CRANSTON

CranstonEngineering.com

452 Ellis Street Augusta, Georgia 30901
PO Box 2546 Augusta, Georgia 30903
706.722.1588

December 22, 2023

Mr. Wes Byne
Augusta Utilities Department
452 Walker Street, Suite 200
Augusta, Georgia 30901

RE: New Savannah Bluff Lock and Dam
Updated Proposal for Datums Surveys
USGS Gaging Station and Key Locations
Cranston File No. 2019-0543(K)

Dear Mr. Byne:

In accordance with your request, we are pleased to offer the following updated proposal for conducting field surveys, analyses, and reporting to establish new benchmarks at key United States Geological Survey (USGS) gaging stations related to the Lock and Dam pool and at other key locations to be described in the paragraphs below.

PURPOSE

The purpose of the USGS gage datum surveys is to make independent field surveys to establish benchmarks at each published USGS gaging station, along with other key locations, on the Savannah River in the vicinity of the New Savannah Bluff Lock and Dam and in the pool impounded by the dam. The benchmarks to be established can be readily used to verify and/or correct the elevation datums of the several primary USGS gaging stations, so that they are all related to the same elevation datum, namely the North American Vertical Datum of 1988 (NAVD 1988).

Note that the exact location and type of fixture where the elevation points are referenced at each station are not known at this time, because many are likely

located within locked enclosures. Nevertheless, comparisons using simple direct level surveys to the benchmarks to be established under this proposal may be readily made at such time as the official reference points become known and physical access permissions procured.

GENERAL SCOPE

The scope of work proposed herein is generally based on the original scope contained in our previous proposal letter of October 22, 2022, enlarged to encompass the several specific tasks you have outlined during our recent scoping meeting and to add OPUS GPS processing as described in a paragraph below.

The scope is divided into five parts: first, conducting background research of published elevations, public records, and summarizing results; second, making field surveys for the four Principal USGS gaging stations that are used to measure the level of the pool and designating one temporary benchmark and one permanent benchmark monument at each site; third, making surveys to establish temporary benchmarks at the Secondary USGS gaging stations and other key locations at or near the pool; fourth, furnishing shop-made concrete monuments with integral caps; making near-simultaneous water level elevation surveys at each of the Principal USGS gaging stations during a period of steady flow conditions; and, sixth, furnishing a written report and GIS-compatible maps to document the findings. A seventh task is proposed to determine the elevations of the four Principal USGS gaging stations reference points and the "zero" of each gage, to be done at such time as access to the station enclosures can be gained.

METHODOLOGY

Establish temporary benchmarks at immediate sites of all gaging station and selected secondary locations, using existing fixed identifiable features without installing any new objects nor defacing any facilities.

Establish permanent benchmark monuments located as close as possible to the principal gaging stations. These monuments are not to be located on federal lands, but on property owned by local government or on private property by permission. Use brass or bronze caps anchored in concrete monuments or in fixed structural elements.

Survey direct levels from published federal government First Order Survey benchmarks, employing digital leveling equipment to loop elevation surveys through new benchmarks and back to the original benchmark to check elevations against allowable error. Also, loop through previously established State benchmarks that have been officially checked and verified by OPUS GPS methodology. Loop through other established City benchmarks, if located convenient to the work sites, particularly those along the Augusta Levee and/or Augusta Canal. Employ Second

Order, Class 2 Precision for permanent and temporary benchmarks at the four Principal USGS Gaging Stations, and Third Order Precision for the temporary benchmarks at the Secondary USGS Gaging Stations and Key Locations. These orders specify general misclosure limits of 0.026 foot and 0.04 foot, respectively. Precision orders are defined in by National Geodetic Survey in *Control Leveling, Report 8*. (Available at https://www.ngs.noaa.gov/PUBS_LIB/TRNOS73NGS8.pdf). In addition, vertical closures of measurements are to meet State of Georgia Rule 180-7-.04 Measurements—Vertical: "A circuit of levels between precise benchmarks or a circuit closed upon the initial benchmark shall not differ more than 0.02 foot multiplied by the square root of the number of miles in the circuit, and in no case to exceed 0.05 foot."

Calculate datum shift differences from NGVD 1929 (or mean sea level) and NAVD 1988 for each survey loop (or for each benchmark, if different).

Obtain GPS and OPUS elevations using Survey Grade GPS equipment observations on all temporary and permanent benchmarks. For obscured points, use offset points for observations and direct leveling and traverse surveys, if necessary, because of tree cover or other obstructions to clear views of satellite arrays in the celestial sphere. Compare resulting elevation values to elevations obtained from direct leveling and datum shifts calculations, to demonstrate the specified precision.

