

**TASK AUTHORIZATION
NORTH BUFFALO SSES AND REHABILITATION DESIGN ASSISTANCE**

- 1. The Basic Services of the ENGINEER as described in the Agreement are supplemented as follows, to be referred to as the PROJECT:**

BACKGROUND

The City of Greensboro (City) has focused their gravity sewer rehabilitation program to date on infiltration/inflow (I/I) reduction in the upper North Buffalo Drainage Basin. The I/I entering the sewer system must be kept under control to not exceed the downstream design limits of the North Buffalo equalization tank and pump station. It is also a “best practice” to continuously reduce I/I in some areas of the system as the pipes will deteriorate over time and I/I will increase over time with no I/I reduction efforts. The City has completed the rehabilitation of the Priority 1, Priority 2, and a portion of the Priority 3 sewersheds. The City intends to continue sanitary sewer evaluation surveys (SSES) and rehabilitation in priority subbasins of the upper North Buffalo Drainage Basin, and intends to choose a new location for which to focus efforts based on historical flow data, work orders, and SSOs. To choose the next area for rehabilitation to reduce I/I, flow monitors must be installed at the mini-basin level. Flow monitoring analysis is best performed in the winter and early spring when groundwater levels are highest. The City therefore intends to install flow meters in February of 2018 and monitor for 2 months duration. Following the analysis of the flow monitoring data, mini-basins with the highest I/I will be identified for SSES and rehabilitation.

In addition, it is anticipated that in Year 2 of this authorization, when approved in writing by the City, the City wishes to evaluate the highest priority areas for flow monitoring, SSES, and rehabilitation. This authorization assumes that approximately 150,000 LF of sewer will be evaluated by CCTV and smoke testing for the scope of work Tasks 2-4 in Year 2.

This scope of services consists of the following major tasks:

- Task 1 – Flow Monitoring and Analysis
- Task 2 – SSES Data Collection
- Task 3 – Data Analysis
- Task 4 – Design Assistance and Memorandum

SCOPE OF SERVICES

Task 1– Flow Monitoring and Analysis

1.A Flow Monitoring Data Collection

ENGINEER will develop a flow monitoring plan to collect pertinent flow and rainfall data for the City of Greensboro’s chosen service area. ENGINEER will make recommendations regarding flow monitor and rain gage locations, subbasin size, and duration of flow monitoring.

This scope of work includes an allowance of \$138,600 for flow-monitoring field data collection based on the estimated cost for mobilization, installation, and maintenance of 20 temporary flow monitors and 6 rain gages installed for 60 days. Sixteen of the flow monitors will be used to analyze I/I in new mini-basin areas and to prioritize the next areas for rehabilitation. The new mini-basin areas to be monitored include portions of NB18, 17, 2, 13, and 14 and GIS files of these areas and proposed monitor locations have been sent to the City. Four of the flow monitors will be used for post rehabilitation I/I reduction analysis to measure the amount of I/I reduced through the prior phase of this program, where rehabilitation has been completed in 2017. Should the flow monitoring require a time extension due to lack of rainfall, additional weeks may be added to the agreement at the following additional extended monitoring costs: \$715 per meter per week and \$110 per rain gage per week.

ENGINEER intends to subcontract the field flow monitoring services to Hydrostructures. The flow monitoring equipment will be capable for measuring the depth and velocity of wastewater flows at preset, synchronized time intervals of 15 minutes. Pressure sensors will be installed with the capability of measuring depth of surcharging at the monitoring locations. Flow monitoring sites will be selected in conjunction with City of Greensboro. Concurrent data will be recorded from 6 temporary rain gages. Rain gage locations will be determined with the assistance of the City of Greensboro. The rain gage equipment shall be capable of measuring rainfall depth in increments of 0.01 inches at preset synchronized time intervals of 15 minutes. Flow and rainfall shall be provided to City of Greensboro in digital spreadsheet-compatible format. Data shall include date, time, depth, and average velocity, and flow at not more than 15-minute increments. Site installation logs will also be provided for each monitoring site.

1.B Data Review and Analysis

ENGINEER will review the raw data from all temporary meters at the start date of the flow monitoring period to make sure that the flow monitor site hydraulics are conducive to collection of quality data and that the equipment is functioning properly. During the flow monitoring period, ENGINEER will also review data bi-weekly thereafter to monitor any potential change in conditions.

