STANDARD AGREEMENT FOR PROFESSIONAL SERVICES

THIS AGREEMENT made between the City of Aurora, whose address is 44 E. Downer Place, Aurora, Illinois 60507 hereinafter called the **CLIENT** and Crawford, Murphy & Tilly, Inc., Consulting Engineers, 2750 West Washington Street, Springfield, Illinois 62702, hereinafter called the **ENGINEER**.

WITNESSETH, that whereas the **CLIENT** desires the following described professional engineering, land surveying or architectural services:

Continuation of a planned and organized system-wide watermain flushing program through the following:

- Implementation of watermain flushing operations for a portion of the City of Aurora (Areas 5 and 6) based on flushing sequences developed previously.
- Update of flushing sequences for the entire City of Aurora (Areas 1 through 6) including any new watermain and changes identified in the field during flushing with the use of a hydraulic model of the City of Aurora's watermain system.

The engineering services for the implementation of watermain flushing operations for Areas 5 and 6 and the updated design of flushing sequences for Areas 1 through 6 are described in the attached Exhibit A – Scope of Services. The limits of Areas 1 through 6 are shown in the attached Exhibit B.

The system wide program has been performed over multiple years with development of flushing sequences for an area generally occurring in the year before flushing operations are performed. The flushing of Area 1 was completed in 2013 along with the design of the flushing sequences for Area 2. The flushing of Area 2 was completed in 2014 along with the design of flushing sequences for Areas 3 and 4. The flushing of Areas 3 and 4 was completed in 2015 along with the design of flushing sequences for Areas 5 and 6. The areas for the system-wide program are shown in the attached Exhibit B.

NOW THEREFORE, the **ENGINEER** agrees to provide the above described services and the **CLIENT** agrees to compensate the **ENGINEER** for these services in the manner checked below:

☒ On a time and expense basis in accordance with the attached Exhibit C - Schedule of Hourly Charges which is subject to change at the beginning of each calendar year. Reimbursable direct expenses will be invoiced at cost. Professional or Subconsultant services performed by another firm will be invoiced at cost plus ten percent. Note that no Professional or Subconsultant services are anticipated to be furnished to the ENGINEER by another firm on this project.

☐ At the lump sum amount of $_____.

IT IS MUTUALLY AGREED THAT, payment for services rendered shall be made monthly in accordance with invoices rendered by the **ENGINEER**.

IT IS FURTHER MUTUALLY AGREED:

That the compensation for services for the implementation of watermain flushing operations for Areas 5 and 6 and the update of the design of flushing sequences for Areas 1 through 6 for the system-wide flushing program shall not exceed $369,500 per the attached Exhibits D, D-1, D-2, D-3 – Professional Cost Estimate without further authorization from the CLIENT.

The **CLIENT** and the **ENGINEER** each binds himself, his partners, successors, executors, administrators and assignees to each other party hereto in respect to all the covenants and agreements herein and, except as above, neither the **CLIENT** nor the **ENGINEER** shall assign, sublet or transfer any part of his interest in this **AGREEMENT** without the written consent of the other party hereto. This **AGREEMENT**, and its construction, validity and performance, shall be governed and construed in accordance with the laws of the State of Illinois. This **AGREEMENT** is subject to the General Conditions attached hereto.

IN WITNESS WHEREOF, the parties hereto have affixed their hands and seals this _____ day of _____, 2016.

CLIENT:

CITY OF AURORA
(Client Name)

_____
(Signature)

_____
(Name and Title)

CMT Job No. _____

ENGINEER:

CRAWFORD, MURPHY & TILLY, INC.

Theresa O'Grady, P.E.
(Signature)

Theresa O'Grady, P.E. - Group Manager Water Resources
(Name and Title)

STANDARD GENERAL CONDITIONS
Crawford, Murphy & Tilly, Inc.

1. Standard of Care

In performing its professional services hereunder, the **ENGINEER** will use that degree of care and skill ordinarily exercised, under similar circumstances, by members of its profession practicing in the same or similar locality. No other warranty, express or implied, is made or intended by the **ENGINEER'S** undertaking herein or its performance of services hereunder.

2. Reuse of Document

All Reports, Drawings, Specifications, other documents, and electronic media prepared or furnished by **ENGINEER** pursuant to this Agreement are instruments of service in respect to the Project and shall be the property of the **CLIENT**. **ENGINEER** shall retain the right of reuse of said documents and electronic media by and at the discretion of the **ENGINEER** whether or not the Project is completed. Reproducible copies of **ENGINEER'S** documents and electronic media of the Project and **ENGINEER's** documents shall be delivered to the **CLIENT**; however, Project and **ENGINEER's** documents and electronic media are not intended or represented to be suitable for reuse by the **CLIENT** or others on additions or extensions of the Project, or on any other project.

