Report may be conveyed in commonly used digital format rather than in hardcopy. The Program Manager may require that additional information be included in the Report.

3. Prior to the final payment being issued, Consultant shall submit to the Program Manager five (5) paper copies, and one (1) electronic copy on a portable hard disc drive, of the Final Report.

1.15 PROJECT ADMINISTRATION

A. Payments

1. Consultant shall periodically apply for progress payments (no more frequently than monthly) during the course of the project. The application shall include a breakdown of quantities of work produced during that period, as well as the cumulative quantities produced to date, based on the Schedule of Unit Prices provided.

2. The Program Manager will review each application and, if not disputed, will process it in timely fashion for approval by the City Council at the Council's next normal date for releasing payments.

3. No payments shall be made until services have actually been performed.

4. Payment for the Digital Database, Final Report, and other Administrative Costs as well as the last payment for quantities of field work, shall not be paid until the Final Report has been provided to the City.

B. Adjustments to Quantities – Because this is a Professional Services Agreement, the City may amend the Agreement to increase or decrease the quantities of each item of work.

C. Reproduction Costs – Reproducing and distributing the Door Hangers shall be included in the price of the project.

D. Business License Required – The Consultant (and any firm that performs subcontract work for the Consultant) shall obtain/maintain a Business License from the City of Jackson in good standing throughout this project.

2.00 PART 2 – PRODUCTS (NOT USED)

3.00 PART 3 - SMOKE TESTING SPECIFICATIONS

3.01 SCOPE OF WORK

A. This specification covers the work necessary to conduct smoke testing to locate sources of inflow and infiltration within the designated mainline segments and attached properties. Also covered is follow-up on-site introduction of smoke, which might be necessary when the mainline smoke-testing does not produce conclusive results on an individual property. This is to be considered a minimum performance threshold, and the Consultant is encouraged to recommend additional or stronger provisions. If the Consultant feels that any provisions herein are excessive, unnecessary or ineffective, this should be brought to the Town's attention prior to submitting a proposal.

3.02 PUBLIC NOTIFICATIONS

A. Emergency Phone Number – The Consultant shall provide an emergency phone number for the public to use, which will reach a live person 24 hours a day, seven days a week. That live person must be able to reach the primary contact person for the Consultant to notify them of emergencies.

B. Initial Notification Letter

1. The Consultant shall work with the Program Manager to develop a Notification Letter to all residents in subject neighborhoods, explaining how the inspection process will affect them, including the requirement for residents to allow City workers onto their private properties, and containing answers to commonly asked questions. It shall include the emergency phone number, prominently displayed, as well as reference to the City's web page for this project. It shall also inform residents who may not be directly affected, but who may observe the smoke, not to worry.

2. The Consultant shall provide a preliminary draft, based on experience in similar communities, which the Program Manager will review and revise as deemed appropriate.

3. Two (2) weeks prior to commencing Smoke Testing the Consultant shall mail out the Notification Letter to all targeted residents, and to the Jackson Police Department.

C. Door Hangers

1. Forty eight (48) hours prior to smoke testing, the Consultant shall distribute to the residences being tested a notification alerting the inhabitants that smoke testing is about to be conducted at their property. It shall contain a brief reminder of what they should do beforehand and what to expect during the test, and the emergency phone number shall be prominently displayed (it may have printing on both sides).

2. The Door Hangers shall be at least 3½" wide and 8½" high, and shall use eye-catching colors to attract attention. They shall be placed on the front entry door and at least one garage door of each residence. If unable to enter a property, the door hanger shall be affixed securely and prominently to the driveway gate.

3. The proposed door hanger shall be presented to the Program Manager for approval before the Notice to Proceed will be issued.

D. Emergency Services – The Consultant shall contact all emergency services each day to alert them of the locations to be tested on the following day.

E. "Persons of Concern" – The Consultant and the Program Manager shall collaboratively maintain a list of residences with particular sensitivities, such as bedridden patients and house-confined invalids, day-sleepers, persons with respiratory problems, households with vulnerable pets, and any other situations that require special treatment, and it shall be updated daily as residents notify the City or the Consultant of their special needs. Before conducting a smoke test on a residence on this list, Consultant shall take whatever additional precautions are necessary to accommodate the inhabitants.

F. Temporary Street Signs – Consultant's crew should place temporary signs on the roadway in the vicinity of their operation so that passing motorists will not be unnecessarily alarmed by smoke releases they observe.

3.03 SMOKE TESTING MATERIALS, EQUIPMENT & PROCEDURES

A. Personnel

1. A smoke testing crew shall be comprised of a sufficient number of persons to generate and distribute the smoke while simultaneously examining the subject properties thoroughly and conducting Traffic Control as necessary. It may be necessary for multiple crews to be working simultaneously in order to complete the work in the time allowed.

2. Personnel conducting smoke testing shall be properly trained in the use of the equipment and procedures. Each of them shall have a documented minimum of six (6) months of direct first-hand experience prior to starting this project.

3. Crews shall take all proper precautions in conducting the smoke testing.

B. Equipment

1. The manhole blower shall be a high-volume, low-pressure (HVLP) fan designed and built specifically for sewer system smoke testing, with appropriate adapters to seal to the City's manholes with minimal leakage. It shall have a free-air delivery capacity of at least 1700 CFM and be capable of maintaining a positive pressure within the system sufficient to expel smoke from the most distant open vent stack continuously until the testing is completed. *It shall not be operated so as to force water out of properly installed and maintained plumbing traps* connected to the system.

2. Due to the size of some of the properties in Jackson, it may be required - if the Program Manager deems it necessary – to place blowers at both the upstream and downstream ends of the section of main being tested.

3. If significant amounts of smoke are escaping around the edges of the blower, it may be required - if the Program Manager deems it necessary – to place a sealing gasket of some kind between the edges of the blower and the manhole frame.

4. If a backflow prevention device is encountered that cannot be safely removed, or if for any other reason smoke cannot flow up a lateral in sufficient quantity to produce conclusive results, a blower designed to introduce smoke through a cleanout or other small-diameter opening shall be used in that particular lateral system. The Program Manager shall make the determination of the need for such follow-up work.

5. The Consultant shall provide all other equipment, tools and incidentals necessary to perform smoke testing as described in these Specifictions and as directed by the Program Manger, including but not limited to plugs, photo-imaging and measuring equipment, forms, personal protective gear, and confined-space entry and self-rescue equipment, all in good working condition.

C. Smoke Products

1. The smoke shall be non-toxic, non-staining, and non-explosive, white to light gray in color, produced by chemical reaction from safe, stable components, and shall dissipate quickly leaving no residue.

2. Liquid or solid smoke sources may be used. It is recommended that the Consultant's crews have both types of products available and be ready to use either or both as appropriate to conditions encountered.

3. Sufficient smoke volume shall be generated to completely fill the sewer main and laterals being investigated and to clearly identify any points of release in addition to roof vents.
4. Consultant shall submit product data, including MSDS and manufacturer's recommendations for applications, storage, and handling, to the Program Manager for review and approval two weeks prior to commencing smoke testing.

D. Distribution of Smoke

1. Due to the size of many of the properties within Jackson, the maximum allowable setup length shall be no more than a two adjacent reaches at a time, unless the reaches are unusually short. If a stretch of mainline is serviced by intermediate cleanouts rather than manholes, the entire manhole-to-manhole stretch may have to be tested at once.

2. In order to isolate the sewer segment to be tested, partial blocking shall be preferred. If sandbags or plugs are used, care must be taken to prevent surcharging in the system. Plugs shall not be placed in the inlet side of the upstream manhole. If the outlet at the downstream manhole has been plugged a continuous watch may be necessary. Bypass pumping is discouraged.

3. Prior to introducing smoke into a sewer segment, the sewer gas within the segment shall be removed by opening both manholes and using the blower, in either positive or negative pressure mode, to displace the existing atmosphere with fresh air. The atmosphere within a manhole shall be checked for toxicity when the lid is removed.

4. Prior to introducing smoke into a sewer segment, any backflow-prevention devices on laterals connected to that segment must be removed if they can be removed without damage (*NOTE: due to the potential for liability arising from future failures of backflow-prevention devices, it is imperative that the condition of the device, and its proper replacement after the test, are to be thoroughly documented.*)

5. Smoke shall be continuously introduced into the setup until adequate coverage has been obtained and a visual inspection of the area being tested has been completed. Testing crews shall ascertain that adequate smoke coverage has been obtained by observing smoke concentrations at house plumbing vents within the setup.

6. If the Town’s Inspector determines that there is not sufficient smoke at a house, despite the introduction ample quantities of solid and liquid products, the Consultant’s crew shall conduct a follow-up on-site smoke testing procedure through an accessible cleanout between the main and the house. A portable blower designed for this shall be set up at an accessible cleanout or plumbing device to introduce smoke directly into the lateral.

E. Inspection

1. Testing crews shall inspect all connected lines and surface areas along the mainline section being tested. In addition to examining the landscaping between the lateral tie-in and the structure it serves, the features to be inspected include but are not limited to abandoned and supposedly disconnected sewer laterals, cleanouts, manholes, driveway drains, patio and area drains, foundation drains, retaining wall drains, barbecue and exterior wetbar sinks, roof gutters, at-grade rain-leader connections, downspouts piped underground, street gutters, and storm drain inlets.

2. When cross-connections are discovered, the crew shall document them as described in Section 3.04 below.

3. It is recommended that smoke testing be conducted during hours of relatively low flow.

4. Testing shall not be done when unfavorable weather conditions (breeze or precipitation) would interfere with obtaining good results.

5. Personnel shall be in constant communication via portable radios.

6. If a cross-connection is discovered, and it is unclear which fixtures are connected, a follow-up dye test (as described in Section 3), and/or a follow-up video inspection (as described in CCTV Specification) may be required.

3.04 DOCUMENTATION

A. Field Reports

1. The crews shall produce digital photographic and tabular records of every identifiable smoke release point.

2. Photographs of smoke releases shall include a whiteboard on which identifying information has been hand-written for that specific photograph, including date, time, property address, and reference ID for the specific location of the release.

3. A Global Positioning System (GPS) instrument shall be used to record the geographic locations of features and observations recorded.

4. Wherever a source of I&I is discovered, the tributary area contributing rainwater to this source is to be estimated (in square feet) and noted in the documentation for that source.

5. The individual Plot Plans for each property, which will be provided to the Consultant by the Program Manager, shall be marked-up using the symbols in the accompanying Legend, showing:

a. Date, day and time that the inspection of the property was started;

b. Observed street address of the property (if different than shown on the Plot Plans);

c. Public Works Permit number (PWP#);

d. Actual location of the sewer main and manholes serving the property if different than shown;

e. The locations of detected sources of I&I, with their reference ID's (both on public and private property);

f. Indications of important physical features referenced in the photographic and/or narrative descriptions of discovered cross-connections;

g. Locations of existing backflow prevention devices and cleanouts;

h. Prominent indications of manholes and cleanouts shown that could not be found;

i. The Plot Plan mark-ups produced during smoke testing will be further marked-up during dye-testing and video inspections if needed. They will also be used during basin-wide video inspections conducted in the future throughout each mini-basin. Additional information will be added during video inspections, including cleanout locations, bends and junctions, major defects, and the locations of the lateral connections to the mains.

6. A Field Log shall be produced for each property, noting in narrative form:

a. Street address of the property;

b. Public Works Permit number (PWP#);

c. Date, day and time that the inspection of the property was started;

d. General weather conditions;

e. Documentation of condition and specific action taken with any backflow prevention devices;

f. For each smoke release, provide:

i. A unique reference ID that will correlate among the Field Log, the Site Sketch, the photograph and the digital database
ii The manhole segment being tested, identified by the City's convention;
iii. The geographic location of the release;

iv. The type of release, based on a limited set of types (this will be worked-out with the Program Manager)
v. The severity of the release, based on a range of three levels;
vi. A brief description of the release, particularly indicating if it is evidently a prohibited connection;

g. The Field Log for each property shall present the numbers of releases of each different type being recorded; it shall also describe all dye testing and/or video inspections done.
h. The approximate length and size of each lateral, determined by the cleanouts found;

B. Digital Database

1. The Consultant's digital database shall provide a separate record for each sewer main segment tested and separate records for each of the properties connected to it.

2. Each record shall link to all of the individual Field Logs, Plot Plans, videos, photographs and any other documentation for the segment or the property.

3. Records will be sorted by segment ID's or by property addresses.

4. Plot Plans, Field Logs and all other notes, videos and photographs shall be entered into the Consultant's digital database daily. The updated database shall be conveyed to the Town for review with each Application for Payment, but no less frequently than monthly.

3.06 MEASUREMENT AND PAYMENT

A. Smoke testing shall be paid for at the proposed unit prices per linear foot of sewer main pipe and per each separate lateral system. Measurements of the lengths of mainline shall be made from the centers of the manholes. Follow-up on-site smoke testing shall be paid for at the proposed unit price per lateral system so tested. The unit prices shall include full compensation for furnishing all material, labor, equipment, services and incidentals necessary to conduct the smoke testing, including, but not limited to, preparations, the testing itself (and site inspections) and documentation.

4.00 PART 4 – DYE TESTING SPECIFICATIONS

4.01 SCOPE OF WORK

A. If smoke testing results are not conclusive, the Program Manager may direct the Consultant to conduct follow-up dye testing to confirm or rule-out potential I&I sources. This specification covers the work necessary to conduct follow-up dye testing. It is to be considered a minimum performance threshold, and the Consultant is encouraged to recommend additional or stronger provisions. If the Consultant feels

that any provisions herein are excessive, unnecessary or ineffective, this should be brought to the Program Manager's attention prior to submitting a proposal.

4.02 DYE TESTING MATERIALS, EQUIPMENT & PROCEDURES

A. Products

1. Dye used shall be non-toxic, water soluble, biodegradable, and EPA-approved for this purpose. ANSI/NSF Standard 60 certification is preferred.

2. Liquid, power or solid products must be pre-dissolved and pre-diluted prior to bringing them onto a site.

3. The Consultant's crews shall have three colors of dye available in order to check multiple suspected inflow sources without having to wait for previously-introduced dye to dissipate completely.

4. Dyes must be capable of being color-neutralized with ordinary materials such as chlorine bleach, which shall be present when the dye is introduced into the suspected source.

B. Release of Dye

1. Liquid dye is to be introduced into the suspected source, and an member of theConsultant's crew will watch for it at the manhole that the property's lateral is connected to (or at the manhole below where that property's lateral is connected to the main).

2. At a suspected source of inflow, care shall be taken to avoid spilling or splashing dye onto adjacent surfaces; grates shall be removed from drains and roof leader connections shall be disconnected if possible. Any accidental staining shall be immediately neutralized.

C. Inspection

1. When dye is introduced into a suspected source of I&I, a member of the Consultant's crew shall attempt to locate its possible release to the surface rather than to the sewer lateral. This is particularly important where the house is close to a creek.

2. A crew member shall also be posted at the manhole with a portable light of sufficient intensity to see clearly if dye is present.

3. Personnel shall be in constant communication via portable radios.

4.03 DOCUMENTATION

A. Field Records

1. The specific location of each dye introduction shall be carefully noted on the Plot Plan for the subject property, and it shall be noted if the cross-connection to the sewer is confirmed.

2. A photograph shall be taken that clearly shows the location of the dye introduction in the context of its surroundings, so that the particular location is unmistakable.