ENGINEER will perform hydrograph decomposition to determine the rainfall dependent inflow and infiltration (RDI/I) contributions for three monitored storm events. Flow hydrographs recorded during a storm event will be decomposed into their wet weather and base flow components by subtracting the typical base flow hydrograph. R values (defined as the fraction of rainfall over a sewershed that enters the sanitary sewer as RDI/I), peaking factors, and RDI/I per linear foot of sewer will be evaluated. This analysis will reveal the relative RDI/I contributions of various portions of the service area.

This task includes prioritization of the subbasins based on the flow monitoring data analysis which will be used as a basis for determining the subbasins for SSES and rehabilitation in Tasks 2, 3 and 4.

Maps and tables of the analysis results will be created and presented at a meeting with the City. A memorandum will be delivered as part of Task 1.D.

1.C Post Rehab Flow Monitoring Analysis

For the flow monitors designated for post-rehabilitation analysis (Mini-basins 13, 2, 21, and a control), ENGINEER will analyze the pre-rehabilitation and post-rehabilitation flow monitoring data. Pre-rehabilitation data was obtained in 2011 and post-rehabilitation data will be obtained in 2018 as part of Task 1. Based on this analysis, the percent reduction of infiltration and inflow will be estimated. The data will be normalized and a linear regression analysis performed. ENGINEER will prepare a letter summarizing the results of the post-rehabilitation monitoring, and meet with the City to discuss the results.

1.D Technical Memorandum

ENGINEER will prepare a memorandum to document the results of the analysis and recommendations for additional SSES or rehabilitation work in the priority basins.

Task 2 – SSES Data Collection

This task includes a kickoff meeting, field reconnaissance, and SSES data collection. During the kickoff meeting, project goals, deliverables, schedule and data collection coordination will be discussed. This task includes field reconnaissance of the study area to observe surface conditions that could impact costs of open-excavation pipe replacement or excavation of insertion pits for sliplining or pipe bursting. This task also includes visual inspection of the aerial crossings to determine if there is any obvious deterioration of the piping or piers.

This scope of work assumes that the City will obtain CCTV inspection data through its annual services contract. To assist the City, ENGINEER will prepare sewershed level mapping for the CCTV subcontractor. It is assumed that the City will be responsible for subcontractor

coordination and QA/QC of the CCTV inspections. This scope also assumes that the deliverables will be PACP coded digital CCTV inspections and logs.

The ENGINEER intends to subcontract the smoke testing to CriTek Engineering Group, P.C. Deliverables for the smoke testing shall include pictures of smoke locations (not including distance measurement for defects which can be easily located again using the photos (such as a broken clean-out cap or roof leader)) as well as sewershed level map showing the smoke locations.

This scope of work assumes an area of up to 150,000 lf will be chosen for SSES Data Collection, Analysis, and Rehabilitation Design for Year 2.

Task 3 – Sewershed SSES Data Analysis

This task includes review and analysis of all CCTV video and smoke testing inspection results. During this review, defect tabulations on the CCTV videos and logs shall be verified for accuracy and interpretations will be made related to necessary repairs according to the final design criteria. The final design criteria will be developed jointly with the City. Defects requiring point repairs shall be identified, including structurally defective pipes, defective lateral connections (hammer taps), root intrusion, offset joints, sags in pipes or joints, and major inflow sources such as stormwater connections. The most cost-effective rehabilitation approach will be determined based on the CCTV. In addition to the rehabilitation technique, a list of major sags observed, stationing of required point repairs, and number of service laterals will be provided in spreadsheet format. Planning level cost estimates for rehabilitation of the sewer and manholes using the current rehabilitation contract unit prices will be prepared. Costs will be based on the City's annual services contract, as appropriate. This task includes a meeting to review the results of the SSES data evaluation.

Task 4 – Design Assistance and Memorandum

ENGINEER will prepare GIS based design drawings of the rehabilitation and enter bid tab quantities in spreadsheets for each sewershed area, similar to what was done for the November 2013 CDM Smith report, "North Buffalo Sanitary Sewer Inspection and Evaluation."

This task includes development of a draft memorandum outlining proposed final design criteria and recommended rehabilitation technologies to be used. The memorandum will outline the design approach and assumptions related to issues such as repairs to service laterals, replacement of pipe sags, pavement replacement, and criteria for making point repairs. The memorandum will include a GIS-based map/drawing of the rehabilitation and tables of estimated bid quantities based on the recommended rehabilitation.

A draft of the memorandum will be forwarded to the OWNER for review, and a meeting will be held to discuss comments on the draft memorandum. The final memorandum will incorporate comments on the draft.

