

QUALIFICATIONS FOR

SPRWS Distribution System Hydraulic Model Calibration

SAINT PAUL REGIONAL WATER SERVICES

November 13, 2019



BLACK & VEATCH



November 13, 2019

Queenie Tran
City of St. Paul - Regional Water Services (SPRWS)
1900 Rice Street | Saint Paul, MN 55113

RE: Distribution System Hydraulic Model Calibration

Dear Ms. Tran:

SPRWS has been proactively focused on managing and improving critical assets to produce and distribute safe and reliable drinking water, as evidenced by your electrical upgrades at the McCarron's Water Treatment Facility and the inspections of your raw water conduits. The Distribution System Hydraulic Model Calibration project is an important step to managing critical assets by providing benefits in water quality, reliability, and operational flexibility. Black & Veatch is pleased to present this proposal for model calibration services. We offer three distinct benefits to SPRWS:

Direct experience calibrating large, complex water distribution system models. The size of St. Paul's distribution system requires experience with similar sized cities to calibrate your model to a 90% accuracy. Black & Veatch has been actively involved in the modeling and planning of water distribution networks for municipal clients for over 75 years. We have completed more than 40 water master plans in the last five years. You can have confidence that our professionals, who routinely develop large models with multiple pressure zones, pumping stations, and complex controls, will have the precise and focused expertise to calibrate a large and complex model such as yours. Our three examples of previous work demonstrate this expertise.

Best understanding of a successful project. Black & Veatch understands that this project needs to not only to create a calibrated model, but help develop your staff capabilities and expertise. It is important that you understand how the model is calibrated and become proficient in completing routine tasks such as model updating, fire flow calculations, and system analysis. You can trust we will help you achieve this as we have helped the City of Minneapolis achieve these same training goals.

Five years ago, Tricia Christensen helped rebuild the City of Minneapolis model from GIS data. Over the past three years, she has been actively working with the City providing ongoing guidance and expertise so that Minneapolis personnel can conduct model analysis runs, explore water quality issues, and plan for large scale distribution system maintenance. Tricia will bring this collaborative and adaptable training approach to your project.

Local, dedicated, and available project team. The nature of this project will require many face to face discussions and meetings between our technical team and your personnel. Our proposed Project Manager Tricia Christensen is located less than 30 minutes from your office and will efficiently and responsively provide this in-person support.

Please call us if you have any questions about our proposal. We look forward to doing this work with SPRWS.

Sincerely,

Black & Veatch Corporation

Scott Fronek
Project Director

Tricia Christensen
Project Manager & Technical Lead

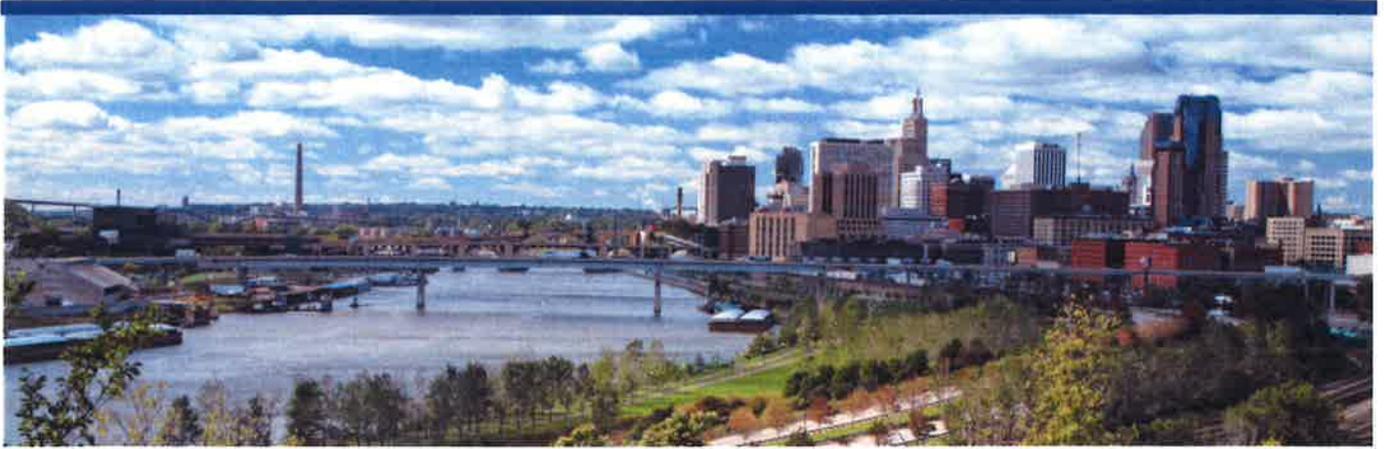


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SECTION 1

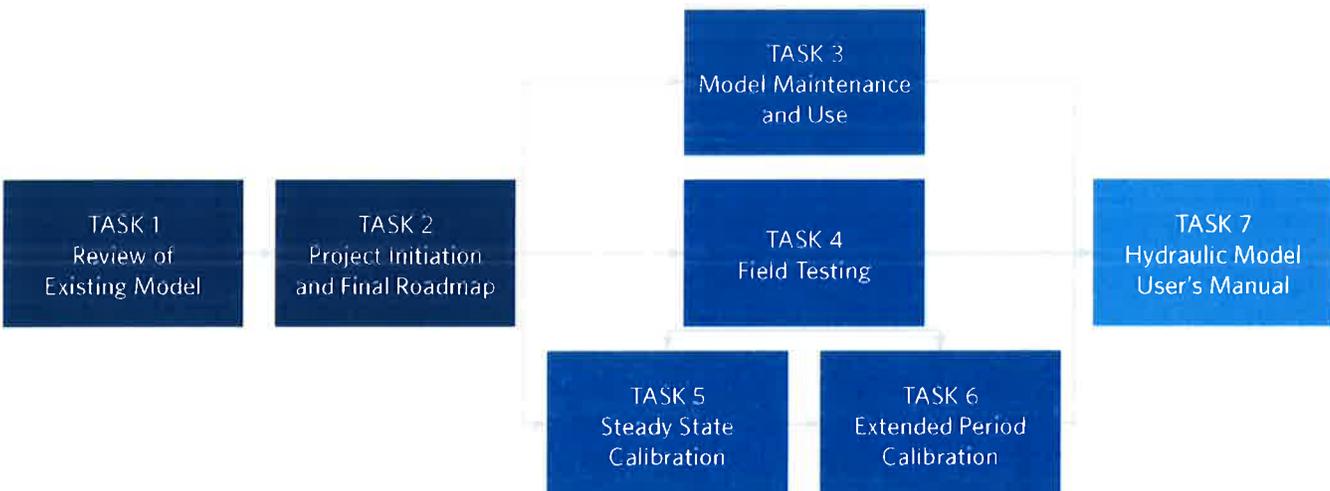
Description of Proposer's Overall Approach or Solution

St. Paul Regional Water Services has made an important and worthwhile investment in your distribution system model. The creation of your model is a vital and important step toward a complete, functioning, and accurate model. The next phase of this project will require a collaborative and local approach to achieve project success. Simply put, our approach is our staff working with your staff to meet your goals—now and in the future. This approach will facilitate SPWRS learning and development and fits the vision SPWRS has for long term utilization of your hydraulic model.

PROJECT DELIVERY APPROACH AND WORKPLAN

Our technical approach will strike the right balance between allowing SPWRS to complete much of the modeling tasks while allowing Black & Veatch to leverage our experience with other large utilities. Our approach matches your plan for this project—to build upon the model construction and calibration work the SPWRS team has already completed. We will create a clear calibration plan and integrate with your staff to provide guidance and assistance as needed. SPWRS can be confident in the path forward, knowing that we will work with you to make successful model calibration a reality. At the end of this project your team and your model will be ready to take on future challenges.

Our project workplan is laid out in seven tasks, as detailed in the figure below.



The project will begin with a thorough review of the existing SPWRS hydraulic model. Following this review, we will develop a draft plan for model calibration. This draft plan, or roadmap, will be presented for review by the team at a project initiation meeting where it will be finalized. The roadmap will clearly define roles and responsibilities for all team members and contain milestone dates to keep us on schedule throughout the course of the project. The team will then

begin steady state and extended period calibration activities. A field-testing plan will be developed to supplement the data available for both the steady state and extended period calibrations. In addition to calibration activity, a model maintenance and use plan, which is necessary for the model to remain up-to-date, will begin after project initiation and conclude following the calibration activity. All model build information, field testing, calibration data, and model maintenance information will be documented in a hydraulic model user’s manual for use by the City’s hydraulic modeling team.

Each of the individual tasks is described in greater detail below.

Task 1—Review of Existing Model

Black & Veatch will request data from SPRWS to review your model. We will review all model attributes including pumps (pump curves), tank data, operational controls, demand loading methodology, scenario set-up, and GIS model integration. Other items, such as available flow testing information will be requested and reviewed. The model review will give us the opportunity to understand the SPRWS system, the data already available from past field-testing efforts, and the current model set up. Following the review, a draft roadmap will be developed, which will clearly outline the recommended activities and schedule for calibration, field testing, and GIS script development.

Task 2—Project Initiation and Final Roadmap

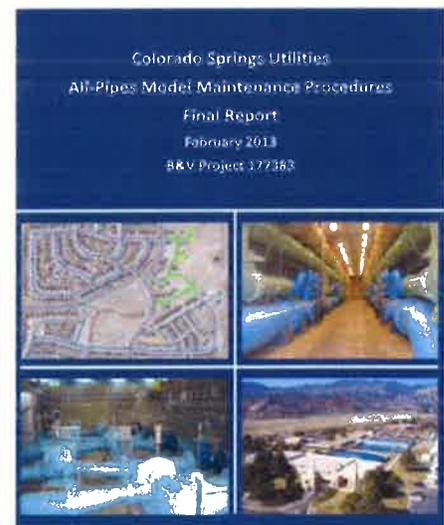
A project initiation meeting will be held to discuss overall project objectives, the findings of the existing model review, and the draft roadmap. This meeting will facilitate open communication between SPRWS team members and the Black & Veatch team. SPRWS will have an opportunity to discuss past model build and calibration activities. Black & Veatch will share feedback from the model and data review, with both teams working together to modify the draft roadmap to develop the final roadmap for this project. The final roadmap will detail activities, responsible parties, schedules, and other details related to each task.

