



**Biennial Effectiveness Monitoring Report (EMR) for
Monitored Natural Attenuation (MNA) at the C-Area
Burning/Rubble Pit (131-C) and Old C-Area
Burning/Rubble Pit (NBN) Operable Unit (U)**

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EXECUTIVE SUMMARY

The final remedy for the C-Area Burning/Rubble Pit (CBRP) Operable Unit (OU) is Soil Vapor Extraction (SVE) and Monitored Natural Attenuation (MNA) with Land Use Controls. The MicroBlower™ SVE system began operating in 2004. It continues to remove volatile organic compounds from the fine-grained sediment within the vadose zone of the CBRP OU at a greater rate than vadose zone mass transport models indicate would be necessary to control migration to groundwater. Over the past two years volatile organic compounds (VOCs) have been removed at an estimated rate of 39 pounds per year. In general, groundwater monitoring data indicate that the selected remedy is working as anticipated and remains protective.

The CBRP monitoring network includes 18 monitoring wells, 12 MNA monitoring wells, and five surface water sampling stations in Twin Lakes and Fourmile Branch. Groundwater monitoring is conducted in accordance with the CBRP OU Effectiveness Monitoring Plan (EMP) as approved by the U.S. Environmental Protection Agency and the South Carolina Department of Health and Environmental Control. This document summarizes data collected in 2017 and 2018.

In general, the MNA monitoring wells and surface water sampling points exhibit decreasing contaminant concentration trends. Detections of cis-1,2-dichloroethylene, vinyl chloride, and ethylene in the wetland and surface water sampling locations demonstrate that reductive dechlorination of trichloroethylene (TCE) and tetrachloroethylene is occurring in the distal portions of the CBRP OU plumes.

The EMP identifies TCE concentration levels for selected individual wells that ‘trigger’ additional attention. With the exception of one well, measurements at all monitoring wells associated with the CBRP OU were below their respective trigger levels. Well CRW010CU exceeded its trigger level in 2017 and 2018, repeating the elevated detections reported in the previous Effectiveness Monitoring Report. However, groundwater flow directions (WSRC 2003b) and recent groundwater data indicate that the C-Area Groundwater (CAGW) OU TCE plume from the reactor area impacts well CRW010CU, not the CBRP OU TCE plume. Nevertheless, CRW010CU will continue to be monitored as part of the CBRP OU well network. Well CRP 8D was added in 2014 and CRP 6DR was added in 2017 to the CBRP OU monitoring well network to help delineate the

CBRP OU TCE plume from the CAGW OU TCE plume. In 2017 and 2018, the TCE concentrations were below the detection limit in the groundwater at wells CRP 8D and CRP 6DR.

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LIST OF ABBREVIATIONS AND ACRONYMS

CBRP	C-Area Burning/Rubble Pit
cis-1,2-DCE	cis-1,2-dichloroethylene
CSM	conceptual site model
1,1-DCE	1,1-dichloroethylene
DCM	dichloromethane
EMP	Effectiveness Monitoring Plan
EMR	Effectiveness Monitoring Report
EQL	Estimated Quantitation Limit
FMB	Fourmile Branch
ft	feet
GA	Gordon Aquifer
GCU	Gordon Confining Unit
kg	kilograms
KSZ	key source zone
LAZ	Lower Aquifer Zone
lbs	pounds
LUC	land use control
µg/L	microgram per liter
µg/kg	microgram per kilogram
m	meter
MAZ	middle aquifer zone
MCL	maximum contaminant level
mi	mile
min	minute
MNA	monitored natural attenuation
msl	mean sea level
NBN	no building number
OU	operable unit
PCE	tetrachloroethylene
ppmv	parts per million vapor
RA	remedial action
RCOC	refined Constituent of Concern
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SCDHEC	South Carolina Department of Health and Environmental Control
SRNS	Savannah River Nuclear Solutions, LLC
SRS	Savannah River Site
SVE	soil vapor extraction
TCCZ	Tan Clay Confining Zone
TCE	trichloroethylene
trans-1,2-DCE	trans-1,2-dichloroethylene
UAZ	Upper Aquifer Zone

LIST OF ABBREVIATIONS AND ACRONYMS *(Continued/End)*

USEPA	U.S. Environmental Protection Agency
UTRA	Upper Three Runs Aquifer
VC	vinyl chloride
VOC	volatile organic compound
WSRC	Washington Savannah River Company LLC (October 2005 through August 2008)
WSRC	Westinghouse Savannah River Company (before October 2005)
yr	year

1.0 INTRODUCTION

The C-Area Burning/Rubble Pit (CBRP) Operable Unit (OU) is listed as a Resource Conservation and Recovery Act (RCRA) 3004(u) Solid Waste Management Unit/Comprehensive Environmental Response, Compensation, and Liability Act unit in Appendix C of the Federal Facility Agreement (FFA 1993) for the Savannah River Site (SRS). The final remedy for the CBRP OU is Soil Vapor Extraction (SVE) and Monitored Natural Attenuation (MNA) with Land Use Controls (LUCs), with annual monitoring and biennial reporting. This Environmental Monitoring Report (EMR) documents groundwater monitoring well and surface water data collected in 2017 and 2018, in compliance with the *Monitored Natural Attenuation Effectiveness Monitoring Plan for the C-Area Burning/Rubble Pit Operable Unit (131-C) and Old C-Area Burning/Rubble Pit (NBN) (U)* (EMP) (SRNS 2009a) as approved by the U.S. Environmental Protection Agency (USEPA) and the South Carolina Department of Health and Environmental Control (SCDHEC). The previous EMR covered the years 2015-2016 (SRNS 2017).

2.0 OPERABLE UNIT DESCRIPTION AND HISTORY

C Area is located in the central portion of the SRS in Barnwell County, South Carolina (Figure 1). C-Reactor achieved criticality in March 1955 and operated until 1985 when it was placed in warm standby. The reactor was placed in cold standby in 1987. Past activities associated with C-Reactor operations have resulted in groundwater contamination beneath CBRP OU. During operations at the CBRP source unit, trichloroethylene (TCE) and tetrachloroethylene (PCE) were released to the environment, resulting in a groundwater contamination plume beneath CBRP OU. TCE is the principal volatile organic compound (VOC) in the groundwater. Additional groundwater contaminants that have also historically exceeded their maximum contaminant levels (MCLs) include dichloromethane (DCM), 1,1-dichloroethylene (1,1-DCE), cis-1,2-dichloroethylene (cis-1,2-DCE), and vinyl chloride (VC).

The CBRP OU encompasses VOC contaminated groundwater (tritium is excluded and is part of C-Area Groundwater OU) and surface water in the immediate vicinity and directly downgradient of CBRP. The TCE contaminated groundwater plume originates beneath the western end of CBRP

and migrates west toward Twin Lakes and Fourmile Branch. Contamination is vertically confined to the Upper Three Runs Aquifer (UTRA) and outcrops into the wetlands and surface water of Twin Lakes and Fourmile Branch.

The source areas at the CBRP OU have been remediated to reduce the toxicity, mobility, or volume of the contamination that constituted sources of contamination to the groundwater. The source units were previously remediated under the unit-specific interim Record of Decision (ROD) (WSRC 1998). In 1999, a low permeability soil cover was installed, and SVE and air sparging systems were installed as components of an interim action to control the VOC source in the vadose zone. The active SVE systems were shut down in 2004 and replaced by a MicroBlower™ SVE system (Figure 2). The MicroBlower™ system continues to passively recover the VOCs that diffuse from the fine-grained soils located about 9 meters (m) (30 feet [ft]) below ground surface at the western end of CBRP. The final ROD was issued in July 2008 (WSRC 2008).

2.1 Remedial Action Requirements and Objectives

As stated in the ROD (WSRC 2008), the scope of the CBRP OU final remedial action (RA) encompasses all of the TCE contaminated vadose zone, groundwater, and surface water immediately beneath and downgradient of the CBRP OU to Twin Lakes and Fourmile Branch. The final RA for the CBRP OU includes 1) a MicroBlower™ SVE system to control residual TCE in the vadose zone; 2) MNA with LUC boundaries; and 3) maintenance of the low permeability soil cover.

The Remedial Action Objective (RAO) for surface soil in CBRP is to prevent exposure of ecological receptors to heptachlorodibenzodioxin in the pit surface sediments. This objective is met by maintaining the low permeability soil cover.

The RAO for the vadose zone beneath CBRP is to prevent migration of TCE from the vadose zone soils to the groundwater at levels that will exceed the MCL. This objective is met by operating the MicroBlower™ SVE system to control residual TCE in the vadose zone. The RGO for TCE in vadose zone soils is 58 microgram per kilogram ($\mu\text{g}/\text{kg}$).

The RAOs for groundwater are the following:

- Treat and/or mitigate groundwater contaminated above MCLs;
- Prevent human exposure to groundwater contaminated with VOCs above MCLs;
- Reduce the concentration of VOCs in the groundwater to levels at or below their MCLs, and attenuate the groundwater plume to the extent possible; and
- Prevent discharge of contaminated groundwater to surface water resulting in concentrations exceeding their MCLs.

These objectives have not been met, but as TCE concentrations continue to decline, it is anticipated that RAOs will be met by SVE, MNA, and LUCs (SRNS 2009b). CBRP OU LUCs include the following objectives:

- Restrict on-site worker access and prevent unauthorized contact, removal, or excavation of contaminated media (i.e., surface and vadose zone soils);
- Maintain the integrity of any current or future remediation or monitoring systems (i.e., soil cover, soil vapor extraction [SVE] systems, and groundwater monitoring wells);
- Prevent access to or use of groundwater and surface water until remedial goal options (RGOs) are attained;
- Prohibit the development and use of property for residential housing, elementary schools, childcare facilities, and playgrounds; and
- Prevent construction of inhabitable buildings without an evaluation of indoor air quality to address vapor intrusion.

The RAO for surface water is to reduce the levels of VOCs in surface water at or below their MCLs. This objective will be met by MNA.

2.2 Land Use Control Boundary and Monitoring Network

SRS has identified the area in which groundwater contamination exceeds applicable MCLs and developed a LUC boundary. The CBRP OU LUC boundary (Figure 3) encompasses all of the

groundwater exceeding MCLs from CBRP west to Fourmile Branch and comprises approximately 30 acres. Restrictions on the use of groundwater within the LUC boundary will be enforced as long as contaminant levels exceed MCLs.

As outlined in the EMP (SRNS 2009a), the monitoring network at CBRP OU includes eighteen monitoring wells, twelve MNA wells, and five surface water stations (Figure 3). Monitoring well CRP 8D was added to the CBRP OU monitoring well network in 2014 and CRP 6DR was added in 2017 to help delineate the CBRP OU TCE plume.

3.0 SITE HYDROGEOLOGY

3.1 Physiographic Setting

The CBRP OU is approximately 2,000-ft west of C-Area Reactor Building (105-C) (Figure 1). It is located on a broad, convex ridge within the Fourmile Branch watershed. Local relief ranges from 89.9 m (295 ft) mean sea level (msl) to 48.2 m (158 ft) msl along Fourmile Branch. The ground surface slopes gently to the west from the CBRP OU to Fourmile Branch. Fourmile Branch discharges into the Savannah River floodplain and associated swamps about 8 miles (mi) downstream from its confluence with the Twin Lakes drainage.

3.2 Hydrogeologic Setting

A detailed description of the hydrostratigraphic units relevant to the CBRP OU can be found in the RCRA Facility Investigation/Remedial Investigation report (WSRC 2002).

The 30-year (yr) average (1983 – 2013) rainfall for SRS is 46.71 in/yr, based on data from the 773-A rain gauge (SRNL 2016). In 2017, SRS received 53.17 in of rainfall, and in 2018 SRS received 55.37 in of rainfall, based on data from the 773-A rain gauge (SRNL 2019). The average groundwater recharge is estimated at 12.5 in/yr, while the remainder is lost to evapotranspiration or run-off to surface water (WSRC 2003b).

The Floridan aquifer system is the aquifer system of concern within the CBRP OU area. The system is divided into two aquifer units separated by a confining unit. From top to bottom, they are known as the UTRA, the Gordon Confining Unit (GCU), and the Gordon Aquifer (GA). The UTRA occurs

between the water table surface and the GCU. The UTRA is divided into three aquifer zones. The upper and lower aquifer zones are divided by an informal aquitard referred to as the “Tan Clay Confining Zone” (TCCZ). The third aquifer zone resides as a sandy formation within the TCCZ. From top to bottom they are known as the Upper Aquifer Zone (UAZ), Middle Aquifer Zone (MAZ), and Lower Aquifer Zone (LAZ) of the UTRA. While the hydraulic conductivities vary within each of the aquifer zones, the overall average groundwater velocity is 70 ft/yr for the UTRA between the CBRP OU to the points of discharge along Fourmile Branch (WSRC 2001a).

4.0 MONITORING AND REPORTING

The CBRP OU RA start date was on May 13, 2009, and sampling of the CBRP OU monitoring network began in December 2009. The sampling schedule for monitoring wells, MNA monitoring wells, and surface water stations was established in the EMP (SRNS 2009a), and is shown in Table 1. In 2017, sampling was conducted on SVE wells, MNA wells, and surface waters, but one monitoring well was dry and could not be sampled per the schedule. In 2018, all of the monitoring stations were sampled per the sample schedule.

Monitoring results are discussed in text, and presented in the appendices. Appendix A tabulates monitoring data from 2017 and 2018. Appendix B presents hydrographs of water levels at monitoring points since 1995. Appendix C consists of time-series plots of VOCs at monitoring points since 1995. Appendix D is a series of monitoring network maps with fourth quarter 2017 and 2018 TCE concentrations indicated. Appendix E is a series of potentiometric surface maps for the various aquifers.

4.1 Vadose Zone Monitoring

The MicroBlower™ SVE system consists of four SVE wells and is located on the western end of CBRP (Figure 2). The system was installed as an interim remedial action in 2004 to help control residual TCE from migrating out of the vadose zone. A vadose zone mass transport model (WSRC 2004) predicted that a minimum annual recovery rate of 0.82 kilograms (kg) (1.8 pounds [lbs]) of TCE for the operation year would be adequate to control vadose migration to the groundwater.

Over the last two years, the system exceeded the minimal annual recovery rate with a total of 35.17 kg (77.385 lbs) of VOCs removed in the 2017-2018 time period.

4.2 Groundwater Monitoring Well Network

The current monitoring network includes 35 monitoring stations, i.e. eighteen monitoring wells, twelve MNA monitoring wells, and five surface water sampling stations in Twin Lakes and Fourmile Branch (Figure 3). One monitoring well in the original network, CRP 3C, was abandoned in 2009 and is no longer sampled. Well CRP 8D was added to the CBRP OU monitoring network in 2014 and well CRP 6DR was added in 2017 to help delineate the CBRP OU TCE plume from the CAGW OU TCE plume.

The Conceptual Site Model (CSM) for the CBRP OU TCE plume depicts the combination of the MicroBlower™ SVE system and the low-permeability soil cover have achieved source control, such that TCE is no longer contaminating the groundwater beneath the CBRP OU at concentrations above the MCL. Particle track analysis indicates it takes between 37 and 63 years for groundwater under the CBRP OU pit to reach points of discharge along Fourmile Branch (WSRC 2001b). As the TCE is transported from the CBRP OU to the point of discharge, attenuation greatly decreases the concentration of TCE in the groundwater. Very little biodegradation occurs during transport from the CBRP OU to the points of discharge, rather the CSM considers biodegradation to occur only at the wetland areas along Twin Lakes and Fourmile Branch as the TCE plume is discharging through the organic rich sediments.

Monitoring well data are used to assess the effectiveness of the SVE system and the low-permeability soil cover on groundwater. The monitoring well data are also used to evaluate if the VOC plume is contracting or expanding in the Upper Three Runs and Gordon aquifers, and attenuates as the TCE plume travels from the CBRP OU pit to the points of discharge.

MNA well and surface water station data are used to assess the overall attenuation (biodegradation, volatilization, sorption, dilution, dispersion, and diffusion) of the VOC plume from the CBRP OU source area to the points of discharge. Each MNA location has two wells: a lower “B” well; and an upper “A” well. Comparisons are made between the TCE concentrations in the lower and upper wells, as well as the concentrations of TCE degradation products (cis-1,2-DCE, VC, and ethylene).

The CSM predicts higher TCE concentrations in the lower wells, but higher concentrations of TCE degradation products in the upper wells, due to biodegradation occurring as the TCE plume discharges upward to surface water at a given location. The monitoring network overall is designed to verify the attainment of the remedial objectives.

4.3 Groundwater Elevation Measurements and Groundwater Flow Direction

Historic water elevations, extending from 1995 to present, are displayed as hydrographs in Appendix B. Potentiometric surfaces for fourth quarter 2018 were mapped for each aquifer (Appendix E). Water levels near the CBRP OU pit in water table wells CRP 3D and CRP 5D decreased between 2016 and 2018.

Within the CBRP OU LUC boundary, groundwater in the UTRA and the GA flows west from CBRP OU toward Fourmile Branch (Appendix E). Groundwater in the UAZ does flow slightly to the west southwest (Appendix E). Groundwater within the MAZ, LAZ, and GA flows west toward Fourmile Branch.

4.4 Groundwater and Surface Water Compliance

Per the EMP (SRNS 2009a), monitoring well samples are analyzed for seven constituents:

- 1,1-dichloroethylene (1,1-DCE)
- cis-1,2-dichloroethylene (cis-1,2-DCE)
- trans-1,2-dichloroethylene (trans-1,2-DCE)
- vinyl chloride (VC)
- tetrachloroethylene (PCE)
- trichloroethylene (TCE)
- dichloromethane (DCM)

MNA monitoring well samples are analyzed for those seven constituents, plus ethylene. Sample results are compared to two different benchmarks, MCLs and Trigger Levels established in the CBRP OU EMP (SRNS 2009a). The concentrations of these seven constituents, which were identified as refined Constituents of Concern (RCOCs) by the Corrective Measures Implementation/Remedial Action Implementation Plan (SRNS 2009c), are compared to the respective MCLs (Table 2). Seven monitoring wells and one surface water station are assigned as a key source zone well, LUC boundary wells, and a point of compliance MNA station. These

stations have designated trigger levels for TCE and are listed in Table 3 with the recent maximum TCE result for each station.

4.5 Soil Vapor Extraction Results

Vapor concentrations and flow rates were used to estimate the VOC mass removed from the four MicroBlower™ SVE units. The four MicroBlower™ SVE units operated an average of 355.5 days (97.4% Utility) in 2018, and an average of 362.75 days (99.38%) in 2017. In 2018, a total flow rate of 671 liters per minute (L/min) (23.7 cubic feet per minute [ft³/min]) was calculated based on a time-weighted average of the four MicroBlower™ SVE units. The total vapor phase contaminant concentration in 2018 for the four MicroBlower™ SVE units is 37.64 parts per million vapor (ppmv) for a removal of 21.48 kg (47.268 lbs) of VOCs. In 2017, a total flow rate of 465.39 L/min (16.435 ft³/min) was calculated based on a time-weighted average of the four MicroBlower™ SVE units. The total vapor phase contaminant concentration in 2017 period for the four MicroBlower™ SVE units is 38.48 ppmv for a removal of 13.685 kg (30.107 lbs) of VOCs. Based on these conditions over the last two years, the average annual removal rate of TCE from the subsurface was calculated to be approximately 17.58 kg/yr (38.68 lbs/yr.). The VOC removal rates for 2017 and 2018 are slightly higher than the rate for 2015 and 2016 (16.92 kg/yr [37.22 lbs/yr]).

4.6 Groundwater and Surface Water Results

All prescribed samples were successfully collected in 2017-2018, except the November 2017 sample at well CRP 46A because the well was dry. Appendix A provides the results for CBRP OU groundwater and surface water post-remedial action sampling. Appendix C provides time-series plots for the CBRP OU wells for the RCOCs. Four RCOCs exceeded their MCLs in at least one groundwater sample during the 2017-2018 sampling period: PCE, TCE, cis-1,2-DCE and VC. No constituents exceeded their MCLs in surface water. There were no MCL exceedances for 1,1-DCE, trans-1,2-DCE, or DCM in any groundwater or surface water sample during the 2017-2018 reporting period.

Appendix D consists of maps showing TCE concentrations in groundwater and surface water for 2017 and 2018. Maps referring to 2018 also show plume delineations. As originally described in

the EMP (SRNS 2009a), other VOC contaminants associated with CBRP OU are not included in Appendix D because they 1) generally coincide with the TCE contamination; 2) are lower in concentration than TCE; and 3) behave similarly in groundwater as TCE.

Analyte concentrations in CBRP OU groundwater and surface water during 2017-2018 generally continued with previous trends, which are steady or downward in most locations. Sample results for specific RCOCs are described below.

4.6.1 Trichloroethylene

TCE is the major groundwater contaminant at CBRP OU. During the 2017-2018 sampling period, TCE was detected at 17 of 35 monitoring stations. Concentrations exceeded the MCL at 11 stations, including 8 monitoring wells and 3 MNA wells, but no surface water stations. Only one of the LUC boundary wells (CRP010CU) exceeded its trigger level for TCE (Table 3). The highest reported concentration at any station was 2,600 microgram per liter ($\mu\text{g/L}$), in the November 2018 sample from monitoring well CRP 20CU. TCE concentrations are plotted on maps in Appendix D for all monitoring stations.

As TCE is the primary contaminant at CBRP OU, its occurrence can be used to delineate the physical extent of the total groundwater contaminant plume. The groundwater plume emanates westward from CBRP, extending toward Fourmile Branch (Figure D-3). It is constrained vertically to the UTRA and can be found within all three aquifer zones of the UTRA. The 2018 TCE plume has not changed significantly in concentration or extent since last reported in the 2015-2016 EMR (SRNS 2017). The upgradient wells CRP 3D and CRP 18D are continuing their long-term decline, indicating that the 1999 remediation activities at CBRP were successful in cutting off the contamination pathway to groundwater. In general, TCE concentrations are decreasing throughout the monitoring network. In 2000, the highest concentrations were found at CRP 3D and CRP 18D (near the source), but the highest concentration in 2018 was seen downgradient at CRP 20CU. Although concentrations are decreasing in most wells, CRP 20CU is continuing a long-term increase as the highest concentration portion of the plume passes through this well. Each aquifer and surface water body impacted by the CBRP OU TCE plume is discussed in detail below.

Upper Aquifer Zone (UAZ)

Analytical data for TCE in the UAZ are shown in Appendix A and Appendix D, Figure D-1 (2017) and Figure D-3 (2018). The 2018 TCE plume emanates west from CBRP with elevated concentrations in CRP 3D, just downgradient of CBRP, continues farther downgradient to CRP 22CU, and descends into the MAZ before discharging into Fourmile Branch (FMB) as indicated by several MNA stations (CRP 50A, CRP 50B, CRP 51A, and CRP 51B). The southern portion of the TCE plume also seems to discharge into Twin Lakes, as indicated by the TCE concentrations observed at CRP 48B and TL 05 over time (Appendix C, C-112 and C-119).

During 2017-2018, exceedances of the 5 µg/L MCL for TCE were seen in three of six UAZ monitoring wells (CRP 3D, CRP 18D, CRP 22CU), one of four UAZ MNA monitoring well stations (CRP 45B), and none of the surface water stations. The UAZ well with the highest TCE concentration was CRP 18D (11 µg/L) in 2018. Overall, there is less TCE in the UAZ than in former years. The near-source well CRP 3D had 41,700 µg/L in 2000, but only 9.1 µg/L in 2018. Likewise, the downgradient well CRP 22CU had 954 µg/L in 2000, but only 15.0 µg/L in 2018.

Middle Aquifer Zone (MAZ)

TCE concentrations for MAZ stations are shown in Appendix A and Appendix D combined with data for the LAZ. Figure D-2 shows MAZ and LAZ TCE data for 2017, and Figure D-4 shows 2018 TCE data.

The MAZ currently hosts the bulk of VOC contamination at CBRP OU. There are two monitoring wells in the MAZ: CRP 20CU and CRW 12C. In 2018, CRP 20CU had the highest TCE groundwater concentration (2,600 µg/L). This concentration is higher than the 2016 result of 1,640 µg/L. Concentrations from 2001-2004 were in the range of 500 µg/L, so the long-term pattern is an increasing trend as the central axis of the plume passes through CRP 20CU.

Prior to the installation of the soil cover in 1999, heavy rains (107.4 cm [42.28 inches]) from December 1997 to May 1998 transported a large quantity of TCE from the vadose zone into the groundwater as observed in well CRP 3D (Figure C-103). This hot spot has been moving from the CBRP OU source area toward FMB from 1998 to present (Figures 6 to 8). It is this hot spot

which has been impacting TCE concentrations at well CRP 20CU. This TCE hot spot has decreased about 94% in concentration from 41,700 µg/L in November 2000 at CRP 3D to 2,600 µg/L in November 2018 at well CRP 20CU due to attenuation (i.e., sorption, dilution, dispersion, and diffusion). As this TCE plume continues to transport through the wetland soils adjacent to FMB and Twin Lakes, it will continue to attenuate and undergo biodegradation, which is estimated to yield a 99% reduction in TCE discharging to FMB (WSRC 2001b). Both attenuation during plume transport and biodegradation in wetland soils are anticipated to reduce TCE concentrations so that FMB surface water will never exceed the TCE MCL (5 µg/L).

The other MAZ monitoring well (CRW 12C) sample was non-detect in 2018. CRW 12C is near the northern most extent of the TCE plume and has had only one sample above the detection limit for TCE in 2010 (8.34 µg/L). TCE-contaminated groundwater within the MAZ is also discharging into the wetlands of Fourmile Branch near MNA monitoring well station CRP 51. In 2018, CRP 51B MAZ MNA well had a maximum TCE concentration of 5.70 µg/L, and in 2018 CRP 51A had a maximum TCE concentration of 6.50 µg/L.

Lower Aquifer Zone (LAZ)

TCE is present at concentrations exceeding its MCL in five of six monitoring wells screened in the LAZ (CRP 18C, CRP 20CL, CRP 22CL, CRW 10C, CRW010CU). The well with the highest concentration is CRP 20CL with 137 µg/L in 2017. The 2017 TCE concentration at well CRP 20CL is essentially the same as the 2016 concentration (200 µg/L), but it is continuing a long decline from a maximum of 8,330 µg/L recorded in 2003. Data for the LAZ are tabulated in Appendix A, and shown in Appendix D, Figure D-2 and Figure D-4 (combined with MAZ data).

Two of the monitoring wells screened in the LAZ with MCL exceedances are LUC boundary wells: CRW 10C and CRW010CU. The maximum TCE groundwater concentration at well CRW 10C was 12.3 µg/L in November 2017, which did not exceed the trigger value (13.6 µg/L). The April 2018 CRGW OU CRP010CU sample had the maximum TCE concentration (14.9 µg/L), which exceeds the trigger level of 13.6 µg/L for the CBRP OU (Table 3). The CBRP OU sample collected in November 2018 at CRP010CU had a TCE concentration of 14.0 µg/L, which also exceeds the CBRP OU trigger limit.

CRW010CU has a history of exceeding the trigger level, having exceeded it almost every year since the well was installed in 2009. However, several lines of evidence indicate that contamination in CRW010CU and CRW 10C is not associated with CBRP OU, but rather with the CAGW OU northern VOC plume. Figure 4 is a contamination map, showing the maximum historic TCE concentration between 1985 and 2016 for any station sampled during that time. It can be seen that there are two distinct plumes, separated by an uncontaminated zone represented by wells CRP 4, CRP 6DR, and CRP 8D, as well as three 1998 DPT groundwater sample locations (CRSB-88, CRSB-89, and CRSB-90). Well CRP 4 had a maximum TCE groundwater concentration of 11.0 µg/L in January 1991, but all groundwater samples have been below detection limits or less than the MCL (5 µg/L) between August 1991 and November 2005, when monitoring of this station ceased. Well CRP 8D had a maximum TCE groundwater concentration of 1.24 µg/L in August 2003, and the six groundwater samples collected since June 2005 have been below detection limits. All groundwater samples from well CRP 6DR have been below detection limits from 1996 to 2018.

Figure 4 shows the 2003 water table contours (WSRC 2003a). The water table contours indicate that groundwater at the CRW 10 cluster originates from the reactor area, rather than from the CBRP area. The CBRP OU groundwater modeling particle tracks (WSRC 2001b) also indicate the predominant flow path from the former CBRP pit is towards Fourmile Branch (Figure 5). Monitoring well CRP 8D is located between the former CBRP pit and CRW 010CU. The maximum TCE concentration at CRP 8D was only 1.24 µg/L, in 2003, which suggests that it is very unlikely that a flow path exists connecting CRW010CU with a source at the CBRP OU.

SRS concludes that contamination in CRW010CU (and CRW 10C) originates with the CAGW OU plume. However, monitoring of the CRW 10 well cluster will continue.

Gordon Aquifer (GA)

Three monitoring wells are screened in the GA (CRP022A, CRW 10A and CRW 12A). All three GA wells (CRP022A, CRW 10 and CRW 12A) were sampled in 2017 and 2018, and all the TCE results were below detection limits. In 2011, CRW 12A had one “J” qualified result (1.29 µg/L) between the minimum detectable limit (MDL) and estimated quantitation limit (EQL). However,

all previous and subsequent results have been less than the MDL for well CRW 12A, and all TCE results have been less than the MDL for wells CRW 10A and CRW 12A. Likewise, all 18 CAGW OU and CBRP OU wells screened in the GA have had 241 results less than the MDL (U-Qualified) since monitoring began in 2002 and only 2 “J” qualified results and 1 unqualified result. As only three out of 244 TCE results have been slightly above the MDL for the GA, based on both the CBRP OU and CAGW OU sampling results (Table 3), it is believed that these results are spurious and not representative of actual groundwater from this aquifer. Analytical data for the GA wells are tabulated in Appendix A, and TCE is shown in Appendix D, Figure D-5.

Groundwater Plume Development

Interpretive cross-sections of groundwater plume development are presented in Figures 6 through 8, showing the TCE plume extent in 2000, 2012, and 2018, respectively.

Surface Water

Five surface water stations are part of the CBRP OU monitoring network. Surface water stations TL-02, TL-04 and TL-05 are the only stations with TCE concentrations above the detection limit in 2017 and 2018. At TL-05, TCE has decreased from a maximum concentration of 22.8 µg/L in 2010 to a concentration of 3.40 µg/L in 4Q2017 (Appendix C; Figure C-119). Likewise, TCE concentrations at TL-02 have also been declining, from a maximum of 10.1 µg/L in 2003, to 2.74 µg/L in 4Q2017. The 4Q2017 TCE result for TL-04 was 0.44 µg/L. The 2018 results for all three stations (TL-02, TL-04 and TL-05) were below the detection limit (EQL = 5 µg/L). Surface water data are tabulated in Appendix A, and the 2017-2018 TCE plume data are shown in Appendix D.

The CBRP OU TCE groundwater plume appears to be discharging to the Twin Lakes surface water primarily between surface water stations TL-01 and TL-05, based on the lack of TCE and degradation products at station TL-01 and the relatively high TCE concentrations at station TL-05. Likewise, there is a large increase in the concentrations of TCE and TCE degradation products between the MNA well pairs CRP-46A&B and CRP-48A&B for groundwater discharging along this area of the Twin Lakes wetlands. This is likely the result of TCE discharging from the UAZ and/or MAZ along this region of the Twin Lakes wetlands, as the

ground elevation at CRP-48A&B is about 175-ft msl, which corresponds to the top of the TCCZ at this location. TCE has never exceeded the MCL at the Fourmile Branch surface water stations (TL-03 and TL-04).

4.6.2 Tetrachloroethylene

In the 2017-2018 sampling period, samples with PCE results above the detection limit were from monitoring wells CRP 5C, CRP 18C, CRP 20CL, CRP 20CU, CRP 22CL, CRP 22CU, CRW 10C, and CRW010CU. However, only CRP 5C exceeded the MCL with the highest concentrations of PCE (9.55 µg/L) in November 2017, and PCE concentrations at CRP 5C have been trending downward since the maximum (14.2 µg/L) in 2007 (Figure C-70). CRP 5C is a LAZ well that is upgradient of CBRP, which suggest the PCE plume emanating below CBRP OU might be associated with an upgradient source associated with past C-Reactor operations. PCE has never been above the detection limit at any of the surface water monitoring stations.

4.6.3 Cis-1,2-Dichloroethylene

During 2015-2016, cis-1,2-DCE was detected in 6 of 18 monitoring wells, 8 of 12 MNA monitoring wells, and 3 of 5 surface water stations. However, only MNA well CRP 50B exceeded the MCL (70 µg/L), with a maximum concentration of 150 µg/L in November 2018.

Cis-1,2-DCE is prevalent along the longitudinal axis of the TCE plume in the UAZ and detections have been observed from the source (i.e., CRP 3D), downgradient to the wetlands of Twin Lakes and Fourmile Branch. A general trend, observed from the time series plots, shows elevated cis-1,2-DCE concentrations at the start of remediation (2000) to decreasing below the MCL in 2012. Wells CRP 3D and CRP 48B exemplify this trend (Appendix C; Figure C-35 and C-44) and the higher rate of occurrence in the MNA wells indicate that biodegradation is occurring in the wetlands of Twin Lakes and Fourmile Branch as well as in other portions of the VOC plume. Contrary to the long-term trend, cis-1,2-DCE concentrations in well CRP 48B have been increasing since 2011, from 0.60 µg/L in 4Q2010 to a max of 28 µg/L in 4Q2013, but the concentration has fallen to 17.0 µg/L in 4Q2018. These concentrations are still well below the CBRP OU historic maximum cis-1,2-DCE concentration at CRP 48B of 1,890 µg/L sampled in 2003. Groundwater cis-1,2-DCE concentrations in CRP 20CU increased from 4.58 µg/L in 2003

to 40.5 µg/L in 4Q2017 (Appendix C, Figure C-40). Groundwater cis-1,2-DCE concentrations in FMB MNA well CRP 50B increased from 0.70 µg/L in 2010 to 150 µg/L in 4Q2018. TCE concentrations appear to control the cis-1,2-DCE concentrations observed along the axis of the plume from CRP 3 to CRP022, comparing TCE time-series plots (Figures C-103 through C-109) to the cis-1,2-DCE time-series plots (Figures C-35 through C-41). The increase in TCE and cis-1,2-DCE concentrations at CRP 20CU is likely due to an upgradient hotspot, previously located at CRP 18D, which is impacting CRP 20CU. Likewise, TCE groundwater plume discharging along the Twin Lakes and FMB wetlands appears to be impacting cis-1,2-DCE concentrations observed at CRP 48B and CRP 50B. The absence of TCE at CRP 50B, along with the elevated levels of cis-1,2-DCE, VC and ethylene, is an indication of the significant amount of biodegradation occurring in the distal portion of the TCE groundwater plume in the wetland areas.

Surface water cis-1,2-DCE concentrations have never been above the MCL at any of the monitoring stations. The maximum surface water cis-1,2-DCE concentration was 30.6 µg/L in 2Q2010 at TL-05 and has since decreased to 1.96 µg/L in 4Q2018.

4.6.4 Vinyl Chloride

During the 2017-2018 sampling period, VC was detected in 8 of 12 MNA monitoring wells, which border the Twin Lakes area and FMB. VC occurred at levels above the MCL (2 µg/L) in six of the MNA wells (CRP 45A, CRP 45B, CRP 46B, CRP 48B, CRP 50A, and CRP 50B). VC was detected in one of five surface water stations (TL-05) but the result (0.59 µg/L) did not exceed the MCL. The highest VC concentration in the CBRP OU monitoring network for 2017-2018 was 254 µg/L at CRP 50B in November 2017.

Most MNA monitoring wells have shown low levels or decreasing trends since monitoring began at the MNA wells in 2000, but stations CRP 45 and CRP 50 present more complex behavior. VC concentrations at CRP 45B were below the detection limit (5 µg/L) during 2002-2004, but increased steadily thereafter, reaching 30 µg/L in 2012. However, VC concentrations at CRP 45B have declined to 2.00 µg/L in November 2018. VC concentrations at CRP 50B decreased from 68.2 µg/L in May 2007 to 6.47 µg/L in November 2011, and then VC concentrations at CRP 50B have increased to 254 µg/L in 2017. VC concentrations in samples from MNA well CRP 50A

follow the same time-series trends as CRP 50B, but at lower VC levels. The increasing cis-1,2-DCE, VC and ethylene concentrations at well CRP 50A&B may indicate an elevated portion of the TCE plume (previously located at CRP 22CU) is now reaching the CRP 50 well cluster, with the TCE biodegrading to cis-1,2-DCE, VC and ethylene

TL-05 is the only surface water station to consistently detect VC; concentrations in 2009-2011 exceeded the MCL. VC at TL-05 has decreased from a maximum concentration of 7.51 µg/L in 2010 to 0.59 µg/L in November 2017 and below the EQL (2 µg/L) in 2018.

4.6.5 Ethylene

During the 2017-2018 sampling period, ethylene was detected at low levels (< 1.0 µg/L) in one monitoring well. Ethylene was detected in 8 of 12 MNA monitoring wells, with the highest groundwater concentrations (26 - 41 µg/L) occurring at MNA wells CRP 50A and CRP 50B in both 2017 and 2018, which is expected because MNA wells CRP 50A and CRP 50B also had the highest VC concentrations and ethylene is a biodegradation product of VC. During the 2017-2018 sampling period, ethylene was detected in only two surface water stations (TL-02 and TL 05) had samples with detectable levels (0.12 µg/L and 0.11 µg/L, respectively) of ethylene. There is no MCL for ethylene.

4.6.6 Dichloromethane (Methylene Chloride)

Dichloromethane was not detected in any of the 35 sample stations during 2017-2018. In general, DCM does not show a distinct trend at any of the CBRP OU wells, rather sporadic detections were observed at all wells spanning the groundwater monitoring history of the CBRP OU. Dichloromethane is also a common laboratory contaminant. Based on the frequency of results above detection over the years, the low concentrations of the samples above the detection limit, and random distribution of those results above the detection limit at all wells, it appears that the reported detections of DCM are due to lab contamination and do not represent true aquifer conditions at CBRP OU.

4.6.7 MNA Summary

VOC degradation products, cis-1,2-DCE, VC, and ethylene were observed in the groundwater and surface water at CBRP OU, indicating that degradation by reductive dechlorination is occurring in CBRP OU wetlands. The highest concentrations of cis-1,2-DCE, VC, and ethylene were observed in the wetlands (e.g. monitoring well CRP 50B) and surface waters of Twin Lakes and Fourmile Branch. Historically, these data indicate decreasing trends over time for cis-1,2-DCE, VC, and ethylene. During the 2017-2018 sampling period for the MNA wells, the well with the highest concentrations of TCE was CRP 45B. Constituents and their maximum 2017-2018 concentrations at CRP 45B were TCE (17.0 µg/L), cis-1,2-DCE (9.95 µg/L), VC (2.19 µg/L), and ethylene (0.76 µg/L). The well with the highest concentrations of TCE degradation products was CRP 50B. Constituents and their maximum 2017-2018 concentrations at CRP 50B were TCE (0.41 µg/L), cis-1,2-DCE (150 µg/L), VC (254 µg/L), and ethylene (41 µg/L). CRP 48B also had significant concentrations of TCE degradation products. Wells CRP 45A, CRP 48A, and CRP 50A had lower levels of TCE, cis-1,2-DCE, VC, and ethylene than their respective “B” wells. This is consistent with the conceptual model which predicts biodegradation occurs as groundwater moves upward through the wetland soils to discharge into Fourmile Branch or Twin Lakes. Well CRP 45B had shown an increasing trend for VC, but VC has decreased from 30 µg/L in November 2012 to 2.00 µg/L in November 2018. A portion of the plume with elevated TCE (“Plume Hotspot”) has migrated through the CRP 45 MNA well cluster, as indicated by the large decrease in TCE at upgradient well CRP 18D. Well CRP 50B has an increasing trend for VC, and VC has increased from 7.33 µg/L in June 2012 to 210 µg/L in November 2018. A plume hot spot is migrating through the CRP 50 MNA well cluster, as indicated by the large decrease in TCE as the plume passed through upgradient well CRP 22D. Degradation products at the MNA monitoring wells (e.g. CRP 50A and CRP 50B) and surface water sampling points (e.g. TL-05) provide evidence that MNA continues to be a viable remedial action at CBRP OU.

5.0 SUMMARY

Data collected over the past two years indicate the MicroBlower™ SVE system has removed approximately 17.58 kg/yr (38.68 lbs/yr.) of TCE which exceeds the minimal annual recovery rate

of 0.82 kg/yr (1.8 lbs/yr) (WSRC 2004). The minimal annual recovery rate controls the vadose zone source and prevents migration of TCE to the groundwater.

During 2017-2018 sampling period, overall VOC concentrations continued to decrease in most monitoring wells. Well CRP 20CU had an increasing trend from 2000 to November 2018. This indicates the portion of the plume with elevated TCE concentrations (“Plume Hotspot”) is now moving through CRP 20CU. In general, the MNA monitoring wells and surface water sampling points exhibit decreasing VOC concentration trends. However, CRP 50B has an increasing trend for degradation products c-1,2-DCE and VC from June 2012 to November 2018. This indicates a portion of the plume with elevated TCE concentrations (“Plume Hotspot”) is moving through the CRP 50 well cluster, which results in higher concentrations of biodegradation products. Concentrations of cis-1,2-DCE, VC, and ethylene are the highest in the wetland and surface water sampling locations demonstrating that biodegradation, a key component of natural attenuation for VOCs, is occurring in the distal portions of the CBRP OU plumes.

The Statement of Basis/Proposed Plan for the C-Area Burning Rubble Pit Operable Unit (WSRC 2007) indicated Natural Attenuation would require 70 years before all areas of the VOC plume would be below the MCL (5 µg/L) based on groundwater modeling of the remedial alternatives. A simplistic comparison using current data would be to consider just degradation of the TCE and ignore discharge, dilution, and diffusion. The 2018 maximum TCE concentration for the plume was 2,600 µg/L (N_0), the MCL is 5 µg/L (N) and the longest degradation half-life for TCE is 4.53 years (t_h) (Howard 1991). These data yield a time of about 41 years using the following equation:

$$t = (t_h \times \ln(N/N_0))/(-0.693) = 40.88 \text{ years} \simeq 41 \text{ years}$$

The 41-year estimate is similar to the 2016 estimate (38 years), which supports the 2003 modeling estimate of 70 years (WSRC 2003b). The 2018 maximum TCE groundwater concentration (2,600 µg/L) at well CRP 20CU yields a slightly longer time to meet MCLs, but the 2018 concentration is much lower than the 2003 maximum concentration (8,330 µg/L) at co-located well CRP 20CL. The 2003 maximum concentration for well CRP 20CL never led to a TCE MCL exceedance in FMB, as indicated by surface water stations TL-03 and TL-04, so it is unlikely the 2018 groundwater TCE concentration at CRP 20CU will result in a TCE MCL exceedance in FMB.

In 2000, the maximum TCE groundwater plume concentration was 43,200 µg/L at well CRP 3D, and in 2018 the maximum TCE groundwater concentration is 2,600 µg/L at well CRP 20CU. If the 2000 TCE concentration is reduced by 4 half-lives ($4 \times 4.53 = 18.12$) the resulting TCE concentration is 2,700 µg/L, which is about the concentration (2,600 µg/L) observed at CRP 20CU in 2018, so the 4.53 TCE half-life appears to be a good estimate. Likewise, the TCE plume transit of 2,376 ft from CRP 3D to CRP 20CU over 18 years (132 ft/yr) is a reasonable flow velocity for the UAZ. Assuming the plume maximum is approximately halfway to FMB, then the plume will undergo another 4 half-lives of decay while traveling through the TCCZ and the LAZ and arriving in the FMB wetlands at a concentration of 162.5 µg/L at the CRP 50 and CRP 51 well clusters. At this point biodegradation in the wetlands is likely to reduce the TCE concentration to below MCLs, as has been observed at well CRP 50B.

Fluctuations in TCE concentrations at the downgradient wells are expected until residual contamination from the hotspot has completely discharged to FMB and the Twin Lakes. Fluctuations in TCE degradation compounds are also expected at the MNA wells in the FMB and Twin Lakes wetland areas. The hot spot TCE concentrations, transport time, and attenuation mechanisms are incorporated into the 2003 CBRP OU groundwater model, which estimates the entire TCE plume will be below MCLs in 70 years.

Well CRW010CU exceeded the trigger level, repeating exceedances reported in the previous CBRP OU EMR (SRNS 2017). However, groundwater flow paths and recent groundwater data indicate that the CAGW OU TCE plume from the reactor area impacts well CRW010CU, not the CBRP OU TCE plume. Nevertheless, the CRW010 well cluster will continue to be monitored as part of the CBRP OU well network. In addition, groundwater monitoring wells CRP 6DR and CRP 8D are now monitored to help delineate the CBRP OU TCE plume from the CAGW OU TCE plume.

The next CBRP OU EMR is scheduled for June 2021 (Table 1) and will discuss data collected in 2019 and 2020.

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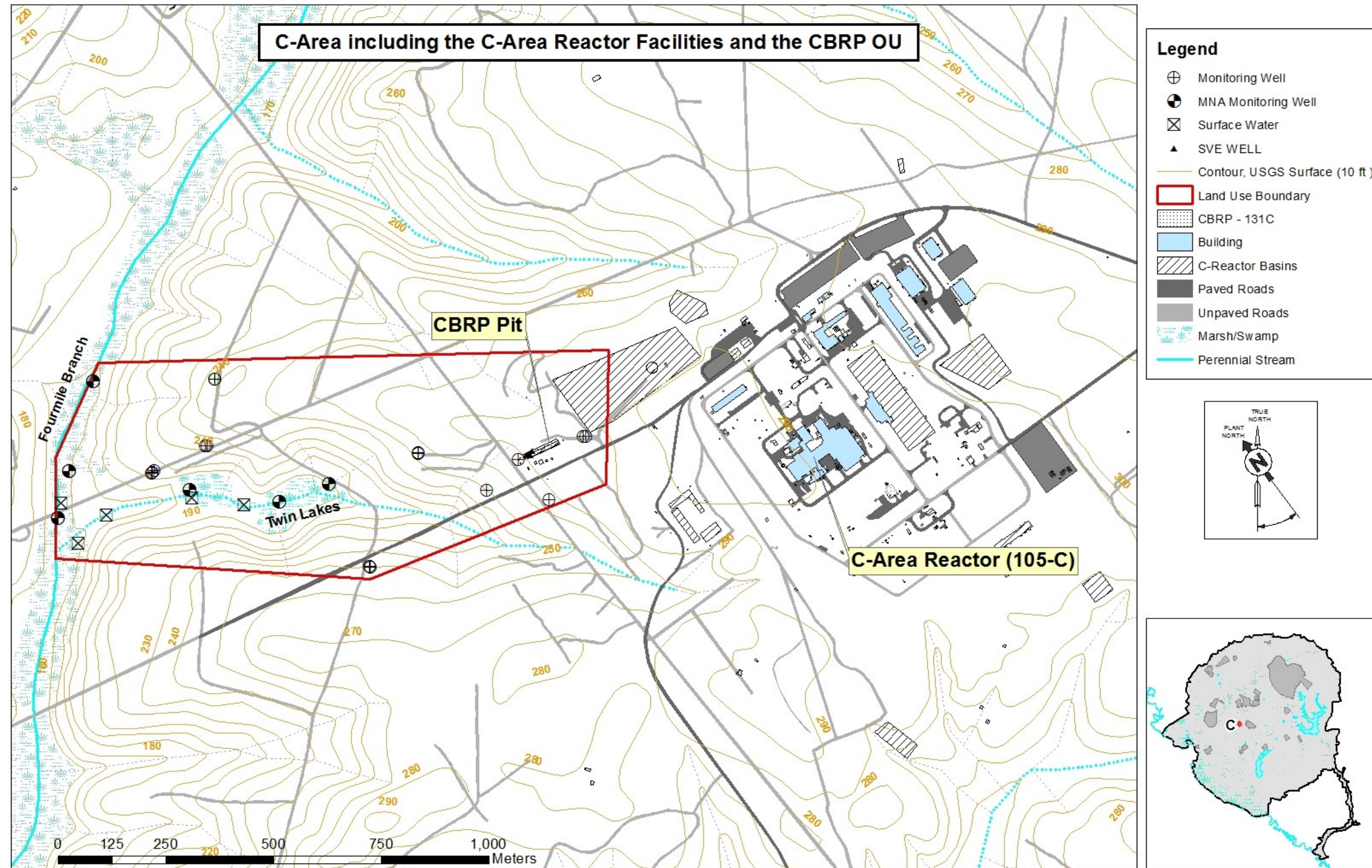


Figure 1. Location of CBRP OU in Relation to the C-Reactor Facilities

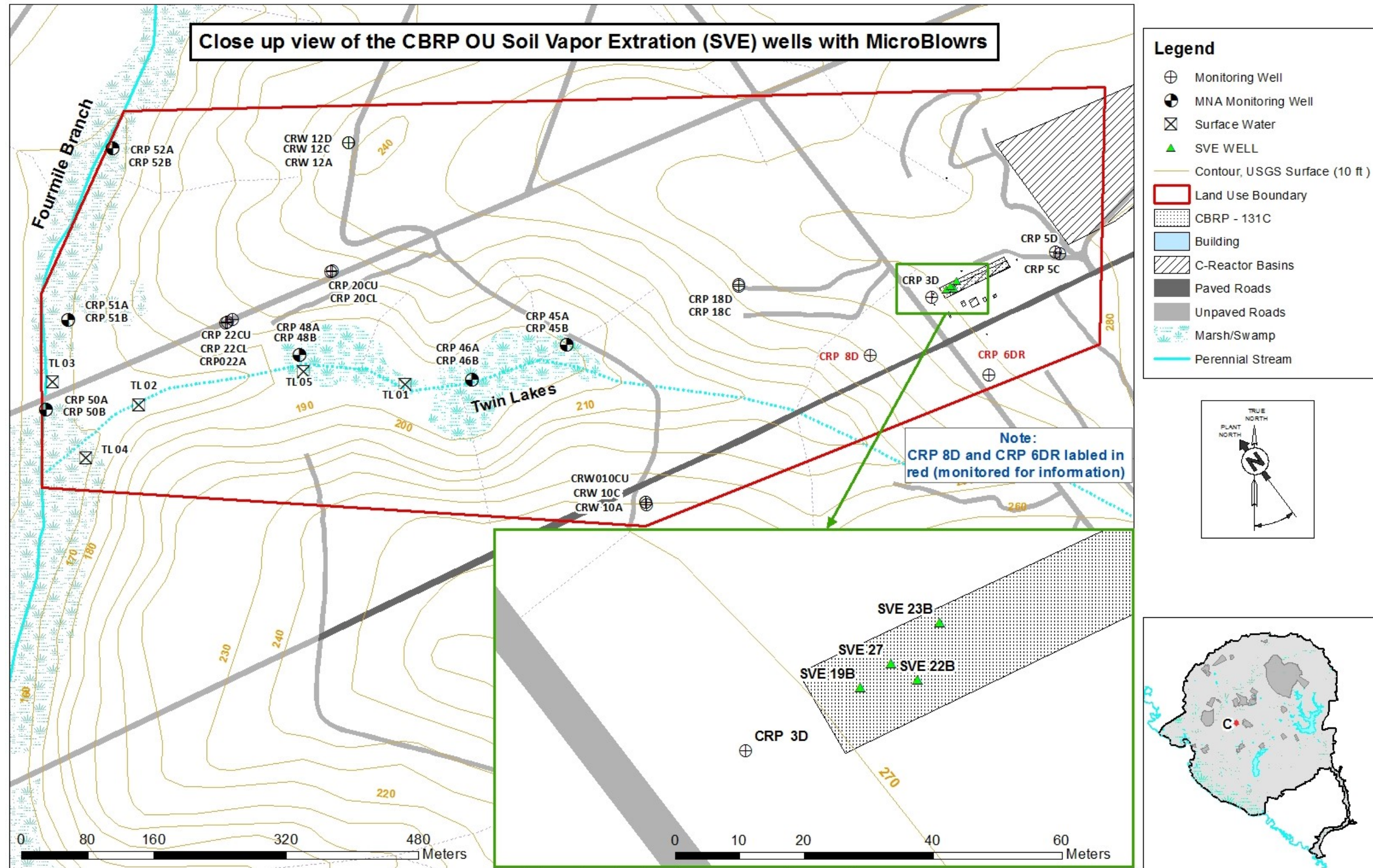


Figure 2. Location of the SVE System at the Western Edge of CBRP

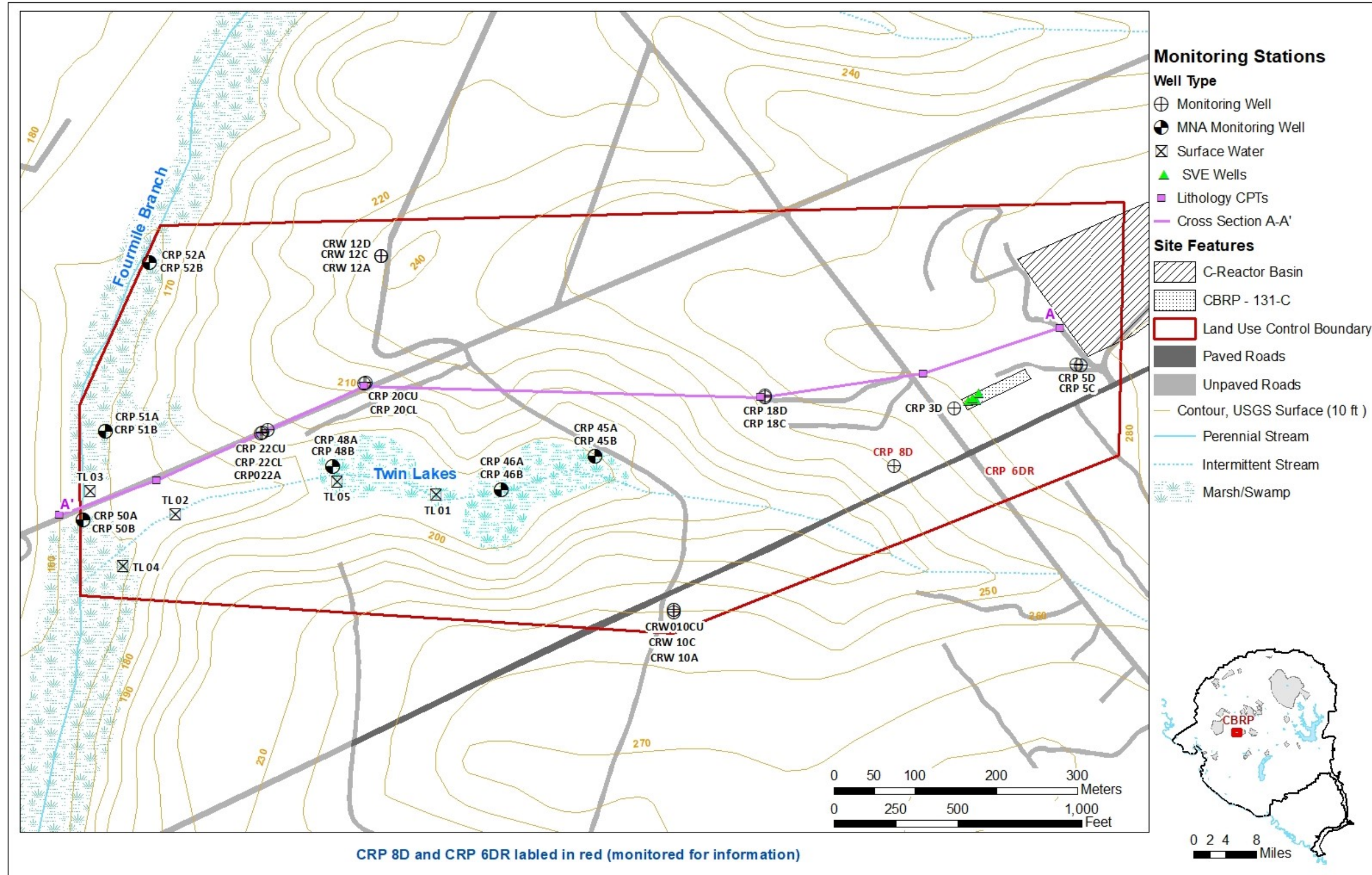


Figure 3. CBRP OU LUC Boundary

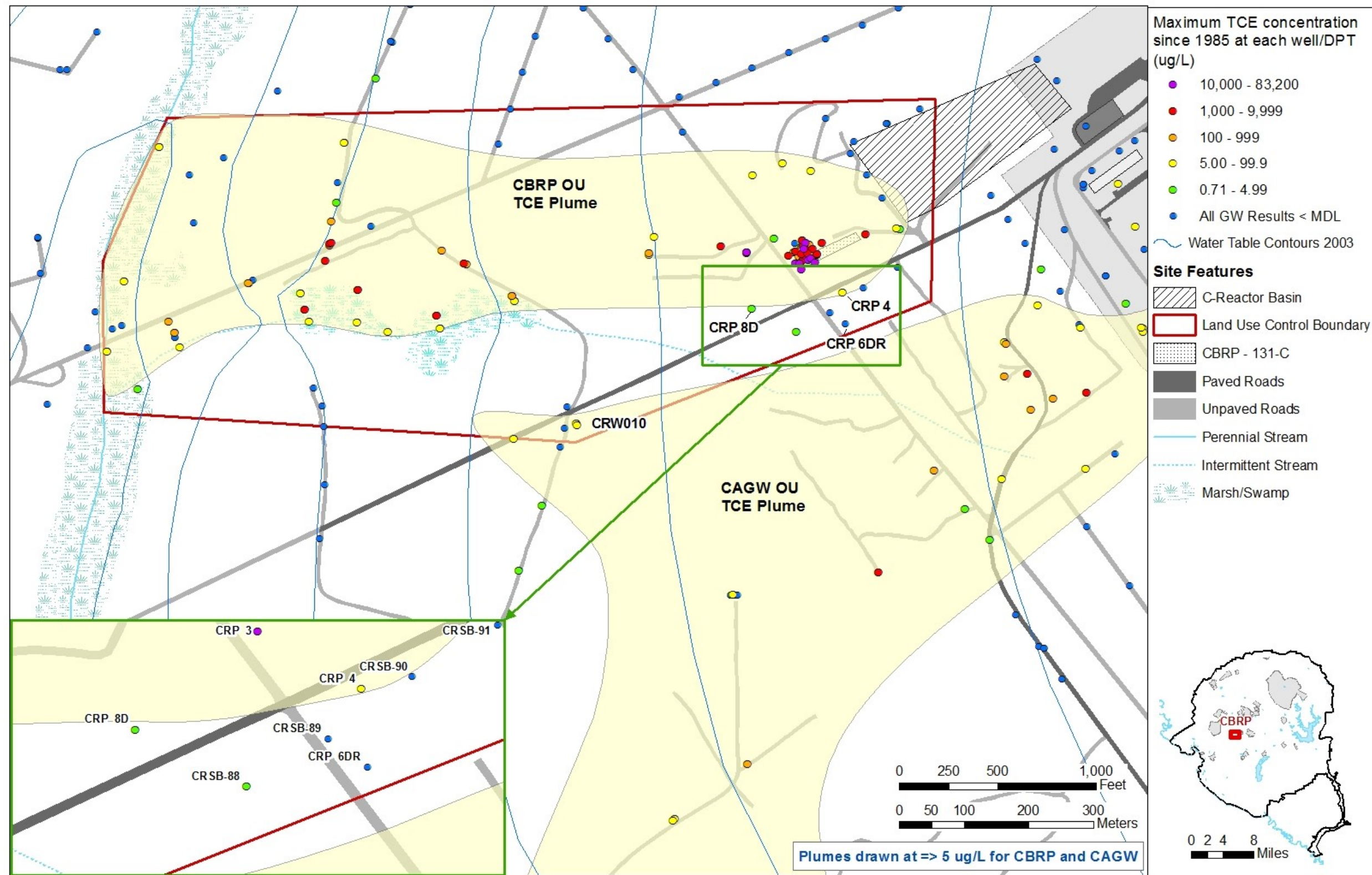


Figure 4. Maximum TCE concentrations for C-Area (1985-2016)

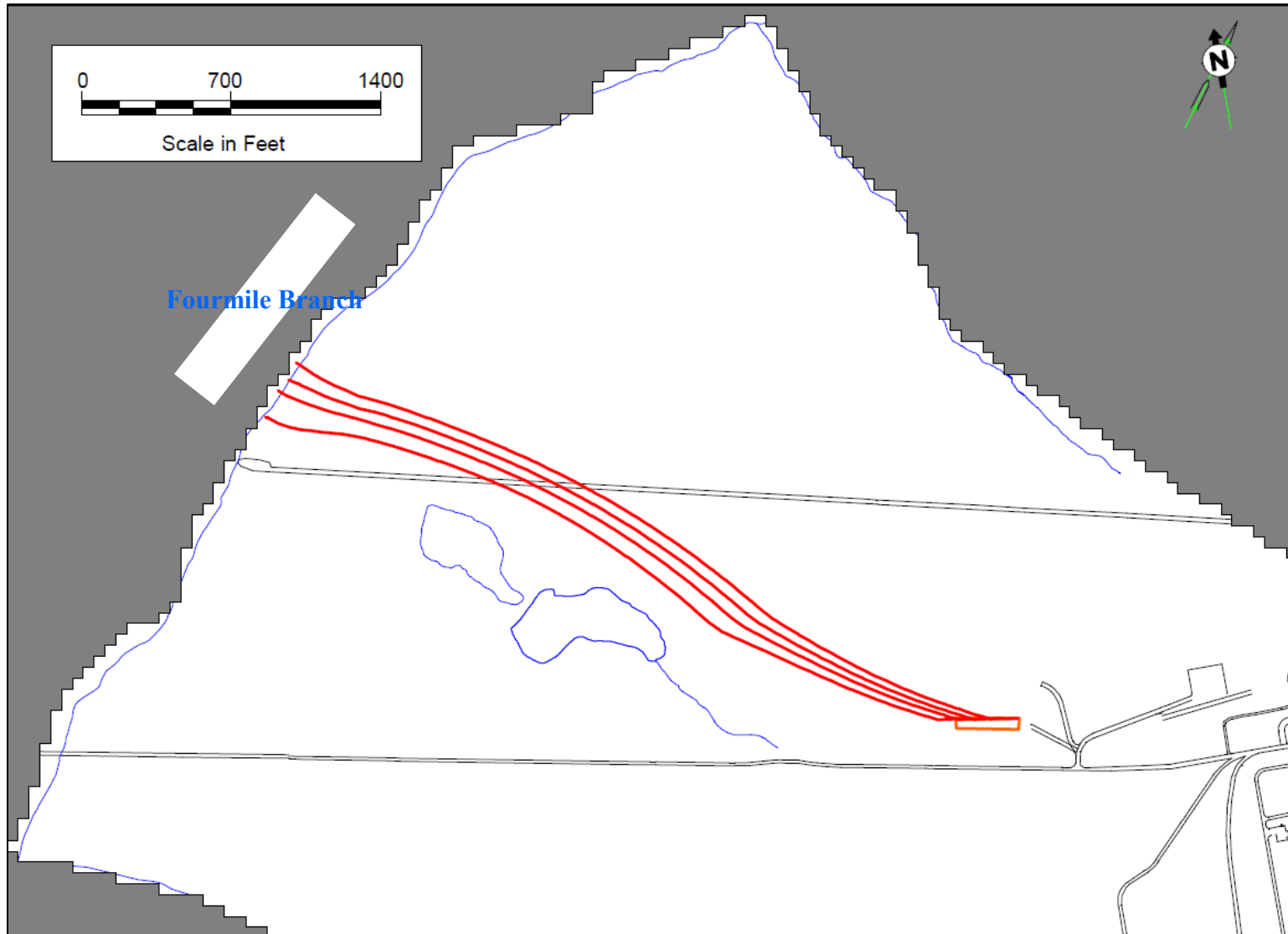


Figure 5. CBRP OU Groundwater Model Particle Tracks (WSRC-TR-2001-00298)

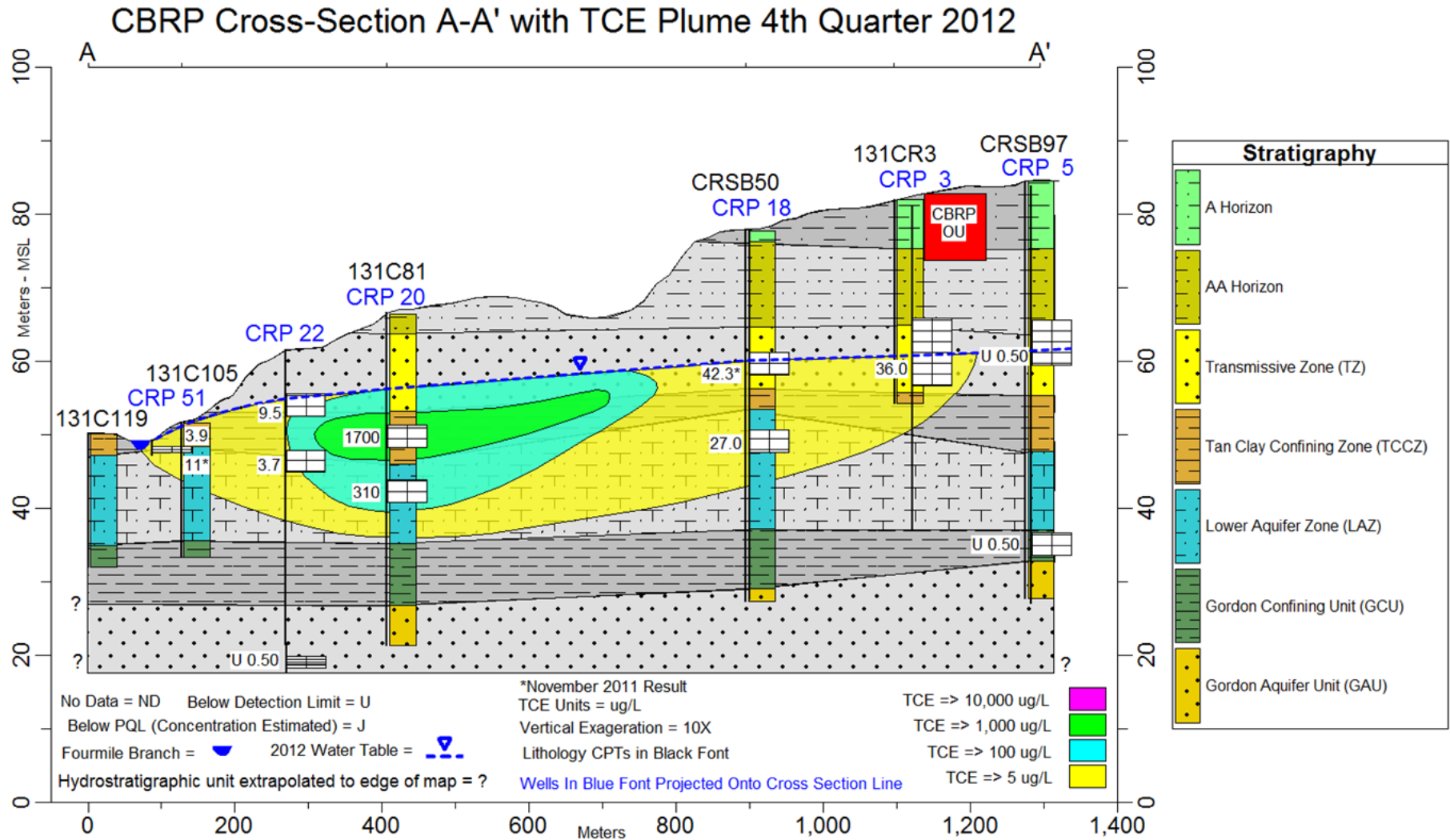


Figure 7. CBRP Plume Cross Section, Fourth Quarter 2012

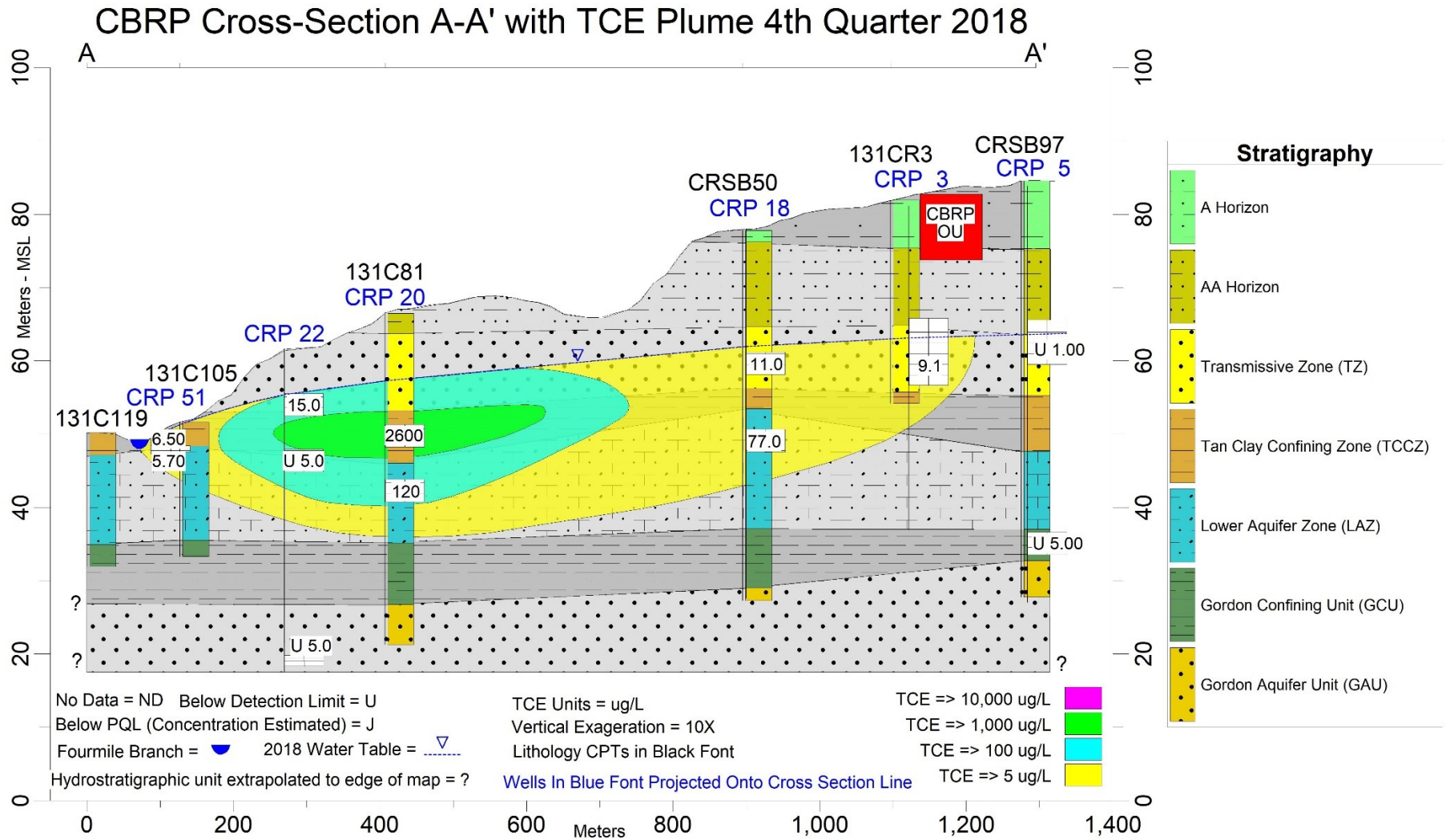


Figure 8. CBRP Plume Cross Section, Fourth Quarter 2018

Table 1. Sampling and Reporting Schedule

Year	Month	SVE Wells	Monitoring Wells	MNA Wells	Surface Sampling	Report
2009	Oct-Dec	X	X	X	X	
2010	Apr-Jun	X	X*	X	X	
	Oct-Dec	X	X	X	X	
2011	Apr-Jun	X		X	X	X
	Oct-Dec	X	X	X	X	
2012	Apr-Jun	X		X	X	
	Oct-Dec	X	X	X	X	
2013	Apr-Jun	X				X
	Oct-Dec	X		X	X	
2014	Apr-Jun	X				
	Oct-Dec	X	X	X	X	
2015	Apr-Jun	X				X
	Oct-Dec	X		X	X	
2016	Apr-Jun	X				
	Oct-Dec	X	X	X	X	
2017	Apr-Jun	X				X
	Oct-Dec	X		X	X	
2018	Apr-Jun	X				
	Oct-Dec	X	X	X	X	
2019	Apr-Jun	X				X
	Oct-Dec	X		X	X	
2020	Apr-Jun	X				
	Oct-Dec	X	X	X	X	
2021	Apr-Jun	X				X
	Oct-Dec	X		X	X	

*Only CRP022A and CRW010CU

Table 2. MCLs for the RCOCs

RCOC*	MCL	Units
1,1-Dichloroethylene	7	µg/L
cis-1,2-Dichloroethylene	70	µg/L
Dichloromethane	5	µg/L
Tetrachloroethylene	5	µg/L
Trichloroethylene	5	µg/L
Vinyl Chloride	2	µg/L

*Trans-1,2-dichloroethylene and ethylene are not RCOCs, but concentrations are reported in Appendices A and C.

Table 3. Groundwater and Surface Water TCE Trigger Levels

Station ID	Well Type	Compliance Use	Station Maximum 2017 – 2018 (µg/L)	TCE Trigger Level
CRP 3D	Monitoring Well	KSZ Monitoring Well	11.9	459 µg/L
CRW 10A	Monitoring Well	LUC Boundary Well	<EQL (5)	13.6 µg/L
CRW 10C	Monitoring Well	LUC Boundary Well	12.3	13.6 µg/L
CRW010CU	Monitoring Well	LUC Boundary Well	14.9 ^a	13.6 µg/L
CRW 12A	Monitoring Well	LUC Boundary Well	<EQL (5)	>5 µg/L (MCL)
CRW 12C	Monitoring Well	LUC Boundary Well	<EQL (5)	>5 µg/L (MCL)
CRW 12D	Monitoring Well	LUC Boundary Well	<EQL (5)	>5 µg/L (MCL)
TL 04	Surface Water	MNA POC	1.43	>5 µg/L (MCL)
KSZ = Key Source Zone LUC = Land Use Control POC = Point of Compliance MCL = Maximum Contaminant Level		EQL = Estimated Quantitation Limit a) Obtained during 4/23/18 CAGW OU sampling event. The highest result for CBRP OU sampling event during this period was 14.7 µg/L on 11/6/17.		

APPENDIX A

CBRP OU Analytical Data 2017-2018

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Table A-1, CBRP OU Monitoring Results, 2017 and 2018			Field Data											CBRP OU Refined Constituents of Concern							
			SAMPLE COLLECTION DATE	DEPTH TO WATER	SAMPLING EVENT WATER ELEVATION	TURBIDITY	PH	TOTAL ALKALINITY (AS CaCO3)	WATER TEMPERATURE	VOLUME PURGED	SPECIFIC CONDUCTANCE	OXIDATION / REDUCTION POTENTIAL	FIELD CONDITIONS	VOCs							
														I,1-DICHLOROETHYLENE	CHLOROETHENE (VINYL CHLORIDE)	CIS-1,2-DICHLOROETHYLENE	DICHLOROMETHANE (METHYLENE CHLORIDE)	ETHYLENE	TETRACHLOROETHYLENE (PCE)	TRANS-1,2-DICHLOROETHYLENE	TRICHLOROETHYLENE (TCE)
Units	ft	ft	NTU	pH	mg/L	degC	gal	uS/cm	mV			ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L			
Station	Well Use	Aquifer Zone	GWPS			15							7	2	70	5	5	100	5		
CRP 3C	Abandoned Well	LAZ UTRAU	NS	NS	NS	NS	NS	NS	NS	NS	NS	A	NS	NS	NS	NS	NS	NS	NS	NS	
CRP 45A	MNA Monitoring Well	TZ UAZ UTRAU	07-Nov-2017	6.3	195.5	9.8	5.8	12	18.6	1	23	160	NC	<EQL (1)	1.36	2.68	<EQL (5)	0.52	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2018	6.09	195.71	11.9	6	99	18.9	1	107	-159	NC	<EQL (5)	3.9	6.2	<EQL (5)	0.33	<EQL (5)	<EQL (5)	<EQL (5)
CRP 45B	MNA Monitoring Well	TZ UAZ UTRAU	07-Nov-2017	2.6	195.7	6.3	5.6	11	19.1	2	23	164	NC	<EQL (1)	2.19	9.95	<EQL (5)	0.76	<EQL (1)	<EQL (1)	8.31
			06-Nov-2018	2.43	195.87	7.4	5.4	2	19.4	2	24	158	NC	<EQL (5)	2	9.7	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	17
CRP 46A	MNA Monitoring Well	TZ UAZ UTRAU	07-Nov-2017	NS	NS	NS	NS	NS	NS	0	NS	NS	D	NS	NS	NS	NS	NS	NS	NS	NS
			06-Nov-2018	3	189.48	3.9	5.8	5	20.6	1	41	71	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)
CRP 46B	MNA Monitoring Well	TZ UAZ UTRAU	07-Nov-2017	3.5	187.38	13.7	6.3	33	18.8	1	68	-24	NC	<EQL (1)	5.85	2.8	<EQL (5)	0.86	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2018	3	187.88	9.4	5.9	5	19.3	1	74	-71	NC	<EQL (5)	5.9	<EQL (5)	<EQL (5)	0.57	<EQL (5)	<EQL (5)	<EQL (5)
CRP 48A	MNA Monitoring Well	TCCZ	07-Nov-2017	3.87	175.36	27.6	5.7	14	23.2	2	33	120	X	<EQL (1)	1.22	0.44	<EQL (5)	0.45	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2018	3.79	175.44	24.3	4.3	0	19	1	60	292	X	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)
CRP 48B	MNA Monitoring Well	TCCZ	07-Nov-2017	3.1	175.98	10.2	6.1	25	17.5	1	43	-16	NC	<EQL (1)	4.92	14.5	<EQL (5)	0.78	<EQL (1)	<EQL (1)	1.26
			06-Nov-2018	3.02	176.06	8.3	5.9	13	20.1	1	41	-73	NC	<EQL (5)	5.7	17	<EQL (5)	0.57	<EQL (5)	<EQL (5)	<EQL (5)
CRP 50A	MNA Monitoring Well	TCCZ	08-Nov-2017	2.93	163.57	14.3	6.2	29	17.4	1	98	-22	NC	<EQL (1)	2.1	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2018	2.78	163.72	3.8	6	25	19.4	1	79	5	NC	<EQL (5)	31	<EQL (5)	<EQL (5)	26	<EQL (5)	<EQL (5)	<EQL (5)
CRP 50B	MNA Monitoring Well	TCCZ	08-Nov-2017	1.3	163.5	1.8	6	24	17.8	1	29	11	NC	1.27	254	97.6	<EQL (5)	41	<EQL (1)	<EQL (1)	0.41
			06-Nov-2018	5.8	159	6.5	5.8	11	19.8	1	32	-30	NC	<EQL (5)	210	150	<EQL (5)	40	<EQL (5)	<EQL (5)	<EQL (5)
CRP 51A	MNA Monitoring Well	MAZ TC	08-Nov-2017	2.8	162.18	9.2	6	18	18.6	1	31	41	NC	<EQL (1)	1.28	1.72	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	5.76
			07-Nov-2018	2.74	162.24	8	5.4	3	17.2	1	21	184	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	0.12	<EQL (5)	<EQL (5)	6.5
CRP 51B	MNA Monitoring Well	MAZ TC	08-Nov-2017	1.74	161.94	11.2	5.7	12	18.1	1	24	115	NC	<EQL (1)	<EQL (1)	0.81	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	2.78
			07-Nov-2018	1.62	162.06	14	5.4	3	17.4	1	21	210	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	5.7
CRP 52A	MNA Monitoring Well	MAZ TC	08-Nov-2017	4.35	164.28	4.4	5.5	13	18.4	2	38	60	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)
			07-Nov-2018	4.18	164.45	5.6	5	0	18.1	2	27	187	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)
CRP 52B	MNA Monitoring Well	MAZ TC	08-Nov-2017	2.38	162.3	4.3	6.2	23	18.5	1	55	53	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)
			07-Nov-2018	1.96	162.72	14	5.4	6	18.5	1	44	81	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)
CRP 3D	Monitoring Well	TZ UAZ UTRAU	06-Nov-2017	60.82	206.88	2.8	5.6	3	20.9	0	21	276	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	11.9
			05-Nov-2018	61.18	206.52	5.5	5.7	2	19.9	0	51	211	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	9.1
CRP 5C	Monitoring Well	LAZ UTRAU	25-Apr-2017	79.8	197.5	4.8	6	15	19	0	56	NS	NC	<EQL (1)	<EQL (2)	<EQL (1)	<EQL (1)	NS	8.5	<EQL (1)	<EQL (1)
			06-Nov-2017	80.2	197.1	4.1	6	14	19.2	0	50	179	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	9.55	<EQL (1)	<EQL (1)
			23-Apr-2018	81	196.3	3.2	6	17	19.3	0	51	244	NC	NS	<EQL (1)	<EQL (1)	NS	NS	8.26	NS	<EQL (1)
			05-Nov-2018	81.4	195.9	4	6.3	42	19.8	0	66	197	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	8.9	<EQL (5)	<EQL (5)
CRP 5D	Monitoring Well	TZ UAZ UTRAU	25-Apr-2017	66.1	210.8	8	5.9	12	19.5	0	16	NS	NC	<EQL (1)	<EQL (2)	<EQL (1)	<EQL (1)	NS	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2017	66.5	210.4	7	6	12	19.3	0	16	184	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)
			23-Apr-2018	67.9	209	3.4	5	0	19	0	15	274	NC	NS	<EQL (1)	<EQL (1)	NS	NS	<EQL (1)	NS	<EQL (1)
			05-Nov-2018	68.76	208.14	4	6.3	7	20	0	24	210	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)
CRP 6DR	Monitoring Well	TZ UAZ UTRAU	24-Apr-2017	55.2	208.7	1.1	5.6	1	20.5	6	24	NS	NC	<EQL (1)	<EQL (2)	<EQL (1)	<EQL (1)	NS	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2017	55.5	208.4	1.7	5.5	8	20.1	5	23	198	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)
			23-Apr-2018	52.6	211.3	1.9	4.8	0	20.6	8	24	315	NC	NS	<EQL (1)	<EQL (1)	NS	NS	<EQL (1)	NS	<EQL (1)
			05-Nov-2018	58.3	205.6	1.2	5.2	4	20.4	5	23	244	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)

Table A-1, CBRP OU Monitoring Results, 2017 and 2018 (Continued)			Field Data											CBRP OU Refined Constituents of Concern								
			SAMPLE COLLECTION DATE	DEPTH TO WATER	SAMPLING EVENT WATER ELEVATION	TURBIDITY	PH	TOTAL ALKALINITY (AS CaCO3)	WATER TEMPERATURE	VOLUME PURGED	SPECIFIC CONDUCTANCE	OXIDATION / REDUCTION POTENTIAL	FIELD CONDITIONS	VOCs								
														1,1-DICHLOROETHYLENE	CHLOROETHENE (VINYL CHLORIDE)	CIS-1,2-DICHLOROETHYLENE	DICHLOROMETHANE (METHYLENE CHLORIDE)	ETHYLENE	TETRACHLOROETHYLENE (PCE)	TRANS-1,2-DICHLOROETHYLENE	TRICHLOROETHYLENE (TCE)	
														ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Station	Well Use	Aquifer Zone	Units	ft	ft	NTU	pH	mg/L	degC	gal	uS/cm	mV		7	2	70	5	5	100	5		
CRP 8D	Monitoring Well	TZ UAZ UTRAU	06-Nov-2017	42.6	206.1	1.2	4.8	0	20.6	5	22	211	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)	
			05-Nov-2018	43.64	205.06	1	4.9	1	22.1	6	23	278	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	
CRP 18C	Monitoring Well	LAZ UTRAU	06-Nov-2017	60.7	197.6	2.5	7.2	8	19.6	2	25	270	NC	<EQL (1)	<EQL (1)		2.25	<EQL (5)	<EQL (0.1)	[0.9]	<EQL (1)	79.8
			05-Nov-2018	61.48	196.82	2.7	5.8	3	19.3	1	25	255	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	77
CRP 18D	Monitoring Well	TZ UAZ UTRAU	06-Nov-2017	54.8	203.6	3.7	6	6	19.4	2	34	251	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)	11.9
			06-Nov-2018	55.37	203.03	5.1	6.1	9	20	2	31	213	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	11
CRP 20CL	Monitoring Well	LAZ UTRAU	06-Nov-2017	38.52	182.39	0.2	5.3	0	19.4	16	22	268	NC	<EQL (1)	<EQL (1)		3.95	<EQL (5)	<EQL (0.1)	1.81	<EQL (5)	137
			06-Nov-2018	38.75	182.16	0.1	5.3	0	19.8	16	22	230	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	120
CRP 20CU	Monitoring Well	MAZ UTRAU	06-Nov-2017	33.1	188.1	2.3	5.3	0	20.7	12	25	280	NC	<EQL (1)	<EQL (1)		40.5	<EQL (5)	<EQL (0.1)	2.06	[0.6]	2260
			06-Nov-2018	33.34	187.86	5.4	5.2	0	21.7	12	25	255	NC	<EQL (250)	<EQL (100)	<EQL (250)	<EQL (250)	<EQL (0.1)	<EQL (250)	<EQL (250)	<EQL (250)	2600
CRP 22CL	Monitoring Well	LAZ UTRAU	06-Nov-2017	29.6	175.07	1.1	5.8	4	20.9	10	22	283	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	[0.67]	<EQL (1)	<EQL (1)	2.09
			06-Nov-2018	29.5	175.17	3	5.4	6	19.8	10	23	290	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	<EQL (5)
CRP 22CU	Monitoring Well	TZ UAZ UTRAU	06-Nov-2017	22.34	181.79	0.8	5.2	1	21.3	5	21	282	NC	<EQL (1)	<EQL (1)	[0.39]	<EQL (5)	<EQL (0.1)	1.2	<EQL (1)	<EQL (1)	11
			06-Nov-2018	22.43	181.7	0.5	5	0	20.7	6	22	243	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	15
CRP022A	Monitoring Well	GAU	06-Nov-2017	54.4	150.32	4.2	7	53	22.5	0	169	210	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2018	54.2	150.52	10.2	6.1	55	19.7	0	171	227	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)		0.12	<EQL (5)	<EQL (5)	<EQL (5)
CRW 10A	Monitoring Well	GAU	25-Apr-2017	90.81	158.18	1.3	6.2	36	18.2	3	123	NS	NC	<EQL (1)	<EQL (2)	<EQL (1)	<EQL (1)	NS	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2017	91.89	157.1	1.3	6.4	52	18.5	3	125	27	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (1)
			01-May-2018	91.1	157.89	0.6	6.5	35	18.1	4	126	50	NC	NS	<EQL (1)	<EQL (1)	NS	NS	<EQL (1)	NS	<EQL (1)	<EQL (1)
			06-Nov-2018	91.88	157.11	1.2	7	50	19.4	4	124	-22	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	<EQL (5)
CRW 10C	Monitoring Well	LAZ UTRAU	24-Apr-2017	62	186.99	1.5	5.9	8	18	1	28	NS	NC	<EQL (1)	<EQL (2)	[0.25]	<EQL (1)	NS	[1.6]	<EQL (1)	[10]	<EQL (1)
			06-Nov-2017	60.72	188.27	3.2	5.9	8	18.4	1	28	173	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	1.98	<EQL (1)	<EQL (1)	12.3
			30-Apr-2018	61.33	187.66	3	6	16	19.2	2	22	202	NC	NS	<EQL (1)	<EQL (1)	NS	NS	1.55	NS	<EQL (1)	11.4
			06-Nov-2018	61.57	187.42	2.4	5.9	9	19.9	1	22	228	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	11
CRW 12A	Monitoring Well	GCU	07-Nov-2017	79.72	153.85	2.3	5.7	6	18.6	2	60	134	NC	<EQL (1)		1.71	3.21	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)
			05-Nov-2018	81.4	152.17	0.8	5.8	3	19.1	2	59	70	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	<EQL (5)
CRW 12C	Monitoring Well	MAZ TC	06-Nov-2017	49.37	184.2	0.5	5.4	4	19.2	1	25	245	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (1)
			05-Nov-2018	49.55	184.02	2.2	5.4	2	19	1	24	233	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	<EQL (5)
CRW 12D	Monitoring Well	TCCZ	06-Nov-2017	44.22	189.35	1.4	4.9	0	19.5	1	35	280	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (1)
			05-Nov-2018	44.46	189.11	1.3	5	0	18.9	1	38	283	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	<EQL (5)
CRW010CU	Monitoring Well	LAZ UTRAU	25-Apr-2017	59.3	189.53	1.6	6.5	15	16.7	0	41	NS	NC	<EQL (1)	<EQL (2)	[0.17]	<EQL (1)	NS	[0.91]	<EQL (1)	<EQL (1)	13
			06-Nov-2017	60.09	188.74	5.5	6.1	13	18.6	0	43	176	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	[0.93]	<EQL (1)	<EQL (1)	14.7
			23-Apr-2018	60.7	188.13	2.2	6.2	12	18.1	0	41	257	NC	NS	<EQL (1)	<EQL (1)	NS	NS	1.06	NS	<EQL (1)	14.9
			05-Nov-2018	61.22	187.61	1.7	5.6	12	18	0	40	235	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)	14

Table A-1, CBRP OU Monitoring Results, 2017 and 2018 (Continued/End)			Field Data											CBRP OU Refined Constituents of Concern							
			SAMPLE COLLECTION DATE	DEPTH TO WATER	SAMPLING EVENT WATER ELEVATION	TURBIDITY	PH	TOTAL ALKALINITY (AS CaCO3)	WATER TEMPERATURE	VOLUME PURGED	SPECIFIC CONDUCTANCE	OXIDATION / REDUCTION POTENTIAL	FIELD CONDITIONS	VOCs							
														I,1-DICHLOROETHYLENE	CHLOROETHENE (VINYL CHLORIDE)	CIS-1,2-DICHLOROETHYLENE	DICHLOROMETHANE (METHYLENE CHLORIDE)	ETHYLENE	TETRACHLOROETHYLENE (PCE)	TRANS-1,2-DICHLOROETHYLENE	TRICHLOROETHYLENE (TCE)
Station	Well Use	Aquifer Zone	Units	ft	ft	NTU	pH	mg/L	degC	gal	uS/cm	mV		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
			GWPS			15								7	2	70	5		5	100	5
TL 01	Surface Water	TZ UAZ UTRAU	16-May-2017	NS	NS	21	5.7	12	20	0	45	NS	NC	<EQL (1)	<EQL (2)	<EQL (1)	<EQL (1)	NS	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2017	NS	NS	36.1	5.9	18	16.3	0	28	105	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)
			01-May-2018	NS	NS	23.2	5.9	9	13.3	0	22	121	NC	NS	<EQL (1)	<EQL (1)	NS	NS	<EQL (1)	NS	<EQL (1)
			06-Nov-2018	NS	NS	14.4	5.4	2	20.9	0	22	149	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)
TL 02	Surface Water	TZ UAZ UTRAU	06-Nov-2017	NS	NS	4.9	5.9	9	15.9	0	19	157	NC	<EQL (1)	<EQL (1)	[0.91]	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	2.74
			06-Nov-2018	NS	NS	4.8	5.4	2	19.1	0	21	192	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	0.12	<EQL (5)	<EQL (5)	<EQL (5)
TL 03	Surface Water	MAZ TC	16-May-2017	NS	NS	12.8	6.3	22	21.7	0	74	NS	NC	<EQL (1)	<EQL (2)	<EQL (1)	<EQL (1)	NS	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2017	NS	NS	4.9	5.9	15	16	0	111	147	NC	<EQL (1)	<EQL (1)	[0.36]	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	<EQL (1)
			28-Nov-2017	NS	NS	4.5	5.63	NS	8.2	0	57.51	NS	NC	NS	NS	NS	NS	NS	NS	NS	NS
			01-May-2018	NS	NS	10.7	6.5	11	13.8	0	50	161	NC	NS	<EQL (1)	<EQL (1)	NS	NS	<EQL (1)	NS	<EQL (1)
			29-Oct-2018	NS	NS	3.8	6.7	9	14.5	0	84	NS	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	NS	<EQL (1)	<EQL (1)	<EQL (1)
			06-Nov-2018	NS	NS	5.7	6.5	11	19.4	0	76	90	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)
TL 04	Surface Water	MAZ TC	06-Nov-2017	NS	NS	90.7	5.7	10	17.2	0	31	115	NC	<EQL (1)	<EQL (1)	<EQL (1)	<EQL (5)	<EQL (0.1)	<EQL (1)	<EQL (1)	[0.44]
			06-Nov-2018	NS	NS	3.8	5.2	2	19.6	0	21	226	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)
TL 05	Surface Water	TZ UAZ UTRAU	06-Nov-2017	NS	NS	8.8	5.8	11	16.2	0	22	132	NC	<EQL (1)	[0.59]	1.96	<EQL (5)	0.11	<EQL (1)	<EQL (1)	3.4
			06-Nov-2018	NS	NS	6.7	5.3	2	19.1	0	21	171	NC	<EQL (5)	<EQL (2)	<EQL (5)	<EQL (5)	<EQL (0.1)	<EQL (5)	<EQL (5)	<EQL (5)

Table A-1 Table Notes

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

Table A-1 Field Condition Column Notes

A	Abandoned
C	Continuously pumping well / flowing stream
D	Dry well. No sample collected.
NS	Not sampled.
T	High turbidity. Some portions of the sample may not be analyzed.
X	Well pumped dry. Samples collected after well recovered.
N	Field parameters not stable when sample collected.
NC	No comment.

