Savannah River NUCLEAR SOLUTIONS℠

United States Department of Energy

Savannah River Site

Treatability Study Data Report for Groundwater Injection and Discharge Canal Neutralization at the D-Area Groundwater Operable Unit (OU) (U)

2023 Data and Information

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LIST OF ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
bgs	below ground surface
$CaCO_3$	calcium carbonate
CPRB	Coal Pile Runoff Basin
D&D	deactivation and decommissioning
DAG	D-Area Groundwater
DCSA	D-Area Coal Storage Area
ft	feet
gpm	gallons per minute
m	meters
OU	operable unit
PFAS	per- and polyfluoroalkyl substances
RSER/EE/CA	Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis
SCDHEC	South Carolina Department of Health and Environmental Control
SRNS	Savannah River Nuclear Solutions LLC
SRS	Savannah River Site
USEPA	U.S. Environmental Protection Agency
UTRA	Upper Three Runs aquifer

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1.0 INTRODUCTION

The Savannah River Site (SRS) has continued implementation of a groundwater treatability study in D Area to reduce the acidic conditions in groundwater (Savannah River Nuclear Solutions, LLC [SRNS] 2019a). The acidic conditions were caused by the storage of coal in the former 484-17D D-Area Coal Storage Area (DCSA) and the subsequent runoff into the 489-D Coal Pile Runoff Basin (CPRB). This data report summarizes all actions and data that have been taken during 2023 as presented and required in the *Treatability Study Work Plan for Groundwater Injection and Discharge Canal Treatment at the D-Area Groundwater (DAG) Operable Unit (OU)* (SRNS 2019) and subsequent data reports (2020 DAG OU Data Report [SRNS 2021a]; 2021 DAG OU Data Report [SRNS 2022a]; 2022 DAG OU Data Report [SRNS 2023a]).

The coal-fired 484-D Powerhouse provided electricity and steam for the D-Area facilities and other areas at SRS. The power plant was put into operation in 1952. The major ancillary facilities associated with the powerhouse are the former 484-17D DCSA, the 489-D CPRB, and four ash basins (Figure 1). For over 60 years, the 484-17D DCSA was a staging area for coal prior to its use in the powerhouse. Exposure of the coal to rainwater caused the degradation of iron sulfide (pyrite, a mineral commonly found in coal) to sulfuric acid. As a result, the soils underneath the 484-17D DCSA, associated storm water runoff, and groundwater underlying the area have been acidified. Due to acidic conditions, metals were leached from the coal and the natural soil minerals in the underlying vadose zone and aquifer. This has resulted in a metals (e.g., aluminum, beryllium, and cobalt) and sulfate groundwater plume in the Upper Three Runs Aquifer (UTRA) (Figures 2 through 5). Currently, acidic groundwater outcrops into the D-Area Effluent Discharge Canal at pH levels generally below 4.

Although maintenance actions conducted in 2012 and 2013 removed virtually all the coal present at the 484-17D DCSA, the vadose zone soils beneath the 484-17D DCSA remained acidified. To address the vadose zone soils, a Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) was submitted in 2019 to describe a non-time critical removal action for neutralization of the soils to a depth of 1.2 meters (m) (4 feet [ft]) at the 484-17D DCSA (SRNS

2018). This removal action was completed in 2020 with subsequent soil pH sampling completed in the summer of 2022. A Removal Action Report, summarizing the removal action and pH adjustment of the vadose zone soils, was submitted in December 2022 (SRNS 2022b).

This treatability study is designed to address the continuing acidic conditions in the shallow groundwater beneath the 484-17D DCSA and 489-D CPRB as well as the discharge to surface water in the D-Area Effluent Discharge Canal.

2.0 PROJECT DESCRIPTION

The vadose zone and groundwater within the upper water table aquifer beneath the 484-17D DCSA and the 489-D CPRB are impacted by low pH conditions (< pH of 4) that are expected to last for decades under natural groundwater conditions. The low-pH groundwater is currently outcropping into the D-Area Effluent Discharge Canal, which later converges with Beaver Dam Creek and flows through the Savannah River floodplain to the Savannah River. If the pH of the aquifer can be raised to more normal, less acidic conditions, the groundwater and surface water conditions in the D-Area Effluent Discharge Canal would improve.

This study is testing the viability of an approach to remediation that contains two relatively simple elements:

- Add higher pH, potable groundwater sourced from production wells in D Area into the water table aquifer upgradient of the low-pH, metals, and sulfate plumes using injection wells. The injected production well water is naturally buffered, which will aid in the neutralization of acidic conditions currently present in the water table aquifer. The injected production well water will also raise the elevation of the water table that will help displace the low-pH groundwater within the aquifer.
- Treat the low-pH surface water that outcrops into the D-Area Effluent Discharge Canal by adjusting the pH with calcium carbonate ($CaCO_3$) reactive structure(s).

A general schematic of the DAG OU treatability study is provided in Figure 6.

Injection of Production Well Water

Two potable water production wells (PW 3D and PW 136D) are in D-Area northwest of the 484-D Powerhouse. Both production wells were used for operations and are screened approximately 195 - 229 m (640 - 750 ft) below ground surface (bgs) within the McQueen Branch Aquifer. These production wells produce groundwater with a pH of approximately 6.0 to 6.5 containing low, but measurable, levels of carbonate alkalinity. Injecting this water into the upper water table aquifer upgradient of the low-pH, metals, and sulfate plumes will raise the elevation of the water table and increase groundwater flow velocity horizontally to displace the low-pH groundwater currently present in the aquifer. The alkalinity will buffer the system and partially neutralize acidity in the aquifer. Both production wells are artesian and produce over 200 gallons per minute (gpm) each without the use of pumps. The well head pressure of the wells is approximately 5 to 10 pounds per square inch and supports enough flow and pressure to deliver large volumes of water to the proposed injection field, as shown by artesian well flow testing conducted in 2019 on both production wells (SRNS 2021a) as well as the ongoing performance of the groundwater injections and flow from the production well PW 136D.

The production well water has been piped to the 484-17D DCSA and 489-D CPRB and is being injected into the upper water table aquifer with a series of injection wells (Figure 7). A portion of the injection well field has been installed and is described in Section 5.1. Creating a water mound approximately 1.5 m (5 ft) above current conditions is expected to increase the volume of groundwater outcropping into the D-Area Effluent Discharge Canal. The original estimation expected that the production wells can supply enough water to fill the pore space volume (the space between the sediment grains in the vadose zone) to create the 1.5 m (5 ft) water mound in approximately 100 days. The original pore space volume was calculated by multiplying the surface area of the 484-17D DCSA and the 489-D CPRB by the proposed rise in water elevation (1.5 m [5 ft]) by the porosity (30%) and converting to gallons. A total of approximately 19 million gallons was originally estimated to be needed to raise the water table 1.5 m (5 ft). Based on aqueous chemical equilibrium modeling software, a total of 10 pore space volumes of injected potable groundwater could significantly displace and raise the pH levels in the upper water table within a three-year study period. The production wells are expected to support the groundwater injection study in addition to future remedial activities if needed (SRNS 2016a).

In 2023 SRS revisited the assumptions in the original estimation and determined that the potential area that would need to have the water table raised 5 ft would need to be expanded to include additional area to the D-Area Effluent Discharge Canal. This would increase the pore volume size from 19 million gallons to 75 million gallons and additionally increase the time needed to inject one pore volume (SRNS 2023a).

Although the water table is expected to rise approximately 1.5 m (5 ft) into the vadose zone, groundwater injection is not intended to be the only treatment for the vadose zone and is not expected to remove all the acidity from the vadose zone. However, the production well water to be injected within the upper water table aquifer is anticipated to provide an important, but small, buffering interaction to mitigate the low-pH groundwater. The 484-17D DCSA RSER/EE/CA action that added neutralization amendments to the vadose zone soils (SRNS 2018) was intended to reduce acidity in the vadose zone source that has contributed to groundwater contamination. Due to the higher water table condition created by injection, acidity is expected to be gradually released from the now-saturated lower vadose zone soils. However, the lower vadose zone soils that will not become saturated (i.e., remaining above the elevated water table) are not expected to be neutralized or have much change in pH as a result of the groundwater injection treatability study. The lower vadose zone will eventually see the buffering effects of the upper vadose zone amendments through their dissolution and infiltration over time. The combined (or synergistic) effects of the two actions will be apparent from the measurement of the parameters described in the Treatability Study Work Plan and the 484-17D DCSA RSER/EE/CA (SRNS 2018), and the regular DAG OU groundwater and surface water monitoring that occur concurrently.

Reactive Structures in D-Area Effluent Discharge Canal

An increase in the amount of acidic water outcropping into the D-Area Effluent Discharge Canal is expected to occur as groundwater elevations rise and low-pH groundwater is displaced. Titration test results using surface water from the D-Area Effluent Discharge Canal indicate that contact of surface water with a high purity $CaCO_3$ reactive structure will raise the pH of the surface water to over 6.0 (SRNS 2016b). Figure 8 shows the carbonate consumption rates associated with the neutralization of the sulfuric acid and illustrates a titration curve of the test. Although the installation of one reactive structure should be sufficient to raise the pH of the surface water, two

reactive structures were installed to further ensure pH adjustment is sufficient over time. $CaCO_3$ marble chips, placed within the stream in two sections downgradient of the acidic groundwater discharge point within the D-Area Effluent Discharge Canal, are expected to allow enough contact time with the surface water for pH adjustment to natural conditions (Figure 6, 8, and 9). The use of high purity $CaCO_3$ (typically greater than 90% $CaCO_3$) limits the introduction of undesirable materials into the surface water (silt, clay, reactive minerals, etc.). The description of installation, the data collected to date, and maintenance associated with the $CaCO_3$ reactive structures are summarized in Section 5.2.

3.0 TEST OBJECTIVES

The objective of this treatability study is to determine the effectiveness of injecting higher-pH potable groundwater to:

- Displace the acidic groundwater out of the upper water table aquifer of the UTRA in the vicinity of and downgradient of the 484-17D DCSA and 489-D CPRB to improve the aquifer conditions (increase the pH), which will reduce or eliminate the dissolved metal groundwater plumes.
- Increase the pH level of the D-Area Discharge Canal surface water with $CaCO_3$ reactive structures prior to discharge into Beaver Dam Creek, the Savannah River floodplain, and Savannah River.

The results of the treatability study and the 484-17D DCSA non-time critical removal action will be used to support the development of the DAG OU Corrective Measures Study/Feasibility Study, currently scheduled to be submitted by March 9, 2028.

Monitoring of water table elevations and pH measurements in surrounding monitoring wells and streams, as well as metal analyses of groundwater and surface water, will be used to determine the impact of the production well water injections. Stream flow measurements will document any increases in flow in the D-Area Discharge Canal from the groundwater injections.

4.0 SAMPLING AND ANALYSIS

Measurements of water table elevations, stream flow, pH, and sample collection for metal analyses in surface water and/or groundwater are conducted following the SRS *3Q1 Manual: Environmental Requirements and Program Documents, Procedure 9015: Sampling Groundwater Monitoring Wells, Tanks/Vessels (Sample Ports or Spigots) and Surface Water* (SRNS 2023b).

Table 1 includes the stations that were monitored in 2023 and identifies the sampling frequency and constituents that were monitored. Figure 10 shows the locations of the monitored stations. A total of 34 wells and 11 surface water stations outside of the injection field are being monitored. Twenty-one monitoring wells and all 11 surface water stations included samples or measurements for metals, pH, and other routine field analyses. Thirteen wells are sampled for water elevations. (See Appendix A, Table A-1)

A potentiometric surface map of the UTRA during second quarter (2Q)2023 is provided in Figure 11, and a pre-injection water elevation map from 2Q2020 is provided for comparison in Figure 12. Water elevations dropped 3-5 feet overall in D-Area between 2Q2023 and 2Q2020 in wells upgradient or sidegradient of the injection wells; however, the water elevations in the area around the 484-17D DCSA and 489-D CPRB are slightly elevated. Water elevations were measured on a monthly basis for the first eight months after groundwater injections begin in March 2022 and also throughout all of 2023 (although only required quarterly). A map of the acidic groundwater with the 2Q2023 pH data is provided in Figure 2, and a map of the sulfate plume is provided in Figure 4. Pre-injection plume maps from 2Q2020 are provided in Figures 3 and 5.

Stream flow measurements are collected at all surface water station locations within the D-Area Effluent Discharge Canal, the tributary to the east, and downgradient in Beaver Dam Creek where it is safely accessible. Groundwater and surface water samples are monitored for the metals included in the DAG OU monitoring program. Monitoring also includes field pH measurements and other routine field measurements (i.e., oxidation/reduction potential, dissolved oxygen, specific conductance, total alkalinity [as $CaCO_3$], turbidity, water temperature, and water elevation [at wells]).

One round of sampling occurred in 2Q2020 for baseline data before production well water injections began. These data were supplied in the 2020 DAG OU Treatability Study Data Report (SRNS 2021a) and are included in Appendix A, Table A-2 of this report for comparison. Groundwater injections began in March 2022 after preliminary testing of the injection wells. Monthly groundwater elevation measurements were conducted, and hydrographs of the data are provided in Appendix B. Analytical sampling of monitoring wells and surface water stations were conducted quarterly. Monthly pH measurements were conducted at the reactive structures at surface water stations DSWM-8, DSWM-8A, and DSWM-9. All 2023 analytical and field data are provided in Appendix A, Table A-1 and discussed in Sections 5.1 and 5.2.

Any adjustments needed to the monitoring plan based on field conditions or monitoring results will be discussed with the United States Department of Energy – Savannah River, United States Environmental Protection Agency (USEPA), and South Carolina Department of Health and Environmental Control (SCDHEC) for approval prior to implementation. The 2Q and 4Q DAG OU monitoring will not be impacted by the treatability study and will continue as normally scheduled. As field conditions warrant, adjustments such as varying injection flow rates or well re-development could also be employed. Any permanent discontinuation of an injection well will be communicated with USEPA and SCDHEC.

5.0 TREATABILITY STUDY PROGRESS AND DATA

Due to the discovery of unfavorable injection sediments within the UTRA, potential interferences with deactivation & decommissioning (D&D) activities in D Area, and delays in field personnel availability due to Covid-19 management practices, a stepped approach has been taken with implementation of the DAG OU treatability study. Ten injection wells have been installed; five were installed during 2020 (DGI007, DGI010, DGI014, DGI016, and DGI019), and five were installed during 2021 (DGI011, DGI012, DGI013, DGI015, and DGI017) (Figure 7). A letter with the request to operate as part of the Underground Injection Control Permit, including the well installation reports, was submitted to SCDHEC and copied to USEPA after installation of the 10 injection wells (SRNS 2011b). The injection wells were originally planned to be screened within the upper water table aquifer at approximately 3.7 – 9.8 m (12 – 32 ft) bgs. However, due to the abundance of clays, sandy clays, and silty sands, especially near the 484-17D DCSA, the wells

were installed deeper within the mid to lower zone of the UTRA (Table 2). A cross-sectional view of the sediments including all 10 installed injection wells is shown in Figures 13 and 14. Additionally, the two $CaCO_3$ reactive structures were installed within the D-Area Effluent Discharge Canal in 2020. Ongoing monthly monitoring of pH and metal analyses within the D-Area Effluent Discharge Canal was performed upgradient, between, and downgradient of the $CaCO_3$ reactive structures to determine the efficacy of both the $CaCO_3$ material and structure design. Before groundwater injections began, SRS collected per- and polyfluoroalkyl substances (PFAS) samples from both production wells PW 3D and PW 136D on December 17, 2021. Samples were analyzed using method EPA533 for 25 constituents. Results from both wells were non-detect for all PFAS constituents. The complete sample results were provided in Appendix A, Table A-2 of the January 2023 Data Report (SRNS 2023a).

Details on each portion of the treatability study project are provided below.

5.1 Injection Piping System

Due to Covid-19 related delays and material supply issues, the procurement and installation of the piping system did not start until December 2021. The main piping system consists of 6-inch and 4-inch high-density polyethylene pipes, and the installation was completed on February 24, 2022. Figure 7 shows the general layout of the piping system from PW 136D to the injection wells, Figure 15 displays the installation of the piping system, and Figure 16 displays the typical piping setup at the injection wells. Bi-weekly inspections of the passive piping and injection system are conducted which include taking flow totalizer readings at each of the injection wells. Additional information associated with the preliminary testing of the injection wells with the piping system can be found in the January 2023 DAG Treatability Study Report (SRNS 2023a).

5.1.1 Groundwater Injection Observations

After completion of the initial testing at each of the injection wells, continuous groundwater injection into all 11 wells at once was initiated on March 21, 2022. Initially the injection flow rate was targeted at 5 gpm at each well to observe how the wells operated over time. After 3 weeks of injections, with most of the 11 injection wells continuing to operate at 5 gpm, the target injection rate was increased to 10 gpm. In late April 2023, due to continued injection operations being

successful, targeted injection rates were increased to 12 gpm. Well DGI014 displayed a decrease in flow when the other wells were increased. This is likely due to less water pressure to that well. Additionally, there were ongoing issues with water bubbling up to the surface at well DCB 2A, and the decision was made to discontinue injections into DCB 2A. The flow valve was shut off at DCB 2A in April 2023, and no additional issues have been observed.

Figure 17 shows the flow rates for each of the injection wells. The majority of the wells (7 out of 11) have been able to keep injection rates at or near the targeted 12 gpm setting. Injections into the ten 6-inch injection wells have been continuous since injections began in March 2022. As previously stated, injections were discontinued into DCB 2A due to water bubbling up to the ground surface. Injection wells DGI012 and DGI013 accept less than 2 gpm and continue to underperform. The continued performance of production well PW 136D indicates that one production well is likely adequate to support all the groundwater injection needs at this time. If needed, production well PW 3D can be added to the system to support future groundwater injections.

Figure 18 shows the cumulative groundwater injection volume. During 2023, a total of approximately 46 million gallons were injected into the UTRA. This makes a total of approximately 77 million gallons having been injected since March 2022. It can be observed that the 2023 refined estimate of one pore volume, or approximately 75 million gallons of water, was injected into the 10 to 11 injection wells in about 640 days. Averaged, the 10 active injection wells as of the end of December 2023 were allowing a total of approximately 90 gpm of water being injected.

5.1.2 Water Level Observations

Appendix B presents the hydrographs at the monitoring wells over the past 11 years. Rainfall during 2023 was above average with 63 inches of rain, which is approximately 20 inches higher than 2022 levels. All monitoring wells display increased water elevations in 2023 as compared to 2022 regardless of whether they are near/downgradient of the injection wells or outside/upgradient of the injection area. Although a few wells have shown a continued increase in water elevation from the continuous groundwater injections (e.g., DCB 5A, DCB 6, DCB 7, DCB 8, DCB 49,

DCB087A/D), the majority of downgradient wells have not displayed a significant increase in water elevation; potentially only up to approximately a 1-ft increase; however, this is as water elevations decreased across D-Area outside the area of the injection from 2020 through 2022. Well DCB 8 shows the highest increase in water elevation (a 5-ft increase); however, this well is located in the area of groundwater injections near injection well DGI016.

It is evident from the hydrographs that the water levels in downgradient wells have not increased significantly over their previous water elevations, but this is as water elevations decreased across D-Area from 2020 to 2022. Even now, while using the revised higher pore volume calculation of 75 million gallons and having met that level of injection by the end of 2023, levels have not risen to the anticipated additional 5 ft as had been conceptualized. Further water elevation trending will continue to be conducted for analysis.

5.1.3 Groundwater pH and Analytical Observations

The recorded pH levels at the monitoring wells are presented in Appendix C. The pH levels do not show any significant increase after about 650 days of groundwater injection, for an overall 77 million gallons injected or approximately 1.0 pore volume of the revised conceptual estimate. At stations directly downgradient from the injection area pH levels remain consistent at wells DCB 4A, DCB 6, DCB 21A/B/C, DCB 34A/C, DCB 37A/C, and DCB087A (Appendix C). Increases in pH are likely to take additional time as overall buildup of water within the aquifer and movement of the groundwater aquifer is gradual, and residual acidity within the aquifer sediments are likely contributing to ongoing acidity.

Groundwater and surface water metal analyses were conducted quarterly after groundwater injections began. These results, as shown in Table A-1 and in the Appendix C time-series plots for pH, aluminum, beryllium, iron, and sulfate, also do not yet show any overall significant change in concentrations as a result of the groundwater injections, consistent with lack of changes in observed in pH values.

A few decreasing trends are noted in 1 to 4 monitoring wells (i.e., DCB 6, DCB 21A, DCB 35A, DCB 87A) for aluminum, beryllium, and/or sulfate. However, it cannot be determined if these decreases have occurred due to dilution factors from the groundwater injections or from reductions

in additional dissolved metals loading from the 484-17D DCSA and 489-D CPRB due to previous removal actions at those units.

5.1.4 Overall Observations of Groundwater Injections

Based on the groundwater injection flow rates and totals observed in Figures 17 and 18, and water elevation and contaminant concentration trends presented in Appendices B and C, the following overall observations can be made:

1. Groundwater injections are working as conceptualized in most of the injection wells, though deeper than originally designed based on observed site-specific hydrogeologic properties. The UTRA aquifer formation is accepting groundwater without much reduction in injection rates over time.

2. The water levels in downgradient wells have not risen as much as anticipated, with only a 1-ft increase in water elevations being observed in general.

3. Neither pH levels nor metal concentrations are showing significant changes from the background (pre-injection) levels at most monitoring stations.

Based on similar observations from the 2022 data and the 2023 observations cited above, the conceptual design was revisited. A full description can be found in Appendix D. In general, the following observations were noted:

1. The pore volume calculations were likely to have been underestimated. Taking into account the total low-pH plume area (i.e., not just the immediate area at the 484-17D DCSA and 489-D CPRB and area to the D-Area Effluent Discharge Canal), a reanalysis estimates a pore volume of approximately 154.2 million gallons as compared to the original estimate of 19 million gallons, as well as the 2023 estimate of 75 million gallons. At an injection rate of 120 gpm total and a pore volume of approximately 154.2 million gallons, it will take approximately 110 years to achieve a pH increase to 5.5. If the target pH is lowered to 5, then it is estimated to take approximately 24 years of groundwater injection without the addition of pH buffering agents (base).

2. An analysis of groundwater transport modeling indicates that the groundwater injections will reach the extent of the low-pH plume within 3 years.

Based on the results of the groundwater injections over the last 22 months, an additional increase in injection flow rates is expected to be achievable in some of the injection wells. The current SCDHEC groundwater withdrawal permit can support additional use of the production well(s).

5.2 $CaCO_3$ Reactive Structures

Due to the ongoing and further expected acidic conditions within the D-Area Discharge Canal, two $CaCO_3$ reactive structures were installed during 2020. To perform initial testing of the design and function of the structures, the structures were installed at separate times. One reactive structure was installed in February 2020, and a surface water pH increase was observed following its installation. The second reactive structure was installed downgradient of the first structure in October 2020 and a further increase in pH was observed.

Surface water station DSWM-8 monitors upgradient of the first structure, DSWM-8A monitors between the first and second structure, and station DSWM-9 monitors downgradient of the two structures (Figure 10). Monthly stream flow measurements are manually recorded at each of these three stations when safe to do so; the other eight surface water stations are measured and sampled quarterly. Personnel are unable to physically measure stream flow at some stations, including DSWM-7 and DSWM-10, due to safety restrictions associated with the depth of the discharge canal.

Stream flow measurements taken since 2020 are shown in Figure 19. As expected, stream flow rates fluctuate with site conditions and rain events. The data is inconclusive if stream flows have increased due to the groundwater injections. Due to inconsistencies with collecting measurements and to reduce potential errors, SRS will install a permanent electronic stream flow data logger downgradient of the downstream reactive structure in 2024. This will allow constant real-time monitoring of the flow within the D-Area Effluent Discharge Canal and will be more useful in trending measurements and identifying changes that may occur from the groundwater injections. Manual monthly and quarterly flow measurements will continue to be collected until the permanent stream flow gauge is operational.

Figure 20 displays the field pH measurements collected monthly upgradient, between, and downgradient of the two $CaCO_3$ reactive structures at these three surface water stations. Surface water pH increases are occurring as water flows through the reactive structures, with the pH increasing after each structure. However, during periods of prolonged or heavy rains, stream flow increases and surface water tops over the reactive structures. This is part of the design not to restrict the stream during flooding events; however, this consequently also reduces the contact time of the surface water with the reactive structures. Additionally, increased sediment and leaf drop litter over the last three years have created a layer of detritus that limits stream flow through the $CaCO_3$ reactive structures. As a result, surface water overtops the $CaCO_3$ reactive structures, even in low rainfall periods. As part of the DAG OU Treatability Study, if the pH of the surface water downgradient of the two reactive structures at surface water station DSWM-9 is not raised to or above a pH of 5.0 (during times when surface water is not topping over the reactive structures), then remixing, replacement, and/or reconfiguration of the $CaCO_3$material will be evaluated. Only one of the 12 pH measurement events in 2023 were >5. This is not surprising based on the observed plugging of the system with detritus. It was determined that an alternative construction of the reactive structures could help prevent detritus build up and allow more reliable flow through the structures.

In December 2023 the existing reactive structures were intentionally breached, allowing the water level to drop within the D-Area Effluent Discharge Canal in preparation for installation of the alternative materials. Clogging of the original reactive structures was damming up the canal. In February 2024 larger marble aggregate and limestone riprap were obtained. The new design was constructed by installing limestone riprap on the upstream side to help break up and block detritus from clogging up the larger marble aggregate. It is expected that use of larger marble aggregate instead of small chips will allow more water flow over time. A small amount of riprap was also added at the downstream side of the reactive structures to help minimize displacement of the aggregate during higher flow events. The use of limestone riprap instead of granitic rock will also aid in pH adjustment of the surface water. One reactive structure was constructed at the location of the original first reactive structure in-between surface water stations DSWM-8 and DSWM-8A, and the other reactive structure was constructed downstream of the confluence of the tributary canal with the main canal between surface water stations DSWM-4C and DSWM-7 (Figure 21).

Photographs of the new reactive structures are provided in Figure 22. Future maintenance to remove detritus and remix the marble aggregate, if needed, is planned to ensure surface water flow through the reactive structures remains unimpeded.

Due to the new placement of the upgradient reactive structure, future monthly monitoring of surface water stations will be switched from DSWM-8 and DSWM-8A to stations DSWM-4C, DSWM-6, and DSWM-7. Downstream station DSWM-9 will continue to be monitored monthly.

Appendix A, Table A-1 contains all the surface water data analytical and field results from the 2023 sampling. Appendix A, Table A-2 includes the 2Q2020 pre-injection analytical and field results for comparison. Some decreases in surface water metal concentrations were observed as a result of the pH changes in surface water. Figures 23 and 24 display concentrations of pH vs aluminum, beryllium, sulfate, cobalt, and nickel at surface water stations DSWM-8, DSWM-8A, and DSWM-9 at the original reactive structures. The increases in pH generally cause decreases in surface water metal concentrations.

6.0 DATA COLLECTION AND REPORTING

Data (field measurements, sample results, flow rates, etc.) will continue to be collected and presented in a combination of tabular form, graphs, and time-series plots for calendar year 2024. The updated sampling schedule documenting the surface water monitoring station sampling changes for 2024 is provided in Table 3. Maps depicting the water table, pH, beryllium, and sulfate will also be created and compared to background (pre-injection) levels. SRS will submit the next report by April 30, 2025.

7.0 SUMMARY

Baseline sampling was conducted for the treatability study monitoring network in 2Q2020. Ten of the proposed 20 injection wells have been installed in addition to existing well DCB 2A. Groundwater injections have been continuous since injections began in March 2022, and production well water is currently being injected at approximately a combined 90 gpm. This rate is lower than the 120-gpm total flow rate conceptualized in the original design; however, the majority of the injection wells have been able to accept more water than anticipated, which has compensated for installing half (10 of 20) of the proposed injection wells. A stepped approach has

been taken with the DAG OU treatability study, and another increase in injection flow rates is expected to be achievable in some of the injection wells. An increase in flow will be pursued in 2024.

Rainfall during 2023 was above average and groundwater elevations increased in 2023. Groundwater injection over the initial 22 months shows that the 2023 revised conceptual estimate of one pore volume of 75 million gallons has been injected into the aquifer formation (i.e., actual injection was approximately 77 million gallons). However, the water levels have increased less than expected in downgradient monitoring wells, with an approximately 1-ft increase being achieved. The conceptual model was revisited to assess the initial assumptions of the effects of groundwater injections. A reanalysis estimates a pore volume of approximately 154.2 million gallons if the total low-pH plume area is considered and not just the immediate area at the 484-17D DCSA and 489-D CPRB. At an injection rate of 120 gpm total, it will take approximately 110 years to accomplish a pH increase to 5.5 over the entire plume. If the target pH is lowered to 5, then it is estimated to take approximately 24 years of groundwater injection without the addition of pH buffering agents (base). Additionally, an analysis of groundwater transport modeling indicates that the groundwater injections will reach the extent of the low-pH plume within 3 years. No major changes in groundwater pH and metals have been observed as a result of the groundwater injections. Appendix D provides further details the reevaluation of the conceptual model for groundwater injections and groundwater transport.

Monthly monitoring of surface water pH in the D-Area Effluent Discharge Canal is occurring upgradient, between, and downgradient of the $CaCO_3$ reactive structures, with quarterly sampling for metals analyses also taking place. The $CaCO_3$ reactive structures in the D-Area Effluent Discharge Canal are raising the pH of the surface water. However, due to sediment/leaf detritus build up, water flow through the structures has been greatly diminished, and the pH is not being raised to above 5. Surface water sampling has indicated with increases in pH some metals concentrations (e.g., aluminum, beryllium, and cobalt) in surface water decrease.

Maintenance and reworking of the reactive structures were conducted in 2023 and 2024 to address the sediment/leaf detritus issue. The original reactive structures were intentionally breached in December 2023 to eliminate the damming effects in the D-Area Effluent Discharge Canal.

Subsequently in early 2024, redesigned reactive structures were constructed with limestone riprap and larger marble aggregate. Routine maintenance of the reactive structures will be implemented in 2024 to minimize sediment and leaf detritus build-up on the new reactive structures. Surface water monitoring in 2024 will help determine if the current design is satisfactory for raising the pH of the surface water.

The groundwater and surface water monitoring will continue as scheduled as shown in Table 3. With the new location of the upstream reactive structure, the monthly surface water station monitoring is being adjusted to capture locations upstream, between, and downgradient of the reactive structures. Surface water station DSWM-8 and DSWM-8A are being removed from the monthly schedule, and DSWM-4C, DSWM-6, and DSWM-7 are being added to monthly pH monitoring.

The anticipated length of the treatability study is currently estimated at a minimum of three years of groundwater injection. Analysis of the production well flow rates, injection operation, aquifer acceptance, field data, sample data, and performance of the $CaCO_3$ reactive structures will determine the optimal length of the treatability study after further evaluation of the conceptual design and monitoring of the fully operational system for another year. The next DAG OU Treatability Study report will be submitted by April 30, 2025.

8.0 REFERENCES

SRNS, 2016a. *Remediation of the Acidic Groundwater Impacting the Discharge Canal in D Area*; Interoffice Memo, Savannah River Site, October, Savannah River Nuclear Solutions LLC, Aiken, SC

SRNS, 2016b. *Feasibility Study of the Reactive Structures for the D-Area Discharge Canal*; ERD-EN-2016-0042, Savannah River Site, Rev. 0, October, Savannah River Nuclear Solutions LLC, Aiken, SC

SRNS, 2018. *Removal Site Evaluation Report/Engineering Evaluation/Cost Analysis (RSER/EE/CA) for the D-Area Coal Storage Area (484-17D) (U)*, SRNS-RP-2018-00813, Savannah River Site, Rev. 0, November, Savannah River Nuclear Solutions LLC, Aiken, SC

SRNS, 2019. *Treatability Study Work Plan for Groundwater Injection and Discharge Canal Treatment at the D-Area Groundwater (OU) (U)*, SRNS-TR-2018-00128, Savannah River Site, Rev. 1, January, Savannah River Nuclear Solutions LLC, Aiken, SC

SRNS, 2021. *Treatability Study Data Report for Groundwater Injection and Discharge Canal Neutralization at the D-Area Groundwater (OU) (U)*, SRNS-TR-2021-00005, Savannah River Site, Rev. 0, January, Savannah River Nuclear Solutions LLC, Aiken, SC

SRNS, 2021b. Letter, Amy J. Meyer (SRNS) to Courtney Milledge (SCDHEC), *Submittal of the Request for the Underground Injection Control Permit to Operate (Permit #SCHE03020572) for Injection of Groundwater at the D-Area Groundwater Operable Unit – Part 1,* SRNS-J2000-2021-00815, dated October 7, 2021, Savannah River Nuclear Solutions, LLC, Savannah River Site, Aiken, SC

SRNS, 2022a. *Treatability Study Data Report for Groundwater Injection and Discharge Canal Neutralization at the D-Area Groundwater (OU) (U)*, SRNS-TR-2022-00026, Savannah River Site, Rev. 0, January, Savannah River Nuclear Solutions LLC, Aiken, SC

SRNS, 2022b. *Removal Action Report for the D-Area Coal Storage Area (484-17D) (U)*, SRNS-RP-2022-00071, Savannah River Site, Rev. 1, November, Savannah River Nuclear Solutions LLC, Aiken, SC

SRNS, 2023a. *Treatability Study Data Report for Groundwater Injection and Discharge Canal Neutralization at the D-Area Groundwater (OU) (U)*, SRNS-TR-2023-00009, Savannah River Site, Rev. 0, January, Savannah River Nuclear Solutions LLC, Aiken, SC

SRNS, 2023b. *SRS 3Q1 Manual, Environmental Requirements and Program Documents, Sampling Groundwater Monitoring Wells, Tanks/Vessels (Sample Ports or Spigots) and Surface Water*, SRS 3Q1 Manual Procedure 9015, Savannah River Site, Rev date: 2/21/2023, Savannah River Nuclear Solutions LLC, Aiken SC

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Table 1. D-Area Treatability Study 2023 Monitoring Network and Sampling Schedule

Monitoring Well Information							Sampling			
								After Injections start		
Station	Station Type	Ground Elevation (ft amsl)	Total Depth (ft bgs)	Screen Length (ft)	Screened Interval (ft bgs)	Screened Interval (ft amsl)	Before Injection	Monthly - First 8 months	Monthly	Quarterly
PW 3D	Production Well	128.75	736	10, 50	670 - 680, 690 - 730	-541.25 - -551.25, -561.25 - -601.25	M	WL		WL
PW 136D	Production Well	132.5	765	30, 40	640 - 670, 710 - 750	-507.5 - -537.5, -577.5 - -617.5	M	WL		WL
DCB 3A	Monitoring Well	131.2	36.8	30	5 - 35	126.2 - 96.2	WL	WL		WL
DCB 4A	Monitoring Well	127.5	37	30	5 - 35	122.5 - 92.5	M	WL		M
DCB 5A	Monitoring Well	120.9	37	30	5 - 35	115.9 - 85.9	WL	WL		WL
DCB 6	Monitoring Well	131.5	23.7	20	2 - 22	129.5 - 109.5	M	WL		M
DCB 7	Monitoring Well	130.9	23.9	20	2 - 22	128.9 - 108.9	WL	WL		WL
DCB 8	Monitoring Well	134.8	26.5	20	4.5 - 24.5	130.3 - 110.3	M	WL		M
DCB 9	Monitoring Well	120.2	25	20	2.9 - 22.9	117.3 - 97.3	WL	WL		WL
DCB 10	Monitoring Well	121.8	24.1	20	2 - 22	119.8 - 99.8	M	WL		M
DCB 21A	Monitoring Well	126.6	20	10	6.5 - 16.5	120.1 - 110.1	M	WL		M
DCB 21B	Monitoring Well	126.7	27	2.5	22 - 24.5	104.7 - 102.2	M	WL		M
DCB 21C	Monitoring Well	126.8	44	2.5	36 - 38.5	90.8 - 88.3	M	WL		M
DCB 22A	Monitoring Well	125.3	18.5	10	5.5 - 15.5	119.8 - 109.8	M	WL		M
DCB 23A	Monitoring Well	119.2	16	10	3.5 - 13.5	115.7 - 105.7	WL	WL		WL
DCB 23B	Monitoring Well	119.1	27.5	2.5	22.5 - 25	96.6 - 94.1	M	WL		M
DCB 23C	Monitoring Well	119.1	35	2.5	30 - 32.5	89.1 - 86.6	M	WL		M
DCB 26AR	Monitoring Well	122.7	26	14.3	11 - 25.3	111.7 - 97.4	WL	WL		WL
DCB 33B	Monitoring Well	140.5	37	10	26.5 - 36.5	114 - 104	WL	WL		WL
DCB 34A	Monitoring Well	128	26	10	16 - 26	112 - 102	M	WL		M
DCB 34C	Monitoring Well	127.6	59.3	10	46.8 - 56.8	80.8 - 70.8	M	WL		M
DCB 35A	Monitoring Well	118.2	25	10	14.8 - 24.8	103.4 - 93.4	M	WL		M
DCB 35C	Monitoring Well	118	44	10	33.8 - 43.8	84.2 - 74.2	M	WL		M
DCB 36A	Monitoring Well	123.9	20	10	9.8 - 19.8	114.1 - 104.1	M	WL		M
DCB 36C	Monitoring Well	123.8	37	10	26.5 - 36.5	97.3 - 87.3	M	WL		M

M = Metals and field parameters including pH
WL = Water elevation measurement only

Table 1. D-Area Treatability Study 2023 Monitoring Network and Sampling Schedule *(continued/end)*

Monitoring Well Information							Sampling			
								After Injections start		
Station	Station Type	Ground Elevation (ft amsl)	Total Depth (ft bgs)	Screen Length (ft)	Screened Interval (ft bgs)	Screened Interval (ft amsl)	Before Injection	Monthly - First 8 months	Monthly	Quarterly
DCB 37A	Monitoring Well	126.5	25.9	10	15.7 - 25.7	110.8 - 100.8	M	WL		M
DCB 41A	Monitoring Well	130.6	33	10	22.32 - 32.32	108.28 - 98.28	WL	WL		WL
DCB 44A	Monitoring Well	134.6	26.5	15	11.3 - 26.3	123.3 - 108.3	WL	WL		WL
DCB 45A	Monitoring Well	134.9	25.2	15	9.7 - 24.7	125.2 - 110.2	WL	WL		WL
DCB 49	Monitoring Well	122	16.5	12.5	3.35 - 15.85	118.65 - 106.15	WL	WL		WL
DCB 51A	Monitoring Well	157.69	29.71	10	19.37 - 29.37	138.32 - 128.32				WL
DCB 53	Monitoring Well	113.58	41	10.1	26 - 36.1	87.58 - 77.48	WL	WL		WL
DCB 70A	Monitoring Well	116.49	12.5	10	1.8 - 11.8	114.69 - 104.69	M	WL		M
DCB077	Monitoring Well	127.7	31.7	20	9.7 - 29.7	118 - 98	M	WL		M
DCB078	Monitoring Well	126.7	41.7	20	19.7 - 39.7	107 - 87	M	WL		M
DCB087A	Monitoring Well	131.81	30.4	10	18 - 28	113.81 - 103.81				M
DSWM-4	Surface Water Station	--	--	--	--	--	M			M
DSWM-4A	Surface Water Station	--	--	--	--	--	M			M
DSWM-4B	Surface Water Station	--	--	--	--	--	M			M
DSWM-4C	Surface Water Station	--	--	--	--	--	M			M
DSWM-5	Surface Water Station	--	--	--	--	--	M			M
DSWM-6	Surface Water Station	--	--	--	--	--	M			M
DSWM-7	Surface Water Station	--	--	--	--	--	M			M
DSWM-8	Surface Water Station	--	--	--	--	--	M	M	pH	M
DSWM-8A	Surface Water Station	--	--	--	--	--	M	M	pH	M
DSWM-9	Surface Water Station	--	--	--	--	--	M	M	pH	M
DSWM-10	Surface Water Station	--	--	--	--	--				M

M = Metals and field parameters including pH
WL = Water elevation measurement only
pH = pH reading of surface water only for performance monitoring of the reactive structures

Table 2. D-Area Injection Well Screen Zone Depths

Injection Well	Screen Zone (ft bgs)	Screen Zone (ft amsl)	Month/Year Installed
DGI007	21.49 - 42.41	112.91 - 91.99	December/2019
DGI010	30.51 - 51.43	103.22 - 82.3	December/2019
DGI011	24.2 - 45.1	108.67 - 87.77	February/2021
DGI012	26.6 - 47.5	105.57 - 84.64	February/2021
DGI013	34.1 - 55.0	97.42 - 76.52	February/2021
DGI014	34.58 - 55.5	97.73 - 76.81	February/2020
DGI015	35.1 - 56.0	97.47 - 76.57	February/2021
DGI016	34.26 - 55.18	98.24 - 77.32	January/2020
DGI017	34.1 - 55.0	98.35 - 77.45	March/2021
DGI019	23.72 - 44.64	108.25 - 87.33	January/2020
DCB 2A	5.0 – 35.0	127.4 - 97.4	March/1984

Installed during 2020
Installed during 2021
Existing well

amsl- above mean sea level

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Table 3. D-Area Treatability Study Monitoring Network and Sampling Schedule for 2024

Monitoring Well Information							Sampling			
								After Injections start		
Station	Station Type	Ground Elevation (ft amsl)	Total Depth (ft bgs)	Screen Length (ft)	Screened Interval (ft bgs)	Screened Interval (ft amsl)	Before Injection	Monthly - First 8 months	Monthly	Quarterly
PW 3D	Production Well	128.75	736	10, 50	670 - 680, 690 - 730	-541.25 - -551.25, -561.25 - -601.25	M	WL		WL
PW 136D	Production Well	132.5	765	30, 40	640 - 670, 710 - 750	-507.5 - -537.5, -577.5 - -617.5	M	WL		WL
DCB 3A	Monitoring Well	131.2	36.8	30	5 - 35	126.2 - 96.2	WL	WL		WL
DCB 4A	Monitoring Well	127.5	37	30	5 - 35	122.5 - 92.5	M	WL		M
DCB 5A	Monitoring Well	120.9	37	30	5 - 35	115.9 - 85.9	WL	WL		WL
DCB 6	Monitoring Well	131.5	23.7	20	2 - 22	129.5 - 109.5	M	WL		M
DCB 7	Monitoring Well	130.9	23.9	20	2 - 22	128.9 - 108.9	WL	WL		WL
DCB 8	Monitoring Well	134.8	26.5	20	4.5 - 24.5	130.3 - 110.3	M	WL		M
DCB 9	Monitoring Well	120.2	25	20	2.9 - 22.9	117.3 - 97.3	WL	WL		WL
DCB 10	Monitoring Well	121.8	24.1	20	2 - 22	119.8 - 99.8	M	WL		M
DCB 21A	Monitoring Well	126.6	20	10	6.5 - 16.5	120.1 - 110.1	M	WL		M
DCB 21B	Monitoring Well	126.7	27	2.5	22 - 24.5	104.7 - 102.2	M	WL		M
DCB 21C	Monitoring Well	126.8	44	2.5	36 - 38.5	90.8 - 88.3	M	WL		M
DCB 22A	Monitoring Well	125.3	18.5	10	5.5 - 15.5	119.8 - 109.8	M	WL		M
DCB 23A	Monitoring Well	119.2	16	10	3.5 - 13.5	115.7 - 105.7	WL	WL		WL
DCB 23B	Monitoring Well	119.1	27.5	2.5	22.5 - 25	96.6 - 94.1	M	WL		M
DCB 23C	Monitoring Well	119.1	35	2.5	30 - 32.5	89.1 - 86.6	M	WL		M
DCB 26AR	Monitoring Well	122.7	26	14.3	11 - 25.3	111.7 - 97.4	WL	WL		WL
DCB 33B	Monitoring Well	140.5	37	10	26.5 - 36.5	114 - 104	WL	WL		WL
DCB 34A	Monitoring Well	128	26	10	16 - 26	112 - 102	M	WL		M
DCB 34C	Monitoring Well	127.6	59.3	10	46.8 - 56.8	80.8 - 70.8	M	WL		M
DCB 35A	Monitoring Well	118.2	25	10	14.8 - 24.8	103.4 - 93.4	M	WL		M
DCB 35C	Monitoring Well	118	44	10	33.8 - 43.8	84.2 - 74.2	M	WL		M
DCB 36A	Monitoring Well	123.9	20	10	9.8 - 19.8	114.1 - 104.1	M	WL		M
DCB 36C	Monitoring Well	123.8	37	10	26.5 - 36.5	97.3 - 87.3	M	WL		M

M = Metals and field parameters including pH
WL = Water elevation measurement only
pH = pH reading of surface water only for performance monitoring of the reactive structures

Table 3. D-Area Treatability Study Monitoring Network and Sampling Schedule for 2024 *(continued/end)*

Monitoring Well Information							Sampling			
							Before	After Injections start		
DCB 37A	Monitoring Well	126.5	25.9	10	15.7 - 25.7	110.8 - 100.8	M	WL		M
DCB 41A	Monitoring Well	130.6	33	10	22.32 - 32.32	108.28 - 98.28	WL	WL		WL
DCB 44A	Monitoring Well	134.6	26.5	15	11.3 - 26.3	123.3 - 108.3	WL	WL		WL
DCB 45A	Monitoring Well	134.9	25.2	15	9.7 - 24.7	125.2 - 110.2	WL	WL		WL
DCB 49	Monitoring Well	122	16.5	12.5	3.35 - 15.85	118.65 - 106.15	WL	WL		WL
DCB 51A	Monitoring Well	157.69	29.71	10	19.37 - 29.37	138.32 - 128.32				WL
DCB 53	Monitoring Well	113.58	41	10.1	26 - 36.1	87.58 - 77.48	WL	WL		WL
DCB 70A	Monitoring Well	116.49	12.5	10	1.8 - 11.8	114.69 - 104.69	M	WL		M
DCB077	Monitoring Well	127.7	31.7	20	9.7 - 29.7	118 - 98	M	WL		M
DCB078	Monitoring Well	126.7	41.7	20	19.7 - 39.7	107 - 87	M	WL		M
DCB087A	Monitoring Well	131.81	30.4	10	18 - 28	113.81 - 103.81				M
DSWM-4	Surface Water Station	--	--	--	--	--	M			M
DSWM-4A	Surface Water Station	--	--	--	--	--	M			M
DSWM-4B	Surface Water Station	--	--	--	--	--	M			M
DSWM-4C	Surface Water Station	--	--	--	--	--	M		pH	M
DSWM-5	Surface Water Station	--	--	--	--	--	M			M
DSWM-6	Surface Water Station	--	--	--	--	--	M		pH	M
DSWM-7	Surface Water Station	--	--	--	--	--	M		pH	M
DSWM-9	Surface Water Station	--	--	--	--	--	M	M	pH	M
DSWM-10	Surface Water Station	--	--	--	--	--				M

M = Metals and field parameters including pH
WL = Water elevation measurement only
pH = pH reading of surface water only for performance monitoring of the reactive structures

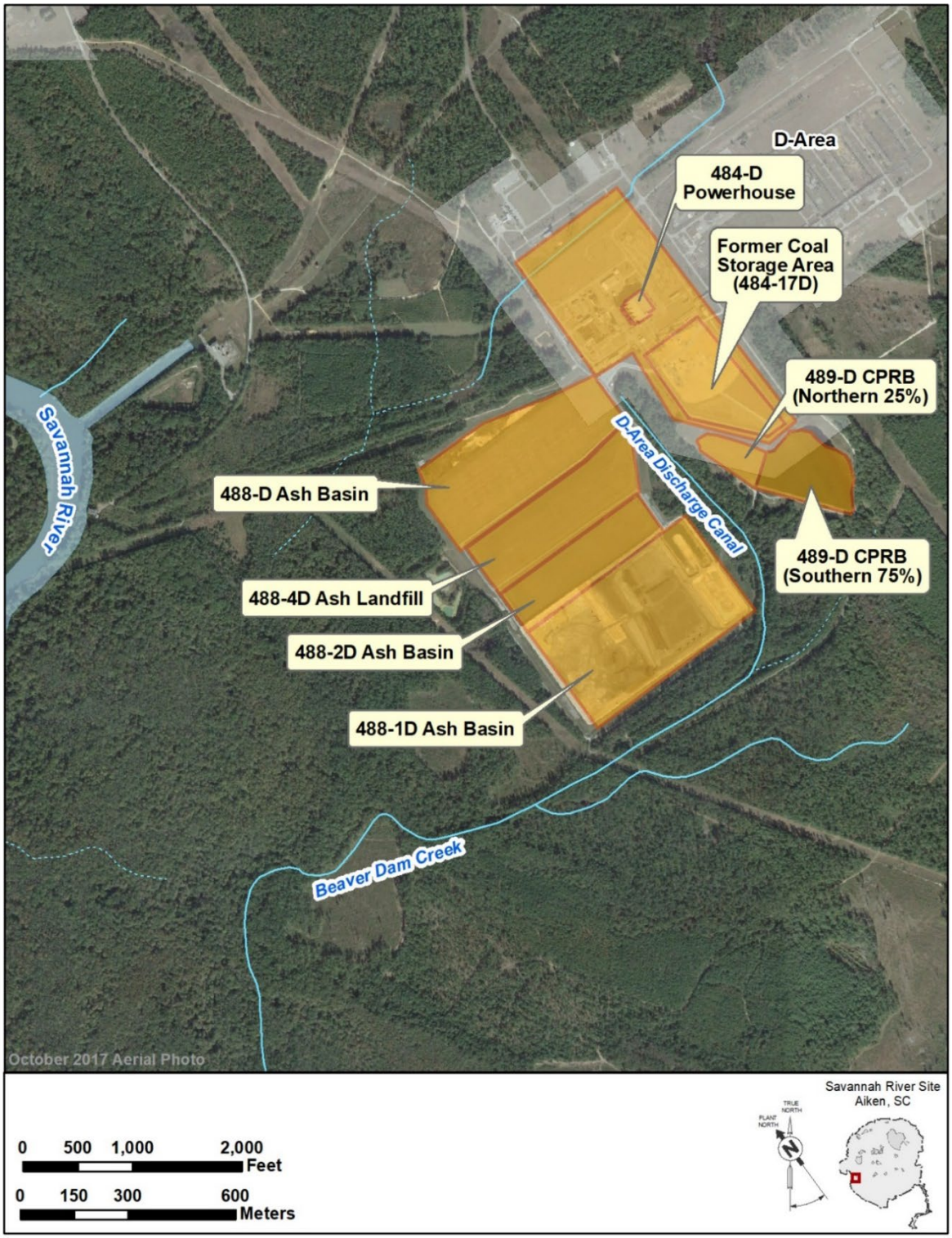
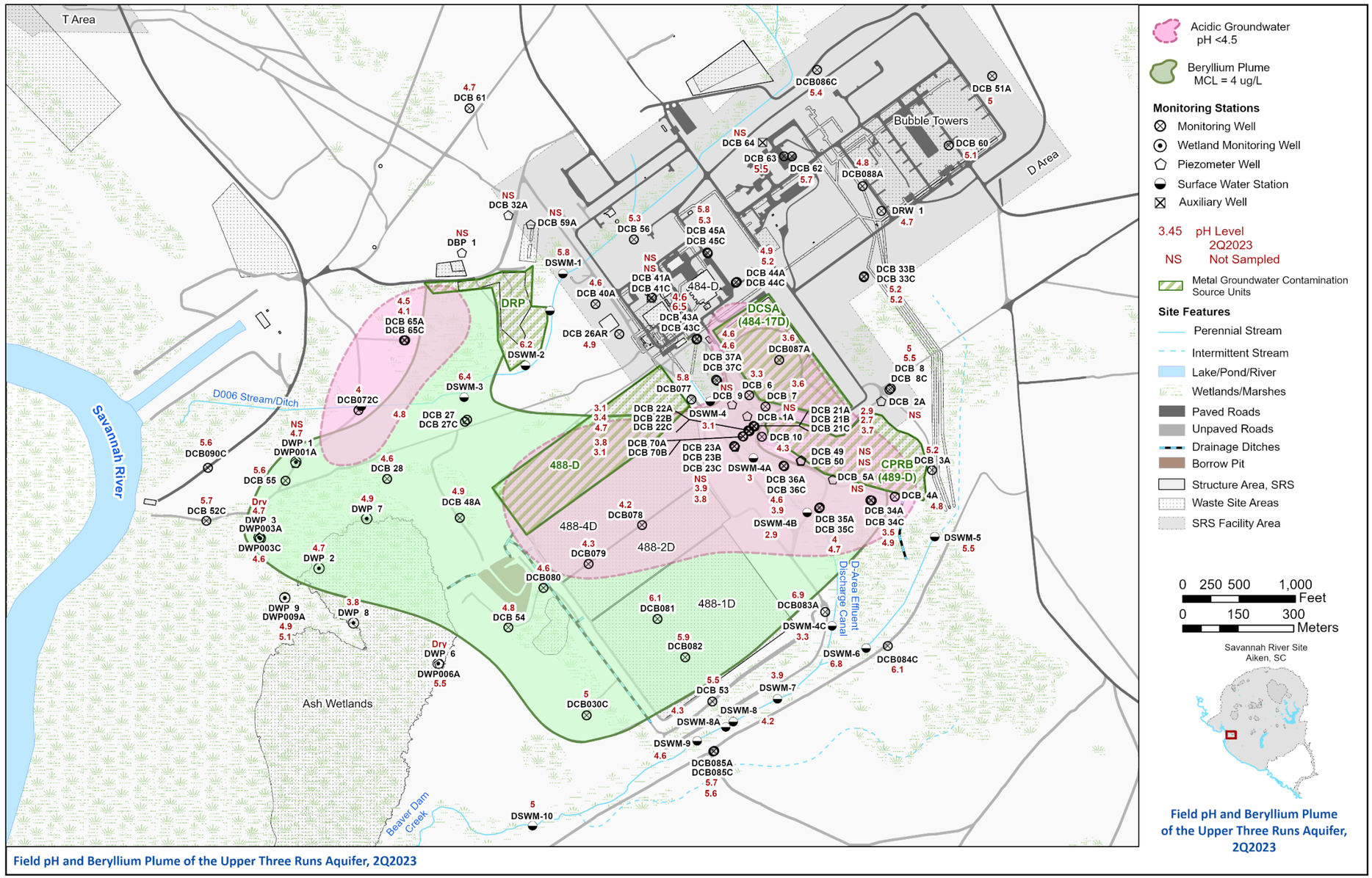


Figure 1. D-Area Powerhouse Associated Facilities

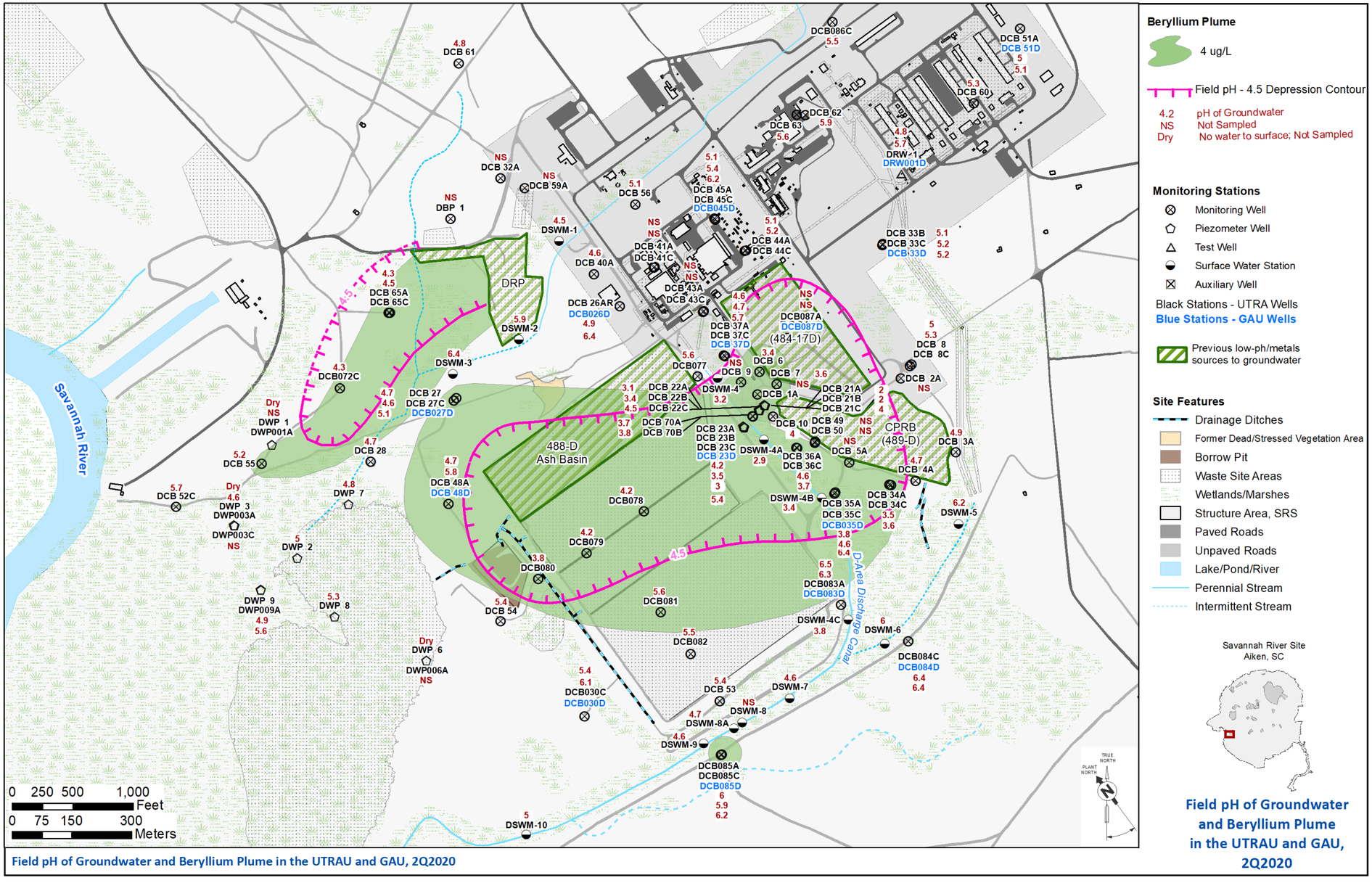
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Field pH and Beryllium Plume of the Upper Three Runs Aquifer, 2Q2023

Figure 2. D-Area Groundwater 2Q2023 pH and Beryllium Plume

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Field pH of Groundwater and Beryllium Plume in the UTRAU and GAU, 2Q2020

Figure 3. D-Area Groundwater 2Q2020 pH and Beryllium Plume

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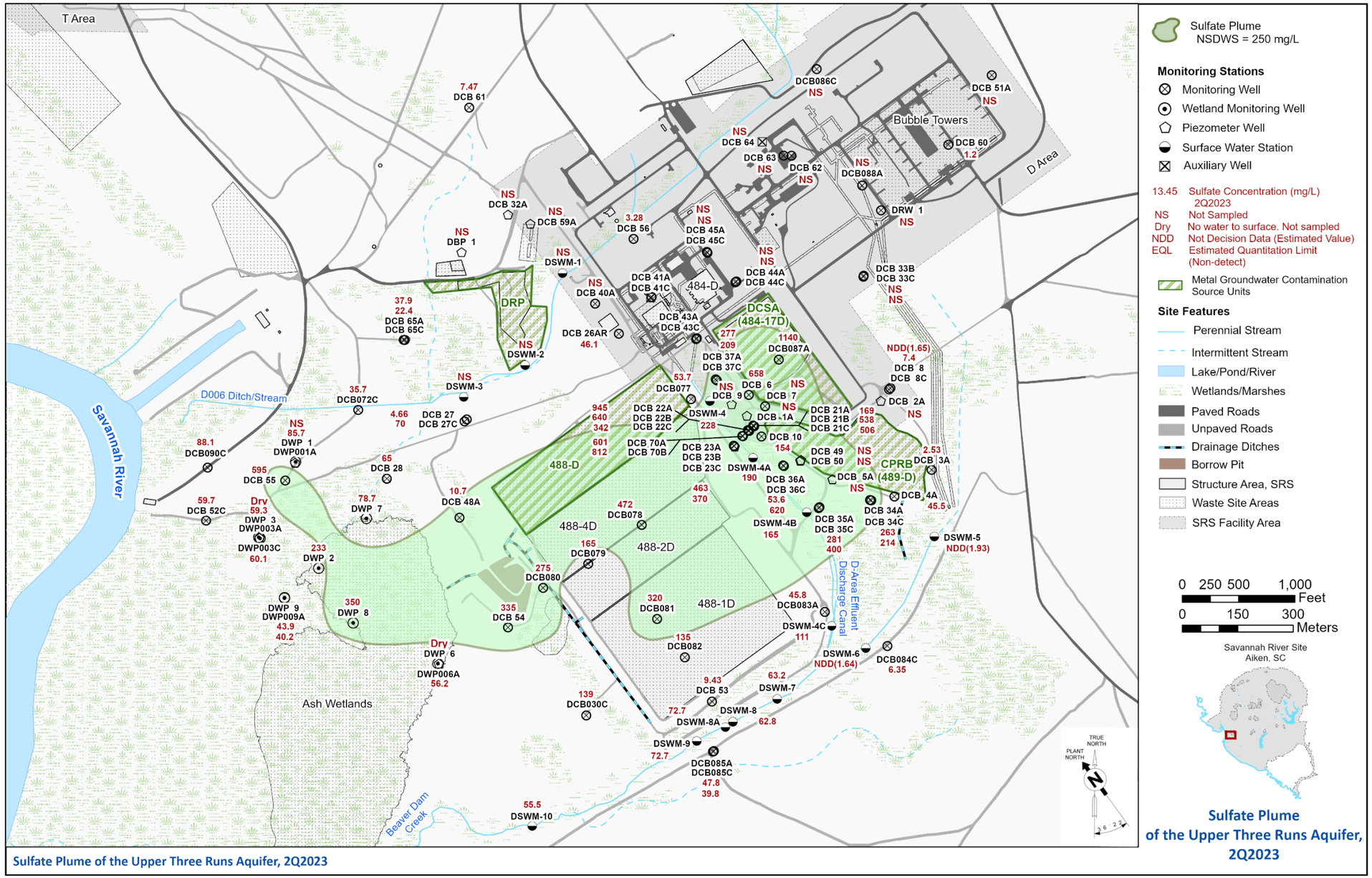


Figure 4. D-Area Groundwater 2Q2023 Sulfate Plume

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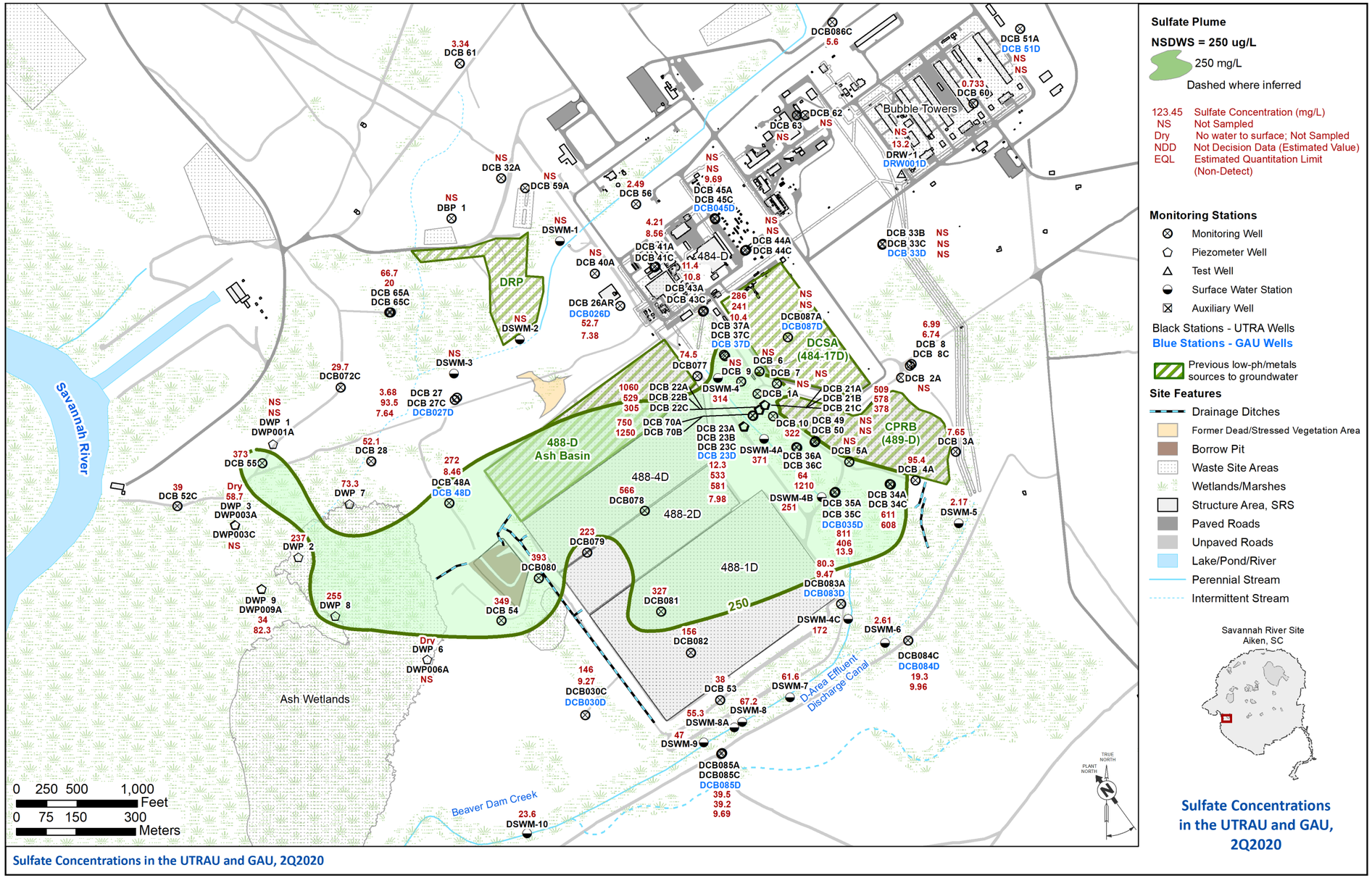


Figure 5. D-Area Groundwater 2Q2020 Sulfate Plume

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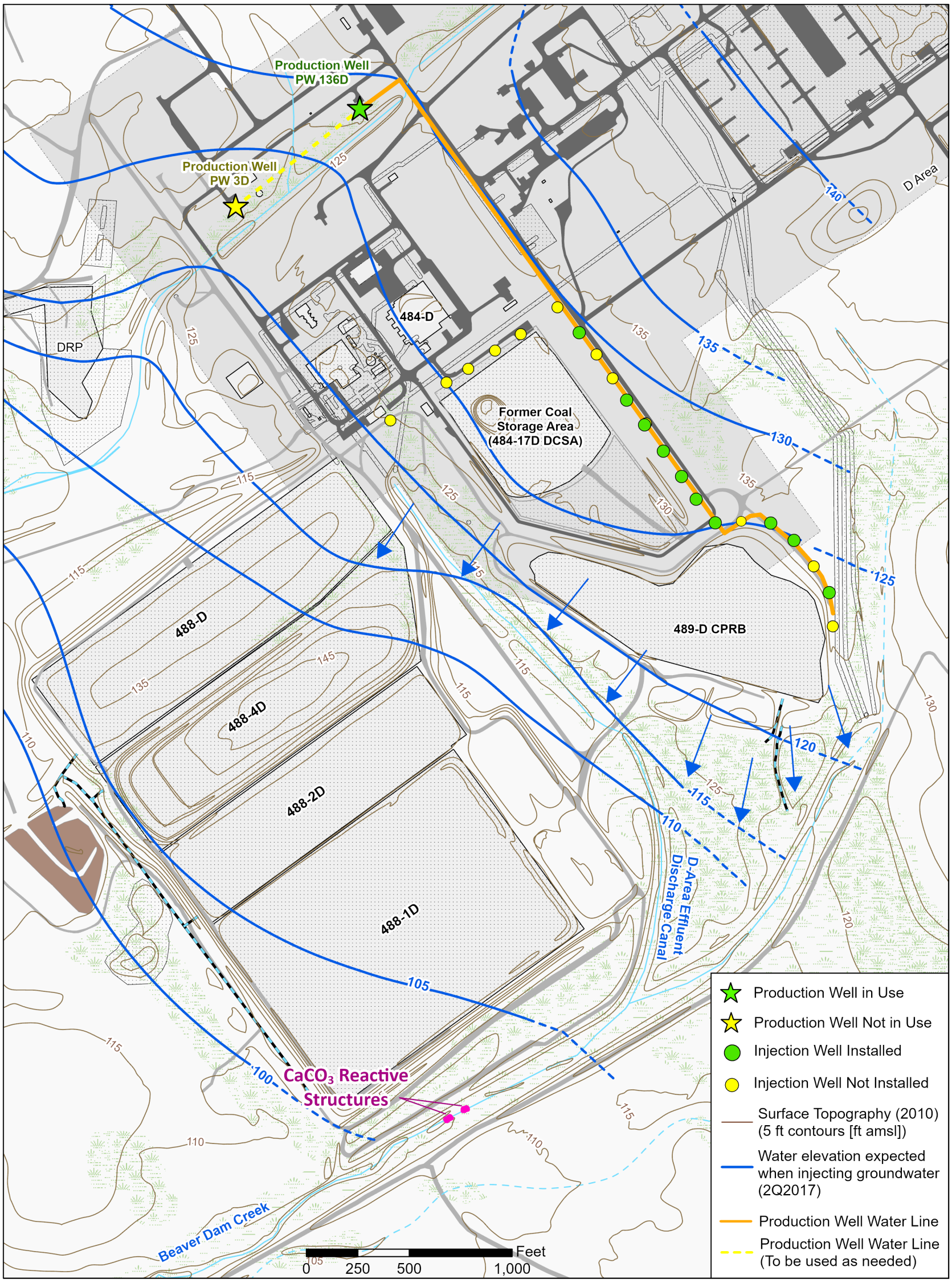


Figure 6. D-Area Treatability Study Injection Wells, Reactive Structure, and Projected Water Table Elevation

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Figure 7. D-Area Injection Wells Installed and Production Well Piping

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Water Volume, ml	$CaCO_3$ Mass, g	Initial pH	Final pH	Mass $CaCO_3$ per Water Volume, mg/l
Initial		3		0
200	0.018	3.08	3.99	90
200	0.05	3.05	5.75	250
200	0.1	3.02	6.15	500
50	0.1	2.98	6.64	2,000
50	0.25	2.93	6.50	5,000
50	0.5	2.90	6.60	10,000

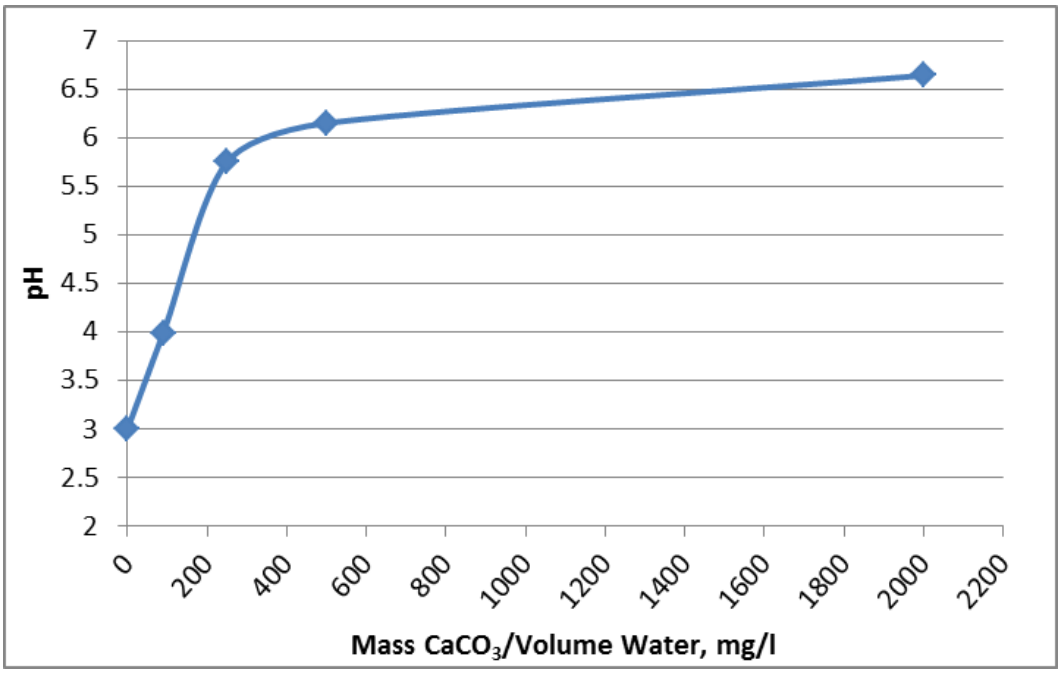


Figure 8. Titration Test Chart and Graph of D-Area Discharge Canal Acidic Surface Water with Calcium Carbonate Additions

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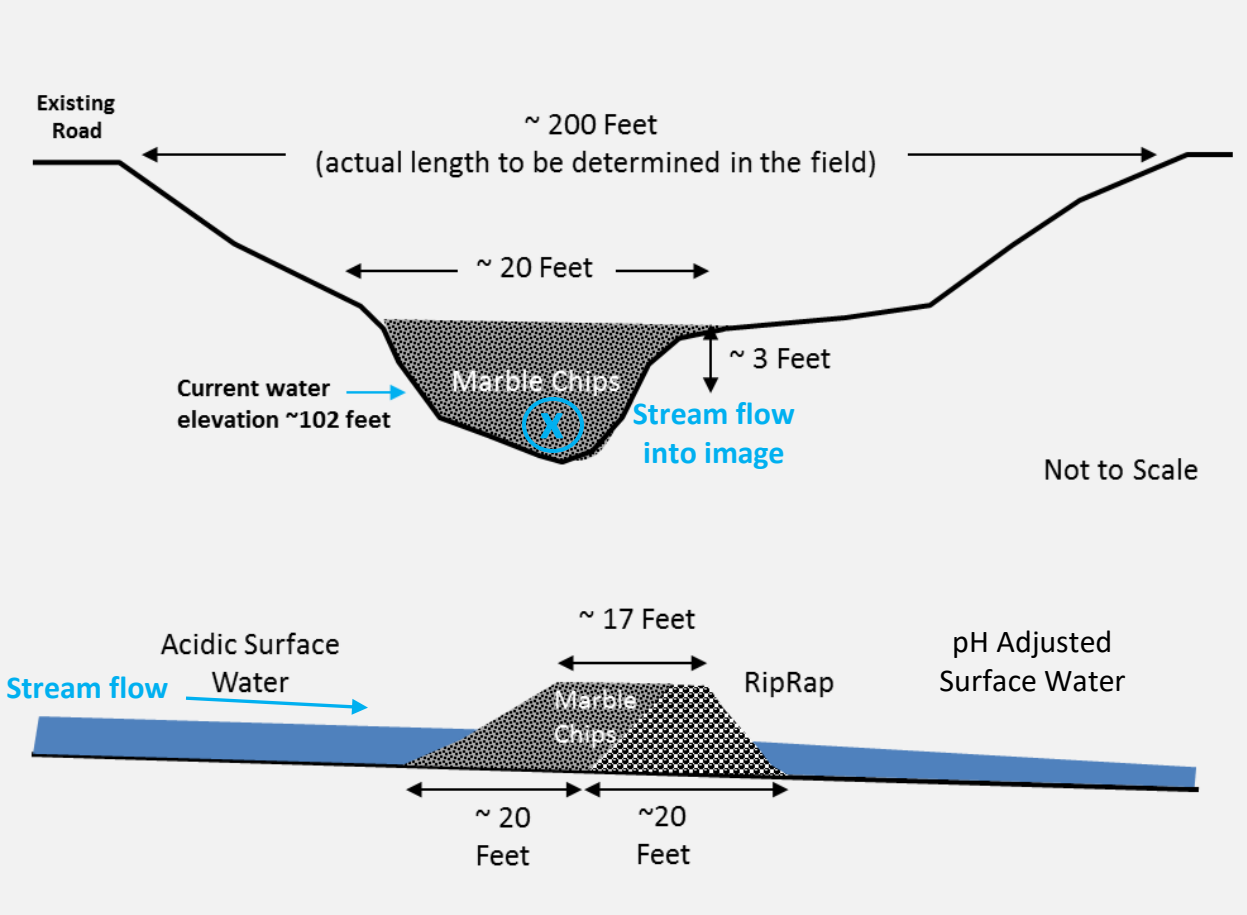


Figure 9. Diagram of $CaCO_3$ Reactive Structures in the D-Area Discharge Canal

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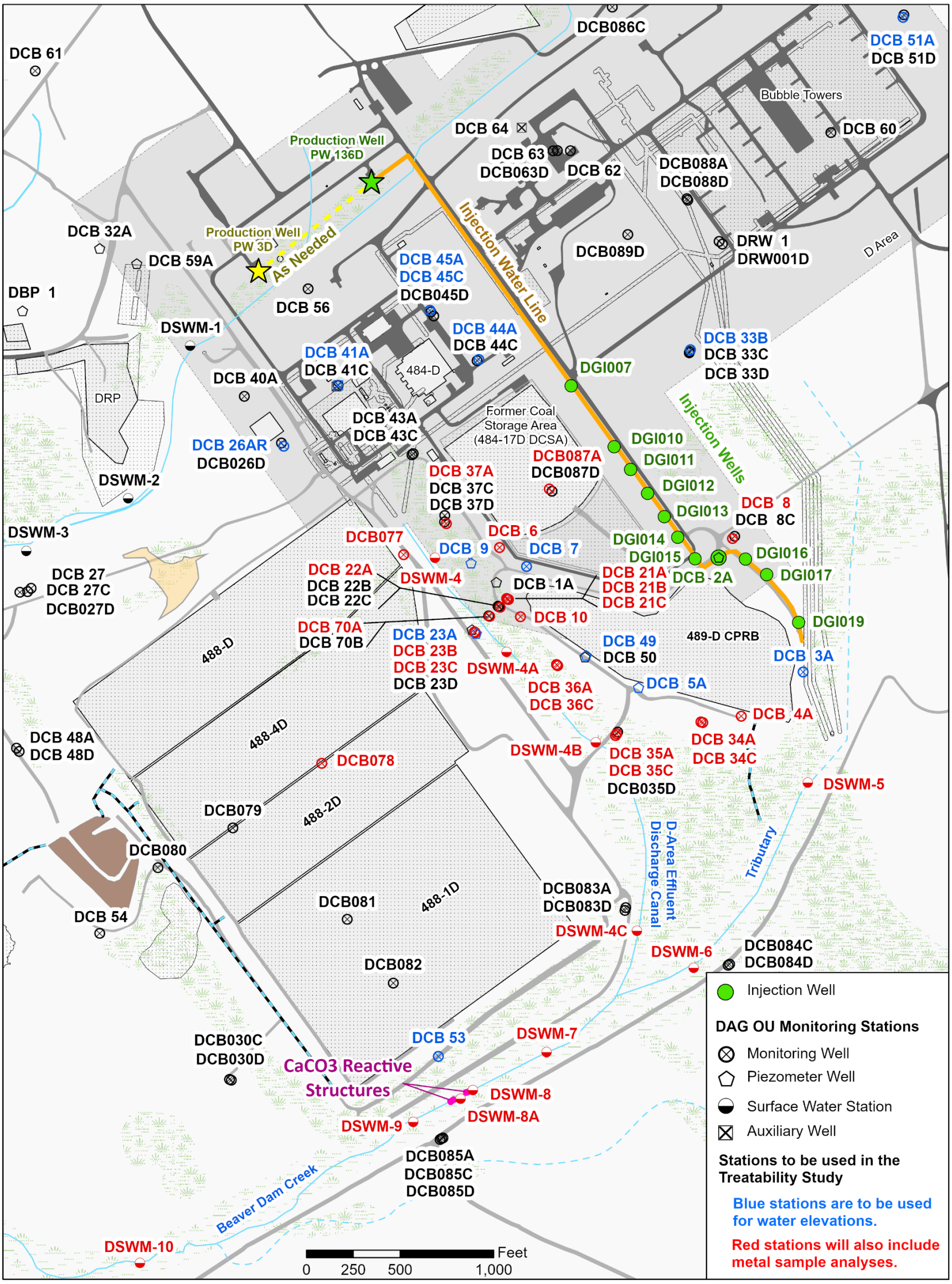


Figure 10. D-Area Treatability Study Monitoring Locations

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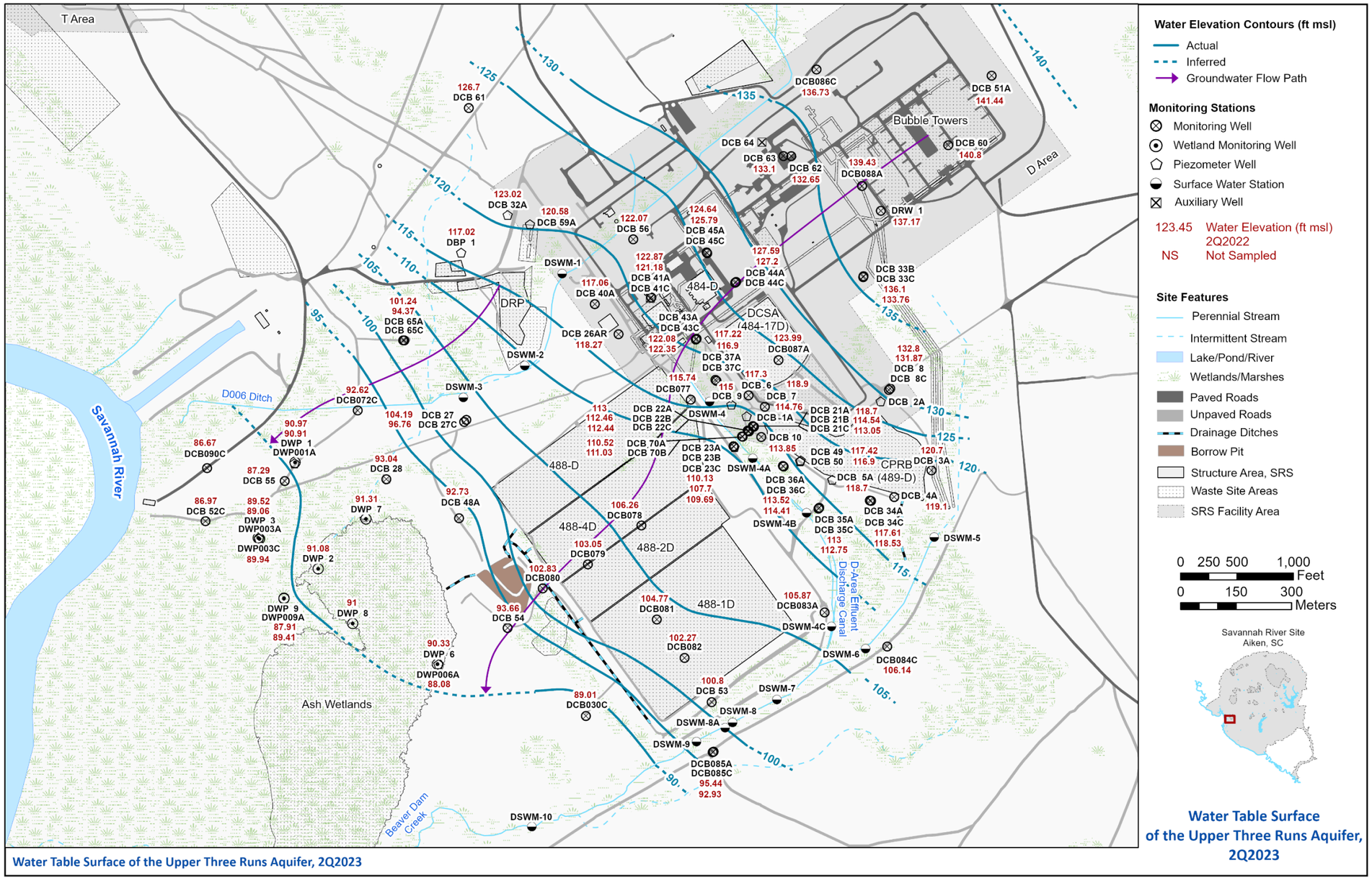


Figure 11. D-Area Groundwater OU UTRA Potentiometric Surface (2Q2023)

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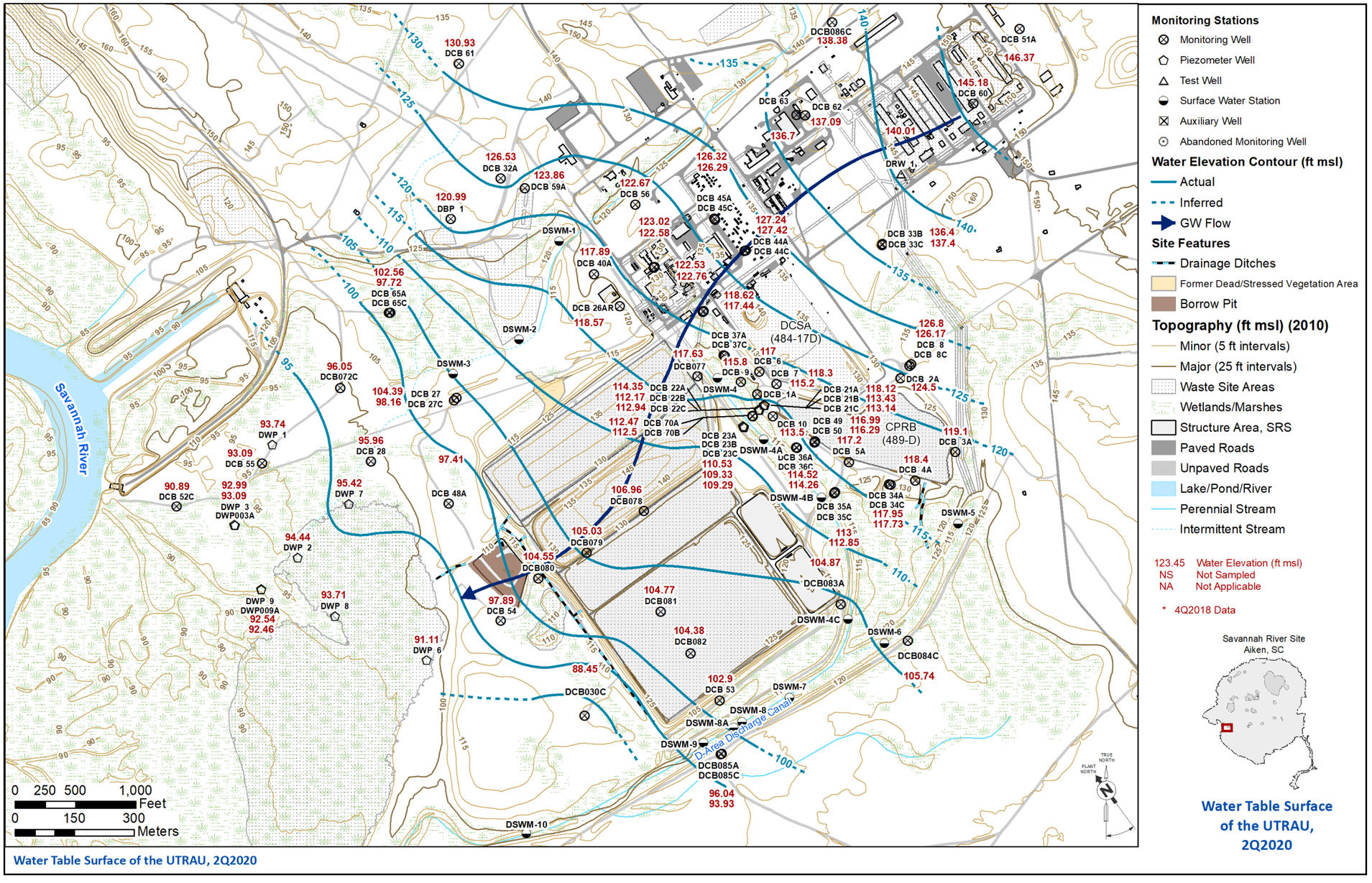


Figure 12. D-Area Groundwater OU UTRA Potentiometric Surface (2Q2020)

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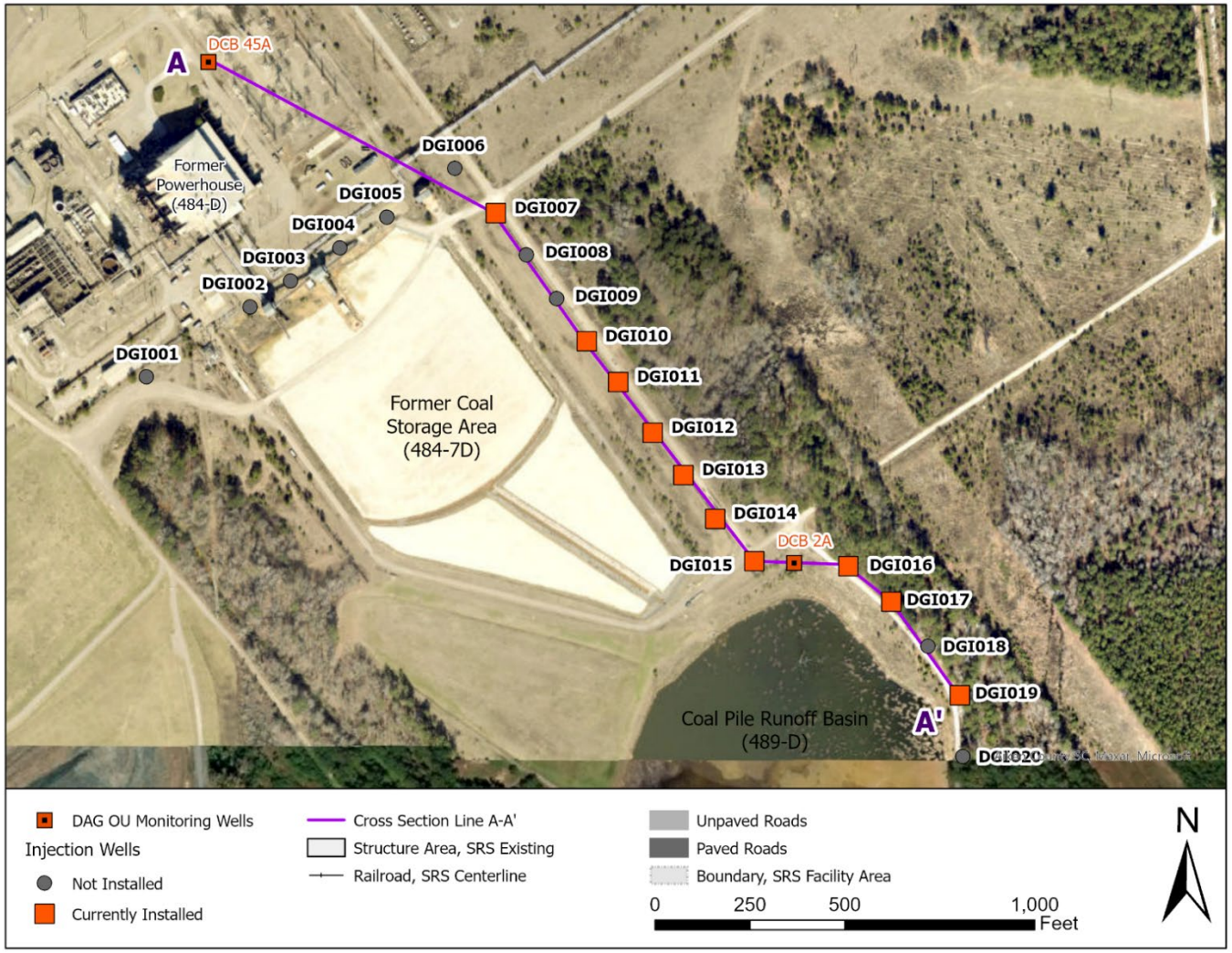


Figure 13. Installed Injection Wells and Cross Section Line A–A'

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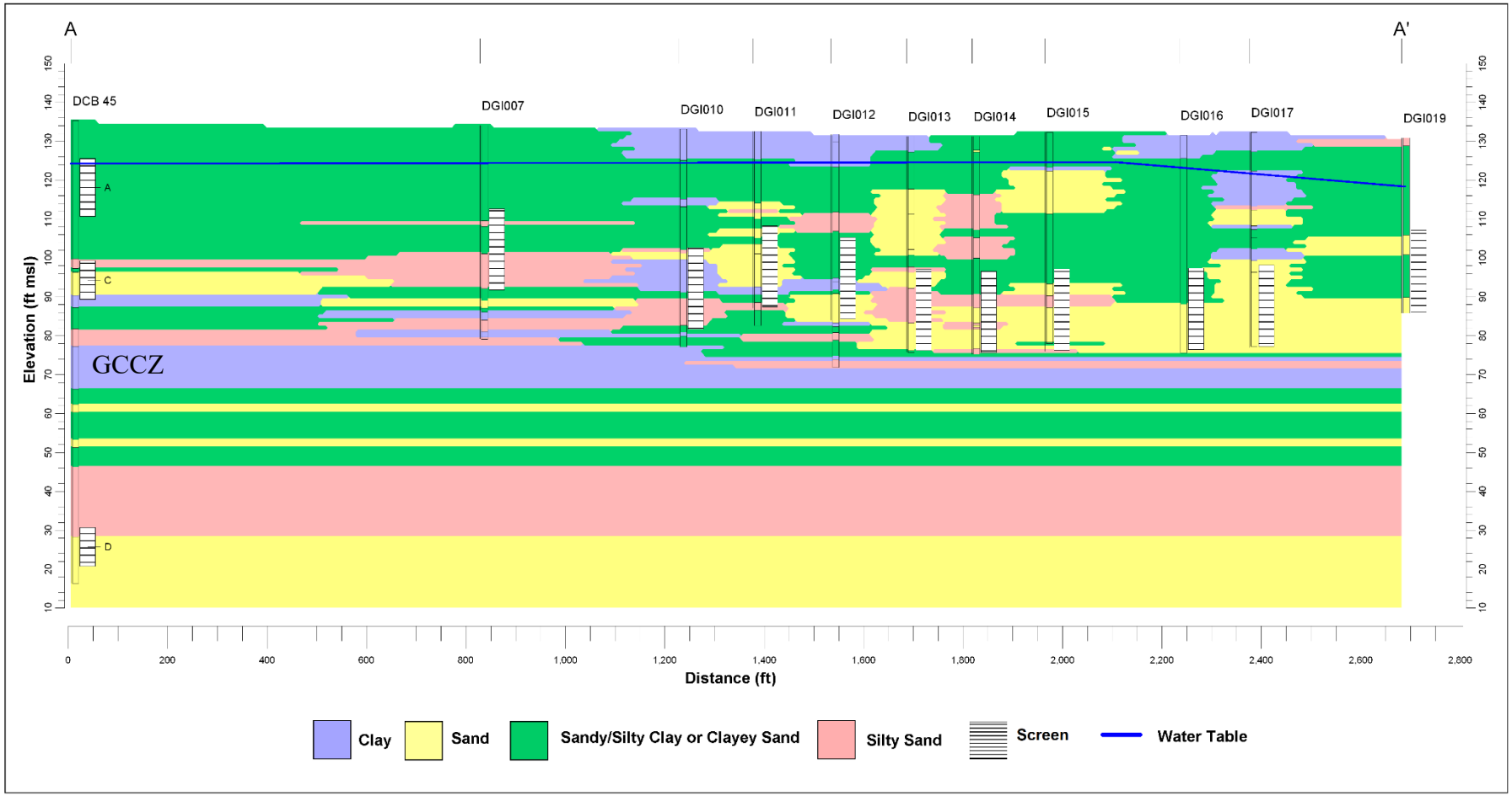


