Oversized distribution systems & redundant storage: A navy approach to water quality management

Burnsville becomes the first metro system with on-site hypochlorite generation
Winona's Wincrest Water Tank Continues to Perform Well

Installed: 2008
Tank Type: Composite Elevated Tank
Storage Capacity: 400,000 Gallons
Engineer: Short Elliott Hendrickson
Contractor: Engineering America

PROJECT OVERVIEW:
Engineering America crews completed the Wincrest water tower in August 2008 for the city of Winona, Minnesota. The 143-foot-tall structure has a capacity of 400,000 gallons and serves the far southwest quadrant of the city.

A life cycle maintenance analysis studied the cost of painting a welded steel water tower over a 50-year life cycle. City officials awarded the project based on a present worth analysis that showed a substantial savings by using Engineering America’s Aquastore composite glass-fused-to-steel elevated tank.

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Visit us at www.mnawwa.org
Message from the Chair

No need for the thawing machines

Nice! The service line thawing machines didn’t leave the shop all winter. With any luck they will continue to collect dust during the winters to come.

Some congratulations are in order. First, to the Membership Committee and others who helped the Minnesota Section beat our membership goal. Congratulations to the Information Technology and Ad-Hoc Website Committees for rolling out the new website. This will enhance many capabilities for our Section moving forward. And last, to Jon Eaton for being elected one of the six Vice-Presidents for the Association.

Once upon a time I remember sitting through a community development seminar. The presenter asked, “What makes your community special or unique?” The only answers that weren’t allowed were people and churches. This is because every town or city says it has good people and churches. Having recently returned from a country where it wasn’t advised to drink the water, I wanted to say, “It’s the water, dummy.” I quickly realized I would have been the dummy for giving that answer. Almost everywhere in Minnesota and the United States the only answers not allowed should be people, churches, and water. Safe and reliable water, often taken for granted, doesn’t just happen. It’s people like you who play the biggest role in providing this service.

Lesson learned – most times it pays to keep my damn mouth shut.

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Warning: This will be more serious than most of my quarterly missives.

Between finishing up the last issue of the Breeze and starting on this one, I have been mostly out of commission. I appreciate the cards and support that have come from the Minnesota Section of AWWA and from individual members as well as from my employer, the Minnesota Department of Health.

A summary: I had been having pain in my right hip since the fall of 2013. Doctors sent me to physical therapy and finally, in August 2014, ordered an MRI on my hip. I was expecting to find out that I have a torn labrum that could be fixed with simple surgery. However, the day after my MRI my primary physician called, spoke of a “soft tissue mass” evident in the MRI, and told me she had arranged an appointment the next day with an orthopedic surgeon.

It wasn’t until I ended my phone call with my doctor that the ominous nature of her words started sinking in. The next day the orthopedic surgeon didn’t use a term like “soft tissue mass.” He spoke of an aggressive tumor that was going to require a hip replacement to remove (and that wouldn’t be a “garden-variety hip replacement”).

A biopsy the next week showed the tumor to be malignant. The surgeon was encouraging, at least, in that he thought the cancer was confined to the tumor and could be entirely removed. A scan a couple weeks later also showed no indication that the cancer had spread.

I prepared for the upcoming surgery while also noticing there seemed to be a change in my demeanor. It wasn’t with how squirrely I usually am; if anything, I was even more off-the-wall with my sense of humor. But I discovered that, even since that phone call from my primary doctor sank in, I began to chill. No longer was I getting worked up over silly things. I wasn’t even getting that worked up over nonsilly things. I guess it’s understandable that something like this can bring about a different perspective, but I was overall a calmer person. I relied on my sense of humor – often in inappropriate ways, as is normal for me – to deal with the situation, but I developed a toned-down manner on other things.

On October 1 I had the surgery, which lasted 13 hours. Not “garden-variety hip replacement” meant that some surrounding bone (mainly pelvis) and muscle was removed to ensure that they completely got the tumor out. Nine days later it was discovered that my new hip was not properly located in the socket, which had been rebuilt. Four days later I had surgery lasting three hours to relocate the hip. Two weeks after the first surgery, I was finally able to begin the rehabilitation and recovery process.

Overall I spent one month exactly in the hospital and then about a month of being home-bound, allowed to get out only for church and medical appointments.

This experience has deepened my admiration for nurses and therapists. Such difficult jobs but such important ones.

And there is no way I can come close to saying how much my wife, Brenda Himrich, has done and how vital she has been to me through all this. While continuing her job (taking some time off) as safety manager for Metro Transit and continuing some of the other things in her life that are important to her, she was at the hospital every day multiple times. She kept track of all the medical details that needed tracking and was my advocate while also keeping my spirits up, sometimes merely by her presence. During this time, she also rearranged our home, getting a large sofa in our living room put into storage to make room for a hospital bed that she rented. This allowed for me to operate mostly on one level when I got home.

As nice as it was coming home on November 1, it meant that there was no nurse readily available to help. But Brenda was there whenever I needed her. This meant putting a leg brace on and off me multiple times a day and
helping me do plenty of other things while she worked from home as best she could and ran back and forth to her office.

My cancer was presumably gone, but the massive surgery left my right leg weak and sometimes painful. The biggest thing was the nerves, which had been irritated during surgery. All we could do is wait for them to heal and respond (with a lot of anxiety by me as to if that would happen) before the leg could function to the point I could be independent.

I was often on a swing of emotions during this time. I understand getting a little stir-crazy, and sometimes I would feel down. But the experience also opened me to a greater state of empathy for other people and whatever struggles they faced.

During my physical therapy sessions, I was exposed to others in therapy with greater physical challenges than I had. That was easy to see. But I somehow got a greater sensitivity to problems other people had, not just physical ones, but other difficulties in their life. Being aware of things like that made me feel like I had it pretty good.

I’d like to think that this entire experience (I hate to call it an ordeal although sometimes I would think of it that way) will be an overall positive one for me – that a few months of dealing with a difficult situation made me a better person. Even if, in the end, I don’t think that I really came out ahead on the whole thing – that the good didn’t really outweigh the bad – I know there were good things that came from it.

Beyond Brenda and the great nurses, therapists, and others, I was blessed with the support of friends, including many of you. Thanks so much for it.

OK, I promise with the next issue of the Breeze I won’t be so philosophical and will be back to my usual smarmy self. •

“The experience also opened me to a greater state of empathy for other people and whatever struggles they faced.”
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When Linda Mullen took over as water superintendent in Burnsville in 2007, the city was in the process of adding surface-water treatment to its existing plant. Burnsville began purchasing water from the nearby Kraemer Mining and Materials quarry, both to supplement its supply and to help the quarry meet discharge permits. The surface-water system went on-line the following summer, during one of the worst years in recent history for algae blooms. “Don’t ever put a surface system on-line in July,” Mullen said, recalling the number of phone calls the utility received because of taste-and-odor issues.

However, the surface-water operated well along with the groundwater plant that has been in place since 1976. Within a few years, another major project loomed when the city began a facilities plan. For the water portion of it, Black & Veatch of Bloomington, Minnesota, explored needs and evaluated options. Upgrades for the utility’s chlorine system stood out.

Mullen said the cost of rehabilitating the chlorine room’s ventilation system was “astronomical,” and a new scrubber would be needed, as well. In addition, safety concerns over the possibility of a leak were a major factor in looking at a new means of disinfecting the water. Within a one-mile radius of the water treatment plant are several schools, a daycare facility, a Wal-Mart, and the city center.