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APPENDIX B

CBRP OU Hydrographs

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Figure B-1.

Hydrograph for Station CRP 3

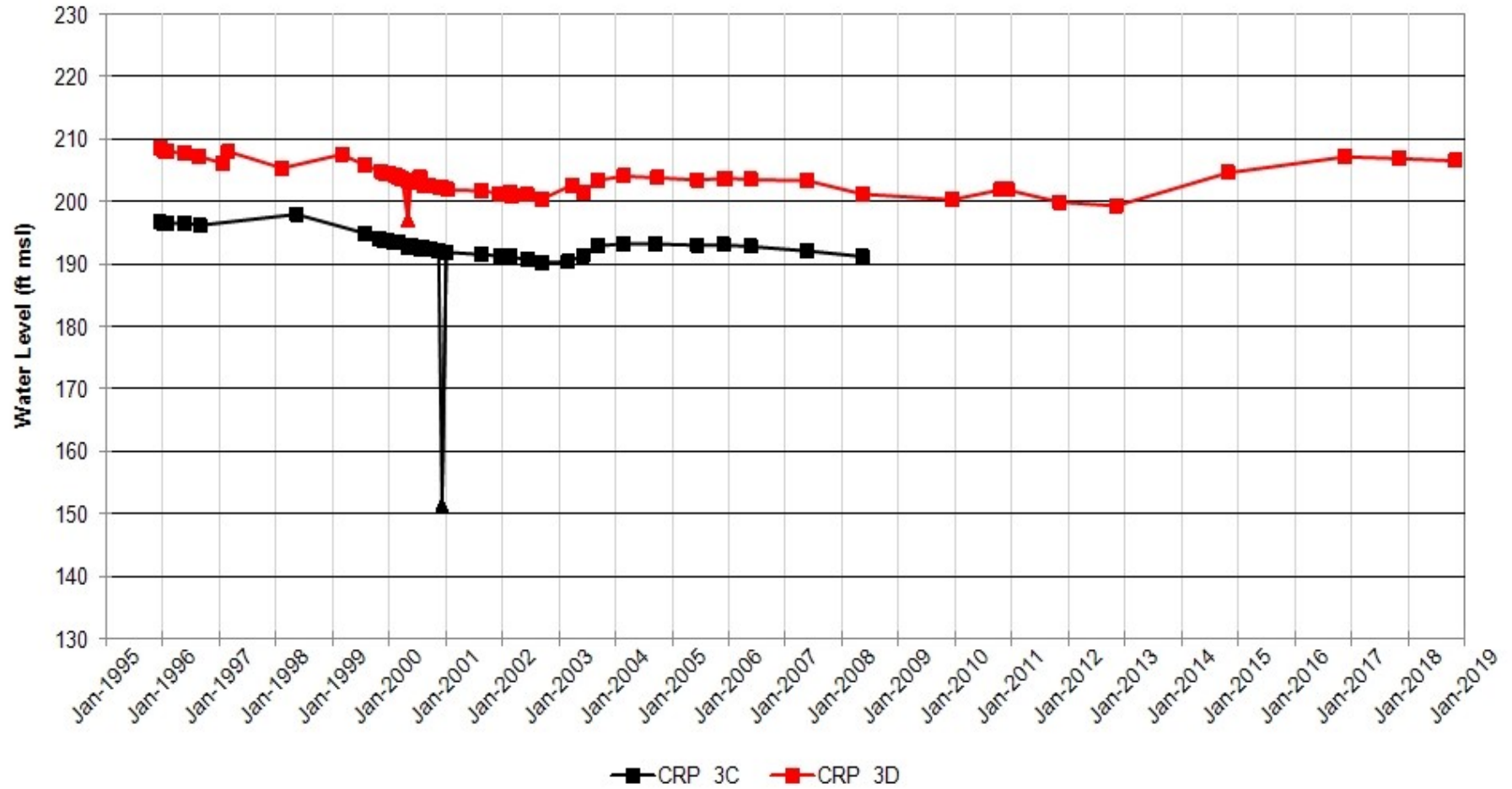


Figure B-2.
Hydrograph for Station CRP 5

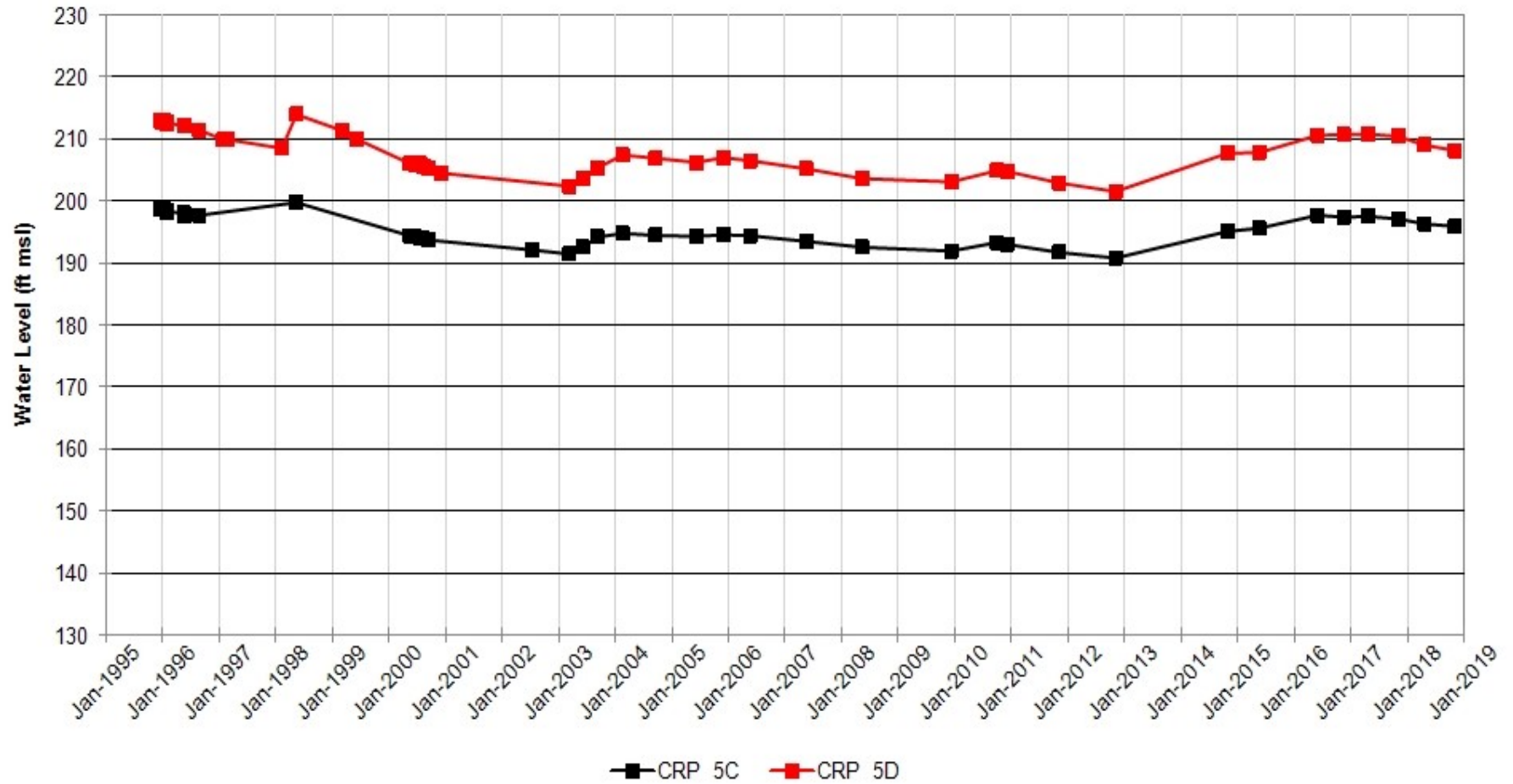


Figure B-3.

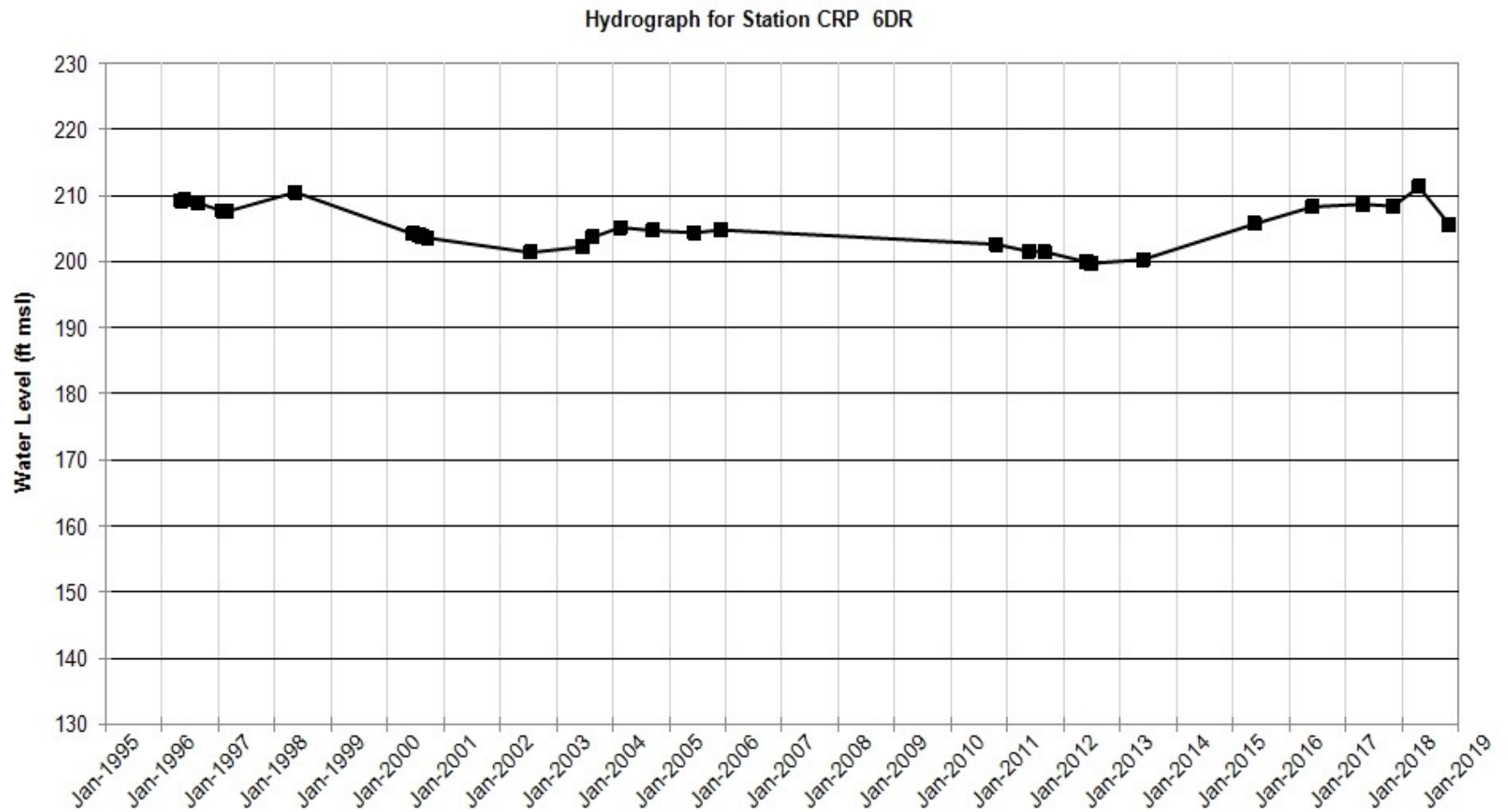


Figure B-4.
Hydrograph for Station CRP 8D

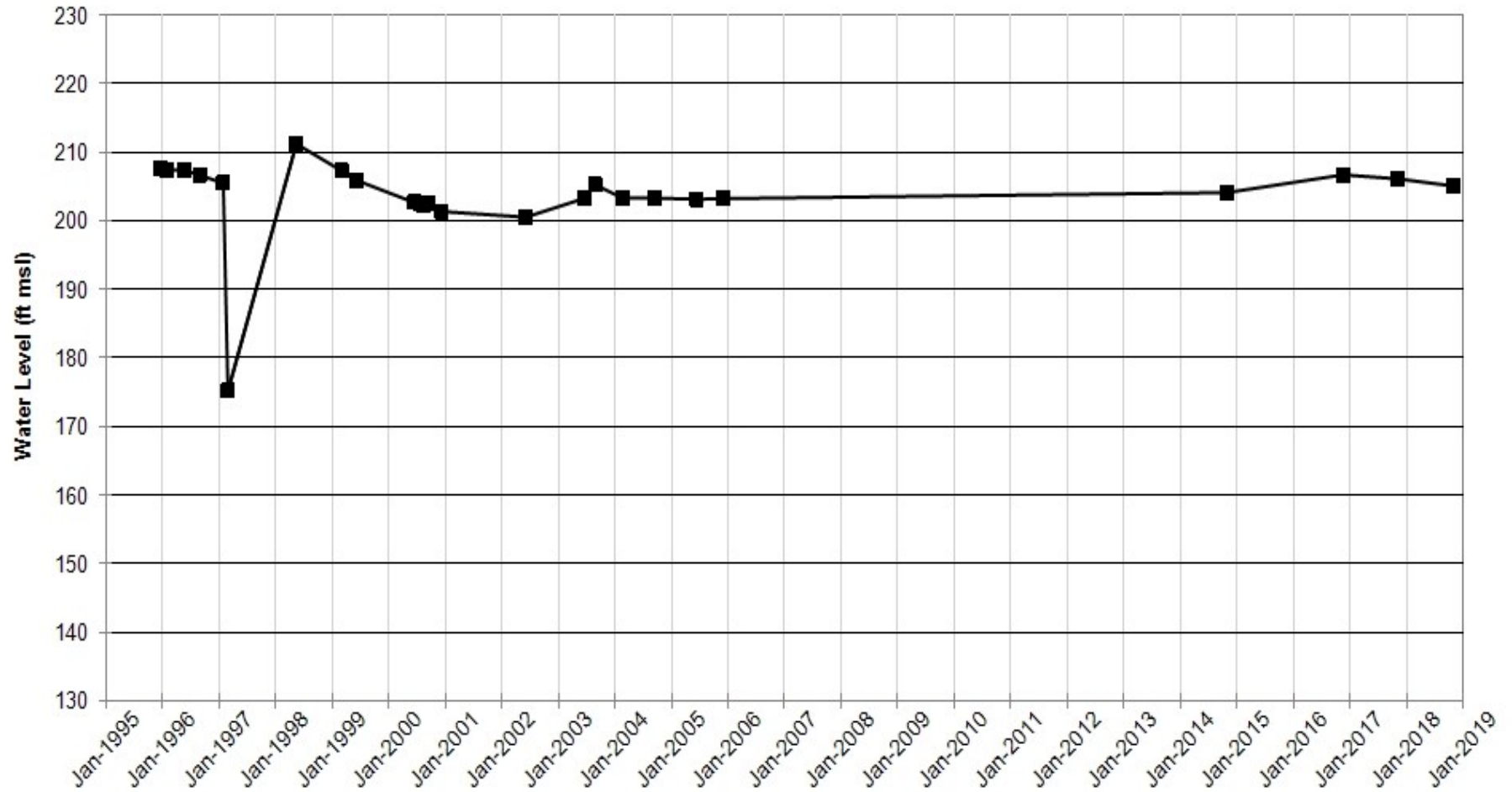


Figure B-5.

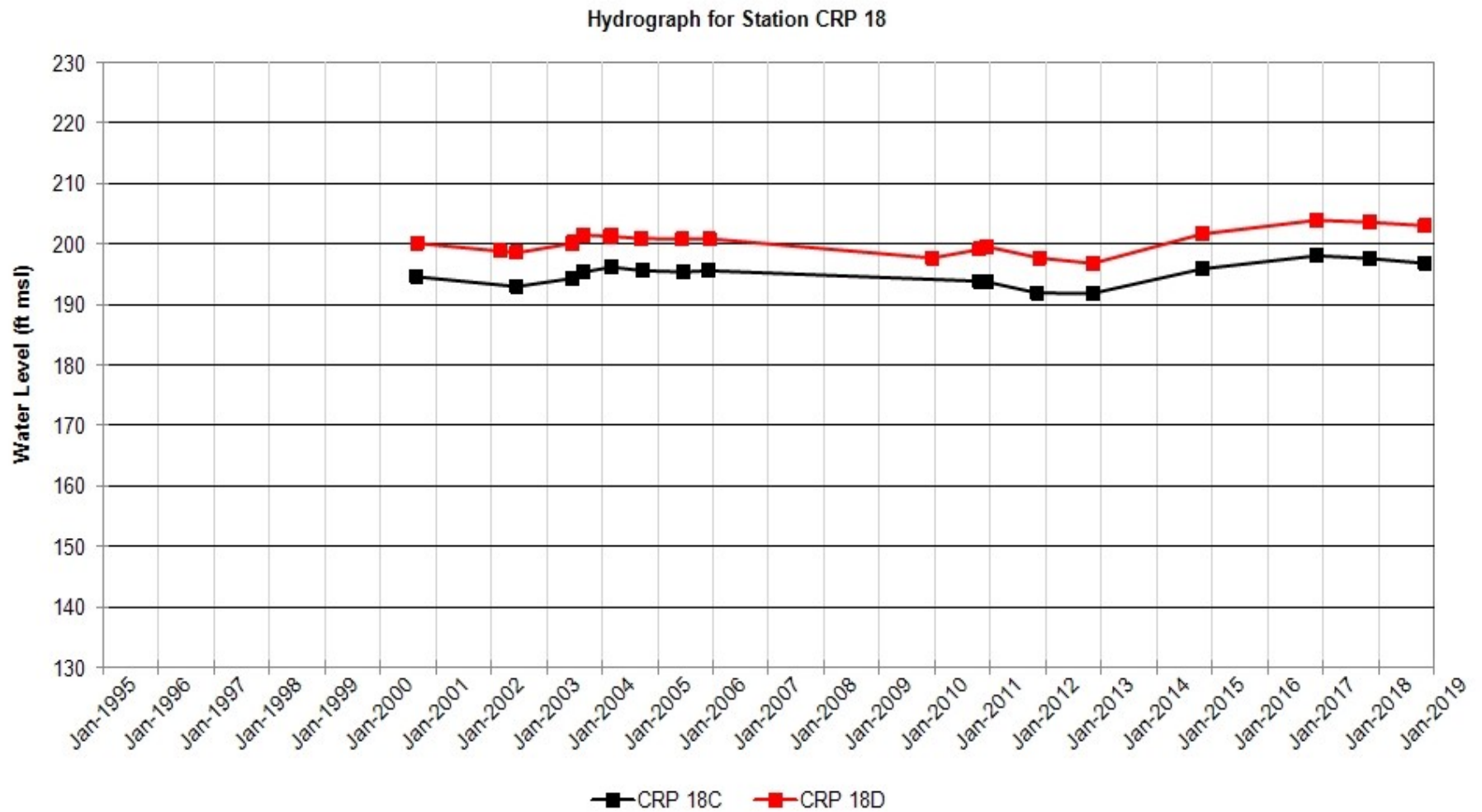


Figure B-6.

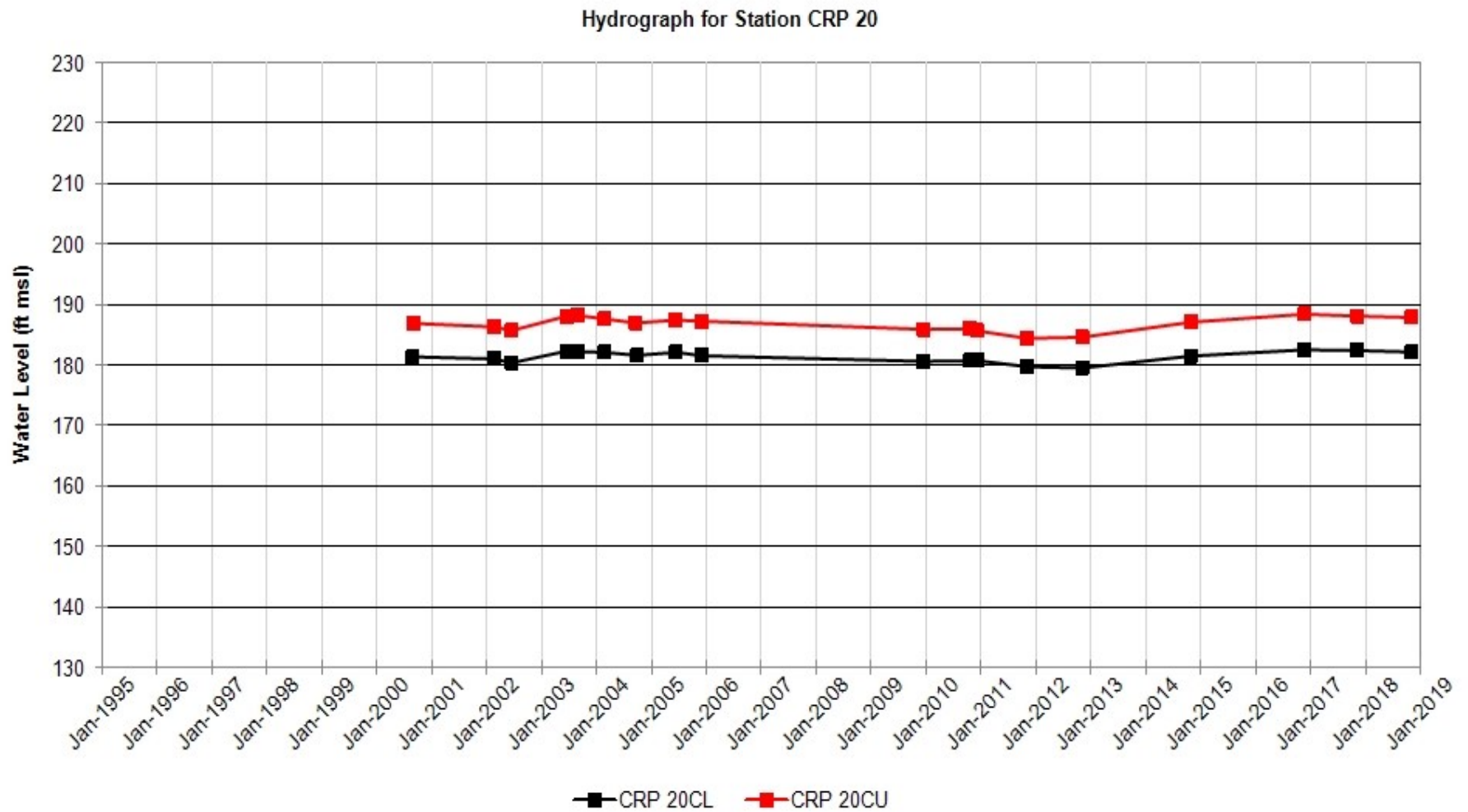


Figure B-7.

Hydrograph for Station CRP 22

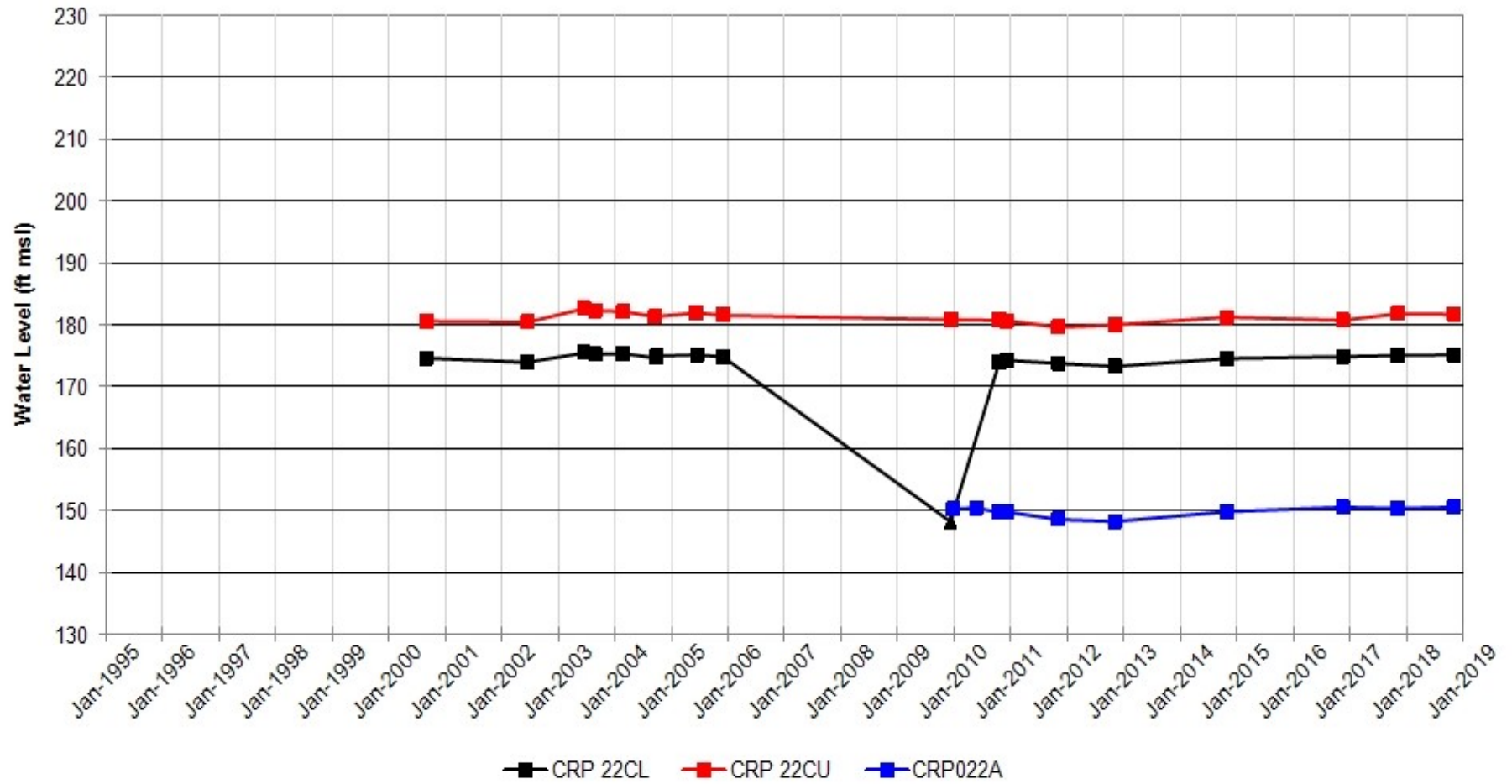


Figure B-8.

Hydrograph for Station CRP 45

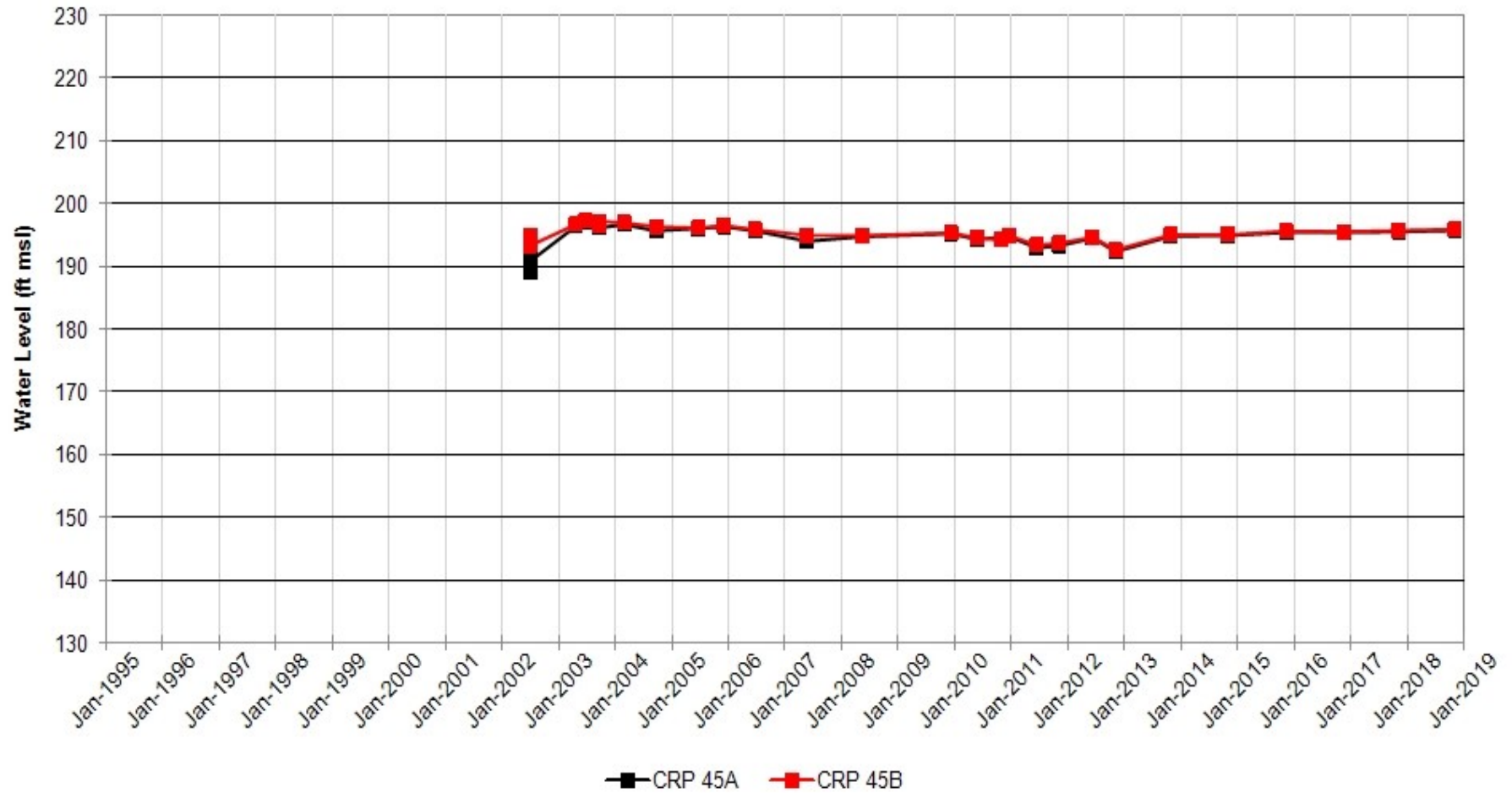


Figure B-9.

Hydrograph for Station CRP 46

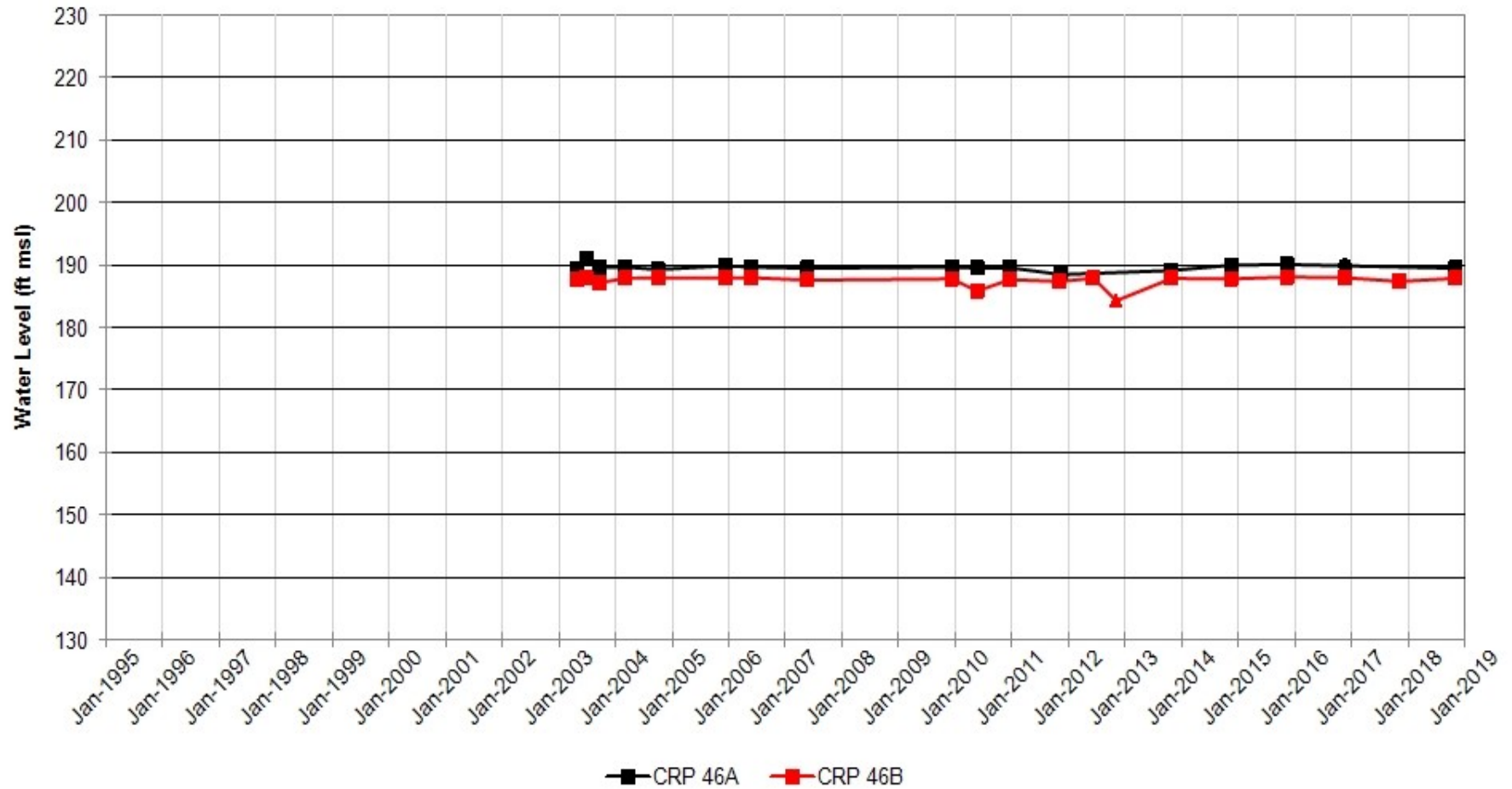


Figure B-10.

Hydrograph for Station CRP 48

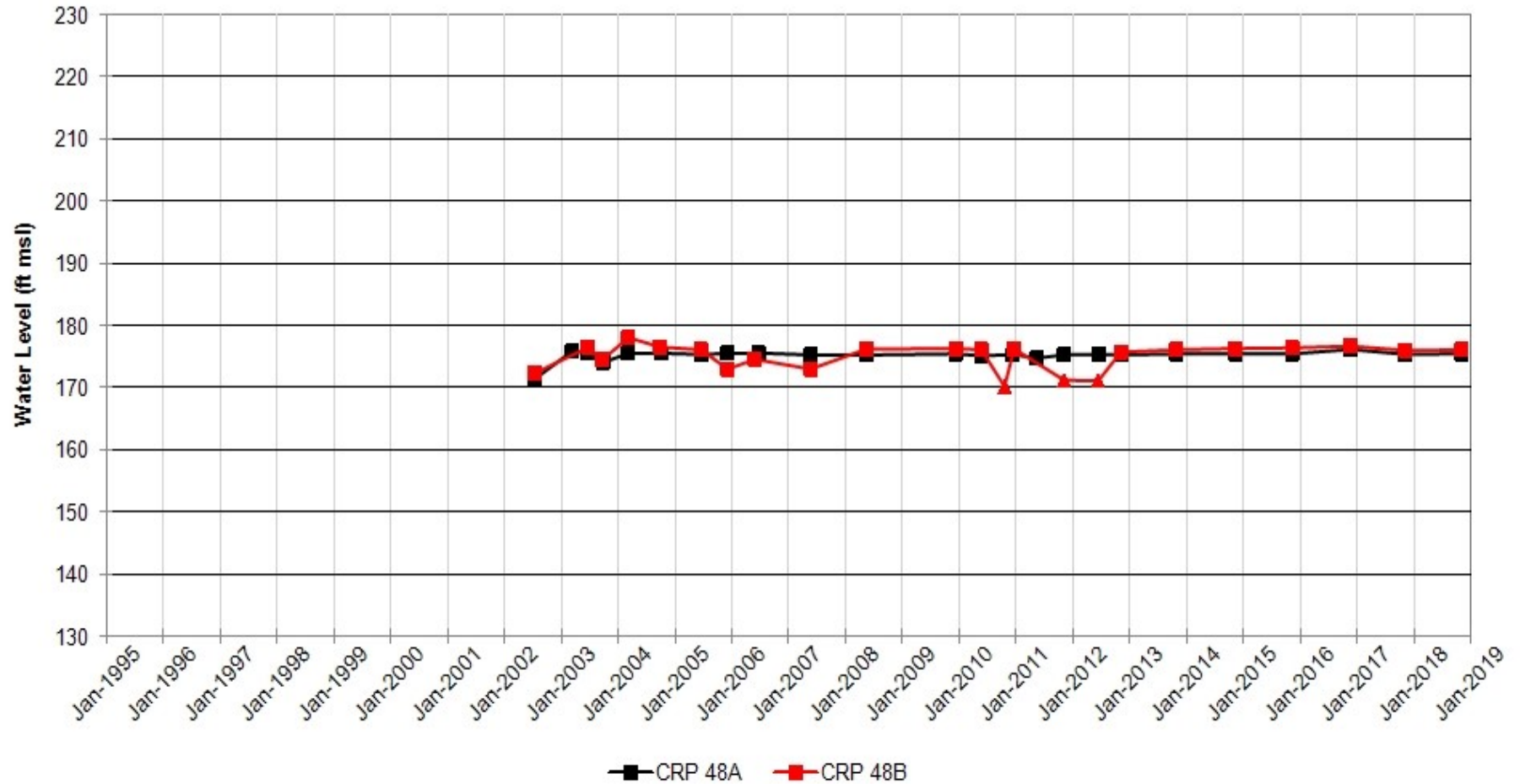


Figure B-11.

Hydrograph for Station CRP 50

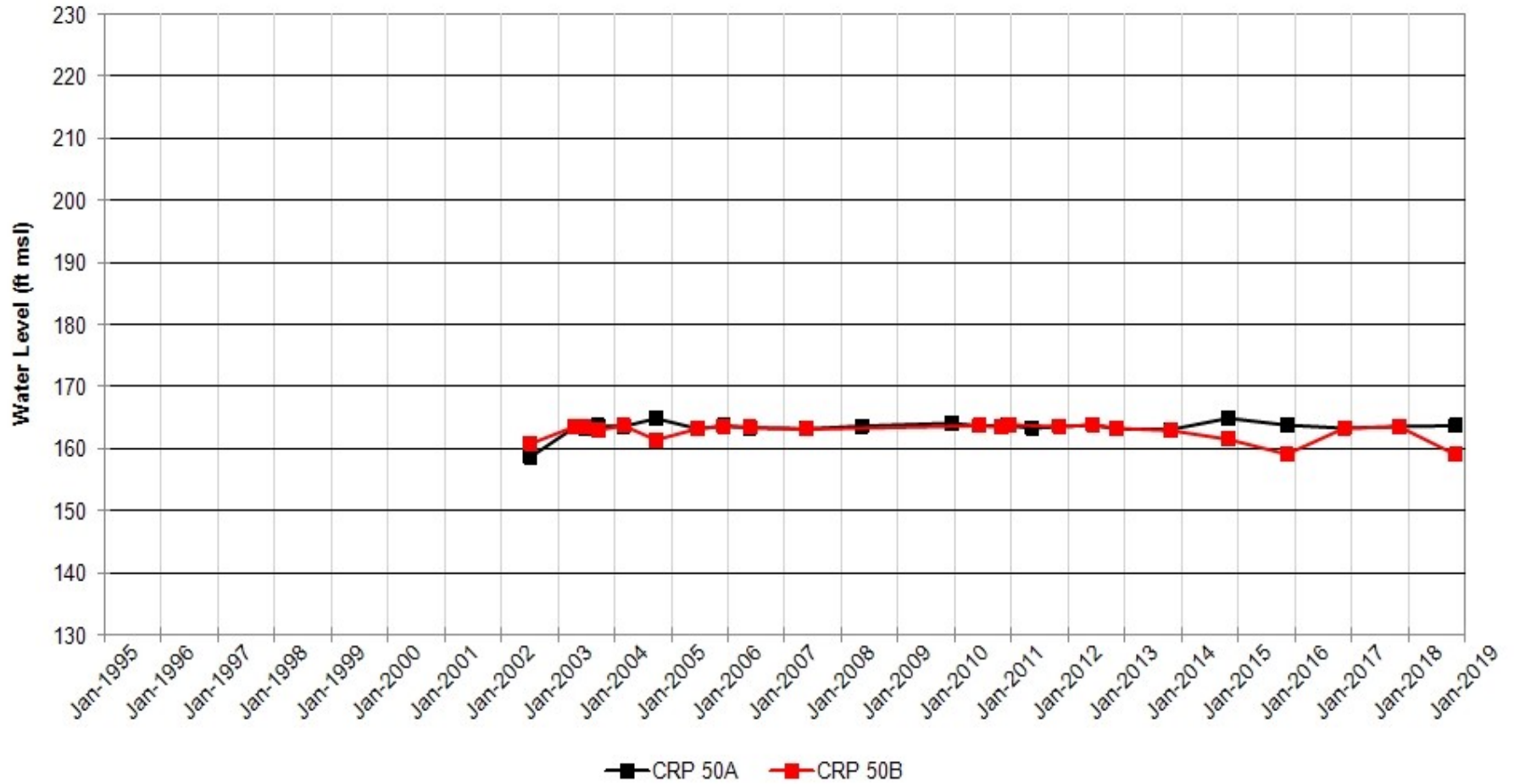


Figure B-12.

Hydrograph for Station CRP 51

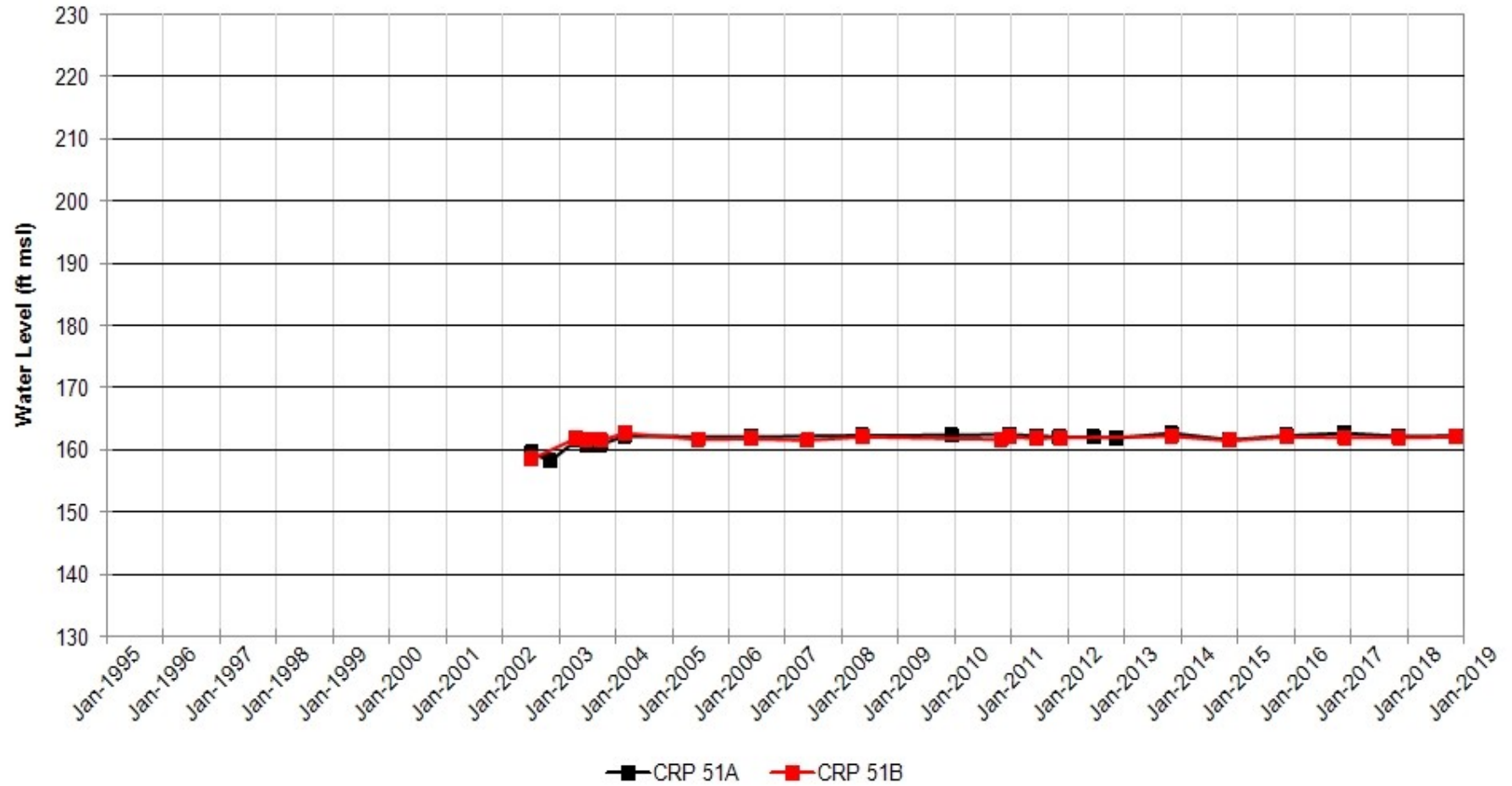


Figure B-13.

Hydrograph for Station CRP 52

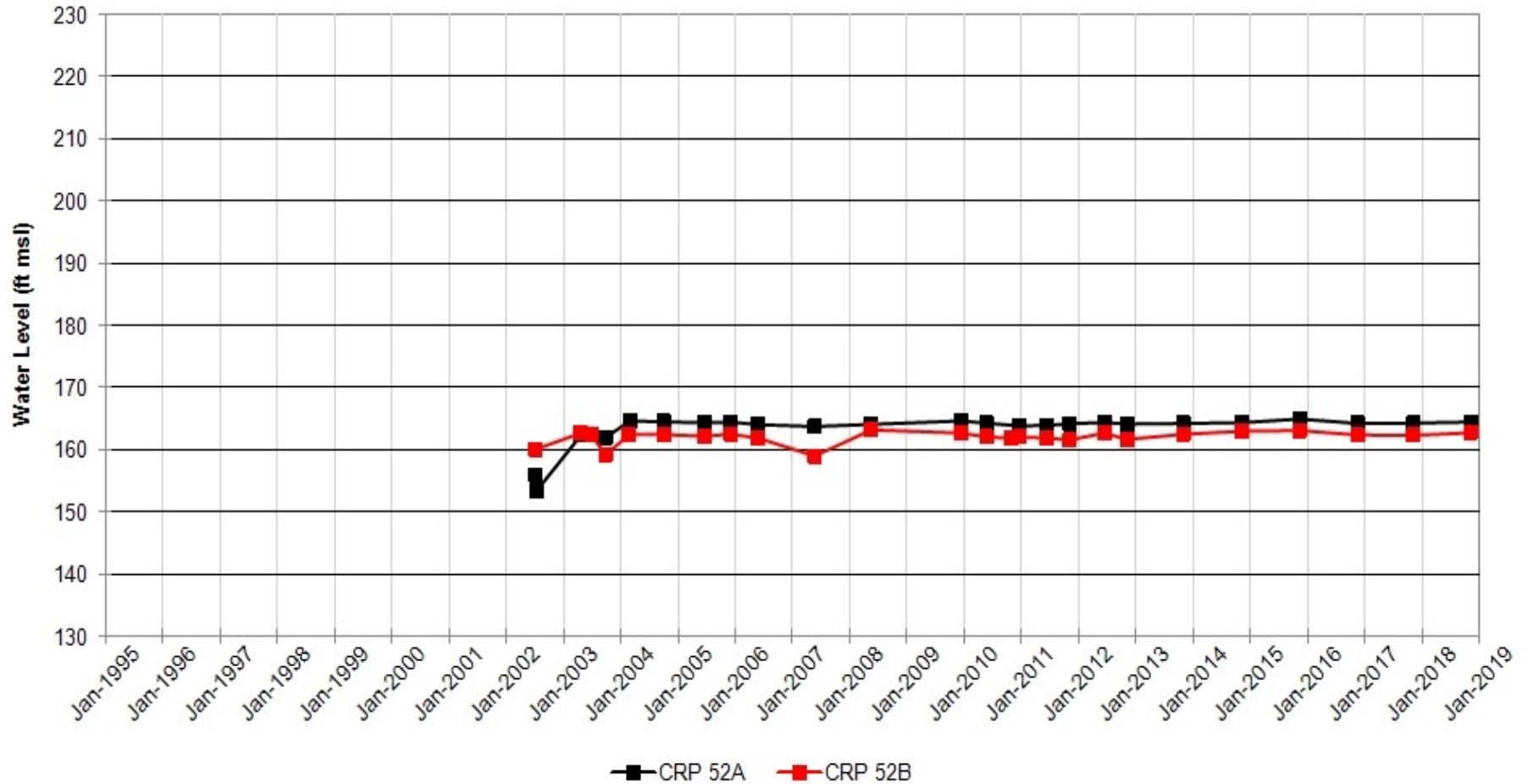


Figure B-14.

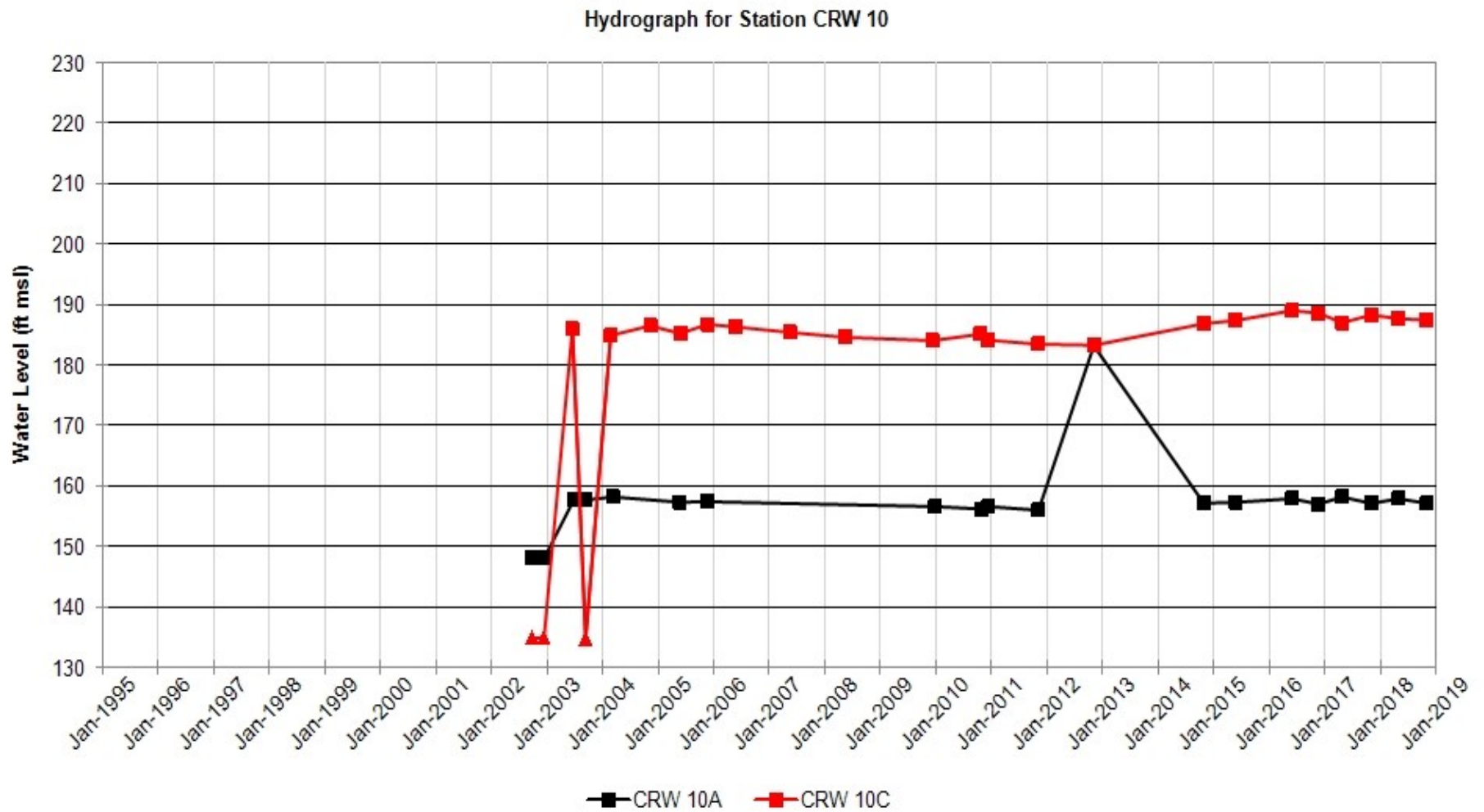


Figure B-15.

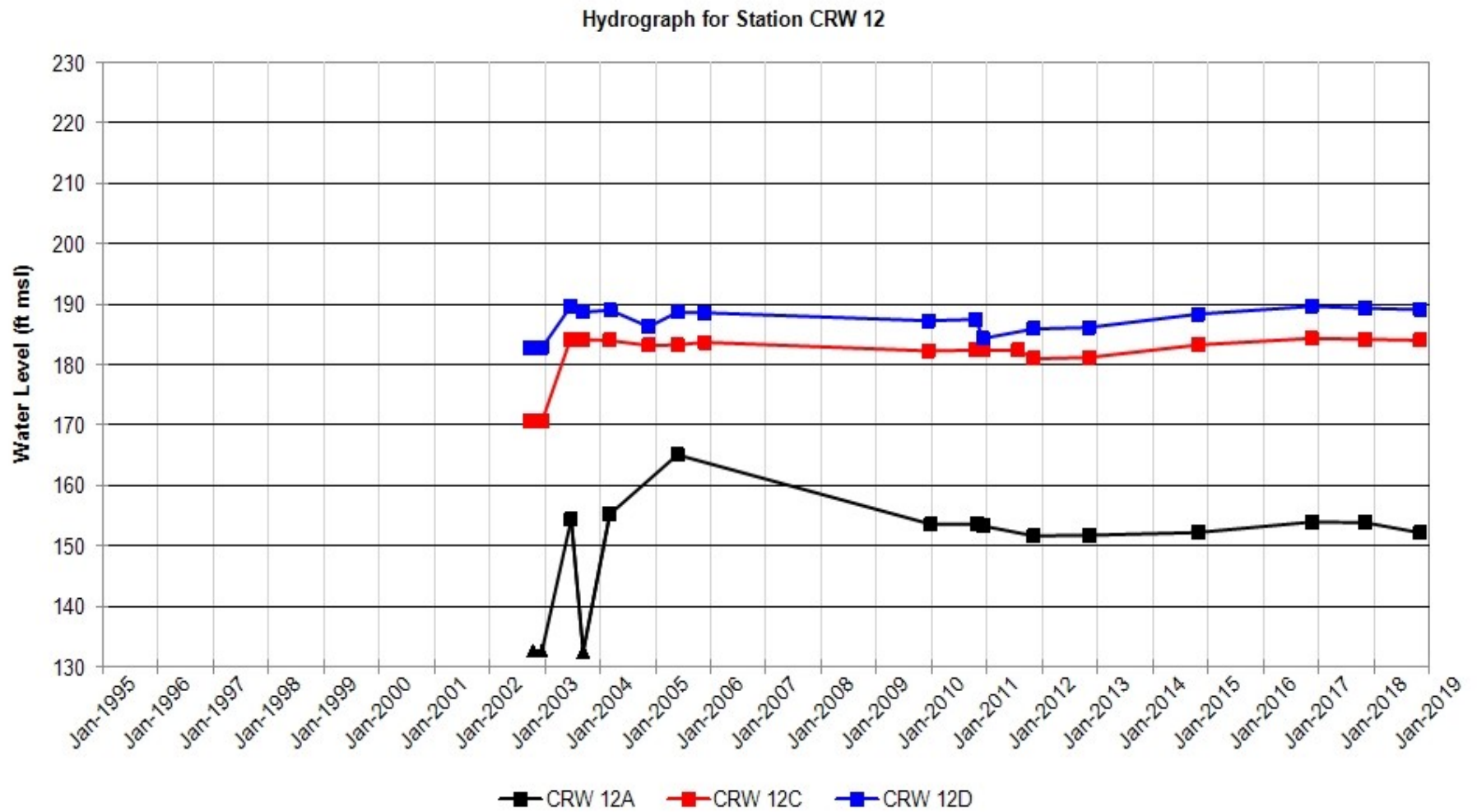
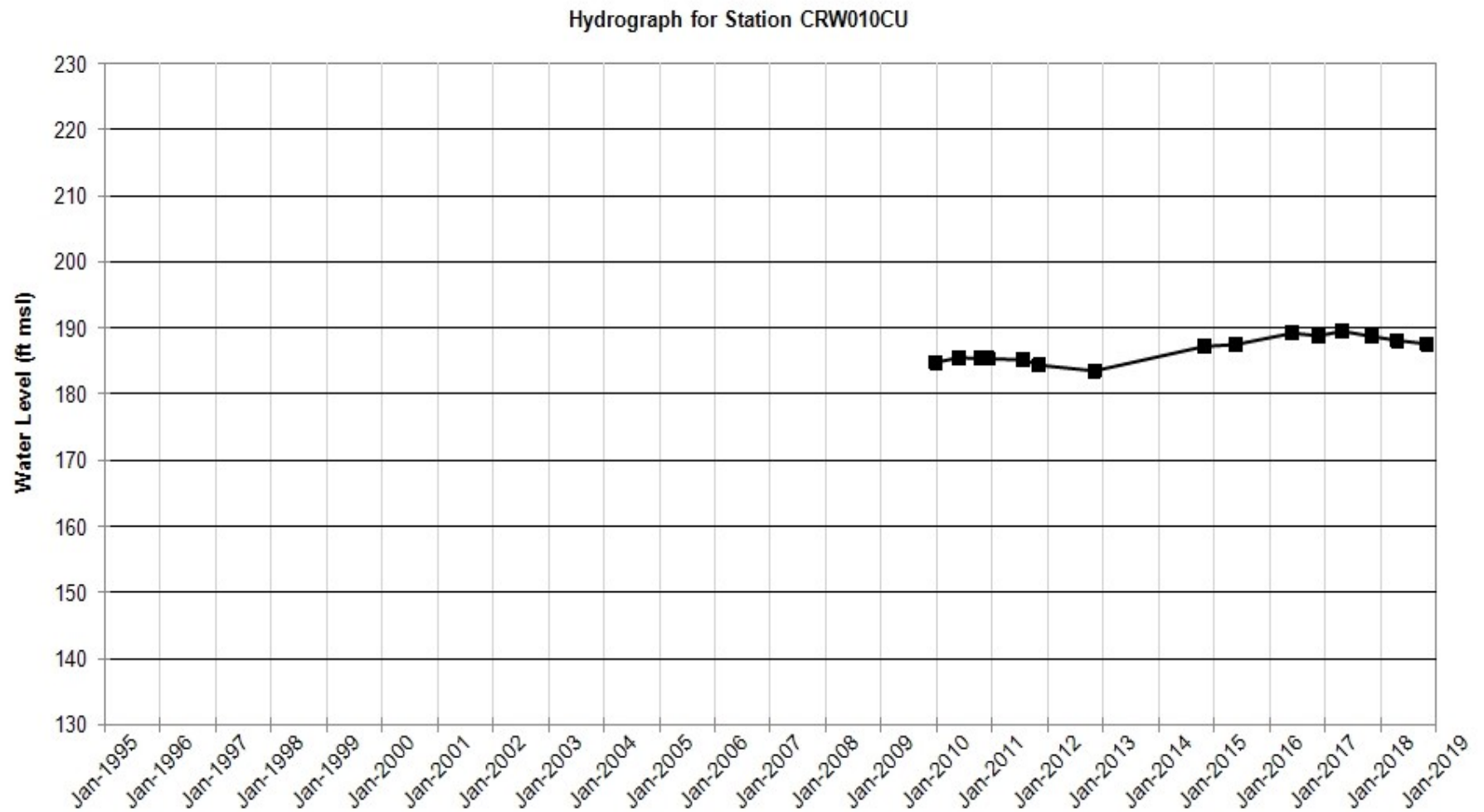


Figure B-16.



APPENDIX C

Time-Series Plots

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Figure C-1.

