

Brunswick County, NC

Northwest Water Treatment Plant
Treatment Evaluation Draft Report

March 19, 2018



**CDM
Smith**

Project Objectives

- Develop a list of target contaminants
- Develop best treatment options for the NWTP
- Evaluate performance of the treatment options
- Prepare budget level cost opinions for each option
- Make a recommendation

County Goal - Best value approach considering target contaminant removal and cost of implementation at the NWTP

Agenda

- Project Status Update
- Source Water
- Target Contaminants
- Technology Evaluation and Treatment Goals
- Advanced Treatment Recommendations
- Proposed Project Schedule

LPRO Pilot Testing Update

- NWTP staff operating pilot since February 19
- Preliminary lab results from February 26 sampling
 - Gen X = ND
 - Nafion Byproduct 1 = ND
 - Nafion Byproduct 2 = ND
 - All other PFAS = ND

ND = below lab detection and reporting limit

Stromberg County Northwest WTP LPRO Membrane Pilot Plant Test Daily Data Logging Sheet

Name: DLW Teel Date: 2/28/18

Run Time: _____

Parameter	Location	Unit	Value
FEED FLOW (from MCP)	FEPT-101	gpm	73.9
FEED FLOW TOTAL	FEPT-101	gpm	24,553
CONC FLOW (from MCP)	FEPT-101	gpm	2.5
CONC FLOW TOTAL	FEPT-101	gpm	15,191
PERM FLOW (from MCP)	FEPT-101	gpm	20.6
PERM FLOW TOTAL	FEPT-101	gpm	64,349
1-2-PERM	PL-101	gpm	7.0
1-1-PERM	PL-102	gpm	7.0
2-2-CONC (Combined)	PL-104	gpm	4.0
2-1-CONC (Combined)	PL-103	gpm	3.5
FEED PRESSURE	PANEL	psi	125
CONCENTRATE PRESSURE	PANEL	psi	12
PERMEATE PRESSURE	PANEL	psi	40
Flow Cartridge Filter	PL-201	psi	36
Feed Pumps	PL-301	psi	110
1A-1-CONC	PL-401	psi	110
1B-1-CONC	PL-402	psi	105
2-1-FEED	PL-403	psi	110
1A-2-PERM	PL-501	psi	40
1B-2-PERM	PL-502	psi	100
2-1-CONC	PL-601	psi	95
1-1-PERM	PL-602	psi	16
2-2-PERM	PL-604	psi	16

Parameter	Location	Unit	Value
Feed Temperature	PANEL	°C	15.4
Feed pH	PANEL	uv	5.7
Feed ORP	PANEL	uv	517-684
Feed Conductivity	PANEL	µS	52
Permeate Conductivity	PANEL	µS	1.06
Concentrate Conductivity	PANEL	µS	1.06

Parameter	Location	Unit	Value
1A-1-PERM	SP-101	µS	168.3
1B-1-PERM	SP-1	µS	42.7
1A-2-PERM	SP-2	µS	3.45
1B-2-PERM	SP-3	µS	4.89
2-1-PERM	SP-4	µS	5.78
2-2-PERM	SP-6	µS	6.57
1B-1-CONC	SP-8	µS	224.6
1A-2-CONC	SP-10	µS	330.9
1B-2-CONC	SP-11	µS	350
2-1-CONC	SP-12	µS	552
2-2-CONC	SP-17	µS	489
COMBINED PERM	SP-17	µS	406.4
COMBINED CONC	SP-18	µS	105.4

Parameter	Location	Unit	Value
Permeate Water Quality Analysis	SP-101	µS	6.24
Permeate Water pH	SP-101	uv	
Permeate Water Temperature	SP-101	uv	
Permeate Water ORP	SP-101	uv	
COMBINED PERM pH	SP-17	uv	
COMBINED CONC pH	SP-18	uv	
ARTIFICIAL LEVEL			14





Source Water

Source Water

- Cape Fear River is an abundant supply
- NCDEQ and CDM Smith confirmed groundwater is inadequate for the County water demand needed (45+ mgd)
- Groundwater supply limitations in this area of North Carolina have already forced others to switch to surface water (e.g. Bladen Bluffs WTP, NRWASA WTP)