Task 3—Model Maintenance and Use Plan

The Model Maintenance and Use Plan is focused on making the model a useful tool for SPRWS over the long term; it will become part of the hydraulic model user’s manual deliverable for this project. The plan will be divided into two distinct phases. The first phase will be the creation and documentation of the model update plan. The second phase will consist of staff education and documentation of applicable information into the plan.

A Model Maintenance and Use Plan is a valuable (and often overlooked) part of hydraulic model development. For the model to remain a useful tool it needs to be updated over time to match changing field conditions. Black & Veatch will work with SPRWS staff to develop this plan, including Python scripting of GIS data for transfer to the hydraulic model. The plan will outline the process to transfer updated GIS data to the model, which will reduce input errors and reduce staff efforts in the future. The model maintenance portion of the plan will clearly lay out each step of the update process and will become part of the City’s hydraulic model user’s manual.

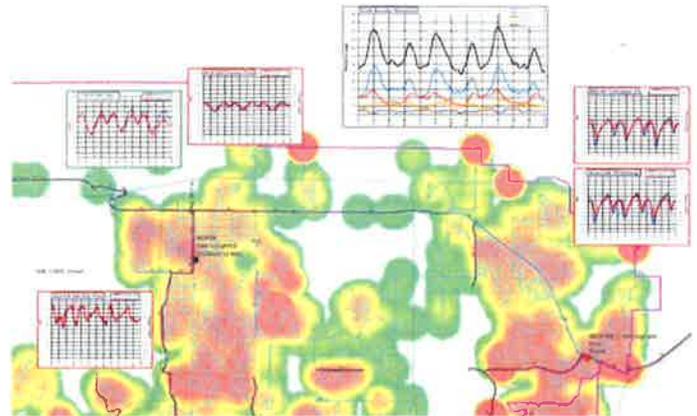
In addition to a model maintenance plan, Black & Veatch will work with SPRWS staff to document a model use portion of the plan. This will include discussions regarding model mechanics such as using scenario explorer, model facility sets, data sets, domain manager and other InfoWater tools. The model use plan will ensure SPRWS staff is equipped with the skills necessary to use the model for fire



THIS MAINTENANCE PLAN DEVELOPED FOR COLORADO SPRINGS PROVIDES A CLEAR PATH FOR KEEPING THE MODEL UP-TO-DATE

flow estimation, network analysis, forensic analysis, water age/water quality analysis, and pump efficiency analysis in the future.

This plan may also include integration of useful tools such as linked graphics for SCADA elements or data dashboards for information sharing to make modeling and model data sharing easier. The Black & Veatch goal is to not only set up SPRWS with a fully calibrated model, but to make sure SPRWS staff have the tools they need to be successful at using the model for desired analyses in the future. Black & Veatch will share various ‘tips and tricks’ with SPRWS to make sure the City gets the most out of their model.

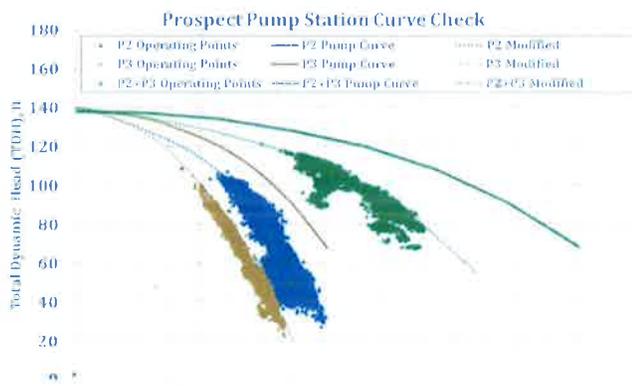


BLACK & VEATCH DEVELOPS VISUAL GRAPHICS TOOLS FOR REVIEW OF MODELING RESULTS AND CALIBRATION FITNESS. THESE TOOLS ARE DYNAMICALLY LINKED TO MODEL RESULTS AND CAN BE USED BY STAFF WITH ACCESS TO ARCGIS FOR FUTURE EVALUATIONS. THEY ILLUSTRATE A RANGE OF RESULTS INCLUDING GRAPHS AT SCADA ELEMENTS FOR MODELED PRESSURES, TANK LEVELS, AND FLOWS. THESE FLEXIBLE AND USER-FRIENDLY MAPS ARE EXAMPLES OF WHAT BLACK & VEATCH WILL ASSIST SPRWS STAFF IN CREATING.

Task 4 – Field Testing

A field-testing plan will be developed to support model calibration. SPRWS existing hydrant flow testing data, system SCADA and other available information will be utilized to the extent possible; however, there may be a need to collect additional field data to fill gaps in available data during the calibration process. The initial field-testing plan will be divided into two distinct parts: pump testing and hydrant flow testing.

As requested by SPRWS staff, a pump curve updating plan will be developed to gather current pump information. Levels of confidence in modeling results can be significantly impacted by the source of pump curve data. Older facilities may have certified curves that were accurate at the time of installation, but these curves may not represent the pumps’ current performance as impeller wear over time affects pump performance. By conducting pump tests SPRWS will have confidence in the pump curve data contained in the hydraulic model. Pump flow and head information will be gathered and the manufacturer’s pump curve data will be validated against the field gathered information. If a difference between the two curves exists, the recent tests of head versus capacity will be used for modeling purposes.



PUMP TEST DATA WILL BE USED TO VALIDATE PUMP CURVES AND FACILITY DATA TO ENSURE THAT CORRECT INFORMATION IS IMPORTED INTO THE MODEL

A hydrant flow testing plan will be developed to supplement any gaps that are identified in the hydrant flow testing data SPRWS has already collected. Through the course of calibration there may be additional flow tests or data collection that are requested by the hydraulic modeling team to determine closed valves or other system anomalies that may be causing the model to produce results that differ from field collected values. Efforts will be made to consolidate field testing activities as much as possible. In addition to hydrant flow testing, Black & Veatch owns 10 pressure data recorders

that the team may deploy to collect extended period pressure data. The need for this will be determined during the calibration process.

Black & Veatch will work with SPRWS staff to communicate the necessary field-testing activities and the plan for execution. It is assumed that once the plan is developed SPRWS staff will conduct the field tests with minimal assistance from Black & Veatch. The field testing plans can be delivered as paper maps or online for field staff who utilize tablets. Either hard copy data collection or online data collection tools may be used to communicate data. Black & Veatch will work with SPRWS to determine the best fit data execution and collection plan.

Task 5—Steady State Calibration

Calibration is the process of adjusting model inputs to accurately simulate measured field conditions. Calibration will begin with an overall comparison of the field data to the model simulated data to assess if there are any underlying trends of data that are not aligning. Significant widespread variances may be a sign of incorrect boundary condition settings, valve settings, pump operation, or tank operation. After the initial assessment a more discrete calibration process focused on smaller diameter pipelines will be conducted. Steady state model scenarios for each flow test event will be setup in the hydraulic model, and boundary conditions will be set to match conditions specific to the day and time of each testing event. Field recorded flow and pressure will be compared to modeled flow and pressure, and modifications to pipeline C-factors will be made to bring the model into alignment with field recorded data.

Our ongoing work with the City of Minneapolis is a testament to the value of one-on-one coaching. We have the experience necessary to guide your team through the calibration process.

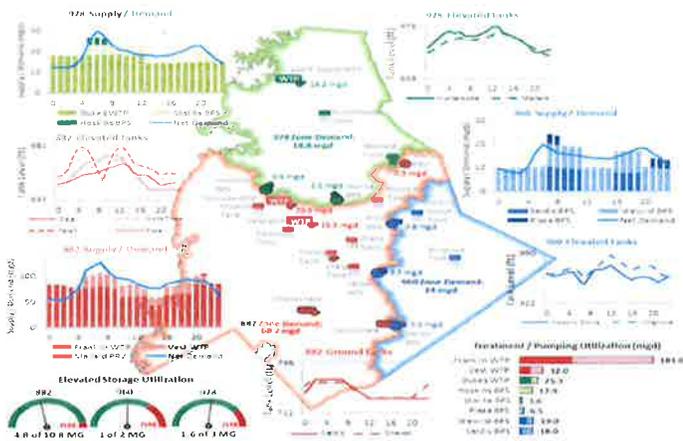
Throughout the steady state and extended period calibration tasks, Black & Veatch will work with SPRWS to provide guidance and troubleshooting as needed to reconcile field data with modeled results. Black & Veatch staff will make visits to the SPRWS office as many times as required during the calibration process to assist staff with questions that arise throughout the calibration process.

Task 6—Extended Period Calibration

The extended period simulation (EPS) model will be calibrated using available SCADA information. Extended period calibration focuses on the overall movement of water through the distribution system, operation of facilities, and system demands. Black & Veatch will assist SPRWS with iteratively simulating system conditions and comparing to field recorded data.

We will set up dynamic model/field data comparisons to facilitate system understanding of how assumptions impact the calibration fitness. The dynamic model/field data comparisons will allow SPRWS staff to see how well the model is calibrated and improve hydraulic knowledge of the system which helps bridge data gaps that exist within large complex systems. Once the model is fully calibrated, the SPRWS 2019 Water Age Tracer Study data will be used to validate the model.

As described in Task 5 above, Black & Veatch staff will be available for in person meetings as often as requested throughout the calibration process. This flexibility and direct contact will result in an optimal learning environment for SPRWS staff.



CHARLOTTE WATER’S UPDATED GIS WAS LEVERAGED TO DEVELOP PIPELINE COHORTS TO ENHANCE FIELD TESTING RESULTS OF THE COMPREHENSIVE FIELD TESTING PLAN WHICH INCLUDED 60 TEMPORARY PRESSURE GAUGES, 60 HYDRANT CAPACITY TESTS, AND 35 C-FACTOR TESTS.