Bo Johnston of Black & Veatch Corporation said they compared the costs of using bulk hypochlorite, generating hypochlorite on-site, and putting in a new gas chlorine system with the required HVAC and scrubber upgrades. Bulk hypochlorite was most expensive, with on-site generation also more than chlorine gas. Safety issues swung the decision from chlorine to on-site hypochlorite generation. Three manufacturers submitted bids to the city for an on-site system. Mullen said they looked beyond the lowest bid and evaluated the proposals on a 20-year life-cycle cost. Plant operators Dan Giles and Tony White went to South Dakota to look at utilities using this technology, including the plant on the Missouri River in Vermillion, which treats water for the Lewis & Clark Regional Water System, which is projected to deliver water to Iowa and southwest Minnesota.

Burnsville ultimately selected a MicrOchlor system from Process

“The city became the first water system in the Twin Cities metropolitan area to opt for on-site hypochlorite generation.”

“On-site generation of hypochlorite in the United States was largely inspired by the use of hypochlorite solution during World War I.... Its success as an antiseptic for treatment of open wounds led to on-site generation of it in hospitals.... Wallace & Tiernan (now part of Evoqua Water Technologies) first made electrolytic chlorinators to provide a safe means of chlorinating swimming pools in buildings where people slept.... The chlorinator aroused the interest of Pan American Airways, which, at the time (1936), was establishing refueling sites on its San Francisco-to-Sydney and Orient flights.

“After World War II, the enthusiasm for on-site generation of chlorine disappeared until the hazard potential of chlorine gas stored in containers was evaluated, owing to the proliferation of chlorine gas installations at wastewater and potable water treatment plants.... In the 1970s the popularity of on-site generation began to rise once again, largely because of the potential hazards of liquid-gas systems using chlorine stored in containers.... Starting in the 1990s, after the advent of the Uniform Fire Code, there has been a great surge in the interest of on-site generation of chlorine. The product is inherently safer because of its lower concentration.... Current on-site generation systems produce chlorine solutions containing only 0.8% chlorine, and this concentration is not classified as hazardous.”

Briggeman said more interest in the system was sparked by the terrorist attacks on September 11, 2001. “After the attacks, the risk associated with chlorine gas systems was reevaluated. In addition, with a culture more attuned to risk and safety of operators and surrounding communities, interest in and installation of on-site generation sodium hypochlorite units have seen a significant increase.”
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Questions: Shawn Mulhern, Chair, MN AWWA Water for People, (612) 817-9899
or Chris Voeltz, City of Saint Peter Public Works, (507) 934-0670
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Willingers Golf Club, 6900 Canby Trail, Northfield, MN

When:
Thursday, May 21
Check In:
12:00 PM
Start Time:
12:45 PM

Cost:
$62.50 per person/ $250 per team of 4 (golf and cart only)
(Please note: 4 person scramble, register as a team or we will put you in one)

Online Registration Only:
www.mnawwa.org/event/SpringGolf

Questions:
Chris Voeltz, City of Saint Peter Public Works, (507) 934-0670

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Willingers Golf Club Directions:
From Burnsville, follow I-35 South approximately 15 minutes to Exit 69. Go right (west) on Highway 19 for 1 1/2 miles to Canby Trail. Right on Canby Trail to Willingers Golf Club.
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EMERGENCY TANK REPAIR, PREVENTION AND PREPARATION

By Erika Henderson, Director of Research, Pittsburg Tank & Tower, Inc. www.watertank.com

Drinking water tanks are surrounded by threats daily, but most problems associated with emergency tank repairs can be prevented. Extra time and maintenance may be needed to ensure the tank is protected, and water operators should have an effective plan to restore water services if a tank emergency does occur.

Most problems that lead to emergency tank repairs can be prevented with proper maintenance and regular inspections. Obtaining accurate information and saving the documentation of every inspection and repair can enable a deeper level of understanding about the tank’s history. The knowledge gained from its history can then be used to help create a more effective strategy in preventing and limiting future tank repairs.

Harsh winter weather often increases the risk for tank damage and emergency repairs. Last winter, several drinking water tanks nationwide experienced damage, leaks, and failures. A Minnesota tank froze twice over the winter because of the prolonged deep freeze. And, according to The Old Farmer’s Almanac for 2014-2015, “this winter will be another Arctic blast with above-normal snowfall throughout much of the nation.” Therefore, measures should be taken now to protect the tanks and help prevent damage that could be caused by snow, ice and freezing temperatures.

Drinking water tanks are more susceptible to freeze during nighttime hours when water demand and turnover rate is low. Moving water is less prone to freezing, so keeping the turnover rate high or adding a mixing system can help. The National Fire Protection Association (NFPA) recommends maintaining the water temperature at or above 42°F to prevent tank freezing, and the water temperature can be monitored by installing a low-water temperature alarm. But, to maintain appropriate temperature, heating may be necessary. Insulation and standby electric heaters can be used for systems not already set up for steam or hot water.

All heater pipes, heating elements and temperature alarms should be tested, inspected and replaced as needed before the heating season.
begins and monthly thereafter, or malfunctions are likely to occur. For example, the heater in a wooden Chicago water tank malfunctioned in March and the water inside froze solid. The tank’s structural integrity was compromised and the tank had to be dismantled later that month. Changes in temperature can cause pipes to expand and contract, making them vulnerable to breaks and leaks. Therefore, all pipes subjected to freezing or temperature change should be protected with insulation and heat tracing. The pipes inside small dry risers of elevated water tanks should also be insulated to prevent the inlet and outlet pipes from freezing. In January, a water pipe broke underneath the foundation of a Minnesota water tower and nearly 500,000 gallons of water was drained from the tank in a mere 30 minutes.

Pipe connections and expansion joint connections should be monitored closely for leaks. Leaks hidden behind insulation can be difficult to locate, and insulation should be inspected and replaced as needed to reveal any hidden defects. The American Water Works Association (AWWA), NFPA and Occupational Safety & Health Association (OSHA) have devised a system of codes and standards that contain several recommendations on pipe inspections and a suggested timetable for inspecting each type of pipe. Pumps, altitude valves, and overflow pipes should be checked before winter to prevent malfunctions. An overflow to grade may freeze solid if screens are plugged or flap valves are stuck, and vents can become clogged with ice and snow if they are not vacuum pressured and frost proof. Pumps or altitude valves that fail to shut off during tank filling can cause the tank to overflow. AWWA states, “A properly operated tank should not overflow during normal operation. An overflowing tank is considered an emergency condition and the malfunction causing the overflow should be determined and corrected as soon
as possible," AWWA does not recommend the use of an internal overflow, because if an overflow failure occurs it could go unnoticed and empty the tank\(^6\). This past winter, five water distribution pumps in Arkansas froze overnight, leaving the city’s above-ground storage tanks empty. Without water, the city’s fire hydrants became useless and firefighters were left with nothing but the water on their trucks\(^6\).

