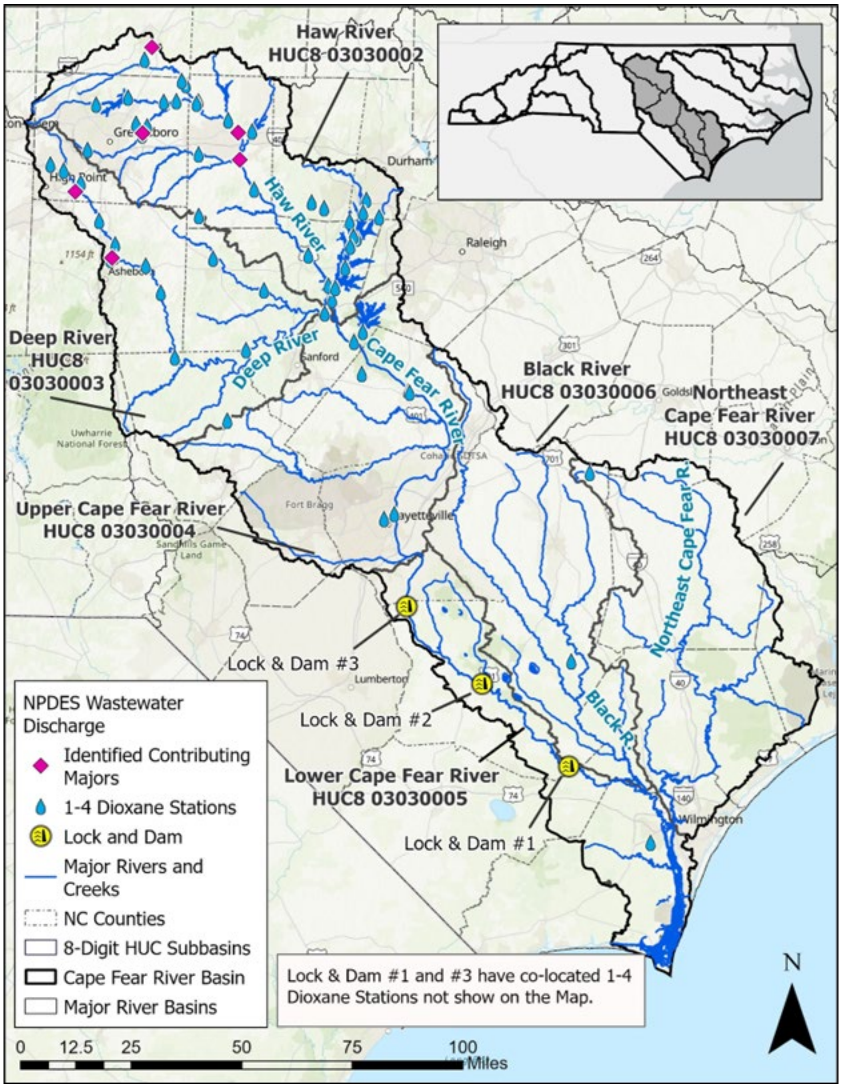

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Chapter 13
1,4-Dioxane Related Emerging Contaminants in the Cape Fear River Basin

BASINWIDE WATER RESOURCES MANAGEMENT PLAN

CYCLE 4 –
CAPE FEAR RIVER BASIN 2026

North Carolina
Department of Environmental Quality
Division of Water Resources
Basin Planning Branch

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13.1 Contaminants of Emerging Concern

Contaminants of Emerging Concern (CECs), or Emerging Compounds (ECs) are chemicals or materials characterized by potential threat to human health or the environment by a lack of published health standards and/or promulgated environmental regulations. They come from a wide range of sources including industrial chemicals as well as their by-products, firefighting foams, pesticides, lawn and agricultural products, disinfection products, wood preservatives, pharmaceutical and personal care products (PCPs) (EPA, 2024). In addition to industrial sources, these contaminants are often sent to landfills and wastewater treatment plants and subsequently discharged to surface waters.

Historically, Per- and polyfluoroalkyl substances (PFAS) and 1,4-dioxane were described as emerging compounds, although the toxicological data and regulations have now progressed significantly. These compounds have been identified in North Carolina. The science and research about emerging contaminants are quickly expanding, so DEQ has created a list of resources to help residents learn more. The latest information and updates can be found on the NC DEQ Emerging Compounds webpage.

13.2 General 1,4-Dioxane Overview

1,4-Dioxane is a clear liquid that is highly miscible in water. It has historically been used as a solvent stabilizer and is currently used for a wide variety of industrial and manufacturing purposes. The compound can be found in industrial solvents, antifreeze and aircraft deicing fluids, paint strippers, dyes and varnishes and is often produced as a by-product of chemical processes to manufacture soaps, plastics and other consumer products such as deodorants, shampoos and cosmetics. In water, 1,4-dioxane does not readily biodegrade in the aquatic environment. Consequently, it persists in water and is readily transported downstream because of a unique combination of physical and chemical properties that make it highly mobile and resistant to natural degradation. 1,4-Dioxane does not readily stick to soil particles, sludge/biosolids or sediments. As a result, when 1,4-dioxane enters a waterway, it remains dissolved and travels long distances, leading to widespread contamination of surface water resources. Conventional wastewater treatment processes and techniques typical of Publicly Owned Treatment Works (POTWs) do not remove emerging contaminants and generally pass through treatment plants and are discharged with wastewater effluent to receiving streams. 1,4-Dioxane is also not readily captured using granulated activated carbon commonly used to capture PFAS compounds (Wilbur et al., 2012 and Hogue, 2020).

In 2024, EPA released its final risk determination for the solvent 1,4-dioxane under the Toxic Substance Control Act (TSCA). EPA determined that 1,4-dioxane "poses an unreasonable risk of injury to human health" and classified 1,4-dioxane as a likely human carcinogen (website). The US Department of Health and Human Services has also identified 1,4-dioxane as "reasonably anticipated to be a human carcinogen" and the International Agency for Research on Cancer (IARC) has determined that it is "possibly carcinogenic to humans" (Wilbur et al., 2012 and Agency for Toxic Substances and Disease Registry website). EPA risk assessments indicate that the drinking water concentration representing a 1 in a million (1 x10^{-6}) cancer risk level for 1,4-dioxane is 0.35 µg/L (EPA IRIS, 2013).

In July 2021, the European Chemicals Agency (ECHA) announced that 1,4-dioxane was added to its "Candidate List of substances of very high concern". ECHA's website explains that "1,4-dioxane was added to the list because of its carcinogenicity as well as concerns related to its "probable serious effects" to human health and the environment" (ECHA Category 1B carcinogen; AIHA, 2021 and ECHA, 2021).

13.3 DEQ 1,4-Dioxane Monitoring Studies

13.3.1 EPA Third Unregulated Contaminant Monitoring Rule (UCMR3)

From 2013 to 2015, EPA required all drinking water systems across the country serving more than 10,000 people to sample for 1,4-dioxane as part of EPA's Third Unregulated Contaminant Monitoring Rule (UCMR3). The UCMR monitoring program is used to understand the frequency and concentration of unregulated contaminants in the nation's drinking water systems. EPA encourages state and local officials to "use the UCMR data to assess the need for actions to protect public health. States may establish requirements or levels (regulatory or non-regulatory) for drinking water contaminants not yet regulated by the EPA" under the Safe Drinking Water Act (EPA UCMR3 Data Summary report). For this study, EPA established the UCMR minimum reporting level (MRL) of 0.07 µg/L for 1,4-dioxane. EPA also used a reference concentration of 0.35 to 35 µg/L which represents a concentration range based on a cancer risk level of 10^{-6} to 10^{-4} (1-in-a-million to 1-in-10-thousand cancer risk). In NC, surface water quality standards for carcinogens or toxic substances shall not exceed a 1-in-a-million level risk (15A NCAC 02B .0208)

The UCMR3 data revealed that NC was identified as having the 3rd highest measured concentration and ranked 4th highest in the number of drinking water systems impacted nationally with 24 of the 151 public water systems sampled with measurable detection levels above the EPA's 1 in a million health-based risk level of 0.35 µg/L (DEQ, 2024 Legislative Report). The Cape Fear River Basin exhibited some of the highest measured concentrations of 1,4-dioxane in finished drinking water in NC and the US (DWR, 2017).

13.3.2 Cape Fear River Preliminary Investigative 2014-2016 Surface Water Study

Results from the UCMR3 sampling efforts indicated the presence of 1,4-dioxane in NC with elevated concentrations in drinking water supplies in the Cape Fear River Basin. As result, in October 2014, DWR initiated an ambient surface water study of 1,4-dioxane in the Cape Fear River Basin (DEQ-WSS, 2016 Report). The objective was to identify potential sources, understand changes in concentrations throughout the watershed and collect data that would help the state develop a regulatory strategy. The monitoring locations were determined based on watersheds identified as having elevated concentrations of 1,4-dioxane as part of the UCMR 3 assessment.

The study started with 12 stations and expanded to 19 stations after six months to facilitate the identification and isolation of specific watershed sources. Surface water grab (~0.1 meter depth) samples were generally collected monthly. After the first full year, some monitoring locations were adjusted, and the monitoring frequency was reduced to quarterly (October 2015-May 2016). During this study, samples were analyzed by Pace Analytical using a solid waste analytical method with a practical quantitation limit (PQL) of 2 or 3 µg/L (see 2017 Report for specific study details).

During the 2014-2016 study, elevated levels of 1,4-dioxane were documented mainly downstream of the Greensboro, Reidsville and Asheboro wastewater treatment plants (WWTP). From this initial study (October 2014 – May 2016), the maximum instream 1,4-dioxane concentrations below these three wastewater treatment plants ranged between 614 to 1,030 µg/L with a mean and median concentration range of 11 to 351 µg/L and 4 to 269 µg/L, respectively (DEQ-WSS, [2017 Report], Appendix B stations B4/Haw River, B0750000/South Buffalo Creek and NCSU24/Haskett Creek).

13.3.3 Statewide and Cape Fear River Basin 1,4-Dioxane Surface Water Study

In November 2017, DWR added statewide surface water monitoring for 1,4-dioxane in 15 of the 17 river basins in NC (*Table 13-1*). Surface water grab (~0.1 meter depth) sampling generally occurs at established ambient monitoring locations and in drinking water reservoirs assessed as part of routine Ambient Lakes Monitoring Programs (ALMP) rotational basinwide monitoring efforts. These samples are analyzed by the DWR Water Sciences Section Laboratory, Organic Chemistry Branch, using EPA method 624.1 for surface water, with a practical quantitation limit (PQL) of 1.0 µg/L. Most of the 1,4-dioxane sampling occurs in the Cape Fear, Neuse and Yadkin-Pee Dee River basins (*Table 13-1*). DWR has a 1,4-Dioxane Surface Water Sampling Results webpage and dashboard where the data is available. The majority of the 1,4-dioxane results throughout the state were not detected above the PQL. However, the majority of the detectable concentrations were found in the Cape Fear River Basin (*Table 13-1*).

Table 13-1: NC Statewide River Basin 1,4-Dioxane Study Summary Results, November 2017-December 2024. (Table 1 from NC OSBM September 2025 Approved Fiscal Note for 1,4-Dioxane Monitoring and Minimization).

Basin	# Stations	# Results	# Nondetects	% Detects	Minimum	Maximum
Broad	5	44	44	0	<1	<1
Cape Fear	61	1546	1003	35	<1	1000
Catawba	16	89	89	0	<1	<1
Chowan	1	9	9	0	<1	<1
French Broad	11	69	69	0	<1	<1
Hiwassee	3	12	12	0	<1	<1
Little Tennessee	13	65	65	0	<1	<1
Lumber	3	16	16	0	<1	<1
Neuse	33	494	493	0.2	<1	1
New	3	23	23	0	<1	<1
Pasquotank*	0	0	No data	No data	No data	No data
Roanoke	13	82	82	0	<1	<1
Savannah*	0	0	No data	No data	No data	No data
Tar-Pamlico	4	25	25	0	<1	<1
Watauga	1	6	6	0	<1	<1
White Oak	4	17	17	0	<1	<1
Yadkin-Pee Dee	51	859	826	3.8	<1	12
* Pasquotank River Basin and Savannah River Basin not sampled (as of Jan. 2026). There are no Significant Industrial Users in these basins.						

As stated above, DWR added 1,4-dioxane monitoring in the Cape Fear River Basin at several ambient monitoring stations and expanded monitoring to include drinking water reservoirs as part of the 2018 and 2023 basinwide Ambient Lakes Monitoring Program. Special study stations are also added and dropped each year based on specific watershed assessment and source identification needs. *Table 13-2* provides an overview of the ambient monitoring samples collected between 2017 and 2024 in the Cape Fear River Basin (*Figure 13-1*, map of station locations). A detailed data summary is available in (*Table 13-3*). DWR continues to monitor for 1,4-dioxane at many stations throughout the Cape Fear River Basin and has reported specific results in each subbasin watershed chapter throughout the plan.

Table 13-2: 1,4-Dioxane Yearly Summary Results for all Samples Collected in the Cape Fear River Basin, November 2017-December 2024.

Year	# Stations	# Results	# Non-detects[1]	% Detects	Min. µg/L	Median µg/L	Max.* µg/L
2017	9	9	0	100	1.4	5.7	1000
2018	52	251	111	56	<1	1.4	210
2019	22	183	82	55	<1	1.1	170
2020	26	188	132	30	<1	<1	900
2021	28	262	181	31	<1	<1	150
2022	25	234	176	25	<1	<1	120
2023	43	249	195	22	<1	<1	900
2024	23	171	127	26	<1	<1	620

[1]DWR laboratory practical quantitation limit (PQL) for 1,4-dioxane is 1 µg/L.
*All maximum recorded reading were from station B4890000 in Haskett Creek (Deep River Subbasin).

Haskett Creek in the Deep River subbasin consistently had the highest instream 1,4-dioxane concentrations in the Cape Fear River Basin and across the state (*Table 13-1*, *Table 13-2*, *Table 13-3*, and *Table 13-4*). Haskett Creek flows through the City of Asheboro and drains to the Deep River between Cedar Falls and Randleman, NC. Asheboro's WWTP (NC0026123) discharges to Haskett Creek about 0.7 miles upstream of the confluence with the Deep River. DWR has collected 1,4-dioxane surface water samples at two stations in Haskett Creek, one upstream (B2 at Hub Morris Rd) and one downstream (B4890000 at Wow Rd) of the wastewater treatment plant (*Figure 13-1 C*).

For the data collected between November 2017 and December 2024, the upstream (B2) 1,4-dioxane concentrations ranged between <1 and 2.2 µg/L with only seven of the 59 samples (12%) above the PQL of 1 µg/L (*Table 13-3* and *Table 13-4*). The mean and median of the seven samples above the PQL was 1.5 and 1.2 µg/L, respectively (*Table 13-3* and *Figure 13-2*). Of the 71 samples collected downstream of the Asheboro's WWTP at station B489000, only a single sample collected on May 7, 2023, was below the PQL (*Table 13-4*). The range of the remaining 70 samples was between 1.9-1,000 µg/L (*Table 13-3*, *Table 13-4* and *Figure 13-2*). The mean and median concentrations were 115 and 55 µg/L respectively with 50.7% of the records over 50 µg/L and 83% over 10 µg/L. These high instream 1,4-dioxane concentrations are concerning as the downstream water supplies are consistently at risk of exceeding the EPA's drinking water health-based 1 in a million (1×10^{-6}) lifetime cancer risk level of 0.35 µg/L (EPA IRIS, 2013).

Table 13-3: Cape Fear River Basin Ambient Stations Monitored for 1,4-Dioxane between November 2017-December 2022 and January 2023-December 2024. (Based on data set from WSS Nov.2025) -Link to dashboard with map.

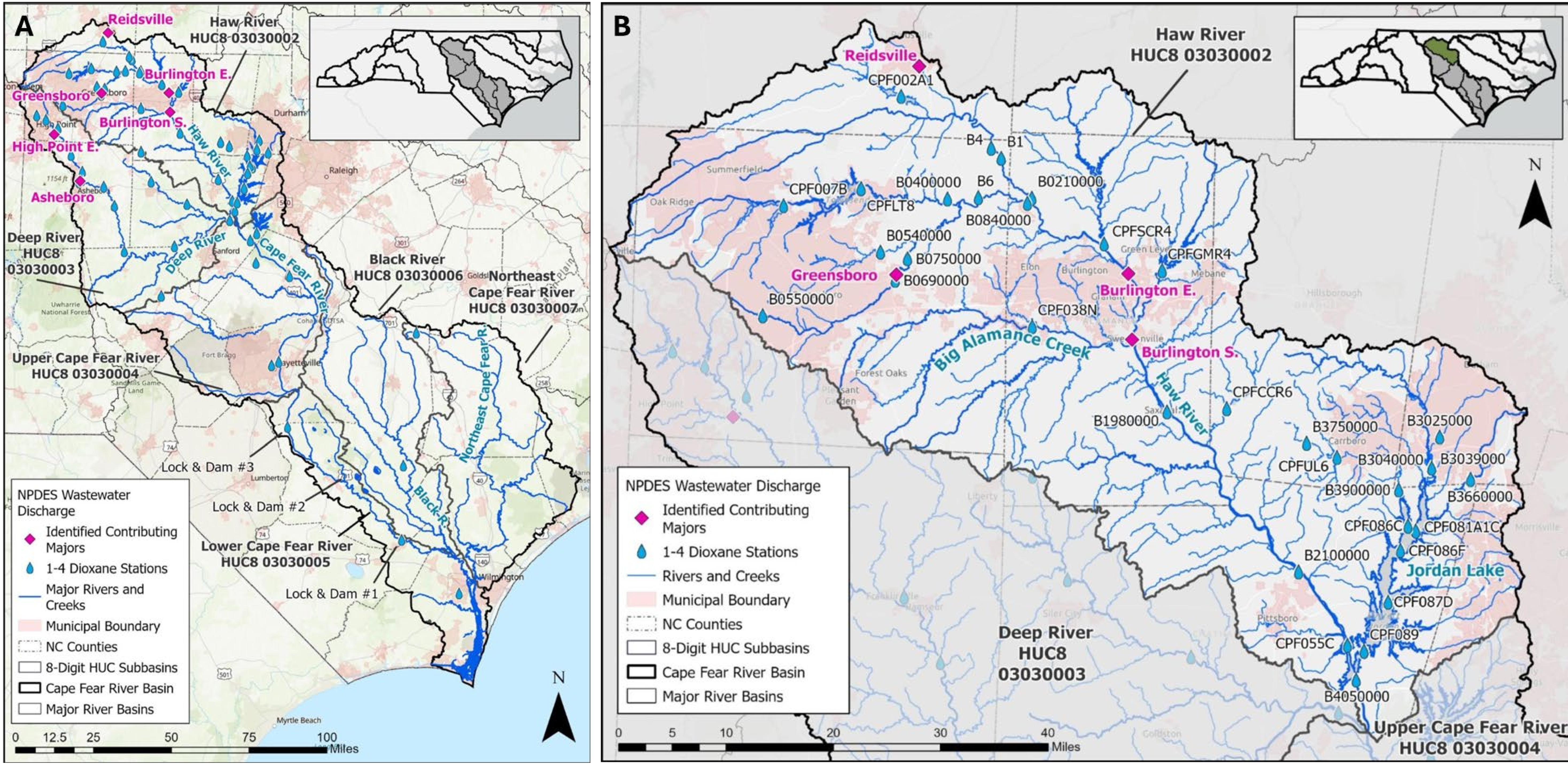
Waterbody (Subbasin)	Assessment Unit Number (AU#)	AU Description	AU Stream Miles	Classification	Sampling Station Number	2017-2022				2023-2024			
						Number of Samples Collected	Number < PQL*	Number > PQL* / Mean^	Concentration Range (µg/L)	Number of Samples Collected	Number < PQL*	Number > PQL* / Mean^	Concentration Range (µg/L)
Haw River (Haw River)	16-(6.5)	From a point 0.9 miles downstream of Troublesome Creek to a point 0.5 miles downstream of SR2711 (Troxler Mill Rd.)	9.4	WS-IV NSW	B4	55	38	17 / 5.9	<1-28	15	14	1 / 1	<1-1
	16-(10.5)a	From a point 0.1 mile upstream of SR2712 to NC 87	4.2	WS-V NSW	B1	54	39	15 / 5.6	<1-19	15	14	1 / 1.5	<1-1.5
	16-(10.5)b	From NC 87 to Reedy Fork	1.3	WS-V NSW	B0210000	54	40	14 / 7.0	<1-27	15	14	1 / 1.1	<1-1.1
	16-(10.5)e	From NC 49 to a point 0.4 miles downstream of Cane Creek (at Saxapahaw)	18.5	WS-V NSW	B1980000	ND	ND	ND	ND	3	2	1 / 1.2	<1-1.2
Reedy Fork (Haw River)	16-11-(9)a3	From UT at SR 2778 to Buffalo Creek (Upstream of Buffalo Creek confluence)	3.0	WS-V NSW	B0400000	40	37	3 / 1.3	<1-1.6	15	15	0	<1
	16-11-(9)b	From Buffalo Creek to Haw River	8.6	WS-V NSW	B6	29	4	25 / 9.0	<1-72	ND	ND	ND	ND
					B0840000	53	12	41 / 7.2	<1-73	16	7	9 / 2.8	<1-5.4
North Buffalo Creek (Haw River)	16-11-14-1b	From North Buffalo Creek WWTP to Buffalo Creek	8.1	WS-V NSW	B0540000	42	34	8 / 1.3	<1-2.4	14	12	2 / 1.4	<1-1.8
South Buffalo Creek (Haw River)	16-11-14-2a	From source to McConnell Road	15.4	WS-V NSW	B055000	ND	ND	ND	ND	10	6	4 / 1.4	<1-1.6
	16-11-14-2b	From McConnell Rd to US 70	4.7	WS-V NSW	B0690000	49	18	31 / 2.2	<1-10	14	5	9 / 2.0	<1-3.1
	16-11-14-2c	From US 70 to Buffalo Creek	4.8	WS-V NSW	B0750000	52	2	50 / 11.8	<1-83	20	1	19 / 3.9	<1-11
Haw River (Haw River)	16-(28.875)	From the Town of Pittsboro water supply intake to a point 0.4 mile downstream of Brooks Branch.	0.5	WS-IV NSW	B2100000	45	20	25 / 9.5	<1-65	5	5	0	<1
New Hope Creek (Haw River)	16-41-1-(11.5)c	From I-40 to a point 0.8 mile downstream of Durham County SR 1107	4	WS-IV NSW	B3039000	21	20	1 / 1.9	<1-1.9	1	1	0	<1
					B3040000	14	14	0	<1	ND	ND	ND	ND
Third Fork Creek (Haw River)	16-41-1-12-(2)	From a point 2.0 miles upstream of NC HWY. 54 to New Hope Creek	3.9	WS-IV NSW	B3025000	2	2	0	<1	ND	ND	ND	ND
Northeast Creek (Haw River)	16-41-1-17-(0.7)b1	From Durham Triangle WWTP to Kit Creek	3.3	WS-IV NSW	B3660000	34	34	0	<1	4	4	0	<1
Morgan Creek (Haw River)	16-41-2-(5.5)b	From Meeting of the Waters to Chatham County SR 1726 (Durham County SR 1109)	4.1	WS-IV NSW	B3900000	33	33	0	<1	1	1	0	<1