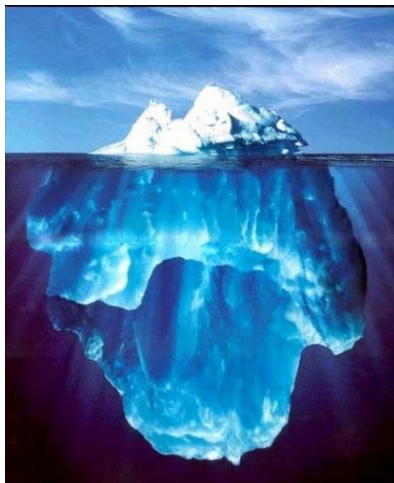
Target Contaminants

Target Contaminants

Primary Target Contaminants

Per- and Poly-fluoroalkyl Substances (PFAS)

- GenX and other PFAS revealed by Dr. Knappe's and others research:
 - PFMOAA, PFMOPrA, PFMOBA, PFPrOPrA (GenX), PFO2HxA, PFO3OA, and PFO4DA
- Nafion by-products
- Other identified PFAS compounds
- Additional PFAS Compounds Not Yet Identified



Secondary Target Contaminants

- 1,4-Dioxane
- Pharmaceuticals and Personal Care Products (PPCPs)
- Endocrine Disrupting Compounds (EDCs)
- Pesticides and Herbicides
- Others – NDMA, Brominated DBPs, Cr6
- Additional Compounds Not Yet Identified



Technology Evaluation and Treatment Goals

Approach to Developing Treatment Goals

- County Goal - Best value approach considering target contaminant removal and cost of implementation at the NWTP.
- Most target contaminants do not have established federal limits:
 - Some regulated at state level
 - Some have health advisories or goals
 - Health effects of most are still uncertain
- Options compared are based primarily on treating for GenX and other PFAS contaminants.
 - Secondary contaminants also considered

Technologies Evaluated



Ion Exchange (IX)