Figure 14. D-Area Injection Well Lithological Cross-Section A-A'

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Figure 15. D-Area Treatability Study Pipeline Installation

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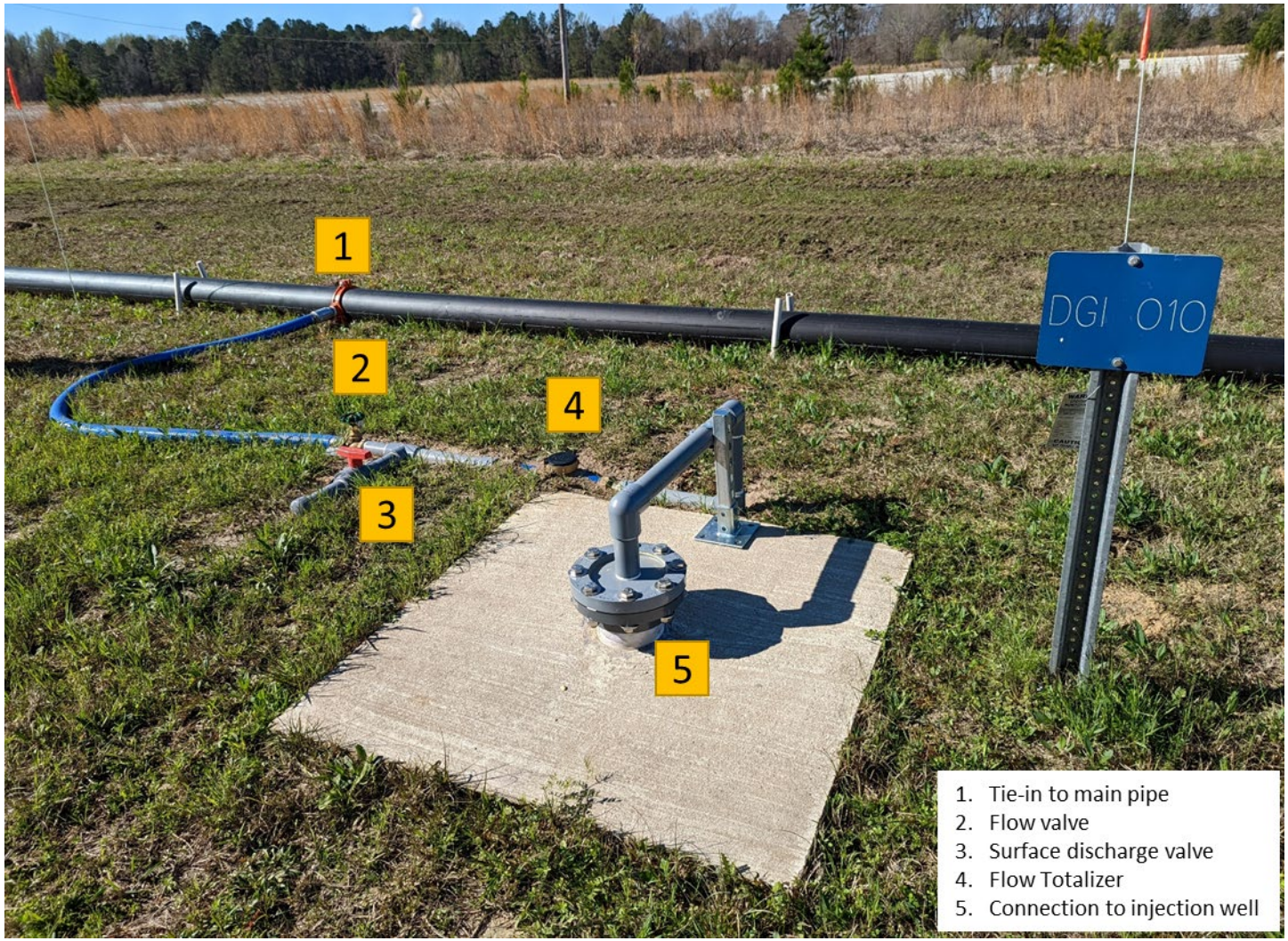


Figure 16. Injection Well Connection to Pipeline (DGI010)

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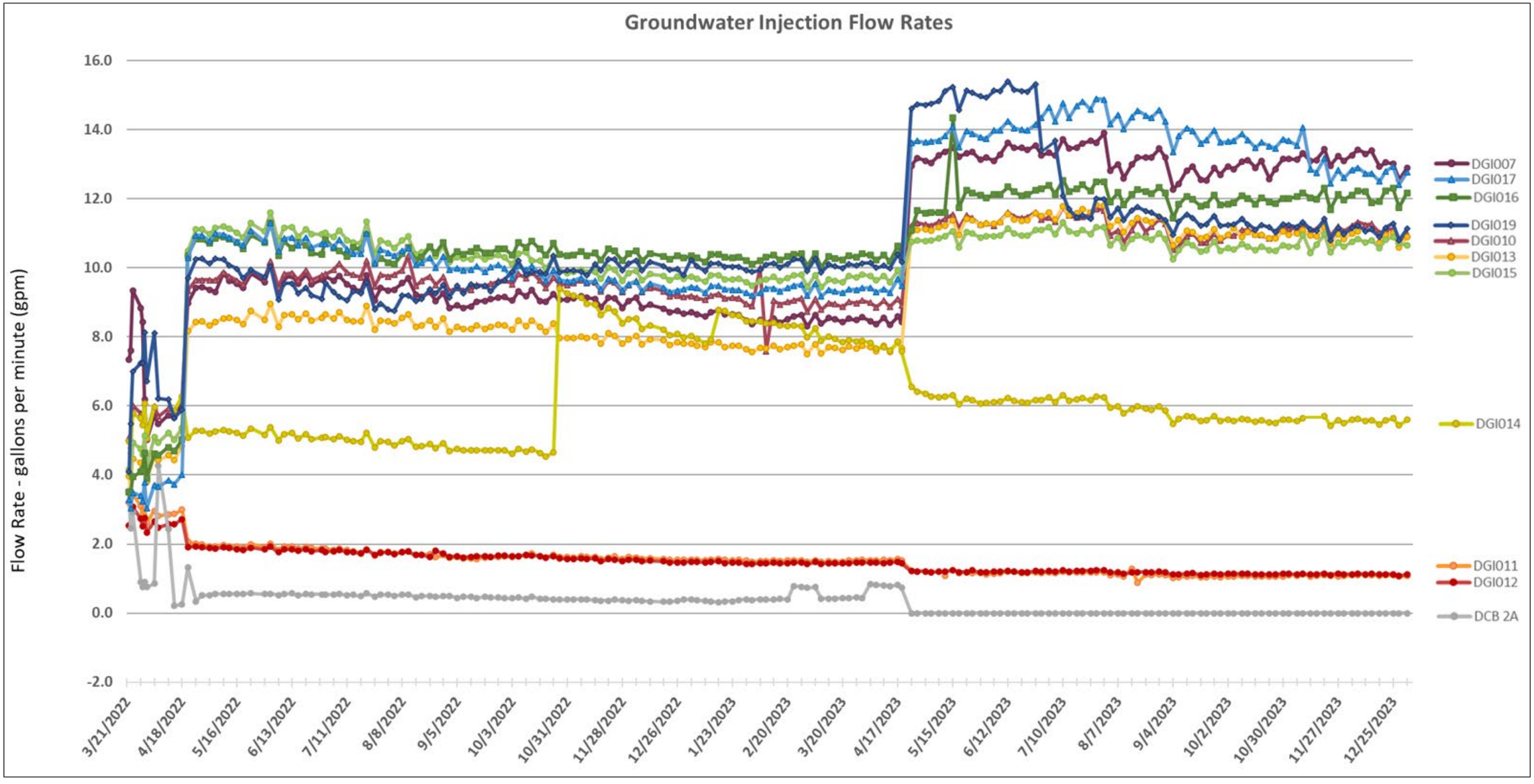


Figure 17. Graph of Injection Well Flow Rates for 2022 and 2023

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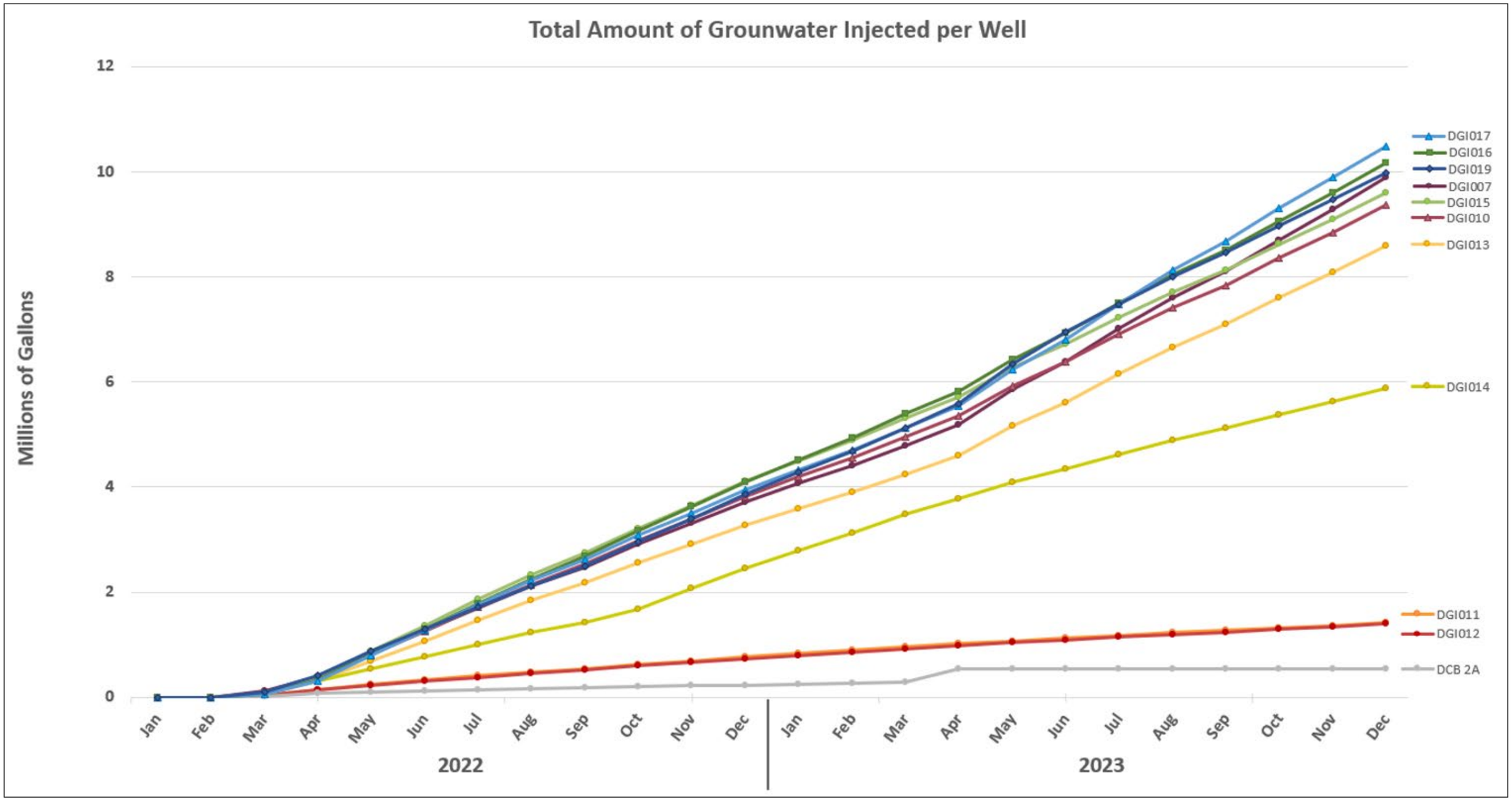


Figure 18. Cumulative Groundwater Injection Volumes Per Well (in millions of gallons)

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D-Area Effluent Discharge Canal Stream Flow Rates (ft³/sec)

	2020	2021		2022											2023											
	May	May	Oct	Jan	Feb	Mar	Groundwater Injection Begins	Apr	May	Jun	Jul	Aug	Sep	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
DSWM-4	0.0001	0.04						0.06			0.0071			0.043									0.0661			0	
DSWM-4A	0	0.02						0.005			0						0.0519			0.0028			0			0	
DSWM-4B	0.032	0.03						0.073			0.0597			0.023			0.1848			0.0029			0.0193			0.0027	
DSWM-4C	0.047	0.03						0.378			0.2392			0.254			0.3751			0			0		0	0	0.206
DSWM-5	0.098	0.05						0.008			0						0.2661			0.0061			0			0	
DSWM-6	0.17	0.27						0.14									0			0			0		0.556	0	0
DSWM-8	0.252		0.04	0.869	0.114	0.0754		0.163		0.008	0.153	0.0472	0.085		0.0093	0.1633	0.6921	0.1916	0.4704	0.137	0.2743	0.4687	0.5149	0.4742	0.103	0.0952	0.571
DSWM-8A			0.05	1.116	0.234	0.0908		0.2373		0.024		0.0031	0.175	0.046	0.2975	0.2723	0.9268	0.2268	0.7133	0.151	0.2157	0.1437	0.4722	0.649	0.128	0.0739	0.512
DSWM-9	1.497					0.2381		0.3983			0.66				0.66	0		0.3951	0	0.0076	0		0	0.7501	0.179	0	0.432

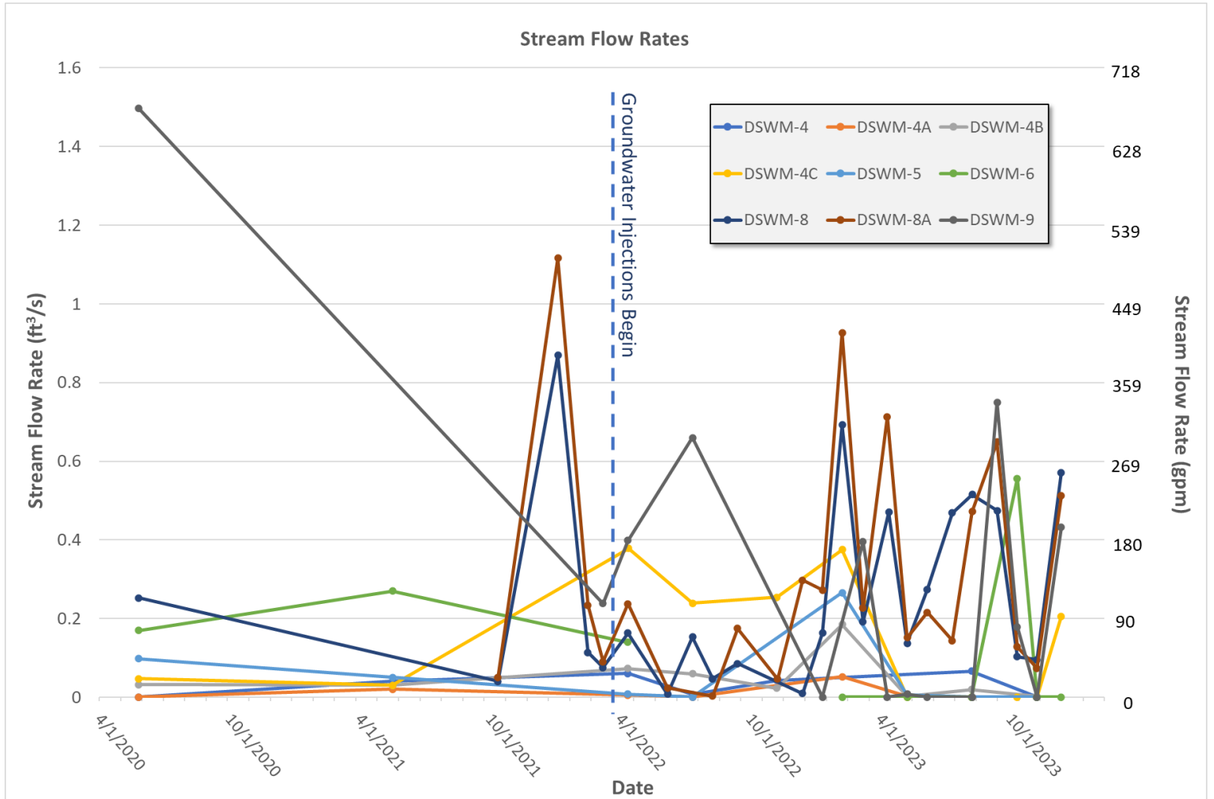


Figure 19. D-Area Effluent Discharge Canal Stream Flow Measurements

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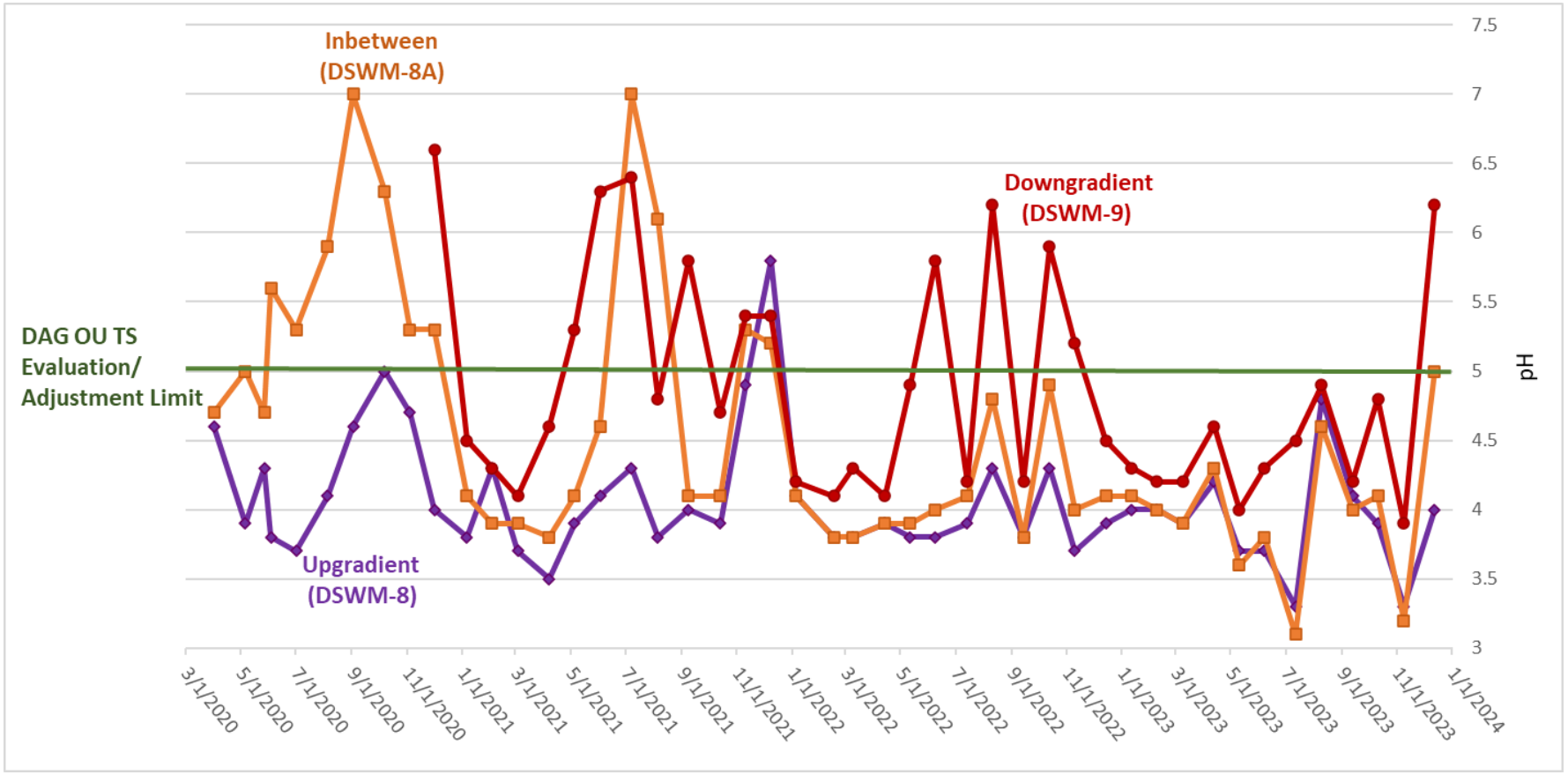


Figure 20. $CaCO_3$ Reactive Structure Surface Water pH Results

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Figure 21. Location of the Reworked $CaCO_3$ Reactive Structures

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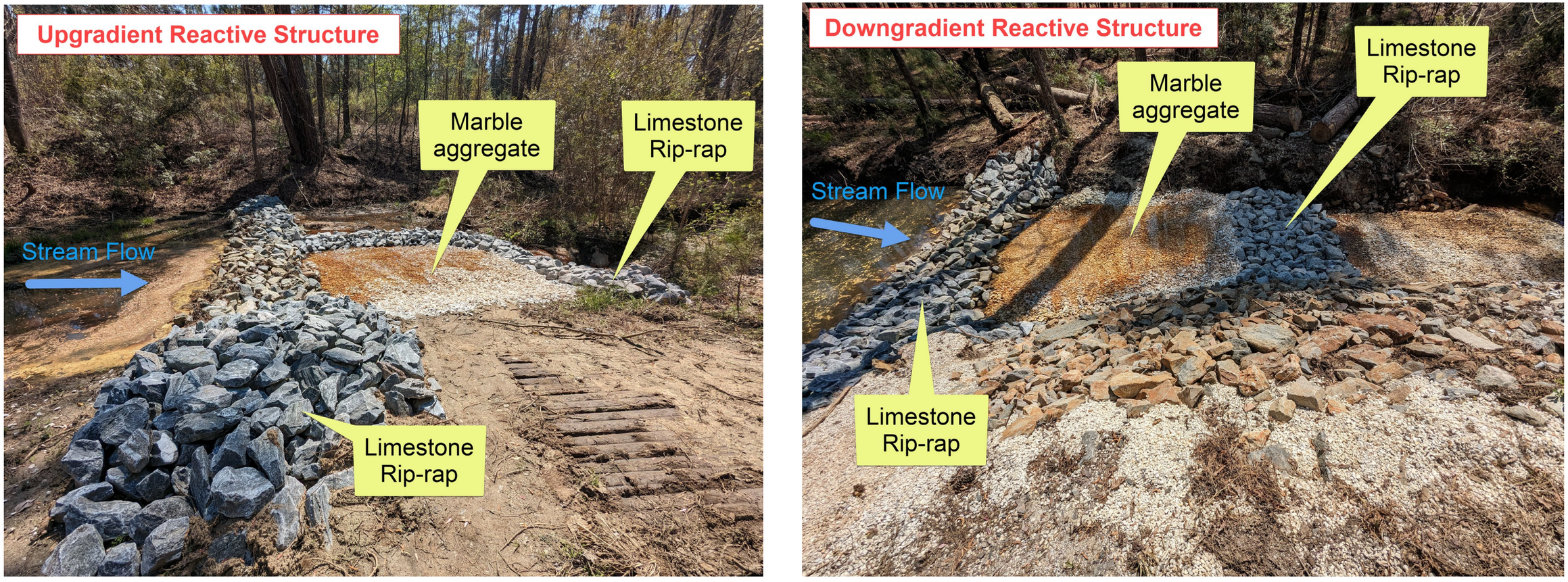


Figure 22. D-Area Effluent Discharge Canal Reactive Structures (March 2024)

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Figure 23. Surface Water Concentrations of pH and Beryllium, Aluminum, and Sulfate at DSWM-8, DSWM-8A, and DSWM-9

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Figure 24. Surface Water Concentrations of pH and Cobalt and Nickel at DSWM-8, DSWM-8A, and DSWM-9

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APPENDIX A

D-Area Groundwater Treatability Study Data Tables

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Table A-1.
D-Area Groundwater Treatability Study Data Table (2023)

Station	Well Use	Aquifer Zone	Field Data: SAMPLE COLLECTION DATE	SAMPLING EVENT DEPTH TO WATER	SAMPLING EVENT WATER ELEVATION	TURBIDITY	pH	WATER TEMPERATURE	SPECIFIC CONDUCTANCE	TOTAL ALKALINITY (AS CaCO3)	OXIDATION REDUCTION POTENTIAL	SYSTEM	DUPLICATE WATER FERRIGHYDRITE ROUTE	Combined	NRDEL	NRDEL Val	D Area Analytic Suite: Inorganics: ALUMINUM	ANTIMONY	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM	COBALT	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	POTASSIUM	SELENIUM	SILVER	SODIUM	THALLIUM	VANADIUM	ZINC	FIELD CONDITIONS
			Acceptable Limits														20000	6	10	2000	4	5		100	6	1300	300	15	50	2	390	7	50	100	2	30		5000	
																	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
GCB 16	Well - Water Elevations	UTRA	12-Jan-2023	13.59	119.61	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	09-Feb-2023	13.75	119.45	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	09-Mar-2023	12.762	120.46	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	13-Apr-2023	12.542	120.66	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	11-May-2023	13.4	119.8	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	13-Jun-2023	14.5	118.7	SN	5.1	20.1	0	0	0	0						0.611	[EQL (3)]	[EQL (30)]	14	[EQL (1)]	[EQL (5)]	1750	[EQL (5)]	[EQL (15)]	[EQL (10)]	20	[EQL (0.5)]	0.5	1360	[EQL (0.5)]	0.0	[EQL (1)]	317	[EQL (30)]	[EQL (2)]	1.5	[EQL (5)]	[EQL (10)]	
GCB 16	Well - Water Elevations	UTRA	07-Jun-2011	12.43	120.36	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	11-Jul-2023	13.946	120.214	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	09-Aug-2023	12.292	120.414	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	12-Sep-2023	12.3	120.406	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	12-Oct-2023	12.3	120.406	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	09-Nov-2023	12.5	120.206	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	11-Dec-2023	12.5	120.206	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	10-Jan-2024	12.5	120.206	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Well - Water Elevations	UTRA	07-Dec-2023	4.825	118.25	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Monitoring Well	UTRA	12-Jan-2023	10.81	117.93	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Monitoring Well	UTRA	07-Feb-2023	14.832	116.972	4.6	3.4	18.5	460	0	321	0.17						0.611	[EQL (3)]	[EQL (30)]	47	[EQL (1)]	[EQL (5)]	14100	[EQL (5)]	[EQL (15)]	[EQL (10)]	1550	[EQL (0.5)]	0.5	1440	[EQL (0.5)]	0.0	[EQL (1)]	3680	[EQL (30)]	[EQL (2)]	3.7	[EQL (5)]	[EQL (10)]	
GCB 16	Monitoring Well	UTRA	13-Mar-2023	15.298	116.506	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Monitoring Well	UTRA	26-Apr-2023	16	117.81	4.4	3.32	19.91	3680	0	401	0.45						0.611	[EQL (3)]	[EQL (30)]	1.54	2.12	0.5	42000	[EQL (5)]	[EQL (15)]	[EQL (10)]	693	[EQL (0.5)]	0.5	1960	[EQL (0.5)]	0.0	[EQL (1)]	4110	[EQL (30)]	[EQL (2)]	0.113	[EQL (5)]	[EQL (10)]	
GCB 16	Monitoring Well	UTRA	11-May-2023	16.81	117.29	4.4	3.3	19.8	3450	0	336	1.8						0.611	[EQL (3)]	[EQL (30)]	1.13	2.1	0.5	41000	[EQL (5)]	[EQL (15)]	[EQL (10)]	1150	[EQL (0.5)]	0.5	1940	[EQL (0.5)]	0.0	[EQL (1)]	4110	[EQL (30)]	[EQL (2)]	0.113	[EQL (5)]	[EQL (10)]	
GCB 16	Monitoring Well	UTRA	13-Jun-2023	16.92	117.37	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Monitoring Well	UTRA	11-Jul-2023	16.92	117.37	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Monitoring Well	UTRA	09-Aug-2023	17.242	116.96	4.4	3.3	19.7	3450	0	342	0.88						0.611	[EQL (3)]	[EQL (30)]	1.29	1.9	0.5	42200	[EQL (5)]	[EQL (15)]	[EQL (10)]	1550	[EQL (0.5)]	0.5	2320	[EQL (0.5)]	0.0	[EQL (1)]	4240	[EQL (30)]	[EQL (2)]	0.113	[EQL (5)]	[EQL (10)]	1020
GCB 16	Monitoring Well	UTRA	14-Jun-2023	18.53	118.3	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Monitoring Well	UTRA	11-Oct-2023	18.5	118.34	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Monitoring Well	UTRA	13-Nov-2023	17.94	118.89	4.4	3.3	20.1	3450	0	402	1.83						0.611	[EQL (3)]	[EQL (30)]	1.14	2.1	0.5	41000	[EQL (5)]	[EQL (15)]	[EQL (10)]	1150	[EQL (0.5)]	0.5	2030	[EQL (0.5)]	0.0	[EQL (1)]	3980	[EQL (30)]	[EQL (2)]	0.113	[EQL (5)]	[EQL (10)]	820
GCB 16	Monitoring Well	UTRA	07-Dec-2023	17.97	116.23	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 16	Monitoring Well	UTRA	12-Jan-2024	14.948	119.814	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	09-Feb-2023	12.32	119.91	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	09-Mar-2023	12.32	120.06	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	13-Apr-2023	12.54	120.24	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	10-May-2023	14.21	118.57	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	13-Jun-2023	13.93	119.07	SN	5.1	20.1	0	0	0	0						0.611	[EQL (3)]	[EQL (30)]	14	[EQL (1)]	[EQL (5)]	1750	[EQL (5)]	[EQL (15)]	[EQL (10)]	20	[EQL (0.5)]	0.5	1360	[EQL (0.5)]	0.0	[EQL (1)]	317	[EQL (30)]	[EQL (2)]	1.5	[EQL (5)]	[EQL (10)]	
GCB 17	Well - Water Elevations	UTRA	11-Jul-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	09-Aug-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	12-Sep-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	12-Oct-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	09-Nov-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	11-Dec-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Well - Water Elevations	UTRA	10-Jan-2024	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Monitoring Well	UTRA	12-Jan-2023	16.232	118.67	4.4	3.31	21.1	4010	0	408	0.41						0.611	[EQL (3)]	[EQL (30)]	1.2	2.1	0.5	43000	[EQL (5)]	[EQL (15)]	[EQL (10)]	1150	[EQL (0.5)]	0.5	2110	[EQL (0.5)]	0.0	[EQL (1)]	4110	[EQL (30)]	[EQL (2)]	0.113	[EQL (5)]	[EQL (10)]	
GCB 17	Monitoring Well	UTRA	09-Aug-2023	17.753	117.15	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Monitoring Well	UTRA	14-Jun-2023	13.1	120.1	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Monitoring Well	UTRA	11-Jul-2023	14.1	119.23	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 17	Monitoring Well	UTRA	07-Dec-2023	17.452	117.75	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	11-Jan-2023	8.11	121.09	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	06-Feb-2023	8.533	120.67	14.8	5	16.3	611	0	285	5.11						0.611	[EQL (3)]	[EQL (30)]	1.29	[EQL (1)]	[EQL (5)]	1290	[EQL (5)]	[EQL (15)]	[EQL (10)]	562	[EQL (0.5)]	0.5	1750	[EQL (0.5)]	0.0	[EQL (1)]	4970	8.26	[EQL (30)]	[EQL (2)]	[EQL (5)]	[EQL (10)]	
GCB 18	Monitoring Well	UTRA	06-Mar-2023	8.533	120.67	14.8	5	16.3	611	0	285	5.11						0.611	[EQL (3)]	[EQL (30)]	1.29	[EQL (1)]	[EQL (5)]	1290	[EQL (5)]	[EQL (15)]	[EQL (10)]	562	[EQL (0.5)]	0.5	1750	[EQL (0.5)]	0.0	[EQL (1)]	4970	8.26	[EQL (30)]	[EQL (2)]	[EQL (5)]	[EQL (10)]	
GCB 18	Monitoring Well	UTRA	11-May-2023	4.34	124.86	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	13-Jun-2023	4.653	124.547	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	11-Jul-2023	4.653	124.547	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	09-Aug-2023	4.653	124.547	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	12-Sep-2023	4.653	124.547	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	11-Oct-2023	4.824	125.426	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	13-Nov-2023	4.941	124.309	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	11-Dec-2023	4.941	124.309	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	10-Jan-2024	4.941	124.309	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	07-Dec-2023	17.97	116.23	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	12-Jan-2024	14.948	119.814	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	09-Feb-2023	12.32	119.91	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	09-Mar-2023	12.32	120.06	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	13-Apr-2023	12.54	120.24	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	10-May-2023	14.21	118.57	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	13-Jun-2023	13.93	119.07	SN	5.1	20.1	0	0	0	0						0.611	[EQL (3)]	[EQL (30)]	14	[EQL (1)]	[EQL (5)]	1750	[EQL (5)]	[EQL (15)]	[EQL (10)]	20	[EQL (0.5)]	0.5	1360	[EQL (0.5)]	0.0	[EQL (1)]	317	[EQL (30)]	[EQL (2)]	1.5	[EQL (5)]	[EQL (10)]	
GCB 18	Well - Water Elevations	UTRA	11-Jul-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	09-Aug-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	12-Sep-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	12-Oct-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	09-Nov-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	11-Dec-2023	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Well - Water Elevations	UTRA	10-Jan-2024	14.232	118.768	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	12-Jan-2023	10.81	117.93	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	07-Feb-2023	10.832	117.912	4.6	3.4	18.5	460	0	321	0.17						0.611	[EQL (3)]	[EQL (30)]	47	[EQL (1)]	[EQL (5)]	14100	[EQL (5)]	[EQL (15)]	[EQL (10)]	1550	[EQL (0.5)]	0.5	1440	[EQL (0.5)]	0.0	[EQL (1)]	3680	[EQL (30)]	[EQL (2)]	3.7	[EQL (5)]	[EQL (10)]	
GCB 18	Monitoring Well	UTRA	13-Mar-2023	12.298	116.506	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	26-Apr-2023	16	117.81	4.4	3.32	19.91	3680	0	401	0.45						0.611	[EQL (3)]	[EQL (30)]	1.54	2.12	0.5	42000	[EQL (5)]	[EQL (15)]	[EQL (10)]	693	[EQL (0.5)]	0.5	1960	[EQL (0.5)]	0.0	[EQL (1)]	4110	[EQL (30)]	[EQL (2)]	0.113	[EQL (5)]	[EQL (10)]	
GCB 18	Monitoring Well	UTRA	11-May-2023	16.81	117.29	4.4	3.3	19.8	3450	0	336	1.8						0.611	[EQL (3)]	[EQL (30)]	1.13	2.1	0.5	41000	[EQL (5)]	[EQL (15)]	[EQL (10)]	1150	[EQL (0.5)]	0.5	1940	[EQL (0.5)]	0.0	[EQL (1)]	4110	[EQL (30)]	[EQL (2)]	0.113	[EQL (5)]	[EQL (10)]	
GCB 18	Monitoring Well	UTRA	13-Jun-2023	16.92	117.37	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	11-Jul-2023	16.92	117.37	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	09-Aug-2023	17.242	116.96	4.4	3.3	19.7	3450	0	342	0.88						0.611	[EQL (3)]	[EQL (30)]	1.29	1.9	0.5	42200	[EQL (5)]	[EQL (15)]	[EQL (10)]	1550	[EQL (0.5)]	0.5	2320	[EQL (0.5)]	0.0	[EQL (1)]	4240	[EQL (30)]	[EQL (2)]	0.113	[EQL (5)]	[EQL (10)]	1020
GCB 18	Monitoring Well	UTRA	12-Sep-2023	17.242	116.96	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	12-Oct-2023	17.242	116.96	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	13-Nov-2023	17.94	118.89	4.4	3.3	20.1	3450	0	402	1.83						0.611	[EQL (3)]	[EQL (30)]	1.14	2.1	0.5	41000	[EQL (5)]	[EQL (15)]	[EQL (10)]	1150	[EQL (0.5)]	0.5	2030	[EQL (0.5)]	0.0	[EQL (1)]	3980	[EQL (30)]	[EQL (2)]	0.113	[EQL (5)]	[EQL (10)]	820
GCB 18	Monitoring Well	UTRA	07-Dec-2023	17.97	116.23	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 18	Monitoring Well	UTRA	12-Jan-2024	14.948	119.814	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Well - Water Elevations	UTRA	09-Feb-2023	8.5	117.5	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Well - Water Elevations	UTRA	09-Mar-2023	8.54	116.7	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Well - Water Elevations	UTRA	13-Apr-2023	8.541	116.713	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Well - Water Elevations	UTRA	10-May-2023	7.54	117.5	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Well - Water Elevations	UTRA	13-Jun-2023	7.41	117.6	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Well - Water Elevations	UTRA	11-Jul-2023	7.41	117.6	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Well - Water Elevations	UTRA	09-Aug-2023	6.381	116.22	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Well - Water Elevations	UTRA	12-Sep-2023	7.41	116.22	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Well - Water Elevations	UTRA	09-Aug-2023	13.753	120.45	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Monitoring Well	UTRA	14-Jun-2023	13.1	120.1	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Monitoring Well	UTRA	11-Jul-2023	14.1	119.23	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Monitoring Well	UTRA	07-Dec-2023	17.452	117.75	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
GCB 19	Monitoring Well	UTRA	12-Jan-2023	10.232	114.17	SN	NS	NS	NS	NS	NS	NS						NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

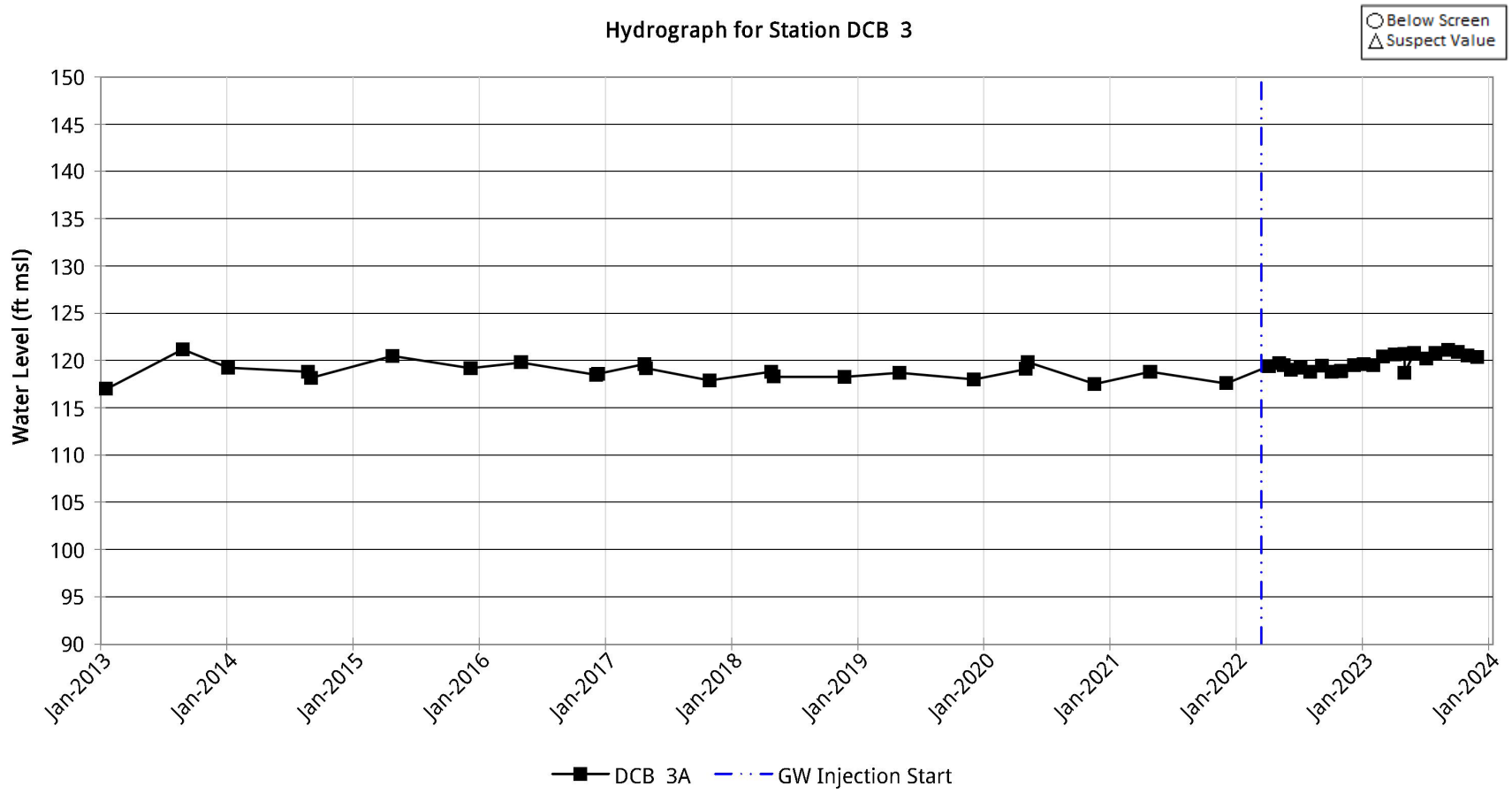
Table A-2. D-Area Groundwater Treatability Study Data Table (2020)

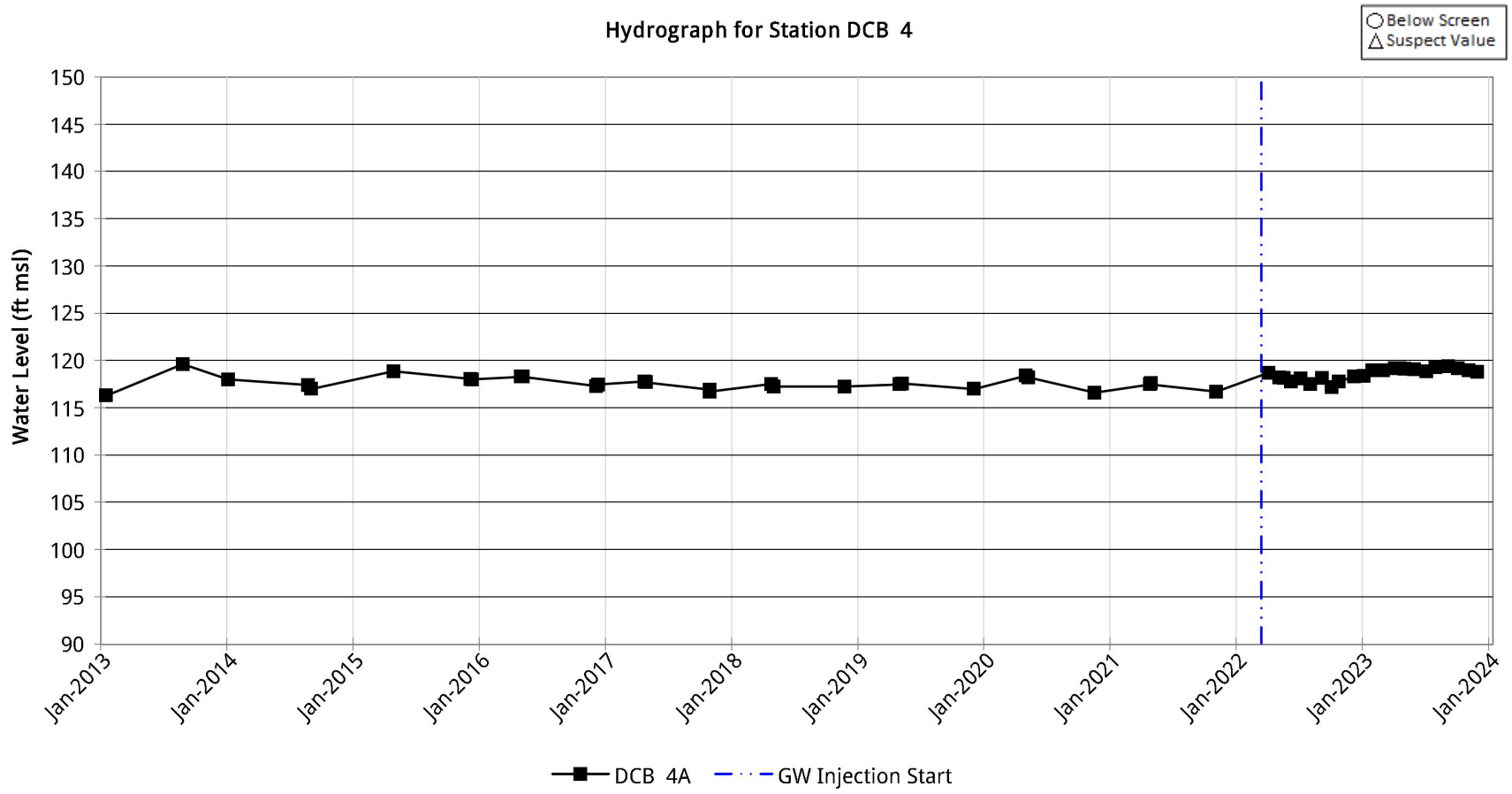
| | | | Field Data | | | | | | | | | | | | | | D Area Analyte Suite | | | | | | | | | | | | | |

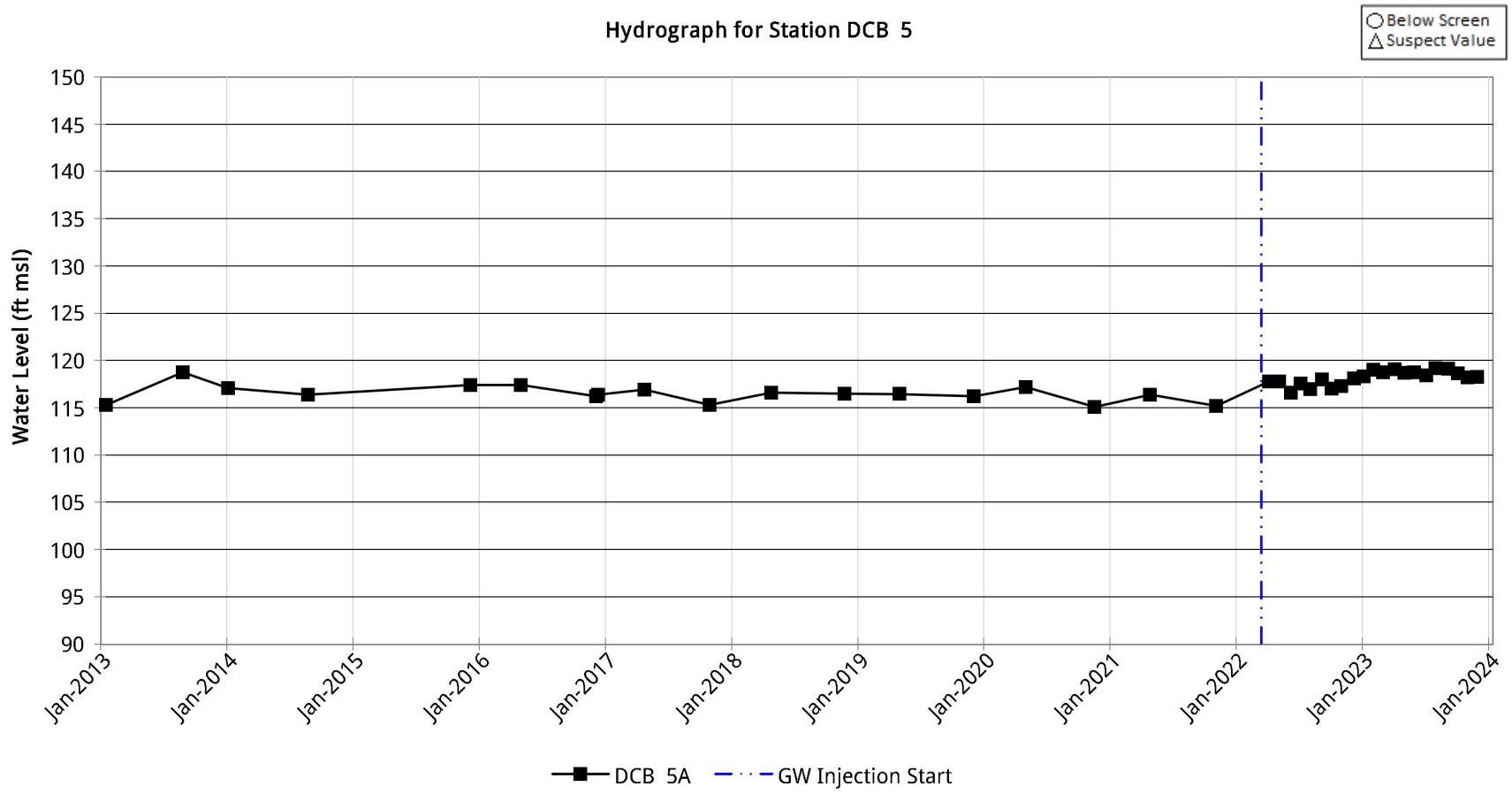
Appendix B

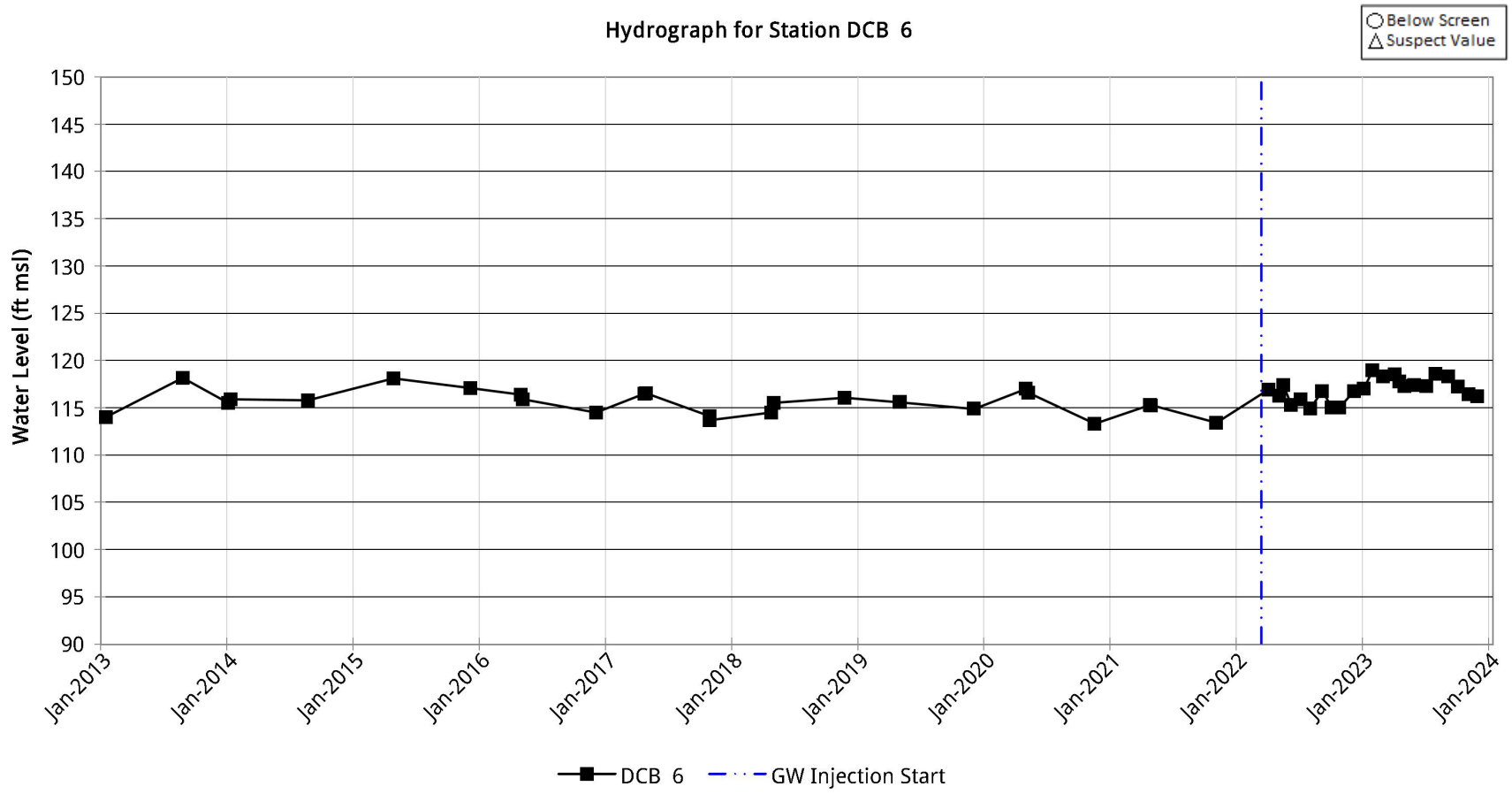
Hydrographs

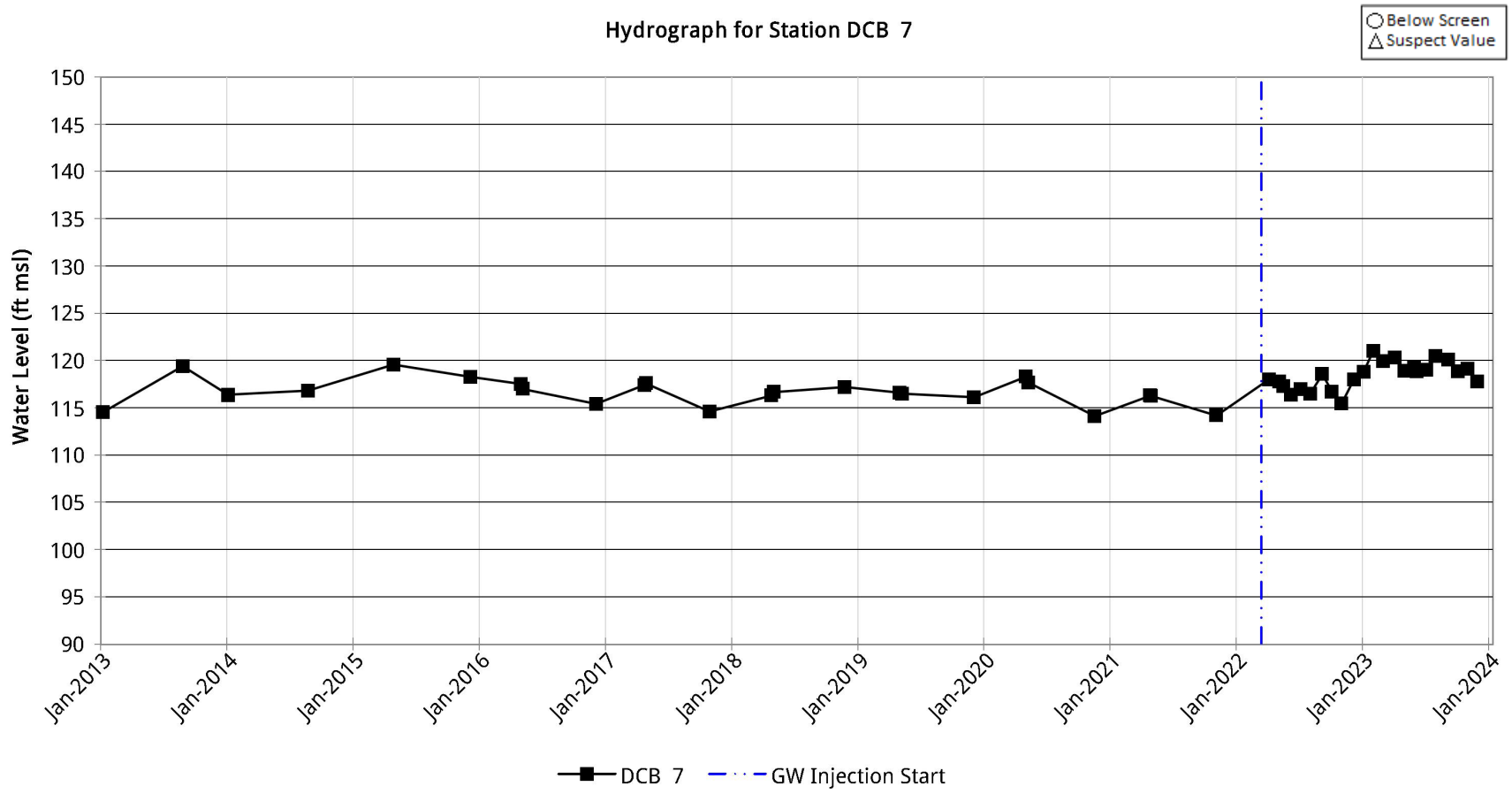
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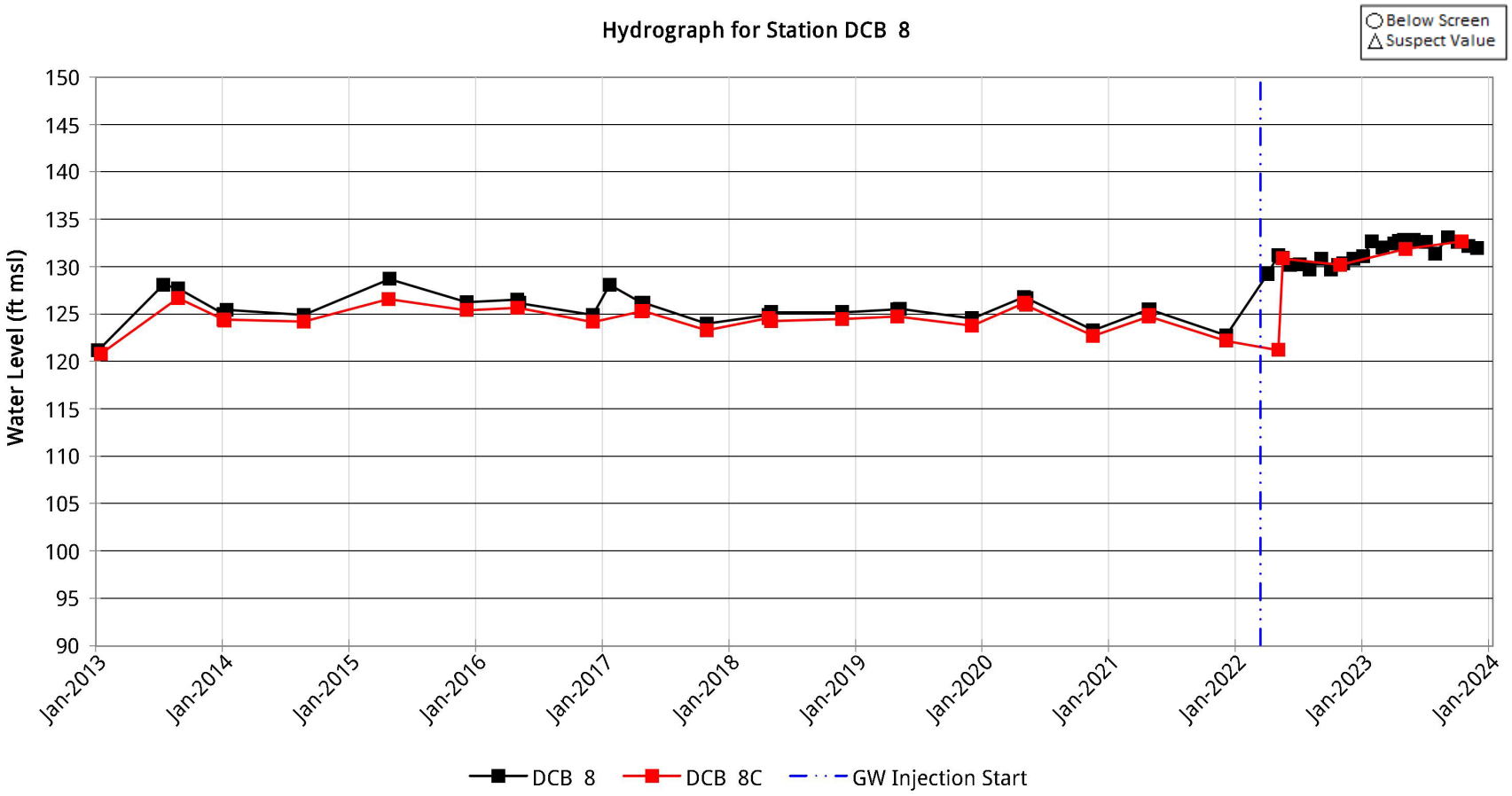

Hydrograph for Station DCB 3
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 3A
GW Injection Start

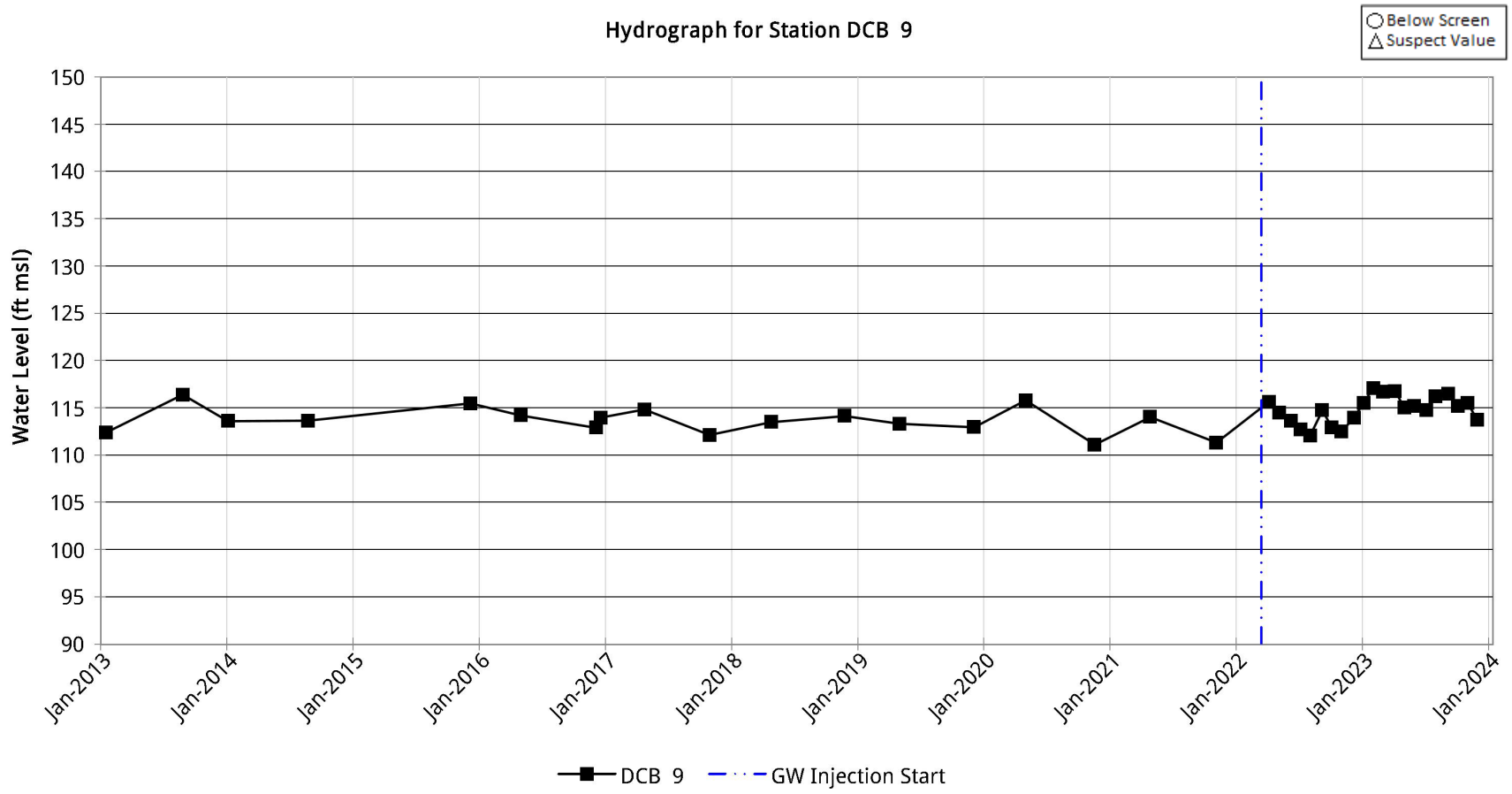

Hydrograph for Station DCB 4
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 4A
GW Injection Start

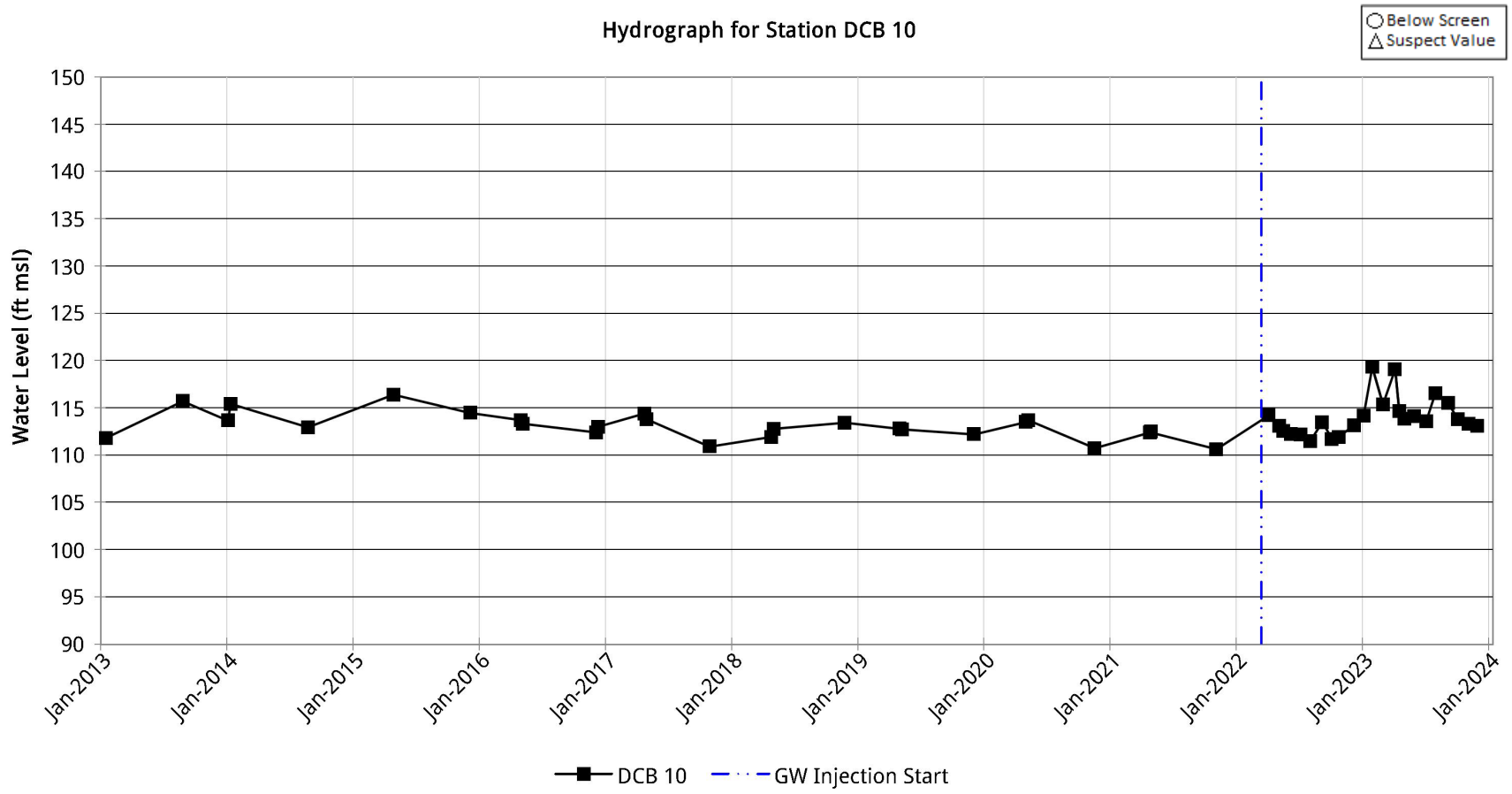

Hydrograph for Station DCB 5
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 5A
GW Injection Start

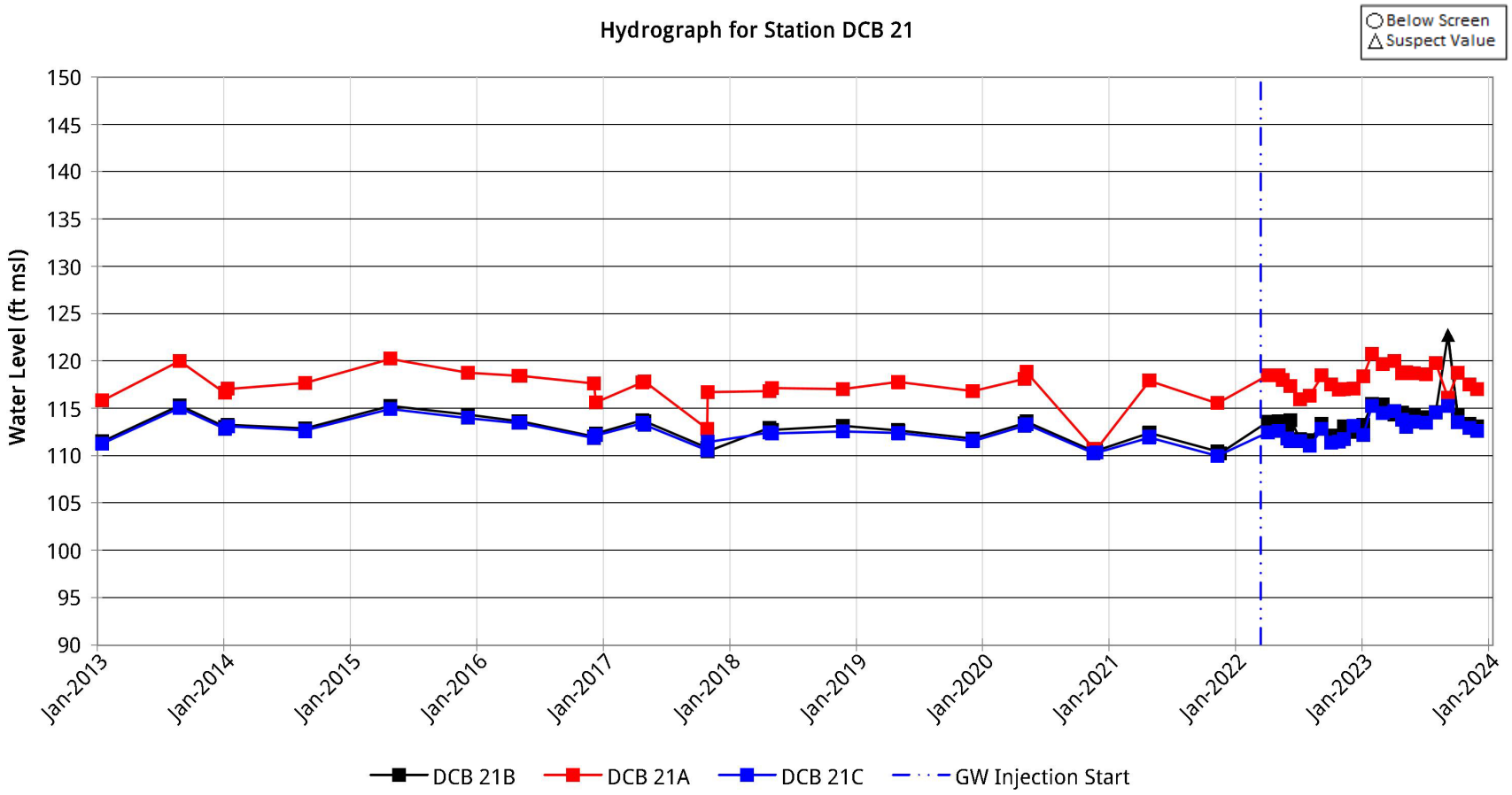

Hydrograph for Station DCB 6
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 6
GW Injection Start

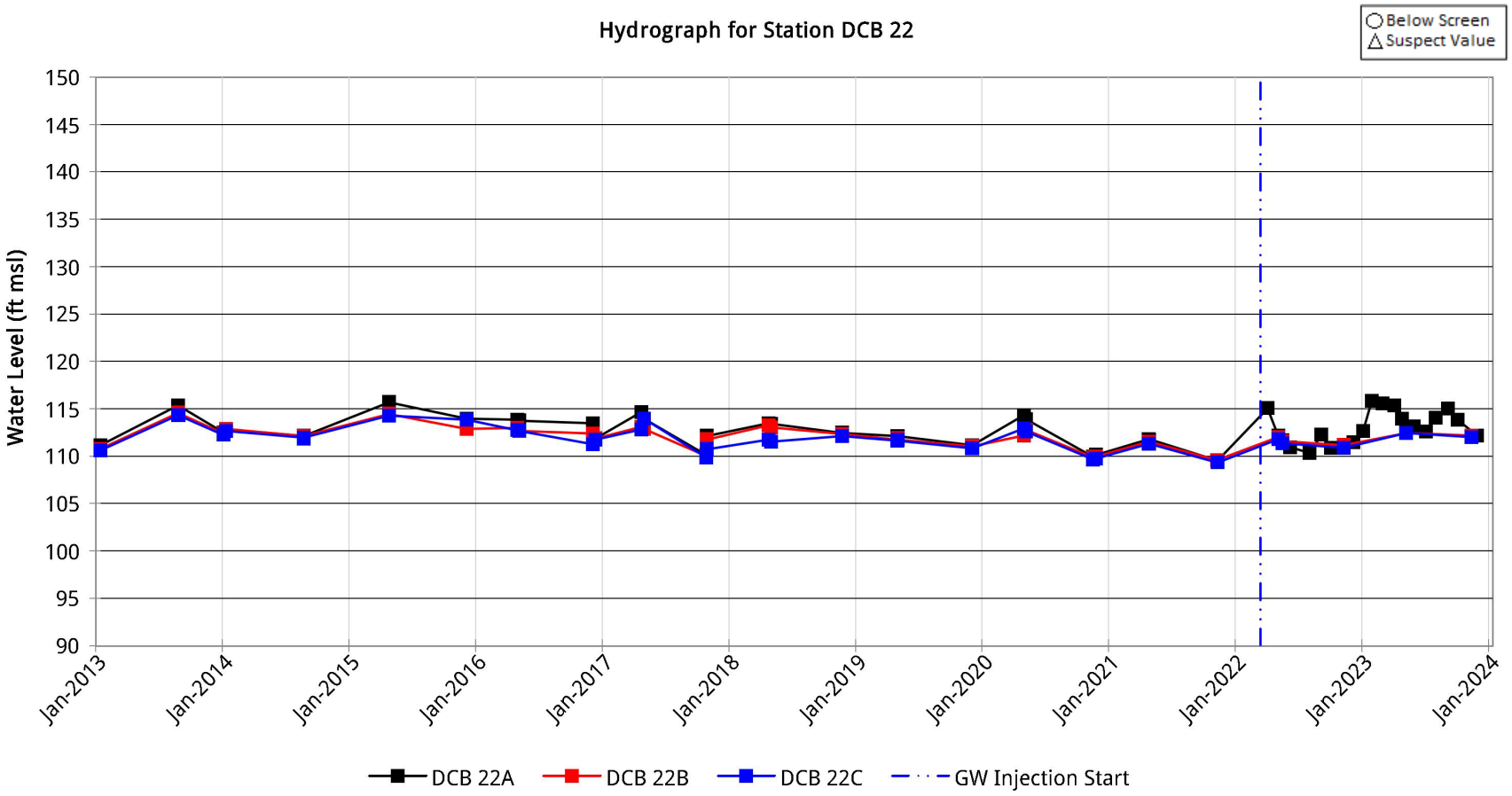

Hydrograph for Station DCB 7
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 7
GW Injection Start

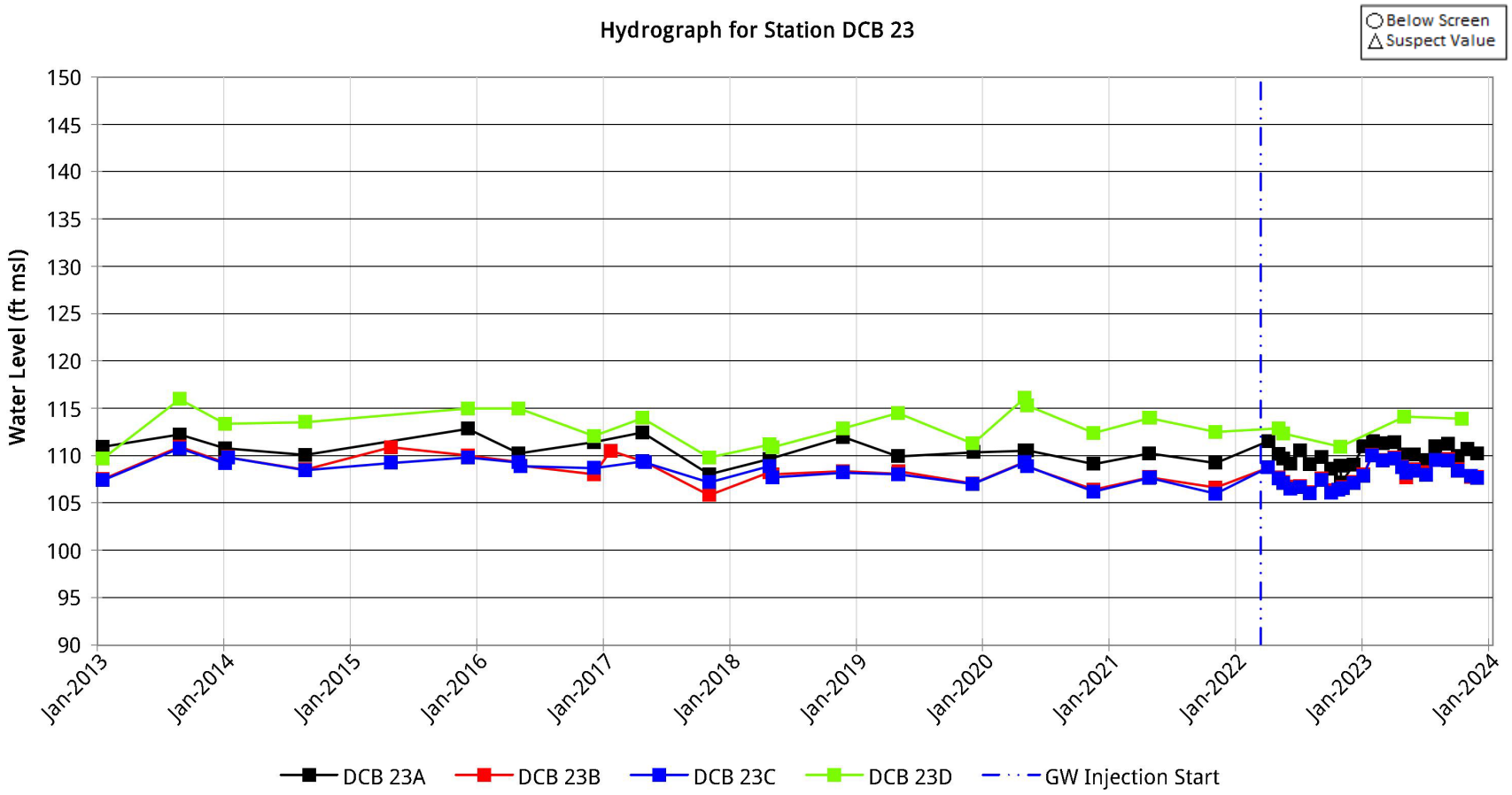

Hydrograph for Station DCB 8
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 8
DCB 8C
GW Injection Start

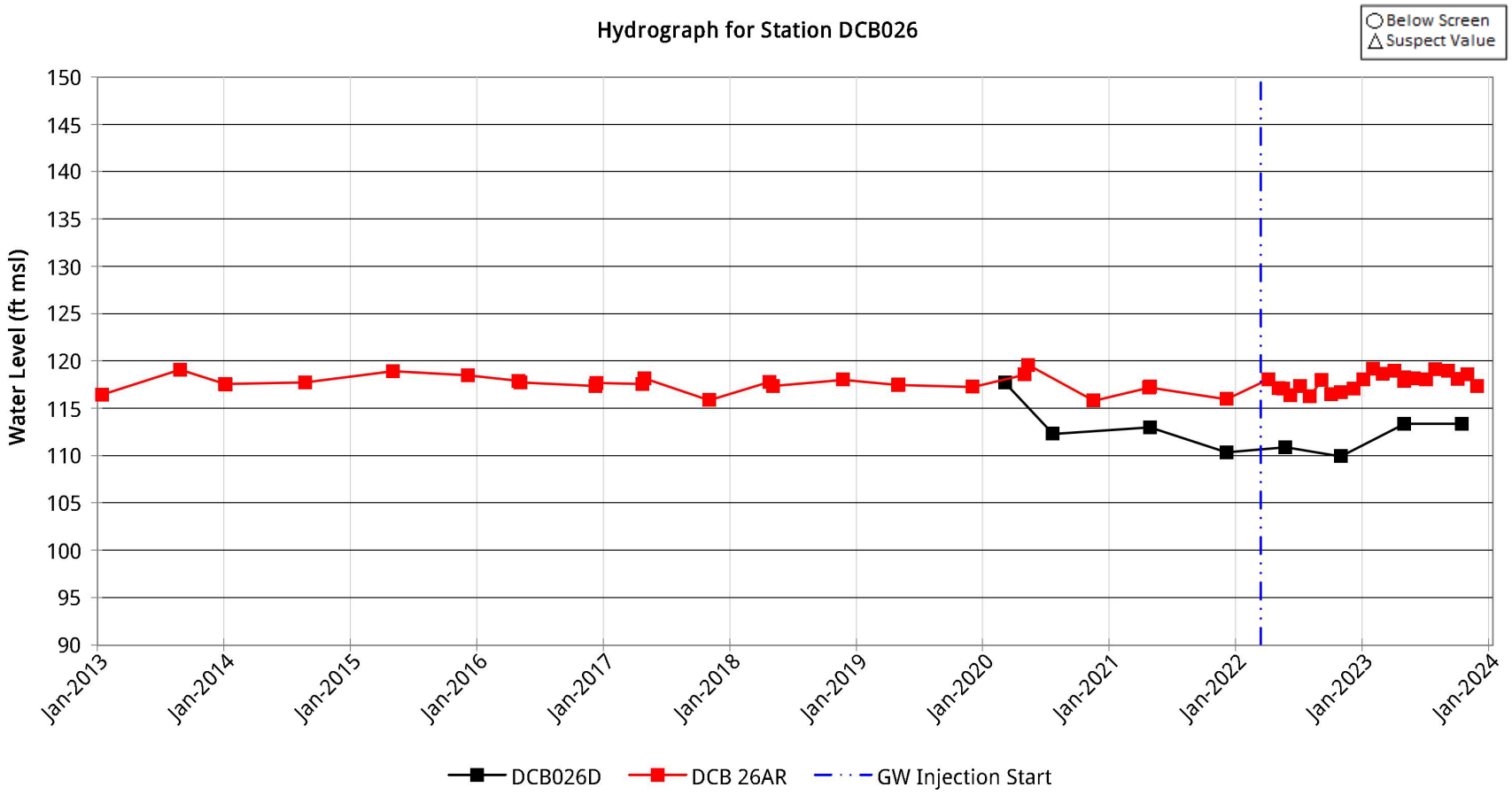

Hydrograph for Station DCB 9
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 9
GW Injection Start

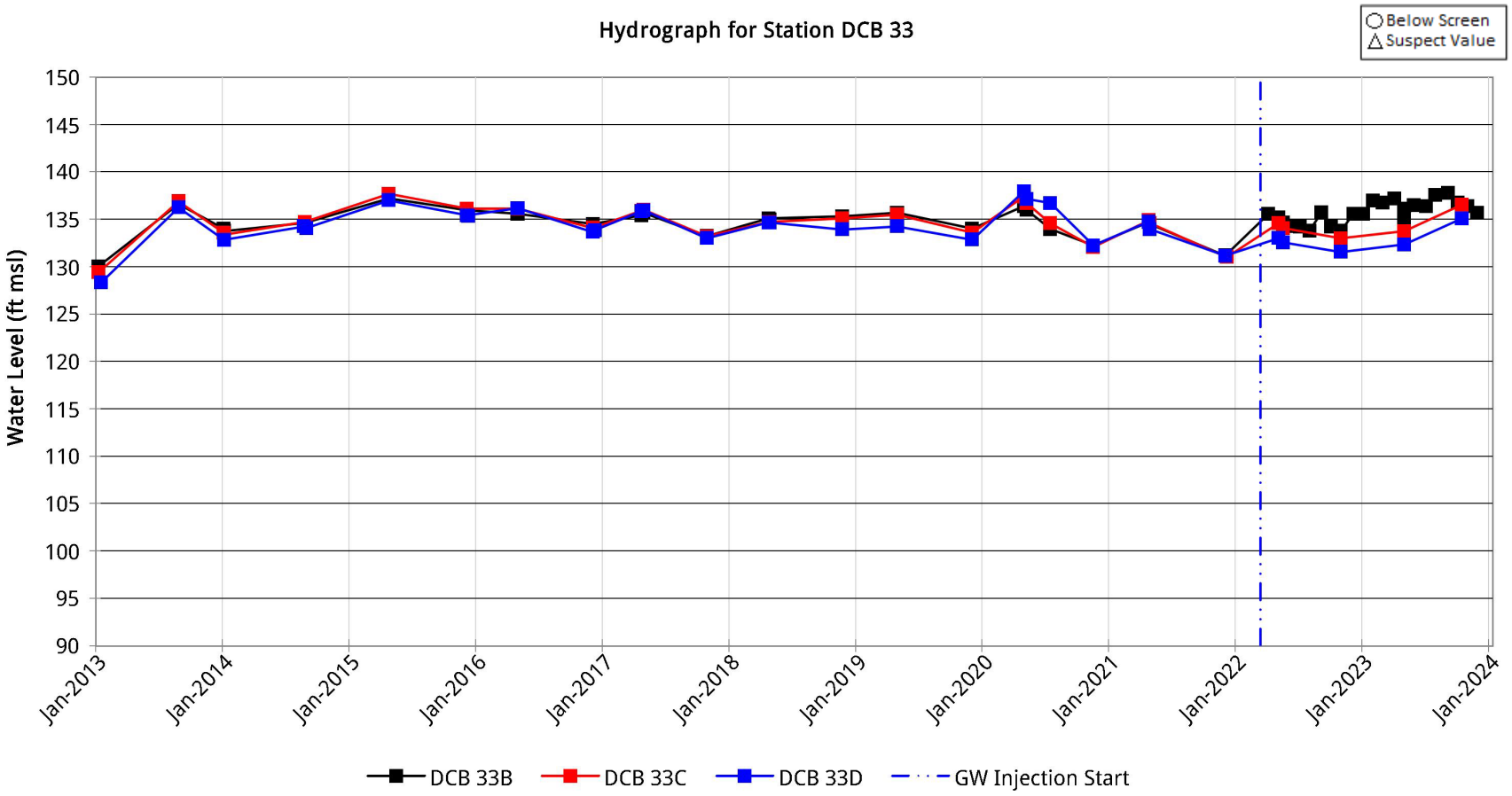

Hydrograph for Station DCB 10
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 10
GW Injection Start

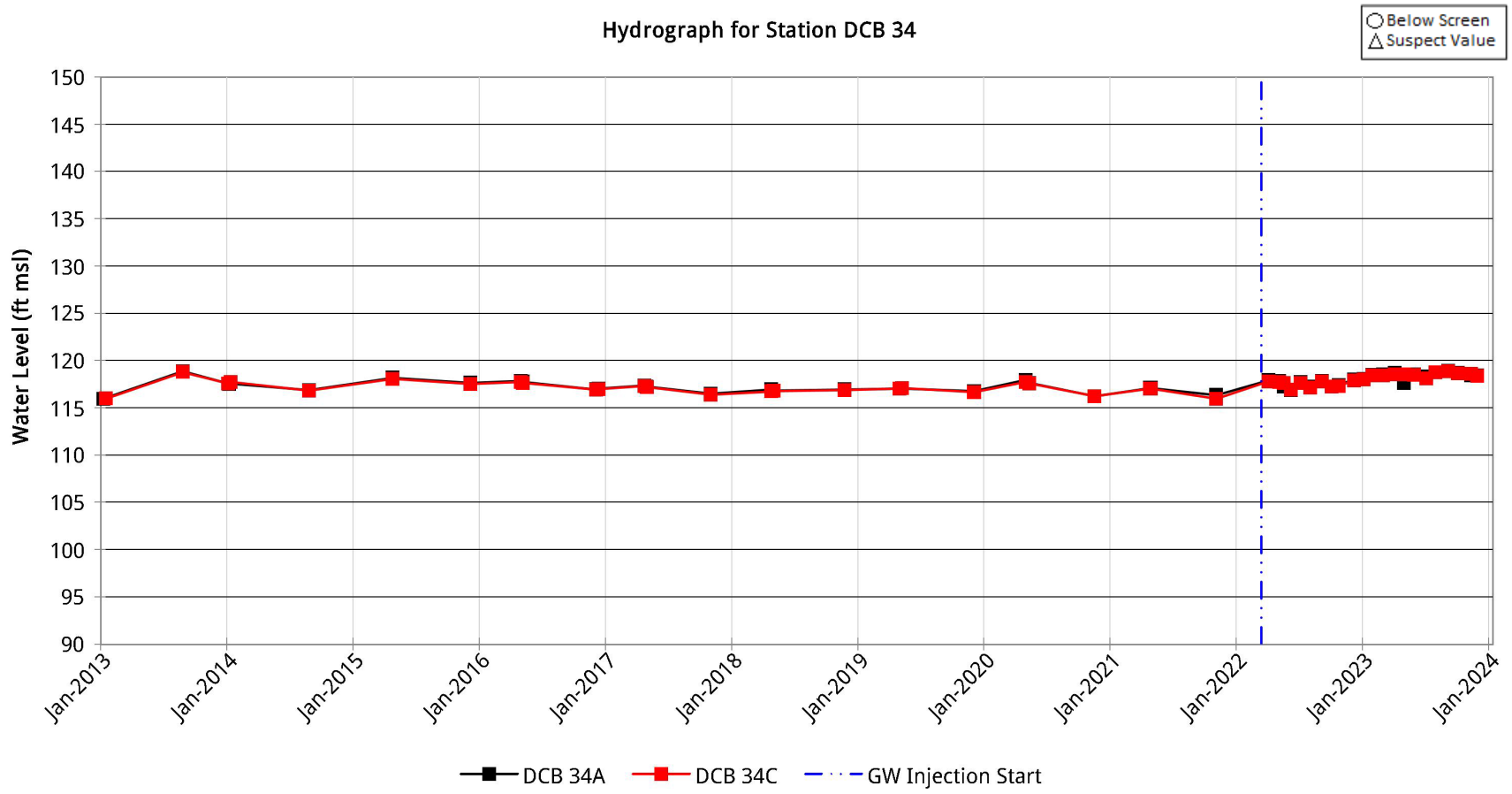

Hydrograph for Station DCB 21
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 21B
DCB 21A
DCB 21C
GW Injection Start

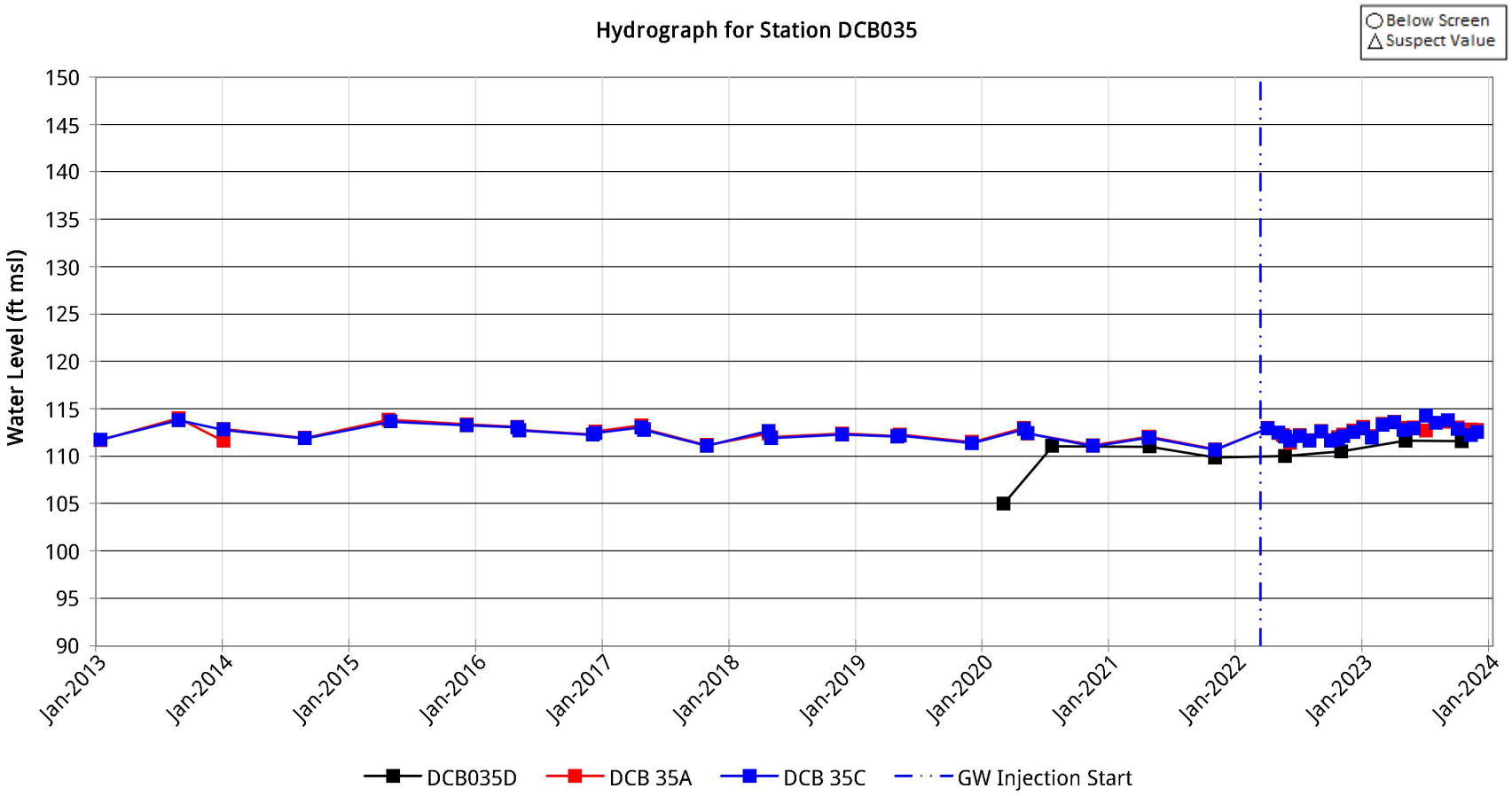

Hydrograph for Station DCB 22
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 22A
DCB 22B
DCB 22C
GW Injection Start