3. Termination

This Agreement may be terminated by either party upon seven days prior written notice. In the event of termination, the **ENGINEER** shall be compensated by the client for all services performed up to and including the termination date, including reimbursable expenses.

4. Parties to the Agreement

The services to be performed by the **ENGINEER** under this Agreement are intended solely for the benefit of the **CLIENT**. Nothing contained herein shall confer any rights upon or create any duties on the part of the **ENGINEER** toward any person or persons not a party to this Agreement including, but not limited to any contractor, subcontractor, supplier, or the agents, officers, employees, insurers, or sureties of any of them.

5. Construction and Safety

This project will be completed with CLIENT staff working alongside ENGINEER staff. The ENGINEER shall be responsible for the safety of their own personnel working on the job site. The CLIENT shall be responsible for the safety of their own personnel working on the job site.

6. Payment

Payment for services rendered shall be made monthly in accordance with invoices rendered by the **ENGINEER**. If payment is to be on a lump sum basis, monthly payments will be based on the portion of total services completed during the month. Invoices, or any part thereof, which are not paid within 45 days after the date of issue shall bear interest at the rate of 1% for each month or fraction thereof from the date 45 days after issue to time of payment.

7. Risk Allocation

Inherent to the completion of this project, ENGINEER staff will be required to operate CLIENT owned valves and fire hydrants. ENGINEER staff will be provided training by CLIENT staff at the beginning of the project on the proper operation of valves and fire hydrants. Subject to the condition of the existing valves and fire hydrants, such proper operation of the existing valves and fire hydrants may result in damage and consequential damages for which the ENGINEER cannot be held responsible.

CITY OF AURORA
2016 FLUSHING PROGRAM –
AREAS 5 & 6 FLUSHING AND UPDATING AREAS 1 THROUGH 6 FLUSHING ANALYSIS

EXHIBIT A - SCOPE OF SERVICES
January 15, 2016

Background

In 2012, the city of Aurora embarked upon the development of a planned and organized system-wide multi-year watermain flushing program as part of routine water distribution system maintenance. Flushing distribution system watermains is considered a standard and recommended practice by the American Water Works Association (AWWA).

Watermain flushing can be performed either by means of conventional flushing or unidirectional flushing. In order to effectively flush the watermain, a target velocity of 5 feet per second is desired. Conventional flushing which consists of sequentially opening fire hydrants can sometimes achieve the target velocities. In locations where the target velocity cannot be achieved, unidirectional flushing is required. Unidirectional flushing is a systematic method of closing watermain valves and opening hydrants to direct water one-way at high velocities through targeted segments of pipe. Unidirectional flushing induces high water velocities which effectively removes deposits and cleans the pipe. The benefits of flushing include removal of rust and sediment, improved chlorine residual, and reduction in taste and odor; all of which can help provide high quality water to city of Aurora residents.

The watermain flushing program began in 2012 with the design of Area 1 flushing sequences. In 2013, Area 1 was flushed and the design of the flushing sequences for Area 2 was completed. In 2014, Area 2 was flushed and the design of flushing sequences for Areas 3 and 4 were completed. In 2015, remainder of Area 3 and Area 4 were flushed and the design of flushing sequences for Areas 5 and 6 was completed. The design of flushing sequences is being developed with the aid of the City of Aurora Water System hydraulic model. As part of this project, flushing will be completed for Areas 5 and 6. Also, the hydraulic analysis and the design of flushing sequences will be updated for Areas 1 through 6 to incorporate field changes, modifications to the flushing program parameters learned through the previous 3 years of field work, and new watermains constructed or replaced since the program began.

The city's water distribution system consists of over 740 miles of pipe. Therefore, city staff recommends a multi-year watermain flushing program for the entire city. The extents of the flushing areas for the entire water distribution system have been determined as shown in Exhibit B. Flushing areas have been determined based on: dividing the city into 6 areas with similar total lengths of watermain; the location of water transmission main endpoints (locations that potable water from the Water Treatment Plant enters the distribution system) and a summary of water quality issue locations for ten years previous to 2012.

Project Tasks

Project tasks will be divided into two components: flushing of Areas 5 and 6, and updating flushing sequences for Areas 1 through 6.

Areas 5 and 6 Flushing

The scope of the work for the flushing has been assumed to be similar to the flushing performed in 2013, 2014 and 2015 and will include the following:

1. *Project Start-up*

   At the start of the flushing portion of the project, a kick-off meeting will be held with city staff to coordinate the field effort. The kick-off meeting will be attended by the proposed flushing crew so that flushing protocol/procedures can be reviewed by everyone at the same time. Project start-up activities will also include the development of a flushing schedule and the generation of checklists for field use.

   It is anticipated that the city will provide equipment required for the flushing including diffusers, hydrant wrenches, valve keys, hydrant flow meter, pressure gauges, hoses, signs, and traffic control. The equipment to be used will be coordinated at the kick-off meeting.