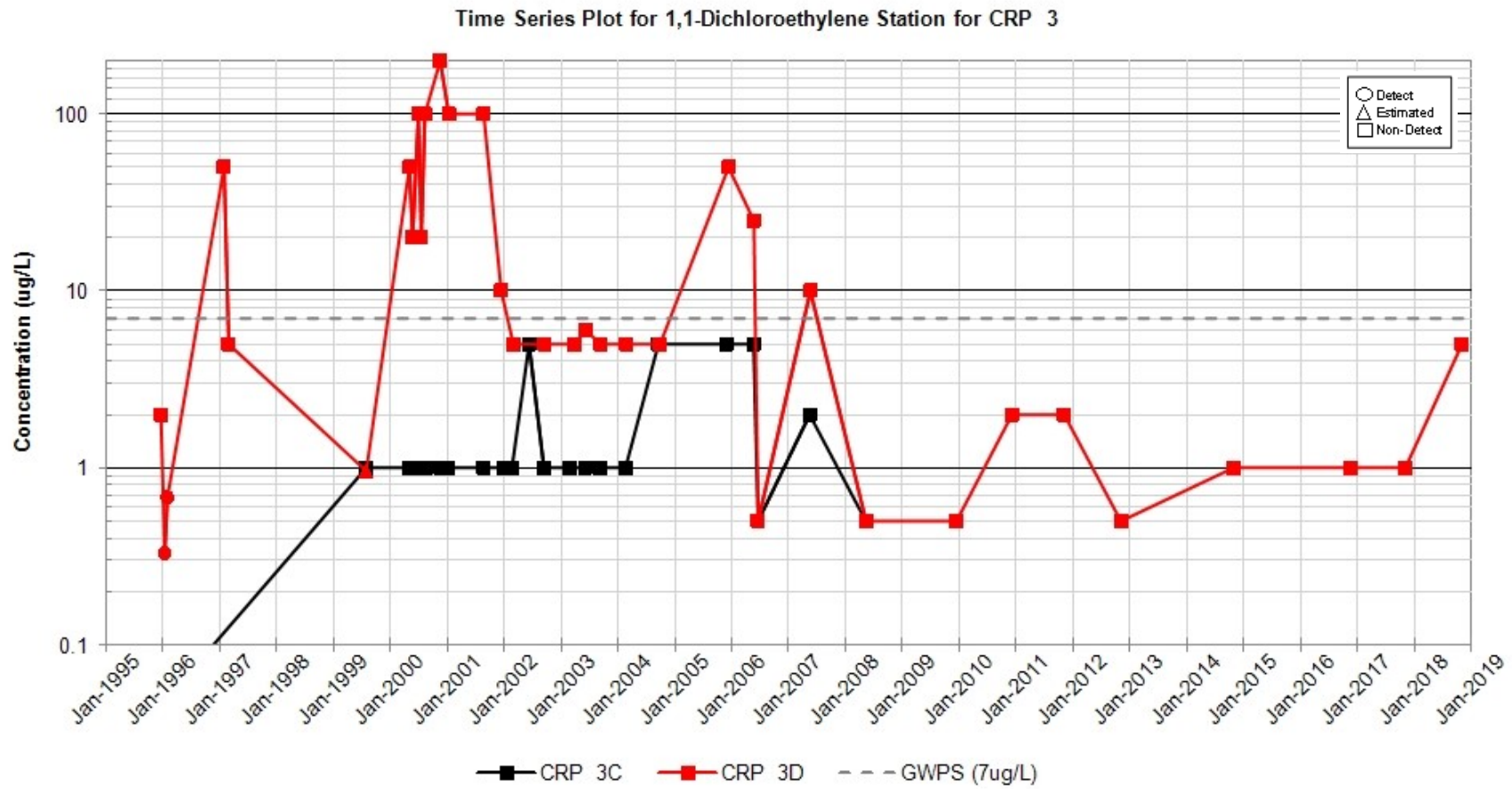


Figure C-2.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 5

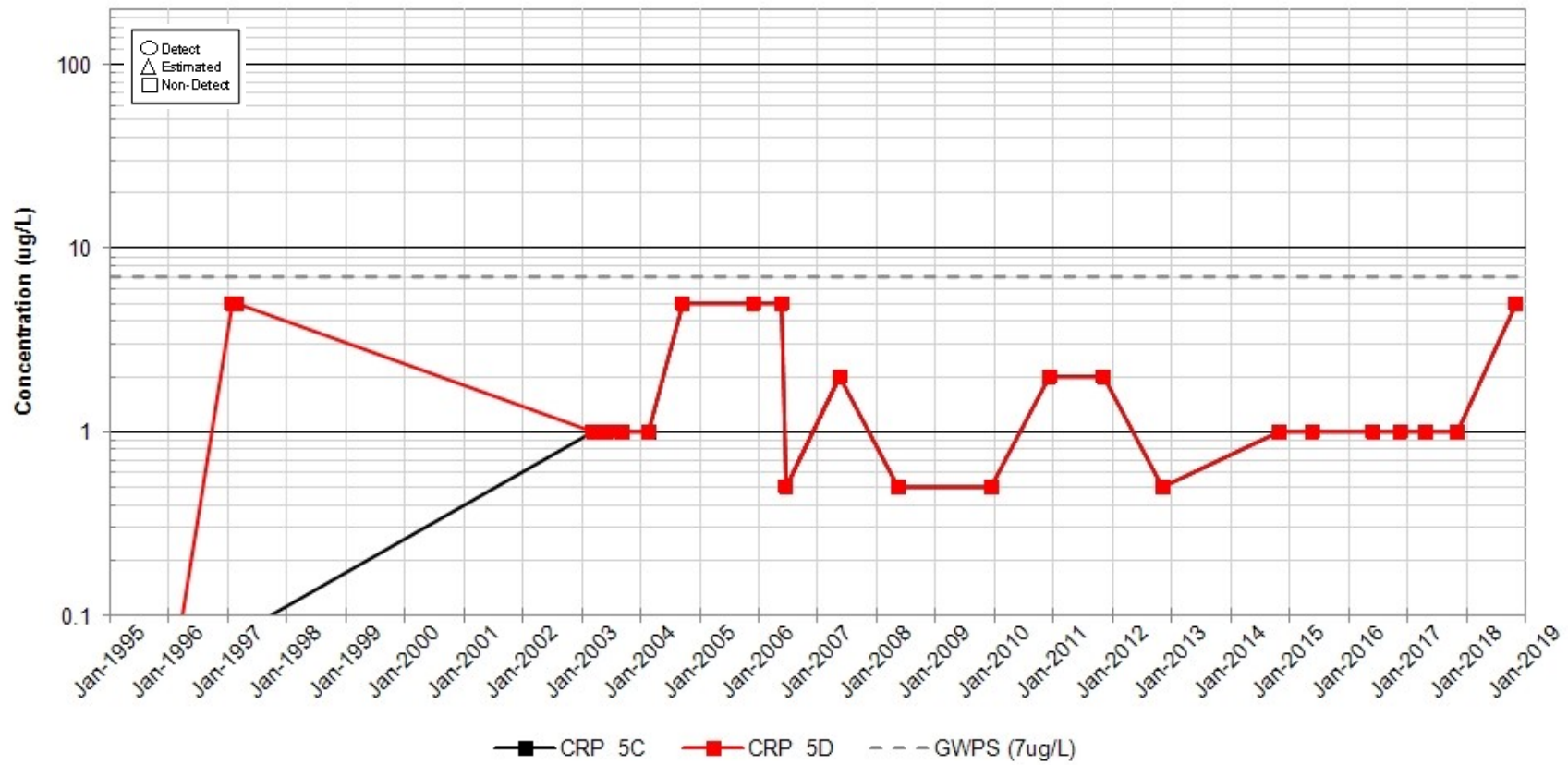


Figure C-3.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 6

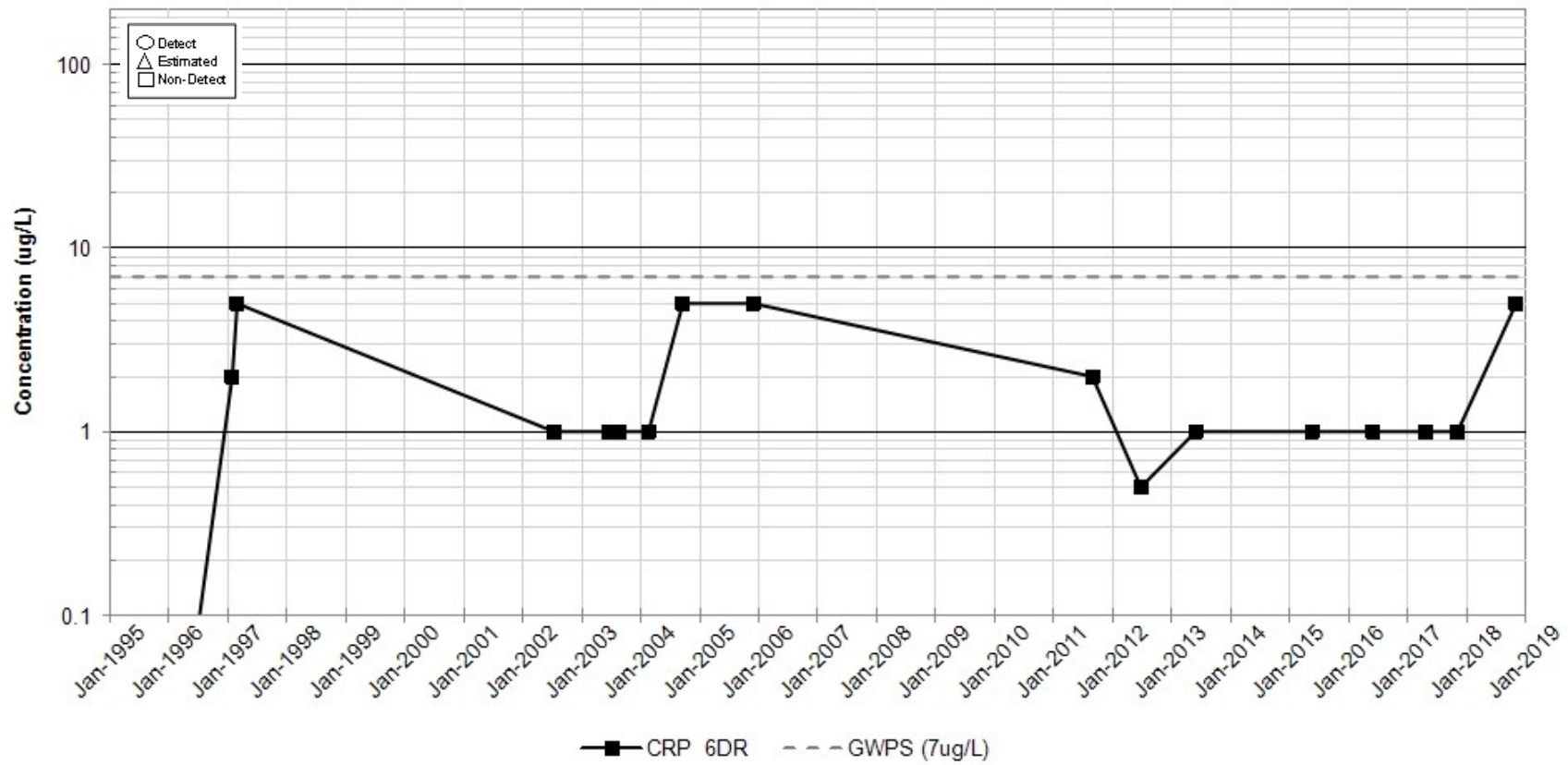


Figure C-4.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 8

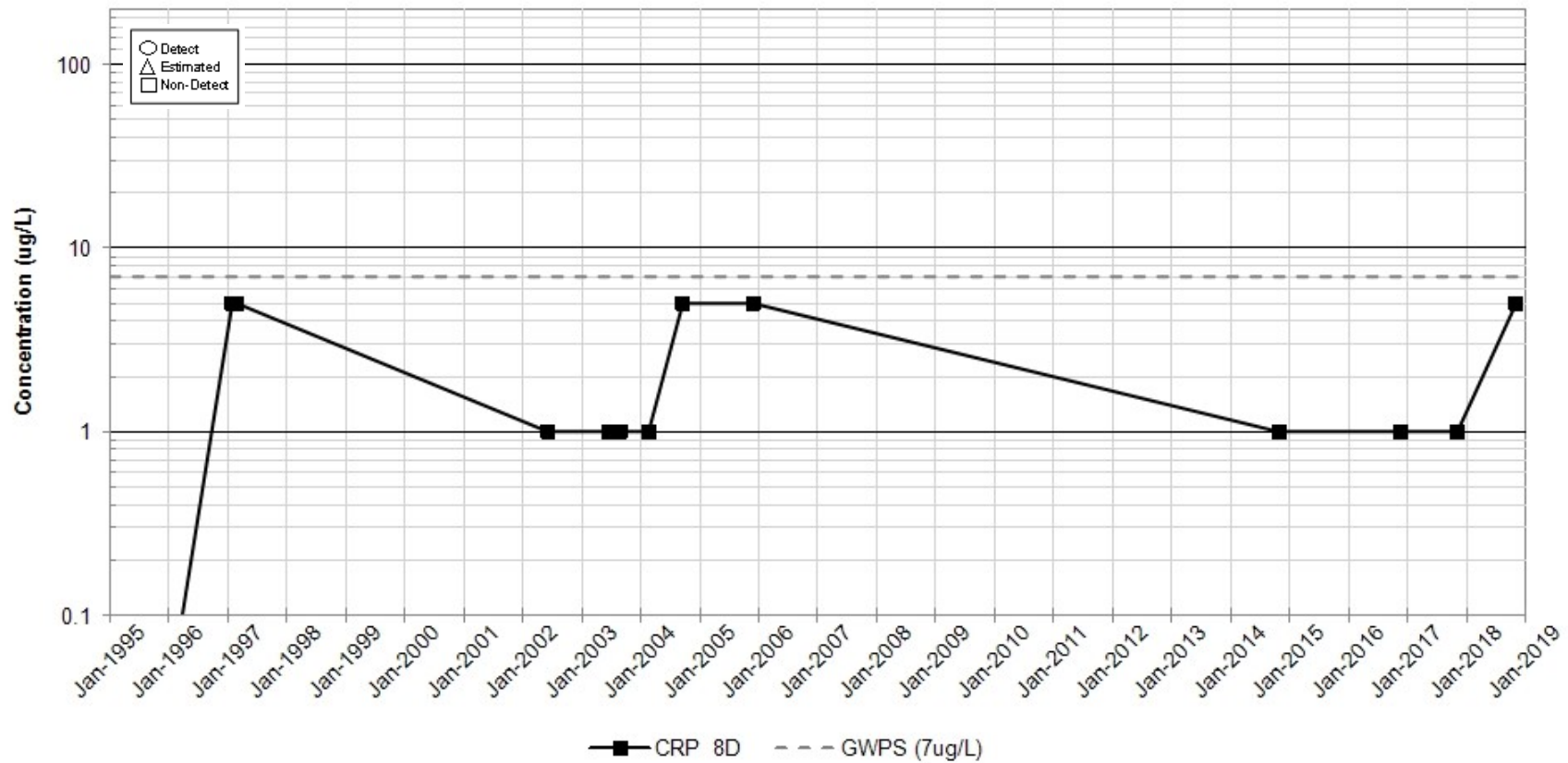


Figure C-5.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 18

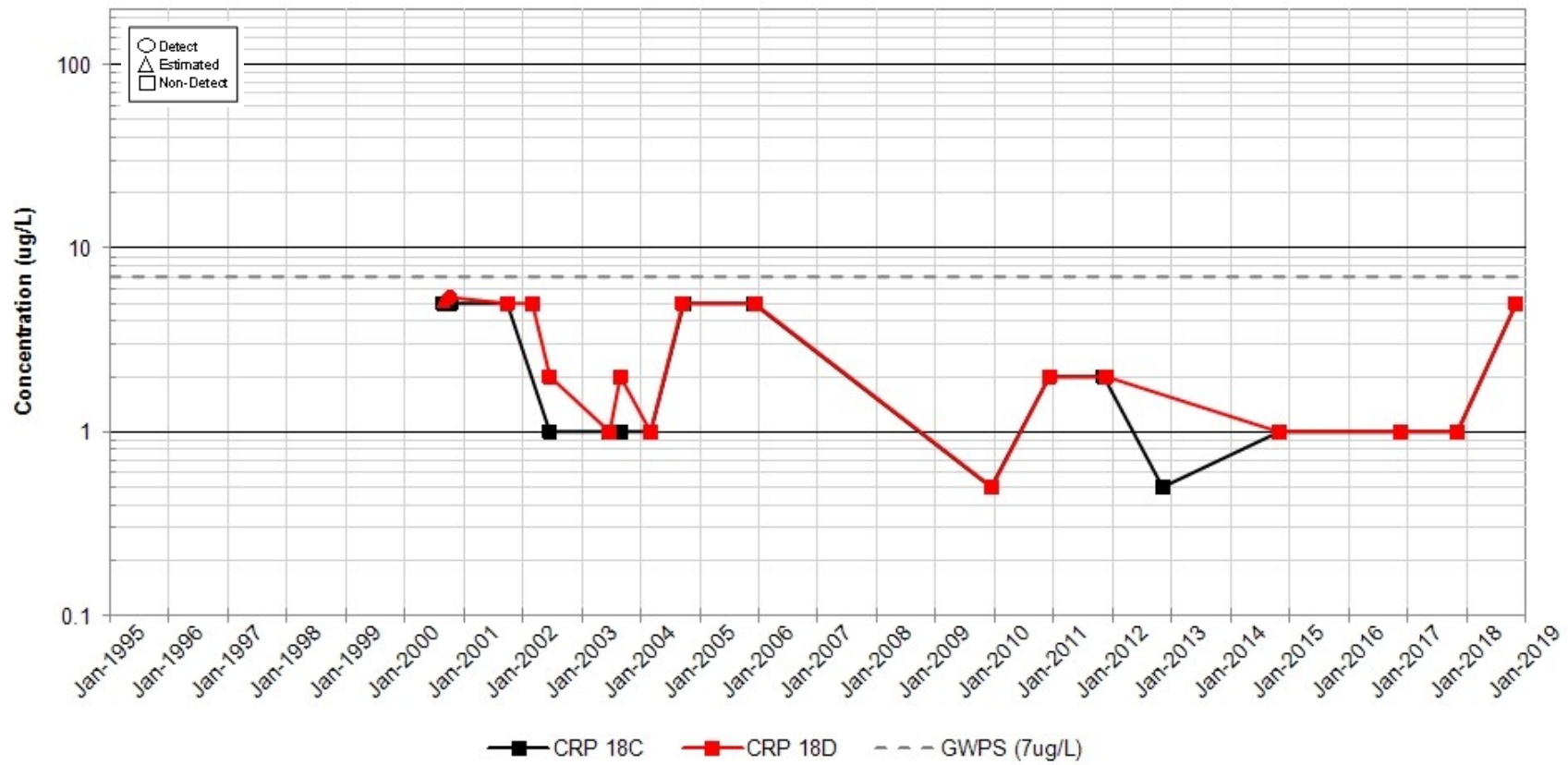


Figure C-6.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 20

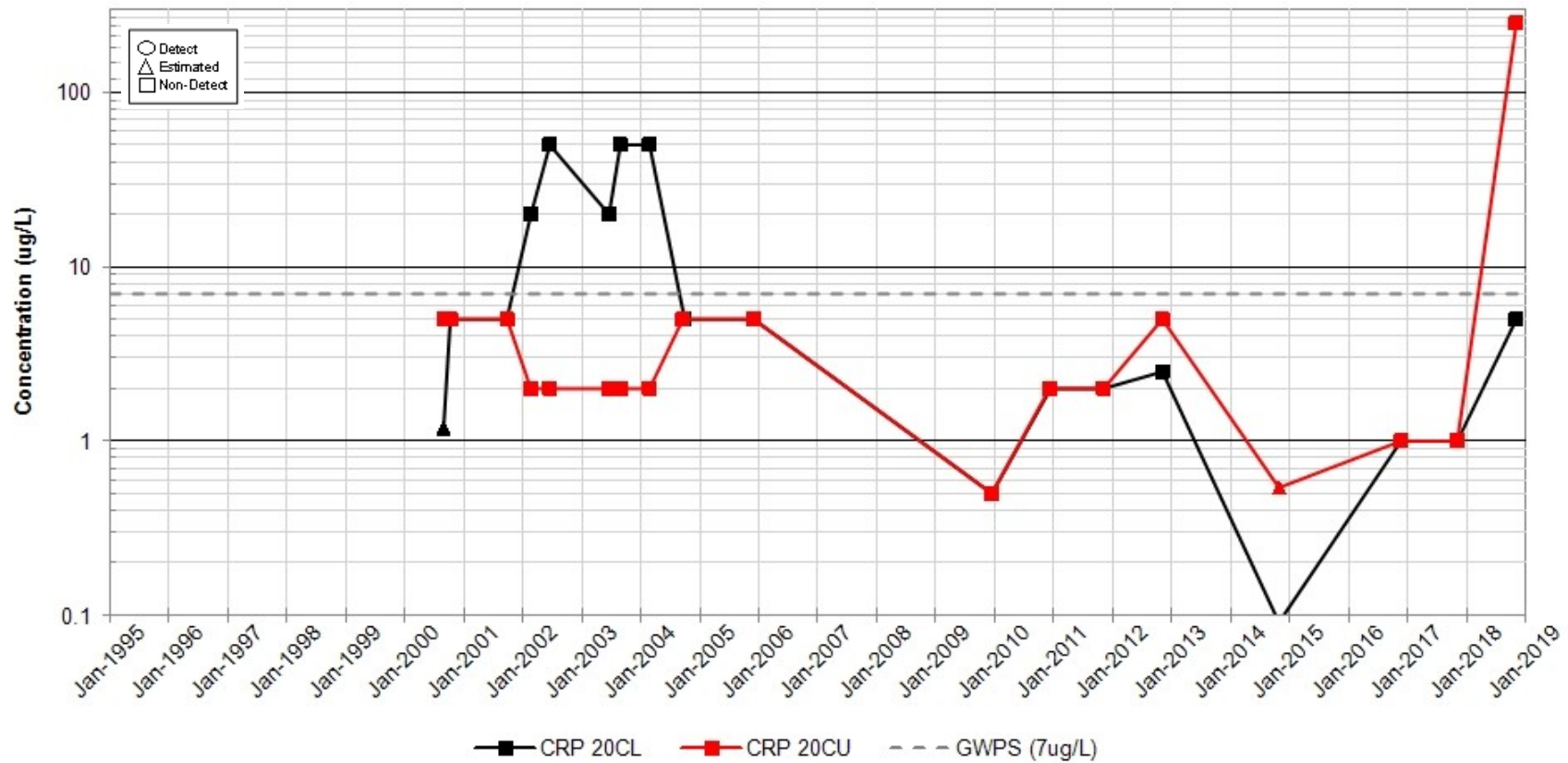


Figure C-7.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 22

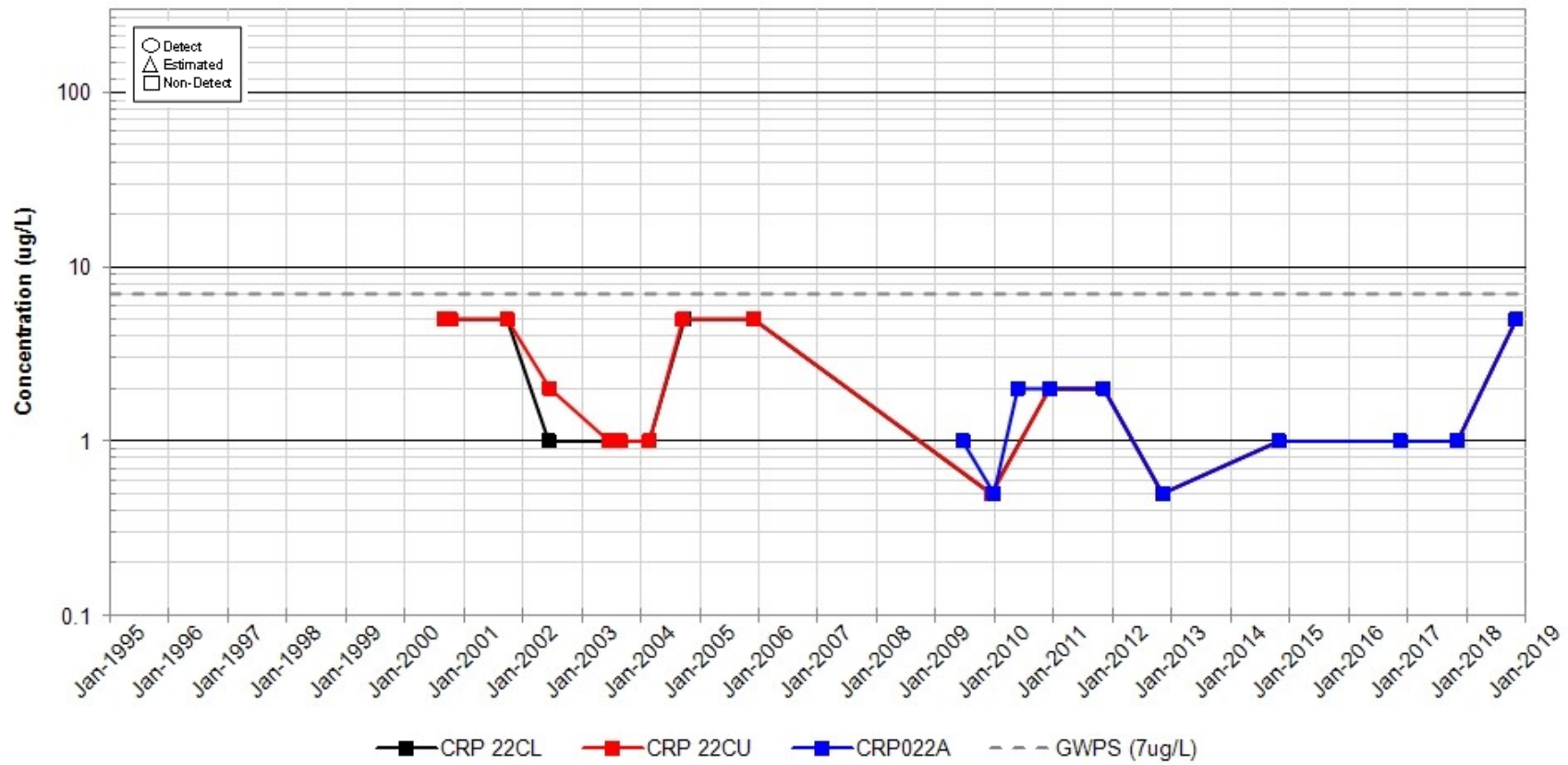


Figure C-8.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 45

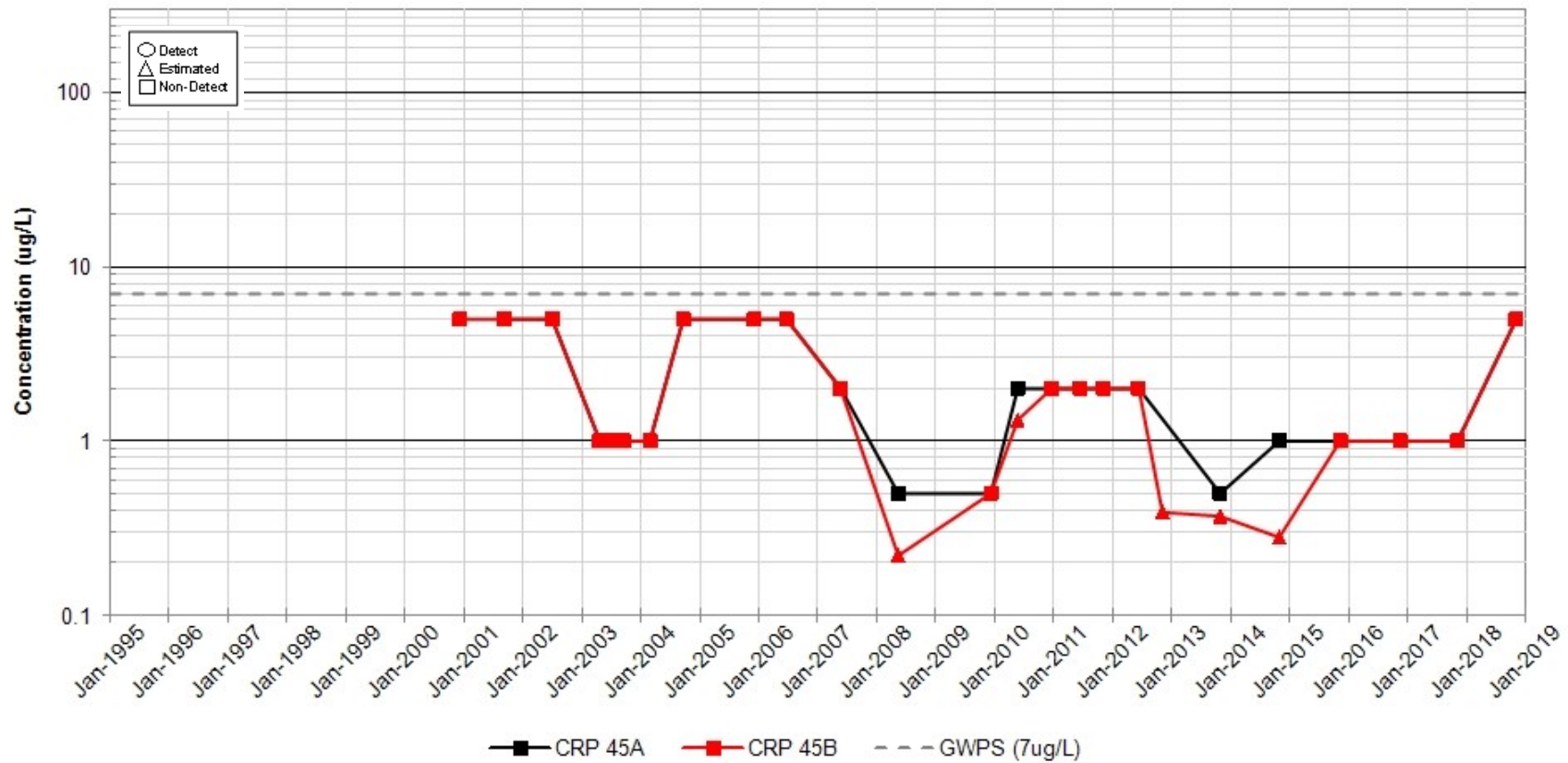


Figure C-9.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 46

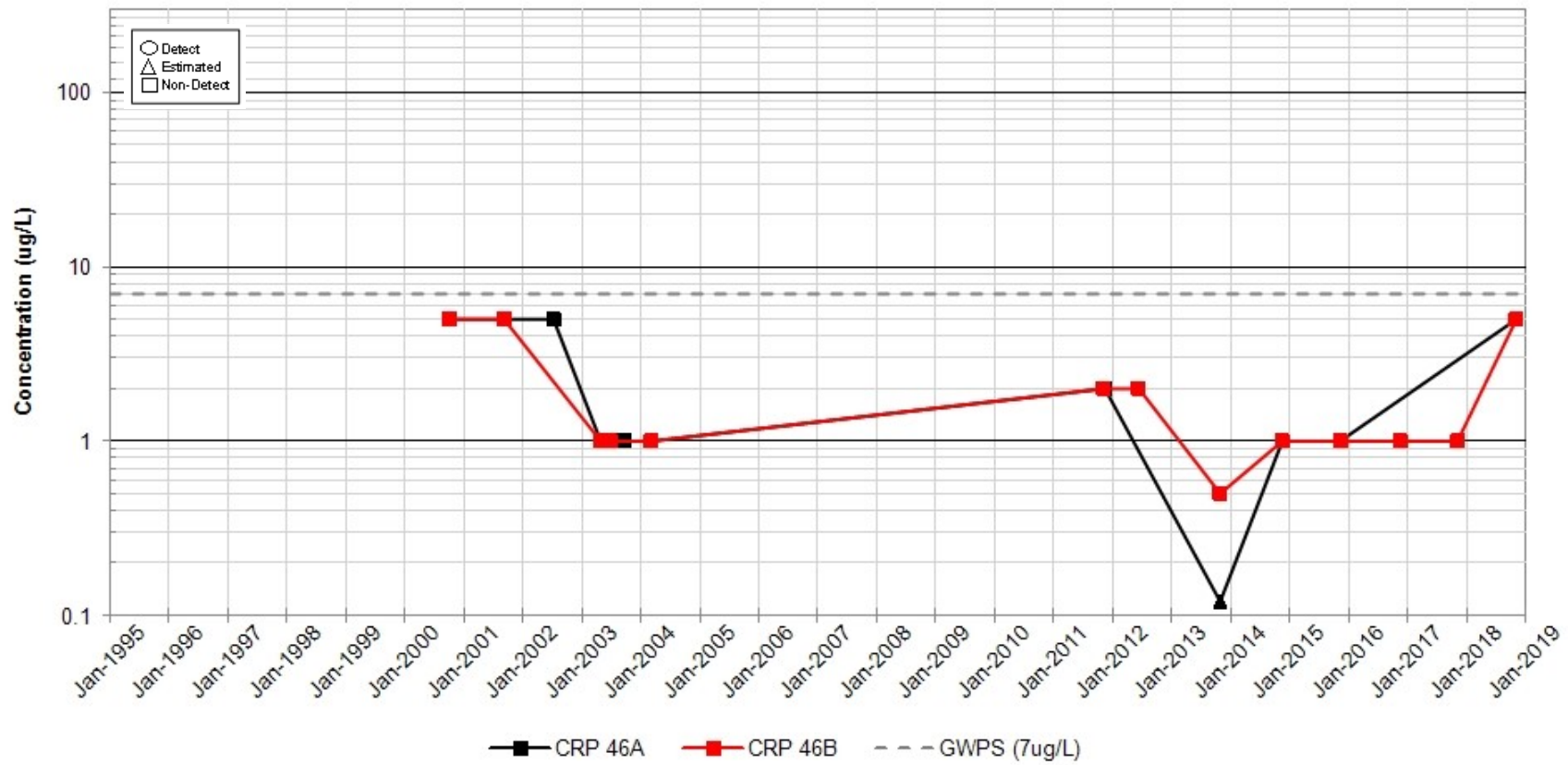


Figure C-10.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 48

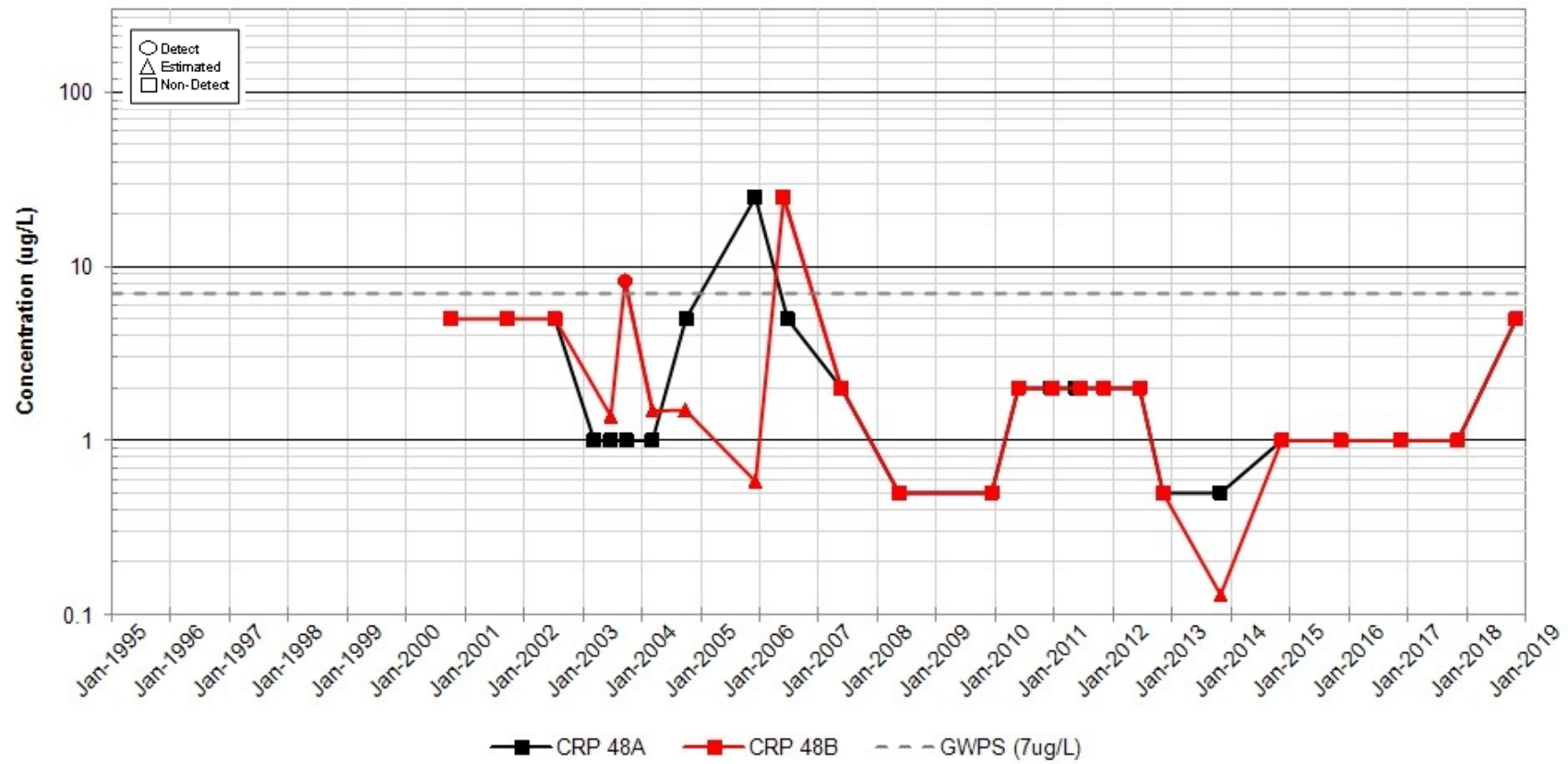


Figure C-11.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 50

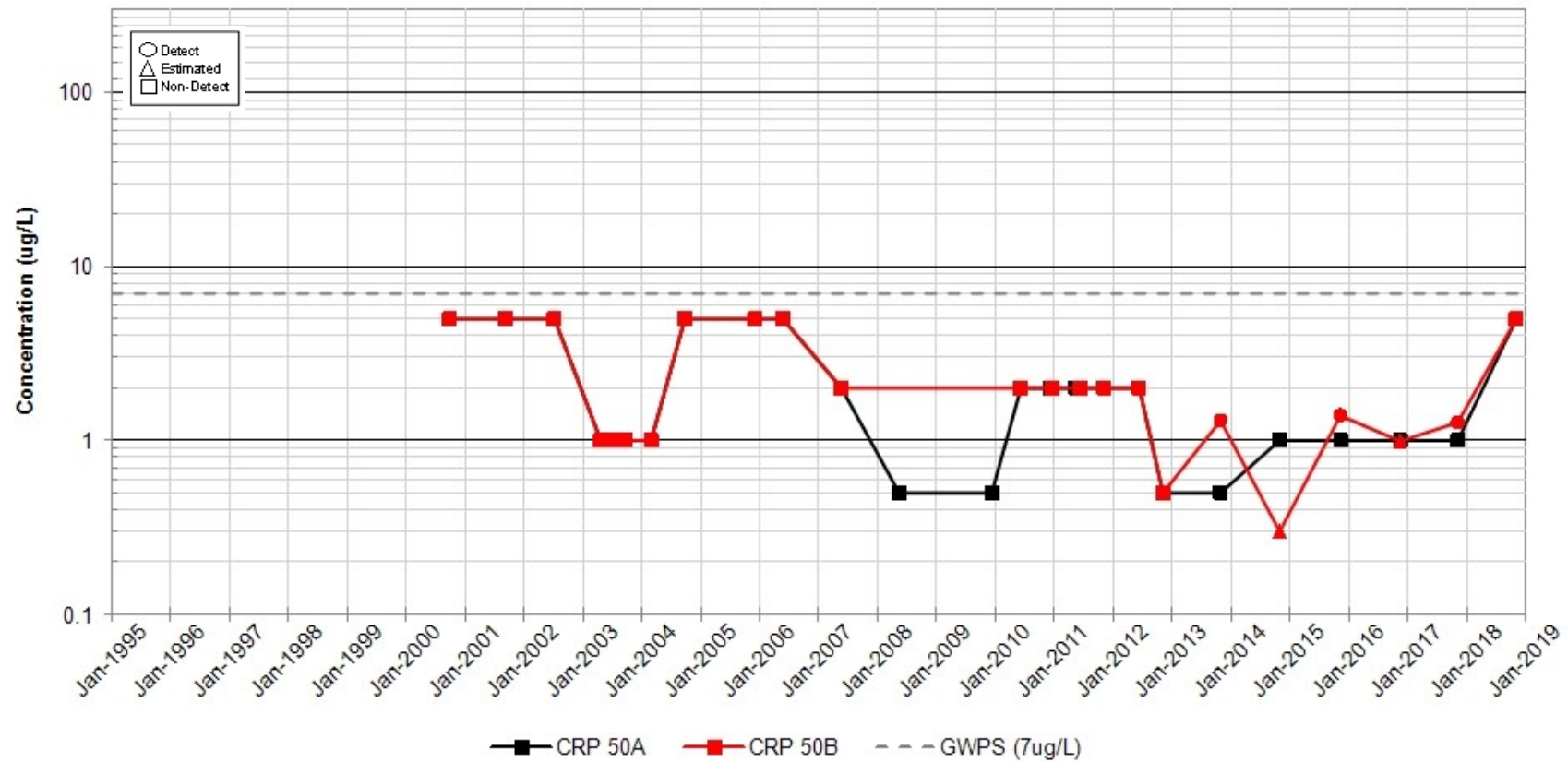


Figure C-12.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 51

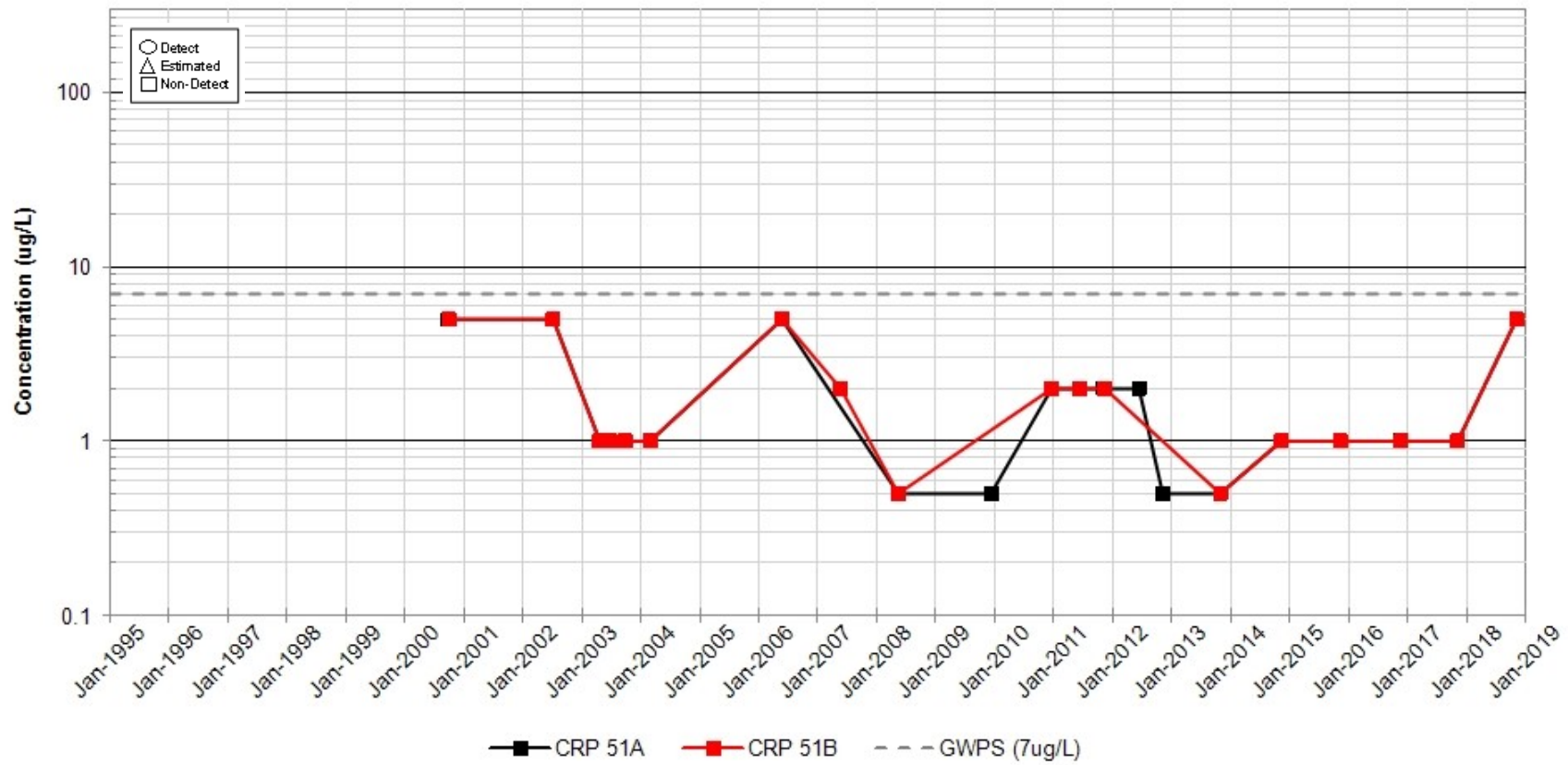


Figure C-13.

Time Series Plot for 1,1-Dichloroethylene Station for CRP 52

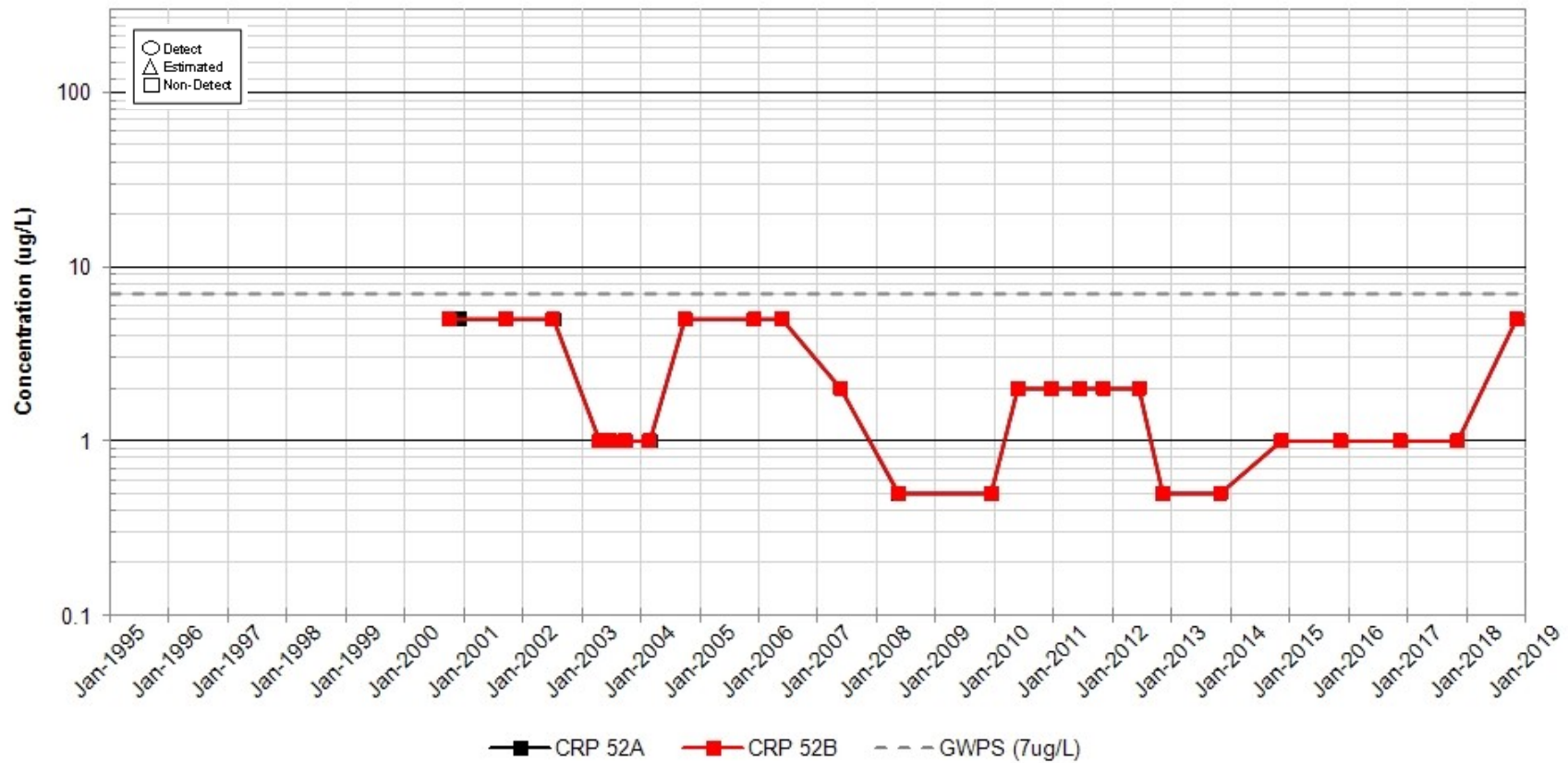


Figure C-14.

Time Series Plot for 1,1-Dichloroethylene Station for CRW 10

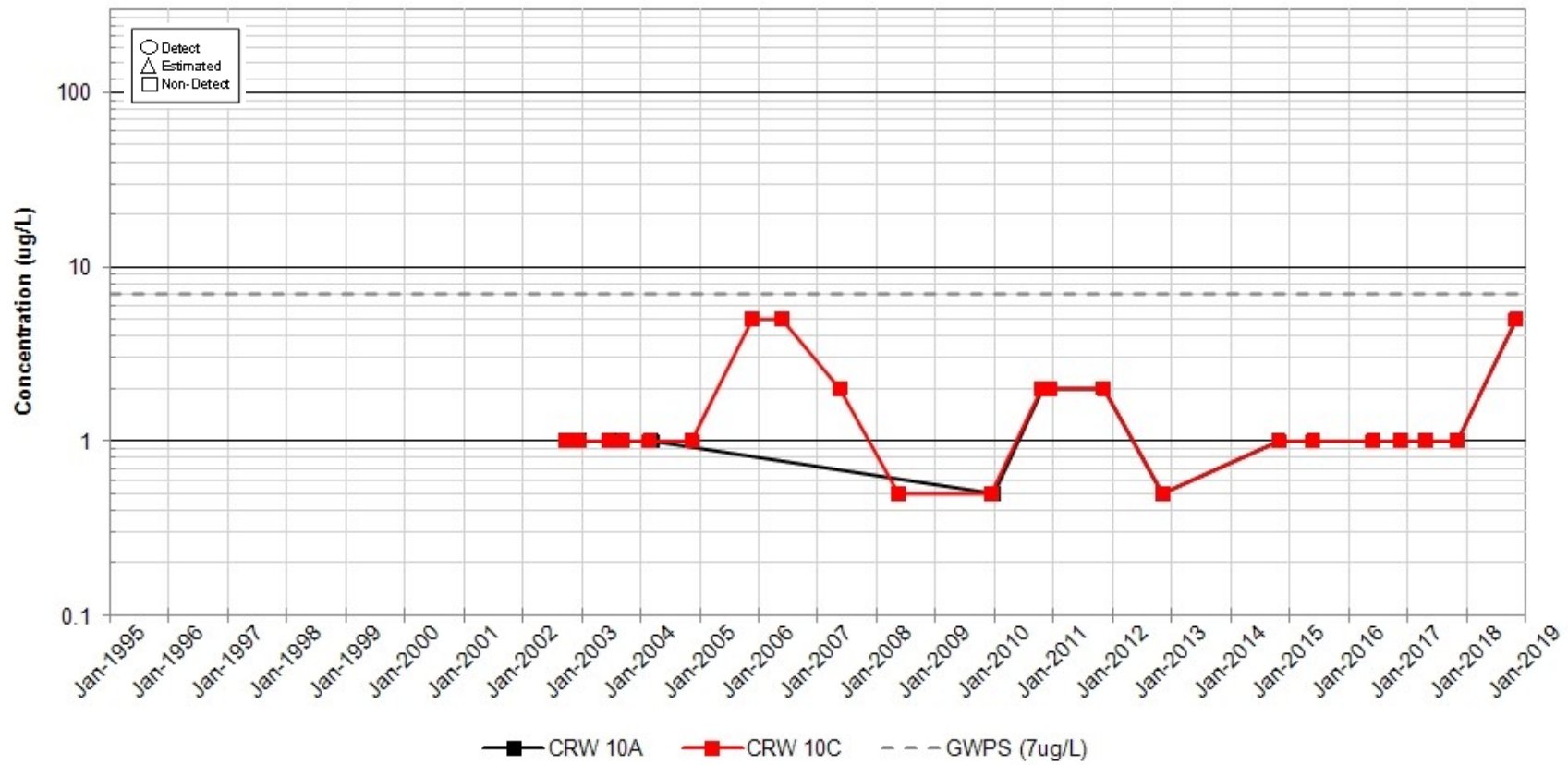


Figure C-15.

Time Series Plot for 1,1-Dichloroethylene Station for CRW 12

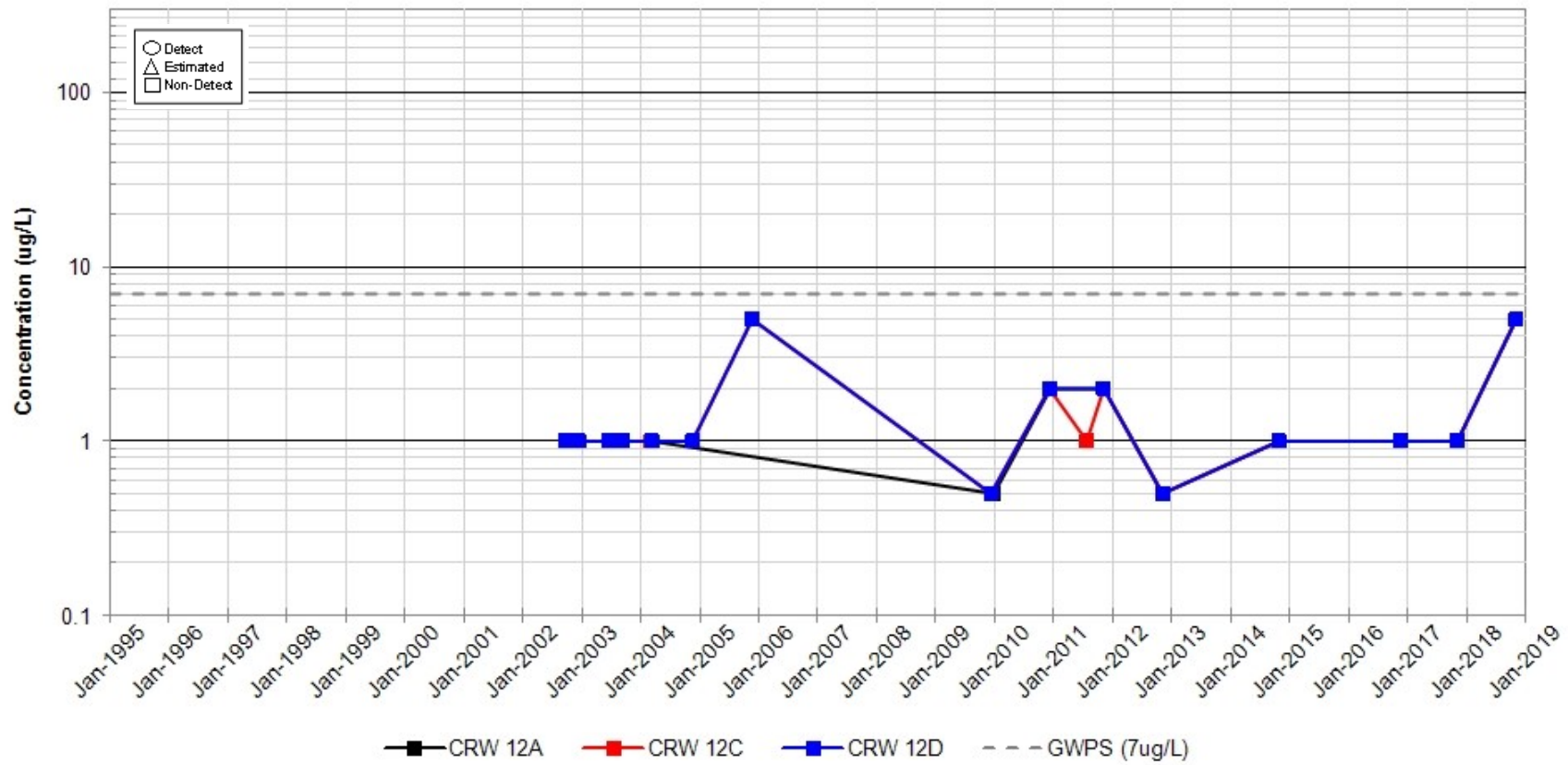


Figure C-16.

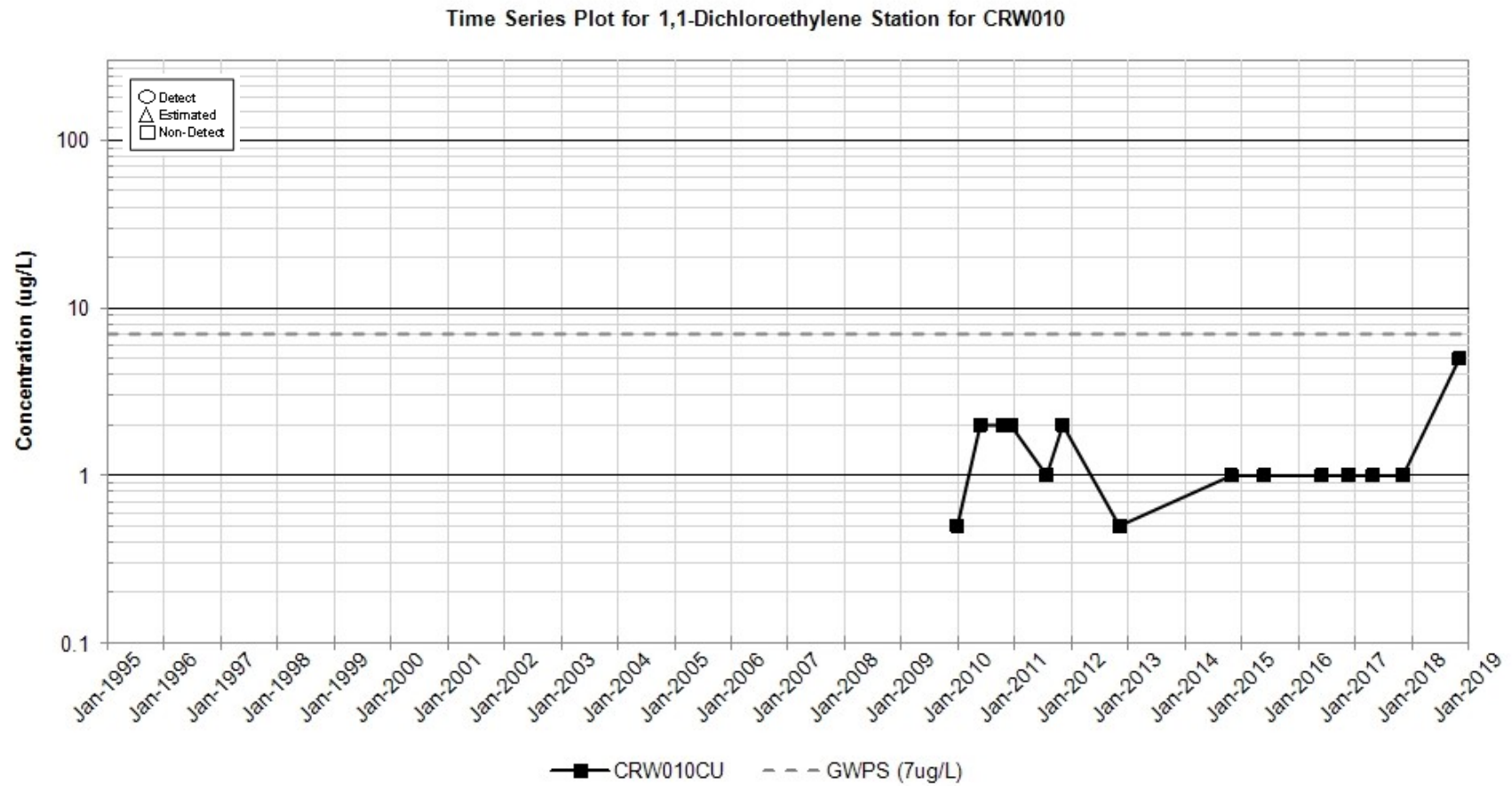


Figure C-17.

Time Series Plot for 1,1-Dichloroethylene Station for TL 01

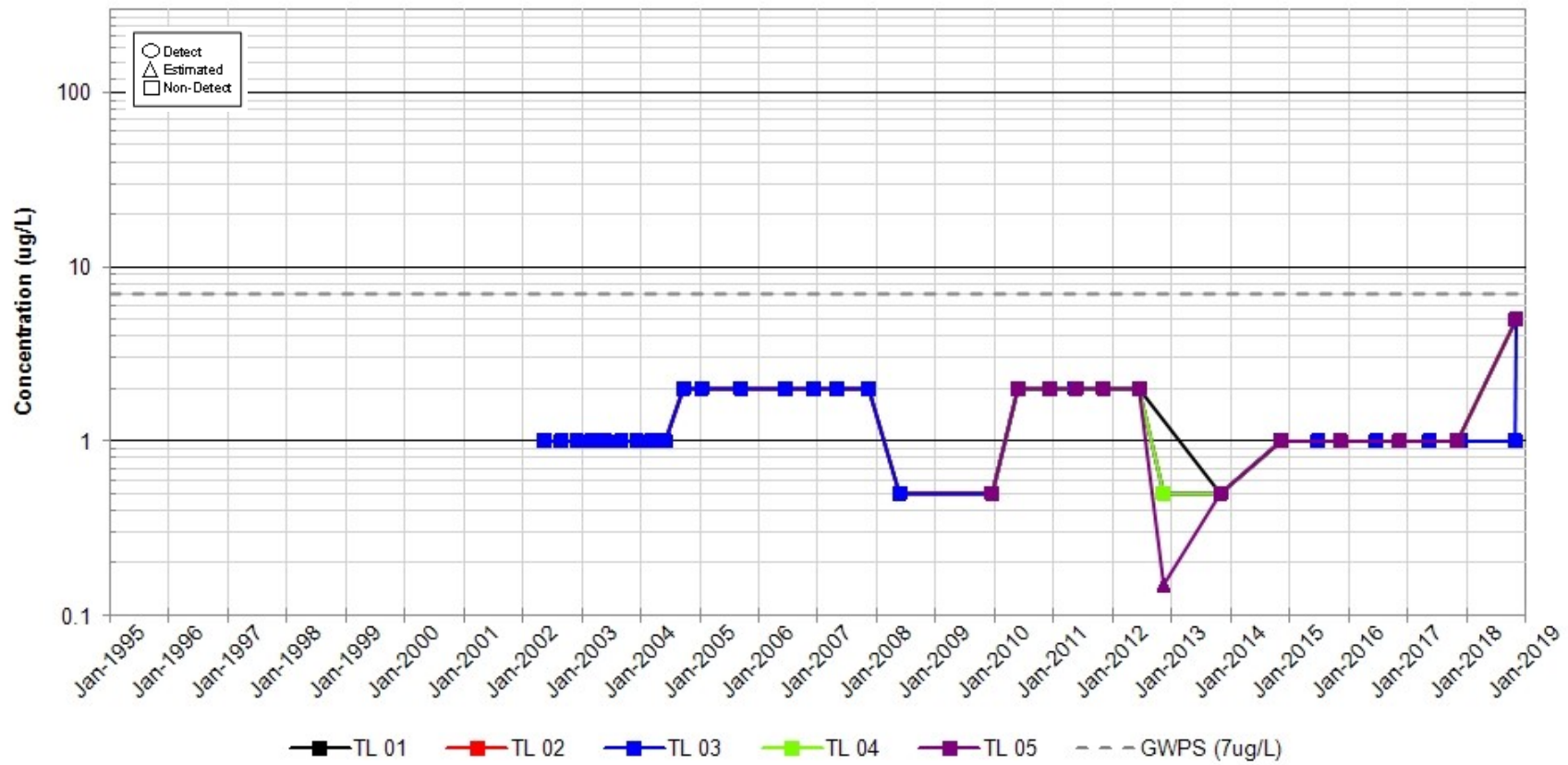


Figure C-18.