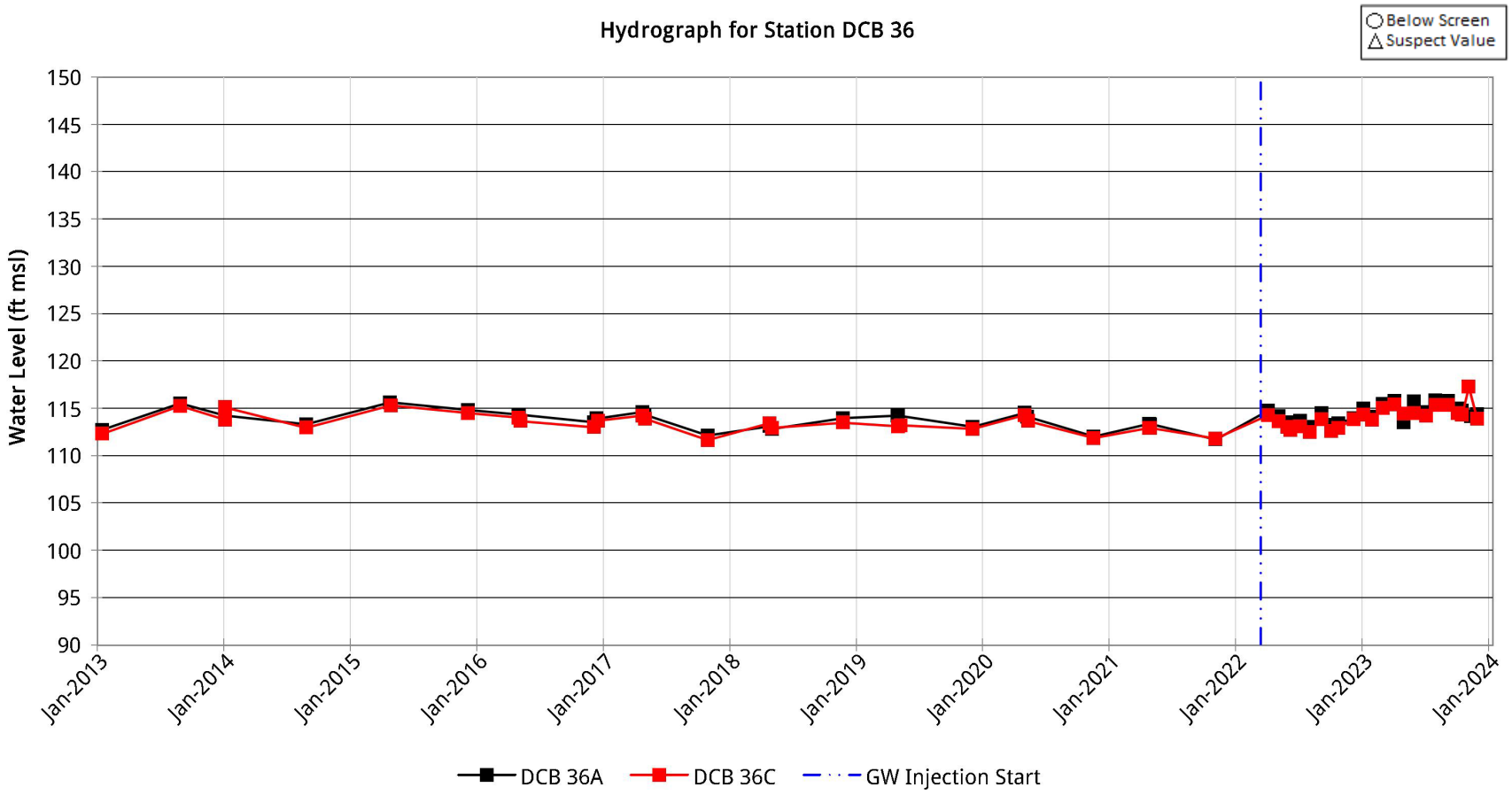

Hydrograph for Station DCB 23
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 23A
DCB 23B
DCB 23C
DCB 23D
GW Injection Start

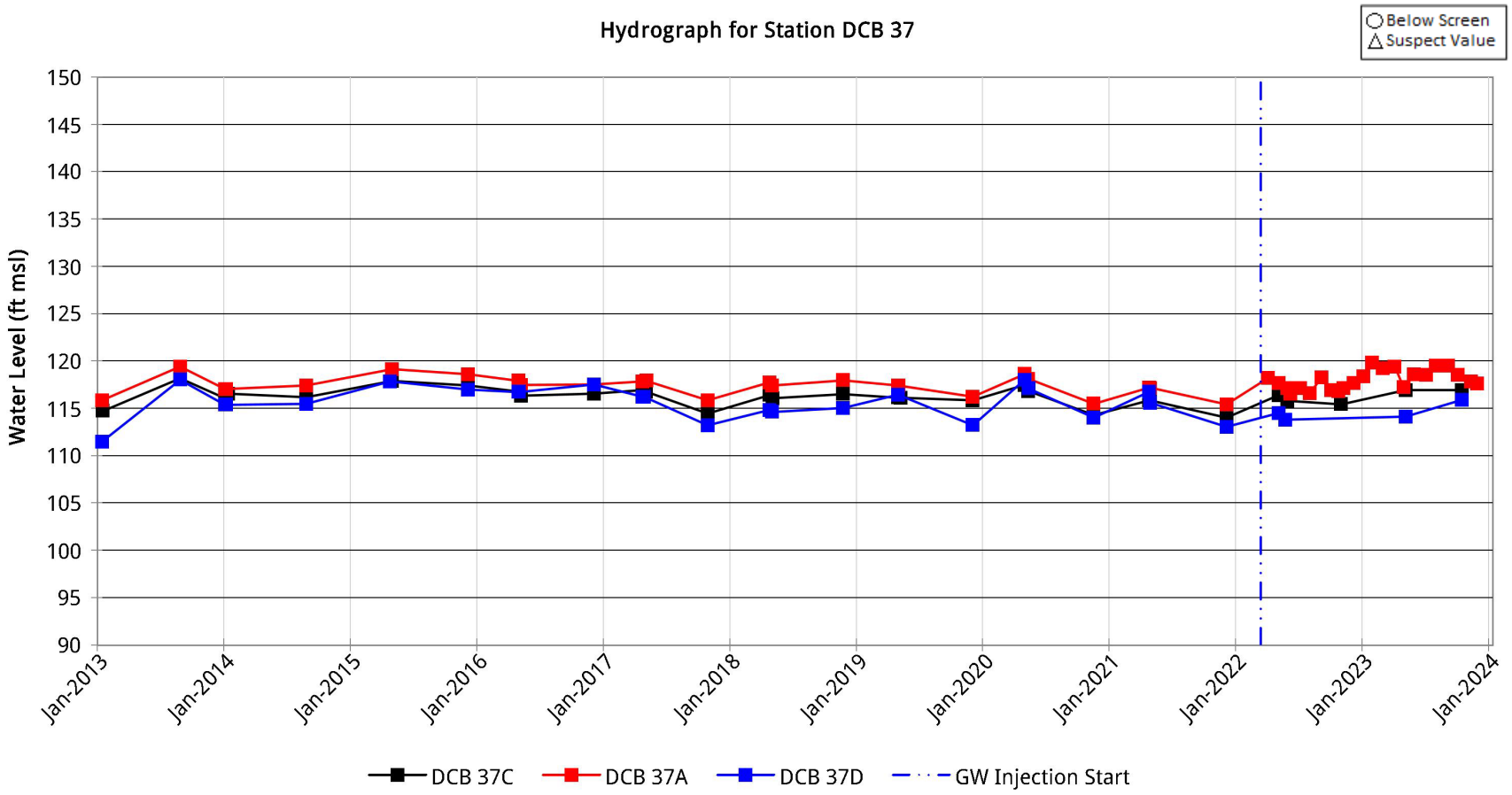

Hydrograph for Station DCB026
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB026D
DCB 26AR
GW Injection Start

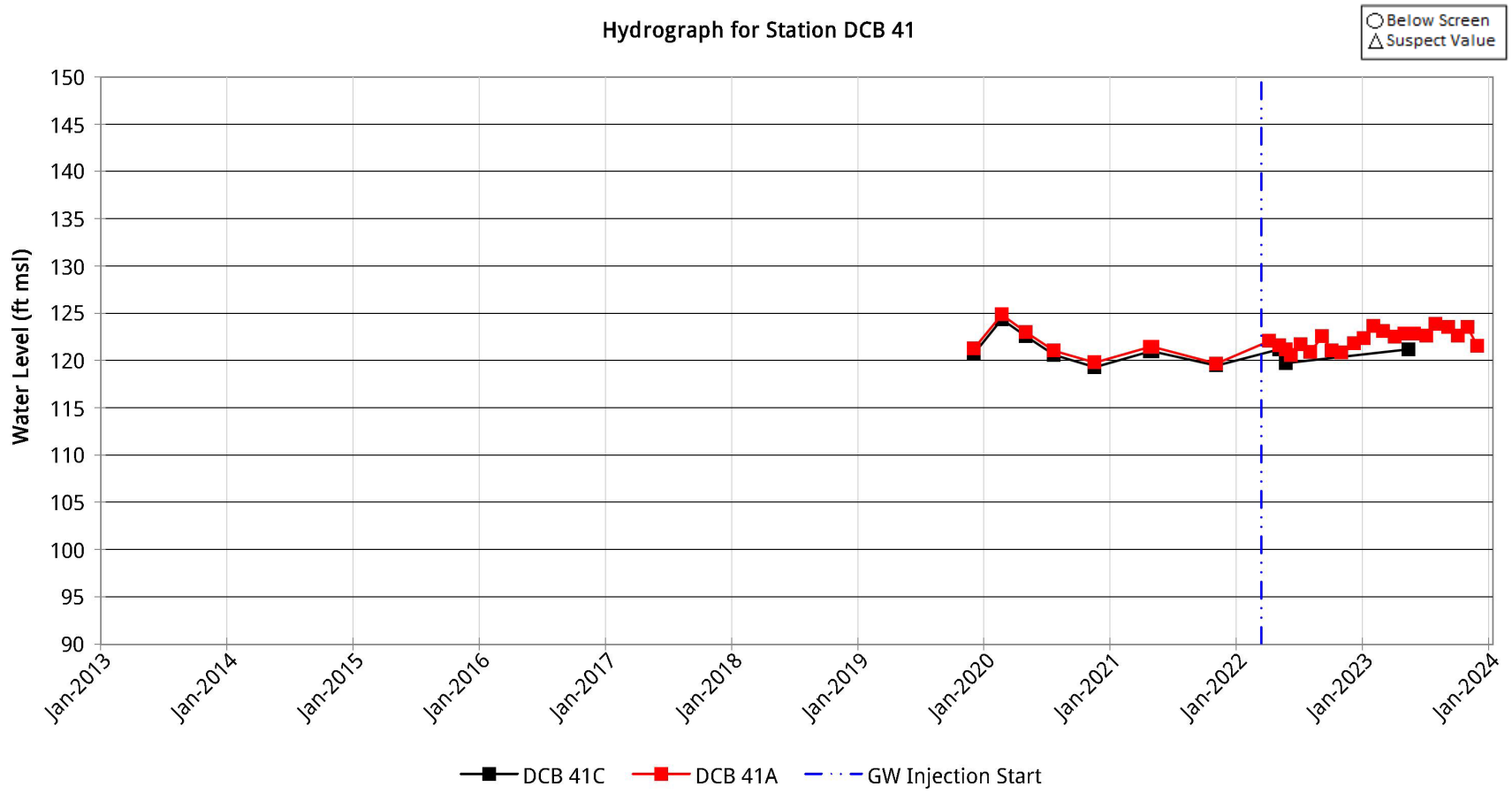

Hydrograph for Station DCB 33
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 33B
DCB 33C
DCB 33D
GW Injection Start

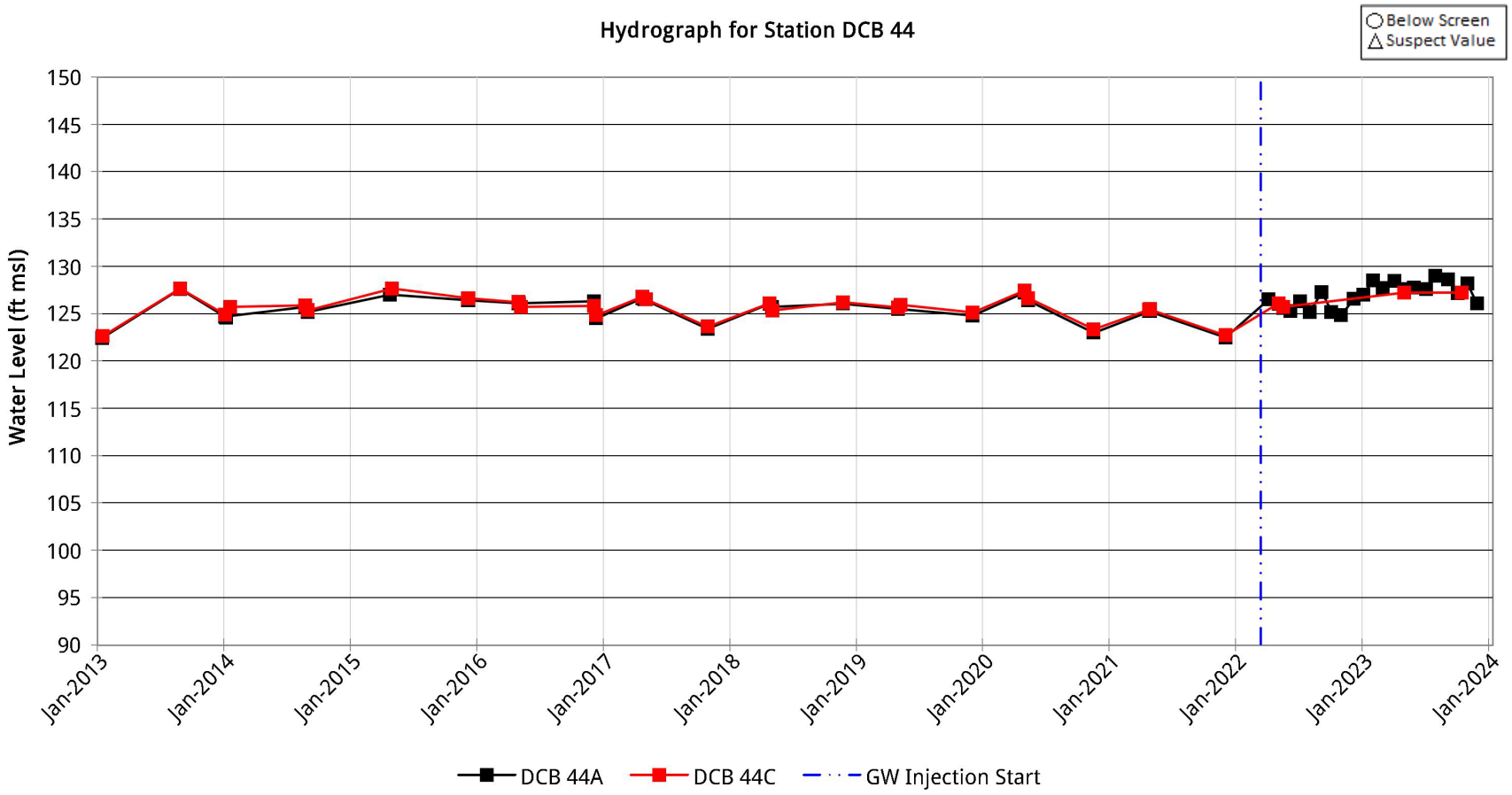

Hydrograph for Station DCB 34
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 34A
DCB 34C
GW Injection Start

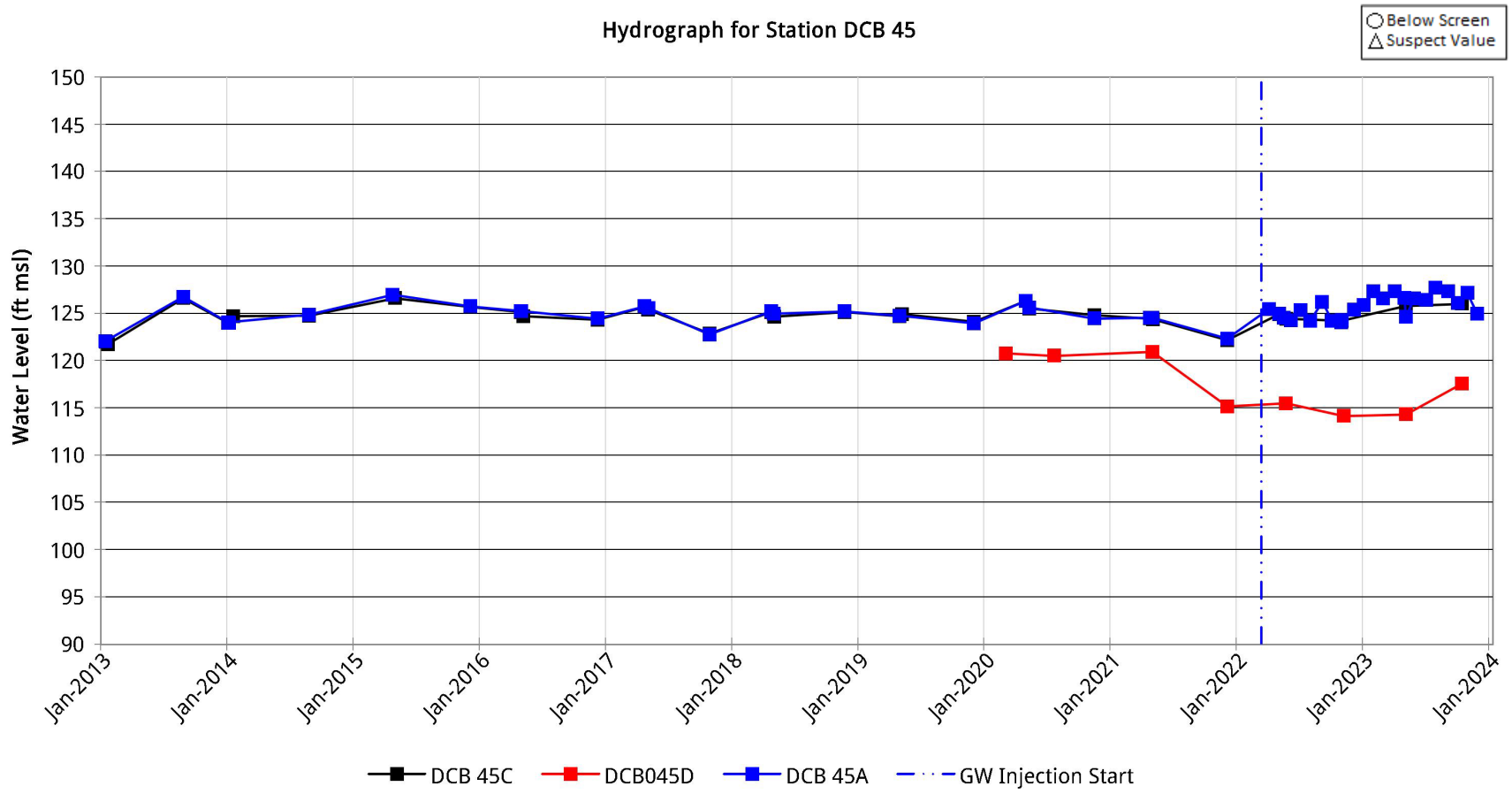

Hydrograph for Station DCB035
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB035D
DCB 35A
DCB 35C
GW Injection Start

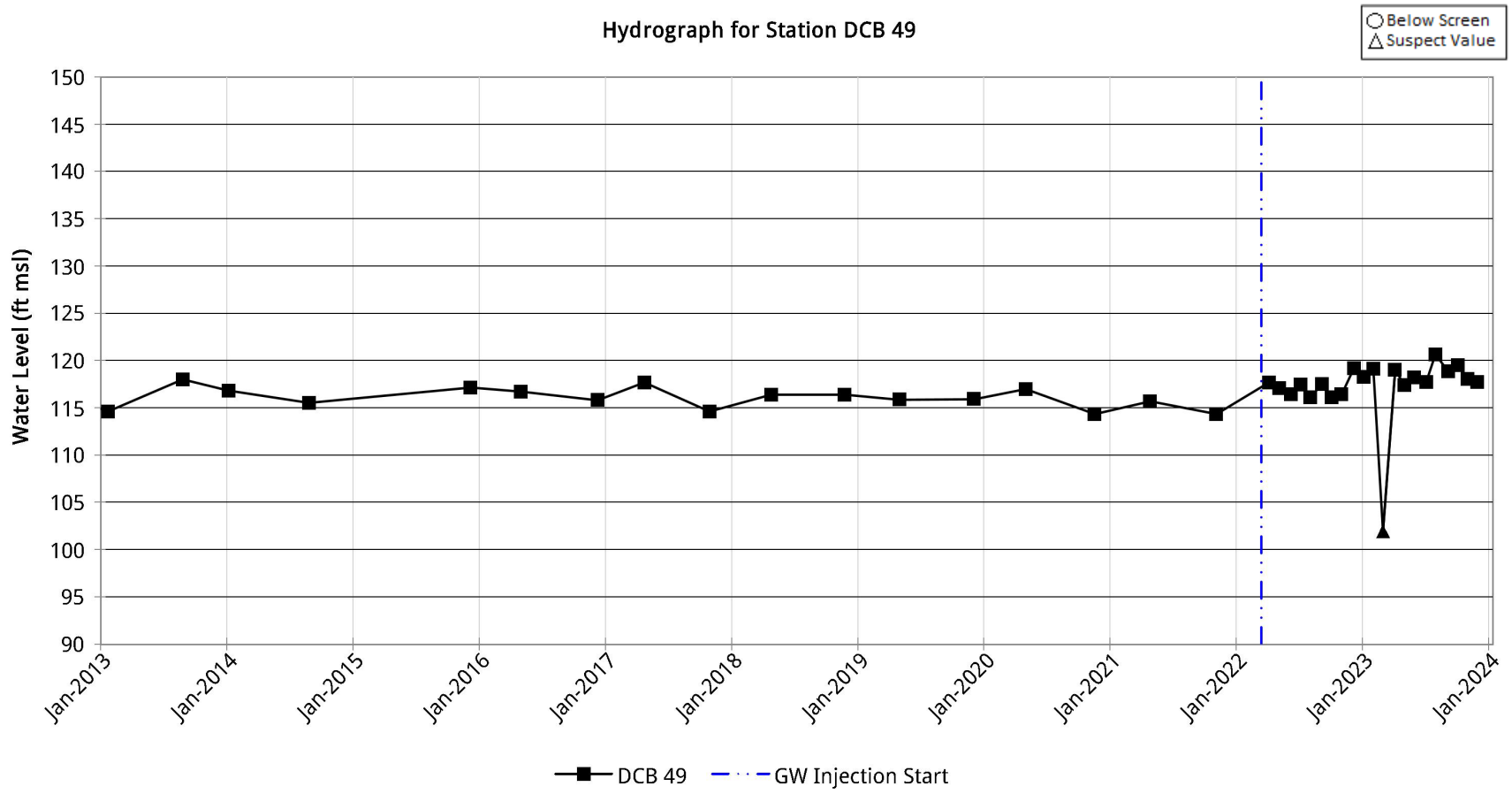

Hydrograph for Station DCB 36
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 36A
DCB 36C
GW Injection Start

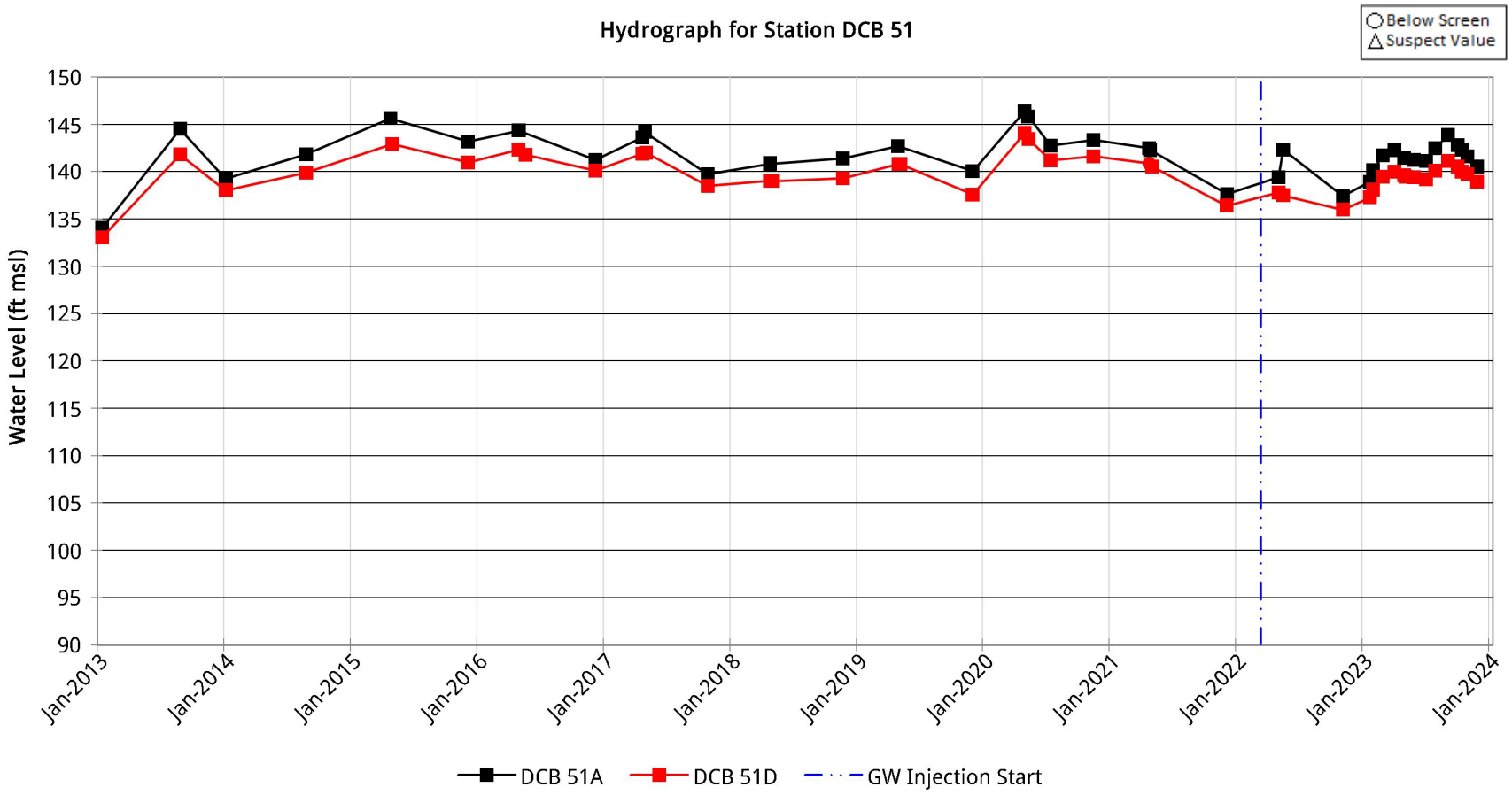

Hydrograph for Station DCB 37
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 37C
DCB 37A
DCB 37D
GW Injection Start

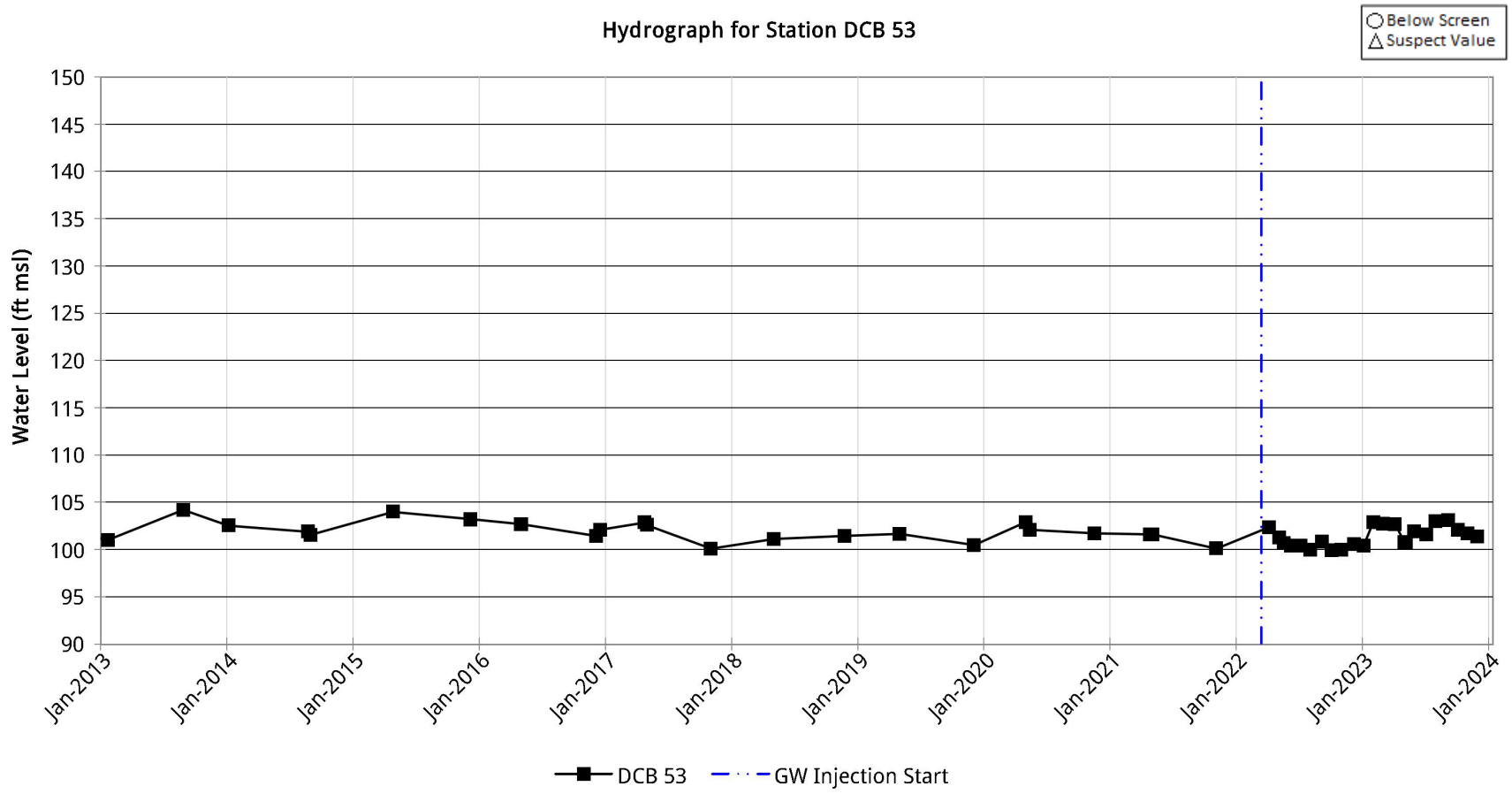

Hydrograph for Station DCB 41
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 41C
DCB 41A
GW Injection Start

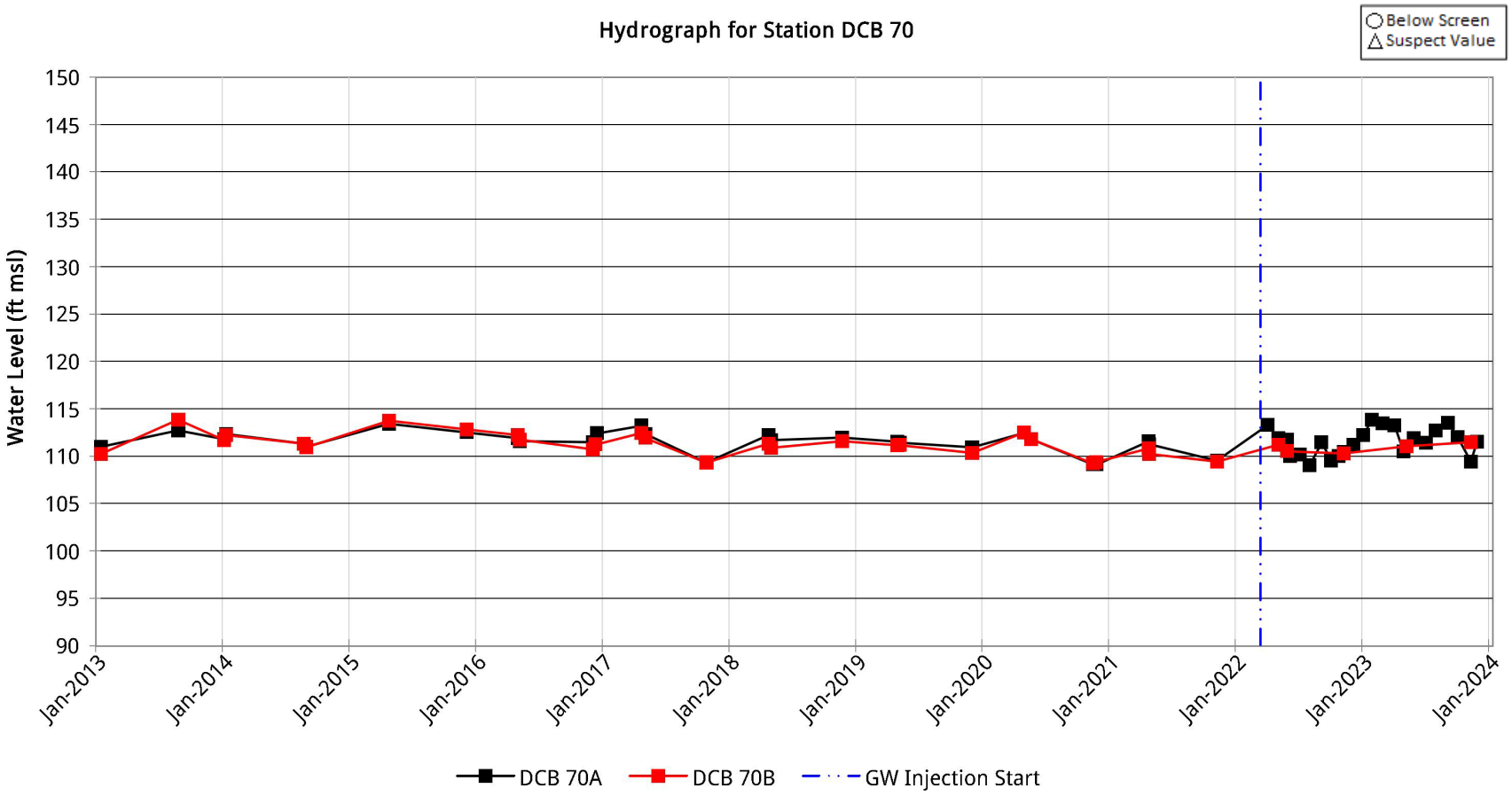

Hydrograph for Station DCB 44
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 44A
DCB 44C
GW Injection Start

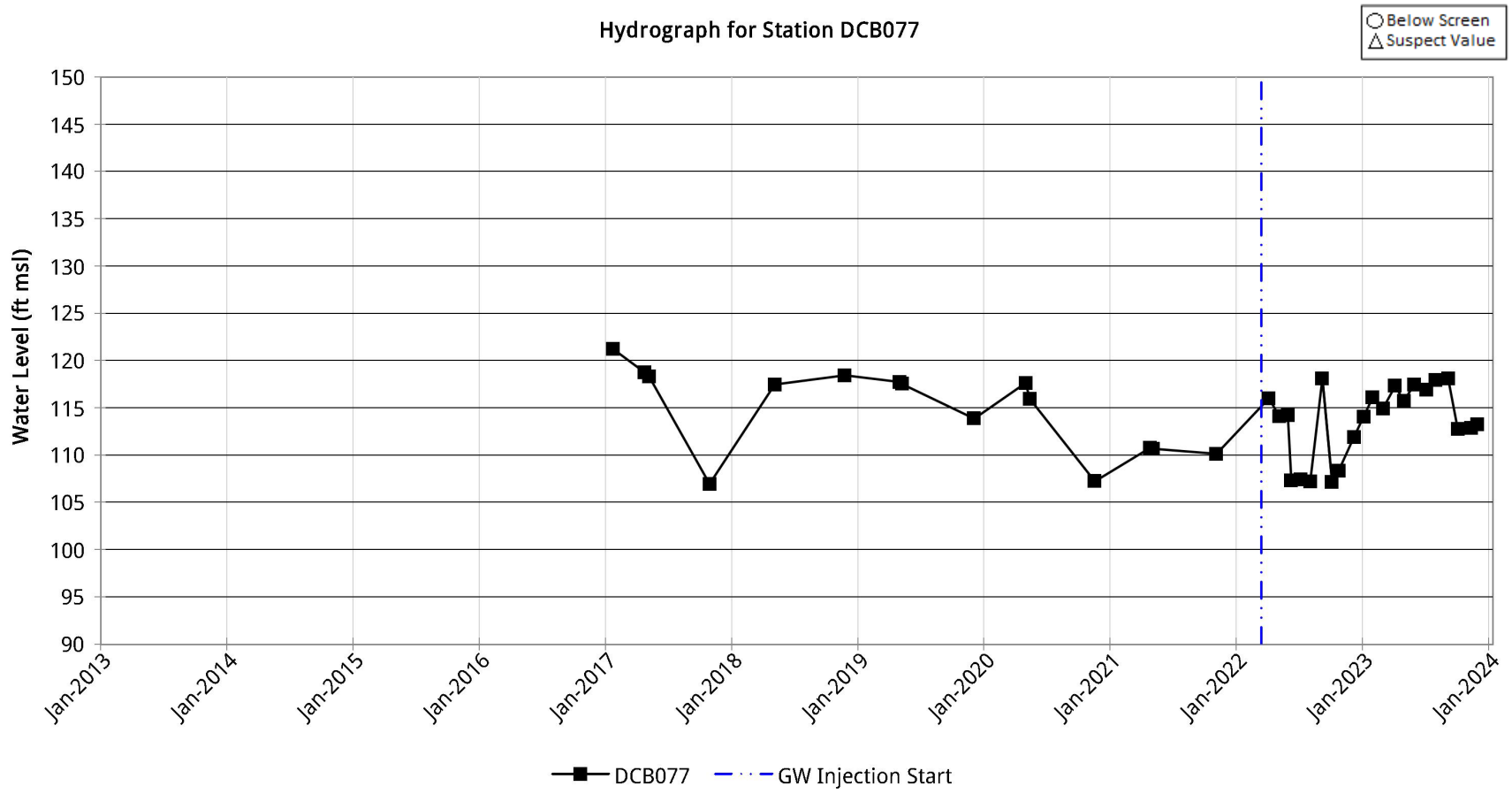

Hydrograph for Station DCB 45
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 45C
DCB045D
DCB 45A
GW Injection Start

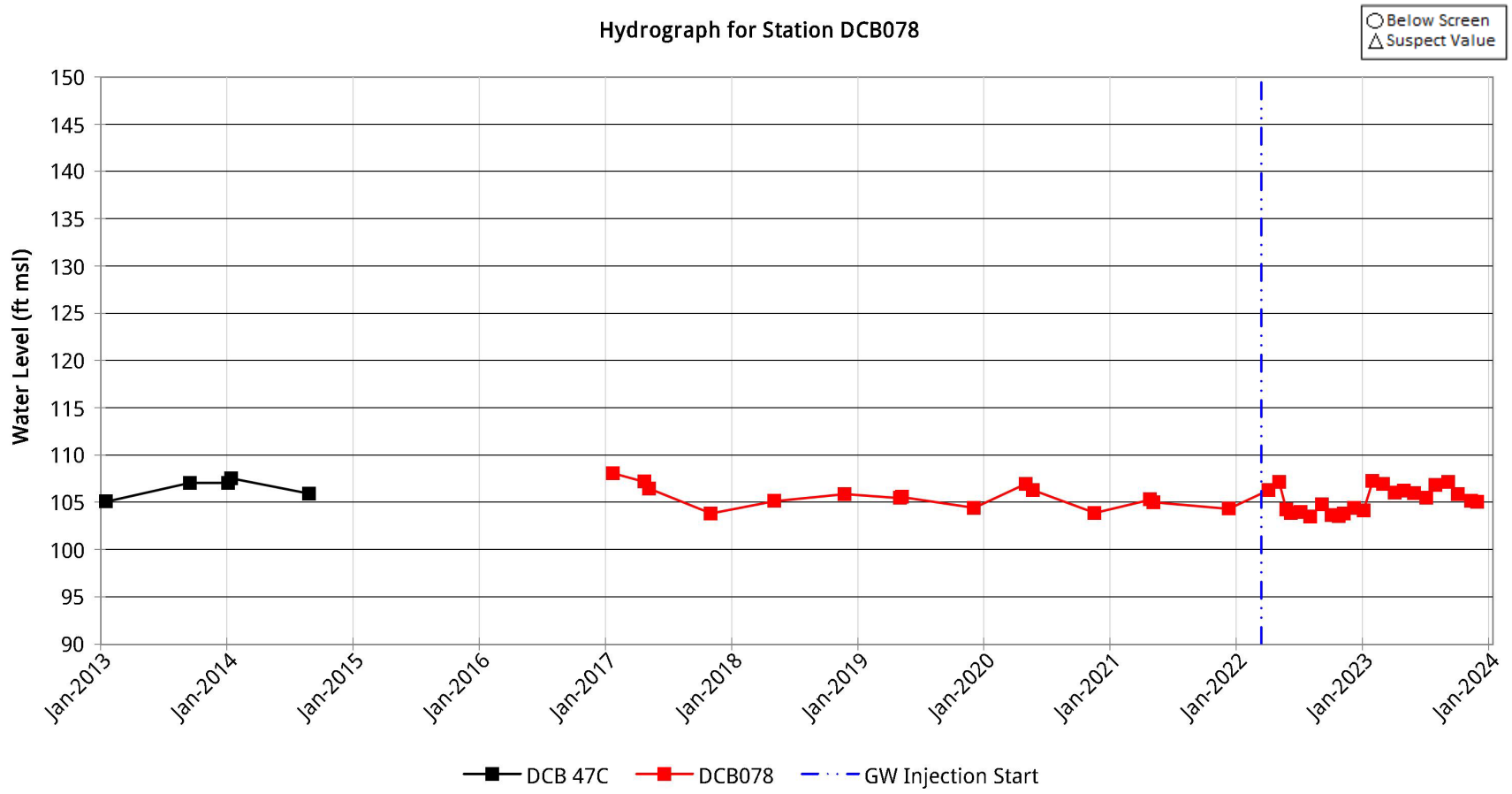

Hydrograph for Station DCB 49
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 49
GW Injection Start

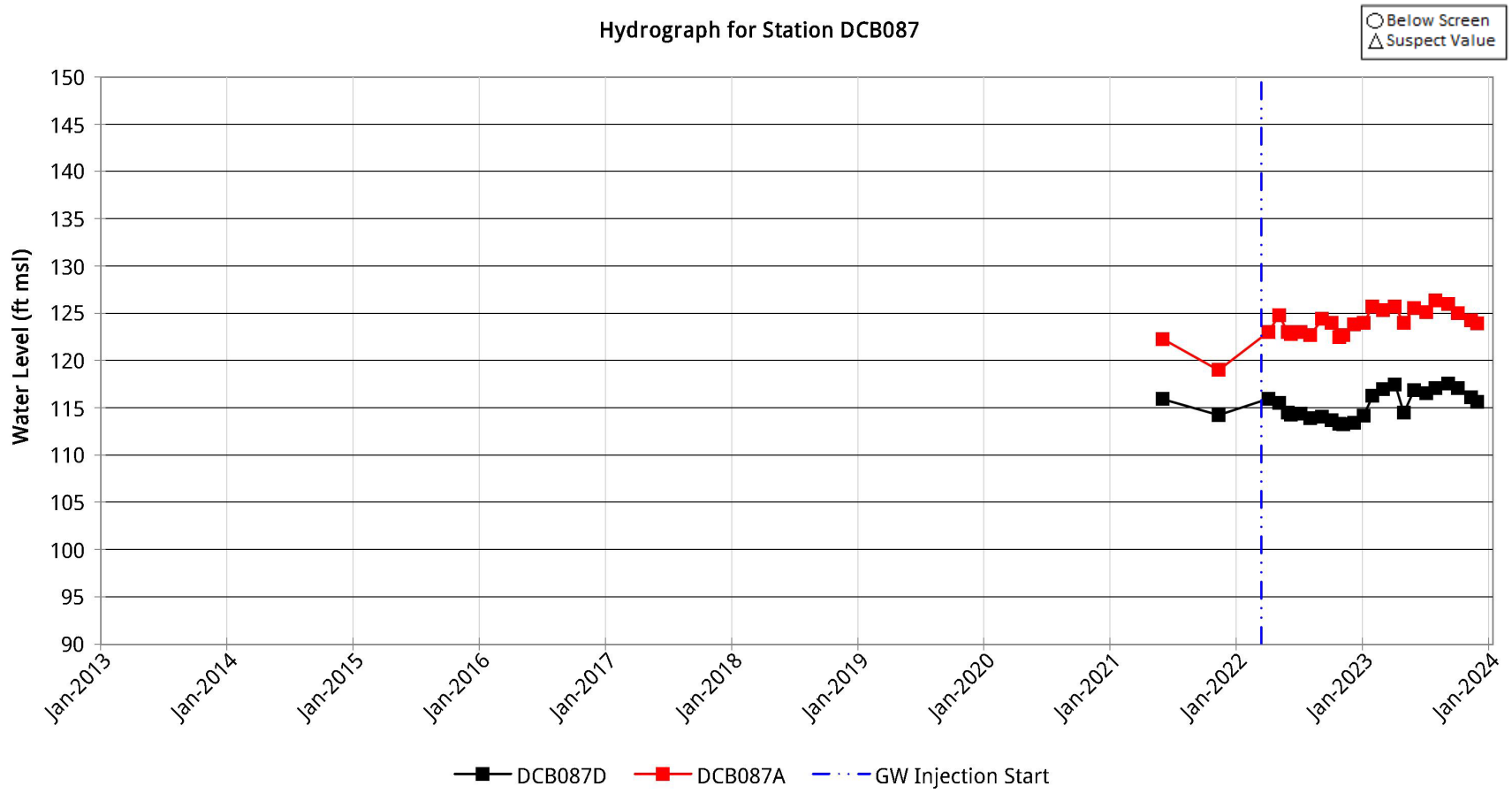

Hydrograph for Station DCB 51
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 51A
DCB 51D
GW Injection Start


Hydrograph for Station DCB 53
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 53
GW Injection Start


Hydrograph for Station DCB 70
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 70A
DCB 70B
GW Injection Start


Hydrograph for Station DCB077
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB077
GW Injection Start


Hydrograph for Station DCB078
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 47C
DCB078
GW Injection Start


Hydrograph for Station DCB087
Below Screen
Suspect Value
Water Level (ft msl)
150
145
140
135
130
125
120
115
110
105
100
95
90
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB087D
DCB087A
GW Injection Start

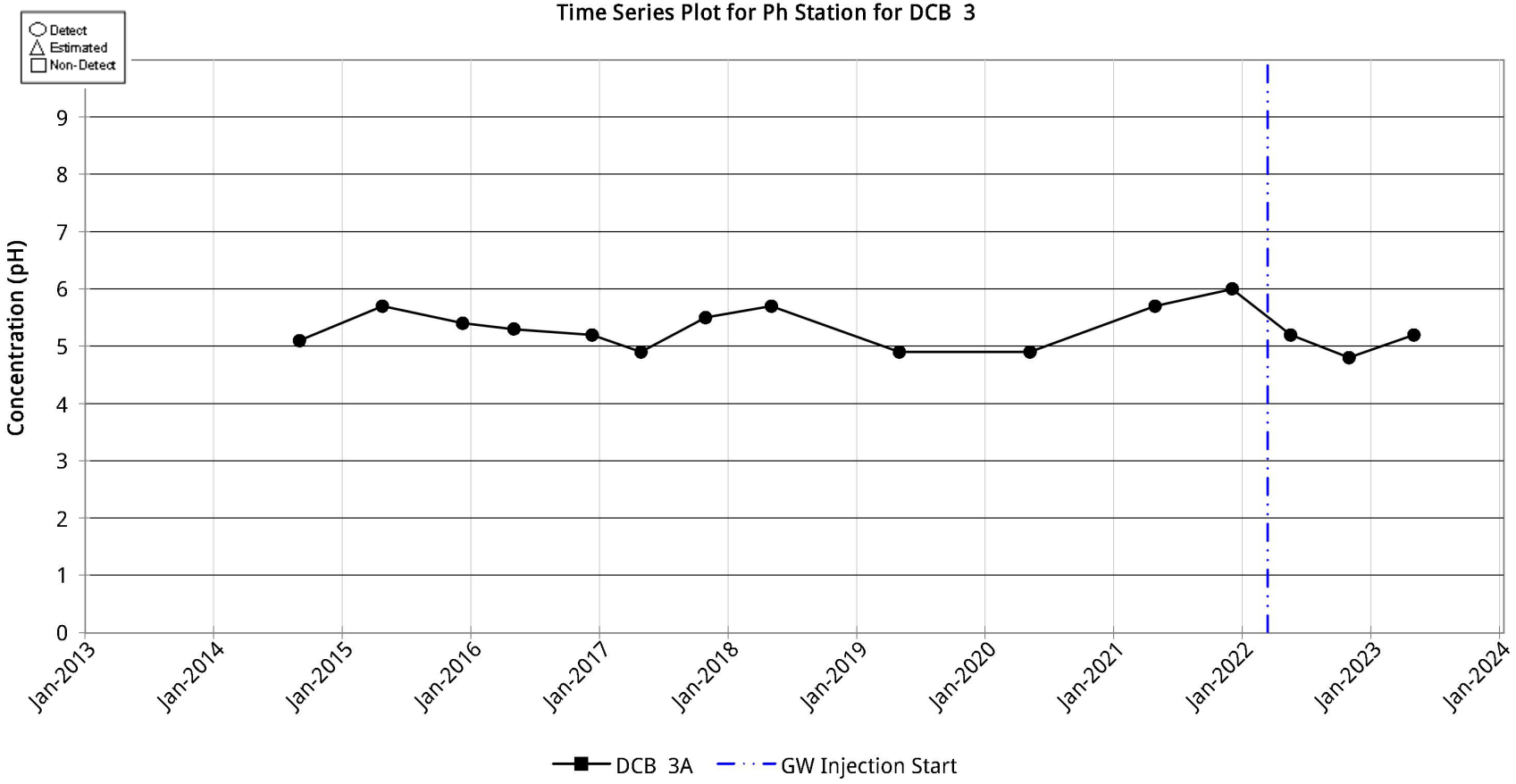
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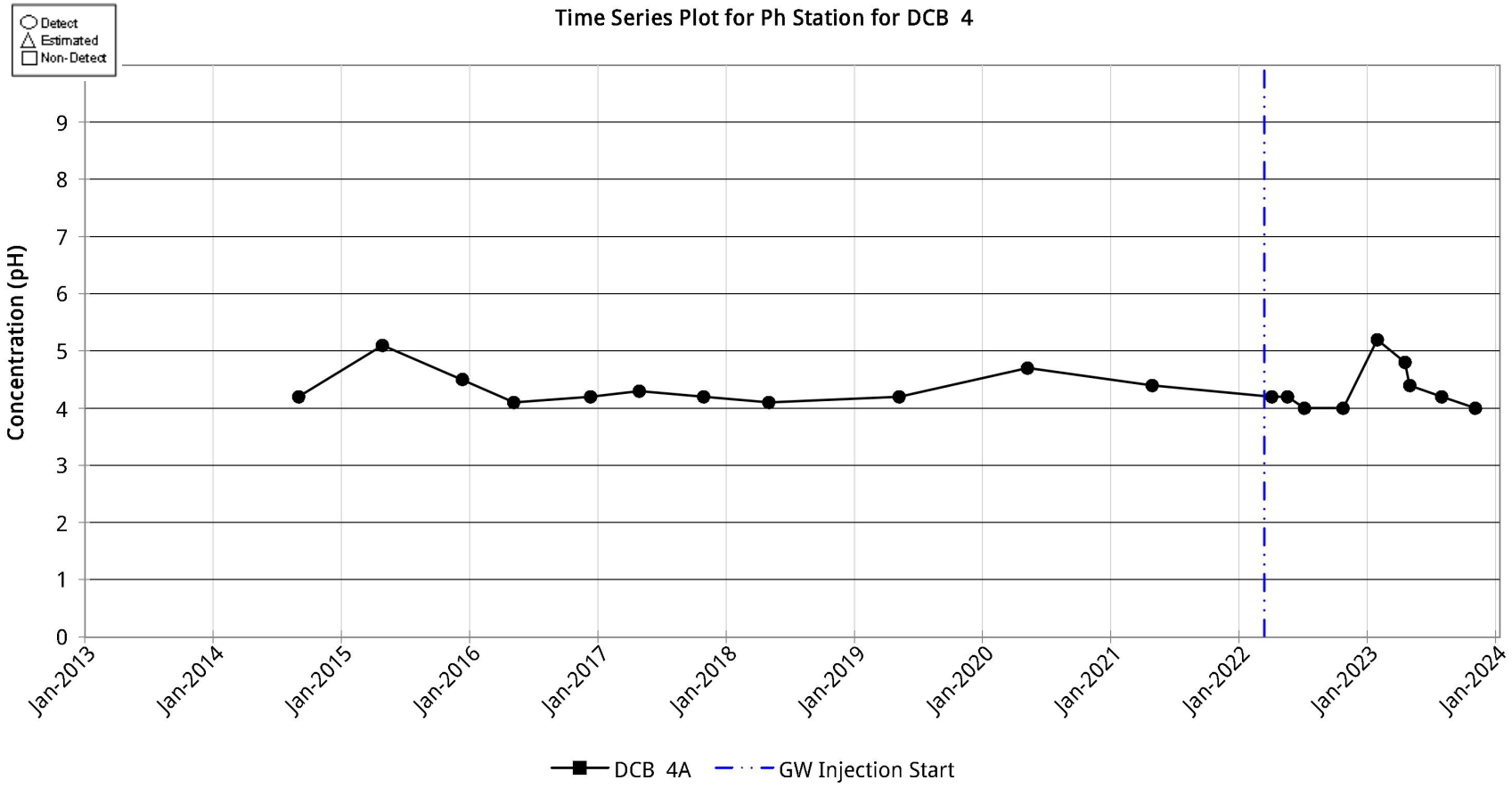
Appendix C

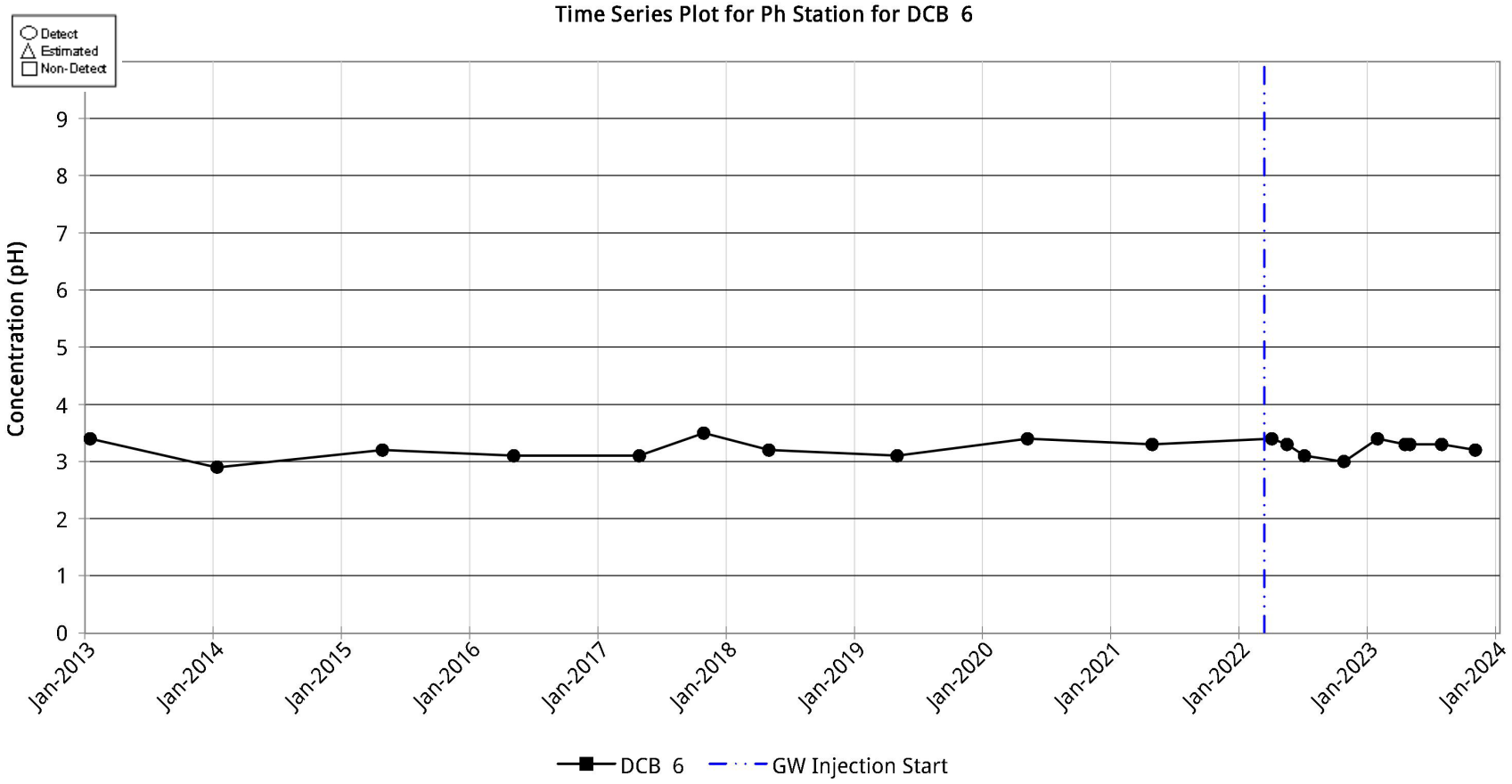
Times-Series Plots

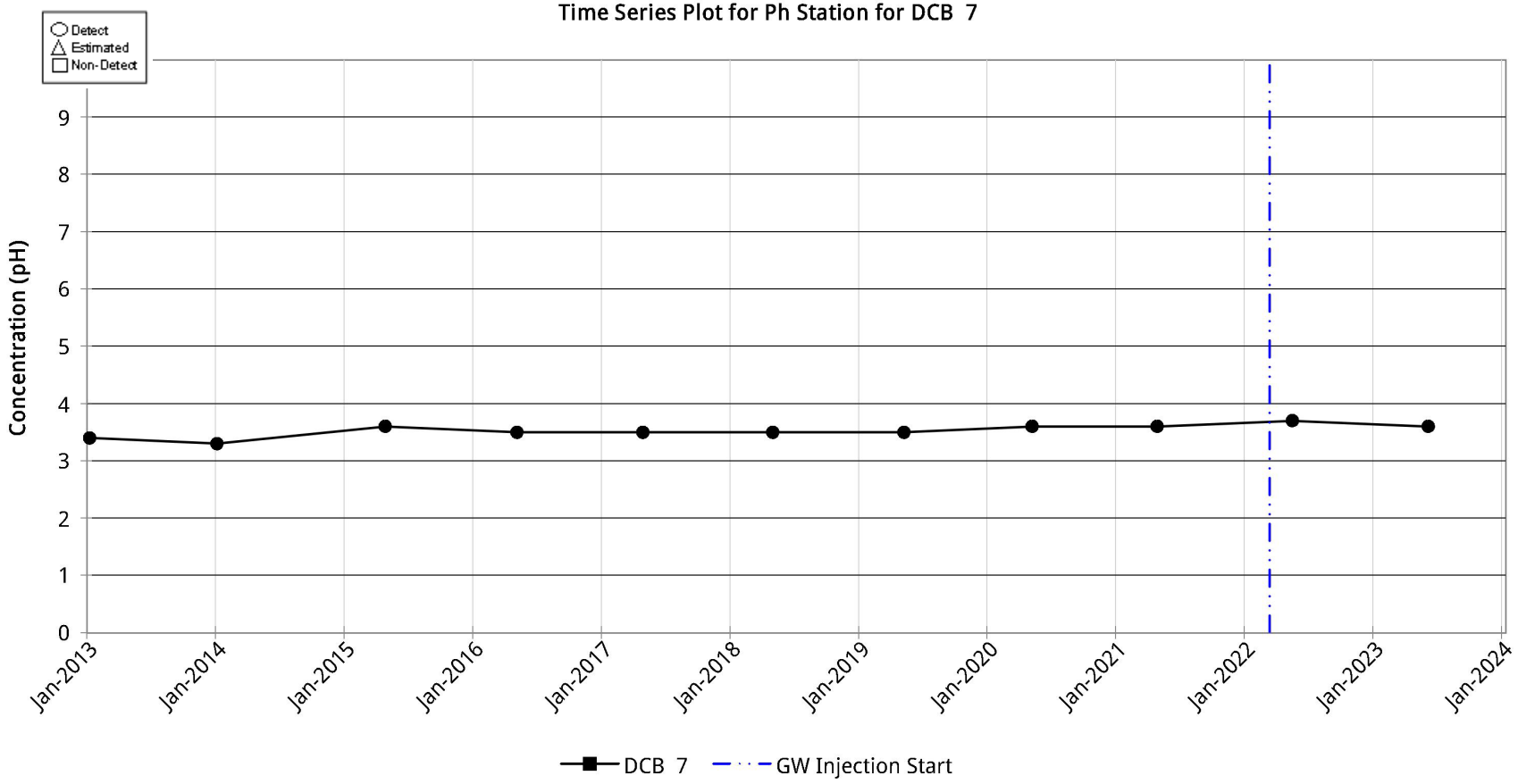
of pH, Aluminum, Beryllium, Iron, and Sulfate

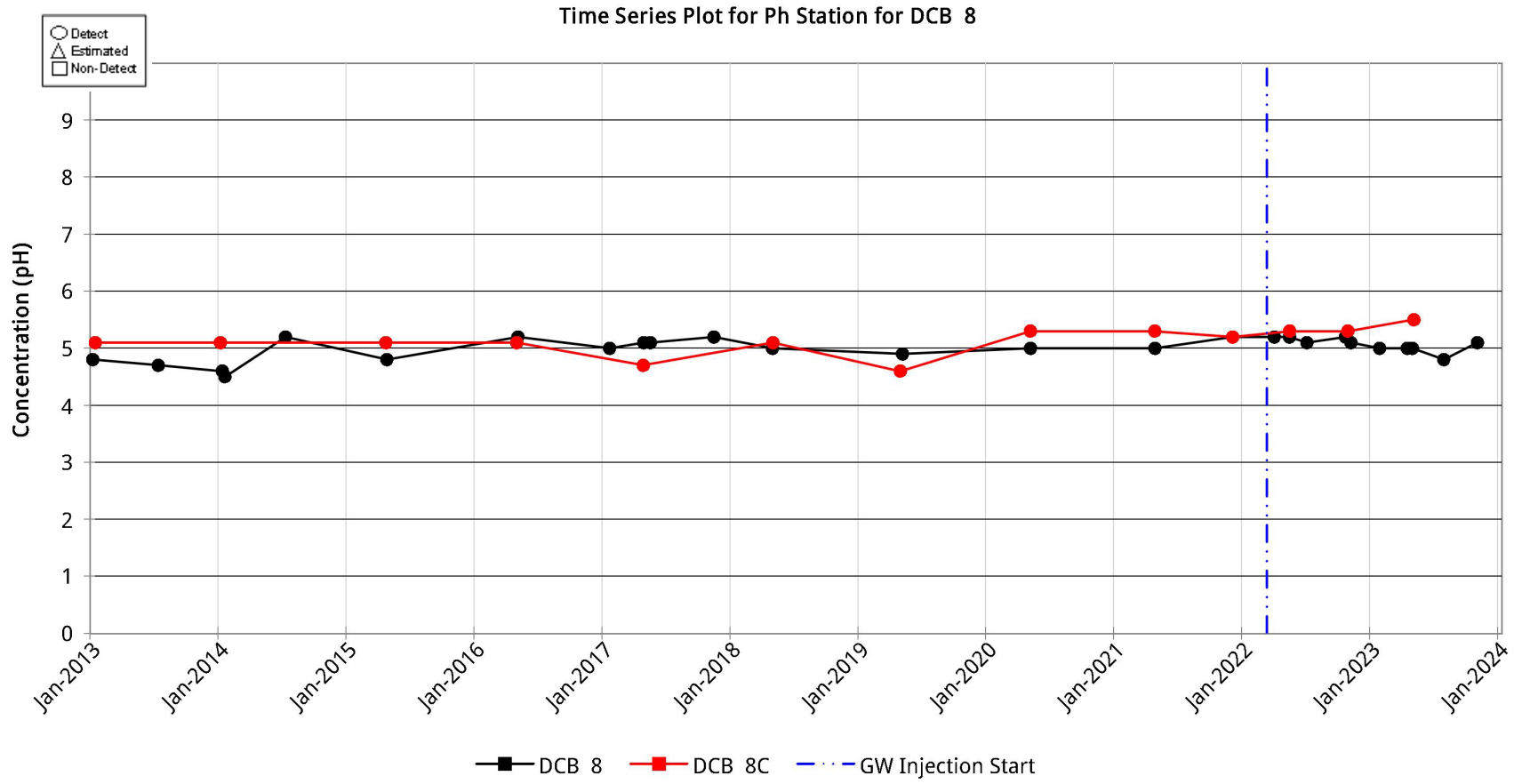
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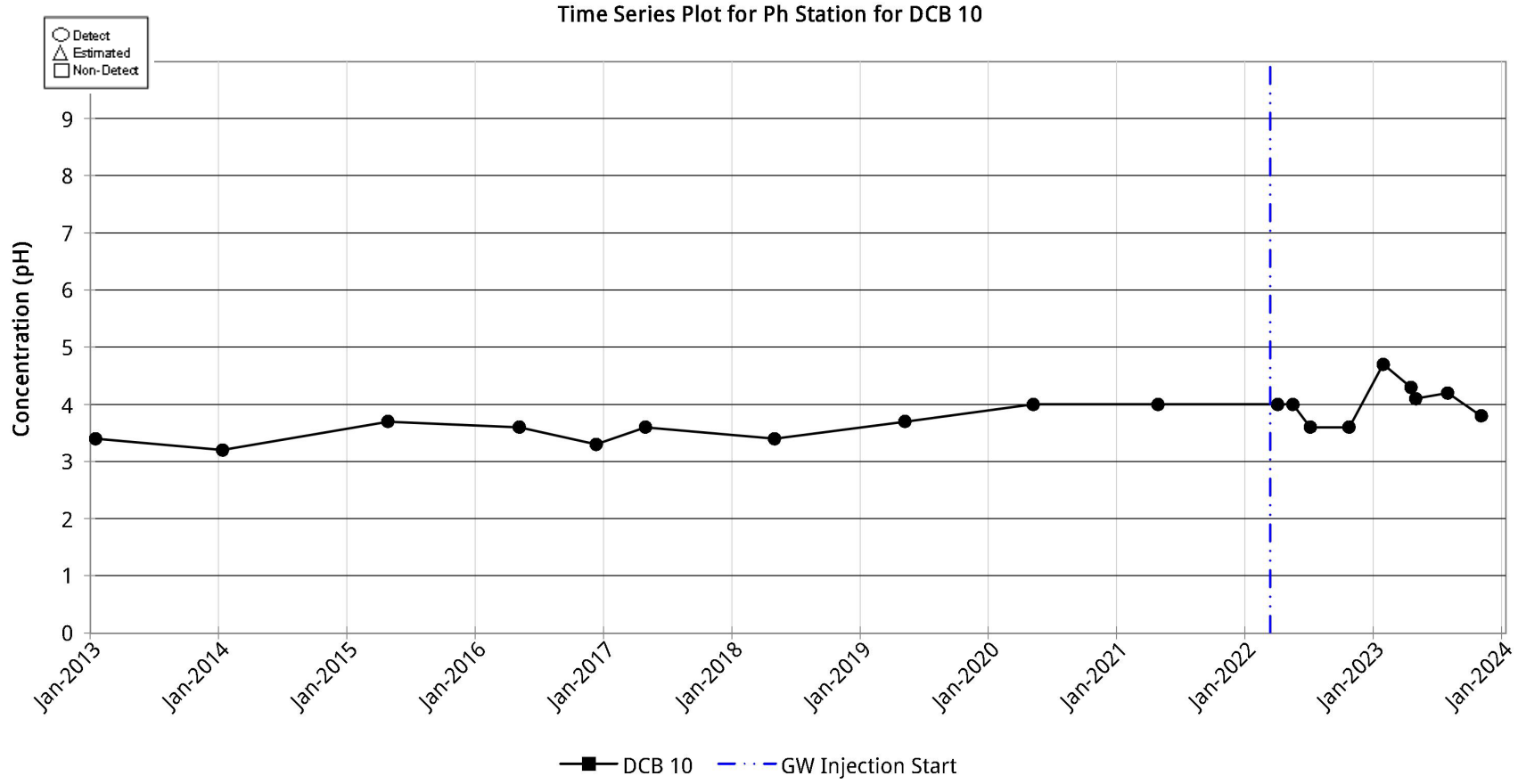

Time Series Plot for Ph Station for DCB 3
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 3A
GW Injection Start

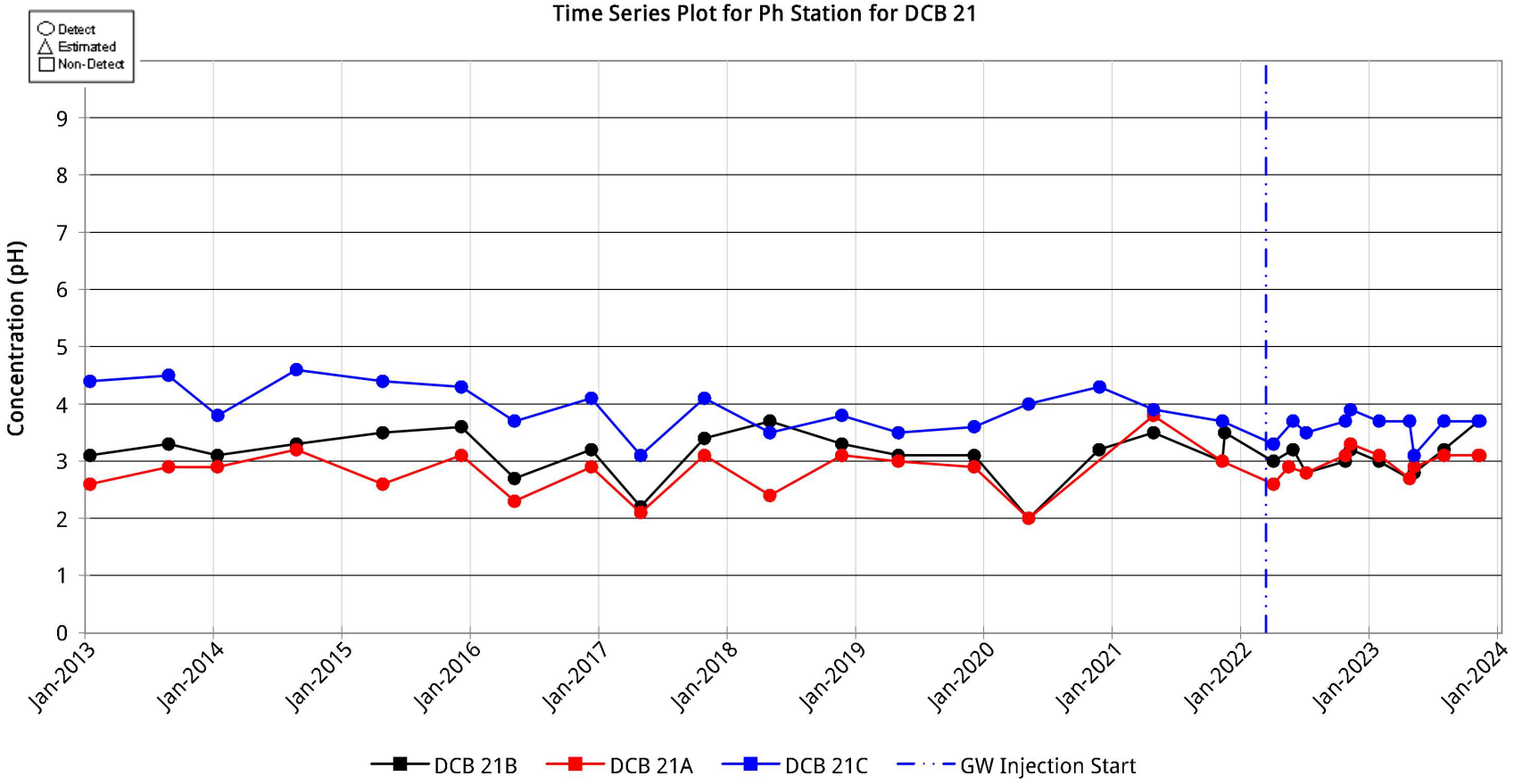

Time Series Plot for Ph Station for DCB 4
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 4A
GW Injection Start

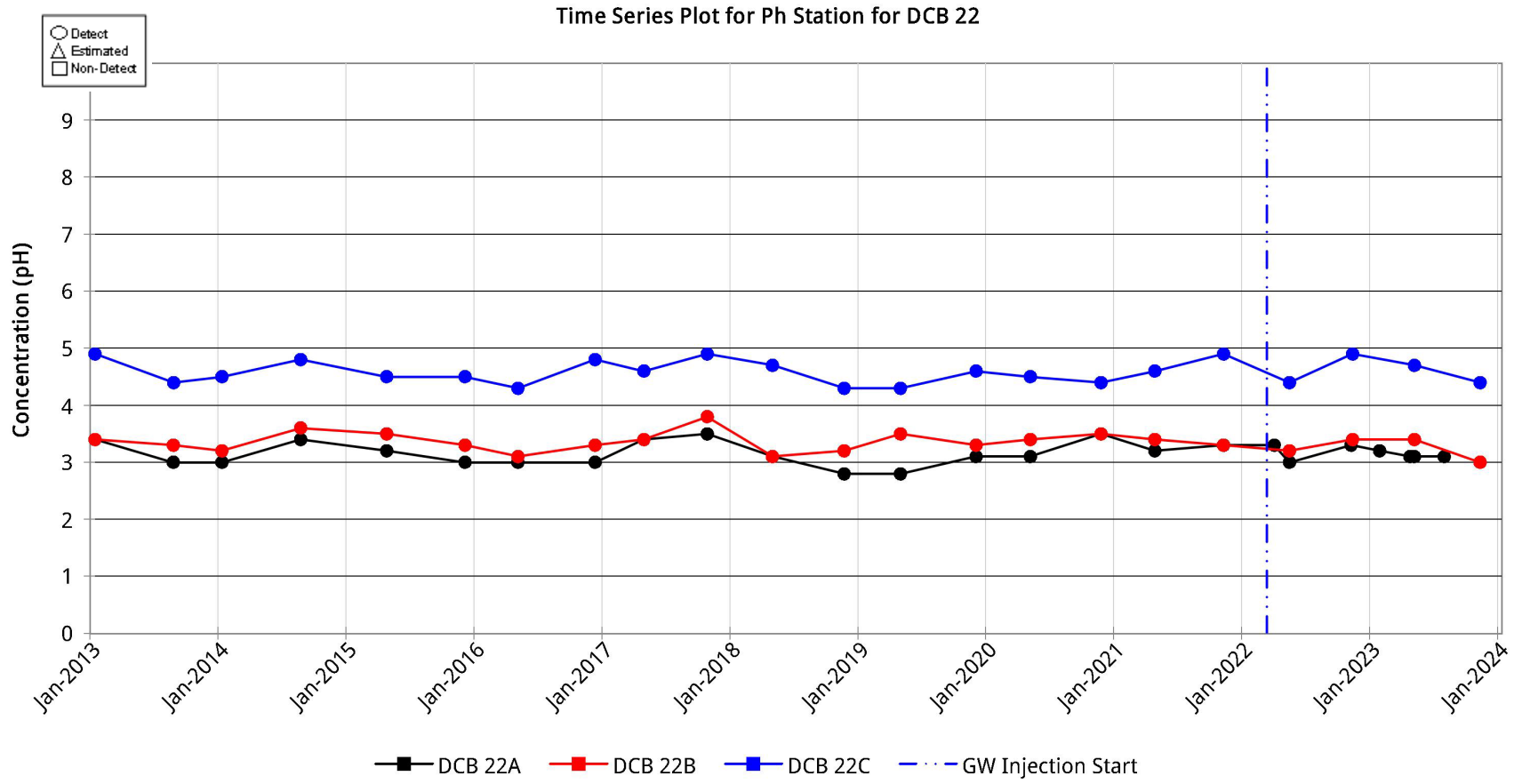

Time Series Plot for Ph Station for DCB 6
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 6
GW Injection Start

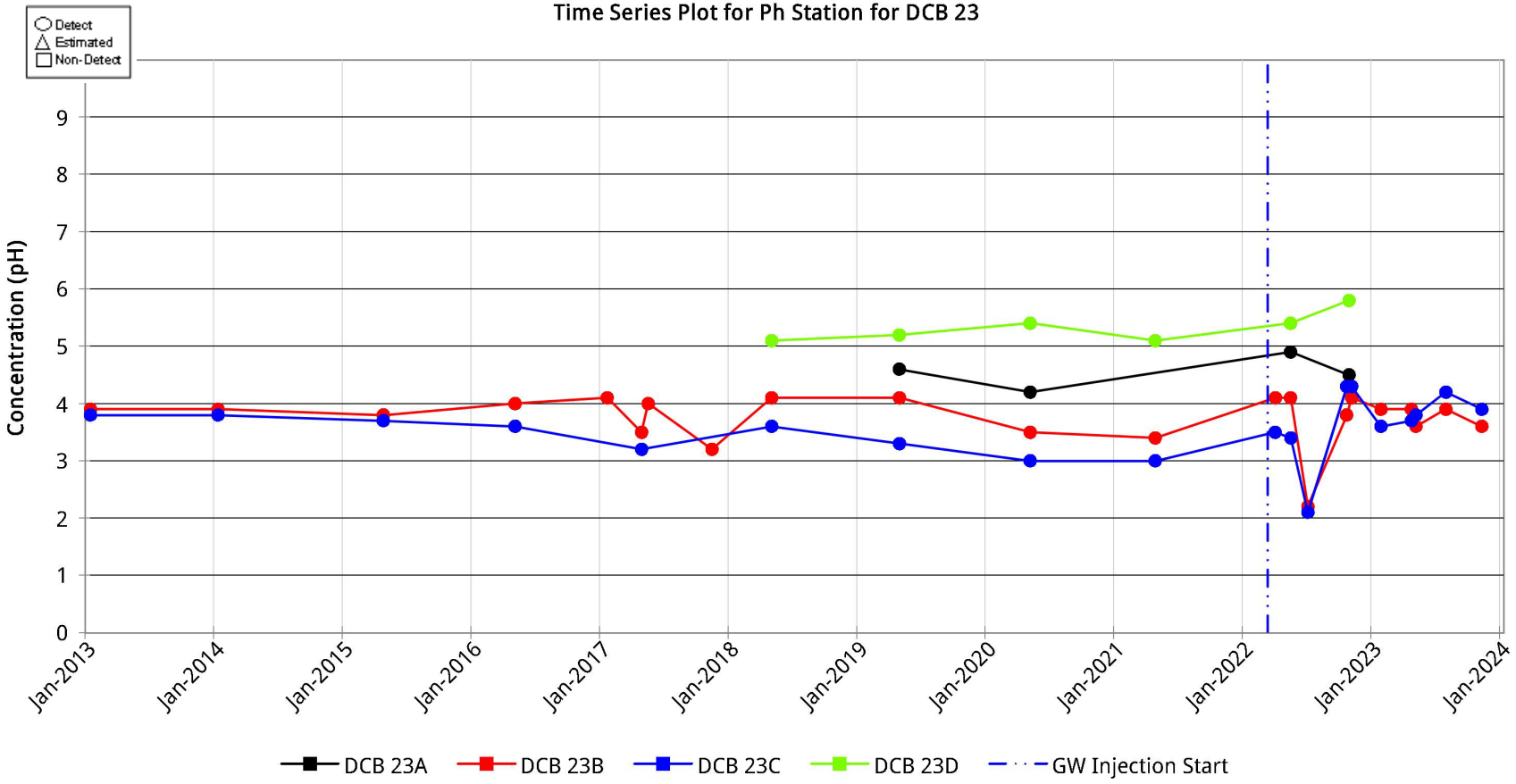

Time Series Plot for Ph Station for DCB 7
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 7
GW Injection Start

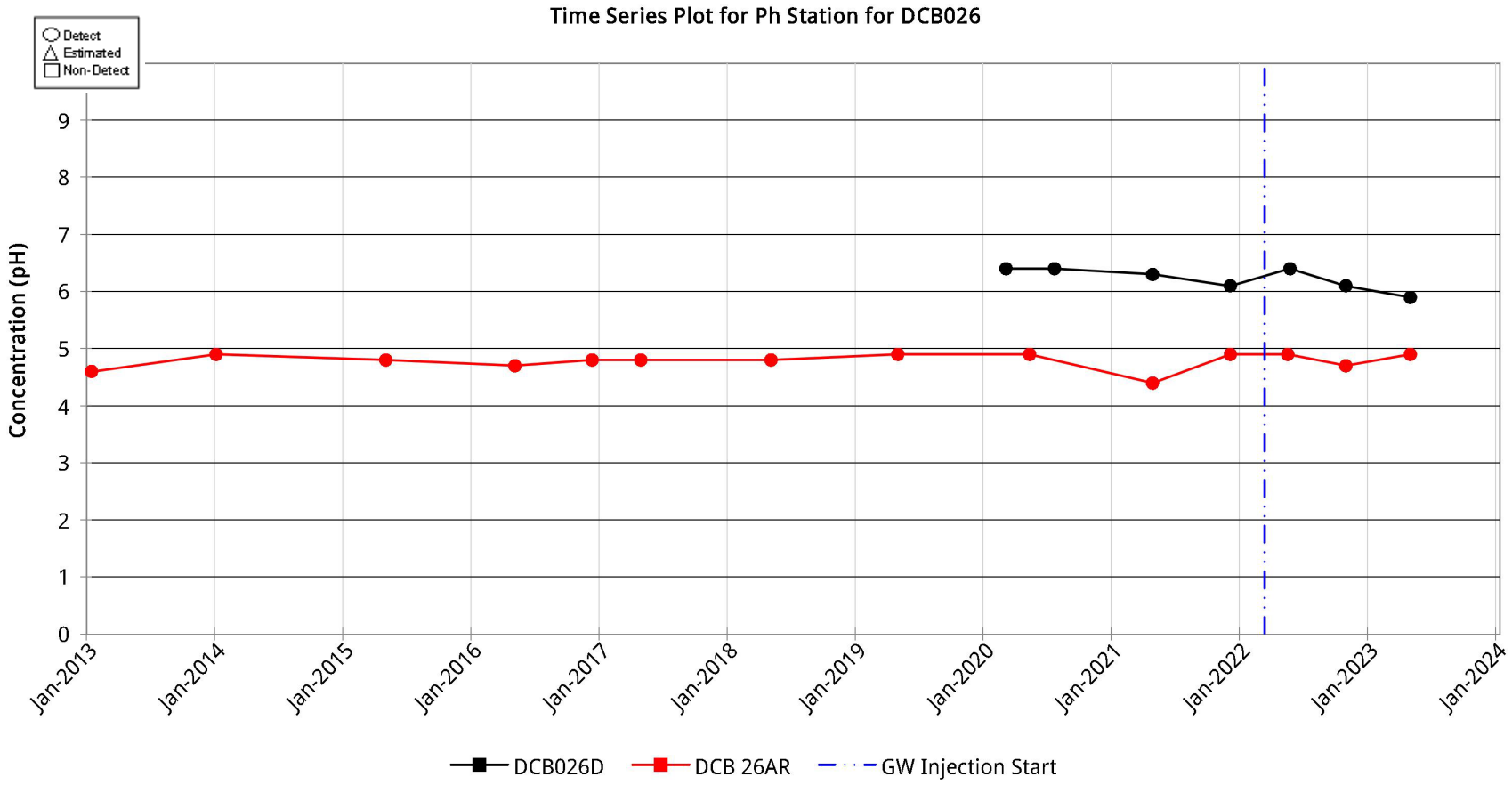

Time Series Plot for Ph Station for DCB 8
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 8
DCB 8C
GW Injection Start

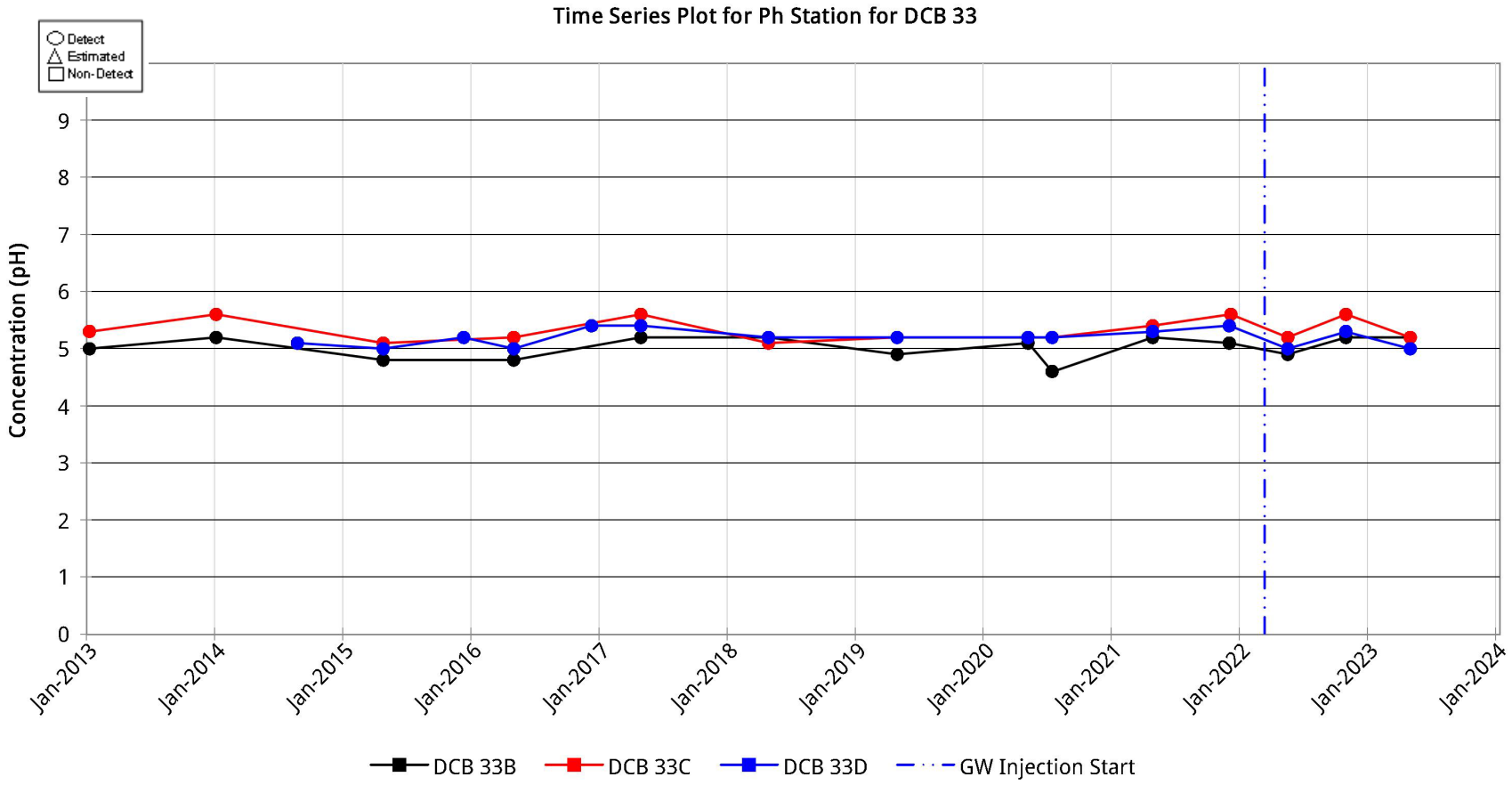

Time Series Plot for Ph Station for DCB 10
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 10
GW Injection Start

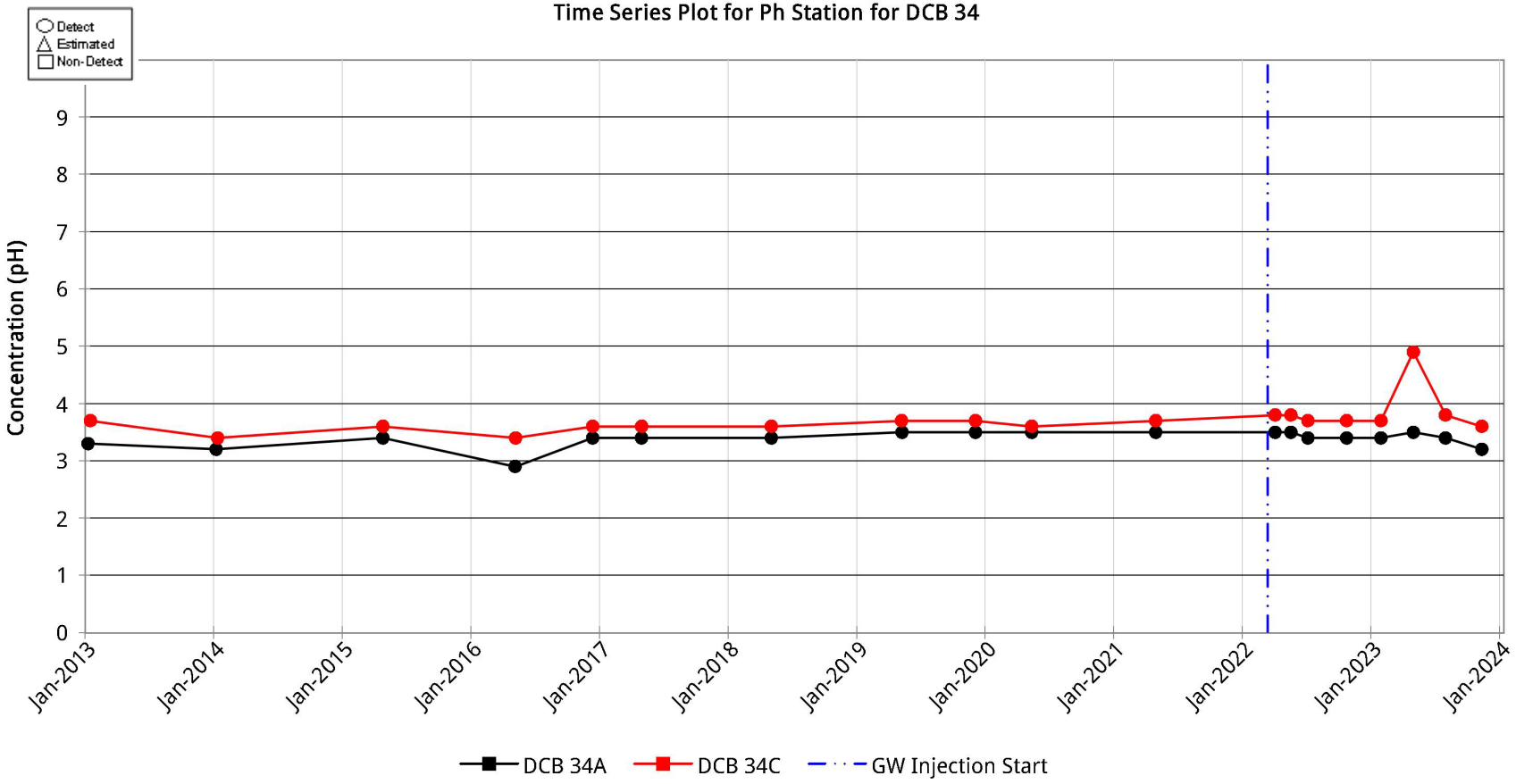

Time Series Plot for Ph Station for DCB 21
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 21B
DCB 21A
DCB 21C
GW Injection Start

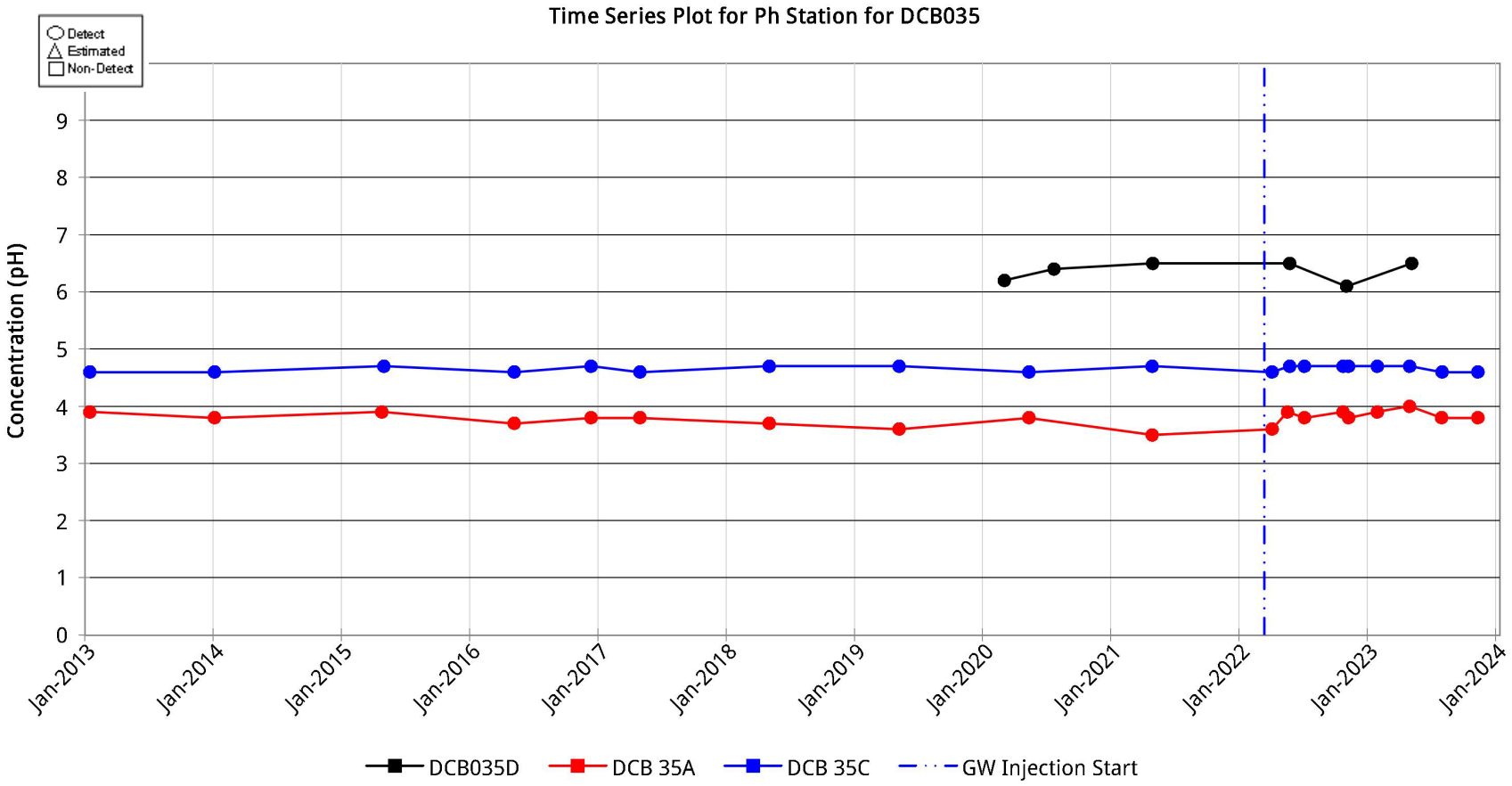

Time Series Plot for Ph Station for DCB 22
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 22A
DCB 22B
DCB 22C
GW Injection Start

