

# **FORREST CITY WATER UTILITY**



## **I/I TRAINING & PROGRAM IMPLEMENTATION**

**ADEQ  
Layne Pemberton  
Enforcement Analysis  
Water Division, Enforcement Branch**



Forrest City Water Utility  
303 N. Rosser St./ P.O. Box 816  
Forrest City, AR 72336  
Phone: 870.633.2921/ 870.270.5017

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June 12, 2015,

Mr. Layne Pemberton  
ADEQ  
5301 North Shore Drive  
Little Rock, AR 72118-5317

Re: NPDES Permit #AR0020087  
AFIN 62-00070  
Sanitary Sewer Overflow (SSO)  
Corrective Action Plan (CAP) Request  
Letter Dated May 11, 2015

Dear Sir,

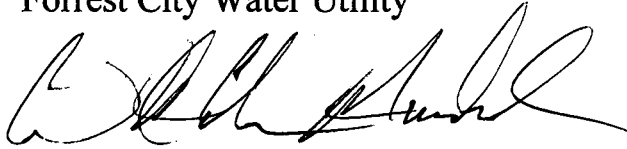
In response to your request for a Corrective Action Plan (CAP), we submit the following:

- A. Our outline program of training and program implementation for I/I.
- B. Our public information and customer training on the proper utilization of our systems. (Via our monthly newsletter, enclosed)
- C. Professional engagement: We have engaged RJN Group to act as our overall program manager to properly train our staff on all functional areas and analysis data collected during our study and make recommendations on remedial activities.

It is our belief and expectations that these continual measures will ensure a system that conforms in every respect to our commitment to being a responsive and responsible operator in accordance with NPDES regulations.

If there are further questions or concerns, please contact me at your earliest opportunity

Respectfully Yours,  
Forrest City Water Utility

A handwritten signature in black ink, appearing to read "W.H. Calvin Murdock". The signature is fluid and cursive, with the first name "W.H." being particularly prominent.

W.H. Calvin Murdock, Utility Manager  
870.633.2921 Office  
870.261.2849 Cellular  
[Whcm2@ForrestCityWater.com](mailto:Whcm2@ForrestCityWater.com)

Cc: The Honorable Larry S. Bryant,  
Mayor, City of Forrest City

## Forrest City Water Utility

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# Alive With Pride

### Special points of interest:

- The Affects of Water Pollution
- Origins of Father's Day
- Manager's Corner

*Remember: Please  
DO NOT pour FATS,  
OILS, or GREASE in  
your drains. It will  
leave a "yuck" of a  
mess in our sewer  
pipes! Thank You!!*

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JUNE 2015

Volume 1 Issue 9

## The Affects of Water Pollution

Water they say is life, and indeed they were right. With about 70% of the earth's cover being water, it is undeniably one of our greatest resources. As young students, we learned about the various ways to conserve water: coming to think of it, water, is used in almost every important chores and processes. It is an important element in both domestic as well as industrial purposes. However a closer inspection of our water resources today give us a rude shock.

Infested with waste ranging from floating plastic bags to chemical waste, our water bodies have turned into a pool of poison. The contamination of

water bodies in simplest words means water pollution. Thereby the abuse of lakes, ponds, oceans, rivers, reservoirs, etc. is water pollution. Pollution of water occurs when substances



that will modify the water in negative fashion are discharged in it. This discharge of pollutants

can be direct as well as indirect. Water pollution is an appalling problem, powerful enough to lead the world on a path of destruction. Water is an easy solvent, enabling most pollutants to dissolve in it easily and contaminate it. The most basic effect of water pollution is directly suffered by the organisms

and vegetation that survive in water, including amphibians. On a human level, several people die each day to consumption of polluted and infected water.

As per the Economist report (dated 2008) each day over 1000 children die of diarrheal sickness in India and the numbers have only increased alarming in the last five years. Water is polluted by both natural and man-made activities. Volcanic eruptions, earthquakes, Tsunamis, etc. are known to alter water and contaminate it, also affecting the ecosystem that survives under water.

## Origin of Father's Day

The campaign to celebrate the nation's fathers did not meet with the same enthusiasm—perhaps because, as one florist explained, "fathers haven't the same sentimental appeal that mothers have." On July 5, 1908, a West Virginia church sponsored the nation's first

event explicitly in honor of fathers, a Sunday sermon in memory of the 362 men who had died in the previous December's explosions at the Fairmont Coal Company mines in Morningside, but it was a one-time commemoration and not an annual holiday. The next year, a woman

named Sonora Smart Dodd, tried to establish an official equivalent to Mother's Day for male parents. She went to local churches, the YMCA, shopkeepers and government officials to drum up support for her idea, and was successful. Washington State celebrated the



## Water Pollution cont.

### Some Causes of Water Pollution



**Industrial Waste:** Industries produce huge amount of waste which contains toxic chemicals and pollutants which can cause air pollution and damage to us and our environment. They contain pollutants such as lead, mercury, sulphur, asbestos, nitrates and many other harmful chemicals. Many industries do not have proper waste management system and drain the waste in the fresh water which goes into the rivers, canals, and later to the sea. The toxic

chemicals have the capacity to change the color of the water, increase the amount of minerals, also known as Eutrophication, change the temperature of water and pose serious hazard to water organisms.

### Sewage and Waste Water

The sewage and waste water that is produced by each household is chemically treated and released into the sea with fresh water. The sewage water carries harmful bacteria and chemicals that can cause serious health problems. Pathogens are known as a common water

pollutant; the sewers of cities house several pathogens and thereby diseases. Microorganisms in water are known to be causes of some very deadly diseases and become the breeding ground for other creatures that act like carriers. These carriers inflict these diseases via various forms of contact onto an individual. A very common example of this process would be Malaria.

Water pollution is common and is an area of high alert. Water needs to be preserved and respected today, for us to live a tomorrow.

If you have a water emergency after-hours, weekends or on holidays, please call us at 870.633.1366

## Origin of Father's Day cont.

nation's first statewide Father's Day on July 19, 1910. Slowly, the holiday spread. In 1916, President Wilson honored the day by using telegraph signals to unfurl a flag in Spokane when he pressed a button in Washington, D.C. In 1924, President Calvin Coolidge urged state governments to observe Father's Day. Struggling retailers and advertisers redoubled their efforts to make Father's Day

### Happy Fathers Day



a "second Christmas" for men, promoting goods such as neckties, hats, socks, pipes and tobacco, golf clubs and other sporting goods, and greeting cards.

In 1972, in the middle of a hard-fought presidential re-election campaign, Richard Nixon signed a proclamation making Father's Day a federal holiday at last. Today, economists estimate that Americans spend more than \$1 billion each year on Father's Day gifts

MY POP ROCKS

## Manager's Corner

Congratulations to all of our seniors who will begin the next chapter of their lives by entering the world of work. Others will begin their next leg of their education by entering institutions of higher learning.

I want to encourage you; in that whatever path you

take, be encouraged and take that next step towards achieving your goals, and pursue it with all your energy.

Remember that focus and hard work will produce the desired result.

W.H. Calvin Murdock,  
Manager

Arkansas One Call



Know what's below. Call before you dig.



# ADEQ

ARKANSAS  
Department of Environmental Quality





## Forrest City Water Utility

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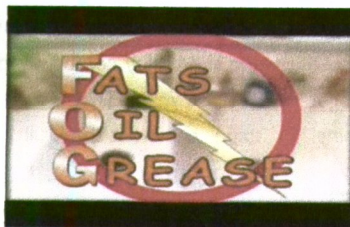


Happy New Year  
**2015**

# Alive With Pride

### Special points of interest:

- Clogging of Pipes and Drains
- FCWU Christmas Party
- Two to Retire
- Manager's Corner



## Grease Goblin

**LAST SEEN:**  
Loitering in Sinks  
and Drains  
**WANTED FOR:**  
Causing Sewer  
Overflows



January 2015

Volume 1 Issue 4

## F.O.G. Fats Oil & Grease

### Fats, Oils & Grease (FOG)

When Fats, Oils, and Grease (FOG) go down the drain, it builds up in the pipes, causing clogs. These clogs can cause a sewer pipe to break or back up into the street, causing a Sanitary Sewer Overflow (SSO). Large amounts of oil and grease in the wastewater cause trouble in the collection system pipes and the wastewater treatment plant. It decreases pipe capacity and requires that piping systems be cleaned more often and/or some piping to be replaced sooner than otherwise expected.

Grease in a warm liquid may not appear harmful. But, as the liquid cools, the grease or fat congeals and causes nauseous mats on the surface of

settling tanks, digesters, and the interior of pipes and other surfaces and this may cause a shutdown of treatment plant units or messy backups in your home or business.

This can also cause harmful bacteria that is unhealthy for people and pets that might come in contact with them. SSOs are usually cleaned up at the site, but they can spill into the gutter and storm drain system before we can get there. Raw sewage in our waterways causes pollution that kills wildlife, causes foul odors, and makes our waterways unsafe to enter.

### Help Us - Keep It Off the Streets

If you see water and sewage bubbling up from a maintenance hole or pooling in a

grassy area, please report it immediately by calling the office 870.633.2921. Here are some ways that you can help prevent SSOs.

### In the Home

Never pour grease down sinks, drains, or the toilet.

Collect cooking fats, oils, and grease (FOG) into a container and dispose of them in the garbage.

Before washing, wipe FOG from pans with a paper towel.

Catch food scraps with baskets or strainers in sink drains. Throw scraps in the garbage.



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## Observing the Holidays

During the month of December, Forrest City Water Utility had their company Christmas Party at the Forrest City Civic Center. This was a D & R catered event. D & R Caterers did a fabulous job with the food and the delicious peach cobbler. Many thanks

goes out to the manager, W.H. Calvin Murdock and the Administrative Assistant, Kimmie-K. Autry for putting on such a well received event. It has been awhile since Forrest City Utility has had a company Christmas Party and there is hope there will be

more to come. Pictures from the party follows :





Alive with Pride

## Observing Holiday cont.



Our office will be closed on Monday, January 19, 2015 to observe Martin Luther King Holiday.



Arkansas One Call



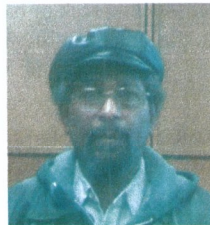
Know what's below. Call before you dig.



ARKANSAS Department of Environmental Quality

## Two FCWU Employees Set for Retirement

Forrest City Water Utility would like to recognize two employees who are set to retire this month. One is Anderson Byers who has served the Utility and his community for forty-one years as our Back Hoe Operator and Truck Supervisor. Mr. Anderson says he has enjoyed his time here at Forrest City Wa-



ter Utility. According to Mr. Anderson, "If and when I can, I would like to get back into fishing. However, my time now is to rest, spend more time with the wife, and spoil my only granddaughter." The other employee is Kenny Douglas who has served the

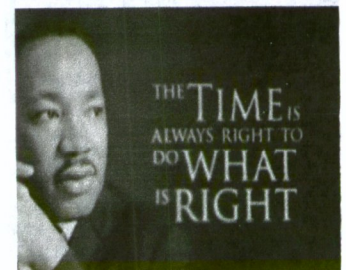
Utility and his community for forty years. These two men have served their community and the Utility combined for over 80 years. That is a lot of experience that the Utility will be losing.

These two men have shown this company bountiful years of service. FCWU is very thankful for their years of service and will be sorely missed.

## Manager's Corner

2014 was a very successful year for Forrest City Water Utility. We are saddened by the departure of some of our key employees, but we are also encouraged by the addition of new youthful employees who will bring new energy and enthusiasm to the Utility.

We are looking forward to 2015 with great expectations for exciting new programs to launch. Forrest City Water Utility is committed to self-evaluation and continuous improvement in every level of operations. W.H. Calvin Murdock, Manager





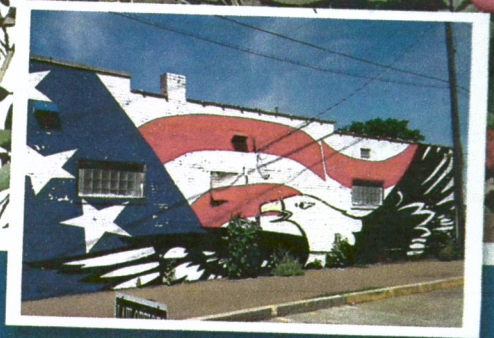
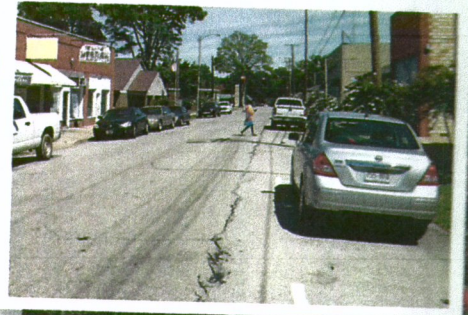
August 26, 2013

A Statement of Qualifications Prepared for the

# Forrest City Water Utility

FORREST CITY  
AREA  
Chamber  
of  
Commerce

## I & I Study



Prepared by

**rjngroup**

The Choice for Collection System Solutions

900 South Shackelford, Suite 28 • Little Rock, AR 72211 • [www.rjn.com](http://www.rjn.com)





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I/I  
Training and Implementation

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- ASSET PROJECT
- EQUIPMENT
- STAFFING
- SCHEDULING

**From:** Stephen Jeffus <sjeffus@rjnmail.com>

**To:** Calvin Murdock <whcm2@aol.com>

**Subject:** Revised field training scope and additional info on Mapping and Asset Management

**Date:** Mon, Apr 13, 2015 3:20 pm

**Attachments:** Asset Management Program Development for Forrest City.docx (48K),  
Field Inspection Training for Forrest City Draft 04092015.docx (43K),  
Overall Wastewater System Maps Inventory and Map Development.docx (43K)

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Mr. Murdoch,

As per our discussion recently I've compiled some additional information for your review and consideration. I've revised the training scope and added a scope on mapping and one covering the development of an asset management program.