All valves, pipes, controls, alarms, and liquid level indicators must be in proper working order for adequate water to be available. Failure of any component could have dire consequences, and all components may need to be inspected daily during extreme weather for signs of frozen, cracked or damaged areas. Sometimes, despite all measures taken, emergency repairs may still be needed. Therefore, effective strategies must be devised for a quick response and recovery. An established relationship with a dependable and experienced tank professional, already familiar with the tank, can be extremely useful. The selected full-service tank company should be educated, certified and have received the proper safety training necessary to perform tank inspections, repairs and modifications. They should be available 365 day a year to answer questions, address concerns, and be flexible enough in their scheduling to make emergency repairs when needed. For more information on emergency tank repairs, contact the author or Don Johnston at djohnston@watertank.com 270-826-9000.

End notes

• WELL SITING STUDIES
• WELL AND WELL HOUSES
• WATER AND WASTE WATER TREATMENT
• WATER STORAGE FACILITIES
• LIFT STATIONS AND FORCEMAINS
• BOOSTER STATIONS
What is PRESSURE MANAGEMENT?

By W. Scott Jamieson, Operations Engineering, Business Performance – Field Services, Water Services, City of Calgary

In this time of ever increasing demands on the environment we are always looking for a better way of doing things. A water loss control program has long been one of the tools to maximize our use of water and be responsible environmental stewards.

The traditional approach to water loss control has used three techniques: active leakage control, pipeline and asset management, and speed and quality of repair.

Briefly, active leakage control is largely done through a program of leak surveying – going out and looking for leaks. A typical tool for this work is a leak noise correlator (often just called a “correlator”). This works best on metallic pipe but has significant limitations on plastic pipe.

Asset management looks at the condition of the pipes and the need to renew failing pipes. This often manifests itself as a main renewal program.

The speed and quality of repair is the most intuitive aspect of a water loss program. The faster we can find a leak and repair it the less water we lose.

Another approach that has been gaining attention looks at controlling the amount of water lost through the leaks. Called “pressure management,” it attempts to reduce the amount of water that is lost through the leaks in the pipe that are not found or are not economically feasible to repair.

It is based on the physical behaviour of water through a hole. The higher the pressure the more water flows through the hole. With pressure management we attempt to manipulate the pressure to minimize the water flowing through the holes in the pipe.

There are three basic approaches to pressure management: (1) lowest constant pressure, (2) time of day pressure settings, and (3) pressure modulation.

Image from Economic Level of Leakage 2008 & Real Loss Reduction Strategies report by Veritec Consulting to the City of Calgary.
What we are looking for
With the growing knowledge of pressure management the City undertook a study with a consultant to see how pressure management would work in Calgary. One of the complicating aspects of the city’s water distribution system is its complexity. We want to know if we can obtain a benefit from active pressure management in our distribution system.

What we did
With the help Veritec Consulting two zones were selected for a pressure management study. All three pressure management techniques were used over a period of 12 months. The zones were isolated from the rest of the distribution system through pressure reducing valve chambers (PRVs) that provided the control points for adjusting and measuring the pressure and flow. A programmable controller was part of the equipment and the data was collected remotely. Residents in the study areas were notified with a mail out, letting them know what was happening.

What results we obtained
The data collected remotely via a modem system included a set of base line data was collected along with measures of each pressure management technique. Initially it was projected that one percent of the total water flow could be saved. Actual flow volumes showed that number to be between 4% and 7%. These results were very encouraging.

Next steps
With such promising results it is tempting to jump in and implement these measures, but as is often the case it is not that simple. There is a significant capital cost associated with setting up the controls and communicating with the controllers. With additional equipment come additional maintenance costs. These have yet to be evaluated to determine they make economic sense.

Additionally, there is also a social cost. Many residents like high pressure in their water system. Also there are some additional systems that were built based on the existing pressure in the water distribution pipes, systems such as fire sprinklers in commercial buildings and lawn irrigation systems. Concerns about these systems and how to ensure they all work still need to be addressed.

The potential is there; we just need to lead in the right direction.

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Introduction
The Navy has increasingly understood that the water distribution system is a dynamic environment. As a biological and chemical reactor, water tank location and geometry are the primary factors in determining water residence times and mixing characteristics for the entire distribution system. Because the industrial fire demands are significantly higher than many municipalities, the distribution systems can be generally oversized with respect to pipe size and available reservoir storage capacity. This article details how Navy water system dynamics vary from municipal systems and how these operational challenges have been overcome.

Background of Problem
Military installation distribution systems have unique characteristics that degrade water quality when compared to municipal distribution systems. These systems can experience poor water quality due to the following circumstances:

- Sporadic land development creates long runs of pipe with relatively low water usage.
- Explosive arc requirements for ordnance areas further isolate buildings.
- Decreasing military populations decrease water consumption while fire demand storage requirements remain intact.
- Distribution systems contain significant sections of unlined cast iron with possible biofilm implications (Figure 1).
- Fire protection requirements for nonresidential facilities have frequently resulted in oversized pipes in terms of domestic consumption.
- Storage tanks were initially constructed for fire protection had little thought given for finished water quality.
- Elevated towers have a flat hydraulic grade lines as naval installations are frequently located in relatively flat coastal areas.
- Variable ship berthing movements create dynamic or rolling demands (Figure 2).

In 2009, President Obama signed Executive Order 13514, which set energy sustainability goals for government buildings and vehicles. The Federal Government occupies 500,000 buildings, operates 600,000 vehicles, and employs more than 1.8 million civilians. Leading by example, the order mandates reductions in greenhouse gas emissions, fuel petroleum usage, energy consumption, and the implementation of more efficient

**Figure 1**
Typical cast iron pipe tuberculation

**Figure 2**
Frequent ship berthing movements create highly variable water demand
building designs. In particular, the Navy has targeted and met a 26% reduction in water consumption based on an overall 2007 baseline. The Navy has already met these reduction goals, yet it only further complicates the water quality dynamics by increasing water age.

**Corrective Actions**
The Navy realized that a complete array of options was necessary to deal with each individual installation. As such, the Navy has incorporated a multiple option strategy for each installation:

- Hydraulic analysis and review of fire protection criteria to justify the demolition of redundant water tanks.
- Retrofit devices and piping configurations of reservoirs to promote more complete mixing.
- Specialty altitude valves to force tank turnover.
- Conversion of high fire demand areas into non-potable water grids.
- Securing more municipal water feeds to diminish military requirements for storage.

**Fire Flow Criteria & Fluctuating Domestic Demand Patterns**
As in the case of any municipality, the Navy is responsible for utility operation and maintenance. For fire protection, the Navy follows Unified Field Criteria (UFC) guidance which mirrors the current National Fire Protection Association (NFPA) criteria. With many sprinklered facilities in an industrial storage setting, it is not unusual to have multiple facilities with sprinkler demands over 2500 gpm for 120 minutes. UFC 3-230-01A “Water Supply, Distribution & Transmission” requires available storage to be:

\[
\text{Storage} = \frac{1}{2} \text{Average Daily Demand} + \text{Worst Case Fire}
\]

With sporadic development and blast arc requirements, distribution systems are frequently segmented into isolated zones which are unable to share storage capacity (Figure 3). As a result, multiple reservoirs become necessary to serve independent water system within the same military installation.

These factors tend to make military installations top-heavy with respect to storage requirements. In the Hampton Roads region, the Navy manages each system with the general premise of maintaining a residence time of less than five days. Table 1 illustrates the variability of each base with respect to managing water age.

Many military installations still operate steam plants to provide for ship and heating purposes. As such, the daily peak water demands usually occur in wintertime. In the summertime, water usage is lower when distribution disinfectant residuals can be more problematic to maintain. Decreasing summertime residuals typically follow the same pattern as the surrounding municipalities (Figure 4).