Waterbody (Subbasin)	Assessment Unit Number (AU#)	AU Description	AU Stream Miles	Classification	Sampling Station Number	2017-2022				2023-2024			
						Number of Samples Collected	Number < PQL*	Number > PQL* / Mean^	Concentration Range (µg/L)	Number of Samples Collected	Number < PQL*	Number > PQL* / Mean^	Concentration Range (µg/L)
Phils Creek (Haw River)	16-41-2-2-(0.3)	From source to a point 0.2 mile downstream of Orange County SR 1005	5	WS-II HQW; NSW	B3750000	4	4	0	<1	ND	ND	ND	ND
Haw River (Haw River)	16-(42)	From dam at B. Everett Jordan Lake to Cape Fear River (junction with Deep River)	4.3	WS-IV NSW	B4050000	32	13	19 / 3.6	<1-12	5	5	0	<1
Reddicks Creek (Deep River)	17-8-(0.5)a	From source to Groomtown Road	5.1	WS-IV; *	B4550000	ND	ND	ND	ND	9	9	0	<1
Deep River (Deep River)	17-(10.5)b	From US 220 business to Subbasin 03-06-08 and 03-06-09 boundary (Downstream of Randleman Res.)	2.2	C	B4800000	3	0	2.6	2.3-3	ND	ND	ND	ND
	17-(10.5)d2	From Gabriels Creek to Brush Creek (at Hinshaw Town Rd.)	18.2	C	B5100000	3	0	3 / 12.8	3.4-23	ND	ND	ND	ND
	17-(10.5)e2	From Subbasin 03-06-09 and 03-06-10 boundary to Grassy Creek	2.8	C	B5190000	3	0	3/ 8.1	1.3-16	ND	ND	ND	ND
Haskett Creek (Deep River)	**17-12a**	**From source to SR 2149 (Upstream of WWTP discharge)**	**6.3**	**C**	**B2**	**46**	**39**	**7 / 1.5**	**<1-2.2**	**13**	**13**	**0**	**<1**
	17-12b2	**From Asheboro WWTP Outfall to Deep River**	**0.7**	**C**	**B4890000**	**51**	**0**	**51 / 118.6**	**1.9-1000**	**20**	**1**	**19 / 104.6**	**<1-900**
Deep River (Deep River)	17-(32.5)	From mouth of Big Governors Creek to Carbonton Dam	4	WS-IV HQW	B5575000	3	0	3 / 1.7	1.4-1.9	ND	ND	ND	ND
	17-(43.5)	From a point 0.4 mile upstream of Rocky Branch to Cape Fear River (junction with Haw River)	6	WS-IV	B6040300	3	1	2 / 1.7	<1-1.7	ND	ND	ND	ND
Greenbrier Creek (Deep River)	17-43-5	From source to Rocky River	8.1	WS-III	B5500000	ND	ND	ND	ND	6	6	0	<1
Rocky River (Deep River)	17-43-(8)b1	From Varnal Creek to backwater of Woody's Dam	15.1	C	B6000000	3	3	0	<1	ND	ND	ND	ND
Cedar Creek (Upper CFR)	18-11-(2)	From a point 0.4 miles downstream of Harnett County SR 1265 to Cape Fear River (RAMS)	3.6	WS-IV	B6225000	10	10	0	<1	ND	ND	ND	ND
Cape Fear River (Upper Cape Fear River)	18-(16.3)	From a point 0.2 mile downstream of Neills Creek to Lillington water supply (Harnett Co. Intake)	0.5	WS-IV CA	B8	53	31	22 / 2.3	<1-5.7	14	13	1 / 2.4	<1-2.4
	18-(16.7)	From Lillington water supply intake to Upper Little River	9.0	WS-IV	B6370000	33	18	15 / 2.3	<1-5.7	10	10	0	<1
	18-(25.5)	From a point 0.5 mile upstream of City of Fayetteville water supply intake to City of Fayetteville water supply intake	0.5	WS-IV CA	B7480000	53	37	16 / 2.5	<1-9.1	13	12	1 / 1.9	<1-1.9
Cape Fear River (Lower Cape Fear River)	18-(26.25)c	From Lock and dam 3 to a point approximately 0.5 mile upstream of Smithfield Packing Company's intake.	4.4	WS-IV	B8300000	25	8	17 / 2.5	<1-5.7	32	14	18 / 2.0	<1-3.6
	18-(59)	From US Corps of Engineers Lock #1 near Acme to a pt 0.5 mile upstream of raw WSI at Fed. Paper (Riegelwood)	7.7	WS-IV Sw	B8350000	44	12	32 / 2.9	<1-11	15	10	5 / 2.2	<1-3.9
Piney Branch (Lower CFR)	18-77-3-1	From source to Jackeys Creek	0.9	C; Sw	B9790500	3	3	0	<1	ND	ND	ND	ND
Keith Branch (Black River)	18-68-9	From source to Black River (at Scronce Rd.) (RAMS Station)	4.1	C; Sw	B8753000	11	11	0	<1	ND	ND	ND	ND
Goshen Swamp (Northeast CFR)	18-74-19a	From source to Bear Swamp near Suttontown	16.6	C; Sw	B9000500	ND	ND	ND	ND	9	9	0	<1

*DWR laboratory practical quantitation limit (PQL) for 1,4-dioxane is 1 µg/L; ^Mean = mean for records above the PQL only; ND – No Data available for that time period.

Figure 13-1: Cape Fear River Basin 1,4-Dioxane Ambient Water Quality Monitoring Station Maps with Location of NPDES Dischargers Known to Contribute to Elevated Instream Concentrations in the past.

A.) Full Cape Fear River Basin; B.) Haw River Subbasin; C.) Deep River Subbasin; D.) Upper Cape Fear River, Lower Cape Fear River, Black River and Northeast Cape Fear River Subbasins.



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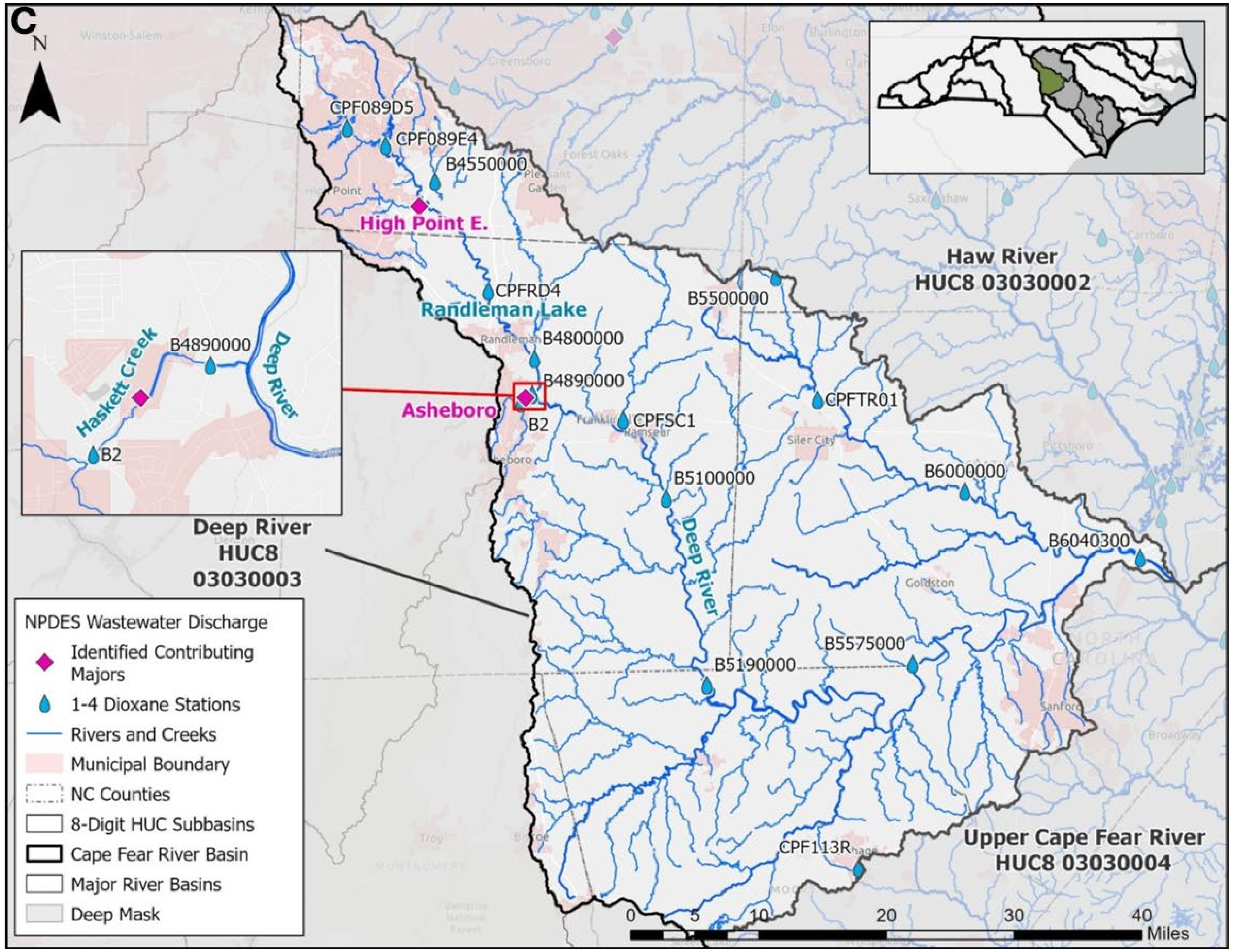

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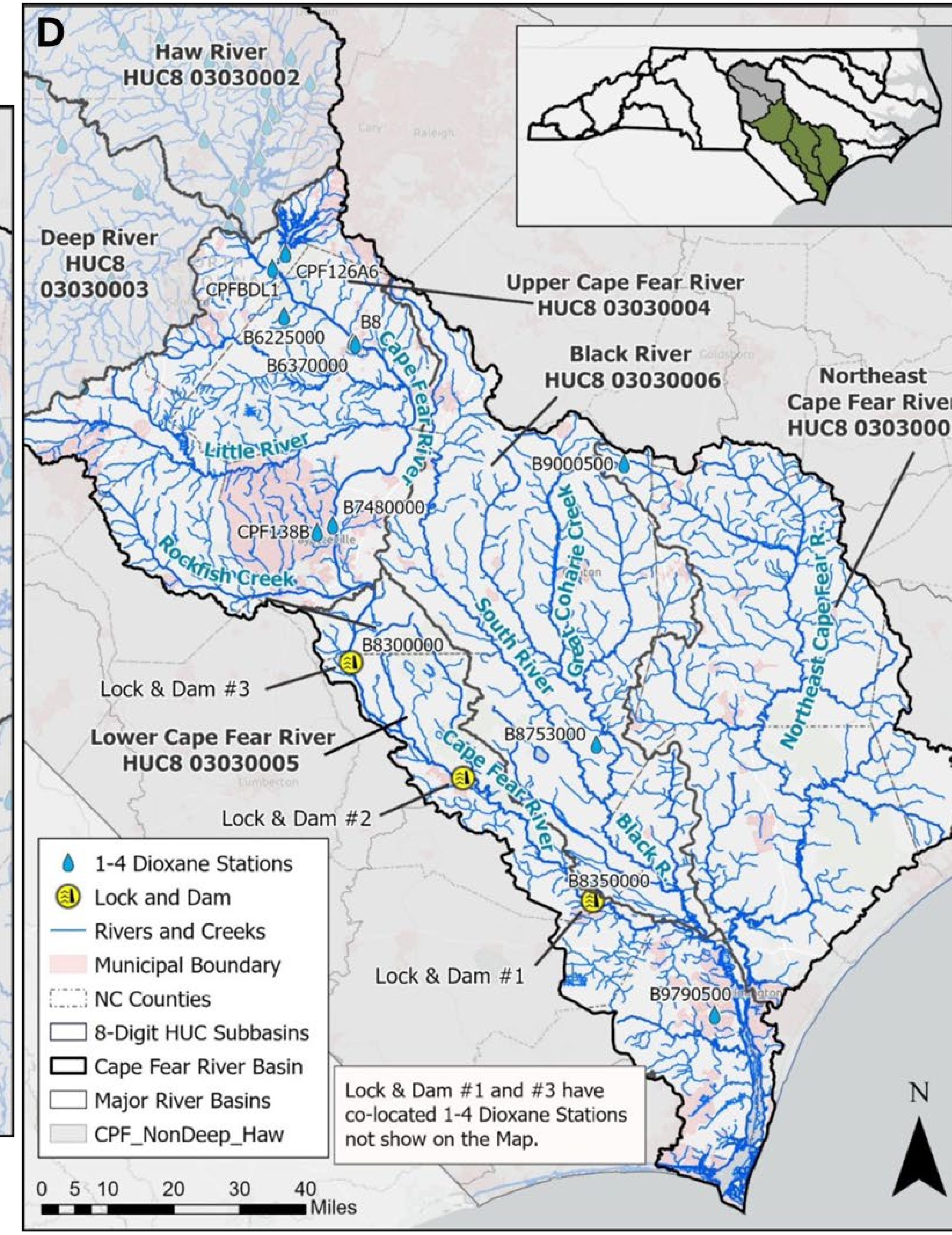

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Lower Cape Fear River
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Cape Fear River
Lock & Dam #2
Black R.
B8350000
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1-4 Dioxane Stations
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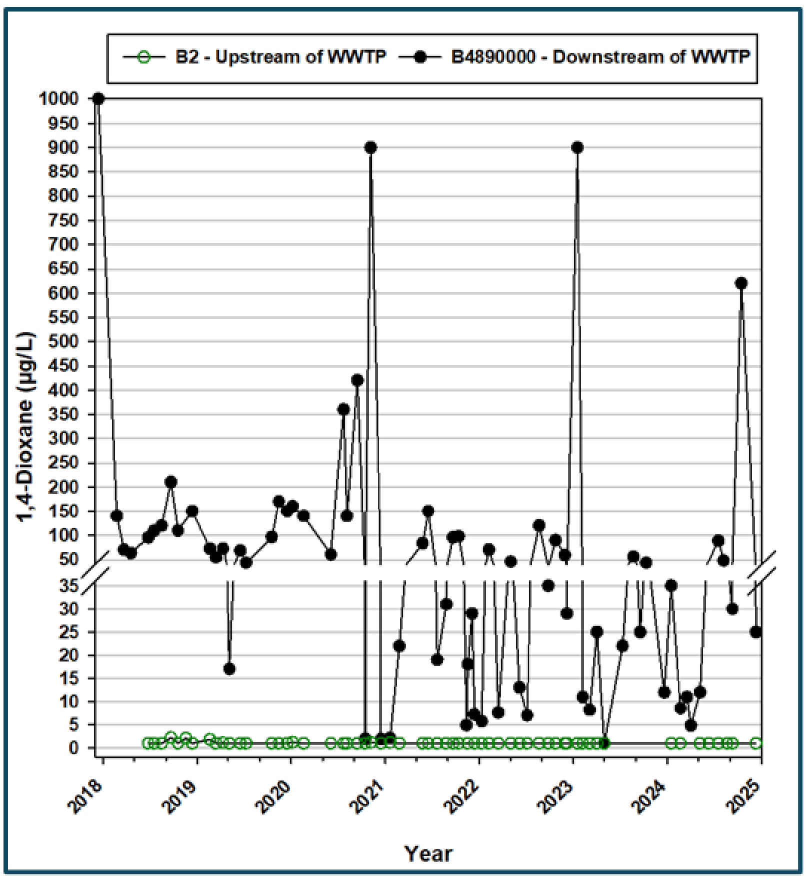
Table 13-4: 1,4-Dioxane Yearly Summary Results for Samples Collected in Haskett Creek, November 2017-December 2024. Water Quality Monitoring Station B2, Upstream and B4890000, Downstream of Asheboro's WWTP.

