Savannah River NUCLEAR SOLUTIONS℠

488-4D Ash Landfill
Annual Groundwater Monitoring Report

2023 Data

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DISCLAIMER

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U.S. Department of Energy
and
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LIST OF ABBREVIATIONS AND ACRONYMS

bgs	below ground surface
DAG	D-Area Groundwater
DCSA	484-17D D-Area Coal Storage Area
CPRB	489-D D-Area Coal Pile Runoff Basin
ft	foot, feet
ft amsl	feet above mean sea level
GCU	Gordon Confining Unit
m	meters
MCL	Maximum Contaminant Level
µg/L	microgram per Liter
NSDWS	National Secondary Drinking Water Standard
OU	Operable Unit
PCE	tetrachloroethylene
PFAS	per- and polyfluoroalkyl substances
RSL	Regional Screening Level
SCDES	South Carolina Department of Environmental Services[1]
SRS	Savannah River Site
TCE	trichloroethylene
USEPA	United States Environmental Protection Agency
UTRA	Upper Three Runs Aquifer
VOC	volatile organic compounds

[1] South Carolina Department of Environmental Services (SCDES) was known as South Carolina Department of Health and Environmental Control (SCDHEC) prior to July 1, 2024.

1.0 SITE DESCRIPTION AND BACKGROUND

The 488-4D Ash Landfill is a 15-acre landfill that received coal ash and is located in D Area on the Savannah River Site (SRS). Although the ash landfill is located within the boundary of the D-Area Groundwater (DAG) Operable Unit (OU) where multiple groundwater plumes are monitored, the 488-4D Ash Landfill is specifically monitored with five (5) groundwater wells (DCB077, DCB078, DCB079, and DCB080 and DCB 8) (**Figure 1, Table 1**). The 488-4D Ash Landfill was closed in 2016 under a non-time critical removal action and was included in the DAOU Second Early Action Record of Decision (SRNS 2020). The groundwater associated with the landfill was previously monitored and reported to South Carolina Department of Environmental Services (SCDES) under the Solid Waste Division (previous Solid Waste Permit #025800-1602). In 2018, groundwater monitoring and reporting for the 488-4D Ash Landfill was combined with the DAG OU. The DAG OU has now transitioned to the RCRA Facility Investigation/Remedial Investigation/Baseline Risk Assessment project phase. As agreed to by the U.S. Environmental Protection Agency (USEPA) and SCDES in the November 2023 DAG OU Post-Characterization Scoping Meeting (SRNS 2023b), the last full monitoring report was submitted in 2023 with sampling of the DAG OU continuing until submittal of a Corrective Measures Study/Feasibility Study. To fulfill the SCDES post-closure care requirements for the 488-4D Ash Landfill, a focused groundwater monitoring report specifically for the landfill is submitted annually.

This 2024 annual groundwater monitoring data report for the 488-4D Ash Landfill describes sampling activities specifically conducted at the five (5) landfill monitoring wells during calendar year 2023. An agreement was made during the November 2023 DAG OU Post-Characterization Scoping Meeting (SRNS 2023b) to include all other 2023 groundwater and surface water monitoring data that is part of the DAG OU and that is outside of the 488-4D Ash landfill in a separate DAG OU data report to be submitted in 2024.

2.0 GROUNDWATER MONITORING

The 488-4D Ash Landfill groundwater monitoring and current sampling schedule is reported in the most recent DAG OU report (SRNS 2023a). **Table 2** includes the sampling schedule and requirements for the 488-4D Ash Landfill groundwater monitoring. Monitoring wells DCB078,

DCB079, and DCB080 are located downgradient of the 488-4D Ash Landfill: (**Figure 1**). A fourth well, DCB077, is located upgradient and northwest of the landfill. These four wells are also downgradient of the 484-17D D-Area Coal Storage Area (DCSA) and the 489-D Coal Pile Runoff Basin (CPRB), which are primary sources of metals contamination in D Area. Additionally, a fifth well, DCB 8, is upgradient 500 meters (m) (1,640 feet [ft]) of the landfill and is also upgradient of the 484-17D DCSA and the 489-D CPRB. All five (5) 488-4D Ash Landfill wells are water table wells and screened no deeper than 13.4 m (44 ft) below ground surface (bgs).

Groundwater monitoring wells in the DAG OU monitoring program downgradient of the 484-17D DCSA and 489-D CBRB indicate metal contamination in the low-pH conditions. Groundwater at the 488-4D Ash Landfill has been impacted by the acidic leachate from the 484-17D DCSA and the 489-D CPRB source units. **Figure 2** displays the beryllium plume across D Area. Additionally, many of these wells are located within areas of tritium, volatile organic compounds (VOCs) (i.e., trichloroethylene [TCE] and tetrachloroethylene [PCE]), and per- and polyfluoroalkyl substances (PFAS) groundwater contamination plumes. The previous sources of tritium, VOC, and PFAS contamination are located farther upgradient in D Area and are unrelated to the 488-4D Ash Landfill as shown in **Figures 3** (SRNS 2023a).

2.1 Site Geology and Hydrogeology

The SRS is underlain by Atlantic Coastal Plan sediments that thicken to the southeast. Sediments range in age from Late Cretaceous to recent and are approximately 270 m (900 ft) thick at SRS (Aadland et al., 1995; Fallaw and Price, 1995). The pertinent stratigraphy beneath D-Area, in ascending order, is the Snapp, Fourmile Branch, Congaree, Warley Hill, Tinker/Santee, and Clinchfield Formations (Aadland et. al, 1995). Quaternary Savannah River deposits exists at D-Area, with more extensive reworking of the shallow material west of the 488-D D-Area Ash Basin, and 488-4D Ash Landfill near the current Savannah River as shown in **Figure 1** and in cross-sectional view in **Figure 4**.

The shallow aquifer system at D Area includes a semi-confined and an unconfined aquifer system. The semi-confined Gordon Aquifer is a 15 m (50 ft) thick sequence of fine to medium-grained sand that is overlain by the Gordon Confining Unit (GCU); the GCU can be up to a 3 m (10 ft)

thick clay layer or consist of silty/sandy clays to silty sands. The GCU is overlain by the Upper Three Runs Aquifer (UTRA), which is an unconfined series of interbedded and laterally discontinuous sand, silt, and clay beds ranging in thickness from 12 m (40 ft) to 18 m (60 ft) beneath D Area. In D Area, the UTRA has been partially eroded and the tan clay confining layer is not present; therefore, the UTRA in D Area is not defined by upper and lower zones separated by a confining layer as often seen at other units at SRS. A schematic of the lithostratigraphy and hydrostratigraphy generally observed at SRS is provided in **Figure 5**. The 488-4D Ash Landfill monitoring wells are screened within the UTRA.

2.2 Groundwater Flow

Water elevation data for the second quarter 2023 are presented in **Figure 1**. The water table near the 488-4D Ash Landfill is approximately 4.6 to 7.6 m (15 to 25 ft) bgs and the shallow groundwater in the UTRA flows toward the southwest. Water elevations ranged from 1.3 to 7.5 m (4.4 to 24.6 ft) bgs. Water elevations have been stable at downgradient wells DCB078, DCB079, and DCB080. Water elevations vary more at well DCB077 due to localized effects from the screen zone being directly above a thick competent clay layer causing some perched effects. Well DCB 8, which is in the injection field line of the D-Area Treatability Study, has displayed elevated groundwater elevations since March 2022 due to the ongoing groundwater injections. The treatability study has not impacted groundwater monitoring or results for the 488-4D Ash Landfill. More information about the D-Area Treatability Study can be found in the recent 2024 treatability study data report (SRNS 2024). Water elevations for April/May 2023 and October/November 2023 are provided in **Table 3**. Hydrographs for the five (5) monitoring wells are provided in **Figures 6 through 8**.

2.3 Groundwater Constituents and Parameters

The five (5) 488-4D Ash Landfill wells are monitored for constituents according to the DAG OU *Groundwater Samples Analyte List and Sample Frequency* table that is included in the DAG OU groundwater monitoring reports and letters (SRNS 2023a; *Appendix B, Table B-1*). **Table 2** lists the current analytical and field parameters being monitored for the 488-4D Landfill. Results are compared to Maximum Contaminant Levels (MCLs), National Secondary Drinking Water Standards (NSDWS), or USEPA Regional Screening Levels (RSLs), in that order.

3.0 RESULTS

Groundwater water elevations and analytical samples were collected in April/May 2023 for all five (5) wells associated with the 488-4D Ash Landfill. Water elevations were also collected during October/November 2023. Monitoring wells DCB 8 and DCB077 are also used for monitoring in the D-Area Treatability Study (SRNS 2024) and include additional metal sample analyses in October/November. These analytical and field results are presented in **Table 3**.