2. *Unidirectional Flushing*

   Within each subarea, there are sections of watermain noted for conventional flushing and sections noted for unidirectional flushing. The unidirectional flushing will be performed first in each subarea.

   The unidirectional flushing will be performed with a crew of 6 people (2 valve operating crews each with 2 people, 1 person on the flushing hydrant, and 1 supervisor with 1 of the valve operators also covering the residual pressure monitoring hydrant). Of the 6 unidirectional flushing crew members, it has been assumed that 1 will be a city staff member. CMT will provide the remaining 5 crew members. It has been assumed that 1 of the 5 crew members provided by CMT will be in a supervisory position and would be an engineer. The remaining 4 positions would be either technical assistants or summer intern positions.

   Based on production rates achieved with unidirectional flushing completed in 2013, 2014 and 2015, it has been assumed that 7,500 ft. of watermain can be unidirectionally flushed each day. The production rates for the unidirectional flushing will be evaluated periodically throughout the project.

3. *Conventional Flushing*

   After the unidirectional flushing is completed in each subarea, conventional flushing will be performed. Given the amount of conventional flushing in Areas 5 and 6, Conventional flushing will be performed with a full-time crew of 2 people and supplemented with 4 of the crew members from the Unidirectional flushing crew.

   It is anticipated that one crew can be setting up/tearing down while the other crew is flushing a hydrant so that only one hydrant is flushed at a time in a given subarea. It has

been assumed that all of the crew members for conventional flushing will be provided by CMT. The full-time conventional flushing crew will consist of a CMT engineer and a technical assistant or summer intern.

It has been assumed that a 2 person crew will be able to conventionally flush 21 hydrants per day. The production rates for the conventional flushing will be evaluated periodically throughout the project.

4. *Coordination Meetings*

   It has been assumed that coordination meetings (no more than once per month) will be required throughout the project.

5. Schedule

   Flushing is planned to begin the third week in May and will continue through the second week in August, resulting in approximately 60 working days taking into account holidays and a couple of rain days.

   Note that a smaller crew will begin unidirectional flushing of the first subarea in April so that conventional flushing of the first subarea can begin the third week in May.

Updating Areas 1 through 6 Flushing Analysis

With the completion of flushing of Areas 5 and 6 in 2016, the first cycle of the system-wide multi-year water main flushing program will be completed for the first time. As part of the routine water distribution system maintenance recommended by AWWA, it is anticipated that another cycle of the system-wide flushing program may begin again from Area 1 in 2017.

In order to be prepared to begin with Area 1 in 2017, the flushing sequences and maps for all of the areas need to be updated to take into account field changes, modifications to flushing program parameters learned through the previous 3 years of work, and new watermains constructed or replaced since the flushing program began.

The scope of work for updating flushing sequences and maps in Areas 1 through Area 6 will include the following:

1. *Kick-off Meeting*

   The project scope and schedule will be discussed at the kick-off meeting as well as any items that will be required from the city.

2. *Data Collection*

   The following information will be needed to modify the hydraulic model and develop flushing sequences:
   - An updated electronic copy of the city's AutoCAD map including:
     - hydrants
     - valves
   - A list of the city's top 25 water users
   - An updated list of critical use facilities in each flushing area
   - An updated list of known areas of concern in each flushing area

- Best available information on removed and replaced watermains in the each flushing area

3. *Incorporation of AutoCAD information into Hydraulic Model and Hydraulic Model Modifications*

All new data will be incorporated into the existing hydraulic model to supplement the information currently in the model. Information to be incorporated into the model includes all new water main, new hydrants, new hydrant laterals, locations for all main line valves and pipe diameter and material information for all new watermain.

A) Incorporation of AutoCAD data into the Hydraulic Model

- CMT will update the City's GIS map based on the updated AutoCAD map
- Distribution watermains that are not currently in the hydraulic model will be identified in each flushing area by comparing the updated GIS map with the hydraulic model.
- New distribution watermains and hydrant laterals will be manually added into the hydraulic model. Automatically assigned pipe numbers and junction numbers in the model will not be modified.
- Newly added distribution water main will be assigned a Hazen-Williams C value based on the new water main material and installation year.
- Hydrant laterals will be assigned a Hazen-Williams C value of 100.

B) Hydraulic Model Modifications

The following modifications will be made to the existing hydraulic model in the each flushing area in the steady state model previously created for the development of flushing sequences:

- Any watermain that has been abandoned or replaced in each flushing area since the flushing program began in 2012 will be identified by the city using best available information and will be input into the hydraulic model. This will include pipe diameters, material, and a Hazen-Williams C value based on construction year.
- If new customers are now in the list of Top 25 water users, demands will be added to the hydraulic model for these customers. If previous customers were on the list of Top 25 water users but are no longer on this list, demands for these customers will be modified.
- Elevations for newly created junction nodes within the evaluation area will be automatically calculated using elevation contours and the TREX elevation extractor in the hydraulic model software.