Year	Haskett Creek Station B2						Haskett Creek Station B4890000					
	# of samples	# Non-detects[1]	Min	Max	Mean	Median	# of samples	# Non-detects[1]	Min	Max	Mean	Median
2017	0	-	-	-	-	-	1	0	1000	1000	1000	1000
2018	7	5	2.1	2.2	2.15	2.15	9	0	64	210	119	110
2019	9	7	1.1	1.8	1.45	1.45	9	0	17	170	83	73
2020	9	7	1.2	1.2	1.2	1.2	9	0	1.9	900	243	140
2021	10	9	1.2	1.2	-	-	12	0	2.1	150	47	26
2022	11	11	<1	-	-	-	11	0	2.7	120	44	35
2023	5	5	<1	-	-	-	10	1*	8.2^	900	123	24
2024	8	8	<1	-	-	-	10	0	4.8	620	88	28

[1]DWR laboratory practical quantitation limit (PQL) for 1,4-dioxane is 1 µg/L.
*In 2023, one sample was non-detect (<1 µg/L) collected on May 7, 2023. Not included in the mean and median values for 2023.
^Minimum record not including sample < PQL of 1 µg/L.

Figure 13-2: Haskett Creek's Instream 1,4-Dioxane Concentrations Upstream (B2) and Downstream (B4890000) of the City of Asheboro's Wastewater Treatment Plant. Note: The Axis Break on the Y-Axis (break between 36 and 40 µg/L).



Elevated concentrations of 1,4-dioxane in the wastewater effluent have been traced primarily to discharges from Significant Industrial Users (SUIs) into Publicly Owned Treatment Works (POTWs). In this specific case, two SIUs were identified as the source of 1,4-dioxane to the City of Asheboro's WWTP. Staff from DWR and pretreatment programs have actively collaborated with POTWs and SIUs to minimize the amount of 1,4-dioxane entering surface waters. DWR issued a NPDES permit to Asheboro with a 1,4 dioxane effluent limit of 21.58 µg/L monthly average and a daily maximum of 49.4 µg/L. This permit was contested by the City of Asheboro. The ALJ ruled that the limits had to be removed from the permit, but that decision was reversed by the Wake County Superior Court. This Superior Court decision has itself been appealed to the Court of Appeals.

The Haw River subbasin is a critical water resource, with nearly the entire watershed classified as a water supply which flows through B. Everett Jordan Reservoir. Based on 2020 data from the public water supply systems, the Haw River subbasin supports approximately 825,000 residents primarily through surface water sources and has the greatest service area demand of any subbasin in the Cape Fear River Basin (2020 Local Water Supply Plans). South Buffalo Creek, Reedy Fork, and the Haw River were identified as having high concentrations of 1,4-dioxane as part of the Cape Fear River Basin studies (*Figure 13-3* and *Figure 13-4*).

Figure 13-3: 1,4-Dioxane Concentrations Downstream of the City of Greensboro's TZ Osborne WWTP in South Buffalo Creek (B0750000) and Reedy Fork (B0840000). Note: The Axis Break is on the Y-Axis (break between 35 and 40 µg/L).

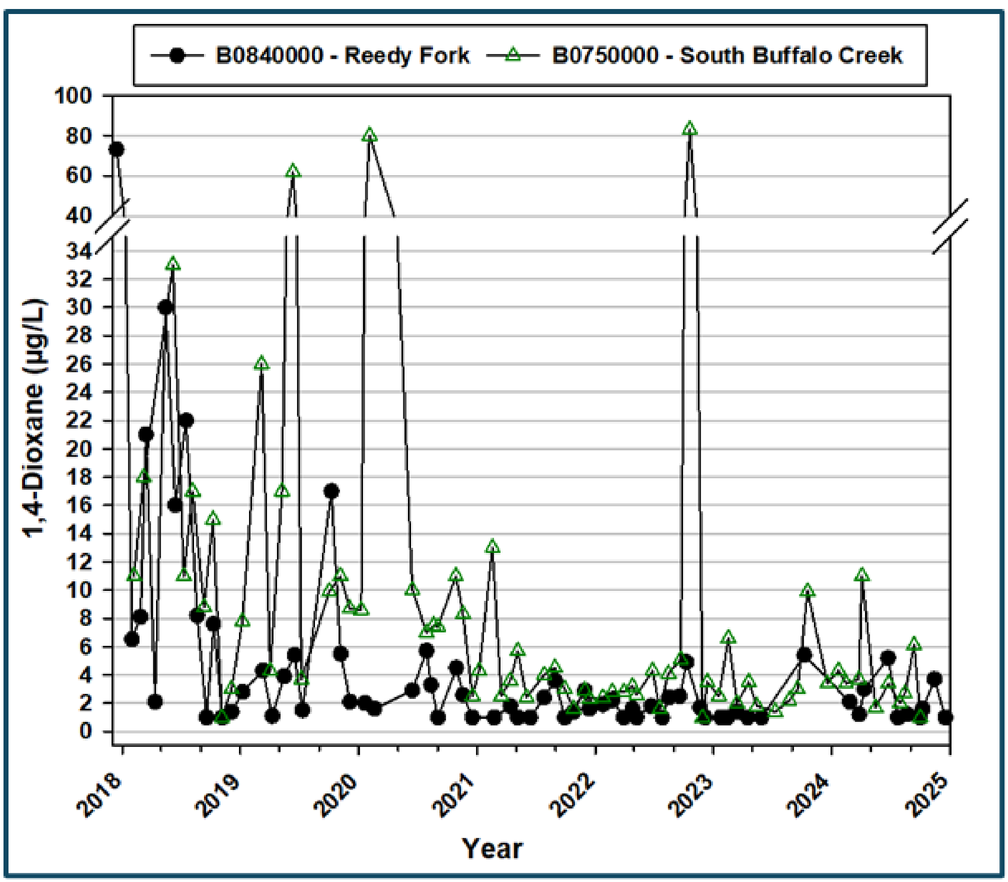
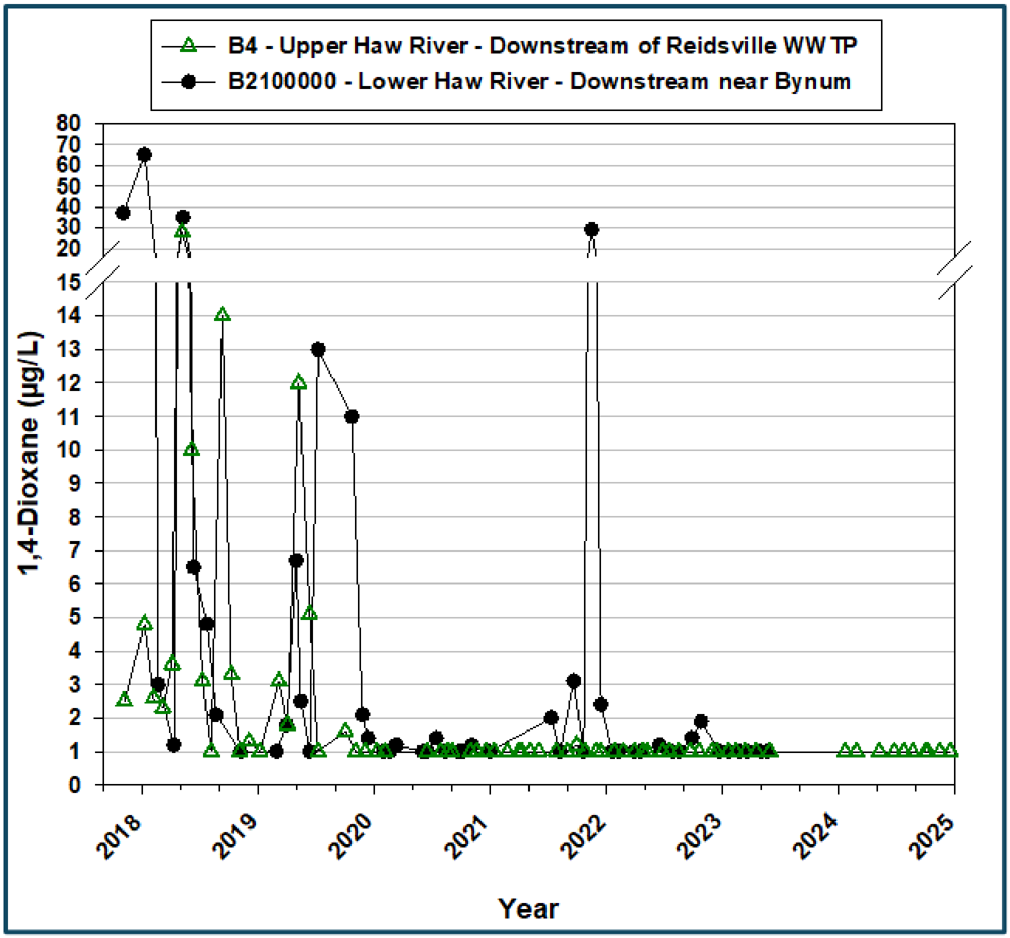


Figure 13-4: 1,4-Dioxane Concentrations in the Haw River Downstream of Reidsville's WWTP (B4) and in the Lower Haw River near Bynum (B2100000) Downstream of Many WWTP's. Note: The Axis Break on the Y-Axis (break between 15 and 16 µg/L).



Several SIUs discharging to POTWs in the Haw River watershed were identified as contributing 1,4-dioxane to this system (*Figure 13-1 B*). POTWs worked with DWR and pretreatment staff to identify the SIU sources and actively took steps to reduce 1,4-dioxane waste to their treatment works as seen by the reduction in the instream concentrations since 2022 (*Figure 13-3* and *Figure 13-4*).

The instream 1,4-dioxane concentrations recorded at the stations downstream of the City of Greensboro's TZ Osborne WWTP on South Buffalo Creek (B0750000) and further downstream in Reedy Fork (B0840000) (*Figure 13-1 B*) show a significant decline in instream concentrations as seen in *Figure 13-3*. The City of Greensboro entered into a Special Order by Consent (SOC) with the NC Environmental Management Commission which included phased annual compliance values of 35, 31.5, and 23 µg/L in years 2021, 2022 and 2023. Greensboro did not exceed any of the SOC yearly compliance values since year one (more information below in permitting section). The mean concentration in South Buffalo Creek downstream of the treatment plant between 2018 and 2022 was 11.8 µg/L, with maximum reading of 83 µg/L (n=52; n<1=2). The instream concentrations dropped to a mean of 3.9 µg/L, with maximum reading of 11 µg/L (n=20; n<1=1) for data collected between 2023 and 2024 (*Figure 13-3*). Further downstream from the wastewater treatment plant in Reedy Fork, the mean concentration between 2018 and 2022 was 7.2 µg/L, with a maximum reading of 73 µg/L (n=53; n<1=12). The instream concentrations dropped to a mean 2.8 µg/L and a maximum reading of 5.4 µg/L (n=16; n<1=7) for data collected between 2023 and 2024 (*Figure 13-3*).

Investigations identified specific SIUs as the source of 1,4-dioxane released into the upper Haw River via the City of Reidsville's WWTP. Elevated 1,4-dioxane concentration were observed at station B4 (Troxler Mill Rd), approximately 6.5 miles downstream of the WWTP discharge point (*Figure 13-1 B*). This section of the Haw River is classified as a Water Supply-IV (WS-IV). This means that the instream concentration must be protective of the EPA's drinking water health-based 1 in a million (1×10^{-6}) cancer risk level of 0.35 µg/L (EPA IRIS, 2013) at the discharge point. Between 2018 and 2019, 22 samples were collected at station B4. Of these, 17 samples (77%) had concentrations of 1,4-dioxane above the PQL with a mean concentration of 5.9 µg/L and a maximum concentration of 28 µg/L (*Figure 13-4*). In contrast, instream concentrations decreased significantly between 2020 and 2024, with only two out of 48 total samples (4%) at or above the PQL. The highest concentration recorded at station B4 during this time period was 1.2 µg/L in September 2021 (*Figure 13-4*).

Based on a May 2022 NPDES discharge permitting analysis, the lower Haw River near Bynum (stations B2100000), captures the flow from six major and 67 minor dischargers with a total permitted flow of 94.269 MGD. SIUs to any of these major POTWs could be contributing to the 1,4-dioxane load in the lower Haw River proper (*Figure 13-4*). Data from these studies and the POTWs found that Greensboro and Reidsville were the primary dischargers of 1,4-dioxane to the Haw River subbasin and downstream into Jordan Lake. The City of Burlington was also identified as discharging 1,4-dioxane to this system. The City of Burlington signed a memorandum of agreement (MOA) with the Haw River Assembly on October 22, 2020, to formalize a commitment by the city to test, analyze, and examine potential sources of PFAS and 1,4-dioxane compounds discharged from the City's two WWTPs (City of Burlington website and Oct. 22, 2020 media information release). The goal was to identify potential sources and reduce or eliminate these compounds prior to the WWTP discharge point. Their program could serve as a model for utilities across the state.

The Haw River instream 1,4 dioxane concentrations at station B2100000 near Bynum (*Figure 13-1 B*), NC have decreased significantly since 2020 with a few spikes captured in 2021 (*Figure 13-4*). These decreases coincide with the decreased discharge from the three major dischargers upstream (Greensboro, Reidsville and Burlington). Instream data at B2100000 is not available after May 2023. Monitoring has resumed as of March 2025 with results available on the 1,4-Dioxane Surface Water Sampling Results dashboard.

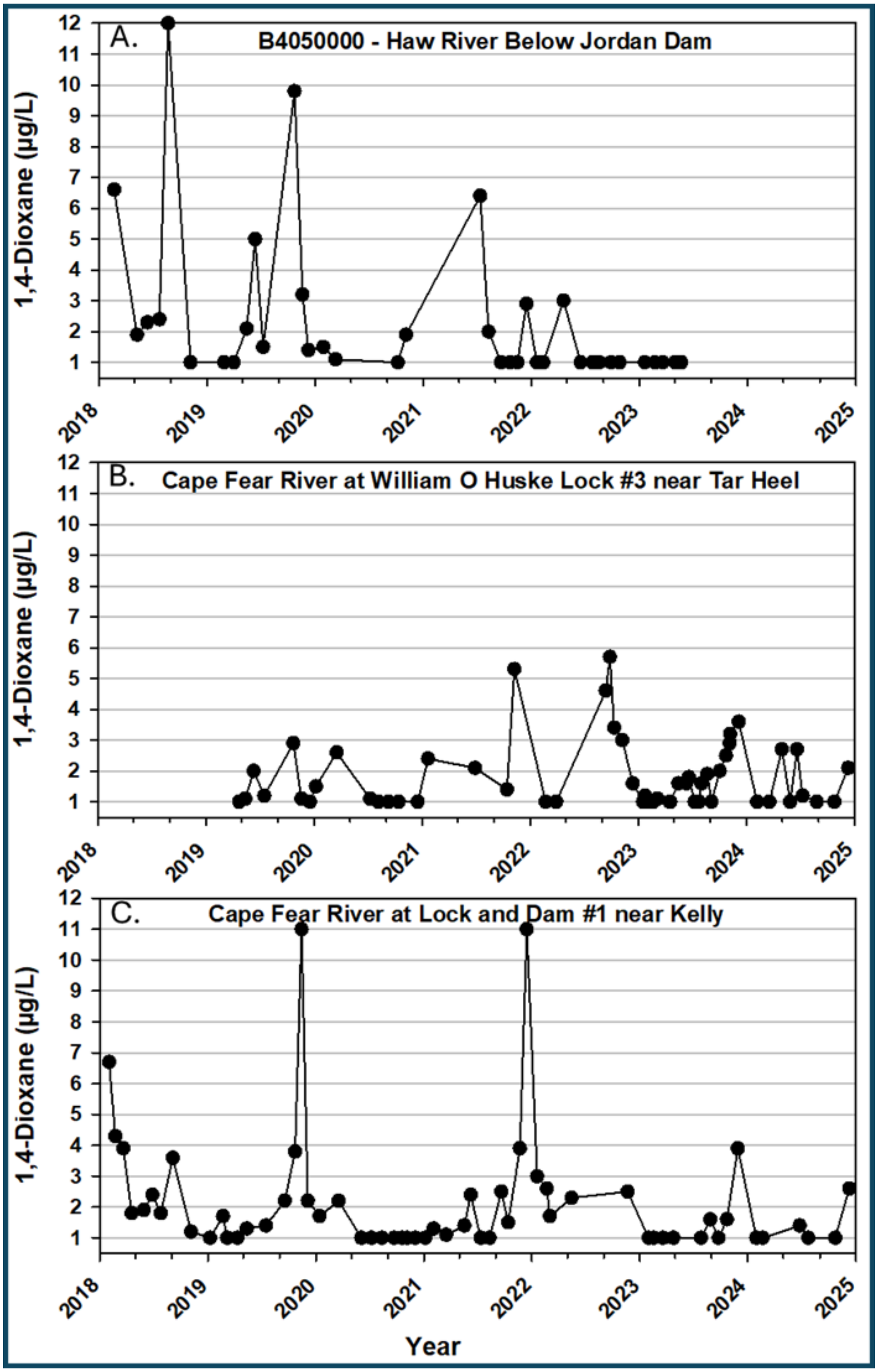
Overall, the instream 1,4-dioxane data in the Haw River shows a major drop in the instream concentrations overtime. There were several periods where overlapping spikes occurred at the upstream B4 station and downstream B2100000 station showing the impact from Reidsville. There are other spikes detected at the Haw River downstream station (B2100000) that are contributed by other sources below Reidsville. Efforts to reduce 1,4-dioxane from POTWs to surface water supplies in the Haw River subbasin have been successful. POTWs must remain committed to controlling this compound at the source by utilizing their pretreatment permitting authority to eliminate discharge of 1,4-dioxane to their treatment works in order to continue to protect all uses in this subbasin.

Downstream below Jordan Lake, the Haw River converges with the Deep River to form the Cape Fear River (*Figure 13-1 A*). From the confluence, the Cape Fear River flows south/southeast for 191 miles to the coast. Any 1,4-dioxane discharged into any of these river systems is highly mobile and readily transported downstream through many water supply watershed along the flow path towards the coast. Because 1,4-dioxane is not removed by conventional water treatment process, water supply treatment facilities that don't have advanced treatments technology pass 1,4-dioxane onto their customers.

The concentrations in the Haw River (B4050000) below Jordan Lake dam (*Figure 13-1 B*) demonstrates that the high concentrations in the Haw River above Jordan Lake prior to 2022 were transported downstream below the lake as well (*Figure 13-5 A*). Stations on the mainstem Cape Fear River (*Figure 13-1 D*) at the William O Huske Lock and Dam #3 (B8300000) and at Lock and Dam #1 near Kelly (B8350000) continue to show spikes of 1,4-dioxane in 2023 and 2024, likely due to the continued discharge of 1,4-dioxane from the Asheboro WWTP (*Figure 13-5 B and C*). Chemours Fayetteville Works Facility (located near Lock and Dam #3) participated in an effluent monitoring study (described below) to ensure that Chemours was not a source of 1,4-dioxane to the Cape Fear River.

Surface waters with the Cape Fear River Basin serve as the primary drinking water source for more than 1.2 million people (based on 2020 Local Water Supply Plan data; see section 5.7.3 and Table 5.5). Drinking water treatment plants face the challenge of installing expensive new technologies to eliminate emerging contaminants to meet safe drinking water standards. Many drinking water treatment facilities in the Cape Fear River Basin are modifying their treatment processes to ensure their water supply is below the EPA 1-in-a-million health-based risk level of 0.35 µg/L (DEQ, 2024 Legislative Report). The cost of this will be borne by the consumer instead of the chemical generator/discharger.

