PFAS in Septic Systems and Private Wells: What's Next?

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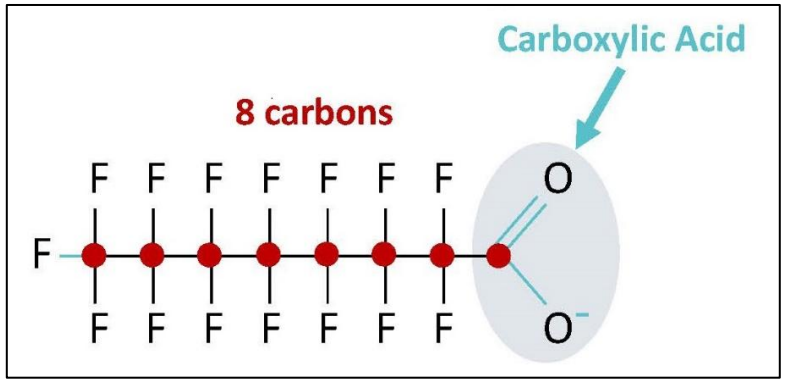
Septic Systems and Private Wells in NC

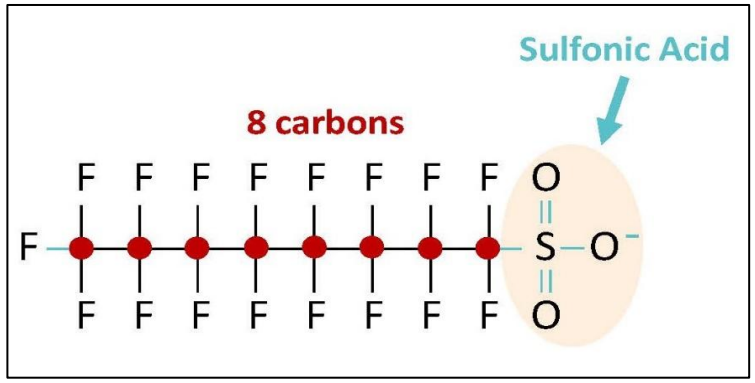
- Septic systems users: ~ 50% statewide
- - County level 14% to 93%
- Domestic well users : ~ 25% statewide
- - County level 4% to 86 %
- Homeowners are responsible for keeping their water and wastewater infrastructure safe.
- Private wells and septic systems, also know as on-site wastewater treatment systems (OWTSs), are critical to development and growth in NC, providing rural areas with drinking water and wastewater treatment.

PFOA, PFOS and GenX

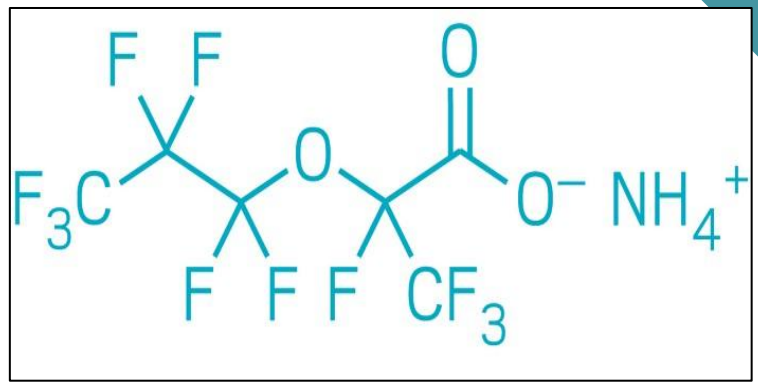
Most concerned chemicals in the PFAS family.