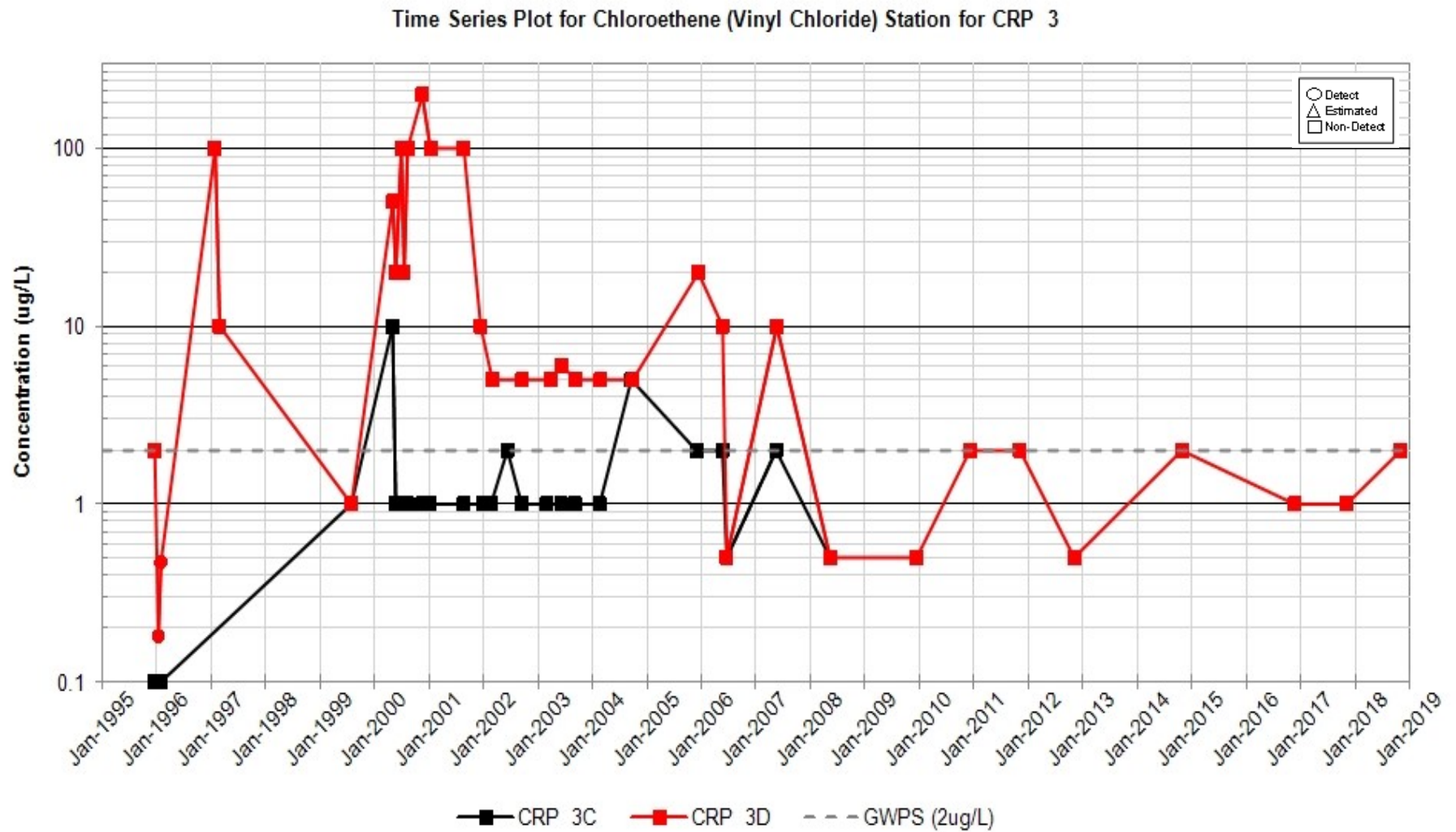


Figure C-19.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 5

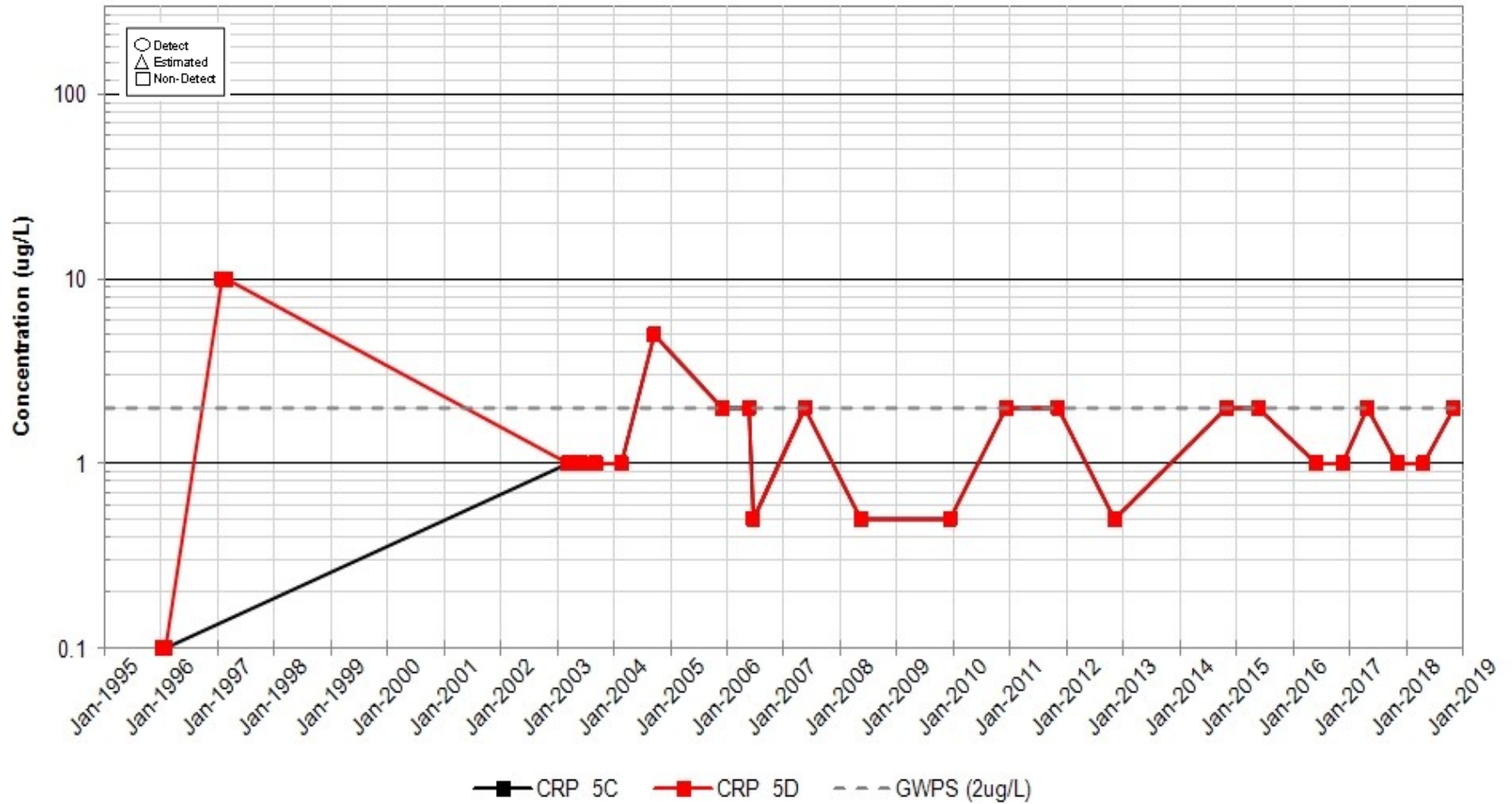


Figure C-20.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 6

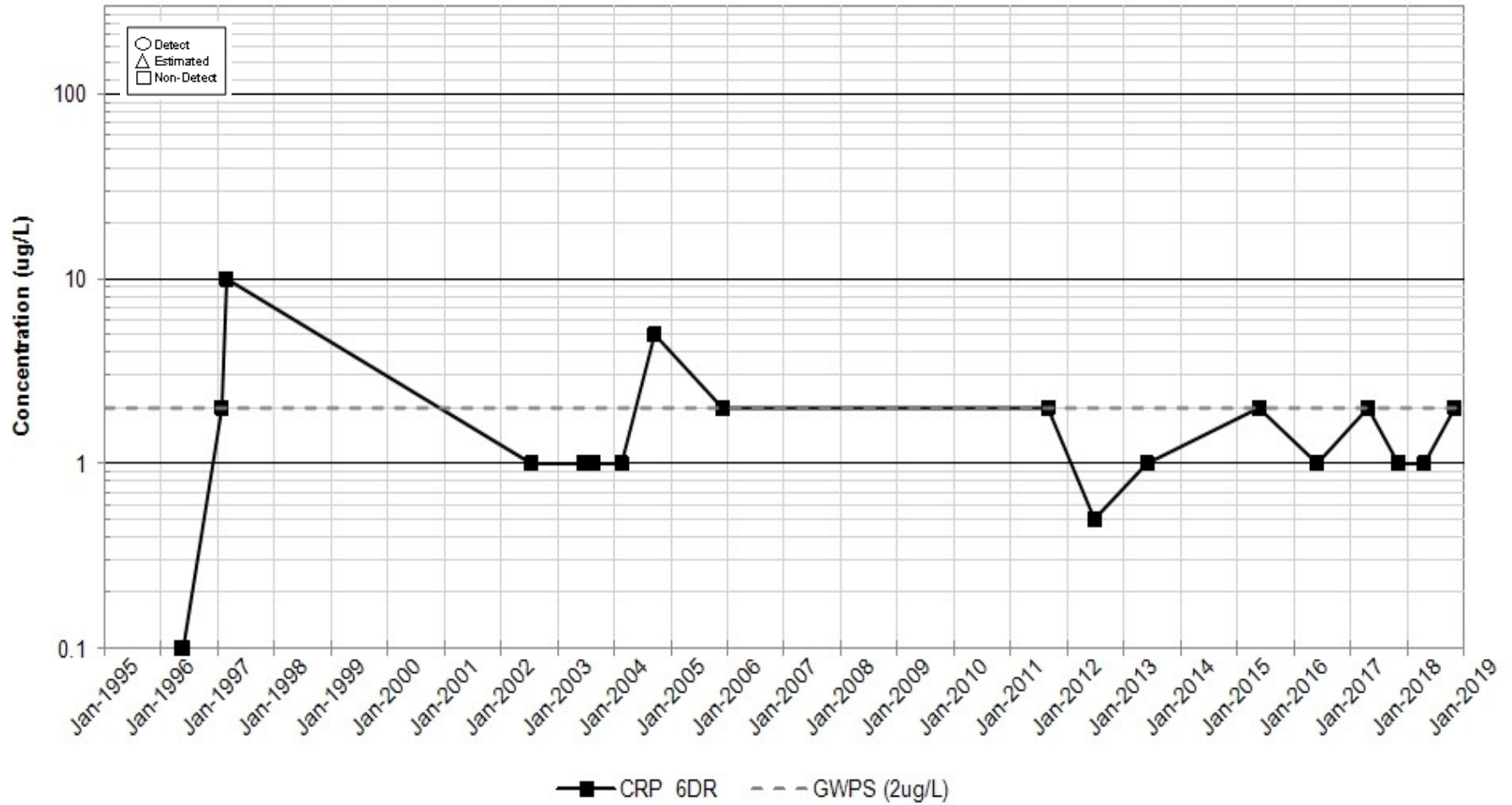


Figure C-21.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 8

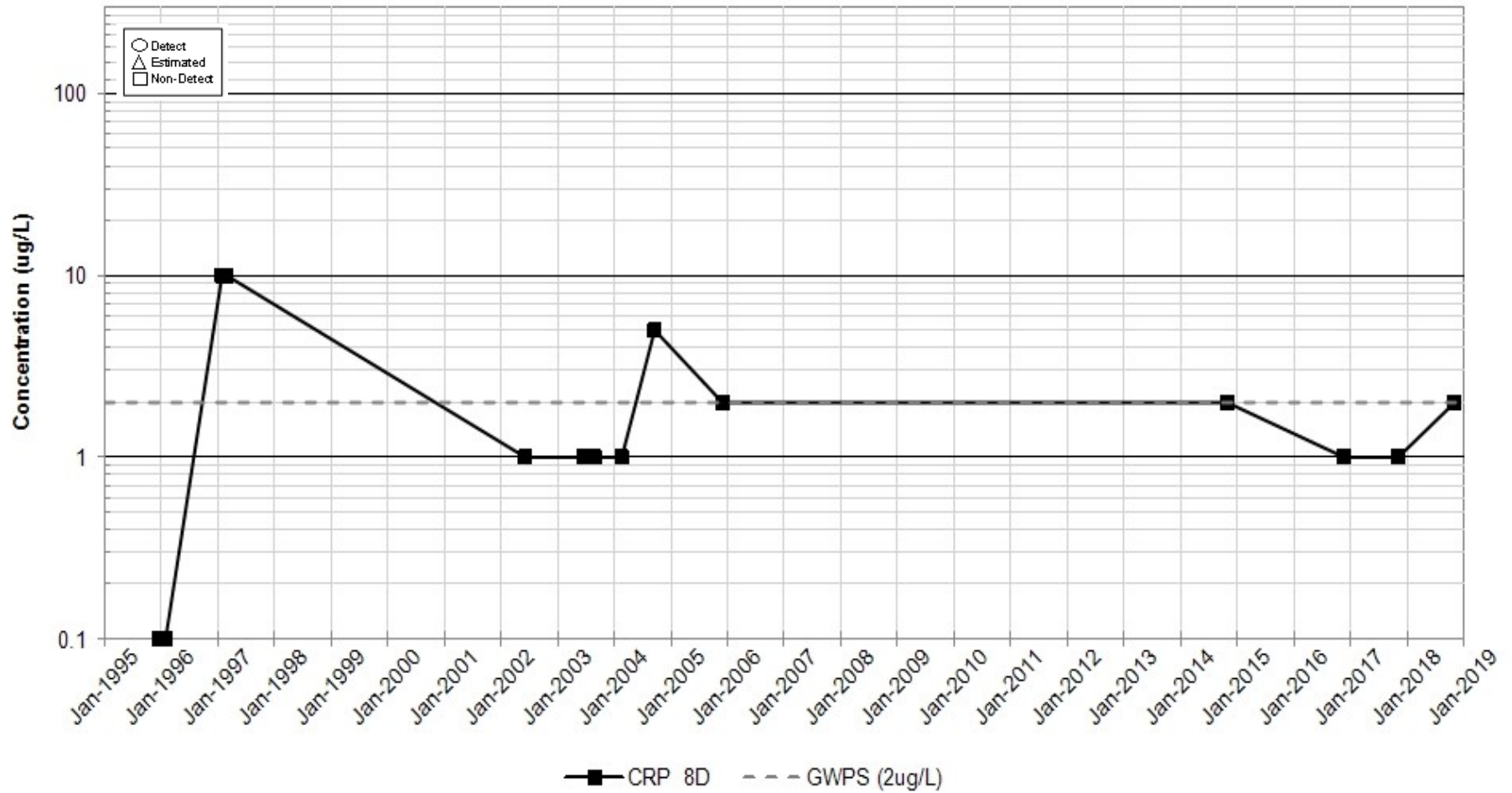


Figure C-22.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 18

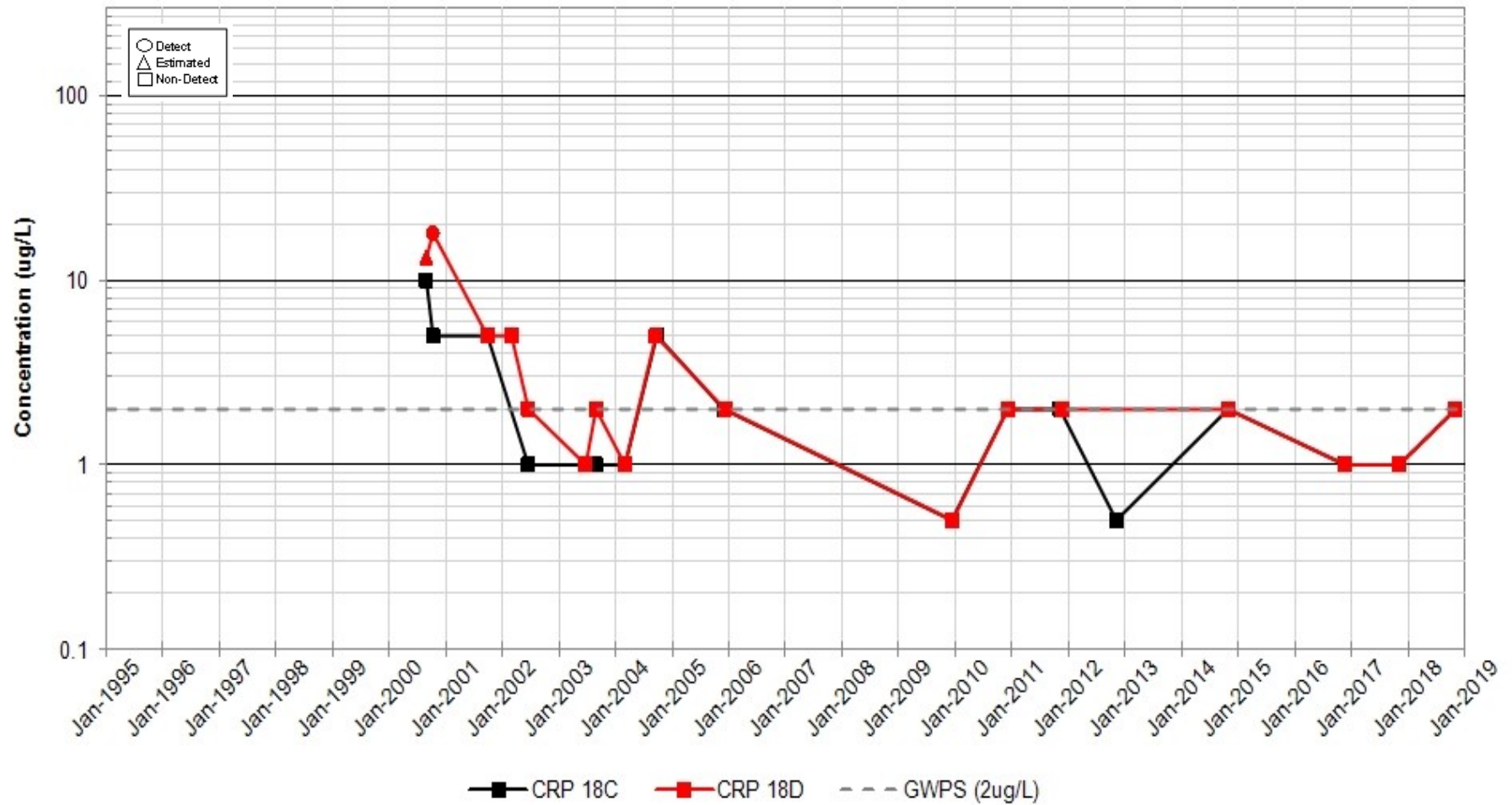


Figure C-23.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 20

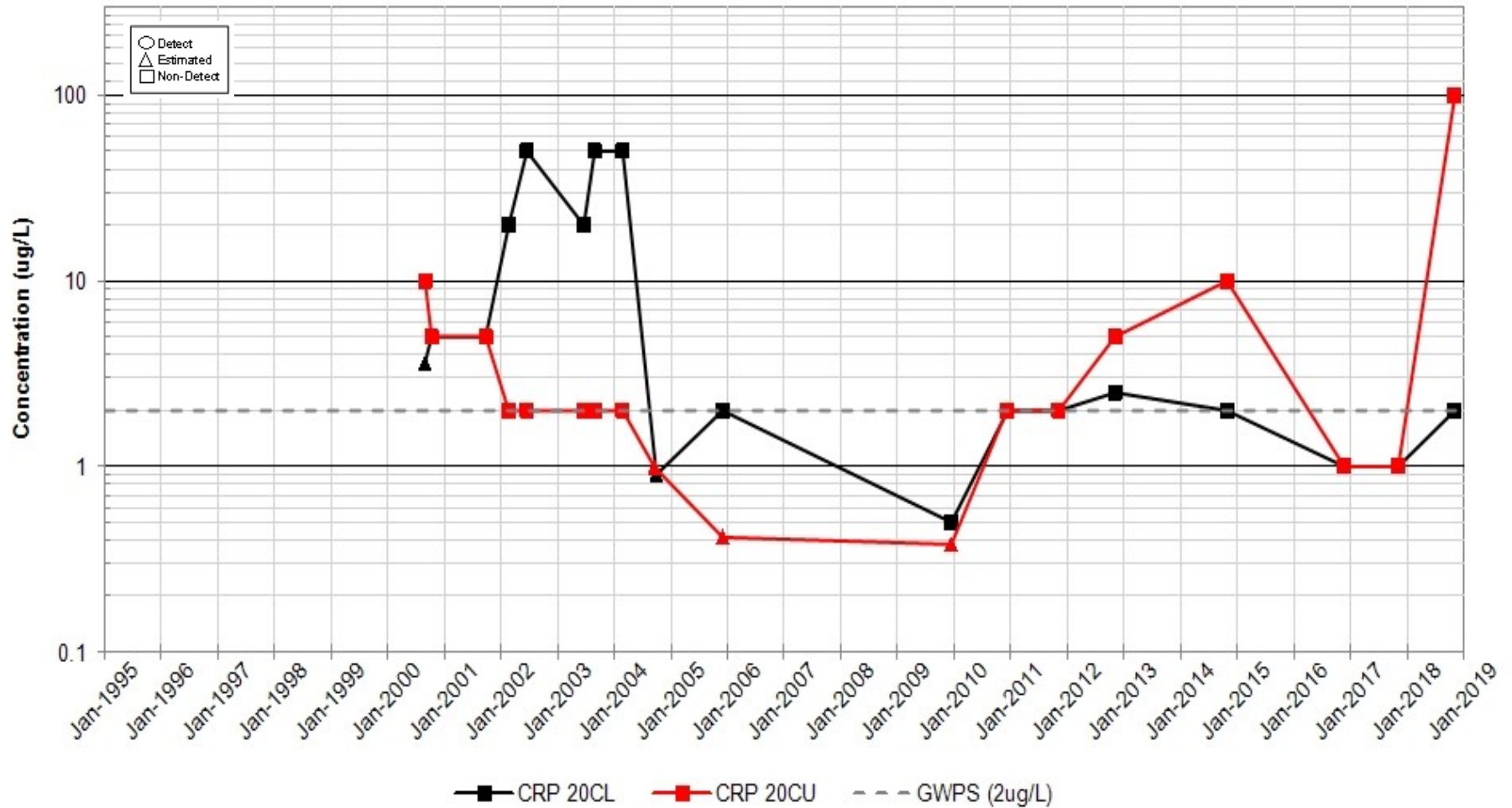


Figure C-24.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 22

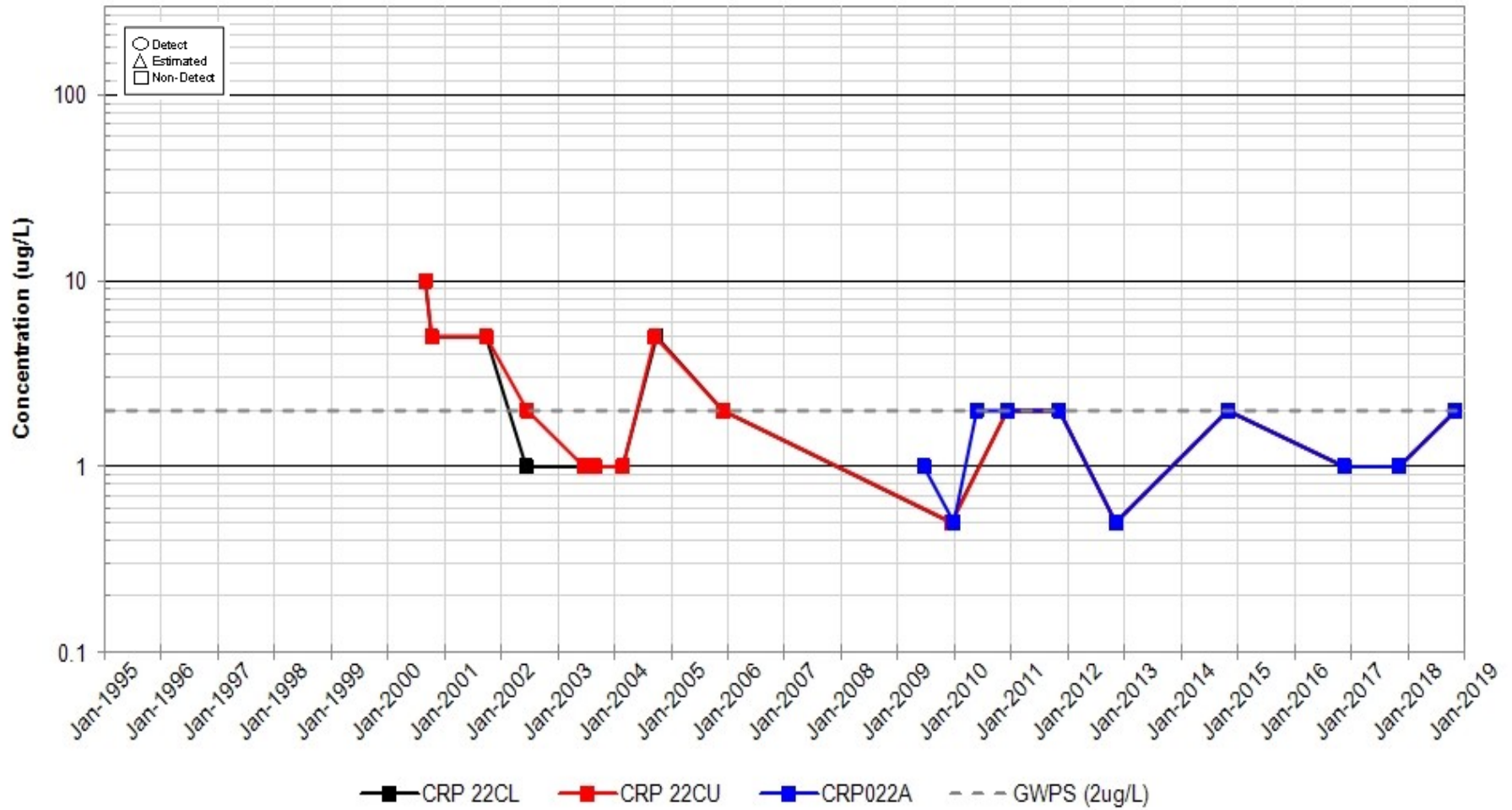


Figure C-25.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 45

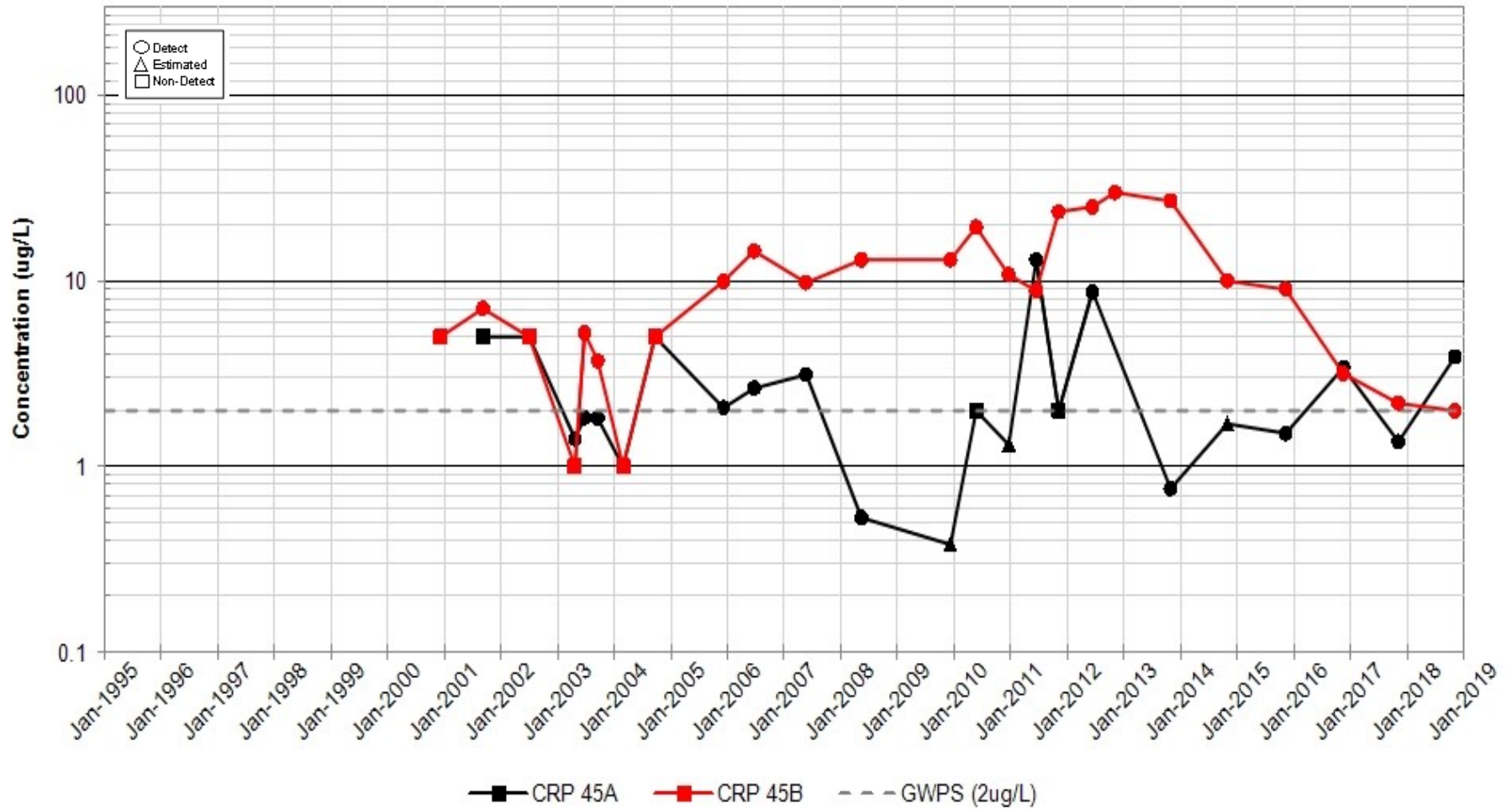


Figure C-26.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 46

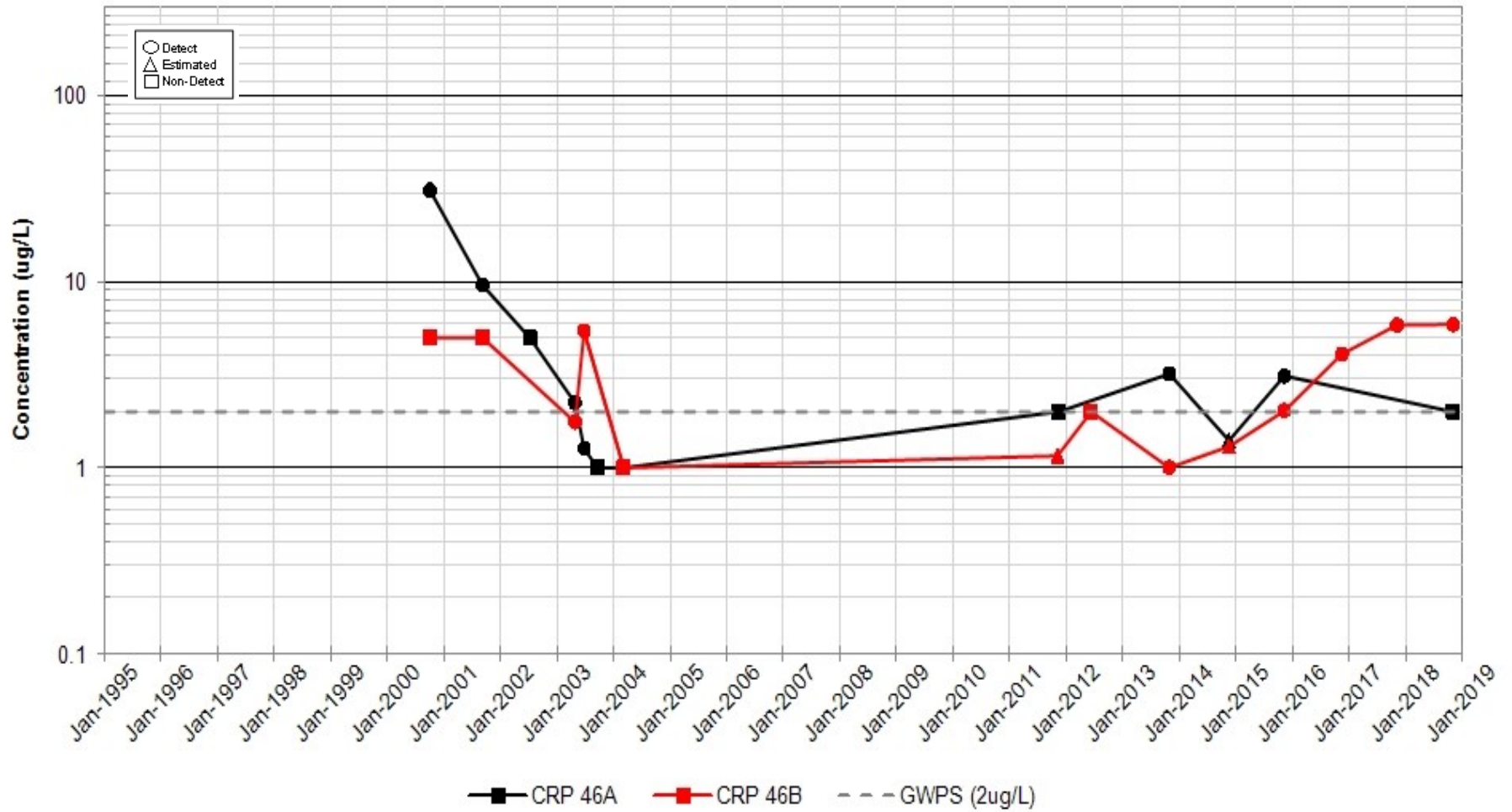


Figure C-27.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 48

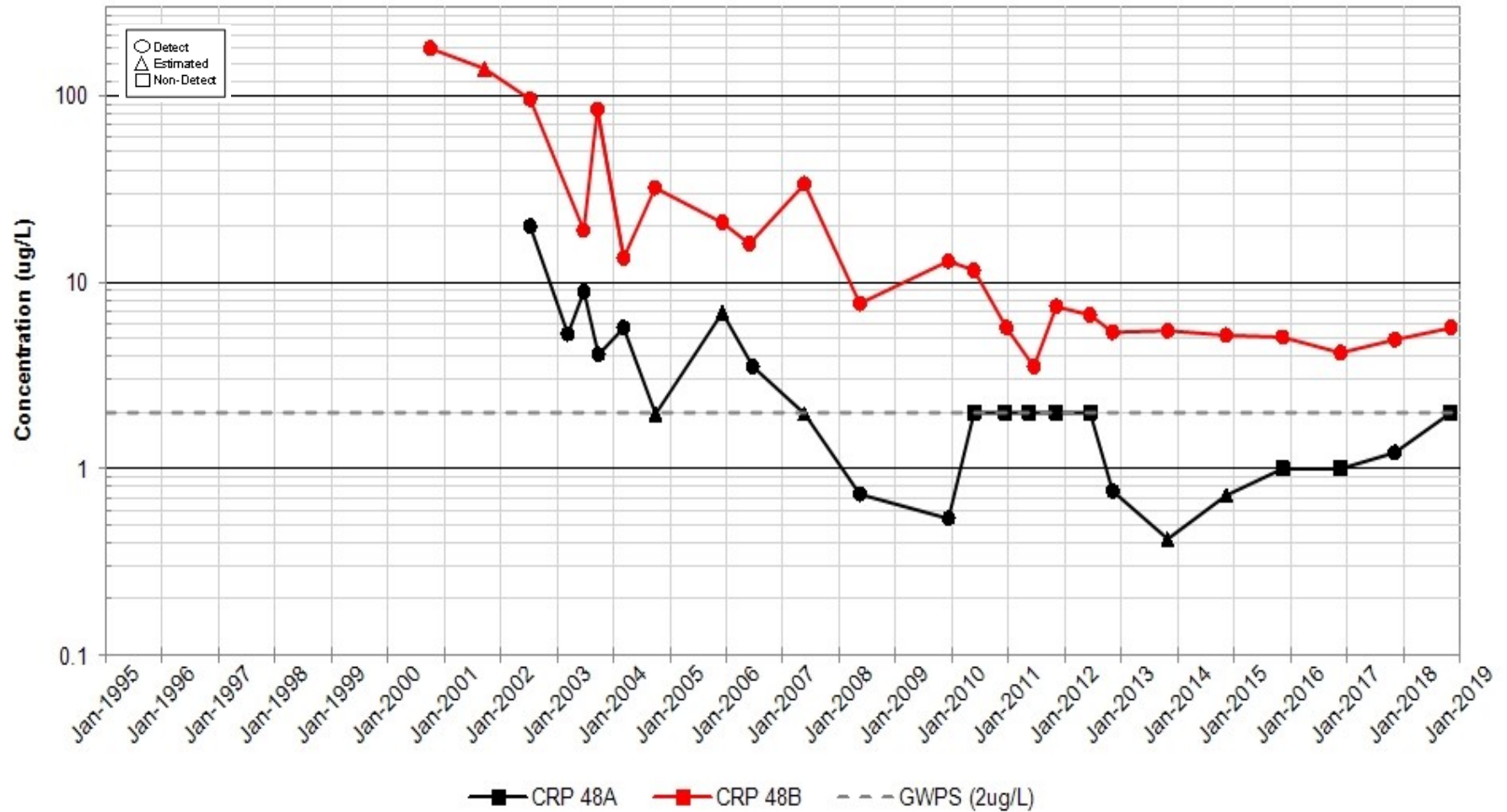


Figure C-28.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 50

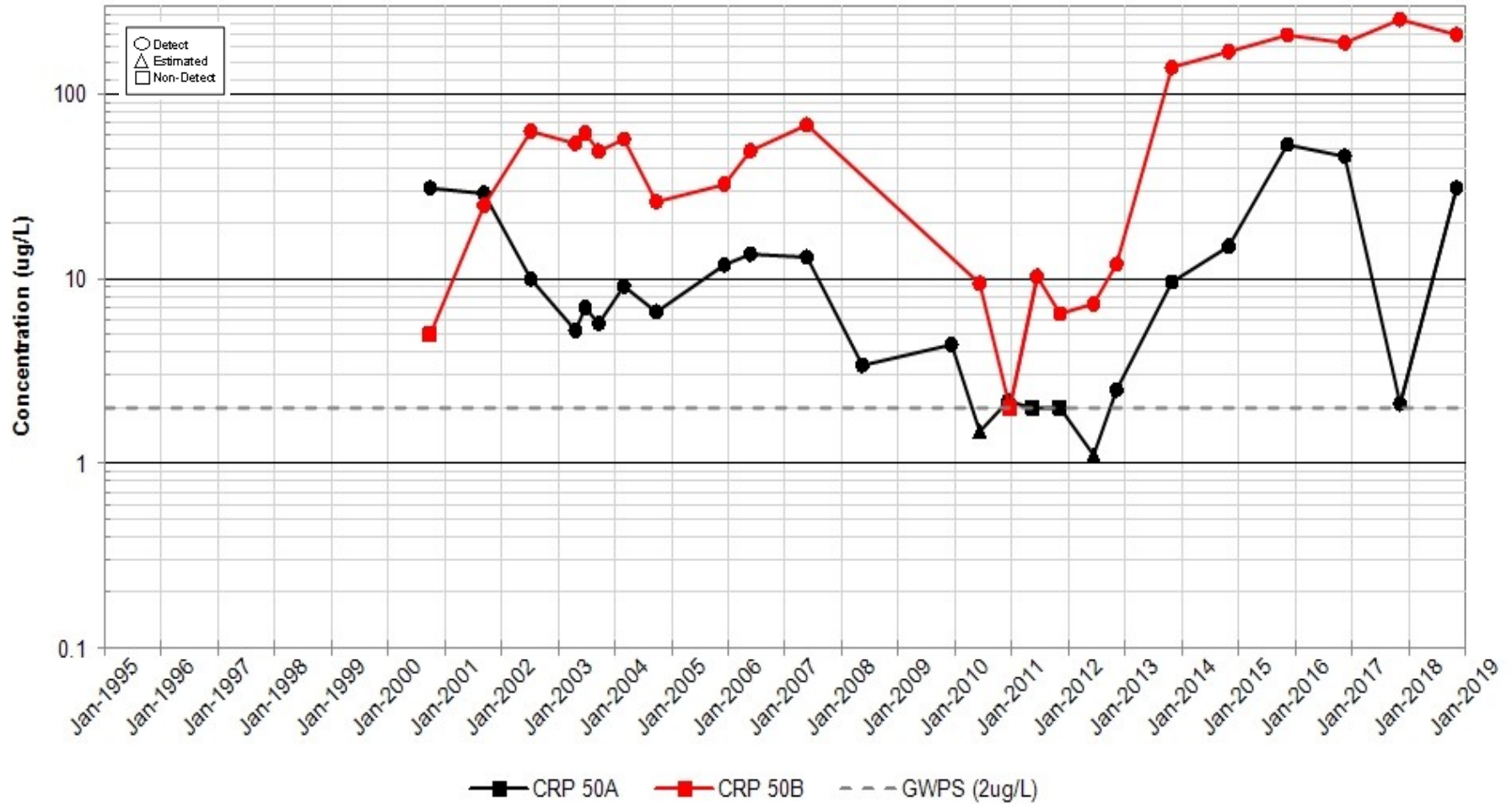


Figure C-29.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 51

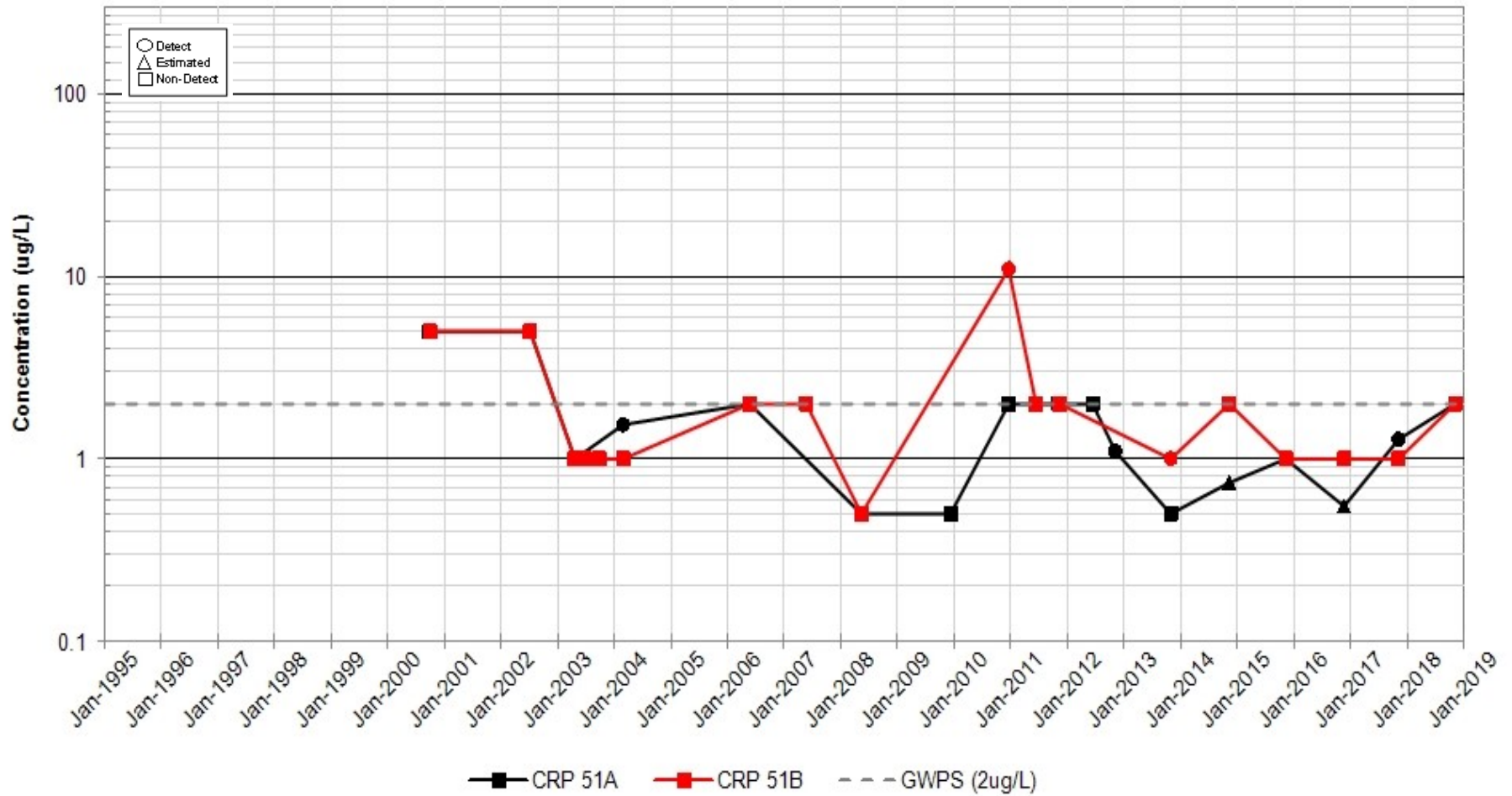


Figure C-30.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRP 52

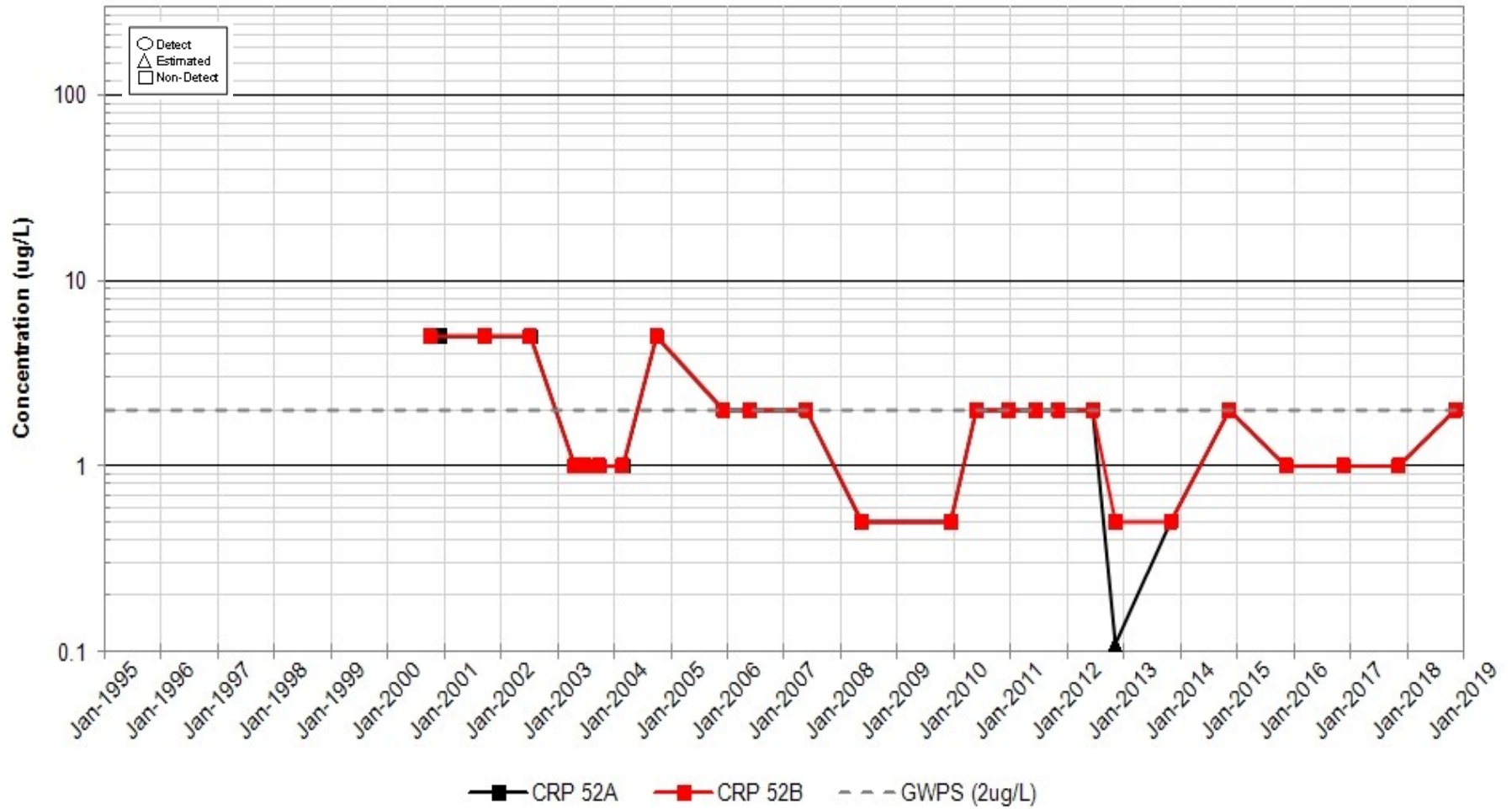


Figure C-31.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRW 10

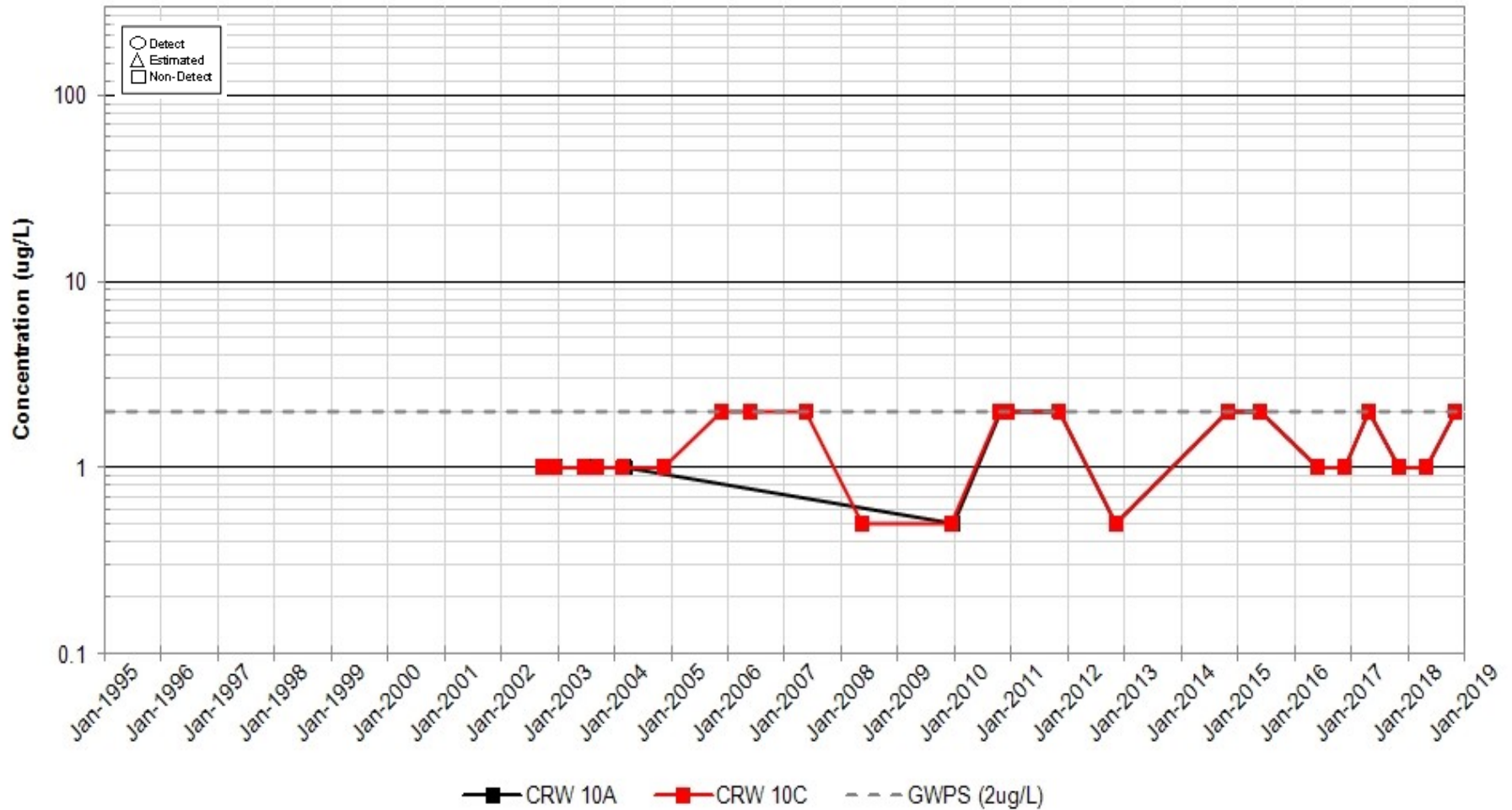


Figure C-32.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRW 12

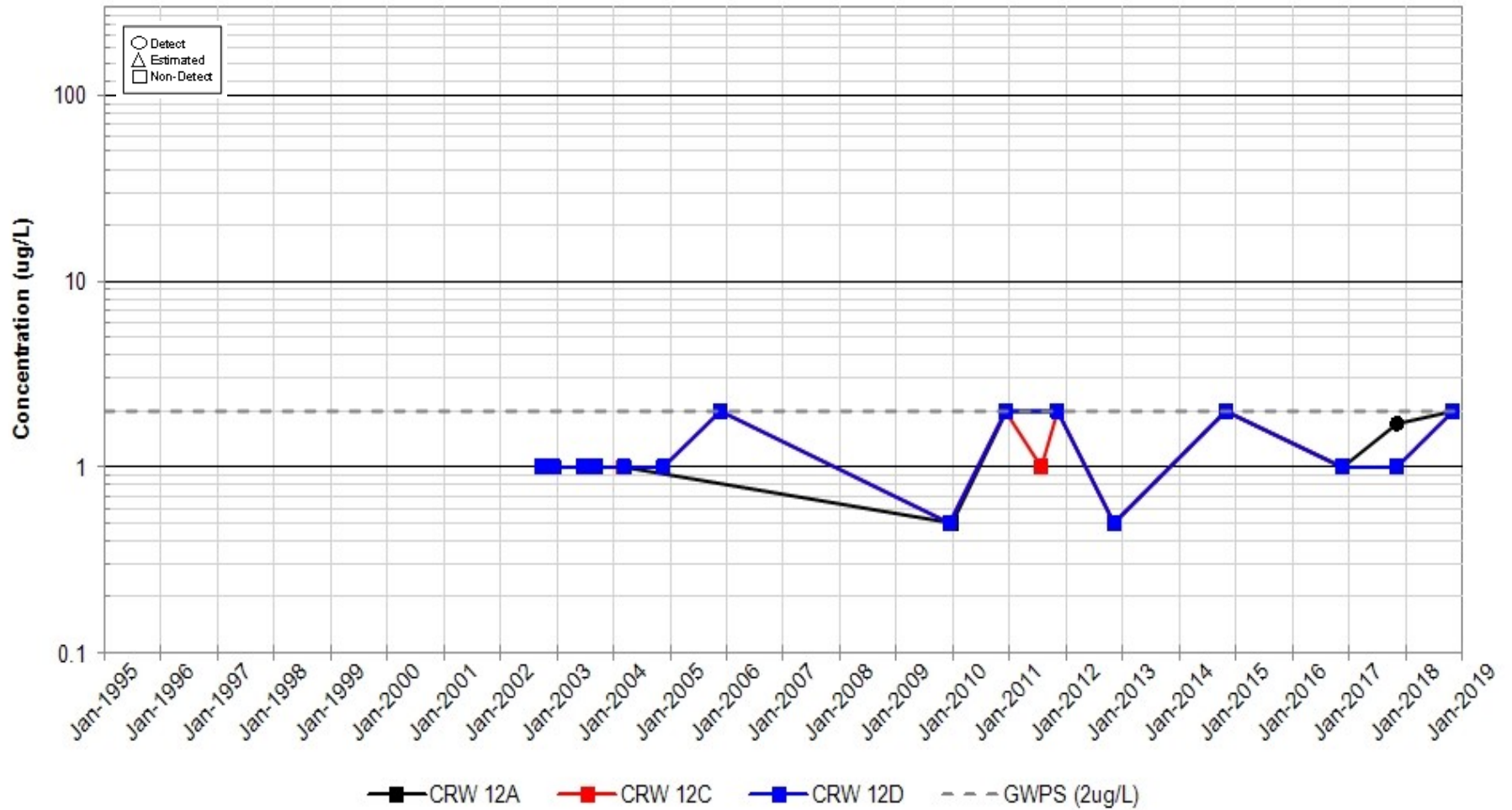


Figure C-33.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for CRW010

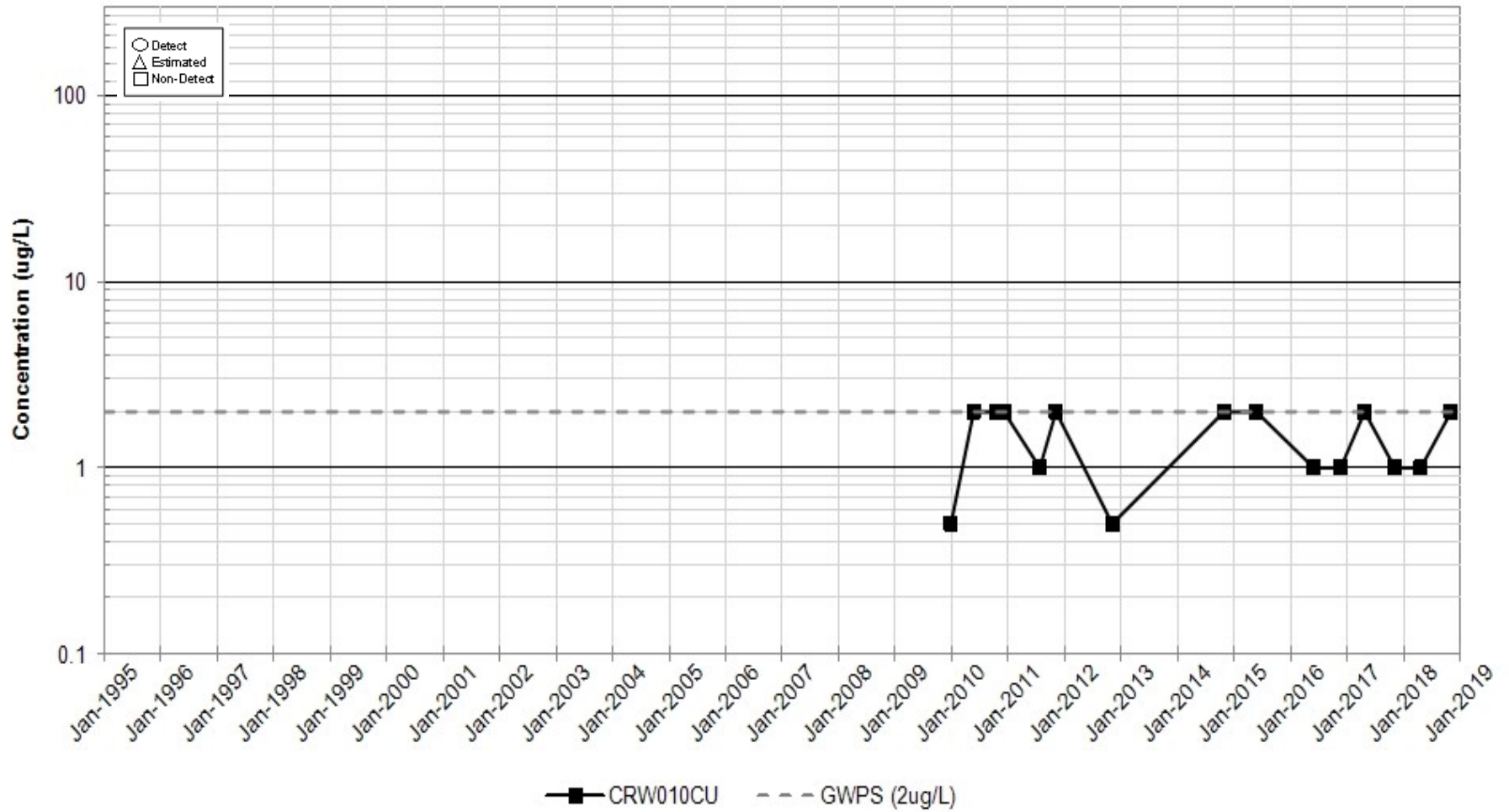


Figure C-34.

Time Series Plot for Chloroethene (Vinyl Chloride) Station for TL 01

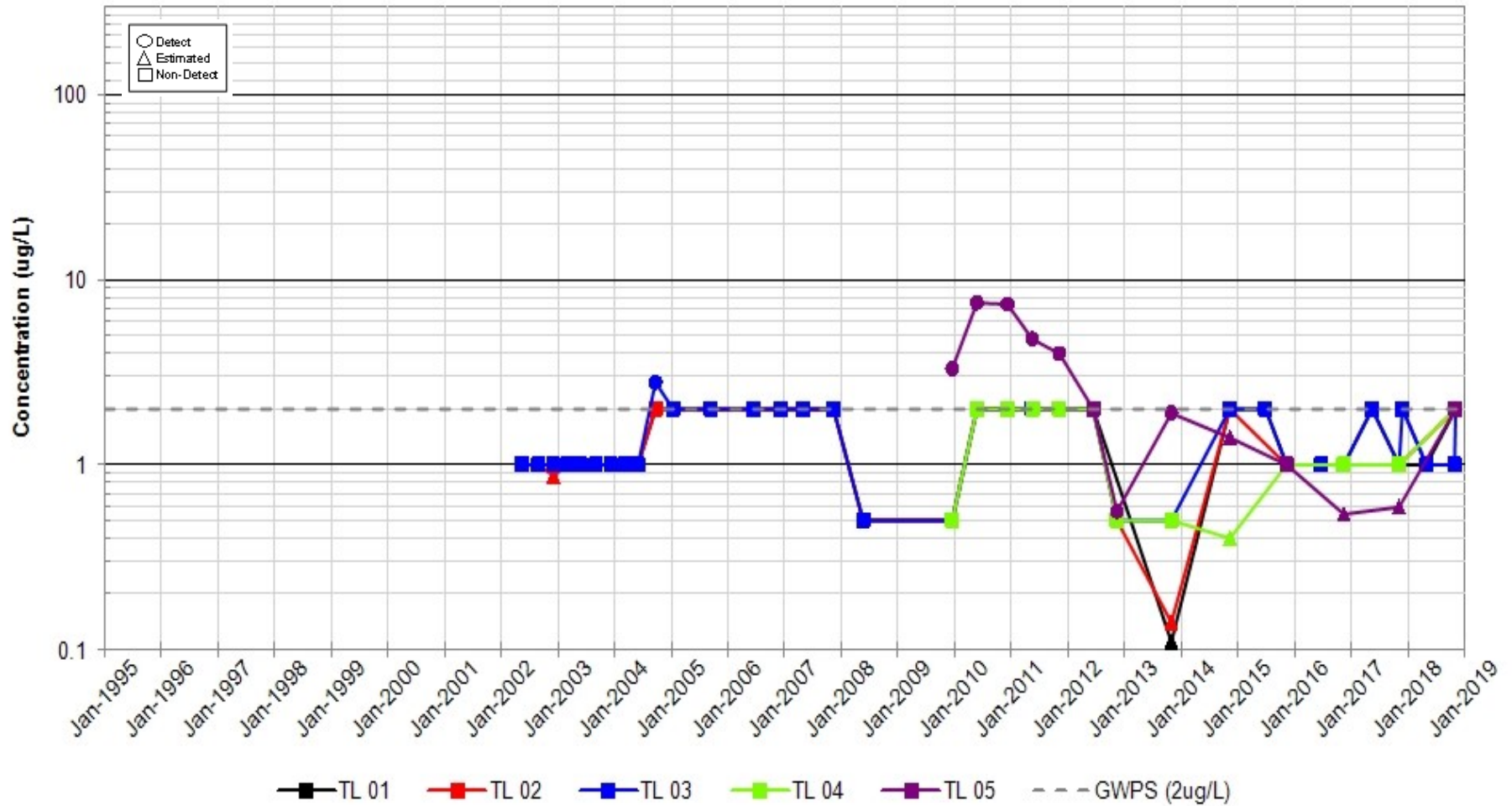


Figure C-35.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 3

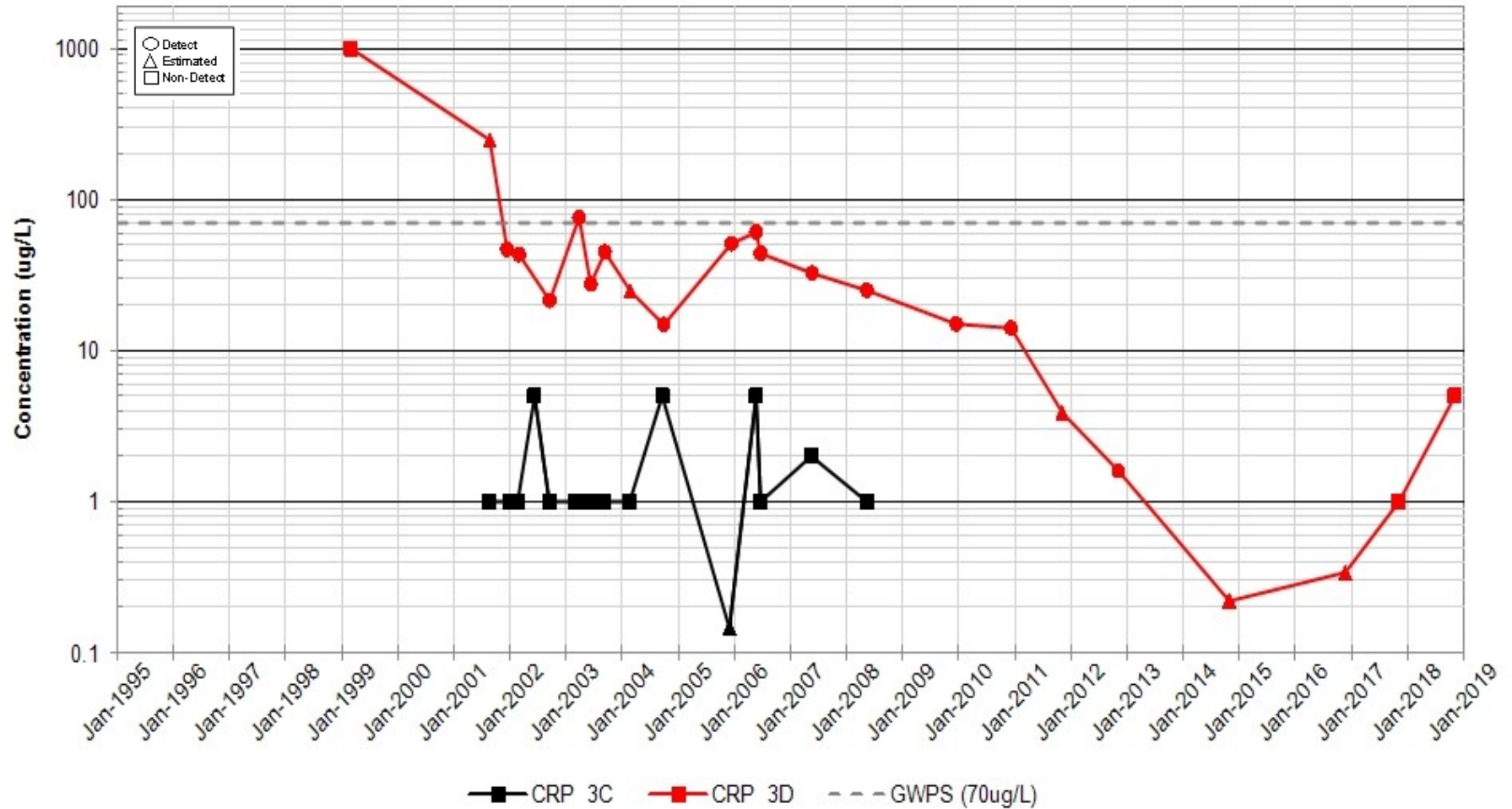


Figure C-36.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 5

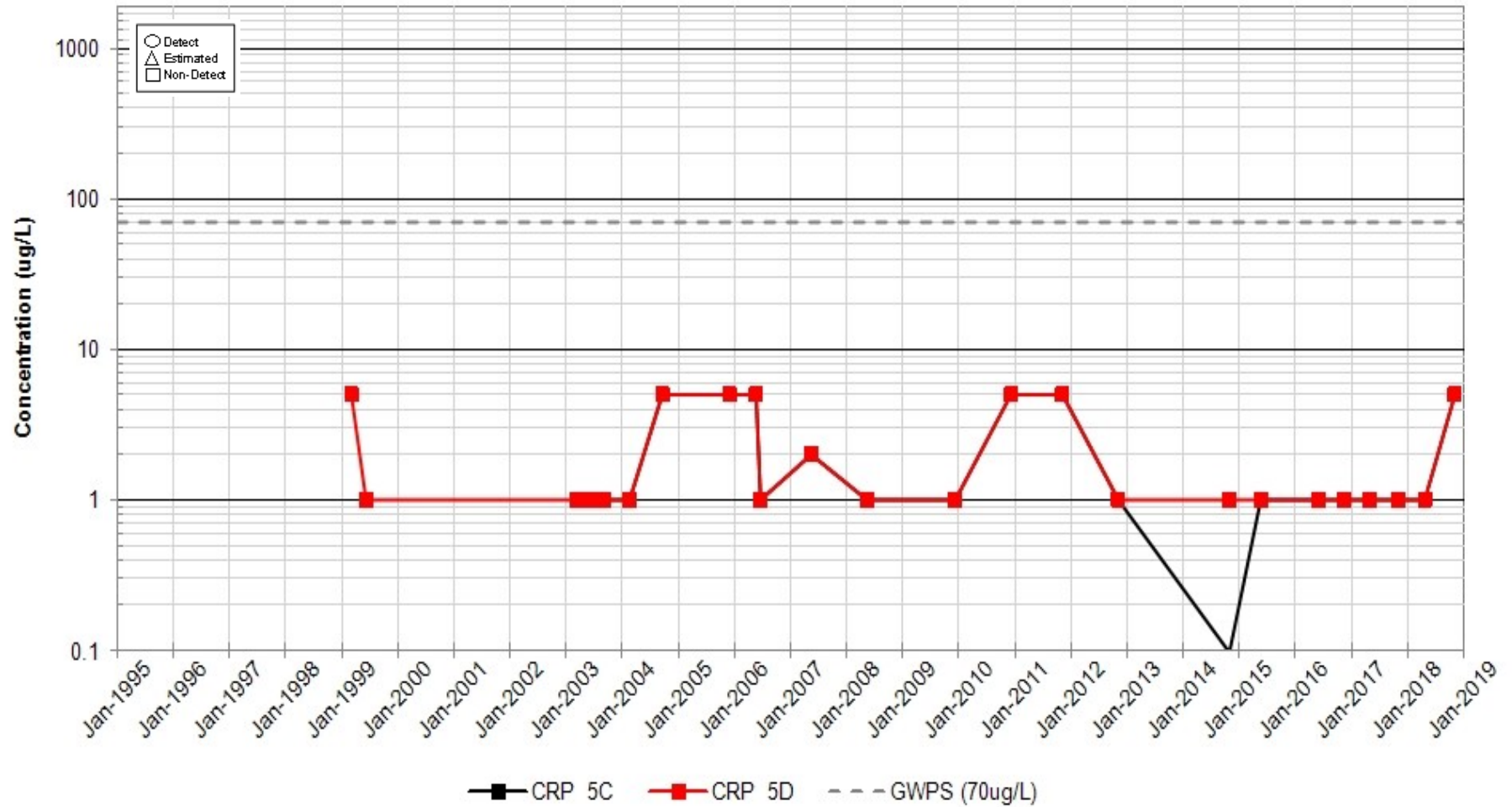


Figure C-37.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 6

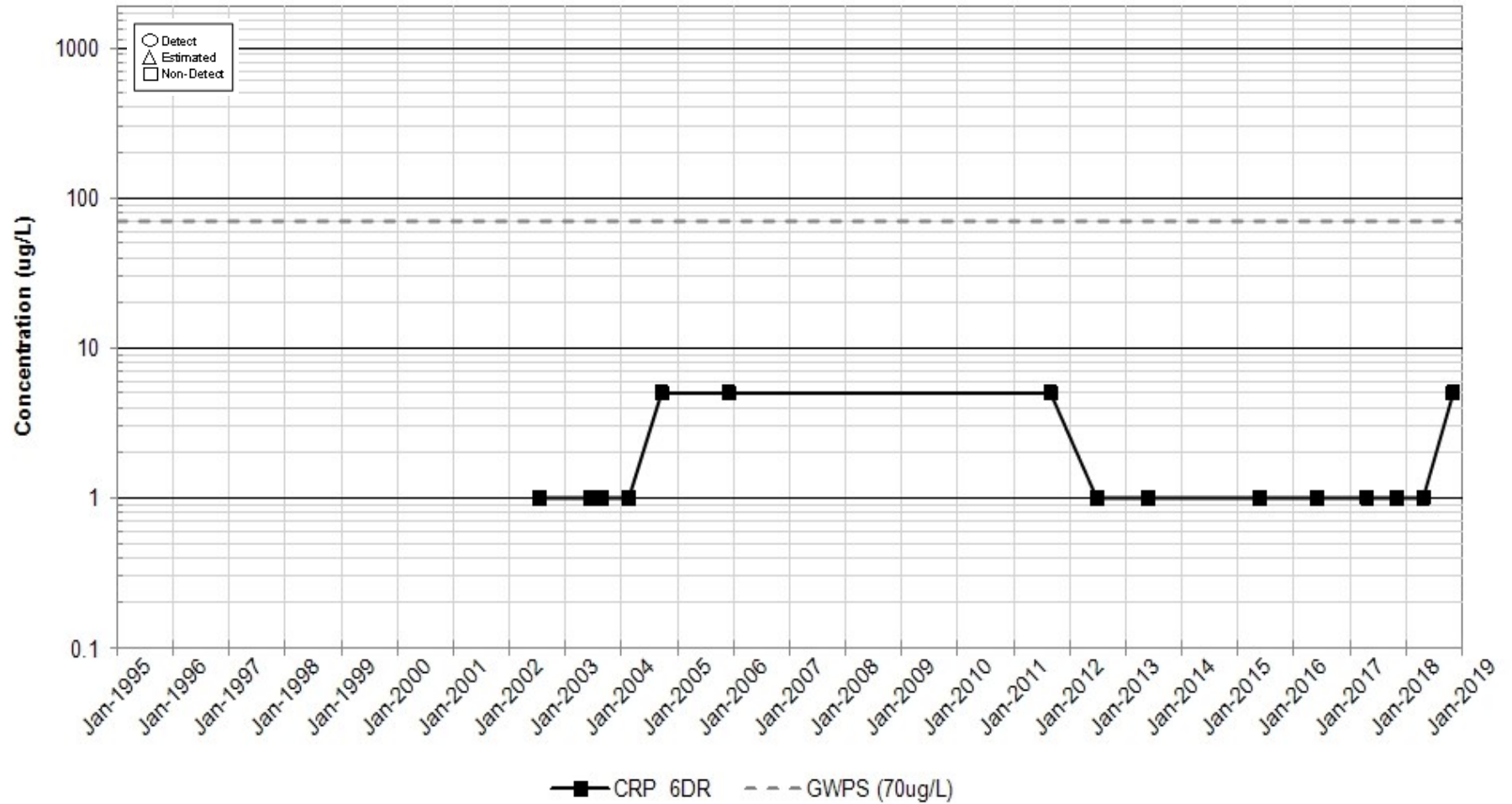


Figure C-38.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 8

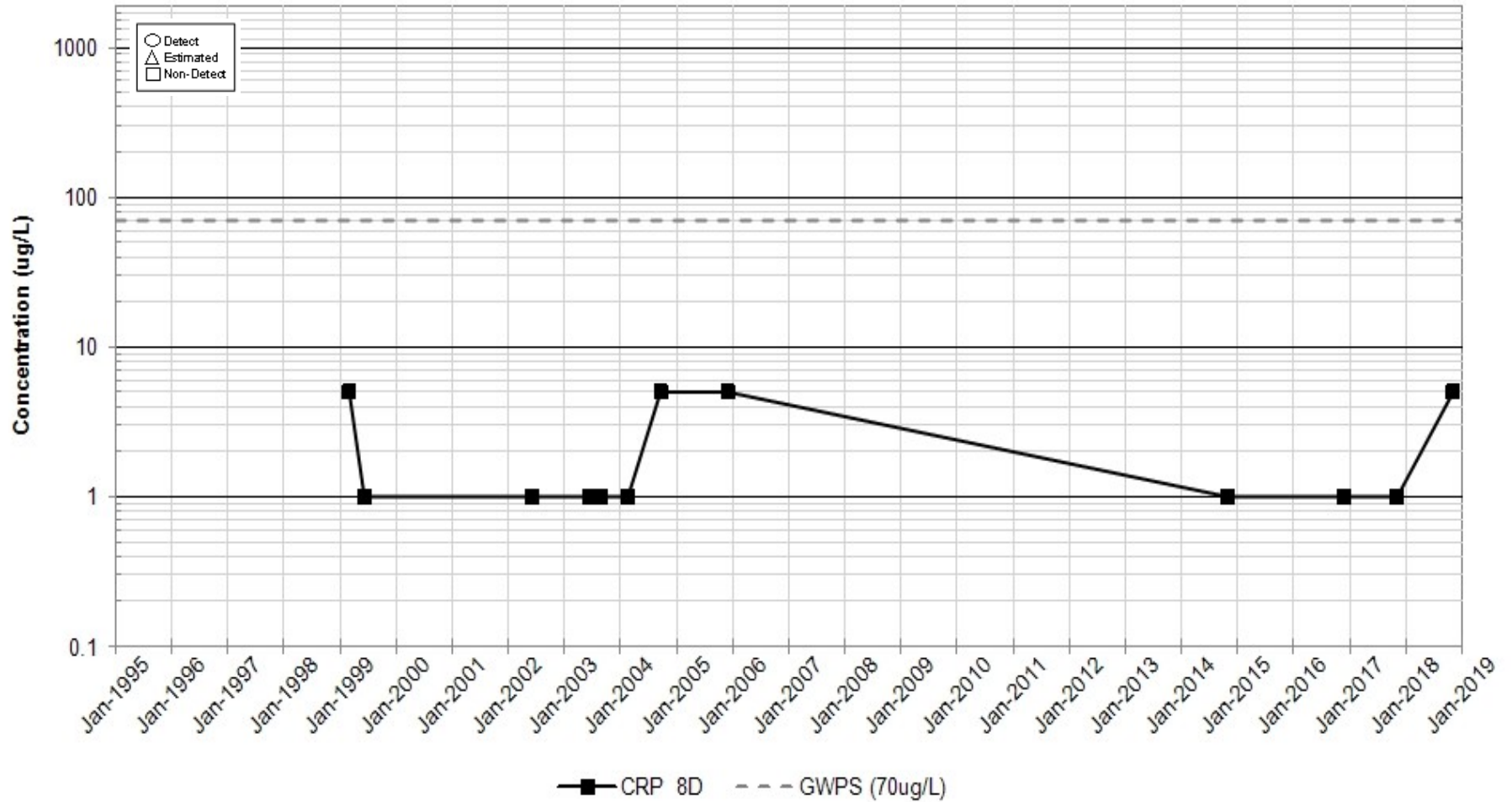


Figure C-39.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 18

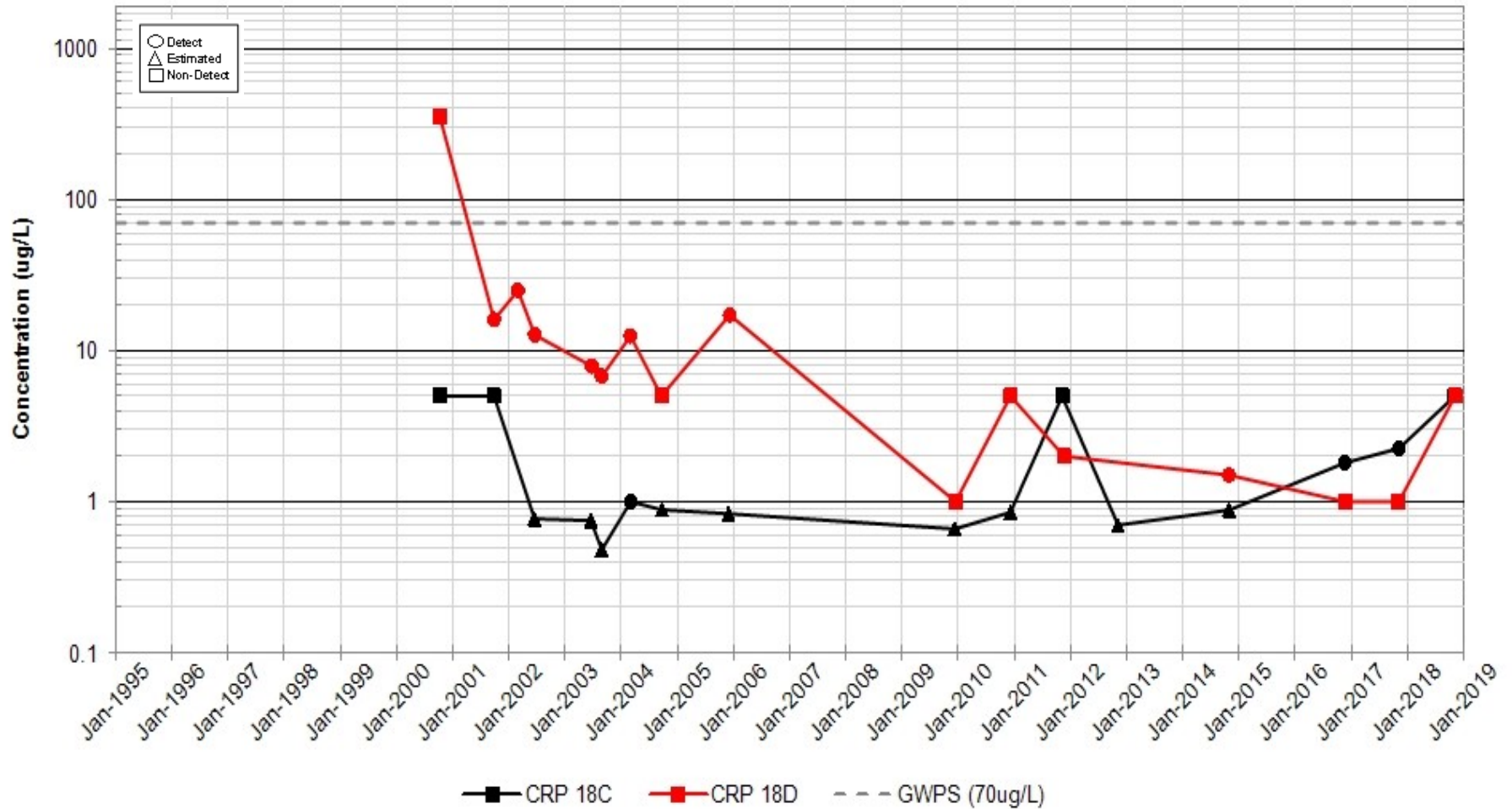


Figure C-40.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 20

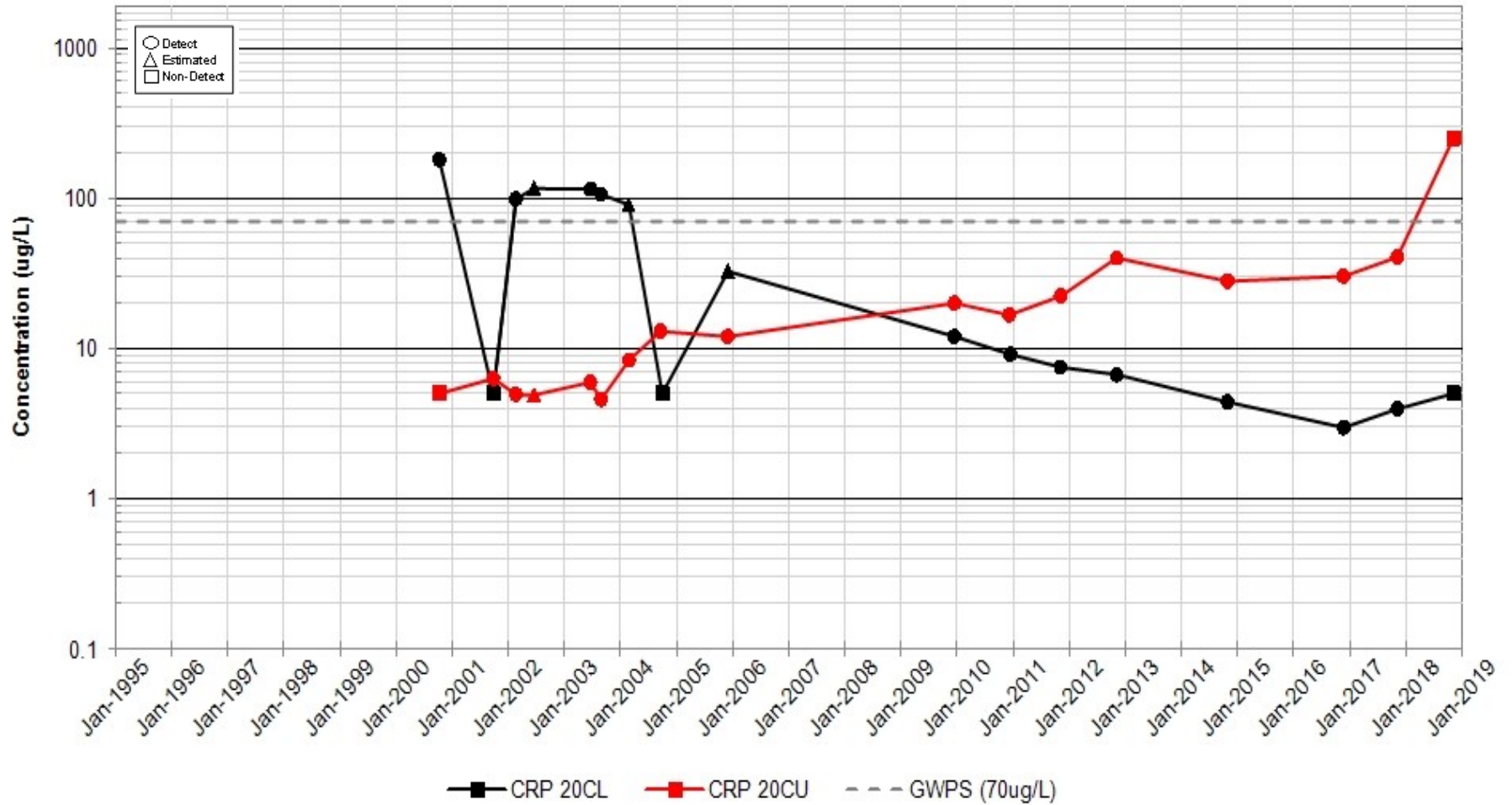


Figure C-41.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 22

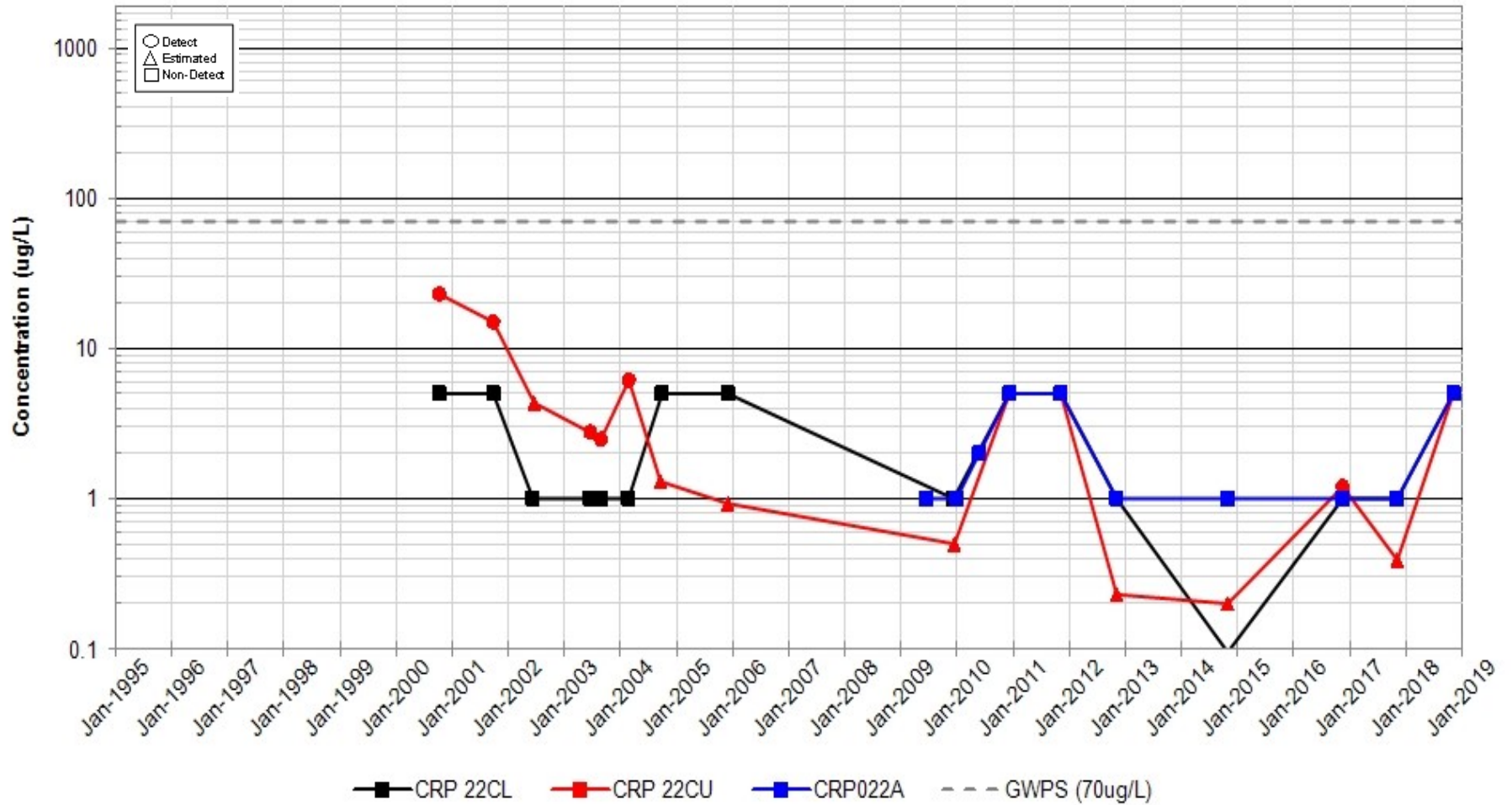


Figure C-42.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 45

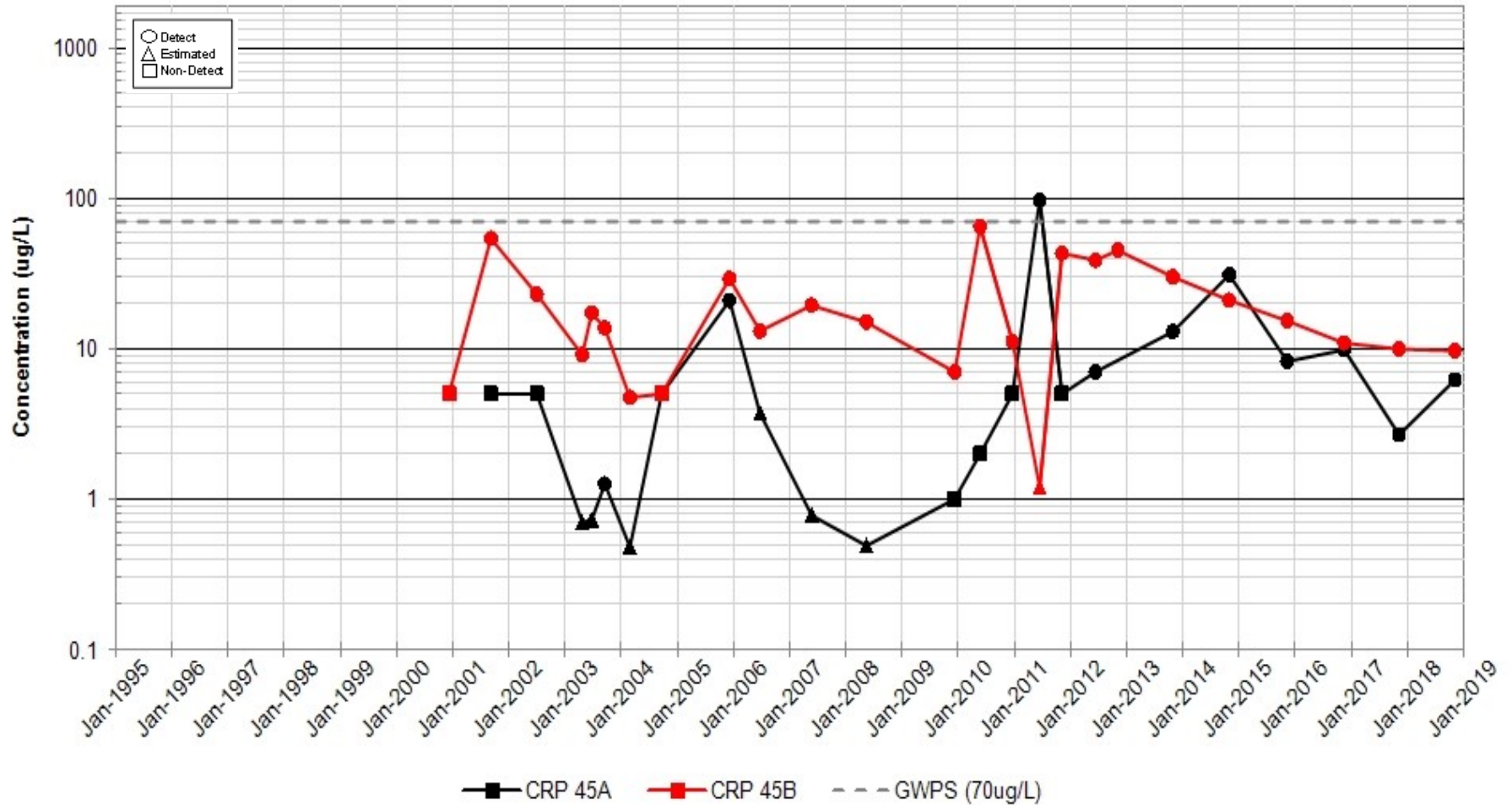


Figure C-43.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 46

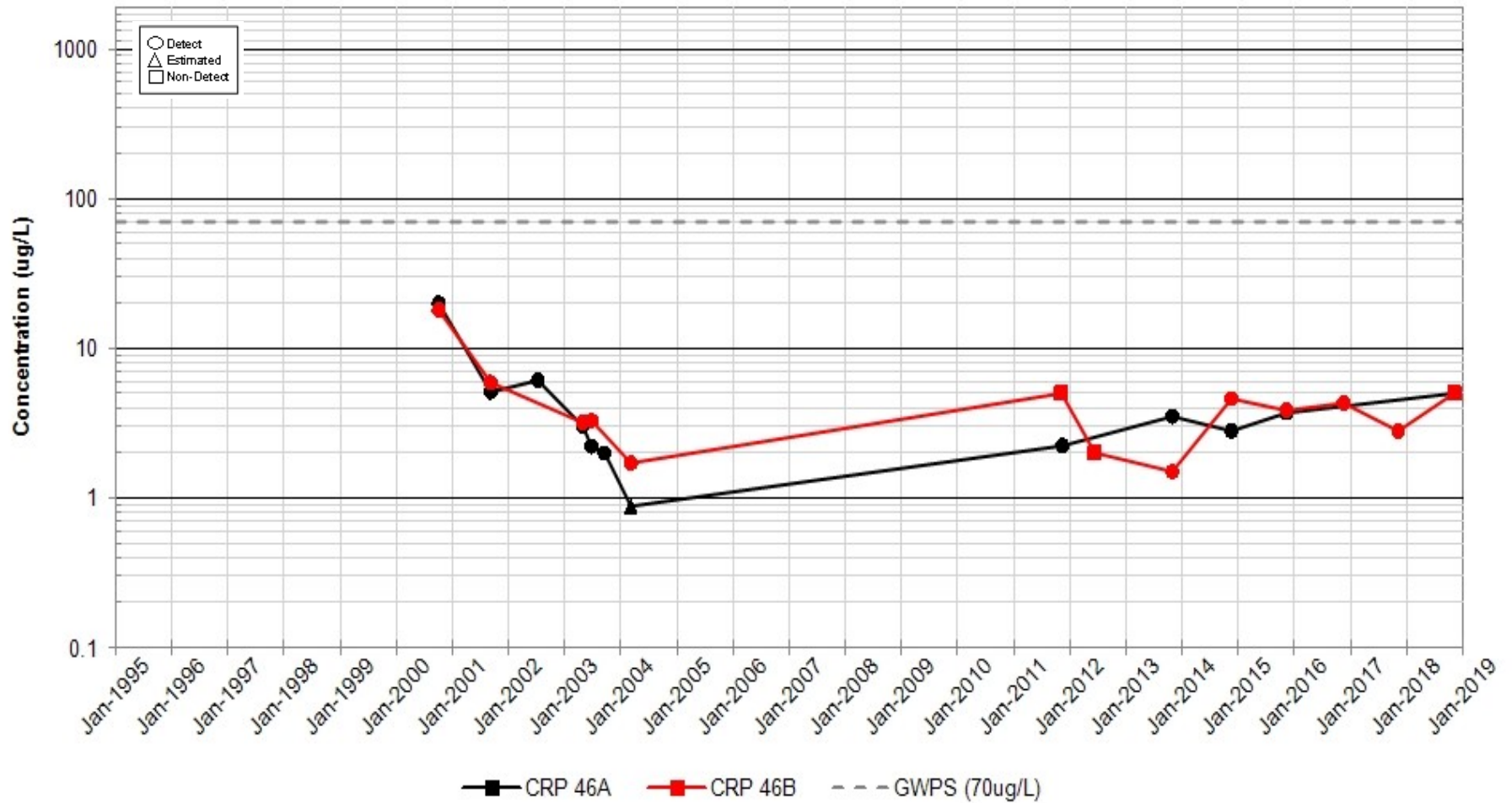


Figure C-44.

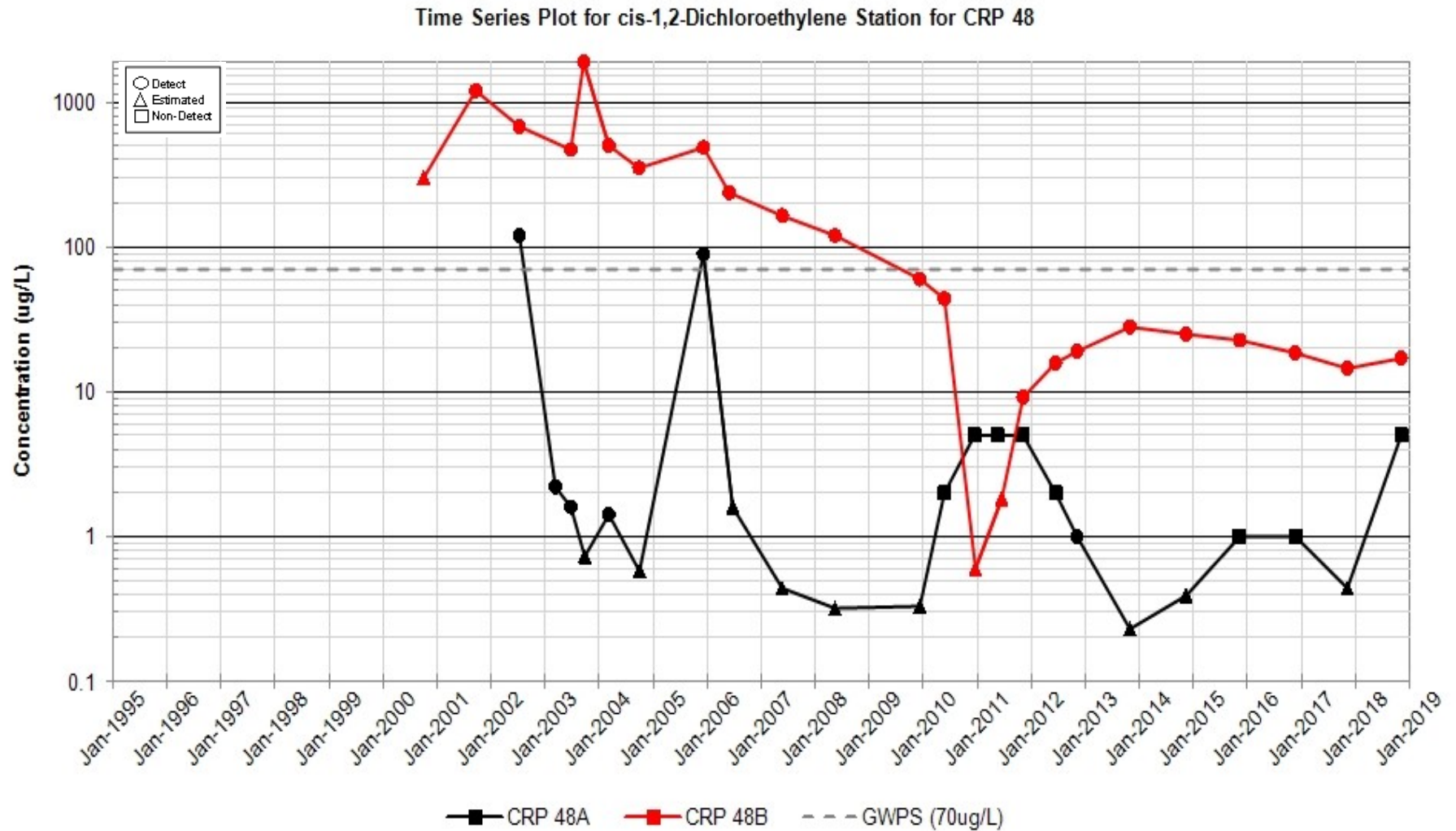


Figure C-45.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 50

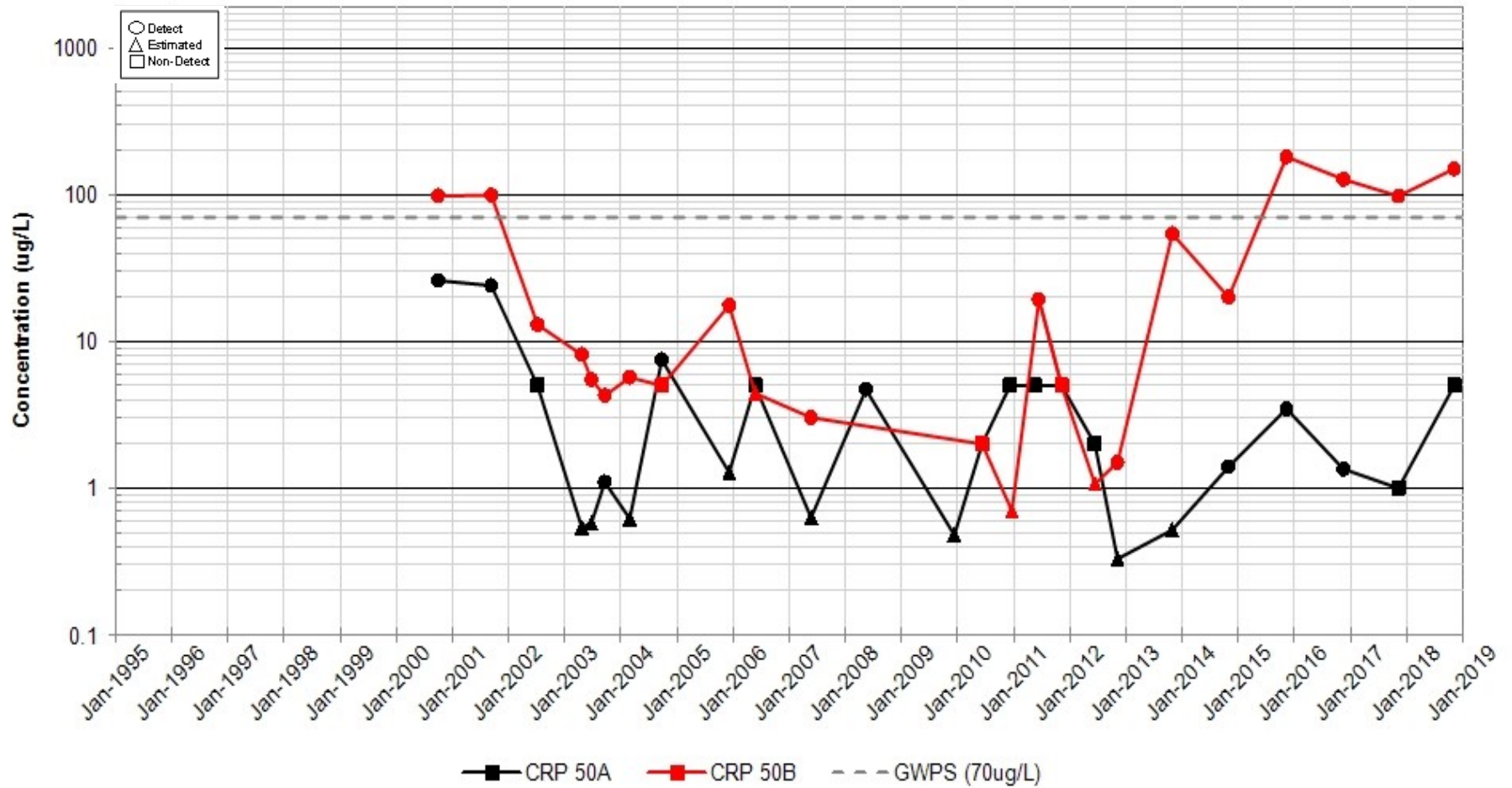


Figure C-46.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 51

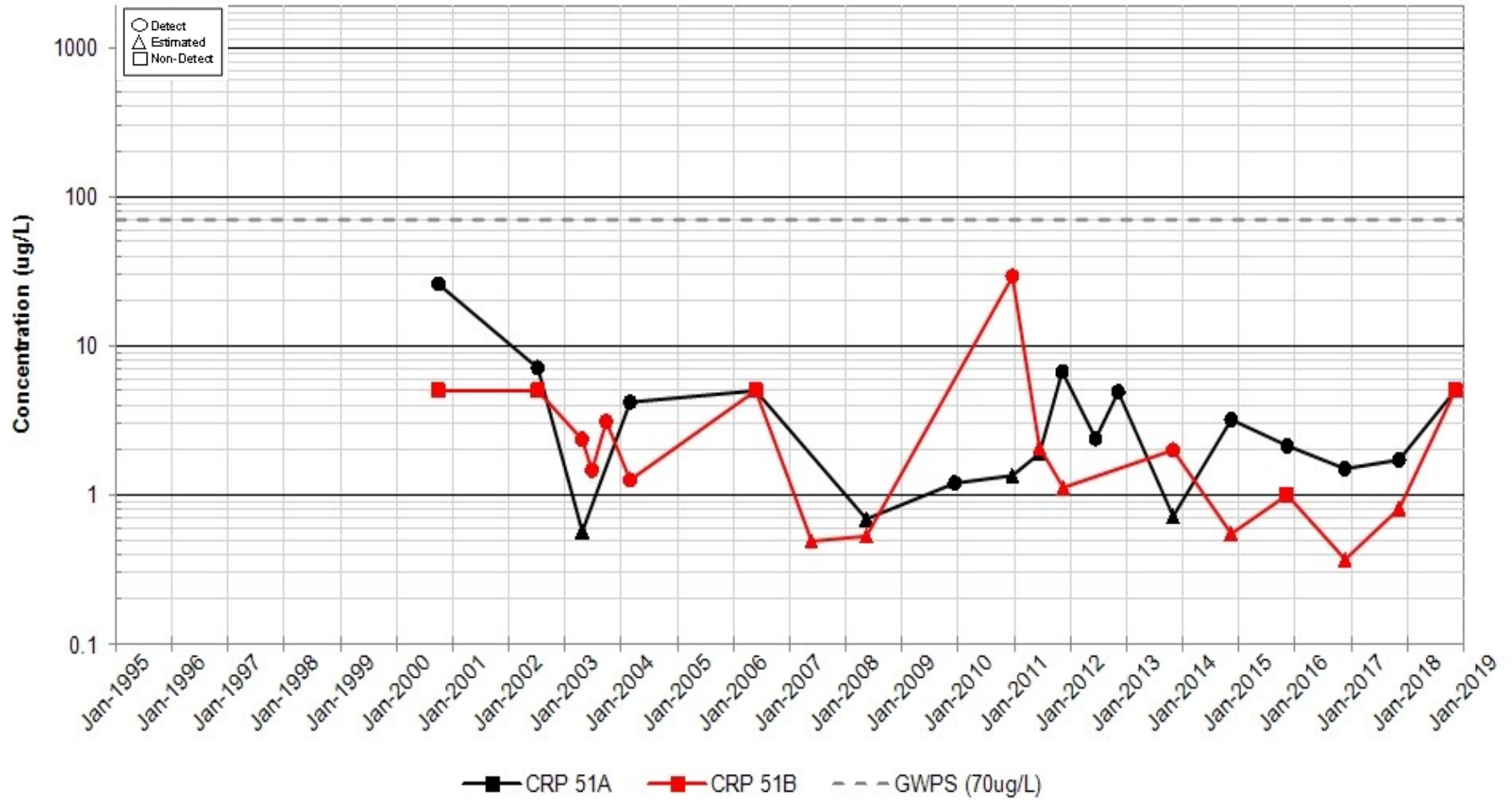


Figure C-47.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRP 52

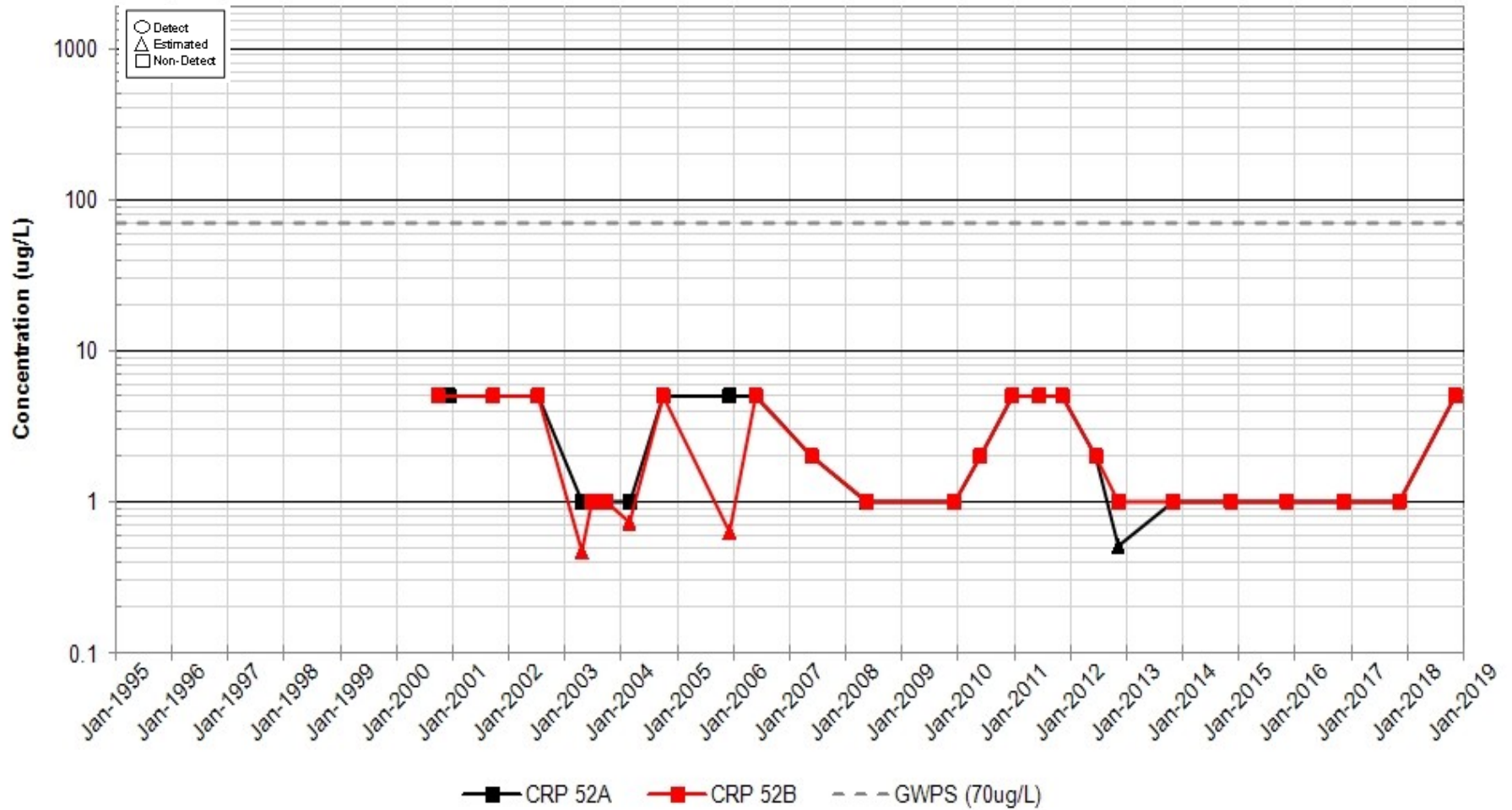


Figure C-48.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRW 10

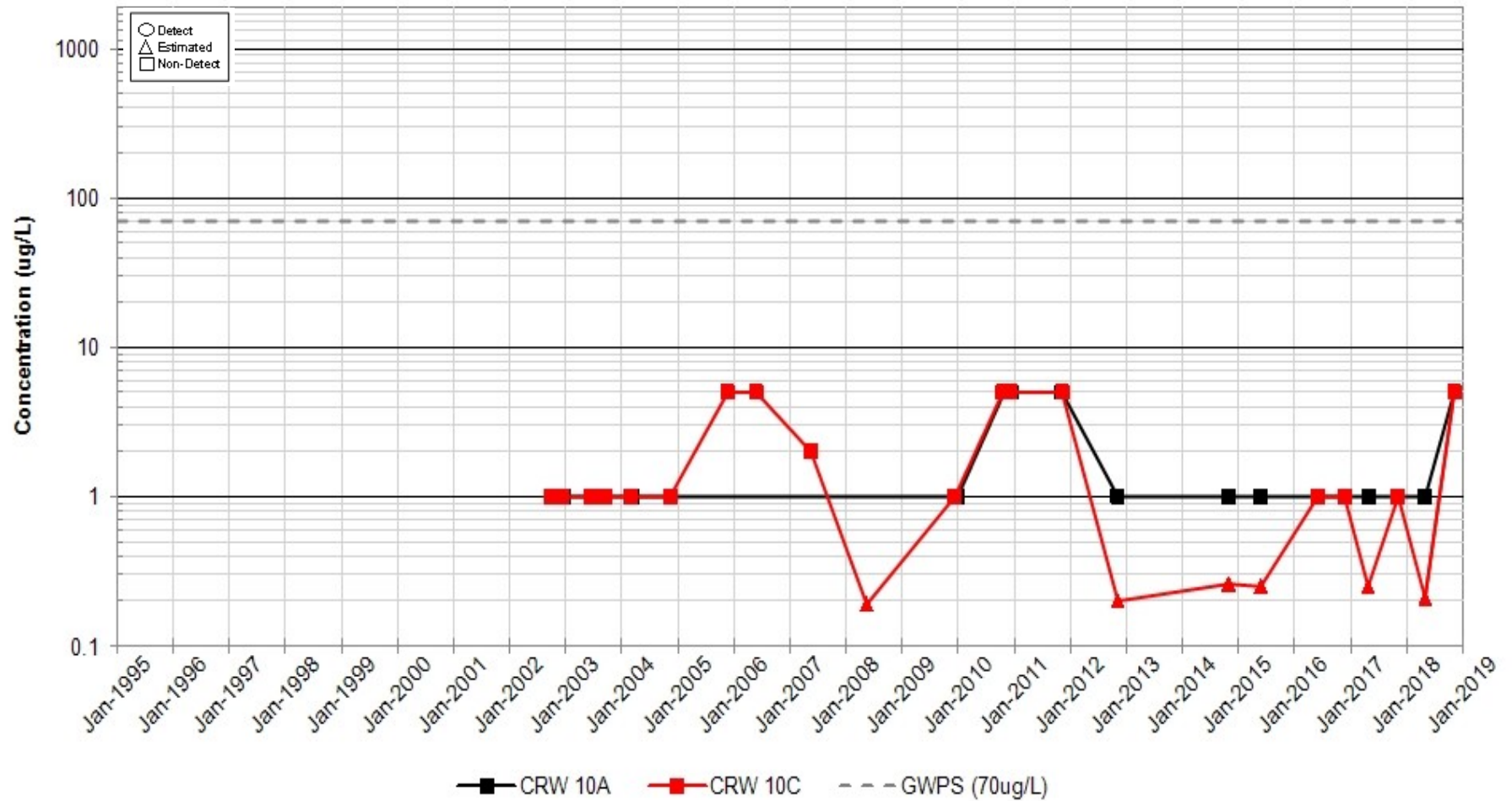


Figure C-49.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRW 12

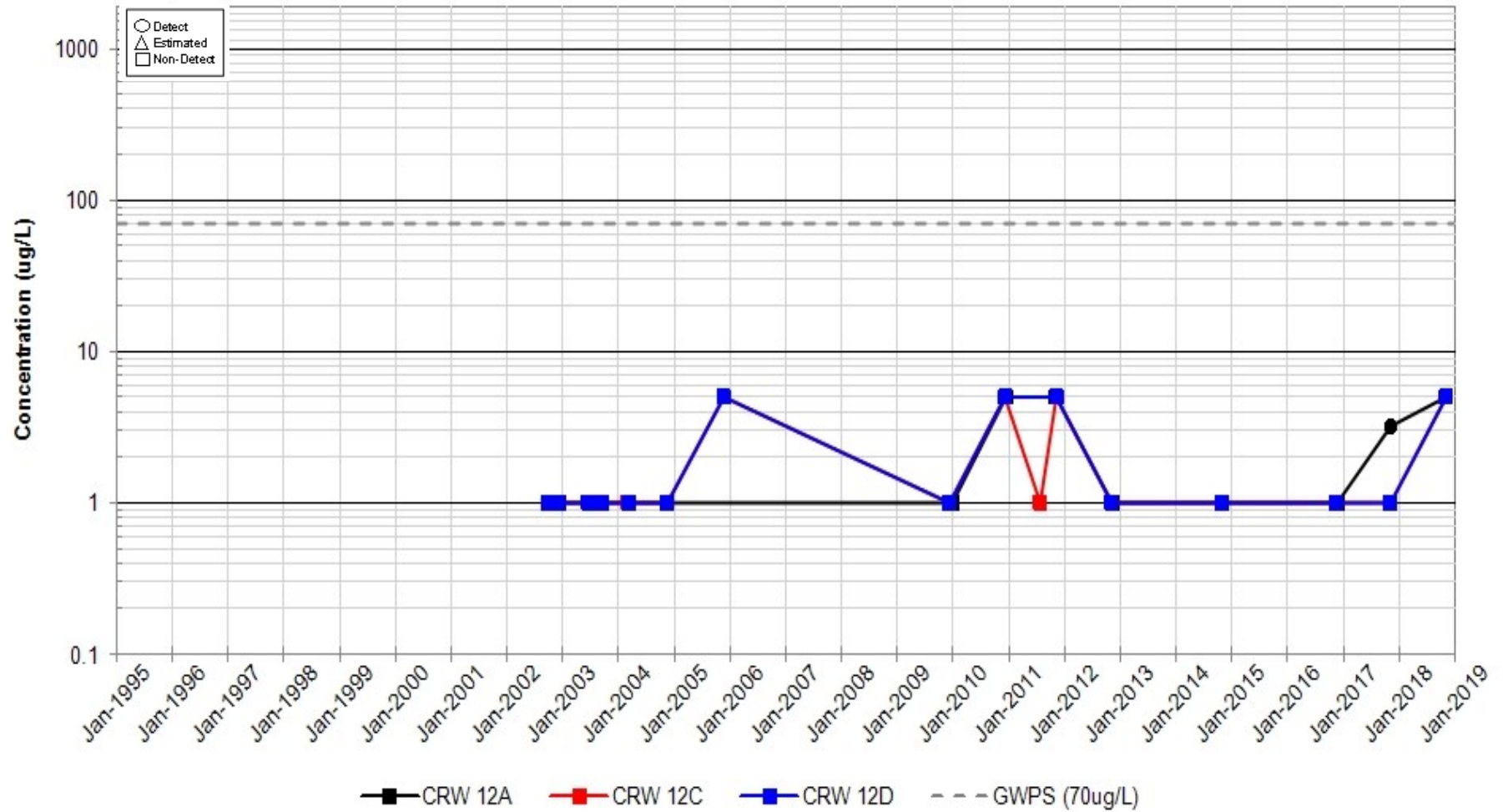


Figure C-50.