The following are <u>not</u> included for hydraulic model modifications:

- Modifications to residential and commercial demands that are not newly on or off the Top 25 list within the evaluation area.
- Modifications to pipe Hazen-Williams C value to reflect watermain aging since the last hydraulic model update.

4. *Conventional Flushing Analysis (CF)*

Conventional flushing involves opening a hydrant and flushing watermain without closing valves. A conventional flushing analysis will be rerun on the modified hydraulic model under high average day demand conditions for all the hydrants in the City. All scenario parameters (i.e. tank levels, pump status, etc.) that were used for the development of flushing sequences initially will be maintained for the update of flushing sequences for Areas 1 through 6.

This analysis will be performed first to determine if any watermains in the evaluation area can reach target velocities (at least 5 feet per second) with conventional flushing as conventional flushing takes less effort to model and perform in the field. Exhibits will be created and/or modified showing the locations of the flushed watermain that met requirements using conventional flushing techniques and the minimum hydrant flow in order to reach target velocities.

Once the conventional analysis is complete, a preliminary color map showing the results of the conventional flushing analysis (boundary of conventional flushing areas) will be submitted to the city before the unidirectional flushing analysis.

The conventional flushing analysis will be performed for all Areas 1 through 6. Once the conventional flushing analysis is complete, the following items will be submitted to the city:

- 2 color copies of preliminary conventional flushing maps
- 7 color copies of final conventional flushing maps
- Final color conventional flushing maps in electronic format

5. *Unidirectional Flushing Analysis (UDF)*

Areas that do not reach target velocities (at least 5 feet per second) in the conventional flushing analysis will be selected for unidirectional flushing analysis. Historically, water mains between 10” and 16” in diameter will be unidirectionally flushed, as water mains 8” in diameter and smaller can usually reach target velocities with conventional flushing. The sub areas that were created during the original development of flushing sequences in each area will be maintained as part of this update. A portion of Area 3 that was flushed along with Area 2 will now be identified as part of Area 2.

After flushing was completed for Area 1 in 2013, the City modified the parameters for the development of flushing sequences for Area 2 through 6 to allow no upper limit for the number of valves to close in each UDF sequence. Also a minimum residual pressure of 30 psi was maintained for all the sequences.

During the 2013 development of flushing legs for Area 2, a data table was created on a separate page for each UDF leg to include the testing values. During the 2014 development of hydraulic model for Areas 3 and 4, the City suggested including a table for all the flushing legs that listed all the valves operated in the sequences to identify distribution system valve issues as part of the flushing operation. The table tracks valves to be opened that were closed during the sequence, valves found closed and valves that need maintenance.

The following tasks will be performed for the unidirectional flushing analysis under high average day demand conditions for the new/updated watermain that cannot reach target velocities during conventional flushing:

Area 1

- For Area 1, flushing sequences will be modified/combined to allow no upper limit of valves to be closed while at the same time maintaining a minimum residual pressure of 30 psi.
- Also for Area 1, all the UDF maps will be recreated with updated symbols along with a data table and valve table for each leg.

Area 2

- For the update of Area 2, valve tables will be created for all the UDF legs.

All Areas

- Create flushing scenarios for any new watermain in order to determine flushing sequences
- Create location maps of flushing sequence showing hydrant flow, valves to close, minimum system pressure, and flushed pipe for any new watermain
- The flushing sequences for all areas will also be revised in accordance with the changes that were observed in the field during the flushing program.
- As part of this update, tables will be created for all the flushing maps created during the development of flushing sequences for Areas 1 and 2 and for any new flushing sequences that will be developed as part of this update.

Once the unidirectional flushing analysis is complete, the following items will be submitted to the city:

- 2 color copies of preliminary unidirectional flushing maps
- 7 color copies of final unidirectional flushing maps
- Final color unidirectional flushing maps in electronic format