I revised the training scope to provide some clarification and to add content based on feedback we received from other clients that have gone through a training program with us. The mapping scope includes the development of an asset ID and naming protocol along with the development of an asset database that facilitates GIS and compilation of a digital map of the sewer system. This can be done whether the surveying is completed by RJN or by Forrest City Water Utility. The Asset Management scope includes the development of the standards and protocol for listing and naming of water and sewer assets. There is some potential overlap between some areas of each scope. Each scope is designed to stand-alone but can easily be meshed with any of the others.

#### TRAINING

One change to the training scope based on the feedback from our clients is the addition of an initial workshop to go over the Forrest City Water Utility's goals and discuss the resources needed to meet those goals. The training modules can then be selected that best the Utility's goals and available resources. For example, dyed water testing involves a considerable amount of equipment that might only serve that one purpose. If the Utility doesn't want to tie up the resources in a dye trailer there is no need to include training on dyed water inspections. Each investigation technique, and its resource requirement, will be evaluated in terms of the expected resources and capital to implement and sustain.

We also recommend that consideration be given to developing a field manager or "champion" that can take the lead in the Utility's efforts in developing a sustainable sewer evaluation practice. It is also recommended that the Utility consider and implement a proactive training cycle to keep all of the Utility apprised of enhancements in sewer evaluation techniques and technology.

#### MAPPING

This scope includes developing digital maps for the Utility. It starts by working with the Utility to develop a naming protocol and then collecting survey data. This can be done by RJN or the Utility.

#### ASSET MANAGEMENT

This scope is for developing a long term asset management plan that can be used by the Utility for both water and sewer assets. It is designed to develop the foundation of an asset management plan first and then proceed, as resources allow, into condition assessment and then proactive, predictive care of the Utility's assets. The assessments can be done by RJN or the Utility.

#### Conclusion

I would appreciate a chance to meet with you to further discuss these scopes. Would you be available for lunch or dinner one day during the Arkansas Water show in Hot Springs?

I am working on budget pricing for the training scope. I hope to have that to you in a few days. I'll also compile a list of references as requested.

Thanks,

**Stephen Jeffus, PE**

Client Manager

[sjeffus@rjnmail.com](mailto:sjeffus@rjnmail.com)

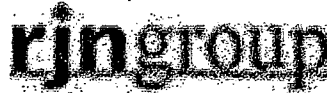
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**View Profile**



Please note: I have a new email address. [sjeffus@rjnmail.com](mailto:sjeffus@rjnmail.com).



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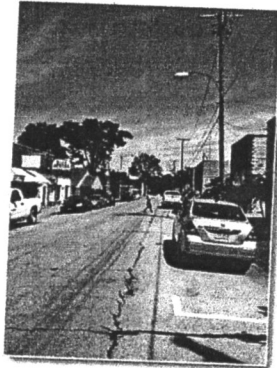
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## PROJECT UNDERSTANDING

Similar to most cities in Arkansas, Forrest City is seeing signs of an aging and deteriorating sanitary sewer collection system. Those signs have included surcharging sewers with possible overflows near the lift stations during wet-weather events. Surcharging is usually an indication that extraneous water is entering the system through inflow and/or infiltration. Extraneous water puts additional wear and tear on the sewer infrastructure and adds an additional expense to Forrest City Water Utility (FCWU) for transporting and treating the extra flow.



The Forrest City Water Utility is undertaking the Flow Monitoring and Sanitary Sewer Evaluation (SSES) project identified in the RFP to mitigate excess inflow and infiltration (I&I) from the City's sanitary sewer system. This proactive measure will result in FCWU being able to identify particular areas in the sewer collection system that are contributing to the I&I problem.

When the areas are identified, FCWU resources can effectively be focused on rehabilitating and restoring the sewer infrastructure. RJN will support this effort understanding that:

- A well executed SSES will give Forrest City the information it needs to proactively manage improvements to the sewer system while maintaining the level of service that the citizens and rate payers expect
- A well executed SSES will make an impact right away and will also produce long-term recommendations and solutions that can be incorporated for capital planning

## PROJECT APPROACH

RJN is an expert in sewer evaluation and investigation, but more importantly, an expert in managing and analyzing the data to develop recommendations for improving the levels of service, resulting in a system that can be sustainably managed.

RJN SSES programs cost-effectively and methodically evaluate the performance and integrity using proven methods and resources. RJN inspections produce accurate, meaningful data that coupled with analysis performed by a team of experienced and knowledgeable engineers/analysts will transform data into sensible recommendations for short- and long-term solutions.

### Project Management Tasks Approach

A successful sewer inspection and evaluation program requires effective communication protocols, proactive management, accurate inspection techniques, task tracking, and data handling and delivery. Standard RJN management is described below.

### Meetings

**Preliminary/Project Kick-off Meeting** — The kick-off meeting will review the program objectives and timelines and define the roles of each project team member. Topics typically include:

- Field investigation procedures and processes
- Codes, standards, numbering systems, forms, interfaces, and online reporting parameters
- **Field inspection technique mentoring and training program for FCWU staff**
- Data management, delivery, and access
- Rights of access
- Regulatory agency requirements



**Project Meetings** —Regular project meetings will be conducted with all project team members and relevant subcontractors.

The RJN field data browser, **RJN Online**, can be used to facilitate client meetings during inspection tasks.



### Work Plan/Project Tracking

The RJN detailed Work Plan, developed at the beginning of the project, outlines tasks, and defines procedures, communication means, quality control measures, milestones, deliverables, and staff allocation requirements for each task.

A variety of internal and project management tools are used to monitor project progress, budgets, and schedules. Project tracking procedures and protocols are in place to ensure that the project stays within budget and meets project deadlines.

### Standards and Defect Coding

During project kick-off, program standards, including deliverable formats, local permitting, and inspection communications will be determined. NASSCO PACP (pipeline) and MACP (manholes) standards are used to categorize structural defects. NASSCO is the recognized industry standard for defect coding for rehabilitation of underground pipelines.

### Safety

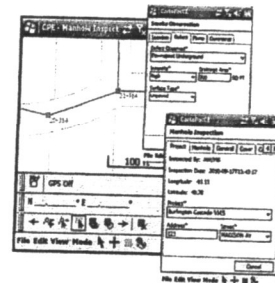
Safety for our staff and community members is our first priority. RJN field staff is required to maintain certifications in first aid, confined space entry, self contained breathing apparatus (SCBA), and work zone traffic management. RJN crews travel in RJN field vans, wear RJN field uniforms, and carry RJN identification badges — all are clearly marked with the RJN logo.

### QA/QC

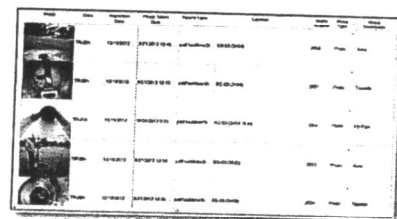
RJN incorporates internal quality control standards on all projects to ensure that our clients receive results that are technically correct. Our quality control program is geared to ensure accuracy of data collection activities, validate findings, and review report documents. **Based on experience, we understand that bad data is worse than no data. Ensuring the accuracy of data adds value to the project.**

Field inspection data collected through flow monitoring, manhole inspections, smoke testing, and other field inspections are captured using customized digital data collectors. We have customized data entry screens with “scripts” for each inspection task to ensure the inspection is conducted completely. The data screens also utilize field-level drop down boxes and dependency checks to ensure data collection standards.

Field inspectors are required to complete the full series of task-specific “questions” to successfully finish the inspection. GPS coordinates are captured for each defect and also for metering sites when flow meters are installed. Digital photos recording inspection sites/conditions are tagged to the inspection site coordinates. At the end of each day, the data is uploaded to the field inspection database.



Additional data checking is performed by data analysts when the data is transferred into the field inspection database. The **RJN RPM** tool utilizes customized data validation routines during data uploads for flow data and SSES field inspection data to support Field Manager/Data Analyst QA/QC and ensure standards and accuracy.



## Existing Data Review/Planning

One of the more important aspects of performing an effective Sanitary Sewer Evaluation Study and developing/updating system mapping is to understand the layout and complexities of the collection system. A review of existing system information provides an initial overview of the system. RJN will work with Forrest City staff to collect all available system data including existing:

- Sewer atlases/maps
- Aerial photography and contour maps
- Resident flood surveys
- Maintenance records
- Previous flow data and I/I analysis, and reports
- Maintenance records, pump logs, pump station evaluation reports, etc.

Existing data sources help steer field inspection tasks pointing to locations where the known problem areas exist so that inspection activities can be directed at these critical locations. Maintenance records help to identify areas of the system that have required repeated maintenance so that special attention can be directed to locating the root of the problem.



Every mapping program includes the initial task of understanding the configuration and standards used for existing mapping platforms, and the type and level of data that exists or must be collected to develop an accurate and current map feature database. The key to RJN's success with utility mapping programs stems from our understanding of client utility data sources and map data requirements.

## Map Development

A digital utility map provides a tool to support managing and monitoring collection system assets. PCWU is proactively taking the opportunity to use data that will be collected during SSES field

inspections to construct a digital map of the sewer system.

RJN utilizes proven methodologies to create and update utility maps and asset databases. The key aspect of the RJN approach is to establish complete and clear **functional requirements** for the map including level of mapping detail, naming conventions, software, hardware, etc. Key tasks include:

1. Conducting a Data Review Workshop to determine the level, accessibility, and convertibility of existing data sources and tools
2. Collecting and converting data
3. Performing a "Gap Analysis"
4. Creating and validating mapping layers
5. Collecting "Gap Data"

The actual process of integrating existing information and as-built data into a digital map can be done in various ways and is a function of the accuracy of existing data sources (positional).

## Data Review Workshop

The **Data Review Workshop** will lead to an understanding of goals and objectives including:

- How will the map be used?
- What are the operational objectives?
- What is the level and quality of the data available for integration (as-builts, reference maps, etc.)?

The Workshop format has proven to be a successful method capitalizing on institutional knowledge. Topics will aim at developing specifications for configuring the map and will include:

- GPS mapping accuracy
- Attribute data collection methods
- Metadata specifications
- Process workflow diagrams
- Quality control/quality assurance procedures
- Acceptance criteria

## Data Collection

RJN field inspection digital data collectors are equipped to capture mapping grade (sub-meter) GPS coordinates (X and Y coordinates). During inspection tasks coordinates will be recorded for all accessible manholes, mainline cleanouts, lift station structures, and found defects in the collection system. This data will be used to develop map layers.

Survey grade (sub-centimeter) X, Y, and Z coordinates should be collected on manholes with sewer lines 10-inches diameter and larger (and on select 8-inch lines with known overflows). Gunn and Associates, Inc., our local teaming partner, will use their extensive knowledge of Forrest City and the surrounding area to collect survey grade data as is required to develop an accurate map.



## Map Layer Creation

RJN digitizes mapping layers using existing as-builts, reference maps, GPS survey data, and data collected through condition inspections. RJN will work with FCWU staff to develop specifications for the map data model. This includes:

- Defining structure layers (point features)
- Define pipeline layers (line features)
- Define basin layers (polygon features)
- Define spatial accuracy required

Any existing mapping will be evaluated for specific potential for conversion.

## Field Inspection/SSES Approach

RJN has unparalleled knowledge and experience with effective field inspection and data collection techniques and uses a systematic approach to transform system data into sensible and sustainable recommendations for short- and long-term solutions. RJN field staff is trained and has experience with a full range of services to inspect

the condition of sanitary sewer system manholes and pipelines. Services identified for this project will include:

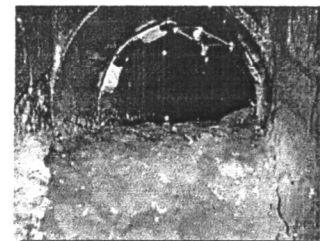
- Flow/rainfall monitoring
- Manhole inspections
- Smoke testing
- Dye flooding
- CCTV inspection

It is important to not only locate defects in the sewer system but to quantify their effect on the system as well. **The magnitude of the excess I&I will be determined during the flow monitoring. Through field inspection activities, RJN will work to account for a large percentage of the found inflow.** This is important because it helps to ensure that any recommended improvements will deliver a high return on investment.