For six benchmark locations obtain longer duration GPS observations and employ OPUS processing methodology for at least six of them for additional precise checking of accuracy. This includes submitting the GPS observations to the National Geodetic Survey (NGS) Online Position User Service (OPUS) for precise solutions to the GPS positions and ties to the National Spatial Reference System. (Further information on OPUS available at https://geodesy.noaa.gov/OPUS/about.jsp#about) The six benchmarks are proposed to be locations 2, 3, 5, 6, 7, and 9 under Paragraph C below.

Survey Simultaneous Water Elevations by making water level elevation surveys at each of the Principal USGS gaging stations as nearly simultaneously as possible during a period of steady flow conditions in the river.

Furnish Written Report of Findings, including project management and quality reviews. The report will cover methodology, descriptions, maps, GIS layer map, and details, as further defined below. The report will be prepared and signed by land surveyors and engineers licensed to practice in both Georgia and South Carolina; Thomas H. Robertson, RLS, PE; John T. Attaway, RLS; and other similarly qualified Cranston staff professionals.

Determine Gaging Station Reference Elevations of the four Principal Gaging Stations, and determine the elevation of the "zero" of each gage. This task is proposed to be accomplished at such time (possibly at a future date) when access to each enclosure and the exact physical place of elevation reference are provided by the appropriate owner(s) of the stations.

SPECIFIC SCOPE

A. RESEARCH OF PUBLIC RECORDS FOR USGS GAGING STATIONS AND EASEMENTS.

1 USGS Stations. The identifying nomenclature obtained to date for each gaging station and key location is presented below. Further details from published sources as of 3/12/21 and 9/6/22 are summarized in Attachment A hereto. (Note the USGS pages at those times are endorsed "PROVISIONAL DATA SUBJECT TO REVISION". The current elevations, and perhaps other data, appear to be different.)

2 Flowage Easements. The elevations for flowage easements on the South Carolina properties from 1934 state specific elevations for the then-proposed pool, referenced ". . . the point of zero on the gauge located on this date at the 5th Street Bridge. . . ." (Note that these elevations seem to be at variance with the gauge data published historically by the USGS in their *Water-Supply Paper 1673*, 1964, p. 318.)

B. SURVEYS FOR PRINCIPAL GAGING STATIONS (SECOND ORDER PRECISION)

The basic nomenclature obtained to date for each of the four principal stations in or adjacent to the Augusta pool is summarized below. Further details on information on each station as of 3/12/21 and 9/6/22 is included herewith as Attachment A.

1 USGS GAGE 02197000 SAVANNAH RIVER AT AUGUSTA, GA
Location: Downstream side of New Savannah Bluff Lock and Dam.

2 USGS GAGE 02196999 SAVANNAH RV ABOVE NEW SAV. LOCK AND DAM.
Location: Upstream side of New Savannah Bluff Lock and Dam. (Proposed OPUS Observation Location)

3 USGS GAGE 02196670 SAVANNAH RIVER JEFFERSON DAVIS BR, AT AUGUSTA, GA
Location: Staff gage at first pier of Fifth Street Bridge from Georgia. Recording gage formerly located at second pier, until recently. (Proposed OPUS Observation Location)

4 RELOCATED "FIFTH STREET" GAGE.
Location: On River Walk Bulkhead at Eighth Street. Further information is needed for this gage, as the USGS has been unresponsive to inquiries by telephone and email.

C. SURVEYS FOR SECONDARY GAGING STATIONS AND KEY LOCATIONS (THIRD ORDER PRECISION)

5 AUGUSTA RAW WATER INTAKE PUMPING STATION
Location: On Savannah Riverbank opposite 234 Pistol Range Road, off Sand Bar Ferry Road. (Proposed OPUS Observation Location)

Note: If desired by the City, a permanent benchmark will be established at this important site, at no additional cost to the City.

6 NORTH AUGUSTA RAW WATER INTAKE
Location: North Augusta, South Carolina (Proposed OPUS Observation Location)

7 AUGUSTA CANAL RAW WATER PUMPING STATION

Location: North bank of Augusta Canal a short distance upstream of the CSX railroad bridge over the canal. (Proposed OPUS Observation Location)

8 USGS GAGE 02196485 AUGUSTA CANAL NR AUGUSTA, GA (UPPER)
Location: South bank of the Augusta Canal a short distance downstream of the Canal Headgates.