Figure 13-5: 1,4-Dioxane Concentrations in the (A.) Haw River Below Jordan Lake Dam (B0750000) and in the Mainstem Cape Fear River at (B.) Lock and Dam #3 near Tar Heel (B8300000) and (C.) Lock and Dam #1 near Kelly (B8350000).

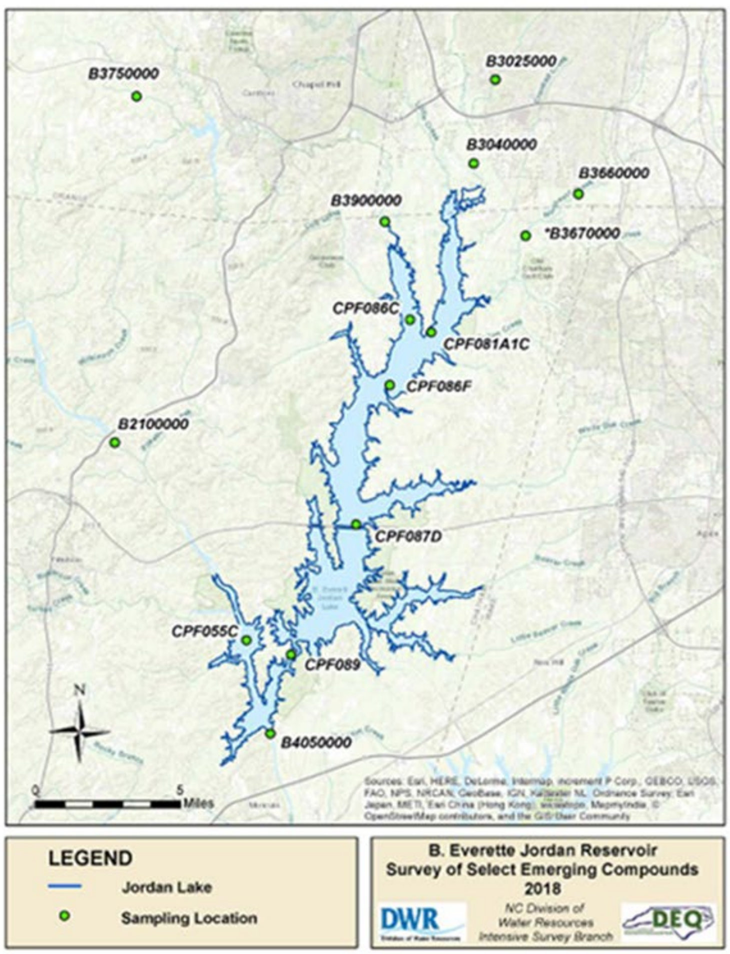


13.3.4 Jordan Lake Drinking Water Reservoir Monitoring Studies

In 2018, a study to characterize the presence, concentration and to identify which tributaries might contribute 1,4-dioxane to B. Everette Jordan Reservoir (Jordan Lake), a special study was initiated by DWR's Intensive Survey Branch (ISB) as part of their routine basinwide Ambient Lakes Monitoring Program (ALMP). Jordan Lake is a US Army Corps of Engineers multipurpose reservoir that was created to provide flood control, water supply, provide low-flow augmentation/protect downstream water quality, fish and wildlife conservation and recreation. Jordan Lake is a primary drinking water source for the Triangle area and can reliably provide up to a 100 million gallons per day water supply.

ISB collected 1,4-dioxane samples at six in-lake stations and at six tributary ambient monitoring stations in the watershed draining to Jordan Lake as well as one station below the dam of Jordan Lake (*Figure 13-1 B* and *Figure 13-6*).

Figure 13-6: B. Everette Jordan Reservoir Study Map (from [2018 Jordan Lake watershed study report](#)).



Station ID	Station Description
CPF086C	JORDAN LAKE AT MOUTH OF MORGAN CRK NR FARRINGTON
CPF081A1C	JORDAN LAKE AT MOUTH OF NEW HOPE CREEK
CPF086F	JORDAN LAKE NEAR FARRINGTON NC
CPF087D	JORDAN LAKE AT MOUTH OF WHITE OAK CREEK NR SEAFORTH
CPF055C	JORDAN LAKE ABOVE STINKING CREEK NR PITTSBORO NC
CPF089	JORDAN LAKE NEAR MERRY OAKS
B4050000	HAW RIV BELOW JORDAN DAM NR MONCURE
B2100000	HAW RIV AT SR 1713 NR BYNUM
B3900000	MORGAN CRK AT SR 1726 NR FARRINGTON
B3040000	NEW HOPE CRK AT SR 1107 NR BLANDS
B3660000	NORTHEAST CRK AT SR 1100 NR NELSON
B3025000	THIRD FORK CRK AT NC 54 NR DURHAM
B3750000	PHILS CRK NR CALVANDER

In 2018, 1,4-dioxane was detected above the detection limit or PQL of 1 µg/L, in three of the seven Jordan Lake stations (*Table 13-5*; [2018 Jordan Lake watershed study report](#)). The 1,4-dioxane mean concentrations for these three stations were 5.7, 1.7 and 3.9 µg/L for stations CPF055C/near Pittsboro, CPF087D/mouth of White Oak Creek and CPF089/near Merry Oaks, respectively (*Table 13-5*). The highest mean (5.7 µg/L) and maximum (11 µg/L) readings were in the Haw River arm of Jordan Lake (CPF055C) near Pittsboro. This station (CPF055C) is about 6.8 miles downstream of the Haw River ambient monitoring station B2100000 near Bynum (*Figure 13-1 B*). The two stations with reported 1,4-dioxane concentrations above the PQL in the 2018 watershed tributary study were B2100000, Haw River near Bynum and B4050000, Haw River just below the Jordan Lake dam. The results from these two watershed stations were presented above (*Figure 13-4* and *Figure 13-5*).

Table 13-5: B. Everette Jordan In-Reservoir 1,4-Dioxane Study Summary Results for Years 2018-2024.

Station CPF055C – Haw River Arm near Pittsboro; CPF087D – Lower New Hope Arm at mouth of White Oak Creek; and CPF089 – Lower New Hope Arm near Merry Oaks (See Figure 13-6).

Year	Summary	Jordan Lake			
		CPF055C Haw River arm near Pittsboro	**CPF087D** New Hope Cr. arm near White Oak Cr.	**CPF089** New Hope Cr. arm near Merry Oaks	**Other Stations Sampled^ All samples <1 µg/L***
2018	**Mean+**	**5.7**	1.7	3.9	81A1C, 86C, 86F, 87D
	n	5	4	5	
	n<1*	0	1	0	
	min	2.5	<1	1.6	
	max	11	1.8	6.4	
2020	**Mean+**	**<1**	<1	ND	81A1C, 86C, 86F
	n	6	6		
	n<1*	6	6		
2021	**Mean+**	**5.5**	<1	ND	81A1C, 86C, 86F
	n	10	10		
	n<1*	5	10		
	min	<1	<1		
	max	18	<1		
2022	**Mean+**	**2.8**	<1	ND	86F
	n	12	12		
	n<1*	10	12		
	min	<1	<1		
	max	3.1	<1		
2023	**Mean+**	**2.9**	<1	ND	86F
	n	10	11		
	n<1*	8	11		
	min	<1	<1		
	max	4.7	<1		
2024	**Mean**	**<1**	<1	ND	86F
	n	8	8		
	n<1*	8	8		

+The mean is equal to the average of all the samples above the PQL.
*The practical Quantitation Limit (PQL) or detection limit is 1 µg/L.
^Other stations in Jordan Lake sampled with no readings above the PQL.
ND – No data available for station that specific year.
Study Report links for 2018, 2020, 2021, 2022, 2023, & 2024 data.

Except for 2019, ISB has continued to sample Jordan Lake for 1,4-dioxane as part of their yearly monitoring program (ISB website). They sample between three and five stations each year (*Table 13-5*). Station CPF055C in the Haw River arm of Jordan Lake is the only station with detectable 1,4-dioxane since 2021. The yearly mean concentrations were 5.5, 2.8 and 2.9 µg/L in 2021, 2022, and 2023 respectively with a maximum recorded concentration of 18 µg/L on July 12, 2021 (*Table 13-5*). All stations in 2020 and 2024 were below the detection limit (*Table 13-5*).

13.3.5 Drinking Water Reservoir Monitoring Studies

As part of the ISB routine basinwide Ambient Lakes Monitoring Program in the Cape Fear River Basin, ISB collected 1,4-dioxane samples from 17 drinking water reservoirs in 2018 and 15 reservoirs in 2023 (does not include Jordan Lake as reported above). Due to limited resources in 2018, a single sample was collected from each of 17 drinking water reservoirs between May and August (*Table 13-6*). In 2023, four to five samples were collected at the 15 reservoirs between May and September (*Table 13-6*).

Table 13-6: 2018 and 2023 Cape Fear River Basin 1,4-Dioxane In-Lake/Drinking Water Reservoir Studies.

Waterbody Name	Subbasin – HUC 8#	ISB Station ID	Lake/Reservoir Station Location	2018 1,4-Dioxane µg/L Concentration	2023 1,4-Dioxane µg/L Concentration
Reidsville Lake	Haw River - 03030002	CPF002A2	At dam intake near Reidsville	<1*	<1*
Lake Brandt	Haw River – 03030002	CPF007B	At dam near Hillsdale	<1*	<1*
Lake Townsend	Haw River - 03030002	CPFLT8	At dam near Greensboro	<1*	<1*
Stony Creek Reservoir/ Lake Burlington	Haw River - 03030002	CPFSCR4	At dam near Carolina	<1*	<1*
Graham-Mebane Reservoir	Haw River - 03030002	CPFGMR4	At dam near Haw River	<1*	<1*
Lake Mackintosh	Haw River - 03030002	CPF038N	At dam near Alamance	<1*	<1*
Cane Creek Reservoir	Haw River – 03030002	CPFCCR6	At dam near Oaks	<1*	<1*
University Lake	Haw River - 03030002	CPFUL6	At dam near Chapel Hill	<1*	<1*
Oak Hollow Lake/High Point Res.	Deep River - 0303003	CPF089D5	At dam near High Point	<1*	<1*
High Point Lake/City Lake	Deep River – 0303003	CPF089E4	High Point Lake above Deep River	<1*	<1*
Randleman Lake	**Deep River - 0303003**	**CPFRD4**	**At Water Intake**	**2.7**	**1.1, 1.6, & 1.1** (Total n=5 & 2 <1 µg/L)
Sandy Creek Reservoir	Deep River - 0303003	CPFSC1	At dam near Ramseur	<1*	<1*
Carthage City Lake	Deep River - 0303003	CPF113R	At dam near Carthage	<1*	ND
Turner Reservoir	Deep River - 0303003	CPFTR01	At dam near Siler City	<1*	<1*

Waterbody Name	Subbasin – HUC 8#	ISB Station ID	Lake/Reservoir Station Location	2018 1,4-Dioxane µg/L Concentration	2023 1,4-Dioxane µg/L Concentration
Buckhorn Dam on Cape Fear River	**Upper Cape Fear River - 03030004**	**CPFBDL1**	**Buckhorn Dam Lake upstream of dam**	**1.4**	**1.8, 1.3** (Total n=5 & 3 <1 µg/L)
Harris Lake	Upper Cape Fear River - 03030004	CPF126A6	At SR1915 near Corinth	<1*	ND
Glenville Lake	Upper Cape Fear River - 03030004	CPF138B	At dam near Fayetteville	<1*	<1*

See April 1, 2019 ISB 2018 study report and March 12, 2024 ISB 2023 study report for data specific information.
*Below the Practical Quantitation Limit (PQL) of 1 µg/L.
ND- No data collected for assessment.

In both 2018 and 2023, only two drinking water reservoirs were identified with concentration of 1,4-dioxane above the PQL of 1 µg/L. These were Randleman Lake at station CPFRD4 near the water supply intake and behind Buckhorn Dam at station CPFBDL1 on the mainstem Cape Fear River (*Figure 13-1 C* and *D*). Randleman Lake is classified as a water supply-IV (WS-IV) and is the water supply reservoir for the High Point region. Randleman Lake receives wastewater impacts from the High Point East Side WWTP which discharges into the channel of the Deep River in the Randleman Lake/Reservoir (Outfall 002) about 8.5 miles upstream of their water supply intake. The concentration of the six samples collected in Randleman Lake at station CPFRD4 ranged between <1 to 2.7 µg/L (*Table 13-6*).

The Cape Fear River behind Buckhorn Dam is also classified as WS-IV and is the water supply for TriRiver Water which supplies treated drinking water to several communities in the area. The 1,4-dioxane concentration has ranged between <1 and 1.8 µg/L with three of the six samples below the PQL (*Table 13-6*). The source of 1,4-dioxane after 2021 is likely to be SIUs discharging to the City of Asheboro and High Points WWTPs. Reducing 1,4-dioxane to these water supplies is necessary and relies on discharges to work with their SIUs to eliminate the contaminant to their systems and protect downstream users. TriRiver Water tests for 1,4-dioxane and provides reports on their website.

13.3.6 NPDES Point Source Monitoring Studies

13.3.6.1 Winston-Salem Regional Office Monitoring

As result of the early Cape Fear River Basin watershed studies which found the highest instream concentrations of 1,4-dioxane immediately downstream of several major dischargers in the Haw and Deep rivers, the Winston-Salem Regional Office (WSRO) began (late 2017) a study monitoring the effluent discharge of several major NPDES permittees. WSRO collects or has collected long-term weekly grab and composite samples at six wastewater treatment plants (WWTP) (*Table 13-7*).

DWR sent letters to these six treatment plants to require investigative monitoring of their effluent. Due to ongoing concerns, WSRO continues to collect samples at Asheboro, High Point East Side and Burlington Southside WWTPs to confirm weekly 1,4-dioxane concentrations being released into surface waters. All six WWTPs continue to collect their own samples and report these results to DWR on their required monthly Discharge Monitoring Reports (DMRs). All municipalities in the Haw River subbasin have worked successfully with their SIUs to reduce the contribution of 1,4-dioxane to their treatment works, thereby reducing the 1,4-dioxane contribution to surface waters which was described above (*Figure 13-3* and *Figure 13-4*). See the Permitting Section below for additional details on these dischargers and their 1,4-dioxane reduction achievements.

Table 13-7: DWR-Winston-Salem Regional Office Point Source Effluent Monitoring

Wastewater Treatment Plants	WSRO Monitoring Period	Monitoring Activities	SIU's Reduced Discharge	DEQ Additional Investigative Monitoring Requested
Asheboro WWTP (NC00026123)	July 2021 - Present	Ongoing DEQ split samples		October 31, 2017 letter
Burlington – Eastside WWTP (NC0023868)	November 2019 – April 2020	Burlington entered into an agreement with Haw River Assembly to do monitoring and address sources.	✓	October 3, 2023 letter
Burlington - Southside WWTP (NC0023876)	October 2023 – Present	Burlington/Haw River Assembly agreement. Ongoing DEQ split samples	✓	October 3, 2023 letter
Greensboro TZ Osborne (NC0047384)	October 2019 - April 2021	SOC became effective and required monitoring.	✓	October 31, 2017 letter
High Point East Side (NC0024210)	June 2022 - Present	Ongoing DEQ split samples		October 1, 2018 letter
Reidsville WWTP (NC0024881)	October 2019 – September 2023	Reidsville continues to report weekly monitoring	✓	October 31, 2017 letter
T.Z. Osborne and Reidsville WWTP Dashboard (2017-2019) - Link				

13.3.6.2 Point Source Monitoring Studies

In 2019, to further assess the presence of 1,4-dioxane throughout the Cape Fear River Basin, a follow-up screening was conducted to better characterize the presence in various types of wastewater. DWR utilized the authority under 15A NCAC 02B .0508 (B)(2) and G.S. 143-215.66 to request investigative monitoring of POTWs with pretreatment programs and direct industrial discharges. The results of this monitoring will guide the development of a NPDES emerging compounds strategy to reduce or eliminate levels of emerging compounds discharged to surface waters to protect downstream ecological and human health uses. EPA method 624.1 was used for 2019 1,4-dioxane investigative monitoring with a reported PQL of 1 µg/L. All results were reported on the permittee's monthly DMRs. More information on these studies are available on the DEQ Managing Emerging Compounds in Water webpage.

Publicly Owned Treatment Works (POTWs) with Pretreatment Programs

Twenty eight POTWs with approved pretreatment programs in the Cape Fear River Basin received an investigative monitoring request letter in April 2019 (link). They were required to perform investigative monitoring at the treatment plant influent (incoming wastewater stream) because they receive wastewater from industrial sources that may contain 1,4-dioxane. Sampling was performed monthly for three consecutive months starting in July 2019.

The influent sampling study for 1,4-dioxane found that six of the 28 POTWs discharged elevated concentrations of 1,4-dioxane directly to water supplies or that would impact downstream water supplies resulting in instream concentration above the EPA 1-in-a-million health-based risk level (0.35 µg/L). These facilities include Greensboro T.Z. Osborne, Burlington Eastside, and Burlington Southside, Reidsville, High Point Eastside, and Asheboro WWTP. Three showed potential impacts to downstream water supplies but additional data is needed to confirm actual impacts. Fourteen POTWs report levels indicating no impacts to water supplies. Four POTWs reported concentrations below the PQL (1 µg/L), and one facility was not discharging during the study period. The NPDES permitting strategy later required monitoring at these and other facilities across the state. See these results in section 13.4, NPDES permitting strategy.

Industrial Direct Dischargers

Twenty Industries and Groundwater Remediation (GWR) sites in the Cape Fear River Basin received an investigative monitoring request letter in August and October 2019 (link). The effluent sampling was performed over a three-month period starting in October 2019. DWR required sampling at these facilities because they either had a history of discharging 1,4-dioxane indicator compounds or are industry types that are historically linked to the discharge of 1,4 dioxane or one or more of the PFAS compounds. DAK (NC0003719) located in Cedar Creek, NC was found to be the most significant industrial discharger of 1,4-dioxane impacting downstream water supplies. Their 2019 concentrations ranged between 1,030 – 3,180 µg/L. DAK ceased operations in July of 2025.

To view a map of the POTWs and industrial discharges included in the 2019 study and the 1,4-dioxane results, see DEQ Emerging Compound Facility Sampling map and website. Based on the data received, DWR has asked several of the POTWs and industries to continue monitoring for 1,4-dioxane in their effluent.

DWR continues to sample municipal wastewater treatment plants and surface waters across the Cape Fear River Basin. In addition, DWR continues to assist municipalities to minimize or reduce 1,4-dioxane coming from industrial wastewater. Reductions of 1,4-dioxane will primarily be achieved by SIUs installing best available treatment technologies to remove 1,4-dioxane or to substitute products used in their industrial processes. In January 2023, DWR presented the final Semi-Annual Progress Report on 1,4-dioxane in the Cape Fear River Basin and provided a written annual progress report on the 1,4-dioxane NPDES permitting strategy to the Water Quality Committee of the EMC, see the link for these documents.

The majority of the SIUs across the basin have taken steps to implement reduction measures to reduce their discharge load to their local WWTP or from direct discharge to surface waters. This has reduced the instream concentration downstream of these sources which have resulted in a decrease in concentration in drinking water supplies in the Haw River subbasin. However, there are still a few SIUs that need to do more to protect downstream users. DWR and some permittees notify downstream users when there is a discharge of elevated levels of 1,4-dioxane. Many drinking water treatment facilities in the Cape Fear River Basin are modifying their treatment processes to ensure their water supply is below the EPA 1-in-a-million health-based risk level of 0.35 µg/L (DEQ, 2024 Legislative Report). The cost of this will be borne by the consumer instead of the chemical generator/discharger.