Description of Proposer’s Overall Approach or Solution

Task 7. – Hydraulic Model User’s Manual

Black & Veatch understands that quality deliverables need to be both technically precise and easy to understand, which is why we are recommending a Hydraulic Model User’s Manual. The user’s manual will be developed throughout the course of this project documenting the methodology and processes used for field testing, calibration, model update planning, and future use. The user’s manual will communicate complex technical information in an easy to understand manner. The manual development approach will be tailored to SPRWS specific preferences to facilitate creation of a reference manual that provides value for your current and future staff.

OVERALL PROJECT MANAGER

Tricia Christensen will serve as overall project manager. With over 18 years of consulting experience assisting clients with water distribution system analysis and management, she has created and executed model calibrations for over 17 hydraulic models.

Tricia has a track record of long-term client relationships; prior to starting at Black & Veatch she built and calibrated both the water and wastewater hydraulic models for the City of Oshkosh, WI and served as their on-call modeler for 8 years. Tricia re-built and calibrated the City of Minneapolis distribution system hydraulic model in 2015 and has been an integral part of City’s hydraulic modeling team since that time. Both examples illustrate her unique ability to collaborate with utility staff providing long term value. Since starting at Black & Veatch, Tricia has been actively involved in storm water and water supply planning activities for the City of Eagan, MN. She also recently assisted the City of Savage, MN with a distribution system pressure zone realignment to improve level of service in an area of high growth. This project was highlighted at the MN AWWA conference in September, as she presented “Hydraulic Modeling Takes the Pressure Off – City of Savage Pressure Zone Realignment” jointly with the City of Savage.

In addition to field testing and model calibration, Tricia has been at the forefront of our industry’s advances in GIS model integration. In 2016 she assisted the City of Minneapolis with creation of scripts to automate the updating of the hydraulic model from GIS. In April of this year, Tricia was one of five national speakers who participated in the AWWA Educational Webinar “Keeping Your Hydraulic Model Fresh with Integrated Data”.

Throughout this project Tricia will be the primary point of contact for SPRWS staff and will lead and direct all technical tasks. Tricia’s strong technical background in hydraulic model analysis and calibration, her proximity to SPRWS offices, and her collaborative experience working as a hydraulic modeling team member with other utilities provides the project leadership this project warrants. As project manager, Tricia’s goal is to create an environment of collaboration and learning. SPRWS has done a great job of organizing, building, and calibrating the existing hydraulic model. Tricia will work with SPRWS to build upon those successes and make SPRWS self-sufficient in the daily use of your hydraulic model. To accomplish this, Tricia will spend one-on-one time with SPRWS hydraulic modelers throughout the course of the project, helping you understand all aspects of the model calibration and GIS to model update processes.

File Name	Description	Version Provided
Micro Calibration Results (Excel)	Micro-Calibration Results for the ten hydrant flow tests. Includes results both with and without potential valve isolations.	Mostly Electronic with Results in Paper Format
Model Data Export (Excel)	Model Export of system inputs, pipes, junctions, hydrants, tanks, reservoirs, valves, customer meters and GIS ID linkage	Electronic Only
Pump Curves Export (Excel)	Copy of updated pump curves from model	Both Electronic and Paper
Distribution of Demands Spreadsheet (Excel)	Export of the allocated demands for the Calibration, EPS ADD and EPS MDD scenarios. Includes Customer Meter Demand Allocations, the active demand adjustments and the diurnal patterns.	Electronic Only

Current Year Scenario Setup Documents

File Name	Description	Version Provided
Current Year Scenario Setup (Word)	Documentation of the current year (2018) model scenario setup including discussion on scenarios, demands and operational controls.	Both Electronic and Paper
ResultsMap_MDD_EPS_Scenario (PDF)	Reproducible Map that documents the results of the LPS MDD scenario.	Both Electronic and Paper
08_EPS_Scenarios - MDD Scenario (zip)	Zippered folder that includes the files required to create the reproducible map of the INAW system. Includes the worksheet where model results can be exported; the ArcGIS Map; shapefiles of pipes/junctions and the excel inserts (graphics).	Electronic Only
ResultsMap_ADD_EPS_Scenario (PDF)	Reproducible Map that documents the results of the LPS ADD scenario.	Both Electronic and Paper
08_EPS_Scenarios - ADD Scenario (zip)	Zippered folder that includes the files required to create the reproducible map of the INAW system. Includes the worksheet where model results can be exported; the ArcGIS Map; shapefiles of pipes/junctions and the excel inserts (graphics).	Electronic Only

THIS EXCERPT IS FROM A TABLE OF CONTENTS B&V CREATED FOR INDIANA AMERICAN WATER COMPANY’S “DATA BINDER”. THE DATA BINDER (OR HYDRAULIC MODEL USER’S MANUAL) IS SET UP TO BE USER FRIENDLY AND DOCUMENT EACH DETAIL OF THE MODEL BUILD, SETUP, CALIBRATION, AND ANALYSIS.

SECTION 2

Scope of Services

We have organized this section to address the following elements requested in your RFP: Personnel (Roles & Responsibilities), Level of Effort, Schedule, Deliverables, City Responsibilities, Other Details.

ROLES AND RESPONSIBILITIES FOR PROJECT PERSONNEL

The table below indicates our proposed personnel, and their respective roles and responsibilities on the project. Additional information on each person is provided in Section 4 in our Organizational Qualifications.

Black & Veatch

NAME	ROLE	RESPONSIBILITIES
Scott Fronck	Project Director	Contract development, financial responsibility, SPRWS satisfaction
Tricia Christensen	Project Manager & Technical Leader	Primary point of contact, leader for all technical tasks
Kyle Blommer	Staff Hydraulic Engineer	Staff level hydraulic modeling assistance
Brian Lendt	GIS Specialist	Subcontractor QA/QC, GIS support
Karen Burgi	Technical Director	Black & Veatch QA/QC, technical oversight

Rani Engineering

In addition to the Black & Veatch personnel noted above, we plan to utilize Rani Engineering as subconsultant to complete Python scripting for the project. Their responsibilities will be to translate documented logic to Python scripts for data extraction from the City's GIS database.

LEVEL OF EFFORT

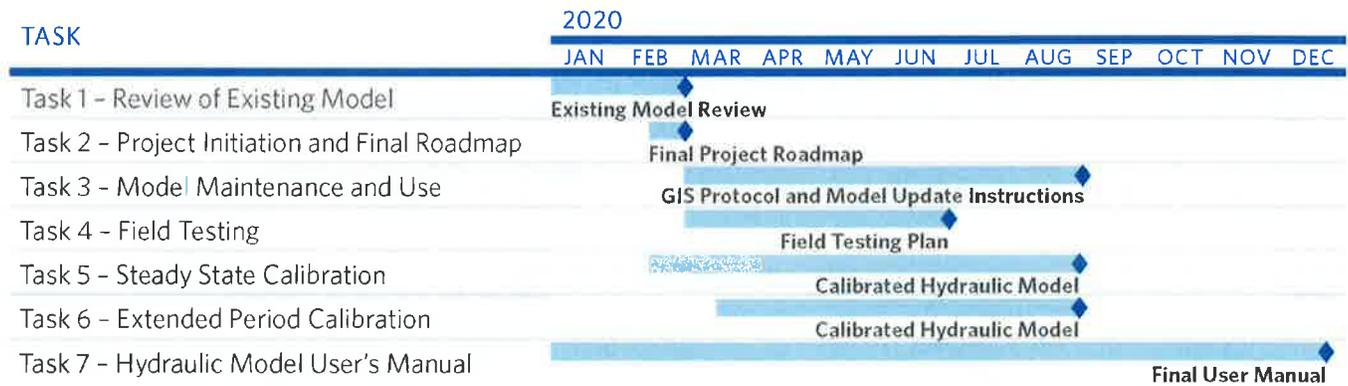
As requested in the RFP, included in the table below is a summary of our proposed level of effort. It includes a list of proposed tasks, the level of effort for each task, and the estimate of hours for each individual.

TASKS	SCOTT FRONEK	TRICIA CHRISTENSEN	KYLE BLOMMER	BRIAN LENDT	KAREN BURGI	ADMIN.	TOTAL
1 – Review of Existing Model	2	60	-	16	4	-	82
2 - Project Initiation & Roadmap	4	16	-	-	4	-	24
3 – Model Maintenance	2	60	40	-	4	-	106
4 - Field Testing	2	24	16	-	4	-	46
5 - Steady State Calibration	2	72	16	-	12	-	102
6 - Extended Period Calibration	2	64	16	-	8	-	90
7 - Hydraulic Model User's Manual	12	28	16	-	4	64	124
TOTAL EFFORT	26	324	104	16	40	64	574

PROPOSED SCHEDULE AND DELIVERABLES

Below is a proposed schedule that follows the approach that is described in Section 1. The schedule also includes a list of proposed deliverables that are associated with each of the proposed tasks. Following the schedule, a more detailed list of deliverables is included.

For project meetings, we are anticipating one meeting each for Tasks 1, 2, 3, 4, and 7. For Tasks 5 and 6, we anticipate working with SPRWS on a regular and routine basis (e.g. weekly during the calibration) and as such, these will be informal meetings that will occur weekly during calibration.



PROPOSED SCHEDULE FOR DISTRIBUTION SYSTEM HYDRAULIC MODEL CALIBRATION

Detailed List of Project Deliverables

Task 1—Review of Existing Model (data request, existing model review, draft roadmap development)

- Much of the data requested (system pump curves, pump station drawings, tank drawings, etc.) will be organized in the Hydraulic Model User’s Manual for easy reference in the future (Task 7)
- Documentation of the model review, presented in a PowerPoint presentation
- Development of a draft roadmap which will outline the recommended activities and schedule for calibration, field testing, and GIS script development.

Task 2—Project Initiation and Final Roadmap

- A finalized roadmap outlining key project activities.

Task 3—Model Maintenance and Use Plan

- Development of a chapter in the Hydraulic Model User’s manual that details GIS protocol and step-by-step instructions for hydraulic model updates and model use.
- Tools such as Python scripts and any other tools developed in conjunction with SPRWS will be transferred to SPRWS.

