

The services rendered pursuant to this Task Authorization No. 17 are in accordance with the terms and conditions of the Contract for Consulting / Professional Services between the City of Pompano Beach and Carollo Engineers, Inc., ORD. NO. 2016-26 adopted January 12, 2016.

**Scope of Work
City of Pompano Beach
Water Master Plan
August 13, 2018**

Project Description:

The City of Pompano Beach (City) requires the development of a Water Master Plan that includes their potable water distribution and treatment systems. Based on the Water Master Plan, a Capital Improvement Program (CIP) will be developed.

The City's most recent Water Distribution System Master Plan Update was completed in October 2016. That Master Plan was based on a model developed in 2014, using the City's existing GIS and Innovyze InfoWater® software. That Master Plan evaluated demand projections through 2020.

The City has requested to Carollo Engineers, Inc. (Consultant) to prepare a comprehensive Water Master Plan, which includes water treatment facilities as well as an update of the previously completed Water Distribution Master Plan to include the most recent changes related to population projections and projects development. The Master Plan will be completed for a 20-year period and will consider the new water demand projections to be determined in the Water Supply Facility Work Plan, which will be also updated by the Consultant under a separate work assignment.

The water distribution component of the Water Master Plan will include an update of the existing hydraulic model and will expand the modeling scenarios analyses to help in planning future capital projects. The Water Master Plan will include the following planning periods: existing (2018), 2025, 2030, and 2040. The Water Master Plan will also include a desktop assessment for the remaining useful life and estimated replacement schedule for the water pipelines.

The water treatment component of the Water Master Plan will include a condition assessment, capacity analysis, and renovation and replacement (R&R) needs evaluation of the existing treatment facilities. The City of Pompano Beach has 25 wells and two water treatment plants. One of the plants uses traditional lime filtration, while the other uses a membrane filtration system. Water is pumped from the Biscayne Aquifer at two wellfield sites and transported to the water treatment plants. At the plants, the water is membrane softened or lime softened and filtered, fluoridated, and disinfected prior to entering the water distribution system.

The Consultant will evaluate both facilities considering production capacity versus projected water demand scenarios, the age and condition of the infrastructure, and compliance with existing regulations. The objective is to develop a Water Master Plan that includes improvements directed to optimizing treatment, improving treated water quality, reducing operating costs, and enhancing the reliability of treatment and operations through a repair and replacement program. Also, if required based on the demand projections, the Water Master Plan will include the development of projects to accommodate future plant expansions to increase their treatment capacity. Prior evaluations to these treatment facilities performed by the City and the Consultant will be incorporated in this Water Master Plan.

This Master Plan will also include a benchmarking effort to compare operation and performance of the water treatment plants to utilities with similarly sized plants, complexity, process systems, and raw water quality. This benchmarking effort will include a comparison of total cost of operations, normalized to eliminate discrepancies based on geographical differences in chemical, power, and labor costs.

Based on the findings of the project, a Water Master Plan will be developed that outlines the recommended infrastructure projects, including a general description of their components, a planning-level cost estimate for the CIP, and their respective priority based on the demand projections and water infrastructure aging.

Scope of Work:

Task 1: Project Management and Coordination

Consultant's project manager will direct and coordinate the efforts of the project team members to deliver the project. Work under this task includes the following:

1.1 Project Management/Communication

The project manager will make staffing assignments, review work progress, and coordinate quality assurance and review procedures. The project manager will manage the budget, schedule, and invoicing.

The project manager will prepare and maintain a decision log that will record the decisions made by City throughout the project. The decision log will contain decisions made during regular meetings and phone conversations with City staff. The decision log will list the date the decision was made, the type of meeting in which it was made, the individuals involved in making the decision, and the nature of the decision.

1.2 Meetings and Workshops

Consultant will schedule progress meetings with City staff to keep staff informed of the project status, discuss upcoming tasks and deliverables, and to address issues relating to the project. It is estimated that the project will require a kickoff meeting, two (2) modeling/operations workshops, two (2) progress meetings or field visits, one (1) preliminary results meeting, and a final meeting. These meetings will be combined with the deliverable review meetings when possible. Consultant will prepare meeting agendas and meeting notes to document discussions, decisions, and work progress.