**Corrective Actions and Strategies**

**GROUND LEVEL RESERVOIRS**
During tank renovations, engineers evaluate the tank to provide as much mixing as practicable during the filling operation. Common pipes which serve as the tank inlet and outlet are always reconfigured.

Figure 5 illustrates a 1 MG ground level reservoir located at Little Creek Joint Expeditionary Base (JEB). The tank fill line discharges above the water level and the bottom suction line feeds the station pumps. Other measures to promote mixing are discussed in subsequent sections. Reducing the tank fill levels in response to lower distribution demands also provides some flexibility in minimizing water age. Figure 6 illustrates the

<table>
<thead>
<tr>
<th>Base</th>
<th>Ratio of Storage Capacity: Average Daily Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norfolk Naval Base</td>
<td>1.1</td>
</tr>
<tr>
<td>Little Creek Joint Expeditionary Base</td>
<td>3.5</td>
</tr>
<tr>
<td>Yorktown Naval Weapons Station</td>
<td>2.8</td>
</tr>
<tr>
<td>Oceana Naval Air Station</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Table 1: Storage Capacity Ratios for Hampton Roads Naval Installations

![Figure 3](image3.png)

Isolated fire hydrant in munitions storage Area

![Figure 4](image4.png)

Typical Seasonal Variation of Distribution Chloramine Readings

![Figure 5](image5.png)

Ground level reservoir with top fill and bottom suction
Seasonal Variations in Adjusted Tank Fill Levels

Rectangular shaped reservoirs can provide challenges to water mixing.

different tank fill levels selected during the winter and summer seasons. Because there is no significant steam production in summer, the average daily water demand diminishes which justifies reducing available storage by 400,000 gallons.

At the main booster pump station, a graphic user interface allows the operator to set the tank levels by controlling when the altitude valve opens and closes. Electronically controlled solenoid valves activate the pilot valves to commence filling.

At Norfolk Naval Station, the reservoir inlet and outlet were located in a small interior sump area less than 500 ft². As a relatively long and narrow rectangular basin with an overall length of 225 feet, the back two-thirds of the reservoir remained highly stratified and did not mix adequately (Figure 7). During a renovation, engineers designed two pump suction lines to extend 200 feet to the back ends of the reservoir to create a “tank tread” rollover mixing effect. An online chloramine analyzer confirms that mixing is sufficient.

BOOSTER PUMP STATION OPERATION

Figure 8 is a pressure data logger plot of the main booster pump station located at the Little Creek JEB. Three elevated water tanks anchor the hydraulic grade line at 135 feet TDH. However, water age could exceed one week unless the system is manipulated to induce elevated tank turnover. The main booster station operates with pressure switches to activate pumps to boost system pressure and fill the elevated towers completely. When the pumps cycle off, the tanks feed the distribution system until the tank levels approach the bottom of the bowls. The pumps then repeat the fill sequence. Because of the available ground level storage, backup diesel generators, and existing municipal bypasses, firefighting capability is not compromised. Figure 8

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Older Tanks can frequently be situated below the current HGL, confirming that the tanks exchange their bowl volumes approximately three times daily to minimize residence time.

CYCLING ELEVATED TANKS BELOW THE HYDRAULIC GRADE LINE

Older installations constructed during World War II experienced water distribution pressures typically around 40 psi. As incoming municipal supply pressures increased, the elevated water towers frequently become hydraulically locked out of the system. These tanks do not exchange water with the system unless a water main break or a fire-fighting scenario occurs (Figure 9).

As a simple solution at Yorktown Naval Weapons Station, the field engineer installed an altitude valve with a delayed opening feature. An additional pilot valve allows the tank level to drop 15 feet before the valve reopens to fill the tank (Figure 10).

To force water from the tank into the distribution, a small jockey pump operated...
by a timer simulates a water demand and lowers the tank levels (Figure 11). Once the water level drops by 15 feet by the action of the jockey pump, the altitude valve then reopens to fill the tower.

RESIZING EXISTING GROUND LEVEL RESERVOIRS
Sometimes an existing ground level reservoir can be downsized for new hydraulic demands. At Newport Naval Station, engineers reduced a reservoir from 1.0 MG capacity down to 0.35 MG capacity. Figure 12 depicts the new pump station installed directly upon what was previously the reservoir interior floor. Figure 13 shows a view of a fluted roof support column which previously was located inside the reservoir structure itself.

MIXERS TO REDUCE TANK STRATIFICATION
The Navy uses multiple products to promote interior tank mixing without endorsing any specific product or company. Quiescent or turbulent mixing, spray aeration, and multiple inlet piping designs all have their applicability. Variable temperature readings indicate whether tank stratification is occurring. A sample temperature profile (Table 2) at Little Creek JEB verifies this mixing system is performing as intended.

CONVERSION TO NON-POTABLE GRIDS & DUAL WATER SYSTEMS
Where fire flow requirements far outweigh any domestic demand, establishing a non-potable fire protection grid works...
“The Navy has successfully dealt with these challenges by using multiple design and operational approaches to manage their systems.”

Table 2: Sample Temperature Readings at Little Creek JEB Reservoirs

<table>
<thead>
<tr>
<th>Water Temperatures at Various Depths</th>
<th>Surface</th>
<th>1 m</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Level Reservoir</td>
<td>18.3°C</td>
<td>18.3°C</td>
<td>18.3°C</td>
<td>18.3°C</td>
</tr>
<tr>
<td>Elevated Water</td>
<td>17.1°C</td>
<td>17.2°C</td>
<td>17.2°C</td>
<td>17.2°C</td>
</tr>
</tbody>
</table>

very well for maintaining water quality. At an isolated ammunition storage area located at Norfolk Naval Station (Figure 14), water quality suffered with respect to decreased disinfectant residuals, increased disinfectant byproduct levels, and chronic red water complaints. A 20,000-foot distribution system served less than 25 people, and weekly hydrant flushing schedules consumed manpower without significantly improving the water quality.

For this scenario, the field engineer designed a new right-sized domestic water system for consumption and building needs. The entire system was less than 10 percent the size of the existing grid. To provide fire protection, the original distribution grid was converted to a non-potable firefighting grid isolated by new reduced pressure zone (RPZ) backflow preventers at the incoming mains. Flushing program volumes dropped by 50,000 gallons per week, and water quality became a non-issue as evidenced by bacteriological and Stage 2 DBP sampling.

Conclusions

Each water distribution system provides opportunities for water quality improvement. Individual systems require different approaches based on tank geometry and location, hydraulic demand patterns, firefighting requirements, and the general building development densities. Naval installations have unique characteristics that degrade water quality when compared to municipal distribution systems. However, the Navy has successfully dealt with these challenges by using multiple design and operational approaches to manage their systems. While not discussed in this paper, the Navy also vigorously promotes knowledge sharing among the installation commands so that operational practices do not get cubby-holed away from other installations.

*All photos are US Navy, released.*
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Paper-Based Sensors for detection of Cyanobacteria and their toxins in water samples

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Abstract
Occurrence of cyanobacteria and their toxins is a worldwide phenomenon. Cyanotoxins such as microcystins and noludrin are deadly to animals and humans at low levels of exposure and need to be monitored effectively to ensure safety of consumers.