6. Project Meetings

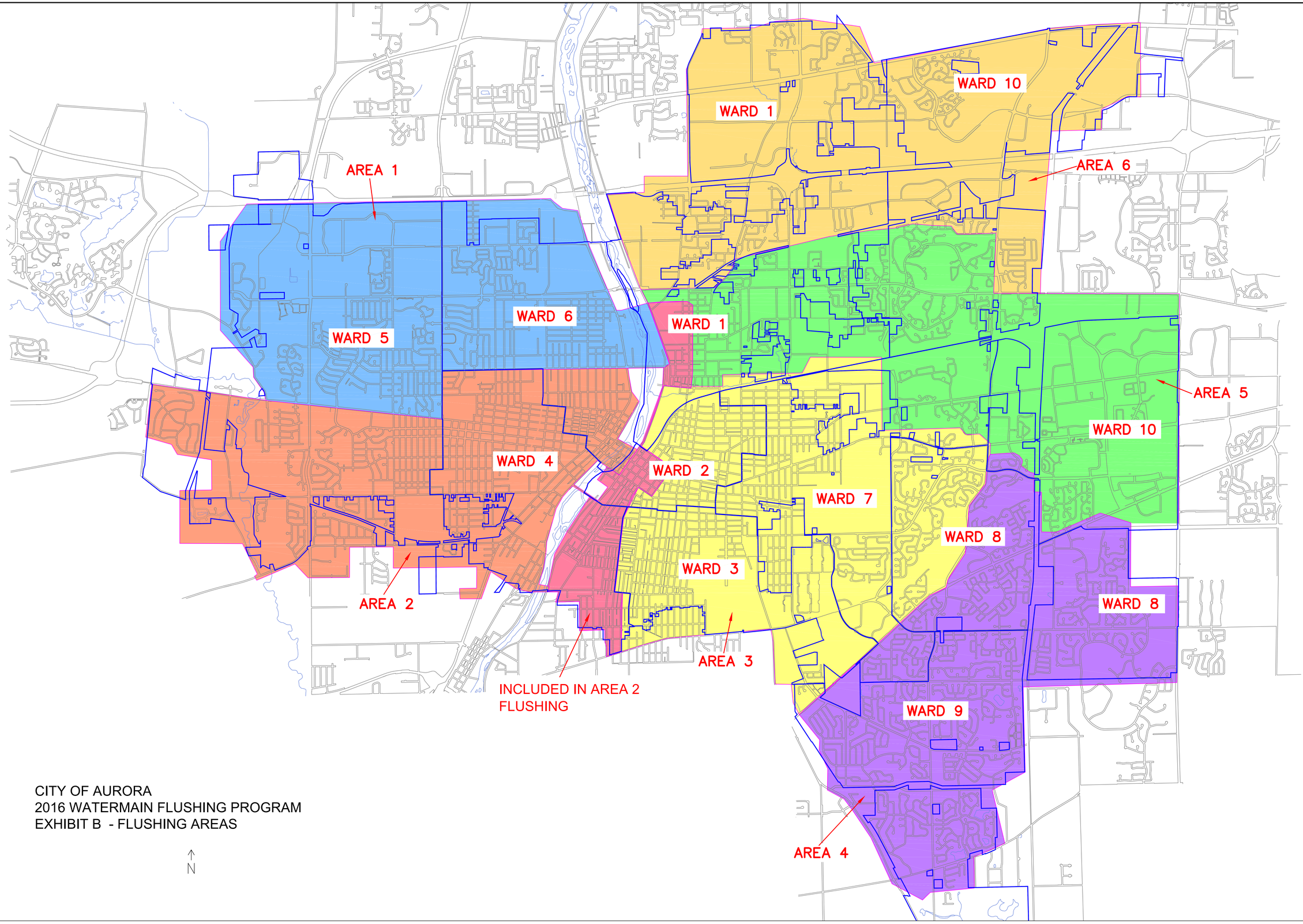
A project status meeting (no more than one hour) will be held after the updates are complete to review the updated flushing sequences/maps. After the project meeting, flushing sequences/maps will be finalized and submitted to the city.

7. Schedule

It has been assumed that the update of flushing sequences for Areas 1 through 6 will be completed after the flushing of Areas 5 and 6 is completed.

Assuming the data required from the City is available at the kick-off meeting, the following are anticipated milestone/completion dates:

- Kick-off Meeting — April 1, 2016
- Begin Unidirectional Flushing — April 21, 2016
- Begin Conventional Flushing — May 16, 2016
- Complete Flushing of Areas 5 and 6 — August 12, 2016
- Revised Flushing Sequences for Areas 1 through 6 - Draft — February 17, 2017
- Assume 3 weeks City review — March 10, 2017
- Revised Flushing Sequences for Areas 1 through 6 - Final — March 31, 2017



