MALCOLM PIRNIE | ARCADIS

The Water Division of ARCADIS

CITY OF HOLLYWOOD

HYDRAULIC MODEL UPDATES AND CALIBRATION

PROJECT NO. 14-1601

DECEMBER 9, 2014

GENERAL

This work authorization covers the services to upgrade the City of Hollywood's hydraulic water model to better represent the existing system. This work authorization also covers the services to perform appropriate system sampling required to properly calibrate the hydraulic model. All services for this authorization shall be provided under the terms and conditions of the Professional Engineering Services Agreement (Agreement) between the City of Hollywood (City) and Malcolm Pirnie, Inc. (Engineer), dated January 8, 2003, amended on June 6, 2012 and renewed on May 1, 2013.

SCOPE OF WORK

Malcom Pirnie, Inc. initially began working on the first hydraulic model for the City of Hollywood in 2007. Since that time, various updates have been made to the model by groups other than Malcolm Pirnie, Inc., including the conversion of the original WaterGEMS model to the InfoWorks WS software in 2012 by AECOM. In 2013, Malcolm Pirnie, Inc. performed a water quality analysis on only the A1A corridor of the Hollywood system. The last complete model calibration has not been documented since the model conversion in 2007. Over the past several years there have been various system upgrades. Additionally, the City has installed pressure transmitters on the water system that can supply significant real time data that is available for use to calibrate the model. The purpose of this work effort is to update and calibrate the model to better reflect the existing system. The targeted average accuracy of this effort is to develop pressure projections that are within 2 psi of the actual. Calibration will follow the Water Research Foundations *Guidelines for Developing, Calibrating and Using Hydraulic Models.*

The following specific services will be provided by the Engineer.

1. Secure and review existing real time data from pressure transmitters located on the water system at approximately 80 lift stations throughout the City. It is acknowledged that the accuracy of some of this data may be suspect.
2. Review transmitter data collected from the City's lift stations. Provide recommendations for replacement of the transmitters to the City as needed.
3. Secure and review 24 months of plant flow data including hourly flow, total daily flow, and pressure. Diurnal demand patterns will be developed based on the actual system demands and applied to the extended period simulations. System demands will be evaluated to determine an annual average day demand scenario and a maximum day demand scenario.
4. Secure and review planning data and population projections to develop projected water consumptions rates for the 2030 planning period.

5. Secure and review geo-referenced user demand flow data for analysis and inclusion in the model. Average annual customer demands will be applied to the nearest model junction. An average to maximum day demand peaking factor will be applied to each model junction for the maximum day scenario.
6. Coordinate with a City representative to develop appropriate criteria for field sampling locations based on pipe material, age and size. The criteria should provide a holistic representation of the system.
7. Perform field sampling at predetermined points throughout the system. Field sampling will consist of flowing hydrants along sections of the City's system that meet the criteria determined through the efforts of the City and Engineer to obtain roughness coefficients for use in calibration efforts.
8. Gather anticipated plans and information from the City pertaining to water system improvements made throughout the system following the last model update for incorporation of these upgrades and expansions in the hydraulic model prior to calibration.
9. Gather anticipated plans and information from the City pertaining to all planned water system improvements to be made until 2030 for scenario generation and model analysis to be run after model calibration.
10. Perform initial calibration efforts on the extended period hydraulic model received from field sampling, billing data, flow data and real time data transmitters that have been installed throughout the system. For those areas with suspect results, a maximum of 10 additional C factor tests will be performed for confirmatory purposes.
11. Recalibrate the extended period hydraulic model based on confirmatory C factor field test results in addition to data received from field sampling, flow data and real time data transmitters that have been installed throughout the system. Recalibration efforts shall be repeated until stipulated accuracy thresholds are met. System operations will be represented with rule-based controls and tank levels will be utilized to gauge level of calibration. Extended Period Simulation results will achieve repeatable diurnal results and calibration data will consist of the final 24 hours of the simulation (i.e. exclude model initialization period results).
12. Extended Period Simulation calibration period shall be sufficient to simulate and analyze effects of the complete tank turnover for all tanks in the system.
13. A technical memorandum will be prepared to demonstrate the level of calibration.
14. Provide the City with a calibration technical memo outlining the results of the calibration efforts. These results will include comparison charts between the model results and field measurements of the following,
    a. Data collected from pressure transmitters at all lift stations, WTP service pump station and western pump station.
    b. All pump data collected during calibration period.
    c. Flowmeter data collected from WTP discharge and western pump station discharge.
    d. Level data for two elevated tanks, west tank and WTP storage tank.
15. Construct or update the following scenarios that are to be applied to the model once required calibration accuracy has been achieved. Results will be analyzed and reported to the City upon completion of this project.
    a. Extended Period Maximum Day + Fire Flow Scenario
    b. Steady-State Peak Hour Scenario
    c. Extended Period Average Day Scenario

d. 2030 System Improvements Scenario, based on Extended Period Average Day
e. 2030 System Improvements Scenario, based on Extended Period Maximum Day

