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Sent: Fri, 18 Sep 2015 22:12:36 +0000
To: emcdonald@apaienv.com
Cc: daniel.nix@wichitafallstx.gov
Subject: Wichita Falls case study for the EPA supplement on potable reuse
Attachments: A6 WichitaFallsCaseStudy 20150717.docx

Dear Ellen,

It was great to see you in Seattle!

Thank you for being willing to review the Wichita Falls case study that will be included in the EPA potable reuse supplement to the 2012 *Guidelines for Water Reuse*. If you could take a look for central themes that are missing, that would be great. Daniel and I might be able to incorporate some more sections, if needed. Can you remind me who it was that mentioned we needed a case study on Wichita Falls?

By the way, Daniel is working on an article to submit to the Journal for AWWA as well.

Thanks,
Allegra

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A.6 Wichita Falls

River Road WWTP and Cypress WTP Permanent IPR and Emergency DPR Project

Daniel Nix and Russell Schreiber, City of Wichita Falls

Project Facts

Location

Wichita Falls, Texas

Size

DPR: 5 MGD IPR: 16 MGD

Year of Installation

DPR: 2014 IPR: by 2018 TBD

Status

DPR: Operational IPR: Planning Stages

Cost

DPR: \$13 Million IPR: Projected \$33.5 Million

Background

Lake Arrowhead and Lake Kickapoo are the main surface water supplies for the City of Wichita Falls, Texas. During 2013, both lakes were less than 35% full (**Figure A.6-1**) sending Wichita Falls into extreme drought conditions with no readily available water supply solution (Khan, 2013). By May 2014, Wichita Falls declared a Stage 5 drought catastrophe with a total combined reservoir capacity in the region of 20% (TRNS, 2015).

Wichita Falls, however, proactively began investigating wastewater reuse following the drought of 1995-2000 during which they supplemented their drinking water supply with highly saline water from Lake Kemp and Lake Diversion (Dahl, 2014). By using microfiltration (MF) and reverse osmosis (RO), they were able to integrate the treated saline lake water with the existing potable water supply. Wichita Falls Public Works Department was confident they could do the same with municipal wastewater when faced with the most recent drought conditions. In 2012, recognizing the City would be out of water by 2014 without further action, the City drafted a two-phase project plan involving both a

permanent IPR scheme and an emergency temporary DPR scheme.

Conservation efforts

By December 2014, staged water conservation efforts saved up to 6.1 billion gallons of water (about 1.5 years' supply). Stage 5 drought restrictions had lowered the average summer usage by 65%. Nonetheless, conservation alone was insufficient to sustain a reliable drinking water supply (Nix, 2013).

Emergency (short-term) DPR system

The DPR scheme was implemented because drought conditions led to severe and abrupt drinking water needs for the City of Wichita Falls. The emergency DPR project began operating online on July 9, 2014 after only 27 months of design, permitting, and construction duration. The city expects the temporary DPR system to remain in operation for 2 – 2.5 years, at which time the permanent IPR system will come online.

A unique context in Wichita Falls was that the city already had an MF/RO plant that treated the Lake Kemp water. This MF/RO system was scheduled to be taken offline because Lake Kemp water had become brackish due to evaporation and reduced recharge (going from the normal 2500 ppm TDS to 8000 ppm TDS). The Lake Kemp MF/RO system could not successfully treat this higher TDS water. Reusing the facility kept costs and time down because design and construction of a new membrane plant was not needed.

The DPR system transfers treated effluent from River Road WWTP to Cypress WTP through 13 miles of pipe that were laid in 3 months – all above ground. The pipeline was sized for the future permanent IPR system and will be reused. By laying the pipeline through the city's flood control channels, the city did not face any right of way issues.

At the Cypress WTP, the treated effluent is further purified through MF, RO, and UV disinfection. The RO permeate is then blended at a 1:1 ratio with raw, untreated Lake Arrowhead water, and subsequently treated at a conventional WTP, followed by holding in an engineered storage buffer for 24 hours before being sent to the distribution system. The process creates an additional 5 MGD (up to 50% of daily demand) of municipal drinking water. 2.5 MGD of brine from the MF and RO processes is discharged to the Big Wichita River under the existing discharge permit that was acquired for the Lake Kemp operation (Nix, 2013).