$C_8HF_{15}O_2$
Perfluorooctanoic Acid
(PFOA)



$C_8HF_{17}O_3S$
Perfluorooctane Sulfonic Acid
(PFOS)



$C_6H_4F_{11}NO_3$
Hexafluoropropylene Oxide-Dimer Acid **(GenX)**

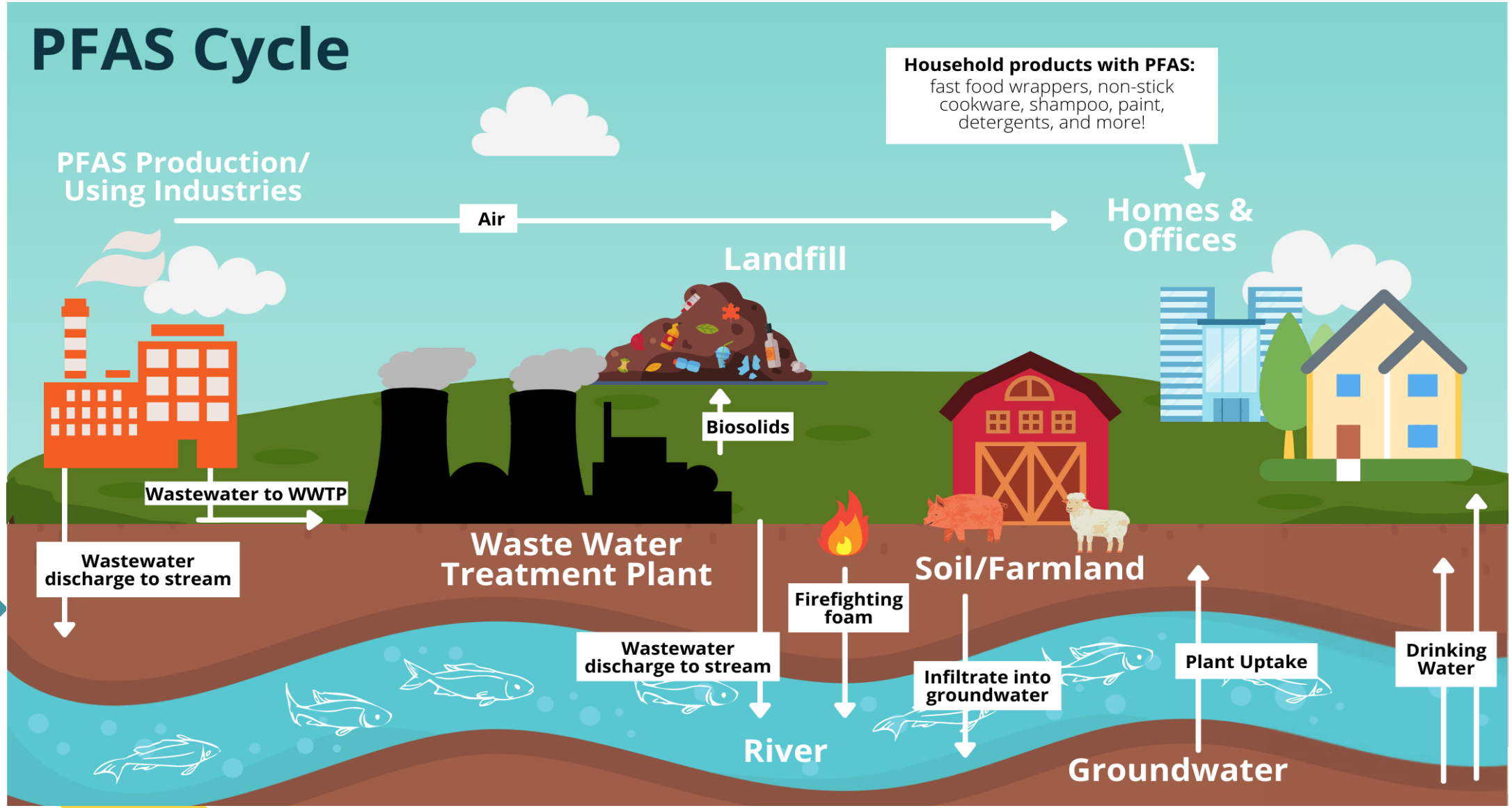
- Perfluoroalkyls repel oil, grease, and water
- C-F bond is one of strongest - hard to break
- Bioaccumulation potential

Common Source of PFOA, PFOS and GenX

- PFOA - very good at repelling oil and water. Used in Textile industries, the non-stick coating of pans, fast-food wrappers, takeout containers and personal care products, toilet paler.
- PFOS – very good at repelling water, oil, and dirt. Used in: Carpets, clothing, fabrics for furniture, paper packaging for food, and other materials that are resistant to water, grease or stains.
- GenX – Developed as a replacement for PFOA. Used in products such as food packaging, paints, cleaning products, non-stick coatings, outdoor fabrics and firefighting foam.