CITY OF AURORA
2016 WATERMAIN FLUSHING PROGRAM
EXHIBIT B - FLUSHING AREAS

EXHIBIT C– SCHEDULE OF HOURLY CHARGES
CITY OF AURORA
RESIDENT INSPECTION AND ENGINEERING SERVICES

CLASS NO.	CLASSIFICATION	2014 AVG DIRECT LABOR RATE	BILLING RATE MULTIPLIER @ 2.78	2015/2016 BILLING RATE*
10	**Principal** (IDOT cap at $70)	$70.00	$194.60	$197.40
20	**Senior Project Engineer/Manager** (CMT management engineer)	$55.78	$155.06	$157.29
30	**Project Engineer/Manager** (sr. level PE or special discipline struct. or elect.)	$49.38	$137.28	$139.26
40	**Senior Engineer** (licensed professional engineer)	$36.19	$100.62	$102.07
42	**Senior Technical Manager**	$45.48	$126.43	$128.25
43	**Senior Planner**	$32.58	$90.58	$91.88
50	**Engineer** (graduate engineer)	$28.57	$79.41	$80.55
51	**Architect**	$24.76	$68.83	$69.82
60	**Planner** (aviation planning, environ. assessments, etc.)	$51.77	$143.92	$145.99
65	**Technical Manager**	$23.49	$65.31	$66.25
70	**Registered Land Surveyor** (PLS for plats, easements, etc.)	$40.05	$111.35	$112.95
80	**Senior Technician** (exp survey tech, CAD tech, resident inspector)	$31.92	$88.74	$90.02
90	**Technician** (survey instrument man, CAD operator, inspector)	$27.17	$75.53	$76.62
100	**Technical Assistant** (junior-level rodman, inspector, CAD operator)	$19.39	$53.89	$54.67
110	**Clerical/Word Processor**	$19.30	$53.66	$54.43

* Using escalation rate of 1.44% based on CPI change from November 2013 to November 2014

Computation of billing rate multiplier:

Direct labor factor	1.0000
Audited overhead rate (3-yr average)	1.531
Subtotal	2.5307
Profit factor	1.10
Total	2.78

Overhead and rate calculation is based on AASHTO guidelines for all US DOT's nationwide.

CITY OF AURORA
2016 WATERMAIN FLUSHING PROGRAM - Flushing and Modeling Analysis

Exhibit D - Professional Services Cost Estimate Summary
29-Jan-16

Exhibit	Description	Manhours	Amount
D-1	Areas 5 & 6 - Flushing Costs	4,249	$315,500
D-3	Areas 1 through 6 - Updating Flushing Maps Costs	528	$54,000
	TOTAL	**4,777**	**$369,500**

CITY OF AURORA

2016 Watermain Flushing Program - Area 5 & 6 Flushing

Exhibit D-1 - Professional Services Cost Estimate

29-Jan-16

Assume 1 full-time Conventional Crew (1 CMT engineer and 1 CMT intern) and 1 crew (1 CMT engineer, 4 CMT interns and 1 Aurora worker) who would perform UDF Flushing primarily and then supplement with Conventional Flushing.

Assumptions:

Full-time Conventional Flushing Crew:		
Crew Size	2	
Technical Assistant ($/hr.)	$54.67	
Engineer ($/hr.)	$80.55	
Crew Cost ($/hour)	$135.22	
Number of Hydrants per day	21	Assumed 21 hydrants per day for a 2 person crew based on a 4 person crew flushing between 40 - 50 hydrants per day in 2015 Watermain Flushing Program
Conventional Flushing:		
Crew Size	4	
Technical Assistant ($/hr)	$54.67	
Technical Assistant ($/hr)	$54.67	
Technical Assistant ($/hr.)	$54.67	
Engineer ($/hr.)	$102.07	
Crew Cost ($/hour)	$266.08	
Number of Hydrants per day	42	Based on a 4 person crew flushing between 40 - 50 hydrants per day in 2015 Watermain Flushing Program
Unidirectional Flushing:		
Crew Size	5	
Technical Assistant ($/hr)	$54.67	
Technical Assistant ($/hr)	$54.67	
Technical Assistant ($/hr.)	$54.67	
Technical Assistant ($/hr.)	$54.67	
Engineer ($/hr.)	$102.07	
Crew Cost ($/hour)	$320.75	
Approximate feet per day	7,500	Based on average of 7,657 feet/day of UDF Flushing in 2014 Watermain Flushing Program

Field Paperwork - assume 5 hours per week
Coordination Meetings - assume 4 hours per week
Project Management Time ($157.29/hour) - 5 hours per week
Assume flushing duration of 16 weeks - 13 weeks with interns and 3 weeks prior to interns arriving to complete UDF in Area 5A, 5B, 5C and 5D (highlighted in red)