Task 4—Field Testing Plan and Field-Testing Activity

- Detailed field-testing plan document for pump tests and hydrant flow testing. Plan and resultant data will be documented in the hydraulic model user’s manual

Task 5—Steady State Calibration

- Calibrated hydraulic InfoWater or InfoWater Pro model with existing system steady state model scenarios.

Task 6—Extended Period Calibration

- Calibrated hydraulic InfoWater or InfoWater Pro model with existing system EPS scenarios.

Task 7—Hydraulic Model User’s Manual

- Paper and electronic copies of the hydraulic model user’s manual documenting all tasks, data, and procedures utilized throughout the hydraulic model calibration process. This document will be compiled in conjunction with St. Paul staff. It will be in a tabbed binder format (and bookmarked PDF) rather than a report document. Important data that is utilized or developed as part of this project will be compiled into the binder for future reference and use by St. Paul hydraulic modeling staff.

CITY RESPONSIBILITIES

This proposal is based on the expectation that SPRWS will actively participate in all model calibration and field-testing activities. Black & Veatch will provide guidance and assistance to SPRWS staff in a structured format to allow you to lead field testing activities and calibration iterations. The following are estimates of anticipated hours for involvement by a SPRWS hydraulic modeler.

TASK	ACTIVITY DESCRIPTION	SPRWS HOURS
Task 1 – Review of Existing Model	Provide requested data	20
Task 2 – Project Initiation and Final Roadmap	Participate in Initiation meeting	8
Task 3 – Model Maintenance and Use Plan	Logic development collaboration	40
	Testing the GIS scripts	24
	Model use collaboration	16
Task 4 – Field Testing	Lead Field pump tests & hydrant flow tests (per person)	60
	Field data consolidation	8
Task 5 – Steady State Calibration	Active calibration	120
Task 6 – EPS Calibration	Active calibration	80
Task 7 – Hydraulic Model User’s Manual	Review of manual	24
TOTAL EFFORT FOR HYDRAULIC MODELER		400

If for some reason, SPRWS needs to provide a reduced level of support on this project, we are able to adapt and do not anticipate any issues. We have sufficient personnel capable of executing this model calibration project; we can gather the data, calibrate the model, and return the final calibrated model to SPRWS. In addition, we are able to provide support for field testing activities if needed. We welcome the opportunity to provide support to meet the project within your desired schedule.

OTHER PERTINENT DETAILS

We understand that SPRWS has two Telog HPR-32 units that can be deployed to gather extended period pressure information around the system. Black & Veatch owns 10 Telog HPR-31 units that could be used to supplement the two loggers the City owns. These pressure loggers may be helpful for the following tasks:

- Static (not moving) pressure loggers installed during hydrant flow testing within a pressure zone, which will provide additional calibration points (or points of pressure reference) during the testing that may help resolve closed valve issues.
- Gather EPS pressure information around PRV areas.
- Obtain pressure information in any areas of question throughout the calibration process.

SECTION 3

Previous Work Providing Similar Services

Previous experience on projects of similar size and complexity is the best indication of success for your project. Our recent experience highlights the breadth, depth, and responsiveness of Black & Veatch on modeling projects.

PROJECT DESCRIPTIONS

As requested in the RFP, listed on the following pages are three (3) examples of successful past projects where Black & Veatch completed distribution modeling work similar to the work proposed by SPRWS. Each of these projects has involved at least one member of our proposed team. These projects were specifically chosen to be relevant to your proposed work related to the following:

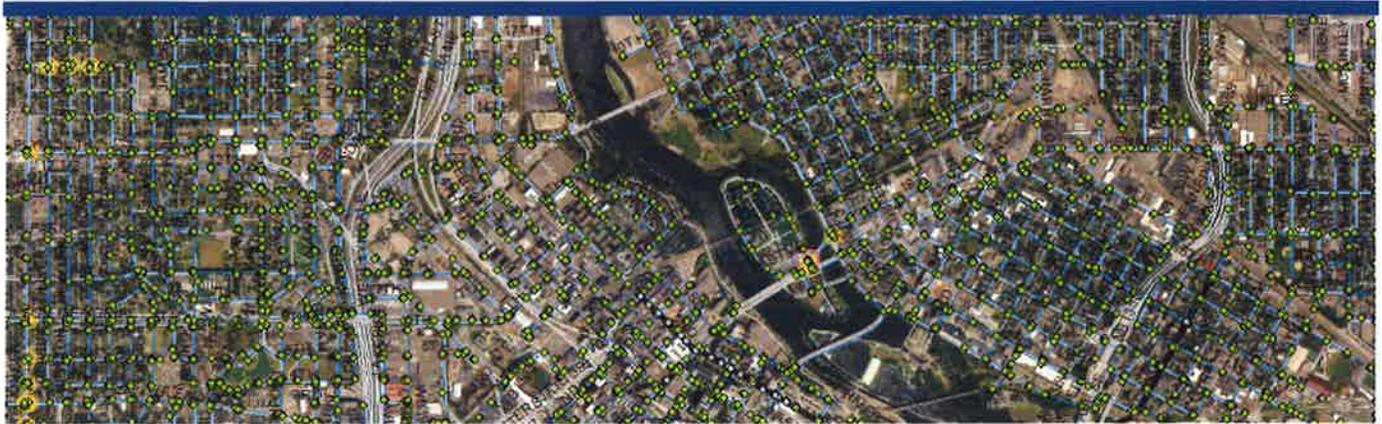
- **Large and Complex InfoWater Hydraulic Models**
 - City of Minneapolis EPS hydraulic model serves a population greater than 500,000, including 10 wholesale customers. The system is divided into five boosted high service areas with no in-zone storage. The City has a complex transfer of water between their two treatment campuses (Fridley and Columbia Heights). A skeletonized version of the water transfer between campuses is included in the distribution system hydraulic model.
 - The San Antonio Water System (SAWS) has an all-pipes EPS hydraulic model simulating 250 MGD average day service to approximately 1.7 million customers. The hydraulic model consists of a complex integration of approximately 30 water sources, 50 tanks, and 30 pressure zones. Karen Burgi has been providing hydraulic modeling services to SAWS since 2011.
 - Colorado Springs Utilities EPS hydraulic model serves a population of approximately 400,000. Average annual daily demand is 75 mgd with a max day of 170 mgd. The model contains 5 pressure zones, 40 tanks, 98 pumps, and 31 valves. Karen Burgi has been working with Colorado Springs Utilities on their distribution system modeling since 2005.
- **Hydraulic Model Calibration (Static and EPS)**
 - The City of Minneapolis EPS hydraulic model was calibrated to system SCADA, field hydrant flow test data, and extended period flow and pressure information collected over a 3-month period. Tricia Christensen developed the flow monitoring plan, led the field data collection activities in conjunction with City Staff, and calibrated the model in 2015.
 - Black & Veatch assisted SAWS with steady-state model calibration of their all-pipes InfoWater hydraulic model in 2008. The model was validated against available data in 2011 when three new rural water systems and facilities were integrated into the model.
 - Black & Veatch assisted Colorado Springs with their 2010 all-pipes model calibration, which was the first time Colorado Springs did an all-pipes model build from their GIS.

- **Model Maintenance Plans and Staff Collaboration**

- City of Minneapolis has an automated update process linking GIS with their hydraulic model. Tricia Christensen helped the City develop this plan in 2016. Python scripts were originally written to extract the appropriate information from the GIS, and InfoWater tools are used to import and update the hydraulic model. Tricia continues to work with Minneapolis modelers in an ongoing, collaborative arrangement.
- The SAWS hydraulic model was used to test SCADA controls prior to being implemented. This was a unique use of a hydraulic model and great collaboration between the SCADA and hydraulic modeling teams.
- The Colorado Springs Utilities all-pipes model (115,000 pipes) was updated using GIS data. Model maintenance procedures were developed as part of the 2013 all-pipes model calibration and maintenance strategy project. The model was also used in collaboration with staff to develop distribution system operating procedures for summer, spring/fall, and winter following start-up of the SDS Water Treatment Plant.

- **Water Age and Source Trace**

- The City of Minneapolis EPS model is routinely used for water age simulation and system analysis.
- The SAWS EPS hydraulic model has been used by Black & Veatch to trace source water mixing and analyze water age.
- The Colorado Springs Utilities model was utilized to simulate tank levels, pipeline velocities and flow reversals, water age, WTP source trace, energy, and treatment plant operating rates during the development of operational procedures following the start-up of the SDS Water Treatment Plant.



Ongoing Modeling Services

CITY OF MINNEAPOLIS | MINNEAPOLIS, MN

The City of Minneapolis Water Treatment Distribution Service provides water to over 500,000 customers, including 10 wholesale customers. Average water production is 60 MGD. The distribution system contains approximately 1,000 miles of water main, 15,000 isolation valves, and 8,000 fire hydrants. The City has an all-pipe EPS hydraulic model which is used for system analysis, water age, and fire flow simulation.

Black & Veatch has been providing hydraulic modeling support to City of Minneapolis staff since 2018. This support consists of an in-house contract where Tricia Christensen works with City of Minneapolis Staff at their facility one day a week. This work supports Minneapolis staff in the use of the hydraulic model. Typical activities include QA/QC of the City's troubleshooting of model errors and support for complex analysis including fire flow, water age, and system trace analysis. A few of the current in-house activities are:

- System shut-down analysis (large watermain main shutdown for repair or emergency)
- Current construction project shut-downs (Interstate 35W construction)
- Staging of yearly system maintenance such as valve replacement
- Simulation of operational change (specifically pumping operations)

In addition to the in-house contract, Black & Veatch has completed or is in the process of completing other hydraulic modeling projects for the City of Minneapolis. These projects include:

- Southwest High Service Area Study
- Cleaning and Lining Optimization
- 3rd Avenue Bridge Crossing Analysis

Prior to starting with Black & Veatch, working for another consultant, Tricia Christensen worked closely with City of Minneapolis staff and their hydraulic model. Starting with a project in 2015, Tricia re-built the City's hydraulic model to integrate one-to-one with GIS, developed a model update plan to script information from GIS for easy model updates, created and executed a field data collection plan, and calibrated the model. Following calibration of the hydraulic model, Tricia assisted the City with a hydraulic consequence of failure analysis using Optimatics Opticritical software and performed hydraulic analysis related to sizing of a new, 48" watermain crossing the Mississippi River. Tricia has been working with the City of Minneapolis in an ongoing capacity since 2015.