## Flow and Rainfall Monitoring

Flow monitoring data will set the stage for the program and, ultimately, will determine the scope and magnitude of short- and long-term recommendations. It is, therefore, important that the flow monitoring be done correctly.

**RJN staff conducts all tasks required to successfully collect accurate flow and rainfall data.** We own and maintain an inventory of 285 flow meters and 95 rain gauges and have a Flow Meter Data Group specifically dedicated to collecting, validating, managing, and analyzing flow data as it is captured. Flow data is managed and maintained through web-accessible platforms that are connected to RJN RPM. RPM supports metering program management tools including:



- Flow meter site investigation reports
- Calibration summaries
- Meter maintenance logs
- Traffic control diagrams

- Meter production logs
- Uptime charts
- Battery level charts

Temporary flow monitoring targeted for I&I analysis typically runs 60 to 90 days depending on weather conditions. That duration has proven effective for collecting various data to capture meaningful dry-weather and wet-weather flows. A thorough I&I analysis requires 4 or more significant wet-weather (rainfall) events; these events are defined as short duration, high intensity rains. **Historically, the fall season in Arkansas has yielded a good number of these types of rain events. We propose to start the flow monitoring in October (2013) to capture fall rains.**

**Site Investigation/Installation** — Determining appropriate sites for meters and rainfall gauges is critical to the validity of the data collected. When RJN conducts flow monitoring for a system-wide I&I reduction program, the collection system is typically divided into smaller sub-basins, or discrete sewersheds, sized to approximately 40,000 to 50,000 linear feet. This segregation effectively divides the system into manageable “chunks” and helps to isolate the areas that are contributing the most to an I&I problem. Basin segregation requires an understanding of the system configuration to account for any bypasses or cross-connections between basins.

Site investigations evaluate hydraulic flow characteristics to ensure that conditions at the sites are suitable for measuring flows. The selection will consider capturing relative flows geographically, along interceptors and sub-mains as well as key land use characteristics.

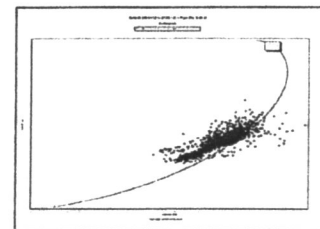
Site investigation results are also used to determine appropriate flow metering technology. Depth and velocity flow meters provide a continuous record of flow at either 5-minute or 15-minute intervals to reflect dry- and wet-weather responses. For



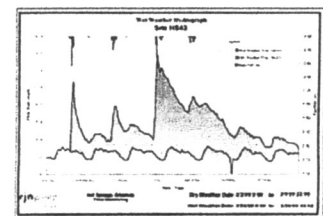
temporary flow monitoring, as proposed for FCWU, where the data is critical and flow characteristics can quickly change during a storm, we recommend utilizing 5-minute intervals. At the time of installation, manual depth and velocity readings are taken by the field crew to confirm that the meter is reading accurately.

**Flow Meter Management/Maintenance** — RJN field technicians complete weekly maintenance checks and data downloads. At regular, frequent intervals during a monitoring period, manual depth and velocity readings are taken as a calibration check on the meter readings. With these calibration checks, the accuracy of the meter data is verified. Equipment that is working improperly is repaired at the site or replaced with a spare unit to minimize the data downtime.

RJN's Flow Meter Data Group analyzes data from each monitoring site immediately upon delivery from the field (within 24 hours from interrogation) using various analytical tools, such as hydrographs, scattergraphs, and flow balancing methods to verify the accuracy and precision of the equipment. Data is reviewed for bottlenecks, surcharging, suspected overflows, and excessive inflow and infiltration. Indications of concern will be reported immediately to FCWU.



**Rainfall Contributions** — Rain gauges record the wet-weather events and are placed to provide adequate and equal geographic coverage throughout system's sewersheds. Several rainfall events — unique in terms of duration, intensity, and amount — are needed to obtain a solid correlation between data points to allow for accurate predictions of the amount of I&I that would be in the system during a large





design storm event (i.e. 1-, 5-, or 10-year storm). It is also important to use data from storm events that do not overload the collection system and cause surcharging. The projections of smaller storms are used to determine inflow rates that extend beyond the hydraulic capacity of the existing collection system.

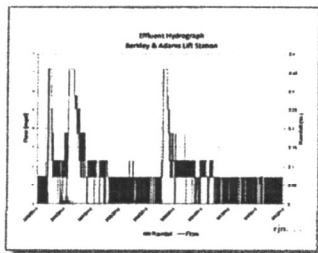
### Pump Station Evaluations (If Required)

If needed, RJN engineers can evaluate the operations and performance of the Forrest City pump stations determining and evaluating:

- Capacity of the stations
- Operating set points
- Structural integrity of the piping to and from the stations

Available flow and pump run data can be reviewed for each station or collected in conjunction with the monitoring. Physical data for each station is collected along with pictures of the exterior and interior of the station. All data and photos can be linked with the station on the digital map.

We will also review the force main maintenance history and the construction plans (as available) to review the pipe material and year of construction. There were periods of time where inferior materials were used that are prone to corrosion and failure. In each case, Forrest City staff will be notified if additional investigations are recommended based on this information.

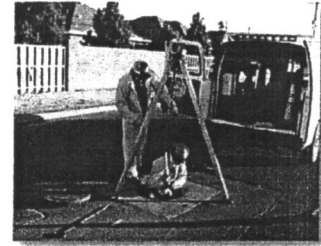


### Manhole/Visual Pipe Inspections

Comprehensive above- and below-ground manhole inspections and visual pipe inspections examine and document the condition of the manhole structure (surface and interior), and the pipes entering and leaving the manhole. **RJN uses and recommends a full descent technique.** This technique is conducted through a physical descent of the manhole by a

trained technician to evaluate the physical condition of the manhole and line segment continuity. Data collected generally includes:

- Location and identification number
- Potential for ponding on manhole cover
- Cover type, fit, description, segment length, distance above or below grade, evidence of inflow
- Frame adjustment, seal, evidence of inflow
- Corbel construction, condition, evidence of inflow
- Wall construction, condition, evidence of infiltration
- Bench/trough construction, condition, deposition, evidence of infiltration
- Pipe seal condition, evidence of infiltration
- Manhole inside diameter
- Surcharging or evidence of surcharging
- Indication of groundwater level
- Pipe condition (visual pipe) and material and diameter



RJN uses NASSCO MACP compliant coding to ensure consistency in data collection, data evaluation, quality control, and defect assessment. All observed defects are categorized in MACP-compliant format with digital photos recording each observed defect.

Our standard manhole inspection photographic documentation includes the critical components of each manhole (cover, frame seal, pipe seals), regardless of condition.

Each pipe connected to the manhole is inspected to assist with in-pipe defect identification and the prioritization of CCTV inspections. All



inspection data can be made available to FCWU staff upon verification through **RJN Online.**

Critical defects observable from the manhole, such as collapsed or broken pipe, or observed obstructions, will be used to direct CCTV crews to critical areas early on in the subsequent CCTV inspection process. **Any "imminent failure" conditions observed during the visual pipe inspection will be immediately reported to FCWU.**

### Smoke Testing

Smoke testing isolates and identifies sections of sewer lines where excessive I&I may occur during wet-weather periods. This includes locations of clear water transfer into the sanitary sewer system. Through experience and experimentation, RJN has developed the following criteria to achieve the best results:

- Two blowers, one at each end, provide greater smoke pressure and more evenly disperses the smoke throughout the piping system
- Use high-pressure smoke blowers between 4,000-8,000 cfm
- No more than one reach of piping greater than 300 feet between two manholes should be tested at a time
- Both ends of the tested segment should be plugged or sandbagged to contain the smoke when possible



The dual blow blower method has proven to identify four to six times as many defects as the single blower method (shown above).

Smoke testing is a highly visible inspection technique. RJN has performed smoke testing at off times to avoid unnecessary disruption to sensitive community facilities and business districts. Procedures are in place to ensure that smoke testing is conducted to minimize public inconvenience.

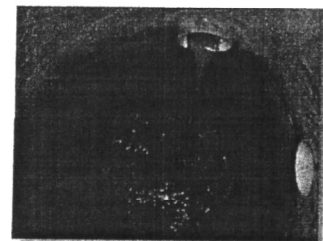
GPS coordinates and digital photos record found smoke testing defects. Findings can be available to FCWU staff through **RJN Online** upon verification.



**Private Source Defects** — RJN inspectors also record "suspect sources" located on private property. Suspect sources are those that do not smoke, but due to the potential of being connected to the sanitary sewer (i.e., yard drains) are detectable when followed up with dyed water testing.

### Dye Water Testing

Dye water testing is typically performed by flooding an area with fluorescent dye to pinpoint the location and magnitude of a defect. Inflow sources are identified by means of dyed water flooding including storm sewer sections, stream sections, ditch sections, and ponding areas that may be contributing to inflow.



Dye test areas are selected based on results of the smoke testing program. Positive dye tests are quantified for leakage rates. An analysis of the dye test is performed to determine the possible TV inspection follow-up requirements. The types of data gathered include:

Smoke Testing Identified Defect Summary

Type of I/I Source	SINGLE Blower	DUAL Blower
Sewer Main Defect	8	26
Indirect Cross Connections	8	16
Building Lateral Defect	29	100
Area Drains/Downspouts	2	12
Cleanouts	22	80

\*These results are from actual drainage basins that were smoke tested twice during a sewer study.

- Area flooded with dyed water
- Evidence of dyed water observed at the nearby sanitary manhole
- Type of connections (indirect cross connections with storm sewer or ditches or defective sanitary sewer manholes, direct catch basin connections, etc.)
- Depth of flow and velocity before and during dyed water flooding

Dye testing can also be performed concurrently with TV inspection allowing dye to be traced with TV inspection to locate the source, etc. Findings are recorded by GPS coordinates with digital photos.

### Cleaning/TV Inspection (As Needed)

Sewer TV inspection effectively provides a structural assessment of the pipeline. Certified staff will assess all TV inspection results using the standardized

#### NASSCO Pipeline

Assessment Certification Program (PACP) coding scheme. We will advise FCWU of any locations that, in our opinion, require immediate attention either due to

structural condition or buildup of fats, oil or grease. RJN will use our highly experienced team member, Ace Pipe, to perform CCTV and cleaning services.



Defects will be reviewed and categorized based on severity. Rehabilitation through lining or point repairs (or both) will be assessed for success of rehabilitation. Pipe segments may also be assigned to a "watch" list, where the pipe is deteriorating, but the condition is not considered severe enough to require rehabilitation.

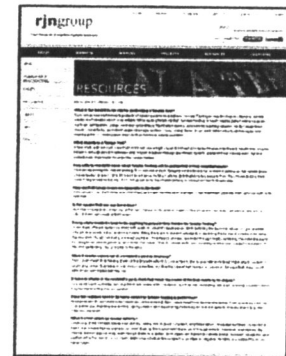
### Public Information Services

The goal of the public education efforts for field inspections is to inform community members and stakeholders about project status, progress, and outcomes. RJN will coordinate and distribute public information to support field investigation tasks, such as:

- Newsletter(s)/Notices distributed prior to visible field testing procedures (e.g., smoke testing). These notices provide residents and businesses with information about the purpose and expected affects of the field activities
- Highly visible signs are placed on right-of-ways during smoke testing
- Individuals requiring special assistance (handicap or incapacitated persons, etc.) that are known or made known to RJN receive special consideration and notification
- Special attention is paid to schools and shopping areas to ensure testing is done during hours when these facilities are closed or minimally impacted
- During the smoke testing program, police and fire departments are notified of crew locations and activities on a daily basis
- A "Hot Line" can be maintained on a 24-hour basis to accommodate any inquires and provide field action, if necessary



The RJN web site can also be used to post project information and project FAQs for the project.



## DATA COLLECTION AND MANAGEMENT

RJN field crews use digital handheld data collectors equipped with mapping grade GPS receivers to conduct site investigations and collect field inspection data. In addition to customized input views, digital photos are used to record defects and conditions at inspection sites. These photos are tagged to the GPS coordinates recorded in the data collectors.

The data collector technology provides the ability to seamlessly roll collected data into the RJN inspection database (CASS PC), a GIS, or other GIS-supported field result databases. Existing mapping data can be preloaded into the collectors so that existing data can be validated and updated — including spatial locations and attribute information; structure depth; structure diameter; and pipe invert depth.



All collected field data is uploaded to CASS PC, the RJN internal inspection database. CASS PC is an MS Access tool and is the basis for all analysis of system conditions and defects. RJN has developed software tools to perform prioritization analysis to select effective rehabilitation recommendations based on the severity and cost of rehabilitation.

### Map Data Integration

All collected inspection data — GPS coordinates, manhole inspection, smoke defect data, etc. — will be integrated with the proposed FCWU digital maps. Color coded (thematic) maps that portray the findings of field investigations and recommended system improvements will be prepared.