3. The record for the subject property may reference multiple dye test locations and their results.

B. Digital Database – The results of dye testing shall be recorded in the digital database established for the subject property.

4.04 MEASUREMENT AND PAYMENT

A. Follow-up dye testing shall be paid for at the proposed unit price per point of introduction of dye.

B. The unit prices shall include full compensation for furnishing all material, labor, equipment, services and incidentals necessary to conduct the dye testing, including, but not limited to, preparations, the testing itself, and documentation.

TECHNICAL SPECIFICATIONS FOR THE INSPECTION AND EVALUATION OF GRAVITY PIPELINES

1.00 PART 1 -- GENERAL

1.01 SCOPE

A. It is the intent of this contract to assess the internal structural and service condition of sewer systems, including manholes, lift stations, and sewer lines prior to preconditioning or rehabilitation. Assessment will be performed using visual inspection and pan and tilt color camera-CCTV.

B. Qualifications of contractor:

1. If requested by the Engineer, the proposed contractor shall submit a verifiable reference list documenting the successful completion of a minimum of 500,000 linear feet of internal sewer condition assessment on projects of similar size and scope to this project. The reference list along with a list of available equipment & resumes of key personnel shall be submitted to the engineer a minimum of two weeks prior to bid.

C. It is also the intent of this contract to survey individual sewer lines that have been preconditioned to further assess condition and record findings.

D. It is the responsibility of the Contractor to comply with applicable OSHA regulations. The Contractor shall provide written documentation that all workers have received the training required under these regulations and guidelines.

E. Two forms of internal condition assessment are addressed by this specifications:

1. Sewer survey – Detailed viewing of the sewer (“survey”) ,with the aid of CCTV equipment, to assess internal structural condition, service condition, and identify and locate miscellaneous construction features as well as assess the structural and service condition of laterals.

2. Sewer inspection – Viewing the sewer system pursuant to investigative work following other operational activity including:

a. Locating manhole(s) and/or lateral(s) with or without radio-sonde

b. Sewer preconditioning and cleaning activities

c. Sewer rehabilitation, including point repairs

d. Such other similar purposes as may be required by the Owner.

3. Sewer inspection shall be carried out manually or with the aid of CCTV equipment, to assess overall condition.

1.02 SUBMITTALS

A. As requested by the Engineer, the Contractor shall provide to the Engineer the following information in writing prior to the set deadline, or at the indicated frequency, whichever is applicable.

1. Project Schedule (At Pre-Construction Conference)

2. Listing of Cleaning Equipment & Procedures (At Commencement)

3. Listing of Flow Diversion Procedures (At Commencement)

4. Listing of Preconditioning Procedures (At Commencement)

5. Listing of Safety Precautions and Traffic Control Measures (At Commencement)

6. Listing of CCTV Equipment (At Commencement)

7. Listing of Backup and Standby Equipment (At Commencement)

8. Manufacturers Details of CCTV Equipment (At Commencement)

9. Location where Debris from Cleaning will be Disposed (At Commencement)

10. Updated Schedule of Planned Inspections/Cleaning of Sewer Reaches (Post Commencement, Weekly)

11. Two (2) Copies of CCTV Video Tapes, Two (2) Copies of CCTV DVD's, Two (2) Copies of Inspection Report incorporating a summary statistical breakdown of defects and main findings (As per Schedule in Exhibit "C")

12. Daily Logs and Progress Reports (Daily)

13. Confined Space Entry Logs (Daily)

B. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of work which were incidental to the contract. The Contractor shall include in his daily record, reference to:

1. Delays: e.g. dense traffic, lack of information, sickness, labor or equipment shortage.

2. Weather: conditions, e.g. rain, etc.

3. Equipment: on site, e.g. specialist cleaning, by-pass equipment, etc.

4. Submittals: to the designated representative

5. Personnel: on site by name, e.g., all labor, Specialist Services, etc.

6. Accident: report, e.g. all injuries, vehicles, etc.

7. Incident: report, e.g. damage to property, property owner complaint, etc.

8. Major defects encountered, including collapsed pipe, if any: e.g. cave-ins, sink holes, etc.

9. Visitors: on site

C. The Engineer's designated representative on site shall certify receipt of the daily record noting any items and adding any observations with reference to claims for payment to the Contractor. The Owner may at his discretion, for which the Contractor must receive direction in writing, make an exception to this requirement for weekly submission of progress rather than for daily submission.

1.03 REQUIREMENTS AND EXTENT OF SURVEY/INSPECTION

A. The Contractor shall survey and/or inspect sewer systems with digital cameras or color pan and tilt CCTV imagery as specified in order to record all relevant features and confirm their structural and service condition. Surveys/Inspections of sewer systems shall be carried out in compliance with the NASSCO PACP reporting format and coding standards.

B. All CCTV operator(s) responsible for direct reporting of sewer condition shall have a minimum of 3 years previous experience in surveying, processing, and interpretation of data associated with CCTV surveys/inspections. If requested by the Engineer, the Contractor shall provide the designated representative with written documentation that all CCTV survey operators meet these experience requirements which shall include a list of projects undertaken as well as client name and telephone number for reference.

C. Approved Contractors will be required to provide evidence acceptable to the Engineer that all CCTV technicians performing work under this contract have satisfactorily completed NASSCO Pipeline Assessment Certification Program

(PACP) training and possess valid PACP Certification documents. All defect coding, as well as material, shape and lining coding used throughout the project will conform to NASSCO's Pipeline Assessment Certification Program, PACP. Required training to meet these requirements will be carried out at the Contractor's expense.

D. The Contractor shall complete a daily written record (diary) detailing the work carried out and any small items of work which were incidental to the contract as previously described in Item 1.03.

1.04 SURVEY/INSPECTION UNITS

A. The Contractor shall provide sufficient survey/inspection units and all relevant ancillary equipment, including standby units in the event of breakdown, in order to complete all sewer and manhole surveys/inspections as specified.

1.05 SURVEY/INSPECTION VEHICLE

A. The survey/inspection vehicle shall comprise of two totally separate areas. One of these, designated as the viewing area, shall be insulated against noise and extremes in temperature, include the provision for air conditioning, and shall be provided with means of controlling external and internal sources of light in a manner capable of ensuring that the monitor screen display is in accordance with the specification. Seating accommodation shall be provided by the Contractor to enable two people, in addition to the operator, to view clearly the on-site monitor, which shall display the survey/inspection as it proceeds.

B. The working area shall be reserved for equipment, both operational and stored, and no equipment utilized within the sewer shall be allowed to be stored in the viewing area.

1.06 CCTV SURVEY/INSPECTION AND OPERATIONAL EQUIPMENT REQUIREMENTS

A. The surveying/inspecting equipment shall be capable of surveying/inspecting equipment shall be capable of surveying/inspecting a length of sewer up to at least 1000 ft. when entry onto the sewer may be obtained at each end and up to 750 ft. where a self propelled unit is used, where entry is possible at one end only. The Contractor shall maintain this equipment in full working order and shall satisfy the designated representative at the commencement of each working shift that all items of equipment have been provided and are in full working order.

B. Each survey/inspection unit shall contain a means to transport the CCTV camera in a stable condition through the sewer under survey and/or inspection.

Such equipment shall ensure the maintained location of the CCTV camera when used independently on or near to the central axis of a circular shaped sewer when required in the prime position.

C. Where the CCTV camera is towed by winch and drum through the sewer, all winches shall be stable with either lockable or ratcheted drums. All drums shall be steel or of an equally non-elastic material to ensure the smooth and steady progress of the CCTV camera equipment. All winches shall be inherently stable under loaded conditions.

D. Each unit shall carry sufficient numbers of guides and rollers such that, when surveying or inspecting, all bonds are supported away from pipe and manhole structures and all CCTV cables and/or lines used to measure the CCTV camera's location within the sewer are maintained in a taut manner and set at right angles where possible, to run through or over the measuring equipment.

E. Each unit shall carry a range of flow control plugs or diaphragms for use in controlling the flow during the survey/inspection. A minimum of one item of each size of plug or diaphragm – within the range of pipe sizes set out in the contract - shall be carried

F. Each survey/inspection unit shall have on call equipment available to carry out the flushing, rodding and jetting of sewers as and when such procedures are deemed to be necessary.

1.07 FIELD SUPERVISION BY CONTRACTOR

A. The Contractor shall maintain on site at all times a competent field supervisor in charge of the survey/inspection. The field supervisor shall be approved in writing by the designated Engineer prior to commencement of work. Any change of supervision must also be approved in writing by the designated Engineer prior to the change. The field supervisor shall be responsible for the safety of all site workers and site conditions as well as ensuring that all work is conducted in conformance with these specifications and to the level of quality specified.

1.08 APPLICATION OF INSPECTION TYPE

A. The following guidelines concerning the use of CCTV shall be followed, subject to the review and approval of the designated Engineer:

1. Generally CCTV alone shall be used for internal condition assessment where the depth of flow of sewage is less than 25% of overall sewer diameter at the start of the survey. The Contractor will make an informed decision to continue should the depth of flow increase

beyond the 25% level but no greater than 40% of overall sewer diameter at any time throughout the length.

2. Generally CCTV combined with plugging and/or bypassing shall be used for internal condition assessment where depth of flow of sewage varies from 25% to 75% of overall sewer diameter for sewers greater than 24-inches in diameter. Where depth of flow of sewage exceeds 25% and is less than 75% of overall sewer diameter the designated Engineer shall instruct Contractor to either:

   a. Continue using CCTV (where depth of flow is only marginally greater than 25% of overall diameter) or

   b. Use plugging/bypass pumping to reduce flow levels below 25%.

1.09 RESPONSIBILITY FOR OVERFLOWS OR SPILLS

A. It shall be the responsibility of the Contractor to schedule and perform his work in a manner that does not cause or contribute to incidence of overflows or spills of sewage from the sewer system.

B. In the event that the Contractor work activities contribute to overflows or spills, the Contractor shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify the designated representative in a timely manner.

C. Contractor will indemnify and hold harmless the Owner for any fines or third-party claims for personal or property damage arising out of a spill or overflow that is fully or partially the responsibility of the Contractor, including the legal, engineering and administrative expenses of the Owner in defending such fines and claims.

2.00 PART 2 – PRODUCTS (NOT USED)

3.00 PART 3 – EXECUTION

3.01 CLEANING PRIOR TO INTERNAL CONDITION INSPECTION

A. Where required by the contract and instructed in writing or by written Order to Proceed, the Contractor shall clean the sewer prior to internal condition inspection.

3.02 SEWER CLEANING UNITS AND EQUIPMENT

A. The Contractor shall provide sufficient sewer cleaning units and equipment, including standby units in the event of breakdown, in order to complete cleaning operations as specified.

3.03 REASONS FOR CLEANING OF SEWERS

A. Normal sewer cleaning is defined as removal of minor quantities of silt and debris preventing observation of sewer condition and defects.

B. Heavy sewer cleaning is defined as removal and extraction of silt, debris, and obstructions from the sewer which actually prevent entry and use of CCTV equipment, or the completion of the sewer run and/or manned-entry inspection of sewers.

C. Mechanical cleaning is defined as the removal of hard or semi-hard deposits, tuberculation, or other materials requiring the use of mechanically operated equipment which actually prevent entry and use of CCTV equipment, or the completion of the sewer run and/or manned-entry inspection of sewers.

3.04 EXTENT OF NORMAL CLEANING

A. Normal Cleaning is considered to be cleaning of the sewer prior to CCTV or manned-entry inspection and does not necessarily require removal and extraction of the silt and debris from the wastewater flow and will only be required should the level of silt be deemed to prohibit the accurate assessment of the pipeline under inspection. It normally includes up to three (3) complete cleaner passes of the entire sewer line segment.

3.05 EXTENT OF HEAVY OR MECHANICAL CLEANING

A. Heavy or mechanical cleaning is not required as part of the internal condition inspection service unless specifically designated in the bid schedule. Where such designation exists, heavy or mechanical cleaning shall be performed as necessary. Heavy cleaning is defined as the removal of loose debris that requires more than three (3) complete cleaner passes the entire sewer line segment Mechanical cleaning is defined as the removal of hardened deposits, tuberculation, etc. and generally requires specialized cutting and cleaning equipment.

B. In the event that heavy or mechanical cleaning is required, the Contractor shall:

1. Provide and/or manage the equipment necessary for proper jetting, rodding, bucketing, brushing, root cutting, flushing and vacuum uplift or any other approved removal and extraction system necessary to

remove and extract silt, debris and obstructions from the sewer which would otherwise preclude use of CCTV equipment and/or manned-entry inspection of the sewers.

2. Demonstrate the performance capabilities of the cleaning equipment and method for use when requested by the designated Engineer. If results obtained by the demonstration are not satisfactory, select other methods or equipment that will clean the sewer line and repeat demonstration.

3. Install a gauge to monitor working pressure on the discharge of high-pressure pumps for jetting equipment.

4. Provide more than one type of equipment or attachments on a single reach or at a single location as required.

C. The Contractor shall exert all reasonable care to avoid damage to the sewer or manhole during the cleaning operation. Mechanical equipment used for heavy cleaning shall be equipped with an overload clutch to limit the risk of damage to the pipe.

3.06 REMOVAL OF DEBRIS WITH CLEANING

A. The Contractor shall provide all equipment and personnel necessary to safely remove and extract silt and debris from the sewer through existing manhole access, load it onto trucks for disposal, and dispose of the silt and debris at approved sites.

3.07 CCTV – GENERAL

A. CCTV Camera Prime Position: The CCTV camera shall be positioned to reduce the risk of picture distortion. In circular sewers the CCTV camera lens head shall be positioned centrally (i.e. in prime position) within the sewer. In non-circular sewers, picture orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally. In all instances the camera lens head shall be positioned looking along the axis of the sewer when in prime position. A positioning tolerance of ± 10% of the vertical sewer dimension shall be allowed when the camera is in prime position.

B. CCTV Camera Speed: The speed of the CCTV camera in the sewer shall be limited to 30 LF per minute for surveys to enable all details to be extracted from the ultimate CD-ROM recording. Similar or slightly higher speed as agreed by the designated Engineer shall be provided for inspections.

C. CCTV Color Camera: The Contractor shall provide a color pan and tilt camera(s) to facilitate the survey and inspection of all laterals, including

defects such as hydrogen sulfide corrosion in the soffit of sewers and benching or walls of manholes over and above the standard defects that require reporting, where required by the designated Engineer. These will be carried out as part of the normal CCTV assessment as the survey or inspection proceeds when instructed by the designated representative.

D. Linear Measurement:

1. The CCTV monitor display shall incorporate an automatically updated record in feet and tenths of a foot of the footage of the camera or center point of the transducer, whichever unit is being metered, from the cable calibration point. The relative positions of the two center points should also be noted.

2. The Contractor shall use a suitable metering device, which enables the cable length to be accurately measured; this shall be accurate to ±1% or 3 inches whichever is the greater.

3. The Contractor shall demonstrate compliance with the tolerance listed above, using one or both of the following methods in conjunction with a linear measurement audit form which shall be completed each day during the survey:

   a. Use of a cable calibration device

   b. Tape measurement of the surface between manholes

4. A quality control form will be completed and submitted by the contractor depicting the level of accuracy achieved.

5. If the Contractor fails to meet the required standard of accuracy, the designated representative shall instruct the Contractor to provide a new device to measure the footage. The designated Engineer retains the right to instruct the Contractor in writing, to re-survey those lengths of sewer first inspected with the original measuring device using the new measuring device.