13.4 NPDES Permitting Strategy

1,4-Dioxane enters publicly owned treatment works as a constituent of industrial and domestic wastewater. Most wastewater treatment plants are not currently designed for the removal of compounds such as 1,4-dioxane; therefore, it can pass through the treatment system and enter surface waters through effluent discharge. All wastewater discharged to surface waters must receive a National Pollutant Discharge Elimination System (NPDES) permit to track and control point sources of pollution.

Under the Clean Water Act (CWA), NPDES permits are required to set discharge limits for point source pollutants to protect water quality and downstream uses. Permit limits are based on a combination of technology-based effluent limits (TBEL) and water quality-based effluent limits (WQBEL) to control pollution from sources like industrial and municipal facilities (EPA NPDES Permit Basics website).

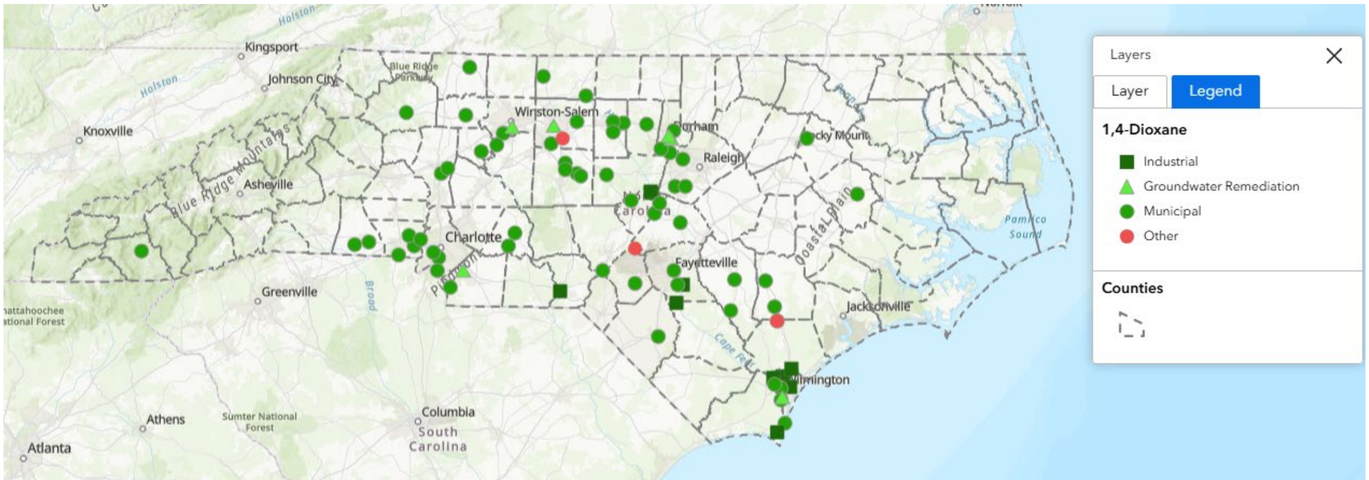
DWRs regulations applicable to the development of 1,4-dioxane effluent limits include:

- 15A NCAC 02B . 0203 identifies that water quality -based effluent limits for direct dischargers shall be developed by the Division such that the water quality standards and best usage of receiving waters and all downstream waters will not be impaired."
- 15A NCAC 02B . 0206(a)(4)(B) identifies that for the flow design criteria for effluent limitations, the average annual flow for toxic substances shall be used to protect human health.
- 15A NCAC 02B . 0208(a)(2)(B) identifies for carcinogens, an unacceptable exposed risk level is $1x10^{-6}$ or greater.
- 15A NCAC 02B . 0216(4)(d) Fresh Surface Water Quality Standards for Class WS- IV Waters identifies that no discharge of sewage... “shall be allowed that have an adverse effect on human health or that are not treated in accordance with the permit or other requirements established by the Division…”.

To ensure compliance and prevent further 1,4-dioxane contamination, DWR started incorporating monitoring requirements into NPDES permits renewals in 2018 for direct dischargers or POTWs that receive wastewater from SIUs that are likely to discharge 1,4-dioxane in their waste stream (DEQ, 2024 2nd Annual 1,4-Dioxane Progress Report).

DWR’s NPDES Permitting Section started in 2020 and continues to add 1,4 dioxane monitoring to industrial direct discharge permits as they are renewed, if they are known to discharge 1,4 dioxane, or if they have a Standard Industrial Classification (SIC) code or Toxics Release Inventory (TRI) information identifying that it could be a possible source of 1,4 dioxane. In addition, the permitting staff are adding 1,4 dioxane monitoring to Publicly Owned Treatment Works (POTWs) that have Significant Industrial Users (SIUs) that are possible sources based on SIC and TRI information as well. As of January 2026, approximately 82 NPDES permitted facilities are monitoring or have monitored for 1,4-dioxane (includes groundwater remediation permits and an “other” category that are likely to discharge 1,4-dioxane) (*Figure 13-7*).

Figure 13-7: NC Map of NPDES Wastewater Dischargers that have and/or Continue to Monitor Effluent for 1,4-Dioxane Concentrations (December 2025 – NPDES Permitting Section).



To date, the most elevated levels of 1,4-dioxane discharged from direct or indirect (SIUs) industrial facilities have been from industries located in the Cape Fear River Basin. Of the approximately 82 NPDES permitters monitoring for 1,4-dioxane, 60 are POTWs and 22 are Industrial Direct Dischargers (IDDs). These 60 POTWs covers discharge from 109 of the 155 SIUs suspected of having 1,4-dioxane in their discharge to POTWs (NPDES Permitting Branch data January 7, 2026).

The POTW results specifically includes (NPDES Municipal Permitting Branch, January 2026):

- Required 1,4-dioxane monitoring be conducted at 60 POTWs, with a mixture of major facilities (> 1 MGD) and minor facilities (< 1 MGD) with an active pretreatment program.
- Based on the data provided to date from the 60 sampled POTWs:
    - 34 POTW facilities have reported no detectable levels of 1,4-dioxane, with varying amounts of sampling ranging from 3 samples to 24 samples,
    - 15 POTW facilities have reported detectable levels of 1,4-dioxane but would not need permit effluent limits due to levels detected being sufficiently below the pertinent allowable discharge concentration,
    - 11 POTW facilities have shown a potential need for 1,4-dioxane limits.
        - 1 in the Tar-Pam River Basin
        - 2 in the Yadkin River Basin
        - 8 in the Cape Fear River Basin
            - Only 2 facilities exceed the calculated 1,4-dioxane allowable discharge concentrations in their discharge (City of Asheboro and High Point WWTPs)

The Industrial Direct Dischargers specifically include (Industrial Permitting Branch, January 2026):

- Required 22 IDDs to monitor for 1,4-dioxane concentrations. This work is still in the investigative stage (results are pending).
    - 1 Industrial facilities showed a potential need for a calculated 1,4-dioxane allowable discharge concentration; this facility closed operation in July 2025 (Alpek/DAK America).

- 2 industrial facilities showed 1,4-dioxane concentrations greater than non-detect but no reasonable potential to exceed effluent concentrations that would be protective of the EPA health-based drinking water concentration representing a 1-in-a-million (1x10-6) cancer risk level for 1,4-dioxane of 0.35 µg/L at the nearest downstream water supply. Both of these facilities discharge groundwater remediation wastewater.

Unlike PFAS, 1,4-dioxane comes from a smaller number of sources and is not widespread across the state. Most of North Carolina's 1,4-dioxane pollution can be traced to specific industrial dischargers in the Cape Fear River Basin. The surface water data shown in *Table 13-1* and *Table 13-2* supports these findings and demonstrates that 1,4-dioxane is primarily of concern in the Cape Fear River Basin with some lesser detections found in the Yadkin-Pee Dee River Basin. Setting enforceable limits in discharge permits would protect drinking water supplies.

Regulating these discharges has been difficult given current litigation over the ability to regulate 1,4-dioxane through the state's narrative standard for toxics. As of late 2025, DEQ is in litigation over DWR's NPDES permitting authority to include 1,4-dioxane water quality-based effluent limits into NPDES permits. The US EPA Region 4 stated in a January 2025 letter to DWR that 1,4-dioxane limits is a requirement of the CWA Section 301(b)(1)(C) and 40 CFR § 122.44(d) if a discharger is found to discharge 1,4-dioxane to waters of the United States in amounts that had a reasonable potential to cause the receiving waters to exceed state water quality standards.

On February 5, 2026, the Wake County Superior Court upheld DEQs authority to set wastewater permit limits for 1,4-dioxane (DEQ Feb 12, 2026 press release). The court found that DEQ followed proper state and US EPA protocols in creating the 1,4-dioxane limits and "created the criteria for the purpose of protecting the health and wellbeing of North Carolinians". The Wake County Superior Court ruling is on hold while the City of Asheboro, joined by Greensboro and Reidsville are appealing the ruling to the North Carolina Court of Appeals.

13.5 Implementation through NPDES Permitting and State and Local Pretreatment Programs

Since 2014, DWR has been investigating and sampling for 1, 4 dioxane in the Cape Fear River Basin and actively working to prevent discharges. DWR identified target areas of concern, including areas downstream of the Asheboro, Greensboro, Reidsville, Burlington and High Point wastewater treatment plants (*Figure 13-1*). The division has worked with those facilities to reduce and prevent discharges through several measures including requiring effluent monitoring and the submission of corrective action plans outlining steps to further reduce 1,4 dioxane in their discharge and encouraging industrial dischargers to use the Division of Environmental Assistance and Customer Services' engineering consultants to evaluate pollution prevention options at the source.

For this document, an NPDES permit overview of the five municipalities/POTWs identified as contributing to the highest 1,4-dioxane load in 2014 is included (*Table 13-1, Table 13-8* and *Figure 13-1*). Most of the SIUs discharging to these POTWs have made significant improvements over the last several years resulting in limited excursions of any proposed effluent limits that would be protective of the EPA health-based drinking water concentration representing a 1-in-a-million (1 $x10^{-6}$) cancer risk level for 1,4-dioxane of 0.35 µg/L (EPA IRIS, 2013).

Table 13-8: DWR NPDES Permitted Flow and Significant Industrial Users (SIU) Summary for the Five Municipalities with the Highest Potential 1,4-Dioxane Contributions to the Cape Fear River Basin.

WWTP Name	Permitted Discharge Volume (MDG)	2024 Average Monthly Discharge (MGD)	% Non-SIU*	% SIU	Permitted Industrial Flow (MGD)	2024 Average Industrial Flow (MGD)	2024 Number of Pretreat-ment SIUs	1,4-Dioxane Monthly Ave. Max^ (µg/L)	1,4-Dioxane Daily Max^ (µg/L)
Asheboro (NC0026123)	9	3.78	93.64	6.36	0.572	0.2531	12	21.58	49.4
Burlington – Eastside (NC0023868)	12	4.47	81.1	18.9	N/A	0.781	6	21.99	63
Burlington - Southside (NC0023876)	12	7.49	91.28	8.72	N/A	0.533	10	21.99	63
Greensboro TZ Osborne (NC0047384)	56	35.37	93.43	6.57	3.68	1.84	29	5	10
High Point East Side (NC0024210)	26	14.55	96.91	3.09	0.804	0.19	18	1.19	NA
Reidsville (NC0024881)	7.5/5.5	2.29	76.51	23.49	1.76	0.646	8	6.3	6.9

*Non-SIU or domestic wastewater is wastewater from non-industrial, domestic-type activities such as wastewater from toilets, showers, sinks, and kitchens, originating from residential, commercial or public facilities. This could also include small industrial practices that do not require a pretreatment permit from the local municipality.
^1,4-Dioxane effluent concentrations that would be protective of the EPA health-based drinking water concentration representing a 1-in-a-million (1 x10^{-6}) cancer risk level for 1,4-dioxane of 0.35 µg/L at the nearest downstream water supply classified stream segment (EPA IRIS, 2013).
Pretreatment information provided by DWR Pretreatment Unit Dynamics 365 data pull, January 26, 2026.

13.5.1 City of Asheboro WWTP (NC0026123)

The City of Asheboro owns and operates the Asheboro WWTP and is permitted to treat domestic (non-SIU) (93.64%) and industrial (6.36%) wastewater. The industrial portion represents up to 0.572 MGD of the 9.0 MGD total as-built permitted flow. The 2024 monthly average effluent flow rate was 3.78 MGD with an average industrial flow of 0.2531 MGD (6.7% of the 2024 average monthly flow rate) (*Table 13-8*). The facility serves a population of about 26 thousand residents and operates a pretreatment program with 12 SIUs. The WWTP discharges to Haskett Creek about 0.7 miles upstream of the confluence with the Deep River. There is a DWR ambient monitoring station (B4890000) and co-located benthic macroinvertebrate station (BB363) at Wow Road, about 0.5 miles downstream of the discharge point on Haskett Creek (*Figure 13-1 C*). This section of Haskett Creek [AU# 17-12b2] is listed as impaired on the EPA approved NC 2022 Integrated Report (IR) due to elevated levels of copper and for poor benthic macroinvertebrate health and community structure. The water quality data collected at this location indicates that there are elevated levels of inorganic nitrogen (NO_3+NO_2), total nitrogen, total phosphorus, fecal coliform bacteria, conductivity as well as 1,4-dioxane concentrations. Haskett Creek has consistently had the highest levels of 1,4-dioxane concentration identified in the Cape Fear River Basin and across the state (see data above (add section # here). According to the 2023 NPDES permit fact sheet, the average flow rate of Haskett Creek is 12 cfs, with a summer 7Q10 of zero cfs. This does not provide much dilution until Haskett Creek flows into the Deep River.

1,4-Dioxane is completely miscible in water and resistant to biodegradation. The mass loading of 1,4-dioxane identified in the facility discharged to Haskett Creek is expected to persist downstream to the nearest water supply (WS-IV) boundary on the Deep River, located 43.5 miles downstream of the outfall.

As previously stated above, DWR issued a letter dated October 31, 2017, requiring monthly effluent monitoring beginning December 2017 and reporting these results on their monthly eDMRs. DWR also issued a letter requesting the City develop and submit a corrective action plan for 1,4-dioxane reduction by September 23, 2019. The requested plan was submitted and outlined the City's aim to continue monitoring and coordinating with industrial users toward reduction of 1,4-dioxane entering the WWTP (2023 DWR fact sheet).

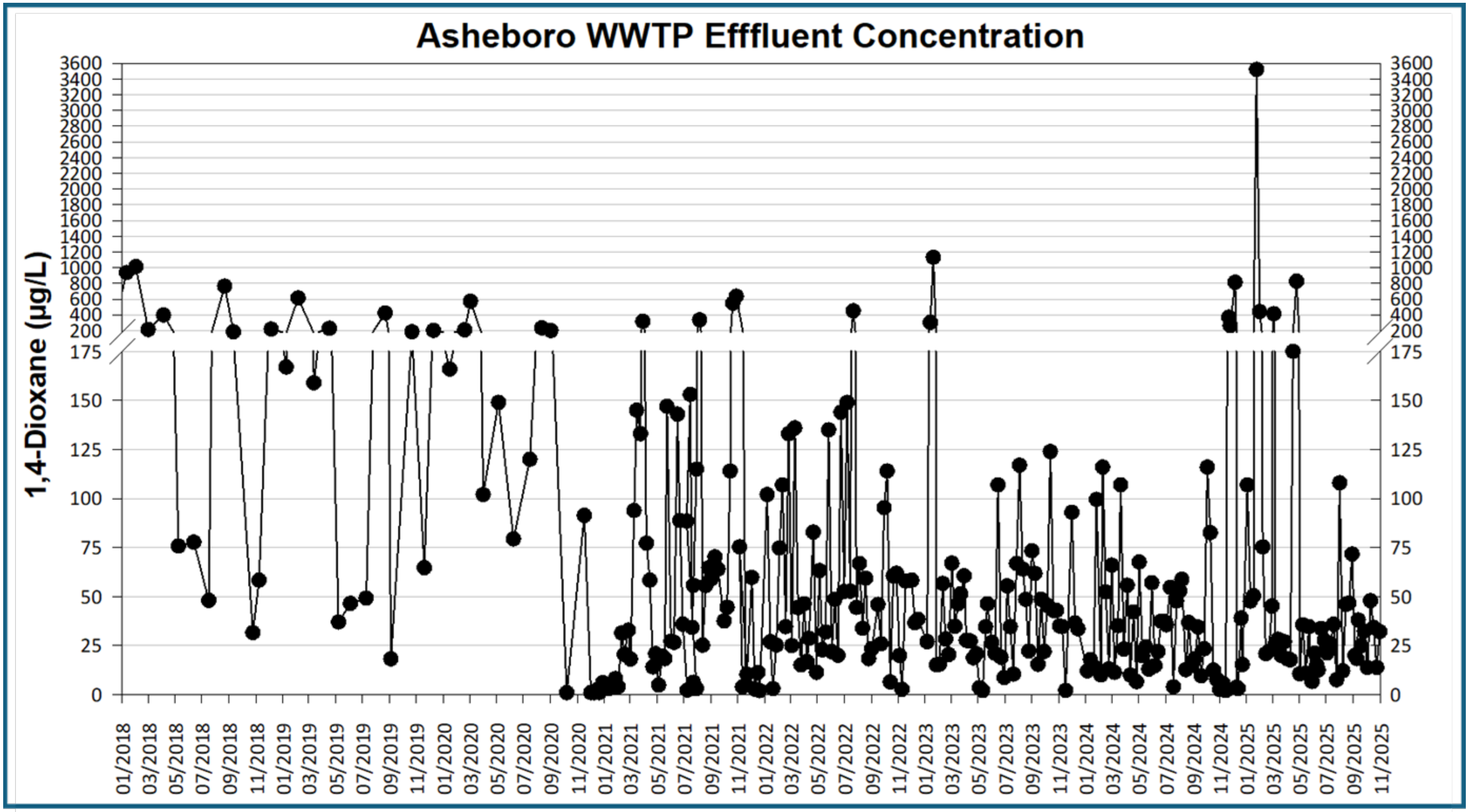
The City of Asheboro's WWTP 1,4-dioxane effluent monitoring results range between less than 1 to 3,520 µg/L, with a mean and median of 96.9 and 36.5 µg/L respectively from 295 grab samples collected between January 2018 and October 2025 (*Table 13-9* and *Figure 13-8*). Of the 71 instream ambient samples collected in Haskett Creek, downstream of the Asheboro's WWTP at station B489000 between January 2018 and December 2024, only a single sample collected on May 7, 2023, was below the PQL. The range of the remaining 70 samples was between 1.9-1,000 µg/L (*Table 13-3*, *Table 13-4* and *Figure 13-2*). The mean and median concentrations were 115 and 55 µg/L respectively with 50.7% of the records over 50 µg/L and 83% over 10 µg/L.

