

# UF/ RO

## Surface Water and Groundwater Treatment Plant

**APPLICATION:** Municipal Drinking Water

**CAPACITY:** 7.2 MGD

**LOCATION:** Delaware, Ohio, USA

**TECHNOLOGY:** Ultrafiltration and  
Reverse Osmosis

**COMMISSIONED:** 2014

## BACKGROUND

Before its upgrade in 2014, the City of Delaware water treatment plant used a conventional lime softening and rapid sand filtration system with a capacity of 6 MGD. Because the City pumps water from multiple sources, including the Olentangy River and several wells, it needed a flexible treatment process to accommodate a range of feed water quality.

## CHALLENGE

With the original system, the City was not able to meet the total trihalomethanes (TTHM) limits of the Disinfectants and Disinfection By-products Rule (D/DBPR), and the nitrate levels were problematic. Because the City also experienced seasonally high atrazine levels, it needed to purchase a powdered activated carbon (PAC) feed system to remove atrazine. To add to these water quality issues, after the City completed its *Cryptosporidium* sampling as part of the Information Collection Rule and the Long Term 1 Enhanced Surface Water Treatment Rule (LT1ESWTR), the facility source water was placed in Bin 2 for *Cryptosporidium*, which required an additional log removal of *Cryptosporidium* (4.0 log removal total). Unfortunately, the existing lime softening facility with conventional rapid sand filters could not meet the tighter filter effluent turbidity requirement of 0.15 NTU to obtain the additional log removal/inactivation credits.

There are significant variations in the raw water due to the wide range of possible blending ratios of groundwater and surface water. The raw water is fed directly from the Olentangy River with no upstream reservoir, and experiences wide fluctuations in water quality partially influenced by rainfall. As such, the original system sometimes lacked the flexibility required to accommodate the unstable properties of the water.

## SOLUTION

H<sub>2</sub>O Innovation provided the skids that included the Toray HFU-2020N ultrafiltration (UF) membranes and the Hydranautics ESPA4-LD reverse osmosis (RO) membranes. The surface water now passes through a new inline rapid mixer, then through the rehabilitated flocculators and modified sedimentation basins, which were covered with a pre-engineered metal building to prevent freeze and thaw that would cause the concrete to spall, to keep out debris, and to block sunlight, thereby lowering the potential for algae formation. The UF filtrate supplies pretreated surface water to three RO membrane skids arranged in parallel.



UF System in Delaware, OH

The groundwater is pretreated with chlorine and high-rate pressure filters for iron and manganese removal. The RO bypass is blended with the RO permeate separately for the groundwater and surface water, after which the permeate is combined prior to the degassifiers, which help blend the two streams while increasing dissolved oxygen concentration and pH by removing carbon dioxide gas (CO<sub>2</sub>). Fluoride, zinc orthophosphate, and chlorine are added prior to the clearwell.

The expanded plant has a capacity of 7.2 MGD with space for additional expansion to 11.5 MGD in the same building through the simple installation of more UF and RO skids. The design also includes the modernization of the plant control system, which is key to the RO concentrate disposal.

The diagram illustrates the water treatment process at the Orla Water Treatment Works. It shows the flow from various water sources (GW Wells, River Intake Screens, Intake Pumps) through several stages of treatment including Pressure Filters, Feed Wells, Cartridge Filter, GW RO, Highservice Pumps, Degasifiers, Clearwells, Elevated Tank, SW RO Feed Pump, Cartridge Filter, SW RO, Backwash Holding Tank, Backwash Lagoon, Lagoon Drain P.S., Cascade Aerator, and Orla River. The process also includes a Sanitary Sewer and NFC P.S. (Non-Ferrous Chemical Plant) for sludge handling.

The water quality produced by the UF and RO system is superior to that of the lime softening and sand filtration system. As shown in the table below, the levels of TOC, TTHM, hardness, nitrates, and turbidity are lower in the finished water with the new membrane system. While the levels of atrazine are equivalent, the new UF and RO system no longer requires the use of PAC. The facility is now able to meet the LT1ESWTR *Cryptosporidium* removal/inactivation requirement of 4.0 log.

Parameter (Finished Water)	Units	Lime Softening Water Quality	UF/RO Membrane Water Quality
Total Organic Carbon (TOC) (avg)	mg/L	2.4	0.8
Total Trihalomethanes (TTHM) (max)	mg/L	121	22
HAA5 (max)	ug/L	40	12
Hardness (avg)	mg/L	180	120
Atrazine (max)	mg/L	<0.02 (with PAC)	<0.003
Nitrates (max)	mg/L	6.6	3.3
Turbidity (avg)	NTU	0.2	0.03
Cryptosporidium log removal	-	3.0	>4.0



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