E. Data Display, Recording and Start of Survey/Inspection:

1. At the start of each sewer length being surveyed or inspected and each reverse set-up, the length of pipeline from zero footage, the entrance to the pipe, up to the cable calibration point shall be recorded and reported in order to obtain a full record of the sewer length. Only one survey shall be indicated in the final report. All reverse set-ups, blind manholes, and buried manholes shall be logged on a separate log. Video digits shall be recorded so that every recorded feature has a

correct tape elapsed time stamp. Each log shall make reference to a start and finish manhole unless abandonment took place because of blockage. Manhole number shall be indicated in the remark's column of the detail report. Surveys must not extend over 2 tapes.

2. The footage reading entered on to the data display at the cable calibration point must allow for the distance from the start of the survey/inspection to the cable calibration point such that the footage at the start of the survey is zero.

3. In the case of surveying through a manhole where a new header sheet must be completed, the footage shall be set at zero with the camera focused on the outgoing pipe entrance.

4. At the start of each manhole length a data generator shall electronically generate and clearly display on the viewing monitor and subsequently on the CD-ROM recording a record of data in alpha-numeric form containing all fields required by the PACP information standard:

5. The size and position of the data display shall be such as not to interfere with the main subject of the picture.

6. Once the survey of the pipeline is under way, the following minimum Information shall be continually displayed:

    a. Automatic update of the camera's footage position in the sewer line from adjusted zero

    b. Sewer dimensions in inches

    c. Manhole or pipe length reference number (PLR). General convention allows upstream manhole number to be designated PLR.

    d. Direction of survey, i.e., downstream or upstream

7. Correct adjustment of the recording apparatus and monitor shall be demonstrated by use of the test tape or other device approved by the Contractor. Satisfactory performance of the camera shall be demonstrated by the recording of the appropriate test device at the commencement of each day for a minimum period of 30 seconds.

8. Footage and corresponding time elapsed video digit shall be given throughout survey/inspection for all relevant defects and construction features encountered unless otherwise agreed.

9. Where silt encountered is greater than 10 percent of the diameter of the pipe, the depth of silt shall be recorded at approximately 50-foot intervals.

10. CD-ROM capacity shall be adequate to record two hours of video inspection. Recording of a single segment shall not extend over more than one video tape. No unrecorded gaps shall be left in the recording of a segment between surveys/inspections.

11. Only segments between manholes on the same sewer reach or basin shall be included on one CD-ROM. There shall be no "split surveys" or "split basins" between CD-ROMs.

12. All continuous defects shall incorporate a start and finish abbreviation in the log report

F. Coding: Defect Coding, as well as Material, Shape, and Lining Coding, and conventions used throughout the project will be PACP-compliant. The CCTV Contractor must ensure that all surveyors conform to the detailed requirements of the reporting procedure concerning feature description and feature definition as well as the computer file format.

3.08 MAN ENTRY SURVEY – GENERAL

A. Photographic Camera Position – General Illustration of Sewer Interior:

1. The CCTV camera shall be positioned to reduce the risk of picture distortion. In circular sewers the camera will be centered and oriented to look along the axis of the sewer. In non-circular sewers, picture orientation shall be taken at mid-height, unless otherwise agreed, and centered horizontally.

2. The CCTV camera shall be positioned so that the long side of the photograph or CD-ROM frame is horizontal.

B. Camera Position – Laterals/Specific Defect:

1. A means of accurately locating the photographic or camera's footage and any recorded lateral or defect, along the sewer shall be provided, to an accuracy of ± 1% or 6 inches whichever is the greater.

2. When requested by the designated representative in writing at any time during a survey or inspection, the Contractor shall demonstrate compliance with the above tolerance in subparagraph 3.2.B.1. The

device used by the Contractor to measure the footage along the sewer will be compared with a standard tape measure. The results will be noted. If the Contractor fails to meet the required standard of accuracy, the designated Engineer shall instruct the Contractor to provide a new device to measure the footage. The designated representative retains the right to instruct the Contractor in writing to re-survey those lengths of sewer inspected with the original measuring device at no extra cost.

C. Photographic Quality: The CCTV system and suitable illumination shall be capable of providing an accurate, uniform and clear record of the sewer's internal condition. In-sewer lighting standards shall meet the requirements of the PACP and applicable codes regarding safety and power.

3.09 PHYSICAL INSPECTION OF MANHOLES AND LIFT STATIONS

A. General

1. Manholes and lift stations shall be inspected to assess general physical condition and to locate leaks which are causing or could cause soil erosion and degradation to the sanitary systems, and/or other underground utilities or surface structures, and which are allowing leaks into, or out of, the sewer system.

B. Documentation of Inspection

1. Observations shall be recorded on a manhole and lift station physical inspection report form. Information recorded on these forms shall include but not be limited to location of the structure, relationship of a structure's incoming and outgoing lines, size of lines, depth of structure, condition of cover, ring, wall, bench and invert, type of material, and any other pertinent information which would allow sources of Infiltration/Inflow.

2. If requested by the Engineer, horizontal GPS coordinates, to an accuracy of 1 meter, shall be obtained for each manhole and wet well, geo-referenced and recorded as per these technical specifications.

3. Owner to provide manhole and lift station I.D. Residential addresses will I.D. private property.

4. Color photographs shall be taken of the interior and exposed exterior of all manholes and lift stations, and shall portray any defects as best as possible. The main purpose of the photographs is to assist management in decisions for future testing or rehabilitation purposes. The "Manhole and Lift Station Inspection Report" form will be used to

record the inspection results. The Engineer shall approve the form to be used.

5. Besides any hard copy in the reports, photographs shall be provided to the Owner in a digital electronic version on computer discs (CD's) in the JPEG format. Each digital photo file and photograph, shall have a unique I.D. applied to it that will indicate which manhole or Lift station is pictured, and will correspond to that features I.D. in the data.

C. Contractor shall furnish all data and photographs gathered in the field investigation, and it shall be incorporated into a report listing all findings and recommendations for future inspection or rehabilitation.

3.10 CCTV AND MAN ENTRY SURVEY DATA SPECIFICATION

A. Survey Reporting:

1. The Contractor shall submit to the Engineer two printed "Full English" reports including summary statistical breakdown of all defects encountered and two CD-ROM/DVD's with copies of all descriptive data in digital format. All video and survey information shall be provided in electronic form utilizing a Microsoft Access compatible database. The supplied data and information shall remain the property of the Engineer.

2. The report shall be computer validated using PACP-compatible software approved by the designated representative.

3. When requested, the Contractor shall provide hard copy output or manually completed site coding sheets at the time of the survey and shall forward copies of these sheets to the designated representative, preferably each day, but at least every other day, together with a daily report on progress.

B. Site Coding Sheets: Each sewer length, i.e. the length of sewer between two consecutive manholes, shall be entered on a separate coding sheet or entered separately electronically. Thus where a Contractor elects to "pull through" a manhole during a CCTV Survey or "walk through" during a Man Entry survey a new coding sheet shall be started at the manhole "pulled or walked through" and the footage re-set to zero on the coding sheet. Where a length of sewer between consecutive manholes is surveyed from each end (due to an obstruction) two coding sheets should be used. Where a length of sewer between two consecutive manholes cannot be surveyed or attempted for practical reasons a (complete header) coded sheet shall be made out defining the reason for abandonment. At uncharted manholes a new coding sheet must be started and the footage re-set to zero.

C. Measurement Units: All dimensions shall be in feet and tenths of a foot. Measurement of sewers shall be to the nearest tenth of a foot.

D. CCTV And Man Entry Photographs:

1. Still photographs (JPEG format) shall be taken of all defective laterals and pipeline defects. Where a defect is continuous or repeated the photographs shall be taken at the beginning and end of the defect.

2. CCTV Photographs must clearly and accurately show what is displayed on the monitor, which shall be in proper adjustment.

3. Still photographs shall be durable and clearly identified in relation to the photograph number (cross referenced to the site survey sheet) street location, sewer dimensions, manhole start and finish numbers, survey direction, footage and date when the photograph was taken.

4. The annotation shall be clearly visible and in contrast to its background, shall have a figure size no greater than 14 point, and be type printed in upper case.

5. The annotation shall be positioned so as not to interfere with the subject of the photograph.

E. Control Sample Photographs and/or CD-ROMs: The designated representative may issue a written instruction to the Contractor to provide a sample of the photographs and/or CCTV tapes taken during the contract period which the Contractor shall provide within 5 working days of receiving the written instruction.

3.11 CCTV PERFORMANCE

A. Color CCTV: All CCTV work shall use color CCTV reproduction.

B. CCTV Picture Quality:

1. An approved test device shall be provided and be available on site throughout the Contract, enabling the test specified in this clause to be checked.

2. The test card shall be Marconi Regulation Chart No.1 or its approved derivatives with a color bar, clearly differentiating between colors, with no tinting, to show the following: White, Yellow, Cyan, Green, Magenta, Red, Blue, and Black.

3. At the start of each and every working shift, the camera shall be positioned centrally and at right angles to the test card at a distance where the full test card just fills the monitor screen. The Contractor shall ensure that the edges of the test card castellations coincide with the edges of the horizontal and vertical scan (raster). The card shall be illuminated evenly and uniformly without any reflection. The illumination shall be to the same color temperature as the color temperature of the lighting that recorded for subsequent use by the designated Engineer, the recording time to be at least 30 seconds. The type of camera used is to be identified on the test recording. The recording must show the camera being introduced into the test device and reaching its stop position. Other test devices may be used subject to approval by the designated Engineer.

4. The electronic systems, television camera and monitor shall be of such quality as to enable the following to be achieved:

C. Shades of Gray: The gray scale shall show equal changes in brightness ranging from black to white with a minimum of five clearly recognizable stages.

D. Color: With monitor adjusted for correct saturation, the six colors plus black and white shall be clearly resolved with the primary and complementary colors in order of decreasing luminance. The gray scale shall appear in contrasting shades of gray with no tint.

E. Linearity: The background grid shall show squares of equal size, without convergence/divergence over the whole of picture. The center circle shall appear round and have the correct height/width relationship (± 5%)

F. Resolution: The live picture must be clearly visible with no interference and capable of registering a minimum number of TV lines/pictures height lines. The resolution shall be checked with the monitor color turned down. In the case of tube cameras this shall be 600 lines.

G. Color Constancy: To ensure the camera shall provide similar results when used with its own illumination source, the lighting shall be fixed in intensity prior to commencing the survey. In order to ensure color constancy, no variation in illumination shall normally take place during the survey.

H. The Contractor shall note that the designated Engineer may periodically check both the live and picture color consistency against the color bar. Any differences will require re-survey of the new length or lengths affected, at the Contractor's expense.

I. Playback and CD-ROM Labeling:

1. Playback video shall be capable of a resolution of a minimum of 400 lines recorded at standard (SP setting) VHS speed. CD-ROM playback imaging shall be linked to electronic out put of alpha-numeric data so that if necessary direct interrogation of database can take place with simultaneous viewing of CCTV images.

2. Each CD-ROM disc shall be labeled by reference to the header record for the survey section completed together with the following information:

   a. Sequential (unique) CD-ROM number

   b. Basin/ catchment worked in

   c. Survey company name and logo

   d. Survey date

J. CCTV Focus/Iris/Illumination: The adjustment of focus and iris shall allow optimum picture quality to be achieved and shall be remotely operated. The adjustment of focus and iris shall provide a minimum focal range from 6 inches in front of the camera's lens to infinity. The distance along the sewer in focus from the initial point of observation shall be a minimum of twice the vertical height of the sewer. The illumination must allow an even distribution of the light around the sewer perimeter without the loss of contract picture, flare out or shadowing.

K. Contractor's Data Quality Control Procedure:

1. The Contractor shall operate a quality control system, to be approved by the designated Engineer, which will effectively gauge the accuracy of all survey reports produced by the operator.

2. The system shall be such that the accuracy of reporting is a function particularly of:

   a. The number of faults not recorded (omissions)

   b. The correctness of the coding and classification of each fault recorded.

3. The minimum levels of accuracy to be attained under the various survey headings are as follows:

a. Header Accuracy 95%

b. Detail Accuracy 85%

3.12 COLLAPSED SEWERS/DEFECTIVE MANHOLES

A. Any sewer found with greater than 10% deformation (i.e. collapsed or near to collapse) must be reported to the designated representative immediately for remedial action.

B. Any manhole found broken, cracked, with missing covers or surcharged, must be reported to the designated representative immediately for remedial action

C. Any sewer found with existing conditions that pose a threat of personal injury to the public, such as a collapsed sewer with attendant depression roadway, must be protected by the Contractor until the designated representative arrives at the job site

D. Any manhole found where the existing conditions pose a threat of personal injury to the public, such as broken, cracked or missing covers or covers found in traveled portions of any sidewalk or roadway must be protected by the Contractor until the designated representative arrives at the job site.

4.00 PART 4 – MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Mobilization, when listed on the Proposal, will be measured as a lump sum item.

B. Normal Cleaning, when listed on the Proposal, shall be measured as the horizontal distance from the center of the entry manhole to the furthermost extent of the cleaning performed. Measurements shall be made to the nearest foot.

C. Heavy Cleaning, when listed on the Proposal, shall be measured as the horizontal distance from the center of the entry manhole to the furthermost extent of the heavy cleaning performed. Measurements shall be made to the nearest foot.

D. Mechanical Cleaning, when listed on the Proposal, shall be measured by the hour. Measurement shall be made to the nearest half hour.

E. Grease/Root Removal, when listed on the Proposal, shall be measured as the horizontal distance from the center of the entry manhole to the furthermost

extent of the grease or roots removed. Measurements shall be made to the nearest foot.

F. Removal of Protruding Taps, when listed on the Proposal, shall be measured for each tap removed.

G. CCTV Inspection, when listed on the proposal, shall be measured as the horizontal distance from the center of the entry manhole to the furthermost extent of the inspection performed. Measurements shall be made to the nearest foot.

H. Additional CCTV Setup, when listed on the Proposal, shall be for each setup made.

I. Physical Inspection of Manhole or Lift Station, when listed on the proposal, shall be for each inspection made.

4.02 PAYMENT

A. Payment for Mobilization shall be 50% with first pay request, 40% with second pay request, and 10% with final pay request.

B. Payment for Normal Cleaning shall be made per LF.

C. Payment for Heavy Cleaning shall be made per LF.

D. Payment for Mechanical Cleaning shall be made per HR.

E. Payment for Grease/Root Removal shall be made per LF

F. Payment for Removal of Protruding Taps shall be per EA.

G. Payment for CCTV Inspection shall be made per LF.

H. Payment for Additional CCTV Setup shall be per EA.

I. Payment for Physical Inspection of Manhole or Lift Station shall be per EA.

Appendix B

Sewer Rehabilitation Technical Specifications

1. Grouting
2. Cured-in-Place Pipe
3. Manhole Rehabilitation

CHEMICAL GROUTING

PART 1: GENERAL REQUIREMENTS

1.01 Description of Work

A. This section covers the work necessary to restore existing sanitary sewers and manholes by remotely sealing leaking joints, small holes, and radial cracks in structurally sound sewer pipes and manholes using chemical sealing (grouting) materials. The CONTRACTOR shall provide all materials, labor, equipment, and services necessary for bypass pumping of sewage flows, cleaning and television inspection of sewer to be grouted, application of grout, and final television inspection. This specification represents minimum standards and the CONTRACTOR shall abide by any manufacturer specifications that exceed these specifications.