3.1 Results Above Regulatory Threshold Limits

Analytical results from the 2023 sampling show the following seven (7) metals/sulfate constituents were detected in the five (5) 488-4D Ash Landfill monitoring wells at concentrations above their applicable regulatory threshold level in at least one monitoring well:

- Aluminum (NSDWS)
- Arsenic (MCL)
- Beryllium (MCL)
- Cobalt (RSL)
- Iron (NSDWS)
- Manganese (NSDWS)
- Sulfate (NSDWS)

These are the same constituents observed within the DAG OU (SRNS 2023a). Metals contamination is sourced from the 484-17D CBRB DCSA and 489-D CPRB from low-pH groundwater conditions caused by long-term coal storage and subsequent dissolution of coal and natural aquifer minerals due to acidic water leachate. Although the groundwater is elevated in metal concentrations including beryllium (**Figure 2**), the concentrations have been steady or decreasing for the last seven (7) years. **Figures 9 through 11** show the time-series plots for beryllium for the 488-4D Ash Landfill monitoring wells. Additionally, upgradient DAG OU wells, such as DCB 23C, display higher groundwater concentrations of metals including beryllium indicating metals contamination originates from upgradient sources (i.e., the 484-17D DCSA and 489-D CPRB) (**Figure 2**).

Although tritium, VOC (i.e., PCE and TCE), and PFAS contamination are present in the groundwater beneath the 488-4D Ash Landfill and in some of its monitoring wells, these constituents are not associated with the waste disposal activities for the 488-4D Ash. The tritium, VOC, and PFAS groundwater contaminants originate from upgradient sources within D Area and

are monitored as part of DAG OU (SRNS 2023a). **Figure 3** displays the tritium, VOC, and PFAS source areas that are upgradient and unrelated to the 488-4D Ash Landfill.

All other 2023 D-Area groundwater and surface water data outside of the 488-4D Ash landfill monitoring will be submitted to USEPA and SCDES under a separate data report as agreed upon in the November 2023 DAG OU Post-Characterization Scoping Meeting (SRNS 2023b). Groundwater will continue to be monitored at the five (5) 488-4D Ash Landfill monitoring wells annually. Subsequent 488-4D Ash Landfill groundwater data will be reported in July the year after the data was collected.

4.0 REFERENCES

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Fallow, W.C. and Rice, V., 1995. *Stratigraphy of the Savannah River Site and Vicinity*, Southeastern Geology V35.N1, p.21-58

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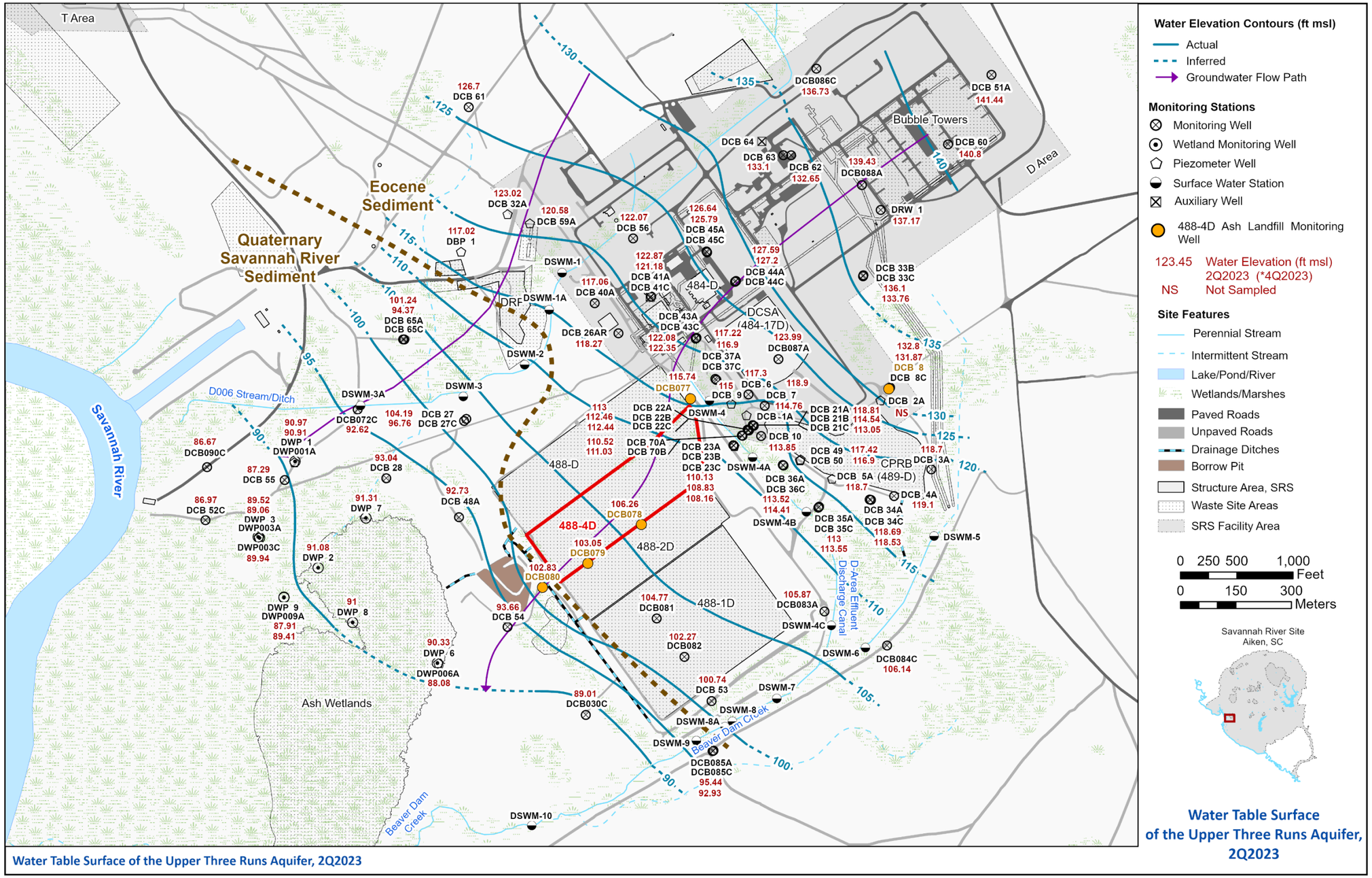

Figure 1. Monitoring Well Locations at the 488-4D Ash Landfill and 2Q2023 Water Level Elevations

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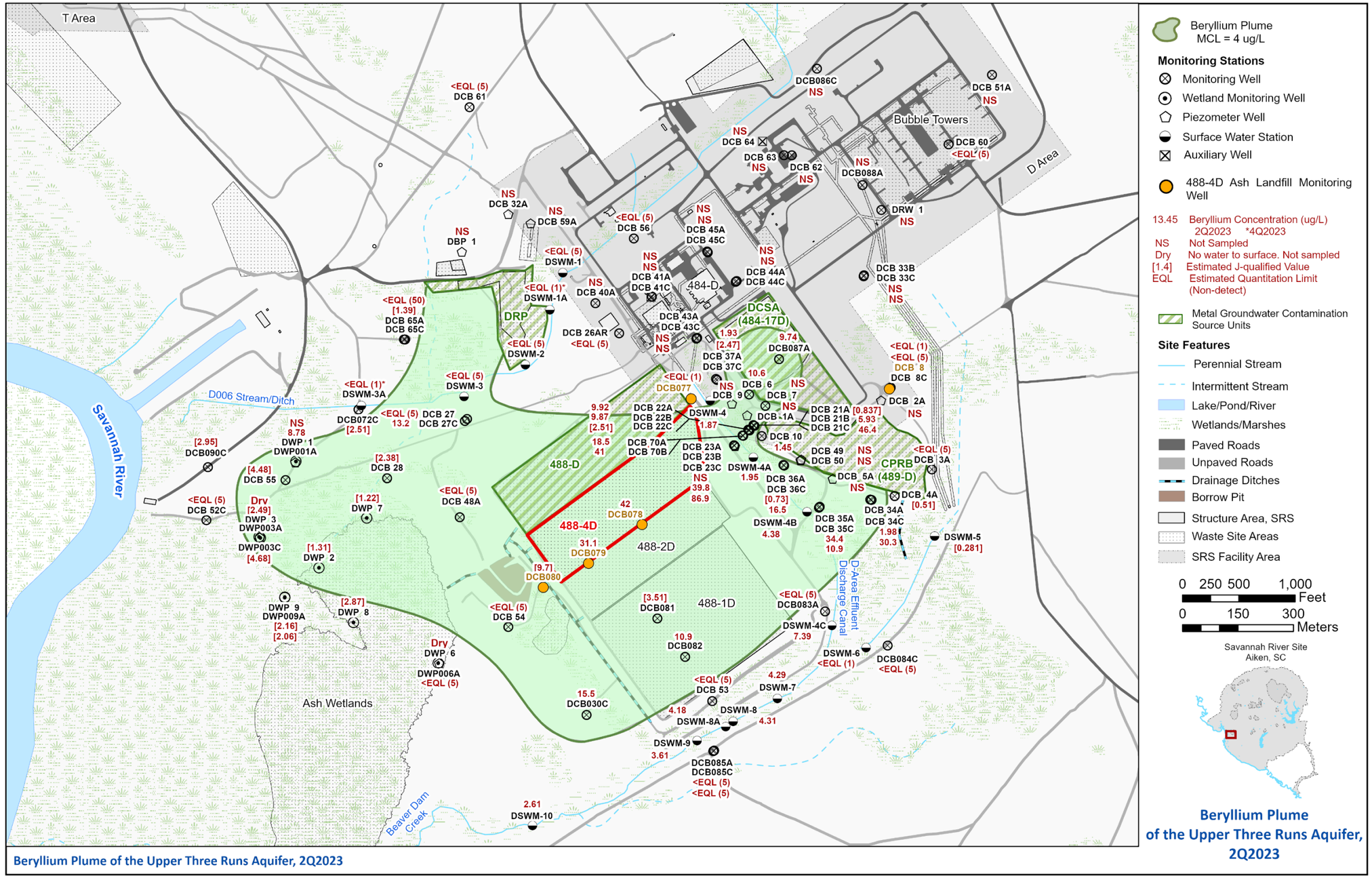