Permanent (long-term) IPR system

The IPR project will utilize the existing 13-mile pipeline constructed for the DPR project to complete the 15-mile pipeline from River Road WWTP to Lake Arrowhead. The City has received a new discharge permit from TCEQ for the permanent IPR installation. The IPR project will ultimately pipe up to 16 MGD of highly purified effluent from River Road WWTP back to Lake Arrowhead, which will serve as an environmental buffer, before the water is treated at the city's conventional WTPs and distributed to customers. River Road WWTP will be retrofitted with a new phosphorous reduction process, tertiary filtration processes and a new pump station using loan money to fund the upgrades (Ingle, 2014).

Treatment Process

DPR

WWTP → Pipeline (including chloramine disinfectant down the pipeline) → WTP (MF→RO →UV) → Holding Lagoon (Engineered Storage Buffer) → Blending 50-50 → Conventional WTP (Chlorine dioxide pre-disinfection, chloramine primary disinfection, coagulation, lime, sedimentation, gravity media filtration, fluoridation, chloramine terminal disinfection) → Storage (engineered storage buffer) (**Figure A.6-3**)

IPR

River Road WWTP (upgrades will include chemical phosphorus reduction with filters and new re-aeration) → Effluent Pump station and pipeline → Lake Arrowhead (environmental storage buffer) → Conventional WTP

Collaboration between TCEQ and City

Although there are no IPR or DPR regulations currently implemented in Texas, TCEQ reviews submitted project

proposals individually and grants approval and discharge permits on a case-by-case basis. TCEQ approved the Wichita Falls DPR scheme after reviewing the DPR project proposal and the proposed long-term IPR system solution. Since there are no regulatory guidelines for DPR in Texas (or in any other state), TCEQ and the City of Wichita Falls Public Works Department collaboratively discussed the necessary treatment requirements and effluent limitations.

DPR Permitting Process

The city worked with TCEQ for the first 9 months of 2013 to discuss how to operate the plant and received the approval to build the pipeline towards the end of 2013. Following the completion of the DPR system installation in December 2013, TCEQ worked with the city on carrying out an intense 45-day testing period, followed by 30 additional days of testing. During this full-scale verification testing, TCEQ staff spent time onsite understanding how the plant was operating and observing the lab operations. Based on the results from these full-scale verification test periods, TCEQ approved a permit on June 28, 2014 which allowed six months of operation. TCEQ has subsequently extended the permit based on excellent operation but required the addition of UV after the initial six months of operation.

DPR Microbial Log Removal Requirements

TCEQ used the Surface Water Treatment Rule (SWTR) as the basis for assigning log removal requirements. However, to be more conservative than required by the SWTR, rather than using a 24-sample average concentration as the basis for assigning log removal requirements for *Giardia* and *Cryptosporidium*, they took the maximum concentration ever observed.

The DPR process is required to achieve 9-log virus removal, 8-log *Giardia* removal, and 5.5-log *Cryptosporidium* removal as specified by TCEQ. Initially, TCEQ had required 8-log virus removal but increased it to 9-log because chloramines were pre-forming at the wastewater plant and therefore TCEQ felt that there would not be as much free chlorine disinfection occurring. Likewise, TCEQ initially required a lower *Giardia* removal target (6-log) but increased it to 8-log removal required after continuous effluent monitoring indicated higher concentrations of *Giardia* could be present in the raw wastewater than the maximum concentration observed previously. These adjustments show the adaptability on the part of TCEQ

to changing conditions and the open communication between the regulators and the City with the common goal of protecting public health.

Because daily integrity testing of the RO elements is not possible, TCEQ does not give microbial log-removal credits for the DPR RO elements. As a result, other employed treatment methods must successfully achieve the log removal requirements.

IPR Permitting Process

TCEQ approved the permit for the IPR system in Fall of 2014 which allowed the city to go forward with design. The system is funded with a \$33.5 million loan through the Texas Water Development Board and the Clean Water Act State Revolving Fund. The city is in the midst of a required archaeological investigation along the pipeline route and the design process and expects to have the permanent IPR system online and upgrades to the River Road WWTP complete by 2017.

