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

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)

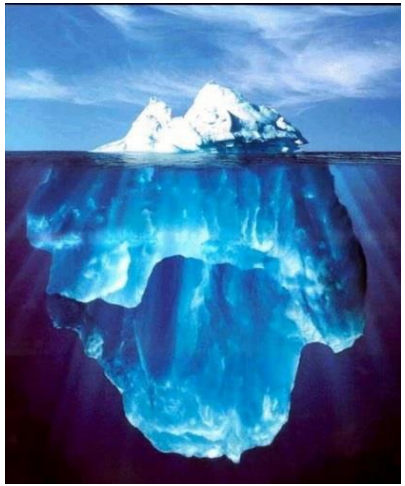
Target Contaminants

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)

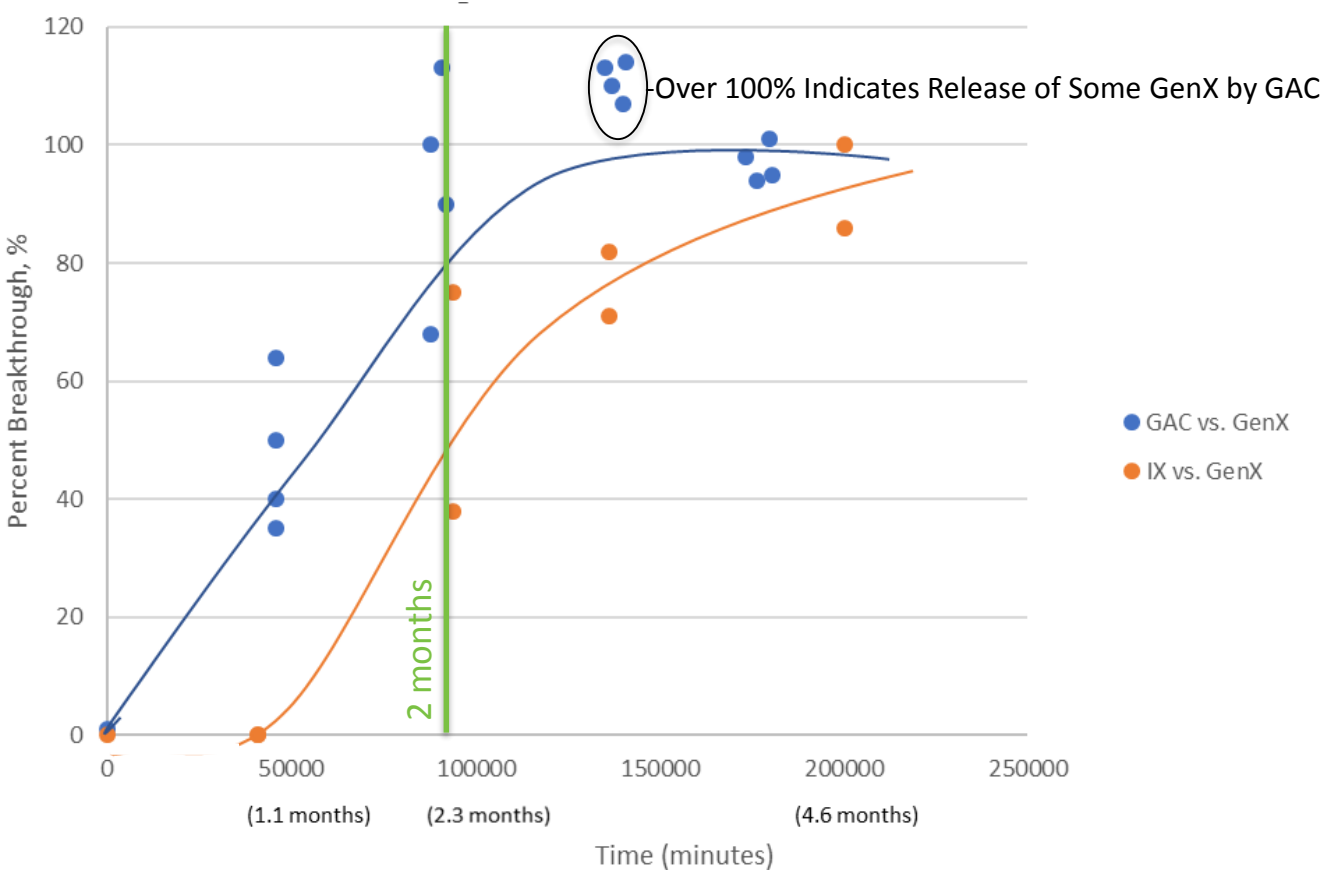
Low Pressure Reverse Osmosis (LPRO)

Granular Activated Carbon (GAC)

UV-Advanced Oxidation Process (UV-AOP)

Ozone-Biofiltration

GenX Breakthrough Curves: From HB 56 Data



Pilot Test Using 10 min GAC & 1.5 min IX

Summary of Technologies

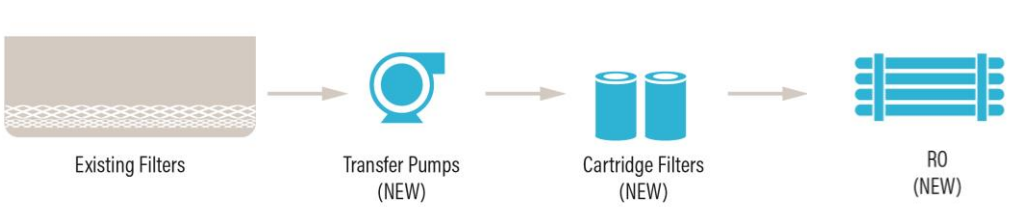
- **Low Pressure Reverse Osmosis (LPRO)**
  - Best technology for removal of PFAS such as GenX and Nafion Byproducts, PPCPs & DBP precursors - over 90% removal
  - Expect 90% removal for 1,4 Dioxane (pilot results pending)
  - Requires new NPDES discharge permit
  - Physical barrier so not as affected 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)

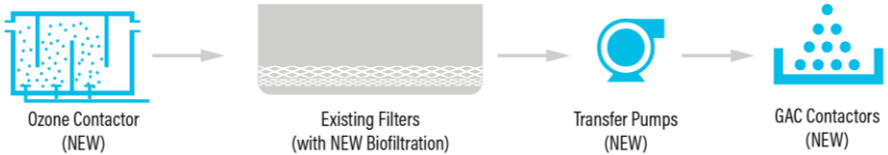
- Ozone-Biofiltration
  - Partial removal of 1,4 Dioxane
  - Good removal of DBP precursors and PPCPs
  - Not effective for most PFAS
- Ultraviolet-Advanced Oxidation Process (UV-AOP)
  - Can oxidize 1,4 Dioxane
  - Good removal for DBP precursors and PPCPs
  - Not effective for most PFAS

Combinations of Technologies

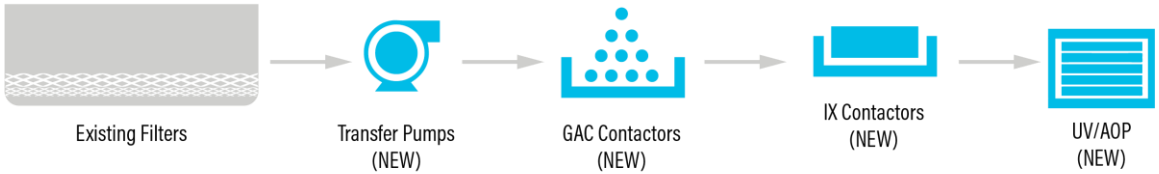
- Low Pressure Reverse Osmosis



- 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?