	5A	5B	5C	5D	5E	5F	5G	6A	6B	6C	6D	6E	6F	6G	TOTAL
Conventional Flushing															
Length of watermain (feet)	93,869	37,077	65,532	51,463	69,902	49,455	68,517	52,242	20,163	21,333	34,605	29,473	43,426	43,669	680,726
Length of watermain (miles)	17.78	7.02	12.41	9.75	13.24	9.37	12.98	9.89	3.82	4.04	6.55	5.58	8.22	8.27	129
-->Full-Time Conventional Flushing (2 CMT person crew)															
# of Hydrants	166	36	48	151	173	117	182	51	21	17	76	63	115	42	1258
Estimated flushing time (crew hours)	64	14	19	58	66	45	70	20	8	7	29	24	44	16	484
Estimated flushing time (crew days)*	8.5	2.0	3.0	7.5	8.5	6.0	9.0	2.5	1.0	1.0	4.0	3.5	5.5	2.5	65
Estimated Crew Labor Cost	$9,194.96	$2,163.52	$3,245.28	$8,113.20	$9,194.96	$6,490.56	$9,735.84	$2,704.40	$1,081.76	$1,081.76	$4,327.04	$3,786.16	$5,949.68	$2,704.40	$69,773.52
-->Conventional Flushing (4 CMT person crew)															
# of Hydrants	90	80	125	0	0	0	0	90	42	40	25	20	20	90	622
Estimated flushing time (crew hours)	18	16	24	0	0	0	0	18	8	8	5	4	4	18	123
Estimated flushing time (crew days)*	2.5	2.0	3.0	0.0	0.0	0.0	0.0	2.5	1.0	1.0	1.0	0.5	0.5	2.5	17
Estimated Crew Labor Cost	$5,321.60	$4,257.28	$6,385.92	$0.00	$0.00	$0.00	$0.00	$5,321.60	$2,128.64	$2,128.64	$2,128.64	$1,064.32	$1,064.32	$5,321.60	$35,122.56
Unidirectional Flushing (6 person crew - 5 CMT people)															
Length of watermain (feet)	45,133	39,853	27,920	5,953	41,320	27,743	24,341	50,173	54,103	32,335	30,568	19,779	19,407	36,959	455,587
Length of watermain (miles)	8.55	7.55	5.29	1.13	7.83	5.25	4.61	9.50	10.25	6.12	5.79	3.75	3.68	7.00	86.29
Number of Sequences	18	15	11	2	20	8	9	16	24	10	13	8	7	15	176
Number of Valves to Operate	98	78	60	9	99	58	64	60	93	33	55	31	40	49	827
Average Length of Watermain per Sequence (feet)	2,507	2,657	2,538	2,977	2,066	3,468	2,705	3,136	2,254	3,234	2,351	2,472	2,772	2,464	2,589
Average # of Valves per Sequence	5	5	5	5	5	7	7	4	4	3	4	4	6	3	5
# of valves per mile of watermain	11	10	11	8	13	11	14	6	9	5	10	8	11	7	10
Estimated flushing time (crew hours)	49	43	30	7	45	30	26	54	58	35	33	22	21	40	493
Estimated flushing time (crew days)*	**6.5**	**5.5**	**4.0**	**1.0**	6.0	4.0	3.5	7.0	7.5	4.5	4.5	3.0	3.0	5.0	65.0
Estimated Crew Labor Cost	$16,679.00	$14,113.00	$10,264.00	$2,566.00	$15,396.00	$10,264.00	$8,981.00	$17,962.00	$19,245.00	$11,547.00	$11,547.00	$7,698.00	$7,698.00	$12,830.00	$166,790.00
Total															
Length of watermain (feet)															1,136,313
Length of watermain (miles)															215
Miscellaneous Effort															
Project Start-up/Close-Out (hours)															100
Project Start-up/Close-Out Costs															$12,968.00
Field Paperwork (hours)															80.0
Field Paperwork Cost															$8,165.60
Coordination Meetings (hours)															64.0
Coordination Meetings Cost															$10,066.56
Project Management (hours)															80.0
Project Management Cost															$12,583.20
Total Labor Hours	445	307	284	151	357	240	270	382	338	221	243	174	209	304	4249
Total Cost	$31,195.56	$20,533.80	$19,895.20	$10,679.20	$24,590.96	$16,754.56	$18,716.84	$25,988.00	$22,455.40	$14,757.40	$18,002.68	$12,548.48	$14,712.00	$20,856.00	$315,469.44
															*rounded up to $315,500

*Rounded up to nearest half day. Additional time additional for UDF Sequences which had greater than 15 valves to operate per mile of pipe being flushed.

CITY OF AURORA

2016 Watermain Flushing Program - Areas 5 & 6 Flushing

Exhibit D-2 - Summary of Unidirecitonal and Conventional Flushing Statistics

29-Jan-16

	5A	5B	5C	5D	5E	5F	5G	6A	6B	6C	6D	6E	6F	6G	**TOTAL**
Conventional Flushing															
# of Hydrants	256	116	173	151	173	117	182	141	63	57	101	83	135	132	**1,880**
Length of watermain (feet)	93,869	37,077	65,532	51,463	69,902	49,455	68,517	52,242	20,163	21,333	34,605	29,473	43,426	43,669	**680,726**
Length of watermain (miles)	17.78	7.02	12.41	9.75	13.24	9.37	12.98	9.89	3.82	4.04	6.55	5.58	8.22	8.27	**128.93**
Unidirectional Flushing															
Length of watermain (feet)	45,133	39,853	27,920	5,953	41,320	27,743	24,341	50,173	54,103	32,335	30,568	19,779	19,407	36,959	**455,587**
Length of watermain (miles)	8.55	7.55	5.29	1.13	7.83	5.25	4.61	9.50	10.25	6.12	5.79	3.75	3.68	7.00	**86.29**
Number of Sequences	18	15	11	2	20	8	9	16	24	10	13	8	7	15	**176**
Number of Valves to Operate	98	78	60	9	99	58	64	60	93	33	55	31	40	49	**827**
TOTAL															
Length of watermain (feet)	139,002	76,930	93,452	57,416	111,222	77,198	92,858	102,415	74,266	53,668	65,173	49,252	62,833	80,628	**1,136,313**
Length of watermain (miles)	26.33	14.57	17.70	10.87	21.06	14.62	17.59	19.40	14.07	10.16	12.34	9.33	11.90	15.27	**215.21**

