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2017 Annual Comprehensive TNX Area Groundwater Monitoring and Remedial Action Effectiveness Interim Report (U)

SEMS NUMBERS: 21, 29

SRNS-RP-2018-00573

Revision 0

June 2018

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Printed in the United States of America
Prepared for
U.S. Department of Energy
And
Savannah River Nuclear Solutions, LLC
Aiken, South Carolina

EXECUTIVE SUMMARY

The *2017 Annual Comprehensive TNX Area Groundwater Monitoring and Remedial Action Effectiveness Interim Report* has been prepared to support the regulatory reporting requirements for the TNX-Area Groundwater (TNX) Operable Unit (OU) at the Savannah River Site. The reporting requirements are specified in the *TNX Effectiveness Monitoring Strategy Addendum to the TNX Groundwater Operable Unit Remedial Design Report/Remedial Action Work Plan* (U) (WSRC 1995, Revision 1.5, Attachment 17). In accordance with the Effectiveness Monitoring Strategy, an annual report must be submitted on or before June 30, 2018, to document groundwater conditions and evaluate remedial action effectiveness based on data collected during the second and fourth quarter, calendar year 2017.

Past operation processes within the TNX Area resulted in contamination of the vadose zone and groundwater. All potential sources of groundwater contamination were assessed and remediated as part of the TNX Area OU Record of Decision or the T-Area OU Record of Decision.

Current Remedial Action

Remedial actions are currently implemented to address the chlorinated volatile organic compound contamination in the vadose zone with a soil vapor extraction system, which started up in 2002; and edible oil treatment to target the groundwater, which started as a treatability study in 2008.

The edible oil treatability study demonstrated the ability to decrease the contaminant mass and areal extent of the trichloroethylene plume in less time and at lower cost than the remedy selected in the TNX Area OU Record of Decision, and still be protective of the groundwater. The effectiveness of edible oil warranted a change in the remedy for TNX groundwater. An Explanation of Significant Difference was issued on June 12, 2013 with the following modifications to the remedy selected in the Record of Decision for the TNX Area OU groundwater component:

- Injection of additional edible oil treatment as needed using the existing well network if a sustained rebound lasting over one (1) year in excess of 75 µg/L of trichloroethylene, tetrachloroethylene, or carbon tetrachloride occurs in any well. If the rebound occurs, then additional edible oil will be determined appropriate by the United States Department of

Energy, South Carolina Department of Health and Environmental Control, and the United States Environmental Protection Agency.

- Permanent removal of the T-1 Air Stripper from service. The T-1 Air Stripper was closed in accordance with a state approved closure plan.

In 2015, although the rebound conditions to trigger additional oil injections had not been exceeded, additional edible oil was injected at ten monitoring wells to prevent future rebound of trichloroethylene concentrations. Emulsified Oil Substrate® was reinjected into the original treatment zone and both neat oil and Emulsified Oil Substrate® were injected outside of the original treatment zone to target monitoring wells with elevated trichloroethylene concentrations.

Results collected since the 2015 edible oil injections indicate that injection fluids were placed into the aquifer successfully. Trichloroethylene concentrations are less than the maximum contamination level in all wells in the treatment area, and reductive conditions are present in the treatment area. Trichloroethylene concentrations exceeding the maximum concentration level are located downgradient of the edible oil treatment area in the distal groundwater plume. SRS estimates that all trichloroethylene concentrations will be less than the maximum concentration level in two to three years.

Previous Remedial Action

Previous remedial action included a recovery well network and air stripper system, which operated from 1996 to 2007, and one recirculation well. The recirculation well was deemed ineffective and removed from service in 1997.

The recovery well system proved to be effective in capturing and treating chlorinated volatile organic compounds, resulting in depletion of the chlorinated volatile organic compounds in the groundwater near the T-Area Burial Ground. To accommodate the edible oil treatability study at the TNX Area OU, the recovery well system was shut down and put in standby mode in December 2007. Reductions in contaminant mass during the edible oil study accelerated the time to reach the maximum contaminant levels and lead to the permanent shut down and removal of the T-1 Air Stripper in 2013.

Groundwater Monitoring

The TNX groundwater monitoring program includes sampling a network of 42 monitoring wells (Figure ES-1) during the second and fourth quarters of each calendar year.

Four parameters (i.e., combined radium, gross alpha, trichloroethylene, and uranium [total recoverable]) exceeded maximum contaminant levels during 2017. Trichloroethylene is the only contaminant present with a defined plume (Figure ES-2). The trichloroethylene plume has been significantly reduced in response to the injection of edible oil (Figure ES-3). The distribution of combined radium, uranium (total recoverable), and gross alpha is minimal and isolated, with the highest concentrations observed primarily in the vicinity of the TNX Burial Ground and in the wetlands downgradient of the Old TNX Seepage Basin.

1,4-Dioxane was sampled in 2017 at all monitoring wells during the second and fourth quarter. 1,4-Dioxane was detected in two monitoring wells in 2017.

Recommendation

A new monitoring well located downgradient of the Old TNX Seepage Basin was requested by the United States Environmental Protection Agency and the South Carolina Department of Health and Environmental Control to better define the eastern edge of the trichloroethylene groundwater plume. The new well will be installed east of the Outfall Delta near abandoned well XSB 6, during the 2019 fiscal year.

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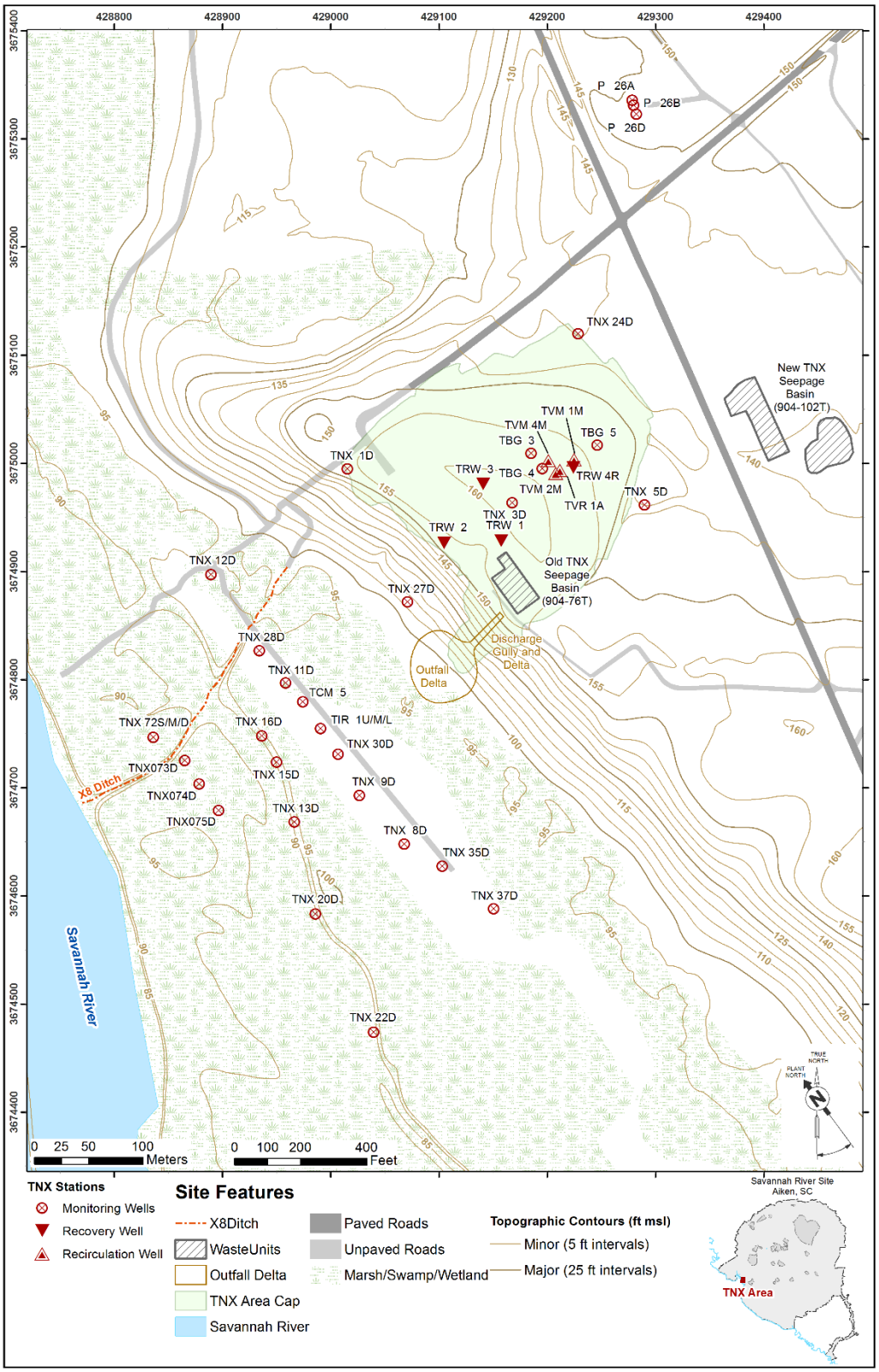


Figure ES-1. TNX Area Well Locations

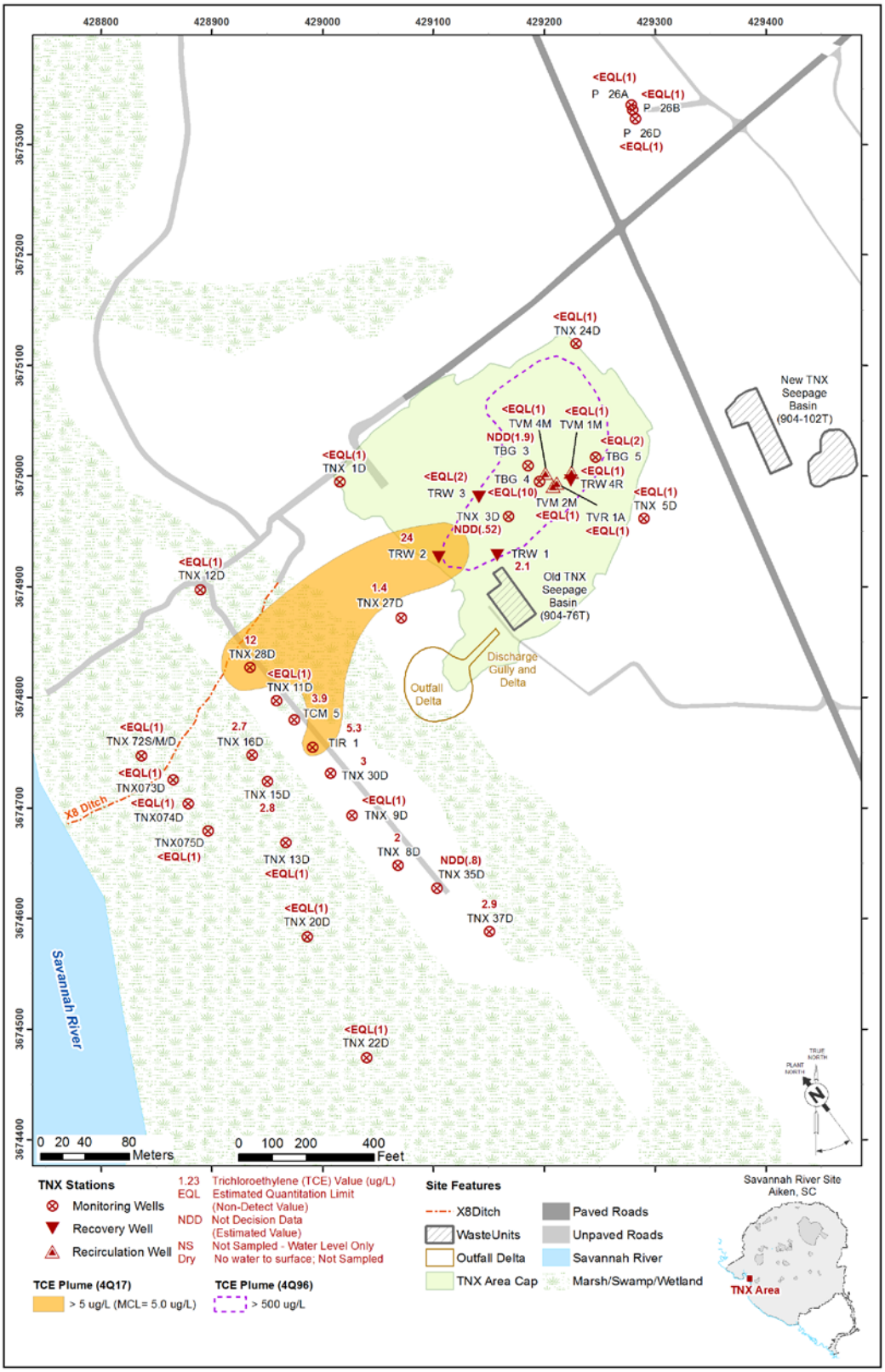
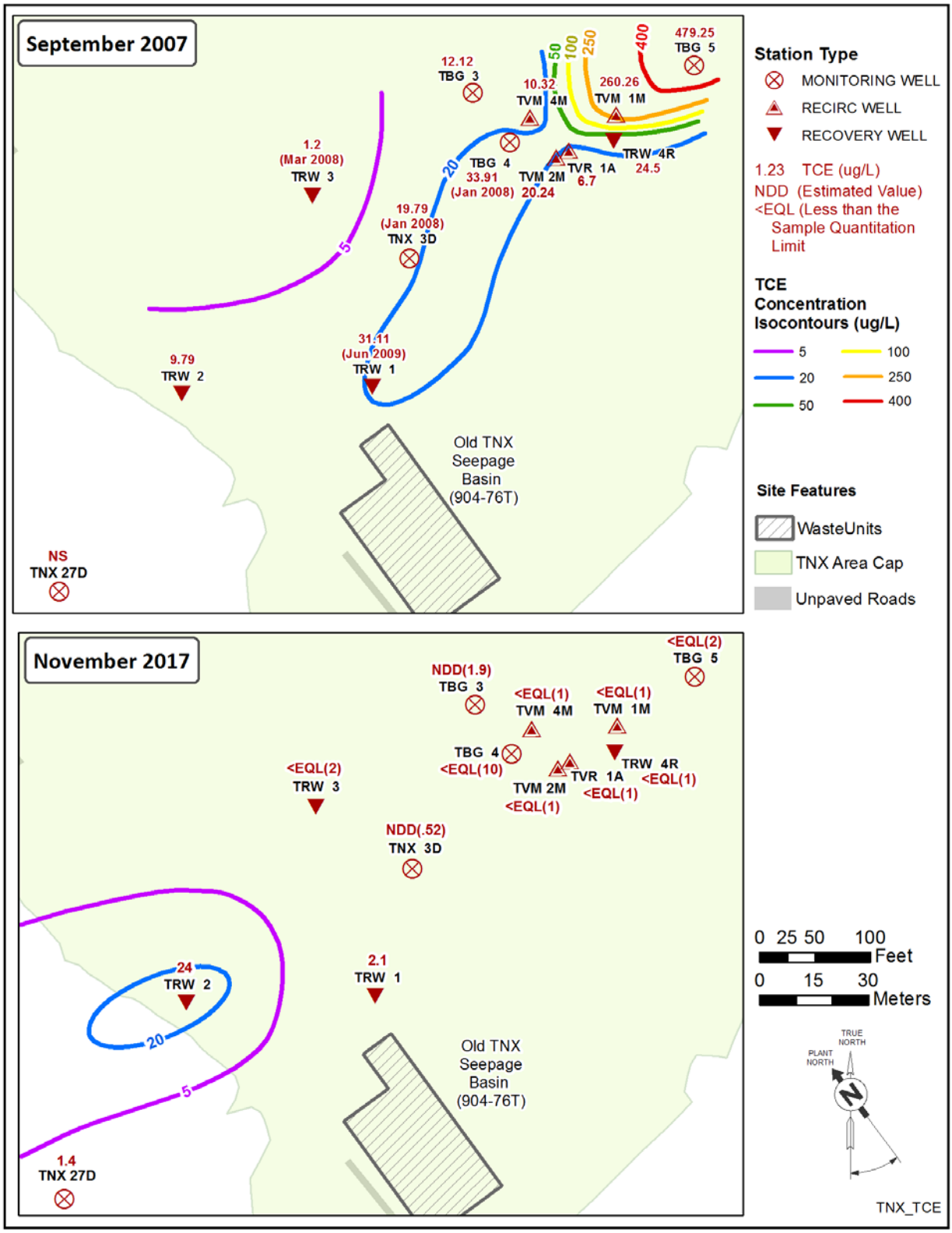


Figure ES-2. TNX Area Trichloroethylene (TCE) Concentration in Groundwater, 4Q2017 with >500 µg/L TCE Plume from 4Q1996 Superimposed



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LIST OF ABBREVIATIONS AND ACRONYMS

amsl	above mean sea level
CCl_4	carbon tetrachloride
CERCLA	Comprehensive Environmental Response, Compensation And Liability Act
cfm	cubic feet per minute
cm	centimeter
DG	Discharge Gully
DO	dissolved oxygen
DWPF	Defense Waste Processing Facility
EO	edible oil
EOS®	Emulsified Oil Substrate®
EQL	estimated quantitation limit
ESD	Explanation of Significant Difference
ft	feet
gal	gallon
GAU	Gordon aquifer unit
GCU	Gordon confining unit
gpm	gallons per minute
HGCA	Hybrid Groundwater Corrective Action
in	inch
IROD	Interim Record Of Decision
km	kilometer
LAZ	Lower Aquifer Zone
lb	pound
IPSL	inactive process sewer line
MCL	maximum contaminant level
µg/L	micrograms per liter
m	meter
m^3	cubic meter
MNA	monitored natural attenuation
mV	millivolt
NTSB	New TNX Seepage Basin
ORP	oxidation reduction potential
NTU	nephelometric turbidity units
OTSB	Old TNX Seepage Basin

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

OU	Operable Unit
PCE	tetrachloroethylene
pCi/g	picocuries per gram
pCi/L	picocuries per liter
ppb	parts per billion
Q	quarter
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
TAOU	T-Area Operable Unit
TBG	TNX Burying Ground
TCE	trichloroethylene
TNX OD	TNX Outfall Delta
TOC	total organic carbon
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
UTRAU	Upper Three Runs aquifer unit
VC	vinyl chloride
VFA	volatile fatty acid
VOC	volatile organic compound
	Westinghouse Savannah River Company (prior to 2005)
WSRC	Washington Savannah River Company, LLC (post 2005)

1.0 INTRODUCTION

1.1 Purpose

The 2017 Annual Comprehensive TNX Area Groundwater Monitoring and Remedial Action Effectiveness Interim Report[i] was prepared to support the regulatory reporting requirements for the TNX Area Operable Unit (OU) at the Savannah River Site (SRS), and provide interim results from the edible oil (EO) remedial action deployed in 2015. The reporting requirements are specified in the TNX Effectiveness Monitoring Strategy Addendum to the TNX Groundwater Operable Unit Remedial Design Report/Remedial Action Work Plan (U) (WSRC 1999a). In accordance with the TNX Area Effectiveness Monitoring Strategy, an annual report is required to be submitted on or before June 30th of each year, to document groundwater conditions and to evaluate the remedial action effectiveness based on data collected during the second and fourth quarters of the previous calendar year.

1.2 Unit History/Description

The TNX Area is in the southwest portion of the SRS, approximately 0.4 km (0.25 mi) east of the Savannah River (Figure A-1). The TNX Area was a pilot-scale testing and evaluation facility that supported nuclear fuel, target manufacturing chemical process, and the Defense Waste Processing Facility (DWPF). Past operations processes within the TNX Area resulted in contamination of the vadose zone and groundwater. Sources of groundwater contamination included seepage from unlined basins (Old TNX Seepage Basin [OTSB] and New TNX Seepage Basin [NTSB]), leakage from the process sewers, and leachate from other sources at TNX (e.g., temporary storage facility drums during the 1950's and an equipment staging area).

The TNX Area OU consists of four subunits: the TNX Burying Ground (TBG), the OTSB, the NTSB, and the TNX Groundwater beneath the surface units (Figure A-2).

[i] This report was formerly known as the Comprehensive TNX Area Annual Groundwater and Effectiveness Monitoring Strategy Report. The title was modified at a June 10, 2015 Core Team meeting to more accurately represent the contents of the report.

1.2.1 TNX Burying Ground (TBG)

The TBG was created in 1953 to dispose of debris that resulted from the explosion of an experimental separation process (Purex) in the TNX Area earlier that year. The separation process used nitric acid, organic solvents, and an evaporator to concentrate uranium. The debris included conduit, drums, tin, and structural steel contaminated with uranyl nitrate and depleted uranium. Between 1980 and 1984, most of the waste buried at the TBG was excavated and sent to the Radioactive Waste Burial Ground (643-7E). The remaining waste remains beneath the asphalt, building, and transformer pads. An estimated 27 kg (60 lbs) of uranyl nitrate are thought to remain buried at the TBG.

1.2.2 Old TNX Seepage Basin (OTSB)

The OTSB was an unlined excavation designed to contain wastewater until it could seep into the underlying sediments that were believed to act as a natural ion-exchange media. The OTSB received process wastewater between 1956 and 1980 from pilot-scale tests conducted in the TNX Area for the DWPF and the General Separations Area. The waste discharged to the basin included large quantities of mercury, primarily in the form of mercuric nitrate, other heavy metals, sodium compounds, uranium, and other radionuclides. During periods of high flow, the OTSB periodically overflowed downhill into the Savannah River floodplain adjacent to the TNX facility. In 1980, area wastewater was re-routed from the OTSB to the NTSB. During closure of the OTSB in 1981, the remaining liquid was drained to the nearby floodplain. A result of draining the remaining liquid and overflow events, erosion occurred in the hillside forming a Discharge Gully (DG).

1.2.3 New TNX Seepage Basin (NTSB)

The NTSB was an unlined excavation (constructed to replace the OTSB) that operated between 1980 and 1988. While in operation, the basin received waste from pilot-scale chemical processing tests for DWPF and chemical separation. The waste discharged to the basin included simulated, non-radioactive DWPF sludge; simulated, non-radioactive salt supernate; glass frit; other processing chemicals; and laboratory sink wastewater. No

hazardous waste was discharged to the basin. During periods of unusually high discharge, the seepage section of the basin overflowed to Outfall X-013A which in turn discharged to a local surface depression.

1.2.4 TNX Groundwater

All sources of groundwater contamination were assessed and remediated as part of the TNX Area OU Record of Decision (ROD) (WSRC 2003) or the T-Area OU (TAOU) ROD (WSRC 2005a). Specific remedial actions are listed in Section 1.4 of this document.

The TNX Groundwater is the groundwater beneath the TNX Area subunits described above and extends to the Savannah River. Groundwater at TNX is divided into two main aquifer systems, the Lower Aquifer Zone (LAZ) of the Upper Three Runs Aquifer Unit (UTRAU) and the underlying Gordon Aquifer Unit (GAU) system. The LAZ of the UTRA is an unconfined water table aquifer present at the northeastern portion of TNX Area that pinches out as water elevations decline to the southwest. The GAU is a semi-confined aquifer approximately 6 to 12 m (20 to 40 ft) thick. Groundwater flows progressively from deep to shallow aquifers (i.e., upward hydraulic gradient) and to the Savannah River (WSRC 1998).

1.3 Regulatory History

Shallow groundwater beneath the TNX Area has been contaminated with chlorinated volatile organic compounds (VOCs), such as trichloroethylene (TCE), tetrachloroethylene (PCE), and carbon tetrachloride (CCl_4). In November 1994, an Interim ROD (IROD) was approved by the United States Department of Energy (USDOE), United States Environmental Protection Agency (USEPA), and South Carolina Department of Health and Environmental Control (SCDHEC) (WSRC 1994). The IROD required installation of a hybrid groundwater corrective action (HGCA) for the VOC groundwater plume. The HGCA consisted of 1) a pump and treat system (recovery well network and low-profile air stripper) to treat and inhibit further migration of the 500 μg/L TCE plume; and 2) an airlift recirculation well located at the heart of the plume to expedite remediation. Figure A-2 shows the location of the TNX well system for the interim remedial action during startup

and initial operations. The recirculation well system was determined to be ineffective at the TNX Area, due to both geological factors and the nature of the contamination. Consequently, an Explanation of Significant Difference (ESD) (WSRC 1997b) to the IROD was issued in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations to remove the recirculation well from the HGCA. In 2002, a multi-well soil vapor extraction (SVE) system was added to the IA as part of a vadose zone source term remedy, via an ESD to the IROD (WSRC 2001).

In 2003, the TNX Area OU ROD was issued and outlined the selected remedy for the vadose zone and groundwater (WSRC 2003). The selected remedy was Extraction in High Chlorinated VOC Area with Monitoring/Mixing Zone and Institutional Controls. This remedy entailed SVE at high VOC concentration areas and operation of the existing T-1 pump-and-treat system until monitoring determined that passive remediation (mixing zone) and continued monitoring and land use controls would be appropriate.

Between 2004 and 2006, the final remedial and removal action for the TNX Area OU and T-Area OU were completed. In 2005, the *Explanation of Significant Differences to the Record of Decision for the TNX Area Operable Unit* (WSRC 2005c) was issued to address principal threat source material in the soil associated with the Old TNX Seepage Basin/Inactive Process Sewer Line/Discharge Gully subunit and selected sumps and a small area of contamination on the western exterior of Building 678-T. This change to the remedy increased the volume of material to be excavated for offsite disposal. The remedial action for the OTSB and the NTSB subunits are detailed in the *Post-Construction Report (PCR) for the TNX Area Operable Unit (U)* (WRSC 2005b). The remedial action for the T-Area OU, including the TNX Outfall Delta (TNX OD), is detailed in the *Post-Construction Report (PCR) for T Area Operable Unit (TAOU) (U)* (WSRC 2006). The removal action for the TNX OD, Lower DG, and Swamp is detailed in the *Removal Site Evaluation Report/Engineering Evaluation and Cost Analysis for the TNX Outfall Delta, Lower Discharge Gully, and Swamp Operable Unit (U)* (WSRC 2004c). A summary of the remedial actions and removal action is provided below.

- Remedial action for the OTSB started in April 2005 and was completed in February 2006. Remedial action included excavation of contaminated soil, confirmation sampling, backfilling the basin and backfilling the DG.

- Remedial action for the NTSB started in August 2004 and was completed in December 2004. Remedial action included drainage of the basin, backfilling the basin, and grouting the process sewer line.

- Removal action to excavate soil from the TNX OD, Lower DG, and Swamp was started in December 2004 and completed in September 2005. This removal action excavated radiologically contaminated soil from three areas within the inner swamp.

- Remedial action for the TAOU included a low permeability, geosynthetic cap and a soil amendment. Construction of the TAOU cap was started in January 2006 and completed in November 2006. The soil amendment included application of apatite to the Inner Swamp and the TNX OD to attenuate the leachability of the radiological contaminants in the soil. The soil amendment application was completed in March 2006.

During 2005, the TNX-Area OU was incorporated into an area-based remedial strategy for the TAOU, as documented in the TAOU ROD (WSRC 2005a). The TAOU is an area-based OU that incorporates most of the T-Area footprint and the TNX OD.

After completion of the TAOU cap, the T-1 Air Stripper was operated from January to December 2007. In December 2007, the T-1 Air Stripper was placed in standby mode to accommodate a pilot treatability study for the deployment of EO onto the water table surface and into the water table aquifer to reduce VOC concentrations. The SVE system remained operational. The treatability study was initiated in February 2008 and completed in May 2010 (SRNS 2009). Per agreement with USEPA and SCDHEC, the pump and treat system and T-1 Air Stripper were not returned to service during the subsequent

groundwater sampling period in order to evaluate the overall effectiveness of the EO injections.

In 2013, the second ESD to the TNX Area OU ROD was approved which modified the groundwater remedy to add EO treatments as needed and remove the air stripper from service (SRNS 2012a). Modifications to the remedy via the ESD did not impact any other components of the selected remedy as described in the TNX Area OU ROD including operations of the passive SVE system, groundwater monitoring, and institutional controls.

Although the rebound conditions to trigger the additional edible oil injections did not occur, SRS observed TCE increases in some monitoring wells that correlated with an increase in water elevation due to increased precipitation and associated recharge (SRNS 2015a). To prevent future rebound, additional EO treatment was applied to the VOC source area as detailed in the *Second Corrective Measures Implementation/Remedial Action Implementation Plan (CMI/RAIP) for the TNX Area Operable Unit (U)* (SRNS 2015b). The additional EO injections were completed in 2015.

2.0 SITE HYDROGEOLOGY

The Floridan aquifer system is the aquifer system of concern within the TNX Area between Upper Three Runs Creek and the southern boundary of SRS. The Floridan aquifer system is divided into two aquifer units separated by a confining unit. From top to bottom, they are known as the LAZ of the UTRAU, the Gordon confining unit (GCU), and the GAU (Figures A-3, A-4, and A-5). The unsaturated zone within the TNX Area includes fluvial terrace sediments and the sediments of the LAZ of the UTRAU, which lie atop the water bearing units of the Floridan aquifer system.

The LAZ of the UTRAU is barely represented in the hydrostratigraphic section beneath the TNX Area. From east to west, the water table elevation drops from approximately 33 m (108 ft) above mean sea level (amsl) near TNX 24D to less than 26 m (85 ft) amsl in the TNX Swamp. Beneath the TNX Area, the clayey silt to silty clay beds of the GCU are sporadic, and the confining unit does not represent an effective aquitard. However, clayey silt to silty clay beds that occur in the GAU locally retard vertical groundwater movement

within the aquifer. These beds represent a semi-confining zone that divides the GAU. The water table aquifer includes the unconfined portion of the LAZ of the UTRA in the northeast and the semi-confining zone of the GAU southwest of TNX 24D.

The water table receives recharge from infiltrating precipitation and from the GAU through the semi-confining zone of the GAU. The GAU is at a higher pressure than the overlying water table aquifer. This is evident by looking at average values for water level data collected between first quarter 1995 and fourth quarter 2017 from wells P 26A, P 26B, and P 26D. The average hydraulic head measured in the semi-confined GAU at P 26A is 35.4 m (116.1 ft) amsl which is approximately 3.0 m (9.9 ft) greater than the average hydraulic head measured in the unconfined GAU at P 26B (34.2 m [106.2 ft] amsl). The average hydraulic head measured in the LAZ of the UTRAU at P 26D is 35.2 m (115.4 ft) amsl which is 0.21 m (0.7 ft) less than the average hydraulic head measured in the semi-confined GAU. Water level data collected since the first quarter 1995 from wells P 26A, P 26B, and P 26D indicate that the hydraulic gradient is consistently upward from the confined GAU and downward from the LAZ of the UTRAU (Appendix D, Hydrograph for Station P 26). The hydraulic conductivity of the water table varies from 6 to 18 m/day (20 to 60 ft/day) (WSRC 1997c), which is consistent with groundwater modeling analyses showing calibrated horizontal hydraulic conductivities in the range of 1.8 to 22.5 m/day (6 to 75 ft/day) (WSRC 2000).

The Savannah River is the major discharge point for the Floridan aquifer system and thus exerts control on the direction and rate of horizontal and vertical groundwater movement. Particle tracking from the groundwater model (WSRC 2000) illustrates westerly flow from TNX source areas to the Savannah River with some water discharging to the X-08 Ditch and wetlands (Figures A-6 and A-7).

3.0 REMEDIAL ACTION

The groundwater remedy selected in the 2003 TNX Area OU ROD (WSRC 2003) entailed SVE in high VOC concentration areas, operation of the existing T-1 pump-and treat system, and continued monitoring and land use controls. In 2013, an ESD to the TNX Area

OU ROD was issued which modified the groundwater remedy to permanently remove the T-1 Air Stripper system from service and add EO treatments as needed. Figure A-8 is a schematic of the TNX Area OUs and the current remedial actions.

3.1 Objectives

The overall objectives of the groundwater RA are as follows:

- Protect future industrial workers from exposure to contaminated groundwater;
- Return groundwater to beneficial uses;
- Prevent, minimize, or eliminate discharge of contaminated groundwater to surface water that would result in unacceptable risk to human or ecological receptors; and
- Minimize adverse impact to the wetland ecosystem of the TNX Area floodplain.

3.2 Soil Vapor Extraction

Two SVE treatability studies were performed in the vadose zone near the TBG, Phase I in 1997 (WSRC 1997d) and Phase II in 1999 (WSRC 1999b). Phase I and II utilized the recirculation well (i.e., TVR 1A) and associated monitoring wells (i.e., TVM series, 'V' and 'U' horizons). Based on the results from these treatability studies, SVE was shown to be an effective and cost-efficient approach at reducing the mass of VOCs at TNX (i.e., removing vadose zone secondary source VOCs near the plume core) and minimizing future VOC groundwater concentrations in the TNX floodplain.

In October 2001, an ESD to the IROD (WSRC 2001) was approved to add SVE to the HGCA system and to modify the effectiveness monitoring reporting requirements from two semiannual reports to one annual report. In 2002, a portable SVE unit and twelve additional SVE wells (i.e., TVX series) were installed at the TNX Area OU. In 2006, the SVE wells were shut down to accommodate the placement of the engineered cover system over the former TNX Area. After completion of the engineered cover, the conventional active SVE unit was replaced with five 24-volt passive (MicroBlower™) SVE systems. The five Microblowers™ are rotated between any of the SVE wells to optimize VOC vapor removal. Location of the current SVE well network is presented in Figure A-9. The SVE

wells not equipped with a MicroBlower™ have been equipped with BaroBalls™ which allow for venting of subsurface vapors based on changes in the barometric pressure of the atmosphere.

There are twenty SVE wells associated with the TNX OU. Previous reports listed twenty-nine SVE wells which included the TVX series, TVM series, and TVR 1A. The TVM series have four wells at each location (i.e., V, U, M, and L, from shallow to deep). The 'V' and 'U' screen horizons are in the unsaturated zone and are viable SVE wells. The 'M' and 'L' screen horizons are in the saturated zone and are not viable SVE wells. TVR 1A was originally installed as a recirculation well but is now sampled as a monitoring well. The eight 'M' and 'L' wells (i.e., TVM 1L, TVM 1M, TVM 2L, TVM 2M, TVM 3L, TVM 3M, TVM 4L, and TVM 4M) and TVR 1A will be removed from Figure A-9 and Table 7-1. TVM 2L and TVM 4L will remain on Table 7-1 because these wells were connected to the MicroBlowers™ between 2010 to 2014.

3.3 Edible Oil Treatment

In December 2007, the T-1 Air Stripper was temporarily placed in standby mode to accommodate an EO treatability study (SRNL 2012). Most of the SVE system remained operational during the treatability study, except three SVE wells (i.e., TVX 3L, TVX 5L and TVX 6L) with screens near the top of the water table were used to deploy neat oil.

The two-phase EO treatability study was conducted with the initial deployment of EO starting in February 2008 and completed in April 2008, and the second injection occurred in May 2010. The purpose of the treatability study was to determine how effective EO deployment was on treating VOCs and reducing the cost and the time associated with treatment. The EO treatment technology consisted of 1) deployment of neat (pure) vegetable oil at the top of the water table in the residual source area (vicinity of the smear zone); and 2) deployment of emulsified oil substrate (EOS®) in the core of the groundwater VOC plume (Figure A-8). Table 3-1 lists the construction details of the injection wells as well as the volumes of the neat and emulsified oil injected at each location. Figure A-10 provides the location of the injection wells associated with the 2008 and 2010 injects.

The EO treatments have significantly reduced VOC concentrations in the groundwater. In 2013, an ESD to the TNX Area OU ROD was approved which modified the remedial action to add EO treatments as needed and remove the pump and treat system from service. A trigger to inject additional EO was defined in the *Second Explanation of Significant Differences (ESD) for the Revision 1 TNX Area Operable Unit Record of Decision (U)* (SRNS 2012a). This document states that additional EO treatment will be applied if a sustained rebound lasting over one (1) year in excess of 75 µg/L (ppb) of TCE, PCE, or CCl_4 in any well if determined appropriate by the USDOE, USEPA, and SCDHEC.

In 2015, a third amendment of EO was applied to a larger area outside of the originally targeted treatment zone. This injection was initiated based on TCE results at TBG 3 and TVM 1M that came close to exceeding the trigger criteria identified in the ESD to the TNX Area OU ROD (i.e., >75 ppb increase sustained for one year). The rebound in TCE concentration at TBG 3 was correlated to an increase in water table elevation (Figure A-25 and Figure A-26). The elevated water table likely came in contact with residual VOC mass present in the smear zone or capillary fringe. Although the trigger criteria were not exceeded, SRS proceeded with the injections to take advantage of the high-water table and to prevent future rebounds. On April 28, 2015, the SRS met with the USDOE, USEPA and SCDHEC and an agreement was reached to inject neat and emulsified oils at 10 existing monitoring wells during the third quarter 2015. These events are documented in an Underground Injection Control Application (SRNS 2015a) and a CMI/RAIP for the TNX Area OU (SRNS 2015b).

The 2015 injection campaign injected EO inside and outside of the original treatment zone (Figure A-11) at monitoring wells (i.e., TBG 3, TRW 3, and TVM 1M) and SVE wells (i.e., TVX002L, TVX003L, TVX004L, and TVX005L), as well as, re-injecting into the original treatment zone (i.e., TBG 4, TBG 5, and TRW 4R). Table 3-1 lists the construction details of the injection wells and the volumes of the neat and/or emulsified oil injected at each location.

3.4 Recovery Well/Air Stripper System

The recovery well system was designed to capture the migration of contaminated groundwater containing >500 μg/L TCE and to remove TCE from the groundwater. The recovery wells were positioned at the downgradient edge of the initial >500 μg/L TCE plume, and groundwater was pumped to the T-1 Air Stripper for removal of VOCs. Recovery wells TRW 1, 2, 3 and 4 were installed to pump contaminated water from the unconfined portion of the UTRA/GAU (WSRC 1997a) (Figure A-4). The recovery well network and T-1 Air Stripper began operation on September 16, 1996. During 2005 the T-1 Air Stripper was temporarily shut down to accommodate the remedial action activities occurring at the TNX Area OU and the T-Area OU. During the shutdown, recovery well TRW 4 was abandoned and replaced by TRW 4R. The T-1 Air Stripper was restarted in January 2007 and operated until December 2007.

The system proved to be effective in capturing and treating VOCs, resulting in depletion of the VOCs in the groundwater near the source area. SRS determined that the recovery well/air stripper system would have to be operated for an extended period of time to manage the secondary source term in the groundwater near the source area (in the capillary fringe of the water table and within the water table). In December 2007, the T-1 Air Stripper and associated recovery wells were placed in stand-by to allow for the deployment of EO in the source area. After a successful EO demonstration, the T-1 Air Stripper was removed as the remedial action as documented in an ESD to the ROD and issued on June 12, 2013. The T-1 Air Stripper was permanently removed from service as permitted under state regulations and in accordance with a state approved closure plan in 2013.

3.5 Radiologically Contaminated Groundwater

The radiologically contaminated source areas were excavated during previous remedial actions associated with both the TAOU and TNX Area OU. Excavation activities occurred at the TBG, OTSB, and in the wetlands (WSRC 2005b and WSRC 2006). There are two localized areas where the groundwater monitoring wells exceed the MCLs for the respective radionuclide constituents. The two areas are downgradient of the TBG and in the wetlands downgradient of the OTSB, near the TNX OD. Based on the monitoring data

and historical trends, the exceedances are sporadic or one-time occurrences. TCM 5 is the only well with persistent gross alpha and uranium concentrations that exceed the respective MCLs. There are no discernible and consistent groundwater plumes present and therefore no remedial action is recommended at this time. However, a new well will be installed in 2019 downgradient of the OTSB and sampled for both radiological parameters and VOC analysis. The radiological results from the new well will be evaluated and discussed in the corresponding annual report.

Table 3–1. Injection Well Elevations and Injection Volumes

Well ID	Injection Date	Type of Oil	Volume of Oil (gal)	Top Screen Elevation (ft msl)	Bottom Screen Elevation (ft msl)	Ground Elevation (ft msl)	Well Diameter (in)
TBG 3	August 2015	EOS®	550	49.77	69.77	158.67	4
TBG 4	August 2015	EOS®	550	50.66	70.66	159.96	4
TBG 5	August 2015	EOS®	550	42.65	62.65	155.05	4
TRW 3	August 2015	EOS®	1100	49.88	84.78	162.18	6
TRW 4R	August 2015	EOS®	2200	50	80	157.61	6
TVM 1M	August 2015	EOS®	550	71.08	72.08	157.28	2
TVX002L	August 2015	EOS®	550	44.38	64.38	156.64	2
TVX002L	August 2015	Neat Oil	550	44.38	64.38	156.64	2
TVX003L	August 2015	Neat Oil	550	41.8	56.8	154.1	2
TVX004L	August 2015	EOS®	550	43.85	55.85	152.95	2
TVX004L	August 2015	Neat Oil	550	43.85	55.85	152.95	2
TVX005L	July 2015	Neat Oil	550	46.92	56.92	155.16	2
TBG 4	May 2010	EOS®	55	109.30	89.30	159.96	4
TBG 5	Feb 2008	EOS®	960	112.40	92.40	155.05	4
TNX 3D	March 2008	EOS®	1,250	104.90	84.90	162.97	4
TRW 4R	March 2008	EOS®	1,250	107.45	77.45	157.45	6
TVX003 L	April 2008	Neat Oil	300	112.30	97.30	154.1	2
TVX005 L	April 2008	Neat Oil	900	108.24	98.24	155.16	2
TVX006 L	April 2008	Neat Oil	1,500	107.49	92.49	155.18	2

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4.0 MONITORING NETWORK

Figure A-2 shows the T-Area monitoring well network and locations that were in place during the start-up and initial operation of the RA system. Monitoring wells were abandoned between 2004 and 2006, due to their location on and outside of the final TAOU cover system (WSRC 2005b and WSRC 2006). The TNX Area monitoring well network currently consists of 42 wells (Table 4-1 and Figure A-12). Table 4-2 provides a summary of the sampling analysis plan for the monitoring wells network at the TNX Area OU. The monitoring wells associated with the EO remedial action are also identified on Table 4-1 and receive additional analysis to monitor the effects of the EO (Table 4-2).

1,4-Dixoane analysis was initiated at all monitoring wells in the fourth quarter 2013 in response to comments provided by the USEPA and SCDHEC during review of the *Fourth Five-Year Remedy Review Report for the Savannah River Site* (SRNS 2012b).

In the fourth quarter 2015, volatile fatty acids (VFA) were added to the list of constituents monitored for at the EO monitoring well network (Table 4-2) in accordance with the sampling requirements identified in the *Second Corrective Measures Implementation /Remedial Action Implementation Plan (CMI/RAIP) for the TNX Operable Unit (U)* (SRNS 2015b). EO, soybean oil, is composed almost entirely of fatty acids (saturated, mono-unsaturated, poly-unsaturated, and oleic). VFAs are a series of acids present in EO and are theorized to be produced as microbes consume the EO or fatty acids. VFAs can be used to indicate the general presence and longevity of EO in the subsurface. The change in VFA composition might be an indicator of microbial de-polymerization of the EO.

VFA analytical method measures the concentration of up to five individual VFAs. The individual concentrations will be presented in Appendix B along with the total VFA, which will be the sum of VFA analyzed. Time series graphs of total VFA are presented in Appendix E VFAs will be sampled until 2018 and continued sampling will be assessed at that time.

4.1 Sampling Events

The 2017 TNX groundwater sampling program included a 42 monitoring well network to be sampled in the second and fourth quarters of the calendar year (Table 4-1 and Figure A-12). During the second quarter 2017, samples from 41 of the 42 wells were collected. During the fourth quarter 2017, samples from 40 of the 42 wells were collected.

4.1.1 Sampling Issues

During the second quarter 2017 sampling event, water elevations were collected from TNX 72S, but there was an insufficient amount of water to collect a sample. TNX 72D pumped dry during sampling; therefore, not all of samples were collected due to insufficient water volume and analysis was only completed for organic compounds. The nitrate samples at P 26A, P26B, P 26D, and TBG 5 were collected during a second sampling event because laboratory hold times were exceeding during the initial sampling event.

During the fourth quarter 2017 sampling event, water elevations could not be collected from TNX 72M and TNX 72S because they were dry. TNX 72D pumped dry during sampling; therefore, not all of samples were collected due to insufficient water volume and analysis was only completed for organic compounds.

Monitoring wells TNX 72S and TNX 72M are shallow wells that were installed to observe the possibility of contaminated groundwater discharging in the wetlands. The shallow well construction of these wells and the low permeability sediments of the wetlands make it difficult to sample these wells.

Table 4–1. TNX Monitoring Well Network

Well Name	Screen Zone	Well Category	Top of Screen Depth (ft bgs)	Bottom of Screen Depth (ft bgs)	Total Well Depth (ft bgs)	Well Diameter (in)	Ground Elevation (ft msl)
P 26A	Semi-confined GAU	Background/EO Monitoring Well	119.8	129.8	132	4	151.8
P 26B	Unconfined UTRAU/GAU	Background/EO Monitoring Well	69.5	80	82.2	4	151.9
P 26D	Unconfined UTRAU/GAU	Background/EO Monitoring Well	29.9	50	52.1	4	151.8
TBG 3	Unconfined UTRAU/GAU	Primary/EO Monitoring Well	49.77	69.77	79.77	4	158.67
TBG 4	Unconfined UTRAU/GAU	Primary/EO Monitoring Well	50.66	70.66	80.66	4	159.96
TBG 5	Unconfined UTRAU/GAU	Primary/EO Monitoring Well	42.65	62.65	77.65	4	155.05
TCM 5	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	2.25	17.25	20	2	97.11
TIR 1L	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	32	34.01	40	2	99.72
TIR 1M	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	13	14.97	22.65	2	99.56
TIR 1U	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	7.5	9.47	13	2	99.48
TNX 1D	Unconfined UTRAU/GAU	Secondary	54.5	74.5	76.9	4	154.1
TNX 3D	Unconfined UTRAU/GAU	Primary/EO Monitoring Well	58.07	78.07	89.07	4	162.97
TNX 5D	Unconfined UTRAU/GAU	Secondary	38.5	58.5	60.8	4	147
TNX 8D	Unconfined UTRAU/GAU	Primary	4	24	26.3	4	98
TNX 9D	Unconfined UTRAU/GAU	Secondary	4	24	26.3	4	99.4
TNX 11D	Unconfined UTRAU/GAU	Primary	4.5	24.5	26.6	4	97.7
TNX 12D	Unconfined UTRAU/GAU	Secondary	4	24	26.1	4	97.1
TNX 13D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	3.5	5.5	6	2	93.4
TNX 15D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	4.6	6.6	7.08	2	92.5
TNX 16D	Unconfined UTRAU/GAU	Primary	4.6	6.6	7.08	2	92.7
TNX 20D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	3.2	5.2	5.7	2	91.4
TNX 22D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	2.7	4.7	5.2	2	90.5
TNX 24D	Unconfined UTRAU/GAU	Secondary	26	40.96	45	2	139.7
TNX 27D	Unconfined UTRAU/GAU	Primary/EO Monitoring Well	7	27	35	2	108.27
TNX 28D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	4.8	14.8	15.1	2	97.4
TNX 30D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	4.7	14.7	15	2	100.3
TNX 35D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	4.9	14.9	15.2	2	97.4
TNX 37D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	4.7	14.7	15	2	98.2
TNX 72D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	12.3	14.8	15.58	2	92.8
TNX 72M	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	6.4	8.9	2.57	2	92.8
TNX 72S	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	3.4	5.9	2.62	2	92.8
TNX073D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	12.08	17	18	2	95.4
TNX074D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	12.75	17.78	18	2	93.3
TNX075D	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells	12.71	17.7	18	2	92
TRW 1	Unconfined UTRAU/GAU	Recovery/EO Monitoring Well	53.5	78.5	84	6	159.9
TRW 2	Unconfined UTRAU/GAU	Recovery/EO Monitoring Well	40.3	75.3	82.3	6	152.56
TRW 3	Unconfined UTRAU/GAU	Recovery/EO Monitoring Well	49.88	84.78	90.28	6	162.18
TRW 4R	Unconfined UTRAU/GAU	Recovery/EO Monitoring Well	50	80	83	6	156.6
TVM 1M	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells/EO Monitoring Well	71.08	72.08	73.68	2	157.28
TVM 2M	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells/EO Monitoring Well	71.29	72.29	73.79	2	159.39
TVM 4M	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells/EO Monitoring Well	71.75	73.75	76.47	2	158.87
TVR 1A	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells/EO Monitoring Well	15	40	80.6	8	148.2
TVR 1A	Unconfined UTRAU/GAU	Auxiliary TNX Area Wells/EO Monitoring Well	65	75	80.6	8	148.2

Table 4–2. Summary of the Groundwater Sampling and Analyses Plan at TNX (2nd and 4th Quarters)

Requested Analyses	Hydrocarbons	Organic Compounds	Mercury	Nitrate	Nitrate-Nitrite as Nitrogen	Sulfate	Total Organic Carbon	Uranium, Total	Gross Alpha	Nonvolatile Beta	Radium-226 & Radium 228	Total Volatile Fatty Acids	Field Parameters
Background Wells													
P 26A (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
P 26B (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
P 26D (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
Primary Wells													
TBG 3 (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
TBG 4 (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
TBG 5 (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
TNX 3D (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
TNX 8D		1	x		x			x	x	x	x		3
TNX 11D		1	x		x			x	x	x	x		3
TNX 16D		1	x		x			x	x	x	x		3
TNX 27D (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
Recovery Wells													
TRW 1 (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
TRW 2 (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
TRW 3 (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
TRW 4R (EO)	2	1	x	x	x	x	x	x	x	x	x	x	3
Secondary Wells													
TNX 1D		1	x		x			x	x	x	x		3
TNX 5D		1	x		x			x	x	x	x		3
TNX 9D		1	x		x			x	x	x	x		3
TNX 12D		1	x		x			x	x	x	x		3
TNX 24D		1	x		x			x	x	x	x		3
Auxiliary Wells													
TCM 5		1	x		x			x	x	x	x		3
TIR 1L		1	x		x			x	x	x	x		3
Auxiliary Wells (continued)													
TIR 1M		1	x		x			x	x	x	x		3
TIR 1U		1	x		x			x	x	x	x		3
TNX 13D		1	x		x			x	x	x	x		3
TNX 15D		1	x		x			x	x	x	x		3
TNX 20D		1	x		x			x	x	x	x		3
TNX 22D		1	x		x			x	x	x	x		3
TNX 28D		1	x		x			x	x	x	x		3
TNX 30D		1	x		x			x	x	x	x		3
TNX 35D		1	x		x			x	x	x	x		3
TNX 37D		1	x		x			x	x	x	x		3
TNX 72D		1	x		x			x	x	x	x		3
TNX 72M		1	x		x			x	x	x	x		3
TNX 72S		1	x		x			x	x	x	x		3
TNX073D		1	x		x			x	x	x	x		3
TNX074D		1	x		x			x	x	x	x		3
TNX075D		1	x		x			x	x	x	x		3
TVM 1M (EO)	2	1		x		x	x					x	3
TVM 2M (EO)	2	1		x		x	x					x	3
TVM 4M (EO)	2	1		x		x	x					x	3
TVR 1A (EO)	2	1		x		x	x					x	3

NOTES:
1 Organic compounds include; trichloroethylene, cis-1,2-dichloroethylene, vinyl chloride, carbon tetrachloride, tetrachloroethylene, and 1,4-dioxane
2 Hydrocarbons include; methane, ethylene, nitrogen, and carbon dioxide
3 Field parameters include; pH, specific conductivity, dissolved oxygen, oxidation reduction potential, turbidity, total alkalinity, water elevation, and water temperature
x Sample to be obtained
(EO) Edible oil monitoring well network

5.0 FIELD AND ANALYTICAL RESULTS

The following sections summarize the results of the field and analytical data. Field and analytical data are shown in Appendix B, Tables B-1, and B-2. Historic data trends are presented as hydrographs in Appendix D and analytical time series graphs in Appendix E. Table 5-2 summarizes the constituents that exceeded an MCL during 2017. Appendix C includes the Data Review Key.

5.1 Precipitation Measurements

Precipitation measurements are collected at a meteorological station located approximately 4.0 km (2.5 mi) southeast of TNX Area at D Area (Figure A-1). Monthly precipitation measurements for D Area since 1973 are shown in Table 5-1. During 2017, precipitation data was collected at regular intervals (24-hr period) at the D-Area meteorological station and 2017 results are presented on Table 5-1. Rainfall in D-Area totaled 114.5 cm (45.07 in) in 2017 which is approximately 2.2 cm (0.87 in) below the historic average.

5.2 Water-Level Measurements

The water table map showing current conditions (Figure A-13) was constructed from water-level measurements collected during the fourth quarter 2017. Appendix D includes the hydrographs showing water elevations for the period of record.

The horizontal groundwater flow in the TNX Area is to the southwest toward the Savannah River Swamp. Horizontal flow rate calculations provide estimates of the transport rate of constituents originating from the TNX Area. Flow rates are estimated using the following equation:

$$Flow\ \left(\frac{ft}{day}\right) = \frac{Hydraulic\ Conductivity\ Kh\ \left(\frac{ft}{day}\right)}{Effective\ Porosity\ (unit\ less)}\ x\ \frac{dh\ (ft)}{dl\ (ft)}$$

Where the hydraulic conductivity (*Kh*) constant is 10 ft/day, the effective porosity value is 20 percent, the change in head is *dh*, and the horizontal distance along each flow direction arrow is *dl*. Flow path length is calculated to the nearest five feet. Flow rate per day is

calculated to two significant figures, then multiplied by 365 and rounded to two significant figures for the flow rate per year. Flow rate estimates vary depending upon the vertical gradient between wells, the size of the area under consideration, the number of data points, and the length and location of the flow path. Because these are inferred or estimated parameters, flow rate estimates should be considered accurate to an order of magnitude only.

In the fourth quarter 2017, horizontal flow rates in the unconfined portion of the UTRAU/GAU range from approximately 110 m per year (360 ft/yr) in the northeast beneath the TAOU cap (Flow path A-A', Figure A-13) to approximately 22 m per year (73 ft/yr) near the OTSB and in the swamp (Flow path B-B', Figure A-13). As shown on Figure A-13, the gradient flattens on the southern end of the TAOU cap.

5.3 pH

Field pH values measured during 2017 ranged from 4.2 to 7.7 with the annual average being 5.6. There were seven monitoring wells (i.e., TBG 3, TIR 1L, TIR 1M, TIR 1U, TNX15D, TNX 16D, and TNX 30D) that had a pH less than 5 in the second quarter 2017. During the fourth quarter 2017, there were two monitoring wells (i.e., TIR 1L and TIR 1M) that had a pH less than 5 (Figure A-14).

5.4 Analytical Results

Analytical results for 2017 are included on Tables B-1 and B-2. Appendix E includes time series plots for selected constituents and monitoring wells. Interpretations for the analytical results reported in this section are provided in the Evaluation of Field and Analytical Results section (i.e., Section 6.0).

The monitoring wells used during the 2015 edible oil injection (i.e., TBG 3, TBG 4, TBG 5, TRW 3, TRW 4R, and TVM 1M) have been experiencing foamy samples. The foam is likely a by-product of the edible oil and the complex biogeochemistry that is occurring in the subsurface. The foamy nature of the sample has caused the laboratories to alter the samples to preserve the integrity of their instrumentation causing above normal method detection limits and sample quantitation limits. This issue is not persistent or isolated to

one particular analytical method. Analytical methods effected by a foamy sample will be identified in the appropriate section below.

Tetrachloroethylene (PCE). During the second and fourth quarter 2017, PCE was not detected at any of the wells.

Trichloroethylene (TCE). During the second quarter 2017, TCE was detected in 18 wells. Concentrations of TCE exceeded the MCL (5 µg/L) in the following three wells: TRW 2 (21 µg/L), TCM 5 (7.3 µg/L), and TNX 28D (7.2 µg/L). TRW 2 and TCM 5 have a history of exceeding the MCL (5 µg/L) for TCE. TNX 28D has a history of detectable concentrations of TCE, but only recently exceeding the MCL.

During the fourth quarter 2017, TCE was detected in 15 wells. Concentrations of TCE exceeded the MCL (5 µg/L) in the following three wells: TRW 2 (24 µg/L) TIR 1U (5.3 µg/L), and TNX 28D (12 µg/L). TCE concentrations at TIR 1U have previously exceeded the MCL, declining to less than the MCL during 2016.

Cis-1,2-Dichloroethylene (cis-1,2 DCE). During the second quarter 2017, cis-1,2-DCE was detected in ten wells. The concentration of cis-1,2-DCE did not exceed the MCL (70 µg/L) in the second quarter 2017.

During the fourth quarter 2017, cis-1,2-DCE was detected in 15 wells. Concentrations of cis-1,2-DCE did not exceed the MCL (70 µg/L) during the fourth quarter 2017.

Vinyl Chloride (VC). During the second quarter 2017, VC was detected in one well. Concentrations of VC did not exceed the MCL (2 µg/L).

During the fourth quarter 2017, VC was detected in two wells and did not exceed the MCL (2 µg/L).

Ethylene. During the second quarter 2017, ethylene was detected in five wells. The detections ranged from 0.11 to 0.53 µg/L.

During the fourth quarter 2017, ethylene was detected in five monitoring wells with concentrations ranging from 0.11 to 0.46 µg/L.

Carbon Tetrachloride (CCl_4). During the second and fourth quarter 2017, CCl_4 was not detected at any of the monitoring wells.

Gross Alpha. During the second quarter 2017, gross alpha was detected in 12 wells. The gross alpha activity at TCM 5 (15.4 pCi/L) was the only well to exceed the MCL (15 pCi/L).

During the fourth quarter 2017, gross alpha was detected in eight wells. The gross alpha activity exceeded the MCL (15 pCi/L) in one well, TCM 5 (32.6 pCi/L).

Uranium. During the second quarter 2017, total recoverable uranium was detected in nine wells. None of the monitoring wells exceeded the MCL (30 µg/L) for uranium.

During the fourth quarter 2017, total recoverable uranium was detected in seven wells. The uranium concentrations exceeded the MCL (30 µg/L) at TCM 5 (81.1 µg/L)

Radium-226 and Radium 228. During the second quarter 2017, the combined radium (sum of radium-226 and radium-228) was detected in 29 wells. There were no exceedances over the MCL (5 ρCi/L) for combined radium.

During the fourth quarter 2017, combined radium (radium-226 and radium-228) was detected in 35 wells. Two wells, TNX 37D and TNX 24D, exceeded the MCL (5 ρCi/L) for the combined radium with activities of 26.09 ρCi/L and 5.61 ρCi/L, respectively. These wells do not have a history of combined radium activity exceeding the MCL.

Mercury. During the second quarter 2017, mercury was detected in twelve wells. All of the detections were below the MCL (2 µg/L) for mercury.

During the fourth quarter 2017, mercury was detected in thirteen wells. All detections were below the MCL (2 µg/L) for mercury.

Nitrate-Nitrite as Nitrogen (NO_3/NO_2 as N). During the second quarter 2017, NO_3/NO_2 as N was detected in 37 wells and all the results were below the MCL (10 mg/L).

During the fourth quarter 2017, NO_3/NO_2 as N was detected in 40 wells, and all results were below the MCL for NO_3/NO_2 as N (10 mg/L).

1,4-Dioxane. During the second quarter 2017, 1,4-dioxane was detected in two wells. TBG 5 and TRW 3 had 1,4-dioxane concentrations that exceeded the regional screening level for tap water (0.46 µg/L) with concentrations of 4.3 and 1.3 µg/L, respectively.

During the fourth quarter 2017, 1,4-dioxane was not detected in any of the monitoring wells. Although there were no detections, four monitoring wells (i.e., TBG 3, TBG 4, TBG 5, and TRW 3) had above normal method detection limits (25 µg/L) and sample quantitation limits (100 µg/L). The high method detection limits and sample quantitation limits were a result from the laboratory diluting the sample because of the presence of foam. The foam is assumed to be a by-product of the EO injections.

1,4-Dioxane samples were analyzed using SCDHEC certified method EPA8260SIM. Method EPA8260SIM cannot achieve detection limits less than the regional screening level (RSL) for tap water (0.46 µg/L). SRS is attempting to acquire analytical method EPA522 which can achieve detection limits less than the RSL for tap water; however, this method is not currently SCDHEC certified.

Edible Oil Parameters. The EO parameters are analyzed near the treatment zone to identify the reductive conditions created after injection of the EO in the groundwater. These parameters include DO, total organic carbon (TOC), ORP, sulfate, methane, nitrate, and VFA, and are compared to concentrations measured prior to or during the EO injections (Appendix A, Figures A-32 through A-41). These parameters are also presented in Appendix E on time series graphs. It should be noted that the results for DO, ORP, sulfate, nitrate, and TOC from 2008 to 2014 are not present in the database yet; therefore, the program used to create the time series graphs could not be used. The graphs for these

constituents were created manually. Although the data is presented accurately, the graph formatting looks slightly different than the other time series graphs.

DO decreased at injection wells in the treatment zone after the 2008, 2010, and 2015 EO injections. In the fourth quarter 2017, DO concentrations at the 2015 injection wells, TBG 3 and TRW 3, were less than DO concentrations observed prior to the 2015 EO injection. The DO concentration at TBG 3 decreased from 8.16 mg/L in the second quarter 2014 to 2.1 mg/L in the fourth quarter 2015. Since fourth quarter 2015, DO concentrations at TBG 3 have remained low with concentrations at 1.4 mg/L in the fourth quarter 2017. At TRW 3, the DO concentration was 4.1 mg/L in the second quarter 2014 and decreased to 1.3 mg/L in fourth quarter 2015. Since the fourth quarter 2015, DO concentrations have increased back to pre-injection concentrations, which were 3.9 mg/L in the fourth quarter 2017. At the original EO injection wells (i.e., TBG 4, TBG 5, TNX 3D and TRW 4R), DO concentrations continue to be less than background. The DO concentration at TBG 4, although lower than background concentrations, have been increasing from 1.2 mg/L in the fourth quarter 2015 to 3.8 mg/L in the fourth quarter 2017. The DO concentration at TBG 5 was 6.9 mg/L in the first quarter 2008 and has averaged 2.7 mg/L since the fourth quarter 2015. The DO concentration at TNX 3D was 7.8 mg/L in the first quarter 2008 and decreased to less than 1.0 mg/L from 2009 to 2014. After the 2015 EO injections, DO concentrations at TNX 3D have increased with DO concentrations at 2.1 mg/L during the fourth quarter 2017. The DO concentration at TRW 4R decreased to less than 1.0 mg/L after the initial EO injection in 2008. After the 2015 injection, DO concentrations at TRW 4R were 2.9 mg/L and have decreased to 0.57 mg/L in the fourth quarter 2017.

The TOC concentrations increased at injection wells immediately after each injection occurred. After the 2015 injections, TOC concentrations increased at the injection wells (i.e., TBG 3, TGB 4, TBG 5, TRW 3, TRW 4R, and TVM 1M) and one monitoring well (i.e., TVR 1A). Since the 2015 injections, TOC concentrations at all of these well have steadily decreased with time. The TOC concentrations at TBG 4 have decreased the least since 2015, from 8 million µg/L in the second quarter 2016 to 3.9 million µg/L in the fourth quarter 2017.

The ORP results have decreased at most of the injection wells after the EO injections. Injection wells TBG 4, TBG 5, and TNX 3D have sustained low ORP results since EO was injected in 2008 and 2010. Since the 2015 injection, the ORP result at TBG 4 have continued to decrease with ORP results of -106 millivolts (mV) in the fourth quarter 2017. The ORP result at TBG 5 was 212 mV in the first quarter 2008 and -96 mV during the fourth quarter 2017. The ORP result at TNX 3D was 188 mV in the second quarter 2008 and -50 mV during the fourth quarter 2017. The ORP results at TRW 4R have been variable with time. After the 2015 EO injection, ORP results at TRW 4R decreased in the fourth quarter 2015 to -65 mV while steadily increasing to 18 mV in the second quarter 2017. The fourth quarter 2017 ORP result at TRW 4R was -133 mV. The ORP results at TBG 3 have steadily declined since the 2015 injections, but have yet to be come negative. In the fourth quarter 2017, ORP results at TBG 3 were 32 mV. ORP results have also declined at some monitoring wells. The ORP results declined after the 2008 injections at TVM 2M, TVM 4M, and TVR 1A and have remained low. After the 2015 injections, changes in ORP results were observed in TRW 2 declining from 263 mV in the second quarter 2014 to 64 mV in the fourth quarter 2017.

Sulfate concentrations were variable after the 2008 and 2010 injections. After the 2015 injections, sulfate concentrations decreased at some of the injection wells (i.e., TBG 3, TBG 5, TRW 4R). TRW 4R had the most extreme decline in sulfate concentrations averaging 7.7 mg/L between 2008 and 2014 and decreasing to an average of 1.1 mg/L from 2015 to 2017. The sulfate concentration at TRW 4R was 2.7 mg/L during the fourth quarter 2017. The sulfate concentrations at TBG 3 and TBG 5 declined gradually from 2015 to 2017. TBG 3 had sulfate concentrations decline from 3.2 mg/L in the second quarter 2015 to 0.076mg/L in the fourth quarter 2017. Sulfate concentrations at TBG 5 were variable but averaged 8.6 mg/L between 2012 and 2014 and have declined to average 1.8 mg/L between 2015 and 2017. The sulfate concentration at TBG 5 was 0.29 mg/L during the fourth quarter 2017.

Methane concentrations at injection and monitoring wells near the treatment zone increased to greater than 1,000 µg/L after the 2008 and 2010 injections. Methane concentrations at

TBG 3 and TRW 3 had increased to greater than 1,000 µg/L after the 2015 injections. The methane concentration at TBG 3 was 12,000 µg/L during the fourth quarter 2017, while the methane concentration at TRW 3 was 10,000 µg/L during the fourth quarter 2017. Previous injections wells (i.e., TBG 4, TBG 5, TNX 3D, and TRW 4R) continue to have elevated methane concentrations. The methane concentrations during the fourth quarter 2017 at TBG 4, TBG 5, TNX 3D, and TRW 4R were 8,600, 7,700, 14,000, and 14,000 µg/L, respectively. Outside of the treatment zone, TRW 2 experienced increased methane concentrations starting in 2014. The methane concentration at TRW 2 was 1,600 µg/L during the fourth quarter 2017.

Nitrate concentrations decreased in the treatment zone at injection wells (i.e., TBG 4, TBG 5, and TNX 3D) after the 2008 and 2010 injections. After the 2015 injections, nitrate concentrations decreased at injection wells, TBG 3, TRW 3, and TVM 1M. The nitrate concentrations in TBG 3, TRW 3, and TVM 1M continue to remain low during 2017.

Total Volatile Fatty Acids. The total VFA concentrations were elevated immediately after the 2015 EO injection in the injection wells. Most of the injection wells had total VFA concentrations greater than 100,000 µg/L except for TBG 4 and TBG 5 which had total VFA concentrations of greater than one million µg/L. Since 2015, a decrease in total VFA concentrations has been observed at TBG 3, TBG 5, TRW 3, and TVM 1M. TBG 4 is the only injection well to experience no change in total VFA concentrations between 2015 and 2017 with concentrations averaging 5.4 million µg/L. At the monitoring wells (i.e., TRW 1, TRW 2, TVM 2M and TVR 1A), total VFA concentrations have detected at concentrations less than 100,000 µg/L, but detections have not been consistent with time.

Table 5–1. Rainfall (inches) at 400-D, 1973 to 2017

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
1973	5.19	4.52	6.54	5.03	3.05	7.7	4.3	2.74	4.07	0.87	0.32	3.99	48.32
1974	2.15	6.78	2.28	1.69	4.82	3.31	2.43	6.06	2.92	0	1.9	4.09	38.43
1975	3.42	6.04	6.05	4.38	6.46	4.72	10.91	1.37	7.06	0.74	3.15	4.03	58.33
1976	3.89	1.07	3.52	2.3	10.23	6.95	1.81	1.46	6.41	5.02	3.44	4.7	50.8
1977	3.33	3.25	7.6	1.3	1.23	2.91	1.47	7.1	3.06	4	2.46	4.15	41.86
1978	8.41	1.5	3.12	3.75	3.96	1.77	1.99	5.08	4.96	0.75	3.37	1.72	40.38
1979	3.48	9.49	3.06	4.54	7.45	1.37	5.57	7.14	6.13	0.82	6.38	2.35	57.78
1980	4.23	3.05	11.1	2.45	4.15	4.5	0.97	1.65	7.51	2.05	1.73	2.71	46.1
1981	0.72	3.8	4.16	2.64	3.7	4.96	4.56	6.18	0.06	3.04	0.66	8.86	43.34
1982	4.48	4.89	3.17	4.98	3.64	5.82	3.36	3.12	3.2	3.71	1.68	6.08	48.13
1983	4.09	7.12	5.36	5.43	2.4	3.44	1.63	5.32	2.54	2.42	4.35	4.03	48.13
1984	3.22	5.65	5.3	4.91	5.39	6.07	8.81	1.97	0.73	0.38	1.15	1.34	44.92
1985	2.64	5.71	1.01	1.53	1.79	6.25	8.9	4.15	0.2	5.53	7.16	2.7	47.57
1986	1.14	2.8	3.07	0.48	2.48	5.01	1.66	8.13	0.52	2.52	4.7	3.96	36.47
1987	6.49	6.65	3.85	0.28	1.39	4.69	2.45	1.73	4.64	0.19	2.34	1.27	35.97
1988	3.55	5.3	2.04	6.18	1.56	6.94	1.76	5.04	5.06	2.45	1.81	1.15	42.84
1989	1.78	3.17	4.56	4.72	2.42	5.73	7.39	0.23	5.11	4.57	2.61	2.37	44.66
1990	2.05	3.51	3.19	0.29	1.1	1.22	4.8	5.23	0.44	17.12	1.26	1.67	41.88
1991	7.49	2	7.15	4.9	3.09	2.58	9.11	8.59	1.52	0.53	1.01	3.34	51.31
1992	3.59	4.86	3.27	2.48	2.15	7.55	7.29	6.27	3.58	3.91	6.64	1.95	53.54
1993	7.92	2.55	9.7	1.3	2.24	8.65	1.85	3.06	6.42	0.87	1.84	2.25	48.65
1994	4.71	4.49	6.72	1.29	1.66	7.33	6.08	3.62	2.33	8.98	2.86	4.71	54.78
1995	5.28	6.06	2.47	0.17	2.28	7.24	4.2	6.86	3.95	2.11	2.49	4.47	47.58
1996	2.6	2.05	6.26	1.69	1.6	3.65	4.89	7.93	3.72	1.98	1.5	2.74	40.61
1997	4.14	5.1	1.98	3.42	1.69	6.82	6.54	1.37	5.41	4.74	4.29	7.93	53.43
1998	7.76	6.26	7.86	7.14	4.2	2.86	7.53	2.98	6.33	0.65	0.57	1.89	56.03
1999	6.9	2.26	2.98	2.12	2.59	7.37	6.36	5.46	3.45	2.18	0.65	0.91	43.23
2000	5.11	0.77	4.26	1.62	0.21	5.85	3.86	4.15	9.11	0.06	3.33	1.61	39.94
2001	2.69	3.05	7.28	1.43	3.24	6.54	2.19	3.14	3.31	0.18	1.12	0.57	34.74
2002	2.04	2.23	4	1.59	1.63	3.9	4.41	4.55	3.72	4.57	3.94	3.86	40.44
2003	2.07	5.31	8.07	8.64	6.81	9.18	10.14	3.96	2.63	3.39	1.19	2.26	63.65
2004	2.7	7.11	0.86	1.28	2.79	7.83	2.91	1.96	7.05	0.59	2.74	2.54	40.36
2005	2.35	4.43	6.07	1.26	4.12	9.57	5.19	4.64	2.07	2.95	2.53	6.4	51.58
2006	3.19	2.61	1.35	2.29	2.34	6	5.26	1.59	2.81	1.77	3.76	4.4	37.37
2007	3.18	2.87	1.7	2.48	1.23	5.42	4.97	3.04	0.91	1.47	0.14	9.67	37.08
2008	4	5.89	4.66	2.35	2.42	0.27	6.82	6.86	0.57	4.47	2.93	5.13	46.37
2009	2.03	0.8	4.25	5.86	8.21	1.72	4.47	7.67	5.74	2.89	4.56	9.75	57.95

Table 5–1. Rainfall (inches) at 400-D, 1973 to 2017 (*Continued/Ended*)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
2010	4.9	2.62	2.5	1.71	1.34	7.29	2.39	7.04	2.51	0.48	1.45	1.41	35.64
2011	2.2	4.95	5.67	3.53	1.17	2.81	2.5	2.54	2.38	1.86	2.68	1.91	34.2
2012	1.91	1.59	3.07	1.43	6.96	3	5.27	9.85	1.55	.54			35.17
2013*			1.75	1.05		5.64	4.99			0.08	1.64	4.64	19.79
2013**	0.68	13.5	4.44	4.09	2.6	7.15	13.29	6.69	0.6	2.45	0.83	4.84	61.16
2014	2.77	5.22	3.15	3.69	4.08	5.2	6.1	3.8	4.46	1.13	3.88	5.17	48.65
2015	3.47	5.09	4.12	7.08	0.35	6.03	4.33	2.81	4.64	4.99	7.25	5.36	55.52
2016	2.8	4.8	3.45	3.51	5.58	6.87	4.06	5	6	4.8	0.26	5.54	52.67
2017	4.5	1.43	1.57	7.23	3.41	6.53	3.26	3.27	6.12	1.27	1.58	4.9	45.07
Average	3.79	4.11	4.40	3.14	3.29	5.26	4.70	4.45	3.79	2.72	2.69	3.76	45.94
Max	8.41	9.49	11.1	8.64	10.23	9.57	10.91	9.85	9.11	17.12	7.25	9.75	63.65
Min	0.72	0.77	0.86	0.17	0.21	0.27	0.97	0.23	0.06	0	0.14	0.57	34.2

*Incomplete 2013 precipitation data from the D-Area meteorological station (400-D).
**Precipitation data from the K-Area meteorological station.

Table 5–2. Constituents Exceeding USEPA NPDWS MCLs in T-Area Wells During 2017

Aquifer	Monitoring Category	TAOU Groundwater Monitoring Constituents										
		Carbon Tetrachloride (CCl_4)	Tetrachlorethylene (PCE)	Trichloroethylene (TCE)	cis-1,2-Dichloroethylene (cis-1,2-DCE)	Chloroethane (vinyl chloride)	Mercury	Nitrate-nitrite as Nitrogen (NO_3/NO_2 as N)	Uranium (total recoverable)	Gross alpha	Adjusted gross alpha	Combined Radium (Radium 226 and 228)
Unconfined UTRAU/GAU	Background											
	Primary								X			
	Secondary											X
	Auxiliary			X					X	X		X
	Recovery			X								

NOTES:
X = Constituents Exceeding USEPA NPDWS MCLs
UTRAU/GAU = Upper Three Runs Aquifer Unit/ Gordon Aquifer Unit
N = Nitrogen
O = Oxygen
USEPA NPDWS MCLs = USEPA National Primary Drinking Water Standards MCLs (USEPA 2001)

6.0 EVALUATION OF FIELD AND ANALYTICAL RESULTS

Analytical results and field parameters for the second and fourth quarter 2017 are included in Tables B-1 and B-2. Two dimensional planar and cross section maps displaying fourth quarter 2017 results for selected constituents are shown in Figures A-13 through A-24. Figures A-32 through A-41 provide a comparison of pre-EO injection parameters with fourth quarter 2017 results. Hydrographs and time series plots of selected constituents are provided in Appendix D and Appendix E, respectively.

6.1 Potentiometric Surface

The water table was initially drawn down during the operation of the four extraction wells between 1996 and 2007. The termination of extraction in 2007 allowed the water table to rebound. In response to the rebound, the water table elevation increased significantly in TRW 1, TRW 2, TRW 3 and TRW 4R, and to a lesser extent in most of the other wells. The EO injections are thought to have only temporarily affected the water table elevation during injection. There is no evidence of long term impacts to the water table elevation.

Between 2012 and 2013, most wells experienced a 2 to 5 ft increase in water elevation. The elevated water elevations have been sustained at most monitoring wells during 2016 and into the first half of 2017. The elevated water elevations are the result of above average precipitation totals from 2013 to 2016. In 2017, the annual precipitation was 45.07 inches, which is lower than the 40-year average of 45.94 inches. Declining water elevations during the second half of 2017 at monitoring wells located on or upgradient of the TAOU cover may be the result of below average precipitation for the area. The changes in water elevation did not have a significant effect on groundwater flow directions with the predominant flow direction continuing to be in the southwest toward the Savannah River.

6.2 pH

Low pH conditions have previously been observed in the groundwater at discrete locations in the TNX Area OU. The low pH conditions beneath the TAOU cap are likely the result

of groundwater in contact with nitric acid and the uranyl nitrate that was associated with the TBG. Low pH conditions observed in the wetlands may be a combination of naturally occurring low pH conditions as wells as disposal of acids at the OTSB and TNX OD.

During the fourth quarter 2017, there were no wells with a pH of less than 5 (Figure A-14). TBG 3 has had a history of pH fluctuating above and below 5. There appears to be a correlation to increased water elevation and lower pH (< 5) at TBG 3 (Figure A-28). On a similar note, nitrate/nitrite as nitrogen concentrations at TBG 3 also correlate to changes in water elevation (Figure A-29). As water elevation increases so does the concentration of nitrate/nitrite as nitrogen. This could indicate that there is source material (i.e. nitrates) in the capillary fringe near TBG 3 and as the water table rises and contacts source material the pH decreases.

The EO injections added a basic solution to buffer the lower pH of the groundwater to a pH of between 6 to 8 to promote bacterial activity. After the 2008 and 2010 injections, elevated pH was observed in three of the injection wells, TBG 4, TBG 5, and TNX 3D. A basic solution was also added during the 2015 EO injections; however, it does not appear to have buffered the aquifer as much as the 2008 and 2010 injections. Additional sampling results will continue to provide insight on the effects of pH on the EO treatment at the TNX Area OU.

6.3 VOC Constituents (i.e., PCE, TCE, Cis-1,2-DCE, VC, Ethylene, and CCl_4)

The T-1 Air Stripper and associated recovery wells removed a significant amount of mass from the groundwater at TNX Area OU. Monitoring wells located in the source area (i.e., TBG 3, TBG 4, and TBG 5) as well as the downgradient monitoring wells (i.e., TNX 3D, TNX 11D, and TNX 27D) experienced decreasing TCE and PCE concentrations during operation of the T-1 Air Stripper (i.e., 1996 to 2007). When the T-1 Air Stripper was temporarily shut down (i.e., 2005 to 2007) during the installation of the TAOU cap, TCE and PCE concentrations rebounded revealing a residual source was still present in the source area. The EO treatability study was designed to target the residual source and further reduce VOC mass in the groundwater. Since the 2015 EO injections, the TCE

concentrations at TBG 3, TRW 3, and TVM 1M have been less than the MCL (5 µg/L). In 2017, all of the injection and monitoring wells within the treatment area had TCE concentrations less than the MCL.

The removal of TCE mass at the source has had a direct effect on the TCE concentrations observed in the wetland wells. As source TCE concentrations have declined, distal TCE concentrations have concurrently declined (Figure A-27). Figure A-27 provides a comparison of the average annual TCE concentrations for eight monitoring wells (i.e., TBG 3, TBG 4, TBG 5, TNX 3D, TRW 1, TRW 2, TRW 3, and TRW 4R) located on the TAOU cap in the source plume and seven wells (i.e., TCM 5, TIR 1U, TNX 15D, TNX 16D, TNX 27D, TNX 28D, and TNX 30D) located in the wetlands or distal plume. Between 2007 and 2015, declining average TCE concentrations in both source and distal monitoring wells are evidence of how source removal has had a direct effect on the concentrations throughout the plume. Since 2015, the average TCE concentrations has fluctuated above and below the MCL (5 µg/L). In 2017, both averages were greater than the MCL (5 µg/L).

The 2017 TCE plume (<5 µg/L) is defined by three monitoring wells (i.e. TIR 1U, TNX 28D and TRW 2). TRW 2 is located on the TAOU cap, outside of the EO treatment zone. TCE concentrations at TRW 2 fluctuated above and below the MCL prior to 2015 and have been consistently above the MCL averaging 23 µg/L since the 2015 EO injections. TNX 28D and TIR 1U are in the wetlands. TCE concentrations at TNX 28D have been steadily increasing since 2013 with the last three sampling events exceeding the MCL (5 µg/L). The TCE concentrations at TIR 1U declined from approximately 20 µg/L in 2010 to less than the MCL (5 µg/L) in 2016. The TCE concentration at TIR 1U during the fourth quarter 2017 was 5.3 µg/L. This is the first exceedance of the MCL since 2016. It is not apparent the exact cause of the elevated TCE concentrations at these three wells. It is possible that the dissolved TCE plume was redistributed as EO was injected into the aquifer in 2015. TCE concentrations at these monitoring wells will continue to be assessed in future reports.

Cis-1,2-DCE was observed at the monitoring wells in the source area (i.e., TBG 3, TBG 4, TGB 5, TNX 3D, and TRW 1) prior to the injection of EO. Similar to TCE and PCE, cis-

1,2-DCE concentrations decreased as VOC mass was removed by the operation of the recovery wells and T-1 Air Stripper. After the 2008 and 2010 EO injections, cis-1,2-DCE concentrations began to increase at wells near the treatment area indicating TCE degradation is likely occurring. After the 2015 EO injections, cis-1,2-DCE concentrations increased at TRW 2, TRW 4R, and TVM 1M indicating the degradation of TCE is likely occurring. It is anticipated that cis-1,2-DCE concentrations will increase at TBG 3 and TRW 3 with time. In the wetlands, cis-1,2-DCE concentrations have been below the detection limit since the 2015 EO injections.

There were no VC concentrations that exceeded the MCL (2 µg/L) during 2017. In 2017, TBG 5 was the only well with VC concentrations above the detection limit.

Elevated ethylene concentrations were observed immediately after the 2008 and 2010 EO injections at injection wells TBG 4, TBG 5, and TNX 3D. After the 2015 EO injections, ethylene concentrations increased at TBG 3, TBG 4, TRW 3, and TVM 1M. Since the increase in ethylene concentrations in 2015, ethylene concentrations have steadily decreased but remain at detectable concentrations into 2017 at these four wells. The presence of ethylene indicates the complete degradation of TCE and daughters.

CCl_4 exceeded the MCL (5 µg/L) at wells located near the TBG from the late 1990's to the early 2000's. CCl_4 concentrations decreased to below the MCL at the majority of monitoring wells with the operation of the T-1 Air Stripper and associated recovery wells. From 2013 to 2015, CCl_4 concentrations exceeded the MCL at TBG 3. These elevated concentrations were likely associated with the elevated water table coming in contact with residual source present in the shallow vadose zone and capillary fringe. CCl_4 concentrations declined to below the detection limit at TBG 3 since the 2015 EO injections and continue to be less than the detection limit in 2017. It is uncertain what process is causing the decline in CCl_4 concentrations at TBG 3, but it appears the same processes degrading the TCE are also degrading the CCl_4.

6.4 Edible Oil Parameters

The injection of EO into the groundwater during 2008, 2010, and 2015 converted the aerobic aquifer to a reducing environment. The EO parameters monitor for methane, DO, ORP, TOC, sulfate, and nitrate to identify areas that have become anaerobic and potentially where reductive dechlorination is occurring. The reductive environment created in the EO treatment area is illustrated in Figures A-32 through A-37 which compares pre-injection groundwater parameters to post-injection parameters collected during the fourth quarter 2017. Time series trends for these parameters are presented in Appendix E. Evidence of a reductive environment in the treatment area includes:

- TOC is elevated in the treatment area.
- DO has decreased in the treatment area.
- ORP results indicate more reductive conditions in the treatment area.
- Sulfate concentrations indicate a sulfate reduction in the treatment area.
- Methane concentrations increased at injection wells.
- Denitrification (decreasing nitrate concentrations) occurred in the treatment area.

After the EO injections, TOC concentrations increased from approximately 1,000 µg/L to greater than 100,000 µg/L. This is evident at all of the injection wells including 2015 injection wells, TBG 3 and TRW 3. After each of the injections, TOC concentrations spiked and generally began to decline at the injection wells. In 2017, TOC concentrations continue to be elevated at the 2015 injection wells.

The DO at all the injection wells have decreased after the injection of EO indicating that the aquifer has become anaerobic. As the oxygen in the aquifer is consumed, reductive conditions will become more prevalent and eventually lead to conditions favorable for reductive dechlorination. Since the 2015 EO injections, DO concentrations have remained below pre-injection concentrations (i.e., > 6 mg/L) at the injection and monitoring wells. Although DO concentrations are low after the 2015 injections (i.e. 1 mg/L > DO < 4 mg/L), DO concentrations were less than 1 mg/L after the 2008 and 2010 injections. The slightly

higher DO concentrations since the 2015 injections do not appear to be causing any negative effects on the reductive environment created by the degradation of the EO.

The ORP of the injection wells has decreased after each injection of EO. TBG 3 is the exception as ORP have decreased since the 2015 injections but have not become negative like the other injection wells. TRW 4R is the only injection well that had ORP measurements increase after the 2008 EO injection. TRW 4R is a larger diameter well with a 30 ft continuous screen, and only the upper portion of the screen was injected into during 2008 injection. The mixing of aerobic groundwater from the deeper portion of the aquifer likely influenced the change in ORP at TRW 4R. Since the 2015 EO injection, ORP has decreased at TRW 4R.

Denitrification, changes in sulfate, and increased methane are further indicators for the presence of a reducing environment and suggest reductive dechlorination could be occurring. Decreasing nitrate concentrations is evidence that reductive conditions have progressed enough to allow dechlorination of VOCs. Denitrification is most noticeable at injection wells (i.e., TBG 3, TBG 4, TRW 3, and TVM 1M) and monitoring wells (i.e., TRW 1, and TRW 2). Evidence of sulfate reduction is not as apparent, but in comparison to 2007 sulfate concentrations, 2017 sulfate concentrations have been reduced in the treatment area (Figure A-35). Methane concentrations increased immediately after each injection at the injection wells and are also elevated at surrounding monitoring well. The presence of methane is an indication that highly reductive conditions are present in the aquifer and that reductive dechlorination of VOCs is likely occurring.

VFAs indicate the general presence and longevity of EO in the subsurface. EO is composed of long chain fatty acids, and as these fatty acids are consumed, they are broken into short chain fatty acids or VFA. After the 2015 injections, total VFA concentrations were the highest at the injection wells and were not detected in the monitoring wells. Since 2015, the concentration of VFA have begun to decrease at most of the injection wells. VFA concentrations have also been detected in the monitoring wells (i.e., TVR 1A, TRW 1, and TRW 2) suggesting that EO has been distributed out into the aquifer. The concentrations of VFA observed at the monitoring wells is an order of magnitude lower than those concentrations observed at the injection wells.

6.5 Combined Radium, Uranium, Gross Alpha, and Adjusted Gross Alpha

These constituents are being discussed together because uranium, radium-226, and radium-228 contribute along with other alpha emitters to the gross alpha concentration. The adjusted gross alpha concentration is calculated to exclude naturally occurring uranium 234, 235, and 238. A description of the calculations is provided in Appendix C, page C-7. The combined radium activity concentration is the sum of radium-226 and radium-228.

Detections of combined radium and uranium are associated with the TBG, OTSB, DG, OD, and naturally occurring uranium in the fluvial sediments of the wetlands. Uranium isotope data collected between 1998 and 2004 was evaluated in the *Addendum to the CERCLA Facility Investigation/Remedial Investigation/Baseline Risk Assessment (RFI/RI/BRA) Report for the TNX Area Operable Unit, Groundwater Radiological Characterization* (WSRC-RP-2001-4180). Figure A-30 graphs the mass of the three uranium isotopes (i.e. uranium-238, -235, and -233/234) with the total uranium mass. In Figure A-30, the percent mass of the uranium isotopes is comparable to naturally occurring uranium (i.e., uranium-238 [99%], uranium-235 [0.7%], and uranium -234 [0.005%]). It has also been observed that a combination of increasing water elevation, oxidizing and reducing environments, and high and low pH influences the solubility of uranium and radium, and ultimately the gross alpha, in a particular groundwater sample.

Groundwater in the TNX Area OU monitoring wells exceed the MCLs for the respective radionuclide near the TBG (area under the TAOU cap) and in the wetlands near the OTSB and TNX OD. The area under the TAOU cap has been further altered by the EO injections. In the wetlands, in addition to being sourced by the OTSB, naturally occurring radionuclides are present in the organic rich fluvial sediments which are entrained within the aquifer sediments.

TBG (Area under the TAOU Cap). Uranium concentrations beneath the TBG have not consistently exceeded the MCL (30 µg/L). The uranium concentration at TBG 4 has exceeded the MCL on and off since 2013 with the most recent exceedance occurring in the second quarter 2017. These exceedances may be associated with the increased solubility

of uranium caused by high pH, a reductive environment, and possibly a rising water table. The reductive environment and elevated pH conditions at TBG 4 were initiated after the EO injections in 2008 and 2010. During this same time (i.e., 2013 to 2017), the increase in water elevation may have brought the groundwater in contact with residual mass in the vadose zone. Either of these conditions or any combination may have resulted in the elevated uranium concentrations observed at TBG 4.

Although radium-226 is the potential contaminant of concern, the MCL is measured for combined radium-226 and radium-228 (thorium decay series). Combined radium has historically exceeded the MCL (5 ρCi/L) at monitoring wells TBG 3 and TBG 4. The exceedances at these monitoring wells appear to be associated with lower pH created from nitric acid releases from the TBG. The solubility of radium increases with decreasing pH. This relationship is presented on time series graphs in Appendix E. Combined radium concentrations at TBG 3 have exceeded the MCL since the 2008 and 2010 EO injections; however, the pH at TBG 3 was not directly impacted by the 2008 and 2010 EO injections. In 2015, EO and buffer was injected into TBG 3 and combined radium concentrations decreased to less than the MCL. There were no exceedances for combined radium at TBG 3 during 2017.

Gross Alpha exceedances under the TAOU cap directly correspond to the combined radium exceedances observed at TBG 3 and TBG 4.

Wetlands. The OTSB and fluvial sediments are two potential sources of radiological constituents in the wetlands. The exceedances of radiological constituents in the wetlands have been sporadic and there appears to not be a discernible groundwater plume present.

Most of the occurrences of combined radium in the wetland are sporadic or one-time occurrences. The sporadic nature of the combined radium exceedances is likely due to naturally occurring radium in the fluvial sediments beneath the wetlands.

Uranium concentrations are mostly sporadic with one exception (i.e., TCM 5). Uranium concentrations have regularly exceeded the MCL at TCM 5 since 2003 with a couple of

concentrations between 2014 and 2016 that were less than the MCL. It is not apparently clear if the uranium observed at TCM 5 is sourced from TNX processes or is naturally occurring. TCM 5 is located downgradient of the OD which received overflow from the OTSB.

Gross alpha exceedances in the wetlands directly correspond to the uranium exceedances observed at TCM 5. Adjusted gross alpha concentrations at TCM 5 suggest uranium is the primary alpha emitter contributing to the gross alpha concentrations.

6.6 Mercury and NO_3/NO_2 as N

The graphs for mercury are presented with pH and NO_3/NO_2 as N (Appendix E) and convey the relationship that mercury increases as pH decreases. Mercury is graphed for TBG 4 which is the only well that has previously experienced elevated mercury concentrations above the MCL (2 µg/L). Since pH increased after the 2008 and 2010 EO injections, mercury concentrations have been less than the MCL.

The NO_3/NO_2 as N graph is also presented with pH to show the relationship that pH decreases with increases in NO_3/NO_2 as N concentrations. Uranyl nitrate was disposed of at the TBG and as water infiltrated the burial ground nitric acid was produced; therefore, the NO_3/NO_2 as N concentrations are presented for TBG 3, TBG 4, and TBG 5. Since pH increased after the EO injections, NO_3/NO_2 as N concentrations have been less than the MCL to date.

6.7 1,4-Dioxane

1,4-Dioxane was initially sampled at all TNX Area OU monitoring wells during the fourth quarter 2013. Thirty of the 38 monitoring wells had a detection of 1,4-dioxane. The detections were scattered across the TNX Area OU including the background wells and monitoring wells upgradient of the source areas. It is not apparent why 1,4-dioxane concentrations were detected in almost every monitoring well. Since 2014, 1,4-dioxane concentrations at TBG 5 are consistently detected while most of the other monitoring wells have been less than the detection limit. At TBG 5, 1,4-dioxane concentrations have exceeded the regional screening level for drinking water (0.46 µg/L) during five of the

eight sampling events from fourth quarter 2013 through 2017. The 1,4-dioxane concentrations are likely associated with debris buried at the TBG. 1,4-Dioxane was detected at TRW 3 during the second quarter 2017. This is the first detection at TRW 3 since the initial sampling in 2013.

7.0 SYSTEM PERFORMANCE

7.1 Soil Vapor Extraction (SVE) Operations

During 2017, the MicroBlowers™ were connected to TVM 1U, TVM 4V, TVM 2U, TMV 4U, and TVX006L from January to November. In November 2017, four of the five MicroBlowers™ were switched to different SVE wells (i.e., TVM 1V, TVM 3V, TVX 4U, and TVX 7U). No changes were made to the MicroBlower™ at TVM 4U. Because the MicroBlowers™ were switched 10 months into the year, the total pounds of VOCs removed will include pounds removed calculated from the original set of five MicroBlowers™ for 10 months and the new set of five MicroBlowers™ for two months. In the future, changes to the MicroBlowers™ will be completed in January to better correspond to the twelve-month reporting period.

Table 7-1 provides details of construction, history, and duration each SVE well has been connected to a MicroBlower™. Vapor concentrations, flow rates, and the estimated time of operation for each SVE well are presented in Table 7-2. The data presented in Table 7-2 was used to determine the mass removed by each MicroBlower™ by using a mass balance calculation that measures the time average concentration of VOCs from the off gases. This concentration is then multiplied by the volume of air (ft3) that passes through the MicroBlower™ during a given period. Unit conversions are integrated into these calculations. These calculations assume the MicroBlowers™ operate 12 hours per day and the flow rates are constant during operation. Table 7-3 summarizes the VOCs removal per month, during 2017.

The new set of MicroBlowers™ (i.e., TVM 1V, TVM 3V, TVX 4U, and TVX 7U) were not sampled until the first quarter 2018. Vapor concentration results from the first quarter 2018 were used to calculated the pounds of VOCs removed for November and December 2017.

In 2017, approximately 0.54 kg (1.2 lb) of VOCs: 0.31 kg (0.68 lb.) of TCE, 0.21 kg (0.46 lb) of PCE, and 0.008 kg (0.02 lb) of CCl_4 were removed from the TNX vadose zone.

7.2 Edible Oil Injections

EO replaced the T-1 Air Stripper system as the selected remedial action in 2013 with approval of the second ESD to the TNX Area OU ROD (SRNS 2012a). The second ESD states that additional EO treatment will be injected if a sustained rebound in excess of 75 µg/L of TCE, PCE, or carbon tetrachloride lasting over one (1) year in any monitoring well if determined appropriate by the USDOE, USEPA, and SCDHEC (SRNS 2012a).

Additional EO amendments were injected during July to August 2015 even though the criteria to inject established in the second ESD was not met. The 2015 injections targeted areas outside of the 2008 and 2010 treatment zone (i.e. TBG 3, TRW 3, TVM 1M, TVX 2L, and TVX 4L) with elevated TCE concentrations as well as at previously treated areas (i.e., TBG 4, TBG 5, TRW 4R, TVX 3L, and TVX 5L). The placement of EOS® and neat oil injected during the 2015 injections is identified in Figure A-11. The areas previously treated continue to maintain low VOC concentrations and reductive conditions. The injection wells located outside of the original treatment area have had positive results indicating reductive conditions are being created and VOC concentrations decreasing. This system will continue to be monitored and reported in future annual reports.

Since the initial EO injections, TCE concentrations in the treatment area have continued to decrease and are currently less than the MCL (5 µg/L). The reduced TCE concentrations in the source area have also corresponded to decreasing TCE concentrations at most of the wetland wells. To assess the effectiveness of the EO injections, the change in mass of the TCE groundwater plume was quantified and plotted with time from 2007 to 2017 (Figure A-31). Figure A-31 shows the exponential decline of the estimated VOC mass with time. In 2017, TCE mass was estimated to be higher than previous years due to the TCE plume expanding into the area of TNX 28D. The estimated annual mass of TCE in the plume was calculated based on the area of the TCE plume during the fourth quarter for a given year, the average concentration of the plume during that year, assuming a plume thickness of 20 ft, and a porosity of 0.3. The following equation was used to calculate the mass of TCE in the plume for each year between 2007 and 2017;

$$Average\ TCE\ Concentration\ x\ Plume\ Volume\ x\ Porosity = TCE\ Mass$$

Table 7-4 provides the all of the values used in the mass calculations. From 2007 to 2017 it is estimated that the mass of TCE in the plume has been reduced by 92% as a result of the EO injections.

To calculate the longevity of the TCE plume since the initial EO injection, the following equation was used

$$N(t) = N_o\ e(-\lambda t)$$

where N(t) is the mass of TCE remaining in the system when the plume declined to less than the MCL (5 µg/L), N_o is the estimated mass of TCE in 2007 (5.33 kg [11.8 lb]), λ is the rate constant (0.264), and t is time. The area of the 2017 plume with an average concentration of 4.9 µg/L was used to determine, N(t), which was 0.160 kg (0.35 lb). The equation can be reworked to solve for t

$$t = \ln (N(t) / No) / \lambda$$

Using this equation, it would take approximately 13 years or until 2020 before the average concentration of the TCE plume is less than the MCL. This estimate is longer than what was predicted at the end of the treatability study (i.e., 7 to 10 years); however, the additional time is likely caused by the increase in TCE concentrations observed at TBG 3 and TVM 1M during 2013 and 2014.

Table 7–1. Well Construction and Operation for TNX SVE Wells

STATION ID	Date Installed	Ground Elevation (ft msl)	Total Depth (ft)	Screen Length (ft)	MicroBlower™ Operation (yr)
TVM 1U	10/6/1995	157.7	51.8	10	2011, 2013, 2014, 2015, 2016
TVM 1V	10/18/1995	157.3	63	2	2009, 2010
TVM 2L*	10/17/1995	159.5	91.5	1	2013, 2014
TVM 2U	10/17/1995	159.5	60.7	10	2011, 2015, 2016
TVM 2V	10/19/1995	159.4	46.8	2	
TVM 3U	10/13/1995	158.9	67.6	10	2009, 2010, 2011, 2012
TVM 3V	10/20/1995	159	46	2	2009, 2010
TVM 4L*	11/22/1995	158.9	92.4	2	2010
TVM 4U	11/22/1995	158.9	63.4	10	2009, 2011, 2015, 2016
TVM 4V	11/22/1995	158.9	46.9	1	2011, 2013, 2014, 2015, 2016
TVX 1L	7/2/2002	153.2	58.4	15	2009, 2012
TVX002 L	6/27/2002	156.6	67.4	20	2011
TVX002 U	6/27/2002	156.5	42.5	10	2013, 2014
TVX003 L	7/3/2002	154.1	59.3	15	2012
TVX004 L	7/8/2002	153	56	12	2010, 2011
TVX004 U	7/8/2002	153.1	42.1	15	2009, 2010
TVX005 L	7/9/2002	155.2	57.5	10	2013, 2014
TVX005 U	7/9/2002	155.2	48.4	15	2010, 2011
TVX006 L	7/2/2002	155.2	68.3	15	2011, 2012, 2015, 2016
TVX006 U	6/27/2002	155.2	58.4	15	
TVX007 L	6/27/2002	159	64.1	15	2009, 2010
TVX007 U	6/27/2002	158.9	44.6	10	2009, 2010, 2012

* TVM 2L and TVM 4L are screened in the saturated zone and are no longer used as viable SVE wells.

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Table 7–2. Monthly SVE Well VOC Mass Removal (2017)

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.183	0.091	0.006	15.8	Jan-17	744	0.043	0.027	0.002	0.070
TVX-6L	0.09	0	0	1	Jan-17	624	0.001	0.000	0.000	0.001
TVM-1U	0.015	0.015	0.006	2.2	Jan-17	648	0.000	0.001	0.000	0.001
TVM-4V	0.011	0.007	0.029	2.3	Jan-17	744	0.000	0.000	0.000	0.001
TVM-4U	0.082	0.073	0.036	11.9	Jan-17	744	0.015	0.016	0.001	0.031
TNX (5) Jan 2017							0.060	0.044	0.002	0.104

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.183	0.091	0.006	15.8	Jan-17	672	0.039	0.024	0.001	0.064
TVX-6L	0.09	0	0	1	Jan-17	552	0.001	0.000	0.000	0.001
TVM-1U	0.015	0.015	0.006	2.2	Jan-17	672	0.000	0.001	0.000	0.001
TVM-4V	0.011	0.007	0.029	2.3	Jan-17	673	0.000	0.000	0.000	0.001
TVM-4U	0.082	0.073	0.036	11.9	Jan-17	672	0.013	0.015	0.000	0.028
TNX (5) Feb 2017							0.054	0.040	0.002	0.094

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.183	0.091	0.006	15.8	Jan-17	744	0.043	0.027	0.002	0.070
TVX-6L	0.09	0	0	1	Jan-17	744	0.001	0.000	0.000	0.001
TVM-1U	0.015	0.015	0.003	2.2	Jan-17	624	0.000	0.001	0.000	0.001
TVM-4V	0.011	0.007	0.029	2.3	Jan-17	744	0.000	0.000	0.000	0.001
TVM-4U	0.082	0.073	0.041	11.9	Jan-17	744	0.015	0.016	0.001	0.031
TNX (5) Mar 2017							0.060	0.044	0.002	0.104

Table 7–3. Monthly SVE Well VOC Mass Removal (2017) (continued)

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.15	0.07	0.004	18.2	Apr-17	720	0.039	0.023	0.001	0.063
TVX-6L	0.078	0	0.003	0.67	Apr-17	720	0.001	0.000	0.000	0.001
TVM-1U	0.065	0.004	0.003	6.4	Apr-17	720	0.006	0.000	0.000	0.006
TVM-4V	0.014	0.008	0.036	1.2	Apr-17	720	0.000	0.000	0.000	0.000
TVM-4U	0.084	0.051	0.017	15.4	Apr-17	720	0.019	0.014	0.000	0.033
TNX (5) Apr 2017							0.065	0.038	0.002	0.103

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.15	0.07	0.004	18.2	Apr-17	744	0.041	0.024	0.001	0.065
TVX-6L	0.078	0	0.003	0.67	Apr-17	744	0.001	0.000	0.000	0.001
TVM-1U	0.065	0.004	0.003	6.4	Apr-17	744	0.006	0.000	0.000	0.007
TVM-4V	0.014	0.008	0.036	1.2	Apr-17	744	0.000	0.000	0.000	0.000
TVM-4U	0.084	0.051	0.017	15.4	Apr-17	744	0.019	0.015	0.000	0.034
TNX (5) May 2017							0.067	0.040	0.002	0.107

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.15	0.07	0.004	18.2	Apr-17	720	0.039	0.023	0.001	0.063
TVX-6L	0.078	0	0.003	0.67	Apr-17	720	0.001	0.000	0.000	0.001
TVM-1U	0.065	0.004	0.003	6.4	Apr-17	720	0.006	0.000	0.000	0.006
TVM-4V	0.014	0.008	0.036	1.2	Apr-17	504	0.000	0.000	0.000	0.000
TVM-4U	0.084	0.051	0.017	15.4	Apr-17	720	0.019	0.014	0.000	0.033
TNX (5) Jun 2017							0.065	0.038	0.002	0.103

Table 7–4. Monthly SVE Well VOC Mass Removal (2017) (continued)

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.159	0.065	0.004	15.7	Jul-17	744	0.037	0.019	0.001	0.057
TVX-6L	0.075	0	0.003	1.3	Jul-17	648	0.001	0.000	0.000	0.001
TVM-1U	0.067	0.001	0.002	6.8	Jul-17	744	0.007	0.000	0.000	0.007
TVM-4V	0.036	0.016	0.037	1.4	Jul-17	648	0.001	0.000	0.000	0.001
TVM-4U	0.068	0.065	0.012	11.8	Jul-17	744	0.012	0.014	0.000	0.026
TNX (5) Jul 2017							0.058	0.034	0.001	0.092

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.159	0.065	0.004	15.7	Jul-17	744	0.037	0.019	0.001	0.057
TVX-6L	0.075	0	0.003	1.3	Jul-17	720	0.001	0.000	0.000	0.001
TVM-1U	0.067	0.001	0.002	6.8	Jul-17	744	0.007	0.000	0.000	0.007
TVM-4V	0.036	0.016	0.037	1.4	Jul-17	744	0.001	0.000	0.000	0.001
TVM-4U	0.068	0.065	0.012	11.8	Jul-17	744	0.012	0.014	0.000	0.026
TNX (5) Aug 2017							0.058	0.034	0.001	0.093

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.159	0.065	0.004	15.7	Jul-17	720	0.036	0.019	0.001	0.055
TVX-6L	0.075	0	0.003	1.3	Jul-17	720	0.001	0.000	0.000	0.001
TVM-1U	0.067	0.001	0.002	6.8	Jul-17	720	0.007	0.000	0.000	0.007
TVM-4V	0.036	0.016	0.037	1.4	Jul-17	720	0.001	0.000	0.000	0.001
TVM-4U	0.068	0.065	0.012	11.8	Jul-17	720	0.012	0.014	0.000	0.026
TNX (5) Sep 2017							0.056	0.033	0.001	0.090

Table 7–5. Monthly SVE Well VOC Mass Removal (2017) (continued)

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.159	0.045	0.003	17.1	Oct-17	744	0.041	0.015	0.001	0.055
TVX-6L	0.081	0	0.003	1.3	Oct-17	744	0.002	0.000	0.000	0.002
TVM-1U	0.037	0	0.0274	6.2	Oct-17	744	0.003	0.000	0.000	0.003
TVM-4V	0.046	0.021	0.035	2.4	Oct-17	744	0.002	0.001	0.000	0.003
TVM-4U	0.057	0.092	0.01	12.3	Oct-17	744	0.010	0.021	0.000	0.032
TNX (5) Oct 2017							0.058	0.037	0.001	0.095

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.159	0.045	0.003	17.1	Oct-17	0	0.000	0.000	0.000	0.000
TVX-4U	0.056	0	0	7	Jan-18	696	0.005	0.000	0.000	0.005
TVX-6L	0.081	0	0.003	1.3	Oct-17	0	0.000	0.000	0.000	0.000
TVM-1U	0.037	0	0.0274	6.2	Oct-17	0	0.000	0.000	0.000	0.000
TVM-4V	0.046	0.021	0.035	2.4	Oct-17	720	0.002	0.001	0.000	0.003
TVM-4U	0.057	0.092	0.01	12.3	Oct-17	720	0.010	0.021	0.000	0.031
TVM-3V	0.055	0.002	0	18.3	Jan-18	720	0.015	0.001	0.000	0.015
TVM-1V	0.061	0.096	0.011	4.5	Jan-18	720	0.004	0.008	0.000	0.012
TNX (5) Nov 2017							0.036	0.030	0.000	0.066

Table 7–6. Monthly SVE Well VOC Mass Removal (2017) (continued)

Well	TCE (ppmv)	PCE (ppmv)	CCl4 (ppmv)	Flow Rate	Sample Date	Operating Hours	Lbs TCE	Lbs PCE	Lbs CCl4	Total Lbs
TVM-2U	0.159	0.045	0.003	17.1	Oct-17	0	0.000	0.000	0.000	0.000
TVX-4U	0.056	0	0	7	Jan-18	696	0.005	0.000	0.000	0.005
TVX-6L	0.081	0	0.003	1.3	Oct-17	0	0.000	0.000	0.000	0.000
TVM-1U	0.037	0	0.0274	6.2	Oct-17	0	0.000	0.000	0.000	0.000
TVX-7U	0.06	0.095	0.011	9.5	Jan-18	648	0.007	0.015	0.000	0.022
TVM-4V	0.046	0.021	0.035	2.4	Oct-17	0	0.000	0.000	0.000	0.000
TVM-4U	0.057	0.092	0.036	12.3	Oct-17	744	0.010	0.021	0.000	0.032
TVM-3V	0.055	0.002	0	18.3	Jan-18	744	0.015	0.001	0.000	0.016
TVM-1V	0.061	0.096	0.011	4.5	Jan-18	648	0.004	0.007	0.000	0.011
TNX (5) Dec 2017							0.042	0.044	0.001	0.086

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Table 7–7. VOC Mass Removed by SVE (2017)

Month	TCE (lbs)	PCE (lbs)	CC14 (lbs)
January	0.060	0.044	0.002
February	0.054	0.040	0.002
March	0.060	0.044	0.002
April	0.065	0.038	0.002
May	0.067	0.040	0.002
June	0.065	0.038	0.002
July	0.058	0.034	0.001
August	0.058	0.034	0.001
September	0.056	0.033	0.001
October	0.058	0.037	0.001
November	0.036	0.030	0.000
December	0.042	0.044	0.001
Average Monthly Removed in 2017	**0.057**	**0.038**	**0.001**
Totals	**0.680**	**0.457**	**0.017**

Table 7–8. Estimated TCE Plume Mass

Year	Plume Area (ft^2)*	Aquifer thickness (ft)	Plume Volume (ft^3)	Average concentration of >5ppb TCE Plume (ug/L)*	Number of wells used in the average	Porosity	TCE Mass (kg)**
2007	441,695	20	8,833,899	71.15	13	0.3	5.34
2008	326,697	20	6,533,949	37.20	9	0.3	2.06
2009	318,857	20	6,377,134	46.75	11	0.3	2.53
2010	292,721	20	5,854,418	14.08	9	0.3	0.70
2011	277,039	20	5,540,789	27.78	8	0.3	1.31
2012	301,433	20	6,028,657	22.15	11	0.3	1.13
2013	226,946	20	4,538,917	34.08	7	0.3	1.31
2014	309,274	20	6,185,472	12.92	9	0.3	0.68
2015	155,508	20	3,110,160	13.20	4	0.3	0.35
2016	141,569	20	2,831,378	12.07	2	0.3	0.29
2017	192,098	20	3,841,962	13.8	3	0.3	0.45

***Fourth quarter data was utilized when determining the plume area and average TCE concentrations.**
****Unit conversions used in the TCE mass calculation: 28.32 L/ft^3; 1x10^9 µg/kg**

8.0 SUMMARY/RECOMMENDATIONS

8.1 Summary

The TNX Area OU monitoring well network is sampled semi-annually and consists of 42 monitoring wells. Constituents exceeding MCLs during 2017 include combined radium, gross alpha, TCE, and uranium.

Monitoring data indicate that EO injection fluids were placed into the aquifer successfully, trichloroethylene concentrations are less than the MCL at all wells in the treatment area, and reductive conditions are present in the EO treatment area. Reduced TCE concentrations were already established at injection wells used during the 2008 and 2010 injections (TBG 4, TBG 5, TNX 3D, and TRW 4R) and continued after the 2015 injections. TCE concentrations were less than the MCL at all the 2015 injection wells (i.e., TBG 3, TRW 3, and TVM 1M). Evidence of reductive conditions is present at all the wells in the EO treatment area. TCE concentrations exceeding the MCL are located downgradient of the EO treatment area. SRS estimates that TCE concentrations will be less than the MCL in four years. The remedial actions (i.e., EO and SVE) continue to provide effective treatment of the groundwater at TNX Area OU.

There does not appear to a discernible and consistent groundwater plume with respect to radionuclides at TNX. The detection of combined radium appears to be localized to monitoring wells under the capped area (near the TBG and associated with nitric acid releases). Gross alpha and uranium detections exceeding the MCL are associated with some monitoring wells near the TBG and in the wetland.

There does not appear to a discernible and consistent groundwater plume with respect to 1,4-dioxane at TNX. The detections of 1,4-dioxane appear to be localized to TBG 5 with only sporadic detections at the other monitoring wells.

8.2 Recommendations

SRS recommends continued monitoring of the existing well network with the current sampling and analysis schedule (Table 4-2).

It has been recommended by the USEPA and SCDHEC to install one additional monitoring well near the OTSB. The additional well will replace a series of monitoring wells located adjacent to the OTSB that were abandoned prior to the completion of the TAOU cap. On April 29, 2017 representatives from the USDOE, USEPA, and SCDHEC, and the SRS project team conducted a field reconnaissance of the proposed location for the new well. Agreement was reached to locate the new well (i.e., XSB 6R) east of the OD (Figure A-42). XSB 6R will be installed during fiscal year 2019 and will target the Gordon Aquifer with an approximate depth of 20 to 30 ft and a ten-foot screen interval.

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APPENDIX A

FIGURES

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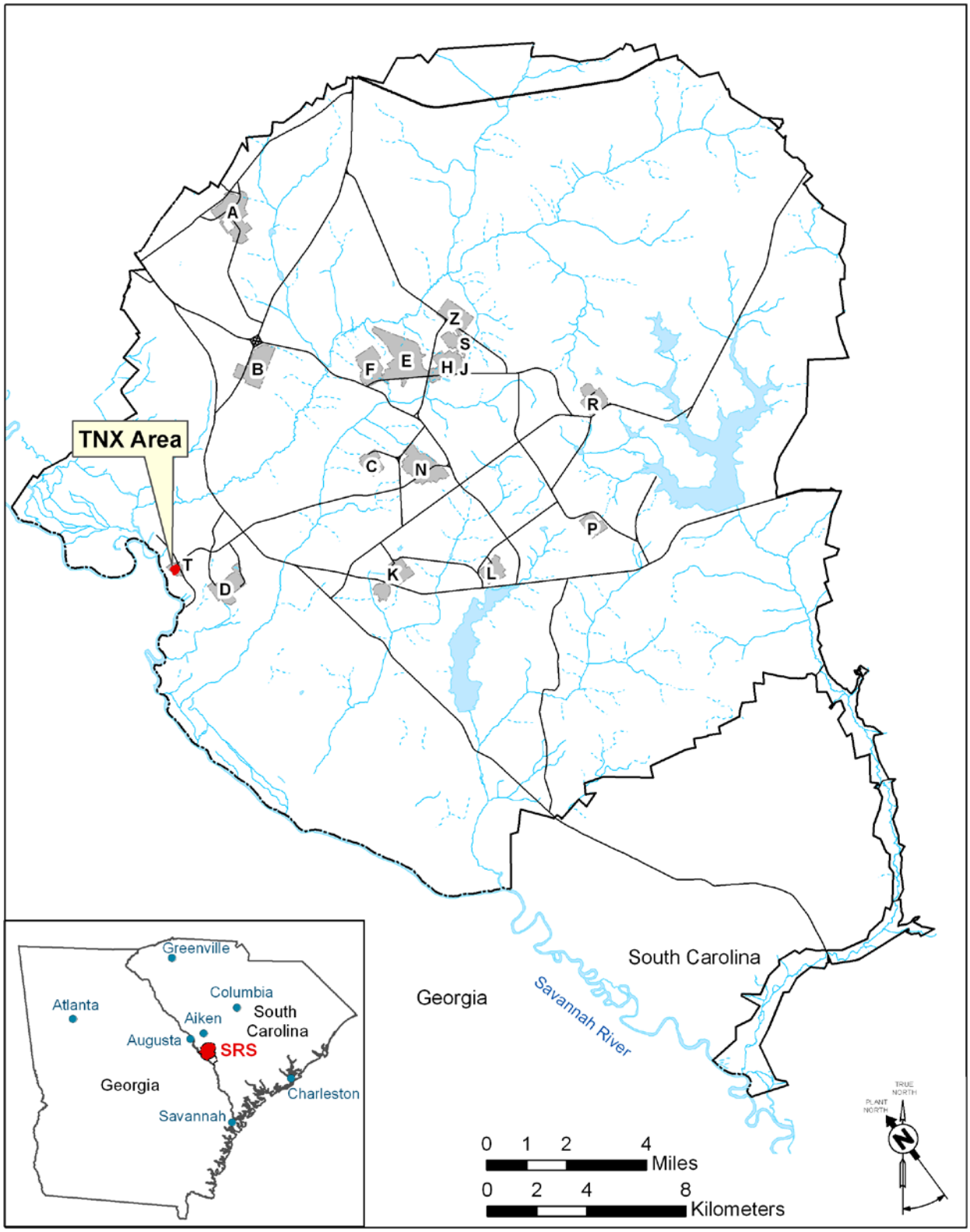

Figure A-1. Location of the TNX Area at the Savannah River

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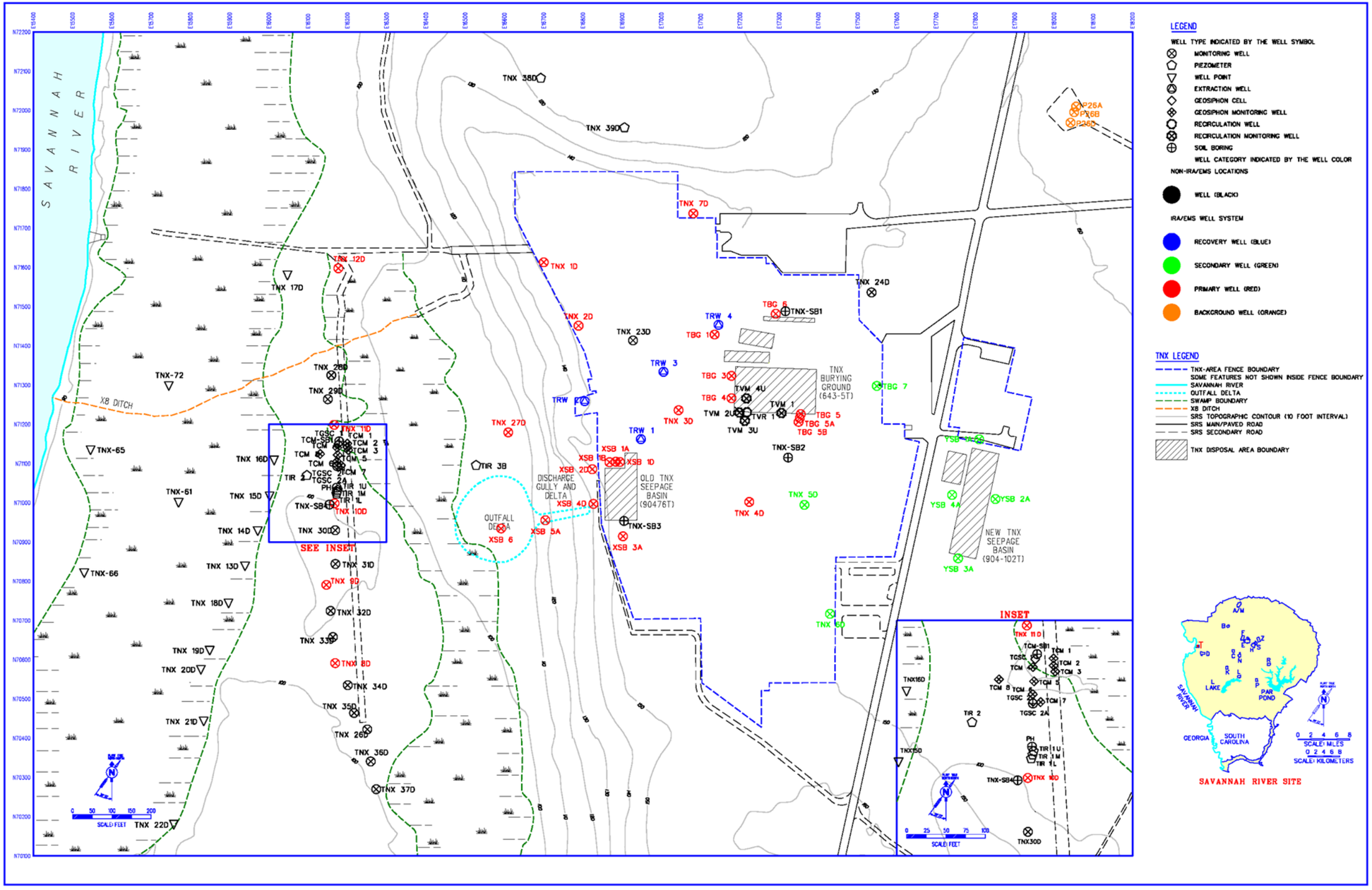

Figure A-2. Location of TNX Area Interim Remedial Action / Effectiveness Monitoring Strategy Well System during Startup and Initial Operations

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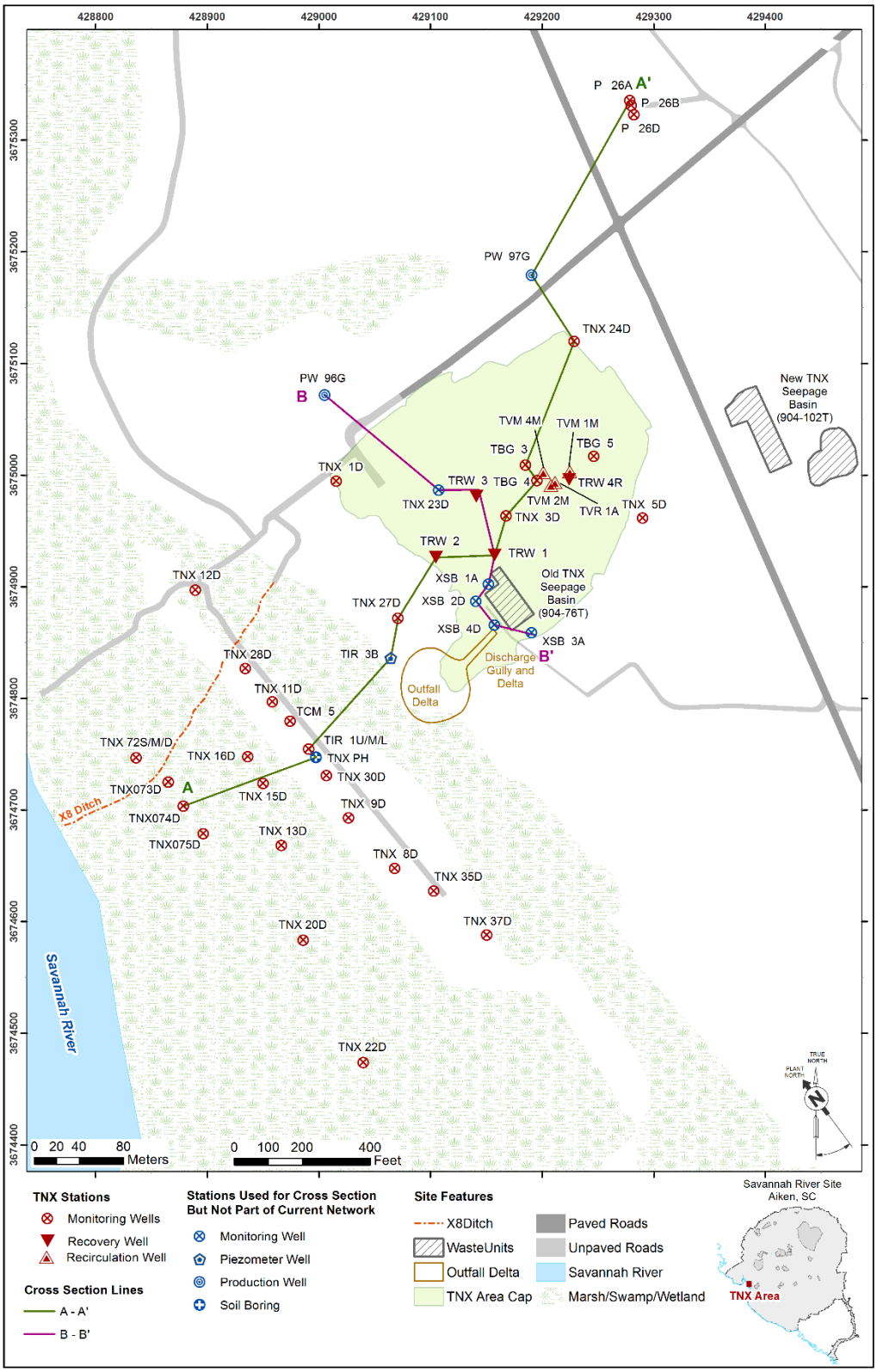

Figure A-3. TNX Area Cross Section Location Plan

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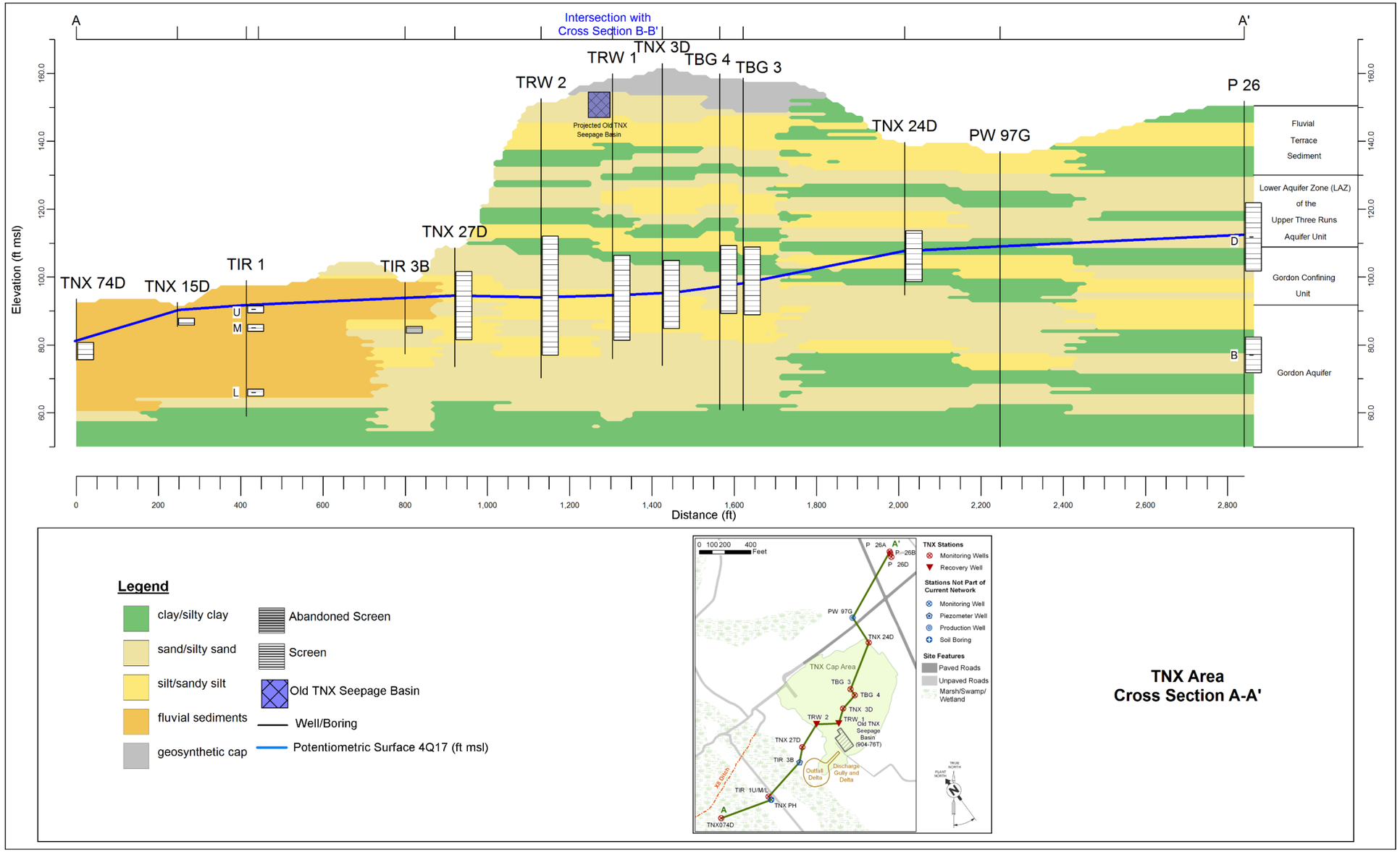

Figure A-4. TNX Area Cross Section A-A'

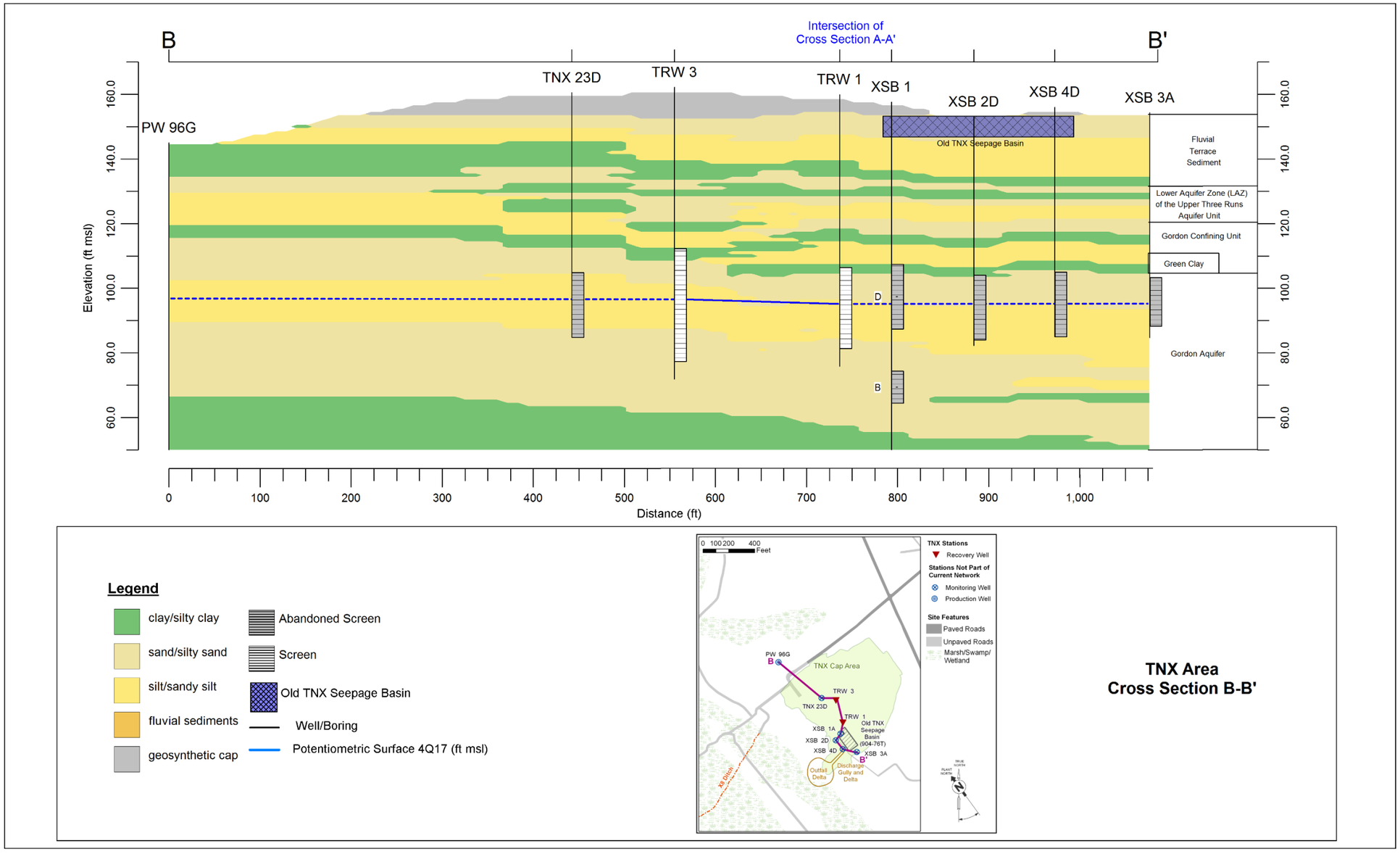

Figure A-5. TNX Area Cross Section B-B'

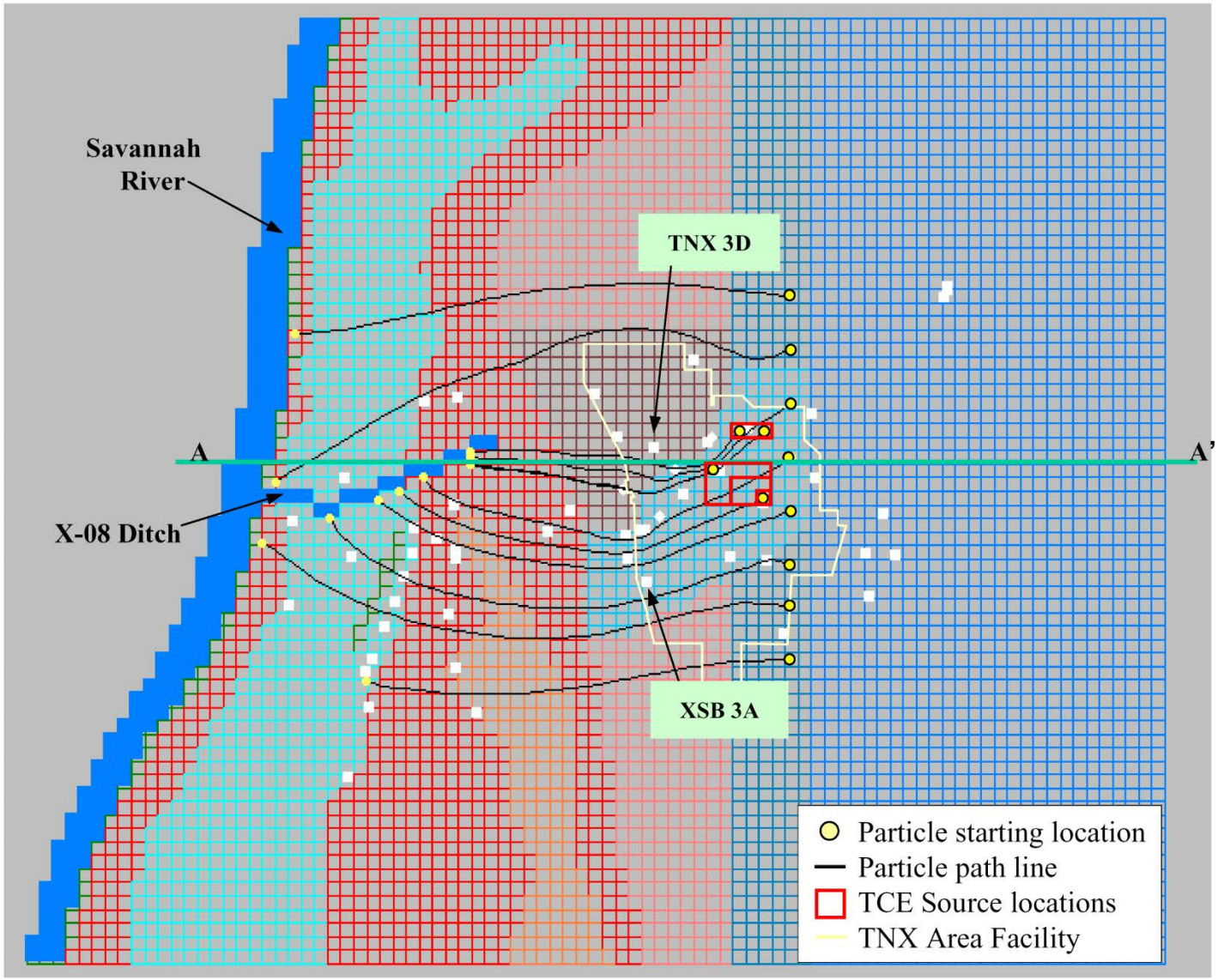

Figure A-6. Plan View of the TNX Area OU Showing Particle Starting Locations and Path Lines Towards the X-008 Ditch and the Savannah River