## FINAL REPORT

As a full service engineering firm specializing in sewer collection system solutions, RJN not only provides the field investigation services to identify system defects, but the engineering report produced upon completion of an SSES program has the detailed information needed to serve as a

conceptual design report. This deliverable provides a summary of the methodologies used as well as detailed listings of I&I quantifications and structural defects that may contribute to dry-weather and wet-weather overflows. Specific recommendations for each type of rehabilitation are prioritized, potential for I&I removal is quantified, and repair costs are estimated.

The RJN strategy for developing rehabilitation recommendations includes:

- Evaluating each type of defect
- Assessing rehabilitation alternatives
- Assessing the costs associated with the recommended repair method using current local contractor bid schedules

RJN engineers will review each inspected system component (manhole, pipe), each observed defect, and will recommend a comprehensive rehabilitation approach for the entire structure.

The report sample pages shown on following pages illustrate the level of information provided which can serve as the **Basis for Design** for defect rehabilitation of identified defects. Rehabilitation can include repairs for manholes, sewer mains and interceptors, and laterals. Design recommendations consider replacement, point repairs, relief, up sizing and the use of trenchless technologies; recommendations will also be based on an assessment of materials and the service life of the rehabilitation measure.

**RJN will work with FCWU staff to develop a prioritization approach to drive the analysis and recommendations.** The development of a rehabilitation plan will be coordinated with the FCWU to ensure that recommendations are realistic and based on known budgeting projections and constraints. Sample Manhole Rehabilitation, Point Repair, Pipeline Rehabilitation and Inflow Removal Reports are provided on the following pages.



# Manhole Rehabilitation Report

## Manhole Rehabilitation Recommendations

Project Number: 16-129-01

Sheet

NO.	DESCRIPTION	STRUCTURE	CONCRETE	PIPE	SIZE	DEPTH	STATUS	REPAIR	CUMULATIVE	TYPE	EST.	EST.	CUMULATIVE	EST.
			TYPE	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS	CLASS
ELK-01-01	Rehab Concrete to 12" Dia. Cover	UNIONVILLE CENTER	Repaired	12"	11.5'	0	0	0	0	0	1.50	1.50	1.50	1.50
ELK-01-02	Rehab Concrete to 12" Dia. Cover	2862 JESSICA PLACE	Repaired	12"	12.0'	0	0	0	0	0	1.50	3.00	3.00	3.00
ELK-01-03	Rehab Concrete to 12" Dia. Cover	UNIONVILLE CENTER STREET	Repaired	12"	12.5'	0	0	0	0	0	1.50	4.50	4.50	4.50
ELK-01-04	Rehab Concrete to 12" Dia. Cover	112 FOXGLOVES	Repaired	12"	12.5'	0	0	0	0	0	1.50	6.00	6.00	6.00
ELK-01-05	Rehab Concrete to 12" Dia. Cover	2180 N CENTER	Repaired	12"	12.5'	0	0	0	0	0	1.50	7.50	7.50	7.50
ELK-01-06	Rehab Concrete to 12" Dia. Cover	1021 N CENTER	Repaired	12"	12.5'	0	0	0	0	0	1.50	9.00	9.00	9.00
ELK-01-07	Rehab Concrete to 12" Dia. Cover	2576 W CENTER AVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	10.50	10.50	10.50
ELK-01-08	Rehab Concrete to 12" Dia. Cover	178 OAK	Repaired	12"	12.5'	0	0	0	0	0	1.50	12.00	12.00	12.00
ELK-01-09	Rehab Concrete to 12" Dia. Cover	2947 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	13.50	13.50	13.50
ELK-01-10	Rehab Concrete to 12" Dia. Cover	2345 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	15.00	15.00	15.00
ELK-01-11	Rehab Concrete to 12" Dia. Cover	2245 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	16.50	16.50	16.50
ELK-01-12	Rehab Concrete to 12" Dia. Cover	2245 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	18.00	18.00	18.00
ELK-01-13	Rehab Concrete to 12" Dia. Cover	1527 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	19.50	19.50	19.50
ELK-01-14	Rehab Concrete to 12" Dia. Cover	2742 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	21.00	21.00	21.00
ELK-01-15	Rehab Concrete to 12" Dia. Cover	1845 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	22.50	22.50	22.50
ELK-01-16	Rehab Concrete to 12" Dia. Cover	1625 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	24.00	24.00	24.00
ELK-01-17	Rehab Concrete to 12" Dia. Cover	1405 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	25.50	25.50	25.50
ELK-01-18	Rehab Concrete to 12" Dia. Cover	1185 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	27.00	27.00	27.00
ELK-01-19	Rehab Concrete to 12" Dia. Cover	965 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	28.50	28.50	28.50
ELK-01-20	Rehab Concrete to 12" Dia. Cover	745 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	30.00	30.00	30.00
ELK-01-21	Rehab Concrete to 12" Dia. Cover	525 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	31.50	31.50	31.50
ELK-01-22	Rehab Concrete to 12" Dia. Cover	305 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	33.00	33.00	33.00
ELK-01-23	Rehab Concrete to 12" Dia. Cover	85 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	34.50	34.50	34.50
ELK-01-24	Rehab Concrete to 12" Dia. Cover	UNIONVILLE CENTER STREET	Repaired	12"	12.5'	0	0	0	0	0	1.50	36.00	36.00	36.00
ELK-01-25	Rehab Concrete to 12" Dia. Cover	2862 JESSICA PLACE	Repaired	12"	12.5'	0	0	0	0	0	1.50	37.50	37.50	37.50
ELK-01-26	Rehab Concrete to 12" Dia. Cover	UNIONVILLE CENTER STREET	Repaired	12"	12.5'	0	0	0	0	0	1.50	39.00	39.00	39.00
ELK-01-27	Rehab Concrete to 12" Dia. Cover	112 FOXGLOVES	Repaired	12"	12.5'	0	0	0	0	0	1.50	40.50	40.50	40.50
ELK-01-28	Rehab Concrete to 12" Dia. Cover	2180 N CENTER	Repaired	12"	12.5'	0	0	0	0	0	1.50	42.00	42.00	42.00
ELK-01-29	Rehab Concrete to 12" Dia. Cover	1021 N CENTER	Repaired	12"	12.5'	0	0	0	0	0	1.50	43.50	43.50	43.50
ELK-01-30	Rehab Concrete to 12" Dia. Cover	2576 W CENTER AVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	45.00	45.00	45.00
ELK-01-31	Rehab Concrete to 12" Dia. Cover	178 OAK	Repaired	12"	12.5'	0	0	0	0	0	1.50	46.50	46.50	46.50
ELK-01-32	Rehab Concrete to 12" Dia. Cover	2947 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	48.00	48.00	48.00
ELK-01-33	Rehab Concrete to 12" Dia. Cover	2345 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	49.50	49.50	49.50
ELK-01-34	Rehab Concrete to 12" Dia. Cover	2245 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	51.00	51.00	51.00
ELK-01-35	Rehab Concrete to 12" Dia. Cover	1527 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	52.50	52.50	52.50
ELK-01-36	Rehab Concrete to 12" Dia. Cover	2742 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	54.00	54.00	54.00
ELK-01-37	Rehab Concrete to 12" Dia. Cover	1845 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	55.50	55.50	55.50
ELK-01-38	Rehab Concrete to 12" Dia. Cover	1625 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	57.00	57.00	57.00
ELK-01-39	Rehab Concrete to 12" Dia. Cover	1405 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	58.50	58.50	58.50
ELK-01-40	Rehab Concrete to 12" Dia. Cover	1185 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	60.00	60.00	60.00
ELK-01-41	Rehab Concrete to 12" Dia. Cover	965 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	61.50	61.50	61.50
ELK-01-42	Rehab Concrete to 12" Dia. Cover	745 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	63.00	63.00	63.00
ELK-01-43	Rehab Concrete to 12" Dia. Cover	525 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	64.50	64.50	64.50
ELK-01-44	Rehab Concrete to 12" Dia. Cover	85 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	66.00	66.00	66.00
ELK-01-45	Rehab Concrete to 12" Dia. Cover	UNIONVILLE CENTER STREET	Repaired	12"	12.5'	0	0	0	0	0	1.50	67.50	67.50	67.50
ELK-01-46	Rehab Concrete to 12" Dia. Cover	2862 JESSICA PLACE	Repaired	12"	12.5'	0	0	0	0	0	1.50	69.00	69.00	69.00
ELK-01-47	Rehab Concrete to 12" Dia. Cover	UNIONVILLE CENTER STREET	Repaired	12"	12.5'	0	0	0	0	0	1.50	70.50	70.50	70.50
ELK-01-48	Rehab Concrete to 12" Dia. Cover	112 FOXGLOVES	Repaired	12"	12.5'	0	0	0	0	0	1.50	72.00	72.00	72.00
ELK-01-49	Rehab Concrete to 12" Dia. Cover	2180 N CENTER	Repaired	12"	12.5'	0	0	0	0	0	1.50	73.50	73.50	73.50
ELK-01-50	Rehab Concrete to 12" Dia. Cover	1021 N CENTER	Repaired	12"	12.5'	0	0	0	0	0	1.50	75.00	75.00	75.00
ELK-01-51	Rehab Concrete to 12" Dia. Cover	2576 W CENTER AVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	76.50	76.50	76.50
ELK-01-52	Rehab Concrete to 12" Dia. Cover	178 OAK	Repaired	12"	12.5'	0	0	0	0	0	1.50	78.00	78.00	78.00
ELK-01-53	Rehab Concrete to 12" Dia. Cover	2947 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	79.50	79.50	79.50
ELK-01-54	Rehab Concrete to 12" Dia. Cover	2345 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	81.00	81.00	81.00
ELK-01-55	Rehab Concrete to 12" Dia. Cover	2245 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	82.50	82.50	82.50
ELK-01-56	Rehab Concrete to 12" Dia. Cover	1527 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	84.00	84.00	84.00
ELK-01-57	Rehab Concrete to 12" Dia. Cover	2742 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	85.50	85.50	85.50
ELK-01-58	Rehab Concrete to 12" Dia. Cover	1845 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	87.00	87.00	87.00
ELK-01-59	Rehab Concrete to 12" Dia. Cover	1625 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	88.50	88.50	88.50
ELK-01-60	Rehab Concrete to 12" Dia. Cover	1405 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	90.00	90.00	90.00
ELK-01-61	Rehab Concrete to 12" Dia. Cover	1185 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	91.50	91.50	91.50
ELK-01-62	Rehab Concrete to 12" Dia. Cover	965 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	93.00	93.00	93.00
ELK-01-63	Rehab Concrete to 12" Dia. Cover	745 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	94.50	94.50	94.50
ELK-01-64	Rehab Concrete to 12" Dia. Cover	525 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	96.00	96.00	96.00
ELK-01-65	Rehab Concrete to 12" Dia. Cover	85 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	97.50	97.50	97.50
ELK-01-66	Rehab Concrete to 12" Dia. Cover	UNIONVILLE CENTER STREET	Repaired	12"	12.5'	0	0	0	0	0	1.50	99.00	99.00	99.00
ELK-01-67	Rehab Concrete to 12" Dia. Cover	2862 JESSICA PLACE	Repaired	12"	12.5'	0	0	0	0	0	1.50	100.50	100.50	100.50
ELK-01-68	Rehab Concrete to 12" Dia. Cover	UNIONVILLE CENTER STREET	Repaired	12"	12.5'	0	0	0	0	0	1.50	102.00	102.00	102.00
ELK-01-69	Rehab Concrete to 12" Dia. Cover	112 FOXGLOVES	Repaired	12"	12.5'	0	0	0	0	0	1.50	103.50	103.50	103.50
ELK-01-70	Rehab Concrete to 12" Dia. Cover	2180 N CENTER	Repaired	12"	12.5'	0	0	0	0	0	1.50	105.00	105.00	105.00
ELK-01-71	Rehab Concrete to 12" Dia. Cover	1021 N CENTER	Repaired	12"	12.5'	0	0	0	0	0	1.50	106.50	106.50	106.50
ELK-01-72	Rehab Concrete to 12" Dia. Cover	2576 W CENTER AVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	108.00	108.00	108.00
ELK-01-73	Rehab Concrete to 12" Dia. Cover	178 OAK	Repaired	12"	12.5'	0	0	0	0	0	1.50	109.50	109.50	109.50
ELK-01-74	Rehab Concrete to 12" Dia. Cover	2947 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	111.00	111.00	111.00
ELK-01-75	Rehab Concrete to 12" Dia. Cover	2345 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	112.50	112.50	112.50
ELK-01-76	Rehab Concrete to 12" Dia. Cover	2245 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0	1.50	114.00	114.00	114.00
ELK-01-77	Rehab Concrete to 12" Dia. Cover	1527 WOOD DRIVE	Repaired	12"	12.5'	0	0	0	0	0				

