Utilizing a No-Discharge Flushing Truck

Successes and Challenges in San Jose

Dr. Susan K. Willis, Water Quality Superintendent
Casey Claborn, Water Quality Engineer
What is a NO-DES Truck?

• A replacement, in most cases, for a traditional unidirectional flushing program
• A single vehicle with multiple applications
What Does the NO-DES System Do?

• Flushes accumulated sediment, rust, and biofilm from water mains
• Filters out these contaminants before returning water to the distribution system
• Can boost chlorine residual on an as-needed basis
• Without discharging thousands of gallons of potable water to waste
What Does the NO-DES System Do?

Alternative applications

– Responding to potential instances of contamination as a result of main breaks or backflow events

– Flushing and disinfecting newly constructed mains awaiting tie-in to eliminate any lingering coliform presence
SJWC Flushing Truck Outreach

Video on Youtube: https://www.youtube.com/watch?v=k3KHPq6vmzk
Why a NO-DES Truck?

• Higher flow velocities = more effective flushing
• Can flush ~ twice as many miles per year
• Reduce discharge management requirements
• Minimize and address Water Quality complaints directly
Why a NO-DES Truck?

Drought.
Why a NO-DES Truck?

With the drought restrictions limiting customers’ water use, hydrant flushing to waste is not perceived favorably or encouraged.
A NO-DES program, on the other hand:

- Promotes dialogue with community members, who are curious about the truck’s function
- Provides an opportunity for innovation and coordination with other utilities
Typical Operating Conditions

- Flush up to 12-inch mains
  Larger mains can be flushed and chlorinated, but with reduced velocities
- Attach to 2” or 4” blow off or hydrant
  4” is ideal for achieving flushing velocities in the water main
Typical Operating Conditions: Results

<table>
<thead>
<tr>
<th></th>
<th>Numerical average</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>flow rate (gpm)</td>
<td>460</td>
<td>820</td>
</tr>
<tr>
<td>velocity (ft/s)</td>
<td>3.4</td>
<td>8.1</td>
</tr>
</tbody>
</table>

Average Final Turbidity: 0.7 NTU
Typical Operating Conditions: Results

• From November through February, crew flushed 18 miles of main in 28 days out
• Average **0.64 mi/day** flushed, ~0.4mi/day when training (55% of operating time), ~0.75 mi/day with trained crew
Typical Operating Conditions: Results

Only one WQ complaint related to Flushing Truck activities in past 10 months; due to hydraulics failure on truck
Typical Operations: Crew

• **Standard crew of two**
  – One crewleader, one worker, 8hr shifts
  – Self-imposed requirements for qualifications, not considered treatment technology

• **Crewleader role (D1 or D2):**
  – Log data, plan flushing runs, maps
  – Calculate flow rates and pressures
  – Calculate rate of chlorine dosing

• **Worker role (D1 recommended):**
  – Working valves, opening between runs
  – Aiding calculations and laying out hose
Typical Operations: Accessory Vehicles

Segway

- Attaches to front of truck
- Outfitted with valve key holders, can carry small cones for working in the road
- Battery operated, zero emissions, 15-20 mi on a single charge
- Requires additional safety equipment
Typical Operations: Accessory Vehicles

Burro

– Attaches to back of truck
– Used to lay out and reel up hose
– Requires additional forklift training
Typical Operations: Deployment

One location per day:

- 1hr each to deploy truck and to break down at end of day
- Maximize flushing from one location
- Flush times range from 10min (initial, just between hydrants) to 1-2hr (longer loops)
Typical Operations: Flushing Routes
Personnel Challenges

• Resistance to change
  – New technologies/ operating procedures are scary
  – Moving parts/troubleshooting truck issues
  – New equipment, don’t want to break it

• Surprisingly high turnover rate
  – 3 crews in 10 months

• Demand for more personnel

• Demand for more transportation
  – “Chaser” truck
Personnel Challenges

• More scientific background required
  – Planning routes
  – Chlorine dosing (some have ignored completely)
  – May require pay bump over traditional flushing operations

• Need to understand costs and benefits of truck operations, priorities for operation, tradeoffs for filter replacement, etc.
**NO-DES Flushing Truck Cl₂ Dosing Calculator**

<table>
<thead>
<tr>
<th>Step 1 - Enter the length of each diameter hose used in loop</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feet of hose:</strong></td>
</tr>
<tr>
<td>Feet of hose:</td>
</tr>
<tr>
<td>Feet of hose:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 2 - Enter Diameter and Length of each pipe segment in loop</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pipe segment 1</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Pipe segment 2</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 3 - Observe your target flow range based on your longest pipe segment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feet/Second</strong></td>
</tr>
<tr>
<td><strong>Target Flow (gpm):</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 4 - Enter your actual flow rate and your Targeted dose per loop</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Flow:</strong></td>
</tr>
<tr>
<td><strong>Dose per loop:</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Step 5 - Use the loop time below to set your pump stroke rate and dosing pump timer</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loop Time:</strong></td>
</tr>
<tr>
<td><strong>Set Pump Rate to:</strong></td>
</tr>
</tbody>
</table>