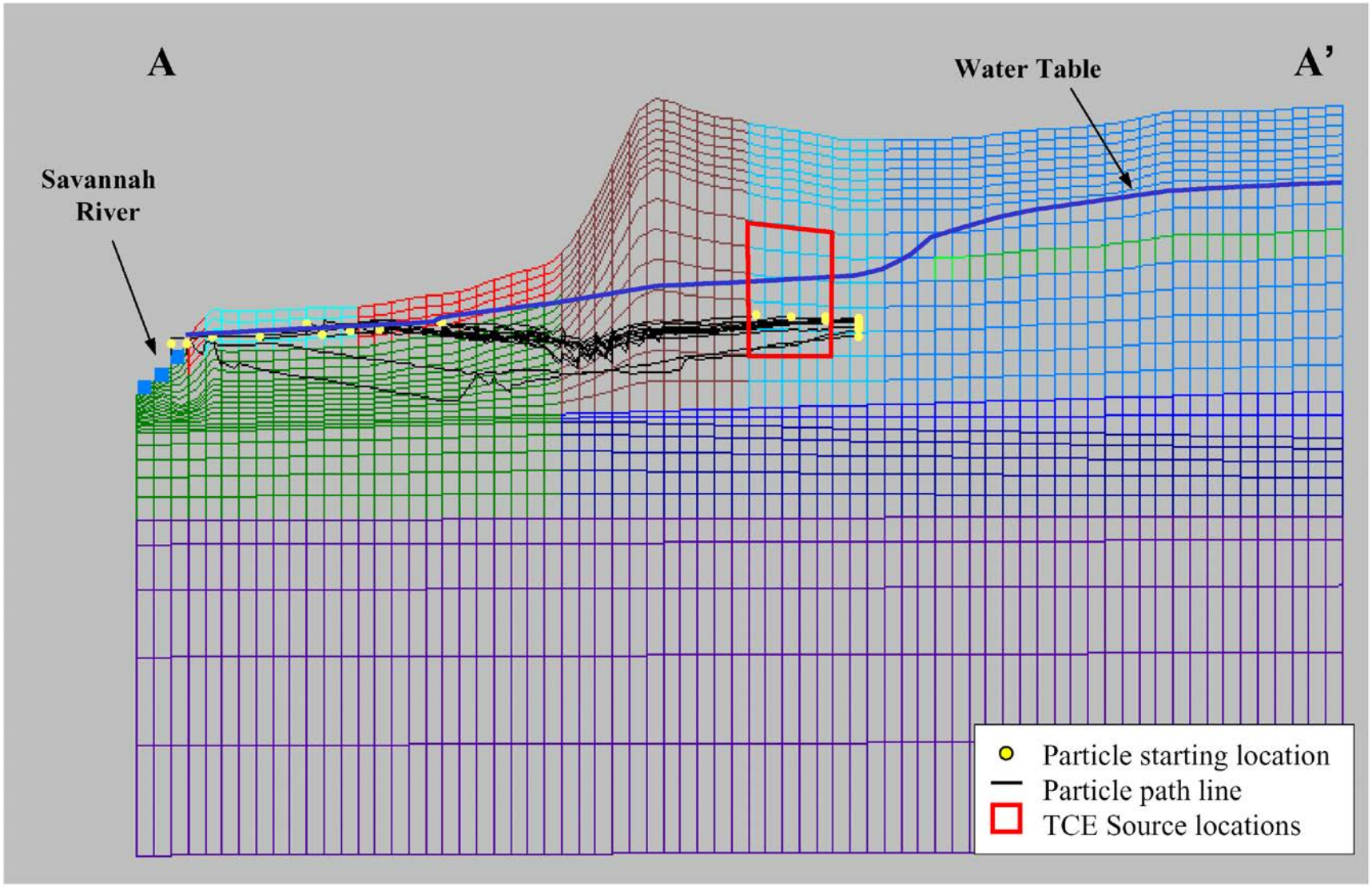

Figure A-7. Cross-sectional View along Section A-A' Showing the Vertical Locations and Particle Path Lines

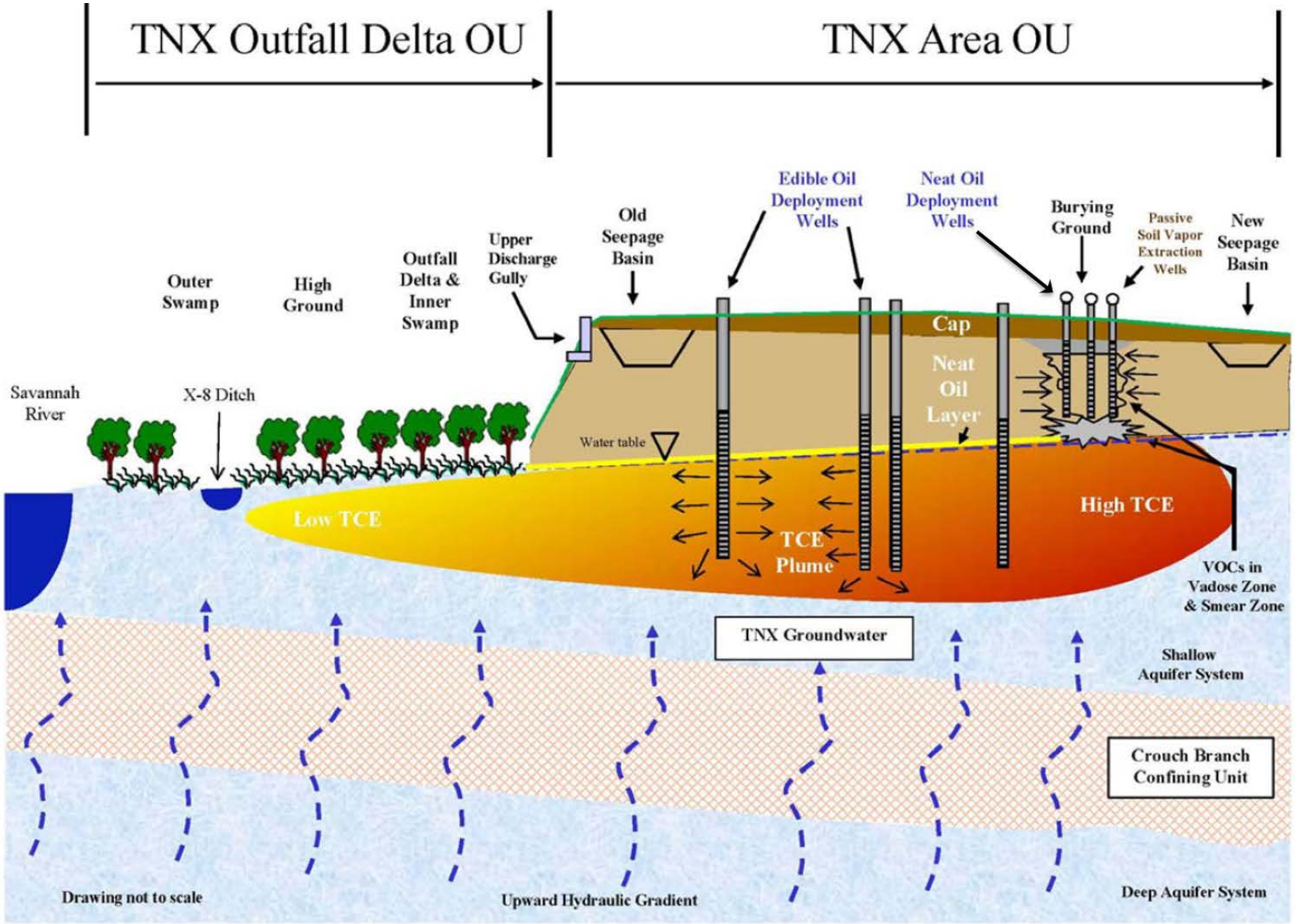

Figure A-8. Schematic Cross Section of TNX Operable Units and Remedial Action

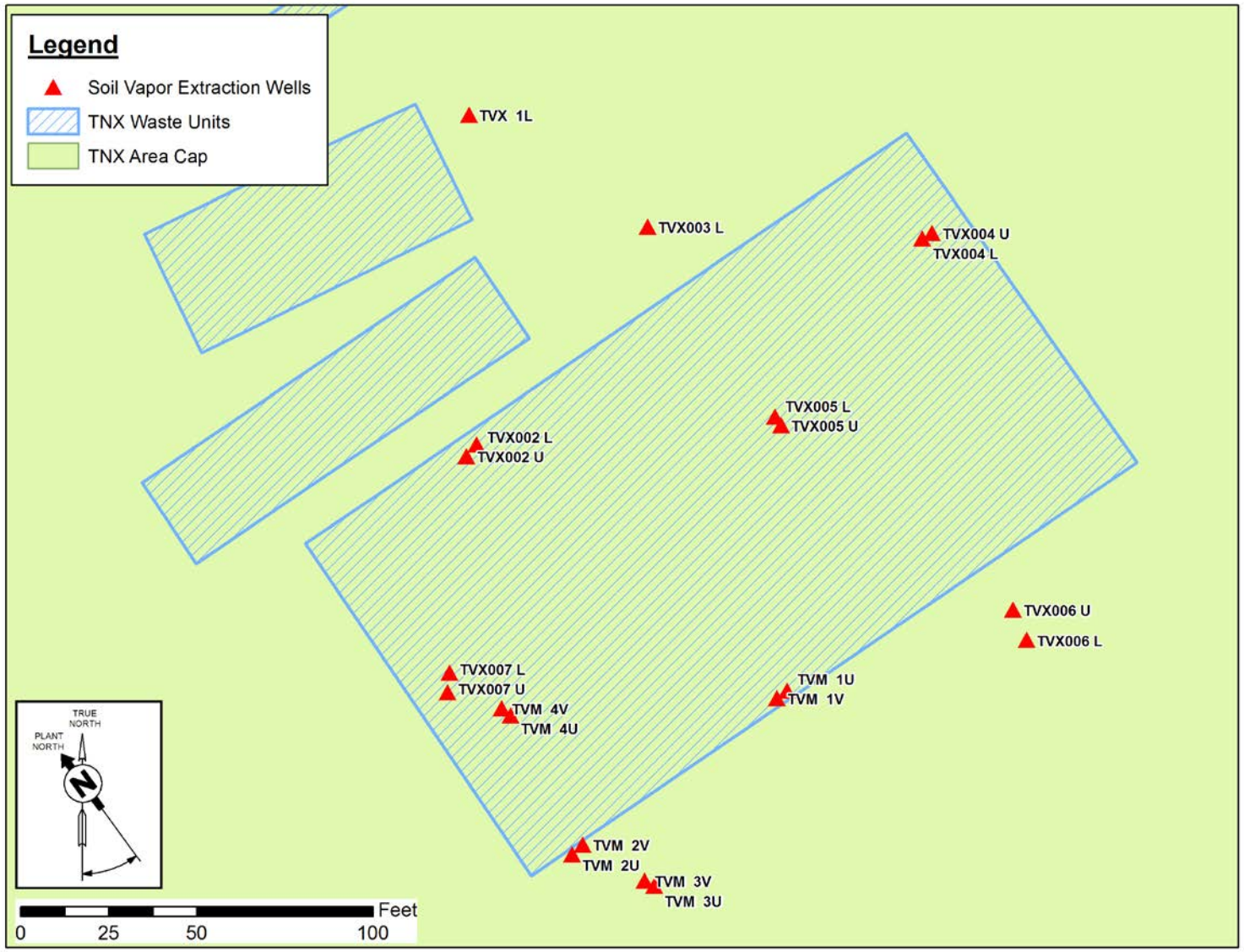

Figure A-9. Location of TNX Area SVE Monitoring Well System

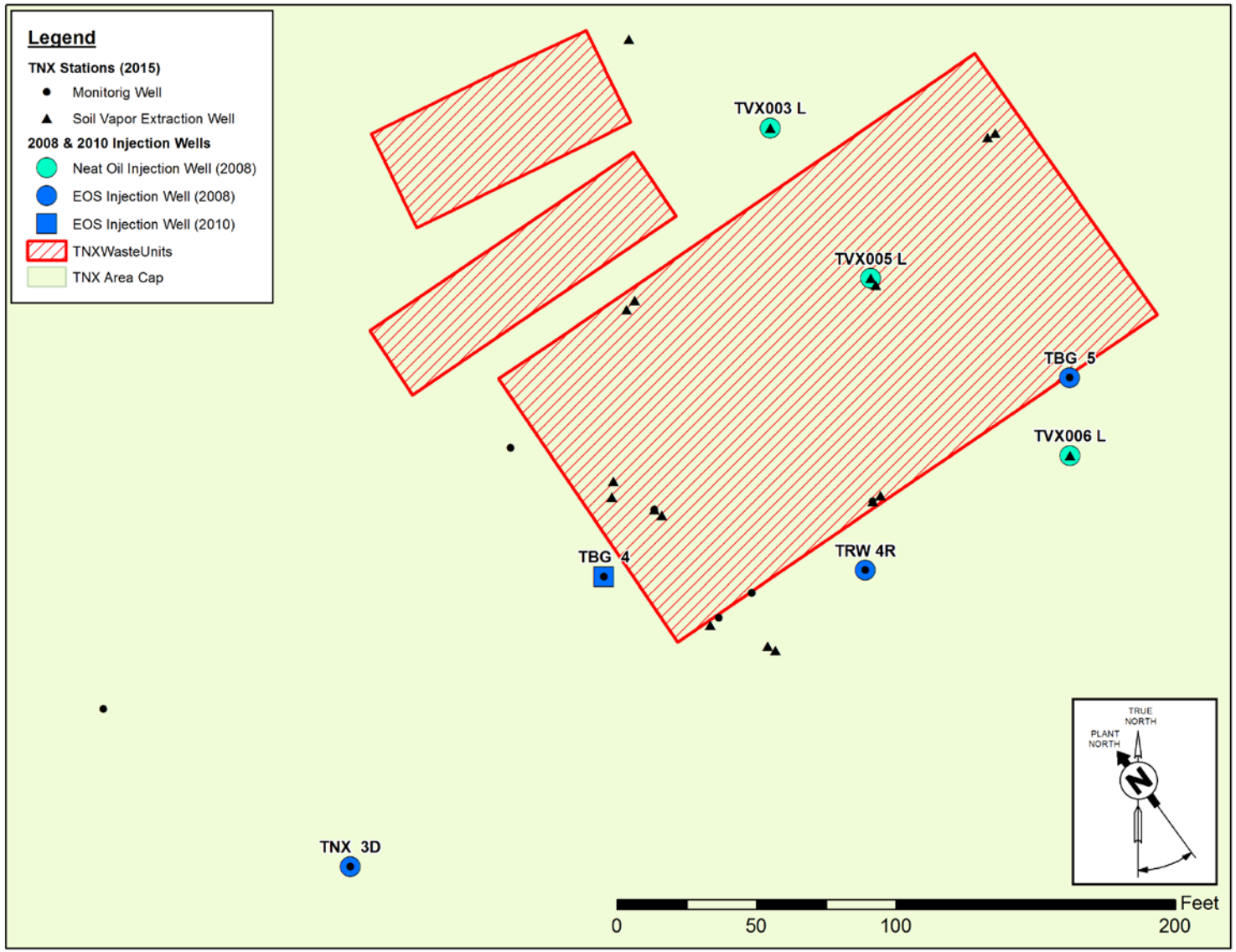

Figure A-10. Location of Edible Oil Injection Wells (2008 and 2010 Injections)

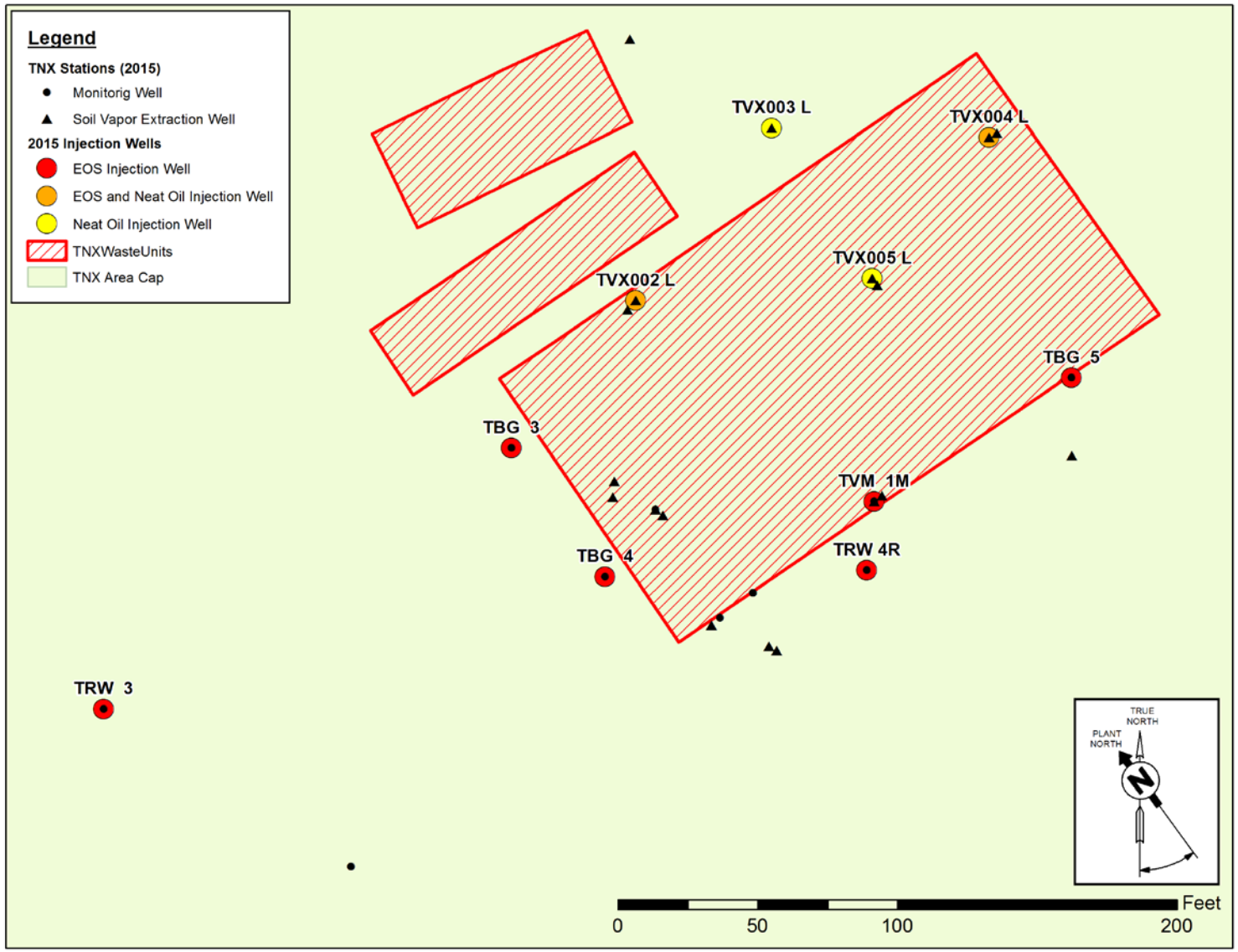

Figure A-11. Location of Edible Oil Injection Wells (2015 Injection)

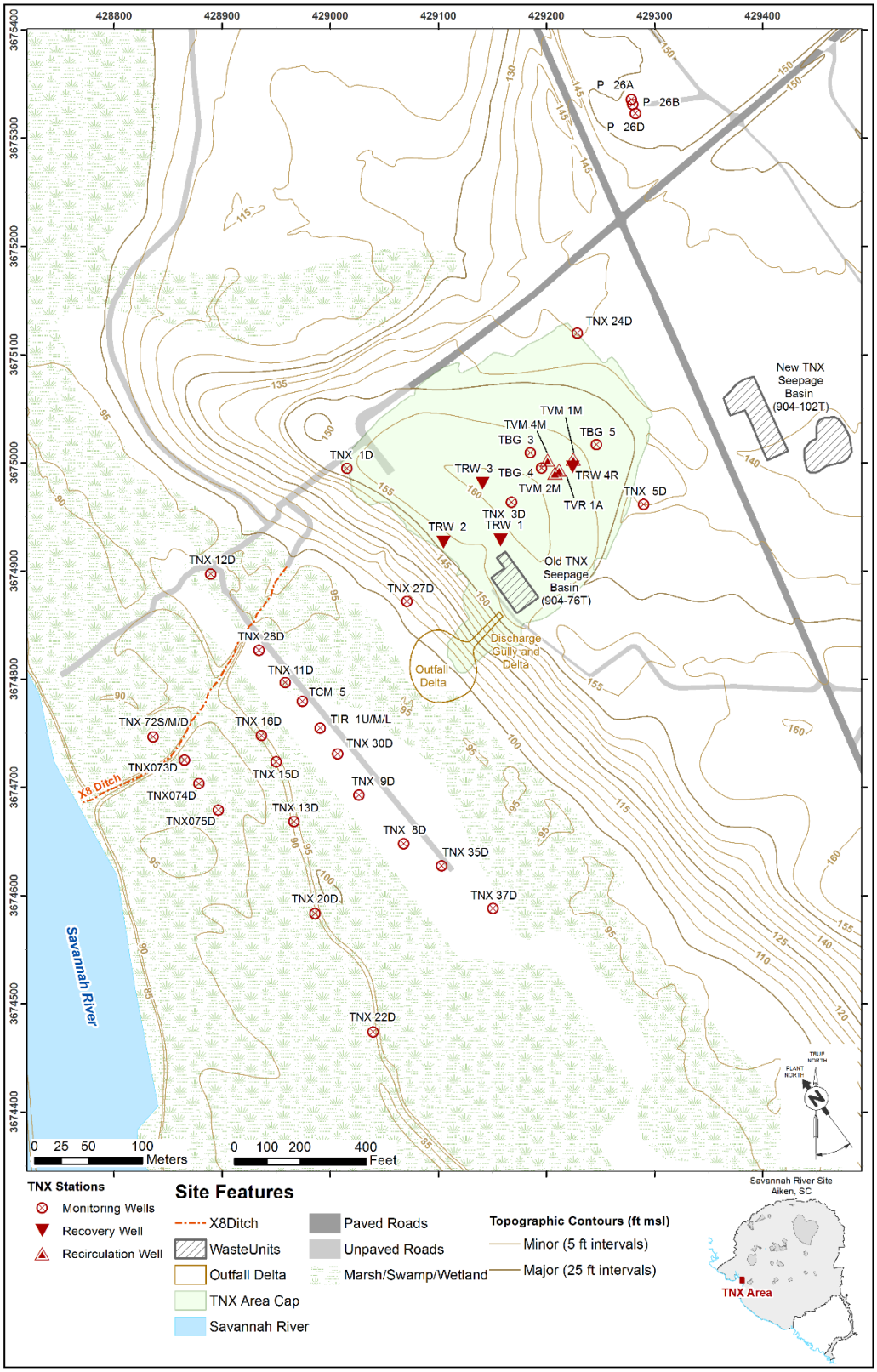

Figure A-12. TNX Area Well Locations

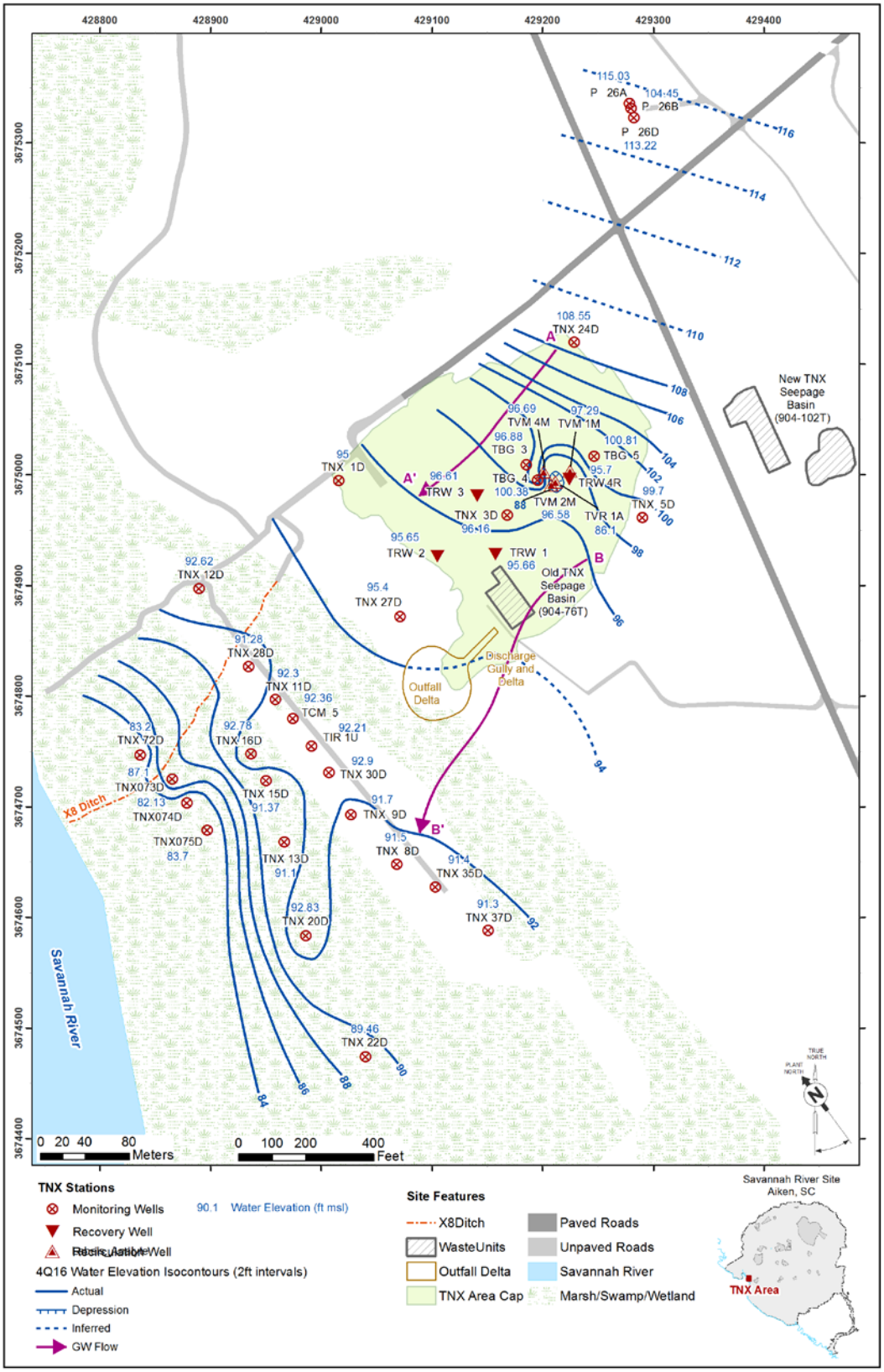

Figure A-13. TNX Area Water Table Elevation Fourth Quarter 2017

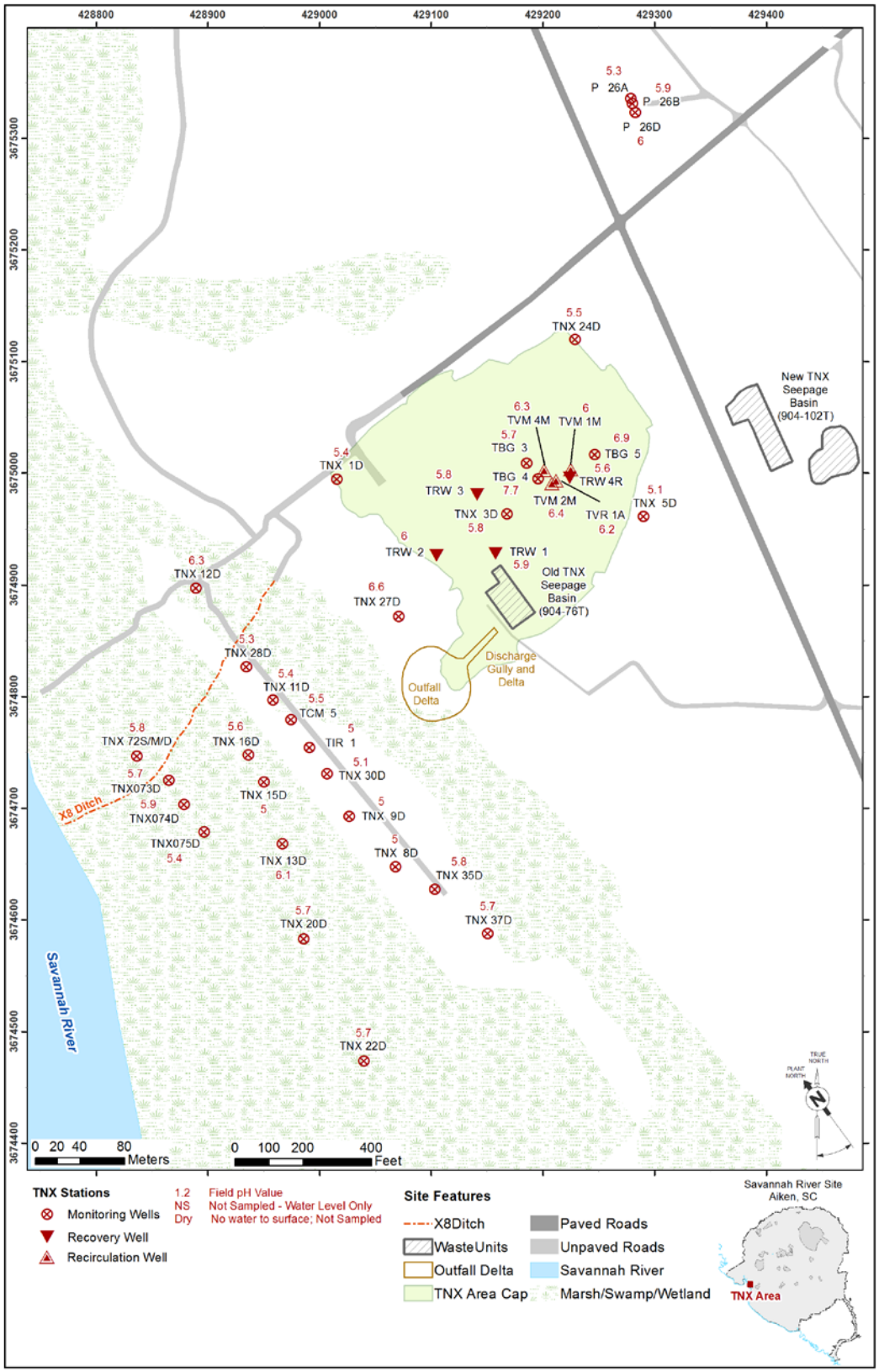

Figure A-14. TNX Area Field pH of Groundwater, Fourth Quarter 2017

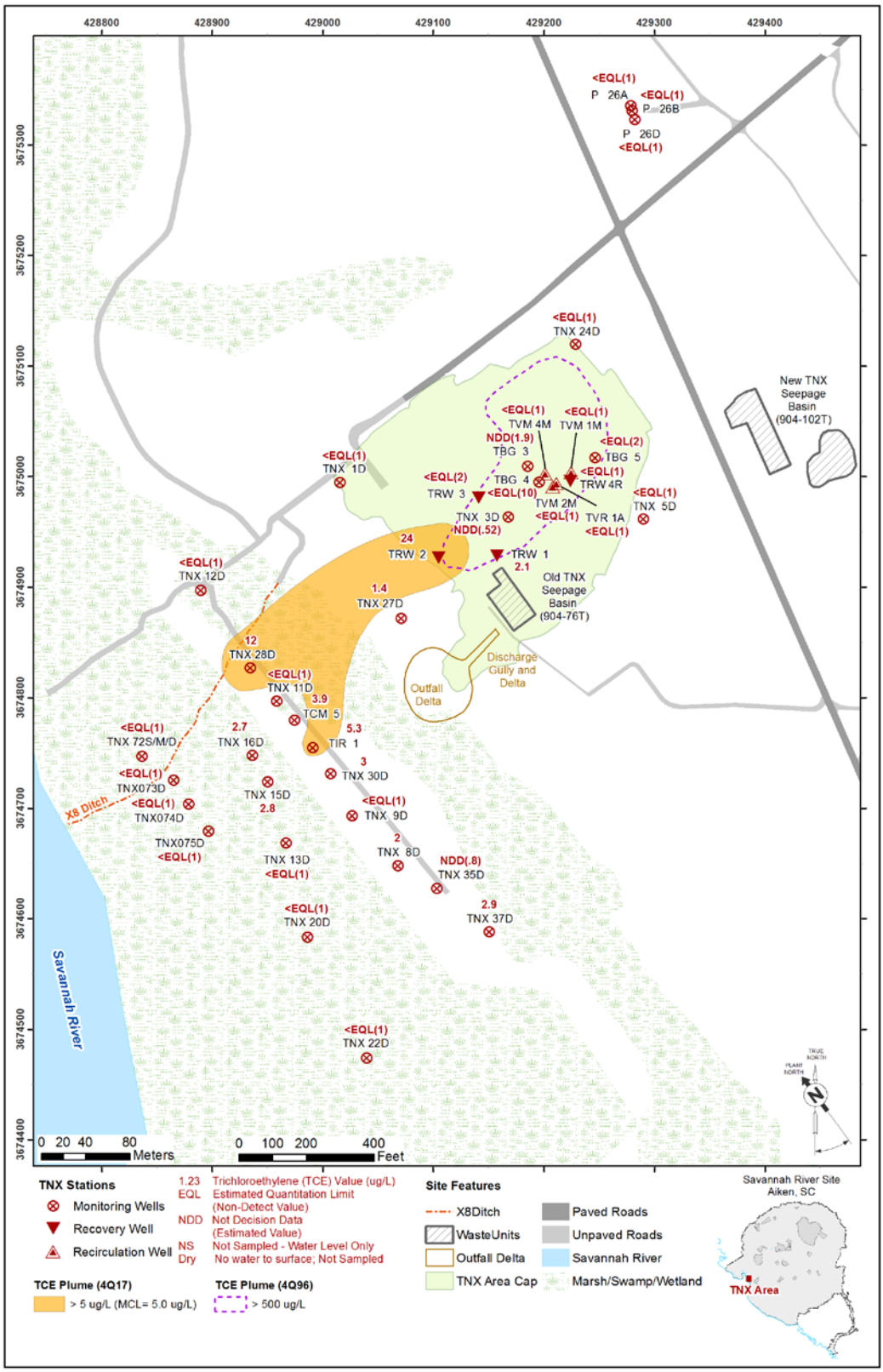

Figure A-15. TNX Area Trichloroethylene (TCE) Concentration in Groundwater, Fourth Quarter 2017 with >500 µg/L TCE Plume from 4Q1996 Superimposed

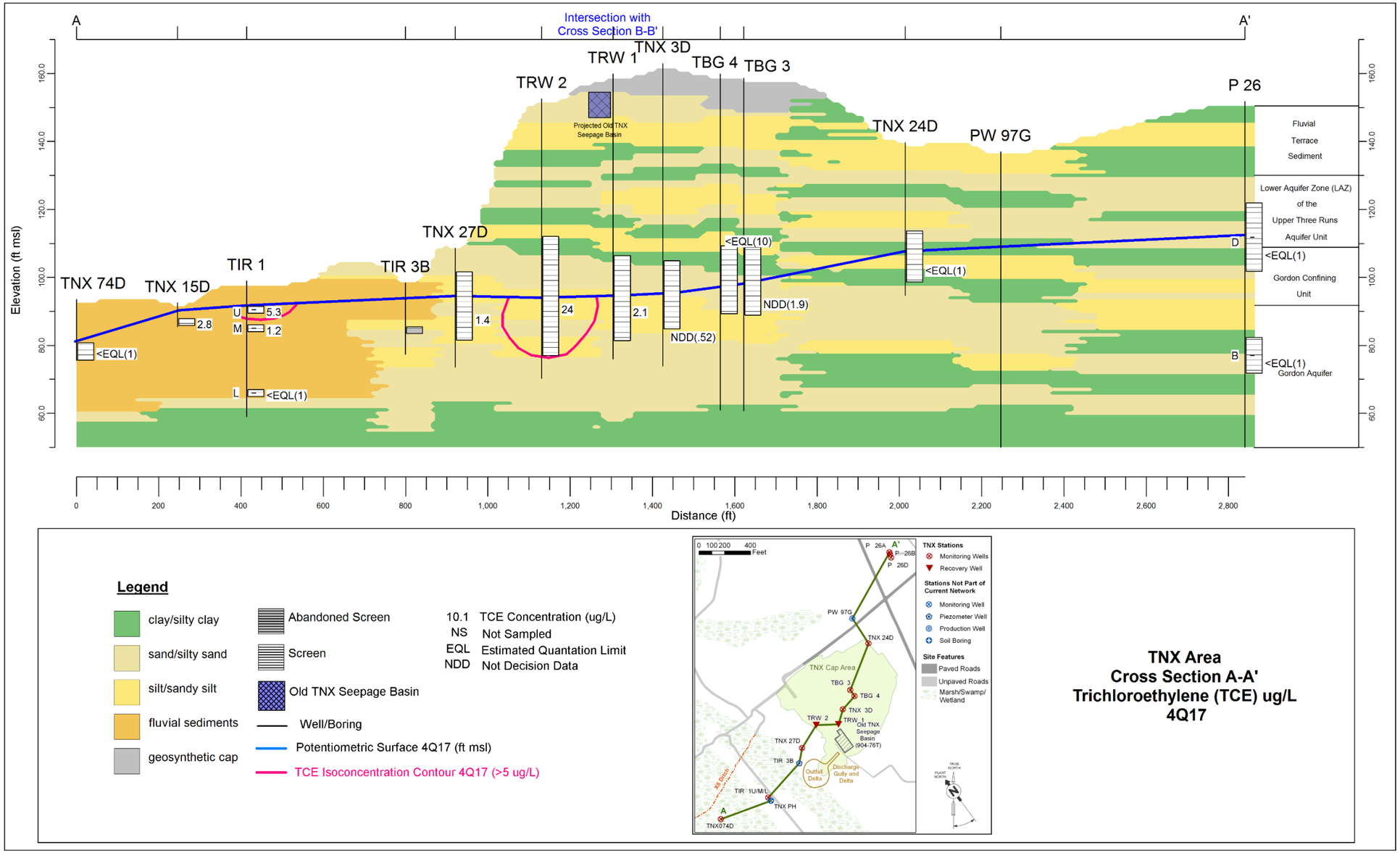

Figure A-16. TNX Area Cross Section A-A' Trichloroethylene (TCE) Concentration in Groundwater, Fourth Quarter 2017

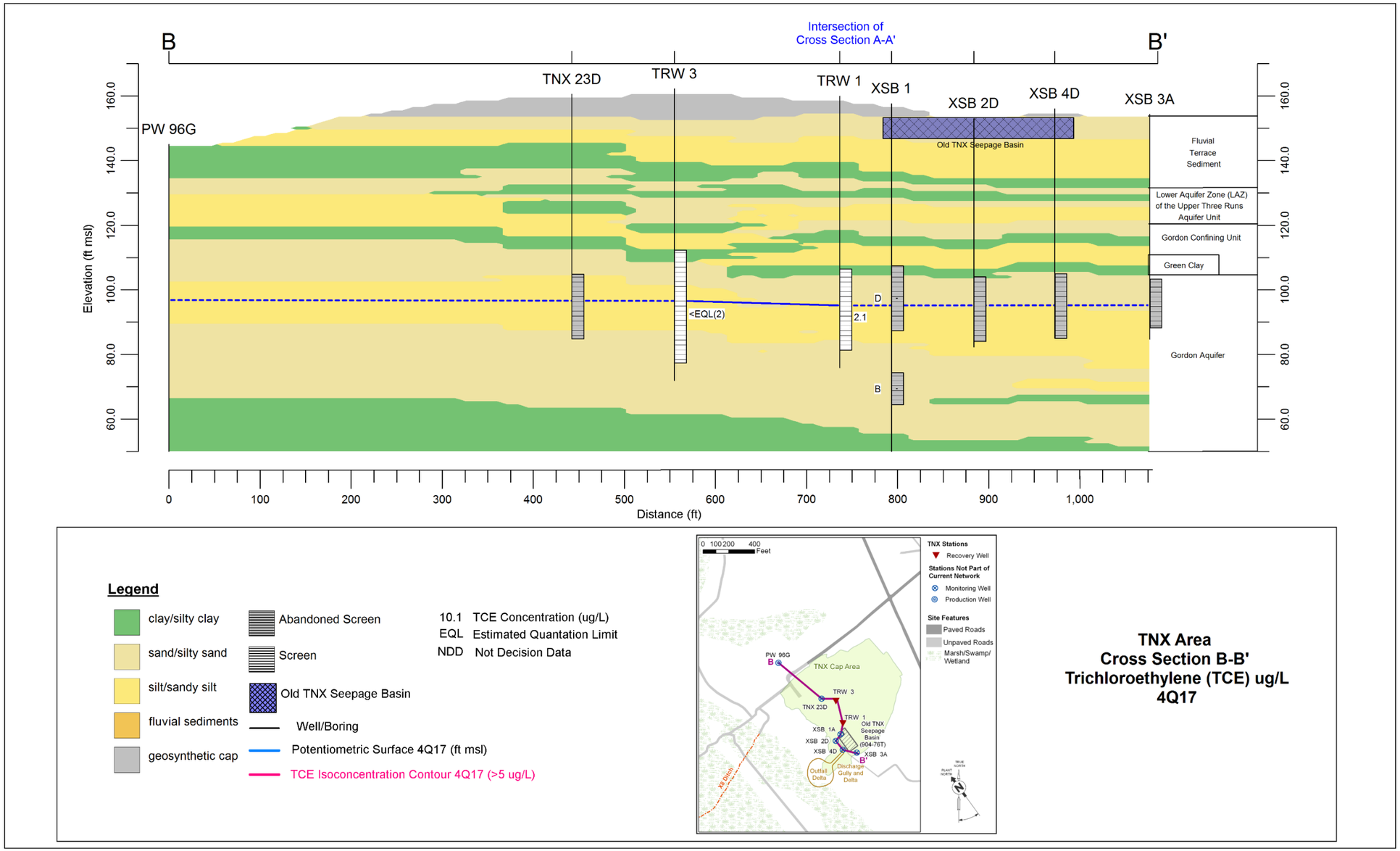

Figure A-17. TNX Area Cross Section B-B' Trichloroethylene (TCE) Concentration in Groundwater, Fourth Quarter 2017

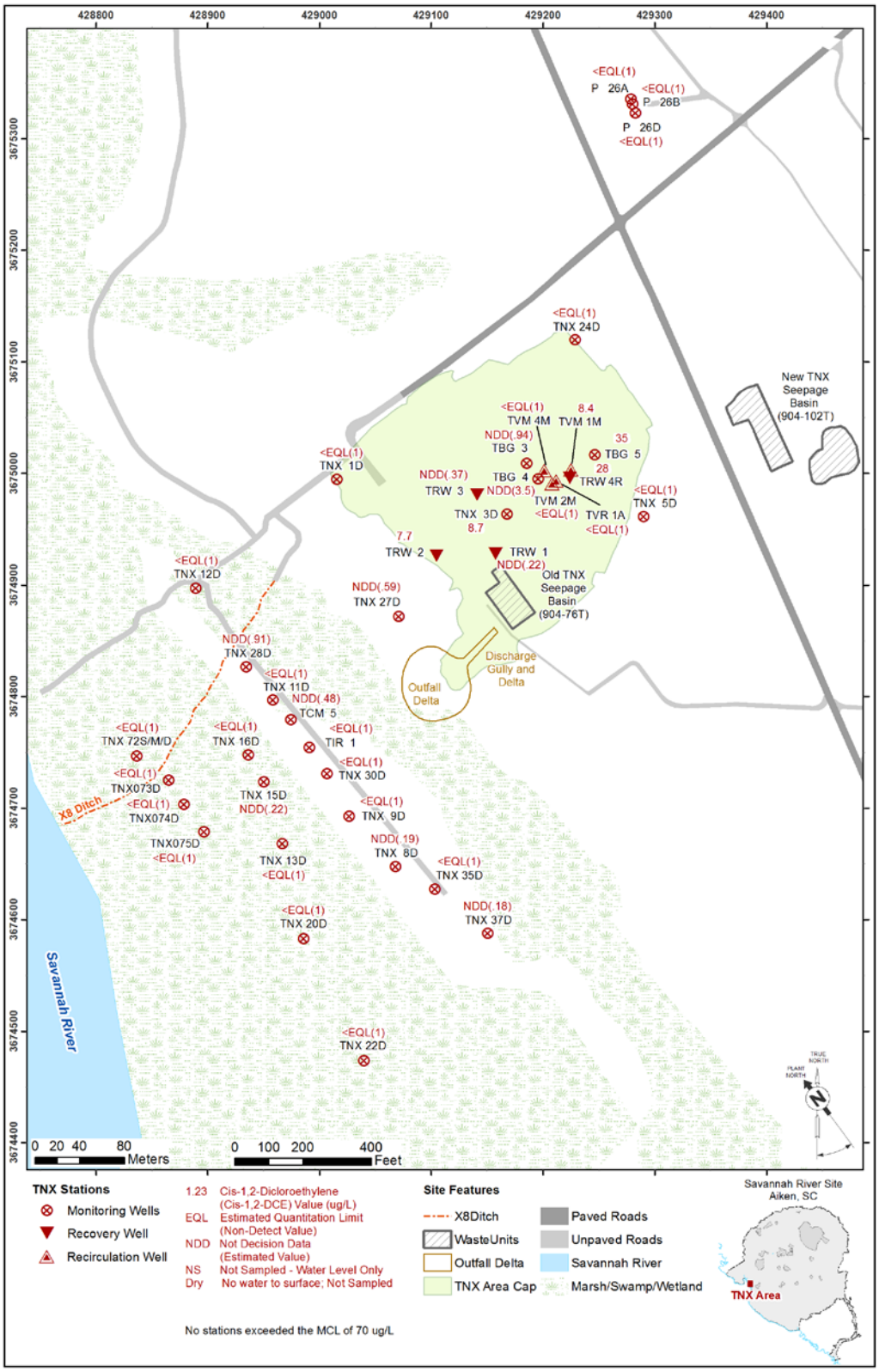

Figure A-18. TNX Area Cis-1,2-Dichloroethylene Concentration in Groundwater, Fourth Quarter 2017

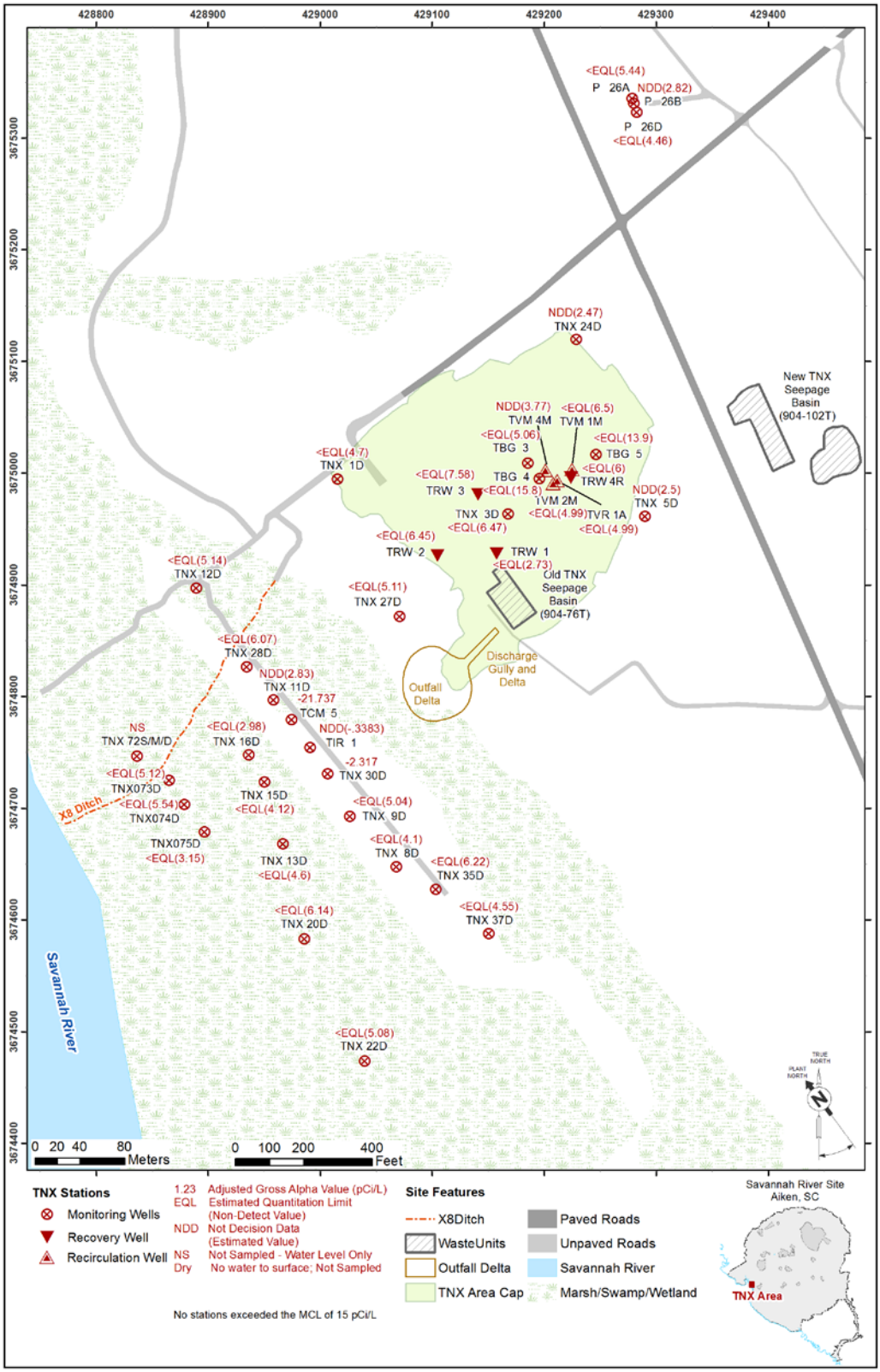

Figure A-19. TNX Area Adjusted Gross Alpha Activity in Groundwater, Fourth Quarter 2017

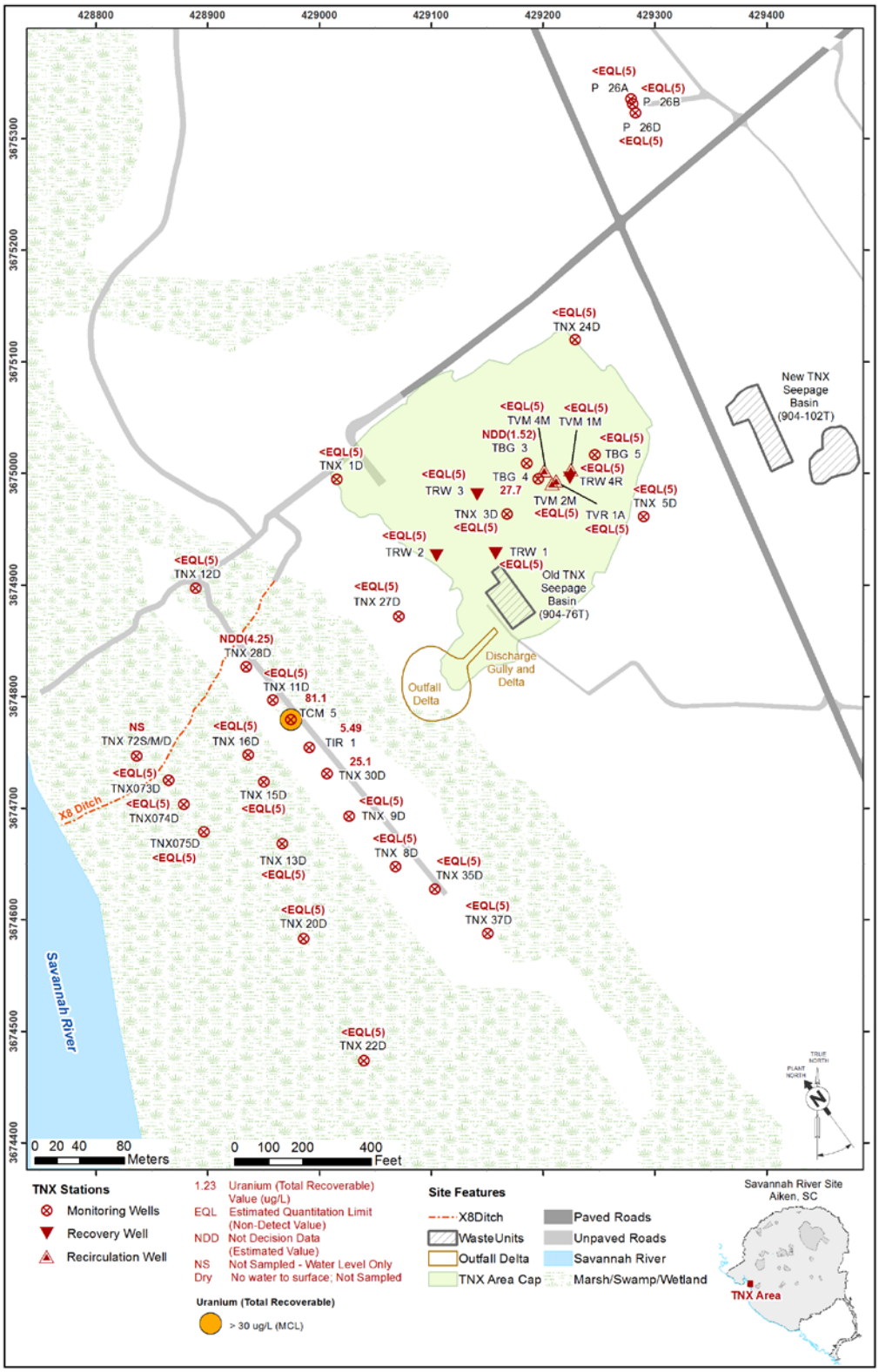

Figure A-20. TNX Area Uranium, Total Recoverable Concentration in Groundwater, Fourth Quarter 2017

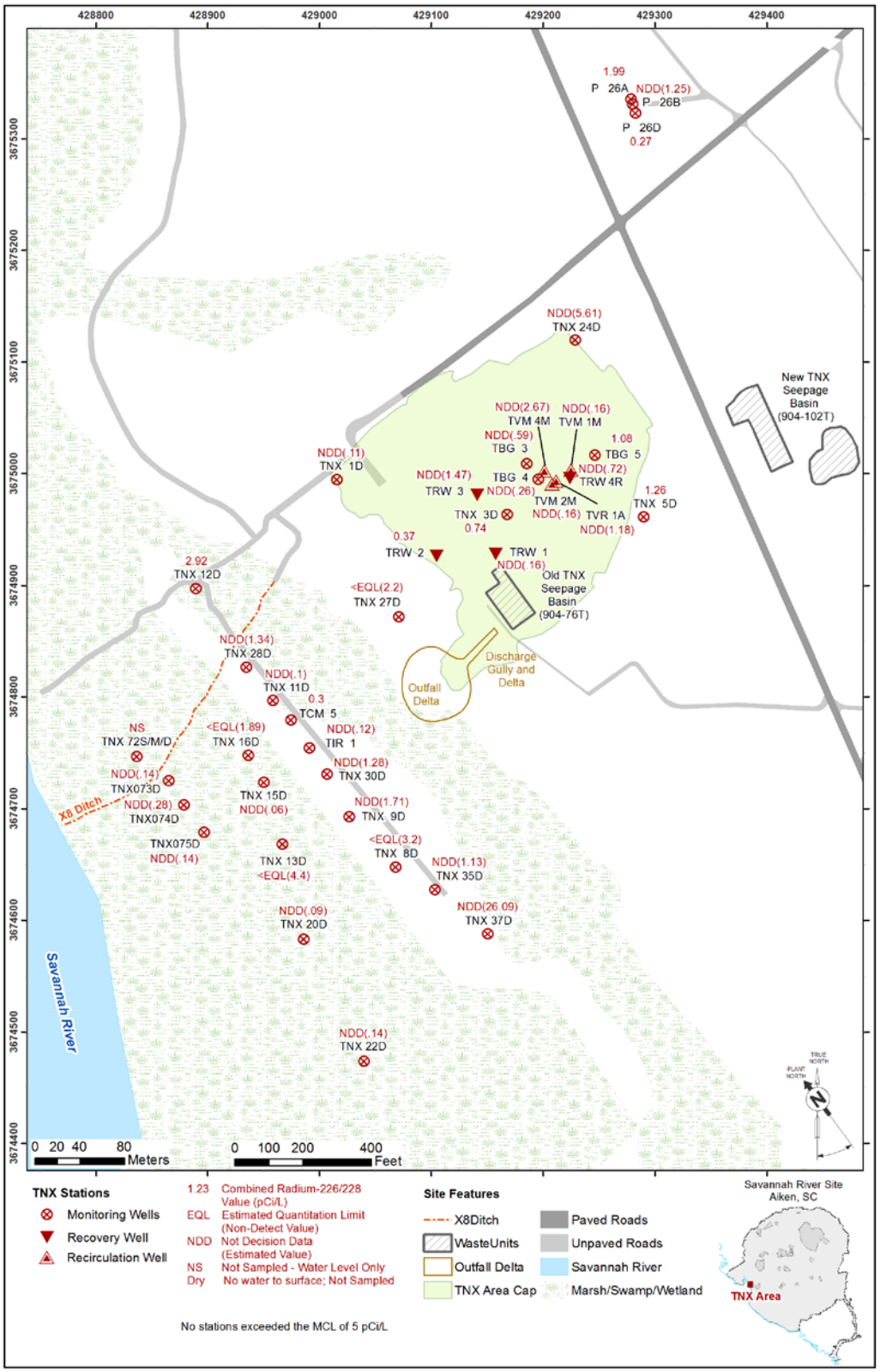

Figure A-21. TNX Area Combined Ra-226/228 Activity in Groundwater, Fourth Quarter 2017

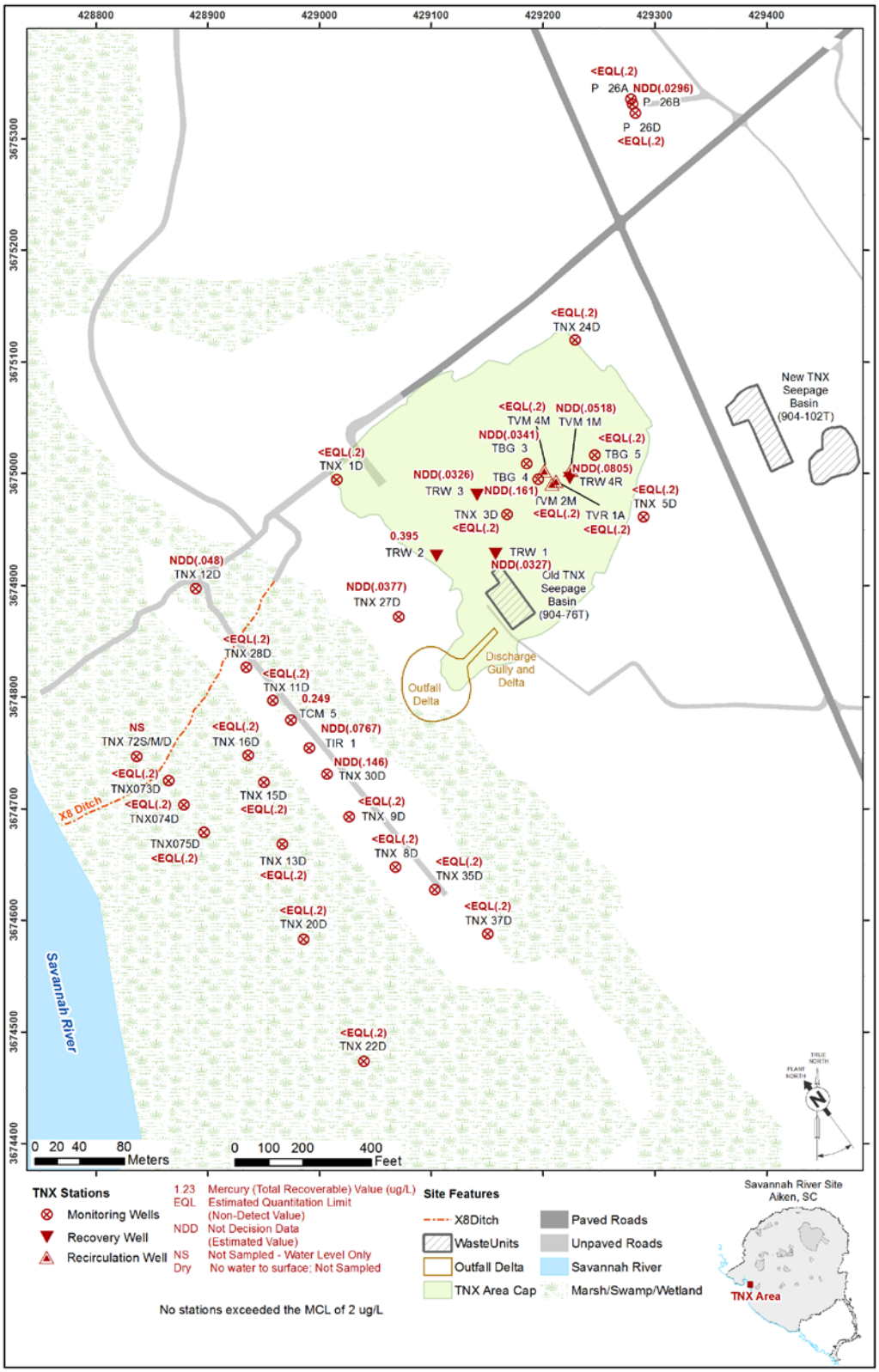

Figure A-22. TNX Area Mercury, Total Recoverable Concentration in Groundwater, Fourth Quarter 2017

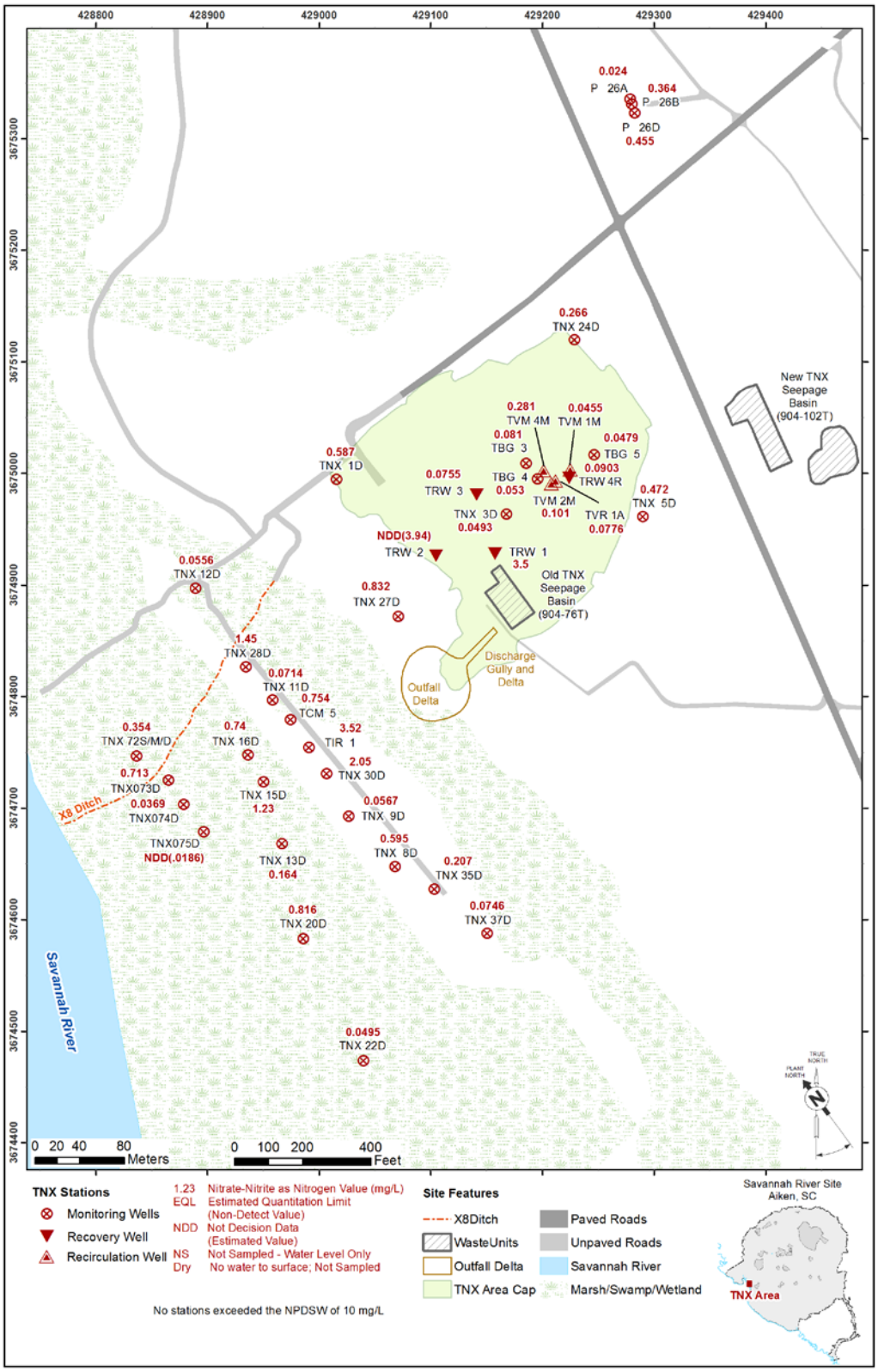

Figure A-23. TNX Area Nitrate-Nitrite as Nitrogen Concentration in Groundwater Fourth Quarter 2017

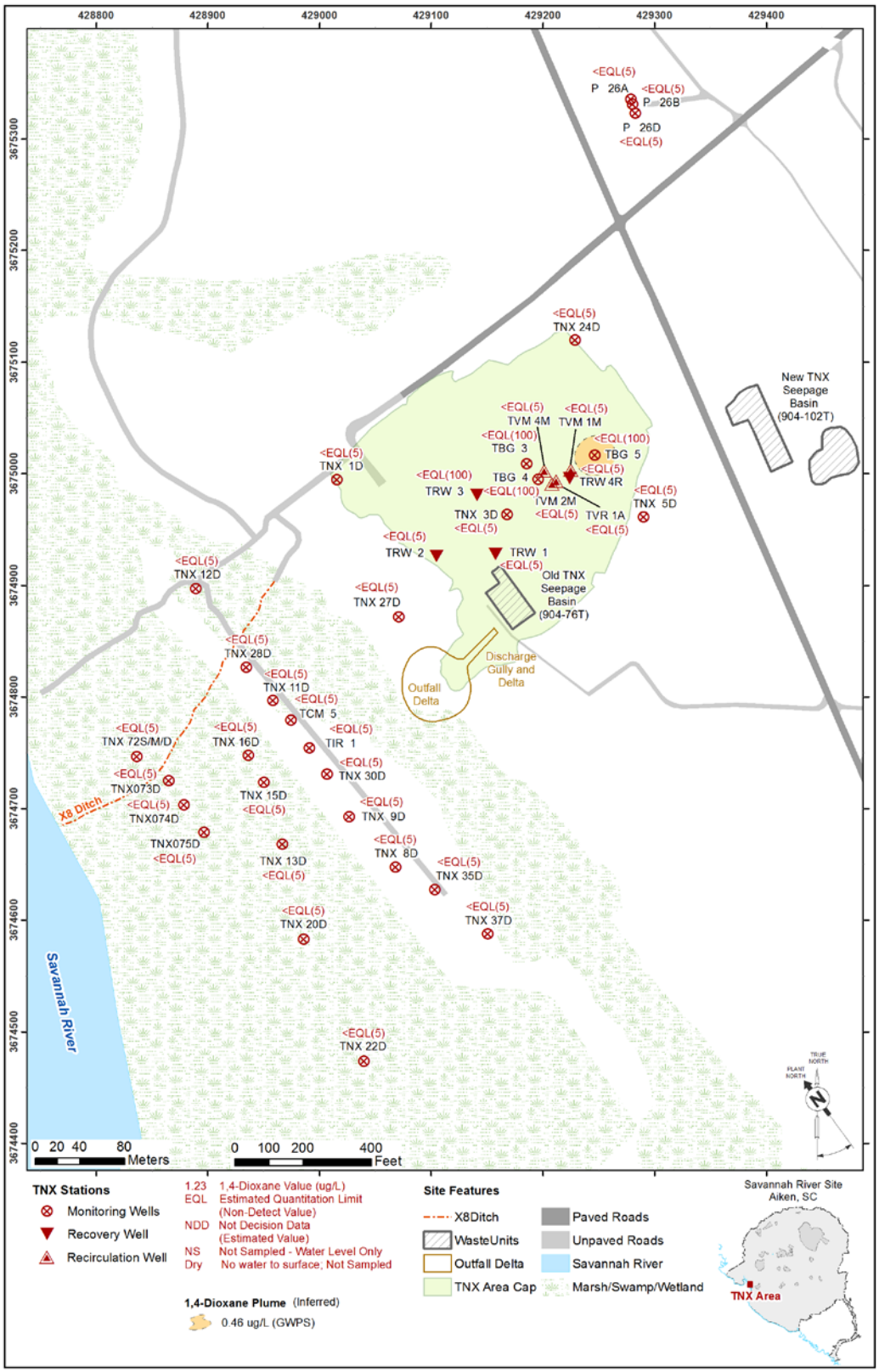

Figure A-24. TNX Area 1,4-Dioxane Concentration in Groundwater, Fourth Quarter 2017

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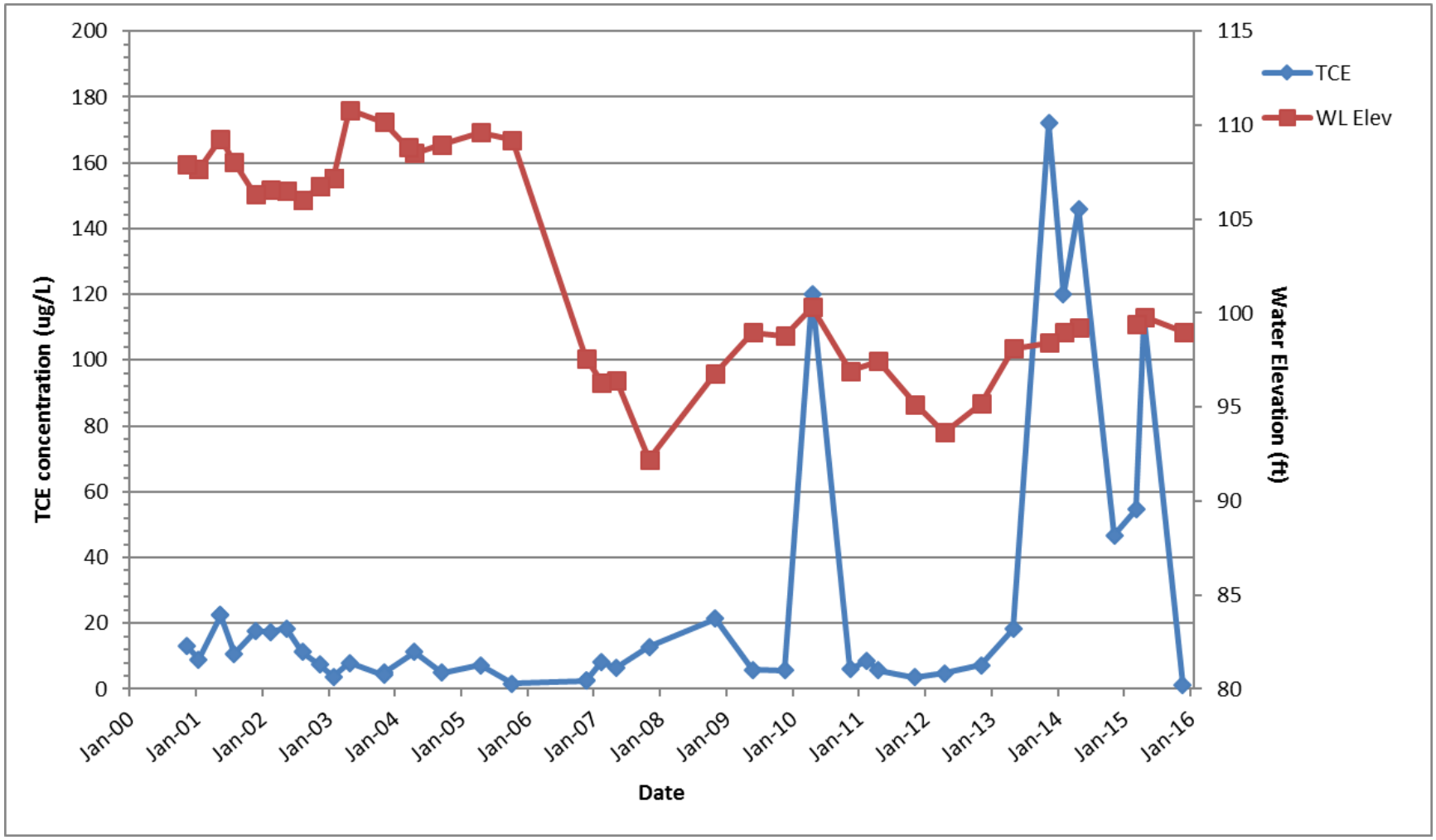

Figure A-25. Comparison of TCE Concentration and Water Elevation at TBG 3

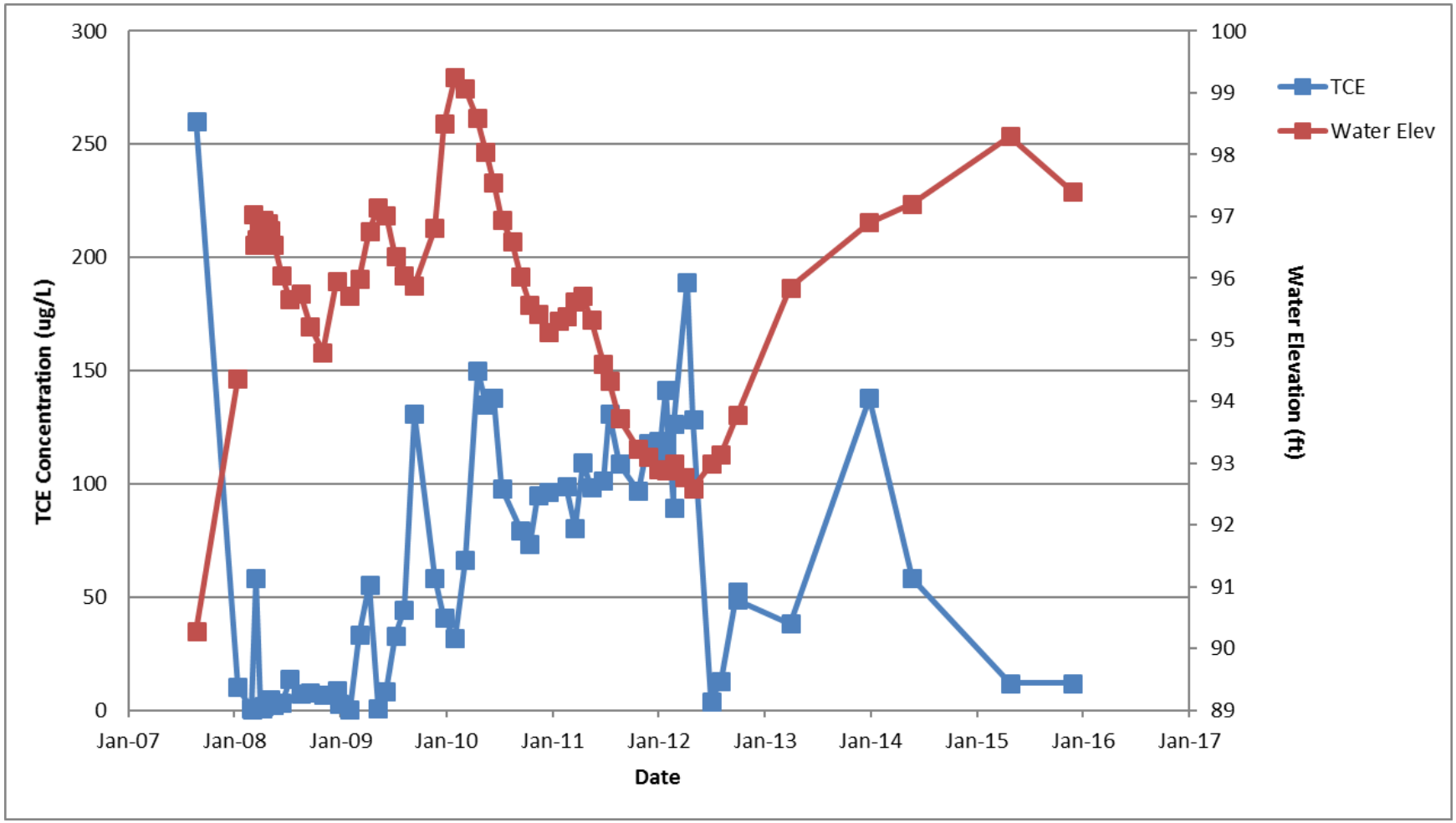

Figure A-26. Comparison of TCE Concentration and Water Elevation at TVM 1M

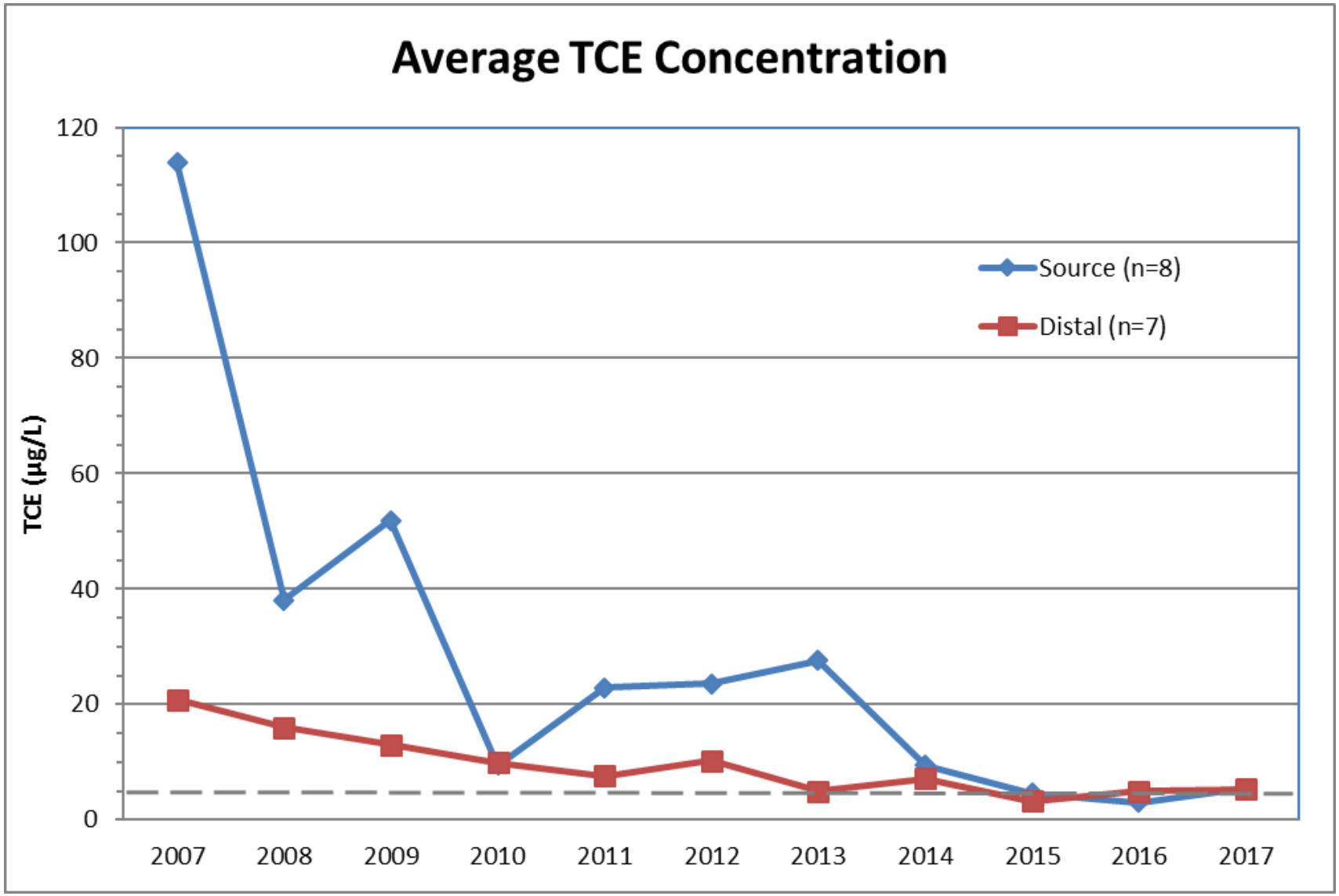

Figure A-27. Average TCE Concentrations of Monitoring Wells in the Treatment Zone and the Distal Plume

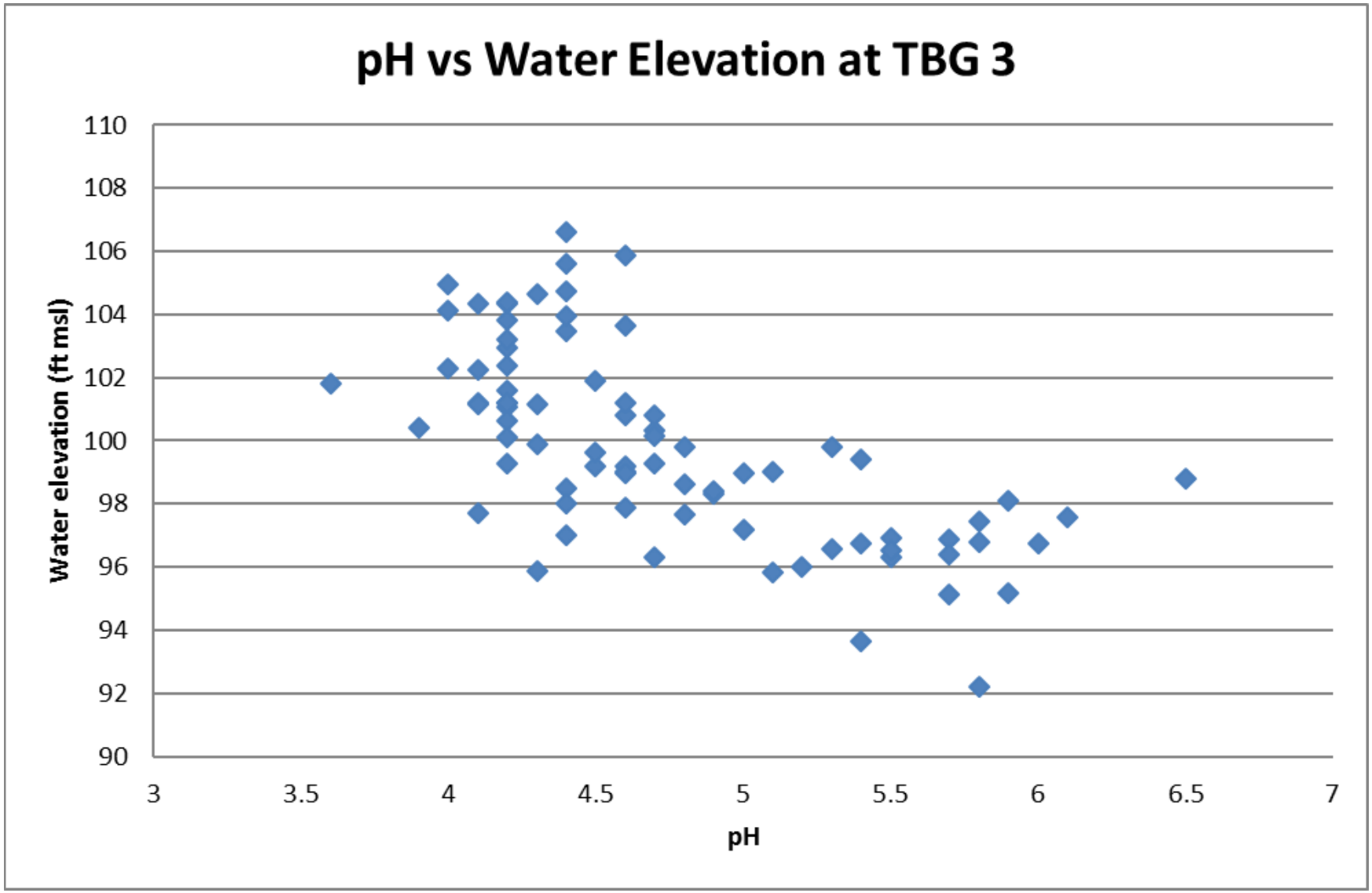

Figure A-28. Graphical Relationship of pH and Water Elevation at TBG 3

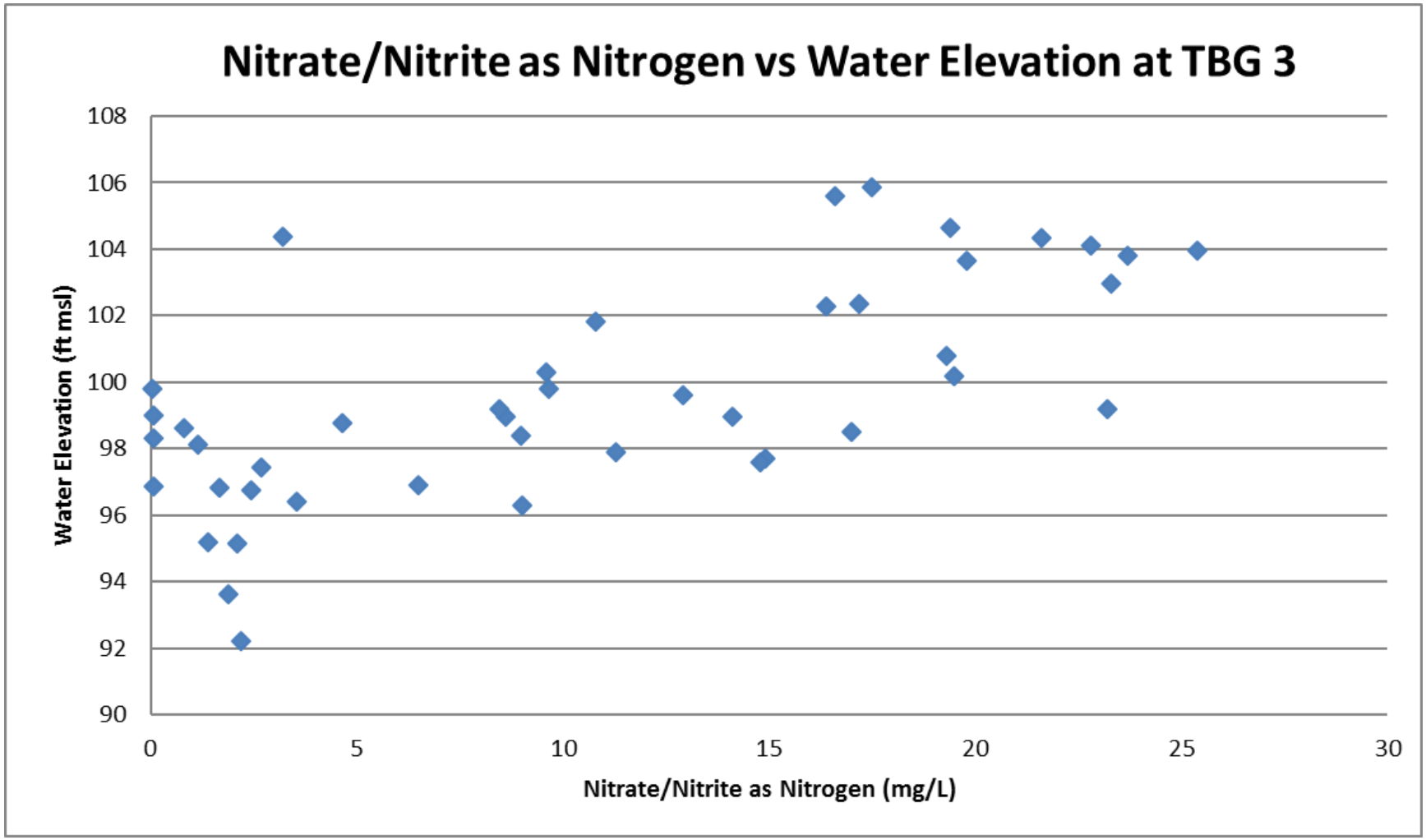

Figure A-29. Graphical Relationship of Nitrate/Nitrite as Nitrogen Concentration and Water Elevation at TBG 3

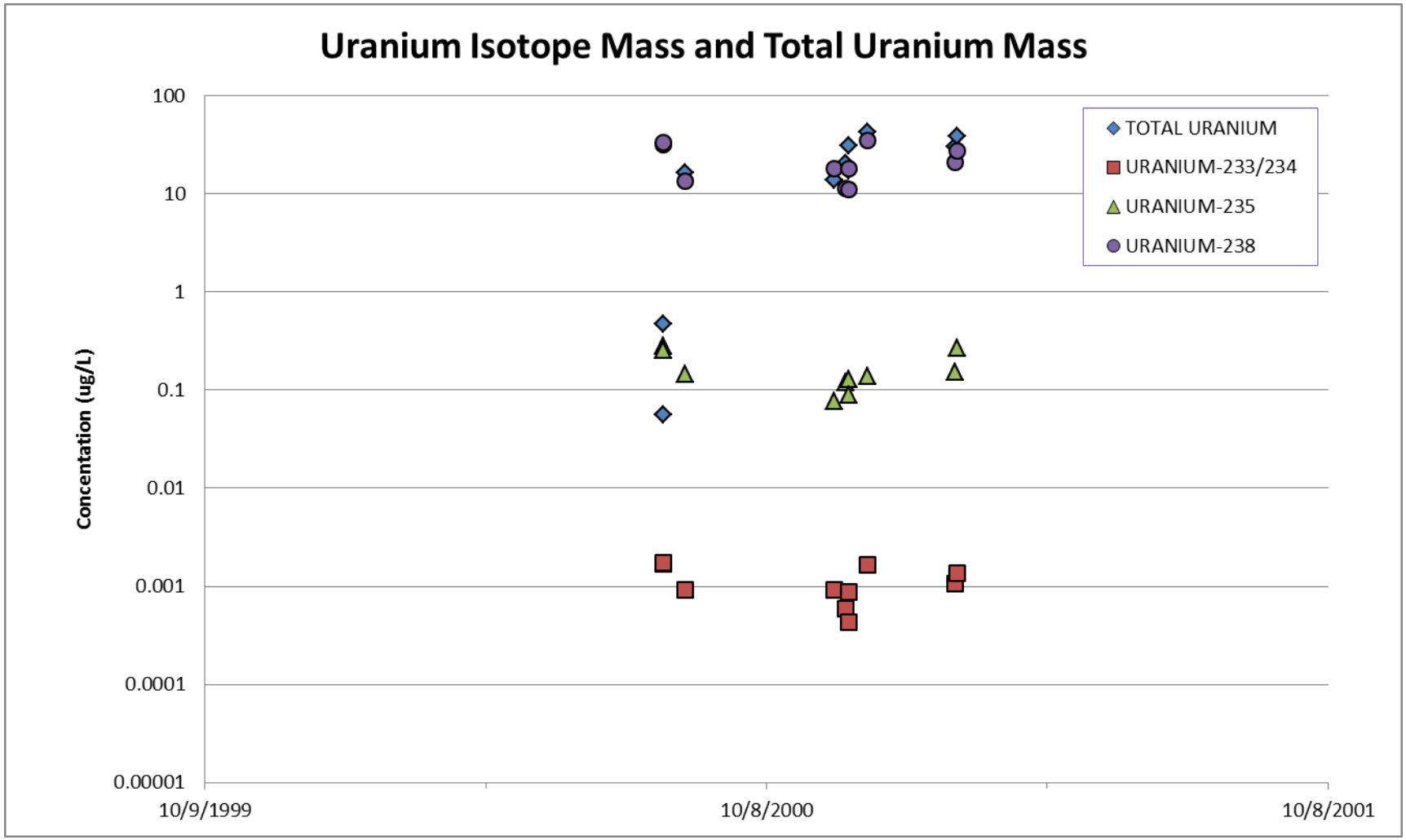

Figure A-30. Uranium Isotope Mass compared to Total Uranium Mass

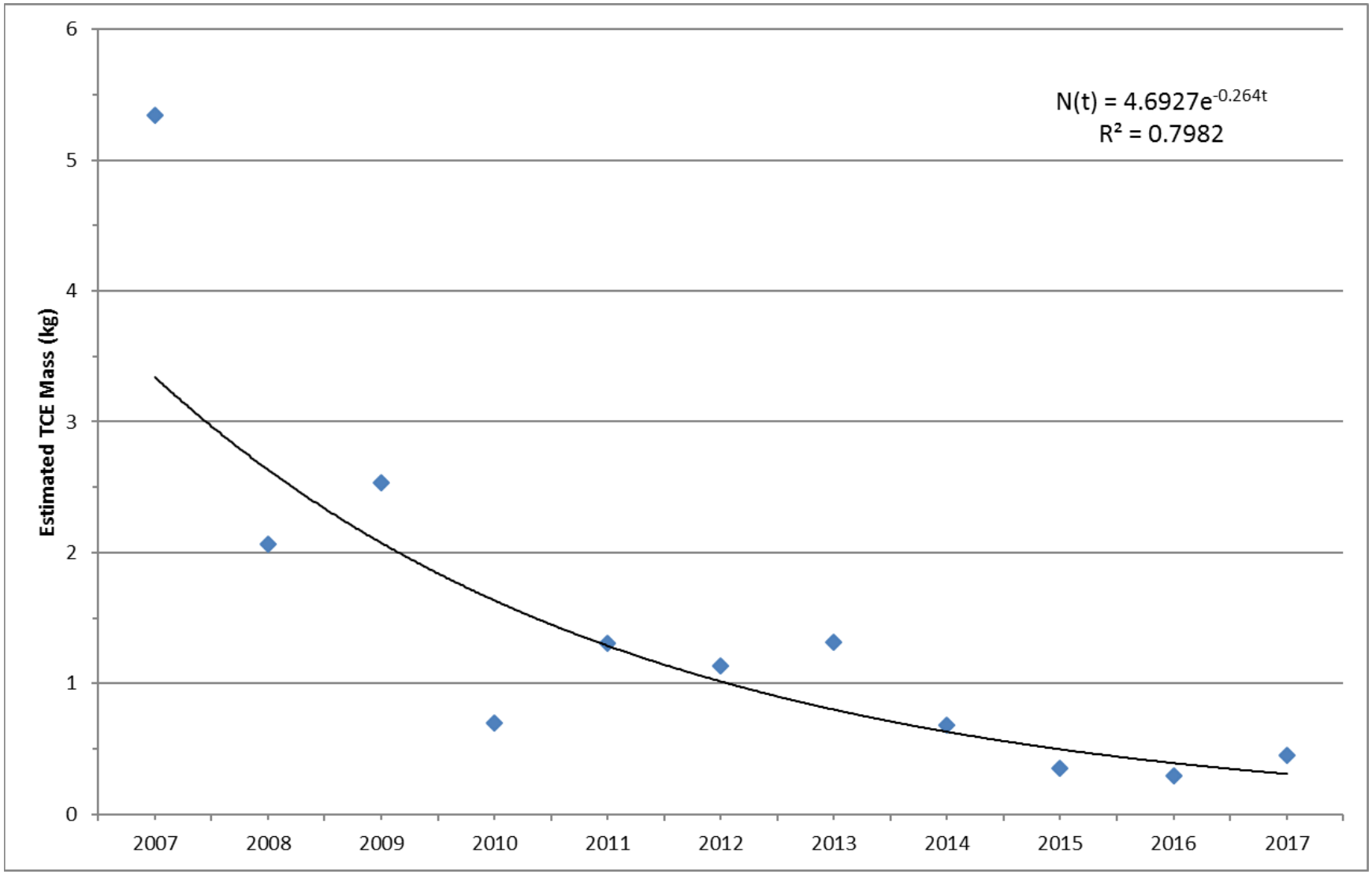

Figure A-31. Estimate of TCE Mass Reduction since Edible Oil Injections

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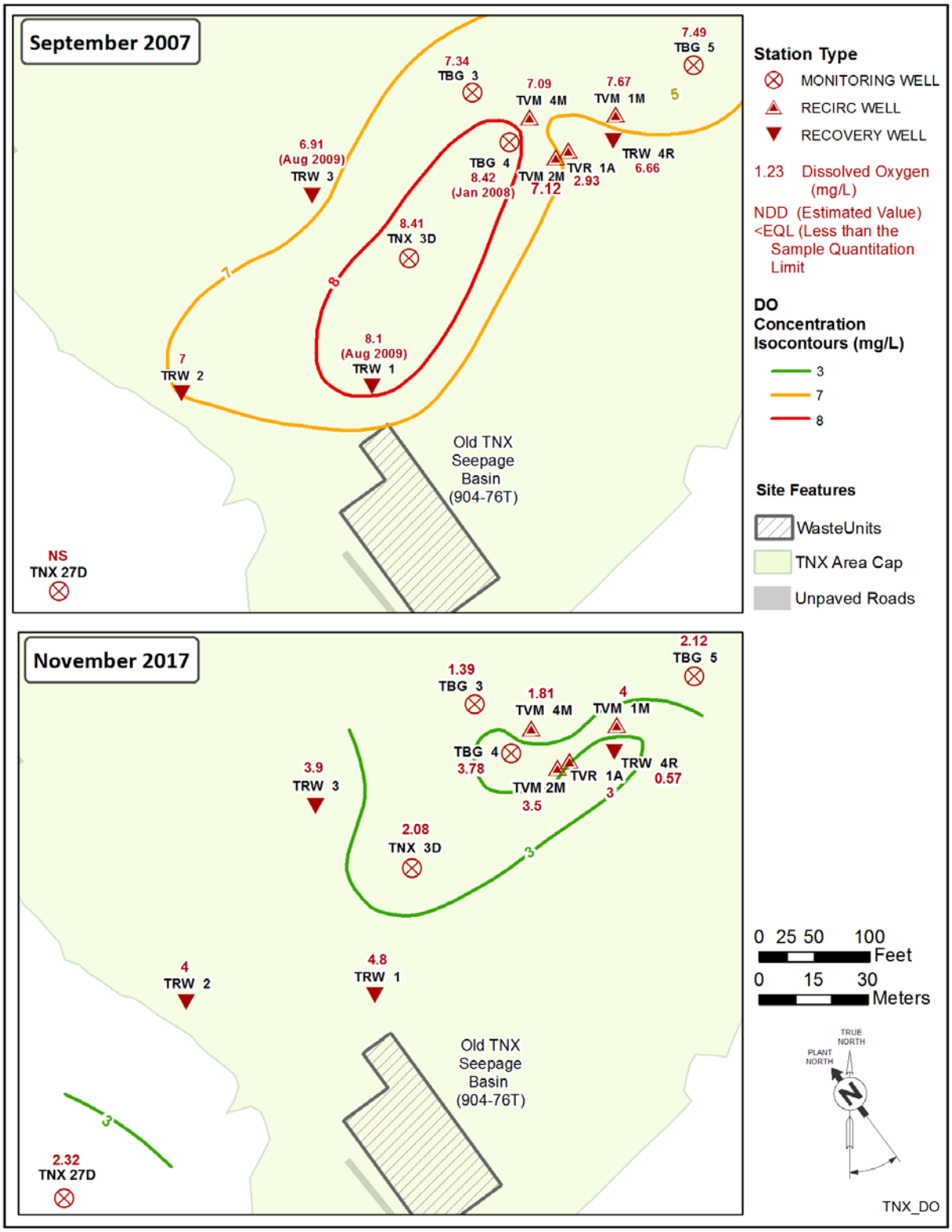

Figure A-32. Comparison of Dissolved Oxygen Concentration in the Treatment Zone in 2007 and 2017

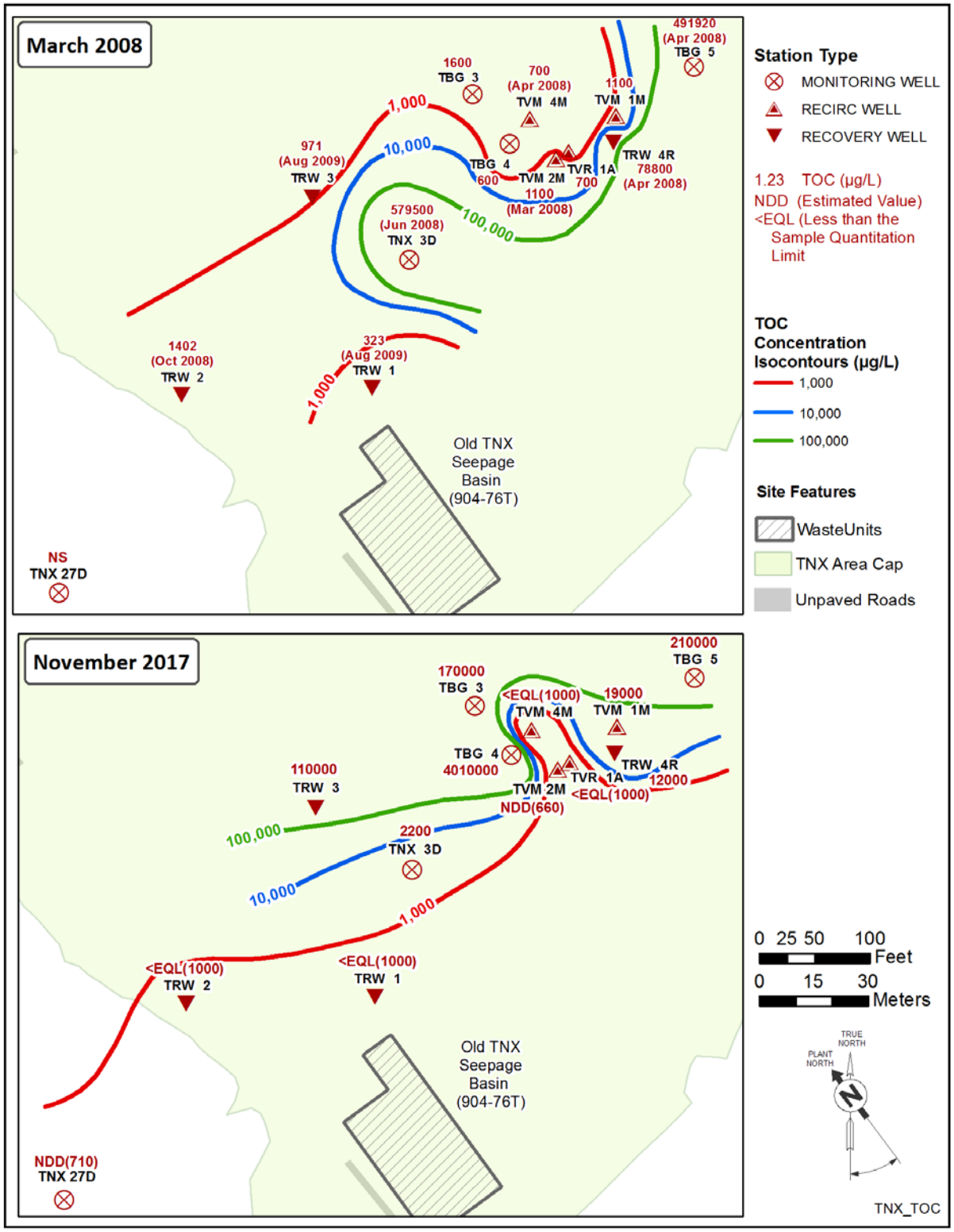

Figure A-33. Comparison of Total Organic Carbon Concentration in the Treatment Zone in 2008 and 2017

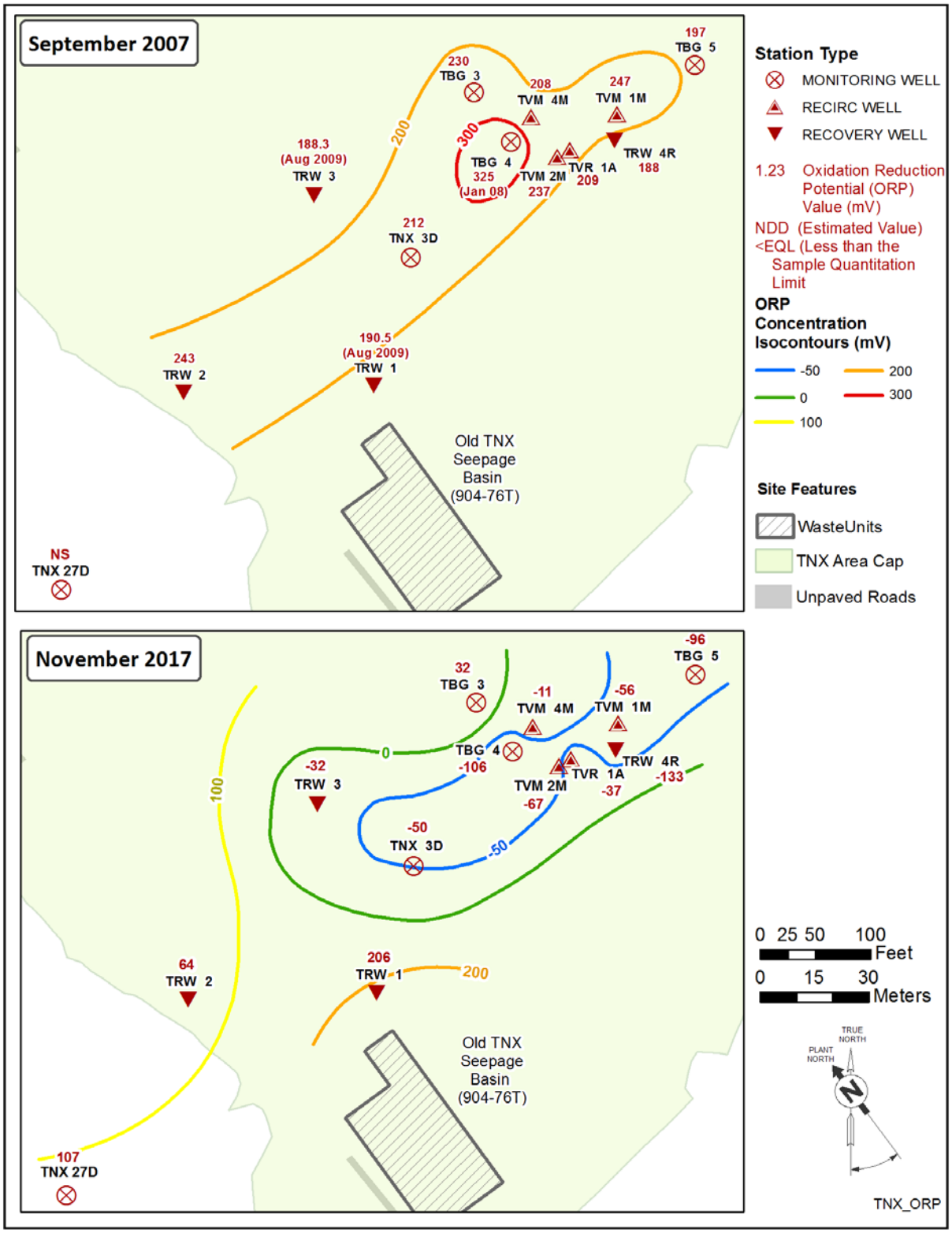

Figure A-34. Comparison of Oxidation Reduction Potential Concentration in the Treatment Zone in 2007 and 2017

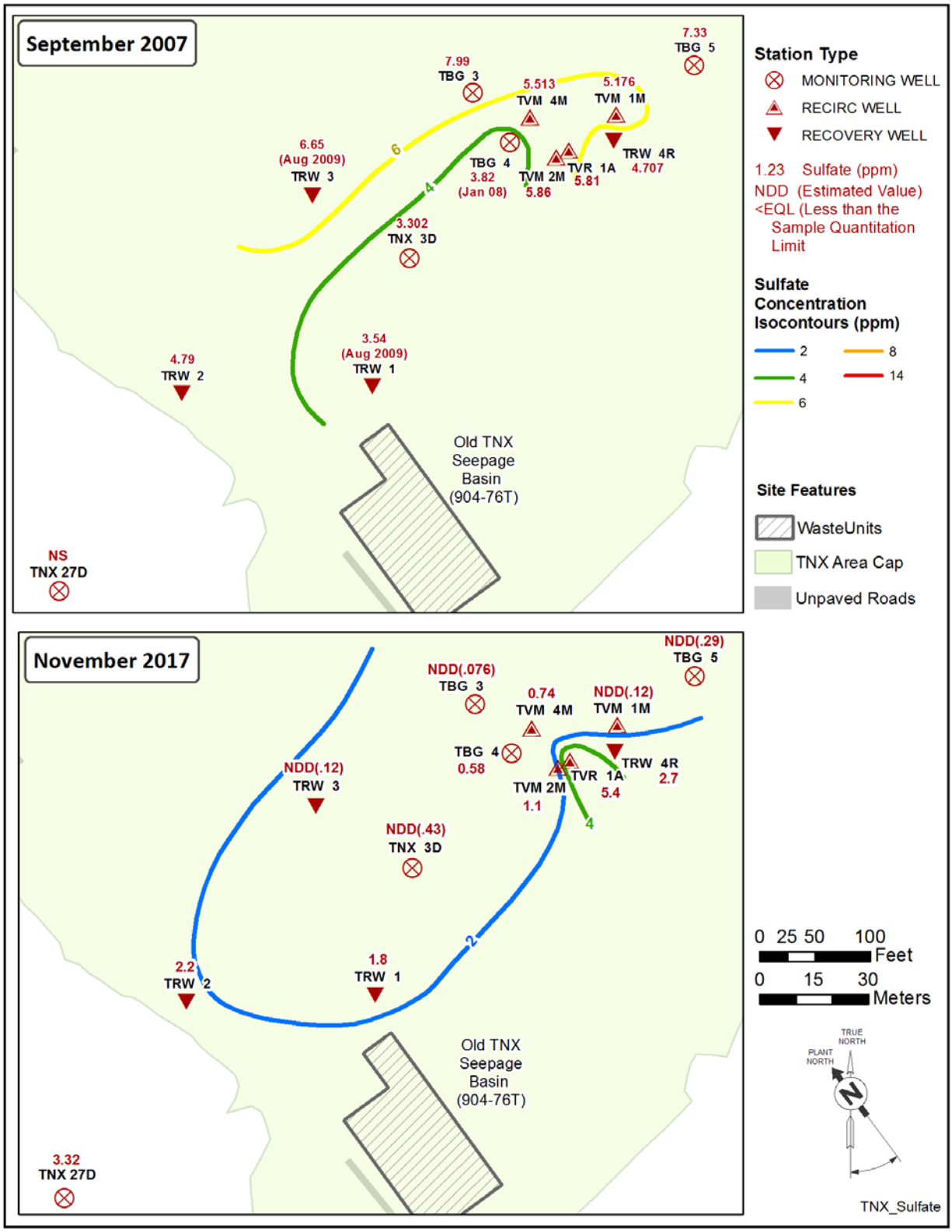

Figure A-35. Comparison of Sulfate Concentration in the Treatment Zone in 2007 and 2017

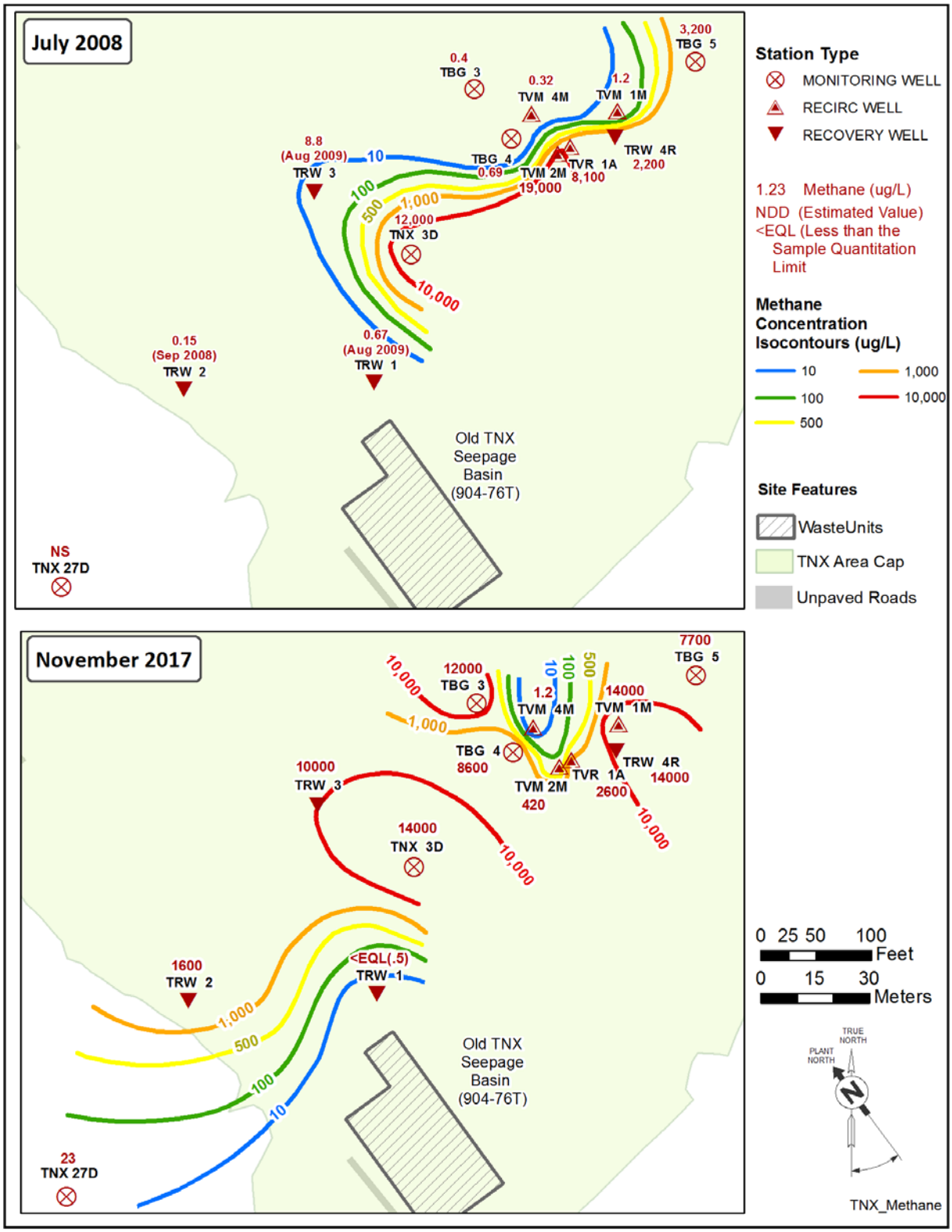

Figure A-36. Comparison of Methane Concentration in the Treatment Zone in 2008 and 2017

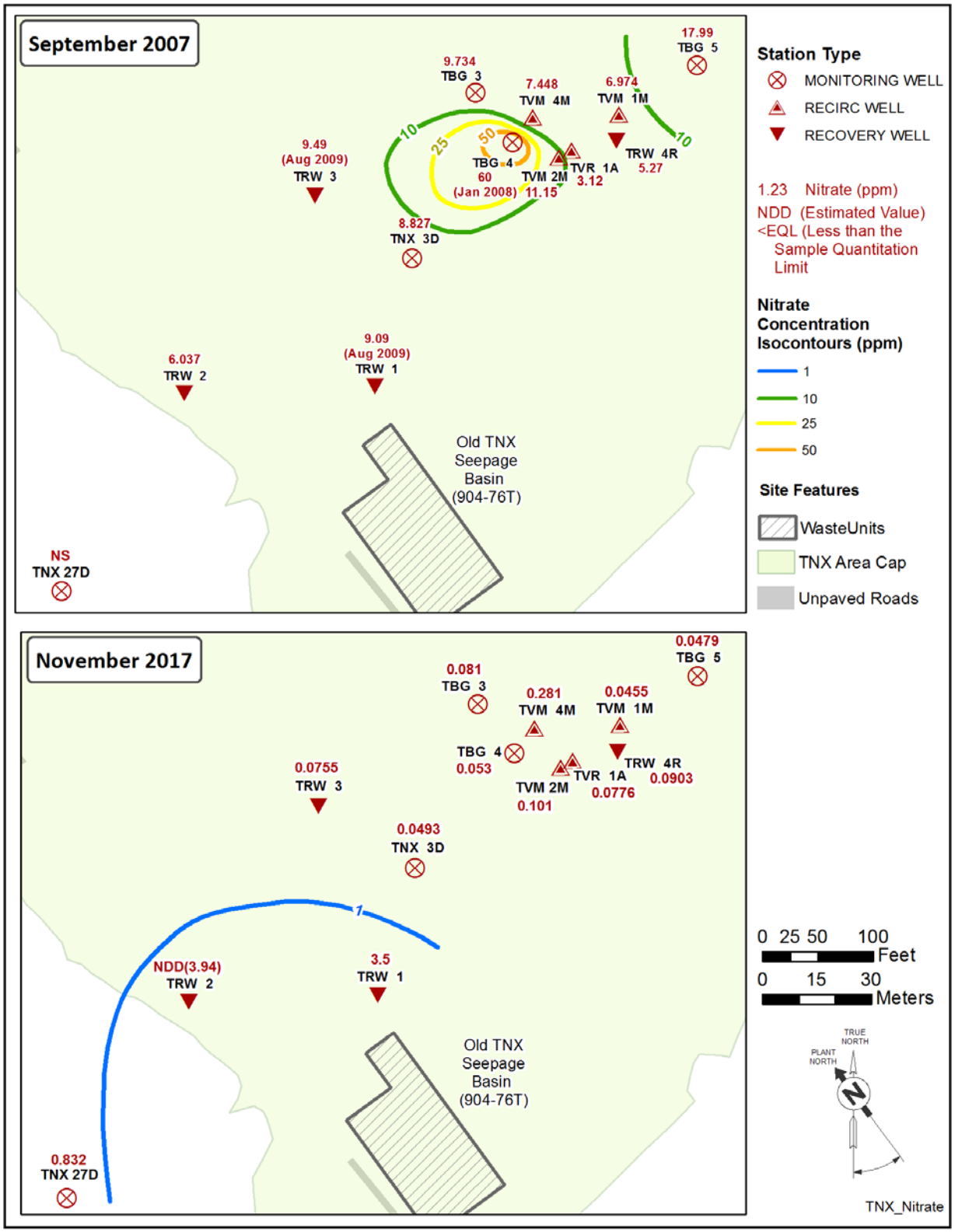

Figure A-37. Comparison of Nitrate Concentration in the Treatment Zone in 2007 and 2017

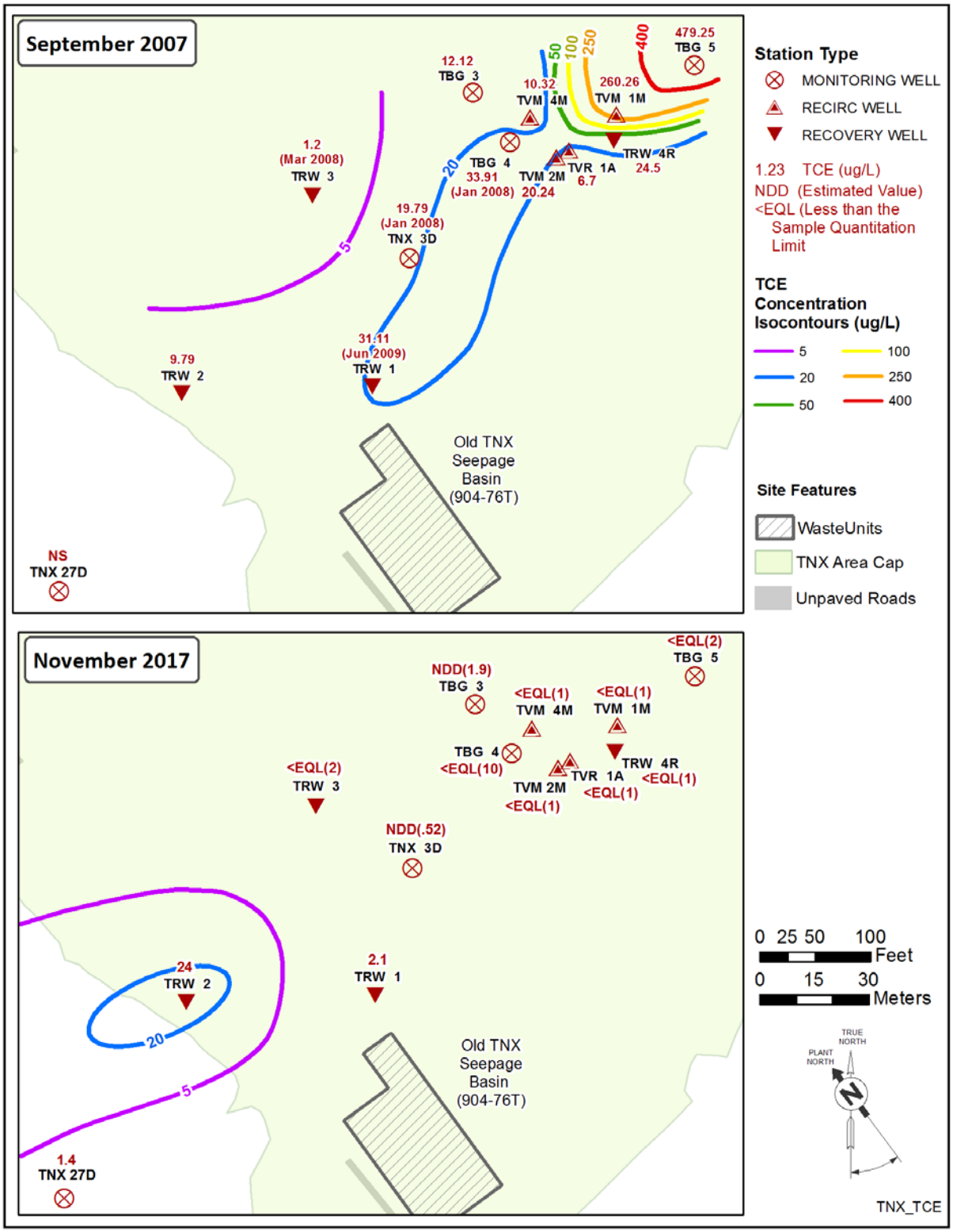

Figure A-38. Comparison of Trichloroethylene Concentration in the Treatment Zone in 2007 and 2017

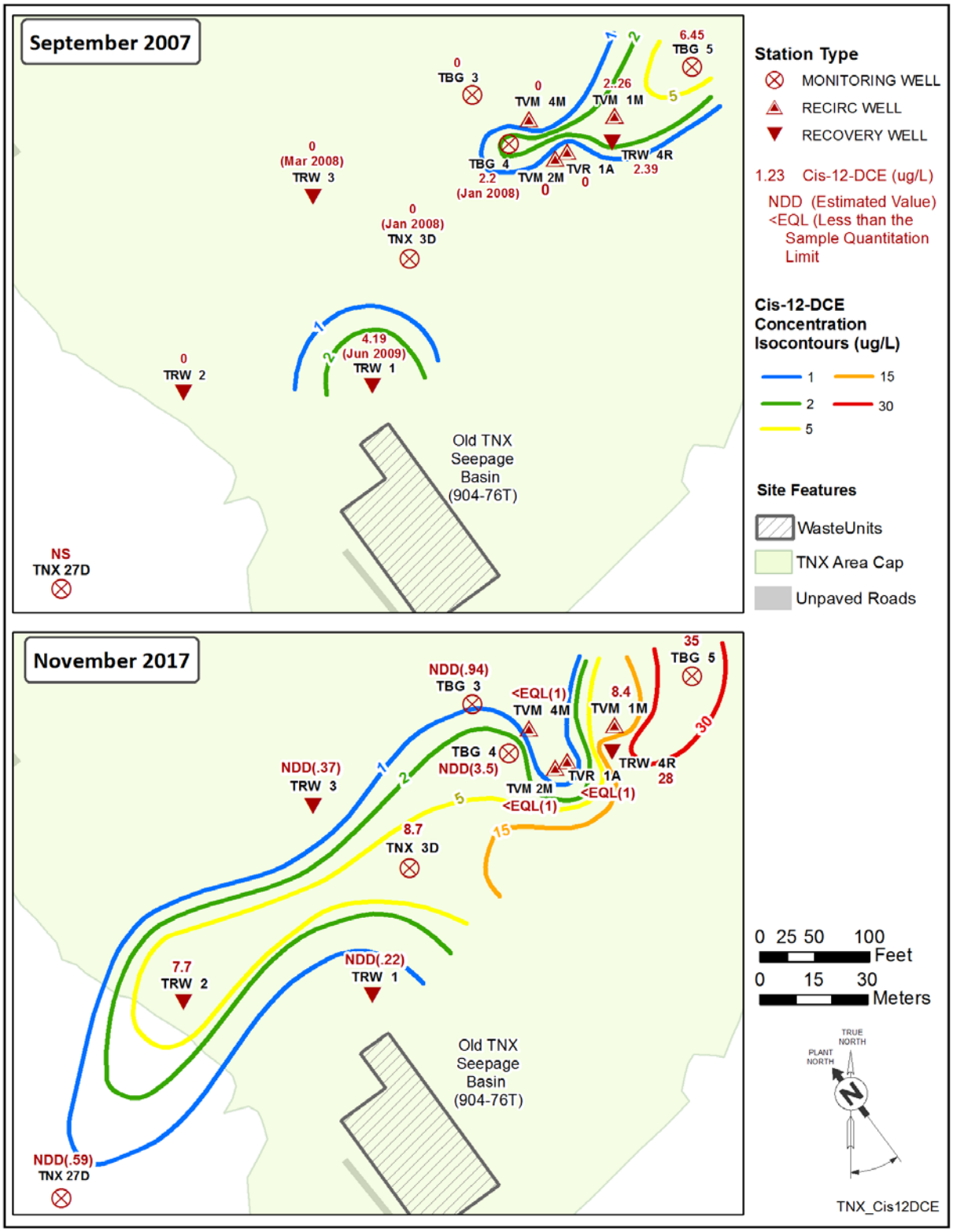

Figure A-39. Comparison of Cis-1,2-Dichloroethylene Concentration in the Treatment Zone in 2007 and 2017

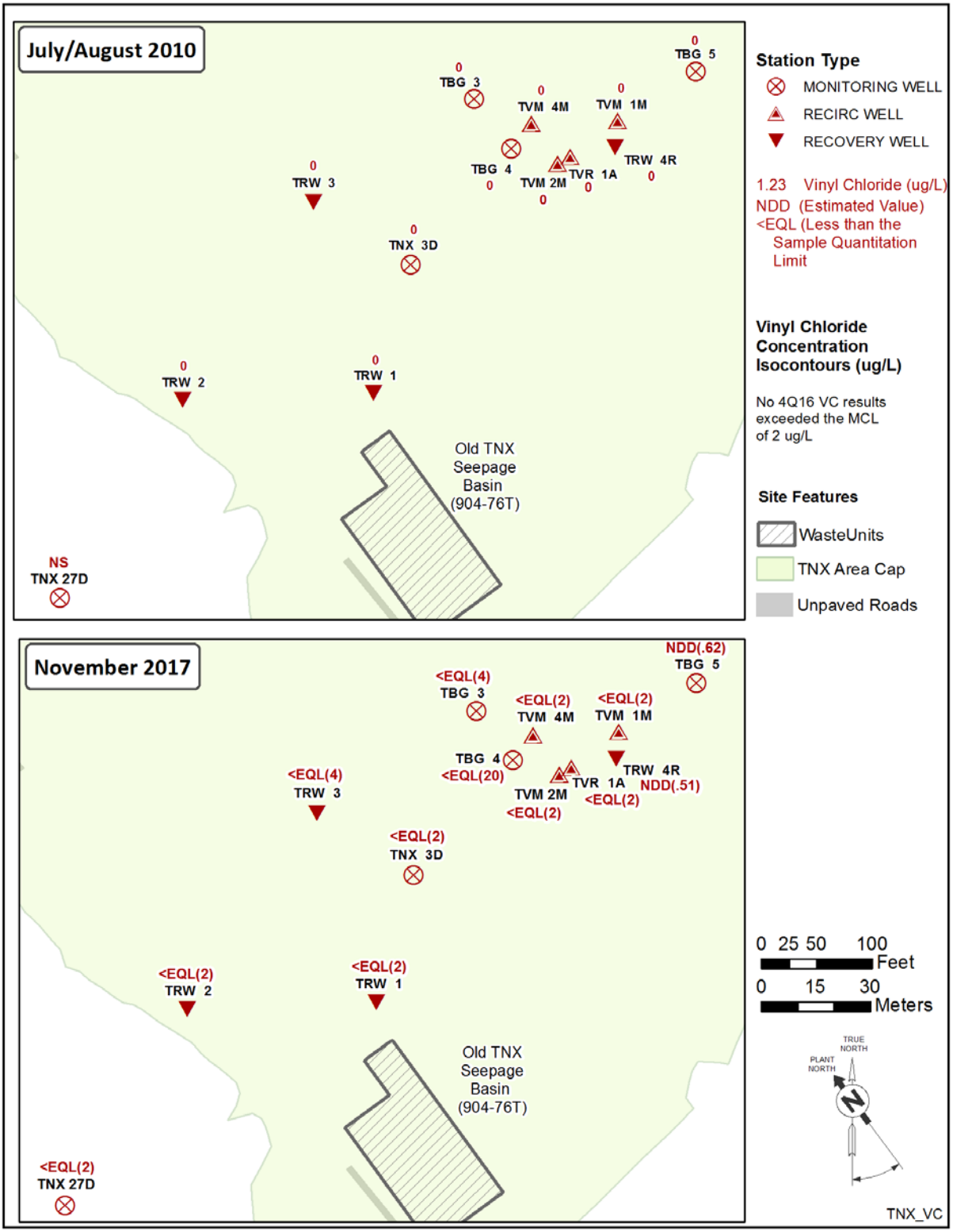

Figure A-40. Comparison of Vinyl Chloride Concentration in the Treatment Zone in 2010 and 2017

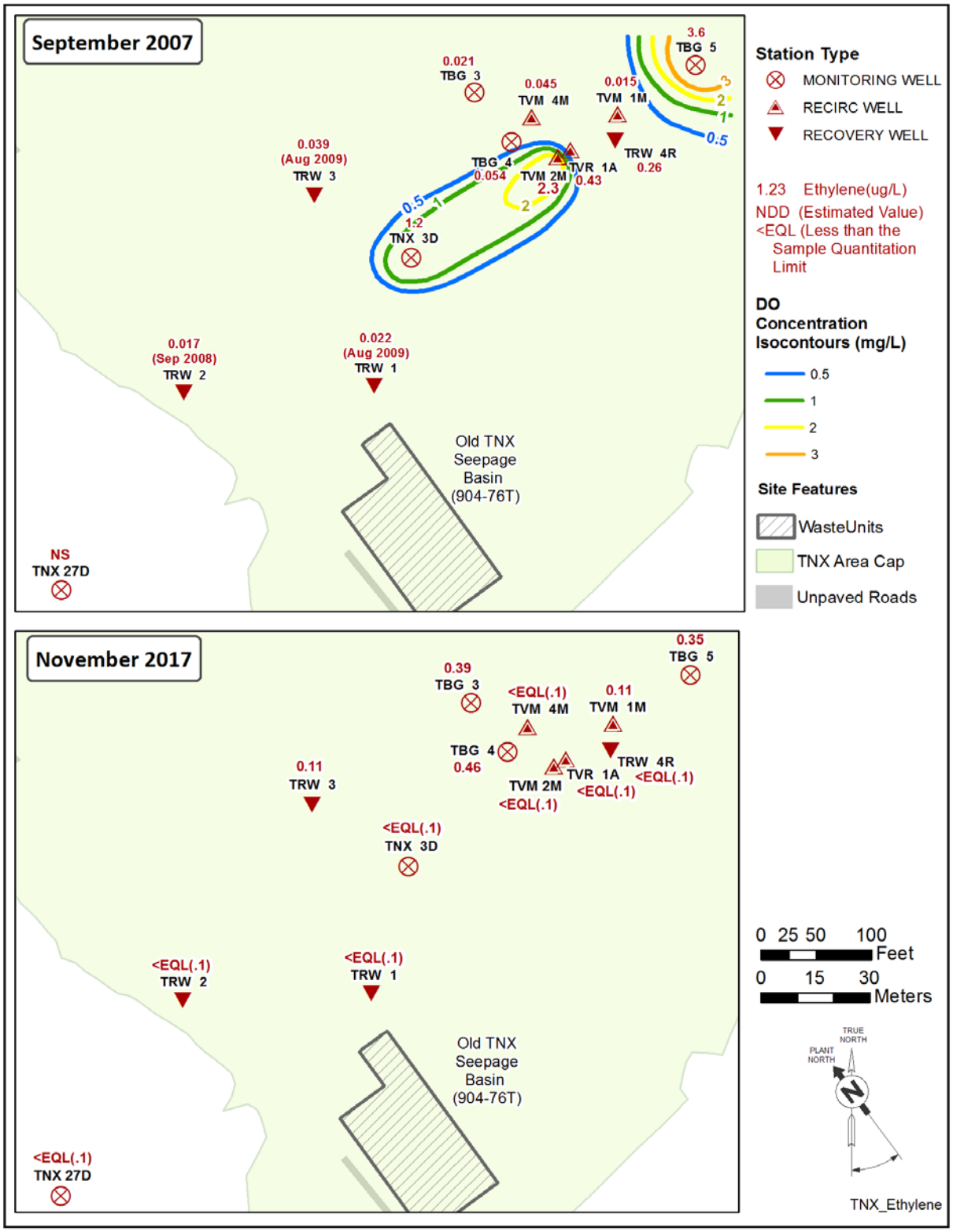

Figure A-41. Comparison of Ethylene Concentration in the Treatment Zone in 2008 and 2017