Sample Pipeline Rehabilitation Summary



**Table C**  
**Lines Recommended for Complete Rehabilitation**

Line Segment		Existing Diameter (in.)	Recommended Diameter (in.)	Segment Length (ft.)	Rehabilitation Method	Estimated Construction Cost (\$)	Estimated Capital Cost (\$) <sup>1/</sup>
USMH	DSMH						
<b>ELK-02</b>							
(2)76	(2)77	12	12	290	CIPP	33,350	43,355
(2)78	(2)78	12	12	320	CIPP	36,800	47,840
(2)80	(2)79	12	12	315	CIPP	36,225	47,093
(2)81	(2)80	12	12	375	CIPP	43,125	56,063
(2)82	(2)81	12	12	230	CIPP	26,450	34,385
(2)94 <sup>2/</sup>	(2)93	8	8	230	CIPP	21,850	28,405
(2)98	(2)82	12	12	200	CIPP	26,450	34,385
(2)100	(2)99	12	12	280	CIPP	32,200	41,860
(2)101	(2)100	12	12	245	CIPP	28,175	36,628
(2)110	(2)107	8	8	310	CIPP	29,450	38,285
(2)121	(2)120	8	8	295	Pipe Bursting	48,675	63,278
(2)130	(2)129	12	12	212	CIPP	24,380	31,694
(2)131	(2)130	12	12	290	CIPP	33,350	43,355
(2)134	(2)133	10	10	120	CIPP	13,200	17,160
Subtotal						433,680	563,784
<b>ELK-04</b>							
(4)80	(4)79	12	12	316	CIPP	36,340	47,242
Subtotal						36,340	47,242
<b>Total</b>						<b>470,020</b>	<b>611,026</b>

<sup>1/</sup> Includes estimated construction cost plus a 30 percent engineering service and contingency fees.  
<sup>2/</sup> Priority 1 Rehabilitation

Sample Inflow Removal Summary

**Recommended Inflow Removal Report**

Project Number 18-2589-01 Elkins

Basin/Structure	Street Address	Type Source	Rehabilitation Work	Repair			Cumulative		
				Flow (GPD)	Cost (\$)	Ratio (%GPD)	Flow (GPD)	Cost (\$)	
ELK-01 44	ELK-01 43	2100 HARRIS DRIVE	Inflow Cleanout	Replace Cleanout Cap	2,523	\$150	0.059	2,523	\$150
ELK-04 80	ELK-04 79	250 CARRIGAN RD	Inflow Cleanout	Replace Cleanout Cap	2,376	\$150	0.063	4,899	\$300
ELK-01 EOL	ELK-01 105	2405 N CENTER	Inflow Cleanout	Repair Broken Cleanout	5,760	\$375	0.065	10,659	\$675
ELK-02 129	ELK-02 128	UNKNOWN N CENTER	Inflow Cleanout	Replace Cleanout Cap	1,901	\$150	0.078	12,560	\$825
ELK-04 83	ELK-04 82	151 CARTER LANE	Inflow Cleanout	Replace Cleanout Cap	1,426	\$150	0.105	13,985	\$975
ELK-01 11	ELK-01 10	2848 COTTON COVE	Inflow Cleanout	Repair Broken Cleanout	2,880	\$375	0.130	16,865	\$1,350
ELK-02 20	ELK-02 19	2127 SCENIC OAKS AVENUE	Inflow Cleanout	Repair Broken Cleanout	2,880	\$375	0.130	19,745	\$1,725
ELK-02 79	ELK-02 78	1965 N CENTER	Inflow Cleanout	Repair Broken Cleanout	2,520	\$375	0.149	22,265	\$2,100
ELK-02 30	ELK-02 35	2140 N CENTER	Inflow Cleanout	Repair Broken Cleanout	2,520	\$375	0.149	24,785	\$2,475
ELK-01 8	ELK-01 5	2243 S BRANDI AVE	Inflow Cleanout	Repair Broken Cleanout	2,376	\$375	0.158	27,161	\$2,850
ELK-02 119	ELK-02 118	739 SHOFFNER	Inflow Cleanout	Repair Broken Cleanout	2,376	\$375	0.158	29,537	\$3,225
ELK-02 97	ELK-02 96	1370 ASPEN CIRCLE	Inflow Cleanout	Repair Broken Cleanout	2,376	\$375	0.158	31,913	\$3,600
ELK-02 3	ELK-02 2	UNKNOWN HWY 16	Inflow Cleanout	Repair Broken Cleanout	2,376	\$375	0.158	34,289	\$3,975
ELK-02 115	ELK-02 111	556 SHOFFNER	Inflow Cleanout	Repair Broken Cleanout	2,376	\$375	0.158	36,665	\$4,350
ELK-02 98	ELK-02 97	1266 ASPEN CIRCLE	Inflow Cleanout	Repair Broken Cleanout	2,376	\$375	0.158	39,041	\$4,725
ELK-03 16	ELK-03 15	512 STOWE	Inflow Cleanout	Repair Broken Cleanout	1,901	\$375	0.197	40,942	\$5,100
ELK-03 20	ELK-03 19	1339 LAURIE LANE	Inflow Cleanout	Repair Broken Cleanout	1,901	\$375	0.197	42,843	\$5,475
ELK-02 57	ELK-02 56	1259 MAPLE	Inflow Cleanout	Repair Broken Cleanout	1,901	\$375	0.197	44,744	\$5,850
ELK-03 10	ELK-03 9	555 ELK AVENUE	Inflow Cleanout	Repair Broken Cleanout	1,901	\$375	0.197	46,644	\$6,225
ELK-02 25	ELK-02 24	2242 BROOKVIEW STREET	Inflow Cleanout	Repair Broken Cleanout	1,901	\$375	0.197	48,545	\$6,600
ELK-03 17	ELK-03 16	516 STOWE	Inflow Cleanout	Repair Broken Cleanout	1,901	\$375	0.197	50,446	\$6,975
ELK-03 31	ELK-03 30	1262 HACKBERRY	Inflow Cleanout	Repair Broken Cleanout	1,901	\$375	0.197	52,347	\$7,350
ELK-01 30	ELK-01 29	2274 GREENBRIAR	Inflow Cleanout	Repair Broken Cleanout	1,901	\$375	0.197	54,248	\$7,725
ELK-03 25	ELK-03 3	1278 WHITE RIVER	Inflow Cleanout	Repair Broken Cleanout	1,901	\$375	0.197	56,149	\$8,100
ELK-02 92	ELK-02 91	1985 N CENTER	Inflow Cleanout	Repair Broken Cleanout	1,901	\$375	0.197	58,049	\$8,475
ELK-04 19	ELK-04 18	162 DOOLIN DRIVE	Inflow Cleanout	Repair Broken Cleanout	1,728	\$375	0.217	59,777	\$8,850
ELK-02 129	ELK-02 128	UNKNOWN N CENTER	Inflow Cleanout	Repair Broken Cleanout	1,440	\$375	0.260	61,217	\$9,225
ELK-04 EOL	ELK-04 18	364 BUNCH LANE	Inflow Cleanout	Repair Broken Cleanout	1,440	\$375	0.260	62,657	\$9,600
ELK-03 27	ELK-03 26	481 RICHLAND CREEK AVENUE	Inflow Cleanout	Repair Broken Cleanout	1,426	\$375	0.283	64,083	\$9,975

EXHIBIT A  
SCOPE OF SERVICES

CITY OF FORREST CITY, ARKANSAS  
SANITARY SEWER EVALUATION SURVEY  
TRAINING AND PROGRAM MANAGEMENT

WORK PLAN

The scope described below consists of professional services designed to engage and assist the City of Forrest City in implementing the processes and performing the tasks related to an Inflow and Infiltration (I/I) identification and remediation program. These professional services are proposed to complement the City's CMOM program.

The scope includes Training for conducting the intensive investigation techniques integral to sanitary sewer evaluation surveys (SSES). It is the intent of this project that the training be conducted with RJN Group, Inc.'s Engineer and Field Supervisors. The equipment and materials required for the training demonstrations will be provided by the City of Forrest City (OWNER).

The scope includes GPS Survey services proposed to complete the compilation of an accurate map of the City's sewer collection system.

The scope includes Quality Control (QC) checks on the inspection data collected. These services will include inspecting portions of the sewer system and providing analyses of the inspection results.

The scope includes Data Management services designed to collaborate with the City and add value to the inspection efforts by processing, evaluating, and analyzing the investigation data collected. These services will include reports and recommendations.

The scope includes Program Management services designed to assist the City in the SSES by providing implementation and integration of the SSES activities into the CMOM program, work process benchmarking and recommendations, and staffing and scheduling analysis.

ITEM 1. TRAINING

A. Overview

Prepare curriculum and workshop materials for general overview of investigation objectives, regulations, processes, and techniques. The training will include both classroom lectures and field demonstrations.

## B. Manhole Inspection

1. Develop, and provide for City use, specific workshop materials consisting of procedures, techniques, tools and the RJN field forms. The field forms will be tailored for the City of Forrest City.
2. Present classroom session.

A RJN field supervisor will conduct one classroom session on full-descent manhole inspection procedures for the purpose of identifying and quantifying infiltration and inflow sources. The RJN instructor will explain each type of source that can be found in a manhole, how to determine that a source exists even if it is not leaking, and the methods of quantifying sources. The classroom session is expected to last approximately 4 hours. Additional classroom time can be added upon request for an additional charge.

The classroom instruction will include an overview of the recommended list of equipment needed to conduct the investigations.

3. Present field session.

Upon completion of the classroom session, the participants and the RJN instructor will inspect manholes in the field for approximately 12 to 14 hours over a two-day period. The field training will allow all the participants to connect the classroom training with actual conditions in the field.

## C. Smoke Testing

1. Prepare curriculum and workshop materials. Workshop materials will consist of description of procedures, processes and the RJN field forms tailored to the City of Forrest City's system.
2. Present classroom session.

An RJN field supervisor will conduct a classroom session on smoke testing procedures. The benefits of concepts such as dual blower methods and line isolation will be introduced and discussed. There will be instruction on how to identify and quantify infiltration and inflow sources by using this inspection technique. The classroom session is expected to last approximately 4 hours. Additional classroom time can be added upon request for an additional charge.

The classroom instruction will include an overview of the recommended list of equipment needed to conduct the investigations.

3. Present field session.

Upon completion of the classroom session, the participants and the RJN instructor will smoke test line segments in the field for approximately 12 to 14 hours over a two-day period. The field training will allow all the participants to link the classroom training with actual conditions in the field.

D. Dyed Water Testing

1. Prepare curriculum and workshop materials. Workshop materials will consist of description of procedures, processes and the RJN field forms tailored to the City of Forrest City's system.
2. Present classroom session.

An RJN field supervisor will conduct a classroom session on dyed water flooding procedures. There will be instruction on how to identify and quantify infiltration and inflow sources. The RJN instructor will explain proper record keeping and how to identify areas for dyed water flooding subsequent to smoke testing. The classroom session is expected to last approximately 4 hours. Additional classroom time can be added upon request for an additional charge.

The classroom instruction will include an overview of the recommended list of equipment needed to conduct the investigations.

3. Present field session.

Upon completion of the classroom session, the participants and the RJN instructor will dye flood line segments in the field for approximately 12 to 14 hours over a two-day period. The field training will allow all the participants to link the classroom training with actual conditions in the field.

The participants and the RJN instructor will televise a line segments previously identified as defective in the smoke and dye testing phase. The field training will allow all the participants to link the classroom training with actual conditions in the field.

E. Closed Circuit Television (CCTV)

1. Prepare curriculum and workshop materials. Workshop materials will consist of description of procedures, processes tailored to the City of Forrest City's needs and resources.
2. Present classroom session.

An RJN field supervisor will conduct a workshop session on CCTV procedures. There will be instruction on how to identify and quantify infiltration and inflow sources by using this inspection technique. The classroom session is expected to last approximately 4 hours. Additional classroom time can be added upon request for an additional charge.

3. Present field session.

Upon completion of the classroom session, the participants and the RJN instructor will televise line segments in the field for approximately 8 hours over a two-day period. The field training will allow all the participants to link the classroom training with actual conditions in the field.

F. Data Management

1. Discuss the various methods and procedures for managing the field information.
2. Present classroom session.

An RJN Engineer will conduct a four-hour session on data management procedures and processes for the purpose of cataloguing and prioritizing infiltration and inflow defects. A demonstration of data management tools will be presented.

G. Rehabilitation Design and Construction Management Training

1. Prepare curriculum and workshop materials. Workshop materials will consist of description of various rehabilitation alternatives.
2. Present classroom session.
  - a. An RJN Engineer will conduct a six-hour session on rehabilitation construction and construction inspection procedures. Topics such as groundwater migration, trenchless technologies, rehabilitation effectiveness testing, state-of-the-art construction techniques, and materials will be discussed.



## ITEM 2. DATA MANAGEMENT

### A. Overview

RJN will collaborate in the City's inspection effort by entering and processing the field inspection data collected. The processed data will be entered into a database and analyzed to help locate and characterize the source of excess Inflow and Infiltration in the sewer collection system.

### B. Data Management

RJN will input the field inspection data received by the City. The City will submit the information to RJN on a weekly, or a predefined, basis where it will be reviewed for completeness. RJN will notify the City of any forms where the information is incomplete or unreadable. The field information will be entered into a database where additional quality reviews will be performed by RJN's data analysts.