Task 2: Quality Management

The Consultant will perform quality assurance and quality control (QA/QC) on all deliverables to ensure they meet standards and contract requirements. All QA/QC will be performed by two Quality Managers assigned to the project (one for treatment and one for distribution/modeling).

Task 3: Planning Framework/Data Collection and Analysis

The Consultant will collect the required data to analyze the distribution and treatment systems of the City. The planning framework consists of population projections and water demands, as well as the criteria that will be used to evaluate the adequacy of system infrastructure. The Consultant will use the population projections determined in the Water Supply Facility Work Plan Update. Geographic distribution of the population and water demands in the model will be based on water billing data, traffic analysis zones (TAZ), and/or planned new developments (for future scenarios), as applicable and available from the City.

3.1 Data Collection

Consultant will collect data from the City that will be needed to update the model, perform a 2018 model verification, and complete the WTP evaluations, including SCADA and WTP operational data. Analysis of historical water demands to determine maximum month and maximum day demand peaking factors is

also included in this task, as well as efforts associated with obtaining and incorporating specific infrastructure improvements in future scenarios as directed by the City.

3.2 Review Past Project Documents and Pertinent Past Studies

The Consultant will review the 2016 Water Distribution System Master Plan Update and hydraulic model to become familiar with the work completed previously. The Consultant will collect and review historic plant documentation including plans, specifications, and water quality data. The Consultant will also collect and review historic plant studies performed to evaluate the performance of the plants and/or to develop recommendations for modification of the facilities.

3.3 Diurnal Pattern Analysis

Consultant will work with the data gathered in Task 3.1 to create a diurnal pattern representative of the existing customer demand during the period of data collection. The diurnal pattern may vary for different portions of the water distribution system based on water usage trends that may be captured using SCADA. Modifications to existing system operations may be required to calculate an accurate diurnal demand curve(s).

3.4 Review and Categorize Historic Plant Operational Performance Records

The Consultant will categorize the past 5 years of plant performance records in both table and graph format. No more than 5 years of monthly data will be summarized for the purpose of establishing a baseline of performance for the plant. Data to be summarized includes pH, turbidity, TOC, color, disinfection by-products, alkalinity, and other parameters as appropriate. Raw data provided to the Consultant from City shall be in an editable electronic format (MS Excel).

Task 4: Hydraulic Model Scenario Development and Analysis

Consultant will update the City's hydraulic model, complete a model verification for 2018, and develop future scenarios for the purpose of planning infrastructure for 2025, 2030, and 2040, considering average annual, maximum month, maximum day, and fire flow.

4.1 Model Update and Verification

It is the Consultant's understanding that the hydraulic model was last updated and calibrated in 2014. The Consultant will update the hydraulic model using the City's latest GIS data and current operating conditions at high service pump stations, etc. Because the model was calibrated relatively recently, a full model calibration will not be completed. The Consultant will work with the City to determine the appropriate level of model verification given the constraints of the SCADA data available. A 2018 model verification scenario will be developed which incorporates new water demands (using recent billing and water production data). Model parameters will be adjusted in order to obtain model results that are similar to available SCADA data.

4.2 Multiple Demand Scenarios Development and Analysis

The Consultant will use the model to develop a maximum month and maximum day demand 24-hour extended period simulation (EPS) scenario for the existing (2018), 2025, 2030, and 2040 time periods using the updated diurnal curves. Model results will be analyzed to evaluate the distribution system operation and determine the distribution system's ability to meet selected performance criteria such as pipe velocity and system pressure under the various demand condition.

The Consultant will develop a 7-day EPS scenario in hourly increments to evaluate the water age in the distribution system under average annual demand conditions for each planning period (2018, 2025,

2030, and 2040). The purpose of the 7-day analysis is to identify areas of the distribution system with high water age in order to recommend looping or other projects that may improve distribution system water quality. The ability for improving tank turnover will also be evaluated.