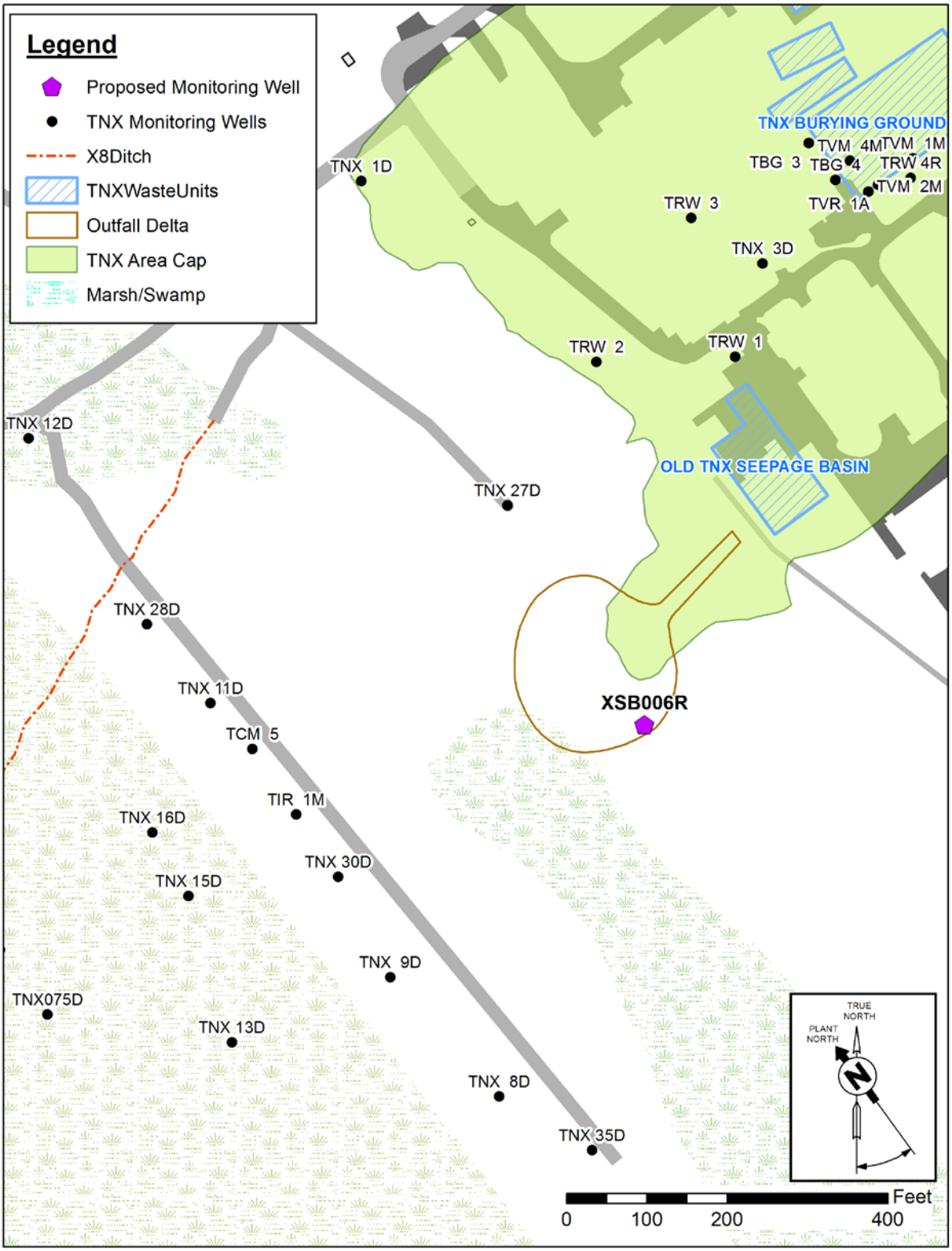

Figure A-42. Proposed Location of New Monitoring Well, XSB 6R

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APPENDIX B

GROUNDWATER MONITORING RESULTS
(MATRIX TABLES)

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Table B-1. Groundwater Monitoring Results for TNX-Area Wells, Second Quarter, 2017

Table B-1 2Q 2017 TNX Annual Groundwater and Monitoring Report			Field Data															TNX Monitoring Constituent	Fatty Acid								Hydrocarbon									Inorganic										Organic							Radionuclide					
Station	Well Use	Aquifer Zone	dmy-mmm-yyyy SAMPLE COLLECTION DATE	DEPTH TO WATER ft	OXIDATION/REDUCTION POTENTIAL mV	OXYGEN mg/L	pH pH	PHENOLPHTHALEIN ALKALINITY (AS CACO3) mg/L	SAMPLING EVENT WATER ELEVATION ft	SPECIFIC CONDUCTANCE uS/cm	TOTAL ALKALINITY (AS CACO3) mg/L	TURBIDITY NTU	VOLUME PURGED gal	WATER TEMPERATURE degC	FIELD CONDITIONS	Constituent	NPDWS Unit	ACETIC ACID ug/L	BUTYRIC ACID ug/L	LACTIC ACID N/A	PROPIONIC ACID ug/L	PYRUVIC ACID N/A	Total Volatile Fatty Acids	BUTANE ug/L	CARBON DIOXIDE ug/L	ETHANE ug/L	ETHYLENE ug/L	ISOBUTANE ug/L	METHANE ug/L	NITROGEN ug/L	PROPANE ug/L	PROPYLENE ug/L	CONVERTED URANIUM MASS mg/L	IRON ug/L	MERCURY ug/L	NITRATE ug/L	NITRATE+NITRITE AS NITROGEN mg/L	SULFATE mg/L	TOTAL ORGANIC CARBON ug/L	URANIUM ug/L	1,4-DIOXANE ug/L	CARBON TETRACHLORIDE ug/L	CHLOROETHENE (VINYL CHLORIDE) ug/L	CIS-1,2-DICHLOROETHYLENE ug/L	TETRACHLOROETHYLENE (PCE) ug/L	TRICHLOROETHYLENE (TCE) ug/L	ADJUSTED GROSS ALPHA pCi/L	COMBINED RADIUM (226 AND 228) pCi/L	CONVERTED URANIUM ACTIVITY ug/L	GROSS ALPHA pCi/L	NONVOLATILE BETA pCi/L	RADIUM-226 pCi/L	RADIUM-228 pCi/L
P_26A	Background Well	Semi-Confined_GAU	11-May-2017	36.6	142	3.55	5.5	0	117.9	39	3	0.3	140	20.1	No Comments			-EQL (5000)	-EQL (5000)	NS	-EQL (5000)	NS		0	-EQL (0.2)	32000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	-EQL (0.5)	18000	-EQL (0.1)	-EQL (0.1)	33	621	-EQL (0.2)	NS	0.039	7	1100	-EQL (5)	0.46	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (3.85)	5	0.36	-EQL (3.35)	-EQL (3.85)	-EQL (8.15)	5	0.355	-EQL (1.69)
			17-May-2017	36.7	124	1.28	5.2	0	117.8	39	2	0.6	135	20	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	30.2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
P_26B	Background Well	Unconfined UTRAU/GAU	11-May-2017	46.5	237	6.28	5.8	0	108	56	14	4.7	56	20.1	No Comments			-EQL (5000)	-EQL (5000)	NS	-EQL (5000)	NS		0	-EQL (0.2)	44000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	-EQL (0.5)	16000	-EQL (0.1)	-EQL (0.1)	NS	[260]	-EQL (0.2)	NS	0.442	1.7	[980]	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (3.85)	0.38	-EQL (3.35)	-EQL (3.85)	-EQL (9.16)	0.378	-EQL (1.44)
			17-May-2017	46.5	192	16	5.6	0	108	55	14	1.3	48	20.5	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	448	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
P_26D	Background Well	Unconfined UTRAU/GAU	17-May-2017	37.7	256	6.62	5.3	0	116.8	46	2	0.4	21	20.9	No Comments			-EQL (5000)	-EQL (5000)	NS	-EQL (5000)	NS		0	-EQL (0.2)	45000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	-EQL (0.5)	17000	-EQL (0.1)	-EQL (0.1)	NS	-EQL (100)	-EQL (0.2)	NS	0.291	1.8	1100	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (4.46)	[0.11]	-EQL (3.35)	-EQL (4.46)	-EQL (8.36)	[0.112]	-EQL (1.53)
			17-May-2017	37.7	227	1.11	5.2	0	116.8	46	10	0.5	20	21	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	297	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TRW 1	Recovery Well	Unconfined UTRAU/GAU	15-May-2017	65.4	220	4.6	5.9	0	97.46	58	8	0.4	32	21.6	No Comments			8800	-EQL (5000)	NS	-EQL (5000)	NS		8800	-EQL (0.2)	37000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	-EQL (0.5)	15000	-EQL (0.1)	-EQL (0.1)	NS	-EQL (100)	[0.0313]	3410	3.38	1.3	1100	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	1.3	-EQL (4.55)	[0.15]	-EQL (3.35)	-EQL (4.55)	-EQL (8.46)	[0.148]	-EQL (1.48)
TRW 2	Recovery Well	Unconfined UTRAU/GAU	15-May-2017	57.5	87	4.1	6.1	0	97.15	49	15	0.7	60	21.3	No Comments			12000	-EQL (5000)	NS	5800	NS		17800	-EQL (0.2)	44000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	600	17000	-EQL (0.1)	-EQL (0.1)	NS	521	0.764	381	0.345	3.4	1600	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	11	-EQL (1)	3	[2.48]	[0.15]	-EQL (3.35)	[2.48]	-EQL (9.8)	[0.149]	-EQL (1.5)
TRW 3	Recovery Well	Unconfined UTRAU/GAU	15-May-2017	66.7	-40	4	5.8	0	98.51	507	44	12.1	63	21.6	No Comments			170000	30000	NS	32000	NS	232000	-EQL (0.2)	220000	-EQL (0.1)	0.13	-EQL (0.2)	12000	5600	-EQL (0.1)	-EQL (0.1)	NS	200000	[0.0536]	65.6	0.171	[0.12]	190000	-EQL (5)	[1.3]	-EQL (1)	-EQL (2)	[0.32]	-EQL (1)	[0.37]	-EQL (7)	[0.26]	-EQL (3.35)	-EQL (7)	[6.98]	[0.259]	-EQL (1.42)
TRW 4R	Recovery Well	Unconfined UTRAU/GAU	16-May-2017	59.9	18	2.06	5.1	0	97.55	199	2	67.7	50	23	X			110000	19000	NS	16000	NS	145000	-EQL (0.2)	350000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	16000	5200	-EQL (0.1)	-EQL (0.1)	NS	52600	[0.0319]	25.6	0.0593	[0.25]	98000	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	23	-EQL (1)	-EQL (1)	-EQL (6.53)	0.32	-EQL (3.35)	-EQL (6.53)	-EQL (10.2)	0.316	-EQL (1.39)
TCM 5	TNX Auxiliary	Unconfined UTRAU/GAU	10-May-2017	6.7	274	3.76	5	0	93.16	98	2	9.4	4	21.4	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	395	[0.0508]	NS	2.7	NS	NS	27	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	[0.27]	-EQL (1)	3	-2.69	-EQL (2.03)	18.09	3	13.1	-EQL (0.205)	-EQL (2.03)
TIR 1L	TNX Auxiliary	Unconfined UTRAU/GAU	10-May-2017	9.1	328	3.6	4.5	0	92.62	64	2	0.3	9	20	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-EQL (100)	-EQL (0.2)	NS	0.327	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (2.72)	-EQL (1.96)	-EQL (3.35)	-EQL (2.72)	-EQL (6.9)	-EQL (0.223)	-EQL (1.96)
TIR 1M	TNX Auxiliary	Unconfined UTRAU/GAU	10-May-2017	8.66	222	4.78	4.9	0	93	63	0	0.5	3	20.1	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-EQL (100)	[0.0522]	NS	2.93	NS	NS	[0.59]	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	[0.88]	-EQL (2.77)	[0.15]	[0.4]	-EQL (2.77)	-EQL (6.59)	[0.149]	-EQL (1.63)
TIR 1U	TNX Auxiliary	Unconfined UTRAU/GAU	10-May-2017	8.52	254	5.62	4.8	0	93.09	76	0	0.7	2	20.1	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-EQL (100)	-EQL (0.2)	NS	3.31	NS	NS	7.64	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	3.2	[0.991]	[0.15]	3.78	[4.77]	-EQL (7.38)	[0.146]	-EQL (2.41)
TNX 13D	TNX Auxiliary	Unconfined UTRAU/GAU	15-May-2017	6.7	91	3.01	5.5	0	90.62	98	11	5.6	4	17.9	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	854	-EQL (0.2)	NS	0.373	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	[0.34]	-EQL (5.19)	[1.45]	-EQL (3.35)	-EQL (5.19)	-EQL (8.2)	-EQL (0.131)	[1.45]	
TNX 15D	TNX Auxiliary	Unconfined UTRAU/GAU	15-May-2017	6.8	243	3.17	4.9	0	90.87	80	0	0.6	3	18	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-EQL (100)	-EQL (0.2)	NS	1.99	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	4.2	-EQL (2.67)	-EQL (1.43)	-EQL (3.35)	-EQL (2.67)	-EQL (8.82)	-EQL (0.102)	-EQL (1.43)	
TNX 20D	TNX Auxiliary	Unconfined UTRAU/GAU	15-May-2017	6.1	261	3.56	5.2	0	89.25	77	3	0.3	3	17.5	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	[45.1]	-EQL (0.2)	NS	1.13	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (4.62)	-EQL (1.76)	-EQL (3.35)	-EQL (4.62)	-EQL (8.57)	-EQL (0.132)	-EQL (1.76)	
TNX 22D	TNX Auxiliary	Unconfined UTRAU/GAU	16-May-2017	7	156	4.4	5.4	0	90.5	70	6	2.1	3	18	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3640	-EQL (0.2)	NS	NS	-EQL (0.02)	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (2.96)	-EQL (1.55)	-EQL (3.35)	-EQL (2.96)	-EQL (8.83)	-EQL (0.197)	-EQL (1.55)	
TNX 28D	TNX Auxiliary	Unconfined UTRAU/GAU	16-May-2017	8.2	164	4.8	5.4	0	91.6	50	6	0.9	4	19.1	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	108	-EQL (0.2)	NS	1.19	NS	NS	[4.68]	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	[0.23]	-EQL (1)	7.3	[2.4144]	[0.15]	0.24	[3.14]	[5.55]	0.243	-EQL (1.72)
TNX 30D	TNX Auxiliary	Unconfined UTRAU/GAU	16-May-2017	10	239	3.85	4.8	0	93	64	2	7.1	6	21.1	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	197	[0.0336]	NS	1.95	NS	NS	[14.3]	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	3.3	2.919	[0.29]	[9.58]	12.5	-EQL (12.3)	0.29	-EQL (1.5)	
TNX 35D	TNX Auxiliary	Unconfined UTRAU/GAU	16-May-2017	7.2	98	3.48	5.7	0	92.7	128	28	18.1	11	17	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	3090	-EQL (0.2)	NS	0.413	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	1.4	-EQL (6.24)	[0.19]	-EQL (3.35)	-EQL (6.24)	-EQL (10.6)	[0.186]	-EQL (1.6)	
TNX 37D	TNX Auxiliary	Unconfined UTRAU/GAU	22-May-2017	8.1	249	2.35	5.7	0	92.6	69	7	4.1	3	18.2	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	[153]	-EQL (0.2)	NS	0.825	NS	NS	[1.67]	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	2.1	[1.4111]	-EQL (1.7)	[1.13]	[2.53]	-EQL (9.81)	-EQL (0.192)	-EQL (1.7)	
TNX 72D	TNX Auxiliary	Unconfined UTRAU/GAU	17-May-2017	11.2	43	4.44	5.7	0	84.9	89	15	86.4	2	19.9	I			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TNX 72M	TNX Auxiliary	Unconfined UTRAU/GAU	17-May-2017	10.2	-76	7.38	5.4	0	85.76	120	27	20.3	1	18	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	14800	-EQL (0.2)	NS	0.381	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (6.08)	[0.19]	-EQL (3.35)	-EQL (6.08)	-EQL (9.65)	[0.192]	-EQL (1.35)	
TNX 72S	TNX Auxiliary	Unconfined UTRAU/GAU	17-May-2017	7NS	NS	NS	NS	NS	89NS	NS	NS	0	NS	D	NS			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TNX073D	TNX Auxiliary	Unconfined UTRAU/GAU	17-May-2017	12.5	203	4.63	5.5	0	87.6	102	22	10.8	3	18.6	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	338	-EQL (0.2)	NS	0.0755	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (4.87)	-EQL (1.26)	-EQL (3.35)	-EQL (4.87)	-EQL (9.62)	-EQL (0.171)	-EQL (1.26)	
TNX074D	TNX Auxiliary	Unconfined UTRAU/GAU	17-May-2017	15.6	162	6.67	5.2	0	82.8	139	0	32.7	1	21.8	I			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	15700	-EQL (0.2)	NS	0.387	NS	NS	[0.613]	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (5.52)	[0.41]	-EQL (3.35)	-EQL (5.52)	-EQL (9.96)	-EQL (0.392)	-EQL (1.82)	
TNX075D	TNX Auxiliary	Unconfined UTRAU/GAU	17-May-2017	11.81	277	4.5	5.3	1	85.19	116	0	10.3	4	18.9	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	268	-EQL (0.2)	NS	-EQL (0.02)	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (5.01)	[0.16]	-EQL (3.35)	-EQL (5.01)	-EQL (9.12)	[0.163]	-EQL (1.51)	
TVM 1M	TNX Auxiliary	Unconfined UTRAU/GAU	15-May-2017	60.4	-87	1.83	5.9	0	99.29	394	147	6.5	8	22.5	No Comments			73000	-EQL (5000)	NS	-EQL (5000)	NS	73000	-EQL (0.2)	290000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	19000	2900	-EQL (0.1)	-EQL (0.1)	NS	108000	[0.0618]	32.6	-EQL (0.0244)	[0.12]	48900	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	10	-EQL (1)	1	-EQL (6.72)	0.43	-EQL (3.35)	-EQL (6.72)	-EQL (9.71)	0.433	-EQL (1.69)	
TVM 2M	TNX Auxiliary	Unconfined UTRAU/GAU	15-May-2017	63.2	-88	3.44	6.2	0	98.68	84	28	2	5	23.9	No Comments			-EQL (5000)	-EQL (5000)	NS	-EQL (5000)	NS		0	-EQL (0.2)	21000	-EQL (0.1)	0.11	-EQL (0.2)	220	18000	-EQL (0.1)	-EQL (0.1)	NS	18900	-EQL (0.2)	39	0.0692	0.95	1500	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (5.2)	0.29	-EQL (3.35)	-EQL (5.2)	-EQL (9.23)	0.292	-EQL (1.67)	
TVM 4M	TNX Auxiliary	Unconfined UTRAU/GAU	15-May-2017	62.7	3	4.81	5.8	0	98.67	61	21	1.4	6	22.9	No Comments			-EQL (5000)	-EQL (5000)	NS	-EQL (5000)	NS		0	-EQL (0.2)	21000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	2.3	18000	-EQL (0.1)	-EQL (0.1)	NS	12100	-EQL (0.2)	235	0.258	0.64	[900]	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (6.25)	[2.64]	-EQL (3.35)	-EQL (6.25)	-EQL (10.1)	1.12	[1.52]	
TVR 1A	TNX Auxiliary	Unconfined UTRAU/GAU	15-May-2017	62.1	-32	2.86	5.9	0	88	135	54	2.6	105	22.6	No Comments			56000	12000	NS	17000	NS	85000	-EQL (0.2)	71000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	7200	12000	-EQL (0.1)	-EQL (0.1)	NS	25500	-EQL (0.2)	54.8	0.0544	4.4	3100	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	[2.87]	[1.3]	-EQL (3.35)	[2.87]	-EQL (10.4)	0.641	[0.663]	
TBG 3	TNX Primary	Unconfined UTRAU/GAU	23-May-2017	63	155	2.03	4.9	0	98.31	272	0	85.4	6	21	X			140000	47000	NS	67000	NS	254000	-EQL (0.2)	150000	0.68	0.26	-EQL (0.2)	3900	13000	-EQL (0.1)	NS	NS	101000	[0.0667]	[12.7]	0.0592	-EQL (0.5)	310000	[2.28]	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	[1]	-EQL (1)	[0.8]	-EQL (7.25)	[0.37]	[1.53]	-EQL (7.25)	17.9	[0.373]	-EQL (1.57)	
TBG 4	TNX Primary	Unconfined UTRAU/GAU	16-May-2017	63.3	-69	2.56	6.3	0	99.28	5664	1848	346	7	21.6	X			2600000	660000	NS	1200000	NS	4460000	-EQL (0.2)	260000	0.17	0.53	-EQL (0.2)	7400	6900	-EQL (0.1)	-EQL (0.1)	NS	51800	0.206	[65]	0.337	25	3700000	[41.9]	-EQL (5)	-EQL (10)	-EQL (20)	[2.8]	-EQL (10)	-EQL (10)	[0.227]	[0.67]	[28.07]	[28.3]	-EQL (54)	[0.672]	-EQL (1.59)	
TBG 5	TNX Primary	Unconfined UTRAU/GAU	11-May-2017	56.8	-75	3.9	6.4	0	100.95	1273	70	14.2	5	21.3	X			6800	-EQL (5000)	NS	-EQL (5000)	NS	6800	-EQL (0.2)	300000	-EQL (0.1)	0.36	-EQL (0.2)	7400	6200	-EQL (0.1)	-EQL (0.1)	NS	107000	-EQL (0.2)	NS	0.146	-EQL (0.5)	300000	-EQL (5)	[4.3]	-EQL (1)	[0.66]	32	-EQL (1)	[0.32]	-EQL (16.5)	0.41	-EQL (3.35)	-EQL (16.5)	24.6	0.408	-EQL (2.12)	
			17-May-2017	56.1	98	17.3	6.2	0	101.65	1019	594	158	5	22.8	X			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	24.3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
TNX 3D	TNX Primary	Unconfined UTRAU/GAU	15-May-2017	67	-59	3.8	6	0	98.63	209	61	11.7	18	22.2	No Comments			-EQL (5000)	-EQL (5000)	NS	-EQL (5000)	NS		0	-EQL (0.2)	130000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	9900	6700	-EQL (0.1)	-EQL (0.1)	NS	40800	-EQL (0.2)	41.1	0.329	1.3	9200	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	9.2	-EQL (1)	[0.41]	-EQL (4.88)	0.65	-EQL (3.35)	-EQL (4.88)	-EQL (9.48)	0.647	-EQL (1.62)	
TNX 8D	TNX Primary	Unconfined UTRAU/GAU	10-May-2017	7	70	4.1	5.5	0	93.5	93	12	1.8	30	18	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	881	-EQL (0.2)	NS	0.401	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	[0.83]	-EQL (3.41)	[0.14]	-EQL (3.35)	-EQL (3.41)	-EQL (6.73)	[0.138]	-EQL (2.27)	
TNX 11D	TNX Primary	Unconfined UTRAU/GAU	11-May-2017	6.9	181	4.6	5.6	0	93.4	42	6	4.2	30	19.7	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	7980	-EQL (0.2)	NS	0.447	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	[3.04]	[0.82]	-EQL (3.35)	[3.04]	-EQL (9.41)	[0.133]	[0.686]	
TNX 16D	TNX Primary	Unconfined UTRAU/GAU	15-May-2017	8.2	217	3.21	4.9	0	85.2	72	0	0.5	3	18.3	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	[80.4]	-EQL (0.2)	NS	0.722	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	3	-EQL (3.89)	-EQL (1.21)	-EQL (3.35)	-EQL (3.89)	-EQL (8.46)	-EQL (0.157)	-EQL (1.21)	
TNX 27D	TNX Primary	Unconfined UTRAU/GAU	16-May-2017	14.9	196	3.18	5.7	0	95.7	61	20	60.3	12	22.8	No Comments			-EQL (5000)	-EQL (5000)	NS	-EQL (5000)	NS		0	-EQL (0.2)	57000	-EQL (0.1)	-EQL (0.1)	-EQL (0.2)	2.7	15000	-EQL (0.1)	-EQL (0.1)	NS	1330	[0.0494]	[1290]	1.72	3.5	1400	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (5.17)	[0.24]	-EQL (3.35)	-EQL (5.17)	[5.17]	[0.243]	-EQL (1.27)	
TNX 1D	TNX Secondary	Unconfined UTRAU/GAU	10-May-2017	59.7	231	2.37	5.7	0	97	48	2	0.7	26	20.5	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-EQL (100)	-EQL (0.2)	NS	0.534	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (2.98)	-EQL (2.27)	-EQL (3.35)	-EQL (2.98)	-EQL (7.04)	-EQL (0.129)	-EQL (2.27)	
TNX 5D	TNX Secondary	Unconfined UTRAU/GAU	10-May-2017	47.1	212	4.9	5.5	0	102.4	80	6	1.8	20	21.5	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	600	-EQL (0.2)	NS	0.714	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	[3.01]	[1.64]	-EQL (3.35)	[3.01]	[3.4]	[1.64]	-EQL (2.73)	
TNX 9D	TNX Secondary	Unconfined UTRAU/GAU	11-May-2017	8.6	54	3.4	5.7	0	93.3	65	6	2	23	18.8	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1250	-EQL (0.2)	NS	0.0613	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	[2.34]	[0.95]	-EQL (3.35)	[2.34]	-EQL (9.55)	[0.22]	[0.733]	
TNX 12D	TNX Secondary	Unconfined UTRAU/GAU	11-May-2017	5.5	28	4.8	6.1	0	93.9	76	34	13.8	29	18.5	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	20500	0.497	NS	0.819	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	[5.21]	[1.94]	-EQL (3.35)	[5.21]	[5.88]	1.11	[0.835]	
TNX 24D	TNX Secondary	Unconfined UTRAU/GAU	11-May-2017	33.15	285	1.74	5.5	0	110.11	78	10	0.7	4	22	No Comments			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	-EQL (100)	-EQL (0.2)	NS	0.407	NS	NS	-EQL (5)	-EQL (5)	-EQL (1)	-EQL (2)	-EQL (1)	-EQL (1)	-EQL (1)	-EQL (4.69)	[0.16]	-EQL (3.35)	-EQL (4.69)	-EQL (8.68)	[0.159]	-EQL (1.68)	

Explanation

[##]	EPA Functional Guideline Code of 7 was applied to the result, indicating an estimated quantity.
-EQL(##)	Constituent was below detection. The sample-specific Estimated Quantitation Limit is in parentheses.
	Result exceeds applicable limit.
REJ	Result Rejected
	Result is less than the applicable limit and without EPA Functional Guidline qualifiers.
NS	Requested to be sampled but was not. See comments as to why not.
Blue Text	Not a required sample analysis.

Table B-2. Groundwater Monitoring Results for TNX-Area Wells, Fourth Quarter, 2017

| Table B-2 4Q 2017 TNX Annual Groundwater and Monitoring Report | | | Field Data | | | | | | | | | | | | | TNX Monitoring Constituents | | | | | | | | | | | | |

APPENDIX C

DATA REVIEW KEY

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Key to Reading the Tables

The following abbreviations may appear in the data tables:

Constituents

CCl_4	Carbon Tetrachloride
VC	Chloroethane (Vinyl Chloride)
cis-1,2-DCE	Cis-1,2-Dichloroethylene
NO_3/NO_2 as N	Nitrate-nitrite as Nitrogen
PCE	Tetrachloroethylene
TCE	Trichloroethylene

Contract Laboratories Available

EBL	Environmental Bioassay Lab
GEL	General Engineering Lab
LVL	Lionville Laboratory
STL	Severn Trent Lab

Nomenclature

AZ		Aquifer Zone
CBAU	CBA	Crouch Branch Aquifer Unit (previously Black Creek)
CBCU	CBC	Crouch Branch Confining Unit
GAU	GAU	Gordon Aquifer Unit
GCCZ	GCU	Green Clay Confining Zone or Gordon Confining Unit
LAZ_UTRA	LAZ	Lower Aquifer Zone-Upper Three Runs Aquifer Unit
LLAZ	LLAZ	Lost Lake Aquifer Zone
LLLAZ	LL	Lower Lost Lake Aquifer Zone (previously Lower Congaree)
MAAZ	M	M-Area Aquifer Zone (previously Water Table)
MSAZ_CBCU	MCBC	Middle Sand Aquifer Zone-CBCU (previously Ellenton Sand)
PZ	PZ	Perched Zone
SPA	SP	Steed Pond Aquifer Unit
UAZ_UTRA	UAZ	Upper Aquifer Zone-Upper Three Runs Aquifer Unit
ULLAZ	UL	Upper Lost Lake Aquifer Zone (previously Upper Congaree)
UNKNOWN	UNK	Unknown

Field Conditions

A	Pump is surging excessively; aerated
B	blank sample was collected
C	well is continuously pumping
D	well is dry-no sample or field data collected
E	equipment blank was collected
I	well went dry during sampling; field data collected but insufficient water to collect all samples
L	well went dry before sampling began; only depth to water can be determined
N	well was not stabilized before sampling began
P	inaccessibility or mechanical failure prevented sample collection and field analysis of the water
S	no water in standpipe; for water level events only
T	samples were collected, but some samples were not sent to the laboratory due to high turbidity
W	unable to sample well because of stabilization or sampling equipment failure; water-level measurements were obtained
X	well went dry during purging; samples collected after well recovered measurements obtained
0	OK
1	Pump Dry
2	Sampled after recovery
3	Gallons purged through sample port
4	DI water taken from 772-7B
5	High turbidity
6	Flow meter leaking
7	Pump failure
8	Flow meter not operating
9	# gallons added
10	Well is inaccessible, well cannot be Sampled
11	Well abandoned
12	No water to surface
13	Field measurements only
14	Not all samples were collected
15	Equipment failure
16	No water in standpipe
17	Bailed well
18	Water level tape not long enough
19	Well not sampled, maintenance required
20	Well sampled, maintenance required

Field Conditions (continued)

21	Measurement Exceeded Criteria

Units

Deg C	degrees Celsius
Deg N	Degrees North
Deg W	Degrees West
E	East
ft	feet
mg/L	milligrams per liter
mV	millivolts
msl	mean sea level
N	North
nM	nanomoles
NTU	nepholometric turbidity unit
pCi/L	picoCuries per liter
pCi/mL	picoCuries per milliliter
pH	pH unit
μg/L	micrograms per liter
μS/cm	microSiemens per centimeter

Other

CLP	USEPA Functional Guideline Codes
E	exponential notation (e.g., 1.1E–09 = 1.1×10^{-9} = 0.0000000011)
STORET	USEPA STORET result qualifiers
Filt.	Data results after application of the Data Usability filter
MCL	Maximum Contaminant Level
NDD	"not decision data"
PDWS	primary drinking water standard
USEPA NPDWS	USEPA National Primary Drinking Water Standard
<EQL	less than the sample-specific estimated quantitation limit

Results Below Detection

For radiological analyses, the analytical result field contains the result recorded on the analytical instrument and reported by the laboratory, even if it is negative. For non-radiological analyses, if the analyte is not detected, the sample-specific estimated quantitation limit (EQL) is entered into the result field and is reported with a less than [<] sign. The EQL is defined as the lowest concentration that can be achieved reliably within specified limits of precision and accuracy during routine laboratory operating conditions. The sample-specific EQL is modified for sample concentration or dilution or unusual aliquot size that affects analytical sensitivity.

Calculated Result

The data tables (matrix tables) may include some calculated values of parameters to allow comparison of the sample concentration with the Maximum Contaminant Level (MCL) of the USEPA National Primary Drinking Water Standards. The calculated results have a "C" as the USEPA STORET code, listed in the "EPA" column. If any of the results used in the calculation were assigned a "J" qualifier, the calculated result was also assigned a "J" qualifier. Results for radium 226, radium 228, and uranium (total recoverable) that were <EQL, were treated as "zero" in the calculations.

- Radium-226 and radium-228 are counted as two contaminants, even though their standard is combined. The calculated result for "Radium 226 and Radium 228 (Combined)" is obtained by adding the result for radium 226 to the result for radium 228. If both results were below detection, the greater of the two values was used to represent the "<EQL" result for Radium 226 and Radium 228 (Combined)".

- The MCL for gross alpha particles radioactivity (15 pCi/L) applies to the calculated or "adjusted" gross alpha radioactivity. The "adjusted" gross alpha is defined as the gross alpha particle activity, excluding radon and naturally occurring uranium 234, 235, and 238. The result for "adjusted" gross alpha can also be determined by converting uranium (total recoverable) results from ug/L to pCi/L, using the conversion factor of 0.67 pCi/µg, and then subtracting the uranium activity from the unadjusted gross alpha activity. In some cases, uranium (total recoverable) was detected by the chemical method of analysis, but the gross alpha measurement of radioactivity was below detection. In these cases, since no calculation could be performed, the results for adjusted gross alpha was shown as less than the method detected limit.

- The Radionuclides Rule uses a "sum-of-the-fractions" method to determine whether a sample is in compliance with the MCL for beta particles and photon radioactivity. While the MCL is in "millirems", contaminants are analyzed in "pCi/L". Therefore, to determine compliance, each beta and photon emitter must be concerted from pCi/L to millirems using the conversion factors listed in the MCL column of the data tables (Matrix Tables). The average annual concentration of beta particle and photon radioactivity from man-made radionuclides in drinking water must not produce an annual dose equivalent to the total body or any internal organ greater than 4 millirem/yr (mrem/yr). For each emitter detected in a sample, the result was divided by the value in the MCL column of the data tables (Matrix Tables). This provided a fraction of how much the particular beta or photon emitter is providing towards the maximum of 4 mrem/yr for all of the beta photon emitters. Each fraction was then converted to a dose equivalent of 4 mrem/yr by multiplying the fraction by 4. The results for each emitter were then summed, and the calculated result shown as "beta and photon emitters' for comparison to the MCL of 4 mrem/yr.

Uncertainty and Data Usability

In April 1998, the South Carolina Department of Health and Environmental Control (SCDHEC) accepted guidance proposed by Savannah River Site (SRS) to apply a method for minimizing uncertainty in compliance decisions potentially affecting long-term monitoring or remediation (letter, Taylor to Cook; April 21, 1998). The method is applied by processing or "filtering" the data, using the United States Environmental Protection Agency (USEPA) Functional Guideline Codes (USEPA 1994; USEPA 1999) applied by the laboratories to qualify the analytical results. By removing all data with a result qualifier of "L", "R", "U", and "J" from consideration, groundwater data users can ensure that only quantified numerical results are applied to the decision process. The output of the filtering process populates the "Filt" column as follows:

1) "Null" or "blank" – Data not remarked. The analytical result is acceptable for use as reported, and the result is not greater than an associated concentration limit for the analyte.
   Rationale: The best result would be one without qualifiers, so the preferred choice would be the maximum result that did not have any qualifiers.
2) "J", "L", "N", "NJ", or "JL" – "J" identifies that the analyte was positively identified; the associated numerical value is an estimated concentration of the analyte in the sample. "L" Indicates the sample result is off scale high. "JL" Indicates an estimated quantity of a sample that is off scale high. "N" is used for all TIC (tentatively identified compounds) and indicates the presence of an analyte for which there is presumptive evidence to make a tentative identification. "NJ" means the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.
   Rationale: an estimate can still provide useful information. Although there may be a range of uncertainty around the actual value, the value itself may still grossly exceed a regulatory standard. However, a estimated value is less certain than an unqualified result. Therefore, this would be labeled as "NDD" (not decision data).
3) "U" - material analyzed for, but not detected. The analyte concentration is less than the sample specific Estimated Quantitation Limit and labeled "<EQL".

   Rationale: a result above the detection limit would be chosen before a result below detection so that the process is not biased toward false negatives.
4) "UJ" - result is not above the reported sample quantitation limit, but the reported quantitation limit itself is approximate, and may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

   Rationale: the additional qualifiers make this result less reliable for use than the "U" without qualifiers. These results would be labeled "<EQL".
5) "Rejected" – The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

   Rationale: the only value in providing this result in the report is to indicate that the lab attempted to analyze the sample. If there are any other results available, the result with the "R" qualifier should not be reported. If it is reported, it is definitely "NDD" (not decision data).

Holding Times

Standard analytical methods include a limit, called holding time, on the maximum elapsed time between sample collection and extraction or analysis by the laboratory. In the data tables (matrix tables), the result qualifier Q in the "EPA" column indicates that holding time was exceeded. Analyses performed beyond holding times may not yield valid results.

SCDHEC allows only 15 minutes elapse between sampling and analysis for pH. Thus, only field pH measurements can meet the holding time criterion; laboratory pH analyses always will exceed it.

The laboratory procedure used for the determination of specific conductance allows one day to elapse between sampling and analysis. Thus, laboratory specific conductance measurements may exceed the holding time criterion.

Data Qualification

The contract laboratories submit sample- or batch-specific quality assurance/quality control information either at the same time as analytical results or in a quarterly summary. Properly defined and used, data qualifiers can be a key component in assessing data usability. The USEPA Functional Guideline Codes (USEPA 1994; EPA 1999) used by the analytical laboratories are shown in the CLP result qualifier column are defined below. These modifiers appear in the data tables (matrix tables) under the associated with the "Qual code" in the drop down comment box of the result cell in the data tables (matrix tables). US EPA STORET codes appear in the data tables (matrix tables) associated with the "EPA code" in the drop down comment box of the result cell in the Matrix tables. USEPA STORET codes are defined below.

Concentrations that exceeded the USEPA NPDWS and are not "estimated quantities" (i.e. do not have a USEPA Functional Guideline Code of "J") are identified in the tables by a red background. Results shown in a lavender background are estimated quantities. Blue font indicates that a particular analysis is not required for a given well for the sampling event presented. An "NS" with a yellow background identifies analyses that were required but could not be completed. Results that were rejected by the laboratory are listed in the data tables (matrix tables) as "REJ", with a pink background.

"CLP" Qualifiers - USEPA Functional Guidelines Codes (USEPA 1994 and USEPA 1999)

(Blank)	Data not remarked. The analytical result is acceptable for use as reported.
J	The analyte was positively identified; the associated numerical value is an estimated concentration of the analyte in the sample.
R	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence of absence of the analyte cannot be verified. Assignment of *R* requires approval by the appropriate WSRC data validation coordinator.
U	Material analyzed for but not detected. Analytical result reported is less than the sample quantitation limit.
U J	The analyte was not detected above the reported sample quantitation limit. The reported quantitation limit is approximate, and may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

Note: These are only some of the qualifiers present in the database. All modifiers associated with the data are published in the official repository of the data.

"EPA" Qualifiers – USEPA STORET Codes

(Blank)	Data not remarked
C	The result is calculated.
I	The result is less than the ssEQL, but equal to or greater than the MDL. Always reported with an associated EPA functional Guideline Code qualifier of *J*.
K	The actual concentration is known to be less than the reported result.
L	The actual concentration is known to be less than the reported result.
N	There is presumptive evidence of the presence of an analyte.
O	Sample received by laboratory, but the analysis was lost or not performed.
Q	Sample was held beyond normal holding time prior to analysis.
V	The analyte was detected in both the method blank and the sample.
Y	The result is from an unpreserved or incorrectly preserved sample; the data may not be accurate.

Note: These are only some of the qualifiers present in the database. All modifiers associated with the data are published in the official repository of the data.

In addition, to the USEPA STORET codes, SRS applies qualifier codes to provide additional information. The SRS codes, also associated with the "EPA code" in the Matrix Tables are defined below.

"SRS" Qualifiers

1 Compound identification criteria were not met.
2 Laboratory control sample (LCS) or blank spike (BS) criteria were not met.
3 Inductively coupled plasma (ICP) serial dilution criteria were not met.
4 Matrix interference is present.
5 Matrix spike concentration was < 0.25× the sample concentration, and the percent recovery cannot be determined.
6 The analyte was detected in both the sample and associated field blank.
7 The analyte was detected in both the sample and associated rinsate.
8 The analyte was detected in both the sample and associated trip blank.
9 The field duplicate RPD was not within control limits.
10 Internal standard (IS) criteria were not met when the IS was used for quantitation.
11 Matrix spike recovery was not within the control limits.
12 A tentatively identified compound is a suspected aldol-condensation product.
13 Initial or continuing calibration criteria were not met.
14 Surrogate or tracer spike recovery is out of specification.
15 Graphite furnace atomic absorption QC: a. Duplicate injection criteria were not met; b. Post-digestion spike recovery was not within control limits and the sample absorbance is > 50% of the post-digestion spike absorbance.
16 The sample was analyzed by the method of standard additions.
17 Graphite furnace atomic absorption QC: the post-digestion spike recovery is not within control limits and the sample absorbance is < 50% of the post-digestion spike absorbance.
18 The laboratory duplicate relative percent difference (RPD) or matrix spike/matrix spike duplicate (MS/MSD) (RPD) was not within control limits.

Note: These are only some of the qualifiers present in the database. All modifiers associated with the data are published in the official repository of the data, the Environmental Restoration Data Management System database.

REFERENCES

SCDHEC, 1998. *RE: Groundwater Data Reporting Change at SRS*, Letter, G. K. Taylor (SCDHEC) to J. W. Cook (EPD/WSRC); April 21, 1998

USEPA, 1994. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, 9240.1-05-01, PB 94-963502, EPA540/R-94/013, February 1994; U.S. Environmental Protection Agency, Washington, DC

USEPA, 2000. EPA (U.S. Environmental Protection Agency, Office of Water), 2000. Federal Register, Vol. 56, No 236, Thursday, December 7, 2000, Rules and Regulations, 40 CFR Parts 9, 141, and 142; National Primary Drinking Water Regulations; Radionuclides; Final Rule

USEPA, 2002. EPA (U.S. Environmental Protection Agency, Office of Water), 2002. Implementation Guidance for Radionuclides; Appendix I, (beta and photon emitter conversion tables); EPA 816-F-00-002, March 2002. http://www.epa.gov/safewater

USEPA, 2003. EPA (U.S. Environmental Protection Agency, Office of Water), 2003. Alphabetical version in .pdf format of the EPA National Primary Drinking Water Stnars; EPA 816-F-03-016, June 2003. (For copies of the complete regulations regarding these contaminants, follow the links to the National Primary Drinking Water Regulations. http://www.epa.gov/safewater/consumer/pdf/mcl..pdf)

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APPENDIX D

HYDROGRAPHS

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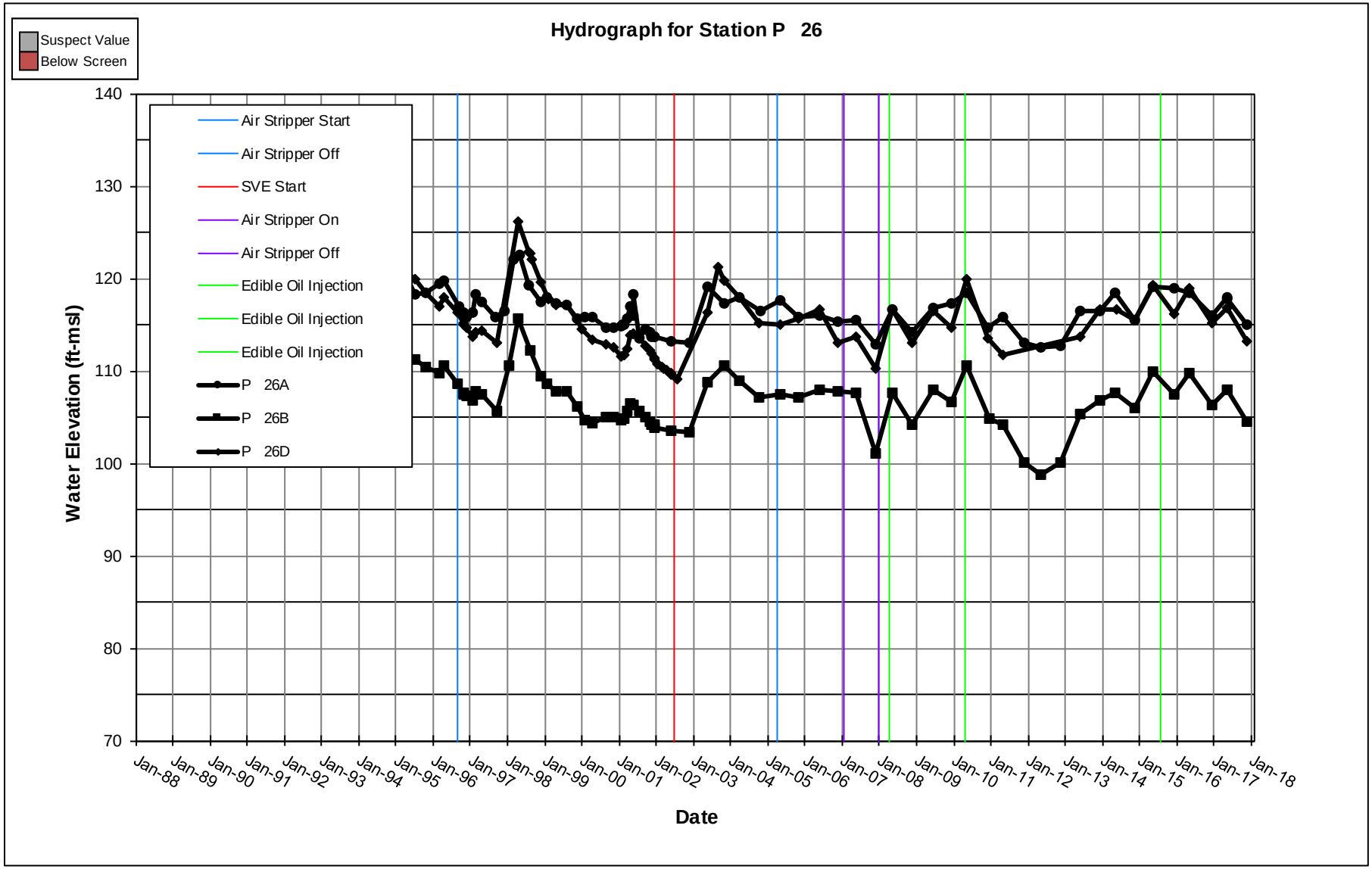
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Suspect Value
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Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
P 26A
P 26B
P 26D
Water Elevation (ft-msl)
140
130
120
110
100
90
80
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Jan-88
Jan-89
Jan-90
Jan-91
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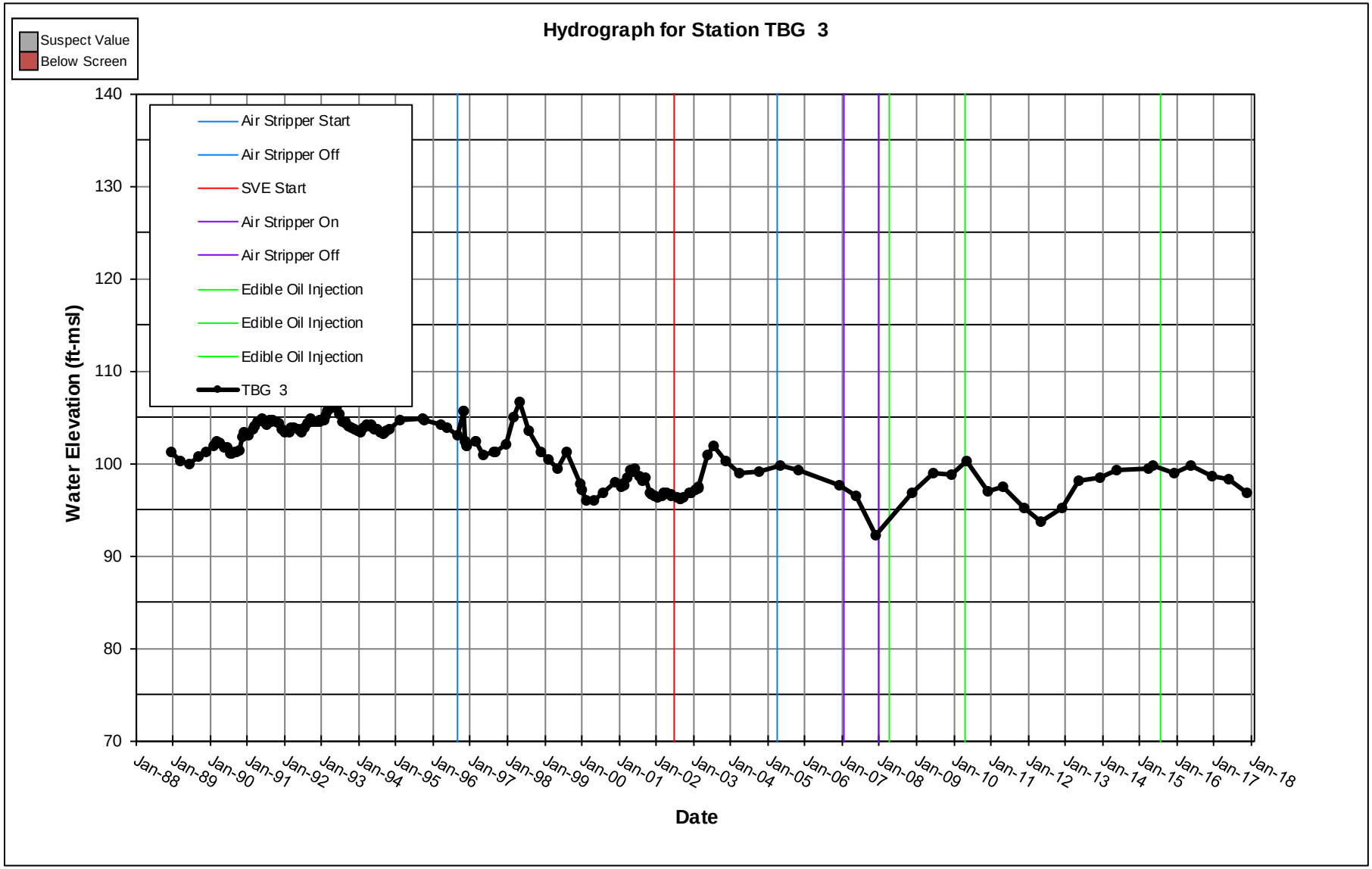
Jan-17
Jan-18
Date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Suspect Value
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Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TBG 3
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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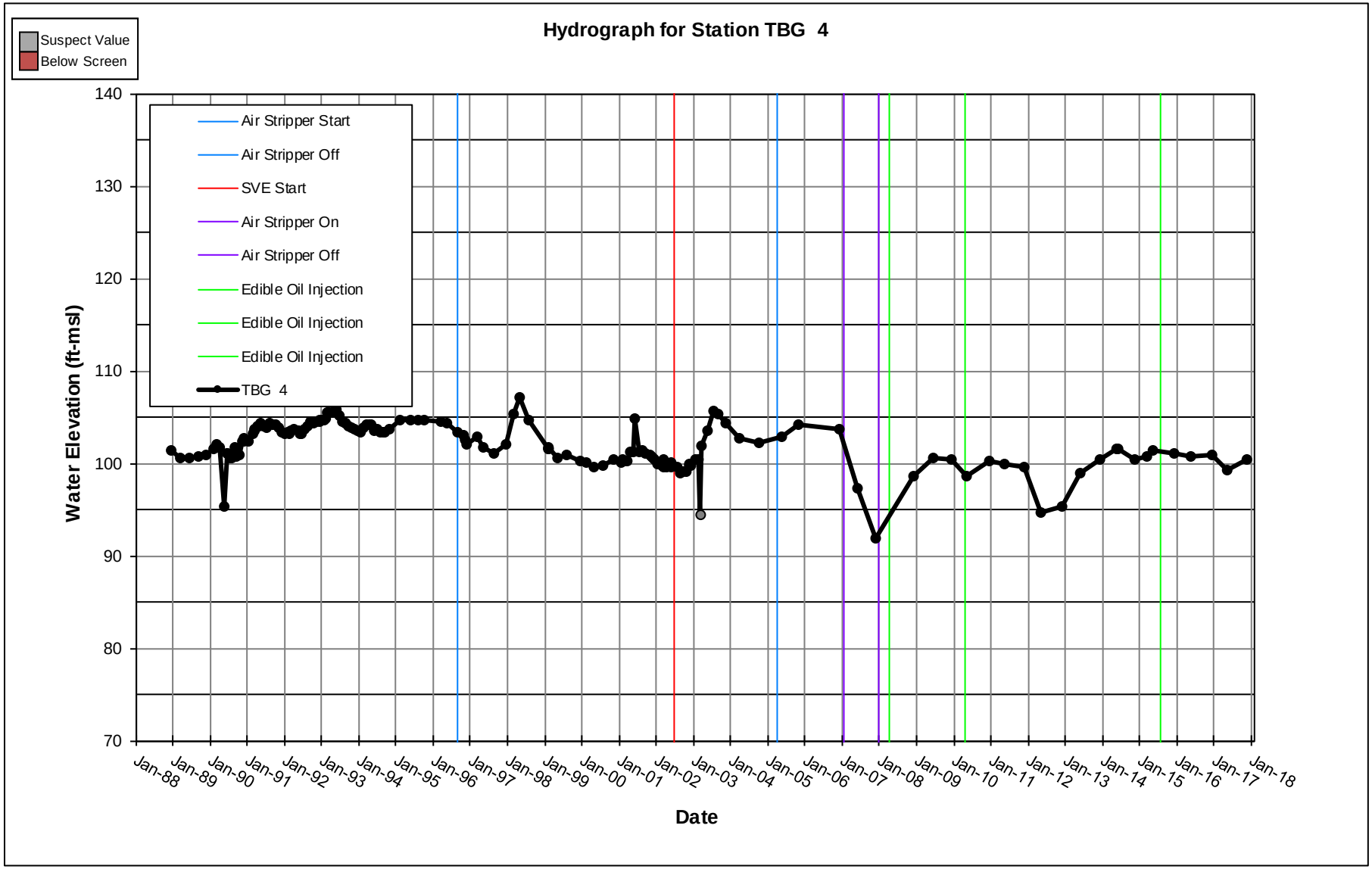
Jan-18
Date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Suspect Value
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Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TBG 4
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
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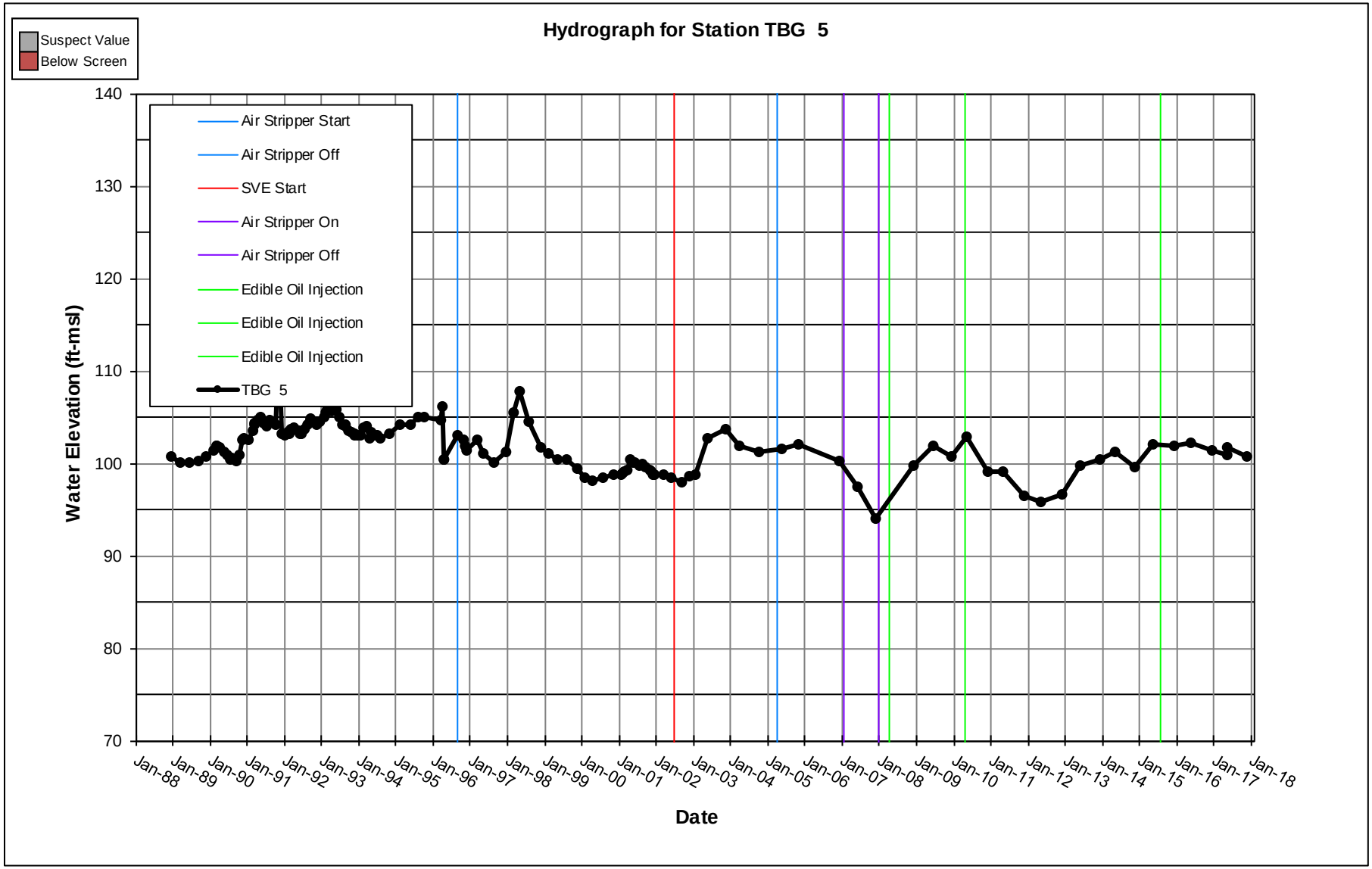
Date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Suspect Value
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Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TBG 5
Water Elevation (ft-msl)
140
130
120
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Jan-88
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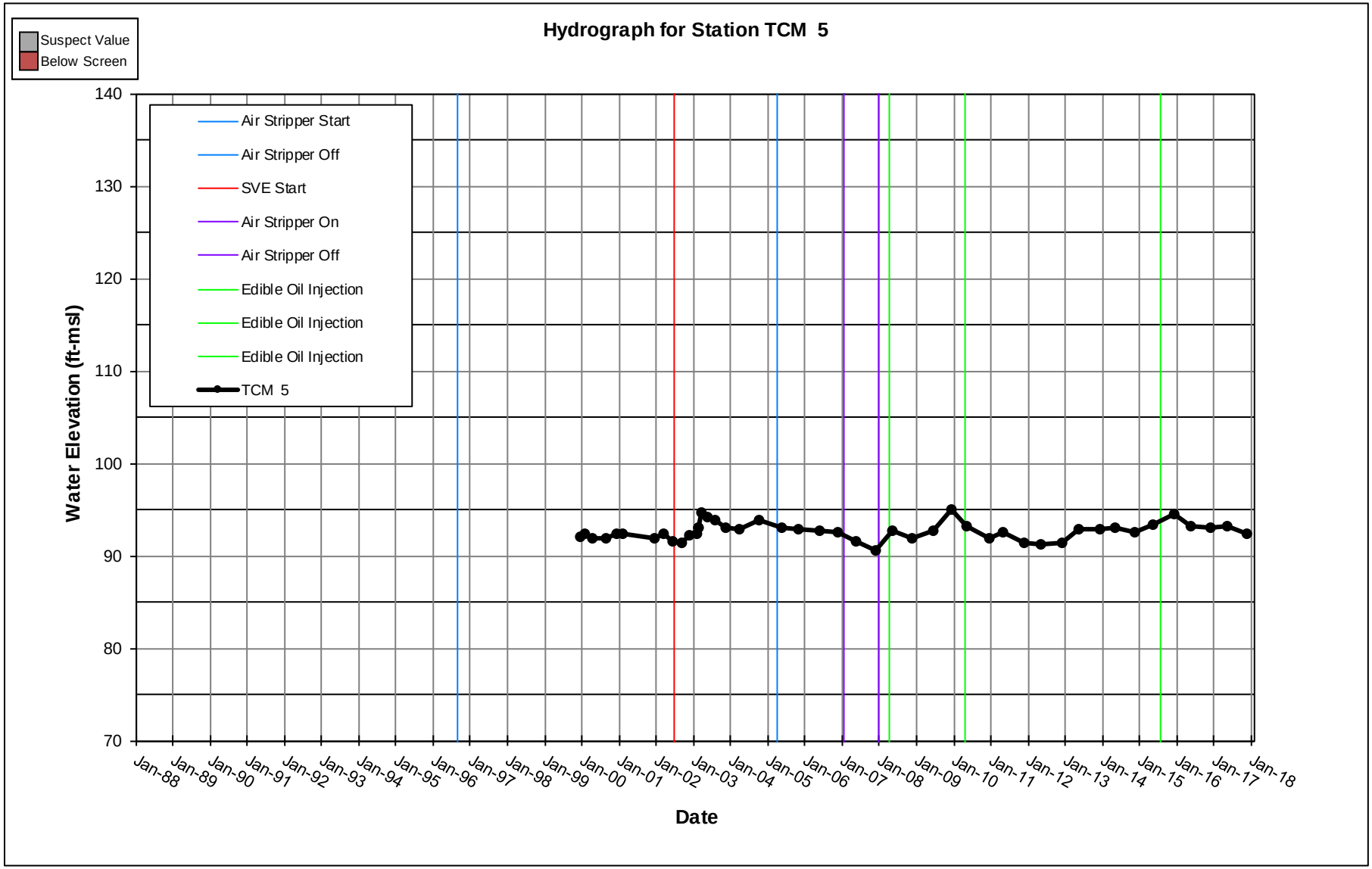
Date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Suspect Value
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Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TCM 5
Water Elevation (ft-msl)
140
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Jan-88
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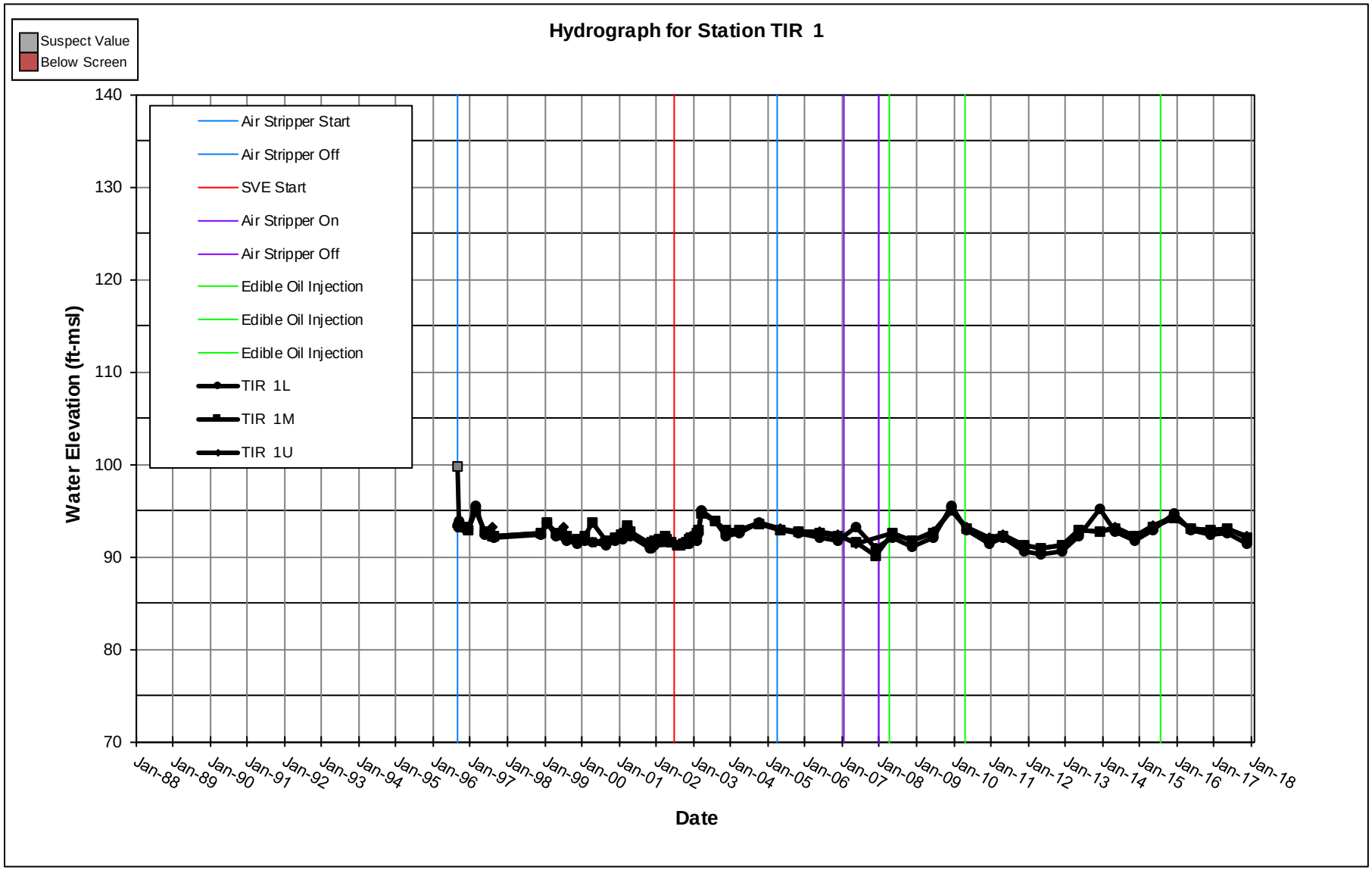
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Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TIR 1L
TIR 1M
TIR 1U
Water Elevation (ft-msl)
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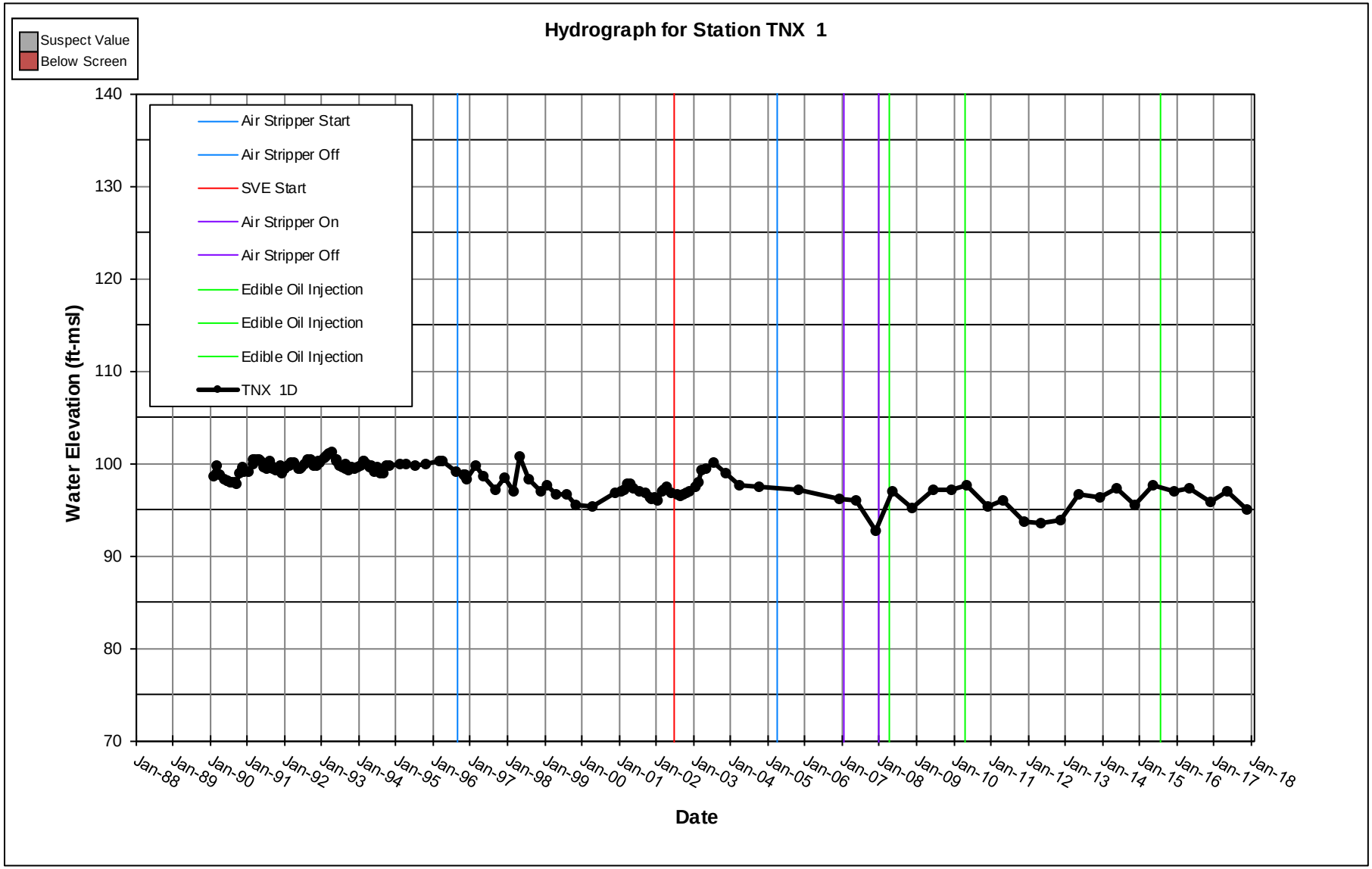
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Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 1D
Water Elevation (ft-msl)
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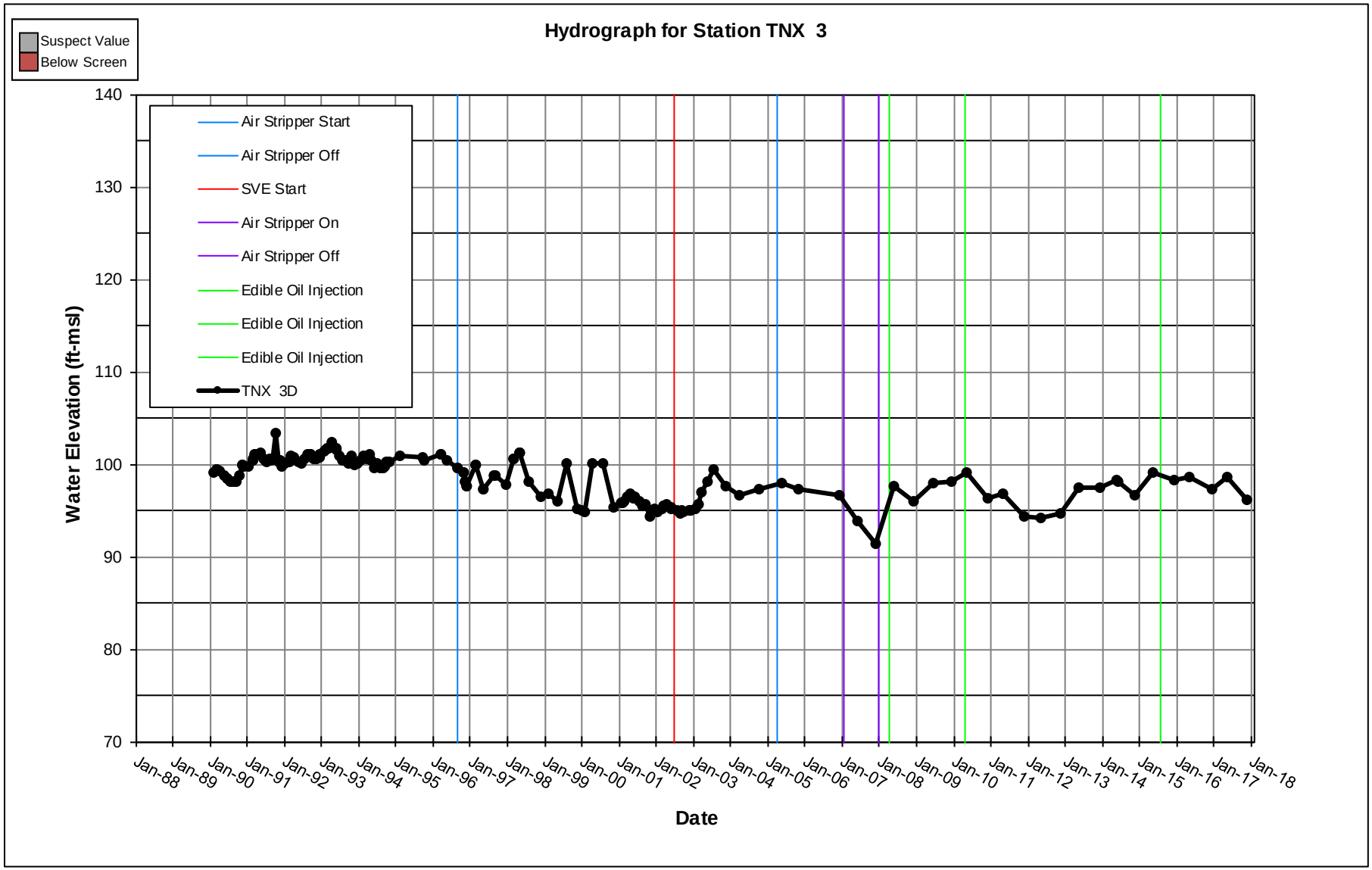
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Suspect Value
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Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 3D
Water Elevation (ft-msl)
140
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Jan-93
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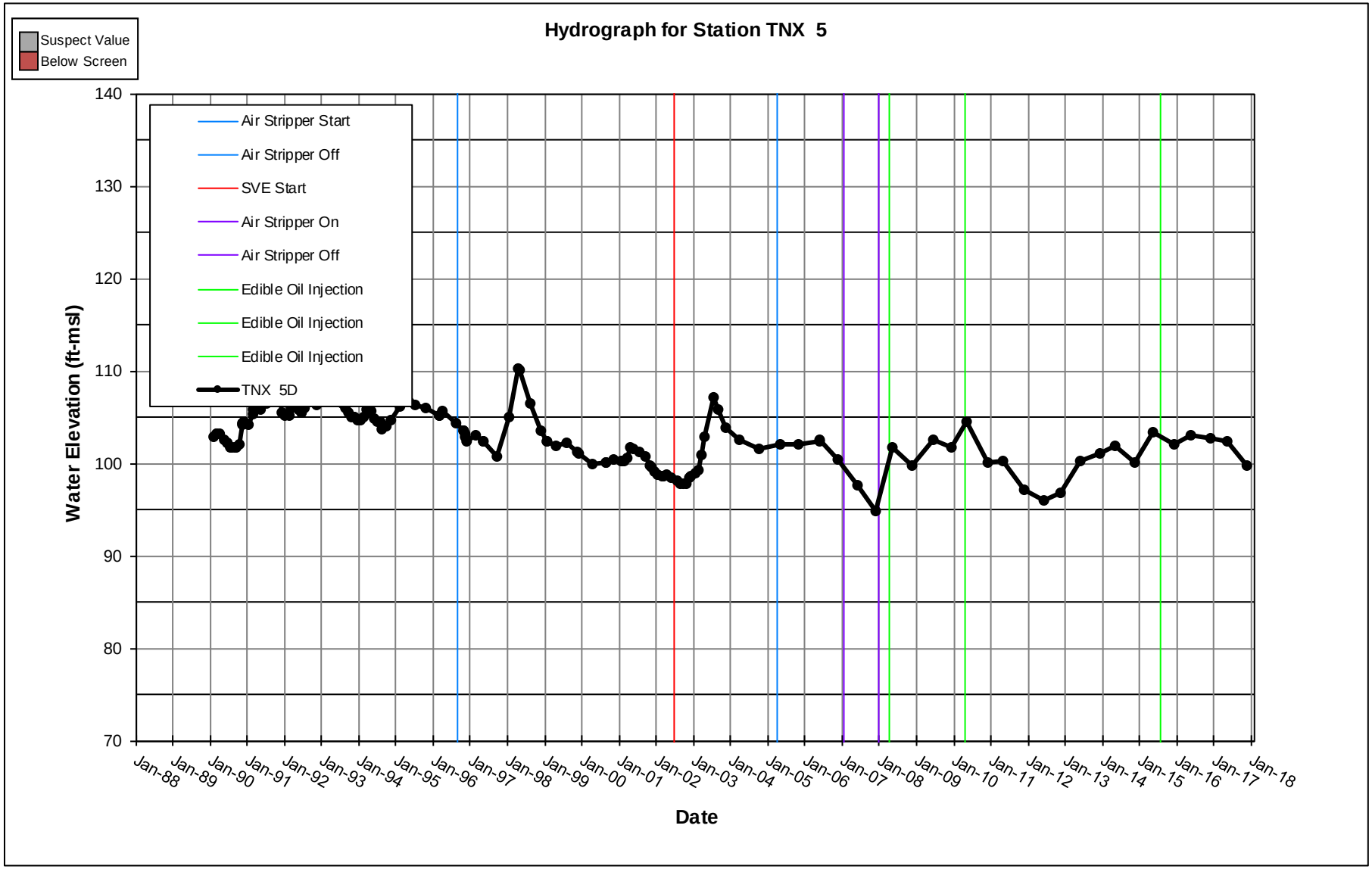
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Suspect Value
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Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 5D
Water Elevation (ft-msl)
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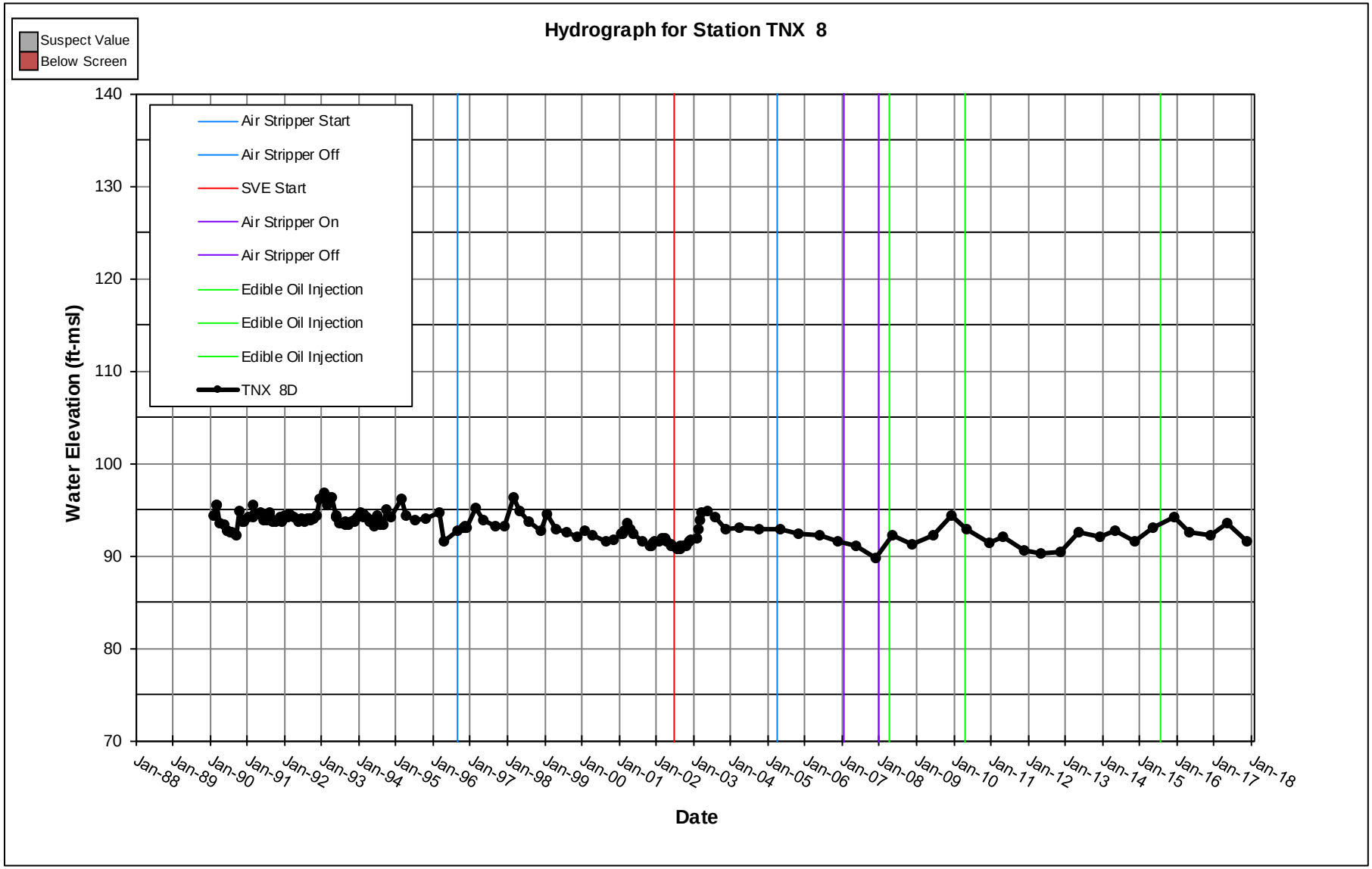
Date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Suspect Value
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Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 8D
Water Elevation (ft-msl)
140
130
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Jan-88
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Jan-93
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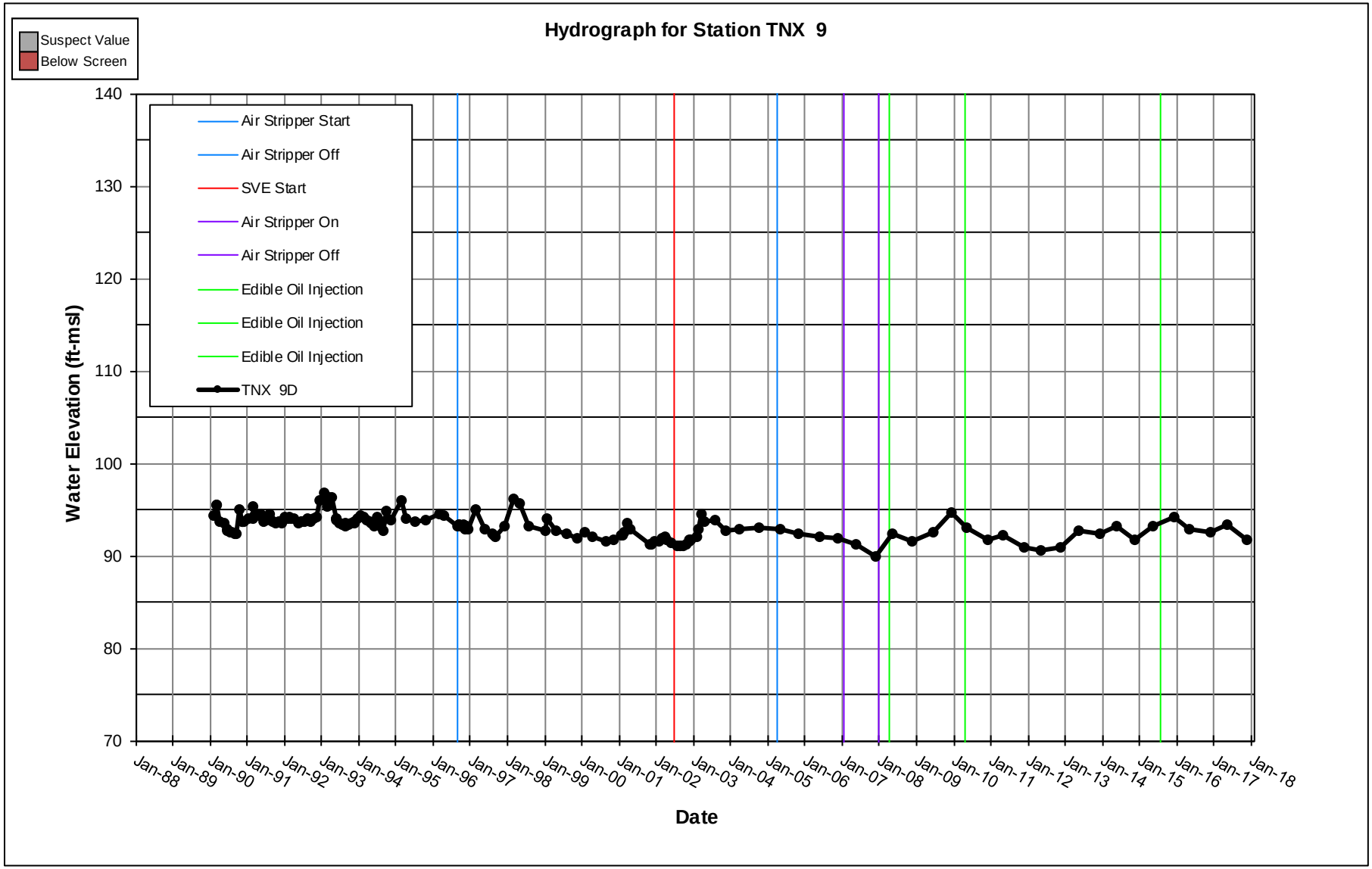
Date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Suspect Value
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Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 9D
Water Elevation (ft-msl)
140
130
120
110
100
90
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Jan-88
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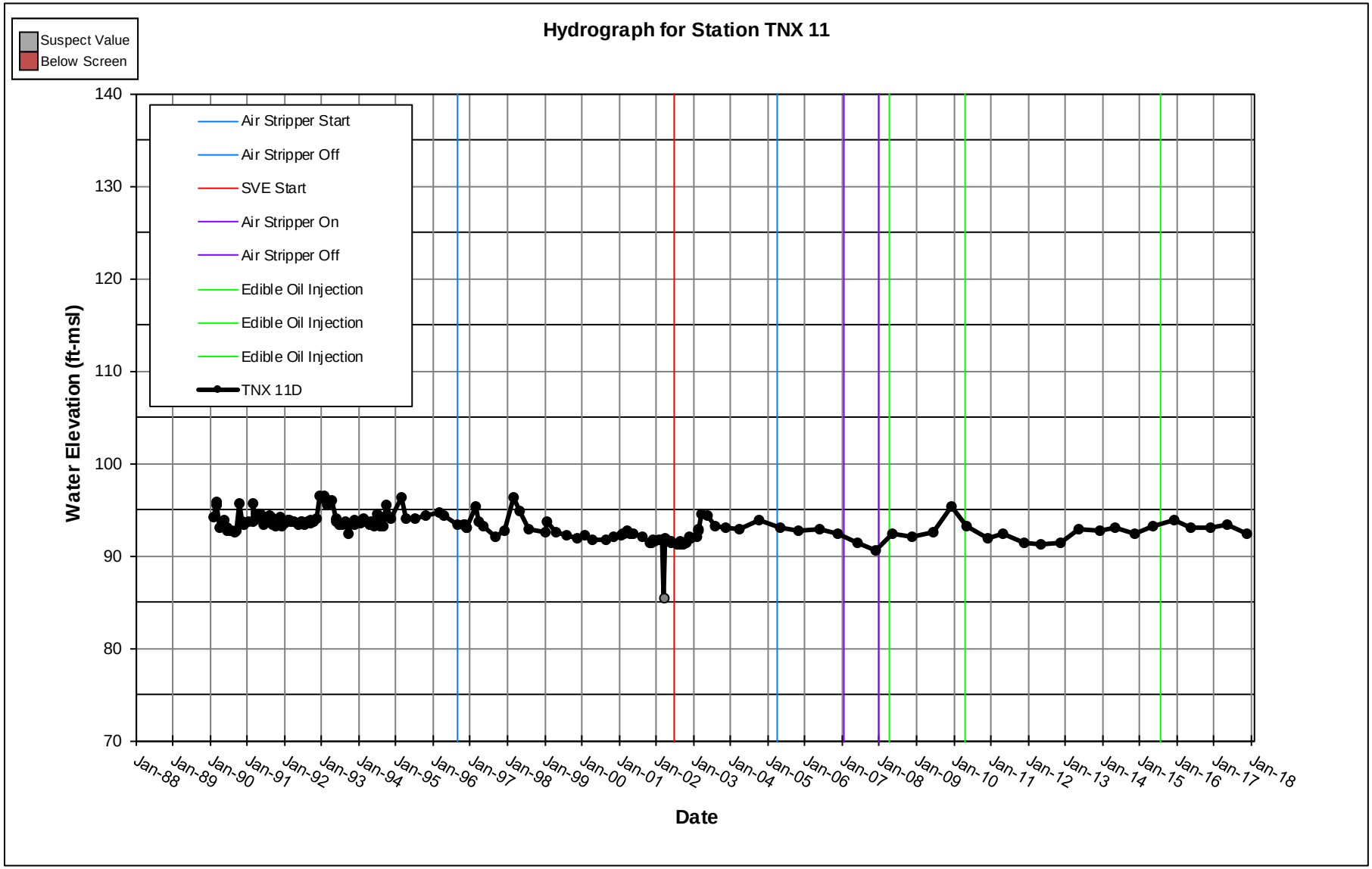
Hydrograph for Station TNX 11
Suspect Value
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Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 11D
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
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Jan-91
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Jan-93
Jan-94
Jan-95
Jan-96
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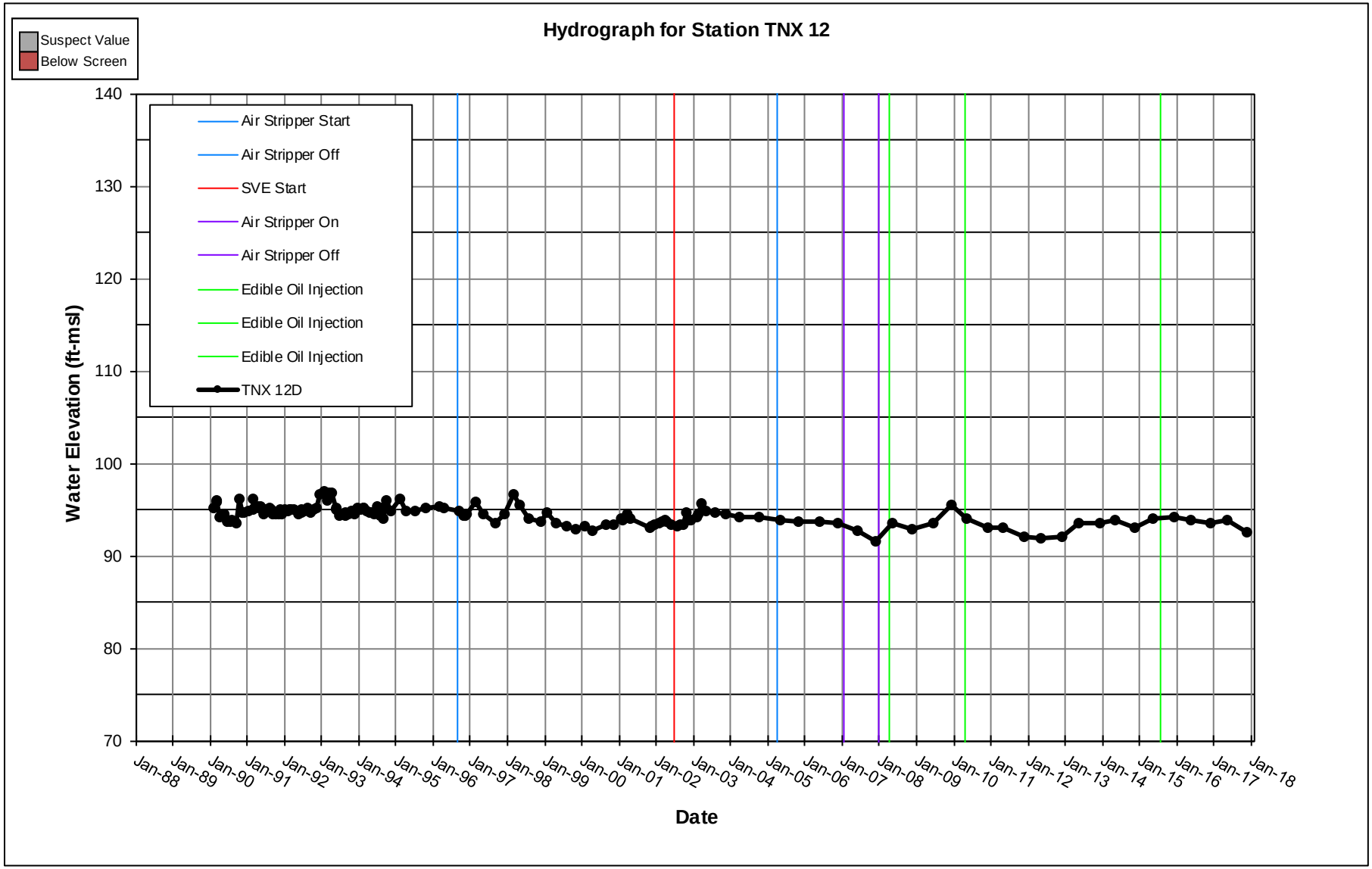
Jan-18
Date


Hydrograph for Station TNX 12
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 12D
Water Elevation (ft-msl)
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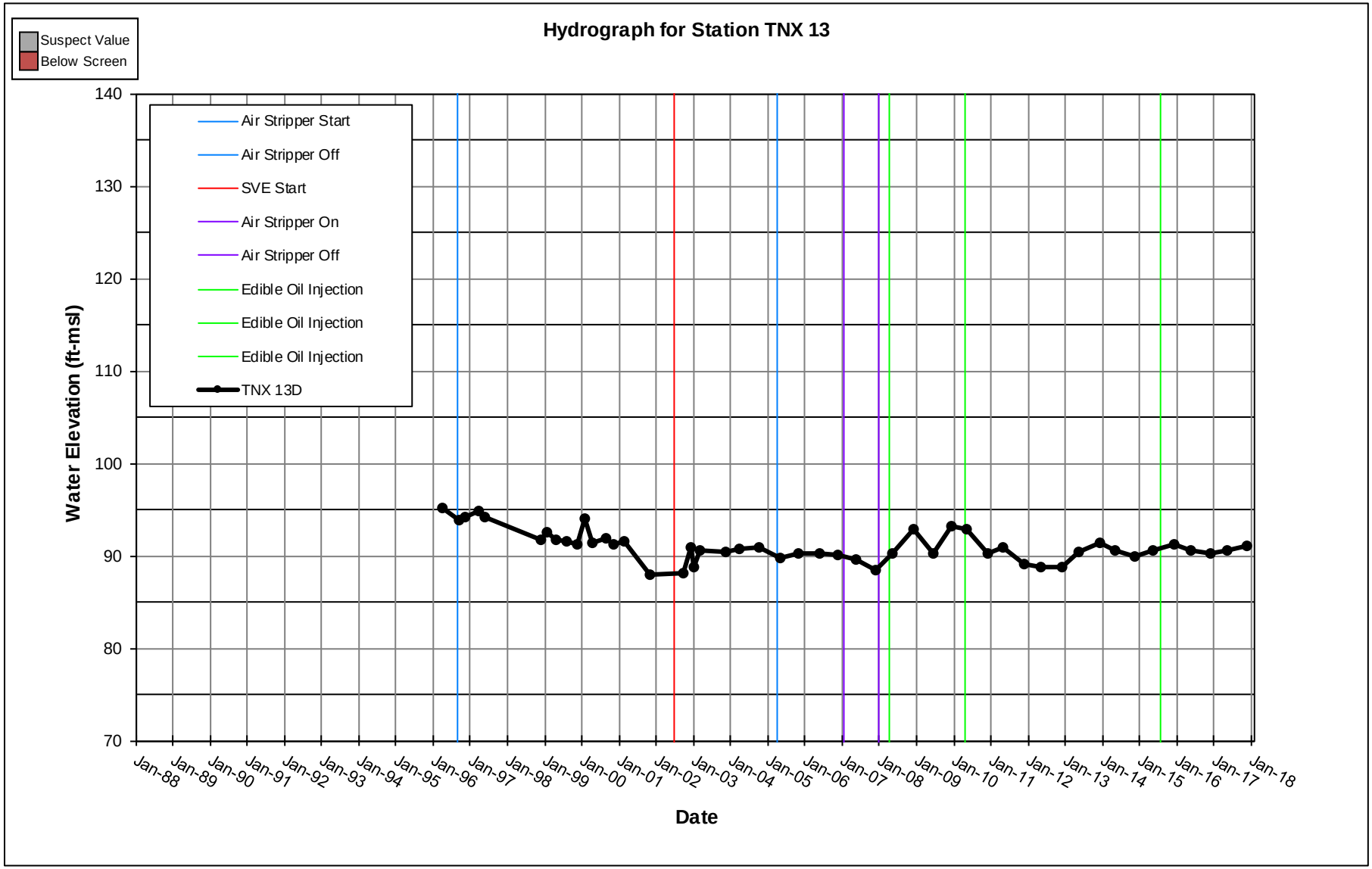
Hydrograph for Station TNX 13
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Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 13D
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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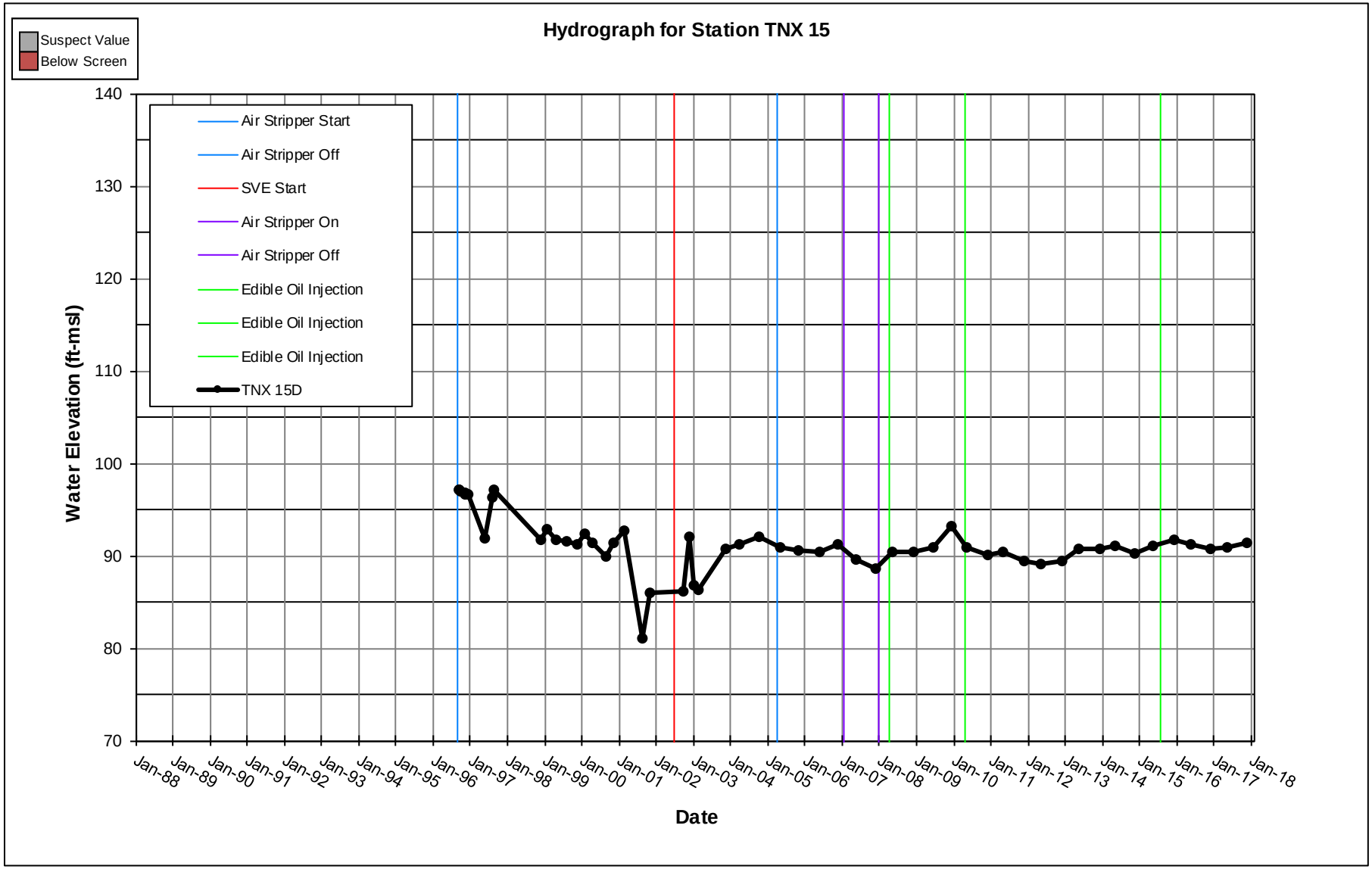
Jan-18
Date


Hydrograph for Station TNX 15
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 15D
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
Jan-91
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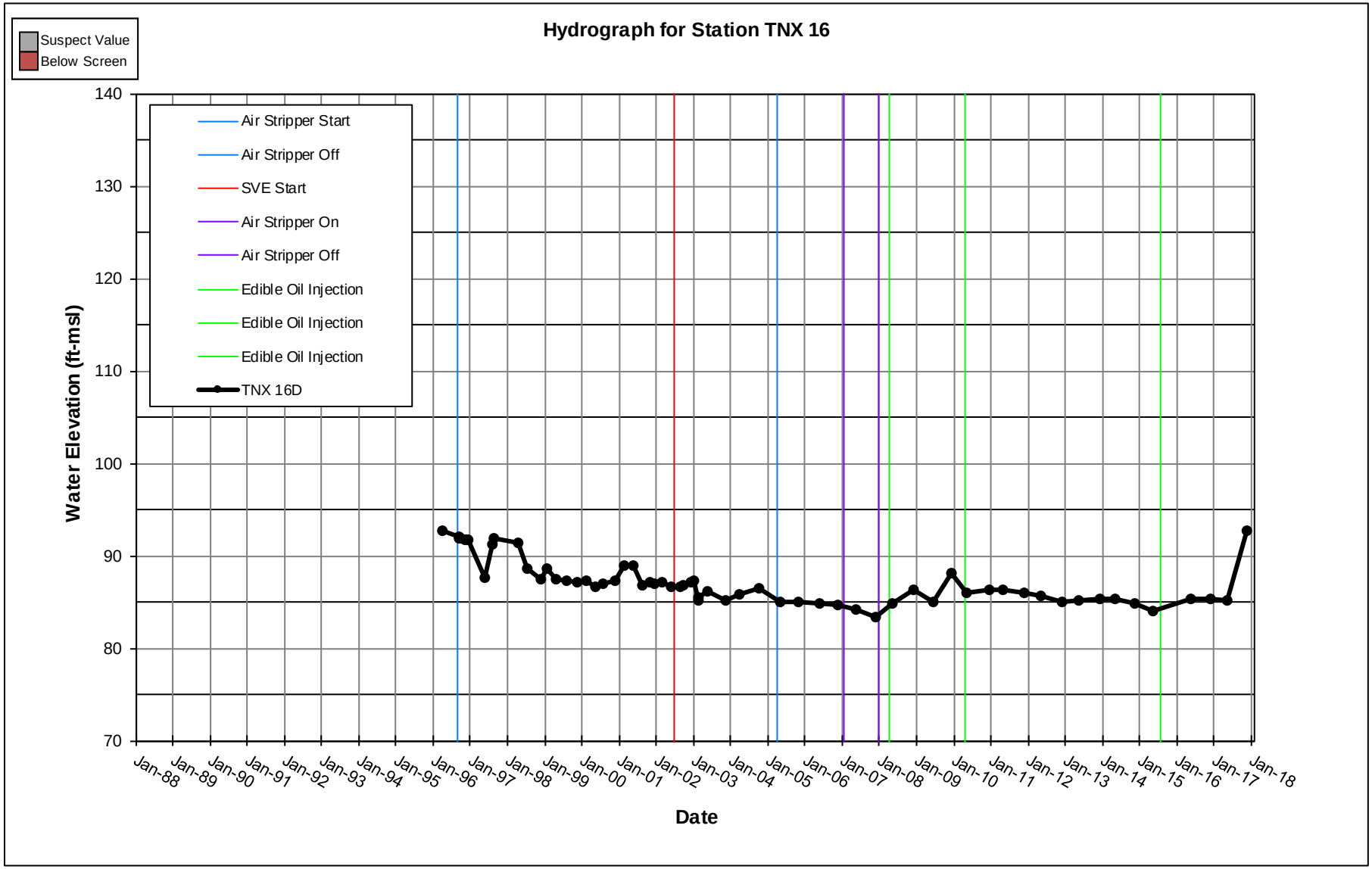
Date


Hydrograph for Station TNX 16
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 16D
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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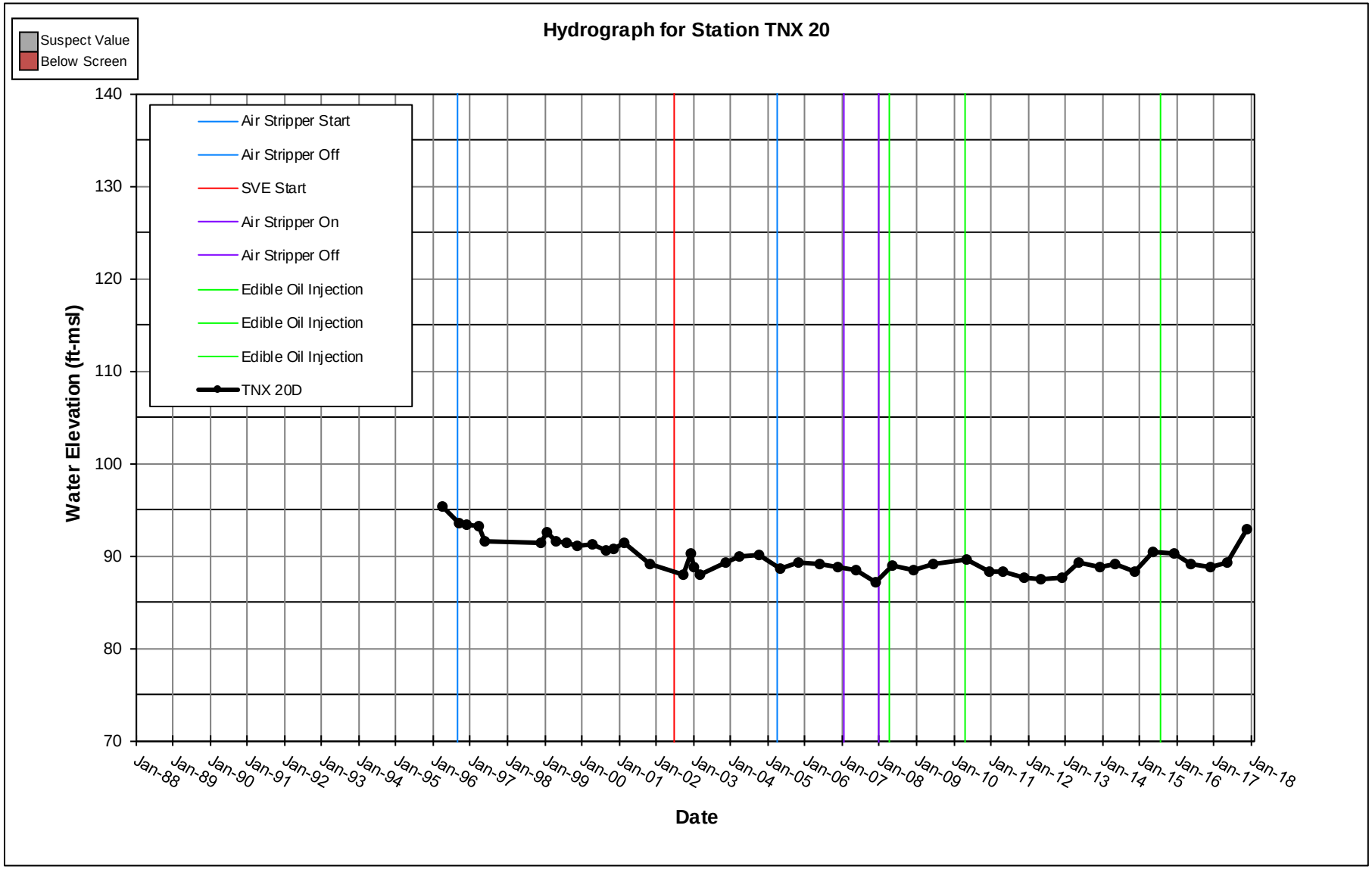
Jan-18
Date


Hydrograph for Station TNX 20
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 20D
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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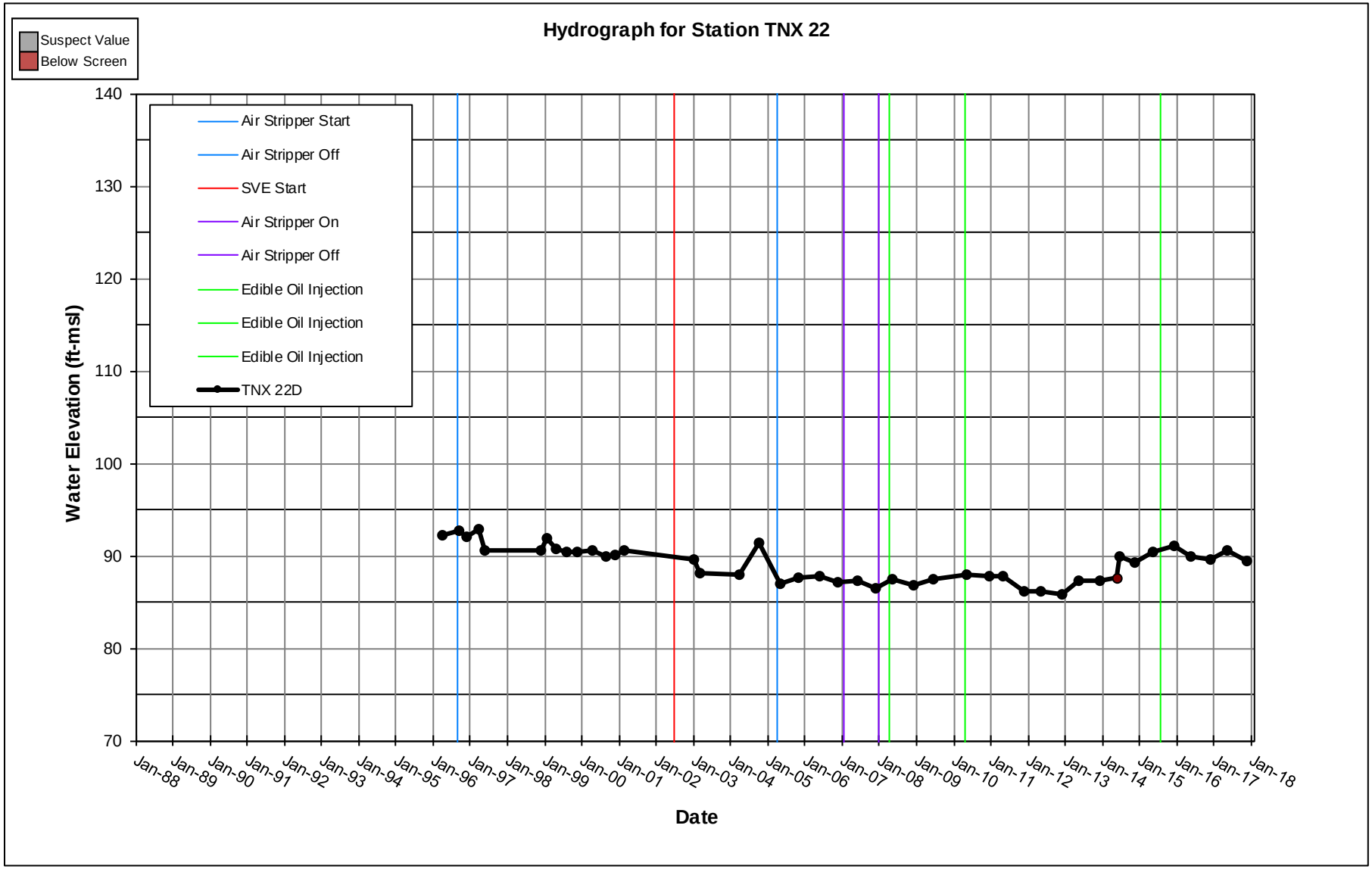
Jan-18
Date


Hydrograph for Station TNX 22
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 22D
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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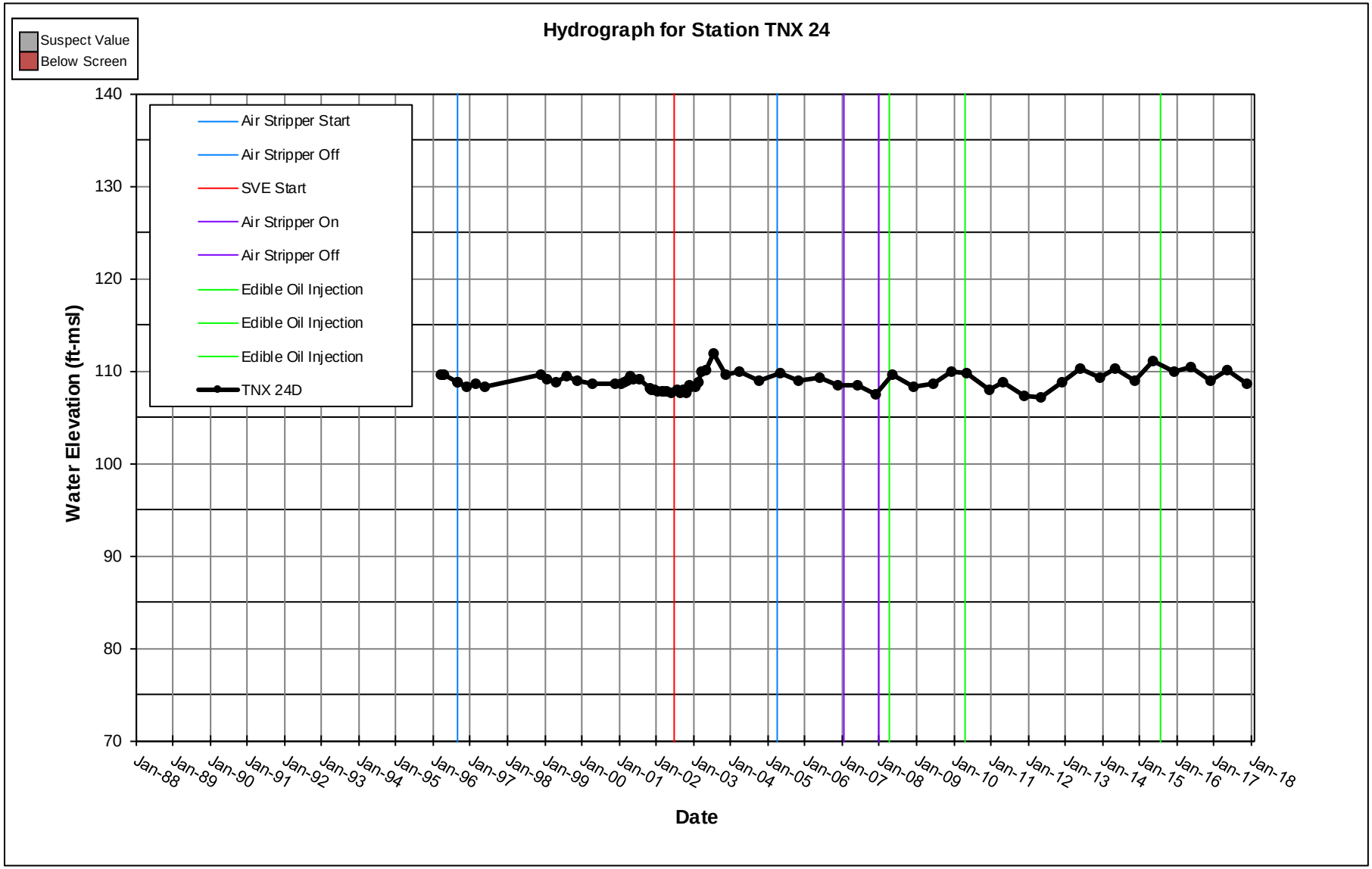
Jan-17
Jan-18
Date


Hydrograph for Station TNX 24
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 24D
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
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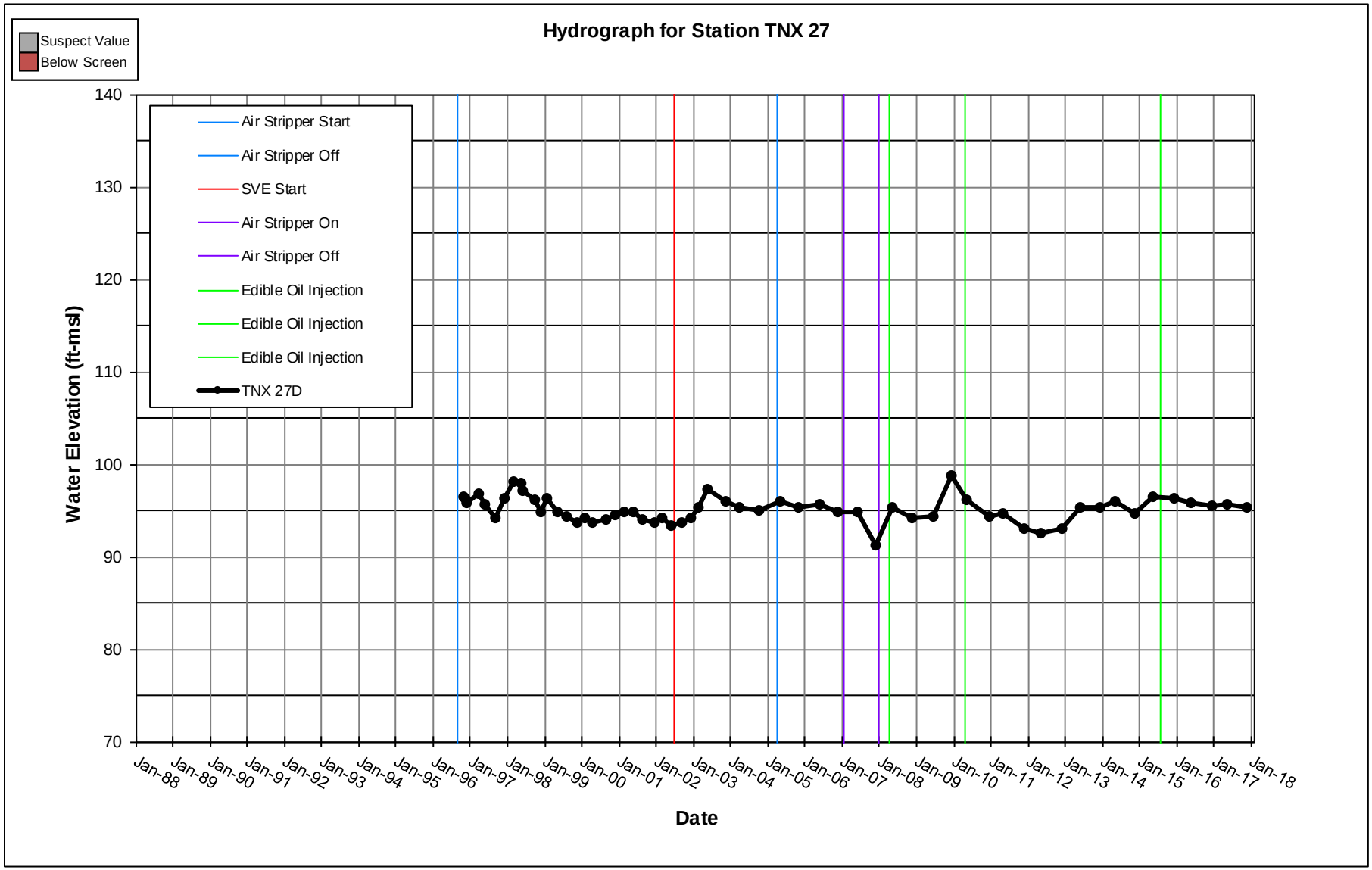
Jan-17
Jan-18
Date


Hydrograph for Station TNX 27
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 27D
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
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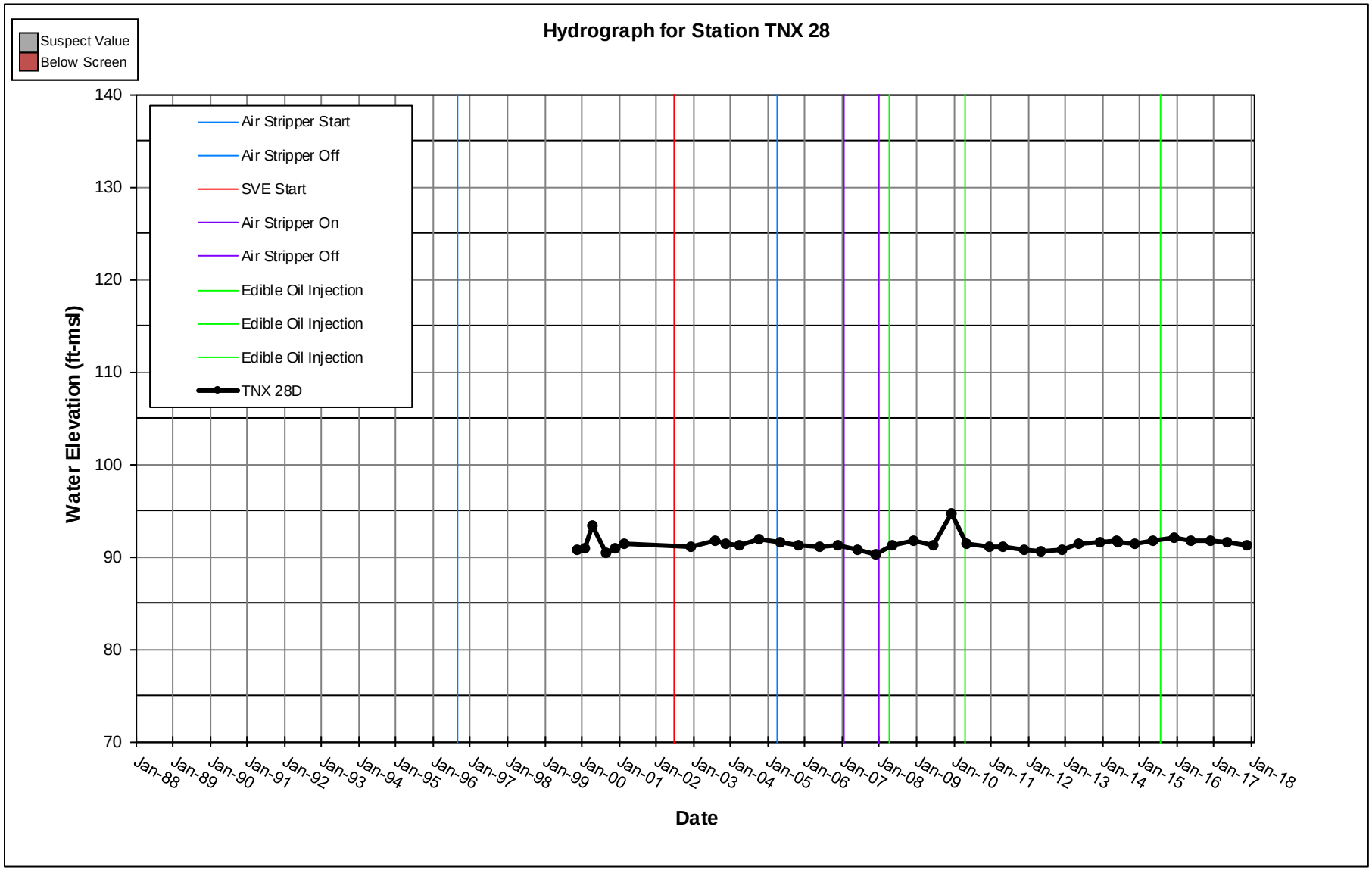
Jan-17
Jan-18
Date


Hydrograph for Station TNX 28
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 28D
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
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Jan-92
Jan-93
Jan-94
Jan-95
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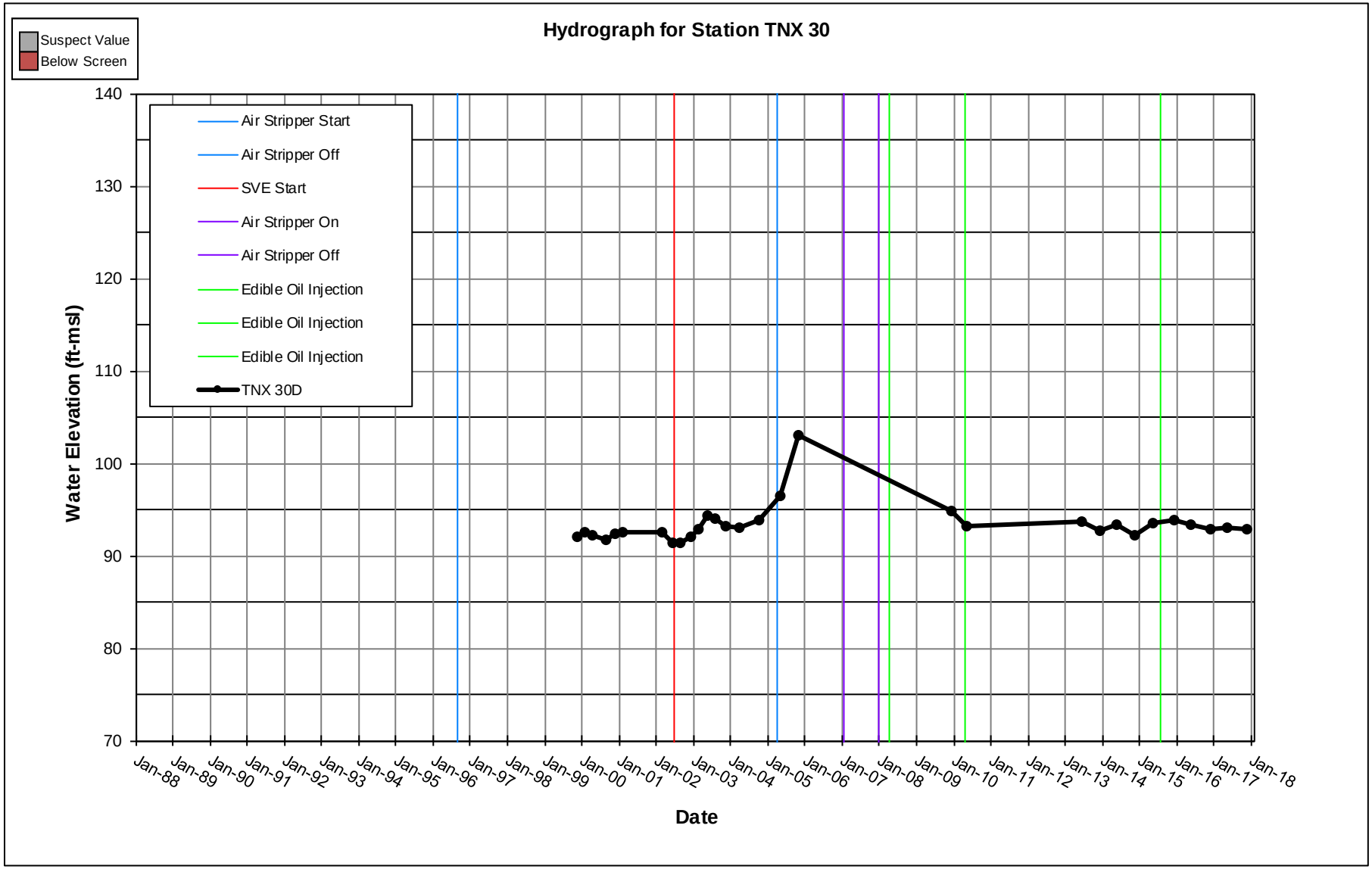
Jan-17
Jan-18
Date


Hydrograph for Station TNX 30
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 30D
Water Elevation (ft-msl)
140
130
120
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90
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Jan-88
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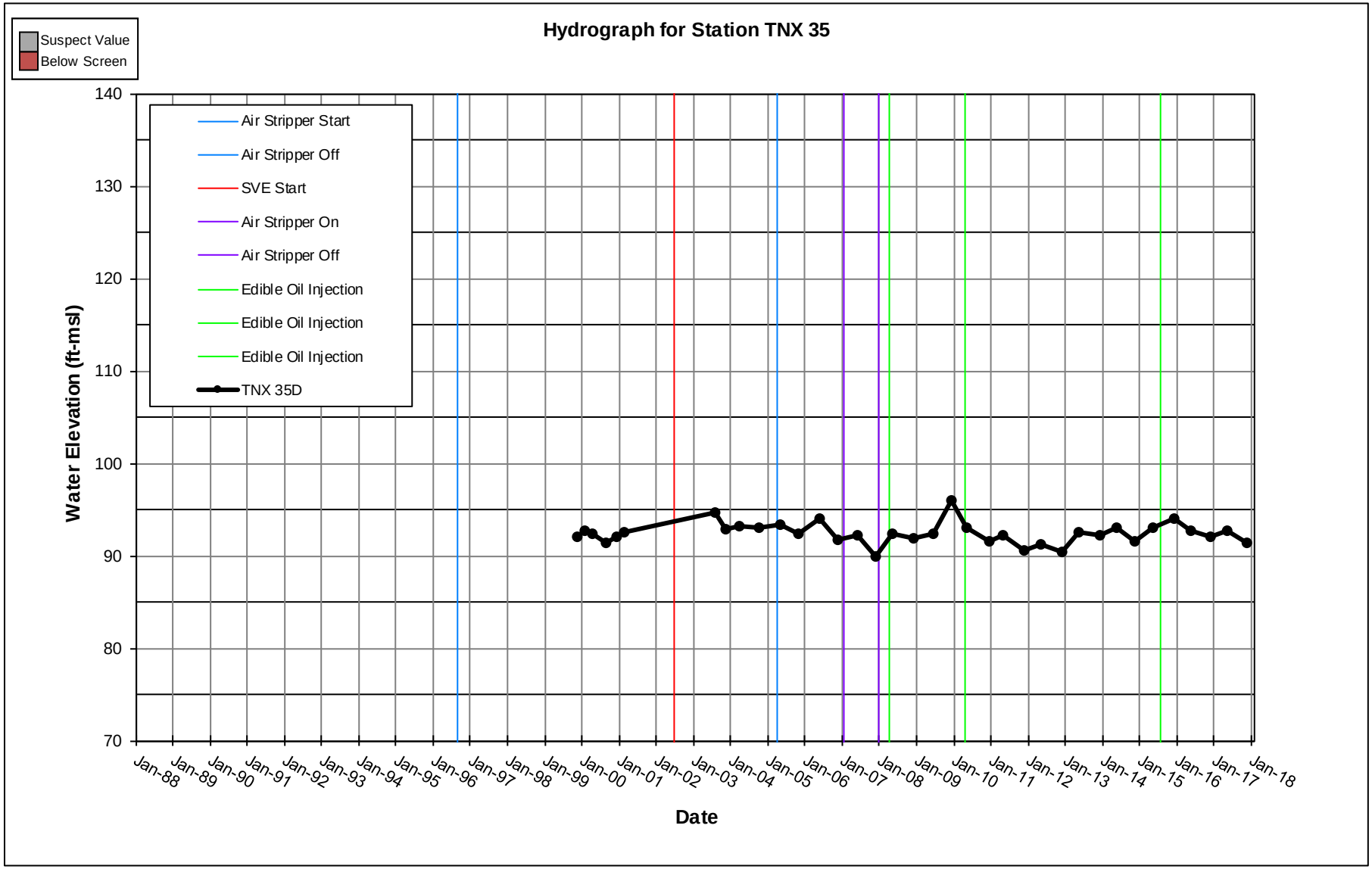
Jan-17
Jan-18
Date