CRAWFORD, MURPHY & TILLY, INC.
CONTRACT ATTACHMENT - EXHIBIT D-3 - 2016 PROFESSIONAL SERVICES COST ESTIMATE
CLIENT CITY OF AURORA
PROJECT NAME 2016 Watermain Flushing Program - Area 1 thru Area 6 Update Summary
CMT JOB NO. TBD

Prep By	TLO
DATE	01/18/16
Apprvd	BDH
DATE	01/28/16

TASK NO.	TASKS \ CLASSIFICATIONS	PRINCIPAL	SR PROJECT ENGR MANAGER	PROJECT ENGINEER MANAGER ARCHITECT	SENIOR ENGINEER	SENIOR MANAGER	ENGINEER	LAND SURVEYOR	SENIOR TECHNICIAN	TECHNICAL MGR	TECHNICIAN	CLERICAL	TECHNICAL ASSISTANT	MAN HOURS & LABOR SUMMARY	
	CURRENT YEAR 2016 CITY OF AURORA HOURLY RATES	$197.40	$157.29	$139.26	$102.07	$128.25	$80.55	$112.95	$90.02	$66.25	$76.62	$54.43	$54.67	TOTAL
1	Kick-off Meeting		3				4							7
2	Data Collection						4							4
5	Incorporation of AutoCAD Data into Hydraulic Model						16				6			22
6	Hydraulic Model Modifications						18							18
7	Project Status Meetings (assume 1 meeting)		3				4							7
8	Conventional Flushing Analysis		14				56							70
9	Unidirectional Flushing Analysis		22				100							122
10	Incorporate City Comments						42							42
11	Map Preparation						80					12		92
12	Table Preparation						80				12	12		104
13	Project Management		40											40
14														0
15														0
16														0
	TOTAL MAN HOURS	0	82	0	0	0	404	0	0	0	18	24	0	528
	SUBTOTAL - BASE LABOR EFFORT	$0	$12,898	$0	$0	$0	$32,542	$0	$0	$0	$1,379	$1,306	$0	$48,125

	TASKS (CONTINUED)	TOTAL LABOR EFFORT	DIRECT EXPENSE & REIMBURSABLES											TOTAL FEE
			TRAVEL MILEAGE	MEALS & LODGING	PRINTING	EQUIP-MENT	MISC	SURVEY MTL	SUBS	SUBS ADMIN	OTHER EXP	OTHER EXP	TOTAL EXPENSE	
1	Kick-off Meeting	$794											$0	$794
2	Data Collection	$322											$0	$322
5	Incorporation of AutoCAD Data into Hydraulic Model	$1,749											$0	$1,749
6	Hydraulic Model Modifications	$1,450											$0	$1,450
7	Project Status Meetings (assume 1 meeting)	$794											$0	$794
8	Conventional Flushing Analysis	$6,713											$0	$6,713
9	Unidirectional Flushing Analysis	$11,515											$0	$11,515
10	Incorporate City Comments	$3,383											$0	$3,383
11	Map Preparation	$7,097			800								$800	$7,897
	Table Preparation	$8,017											$0	$8,017
13	Project Management	$6,292											$0	$6,292
14		$0											$0	$0
15		$0											$0	$0
16		$0											$0	$0
	TOTALS	$48,126	$0	$0	$800	$0	$0	$0	$0	$0	$0	$0	$800	$48,926
	TIME PERIOD OF PROJECT	2015	2016	2017	2018	TOTAL	EST % OF OT HRS INCLUDED ABOVE					0%	MULTI-YEAR + OT	
	PERCENTAGE OF WORK TO BE PERFORMED BY YEAR	100%	0%	0%	0%	100%	AVERAGE OVERTIME RATE PREMIUM					20%	MLTPLR & AMT	
	WEIGHTING FACTOR FOR 5% ANNUAL ADJUSTMENT	1.0000	0.0000	0.0000	0.0000	1.0000	OT ADJUSTMENTFACTOR					0.0000	1.0000	$0
	ESTIMATED CONTINGENCY												10%	$4,890
	ROUNDING													$184
	TOTAL FEE	MATH CROSS CHECK IS OK												$54,000