Monitoring

The city worked with TCEQ in a collaborative process to decide upon 42 monitoring locations and requirements within the DPR System to ensure public health is protected and off-speculation drinking water is prohibited from entering the distribution system (**Figure A.6-3**). The range of chemical and microbial constituents required for monitoring of the temporary DPR scheme are similar to the current Safe Drinking Water Act (SDWA) requirements. Constituents in the SDWA are monitored in the wastewater effluent, RO permeate before blending, lake water, and at the end of the conventional WTP.

TCEQ requires bi-weekly monitoring of *Cryptosporidium*, *Giardia*, and total culturable viruses using standard methods. A PCR based method was also tried for *Cryptosporidium* and *Giardia* during verification testing but was removed from the monitoring requirements because PCR results were difficult to interpret. Other monitoring parameters include *E. coli* (daily); full metal scans; algae counts; inorganic, organic, radioactive, and secondary chemicals specified under Texas drinking water codes; and disinfection byproducts.

The city monitors unit processes to ensure that the required microbial log removals are being met. For example, every eight hours, log removal credits for each disinfection zone is calculated based on disinfectant

concentration and contact time. The log removal values are entered into a table with values from other unit processes and an overall observed log removal is tabulated. The DPR process is regularly providing 25-log removal for viruses and 16-log removal for *Giardia* (compared to the 9- and 7-log removal requirements, respectively).

Operator certification

The City of Wichita Falls has historically produced high-quality drinking water, and pride themselves on the certification system with respect to plant operators. Wichita Falls plant operators must be certified by the State of Texas and continue training throughout their career lifetime. They can achieve certification levels A through D, A being the highest achievable level. Operators must be recertified every three years (City of Wichita Falls, 2014). In total, the City of Wichita Falls has five class A operators, 19 class B operators, and 11 class C operators (City of Wichita Falls, 2014).

Because there are no specific regulations regarding operator certification for reuse, Wichita Falls implemented two additional requirements for its operators. First, water operators are required to tour the wastewater plant, so they would understand the wastewater treatment processes. Second, water operators are required to take a basic wastewater, wastewater treatment, and waterborne pathogens class. Likewise, wastewater operators are required to tour the water treatment plant and take basic water, surface water, and waterborne pathogens classes.

Collaboration between the County Public Health Department and the City's Public Works Department

The city had an existing local water quality task force that was established in 1997 in response to the Milwaukie *Cryptosporidium* outbreak. The task force is made up of members of the City's Public Works Department and the City/County Public Health Department. The task force has met regularly and has established protocols for what action and communication is required in the case of unexpected process upsets or disease outbreaks observed in the population. TCEQ has attended one of the task force meetings to observe how information and data are exchanged. This relationship is unique and helps to guarantee public health safety.

Leadership

The Director of the City's Public Works Department and the Utilities Operations Manager both feel they put their careers on the line to be out front with DPR. However, they also feel that there was nothing innovative technically – all of the components had been previously studied for four decades or more. Wichita Falls simply did extensive research to assemble and digest published literature from the U.S., Australia, Europe, and Japan, and then put the pieces together.

Public outreach

Public outreach techniques were used to educate doctors and professors of environmental science and chemistry and the general public (Dahl, 2014). Ensuring the community was comfortable with the potable reuse concept immensely helped the projects evolution. The leadership of the Public Works Department feels that the DPR and IPR projects have been 100% transparent with the citizens and that they could not have succeeded without the support of the community.

Public perception

To date, city and state officials have not received any complaint calls regarding taste. In fact, some residents feel the water tastes better since the DPR scheme was brought online and the city expects there may be taste complaints when switching to IPR since the water will be mixed with Lake Arrowhead water which typically has a muddy taste.

The Public Works Department monitored bottled water sales at the three large Walmart retailers in town. Water bottle sales increased by about 9% after DPR was brought online, indicating that some residents may have switched from tap water to bottled water for drinking, but that the majority of the population has not begun buying bottled water.

City residents have embraced their place in history as a leader in DPR (**Figure A.6-4**).