Hydrograph for Station TNX 35
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 35D
Water Elevation (ft-msl)
140
130
120
110
100
90
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70
Jan-88
Jan-89
Jan-90
Jan-91
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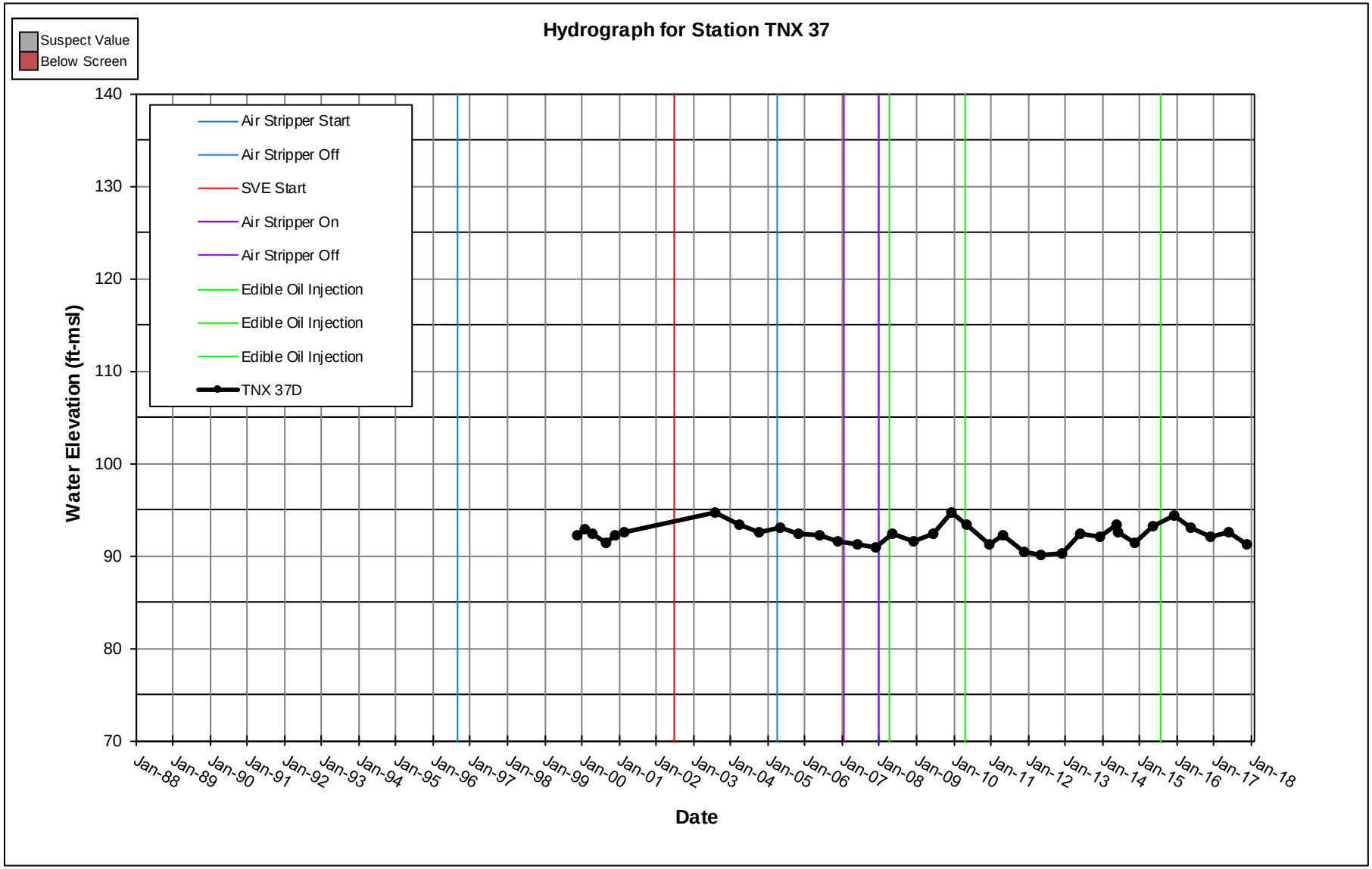
Date


Hydrograph for Station TNX 37
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 37D
Water Elevation (ft-msl)
140
130
120
110
100
90
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Jan-88
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Jan-92
Jan-93
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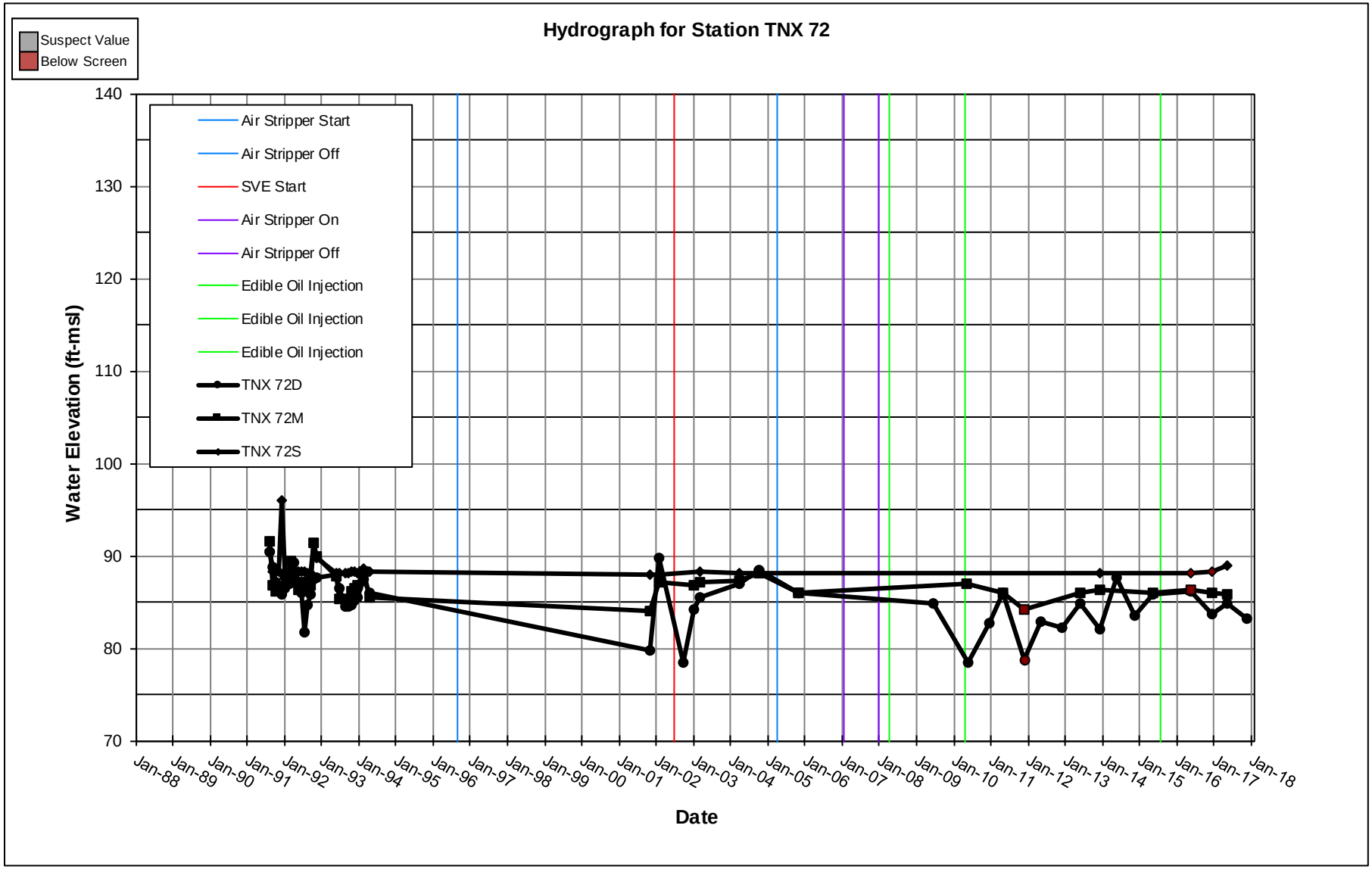
Date


Hydrograph for Station TNX 72
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX 72D
TNX 72M
TNX 72S
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
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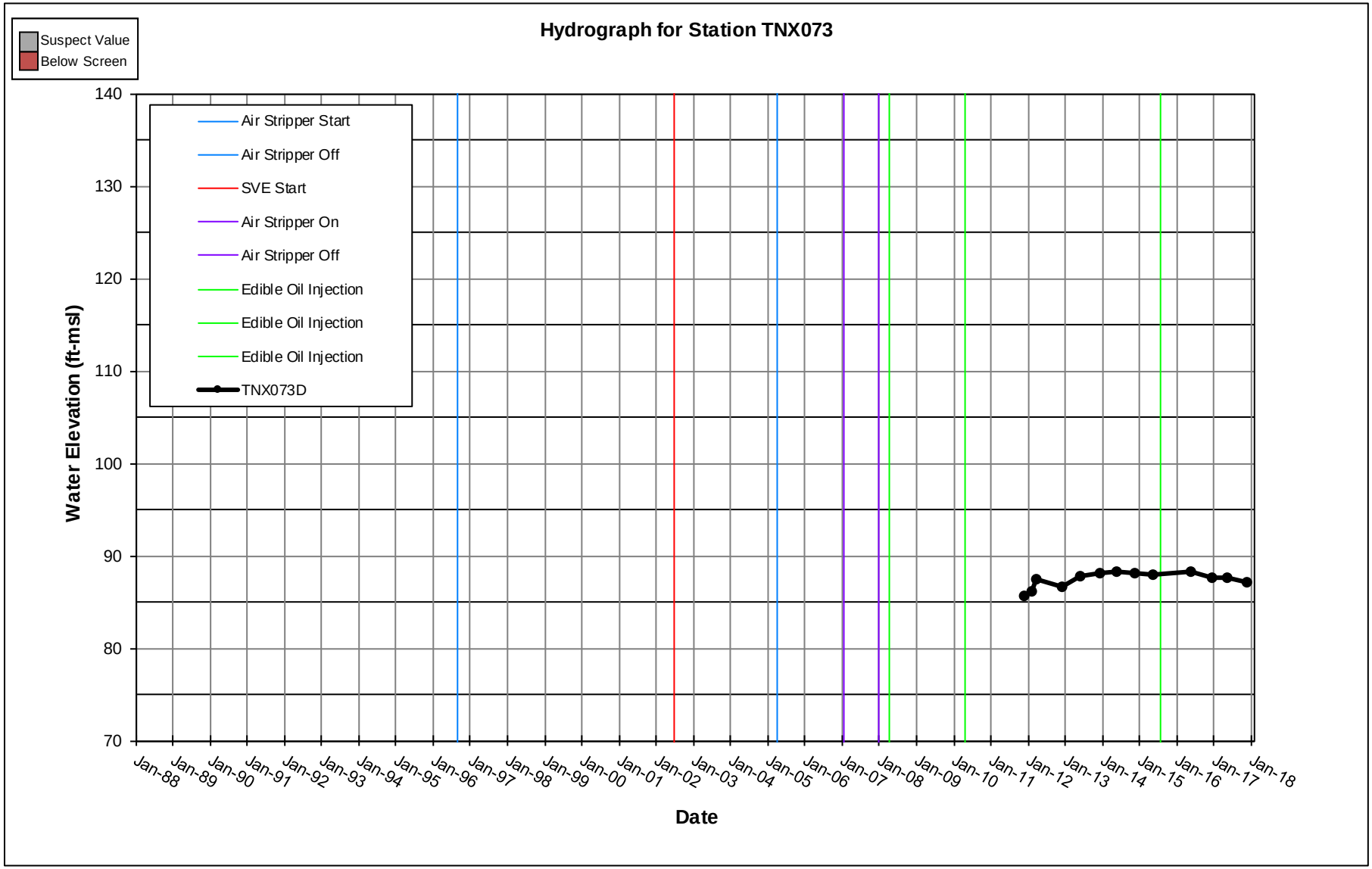
Date


Hydrograph for Station TNX073
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX073D
Water Elevation (ft-msl)
140
130
120
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Jan-88
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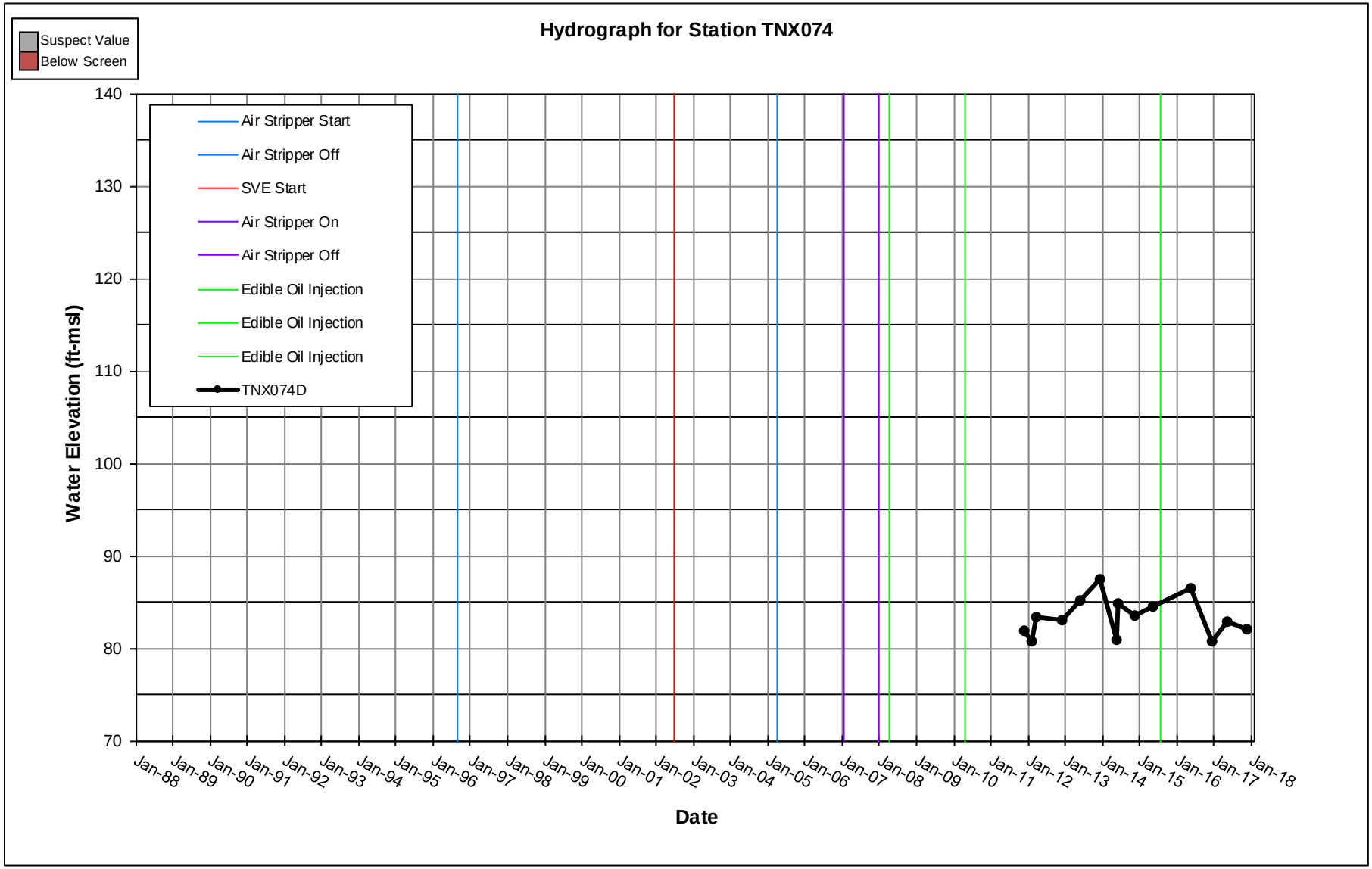
Date


Hydrograph for Station TNX074
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX074D
Water Elevation (ft-msl)
140
130
120
110
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Jan-88
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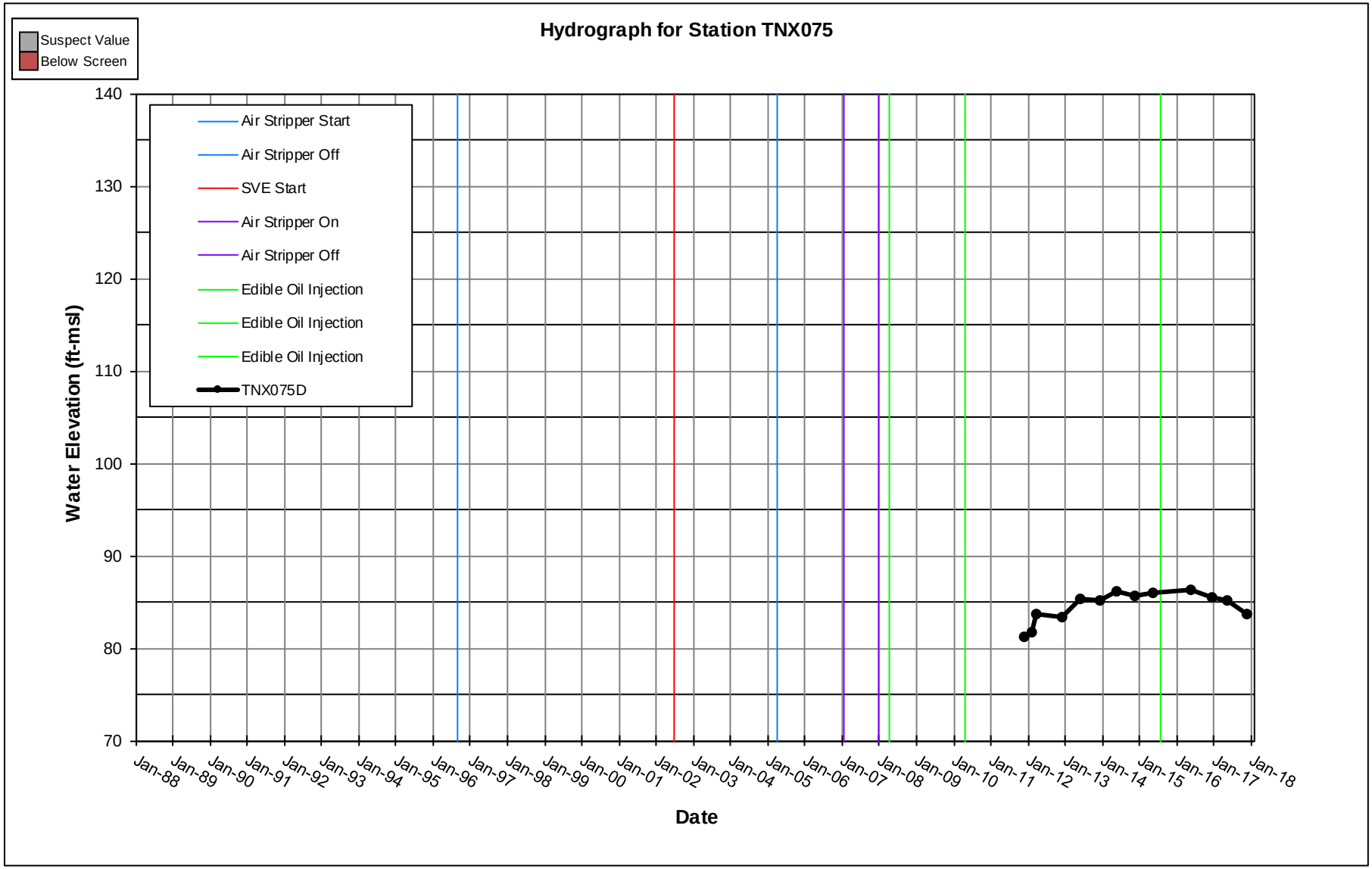
Date


Hydrograph for Station TNX075
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TNX075D
Water Elevation (ft-msl)
140
130
120
110
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90
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Jan-88
Jan-89
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Jan-92
Jan-93
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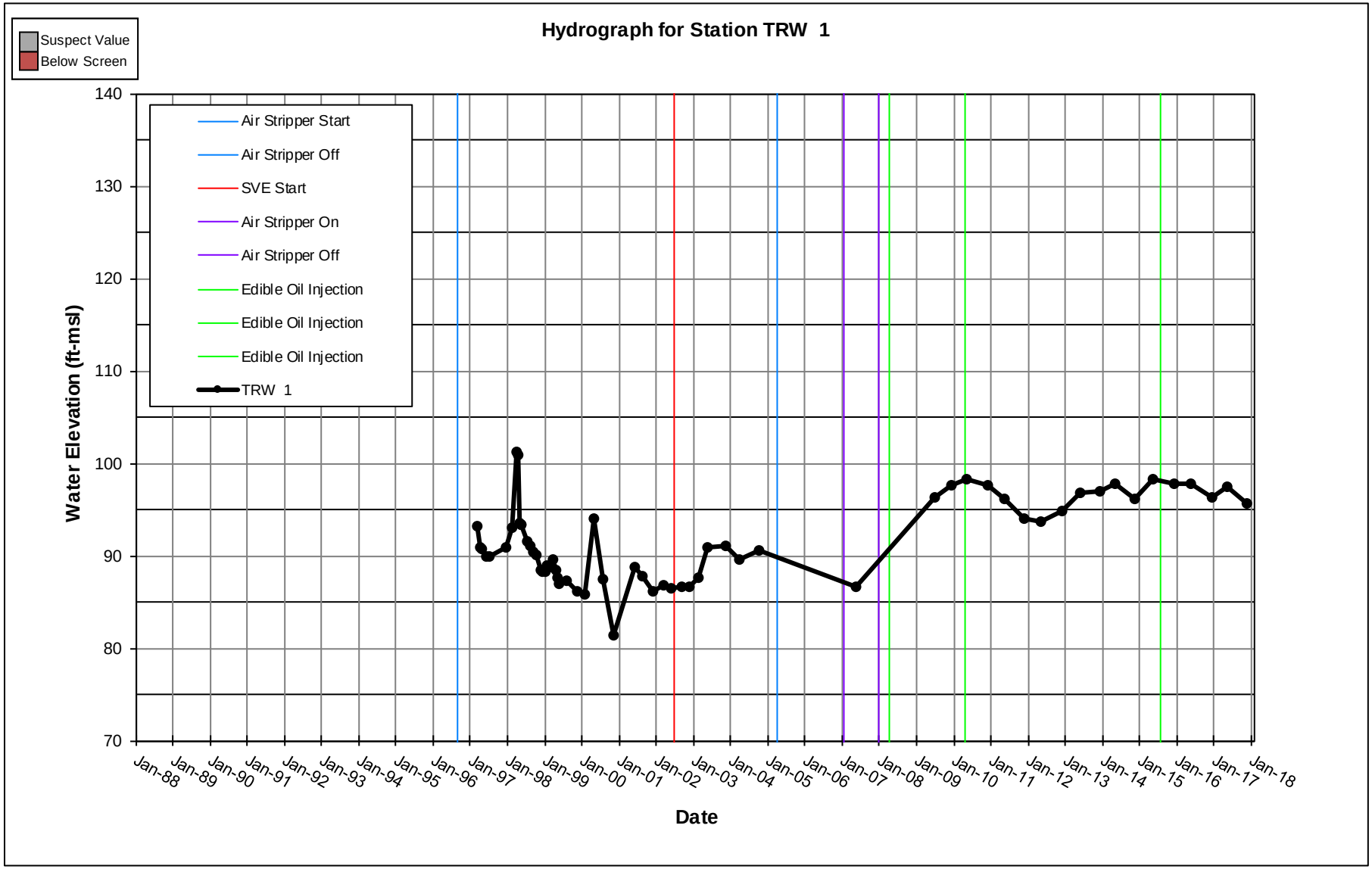
Date


Hydrograph for Station TRW 1
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TRW 1
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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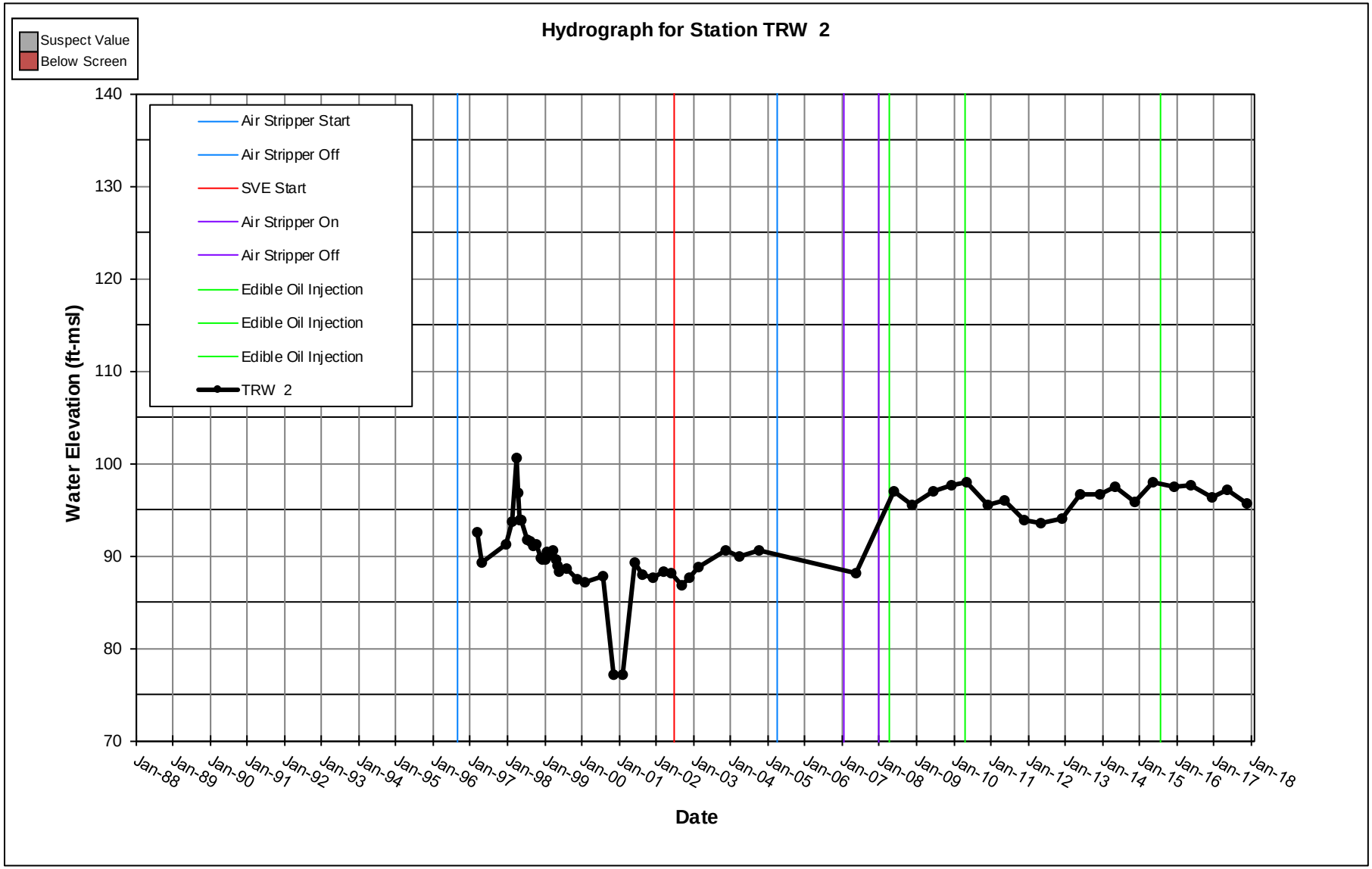
Date


Hydrograph for Station TRW 2
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TRW 2
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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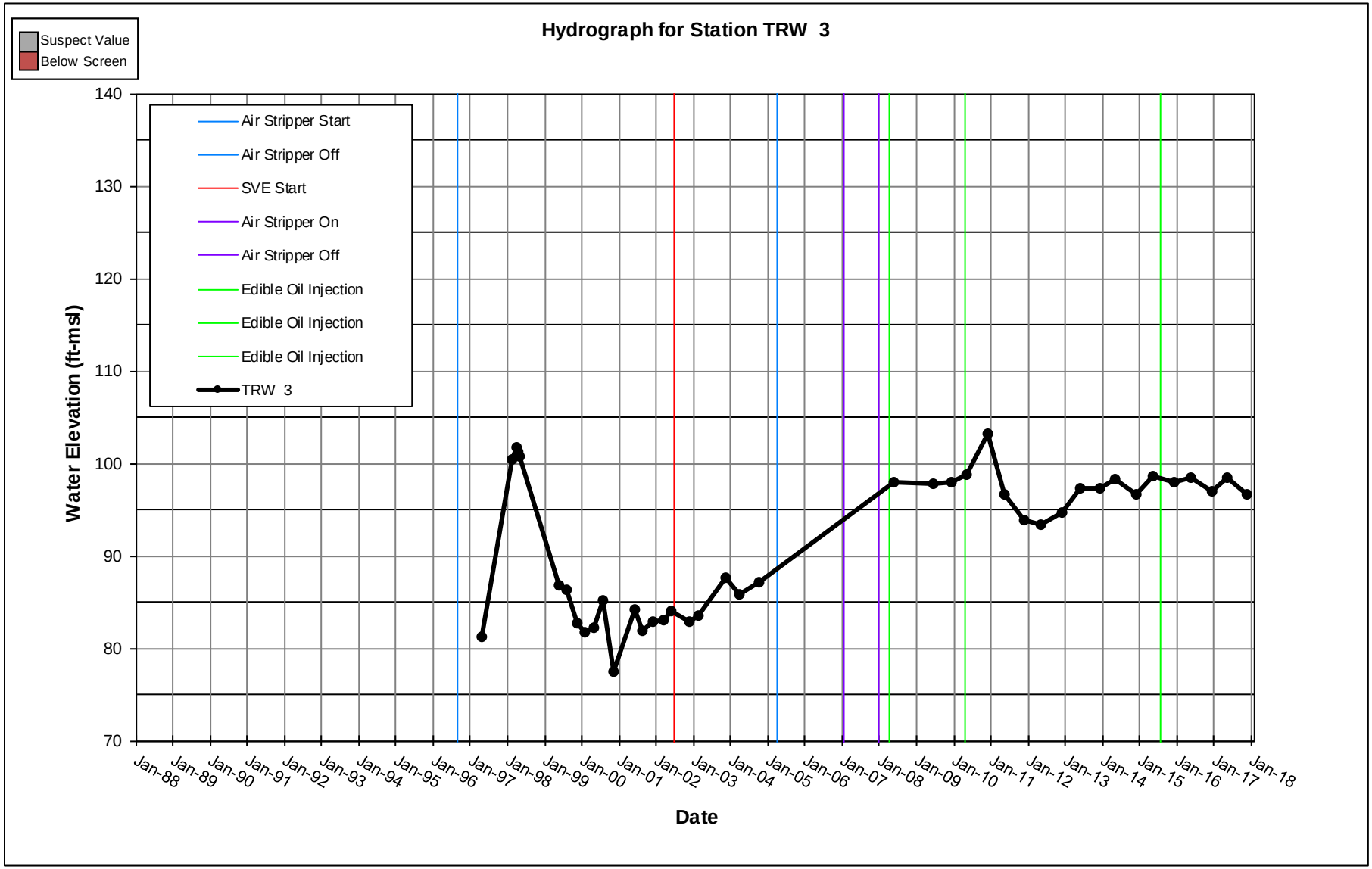
Date


Hydrograph for Station TRW 3
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TRW 3
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
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Jan-92
Jan-93
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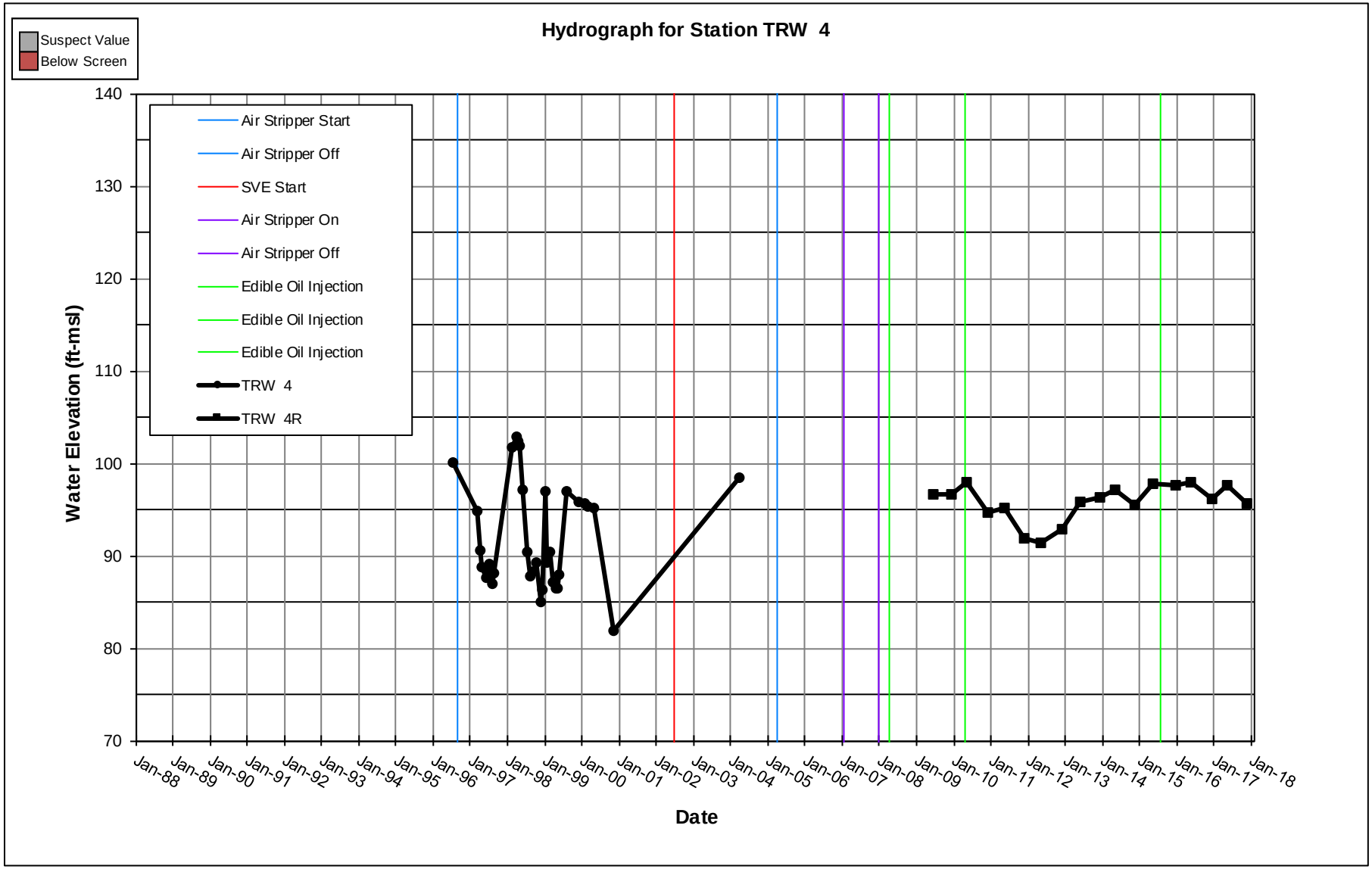
Hydrograph for Station TRW 4
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TRW 4
TRW 4R
Water Elevation (ft-msl)
140
130
120
110
100
90
80
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Jan-88
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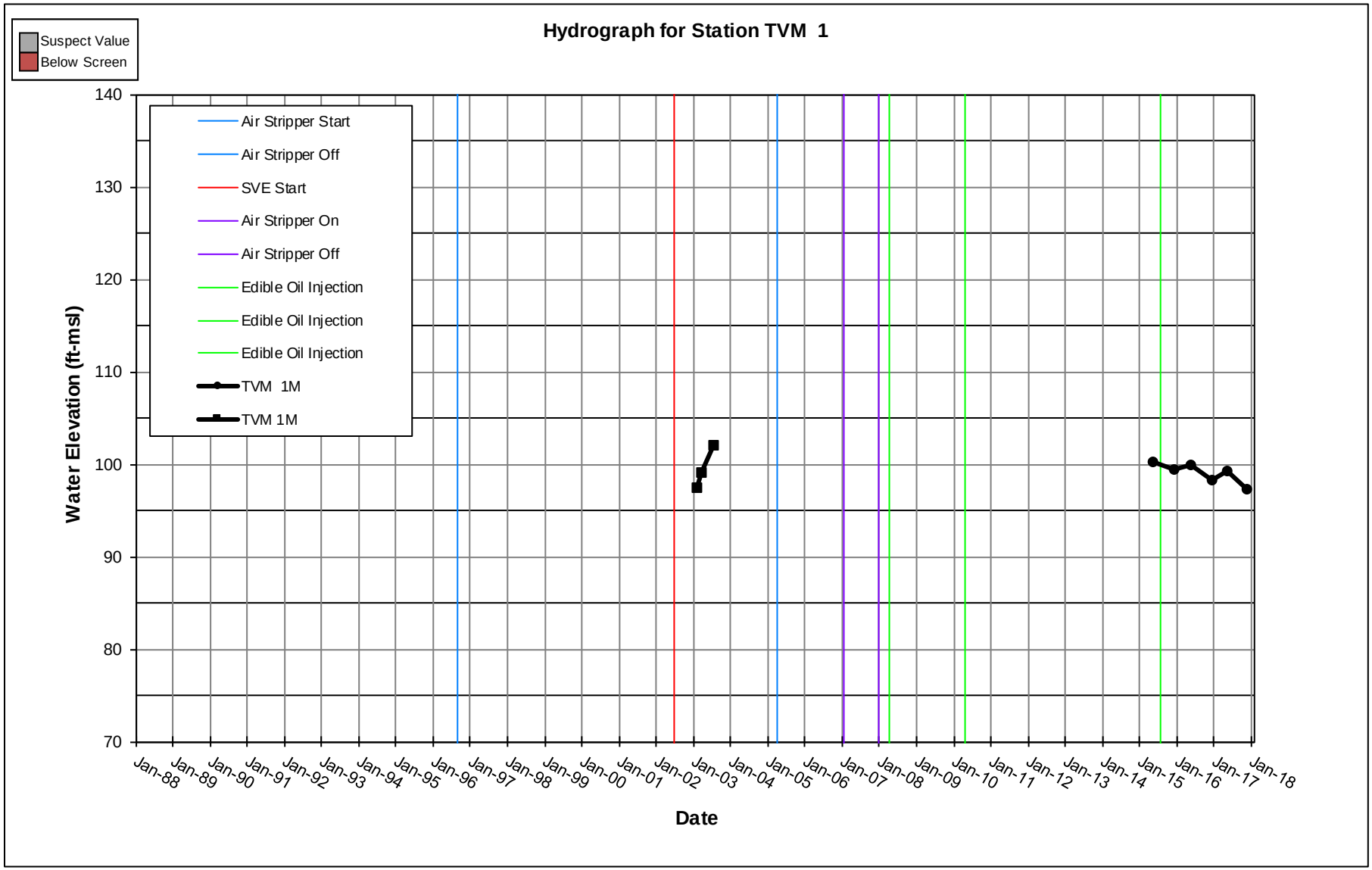
Date


Hydrograph for Station TVM 1
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TVM 1M
TVM 1M
Water Elevation (ft-msl)
140
130
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Jan-88
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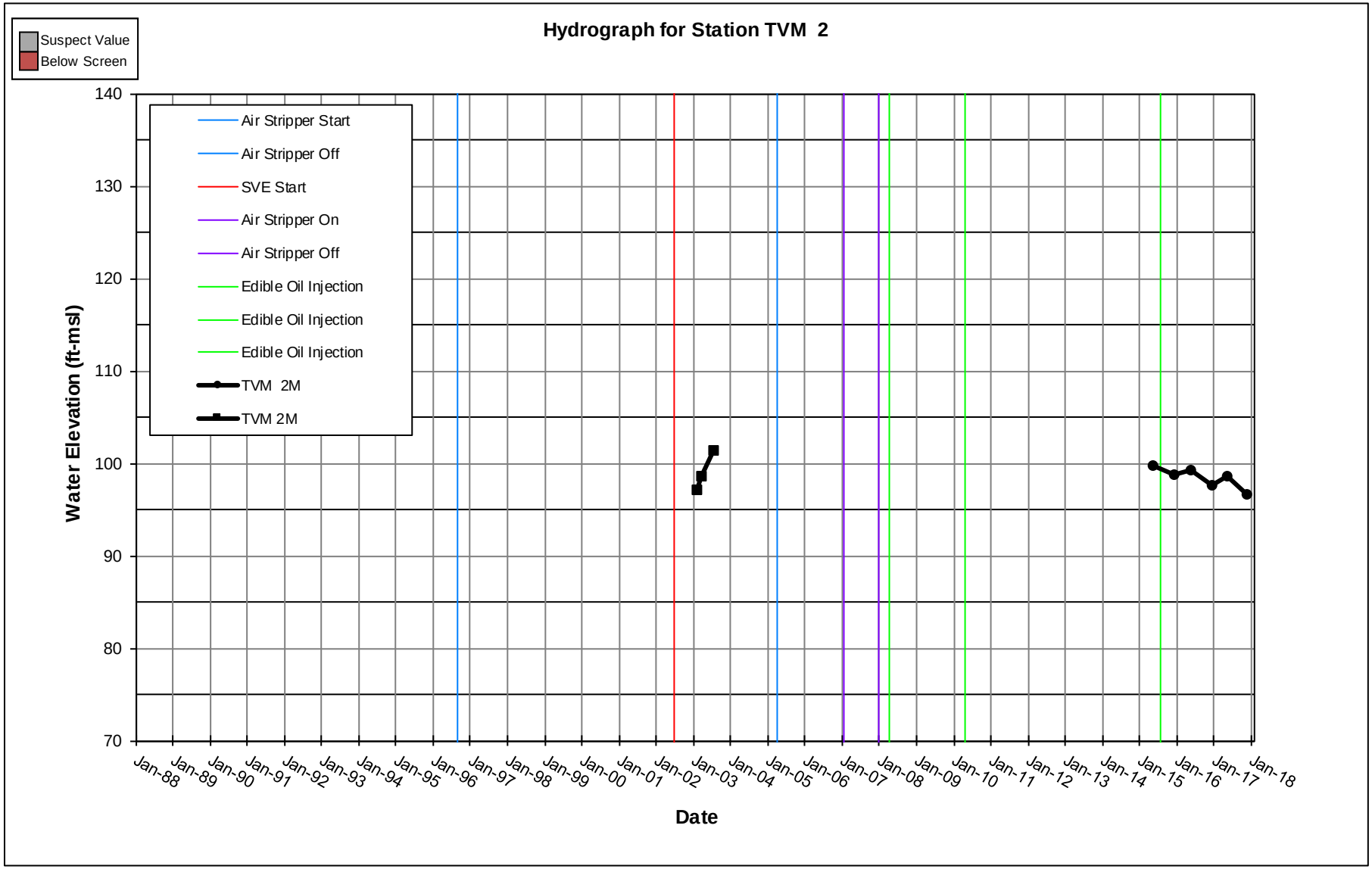
Date


Hydrograph for Station TVM 2
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TVM 2M
TVM 2M
Water Elevation (ft-msl)
140
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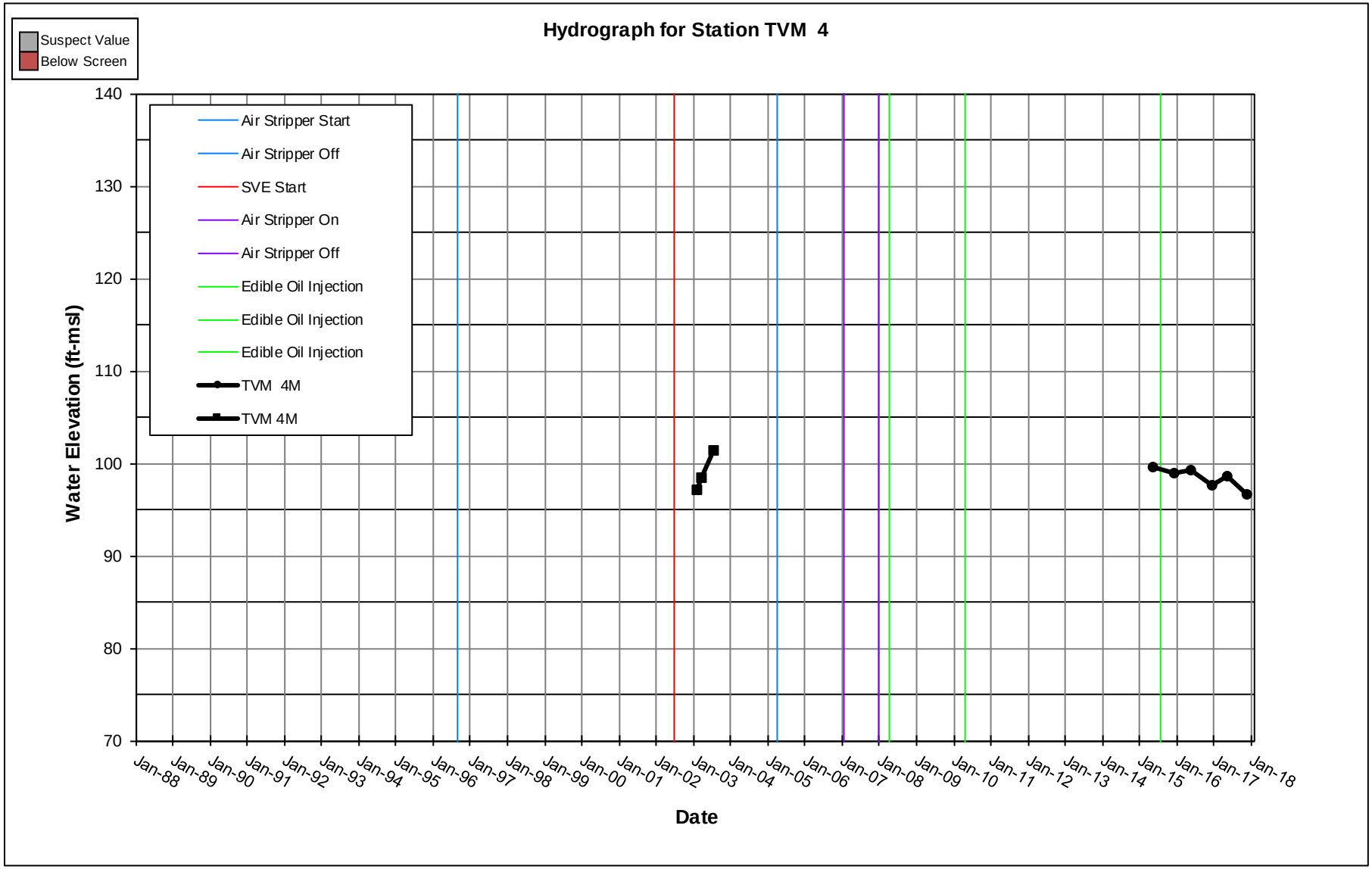
Jan-17
Jan-18
Date


Hydrograph for Station TVM 4
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TVM 4M
TVM 4M
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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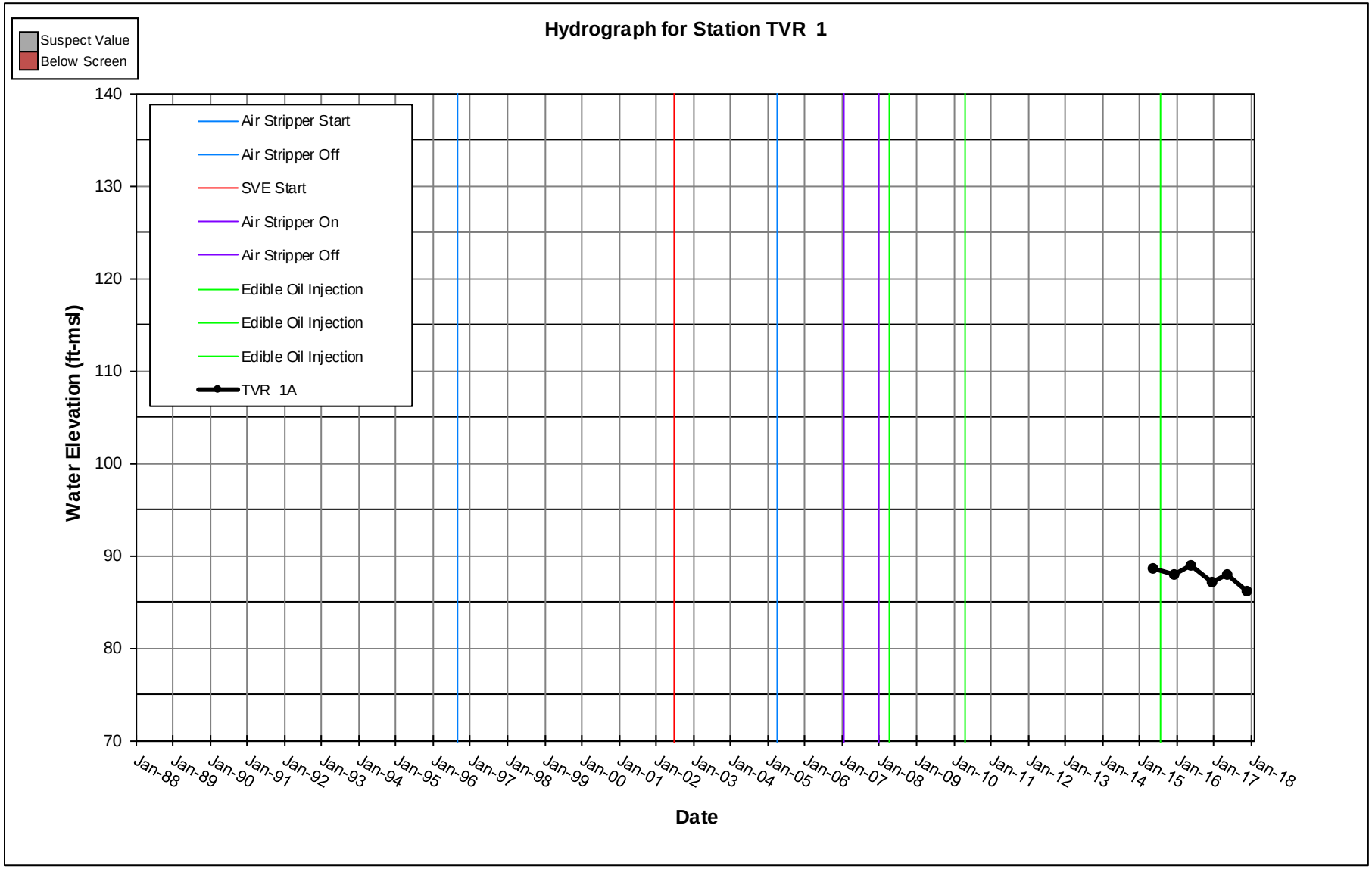
Date


Hydrograph for Station TVR 1
Suspect Value
Below Screen
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
TVR 1A
Water Elevation (ft-msl)
140
130
120
110
100
90
80
70
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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Jan-09
Jan-10
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Jan-18
Date

APPENDIX E

TIME SERIES PLOTS

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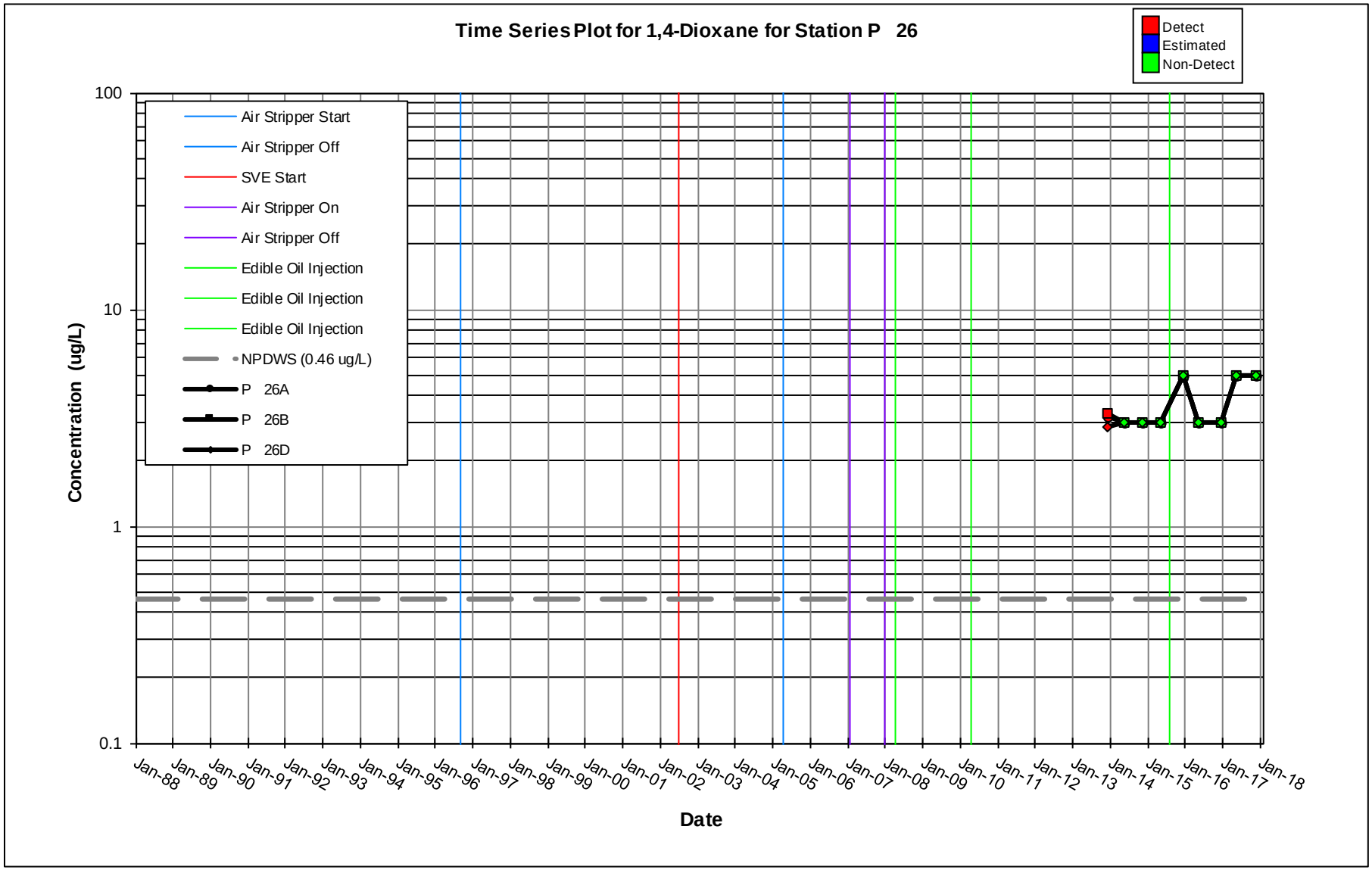
Time Series Plot for 1,4-Dioxane for Station P 26
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
P 26A
P 26B
P 26D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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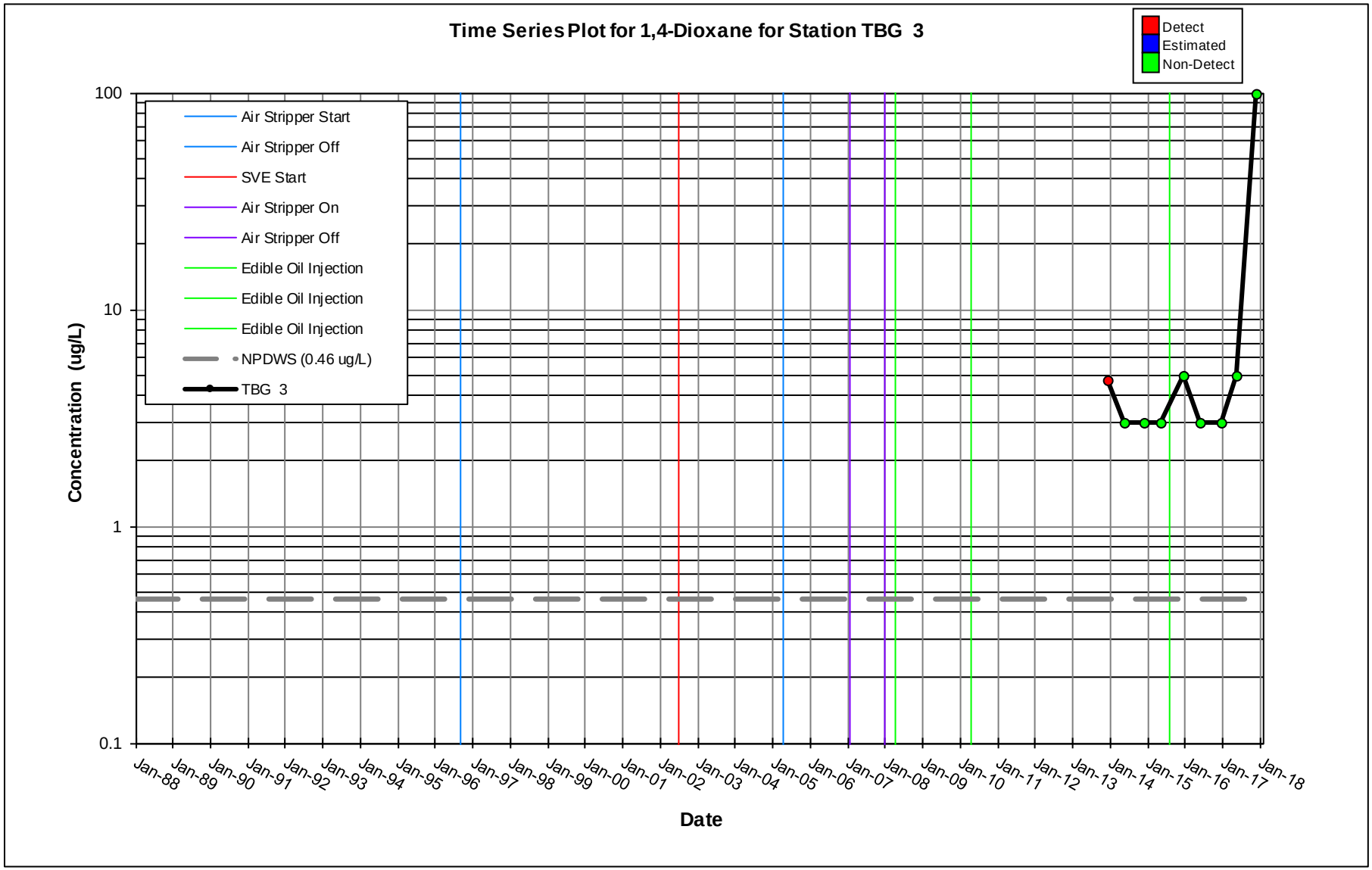
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for 1,4-Dioxane for Station TBG 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TBG 3
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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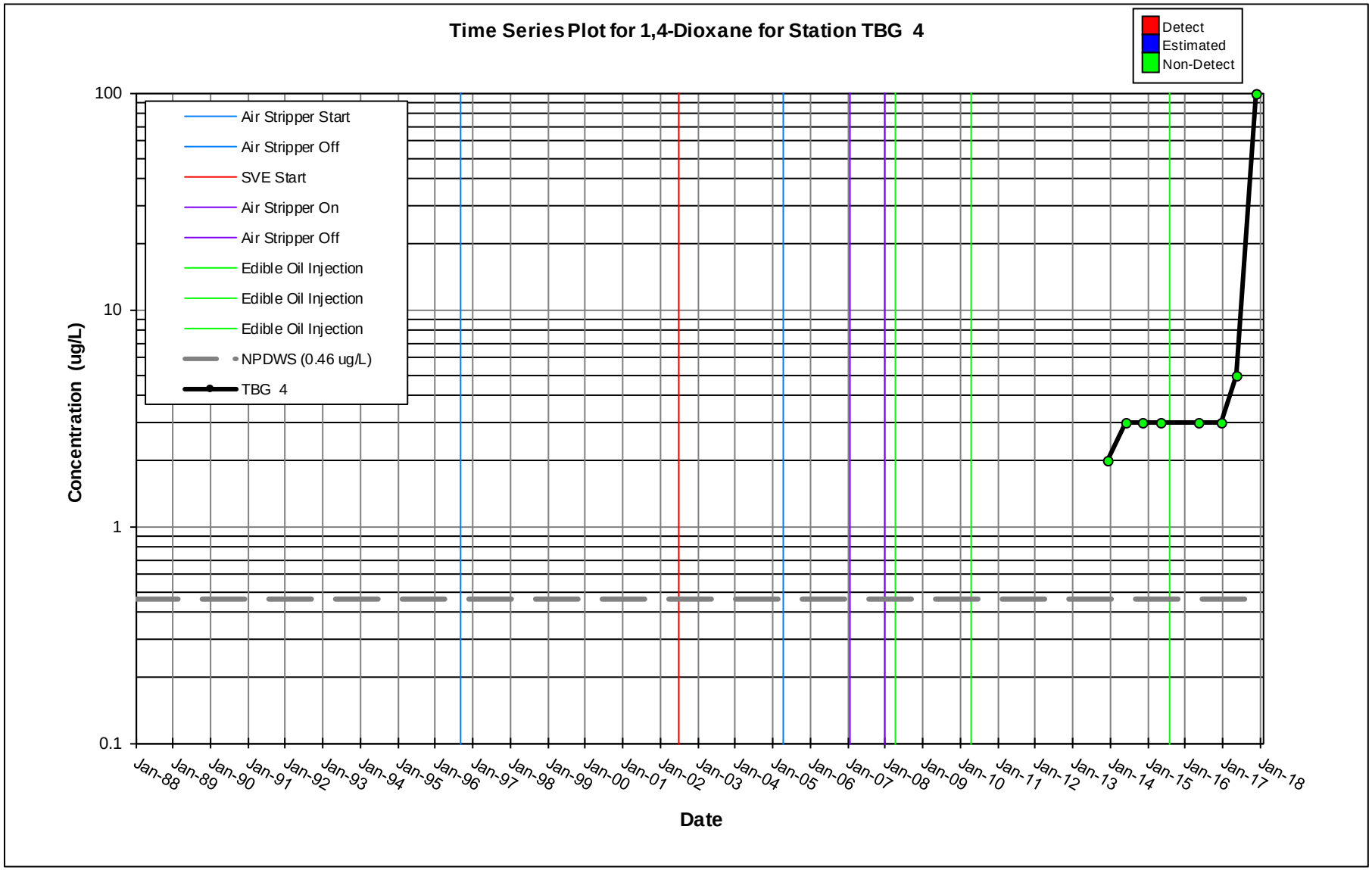
Date


Time Series Plot for 1,4-Dioxane for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TBG 4
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
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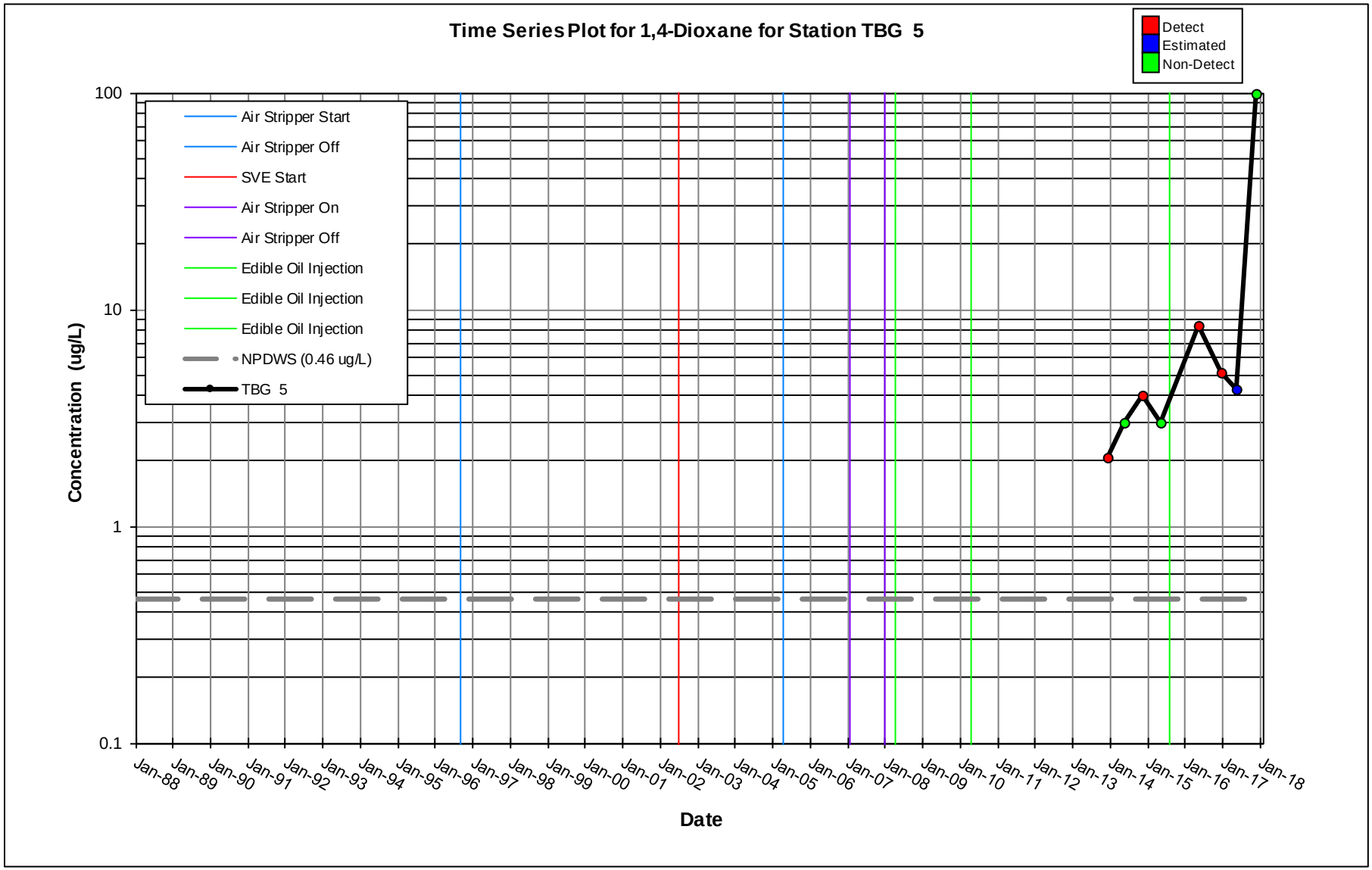
Time Series Plot for 1,4-Dioxane for Station TBG 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TBG 5
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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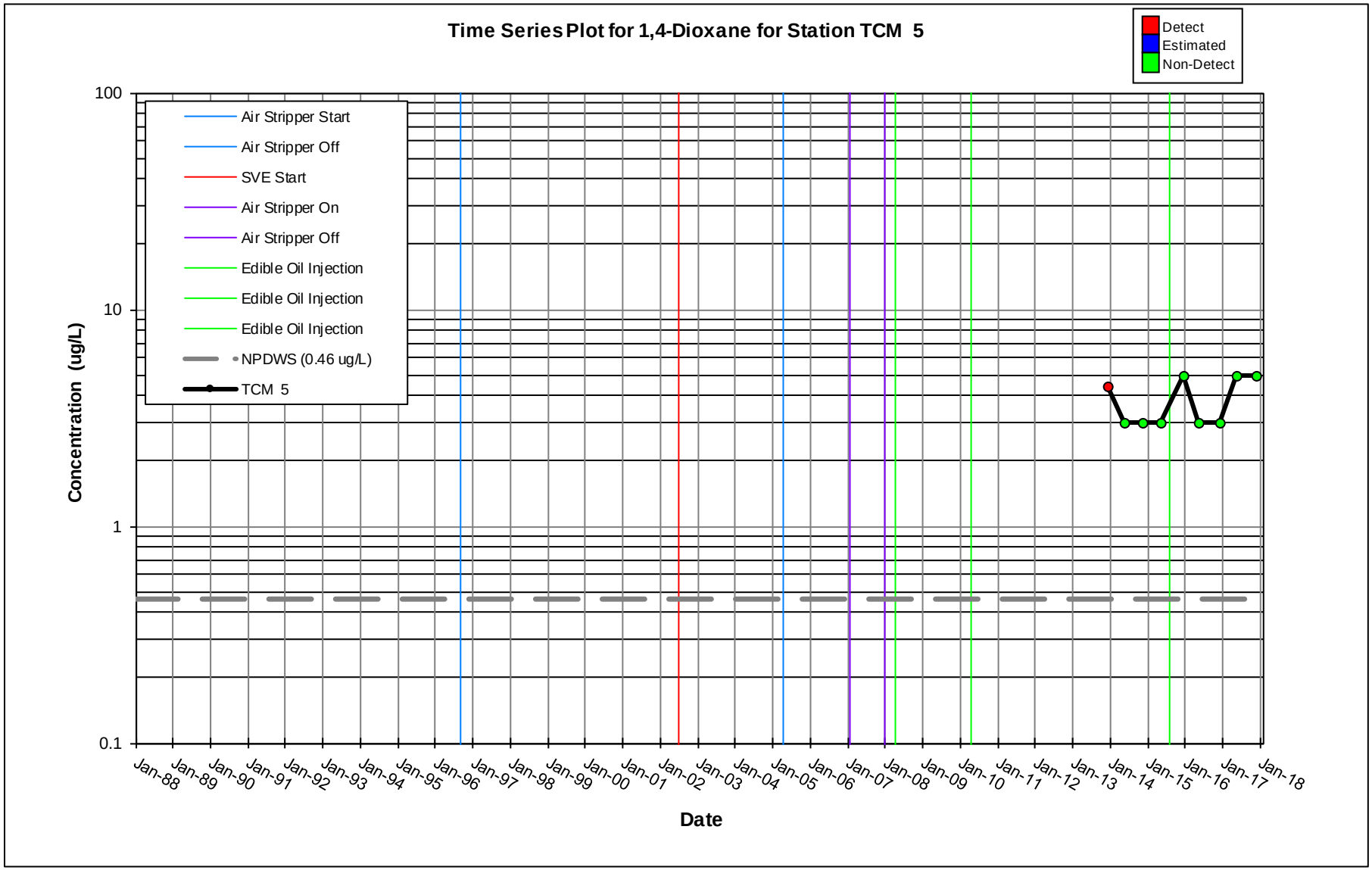
Date


Time Series Plot for 1,4-Dioxane for Station TCM 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TCM 5
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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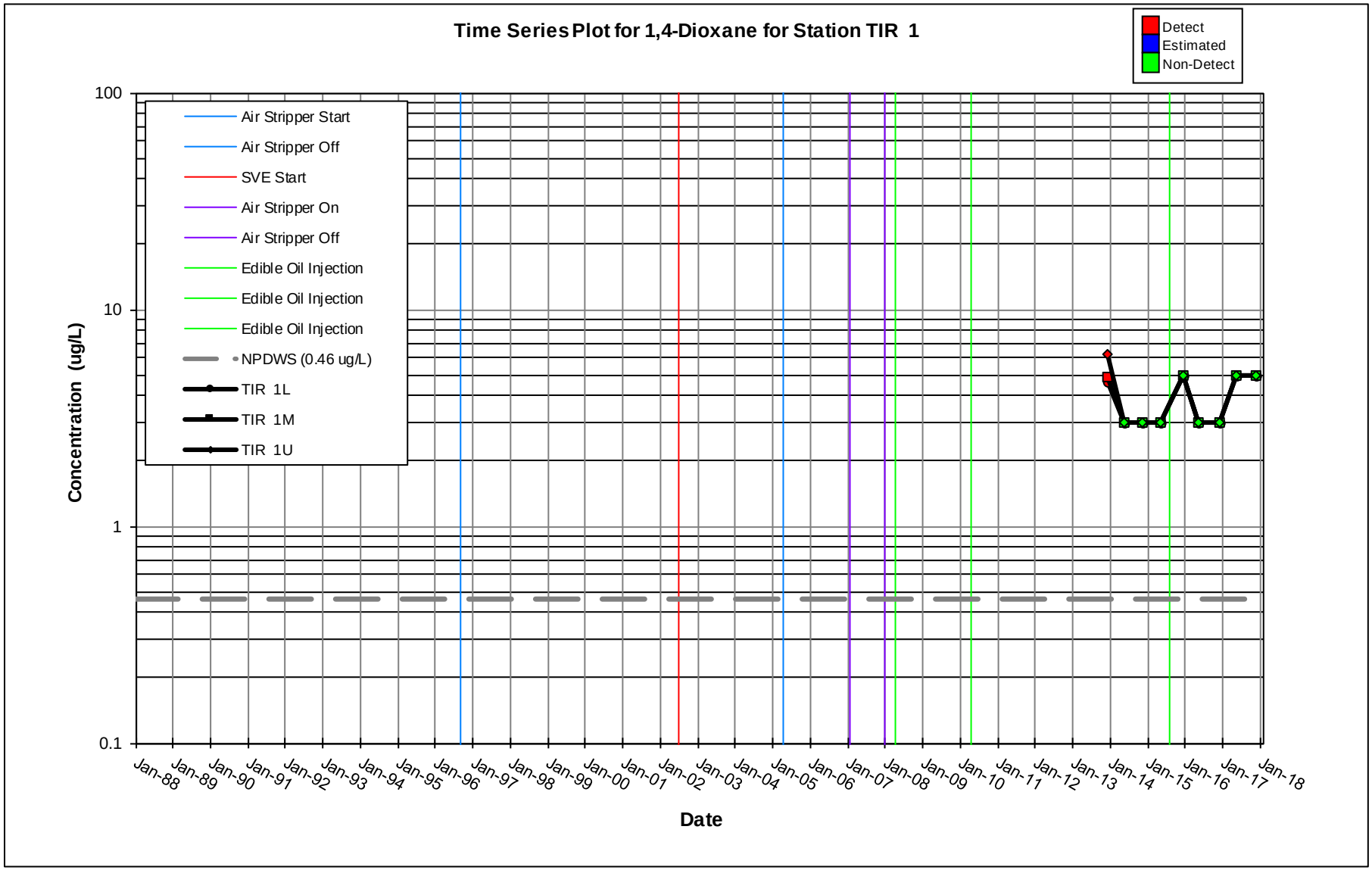
Date


Time Series Plot for 1,4-Dioxane for Station TIR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TIR 1L
TIR 1M
TIR 1U
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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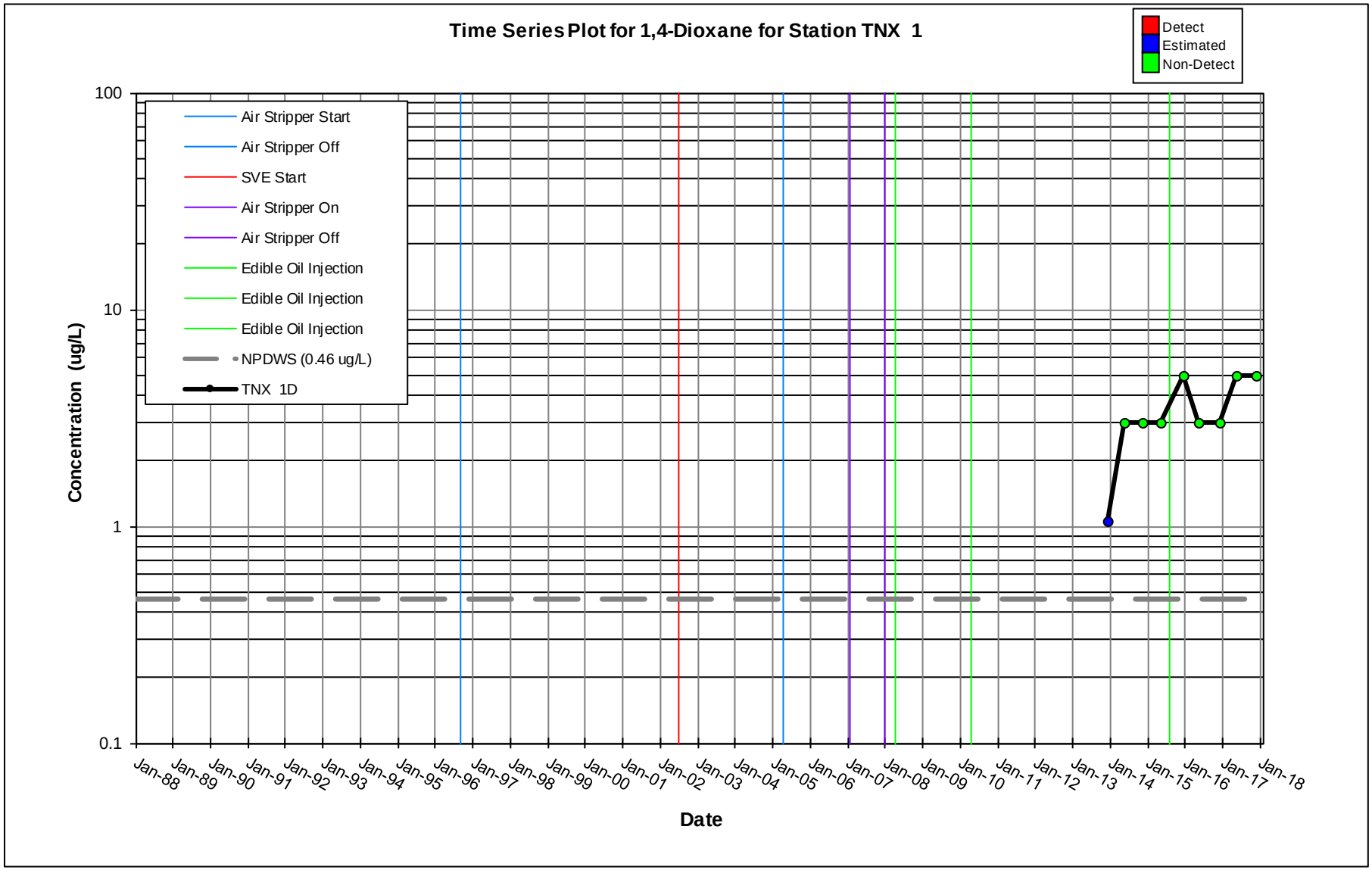
Time Series Plot for 1,4-Dioxane for Station TNX 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 1D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
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Jan-95
Jan-96
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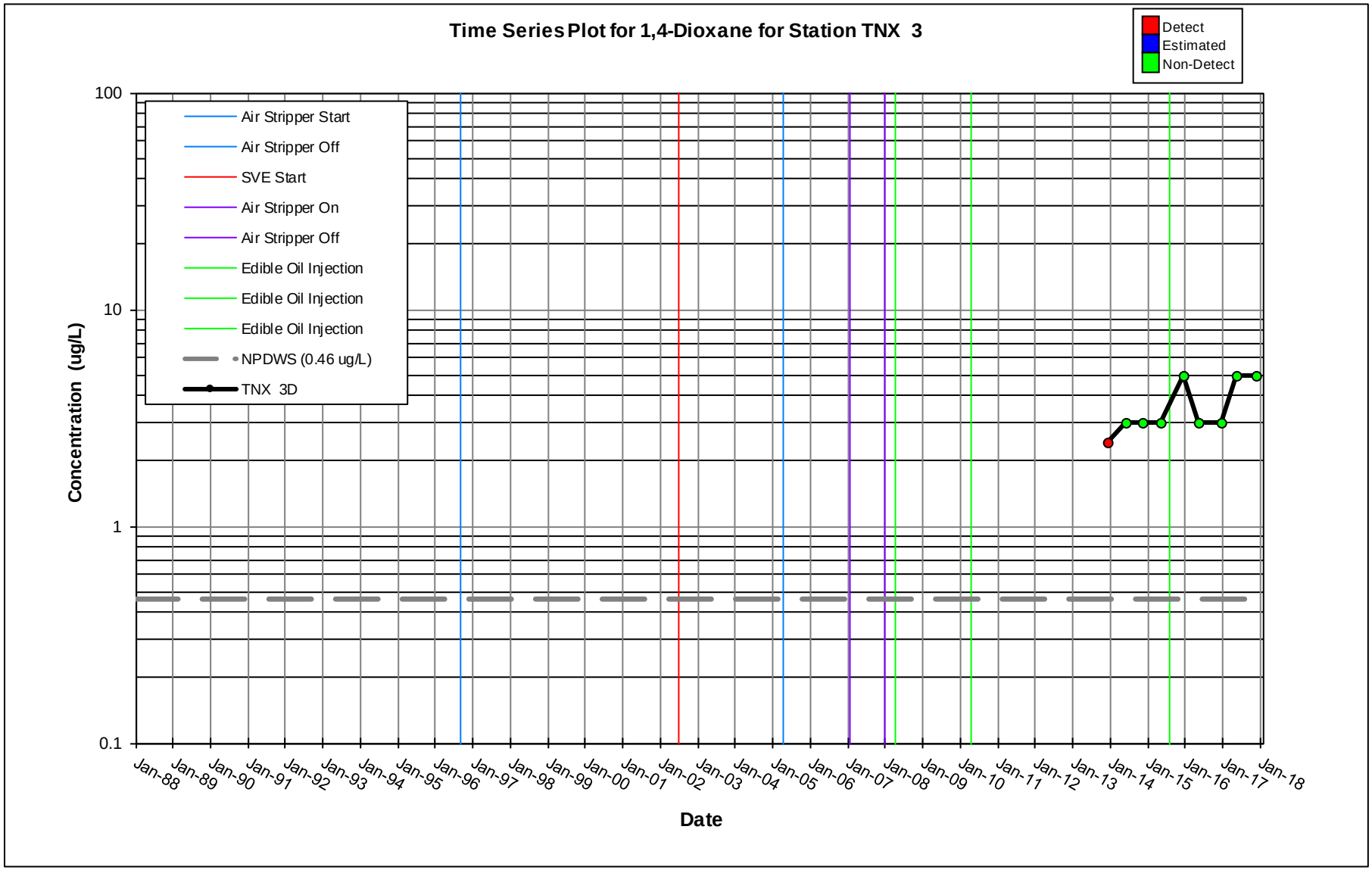
Time Series Plot for 1,4-Dioxane for Station TNX 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 3D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
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Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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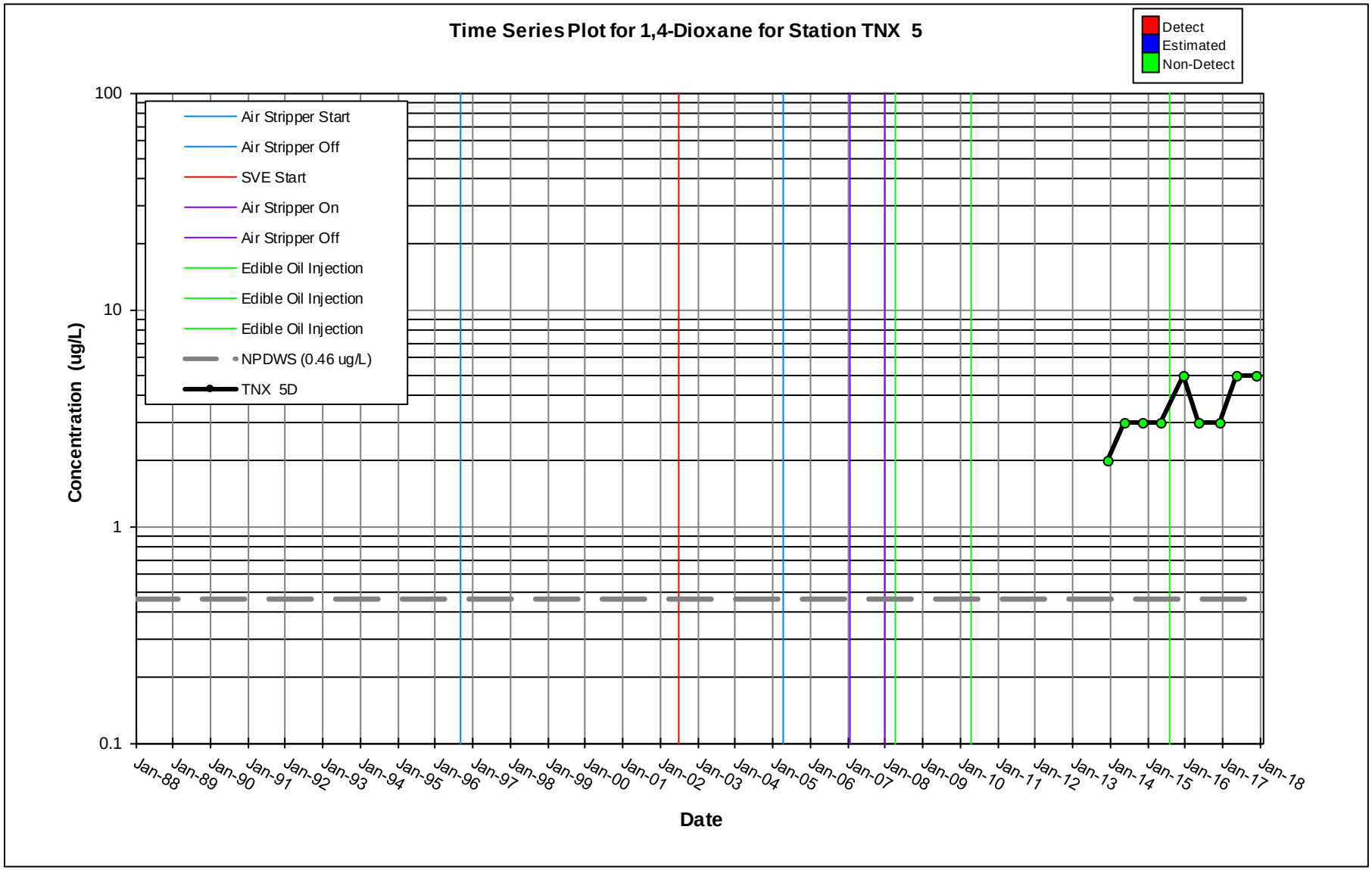
Time Series Plot for 1,4-Dioxane for Station TNX 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 5D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
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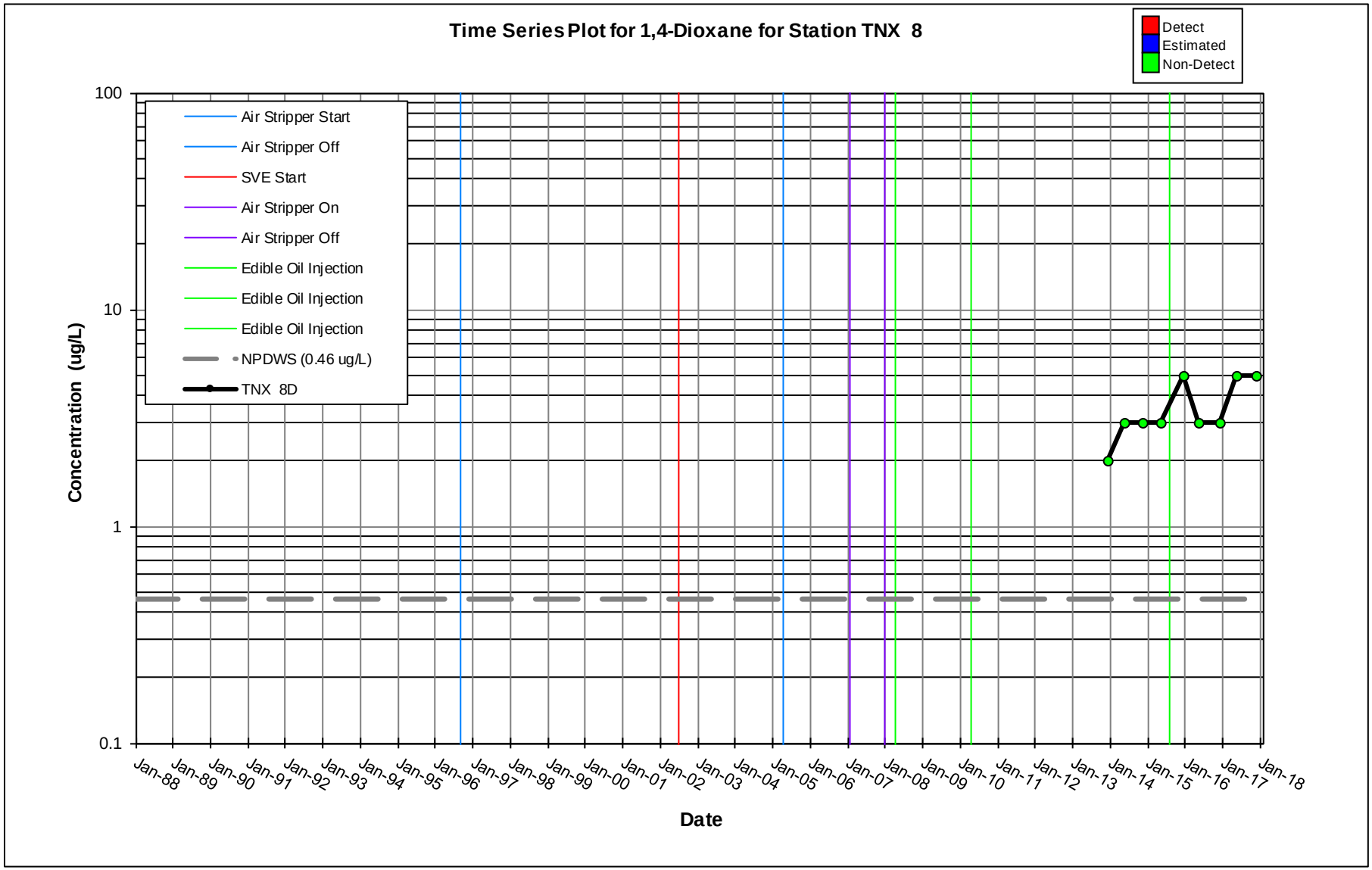
Time Series Plot for 1,4-Dioxane for Station TNX 8
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 8D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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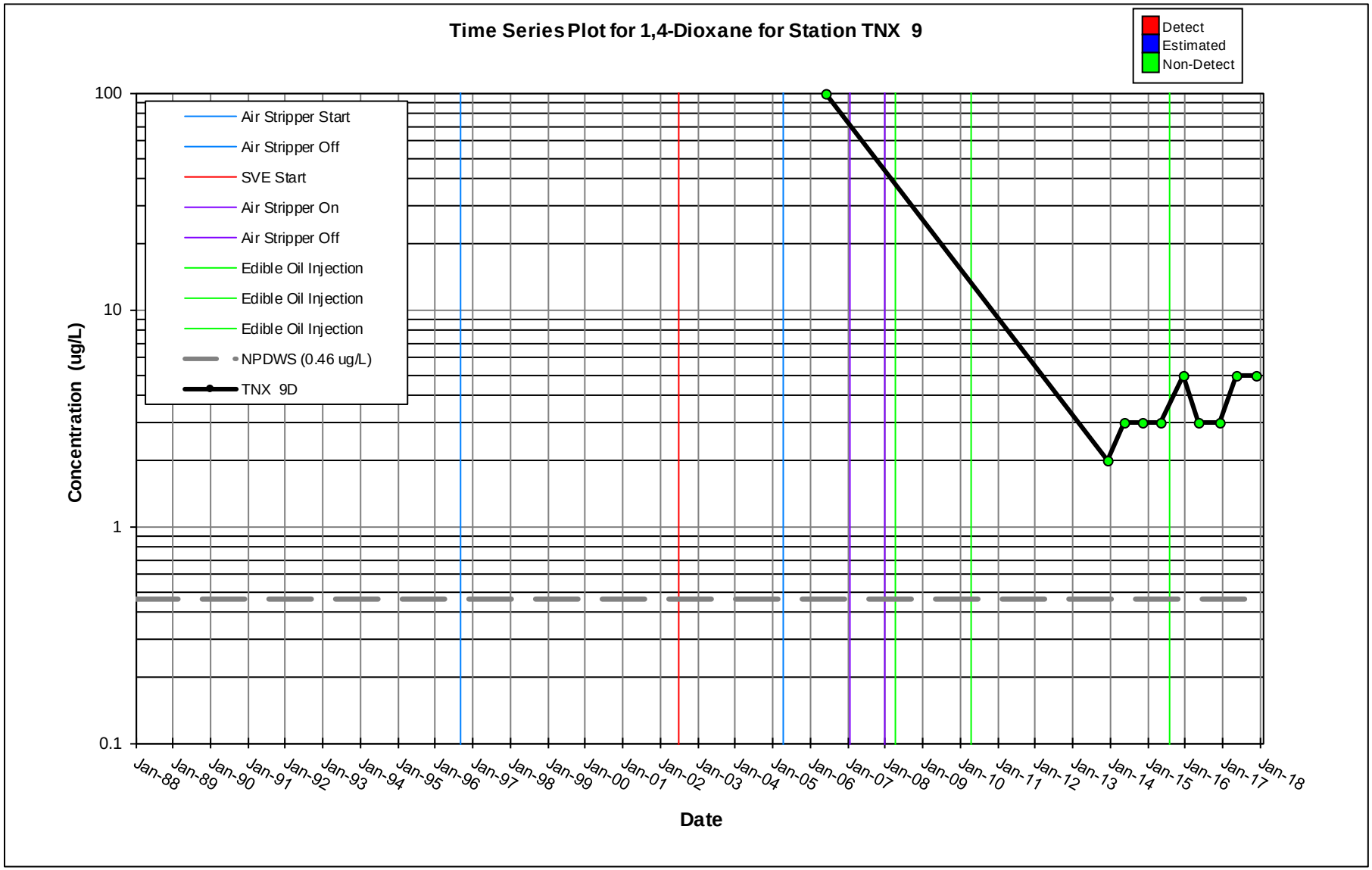
Time Series Plot for 1,4-Dioxane for Station TNX 9
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 9D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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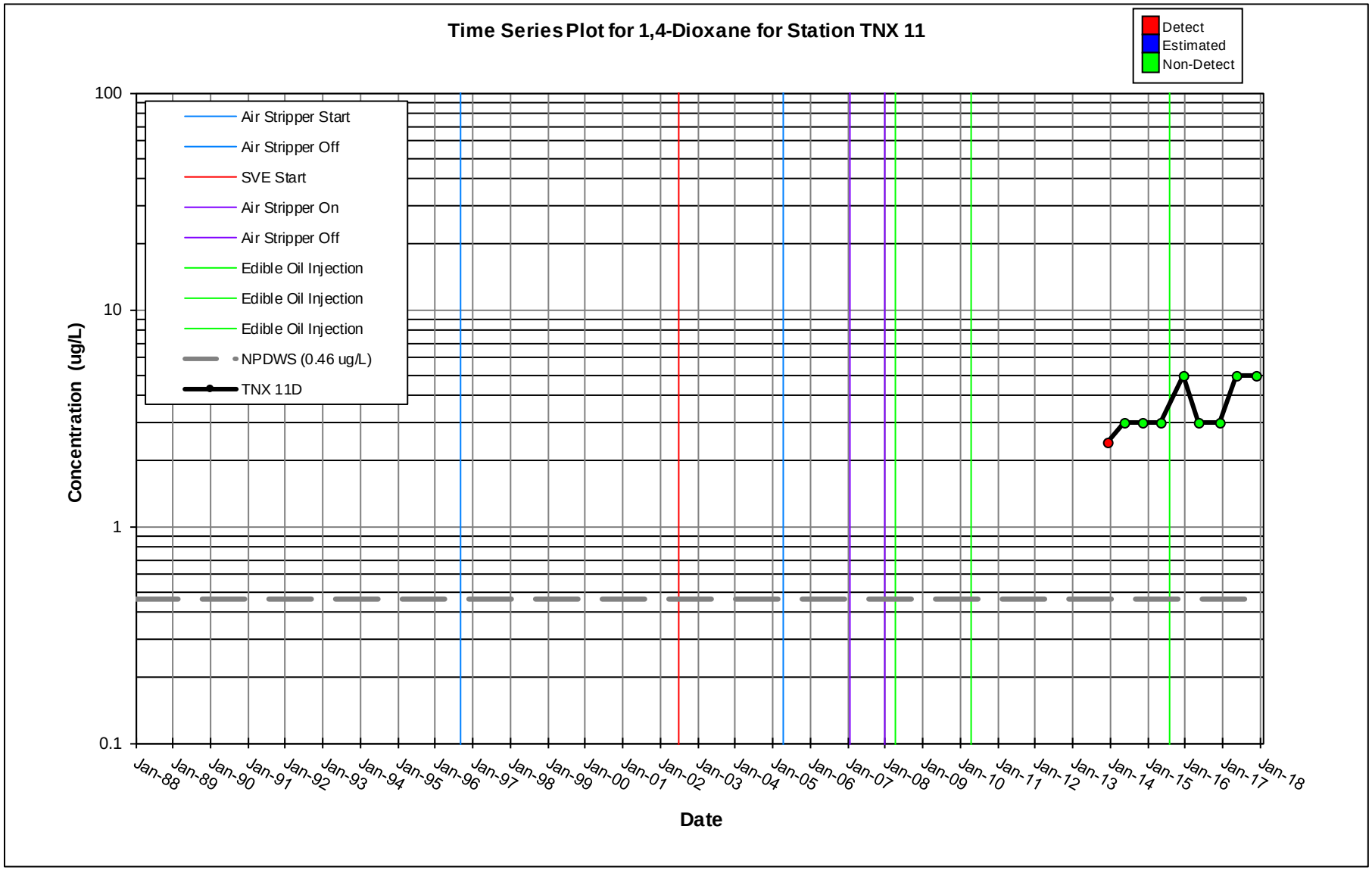
Time Series Plot for 1,4-Dioxane for Station TNX 11
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 11D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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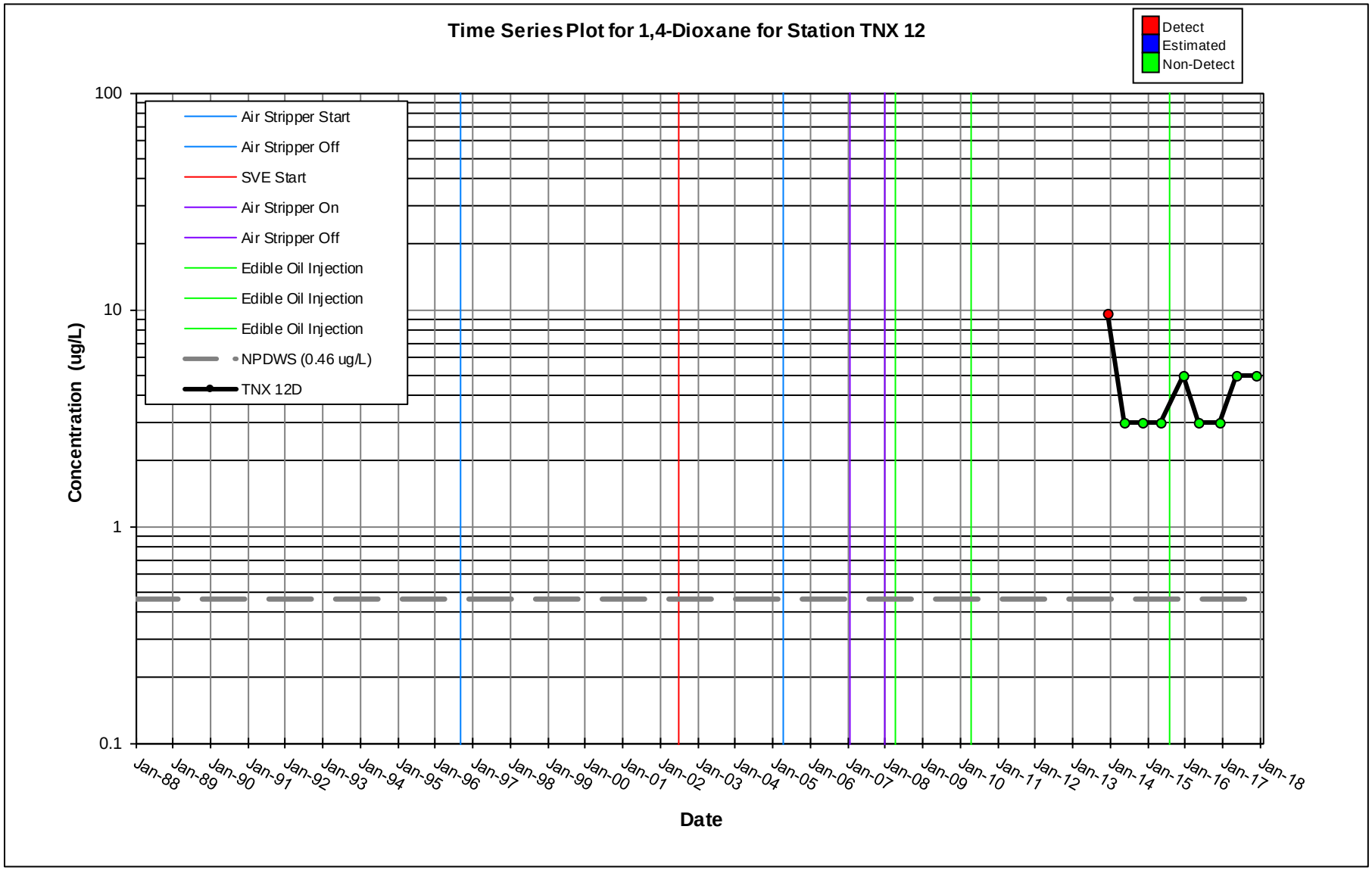
Time Series Plot for 1,4-Dioxane for Station TNX 12
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 12D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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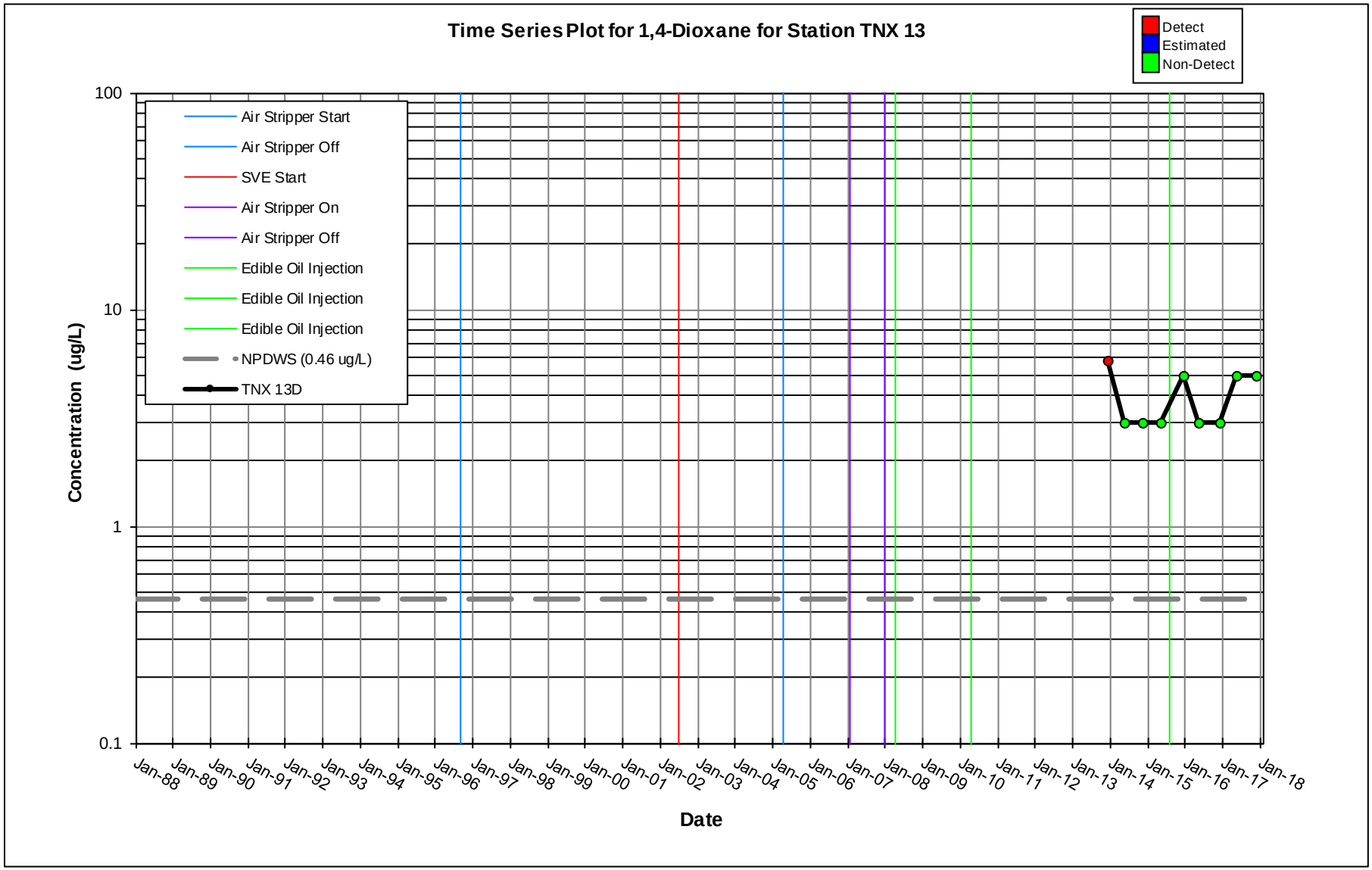
Time Series Plot for 1,4-Dioxane for Station TNX 13
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 13D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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Jan-96
Jan-97
Jan-98
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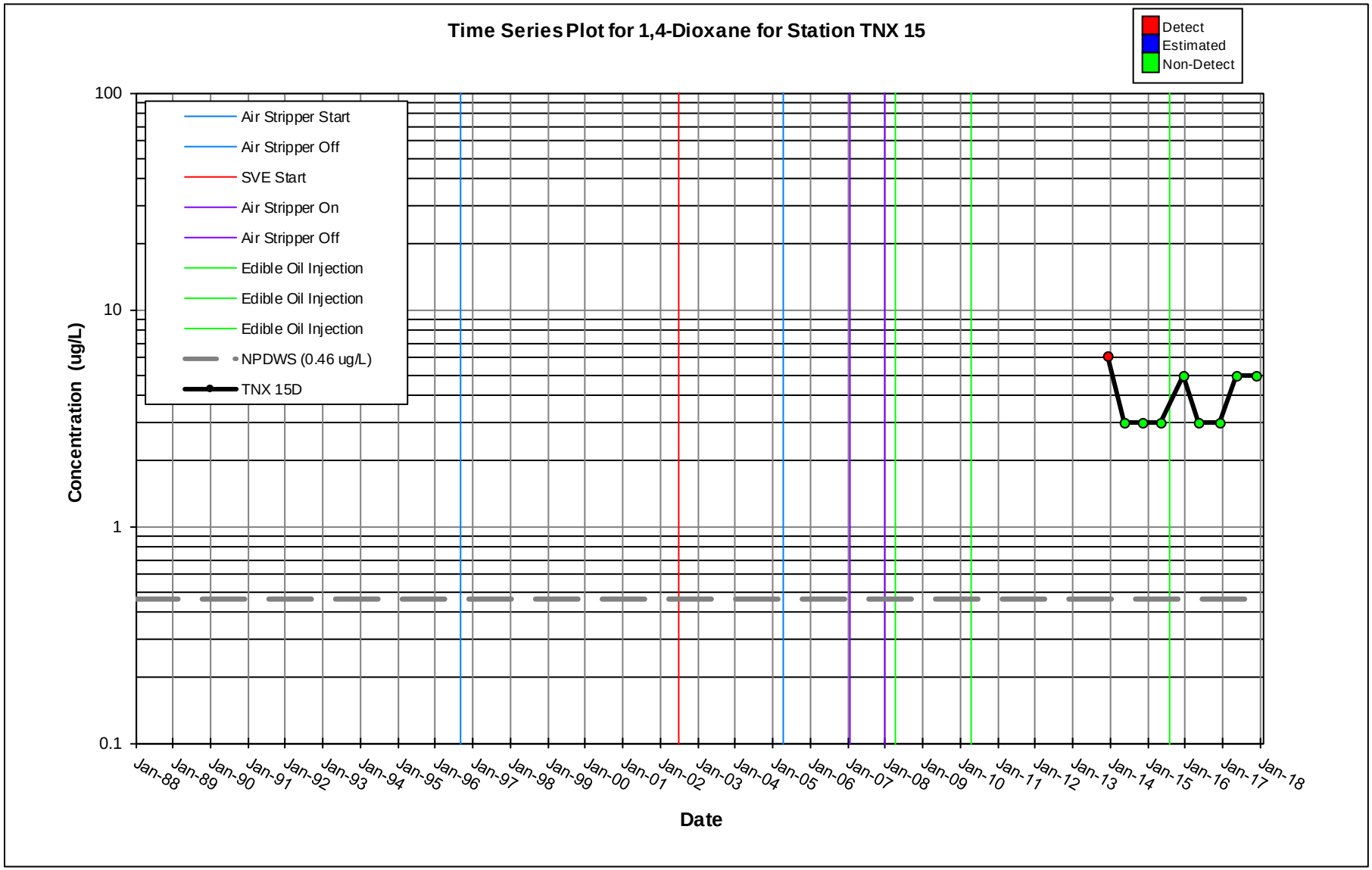
Time Series Plot for 1,4-Dioxane for Station TNX 15
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 15D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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Jan-97
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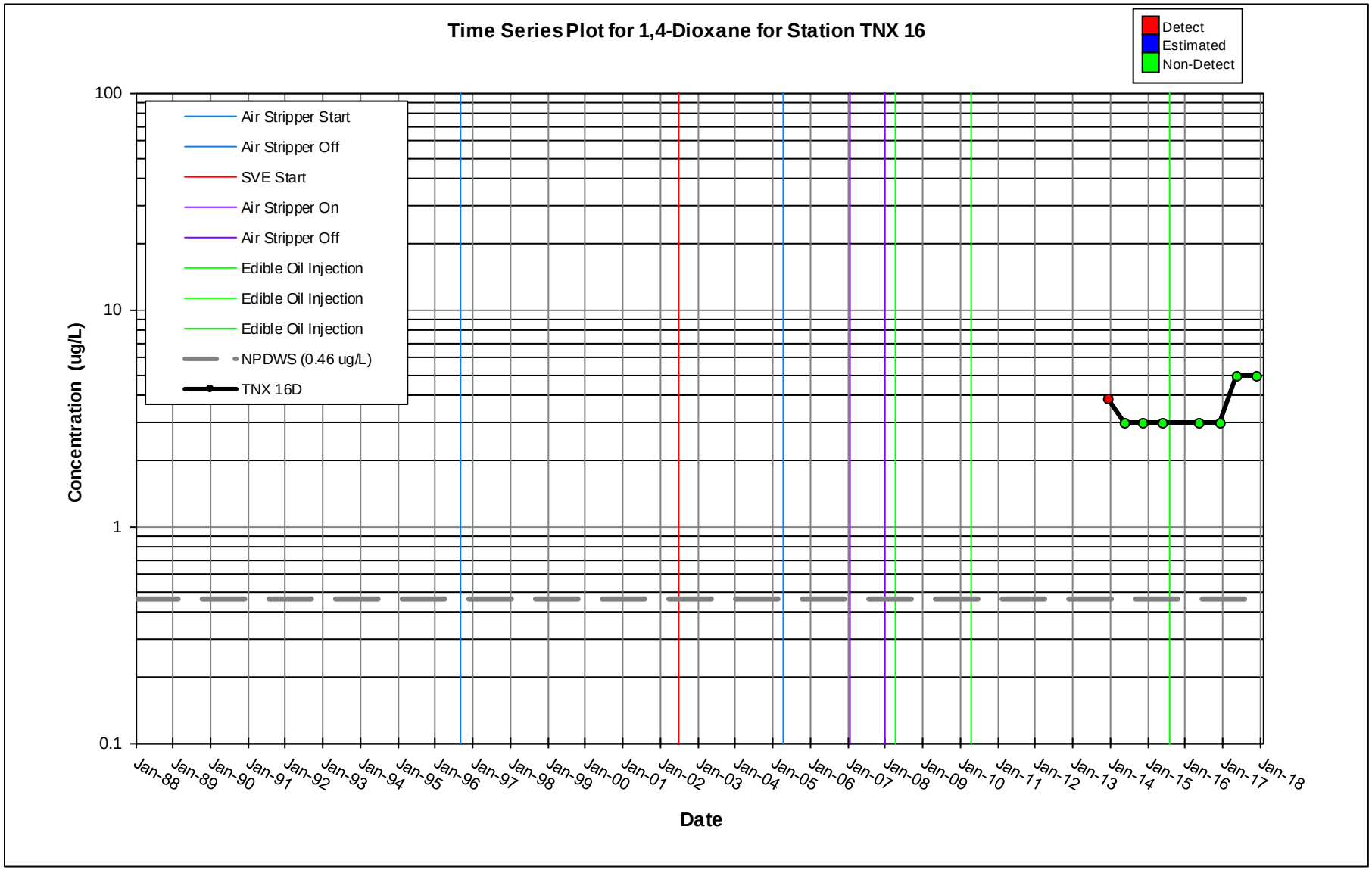
Time Series Plot for 1,4-Dioxane for Station TNX 16
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 16D
Concentration (ug/L)
100
10
1
0.1
Jan-88
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Jan-97
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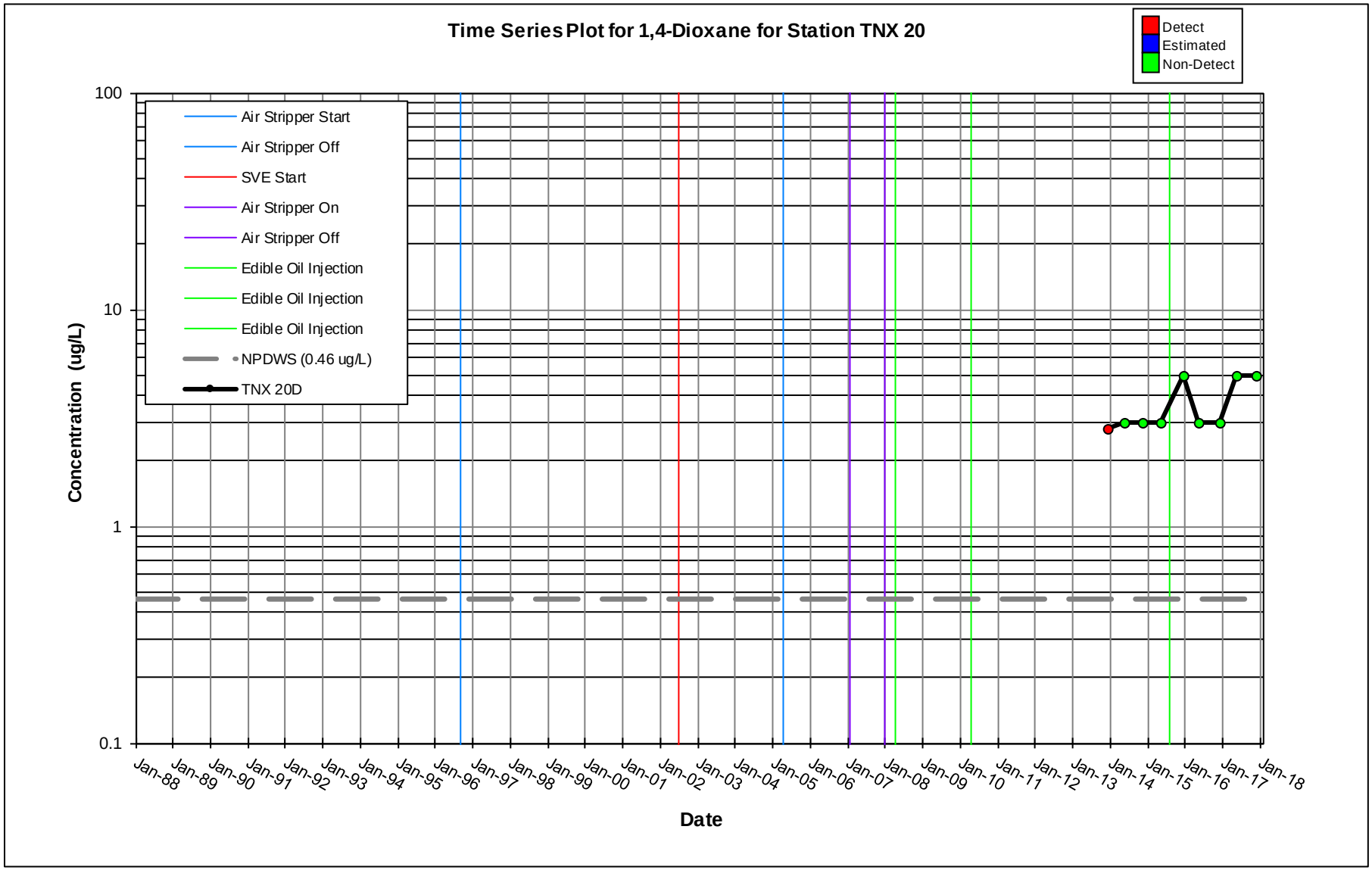
Time Series Plot for 1,4-Dioxane for Station TNX 20
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 20D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
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Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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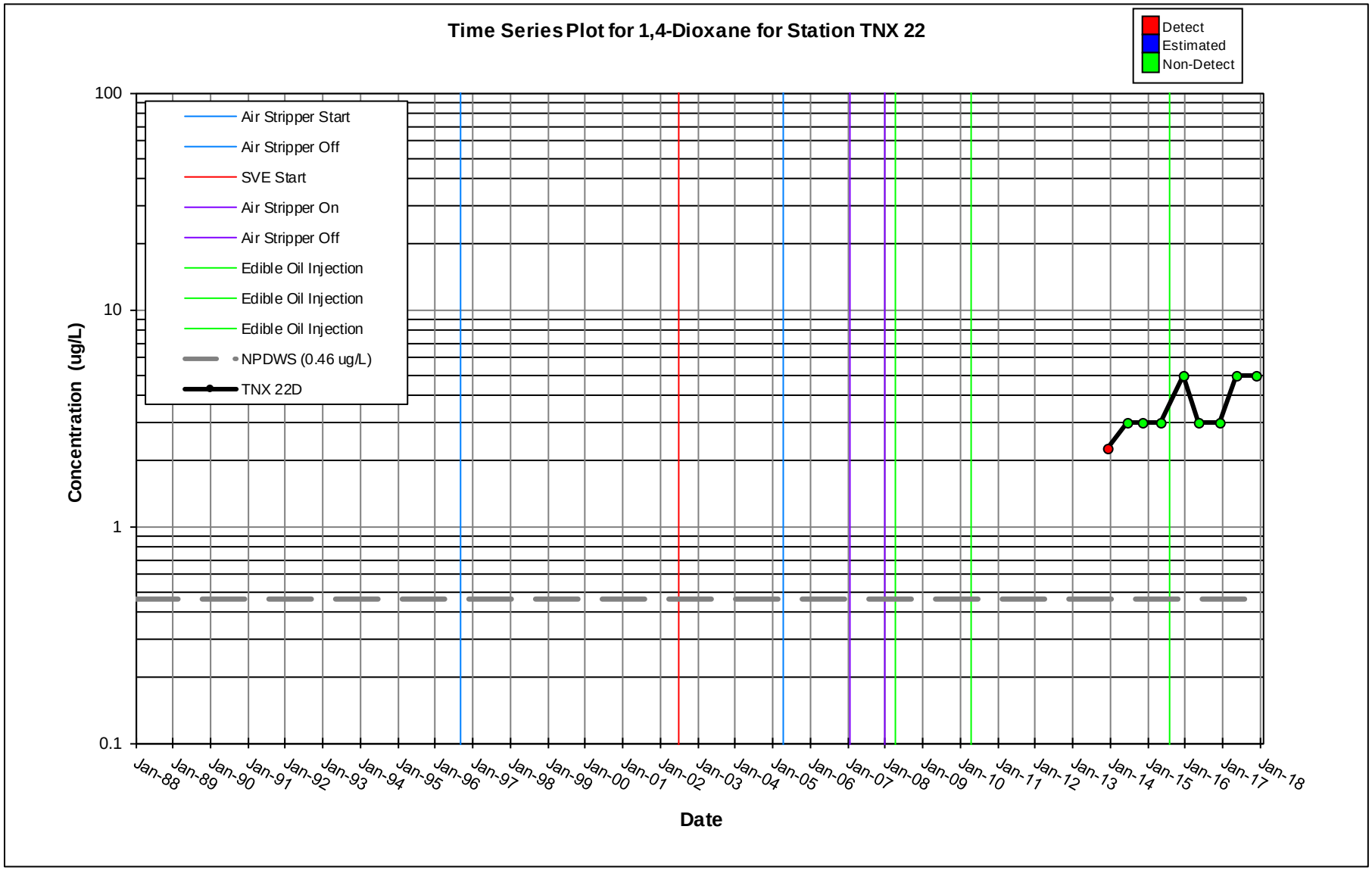
Date


Time Series Plot for 1,4-Dioxane for Station TNX 22
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 22D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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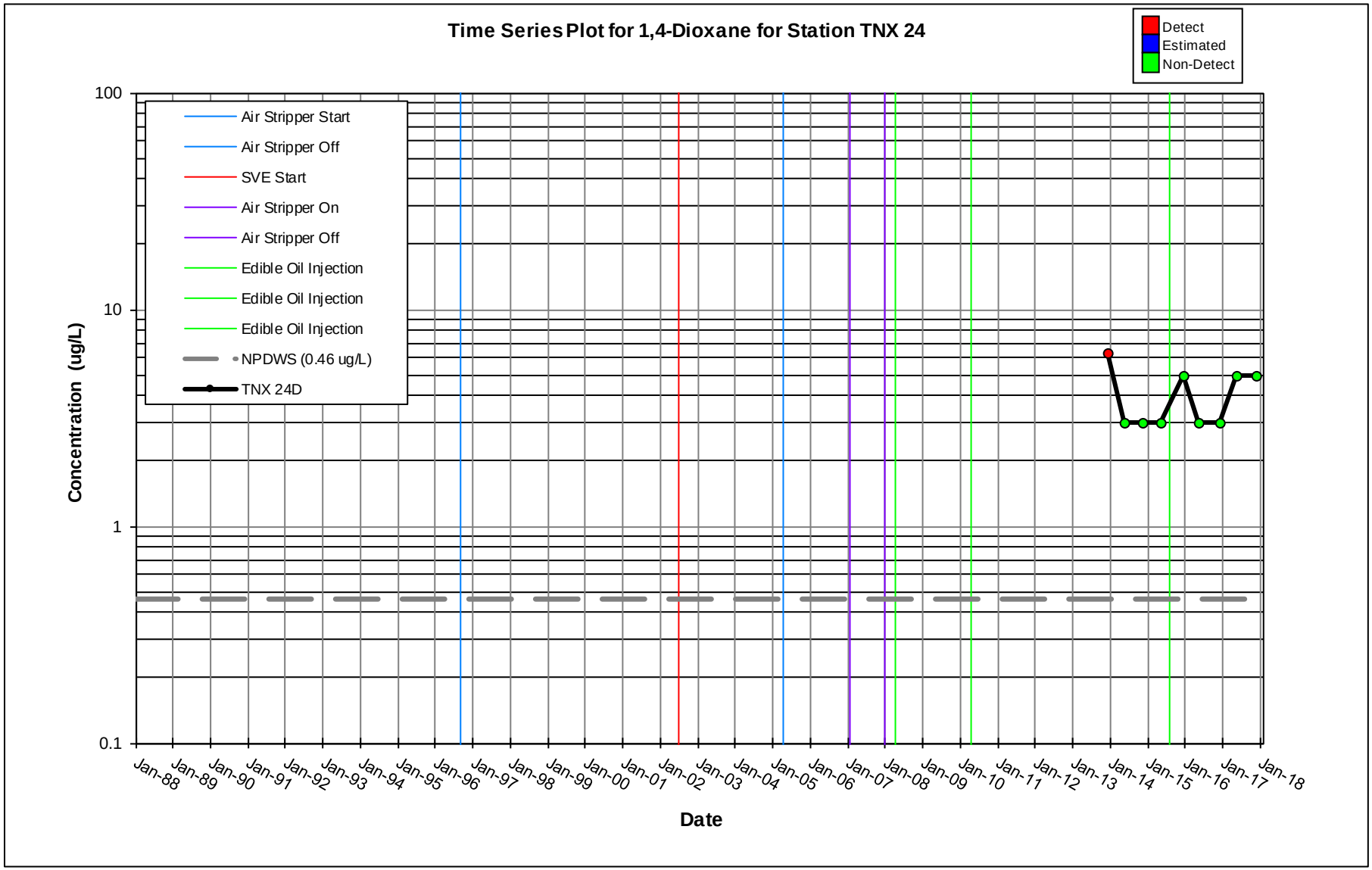
Date


Time Series Plot for 1,4-Dioxane for Station TNX 24
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 24D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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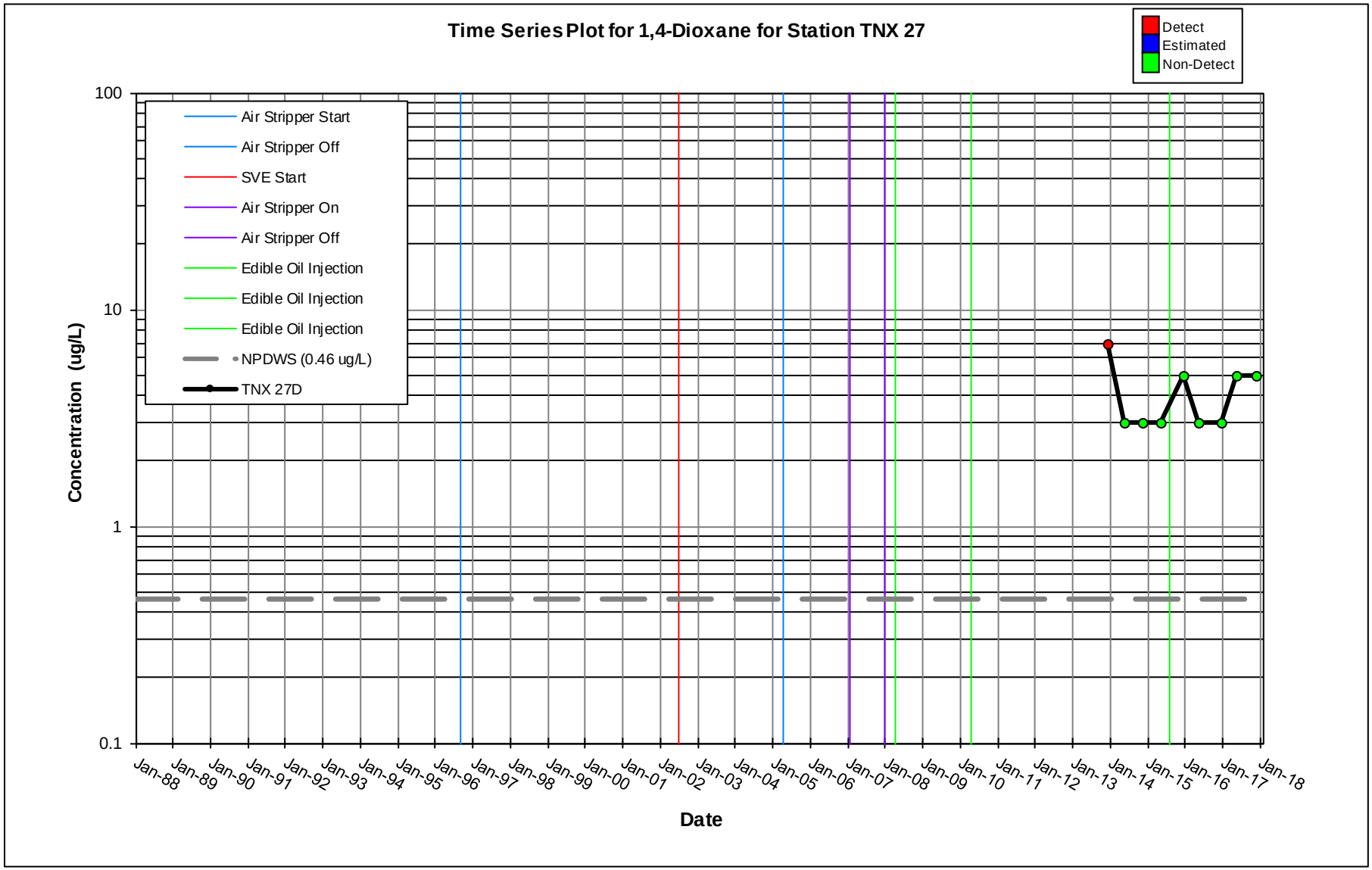
Date


Time Series Plot for 1,4-Dioxane for Station TNX 27
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 27D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
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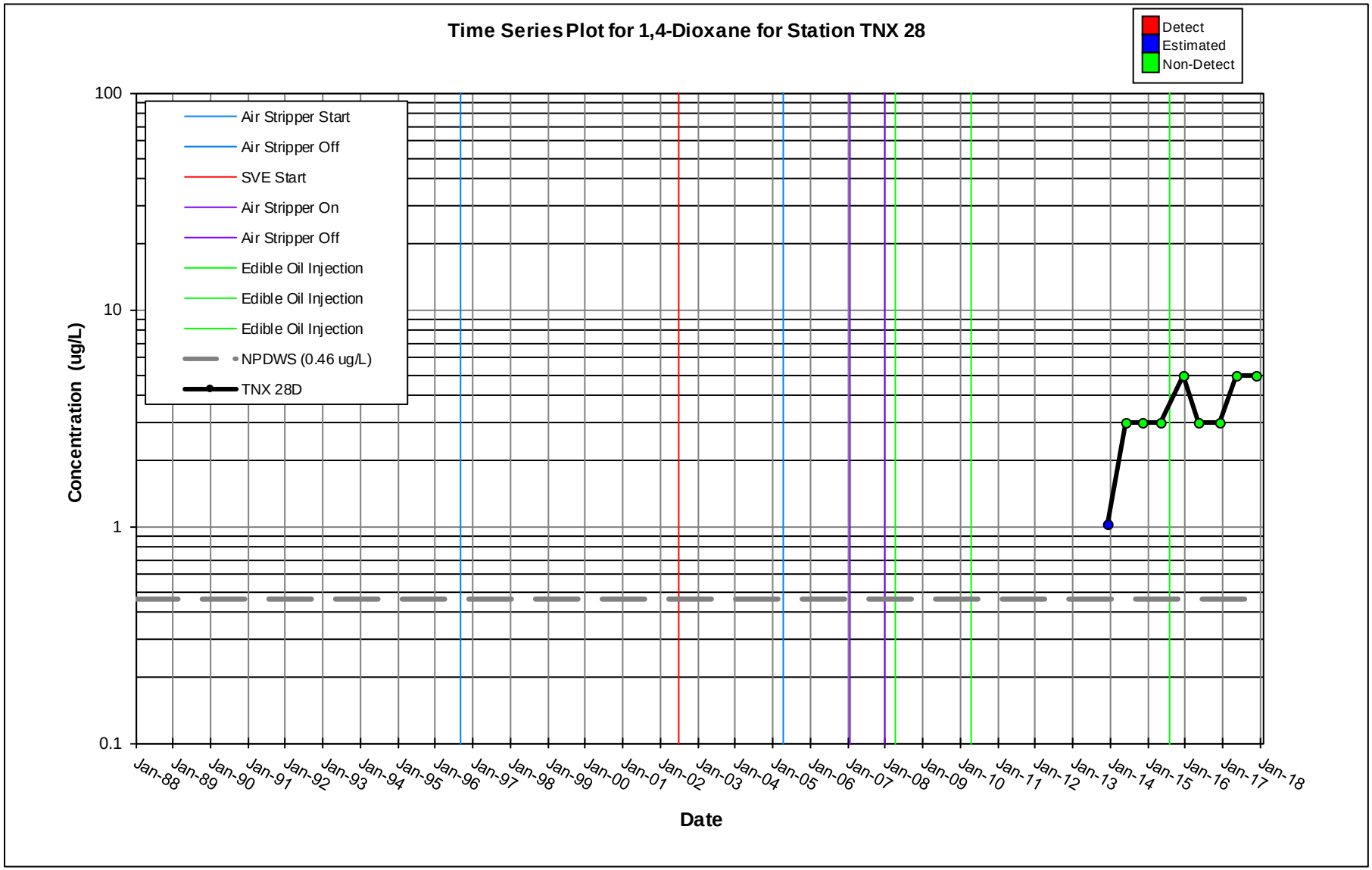
Date


Time Series Plot for 1,4-Dioxane for Station TNX 28
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 28D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
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Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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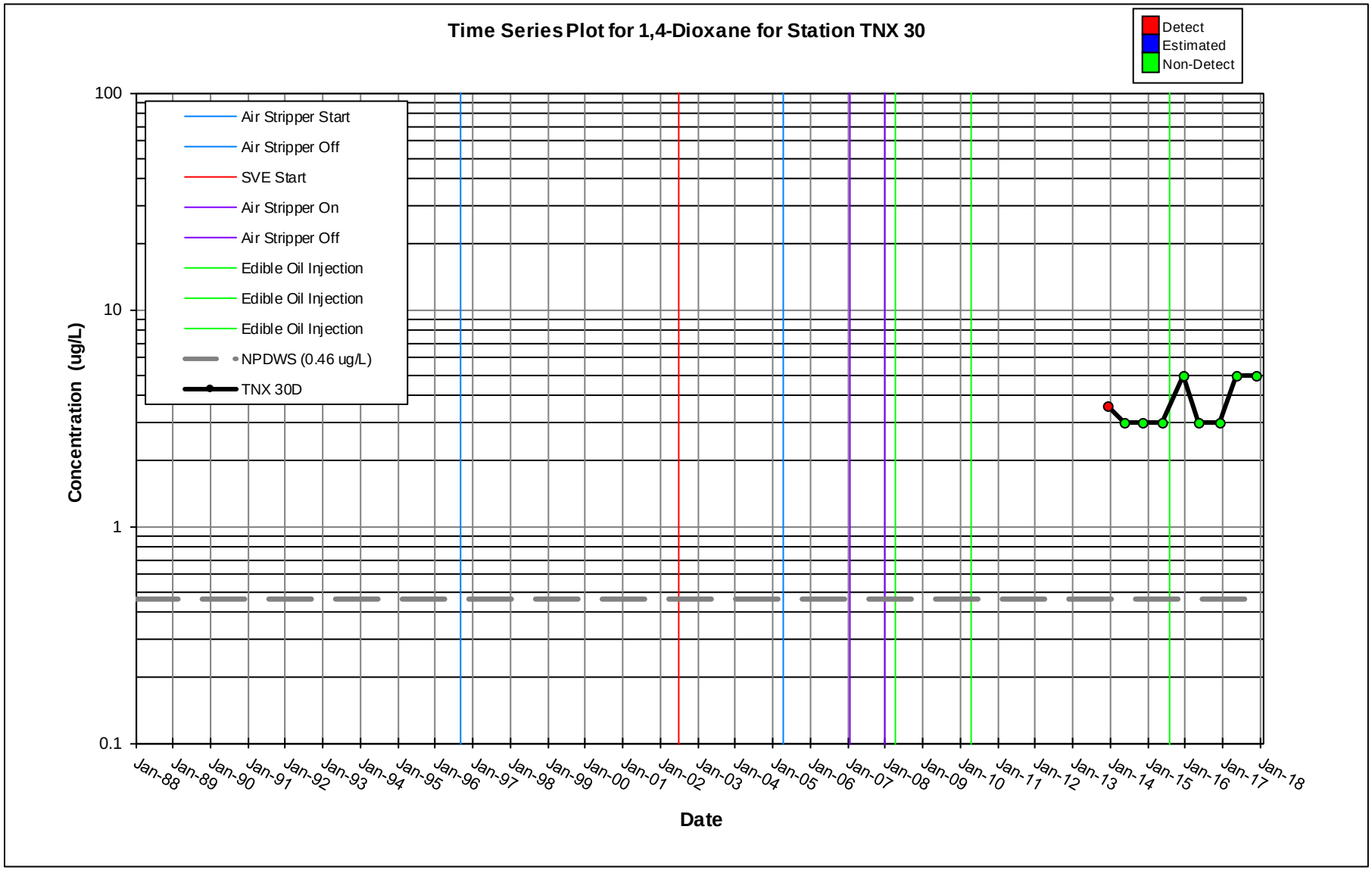
Date