### C. Data Analysis

RJN will perform an analysis of the field investigations in order to provide the City with recommendation as to where to perform CCTV inspection and dyed water flooding tests. A letter report summarizing the location of sewers to be inspected and the justification shall be submitted.

### D. Data Reporting

At the conclusion of the televised inspection and dyed testing activities by the City, all field-collected data, including the smoke testing and manhole inspections, will be used to develop a rehabilitation strategy. The strategy will include the evaluation of each type of defect, a rehabilitation method, and the costs associated with the improvement based on local contractor bid schedules. Possible main line and interceptor rehabilitation methods may include: Point repairs, Section replacements, and trenchless technologies. Efforts will be made to make use of the City's own rehabilitation and replacement resources

Rehabilitation methods that will be evaluated for I/I removal will include repairs for manholes, sewer mains and interceptors, and laterals. RJN will develop a manhole defect summary in order to categorize the nature of the repairs by type. Methods may include: frame sealing, grade adjustment, manhole wall coating and grouting, pipe seal repair, and bench and trough repair.

E. GPS Survey

RJN personnel will GPS Survey the manholes in the collection. The survey will determine manhole X, Y coordinates to within sub-meter accuracy, utilizing NAD83 State Plane Coordinates. The survey will include approximately 50% (i.e. about 1,000) of the manholes in the system. The survey data will be used to produce an updated map of the City's sewer collection system.

F. Deliverables

A rehabilitation method and estimated cost of repair will be provided for each defect. The defects will then be ranked according to their I/I contribution and cost of repair. Defect method, private versus public, and maintenance priorities will then be categorized. Rehabilitation summaries will be presented by sub-basin.

Three copies of a brief letter report will be delivered along with supporting field documentation to include:

- Consolidated source defect report with summary tables categorized by type, method and cost.
- Rehabilitation plan for each defect.

The report will provide an improvement and rehabilitation plan in order to provide the most cost-efficient means of reducing I/I and improving system performance. This plan will provide a basis for subsequent engineering design activities.

An updated collection system map based on the GPS survey of the manholes will be provided.

G. Provided by the CITY

- Field investigation reports, logs and pictures
- Televised inspection disks

ITEM 3. PROGRAM MANAGEMENT

A. Overview

RJN will collaborate with the City's SSES efforts by providing program management services. These services are proposed as a peer review of the City's inspection efforts and may include oversight and recommendations on implementing the field investigations and integrating the processes and results in the CMOM program. The Program Management services will also include periodic review of the inspection data processes, production rate, resource needs analysis, and schedule review.

B. Program Management during SSES

RJN will provide services that will include the development of program documents to define and communicate policies, procedures, responsibilities and performance measures for I/I reduction and sewer system improvements, specifically integrated into the City's CMOM program and to meet the requirements put forth by ADEQ.

RJN will work with the City staff to develop a thorough and effective quality assurance (QA) plan for the data collection and data management efforts to ensure that the collected data is accurate, thorough, and relevant to the I/I reduction efforts and overall CMOM program. As part of the QA plan, it is proposed that RJN personnel will provide periodic quality control (QC) checks on the inspection data collected. This may entail RJN personnel performing inspections on portions of the sewer system previously inspected by City personnel and analyzing the results.

C. Program Management during Engineering Design

RJN will provide services that assist the City during the engineering and rehabilitation design by helping to establish scopes, schedules, and Capital Improvement budgets required for the sewer system improvements. These services may also include value engineering, coordinating design services, and peer review of improvement plans.

D. Program Management during Construction

RJN will provide services that assist the City during sewer improvement construction. These services may include advertising and bidding, constructability reviews, and construction inspection training and services.

ITEM 4: RJN SSES INVESTIGATION SERVICES

A. Overview

To supplement the City's field inspection efforts, RJN can provide crews to perform any, or all, of the inspection efforts described herein. A detailed scope of these services, and associated fees, will be furnished upon request.

**FORREST UTILITY WATER UTILITY  
CITY OF FORREST UTILITY, ARKANSAS  
WASTEWATER SYSTEM MAPS INVENTORY  
AND DIGITAL MAP DEVELOPMENT**

**SCOPE OF SERVICES**

This project will compile the existing drawing base mapping system (plans, drawings, electronic files, source documents) and existing database inventory system, if available, into a homogeneous Open Database Connectivity (ODBC) compliant database access compatible with a GIS platform (ESRI Arc Map). The goal of the ODBC database system is to make it possible to access data from multiple applications.

This project will require a collaboration between RJN Group (ENGINEER) and Forrest City Water Utility to gather and compile all of the existing maps, plans, and location data that might be available for the wastewater collection system.

This collaboration would include the following assumptions:

1. Forrest City Water Utility would make available to ENGINEER all existing paper maps, electronic maps and database systems for use and compilation. The Forrest City Water Utility shall be available to ENGINEER to detail and explain information contained therein.
2. The ENGINEER would not be responsible for verification of information provided by the Forrest City Water Utility unless verification is requested.
3. Forrest City Water Utility would coordinate with ENGINEER to gather information in an electronic format compatible with the database access system, which may include, but not necessarily limited to:
  - a. Property Parcels
  - b. Buildings
  - c. Road geometry
  - d. Stream centerlines and boundaries
4. A reasonable effort will be made to extract as much attribute data from source information provided by the Forrest City Water Utility. In the event that attribute data are absent then additional research, field work, or extensive staff interviews will be conducted only after each sub-basin maps is developed.
5. ENGINEER understands and Forrest City Water Utility accepts that available GIS database information may be derived from third parties and, ENGINEER cannot warrant accuracy of the third party data utilized in support for map

development.

6. Features and assets derived from hard copy maps will be transcribed from the source maps to the GIS interface based upon the position and features on the source maps as they appear. Due to the nature of this relative placement method of positioning features, the features and assets will be located as accurately as possible. It is assumed and accepted by the Forrest City Water Utility that the relative position of features may not agree to the actual relative position found in the field.

#### **PROJECT EXECUTION:**

1. ENGINEER will scan available paper map copies provided by the Forrest City Water Utility, and geographically orient assets from available GIS parcel database information provided by the Forrest City Water Utility.
2. ENGINEER will coordinate with Forrest City Water Utility to comprise GIS alphanumeric database asset assignment system for the wastewater collection system including:
  - a. Manholes
    - i. Rim Elevation
    - ii. Flow Line In Elevation(s)
    - iii. Flow Line Out Elevation
  - b. Gravity Mains
    - i. Material
    - ii. Size
    - iii. Segment Length
    - iv. Slope
  - c. Force Mains
    - i. Material
    - ii. Size
    - iii. Length
  - d. Pump Stations
    - i. Location
  - e. Air/Vacuum Release Valves
    - i. Location
    - ii. Size
3. ENGINEER will develop ODBC compliant database system to utilize guidelines established by the National Association of Sewer Service Companies (NASSCO) for pipeline and manhole assessment.
4. ENGINEER will coordinate with Forrest City Water Utility to capture existing work order and maintenance information that will be linked to a GIS asset, including:

- a. Sanitary Sewer Overflow (SSO) location and disposition of cause
  - b. Historical smoke testing, cleaning, television inspection data
  - c. Blockages
  - d. Point Repairs
  - e. Manhole repair
  - f. Odor Complaints
  - g. Sewer cleaning
5. The ENGINEER will develop a map book to a large format scale with a keyed index. Numbering (or alpha numeric) system of assets will be developed and approved by the Forrest City Water Utility.

**PROJECT DELIVERABLES:**

1. GIS Inventory and Data Management Database (Electronic Media via CD DVD/ROM or equivalent)
2. Wastewater Asset Map Book



## **Manhole Inventory and Subbasin Asset Identification**

This task will physically survey manholes for detailed sanitary sewer system evaluation.

### **Assumptions:**

1. GPS grade field survey (sub-centimeters), when performed, shall be conducted in the Arkansas state plane coordinate system.
2. Invert elevations and main connection sizes for manholes will be determined using measure down information obtained during manhole inspections provided by others.
3. ENGINEER will make every effort to locate manholes in the field. ENGINEER will spend up to 15 minutes physically locating the manhole based upon the overall system map. If a manhole cannot be discovered, the Forrest City Water Utility will be notified for location.

### **PROJECT EXECUTION:**

1. ENGINEER will capture asset data for manholes on 10-inch and larger diameters connecting sewer mains utilizing GPS grade field survey methods.
2. GPS grade field survey (sub-centimeters), when performed, shall be conducted in the Arkansas state plane coordinate system.
3. The sub-basin area identified during field survey efforts will be reflected in the overall system maps and database.

### **PROJECT DELIVERABLE:**

Updated wastewater system maps to reflect GPS field validation of assets.

**FORREST UTILITY WATER UTILITY  
CITY OF FORREST UTILITY, ARKANSAS  
SANITARY SEWER EVALUATION SURVEY TRAINING  
AND PROGRAM MANAGEMENT**

**SCOPE OF SERVICES**

**WORK PLAN**

The scope described below consists of professional services designed to engage and assist the Forrest City Water Utility in implementing the processes and performing the tasks related to an Inflow and Infiltration (I/I) identification and remediation program. These professional services are proposed to complement the City's utility improvement program.

The scope includes training for conducting the intensive investigation techniques integral to sanitary sewer evaluation surveys (SSES). The training will focus on the proper application and execution of the inspection techniques and the reasons each is used. It is the intent of this project that the training be conducted with RJN Group, Inc.'s Engineer and Field Supervisors. The equipment and materials required for the training demonstrations will be provided by the Forrest City Water Utility (OWNER).

**PROGRAM IMPLEMENTATION**

An initial workshop will be conducted to go over Forrest City Water Utility's goals and discuss the resources needed to meet those goals. The field inspection training modules can then be selected that best the Utility's goals and available resources.

Each investigation technique, and its resource requirement, will be evaluated in terms of the expected resources and capital to implement and sustain. The development of a Utility field manager will be discussed as well as the need for a proactive training cycle.

**TRAINING SCOPE**

**A. Overview**

Prepare curriculum and workshop materials for general overview of investigation objectives, regulations, processes, and techniques. The training will include both classroom lectures and field demonstrations.

**B. Manhole Inspection**

1. Develop, and provide for Utility use, specific workshop materials consisting of procedures, techniques, tools and the RJN inspection forms. The inspection forms will be tailored for the Forrest City Water Utility.

2. Present classroom session.

A RJN field supervisor and Engineer will conduct one classroom session on full-descent and other manhole inspection procedures for the purpose of condition assessment and for identifying and quantifying infiltration and inflow sources. The RJN instructor will explain each type of source that can be found in a manhole, how to determine that a source exists even if it is not leaking and an overview of the methods used to quantifying sources (i.e. establishing a flow value for each defect). The classroom session is expected to last approximately 4 hours. Additional classroom time can be added upon request for an additional charge.

The classroom instruction will include an overview of the recommended list of equipment needed to conduct the investigations.

3. Present field session.

Upon completion of the classroom session, the participants and the RJN instructor will inspect manholes in the field for approximately 12 to 14 hours over a two-day period. The field training will allow all the participants to connect the classroom training with actual conditions in the field.

C. Smoke Testing

1. Prepare curriculum and workshop materials. Workshop materials will consist of description of procedures, processes and the RJN inspection forms tailored to Forrest Utility's system.

2. Present classroom session.

An RJN field supervisor and Engineer will conduct a classroom session on smoke testing procedures. The benefits of concepts such as dual blower methods and line isolation will be introduced and discussed. There will be an overview provided on how to this technique is used to identify and quantify (i.e. assign a flow value) infiltration and inflow sources. The classroom session is expected to last approximately 4 hours. Additional classroom time can be added upon request for an additional charge.

The classroom instruction will include an overview of the recommended list of equipment needed to conduct the investigations.

3. Present field session.

Upon completion of the classroom session, the participants and the RJN instructor will smoke test line segments in the field for approximately 12 to 14 hours over a two-day period. The field training will allow all the participants to link the classroom training with actual conditions in the field.

D. Dyed Water Testing (If needed, see Program Implementation)

1. Prepare curriculum and workshop materials. Workshop materials will consist of description of procedures, processes and the RJN inspection forms tailored to Forrest Utility's system.
2. Present classroom session.

An RJN field supervisor and Engineer will conduct a classroom session on dyed water flooding procedures. There will be instruction on how to identify and quantify infiltration and inflow sources. The RJN instructor will explain proper record keeping and how to identify areas for dyed water flooding subsequent to smoke testing. The classroom session would be combined with the CCTV inspection training and is expected to last approximately 4 hours.

The classroom instruction will include an overview of the recommended list of equipment needed to conduct the investigations.

3. Present field session.

Upon completion of the classroom session, the participants and the RJN instructor will dye flood line segments identified as defective during smoke testing in the field for approximately 4 to 6 hours over a one-day period. The training will include an overview of using this technique to identify defective manholes and possible storm drain influence. The field training will allow all the participants to link the classroom training with actual conditions in the field.

E. Closed Circuit Television (CCTV)

1. Prepare curriculum and workshop materials. Workshop materials will consist of description of procedures, processes tailored to Forrest Utility's needs and resources.
2. Present classroom session.