4.3 Fire Flow Scenarios Development and Analysis

The Consultant will use the calibrated hydraulic model to develop fire flow scenarios for the 2018, 2025, and 2040. Areas not meeting the City's fire flow requirements will be identified. Results from the fire flow and maximum day demand scenarios will also be used to size future infrastructure.

Task 5: Desktop Potable Water Pipeline Replacement Assessment

Consultant will perform a desktop asset management assessment of the City's water mains to prioritize future replacement efforts and CIP budgeting projections. This evaluation includes water mains four-inches in diameter or greater that are included in the hydraulic model and GIS. Consultant will estimate the condition and remaining useful life of each potable water main based on industry accepted average pipeline useful lives and other available information.

Consultant will work with City staff to estimate original useful lives based on industry standard guidelines, e.g., American Water Works Association (AWWA), Water Environment Federation (WEF), American Society of Civil Consultants (ASCE), and the International Infrastructure Management Manual (IIMM), the Consultant's past experience, and the institutional knowledge of City's staff. The condition and remaining useful life will reflect the pipe diameter and age, as well as any other contributing factors that may be known by City's staff including past history of breaks. Any pipeline that is projected to reach the end of its useful life and require replacement (due to age) within the timeframe of the Water Master Plan will be included in the CIP.

Task 6: Storage Capacity Analysis

Consultant will complete a storage volume assessment for each planning period (2018, 2025, 2030, and 2040) to determine adequacy of finished water storage based on the demand projections. Recommendations will be provided if additional storage capacity is determined to be required.

Task 7: Water Treatment Plants Evaluation

Consultant will also evaluate the water treatment plants (WTPs) to determine the ultimate required treatment capacity throughout the planning period of 2040. Also, the condition of the treatment facilities will be evaluated, to determine required improvements. An assessment of the WTPs was completed recently by the Consultant, and this information will be incorporated into the Water Master Plan project.

Note that the Water Master Plan Report will document necessary treatment capacity and condition, but will not evaluate or determine the location and quantities of water resources (groundwater, surface water, purchase from regional water supplier, etc.) aside from general planning and hydraulic modeling purposes. The water supply component will be addressed in a separate work assignment (the Water Supply Facilities Work Plan Update).

7.1 Situational Analysis

Consultant will conduct a Situational Analysis consisting of a regulatory evaluation, a hydraulic evaluation, a process evaluation, and a condition assessment. Each evaluation/assessment will be based on the data collection and review of previously completed work/studies performed during Task 3, along with focused workshops and project team meetings. The work associated with each evaluation/assessment is described below.

7.1.1 Facilities Evaluation and Condition Assessment

The purpose of this subtask is to determine the status, condition, and functionality of the existing facilities including structures, electrical components including MCCs, VFD, and PLCs, power systems, HVAC, aboveground/accessible piping, major valves, instrumentation, and mechanical equipment such as pumps, and chemical feed systems. Deficiencies will be noted for areas where such deficiencies may adversely impact treatment process performance, facility expansion (capacity), and where the remaining useful life of the plant components will likely expire during the 20-year planning horizon of the Water Master Plan. The following activities will be completed during this subtask:

- a. Review structural condition of water-bearing structures, buildings, and other structural components of the plant. A structural assessment was completed by the Consultant previously, and that knowledge will be used for development of the Water Master Plan (an additional structural evaluation will not be completed).
- b. Review chemical feed and storage systems condition and capacities. Conduct code review pertaining to chemical facility and current fire and building code standards.
- c. Inspect and establish capacity of electric power supply and distribution systems such as main switchgear, motor control centers, and transformers.
- d. Review the condition and functionality of both treatment process and non-process mechanical equipment (i.e., HVAC, plumbing, and fire suppression systems). This work effort will generally be limited to assets with an approximate monetary value of \$5,000 or greater.
- e. Assess the criticality and vulnerability of plant components as it relates to the impact on treatment, plant reliability, pumping, and meeting the City's established level of service in the event of partial or complete failure of that component (asset).
- f. Develop planning level cost estimates for rehabilitation, repair, and replacement items determined from the facilities evaluation and condition assessment. This information will be used in conjunction with recommendations for process modifications related to facility optimization and expansion to develop a prioritized Capital Improvement Program (CIP).