1.02 CONTRACTOR Submittals

A. All CONTRACTOR Project Submittals shall be submitted to ENGINEER within 14 days of Notice to Proceed issuance. All submittals must be approved by ENGINEER prior to the start of construction. Required submittals are as follows:

1. Bypass Pumping Plan – shop drawing showing bypass pumping locations with sufficient detail to assure that the work can be accomplished without sewage spill.

2. Sample Customer Notification

3. Traffic Control Plan including shop drawings and signage in accordance with MDOT guidelines

4. Manufacturer Specifications for all grouts and component materials

5. Construction Plan including the following submittals; insertion locations, material storage location, installation procedures, sampling procedures, project schedule, erosion control plan, removal of residual sealing materials from the sewer line and cleanup plan.

B. All submittals shall identify the specification section(s) they address.

1.03 Quality Assurance

A. The sealed joints shall be reasonably free of residual sealing materials that extend into the pipe, reduce the pipe diameter, or restrict the flow.

B. After completion of all grouting, the sewer shall be televised in color digital video format using NAASCO PACP codes and suitable logs taken. The logs and the original digital video documentation shall be provided to the ENGINEER.

1.04 Public Notification

A. 72 hours prior to disruption of service the CONTRACTOR shall notify property owners, public, residents, and all who may be affected using a notification form approved by MSD.

B. The CONTRACTOR shall disrupt customer sewer service for no longer than 12 hours. If service will be disrupted for more than 12 hours, the CONTRACTOR must notify affected customers and ENGINEER of the delay

PART 2: MATERIALS

2.01 General

A. While being injected, the grouting must be able to react in the presence of water. The cured material must also be able to withstand submergence in water without degradation.

B. The resultant sealant formation must prevent the passage of water (infiltration) through the sewer pipe joint or repair location.

C. The cured sealant material must be flexible. In place, the sealant formation should be able to withstand the freeze thaw and wet/dry cycles without adversely affecting the seal. The sealant formation must not be biodegradable.

D. The cured sealant should be chemically stable and resistant to withstand internal exposure to sewage gases containing quantities of hydrogen sulfide, carbon monoxide, methane, petroleum hydrocarbons, and dilute sulfuric acid.

E. Packaging of component materials must be compatible with field storage and handling requirements. Packaging must provide for worker safety and minimize spillage during handling

F. Mixing of component materials must be compatible with field operations and not require precise measurement of the ingredients by field personnel.

G. Cleanup must be done without excessive use of flammable or hazardous chemicals.

H. Residual sealing materials must be easily removable from the sewer line to prevent reduction or blockage of sewage flow.

2.02 Acrylamide Base Gel Sealing Materials

A. A minimum of 10% acrylamide base material by weight in the total sealant mix. A higher concentration may be used to increase strength or offset dilution during injection.

B. The ability to tolerate some dilution and react in moving water during injection.

C. A viscosity of approximately 2 centipoise which can be increased with additives.

D. A controlled reaction time from 10 seconds to 1 hour.

E. A reaction producing a homogeneous, chemically stable, non-biodegradable, firm, and flexible gel.

F. The ability to increase mix viscosity, density, and gel strength through the use of additives.

2.03 Acrylic Base Gel Chemical Sealing Material

A. A minimum of 10% acrylamide base material by weight in the total sealant mix. A higher concentration may be used to increase strength or offset dilution during injection.

B. The ability to tolerate some dilution and react in moving water during injection.

C. A viscosity of approximately 2 centipoise which can be increased with additives.

D. A controlled reaction time from 5 seconds to 6 hours.

E. A reaction producing a homogeneous, chemically stable, non-biodegradable, firm, and flexible gel.

F. The ability to increase mix viscosity, density, and gel strength through the use of additives.

2.04 Urethane Base Gel Chemical Sealing Material

A. 1 part urethane prepolymer thoroughly mixed with between 5 and 10 parts of water byweight. The recommended urethane prepolymer concentration is 11% by weight.

B. A liquid prepolymer having a solids content of 77% to 83%, specific gravity of 1.04 (8.65 pounds per gallon), and a flash point of 20°F.

C. A liquid prepolymer having a viscosity of 600 to 1200 centipoise at 70°F.

D. The water used to react the prepolymer should have a pH of 5 to 9.

E. A cure time of 80 seconds at 40°F, 55 seconds at 60°F, and 30 seconds at 80°F when 1 part prepolymer is reacted with 8 parts of water containing a sufficient amount of gel control additive.

F. A relatively rapid viscosity increase of the prepolymer/water mix. Viscosity increases from about 10 to 60 centpoise in the first minute for 1 to 8 prepolymer/water ratio at 50°F.

G. A reaction which produces a chemically stable and non-biodegradable, tough, flexible gel.

H. The ability to increase mix viscosity, density, gel strength, and resistance to shrinkage by the use of additives to the water.

2.05 Urethane Base Foam Chemical Sealing Material

A. Approximately 1 part urethane prepolymer mixed thoroughly with 1 part water by weight.

B. A liquid prepolymer having a solids content of 82% to 88%, specific gravity of 1.1 (9.15 pounds per gallon), and a flash point of 20°F.

C. A liquid prepolymer having a viscosity of 300 to 500 centipoise at 72°F.

D. A cure time of 5.5 minutes at 40°F, 8.2 minutes at 70°F, and 2.6 minutes at 100°F when the prepolymer is reacted with water containing 0.4% accelerator.A cure time of 15 minutes at 40°F, 8.2 minutes at 70°F, and 4.6 minutes at 100°F when the prepolymer is reacted with water only.

E. During injection; foaming, expansion, and viscosity increase occurs.

F. Physical properties of the cured foam of approximately 14 pounds per cubic foot density, 80-90 psi tensile strength, and 700% to 800% elongation when a mixture of 50% prepolymer and 50% water undergoes a confined expansion to five times its initial liquid volume.

PART 3: EXECUTION

3.01 General

A. The grouting material shall be prepared and applied in accordance with manufacturer recommendations.

B. The CONTRACTOR shall protect the manholes to withstand forces generated by equipment, water, or air pressures used while installing the grout.

3.02 Preparation

A. All site work shall be performed or supervised by personnel experienced in the application of grouting as specified herein.

B. The materials and application procedure shall be subject to inspection by ENGINEER.

C. The packaging of component materials must be compatible with field storage and handling requirements such that it will not be damaged or result in any public safety hazard. All materials shall be subject to inspection and review by ENGINEER prior to installation.

3.03 Bypass Pumping

A. Bypass pumping shall consist of furnishing, installing, and maintaining all power, primary and standby pumps, appurtenances and bypass piping required to maintain existing and peak hourly flows and services. The CONTRACTOR shall submit a plan for bypass pumping in accordance with City standards and applicable Special Provisions. The CONTRACTOR shall be aware that most homes in the area have sump pumps connected to the sanitary sewer. The bypass-pumping plan shall include an emergency response plan to be followed in the event of a failure of the bypass pumping system or sump pump activity during the rehabilitation process.

B. Bypass pumping shall be done in such a manner as to not damage private or public property, or create a nuisance or public menace. The pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of sewage on private property, gutters, streets, sidewalks, or into storm sewers is prohibited. The CONTRACTOR shall be liable for all cleanup, damages, and resultant fines in the event of a spill. After the work is completed, flow shall be returned to the rehabilitated sewer.

C. The CONTRACTOR shall take all necessary precautions to ensure that no private properties are subjected to sewage backup or spill.

D. The CONTRACTOR shall be liable for all damages resulting from CONTRACTOR's work.

3.04 Cleaning and Inspection

A. The CONTRACTOR shall be responsible for cleaning, inspecting, confirming the inside diameter, and determining the condition of each manhole-to-manhole segment of the existing sewer to be grouted. The CONTRACTOR shall note that the existing

sewer may have heavy solids, such as drain rock and collapsed sections of pipe, or root intrusion. The mixing of root treatment materials with chemical sealing materials will not be allowed. All debris shall be removed from the downstream manhole. And disposed of off-site in a manner approved by ENGINEER at the CONTRACTOR's expense. The cleaning operation shall be performed in a manner not to further damage the existing pipe. Hydroflushing or balling shall not be permitted.

A. The CONTRACTOR shall perform an internal television inspection after the sewer cleaning operation, point repairs and grouting is completed, and before flow is reintroduced into the sewer. The television inspection shall be completed in the same direction each time and shall be done with logs using approved NAASCO PACP codes and a color digital video format. The logs and television inspection digital video documentation from all televising operations shall be approved by ENGINEER prior to grouting. A pivot head camera shall be used for all television inspection.

B. The CONTRACTOR shall capture, remove, and dispose of all waste materials related to cleaning that could potentially cause a sewer backup, damage existing facilities such as pump stations or cause sedimentation in the downstream sewer system.

3.05 Equipment

A. The basic equipment shall consist of a TVI system, necessary chemical sealant containers, pumps, regulators, valves, hoses, etc., and joint sealing packers for the various sizes of sewer pipes.

B. The packer shall be cylindrical and have a diameter less than the pipe size and have cables attached at each end to pull it through the line. The packer shall be constructed in a manner to allow a restricted amount of sewage to flow.

3.06 Joint Sealing Procedure

A. Joint sealing shall be accomplished by forcing chemical sealing materials into or through faulty joints by a system of pumps, hoses, and sealing packers.

B. The packer shall be positioned over the faulty joint by means of a measuring device and the TVI camera in the line.

C. The packer ends shall be expanded using controlled pressure. The expanded ends shall seal against the inside periphery of the pipe to form a void area at the faulty joint, now completely isolated from the remainder of the pipe line.

D. Into this isolated area, sealant materials shall be pumped through the hose system at controlled pressures which are in excess of groundwater pressures. The pumping unit, metering equipment, and the packer device shall be designed so that proportions and quantities of materials can be regulated in accordance with the type and size of the leak being sealed.

3.07 Joint Sealing Verification

A. Upon completing the sealing of each individual joint, the packer shall be deflated until the void pressure meter reads zero pressure, then reinflated and the joint tested as specified below.

B. Should the void pressure meter not read zero, the CONTRACTOR shall clean his equipment of residual grout material or make the necessary repairs/adjustments to produce accurate void pressure readings.

C. Joints that fail to meet the specified test criteria shall be resealed and retested until the test criteria can be met.

3.08 Sewer Pipe Joint Testing

A. Joint testing pressure shall be 3 psi higher than the groundwater pressure, if any, outside the pipe. Groundwater pressure may be determined by positioning the testing device on a visibly infiltrating joint and measuring the resulting void pressure with the void pressure monitoring equipment (usually a packer). There is generally a practical limit of 10 psi for the test pressure.

B. In the absence of groundwater pressure data, the test pressure shall be equal to ½ psi per vertical foot of pipe depth or 3 psi, whichever is greater.

3.09 Residual Sealing Materials

A. Residual sealing materials that extend into the pipe, reduce the pipe diameter, or restrict the flow shall be removed from the joint. The sealed joints shall be left reasonably flush with the existing pipe surface.

B. If excessive residual sealing materials accumulate in the line and/or if directed by ENGINEER, the manhole section shall be cleaned to remove the residual materials.

C. Complete records shall be kept of joint sealing performed in each manhole section. The records shall identify the manhole section in which the sealing was done, the location of each joint sealed and the joint sealing verification results.

3.10 Warranty

A. The CONTRACTOR shall provide the City a warranty to be in force and effect for a period of five (5) years from the date of acceptance by the City against leakage of grout repairs. The warranty shall require the CONTRACTOR to repair the defective joint at no cost to the City.

CURED-IN-PLACE PIPE

PART 1: GENERAL REQUIREMENTS

1.01 Description of Work

A. This section covers the work necessary to restore existing sanitary sewers by the installation of Cured-In-Place Pipe (CIPP). CIPP is formed by inverting a resin impregnated flexible tube into the existing sewer line using hydrostatic head and curing with circulating hot water**,** air/steam inversions, or other approved means to produce a hard, impermeable pipe. The CONTRACTOR shall provide all materials, labor, equipment and services necessary for bypass pumping of sewage flows, cleaning, preinversion television inspection of sewers to be lined, installation of liner, reconnection of sewer service connections, and final television inspection. This specification represents minimum standards and the CONTRACTOR shall abide by any manufacturer specifications that exceed these specifications.

1.02 Reference Standards

ASTM F 1216 Standard Practice for Rehabilitation of Existing Pipes and Conduits by the Inversion and curing of a Resin-Impregnated Tube

ASTM D 638 Standard Test Methods for Tensile Properties of Plastics

ASTM D 648 Standard Test Methods for Deflection Temperature of Plastics under Flexural Load

ASTM D 790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D 2583 Standard Test Methods for Determination of Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor

ASTM D 2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep Rupture of Plastics

NAASCO Recommended Specifications for Sewer Collection System Infrastructure Analysis and Rehabilitation Manual

NAASCO Pipeline Assessment and Certification Program (PACP)

Federal EPA Sewer System Infrastructure Analysis and Rehabilitation Manual

1.03 Acceptable CIPP Reconstruction Systems/Processes

A. The only acceptable Cured-In-Place pipeline reconstruction system/processes for pipe installation work are Insituform, In-Liner, National Liner, or approved equal.

1.04 CONTRACTOR Submittals

A. All CONTRACTOR Project Submittals shall be submitted to ENGINEER within 30 days of Notice to Proceed issuance. All submittals must be approved by ENGINEER prior to the start of construction. Required submittals are as follows:

1. Bypass Pumping Plan – shop drawing showing bypass pumping locations with sufficient detail to assure that the work can be accomplished without sewage spill.

2. Sample Customer Notification

3. Third Party Testing Laboratory Credentials

4. Traffic Control Plan including shop drawings and signage in accordance with MDOT guidelines

5. Construction calculations for liner size and thickness, including assumptions used in calculations per latest version of ASTM F1216. Include a schedule of pipe segments.

6. Manufacturer Specifications for resins and liner material. Provide third party laboratory test data showing short/long term physical properties of CIPP system being used.

7. Construction Plan including the following submittals; insertion locations and schedule, Inversion plan complete with lengths of inversions, material storage location, installation procedures, sampling procedures, project schedule, erosion control plan, and location of wet-out facility, safety plan, emergency spill plan, chemical safety plan, MSDS sheets, and cleanup plan.

8. Manufacturer Specifications for gap filler material (end seal connections) and Property Service Connection (PSC) liner materials.

B. All submittals shall identify the specification section(s) they address.

1.05 CONTRACTOR Availability

A. The PRIME CONTRACTOR shall be on site from the beginning of the inversion until the final PSC has been reconnected.

B. The CONTRACTOR shall have a local or 1-800 cellular phone or pager active at all times.

1.06 Quality Assurance

A. The CONTRACTOR shall clean the host pipe, remove all roots, and make any necessary point repairs prior to conducting pre-inversion TVI for submittal to ENGINEER.

B. The finished liner shall be continuous over the entire length of the inversion run between access points and shall be free of visual defects such as wrinkles, bulges, tears, foreign inclusions, cracks, crazing, dry spots, pinholes, or de-lamination.

1.07 Public Notification

A. 72 hours prior to disruption of service, the CONTRACTOR shall notify property owners, public, residents, and all others who may be affected using a notification form approved by ENGINEER.

B. The CONTRACTOR shall disrupt customer service for no longer than 12 hours. If service will be disrupted for more than 12 hours, the CONTRACTOR must notify affected customers and ENGINEER of the delay.