An RJN field supervisor will conduct a workshop session on CCTV procedures. This training would coincide with any dyed water testing training. There will be instruction on how to identify and quantify infiltration

and inflow sources by using this inspection technique. The classroom session is expected to last approximately 4 hours. Additional classroom time can be added upon request for an additional charge.

3. Present field session.

Upon completion of the classroom session, the participants and the RJN instructor will televise line segments (using Forrest Utility Water Utility's Equipment) in the field for approximately 8 hours over a two-day period.

The participants and the RJN instructor will televise line segments previously identified as defective in the smoke and dye testing phase. The field training will allow all the participants to link the classroom training with actual conditions in the field.

F. Data Management

1. Discuss the various methods and procedures for maintaining and managing the inspection data collected in the field.
2. Present classroom session.

An RJN Engineer will conduct a 4 hour session on data management procedures and processes. This session will focus on:

- Developing a process with the Utility to track and relay data to the Engineer.
- A project schedule outline will be developed.
- A Quality Control process and schedule that can provide timely feedback to the Utility will be developed.
- Overview of data collection methods
  - Paper Forms
  - Digital Data Collection

G. Rehabilitation Design and Construction Management Training

1. Prepare curriculum and workshop materials. Workshop materials will consist of description of various rehabilitation alternatives.
2. Present classroom session.
  - a. An RJN Engineer will conduct a six-hour session on rehabilitation construction and construction inspection procedures. Topics such as groundwater migration, trenchless technologies, rehabilitation



effectiveness testing, state-of-the-art construction techniques, and materials will be discussed.

## DATA MANAGEMENT SCOPE

This scope includes Data Management services designed to collaborate with the Utility and add value to their inspection efforts by processing, evaluating, and analyzing the investigation data collected. These services will include reports and recommendations.

### A. Overview

RJN will collaborate in the Utility's inspection effort by entering and processing the field inspection data collected by Forrest City Water Utility. The processed data will be entered into a database and analyzed to help locate and characterize the source of excess Inflow and Infiltration in the sewer collection system.

### B. Data Management

RJN will input the field inspection data received by the Utility. The Utility will submit the information to RJN on a weekly, or a predefined, basis where it will be reviewed for completeness. RJN will notify the Utility of any forms where the information is incomplete or unreadable. The field information will be entered into a database where additional quality reviews will be performed by RJN's data analysts. Field check lists will be sent from RJN back to the Utility to address any issues identified with the inspection data that need to be field verified or corrected.

### C. Data Analysis

RJN will perform an analysis of the field investigations in order to provide the Utility with recommendation as to where to perform CCTV inspection and dyed water flooding tests. A letter report summarizing the location of sewers to be inspected and the justification shall be submitted.

### D. Data Reporting

At the conclusion of the televised inspection and dyed testing activities (i.e. sufficient quantities agreed upon by RJN and Utility) by the Utility, the field-collected data, including the smoke testing and manhole inspections, will be used to develop a rehabilitation strategy. The strategy will include the evaluation of each type of defect, a rehabilitation method, and the costs associated with the improvement based on local contractor bid schedules. Possible main line and interceptor rehabilitation methods may include: Point repairs, Section replacements, and trenchless technologies. Efforts will be made to make use of the Utility's own rehabilitation and replacement resources.

Rehabilitation methods that will be evaluated for I/I removal will include repairs for manholes, sewer mains and interceptors, and laterals. RJN will develop a

manhole defect summary in order to categorize the nature of the repairs by type. Methods may include: frame sealing, grade adjustment, manhole wall coating and grouting, pipe seal repair, and bench and trough repair.

**F. Deliverables**

A rehabilitation method and estimated cost of repair will be provided for each defect. The defects will then be ranked according to their I/I contribution and cost of repair. Defect method, private versus public, and maintenance priorities will then be categorized. Rehabilitation summaries will be presented by sub-basin.

Three copies of a brief letter report will be delivered along with supporting field documentation to include:

- Consolidated source defect report with summary tables categorized by type, method and cost.
- Rehabilitation plan for each defect.

The report will provide an improvement and rehabilitation plan in order to provide the most cost-efficient means of reducing I/I and improving system performance. This plan will provide a basis for subsequent engineering design activities.

**G. Provided by the UTILITY**

- Field investigation reports, logs and pictures
- Televised inspection disks
- Sewer Maps

## **PROGRAM MANAGEMENT**

This scope includes Program Management services designed to assist the Utility by providing implementation and integration of the SSES activities into the Utility's Improvement program with work process benchmarking and recommendations and staffing and scheduling analysis.

This scope also includes Quality Control (QC) checks on the inspection data collected. These services will include inspecting portions of the sewer system and providing analyses of the inspection results.

### **A. Overview**

RJN will collaborate with the Utility's SSES efforts by providing program management services. These services are proposed as a peer review of the Utility's inspection efforts and may include oversight and recommendations on implementing the field investigations and integrating the processes and results in the CMOM program. The Program Management services will also include periodic review of the inspection data processes, production rate, resource needs analysis, and schedule review.

### **B. Program Management during SSES**

RJN will provide services that will include the development of program documents to define and communicate policies, procedures, responsibilities and performance measures for I/I reduction and sewer system improvements, specifically integrated into the Utility's CMOM and Improvement program and to meet the requirements put forth by ADEQ.

RJN will work with the Utility staff to develop a thorough and effective quality assurance (QA) plan for the data collection and data management efforts to ensure that the collected data is accurate, thorough, and relevant to the I/I reduction efforts and overall CMOM program. As part of the QA plan, it is proposed that RJN personnel will provide periodic quality control (QC) checks on the inspection data collected. This may entail RJN personnel performing inspections on agreed upon portions (e.g. 10% of all Utility inspections) of the sewer system previously inspected by Utility personnel and analyzing the results.

### **C. Program Management during Engineering Design**

RJN will provide services that assist the Utility during the engineering and rehabilitation design by helping to establish scopes, schedules, and Capital Improvement budgets required for the sewer system improvements. These services may also include value engineering, coordinating design services, and peer review of improvement plans.

D. Program Management during Construction

RJN will provide services that assist the Utility during sewer improvement construction. These services may include advertising and bidding, constructability reviews, and construction inspection training and services.

## RJN SSES INVESTIGATION SERVICES

### A. Overview

To supplement the Utility's field inspection efforts, RJN can provide crews to perform any, or all, of the inspection efforts described herein. A detailed scope of these services, and associated fees, will be furnished upon request.

FORREST UTILITY WATER UTILITY  
CITY OF FORREST UTILITY, ARKANSAS  
ASSET MANAGEMENT PROGRAM DEVELOPMENT

SCOPE OF SERVICES

Forrest City Water Utility's goal is to continue to improve the efficiency of the Utility's operations by researching, developing and implementing innovative practices. A comprehensive, sustainable Asset Management Program can be part of that effort.

An Asset Management Program attempts to define what is an asset is and to implement a cradle-to-grave management approach including acquisition, operation and maintenance, rehabilitation or replacement, and disposal of an asset. It ties together, Capital Planning, Maintenance Planning, Operations Planning, Resource Allocation (both short and long term) and Risk Assessment activities.

An effective Asset Management Program will provide data driven decisions as well as providing the opportunity to: do more with limited resources, justify decisions, justify rates, provide exceptional service, and minimize risk.

In simple terms, the Program will document the Forrest City Water Utility's assets: What does the Utility have? Where are they? What condition are they in? Does the staff know how to properly operate and maintain each asset?

As systematic, phased approach will be used to implement a comprehensive asset management program that is in accordance with the United States Environmental Protection Agency's Asset Management: A Best Practices Guide and Water Effective Utility Management frameworks.

### **Asset Management Introduction**

Forrest City Water Utility manages many varied assets. The goal of the Asset Management Program, as per the International Infrastructure Management Manual, is to allow the Utility to "meet the required level of service, in the most cost-effective manner, through the management of assets for present and future customers".

A successful asset management program provides answers to 5 core questions:

1. What is the current state of my assets?
2. What do I own? Where is it?
3. What condition is it in?
4. What is its remaining useful life?
5. What is its remaining economic value?



Based on our experience and, in accordance with best industry practices, we propose to work collaboratively with the Utility to develop and implement an Asset Management Program using a 10-Step Process. This stepped approach allows the Program to be phased into development organically as time or need and resources allow. The 10-Step Process starts by taking a look at the current state of the Utility's assets and is as follows:

1. Develop Asset Registry (e.g. system layout, data hierarchy, standards, and inventory)
2. Assess Condition, Failure Modes
3. Determine Residual Life
4. Determine Life Cycle and Replacement Costs
5. Set Target Levels of Service (LOS)
6. Determine Business Risk ("Criticality")
7. Optimize O&M Investment
8. Optimize Capital Investment
9. Determine Funding Strategy
10. Build Asset Management Plan

To initiate the Program, RJN and Forrest City Water Utility will develop a project scope to develop an Asset Registry. An asset register is a systematic recording of all assets that the Utility owns or for which it has responsibility. An asset register uses asset identification numbers to which attribute information can be linked. Everything in Asset Management starts with asset registry.

An asset must be defined as well. Within the Water and Wastewater Utility there are Vertical Assets (e.g. Treatment Plants) and Linear Assets (e.g. connected pipelines). The project scope will include objectively defining the assets and the granularity of the asset classes.

To list and record the assets, the project will entail research of many sources of data held by THE UTILITY including:

- As-built drawings
- Design drawings
- Manufacturer's manuals
- Bid documents
- Schedules of quantities
- Staff – current and previous
- Photos and Videos
- Field Surveys

The Project Scope will define the types of asset registers to be used in the THE UTILITY Asset Management Program. These can include:

- Hierarchical – Parent, child
- Category-based
- Process Loops
- Spatial relationships- GPS-generated
- Business Unit Responsibilities
- Service Provisions

Asset Hierarchy Examples:

- Facility (Level 1)
  - Parent Asset (Level 2)
    - Child Asset (Level 3)
      - Grandchild Asset (Level 4)
- Wastewater Services (Level 1)
  - Collection Systems (Level 2)
  - Treatment Systems (Level 2)
  - Disposal Systems (Level 2)
- Gravity Sewers (Level 3)
  - Manholes (Level 4)
  - Pipelines (Level 4)
  - House Connections (Level 4)
  - Drop Structures (Level 4)
  - Sewer Ventilation (Level 4)
  - Siphon Structures (Level 4)
- Pump Stations (Level 3)
  - Inlet sewer and screen (Level 4)
  - Wet and Dry Well (Level 4)
  - Superstructure (Level 4)
  - Pumps and Motors (Level 4)
  - Force Main (Level 4)
  - Electrics (Level 4)
  - Controls (Level 4)
  - Land and Surroundings (Level 4)

The asset registry and related naming convention must make sense to all stakeholders and be effective. Confidence at the asset level is required to roll up cost management (and asset performance). It can start at the "low" level of Maintenance Managed Item:

A Maintenance Managed Item is an item at the lowest level – the smallest subdivision – of an asset registry composed as a nested hierarchy. Typically, it is the level at which an asset is maintained (for example, parts are identified), or decisions are made to repair, refurbish, or replace (Think "work order") (What hierarchy level is best for identifying a maintenance management item?)

The project will develop objective Data Standards for use to ensure the Asset Management program is robust and consistent. Data confidence level within asset hierarchy will provide confidence to the decision makers in the Utility that the decision rendered is the best solution at the right time. The "data standard" is the key building block for Asset Management asset registries.

Data Standards may include, but not be limited to, the following written records:

- Asset identification naming convention
- Attributes
- Record Layouts
- Database architecture and protocols
- Data collection protocols

The project will define an Asset ID naming convention. Naming convention issues can take into account:

- What is an asset? (What gets a unique ID?)
- Linear (pipe) vs. vertical (plant) assets
  - Geo-reference
  - CAD vs. GIS
- Active vs. Passive
  - Lock-out/tag-out
  - Asset ID vs. asset location for mobile assets

Major components of asset data are tied to the asset ID.

- Physical attributes
- Geo-reference
- O&M Manuals
- Drawings and Photos
- Life Cycle Costs
- Knowledge and strategy

The Project will develop an approach to generating registry data taking into account what the Utility already has and what the Utility is about to acquire.

## **PROGRAM GOAL**

One concern might be the manual tasks required for entering and retrieving data and the inability for different systems used by the Utility to efficiently exchange information related to the various assets.

The Utility needs the ability to effectively transfer and exchange asset information between its various existing and future management systems. Forrest City Water Utility might like to integrate and improve the communications between these systems, which can start with developing a common naming convention for all its assets.

To manage assets effectively, information about an asset or group of assets must be periodically queried and merged from multiple database software application systems in order to present the "entire picture" of the asset, i.e. location, drawings and specifications, installation dates, past use history and performance, future use and performance projections, preventive/corrective maintenance history, warranty history and status, expected useful life remaining, current condition assessment/status criticality, initial cost, replacement value, operating cost (including energy and other consumables), etc. for analysis and decision making aimed at ensuring optimal life-cycle cost (direction of funds, manpower, rehab vs. replace, run to failure vs. preventive replacement, etc.)