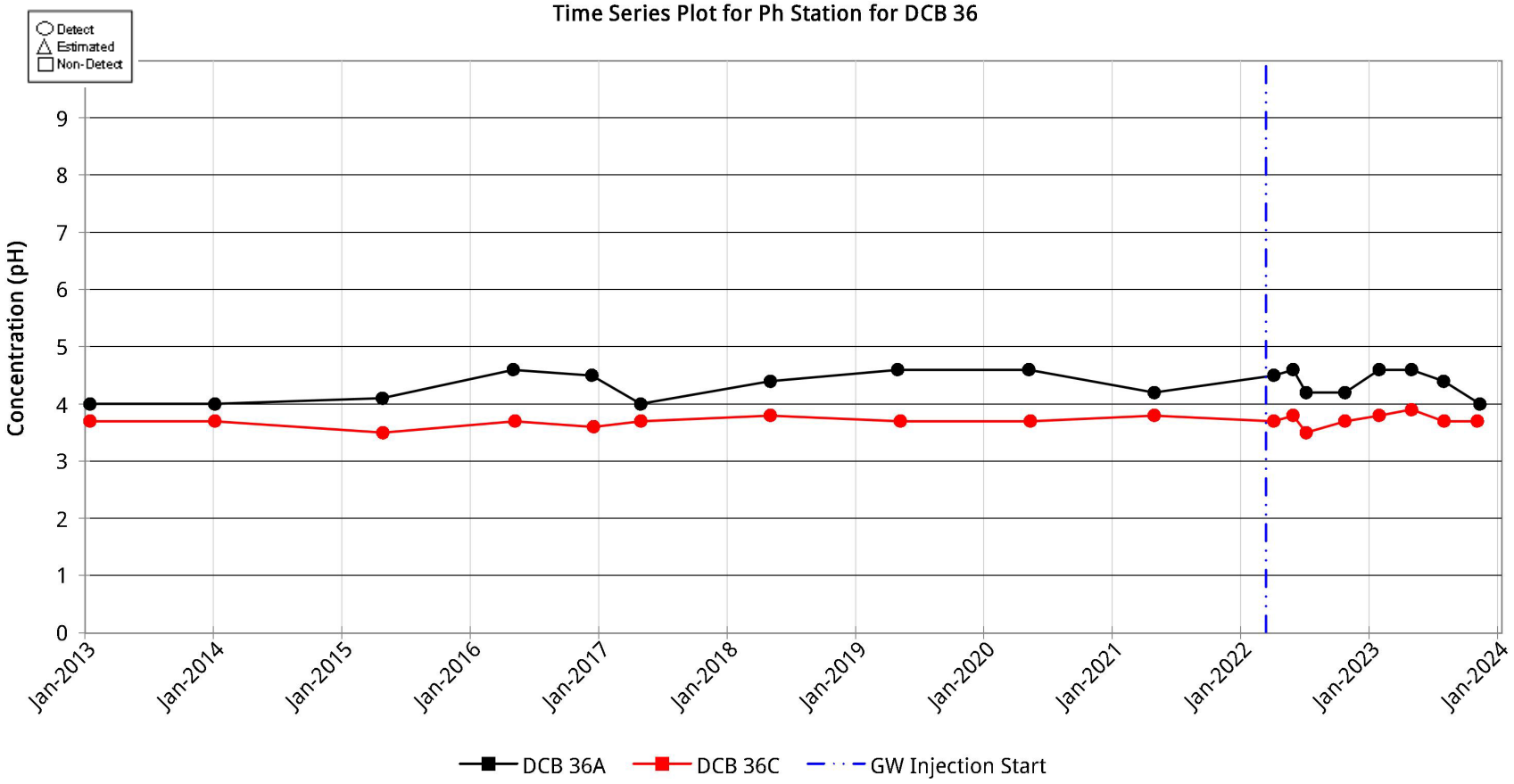

Time Series Plot for Ph Station for DCB 23
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 23A
DCB 23B
DCB 23C
DCB 23D
GW Injection Start

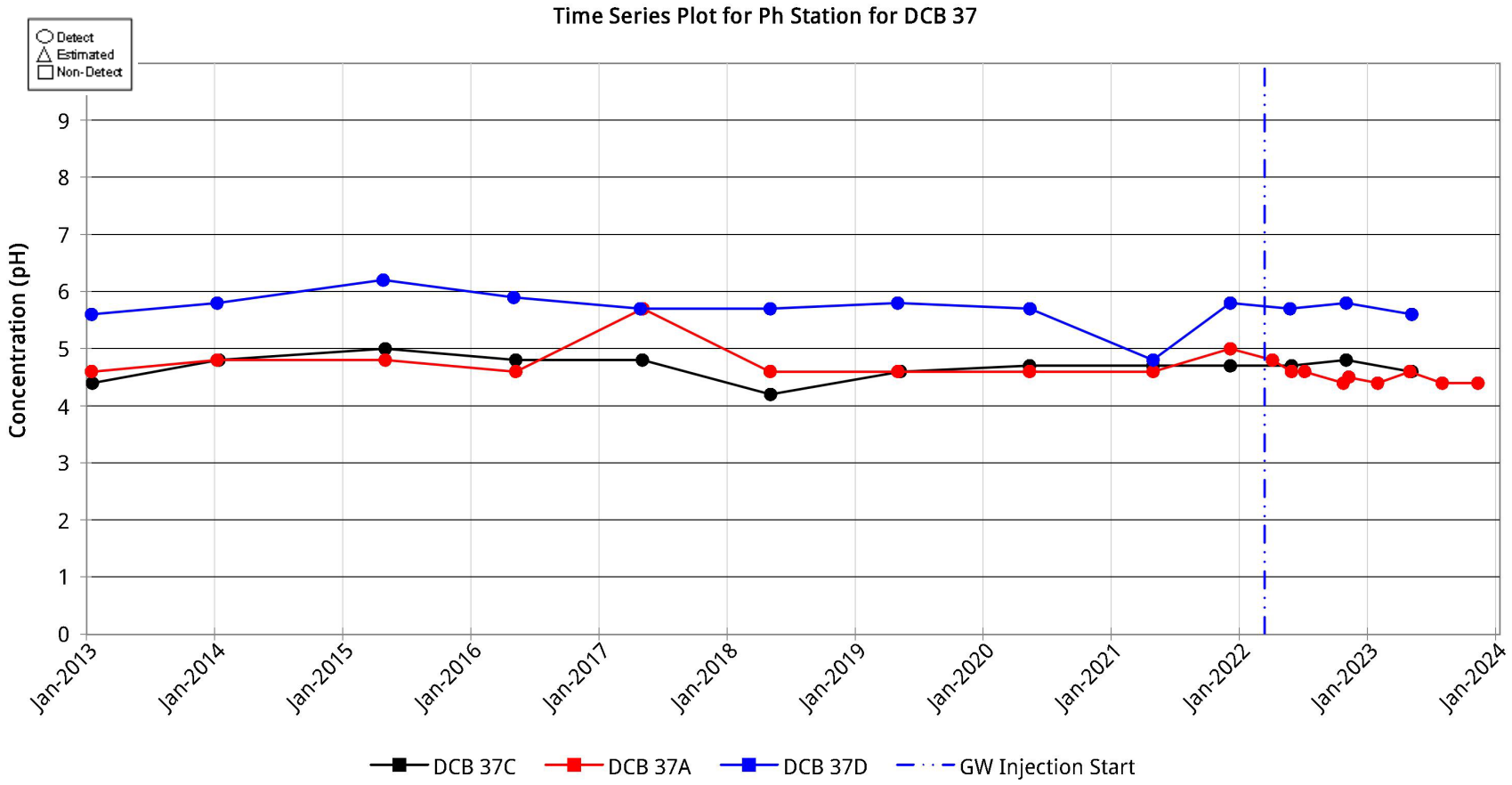

Time Series Plot for Ph Station for DCB026
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB026D
DCB 26AR
GW Injection Start

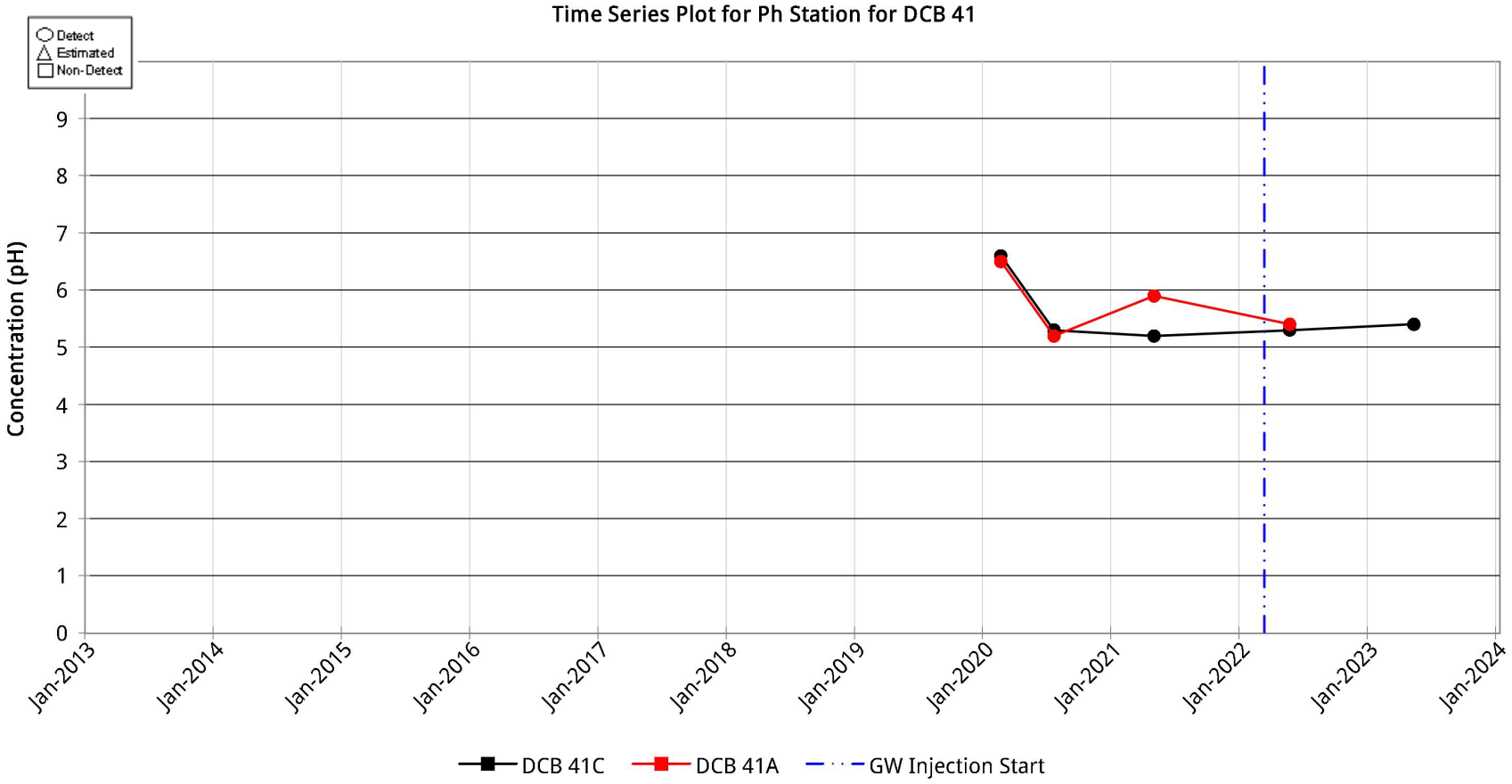

Time Series Plot for Ph Station for DCB 33
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 33B
DCB 33C
DCB 33D
GW Injection Start

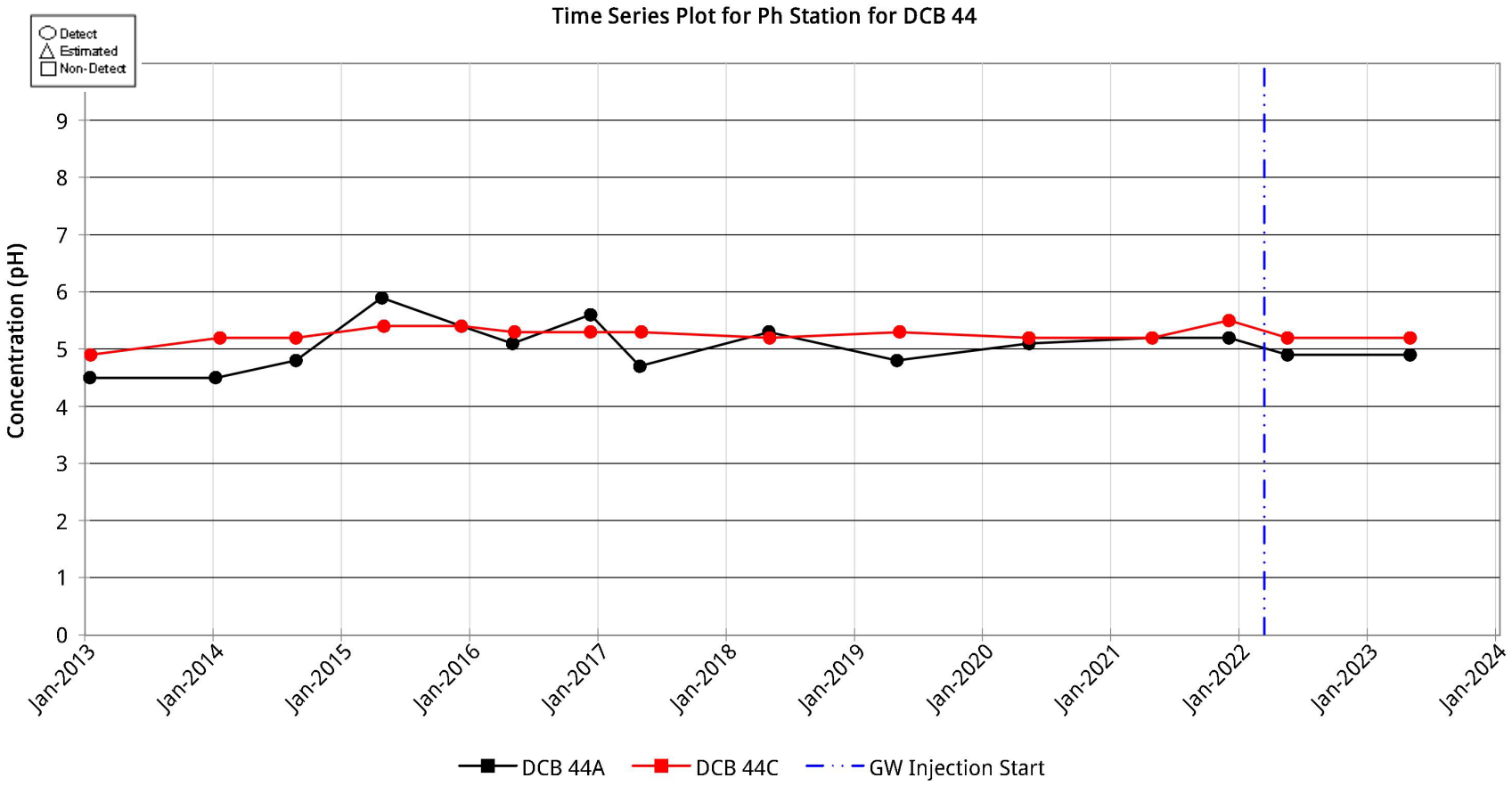

Time Series Plot for Ph Station for DCB 34
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 34A
DCB 34C
GW Injection Start

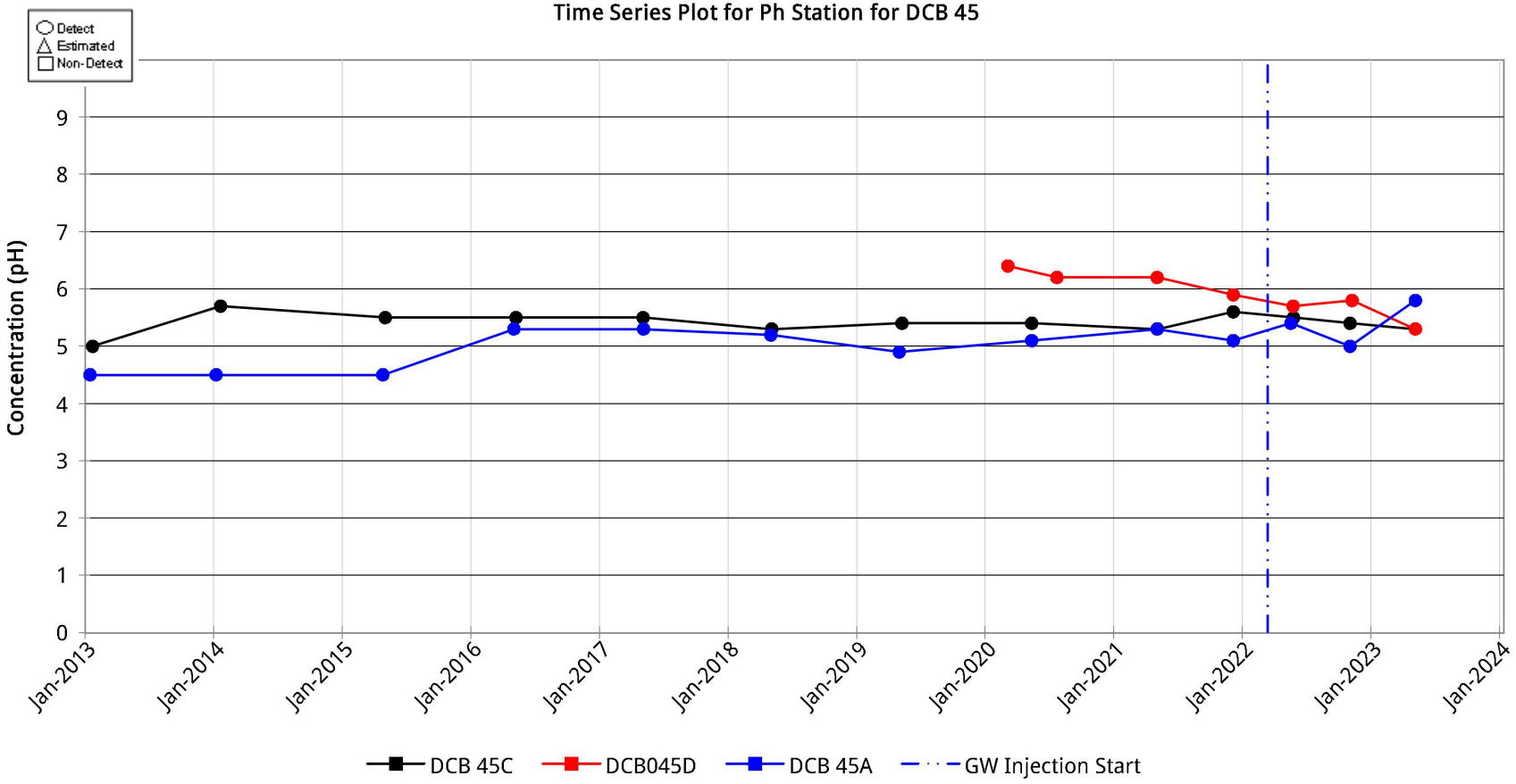

Time Series Plot for Ph Station for DCB035
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB035D
DCB 35A
DCB 35C
GW Injection Start

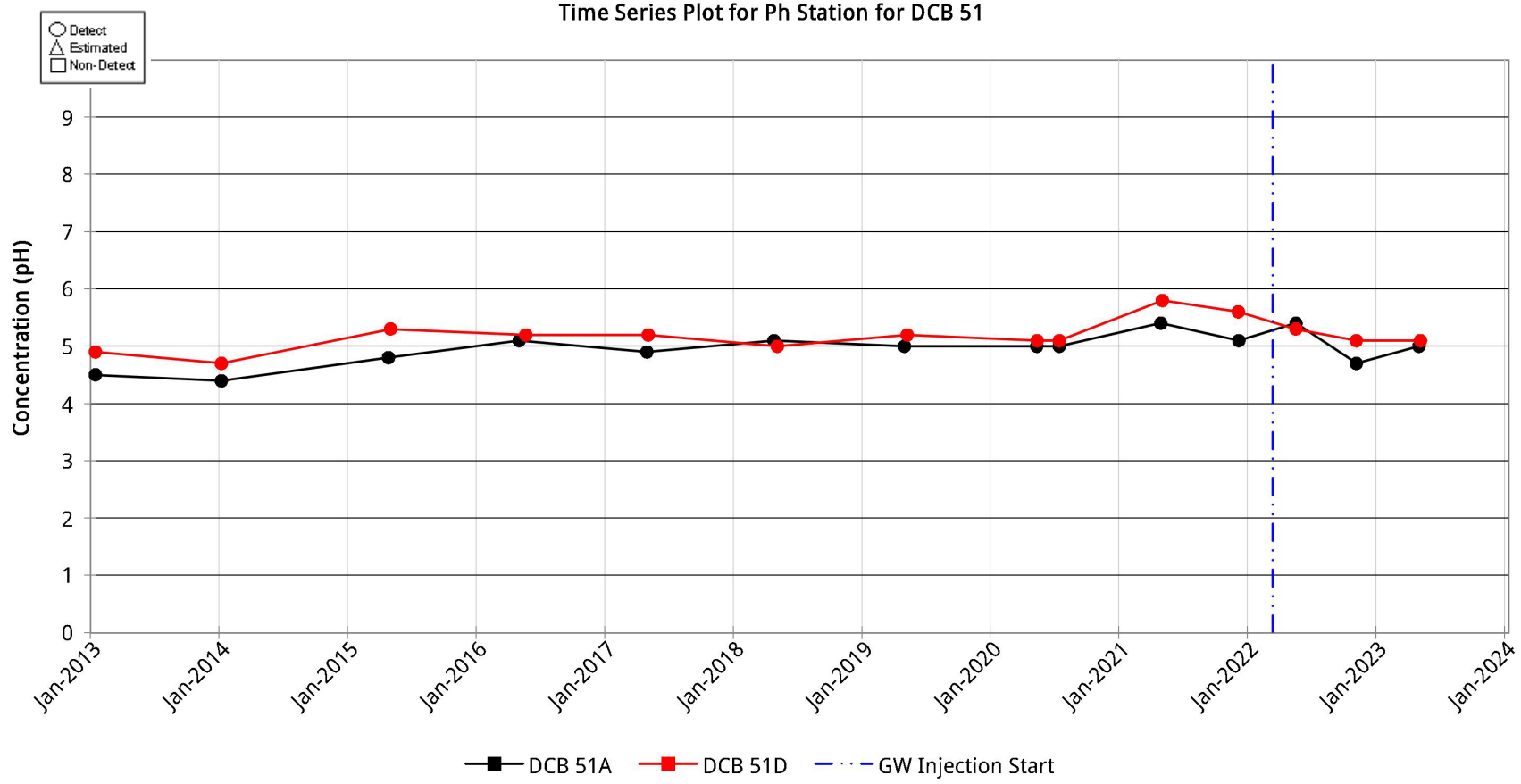

Time Series Plot for Ph Station for DCB 36
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 36A
DCB 36C
GW Injection Start

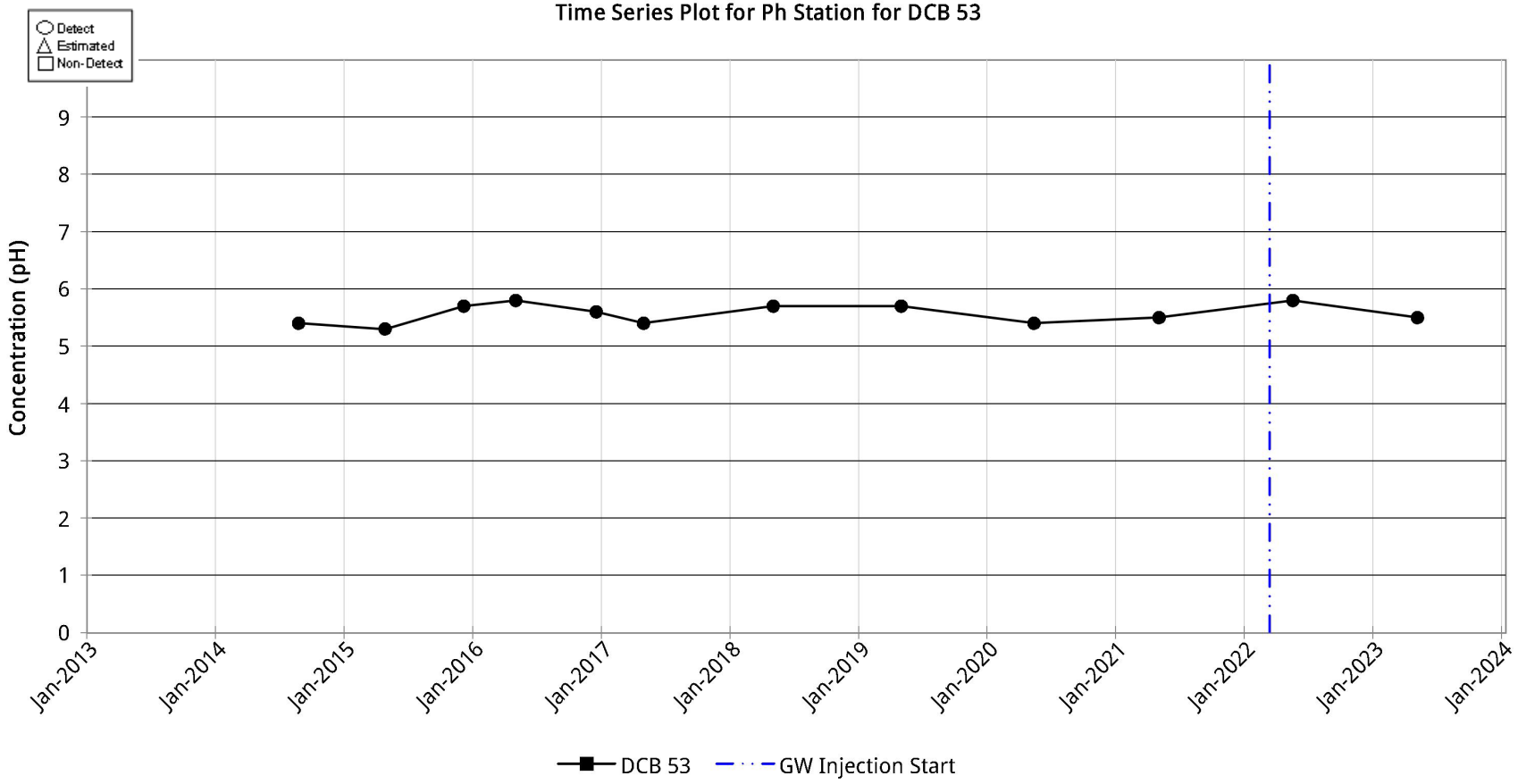

Time Series Plot for Ph Station for DCB 37
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 37C
DCB 37A
DCB 37D
GW Injection Start

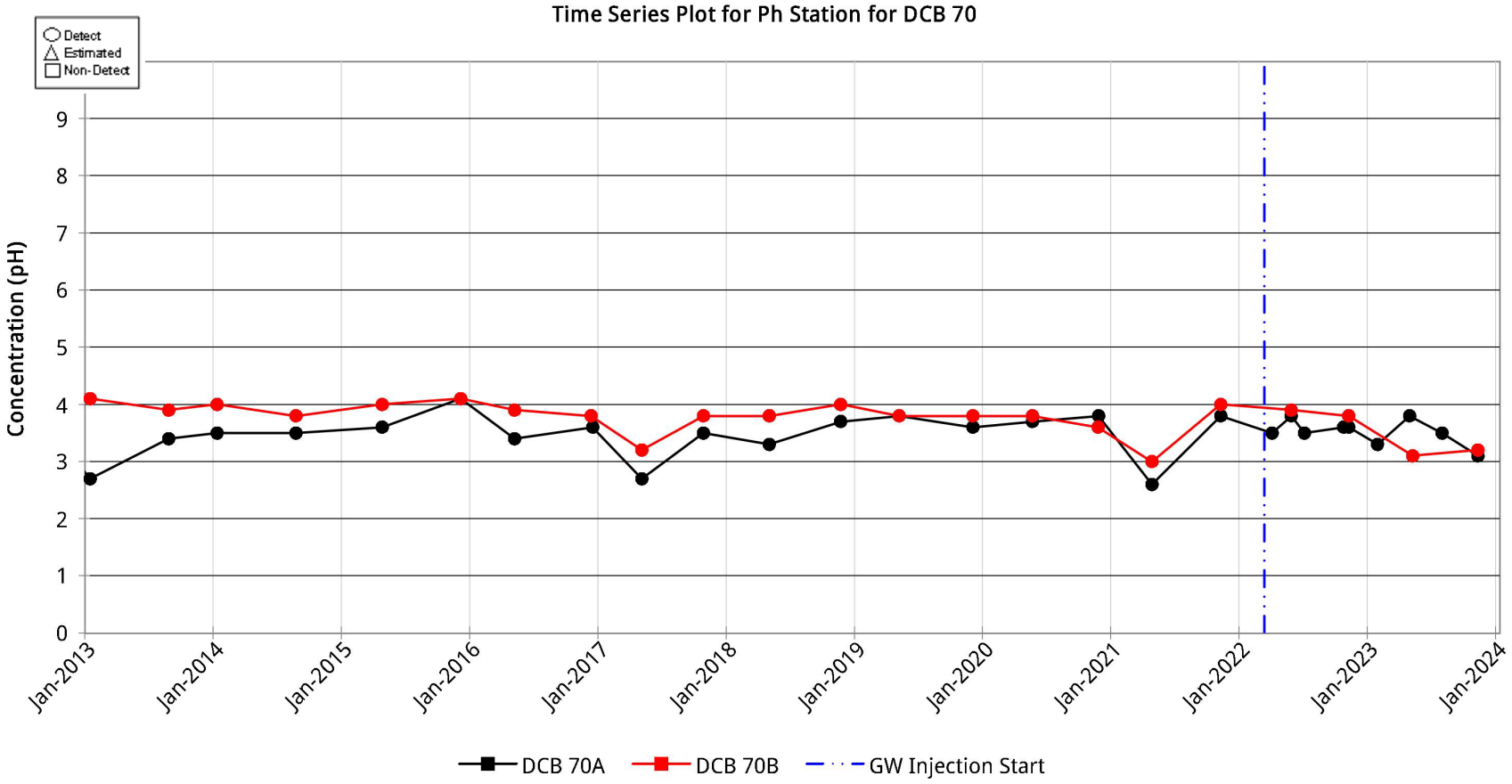

Time Series Plot for Ph Station for DCB 41
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 41C
DCB 41A
GW Injection Start

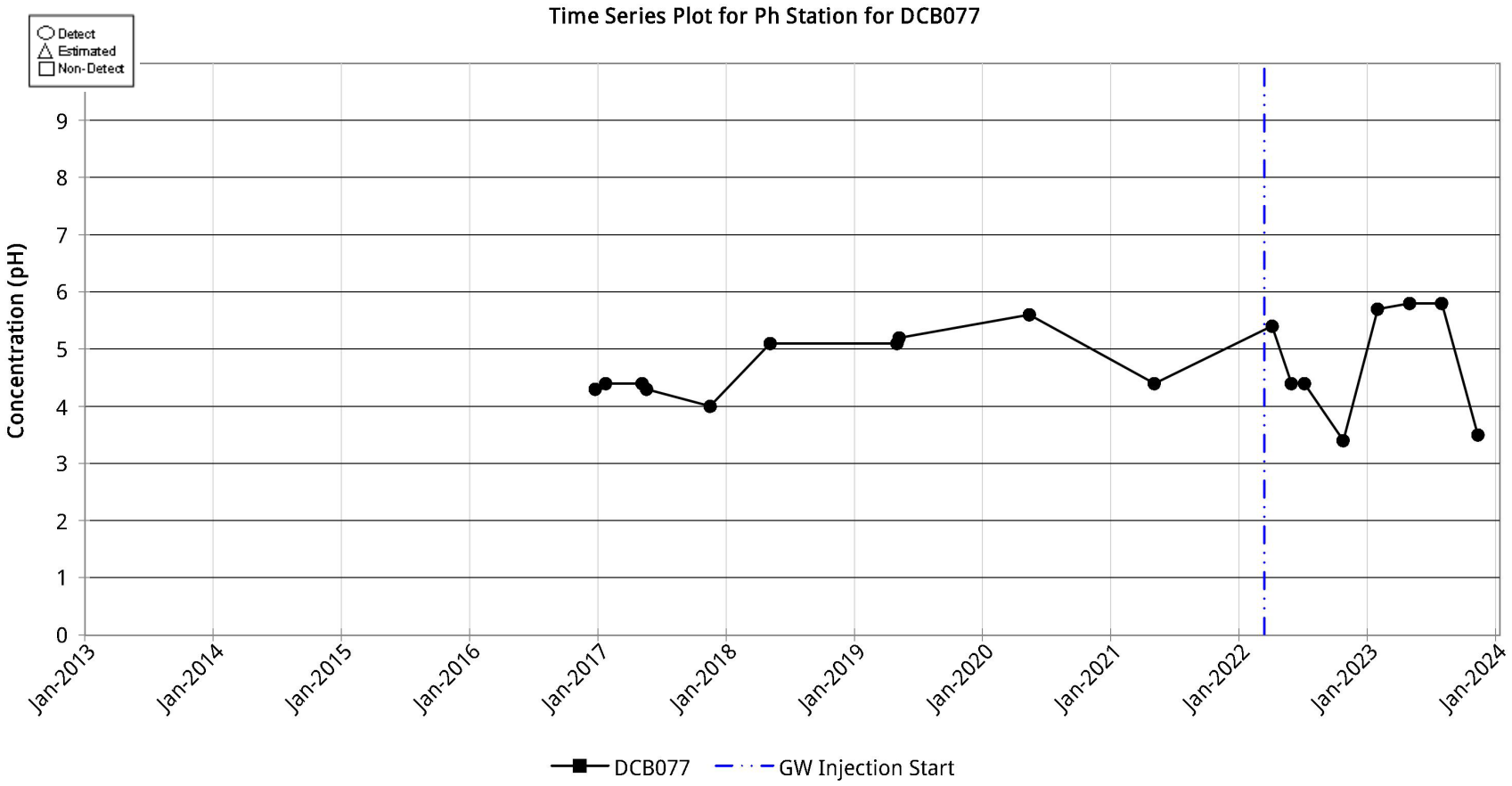

Time Series Plot for Ph Station for DCB 44
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 44A
DCB 44C
GW Injection Start

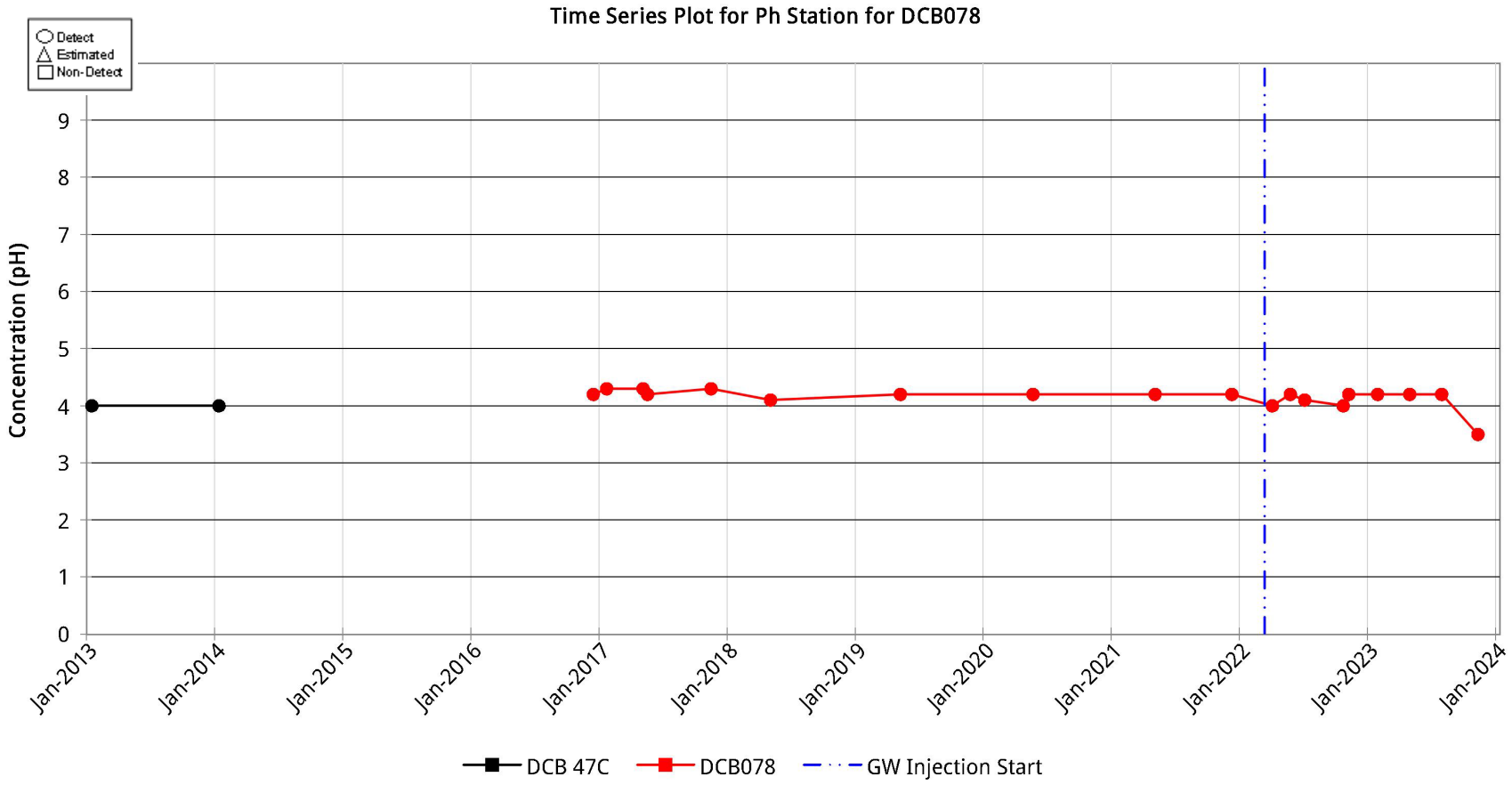

Time Series Plot for Ph Station for DCB 45
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 45C
DCB045D
DCB 45A
GW Injection Start

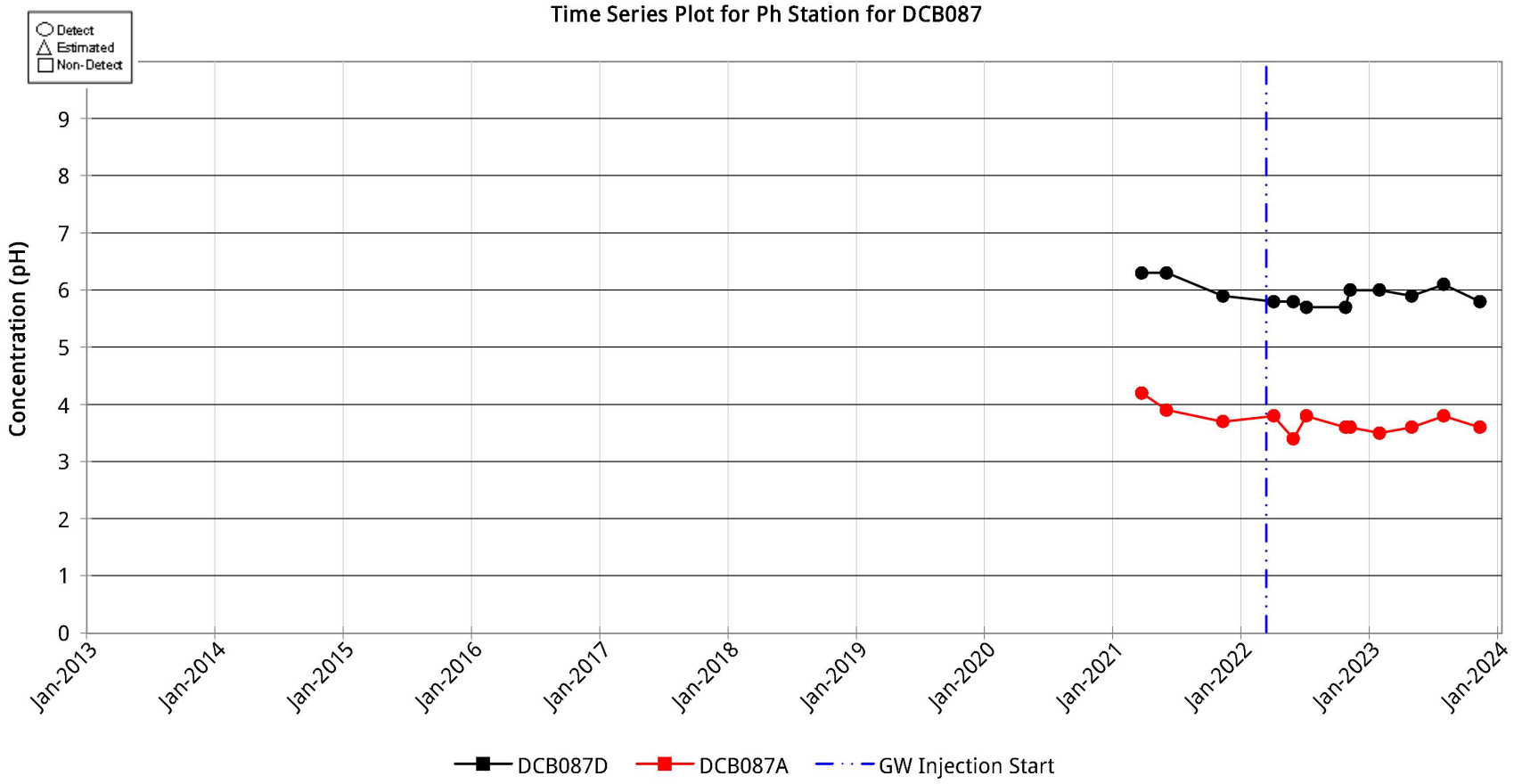

Time Series Plot for Ph Station for DCB 51
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 51A
DCB 51D
GW Injection Start

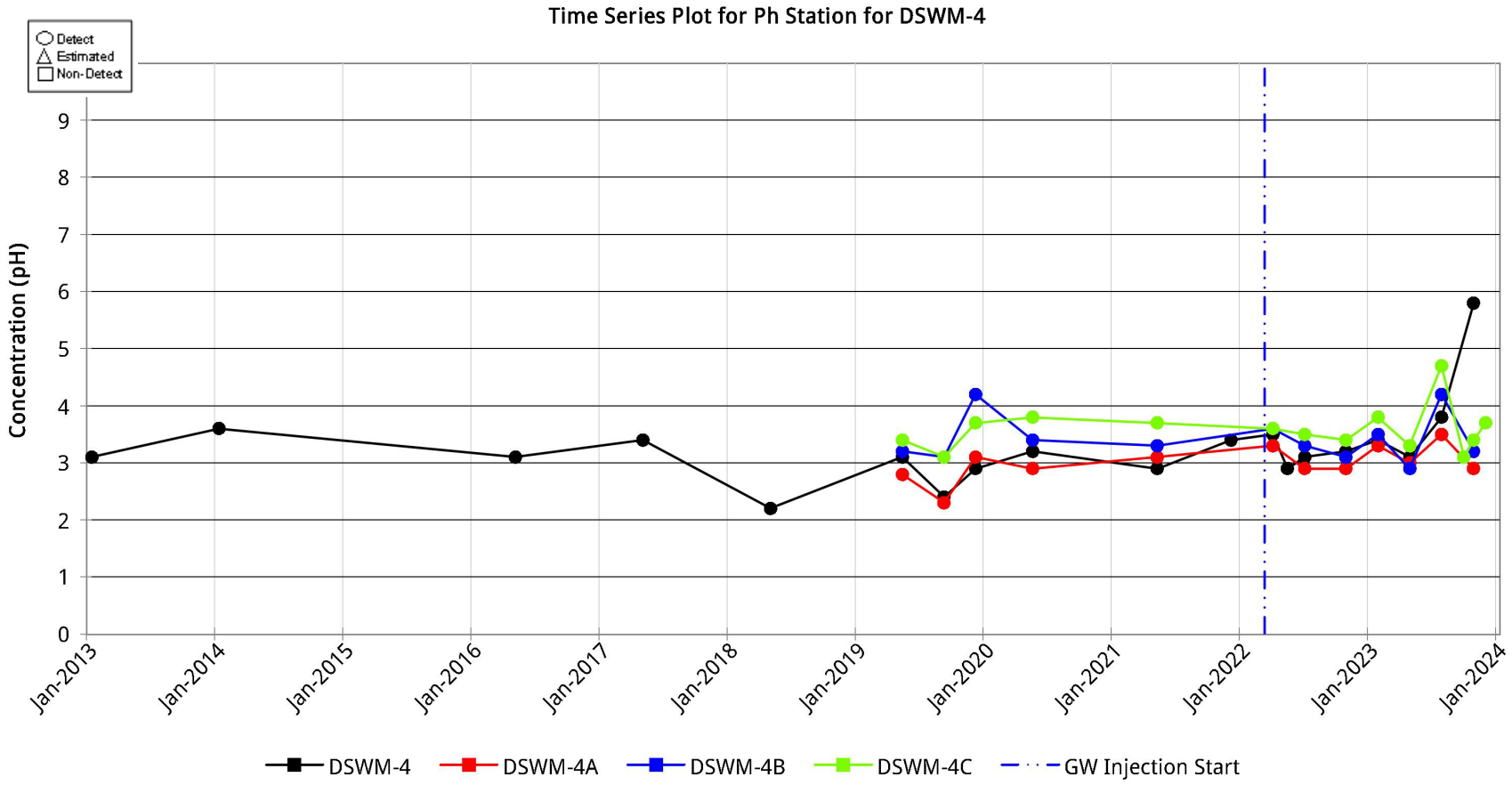

Time Series Plot for Ph Station for DCB 53
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 53
GW Injection Start

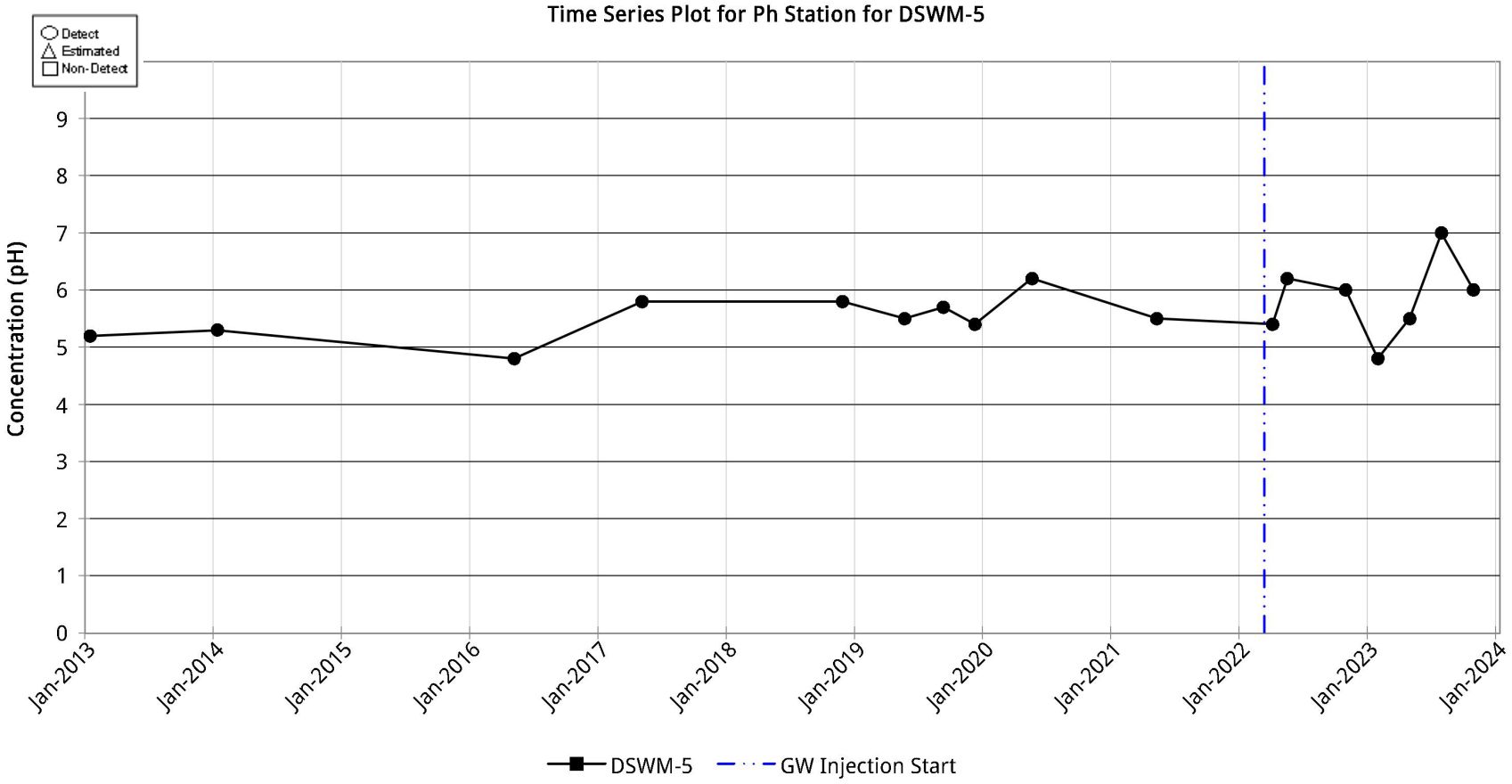

Time Series Plot for Ph Station for DCB 70
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 70A
DCB 70B
GW Injection Start

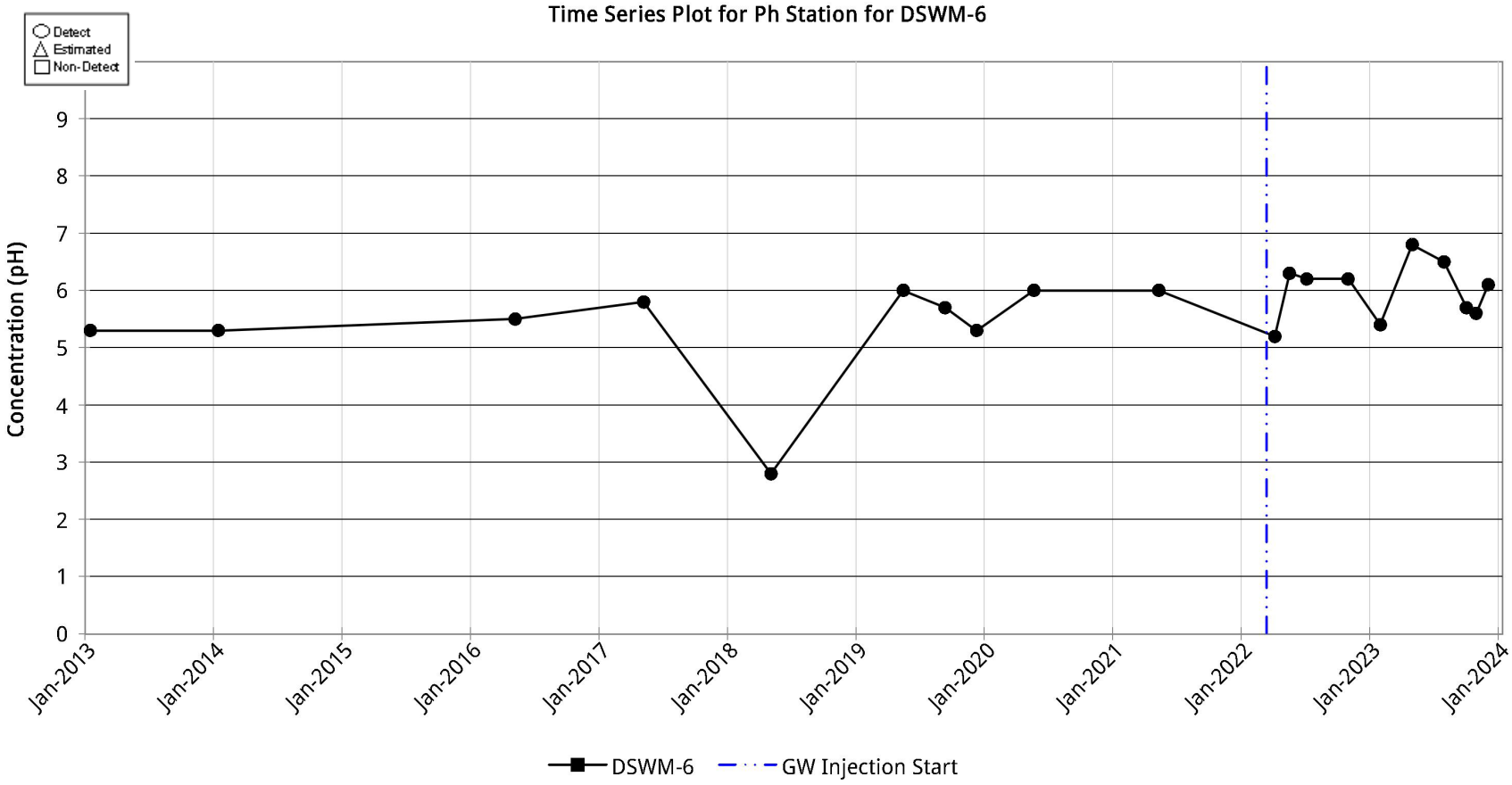

Time Series Plot for Ph Station for DCB077
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB077
GW Injection Start

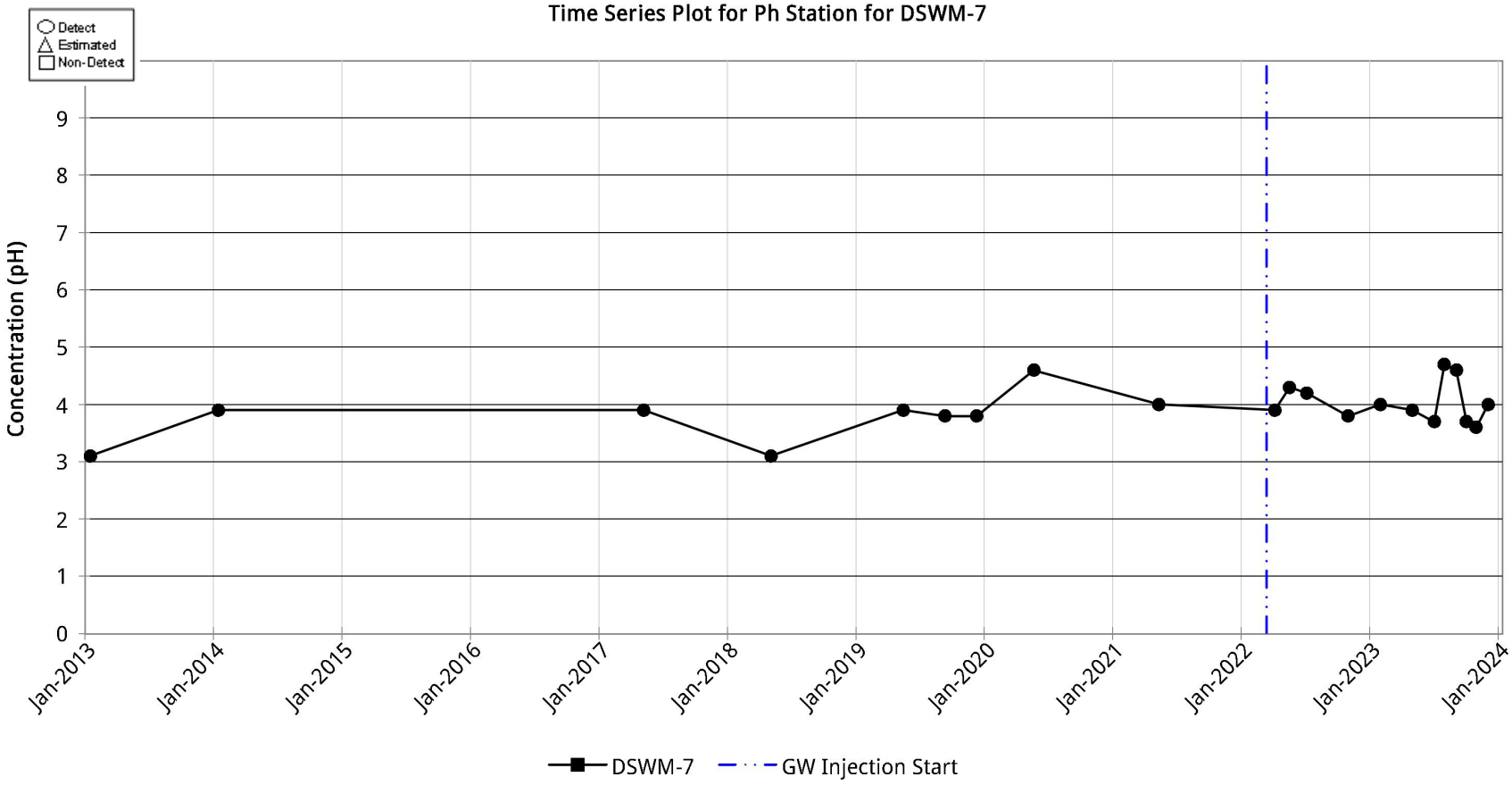

Time Series Plot for Ph Station for DCB078
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 47C
DCB078
GW Injection Start

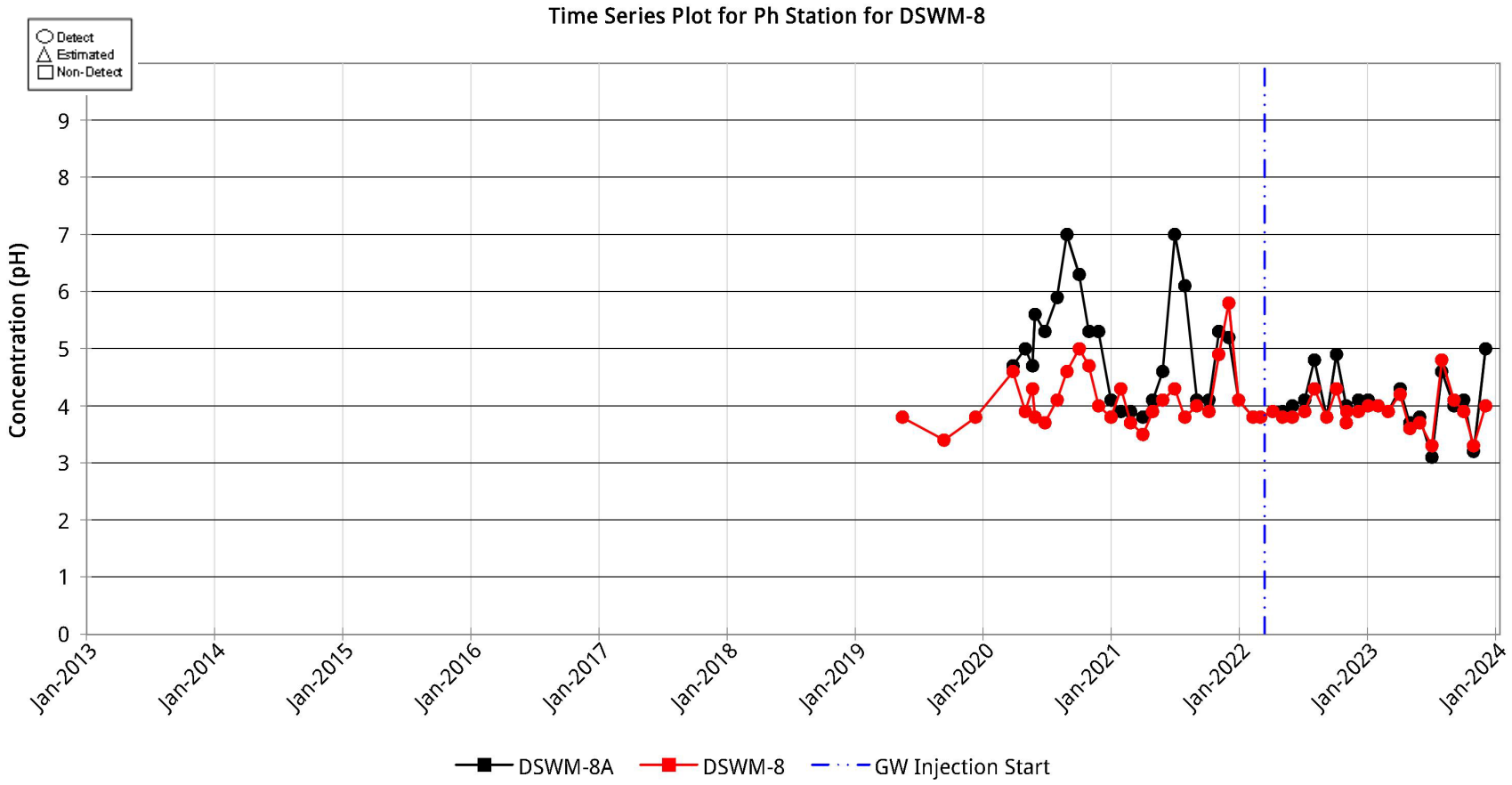

Time Series Plot for Ph Station for DCB087
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB087D
DCB087A
GW Injection Start

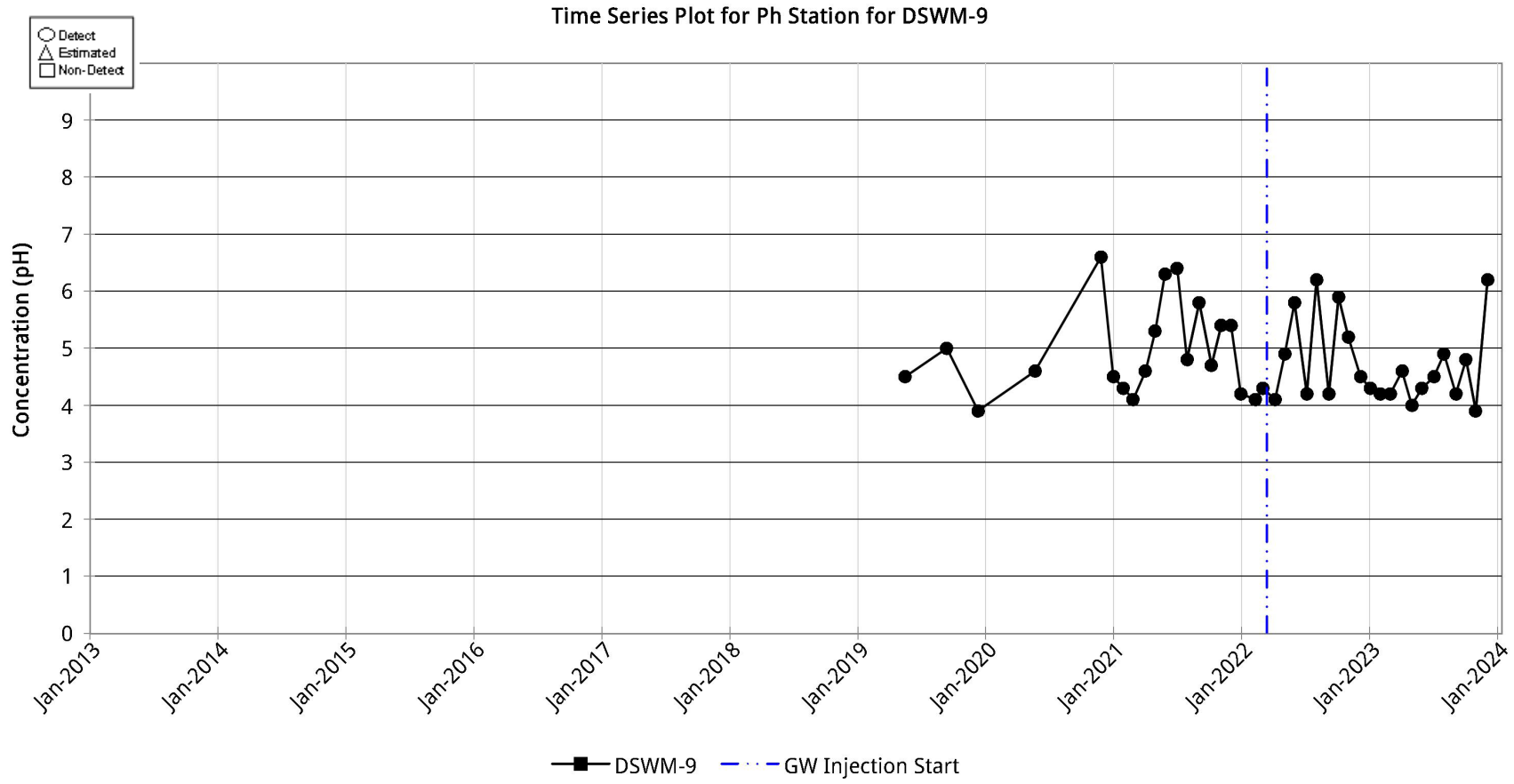

Time Series Plot for Ph Station for DSWM-4
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-4
DSWM-4A
DSWM-4B
DSWM-4C
GW Injection Start

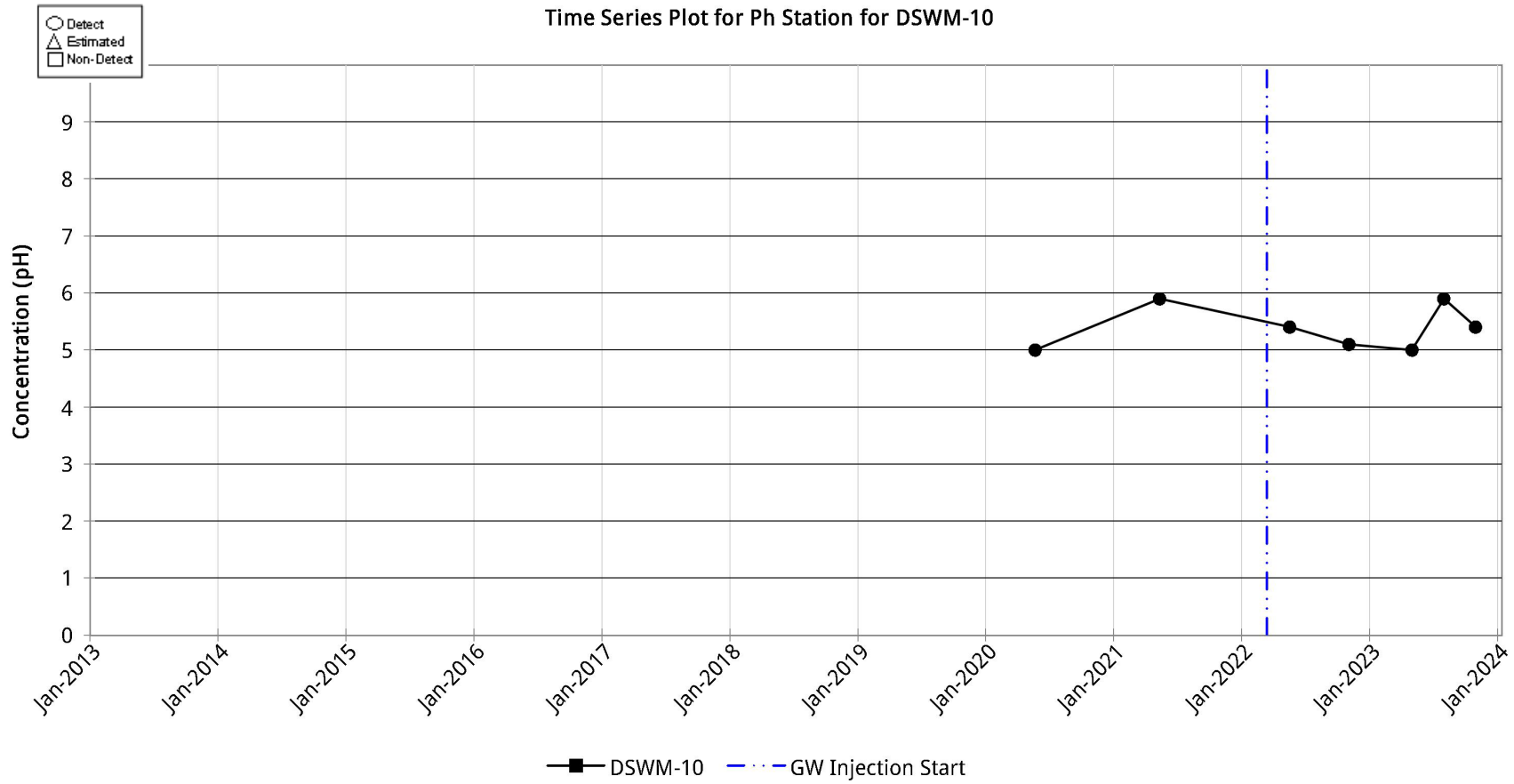

Time Series Plot for Ph Station for DSWM-5
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-5
GW Injection Start

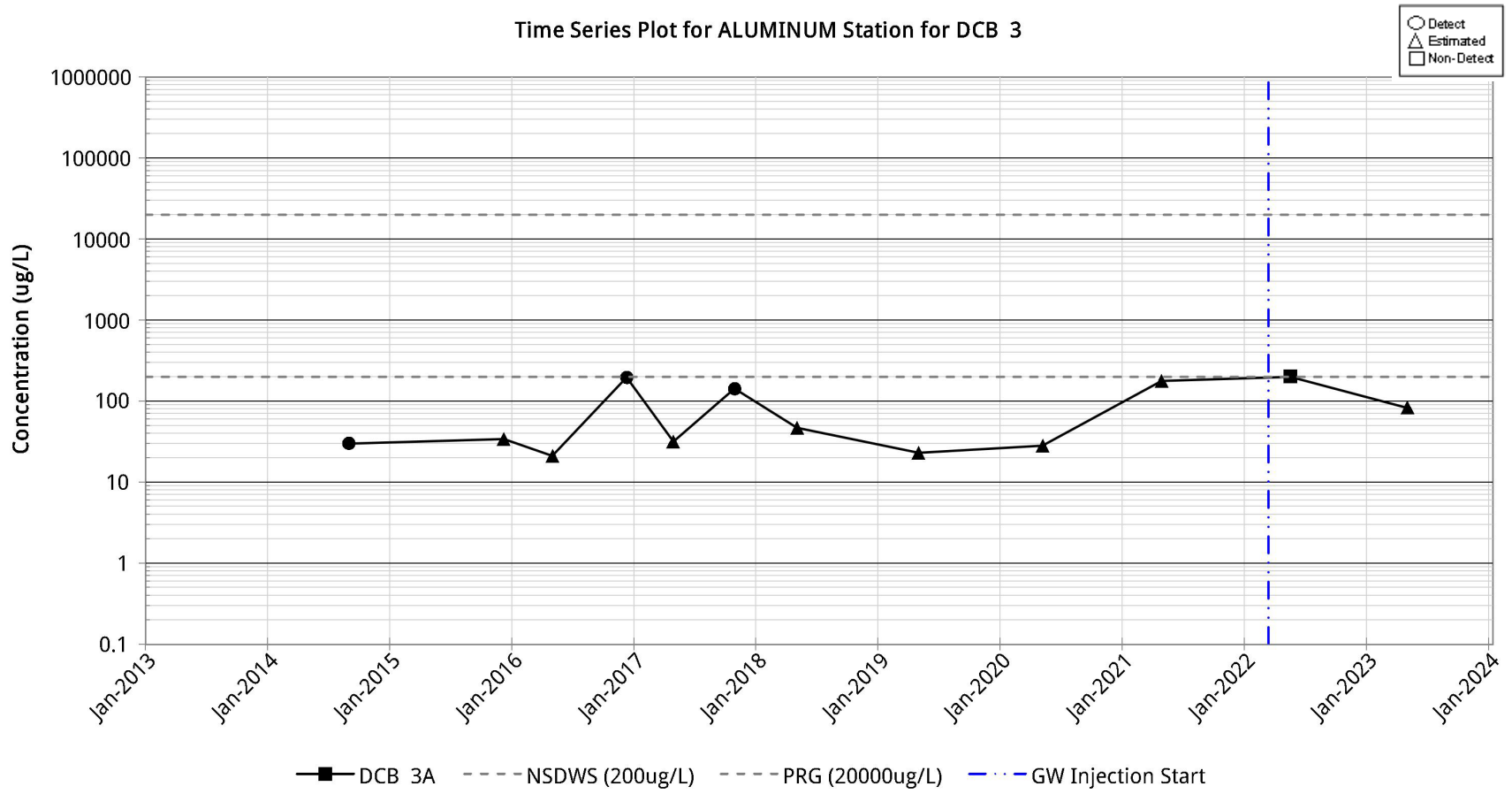

Time Series Plot for Ph Station for DSWM-6
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-6
GW Injection Start

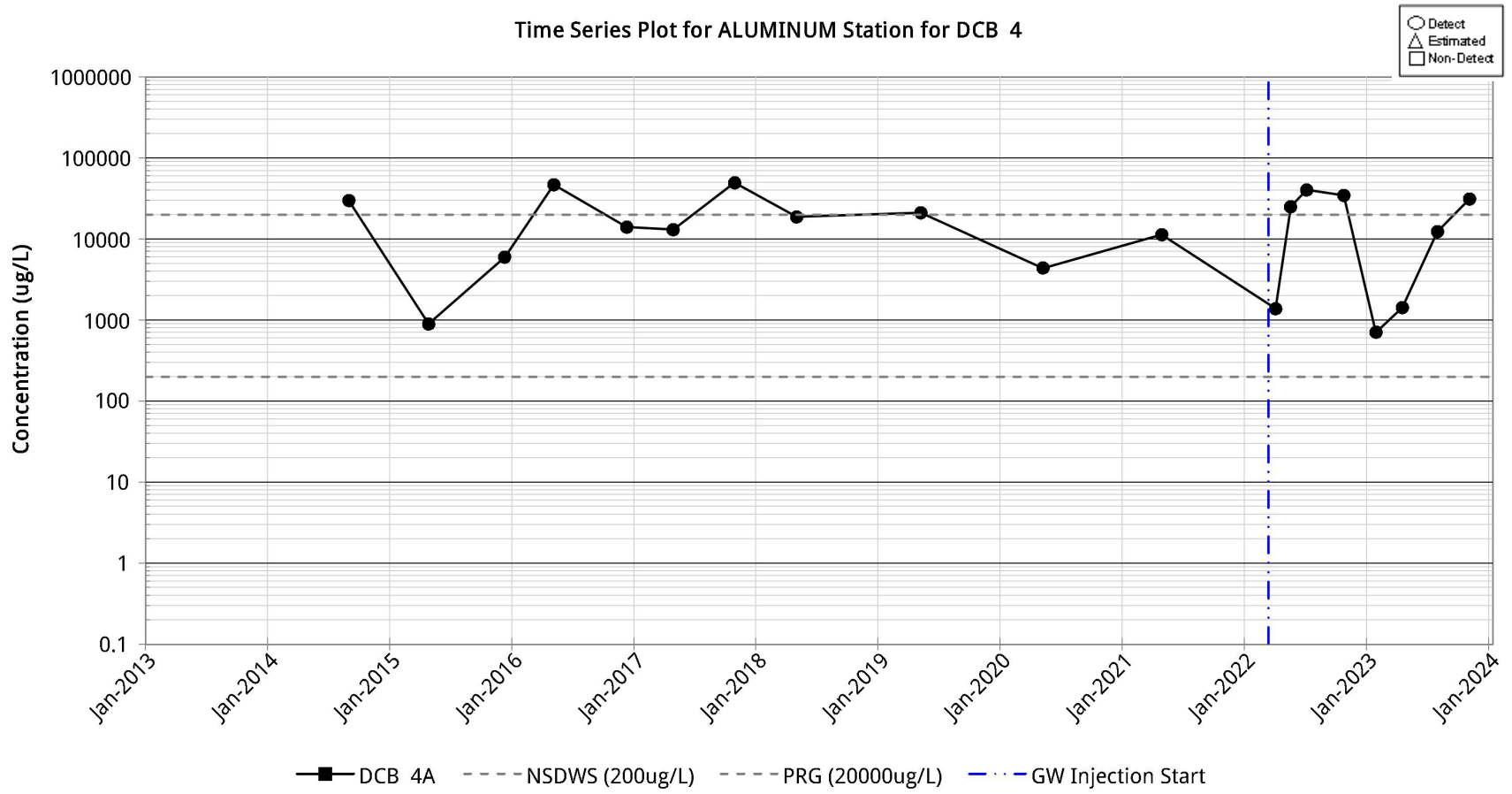

Time Series Plot for Ph Station for DSWM-7
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-7
GW Injection Start

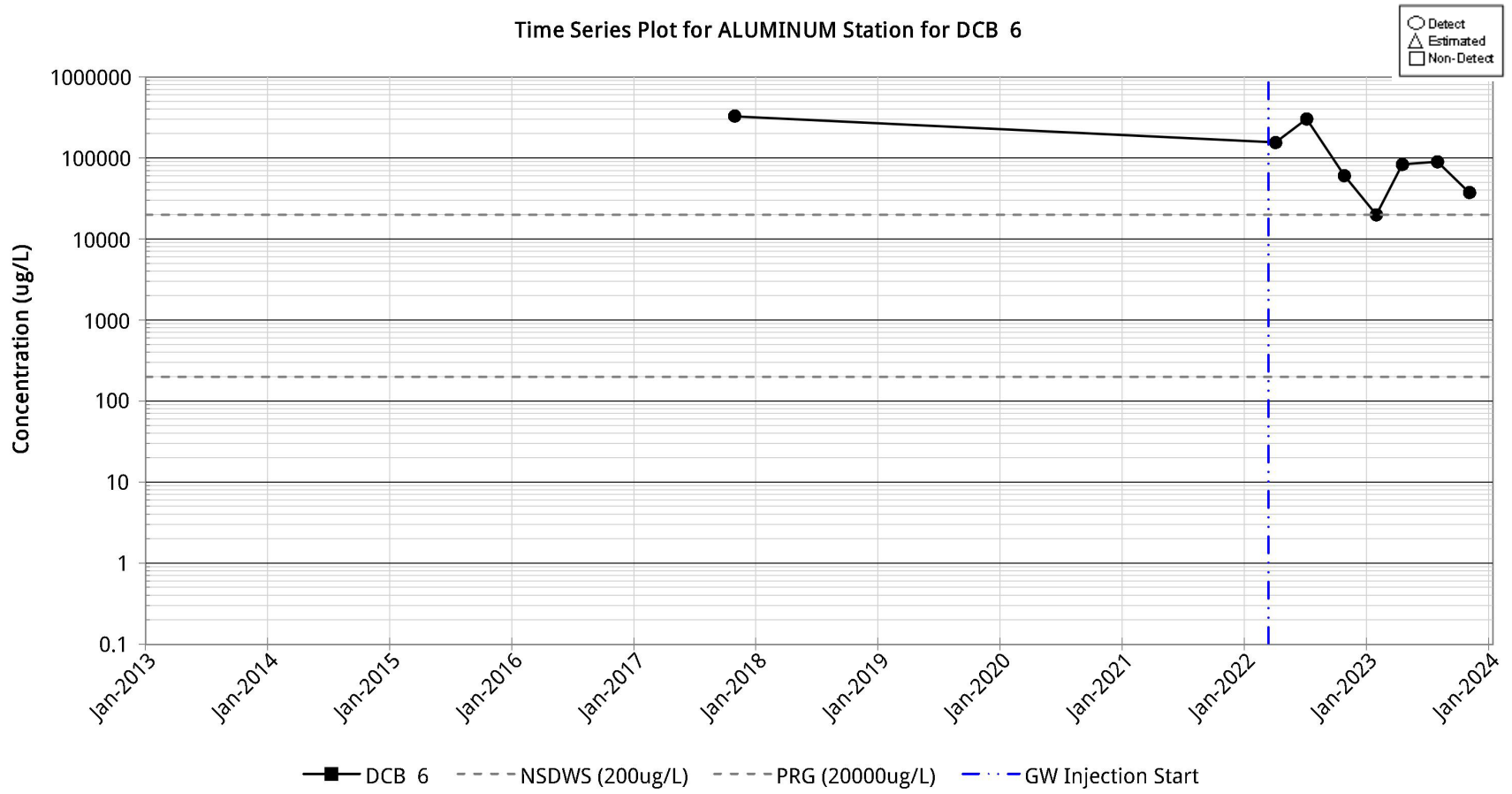

Time Series Plot for Ph Station for DSWM-8
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-8A
DSWM-8
GW Injection Start

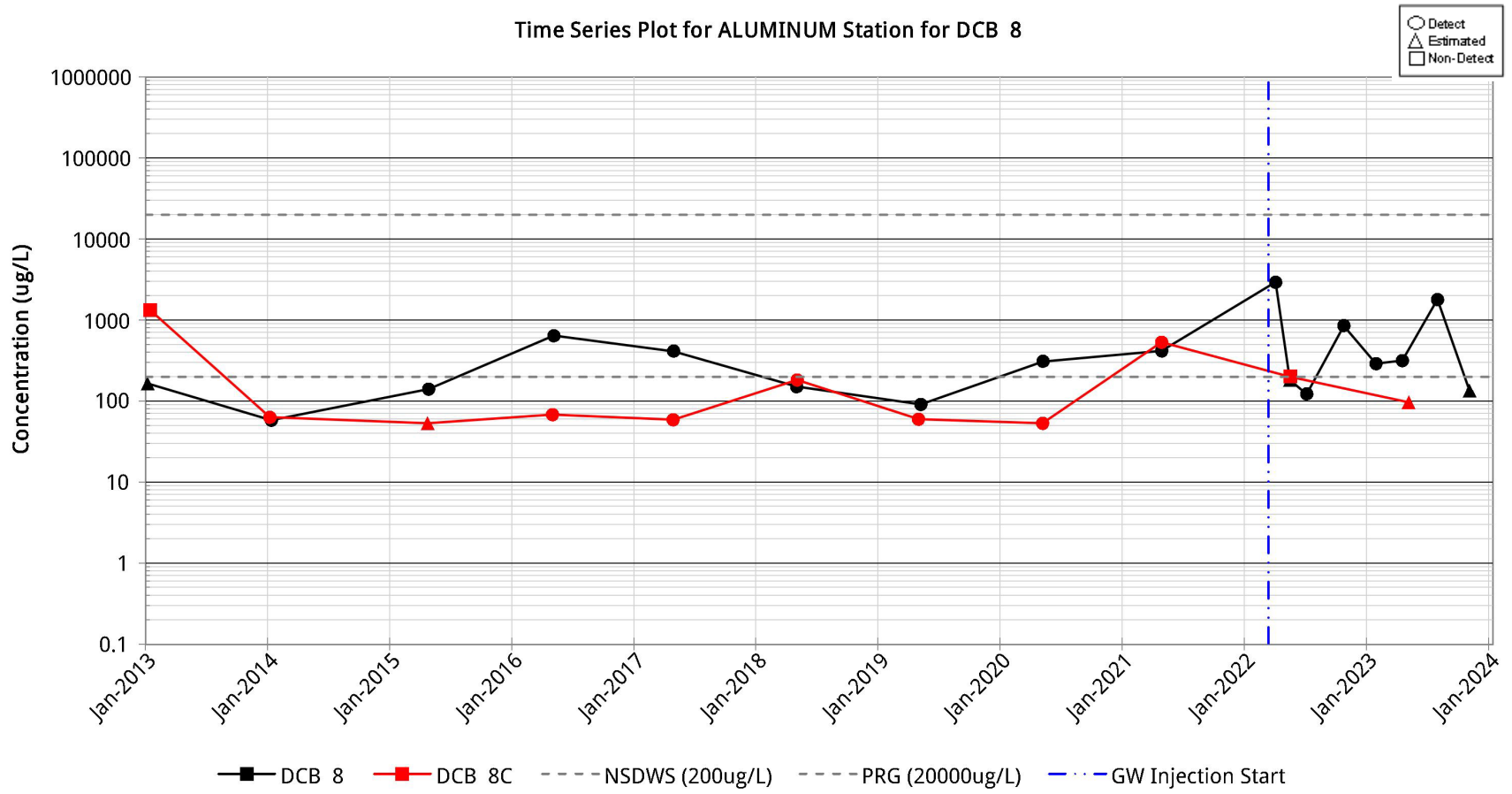

Time Series Plot for Ph Station for DSWM-9
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-9
GW Injection Start

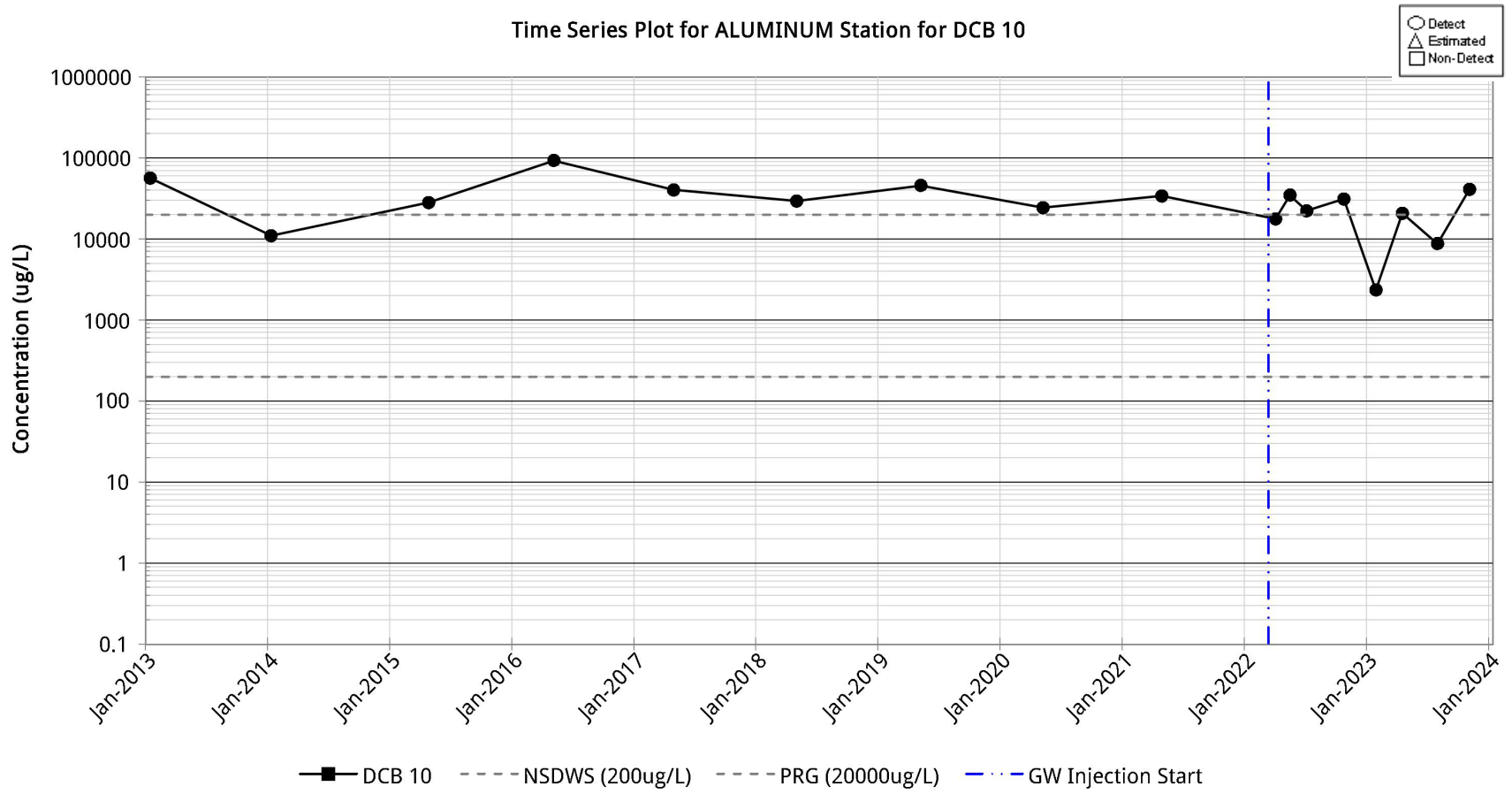

Time Series Plot for Ph Station for DSWM-10
Detect
Estimated
Non-Detect
Concentration (pH)
0
1
2
3
4
5
6
7
8
9
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-10
GW Injection Start

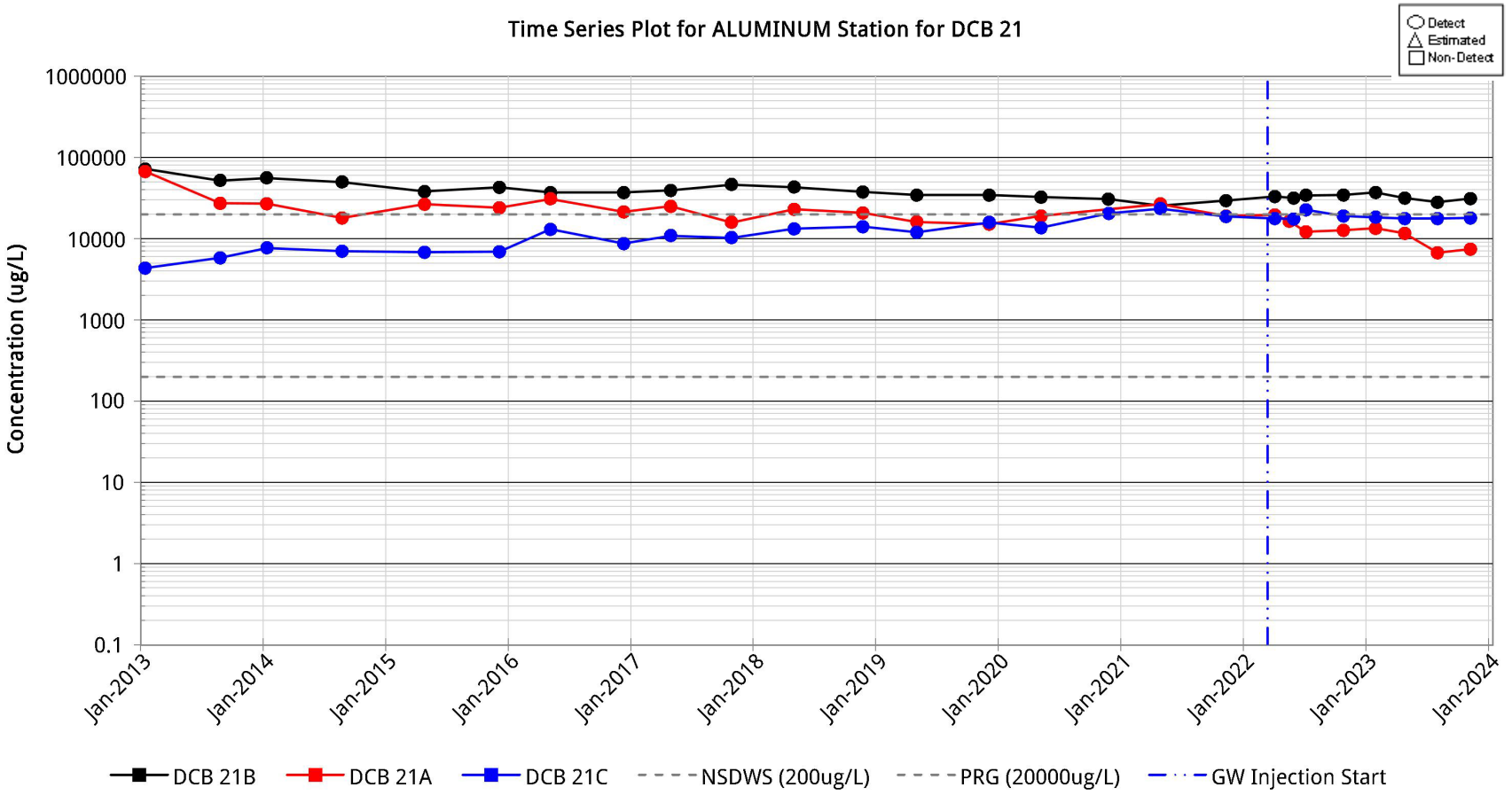

Time Series Plot for ALUMINUM Station for DCB 3
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 3A
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