https://en.wikipedia.org/wiki/Firefighting_foam#/media/File:Firefighters_spray_foam.jpg

https://en.wikipedia.org/wiki/Waxed_paper#/media/File:Waxedpaper.jpg



https://www.clearwatersystems.com/forever-chemicals/

Health Advisory Level of PFOA, PFOS and GenX

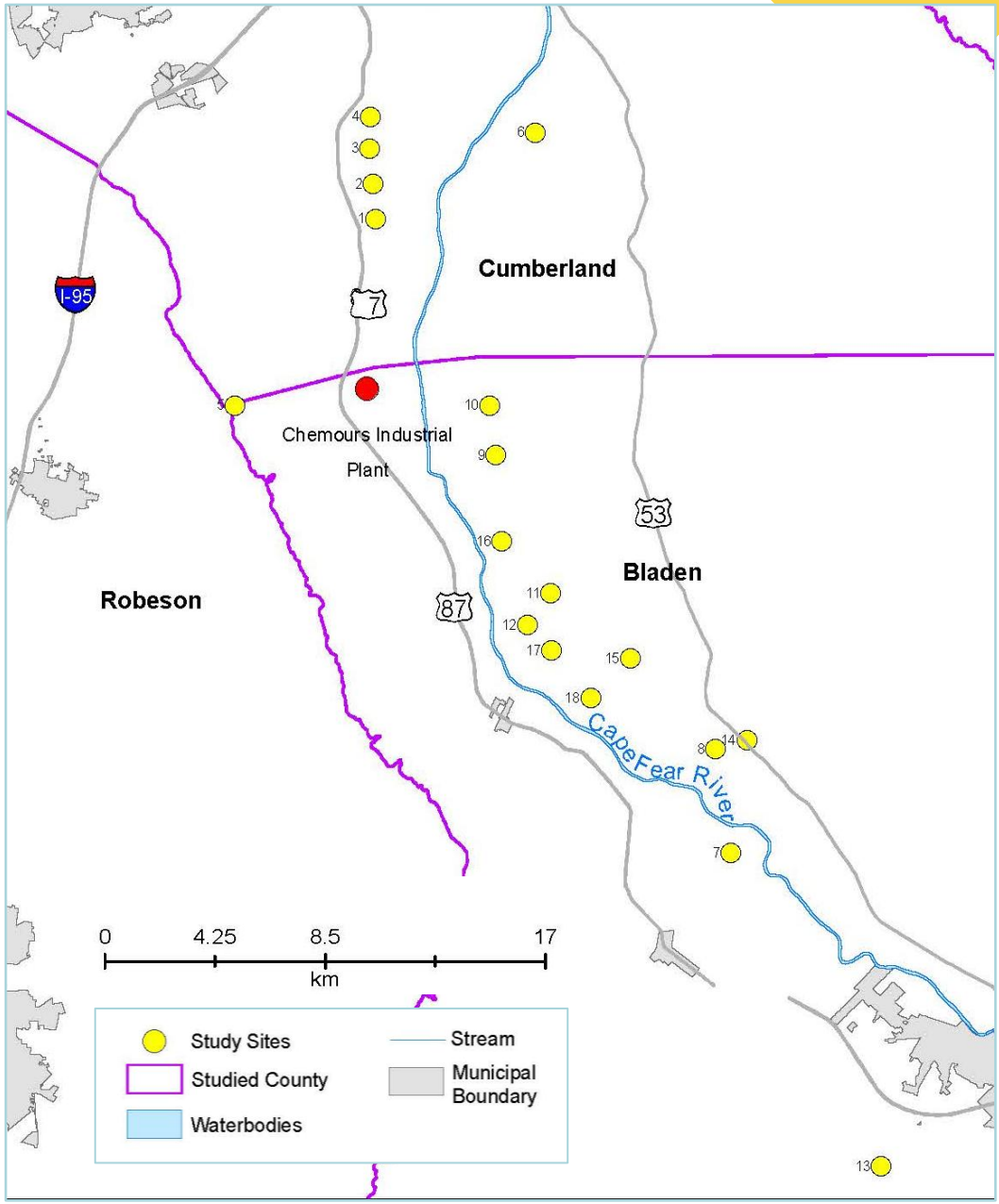
PFAS Analyte	Final MCLG (ng/L)	Final MCL (ng/L)	Tap Water RSLs (ng/L)
PFOA	zero	4.0	60
PFOS	zero	4.0	40
HFPO-DA (Gen-X)	10	10	60