In this article, use of surface enhanced Raman spectroscopy (SERS) is proposed for detection and characterization of cyanobacteria and their toxins. SERS has emerged as one of the most promising analytical technique in the past decade; and is particularly well suited for environmental analyses due to high sensitivity, specificity, ease of operation and rapidity. Detection and characterization of environmental contaminants, through SERS highly depends on uniformity, SERS activity and reproducibility of its substrates. Therefore, in this article, use and development of paper based substrates (also called paper based microfluidic devices) will be discussed.

Introduction
Consumers today demand drinking water that looks, smells and tastes good, as the presence of unpleasant taste and odor in water create a perception of unsafe drinking water [1]. The major sources of taste and odor problems in municipal water supplies are certain type of blue-green algae (cyanobacteria) and actinomycetes [1].

Cyanobacteria are ubiquitous and found worldwide, especially in calm, high nutrient water sources, especially in summer [2, 3]. According to a study in 2009, water bodies of at least 50 countries were infested by cyanotoxins poisoning [4]. Even in the United States, at least 36 states were implicated in illness and death of animals and human associated with cyanobacteria [4]. Furthermore, according to a World Health Organization (WHO) report in 1999, cyanobacteria and their toxins are responsible for animal poisoning and adverse human health impacts in Klamath River, Eel River, Clear Lake, Pinto Lake, and various parts of northern California’s water sources [5].

People may be exposed to cyanobacterial toxins by drinking or bathing in contaminated water. The most frequent and serious health effects are caused by drinking water containing the toxins (from cyanobacteria), or by ingestion during recreational water contact [6]. Based on the type of cyanobacteria and level of exposure, their toxins may cause nerve and liver damage [7]. Microcystis aeruginosa releases toxins called Microcystin which may cause liver failure and promote tumor growth at low level of exposure [8].

According to the WHO guidelines, the acceptable limit for the toxin Microcystin-LR (a natural occurring toxin produced by cyanobacteria, MC-LR) in drinking water is 1 µg/L [8]. Although due to excessive human demand on water resources, amount of toxins usually exceed this limit. The US EPA considered these cyanotoxins

“The most frequent and serious health effects are caused by drinking water containing the toxins (from cyanobacteria), or by ingestion during recreational water contact.”
Paper-Based Sensors for Detection of Cyanobacteria and Their Toxins in Water Samples

in contaminant candidate list 3 (CCL3) and has prepared draft documentation on toxicological review and guidelines for many cyanobacterial toxins such as anatoxin-a, cylindrospermin, and microcystins (MC-LR, MC-LA, MC-YR and MC-RR). Hence, there is a dire demand to monitor these algae and their toxins in drinking water resources.

Current methods for detection of cyanobacteria and their toxins

The existing methods for cyanobacterial detection are chlorophyll counts, microscopic identification, fluorescence monitoring, mass spectroscopy, and gas chromatography. US EPA proposed a multistep method to monitor cyanobacteria and their toxins in water samples (Figure 1). This proposed method has multiple stages and requires expertise. Also, these methods are time-consuming, complex, and require expert trainings. Furthermore, these methods can’t distinguish among non-toxic algae to toxic cyanobacteria.

Raman spectroscopy for cyanobacteria detection

In an effort to distinguish toxic from non-toxic Microcystis, Halvorson R.A. et al., collected normal Raman spectra of several strains of Microcystis aeruginosa and the common green algae Pseudokirchneriella subcapitata (Figure 2). The preliminary data shows distinct differences in the Raman spectra (as noted by the black arrows) of the green algae and the cyanobacteria. Most importantly, it shows the readily apparent differences in the spectra of the toxic and non-toxic strains. This observation indicates that a Raman spectroscopy based approach to detect and differentiate cyanobacteria is potentially feasible and merits further study.

Theoretically, normal Raman spectroscopy can detect and characterize every polarizable molecules. However, its applications to detect cyanobacteria or environmental analytes are mostly limited by its ability to produce very low signals intensity, which make it extremely difficult to detect target analytes. Therefore, researchers have been exploring microfluidics, fluorescence methods of probing, biosensors, and surface enhanced Raman spectroscopy for environmental analyses. Among these novel techniques, surface enhanced Raman spectroscopy (SERS) is most favorable method for environmental analyses mainly due to its ability to provide unique fingerprints for specific analytes with high selectivity, sensitivity, and rapidity.

Surface Enhanced Raman spectroscopy (SERS)

SERS is a powerful vibrational spectroscopy technique that overcomes limitations of traditional Raman spectroscopy and allows for highly sensitive structural detection of low concentration analytes through the...
Paper-Based Sensors for Detection of Cyanobacteria and Their Toxins in Water Samples

amplification of electromagnetic fields generated by the excitation of localized surface plasmons \[^{15-19}\].

In comparison with other analytical techniques, SERS has outstanding advantages. These advantages are summarized in Table 1.

Because of the properties listed in Table 1, SERS field has dramatically progressed from the originally observed enhancement on roughened silver electrode to the current fields of sensing and image applications, single and simultaneous molecules detection \[^{15-18}\]. It is a novel, reliable, economical, highly surface selective and ultrasensitive method to qualitatively identify and quantitatively analyze aqueous and airborne contaminants, cyanobacteria and other pathogens \[^{15}\].

However, whether, SERS can achieve above these applications really depends on its substrates activity and reproducibility of substrates \[^{20}\]. SERS substrates can be made by following four methods: (1) electrochemical oxidation and reduction cycles (EC-ORC) or Vacuum deposition, (2) nanoparticles sols by wet chemical synthesis, (3) nanoparticles with controlled size, and (4) large-area surface nanostructures with defined size, shape and interparticle distance by self-assembly or lithography methods \[^{20}\].

SERS substrates made of roughened noble metal (Au, Ag) surfaces are used to get signal enhancement factors ranging from \(1 \times 10^4\) to \(1 \times 10^{10}\) \[^{15, 21}\]. SERS substrates fabricated from top-down and bottom-up approaches such as e-beam lithography and colloidal lithography can achieve high enhancement factors (>\(10^9\)) \[^{20}\]. With high signal enhancements from SERS substrates, it will be possible to detect and identify various environmental contaminants including cyanobacteria and their toxins.

An ideal SERS substrate should have high SERS activity, suitable reproducibility (less than 20%), good stability and uniformity (deviation less than 20%). Thus providing high sensitivity which can be controlled by varying the size (more than 50 nm) and interparticle spacing (less than 10 nm) of nanoparticles \[^{20, 22}\].

With high signal enhancements from SERS substrates, it will be possible to detect and identify various environmental contaminants including cyanobacteria and their toxins.
Paper-Based Sensors for Detection of Cyanobacteria and Their Toxins in Water Samples

Unfortunately, at present, it is still difficult to obtain ideal SERS substrates which can simultaneously meet all of the above requirements [20, 22]. Conventional SERS substrates based on silicon, glass, and porous alumina are not compatible for analysis of trace amount of analytes because of their nonconformal, rigid and brittle nature [18, 23, 24]. Therefore, researchers are fabricating paper based microfluidic substrates for potential detection of cyanobacteria and other environmental contaminants [23, 25-28].

Microfluidic paper based sensors for SERS applications

Paper is abundant, inexpensive, and its structure and porosity can be modified easily [18, 29, 30]. Microfluidic paper based devices (µPADs) provide a novel system for fluid handling and fluid analysis for a variety of applications including health diagnostics and environmental applications [31]. Paper based device transports liquids using capillary forces without requirement of any external forces [32]. There are various techniques to fabricate the paper based microfluidic device such as ink jet etching, wax printing, plasma treatment, screen printing and laser printing [33].