*Use 1.23 lbs/gal for 12.5% chlorine solution*
*Chemical dosing pump delivers 0.11 mL per stroke per manufacturer specs*
*Optimal pump rate is 180 strokes per minute (50% stroke speed).*

- Crew can quickly set appropriate dosing
- Easily bring free Chlorine residual up to acceptable levels
- Requires only basic operational information
Regulation Requirements

• No set regulations for this technology yet

• Asked by DDW to:
  – Test and provide results for weekly coliform samples from truck outlet
  – Report any related WQ complaints
  – Provide logs of location, length of main, final turbidity, final Cl$_2$ residual, number of runs per day
Regulation Requirements: Results

• As yet **zero** coliform positives, and only one WQ complaint (due to hydraulic leak on truck)

• Benchmarking for internal use and optimization:
  – Miles of main flushed (efficiency)
  – Intake/ effluent turbidity
  – Locations of customer complaints
Operations: Unexpected Benefits

• React to dirty water complaints immediately and effectively

• Aid in cleaning up:
  – Troublesome (positive pre-tie-in) construction projects
  – Main replacement or necessary breakpoint chlorination
  – 5 valuable capital projects assisted so far
Operations: Unexpected Benefits

• Cross-training with DS, Ops in case of emergency
  – Exchange personnel for two weeks
  – Spread institutional knowledge
  – Operators available on all shifts

• Option to clean and superchlorinate pipes for various projects
Operations: Recurring Costs

• 1-micron filters clog quickly
  – Depends on:
    • Time since last flush
    • Proximity to wells/ sediment source
    • Biological activity, disinfectant residual
  – Cost to replace all 24 filters: approx. $300
  – Replace every 1-2 operating days

• Incidental upkeep
  – O-rings for filter canisters
  – Repairs on truck body
  – Hose reels
Operations: Recurring Costs

- Chlorine (12.5%), 1 gallon lasts for 2 months
- BMPs (Dechlor Tablets)
- Occasional training for new staff (~$1000/day)
  - Continuing education for sampling, etc.
- Possible: working valves beforehand would save considerable time (DS/ Ops)
Common Questions

Should we buy or contract?

- **NO-DES** has a consulting arm, ValveTek
  - Contract flushing for a fee
  - Useful for small areas or demonstration runs
- Except for small utilities, not sufficient to maintain a flushing program
  - One-time flushing vs. continuous program
  - Cannot deploy in emergencies
  - Can be difficult to book on short notice
- **Contract** means less startup time
  - Expertly trained staff starts producing immediately
  - Need valves worked in advance
  - Can run 6-10mi/week
Common Questions

How long does it take…?

...to start a flushing program?
  – Expect 1-2 weeks of training on the truck
  – With complete employee buy-in could be fully operational within a month

... for each run?
  – Time to flush is a function of:
    • segment length
    • amount of sediment build-up
    • type of sediment build-up (biofilm sloughing)
  – Short initial run time between hydrants: 10-25min
  – Longer loops: ¾ mile segment can take up to a couple of hours
Common Questions

What are performance metrics?

• On-line turbidity analyzers:
  – Turbidity of inlet and outlet flows
  – Continue flushing until <1 NTU

• Grab samples of Total/Free Cl residual
  – Free Cl or Chloraminated pocket of water
  – Guides Cl$_2$ dosing practices

• Operational performance:
  – Miles flushed per week/month
  – Time spent actually flushing each day
  – Number of runs available from one location

• Optimization goals:
  – Increase operational performance
  – Optimize route to target problem areas (cul-de-sacs, etc)
  – Consider pipe age and flushing velocity expectations
Common Questions

Who at SJWC oversees operations?

• Maintained as Water Quality department vehicle
• Flushing Truck used in response to water quality issues
• At beginning of operation, need chemical and disinfection insight of WQ department
• Future use for optimized flushing program requires WQ data, mapping, regulation inputs
• Training provided by NO-DES and employees, under direction of WQ Superintendent
Common Questions

How to dispose of waste filters?

• Currently, no reason to believe it is harmful waste given SJWC’s history and previous flushing operations
• Project in the works to test sludge for contaminants

photo courtesy joejaworski.wordpress.com
Conclusions

• Difficulty implementing program due to staffing issues
  – Expect a consistent crew will provide better performance (aim for 1-1.5mi/day)
• Many unexpected benefits (e.g. construction)
• Effectiveness of flushing now measurable (sediment collected, final Tu)
• Opportunities for program optimization, research and observing results of flushing
• Effective (and only) solution available during drought
Thanks to Adam Feffer (SJWC) and Chris Wilkinson (NO-DES)

SJWC Crews, Operations, and Distribution Systems Teams

Further questions:
Susan.Willis@sjwater.com
Casey.Claborn@sjwater.com