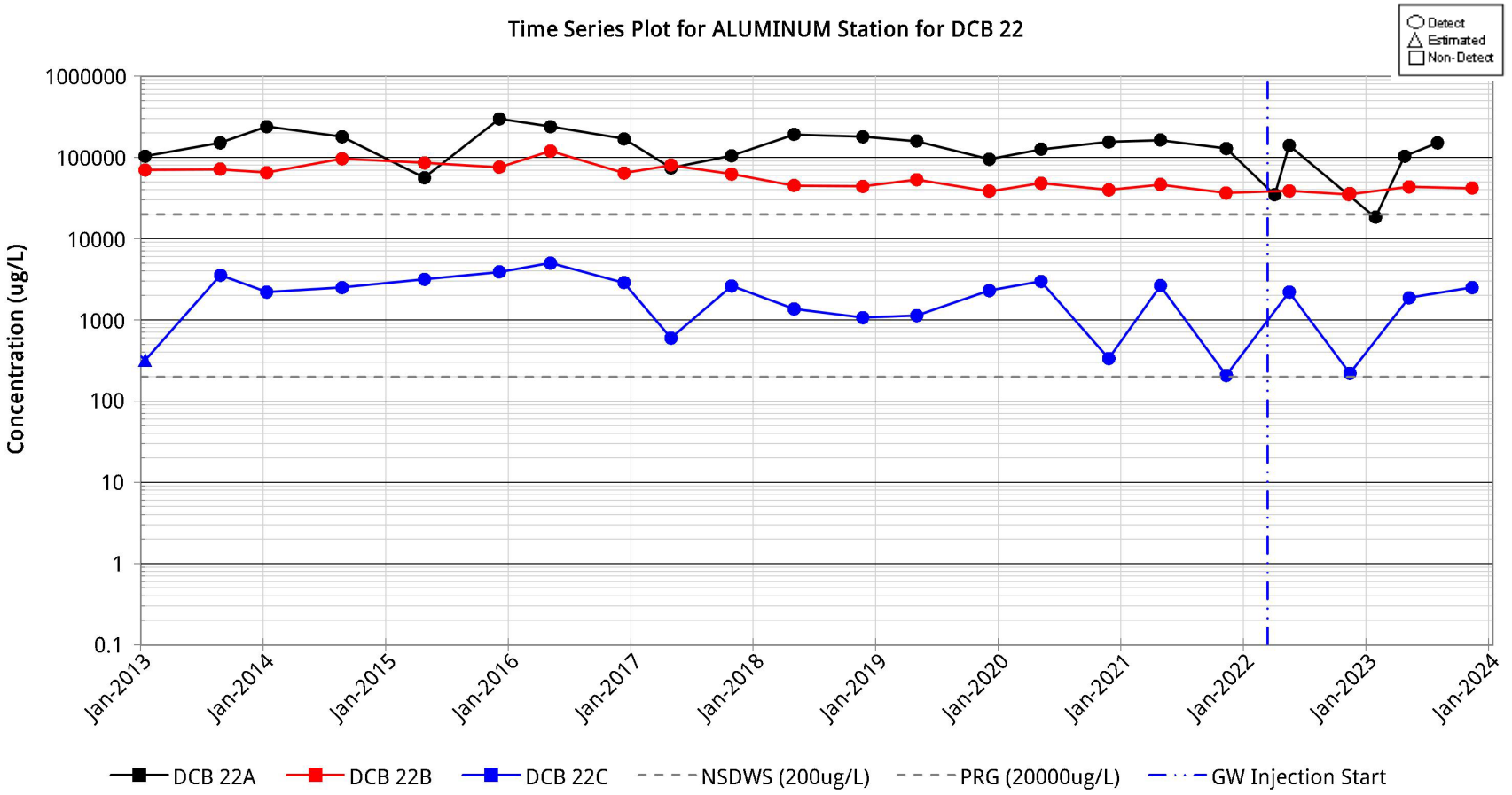

Time Series Plot for ALUMINUM Station for DCB 4
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 4A
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

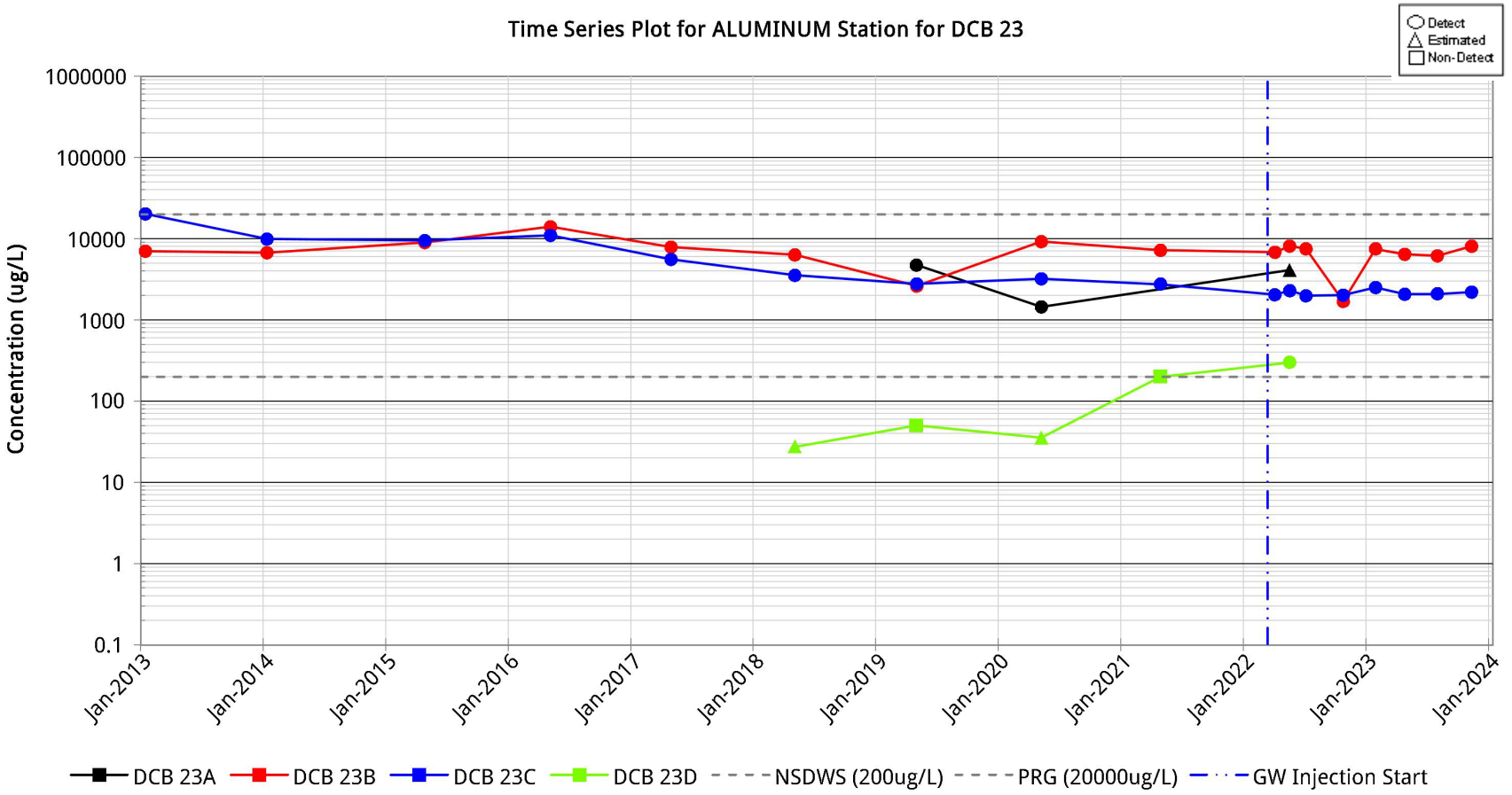

Time Series Plot for ALUMINUM Station for DCB 6
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 6
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

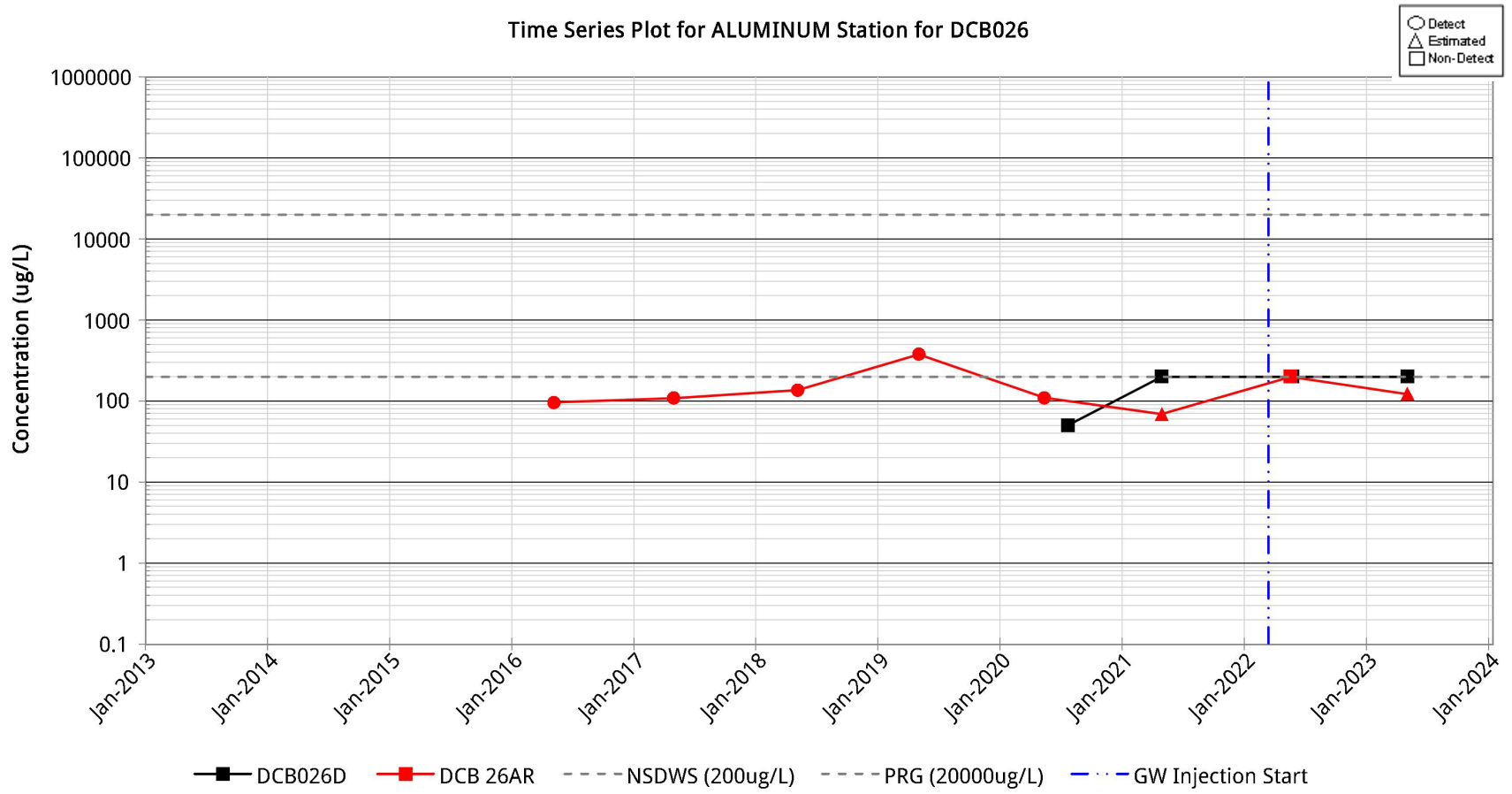

Time Series Plot for ALUMINUM Station for DCB 8
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 8
DCB 8C
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

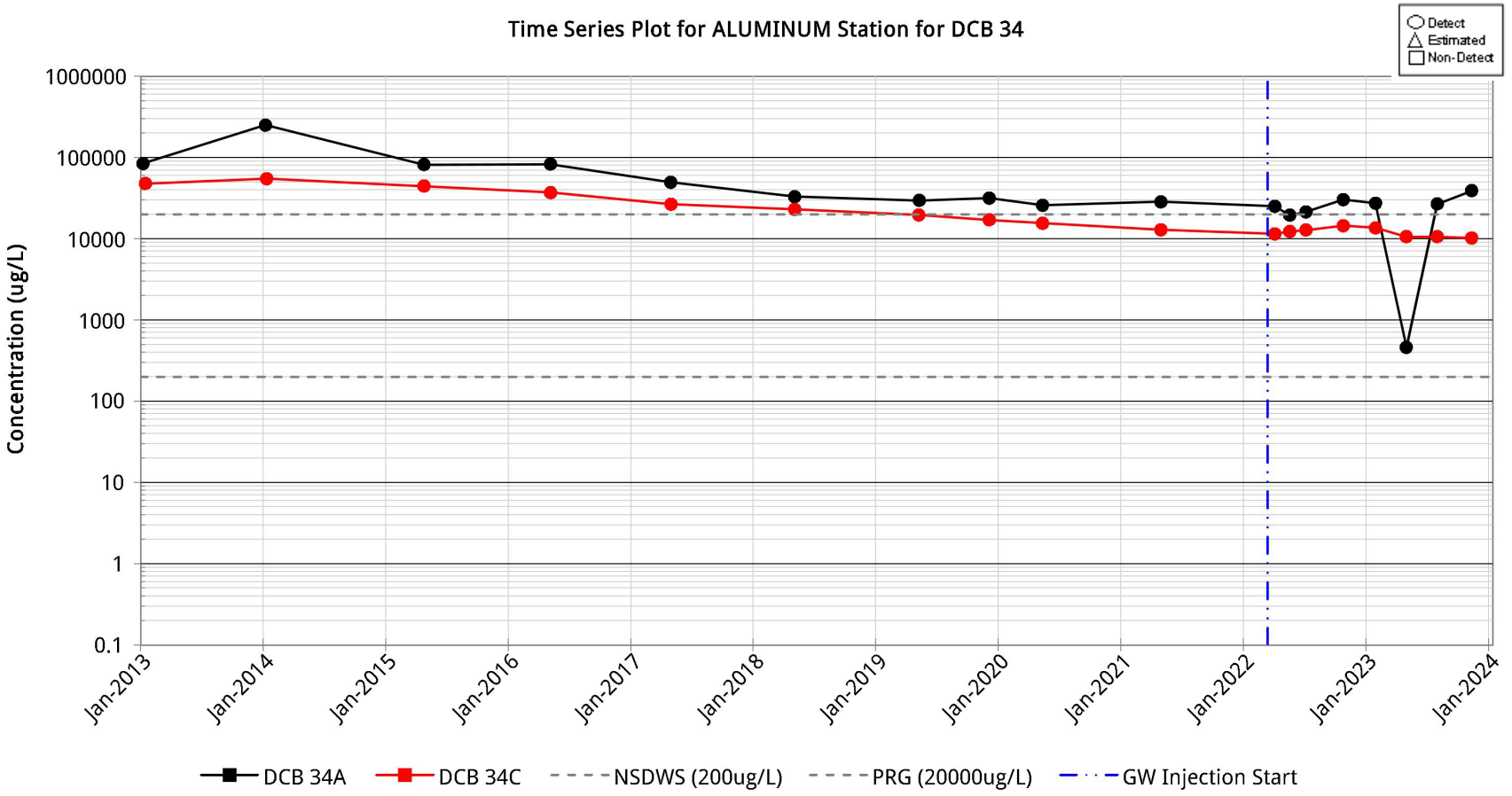

Time Series Plot for ALUMINUM Station for DCB 10
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 10
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

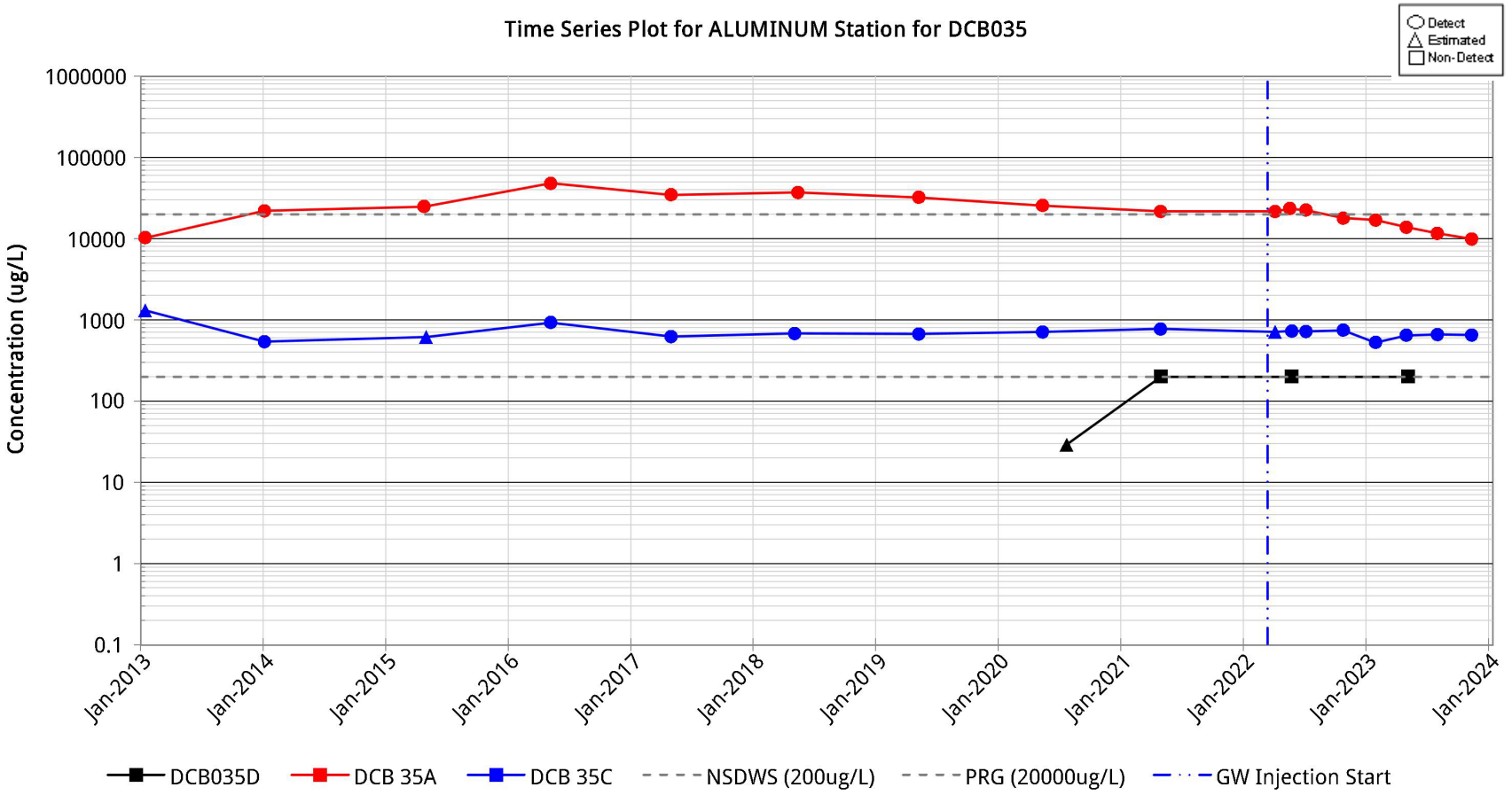

Time Series Plot for ALUMINUM Station for DCB 21
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 21B
DCB 21A
DCB 21C
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

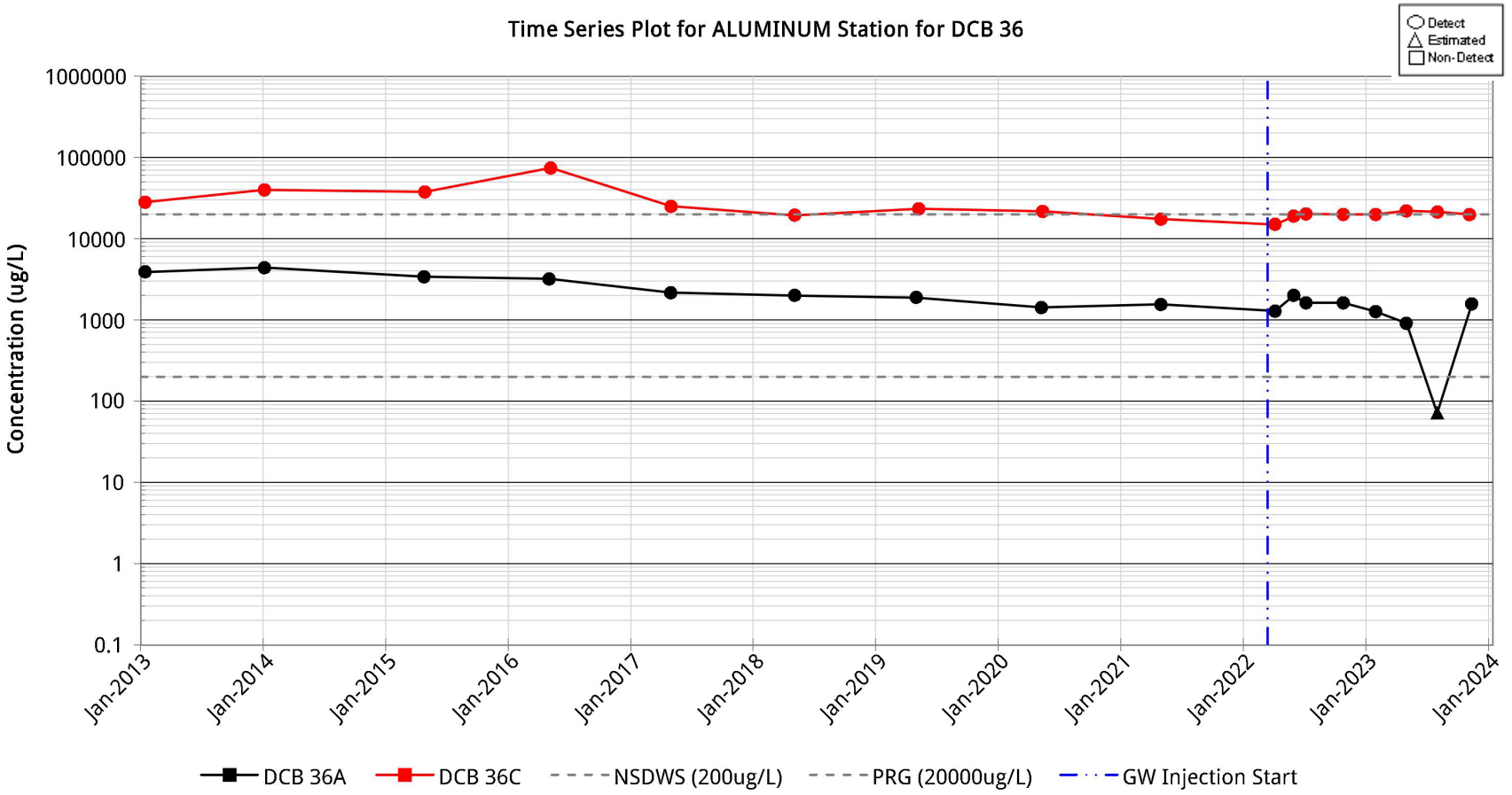

Time Series Plot for ALUMINUM Station for DCB 22
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 22A
DCB 22B
DCB 22C
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

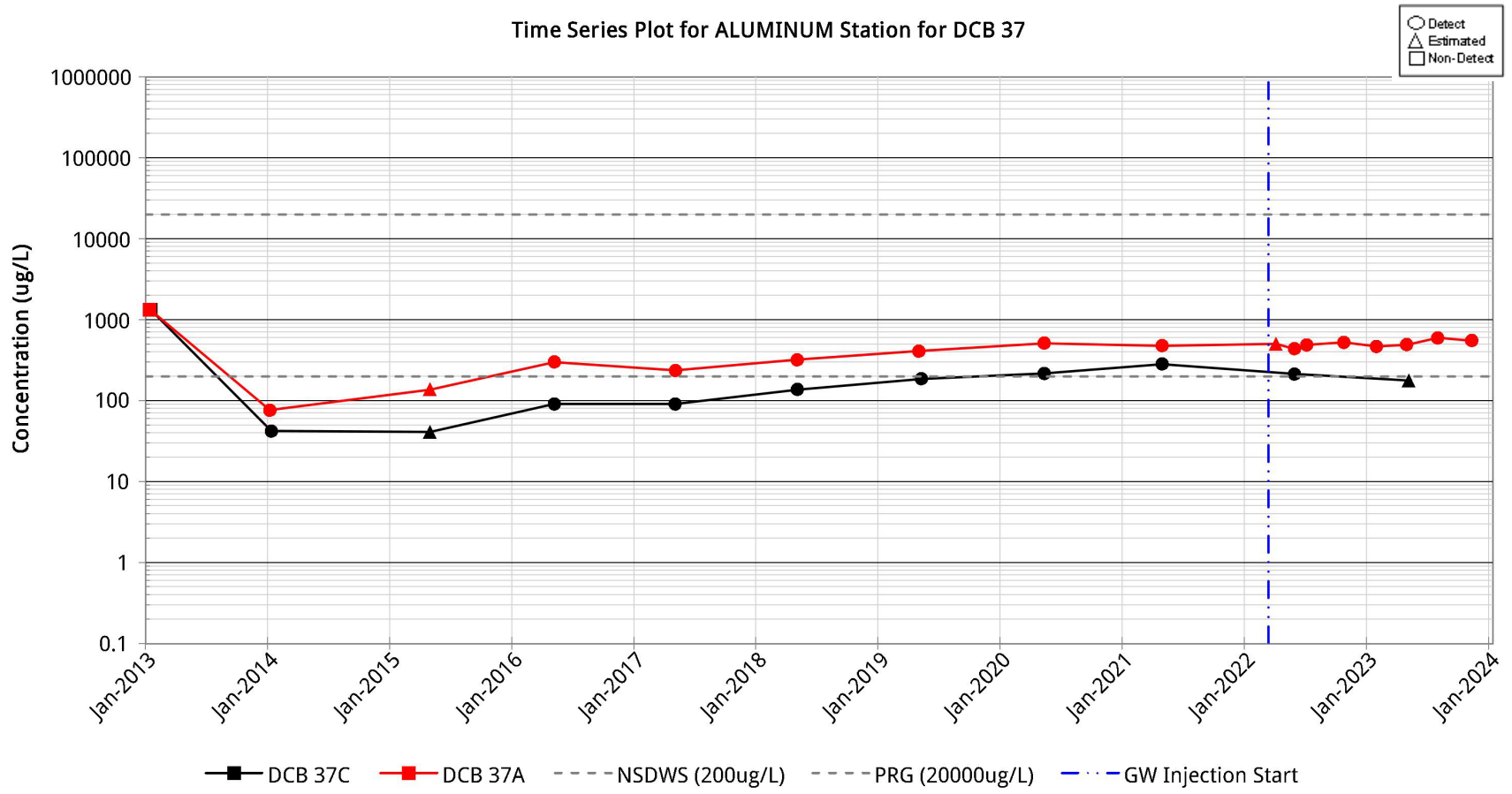

Time Series Plot for ALUMINUM Station for DCB 23
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 23A
DCB 23B
DCB 23C
DCB 23D
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

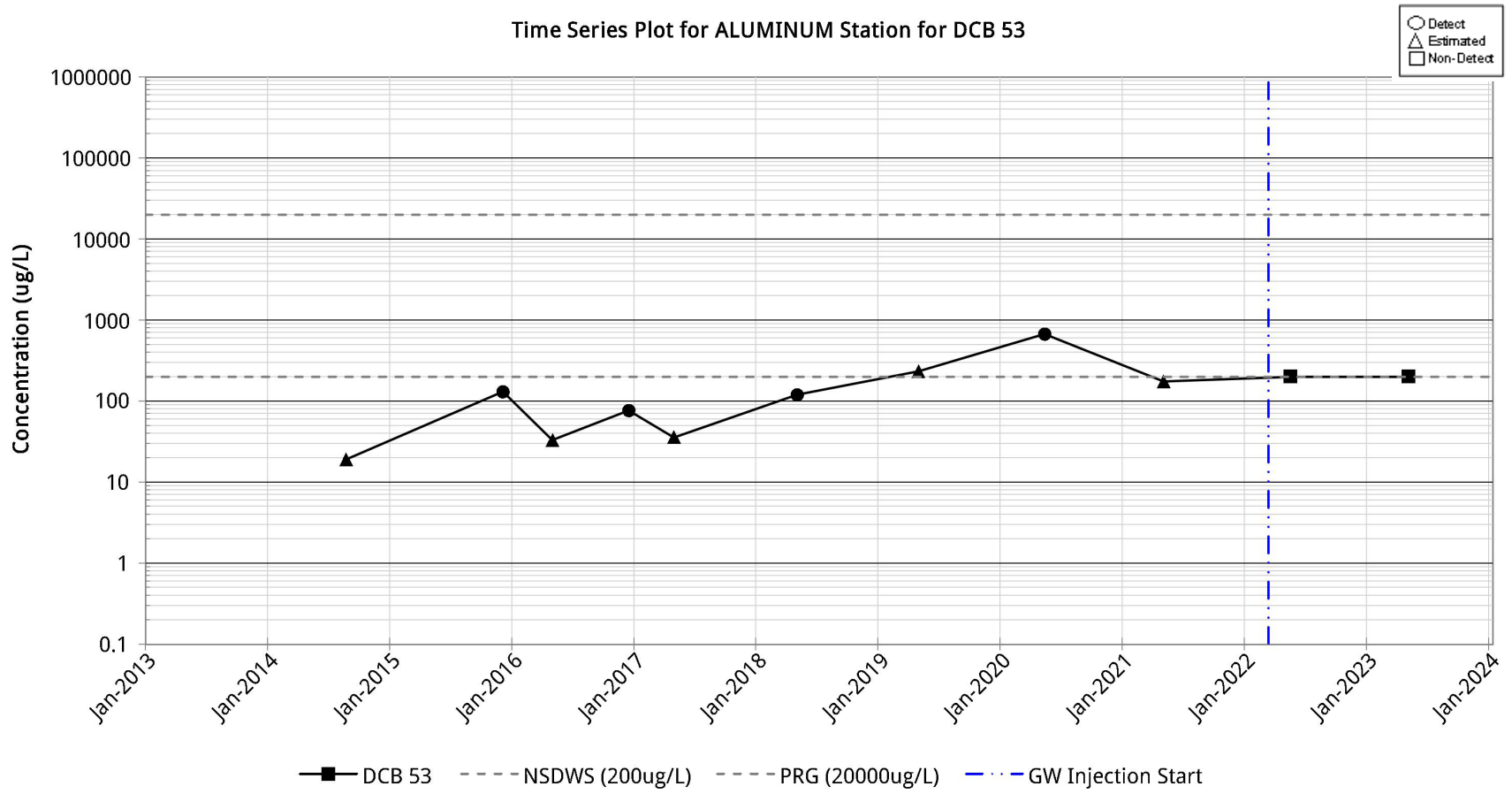

Time Series Plot for ALUMINUM Station for DCB026
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB026D
DCB 26AR
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

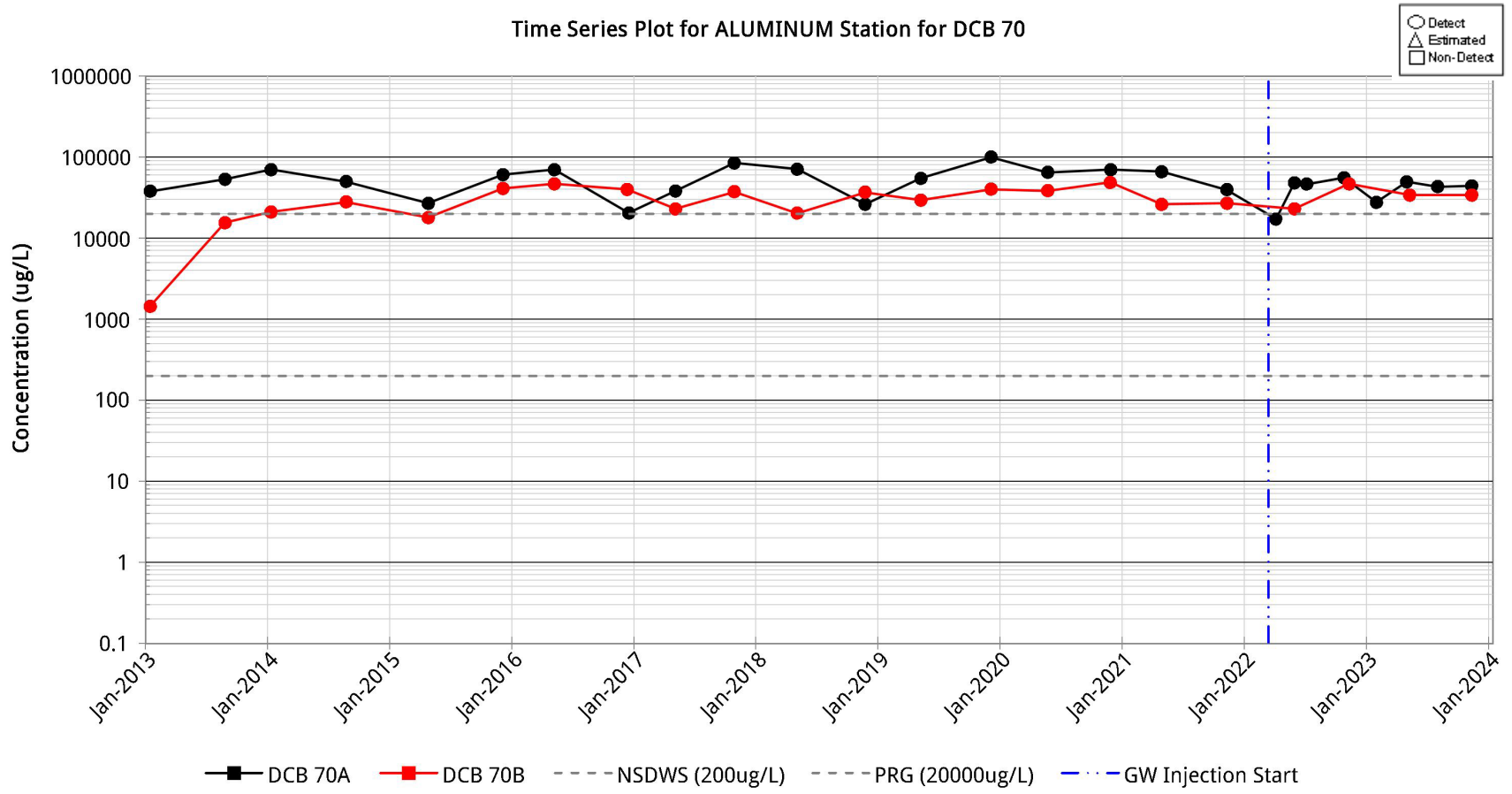

Time Series Plot for ALUMINUM Station for DCB 34
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 34A
DCB 34C
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

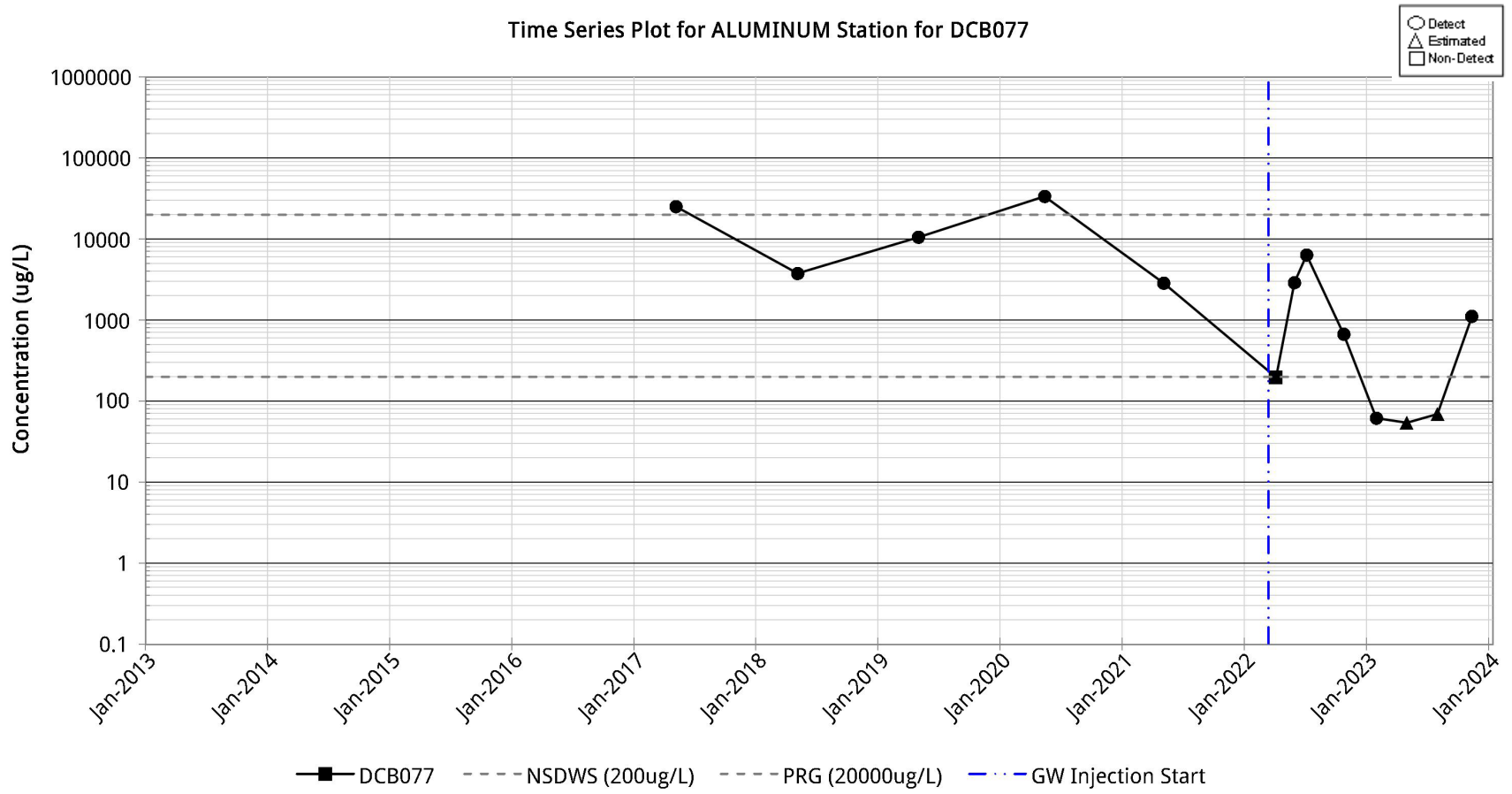

Time Series Plot for ALUMINUM Station for DCB035
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB035D
DCB 35A
DCB 35C
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

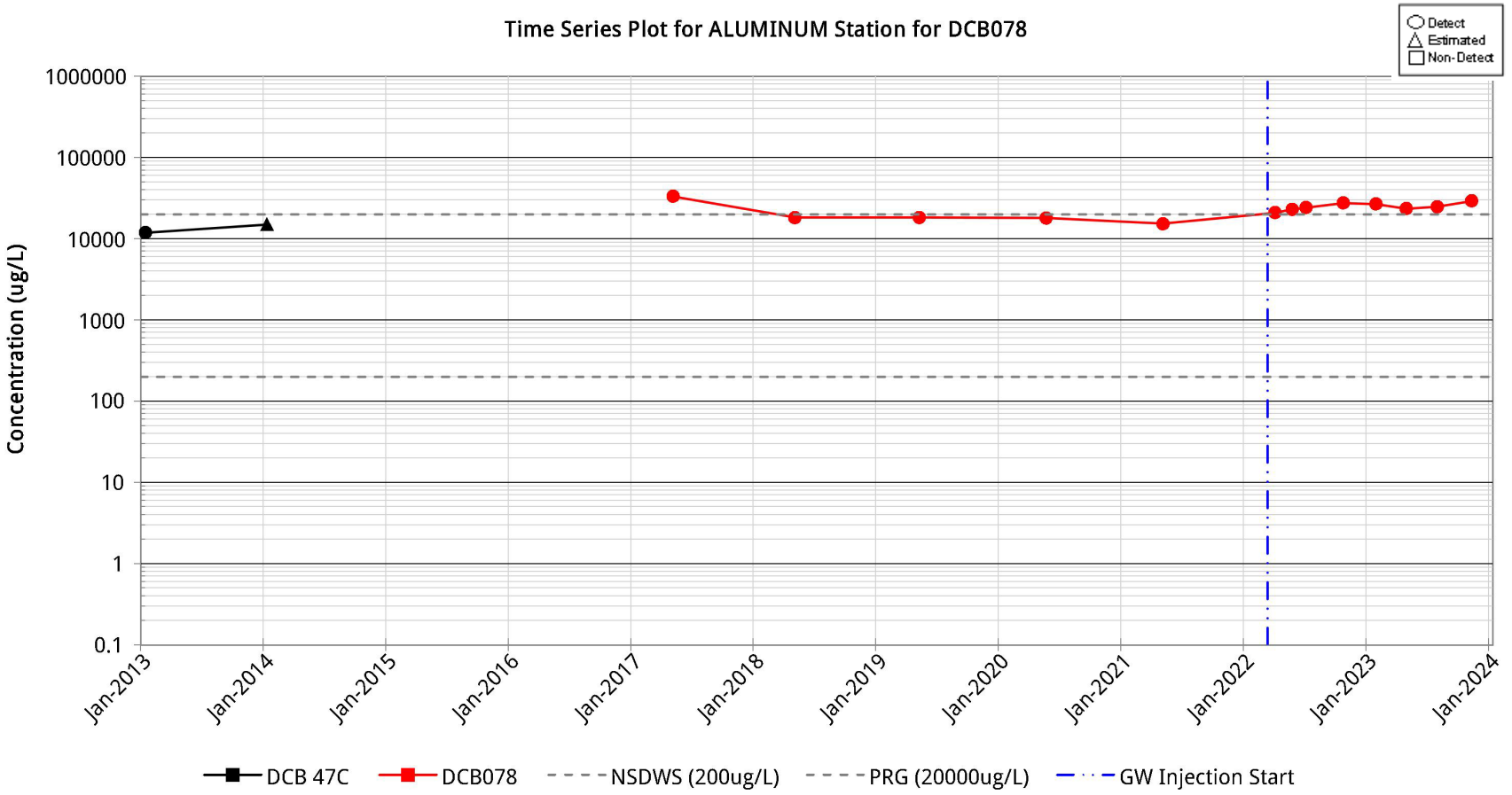

Time Series Plot for ALUMINUM Station for DCB 36
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 36A
DCB 36C
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

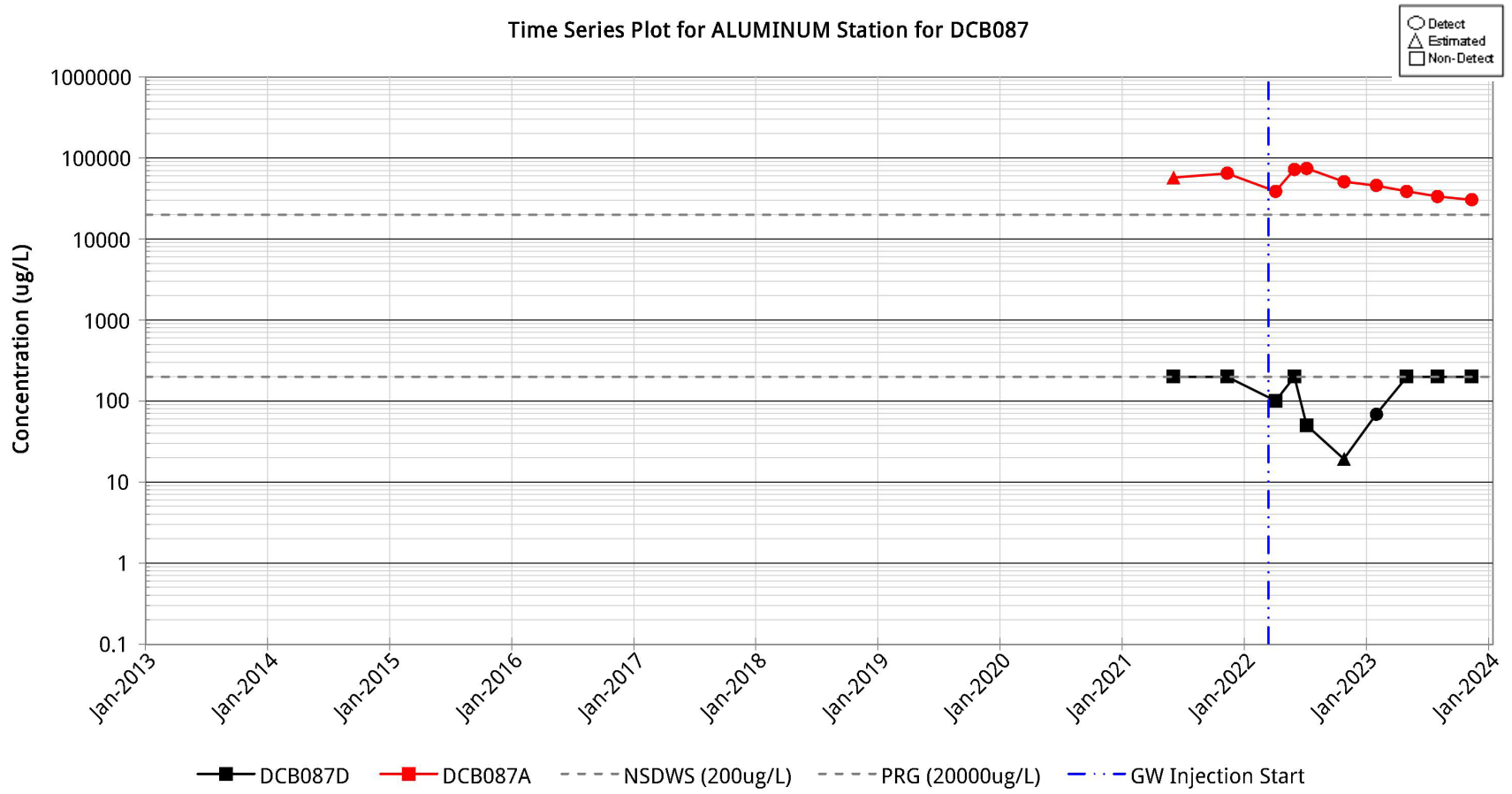

Time Series Plot for ALUMINUM Station for DCB 37
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 37C
DCB 37A
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

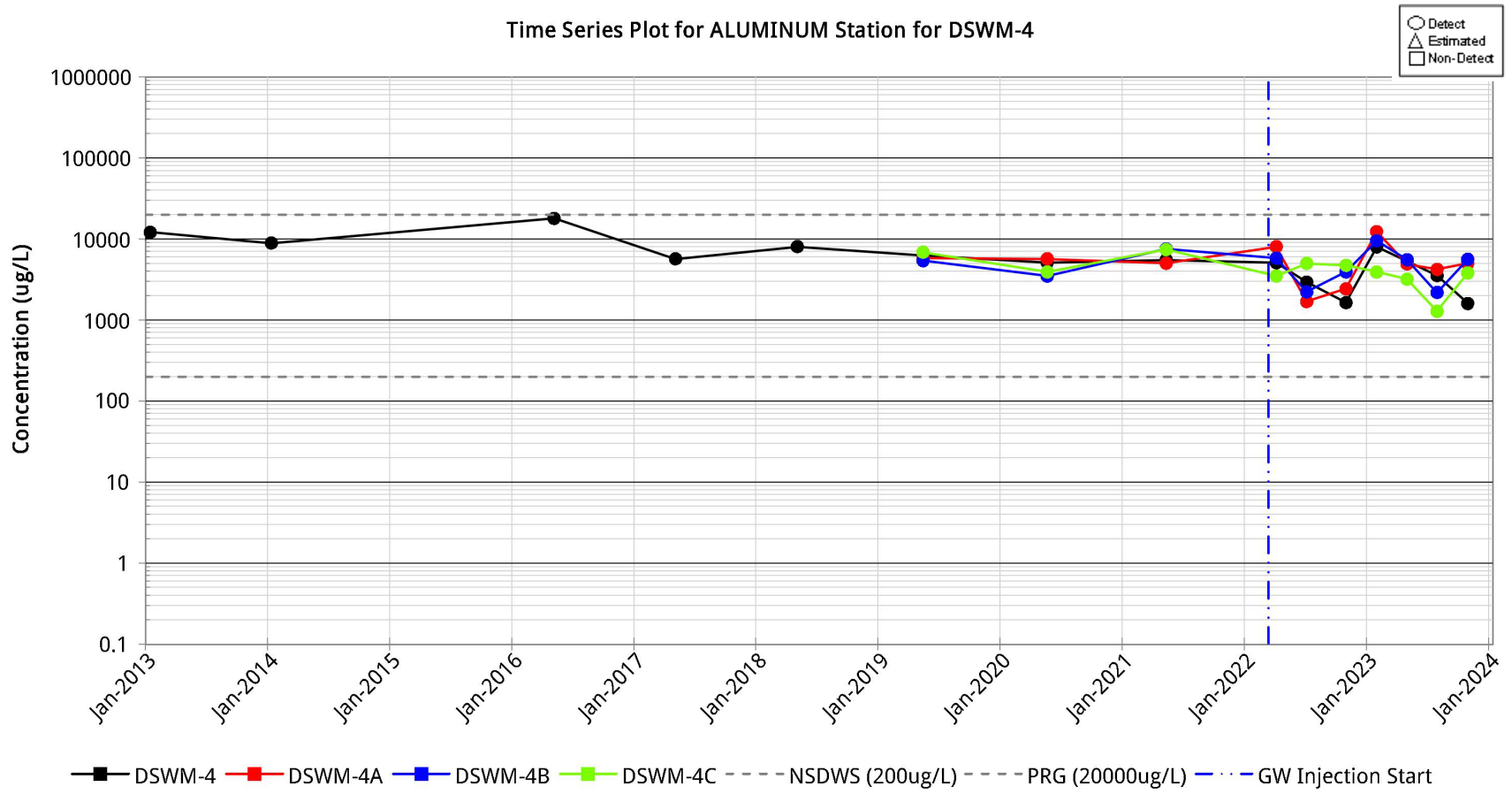

Time Series Plot for ALUMINUM Station for DCB 53
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 53
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

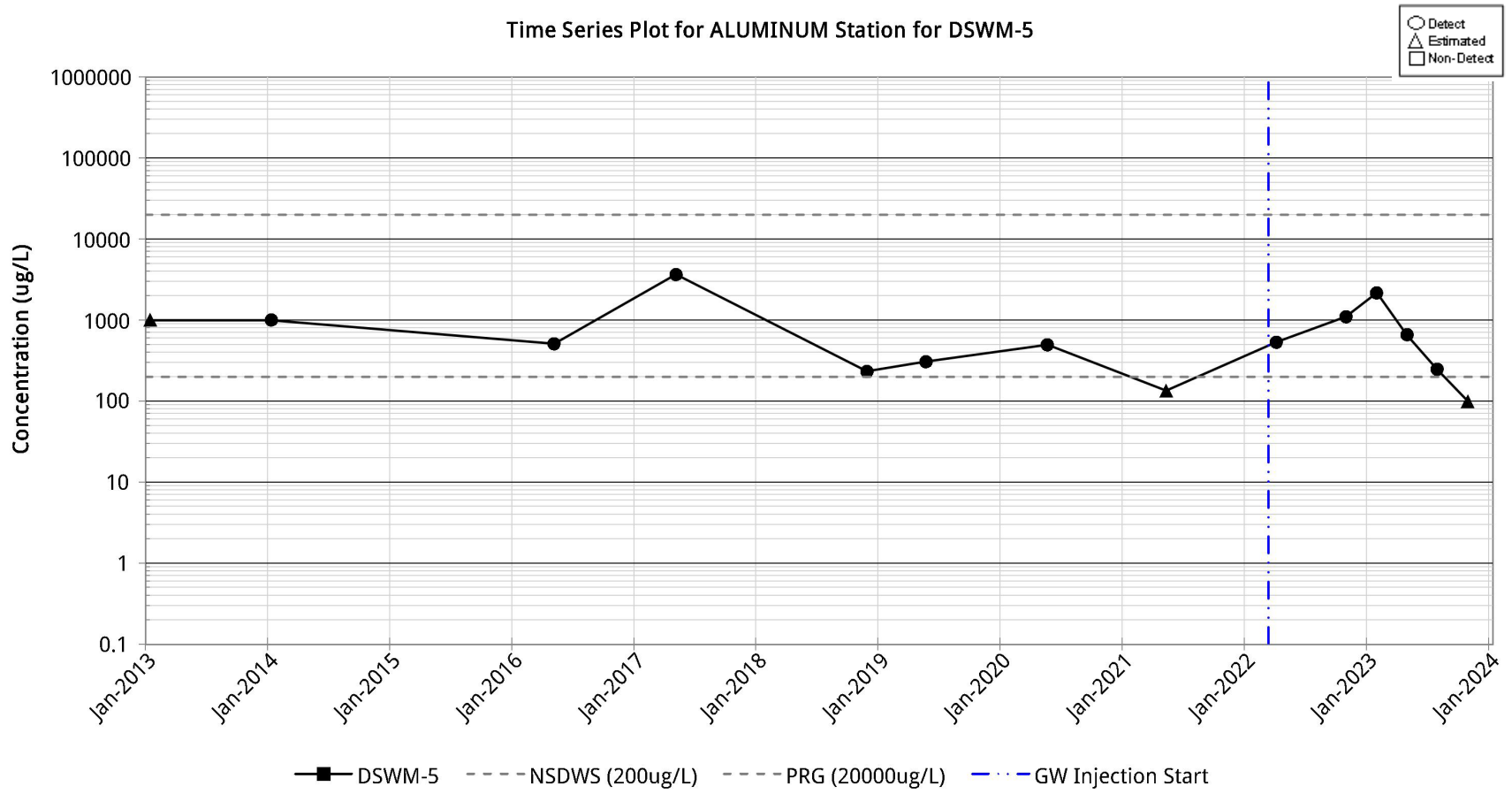

Time Series Plot for ALUMINUM Station for DCB 70
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 70A
DCB 70B
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

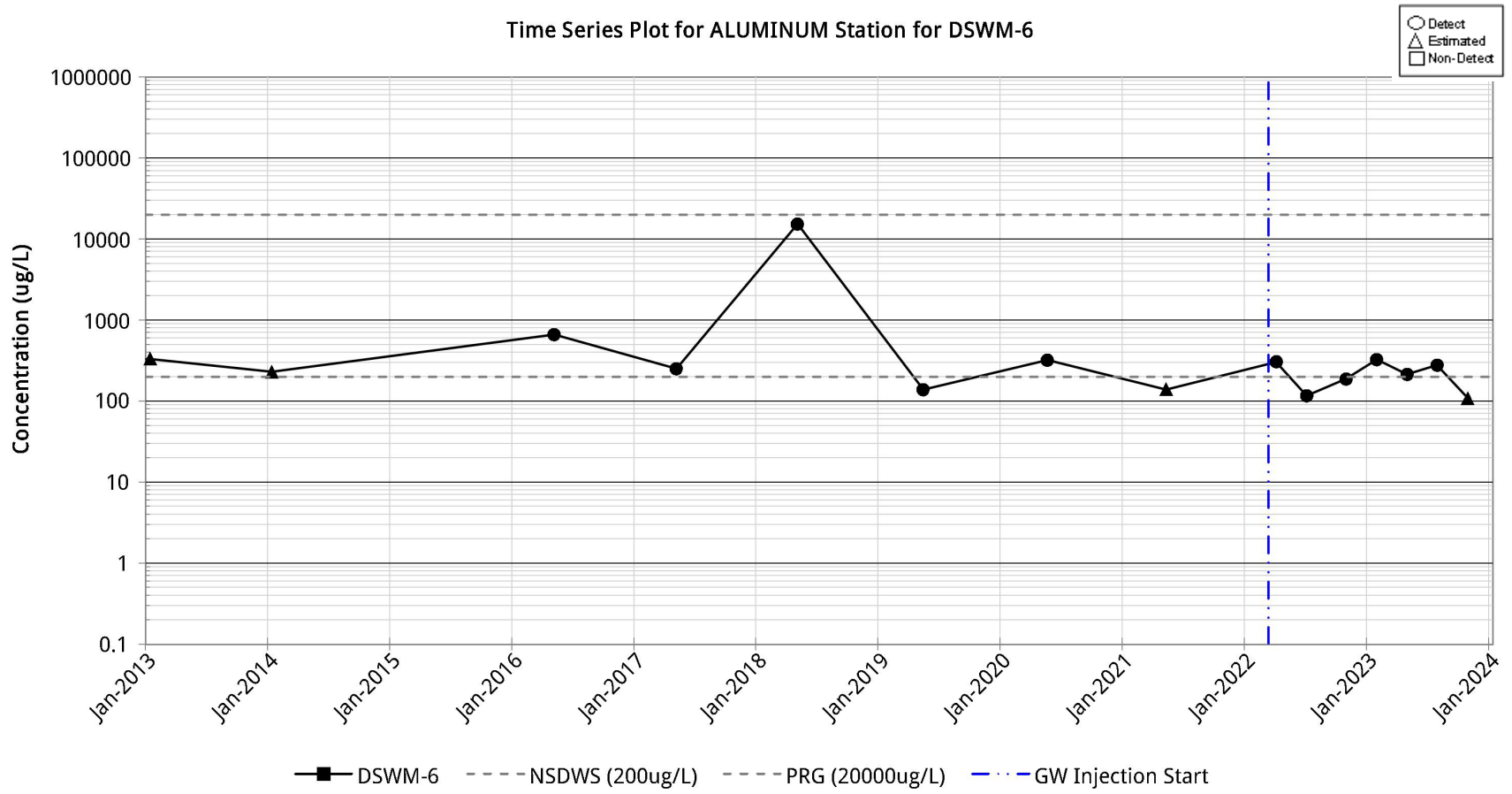

Time Series Plot for ALUMINUM Station for DCB077
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB077
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

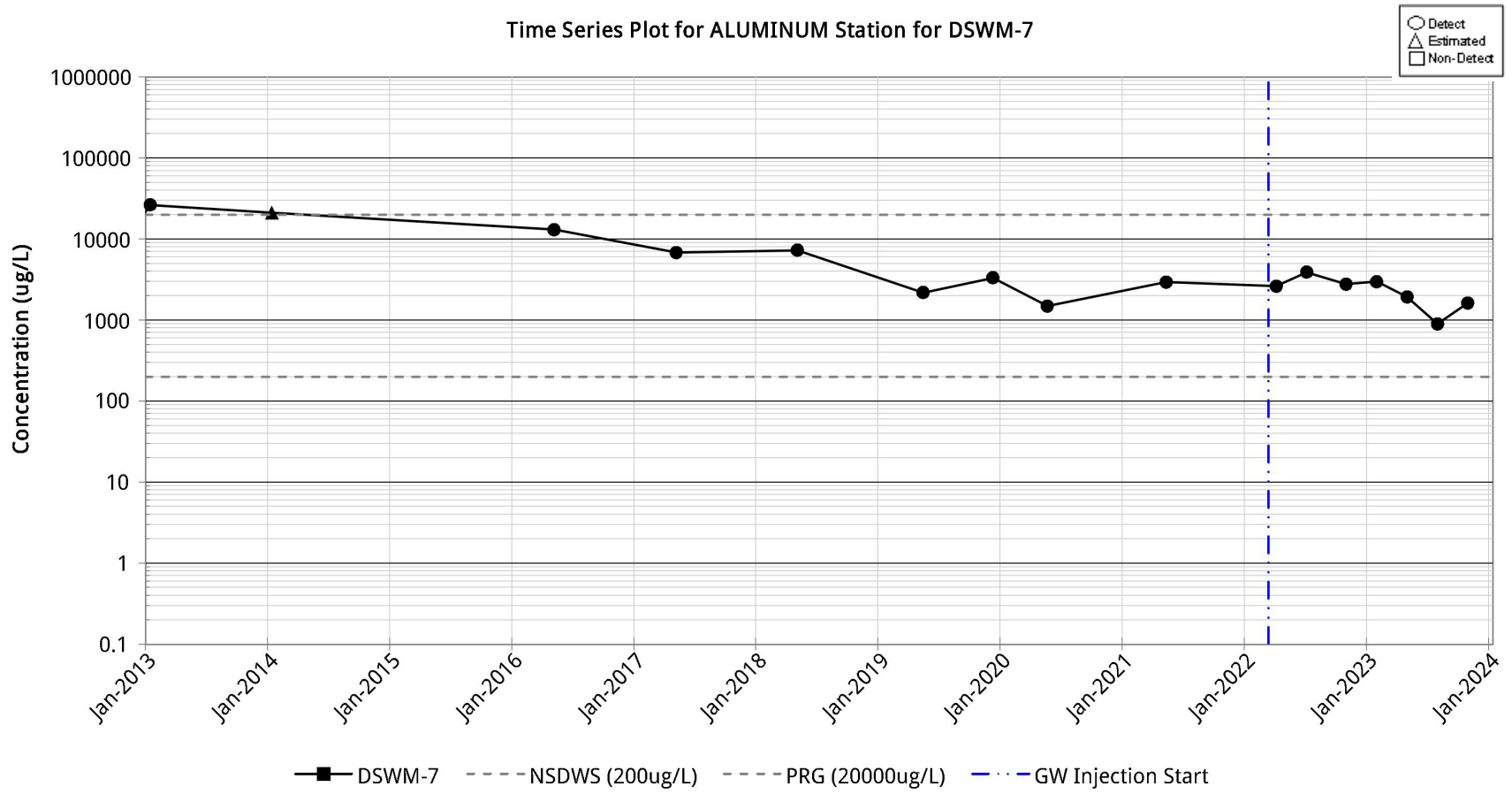

Time Series Plot for ALUMINUM Station for DCB078
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 47C
DCB078
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

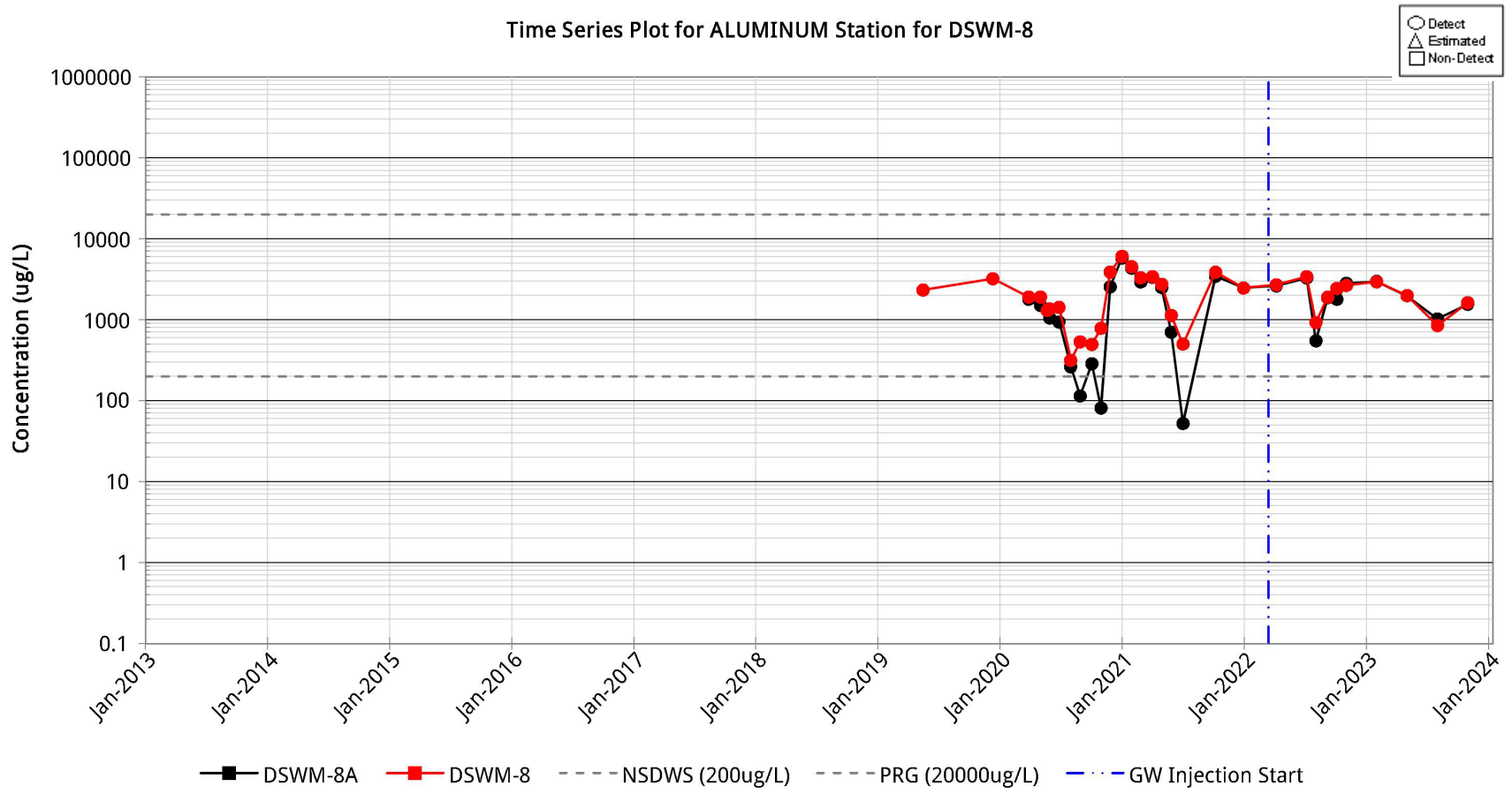

Time Series Plot for ALUMINUM Station for DCB087
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB087D
DCB087A
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

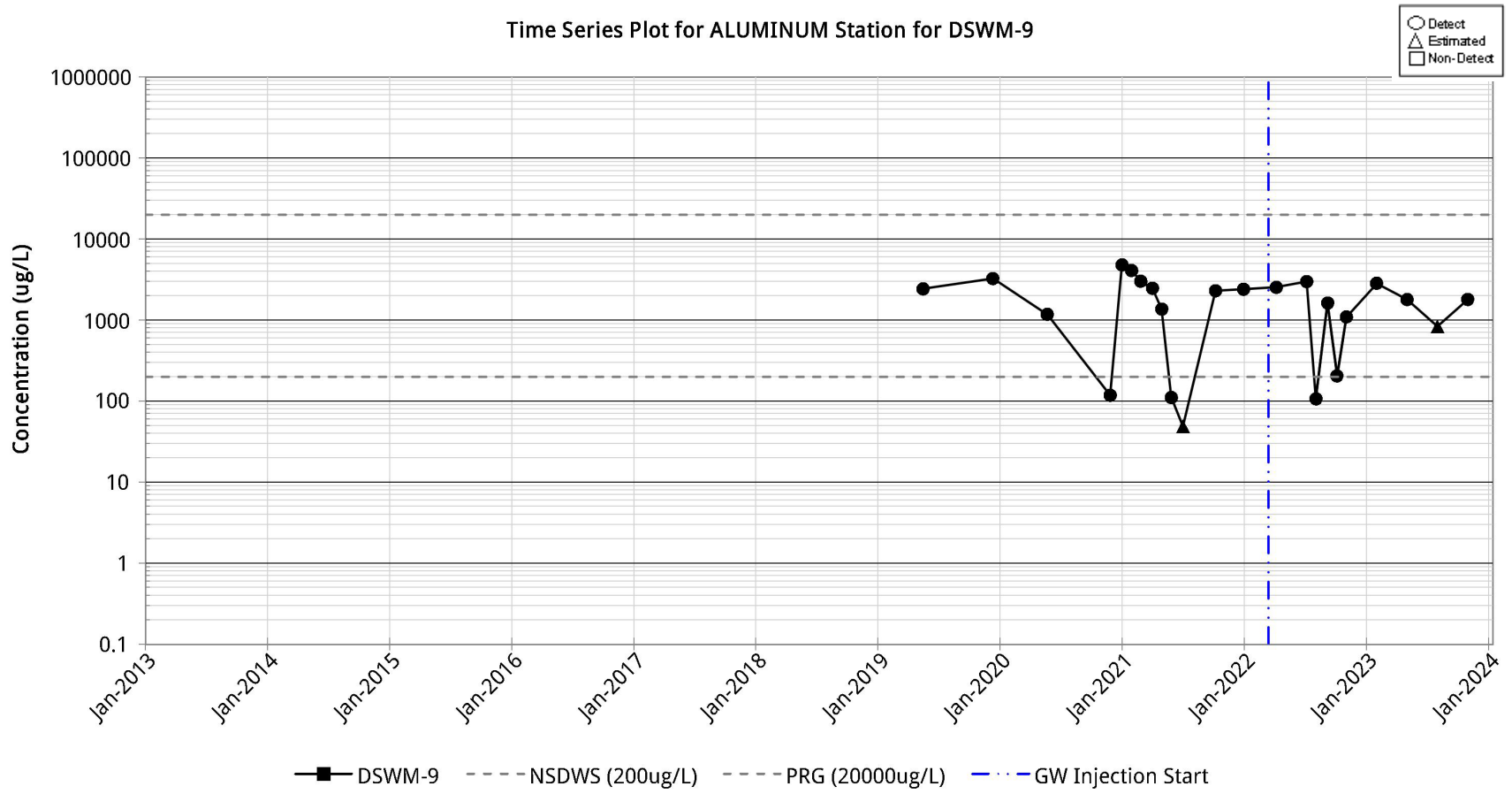

Time Series Plot for ALUMINUM Station for DSWM-4
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-4
DSWM-4A
DSWM-4B
DSWM-4C
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

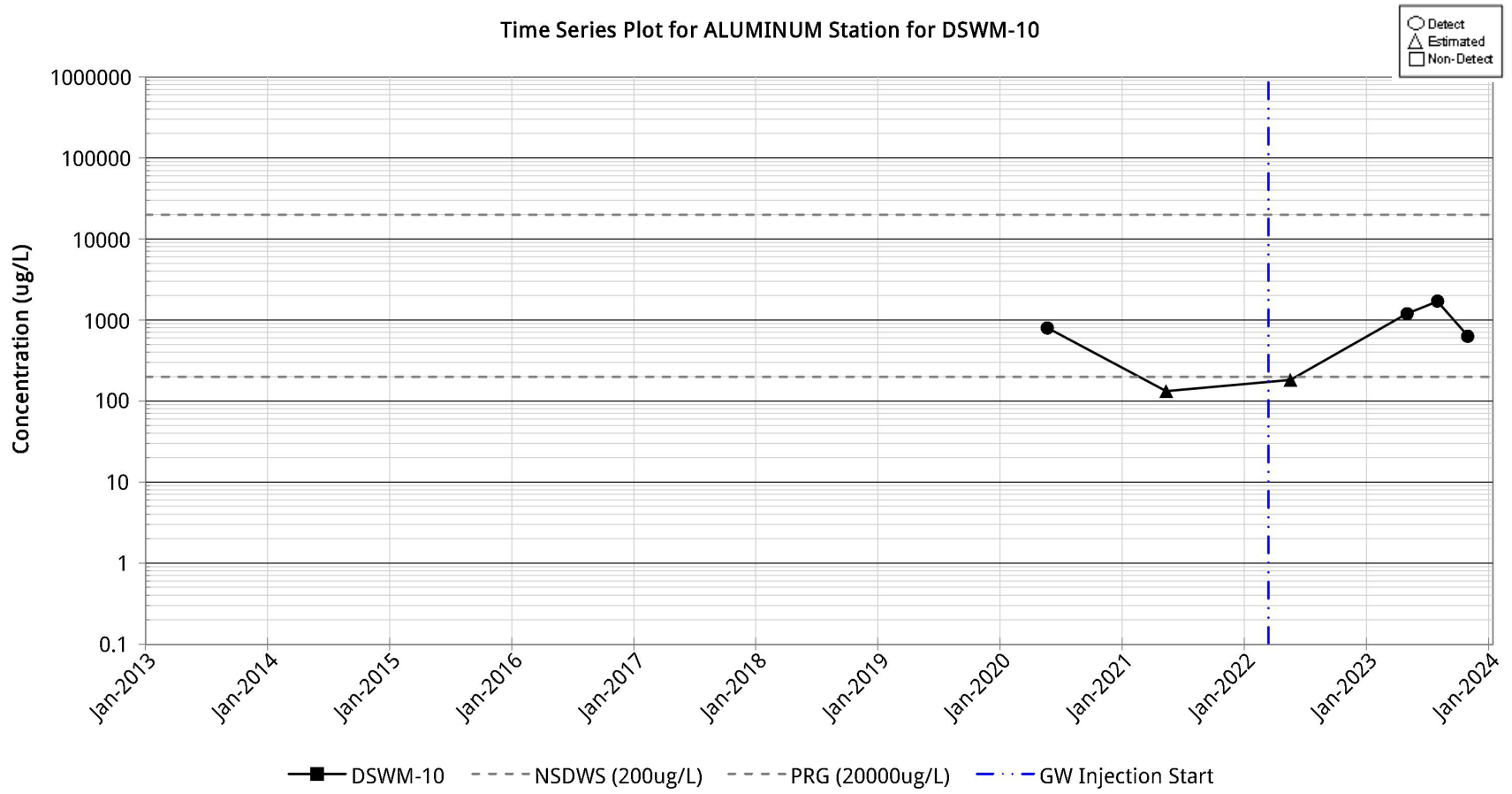

Time Series Plot for ALUMINUM Station for DSWM-5
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-5
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

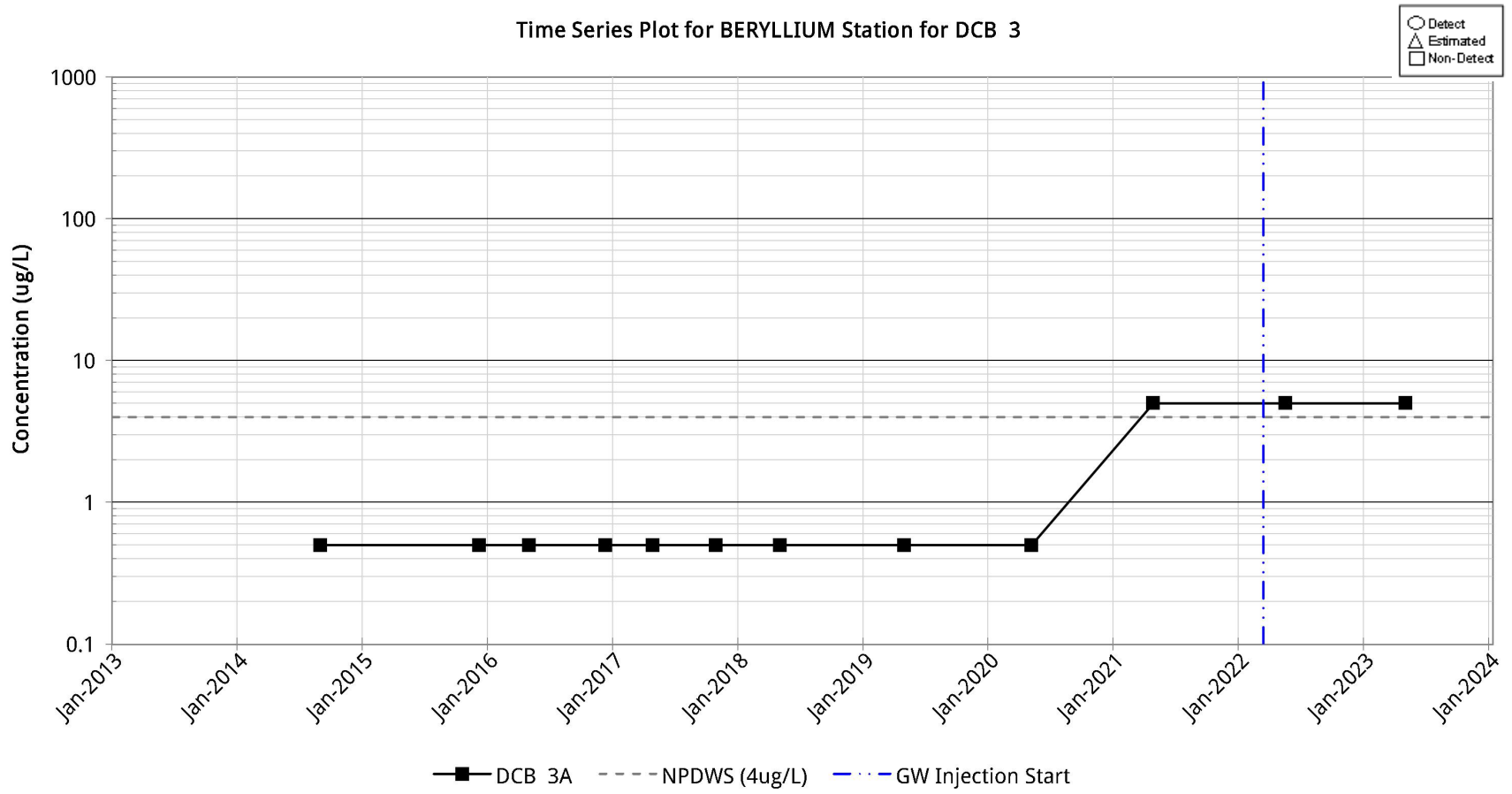

Time Series Plot for ALUMINUM Station for DSWM-6
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-6
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

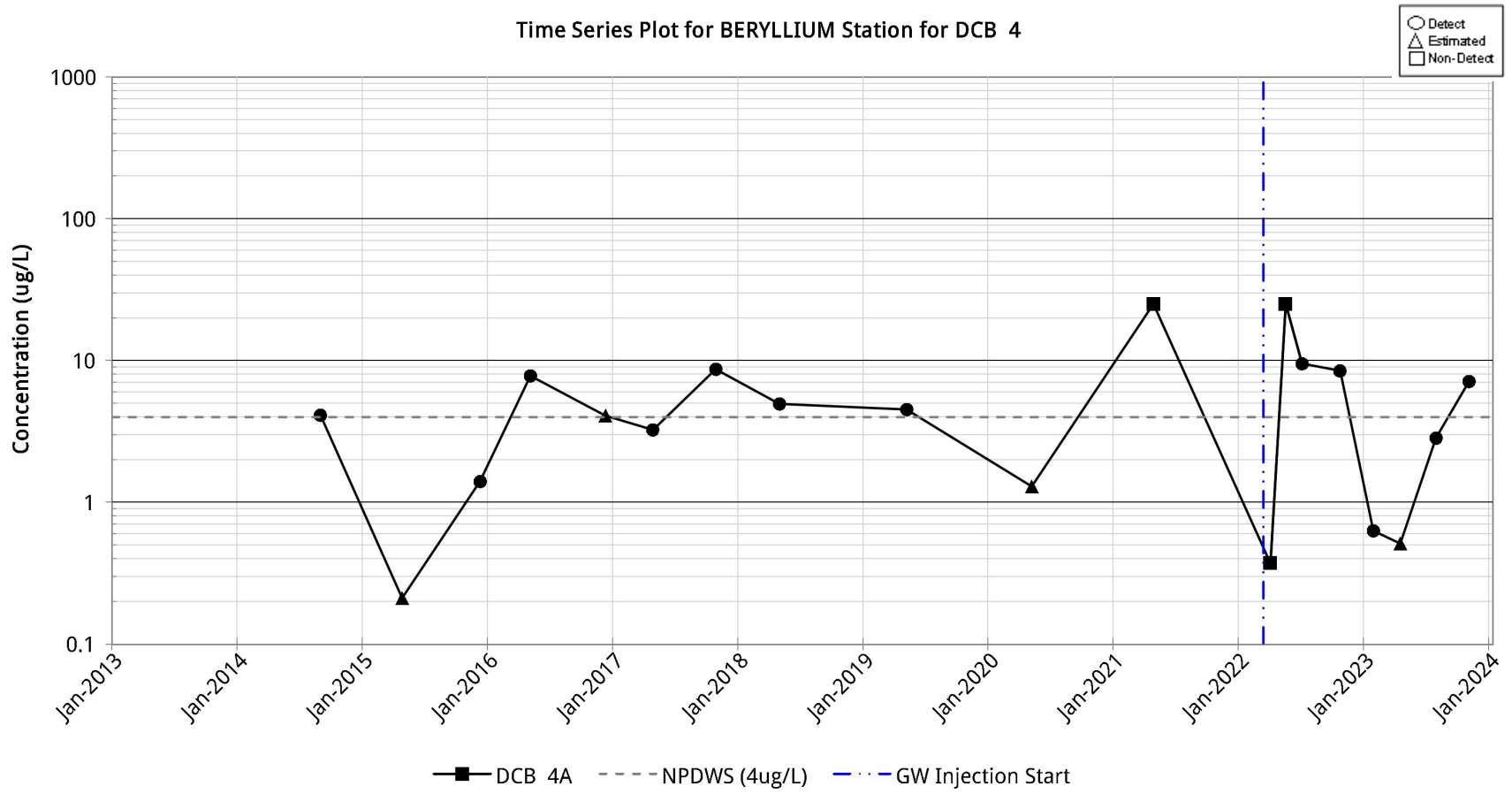

Time Series Plot for ALUMINUM Station for DSWM-7
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-7
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

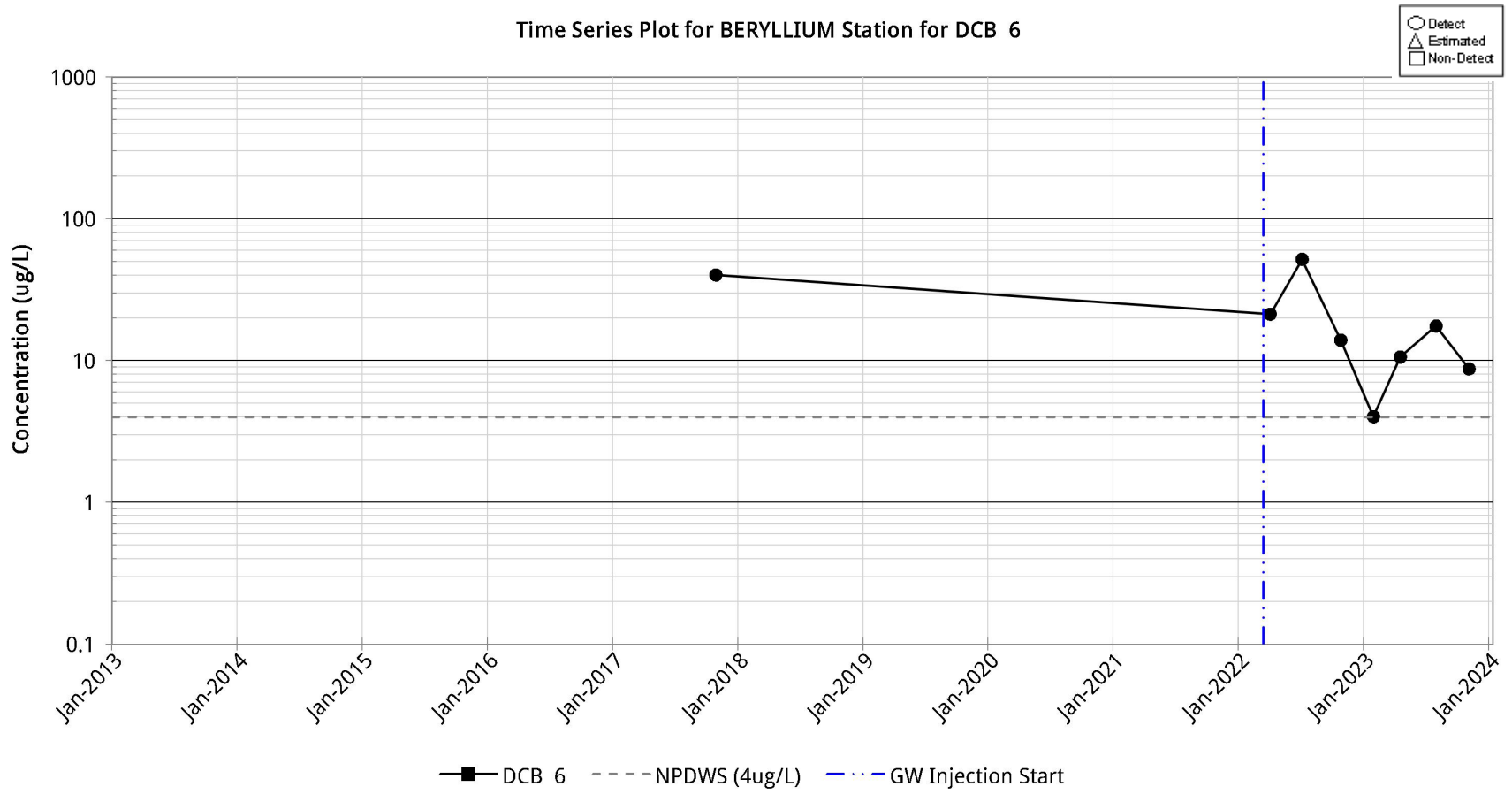

Time Series Plot for ALUMINUM Station for DSWM-8
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-8A
DSWM-8
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

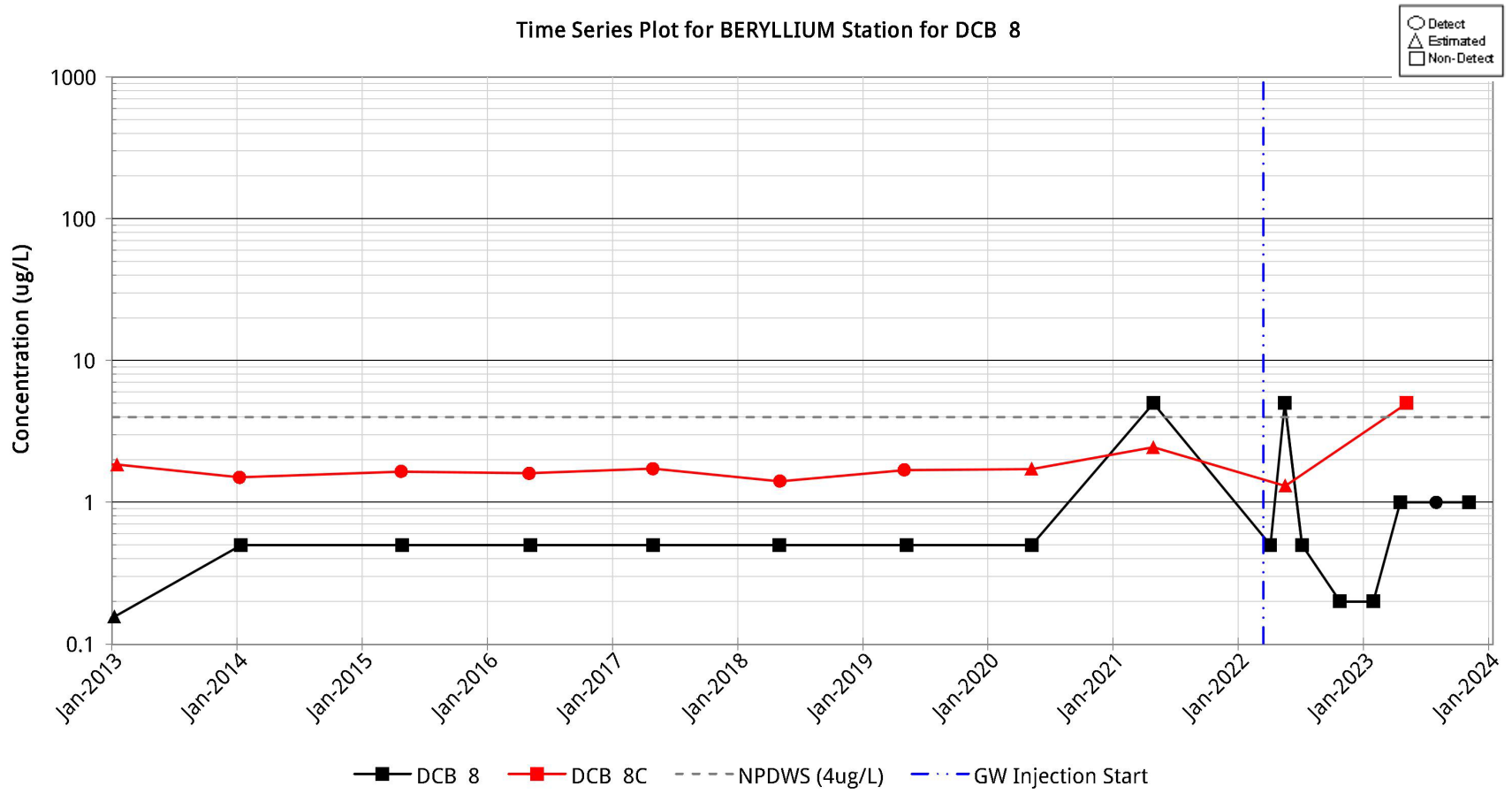

Time Series Plot for ALUMINUM Station for DSWM-9
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-9
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

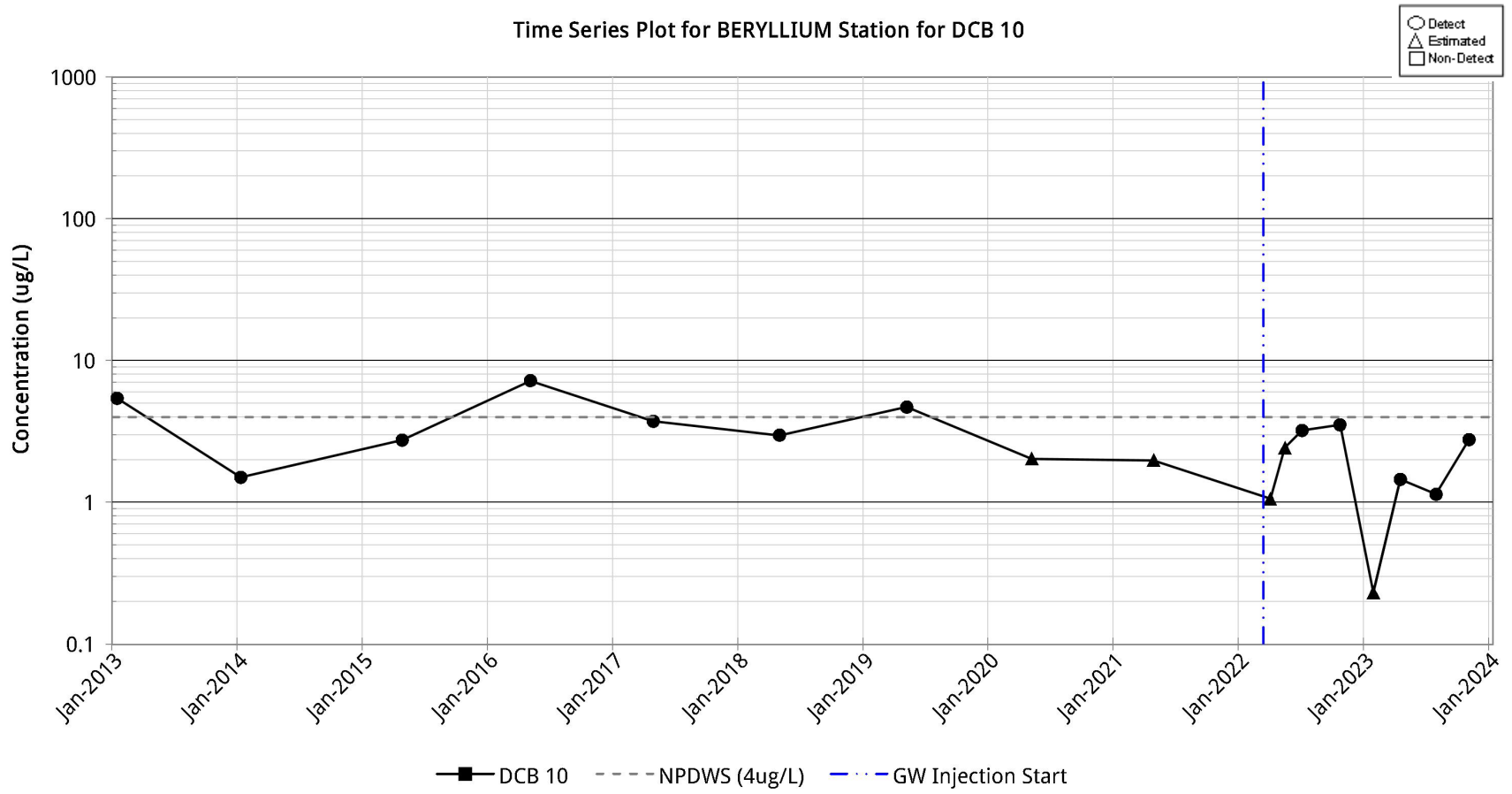

Time Series Plot for ALUMINUM Station for DSWM-10
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-10
NSDWS (200ug/L)
PRG (20000ug/L)
GW Injection Start

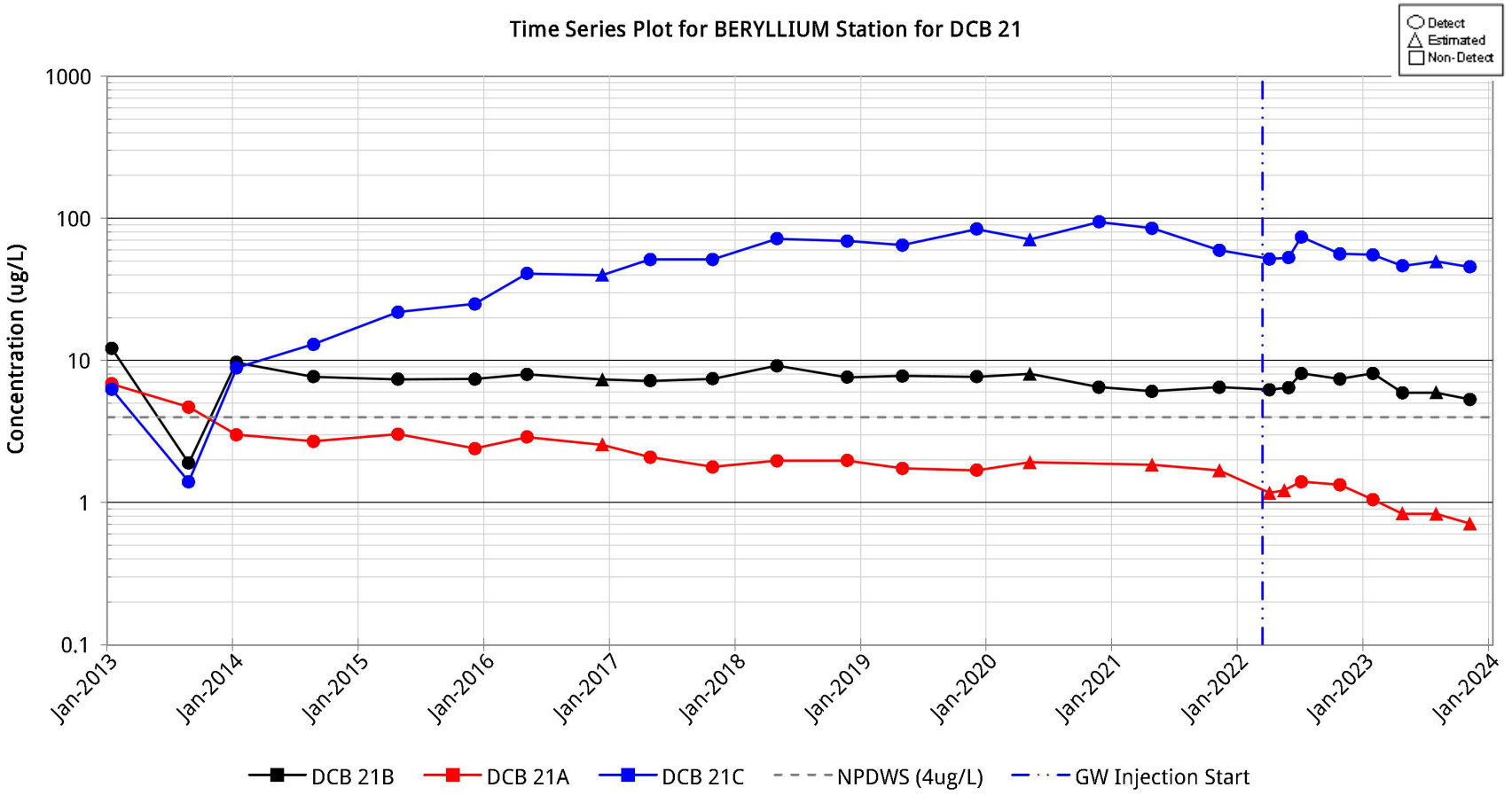

Time Series Plot for BERYLLIUM Station for DCB 3
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 3A
NPDWS (4ug/L)
GW Injection Start