PFAS in OWTSs and Private Wells

- Use of PFAS containing products in residential settings causes the detection of PFAS in OWTSs.
- Sub-surface discharge of OWTS effluent containing PFAS has great potential for the contamination of groundwater drinking water supplies.
- Largely overlooked by state and federal agencies.
- PFAS information on private wells and OWTSs is severely lacking.
- To address this gap, water and wastewater samples from 18 sites with OWTSs and private wells were collected to determine the presence and concentration of PFAS, including PFOA, PFOS, and GenX.

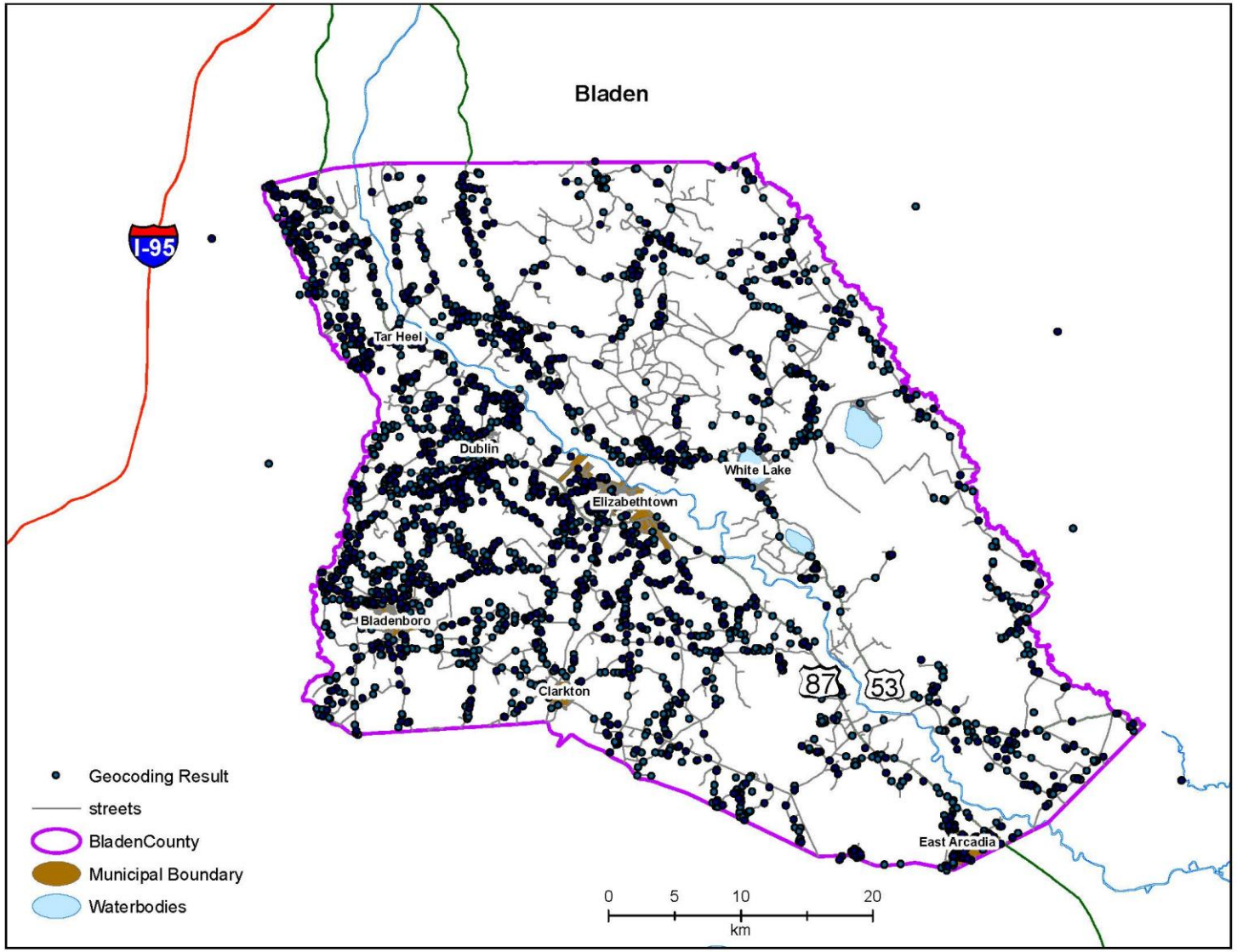
Study locations

Counties of Interest	Persons in Poverty (%)	Median Income
Bladen	24.55	$37,188
Cumberland	18.04	$48,177
Robeson	27.27	$35,362
North Carolina	12.8	$60,516