1.08 Project Documentation

A. The CONTRACTOR shall make a walk through digital video prior to the start of construction and another immediately after the completion of the project. These videos shall document the condition of the entire project area. The project name, contract number, and the date and time of filming shall be clearly identified in the videos. The location within the project area shall be clearly identified as filming progresses.

B. The CONTRACTOR shall take seven pre-rehab digital photos per 100 feet of sewer main detailing the project area.

C. The CONTRACTOR shall provide the digital photos on a CD/DVD including an index with the following information; corresponding photo number, contract number, street address as appropriate, record drawing number, CONTRACTOR name, location by station, and date.

D. Digital videos and digital photo documentation shall be submitted to the ENGINEER at the earliest possible date.

E. Upon completion of installation, the CONTRACTOR shall update the final asbuilt drawings to reflect the actual work performed and shall submit the completed asbuilt drawings to the ENGINEER prior to acceptance testing.

1.09. Property Service Connections

A. Existing property service connections conflicting with the proposed construction shall be adjusted by the CONTRACTOR. To the extent possible, adjustments shall be accomplished using remote equipment. Remote equipment necessary to perform intruding lateral adjustments shall be considered conventional sewer cleaning equipment.

B. Property service connections that are not in service and are visibly plugged shall be lined through and not re-instated unless directed otherwise by the ENGINEER. All property service connections that are lined through shall be documented as follows; CONTRACTOR's name, ENGINEER's Inspector's name, upstream and downstream manhole, property address, distance from upstream manhole and clock reading. The documentation shall be submitted to the ENGINEER prior to inversion of the liner.

C. Reinstated property service connections shall completed using a "top-hat" type or approved equal connection liner to ensure a clean transition from the PSC to the rehabbed pipe. The existing PSC shall be buffed such that the opening is smooth, circular, and free of burrs or other obstructions. Excess resin from lining shall be the CONTRACTOR's responsibility to remove. Coupons from all reinstatement of property service connections shall be removed from the sewer and disposed of properly.

PART 2: MATERIALS

2.01 Cured-In-Place Pipe: The liner tube being installed shall be sized correctly, allowing for stretch, to tightly fit the inside of the existing pipe. A resin and catalyst system that is compatible with the requirements of the method shall be used.

A. The liner tube shall consist of one or more layers of flexible needle felt or an equivalent woven and/or non-woven material capable of carrying resin, withstanding installation pressures and curing temperatures, and that is compatible with the resin system used.

B. The resin used shall be compatible with the rehabilitation process, shall be able to cure in the presence or absence of water, and the initiation temperature for cure shall be as recommended by the resin manufacturer.

C. The finished lining shall consist of an inner polyurethane layer and an outer polyester/terylene felt layer (or layers) impregnated with a thermosetting polyester resin (or approved equal) to fit tight against the inside of the host pipe wall. The liner shall be fabricated from materials that when cured will be chemically resistant to withstand internal exposure to sewer gases containing quantities of hydrogen sulfide, carbon monoxide, methane, petroleum hydrocarbons, saturation with moisture, and dilute sulfuric acid.

D. The CONTRACTOR shall verify both the lengths and diameters for the tubes before they are manufactured. The minimum length shall be that deemed necessary by the CONTRACTOR to effectively span the distance from the inlet to the outlet of the respective manholes unless otherwise specified. The CONTRACTOR shall verify both the lengths and diameters in the field before the liner is impregnated with resin. Individual inversion runs can be made over one or more manhole sections as determined in the field by the CONTRACTOR and approved by the ENGINEER.

E. Prior to inversion, the liner shall be free of all visible tears, holes, cuts, foreign materials, and other defects.

F. The physical properties of the cured liner shall be in accordance with ASTM D 790 and ASTM D 638 and shall have minimum values as follows:

	Polyester Resin	
	Short Term	Long Term
Flexural Strength (psi)	4,500	
Flexural Modulus (psi)	250,000	125,000
Tensile Strength at Yield (psi)	3,000	

G. The liner shall conform to the following:

Parameter	Pipe
Minimum thickness of bonded polyurethane	0.25 mm + 5%
Membrane and inner liner resin content (w/i ± 5%)	85% resin, 15% felt by volume
Thickness	per ASTM F 1216
Hardness	(Barcol) 22 per ASTM D2583
Heat distortion temperature	70°C per ASTM D 648

(CONTRACTOR shall field verify the internal diameter of host pipe prior to sizing liner.)

H. The liner thickness is based on the resin mechanical properties shown in 2.01(G). The liner shall have a wall thickness as set forth in ASTM F 1216 and be structurally sound and without joints. The CONTRACTOR shall calculate the wall thickness for a fully deteriorated pipe and a groundwater depth of 10’ above the top of the pipe or to the ground surface, whichever is less. If the CONTRACTOR uses resins having different mechanical properties, the CONTRACTOR shall submit detailed calculations of the proposed liner thickness for all pipe segments regardless of resin used for the approval of the ENGINEER. Calculations shall consider external hydrostatic pressure, static and earth-load pressures and internal, surcharge pressures. The liner shall be sized in accordance with the design parameters shown below:

Design Life:	50 years
Ovality:	6%
Soil Modulus:	1,000 psi
Soil Weight	125 lb/cf
Enhancement Factor:	7
Excess Resin:	The 5% excess resin requirement shall not be used in determining liner thickness. The supplier, however, shall provide excess resin to meet the project specific requirements.

I. The resin used shall not contain fillers except those required for viscosity control. A thixotropic agent in an amount up to 5% by mass may be added for viscosity control.

2.02 Materials Testing

A. General: All materials testing shall be performed at the CONTRACTOR's expense and by an independent third party laboratory approved by ENGINEER. The samples shall be taken in accordance with ASTM F 1216. Additionally, the third party lab shall provide the thickness of each plate sample.

B. Physical Properties:

1. The cured inversion tube shall be sampled and tested for tensile strength, flexural strength, and flexural modulus. Flexural strength and modulus shall be tested in accordance with the requirements of ASTM D 790.

2. The CONTRACTOR shall provide certified test results of the short term properties of the cured liner material from the actual installed liner at a minimum of one sample per inversion (minimum of one per each 2,000 linear feet of installed liner).

C. Corrosion resistance tests: Corrosion resistance requirements shall be as stated in ASTM F 1216, Section X2, Chemical Resistance Tests. CONTRACTOR shall submit valid resistance tests per ASTM D543.

PART 3: EXECUTION

3.01 General

A. The CONTRACTOR shall protect the manholes to withstand forces generated by equipment, water, or air pressures used while installing the tube.

B. Where "LINE THROUGH MANHOLE" is indicated on the drawings, the CIPP shall be inverted through the manhole and the circular shape of the host pipe shall be maintained. The CIPP is not to be trimmed, cut, or otherwise disturbed after installation.

C. The CONTRACTOR shall have sufficient backup TV Inspection (TVI) cameras, bypass pumps, property service connections (PSC) cutters, intruding property service connection cutters, and appurtenances on site such that the progress of work will not be significantly impeded by equipment failures.

3.02 Preparation

A. All site work shall be performed or supervised by personnel experienced in the installation of the liner as specified herein. The uncured resin in the original containers and the unimpregnated fiber-felt tube shall be impregnated by vacuum or other means prior to installation. The materials and wet-out procedure shall be subject to inspection by ENGINEER. On-site and "over-the-hole" wet-outs shall be acceptable. Transportation of the impregnated tube to the jobsite shall be done in accordance with the manufacturer's recommendations.

B. The impregnated liner bag shall be transported to and stored at the site such that it will not be damaged, exposed to heat and/or direct sunlight, or result in any public safety hazard. All materials shall be subject to inspection and review by ENGINEER prior to installation.

3.03 Bypass Pumping

A. Bypass pumping shall consist of furnishing, installing, and maintaining all power, primary and standby pumps, appurtenances and bypass piping required to maintain existing and peak hourly flows and services. The CONTRACTOR shall submit a plan for bypass pumping in accordance with City standards and special provisions, if any. The CONTRACTOR shall be aware that homes in the area may have sump pumps connected to the sanitary sewer. The bypass pumping plan shall include an emergency response plan to be followed in the event of a failure of the bypass pumping system or sump pump activity during the rehabilitation process.

B. Bypass pumping shall be done in such a manner as to not damage private or public property, or create a nuisance or public menace. The pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of sewage on private property, gutters, streets, sidewalks, or into storm sewers is prohibited. The CONTRACTOR shall be liable for all cleanup, damages, and resultant fines in the event of a spill. After the work is completed, flow shall return to the rehabilitated sewer.

C. The CONTRACTOR shall take all necessary precautions to ensure that no private properties are subjected to sewage backup or spill.

D. The CONTRACTOR shall be liable for all damages and related expenses resulting from CONTRACTOR's work.

3.04 Cleaning and Inspection

A. The CONTRACTOR shall be responsible for cleaning, inspecting, confirming the inside diameter, and determining the condition of each manhole to manhole segment of the existing sanitary sewer to be lined. The CONTRACTOR shall note that the existing sewer may have heavy solids, such as drain rock and collapsed sections of pipe, protruding property service connections or root intrusion. The cleaning operation shall be performed in a manner not to further damage the existing pipe. Hydroflushing or balling shall not be permitted.

B. The CONTRACTOR shall perform an internal television inspection after the sewer cleaning operations, point repairs, and root removal is completed and prior to reintroduction of flow to the sewer (without live flows). The television inspection shall be completed in the same direction each time and shall be done with logs using NAASCO PACP codes and color digital video format. A pivot head camera shall be used for all TVI. TVI shall be performed in the presence of the ENGINEER and the INSPECTOR shall decide whether the sewer is properly prepared for liner installation. A copy of the TVI documentation and logs shall be provided to the ENGINEER at the earliest possible date.

C. The CONTRACTOR shall capture, remove, and dispose of all waste materials related to cleaning that could potentially cause a sewer backup, damage existing facilities such as pump stations or cause sedimentation in the downstream sewer system in a proper manner in accordance with applicable regulations.

3.05 Point Repairs

A. It shall be the responsibility of the CONTRACTOR to clear the lines of obstructions such as solids, offset joints, intruding laterals, or collapsed pipe that will prevent the insertion of the liner. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, the CONTRACTOR shall notify ENGINEER and provide TVI and/or other documentation of the obstruction. ENGINEER will then determine the method of correction which may include excavation to uncover and remove or repair the obstruction. The CONTRACTOR shall be responsible for viewing ENGINEER's TVI documentation prior to bidding, if available. The CONTRACTOR is responsible for bidding point repairs found on any line segment scheduled for relining in the unit cost for lining when video documentation and or logs are available for review. In all other cases, the CONTRACTOR will be reimbursed on a time and material bases in accordance with the contract documents or by other means agreeable to both the CONTRACTOR and ENGINEER.

B. A point repair is defined as replacing the existing pipe with a new pipe having the same internal diameter. Suitable pipe materials consist of PVC, RCP, and DIP. The CONTRACTOR shall provide a flexible rubber Calder-type coupling with type 316 stainless steel bands at each end of the replaced section in order to connect the new pipe with the existing line. The replaced section of pipe shall provide a smooth transition between the existing and the new pipe. The excavation, pipe installation,

backfill, and surface restoration shall be performed in accordance with City standards and applicable transportation regulatory agency requirements. The adjustment of protruding property service connections using remote equipment shall be incidental to the lining process unless directed otherwise by ENGINEER. CIPP installation shall be continuous through all new point repairs.

C. The CONTRACTOR shall update the point repair section of the final as-built drawings to reflect the actual work performed and shall submit the completed as-built drawings to ENGINEER prior to acceptance testing.

3.06 Liner Installation

A. The liner shall be installed through an existing manhole or other access point approved by the ENGINEER by means of the installation process and application of hydrostatic head, compressed air, or other means sufficient to fully expand and extend the liner to the next designated manhole or termination point.

B. The liner shall be installed at a rate not to exceed 32 feet per minute.

C. The inversion head shall be such that, allowing for minor impact, at no time will the hoop tension in the felt liner exceed 500 psi or the hoop stress in the polyurethane membrane exceed 8,000 psi.

D. The liner shall be handled in a manner preventing the contact of resins and epoxy with ground surface, pavement, sidewalks, or driveways. All spillage of resins and epoxies shall be promptly addressed in accordance with manufacturer recommendations and MSDS requirements. Removal of spilled materials shall be the responsibility of the CONTRACTOR and shall be performed at no additional cost to MSD.

3.07 Curing

A. After liner placement is completed, a suitable heat source and distribution equipment shall be provided to distribute or circulate hot water or steam throughout the pipe. The equipment shall be capable of delivering hot water or steam throughout the section by means of a pre-strung hose which has been perforated per the manufacturer’s recommendations or other approved means to uniformly raise the temperature to that required to effectively cure the resin. The temperature shall be determined by the manufacturer and based on the resin/catalyst system employed.

B. The heat source piping shall be fitted with continuous monitoring thermocouples to gauge the temperature of the incoming and outgoing water. Temperatures during the cure period shall meet the requirements of the resin manufacturer as measured at the heat source inflow and outflow return lines. The CONTRACTOR shall provide standby equipment to maintain supply of the heat source. An additional continuous monitoring thermocouple shall be placed between the impregnated felt tube and the

pipe invert at the remote manhole and at a point midway between the upstream and downstream manholes to determine the temperature during cure. The temperature during the cure shall not be more than 190° F or less than 140°F at the boundary between the pipe and the liner.

C. Initial cure shall be deemed to be completed when inspection of the exposed portions of the liner appear hard and sound and the remote sensor indicates that an exothermic reaction has occurred. The cure period shall be of the duration recommended by the resin manufacturer during which time the recirculation of the water and cycling of the heat exchanger to maintain the temperature takes place continuously.

D. Temperature shall be maintained during the curing period as recommended by the resin manufacturer and shall follow the heating schedule supplied by the manufacturer and reviewed by the ENGINEER.

3.08 Cool-Down

A. The hardened liner shall be cooled to a temperature below 100°F before relieving the head in the inverted pipe. Cool-down may be accomplished by introduction of cool water into the inverted tube to replace the water being drained from a small hole made in the downstream end. Care shall be taken in the release of the static head so that a vacuum will not develop that could damage the newly installed liner.

B. After the tube is cured, a cool-down period shall be used prior to opening the downstream plug and returning normal flow back into the system. Cool-down shall be in accordance with the manufacturers recommendations.

C. End seal connections shall always be installed and shall be a seal consisting of a resin mixture compatible with the liner/resin system shall be applied in accordance with the manufacturer specifications and approved by the ENGINEER.

3.09 Service Connections

A. All existing property service connections shall be reconnected by the CONTRACTOR after the pipe has been lined. The reconnection of services shall be done without excavation using a television camera-directed cutting device unless otherwise specified by ENGINEER. All reconnected services shall be free of burrs and frayed edges and any restriction preventing free wastewater flow and/or lateral lining. Location of services shall be made by inspection of the pre-inversion TVI documentation or other proven methods.

B. Any connection not satisfactory to ENGINEER shall be repaired with additional CIPP or by installation of service connection lining at no additional cost to the City.

C. The CONTRACTOR is responsible for removing all coupons resulting from PSC reinstatement.

3.10 Testing

A. CONTRACTOR shall provide ENGINEER with color digital video showing the completed work without live flows including all lateral connections. The video must be provided to ENGINEER prior to testing of property service connections.