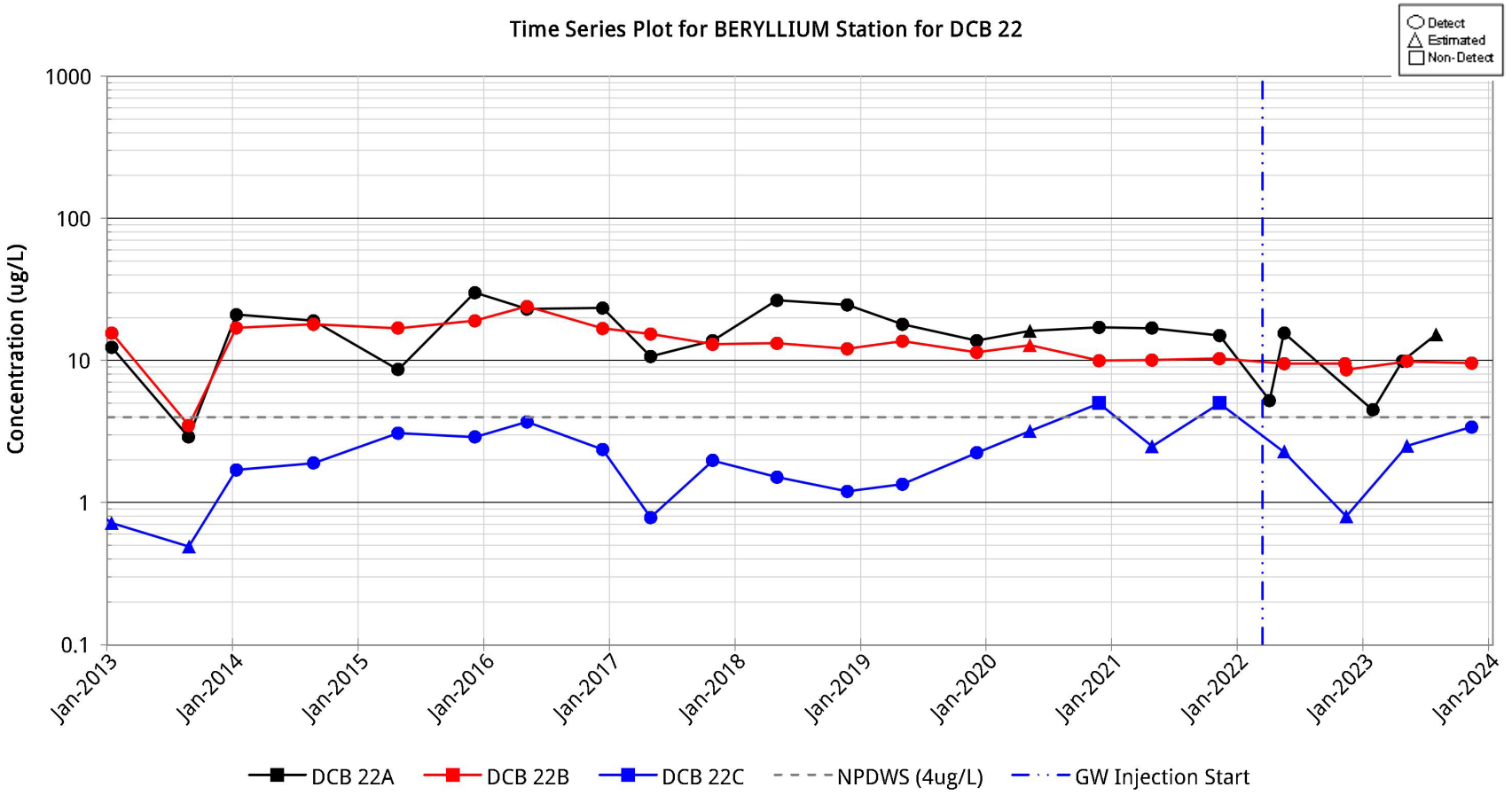

Time Series Plot for BERYLLIUM Station for DCB 4
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 4A
NPDWS (4ug/L)
GW Injection Start

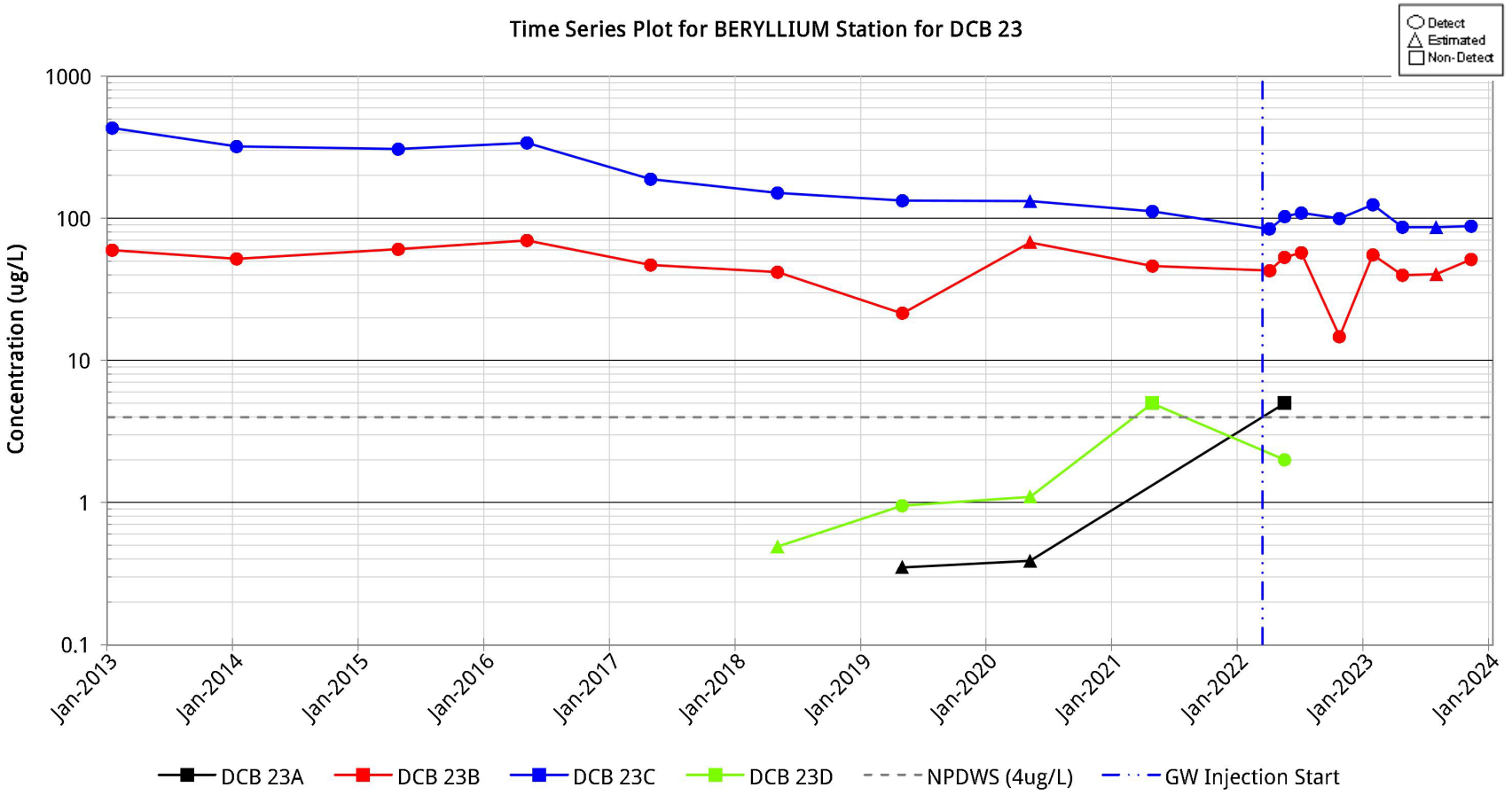

Time Series Plot for BERYLLIUM Station for DCB 6
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 6
NPDWS (4ug/L)
GW Injection Start

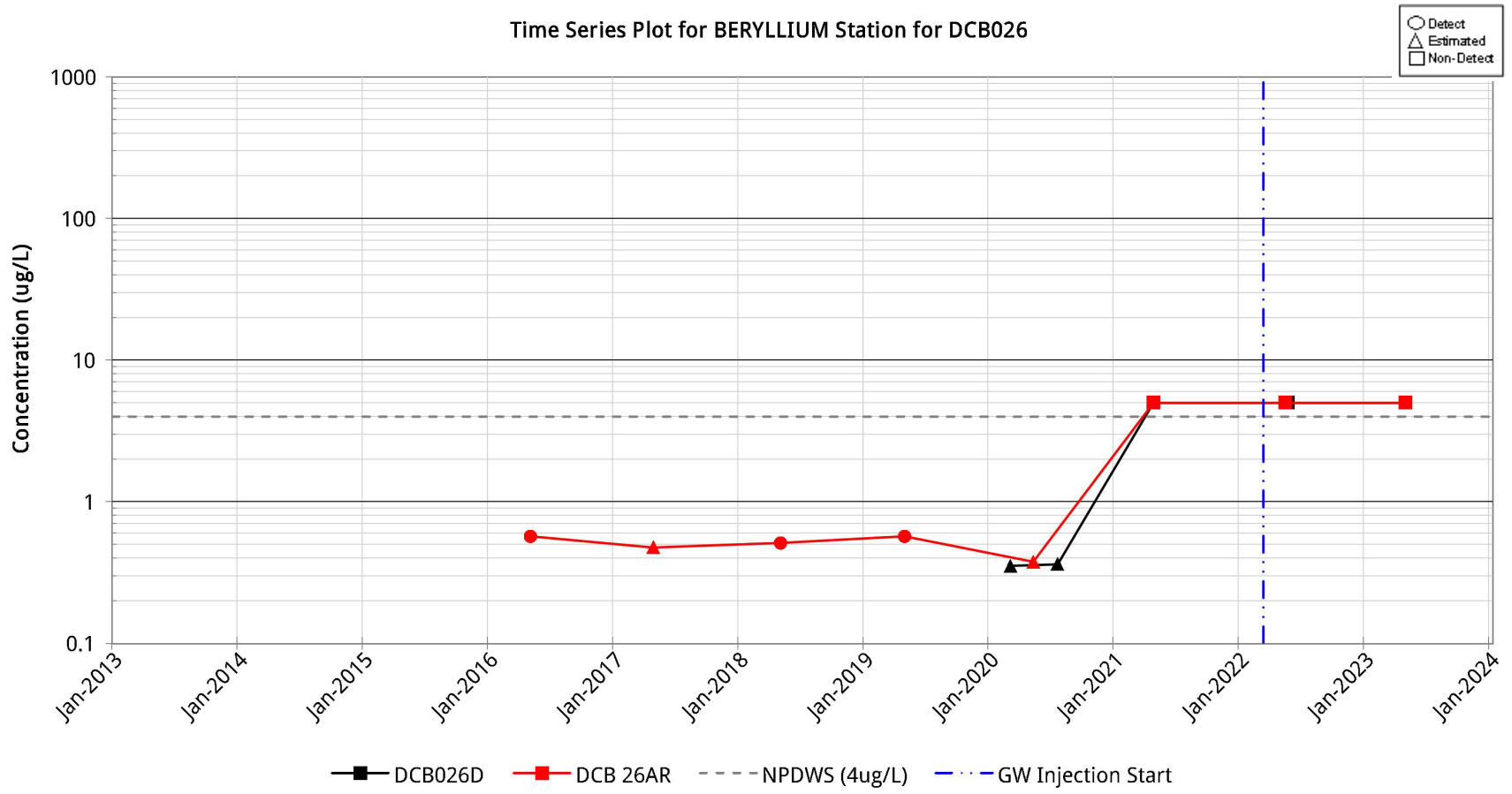

Time Series Plot for BERYLLIUM Station for DCB 8
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 8
DCB 8C
NPDWS (4ug/L)
GW Injection Start

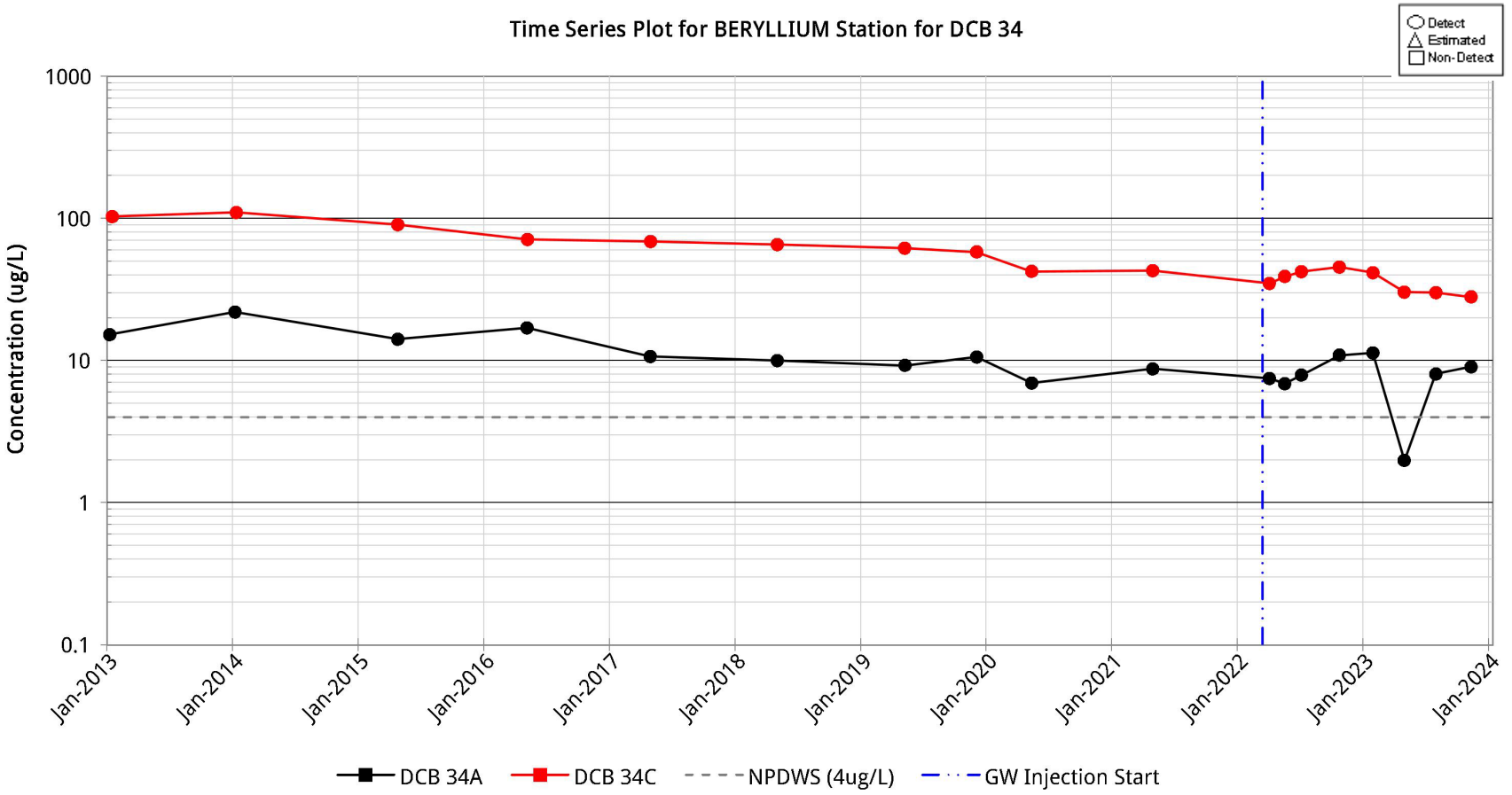

Time Series Plot for BERYLLIUM Station for DCB 10
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 10
NPDWS (4ug/L)
GW Injection Start

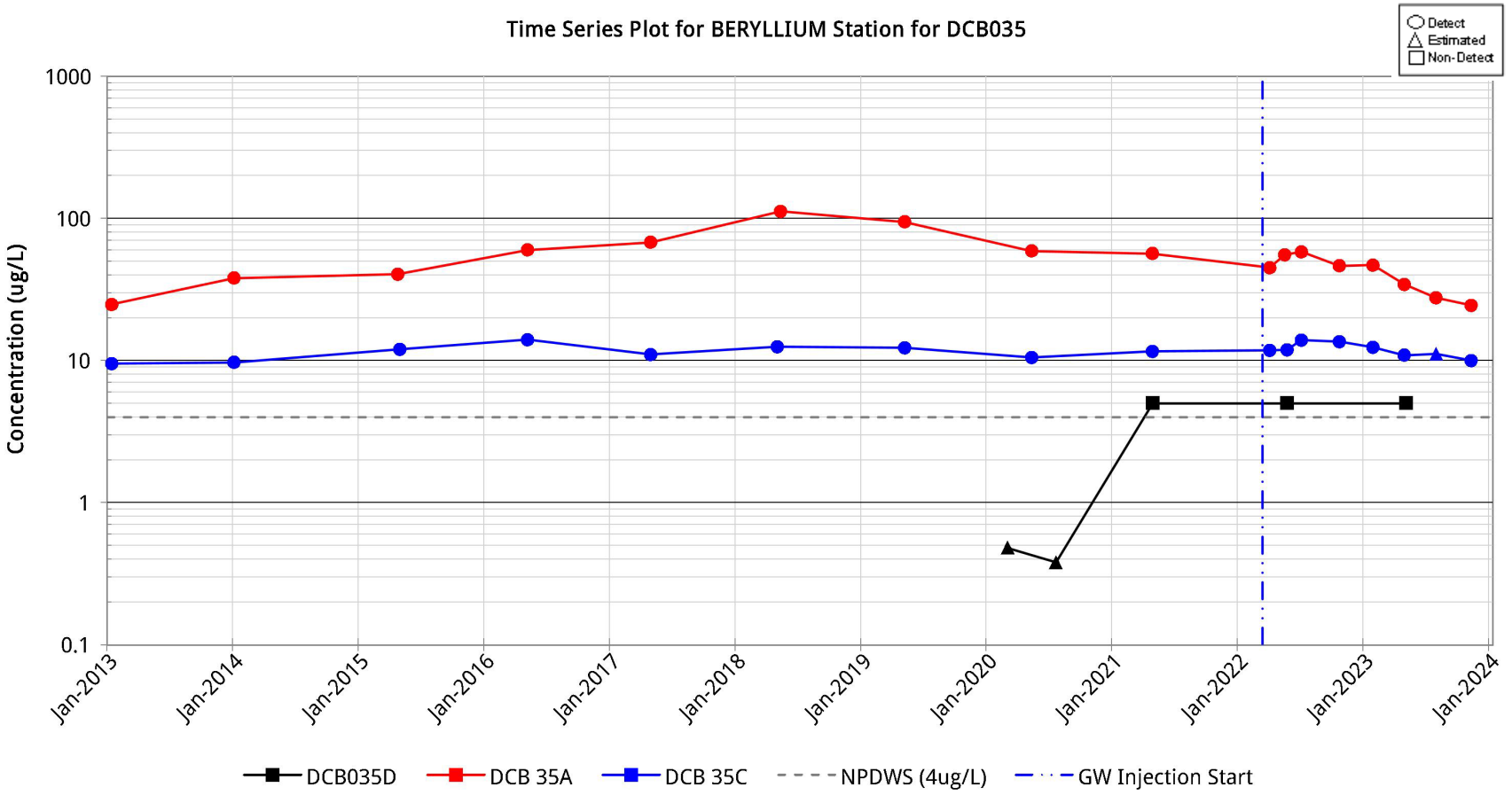

Time Series Plot for BERYLLIUM Station for DCB 21
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 21B
DCB 21A
DCB 21C
NPDWS (4ug/L)
GW Injection Start

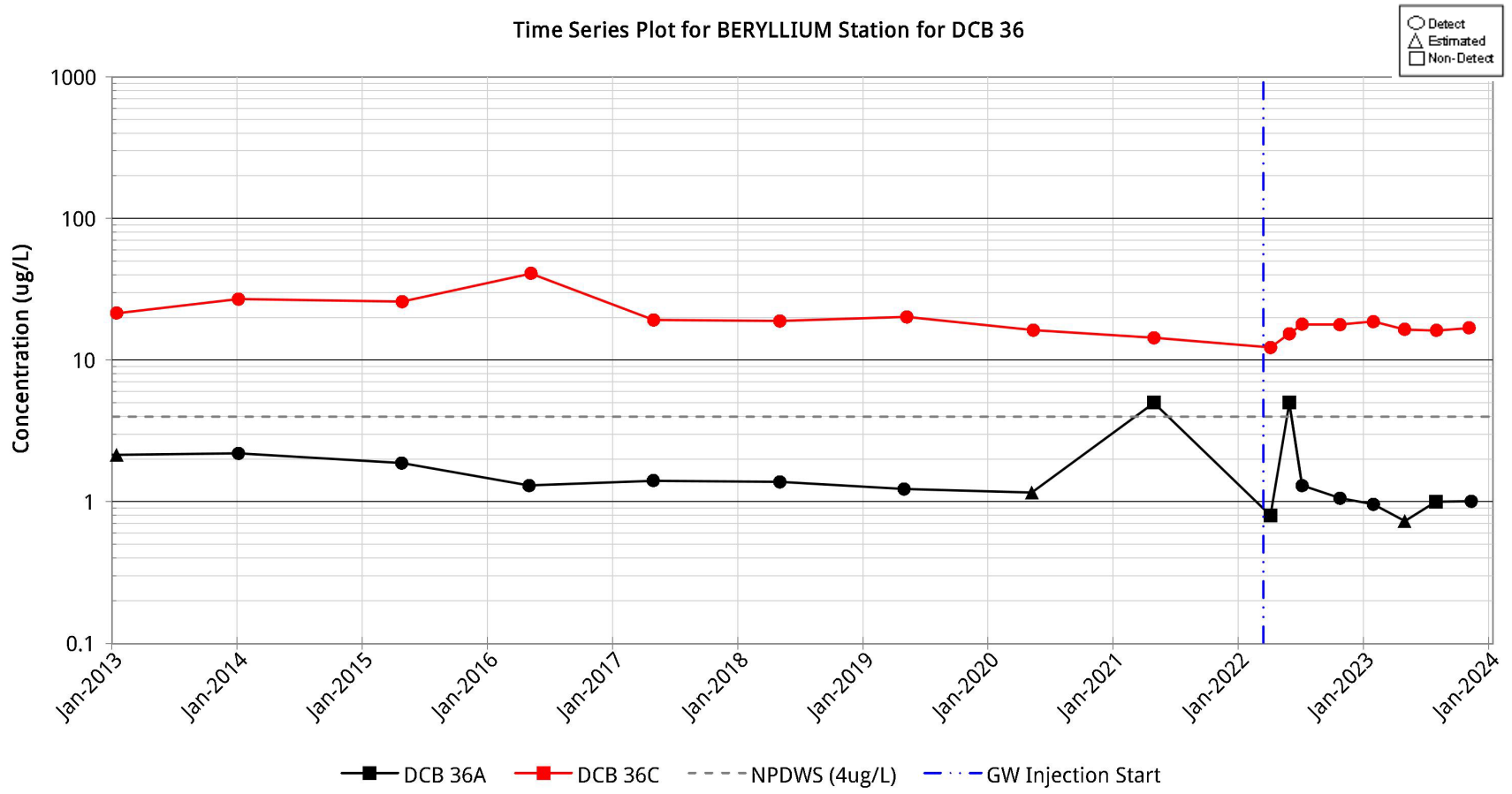

Time Series Plot for BERYLLIUM Station for DCB 22
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 22A
DCB 22B
DCB 22C
NPDWS (4ug/L)
GW Injection Start

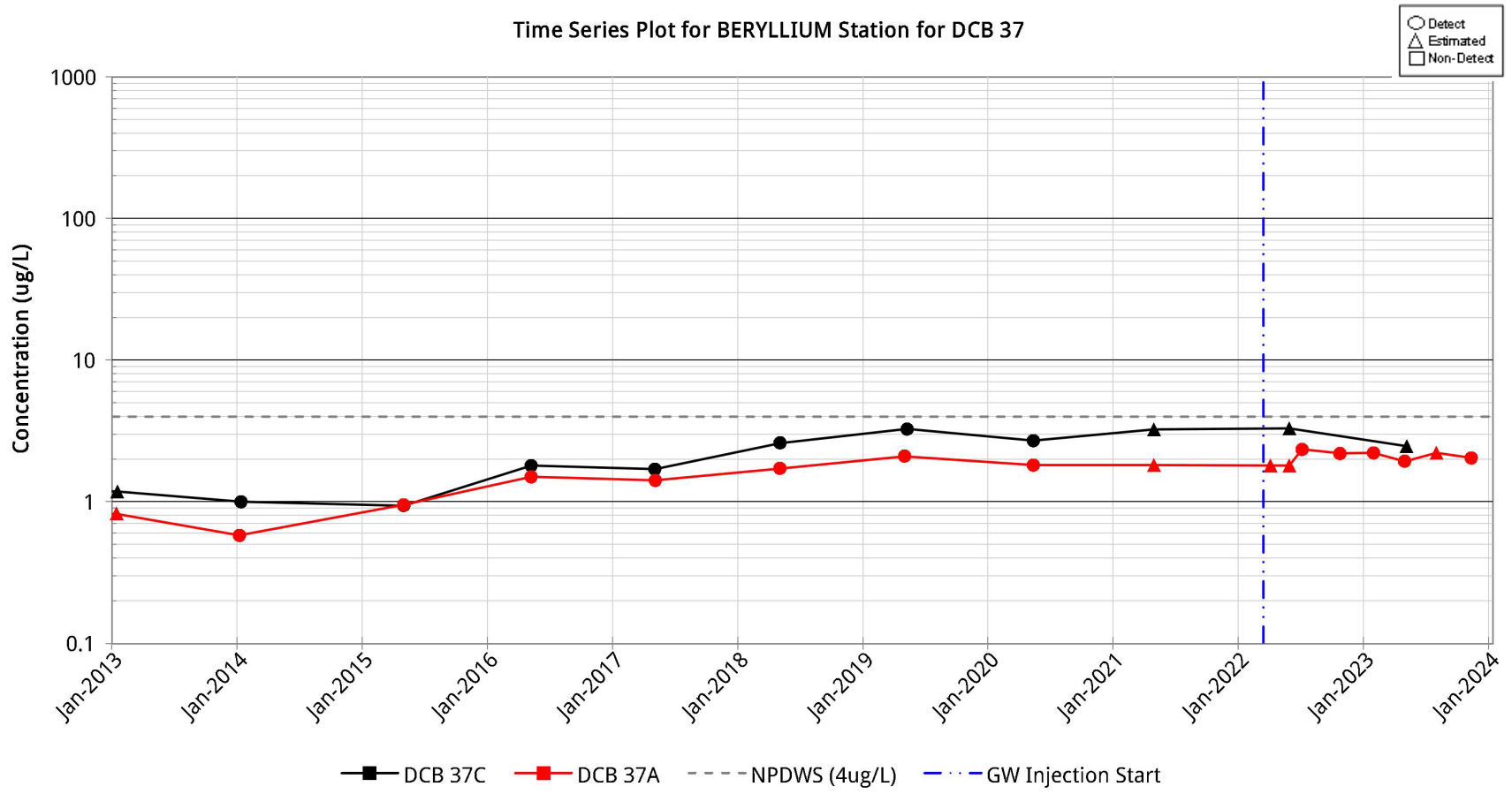

Time Series Plot for BERYLLIUM Station for DCB 23
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 23A
DCB 23B
DCB 23C
DCB 23D
NPDWS (4ug/L)
GW Injection Start

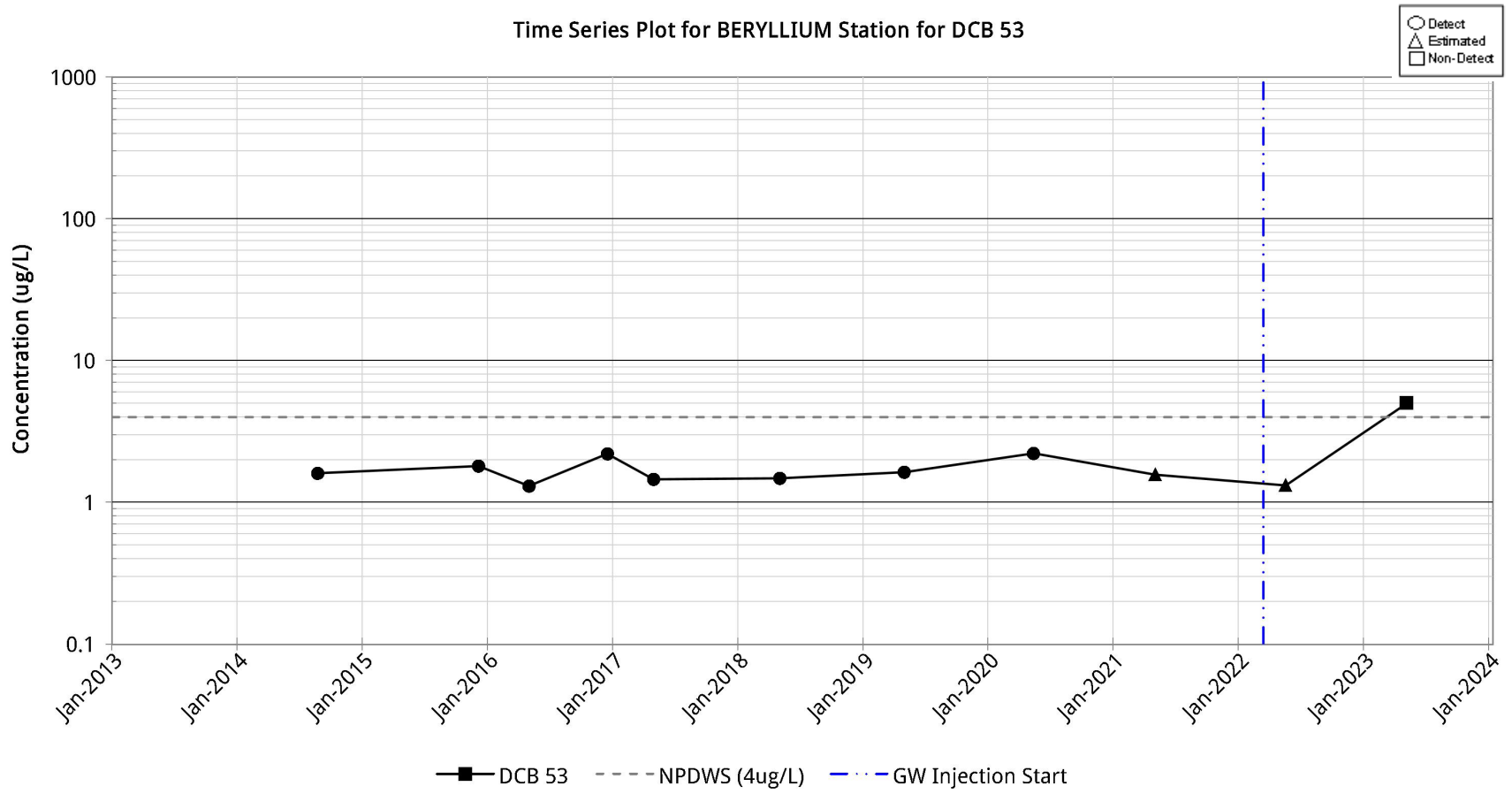

Time Series Plot for BERYLLIUM Station for DCB026
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB026D
DCB 26AR
NPDWS (4ug/L)
GW Injection Start

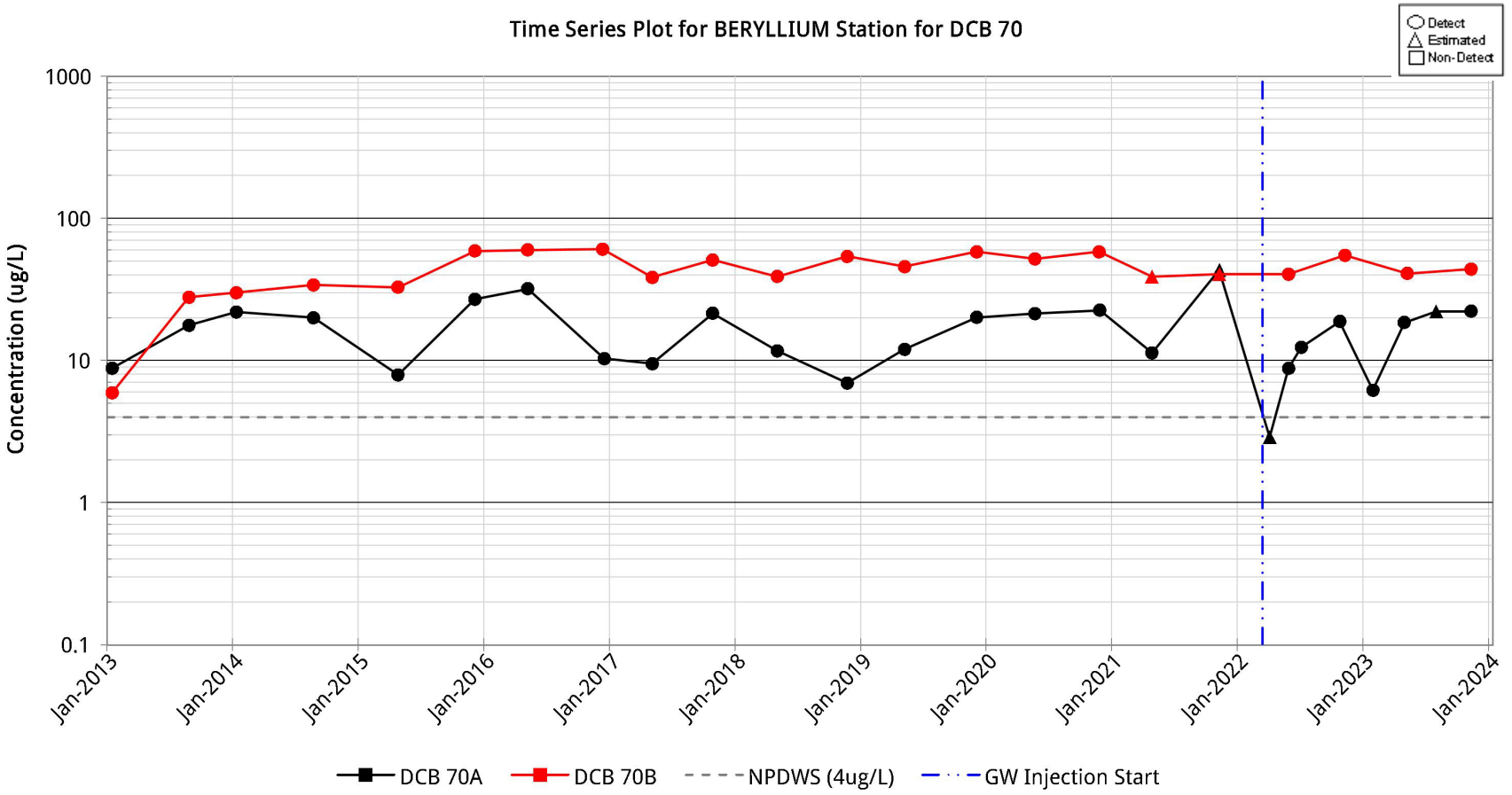

Time Series Plot for BERYLLIUM Station for DCB 34
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 34A
DCB 34C
NPDWS (4ug/L)
GW Injection Start

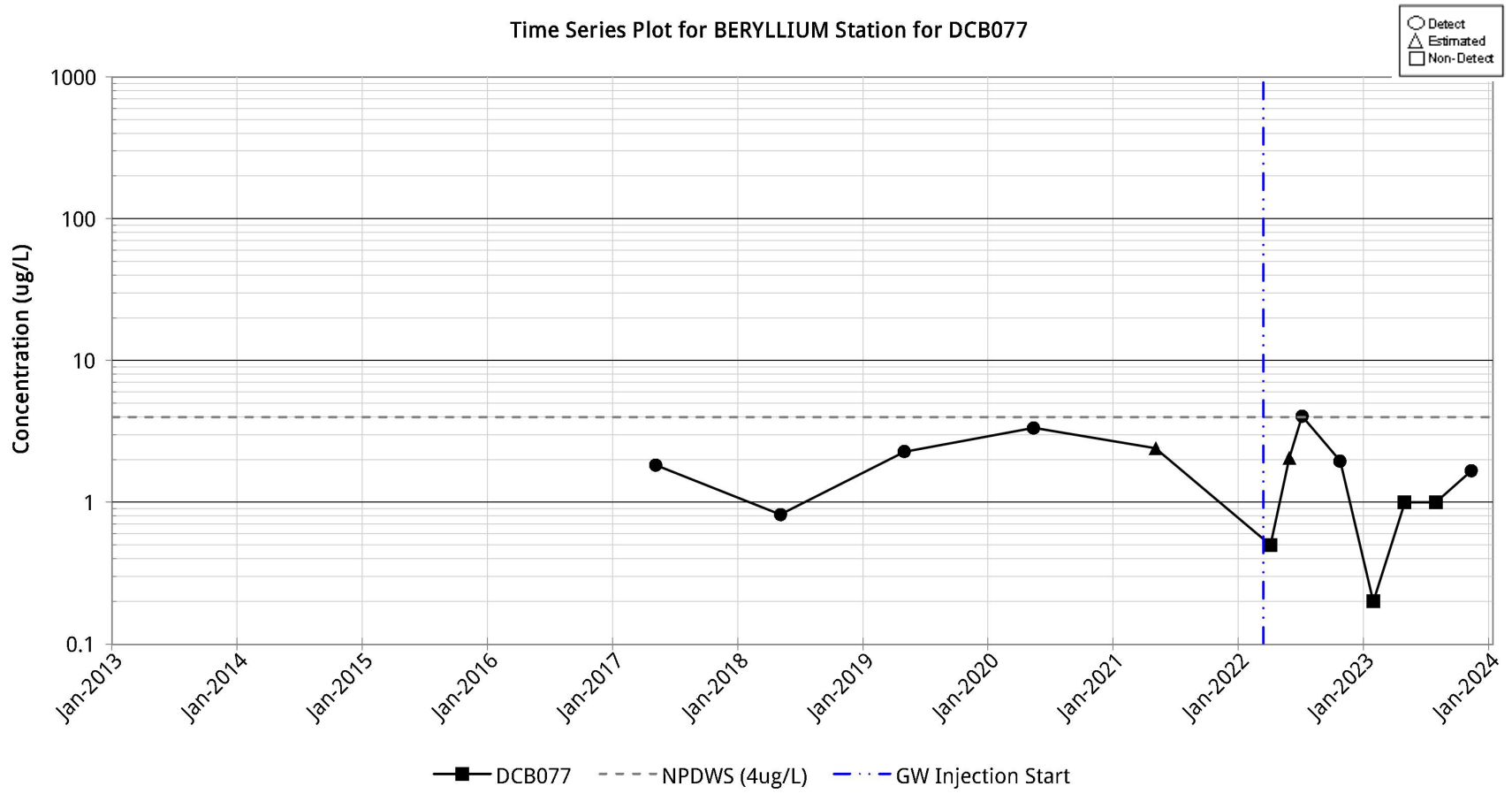

Time Series Plot for BERYLLIUM Station for DCB035
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB035D
DCB 35A
DCB 35C
NPDWS (4ug/L)
GW Injection Start

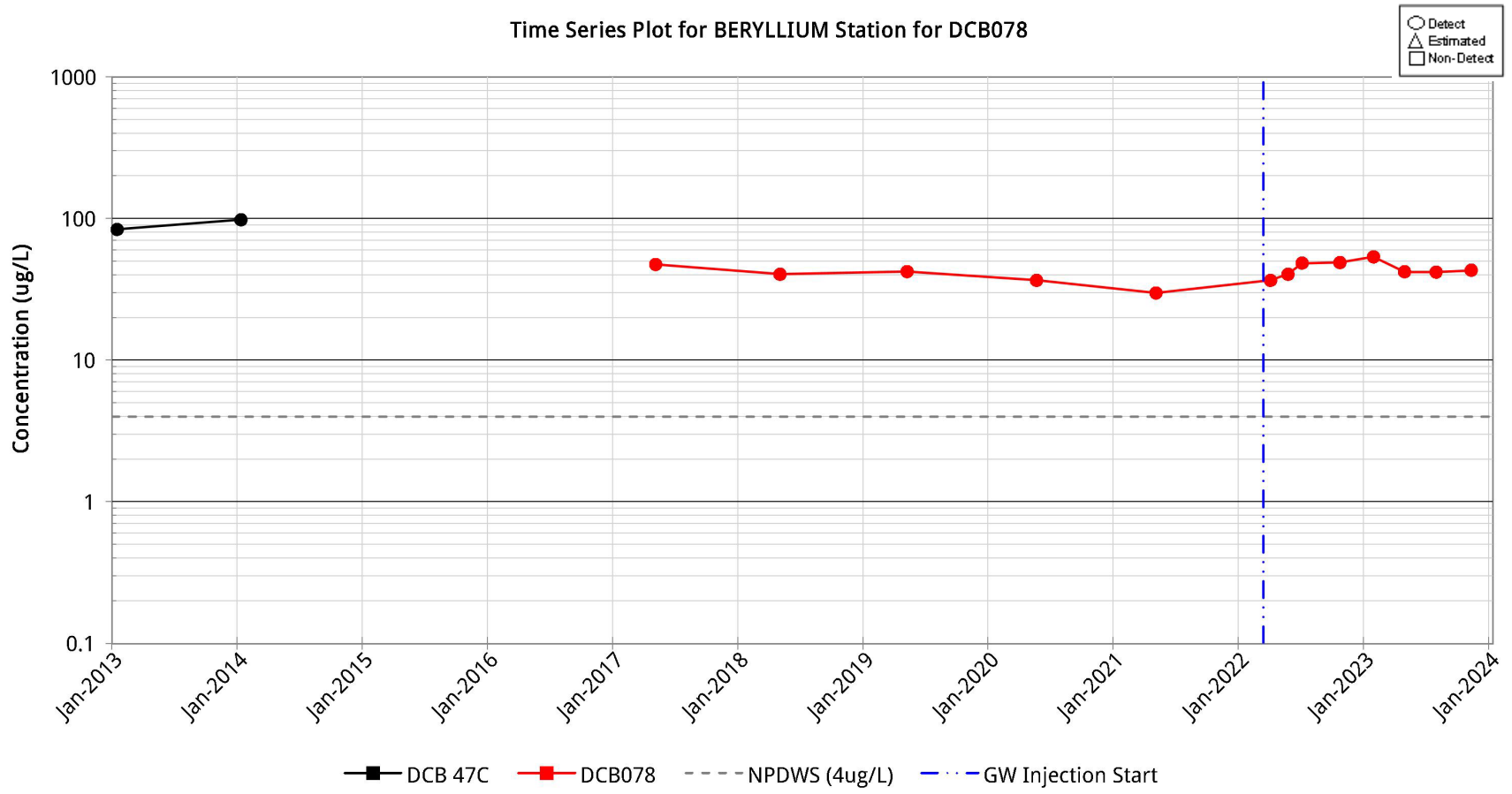

Time Series Plot for BERYLLIUM Station for DCB 36
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 36A
DCB 36C
NPDWS (4ug/L)
GW Injection Start

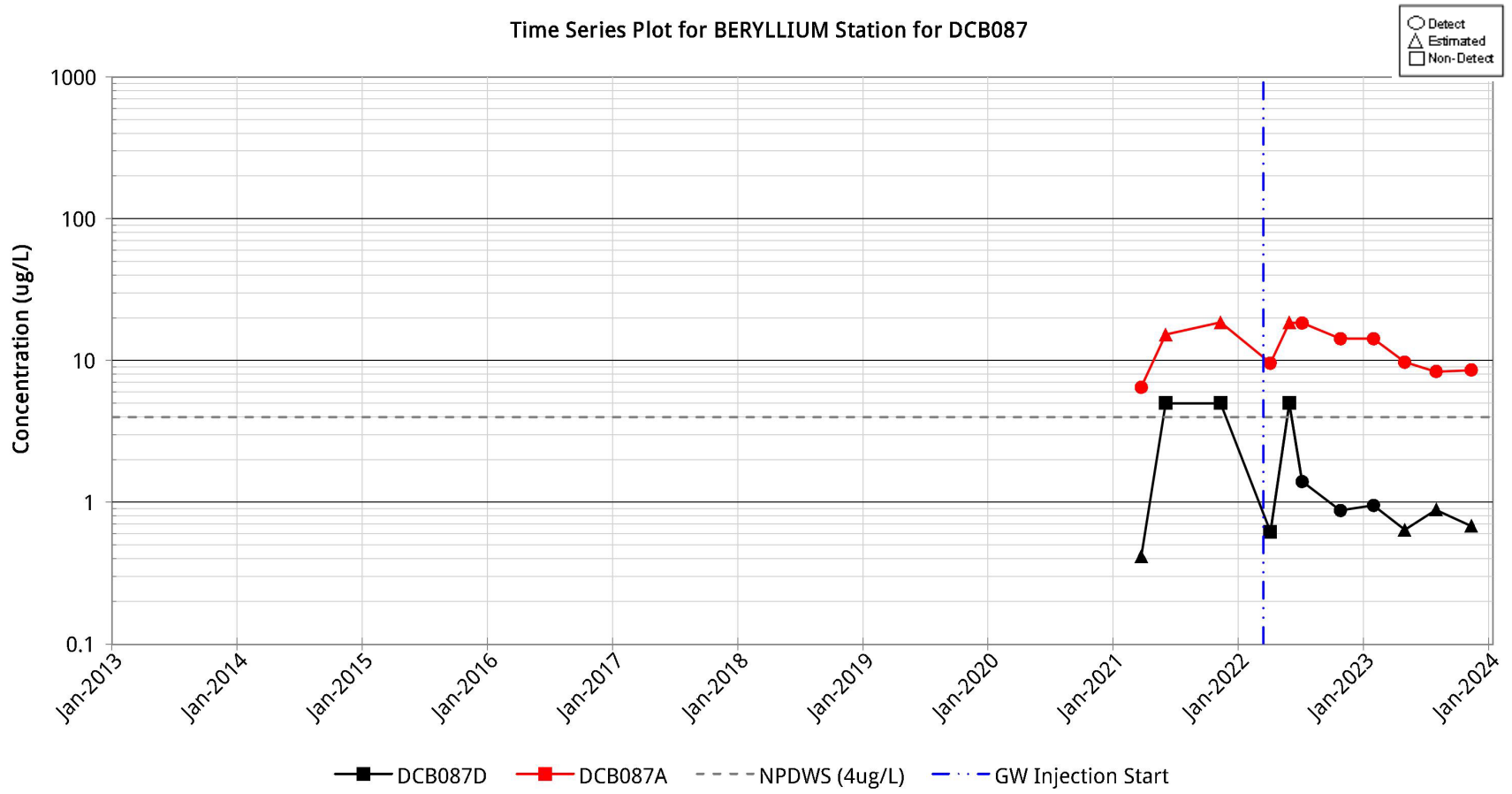

Time Series Plot for BERYLLIUM Station for DCB 37
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 37C
DCB 37A
NPDWS (4ug/L)
GW Injection Start

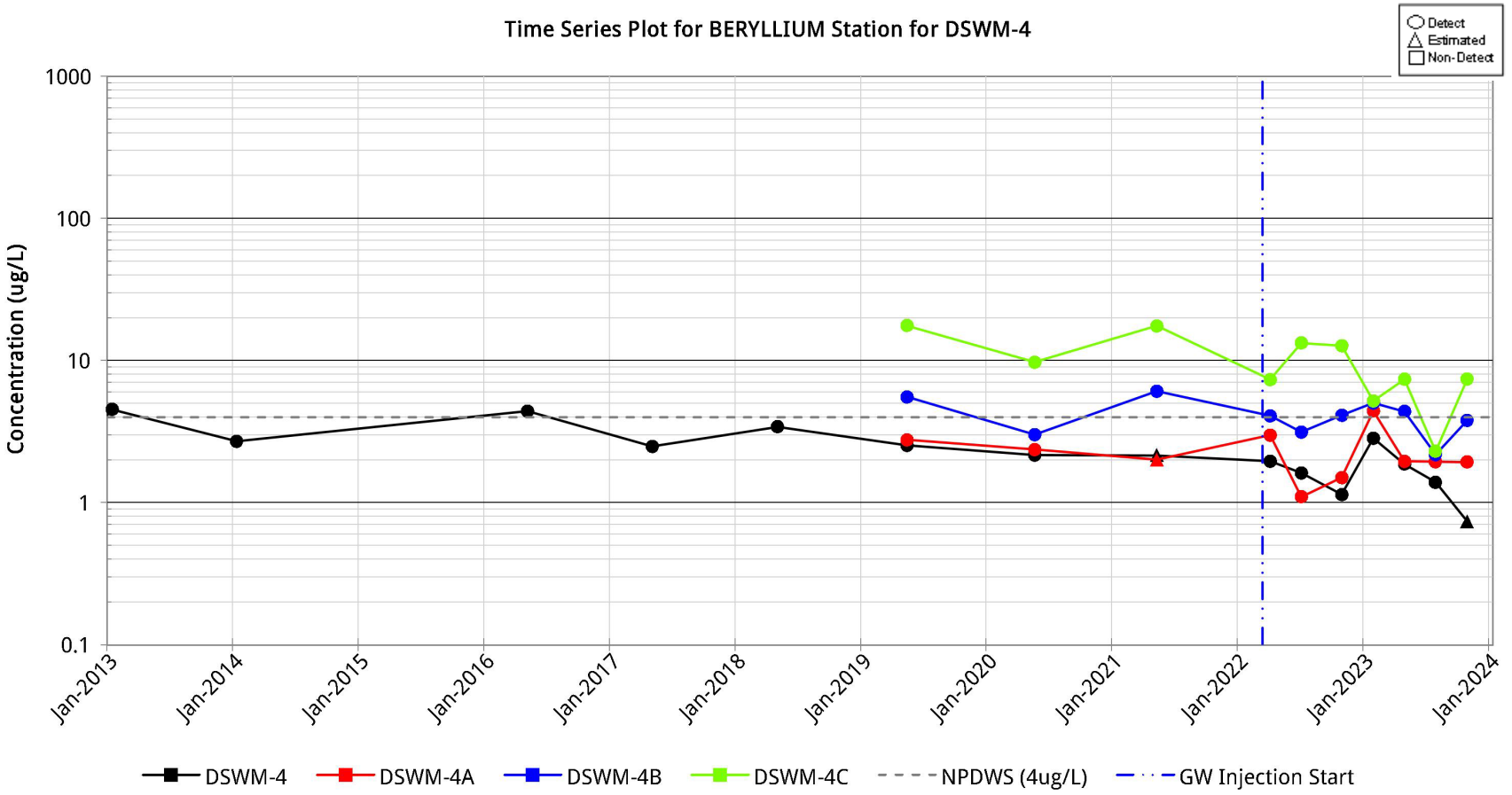

Time Series Plot for BERYLLIUM Station for DCB 53
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 53
NPDWS (4ug/L)
GW Injection Start

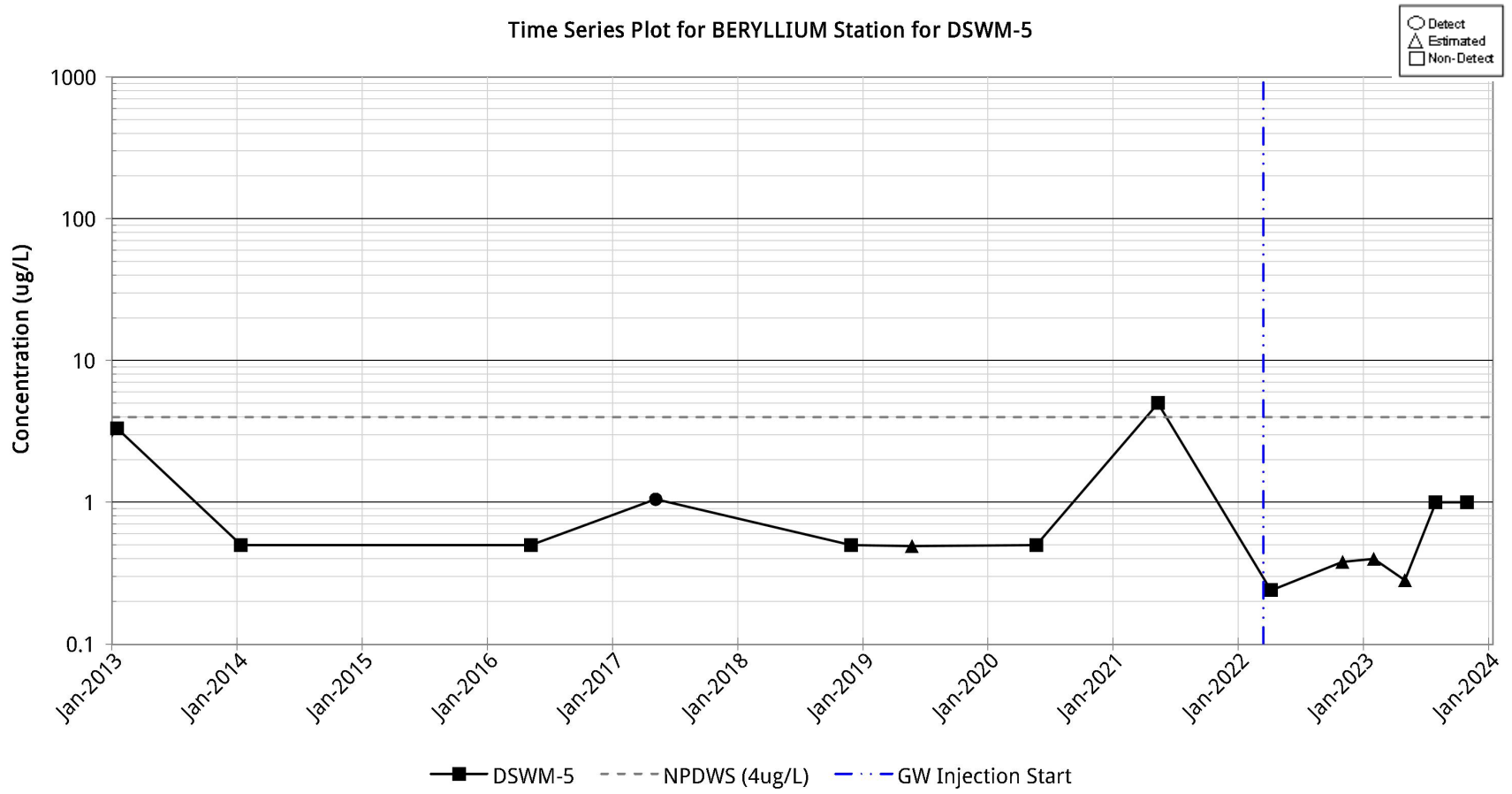

Time Series Plot for BERYLLIUM Station for DCB 70
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 70A
DCB 70B
NPDWS (4ug/L)
GW Injection Start

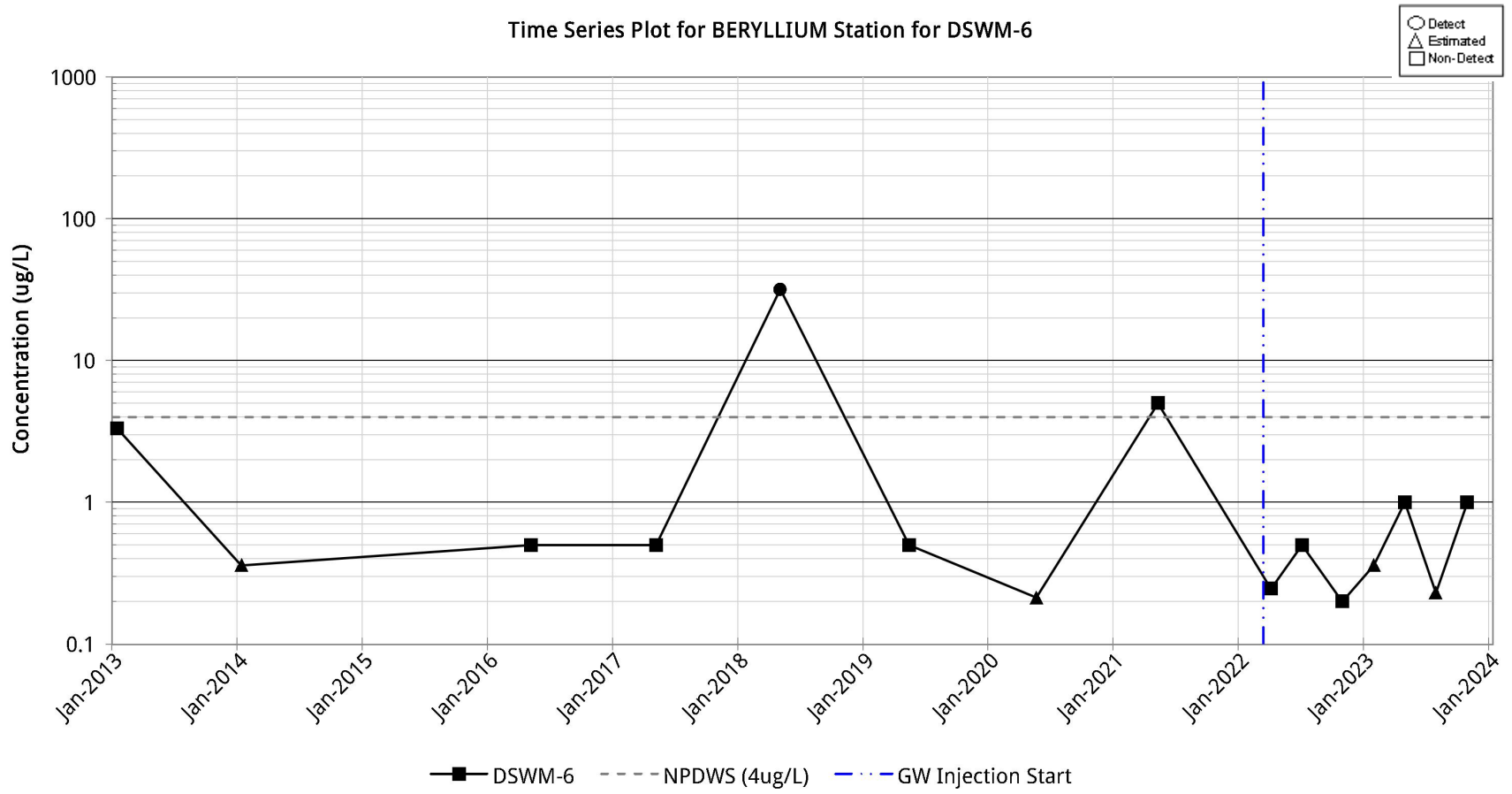

Time Series Plot for BERYLLIUM Station for DCB077
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB077
NPDWS (4ug/L)
GW Injection Start

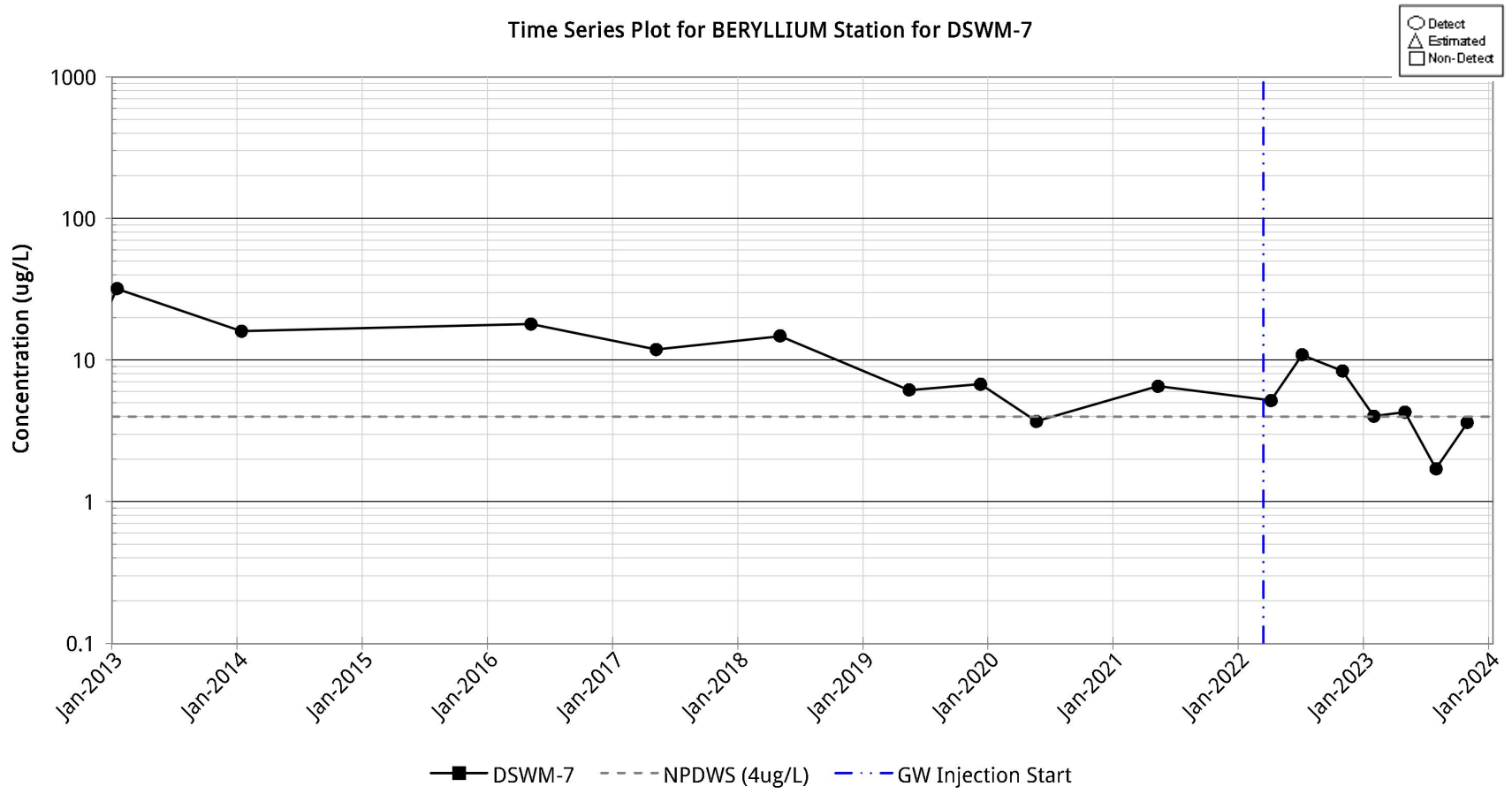

Time Series Plot for BERYLLIUM Station for DCB078
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 47C
DCB078
NPDWS (4ug/L)
GW Injection Start

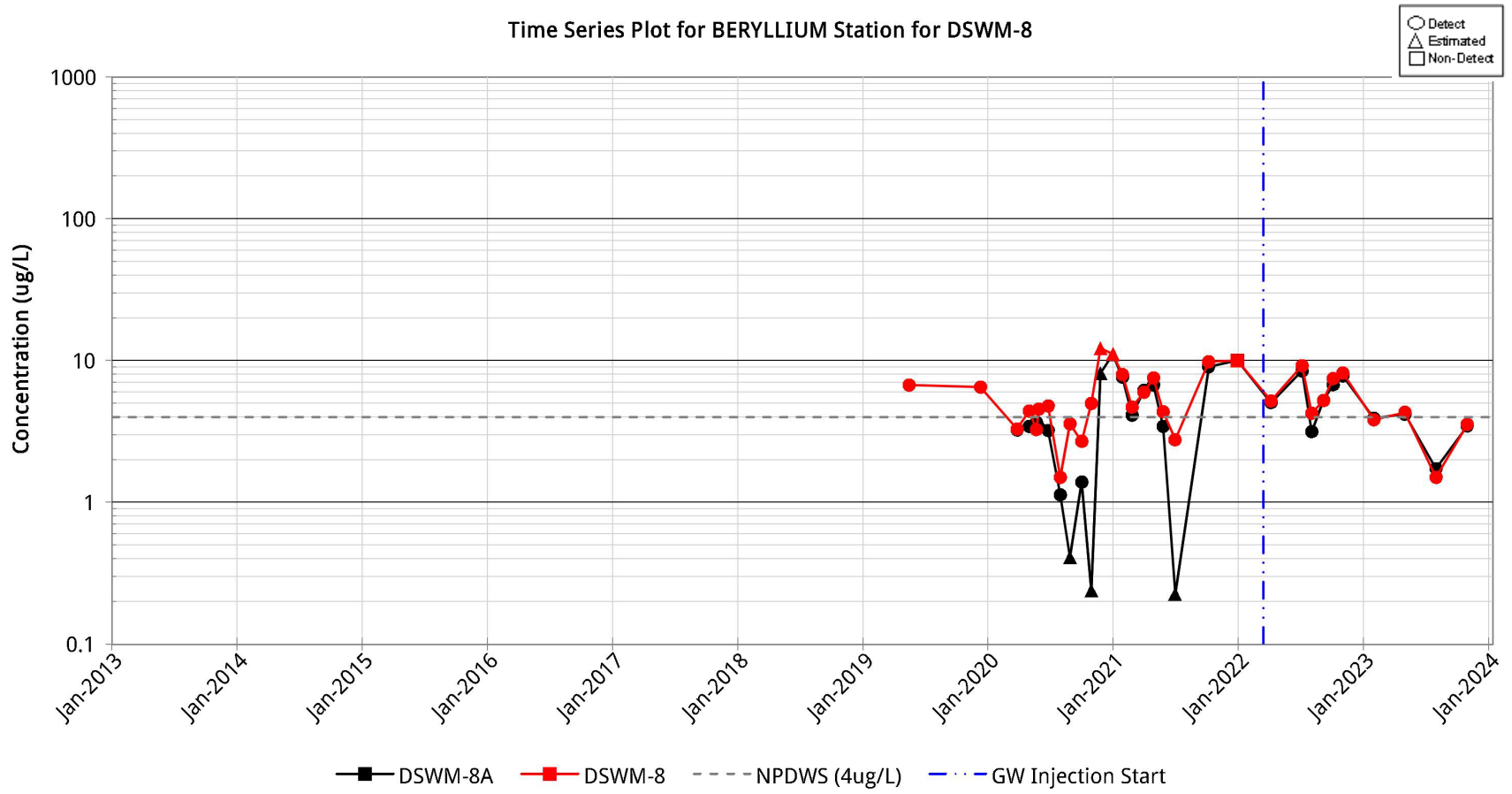

Time Series Plot for BERYLLIUM Station for DCB087
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB087D
DCB087A
NPDWS (4ug/L)
GW Injection Start

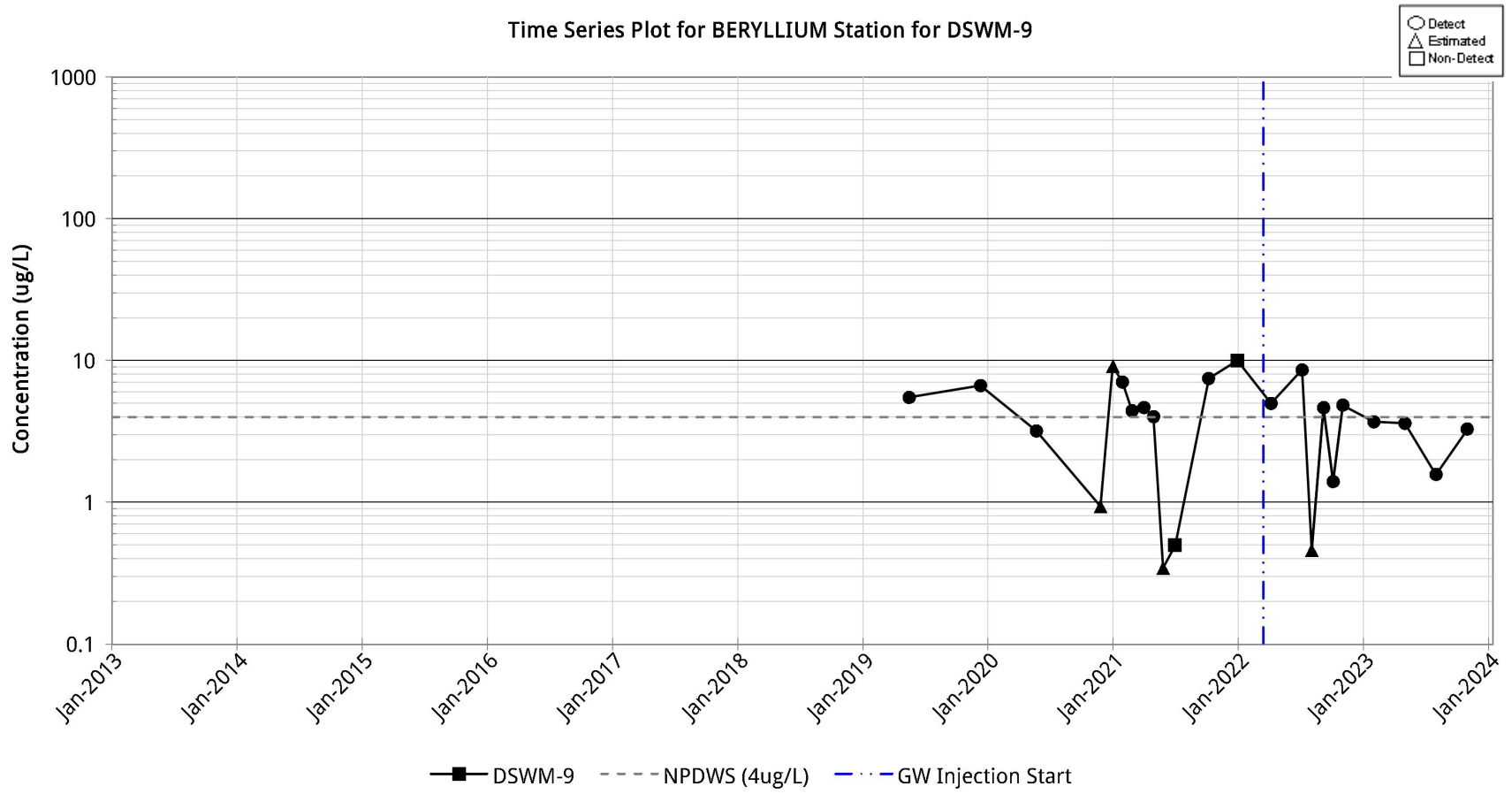

Time Series Plot for BERYLLIUM Station for DSWM-4
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-4
DSWM-4A
DSWM-4B
DSWM-4C
NPDWS (4ug/L)
GW Injection Start

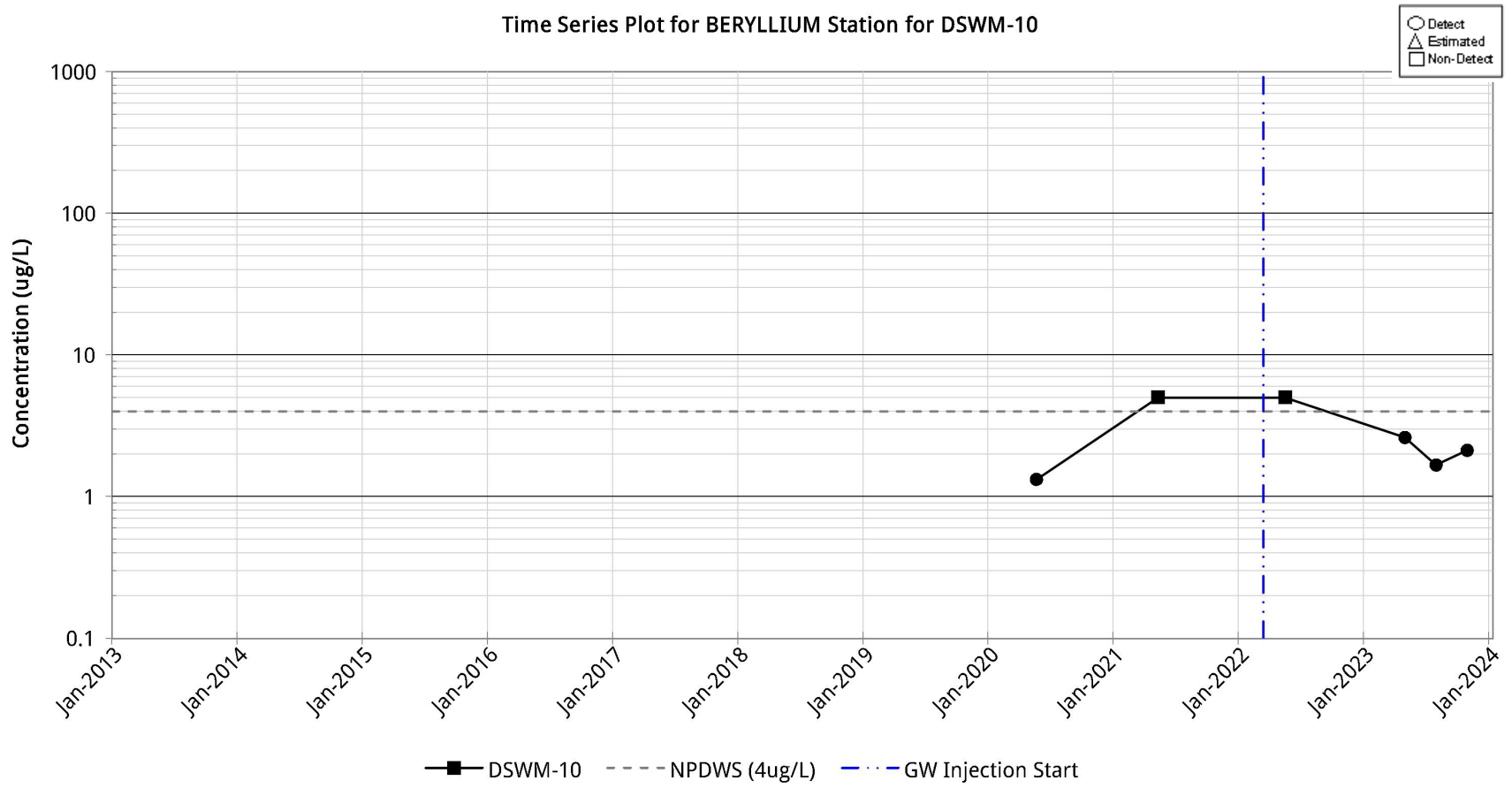

Time Series Plot for BERYLLIUM Station for DSWM-5
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-5
NPDWS (4ug/L)
GW Injection Start

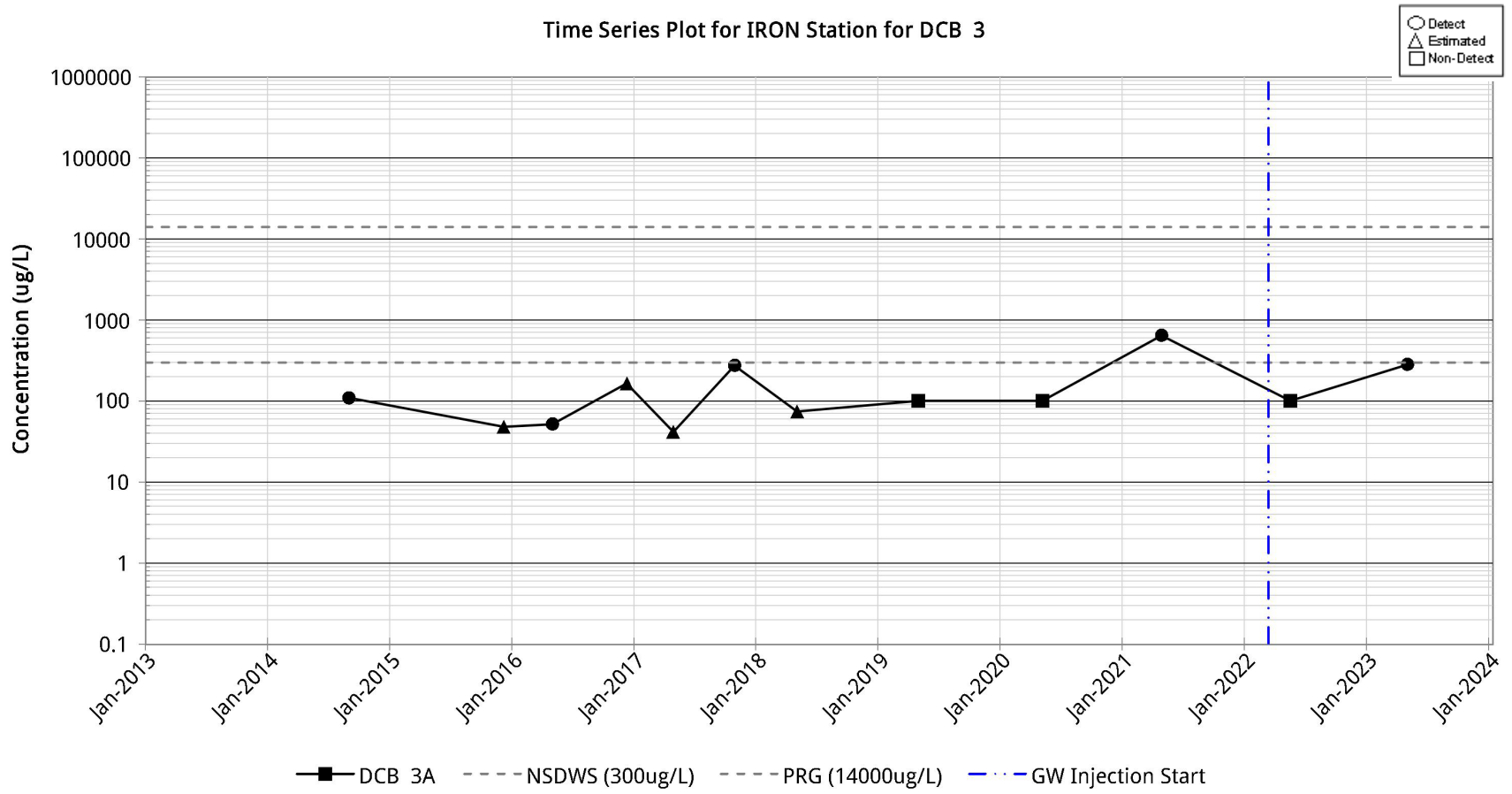

Time Series Plot for BERYLLIUM Station for DSWM-6
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-6
NPDWS (4ug/L)
GW Injection Start

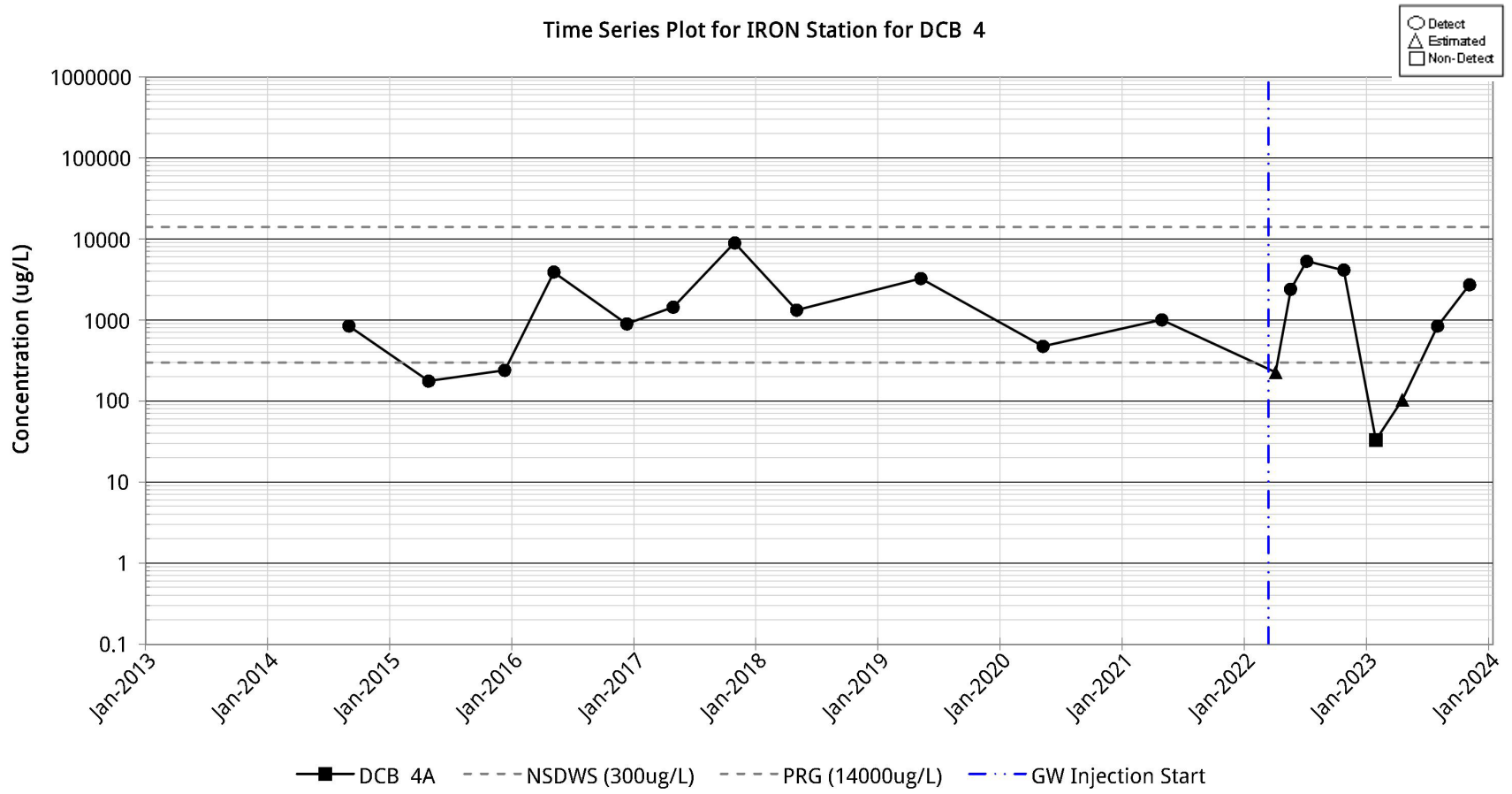

Time Series Plot for BERYLLIUM Station for DSWM-7
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-7
NPDWS (4ug/L)
GW Injection Start

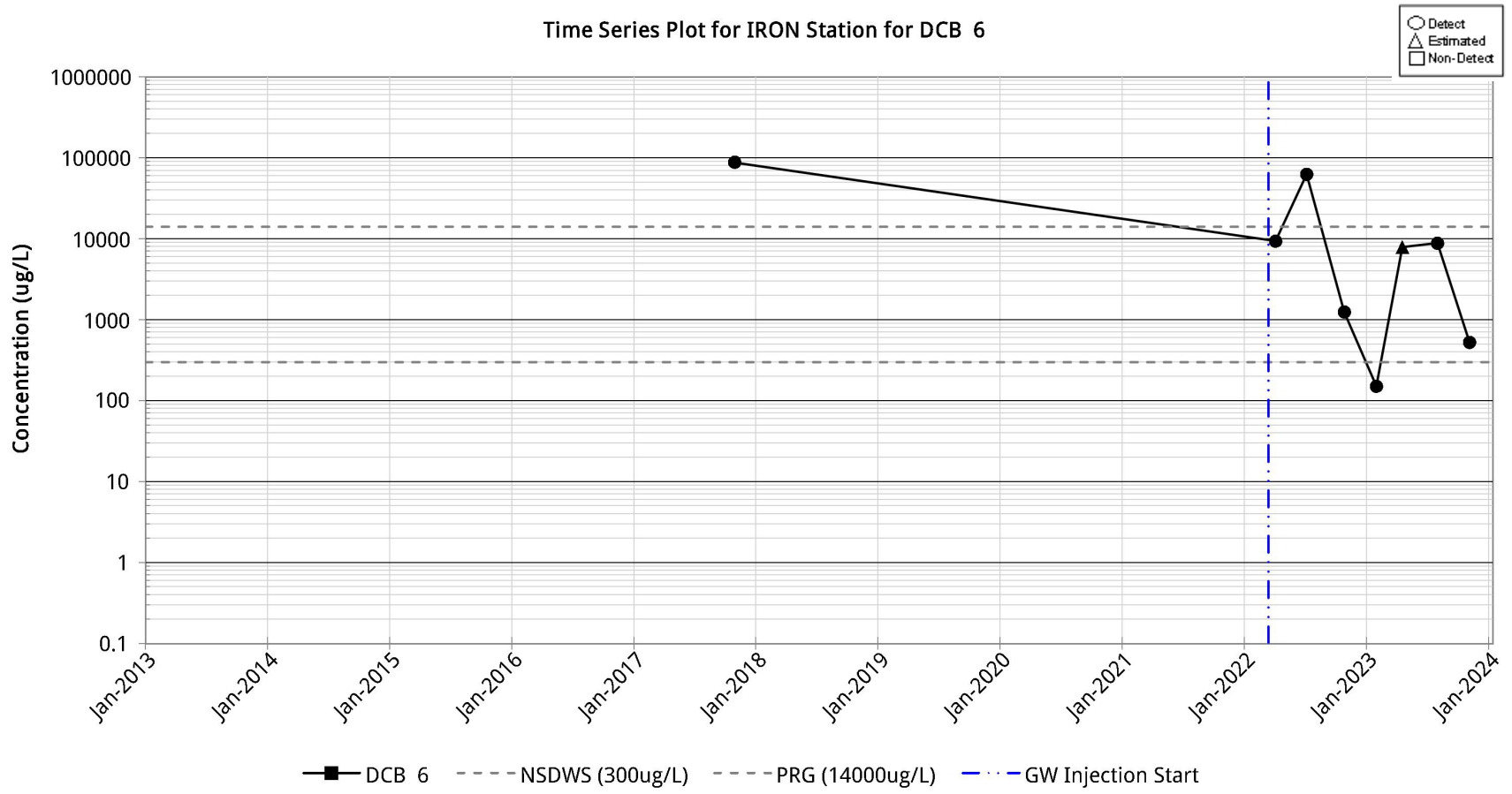

Time Series Plot for BERYLLIUM Station for DSWM-8
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-8A
DSWM-8
NPDWS (4ug/L)
GW Injection Start

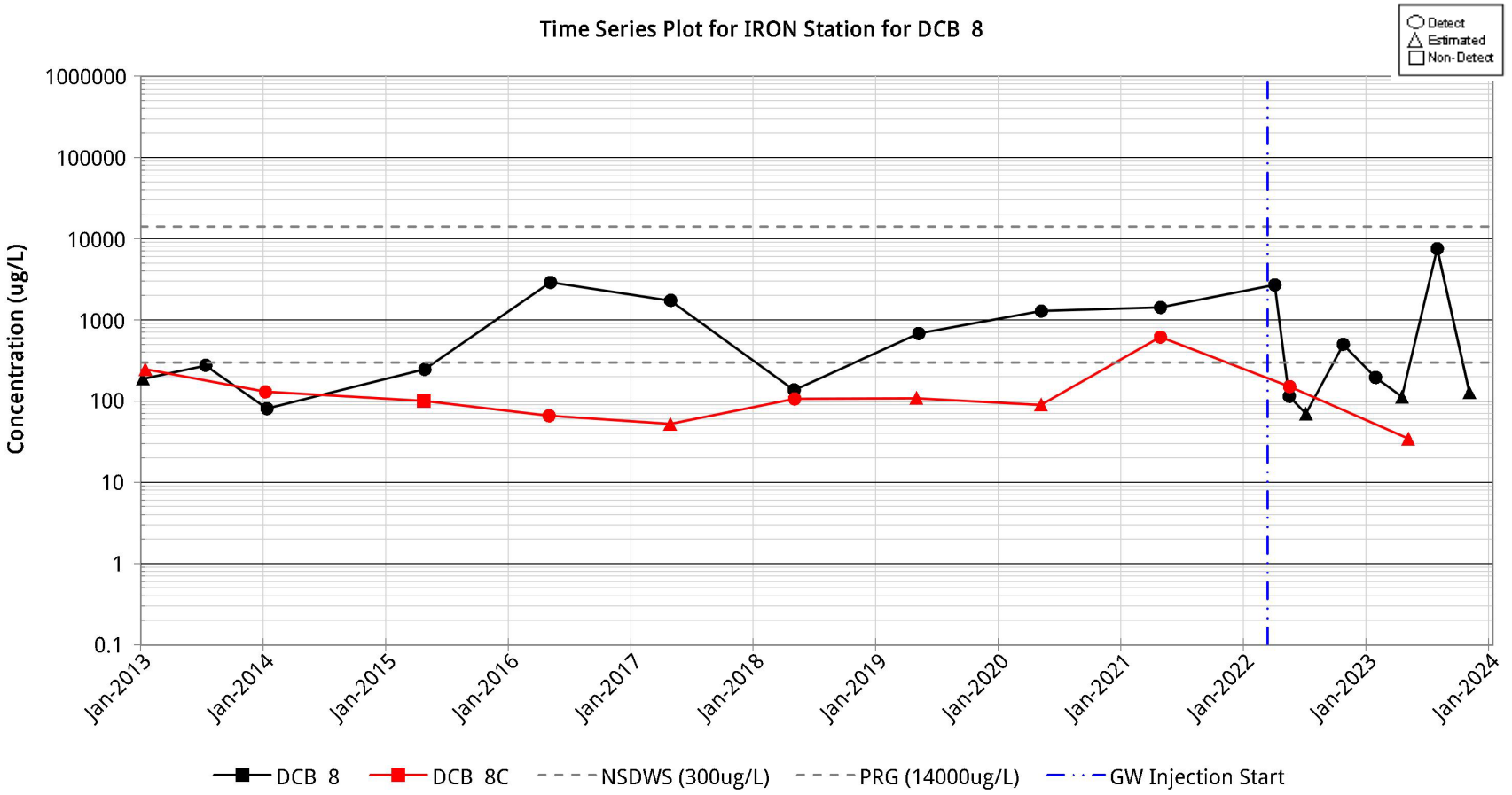

Time Series Plot for BERYLLIUM Station for DSWM-9
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-9
NPDWS (4ug/L)
GW Injection Start

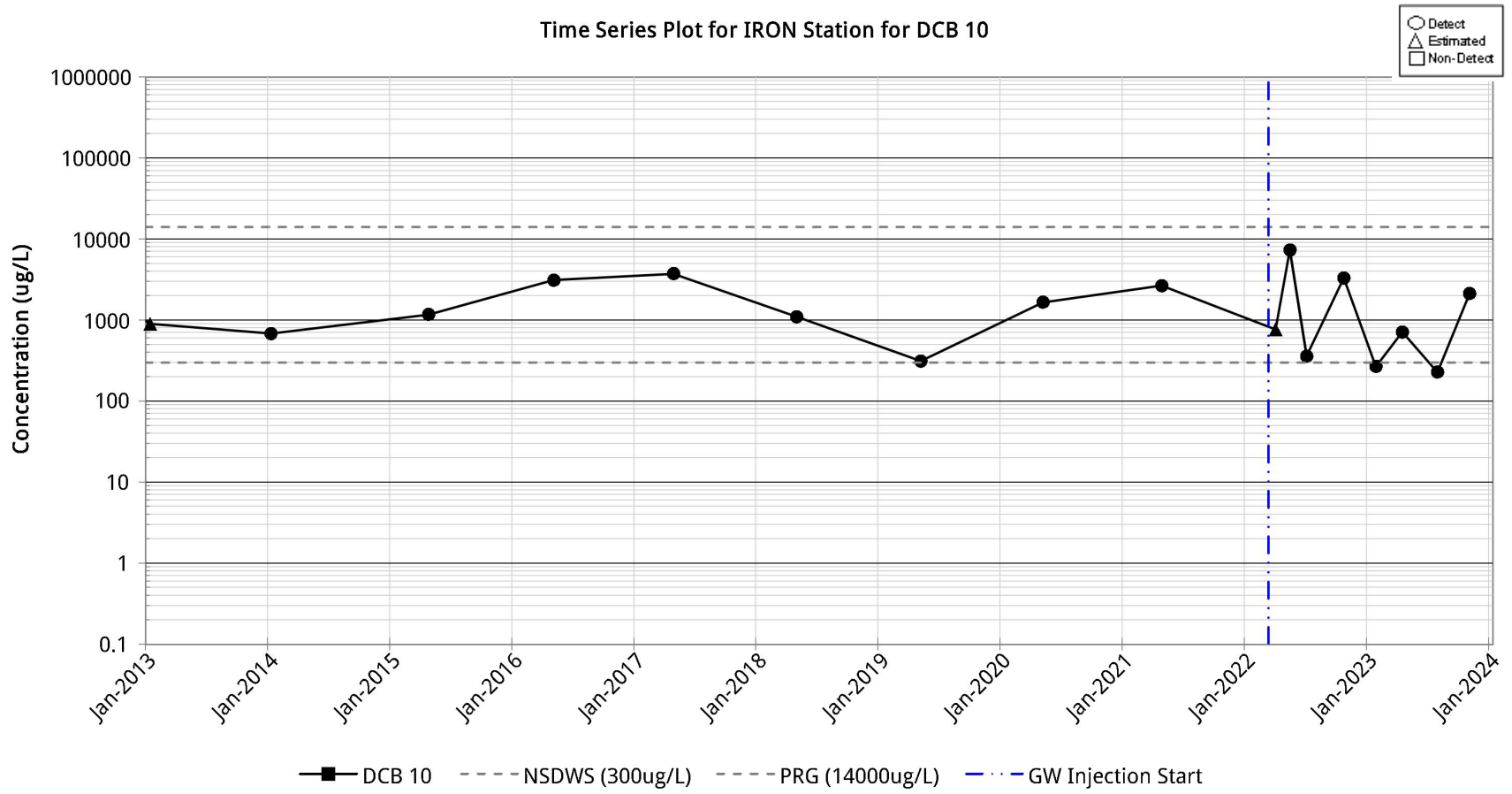

Time Series Plot for BERYLLIUM Station for DSWM-10
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-10
NPDWS (4ug/L)
GW Injection Start