RELEVANCE TO CLIENT

- All Pipes Model Calibration
- Staff Collaboration & Teaching
- Old System – Complex C-Factors
- Scripted Maintenance

KEY TEAM MEMBERS

Tricia Christensen

Kyle Blommer

Scott Fronnek

YEAR

2018-Current

COST

\$207,000

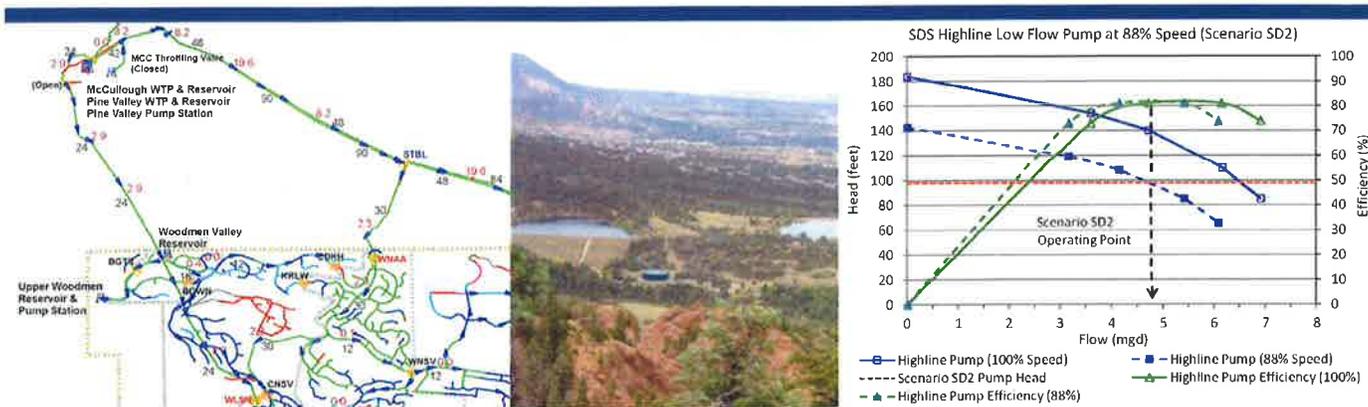
CLIENT REFERENCE

Peter Pfister

4300 Marshall Street NE

Minneapolis, MN

612-661-4906



Distribution System Model

COLORADO SPRINGS UTILITIES | COLORADO SPRINGS, CO

Since 2005, Black & Veatch has provided water distribution modeling services for Colorado Springs Utilities. In 2010 the model was updated to an all-pipes model. GIS data was extracted to represent every pipe in the distribution system. The All-Pipes Model Calibration Project included calibration of the new model for two demand conditions – winter and maximum day, and included the following:

- Metered Sales Data. Metered sales data (131,500 records) was obtained and allocated to the all-pipes model.
- Updated Pipe “C” Factors. Pipe “C” factors were updated for all pipes in the model based on pipe age and curves depicting C values versus pipe age.
- Pump Hydraulic and Efficiency Curves. Pump hydraulic (head versus flow) and efficiency curves (efficiency versus flow) were updated in the all-pipes model.
- Model Preprocessor Operations Spreadsheet – SCADA Data Transfer. A model preprocessor spreadsheet tool was developed to transfer pump, tank, and valve SCADA data to the new all-pipes model.
- Hourly Demands and Demand Factors. The Preprocessor spreadsheet was used to determine winter and maximum day hourly demands by pressure zone based on inter-zone flows at valves and pump stations.
- Pump Controls – Tank Water Level Based. Pump Controls were developed based on typical winter and summer tank operating levels.
- All-pipes Model Calibration. Figures depicting observed (from SCADA) and modeled tank levels were developed to confirm acceptable model performance (calibration).
- Water Age and Treatment Plant Source Trace Analyses. Figures depicting system-wide water age and treatment plant zone of influence (source trace) were developed to provide information on system flows, pressures, and water quality
- All-pipe Model Maintenance Procedures. Detailed all-pipes model maintenance procedures were developed and documented.

RELEVANCE TO ST. PAUL

- All-Pipes Model Calibration – Winter and Maximum Day Conditions
- Updated Model Pipe C Values
- Updated Model Pump Hydraulic and Efficiency Curves
- Water Age and Source Trace System-Wide Figures (Analyses)
- All-Pipe Model Maintenance Procedures

KEY TEAM MEMBERS

Karen Burgi
Brian Lendt

YEAR

2005-2019 (Multiple Projects)

COST

\$600,000 (2016 project)

CLIENT REFERENCE

Lisa Hagerman, Senior PM
1521 Hancock Expressway
Colorado Springs, CO 80947
719-668-3578

Black & Veatch has completed three finished water system plans for Colorado Springs Utilities; 2005, 2010 (described above) and 2016. All the finished water system plans have included model updates and validation to current operating conditions. In addition, Black & Veatch has worked extensively with Colorado Springs on specialty studies such as the 2012 Post SDS Operations Modeling (developed operating procedures following startup of the new Baily WTP), 2017 and 2018 Wildland Urban Interface Studies (to look at the ability of the existing system to provide large fire flows along the Wildland Urban interface and recommend potential improvements to improve firefighting response), and we are currently working on their raw water system to evaluate the hydraulic capacity and potential for transients.

SECTION 4

Organizational Qualifications

BLACK & VEATCH CORPORATION—OVERVIEW

Black & Veatch is a leading global engineering, consulting and construction company with the mission of Building a World of Difference®. From our founding in 1915 by E.B. Black and N.T. Veatch, the areas of water and wastewater have been the principal areas of our endeavors. In the 100 years since, the firm of Black & Veatch has grown to be internationally recognized and is one of the world’s largest engineering/construction organizations. We will deliver this project locally, from our Twin Cities office which was established in 2002 to better serve our local water clients.

BLACK & VEATCH—MODELING QUALIFICATIONS

Water is a valuable resource, whether it is drinking water, wastewater, water reuse, or stormwater. Black & Veatch’s Water Planning Professionals are solving the world’s most important resource challenges by applying creativity, innovation, and superior technical capabilities. We understand that [successful planning solutions require an understanding of your community, your stakeholders, and your needs](#). Our local team is backed by industry leading technical specialists, whose cutting-edge experience is applied to solving your specific needs.

Hydraulic models are one of the most powerful tools available for agencies to evaluate their water distribution systems. Black & Veatch offers comprehensive hydraulic modeling services, including the expertise, software and solution

development experience necessary to assist SPRWS with the goal of a fully calibrated, working version of your 2019 model.

BLACK & VEATCH WATER MODELING LOCATIONS

In recent years, we have developed hydraulic models for water distribution systems in Minneapolis, Eagan, Savage, and Bloomington.

Expertise. Black & Veatch has a dedicated hydraulic modeling group. This group is focused on delivering cutting edge approaches using the latest tools to solve our clients’ issues. Our team of modelers are experts in their field and are committed to delivering a quality product for each client.

Software. Black & Veatch maintains enterprise licenses with major hydraulic model software vendors - meaning our solutions work around our clients’ needs, not what works best for us. We work closely



BLACK & VEATCH HAS COMPLETED MASTER PLANS FOR SOME OF THE SMALLEST WATER SYSTEMS TO PLANNING \$3B CAPITAL IMPROVEMENT PROGRAMS. WE HAVE COMPLETED MORE THAN 40 WATER MASTER PLANS IN THE PAST FIVE YEARS.

Organizational Qualifications

with the vendors to help test and improve the software to fit our clients' needs. We have the InfoWater and InfoWater Pro software experience necessary to help SPRWS be successful.

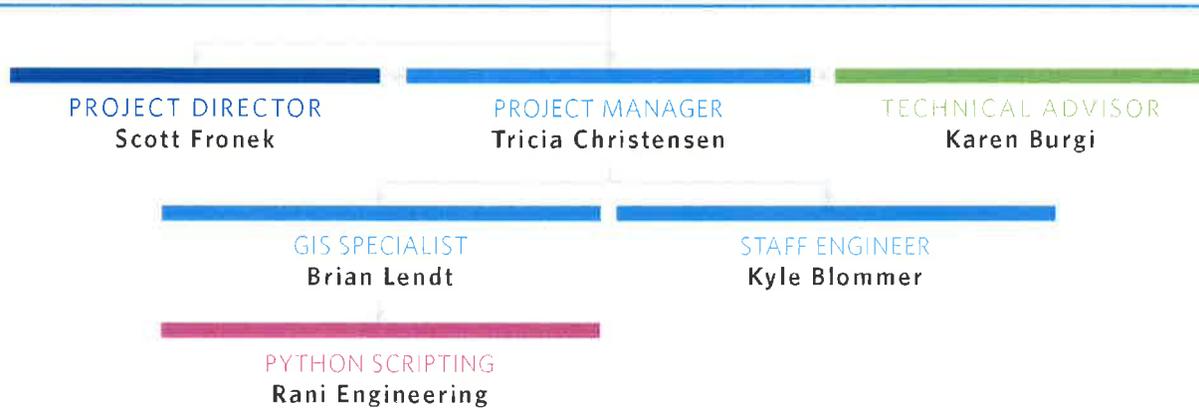
Solutions. Black & Veatch has used hydraulic models to help clients solve problems in the following areas:

- CIP Development
- Energy Cost Savings
- Water Quality Analysis
- Source Water Blending Analysis
- Facility Operation Optimization (treatment, pumping, and storage)
- Operational Guidance
- Peak Flow Management
- Surge/Transient Analysis
- System Resiliency/Major Facility Outages
- Fire Flow Analysis
- New Facility Sizing and Integration
- Private Development Oversight

TEAM ORGANIZATION

Given the specialized nature of this project, we have assembled a small team of specialists in water distribution modeling. This small team will provide the flexibility, cost effectiveness, and responsiveness that this project will need as you seek to complete much of the work with SPRWS personnel while receiving guidance and oversight from our Black & Veatch team. The following is a proposed organization chart for this project:

ST. PAUL REGIONAL WATER SERVICES



Project Leadership

For this project, **Scott Fronek** will serve as the Project Director. Scott's primary role will be to ensure St. Paul's satisfaction with all aspects of Black & Veatch's execution of the work. He will focus on initial contract development and management, as well as overall financial aspects of the project. Scott is currently serving in a similar role for your Electrical Improvements project which is nearing completion. He also oversees all Water projects completed for our local office, which has included water distribution system models for Bloomington, Eagan, and Savage, as well as the ongoing work for the City of Minneapolis' water distribution system modeling.