16. Provide the City with an updated node map, calibrated model and brief-results driven summary report outlining the Engineer's findings of the model efforts and the various scenario results. The summary report shall also include brief recommendations for future system improvements based on the updated model data.
17. Provide the City with 40 hours of training with the recalibrated hydraulic model to impart sufficient knowledge of the model and the software to ensure correct use and understanding of model results. Training will occur during a single site visit but a portion of the training time will be reserved for follow-up questions.
18. Provide the City with up to three SOPs outlining modeling steps for a City staff member to perform as the need of the City arises in the future. One SOP will include the files, with built-in queries and macros and/or approach to update the model demands based on billing database records.

STAFFING APPROACH

This effort outlines a scope of work that will provide the City with a calibrated model of high quality. The following team will be used as set forth below to maximize efficiency of all assets available. The proposed team includes William Reese, Project Manager; James Cooper, Technical Modeling Expert; Jennifer Webster, Senior Water Modeler; and Samantha Ciminello, Junior Water Modeler and Field Engineer. The detailed list of tasks to be performed is as follows:

- William Reese, P.E., Project Manager – Mr. Reese will coordinate all local field work and communication with the City. This includes coordinating and performing the initial analysis of various data received from the City as well as being the lead for all efforts to determine locations for hydrant flow testing. He will be on hand to supervise field tests, both initial and those performed for confirmatory purposes after initial hydraulic model calibration. After completion of the model recalibration, he will also take the lead on producing a summary report that will outline the Engineer's findings of the modeling efforts and various scenario results and provide recommendations for future system improvement.
- James Cooper, P.E., Technical Modeling Expert – Mr. Cooper will direct the team in all modeling related tasks. This includes providing guidance to all data entry tasks as well as supervising and directing all recalibration efforts. After completion of the model recalibration, he will develop the above mentioned scenarios for use in the recalibrated model as well as will lead the development of the SOPs for the City's future use. Mr. Cooper will assist in the development of the final summary report. At the completion of the project, he will also lead the training of the City staff in the proper use and general understanding of the recalibrated model and the basics of the InfoWorks WS software.
- Jennifer Webster, Senior Water Modeler – Ms. Webster will perform QA/QC of all data entry tasks and calibration efforts for the modelling effort. Ms. Webster will assist in determining any areas that may require additional, confirmatory hydrant flow tests. Assistance by Ms. Webster will also be provided on a QA/QC basis during the various

modelling scenarios, compilation of SOPs and as part of the final the final summary documents preparation.

- Samantha Ciminello, E.I., Engineer/Water Modeler – Ms. Ciminello will provide assistance in all tasks performed locally and in all aspects of the water modeling efforts. Assistance will be provided to Mr. Reese in all local field testing efforts both initially and in any that would be required for confirmatory purposes. Ms. Ciminello will perform data entry of field data results and of data received from the City under the supervision of Mr. Reese and Mr. Cooper. She will also assist in the of the recalibration efforts, various scenario development tasks and preparation of all final documents prepared for the City, including the final summary report and SOPs.

COORDINATION

The Engineer will perform all work for the hydraulic model system update services. The City will provide the necessary documents, coordination services and meetings to keep appropriate City Management advised of project progress and status.

TIME OF PERFORMANCE

The work contemplated by this project agreement will commence within 7 days of receipt of an authorization to proceed and be completed in 120 days after receipt of all City generated data, exclusive of delays beyond the control of the Engineer.

COMPENSATION

The Engineer will be compensated for work performed under this agreement on a lump sum basis in the amount of $128,420.

ASSUMPTIONS

The Scope, Time of Performance and Compensation set forth in this agreement are predicated on the following assumptions.