B. Acceptance testing shall be performed using Focused Electrode Leak Location (FELL 41) system of pipe inspection and shall be performed by an independent third party contractor experienced in the use of the FELL 41 system.

3.11 FELL 41 Test Method

A. The FELL 41 test shall be conducted on a sample of 12.5% +/- 2.5% of the total linear footage of mainline pipe rehabilitated using CIPP. Testing shall be performed only on nonconductive host pipe. It shall be the responsibility of the CIPP contractor to accurately identify the host pipe material based on preinstallation TVI.

B. The pipe to be tested shall be selected by ENGINEER after review of post-installation TVI.

C. The FELL 41 testing shall be conducted in accordance with the manufacturers recommended practices. The FELL 41 contractor shall be responsible for any damages to public or private property resulting from FELL 41 testing activities.

D. The following limits shall be used to determine the significance of detected anomalies.

Pipe Diameter	Green Zone	Yellow Zone	Red Zone
8-inch	0 - 4.5 amps	>4.5 - 5.5 amps	>5.5 amps
10-inch	0 - 3.0 amps	>3.0 - 4.0 amps	>4.0 amps
12-inch	0 - 2.5 amps	>2.5 - 3.5 amps	>3.5 amps

- Green zone anomalies are considered unconditionally acceptable

- Yellow zone anomalies are considered acceptable however; these sections will be targeted for future inspection during the warranty period.

- Red zone anomalies are considered unacceptable. The CIPP contractor at no additional cost to the City must address these defects.

E. Pipes with multiple Red zone anomalies shall be failed. For each failed pipe, an additional pipe section shall be added to the test group and tested at no additional cost to the City.

F. CIPP installations shall be considered acceptable when no Red zone anomalies are detected.

G. All pipes with Red zone anomalies shall be retested after CONTRACTOR has addressed the defect at no additional cost to the City.

H. The FELL 41 contractor shall provide analyzed test results to the both the CONTRACTOR and ENGINEER within 2 business days of testing each section.

3.12 Warranty

A. The CONTRACTOR shall provide the City a warranty to be in force and effect for a period of five (5) years from the date of acceptance. The warranty shall require the CONTRACTOR to repair or replace the liner should leakage, separation, de-lamination, collapse, or other failure as determined by the ENGINEER result from faulty materials or installation.

MANHOLE REHABILITATION

PART 1: GENERAL REQUIREMENTS

1.01 Description of Work

A. This specification consists of all work, materials, labor and equipment required for manhole rehabilitation for the purpose of eliminating infiltration and exfiltration, providing corrosion protection, adjusting final grade of manhole top, repair of voids and restoration of the structural integrity of the manhole.

1.02 CONTRACTOR Submittals

A. All CONTRACTOR Project must be approved by ENGINEER prior to the start of construction. Required submittals are as follows:

1. Manhole rehabilitation system manufacturer's literature (cut sheets) describing the rehabilitation system and equipment components, material/chemical properties, MSDS sheets and environmental requirements for application and worker safety requirements. Provide samples of testing, certification and warranty statements.

2. References of projects successfully completed, incorporating not less than 250 manholes in total which were successfully performed within the last 10 years. Each reference shall include the name of the agency, the name of the project, the date of the project, and an agency contact.

3. Written certification by the manhole rehabilitation system manufacturer stating the installation Contractor is approved to install the rehabilitation system specified.

4. Written certification from the product manufacturer that each of the proposed rehabilitation products is compatible with each other.

5. Traffic Control shall be the responsibility of the Contractor. Any necessary lane closures shall require a permit from the Traffic Division of the City of Jackson or MDOT. Copies of the permits shall be submitted to the Engineer prior to commencing Work.

6. Submit with Each Project:

   a. Description, layout, and application sequencing plan.

   b. Rehabilitation system application requirements including material handling and storage requirements, mixing and proportioning requirements (as

applicable), maximum pot life, film/coating thickness, curing, testing and certification requirements of all rehabilitation materials. Product Material Safety Data Sheets.

c. Detailed instructions and methodology for finishing all pipe and manhole connections to rehabilitated manholes to prevent infiltration and exfiltration.

d. Wastewater Flow Control/Bypassing Plan.

e. Confined Space Entry Plan/Permit.

f. Plan for capturing extraneous debris during rehabilitation processes and debris disposal.

g. Liner and vacuum test results.

B. All submittals shall identify the section(s) of the specifications they address.

PART 2: MATERIALS

2.01 The materials used shall be designed, manufactured and solely intended for sewer manhole rehabilitation. The materials shall have a proven history of performance in sewer manhole rehabilitation for a minimum of 10 years nationally, of similar age, groundwater levels and circumstance. Contractor shall comply with all manufacturers' recommendations for the approved products.

2.02 Riser Rings

A. Precast Concrete: New precast concrete riser rings free from cracks, voids and other defects and shall conform to ASTM C478. Contractor shall use precast concrete riser rings of a nominal thickness of not less than four (4) inches and not more than six (6) inches for reconstruction and/or adjustment of the manhole frame and cover. Concrete riser rings shall include the protective admixtures in accordance with Section ___. Joints shall also be externally wrapped with an external seal wrap as specified in Section ___.

B. Cast Iron: New cast iron riser rings shall be of domestic origin, conform to the latest edition of AASHTO M306. Contractor shall use cast iron riser rings for reconstruction and/or adjustment of the manhole frame and cover of less than 4 inches.

2.03 Cone Replacement: The new precast concrete cone shall be concentric, unless otherwise specified, conforming to ASTM C478 and Section ___. Concrete manhole cones shall include the protective admixtures in accordance with Section ___.Joints shall be sealed with gaskets conforming to ASTM C990 or C443. Joints shall also be externally wrapped with an external seal wrap as specified in Section ___.

2.04 Manhole Frame and Cover: New manhole frames and/or covers shall conform to Section ___ and the Contract Documents. Frames and covers shall be completely coated with an environmentally safe, water-base asphaltic coating which is nontoxic, nonflammable, colorless, and dries to a hard black finish.

2.05 Stainless Steel Inserts: The insert body shall be manufactured of 304 stainless steel with a thickness of not less than 18 gauge. The dish shall have a handle of 3/16" plastic coated stainless steel cable installed on the body of the dish. The handle shall be attached with a #6 high grade stainless steel rivet. The gasket shall be made of close cell neoprene, and shall have a pressure sensitive adhesive on one side. The gas relief valve shall be designed to release at a pressure of 0.5 to 1.5 psi. The valve shall be made of Nitrile for prevention of corrosion from contact with hydrogen sulfide, diluted sulfuric acid and other gases associated with waste-water collection systems. Each dish shall have a factory installed five foot long, 3/16" stainless steel cable retaining tether that shall pass through a water tight grommet in the bottom of the dish with a high grade stainless steel adjustable locking device located between the bottom of the dish and lift loop at the top end of tether. The cable terminal and eye end shall be made of stainless steel.

2.06 Cementitious Mortar: Mortar shall be made of one part Portland cement and two parts clean sharp sand. Cement shall be Type 1 and shall conform to ASTM C 150. Sand shall meet the requirements of ASTM C 144.

2.07 Patching Material: A quick setting fiber reinforced cementitious material shall be used as a patching material and is to be mixed and applied according to manufacturer's recommendations.

2.08 Hydraulic Cement: A rapid setting, high-early-strength, cementitious product specifically formulated for leak control shall be used to stop water infiltration. The material shall be mixed and applied according to the manufacturer's recommendations.

2.09 Chemical Grout: A chemical grout shall be used for stopping very active infiltration and filling voids.

2.10 Liner Materials:

1. Cementitious Liner Material: Cementitious liner products shall be used to form a structural monolithic liner covering all interior manhole surfaces and shall have the following minimum requirements:

    a. Compressive Strength (ASTM C109): 6,000 psi, 28days

    b. Tensile Strength (ASTM C496): 600 psi, 28 days

    c. Flexural Strength (ASTM C293): 1,000 psi, 28 days

d. Shrinkage (ASTM C596): 0.02% at 28 days

e. Minimum Bond (ASTM C952): 200 psi, 28 days

When used as the final rehabilitation liner material (no epoxy liner), product shall be made with calcium aluminate cement. Calcium aluminate is not required when the cementitious liner is used as the underlayment for the epoxy liner application.

2. Epoxy Liner Material: 100% solids epoxy liner is to be applied where corrosion is anticipated. The epoxy liner material shall be applied over the completed cementitious liner material (without the calcium aluminate). The liner shall be spray applied or spin cast. The manufacturer of the selected epoxy liner material shall approve in writing that their epoxy liner is compatible with cementitious repair and liner material. The epoxy liner material shall have the following minimum requirements:

   a. Hardness, Shore D (ASTM D2240): 85 (±2)

   b. Adhesion (ASTM D4541), Concrete: Substrate Failure

   c. Abrasion: ASTM D 4060 – Requirement: No more than 180 mg loss after 1,000 cycles

   d. Corrosion Resistance: Suitable for environments PH of .5 or higher

3. Water: Water shall be clean and potable.

2.11 Internal Manhole Chimney Seal Material: An aromatic urethane rubber material or flexible epoxy mastic used to prevent leakage of water into the manhole through the frame joint area and the area above the manhole cone and shall have the following minimum requirements:

1. Elongation (ASTM D412): 600%

2. Tensile Strength (ASTM D412): 1,150 psi

3. Adhesive Strength (ASTM D903): 175 lb. l/in.

4. Tear Resistance (ASTM D1004): 155 lb. l/in.

The seal shall extend from the inside of the manhole frame down to the cone or corbel of the manhole.

2.12 External Manhole Seal Wrap: When work consists of adjusting manholes or cone replacements, an external seal wrap shall be installed to the outside of concrete risers, steel risers and joints of the precast manhole in order to eliminate infiltration. The

external seal wrap shall conform with Section ___ and be installed in accordance with the details of the Contract Documents and the manufacturer's recommendations.

PART 3: EXECUTION

3.01 EQUIPMENT: Contractor shall utilize equipment approved by the material supplier for the specific application. Hard to reach areas, primer application and touch-up may be performed using hand tools as approved by the manufacturer. Contractor shall be trained by, or have their training approved and certified by the coating product manufacturer for the handling, mixing, application and inspection of the coating product(s) to be used as specified herein.

3.02 Preparation

A. Perform traffic control in accordance with the approved traffic control submittal.

B. Store materials in accordance with manufacturer's recommendations.

C. Schedule and perform the work in a manner that does not cause or contribute to overflows or spills of sewage from the sewer system.

D. Install devices to prevent extraneous material from entering the sewer system and to prevent upstream line from flooding the manhole. If extraneous material or debris falls into a "live" manhole during adjustment operations, the Contractor shall remove debris at no cost to the Owner.

E. Dispose of wastes in accordance with applicable regulations.

F. Schedule and perform any bypass pumping that will be necessary to properly rehabilitate the manhole. Refer to Section ___ for sewer flow requirements.

G. If present in the manhole, Contractor shall remove all access steps. Removal shall consist of neatly cutting steps flush with the wall prior to any lining installation. Contractor shall be responsible for proper disposal of steps.

H. For manholes that are located within pavement areas and require resetting or replacement of concrete riser rings, cones, and /or frames, the Contractor shall sawcut, remove, and replace a 6 ft. x 6 ft. square section of pavement and base for rehabilitation operations. Costs for removal and replacement of pavement and base beyond these limits shall be borne by the Contractor.

3.03 INSTALLATION: Prior to any lining all other miscellaneous work must be complete.

A. Cone Replacement: The Contractor shall replace existing deteriorated manhole cone section with new precast concrete cone section. A preformed gasket material shall be placed in all keyways between existing manhole riser section and cone joints. Prior to

backfilling, rubber external seal wraps shall be applied to the cone and manhole section joint, riser rings and frame in accordance with Subsection ___. If the existing manhole is of brick construction, the cone shall be set in a full bed of mortar on the top course of bricks.

B. Riser Rings: The Contractor shall replace existing, deteriorated riser rings with new precast concrete riser rings and/or cast iron riser rings. All manholes designated to receive casting adjustment and/or alignment shall be adjusted to meet existing finished grade unless an alternative elevation is specified. A cementitious mortar shall be placed in between individual precast concrete riser rings, and precast concrete riser ring and cone joints. The mortar shall be struck smooth with the interior surface of the manhole and floated with a sponge float to a surface profile of 8-10 mils. An epoxy system designed for metal-to-metal adhesion shall be used to connect individual cast iron riser rings and the cast iron riser rings to the frame. Prior to backfilling, rubber external seal wraps shall be applied to the cone and manhole section joint, riser rings and frame in accordance with Subsection ___.

C. Manhole Frame and Cover: Existing frames and covers which must be removed to facilitate manhole rehabilitation, riser reconstruction, and/or casting alignment or grade adjustments shall be salvaged, cleaned and given two coats of an approved bituminous coating by the Contractor for replacement unless determined to be defective by Engineer. If manhole frame and/or cover are determined to be defective, Contractor shall replace with new frame and/or cover. Replacement frames and/or covers shall be furnished and installed in accordance with the Contract Documents. Frames shall be set in full mortar bed. The mortar shall be struck smooth with the interior surface of the manhole and floated with a sponge float to a surface profile of 8-10 mils.

D. Cementitious Liner:

1. Active leaks shall be stopped using hydraulic cement or chemical grout as necessary. Installation shall be in accordance with the manufacturer's recommendations.

2. All manholes to be lined shall be cleaned and scarified with a minimum of 5,000 psi water jet at a minimum water temperature of 180 degrees F. The water jet shall hit the manhole wall surface at as near perpendicular angle as possible. Cleaning the manhole walls from the ground surface without the appropriate angled nozzles will not be accepted. Manhole surface build-up of debris and loose manhole construction materials shall be removed during the cleaning process.

3. The intent of the surface preparation and cleaning work is to remove debris, films or unsound, deteriorated concrete and to provide a structurally sound, clean surface that will enable lining materials to bond to the original substrate at adhesion strengths of that specified herein, a substrate pH of 8.3 is the minimum

pH that will be considered acceptable to demonstrate that the surface preparation and cleaning have been properly performed.

4. Additional aggressive surface preparation and cleaning methods may be necessary to remove carbonated cementitious lining concrete or contaminants that remain after the cleaning performed as described above. The Contractor shall test the pH of the cleaned manhole interior surface at various locations of the manhole and when the results indicate a pH less than 8.3 then additional surface preparations and cleaning will be required. As a minimum level of effort the Contractor shall either dry sand blasting or pneumatic jackhammering with a bushing bit followed by a minimum 5,000 psi water blast.

5. Any bench, invert or service line repairs shall be made at this time using quick setting grout or repair mortar per the manufacturer's recommendations.

6. Invert repair shall be performed on all inverts with visible damage or where infiltration is present. After blocking flow through the manhole and thoroughly cleaning the invert, quick setting patch material shall be applied to the invert in an expeditious manner. The finished invert surfaces shall have a smooth surface and form a continuous monolithic conduit with the sewer pipe entering and leaving the manhole. The bench and invert shall form a watertight seal with the manhole walls, base and pipe seal.

7. Wastewater flow shall be controlled by methods which prevent contact with the new bench and invert for 6-8 hours after mortar placement. If 6-8 hours set time is not possible, a fast setting, high early strength mortar shall be used with provisions for flow control until concrete has set.

8. Fill all cracks, holes and joints what have voids using non-shrink grouts in accordance with the manufacturer's recommendations.