Time Series Plot for cis-1,2-Dichloroethylene Station for CRW010

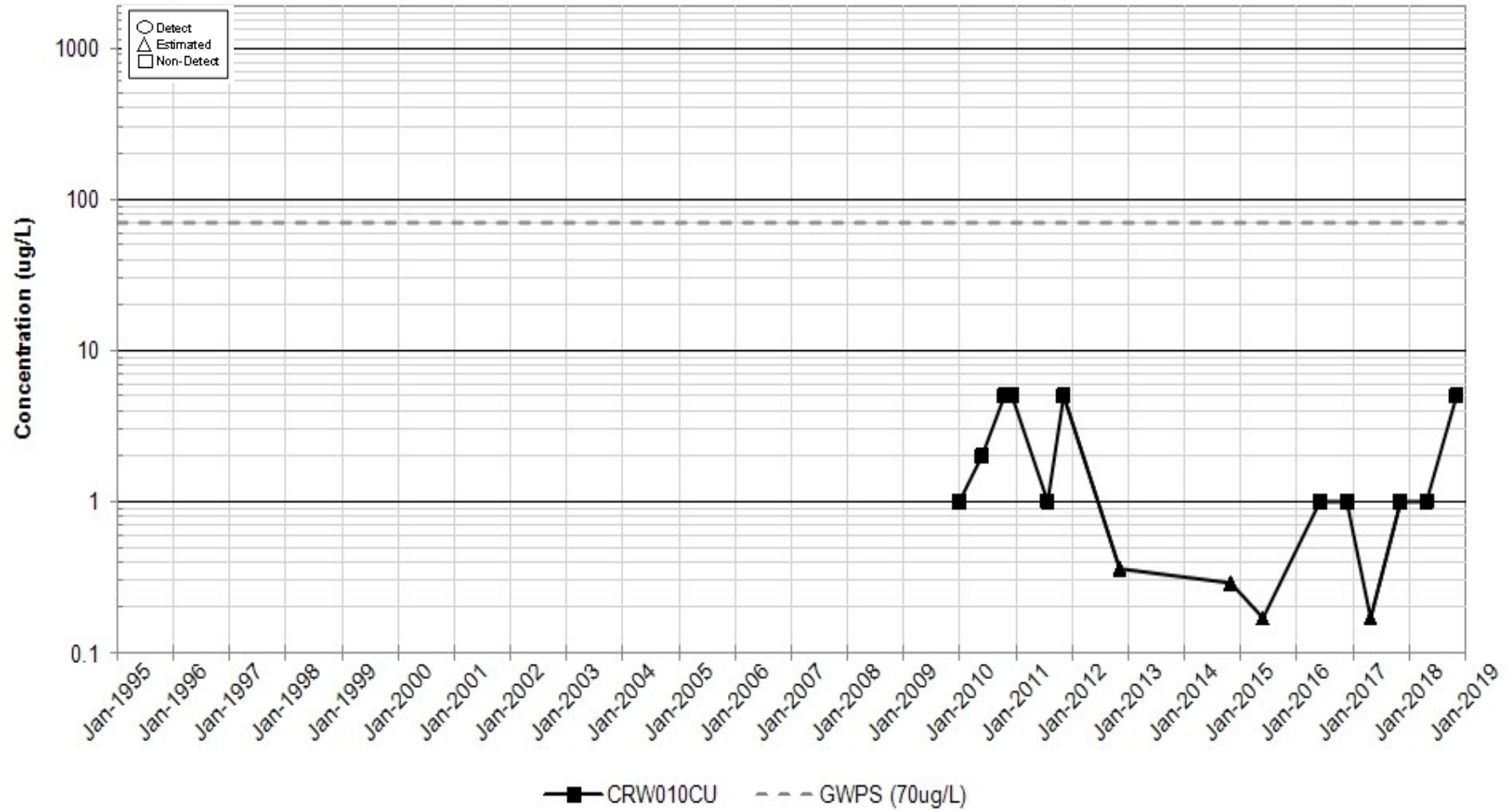


Figure C-51.

Time Series Plot for cis-1,2-Dichloroethylene Station for TL 01

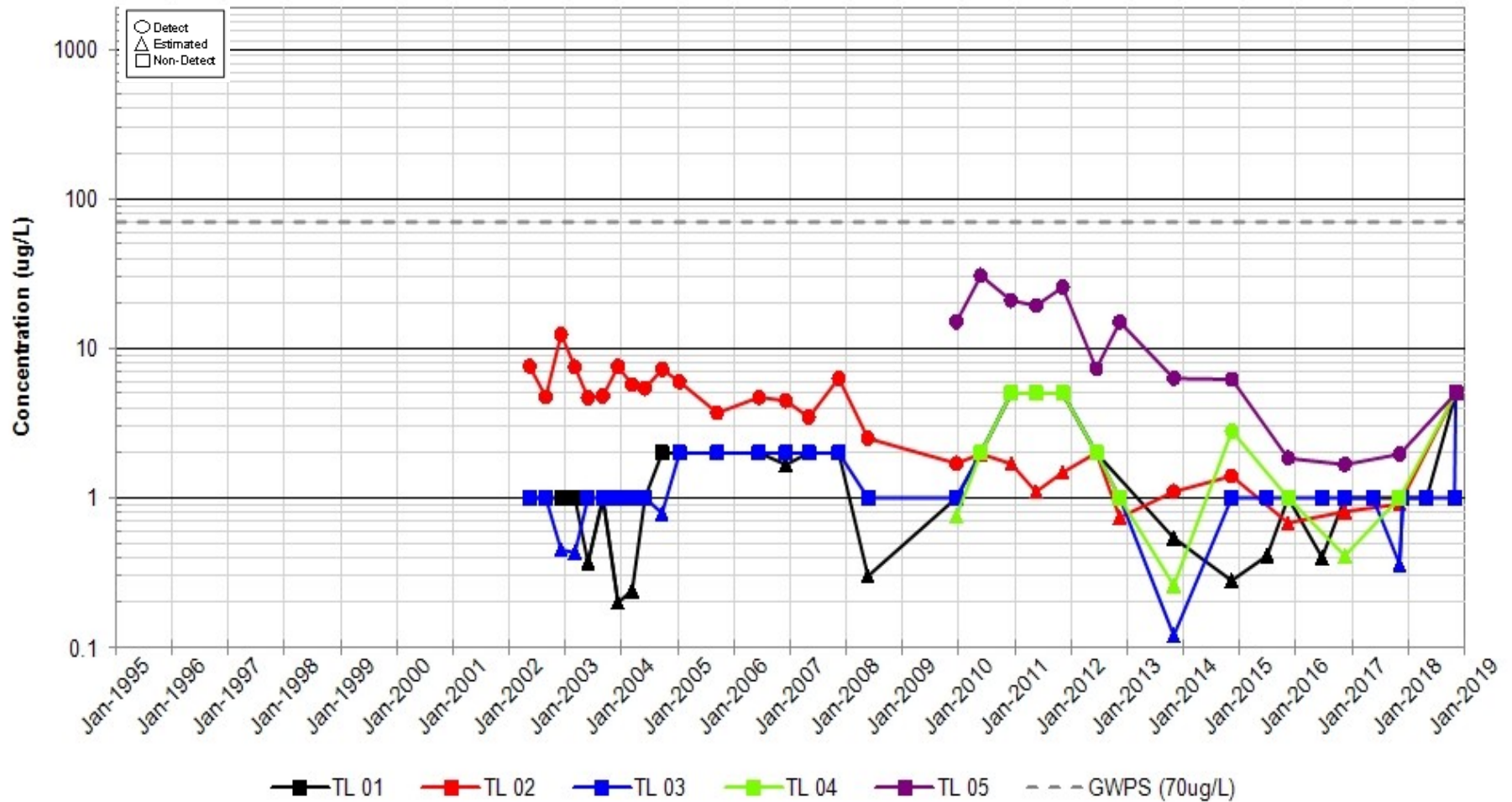


Figure C-52.

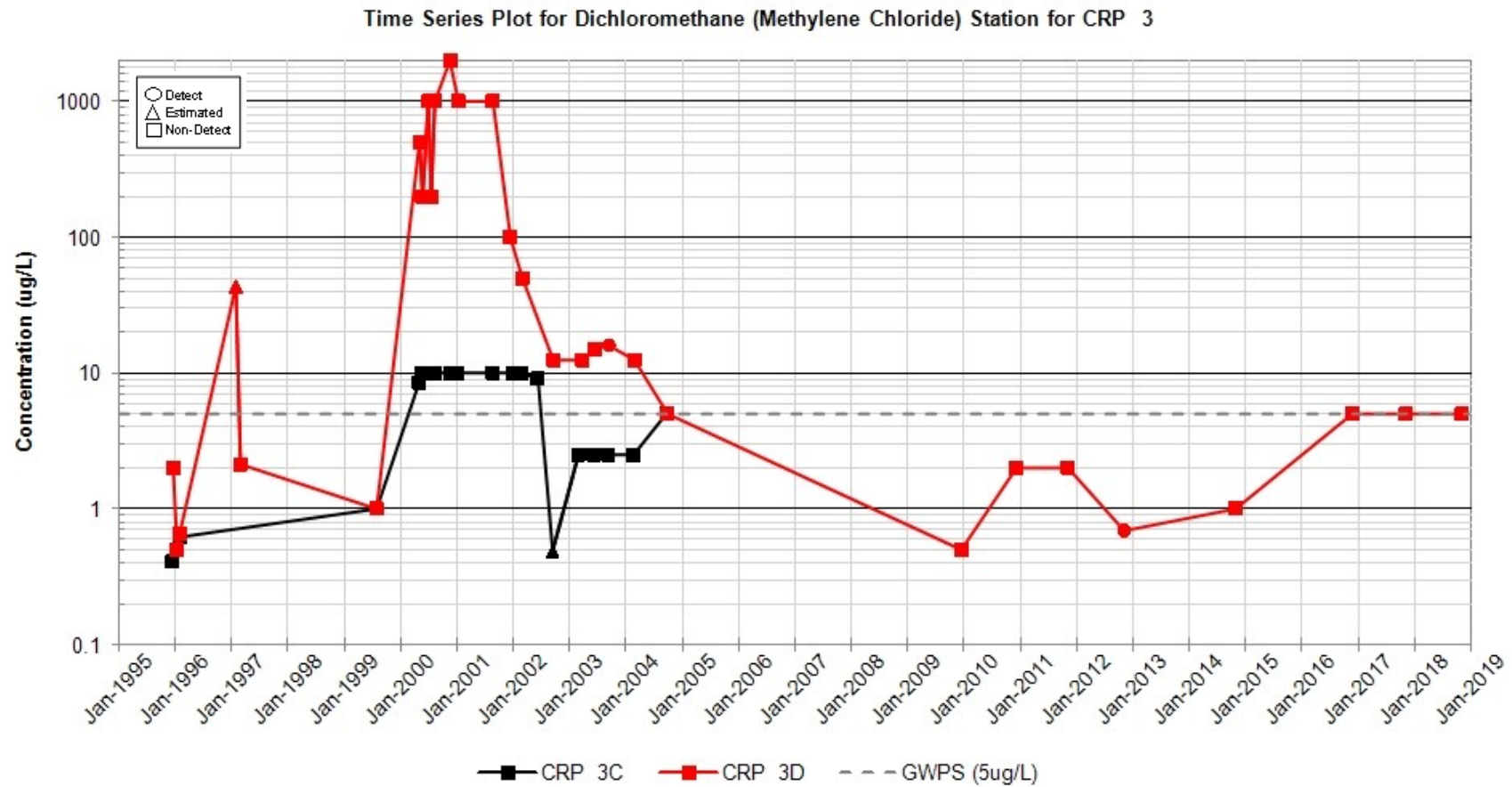


Figure C-53.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 5

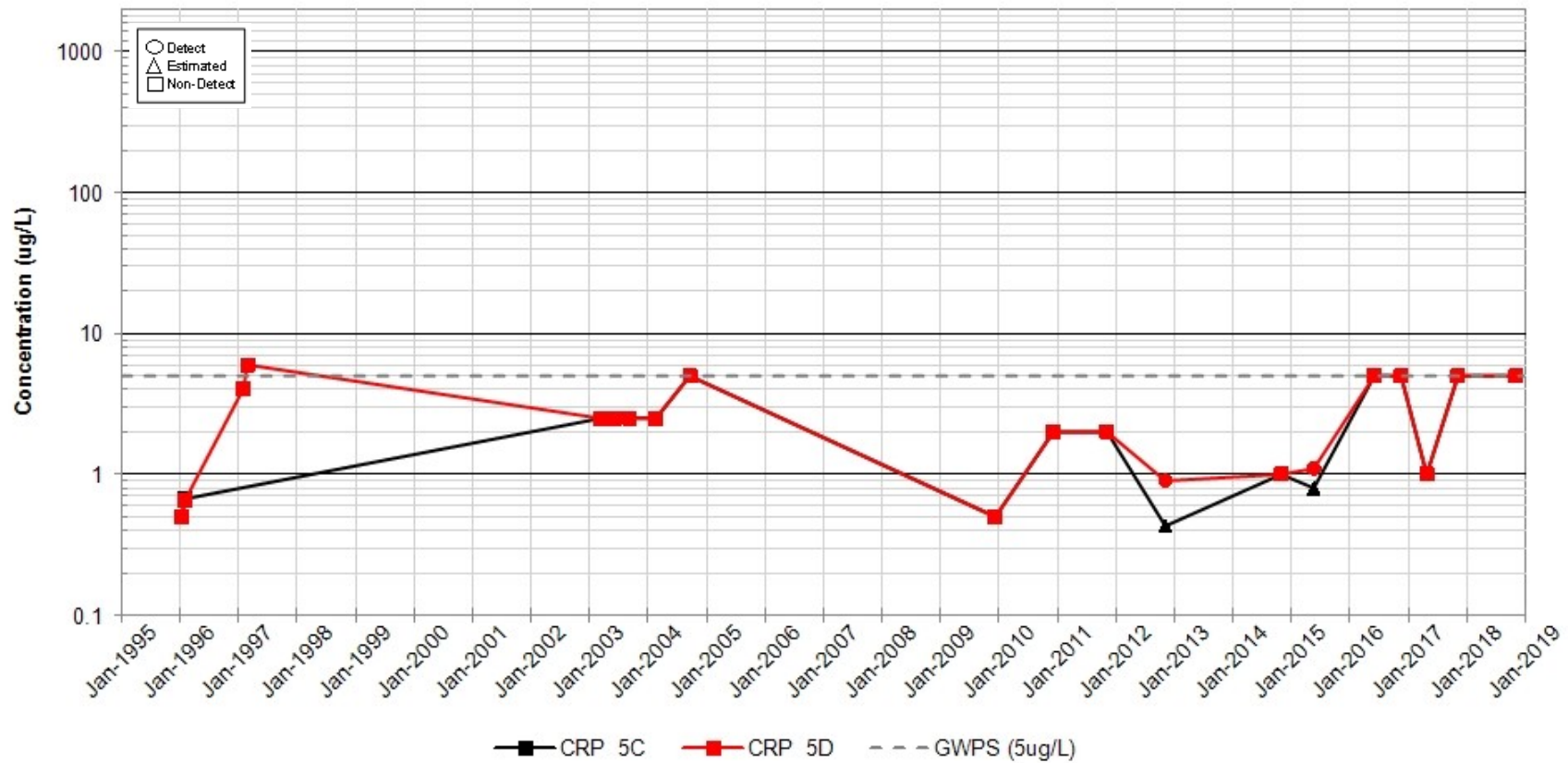


Figure C-54.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 6

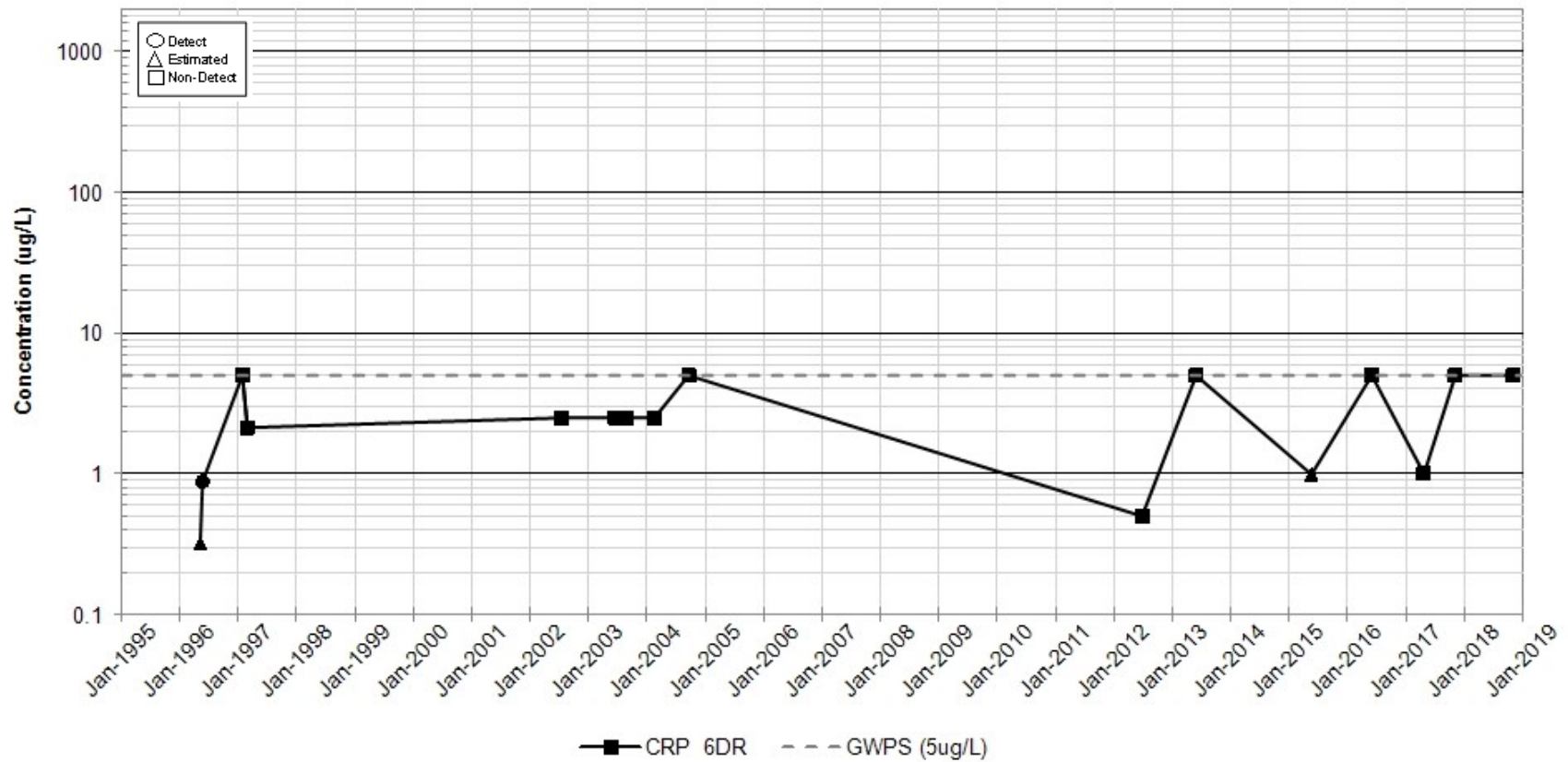


Figure C-55.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 8

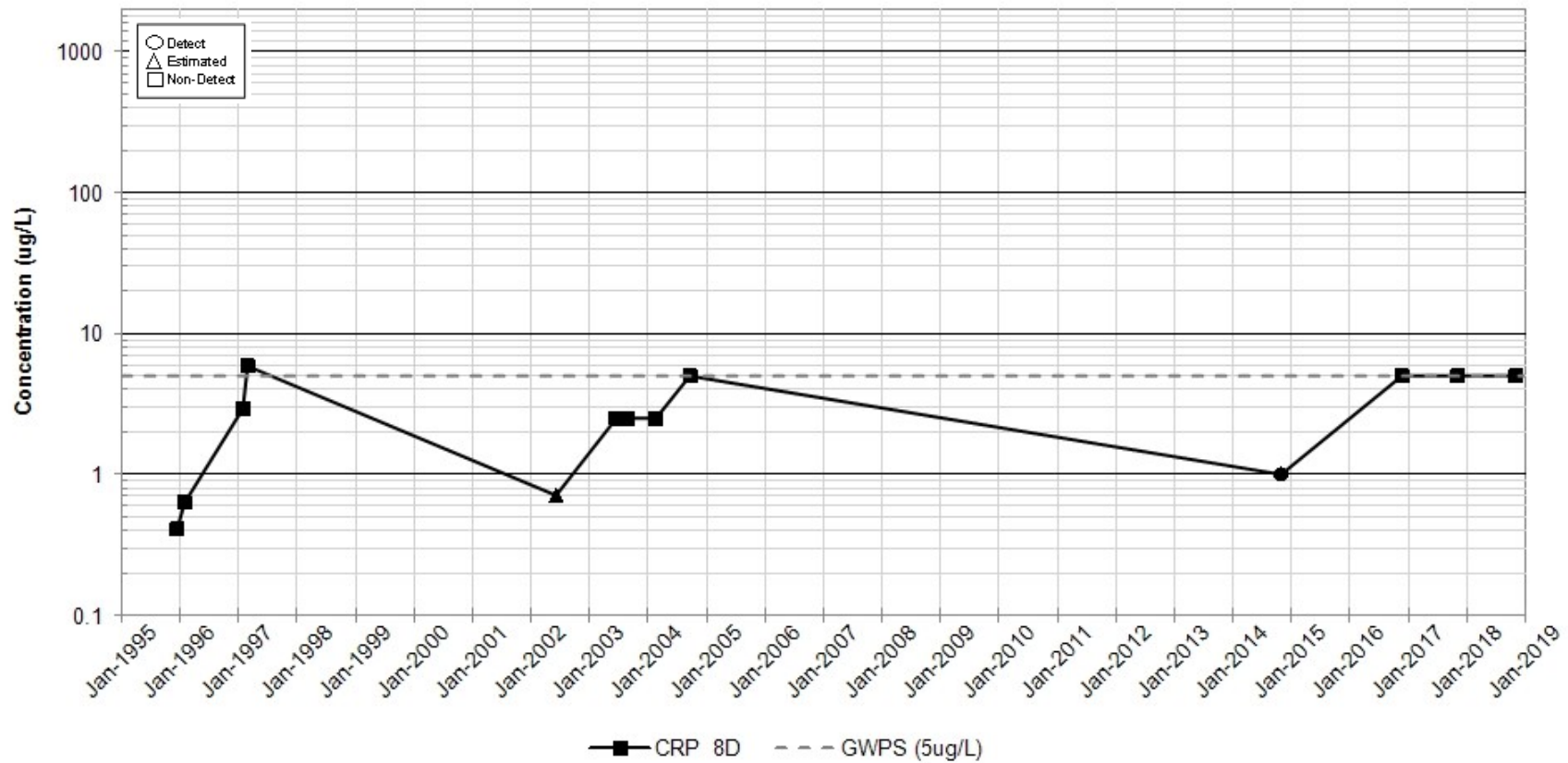


Figure C-56.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 18

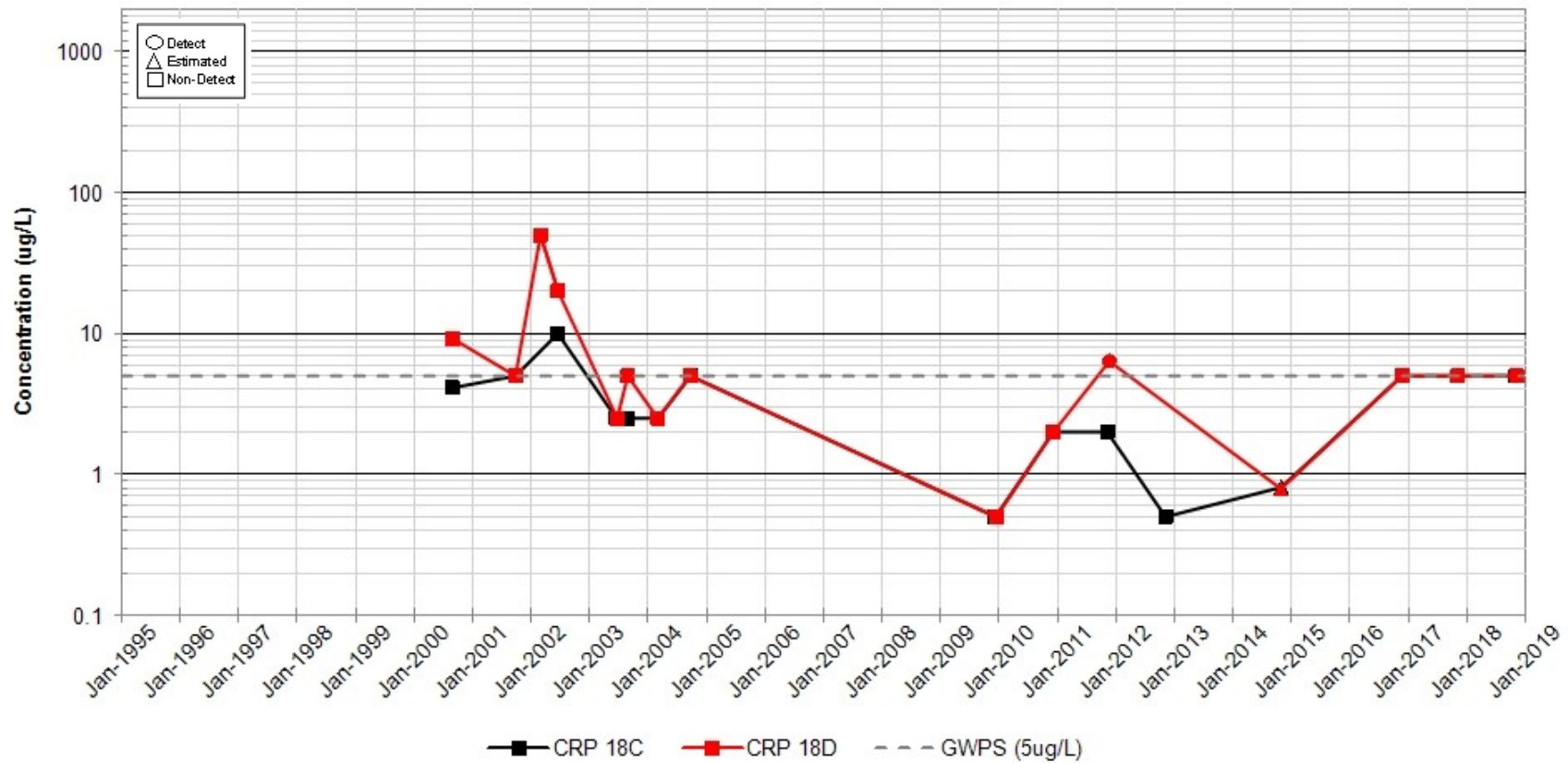


Figure C-57.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 20

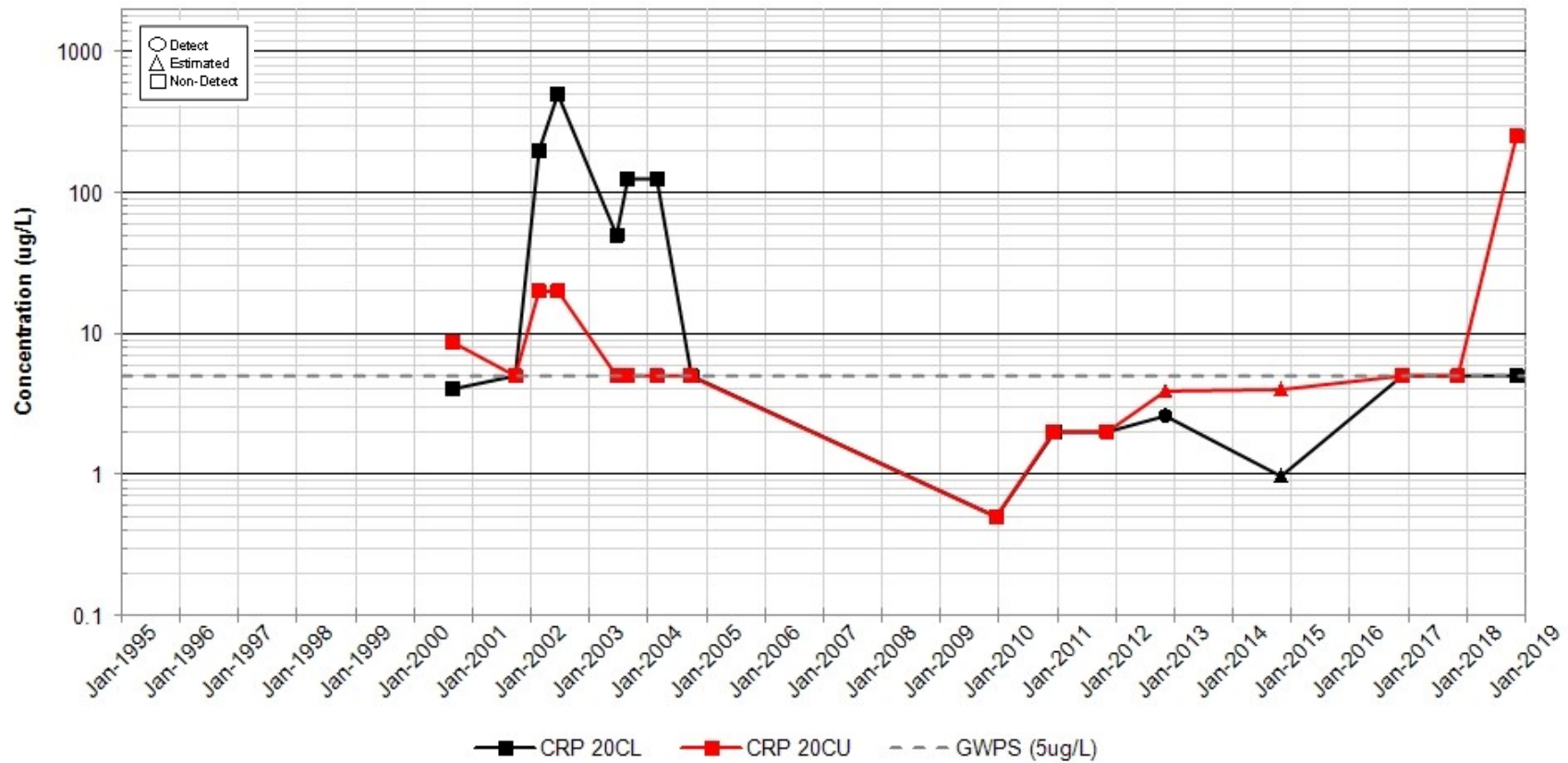


Figure C-58.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 22

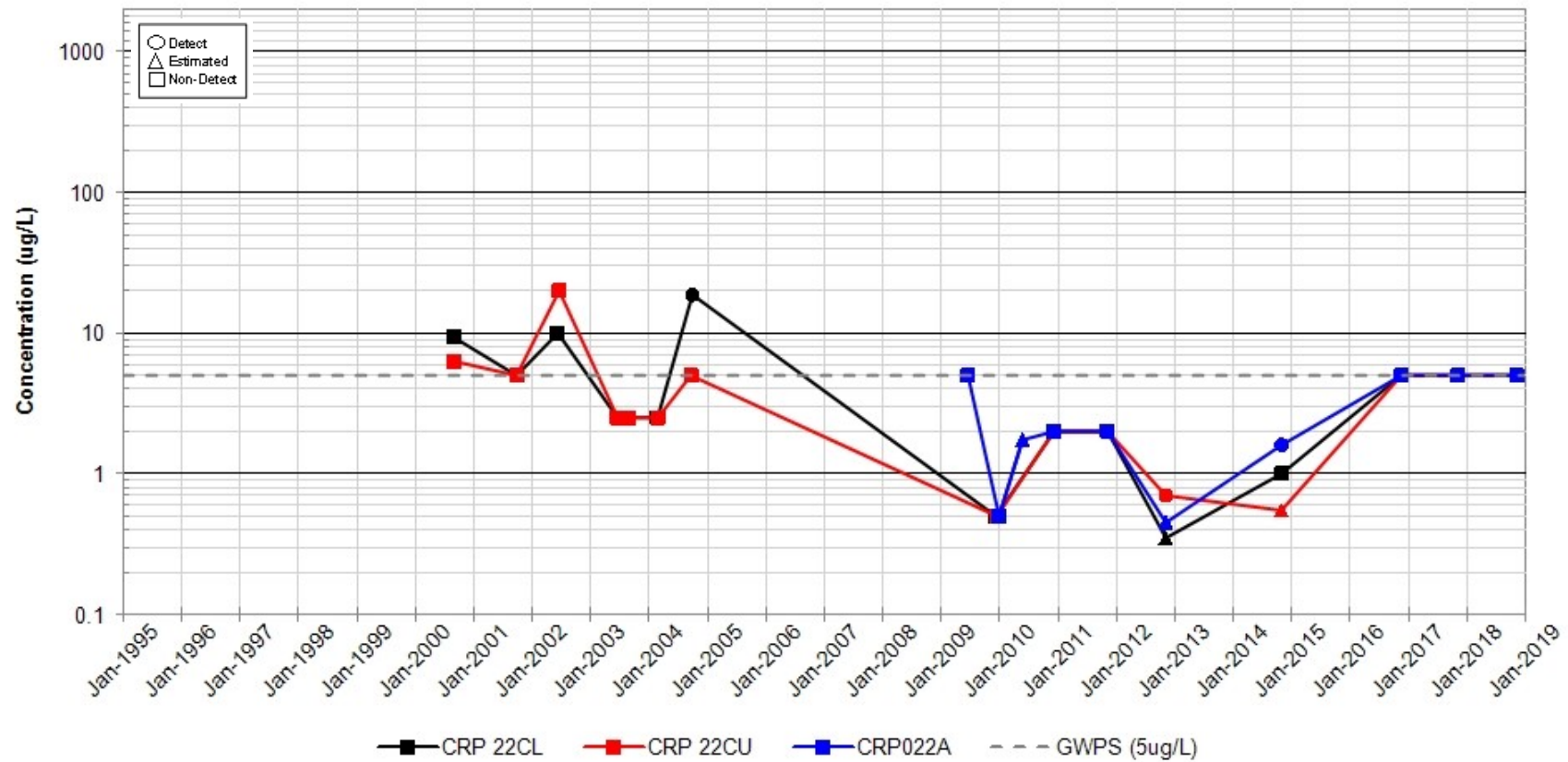


Figure C-59.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 45

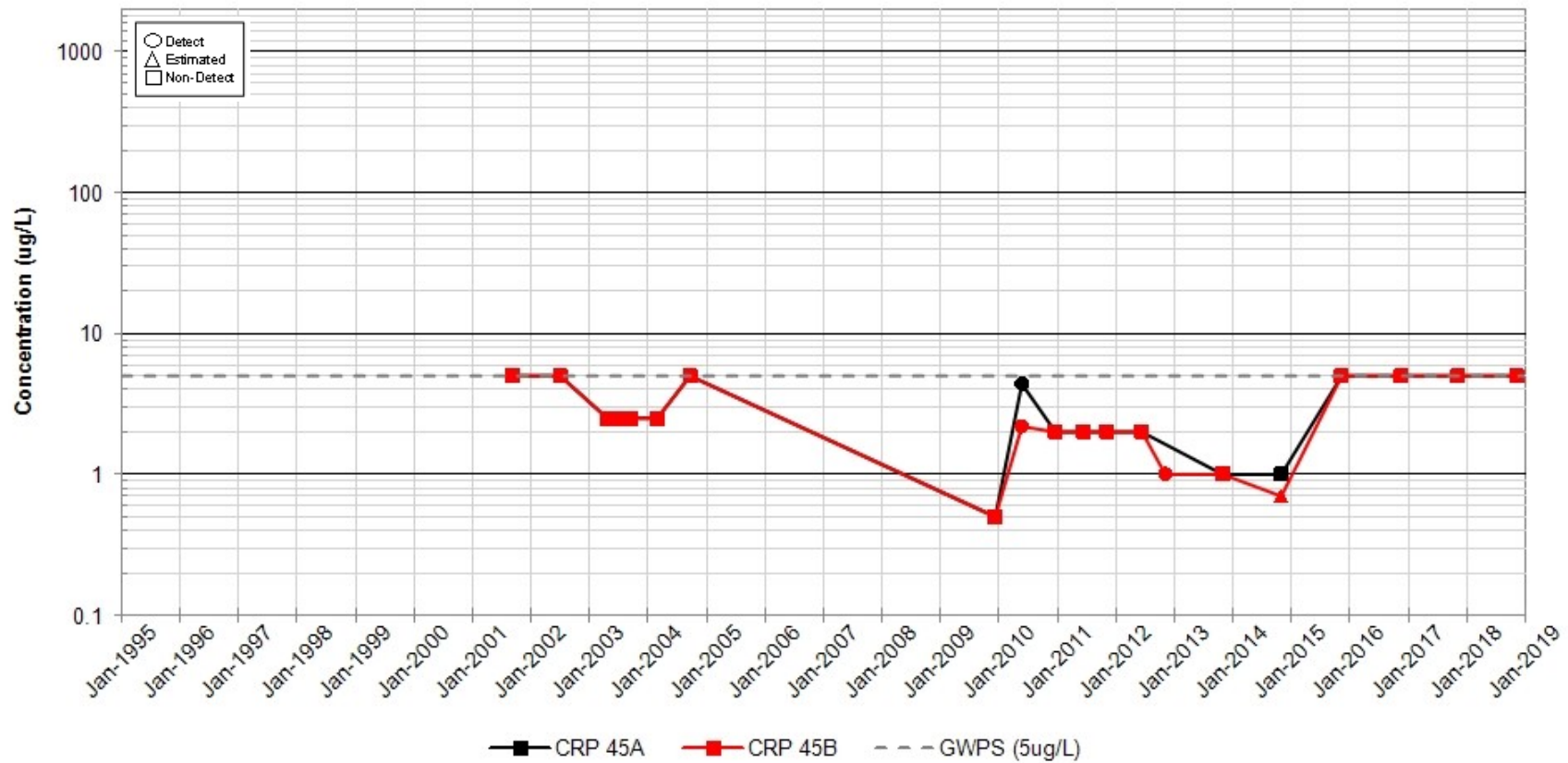


Figure C-60.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 46

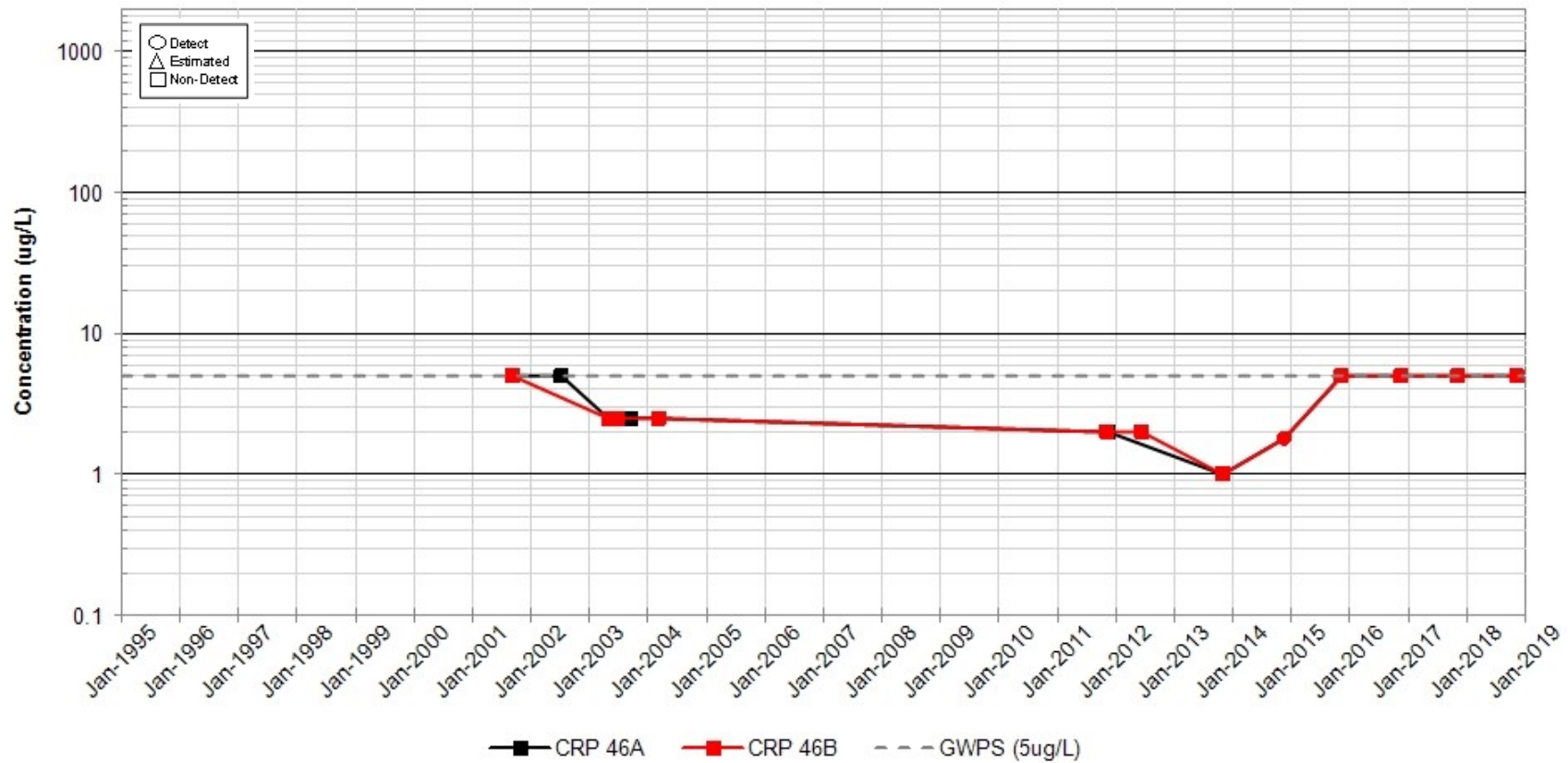


Figure C-61.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 48

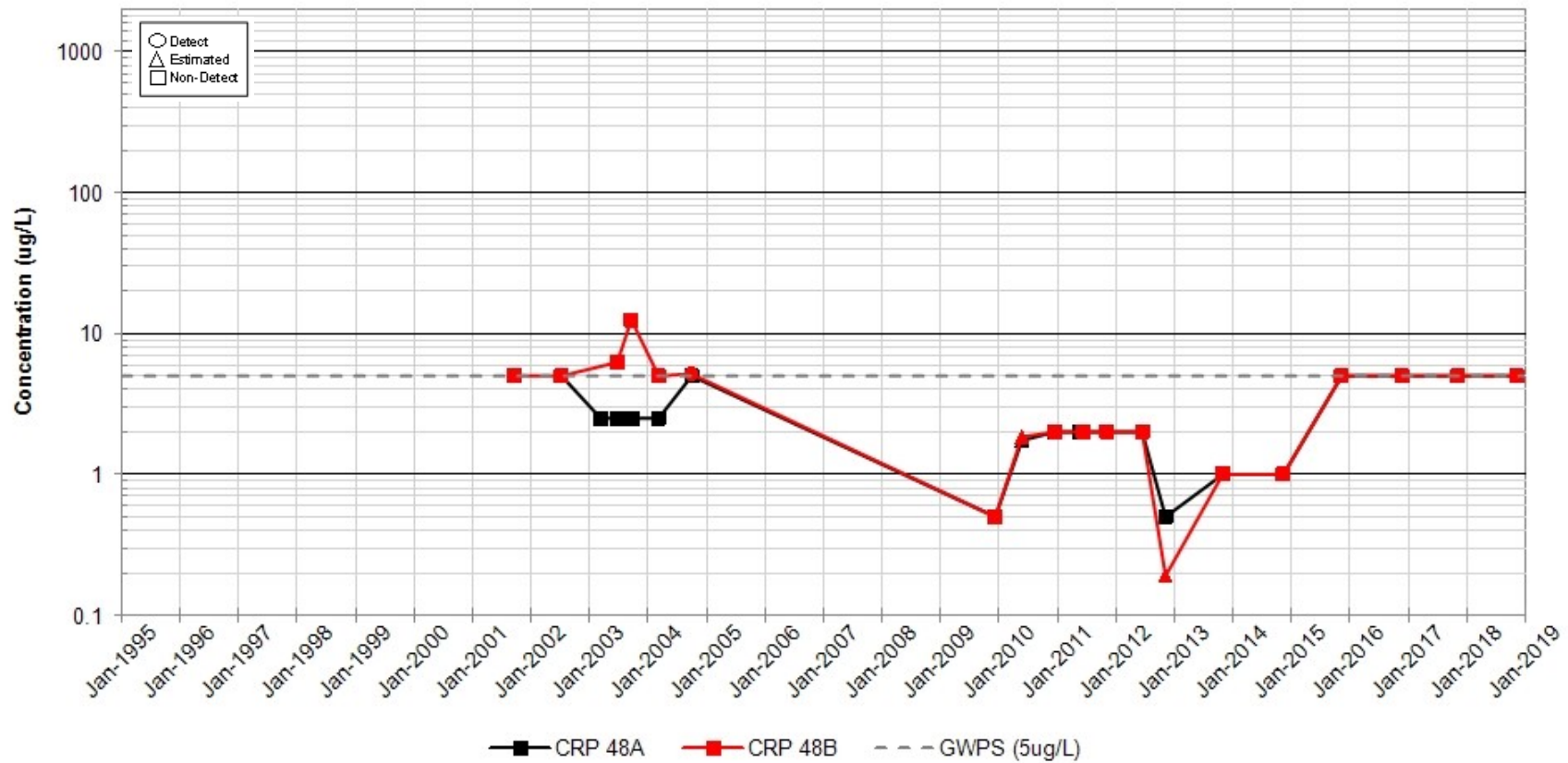


Figure C-62.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 50

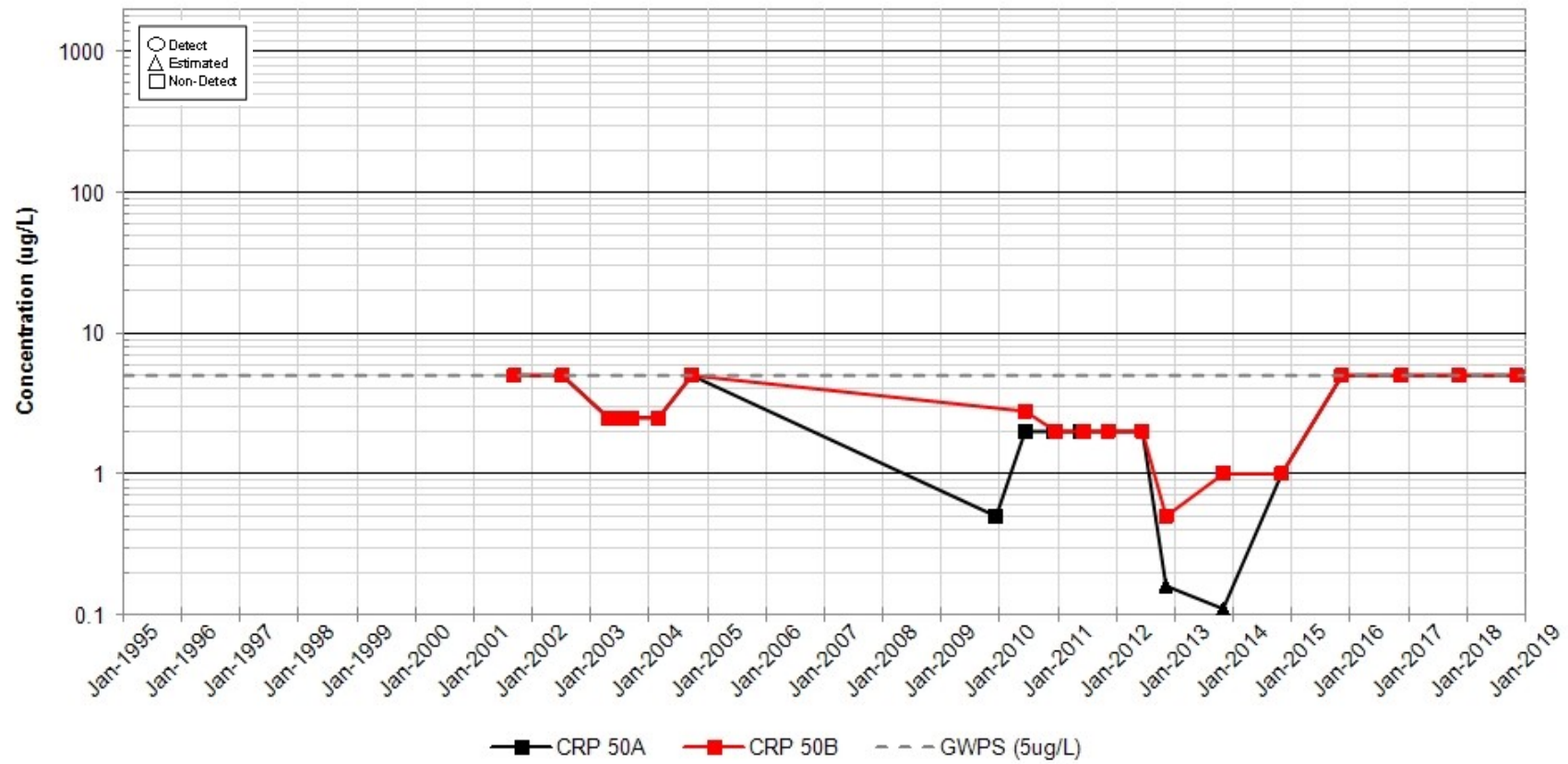


Figure C-63.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 51

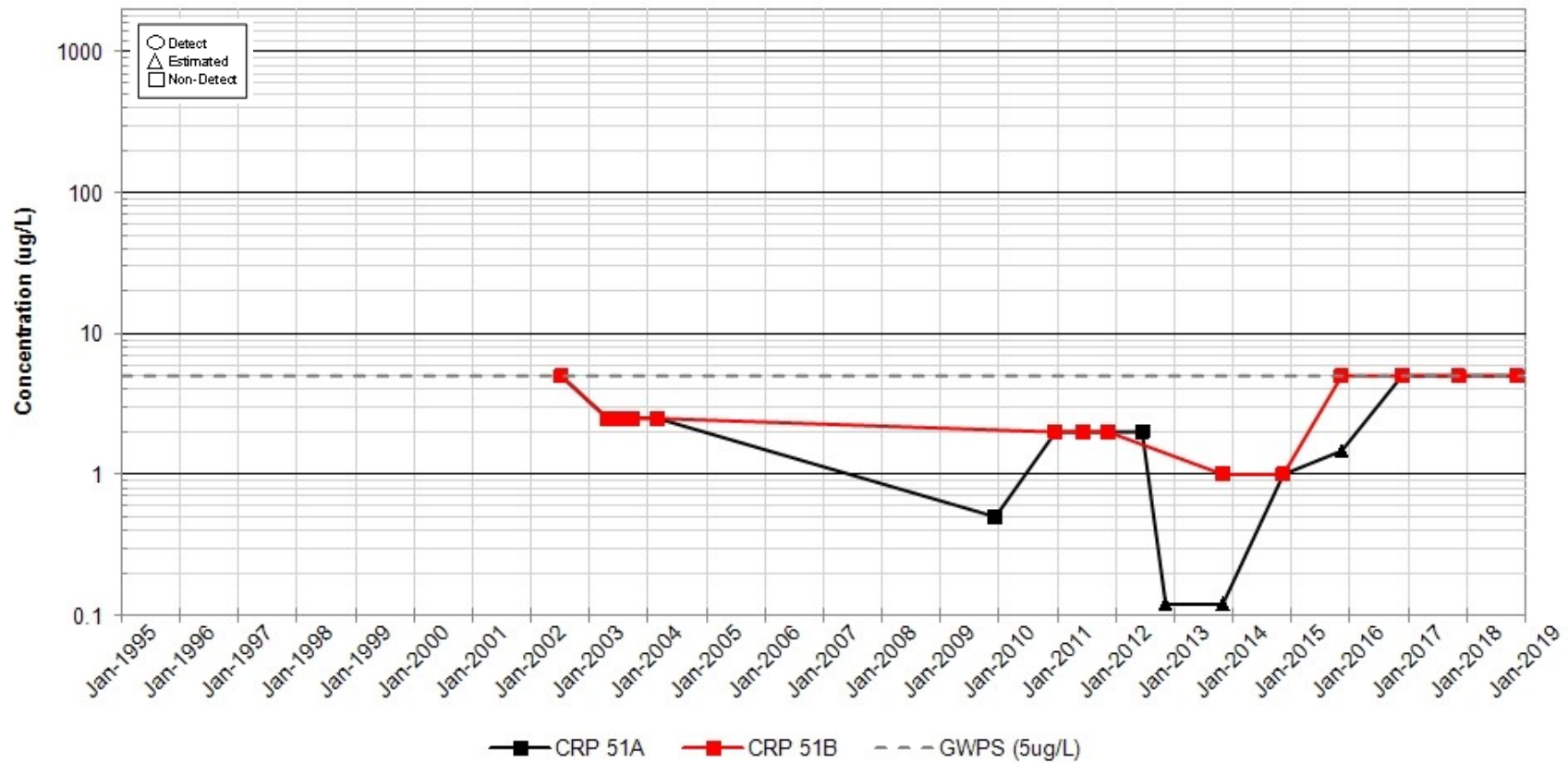


Figure C-64.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRP 52

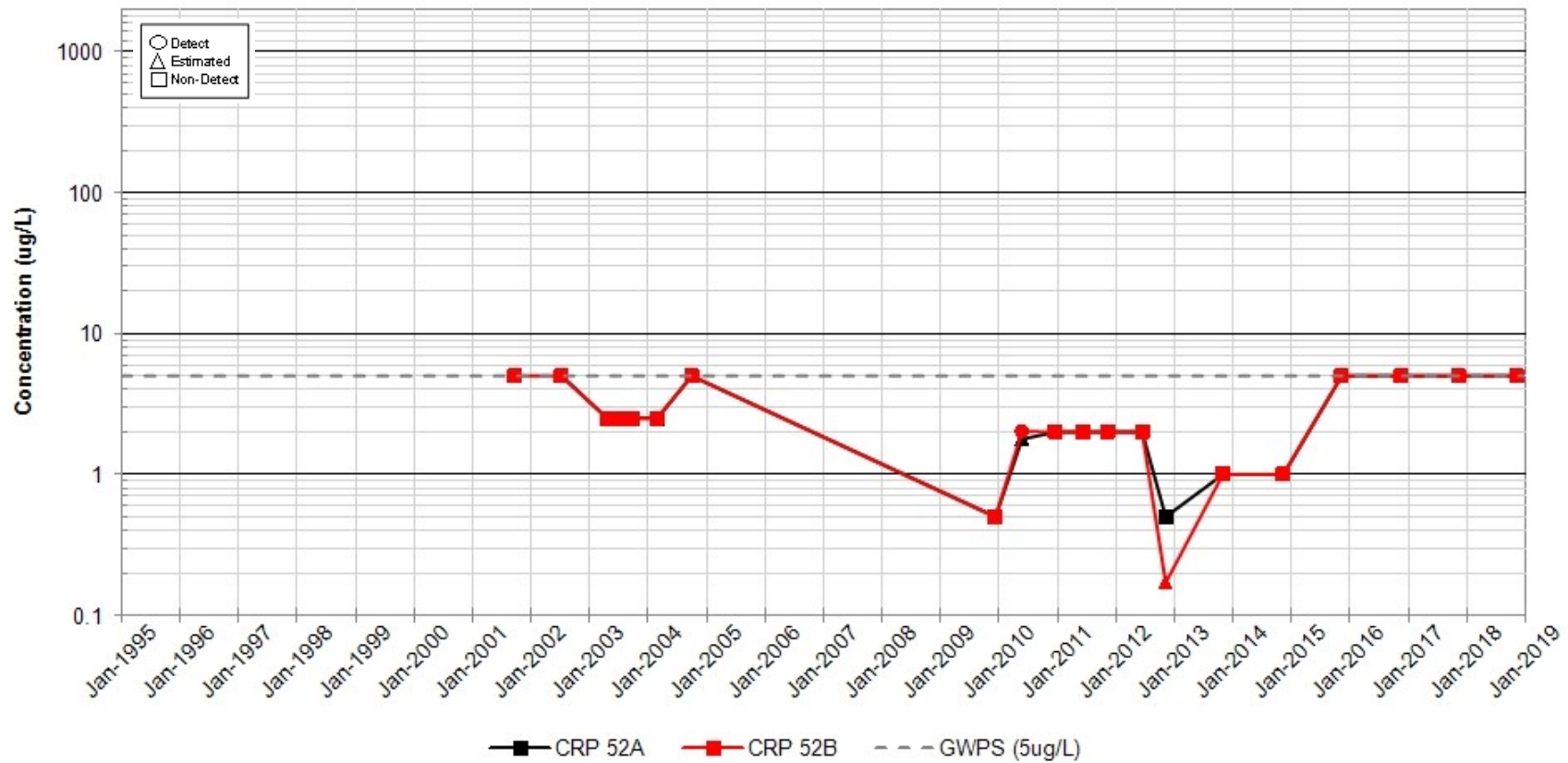


Figure C-65.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRW 10

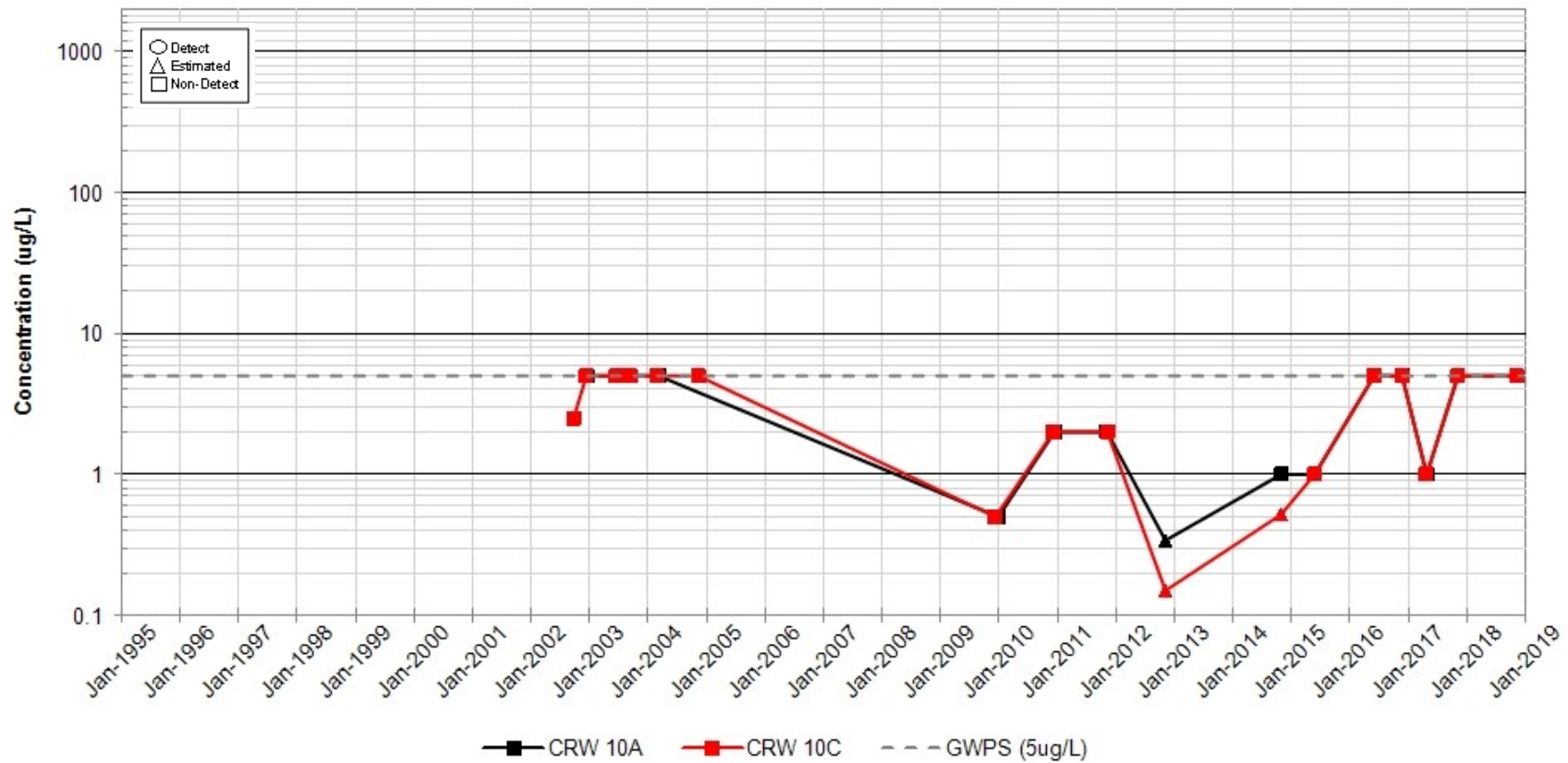


Figure C-66.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRW 12

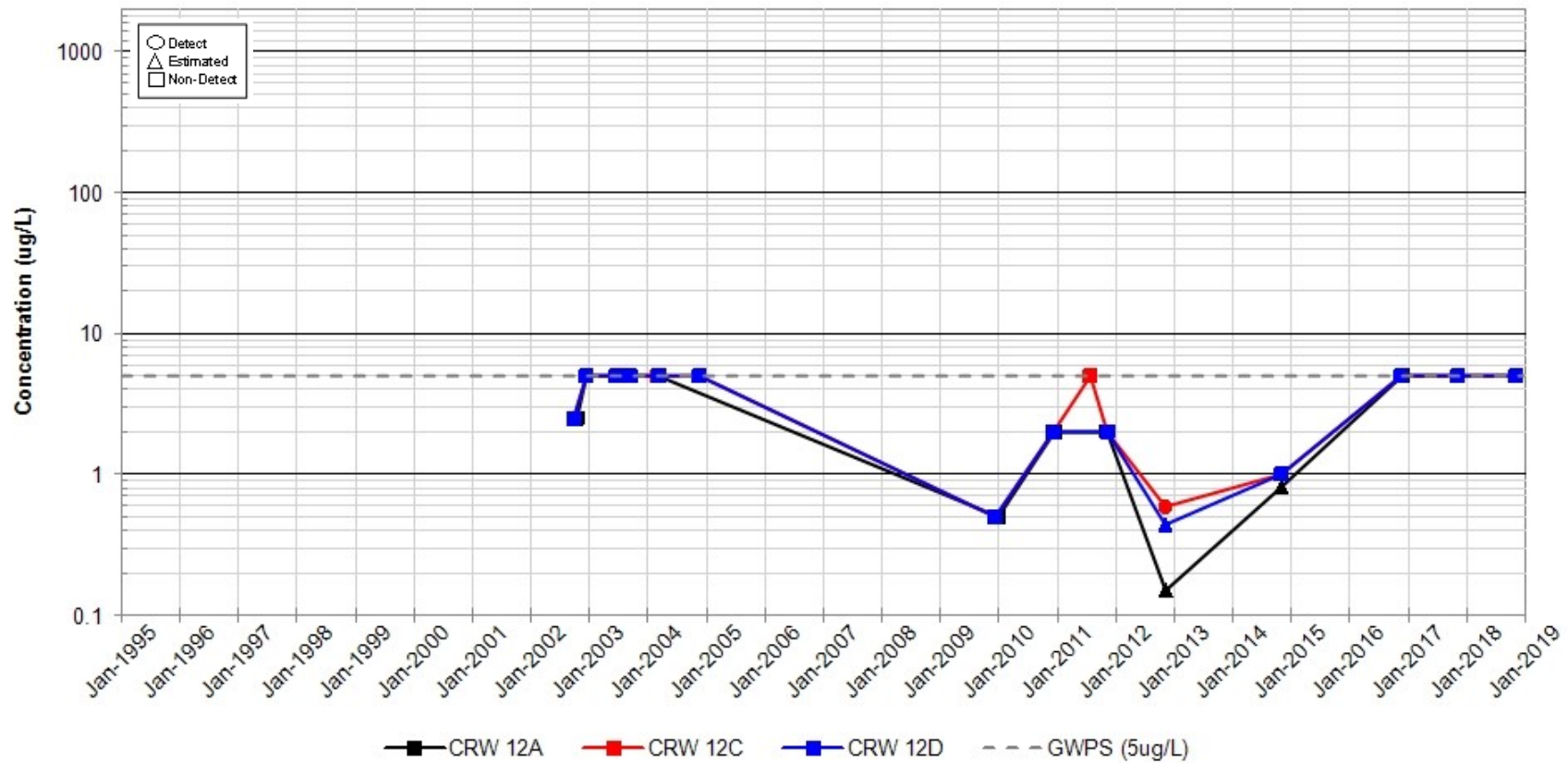


Figure C-67.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for CRW010

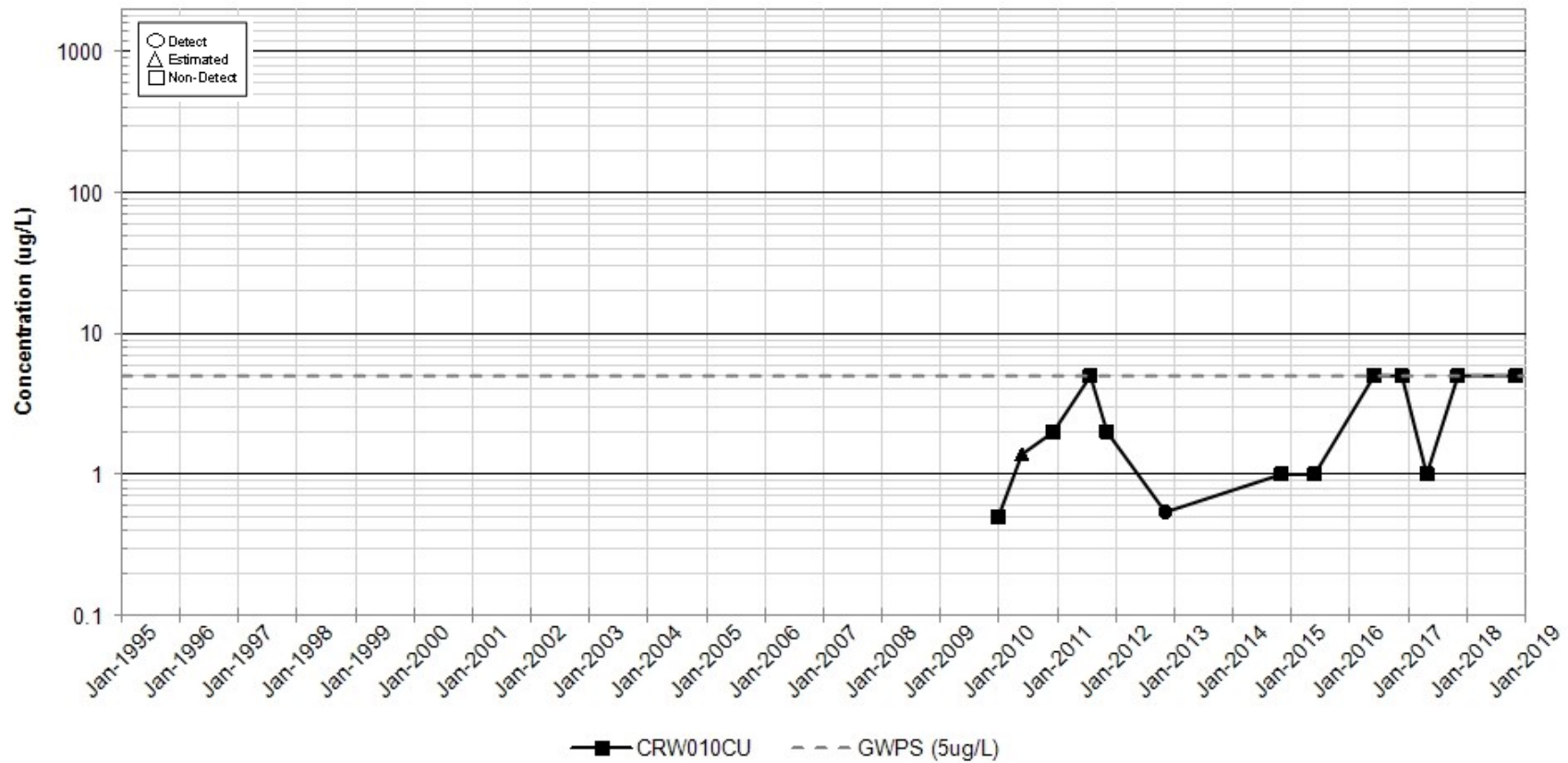


Figure C-68.

Time Series Plot for Dichloromethane (Methylene Chloride) Station for TL 01

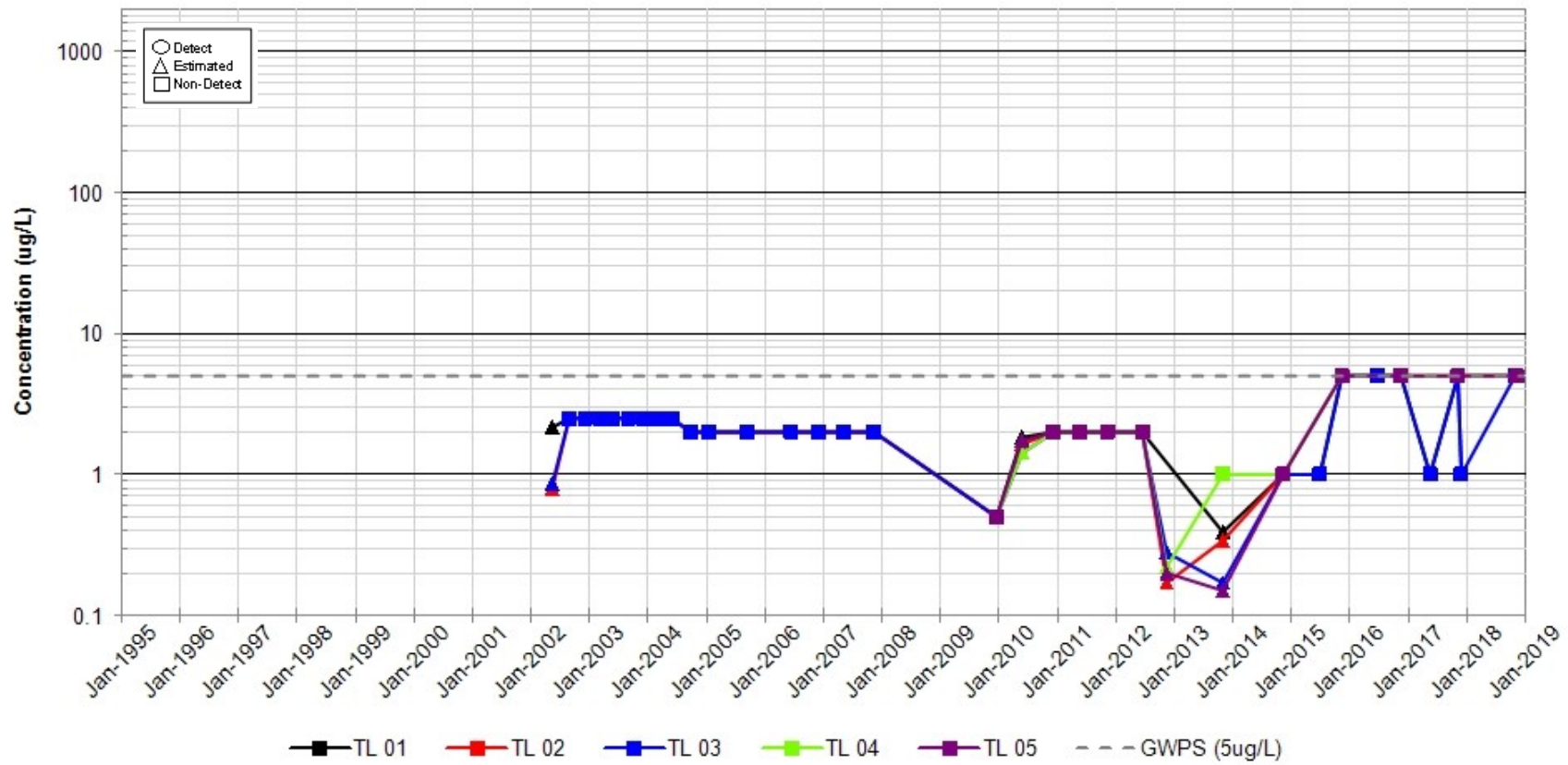


Figure C-69.