Time Series Plot for 1,4-Dioxane for Station TNX 30
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 30D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
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Jan-91
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Jan-97
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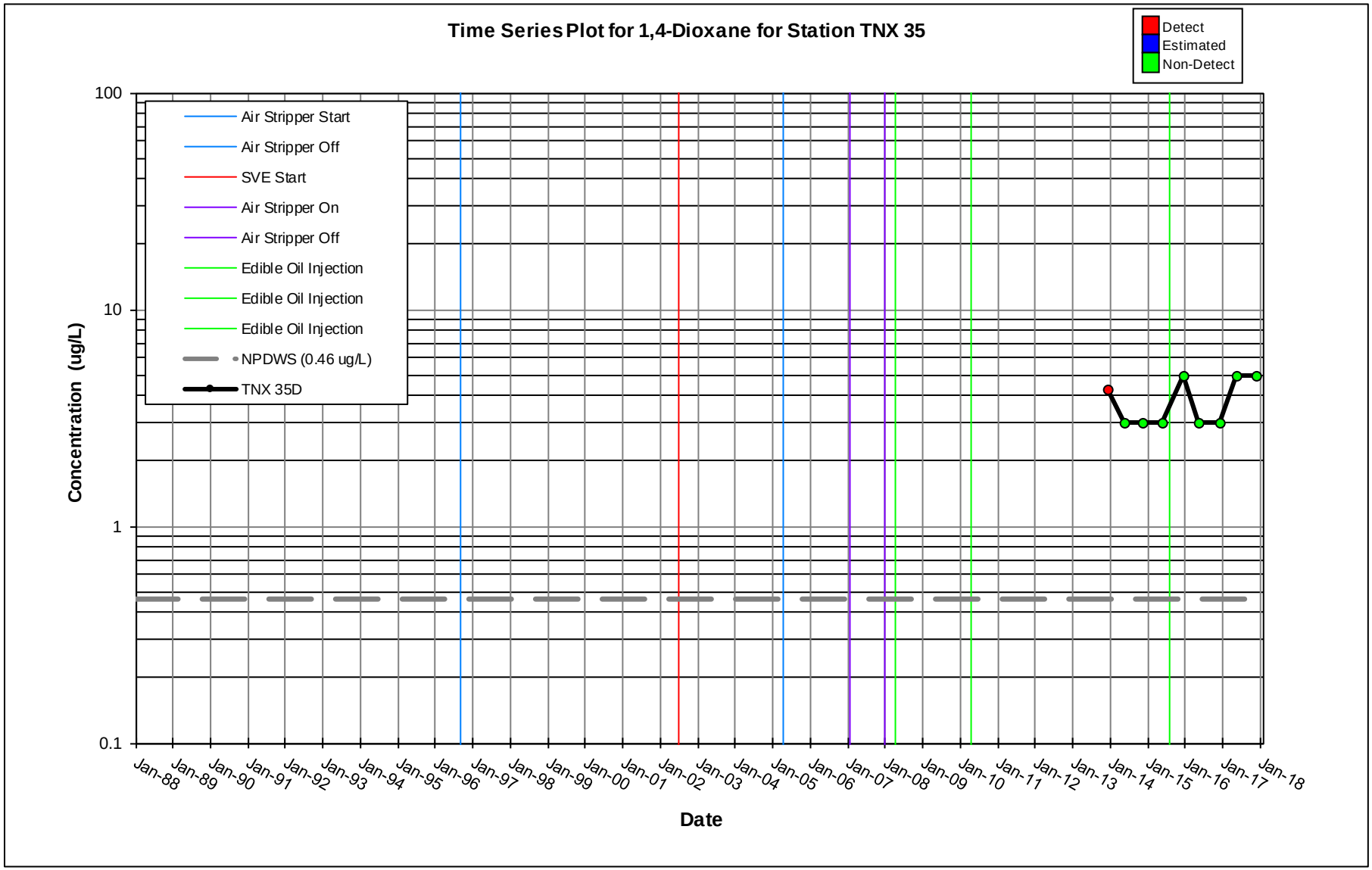
Time Series Plot for 1,4-Dioxane for Station TNX 35
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 35D
Concentration (ug/L)
100
10
1
0.1
Jan-88
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Jan-94
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Jan-96
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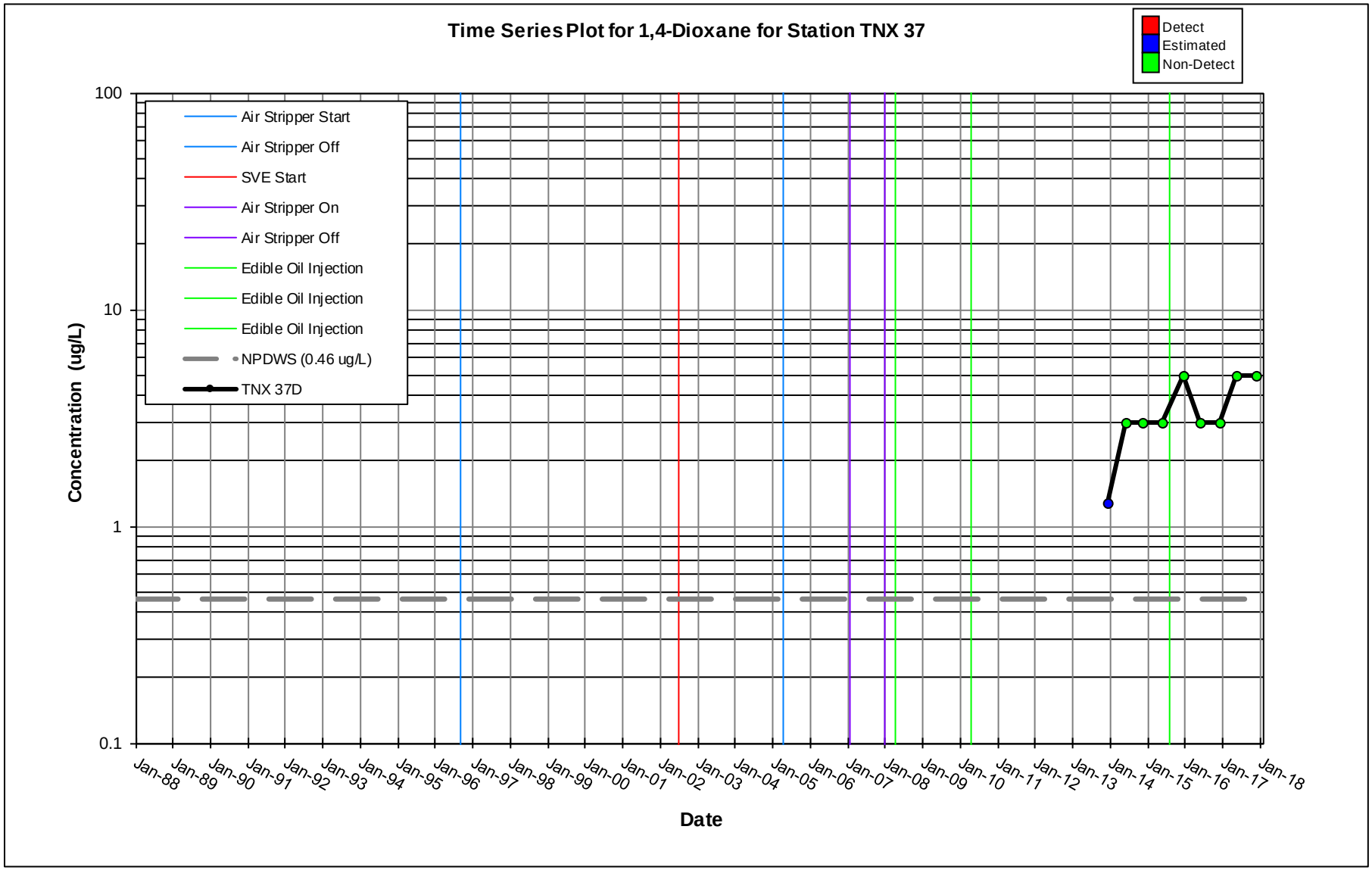
Time Series Plot for 1,4-Dioxane for Station TNX 37
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 37D
Concentration (ug/L)
100
10
1
0.1
Jan-88
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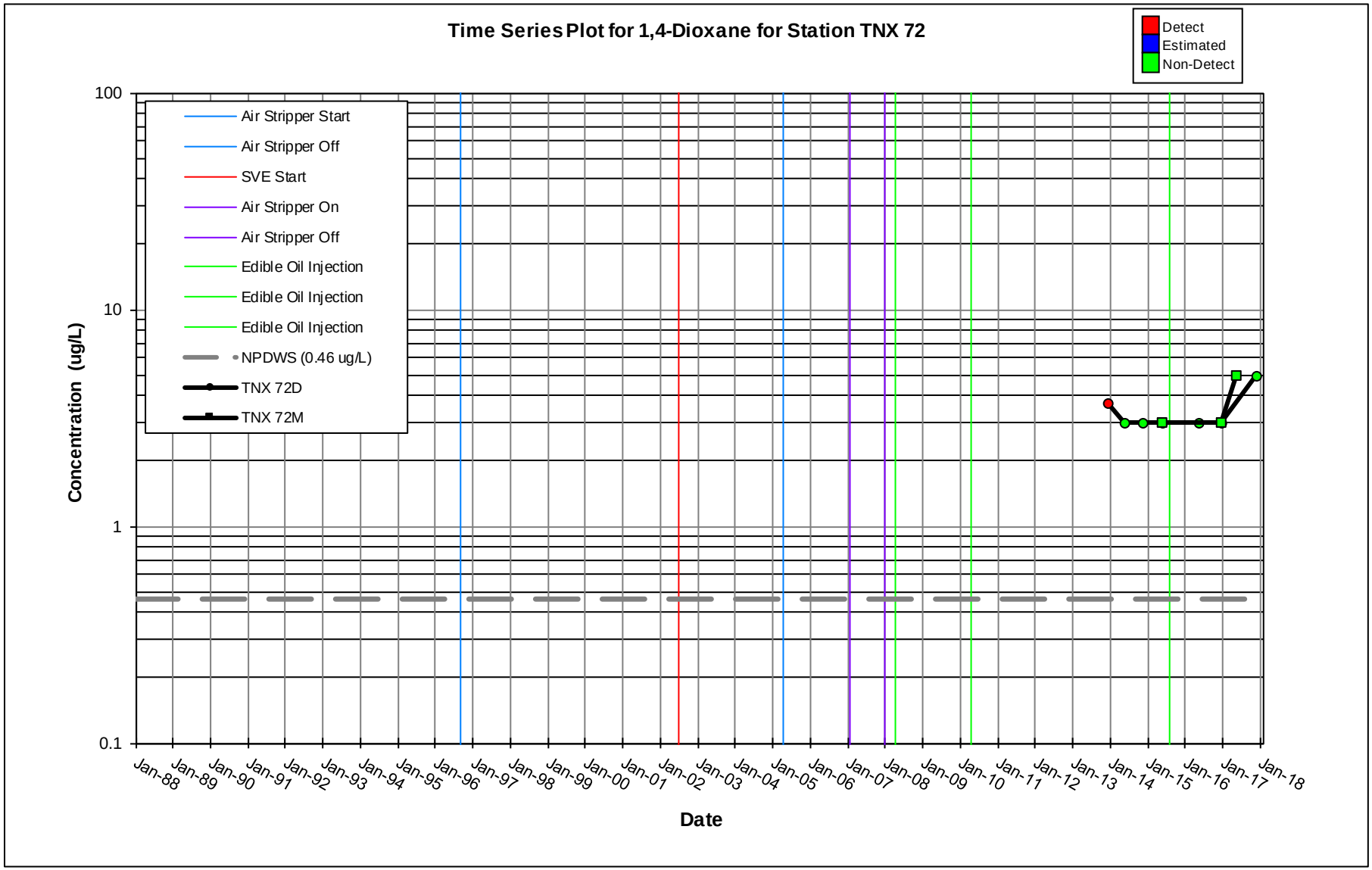
Time Series Plot for 1,4-Dioxane for Station TNX 72
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX 72D
TNX 72M
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
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Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
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Jan-99
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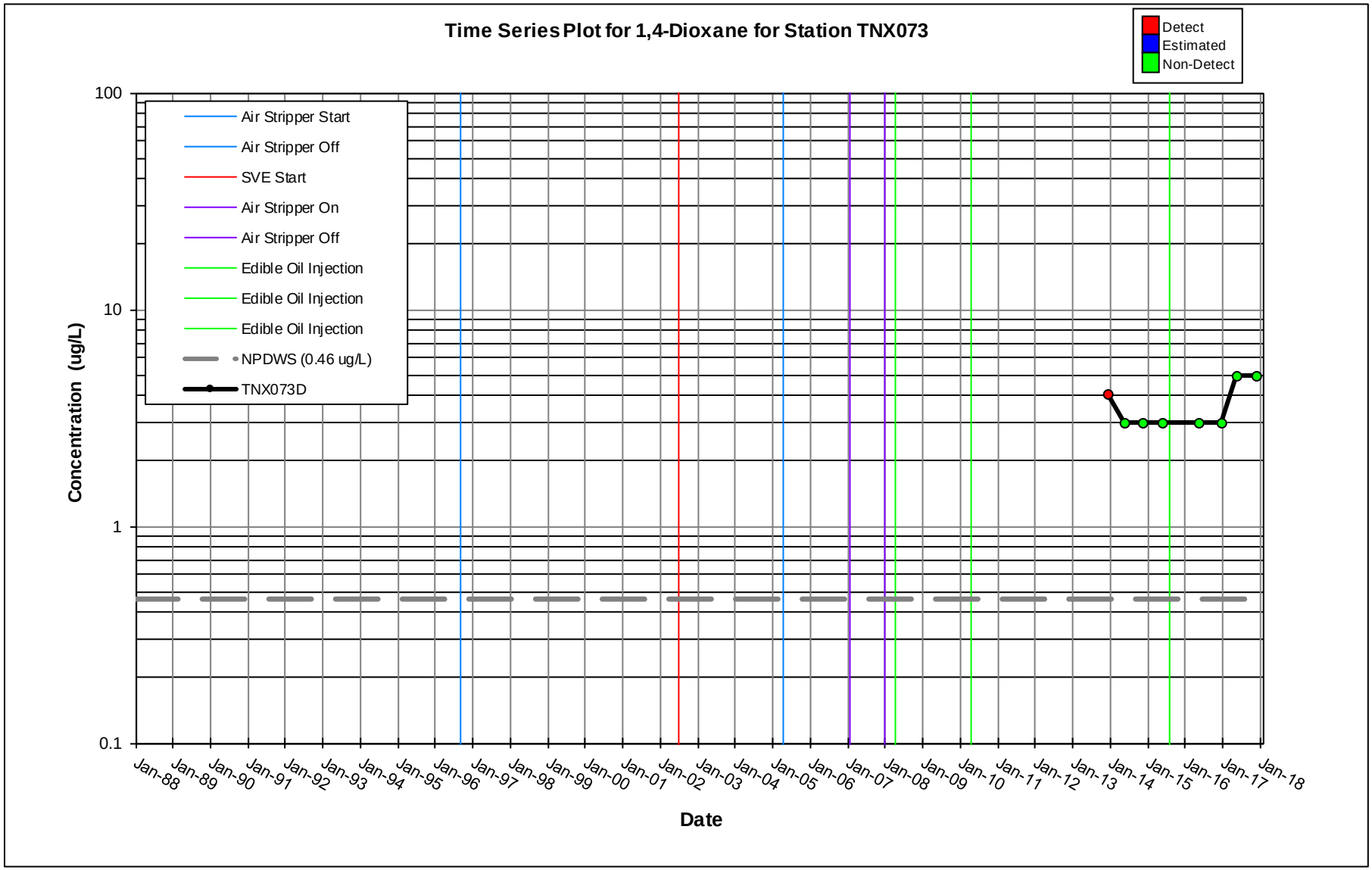
Date


Time Series Plot for 1,4-Dioxane for Station TNX073
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX073D
Concentration (ug/L)
100
10
1
0.1
Jan-88
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Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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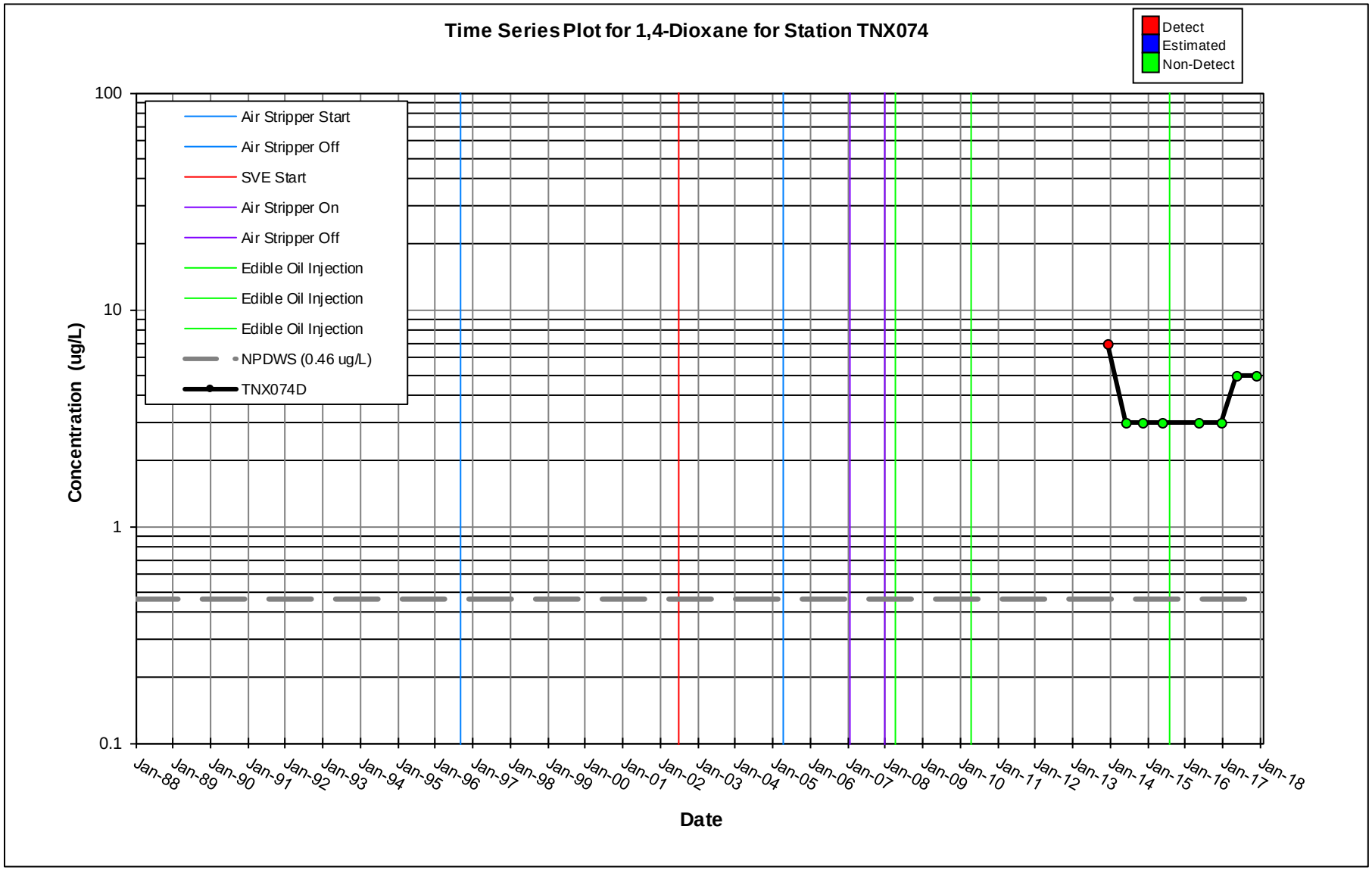
Time Series Plot for 1,4-Dioxane for Station TNX074
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX074D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
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Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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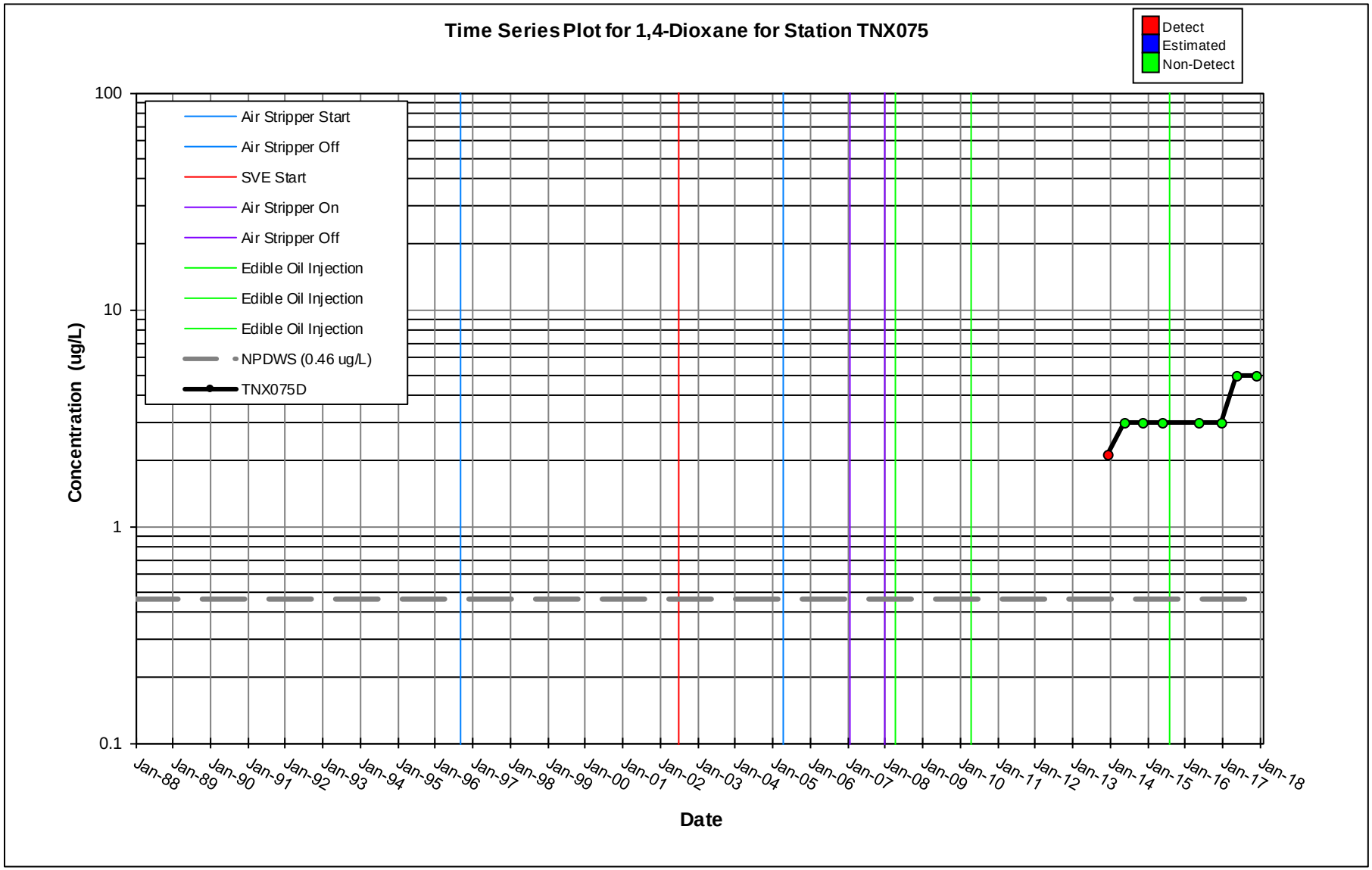
Time Series Plot for 1,4-Dioxane for Station TNX075
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TNX075D
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
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Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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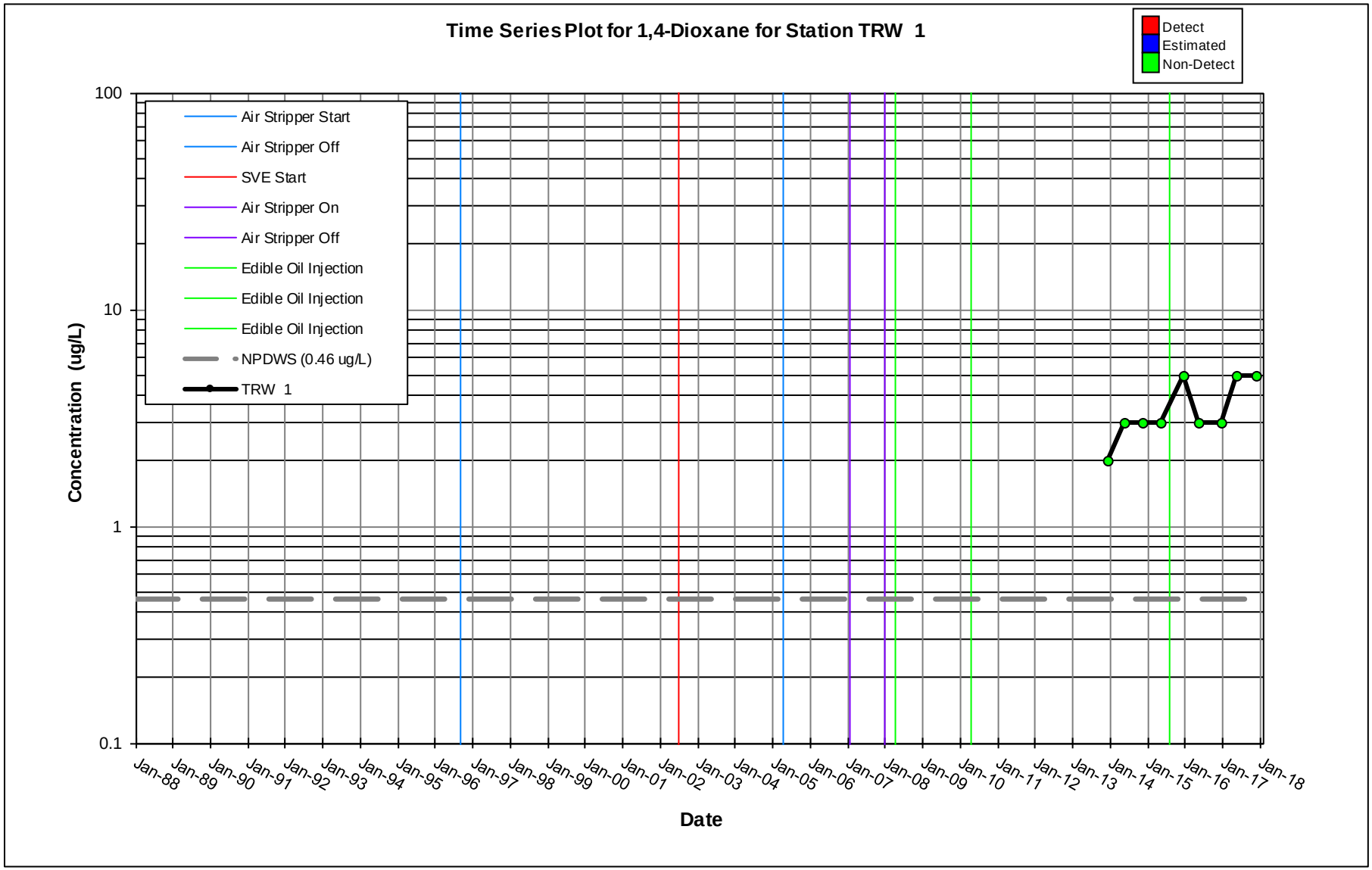
Time Series Plot for 1,4-Dioxane for Station TRW 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TRW 1
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
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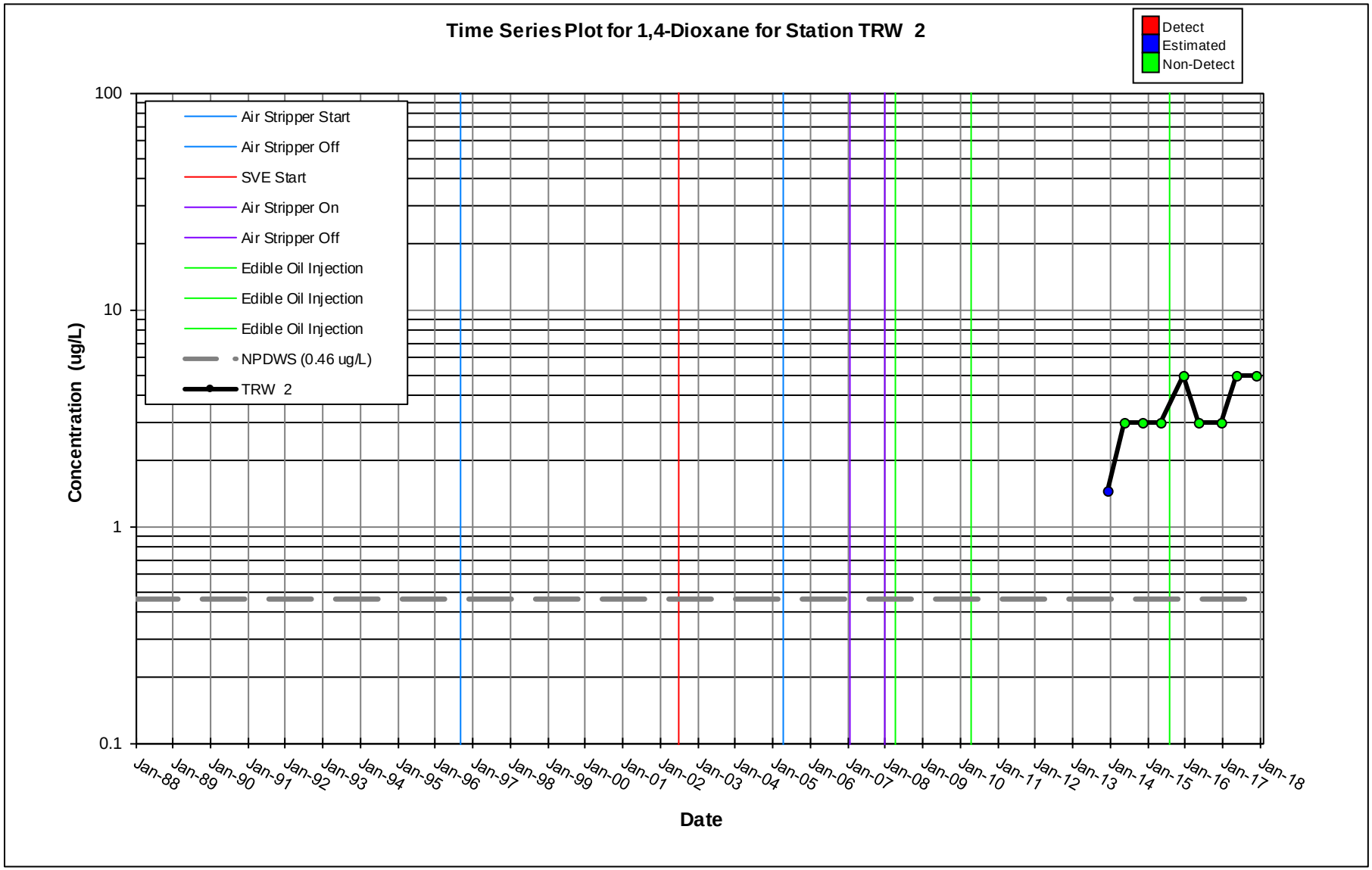
Time Series Plot for 1,4-Dioxane for Station TRW 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TRW 2
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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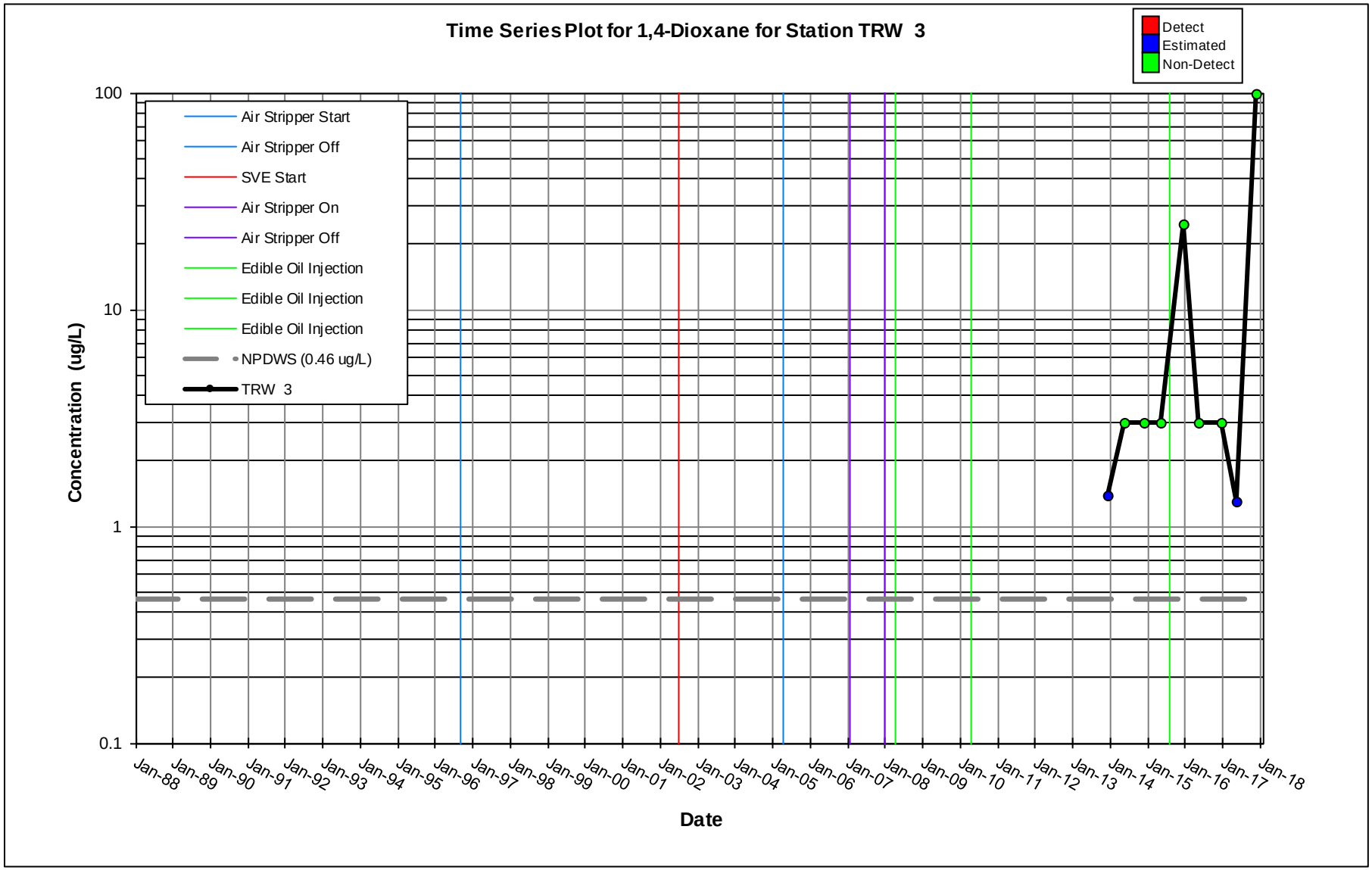
Time Series Plot for 1,4-Dioxane for Station TRW 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TRW 3
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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Jan-95
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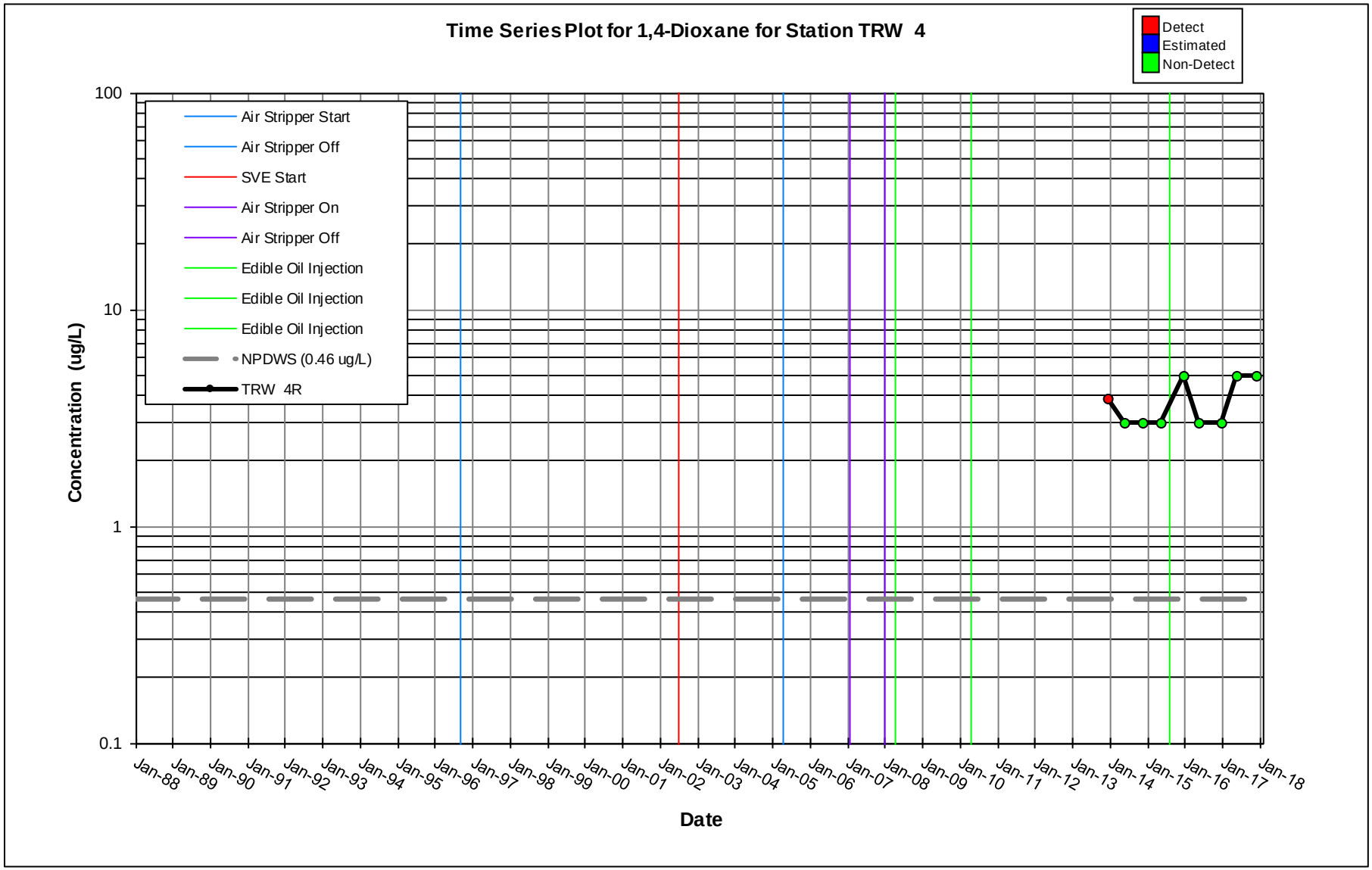
Time Series Plot for 1,4-Dioxane for Station TRW 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TRW 4R
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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Jan-00
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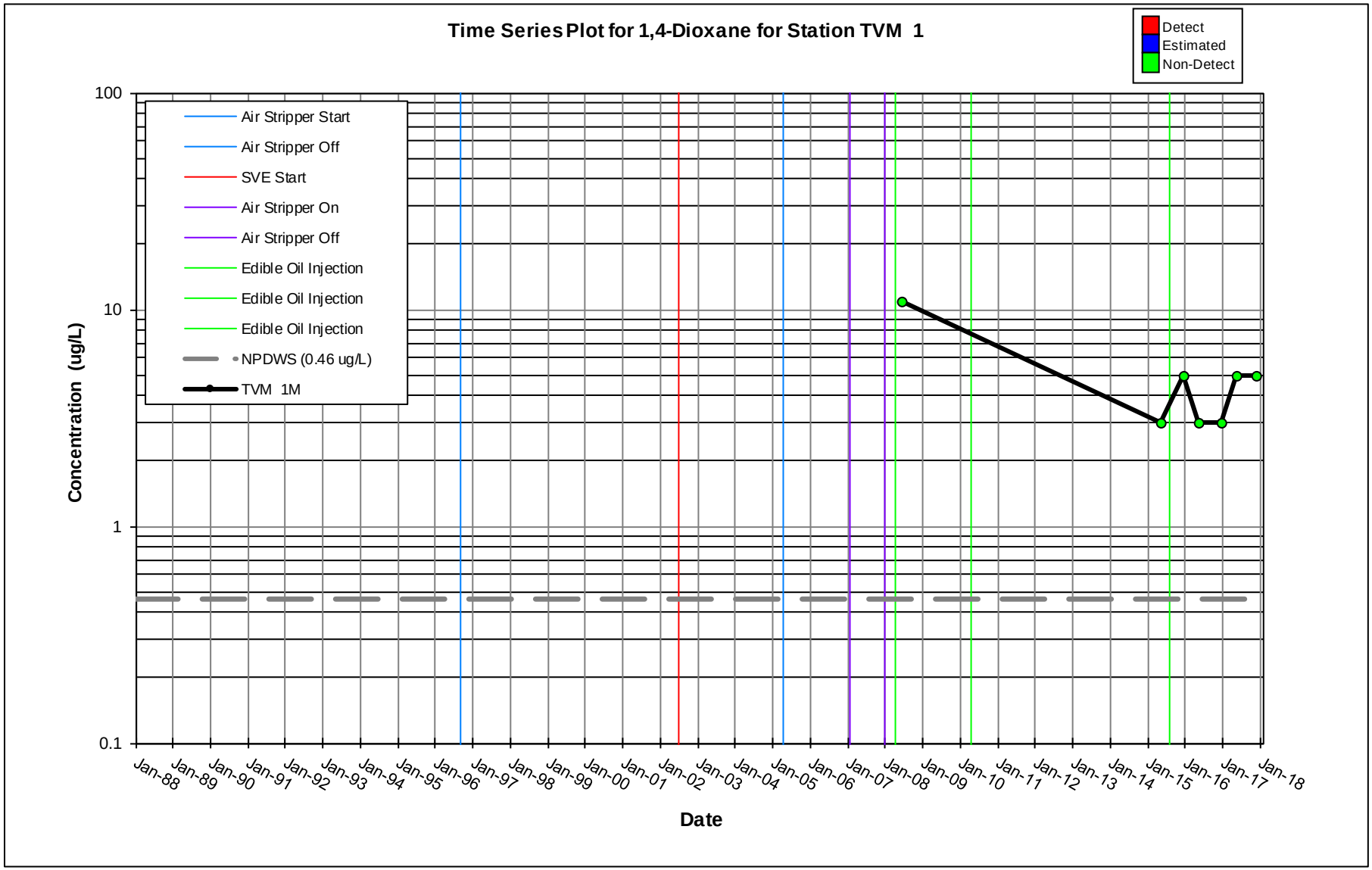
Time Series Plot for 1,4-Dioxane for Station TVM 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TVM 1M
Concentration (ug/L)
100
10
1
0.1
Jan-88
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Jan-90
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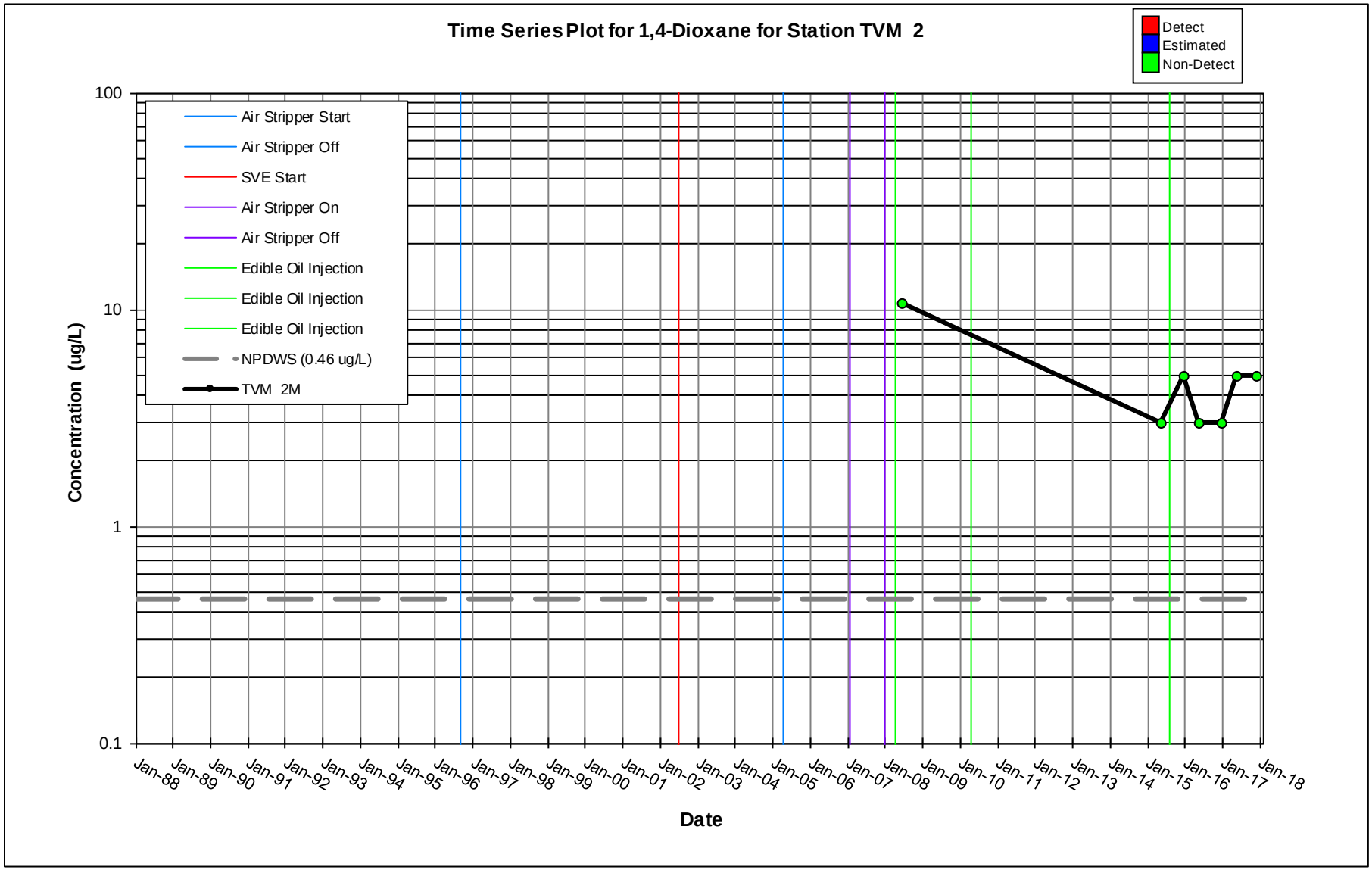
Time Series Plot for 1,4-Dioxane for Station TVM 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TVM 2M
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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Jan-94
Jan-95
Jan-96
Jan-97
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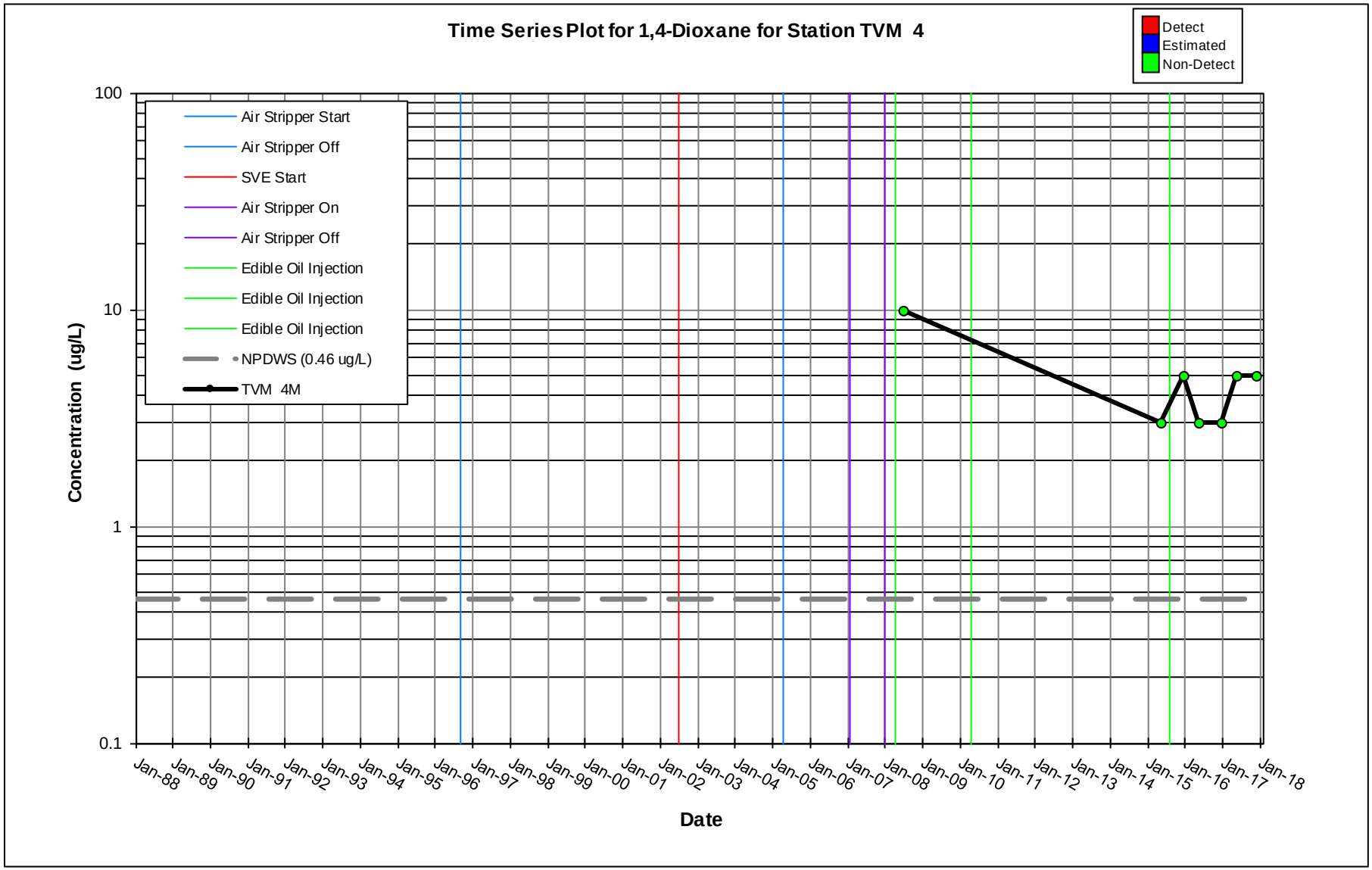
Time Series Plot for 1,4-Dioxane for Station TVM 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TVM 4M
Concentration (ug/L)
100
10
1
0.1
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Jan-96
Jan-97
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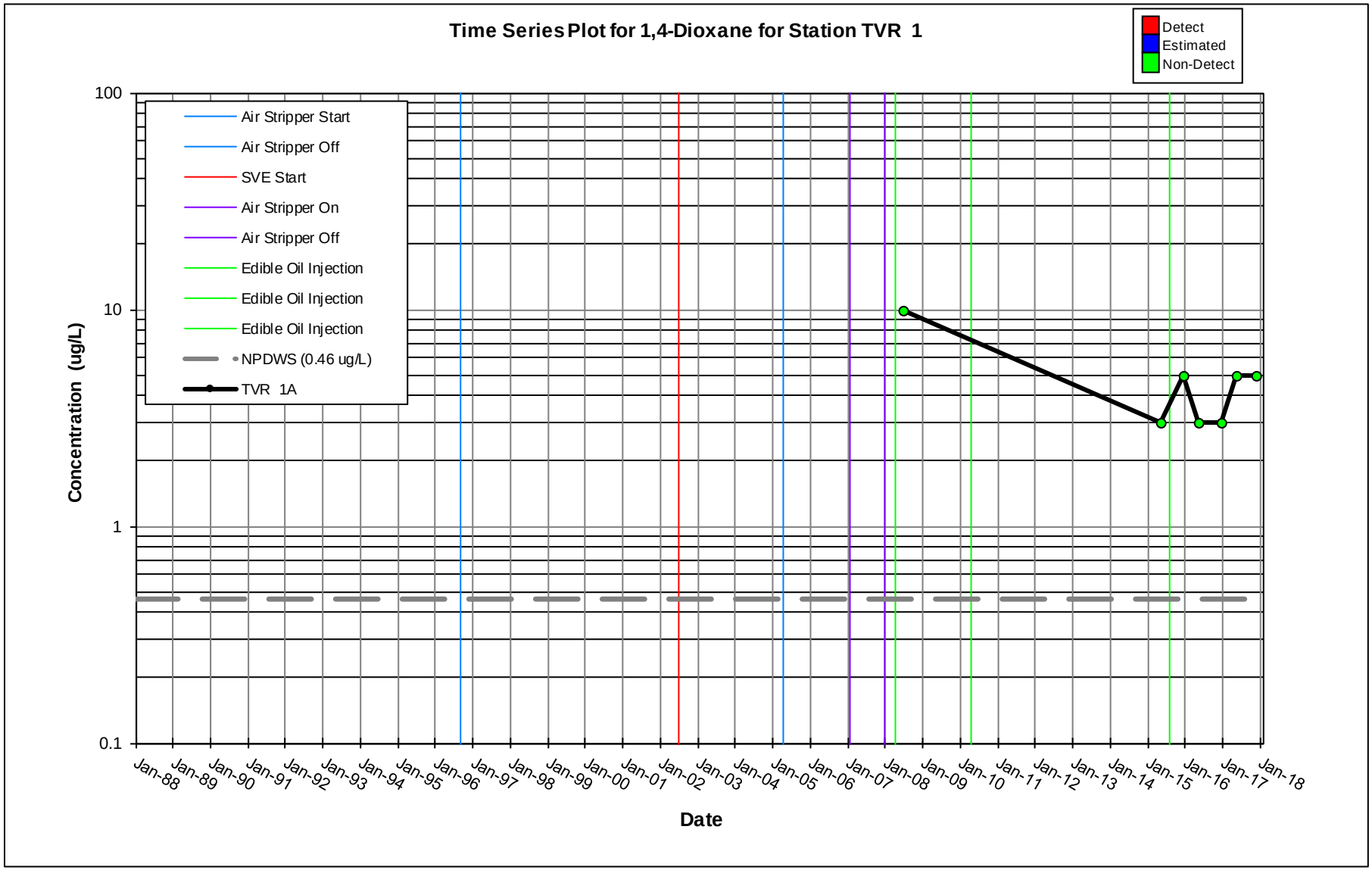
Time Series Plot for 1,4-Dioxane for Station TVR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (0.46 ug/L)
TVR 1A
Concentration (ug/L)
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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Jan-94
Jan-95
Jan-96
Jan-97
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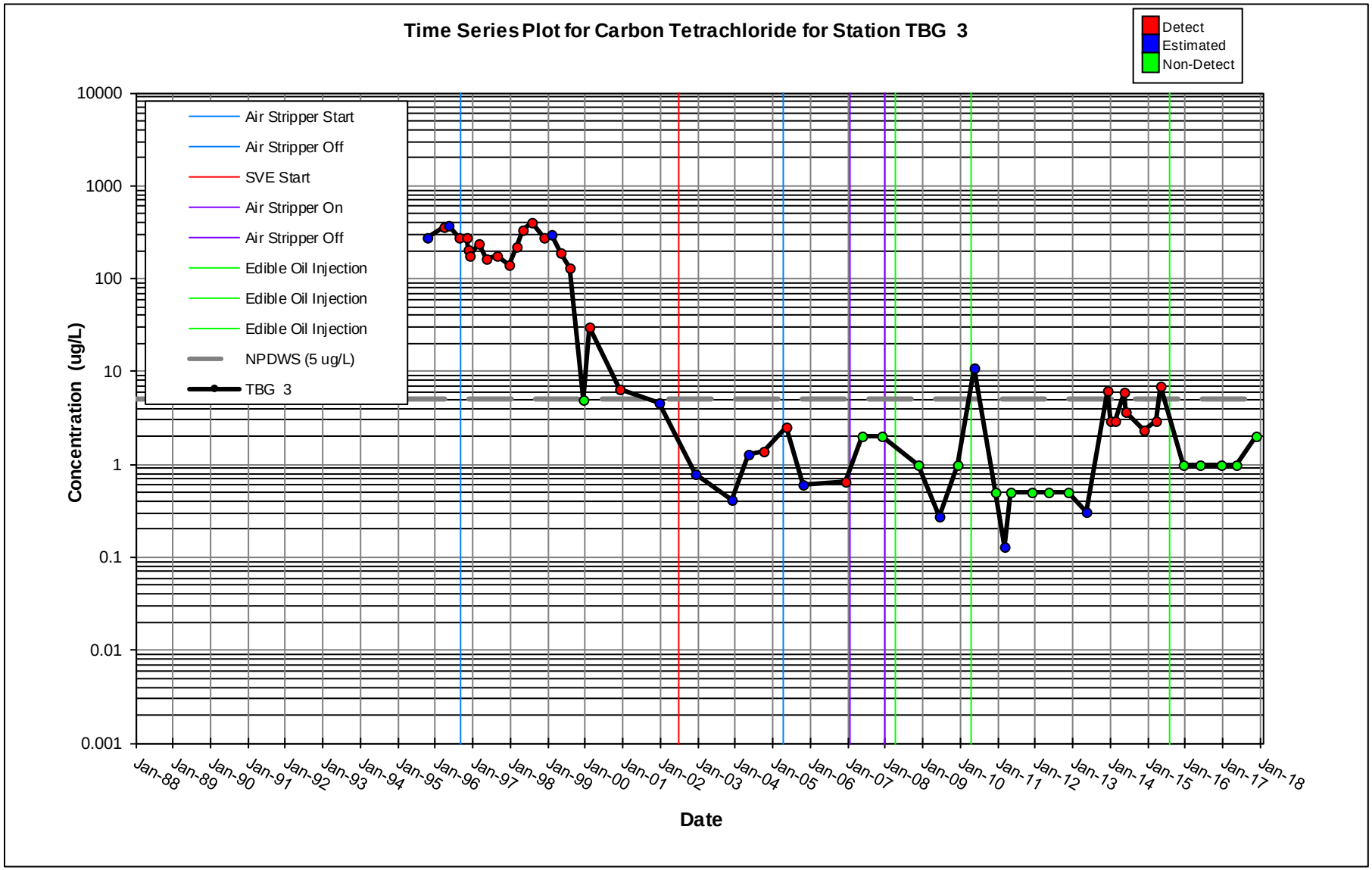
Time Series Plot for Carbon Tetrachloride for Station TBG 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TBG 3
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
0.001
Jan-88
Jan-89
Jan-90
Jan-91
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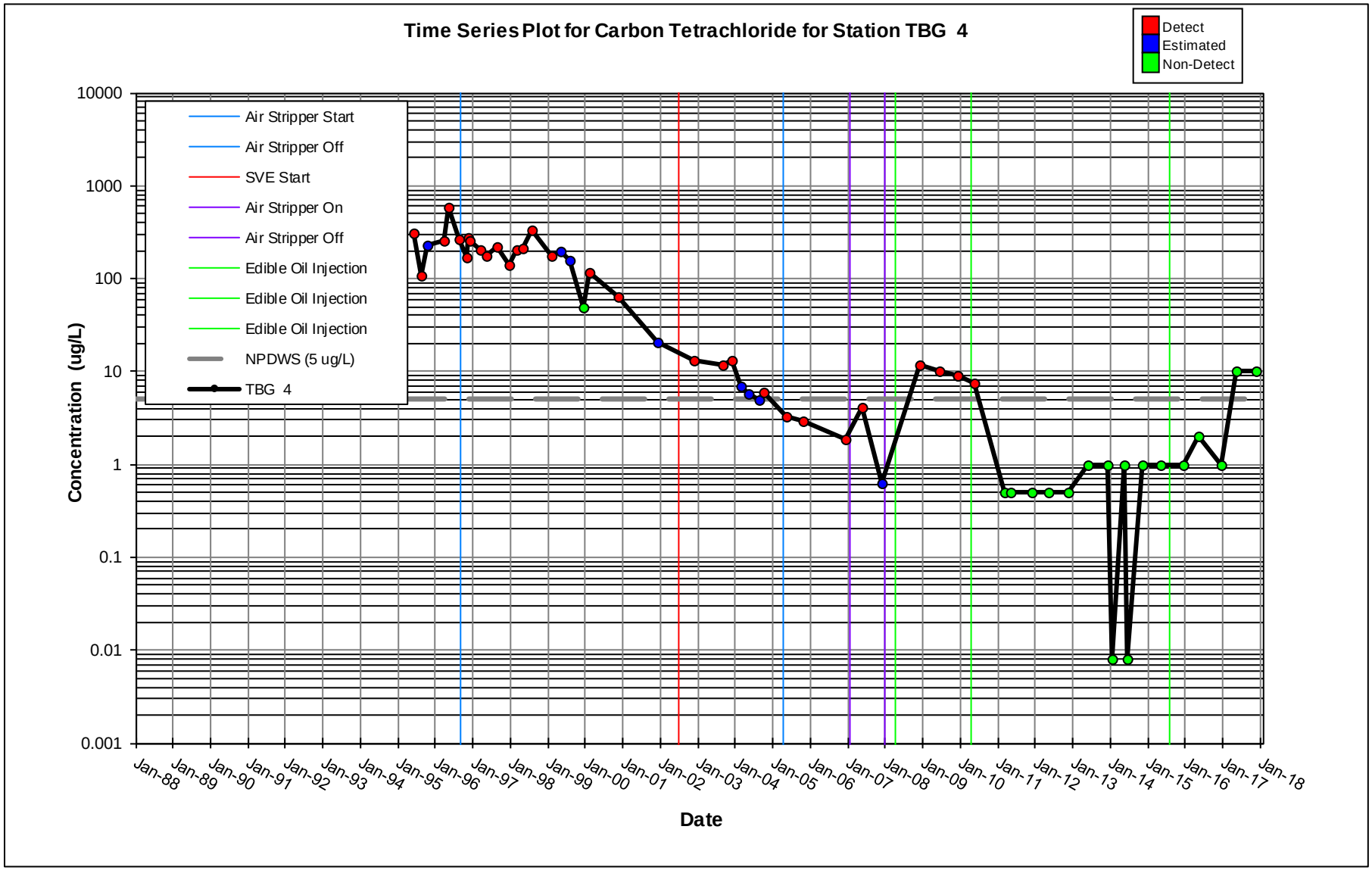
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Carbon Tetrachloride for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TBG 4
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
0.001
Jan-88
Jan-89
Jan-90
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Jan-01
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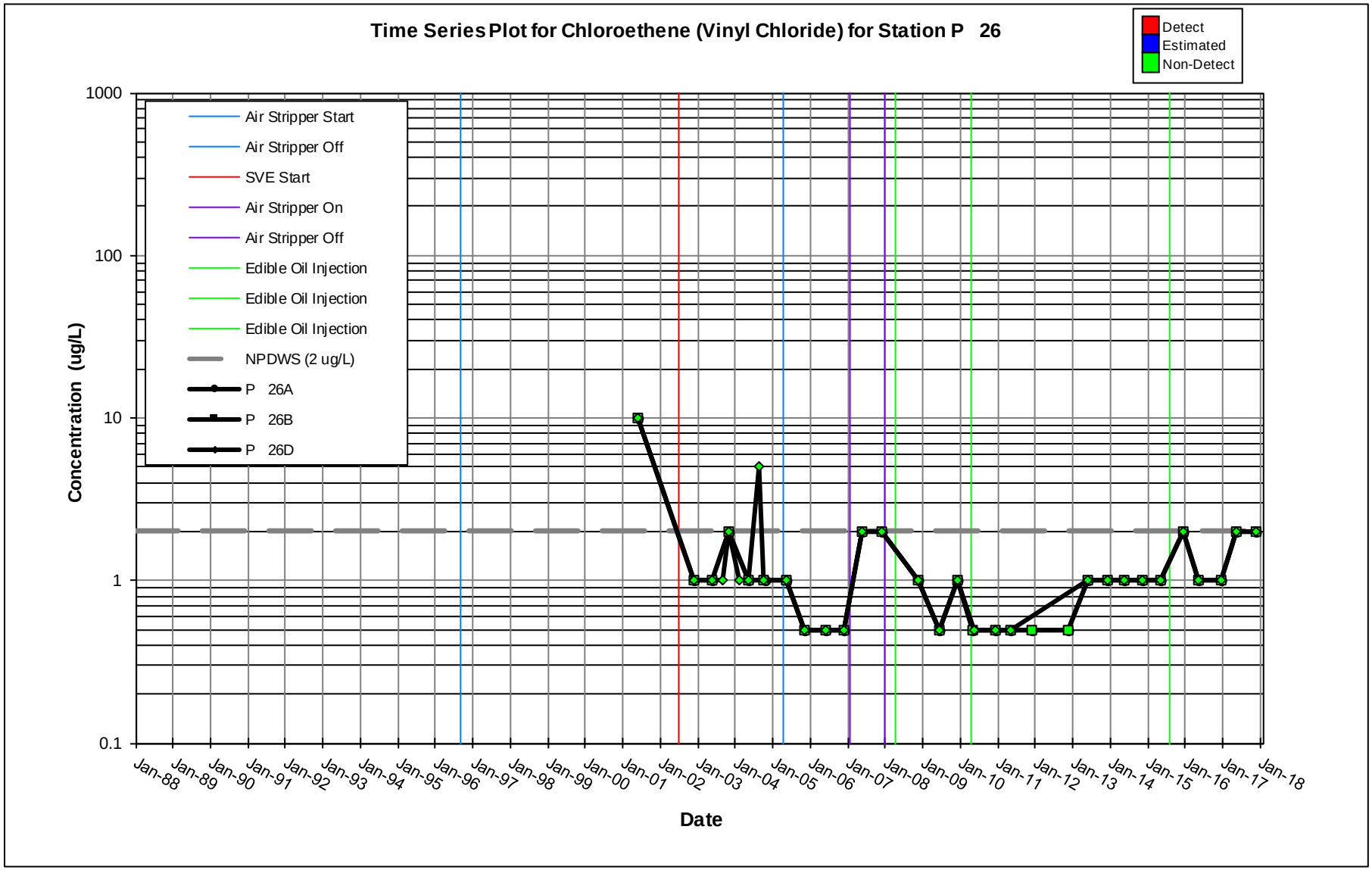
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station P 26
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
P 26A
P 26B
P 26D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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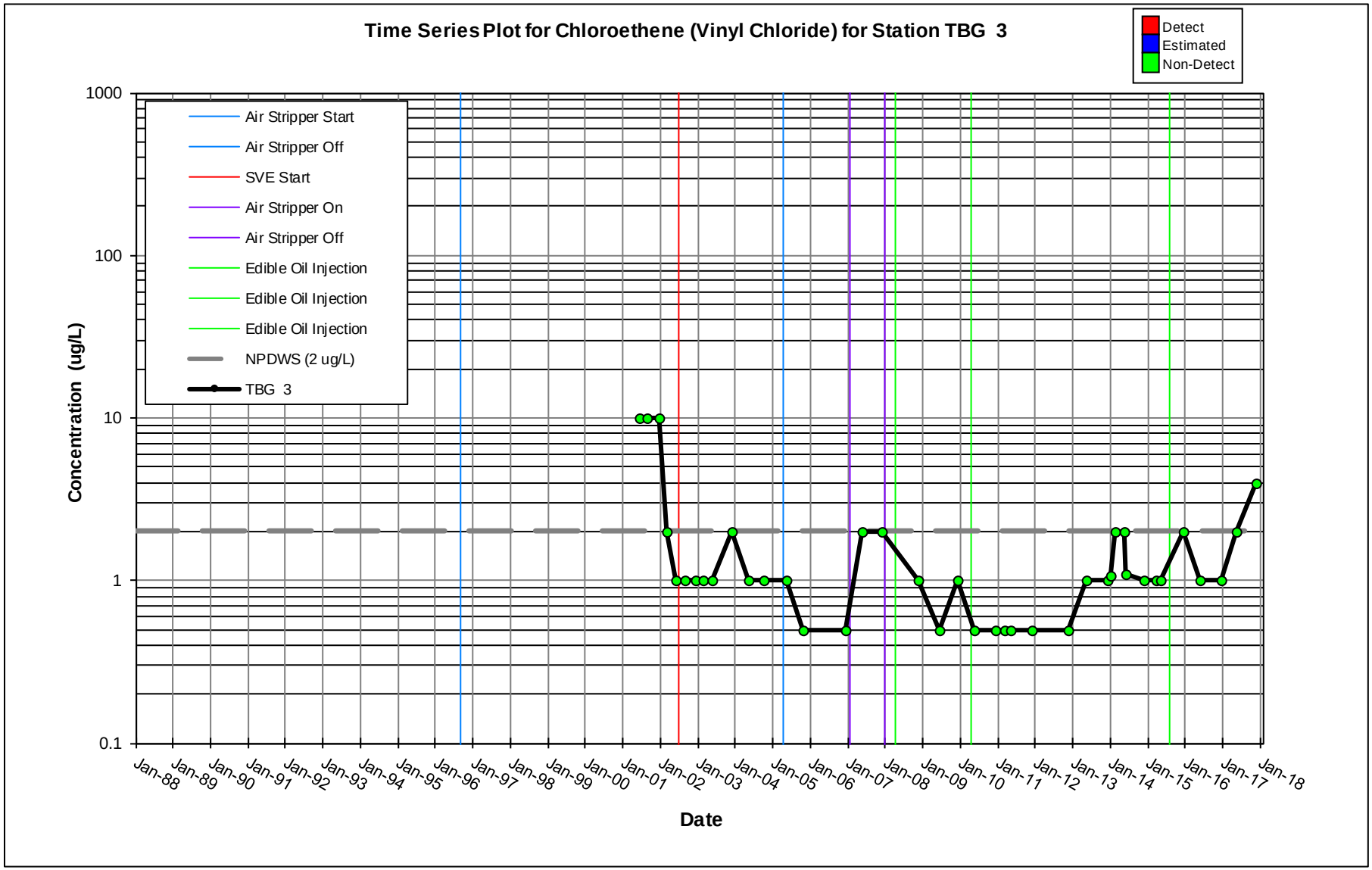
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TBG 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TBG 3
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
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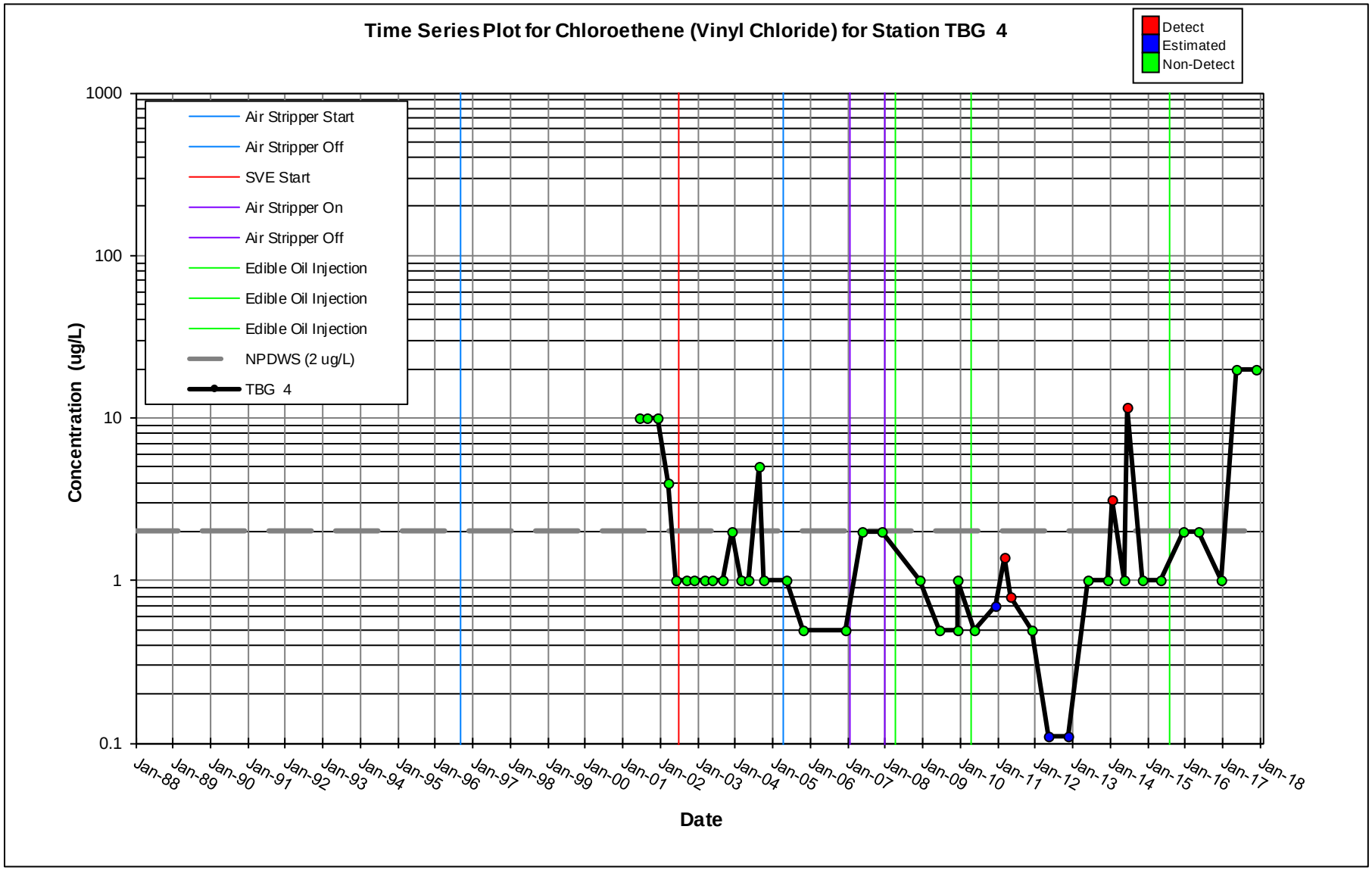
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TBG 4
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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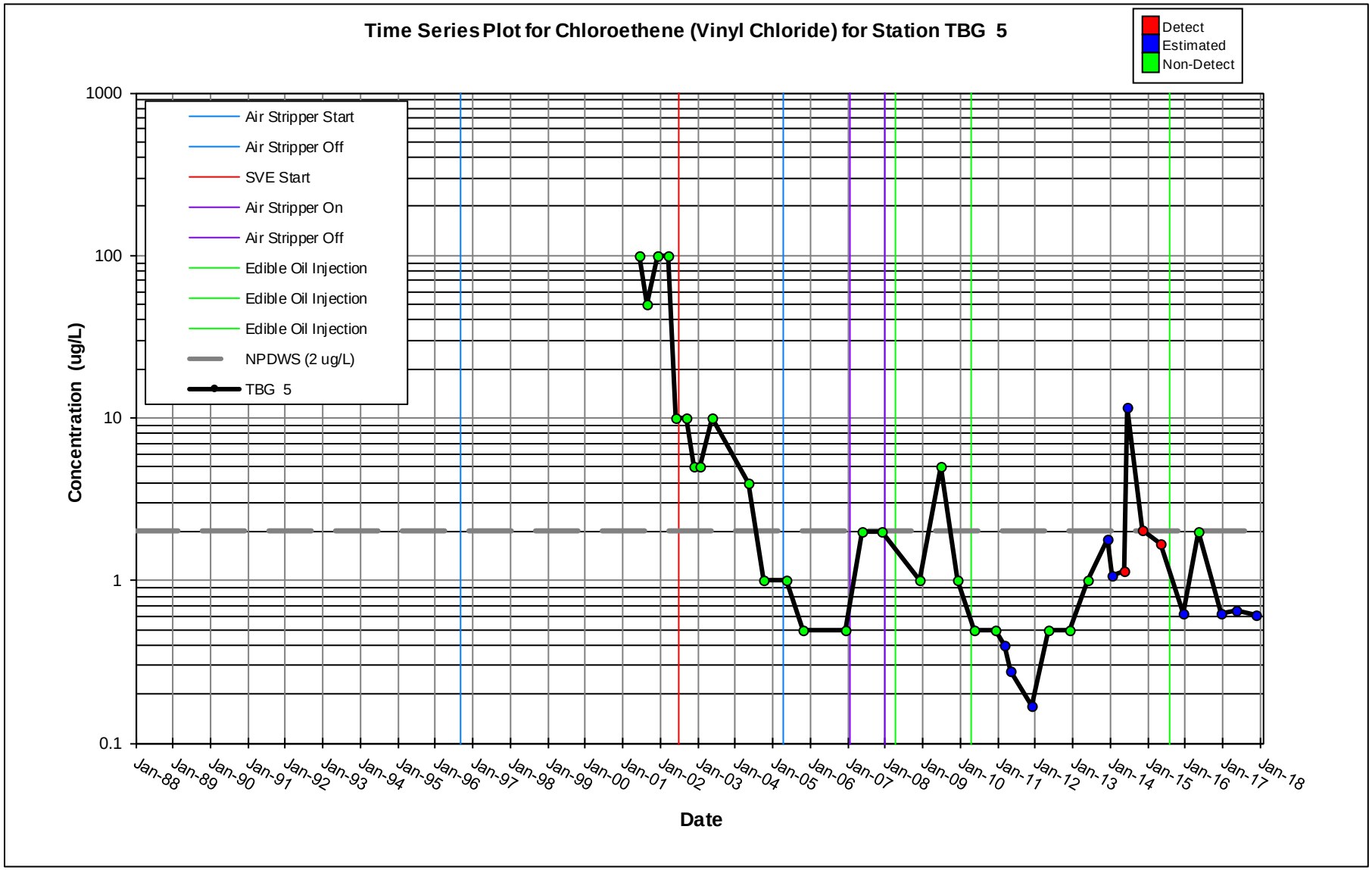
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TBG 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TBG 5
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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Jan-95
Jan-96
Jan-97
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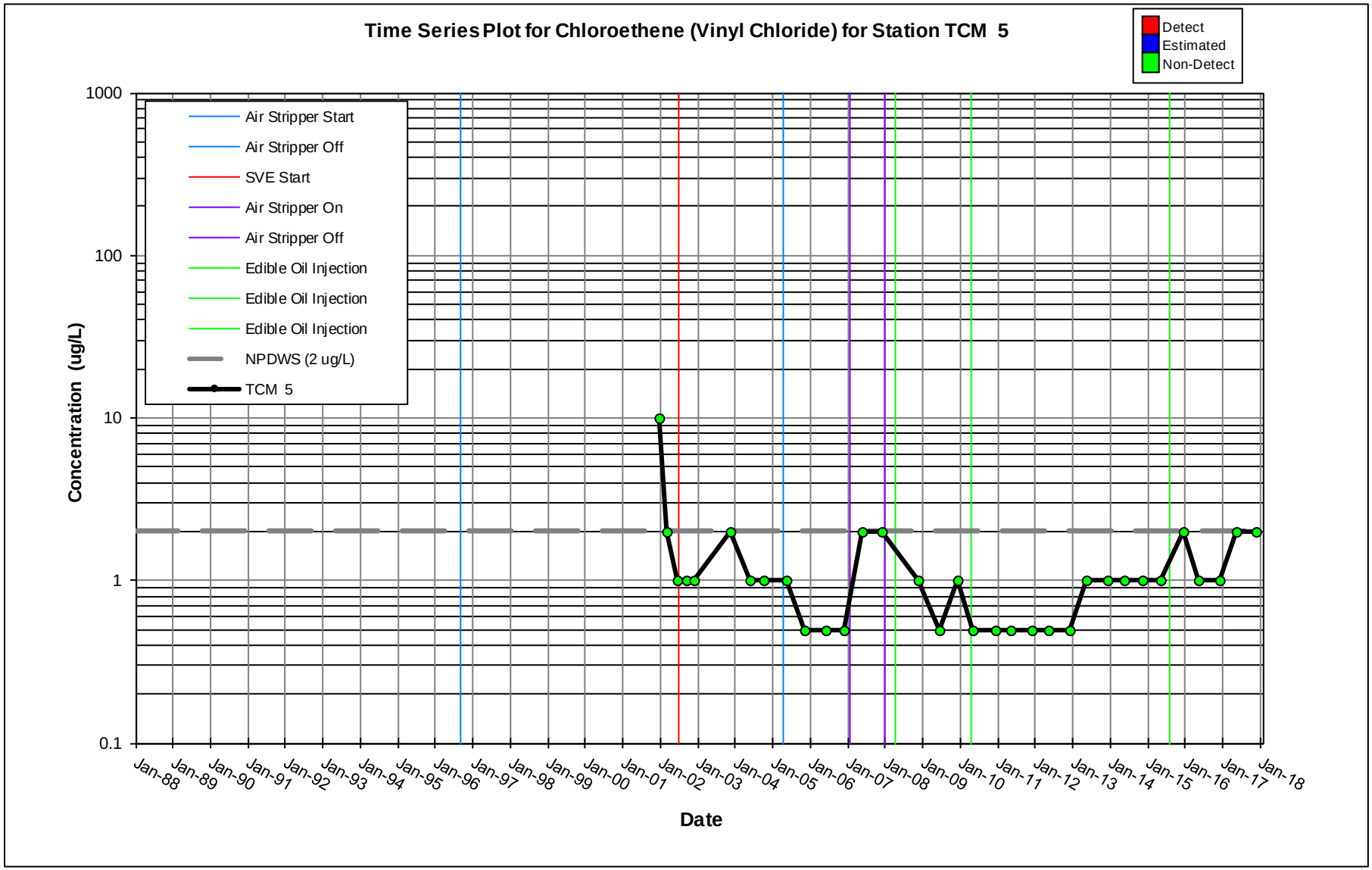
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TCM 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TCM 5
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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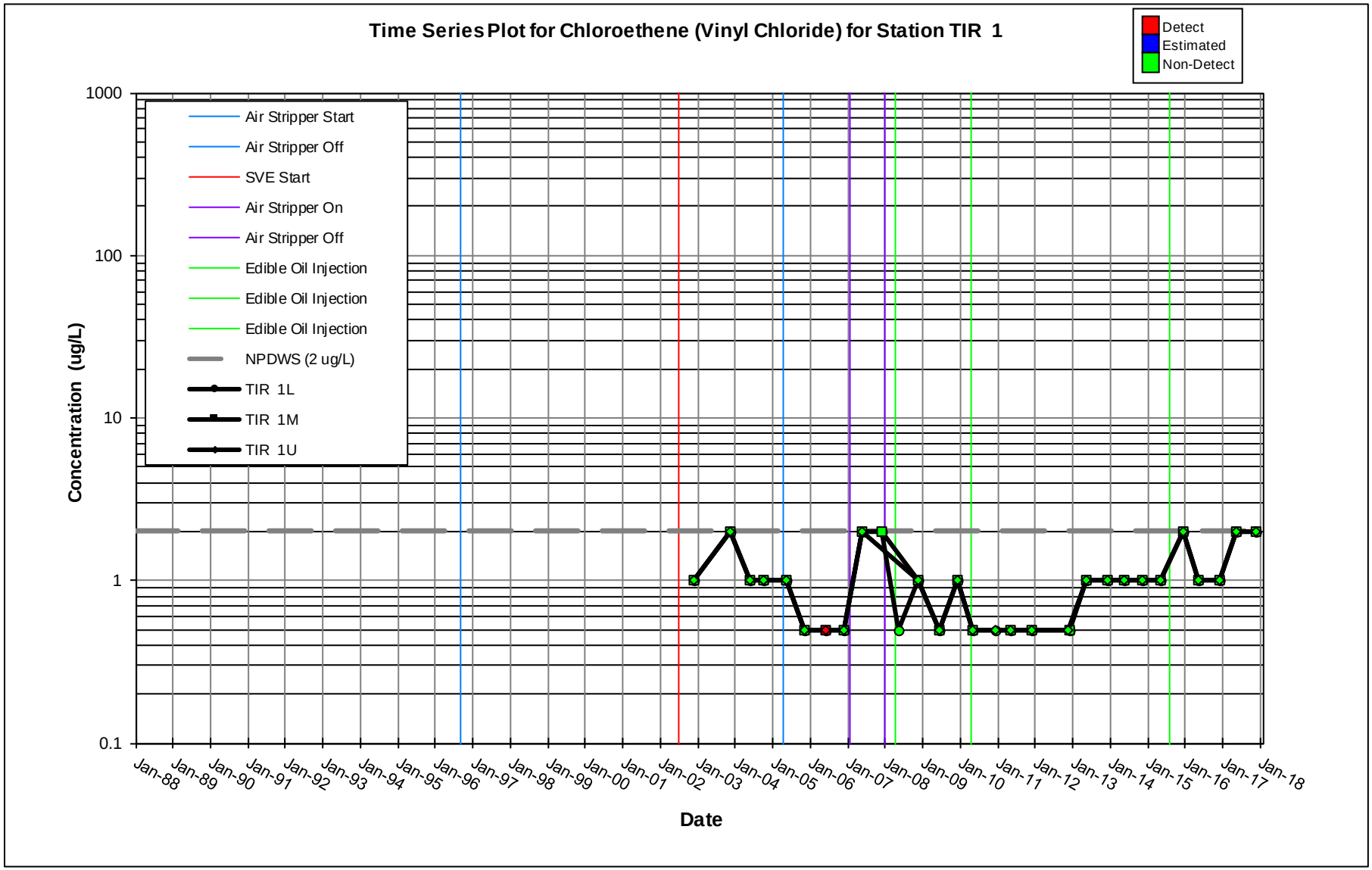
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TIR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TIR 1L
TIR 1M
TIR 1U
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
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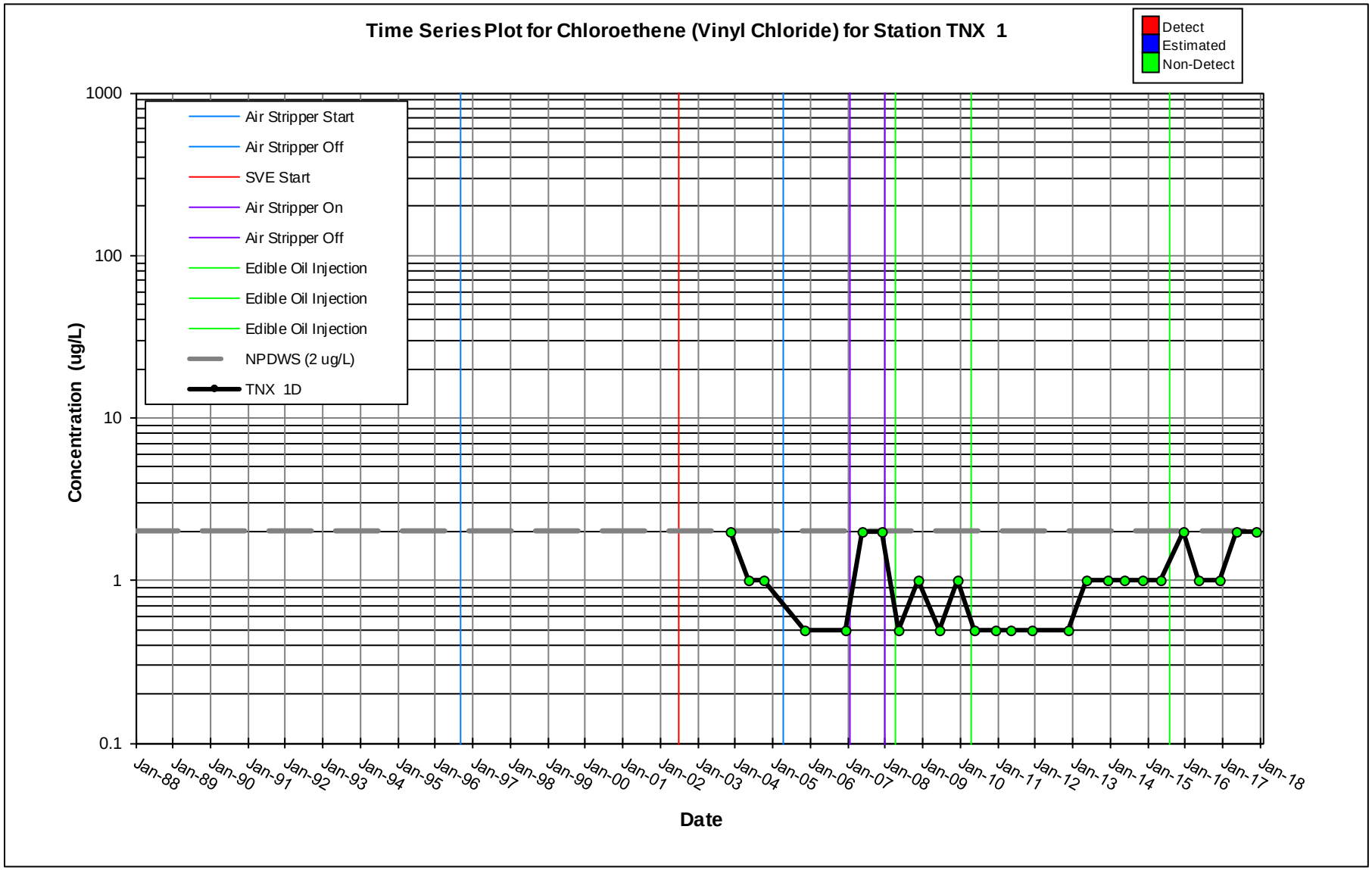
Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 1D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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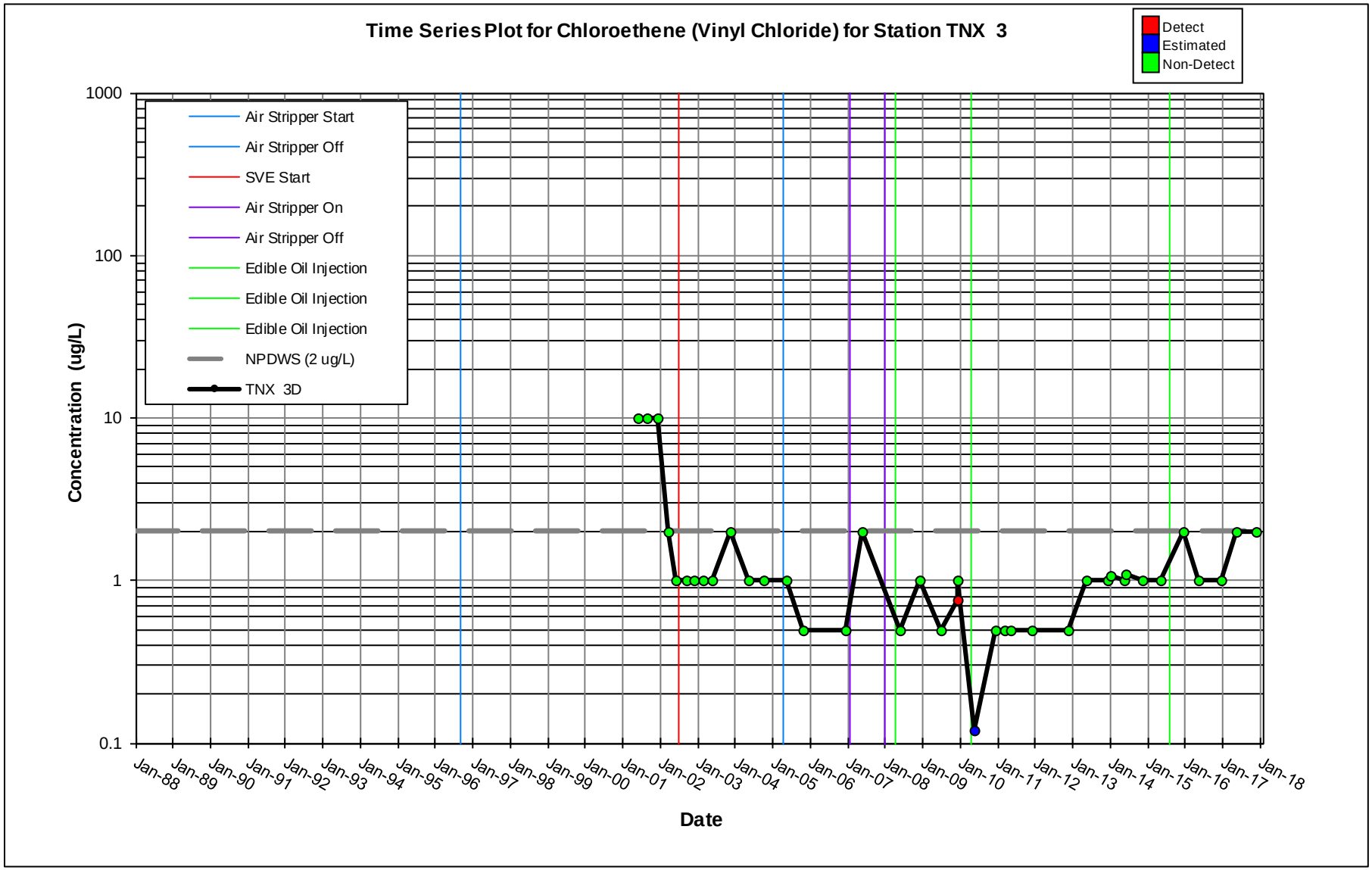
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 3D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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Jan-95
Jan-96
Jan-97
Jan-98
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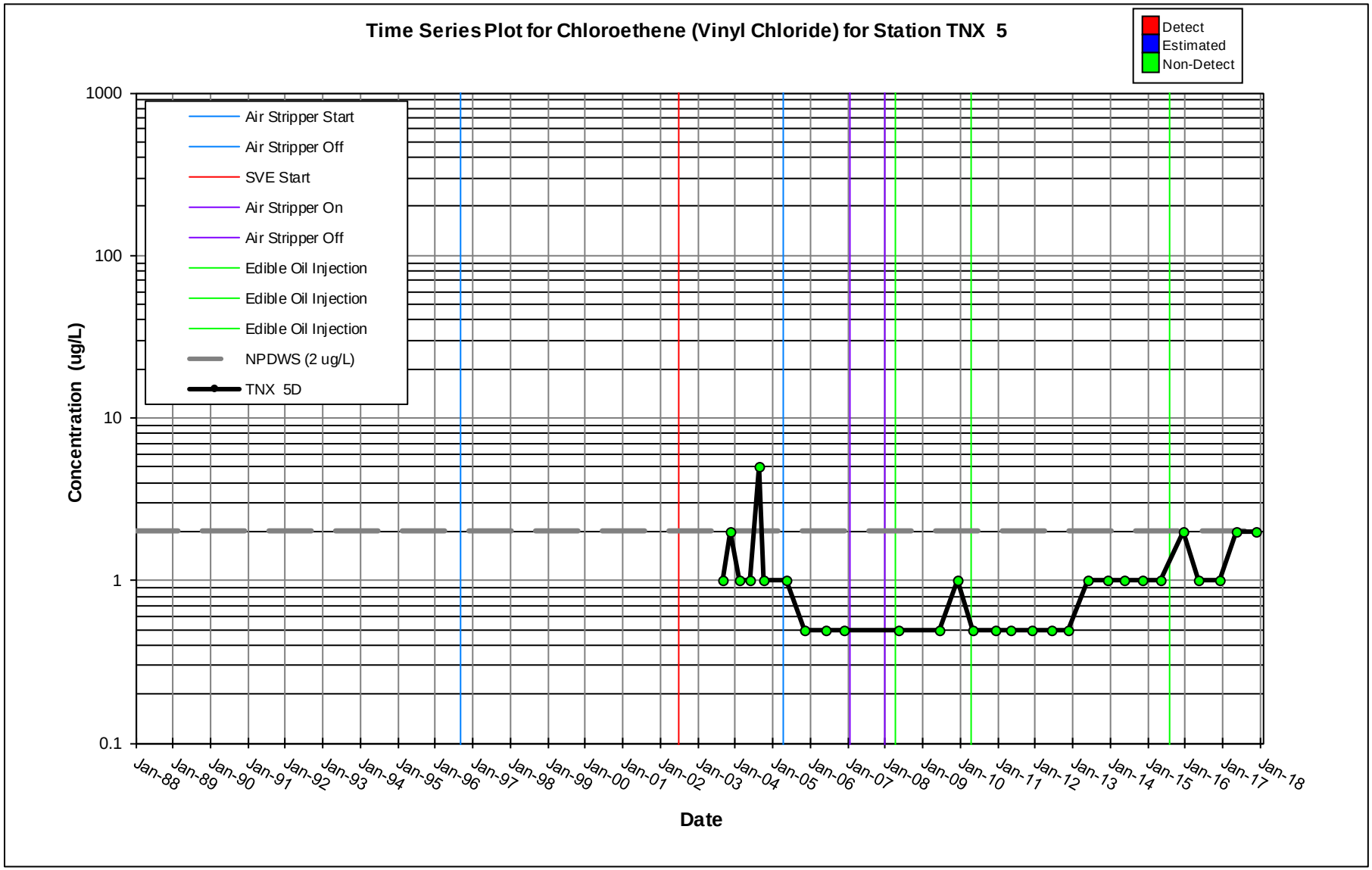
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 5D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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Jan-95
Jan-96
Jan-97
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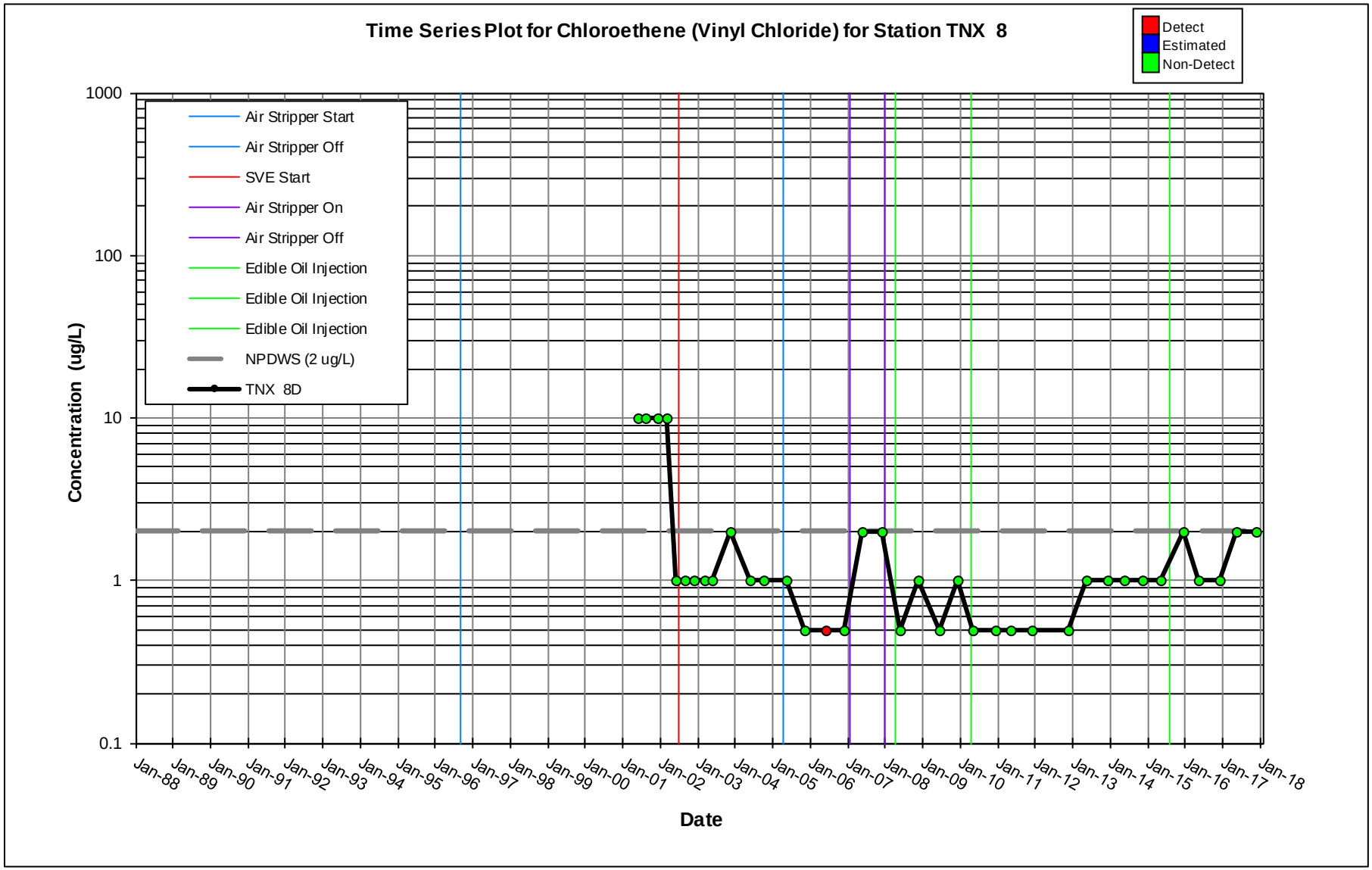
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 8
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 8D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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Jan-96
Jan-97
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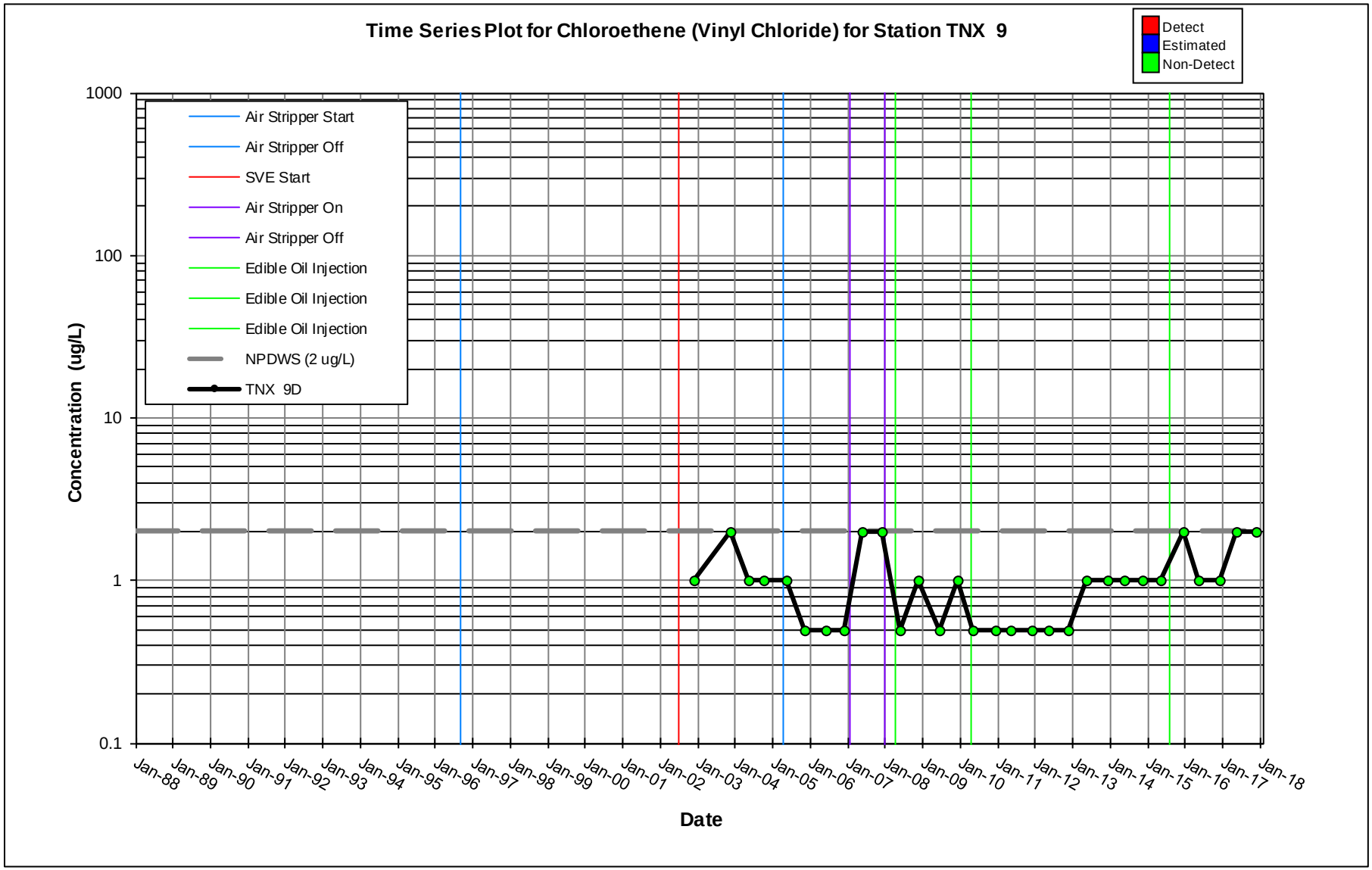
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 9
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 9D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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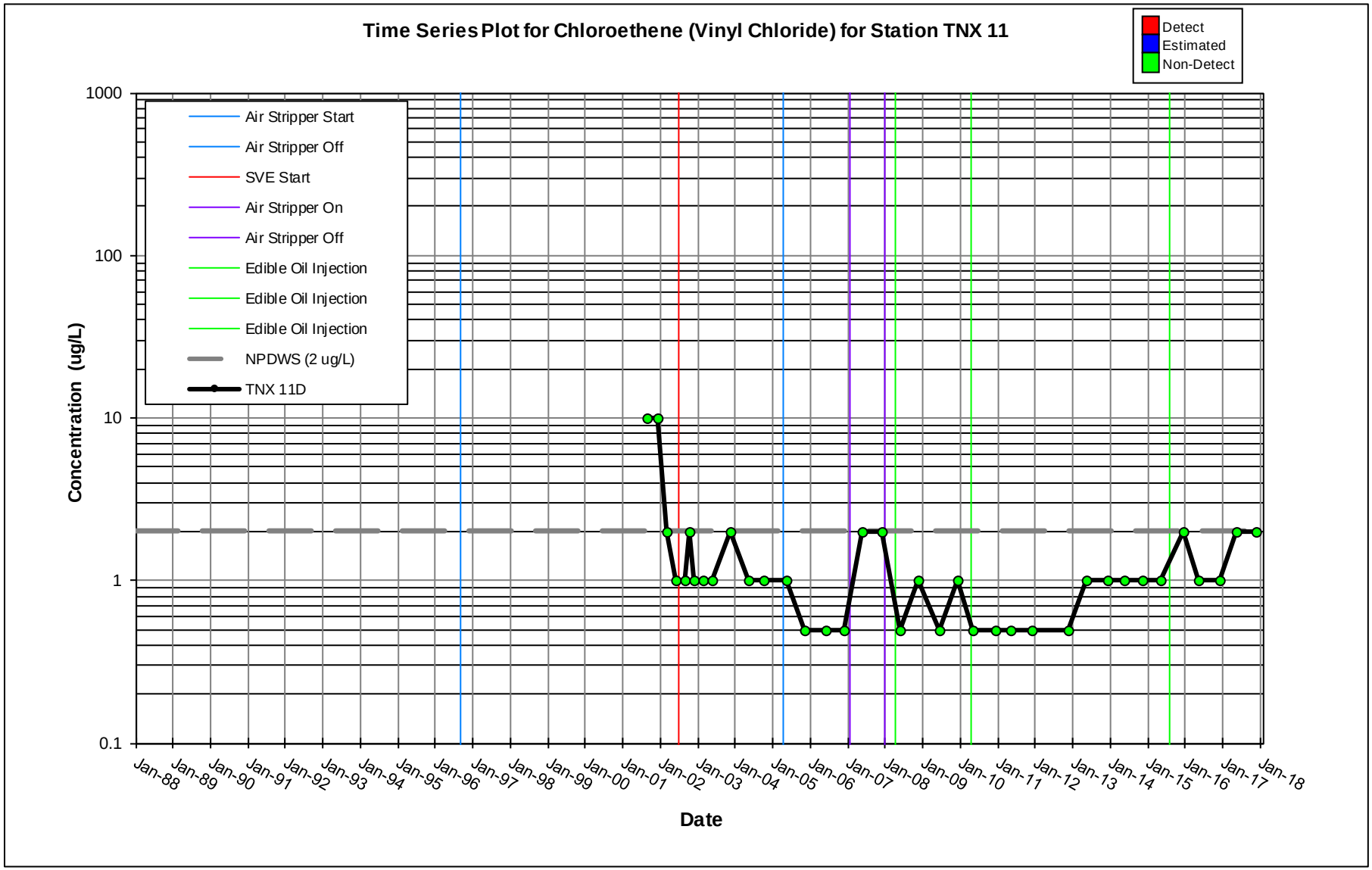
Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 11
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 11D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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Jan-96
Jan-97
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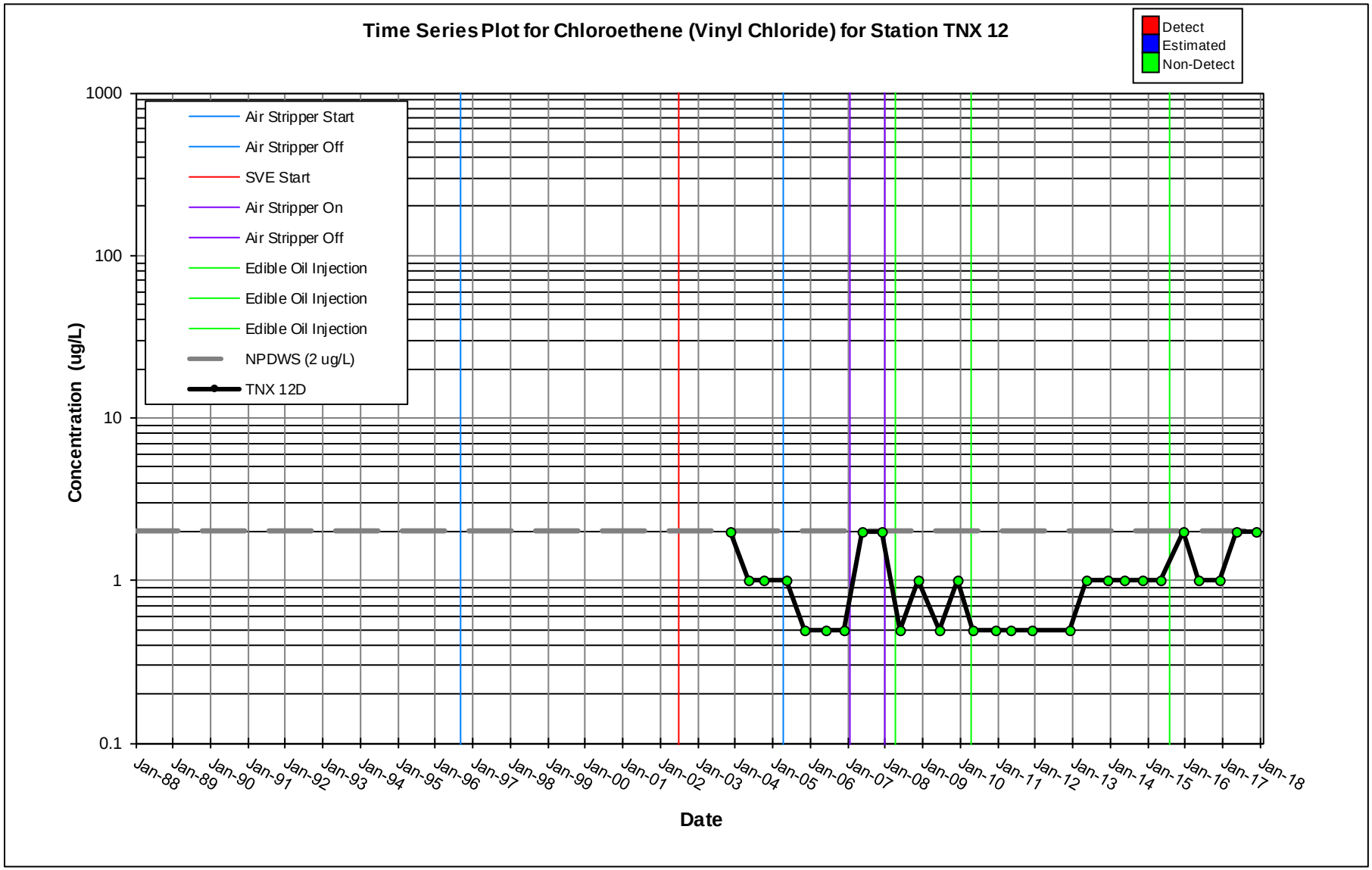
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 12
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 12D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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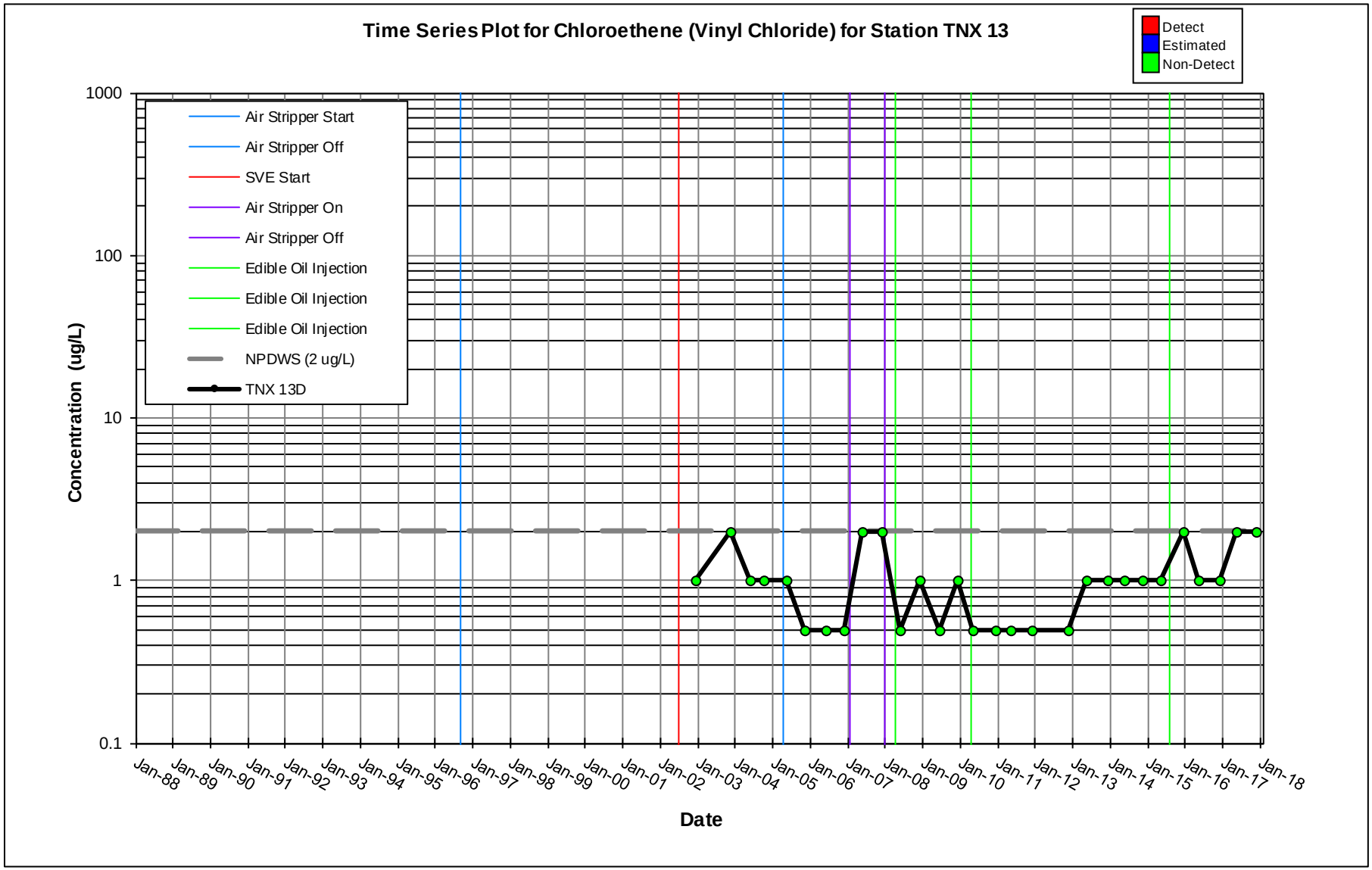
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 13
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 13D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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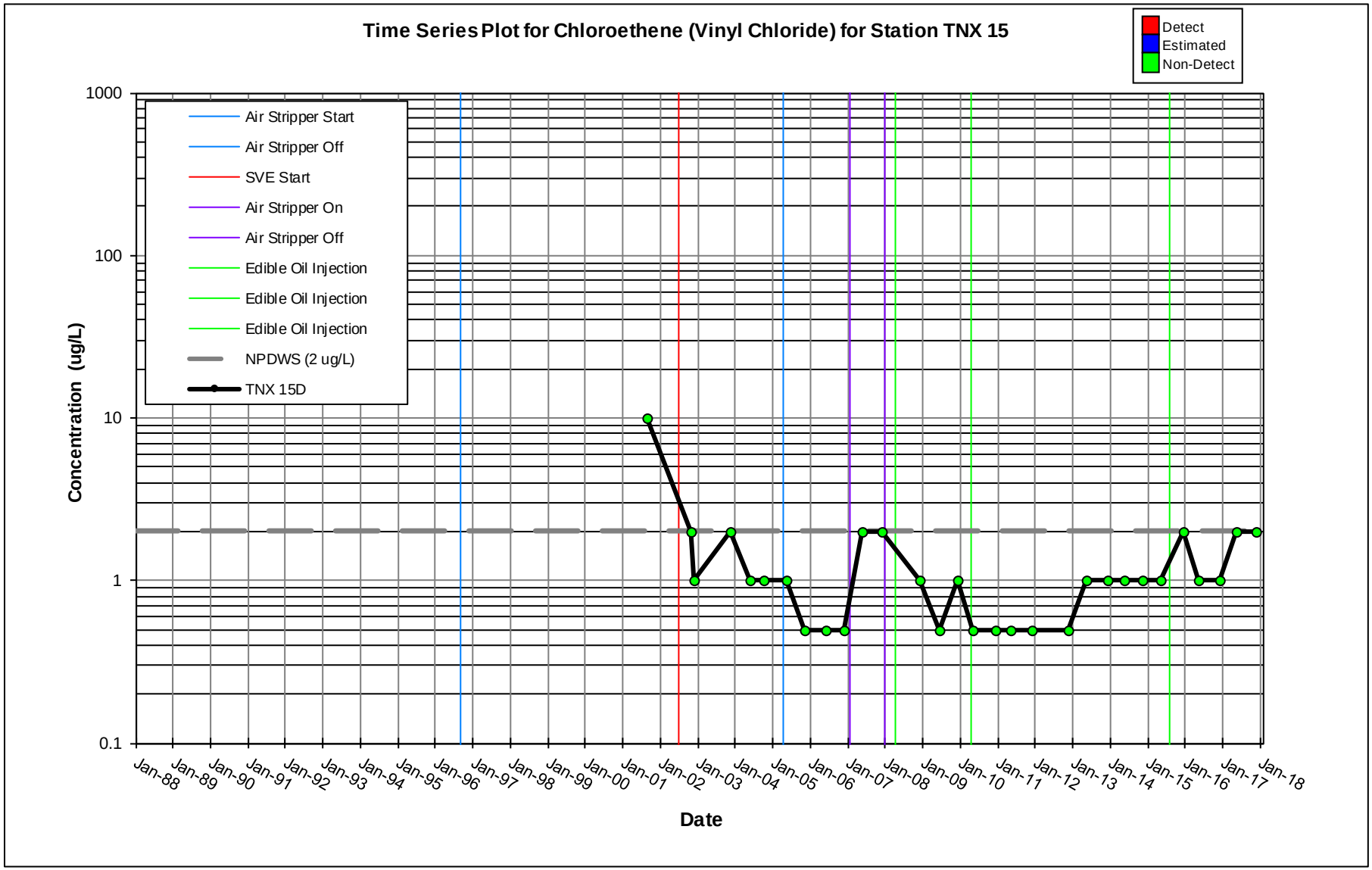
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 15
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 15D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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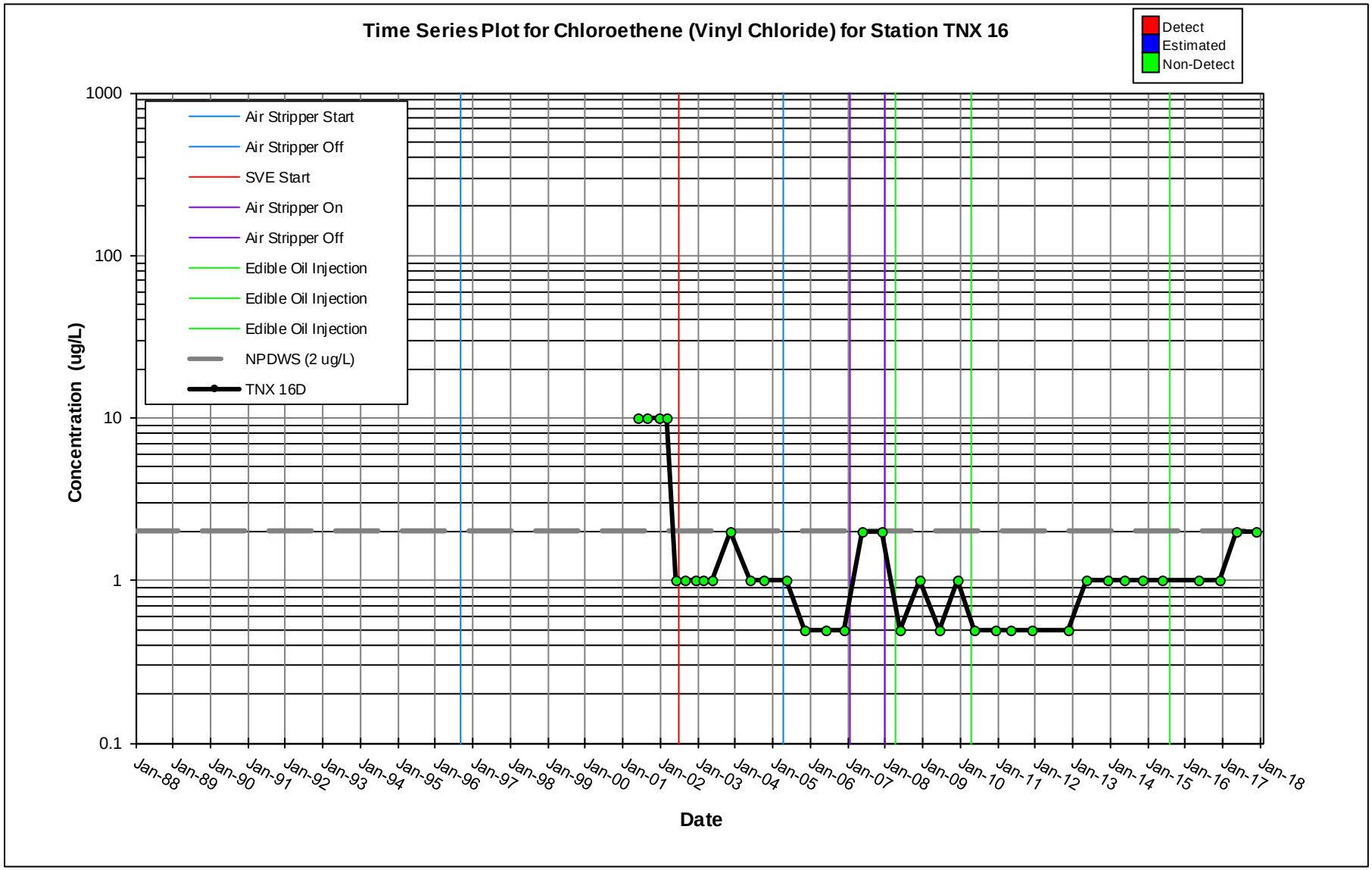
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 16
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 16D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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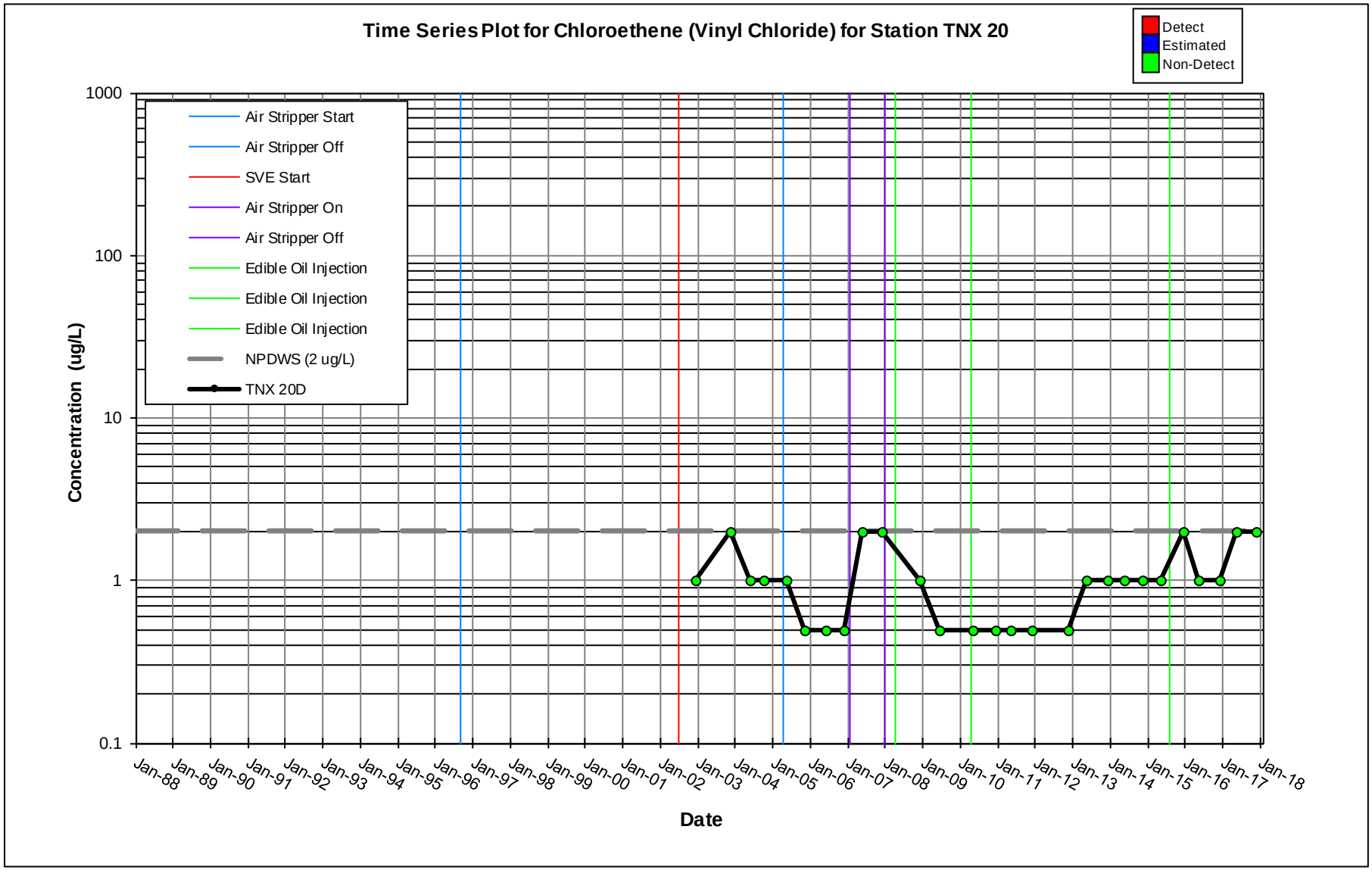
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 20
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 20D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
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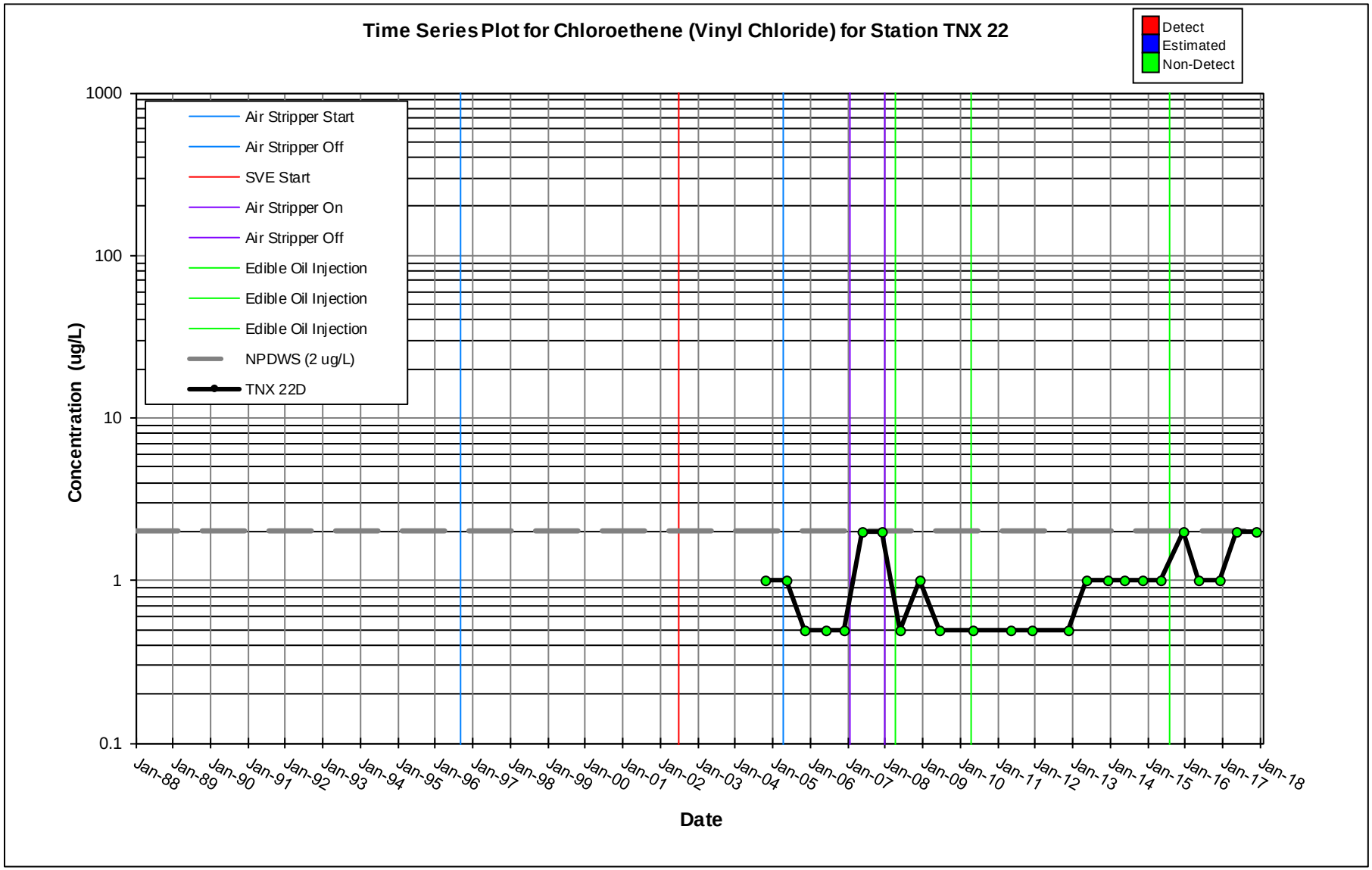
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 22
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 22D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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Jan-96
Jan-97
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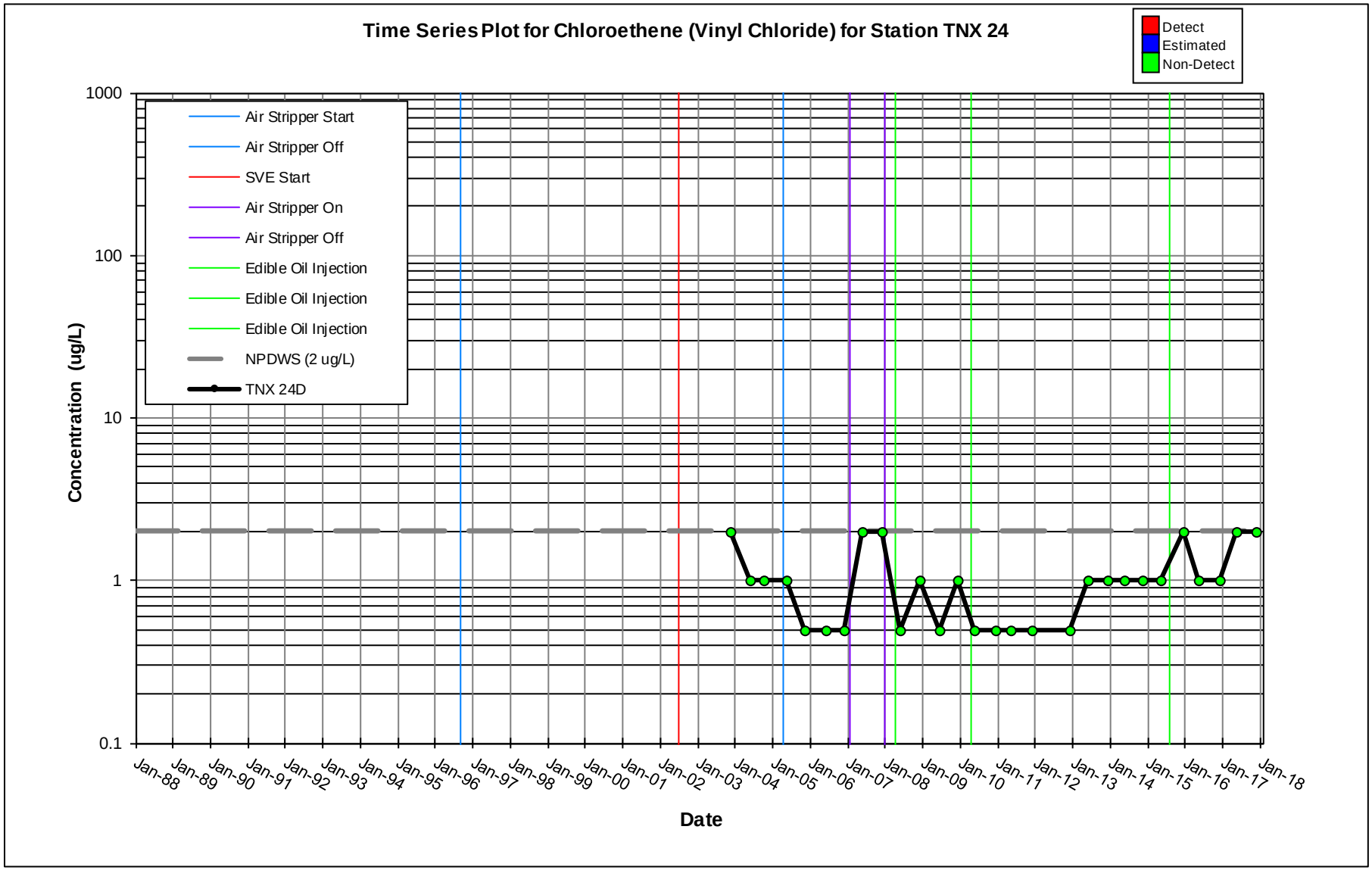
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 24
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 24D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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Jan-96
Jan-97
Jan-98
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Jan-00
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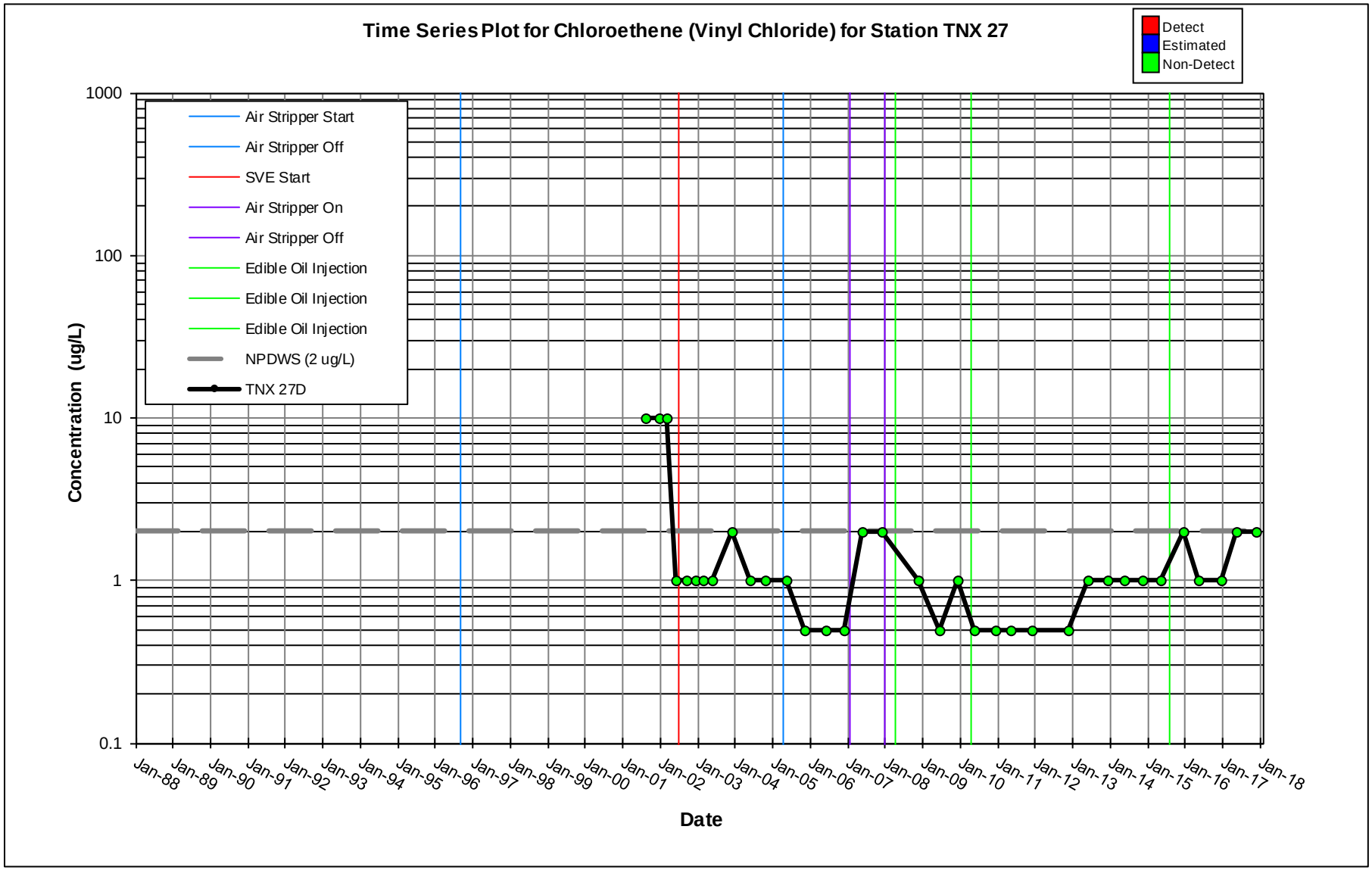
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 27
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 27D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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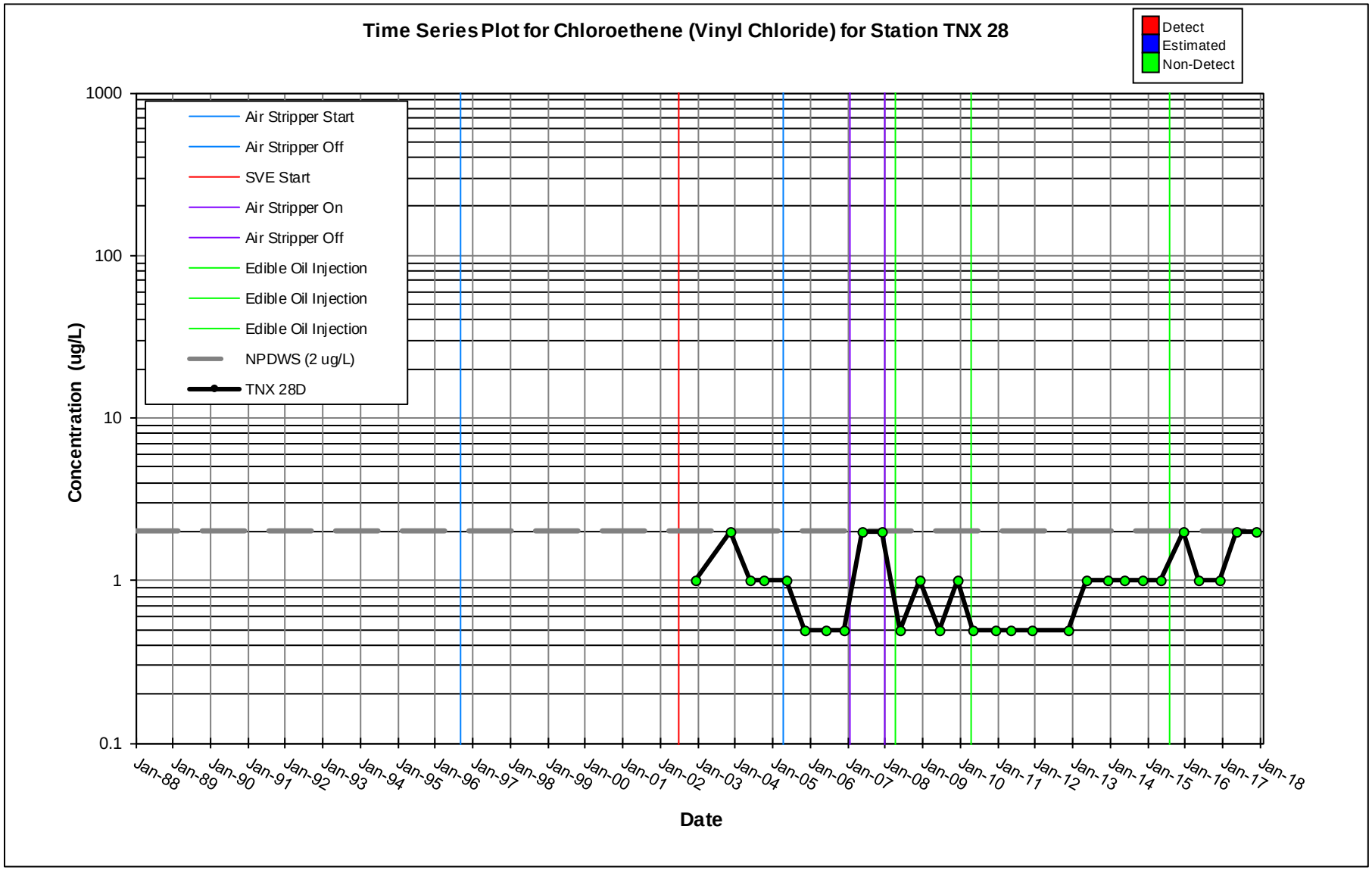
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 28
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 28D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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Jan-05
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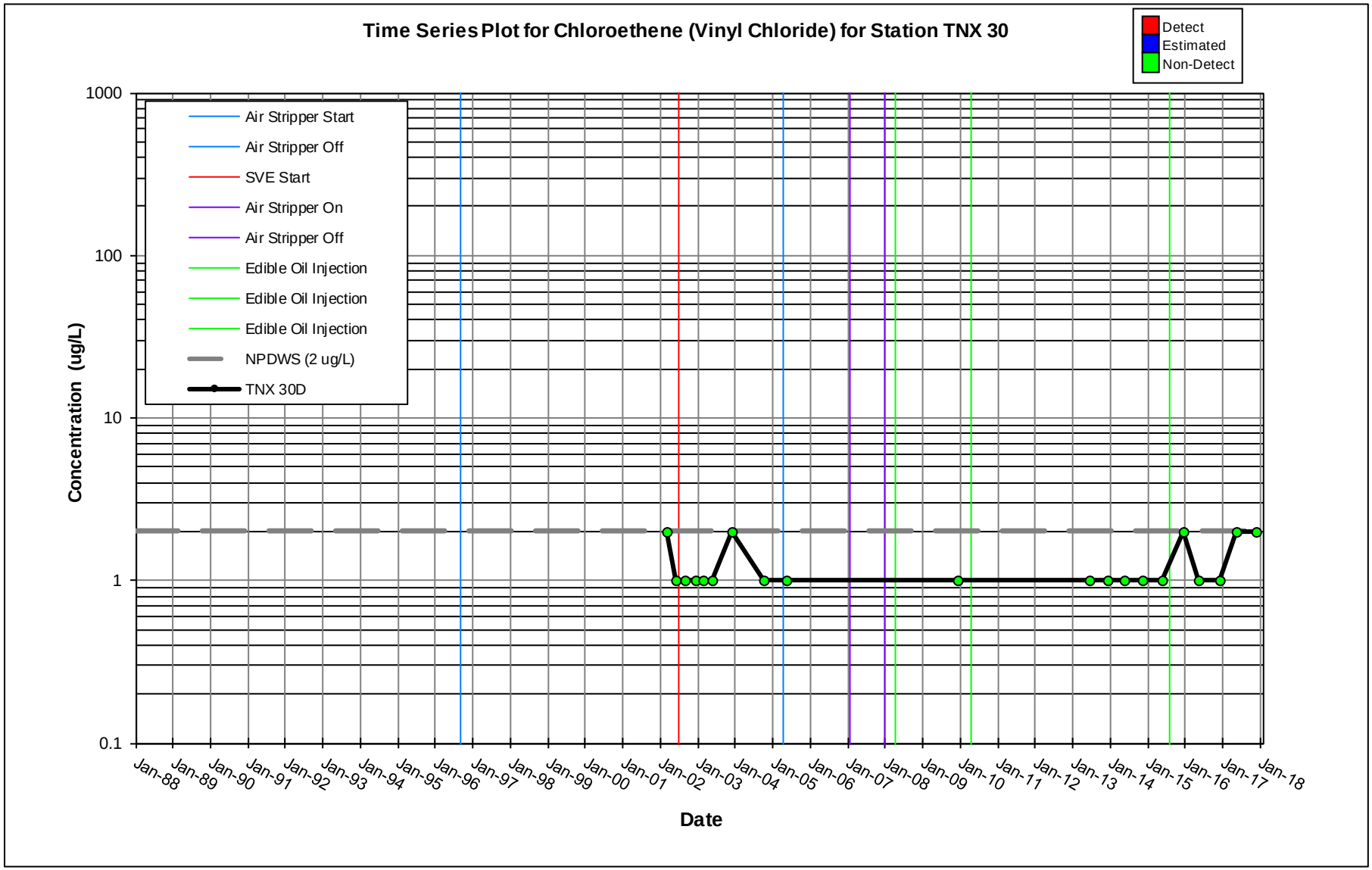
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 30
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 30D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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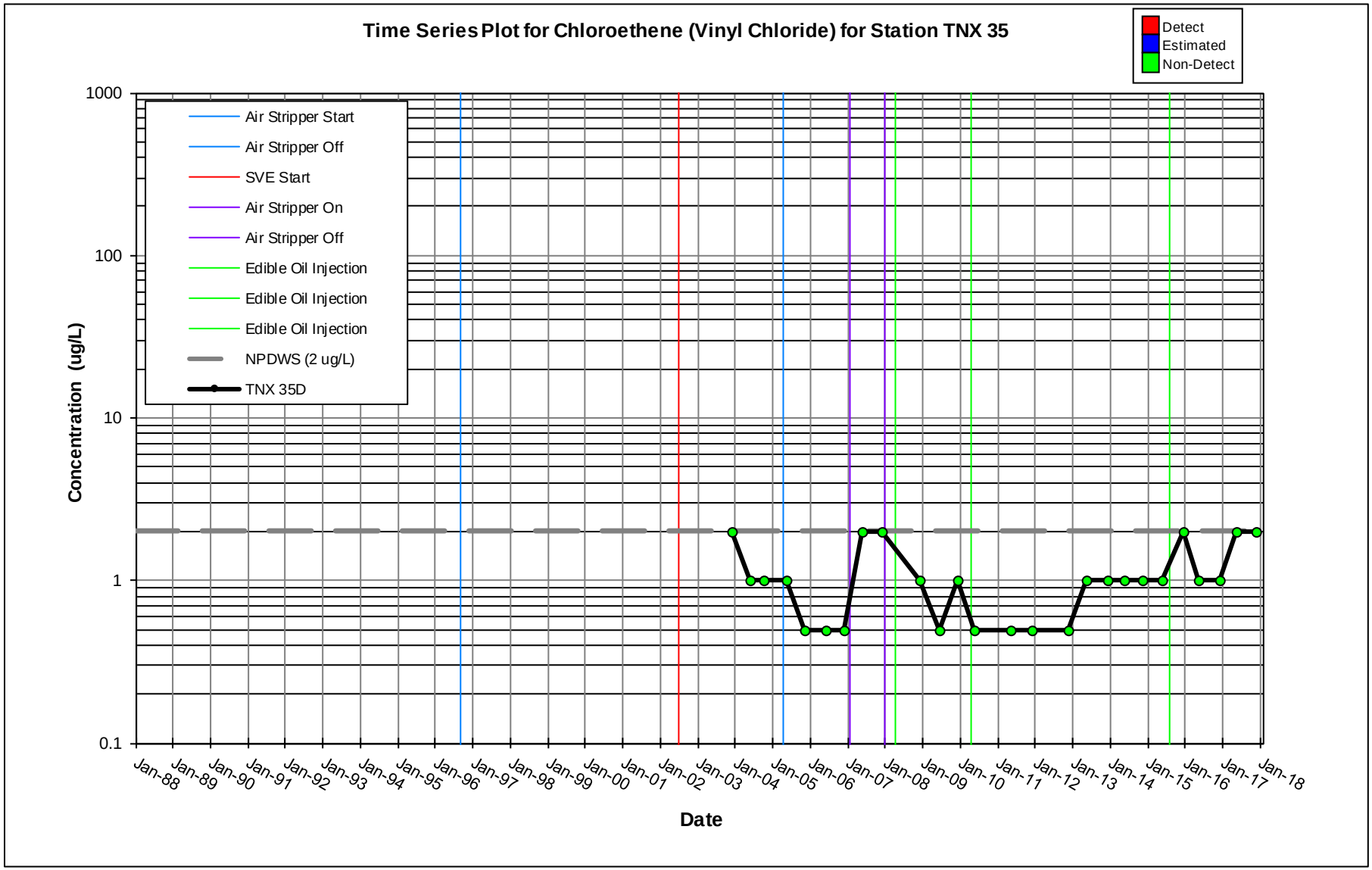
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 35
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 35D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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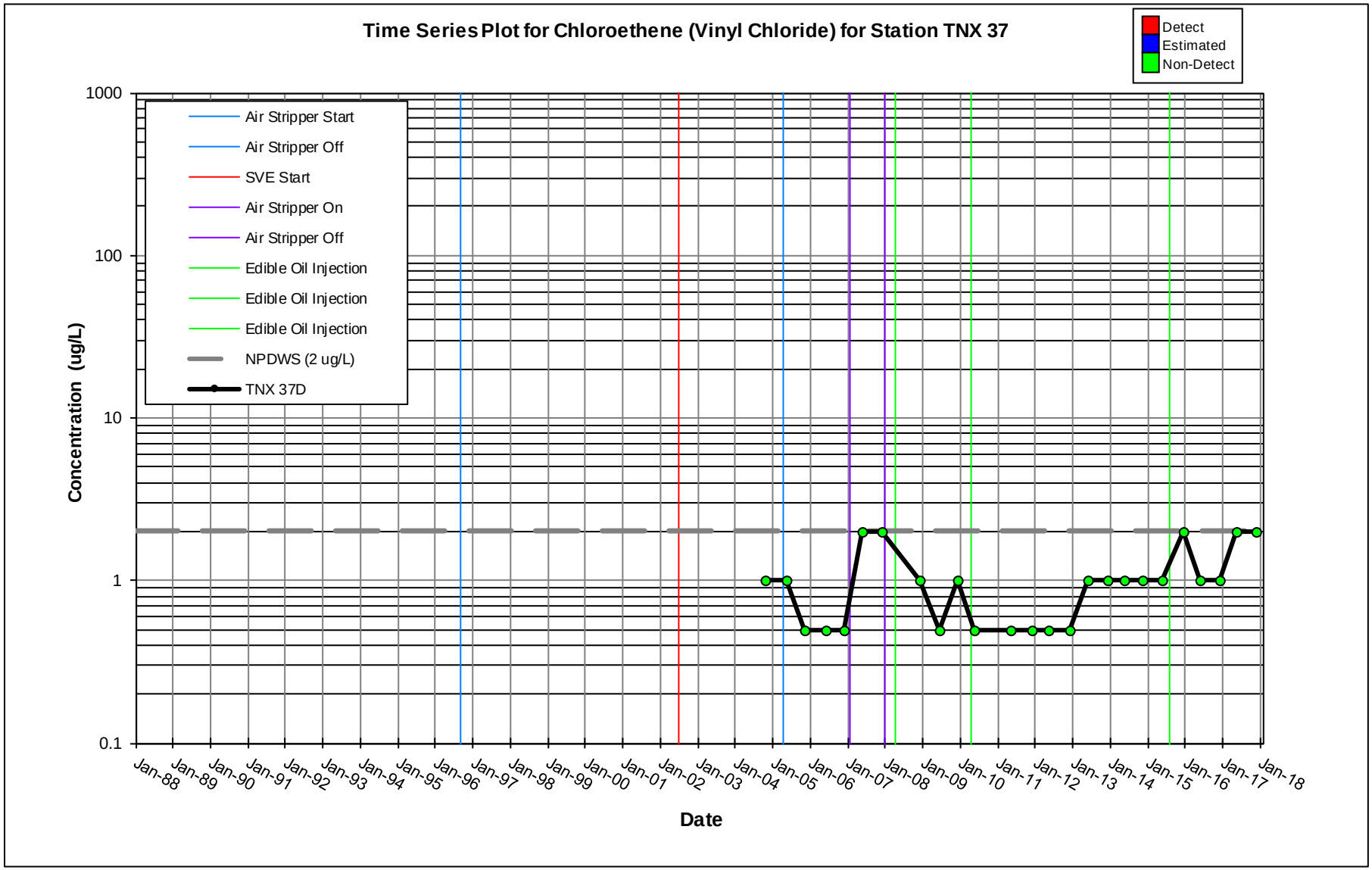
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 37
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 37D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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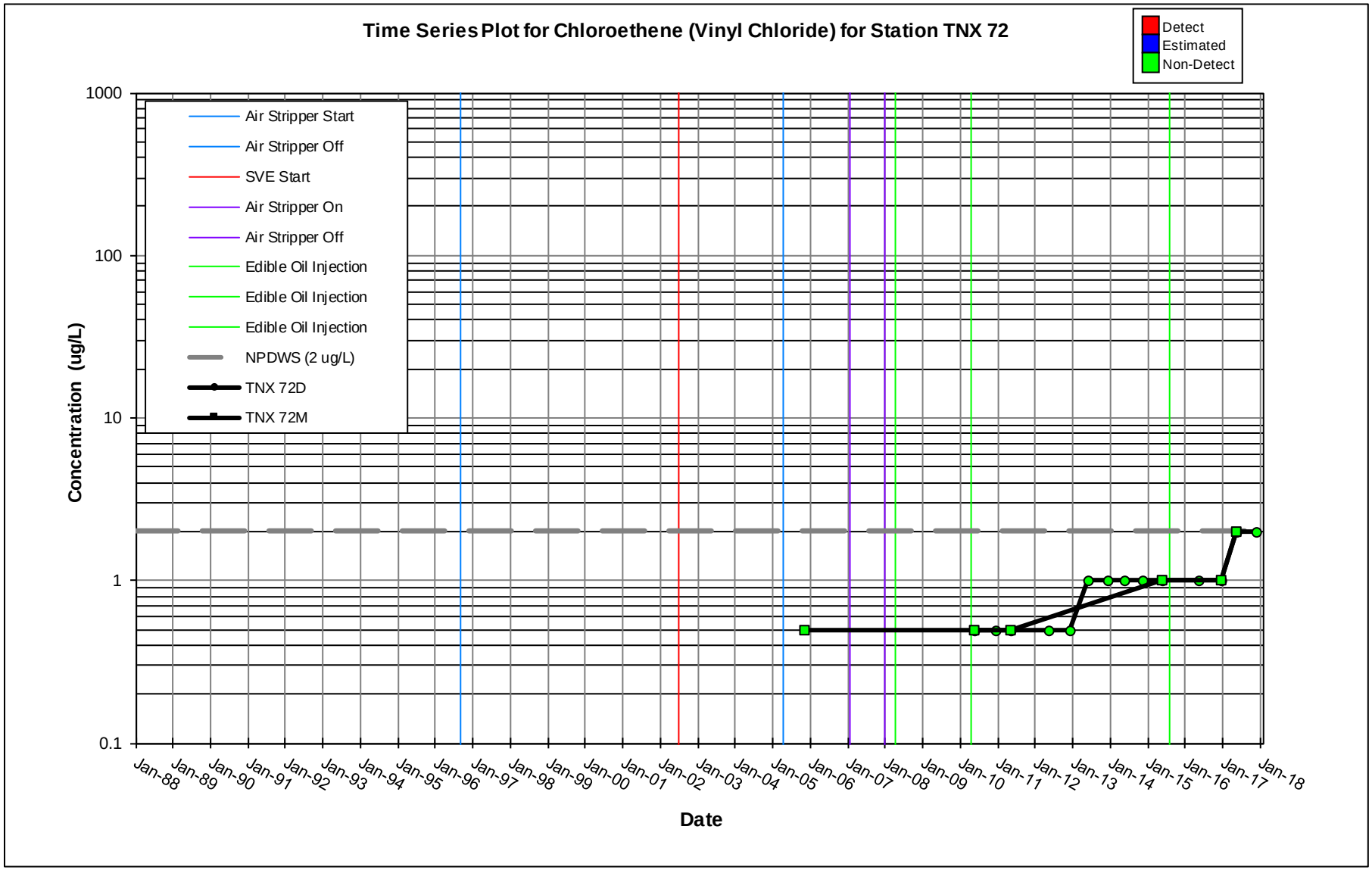
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX 72
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX 72D
TNX 72M
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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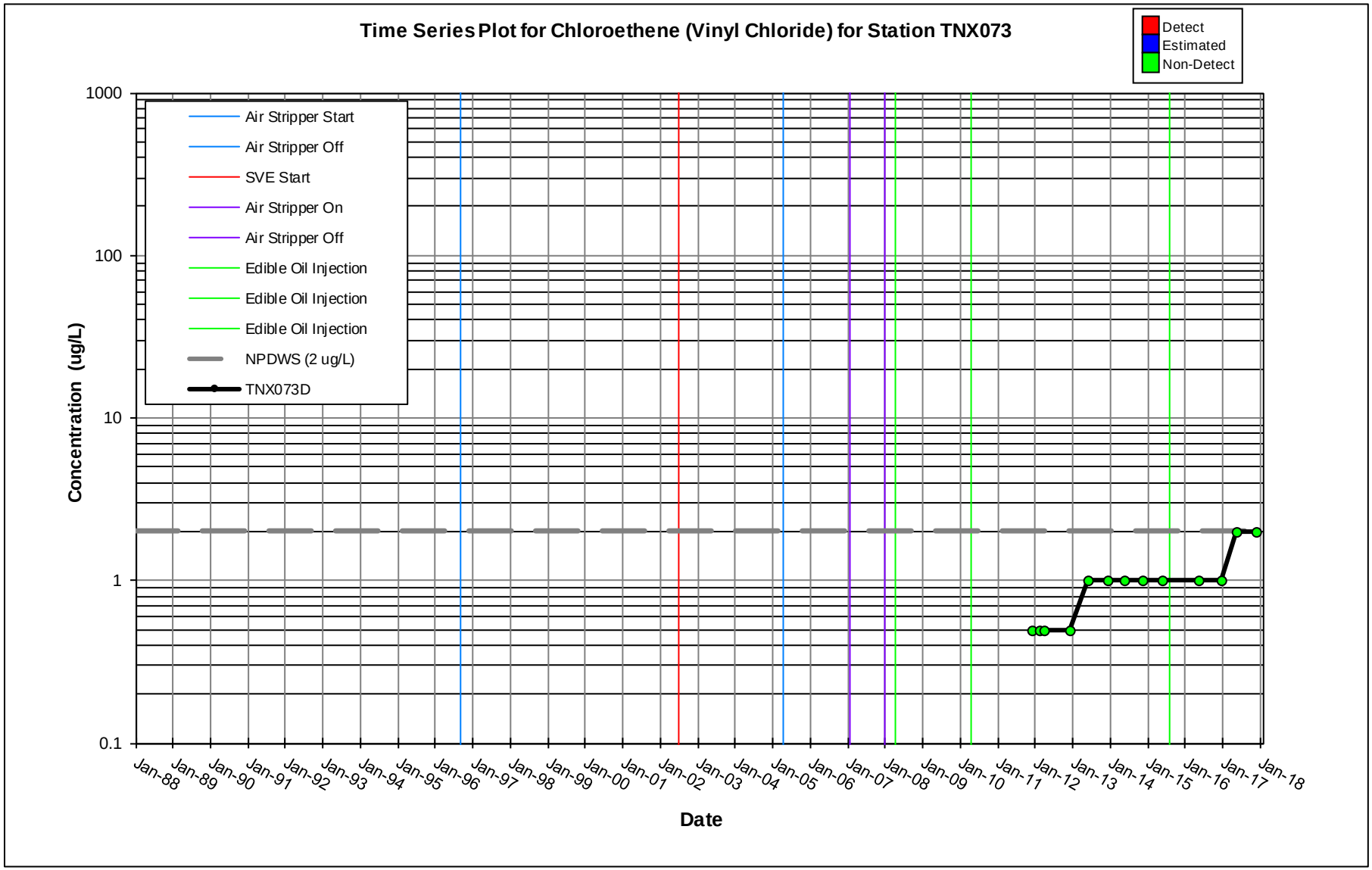
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX073
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX073D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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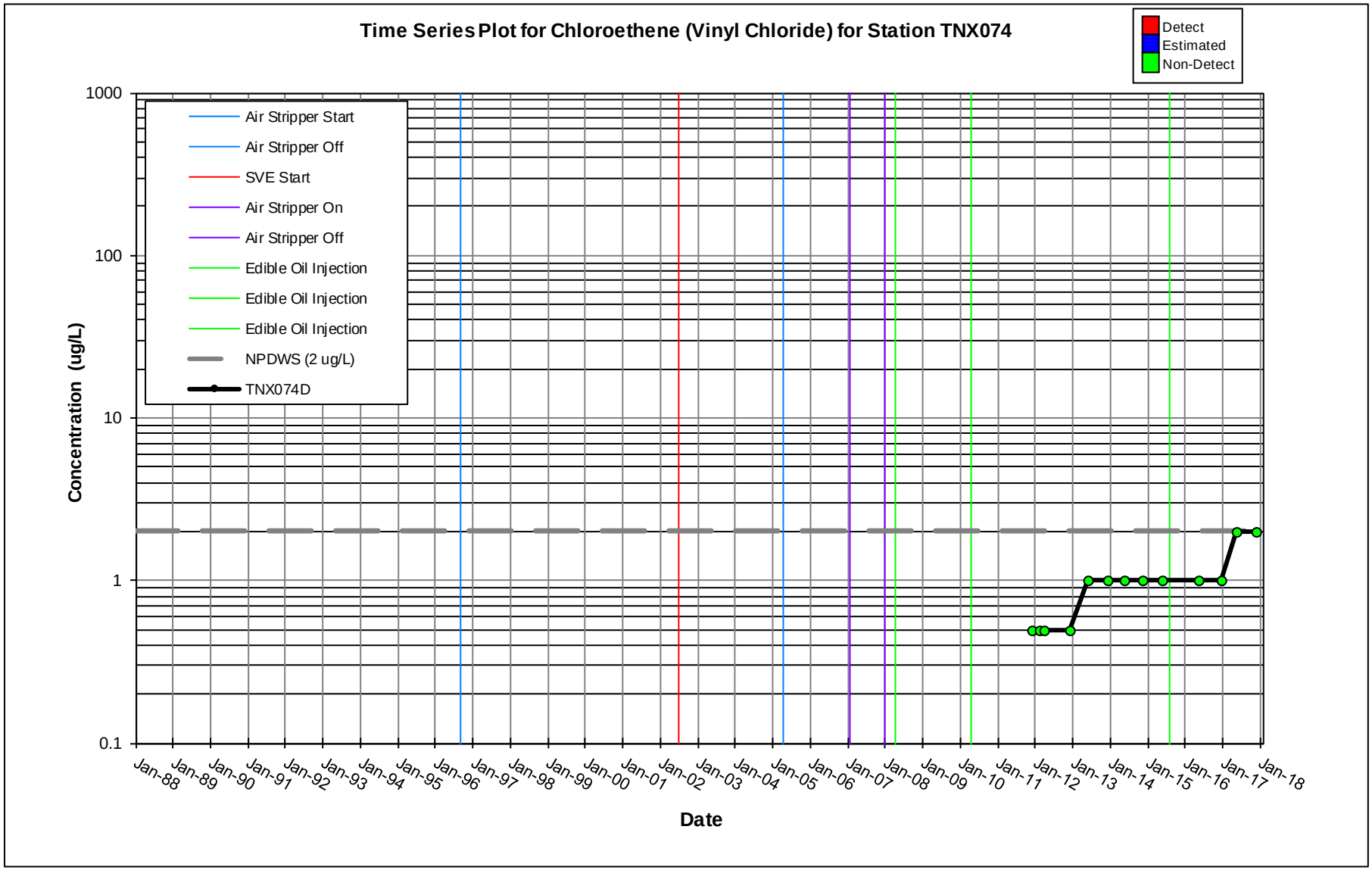
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX074
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX074D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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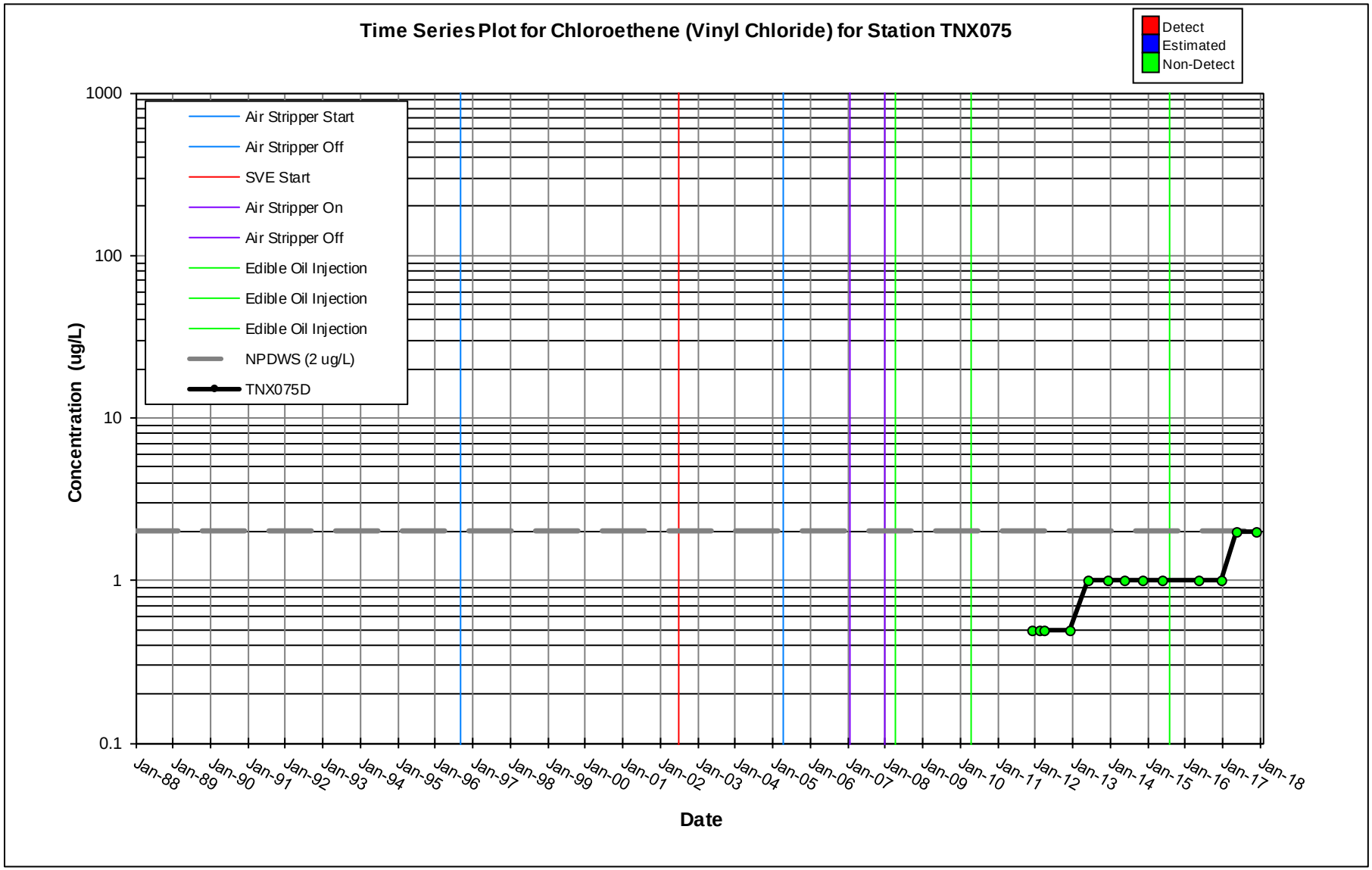
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TNX075
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TNX075D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
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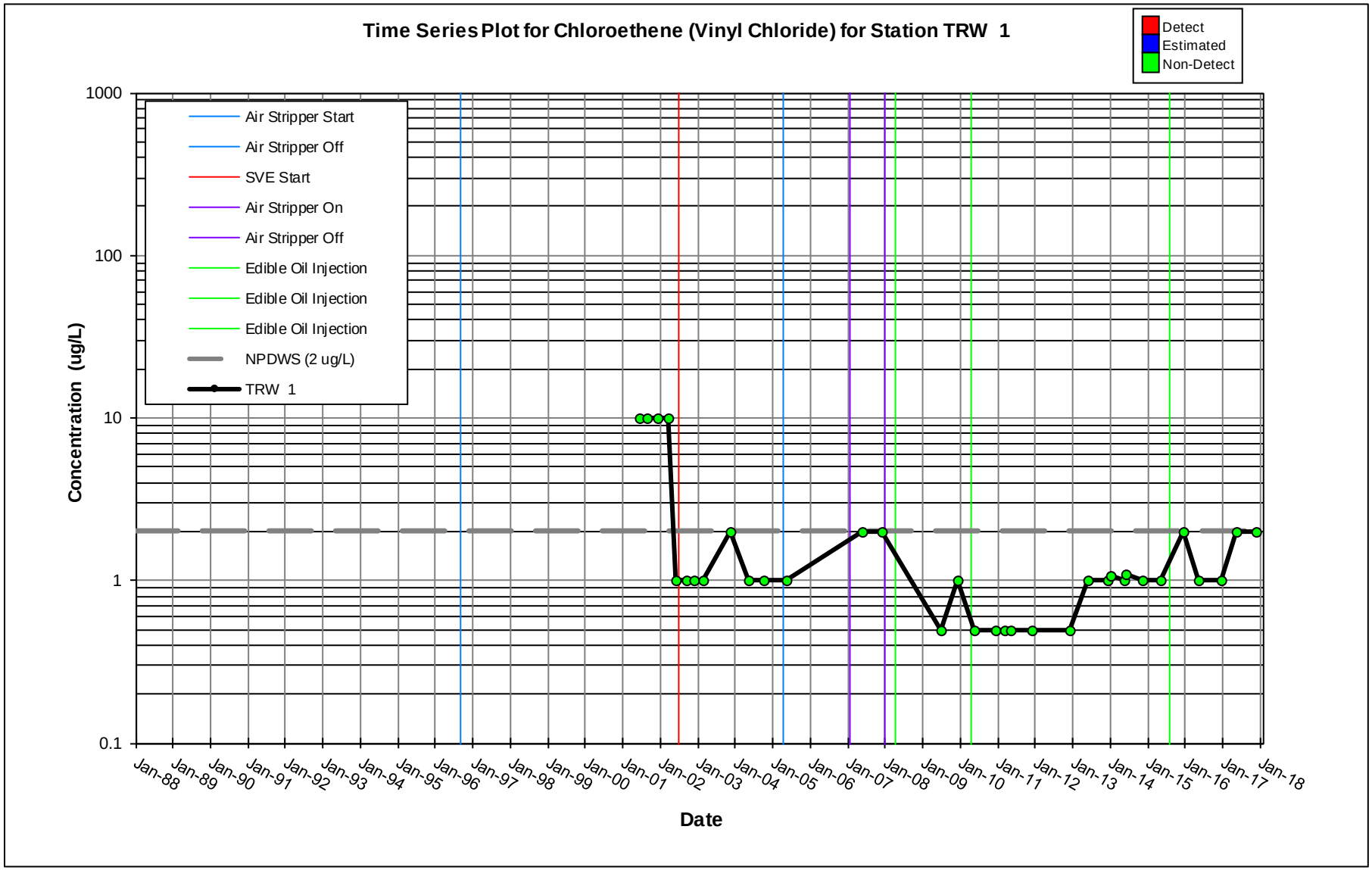
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TRW 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TRW 1
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
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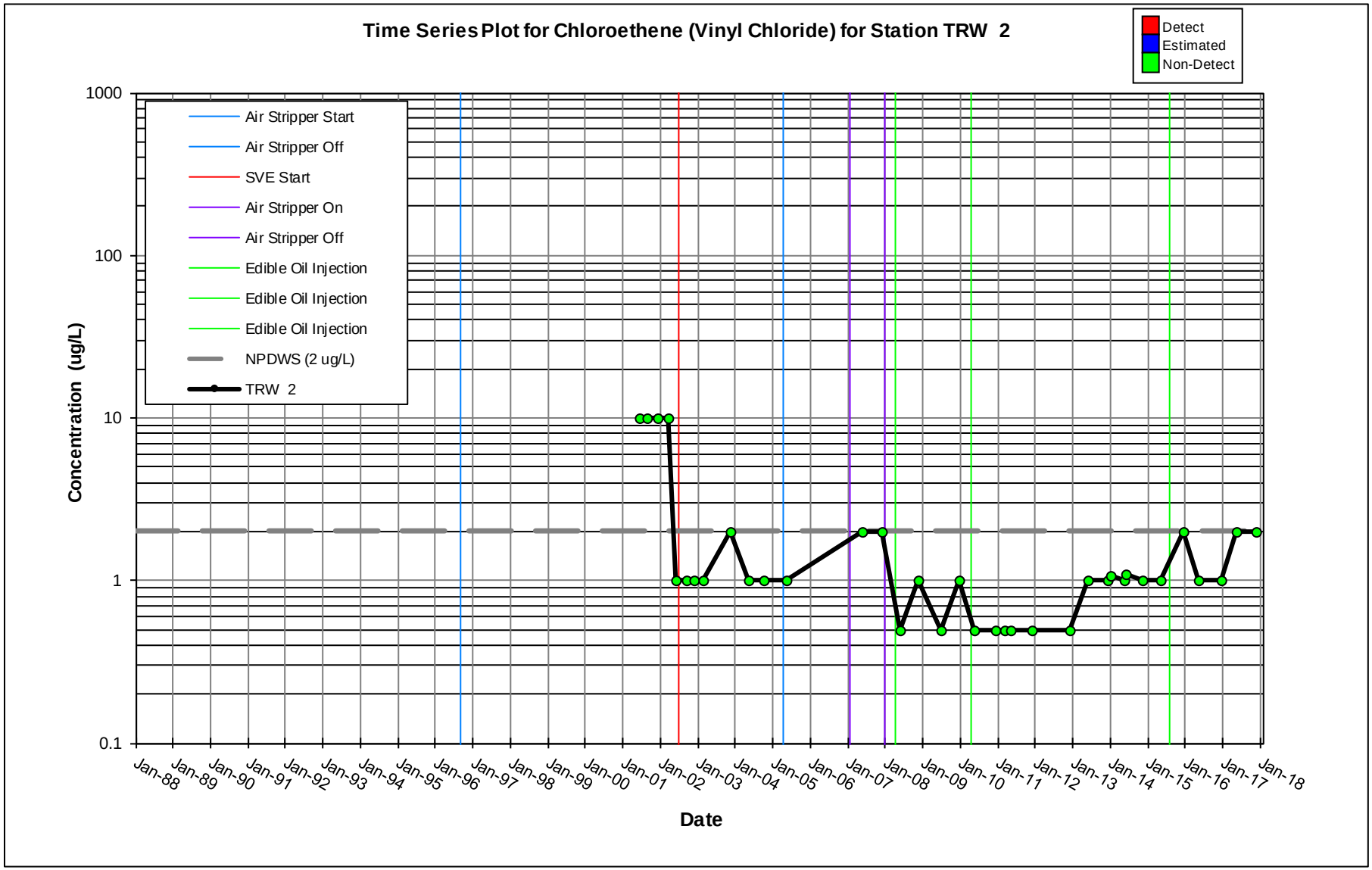
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TRW 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TRW 2
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
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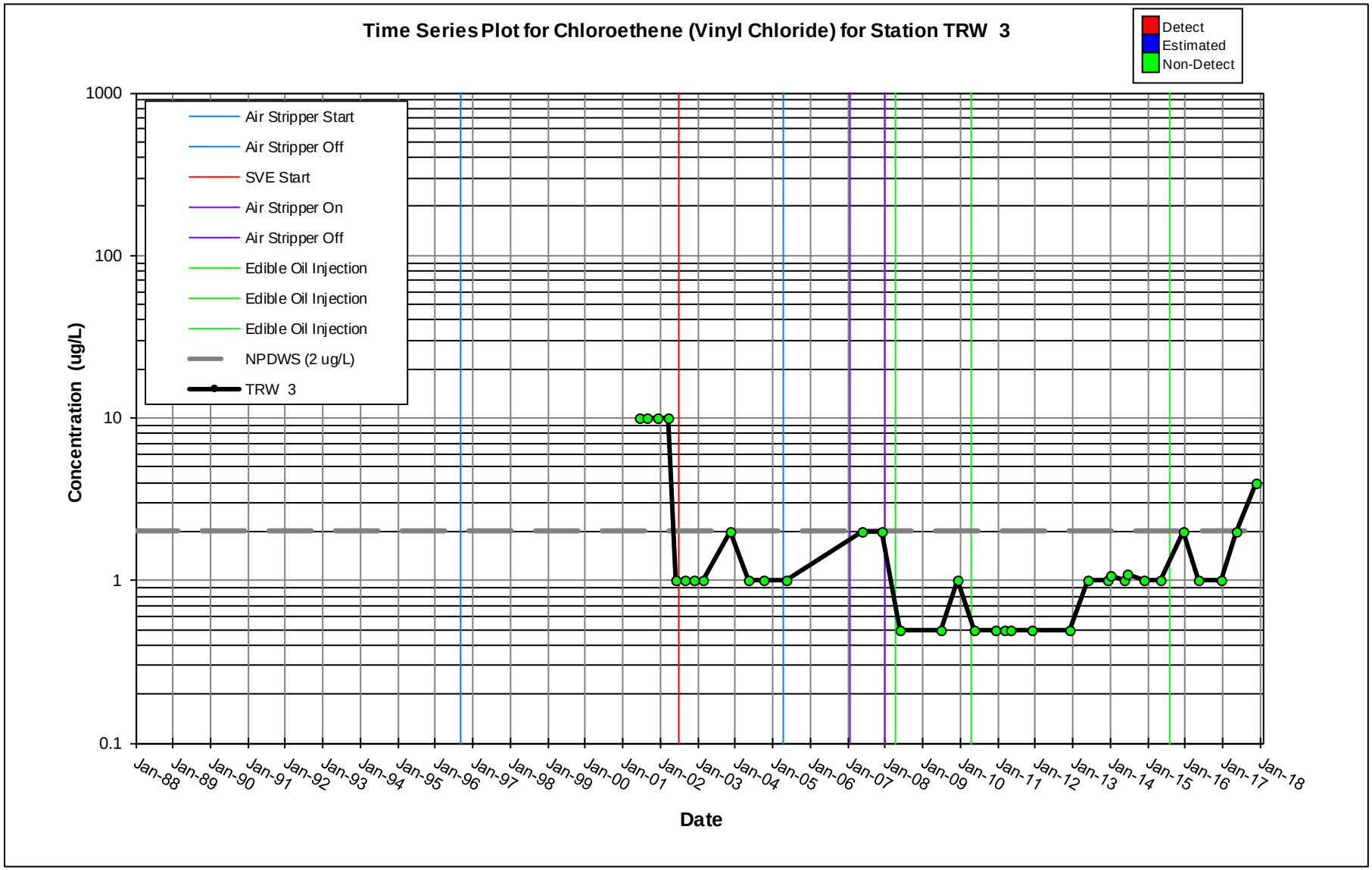
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TRW 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TRW 3
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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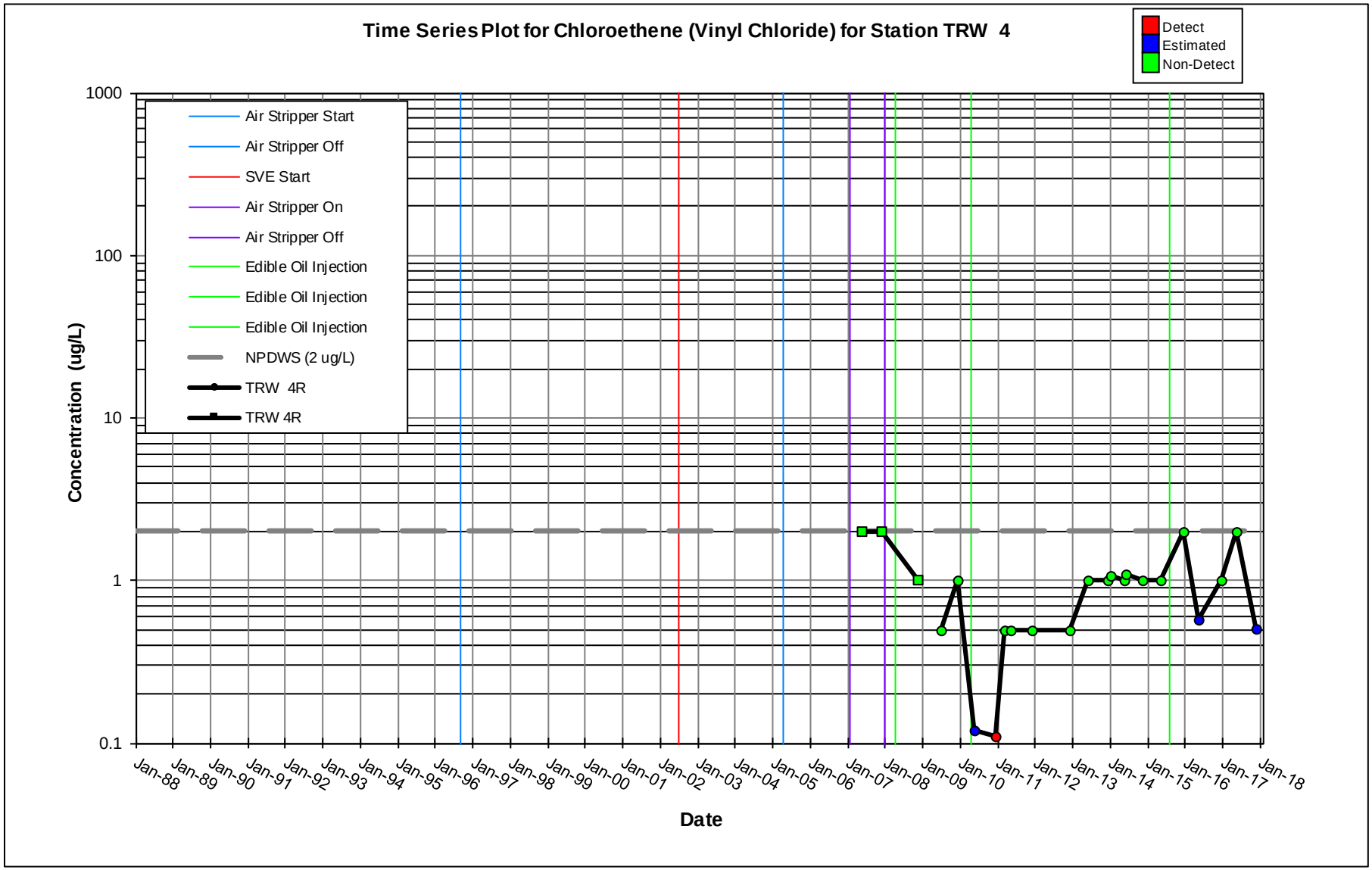
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TRW 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TRW 4R
TRW 4R
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
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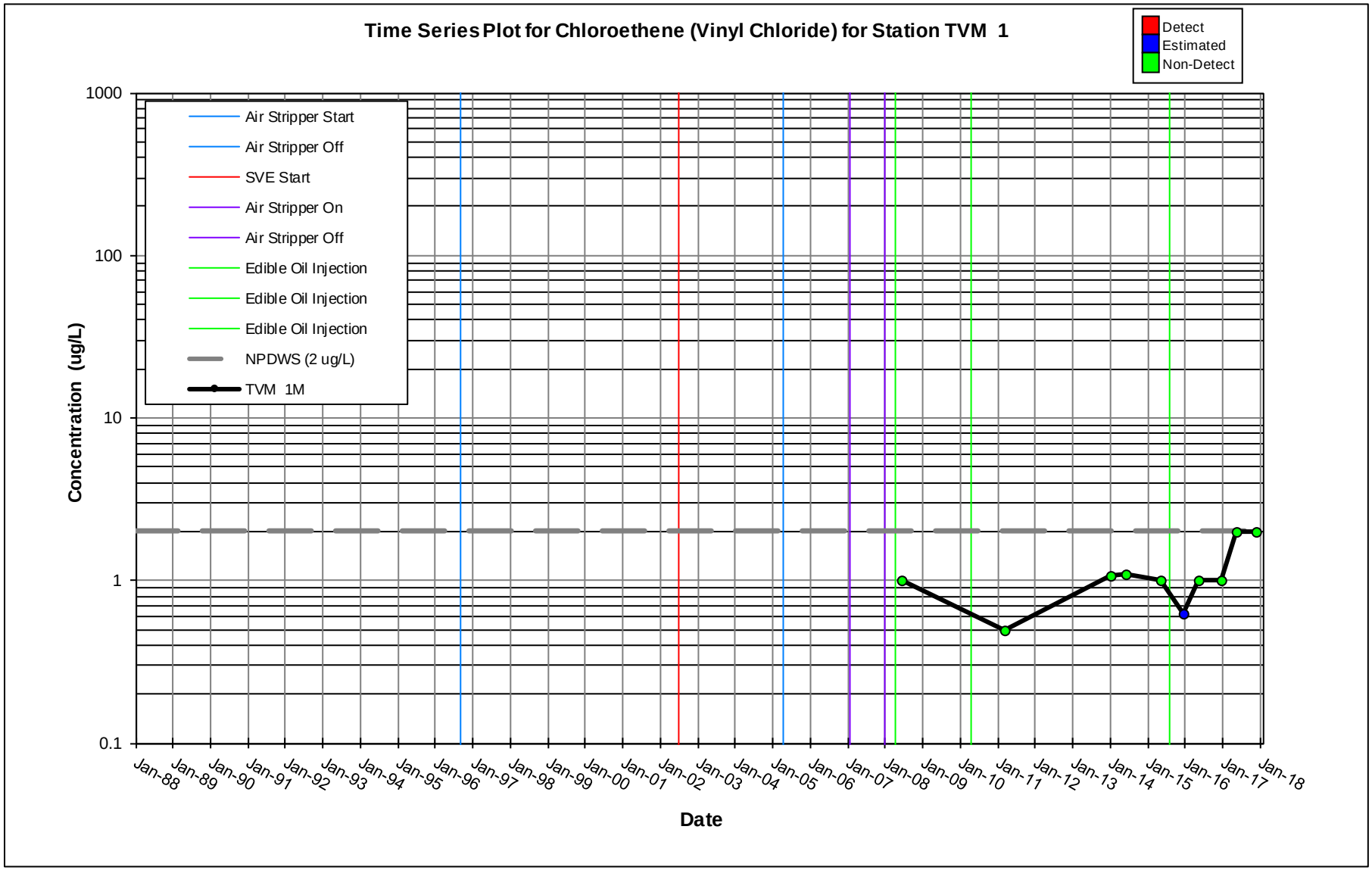
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TVM 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TVM 1M
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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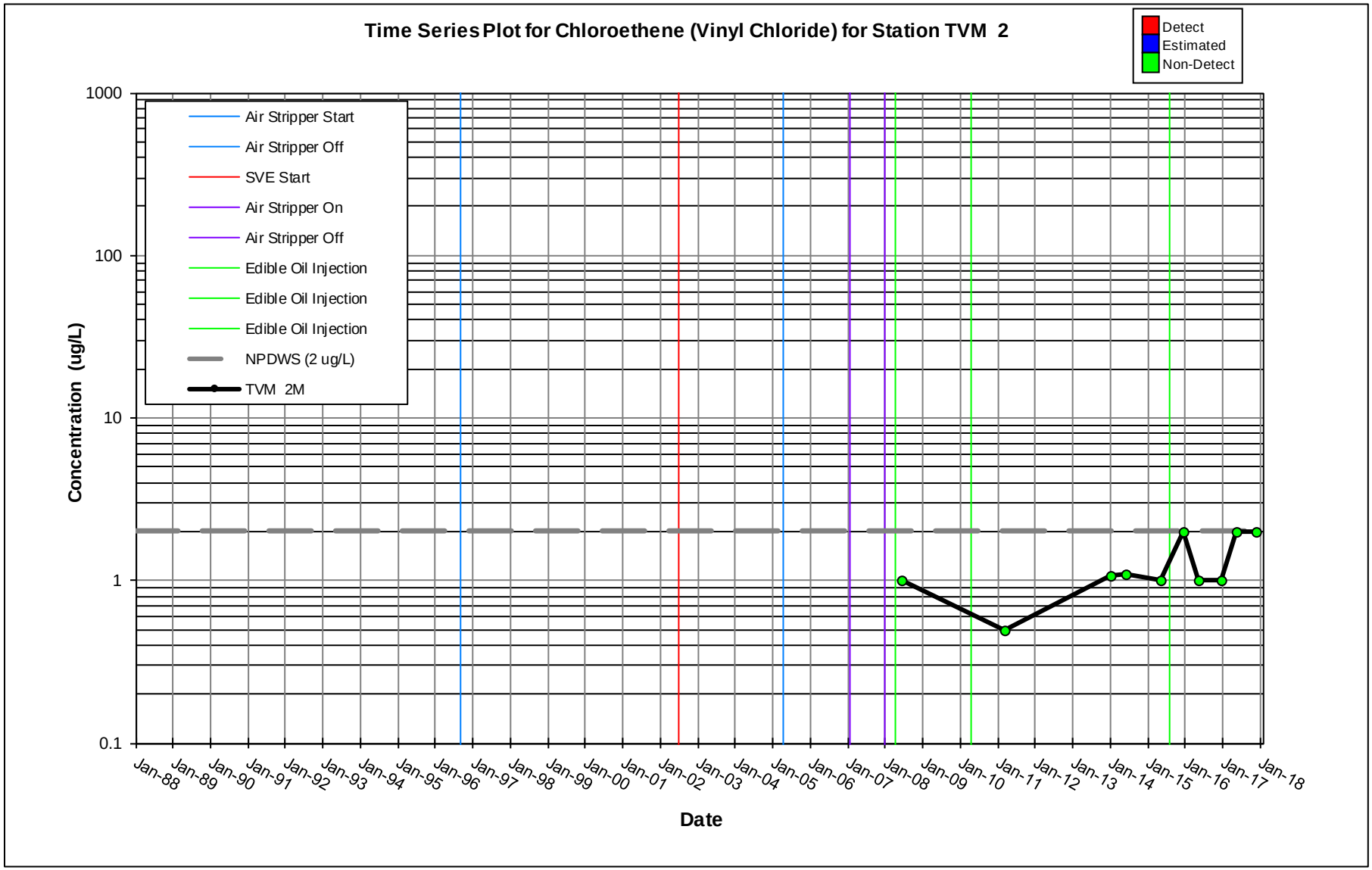
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TVM 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TVM 2M
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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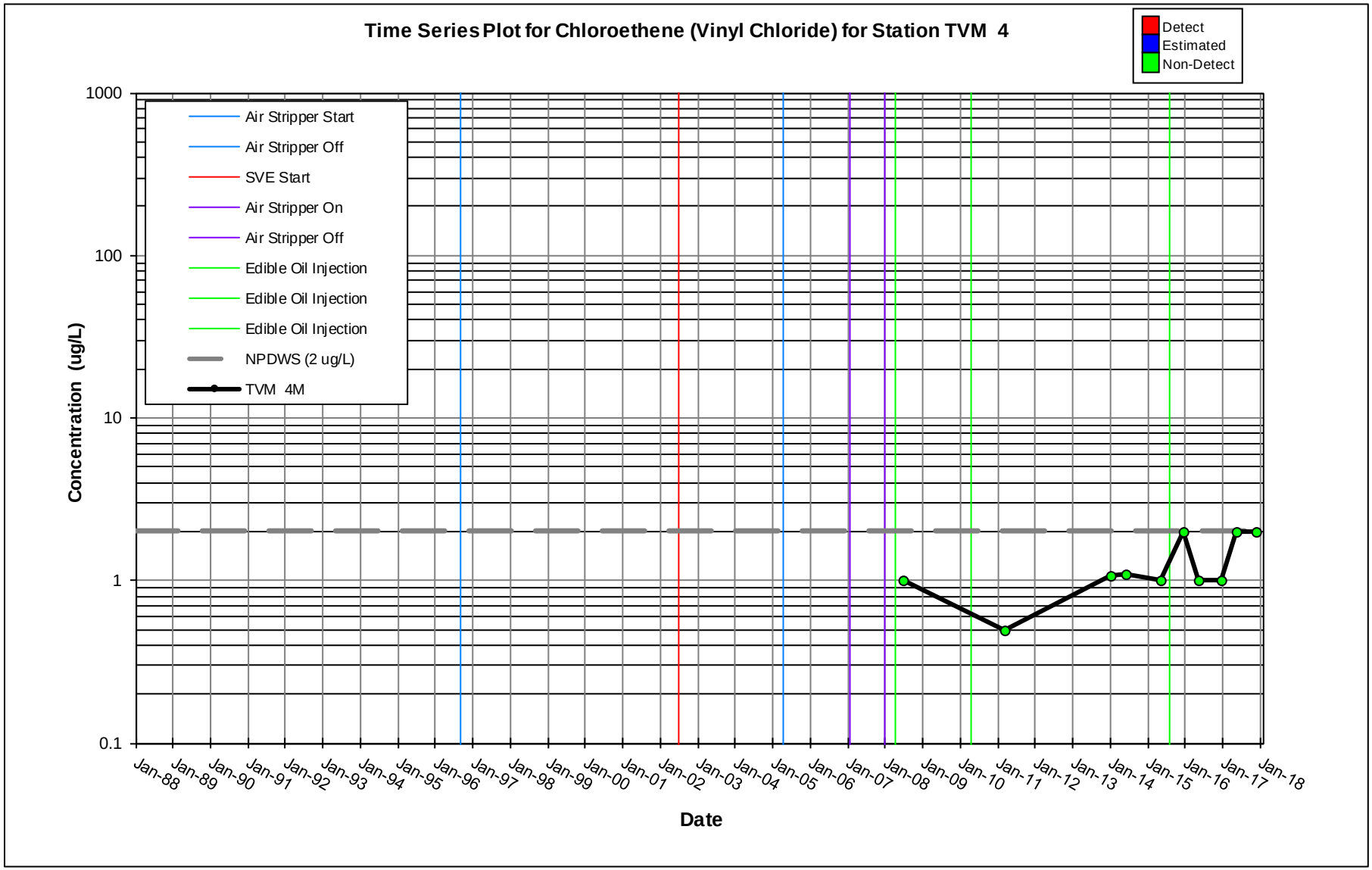
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TVM 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TVM 4M
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
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Jan-99
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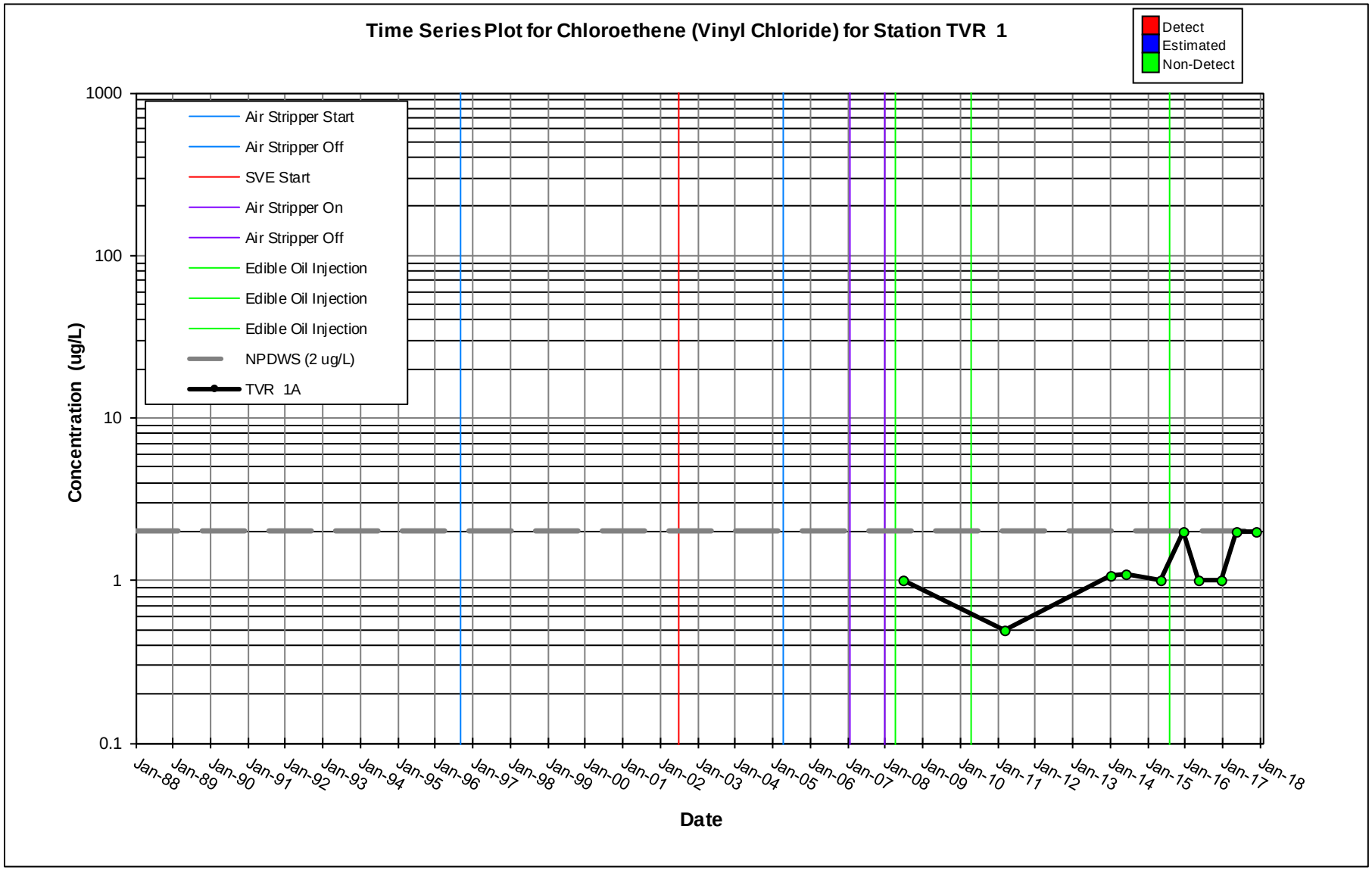
Jan-18
Date


