ATTACHMENT A

TO THE

AGREEMENT FOR ENGINEERING SERVICES

Owner: Board of Public Works,

City of Hannibal, Missouri

Project: Chloramine Replacement Alternative Evaluation

DESCRIPTION OF SCOPE OF SERVICES

On April 4, 2017, City of Hannibal voters passed a referendum requiring the elimination of chloramine treatment technology that has been used at the City's water treatment plant since September 2015 for control of disinfection byproducts and regulatory compliance. The referendum requires that the chloramine technology, specifically the addition of ammonia, be discontinued within 90 days from the date of the referendum. As such, the Hannibal Board of Public Works (BPW) is retaining Black & Veatch to conduct consultant engineering services to assist with both short-term temporary options and long-term permanent options to comply with both the referendum as well as state and federal regulator safe drinking water requirements. The scope of service is outlined as follows:

PHASE 1: PREDESIGN STUDY SERVICES

A. Project Initiation

1. Attend an initial coordination meeting with the Hannibal Board of Public Works (BPW) to understand BPWs legal constraints and requirements, and any changes thereof that may occur as BPW seeks legal and regulatory clarification and guidance to implementation.

2. Implementation Plan - Assist BPW in development of an implementation strategy for meeting the intent of the referendum while adhering to regulatory requirements. The strategy will include:
    a. Identify target treatment goals for the 90 day referendum period, and long term target goals and objectives for the project. It is anticipated the target treatment goals will be in compliance with current drinking water standards.
    b. Identification of project restraints, including regulatory review, and unknowns that may impact overall implementation and schedule of the project.
    c. Working with BPW, assess options for project delivery based on the prevailing legal or regulatory timeline controlling implementation.

d. Development of document to summarize the implementation strategy and ability and challenges to comply with both the City referendum and current drinking water standards.

B. Project Coordination

1. Project Review Meetings - Review meetings will be conducted to receive BPW comments on the deliverables prepared by the Consultant. It is anticipated that three (3) project review meetings will be conducted, one (1) to discuss overall implementation strategy, one (1) to review of initial findings report, and one (1) for review of draft final report. Additional public meetings and regulatory meetings are identified in other sections.

2. Progress Meetings – Biweekly teleconference meetings with BPW will be held to discuss project status and coordination.

3. Deliverables – Monthly updates will be provided and attached to each invoice to provide documentation on progress of the scope, schedule, and budget with comparison to the planned execution of the work.

C. Data Review and Collection

1. Review and assess previous reports, construction documents, and operational data associated with the water treatment and distribution system configuration and historical performance with respect to production capacity and regulatory compliance. These include:
    a. Operating reports containing raw and finished TOC values, and chemical usages.
    b. TTHM data from the distribution system to assess the formation of TTHMs in tanks and usefulness of spray systems (aeration) for the removal of TTHMs.
    c. A minimum of the last three years of data is requested.
    d. Recent CT tracer study results.

2. Review and become familiar with the utility's existing water distribution model to an extent that consultant can evaluate regulatory impacts of system and operational modifications; and be able to utilize model to assess water age and model regulatory objectives.
    a. Verify that all model scenarios are provided.
    b. Gather SCADA data from existing system conditions
    c. Review recent billing data and update/verify model demand allocation

D. 90 Day Referendum Compliance Evaluation

1. Conduct a process feasibility assessment for eliminating the chloramine component at the water treatment plant within a 90-day period beginning from the date the ordinance is established while still meeting drinking water regulations. This assessment will consider a multitude of treatment, distribution, and operational

options (including temporary mobile type systems) from a feasibility and cost perspective. Specific tasks include:

a. Plant Optimization Evaluation
    1. Conduct a one day site visit of the treatment plant to evaluate current operating procedures to identify potential process changes to reduce disinfection byproduct formation (DBPs).
    2. Site visit will include process expert, project engineer, and project manager to be accompanied by Plant Staff
    3. Prior to the site visit BPW to provide current process schematic and chemical feed locations and dosages.
b. CT Profile Evaluation
    1. Review the current CT profile for the plant and develop strategy to minimize DBP formation while achieving primary disinfection.
    2. Determine feasibility and benefit of achieving *Giardia* disinfection credit with the UV disinfection system. Submittal of additional disinfection credits to regulatory agency for UV not included in the scope.
    3. Review recent cT tracer test results and prepare summary that can be submitted to Missouri Department of Natural Resources (MDNR) for approval of updated cT volumes and baffle factors.
c. Bench Scale Testing
    1. Develop a bench scale testing plan to assess treatment performance for feasible treatment options.
    2. For the initial plant assessment one grab sample at the following locations will be collected and shipped to Black & Veatch laboratory in Kansas City, MO for analysis:
        a. Raw water
        b. Pre-Sedimentation Basin Effluent
        c. Primary Flocculation and Settling Basin Effluent
        d. Secondary Settling Basin Effluent
        e. Filter Influent
        f. Filter Effluent
        g. Finished Water