Figure 2. Beryllium Concentrations at the 488-4D Ash Landfill, Second Quarter 2023

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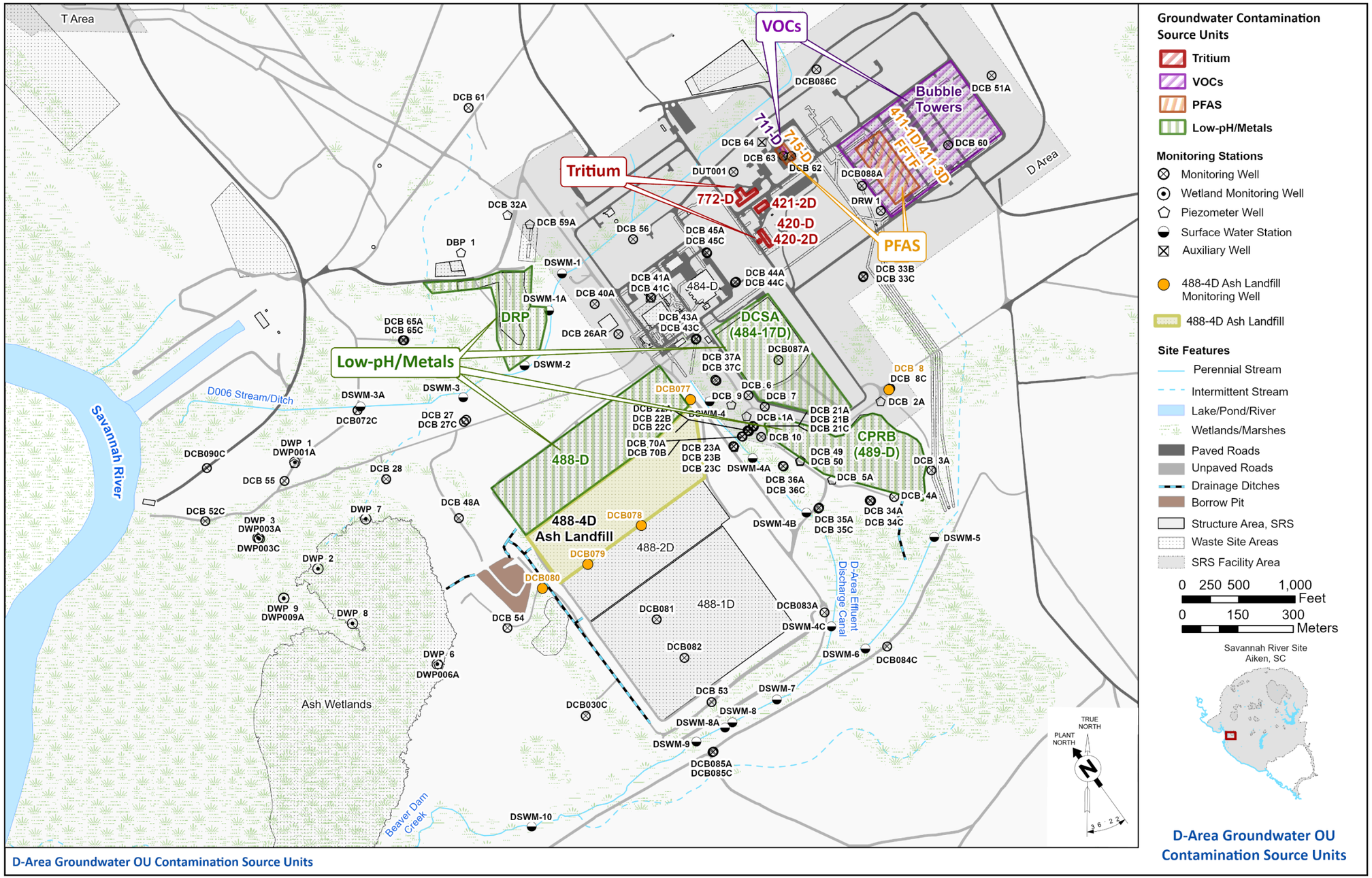

Figure 3. Upgradient Sources of Tritium, VOCs, and PFAS Constituents in D Area

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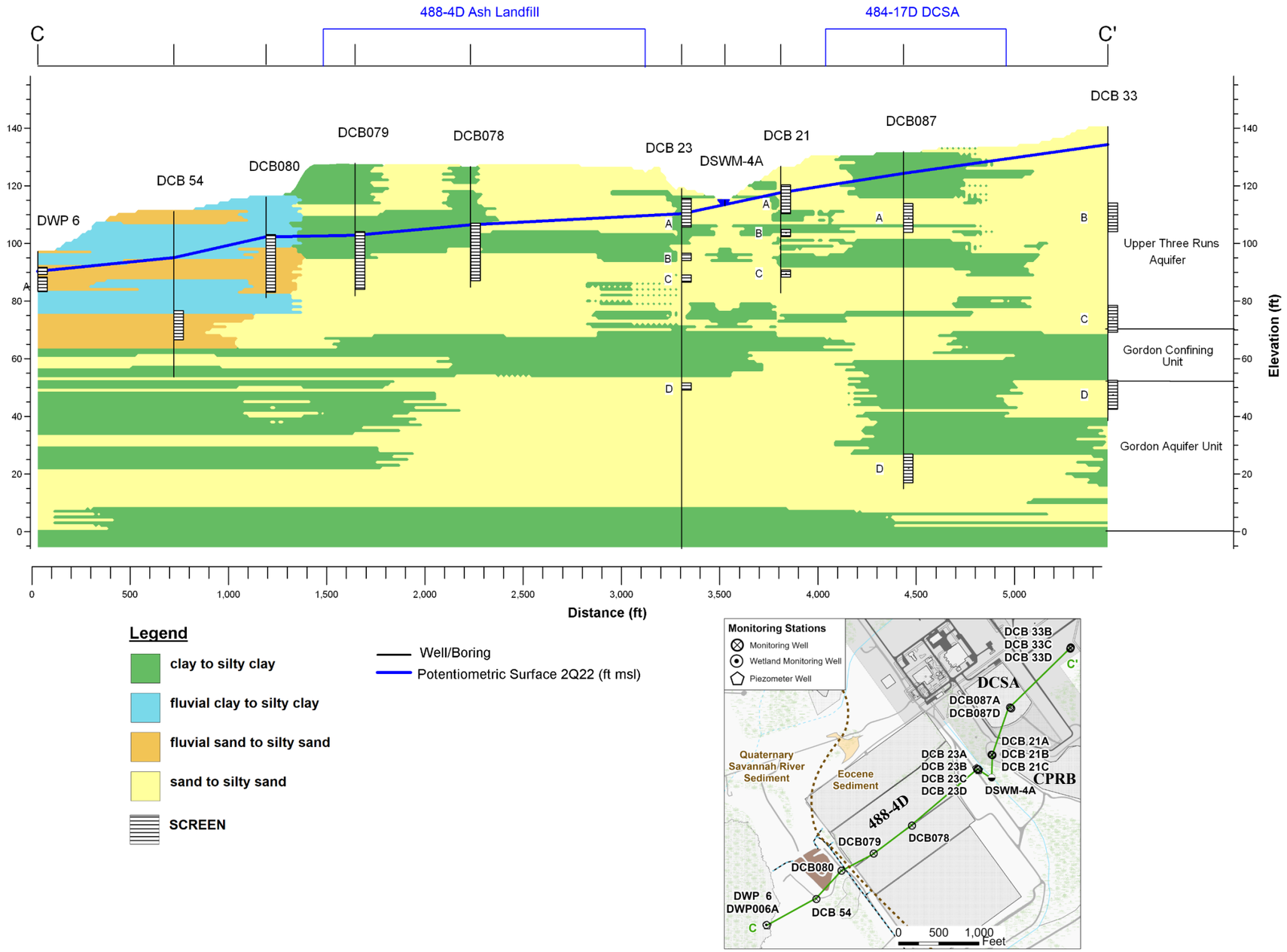