***Low Pressure
Reverse
Osmosis
(LPRO)***



***Granular
Activated
Carbon (GAC)***

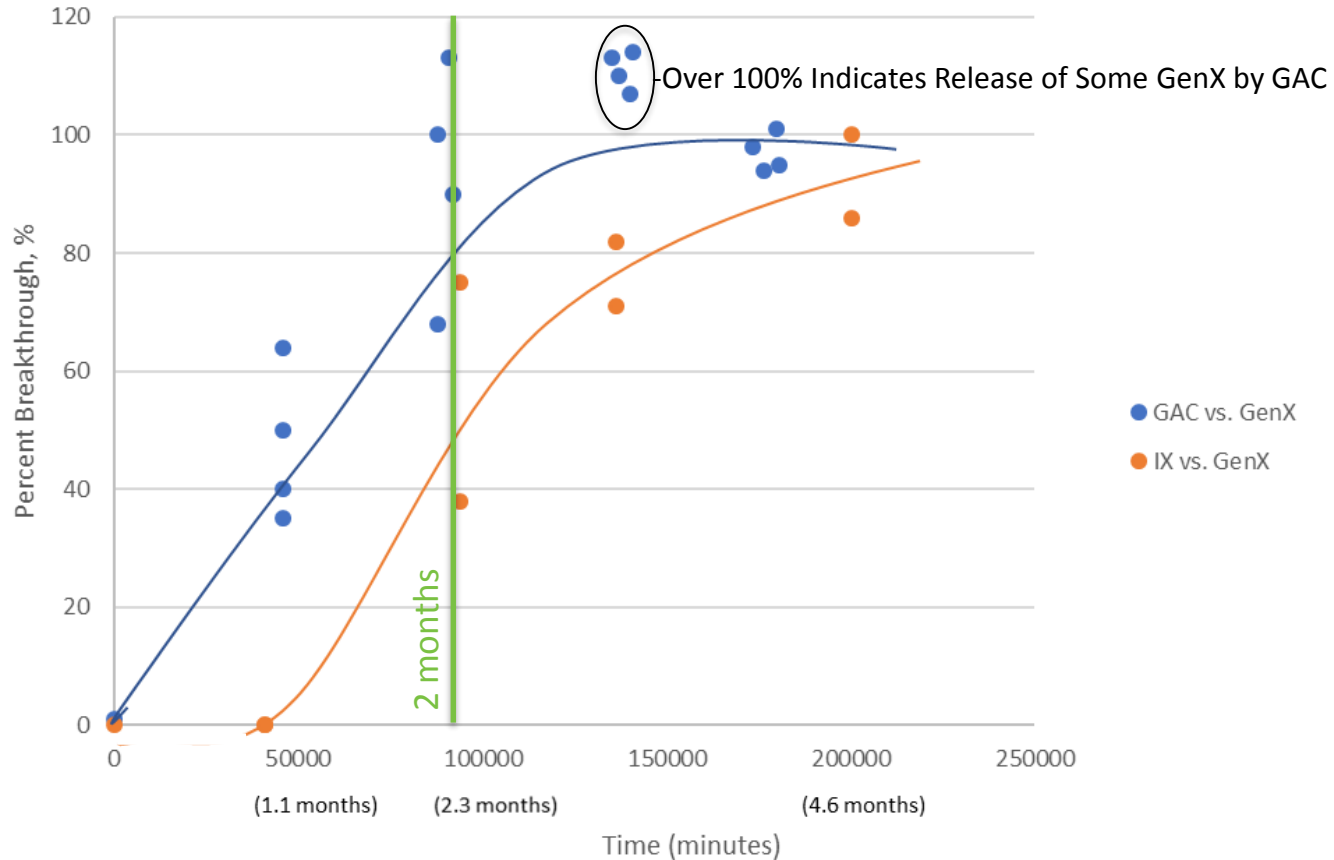


***UV-Advanced
Oxidation Process
(UV-AOP)***



***Ozone-
Biofiltration***

GenX Breakthrough Curves: From HB 56 Data



Summary of Technologies

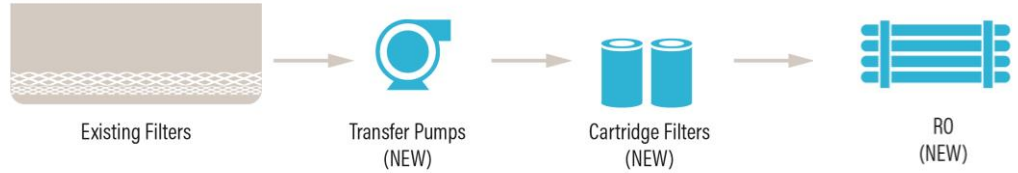
- **Low Pressure Reverse Osmosis (LPRO)**
 - Best technology for removal of PFAS such as GenX and Nafion Byproducts, PPCPs & DBP precursors - over 90% removal
 - Expect 90% removal for 1,4 Dioxane (pilot results pending)
 - Requires new NPDES discharge permit
 - Physical barrier so not as affected by spills
 - Greatest protection from future unidentified PFAS and emerging contaminants
- **Granular Activated Carbon (GAC)**
 - Effective for most PFAS.
 - Good for long-chain PFAS, shorter life for others (e.g. GenX, PFMOAA, PFO2HxA)
 - Good for PPCPs & DBP precursors
 - Not effective for 1,4-dioxane; requires advanced oxidation process (AOP)
- **Ion Exchange (IX)**
 - Effective for most PFAS. Shorter life for some (e.g. PFMOAA, PFO2HxA)
 - Good for DBP precursors
 - Not effective for 1,4-dioxane; requires AOP
 - Not effective for PPCPs; requires GAC

Summary of Technologies (continued)