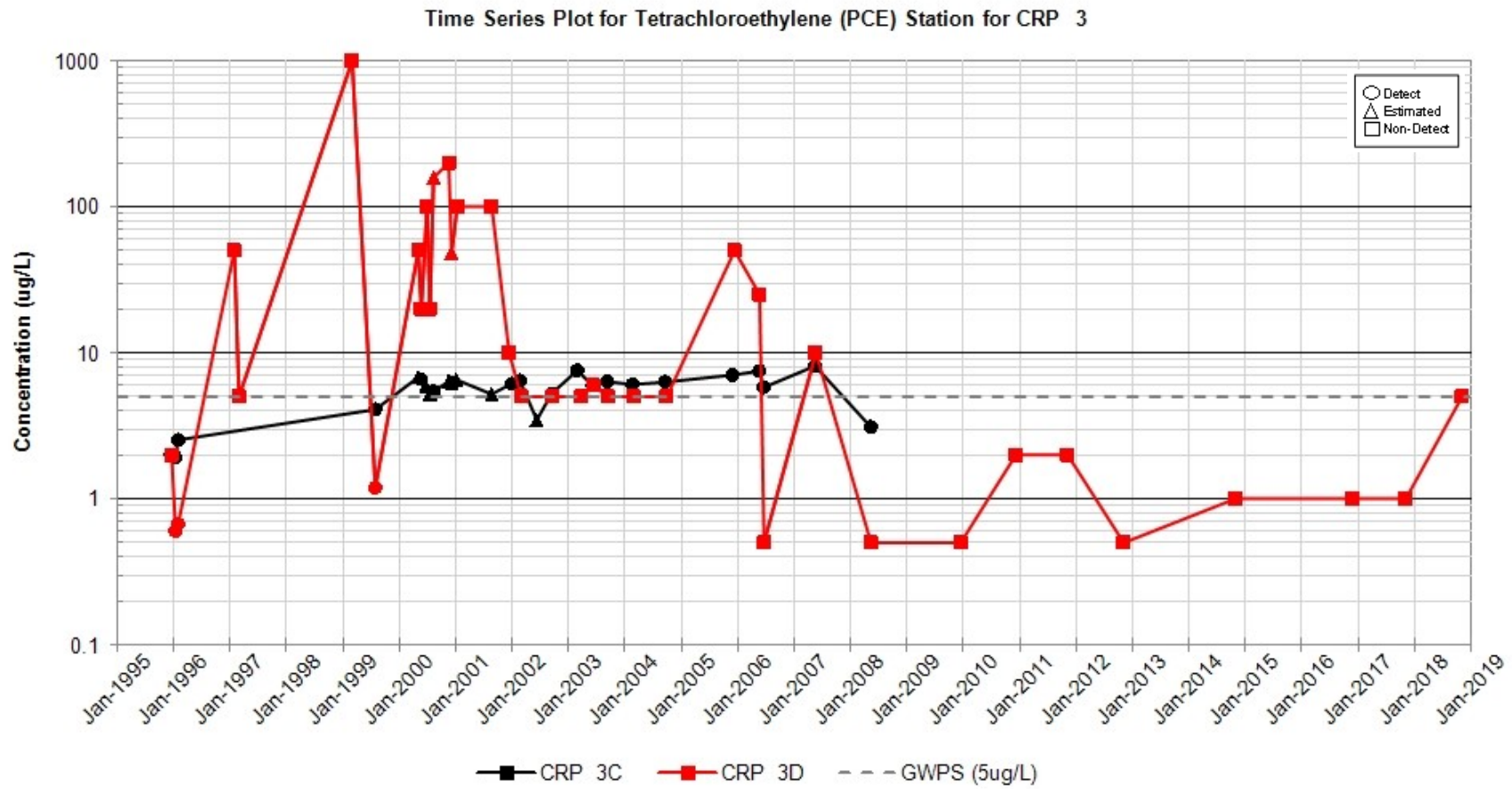


Figure C-70.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 5

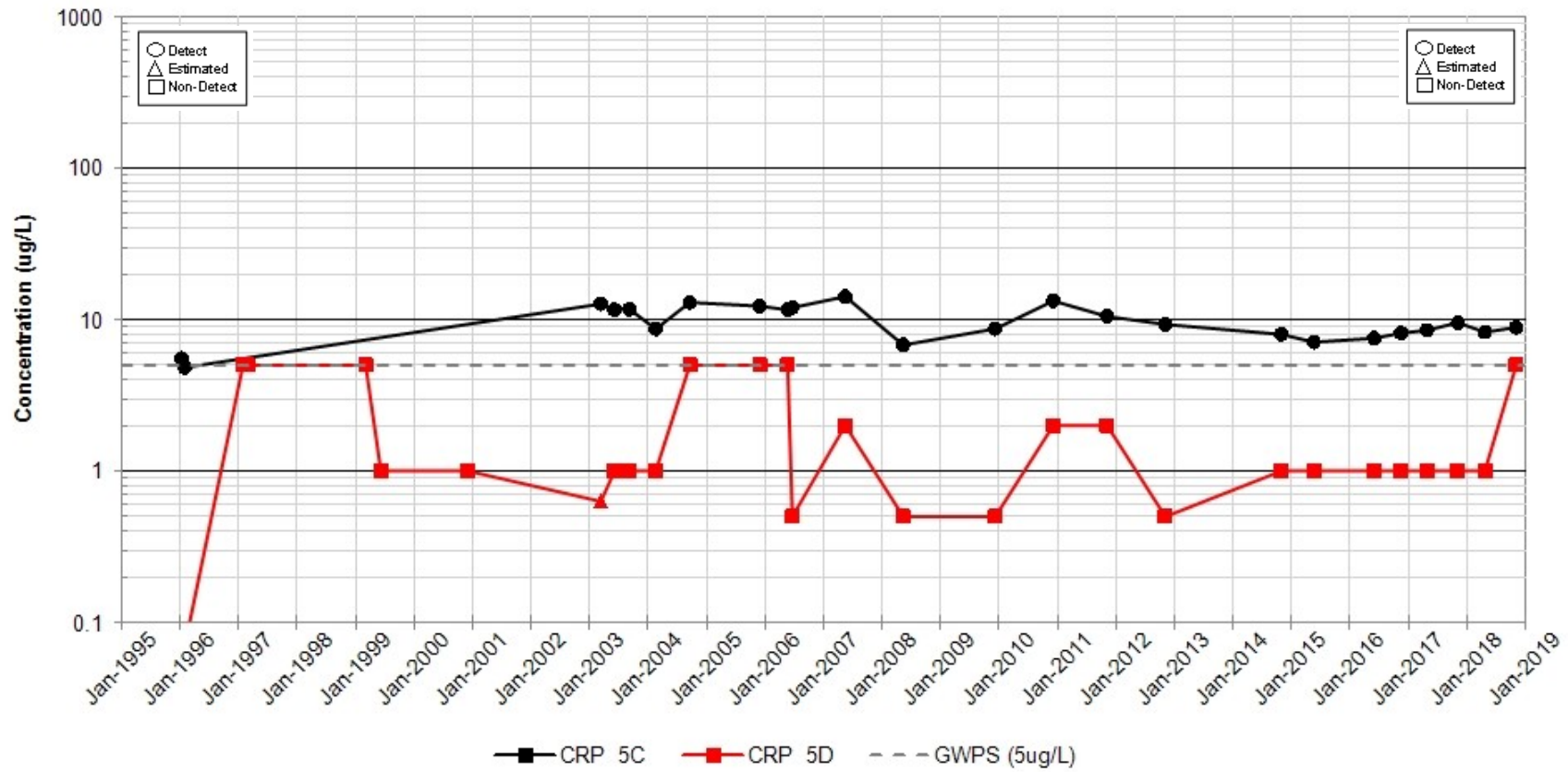


Figure C-71.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 6

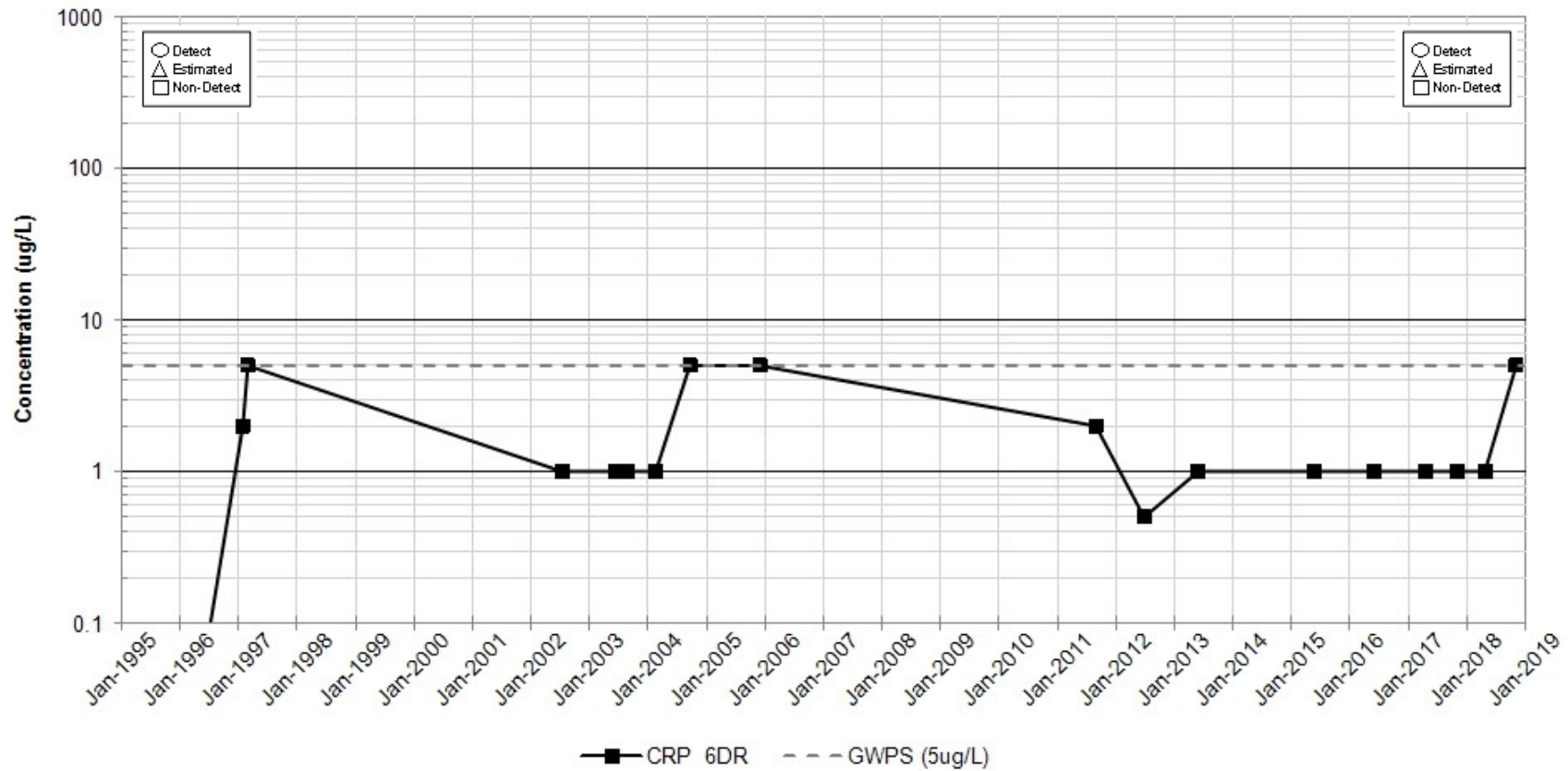


Figure C-72.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 8

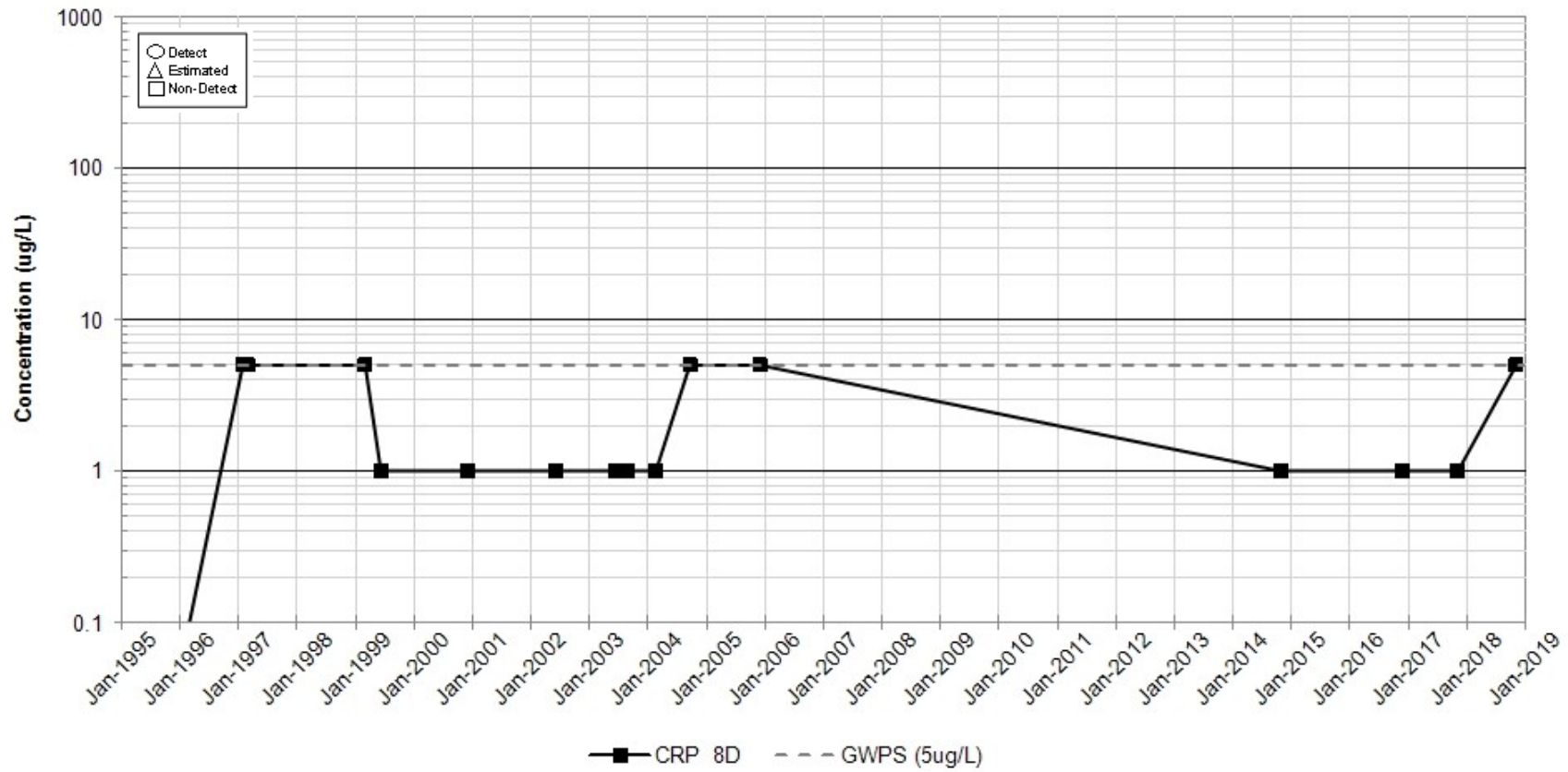


Figure C-73.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 18

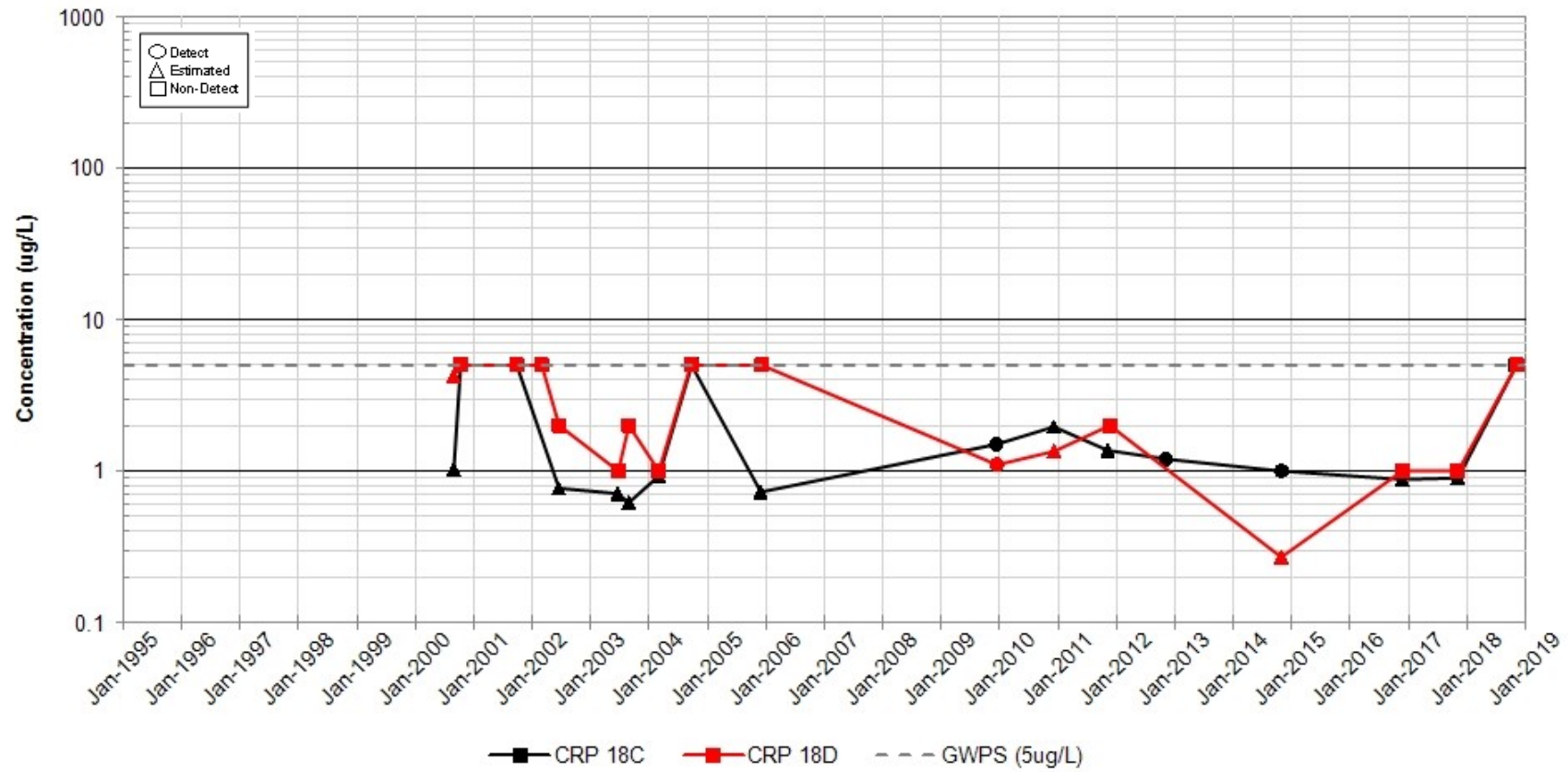


Figure C-74.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 20

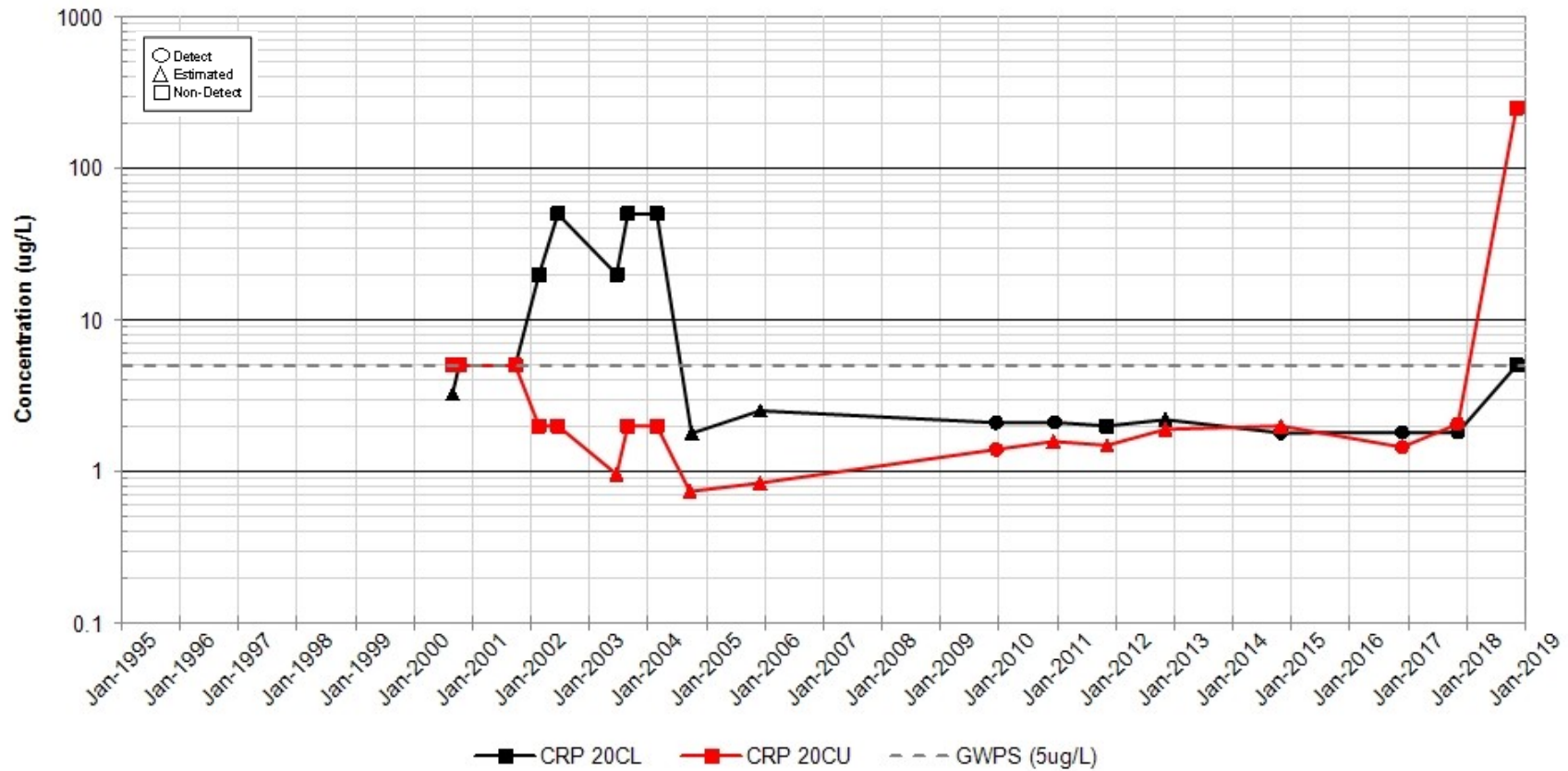


Figure C-75.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 22

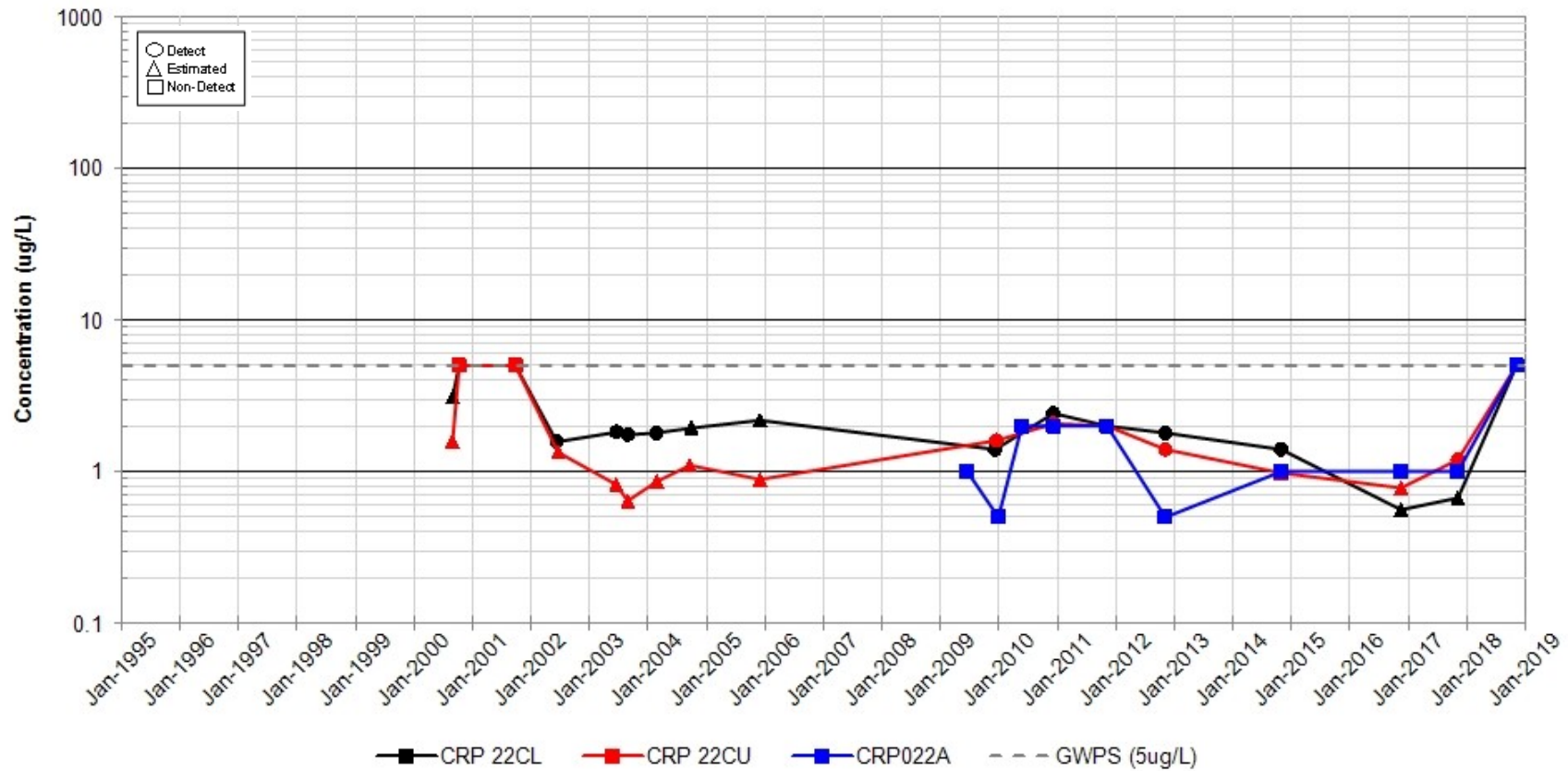


Figure C-76.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 45

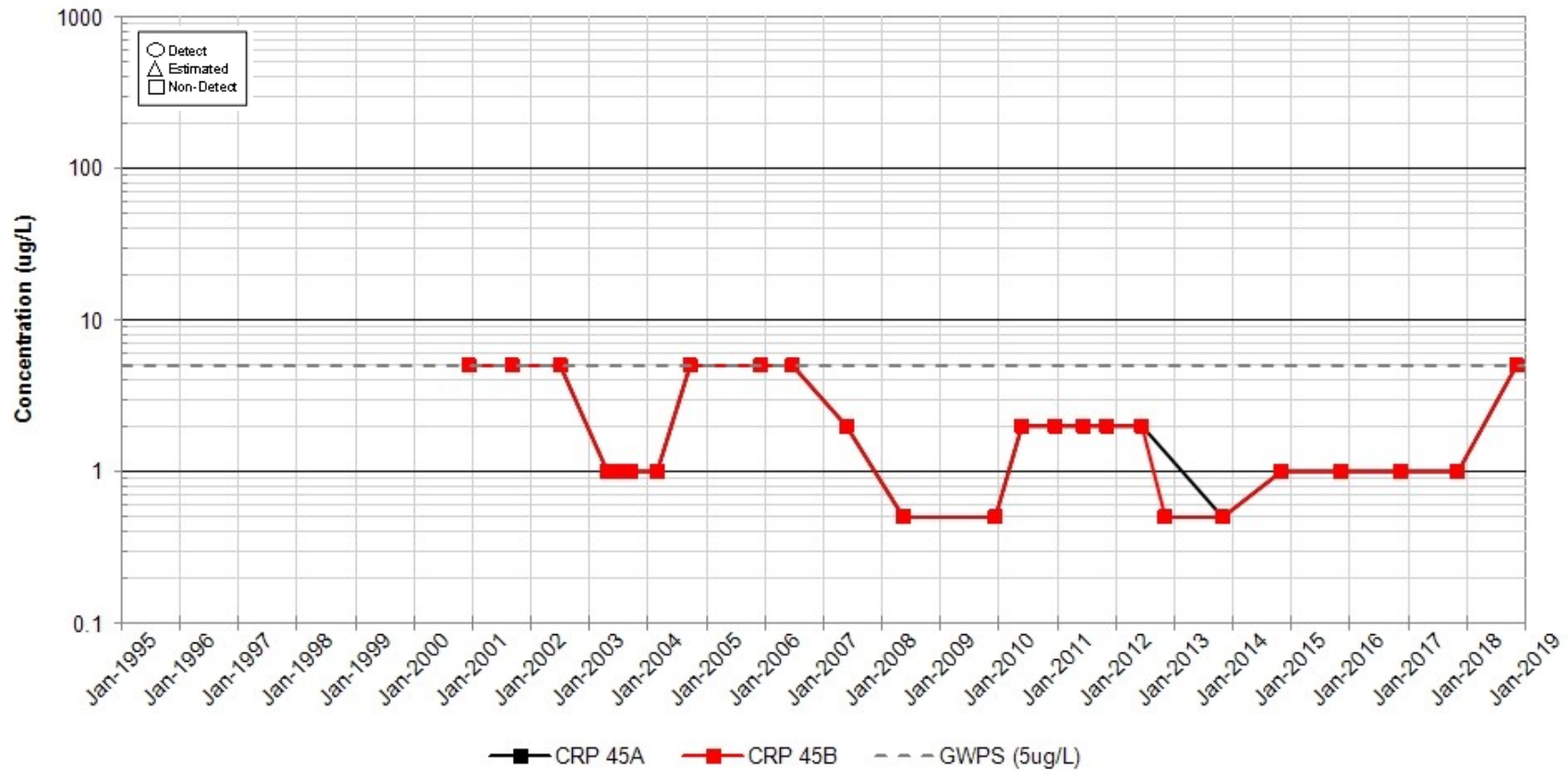


Figure C-77.

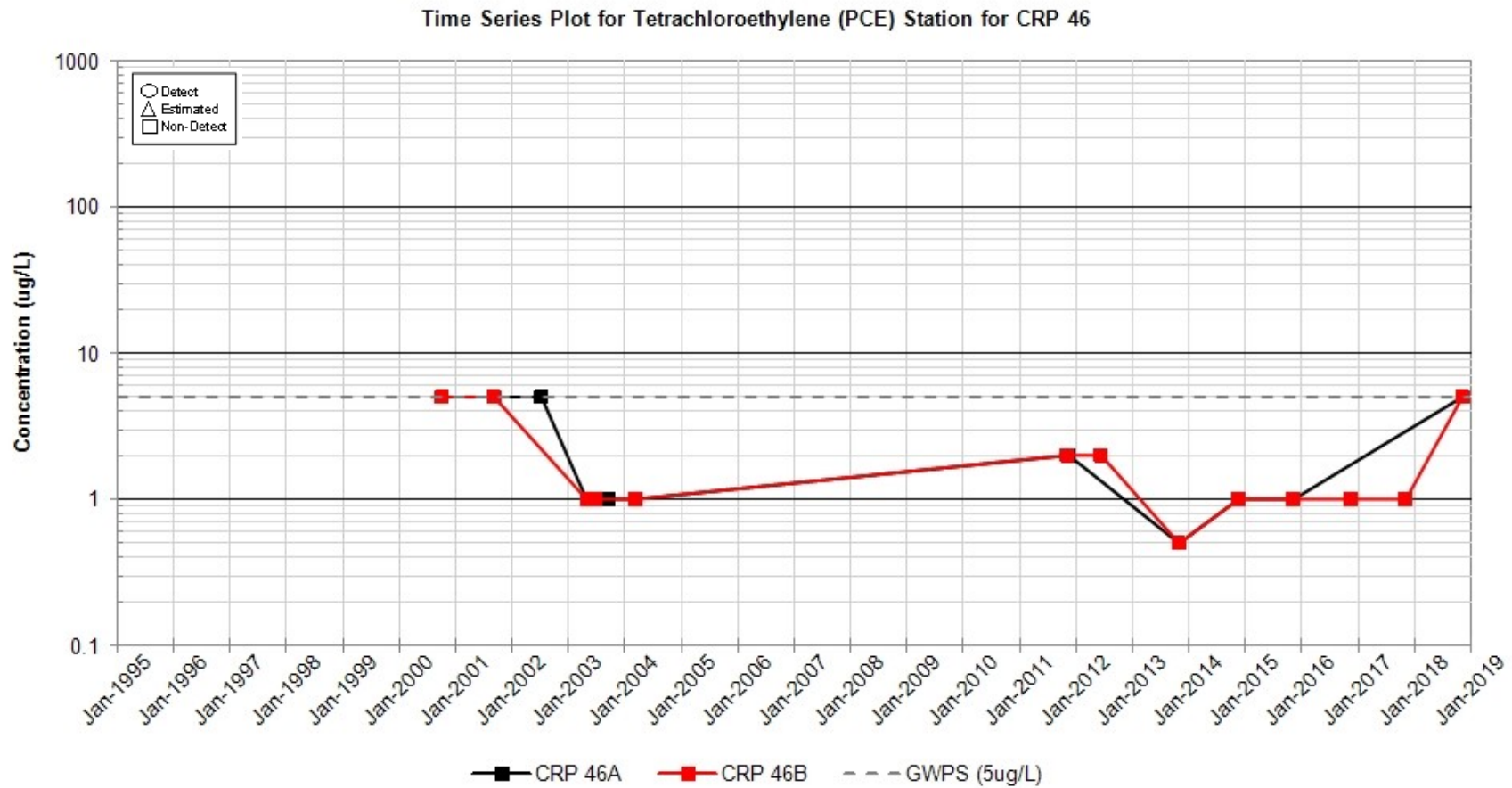


Figure C-78.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 48

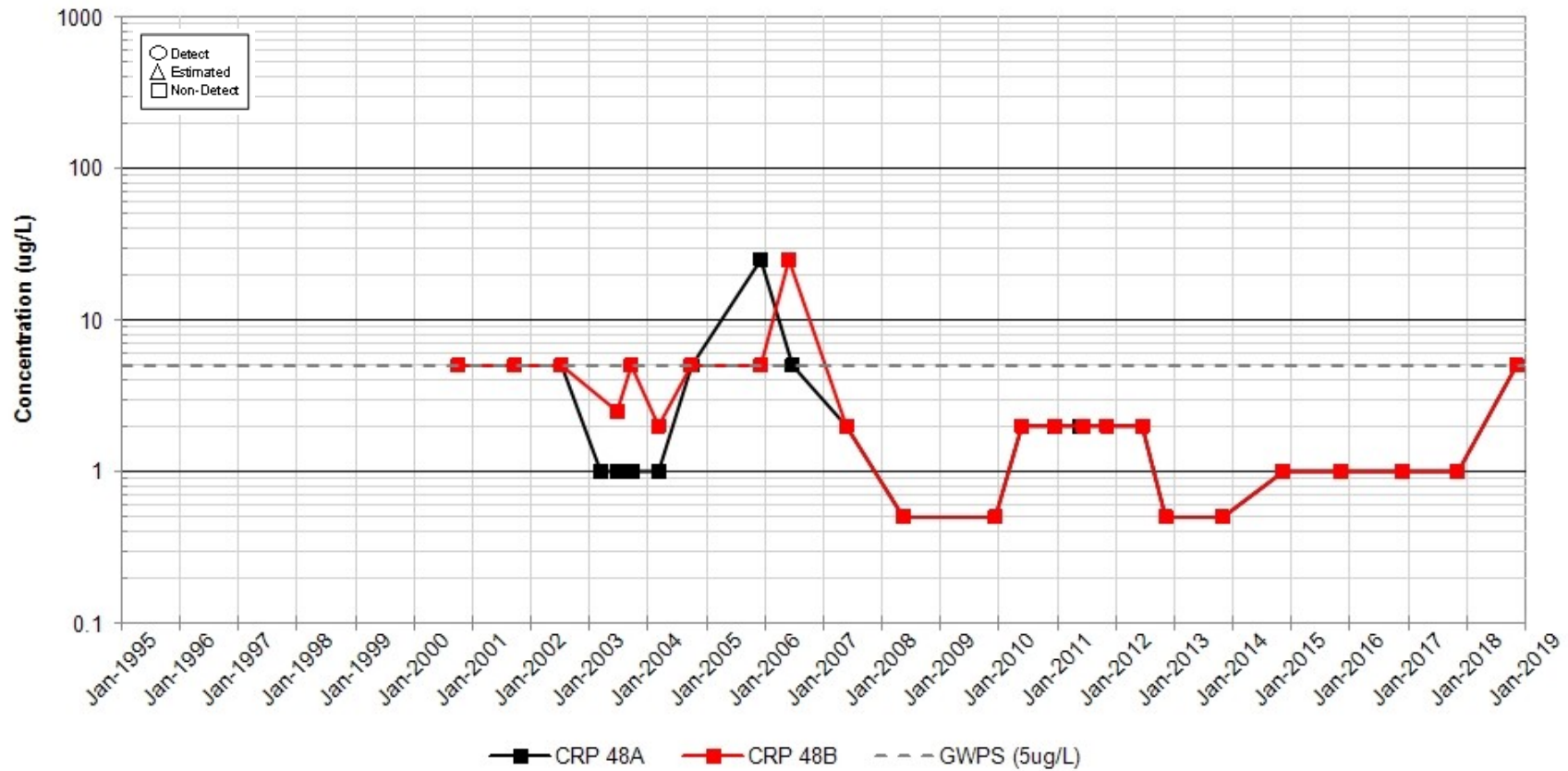


Figure C-79.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 50

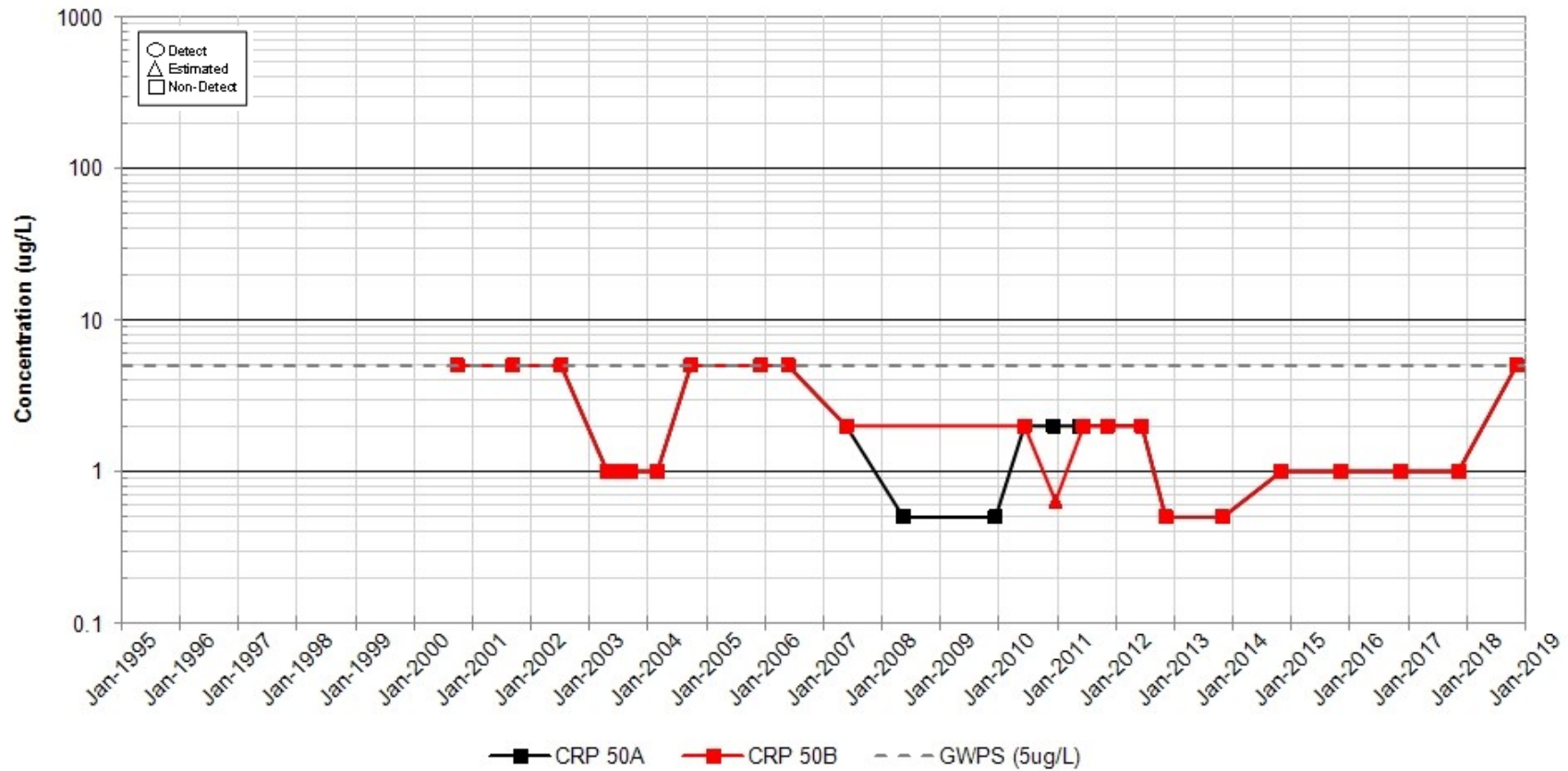


Figure C-80.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 51

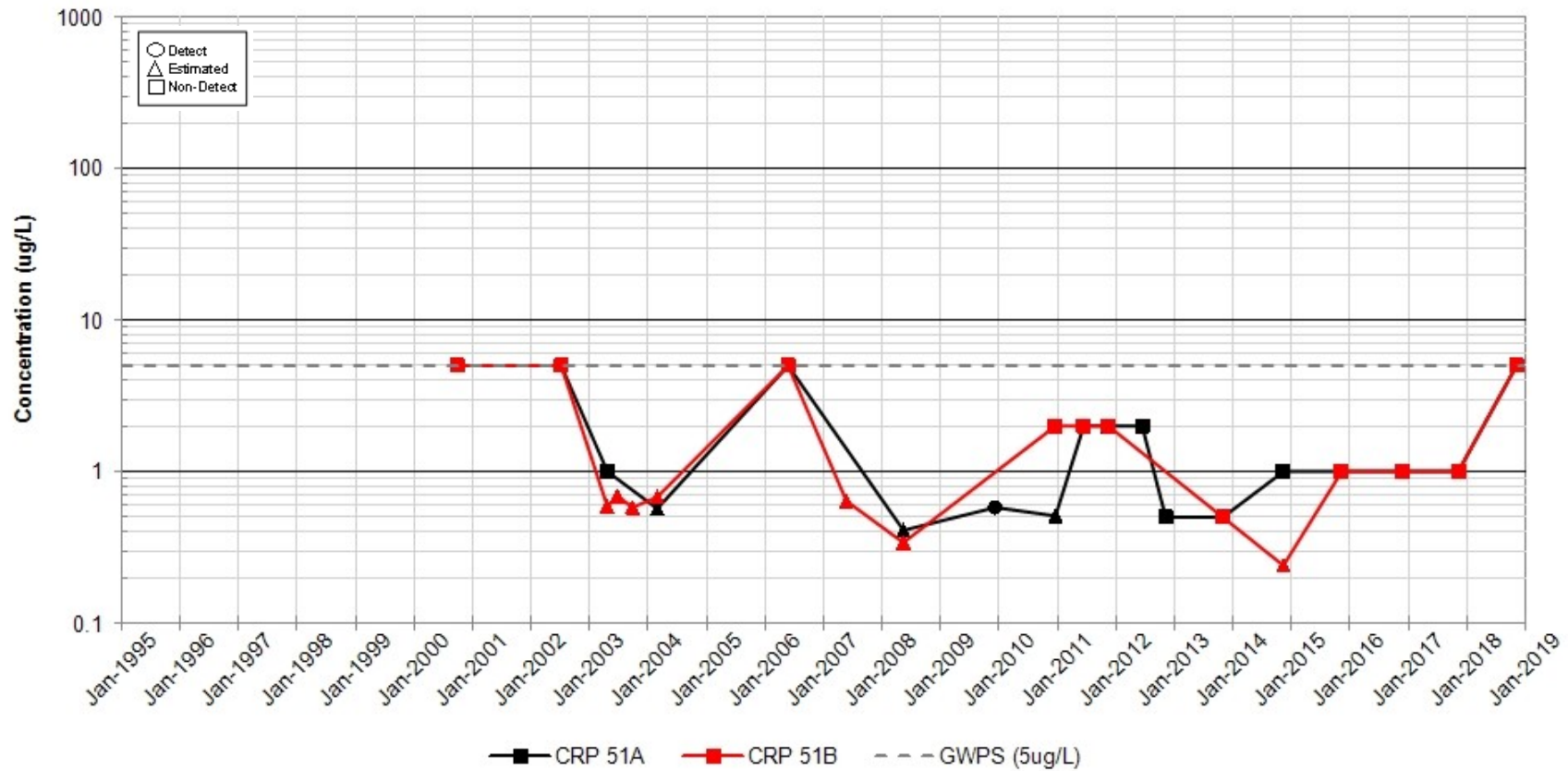


Figure C-81.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRP 52

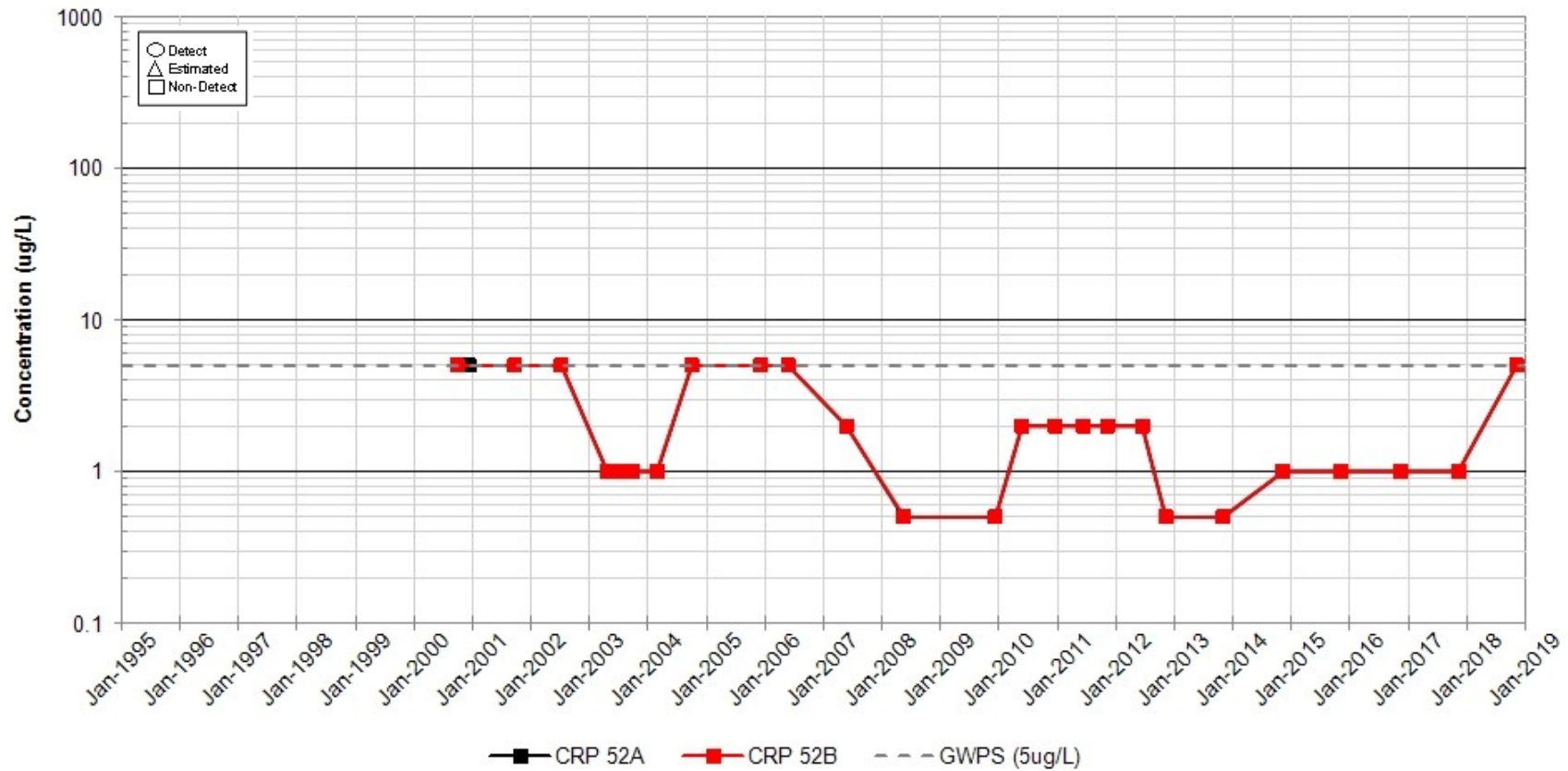


Figure C-82.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRW 10

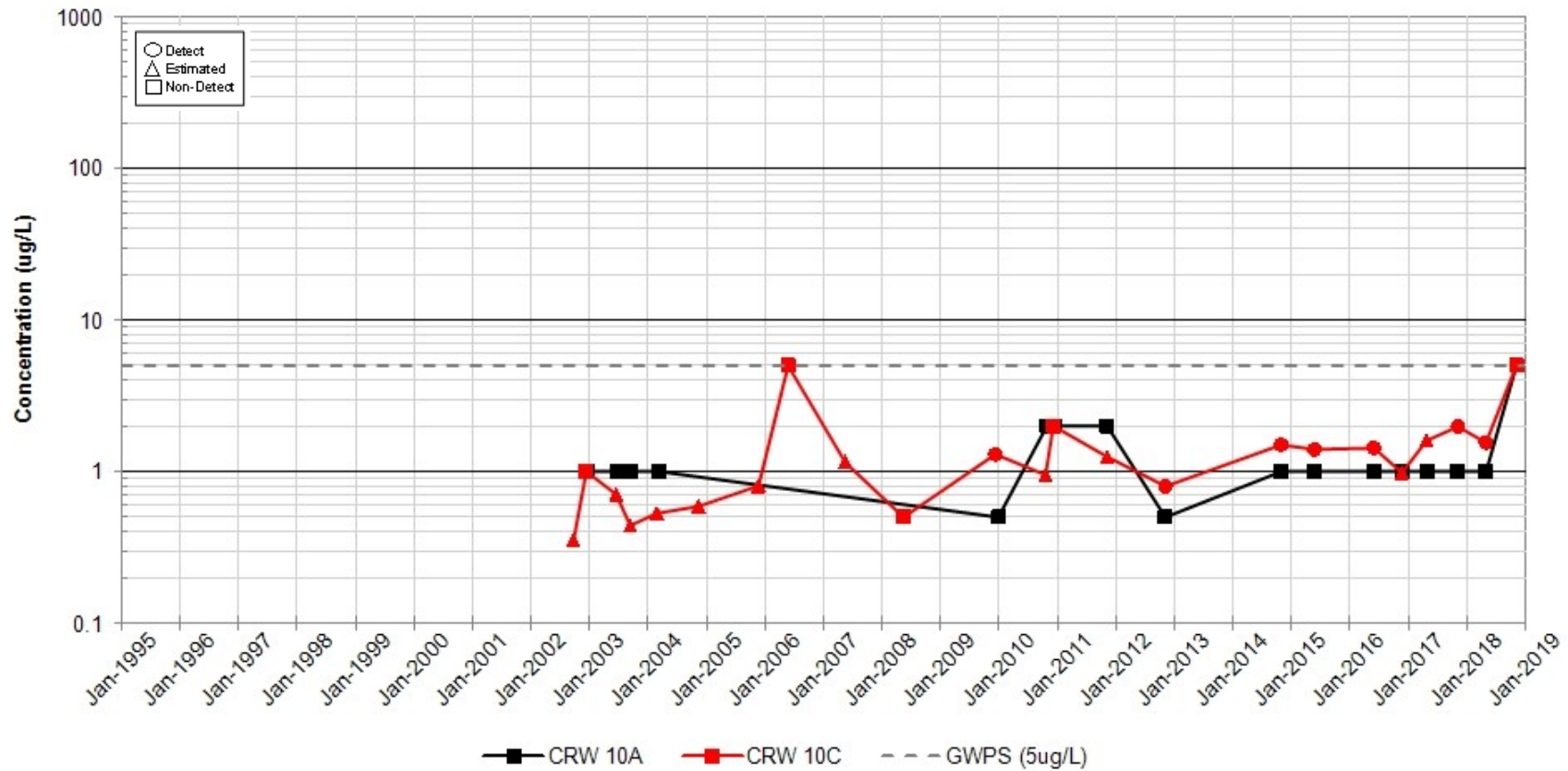


Figure C-83.

Time Series Plot for Tetrachloroethylene (PCE) Station for CRW 12

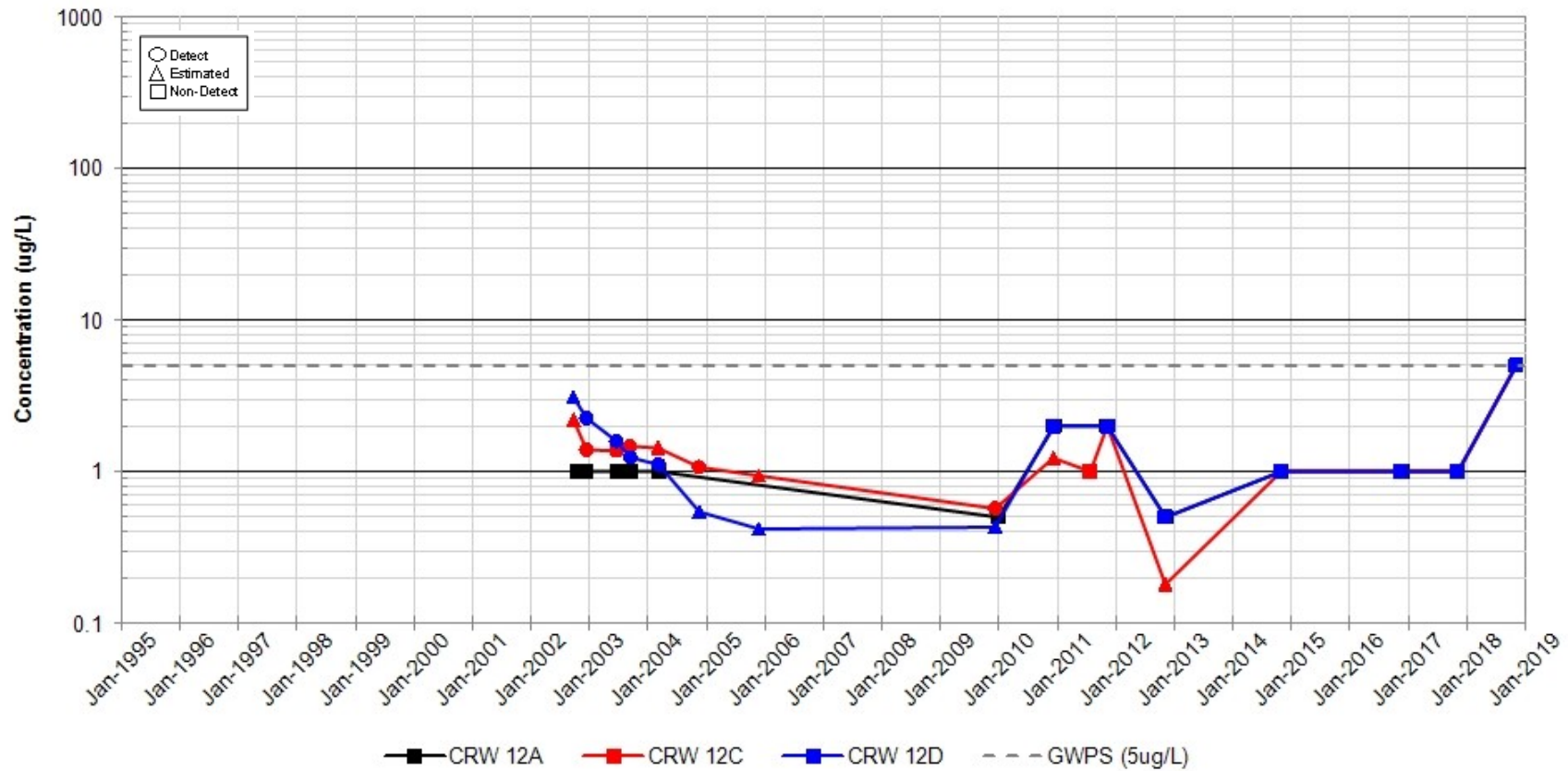


Figure C-84.

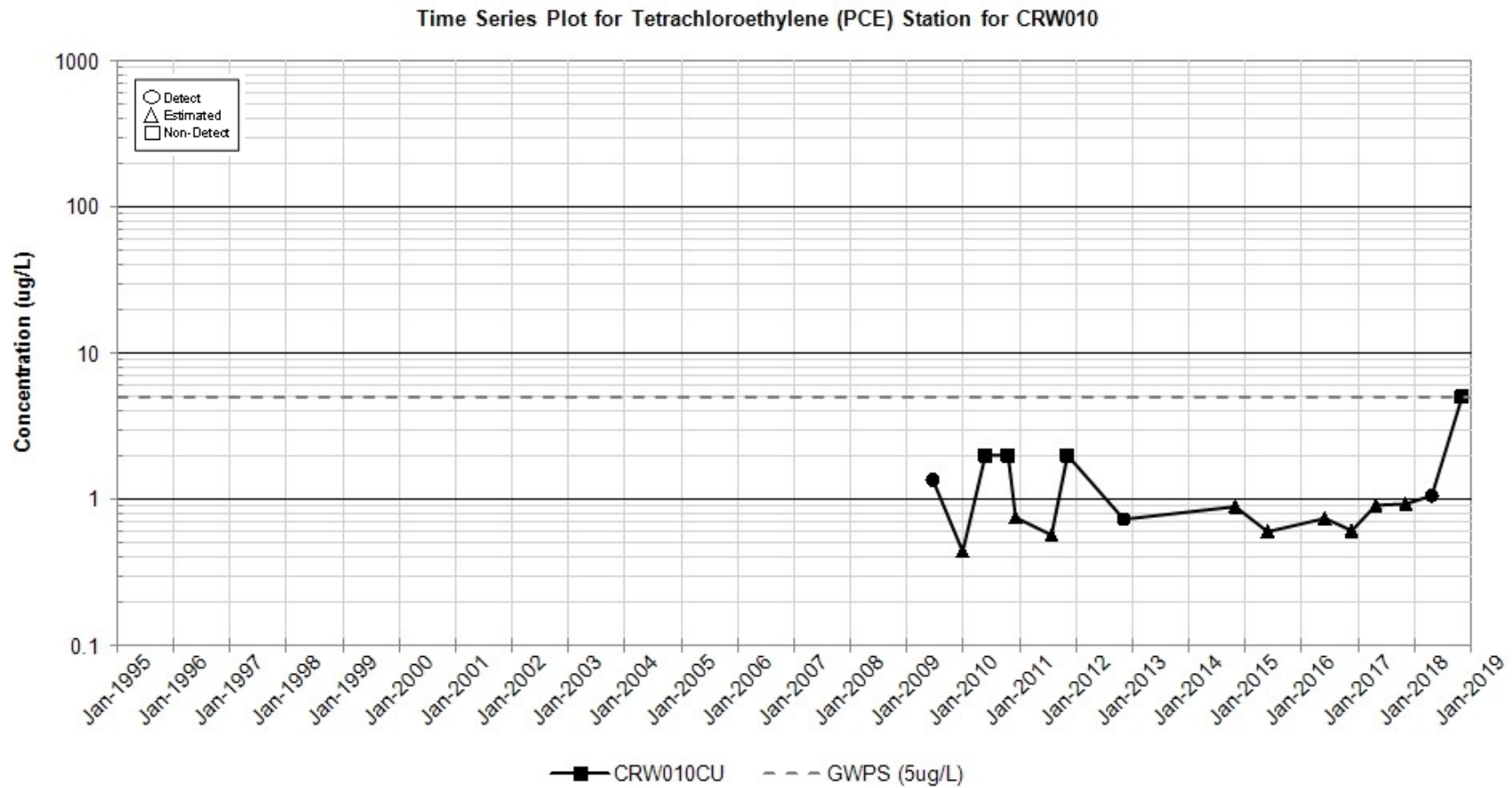


Figure C-85.