Figure 4. Cross-Sectional View at the 488-4D Ash Landfill and Surrounding Area

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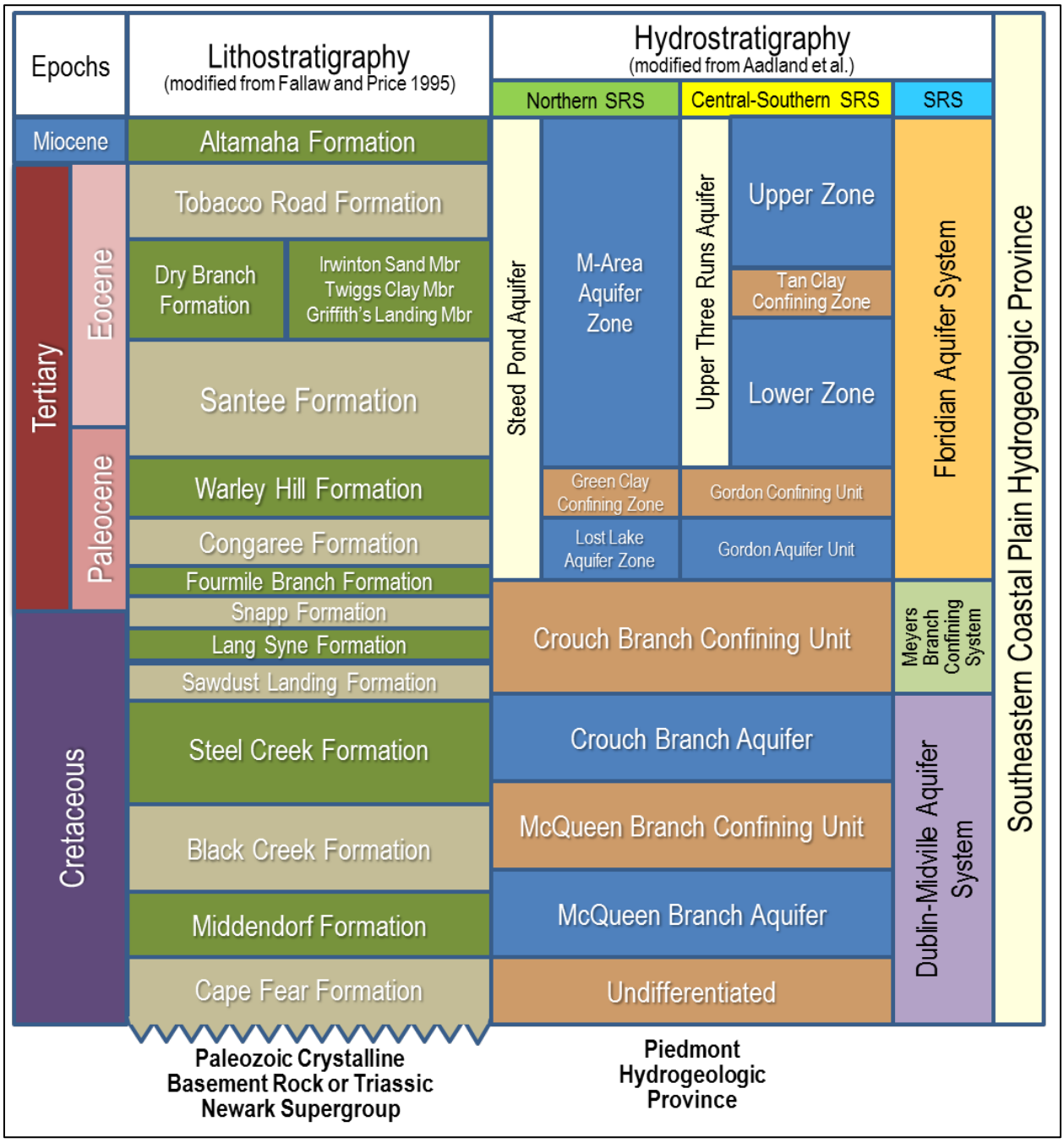

Figure 5. Lithostratigraphic and Hydrostratigraphic Units at SRS

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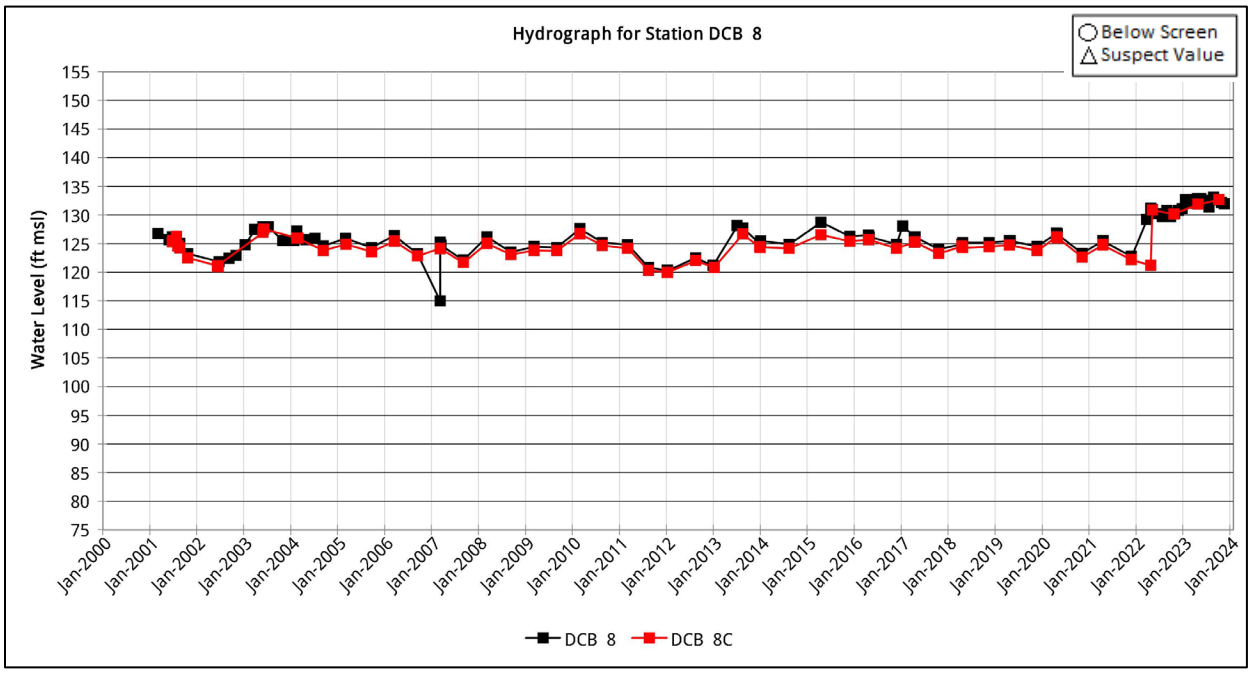