9 CITY OF AUGUSTA GAGE AT AUGUSTA CANAL DIVERSION DAM.
Elevation on existing brass gaging station cap. Also, elevation of height-sensing equipment for impoundment above diversion dam. (Proposed OPUS Observation Location)

10 STEVENS CREEK DAM.

Location: Existing elevation benchmarks at the generating station on property of Dominion Energy, approximately one mile upstream of Augusta Canal Diversion Dam. Exact points to be determined, and site access, coordinated in consultation with Dominion Energy.

11 BENCHMARK(S) ON AUGUSTA LEVEE.
Locations: Wherever pre-established points are located at a convenient position to the survey work.

12 BENCHMARK(S) ON AUGUSTA CANAL.
Locations: Wherever pre-established points are located at a convenient position to the survey work.

D. FURNISH CONCRETE MONUMENTS WITH BRASS/BRONZE CAPS—either local shop-made or store-bought as available at the time of surveys.

E. SURVEY SIMULTANEOUS WATER ELEVATIONS by making water level elevation surveys at each of the Principal USGS gaging stations as nearly simultaneously as possible during a period of steady flow conditions in the river.

F. WRITTEN REPORT OF FINDINGS
The report will include the following major elements:

- Description of methodology.
- Overall map(s) of benchmarks (both new, published, and previous) in electronic (pdf) and physical formats.
- A separate map to consist of an electronic mapping layer compatible with the Augusta GIS System.
- Table of Elevations for Primary Gaging Station Benchmarks, including measured, observed, and OPUS values (where applicable) in NAVD 1988 datum, calculated datum shifts to NVGD 1929 (and/or mean sea level), geographic positions, Georgia State Plane Coordinates, and any special annotations.
- Table of Elevations for Secondary Gaging Station and Key Location Benchmarks, including measured, observed values, and OPUS values (where applicable) in NAVD 1988 datum, calculated datum shifts to NVGD 1929 (and/or mean sea level), geographic positions, Georgia State Plane Coordinates (or South Carolina State Plane Coordinates, as applicable to the particular point), and any special annotations.
- Location descriptions, detailed position sketches, and a photograph for each individual temporary and permanent benchmark to facilitate future recovery.
- Summary of conclusions and discussion of any discrepancies found.

The project management tasks will include overall oversight and quality reviews at key stages of the work.

G. FUTURE SERVICE: DETERMINE GAGING STATION REFERENCE ELEVATIONS of the four Principal Gaging Stations, and determine the elevation of the "zero" of each gage. Furnishing an addendum to the written report. This task is proposed to be accomplished at such time (possibly at a future date) when access to each enclosure and the exact physical place of elevation reference are provided by the appropriate owner(s) of the stations.

FEE PROPOSAL

We propose to accomplish each task at the lump sum fees indicated:

Proposed Services	Proposed Fee
A. RESEARCH OF PUBLISHED RECORDS FOR USGS GAGING STATION	$5,630.00
B. SURVEYS FOR PRINCIPAL GAGING STATIONS (4 LOCATIONS, 2 OPUS)	$21,900.00
C. SURVEYS FOR SECONDARY GAGING STATIONS AND KEY LOCATIONS (7 LOCATIONS; 4 OPUS)	$20,025.00
D. FURNISH CONCRETE MONUMENTS	$1,800.00
E. SIMULTANEOUS WATER ELEVATIONS	3,500.00
F. WRITTEN REPORT OF FINDINGS, PROJECT MANAGEMENT, & QUALITY REVIEWS	$9,265.00
SUBTOTAL	**62,120.00**
G. DETERMINE GAGING STATION REFERENCE ELEVATIONS & REPORT ADDENDUM (FUTURE)	4,500.00
TOTAL	**$66,620.00**

Payment will be expected within thirty (30) days of the completion of each item and the submittal of our invoice.

TIME OF COMPLETION

We propose to begin work immediately upon your direction and to complete the surveys, report and maps within sixty to ninety (60–90) days thereafter.

ACKNOWLEDGEMENT

Your authorized signature in the space provided on a copy of this letter returned to us, or your approved purchase order, will be our authority to proceed.

We appreciate the opportunity of making this proposal and trust that you find it satisfactory. Should you have any question concerning the scope of the services offered, or the fees, please do not hesitate to give us a call.

Sincerely,

CRANSTON LLC

Thomas H. Robertson, PE, RLS

Mitchell B. Murchison, PE

ACCEPTED:

Augusta, Georgia

Utilities Department

BY:_____

TITLE:_____

DATE:_____

Attachment

G:\Projects\2019\2019-0543 NEW SAVANNAH BLUFF LOCK AND DAM FORENSIC ENGINEERING\AB-TempFiles\(K) USGS GAGE DATUM SURVEYS (AU10-160)\2019-0543 (K) USGS Gage Datum Surveys Updated Proposal FINAL 2023-12-22.docx