Wax printing is very promising in producing hydrophobic and probing zone in paper. µPADs (prepared by wax printing) employ hydrophobic barriers printed on cellulose paper to direct the flow of a sample from a sample spotting zone to a detection zone where analytes concentrations are probed.

These paper based sensors prepared (Figure 3) are used to estimate the signal enhancement with respect to normal Raman. One of the cases where detection of microcystin-RR (MC-RR) was performed, observed signals higher than normal Raman spectroscopy as shown in Figure 4. These significant enhancements produced clear and distinguish peaks of MC-RR. This analysis showed that SERS has a great potential to distinguish and detect cyanobacteria in water samples.

Summary

Surface enhanced Raman spectroscopy has great potential to detect cyanobacteria and their toxins. Use of paper based

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Figure 4 Use of paper-based sensors for microcystins-RR detection using SERS. Observed signal intensity of SERS signals (in red) were higher than normal Raman signal (in blue).[11]

sensors for this purpose will provide a rapid, inexpensive, and reliable detection protocol to allow water bodies to be regularly monitored for cyanobacteria and their toxins. Such a detection method with capabilities for detecting analytes across multiple contaminant classes would be immensely useful for protecting human health from drinking water threats.

Development of these paper based sensors may hold great hope for the environmental analyses in the future. This study could be the milestone to monitor cyanobacteria and cyanotoxins for regulating agencies such as CDC and EPA. It will be useful in development of an effective guideline for various cyanotoxins and other contaminants.

Acknowledgements
I would like to offer many thanks to Prof. Peter Vikesland (Virginia Tech, Blacksburg) for providing an opportunity to develop paper-based sensors in his lab. I also appreciate help from Dr. Weinan Leng, Dr. Rebecca Halvorson Lahr, and Marjorie Willner for providing figures and data for this article.

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Valve Maintenance

Maintain Valves and Keep Control of Your Distribution System

A valve maintenance program is a proactive way to ensure distribution system reliability and helps avoid the need to limit damages and downtime during emergency shutdowns.

By Owen Keenan

Owen Keenan, PE, is a project engineer with ME Simpson Co. (www.mesimpson.com), Valparaiso, Ind.

Water Utilities know they have a responsibility to supply their customers with quality water at an adequate pressure in the quantities necessary for residential, commercial, and industrial use as well as for fire protection. Scheduled and emergency water service outages are operations common to all water utilities and should be as short and infrequent as possible. Therefore, all water utilities need to maintain control of their distribution systems by maintaining their valves.

Solving Common Valve Problems

Most valves are installed at selected locations in a distribution system to minimize the number of customers who will be inconvenienced by having their water out of service while repairs are being made. Water utilities face many valve-related problems in their distribution systems, including the following:

• There are no records of the valve.
• The valve box or lid is paved over or buried.
• The valve box is visible but full of debris, so the valve operator is not accessible.
• The metal frame and lid on the valve vault is not aligned with the valve operator, so the valve key cannot be used outside the confined space.
• The lid on the valve vault was switched to an open sewer lid, and road salts have been deposited onto the valve.
• The valve is inoperable due to lack of use.
• The valve’s size is unknown.
• The number of turns to open/close the valve is unknown.
• The direction to open/close the valve is unknown.
• Reduced flow, pressure, and fire protection often stems from ‘unknown’ closed or throttled valves.

Establishing a Valve Program

To maintain distribution system control, a water utility should have a valve program to resolve these common problems. At the very least, a water utility should have a valve database and map system, often a geographic information system (GIS), that is easy to use and update. Field crews should create and use a valve report form that lists all information needed, along with space to draw a sketch, to update the valve database and map system.

Complete a Valve Report

A field crew should complete a valve report for each valve inspection and should have space to include the following:

• List every valve’s location in a consistent manner (e.g., north-south and east-west references from the centerline of streets, property lines, curb lines, etc.). GIS locations are desirable. Assign a number to each valve if applicable.
• Indicate the size and manufacturer of each valve.
• Indicate the number of turns and direction to open and close each valve. Note if valve repairs are needed (e.g., the operator nut is rounded and should be replaced). Use the valve report as a work order to get the repair scheduled.
“Valves are capital assets that a water utility must maintain and protect to control its distribution system.”

- Note any unique features of the valve (e.g., a 48-in. horizontal gate valve with also a 6-in. bypass valve located 8 feet south of the main valve operator).
- Make a graphic sketch on the form so water maps and/or computer-aided design (CAD) drawings can be updated.

Work the plan
A water utility must commit to an action plan regarding its valve program – then stick to it.
1. Gather all the data available, including base maps, valve records, etc. Also, talk to those with the longest knowledge of the distribution system in question.
2. Determine the operations sequence. It does not matter if you start with the oldest valves first or the largest valves first and then work toward smaller valves. However, it is important to decide on and stick to your plan.
3. Identify critical customers, including hospitals, schools, and high water users such as factories.
4. Notify all customers when working in their areas.
5. Prepare for problems. For example, if a neighborhood doesn’t have water, there must be a closed valve somewhere.

Inspect each valve
To properly inspect and operate a valve, follow these steps:
1. Each crew member should wear safety equipment such as, but not limited to, hard hats, safety vests, and safety shoes. Traffic control should be set up before the valve box/lid is opened.
2. After the valve key is placed on the operator, begin with a steady amount of torque in the direction necessary to close the valve, moving through 5 to 10 rotations.
3. Reverse for 2 or 3 rotations.
4. Reverse again and rotate 5 to 10 more turns in the closing direction.
5. Repeat this procedure until full closure is attained.
6. Once the valve is fully closed, it should be opened a few turns so high-velocity water flowing under the gates can move the remainder of the sediment downstream with more force and clear the bottom part of the valve body for seating.
7. Fully close the valve again.
8. Reopen the valve fully, and then close 1 to 2 turns so the valve does not bind.

If it is necessary for a crew member to enter a valve vault to operate a valve, all prevailing rules and regulations regarding entry into a confined-space should be followed.

Additional safety equipment such as air monitors, harnesses, tripods, etc., must be onsite and used.

Locate lost valves
Use the following four-step method to locate lost valves:
1. Perform a visual search, and then use a metal detector to search for the valve box/lid in the field.
2. Locate the water main, and then use a metal detector to search along the water main for the valve box/lid.
3. Return to the office, study the maps and plans, and question the “old timers.”
4. Go back to the field with the additional information, and repeat the line location and metal detector search work.

Keep a list of corrections for water maps and/or CAD drawings. Also keep a list of recommended valve repairs/replacements for scheduling. Documentation is essential to a successful valve program.

The consequences of not having an ongoing valve program include the following:
- Time lost and additional cost spent on finding valves that do not operate during an emergency shutdown
- Extended loss of service to customers
- Decreased pressure and flow to customers
- Diminished fire protection capacity
- Increased cost of break damage and claims
- Negative public relations
- Premature valve failure
- Repairs made reactively instead of proactively
- Lack of control over the distribution system

Valves are capital assets that a water utility must maintain and protect to control its distribution system. It is important to survey the valve system and locate all known valves, and then create detailed valve reports to identify, document, and address key problems to maintain optimal system performance.