7.1.2 Regulatory Evaluation

This subtask will include a review of current and anticipated water quality regulations that may impact the choice of currently available treatment technologies for the plants optimization or expansion and impact laboratory testing requirements.

The following regulations will be evaluated:

- Safe Drinking Water Act (SDWA) and National Primary and Secondary Drinking Water Standards
- Microbial and Disinfection Byproducts Rules
- Revised Total Coliform Rule (RTCR)
- Lead and Copper Rule

The Consultant will perform an initial assessment of available treatment technologies to meet anticipated regulations as well as water quality goals. Information from other projects recently completed by the Consultant will be incorporated into this task.

7.1.3 Hydraulic Evaluation

This task involves performing a hydraulic evaluation and preparation of hydraulic profiles for the existing plants and each of the proposed plants optimization and potential expansion options. The hydraulic profile of the facilities will depict (3) scenarios: current average daily demand, current maximum flow, and the maximum flows anticipated over the 20 year planning horizon. From this work, the Consultant will identify hydraulic bottlenecks that need to be eliminated for facility optimization and/or expansion.

7.1.4 Process Evaluation

Evaluate the unit operations of the existing plants and potential new treatment technologies, to determine opportunities for optimization, regulatory compliance, and expansion. This work will build on previous work and will include optimization as it relates to reductions in the use of chemicals and power, as well as in enhanced performance, such as improved settled water turbidity, filter performance, etc. The evaluation will include an investigation of necessary modifications to existing treatment processes, and the addition of new basins and/or unit processes to achieve increases in performance and increases in capacity. Consideration will be given such that the treatment process selected for optimization will be compatible with future expansion and modifications to the existing facilities.

7.2 Benchmarking Study

This subtask involves comparing various criteria associated with the processes and operations of the WTPs to other treatment plants that are similar in one or more aspects (i.e., size, raw water quality, complexity of operations, treatment processes employed, etc.). It is assumed that data will be gathered for six treatment plants and used together with already published, available, and applicable data from previous benchmarking studies in the waterworks industry.

Benchmarking will compare the cost of operations considering power use, chemical use, labor (O&M), laboratory costs, solids processing, handling, and disposal, and other costs directly related to plant operations and maintenance. Data for chemicals and power will be examined given actual costs incurred by the City as well as usage data to eliminate the biases from geographical differences in the unit costs of chemicals and power. In addition, to comparing these parameters individually, the total annual costs, (and cost/mgd) associated with plant operations will be developed and compared.

The Consultant will identify any shortcomings of the WTPs as benchmarked against other treatment plants and the degree to which the previously developed alternatives for plant optimization, regulatory compliance, and expansion will likewise reduce discrepancies in the benchmarked data (cost of operations and process performance). The Consultant will explore additional or complimentary alternatives over and above deemed essential for overall plant optimization and improved performance.

In addition to the WTPs, the benchmarking evaluation will also compare the City's water distribution field operations performance metrics regarding maintenance, operation, and cross connection control with other utilities. These benchmarks will be developed using data available from the Florida Benchmarking Consortium and AWWA, as available. New data will not be gathered from other utilities for this task.

Task 8: Water Master Plan Report Development

Consultant will develop CIP projects for the City to meet the demand projections in the 2025, 2030, and 2040 planning periods. These projects will be presented in the Water Master Plan.

8.1 Development of CIP Projects

Consultant will evaluate the existing potable water system and WTPs to identify deficiencies (areas not meeting the selected performance criteria) using the results from the updated hydraulic model to

determine the adequacy of existing facilities and water mains. Based on the results, recommended projects will be developed to improve water service and/or system operating conditions.

Consultant will develop cost estimates for the infrastructure and WTPs improvements recommended in the capital CIP. The costs will be based on conceptual level (Class 5) cost estimates. Consultant will develop a 10-year CIP based on these costs with a detailed implementation schedule for the first five years.

