CONVENTIONAL FLUSHING FOR WATER TURNOVER SOP

SOP #431

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SOP VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Approved by

STAFF ACKNOWLEDGEMENT

I certify that the requirements of this SOP have been communicated to me and that I am trained in its use. A copy of this page will be distributed to the employee training record file.

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APPROVAL SIGNATURES

Prepared by: Arcadis U.S., Inc. & Confluence Engineering Group LLC Date: 01/31/2018

Approved by: _____ Date: _____

1 DEFINITIONS AND ACRONYMS

CF	conventional flushing
CWI	clean water interface
FPS	feet per second
GIS	geographic information system
GPM	gallons per minute
GPS	global positioning system
PPE	personal protective equipment
PSI	pounds per square inch
TDS	total dissolved solids
UDF	unidirectional flushing

2 KEY PERSONNEL AND RESPONSIBILITIES

- Water Distribution Superintendent:
  - Maintain schedule and generate work orders (based on objectives listed in scope/purpose section) for flushing areas and events.
  - Identify additional planning/scheduling activities and resources for each flush (such as establishing additional traffic control measures, coordinating pre-flush hydrant inspection, performing customer notification, assessing the hydraulic impact and water quality impact, equipment organization and other planning steps).
  - Maintain records of flush events, including hydrants used, nearest clean water interface (CWI), general direction of water movement, flow rates, duration, start and finish water quality (including chlorine residuals and turbidity measurements).
  - Ensure all problem hydrants, map discrepancies, water quality issues, and other issues are properly communicated to the responsible parties and ensure identified repairs/replacements and/or further remediation steps are executed within a timely manner.
- Water Distribution Operator (2):
  - Perform flushing pre-inspection to ensure operable assets, assemble required flushing and traffic control equipment, and perform flushing efforts as generated by work orders.
  - Prepare records of flushing efforts, issues or maintenance concerns for each hydrant, record all water quality data on standardized forms, and enter into flushing log/database.

3 SCOPE/PURPOSE

The purpose of this SOP is to ensure proper goals and objectives are realized with targeted execution of conventional flushing (CF) for bulk water turnover. It is important to distinguish between bulk water turn over vs. main cleaning using unidirectional flushing (UDF), which is described in a separate SOP. Since valve isolation is not used during CF for bulk water turnover, it is imperative to avoid stirring up sediments that could be pulled into a customer's home.

The Water Distribution Superintendent should consider the following three objectives/situations when scheduling and preparing work orders:

1. CF in response to water quality complaints.
2. CF as part of meeting ongoing water quality goals and regulatory requirements (orthophosphate, chlorine, pH, etc.)
3. CF as part of a hydrant winterization program

For each of the three scenarios listed above the Water Distribution Superintendent should implement the following steps to ensure proper response is affected:

Situation 1 – Customer Complaints

See separate SOP for Customer Complaint Tracking. Prior to conducting any water quality response flushing, the City should conduct monitoring in the localized vicinity of the complaint in an attempt to identify the origin and spatial extent of the water quality upset, as described below.

- Conduct local distribution system water quality "canvass monitoring" to define the spatial extent of the upset. This involves sample collection and field analysis for key parameters (at a minimum: turbidity, color, total dissolved solids (TDS)/conductivity, and chlorine residual) at hydrants/sample stands that are located in the vicinity of the complaint location.
- Sample locations should start at the complaint location and gradually move outwards in each potential flow direction until the water appears clear and field-measured water quality is within desired conditions.
- Based on the results, the affected area should be delineated on a map and the CWIs to be used for CF should be identified.
- Attempt to determine the cause of the upset/release. For example, identify any unusual chemistry conditions in the field dataset. Also, identify any unusual activities in the area that may have caused a hydraulic or physical disturbance, such as construction activity, main break or repair work, a pressure transient, etc. Document such conditions.
- Establish target water quality conditions/criteria to be achieved within the affected area. These should be based on the canvass results for the nearby CWIs. At a minimum, these criteria should include visual clarity (with the white-cup test), turbidity (≤ 5 NTU or same as the CWI), and chlorine residual (≥ 0.5 mg/L or same as the CWI).
- All data collected during water quality response flushing should be entered into the flushing log/database.

Situation 2 – In Support of Water Quality Goals/Regulatory Requirements

Based on the data collected through the city's ongoing Enhanced Water Quality Monitoring Program (and customer complaint response flushing listed in section 1 above), the Water Distribution Superintendent should utilize bulk water turnover to assist with meeting water quality goals (orthophosphate, pH, chlorine residual) through an integrated data collection and response program. This program should involve:

- Create a city-wide GIS map outlining routine problem areas (low orthophosphate, chlorine residual, pH).
- Routine response protocols for areas know to have frequent fluctuations in water quality.
- Integration of field data with customer complaint data.
- Use to support a more comprehensive system wide UDF program.

Situation 3 – Hydrant Winterization

The City of Flint carries out a comprehensive hydrant winterization program, implemented each late summer/early fall to prepare assets for the winter months. CF can be used to support this effort. The following steps should be taken:

- The distribution system should be divided into specific areas for the purpose of hydrant winterization.
- For each area, or grid, the CWIs should be identified.
- A systematic plan, based on these sources, should be outlined which will allow hydrants to be exercised starting with those closest to the clean water source and proceeding out through the established area or grid, according to pipe size, valving, or pressure zone limitations.
- Water quality data, including chlorine residual and turbidity, should be collected and recorded throughout the area at defined intervals and added to the flushing log/database.