Time Series Plot for Chloroethene (Vinyl Chloride) for Station TVR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
TVR 1A
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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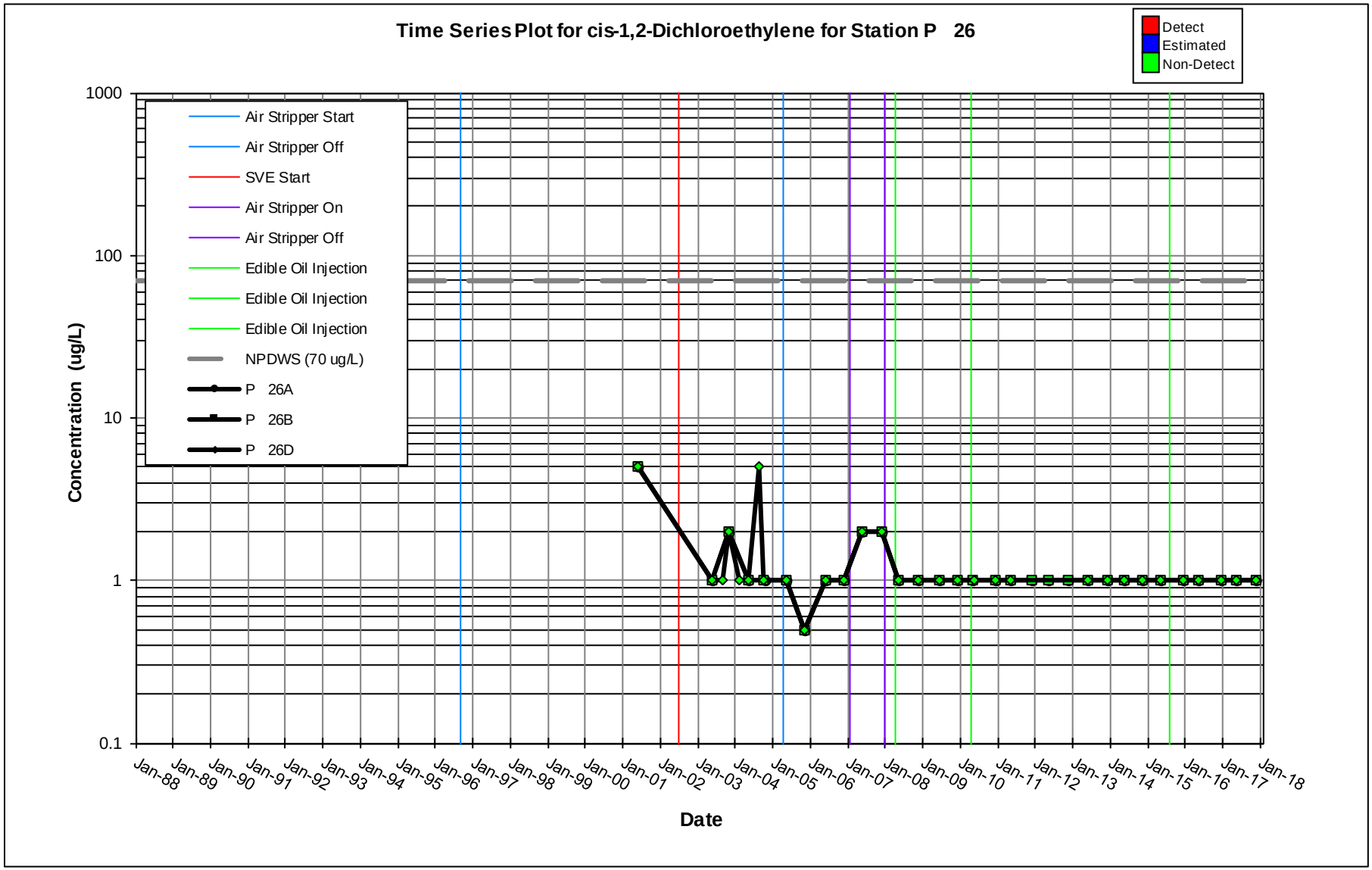
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station P 26
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
P 26A
P 26B
P 26D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
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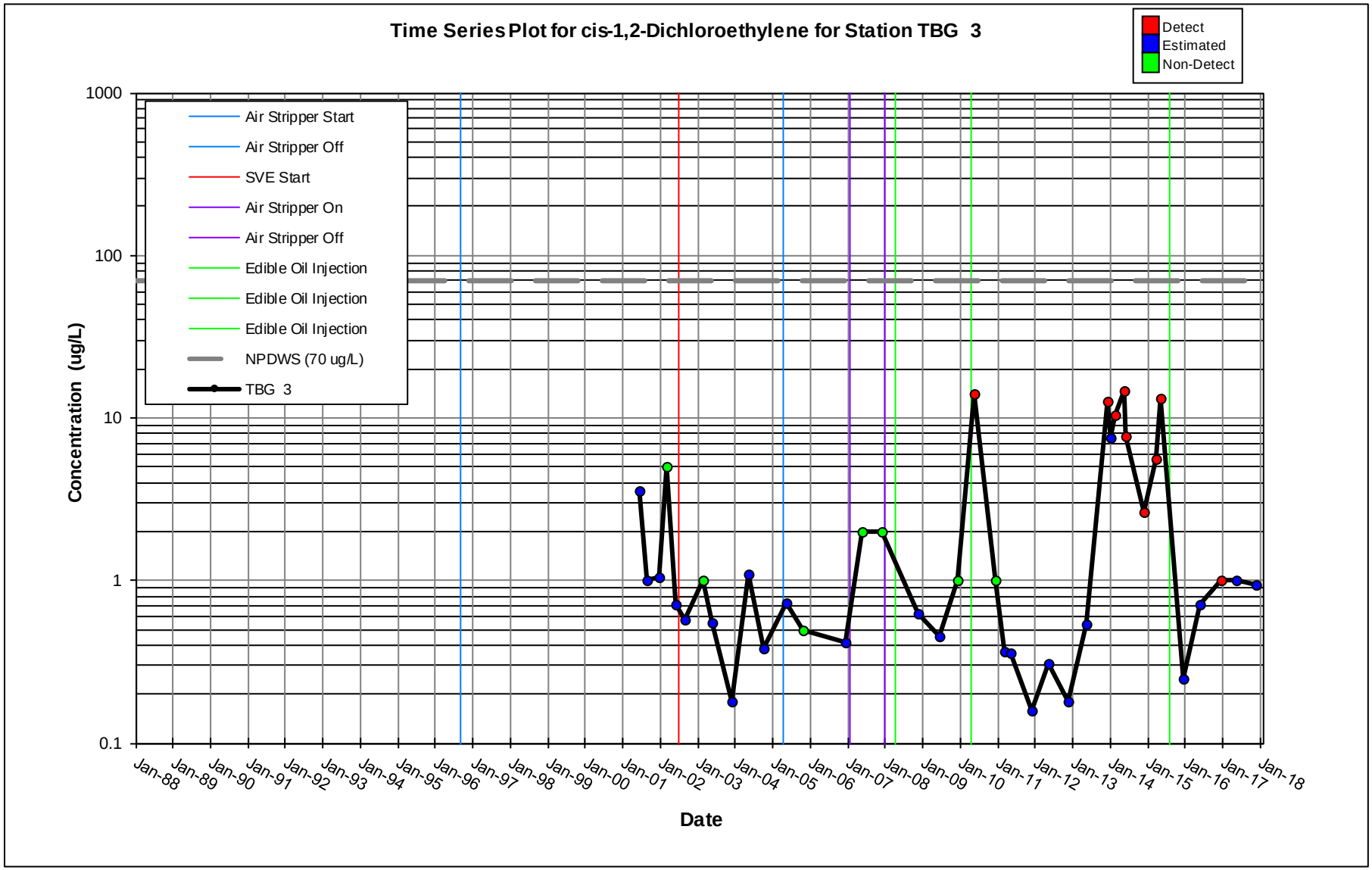
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TBG 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TBG 3
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
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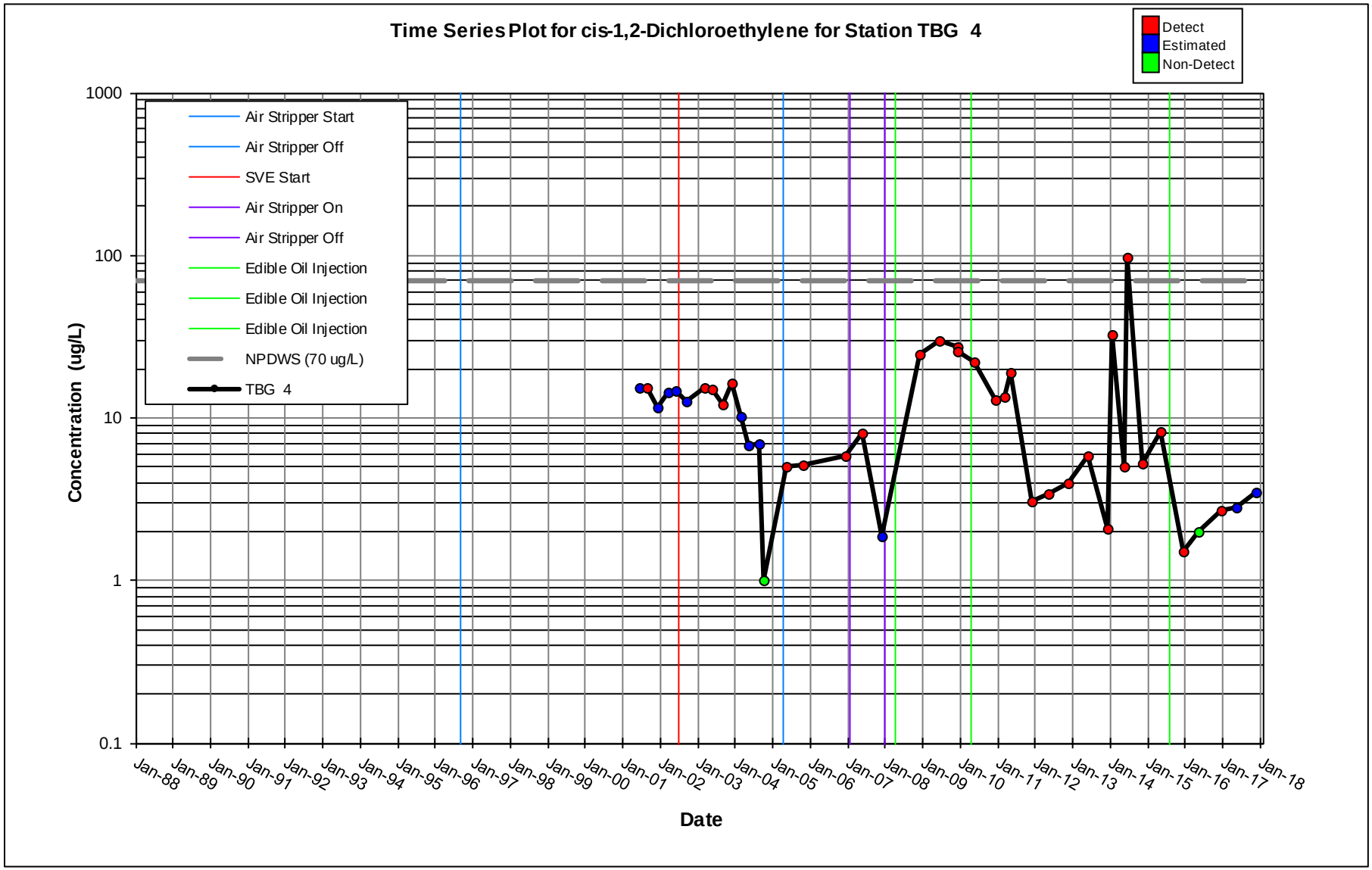
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TBG 4
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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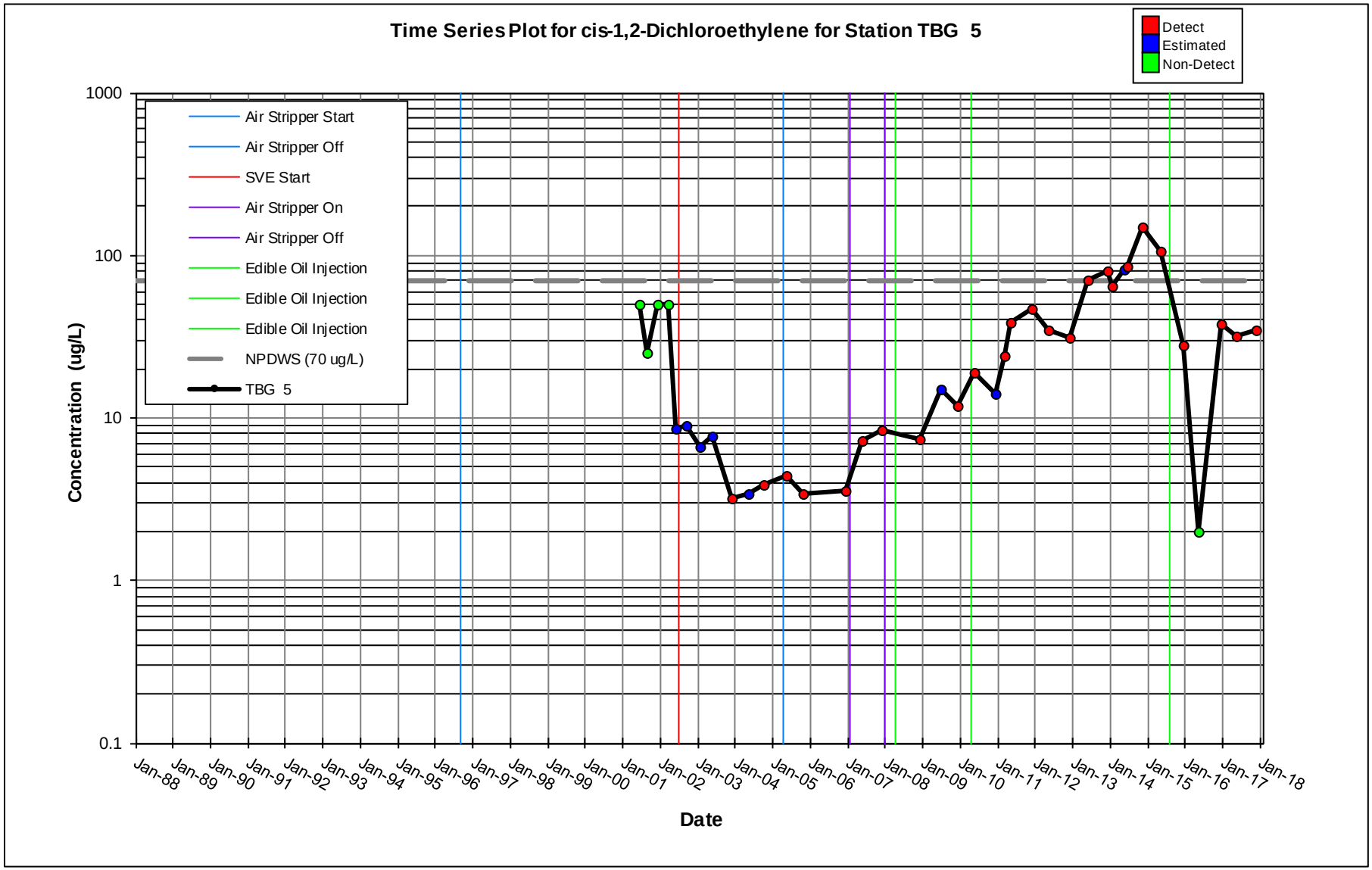
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TBG 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TBG 5
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
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Jan-91
Jan-92
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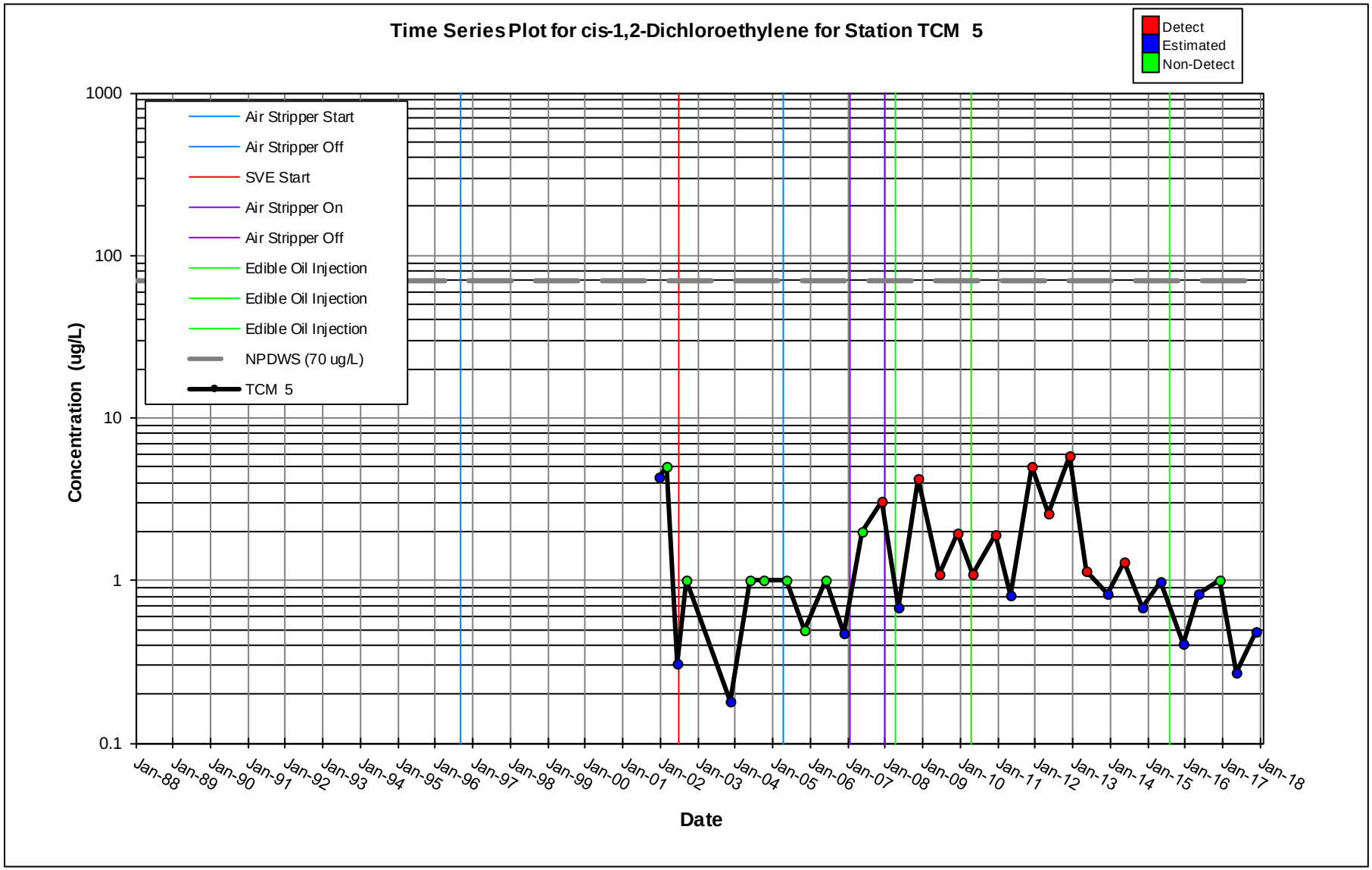
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TCM 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TCM 5
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
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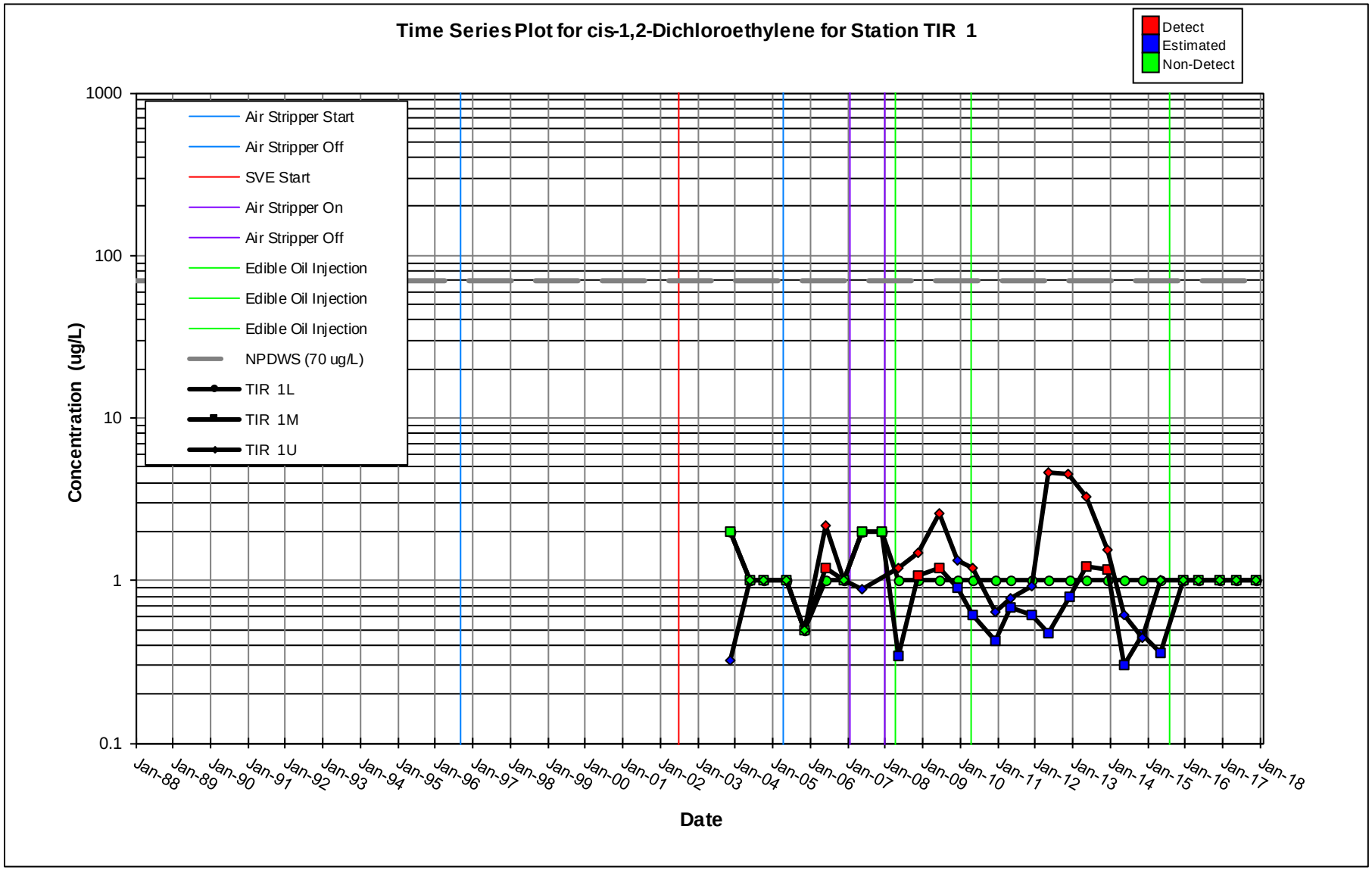
Time Series Plot for cis-1,2-Dichloroethylene for Station TIR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TIR 1L
TIR 1M
TIR 1U
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
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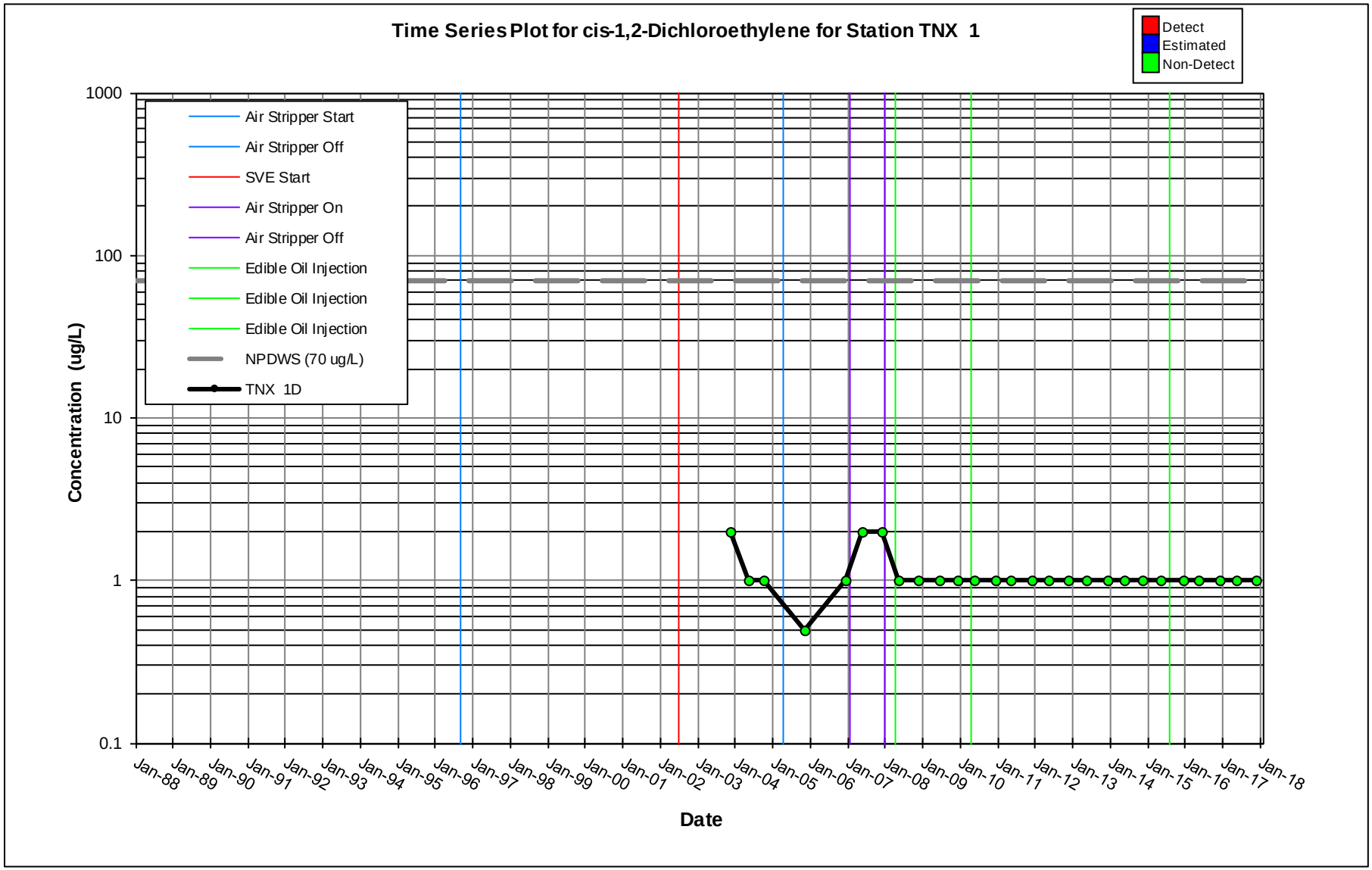
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 1D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
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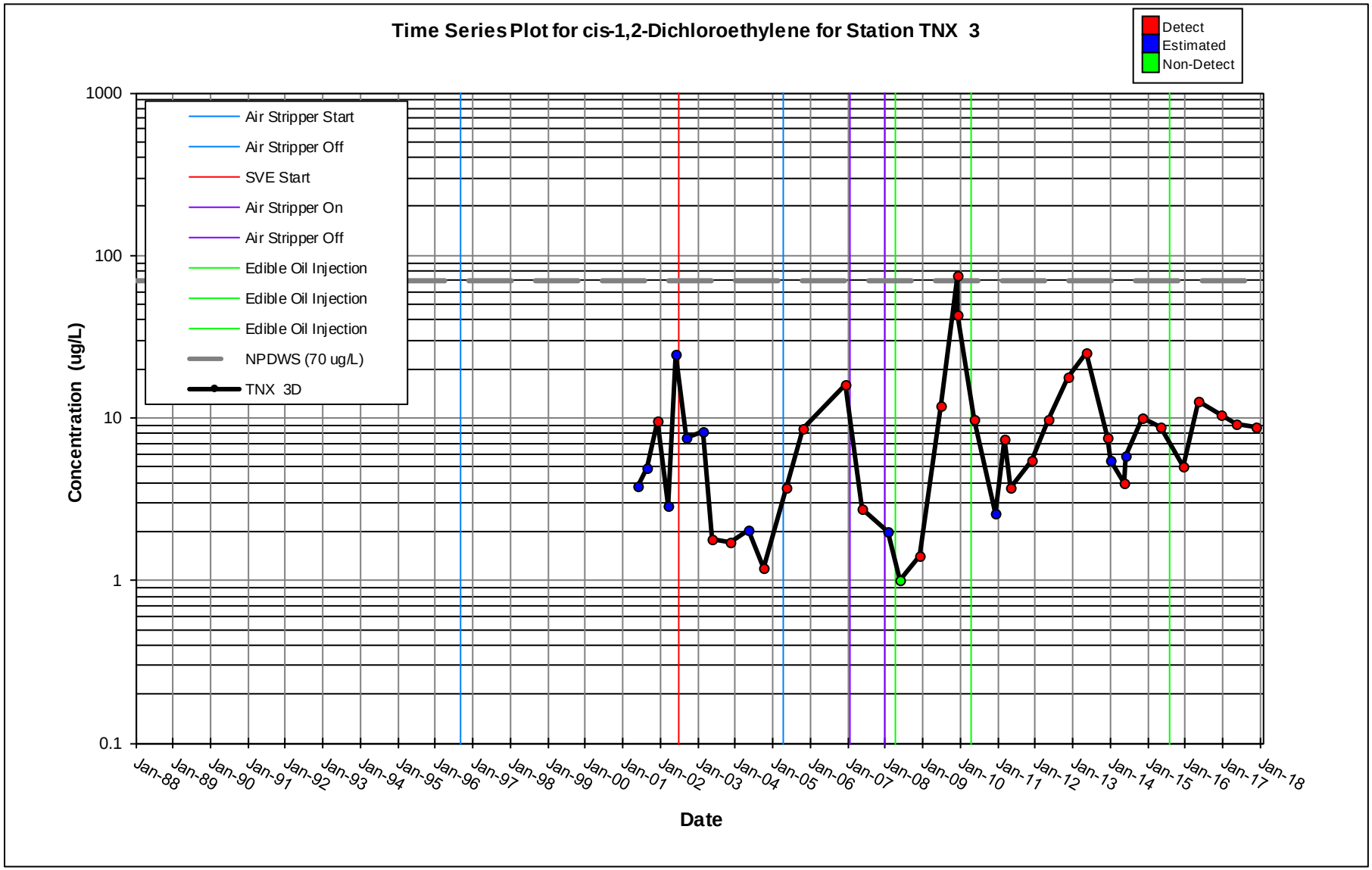
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 3D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
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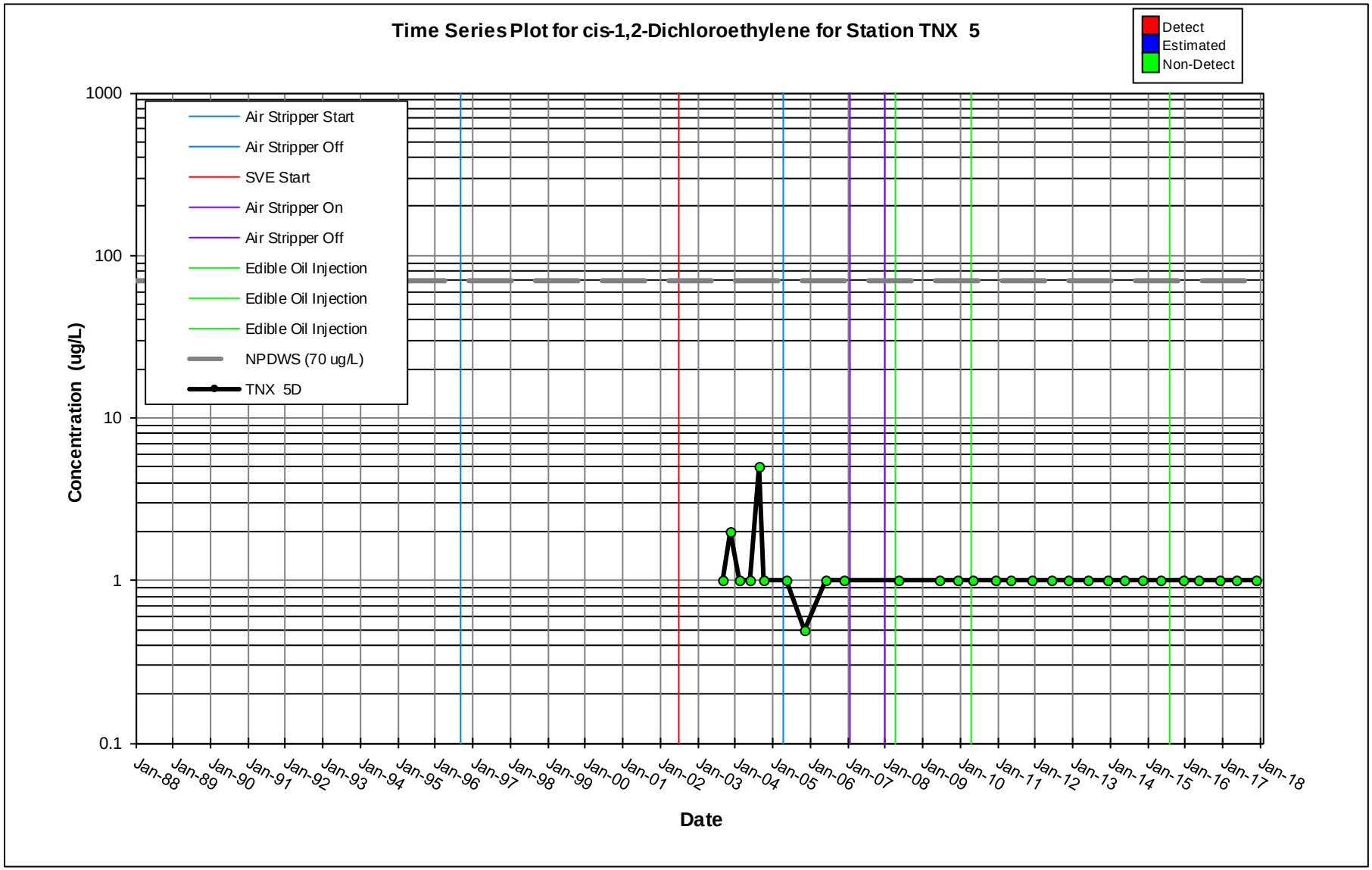
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 5D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
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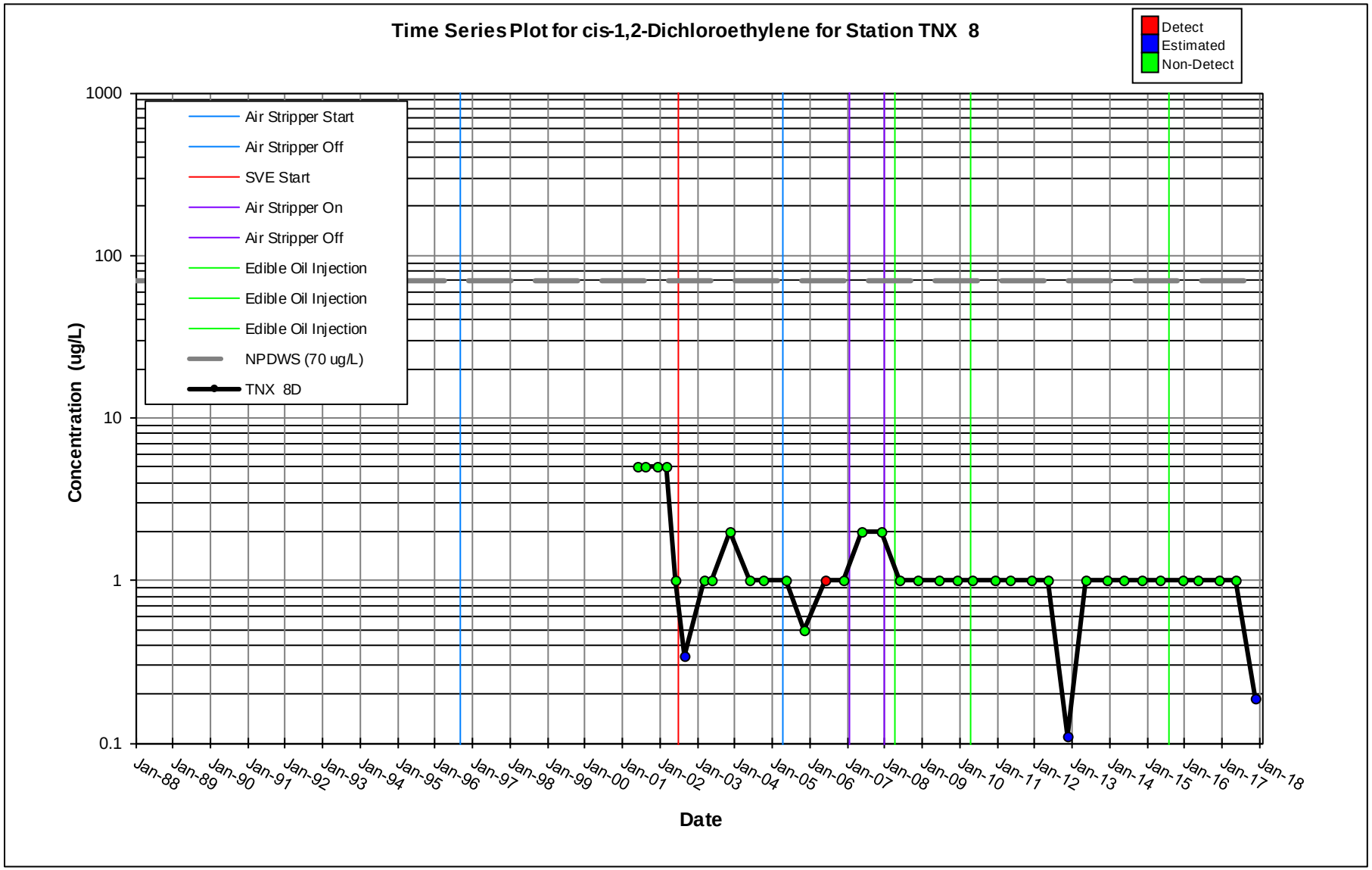
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 8
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 8D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
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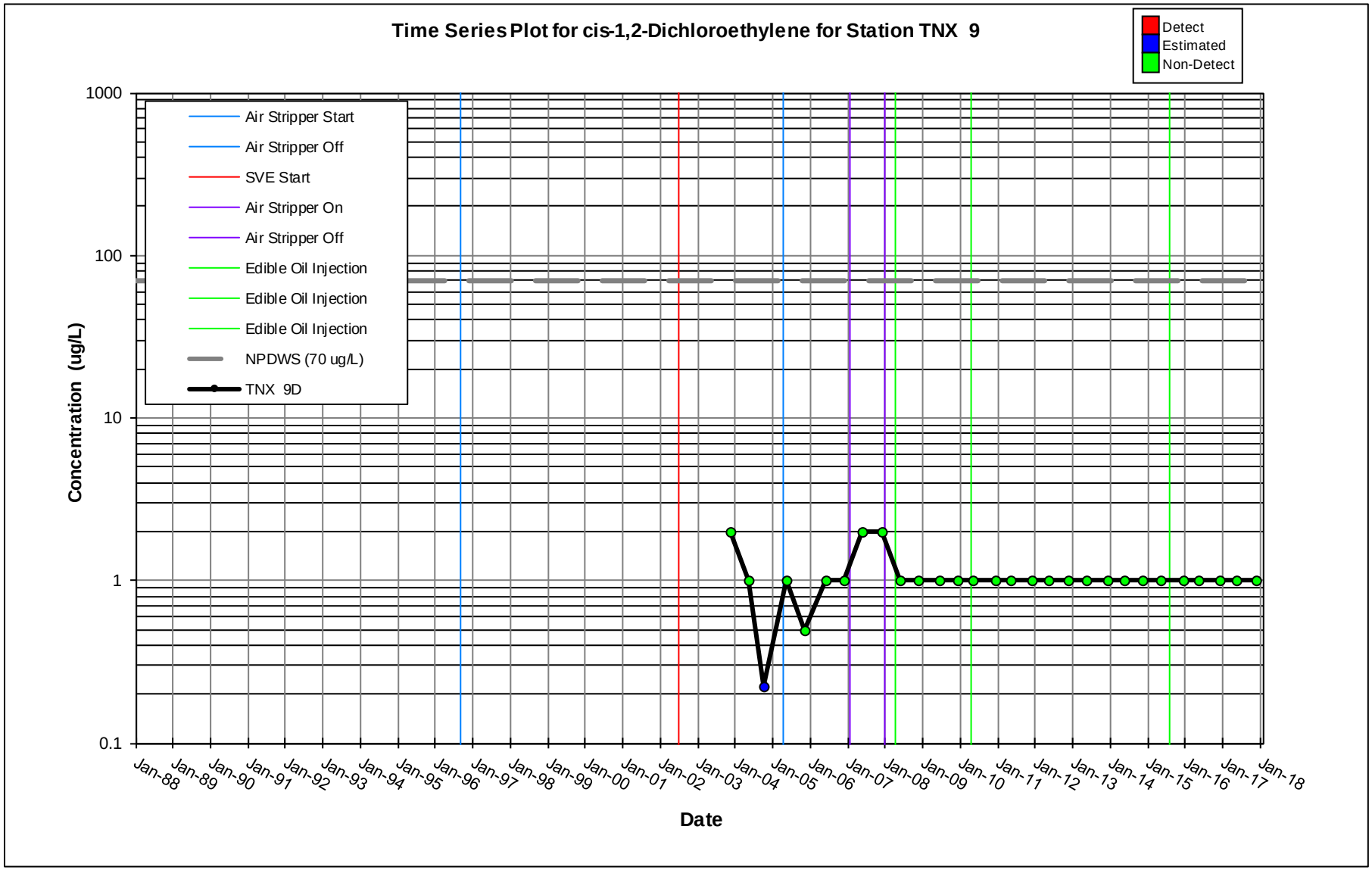
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 9
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 9D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
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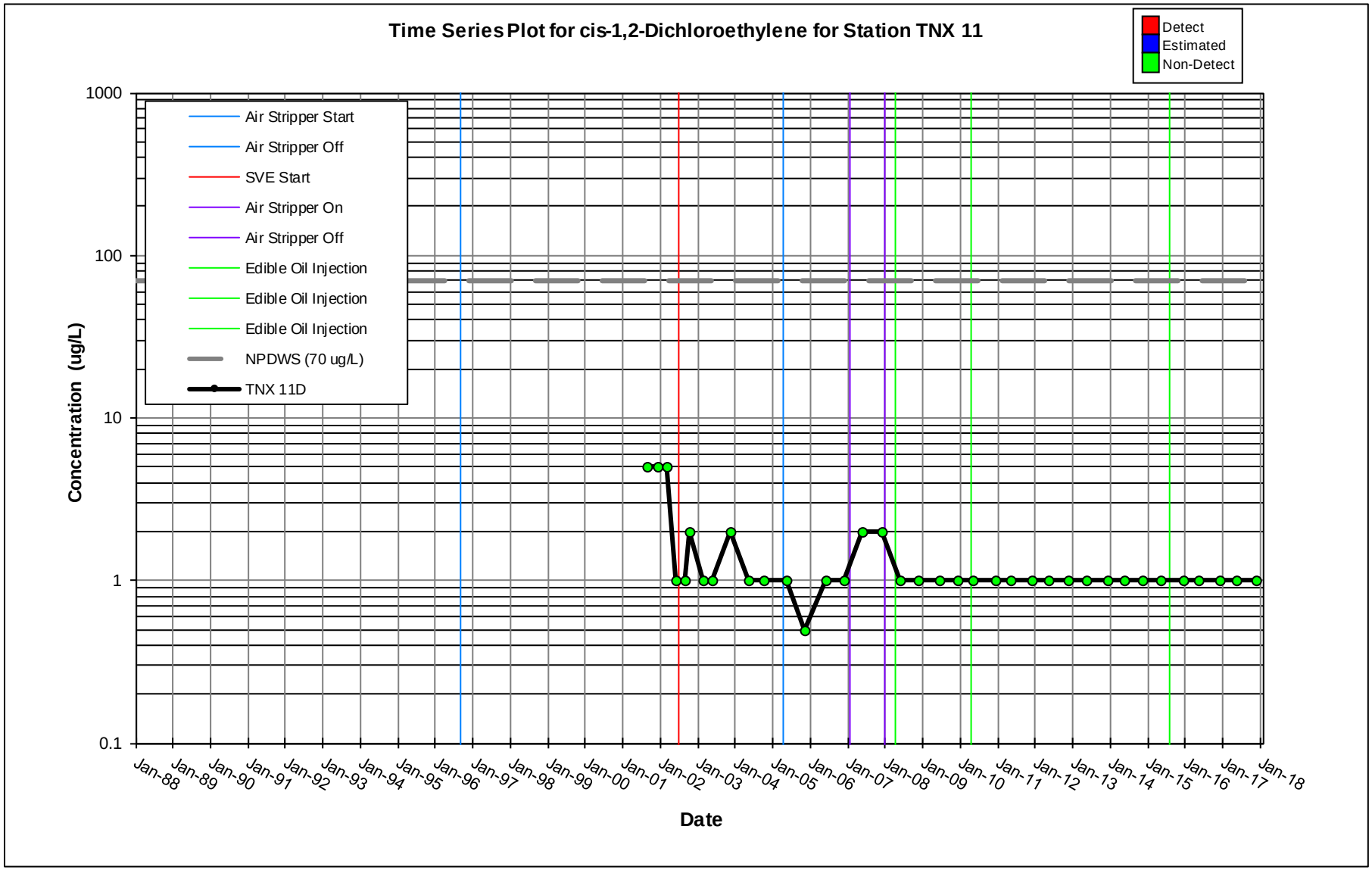
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 11
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 11D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
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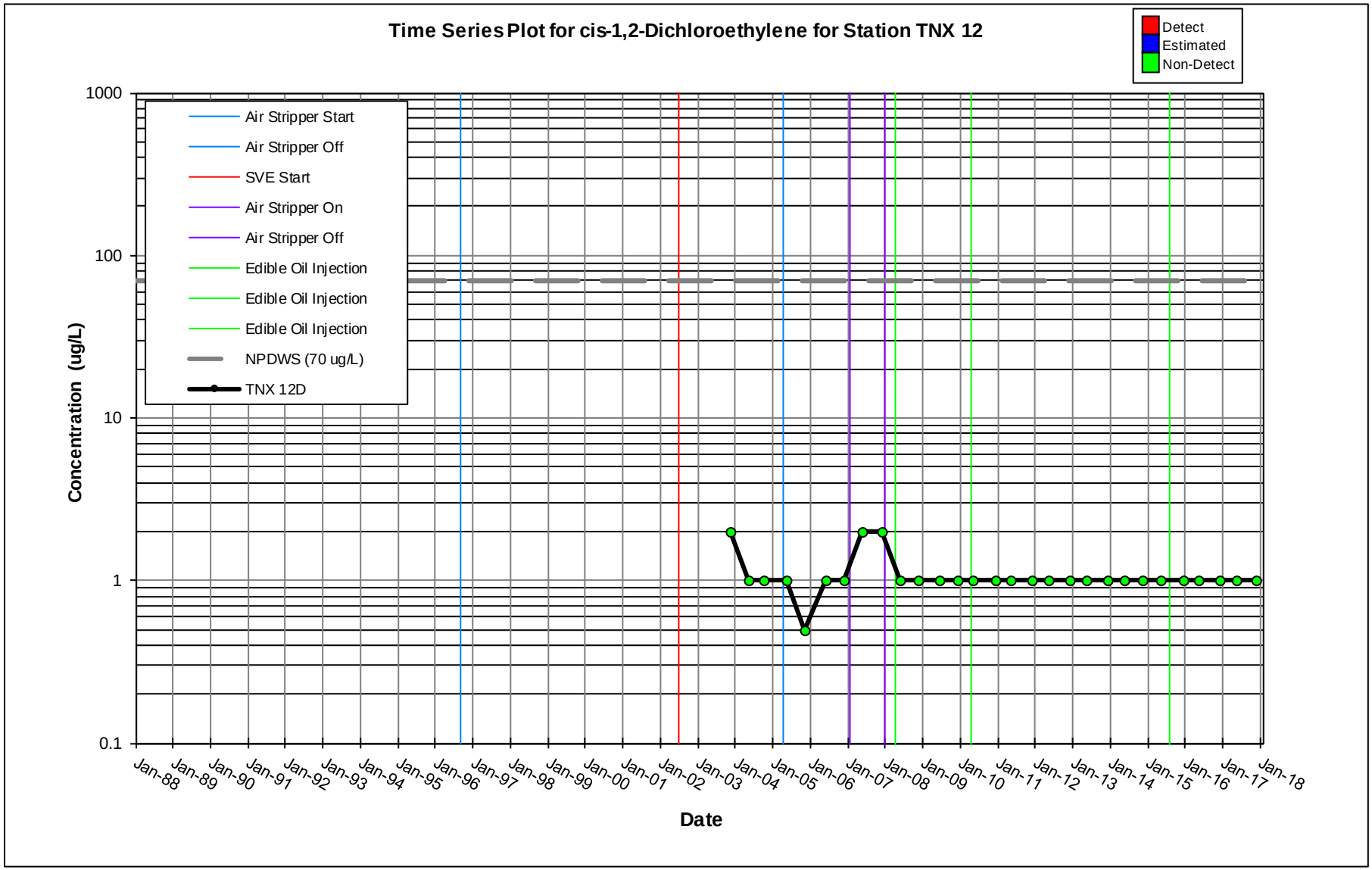
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 12
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 12D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
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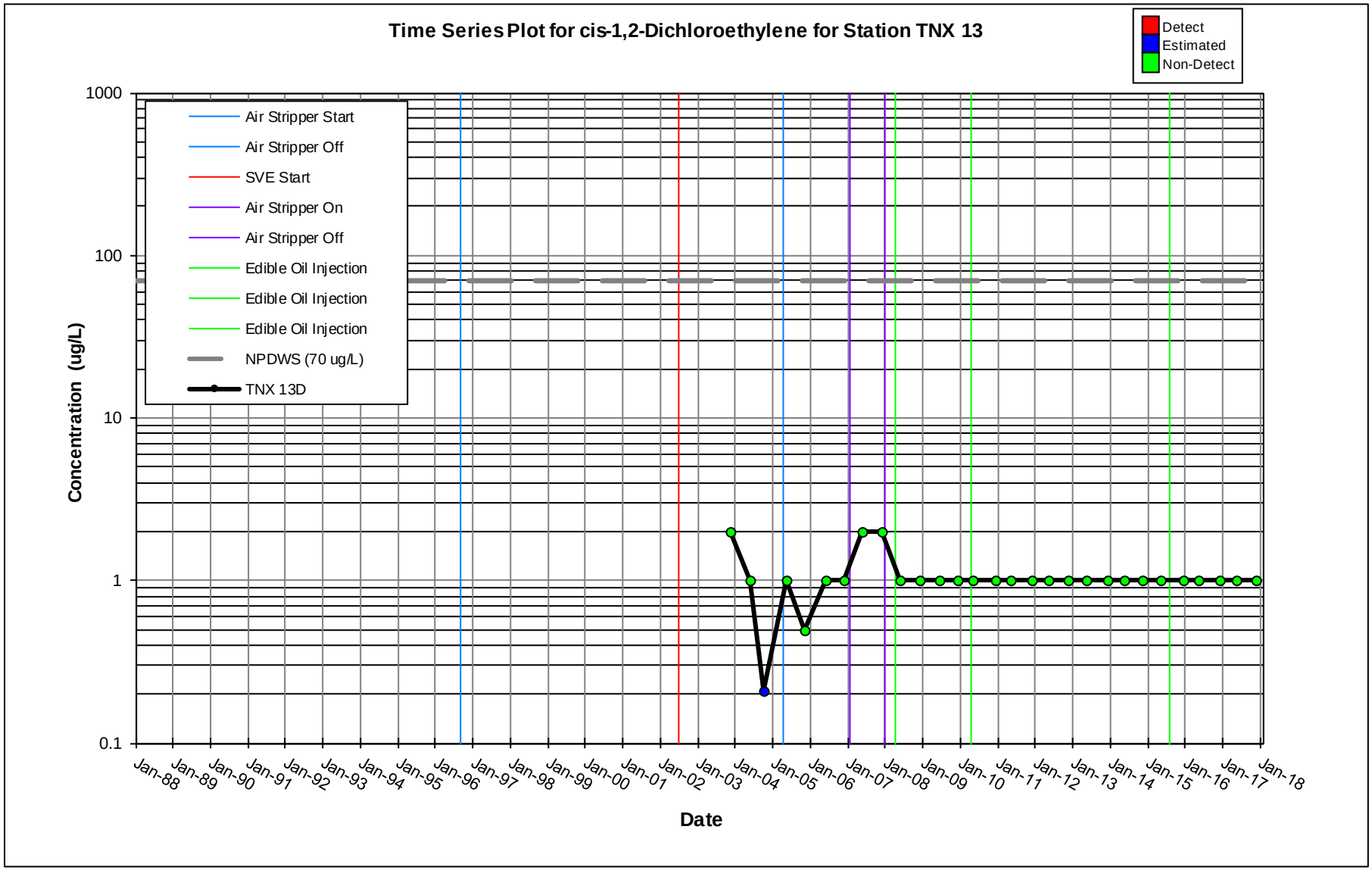
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 13
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 13D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
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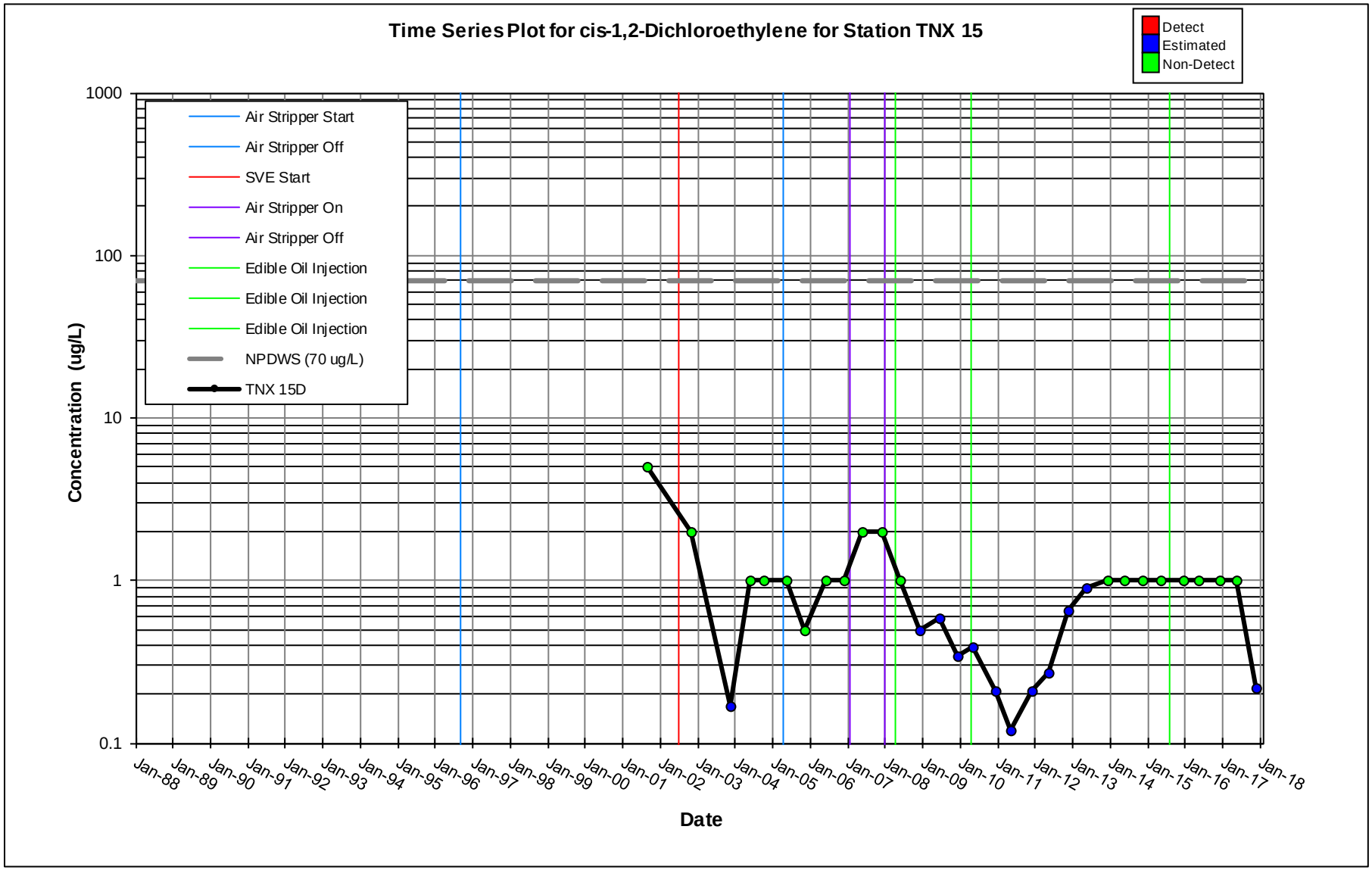
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 15
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 15D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
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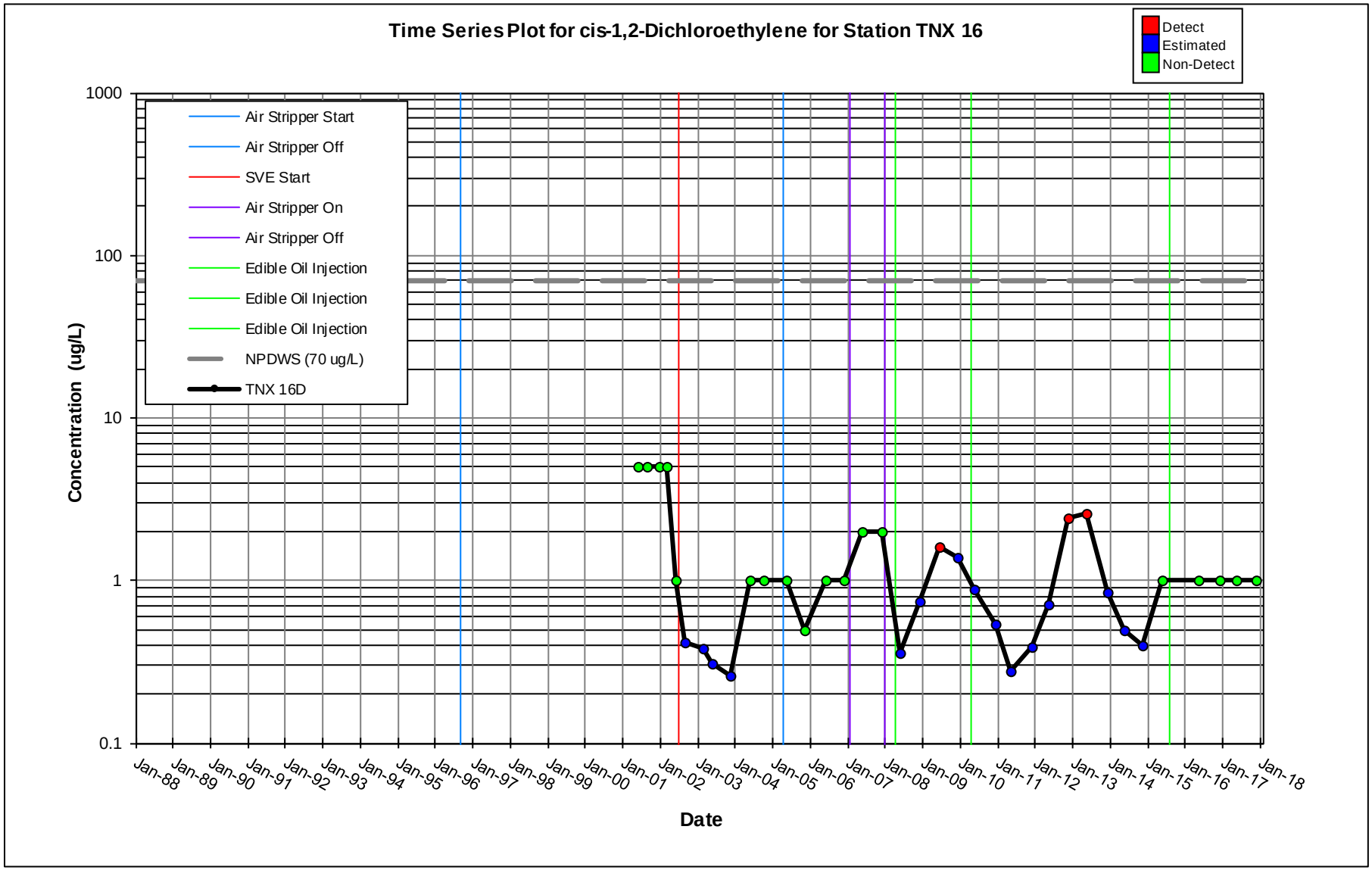
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 16
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 16D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
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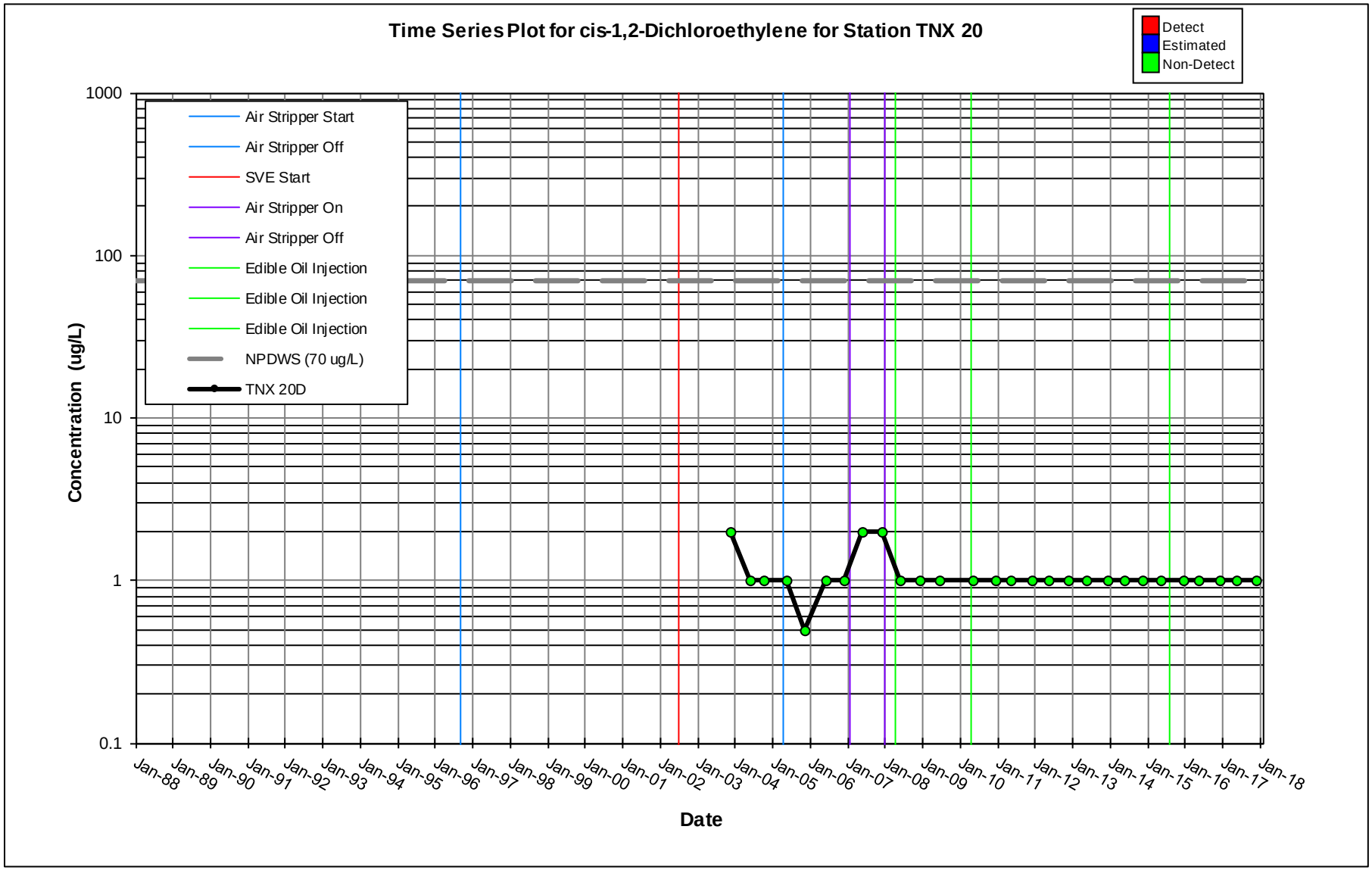
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 20
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 20D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
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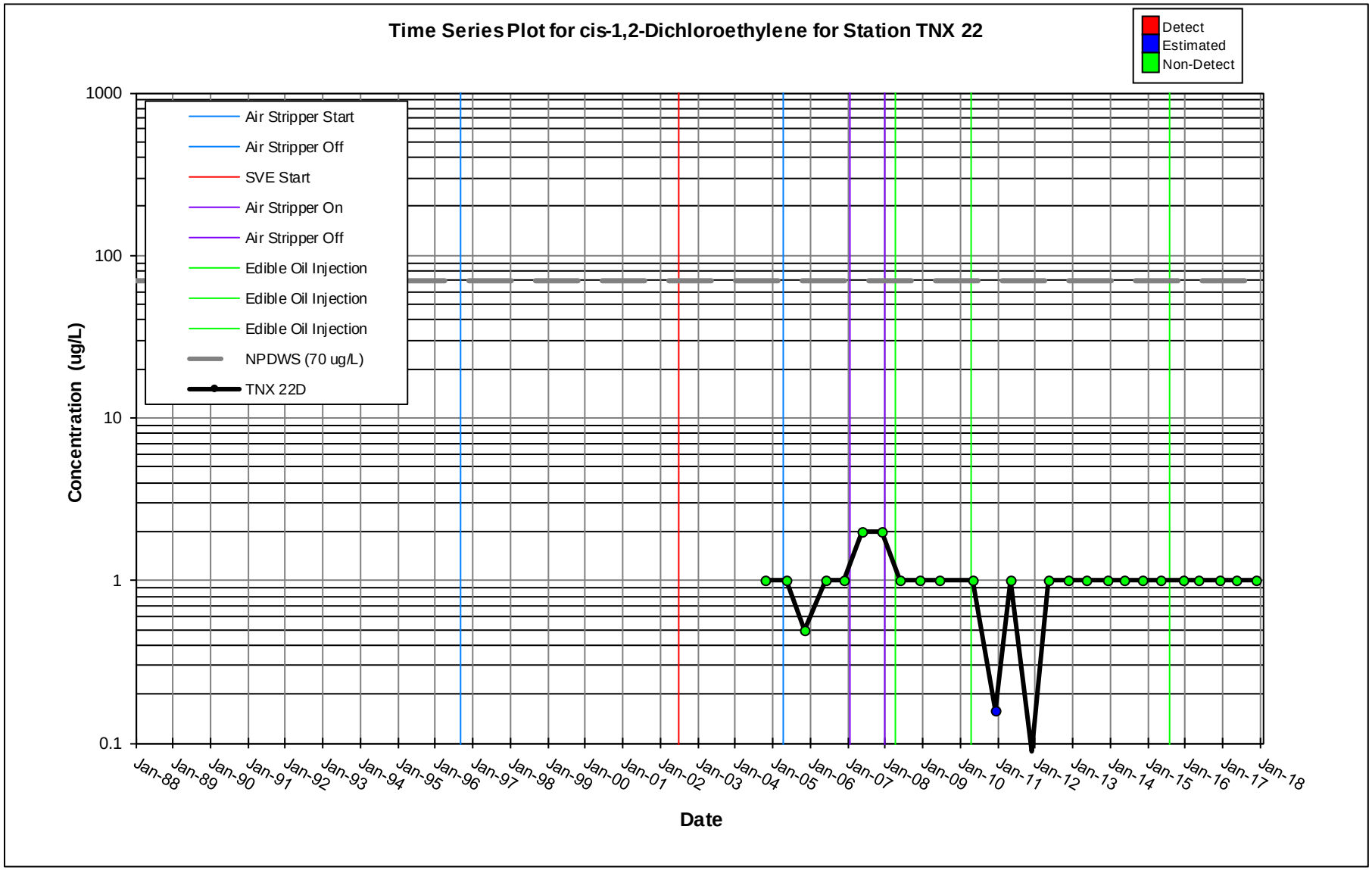
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 22
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 22D
Concentration (ug/L)
1000
100
10
1
0.1
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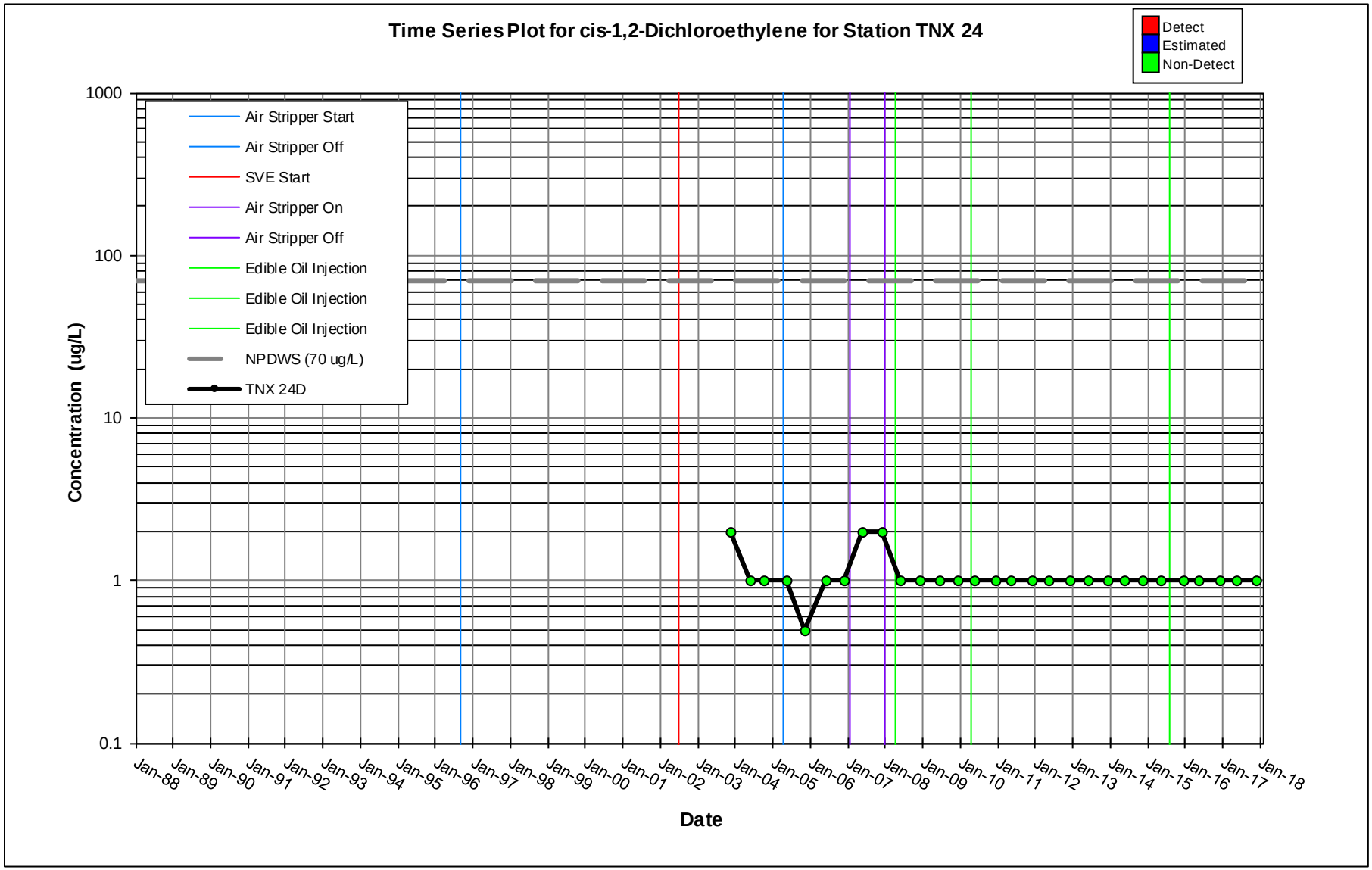
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 24
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 24D
Concentration (ug/L)
1000
100
10
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0.1
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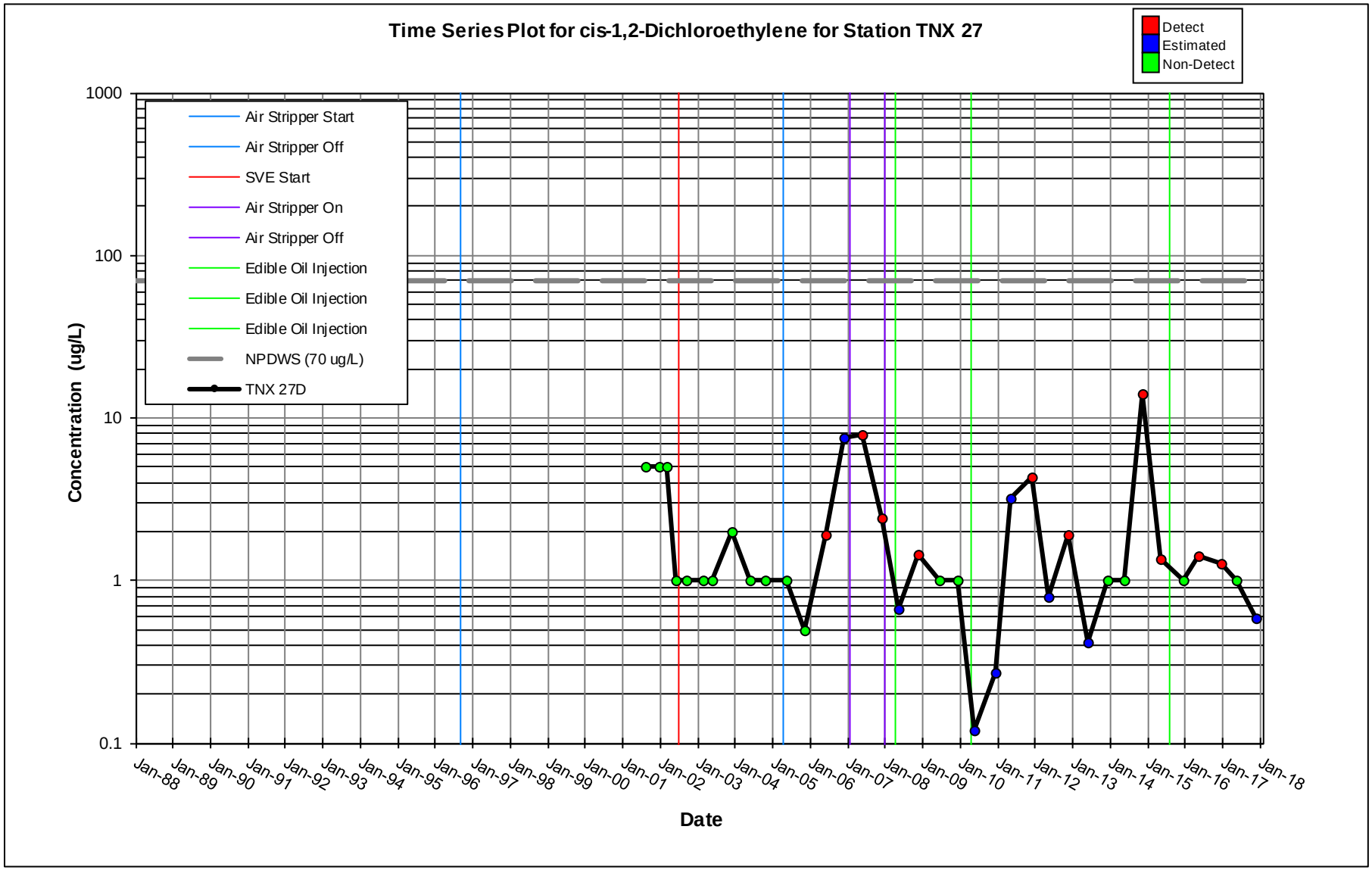
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 27
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 27D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
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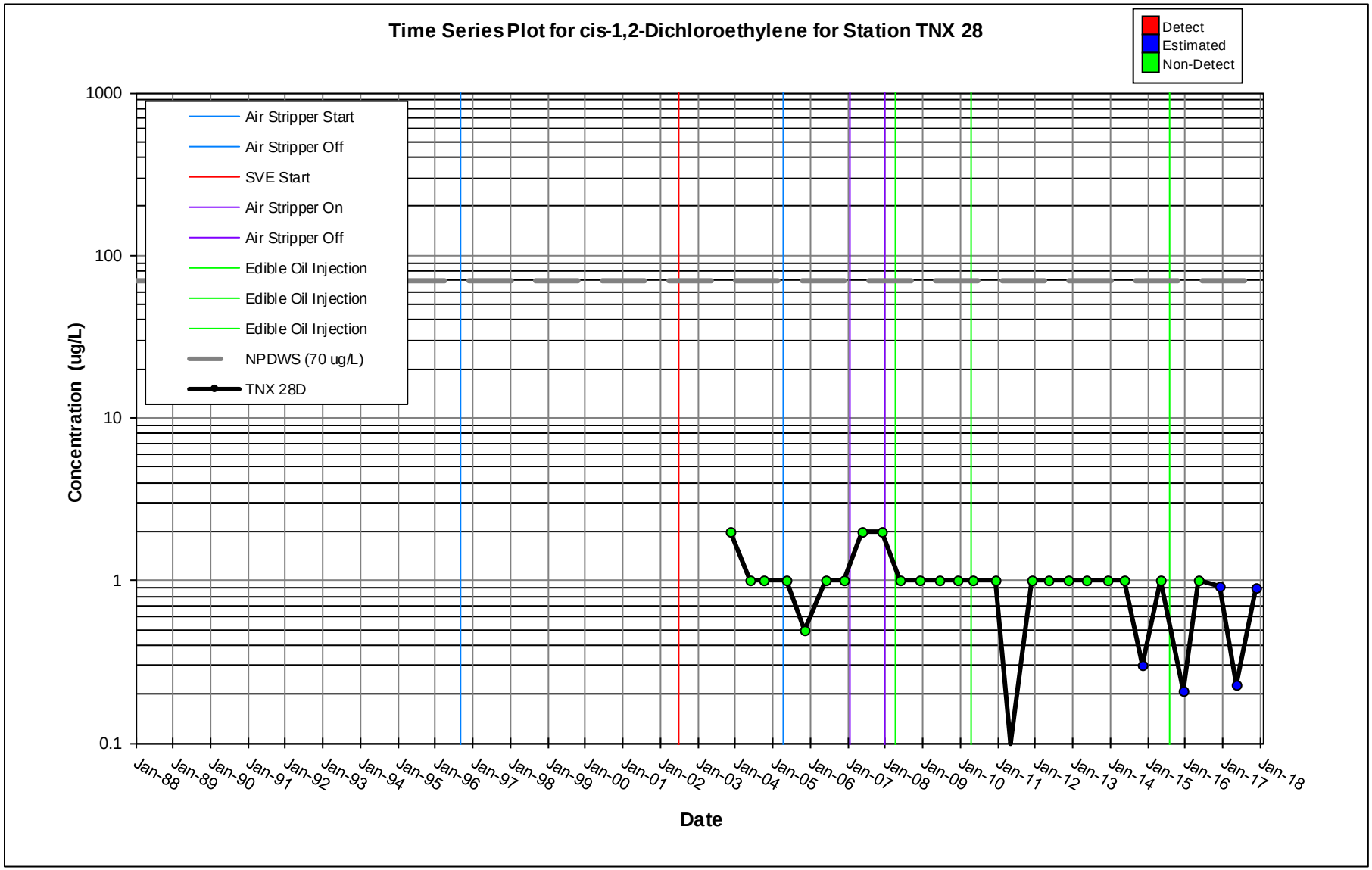
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 28
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 28D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
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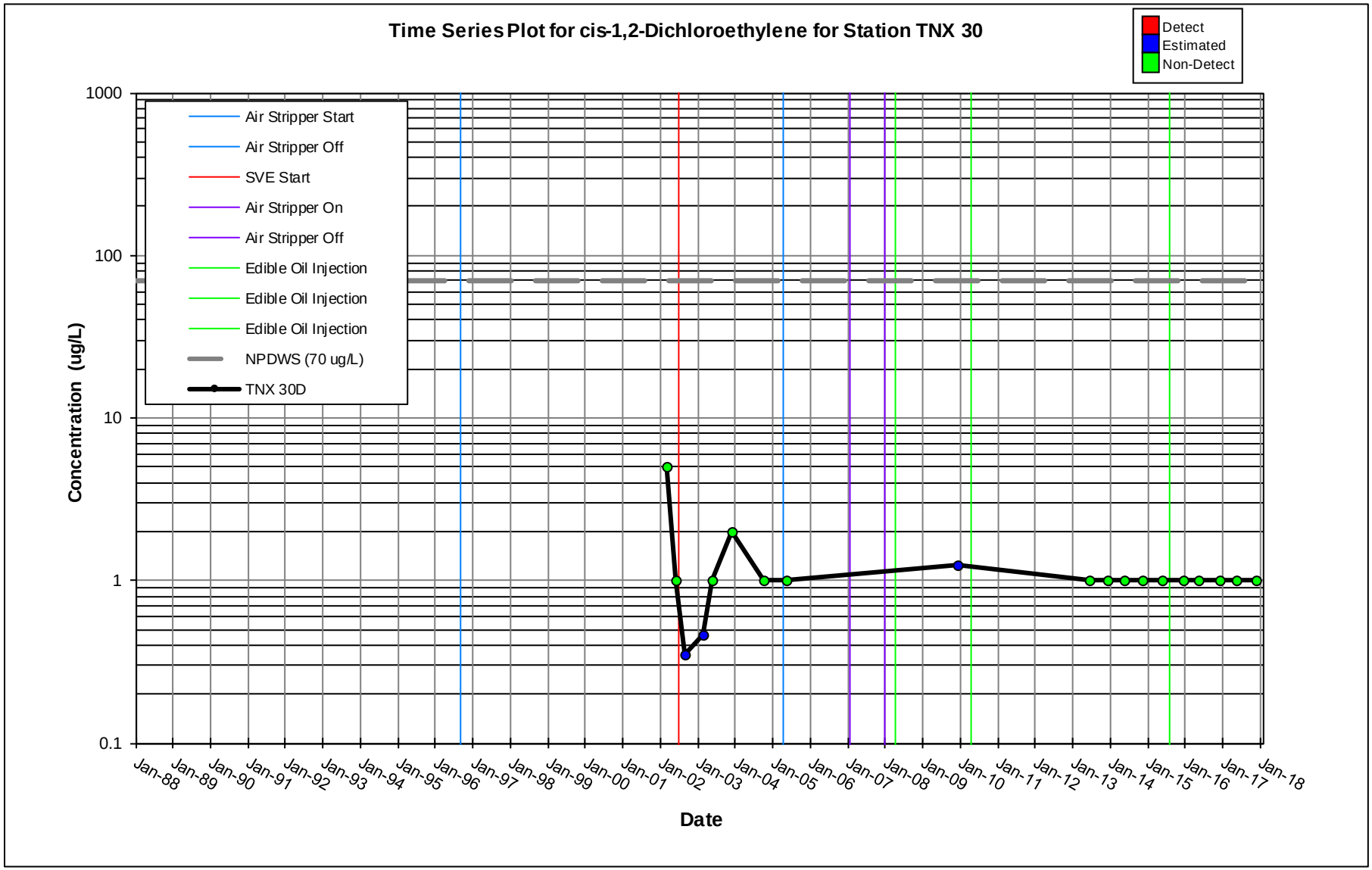
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 30
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 30D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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Jan-96
Jan-97
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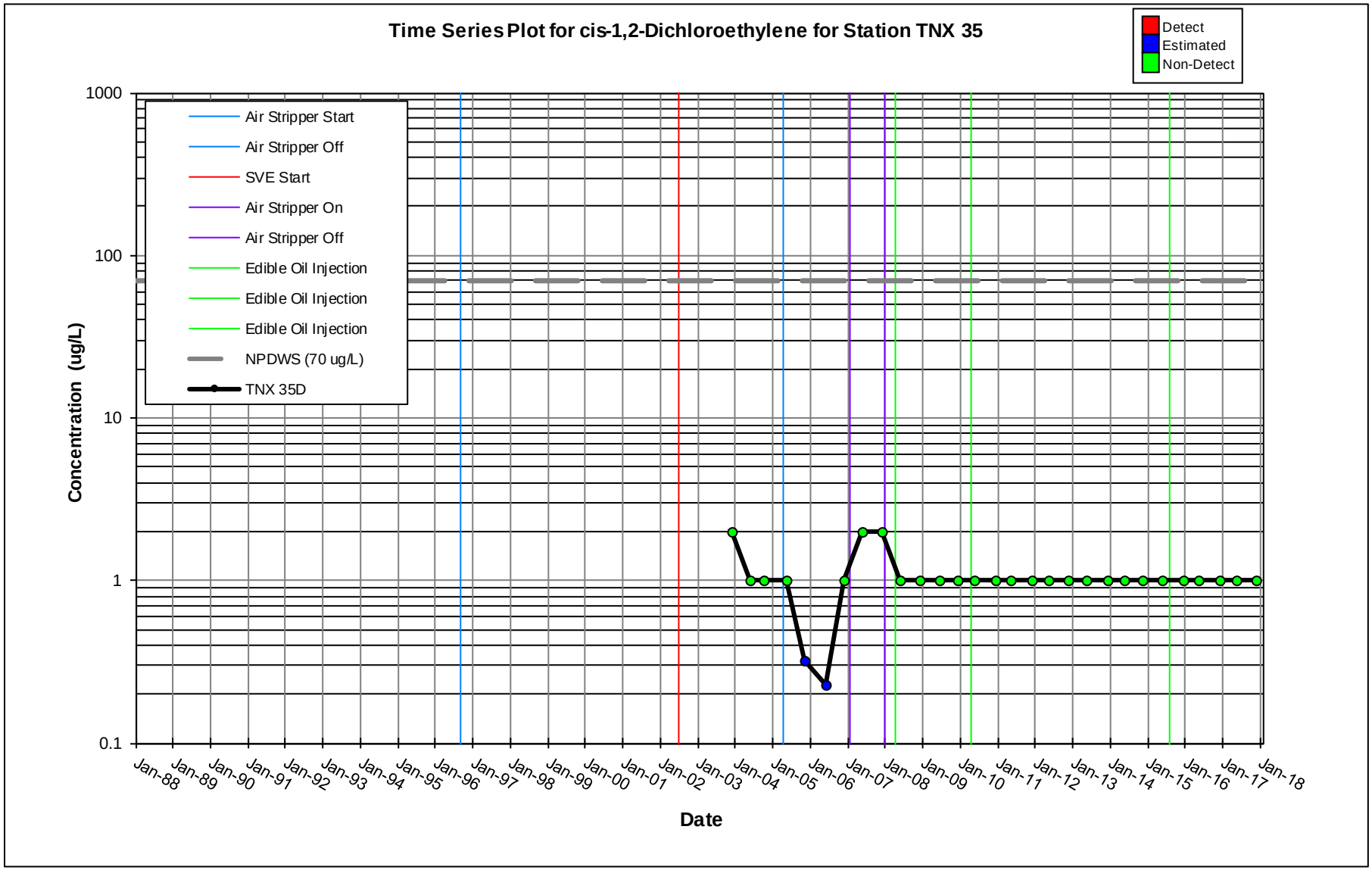
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 35
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 35D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
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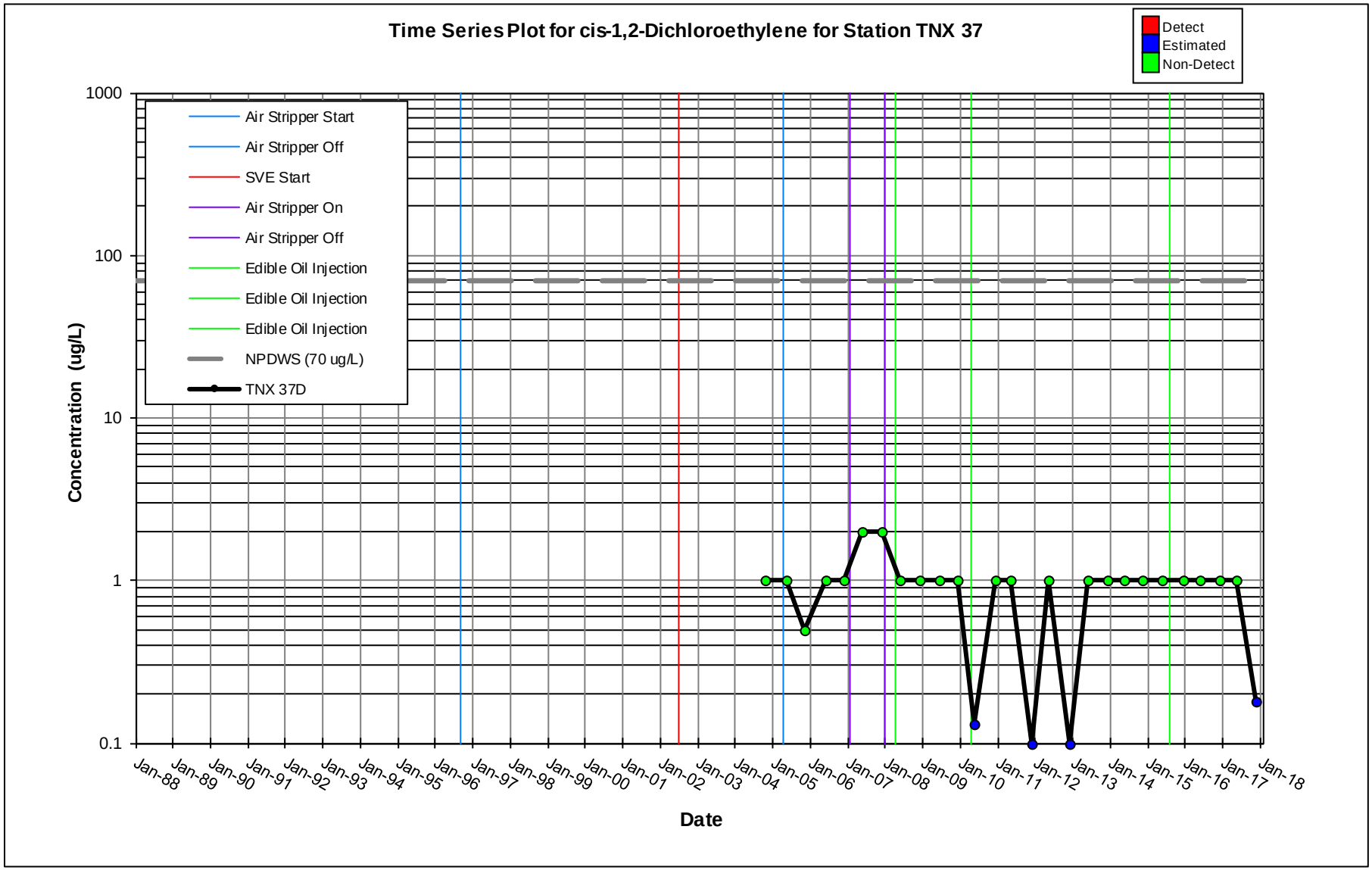
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 37
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 37D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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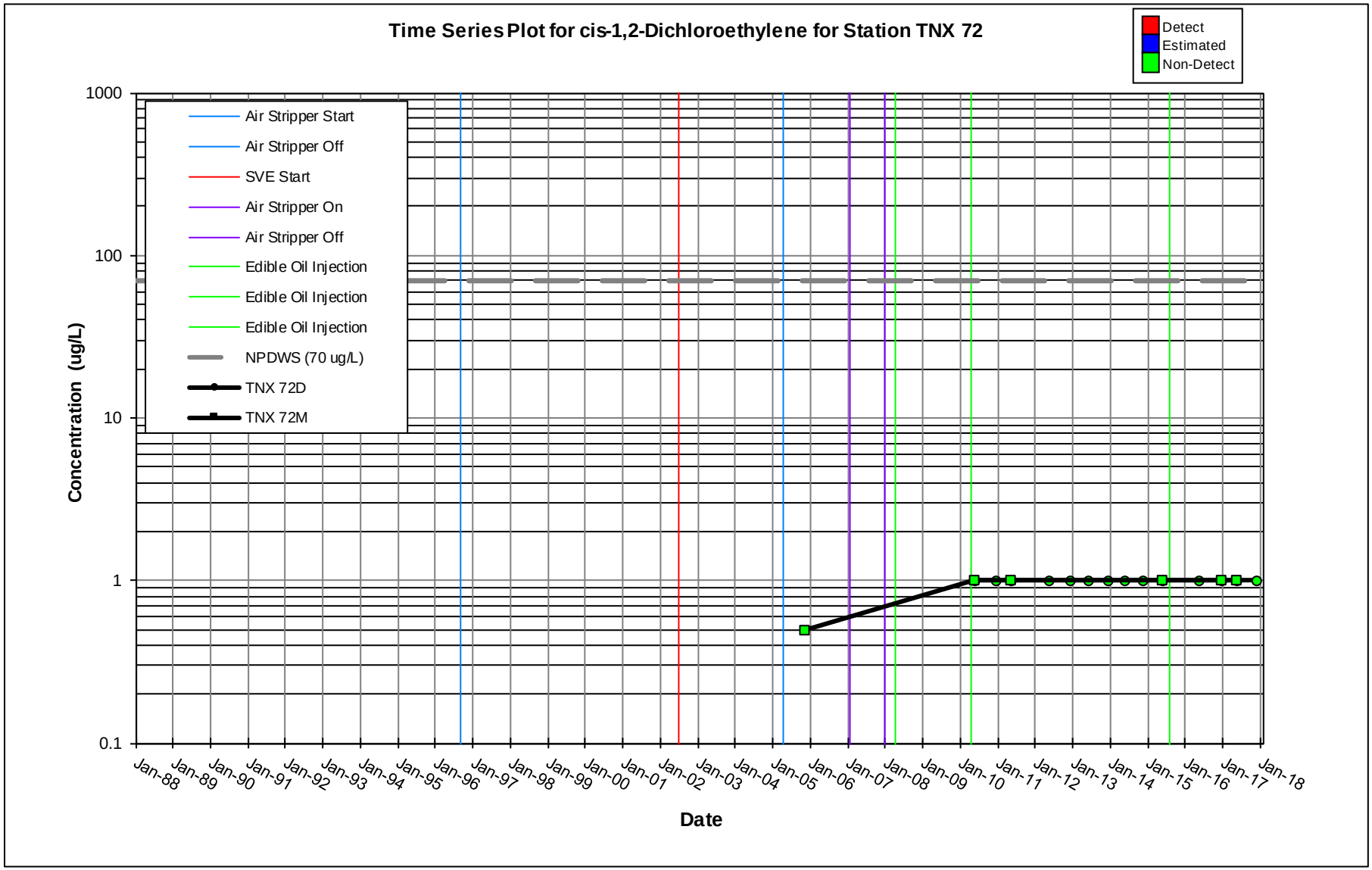
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX 72
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX 72D
TNX 72M
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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Jan-94
Jan-95
Jan-96
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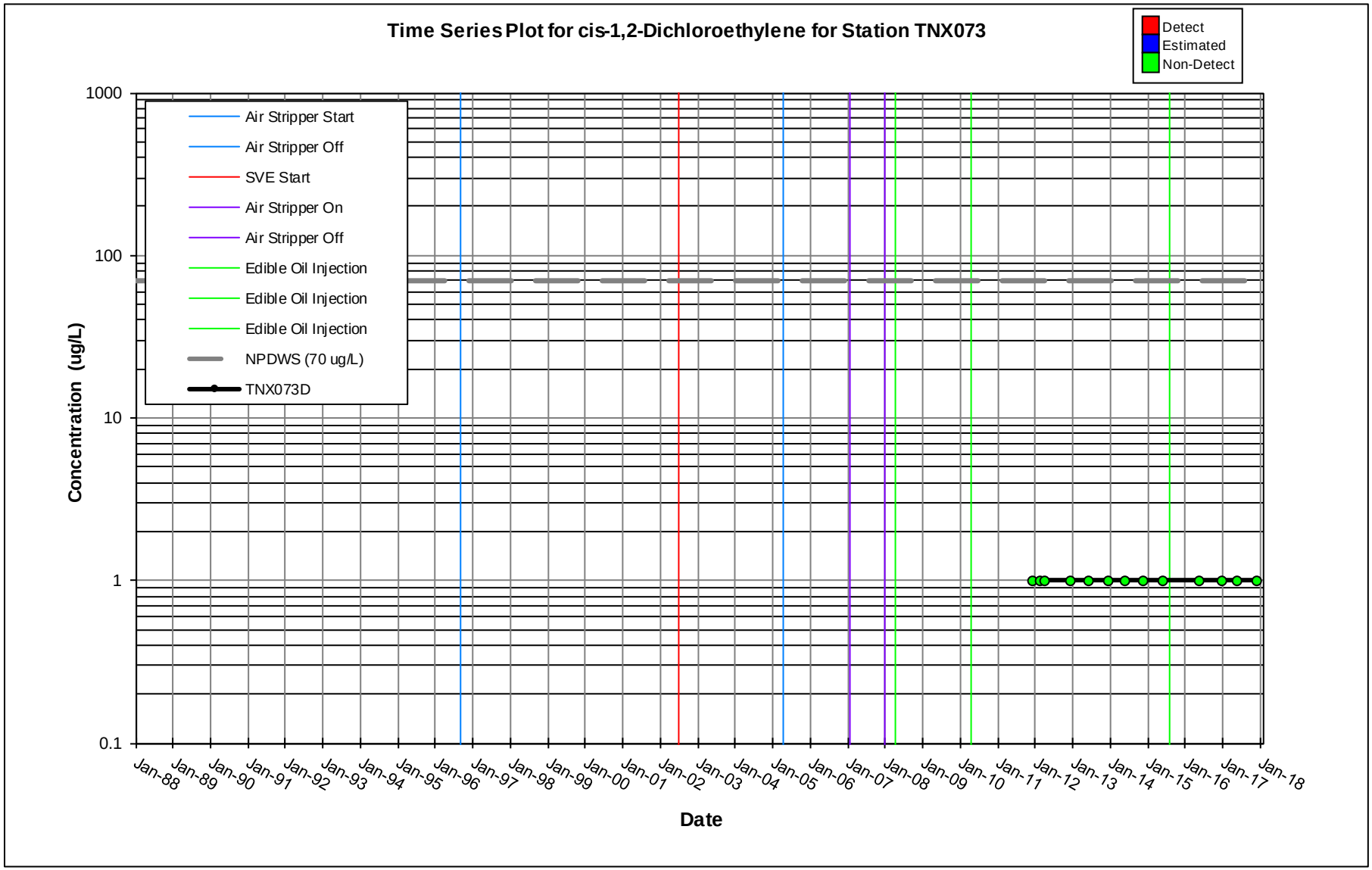
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX073
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX073D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
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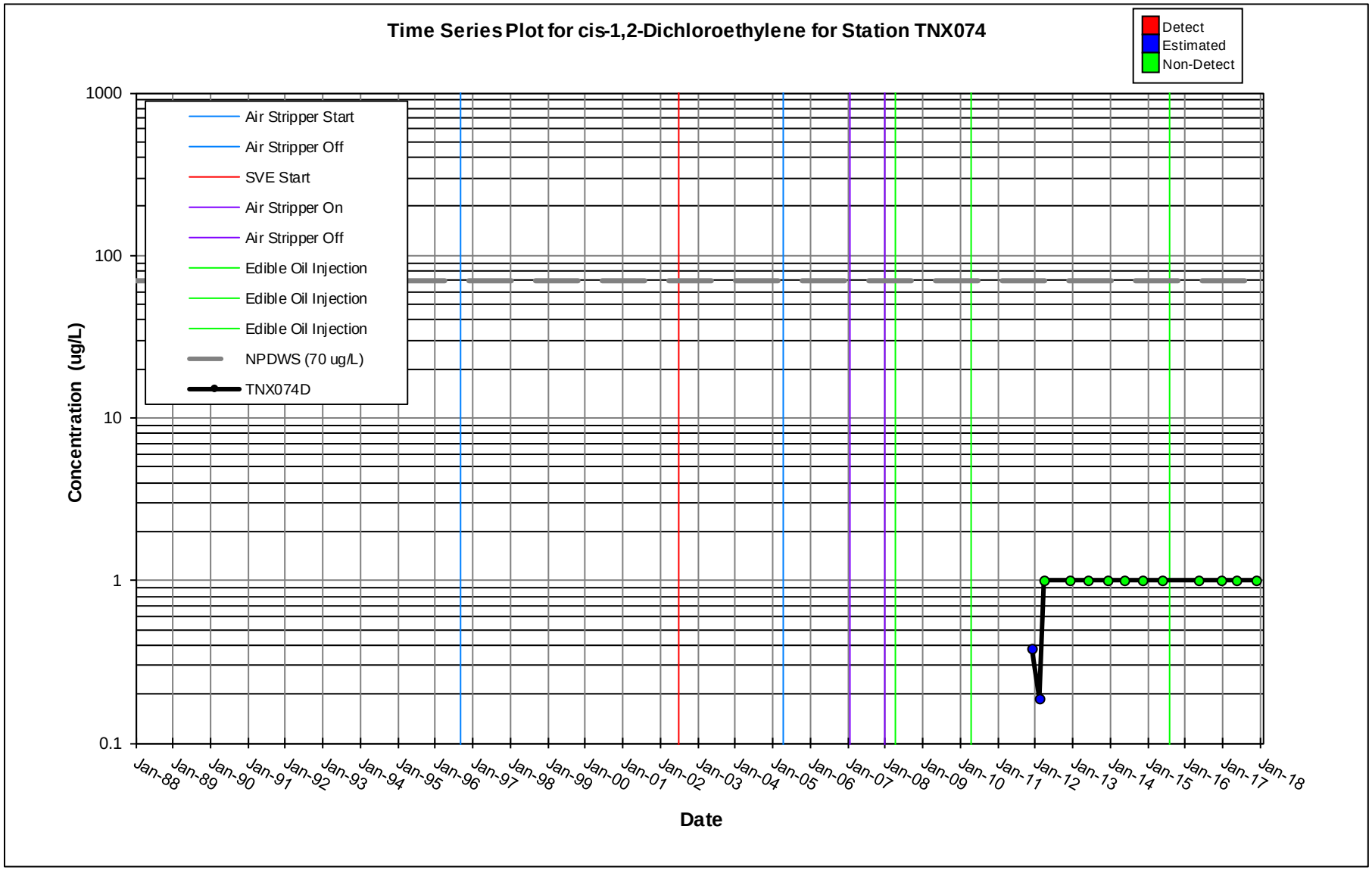
Time Series Plot for cis-1,2-Dichloroethylene for Station TNX074
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX074D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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Jan-96
Jan-97
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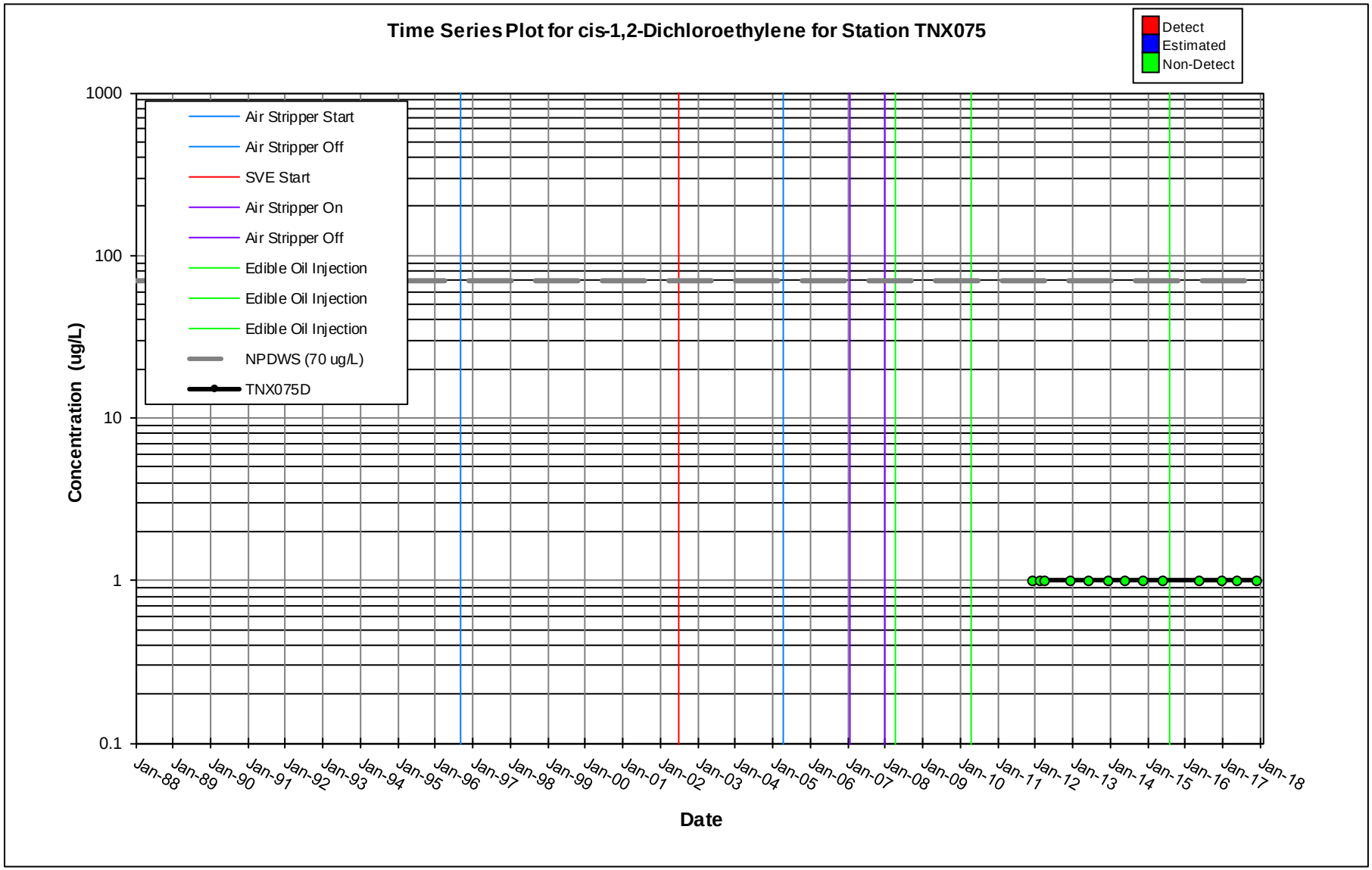
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TNX075
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TNX075D
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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Jan-96
Jan-97
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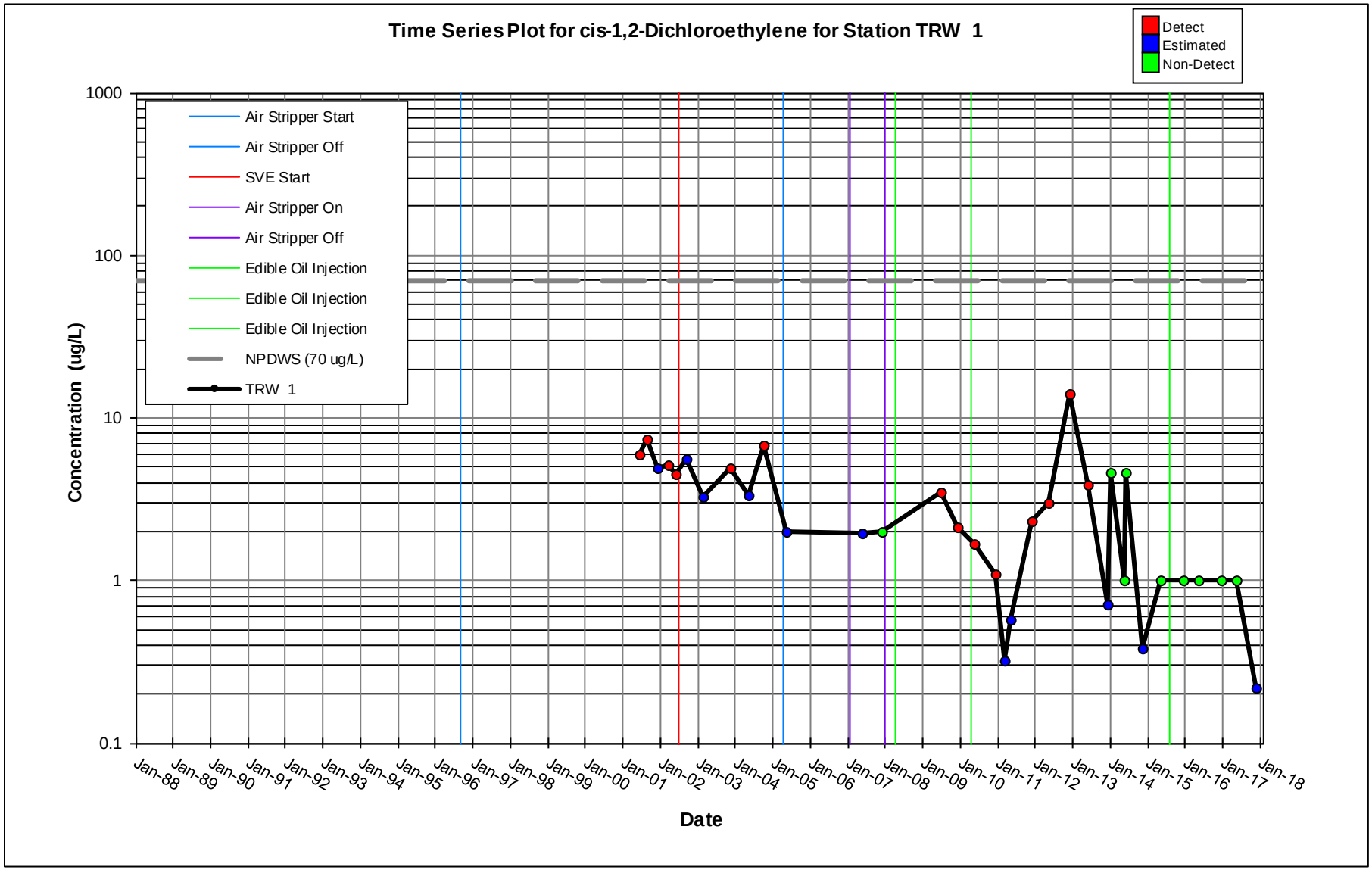
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TRW 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TRW 1
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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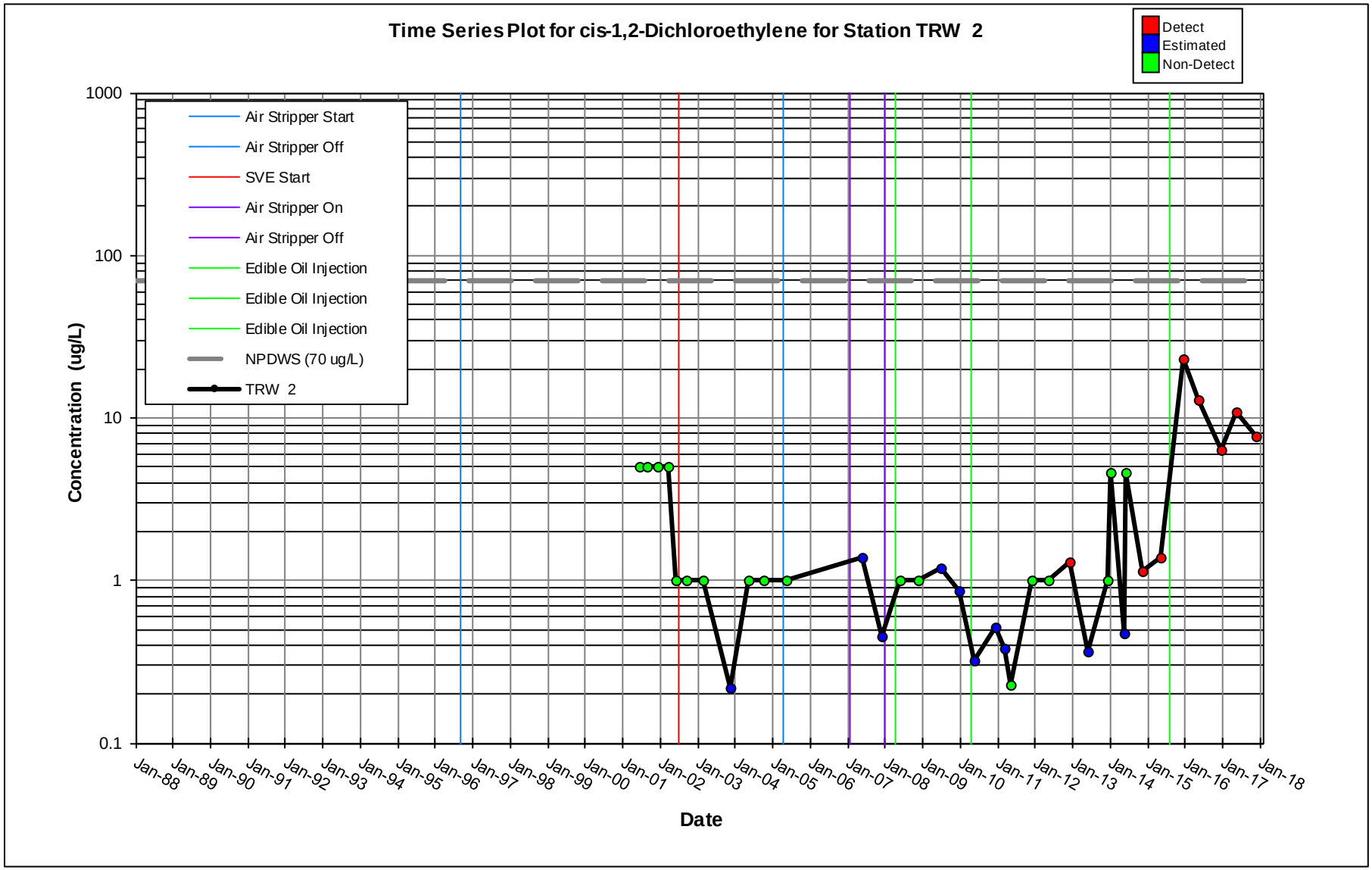
Jan-17
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TRW 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TRW 2
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
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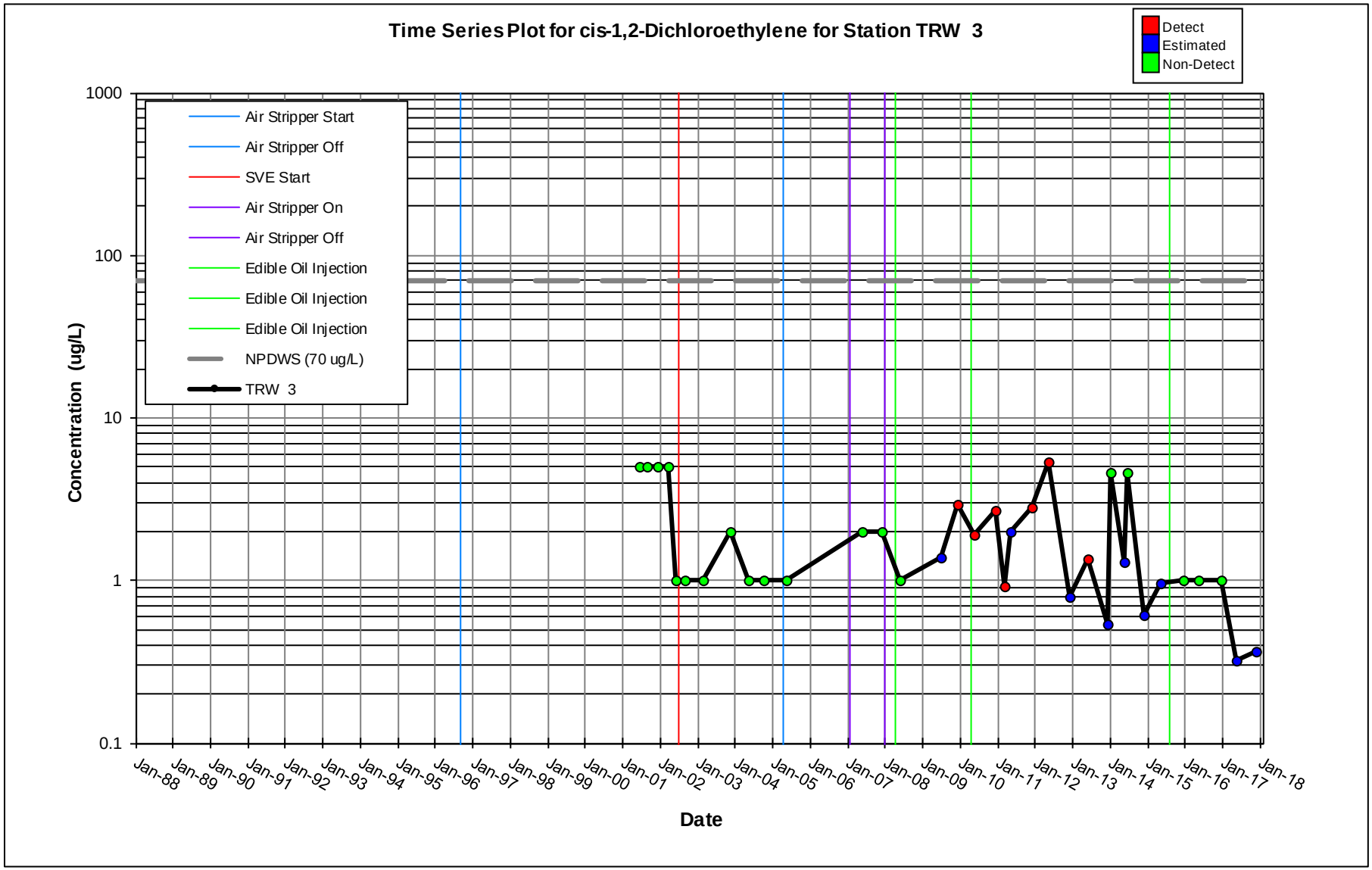
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TRW 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TRW 3
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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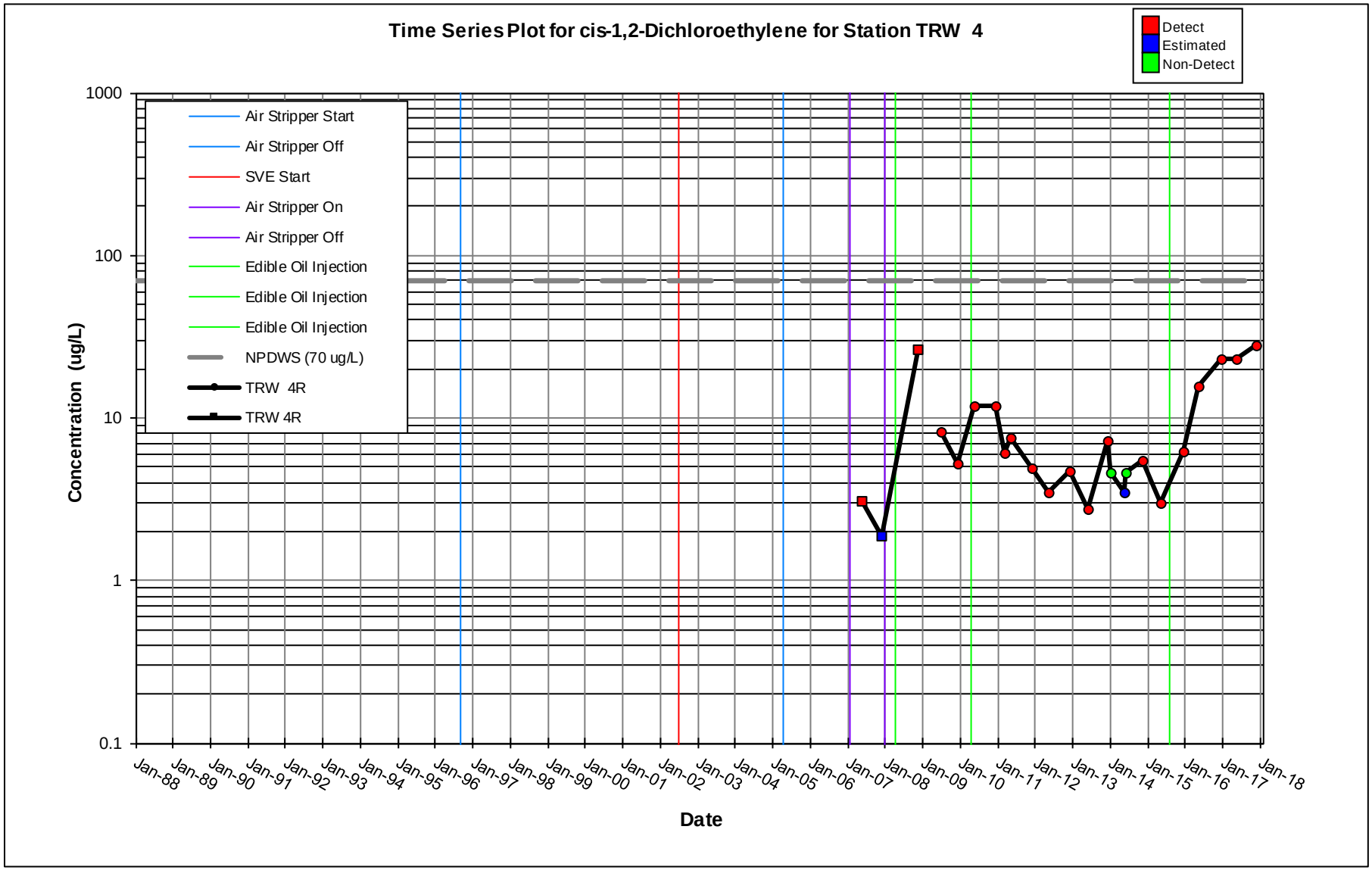
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TRW 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TRW 4R
TRW 4R
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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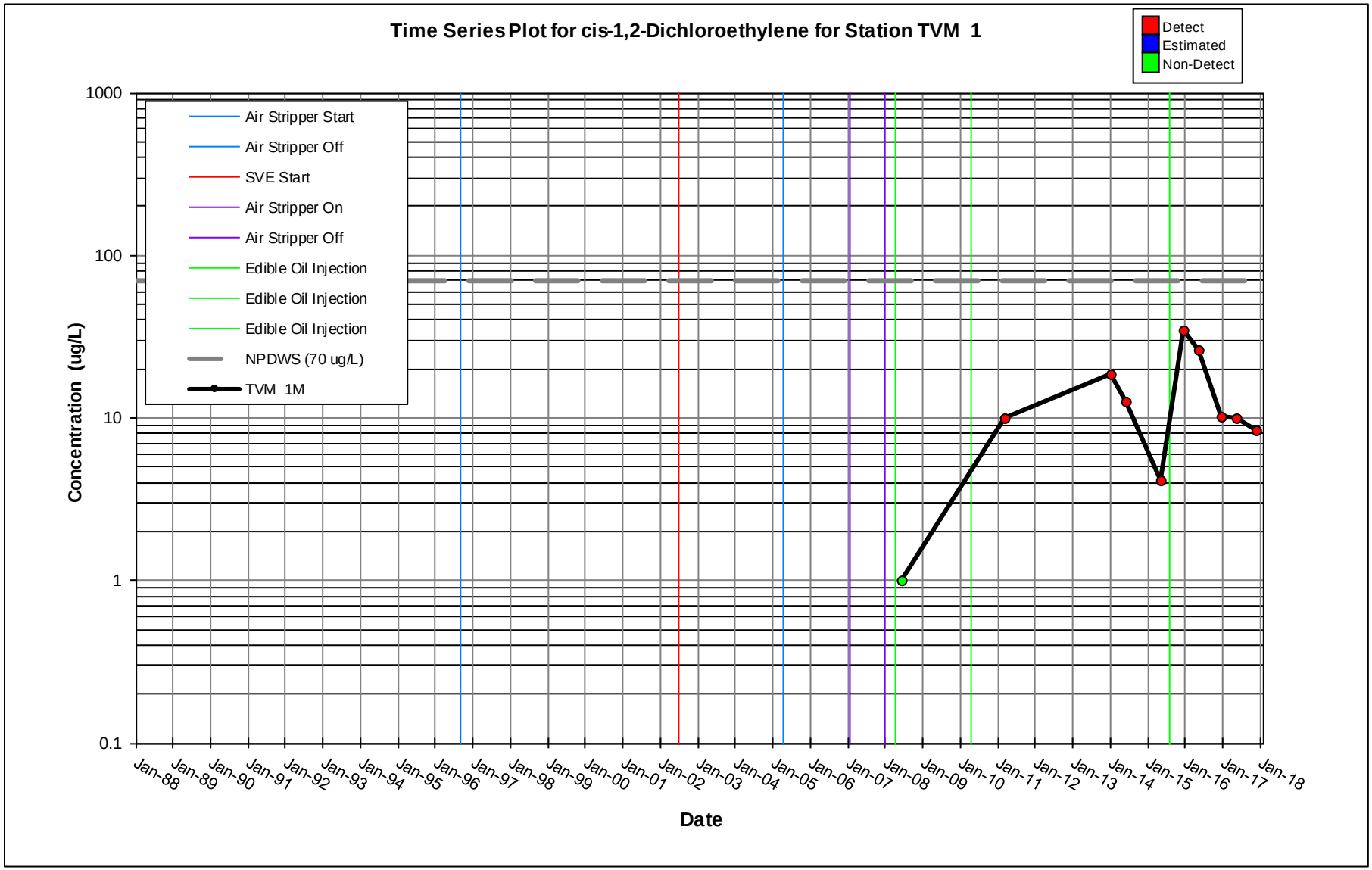
Jan-17
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TVM 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TVM 1M
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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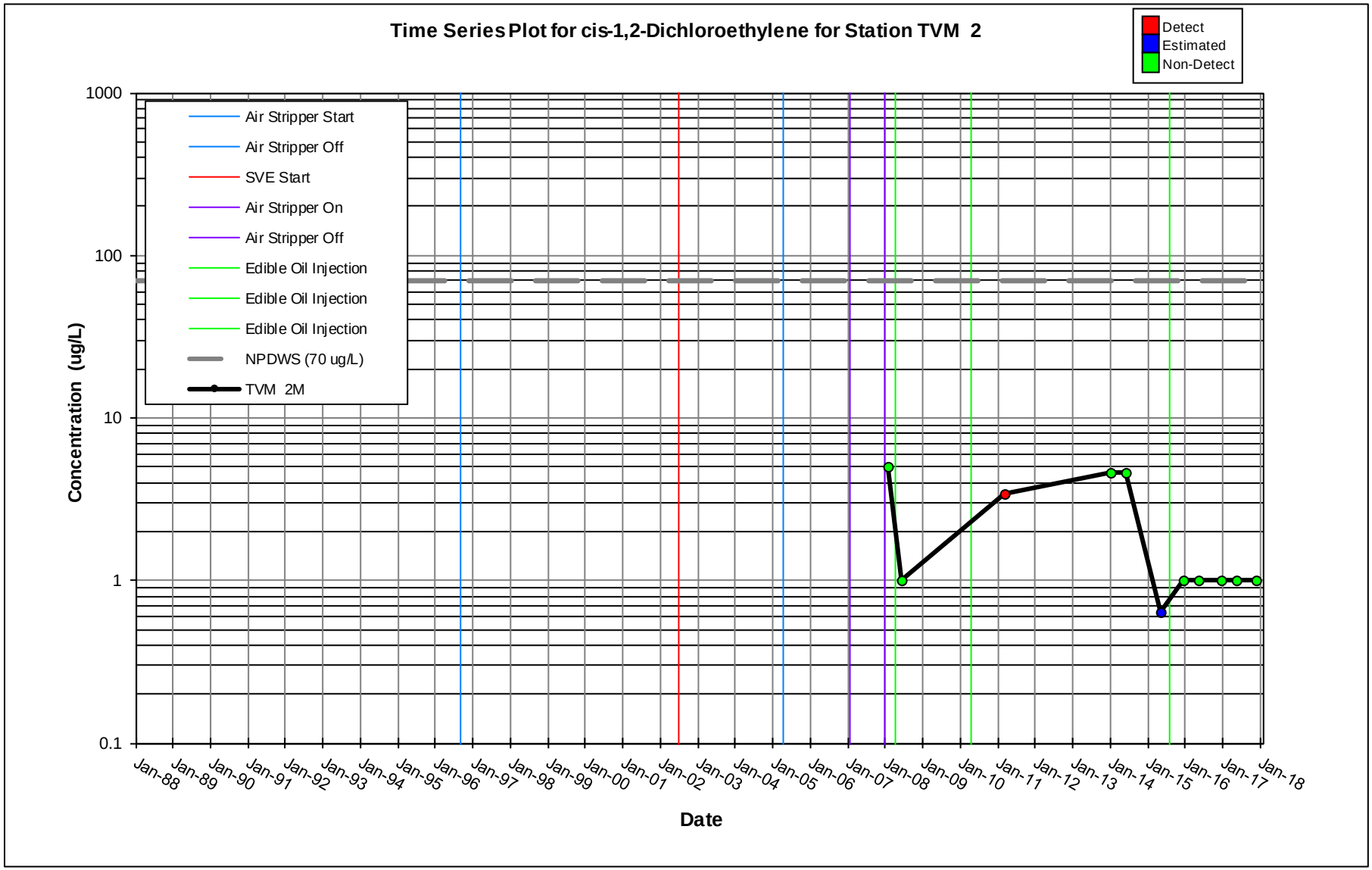
Jan-17
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TVM 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TVM 2M
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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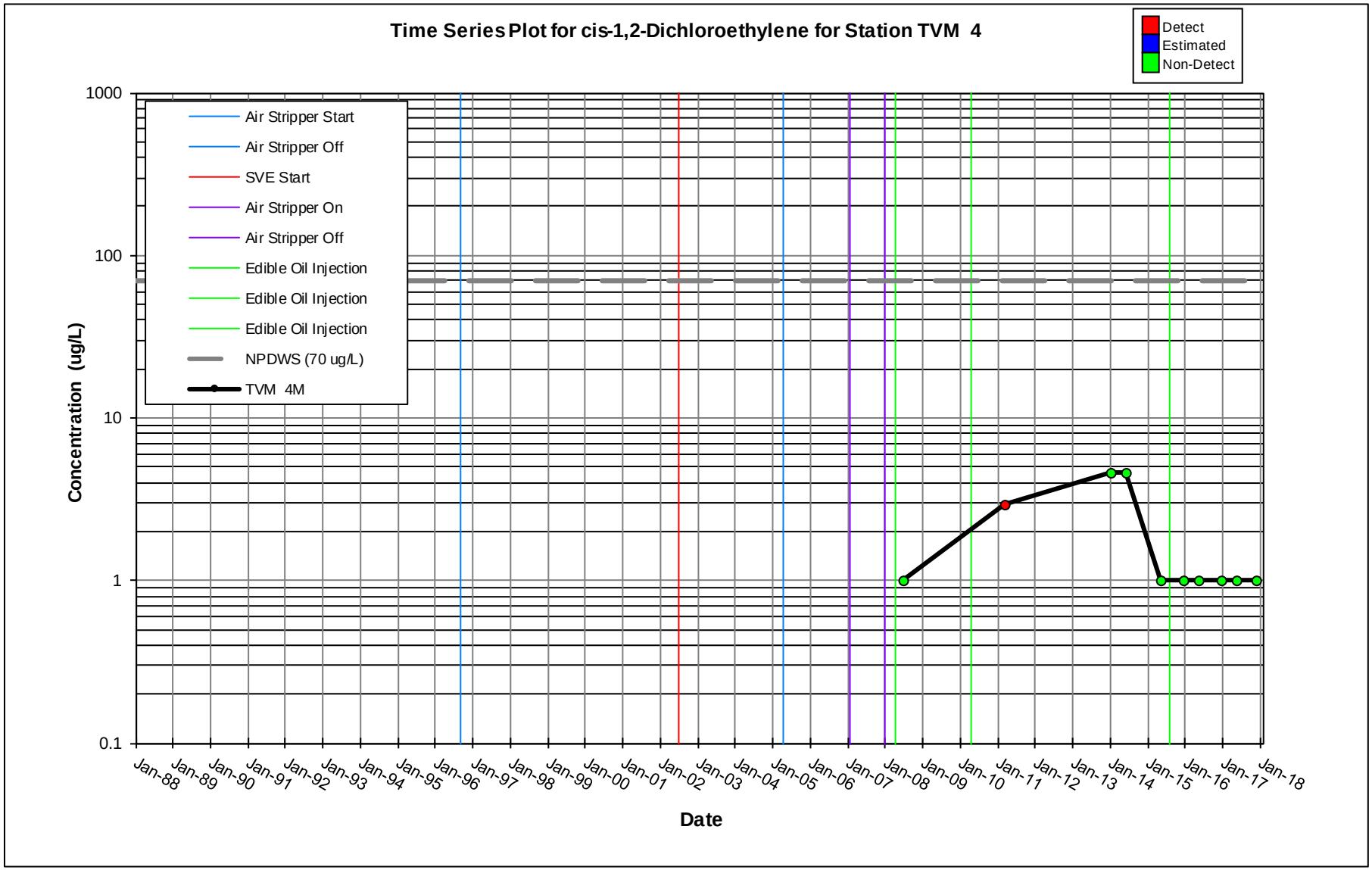
Jan-17
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TVM 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TVM 4M
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
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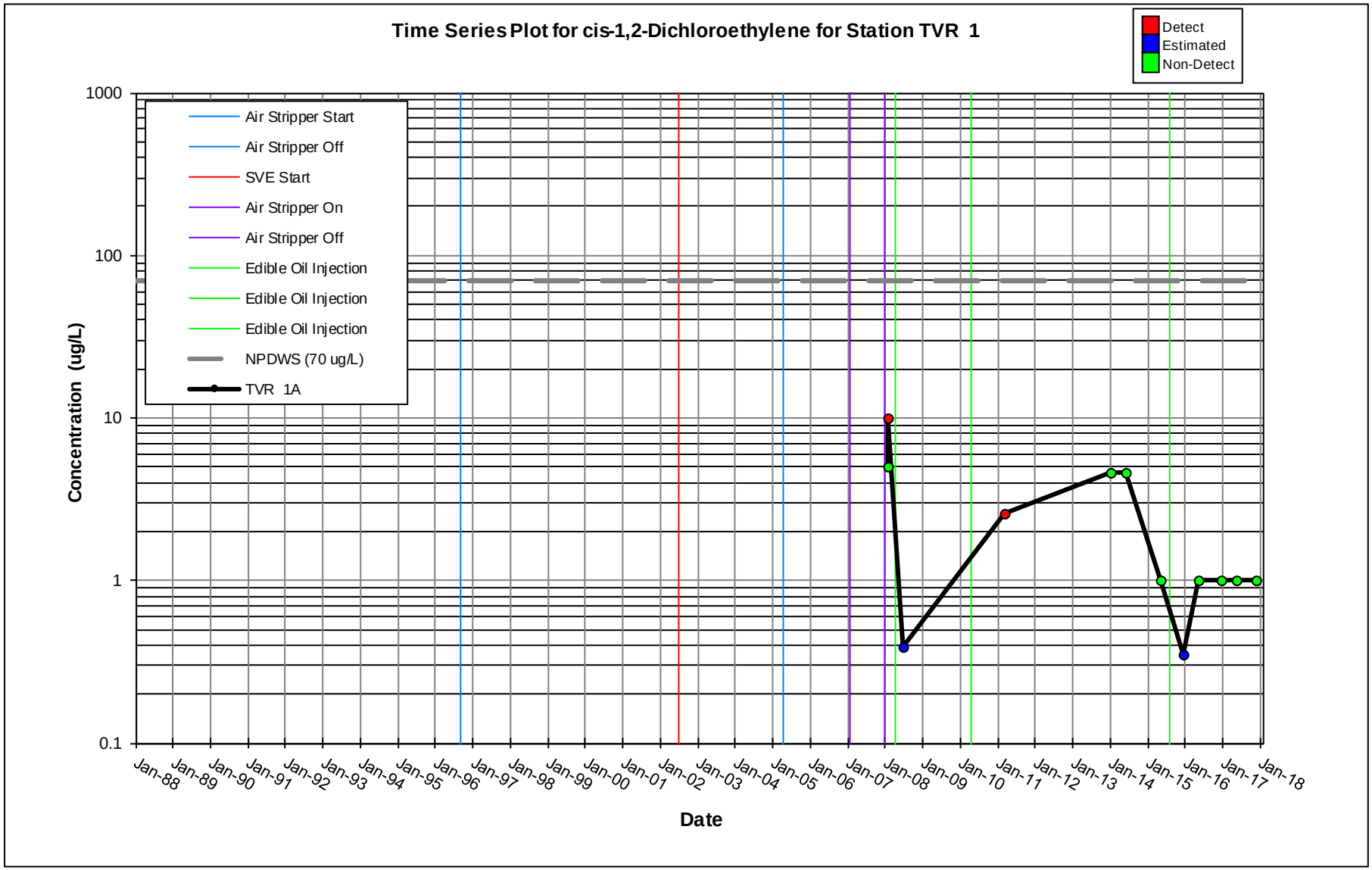
Jan-18
Date