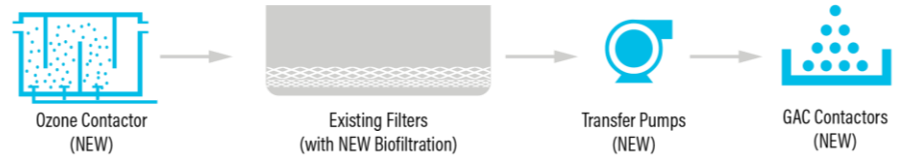
- Ozone-Biofiltration
 - Partial removal of 1,4 Dioxane
 - Good removal of DBP precursors and PPCPs
 - Not effective for most PFAS
- Ultraviolet-Advanced Oxidation Process (UV-AOP)
 - Can oxidize 1,4 Dioxane
 - Good removal for DBP precursors and PPCPs
 - Not effective for most PFAS

Combinations of Technologies

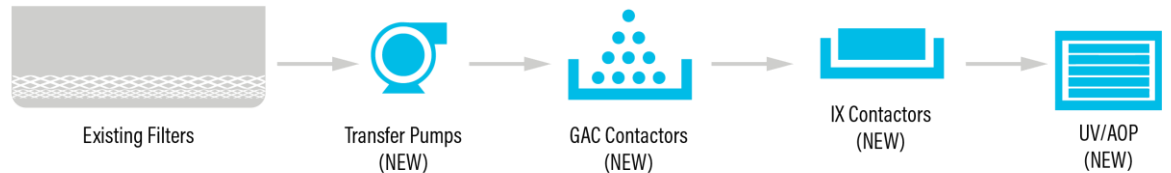
- Low Pressure Reverse Osmosis



- Ozone/Biofiltration/GAC



- GAC/IX/UV-AOP



Typical Percent Removals of Target Contaminants by Potential Treatment Options

Alternative	Lower Cape Fear PFAS Compounds			1,4 Dioxane	PPCPs
	Gen X	PFMOAA, PFO2HxA	Other PFAS		
LPRO	>95%	>90%	>95%	90% ±	>90%
O3/BAF/GAC	90% ±	<90%	>90% for most PFAS	60-70%	>90%
GAC/IX/UV-AOP	>90%	<90%	>90% for most PFAS	>90%	>90%



Advanced Treatment Recommendations

LPRO is recommended for the following reasons

- LPRO is the Best Technology for Removal of PFAS. Some PFAS, such as GenX, Nafion Byproducts 1 and 2, PFMOAA and PFO2HxA would require frequent replacement of GAC and IX media
- GAC and IX would likely result in higher finished water concentrations of GenX, PFMOAA, and PFO2HxA than RO (technologies are not equal)
- LPRO has the lowest net present worth costs for removing 90% or more of the Target Contaminants
- LPRO is the most robust technology for protecting against unidentified contaminants
- LPRO treated water concentrations will not vary as much with influent concentrations as with GAC and IX. LPRO treated water quality does not rely on frequent media change-out to protect from the spills and contaminants in the Cape Fear River
- LPRO does not release elevated concentrations after bed life is spent as can happen with GAC and IX if feed concentration drops

Costs of 3 Advanced Treatment Options

	Low Pressure Reverse Osmosis (LPRO)	Ozone/BAF - GAC	GAC/IX/UV-AOP
Total Capital Costs	\$ 99 M	\$ 99 M	\$ 84 M
Annual O&M Cost (Advanced Treatment Only)			
Initial Annual O&M Cost	\$ 2.9 M	\$ 4.7 M	\$ 4.7 M
25-yr Present Worth of Annual Costs	\$ 59 M	\$ 94 M	\$ 94 M
25-yr Net Present Worth (Capital + Operating Costs)			
Total 25-yr NPW (Capital + Annual O&M)	\$ 158 M	\$ 193 M	\$ 178 M
Opinion of Capital Cost (Advanced Treatment + Capacity Expansion)			
Total Advanced Treatment Cost	\$ 99 M	\$ 99 M	\$ 84 M
Capacity Expansion Project Cost	\$ 35 M	\$ 35 M	\$ 35 M
Opinion of Total Capital Cost	\$134 M	\$134 M	\$119 M



Project Schedule

Implementation Schedule

- April 2018 – Final Report
- April 2018 – Submit Applications for Funding
- May 2018 – Start Preliminary Design
- August 2018 – Start Final Design
- July 2019 – Start Construction



Questions?