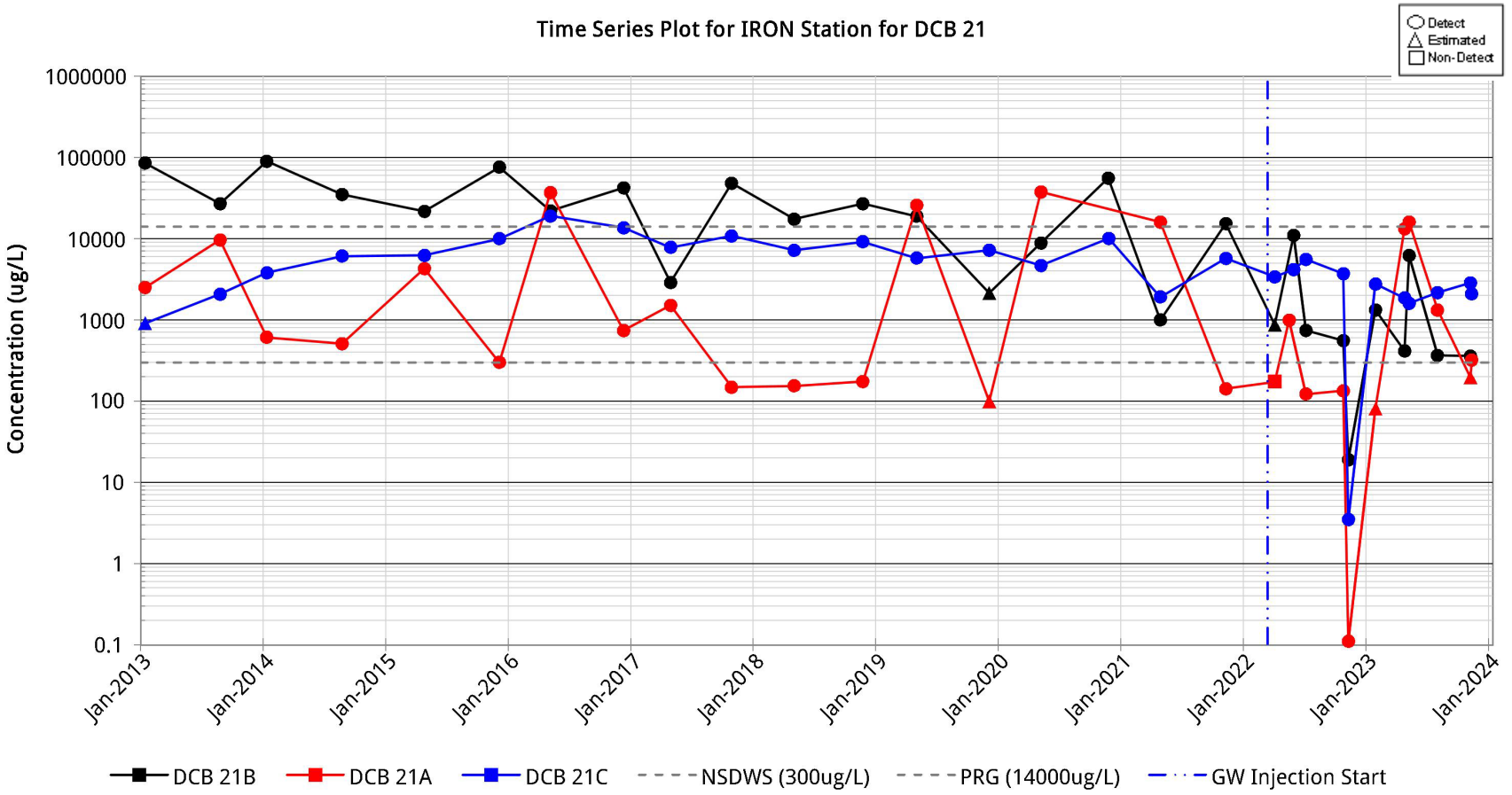

Time Series Plot for IRON Station for DCB 3
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 3A
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

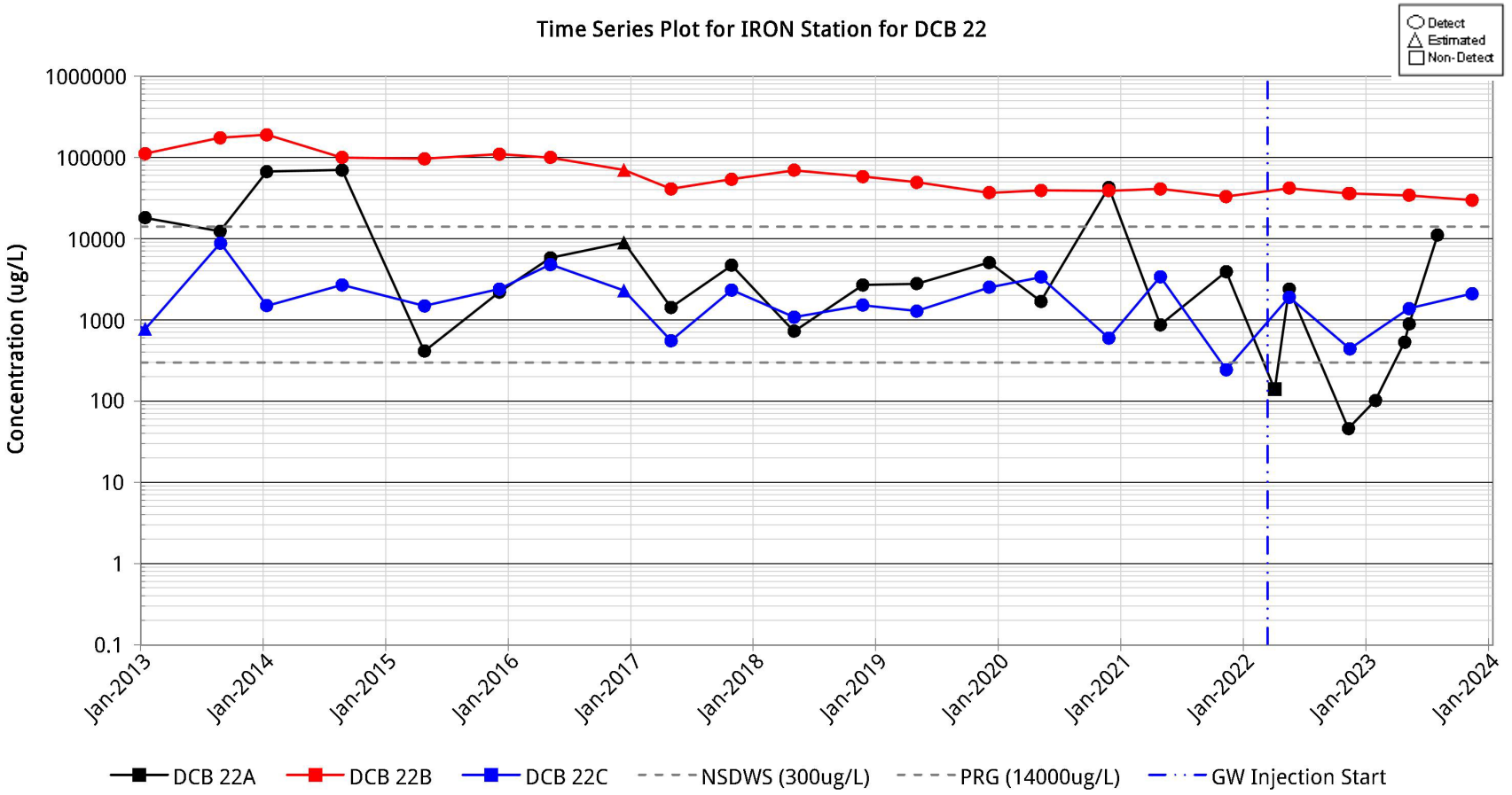

Time Series Plot for IRON Station for DCB 4
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 4A
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

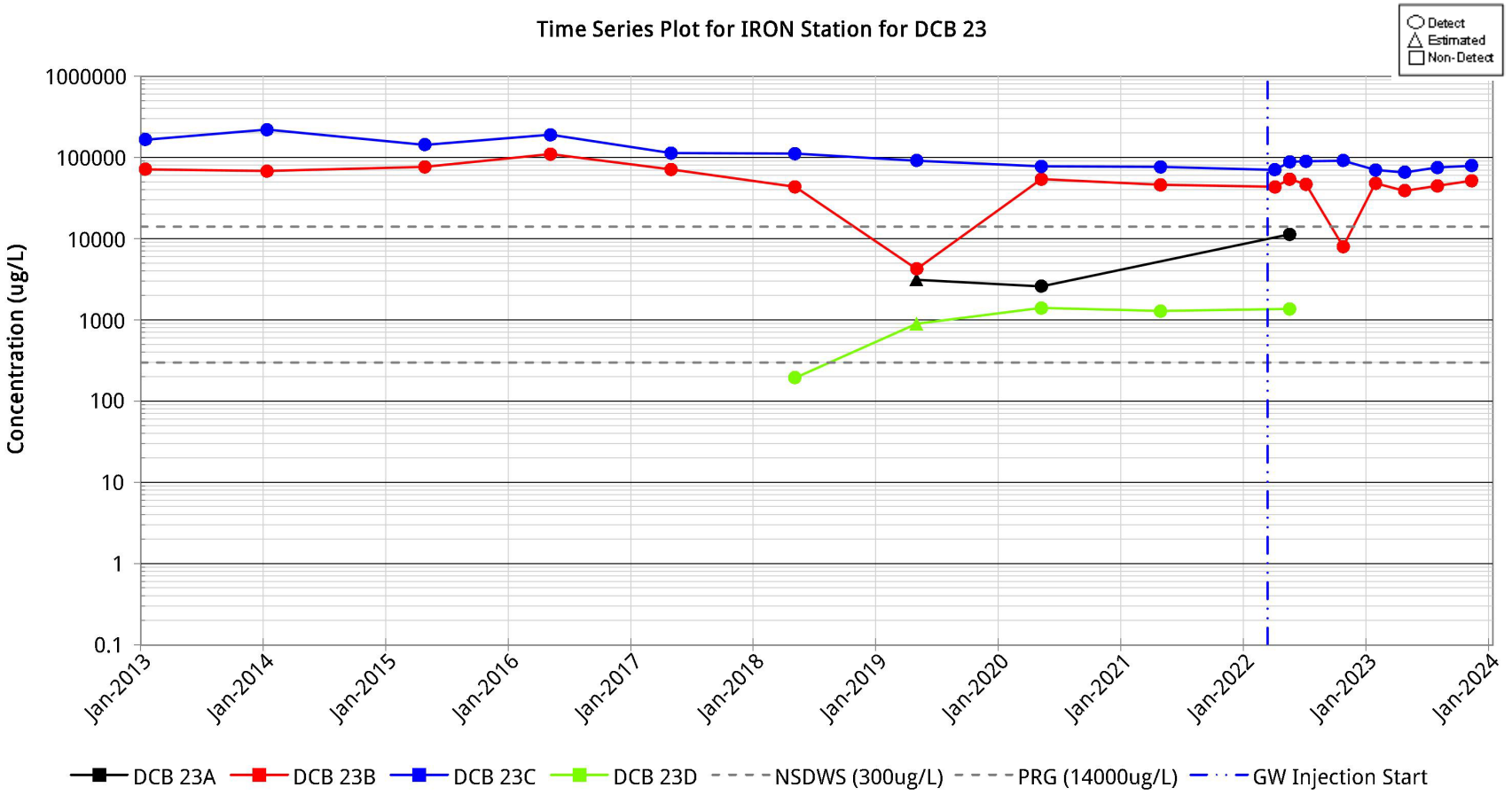

Time Series Plot for IRON Station for DCB 6
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 6
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

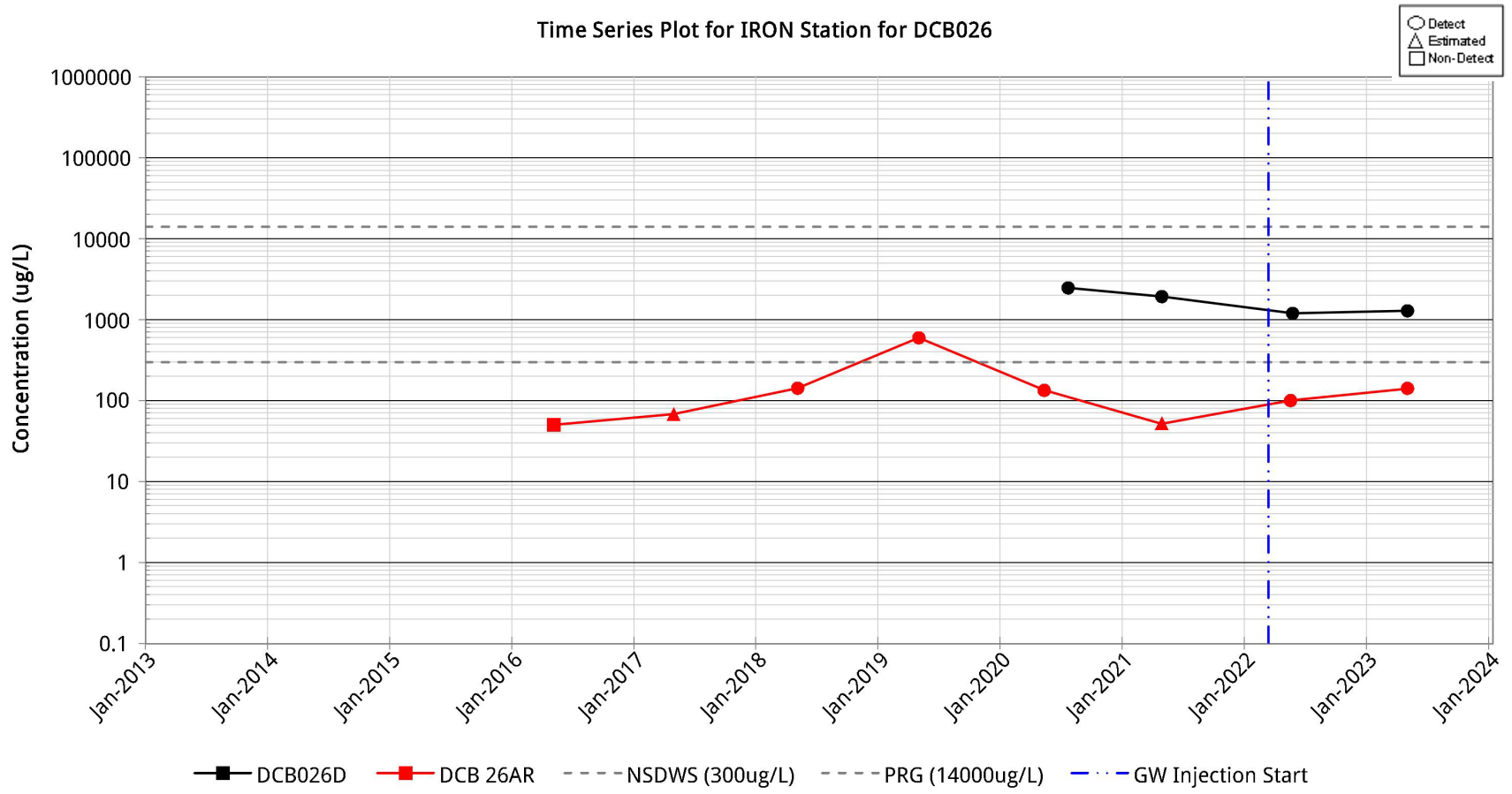

Time Series Plot for IRON Station for DCB 8
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 8
DCB 8C
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

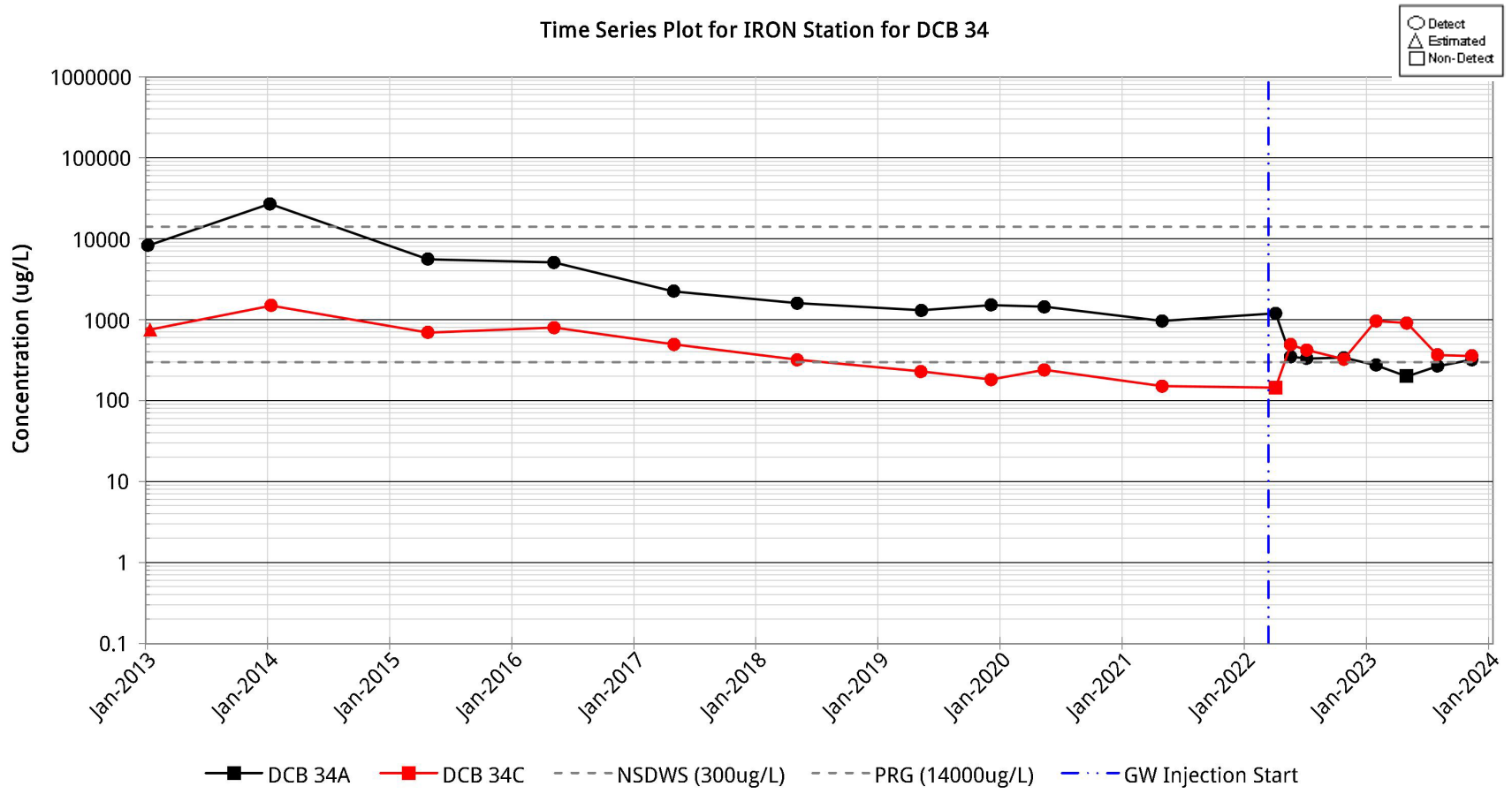

Time Series Plot for IRON Station for DCB 10
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 10
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

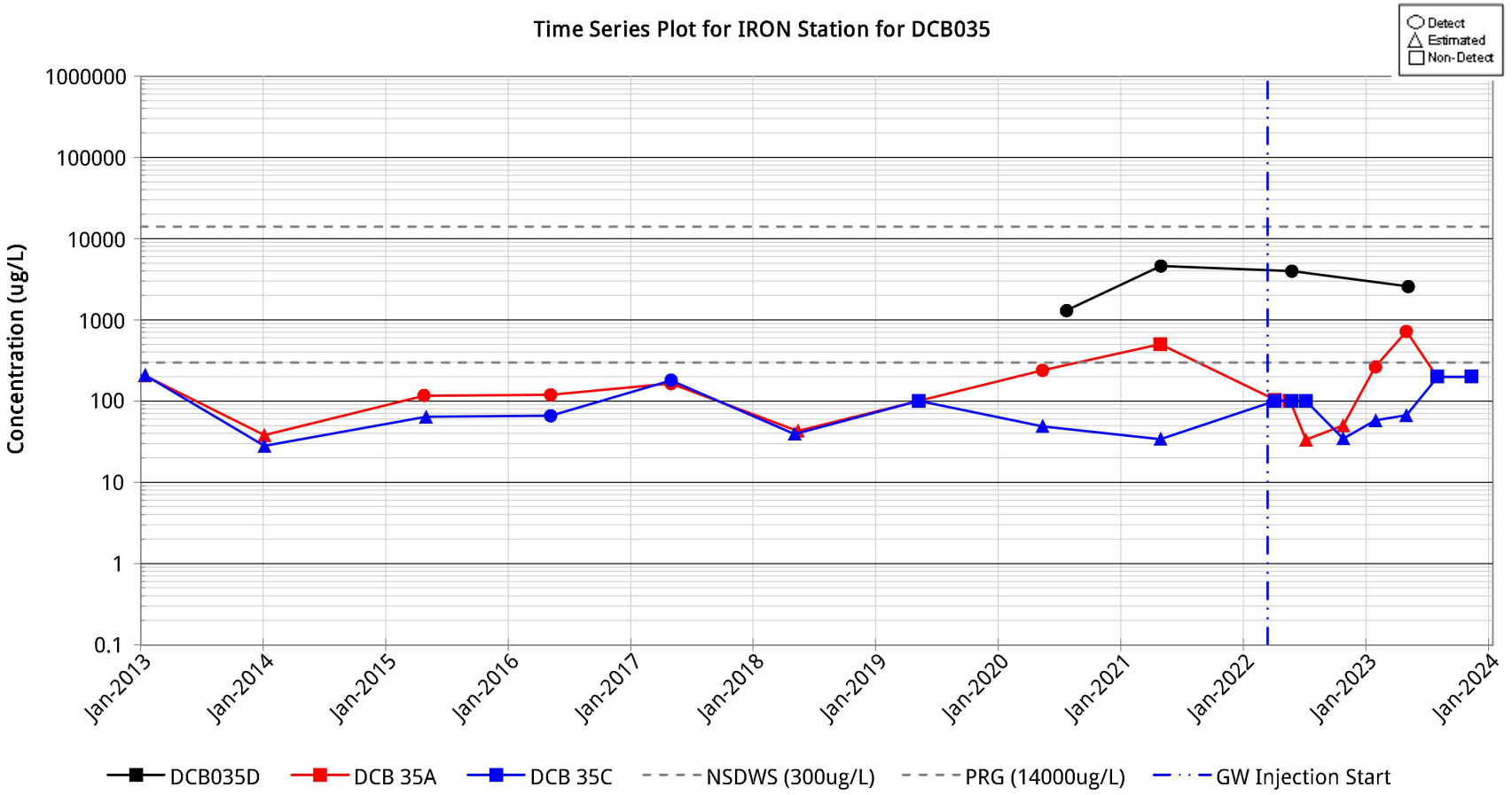

Time Series Plot for IRON Station for DCB 21
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 21B
DCB 21A
DCB 21C
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

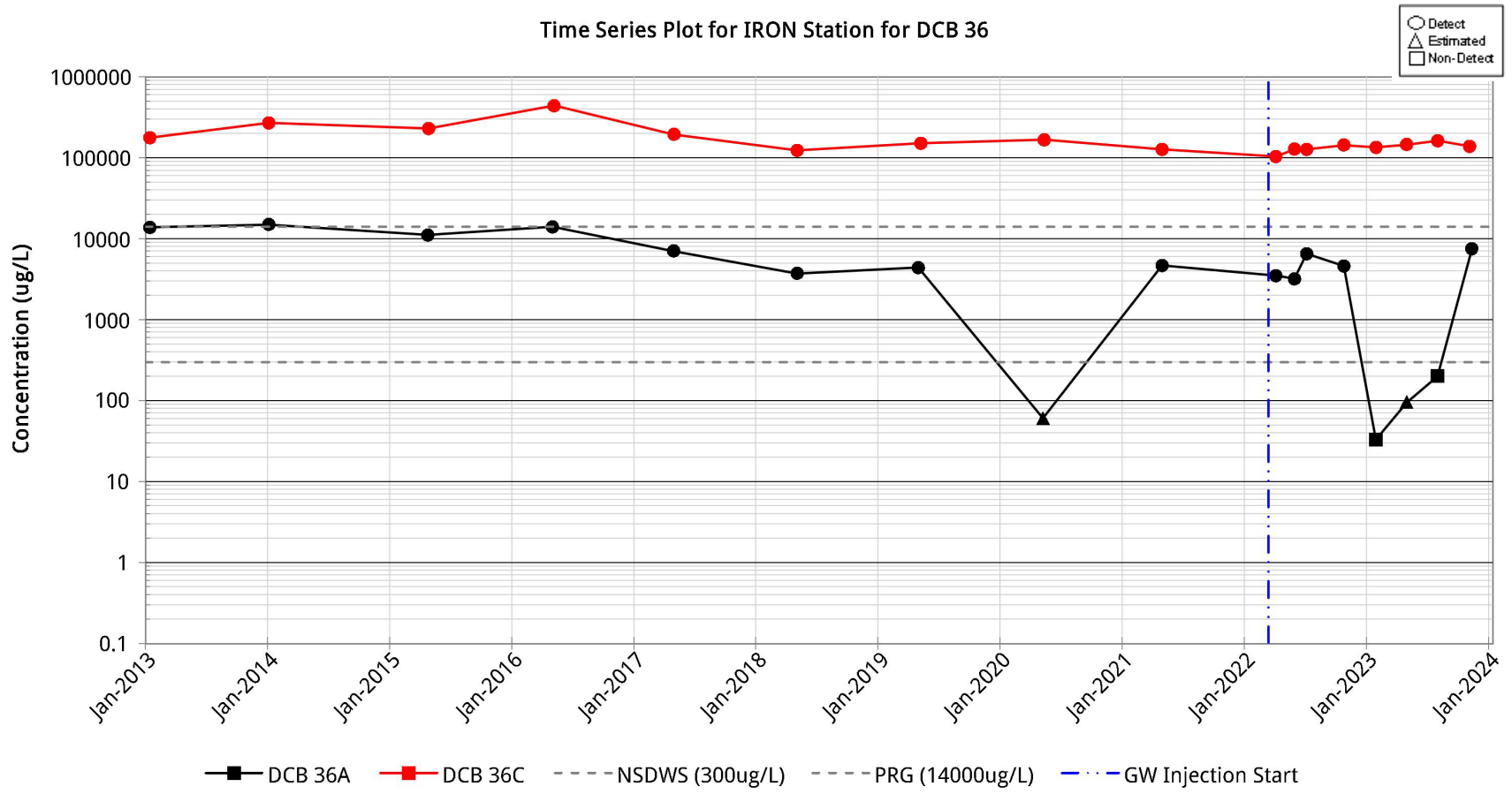

Time Series Plot for IRON Station for DCB 22
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 22A
DCB 22B
DCB 22C
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

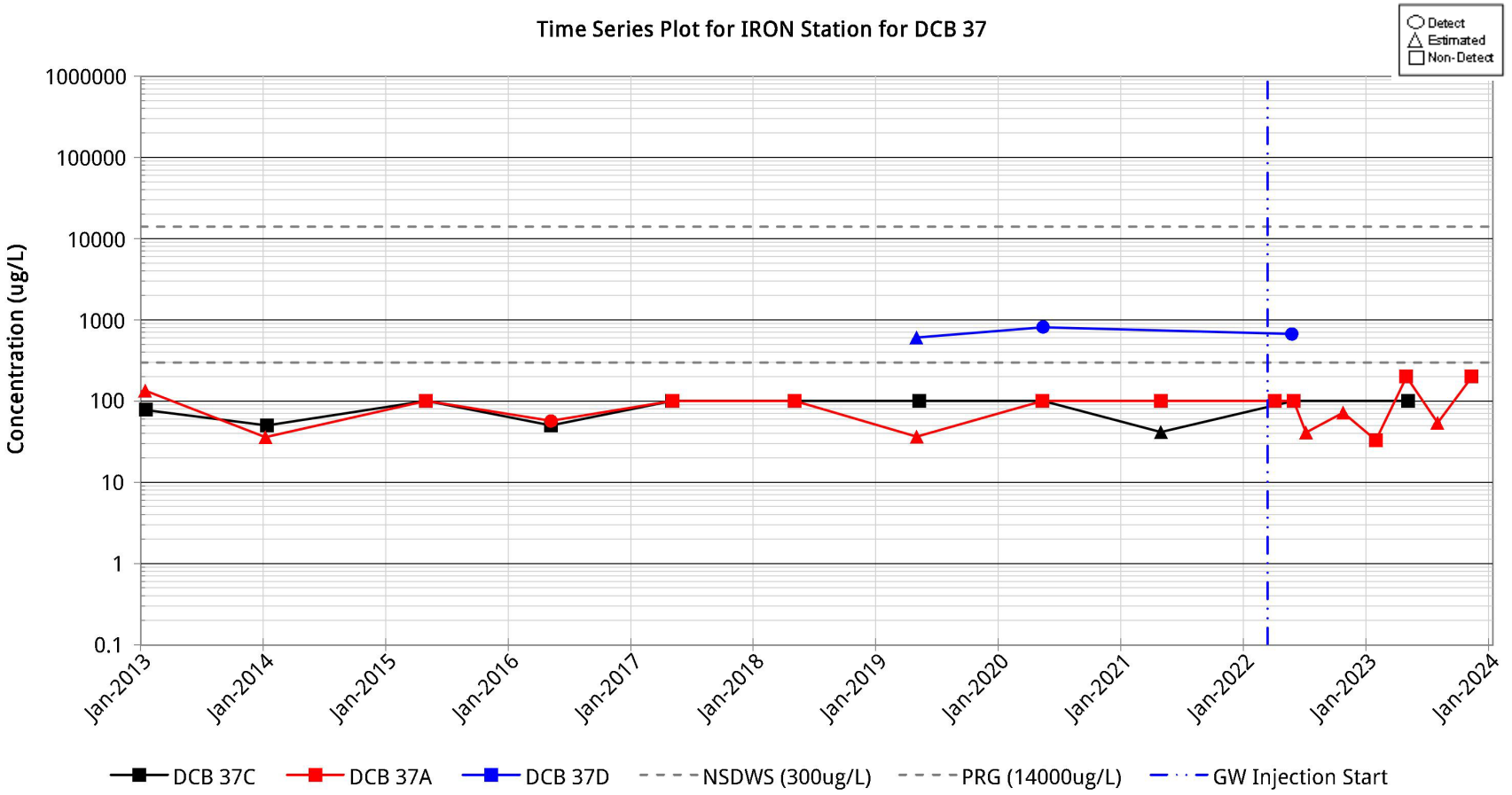

Time Series Plot for IRON Station for DCB 23
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 23A
DCB 23B
DCB 23C
DCB 23D
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

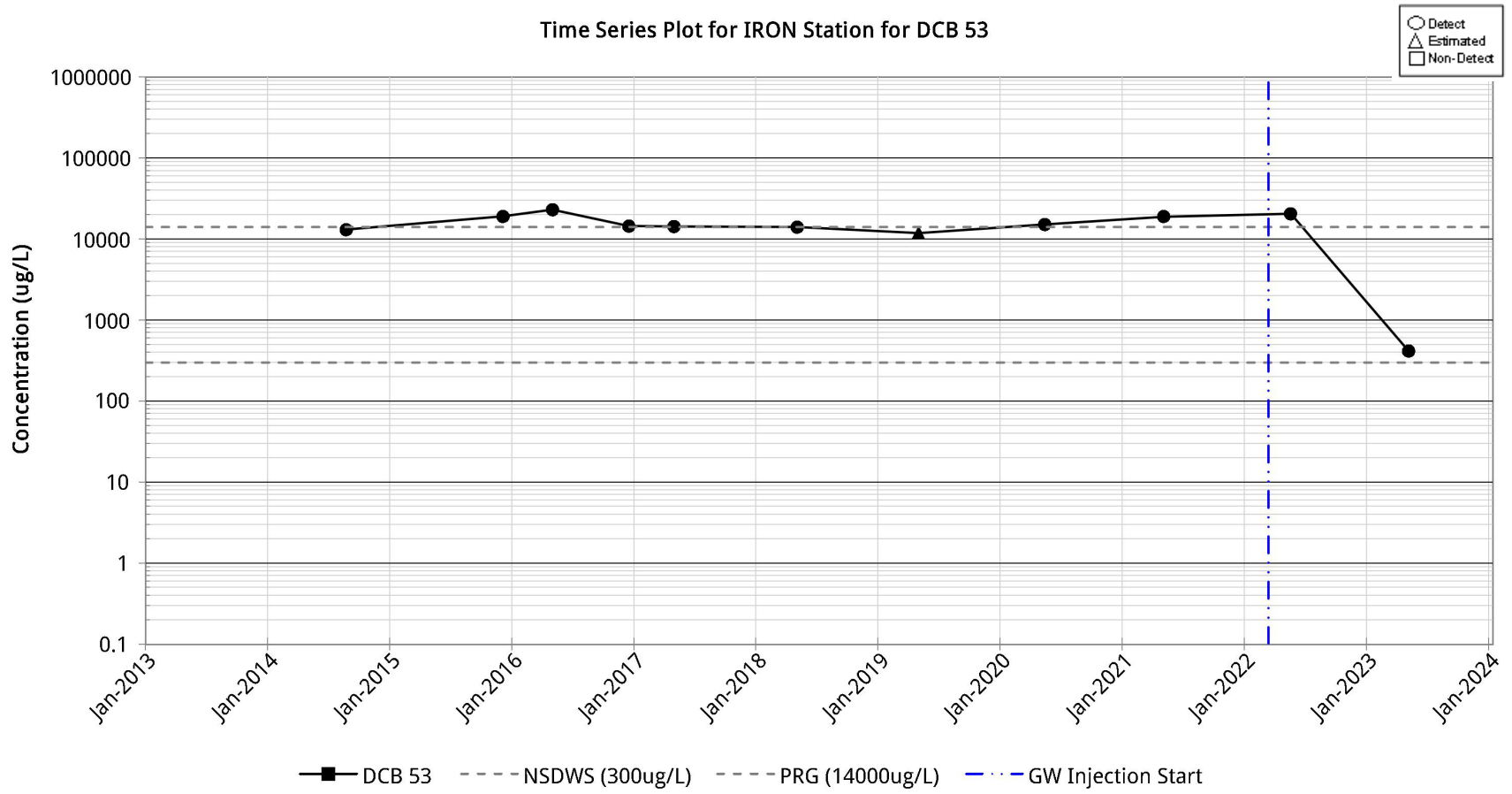

Time Series Plot for IRON Station for DCB026
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB026D
DCB 26AR
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

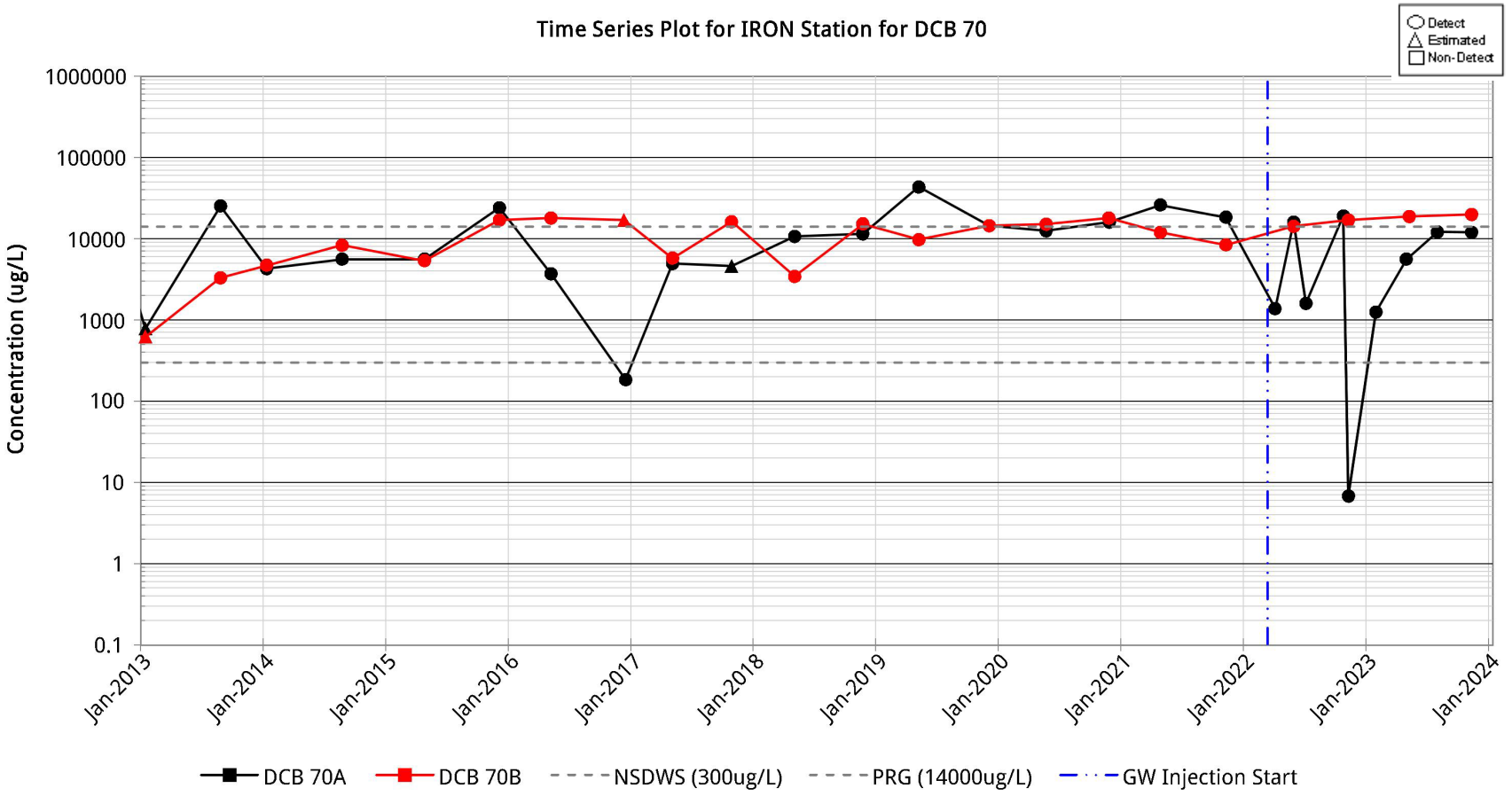

Time Series Plot for IRON Station for DCB 34
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 34A
DCB 34C
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

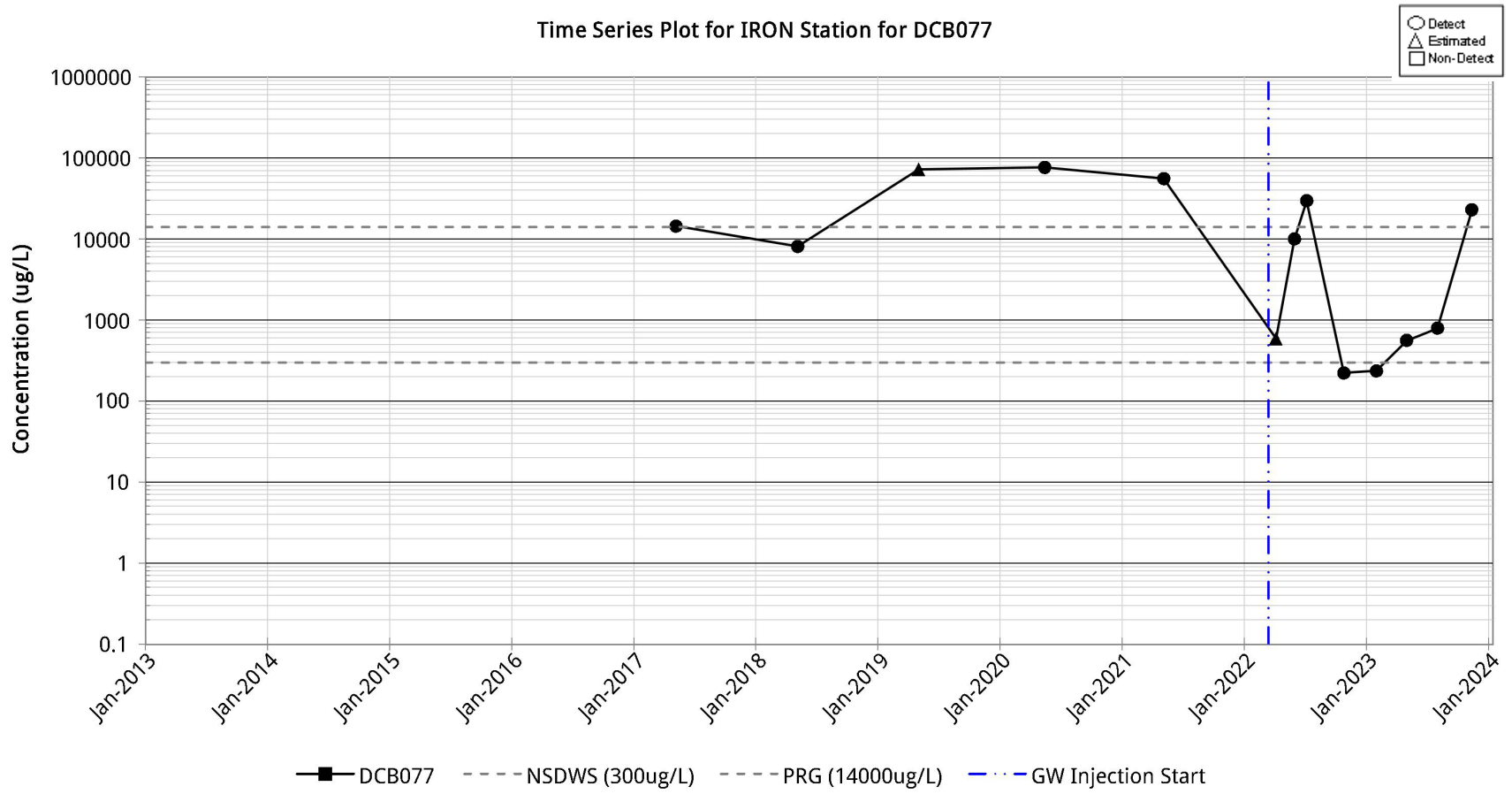

Time Series Plot for IRON Station for DCB035
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB035D
DCB 35A
DCB 35C
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

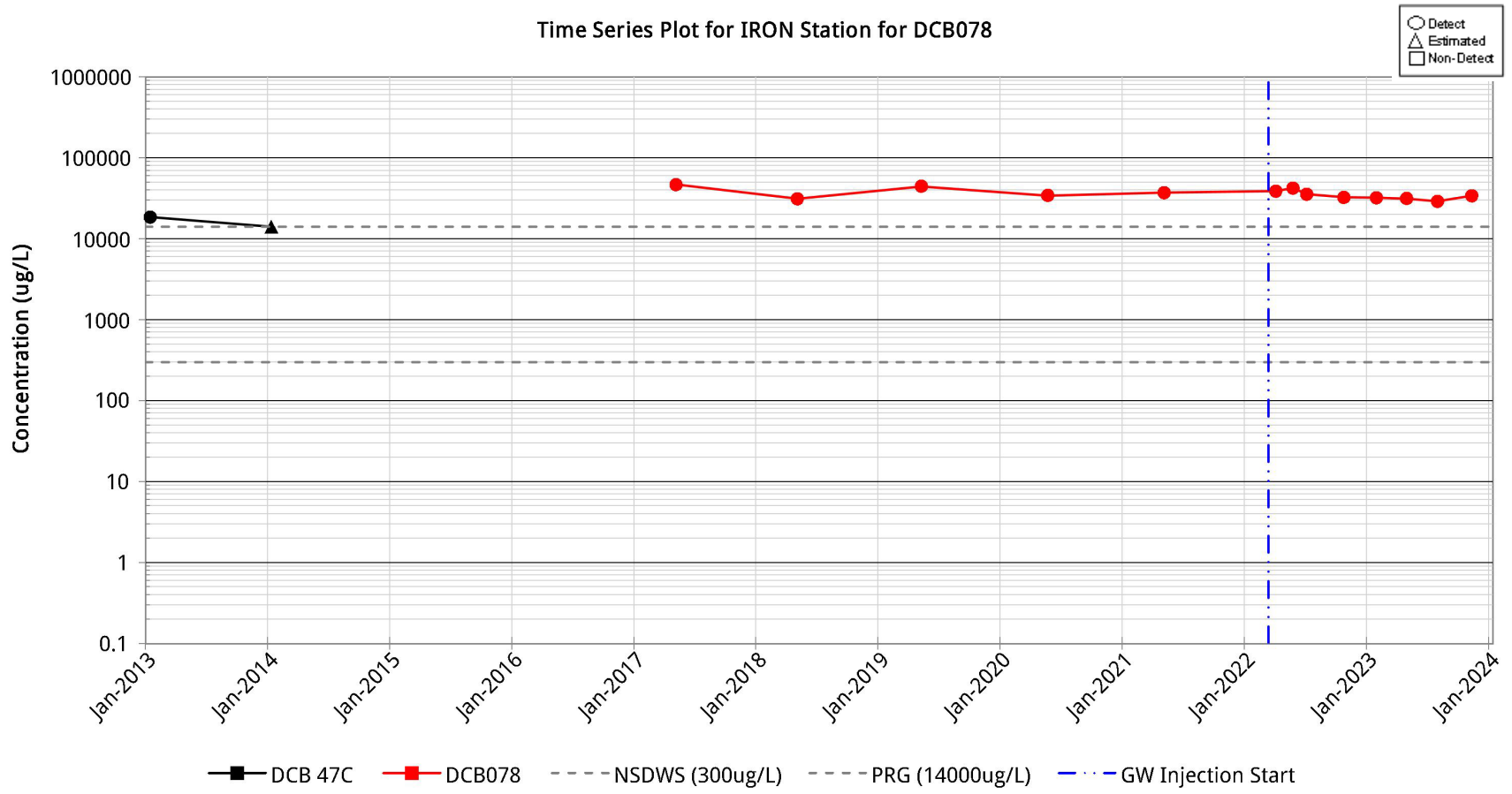

Time Series Plot for IRON Station for DCB 36
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 36A
DCB 36C
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

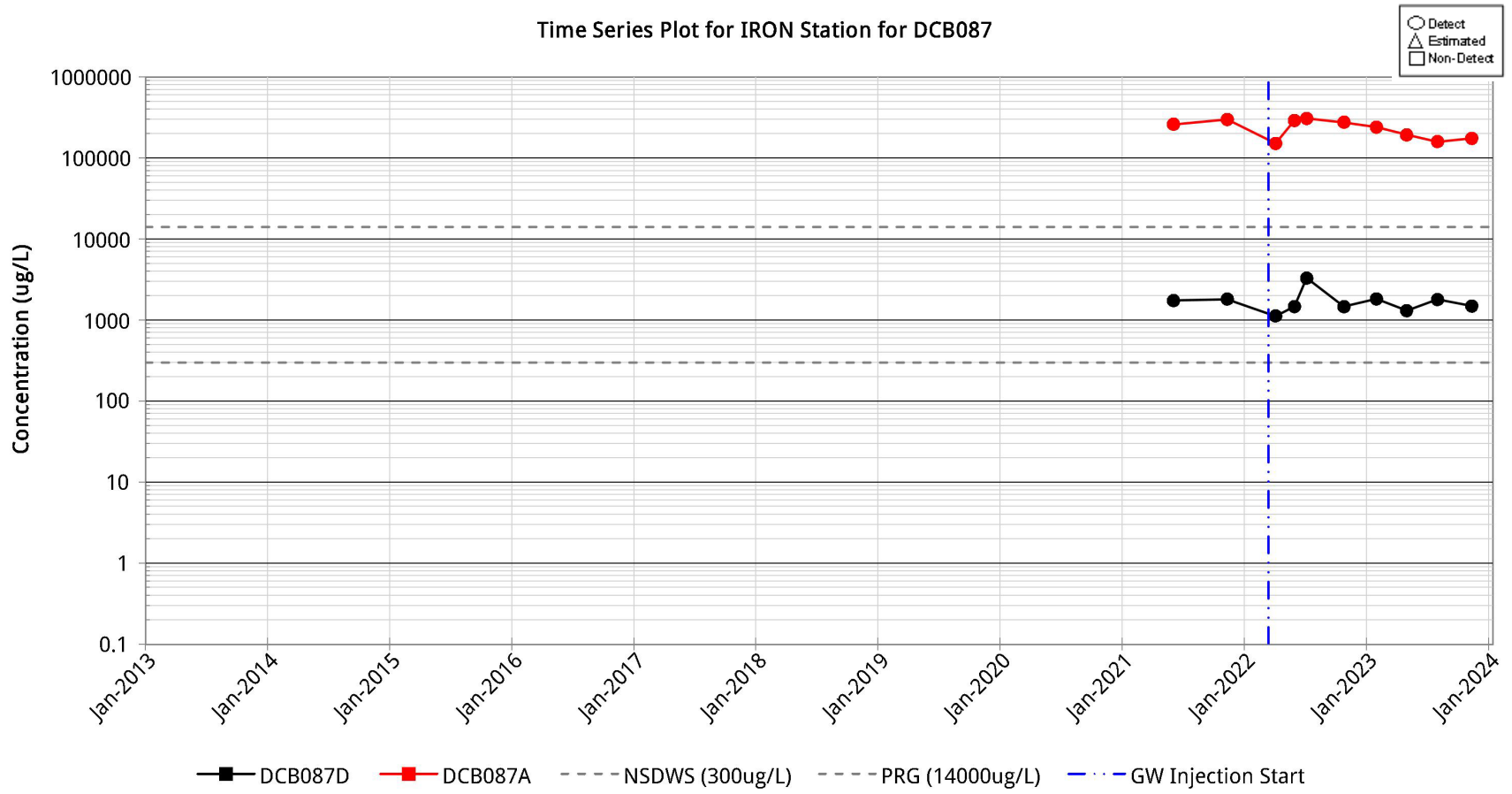

Time Series Plot for IRON Station for DCB 37
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 37C
DCB 37A
DCB 37D
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

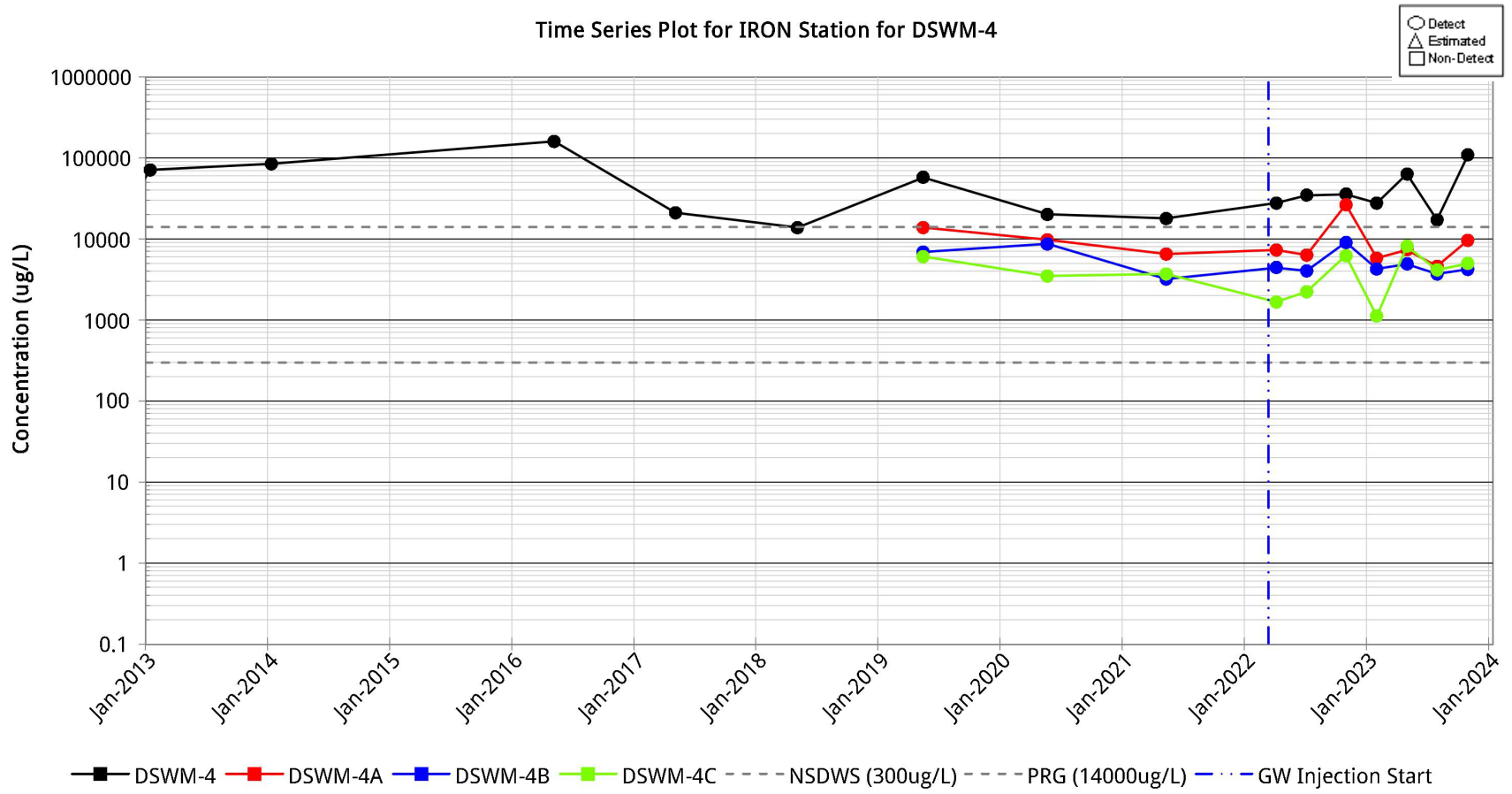

Time Series Plot for IRON Station for DCB 53
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 53
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

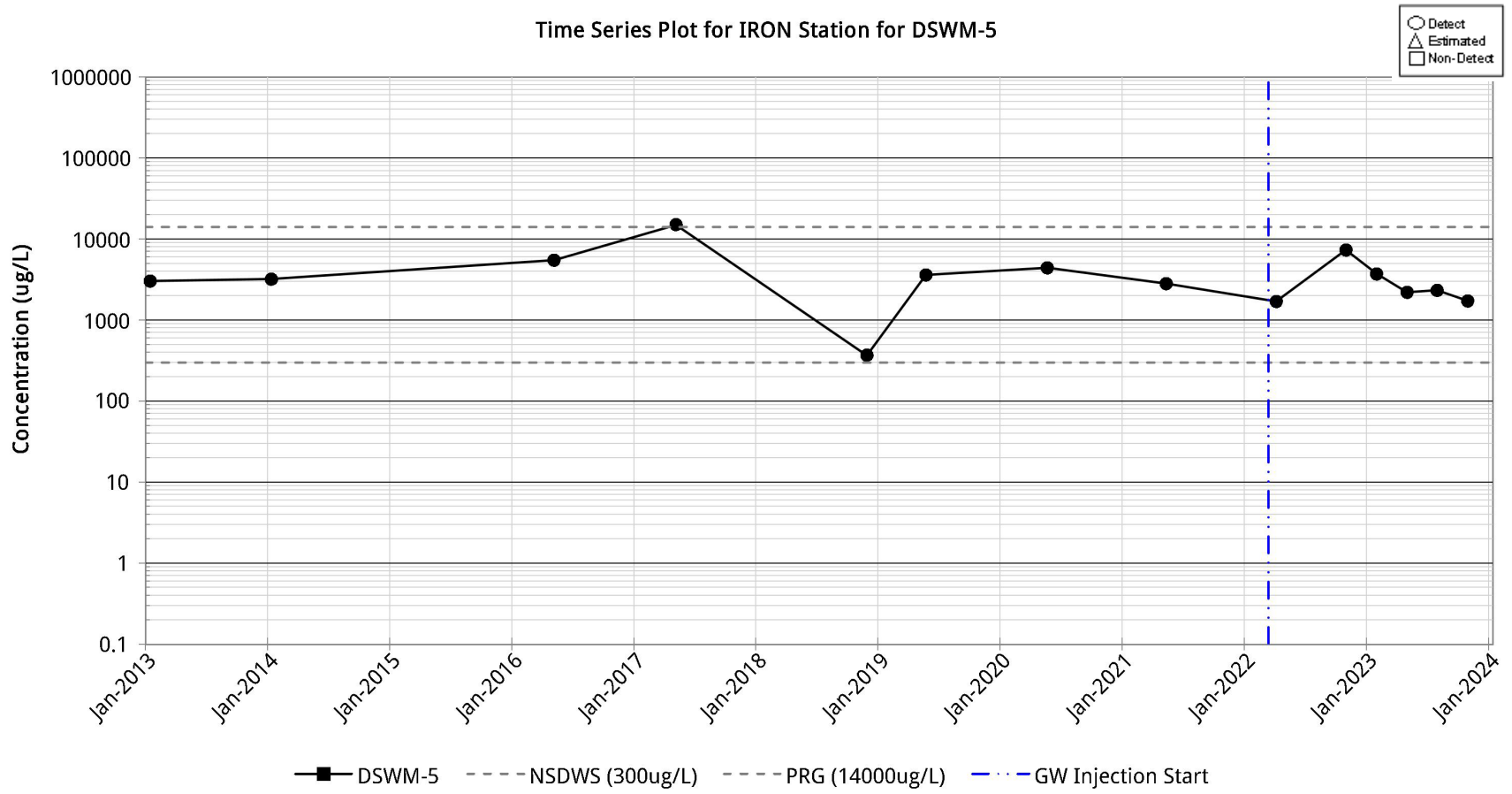

Time Series Plot for IRON Station for DCB 70
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 70A
DCB 70B
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

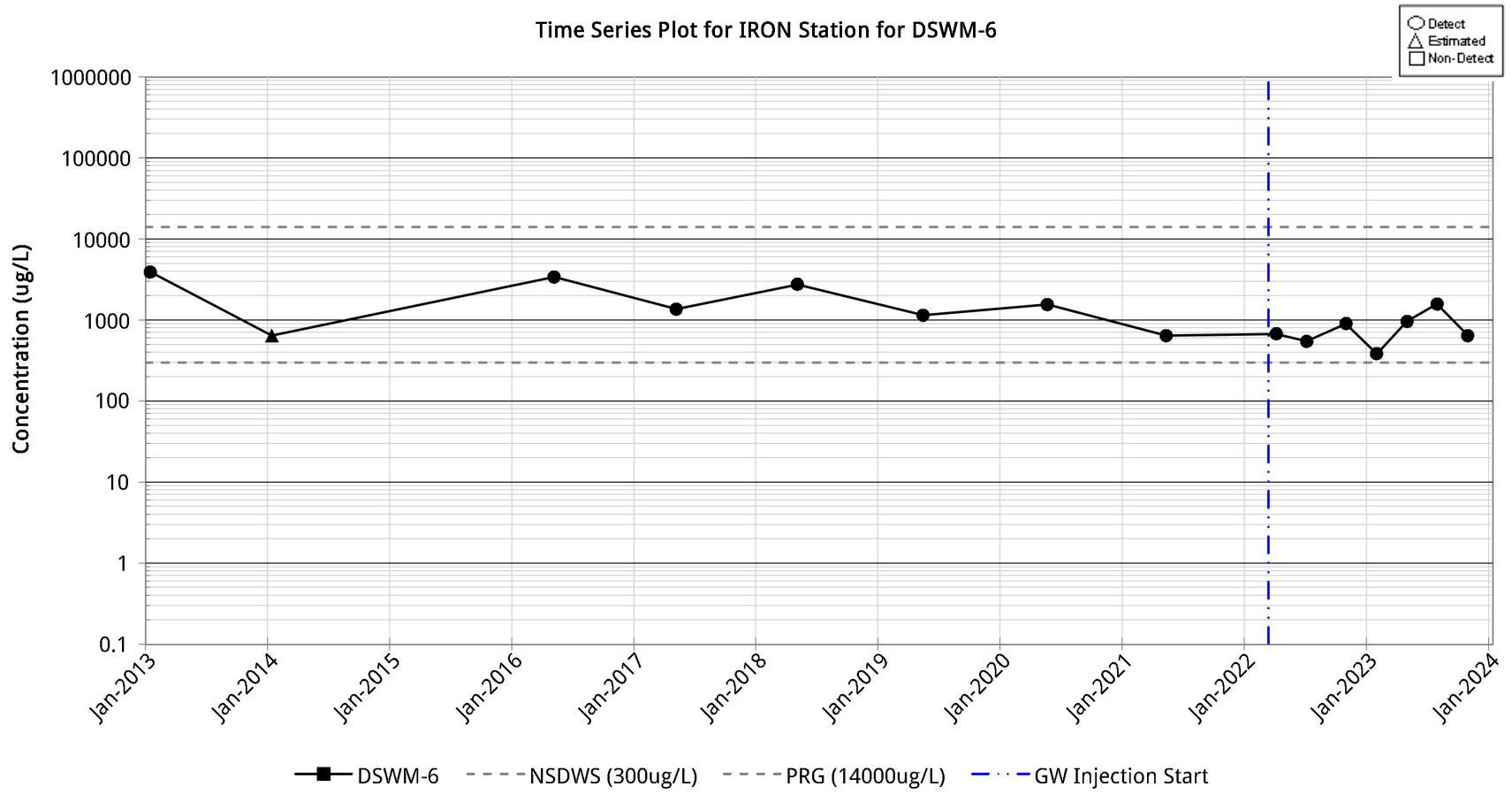

Time Series Plot for IRON Station for DCB077
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB077
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

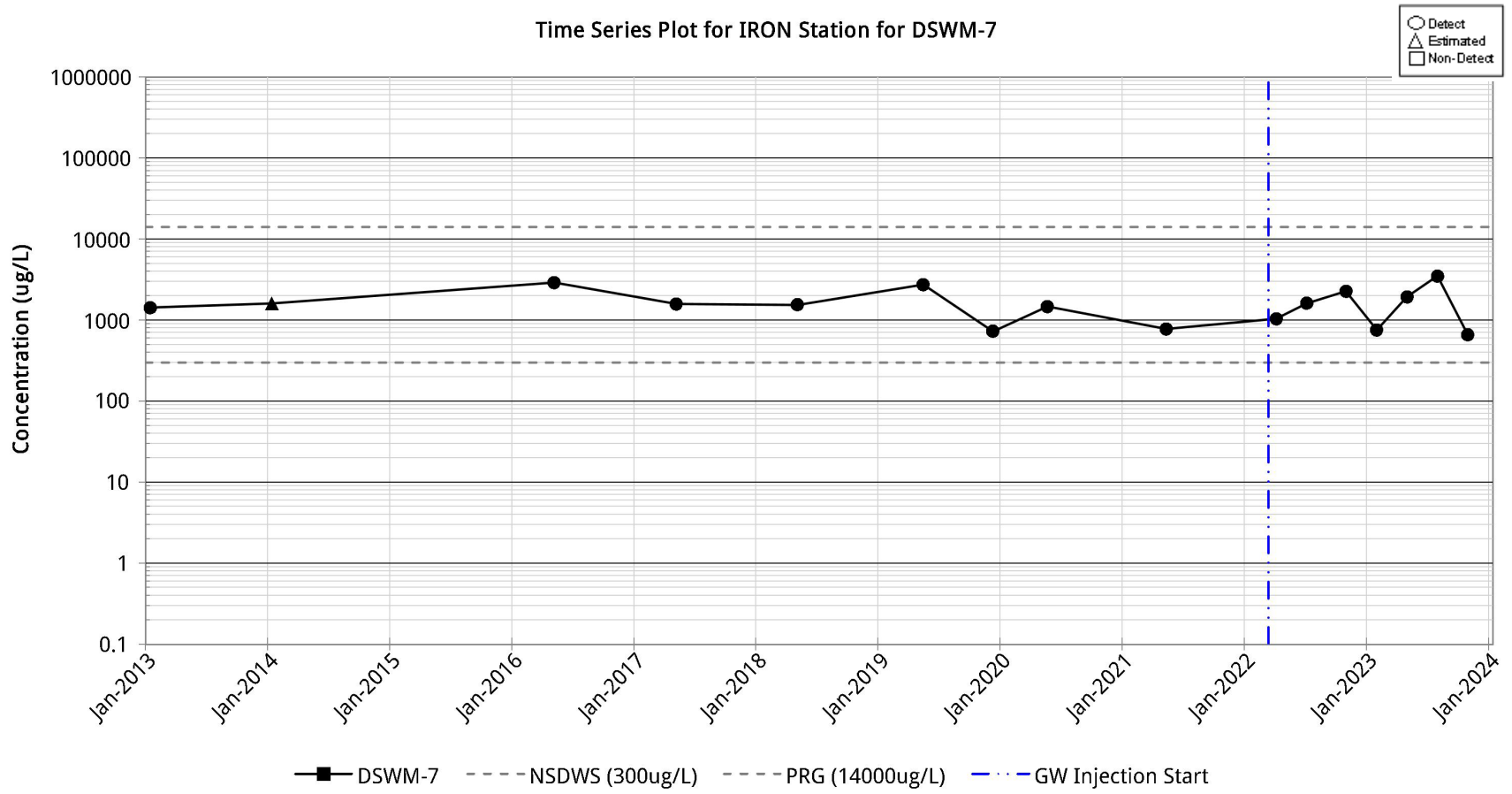

Time Series Plot for IRON Station for DCB078
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 47C
DCB078
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

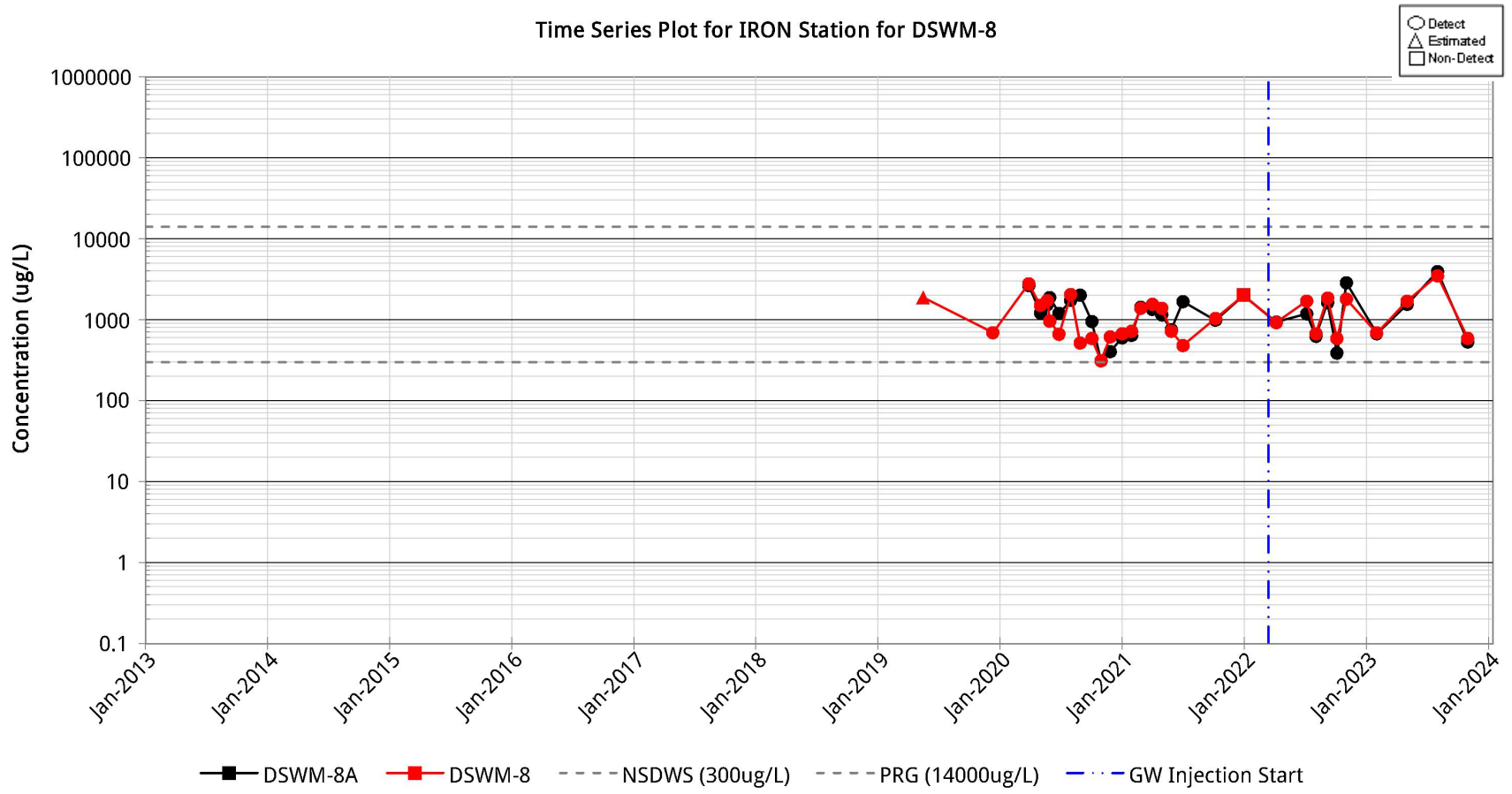

Time Series Plot for IRON Station for DCB087
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB087D
DCB087A
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

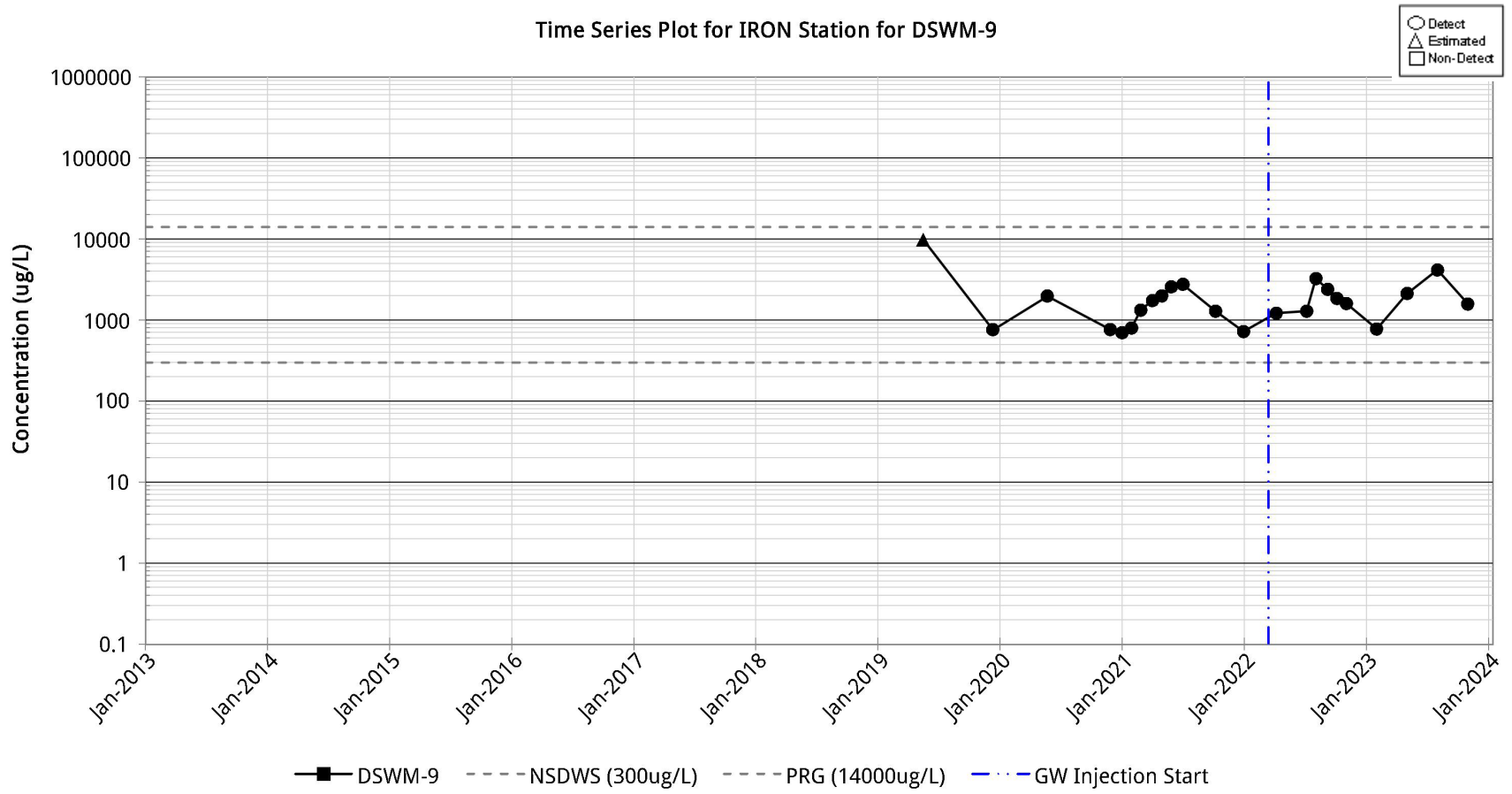

Time Series Plot for IRON Station for DSWM-4
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-4
DSWM-4A
DSWM-4B
DSWM-4C
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

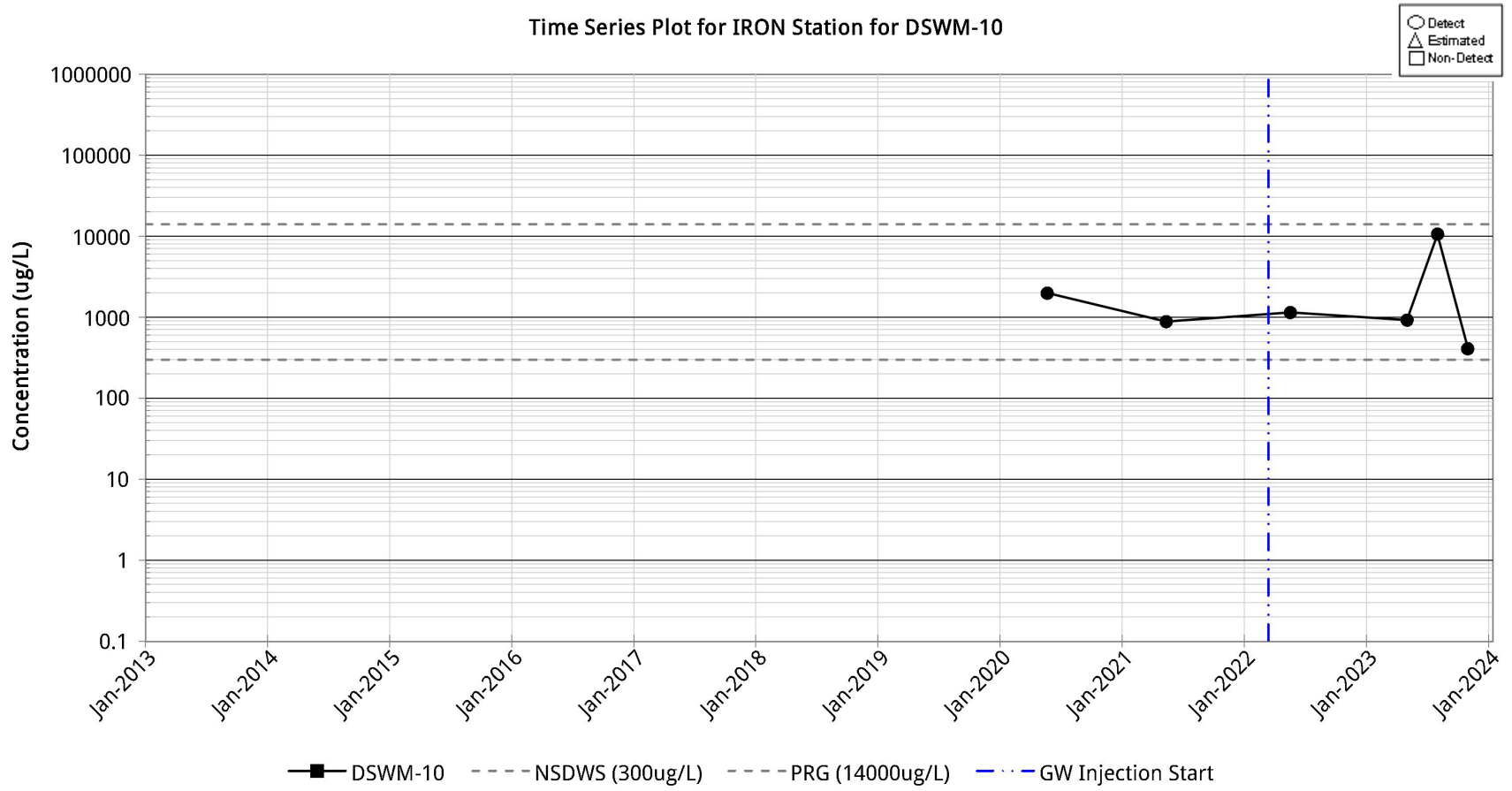

Time Series Plot for IRON Station for DSWM-5
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-5
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

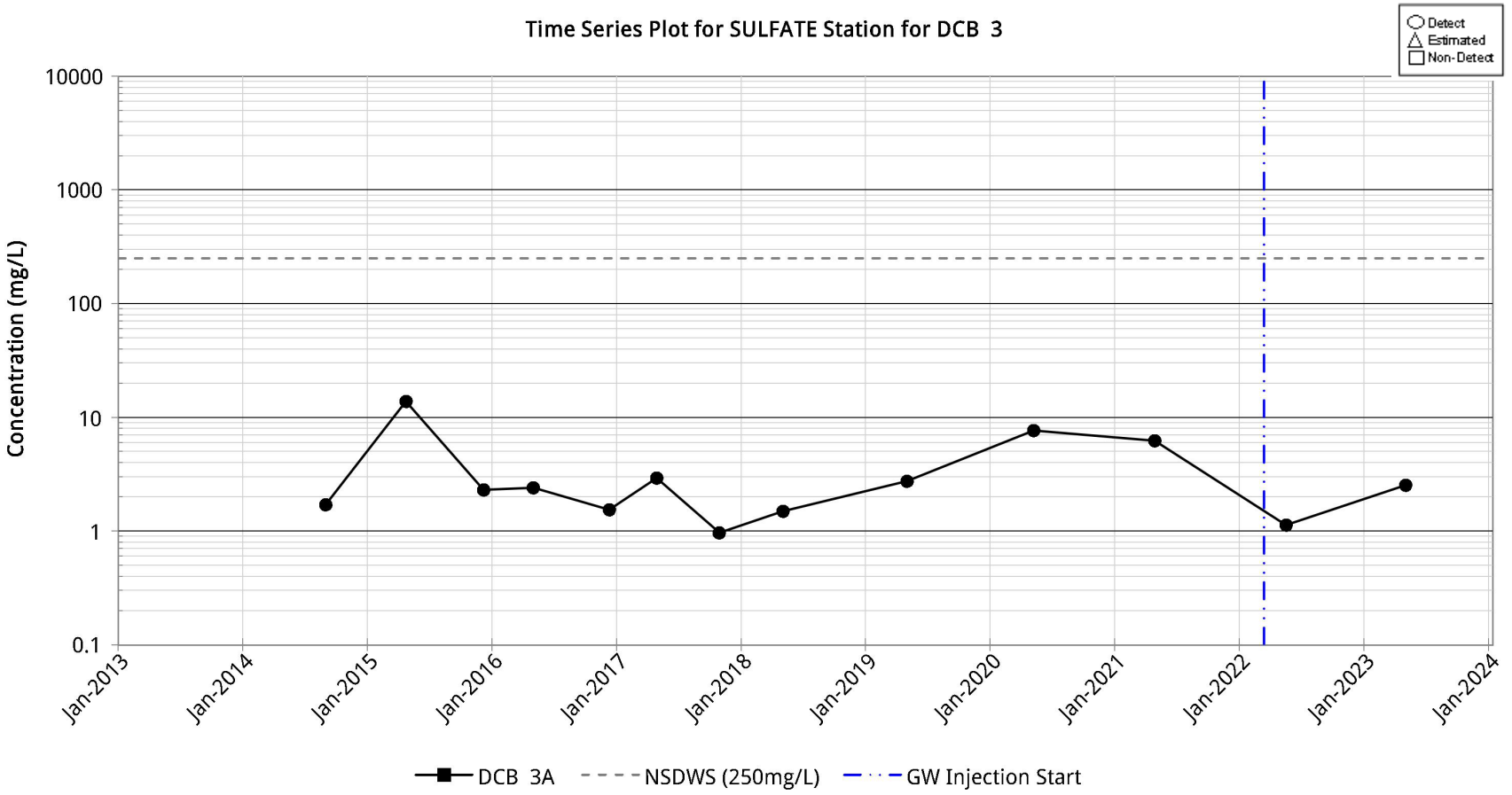

Time Series Plot for IRON Station for DSWM-6
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-6
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

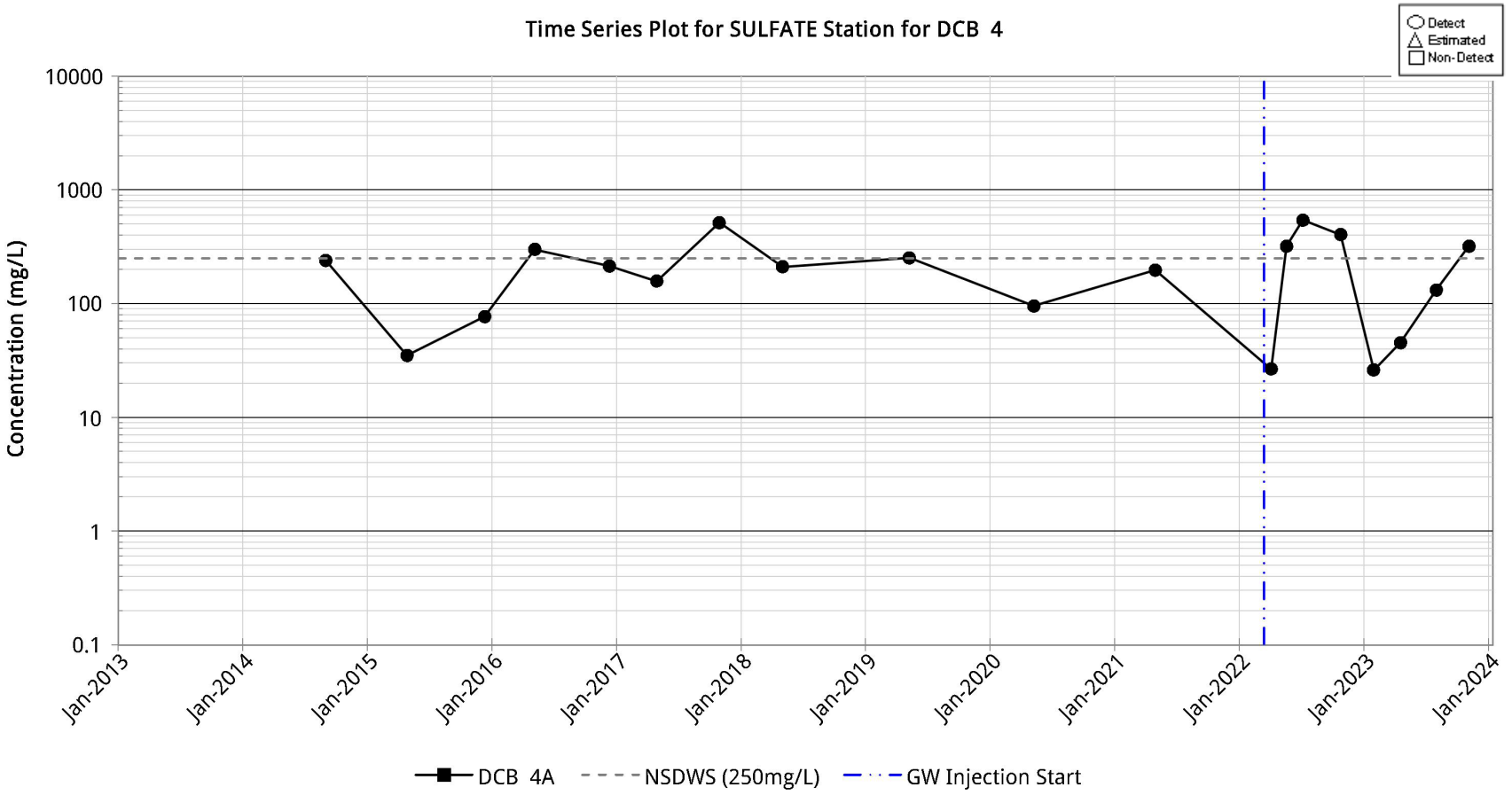

Time Series Plot for IRON Station for DSWM-7
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-7
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

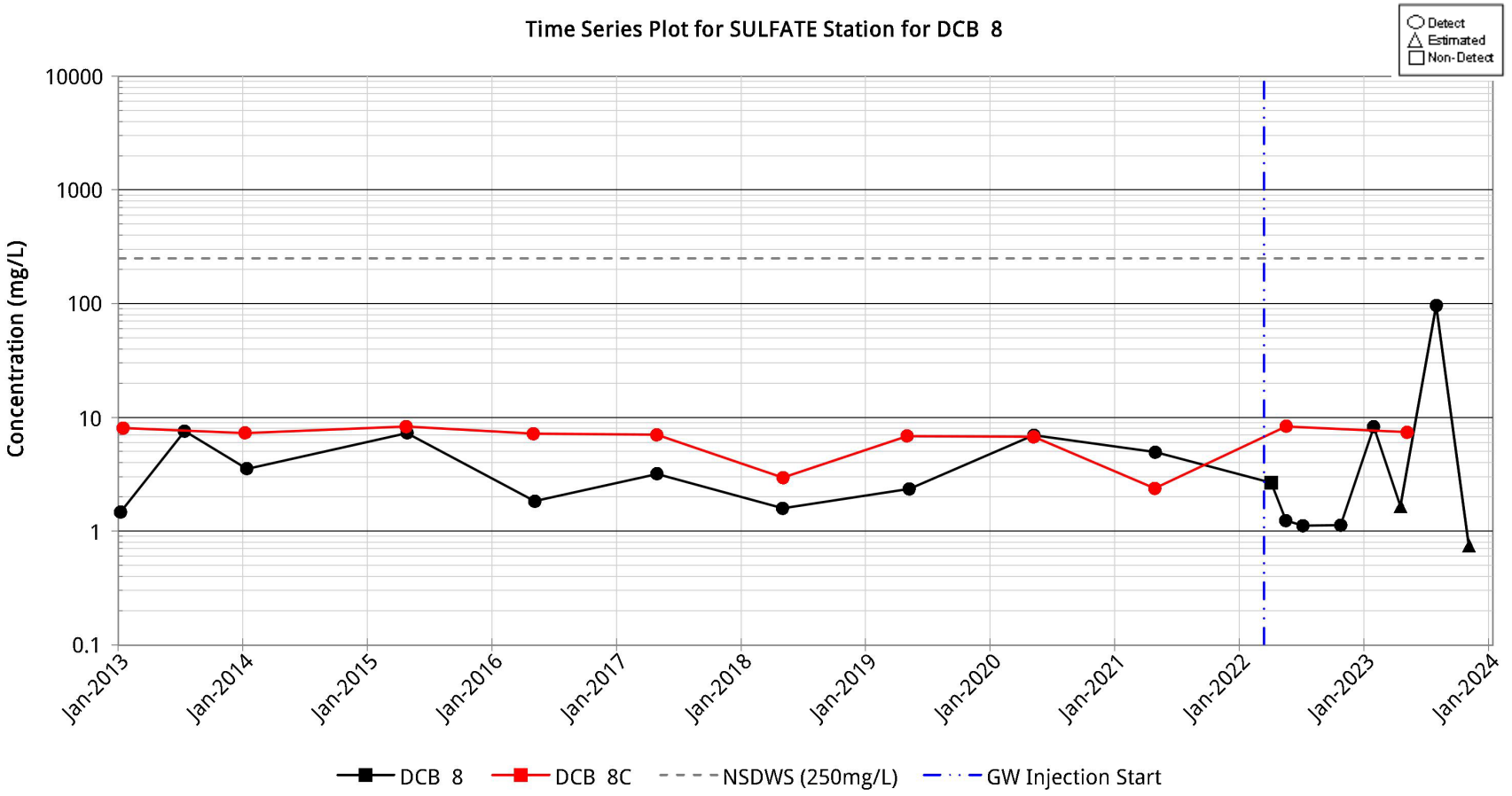

Time Series Plot for IRON Station for DSWM-8
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-8A
DSWM-8
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

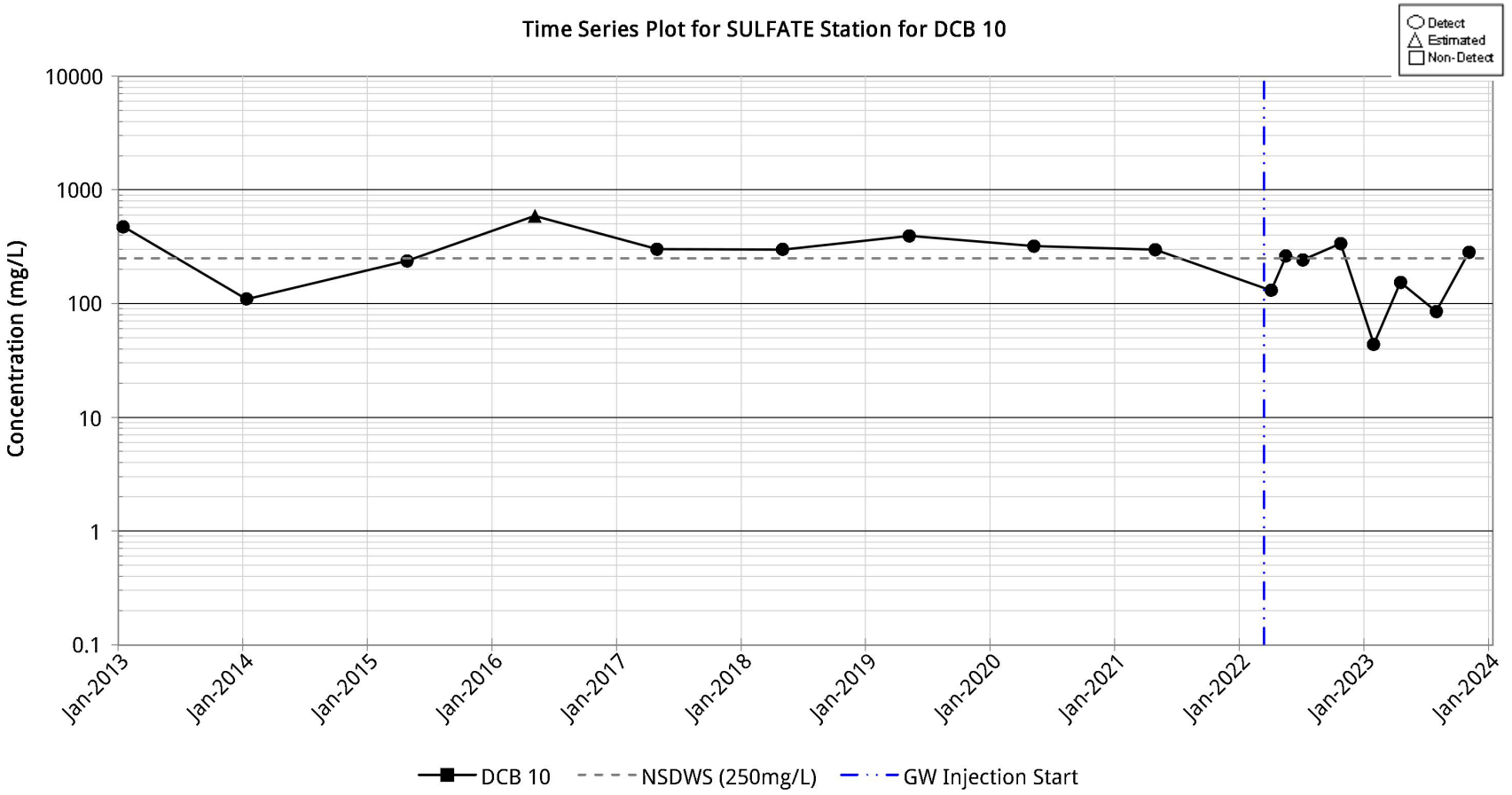

Time Series Plot for IRON Station for DSWM-9
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-9
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

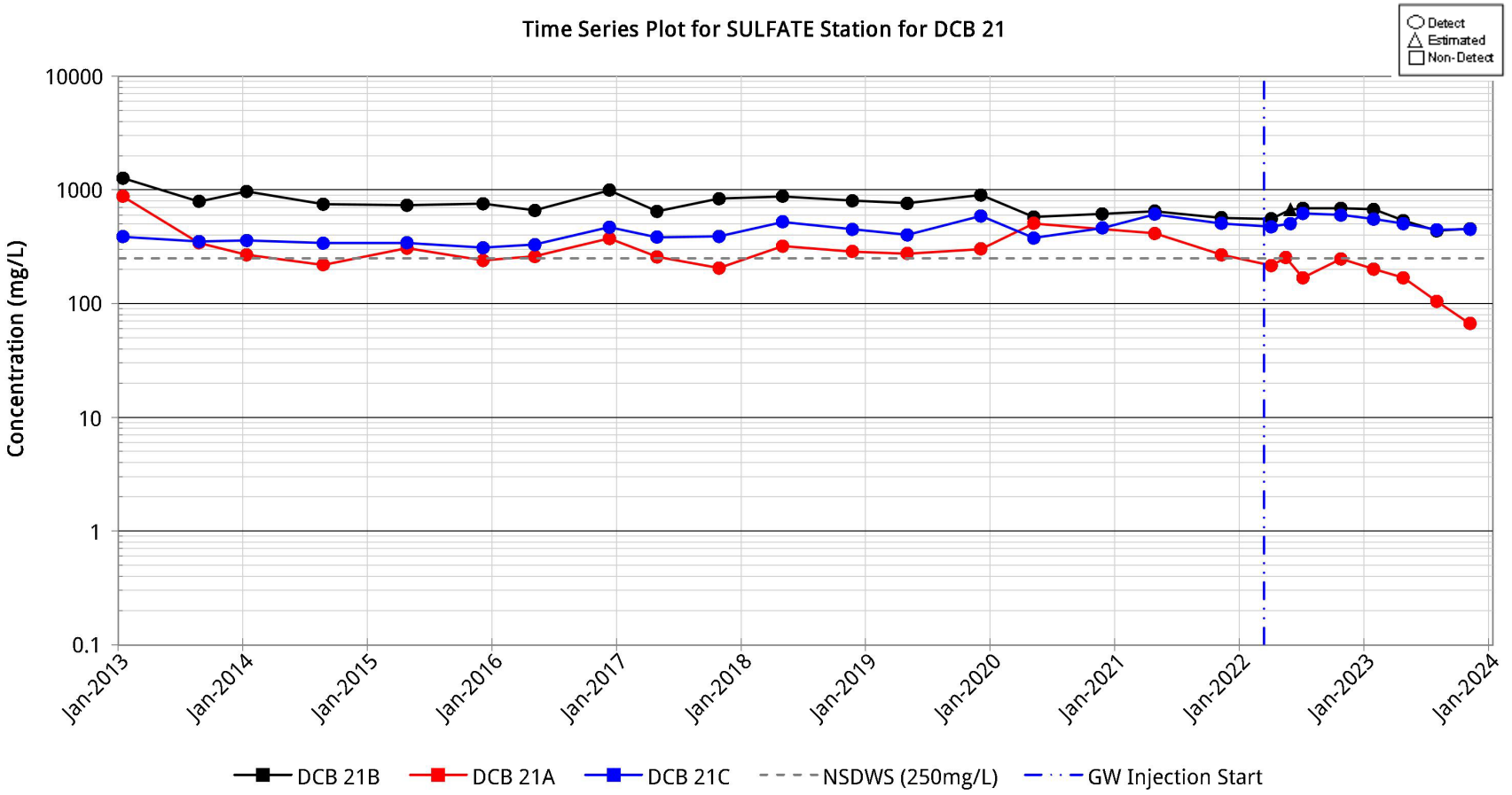

Time Series Plot for IRON Station for DSWM-10
Detect
Estimated
Non-Detect
Concentration (ug/L)
1000000
100000
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-10
NSDWS (300ug/L)
PRG (14000ug/L)
GW Injection Start