9. Apply Cementitious Liner Material per the Manufacturer's recommendations. Apply Cementitious Liner material so that the final thickness is 0.5-inch minimum or per the thickness required by the manufacturer's minimum specification, whichever is greater. The material shall start at the bottom of the manhole frame and extend to the water level of the invert.

10. Finish repair material to a hard trowel finish and then finish with a sponge float. The sponge float finish shall have a surface profile of 8-10 mils.

11. If the cementitious lining material is not immediately coated with epoxy, apply a seal coat compatible with the repair material to aid in curing and minimize recontamination of the substrate prior to application of the epoxy liner material.

E. Epoxy Liner:

1. Prior to any Epoxy lining perform all work shown in Section ___ above.

2. Remove any curing compounds, sealers or contaminates prior to epoxy lining.

3. Apply epoxy lining material in accordance with the manufacturer's recommendations over the waterproofing/structural repair material shown in Section ___.

4. Epoxy liner shall be 125 mils, minimum, dry film thickness.

3.04 Internal Manhole Chimney Sealant:

A. Perform all work shown in Sections ___ prior to any Internal Manhole Chimney Sealant.

B. Clean all contaminates from manhole frame by sandblasting or mechanical methods as recommended by the chimney sealant manufacturer.

C. Install Internal Manhole Chimney Sealant in accordance with the manufacturer's recommendations. The Contractor shall contact the manufacture for thickness recommendations however; the final liner material shall be made no less than 170 mils.

3.05 External Manhole Seal Wrap: When Work consists of adjusting sewer manholes or cone replacement, an external seal wrap shall be installed to the outside of concrete risers, steel risers and joints of the precast manhole in order to eliminate infiltration. Frame and cover shall be completely coated prior to installation of the external seal wrap. The external seal wrap shall be installed in accordance with the details of the Contract Documents and the manufacturer's recommendations.

3.06 Stainless Steel Insert: If existing manhole is equipped with a non-stainless steel insert, Contractor shall remove and dispose of existing insert and furnish and install a new stainless steel insert in accordance with manufacturer's recommendations. Rivet used for attaching insert to manhole shall be installed into the casting. If existing manhole is equipped with a stainless steel insert pan to prevent intrusion of storm water, pan shall be cleaned and reinstalled by the Contractor unless determined to be defective by the Engineer. If insert is determined to be defective, Contractor shall furnish a new stainless steel insert and install in accordance with manufacturer's recommendations at the completion of manhole rehabilitation operations.

3.07 TESTING: After completion of any rehabilitation operation and backfilling (if required), the Contractor shall conduct the following tests on the manholes:

1. Vacuum Test: Manhole shall be vacuum tested in accordance with Subsection ___.

2. Visual Inspection: The Engineer and Applicator shall make a final visual inspection. Any deficiencies in the finished system shall be marked and repaired.

If an epoxy liner is applied, the following additional tests will be required:

1. Wet Film Thickness Gage: During application a wet film thickness gage, meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application.

2. Adhesion Test: A minimum of 10% of the manholes coated shall be tested for adhesion/bond of the coating to the substrate. Testing shall be conducted in accordance with ASTM D7234-05.

3.08 MEASUREMENT:

A. Manhole Riser Ring (Concrete): Measurement for precast concrete manhole riser rings shall be made on a vertical inch basis.

B. Manhole Riser Ring (Cast Iron): Measurement for cast iron manhole riser rings shall be made on a vertical inch basis.

C. Manhole Cone Replacement: Measurement of Work for payment of this Item shall be made at the unit price bid per vertical foot based on manhole diameter. Measurement shall be made from the bottom of cone to top of cone. Excavation, backfill, disposal of deteriorated cones and surplus excavated material is considered incidental to and, if required, shall be included in this Bid Item. Sawcutting, removal and restoration of pavement and base material, curbs and gutters, shall be paid for as required under the Bid Item for that particular portion of the Work.

D. Reset Existing Manhole Frames and Covers: Measurement for removing, cleaning, and resetting existing manhole frames and covers shall be the actual count (each).

E. Manhole Frame: Measurement for new manhole frame shall be the actual count (each).

F. Manhole Frame (Oversized): Measurement for new oversized manhole frame that is larger than the standard 25” diameter manhole frame shall be the actual count (each).

G. Manhole Frame (Bolt Down Watertight): Measurement for new bolt down watertight manhole frame shall be the actual count (each).

H. Manhole Frame and Cover (Hinged): Measurement for new hinged manhole frame and cover assembly shall be the actual count (each).

I. Manhole Cover: Measurement for new manhole cover shall be the actual count (each).

J. Manhole Cover (Oversized): Measurement for new oversized manhole cover that is larger than the standard 23 ¼" diameter manhole cover shall be the actual count (each).

K. Manhole Cover (Bolt Down Watertight): Measurement for new bolt down watertight manhole cover shall be the actual count (each).

L. S.S. Manhole Insert: Measurement for new stainless steel manhole insert shall be the actual count (each).

M. Manhole Repair (Patching): Measurement for manhole repair shall be made on a cubic foot basis as determined by the actual volume of water seal, solid filler, or waterproof grout mix used to make repairs to wall sections, bench, and invert to manhole connections. All application shall be in accordance with manufacturer's recommendations. All work under this Item is considered to be performed from the interior of the manhole. Manhole repair shall not be measured for payment when required as surface preparation for a manhole lining rehabilitation operation.

N. Manhole Rehabilitation (Cementitious Lining): Measurement for payment of these Items shall be based on the actual number of vertical feet of manhole wall rehabilitated for a standard four-foot diameter manhole. Where manhole diameter is significantly different from the standard (i.e., 5' or 6') then the vertical footage shall be adjusted for pay purposes accordingly, to account for the additional square footage of area requiring rehabilitation (i.e., 5' diameter = 1.25 x vertical footage of standard; 6' diameter = 1.50 x vertical footage of standard, etc.). In like manner, structures that are discovered to have geometric shapes other than circular shall be adjusted as above to provide a consistent method of accounting for the actual square footage of area requiring rehabilitation of walls. All other aspects of measurement shall remain as indicated. All measurements shall be as specified or made by conventional means with accuracies consistent with field conditions and common practice. Should a discrepancy in measurement exist which is greater than ten percent (10%), the Item in question shall be re-measured by both the Contractor and the Engineer for verification. Manhole rehabilitation (cementitious lining) shall not be measured for payment when required as underlayment for a manhole rehabilitation (epoxy lining) operation.

O. Manhole Rehabilitation (Epoxy Lining): Measurement for payment of these Items shall be based on the actual number of vertical feet of manhole wall rehabilitated for a standard four-foot diameter manhole. Where manhole diameter is significantly different from the standard (i.e., 5' or 6') then the vertical footage shall be adjusted for pay purposes accordingly, to account for the additional square footage of area requiring rehabilitation (i.e., 5' diameter = 1.25 x vertical footage of standard; 6' diameter = 1.50 x vertical footage of standard, etc.). In like manner, structures that are

discovered to have geometric shapes other than circular shall be adjusted as above to provide a consistent method of accounting for the actual square footage of area requiring rehabilitation of walls. All other aspects of measurement shall remain as indicated. All measurements shall be as specified or made by conventional means with accuracies consistent with field conditions and common practice. Should a discrepancy in measurement exist which is greater than ten percent (10%), the Item in question shall be re-measured by both the Contractor and the Engineer for verification.

P. Internal Manhole Chimney Sealant: Measurement for payment of this Item shall be based on the actual number of vertical inches depending on the depth of each seal applied. The depth of each seal will be measured as the distance from the manhole frame joint to the top joint of the manhole cone for which final liner material is to be applied. Fractional measurement will be rounded down to the nearest whole number as reported in inches.

Q. Removal of Interior Manhole Steps: Measurement of Work for payment of this Item shall be made at the unit price bid per manhole containing steps, regardless of the number of steps in each.

3.09 PAYMENT:

A. Manhole Riser Ring (Concrete): Payment for precast concrete manhole riser rings will be full compensation for all labor, materials, and equipment necessary to remove and dispose of existing deteriorated concrete manhole riser rings and replace with new precast concrete manhole riser rings; including traffic control, excavation, backfill, and disposal of surplus excavated material, if required. Sawcutting, removal and restoration of pavement and base material, curbs and gutters, shall be paid for as required under the Bid Item for that particular portion of the Work.

B. Manhole Riser Ring (Cast Iron): Payment for cast iron manhole riser rings will be full compensation for all labor, materials, and equipment necessary to remove and dispose of existing deteriorated cast iron manhole riser rings and replace with new cast iron manhole riser rings; including traffic control, excavation, backfill, and disposal of surplus excavated material, if required. Sawcutting, removal and restoration of pavement and base material, curbs and gutters, shall be paid for as required under the Bid Item for that particular portion of the Work.

C. Manhole Cone Replacement: Payment of the unit price amount bid for this Item shall be full compensation for furnishing all materials, labor, and equipment; including traffic control, excavation, backfill, external seals, and disposal of deteriorated cones and surplus excavated material, if required. Sawcutting, removal and restoration of pavement and base material, curbs and gutters, shall be paid for as required under the Bid Item for that particular portion of the Work.

D. Reset Existing Manhole Frames and Covers: Payment for resetting existing manhole rings and covers will be full compensation for all materials, labor, equipment; including traffic control, excavation, backfill, and disposal of deteriorated cones and surplus excavated material, if required. Sawcutting, removal and restoration of pavement and base material, curbs and gutters, shall be paid for as required under the Bid Item for that particular portion of the Work.

E. Manhole Frame: Payment for this item includes full compensation for furnishing and installing a new manhole frame, disposal of damaged manhole frame, and traffic control.

F. Manhole Frame (Oversized): Payment for this item includes full compensation for furnishing and installing a new oversized manhole frame, disposal of damaged oversized manhole frame, and traffic control.

G. Manhole Frame (Bolt Down Watertight): Payment for this item includes full compensation for furnishing and installing a new bolt down watertight manhole frame, disposal of damaged manhole frame, and traffic control.

H. Manhole Frame and Cover (Hinged): Payment for this item includes full compensation for furnishing and installing a new hinged manhole frame and cover, disposal of damaged manhole frame and cover, and traffic control.

I. Manhole Cover: Payment for this item includes full compensation for furnishing and installing a new manhole cover, disposal of damaged manhole cover, and traffic control.

J. Manhole Cover (Oversized): Payment for this item includes full compensation for furnishing and installing a new oversized manhole cover, disposal of damaged oversized manhole cover, and traffic control.

K. Manhole Cover (Bolt Down Watertight): Payment for this item includes full compensation for furnishing and installing a new bolt down watertight manhole cover, disposal of damaged manhole cover, and traffic control.

L. S.S. Manhole Insert: Payment for this item includes full compensation for furnishing and installing a new stainless steel manhole insert, and traffic control.

M. Manhole Repair: Payment for manhole repair will be full compensation for cleaning and preparing surfaces; drilling for access or infiltration relief purposes; and for labor, materials and equipment necessary to purchase, store, transport, mix and apply all patching and preparatory items required to complete the Work; sewer flow control, traffic control and testing.

N. Manhole Rehabilitation (Cementitious Lining): Payment of the unit price amount bid for this Item shall be full compensation for all labor, materials, equipment, surface cleaning and preparation, patching and/or grouting, sewer flow control, traffic control, and testing.

O. Manhole Rehabilitation (Epoxy Lining): Payment of the unit price amount bid for this Item shall be full compensation for all labor, materials, equipment, surface cleaning and preparation, patching and/or grouting, cementitious underlayment, sewer flow control, traffic control, and testing.

P. Internal Manhole Chimney Sealant: Payment of the unit price amount bid for this Item shall be full compensation for all labor, materials, sealant system accessories, equipment, surface cleaning and preparation, patching and/or grouting, sewer flow control, traffic control, and testing.

Q. Removal of Interior Manhole Steps : Payment for this item will be full compensation for labor, materials and equipment necessary to remove steps from the interior of the manhole, patch any voids created by the removal, sewer flow control, and traffic control.

3.10 PAY ITEMS:

Item No.	Item Unit
1. Manhole Riser Ring (Concrete)	Vertical Inch
2. Manhole Riser Ring (Cast Iron)	Vertical Inch
3. Manhole Cone Replacement	Vertical Foot
4. Reset Existing Manhole Frames and Covers	Each
5. Manhole Frame	Each
6. Manhole Frame (Oversized)	Each
7. Manhole Frame (Bolt Down Watertight)	Each
8. Manhole Frame and Cover (Hinged)	Each
9. Manhole Cover	Each
10. Manhole Cover (Oversized)	Each
11. Manhole Cover (Bolt Down Watertight)	Each
12. S.S. Manhole Insert	Each
13. Manhole Repair (Patching)	Cubic Foot
14. Manhole Rehabilitation (Cementitious Lining)	Vertical Foot
15. Manhole Rehabilitation (Epoxy Lining)	Vertical Foot
16. Internal Manhole Chimney Sealant	Vertical Inch
17. Removal of Interior Manhole Steps (Per M.H.)	Each

EPA Comments on Evaluation Plan

City of Jackson Response to EPA Comments

EPA Evaluation Plan Approval Letter

TW, MDJ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

MAY 07 2014

CERTIFIED MAIL 7010 1060 0002 1703 9843
RETURN RECEIPT REQUESTED

City of Jackson
Attn.: The Honorable Charles Tillman
Acting Mayor, City Hall
219 South President Street
Jackson, Mississippi 39205

Re: Sewershed Evaluation Plan Comment Letter
City of Jackson, Mississippi Consent Decree
Case No.: 3:12-cv-790 TSL-JMR

Dear Mayor Tillman:

The U.S. Environmental Protection Agency Region 4 has consulted with the Mississippi Department of Environmental Quality (MDEQ) upon reviewing the Sewershed Evaluation Plan dated February 28, 2014, pursuant to Section V. of the subject Consent Decree above. Please address the comments below, incorporate into a revised Sewershed Evaluation Plan as appropriate and resubmit for approval within 30 days of receipt of this letter, in accordance with Paragraph 13 of the Consent Decree.

1. Table 2-1 (pg. 2-1): The table lists Trahon Creek and Big Creek discharging into the West Bank Interceptor (WBI). It is EPA/MDEQ's understanding that these sewer basins flow into the Trahon Wastewater Treatment Plant and does not affect the WBI. Please correct.
2. Table 2-1 (pg. 2-1): Does Caney Creek actually discharge into the West Bank Interceptor or, as EPA believes, is it a separate sewer pipe that directly enters the influent pump station at the Savanna Street WWTP? Please correct if the Caney Creek sewer basin does not discharge into the WBI.
3. Flow Monitoring Results Reporting/Flow and Rainfall Monitoring Data Analysis (pg. 3-9): Please include as part of the monthly Flow Monitoring Program Report, the frequency of flow meter inspection, service, and calibration and specify the minimum acceptable frequency of flow meter inspection.
4. Flow and Rainfall Data Analysis (pg. 3-9): The last paragraph states, "In addition, not all wet season storm events will furnish the necessary I/I data to measure and model system responses to significant rainfall events." Please explain the decision making process (conditions or circumstances) in which the City will exclude specific rain events.
5. Data Acquisition and Review (pg. 3-10): When comparing rain data to the calibration sheet, please explain what procedures will be followed if it is determined that the sensor is malfunctioning and that the monthly data set is erroneous.