Time Series Plot for cis-1,2-Dichloroethylene for Station TVR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (70 ug/L)
TVR 1A
Concentration (ug/L)
1000
100
10
1
0.1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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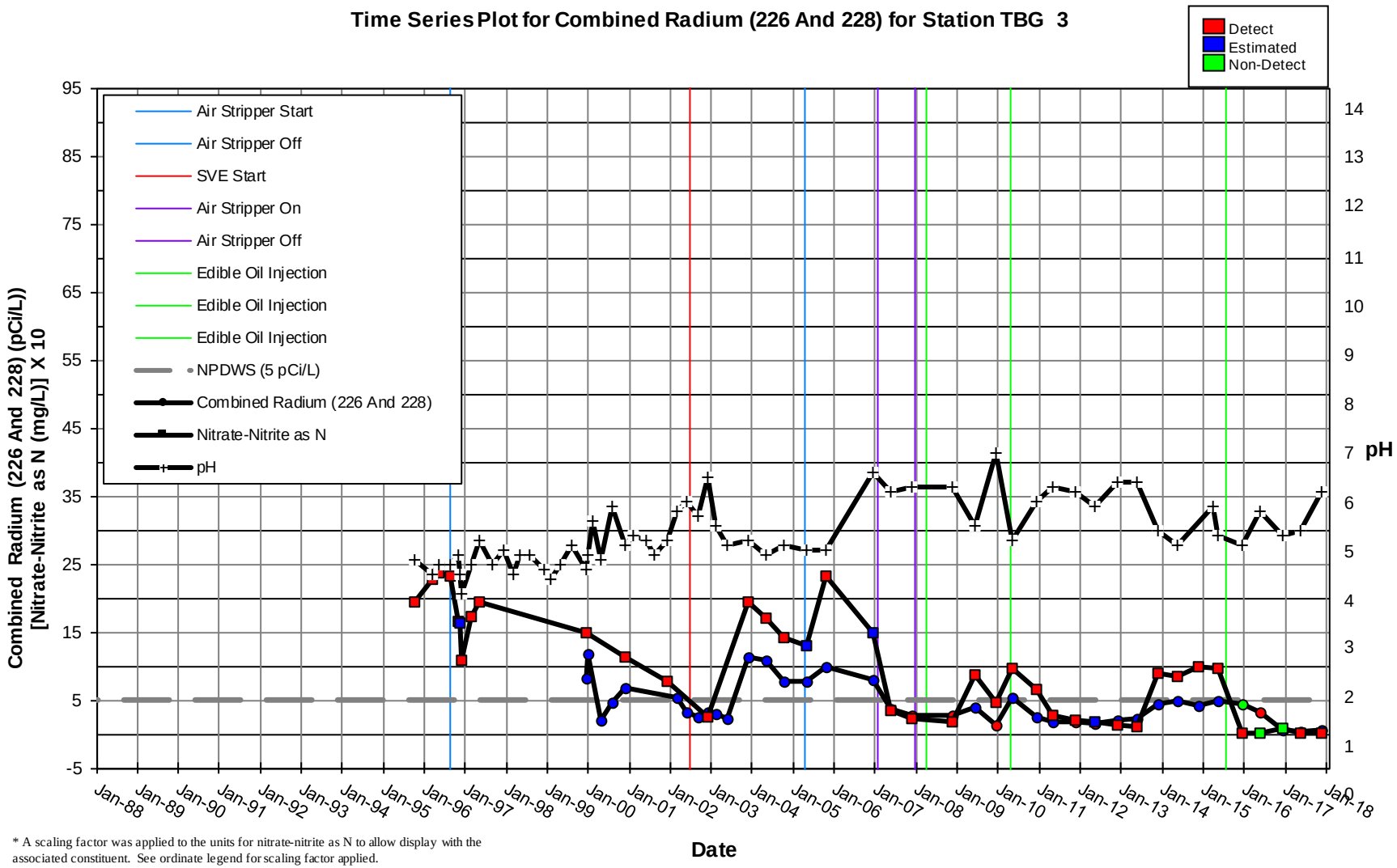
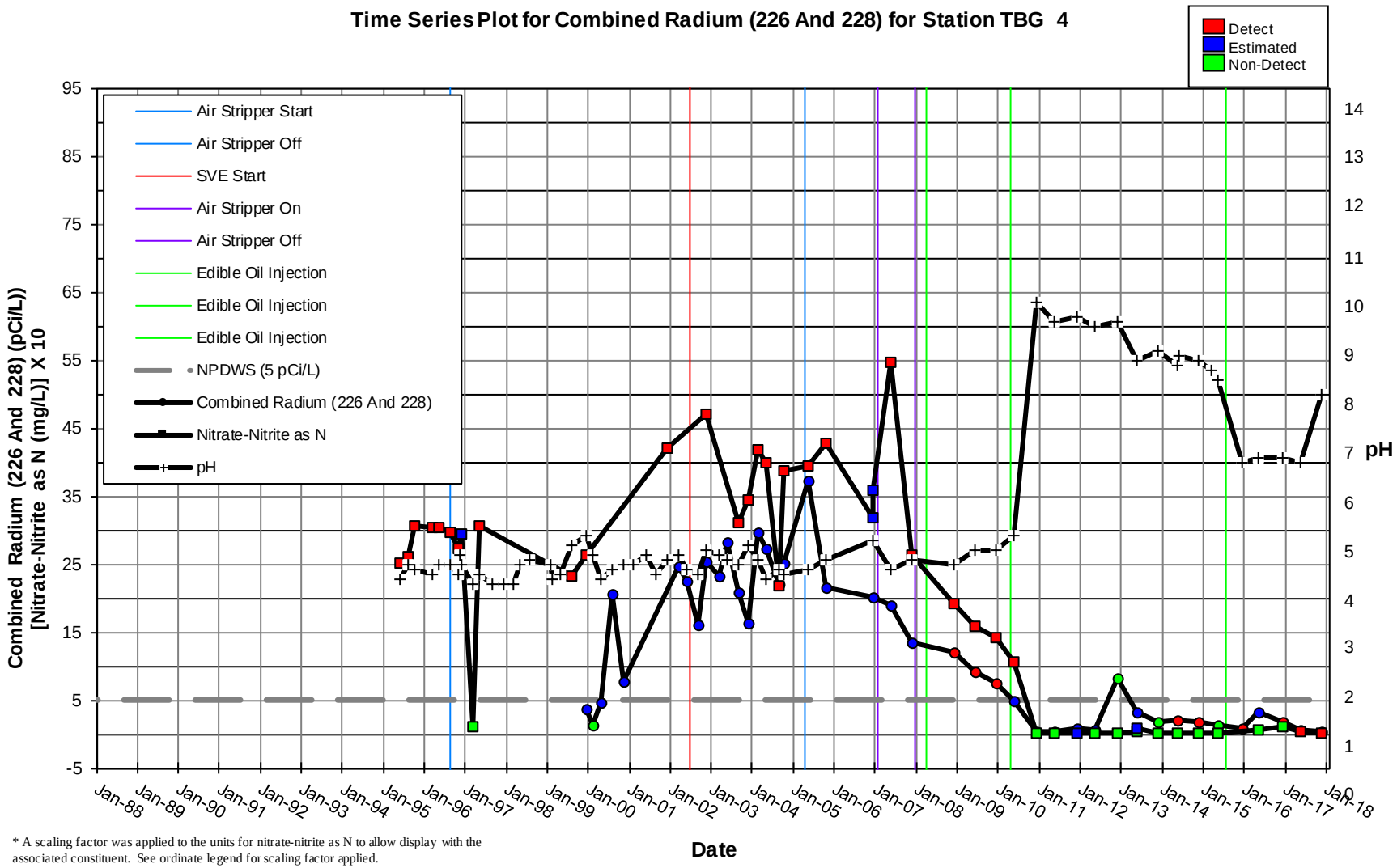
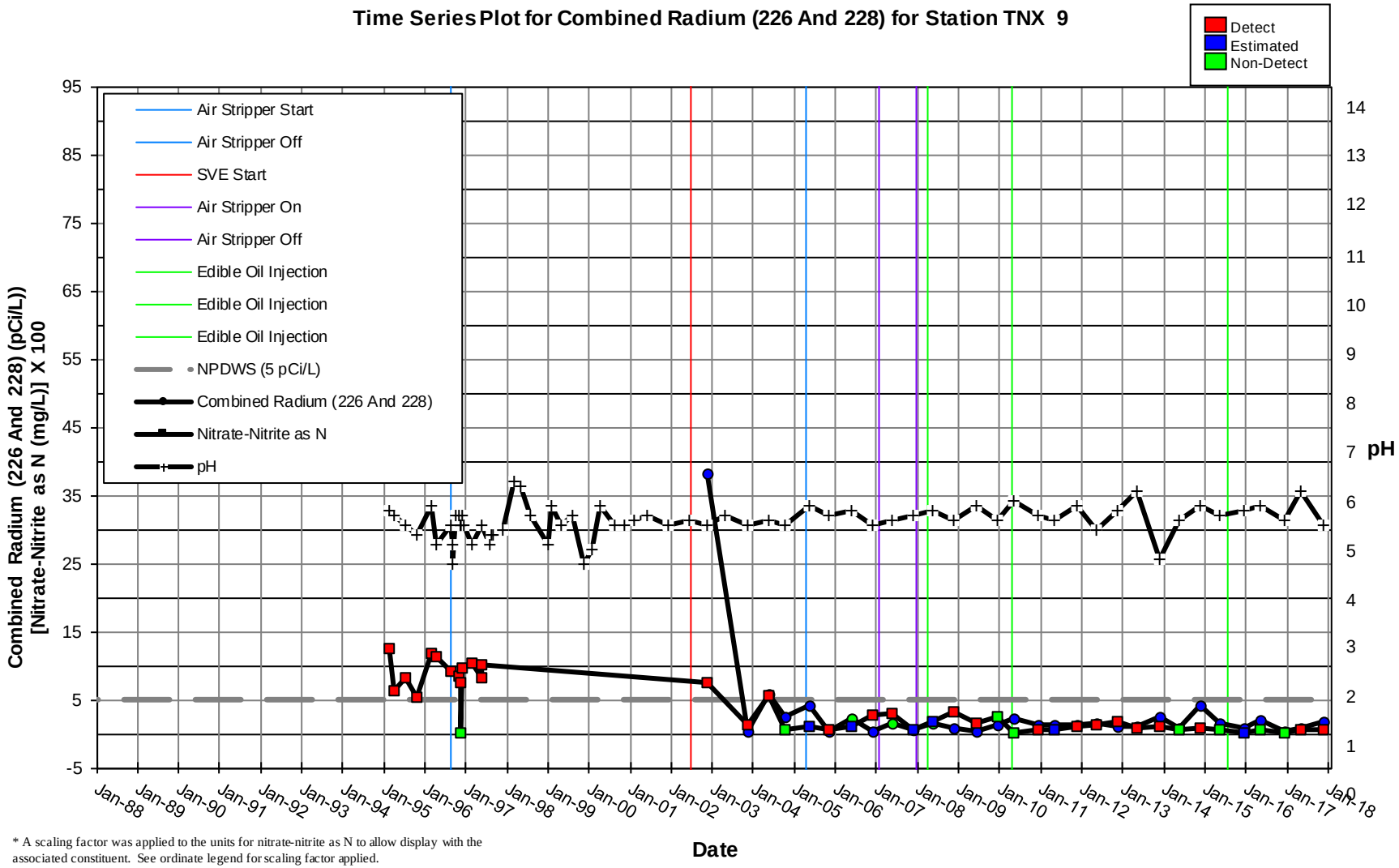
Date



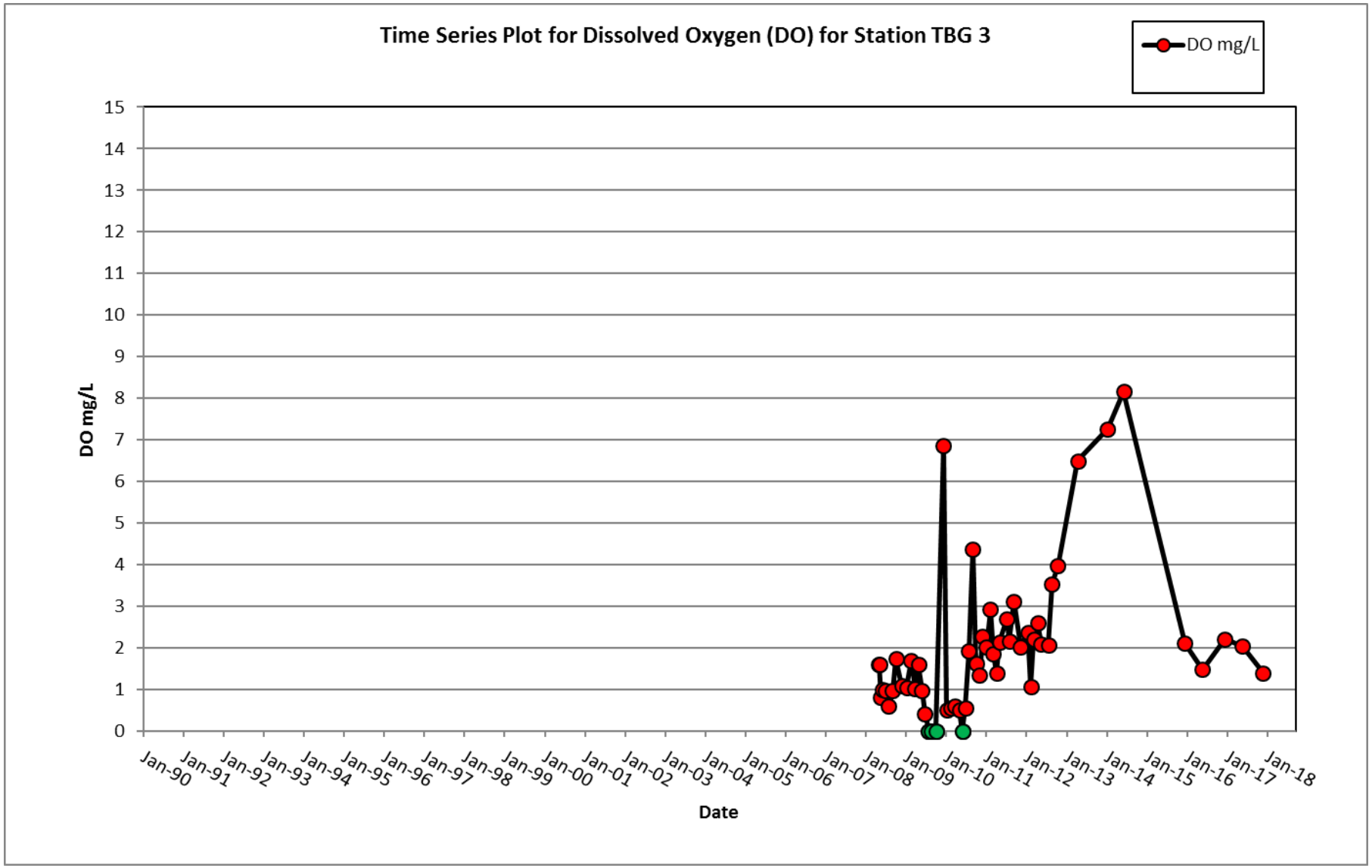
* A scaling factor was applied to the units for nitrate-nitrite as N to allow display with the associated constituent. See ordinate legend for scaling factor applied.



* A scaling factor was applied to the units for nitrate-nitrite as N to allow display with the associated constituent. See ordinate legend for scaling factor applied.



* A scaling factor was applied to the units for nitrate-nitrite as N to allow display with the associated constituent. See ordinate legend for scaling factor applied.


Time Series Plot for Dissolved Oxygen (DO) for Station TBG 3
DO mg/L
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
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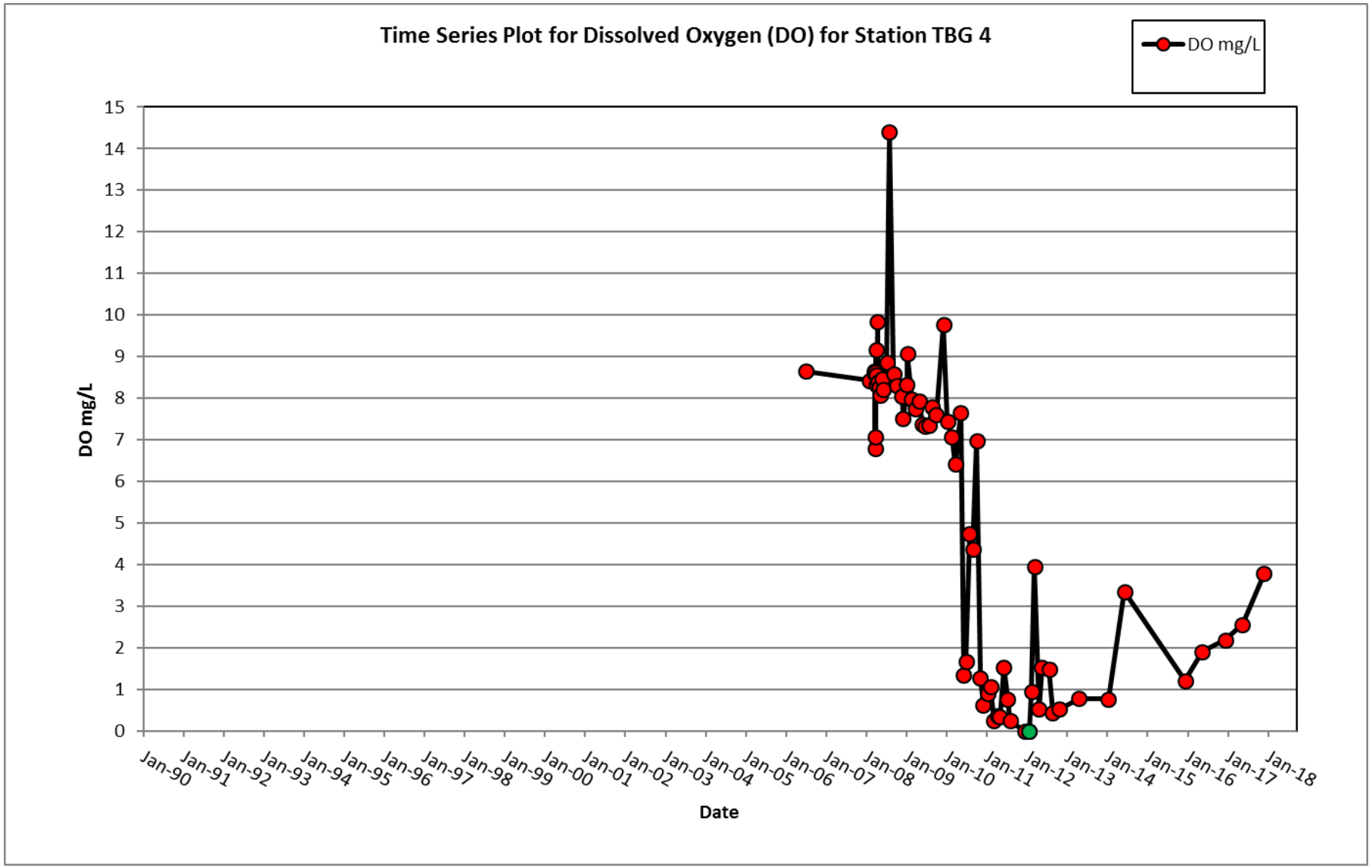
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TBG 4
DO mg/L
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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Jan-13
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Jan-15
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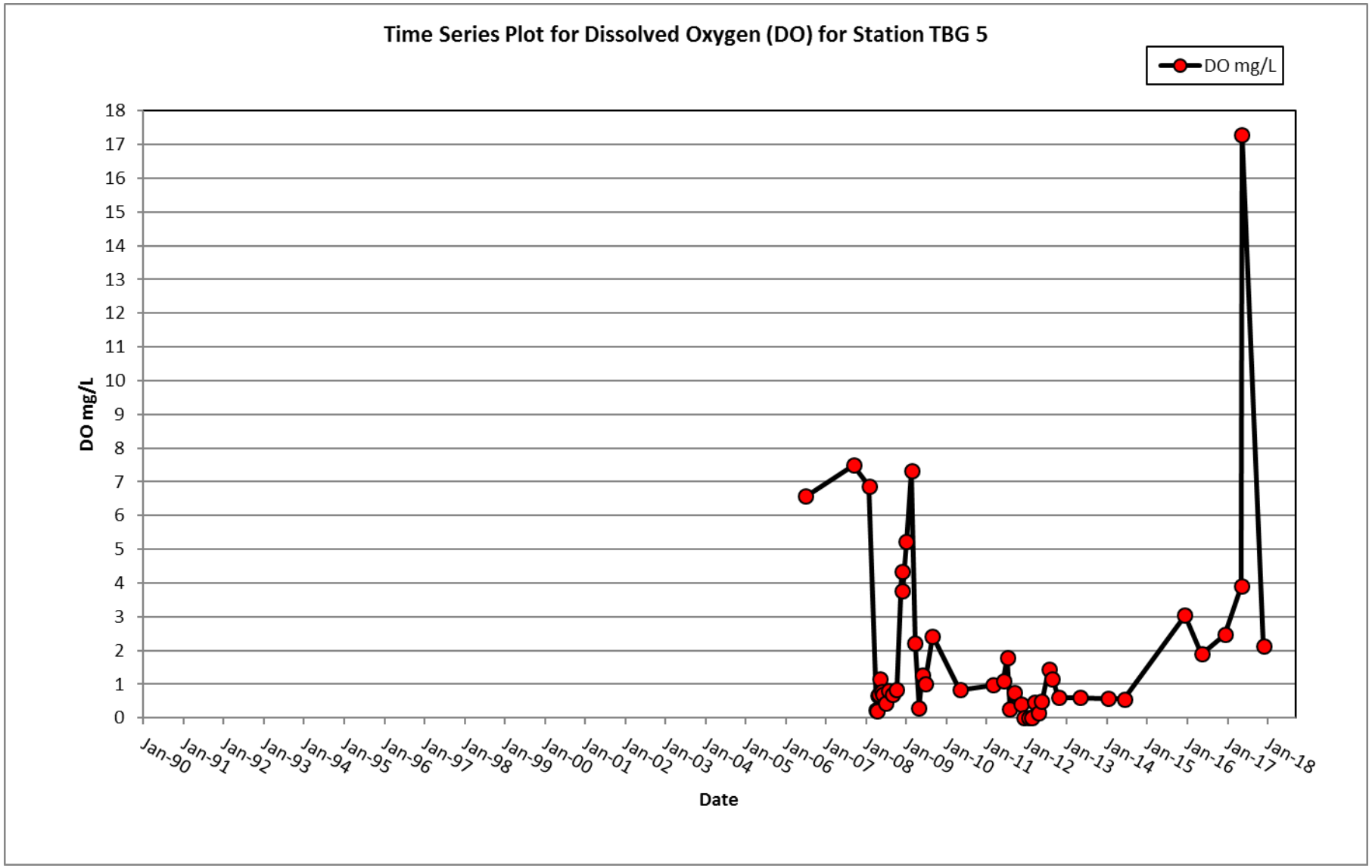
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TBG 5
DO mg/L
DO mg/L
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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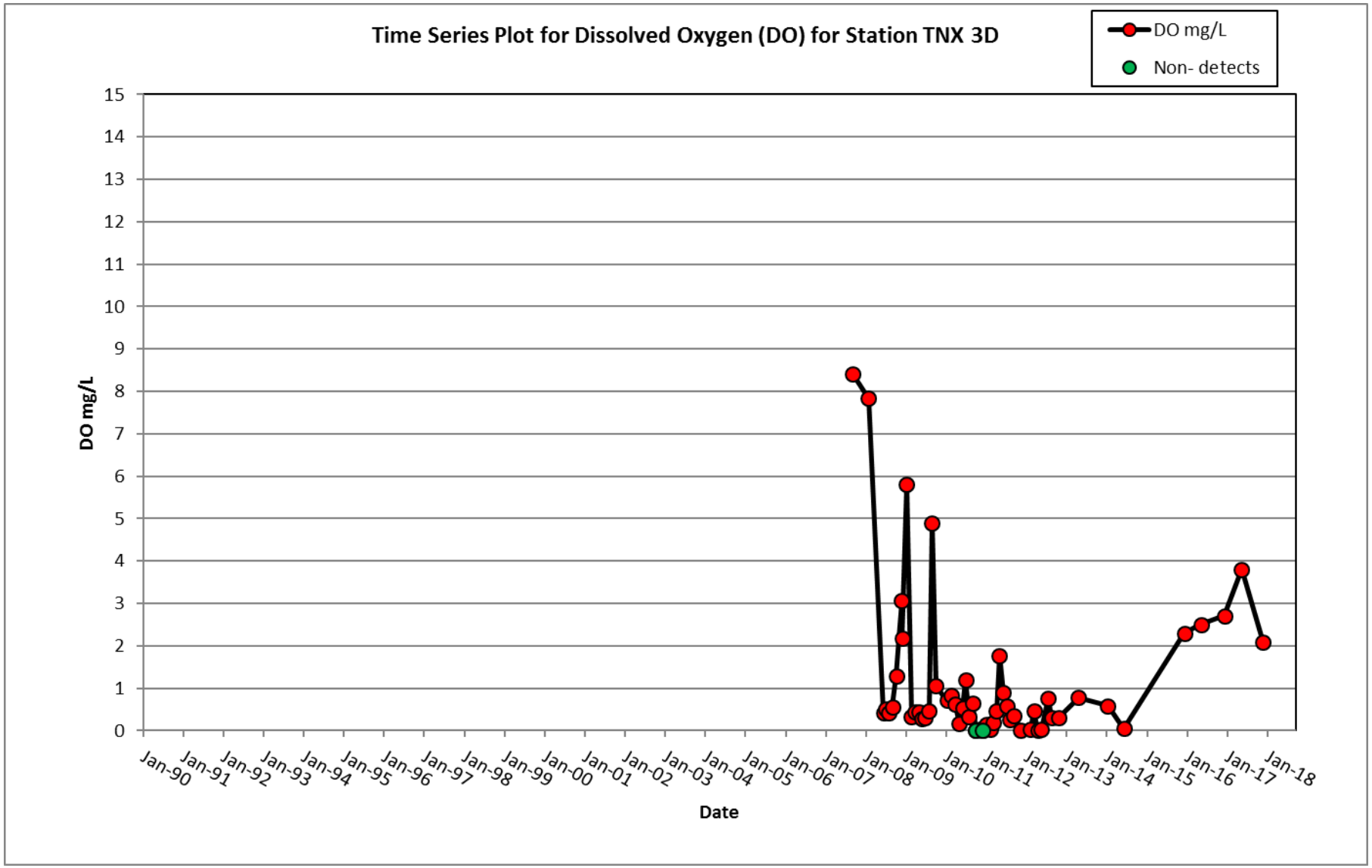
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TNX 3D
DO mg/L
Non- detects
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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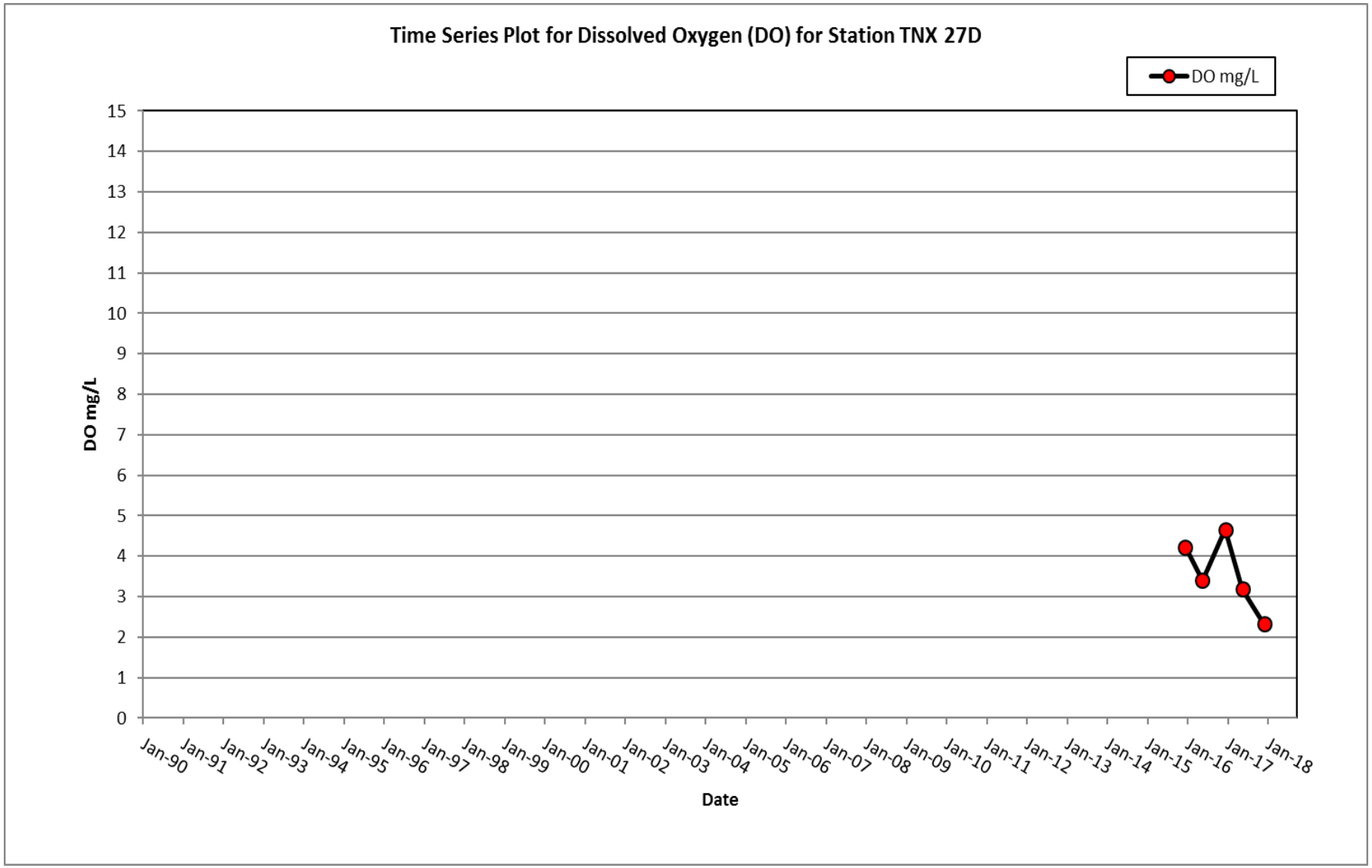
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TNX 27D
DO mg/L
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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Jan-11
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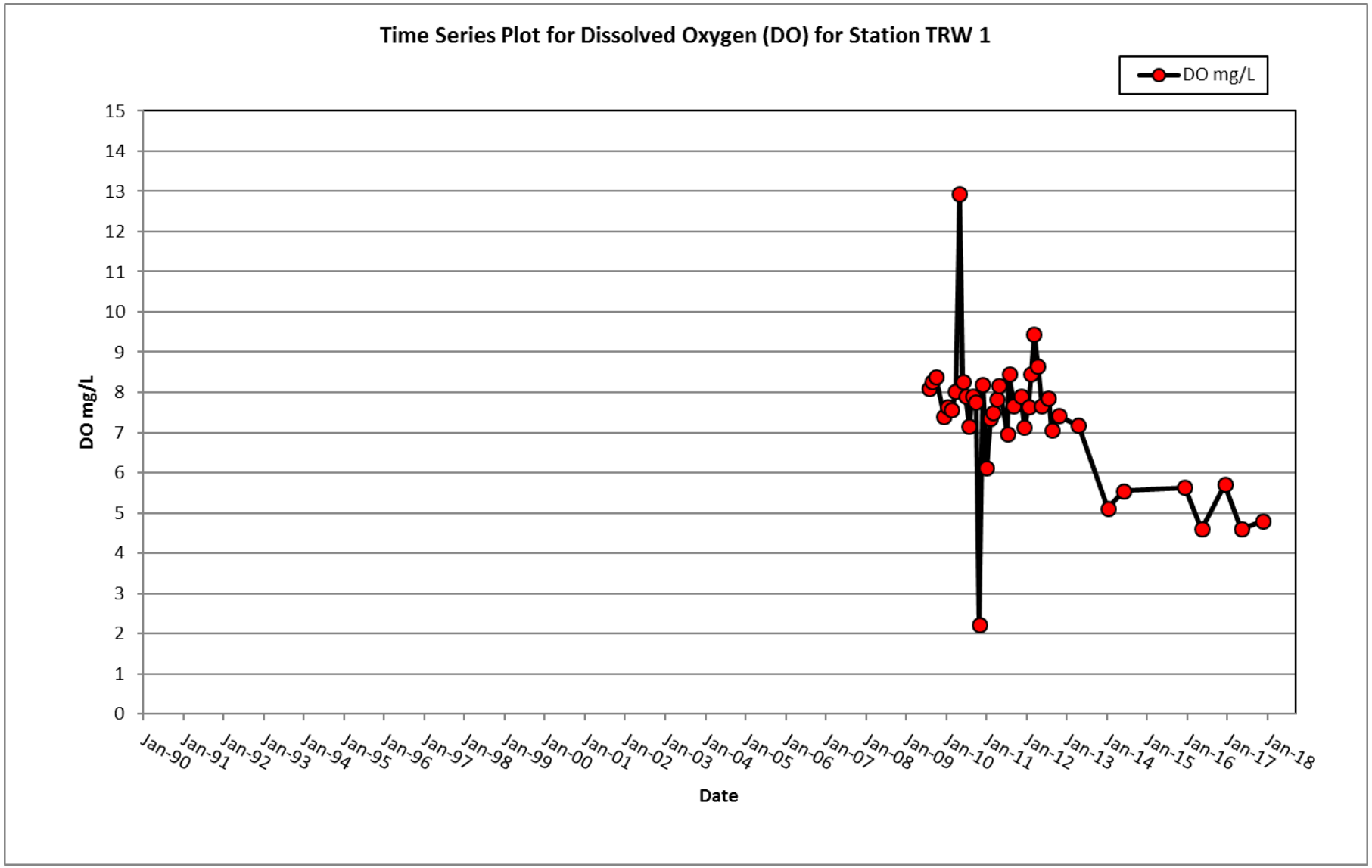
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TRW 1
DO mg/L
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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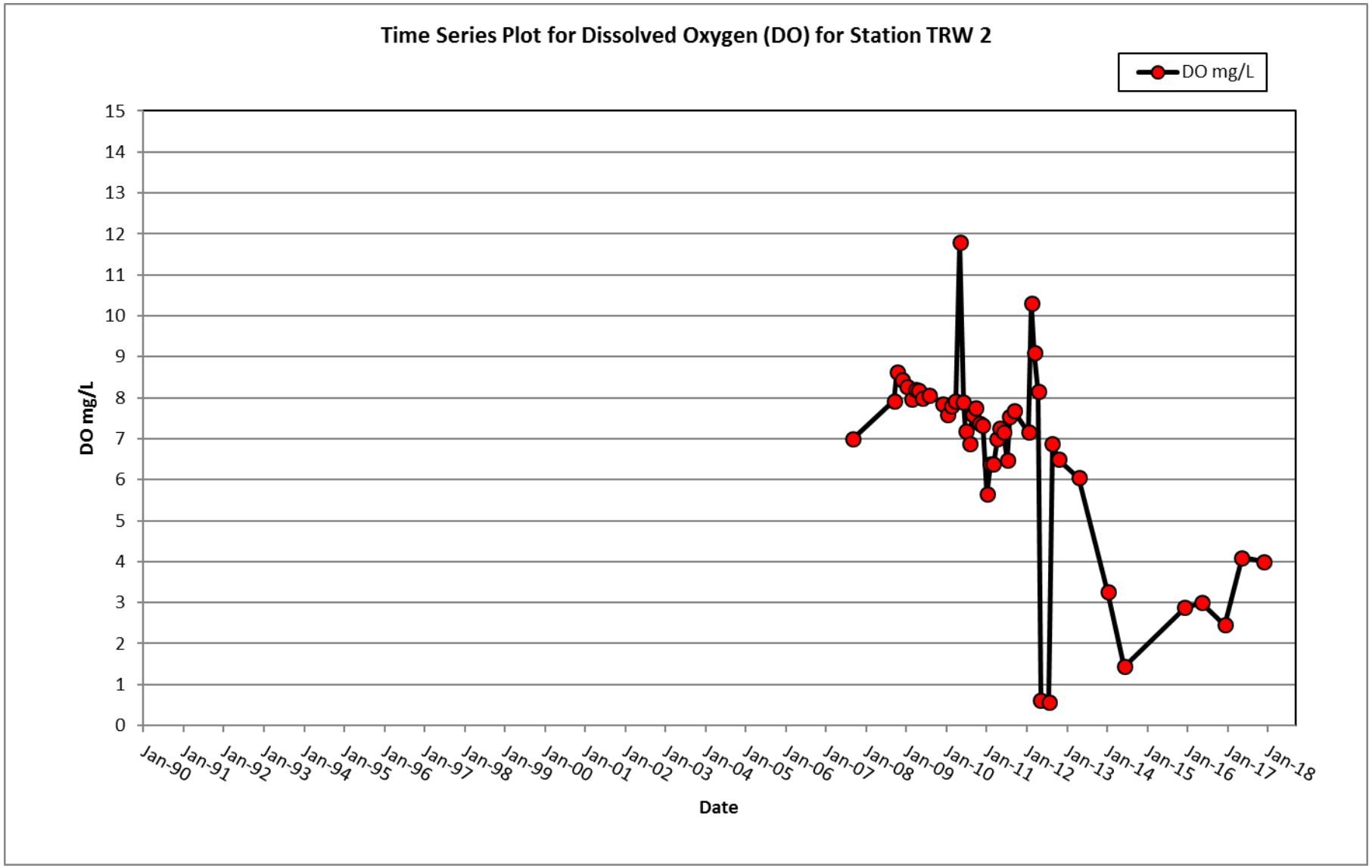
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TRW 2
DO mg/L
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
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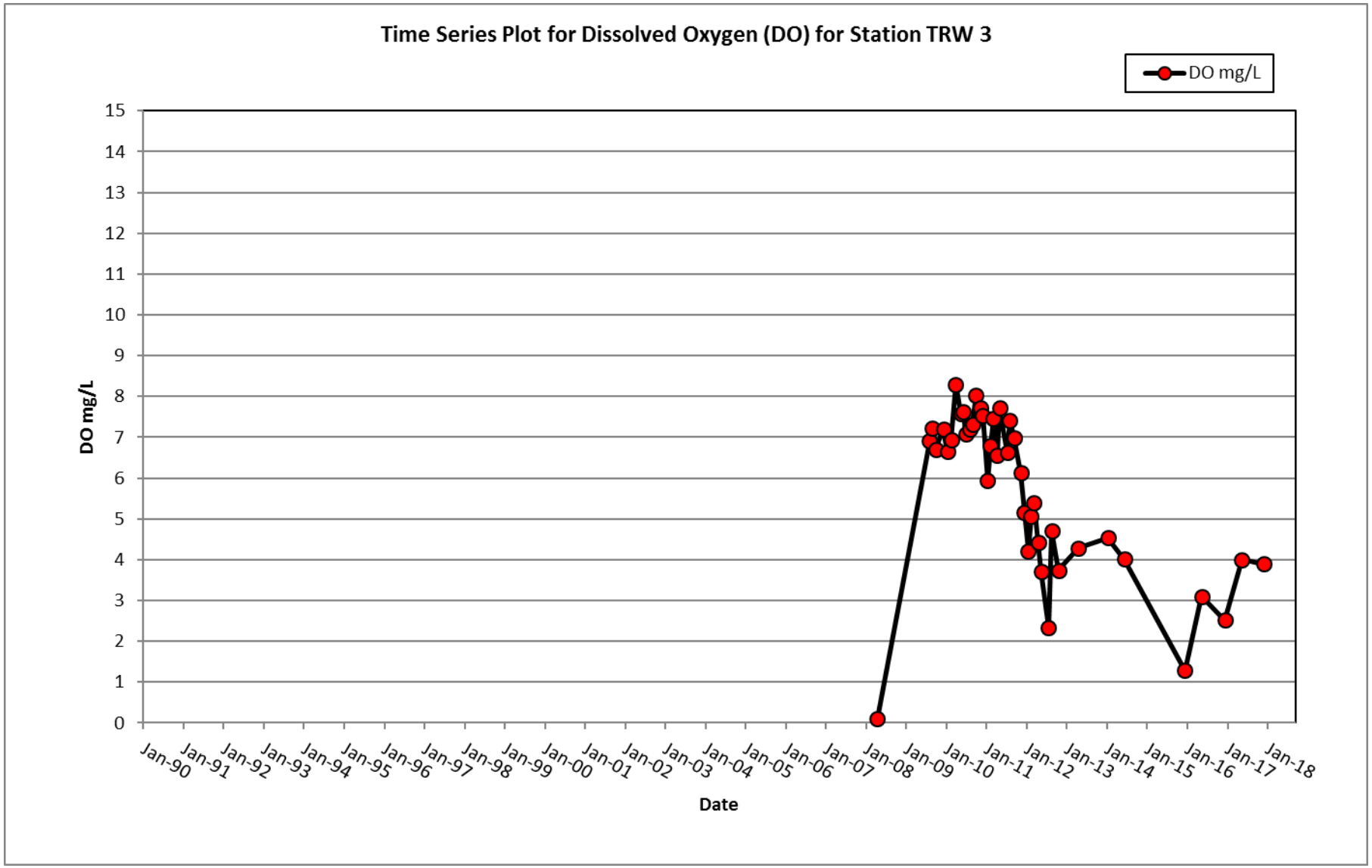
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TRW 3
DO mg/L
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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Jan-10
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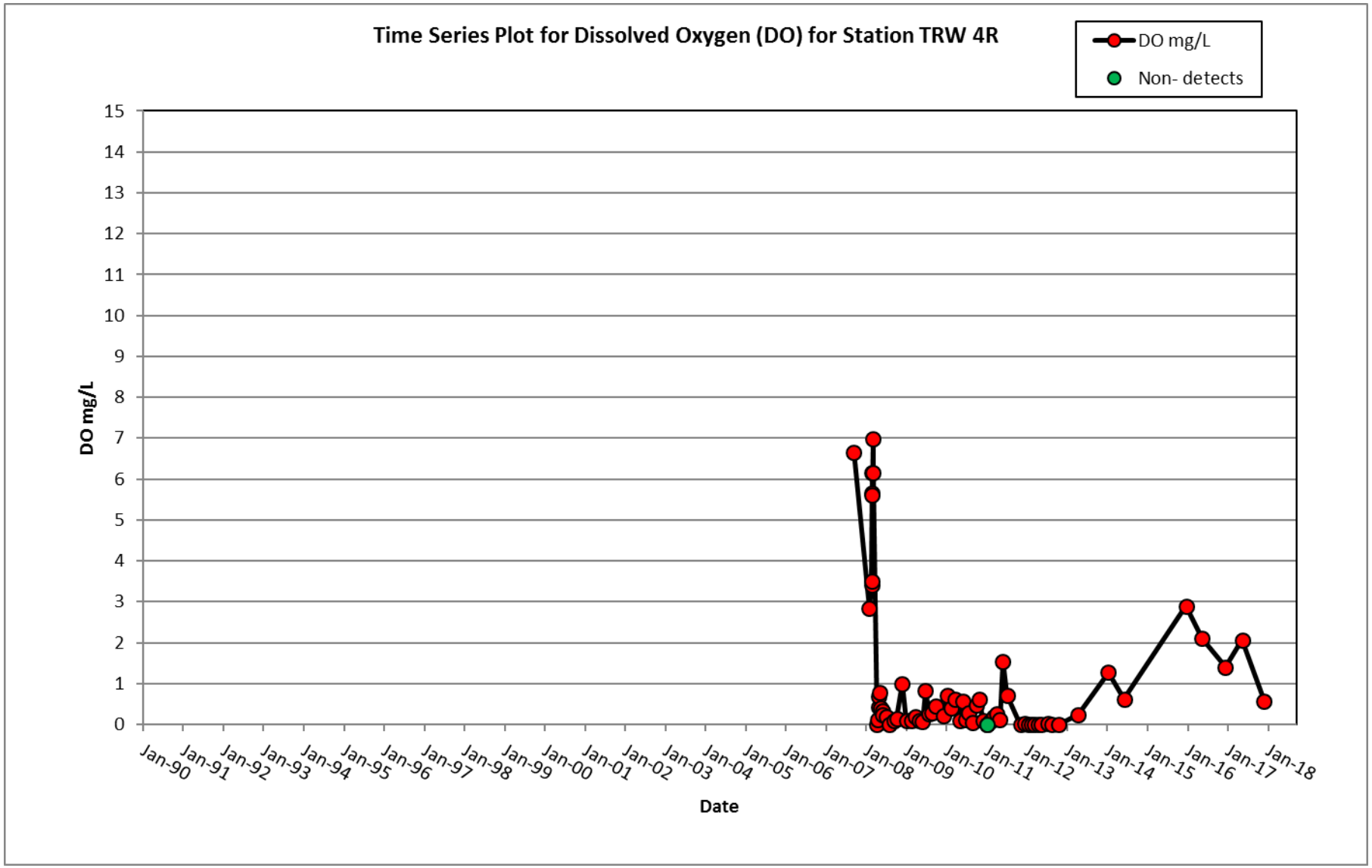
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TRW 4R
DO mg/L
Non- detects
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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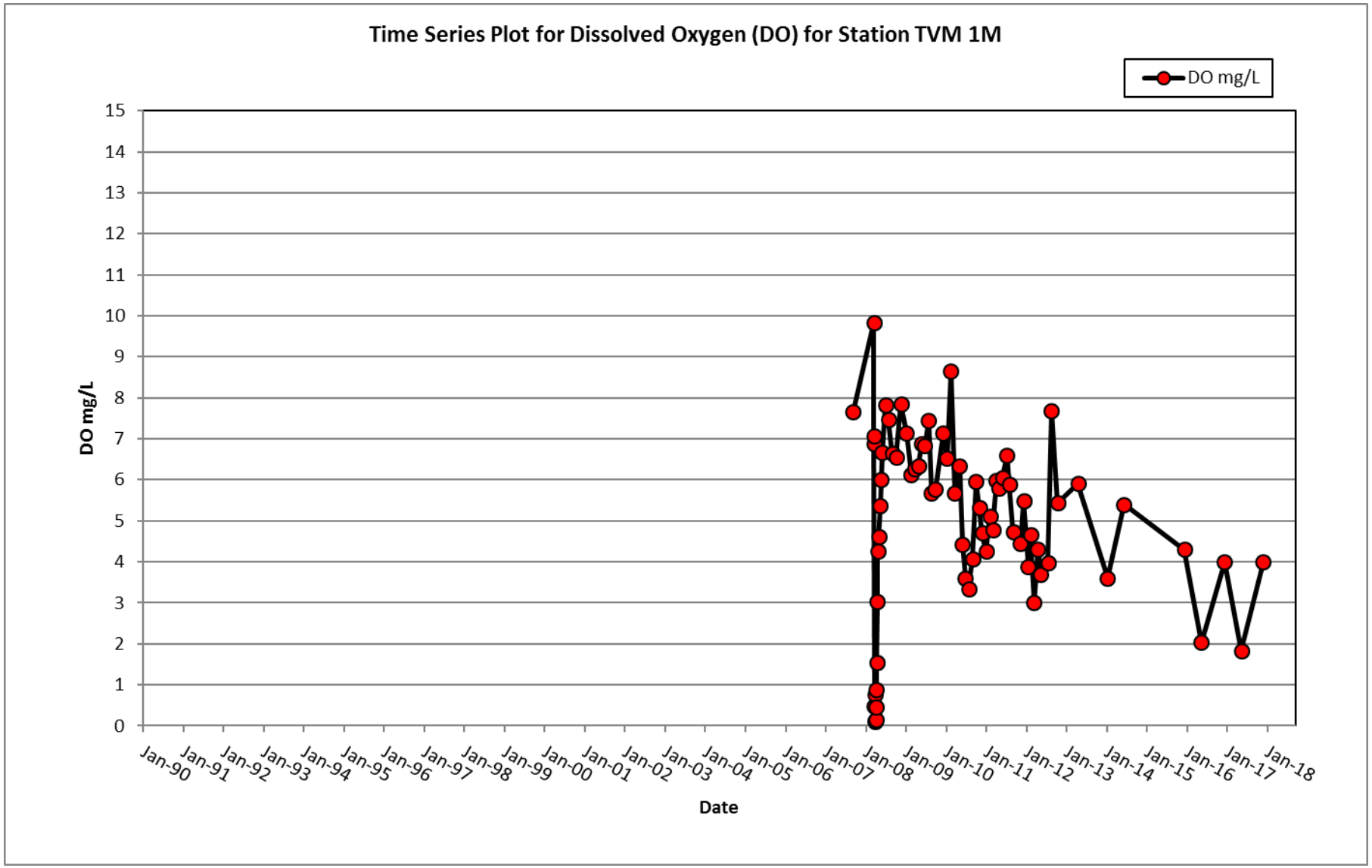
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TVM 1M
DO mg/L
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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Jan-09
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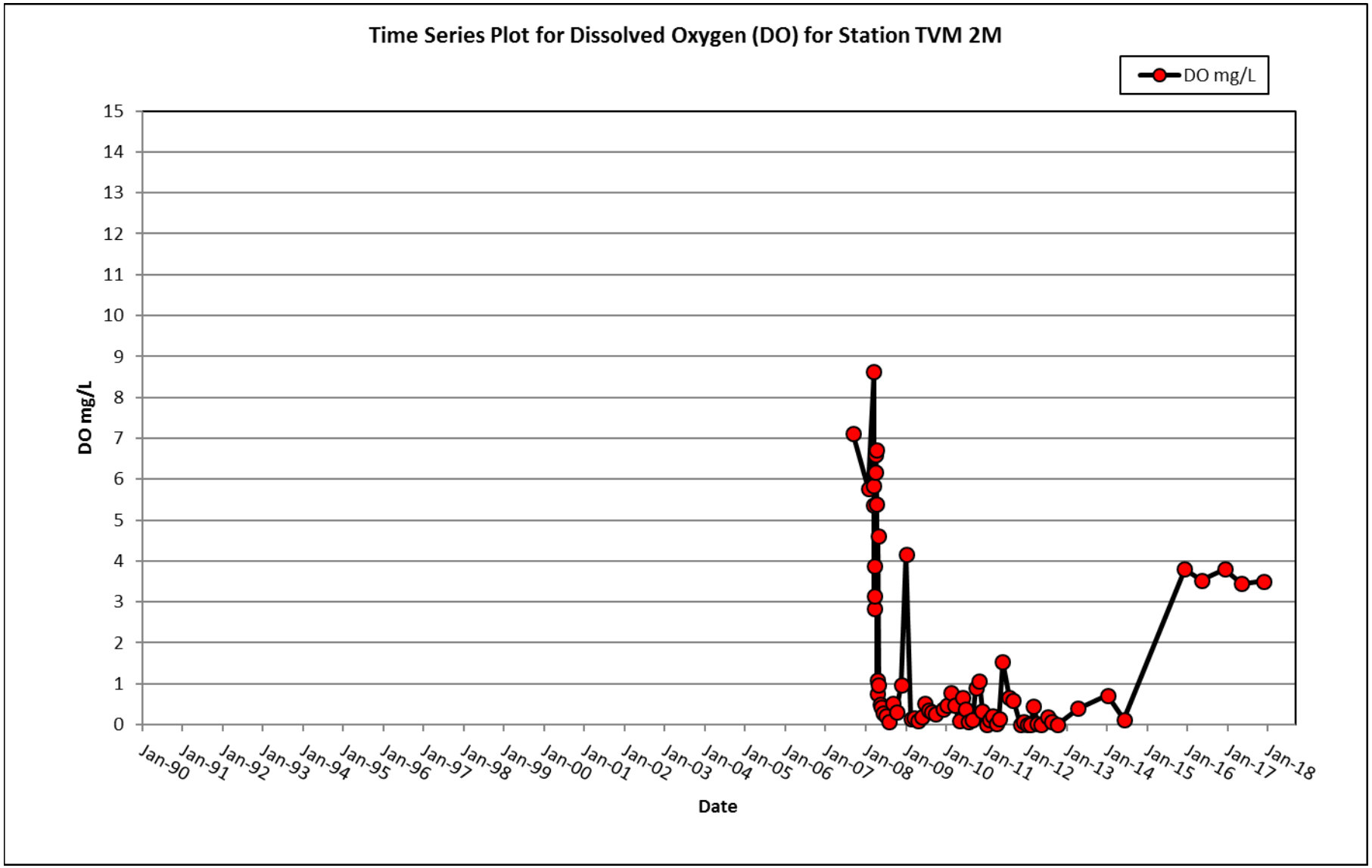
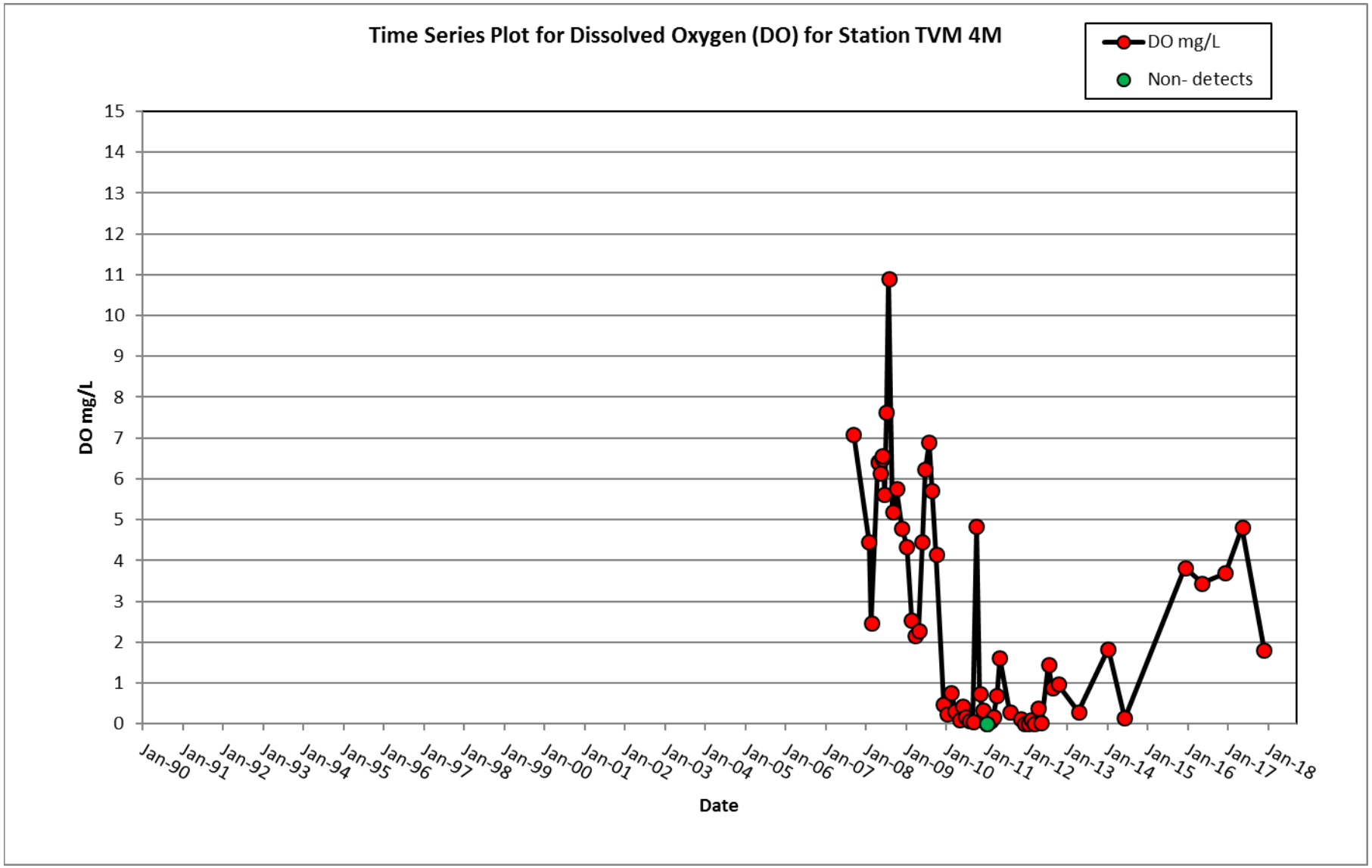
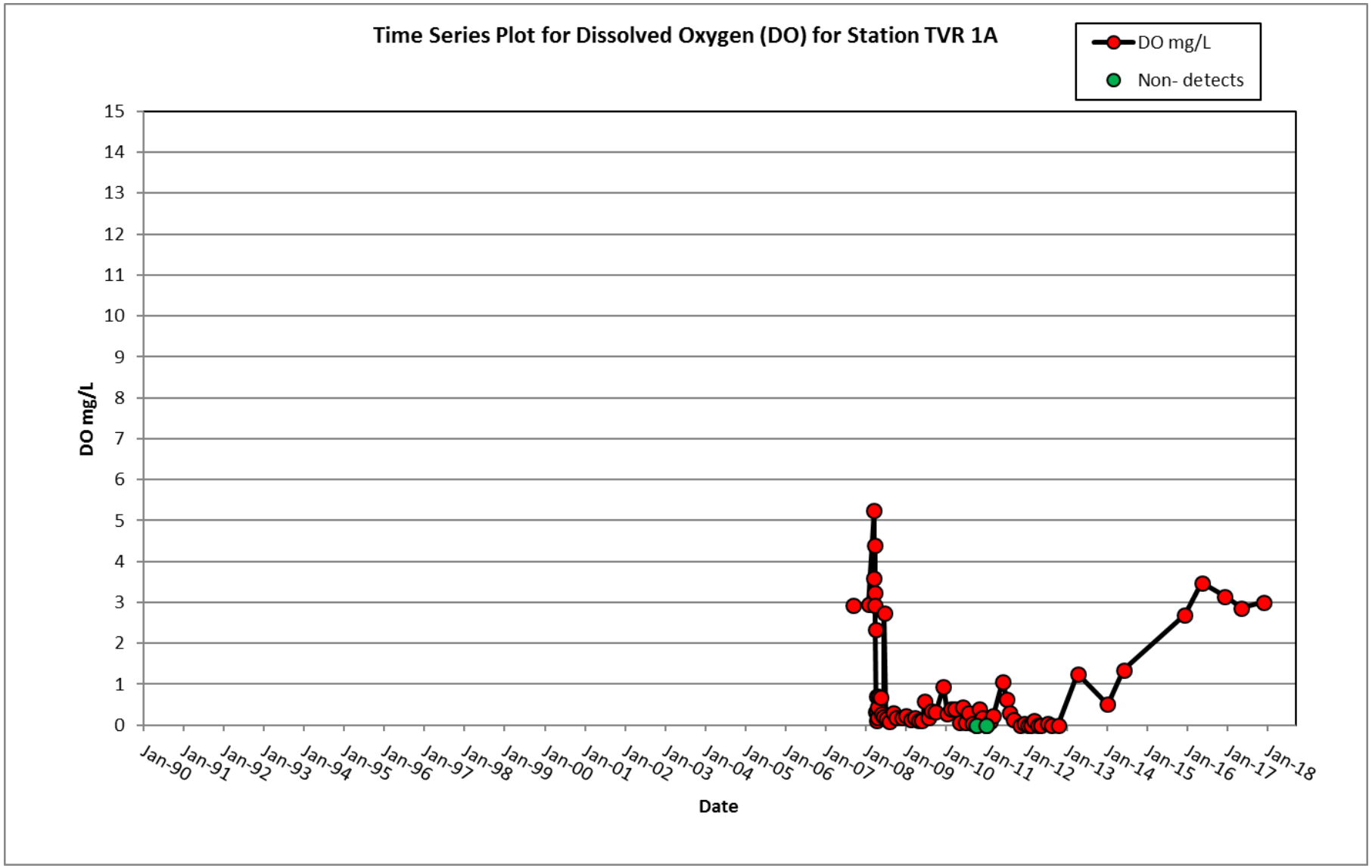
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TVM 2M
DO mg/L
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TVM 4M
DO mg/L
Non- detects
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Dissolved Oxygen (DO) for Station TVR 1A
DO mg/L
Non- detects
DO mg/L
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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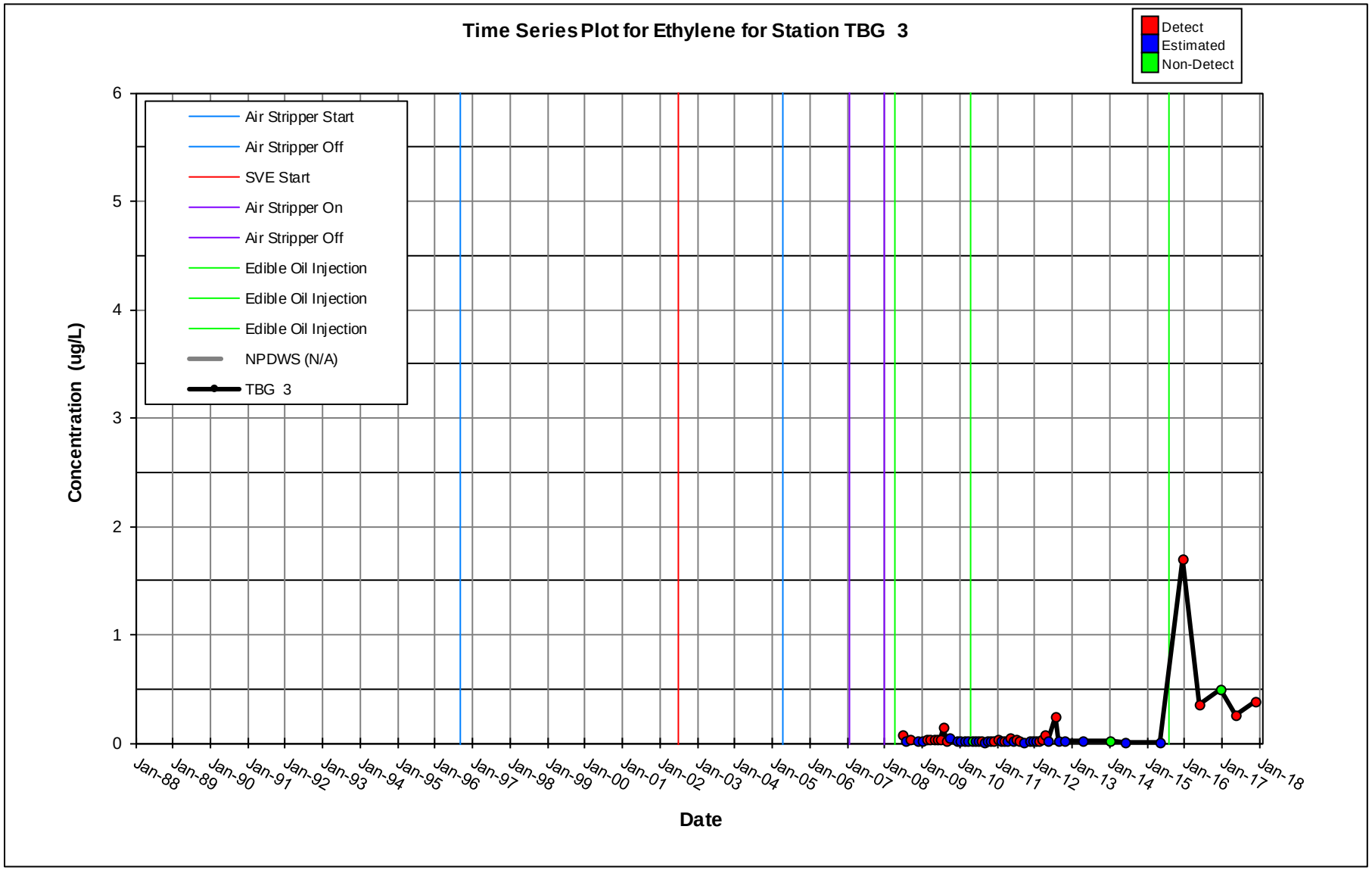
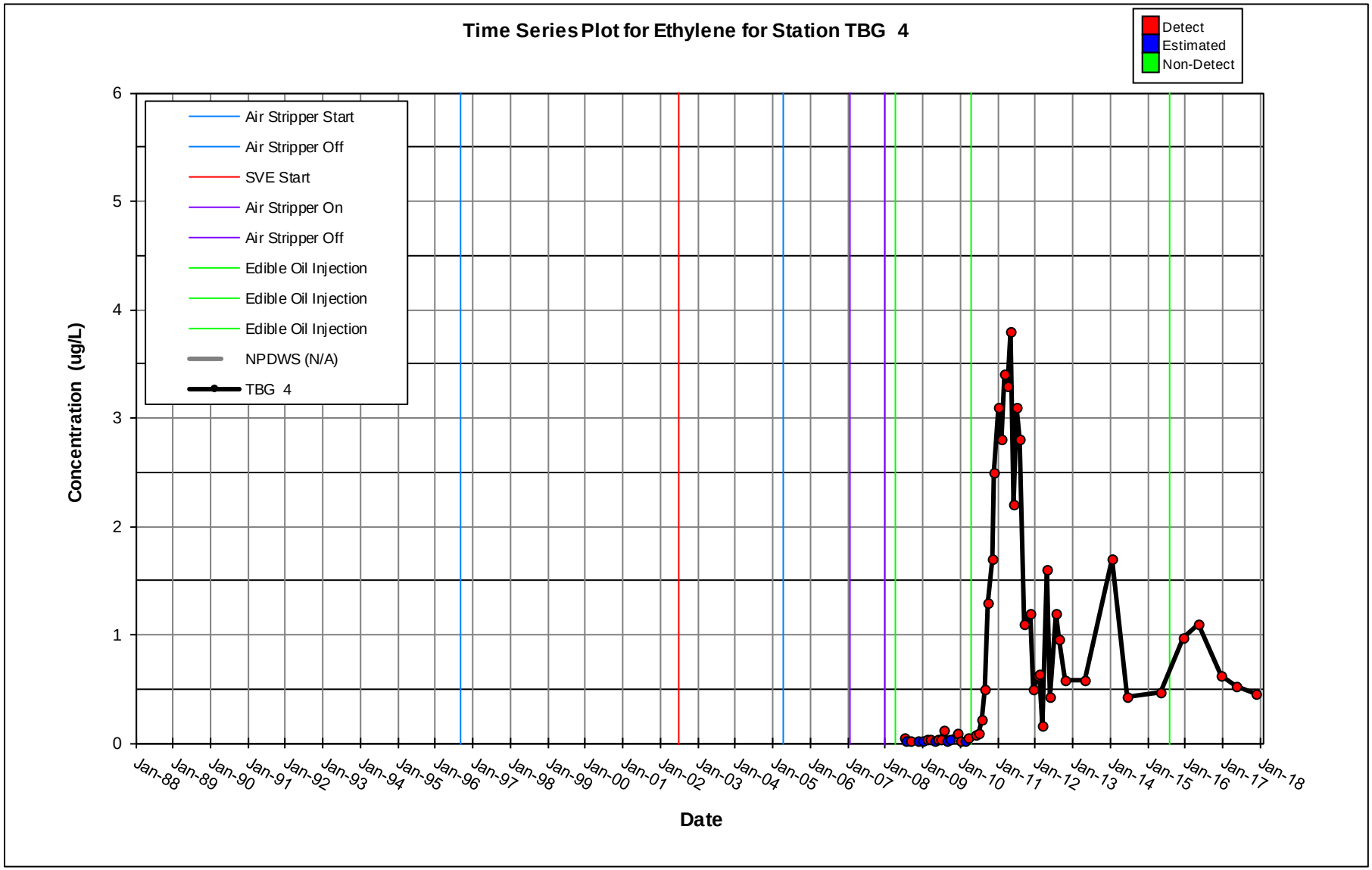
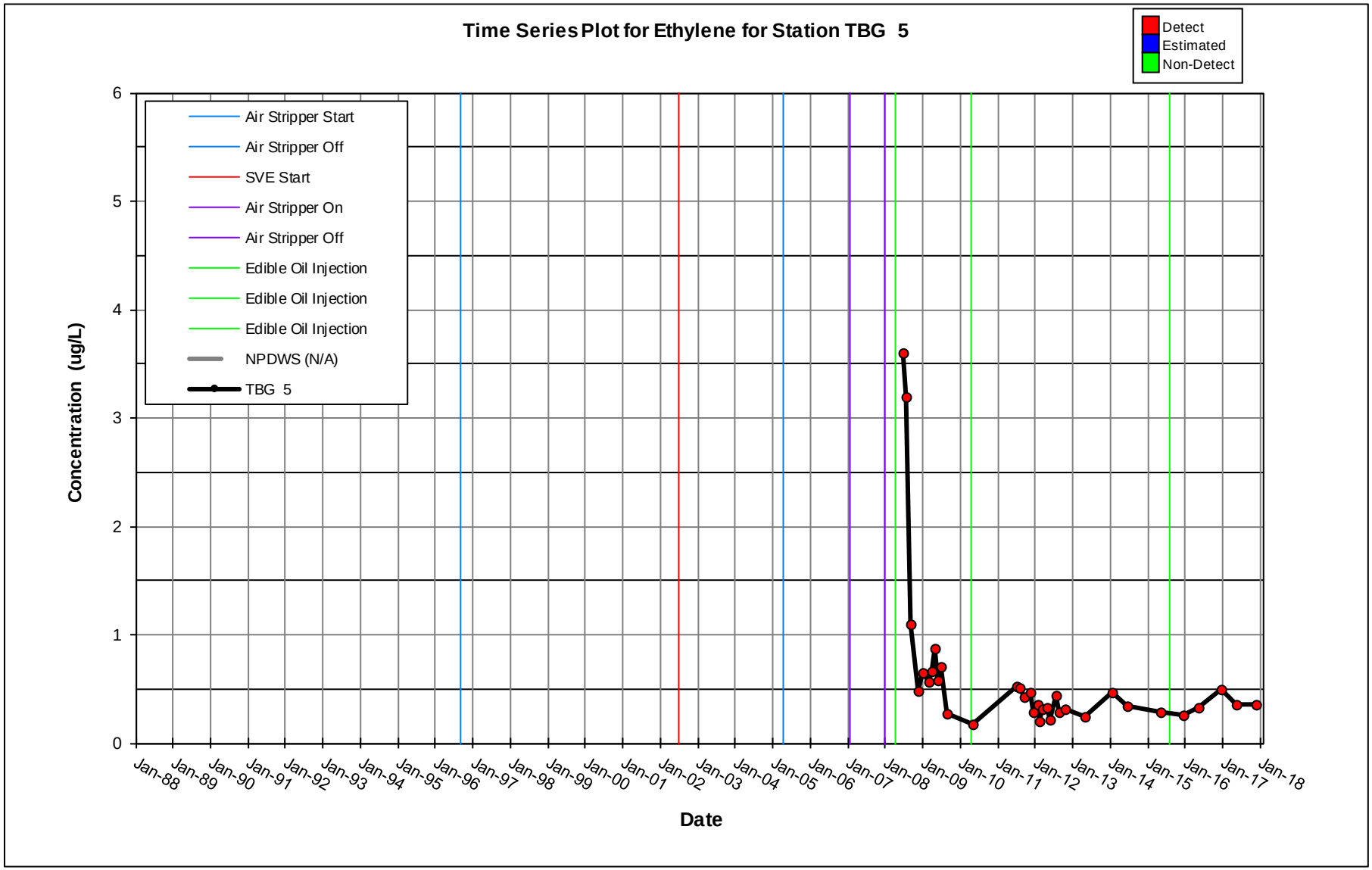
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TBG 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TBG 3
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TBG 4
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TBG 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TBG 5
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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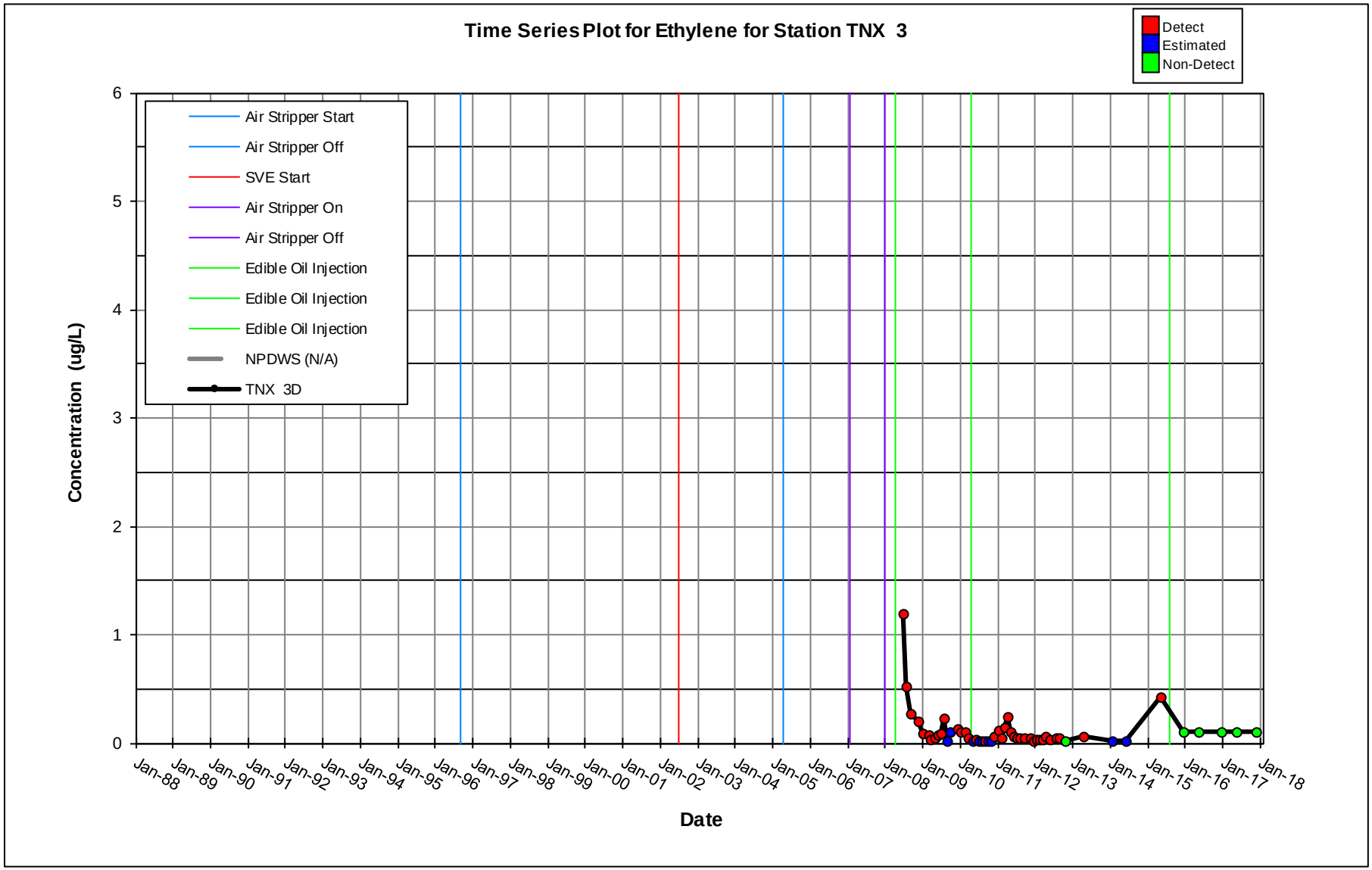
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TNX 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TNX 3D
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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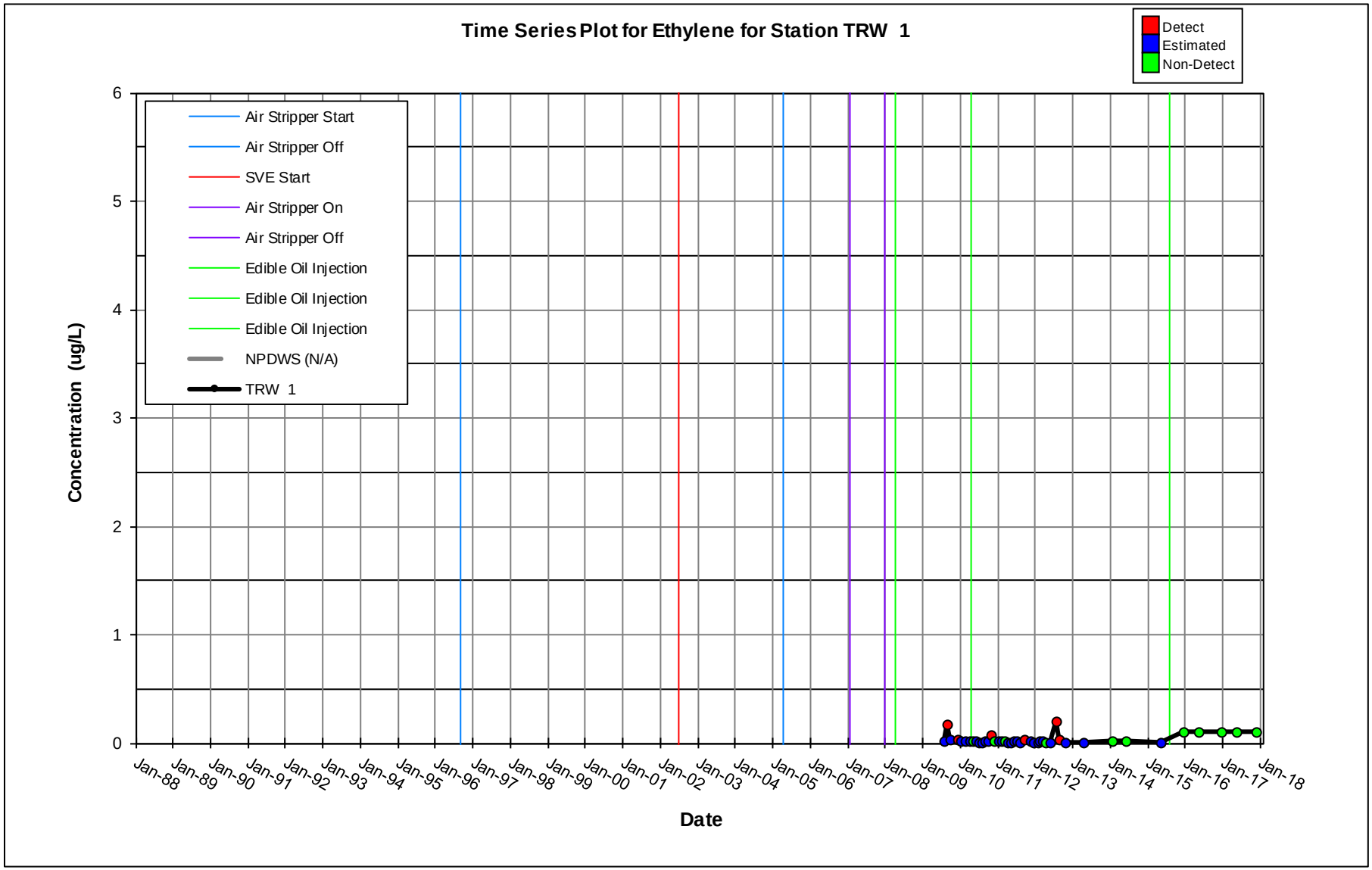
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TRW 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TRW 1
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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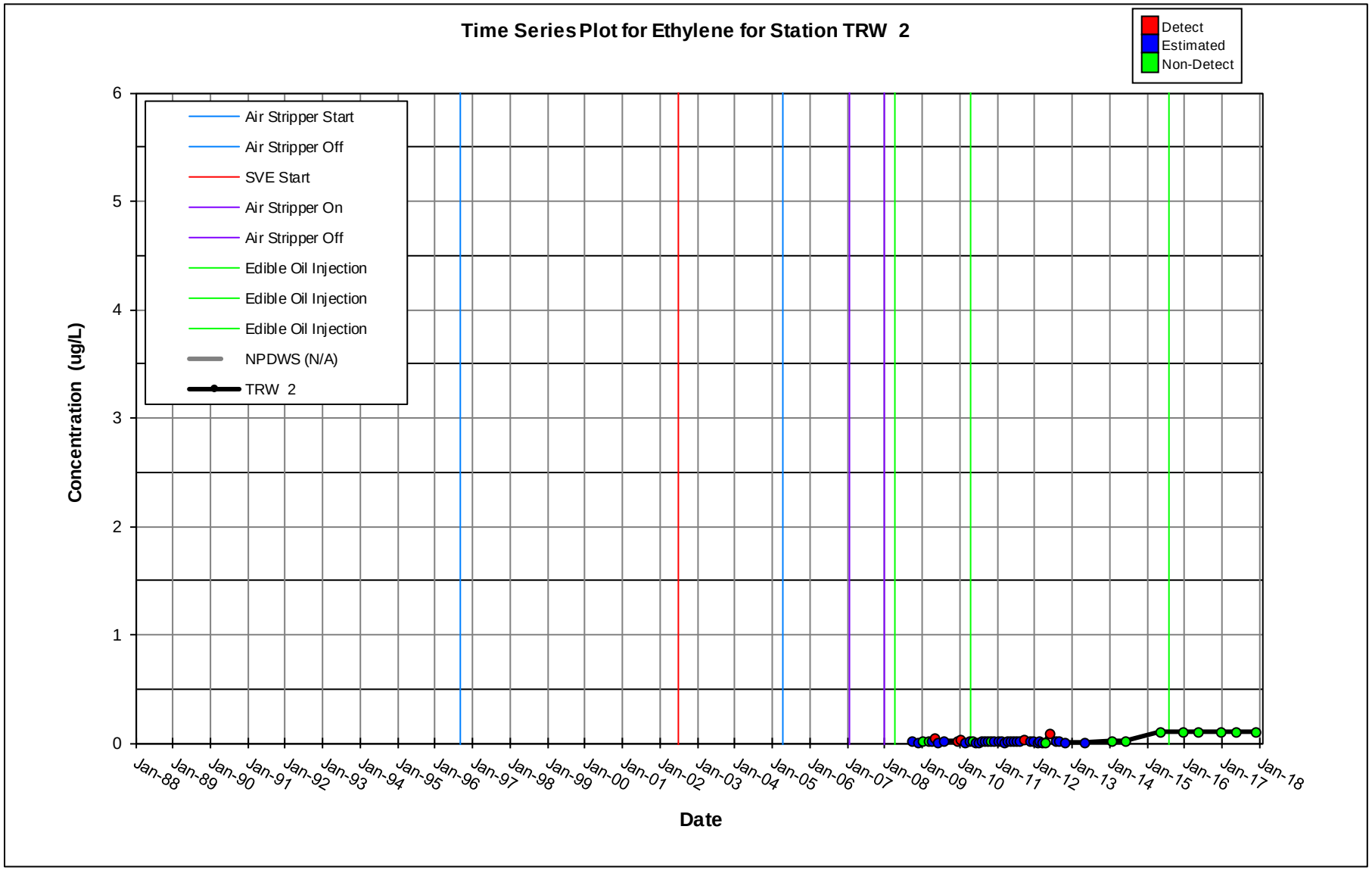
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TRW 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TRW 2
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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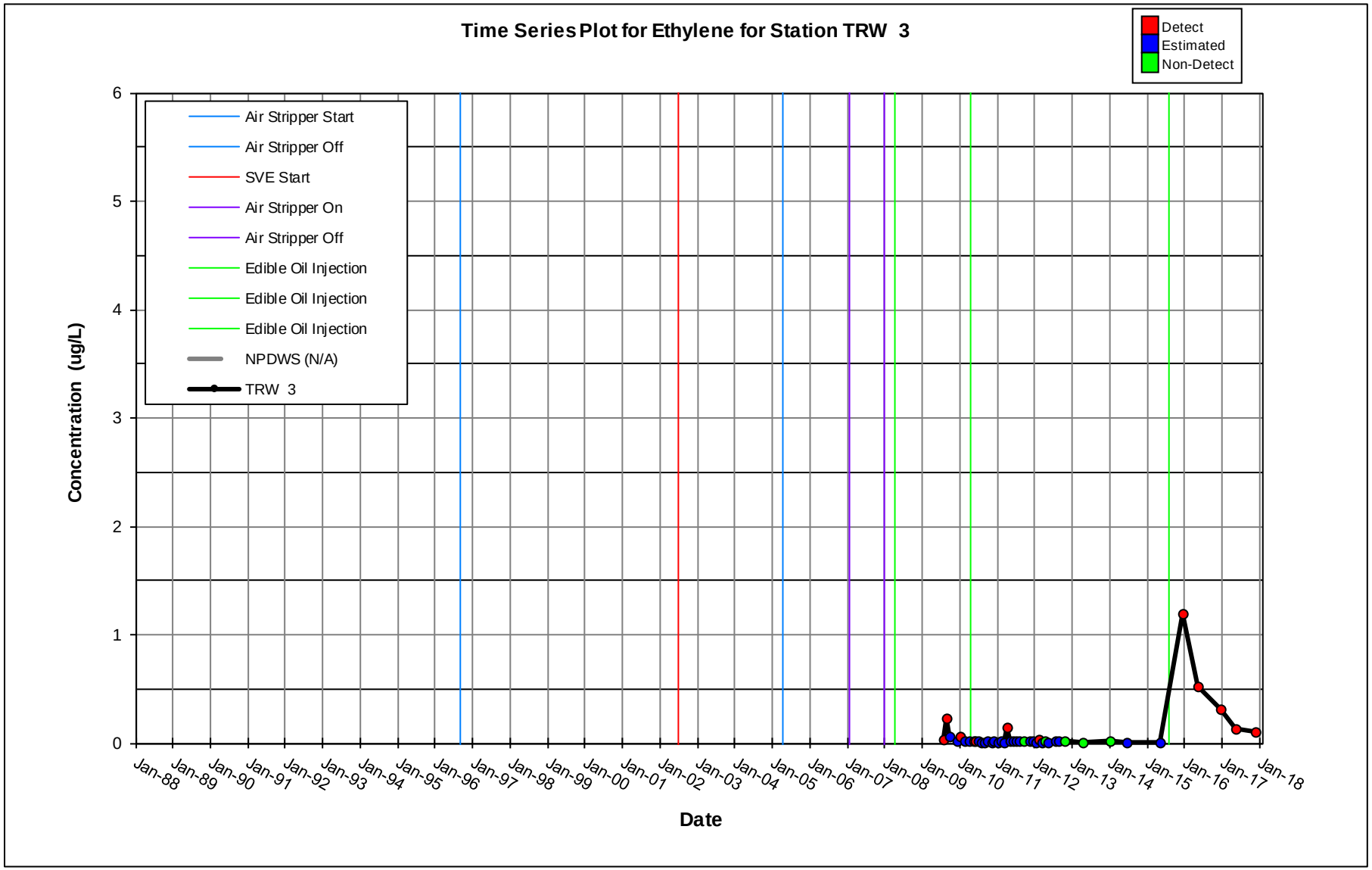
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TRW 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TRW 3
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
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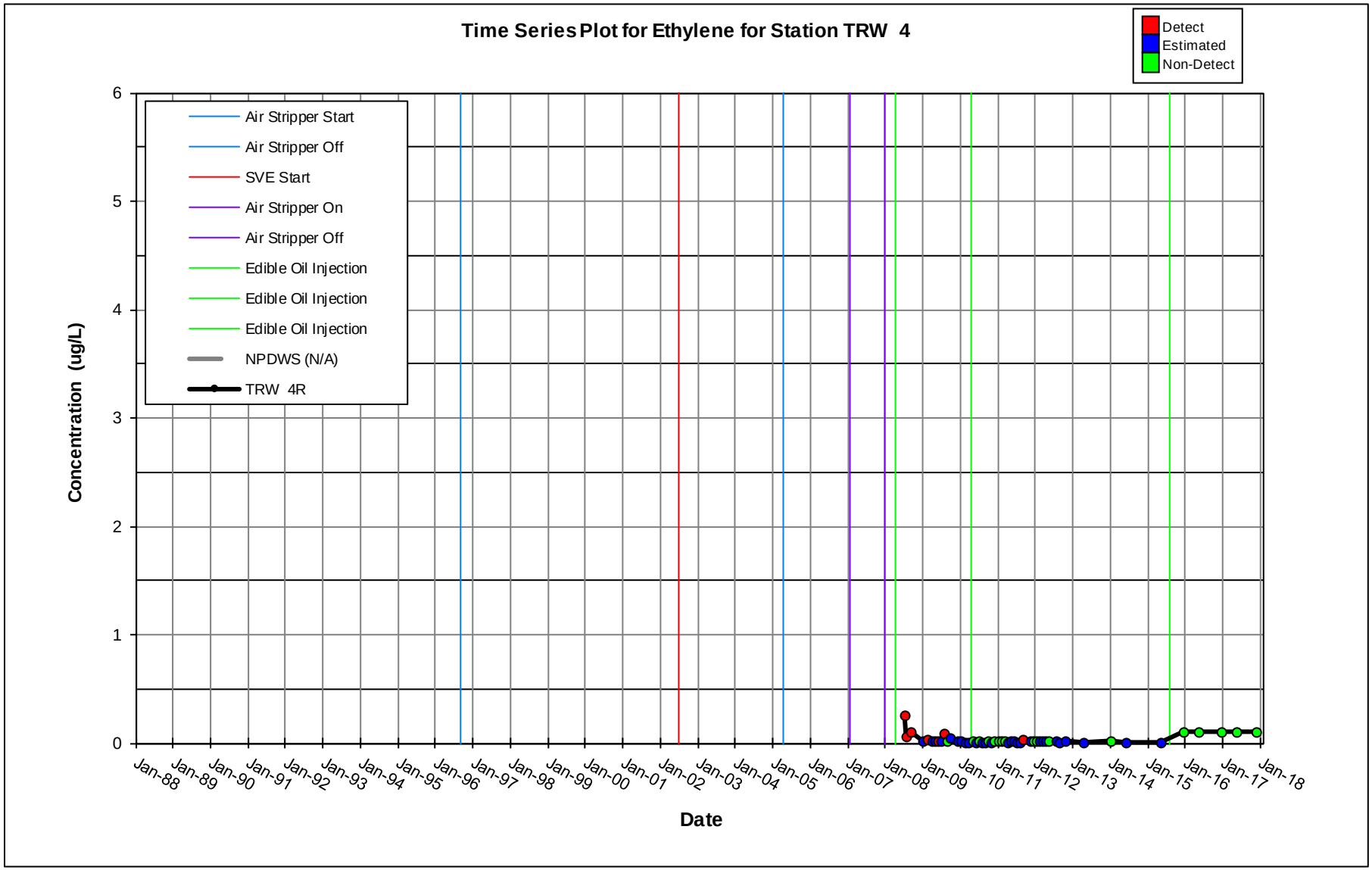
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TRW 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TRW 4R
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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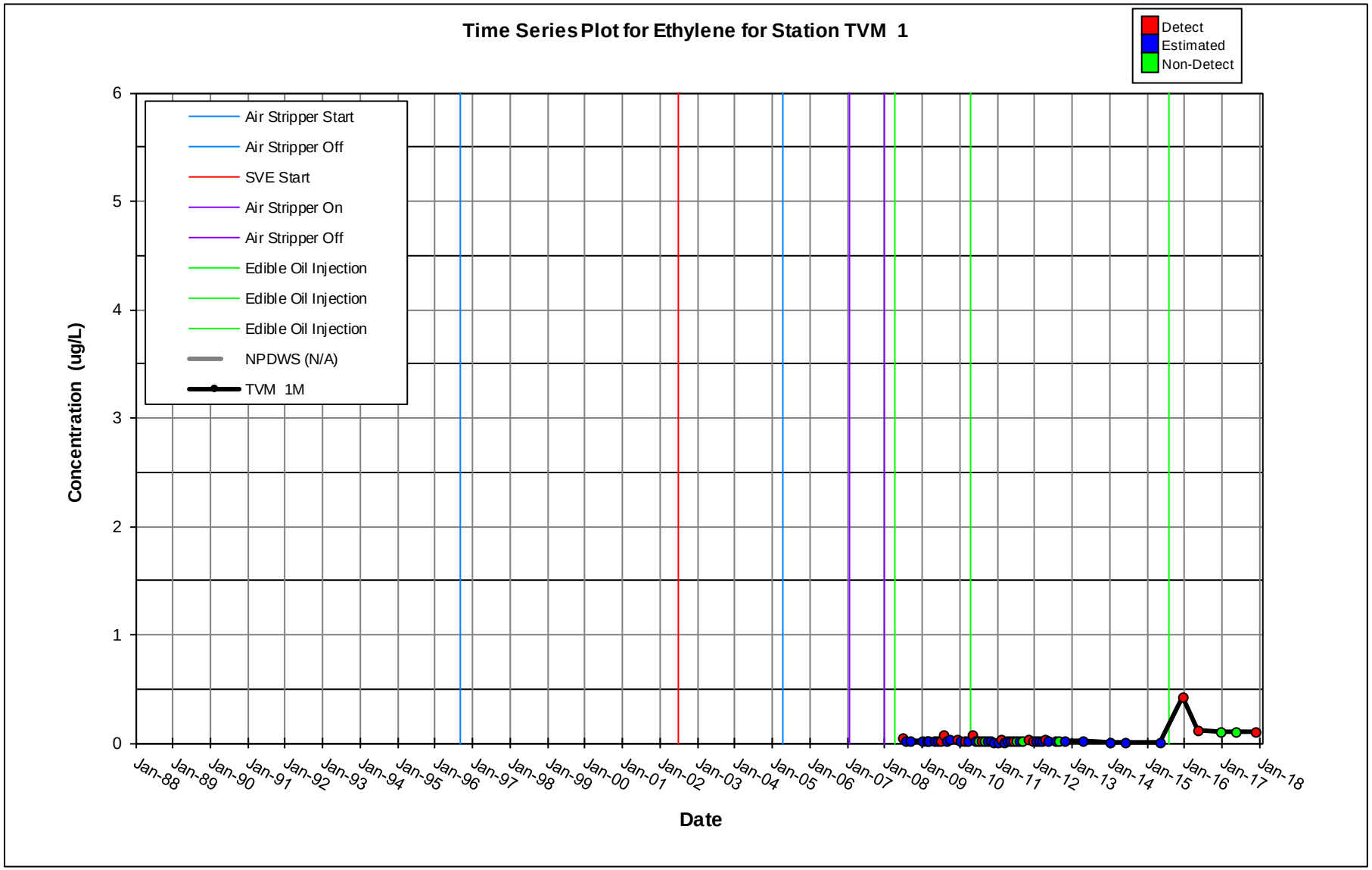
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TVM 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TVM 1M
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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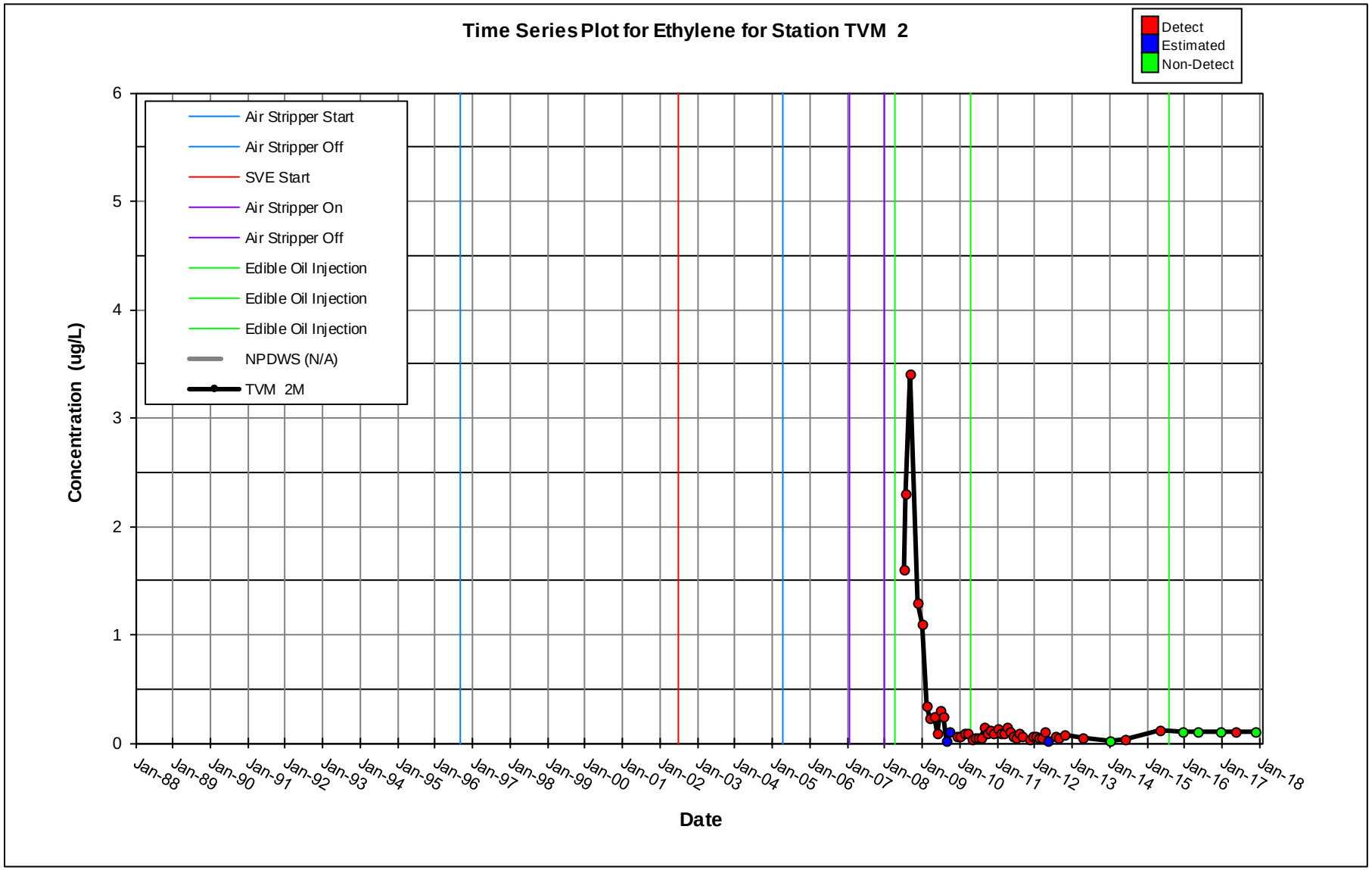
Jan-18
Date