4 HEALTH, SAFETY, AND PUBLIC AWARENESS

Public awareness is key to any successful flushing program. Posted placard, sign boards, or community mailers have been proven effective in keeping residents of the possible water quality side-effects of both CF and UDF activities. One of the most significant health and safety risks during CF is vehicle traffic. The field service team should use trucks, temporary signs, and traffic cones to prevent automotive accidents and injury to staff. In addition, a flag crew may be needed to direct traffic in some locations. Trucks should be parked between oncoming traffic and the work area to provide a barrier. In addition, the following personal protective equipment (PPE) should be worn during maintenance activities:

- Hard hat
- High visibility safety vest
- Safety glasses

- Work gloves
- Steel-toed boots
- Knee pads (as needed)

5 PROCEDURE

Equipment Required (per flushing crew of 2):

- Water system map (with clear labels for pipe diameter, street names, parcel addresses, critical water users, and all hydrant/appurtenance identification numbers)
- Traffic cones
- Temporary signs/arrow boards (warning lights, strobe lights, arrow boards, traffic maintenance signs)
- Hydrant wrench
- Two (2) 50’ sections of 2.5” hose
- 1 Pollard LPD-250 diffuser
- Dechlor pucks for diffuser
- One (1) 2.5” flowmeter
- One (1) Hach colorimeter II for free & total chlorine
- One (1) Hach 2100q turbidimeter
- Data sheets
- GPS unit (optional)
- Digital camera (optional)

Procedure:

1. Once a work order is received from the Water Distribution Superintendent, identify the 2-person maintenance crew to perform the hydrant maintenance.
2. Prior to driving to the site, perform the necessary pre-planning activities. This includes reviewing system maps, GIS, as-builts, and asset history to identify hydrants that are in busy intersections, high-profile of sensitive customers, or may result in a potential hydraulic impact as well as reviewing the manufacturer’s manual for the specific hydrants to be inspected. Notify the Water Service Center Supervisor if additional planning/coordination is needed.
3. Based on objectives, identify the best route to conduct the work. This includes identifying the starting and ending point (hydrant location), sequence of hydrants to be completed for the day, and potential parking areas.
4. Upon arrival to the site, assess the site for safety (including the appropriate PPE) and set up the appropriate traffic control measures. This may include: warning lights, strobe lights, arrow boards, traffic maintenance signs, cones, flagmen (if necessary), safety vests and/or other PPE. Document the following information on the work order:
    - Operators’ last names
    - Flush date
    - Arrival time

5. Locate and access the fire hydrant identified as the starting point for the work order. Identify the unique identification number for the hydrant on the appropriate water system map and confirm the actual field location is a correct match. Verify the following information in the field and document it on the work order:
    - Hydrant ID number
    - Map grid/page number
    - Street
    - Cross street
    - Address
    - GPS position (if applicable)
    - Other location notes (i.e. measurements from the property line)
    - Hydrant source main size
    - Map discrepancies (if applicable)

6. Attach flowmeter and the required length of 2.5” hose to allow for proper water disposal. Attach Pollard LPD-250 to hose end. Check dechlor chamber and make sure there is a puck sufficient to last the expected duration of the flush.
7. Open the hydrant and set the flow to roughly 20 gpm and allow the hydrant barrel to clear (time duration for this will depend on estimated barrel length; at least 2 minutes should be provided; this can usually be ascertained by a visual inspection). Once the barrel has cleared, at a minimum, total chlorine and turbidity measurements should be taken if the hydrant is marked for monitoring. Measurement of other parameters may be appropriate based on CF objective. See item 11 below regarding water quality goals. Record the data on the representative data sheets.
8. Once data is recorded, increase the flowrate using the following guide:
    - 200 gpm for all flushes with adjacent pipe size 6-inch diameter or larger, regardless of pipe type;
    - 100 gpm for all flushes with adjacent pipe size smaller than 6-inch diameter.
    - For transmission lines larger than 12-inch diameter, the flow rate can be increased above 200 gpm, but the flushing velocity (calculated, assuming all flow comes from one direction) should be kept below 2 fps at all times.
    - Note: flow rates can be increased as long as turbidity remains ≤ 5 NTU.

9. Flush at least 2 minutes for every 100 feet of distance from the nearest upstream hydrant that was flushed.
10. Periodically check the water quality during the flush. Because of the nature of CF, there is no industry standard for monitoring frequency during flushing. In practice, the optimal frequency will depend on distance to the clean water source, pipe diameter, and the extent to which valving is used to improve process control. At a minimum, it is recommended that samples be collected and analyzed at least once every 10 minutes. More frequent monitoring may be warranted in certain cases.

11. Continue the flush until established goals have been reached. However, if a given flush lasts more than 30 minutes and water quality criteria are still not met, then the use of strategic valving and/or using multiple hydrants in sequence should be pursued to accelerate the process and conserve resources. Generally, the following water quality goals should be achieved, depending on CF objective described above:
    - Turbidity ≤ 5 NTU
    - Chlorine ≥ 0.5 mg/L
    - Orthophosphate ≥ 3.0 mg/L PO4
    - pH ≥ 7.2
12. End flush. Remove gear and proceed to next designated hydrant.
13. Continue through designated area or grid from clean water source moving out by decreasing pipe size.

6 DATA RECORDING AND MANAGEMENT

Following completion of a CF area work order, enter all necessary information, including the date of flush, hydrant identification, flowrate achieved, duration of flush, water quality results and personnel completing the maintenance into the flushing log/database.

The Water Distribution Superintendent must be notified of any hydrant is inoperable, whether expected flowrates were achievable, and any customer complaints or unexpected water quality upsets. The Water Distribution Superintendent shall assign work orders for any follow-up items and coordinate updates to the asset management plan.

7 REFERENCES

City of Flint. Standard Operating Procedure 421: Customer Complaint Tracking.

City of Flint. Standard Operating Procedure 432: Unidirectional Flushing.