The goal of this project is to facilitate development of an asset registry with asset identification system for Forrest City Water Utility's assets with a common identification system that will promote the exchange of information between all business systems and will enhance Forrest City Water Utility's capabilities to more proactively maintain, operate, and account for all its assets. There will be a phased approach to development of the Asset Management System with subsequent steps and tasks outlined under future projects.

## **Project Understanding**

Forrest City Water Utility's goal is to continue to improve the efficiency of Maumelle Water's operations by researching, developing and implementing innovative practices. A comprehensive, sustainable Asset Management Program will be part of that effort.

An Asset Management Program attempts to define what an asset is and to implement a cradle-to-grave management approach including acquisition, operation and maintenance, rehabilitation or replacement, and disposal of an asset. It ties together,

Capital Planning, Maintenance Planning, Operations Planning, Resource Allocation (both short and long term) and Risk Assessment activities.

A systematic, phased approach will be used to implement a comprehensive asset management program that is in accordance with the United States Environmental Protection Agency's Asset Management: A Best Practices Guide and Water Effective Utility Management frameworks.

### **Project Background**

To manage assets effectively, information about an asset or group of assets must be periodically queried and merged from multiple database software application systems in order to present the "entire picture" of the asset, i.e. location, drawings and specifications, installation dates, past use history and performance, future use and performance projections, preventive/corrective maintenance history, warranty history and status, expected useful life remaining, current condition assessment/status criticality, initial cost, replacement value, operating cost (including energy and other consumables), etc. for analysis and decision making aimed at ensuring optimal life-cycle cost (direction of funds, manpower, rehab vs. replace, run to failure vs. preventive replacement, etc.)

### **Project Goal**

The goal of this project is to facilitate development of an asset registry with asset identification system for Forrest City Water Utility's assets with a common identification system that will promote the exchange of information between all business systems and will enhance Forrest City Water Utility's capabilities to more proactively maintain, operate, and account for all its assets. There will be a phased approach to development of the Asset Management System with subsequent steps and tasks outlined under future projects.

## **SCOPE OF SERVICES – PILOT PROJECT AREA**

The proposed scope of work for this project includes:

### **Information Gathering**

The purpose of this task is to conduct an initial workshop with Forrest City Water Utility's leadership to discuss the project approach and explain the rationale behind an asset registry system with a single, enterprise-wide unique identification system, and its implications for various groups and software tools currently used within Maumelle Water. The goal of this workshop is to identify various stakeholders and the involvement for each group that may be necessary to implement a meaningful, comprehensive, and robust asset management program.

RJN will meet with all stakeholders (e.g. operations, maintenance, engineering, IT and finance) to review the purpose and benefits of the projects. The goals of this workshop include:

- Ensure all stakeholders understand the benefits of an asset registry with common ID system
- Obtain input from all stakeholders on the needs and limitations of their systems
- Obtain input on any naming convention preferences and the reason for those preferences
- Review As-Built drawings (as needed) to reconcile map information

### **Definitions of Asset Registry - Asset Type and Hierarchies**

RJN will meet with key Forrest City Water Utility staff members to review the various business systems to understand the current status and the naming convention used in the existing systems. This task includes a review of recent reports/studies and any naming conventions used on recent projects.

The goal of this task is to obtain a general understanding of Forrest City Water Utility's current system. The project group will study the identification system and criteria in the various systems in use and compile a matrix of IDs used in those systems. This will serve as a starting point for identifying various requirements and constraints that must be considered for developing the unique identifiers. Other considerations such as backward compatibility and loss of data will also be considered and documented in the process.

RJN will meet with the operations, maintenance, and management staff to define asset types and hierarchies. To facilitate the discussion, RJN will prepare a preliminary outline of example asset types and hierarchies as a starting point using a pump station as an

example of vertical assets and a portion of interconnected piping as an example of linear assets. The goals of this workshop include:

- Define all asset types within the system
- Define the hierarchies for both the linear and vertical assets
- Present example asset IDs and test if they will work in the CMMS and accounting systems (if applicable).

### **Presentation of Naming Conventions**

RJN will meet with key Forrest City Water Utility Stakeholders to review the benefits of the naming convention, staff preferences, and naming convention alternatives with the goal of developing a naming convention protocol that will be consistent for all systems.

RJN will meet with all stakeholders to present their findings and review the suggested naming convention. The goals of this include:

- Present detailed findings of asset types and suggested naming convention for each asset type
- Address any outstanding concerns with the key stakeholders
- Present a protocol for creating a new asset and its migration from one system to other systems. This also includes converting existing conventions into the new conventions.
- Review schedule for the conversion to the new naming convention.

### **Report**

RJN will prepare a report to summarize the benefits of the proposed asset registry system and new naming convention and the process used to develop the system. The report will also describe the methodology for converting existing assets and naming any new assets, which may include tables with listings of asset types, processes, disciplines, equipment types and example types and example unique IDs for each type of asset. This document will be used as the basis for converting existing assets into the new naming convention and for entering all new assets into the existing or new systems.

### **PROJECT EXECUTION:**

A pilot project would be performed to locate, map and name the water and sewer assets (i.e. sewer manholes, water meters, fire hydrants, water valves) in four map grid "squares". The grid blocks will encompass the area as defined by the blocks in the utility system map furnished by MWM.



The naming of the assets will follow the convention and protocol proposed during the course of the project (Task C). The goal of the pilot project will be to subject the proposed asset naming process and protocol to a "stress test". This proof of concept testing will gauge the viability and long term robustness of the asset management conventions.

### **Pilot Deliverable**

A database of the water and sewer assets found in the pilot project will be created. The database will list the assets with their new, unique name and other attribute information such as the asset's GPS coordinates and as-built information (where applicable). The database will be delivered to MWM for review and use.

### **GPS Survey**

The X, Y, coordinates will be determined to within sub-meter accuracy of the sewer manholes, water valves, fire hydrants, and water meters. Elevations (Z coordinates) will be collected in the field but will be verified based on as-built elevations.

It is anticipated that some revisions will be made to the MWM water and sewer atlases to correct location discrepancies. This updated information will be furnished to MWM at the conclusion of the project.

### **As-Built Hyperlinks**

Where available and applicable, the as-built drawings of the assets located in the pilot project will be scanned and linked in the database to the respective asset. This link will feature a hyperlink feature to bring forward the as-built and attribute information when the asset is selected in the map or database.

--END--

**List of items needed for Inflow and infiltration.**

Items with an \* Asterisk Are Items in Stock.

**Confined Space Safety Rescue Equipment**

- Tripod\*
- Winches\*
- Harnesses\*
- Hard Hats\*
- Fresh Air Blowers\*

**Equipment required to smoke the Sewer Lines**

- Manhole Smoke Blower\* Manhole Liquid Smoke Blower
- Liquid Smoke\*
- Smoke Bombs\*
- Pipe plugs\* (2) 6" (2) 8" (2)10" (2) Air Pumps with hoses.

**Sewer Camera to Visually Inspect the Sewer Lines**

**Vehicle to Transport the Equipment Used In the Inspection Process**

**Computer to Document the Information Gathered During the Inspections**

and resolve collection system performance issues with services offerings including:

- **Flow and rainfall monitoring**
- **Field investigation/condition assessment services**
- **Inflow/infiltration analysis and reduction**
- **GIS integration and mapping services**
- **Public information programs**
- Hydraulic modeling
- Rehabilitation and replacement design
- Lift station performance and condition assessments, and design
- Private source inflow removal solutions
- Regulatory assistance and compliance programs
- Construction management services

We understand the deadlines, complexities, and sensitive nature of accurate data collection, analysis, and planning required to effectively develop and conduct programs that improve collection system operations and performance.

## EQUIPMENT INVENTORY

As a vertically integrated wastewater collection system specialist, RJN owns and maintains state-of-the-art equipment to support our collection system field investigation and analysis services. Our fleet of 25 field vans is easily identifiable with the company logo and is specially equipped to support all field investigation tasks. These vans have been designed to promote safety providing rapid access for confined space entry; each van has heavy-duty batteries, meter storage bins, and traffic control equipment.



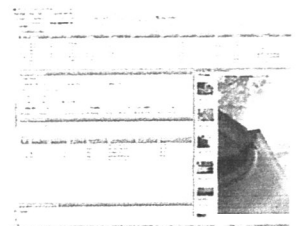
## RJN Field Equipment Inventory

Quantity	Item
280	Flow Meters - Depth and Velocity (170 equipped with Data Telemetry via Cell Phone RTU)
25	Portable Velocity Probes (PVM)
20	Digital Lift Station Event Recorders
2	Portable Pump Station Force Main Dual Channel Flow Meters
94	Continuous Recording Digital Rain Gauges with Data Telemetry via Cell Phone RTU
50	Precalibrated Weirs
6	Envirosight Pole Cameras with Sony Mini Digitation Video Records
10	GPS Survey Trimble Nomad and Trimble Geo XH Instruments
3	Electronic Distance Measurement Instruments
5	Dye Water Flooding Trailers – 350 Gallon Water Tanks, 5 HP Air Compressors and Water Pumps
30	Confined Space Entry Equipment Sets
25	Dyed Water Flooding Equipment Sets
30	35MM, Digital Cameras
25	High Capacity Smoke Blowers
100	Mechanical Plugs, Sandbags
25	Lamping Equipment Sets

## RJN VALUE ADDED

RJN I&I study programs quickly identify areas, or sub-basins, within the collection system that are contributing excess I&I. Those sub-basins are then prioritized for more detailed investigations to locate the defects and quantify their impact. This process has proven to successfully reduce I&I levels.

**Engineering analysis of flow and condition data yields recommendations that can be used to proactively manage short-term improvements and plan capital improvements over a longer term.** "Quick Hit" defects can be quickly repaired and immediately bring results.





## PROPOSED SCHEDULE

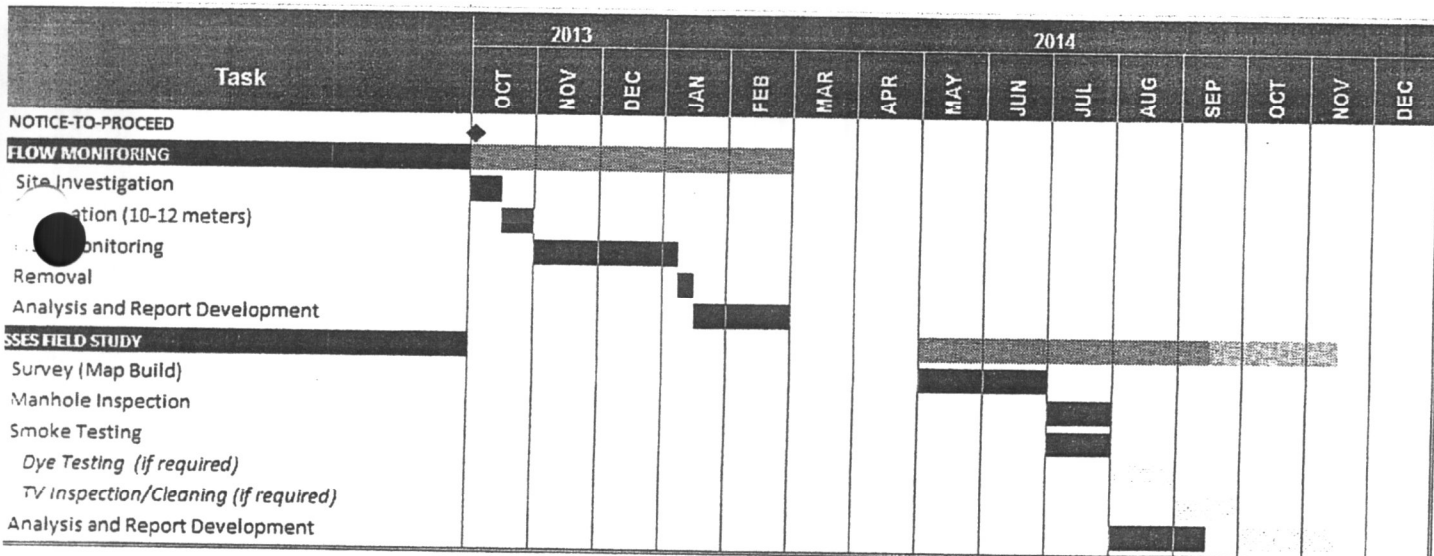
The proposed schedule is illustrated below. This schedule will be finalized upon award of the project to account for any deadlines or milestones FCWU requires.

### Assumptions:

- Flow monitoring will be conducted using 10 to 12 meters

- Field Study inspections will be conducted for basins prioritized through flow analysis
  - Field study tasks assume involvement of City staff (mentoring/training)
- GPS Survey will be conducted for all manholes where 10-inch or larger pipes exit and enter the manhole

Schedule adjustments may be required for weather dependent field tasks to ensure the most accurate data is captured.



\* REVISED START DATE Aug. 2015



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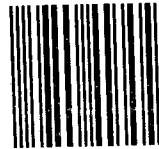
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