Tricia Christensen will serve as Project Manager and will also function as our Technical Task leader. Based in our Minneapolis office, she will be your primary point of contact and will provide leadership for all technical aspects of the project. She has 18 years of planning experience including 38 drinking water distribution projects and 17 distribution system hydraulic model calibrations. She is a subject matter expert in hydraulic modeling of water distribution systems, water distribution system master planning, and urban water management planning. Tricia will be onsite with SPRWS staff

Organizational Qualifications

on a weekly basis (as needed) to plan, guide, and assist SPRWS staff during all phases of the project. Tricia will facilitate communication and collaboration, making sure all team members are engaged in decision making. Her current role providing similar services to the City of Minneapolis will ensure her expertise and guidance is delivered in a timely and efficient manner.

Other Technical Team Members

Karen Burgi—Technical Advisor

Karen has 27 years of experience focused almost entirely on planning services. She currently serves in the role of Regional Planning Leader within the Infrastructure Planning Department. Karen has extensive experience with water and wastewater facilities master plans, and she oversees every project completed in the central US and will be a valuable resource throughout the course of this project. Calibration, like problem solving, is better done with input from a group. On this project Karen will serve as a technical advisor, to be a sounding board for technical concepts and a direct connection to the depth of modeling expertise at Black & Veatch. We have found that this modeling expertise, especially for large and complex utilities like St. Paul, will be especially important for unique challenges that may arise through the course of calibration.

Karen is well versed in the methodologies and practices used to define critical master plan information such as land use and demand projections, supply evaluations, hydraulic modeling, water quality modeling, operational and capital improvement planning, storage utilization, energy reduction, transient analysis, cost estimating, and capital improvement program development.

Brian Lendt—GIS Specialist

Brian will provide GIS and Python scripting support and QA/QC of subcontracted GIS related work. Brian is a GIS and planning consultant specializing in areas related to information solutions and analysis for water and wastewater planning. His experience includes working with clients of various sizes to develop geospatial and information management solutions including mobile and cloud, adaptive capital improvement planning, GIS-hydraulic model integration asset management, and water and wastewater asset prioritization.

Kyle Blommer—Staff Engineer

Kyle will provide staff engineering support as needed for the duration of the project. A recent graduate of the University of Minnesota, he works out of the local Black & Veatch office in Bloomington, MN. Kyle held two internships with local firms prior to graduation where he gained experience building and analyzing hydraulic models. He is currently assisting with the hydraulic modeling for City of Minneapolis.

Subconsultant

Black & Veatch is committed to searching for opportunities to participate in the City's Vendor Outreach Program, as we have on other work assignments with SPRWS. On this proposal, we have identified approximately 10% of the work as an opportunity for subcontracting to the small (SBE), small minority-owned (MBE), and small woman-owned business enterprises.

We will be utilizing Rani Engineering to provide local Python scripting support to SPRWS for the GIS to model update and maintenance plan. Rani currently does Python scripting for rail transit clients and their dedicated staff will be an asset on this project.



Organizational Qualifications

After initiation of the project we will look for additional ways to incorporate Rani in other activities. For example, Rani has capable field services staff, so perhaps there could be future opportunities for them to assist the City with field data collection and other field testing.

Rani Engineering is a Minnesota DBE, MBE, and Veteran-Owned consulting firm, providing professional technical services to public and private sector clients in Minnesota and nationwide. Rani's primary services include civil engineering, land surveying, and rail signal engineering. Rani has provided civil engineering design and project management for clients including MnDOT, the University of Minnesota, Metro Transit, and City of Minneapolis.

Rani Engineering is a small business certified in the Central (CERT) Certification Program.

Resumes

We have included two-page resumes for our key personnel as an appendix. Each of these resumes include an overall description of our personnel, a detailed listing of their professional experience, education, and length of time employed by Black & Veatch.

Scott Fronek

PROJECT DIRECTOR



Scott has more than 27 years of experience in the planning and design of water and wastewater treatment facilities, including facilities planning, preliminary design, detailed design, and construction services.

PROJECT EXPERIENCE

[City of Minneapolis - Water Treatment & Distribution Services | Hydraulic Modeling; Minneapolis, MN](#)

Project Manager. Oversees all modeling work for the City of Minneapolis InfoWater model which includes over 1,000 miles of modeled pipelines. Project work includes weekly work sessions with Minneapolis personnel, along with operating Optimatics software to identify critical pipelines in the distribution system.

[City of Savage | Water System Master Plan; Savage, MN](#)

Project Manager. Provided technical leadership to evaluate the City's water supply, treatment, and distribution system. The project goal was to identify a long-term solution for water supply and upgrade an existing WaterGEMS hydraulic model of the water system

[City of Bloomington | Water System Master Plan; Bloomington, MN](#)

Project Manager. Provided technical leadership for a water system master plan for the City of Bloomington, MN. A robust GIS demand allocation process was completed in order to most wholly represent distribution system customers. In addition, future-year customer development was projected using Forecast Tracker and spatially allocated to the hydraulic model at the precise location that growth was anticipated. These steps led to an accurate model capable of simulating future conditions such that a complete, prioritized, and cost-effective CIP was able to be delivered to the City.

[City of Eagan | Master Plans; Eagan, MN](#)

Project Manager. Provided technical leadership for four master plans—Water Distribution, Wastewater Collection, Stormwater, and an Integrated Master Plan. The master plans in their entirety included a holistic and comprehensive review of all water systems for the City. The project included an update of three models—WaterGEMS, SewerGEMS, and PCSWMM for stormwater.

[City of Minneapolis - Water Treatment & Distribution Services | 3rd Avenue Bridge Water Main Replacement; Minneapolis, MN](#)

Project Manager. Project manager for a study to replace or augment the City's aging 36-inch water main which is supported below the 3rd Avenue Bridge over the Mississippi River. The project evaluated two subsurface options; install under the river by horizontal directional drilling, or install in a sandstone rock tunnel under the river. The project team evaluated local site conditions and geology to determine subsurface conditions suitable for underground piping. For each alternative, pipe alignments, construction methods, and capital costs were developed. The existing pipeline and bridge is in an urban area so space limitations with existing infrastructure made proposed alignments challenging.

[City of Minneapolis - Water Treatment & Distribution Services | Tunneled Water Main Under the Mississippi River; Minneapolis, MN](#)

Project Manager. Project manager for the design and construction to replace the City's aging 54-inch water main which is supported below the 10th Avenue Bridge which crosses over the Mississippi River. The project will replace the pipe with a

EDUCATION

- BS, Civil and Environmental Engineering, University of Wisconsin, 1992

PROFESSIONAL REGISTRATION

- PE – 1997, IL, 062051796
- PE – 2007, MN, 45419
- PE – 2010, ND, PE-7214

PROFESSIONAL ASSOCIATIONS

- American Water Works Association
- Water Environment Federation

YEAR CAREER STARTED

1992

YEAR STARTED WITH B&V

1998

Organizational Qualifications

new, 48-inch steel watermain installed in an 900-foot long tunnel under the Mississippi River. The project includes challenging site conditions on both sides of the river due to environmental contamination and limited land for construction purposes. In addition, significant public access to pedestrian and bike trails will require public communication and complex detours during construction. Securing property easement and permits with a multitude of stakeholders will require frequent communication from Minneapolis Parks, the University of Minnesota, US Army Corps, the Department of Natural Resources, and the Minnesota Pollution Control Agency.

[St. Paul Regional Water Services | McCarron's Electrical System Improvements; St. Paul, Minnesota](#)

Project Manager. Overall Project Manager for renovations to the electrical system for the 130 mgd St. Paul Water Treatment Plant. The project includes the complete replacement of the main 13.8 kV substation, as well as two 2.4 kV switchgear lineups. Considerable construction sequencing was required to replace the electrical equipment while providing the City the ability to produce finished water to its customers during construction.

[City of Grand Forks | Regional Water Treatment Plant Project; Grand Forks, ND](#)

Project Manager. In association with another consultant, Black & Veatch is providing design services for a new 20 mgd Water Treatment Plant that will have 10 mgd of conventional treatment and 10 mgd of membrane treatment. The conventional treatment train will have pre-sedimentation basins, lime softening, ozone, and biologically active filtration with GAC. The membrane treatment train will have integrated membranes (UF and RO) for the removal of sulfates. Black & Veatch's role is to design the ozone, biologically active carbon dual-media filters, and carbon dioxide (carbonic acid) systems design for the conventional treatment train.

[City of Fargo | Membrane Water Treatment Plant Project; Fargo, ND](#)

Project Manager. In association with another consultant, Black & Veatch provided design and construction services of a new, \$110M, 15 mgd integrated membrane (UF and RO) water treatment plant for the removal of sulfates which are often high in the raw water from the river. Black & Veatch's role included design of enhanced coagulation pretreatment with rapid mix, flocculation, and inclined plate sedimentation, and membrane filtration by microfiltration/ultrafiltration. Additionally, Black & Veatch provided design for architectural, structural, and HVAC/Plumbing systems.

[City of Apple Valley | Ground Water System Analysis; Apple Valley, MN](#)

Project Manager. Provided technical leadership to a long-term groundwater management study. The project included a long-range study to consider future water demands due to updated population projections to the year 2040. Using these future water demands, the project also investigated the fate of Well 16, which had been removed from service following a nearby fuel spill in 2012. Using the Met Council's Metro Model 2, a regional groundwater model, aquifer levels and groundwater movement were assessed for future water demand conditions. Modeling alternatives included scenarios with and without Well 16 in service to meet the projected water demand.