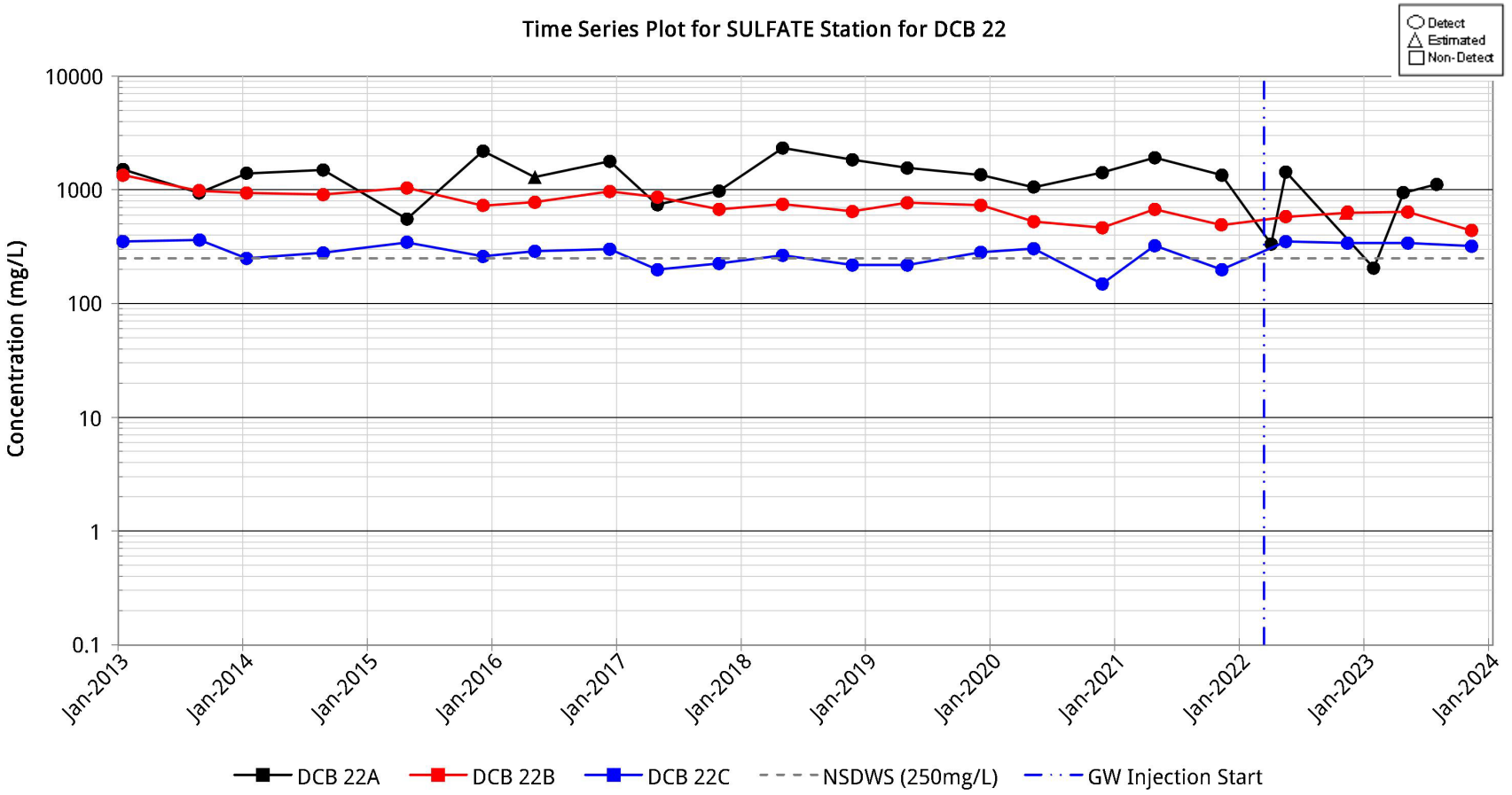

Time Series Plot for SULFATE Station for DCB 3
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 3A
NSDWS (250mg/L)
GW Injection Start

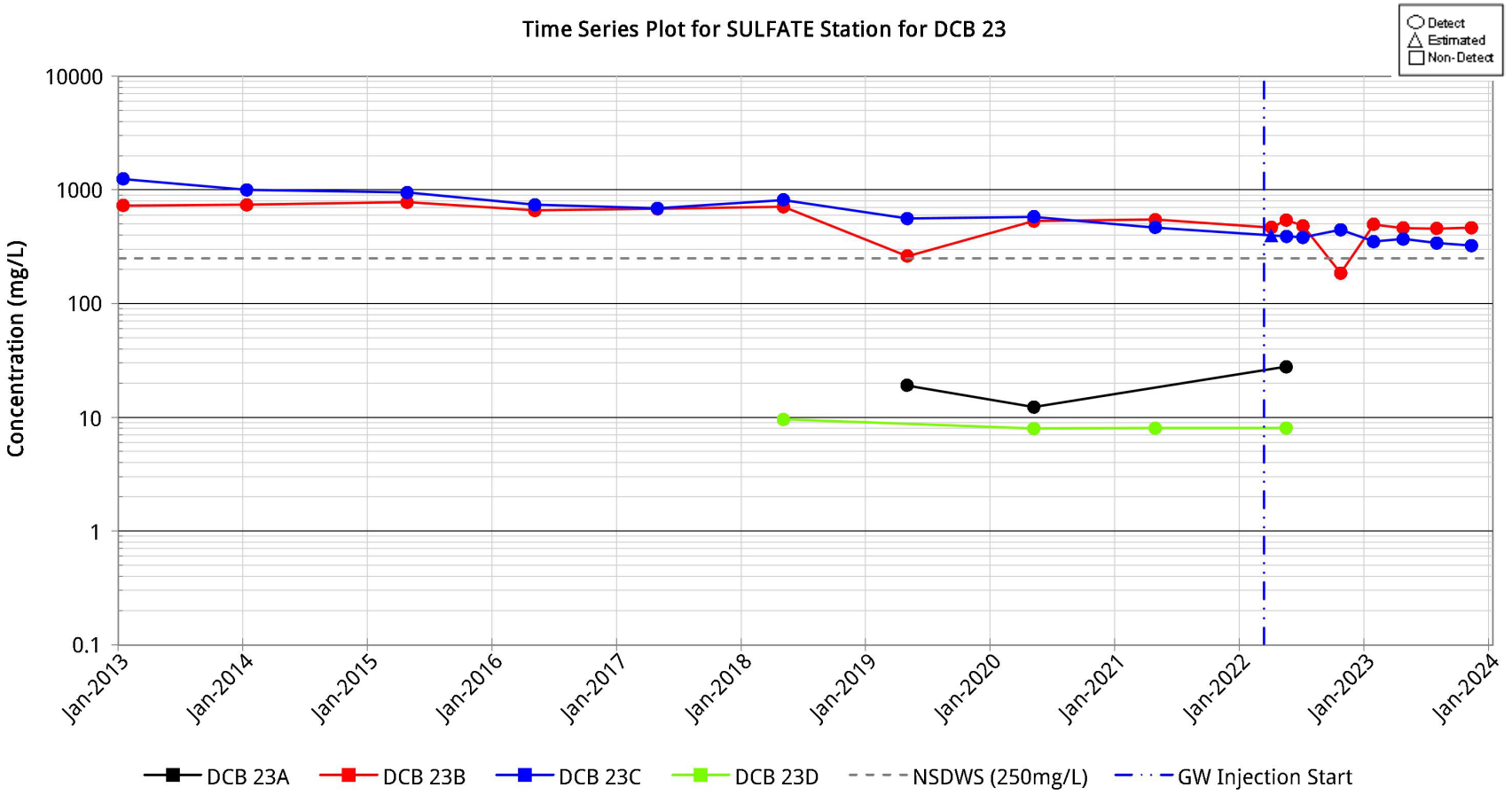

Time Series Plot for SULFATE Station for DCB 4
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 4A
NSDWS (250mg/L)
GW Injection Start

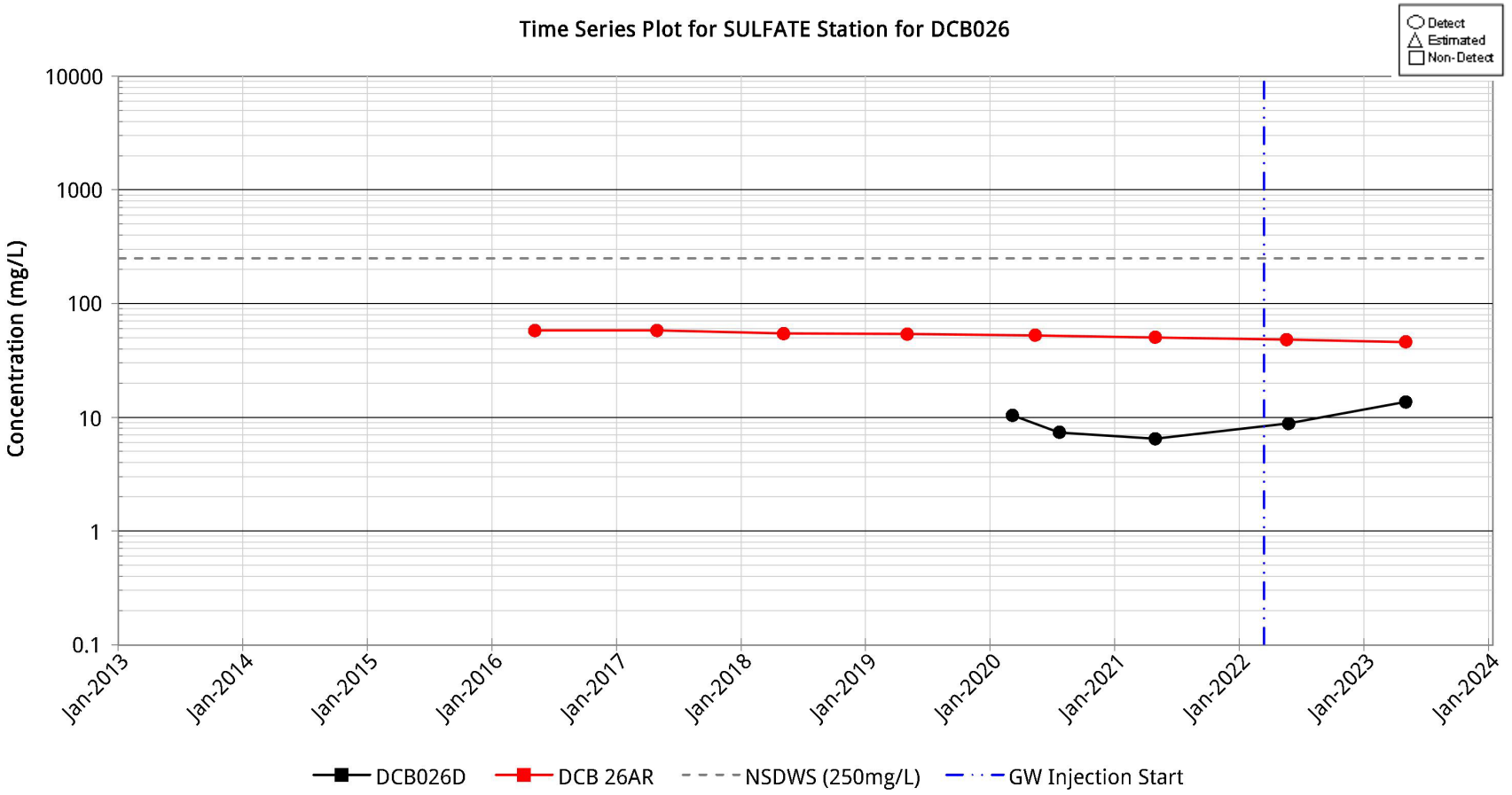

Time Series Plot for SULFATE Station for DCB 8
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 8
DCB 8C
NSDWS (250mg/L)
GW Injection Start

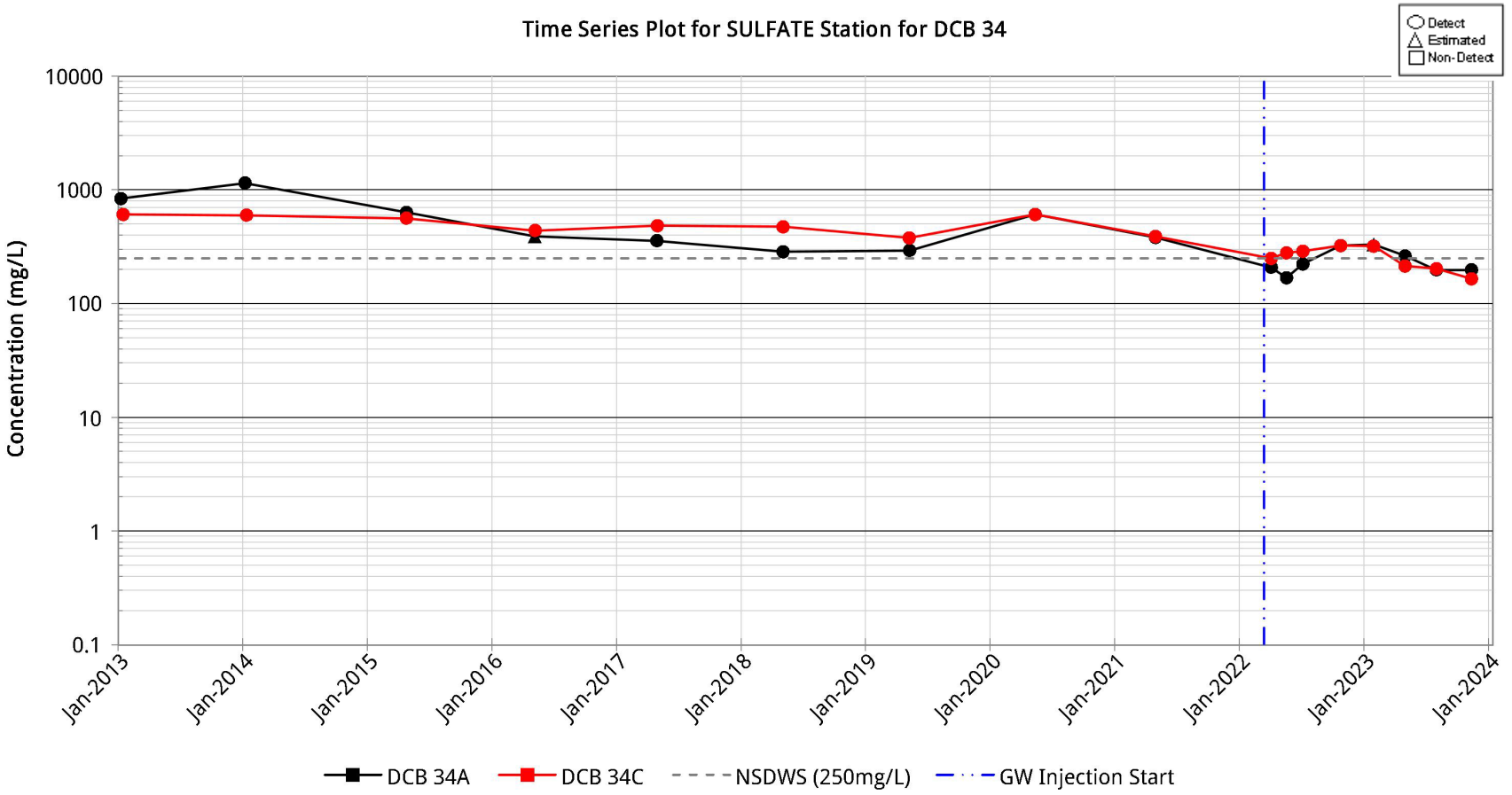

Time Series Plot for SULFATE Station for DCB 10
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 10
NSDWS (250mg/L)
GW Injection Start

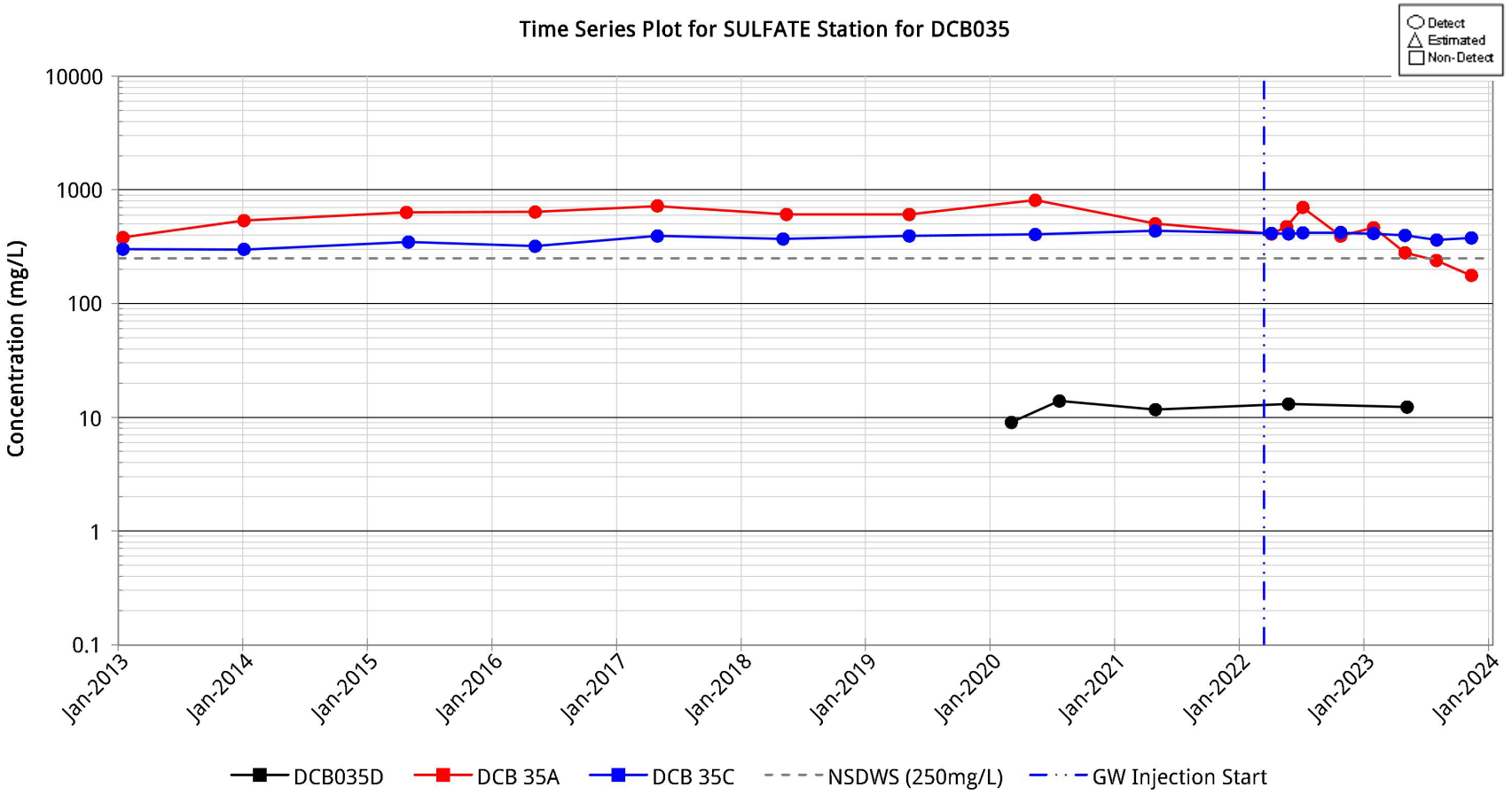

Time Series Plot for SULFATE Station for DCB 21
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 21B
DCB 21A
DCB 21C
NSDWS (250mg/L)
GW Injection Start

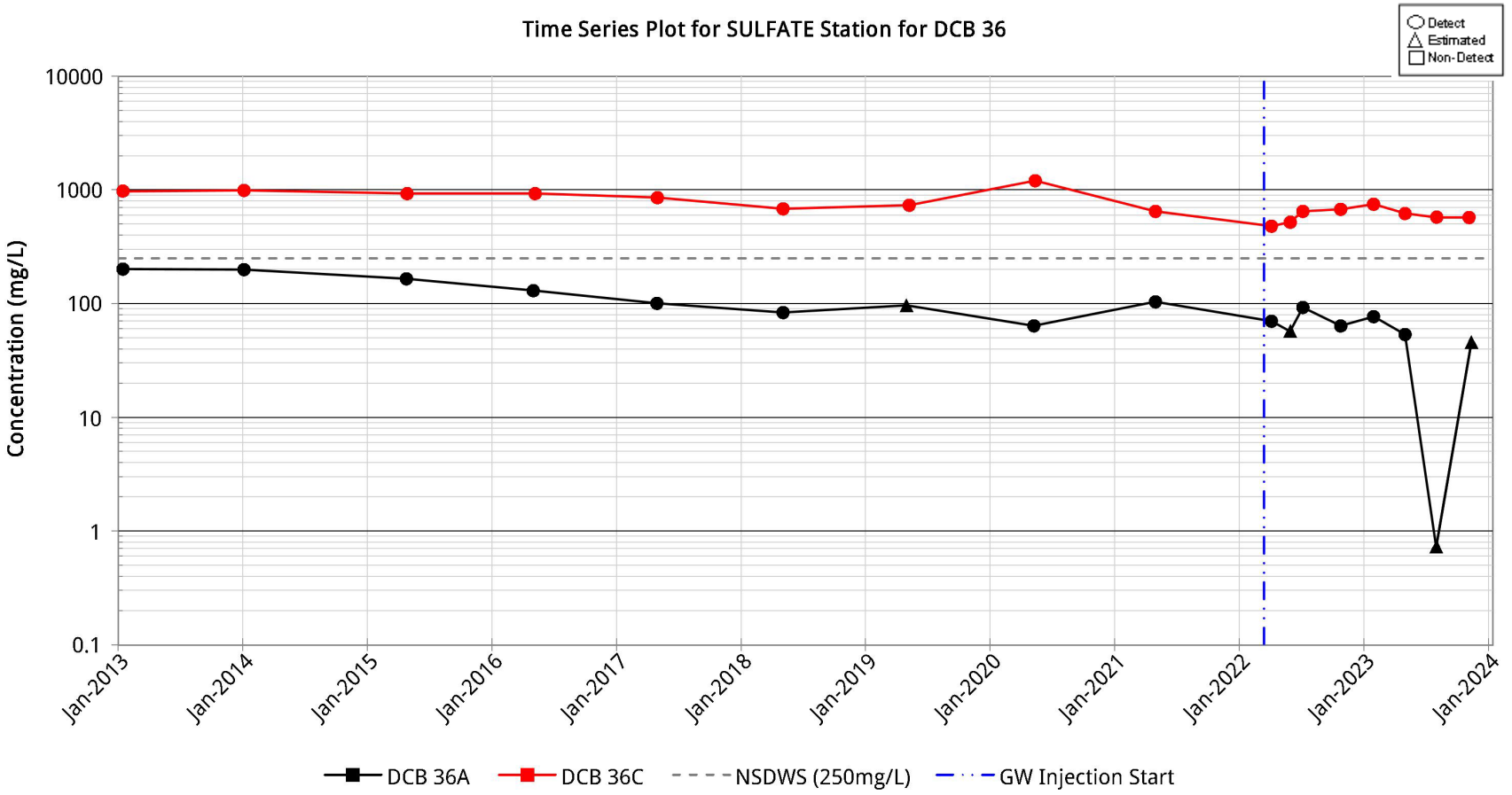

Time Series Plot for SULFATE Station for DCB 22
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 22A
DCB 22B
DCB 22C
NSDWS (250mg/L)
GW Injection Start

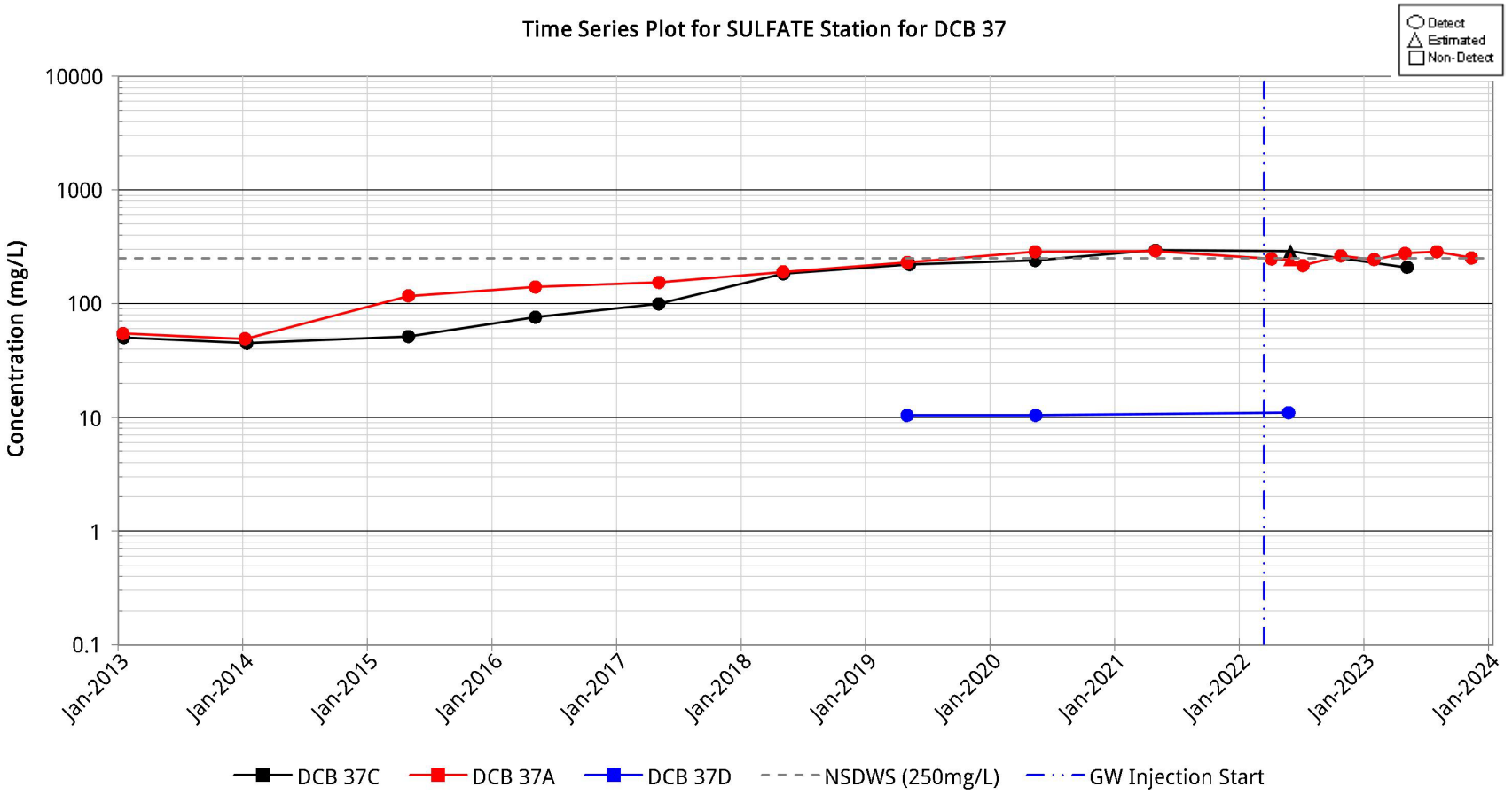

Time Series Plot for SULFATE Station for DCB 23
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 23A
DCB 23B
DCB 23C
DCB 23D
NSDWS (250mg/L)
GW Injection Start

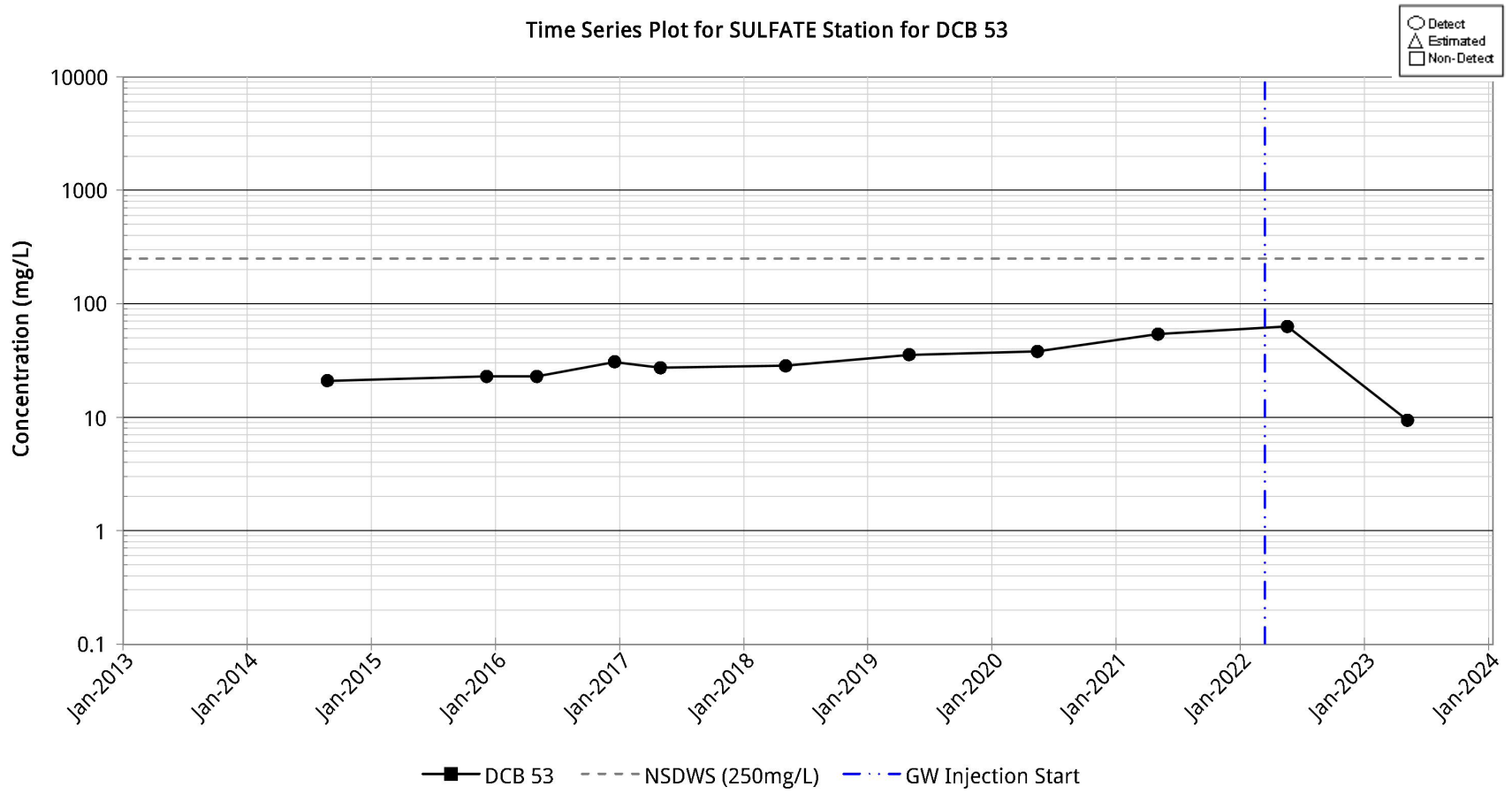

Time Series Plot for SULFATE Station for DCB026
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB026D
DCB 26AR
NSDWS (250mg/L)
GW Injection Start

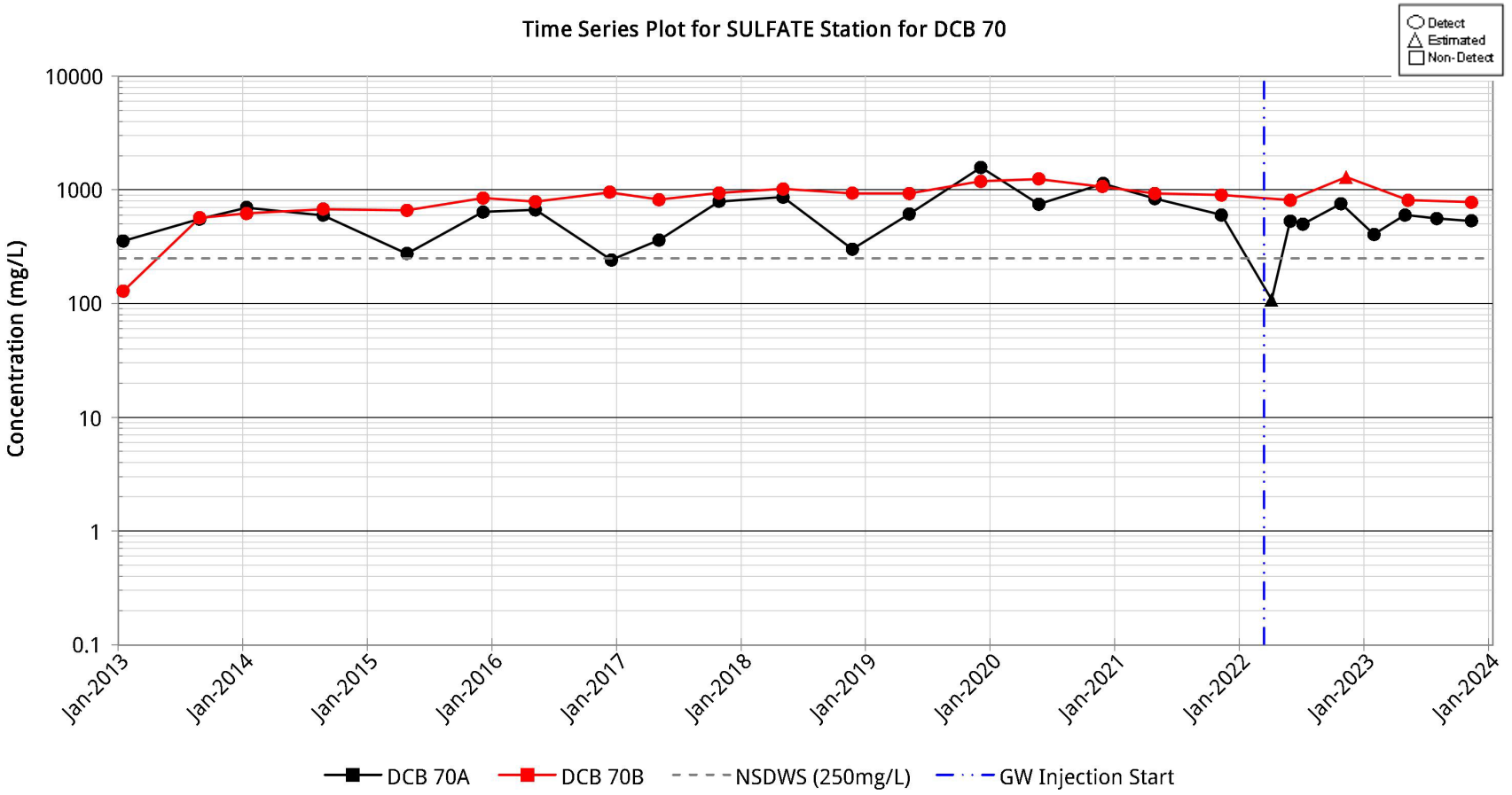

Time Series Plot for SULFATE Station for DCB 34
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 34A
DCB 34C
NSDWS (250mg/L)
GW Injection Start

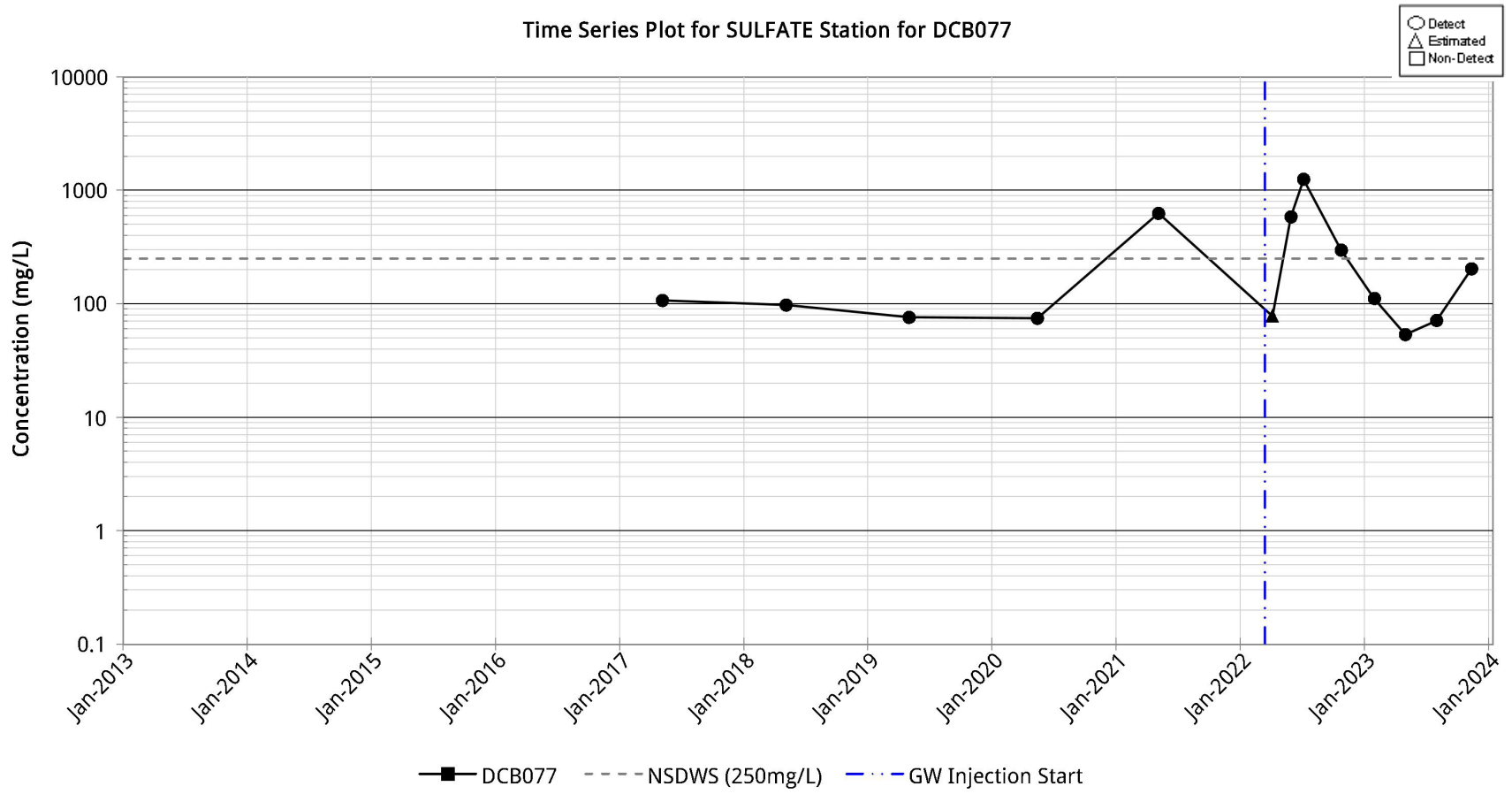

Time Series Plot for SULFATE Station for DCB035
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB035D
DCB 35A
DCB 35C
NSDWS (250mg/L)
GW Injection Start

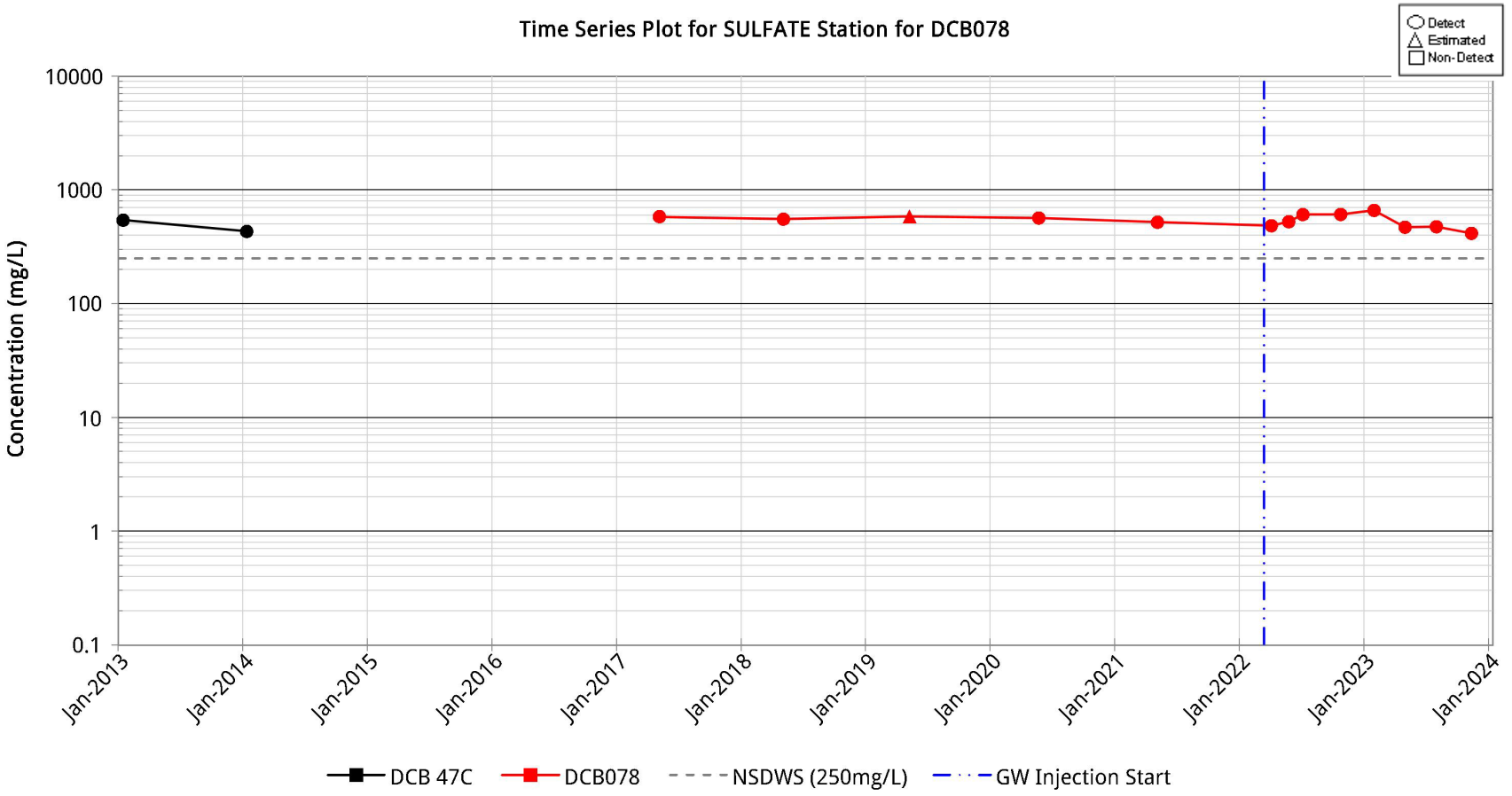

Time Series Plot for SULFATE Station for DCB 36
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 36A
DCB 36C
NSDWS (250mg/L)
GW Injection Start

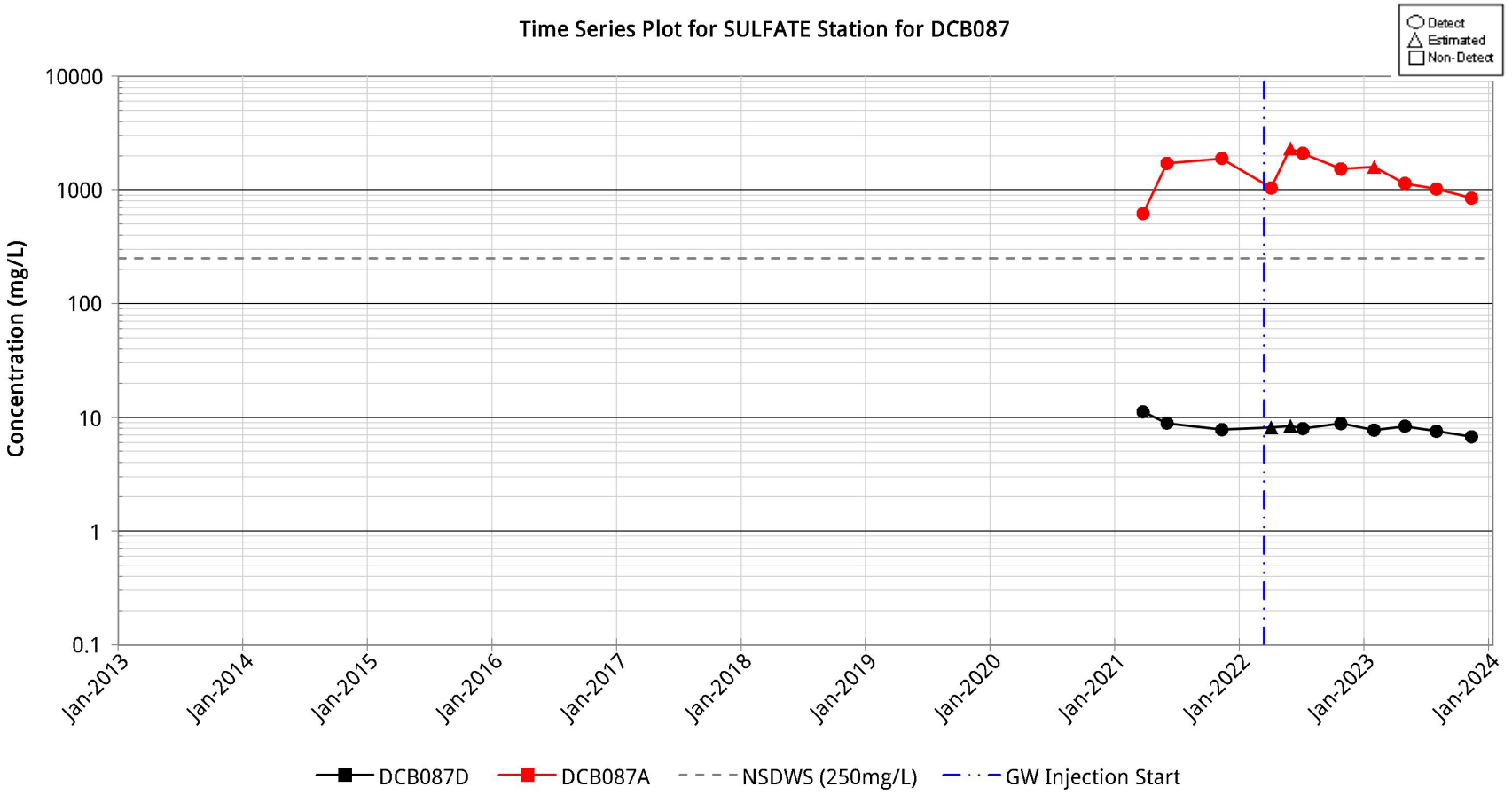

Time Series Plot for SULFATE Station for DCB 37
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 37C
DCB 37A
DCB 37D
NSDWS (250mg/L)
GW Injection Start

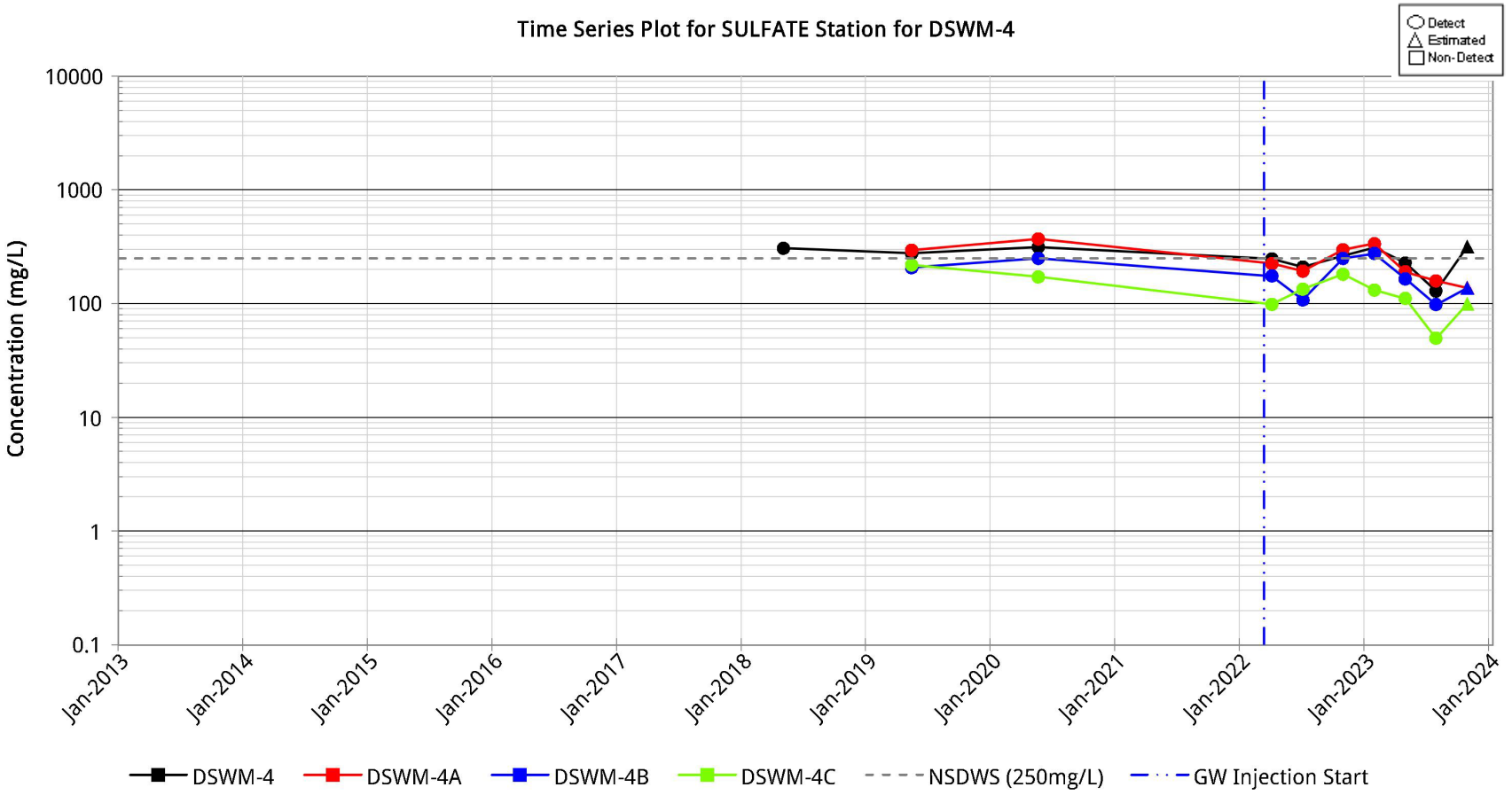

Time Series Plot for SULFATE Station for DCB 53
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 53
NSDWS (250mg/L)
GW Injection Start

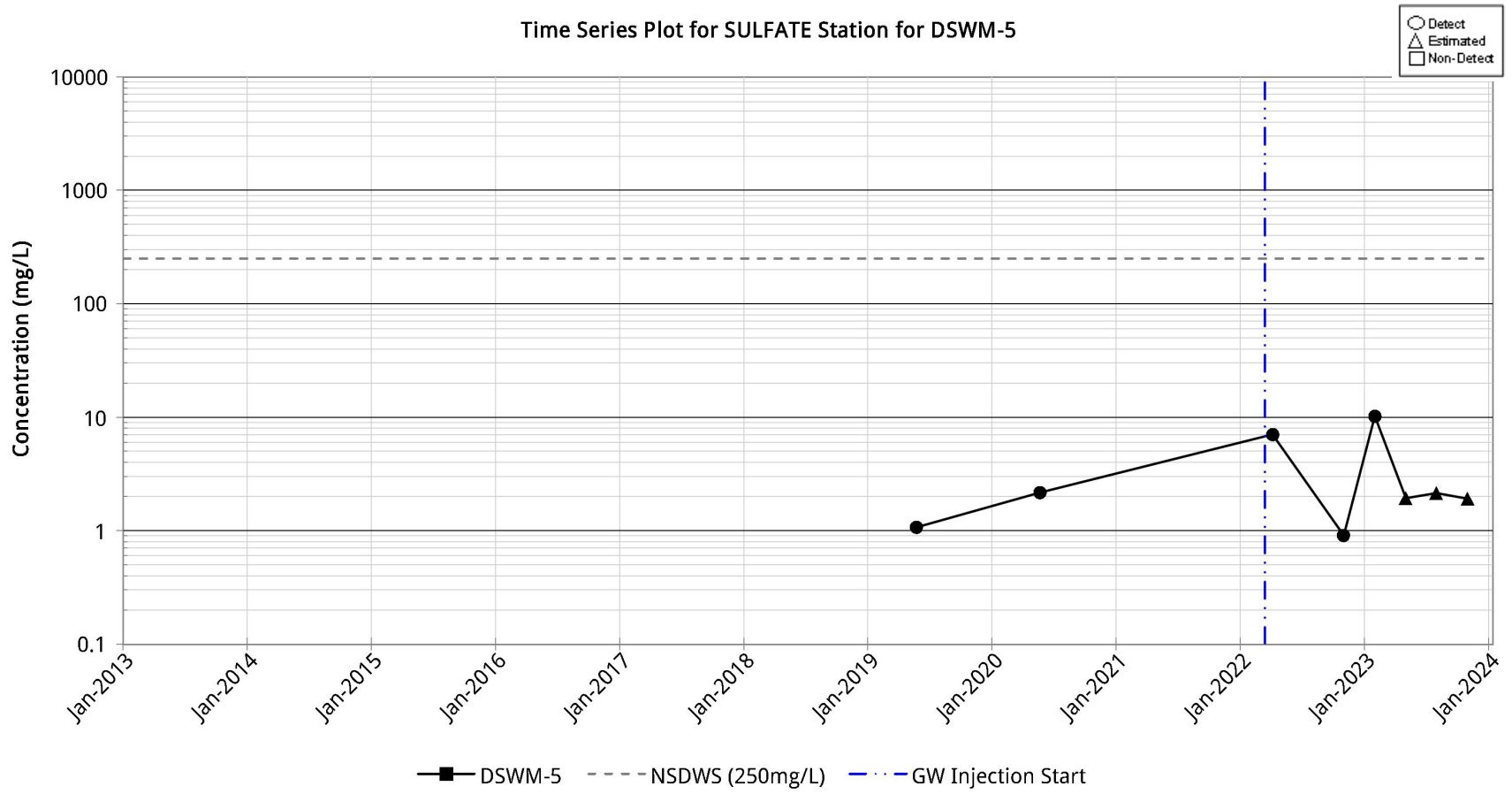

Time Series Plot for SULFATE Station for DCB 70
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 70A
DCB 70B
NSDWS (250mg/L)
GW Injection Start

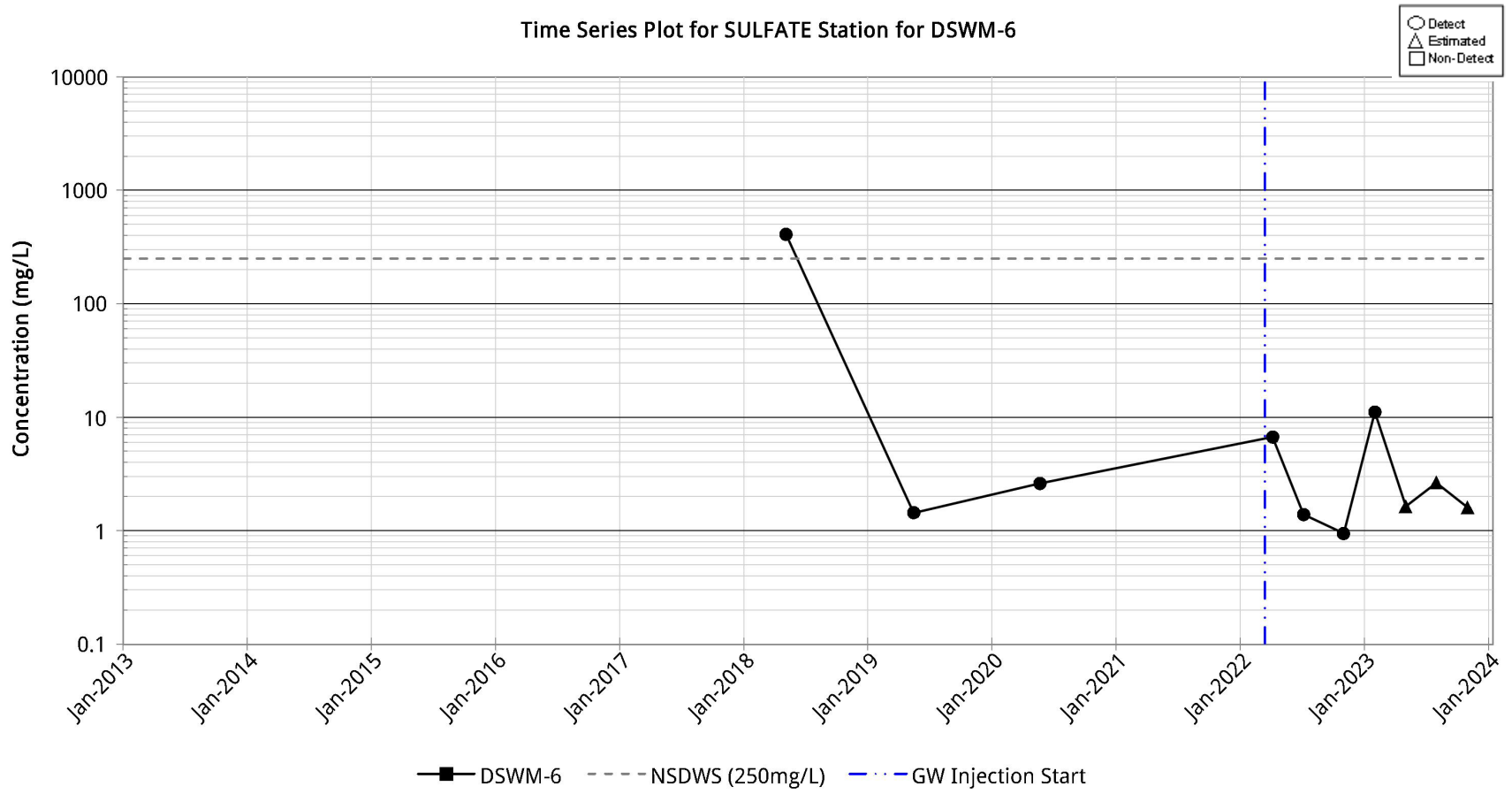

Time Series Plot for SULFATE Station for DCB077
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
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0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB077
NSDWS (250mg/L)
GW Injection Start

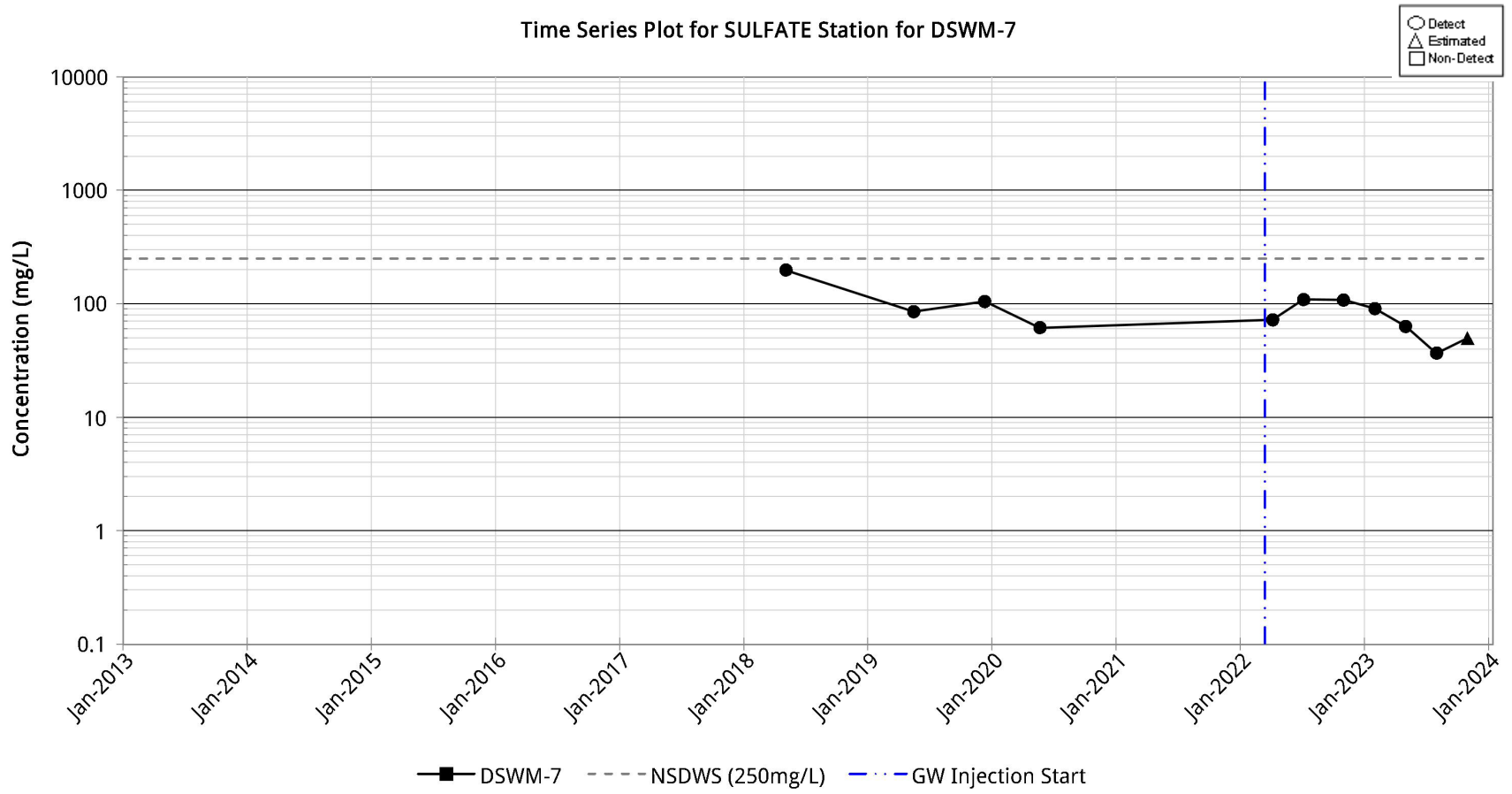

Time Series Plot for SULFATE Station for DCB078
Detect
Estimated
Non-Detect
Concentration (mg/L)
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1000
100
10
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0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB 47C
DCB078
NSDWS (250mg/L)
GW Injection Start

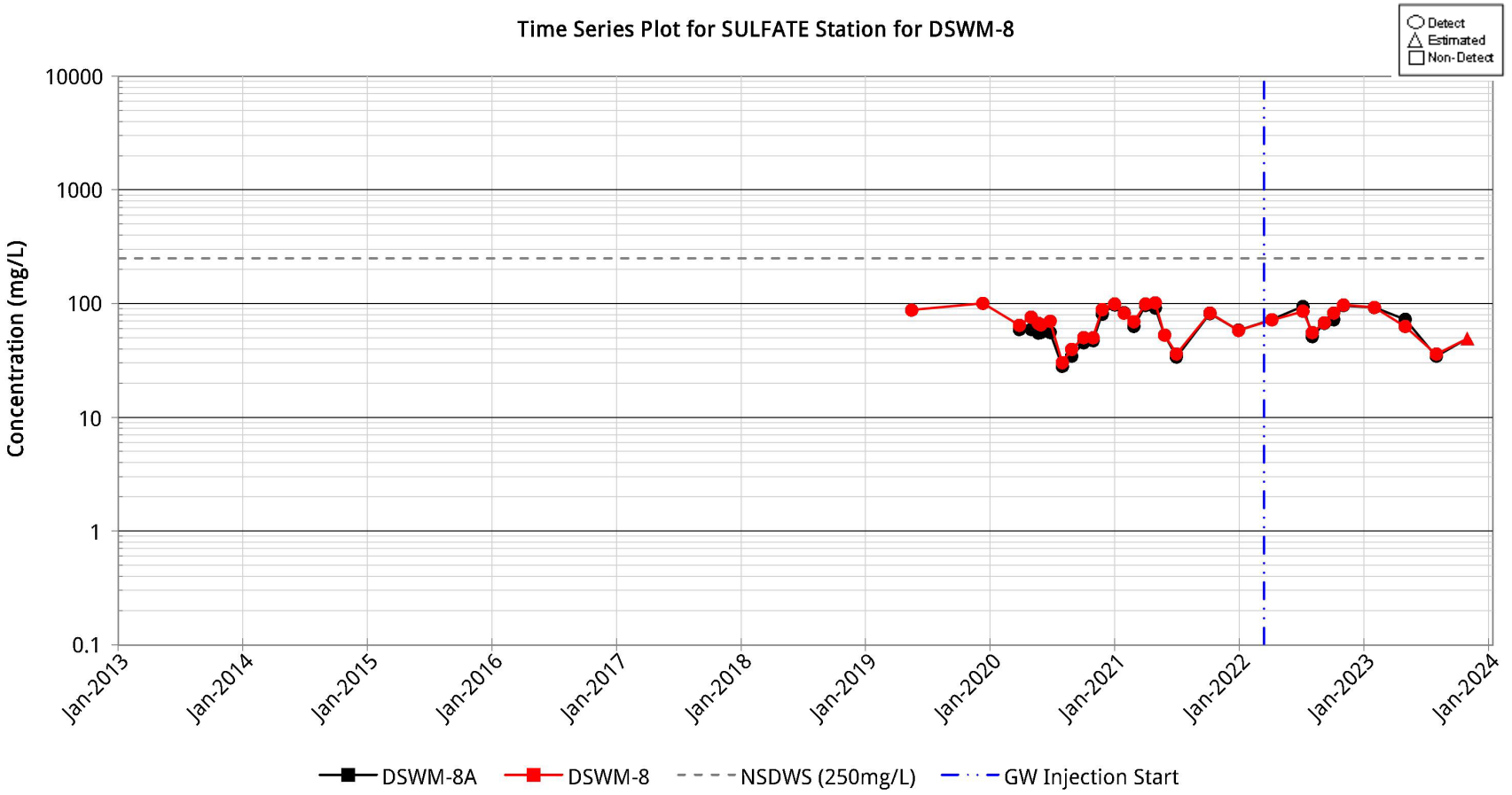

Time Series Plot for SULFATE Station for DCB087
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DCB087D
DCB087A
NSDWS (250mg/L)
GW Injection Start

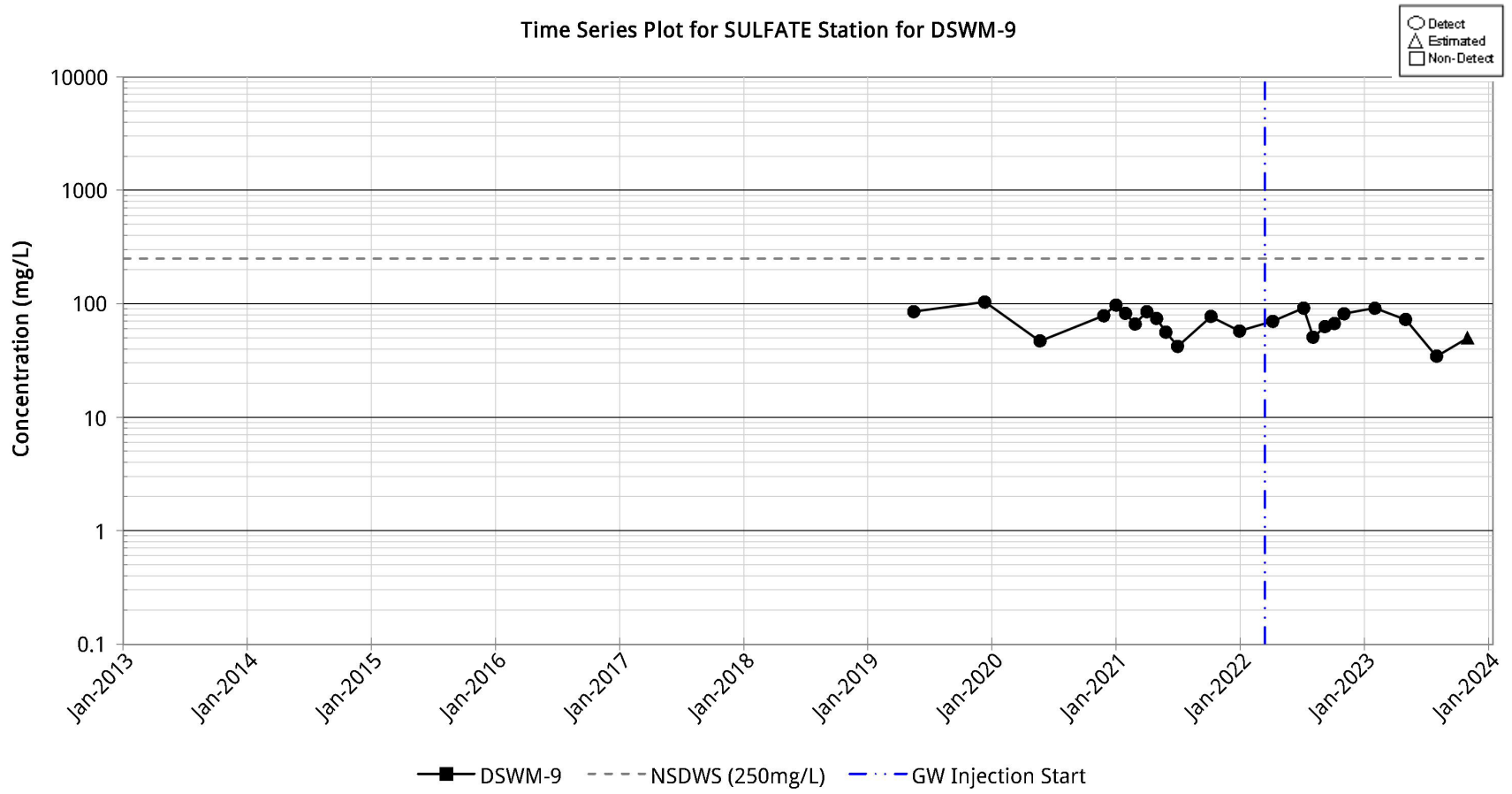

Time Series Plot for SULFATE Station for DSWM-4
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-4
DSWM-4A
DSWM-4B
DSWM-4C
NSDWS (250mg/L)
GW Injection Start

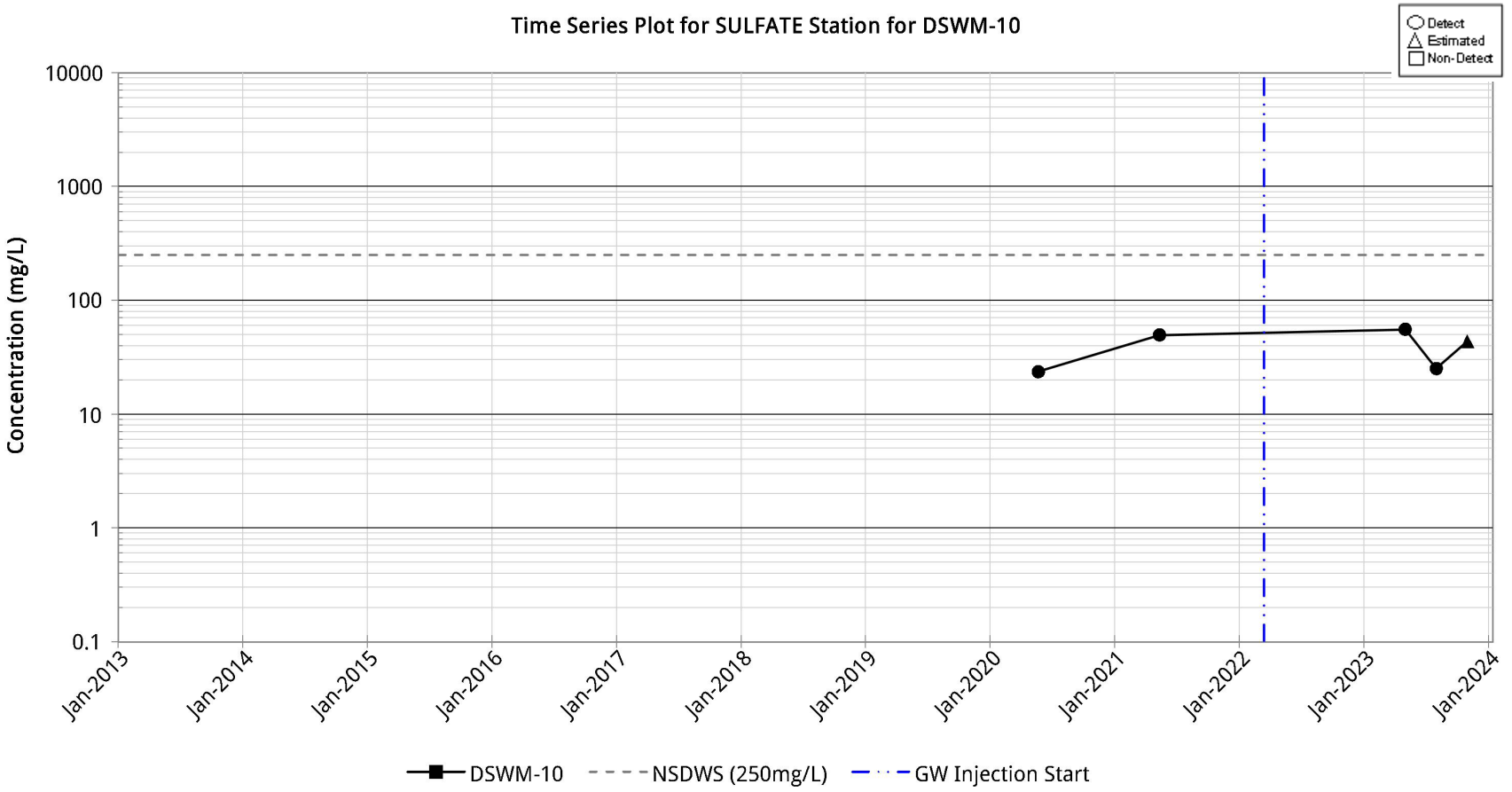

Time Series Plot for SULFATE Station for DSWM-5
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-5
NSDWS (250mg/L)
GW Injection Start


Time Series Plot for SULFATE Station for DSWM-6
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-6
NSDWS (250mg/L)
GW Injection Start


Time Series Plot for SULFATE Station for DSWM-7
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-7
NSDWS (250mg/L)
GW Injection Start


Time Series Plot for SULFATE Station for DSWM-8
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-8A
DSWM-8
NSDWS (250mg/L)
GW Injection Start


Time Series Plot for SULFATE Station for DSWM-9
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-9
NSDWS (250mg/L)
GW Injection Start


Time Series Plot for SULFATE Station for DSWM-10
Detect
Estimated
Non-Detect
Concentration (mg/L)
10000
1000
100
10
1
0.1
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
DSWM-10
NSDWS (250mg/L)
GW Injection Start

Appendix D

DAG OU Treatability Study Injection Reevaluation

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1.0 ALTERNATE ESTIMATION OF INJECTION TIME BASED ON SITE COMPLEXITY AT D AREA

While designing the groundwater injection system at D Area, the injection volume required to bring the in-situ pH up from 4 to 5.5 was estimated. These estimates indicated a total pore volume of approximately 19 million gallons of water. With two wells capable of supplying water at a cumulative rate of 120 gpm, a required total operating time of approximately 1000 days was also calculated. Certain assumptions were made during the calculations, including:

1. water level rising at D Area by 5 feet after injections begin,
2. injected water having a pH of 6.5, and
3. 10 pore volumes being required to achieve the target pH.

Since the time the groundwater injection system has been designed and installed, SRS has obtained additional information about the conditions at D Area. Using this information, SRS has reevaluated the total time required for injection of groundwater for the treatability study. The following three calculations made during the previous analysis have been reanalyzed:

1. quantity of one pore volume,
2. number of pore volumes required,
3. total time required for injection.

1.1 Pore Volume

The first calculation includes estimating one pore volume of the groundwater plume below a pH of 4.5. Figure D-1 shows the lateral extent of the acidic groundwater (pH<4.5). Assuming a simple rectangular shape, the plume can be approximated to be 2,000 feet long and 1,500 feet wide. Injection wells have been installed across approximately 2,000 feet when taken parallel to the Savannah River. Since, the length of installed injection well is larger than that of the plume width, it can be safely assumed that the injected water will mix across the larger width. The water level at D Area was measured to be, on average, 125 feet at DCB 8 (located just upgradient of the plume) before the injections began and approximately 130 feet one year after injections started. This shows that the estimated 5 feet of water level increase has been achieved close to the injection wells. The

water level close to the Savannah River has been measured to be approximately 90 feet. The vertical depth of the screening interval for the injection wells varies from approximately 28 to 50 feet bgs on average. Assuming a head increase of 5 feet at the injection wells, it is estimated that injected water will mix with a 25.8-foot thick aquifer zone. An average porosity of 0.2 across D Area is assumed.

Using these assumptions, one pore volume that the injected groundwater will mix with can be calculated:

Pore Volume = Length of the plume x width of the injection wells x mixing zone thickness x porosity

Pore Volume (PV) = 2,000 x 2,000 x 25.8 x 0.2 = 20.6 million cubic feet or **154.2 million gallons**.

1.2 Total Pore Volumes Required

The original calculations had assumed the pH of the added background groundwater to be 6.5. However, sampling over time has shown that the added background groundwater coming from the two production wells has a pH of 6. The average pH of the acidic groundwater is 4.

Assuming complete mixing, instantaneous equilibrium and not accounting for the various other ions that may be present in the mixing waters, the pH of the resulting mixed water can be calculated as:

$pH_{mix} = - \log_{10}((10 \text{ ^ } -pH_A + NPV*10 \text{ ^ } -pH_B)/(1+ NPV))$

where, pH_A = pH of the in-situ acidic groundwater,

pH_B = pH of the added background groundwater, and

NPV = total number of pore volumes required.

Using 10 pore volumes, the resulting pH of mixed water is calculated to be 5.

45 pore volumes will be required to obtain the target pH of 5.5.

1.3 Total Time of Injection

An injection rate (IR) of 120 gpm likely can be achieved with the 10 currently installed injection wells. The total injection time required (TITR) can be estimated as

TITR = (NPV*PV)/IR

This provides an estimate of **110 years** of continuous groundwater injection required to achieve the target pH of 5.5. If the target pH is lowered to 5, then it is estimated to be achieved within **24.4 years** of groundwater injection operations.

It should be noted that this reanalysis indicates that approximately **2.4 years** will be required to inject one pore volume.

Using the original conceptualized pore volume calculation of 19 million gallons, a **TITR of 13.6 years** is calculated.

These estimates for TITR appear to have a significantly wide range from a minimum of 3 years in the original design analysis to a maximum of 110 years in this current analysis. It should be noted that these estimates will be refined further as more data is collected from the monitoring system and the hydrogeological conceptual model for the area is refined to reflect that data.

2.0 ANALYTICAL TRANSPORT MODELING OF INJECTED WATER AT THE DAG OU

It is important to understand how the injected groundwater will migrate at the DAG OU. Preparations are underway to build a numerical model of the DAG OU. However, numerical modeling projects are complex and require significant time and resources to complete. Therefore, SRS utilized an analytical methodology available within the Aquifer Injection Modeling (AIM) Toolbox (EPA, 2023) to model only the injection site at DAG OU. The methodology is based on Bear and Jacobs (1965) and requires making the following simplifying assumptions:

- Continuous, steady injection – the injection rate stays the same.
- Single injection well – a representative well location is selected in case of multiple wells.
- Well screen penetrates entire aquifer – average well screen thickness and mixing zone thickness are assumed to be equal.
- Homogeneous, isotropic aquifer – aquifer properties are constant.
- Infinite acting aquifer – boundary conditions other than injection don't have any significant impact on the transport except an assumed natural hydraulic gradient.
- Confined aquifer – the aquifer is at Thiem equilibrium.
- Aquifer has constant thickness (flat top & bottom) – sloping impacts not considered.
- Negligible injectate/groundwater density difference – variable-density impacts are not considered.
- Plug Flow (no mixing) – injected water displaces the in-situ water.

In addition to assuming the conditions provided above, the following parameters for building the analytical model of our injection site were also assumed:

- Groundwater flow direction is assumed to be towards the Savannah River.
- Natural hydraulic gradient is estimated to be 0.014 (using water levels between DCB 8 & DCB 22).
- Aquifer thickness assumed to be 26 feet (equal to the estimated mixing zone thickness).
- Aquifer porosity is assumed to be 0.2.

- Aquifer hydraulic conductivity (K) is estimated as 20 ft/day (slug testing at DAOU indicated a maximum hydraulic conductivity of 15 ft/d, which is taken to be the lower limit of hydraulic conductivity). Simple estimation of K was also conducted using the observation that the head close to the injection wells has increased by 5 feet since injection rate stabilized at 120 gpm.
- Dispersion is generally assumed to be 1/10th the length of the plume. However, the plume has not migrated too far away from the potential source areas. Therefore, the solution with and without taking dispersion were taken into consideration (Werner and Lehr, 1977).
- Injection flow rate is assumed to be constant throughout time at 120 gpm.
- The single representative injection well is assumed to be located at the center of the injection well field.
- Injection duration is 3 years and 10 years.

Figures D-2(a & b) and D-3(a & b) present the results of the simple modeling exercise for simulating continuous injection over 3 years and 10 years, respectively. Figures D-2a and D-3a show the areal extent of the injected groundwater. The red polygon shows the results of the areal extent, taking radial and background flow into consideration. The orange polygon shows the areal extent of the injected groundwater, taking radial and background flow as well as dispersion into consideration. Since the assumed dispersivity value was significantly large, it can be assumed that the results will be somewhere in the middle of the red and orange polygon, assuming all other parameters are kept constant. It appears that in 3 years the injected plume would have migrated and covered the current extent of the acidic groundwater plume. This lends confidence to the estimate that one pore volume of the acidic groundwater plume would have mixed with the injected groundwater within 3 years. It also appears that the injected groundwater would have migrated close to or started discharging into the Savannah River within 10 years of continuous injection. Figures D-2b and D-3b show the area covered by the injected groundwater plume over the period of the simulation. The estimated area can be multiplied with the thickness of the mixing zone to obtain the amount of groundwater: a) injected into the aquifer formation for the red polygon value, and b) mixed with the aquifer formation for the orange polygon value. Table D-1 provides a lookup table that matches the area value with number of pore volume (NPV) values.

Table D-1: Estimating Number of Pore Volumes Injected Based on Estimated Area of the Injected Groundwater

Area (mi^2)	Area (ft^2)	Volume Injected (M ft^3)	NPV
0.2	5.58E+06	143.72	0.93
0.4	1.12E+07	287.44	1.86
0.6	1.67E+07	431.15	2.80
0.8	2.23E+07	574.87	3.73
1	2.79E+07	718.59	4.66
1.2	3.35E+07	862.31	5.59
1.4	3.90E+07	1,006.02	6.52
1.6	4.46E+07	1,149.74	7.45
1.8	5.02E+07	1,293.46	8.39

NPV: number of pore volumes

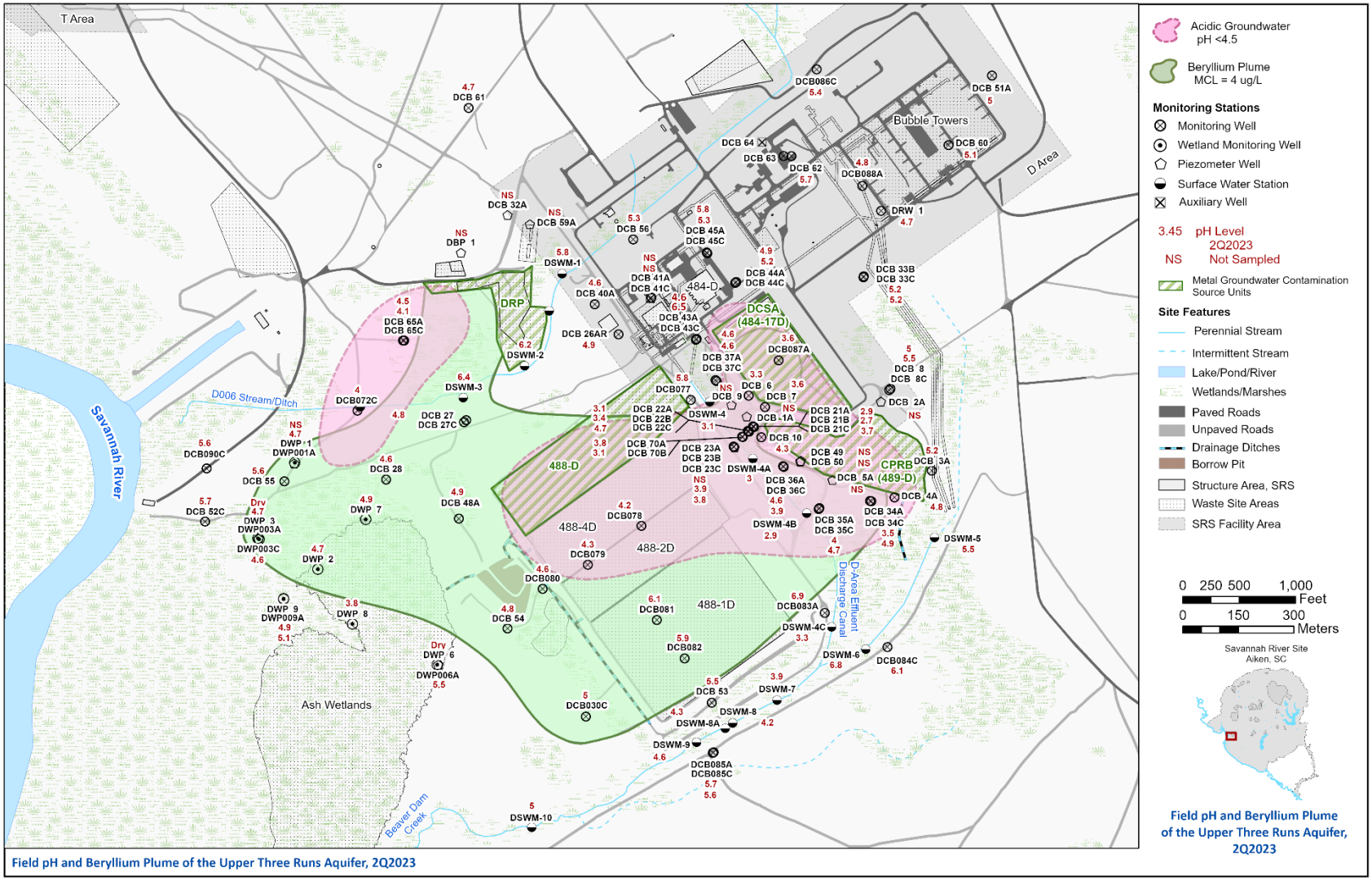


Figure D-1: The D-Area Groundwater Low-pH Plume (2Q2023)

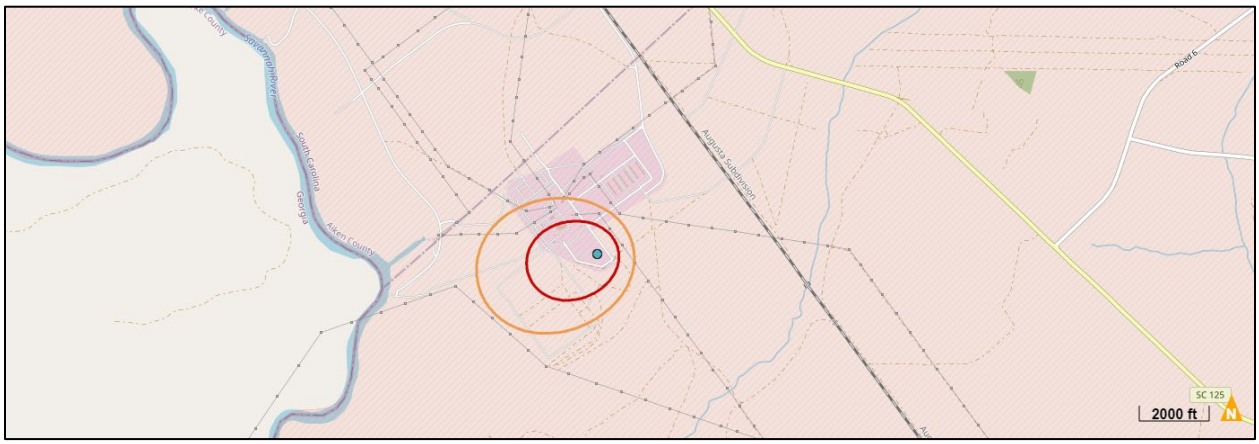


Figure D-2a: Areal Extent of the Injected Groundwater After 3 Years

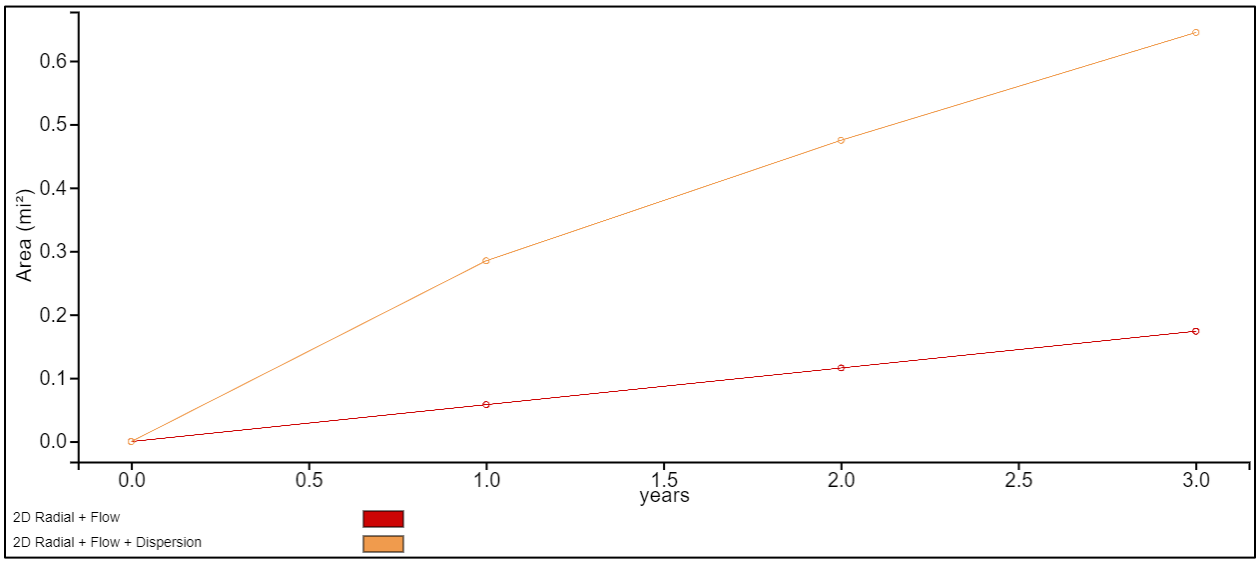


Figure D-2b: Estimated Lateral Area Covered by the Injected Groundwater After 3 Years

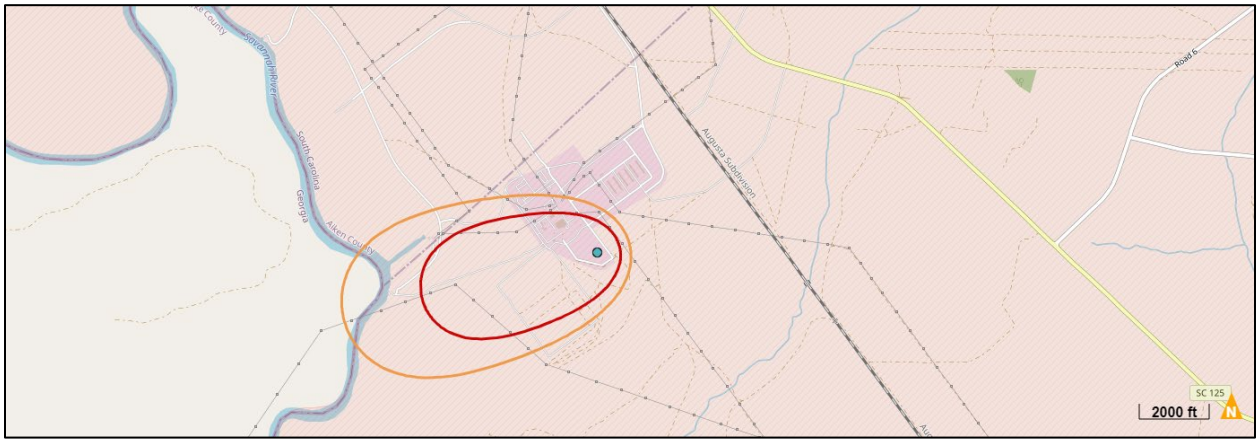


Figure D-3a: Areal Extent of the Injected Groundwater After 10 Years

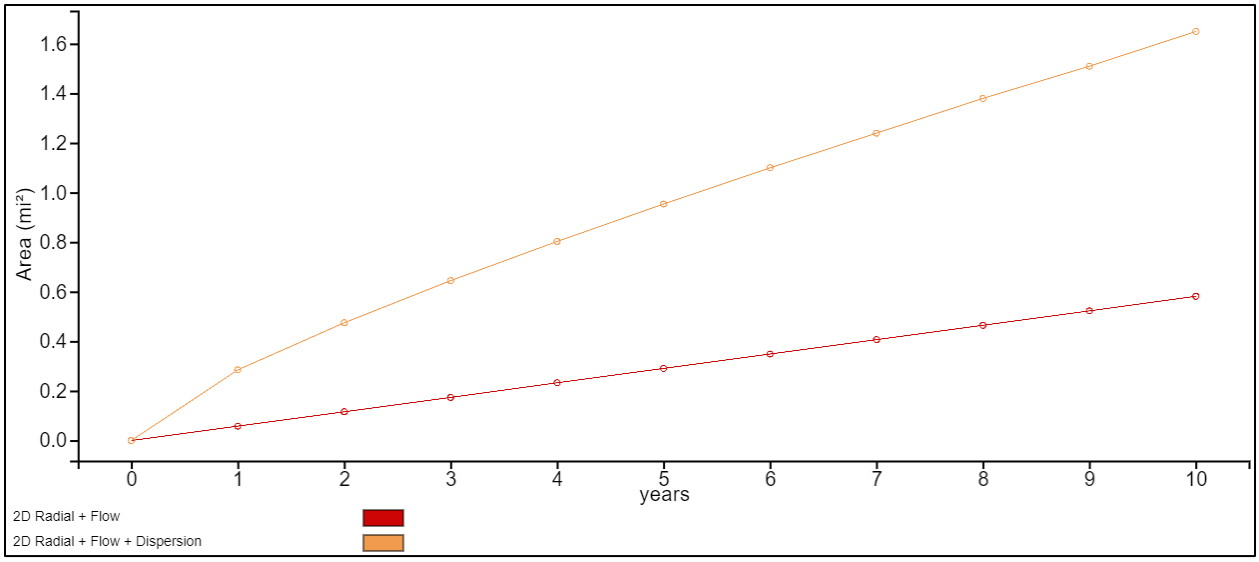


Figure D-3b: Estimated Lateral Area Covered by the Injected Groundwater After 10 Years

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