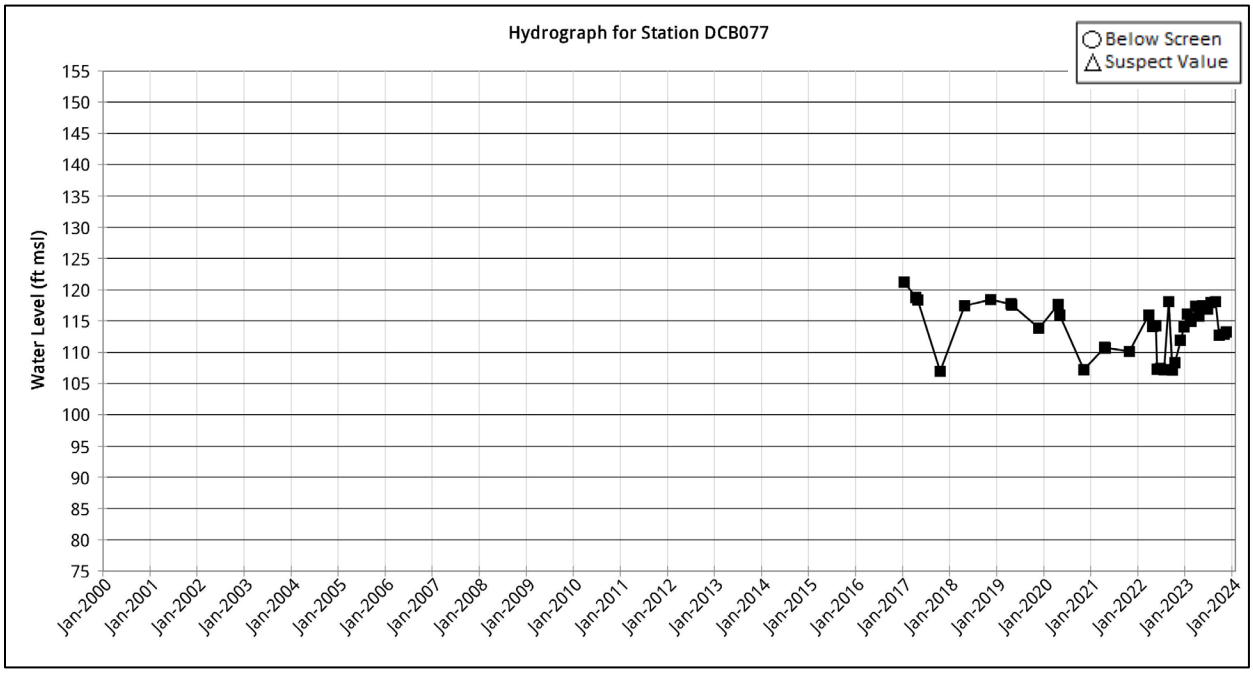
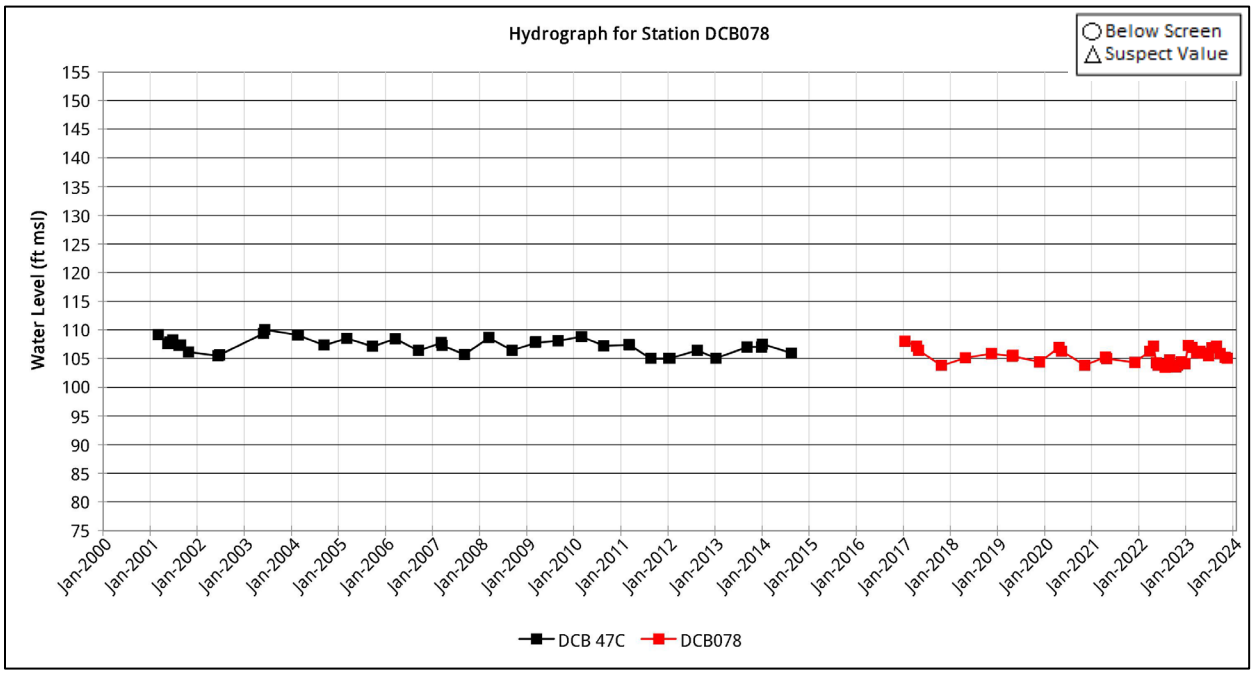