[City of Burnsville | Water System Studies; Burnsville, MN](#)

Project Manager. Responsible for overall project management for all work to-date with the City of Burnsville to work through issues related to taste and odor challenges that surfaced at their water treatment plant in 2009. Black & Veatch has completed a series of studies and designs to assist the City with various water treatment optimizations, including; addition of powdered activated carbon to treat odor-causing compounds; conducting operator training in taste and odor recognition and filter optimization; studying their raw water reservoir to determine the extent of algae formation; and renovation of their 18 mgd water treatment plant.

Tricia Christensen

TECHNICAL LEADER, PROJECT MANAGER



Tricia has over 18 years of consulting experience assisting clients in the areas of water distribution and wastewater collection system analysis and management. Her specific experience includes construction and analysis of computer models, geographical information system (GIS) management, development of capital improvement plans (CIPs), operation and maintenance of assets, and data management for regulatory reporting. Tricia holds a BS in Civil Engineering and an MBA in corporate finance. She has managed work related to water/wastewater system planning and has provided task leadership and QA/QC for multiple projects throughout the United States and internationally.

PROJECT EXPERIENCE

[City of Minneapolis | In-House Hydraulic Modeling Support; Minneapolis, MN](#)

Distribution System Hydraulic Modeler. Provides on-site planning assistance including hydraulic modeling, system analysis, optimization support, and other duties on a weekly basis since 2016. Works in collaboration with City of Minneapolis Staff to supplement and grow their in-house skillset.

[City of Minneapolis | Southwest Area Study; Minneapolis, MN](#)

Lead Hydraulic Modeler. Study of the Southwest high service zone (pressure zone) in advance of booster station redesign. Reviewed and recommended optimal boundary in terms of service pressure, fire flow availability, and water age. Included review of current system demand.

[City of Minneapolis | Cleaning and Lining Optimization; Minneapolis, MN](#)

Lead Hydraulic Modeler. Combined project between Optimatics, Black & Veatch, and City of Minneapolis. Pilot project to Utilize Optimatics Optimizer to prioritize cleaning and lining projects for the City.

[City of Greensboro | Water Resource Opportunities; Greensboro, NC](#)

Water Distribution Modeling Lead. Utilized the City of Greensboro distribution system hydraulic model to assess the potential to incorporate different water supply sources to meet 2040 system demands. Included incorporation of potential water supplies and assessment of existing conveyance and pumping infrastructure. Planning level conveyance and pumping infrastructure recommendations were made for each potential supply integration alternative.

[City of Shelbyville | Indiana American Water Shelbyville Model Build and Calibration; Shelbyville, IN](#)

Task Lead. Lead for Shelbyville distribution system hydraulic model construction and calibration. Including GIS to hydraulic model topology and geometric network creation, model construction/attribute population, control set-up, demand analysis and creation, field test plan, steady state and extended period simulation calibration and existing scenario set up.

[City of San Antonio | San Antonio Water System SCADA Integration; San Antonio, TX](#)

Distribution System Hydraulic Modeler. Project hydraulic modeler testing planned SCADA controls in SAWS InfoWater model. The results of model analysis are used by the SCADA development team to assist in determination of the SCADA integration plan. Modeling includes running controls under multiple source water and customer demand situations to simulate how the controls will work together once they are implemented in the system. Included source trace and water age analysis.

EDUCATION

- MBA, Finance, California State University Fullerton Mihaylo College of Business, 2009
- B.S., Civil and Environmental Engineering, South Dakota State University, 2001

PROFESSIONAL ASSOCIATIONS

- American Water Works Association

YEAR CAREER STARTED

2001

YEAR STARTED WITH B&V

2018

OTHER FIRM - PROJECT EXPERIENCE

[City of Minneapolis | Hydraulic Model Update; Minneapolis, MN](#)

Project Manager and DS Modeling Lead. Managed all aspects of project and completed technical work as scoped. Created model from City GIS and other information gathered from water treatment distribution system (WTDS) personnel. Created advanced controls to simulate manually operated valves that regulate flow from the treatment plant. Planned and conducted a field-testing event including installation of flow and pressure monitors for a 2-month period and fire flow hydrant testing across the system. Used the field test information to calibrate the model. Developed an automated model update plan and created the model on a one-to-one basis with City GIS to facilitate updating of the model from the City's GIS. The updating process uses the GIS exchange tool within InfoWater software to automatically exchange information appropriate information with GIS. The City uses Maximo software to track asset changes, the asset changes transfer to GIS on a nightly basis, and the GIS to model update is planned to happen quarterly.

[City of Hollywood | Seminole Tribe of Florida Distribution and Collection System Planning; Hollywood, FL](#)

QA/QC Lead. Senior modeling resource and QA/QC support for the creation, calibration, and analysis of several water system models for the Seminole Tribe of Florida. Created field testing plans for execution.

[City of Oshkosh | Water Distribution System Hydraulic Model and Planning Study; Oshkosh, WI](#)

Distribution System Modeling Lead. Developed water distribution system model from City GIS. Designed and executed field flow testing plan to gather model calibration data. Developed current system demands from billing records. Calibrated the model. Developed future system demands and analyzed the 30-year planning period. Prepared CIP and cost estimate. On-call system analysis services provided for City of Oshkosh for 8-years following creation of the hydraulic model.

[EMWD | Eastern Municipal Water District \(EMWD\) Master Plan Update | Southern CA 2008-2009.](#)

DS Modeling Lead. Utilized InfoWater software to analyze the Moreno Valley portion of the EMWD system. Analysis was completed for the existing system pressure zones and the realigned system pressure zones. Capital improvement projects were developed through ultimate build out. Completed a pressure zone realignment for the Moreno Valley area of the EMWD system. Utilized GIS and InfoWater software to realign pressure zones to meet district criteria and service the needs of the Moreno Valley Area through ultimate build out. Created an incremental phasing program for zone realignment which would allow EMWD to implement the realignment over a 4-phases. Each phase could be constructed and run independently with the rest of the system. Analyzed the impact of the World Logistics Center Development on the existing EMWD's system. Developed Logistic Center demands and analyzed EMWD pumping capacity, source capacity, and storage capacity. Determined piping requirements and alignment for two phases of Logistics Center build-out.

[Golden State Water Company | Hydraulic Model Development and Master Plans; San Dimas, CA](#)

Distribution System Hydraulic Modeling Task Lead. Supported GSWC by updating existing hydraulic models and developing master plans for the company's Region III water distribution systems. Region III serves more than 93,000 customer connections in 16 separate systems serving 30 cities and several communities in Los Angeles, Orange, San Bernardino, and Imperial Counties. Responsibility included task leadership for 5 of the 16 systems including; Placentia, Cowan Heights, Wrightwood, South Arcadia, and Calipatria. Tasks included: collecting existing system information, establishing existing demands, forecasting future demands, developing field testing plans, executing field testing plans and calibrating system hydraulic models, evaluating supply and storage capacity, performing hydraulic analysis, evaluating hydraulic modeling results and developing the CIP. Field testing plans and leadership of the field-testing team provided for 15 of the 16 systems.

Karen Burgi, PE

TECHNICAL ADVISOR



Karen is a Regional Planning Leader with Black & Veatch’s Infrastructure Planning Department. She has extensive experience master planning of both water and wastewater facilities including: population projections, regulatory compliance, hydraulic modeling, vulnerability analysis, and developing improvement alternatives. Karen also serves as the liaison between the Central Region and company-wide resources in hydraulic modeling and master planning.

PROJECT EXPERIENCE

[San Antonio Water System \(SAWS\) | Central Water Integration Pipeline \(CWIP\); San Antonio, TX](#)

Lead Modeler. The CWIP will provide a long-term new source of water for SAWS. However, integration into the existing distribution system requires significant new piping, control valves, and operational adjustments. Ms. Burgi has led the hydraulic modeling effort to confirm pipe sizing, location of valves, and assist in developing operational controls to integrate the water into the existing distribution system.

[Colorado Springs Utilities | Finished Water System Plan; Colorado Springs, CO](#)

Project Manager. The update to the 2009 Plan includes new population, water use rates, peaking factors, and diurnal curves determined by evaluation of additional data collected in the last seven years. In addition, the 2016 Plan will further analyze plans to address water quality in the distribution system, investigate improvements to support redevelopment of downtown, and assess isolation and control valve criticality.

[Colorado Springs Utilities | Wildland Urban Interface, Phase 2; Colorado Springs, Colorado](#)

Technical Advisor. Colorado Springs is located along the foothills of the Rocky Mountains. Portions of the system are in areas that are at significant risk for wildfires. Colorado Springs Utilities and the Colorado Springs Fire Department are working together to evaluate the ability of the existing distribution system to provide fire flow for a wildfire, identify possible system improvements, and identify needed isolation valves to restore the system after a fire. The goal is to understand the available resources and have a plan in the event of a wildfire in the vicinity of at-risk neighborhoods.

[City of Grand Junction | Hydraulic Modeling Projects; Grand Junction, CO](#)

Project Manager. Black & Veatch has been assisting the City in evaluating the impact of planned development and system improvements on existing operations. The first project was a fire flow analysis for the Las Colonias Park Development. Currently, Black & Veatch is evaluating the hydraulic capacity and operational constraints of the Purdy Mesa and Kannah Creek Flow Lines.

[Dominion Water and Sanitation District | System Master Planning and Development Review; Sterling Ranch, CO](#)

Lead Modeler. This project included developing initial distribution system transmission sizing, identifying pressure zone boundaries, and phasing opportunities prior to development. Recent work has included updating the model to reflect changes in development and reviewing proposed pipeline alignment and facility phasing.