NC Office of State Budget and Management 2021

Septic systems in Bladen County

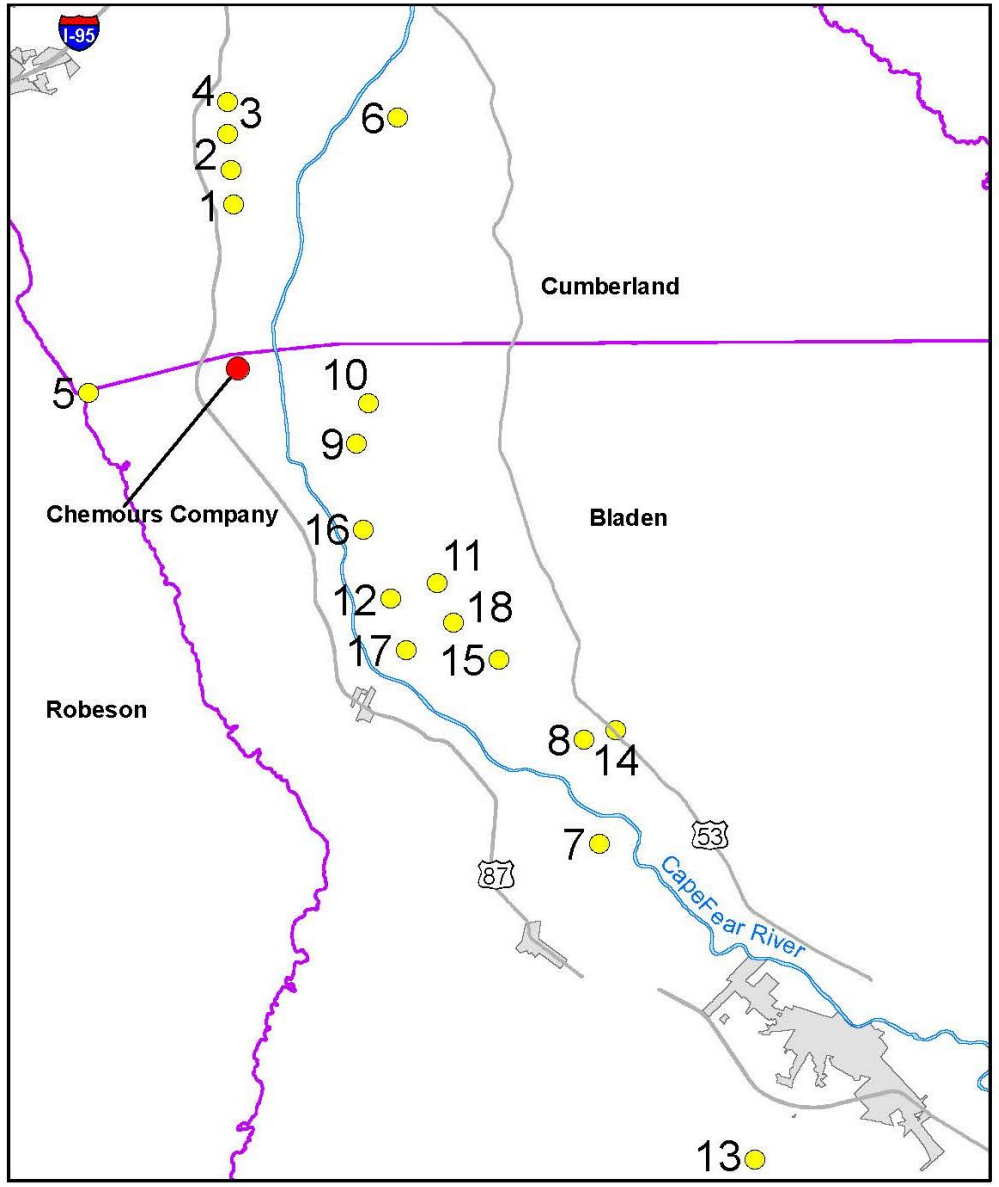


Sample Collection

- Wastewater: Septic tank effluent
- Water: Private wells
- In the field: pH, oxidation reduction potential, turbidity, temperature, and specific conductance
- In the lab – PFAS, PFOA, and GenX, TDN, TSS, NO3, TKN, DOC, Chloride, *E. coli* and total coliform