Figure 6. Hydrographs at DCB 8 and DCB077



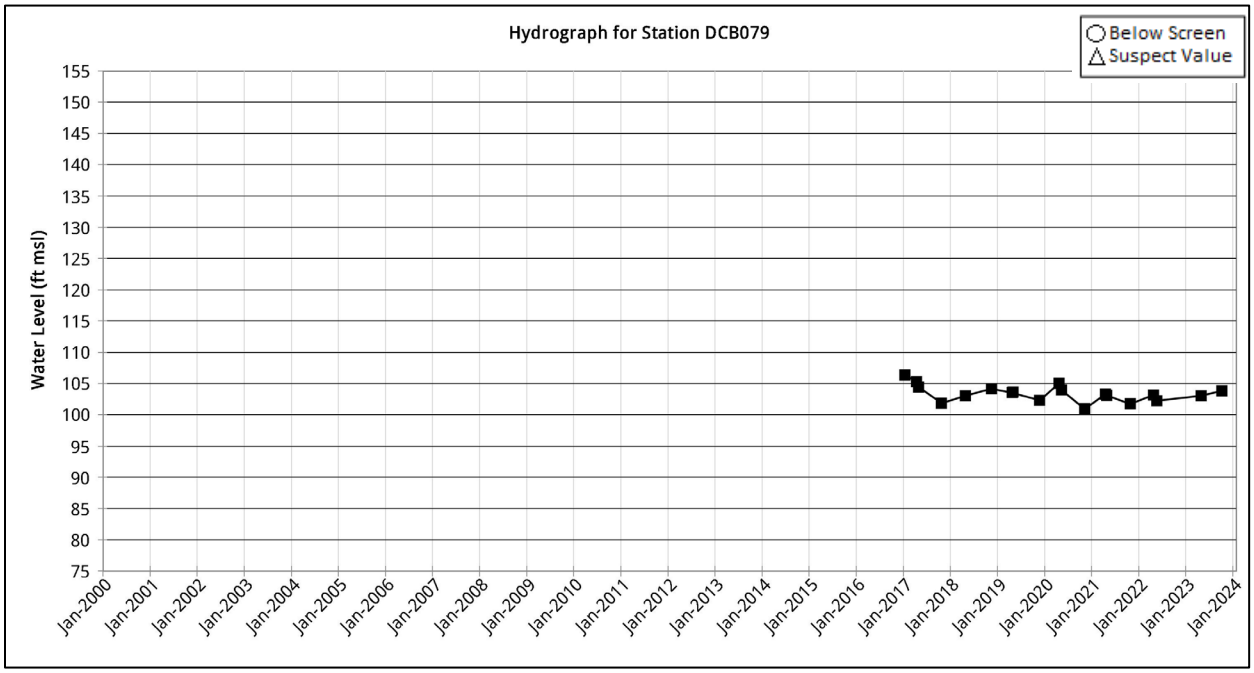


Figure 7. Hydrographs at DCB078 and DCB079

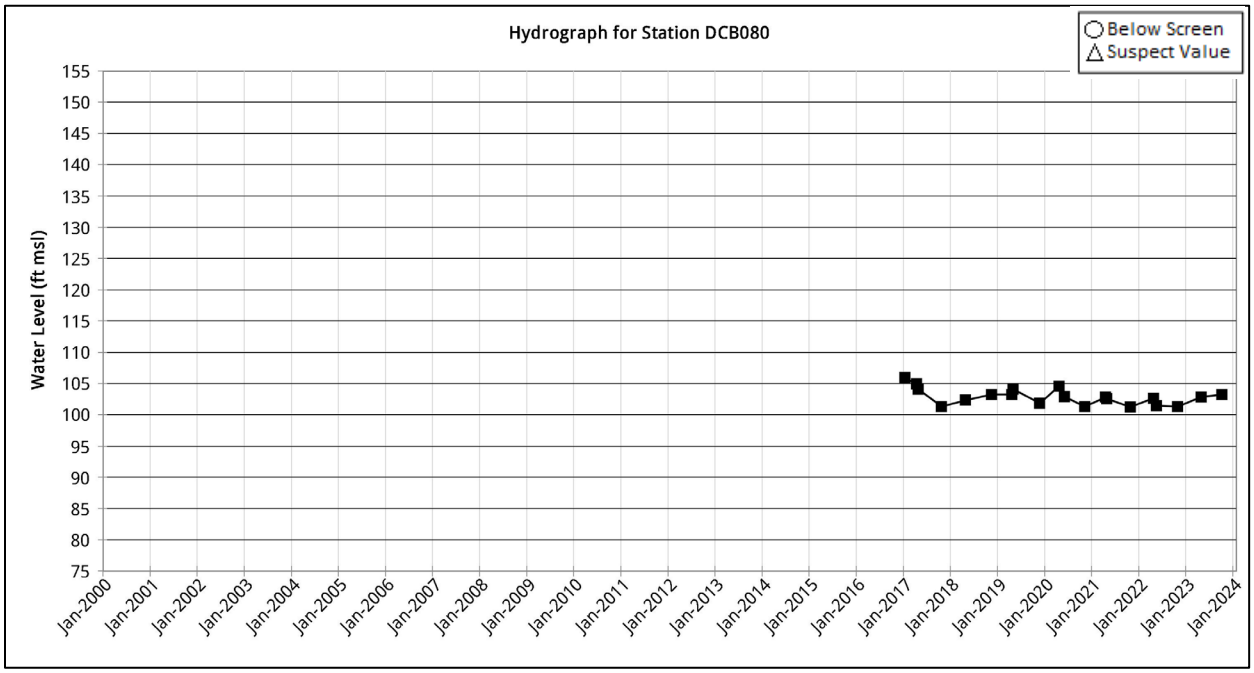
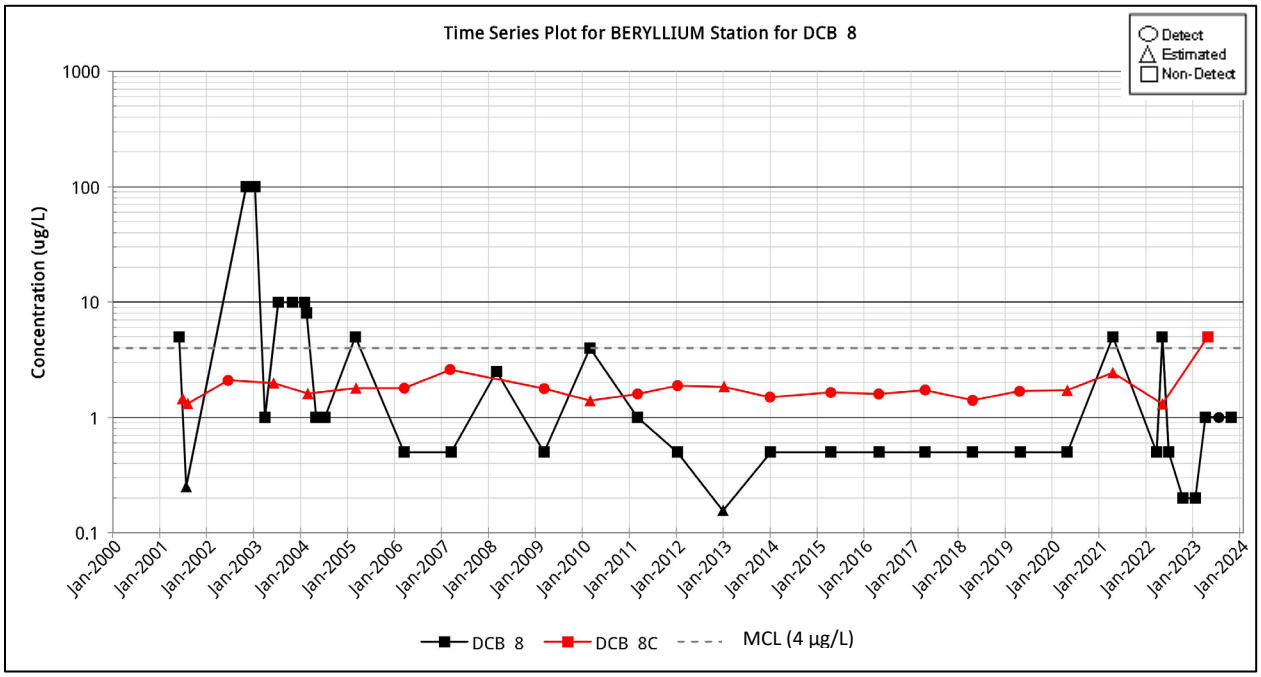


Figure 8. Hydrographs at DCB080



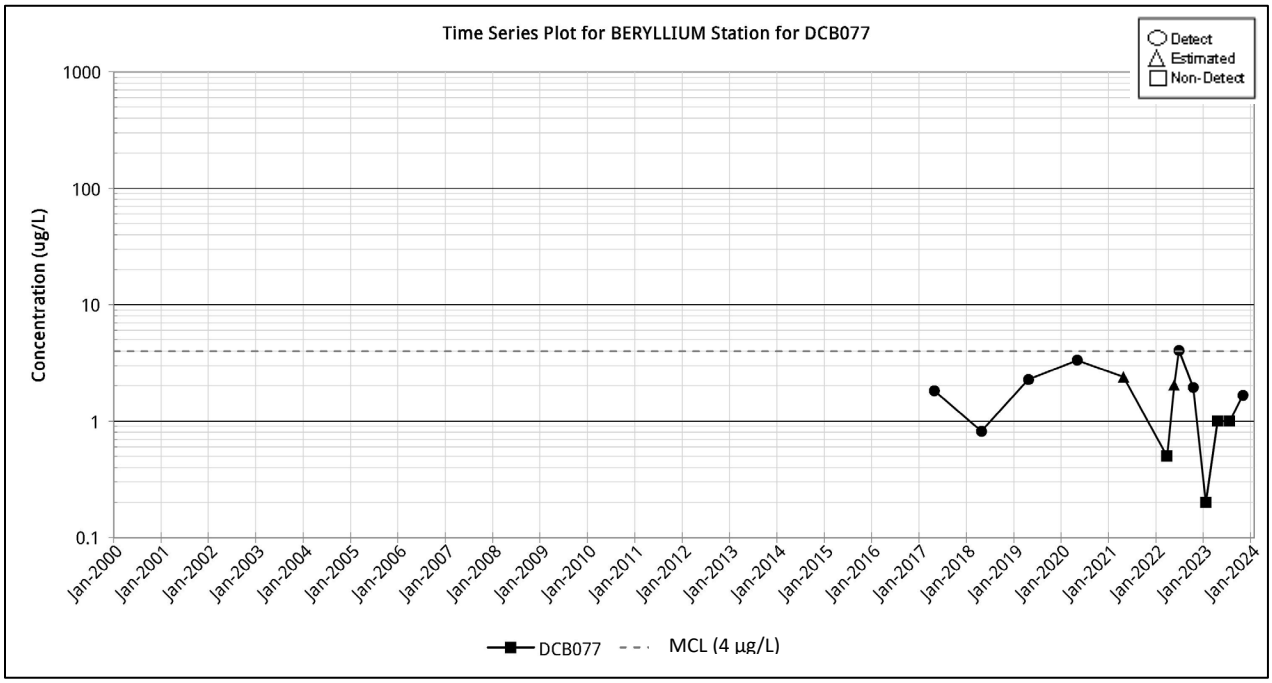
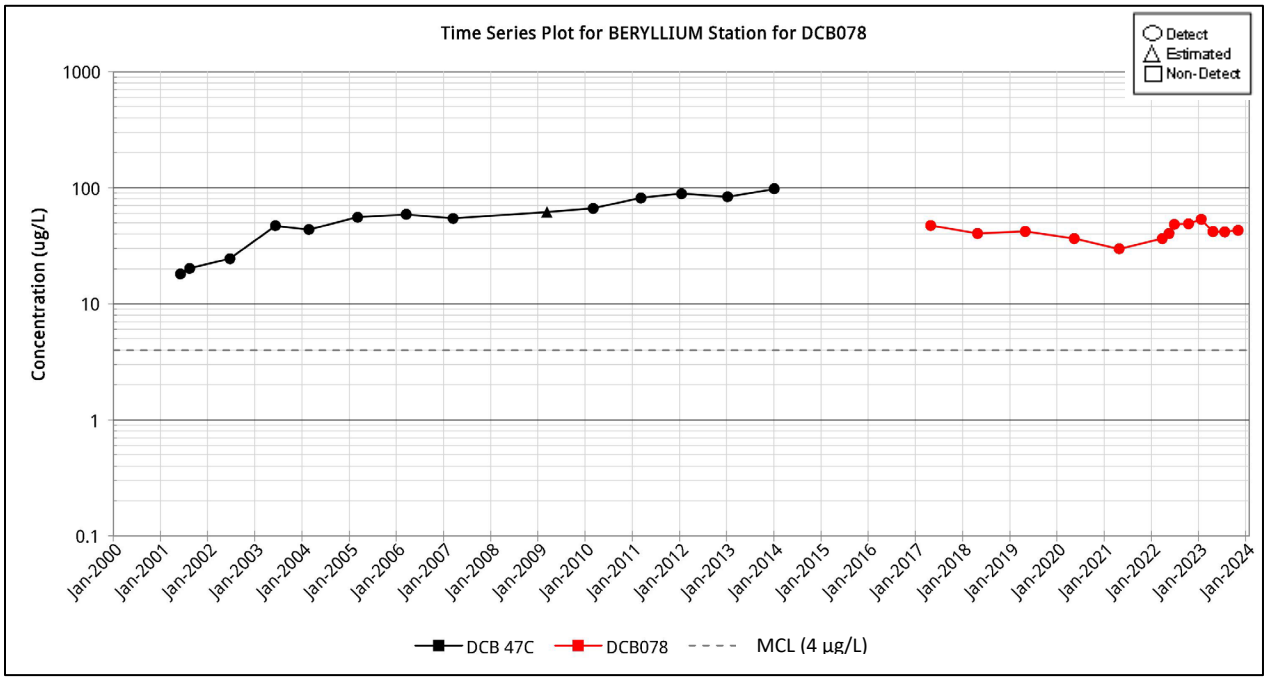