RESOURCES
When fully open, gate valves provide almost unrestricted flow because the gates are pulled fully up into the bonnet.

**GATE VALVES**

Gate valves are the most common distribution system valve type. Hydraulically, a gate valve is often the preferred valve because the gate or disk is raised and lowered by a screw, which is operated by a valve key. When fully opened, gate valves provide almost unrestricted flow because the gates are pulled fully up into the bonnet. When closed, the gate will seat against the two faces of the valve body and close tightly. For underground locations, iron-body nonrising-stem gate valves are preferred because the valve stem itself rotates but does not move up or down. The screw mechanism is located within the valve body, so valves can be directly buried.

In locations where a valve is not buried, such as treatment plants and pumping stations, a rising-stem valve with an outside screw and yoke can be used. These valves can be manufactured with a wheel for operation. These valves cannot be buried.

In the past, when water main diameters were 16 in. or larger, it was common to install horizontal gate valves. The mechanism of a horizontal gate valve does not have to lift the weight of the gate to open the valve. Such valves were installed when a large water main was not buried deeply, and a vertical valve would extend above ground level. Horizontal thrust against the disk of a closed gate valve increases with valve size. Many horizontal gate valves have a bypass valve that is opened before the main valve operator, because thrust on only one side of the gate could cause the gate to bind. Opening the bypass will allow pressure on both sides of the gate and reduce the risk of binding and breakage.

**BUTTERFLY VALVES**

Nowadays, when a large water main is installed, butterfly valves are usually selected instead of horizontal gate valves primarily because the price is much lower than for an equivalent-sized gate valve. The disk of the butterfly valve rotates on a shaft to open or close the valve, and it remains in the water path, which creates a higher resistance to flow, or head loss, than a gate valve. The disadvantage in higher head losses from a butterfly valve must be considered and compared with the lower initial cost.

However, with increases in butterfly valve diameter, the overall head loss relative to diameter decreases. Butterfly valves are easier to operate because water pressure exists on both sides of the disk. Unfortunately, it is easier to break a butterfly valve because the disk does not enter into a seat. Once a butterfly valve is broken, it is difficult to determine a butterfly disk’s position in the water path. Therefore, butterfly valves should always be operated by hand and never with a valve-exercising machine.
AWWA to Congress: Controlling nutrient pollution key to preventing cyanotoxins in drinking water

February 5, 2015

(DENVER) - In testimony today before the U.S. House Subcommittee on Environment and the Economy, American Water Works Association Water Utility Council Chair Aurel Arndt stressed that the solution to keeping drinking water safe from cyanotoxins begins with better managing nutrient pollution.

The subcommittee hearings are in response to an event in August 2014 when the City of Toledo, Ohio, found the cyanotoxin microcystin in finished water and issued a “do not drink” advisory for more than 400,000 people. The contamination was the result of an algal bloom in Lake Erie.

“We recommend that Congress consider ways to greatly increase the effectiveness of nonpoint source pollution programs, including the question of whether nonpoint sources of pollution should be brought under the jurisdiction of the Clean Water Act,” said Arndt, who is also CEO of Lehigh County Authority in Allentown, Pa.

Speaking on behalf of AWWA’s 50,000 water professionals, Arndt noted that cyanotoxin contamination is always associated with excessive amounts of nitrogen and phosphorus in water. According the U.S. Geological Survey, nonpoint sources – predominantly runoff and air deposition – account for 90 percent of the nitrogen and 75 percent of the phosphorus in U.S. waterways.

Arndt commended the U.S. Environmental Protection Agency’s use of the Contaminant Candidate Lists to begin the regulation process of cyanotoxins to protect public health, but he stated that “federal agencies, including EPA and USDA, should use existing authorities to give much higher priority to nutrient reduction projects that protect downstream drinking water supplies and therefore, public health.”

The subcommittee hearing focused on H.R. 212, the Drinking Water Protection Act, a bill introduced by Rep. Bob Latta (R-Ohio). The bill would require EPA to develop a strategic plan for dealing with cyanotoxins within 90 days of the bill’s passage.

The testimony also highlighted the continuous and proactive work AWWA has undertaken to address this issue, including development of materials on protecting against algal blooms, training on protocols for responding to drinking water emergencies, and a creation of a soon-to-be-published cyanotoxins guide for utility managers.

AWWA President John Donahue testified on the same topic in November 2014 in a hearing in front of the U.S. House Subcommittee on Environment and the Economy.

Other witnesses at the hearing were Dr. Peter Grevatt, director of the Office of Ground Water and Drinking Water at EPA; Mike Baker, chief of the Division of Drinking Water and Ground Waters at Ohio EPA; and Kristy Meyer, managing director at the Agricultural, Health, and Clean Water Programs at the Ohio Environmental Council.


AWWA announces historic opening of India office

February 2, 2015

The American Water Works Association announced today that it will establish its first International Community when it opens an office this spring in India.

In comments made during the Indian Water Works Association’s Annual Convention in Kolkata, AWWA CEO David LaFrance said that the newly created AWWAIndia is an important step in achieving the Association’s vision of a “better world through better water.”

“AWWA and the water professionals of India have had a long and proud working relationship, and AWWA is excited about developing its first International Community there,” LaFrance said. “We want to be part of the local community rather than a partner from afar.”

AWWA anticipates introducing AWWAIndia’s first executive manager in the coming months. In addition to opening an office, the executive manager’s initial focus will be on building a community of water professionals who collaborate to support public health, environmental protection and best management practices. AWWAIndia will also develop training for operators and managers.

In addition to attending IWWA’s Annual Convention, LaFrance, AWWA President John Donahue and AWWA Past President Nilaksh Kothari are meeting over the next two weeks with various groups and government entities in India. With an eye toward AWWAIndia’s training mission, they will also host three half-day seminars in New Delhi, Bangalore and Mumbai that will touch on important water issues such as asset management, leak detection and rate issues. •
How to trick yourself into drinking more water every day

http://tinyurl.com/pwo9pro

Lifehacker offers tips that include:

Hide it in your daily routine: Get in the habit of drinking a glass of water right after you get out of the shower or right before you wash your face at night. This is an easy way to add at least two glasses of water a day to your routine.

Get a decent water bottle and mark it with time-oriented goals: You can take your water bottle usage to the next level by coming up with your own timed drinking goals and marking it on the bottle. Get some tape or a label maker and start marking how much water you’d like to drink by a certain time every day. This way you can actually see your water drinking goal and you’ll know whether you need to play catch up or if you’re ahead of the game.

Make it a game: Gamification is an effective way to get yourself to do a lot of things, and drinking water is no exception. Incentivize your new water habit by rewarding yourself when you reach milestones. Go a whole week drinking your goal every day? Treat yourself to something you don’t normally get. It goes both ways too. Forget to drink enough water yesterday? No Netflix or video games until you’ve made up for it.

Set a timer and create mental triggers: If you’re still having a hard time remembering to drink water, set a timer on your phone. Create a few alarms set to go off throughout the day and when one goes off chug a big glass of water....

Part of building a new habit is finding a way to do things without the need of outside help, however, so it’s a good idea to create your own mental triggers. For example, if you start to feel hungry, have a glass of water.