        Black & Veatch will furnish the bottles and shipping containers. BPW will collect the samples and ship.
    3. The technologies that will be tested at the bench-scale include the following:
        a. Pre-oxidation with chlorine dioxide, ozone, and permanganate;
        b. Coagulation evaluation (e.g., jar testing): two alternative coagulants, a range of dose rates, and use of pH adjustment to further optimize ;
        c. Adsorption technologies: alternative powdered activated carbon (PAC) and granular activated carbon (GAC).
            i. For the GAC testing, an accelerated column test will be performed to estimate GAC life and appropriate GAC blend

d. Membrane technologies: use deionized water to simulate various blends of nanofiltration (NF) or reverse osmosis (RO) permeate.
e. Perform Silt Density Index (SDI) testing on existing filter effluent to evaluate impact of the pretreated flow on NF/RO design conditions. B&V will provide the testing equipment and an engineer to assist in collecting and conducting the test.
f. Aeration after chlorine contact to determine level of DBP removal.

4. Testing will occur for regulated DBPs, the regulated Total Trihalomethanes (TTHM) and five Haloacetic acids (HAA5), values that will be determined based on a hold time of 7 days (or an alternative time period if discussions with the BPW indicate a different residence time in the plant and distribution system).
5. Each technology evaluation will occur at three conditions (e.g., chlorine residuals/dose) to determine the necessary operating conditions to achieve DBP compliance.
6. Detailed layouts and costing of the technologies is not included in this task.

d. Distribution Water Quality Evaluation
   1. Develop a 24-hour model verification using existing SCADA data to set demands and operations and perform model verification
   2. Use the verification scenario and run as a repeating 24-hour simulation for several weeks in order to simulate water age and source trace evaluations.

e. Emerging Technology Evaluation
   1. Evaluate results submitted from emerging technology to determine if applicable to meet treatment requirements. Evaluation will consist of 16 hours to review data and include summary of technology. Any additional analysis required to satisfactory review information is not included in scope of services.

f. Source Water Evaluation
   1. Evaluate potential alternative water sources and their viability to serve Hannibal. This includes groundwater wells, collector wells, and/or new treatment facility and how it would impact water quality. No groundwater modeling or firm yield estimates are included in this evaluation.

g. Regulatory Compliance Meeting
   1. Meet with Missouri Department of Natural Resources (MDNR) in Jefferson City to discuss findings and ability to implement any of the proposed treatment improvements.
   2. Discuss an overall compliance schedule for implementation of the final improvements.

2. Summary of Initial Findings Report
   a. The data collected as part of the bench scale testing and initial evaluation will be summarized and submitted in a report The report will include:

1. Recommendations for technologies that should be consider for full implementation and their estimated reduction in DBP formation,
2. Technologies that should no longer be considered.
3. Document results of distribution modeling.
4. Recommended cT volumes and baffle factors.
5. Determination if alternative water sources should be considered.
6. Provide summary of potential treatment or distribution modifications that would reduce DBP formation that could be implemented prior to eliminating chloramines from the distribution system, including temporary systems.
    a. It is understood that due to the time constraints of the 90-day period, various options that require testing and validation to confirm their feasibility, may be considered without a full understanding of outcomes; but considered on the basis of best management practices (BMPs) used at other utilities, or based on a preliminary best professional judgment (BPJ).
    b. Coordination with Contractors and construction plans to implement the short term solutions are supplemental services.
7. Summary of additional data collection required to finalize the process technologies.

E. Public Outreach Assistance

1. Public Meetings Attendance – It is anticipated that public meetings will be held to provide an opportunity for anyone interested in a particular issue or project to become educated about it as well as to offer input throughout the process. Consultant will participate in up to two public meetings as requested.
2. City Council Presentation: The consultant team will present the study results and final report to City Council during a regularly scheduled council session.

F. Preliminary Design Report

1. Phase 2 includes evaluation of the best long term approach to meeting regulatory drinking water requirements and adhering to the referendum for no longer using chloramines as a means to control DBPs. These tasks include:
2. Additional Bench Scale Testing
    a. To evaluate the impact in changing water conditions three additional samples will be collected and sent to laboratory for analysis. It is anticipated that these samples will be collected in July 2017, September 2017, and December 2017. However, the timeframe may change with the goal of water quality testing occurring during the most challenging water quality conditions. At a minimum two of these tests will need to occur prior to issuing the final report. The third test could be completed after the report is issued to assure no outlier conditions would impact treatment and to better confirm and estimate the life cycle costs.

b. Testing will only be conducted on the technologies recommended for further evaluation in Phase 1. The scope is based on conducting GAC testing, and two coagulation tests for each sample event.