1. The City has staff that is knowledgeable regarding the existing system that will be available to assist in determining the most representative field sampling points.
2. The City will provide access to all predetermined sampling points to Engineer. The sampling points will be selected to be representative of piping materials, age and size.
3. The City will provide 24 months of plant flow data, including hourly flow, total daily flow, diurnal flow patterns and pressures.
4. The City will provide reliable real time data from water system transmitters. This data will be delivered in a time-pressure plot format commonly seen when exporting data from SCADA equipment. The data will be secured over the same time increment for all water system transmitters.
5. The City will provide all required information for future system expansions (Year 2030 scenario) and upgrades as well as all improvements made since the previous model calibration.

6. Existing population and commercial growth projections will be used per recent bond report developed by MPI.
7. The City will provide assistance to open/close system valves and flow hydrants as required. The Engineer will supply hydrant flow metering and pressure gauges.
8. It is anticipated that suitable representative data for computing roughness coefficients can be secured by conducting hydrant flow testing at 20 predetermined locations and that this testing can be arranged such that it can all be performed over a 3-4 week period.
9. Flow data and billing data to be used for calibration will be supplied in electronic format suitable for direct load into the model. Flow data shall be geo-referenced.
10. Data to be used for future flow scenarios will be projected in accordance with the recent bond report prepared by MPI.
11. Useable data from the City's pressure transmitters and GPS/address based flow data will be received no later than 90 days after the Notice to Proceed has been received.
12. The City staff performing modeling will have access to the latest water consumption records for updating demands.
13. Pipe lengths and diameters from the original model will be verified / upgraded per GIS shape file to be provided by the City.

ACCEPTED BY:

City of Hollywood

By: _____

Title: _____

Date: _____

Malcolm Pirnie, Inc.

By: _____

Title: VP ARES

Date: 12/9/14

City of Hollywood, FL
Water Distribution Model Update and Calibration
December 9, 2014

Project Position Project Role Tasks	Officer PM	Sr. Engineer QA/QC	Sr Engineer Modeling Lead	Engineer Field Lead	Field Tech Field Tech	Admin. Asst Admin. Asst	Total by Task	Total by Task
Task 1 - Data Collection and Review							**216**	$ 33,240
Project kick-off mtgs (internal and external)	8	2	16	16			42	
Obtain and review SCADA data, identify issues, summarize data for model input	12		4	32			48	
Develop field sampling plan, City coordination, determine areas for testing	8		4	16			28	
Fire flow testing and C-factor testing, prep for testing, data downloads and summary	12		4	30	12		58	
Additional testing (up to 10 locations per scope) in areas of suspect results	8			20	12		40	
							0	
							0	
							0	
							0	
							0	
							0	
Task 2 - Model Update and Calibration							**484**	$ 68,660
Model software implementation, acquisition	2		8	8			18	
Update physical attributes of improvements (pipes, pump curves, etc.)		2	12	48			62	
Develop diurnal patterns from latest data for EPS			24	40			64	
Develop demand geocoding - database link between service meter data and model nodes			12	24			36	
Determine ADD and peaking factor for MDD for current			4	8			12	
Initial calibration based on data and initial field testing - identify inconsistancies		4	20	48			72	
Prepare initial calibration memo, workshop-review with client, define add't testing	16	2	36	16		2	72	
Detailed EPS calibration - adjust diurnal patterns, controls, C-factors, to within avg 2%			30	60			90	
Prepare final calibration memo, graphs, results proving 2%, summary of changes	8		16	24	8	2	58	
							0	
							0	
							0	
							0	
Task 3 - Future System Modeling, Deliverables							**174**	$ 24,360
Forecast future water demands through 2030 based on existing planning data	2	2	16	8			28	
Update physical attributes of planned improvements (pipes, pump curves, etc.)				8			8	
Perform multiple model simulations, export results, create maps/figures, brief report	4	2	12	48		4	70	
Model training session and follow-up phone/email support			24	24			48	
Three SOPs on modeling tasks			12	8			20	
							0	
							0	
Task 4 - Project Management							**12**	$ 2,160
Project setup & Maintenance	8					4	12	
							0	
							0	
							0	
							0	
Total hours	88	14	254	486	32	12	**886**	
Rate	$ 240.00	$ 150.00	$ 150.00	$ 130.00	$ 100.00	$ 60.00		
Total	$21,120	$2,100	$38,100	$63,180	$3,200	$720	**$128,420**	
								$ 128,420