Figure 9. Beryllium Time Series Plots at DCB 8 and DCB077



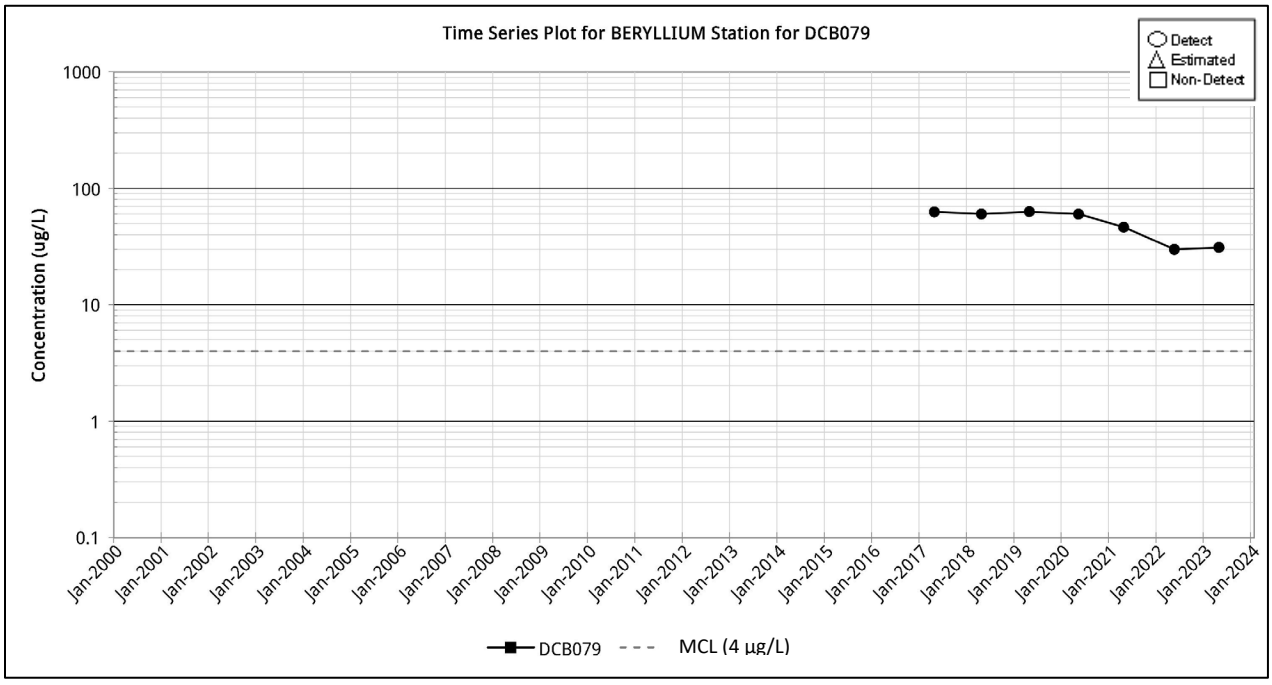


Figure 10. Beryllium Time Series Plots at DCB078 and DCB079

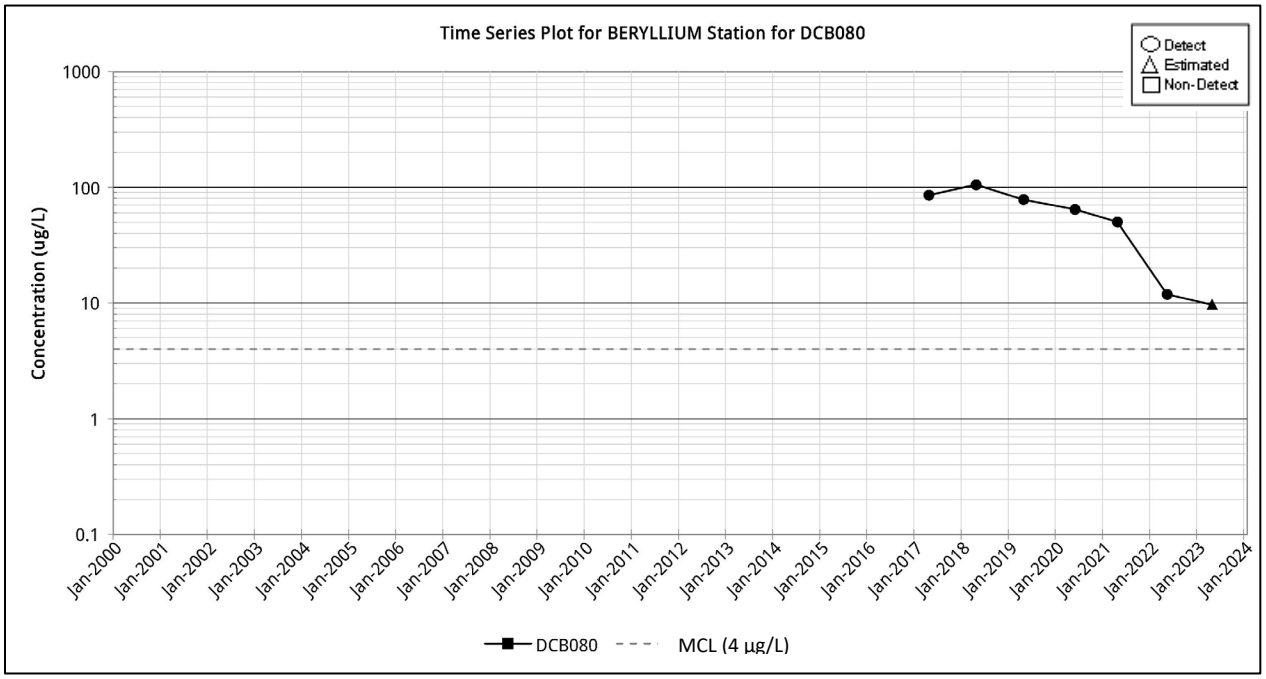


Figure 11. Beryllium Time Series Plot at DCB080

Table 1. Groundwater Monitoring Network at the 488-4D Ash Landfill

Station	Well Use	Aquifer	UTM East (NAD 27)	UTM North (NAD 27)	Reference Elevation *(ft amsl)*	Ground Elevation *(ft amsl)*	Depth to Top of Screen Zone *(ft bgs)*	Depth to Bottom of Screen Zone *(ft bgs)*
DCB 8	upgradient	UTRA	431521.3	3673555.1	137.20	134.80	4.5	24.5
DCB077	upgradient	UTRA	430985.68	3673528.71	130.64	127.7	9.7	29.7
DCB078	downgradient	UTRA	430852.27	3673189.19	126.56	126.7	19.7	39.7
DCB079	downgradient	UTRA	430707.50	3673083.91	127.65	127.8	23.7	43.7
DCB080	downgradient	UTRA	430585.51	3673019.20	119.03	116.1	13.1	33.1