Time Series Plot for Tetrachloroethylene (PCE) Station for TL 01

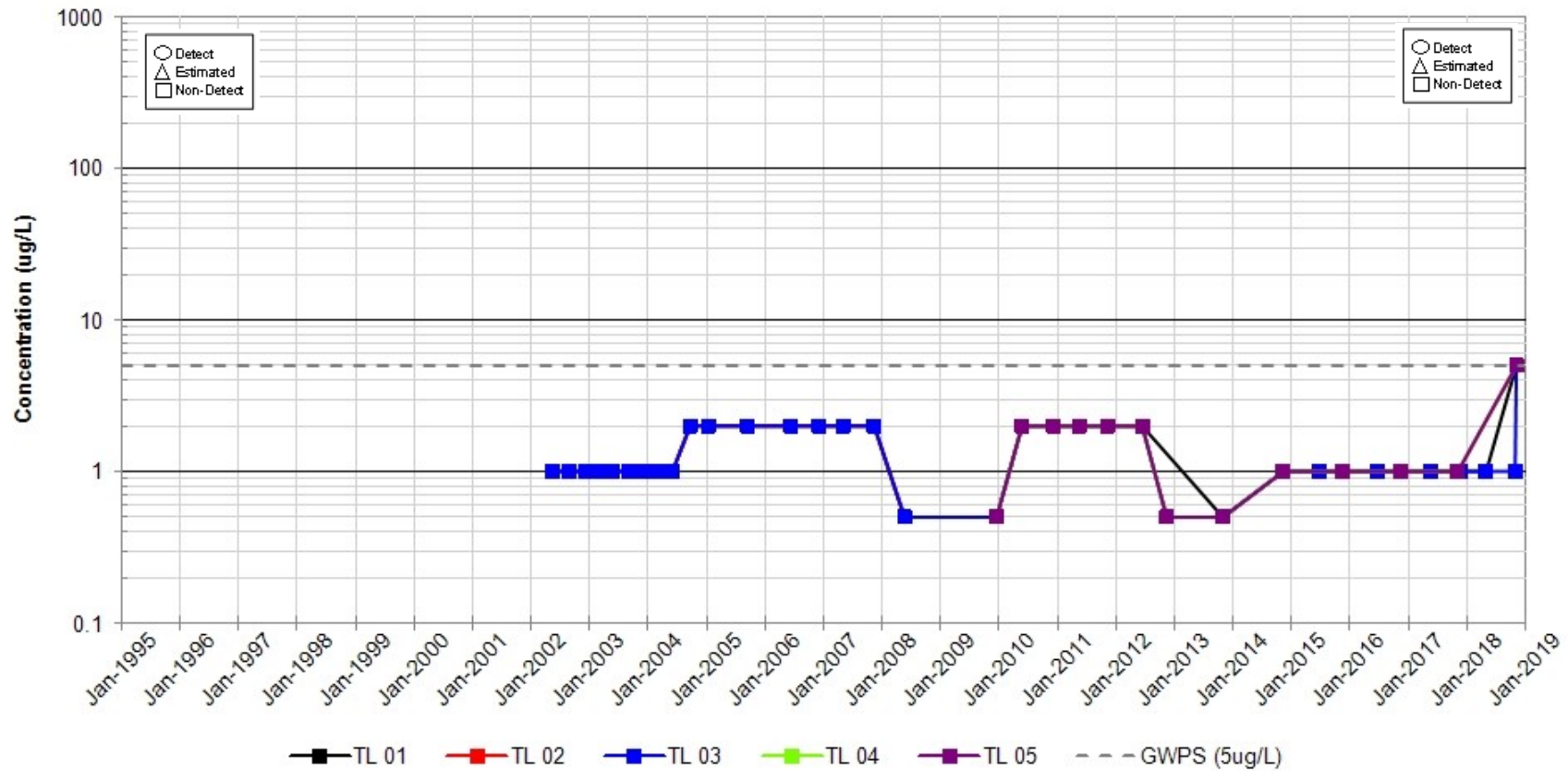


Figure C-86.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 3

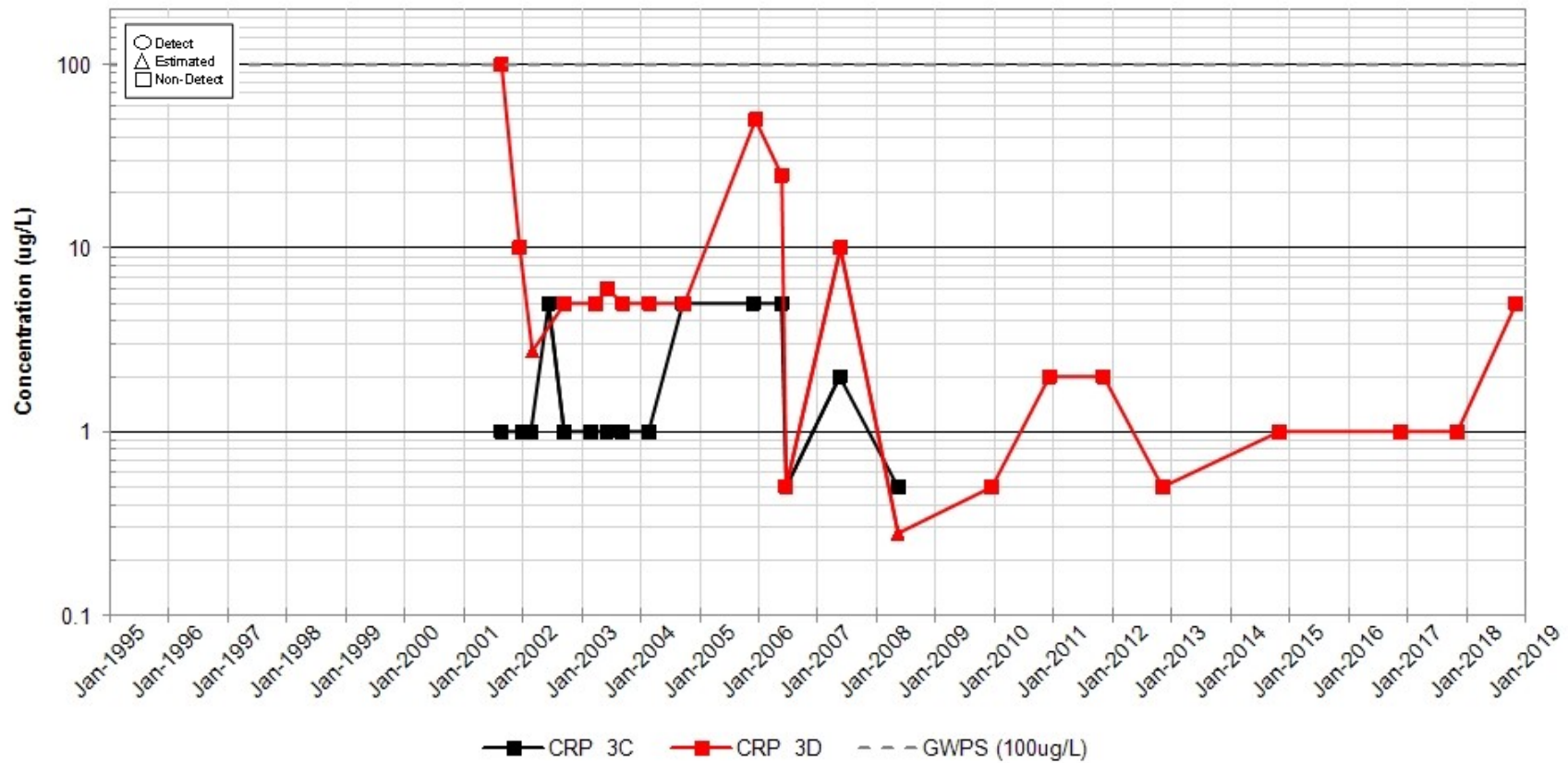


Figure C-87.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 5

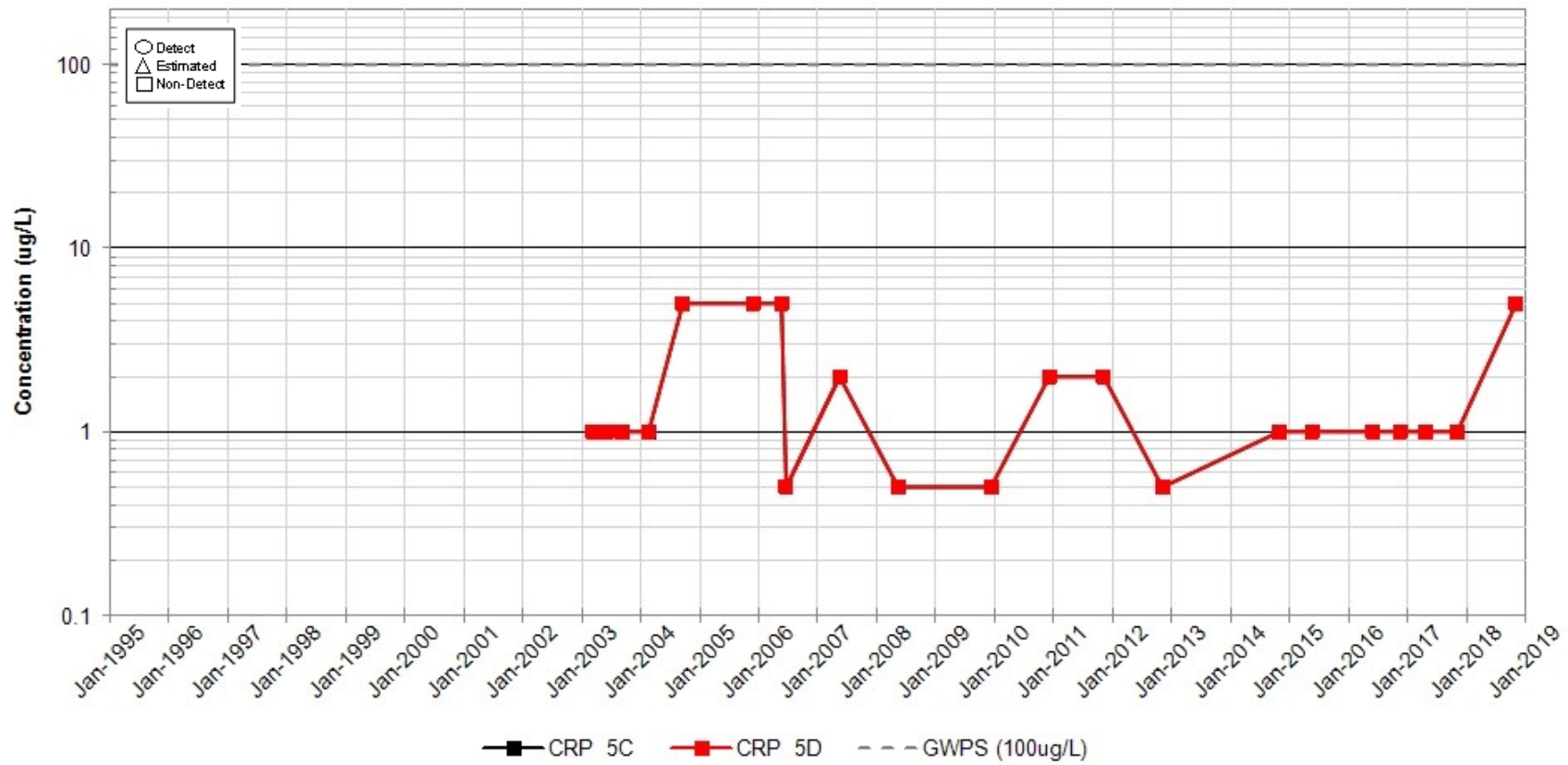


Figure C-88.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 6

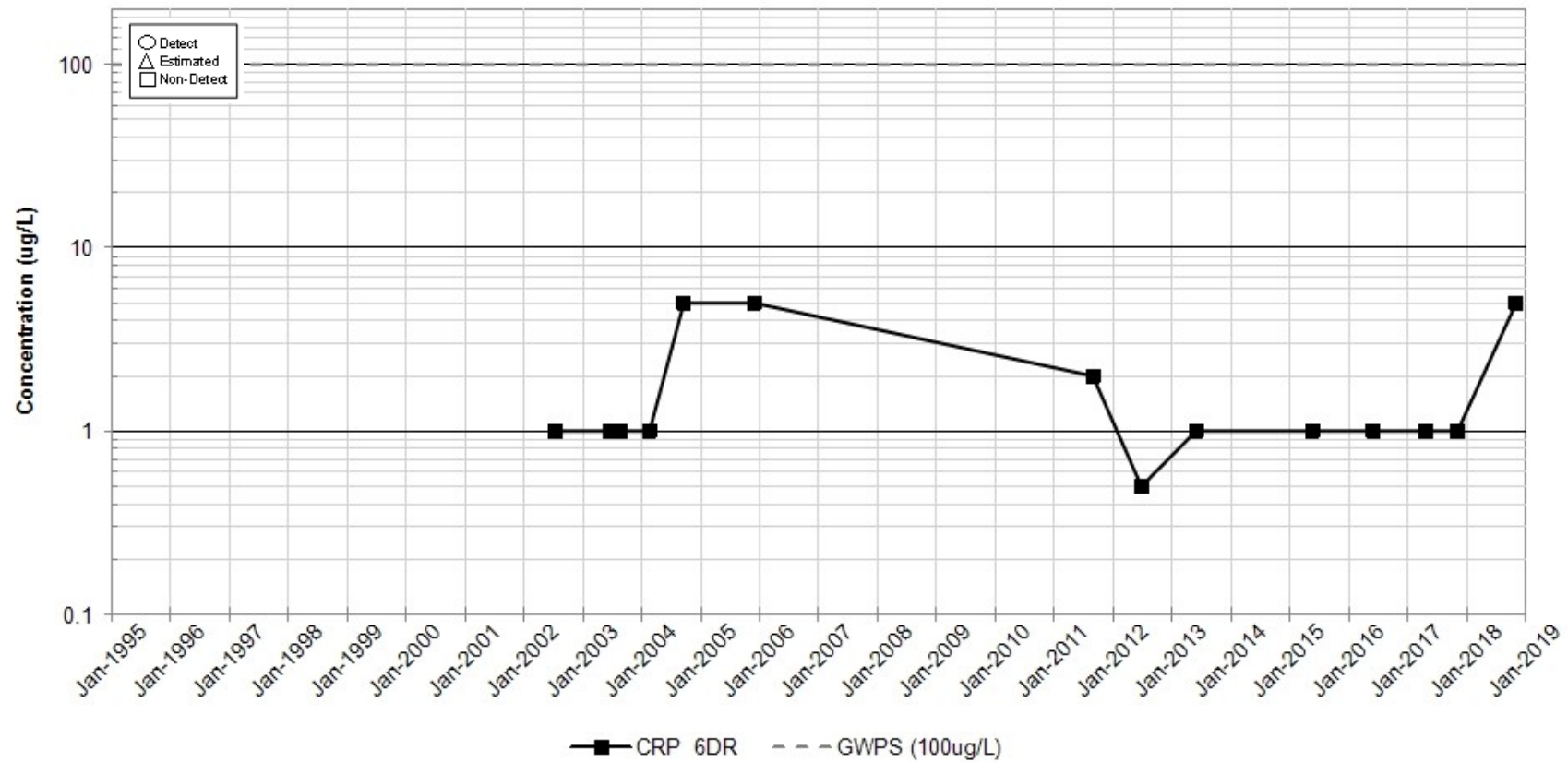


Figure C-89.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 8

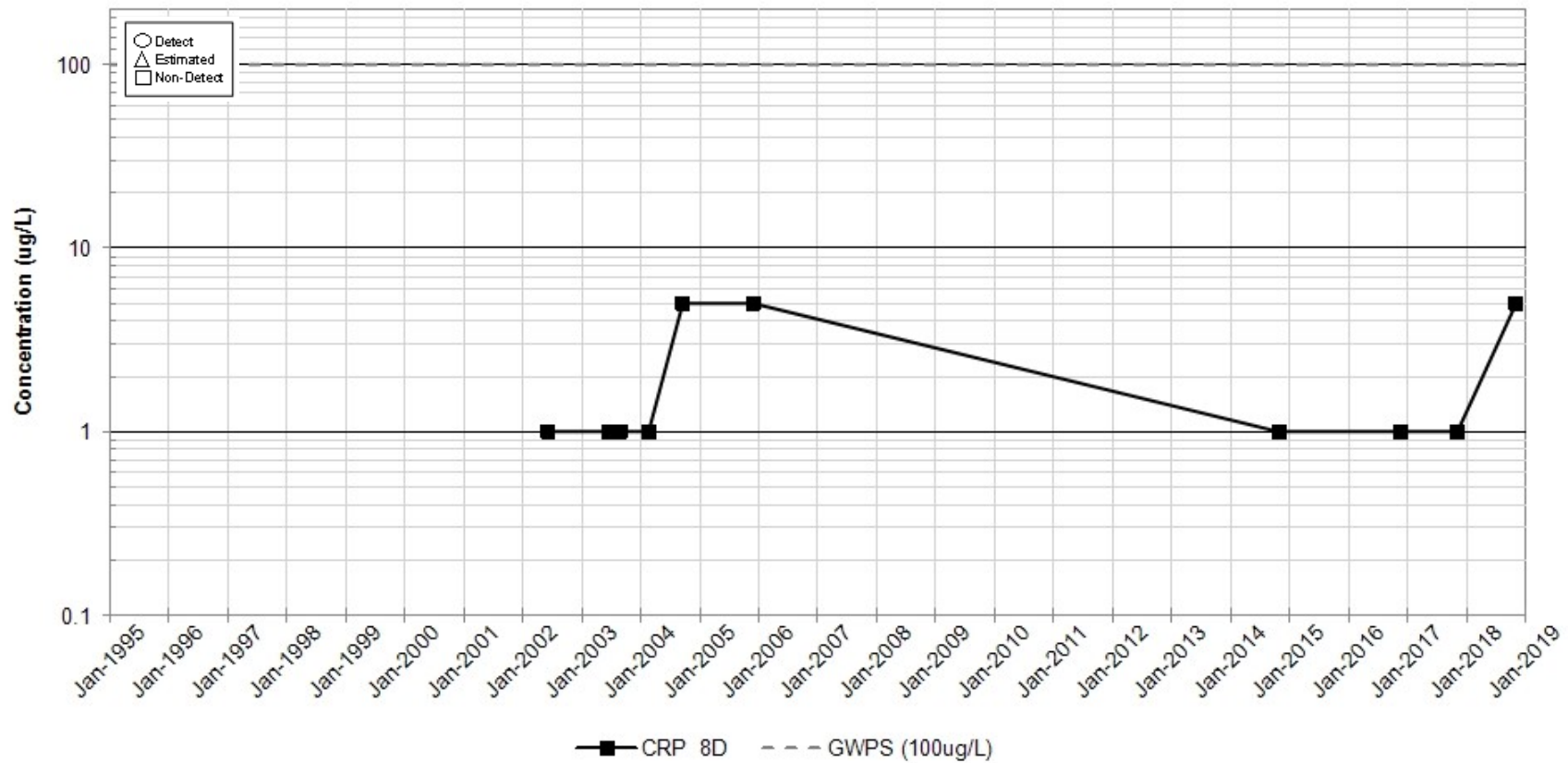


Figure C-90.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 18

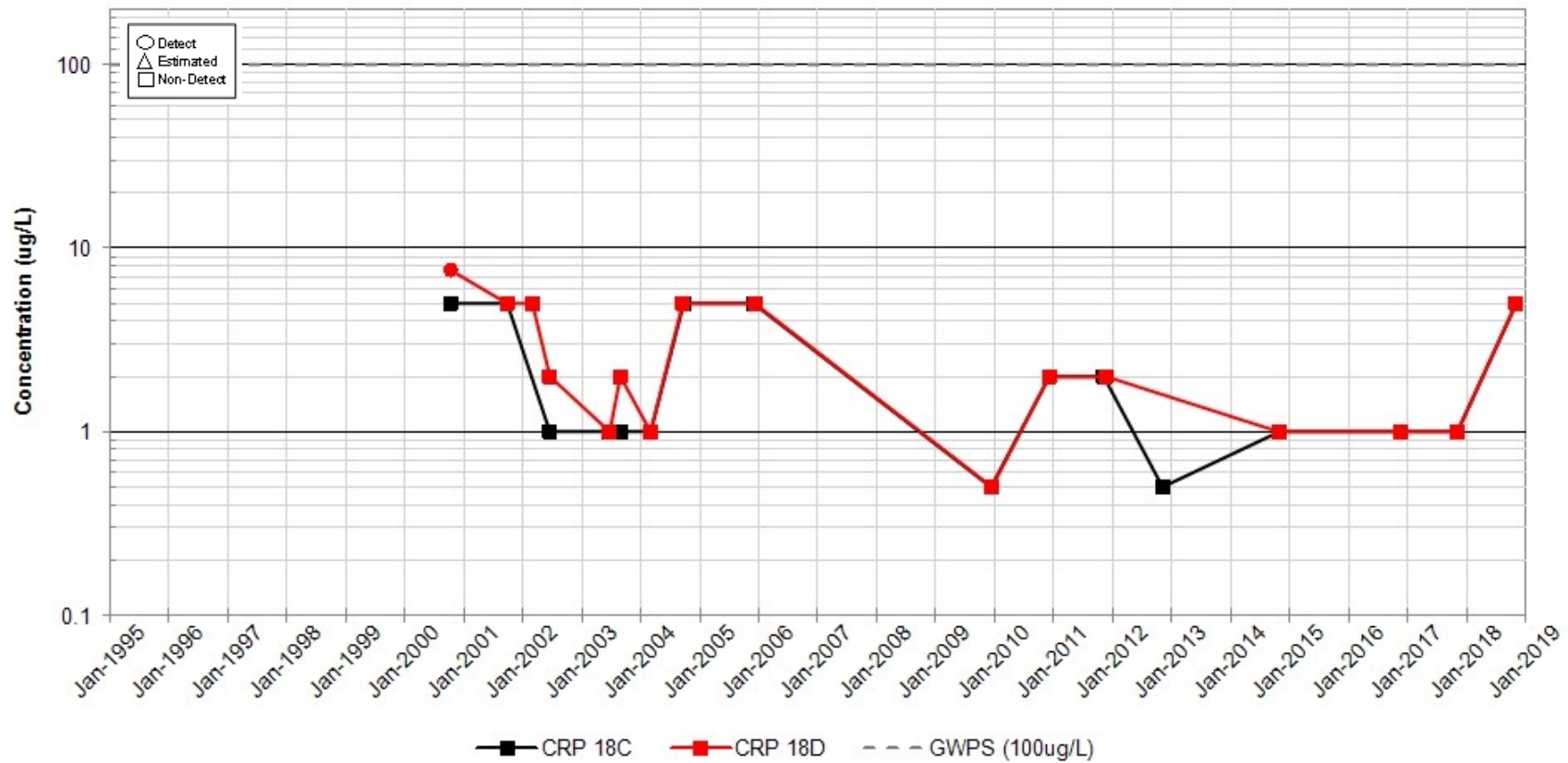


Figure C-91.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 20

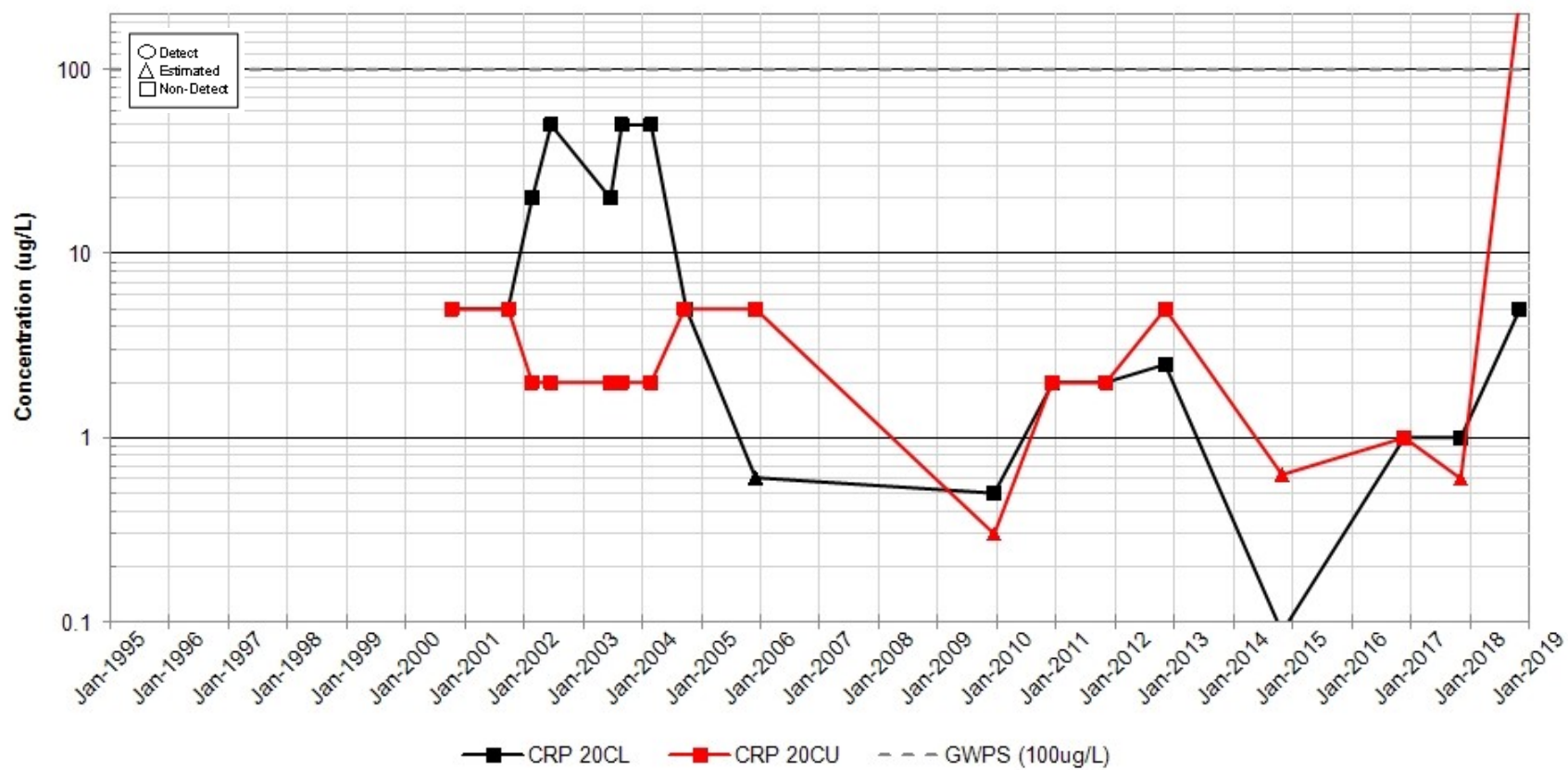


Figure C-92.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 22

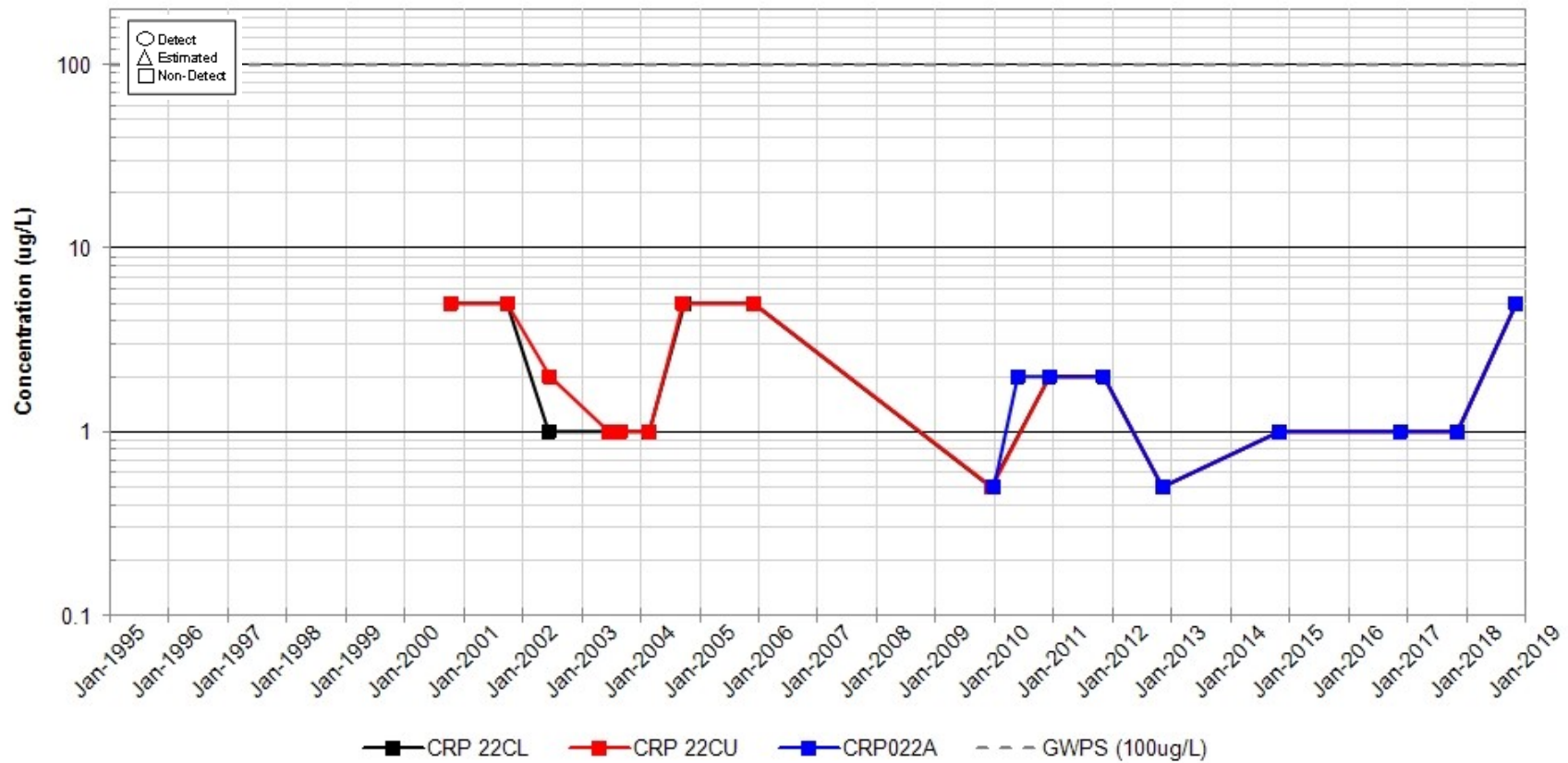


Figure C-93.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 45

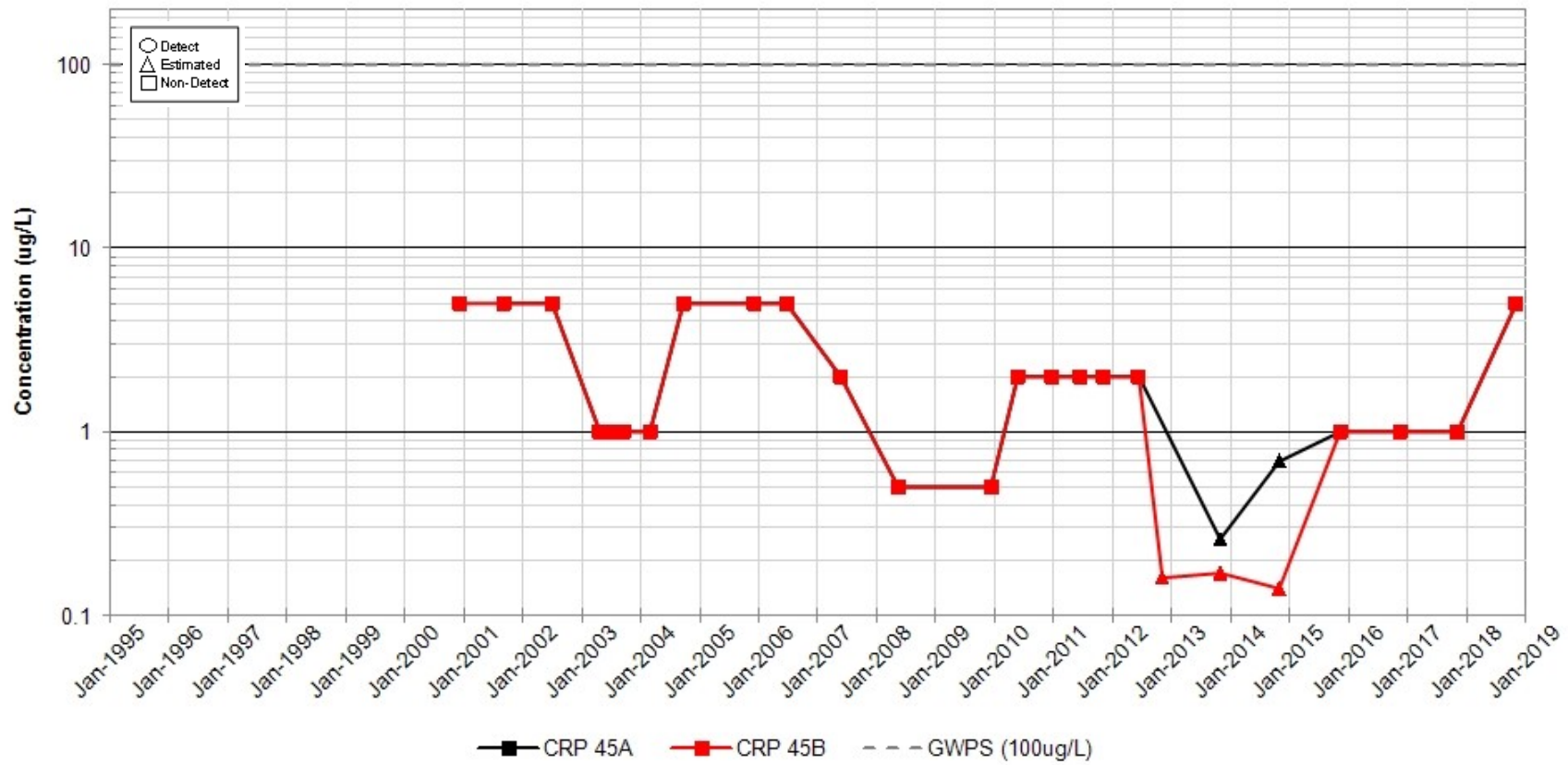


Figure C-94.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 46

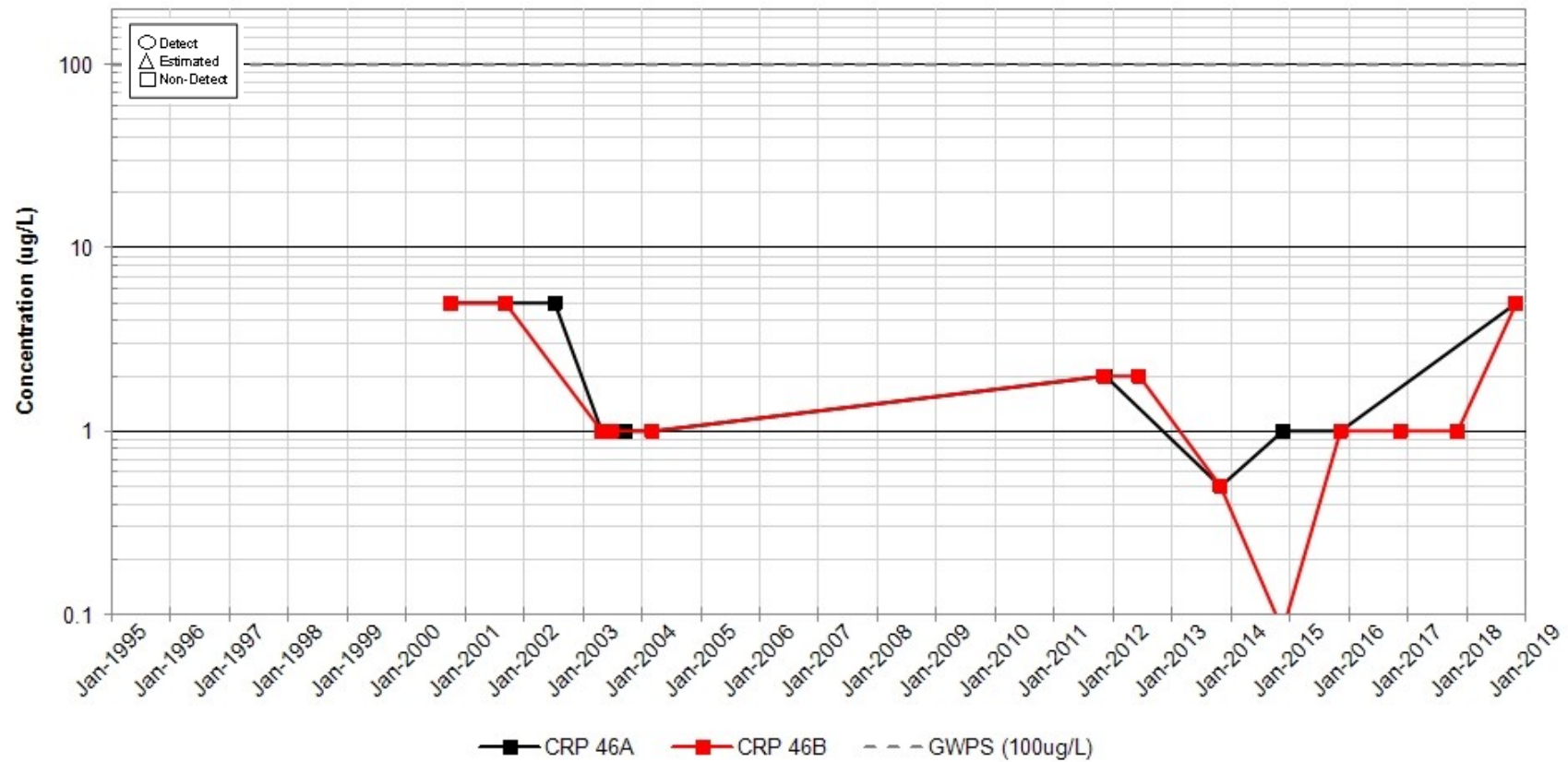


Figure C-95.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 48

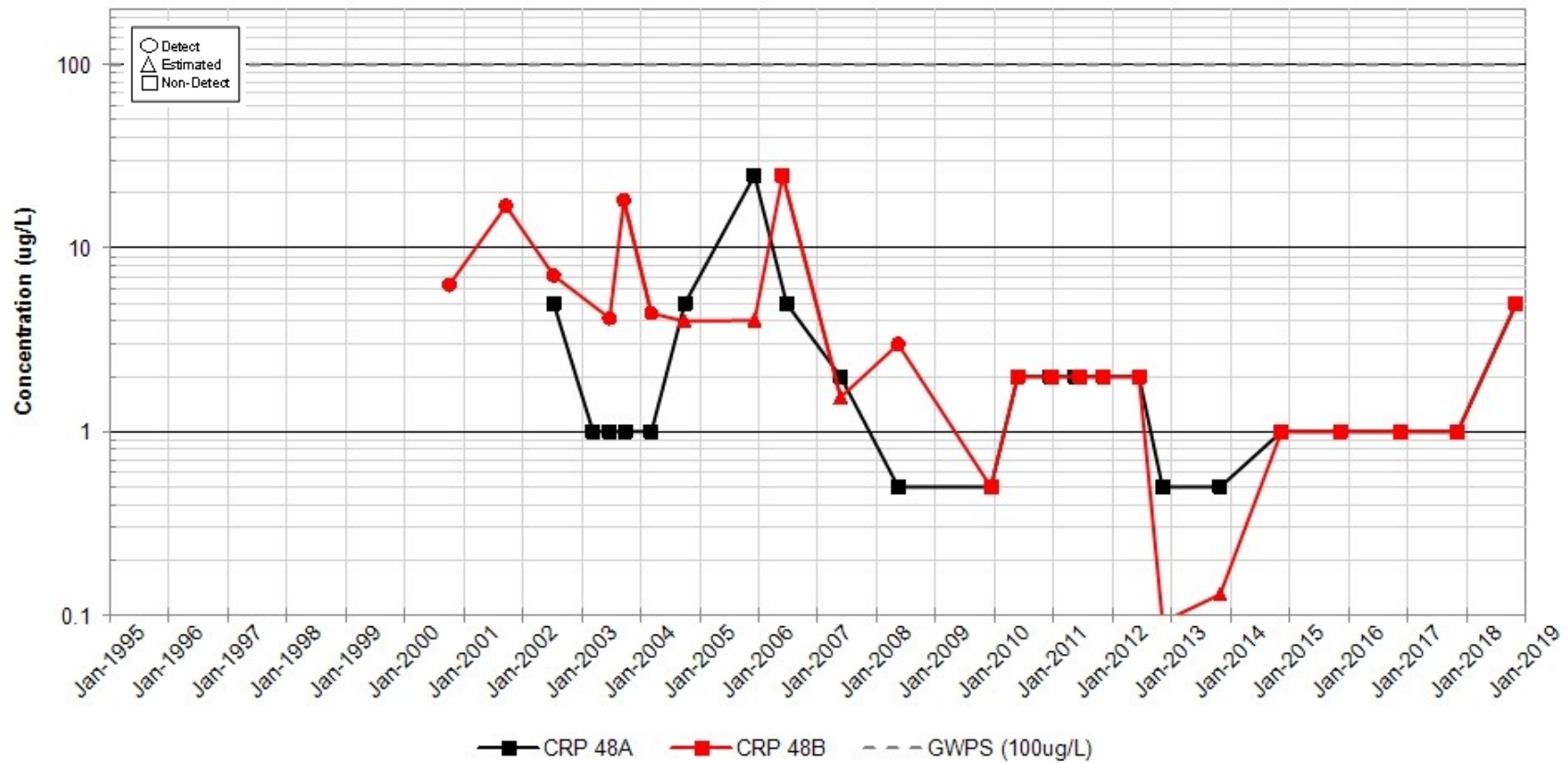


Figure C-96.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 50

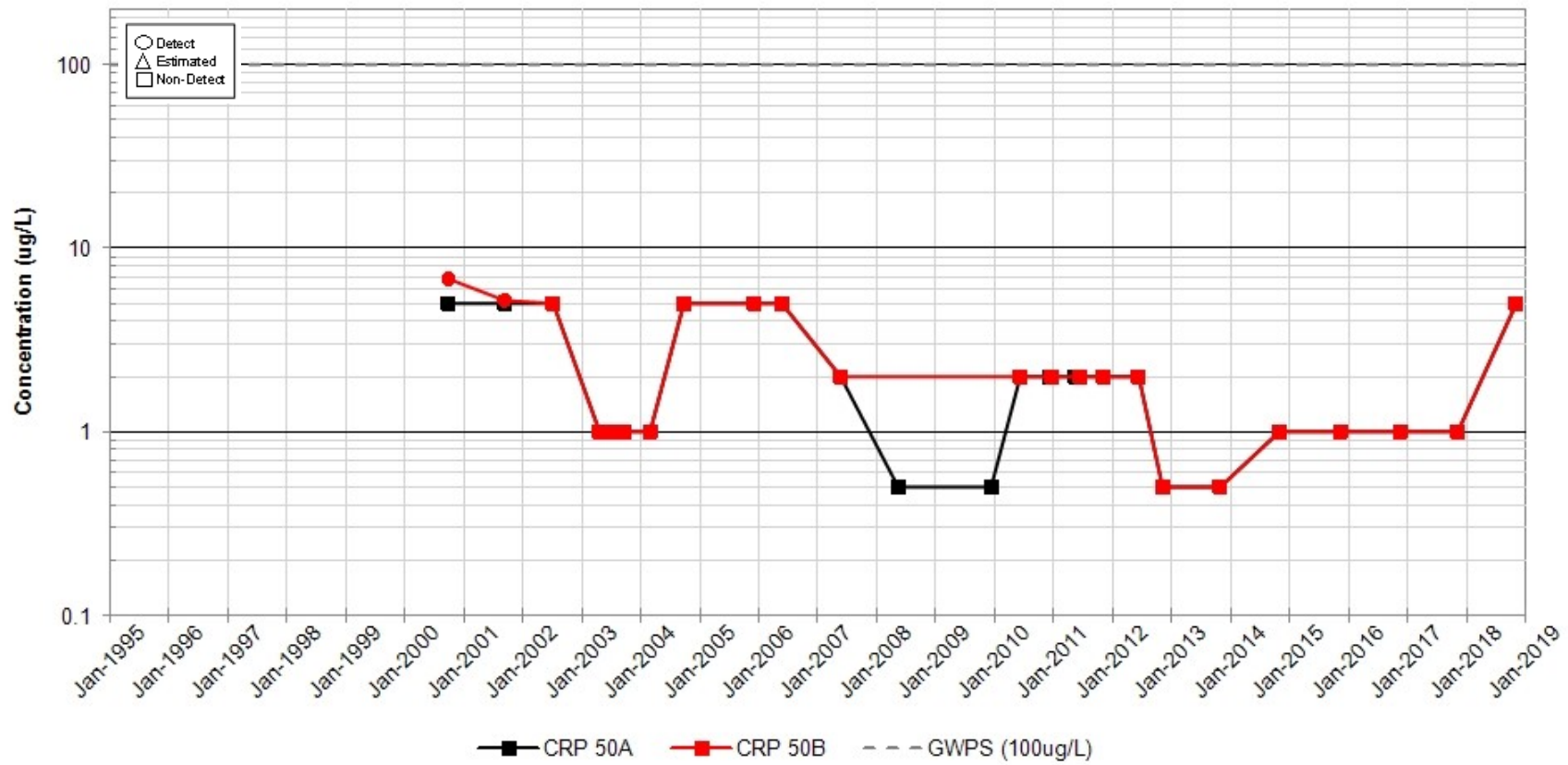


Figure C-97.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 51

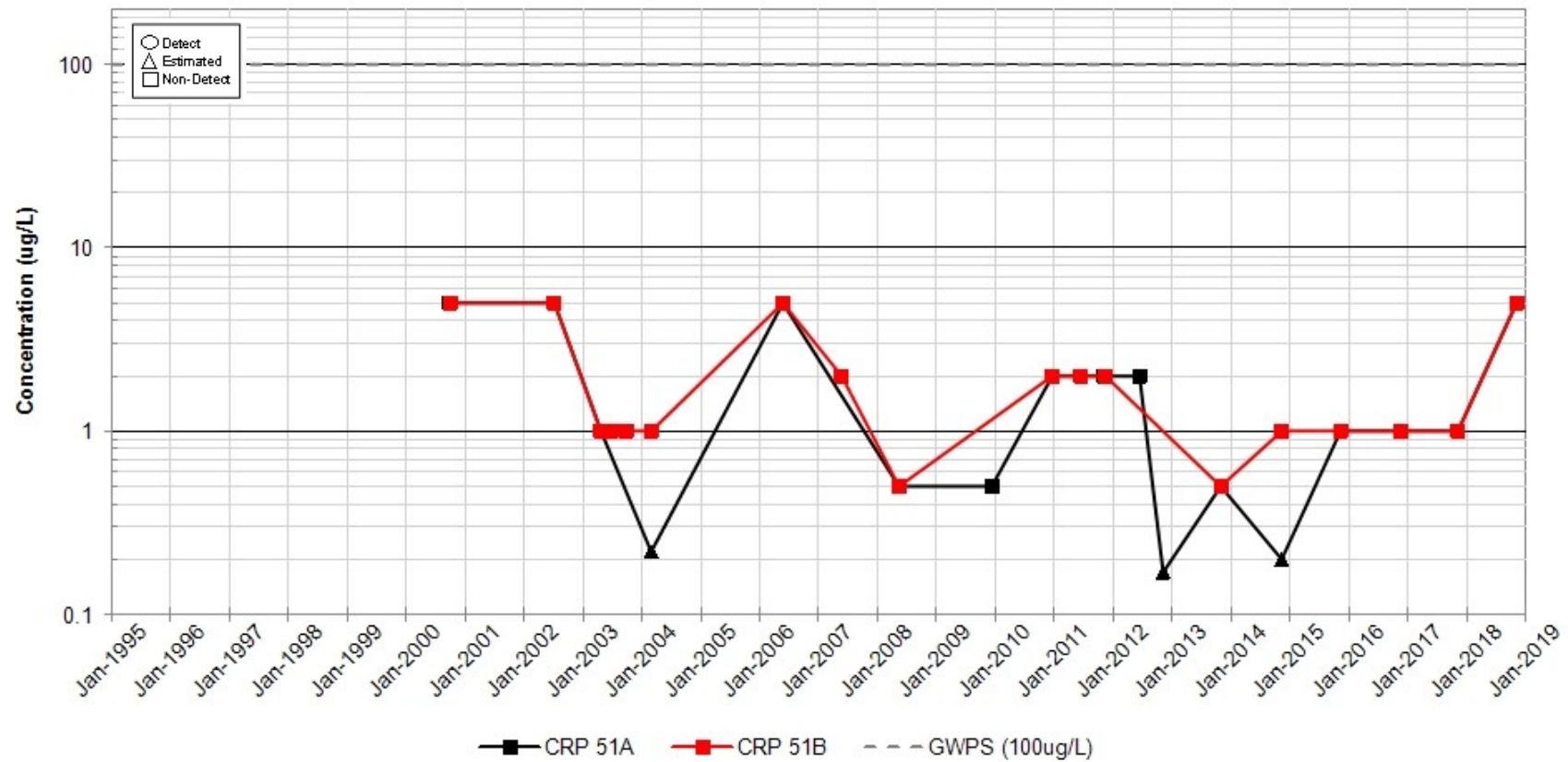


Figure C-98.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRP 52

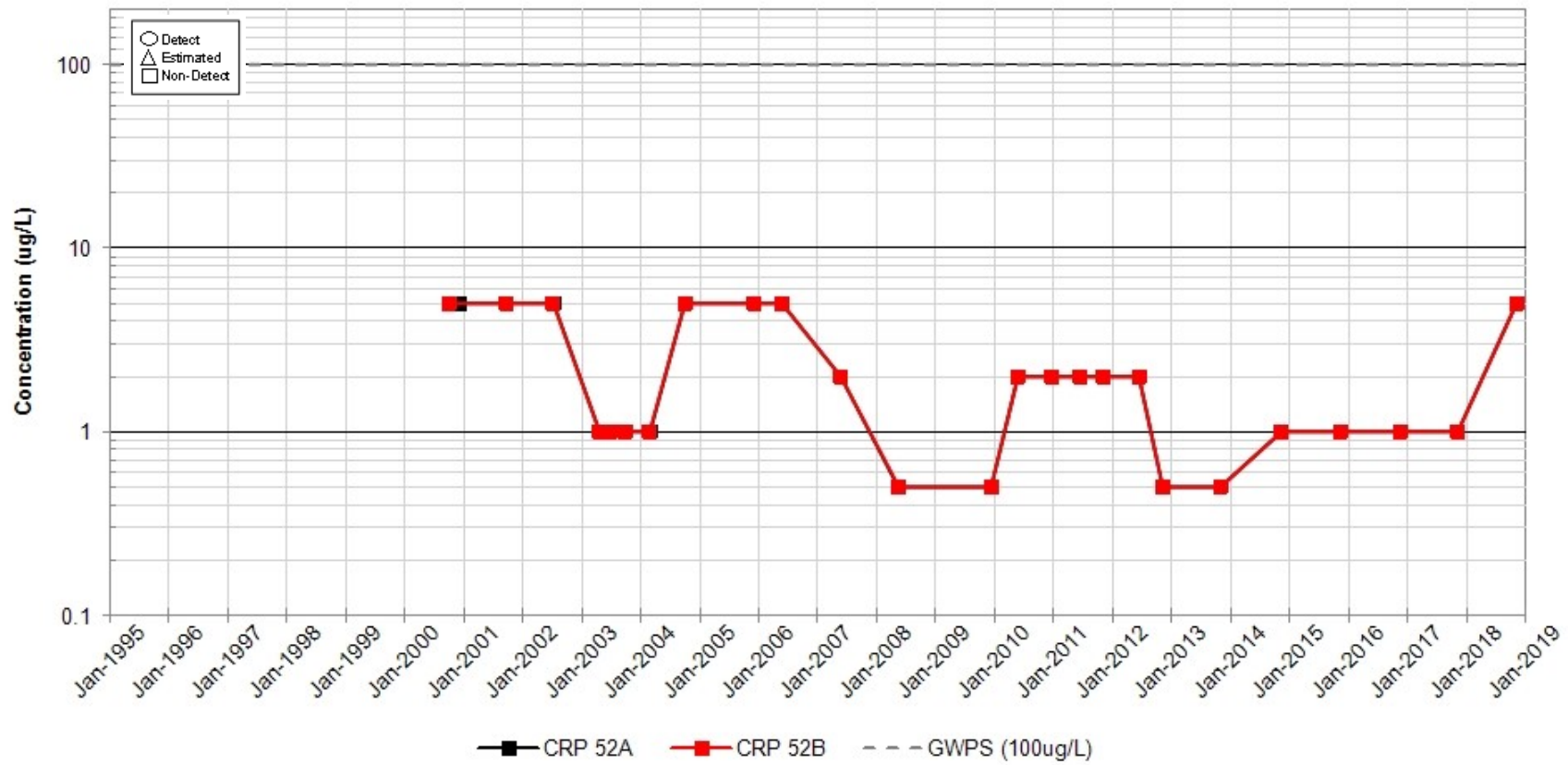


Figure C-99.
Time Series Plot for Trans-1,2-dichloroethylene Station for CRW 10

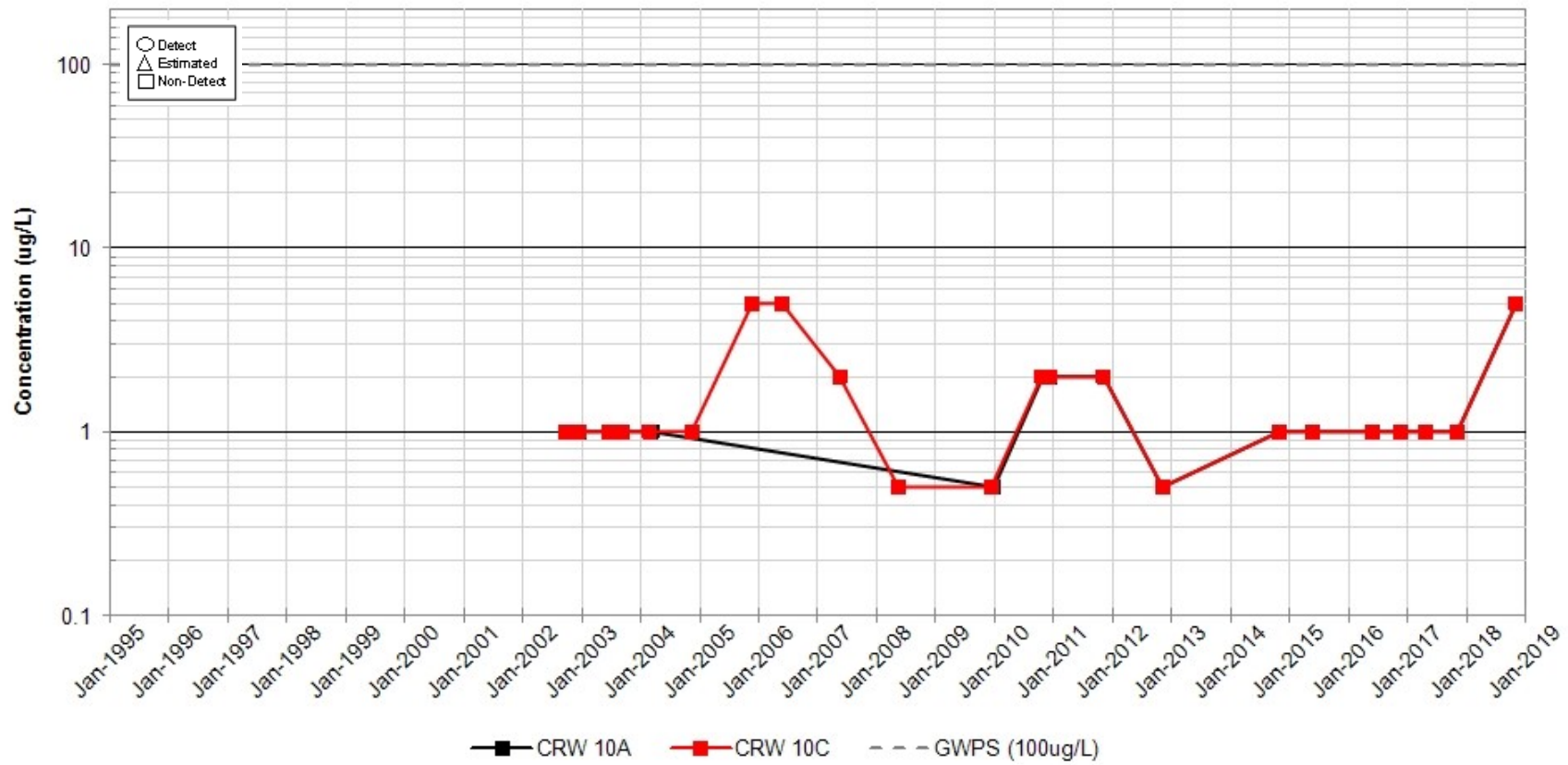


Figure C-100.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRW 12

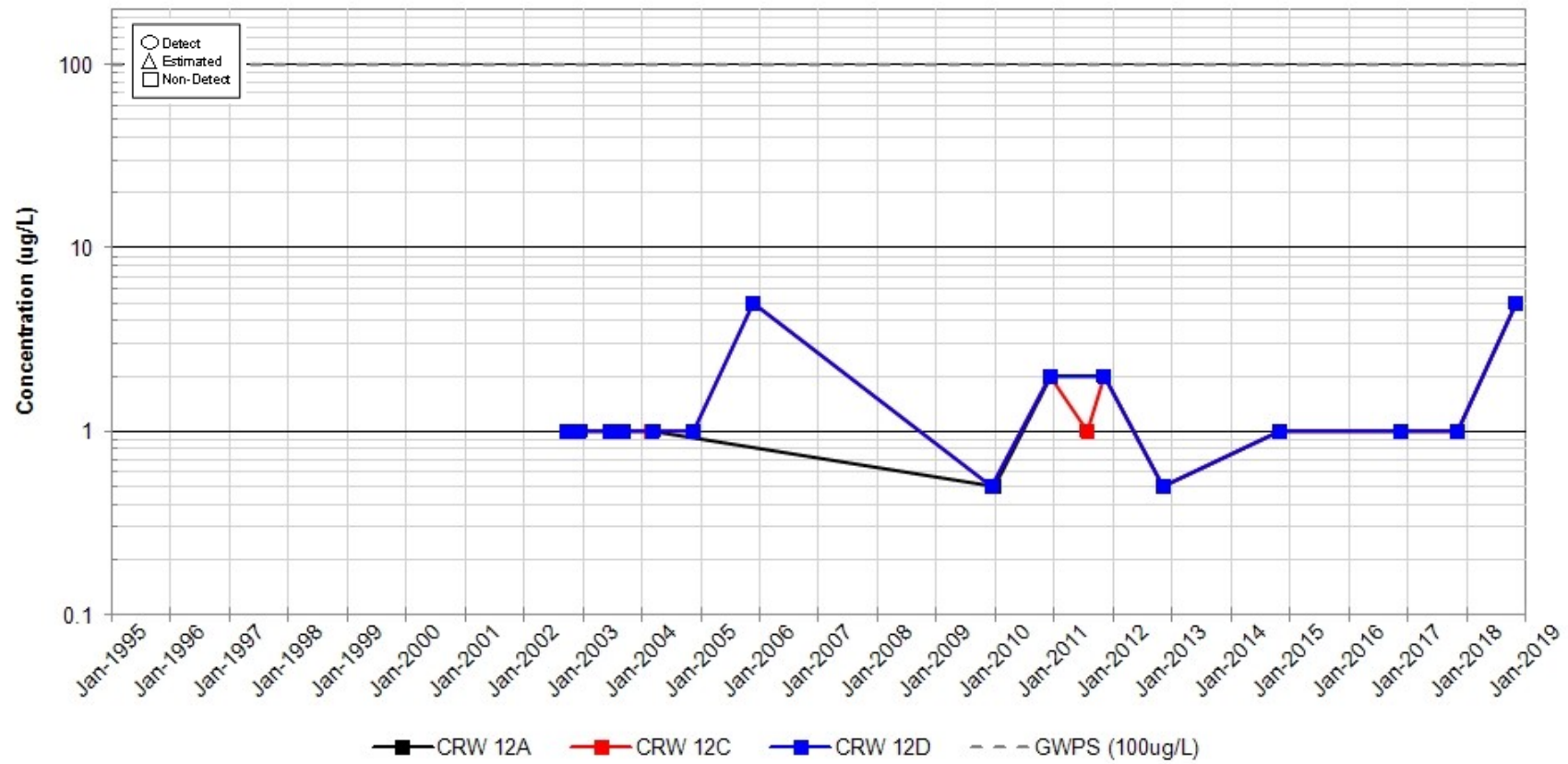


Figure C-101.

Time Series Plot for Trans-1,2-dichloroethylene Station for CRW010

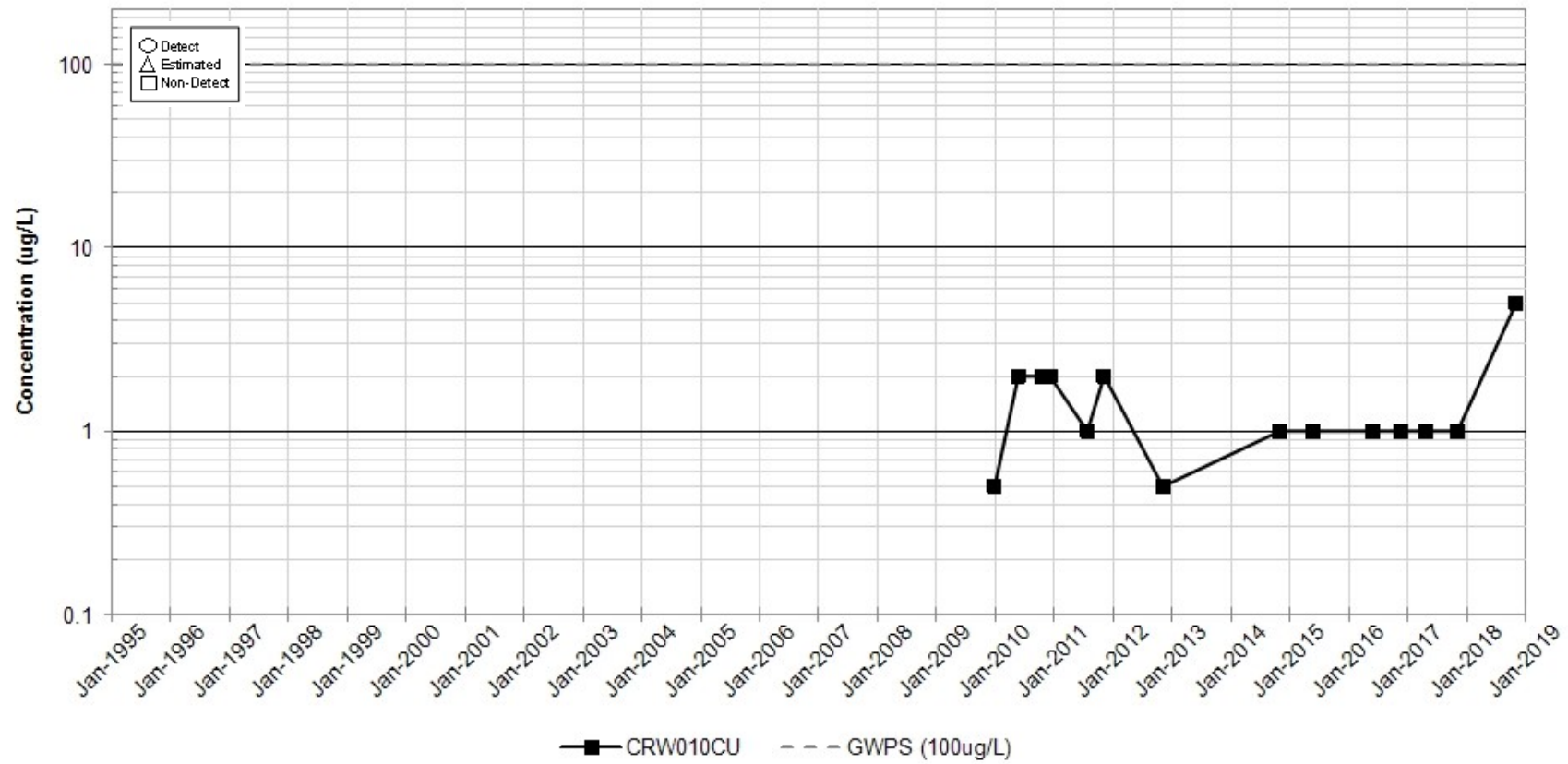


Figure C-102.

Time Series Plot for Trans-1,2-dichloroethylene Station for TL 01

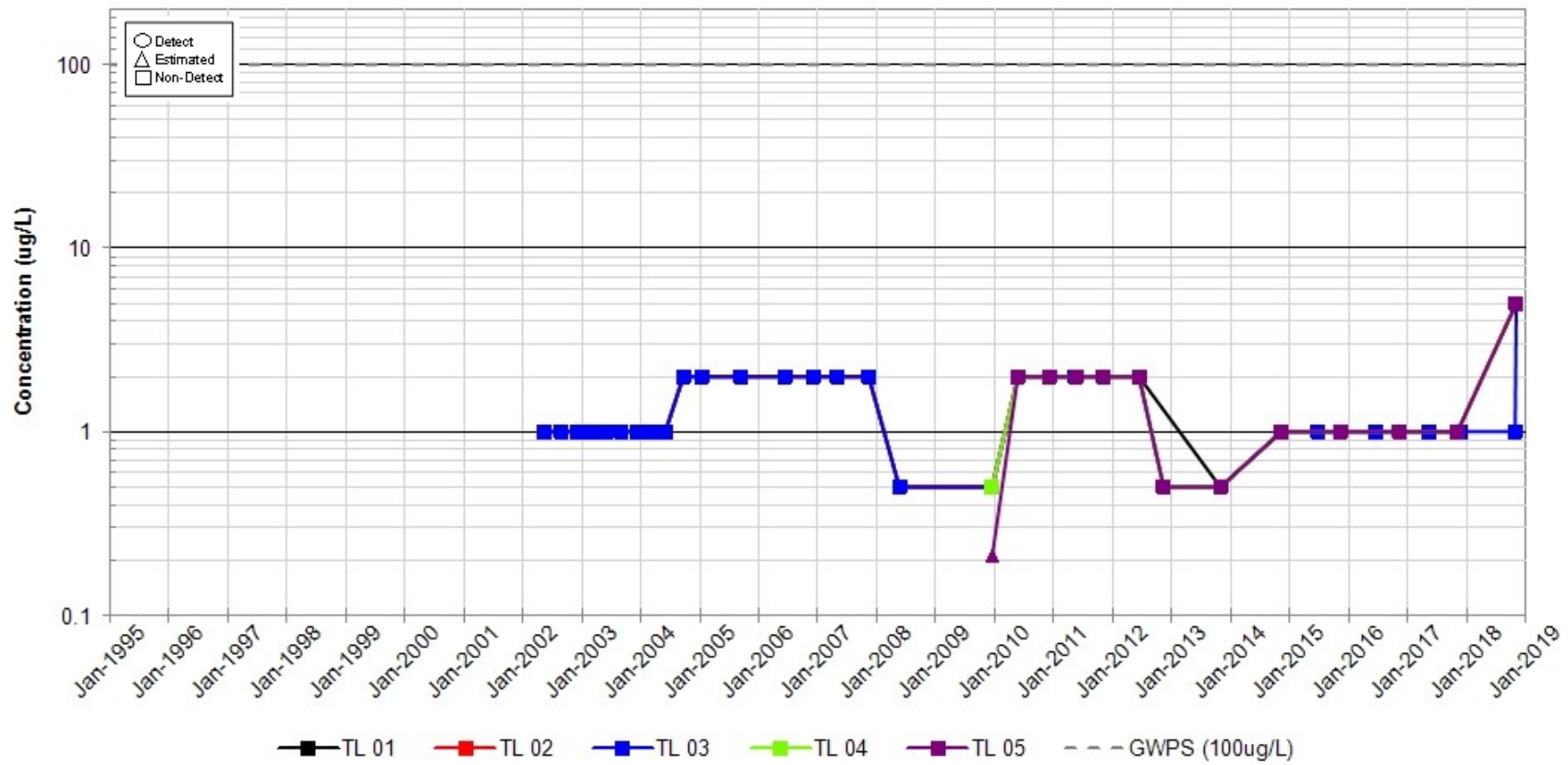


Figure C-103.

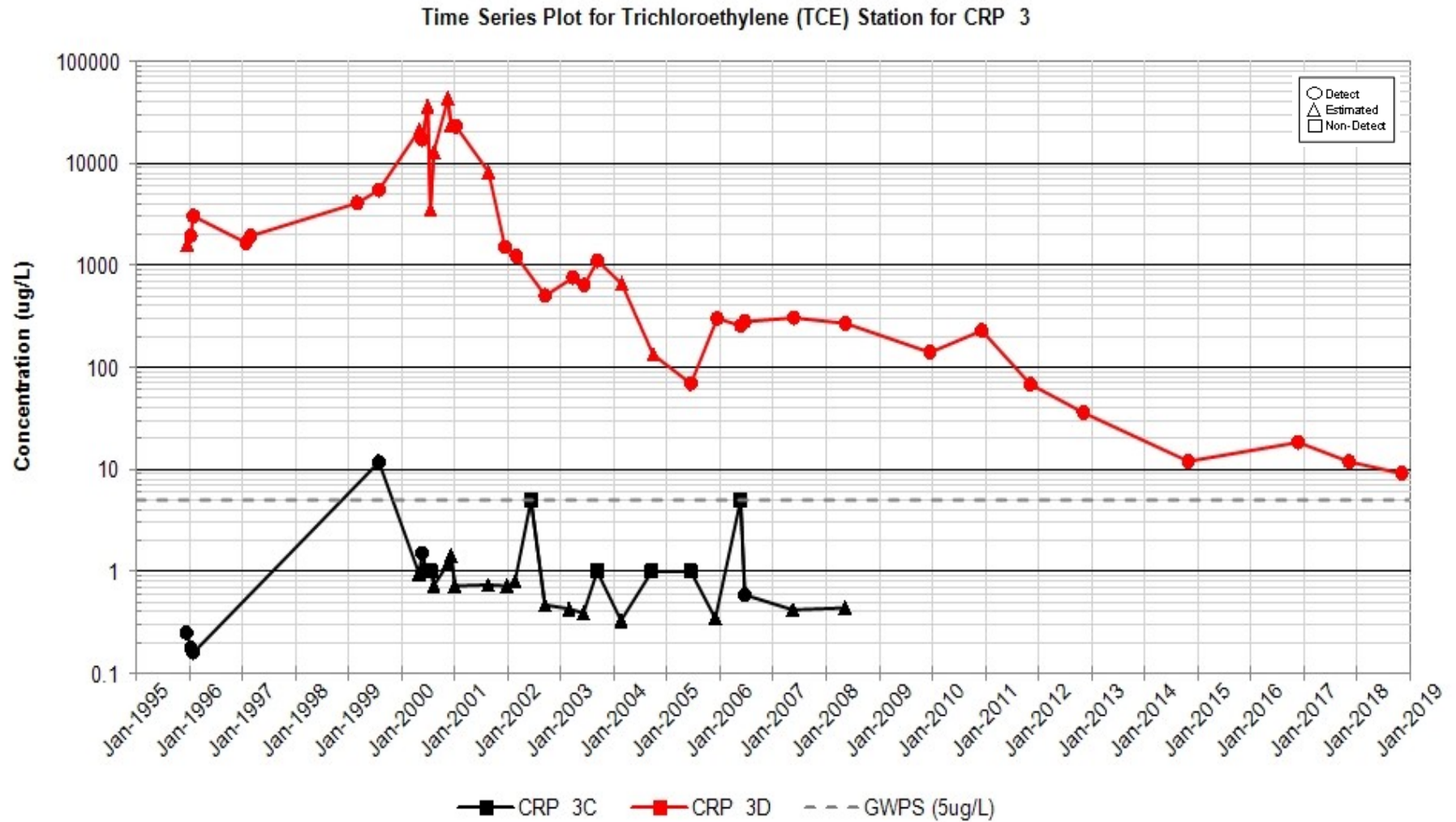


Figure C-104.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 5

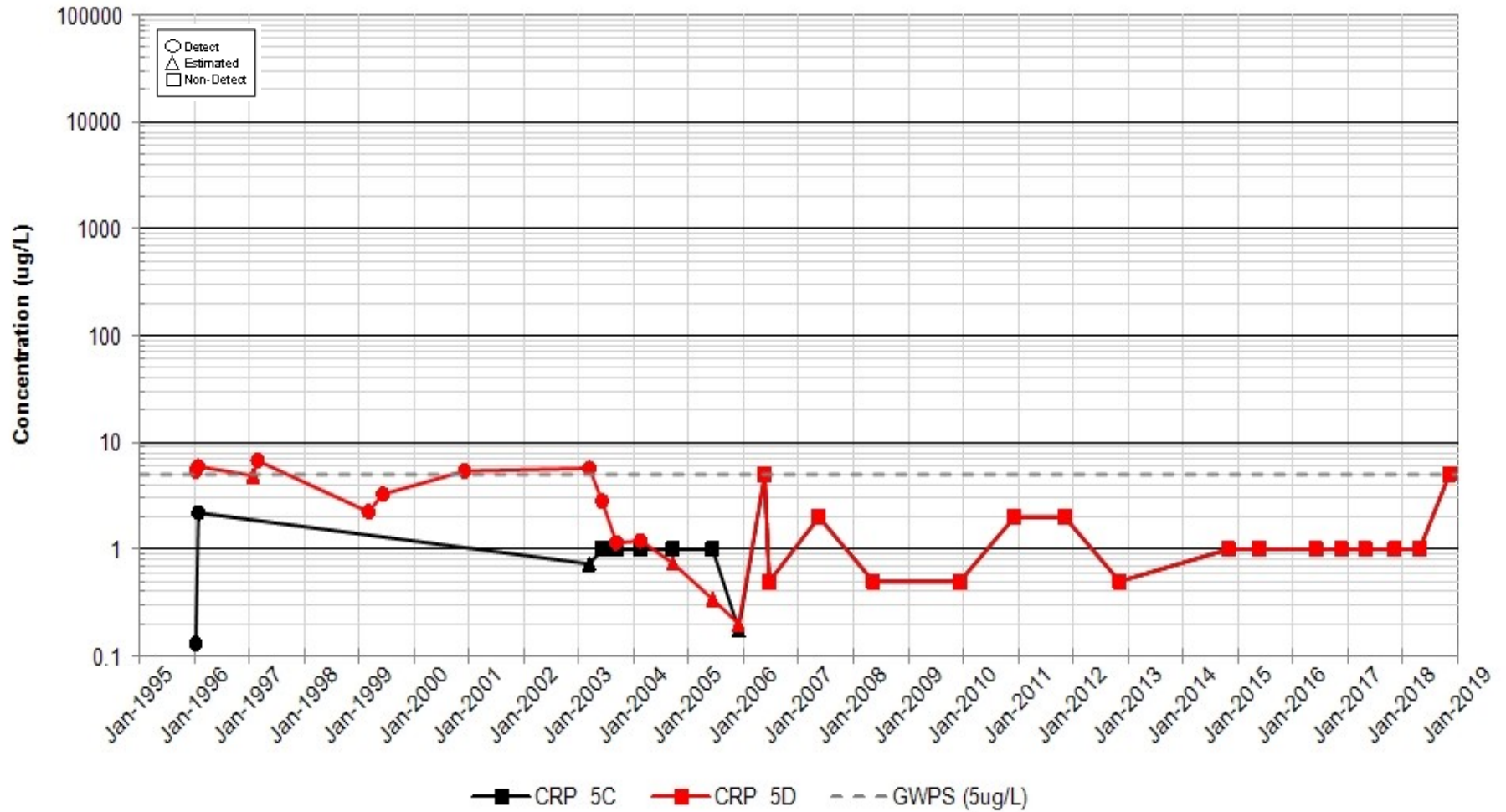


Figure C-105.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 6

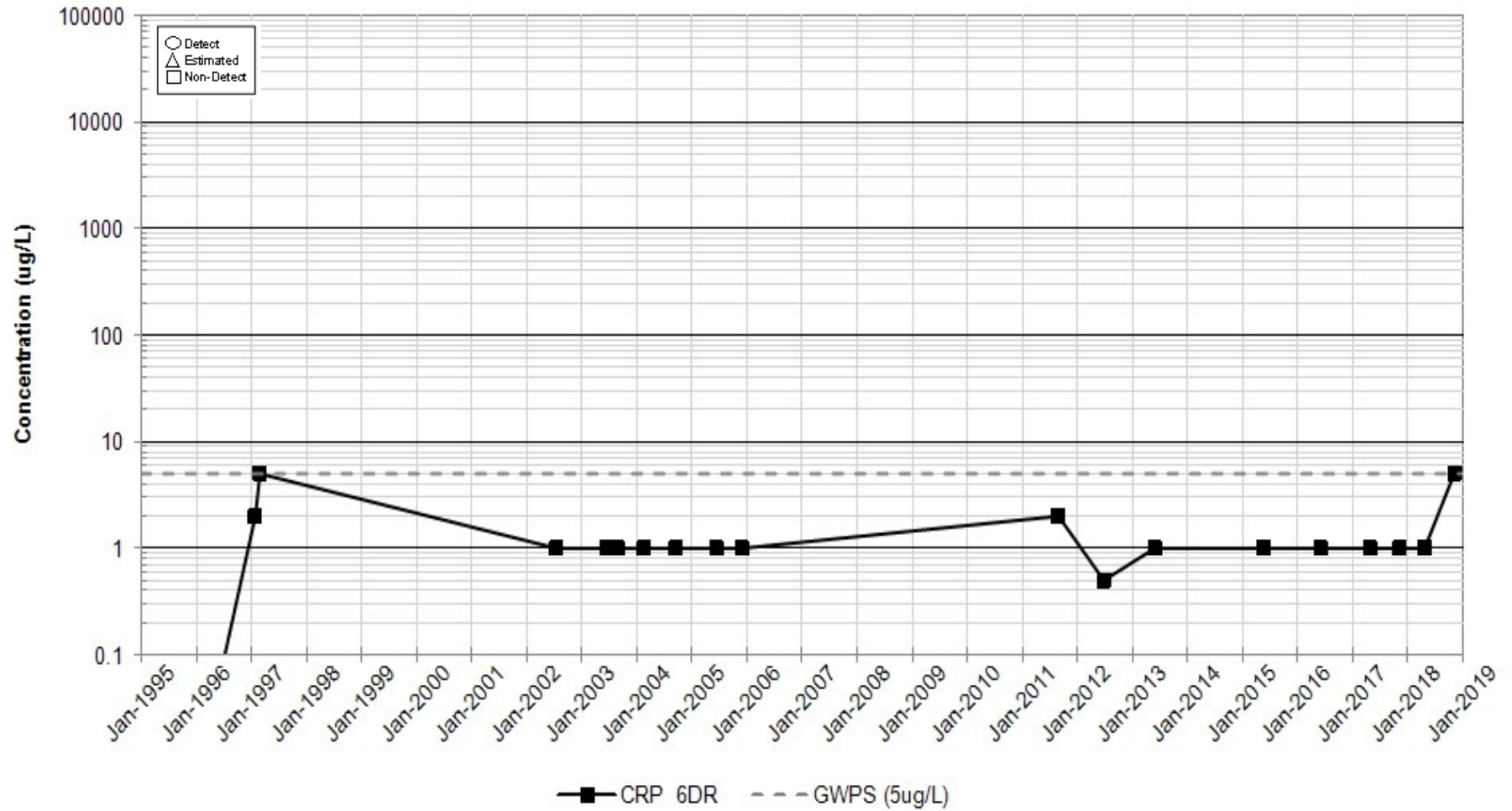


Figure C-106.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 8

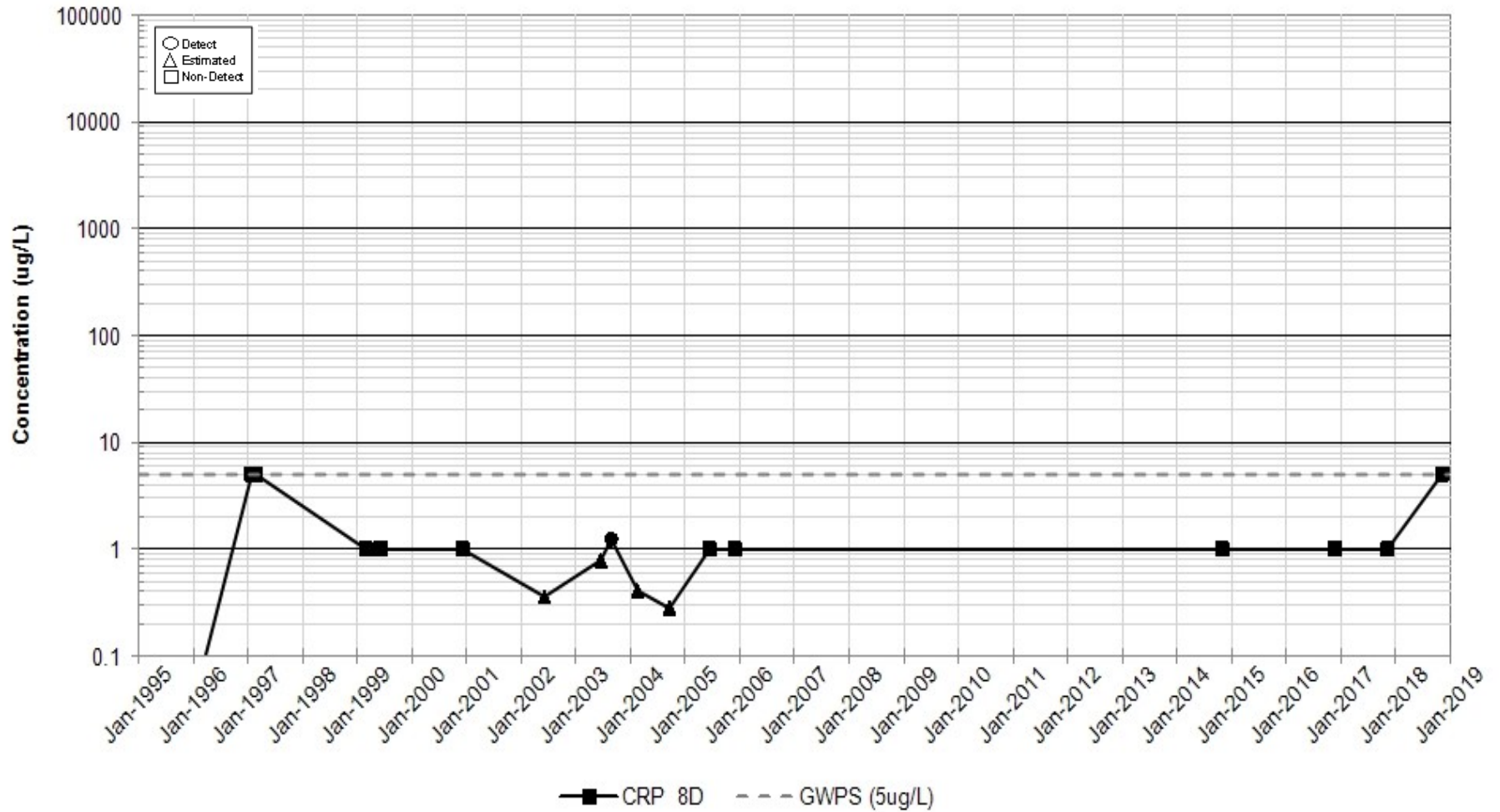


Figure C-107.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 18

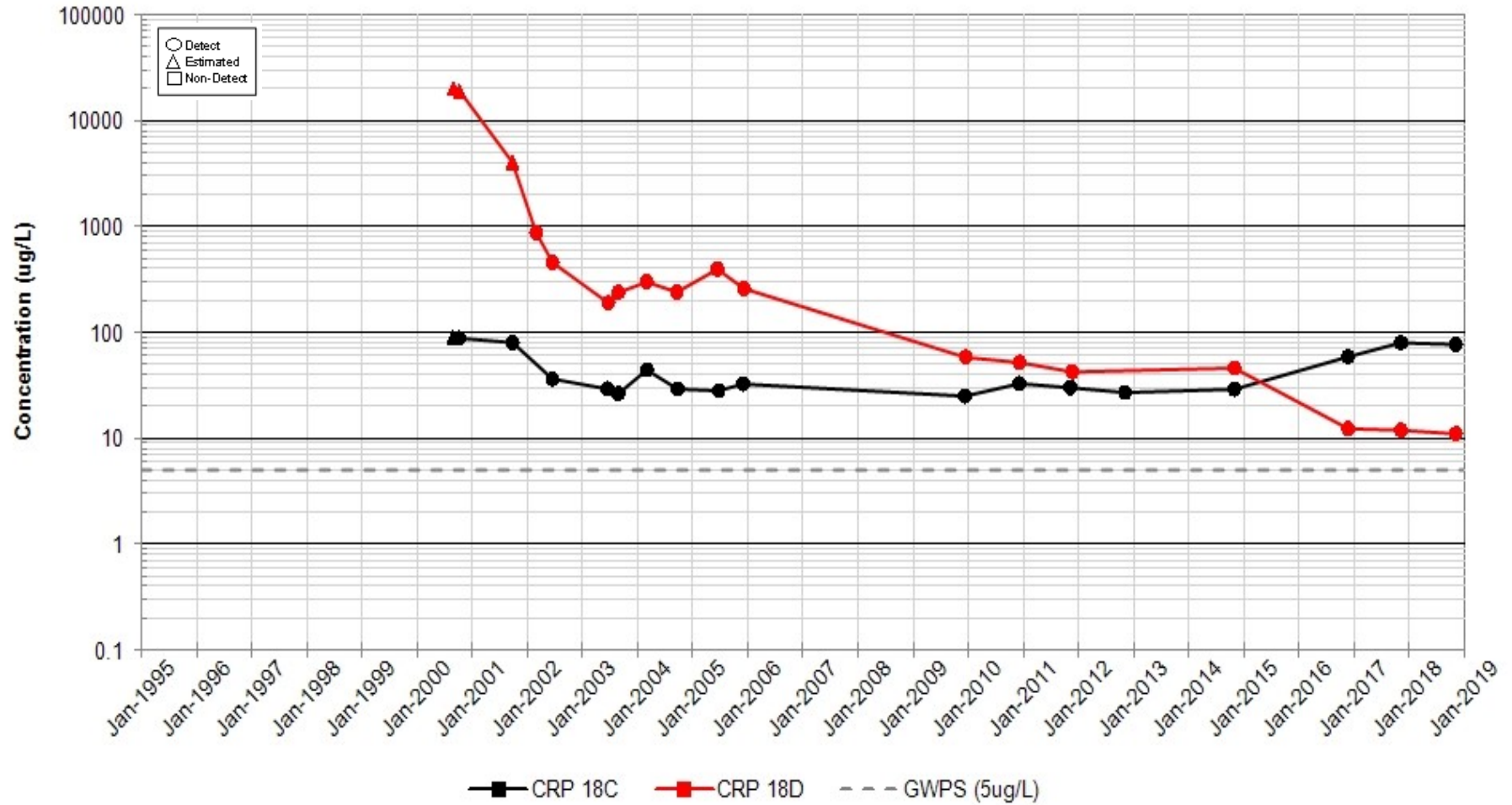


Figure C-108.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 20

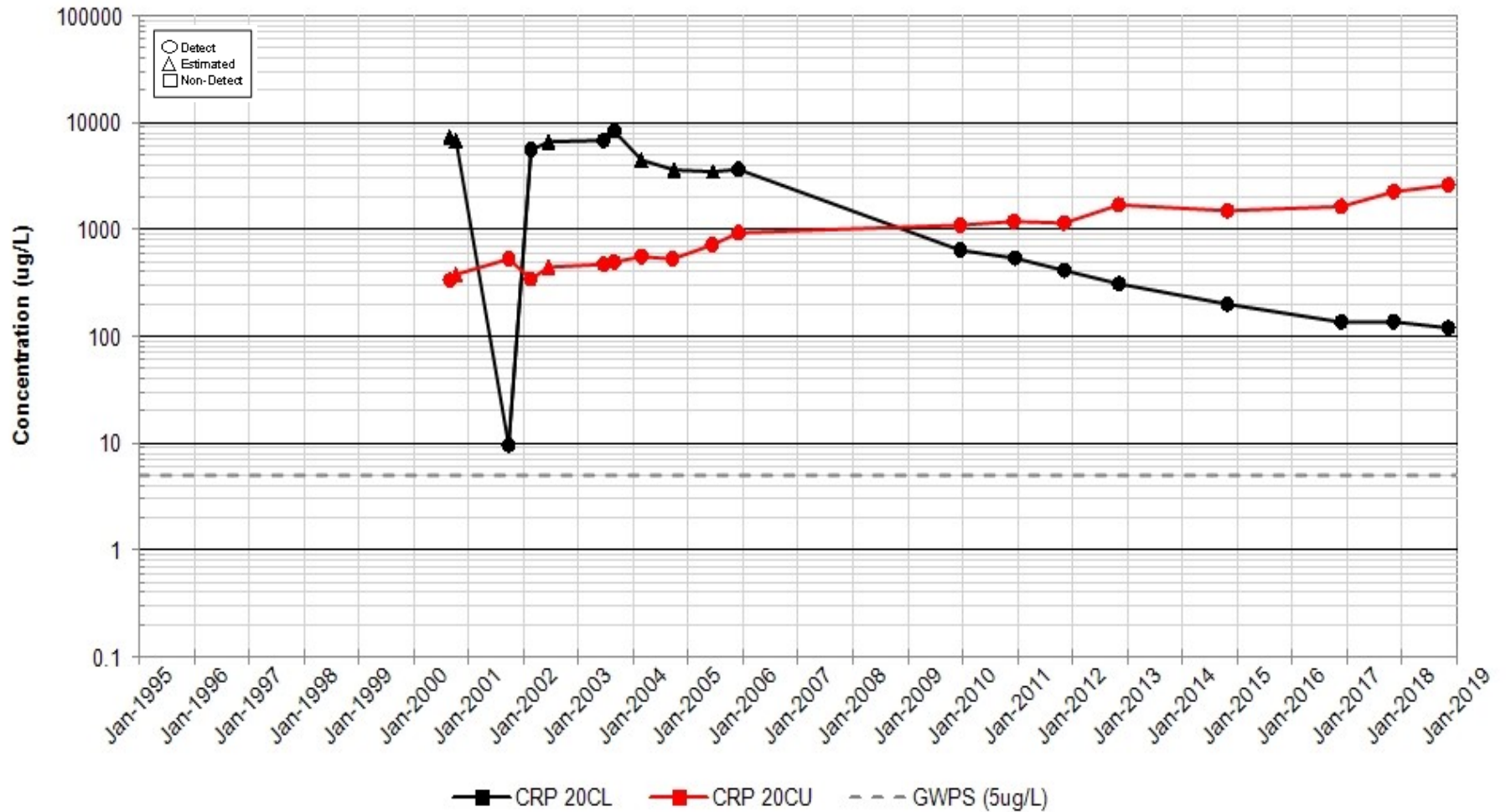


Figure C-109.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 22

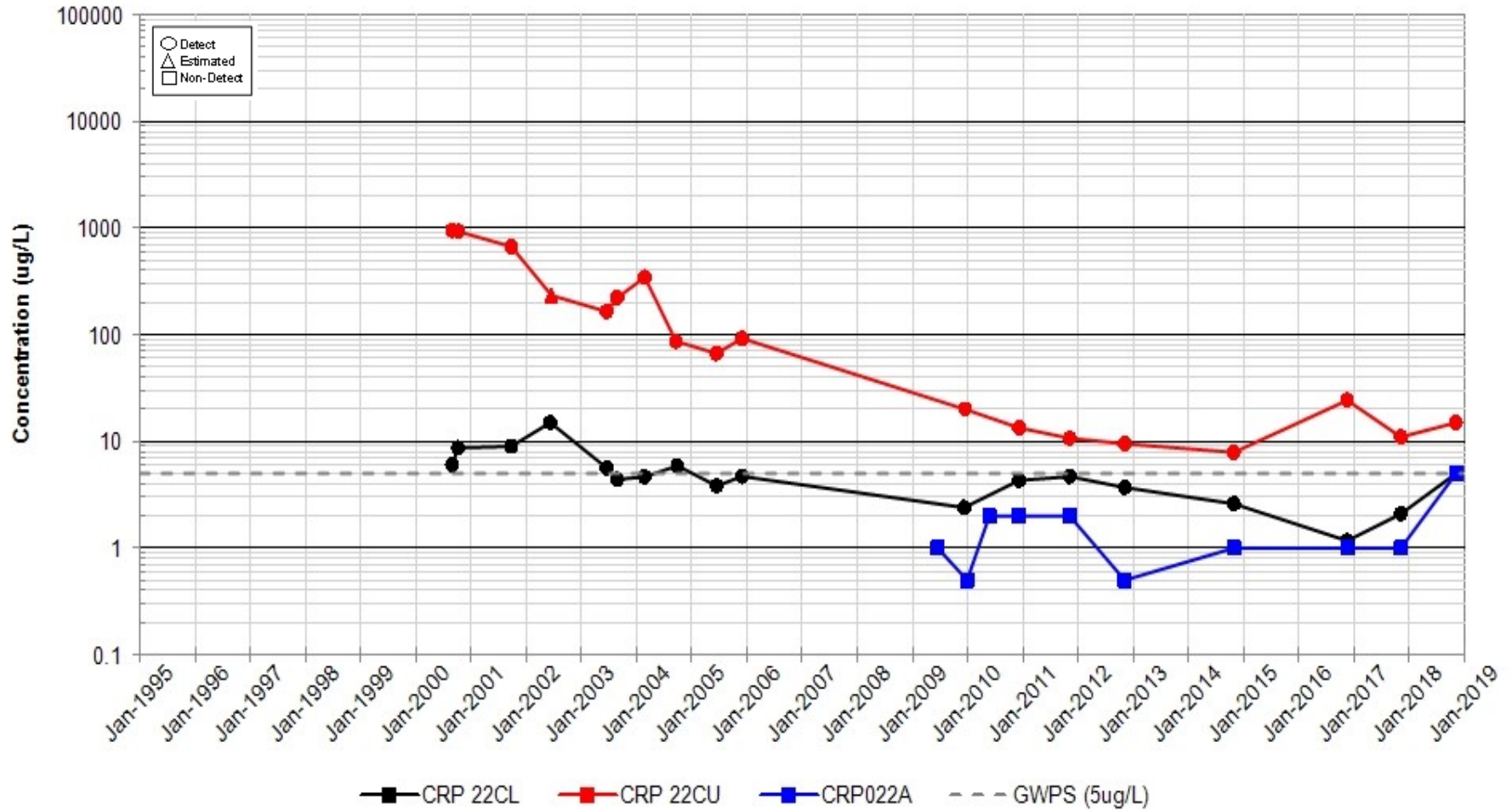


Figure C-110.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 45

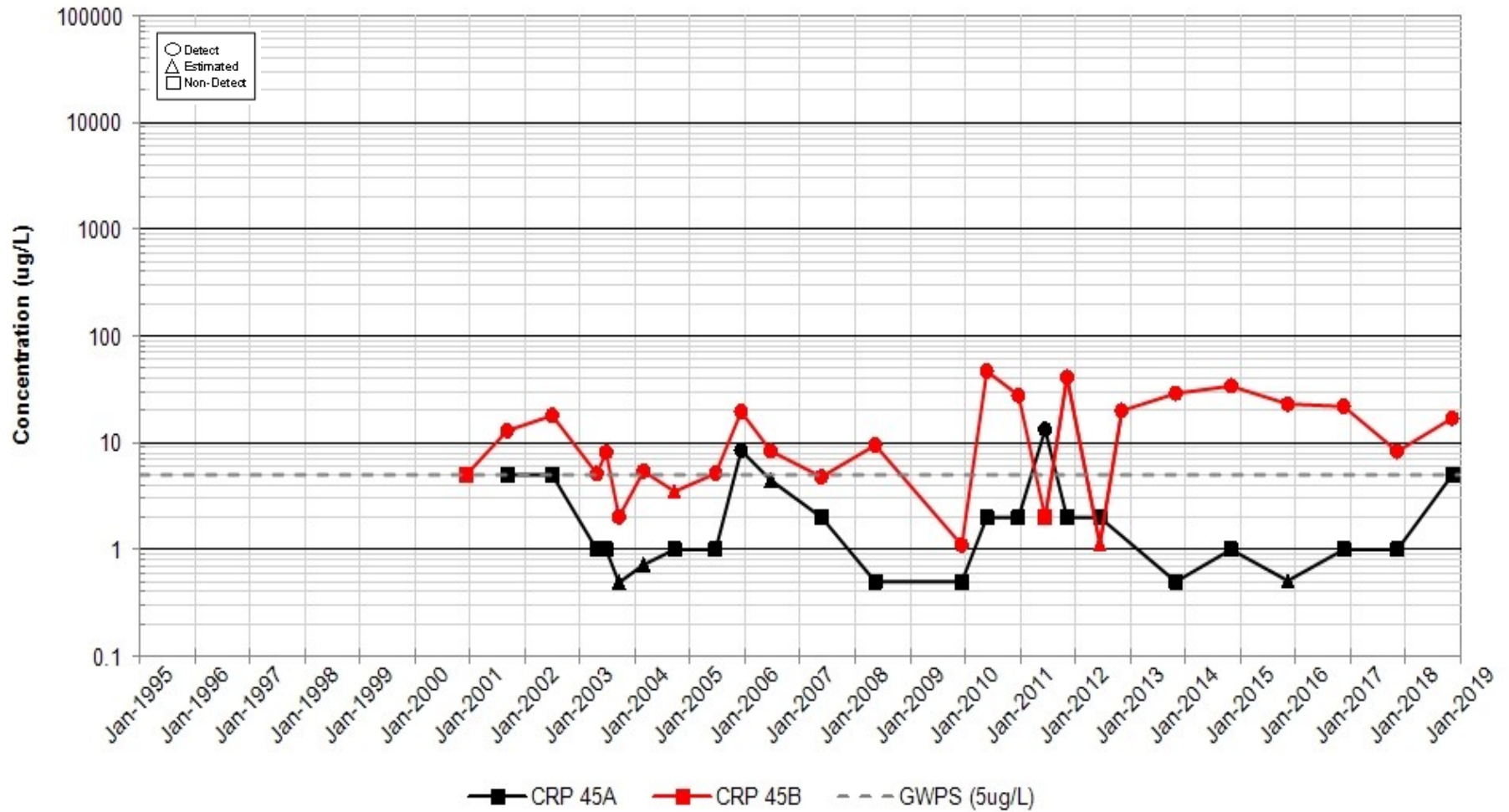


Figure C-111.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 46

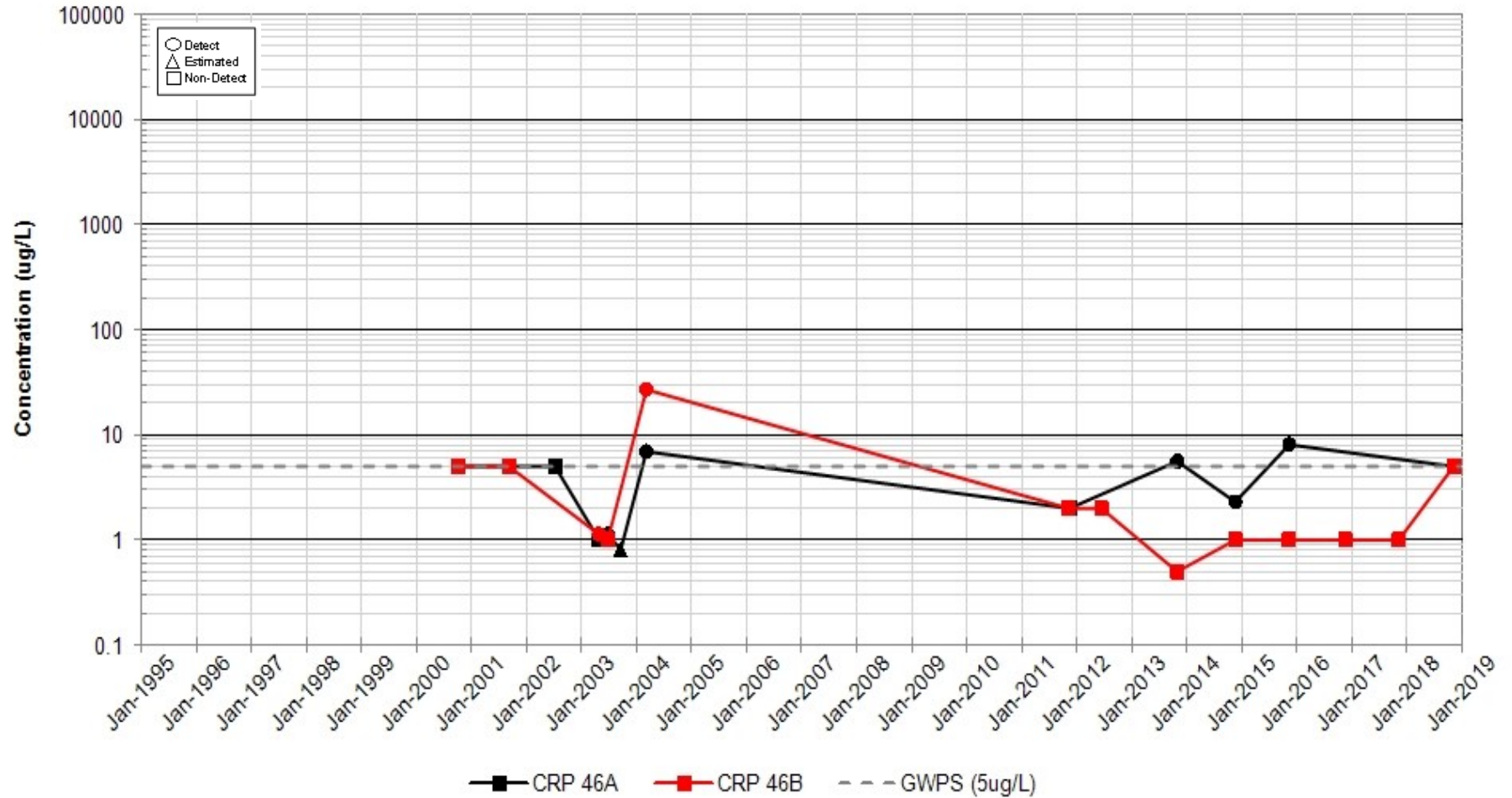


Figure C-112.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 48

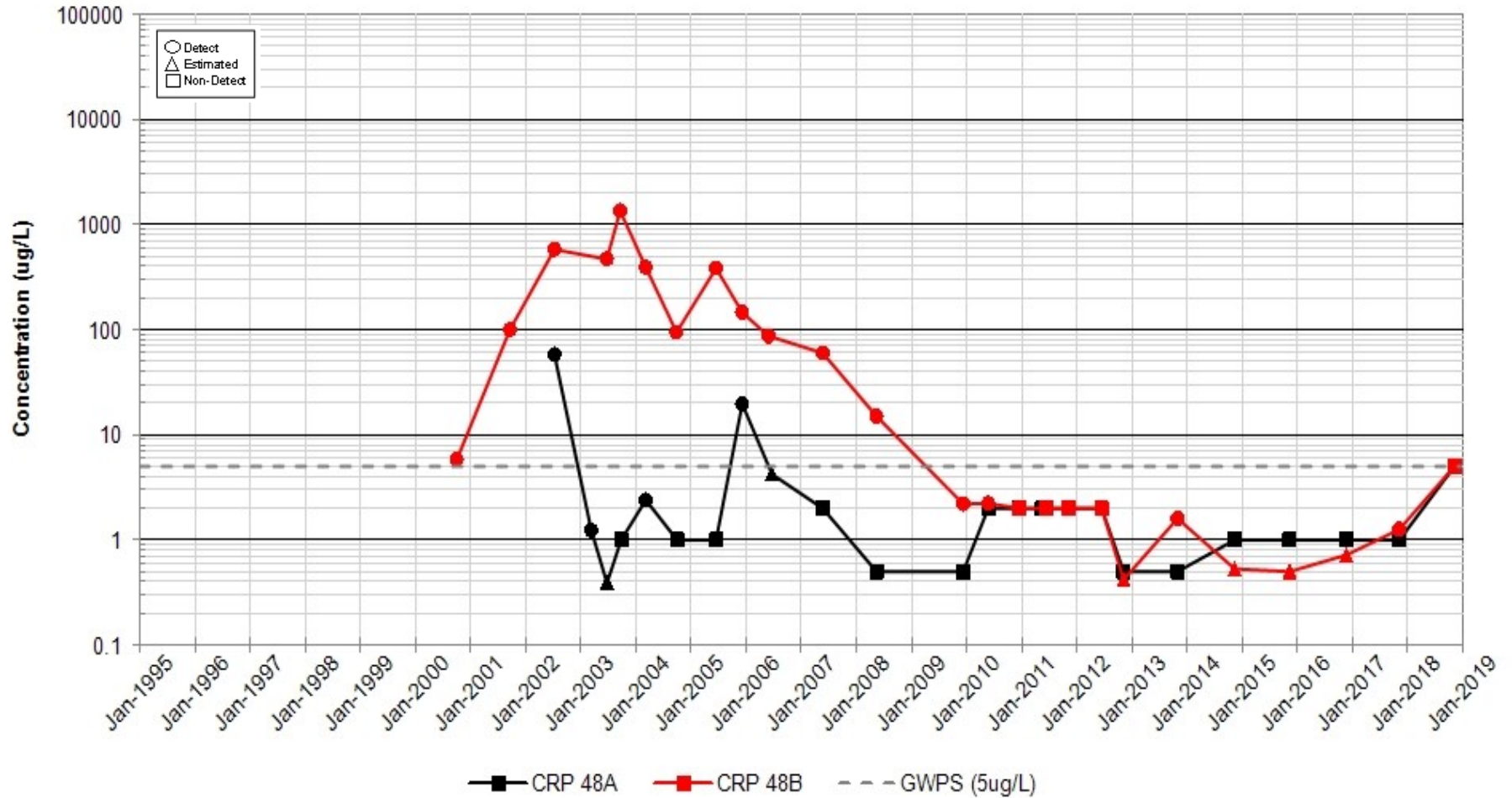


Figure C-113.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 50

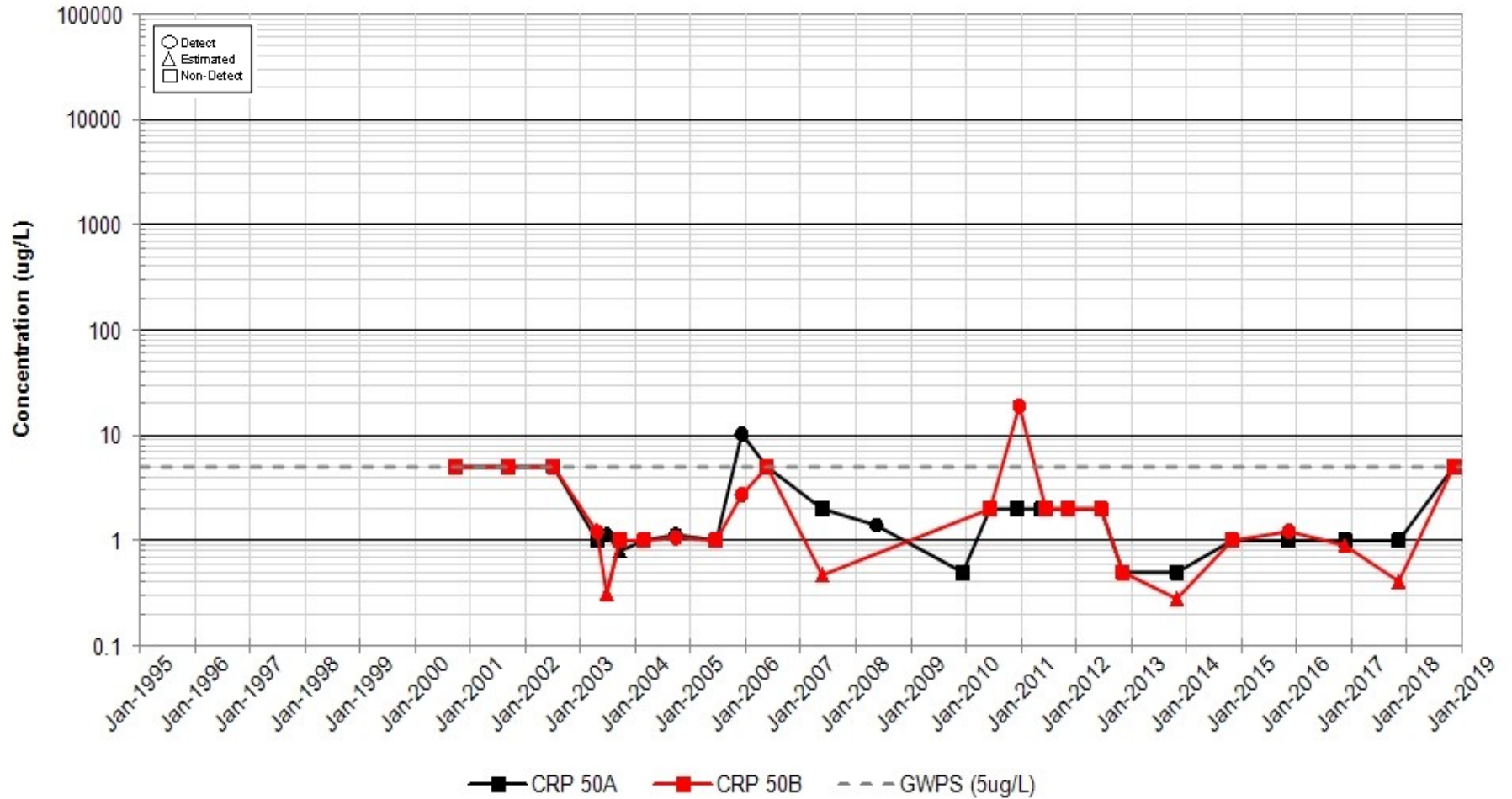


Figure C-114.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 51

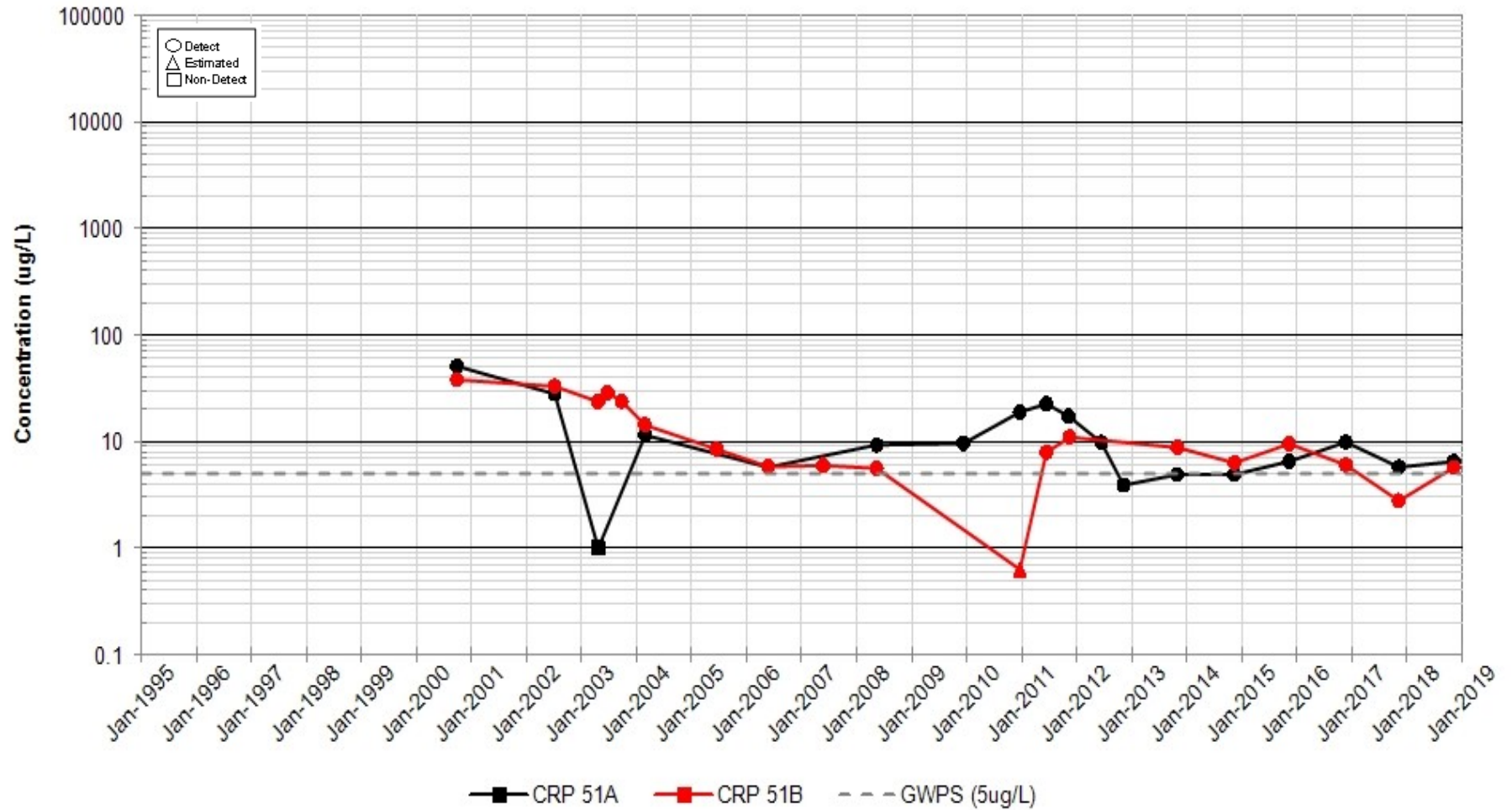


Figure C-115.