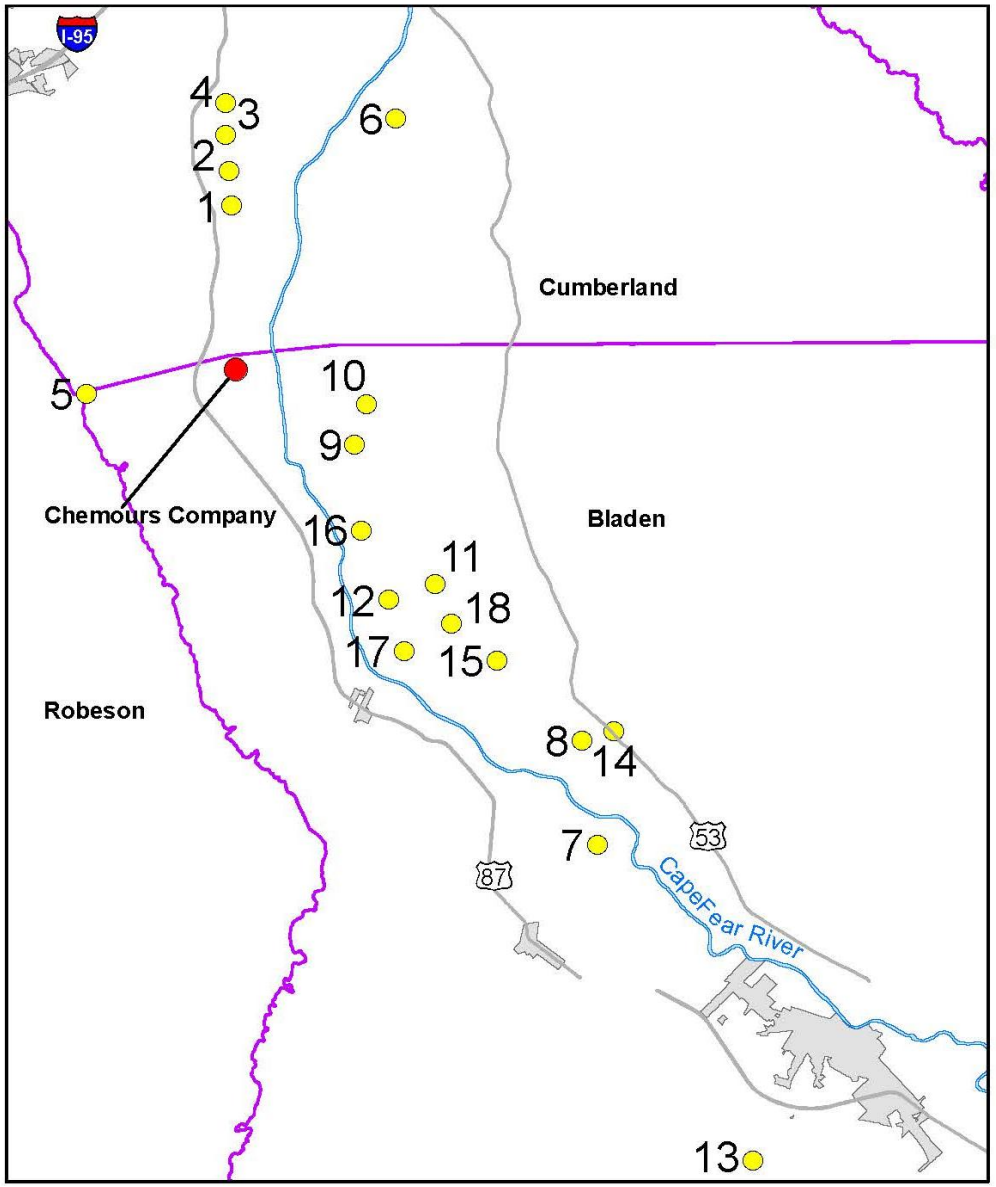
Results: PFOA, PFOS, and GenX in Wells

Location	PFOA (ppt)	PFOS (ppt)	GenX (ppt)
Site 1- Well	0	0	0.35
Site 2 -Well	0	0	2
Site 3 - Well	15.6	0.15	0
Site 4- Well	0	0	0
Site 5 -Well	1.1	0	31.7
Site 6 - Well	2.3	0.13	29.6
Site 7- Well	0	0	0
Site 8 -Well	11.6	0	0
Site 9 - Well	19.3	15.4	44
Site 10- Well	10.9	8.8	43
Site 11 -Well	0	0	0
Site 12 - Well	0	0	0
Site 13- Well	2.7	0	0
Site 14- Well	0.93	0	0
Site 15- Well	22.8	0.15	6.2
Site 16- Well	0	0	0
Site 17- Well	72.4	0.64	0
Site 18- Well	4.9	78.2	0



Results: PFOA, PFOS, and Gen-X in OWTSs

Location	PFOA (ppt)	PFOS (ppt)	Gen-X (ppt)
Site 1 – Septic Tank	1.5	0	2.3
Site 2 – Septic Tank	4.6	17.7	33.7
Site 3 – Septic Tank	2.1	57.8	11.3
Site 4 – Septic Tank	3.4	5.8	8.5
Site 5 – Septic Tank	1.8	18.7	25
Site 6 – Septic Tank	13.7	6.9	13.8
Site 7 – Septic Tank	22.3	47.9	96.3
Site 8 – Septic Tank	12.7	97.5	9.5
Site 9 – Septic Tank	4.6	16.6	120.1
Site 10 – Septic Tank	9.8	13.1	20.8
Site 11 – Septic Tank	0	6.4	2.6
Site 12 – Septic Tank	3.9	143.5	17.3
Site 13 – Septic Tank	0	11.5	221.2
Site 14 – Septic Tank	8.3	11.9	155
Site 15 – Septic Tank	5.5	12.2	71.3
Site 16 – Septic Tank	7.3	15	9.6
Site 17 – Septic Tank	8.7	4.8	0.12
Site 18 – Septic Tank	37	33.9	1.6