Table 13-9: City of Asheboro's Wastewater Treatment Plant 1,4-Dioxane Yearly Effluent Concentration (µg/L) Summary

Year	2018	2019	2020	2021	2022	2023	2024	Jan-Oct 2025	January 2018 – October 2025
n	12	12	16	57	48	49	53	47	295
Mean (µg/L)	334.28	182.47	120.62	73.58	61.94	68.32	58.88	143.35	96.9
Median (µg/L)	197.00	163.00	96.65	32.90	45.15	34.80	23.40	28.20	36.5
Minimum (µg/L)	31.60	18.20	1.00	2.00	2.68	2.10	2.00	6.66	1
Maximum (µg/L)	1,011	613	571	636	449	1,130	813	3,520	3,520
n <21.58* µg/L	0	1	6	24	9	13	24	17	94
n >21.58* µg/L	12	11	10	33	39	36	29	30	201
% >21.58* µg/L	100	91.7	62.5	57.9	81.3	73.5	54.7	63.8	68.1
n <49.4 µg/L	2	4	6	33	27	34	37	37	180
n >49.4 µg/L	10	8	10	24	21	15	16	10	115
% >49.4 µg/L	83.3	66.7	62.5	42.1	43.8	30.6	30.2	21.3	39

*21.58 µg/L monthly average 1,4-dioxane effluent concentration would protect downstream water supplies from exceeding the EPA health-based drinking water concentration representing a 1-in-a-million (1×10^{-6}) cancer risk level for 1,4-dioxane of 0.35 µg/L (EPA IRIS, 2013).
Note: 1,4-Dioxane concentrations are based on a permitted as-built flow of 9 MGD.

Figure 13-8: City of Asheboro's WWTP 1,4-Dioxane Effluent Concentrations for January 2018-October 2025. Note: Y-Axis Break between 175 and 200 µg/L. Data from BIMS data pull Dec. 4, 2025.



Due to these elevated instream concentrations and known 1,4-dioxane sources to Asheboro's WWTP, DWR issued an NPDES permit to the City of Asheboro in August 2023, which included an effluent limit for 1,4-dioxane in order to protect downstream water supplies and fish consumption uses. The NPDES permit limits were developed following established EPA and state approved regulations set in place specifically to protect downstream uses (EPA's 1/3/25 Letter, 15A NCAC 02B .0208). The permit provided for a five-year, three-phase compliance schedule to meet the final effluent limits of 21.58 µg/L monthly average and a daily maximum limit of 49.4 µg/L. These effluent limits were specifically set to ensure that the downstream water supply (~45 mile downstream) would not exceed a 1-in-a-million (1 x10^{-6}) cancer risk level based on NC DEQ's derived numeric standard. Table # shows the number of effluent samples reported to DWR that exceeded these protective 1,4-dioxane values each year with 68% over 21.58 µg/L and 39% over 49.4 µg/L between January 2018 and October 2025.

On September 19, 2023, the City of Asheboro filed a petition for contested case hearing to the NC Office of Administrative Hearings (OAH). Asheboro's petition challenged various 1,4-dioxane effluent limitations and conditions contained in its NPDES renewal permit (NC0026123)(NC OAH 24 EHR 00862 Final Decision Sept. 12, 2024). On September 12, 2024, the administrative law judge (ALJ) determined that the 1,4-dioxane effluent limit included in the permit was void and unenforceable. As a result of the OAH ruling, in October 2024, DWR revised the NPDES permit to not include 1,4-dioxane discharge limits. In accordance with EPA requirements, DWR provided the October 2024 version of the permit to EPA for review.

"On October 31, 2024, EPA sent a General Objection to NC DEQ stating that, based on its preliminary review of the permit, the removal of the effluent limits for 1,4-dioxane may not be consistent with the Clean Water Act (CWA) Section 301(b)(1)(C) and 40 CFR § 122.44(d), which require NPDES permits to include effluent limits as stringent as necessary to meet state water quality standards" (EPA public notice September 4, 2025 and EPA website). According to a January 2025 EPA letter describing their objection, EPA describes in detail their concerns with the OAH ruling and approved of how and why DEQ included the 1,4-dioxane limits in the initial October 2023 NPDES permit for the City of Asheboro.

EPA is required to hold a public hearing on its specific objections if requested. An EPA public hearing was held in Asheboro, NC on October 22, 2025 and took public comments through October 31, 2025 (public hearing link). The Clean Water Act says that after considering the information provided during the public comment period, EPA must make a final decision that either reaffirms their objection, modifies the objection, or withdraws the objection to the permit. As of December 2025, EPA has not completed their final determination.

EPA's letter indicated that "if this objection is not resolved by the state, any permit that ultimately has to be issued by the EPA for Asheboro would include the WQBEL for 1,4-dioxane as established by the NC DEQ as necessary to meet the Narrative Standard" (EPA letter, Jan. 2024).

The original October 2023 City of Asheboro NPDES permit is still (Dec. 2025) in litigation as DEQ has appealed the OAH decision to the NC Superior Court. The final phased in effluent limit in the October 2023 permit was 21.58 µg/L which would protect the downstream water supply from exceeding the EPA health-based drinking water concentration representing a 1-in-a-million (1 x10^{-6}) cancer risk level for 1,4-dioxane of 0.35 µg/L (EPA IRIS, 2013). On February 5, 2026, the Wake County Superior Court upheld DEQs authority to set wastewater permit limits for 1,4-dioxane (DEQ Feb 12, 2026 press release). The court found that DEQ followed proper state and US EPA protocols in creating the 1,4-dioxane limits and "created the criteria for the purpose of protecting the health and wellbeing of North Carolinians". The City of Asheboro has appealed this decision to the Court of Appeals.

Asheboro's WWTP continues to discharge high levels of 1,4-dioxane in their effluent as seen in *Figure 13-8*. According to the NPDES permit fact sheet, there are two sources that discharge high levels of 1,4-dioxane to their WWTP. Asheboro's pretreatment program has the authority to require the SIU and the landfill to treat their waste prior to exporting their waste to the Asheboro WWTP. This would allow the WWTP to meet the instream concentration levels needed to protect downstream users. Ultimately, it is up to the City of Asheboro to determine if they want to bear the cost of treating their waste to eliminate 1,4-dioxane or to pass the burden on to the generator of the contaminant wastewater. DEQ sent out a press release on November 14, 2025 notifying the public and downstream drinking water utilities of a discharge from the Asheboro WWTP of 651 µg/L (ppb) on November 7, 2025 (Link to public notice). This is just an example of the continuing impacts that are occurring downstream of Asheboro's WWTP. Updated effluent graphs will be available on DEQ's Cape Fear River Basin 1,4-Dioxane Wastewater Discharge Data website.

13.5.2 City of Greensboro's T.Z. Osborne WWTP (NC0047384)

The City of Greensboro owns and operates the T.Z. Osborne WWTP and is permitted to discharge domestic (non-SIU) (93.43%) and industrial (6.57%) wastewater. The industrial portion represents up to 3.68 MDG of the 56 MGD total permitted flow. The 2024 monthly average effluent flow rate was 35.37 MGD with an average industrial flow of 1.84 MGD (5.2% of the 2024 average monthly flow rate) (*Table 13-8*). The facility serves a population of about 300 thousand residents and operates a pretreatment program with 29 SIUs. The WWTP discharges to South Buffalo Creek [AU# 16-11-14-2c] which is listed as impaired on the EPA approved NC 2022 Integrated Report (IR) due to elevated levels of fecal coliform bacteria and for aquatic life due to fair benthic macroinvertebrate and poor fish health and community structure. The water quality data collected downstream of the discharge location (B0750000 on South Buffalo Cr. and B0840000 on Reedy Fork) indicates that there are elevated levels of inorganic nitrogen (NO_3+NO_2), organic nitrogen (TKN), ammonia (NH3), total nitrogen, total phosphorus, fecal coliform bacteria, conductivity as well as 1,4-dioxane concentrations. *Table 13-3* shows that in South Buffalo Creek at station B0750000 the 1,4-dioxane concentration range between <1-83 µg/L with a mean of 9.6 µg/L. Approximately 96% of the samples tested were greater than the PQL of 1 µg/L. Instream concentrations in South Buffalo and Reedy Fork have declined substantially since 2018 (*Figure 13-3*; section *13.3.3*).

In 2010, the City of Greensboro requested speculative limits from DWQ for a proposed consolidation of the North Buffalo WWTP into an expanded T.Z. Osborne WWTP (from 40 MGD to 56 MGD). North Buffalo Creek WWTP ceased discharging into North Buffalo Creek on Oct. 6, 2017. All of the City of Greensboro's wastewater is now treated by the T.Z. Osborne WWTP. The T.Z. Osborne expansion and upgrade included biological nutrient removal (BNR), specifically designed to meet the Jordan Lake nutrient reduction requirements and was completed in August 2021. T.Z. Osborne WWTP, like most other treatment plants, was not designed to treat emerging contaminants like 1,4-dioxane or PFAS. These emerging contaminants pass through treatment systems and enter surface waters via effluent discharge. The T.Z. Osborne WWTP was identified as a contributor of 1,4-dioxane into the Haw River system impacting downstream water supply sources. In 2015, the City of Greensboro began a source identification and source reduction plan. DWR regional office, permitting and pretreatment staff are continually working with the municipalities and permitted dischargers to identify potential sources of

1,4-dioxane and to address or eliminate the contamination at the source prior to discharge to the WWTP.

The Winston-Salem Regional Office (WSRO) began (late 2017) a study monitoring the effluent discharge of several major NPDES permittees including T.Z. Osborne. This includes long-term weekly grab and composite samples at six wastewater treatment plants (WWTP) (*Table 13-7*). See Section *13.3.5* above for details. Beginning December 2017, monthly 1,4-Dioxane monitoring was required by a letter from DWR, which was increased to weekly starting May 1, 2021. The City of Greensboro also reports their effluent 1,4-dioxane data on their website.

As result of high effluent concentrations, DEQ in collaboration with the City of Greensboro entered into a special order by consent (SOC) which was amended and went into effect in November 2021. The three year SOC (EMC SOC WQ S19-010) required Greensboro to identify 1,4-dioxane SIU sources and significantly reduce loadings to their POTW. Greensboro did not exceed the SOC compliance value after the first year, significantly reducing 1,4-dioxane that was impacting downstream water supplies (*Figure 13-9*). Their SOC wastewater discharge compliance concentrations were no greater than a daily maximum of 35 µg/L, 31.5 µg/L and 23 µg/L in years 1 through 3 respectively with a requirement to notify DWR and downstream users when violations were detected.

As part of their SOC, the City of Greensboro added direct monitoring of their SIUs and two surface water sites on the Haw River at Pittsboro's drinking water intake and in Haw River arm of Jordan Lake. Greensboro has reported a 97% reduction in their effluent concentration since 2015 (Greensboro's website, Oct. 2025).

Figure 13-9 shows that the Greensboro WWTP continues to discharge 1,4-dioxane at levels at or below their year 3 compliance level of 23 µg/L (data through October 2025). The mean and median 1,4-dioxane concentrations were 3.43 and 2.43 µg/L respectively for the period since the end of the SOC (July 2024). *Table 13-10* shows the change in effluent concentrations since 2018, with a significant decline in the mean and maximum concentrations since 2018. On August 7, 2019, a 957.3 µg/L concentration was recorded as the highest reported effluent measurement during this period (January 2018-October 2025). This was calculated to be a load of 282.3 lbs. The City of Greensboro entered into an SOC with the state shortly after this event. Updated graphs will be available on the DEQ Cape Fear River Basin 1,4-Dioxane Wastewater Discharge Data website and the City of Greensboro's website).

Since the SOC expired on July 15, 2024, prior to the NPDES permit renewal, the City provided a list of post-SOC voluntary activities. These include continued effluent monitoring and reporting, pretreatment program activities, and collection system, influent and surface water monitoring for 1,4-dioxane.

Based on the EPA instream water supply 1,4-dioxane concentration of 0.35 µg/L at the downstream WS-IV supply boundary, a discharge concentration of 5.0 µg/L monthly average and a daily maximum of 10 µg/L would ensure long-term human health protections (less than 1-in-a-million cancer risk level). Since the end of the SOC, the reported effluent grab samples exceeded 10 µg/L two times (*Table 13-10* and *Figure 13-9*).

Figure 13-9: City of Greensboro's T.Z. Osborne 1,4-Dioxane Effluent Concentrations.

A.) 2018-2022 Effluent Concentrations with Amended SOC Year-1 and Year-2 Limits Line with Y-Axis Break (between 80 and 100 µg/L).
B.) 2023-October 2025 Effluent Concentrations with SOC Year-3 Limits Line with Y-Axis Break (between 12 and 20 µg/L).
Note the Y-axis is different for each graph. BIMs data pull Dec. 4, 2025.

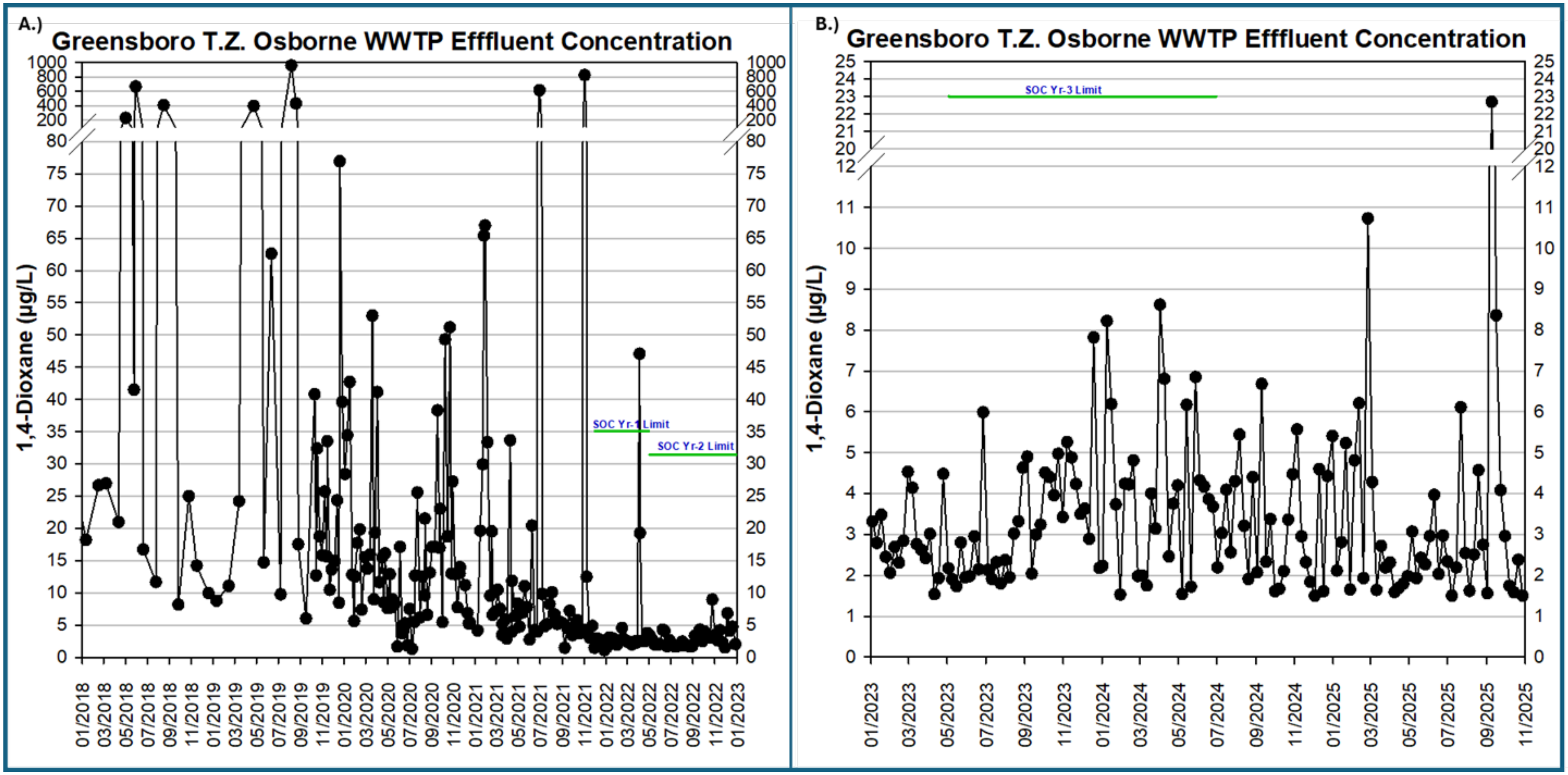


Table 13-10: City of Greensboro's T.Z. Osborne WWTP 1,4-Dioxane Yearly Effluent Concentration (µg/L) Summary and the Post SOC Summary (Aug. 2024-Oct. 2025; highlighted in green/last column).

Year	2018	2019	2020	2021	2022	2023	2024	Jan-Oct 2025	Post SOC Aug 2024-Oct 2025
n	14	26	61	56	53	52	53	43	65
Mean (µg/L)	108.70	89.33	15.65	35.47	4.02	3.18	3.68	3.50	3.43
Median (µg/L)	22.96	18.13	12.85	5.79	2.58	2.87	3.68	2.38	2.43
Minimum (µg/L)	8.14	5.98	1.26	1.06	1.50	1.54	1.50	1.50	1.50
Maximum (µg/L)	665.00	957.50	53.00	823.00	47.10	7.82	8.62	22.70	22.70
n >5 µg/L	14	26	56	34	4	3	10	6	10
% >5 µg/L	100	100	91.8	60.7	7.5	5.8	18.9	14.0	15.4
n >10 µg/L	12	22	37	15	2	0	0	2	2
% >10 µg/L	85.7	84.6	60.7	26.8	3.8	0	0	4.7	3.1

*5 µg/L monthly average 1,4-dioxane effluent concentration would protect downstream water supplies from exceeding the EPA health-based drinking water concentration representing a 1-in-a-million (1 x10-6) cancer risk level for 1,4-dioxane of 0.35 µg/L (EPA IRIS, 2013).
Note: 1,4-Dioxane concentrations are based on a permitted as-built flow of 56 MGD.

13.5.3 City of Reidsville WWTP (NC0024881)

The City of Reidsville owns and operates the Reidsville WWTP and is permitted to treat domestic (76.51%) and industrial (23.49%) wastewater. The permitted industrial portion represents up to 1.76 MDG of the 7.5 MGD total permitted flow. To accommodate lowered flow as well as to meet the Jordan Lake NSW nutrient allocation limits, on July 16, 2020, the City requested a permit modification to add a lower treatment flow tier of 5.5 MGD. Their 2024 monthly average effluent flow rate was 2.29 MGD with an average industrial flow of 0.646 MGD (28.2% of the 2024 average monthly flow rate) (*Table 13-8*). The facility serves a population of about 14.5 thousand residents and operates a pretreatment program with 8 SIUs (2024 System Performance Annual Report, 2025, City of Reidsville).

The City of Reidsville moved their discharge pipe from Little Troublesome Creek to the Haw River in 1998, approximately about 0.35 miles downstream of the confluence with the Little Troublesome Creek near NC Hwy 150. This allowed for greater dilution (IWC=61%) and improved water quality conditions in Little Troublesome Creek. The Haw River [AU# 16-(6.5)] at the discharge point is classified as a water supply-IV (WS-IV). There is a coalition ambient monitoring station (B0170000) at High Rock Road, about five miles downstream of the discharge point on the Haw River. This section of the Haw River [AU# 16-(6.5)] is listed as data inconclusive on the EPA approved NC 2022 Integrated Report (IR) due to elevated levels of turbidity and fecal coliform bacteria concentrations. An increase in instream nitrate concentration at station B0170000 was detected in 2016 in response to a treatment plant modification that resulted in lower ammonia concentrations but higher overall nitrate concentrations in their effluent discharge to the Haw River (see Chapter 6 for more information).