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Figure A.6-1 Lake Arrowhead Levels in 2013 (Photo credit: Daniel Nix)

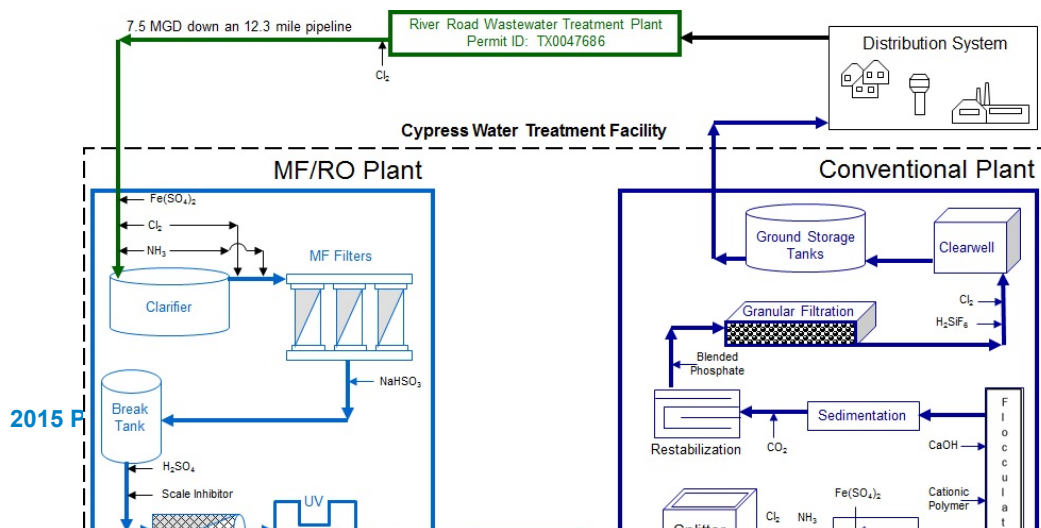


A



B

Figure A.6-2 A. RO modules and B. RO permeate (Photo credit: City of Wichita Falls)



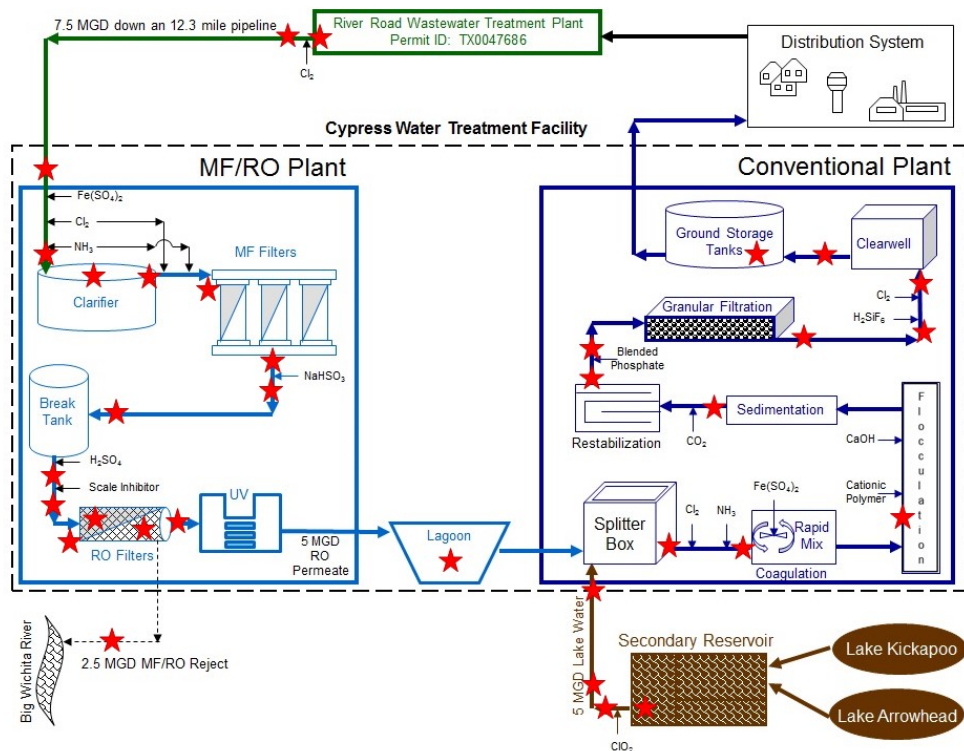


Figure A.6-3: Process Flow Diagram of Emergency DPR Project. (Stars indicate water quality monitoring locations.)



Figure A.6-4: T-shirts sold in Wichita Falls touting DPR. (Photo credit: F5 Concepts, Inc.)