8.2 Water Master Plan Report

The results of the project will be summarized in a comprehensive Water Master Plan Report. The report will include the following sections, at a minimum:

- Executive Summary
- Introduction including background information, general purpose and scope, and description of factors affecting the City's water planning efforts such as permitting, regulations, and population growth/redevelopment trends
- Population and water demand projections
- Summary of existing potable water facilities and operations including water treatment plants, water mains, storage tanks, infrastructure, and pump stations
- Model update description and documentation including model elements, demand allocations, and verification efforts
- Model scenarios and hydraulic analysis (steady state and EPS) including existing (2018), 2025, 2030, and 2040. Demand scenarios for each timeframe will include maximum month demand (24-hour EPS), maximum day demand (24-hour EPS), fire flow (steady state), and annual average (7-day EPS for water age).
- Water main replacement plan (based on estimated remaining useful life) through the 2040 time period including cost estimates and schedule of implementation.
- WTP and storage capacity analysis under the various demand conditions and time periods.
- Implementation schedule of the proposed WTP improvements, along with schematics and a site plan depicting the placement and location of the proposed improvements on the plant site.
- Identify recommended distribution system infrastructure improvements and their corresponding costs.
- Develop a draft and final Capital Improvement Program prioritized list considering condition, capacity and regulatory drivers, client preferences, available funding, etc. This effort shall also consider construction sequencing, minimizing disruptions to plant operations, overall reliability considerations, and other market conditions.

Project Deliverables:

The deliverables to be provided for this project include the following:

- Meeting agendas and notes
- Updated hydraulic model
- Four (4) copies of the Draft Water Master Plan Report and electronic pdf
- Four (4) copies of the Final Water Master Plan Report and electronic pdf

Work Assignment Assumptions:

Because of the nature of this project, certain assumptions apply to this Scope of Services. To the extent possible, these assumptions are stated within this document and are reflected in the budget.

- City shall furnish Consultant available studies, reports, and other data pertinent to Consultant's services; obtain or authorize Consultant to obtain or provide additional reports and data as required; furnish to Consultant services of others required for the performance of Consultant's services hereunder, and Consultant shall be entitled to use and rely upon all such information and services provided by City or others in performing Consultant's services under this Work Assignment.
- In providing opinions of cost, financial analyses, economic feasibility projections, and schedules for potential projects, Consultant has no control over cost or price of labor and material; unknown or latent conditions of existing equipment or structures that may affect operation and maintenance costs; competitive bidding procedures and market conditions; time or quality of performance of third parties; quality, type, management, or direction of operating personnel; and other economic and operational factors that may materially affect the ultimate project cost or schedule. Therefore, Consultant makes no warranty that City's actual project costs, financial aspects, economic feasibility, or schedules will not vary from Consultants opinions, analyses, projections, or estimates.
- City shall attend all meetings to maintain the progress of the project according to the schedule.
- City shall review Draft deliverables and provide comments to Consultant within a two-week period.

Project Schedule:

The contract start date will be the day of the approval of the Work Assignment. The following table summarizes the project schedule.

Milestone	No. of weeks after approval of Work Assignment
Kickoff Meeting and Data Collection	4
Hydraulic Model Update and Verification	12
Future Model Scenarios Development	20
Water Treatment Plants Evaluation	20
Draft Water Master Plan Report	32
Final Water Master Plan Report	36

Compensation:

The method of payment for this project will be time and materials with a maximum not to exceed amount of \$197,866.08. The hourly rates are based on the Ordinance 2016-26 for Consulting/Professional Services between the City and Consultant for Continuing Contract for Engineering Services, included in Attachment A.

The City shall pay Consultant in monthly installments based on submitted invoices for services incurred. Invoices will be accompanied by an overview of progress.

Compensation shall be as follows:

Task	Fee
Task 1: Project Management and Coordination	\$26,394.08
Task 2: Quality Management	\$17,408.00
Task 3: Planning Framework/Data Collection and Analysis	\$20,608.00
Task 4: Hydraulic Model Scenario Development and Analysis	\$37,952.00
Task 5: Desktop Potable Water Pipeline Replacement Assessment	\$8,992.00
Task 6: Storage Capacity Analysis	\$6,880.00
Task 7: Water Treatment Plants Evaluation	\$21,968.00
Task 8: Water Master Plan Report	\$57,664.00
Total	\$197,866.08

Attachment B provides a breakdown of the project fee by task and personnel.