2. ADDITIONAL SERVICES

The OWNER reserves the right to amend this Agreement so that the ENGINEER may furnish services related to the Project that are not currently part of the Basic Services, or services that are stated in this Agreement as optional or add-on services. These additional services will be paid for by the OWNER in an amount and by a method to be determined at the time the services are requested and approved.

3. OWNER'S RESPONSIBILITIES

The responsibilities of OWNER as described in the Agreement are as follows:

- Provide the ENGINEER with QA/QC'd PACP coded CCTV data. CCTV inspections shall be labeled with corresponding pipe or manhole IDs in the City's GIS system. Provide ENGINEER any changes in pipe layout or orientation identified as the result of the CCTV inspection. Provide ENGINEER a list of pipes with incomplete or reverse inspections.
- Provide any public notification or assistance prior to or during smoke testing beyond what the testing subcontractor provides as standard which includes door hangars and in-person notifications to schools and fire stations.
- Provide the ENGINEER with all applicable GIS data.
- Provide historical flow monitoring data as necessary.
- Arrange for access to sites as necessary.
- Aid in selection of flow monitor and rain gage sites.
- Timely review and input of deliverables.
- Bear all costs incident to compliance with the requirements of the OWNER's Responsibilities.

4. TIME PERIOD FOR PERFORMANCE

The time periods for the performance of basic services as set forth in this Agreement are supplemented as follows:

- Work described in this Task Authorization will begin upon execution of this Task Authorization.
- Flow monitors will be installed no later than 4 weeks after NTP is received. The monitors are anticipated to remain in place for 60 days to capture significant rain events (e.g. 2-3 rain event(s) with good system response). It is anticipated that final flow metering data will be received within 4 weeks of the completion of the flow metering period. ENGINEER will complete Task 1.B within 8 weeks of receipt of the data. Task 1.C draft letter of results will be completed within 10 weeks of receipt of data. A draft Technical Memorandum (TM) will be delivered within 2 weeks of completion of Task 1.B. The final TM will be completed within 2 weeks of receiving comments from the OWNER on the draft TM.
- In Year 2, the meeting to review the results of Task 3 Data Analysis will be held within 20 weeks of receipt of CCTV and smoke testing data. The draft TM will be delivered within 8 weeks of the meeting to review results of Task 3. The final TM will be delivered within 2 weeks of receiving comments from the OWNER on the draft TM.

5. COMPENSATION AND PAYMENT

The method of payment for services rendered by the ENGINEER shall be as set forth below:

For the Basic Services Task 1 performed under Section 1 for Year 1 (e.g. FY18), the OWNER agrees to pay the ENGINEER a lump sum amount of \$273,780. The amounts presented in Table 5-1 are estimated values for reference only and ENGINEER will not be held to upper limits by task. The additional services allowance will be used in Year 1 only if needed and as authorized in writing by the City's Project Manager or their designee for a total not-to-exceed upper limit in Year 1 of \$334,780.

Partial payments shall be made by the OWNER on a monthly basis in proportion to the percentage of work completed.

Table 5-1: Year 1 Payment Amounts by Task

Task - Description	Value
1 – Flow Monitoring and Analysis	\$273,780
SUBTOTAL TASK AUTHORIZATION, LUMP SUM	\$273,780
Optional Additional Service Allowance ¹	\$61,000
TOTAL NOT TO EXCEED TASK AUTHORIZATION	\$334,780

¹ *The amount of the allowance was determined based on the amount required to extend the flow monitoring up to 4 weeks due to lack of rainfall. The additional services task may be authorized in writing by the City of Greensboro.*

Year 2: It is anticipated the OWNER will extend services (scope, schedule, and budget) in this agreement for Year 2 to include the tasks outlined in the project description above.

For the Basic Services Tasks 2-4 to be performed for Year 2 services, the OWNER agrees to pay the ENGINEER a lump sum amount of \$321,500. The amounts listed in Table 5-2 are estimated values for reference only and Engineer will not be held to upper limits by task.

The ENGINEER intends to subcontract to CriTek Engineering Group, P.C., an MBE engineering firm, to provide smoke testing and data reporting services for \$67,810 under Tasks 2 and 3.

Table 5-2: Year 2 Payment Amounts by Task

Task - Description	Value
2 – SSES Data Collection	\$96,700
3 – Sewershed SSES Data Analysis	\$141,700
4 – Design Assistance and Memorandum	\$83,100
TOTAL NOT TO EXCEED	\$321,500

The total not to exceed upper limit (including Years 1 and 2 and optional additional authorizations to be authorized in writing by the City) is \$656,280.