Overall Results

Location	TDN (mg/L) ST	TDN (mg/L) Well	NO_3-N (mg/L) ST	NO_3-N (mg/L) Well	NH_4 (mg/L) ST	NH_4 (mg/L) Well	E. Coli ST	E. coli Well	Total Colif ST	Total Colif. Well	GenX (ppt) ST	GenX (ppt) Well	PFOA (ppt) ST	PFOA (ppt) Well	PFOS (ppt) ST	PFOS (ppt)
Site 1	67.76	0.61	< 0.01	0.46	67.76	0.04	32,200	0	2,599,400	0	2.3	0.35	1.5	0	0	0
Site 2	56.07	1.36	< 0.01	1.22	56.07	0.14	39,400	0	4,840,000	0	33.7	2	4.6	0	17.7	0
Site 3	34.56	0.72	< 0.01	0.52	34.56	0.2	244,600	0	111,200	0	11.3	0	2.1	15.6	57.8	0.15
Site 4	28.12	1.87	0.01	1.81	28.11	0.06	2000	0	4,840,000	0	8.5	0	3.4	0	5.8	0
Site 5	64.48	0.44	0.03	0.04	64.45	0.4	2000	0	383,600	0	25	31.7	1.8	1.1	18.7	0
Site 6	32.52	0.54	0.01	0.3	32.51	0.07	120,400	0	1,226,200	0	13.8	29.6	13.7	2.3	6.9	0.13
Site 7	80.74	0.44	0.01	0.01	80.73	0.06	1,804,500	0	9,931,500	0	96.3	0	22.3	0	47.9	0
Site 8	45.26	0.44	0.02	< 0.01	45.24	0.24	487,000	0	3,873,000	1	9.5	0	12.7	11.6	97.5	0
Site 9	46.58	0.51	0.01	< 0.01	46.57	0.25	26,000	0	2,897,000	0	120.1	44	4.6	19.3	16.6	15.4
Site 10	72.56	0.34	0.01	< 0.01	72.55	0.34	15,000	0	1,361,500	0	20.8	43	9.8	10.9	13.1	8.8
Site 11	121.7	0.55	0.02	< 0.01	121.7	0.34	61,000	0	4,604,000	0	2.6	0	0	0	6.4	0
Site 12	31.57	0.59	0.01	< 0.01	31.56	0.59	1,732,800	0	4,840,000	0	17.3	0	3.9	0	144	0
Site 13	84.92	0.44	< 0.01	0.01	84.92	0.12	67,000	0	1,179,500	0	221.2	0	0	2.7	11.5	0
Site 14	102.2	0.44	0.01	0.01	102.2	0.23	37,000	0	540,500	0	155	0	8.3	0.93	11.9	0
Site 15	166.6	7.62	0.01	3.21	166.6	4.41	308,000	0	6,498,500	0	71.3	6.2	5.5	22.8	12.2	0.15
Site 16	68.58	0.71	0.02	0	68.56	0.71	133,000	0	10,000,000	0	9.6	0	7.3	0	15	0
Site 17	56.63	0.44	0.01	0	56.62	0.21	113,000	0	9,931,500	0	0.12	0	8.7	72.4	4.8	0.64
Site 18	38.82	1.78	0.37	1.64	38.45	0.14	2,176,000	0	2,442,000	0	1.6	0	37	4.9	33.9	78.2

Results Summary

- 61% of drinking water wells samples contained detectable levels of PFOA.
- 39% of drinking water wells samples contained detectable levels of PFOS and Gen-X.
- 50% of these private wells exceeded the EPA's recently established National Primary Drinking Water Regulation MCLs for PFAS.
- None of the well water samples tested positive for *E. coli.*
- One of 18 sites was positive for total coliform (1 MPN per 100 mL).
- Nitrate concentrations in the water supplies were all below 10 mg/L and 78% below 1.0 mg/L.
- The main threat to human health in this region with regard to contamination of the private wells was with the synthetic chemicals PFOS, PFOA, and GenX.

What is Next?

- Understanding fate and transport of PFAS in OWTS environment is important for protecting rural drinking water supplies.
- Removing or reducing OWTS-derived PFAS into groundwater. Septic systems may be a non-point source of PFAS to groundwater.
- Adding treatment to drinking water sources to remove contaminants prior to them reaching the wastewater system, or additional treatments to the wastewater system to remove the contaminants prior to dispersal.

Recommendations

- Funding for the assessment of PFAS in private wells is as crucial as providing needed assistance for PFAS treatment systems to support residents with contaminated well water.
- Assessing PFAS in drinking water sources could significantly help determine if OWTSs can effectively reduce the amount of PFAS potentially reintroduced to the natural water cycle.
- Fair share of water and wastewater infrastructure funds to cover operation and management of private wells and OWTSs with a designated amount of legislature approved funds for repair or replacement of malfunctioning OWTSs and domestic wells for underserved communities.
- Safeguarding of public health and protection of the environment by both state and local officials without burdening underprivileged, underserved residents with the substantial costs of testing wells and repairing or replacing OWTSs.

Thank you

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