3. Distribution Analysis
    a. Distribution alternatives will be developed to simulate removal of tanks, aeration inside the tanks, flushing hydrants, and isolation of water lines to reduce water age in the distribution. This evaluation will consist of 40 hours.
4. Development of Treatment Alternatives
    a. Provide written narrative describing each alternative
        1. The scope is limited to three treatment plant alternatives for the final evaluation
        2. The scope is limited to three distribution system alternatives for the final evaluation.
    b. Provide sizing and equipment/facility layouts for each of the three selected alternatives.
    c. Contact equipment suppliers to obtain budget price quotes for the equipment required for each alternative.
    d. Estimate operating and maintenance costs for each alternative.
    e. Estimate probable construction costs and operation and maintenance costs for each alternative.
5. Evaluation of Alternatives
    a. Prepare an evaluation matrix to compare the alternative systems. The alternatives will be compared and evaluated with respect to:
        1. estimated initial capital, operational and maintenance costs;
        2. level of effort required by plant staff to operate the equipment;
        3. ability to comply with water quality objectives;
        4. other possible relevant factors determined by the Owner and Engineer.
    i. Present the evaluation matrix to the BPW for review. Meet with BPW staff to discuss the advantages and disadvantages of each alternative system.
    ii. Select the optimal treatment alternative with input from the Owner's staff. The optimal selection may include a combination of the treatment and distribution alternatives evaluated.
6. Draft Report
    iii. Develop a final technical report that outlines all options considered and develops a recommended solution for implementation, along with an anticipated probable capital and operating costs and implementation schedule.
        1. With input from the BPW staff, develop a cost per thousand gallons for implementation of the recommended plan.
    iv. Meet with Owner to receive and discus Owner's review comments.
    v. After the Owner's staff has reviewed and commented, make any necessary modifications.
7. Final Report
    a. Submit 6 copies of the final report to BPW and two copies to MDNR.
    b. Meet with MDNR to discuss final report.

PHASE 2: DETAIL DESIGN, BID, AND CONSTRUCTION SERVICES

Based on the scale and magnitude of the recommended implementation plan, negotiate to enter into either a design or design-build contract to design/construct replacement or upgraded facilities as appropriate.

SCHEDULE

The following outlines the proposed schedule for the project.

Notice to Proceed	May 8, 2017
Plant Site Visit	May 11, 2017
Bench Scale #1 Sample Collection	May 11, 2017
Submit draft Implementation Plan	**May 22, 2017**
Implementation Plan Review Meeting	*May 29, 2017*
Summary of Initial Findings Draft Memo	**Jun 15, 2017**
Review Meeting No. 1	*June 22, 2017*
Regulatory Compliance Meeting	*Jun 29, 2017*
Bench Scale #2 Sample Collection	July 19, 2017
Bench Scale #3 Sample Collection	Sept 8, 2017
Submit Draft Preliminary Report	**Oct 6, 2017**
Draft Report Review Meeting	*Oct 13, 2017*
Submit Preliminary Report to MDNR	**Nov 1, 2017**
Meet with MDNR to Discuss Report	*Nov 15, 2017*
Anticipated Final Approved Report	Dec 15, 2017
Bench Scale #4 Sample Collection	Dec 16,2017

SUPPLEMENTAL SERVICES

Any work requested by Owner that is not included in one of the items listed in any other phase will be classified as Supplemental Services. Supplemental Services shall include, but are not limited to:

1. Meetings with local, State, or Federal agencies to discuss the project beyond those described herein.
2. Appearances at public hearings or before special boards other than those described herein.
3. Provision, through subcontracts, of geotechnical or surveying services in connection with preliminary site investigations for potential future building sites.
4. Additional laboratory testing services beyond those described herein.
5. Pre-selection of major process equipment and/or pre-negotiation of major process equipment cost.
6. Detailed design or bidding services.

7. Tasks associated with obtaining SRF monies to fund the project's construction.

8. Completion of a Water Quality Review Sheet for Missouri Department of Natural Resources if changes to the plant discharge is required.

9. Supplemental engineering work required to meet the requirements of regulatory or funding agencies that become effective subsequent to the date of this agreement.

10. Preparation for litigation, arbitration, or other legal or administrative proceedings; and appearances in court or at arbitration sessions in connection with project

11. Archaeological and historical investigations of the site.