6. Data Acquisition and Review (pg. 3-10): Please specify requirements for field inspections to be conducted to confirm meter calibration in both wet and dry conditions to ensure meter accuracy during laminar/turbulent flow.

If you should have any questions regarding the above comments, please contact Mr. Brad Ammons at (404) 562-9769 or via email at ammons.brad@epa.gov.

Sincerely,

Maurice L. Horsey, IV, Chief
Municipal & Industrial Enforcement Section
Clean Water Enforcement Branch

cc: Mr. Les Herrington, P.E.
Mississippi Department of Environmental Quality

Mr. Terry Williamson
City of Jackson

Mr. Willie Bell
City of Jackson

Department of Public Works

200 South President Street
Post Office Box 17
Jackson, Mississippi 39205-0017

May 27, 2014

Mr. Maurice L. Horsey, IV, Chief
Municipal & Industrial Enforcement Section
Clean Water Enforcement Branch
Region IV, U.S. Environmental Protection Agency
61 Forsyth Street
Atlanta, GA 30303-8960

Re: Sewershed Evaluation Plan Comments
City of Jackson, Mississippi Consent Decree
Case No.: 3:12-ev-790 TSL-JMR

Dear Mr. Horsey:

We are in receipt of your letter of April 22, 2014 providing review comments for the subject document. A response to each review comment is provided below.

1. Table 2-1 (pg. 2-1) – This table has been corrected to show the proper discharge location for Trahon Creek and Big Creek.

2. Table 2-1 (pg. 2-1) – The table has also been corrected to indicate the proper discharge location of the Caney Creek Interceptor to the Savanna WWTP influent pump station.

3. Flow Monitoring Results Reporting (pg. 3-9) – The Flow and Rainfall Monitoring System Specification Para. 3.3.1 specifies the required frequency for flow meter maintenance and calibration. Each meter must be visited and recalibrated at least monthly or more frequently depending on the type of meter. The Flow and Rainfall Monitoring System specifications used for sewershed evaluation are attached.

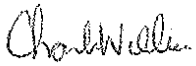
4. Flow and Rainfall Data Analysis (pg. 3-9) – No rain events will be excluded from the analysis. Since these are short-term flow meters located within the sewersheds, the flow monitoring period may be extended if insufficient wet weather events occur within the 90 day monitoring period.

5. Data Acquisition and Review (pg. 3-10) – If flow meter data is determined to be erroneous it will not cause the entire data record for the month to be excluded. Instead, the data will be examined to determine when the recording anomaly began. Only the obviously errant data will be excluded. The data loggers read data every 15 minutes, so it should generally be apparent when the malfunction started.

6. Data Acquisition and Review (pg. 3-10) – No specific measures are being required to recalibrate flow meters during both wet and dry conditions. It is believed that over the course of the project the regularly scheduled maintenance and recalibration site visits will occur in both wet weather and dry weather periods.

We are currently proceeding with implementation of the Sewershed Evaluation Plan in accordance with the schedule submitted. If you have any additional questions or require more information please let us know.

Sincerely,



Charles Williams, Ph.D., P.E.
Interim Director
Department of Public Works

Enclosure

cc: Mr. Les Herrington, P.E.
Mississippi Department of Environmental Quality

Mr. Terry Williamson, Legal Counsel
City of Jackson Department of Public Works

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**	Savanna WWTP	Savanna
12	**Trahon Creek**	Big Creek	Trahon
13	**Big Creek**	Trahon WWTP	Trahon
14	**Bogue Chitto Creek**	Big Black River	Presidential Hills
15	**Bakers Creek**	Lynch Creek	Savanna

SECTION 40 91 23

FLOW AND RAINFALL MONITORING SYSTEM

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SECTION 40 91 23

FLOW AND RAINFALL MONITORING SYSTEM

PART 1: GENERAL REQUIREMENTS

1.01 Purpose

A. The City of Jackson, Mississippi, herein referred to as the Owner, has determined that it will be necessary to perform temporary flow monitoring to locate and quantify Infiltration and Inflow (I/I) within the wastewater collection system.

1.02 Network Overview and Scope

A. Wastewater Flow Monitors

1. The Owner will have wastewater flow monitors installed within the wastewater collection system at forty-six (46) locations. Each of the flow monitors will be networked into a system and provide the Owner with vital information on Infiltration and Inflow (I/I) and the hydraulic performance of the wastewater collection system as indicated in PART 3.

2. The Owner will contract with a Service Provider to deliver, install, and maintain flow monitors for the flow monitoring program. The Service Provider shall supply all hardware for each flow monitoring location as specified in PART 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, and data confirmation services.

B. Rain Gauges

1. Rain gauge monitors will be installed at four (4) locations within the wastewater collection system. Each of the rain gauges will be used, in conjunction with the flow monitors, to provide the flow monitoring basins with critical information correlating rainfall to the flow monitor.

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

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

C. 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 Uptime as specified in PART 3.

D. 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 3.06.

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

E. Service Provider Qualifications

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

PART 2: SERVICE PROVIDER QUALIFICATIONS AND PROPOSAL REQUIREMENTS

2.01 Service Provider Evidence of Certification

A. Quality Management System

1. The Service Provider shall have 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. Manufacturer – 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. 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 flow monitoring 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 temporary network project, noting past experience of similar scope and complexity.

2.04 Service Provider Experience

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

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

   1. Where service provider has provided flow monitoring and rain gauge equipment for the purposes of I/I identification.

   2. At least three (3) of the projects must have over twenty (20) monitors installed for I/I identification purposes with the equipment proposed.

3. The Service Provider shall provide at least three references of projects similar in size and scope where a minimum of 97% overall system-wide Uptime was achieved.

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 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 conducted by the service provider. List the number of units and type specified that the service provider has furnished.

2.05 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.

3. 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 the conditions 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 Wireless Access (Optional Service)

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 may provide a method for remote (wireless) access to the flow monitors. The Service Provider may install wireless equipment and ensure it is operational.

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

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 on contact wetted sensors.

3. Number of confirmations – the Owner will require the service provider to perform a manual depth and velocity measurements at every site in order to

confirm that the sensors are actually measuring accurate depths and accurate velocities at the start of the project.

4. A schedule of confirmations shall be developed to ensure accuracy. It is the intent of the Owner to have high quality raw data. It is the Service Provider's responsibility to maintain/achieve the minimum Uptime requirement. If submerged AV sensors or contact wetted sensors are utilized then an Operation/Maintenance visit needs to be scheduled weekly (every seven (7) days). The Service Provider shall provide a detailed description of their proposed confirmation methodology.

B. Method of confirmation

1. Initial confirmation of the flow meters shall involve an in-manhole measurement 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 weather daily flows.

2. The confirmation checks will be recorded, documented and provided to the Owner fourteen (14) days after the installations are complete. Each confirmation shall consist of an instantaneous depth of flow and velocity measurement and comparison to the flow monitor readings.

3.04 Operations and Maintenance Services

A. The Service Provider shall provide all spare parts at the Service Providers expense to maintain the equipment.

B. The Service Provider shall provide a fixed price for three (3) months of complete maintenance of the network with an option for a one (1) month extension. Pricing will be per meter per month for Operation/Maintenance services.

C. Operation and Maintenance Services will include weekly (defined as every seven (7) days not to exceed ten (10) days) site visits where physical depth and velocity calibration measurements will be performed and compared to flow meter readings, unless Optional Wireless services are provided as described in 3.04 (D).

D. If Optional Wireless Services are used, the service provider will be responsible for collecting the data from the flow monitors and rain gauges at least three (3) times per week and each site shall be visited at least once per month where a physical depth and velocity calibration measurement will be performed and compared to flow meter readings. The service provider shall have the capability to respond within forty-eight (48) hours to maintain the flow monitors should an issue arise.

3.05 Data Uptime

A. Each flow monitor and rain gauge site shall be maintained to assure a minimum up-time of ninety-five percent (95%). Data editing to achieve the uptime requirement is not acceptable. Data editing of depth/velocity outliers is acceptable but missing data or editing wet weather data is not acceptable. For clarification purposes, three (3) DRY weather days per month are allowed for data editing using Manning equations and/or an equivalent method approved by the ENGINEER.

B. The Service Provider must download the original (raw) data files from the flow meters after 30 days of data collection and submit with monthly invoice.

C. The penalty of non-compliance with the required Uptime requirements of each flow monitor will be a non-payment of a unit rate per month. All available data for that month for that meter must be submitted to the Owner.

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 weekly 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 5 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 PART 5.

PART 4: DETAILED EQUIPMENT SPECIFICATIONS

4.01 Flow Monitoring Equipment

A. The Service Provider shall maintain a minimum of 95% uptime on a per site per month basis. The Owner understands that hydraulic conditions can vary greatly from site to site. The Service Provider must decide what flow monitor and sensor technology will achieve the uptime requirements. The service provider must state clearly what equipment will be purchased, utilized and provided for the project. If multiple manufacturers are to be utilized, then a detailed plan and explanation must be submitted as part of the proposal required in PART 2. All equipment for flow monitors, rain gauges and sensors must be calibrated prior to installation. This contract does not require new equipment however if the service provider has equipment greater than five (5) years old, manufacturer proof of calibration or acceptable terms to be approved by the Owner must be provided in the appendix of your proposal. Below are the minimum requirements:

B. 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 (some locations may require 5 minute data). The data logger shall support a circular buffer (wrap) with the oldest data only being written over once the memory is filled.

2. Dynamic Logging may be desired to go from 15 minutes during dry weather to 5 minutes during wet weather events.

3. The Data logger must have an environmental rating of NEMA 6P (IP68) and/or assurances the equipment is waterproof and submersible.

4. Battery Life – Provide battery life capabilities. Clock – Unit shall have a battery-backed hardware real-time clock/calendar. Date/Time stamp will be central time zone.

5. If wireless telemetry is used, a web-based log-in and credentials will be provided to the project management team and the Owner.

6. A depth sensor with cable connection to the data logger shall have the capability of accurately measuring a minimum depth. The Service Provider must clearly show the depth measurement technology utilized along with the manufacturer data sheet outlining a minimum of the following:

   a. Standard Operating Range in centimeters or inches.

b. Accuracy % of reading.

c. Sensor Cable to include material, length and connectors.

7. A velocity sensor with cable connection to the data logger capable of accurately measuring velocity. The Service Provider must clearly show the velocity measurement technology utilized along with a manufacturer data sheet outlining a minimum of the following:

a. Method of Velocity measurement (principle).

b. Range of the Velocity readings in feet per second.

c. Accuracy % of the reading.

8. Include an explanation of the capabilities of the equipment proposed to accurately measure depth and velocity 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 (0.025 mm) per tip of bucket.

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

4.03 Engineering Requirements

A. Power Requirements

1. Battery – The equipment shall be able to use non-rechargeable alkaline batteries to maintain 15-minute sample rate (logging depth and velocity).

B. Error Checking

1. Data Quality – If wireless telemetry is provided, the equipment shall be capable of transferring data accurately and reliably at minimum every four (4) hours to transfer.

2. Alarming – If wireless telemetry is provided, alarming parameters shall be implemented to ensure high quality data. It is the service provider's responsibility to establish the alarming to meet the Uptime requirement.

PART 5: FLOW INFORMATION DELIVERABLES

5.01 Status Report

A. Service Provider will submit all site sheets and flow monitor installation forms to the Owner, fourteen (14) days after the metering period starts.

B. Service Provider will provide status/progress report after thirty (30) days of data has been collected.

C. Service provider will attend a project kickoff meeting, monthly Progress Meetings, and project close-out meeting with the Engineer and Owner. At each Progress Meeting the Service Provider will submit a status report to the Owner presenting the flow monitoring data collected during the preceding month. Service Provider costs for project meeting preparation and attendance shall be incorporated into the unit prices listed on the bid form.

D. Status report 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. Scattergraphs are optional in the status report, only needed if to further explain the hydraulic conditions at the site. PDF format is acceptable for hydrographs and scattergraphs.

E. The Status report 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 first thirty (30) day reporting period. The tabular data can be provided electronically.

F. Status reports shall consist of a narrative summary of observed flow conditions at each monitoring location.

G. Status 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.

H. Status report shall be provided to the Owner no later than fourteen (14) days following the first thirty (30) days of the flow monitoring period.

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

4.02 Flow Analysis Report

A. Service provider will provide the Owner with I/I analysis and reporting.

B. Task 1 – Flow Monitor Installation Forms: Service provider will provide flow monitor installation forms along with photographs, diagrams, locations, sketches and pertinent documentation.

C. Task 2 – Operation/Maintenance Forms: The service provider will generate a flow metering maintenance log documenting field maintenance activities performed during the metering period. The log should cover cleaning of sensors, calibrations, battery replacement, issues, meter swap, etc.

D. Task 3 – Data Editing Forms: The service provider shall provide notes of data irregularities and data found inaccurate. Documentations shall be provided regarding the use of Manning's equation.

E. Task 4 – Flow Balance: The service provider shall conduct a flow balance of the flow monitors sites. Flow balances will be conducted on a daily volumetric basis at the end of the flow monitoring period. A flow schematic will be provided and issues with any flow balancing will be noted to the Owner.

F. Task 5 – RDII Analysis: Service provider to provide a dry weather period and development of a Rainfall Dependent Inflow/Infiltration for each flow monitored location. RDII shall be calculated on a per linear foot per inch per diameter basis. RDII ranking shall be provided from highest to lowest.

END OF SECTION

TW

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

JUN 17 2014

CERTIFIED MAIL 7012 1010 0002 0759 6090
RETURN RECEIPT REQUESTED

City of Jackson
Attn.: The Honorable Charles Tillman
Acting Mayor, City Hall
219 South President Street
Jackson, Mississippi 39205

Re: Approval of the West Bank Interceptor Work Plan; the Sewershed Prioritization Work Plan; the Sewershed Evaluation Plan; the Pump Station Operations Program and the Pump Station Preventative Maintenance Program
City of Jackson, Mississippi Consent Decree
Case No.: 3:12-cv-790 TSL-JMR

Dear Mayor Tillman:

On behalf of the U.S. Environmental Protection Agency Region 4 and the Mississippi Department of Environmental Quality, the EPA has reviewed the responses to comments on the following submittals: (1) the West Bank Interceptor (WBI) Work Plan; (2) the Sewershed Prioritization Work Plan; (3) the Sewershed Evaluation Plan (SEP); (4) the Pump Station Operations Program (PSOP) and (5) the Pump Station Preventative Maintenance Program (PSPMP) for the City of Jackson (Jackson) all dated May 27, 2014. The EPA hereby approves the revised WBI Work Plan, the revised Sewershed Prioritization Work Plan, the revised SEP, the revised PSOP and the revised PSPMP.

Jackson shall place all documents related to the above submittals in the Public Document Repository. In addition, Jackson shall implement the above revised Work Plans, Plans and Programs in accordance with each revised submittal. Finally, Jackson shall certify the status of the implementation of each Work Plan, Plan or Program, including its completion, in the Semi-Annual Report or Annual Report pursuant to Section IX of the subject Consent Decree.

Please contact Mr. Brad Ammons at (404) 562-9769 or via email at ammons.brad@epa.gov, if you have any questions.

Sincerely,

Maurice L. Horsey, IV, Chief
Municipal & Industrial Enforcement Section
Clean Water Enforcement Branch

cc: Mr. Les Herrington, P.E.
Mississippi Department of Environmental Quality

Mr. Terry Williamson
City of Jackson

Mr. Charles Williams, Ph.D., P.E.
City of Jackson