UTM – Universal Transverse Mercator; NAD – North American Datum; UTRA – Upper Three Runs Aquifer (water table)

Table 2. Monitored Constituents for the 488-4D Ash Landfill

Monitoring Well	Second Quarter	Fourth Quarter
DCB 8	Fp, M, S, U	W
DCB077	Fp, M, S	W
DCB078	Fp, M, S	W
DCB079	Fp, M, S	W
DCB080	Fp, M, S	W

Fp-Field Parameters; M-Metals; S-Sulfate; U-Uranium; W-Water Elevation Only

Metals	
Aluminum	Magnesium
Antimony	Manganese
Arsenic	Mercury
Barium	Nickel
Beryllium	Potassium
Cadmium	Selenium
Calcium	Silver
Chromium	Sodium
Cobalt	Thallium
Copper	Vanadium
Iron	Zinc
Lead	

Field Parameters
Depth to Water
Purge Volume
Turbidity
Water Temperature
pH
Specific Conductance
Alkalinity
Dissolved Oxygen

Table 3. 2023 Sampling Results for the 488-4D Ash Landfill

See insert on next page

Table 3. 488-4D Ash Landfill 2023 Groundwater Monitoring Data

Field Data

Station	Well Use	Aquifer Zone	SAMPLE COLLECTION DATE (day-month-year)	DEPTH TO WATER (ft)	WATER ELEVATION (ft amsl)	TURBIDITY (NTU)	PH (pH)	WATER TEMPERATURE (degC)	SPECIFIC CONDUCTANCE (uS/cm)	TOTAL ALKALINITY (AS CACO3) (mg/L)	OXIDATION/REDUCTION POTENTIAL (mV)	OXYGEN (mg/L)	VOLUME PURGED (gal)	FIELD CONDITIONS
DCB 8	Monitoring Well	UTRA	26-Apr-2023	4.5	132.7	4.9	5	19.1	30	0	314	5.42	29	
DCB 8	Monitoring Well	UTRA	11-May-2023	4.4	132.8	9.7	5	19.2	27	0	NS	NS	30	
DCB 8	Monitoring Well	UTRA	13-Nov-2023	5	132.2	6.7	5.1	20.8	26	1	298	4.39	30	
DCB077	Monitoring Well	UTRA	09-May-2023	14.9	115.74	7.8	5.8	21.6	188	32	160	2.5	1	
DCB077	Monitoring Well	UTRA	20-Nov-2023	17.78	112.86	7.5	3.5	21.5	580	0	272	5.4	2	
DCB078	Monitoring Well	UTRA	09-May-2023	20.3	106.26	4.4	4.2	21.2	819	0	230	2	2	
DCB078	Monitoring Well	UTRA	20-Nov-2023	21.38	105.18	6.4	3.5	21	864	0	222	4.3	1	
DCB079	Monitoring Well	UTRA	18-May-2023	24.6	103.05	27.3	4.3	20.9	352	0	NS	NS	5	MS
DCB079	Monitoring Well	UTRA	25-Oct-2023	23.83	103.82	NS	NS	NS	NS	NS	NS	NS	0	
DCB080	Monitoring Well	UTRA	18-May-2023	16.2	102.83	7.2	4.6	18.7	527	0	NS	NS	1	MS
DCB080	Monitoring Well	UTRA	25-Oct-2023	15.81	103.22	NS	NS	NS	NS	NS	NS	NS	0	

D Area Analyte Suite – Inorganics

Station	Date / Constituent	ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM	COBALT	COPPER	IRON	LEAD
	Unit	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
	NPDWS (MCL)		6	10	2000	4	5		100		1300		15
	NSDWS	200										300	
	RSL	20000								6		14000	
DCB 8	26-Apr-2023	316	<EQL (8)	<EQL (1)	14	<EQL (1)	<EQL (1)	1360	<EQL (30)	[0.352]	29.2	[113]	[0.6]
DCB 8	11-May-2023	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
DCB 8	13-Nov-2023	[134]	<EQL (8)	<EQL (1)	11.4	<EQL (1)	<EQL (1)	1180	<EQL (30)	[0.251]	22	[129]	<EQL (3)
DCB077	09-May-2023	[53.9]	<EQL (8)	<EQL (1)	53.8	<EQL (1)	<EQL (1)	24200	<EQL (30)	[0.782]	[0.68]	560	[2.32]
DCB077	20-Nov-2023	1110	<EQL (8)	[0.311]	44	1.67	<EQL (1)	[73200]	<EQL (30)	6.81	5.64	23100	<EQL (3)
DCB078	09-May-2023	23500	<EQL (8)	[0.716]	19.4	42	2.37	61100	<EQL (30)	248	8.72	31400	[1.96]
DCB078	20-Nov-2023	29200	<EQL (8)	[0.81]	21.6	43.1	2.65	[67100]	<EQL (30)	265	13.9	34100	<EQL (3)
DCB079	18-May-2023	3400	<EQL (20)	<EQL (30)	45.9	31.1	<EQL (5)	26800	[1.11]	153	[5.29]	6390	<EQL (20)
DCB079	25-Oct-2023	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
DCB080	18-May-2023	5540	[23]	[25.3]	[20.1]	[9.7]	<EQL (25)	35200	<EQL (50)	111	[23.8]	15400	<EQL (100)
DCB080	25-Oct-2023	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Station	Date / Constituent	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SELENIUM	SILVER	SODIUM	SULFATE	THALLIUM	URANIUM	VANADIUM	ZINC
	Unit	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	mg/L	ug/L	ug/L	mg/L	ug/L
	NPDWS (MCL)			2			50				2	30		
	NSDWS		50					100		250				5000
	RSL		430		390			94						6000
DCB 8	26-Apr-2023	[632]	[4.49]	<EQL (0.4)	[0.717]	[304]	<EQL (2)	<EQL (1)	[1640]	[1.65]	[0.317]	<EQL (20)	<EQL (5)	<EQL (40)
DCB 8	11-May-2023	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	<EQL (0.2)	NS	NS
DCB 8	13-Nov-2023	[557]	[4.21]	[0.153]	[0.537]	[629]	<EQL (2)	<EQL (1)	[1490]	[0.741]	<EQL (2)	<EQL (20)	[0.616]	<EQL (40)
DCB077	09-May-2023	1620	23.2	<EQL (0.4)	[2.64]	6150	10.5	<EQL (1)	[2850]	53.7	[0.343]	<EQL (20)	<EQL (5)	<EQL (40)
DCB077	20-Nov-2023	[6480]	1140	<EQL (0.4)	[13.4]	[15400]	15.3	<EQL (1)	4630	204	[0.959]	<EQL (20)	<EQL (5)	[12.7]
DCB078	09-May-2023	27700	4230	<EQL (0.4)	224	2900	2.88	<EQL (1)	10600	472	[0.243]	<EQL (20)	<EQL (5)	675
DCB078	20-Nov-2023	[29400]	4670	NS	[243]	[3360]	2.05	<EQL (1)	9640	416	[0.288]	<EQL (20)	[0.518]	741
DCB079	18-May-2023	5610	2830	[0.105]	32.8	2810	<EQL (30)	<EQL (5)	18000	165	<EQL (20)	NS	[1.65]	146
DCB079	25-Oct-2023	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
DCB080	18-May-2023	11600	1410	<EQL (0.2)	42.9	6120	[40.9]	<EQL (25)	13900	275	<EQL (100	NS	[6.12]	114
DCB080	25-Oct-2023	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Explanation

[##]	EPA Functional Guideline Code of 'J' was applied to the result, indicating an estimated quanity.
[##]	EPA Functional Guideline Code of 'J' was applied to the result, indicating an estimated quanity, and result exceeds applicable limit.
<EQL(##)	Constituent was below detection. The sample-specific Estimated Quantitation Limit is in parentheses.
	Result exceeds applicable limit.
REJ	Result Rejected.
	Result is less than the applicable limit and without EPA Functional Guidline qualifiers.
NS	Requested to be sampled but was not. See comments as to why not.
Blue Text	Not a required sample analysis.