As previously stated above, the 2014 special study of 1,4-dioxane in the Cape Fear River Basin, DEQ identified elevated levels of 1,4-dioxane in the Haw River directly downstream of the Reidsville WWTP discharge point. Elevated 1,4-dioxane concentrations were observed at station B4 (Troxler Mill Rd), approximately 6.5 miles downstream of the WWTP discharge point (*Figure 13-1 B*). Between 2018 and 2019, 22 samples were collected at station B4, 17 samples (77%) had concentrations of 1,4-dioxane above the PQL with a mean concentration of 5.6 µg/L and a maximum concentration of 28 µg/L (*Table 13-3* and

Figure 13-4). In contrast, instream concentrations decreased significantly between 2020 and 2024, with only two out of 48 total samples (4%) at or above the PQL and a maximum recorded value of 1.2 µg/L in September 2021(*Figure 13-4*).

Beginning December 2017, monthly 1,4-dioxane monitoring was required by a letter from DWR, which was increased to weekly starting October 2019. DEQ also issued a letter to Reidsville requesting the City develop and submit a corrective action plan for 1,4-dioxane reduction by September 23, 2019. The requested plan was submitted and outlined the City's aim to continue monitoring and coordinating with industrial users toward reduction of 1,4-dioxane entering the WWTP. However, no definitive steps or actions to reduce 1,4-dioxane were outlined in the response.

In October 2019 elevated levels of 1,4-dioxane were reported, with one measurement of 1,145 µg/L on October 11, 2019. The calculated load for this event was estimated to be about 13 pounds, much higher than any previous load. On March 17, 2020, a similar measurement of 1,140 µg/L was reported (*Table 13-11* and *Figure 13-10*). These are the two highest reported concentrations since 2018. *Table 13-11* shows that the yearly mean effluent 1,4-dioxane concentrations have dropped each year between 2018 (139.57 µg/L) and 2023 (1.89 µg/L). The effluent concentrations began to increase in late 2024 with the 2025 (Jan-Oct) mean effluent 1,4-dioxane concentration increasing to 6.93 µg/L with a maximum reported concentration of 67 µg/L (*Table 13-11* and *Figure 13-10*).

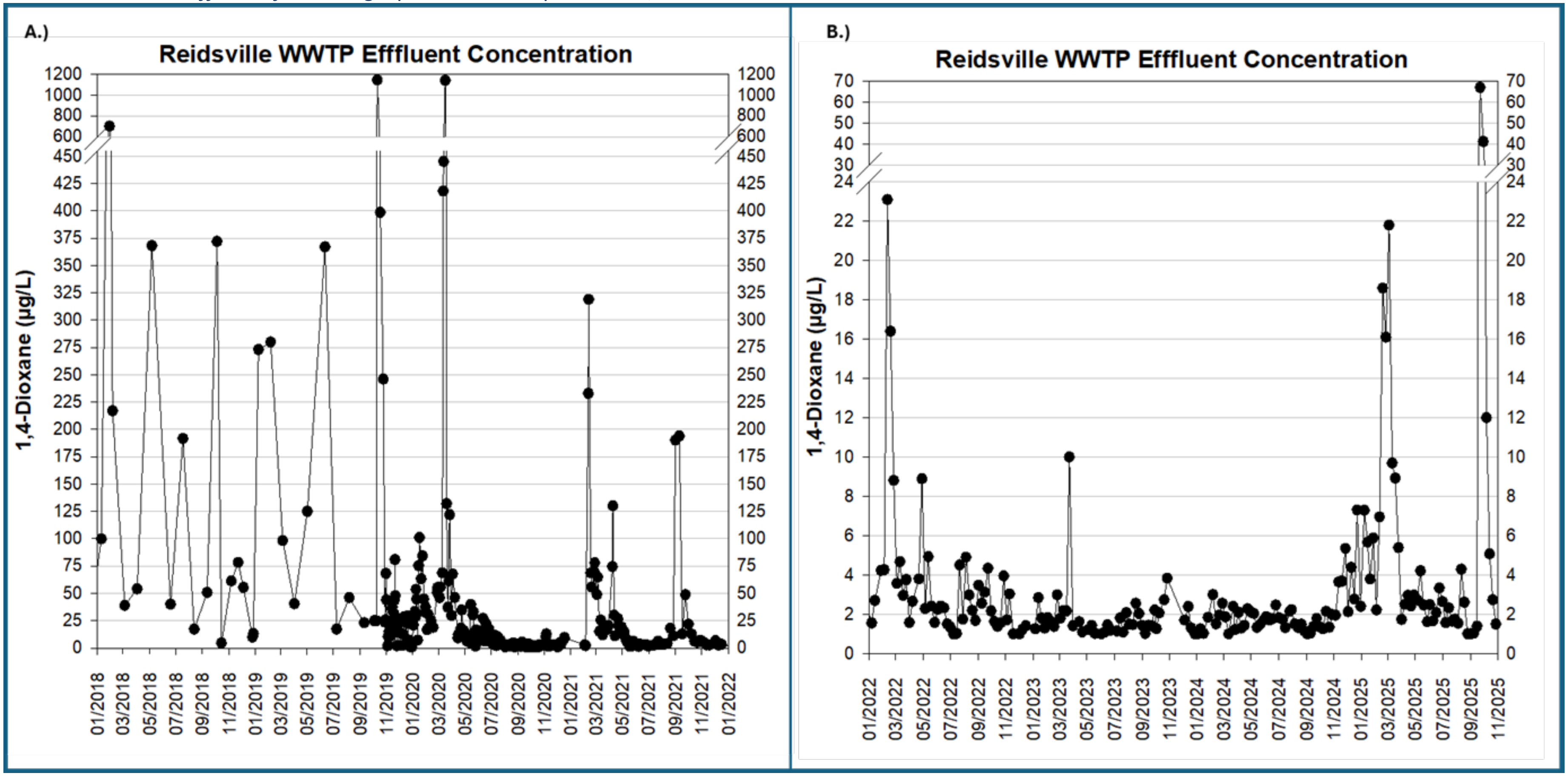
Table 13-11: City of Reidsville WWTP 1,4-Dioxane Yearly Effluent Concentrations (µg/L) Summary and January 2018-October 2025 Period Summary. Note: 6.3 and 6.9 µg/L are based on a permitted flow of 5.5 MGD.

Year	2018	2019	2020	2021	2022	2023	2024	Jan-Oct 2025	Jan. 2018-Oct. 2025
n	17	48	125	61	47	43	52	43	436
Mean (µg/L)	139.57	80.46	33.90	33.11	3.57	1.89	2.04	6.93	30.15
Median (µg/L)	55.30	24.45	9.30	11.10	2.41	1.47	1.81	2.72	3.78
Minimum (µg/L)	4.54	1.00	1.00	1.47	1.00	1.00	1.00	1.00	1.00
Maximum (µg/L)	701.0	1,145.0	1,140.0	319.0	23.1	10.0	7.3	67.0	1,145
n <6.26 µg/L	1	7	53	25	43	42	51	33	255
n >6.26 µg/L	16	41	72	35	4	1	1	10	180
% >6.26 µg/L	94.1	85.4	57.6	57.4	8.5	2.3	1.9	23.3	41.3
n >13.7 µg/L	14	34	48	26	2	0	0	5	129
% >13.7 µg/L	82.4	70.8	38.4	42.6	4.3	0	0	11.6	29.6

*6.26 µg/L monthly average 1,4-dioxane effluent concentration would protect downstream water supplies from exceeding the EPA health-based drinking water concentration representing a 1-in-a-million (1×10^{-6}) cancer risk level for 1,4-dioxane of 0.35 µg/L (EPA IRIS, 2013).
Note: 6.26 & 13.7 µg/L 1,4-dioxane concentrations are based on a permitted flow of 5.5 MGD.

Figure 13-10: City of Reidsville WWTP 1,4-Dioxane Effluent Concentrations.

A.) 2018-2021 Effluent Concentrations with Y-Axis Break (between 455 and 600 µg/L).
B). 2022-October 2025 Effluent Concentrations with Y-Axis Break (between 24 and 30µg/L).
Note the Y-axis is different for each graph. BIMs data pull Dec. 4, 2025.



Investigations identified two specific SIUs as a source of 1,4-dioxane to the City of Reidsville's WWTP. One SIU, Unifi Inc., was able to significantly reduce 1,4-dioxane contributions with product substitution and the other identified SIU, DyStar LP, removed specific products from their manufacturing line to reduce 1,4-dioxane in its waste stream. However, according to Reidsville, DyStar appears to be the source of elevated concentrations in 2024 and 2025. Reidsville's pretreatment program requires DyStar to sample their effluent for 1,4-dioxane daily and issued a notice of Violation in April 2025 for elevated levels of 1,4-dioxane.

Reidsville WWTP discharges directly into a water supply IV section of the Haw River. Based on a water quality based effluent limit analysis and the EPA instream water supply 1,4-dioxane concentration of 0.35 µg/L at the WS-IV supply, a discharge concentration of 6.26 µg/L monthly average and a daily maximum of 13.7 µg/L would ensure long-term human health protections (less than 1-in-a-million cancer risk level). In 2023 and 2024, there was only a single reported sample greater than these human health protected limits, however this number increased to 10 records or 23% of the samples so far in 2025 (Jan-Oct) (*Table 13-11*).

DWR continues to work with the Town of Reidsville to ensure that their pretreatment program is working closely with their SIUs to implement BMPs that will protect downstream uses.

13.5.4 City of High Point's Eastside WWTP (NC0024210)

The City of High Point owns and operates the High Point Eastside WWTP and is permitted to treat domestic (non-SIU) (96.91%) and industrial (3.09%) wastewater. The industrial portion represents up to 0.804 MDG of the 26 MGD total as-built permitted flow (DWR Pretreatment Unit Dynamics 365 data pull, Dec. 17, 2025). Their 2024 average monthly effluent flow rate was 14.55 MGD with an average industrial flow of 0.19 MGD (1.31% of the 2024 average monthly flow rate) (*Table 13-8*). They operate a pretreatment program with 18 SIUs. The facility serves a population of about 95 thousand residents for the City of High Point, the Town of Archdale, and Jamestown/Sedgefield.

The High Point Eastside WWTP has two permitted discharge points. As of May 2008, the plant discharges into the channel of the Deep River in the Randleman Lake/Reservoir (Outfall 002). Outfall 001 to Richland Creek remains as a permitted outfall but is used only on the rare occasion that the effluent pump station to outfall 002 must be taken out of service for maintenance.

Randleman Lake is classified as a water supply-IV (WS-IV) and is the water supply reservoir for High Point. Randleman Lake receives wastewater impacts from the High Point Eastside WWTP which discharges to Deep River/Randleman Lake about 7.8 miles upstream of their water supply intake. Elevated levels of 1,4-dioxane concentrations were found in 2018 (n=1) and 2023 (n=5) as part of the DWR ISB Cape Fear River Basin basinwide lakes assessment (section *13.3.4* above). The 1,4-dioxane concentration of the six samples collected in Randleman Lake at station CPFRD4 ranged between <1 to 2.7 µg/L (*Figure 13-1 C* and *Table 13-6*). DWR and pretreatment program staff are working to identify the sources of 1,4-dioxane to the High Point Eastside WWTP in order to reduce load to their wastewater and drinking water treatment plants. This section of the Deep River/Randleman Lake [AU# 17-(4)] is listed as data inconclusive on the EPA approved NC 2022 Integrated Report (IR) due limited data available to make a full use support assessment.

Beginning November 2018, monthly 1,4-dioxane monitoring was required by a letter from DWR at Outfall 002 (DWR 2018 Letter). In 2022, the sampling frequence increased. The mean effluent 1,4-dioxane concentration between January 2019 and October 2025 was 24.5 µg/L with a median concentration of 2.44 µg/L (*Table 13-12*). The highest recorded reading occurred on July 26, 2024, with a concentration of 1,070 µg/L and the second highest on May 12, 2023 (681 µg/L) (*Figure 13-11*). The highest annual mean 1,4-dioxane concentration of 37.6 µg/L occurred in 2021 and the highest annual median of 23.7 µg/L occurred in 2025 (*Table 13-12*). Their 1,4-dioxane effluent concentration was consistently low between June 2023 and June 2024 (n=53) with mean concentration of 1.44 µg/L and a maximum reading of 4.15 µg/L (*Figure 13-11*). In contrast, their mean effluent concentration between July 2024 and October 2025 (n=61) was 35.3 µg/L with their maximum reading of 1,070 µg/L.

Based on a water quality based effluent limit analysis and the EPA instream water supply 1,4-dioxane concentration of 0.35 µg/L at the WS-IV supply, a discharge concentration of 1.19 µg/L monthly average would ensure long-term human health protections (less than 1-in-a-million cancer risk level). For the January 2019-October 2025 timeframe, their effluent exceeded 1.19 µg/L 80.3% of the time (*Table 13-12*). The percentage above this value was highest in 2025 compared to the other years assessed.

The City of High Point's pretreatment program is working with SIUs to identify the sources of elevated 1,4-dioxane in their processed wastewater. According to the City of High Point's pretreatment program, the SIUs are required to follow a pollution management plan that should reduce the source of 1,4-dioxane in their wastewater. Many of their pretreatment permits will be renewed in July 2026 and the pollutant management plan and monthly monitoring will become a requirement of their pretreatment permits.

Table 13-12: City of High Point WWTP 1,4-Dioxane Yearly Effluent Concentration (µg/L) Summary and January 2018-October 2025 Period Summary.

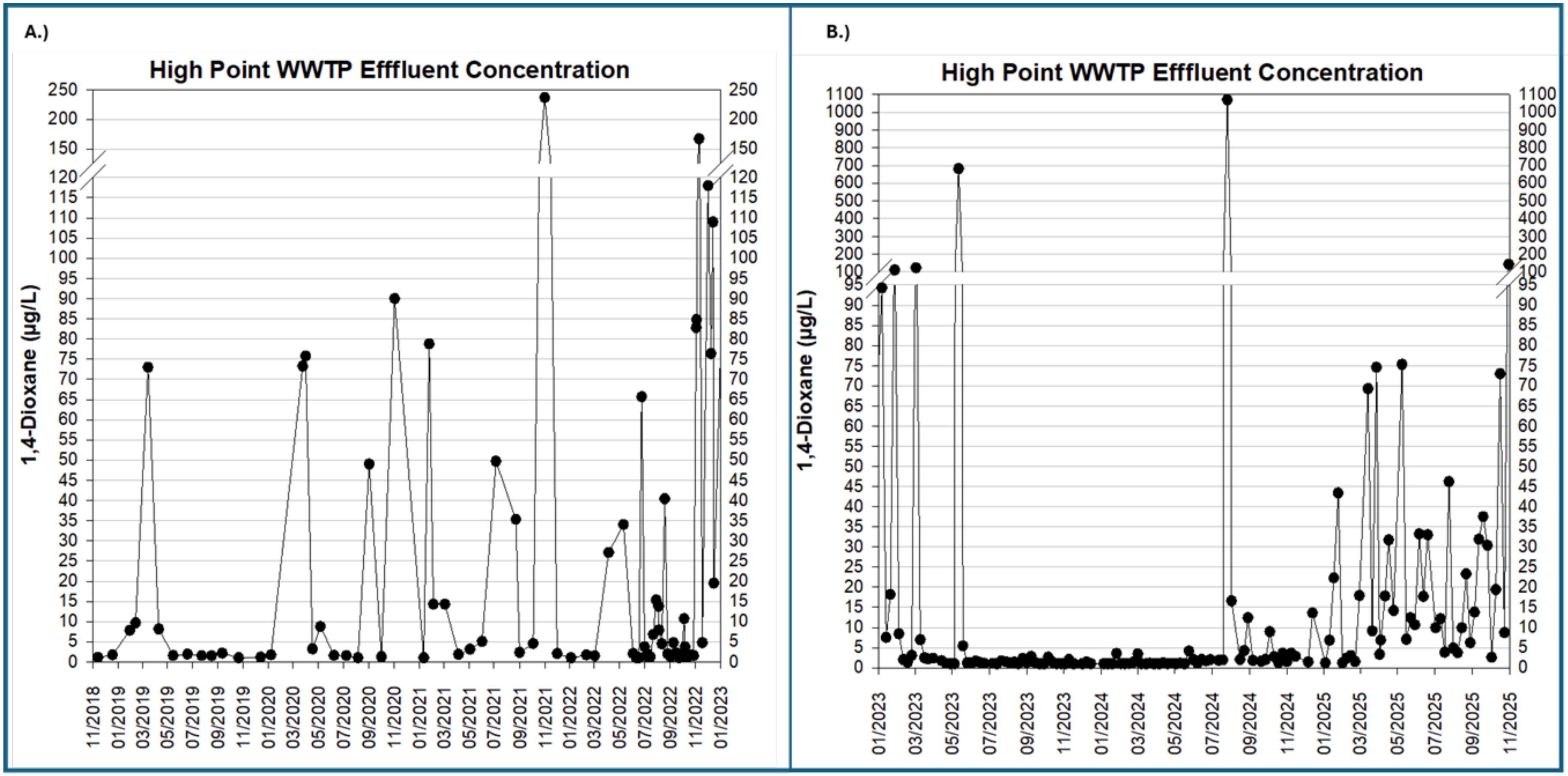
Year	2019	2020	2021	2022	2023	2024	Jan-Oct 2025	Jan. 2019-Oct. 2025
n	11	11	13	39	47	45	42	208
Mean (µg/L)	9.96	27.93	34.57	23.77	23.67	26.51	23.73	24.5
Median (µg/L)	1.93	3.22	5.07	3.77	1.40	1.60	13.10	2.44
Minimum (µg/L)	1.00	1.00	1.00	1.00	1.00	1.00	1.22	1.00
Maximum (µg/L)	73	90	237	167	681	1,070	143	1,070
n <1.19 µg/L	2	1	1	4	17	17	0	43
% <1.19 µg/L	18.2	9.1	7.7	10.3	36.2	37.8	0	20.7
n >1.19 µg/L	9	10	12	35	30	28	42	167
% >1.19 µg/L	81.8	90.9	92.3	89.7	63.8	62.2	100	80.3

*1.19 µg/L monthly average 1,4-dioxane effluent concentration would protect downstream water supplies from exceeding the EPA health-based drinking water concentration representing a 1-in-a-million (1 x10^{-6}) cancer risk level for 1,4-dioxane of 0.35 µg/L (EPA IRIS, 2013).
Note: 1,4-Dioxane concentrations are based on a permitted as-built flow of 26 MGD.

DWR continue to work with High Point to ensure that their pretreatment program is working closely with their SIUs to implement BMPs that will protect downstream uses.

Figure 13-11: City of High Point WWTP 1,4-Dioxane Effluent Concentrations.

A.) 2018-2022 Effluent Concentrations with Y-Axis Break (between 120 and 125 µg/L).
B). 2023-October 2025 Effluent Concentrations with Y-Axis Break (between 95 and 100 µg/L).
Note the Y-axis is different for each graph. BIMs data pull Dec. 4, 2025.



An ongoing source of 1,4-dioxane to the Deep River and Randleman Reservoir is a Resource Conservation and Recovery Act (RCRA) Subtitle C hazardous waste site located near and hydrologically connected to the Deep River. RCRA sites are heavily regulated to manage hazardous waste generation, transport, treatment and disposal, with stringent enforcement to prevent environmental harm.

Operating between 1974 and 1989, Seaboard Chemical Corporation ran a solvent recovery and fuel blending facility in Jamestown, NC, before filing for bankruptcy. Following bankruptcy, Seaboard Group II was established to address liabilities at the site, which shares extensive subsurface contamination with the adjacent City of High Point Riverdale Drive Landfill (active 1950s–1993). On December 29, 2008, the City of High Point and Seaboard Group II entered into a Remedial Action Settlement Agreement (RASA) with DEQs Division of Waste Management (DEQ, DMS 2025 Inspection Report). This agreement (RASA) provides for the design and implementation of the approved remedial action program for the site as well as completion and reporting of annual groundwater and surface water monitoring activities.