Reimbursables are included in the above totals, and will be billed as follows:

- Project equipment, communication technology, and printing expenses (PECE) are to be reimbursed at \$12.00/hour.
- Mileage reimbursables will be at a rate of \$0.54 per mile.
- The total included for reimbursables is \$2,458.08.

TASK NO.	Senior Professional Elizabeth Fujikawa	Lead Project Professional Scott Richards	Lead Project Professional Laura Baumberger	Professional Mark Ludwigson	Professional Angelica Gregory	Staff Professional Tatiana Vargas	Project Professional (HVAC) Chad Green	Project Professional (Structural) Joel Smason	Project Professional (Electrical Engineer) Mario Gamboa	Senior Technician (GIS) Jacke Silber	Document Processing Mary Ann Wandling	Total Hours	Total Labor	Reimbursables (\$0.54/Mile)	PECE	Total Compensation
Hourly Rates (Ordinance No. 2016-26)	\$260	\$260	\$260	\$152	\$152	\$120	\$184	\$184	\$184	\$116	\$104			\$0.54	\$12	
Task 1: Project Management and Coordination																
1.1 Project Management/Communication			32									32	\$8,320		\$384.00	\$8,704.00
1.2 Meetings and Workshops	4		24	12	28	8						76	\$14,320	\$2,458.08	\$912.00	\$17,690.08
												108	\$22,640	\$2,458.08	\$1,296.00	\$26,394.08
Task 2: Quality Management	24	40										64	\$16,640		\$768.00	\$17,408.00
												64	\$16,640		\$768.00	\$17,408.00
Task 3: Planning Framework/Data Collection and Analysis																
3.1 Data Collection				8	8	24						40	\$5,312		\$480.00	\$5,792.00
3.2 Review Past Project Documents and Pertinent Past Studies			8	8	8	8						32	\$5,472		\$384.00	\$5,856.00
3.3 Diurnal Pattern Analysis			2		16	24						42	\$5,832		\$504.00	\$6,336.00
3.4 Review and Categorize Historic Plant Operational Performance Records				16								16	\$2,432		\$192.00	\$2,624.00
												130	\$19,048		\$1,560.00	\$20,608.00
Task 4: Hydraulic Model Scenario Development and Analysis																
4.1 Model Update and Verification			2		24	40				16		82	\$10,824		\$984.00	\$11,808.00
4.2 Multiple Demand Scenarios Development and Analysis			4		40	80						124	\$16,720		\$1,488.00	\$18,208.00
4.3 Fire Flow Scenarios Development and Analysis			4		16	32						52	\$7,312		\$624.00	\$7,936.00
												258	\$34,856		\$3,096.00	\$37,952.00
Task 5: Desktop Potable Water Pipeline Replacement Assessment			4		16	40						60	\$8,272		\$720.00	\$8,992.00
												60	\$8,272		\$720.00	\$8,992.00
Task 6: Storage Capacity Analysis			4		16	24						44	\$6,352		\$528.00	\$6,880.00
												44	\$6,352		\$528.00	\$6,880.00
Task 7: Water Treatment Plants Evaluation																
7.1 Situational Analysis			2	36		40	4	4	8			94	\$13,736		\$1,128.00	\$14,864.00
7.2 Benchmarking Study			2	40								42	\$6,600		\$504.00	\$7,104.00
												136	\$20,336		\$1,632.00	\$21,968.00
Task 8: Water Master Plan Development																
8.1 Development of CIP Projects			4	16	24	40	4	4	16			108	\$16,336		\$1,296.00	\$17,632.00
8.2 Water Master Plan Report			16	24	40	120	4	4	16		40	264	\$36,864		\$3,168.00	\$40,032.00
												372	\$53,200		\$4,464.00	\$57,664.00
TOTAL	28	40	108	160	236	480	12	12	40	16	40	1172	\$181,344	\$2,458.08	\$14,064.00	\$197,866.08