Time Series Plot for Trichloroethylene (TCE) Station for CRP 52

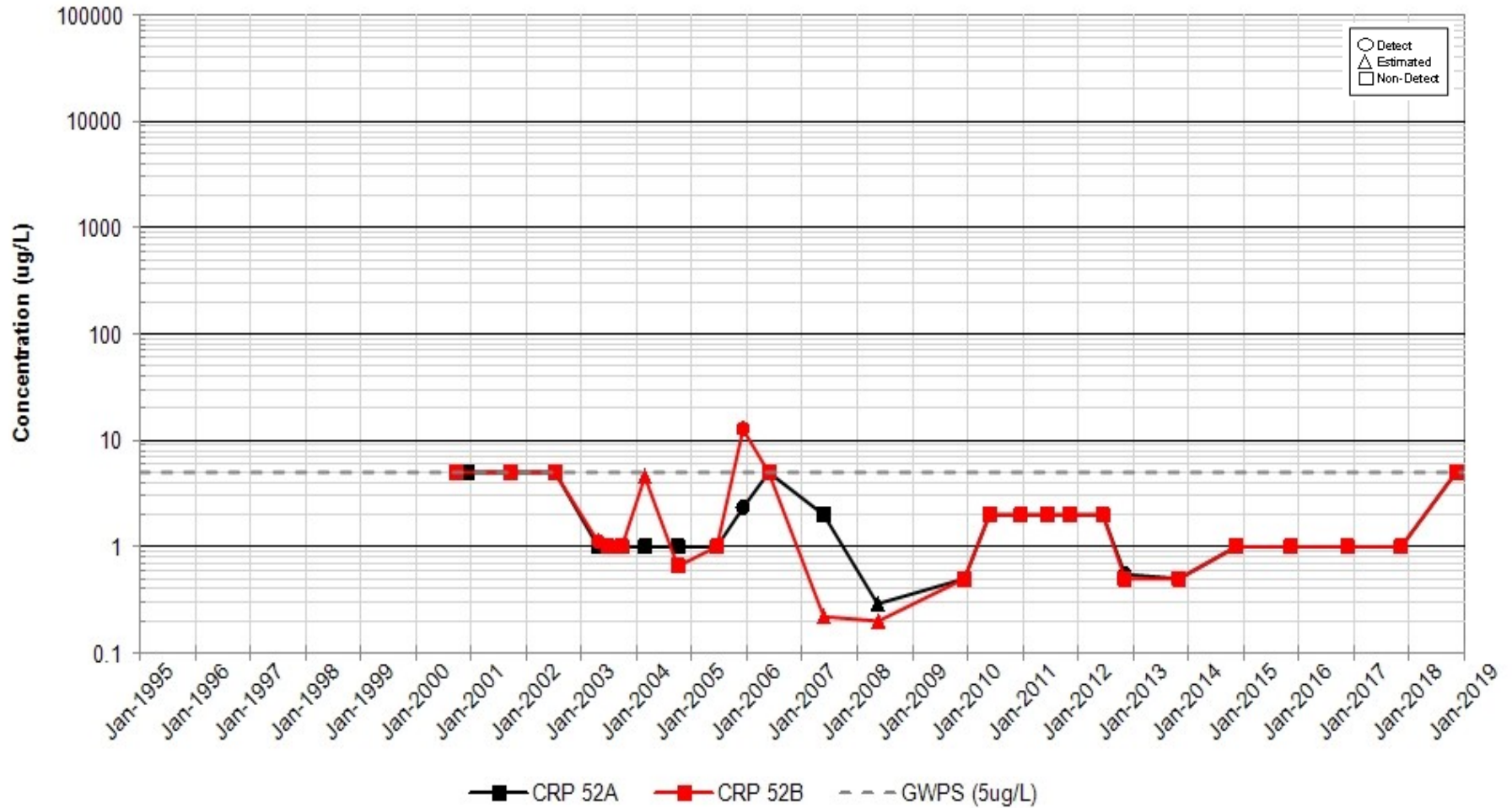


Figure C-116.

Time Series Plot for Trichloroethylene (TCE) Station for CRW 10

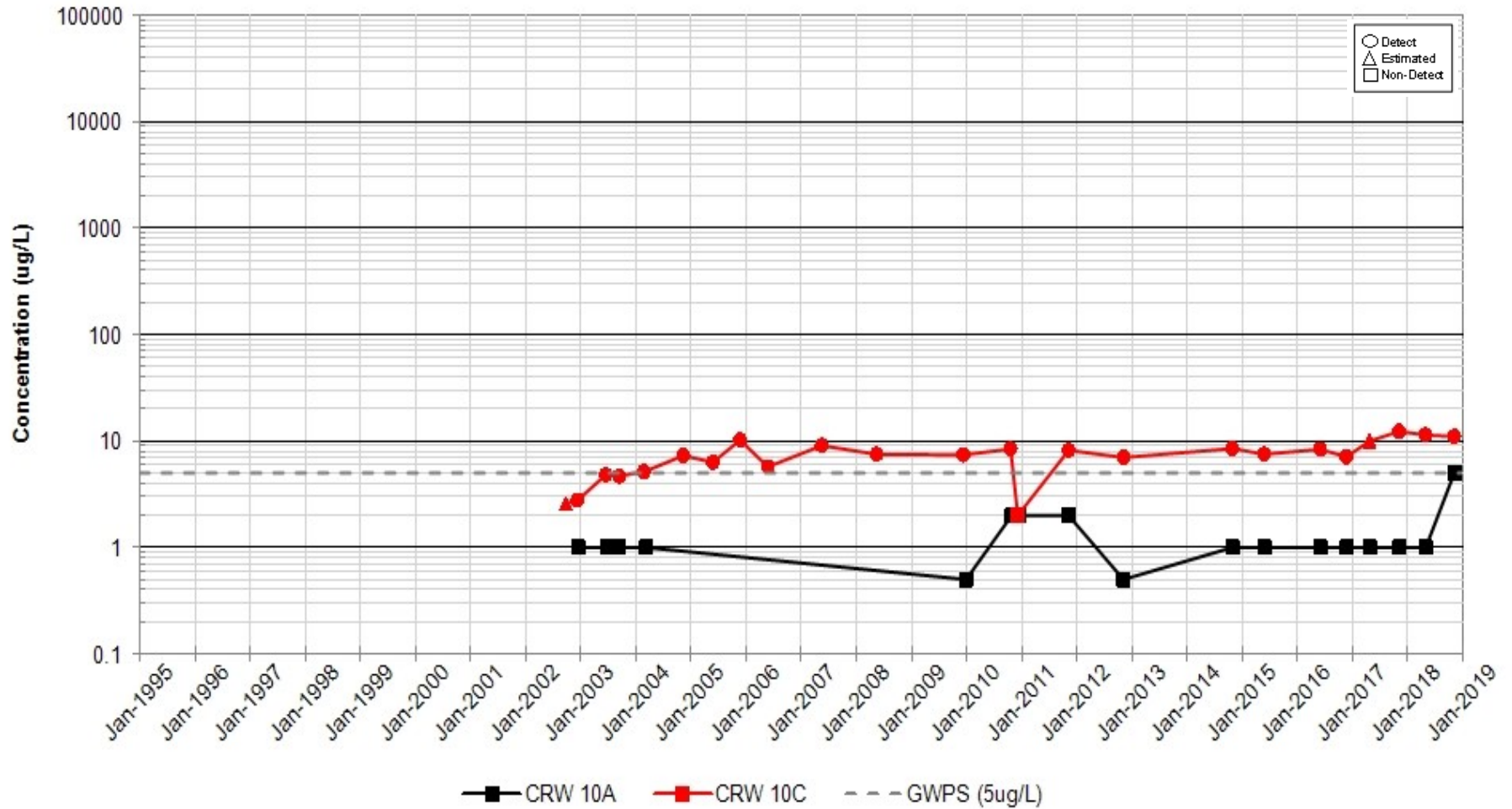


Figure C-117.

Time Series Plot for Trichloroethylene (TCE) Station for CRW 12

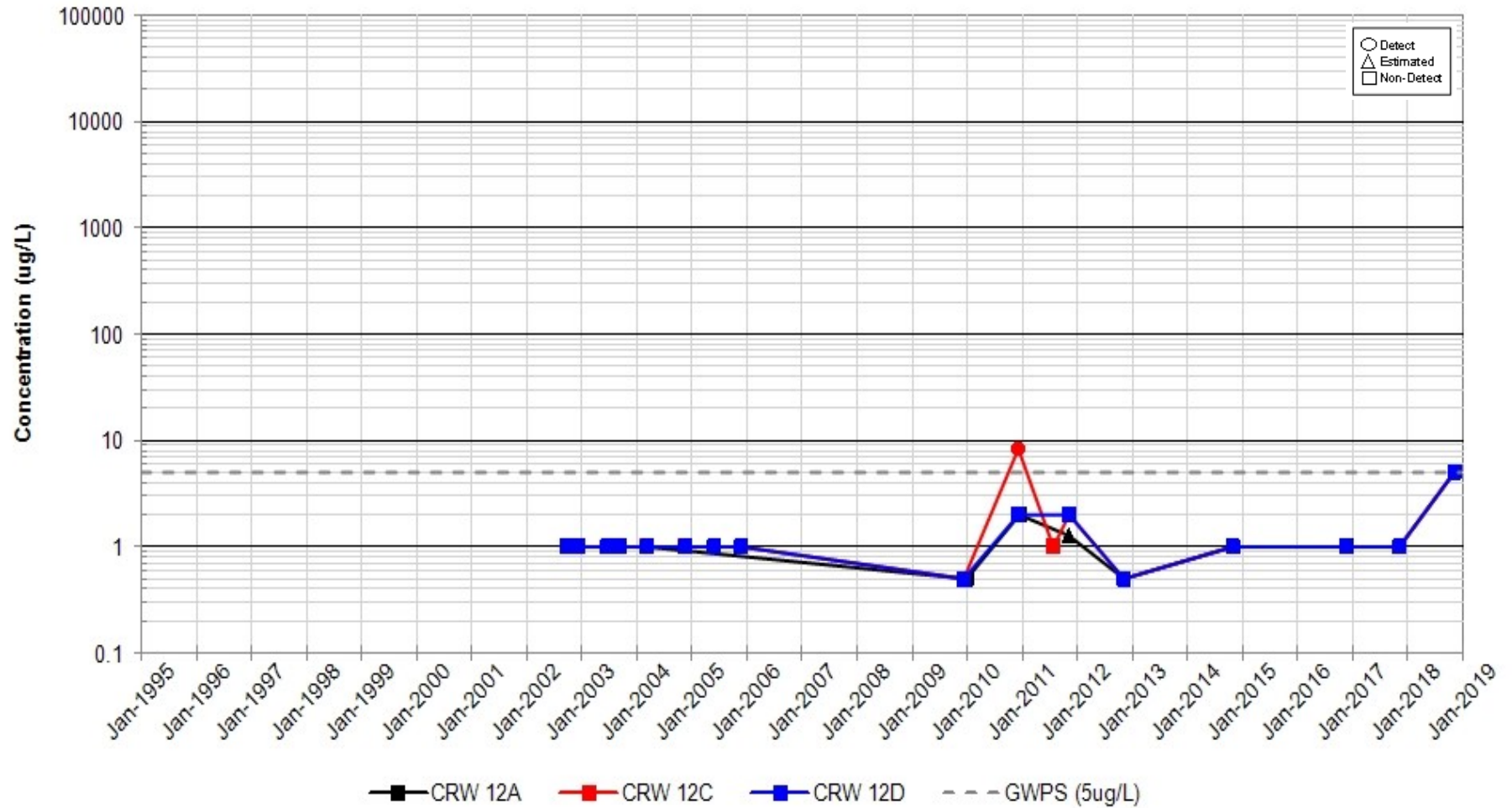


Figure C-118.

Time Series Plot for Trichloroethylene (TCE) Station for CRW010

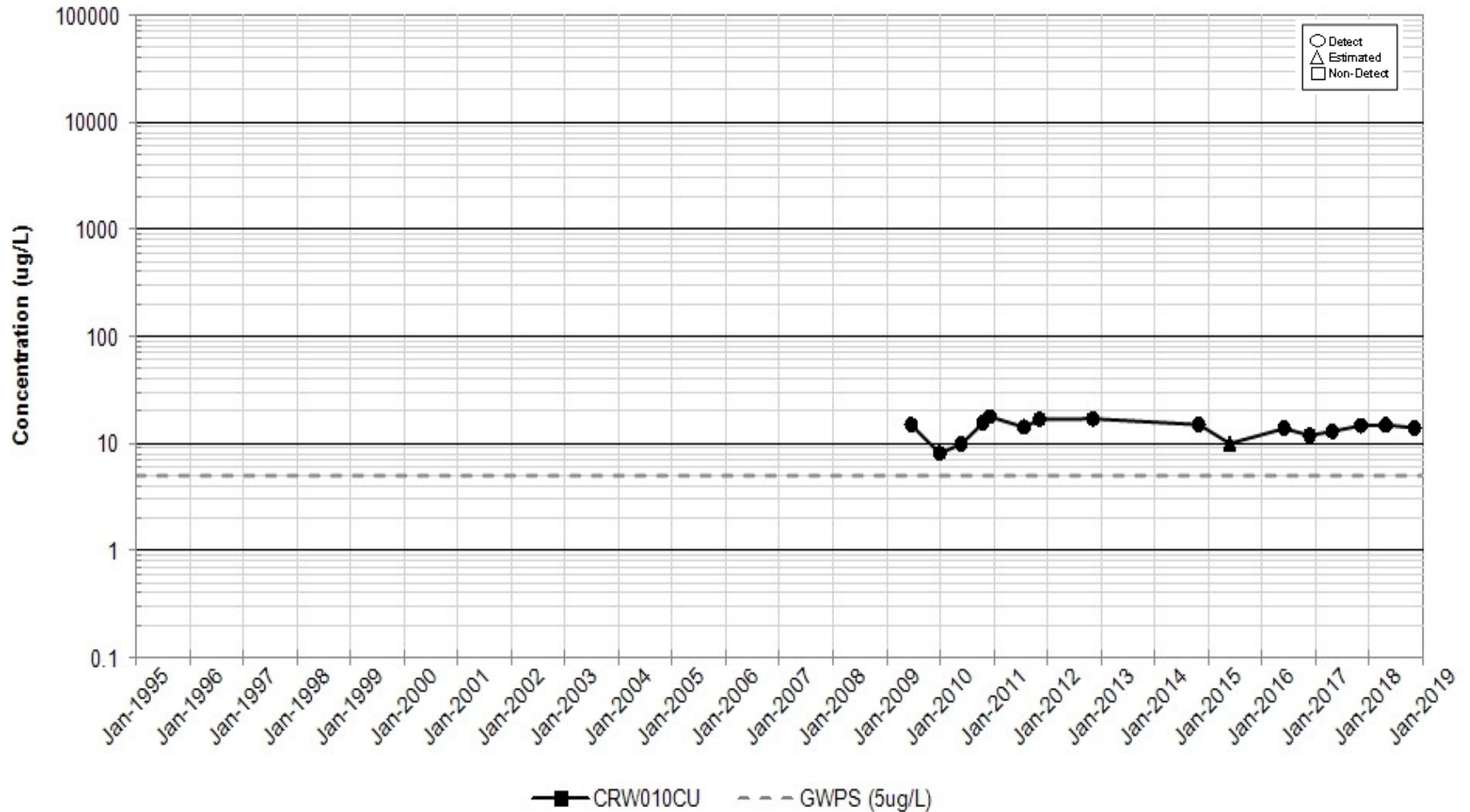


Figure C-119.

Time Series Plot for Trichloroethylene (TCE) Station for TL 01

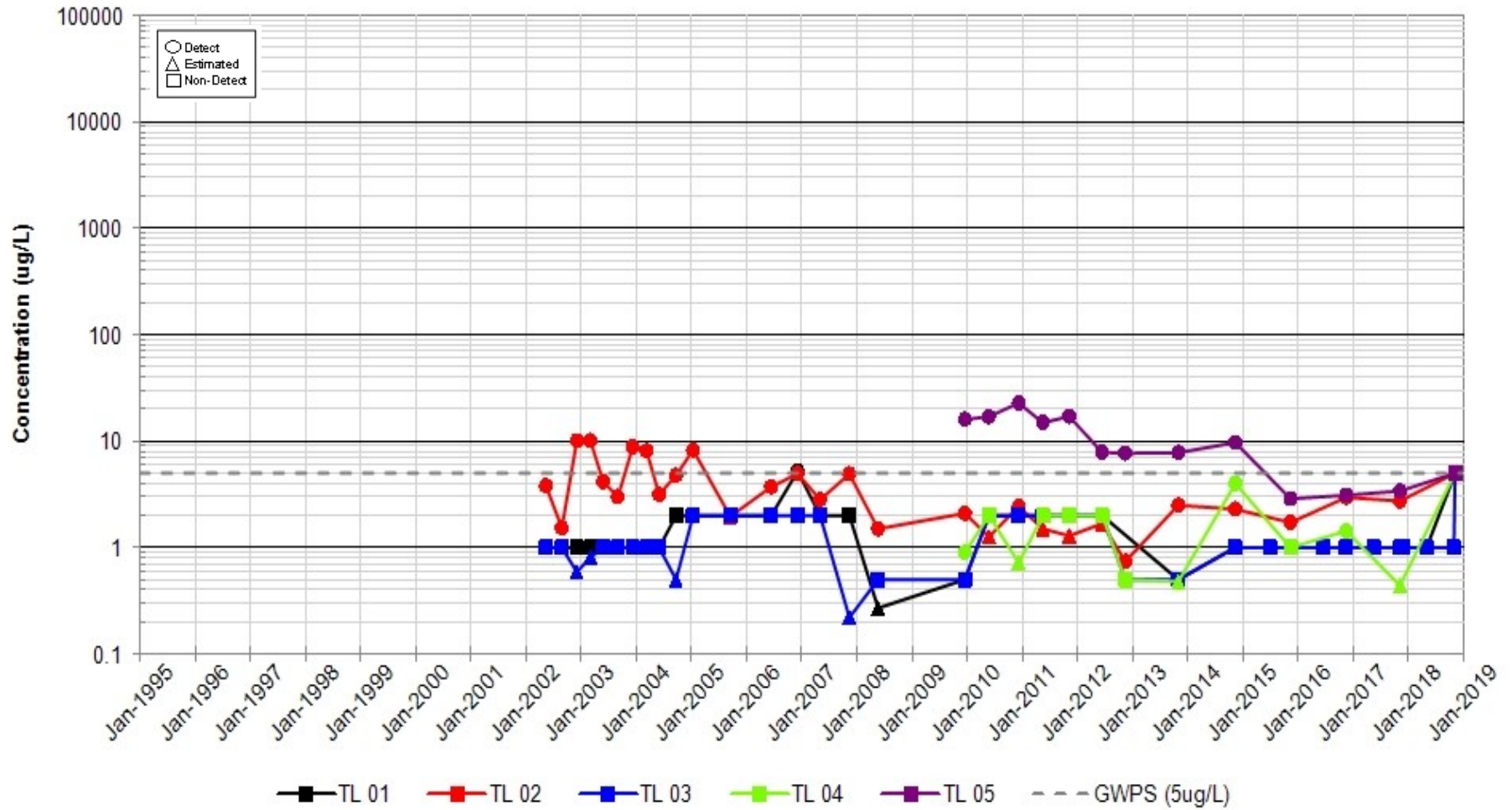


Figure C-120.

Time Series Plot for ETHYLENE Station for CRP 45

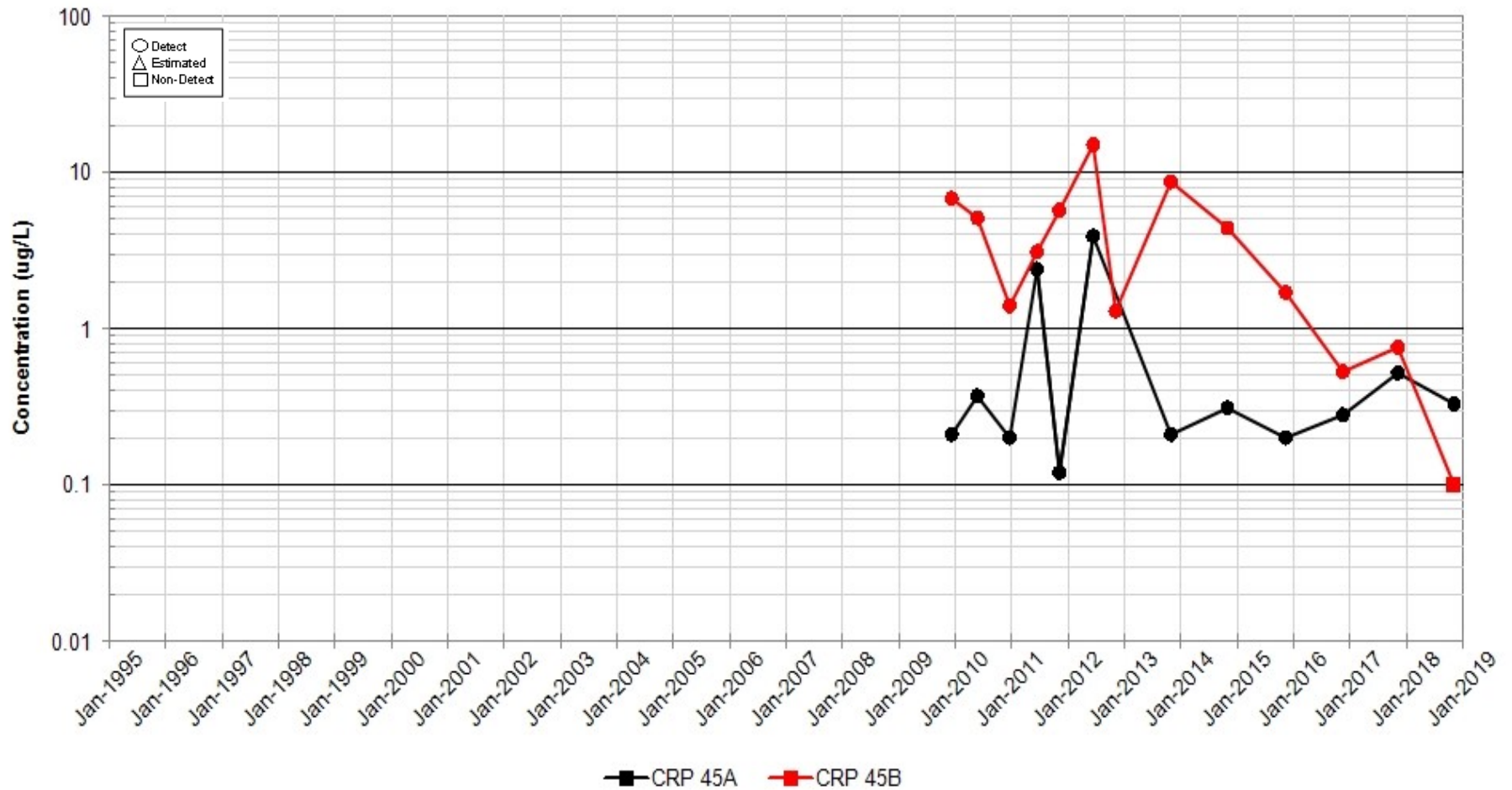


Figure C-121.

Time Series Plot for ETHYLENE Station for CRP 46

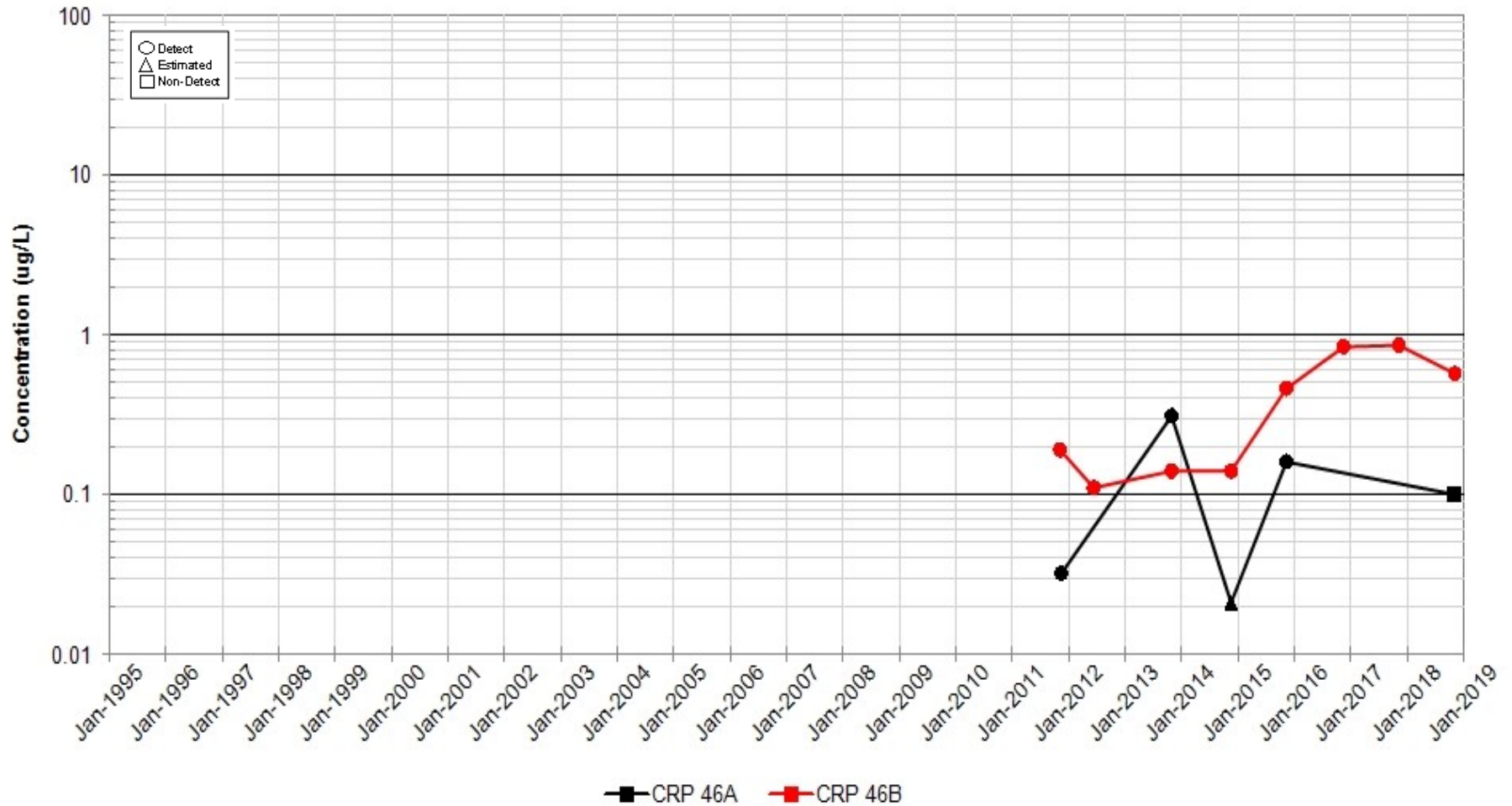


Figure C-122.

Time Series Plot for ETHYLENE Station for CRP 48

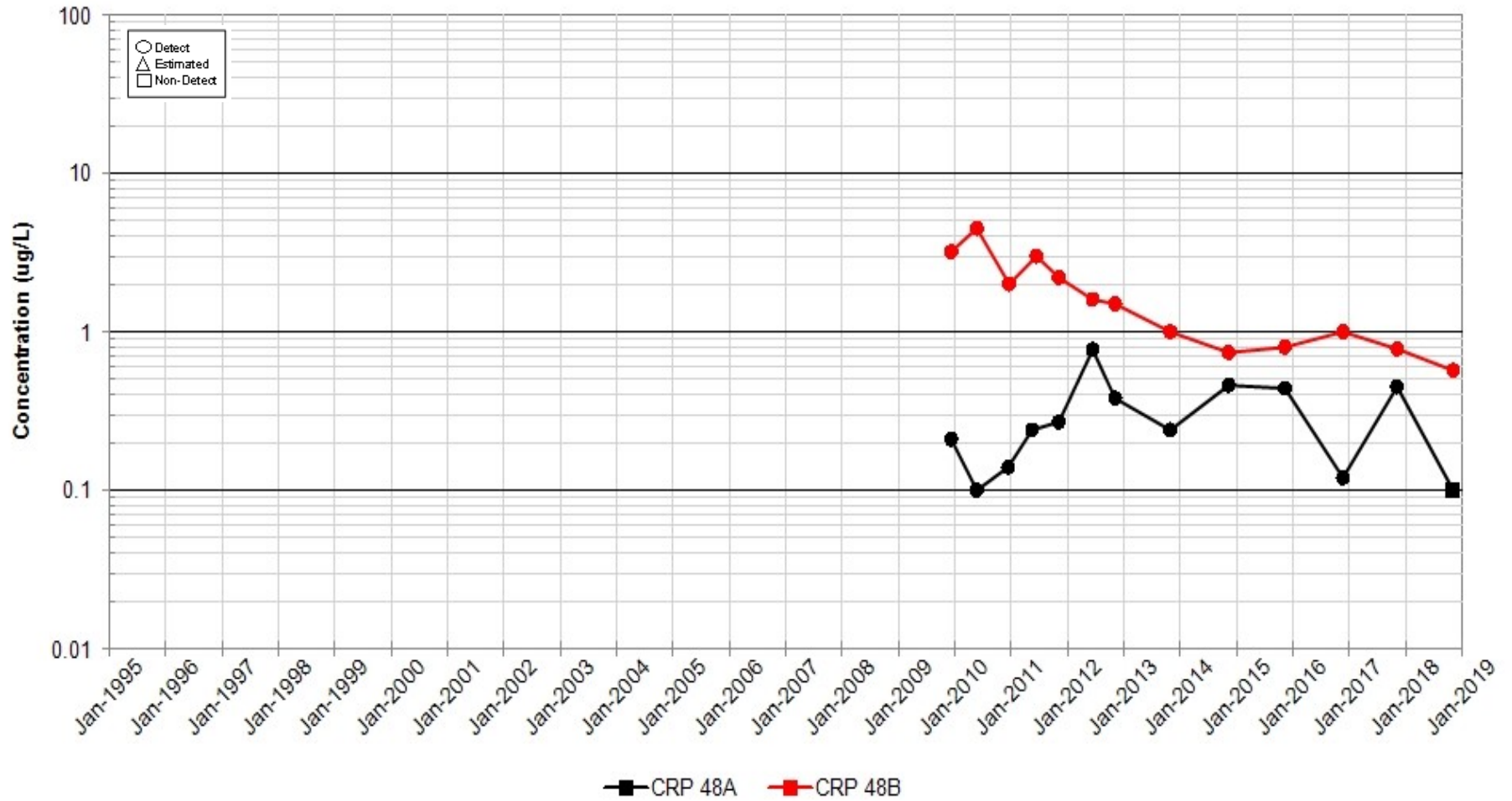


Figure C-123.

Time Series Plot for ETHYLENE Station for CRP 50

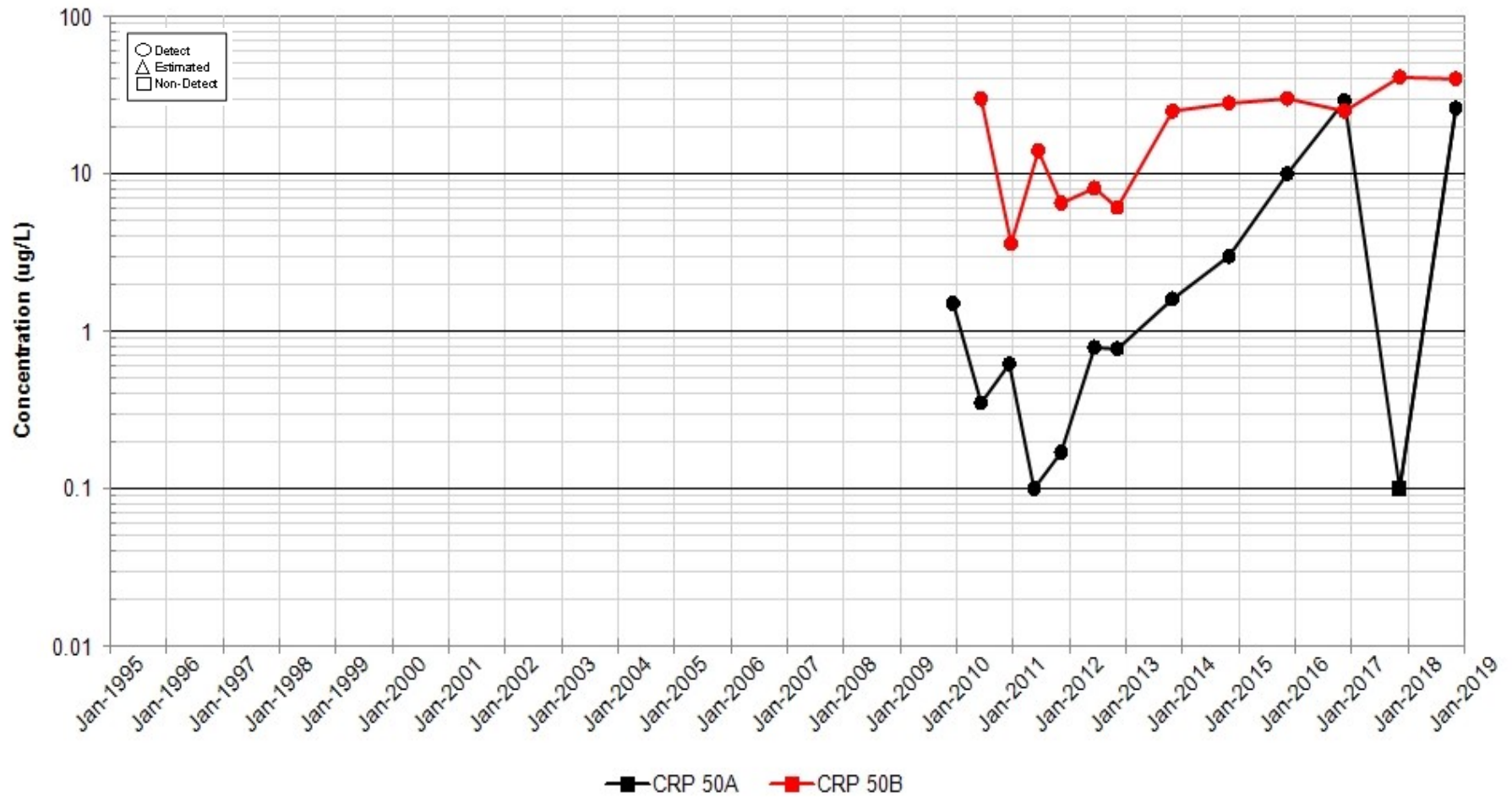


Figure C-124.

Time Series Plot for ETHYLENE Station for CRP 51

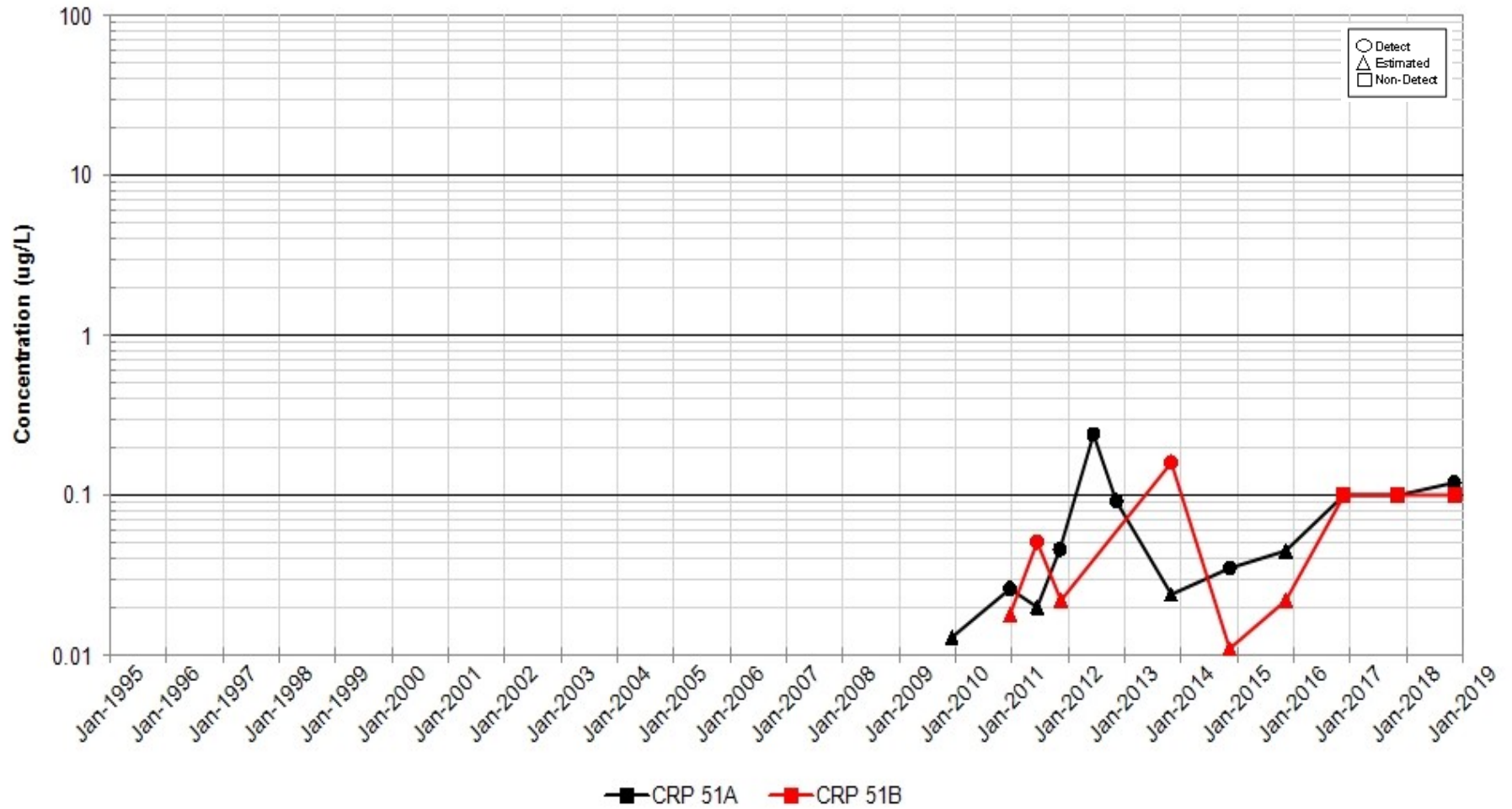


Figure C-125.

Time Series Plot for ETHYLENE Station for CRP 52

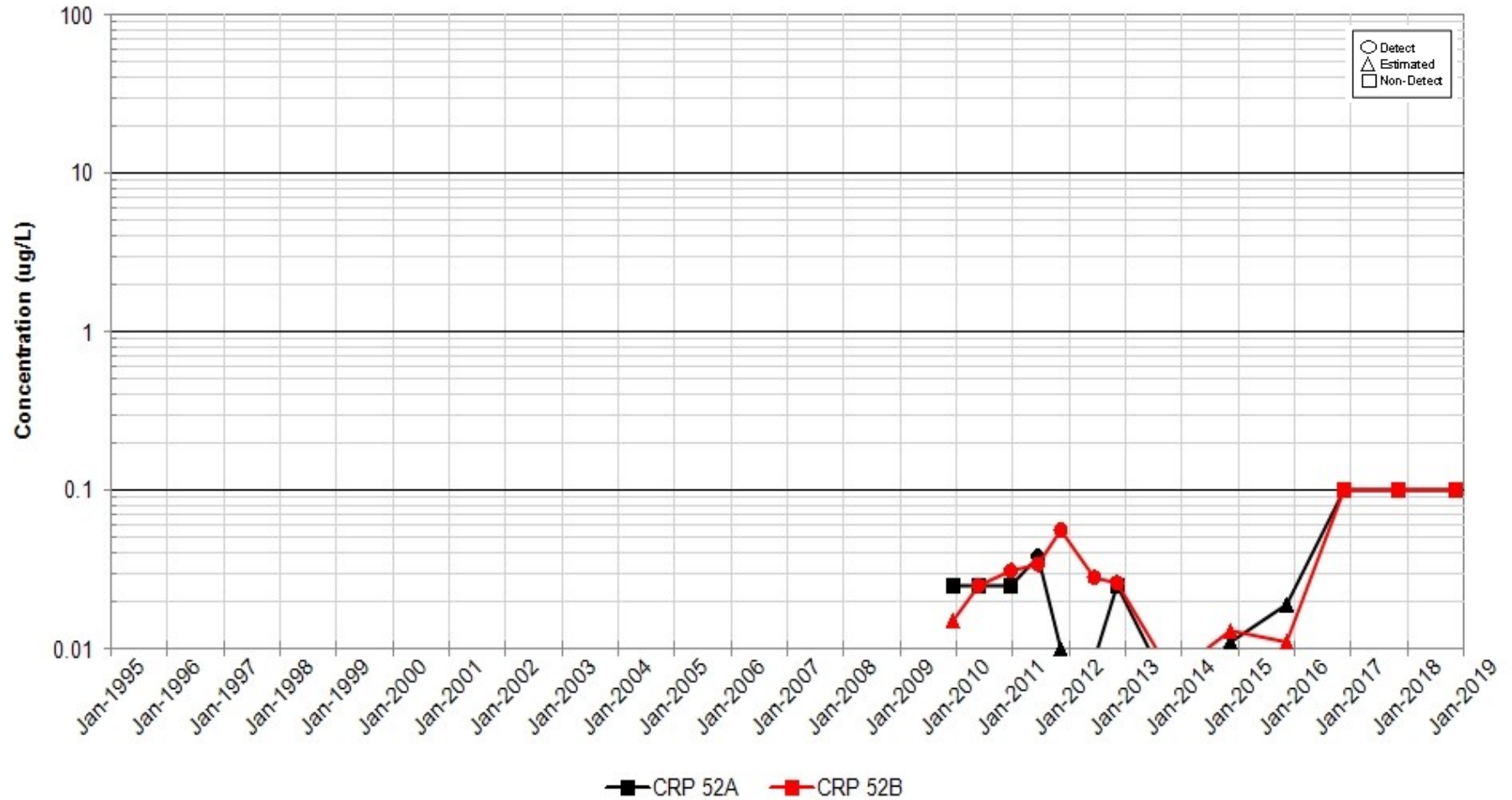
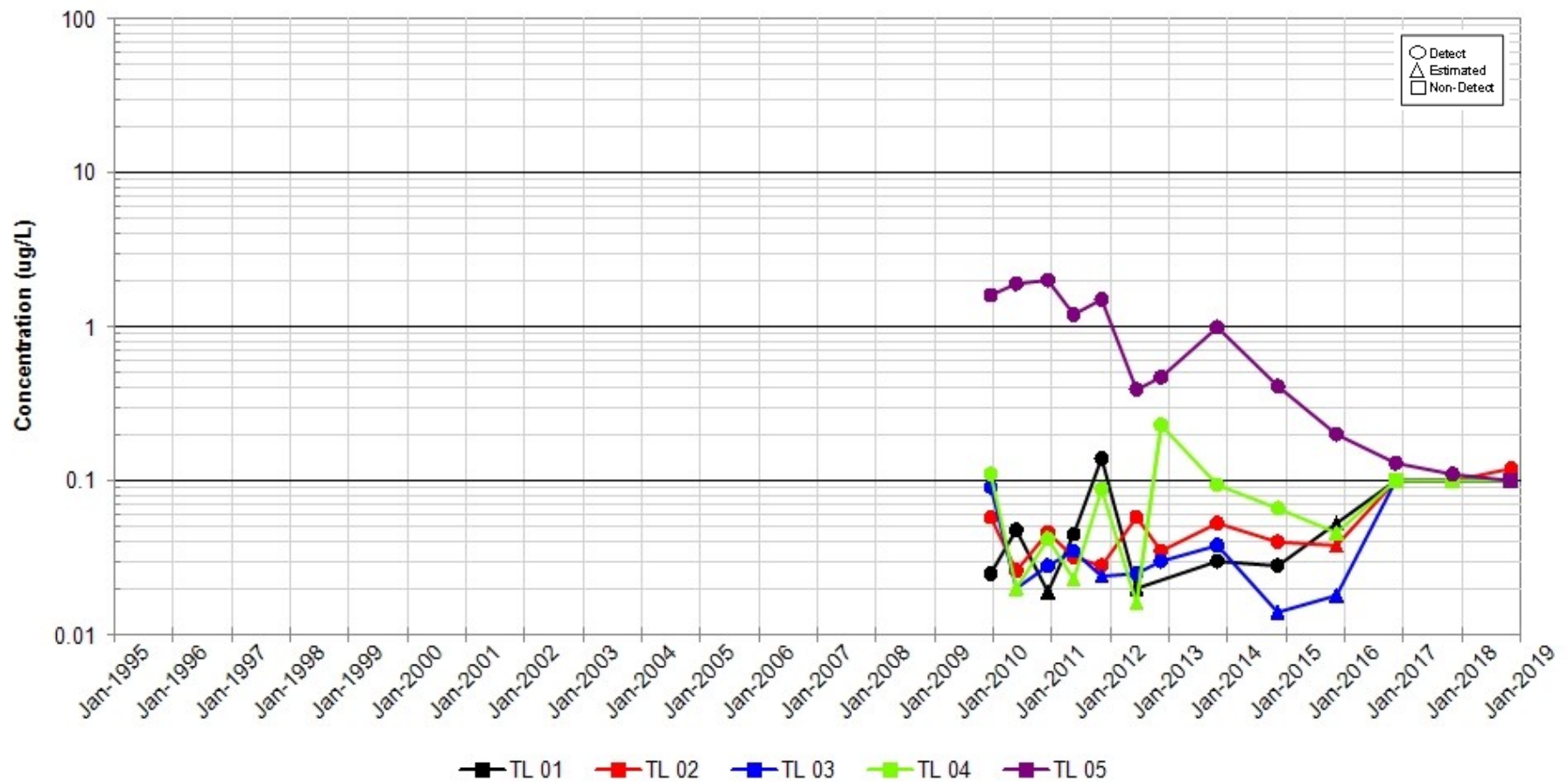


Figure C-126.

Time Series Plot for ETHYLENE Station for TL 01



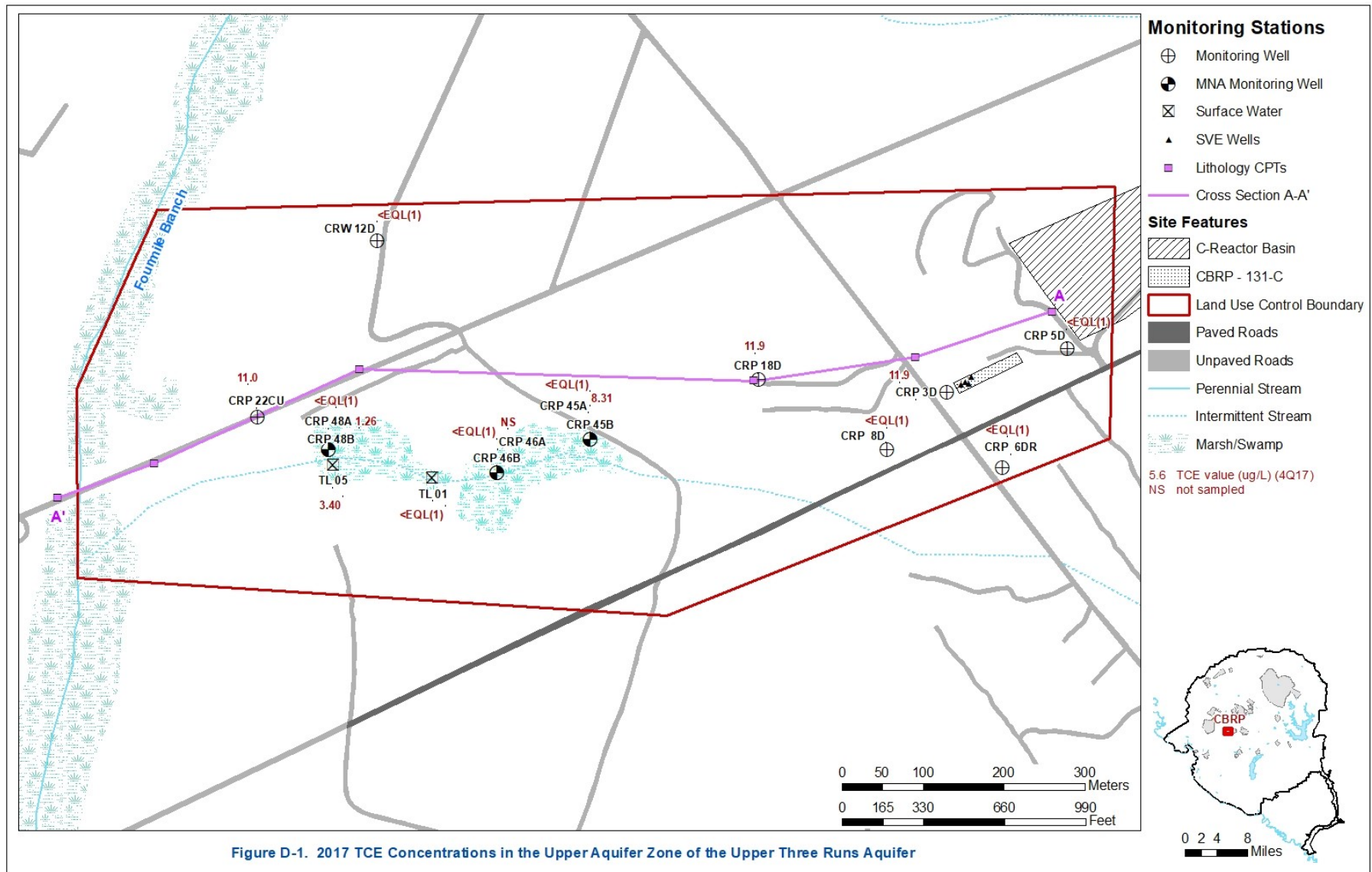
Appendix C Footnotes:

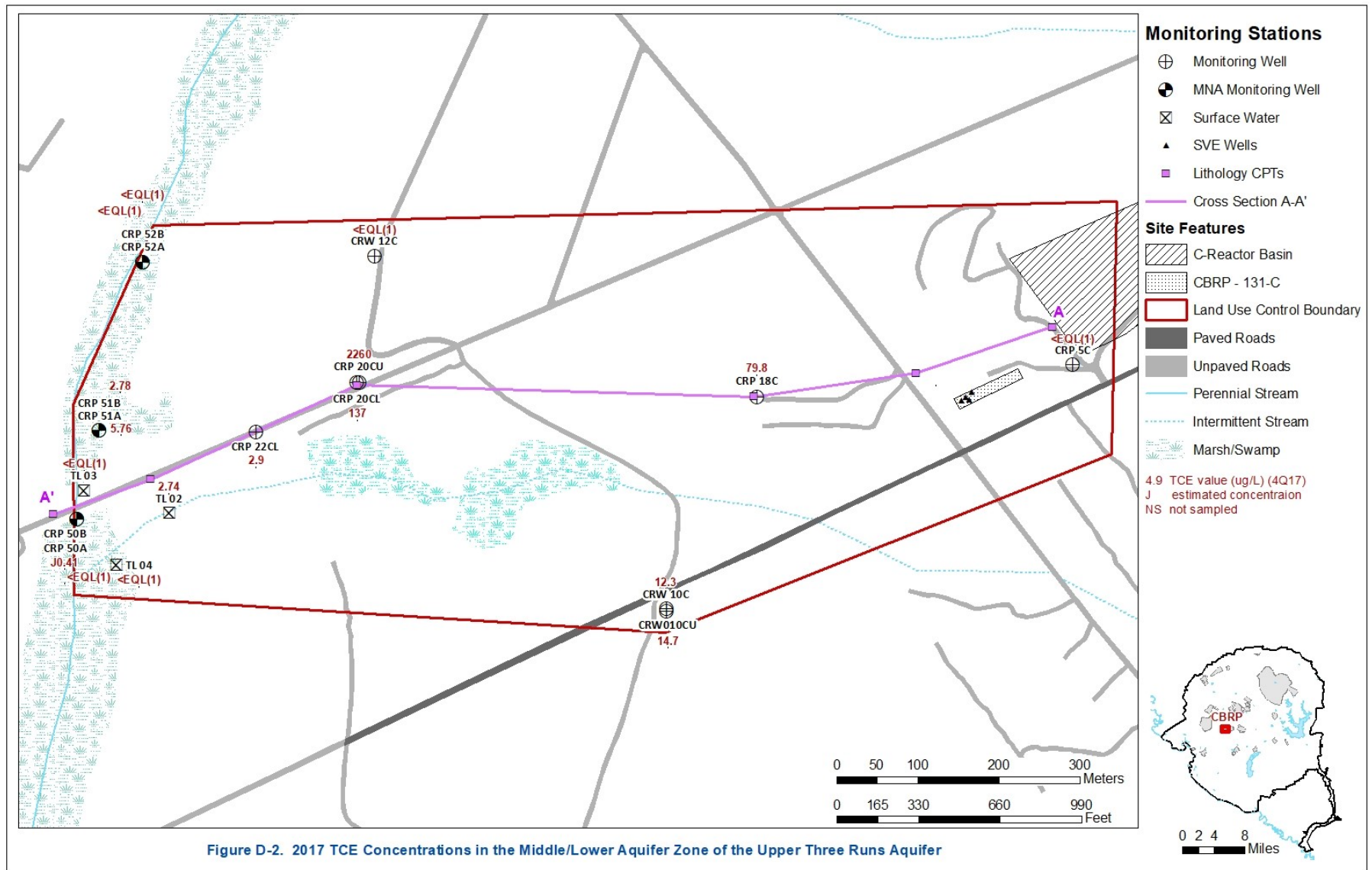
- 1) High concentrations of TCE (e.g. Figure C-103 or Figure C-108) in samples require them to be diluted prior to analysis, which results in elevated MDLs and EQLs for all VOCs in those samples (e.g. Figure C-1 or Figure C-6).

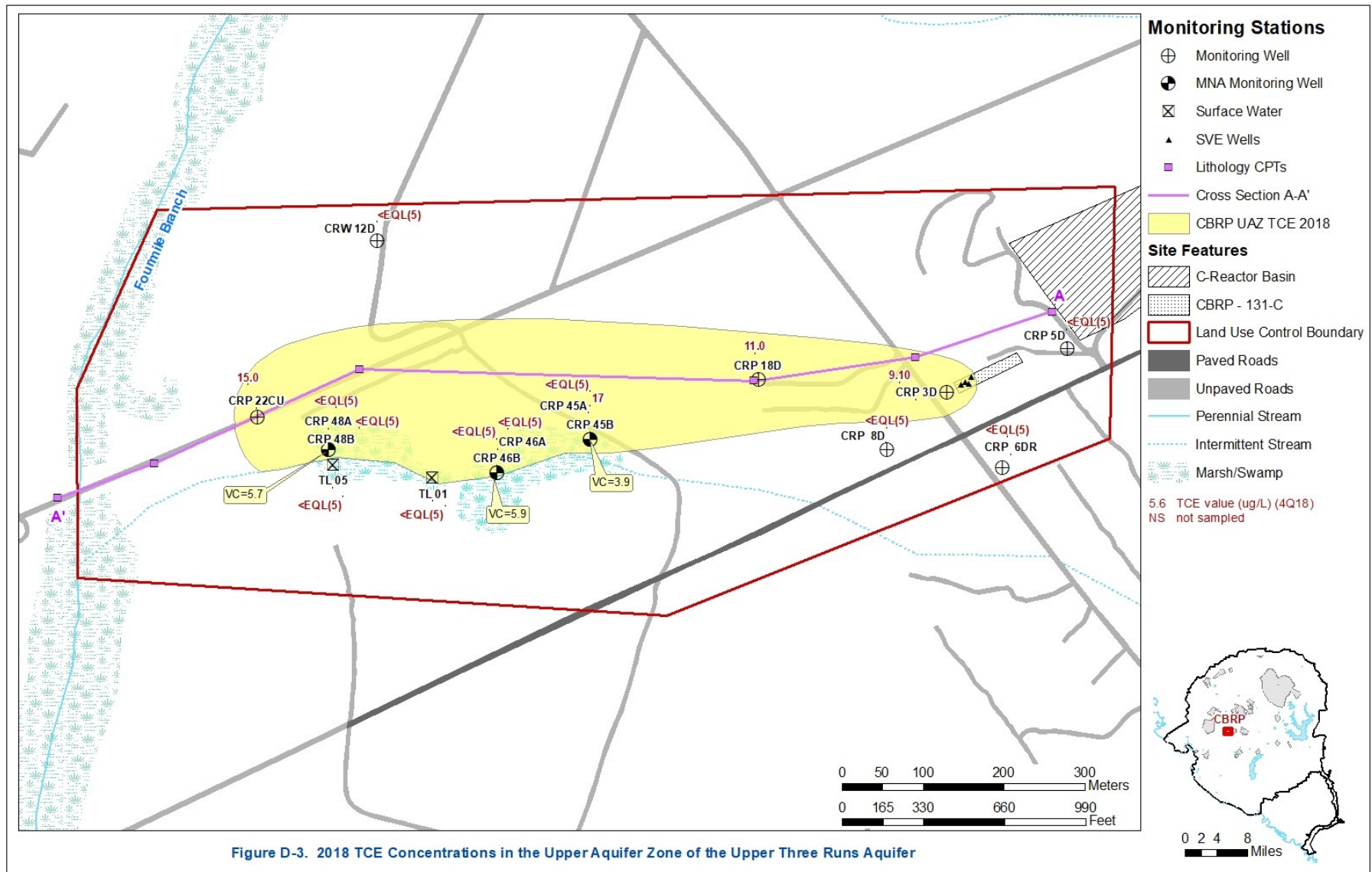
APPENDIX D

TCE Plume Maps

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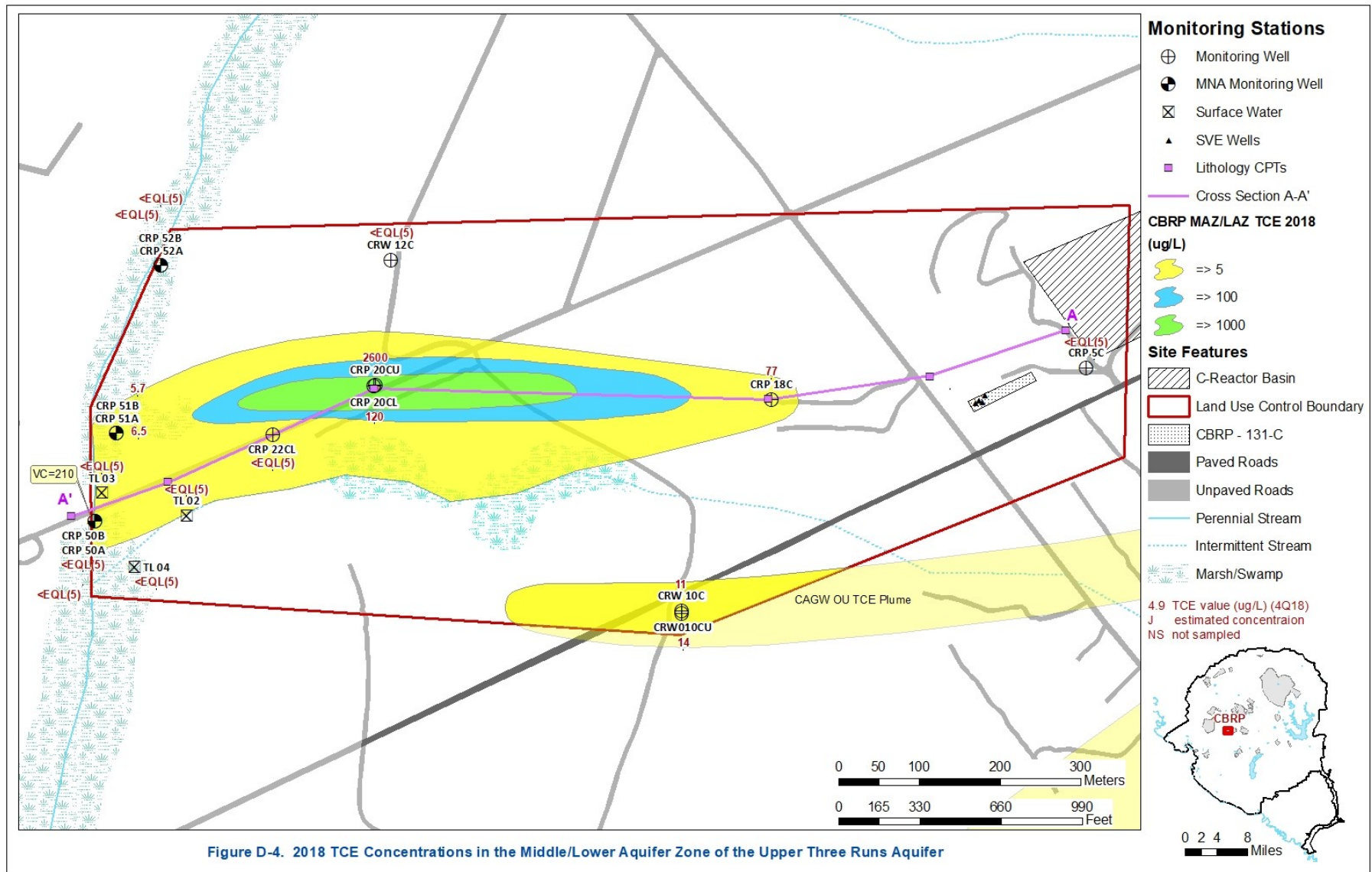
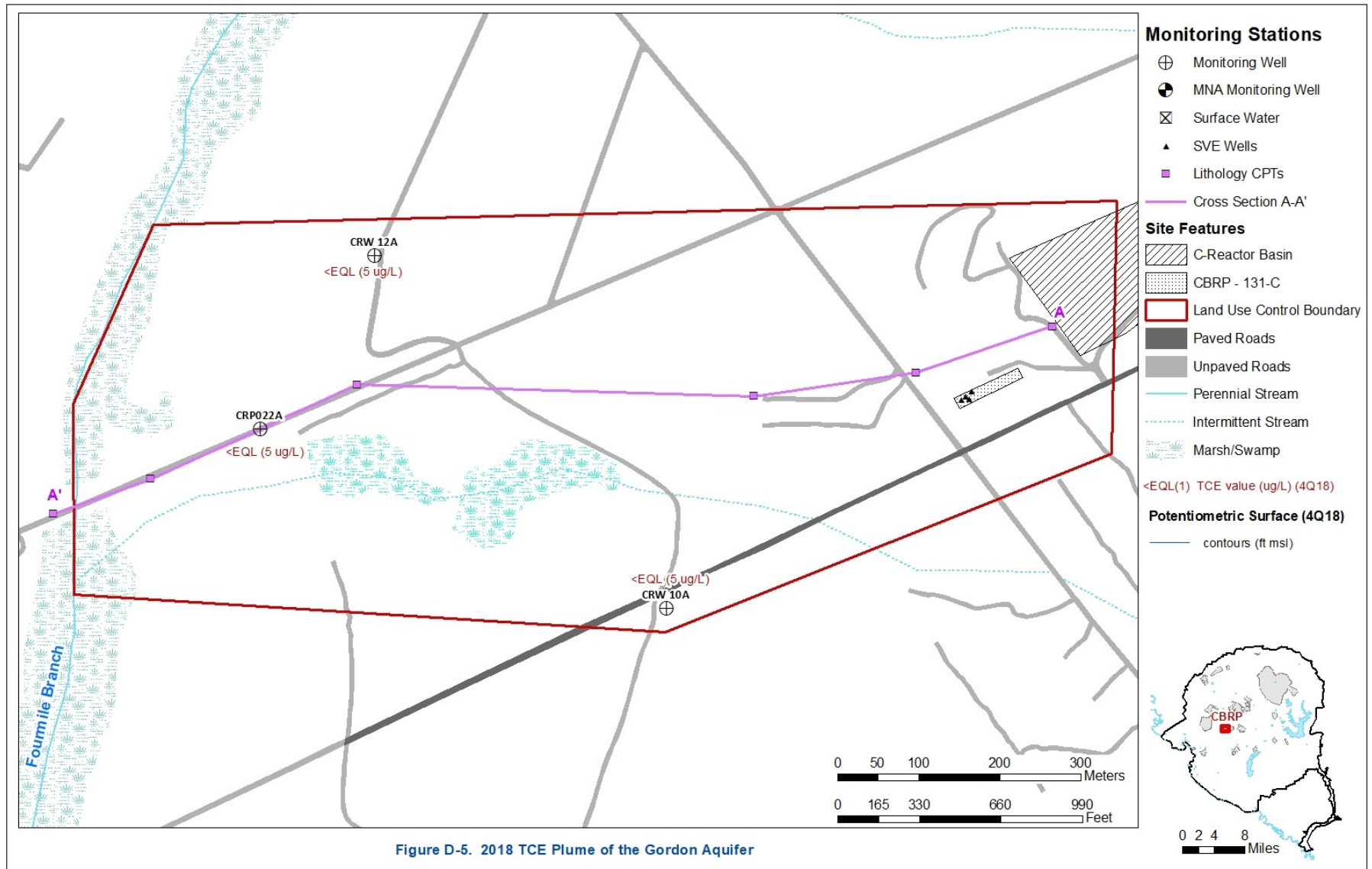


Figure D-4. 2018 TCE Concentrations in the Middle/Lower Aquifer Zone of the Upper Three Runs Aquifer

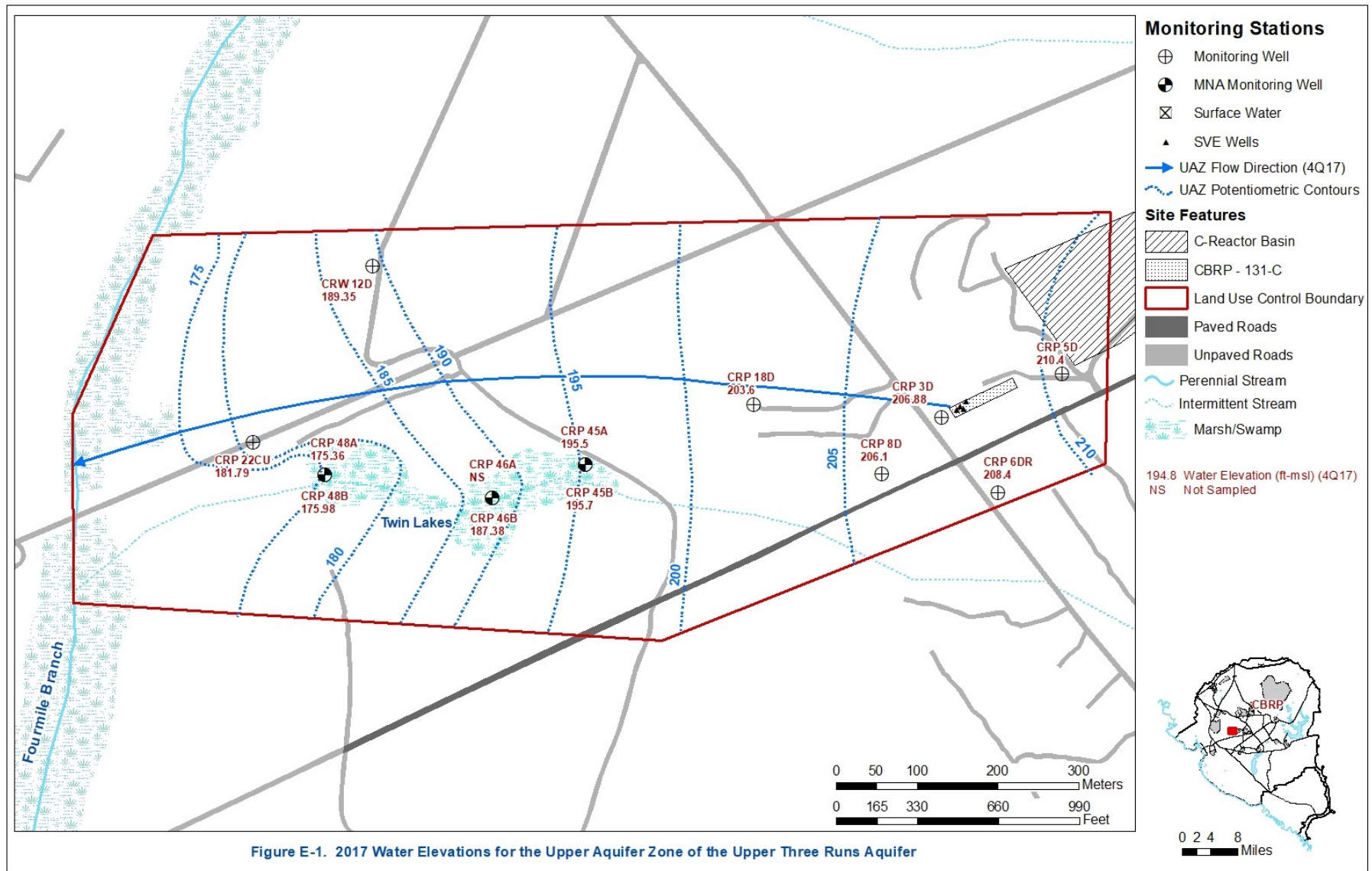


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APPENDIX E

Potentiometric Maps

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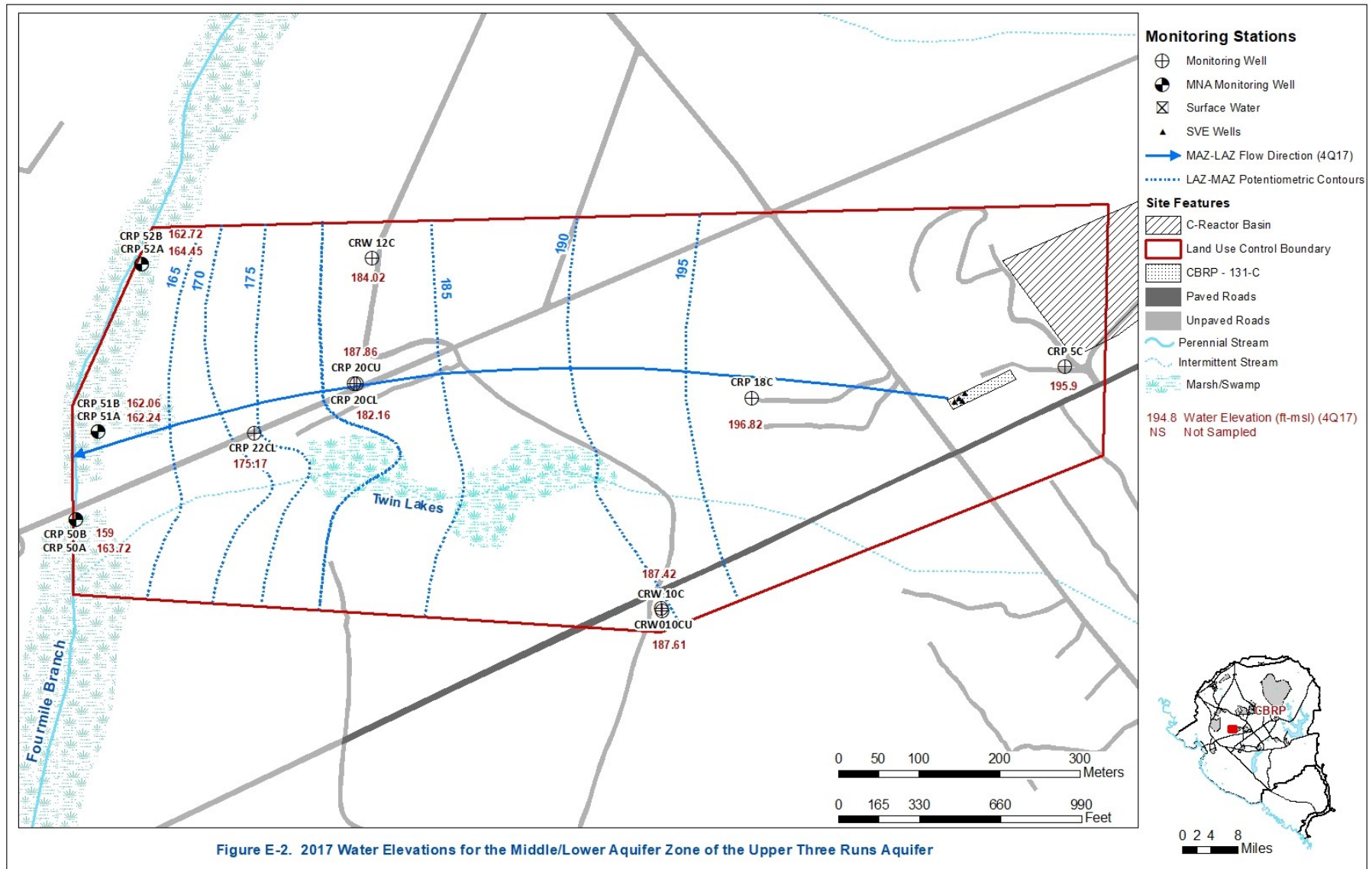
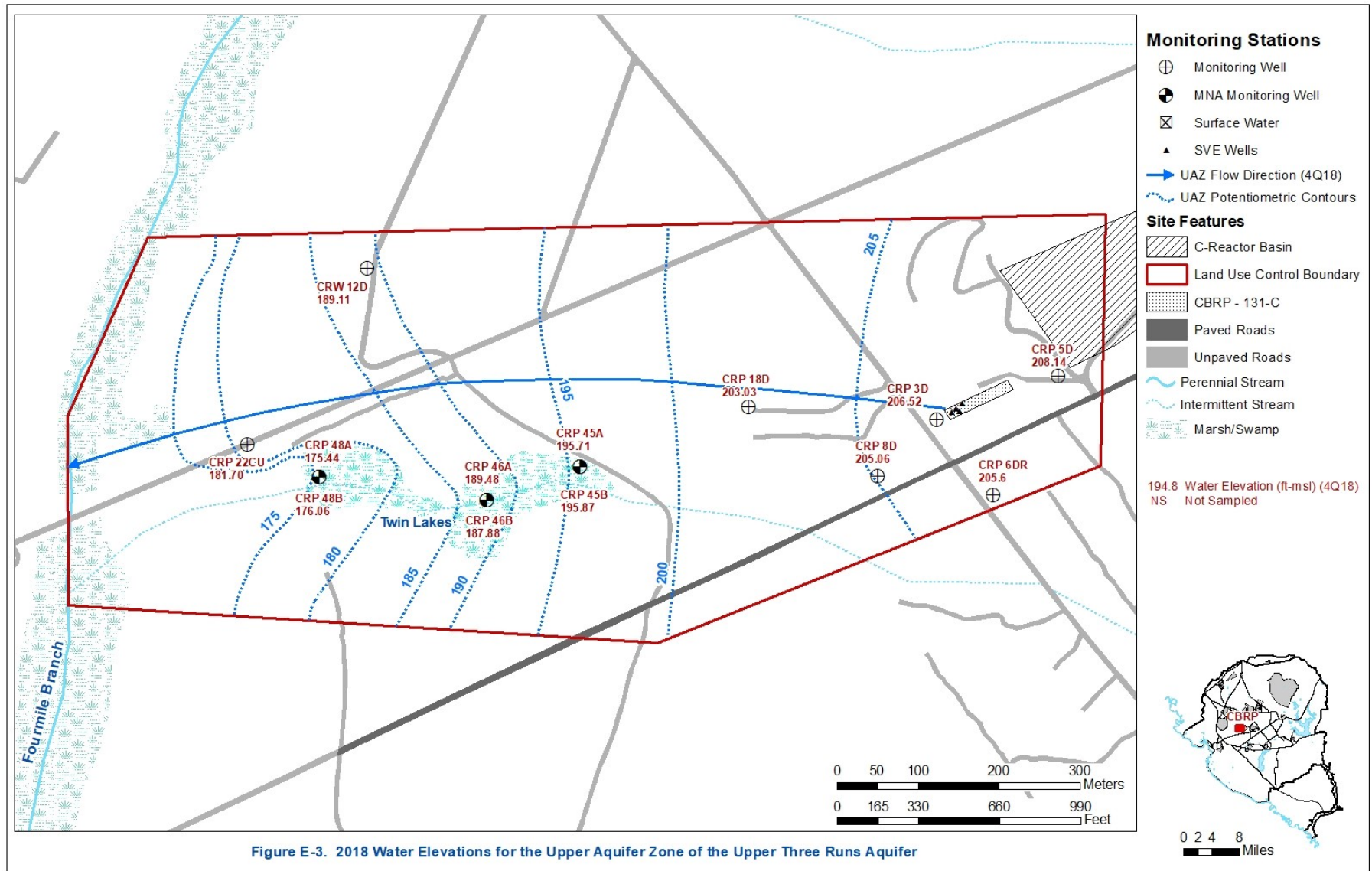


Figure E-2. 2017 Water Elevations for the Middle/Lower Aquifer Zone of the Upper Three Runs Aquifer



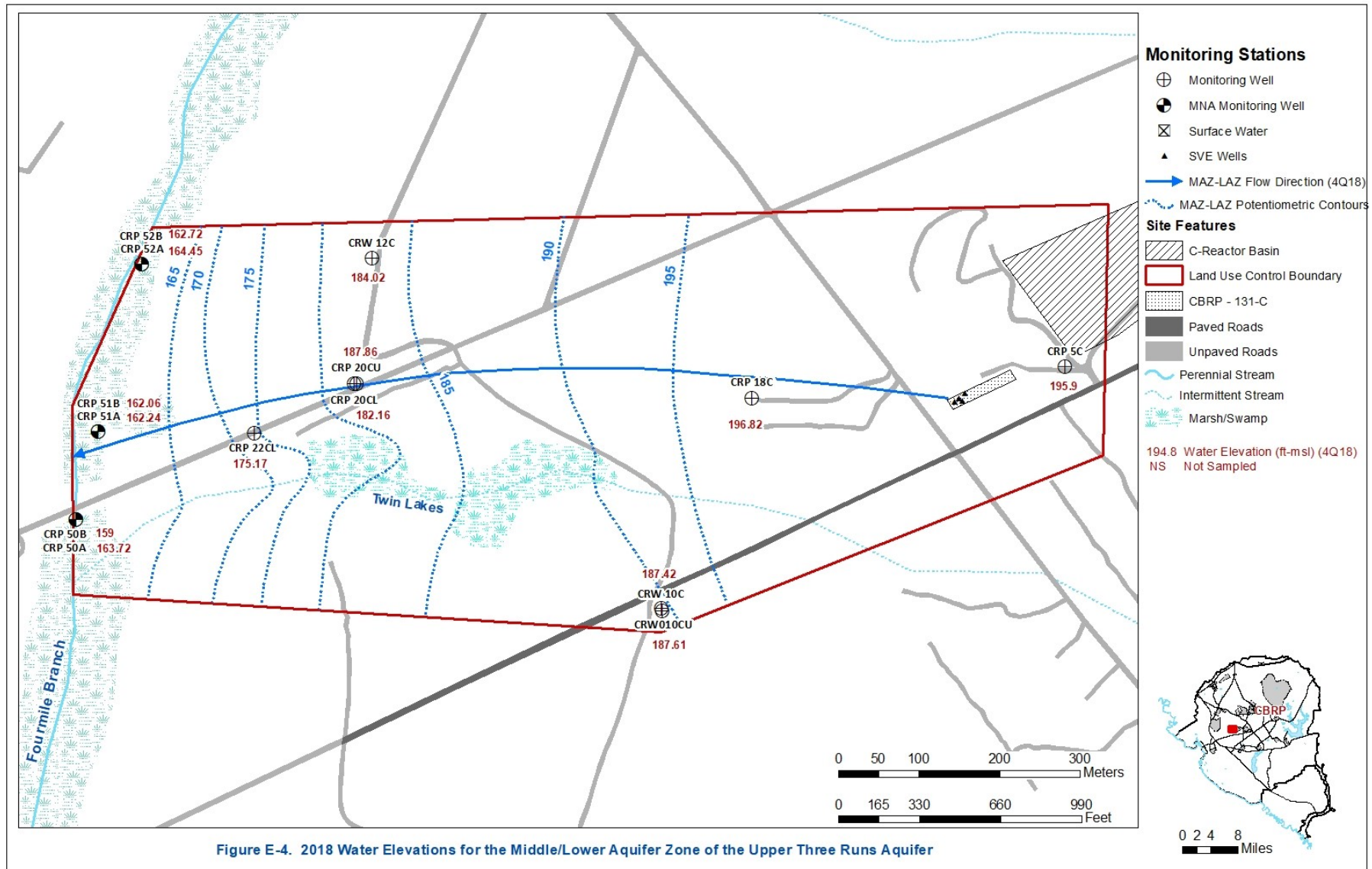
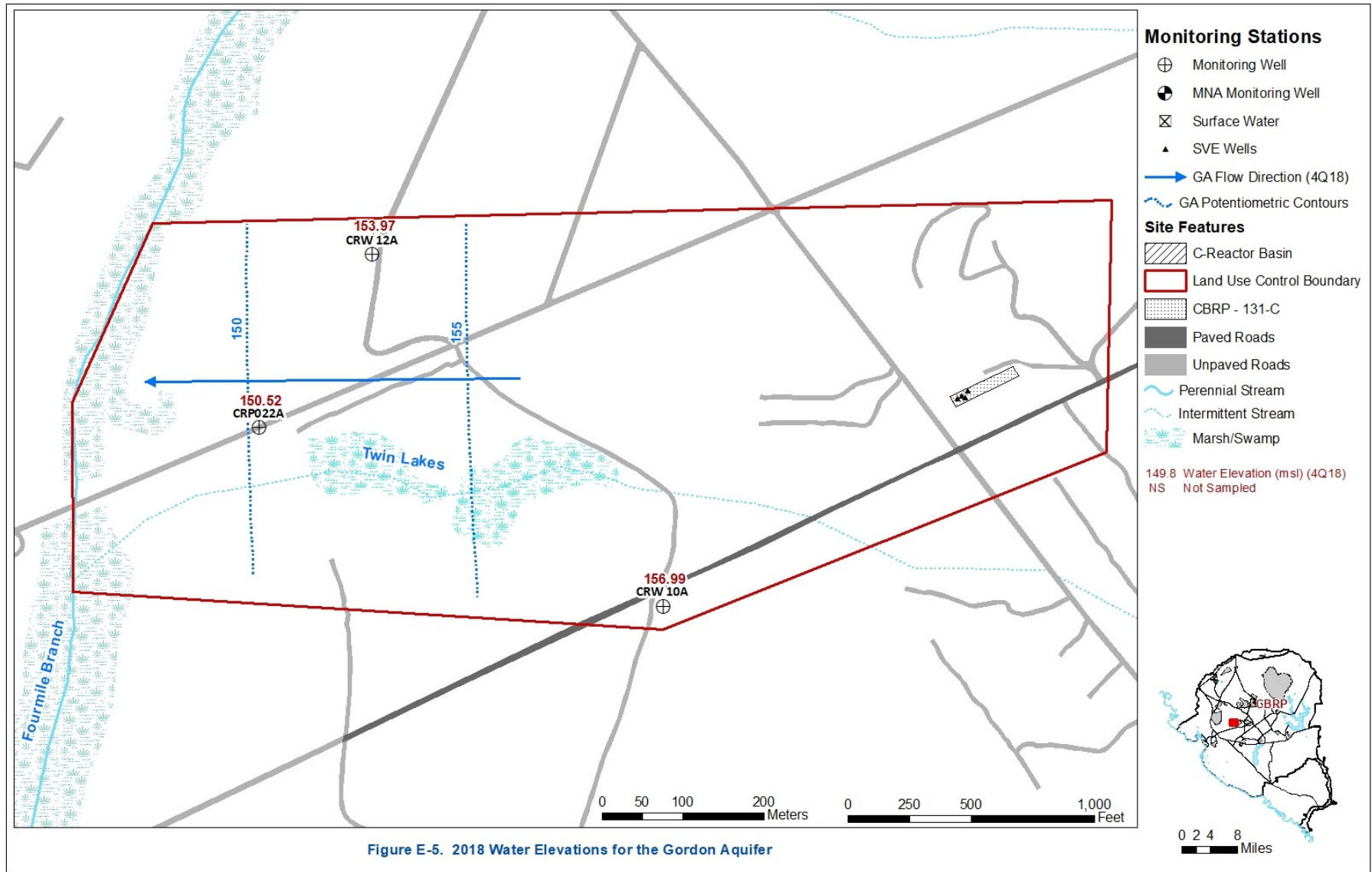


Figure E-4. 2018 Water Elevations for the Middle/Lower Aquifer Zone of the Upper Three Runs Aquifer



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