Remedial investigations have documented the presence of chlorinated and non-chlorinated volatile organic compounds (VOCs), dense non-aqueous phase liquid organics (DNAPL), and 1,4-dioxane in landfill leachate, soil, and shallow/deep groundwater, with migration occurring northeast toward Randleman Lake, which was created by the 2006 impoundment of the Deep River by the Randleman Lake Dam, 11.5 miles downstream (DEQ, DMS 2025 Inspection Report). Based on these findings, remedial actions focus on hydraulic containment and treatment, utilizing groundwater extraction and leachate recovery to prevent contamination from entering the Deep River/Randleman Lake and intermittent onsite streams. To ensure the effectiveness of the remedy and prevent unacceptable contaminant migration, a sampling program for groundwater and surface water will be maintained.

The 2025 annual monitoring occurred September 23-29, 2025, with the groundwater well 1,4-dioxane concentrations ranging between <1 and 2,300 µg/L. The mechanical and phytoremediation treatment system processed approximately 15.7 million gallons of extracted groundwater and leachate and removed an estimated 69.9 lbs of 1,4-dioxane and 851.5 lbs of volatile organic compounds (2025 Annual Report). Surface water sampling occurred at three locations in Randleman Lake near the hazardous site at two depths; one foot below the surface (shallow) and one foot above the bottom (deep) of the lake. The following 1,4-dioxane concentration were detected in the lake surface water samples (2025 Annual Report):

- Upstream station (SW-6), collected 3,400 ft upstream of the hazardous site reported a 1,4-dioxane concentration of <0.6 µg/L (shallow) and 1.7 µg/L in the deep surface water sample;
- Adjacent station (SW-DRP2), collected near Lift Station 1, reported a 1,4-dioxane concentration of 4.5 µg/L (shallow) and 1.2 µg/L (deep); and
- Downstream station (SW-7), collected adjacent and downstream at the I-85 bridge, reported a 1,4-dioxane concentration of 5.5 µg/L (shallow) and 1.4 µg/L (deep).

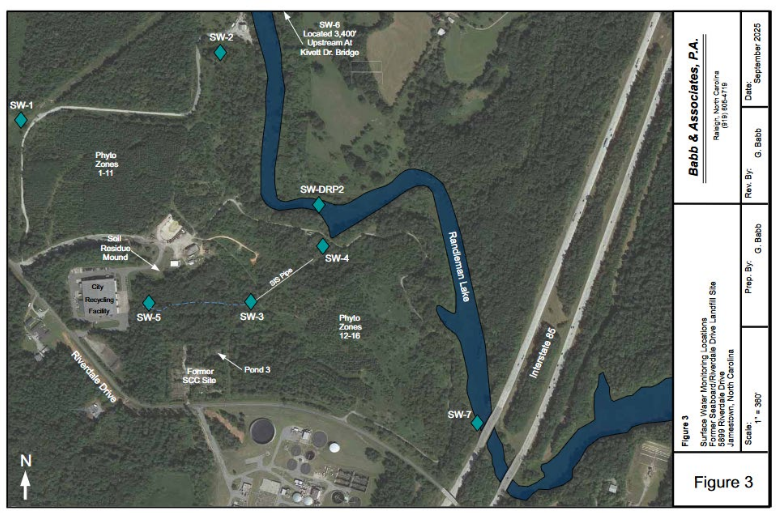


Figure 3

The 2025 instream data show the Seaboard/Landfill site remains a source of 1,4-dioxane to Randleman Lake. These instream 1,4-dioxane concentrations at these three lake sites is concerning as they are directly in the water supply (WS-IV) reservoir and exceed the EPA's drinking water health-based 1 in a million (1 $x10^{-6}$) lifetime cancer risk level of 0.35 µg/L (EPA IRIS, 2013). The 2008 RASA approved phytoremediation treatment was the best available technology at the time; however, to prevent continued, long-term contamination of Randleman Reservoir, site remediation may need to utilize newer advanced treatment technologies, such as Advanced Oxidation Processes (AOPs) to achieve instream concentrations below levels of concern for water supplies.

13.5.1 City of Burlington's Southside WWTP (NC0023876) and Eastside WWTP (NC0023868)

The City of Burlington owns and operates two WWTPs that treats waste for approximately 90 thousand people living in and around the City (City of Burlington Annual Report, 2025). Both the Eastside and Southside wastewater treatment facilities have a permitted capacity of 12 MGD each. Eastside WWTP receives wastewater from the City of Burlington [north and east of the railroad and extraterritorial jurisdiction (ETJ)], Town of Green Level, Town of Haw River and portions of Town of Gibsonville and Town of Elon and discharges to the Haw River [AU# 16-(10.5)d] about 18 miles upstream from the WS-IV boundary to the Haw River (Pittsboro) water supply watershed.

The southside WWTP receives wastewater from the City of Burlington (south and west of the railroad, including ETJ), the Town of Swepsonville, the Village of Alamance, and portions of the City of Graham. Southside WWTP discharges to the Big Alamance Creek [AU# 16-19-(4.5)b; WS-V; NSW] about 13 miles from the WS-IV boundary to the Haw River (Pittsboro) water supply watershed.

The City of Burlington runs a pretreatment program with a total of 16 SIUs between the two treatment plants. According to the DWR September 2025 Pretreatment Compliance Inspection Report, the "City of Burlington's Pretreatment Program is in very good shape". They work well with the industries in their pretreatment program and are working on updating their Long Term Monitoring Plan.

The City of Burlington signed a memorandum of agreement (MOA) with the Haw River Assembly on October 22, 2020, to formalize a commitment by the city to test, analyze, and examine potential sources of PFAS and 1,4-dioxane compounds discharged from the City's two WWTPs (City of Burlington website and Oct. 22, 2020 media information release). According to the press release, the city also partnered with an engineering service to develop a wastewater sampling program aimed at identifying potential sources of these contaminants. The sampling plan included targeted and non-targeted sampling of the Burlington sewer system. Their comprehensive analysis included sampling the City's industrial wastewater users (SIUs and landfill leachate brought to one WWTP), the City's wastewater collection system, and their internal wastewater treatment plant processes. The goal was to identify potential sources and reduce or eliminate these compounds prior to the WWTP discharge point. Their program could serve as a model for utilities across the state.

13.5.1.1 City of Burlington - Southside WWTP (NC0023876)

The City of Burlington operates the Southside WWTP and is permitted to treat domestic (non-SIU) (91.28%) and industrial (8.72%) wastewater. The 2024 monthly average effluent flow rate was 7.49 MGD with an average industrial flow of 0.533 MGD (7.12% of the 2024 average monthly flow rate) (*Table 13-8*). There are 10 SIUs which discharge to the Southside WWTP for treatment.

In July 2023, Burlington identified elevated 1,4-dioxane concentrations in the Southside Burlington WWTP effluent. In August 2023, Apollo Chemical was identified as being the main contributor of 1,4-dioxane discharged to the Southside WWTP (Burlington's Pretreatment 2024 Annual Report, 2025). Apollo Chemical is required to monitor and implement a 1,4-dioxane minimization plan.

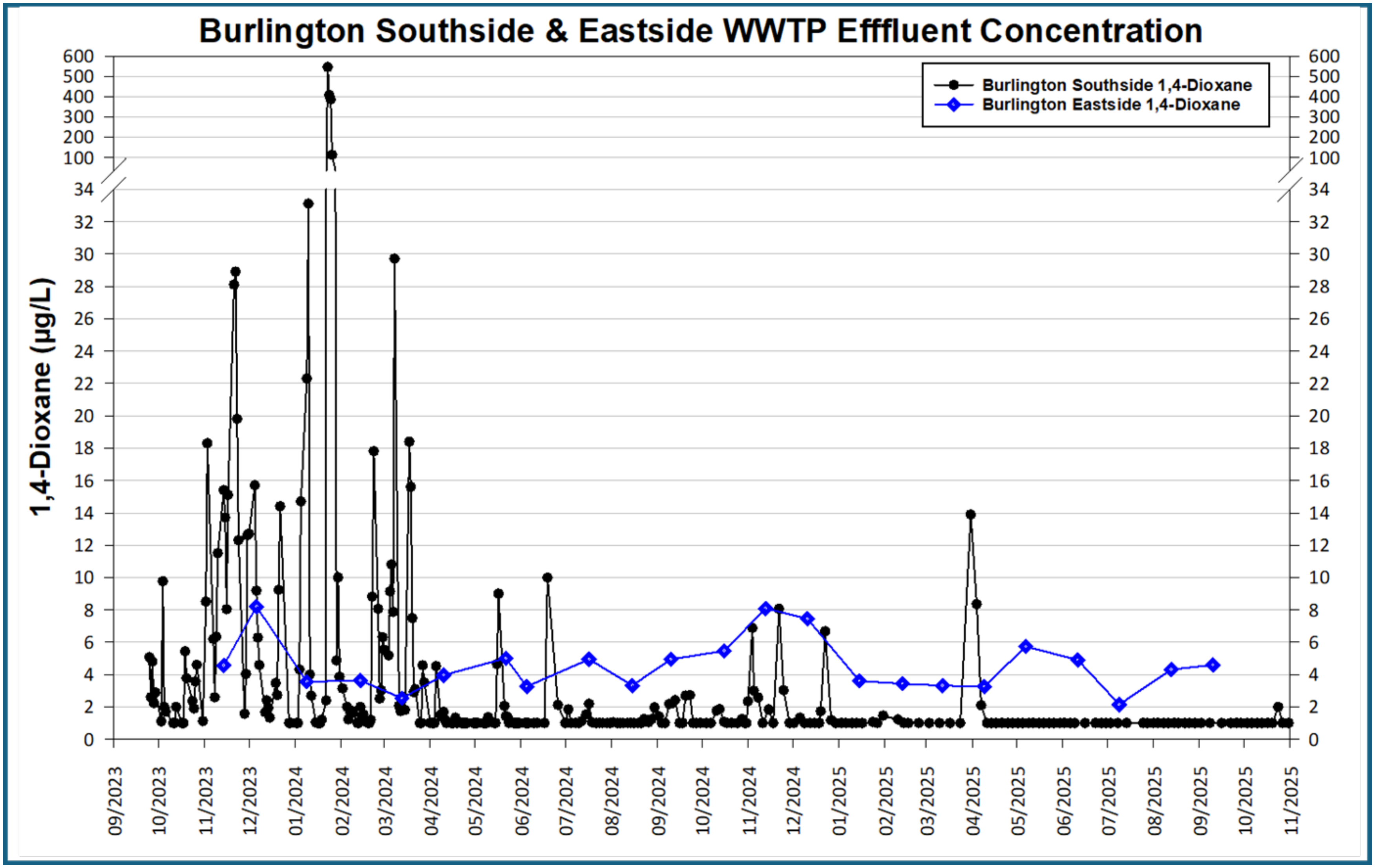
DWR data collected from the Southside Burlington WWTP showed intermittently high levels of 1,4-dioxane. On October 3, 2023, the division requested Burlington to sample their Southside plant effluent once per week (DWR 2023 letter). Weekly effluent grab samples started in November 2023 and are submitted on their eDMRs (*Table 13-13* and *Figure 13-12*). Their average 1,4-dioxane concentrations were 6.82, 10.75 and 1.33 µg/L for 2023, 2024 and for 2025 respectively (*Table 13-13*). Their effluent concentrations dropped dramatically after early 2024 (*Figure 13-12*). The City of Burlington notified DEQ and downstream water supply users on January 25, 2024, of elevated 1,4-dioxane (545 µg/L) discharged from the Southside Burlington WWTP. The City of Burlington took steps to identify the SIU responsible for the spike and instructed them to immediately eliminate 1,4-dioxane from their waste stream and to expedite analysis of their daily effluent samples discharged to the WWTP (DWR January 25, 2024 public notice).

Table 13-13: City of Burlington Southside WWTP 1,4-Dioxane Yearly Effluent Concentrations (µg/L) Summary and September 2023-October 2025 Period Summary.

Year	Sept.-Dec. 2023	2024	Jan.-Oct. 2025	Sept. 2023 - Oct. 2025
n	53	182	70	305
Mean (µg/L)	6.82	10.75	1.33	7.90
Median (µg/L)	4.04	1.08	1	1
Minimum (µg/L)	1	1	1	1
Maximum (µg/L)	28.90	545.00	13.90	545
N>21.99	2	7	0	9
%>21.99	3.8	3.8	0.0	3.0
N<21.99	51	175	70	296
%<21.99	96.2	96.2	100.0	97.0
N>63.0	0	4	0	4
%>63.0	0.0	2.2	0.0	1.3
N<63.0	53	178	70	301
%<63.0	100.0	97.8	100.0	98.7

*21.99 µg/L monthly average 1,4-dioxane effluent concentration would protect downstream water supplies from exceeding the EPA health-based drinking water concentration representing a 1-in-a-million (1 x10^{-6}) cancer risk level for 1,4-dioxane of 0.35 µg/L (EPA IRIS, 2013).
Note: 1,4-Dioxane concentrations are based on a permitted as-built flow of 12 MGD.

Figure 13-12: City of Burlington Southside and Eastside WWTP 1,4-Dioxane Effluent Concentrations with Y-Axis Break (between 34 and 35 µg/L).



There are no 1,4-dioxane instream ambient monitoring data available for Big Alamance Creek. The data in the Haw River downstream of Big Alamance Creek at station B2100000 near Bynum as well as in the Haw River arm of Jordan Lake at station CPF055C have demonstrated high levels of 1,4-dioxane as result of wastewater inputs upstream (*Figure 13-1 B*). The results for these instream water quality stations are described above in sections *13.3.3* and *13.3.4*.

Based on the EPA instream water supply 1,4-dioxane concentration of 0.35 µg/L at the downstream WS-IV supply boundary about 13 miles downstream, a discharge concentration of 21.99 µg/L monthly average and a daily maximum of 63 µg/L would ensure long-term human health protections (less than 1-in-a-million cancer risk level). The reported effluent grab samples exceeded 21.99 µg/L, 3.0% of the time and 63 µg/L 1.3% of the time between September 2023 and October 2025 (*Table 13-13* and *Figure 13-12*). These levels would protect the Town of Pittsboro's water supply intake in the Haw River. For more information see the City of Burlington's water resources and emerging contaminants websites and their Annual Sewage Collection and Wastewater Treatment Report (2024 Report link).

13.5.1.2 City of Burlington – Eastside WWTP (NC0023868)

The City of Burlington operates the Eastside WWTP and is permitted to treat domestic (non-SIU) (81.1%) and industrial (18.9%) wastewater. The 2024 monthly average effluent flow rate was 4.47 MGD with an average industrial flow of 0.781 MGD (17.5% of the 2024 average monthly flow rate) (*Table 13-8*). There are 6 SIUs which discharge to the Eastside WWTP for treatment.

In 2019, the Eastside WWTP participated in the basinwide POTW survey for the emerging contaminants, during which three rounds of influent sampling were conducted in July, August, and September. Data from the samplings yielded detections of 1,4-dioxane ranging from 15.6 – 21.3 µg/L.

Due to the detectable 1,4-dioxane found in the 2019 samples at the Eastside WWTP and due to the intermittently high levels of 1,4-dioxane at the Southside WWTP, DWR requested the City of Burlington to commence monthly effluent grab samples starting in November 2023 (DWR 2023 letter). Their average 2024 and 2025 1,4-dioxane concentrations were 4.69 and 3.93 µg/L (*Table 13-14*). Their monthly reported data have been between 2.15 and 8.09 µg/L (n=21) (*Table 13-14* and *Figure 13-12*).

Table 13-14: City of Burlington Eastside WWTP 1,4-Dioxane Yearly Effluent Concentrations (µg/L) Summary and January 2024-October 2025 Period Summary.

Year	2024	Jan.- Oct. 2025	Jan. 2024 - Oct. 2025
n	12	9	21
Mean (µg/L)	4.69	3.93	4.36
Median (µg/L)	4.46	3.61	3.97
Minimum (µg/L)	2.54	2.15	2.15
Maximum (µg/L)	8.09	5.73	8.09
N>21.99	0	0	0
%>21.99	0	0	0
N<21.99	12	9	21
%<21.99	100	100	100
*21.99 µg/L monthly average 1,4-dioxane effluent concentration would protect downstream water supplies from exceeding the EPA health-based drinking water concentration representing a 1-in-a-million (1 x10^{-6})			

cancer risk level for 1,4-dioxane of 0.35 µg/L (EPA IRIS, 2013). Note: 1,4-Dioxane concentrations are based on a permitted as-built flow of 12 MGD.

Based on the EPA instream water supply 1,4-dioxane concentration of 0.35 µg/L at the downstream WS-IV supply boundary about 18 miles downstream, a discharge concentration of 21.99 µg/L monthly average and a daily maximum of 63 µg/L would ensure long-term human health protections (less than 1-in-a-million cancer risk level). The reported effluent grab samples did not exceeded 21.99 µg/L in any of the samples collected between January 2024 and October 2025 (*Table 13-14* and *Figure 13-12*). These levels would protect the Town of Pittsboro's water supply intake in the Haw River. For more information see the City of Burlington's water resources and emerging contaminants websites and their Annual Sewage Collection and Wastewater Treatment Report (2024 Report link)

13.6 Regulatory Action/Rule Development – EMC Monitoring and Minimization Rule

As of 2025, DEQ has been working with the Environmental Management Commission to develop monitoring and minimization rules for 1,4-dioxane and three PFAS compounds. The goal of these rules are intended to achieve two key objectives: (1) Characterize the presence of PFOS, PFOA, GenX and 1,4-dioxane in NPDES discharges (Publicly Owned Treatment Works (POTWs) with Significant Industrial Users (SIUs) and industrial direct dischargers to surface waters), and (2) require affected entities to develop minimization plans that identify approaches to reduce these emerging compounds discharged directly or indirectly to surface waters (Fiscal note, April 23, 2025). The PFOS, PFOA, and GenX Monitoring and Minimization plan rules (15A NCAC 02B .0512 and 15A NCAC 02H .0923, March 2026 proposed version) and the 1,4-Dioxane Monitoring and Minimization plan rules (15A NCAC 02B .0513 and 15A NCAC 02H .0924, March 2026 proposed version) along with their OSBM approved Minimization Rules Fiscal Notes were presented to the January 2026 EMC (EMC meeting link). The EMC approved the proposed PFAS and 1,4-dioxane rules with amendments, allowing the specific questions and associated fiscal notes to proceed to a public comment period. Three public hearings for each set of rules will be held with public comments accepted between March 16 and June 15, 2026. For specific details on the 2026 public hearings and submission of public comments, see the DEQ press release for PFAS and 1,4-dioxane.

13.7 Conclusions and Path Forward

1,4-dioxane is a more targeted problem than PFAS and is found in fewer places across the state. The Cape Fear River Basin exhibited the highest statewide concentrations of 1,4-dioxane. Comprehensive instream and point source monitoring demonstrated that these concentrations are primarily driven by industrial wastewater from significant industrial users (SIUs) and leachate from landfills. These contaminants enter surface waters largely through municipal point source dischargers, as wastewater treatment facilities are generally not designed to effectively remove 1,4-dioxane from wastewater.

If the sources are properly regulated through permits, we could greatly reduce the amount of this chemical statewide. Without permit limits, local governments may not hold industrial polluters accountable.

DEQ is working within our authority to understand and address 1,4-dioxane in surface waters. DEQ continues to work with the Environmental Management Commission to develop 1,4-dioxane related watershed protection measures for all designated uses by identifying, reducing, and remediating 1,4-dioxane pollution. As progress is made, updated information can be found on the DEQ Emerging Compounds website.

13.8 References

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