EDUCATION

- MS, Civil Engineering, Colorado State University, 1993
- BS, Civil Engineering, Colorado State University, 1991
- BA, Engineering Physics, Westmont College, 1991

PROFESSIONAL REGISTRATION

- PE – 2012, WY, #13750
- PE – 1996, CO, #31252

PROFESSIONAL ASSOCIATIONS

- American Water Works Association
- Water Environment Federation
- Rocky Mountain Section American Water Works Association, Past Chair
- RMSAWWA Awards Chair

YEAR CAREER STARTED

1993

YEAR STARTED WITH B&V

1993

Organizational Qualifications

[City of Fountain | Development Review and System Capacity Evaluation; Fountain, CO](#)

Lead Modeler. These projects used the hydraulic model developed by Black & Veatch during the water master plan to evaluate the required facilities to serve proposed development and to support maximum day water requirements.

[City of Savage | Development Review and Pressure Zone Evaluation; Savage, MN](#)

Technical Lead. These projects used the hydraulic model developed by Black & Veatch during the 2013 Water Master Plan to evaluate the required facilities to serve proposed development and to adjust pressure zone boundaries to provide improved service and decrease water age.

[City of Evanston | Hydraulic Model Evaluations; Evanston, IL](#)

Technical Advisor. Multi-year contract to support water model updates and improvements to support capital improvement planning and asset management for the City. Projects to date have included: updating the model with system changes, validating the model from operations data, and adding hydrants to the hydraulic model.

[United States Agency International Development \(USAID\) | Infrastructure Needs Program II \(INPII\) | Capacity Expansion Projects; West Bank, Palestine](#)

Infrastructure Planning Specialist. This project included development of 15 water hydraulic models and planning documents to support planned infrastructure improvements in the West Bank. This has included hydraulic performance criteria development, project development, project facility sizing, transient evaluation and integration of new facilities with existing and future operations.

[Fort Leonard Wood | Drinking Water and Wastewater Systems Study & Capital Improvement Plans; Fort Leonard Wood, MO](#)

Water Distribution and Wastewater Collection Technical Lead. This project included development of water and wastewater hydraulic models from GIS data supplemented with additional information from other studies and design records. For the water master plan, the WaterGEMS model was calibrated using a combination of SCADA Data and hydrant flow testing. The models were evaluated for existing and future capacity limitations and vulnerability assessments. Recommendations were made to address areas of concern. Planning level cost estimates were developed for recommended improvements and the projects were prioritized and construction triggers identified.

[City of Madison Water Utility | East Side Water Master Plan Update; Madison, WI](#)

Engineering Manager. This project included updating the Madison Water Master Plan to address in more detail areas of concern on the East Side of the City. Included in this study was an outreach effort aimed at informing and getting community input and buy-in on the recommended water supply options. This included trending recent water demand and conservation efforts to estimate future demands and the sensitivity of the capital improvements plan to demand assumptions. Once agreement was reached, on demand projections and the need and location of additional wells, the distribution system modeling was updated and recommended capital improvements were reviewed and the timing or priority adjusted in needed.

Brian Lendt, GISP

GIS SPECIALIST



Brian is a GIS and planning consultant specializing areas related to information solutions and analysis for water and wastewater planning. His experience includes working with clients of various sizes to develop geospatial and information management solutions including mobile and cloud, adaptive capital improvement planning, GIS-hydraulic model integration, asset management and water and wastewater asset prioritization. Brian is a published, national expert in integrating GIS and hydraulic models and served as the lead author several publications and presentations.

PROJECT EXPERIENCE

[City of Rapid City | Water Master Plan; Rapid City, SD](#)

GIS and Planning Consultant. Responsible for the development of a GIS-based pipeline risk assessment using likelihood and consequence of failure criteria to assess overall asset risk. Developed a GIS integrated hydraulic model using InfoWater's GIS Gateway to allow seamless exchange between the GIS and model for future updates.

[City of Tampa; Portable Water Master Plan and Risk Prioritization; City of Tampa, FL](#)

GIS Consultant. Ongoing comprehensive Water System Master Plan update including asset management program framework review and development and risk-based prioritization for pipeline improvements. Developed a dynamic risk-based prioritization model using Innovyze's InfoMaster software and participated in workshops to support development of likelihood of failure and consequence of failure criteria. The results of the model were used to support the capital improvement projects planning.

[Colorado Springs Utilities | 2017 Finished Water System Plan; Colorado Springs, CO](#)

GIS and Planning Consultant. Responsible for the design and coordination of a Python tool developed by Black & Veatch to automatically calculate the criticality of isolation and control valves based on several factors including impacted critical customers, number of customers, impacted demand, number of supplies to a zone, operation purpose and pipe criticality. For the isolation valve criticality analysis, a user-friendly "Criteria Assignment Tool" was developed to aggregate the GIS-based criticality factors by valve isolation area on either side of an isolation valve through iterative network tracing. The results of the Criteria Assignment Tool served as inputs for a "Isolation Valve Criticality Tool" to determine criticality for all isolation valves within the system. A "Control Valve Criticality Tool" was also developed in Python to determine control valve criticality based on pipe criticality, number of supplies to a zone and operation purpose. Provided training and user documentation to allow Utilities to perform valve criticality analysis on a continual basis.

[Trinity River Authority | GIS Needs Assessment; Dallas, TX](#)

GIS Consultant. Led group discussions with Trinity River Authority (Authority) management to identify potential GIS applications that will benefit the organization and leverage existing GIS investments. Assisted in the development of an on-line survey for key Authority staff for preliminary identification of desired GIS-based solutions and processes. Assisted in coordinating a workshop with key Authority staff to discuss and prioritize specific geo-spatial applications for future implementation. Facilitated a group discussion regarding the enhancement of the Authority's service offerings related to mobile, web-based, data collection and data access application.

EDUCATION

- MS, GISciences, Northwest Missouri State University, 2011
- BS, Geography, GIS, Northwest Missouri State University, 2000

PROFESSIONAL ASSOCIATIONS

- American Water Works Association - Member
- Association of American Geographers - GIS Specialization

YEAR CAREER STARTED

2000

YEAR STARTED WITH B&V

2000

Organizational Qualifications

[Colorado Springs Utilities | Post Southern Delivery System Operations Modeling; Colorado Springs, CO](#)

GIS Consultant. The Colorado Springs Utilities All-pipes model (115,000 pipes) was updated using 2013 GIS data. The All-pipes model was used to develop distribution system operating procedures for summer, spring/fall, and winter following start-up of the SDS Water Treatment Plant. Model maintenance procedures developed as part of the 2013 All-pipes Model Calibration and Maintenance Strategy project were used to update the model.

[City of Fountain Valley | Waste Master Plan; Fountain Valley, CA](#)

GIS Consultant. Performed a data gap analysis of the City's GIS network and attribute data to determine suitability for construction of a new InfoWater all-pipes hydraulic model. Made recommendations regarding the development of the model network and facility information to ensure a 1-to-1 compatibility between the GIS and new hydraulic model. Spatially located 100% of meter sales data and utilized InfoWater's demand allocator tool to automatically allocate demand to the hydraulic model. Authored several QA/QC documents and presentations regarding model development.

[Greater Cincinnati Water Works | Hydraulic Model Update Procedures; Cincinnati, OH](#)

GIS Consultant. Developed procedures to update GCWW's all-pipes distribution system hydraulic model using their GIS water asset inventory. Coordinated internal QA/QC efforts of model update procedures. Developed training materials and conducted a 2-day workshop for GCWW engineer and GIS personnel.

[Washington Suburban Sanitary Commission | Water Main Replacement Program Optimization; Maryland](#)

GIS and Planning Consultant. Responsible for the design and creation of geospatial processes to consolidate spatial and tabular data from disparate sources to serve as data inputs for water main replacement (WMR) optimization tool. Coordinated and participated in workshops with the client and several software vendors to identify WMR optimization requirements and assist the client with vendor selection. Prepared and assisted in the development of several technical memorandums and workshops to identify potential WMR optimization workflows and alternatives. Produced a comprehensive data preparation process description that will serve as guidance for the development of an automated data preparation tool that will be built by Black & Veatch using Python.

[New York City Housing Authority; NYCHA Water Metering Program - GPS Application; New York, NY](#)

GIS and Planning Consultant. Responsible for initial design of a GIS-focused web-based program management dashboard to monitor the installation of over 600 water meters throughout the New York City metropolitan area. The dashboard is hosted in Black & Veatch's cloud environment (LoadSpring) and linked to a Primavera P6 SQL Server database.

Kyle Blommer

STAFF ENGINEER

Kyle has a background in design and planning of water and wastewater systems. His project experience includes hydraulic modeling, design of supply wells, system storage evaluations, capital improvement planning, and various water and wastewater improvement projects.

PROJECT EXPERIENCE

[City of Minneapolis | Southwest Area Study; Minneapolis, MN](#)

Staff Hydraulic Modeler. Responsible for hydraulic model analysis of the Southwest Area including; current demand comparison, realignment/optimization of the pressure zone boundary, pressure analysis, available fire flow analysis, and water age analysis in order to determine the best fit zone boundary for the Southwest Area.

[City of Fargo | Fargo Membrane WTP; Fargo, ND](#)

Staff Engineer. Documented design changes in record drawings from the construction of the Fargo Membrane WTP.

[City of Fargo | Fargo Lime Softening WTP – Pretreatment Upgrades; Fargo, ND](#)

Staff Engineer. Designed a sludge blowdown system to facilitate cleaning of the sedimentation basins at the Fargo Lime Softening WTP.

PROJECT EXPERIENCE – PREVIOUS CONSULTANT

[City of Brooklyn Center | 2040 Water Model; Brooklyn Center, MN](#)

Engineer. Developed a 2040 water model for the City of Brooklyn Center, MN based on their 2040 Comprehensive Plan and land use projections to make recommendations for their Capital Improvement Plan. Also updated the Water Supply Plan for the City of Brooklyn Center, MN to assist in implementing long term water sustainability and conservation measures.

Miscellaneous Projects

- Developed cost estimates, drafted plans, and computed design calculations for a waterline replacement project
- Analyzed a hydraulic model in WaterGEMS to propose changes in pipe size, booster station properties, and storage characteristics of a system
- Collaborated with agencies in Illinois such as the EPA, DOT, and USACE to ensure compliance for a water main construction project

EDUCATION

- Bachelor of Engineering, Environmental Engineering, University of Minnesota, 2019

YEAR CAREER STARTED

2018

YEAR STARTED WITH B&V

2019