Jazz up your drinking water experience: You might be more inclined to drink water if it was a little more interesting. If that’s the case, there are plenty of ways to go beyond plain, boring H₂O. Some fruit or cucumber in your water adds a little flavor without adding in the sugar you’d find in straight fruit juice. Freeze some lemon slices in ice cubes for an easy water upgrade or try a little ginger and herbs to switch things up a bit. If you’re missing the fizz from your soda, try some sparkling water or club soda. You’ll get the bubbly without the other not-so-great stuff.

Eat your water: Food has water in it, too. It may not have enough for you to only eat your daily intake of water, but there are some foods you can snack on that can help. Fruits and vegetables are a great source of water, and also make for a healthy alternative to chips or candy. Some with the highest water content are cucumbers, lettuce, celery, radishes, tomatoes, bell peppers, cauliflower, watermelon, spinach, strawberries, broccoli, grapefruit, apricots, cherries, grapes, and zucchini.
Membership summit recap

By Mona Cavalcoli

In early February, I attended the AWWA Membership Summit in Denver, Colorado. As is always the case with an AWWA leadership event, I found the experience to be valuable both for the opportunity to gain information and to network and share knowledge and ideas with other Section membership representatives.

The first day of the summit featured a guest speaker named Tom Morrison, who is the Executive Director of a trade association. Tom has been focused on member engagement throughout his career, and shared his expertise in association membership relationships. He was a dynamic speaker, who really focused on practical, useful ideas and resources that we can use to improve member engagement.

Member Engagement. That was truly the take-away message of this Summit. We all talked about the power of how personal involvement and interaction really enhances the membership experience, and how – by making this a focus of our efforts – we can grow the organization in a really positive way.

We learned that the Intermountain Section revamped their Membership Committee to focus solely on Member Engagement. They moved away from specific recruiting tasks and instead applied their efforts to reaching out to members to personally engage them in attending events, joining committees, and responding to outreach. As a result, they have actually seen a 2.5% increase in membership growth – and they believe the results are due to these efforts to engage the membership.

As we go forward this year, we will be working toward the AWWA 2015 Membership Challenge. Here are our goals:

- Achieve a 62% retention first year members (we had 37 new members in 2014 – we need to retain 23 of them)
- Reach a specific year-end membership count: 965

When you look at the above numbers – these are not insurmountable goals by any means. We can do this. I am committed to helping our Membership Committee – and our Section – meet the 2015 challenge. I strongly encourage you all to do the same. Share your story of how you became a member, and of why you find AWWA membership valuable. Tell colleagues about it. Ask someone to join you at a meeting or on a committee. Ask someone to step up and get just a little bit more involved in AWWA. In no time, we will have achieved our 2015 and beyond!
Industry News

Groundwater virus monitoring study

By Lih-in Rezania, Minnesota Department of Health

Outbreaks of waterborne viral illness have been associated with groundwater sources used as drinking water. National surveys show that about 30 percent of drinking-water wells may be contaminated with viruses that can make people sick. But which viruses are actually in Minnesota’s groundwater? In what amounts or concentrations? Are these viruses making Minnesotans sick? These are some of the questions the Minnesota Department of Health (MDH) is attempting to answer through its Groundwater Virus Monitoring Study.

The goal of the study is to refine MDH’s methodology for identifying wells that are at risk to pathogen contamination by linking the presence of viruses in a groundwater source to such factors as well construction, geologic sensitivity, and chemical and biological water quality parameters. A parallel study will evaluate the association between source water virus concentration and community acute gastrointestinal illness incidence rate. The results will be used to develop and improve health-based guidance tools targeting those sources at greatest risk and therefore reduce the public health risk from groundwater drinking water sources while minimizing cost.

Approximately 80 Minnesota year-round public water systems that do not disinfect groundwater were randomly selected and asked to participate in the study. This study began in May 2014 to assess virus occurrence and evaluate modeling tools. A future phase will include sampling or targeted sources to evaluate viruses as a way to assess groundwater contamination. Sample and data collection efforts will center on viruses found in the human intestinal tract, microbes and chemicals that can provide more information about water quality and the possibility of contamination, and information about the well construction.

Reducing acute microbial risk and exposure is a public health priority associated with drinking water. Data from this study will help MDH determine if virus contamination presents a human health risk in Minnesota. Information gathered from the studies will allow us to develop and improve health-based guidance tools to reduce the public-health risk from viruses in groundwater drinking-water sources in Minnesota.

The water utility in Portland, Oregon, has been in the news in recent years, but not for the most savory of reasons. Twice the utility has had to drain a reservoir after someone had been seen urinating in it. However, the city has rebounded with headlines focusing on how it is generating electricity from turbines installed in its water pipes. Portland has replaced a section of its water distribution system with pipes containing 42-inch turbines with power-attached generators. The energy produced is fed back to the city’s electrical grid. The turbines and generators are installed in pipes in which the water doesn’t have to be pumped (pipes where the water flows downhill, for example). Eventually the system may generate more than 2 million dollars worth of renewable energy capacity over 20 years, projected as enough electricity to power to 150 homes.

More information, including a video, is available at http://tinyurl.com/kynz4wk.

Discussion guide for small communities facing water service disruption

Bridget O’Grady of the Association of State Drinking Water Administrators (ASDWA) notes that ASDWA has worked with Region 5 of the U.S. Environmental Protection Agency to create a discussion guide for smaller communities to use if their water service is disrupted. The guide explains how to have such a discussion: who to invite, what types of questions to ask, what types of impacts a lack of service can cause, whether formal presentations or just shirtsleeves discussions are right for a particular group, and whether this discussion could be the first in an ongoing dialog between the water system and its key customers.

“Gone are the days when the assumption was that the ‘government’ (federal or state) will ride to the rescue with all necessary people and resources to take care of all of a community’s problems,” reads the foreword of the guide, which is a resource for communities to plan for the event “that will never happen here.”

More information and a link to the guide is available at http://tinyurl.com/pmw77g9.
Eaton elected Vice President
At the American Water Works Association (AWWA) winter meetings in Santa Fe, New Mexico, Jon Eaton of Minnesota was elected as one of the vice presidents at the association level.

AWWA grew in 2014 to 50,173. The Minnesota Section was a leader with a 1.3 percent increase and had the fifth-best retention rate in the organization.

The Central District is moving its three-day school to Arrowood Resort in Alexandria. In future years, the Central District will combine with the Northwest District for a joint school.

Through November 30, 2014, the Minnesota Section had $467,747.11 in its Wells Fargo account; the amount is a combination of general funds and the section’s endowment. As of October 2014, section income for the year was $353,760, and expenses were $323,749 for a net gain of $30,011. Investments were up since the beginning of 2014 by $11,702 for a total net gain of $41,714.

Jim Sadler and Brian LeMon are leading efforts to commemorate the 100th anniversary of the Minnesota Section at this year’s annual conference.

Bemidji State Student Council Votes to Ban the Sale of Bottled Water
Bemidji State University’s student government unanimously voted to ban the sale of bottled water on campus, becoming the first college in the Minnesota State Colleges and Universities system to do so. Two other Minnesota colleges, Macalester and St. Benedict, have also banned bottled-water sales.

Bemidji State offers non-disposable water bottles at no charge and has bottle-filling stations in its buildings.

Two members of the student senate had proposed the action to foster environmental sustainability and to promote access to free water. A former senate member objected to the action on the grounds it would “infringe on personal liberty by imposing the senators’ environmental beliefs on others.”

Member Update
Bemidji State Student Council

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