Time Series Plot for Ethylene for Station TVM 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TVM 2M
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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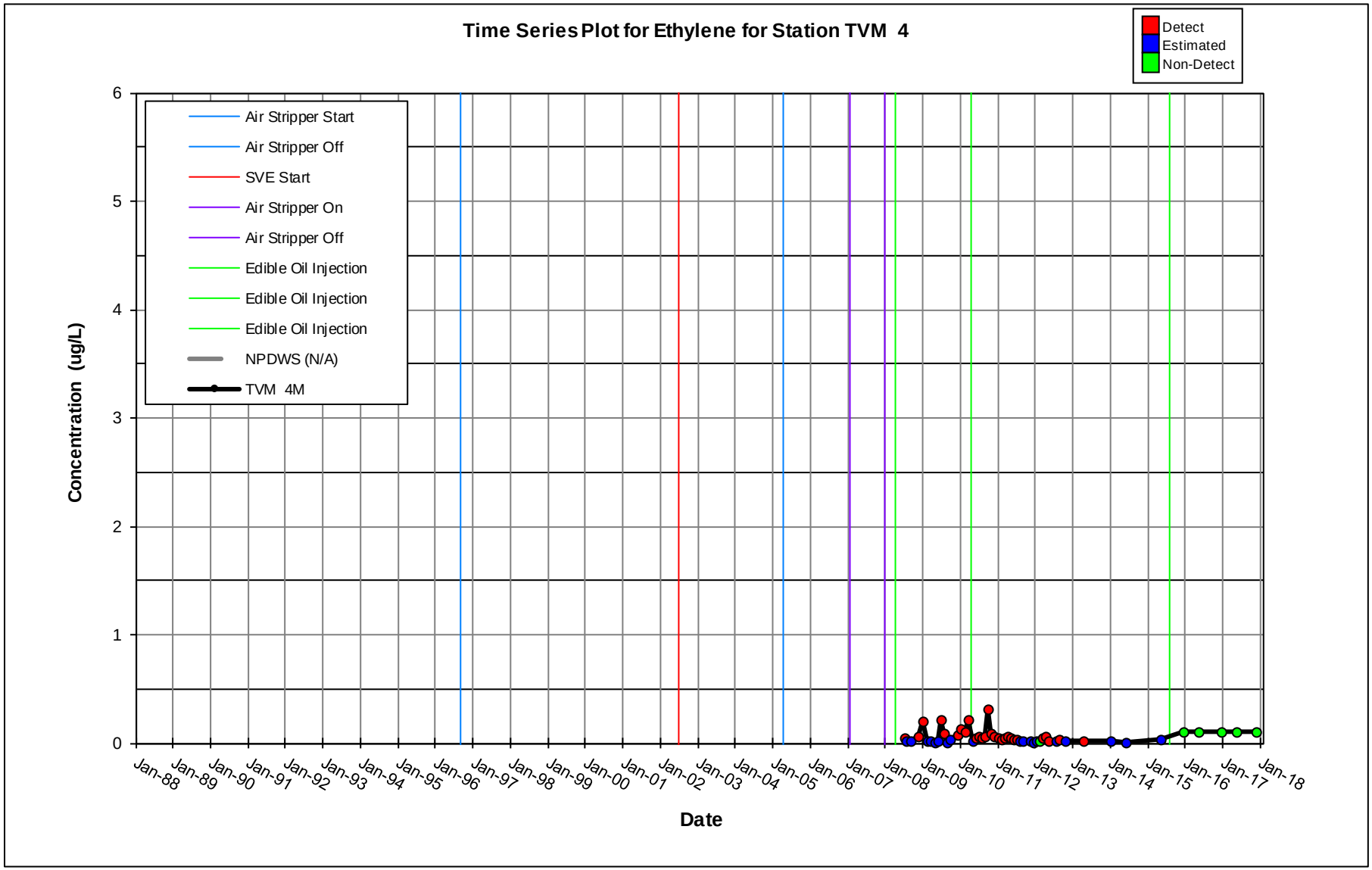
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TVM 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TVM 4M
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
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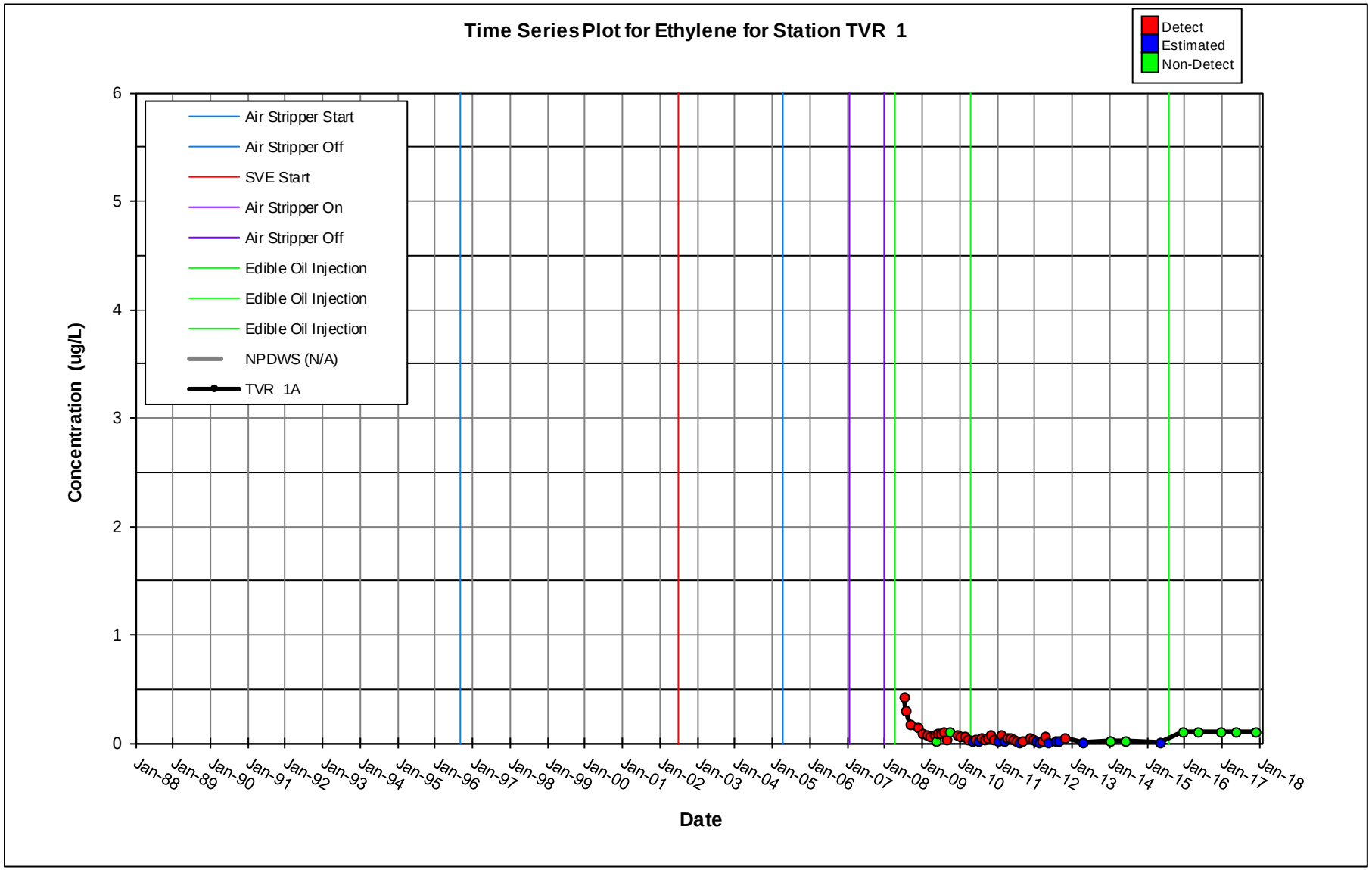
Jan-17
Jan-18
Date


Time Series Plot for Ethylene for Station TVR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TVR 1A
Concentration (ug/L)
0
1
2
3
4
5
6
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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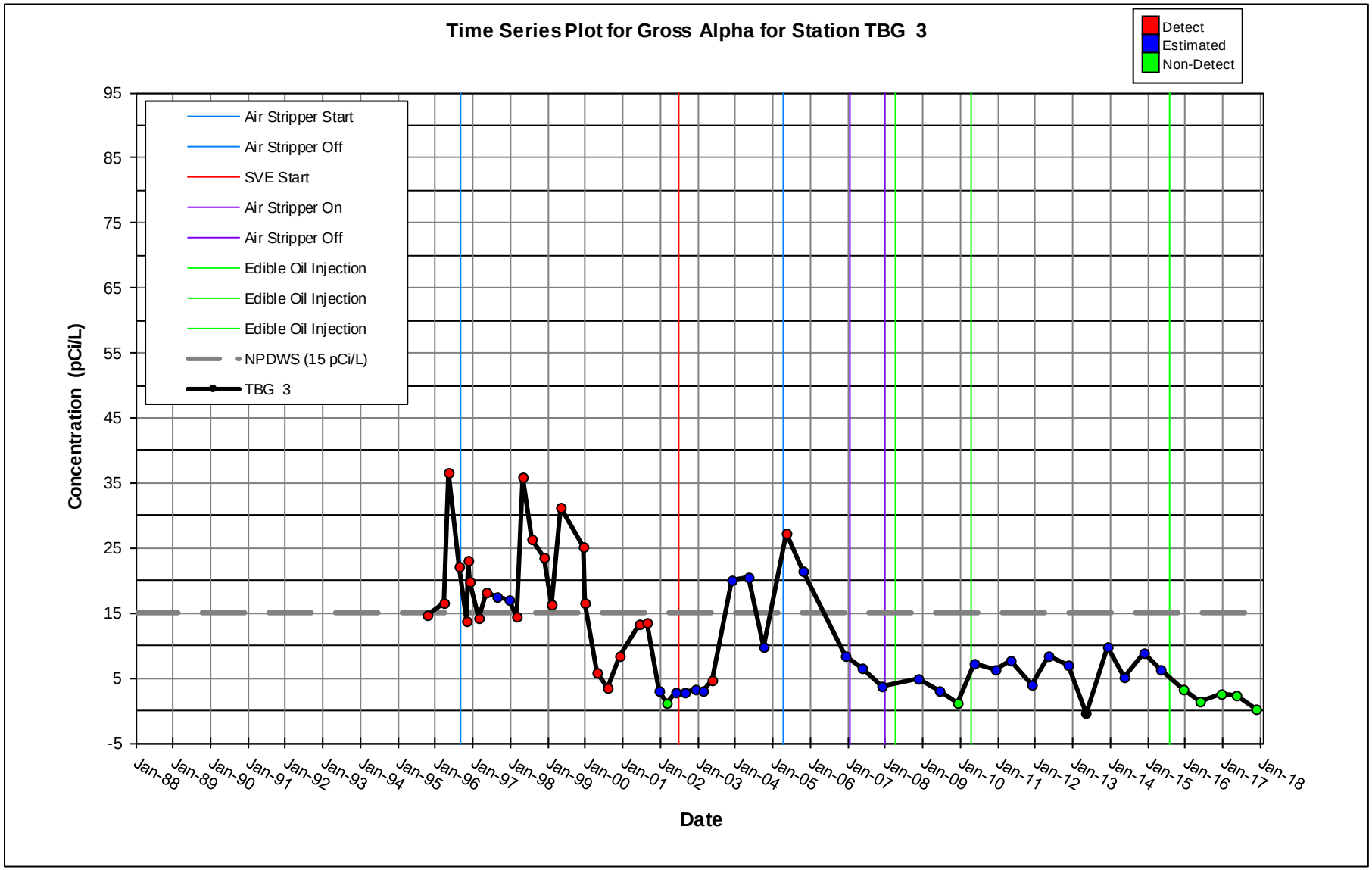
Jan-18
Date


Time Series Plot for Gross Alpha for Station TBG 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (15 pCi/L)
TBG 3
Concentration (pCi/L)
95
85
75
65
55
45
35
25
15
5
-5
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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Jan-98
Jan-99
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Jan-01
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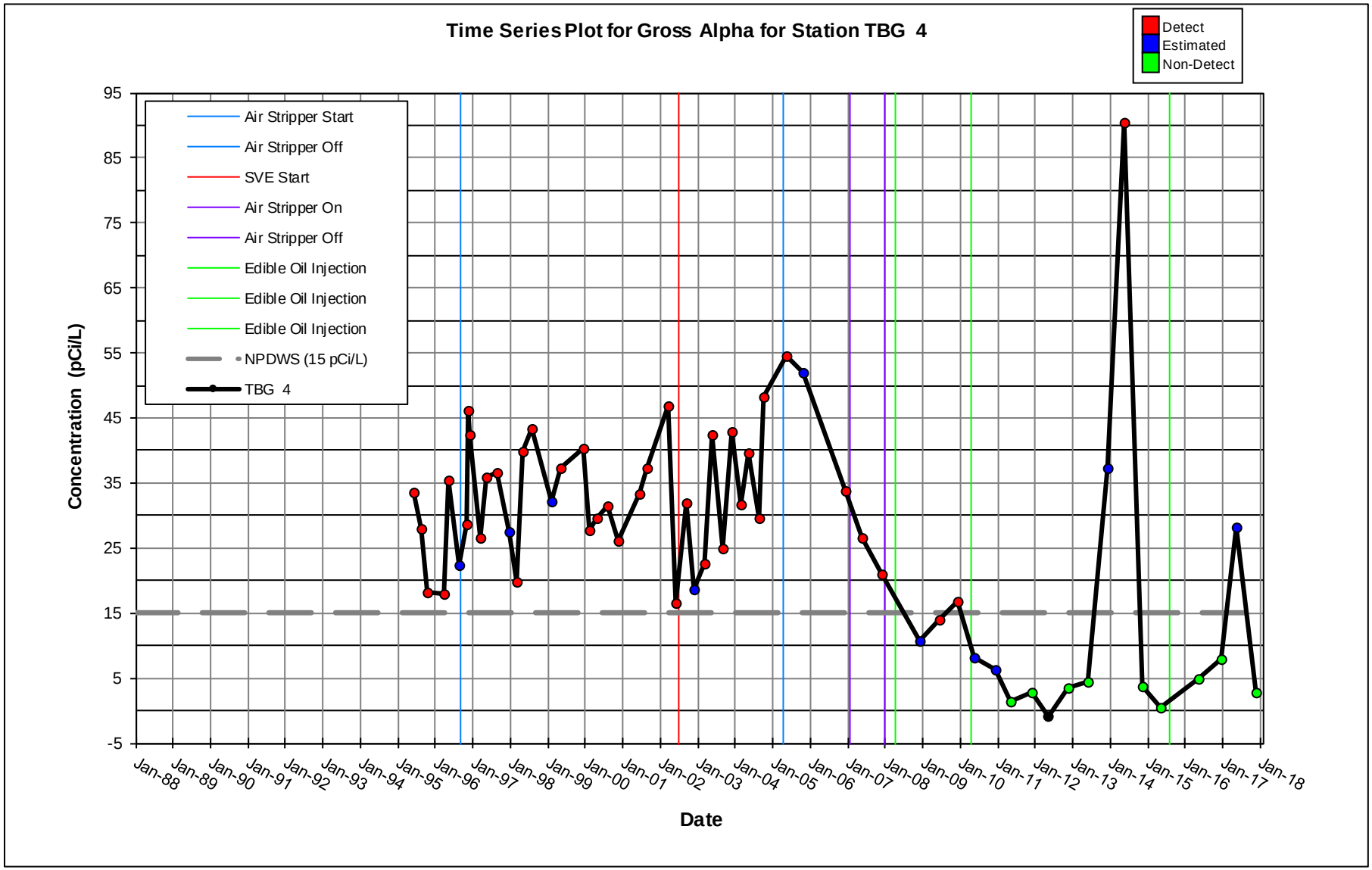
Jan-17
Jan-18
Date


Time Series Plot for Gross Alpha for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (15 pCi/L)
TBG 4
Concentration (pCi/L)
95
85
75
65
55
45
35
25
15
5
-5
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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Jan-98
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Jan-01
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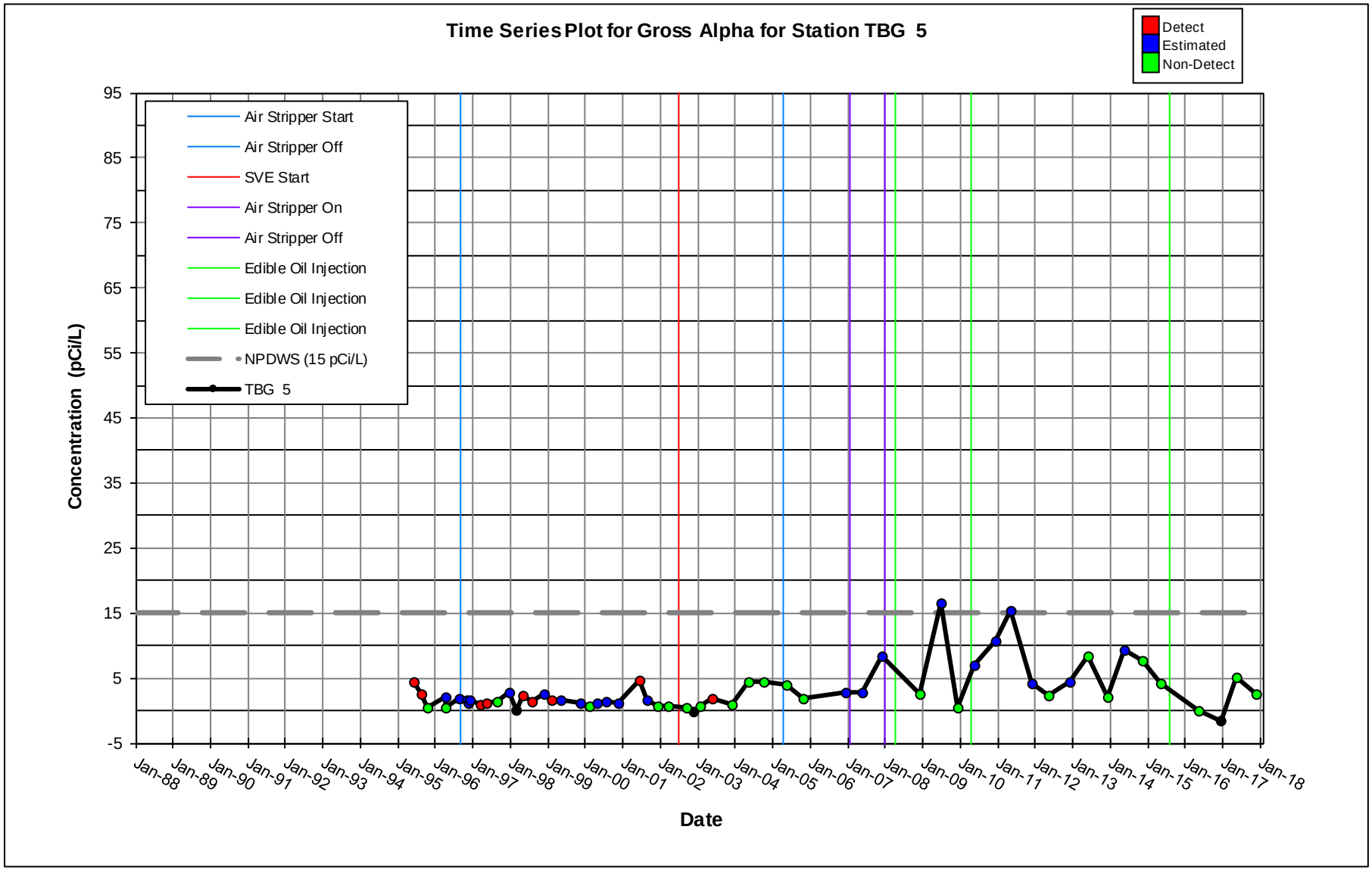
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Gross Alpha for Station TBG 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (15 pCi/L)
TBG 5
Concentration (pCi/L)
95
85
75
65
55
45
35
25
15
5
-5
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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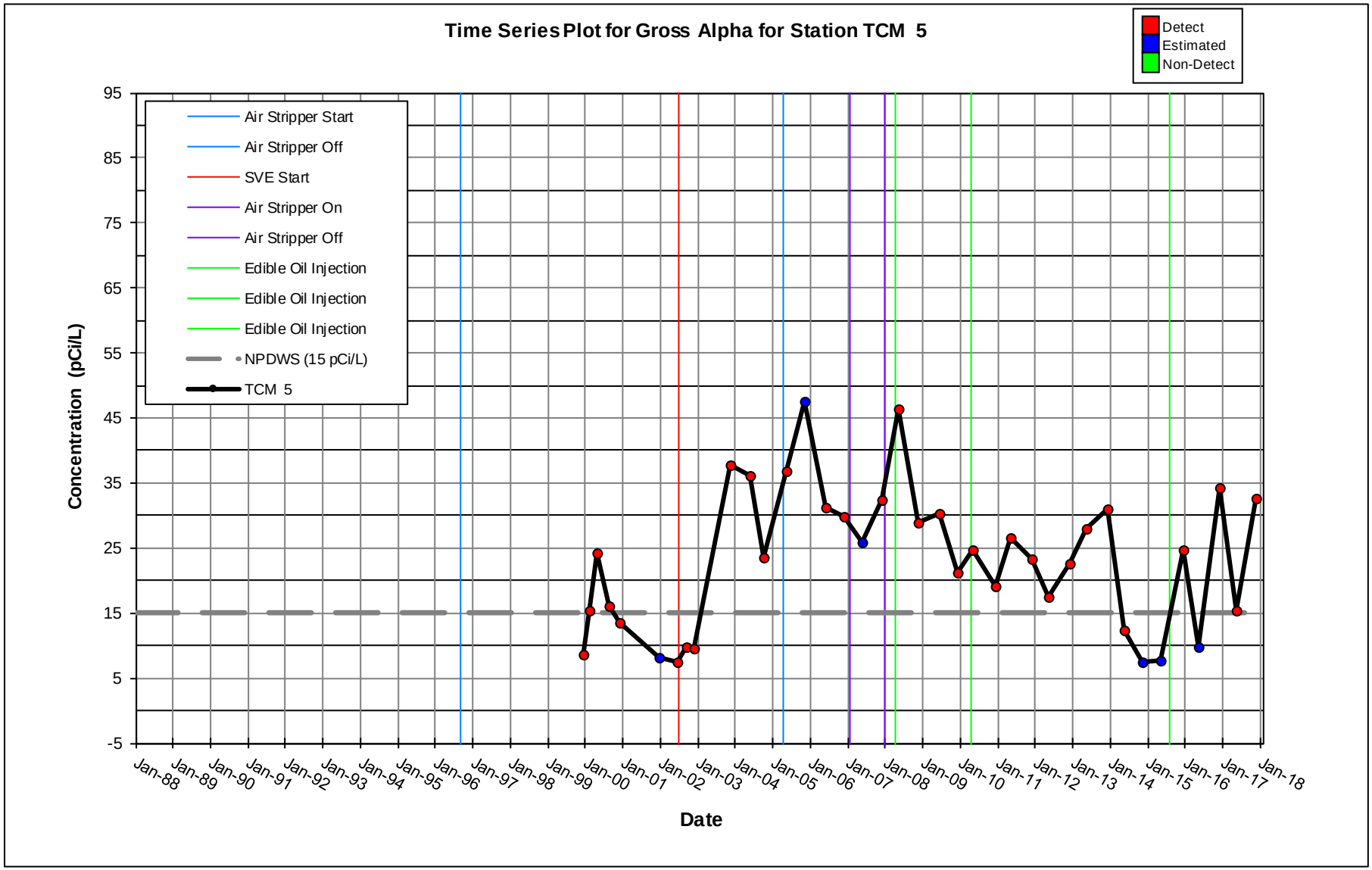
Jan-17
Jan-18
Date


Time Series Plot for Gross Alpha for Station TCM 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (15 pCi/L)
TCM 5
Concentration (pCi/L)
95
85
75
65
55
45
35
25
15
5
-5
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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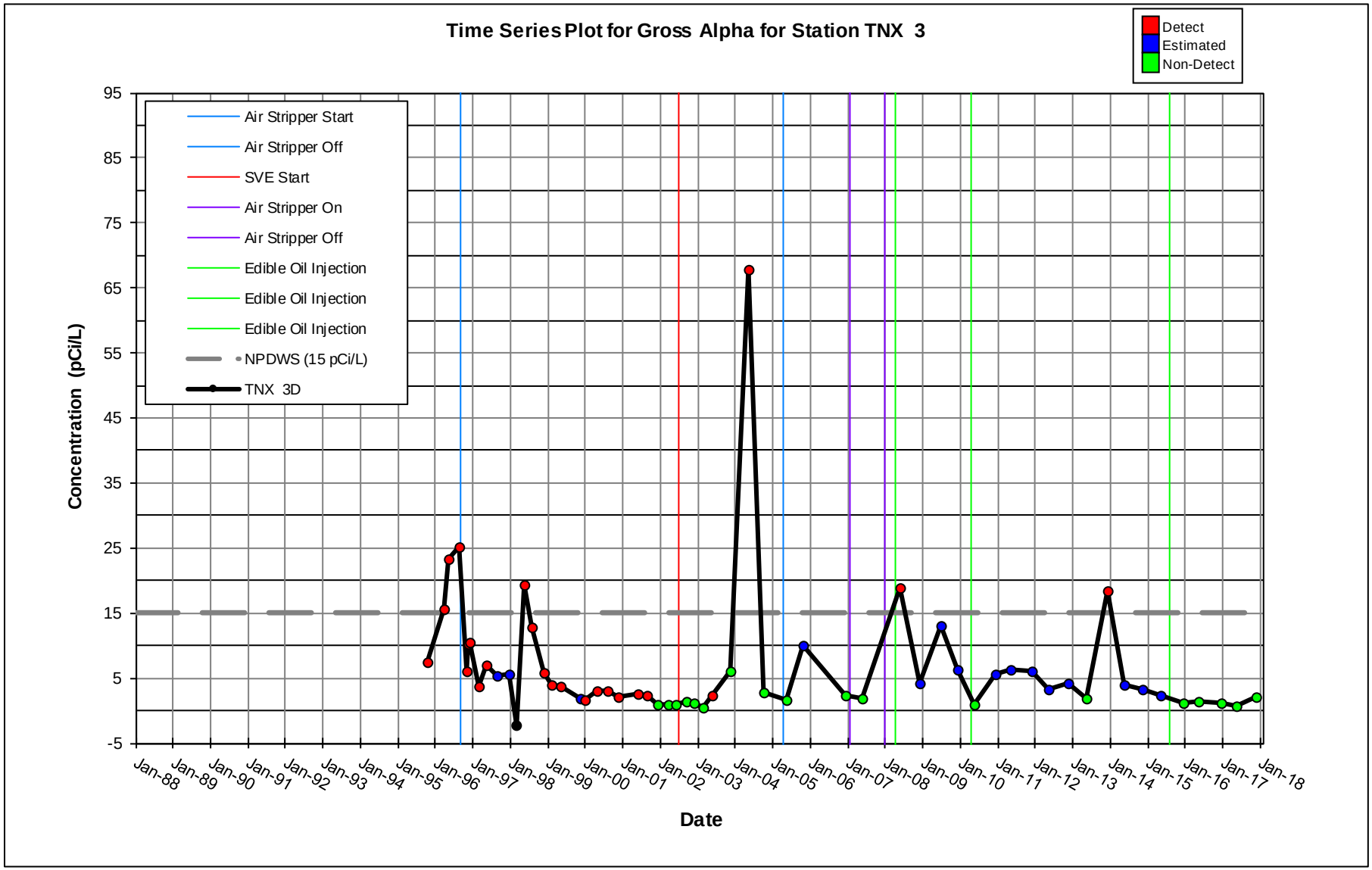
Jan-17
Jan-18
Date


Time Series Plot for Gross Alpha for Station TNX 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (15 pCi/L)
TNX 3D
Concentration (pCi/L)
95
85
75
65
55
45
35
25
15
5
-5
Jan-88
Jan-89
Jan-90
Jan-91
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Jan-93
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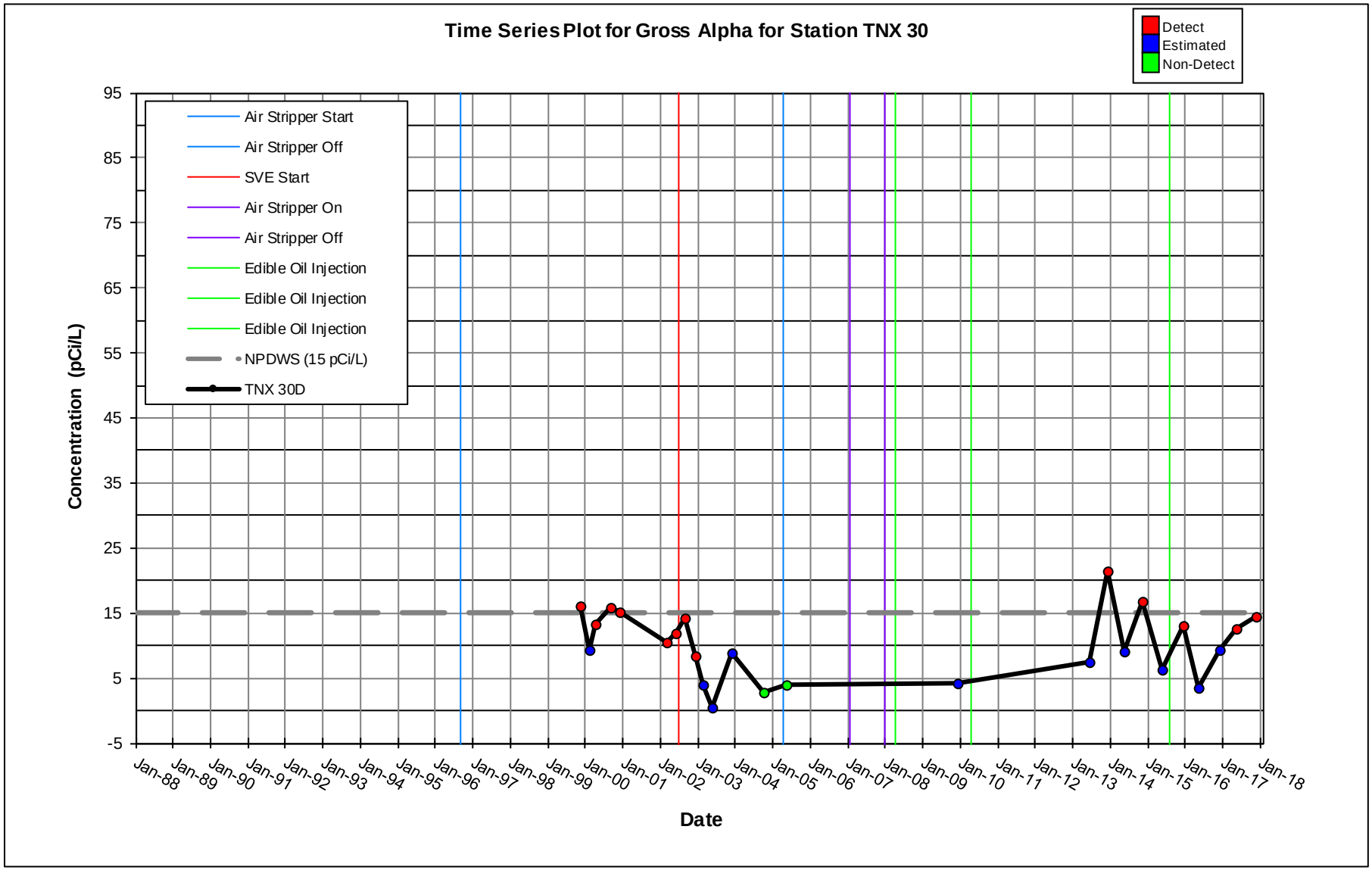
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Gross Alpha for Station TNX 30
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (15 pCi/L)
TNX 30D
Concentration (pCi/L)
95
85
75
65
55
45
35
25
15
5
-5
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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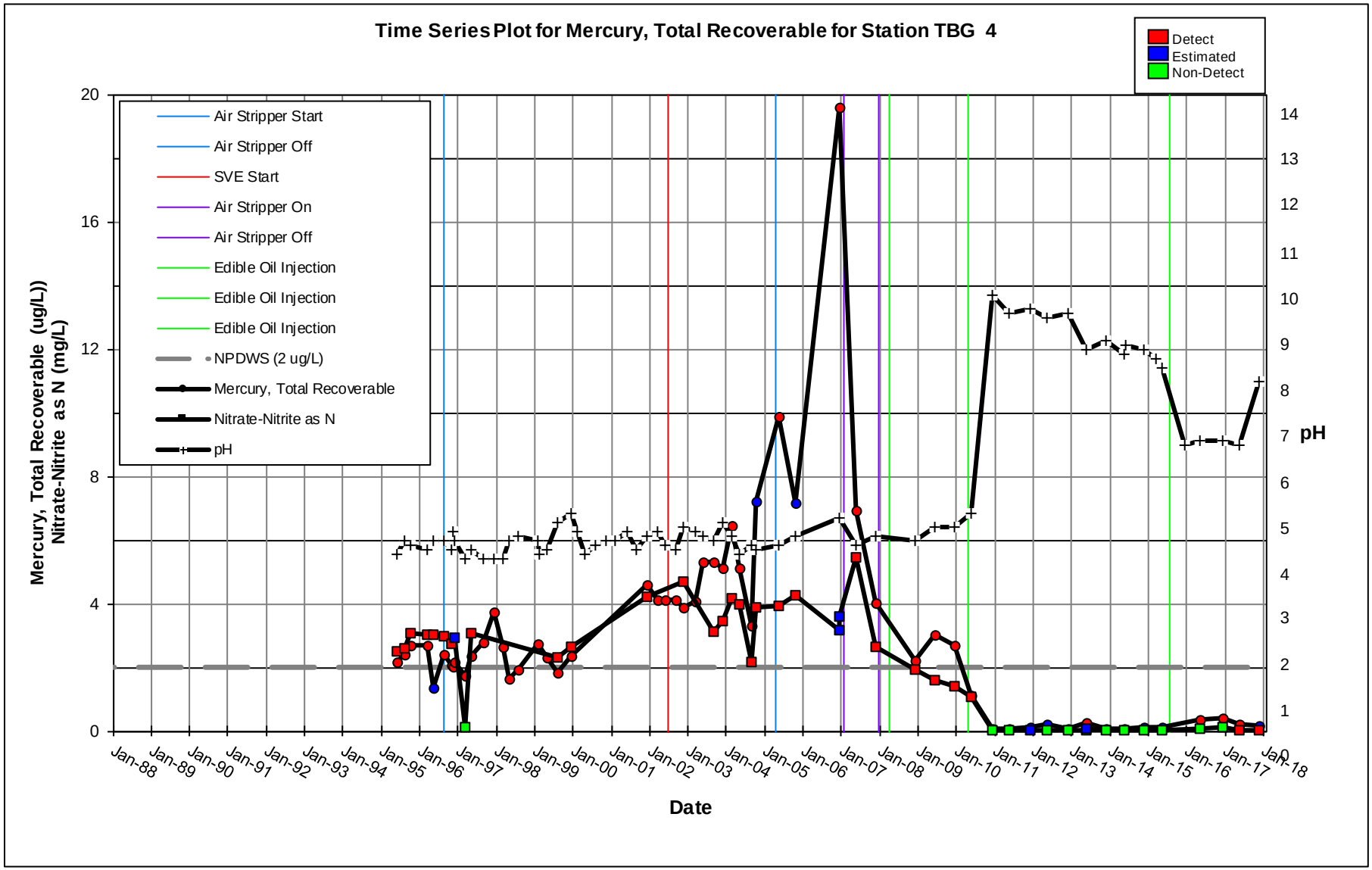
Jan-17
Jan-18
Date


Time Series Plot for Mercury, Total Recoverable for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (2 ug/L)
Mercury, Total Recoverable
Nitrate-Nitrite as N
pH
Mercury, Total Recoverable (ug/L))
Nitrate-Nitrite as N (mg/L)
pH
Date
0
4
8
12
16
20
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Jan-88
Jan-89
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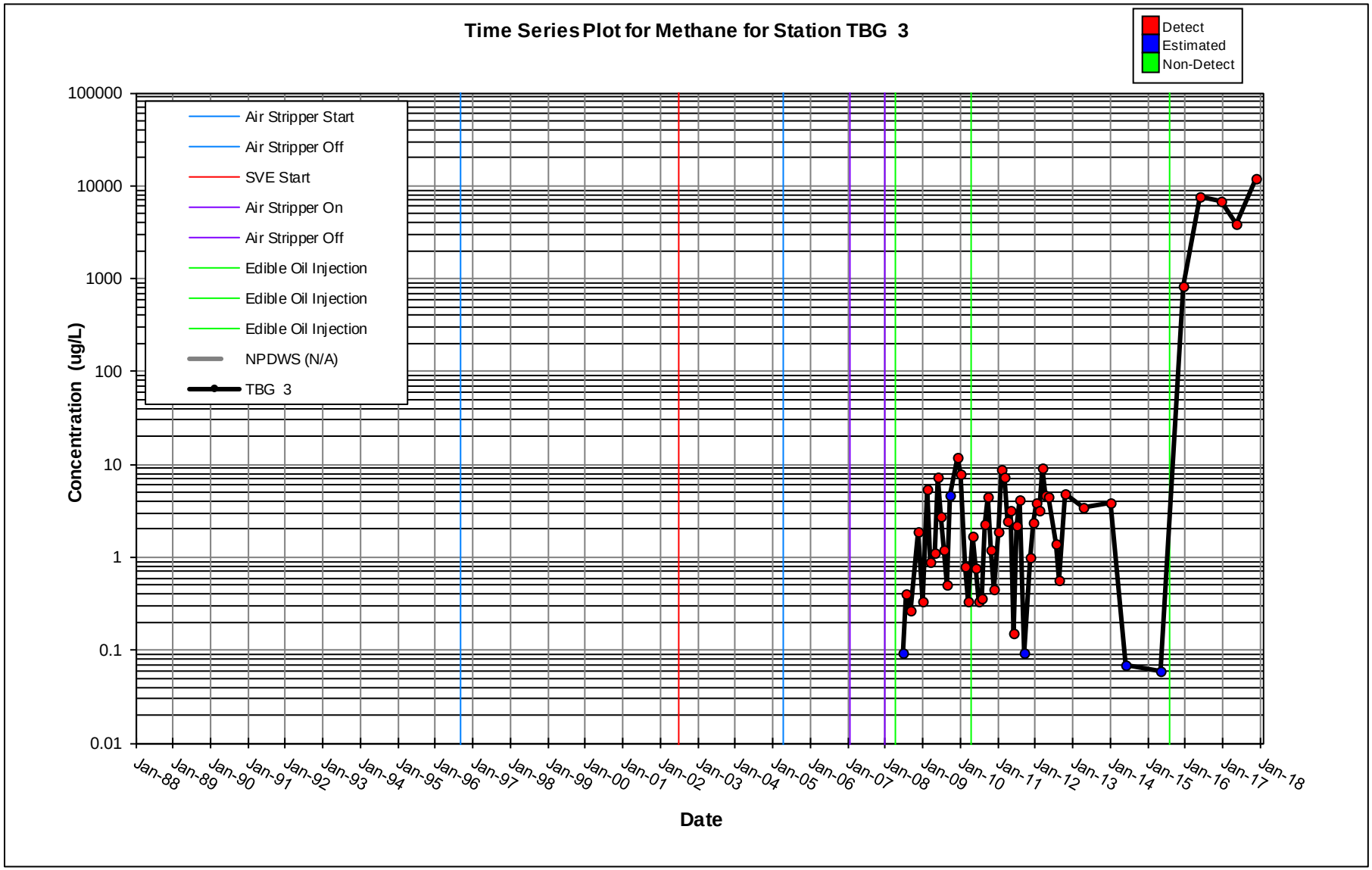
Time Series Plot for Methane for Station TBG 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TBG 3
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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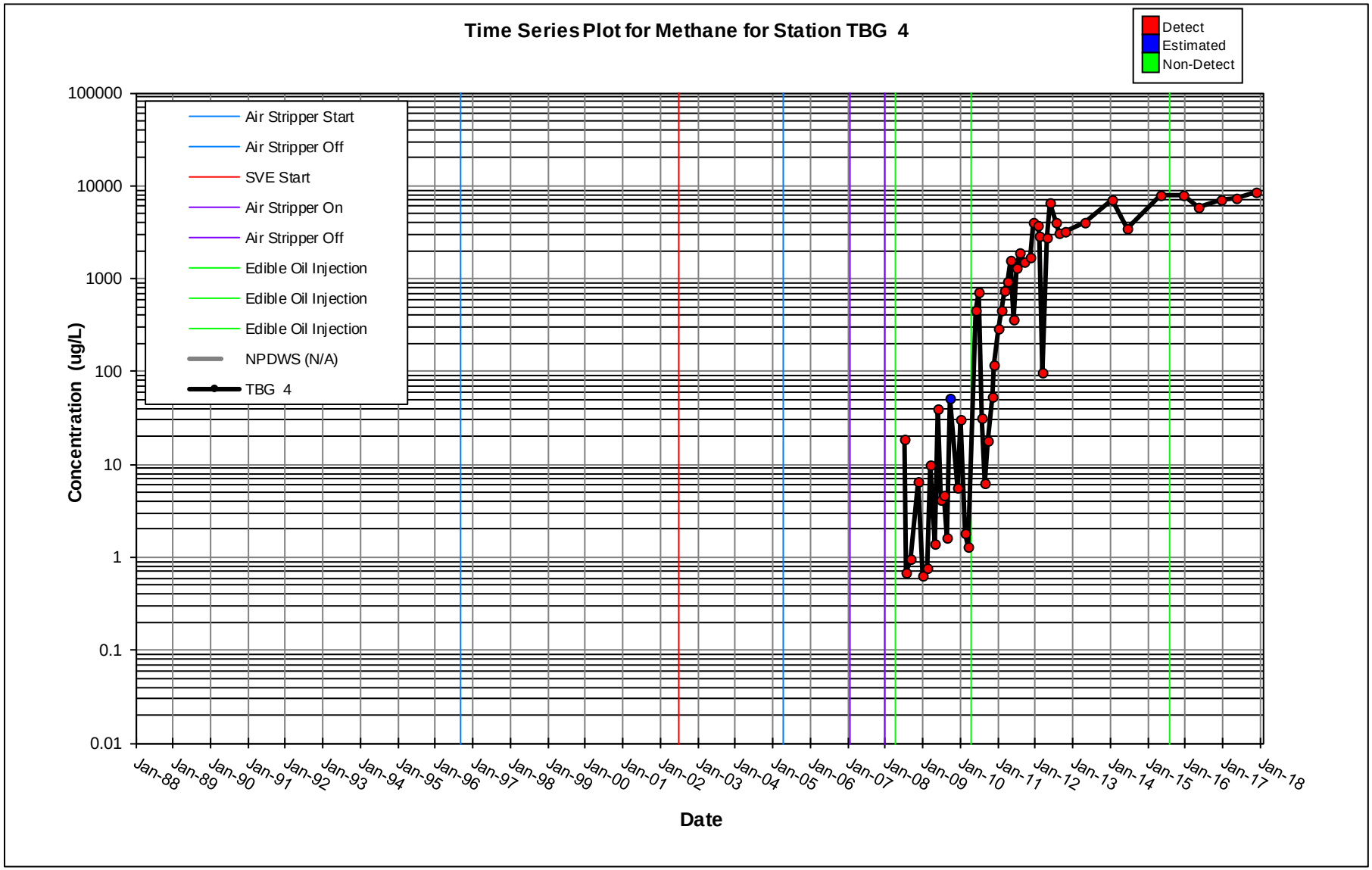
Jan-17
Jan-18
Date


Time Series Plot for Methane for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TBG 4
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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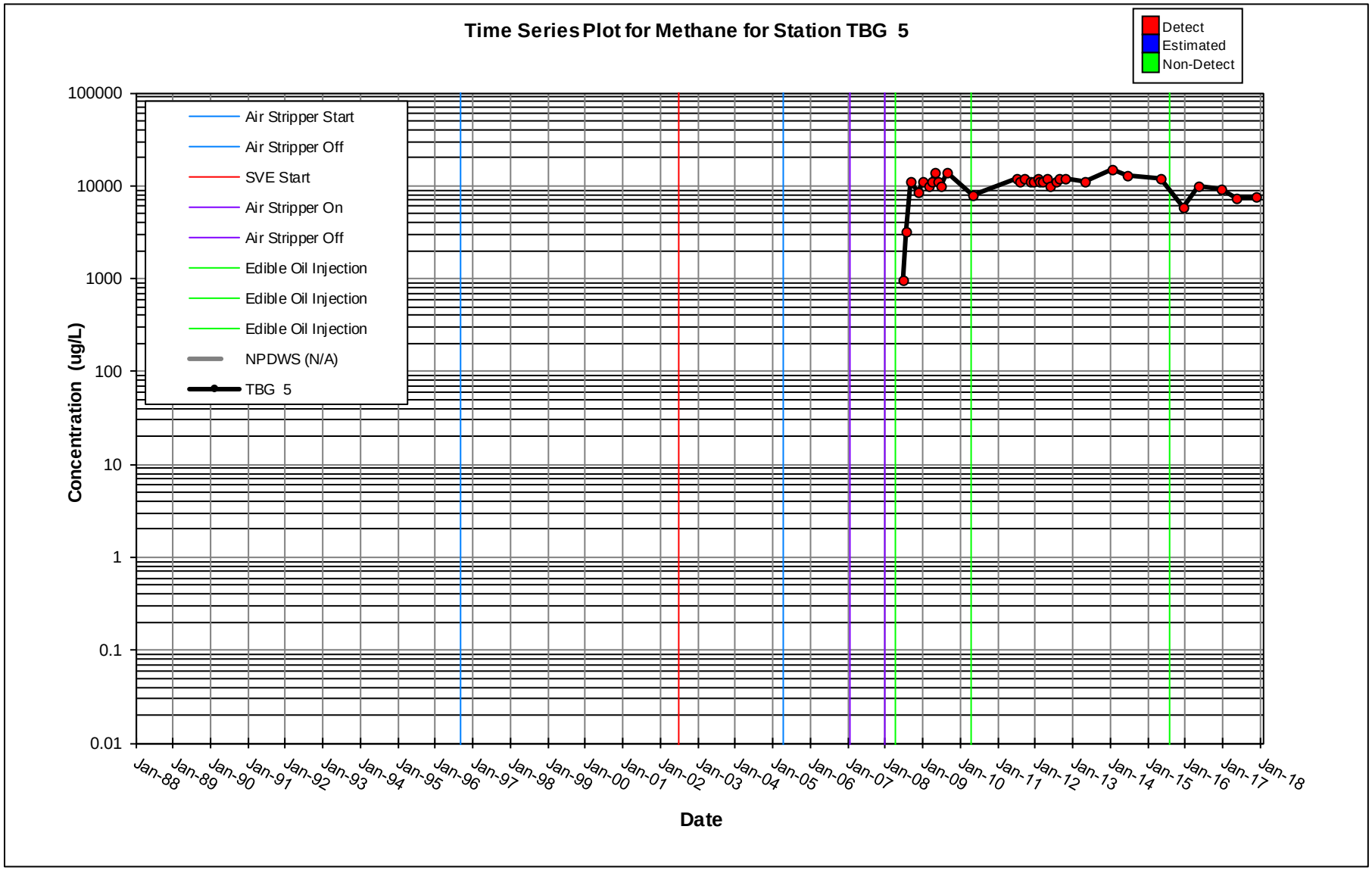
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Methane for Station TBG 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TBG 5
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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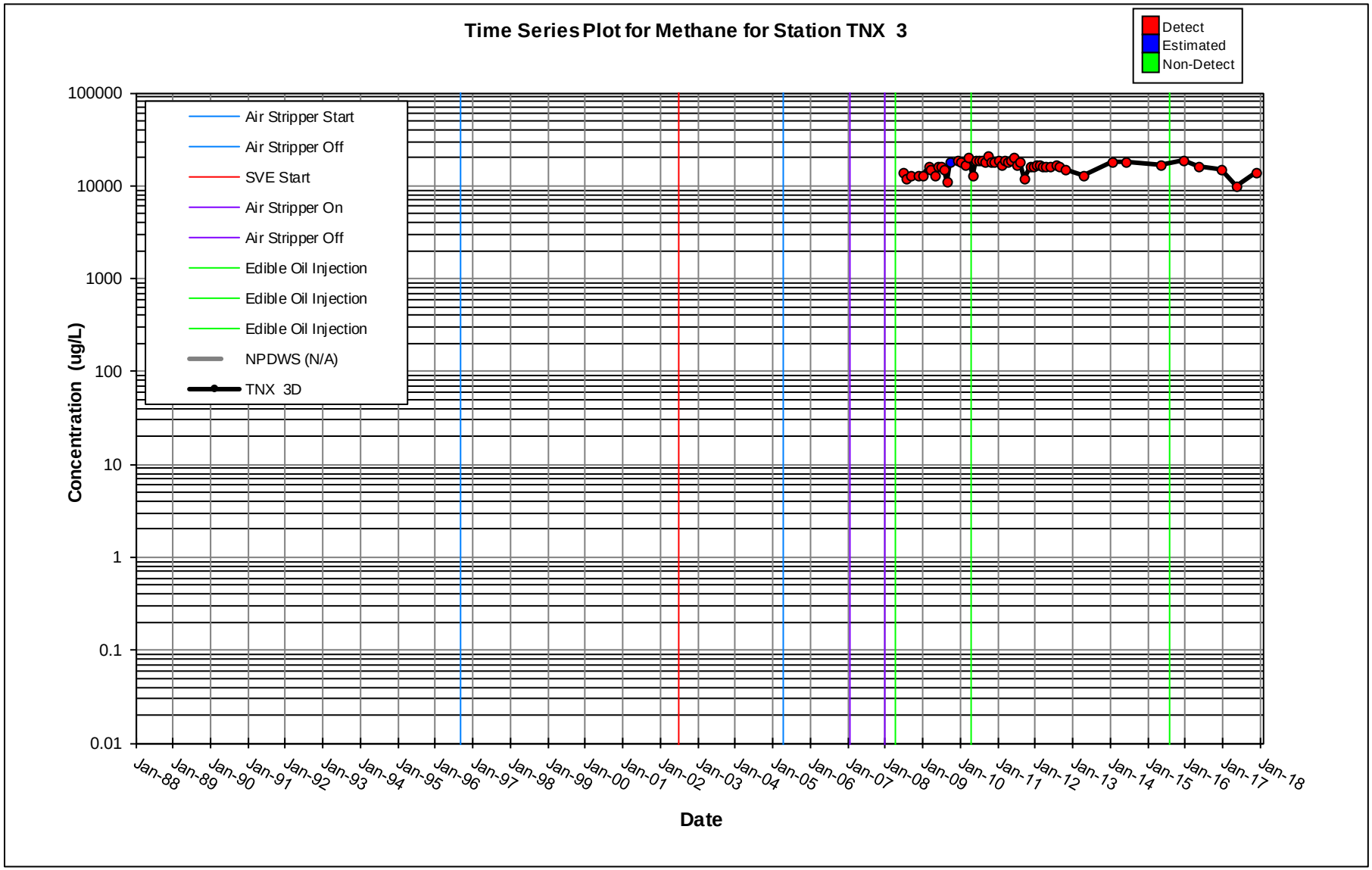
Jan-17
Jan-18
Date


Time Series Plot for Methane for Station TNX 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TNX 3D
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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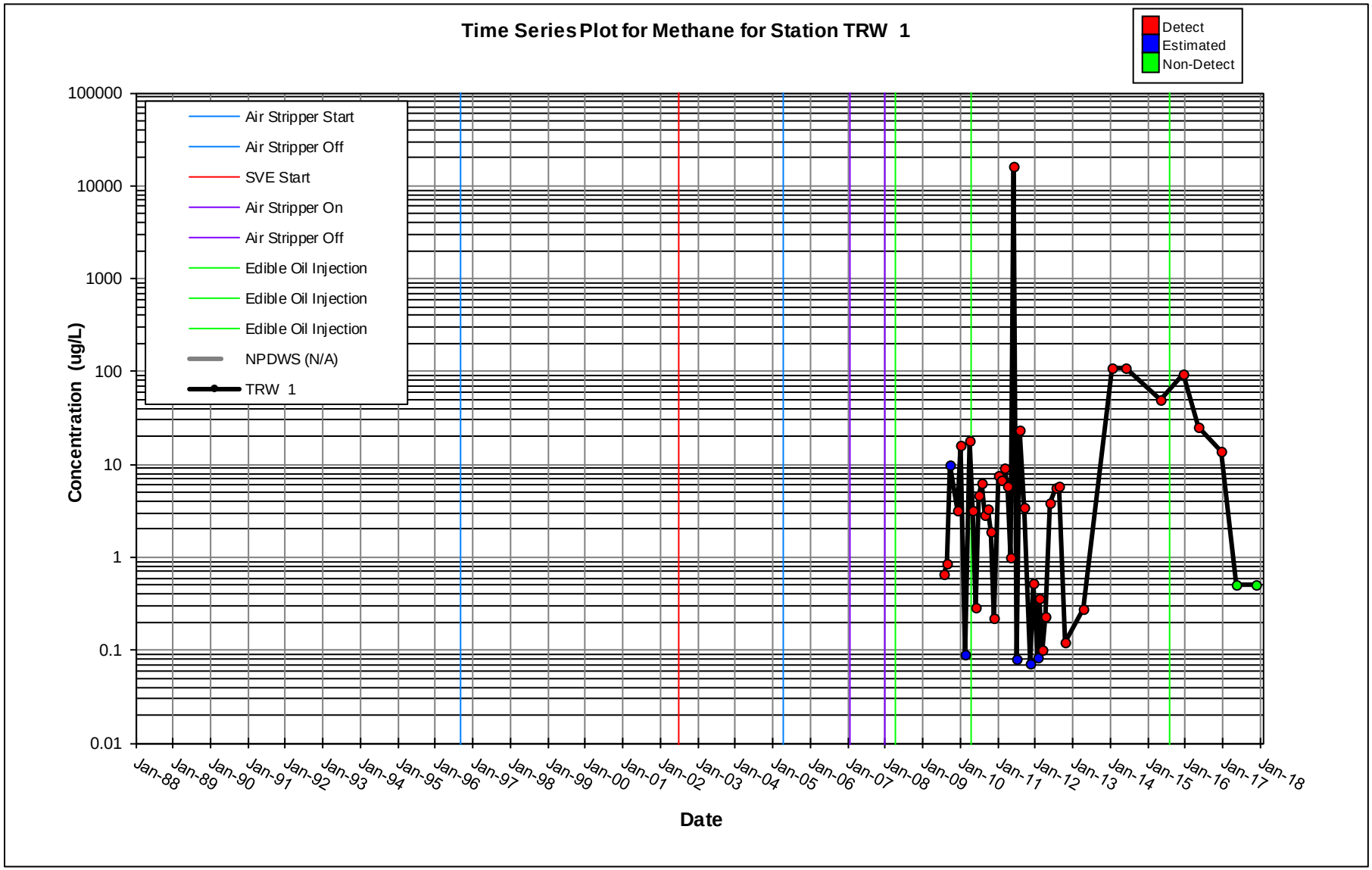
Jan-17
Jan-18
Date


Time Series Plot for Methane for Station TRW 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TRW 1
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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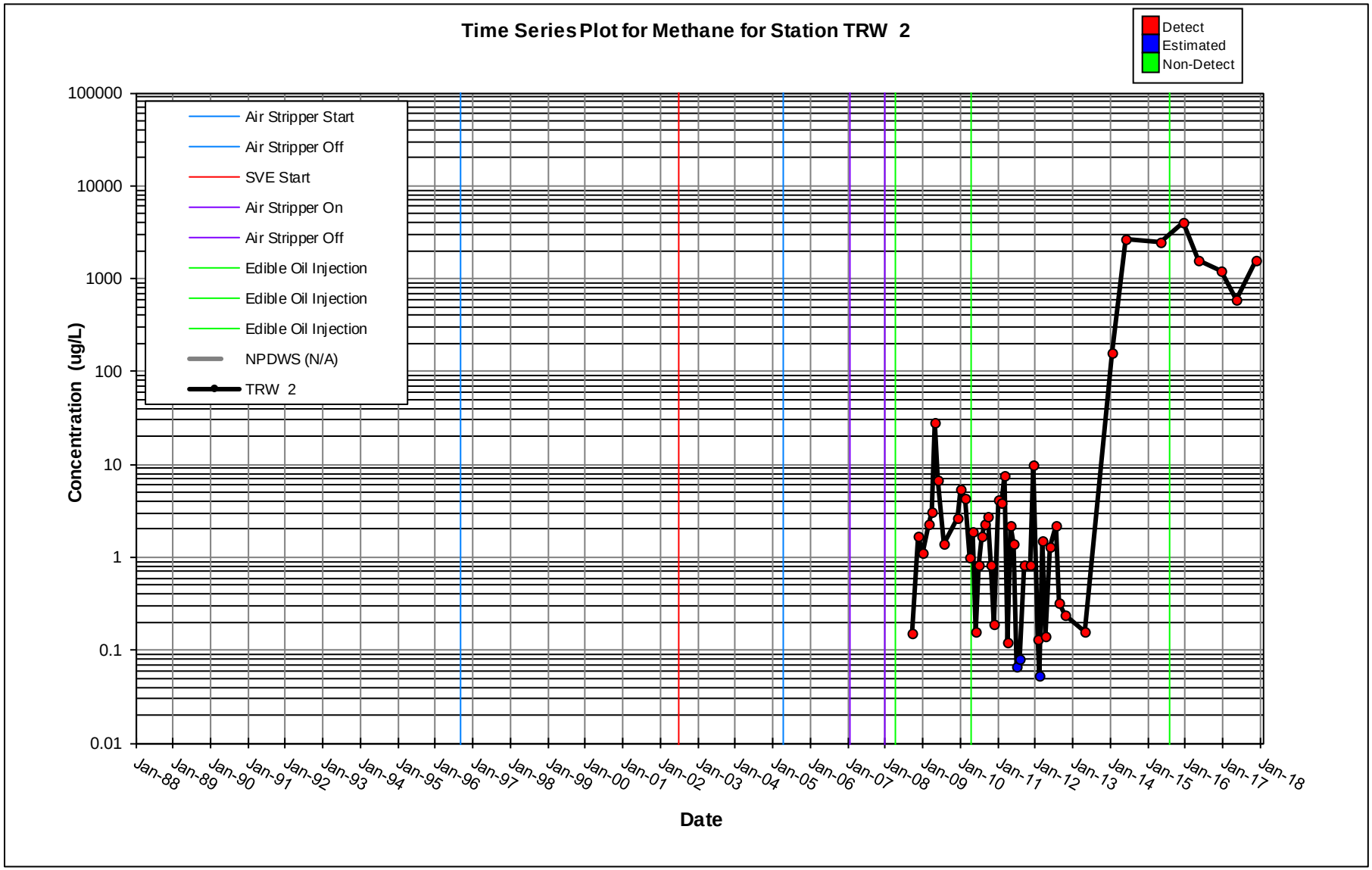
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Methane for Station TRW 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TRW 2
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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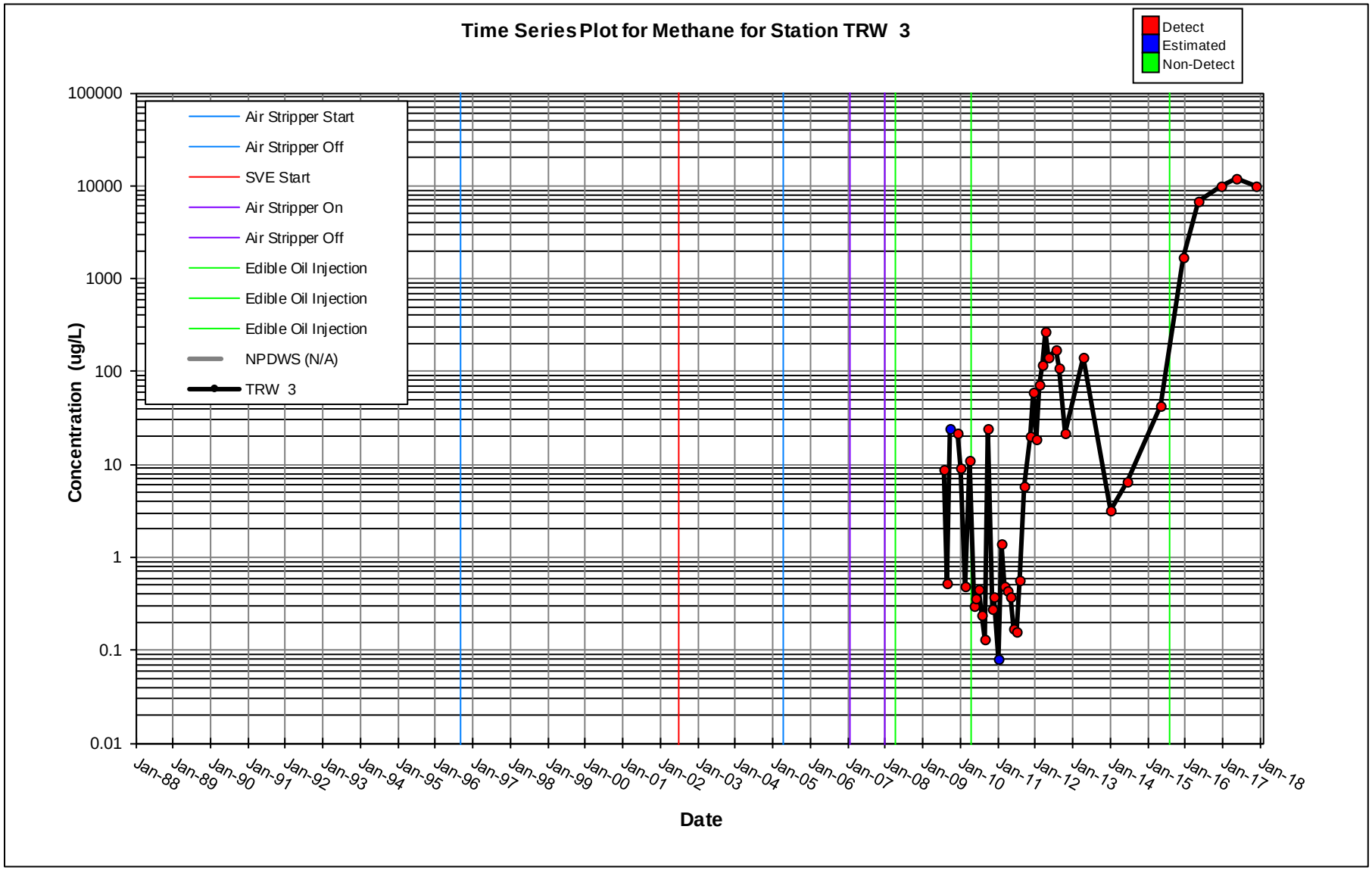
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Methane for Station TRW 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TRW 3
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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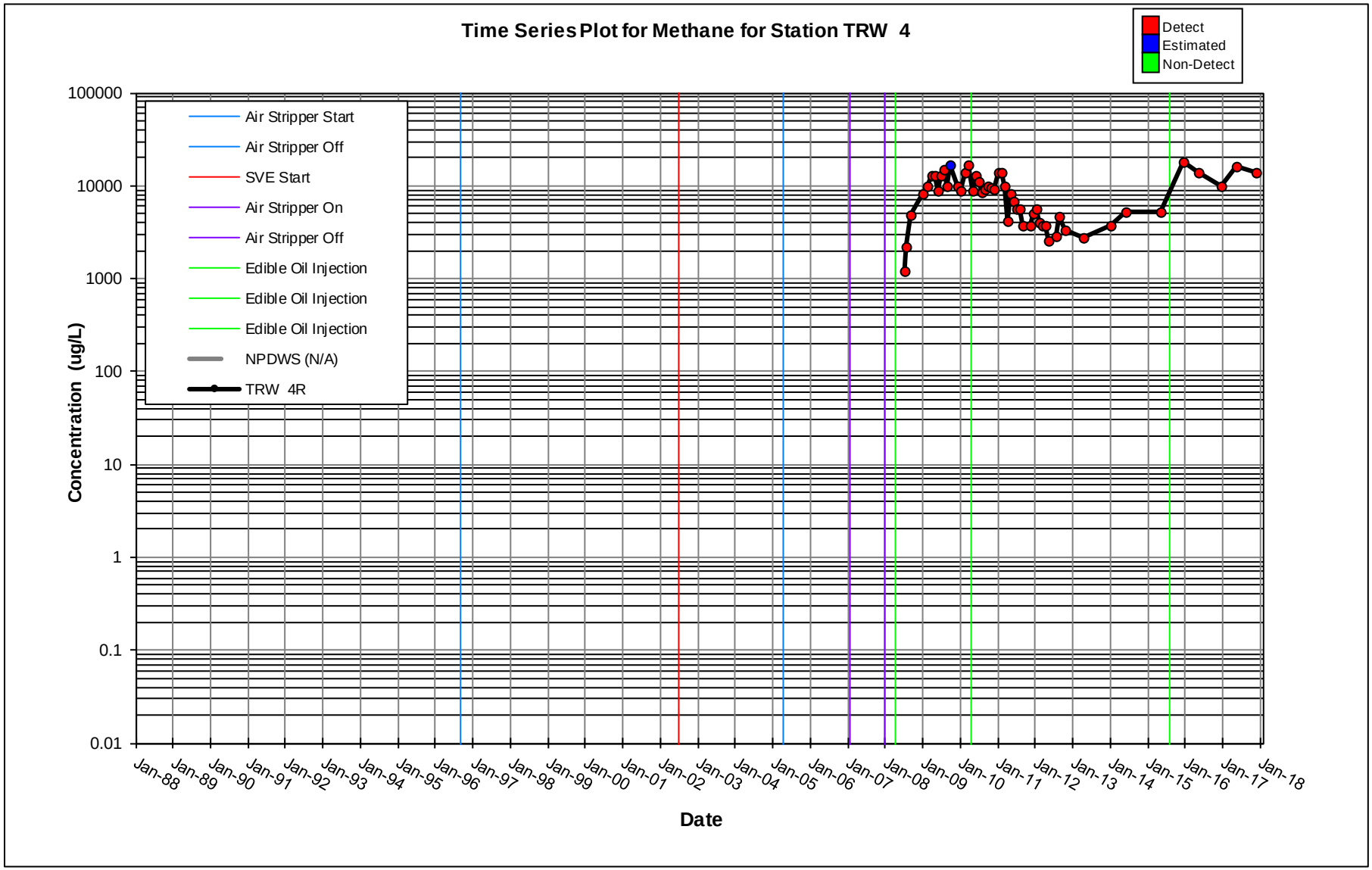
Jan-18
Date


Time Series Plot for Methane for Station TRW 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TRW 4R
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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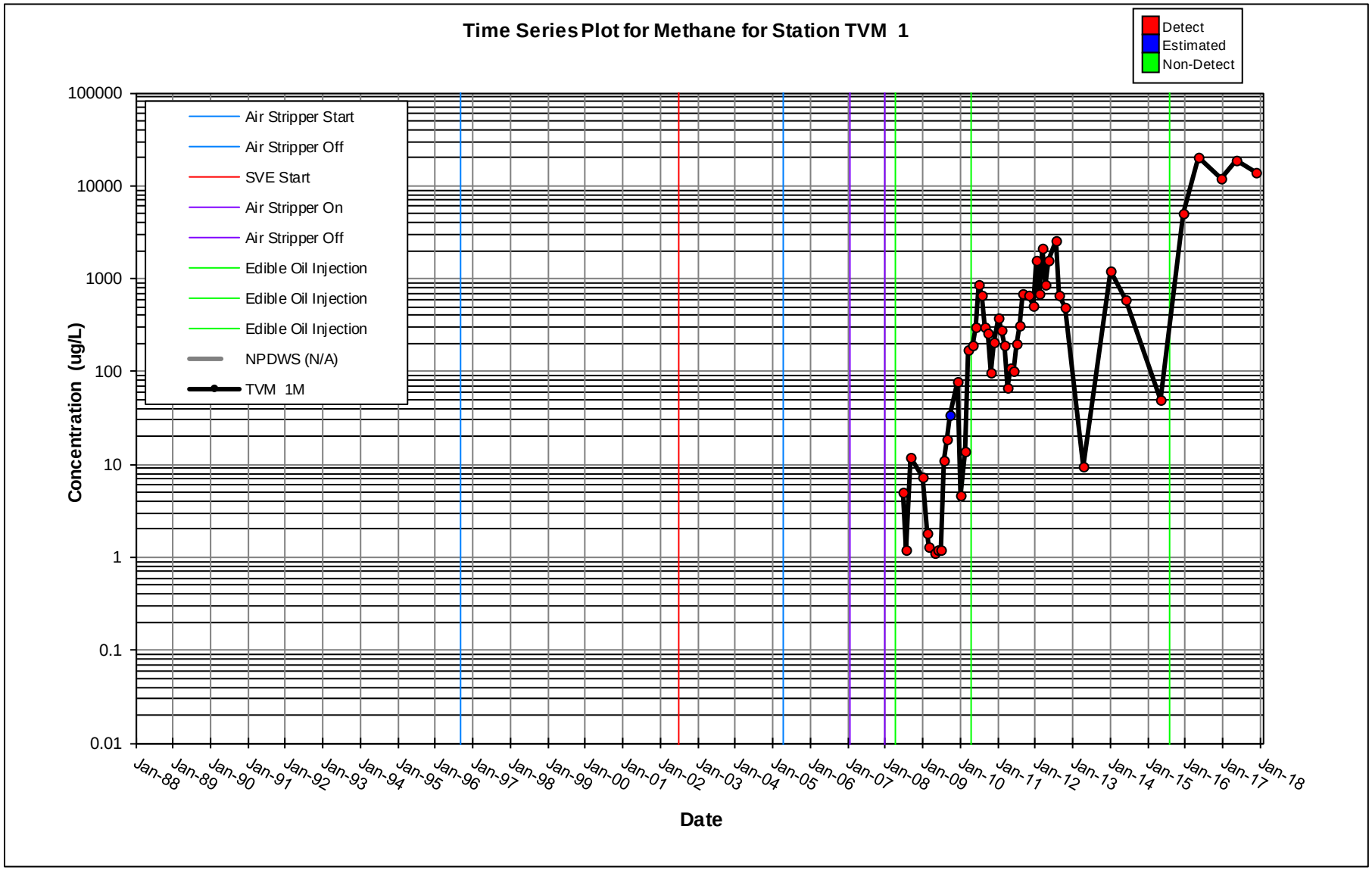
Jan-18
Date


Time Series Plot for Methane for Station TVM 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TVM 1M
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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Jan-01
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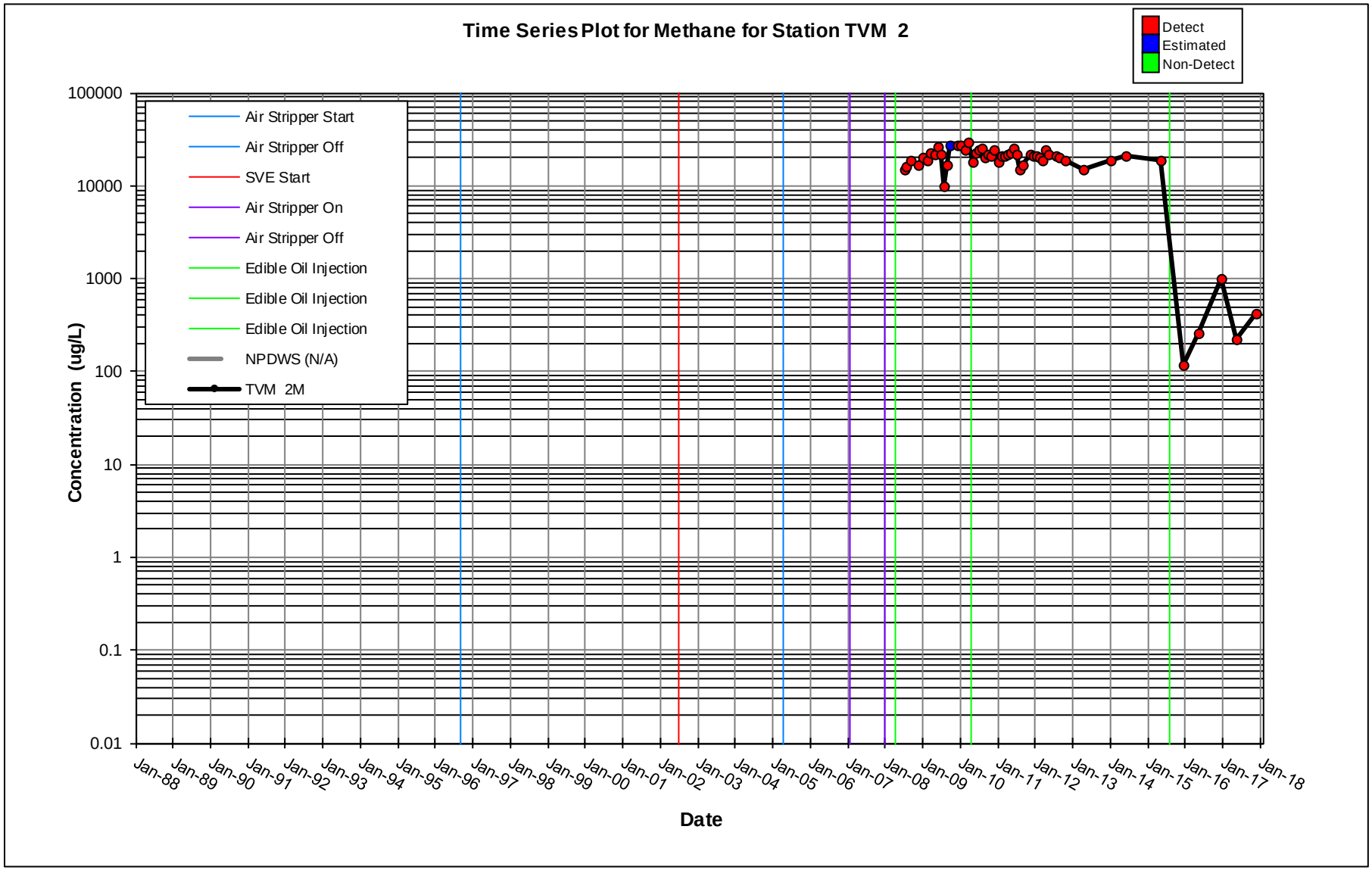
Date


Time Series Plot for Methane for Station TVM 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TVM 2M
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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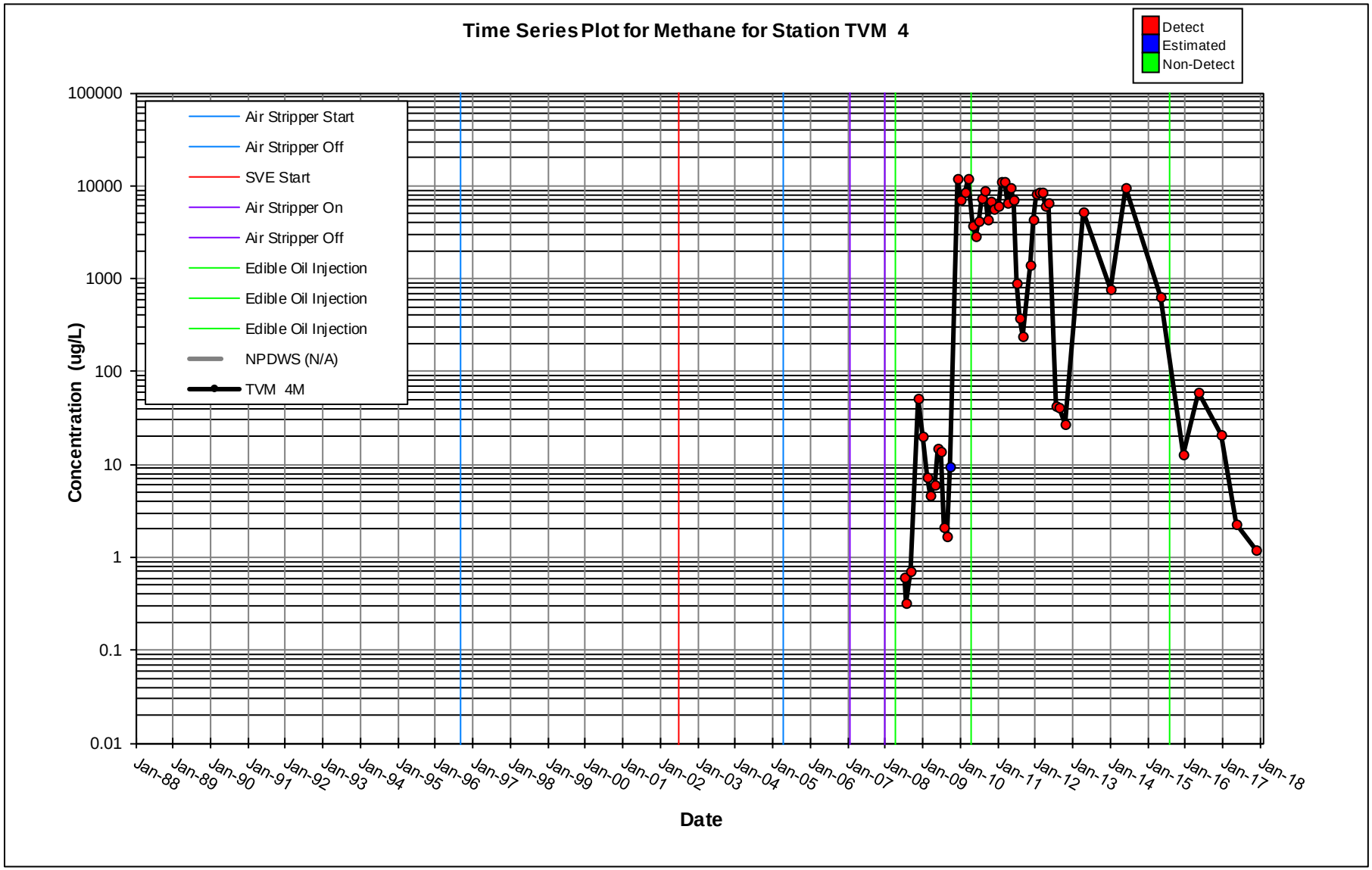
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Methane for Station TVM 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TVM 4M
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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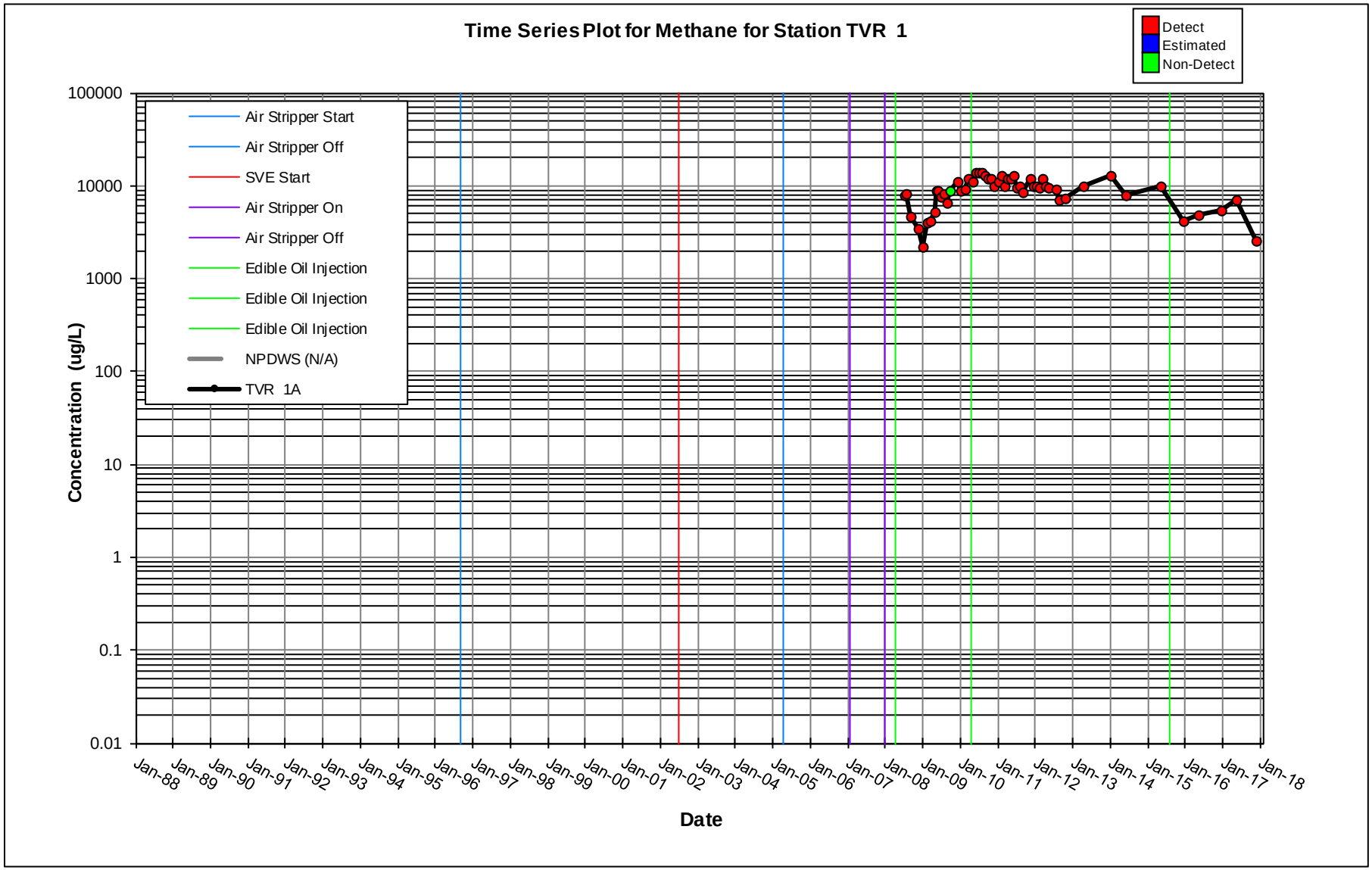
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Methane for Station TVR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (N/A)
TVR 1A
Concentration (ug/L)
100000
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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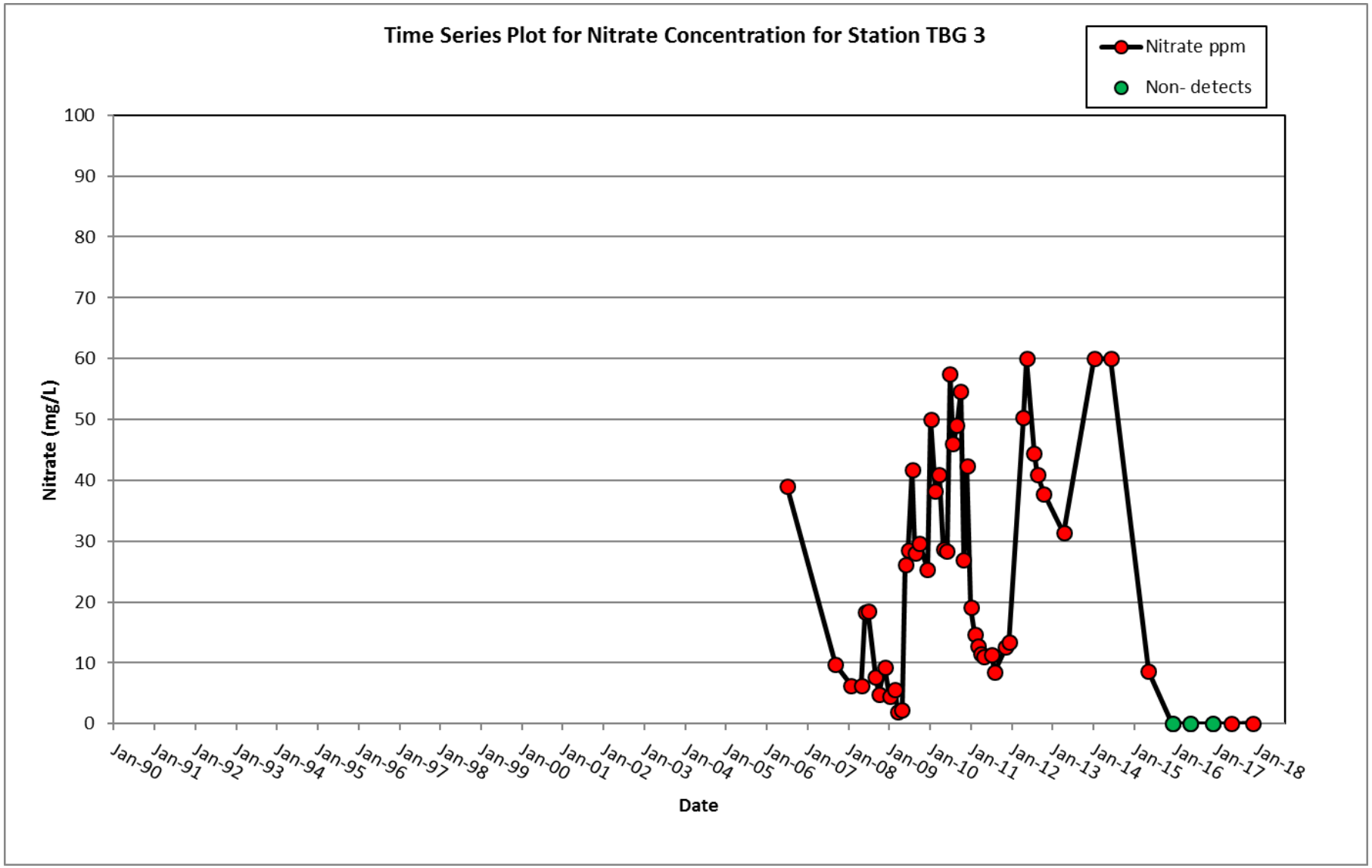
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TBG 3
Nitrate ppm
Non- detects
Nitrate (mg/L)
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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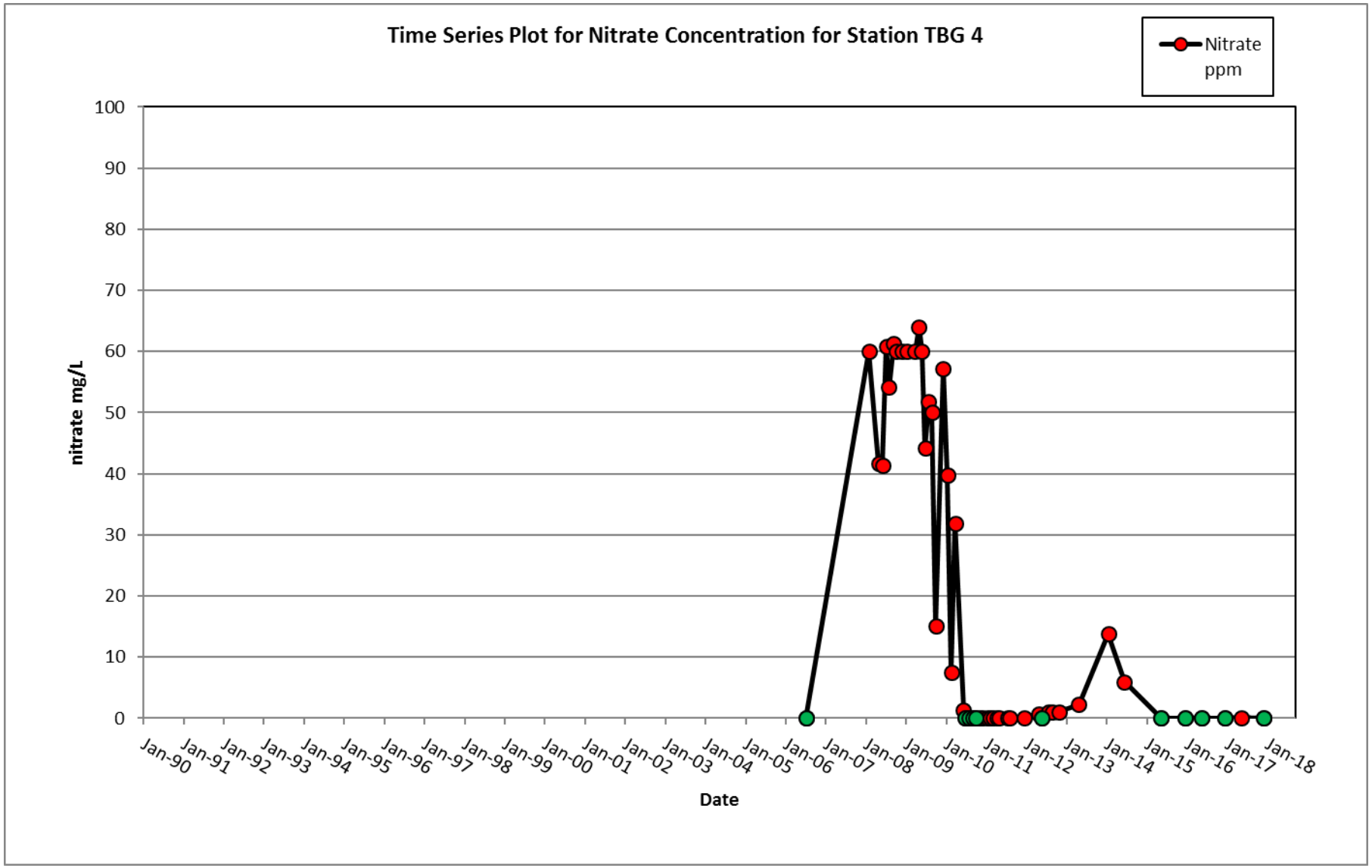
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TBG 4
Nitrate ppm
nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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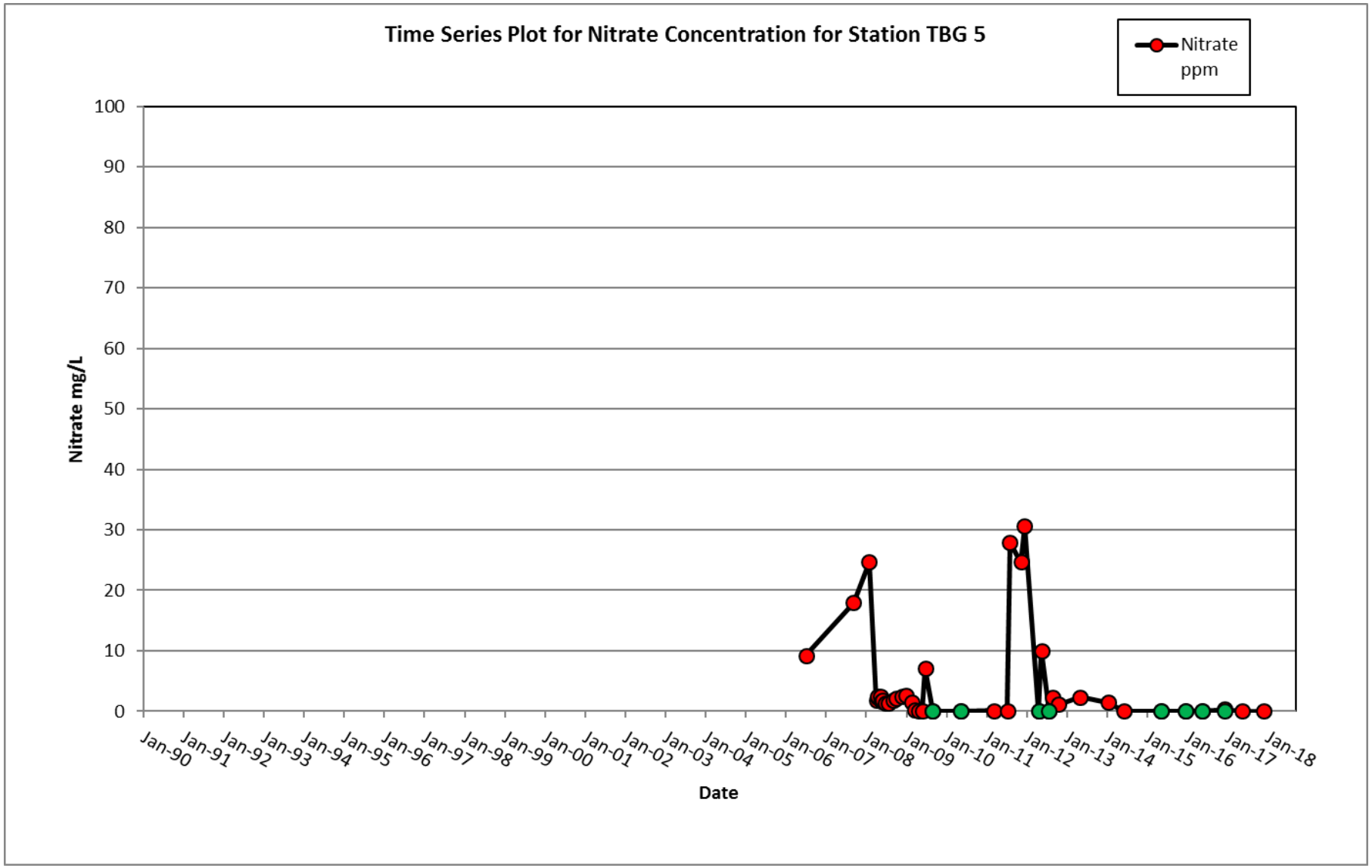
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TBG 5
Nitrate ppm
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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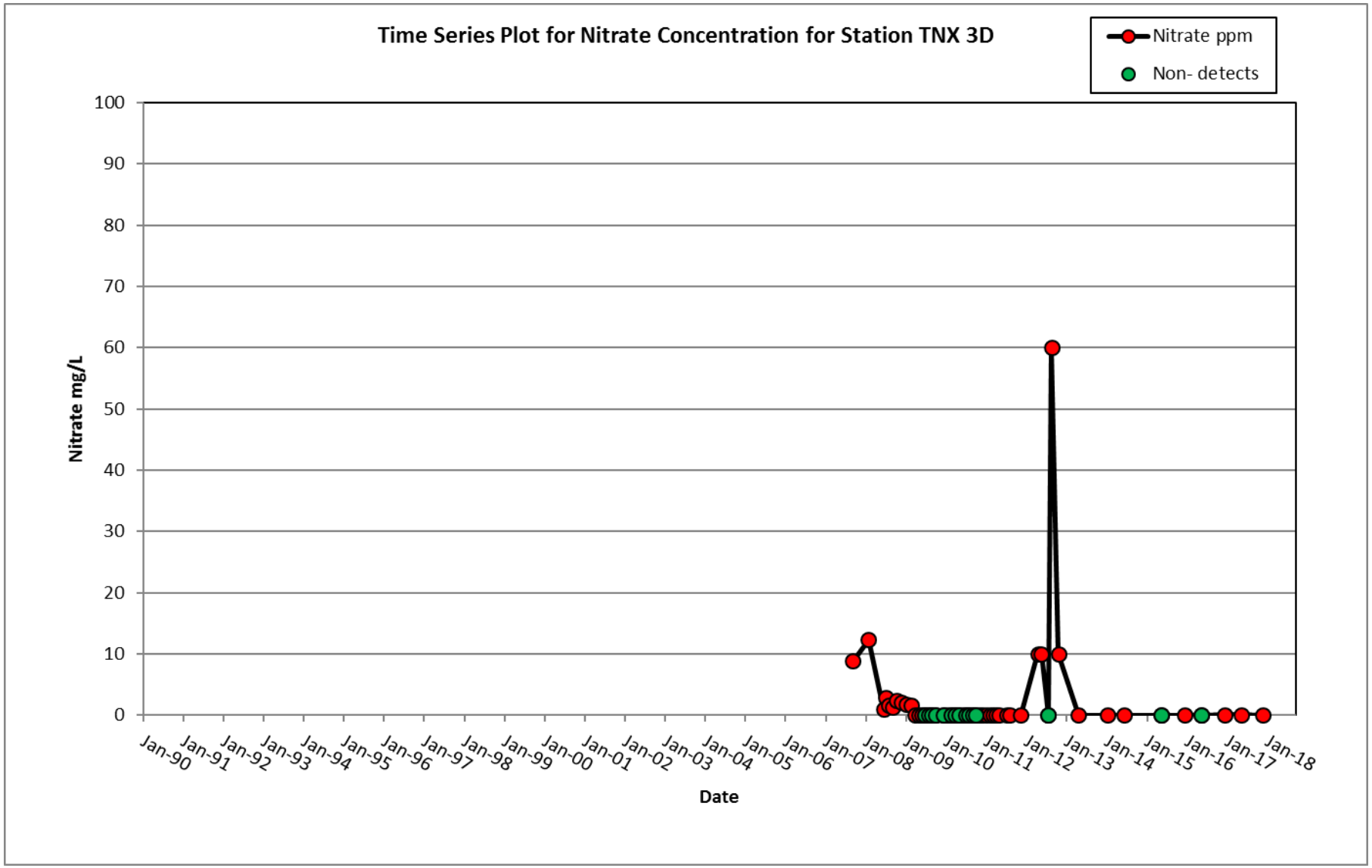
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TNX 3D
Nitrate ppm
Non- detects
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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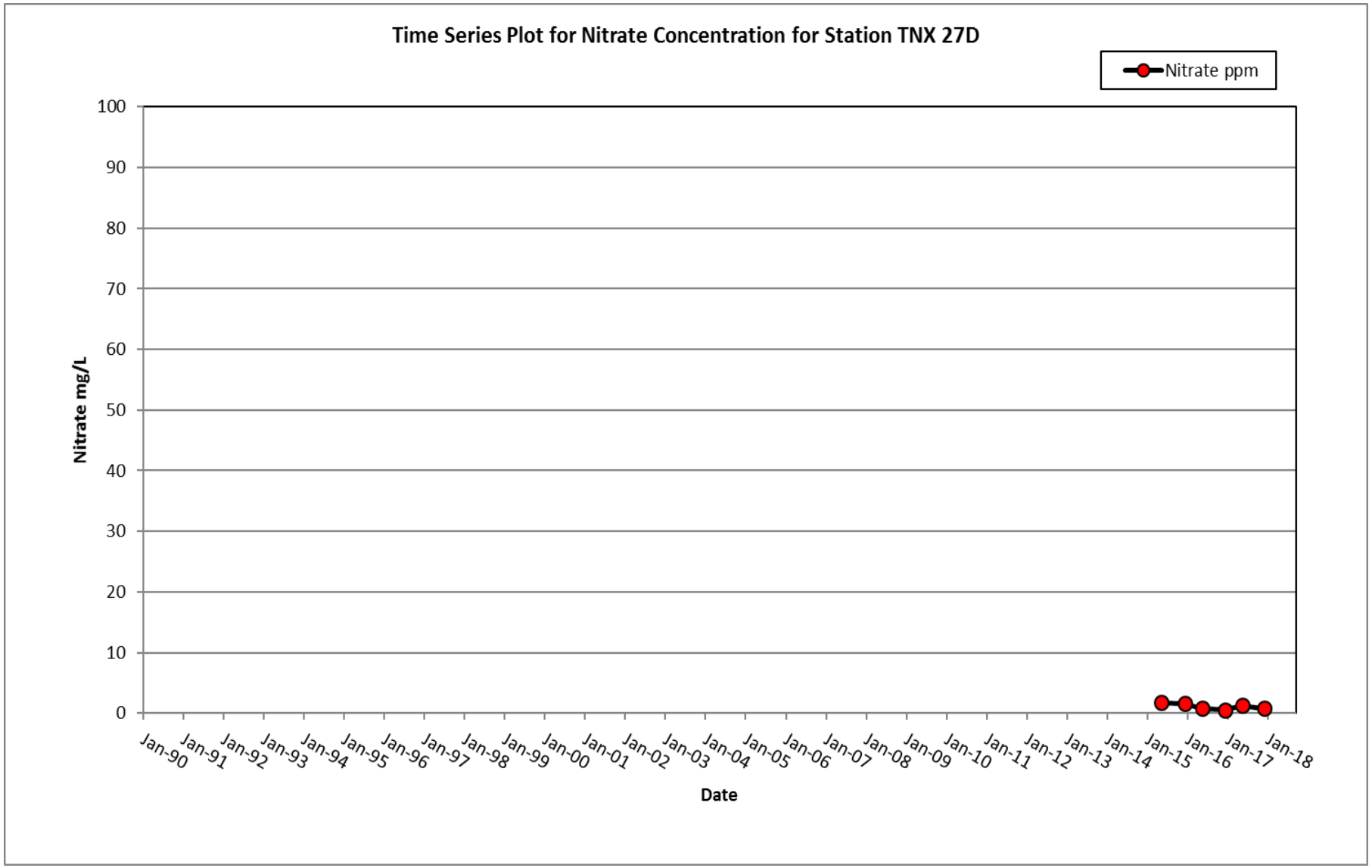
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TNX 27D
Nitrate ppm
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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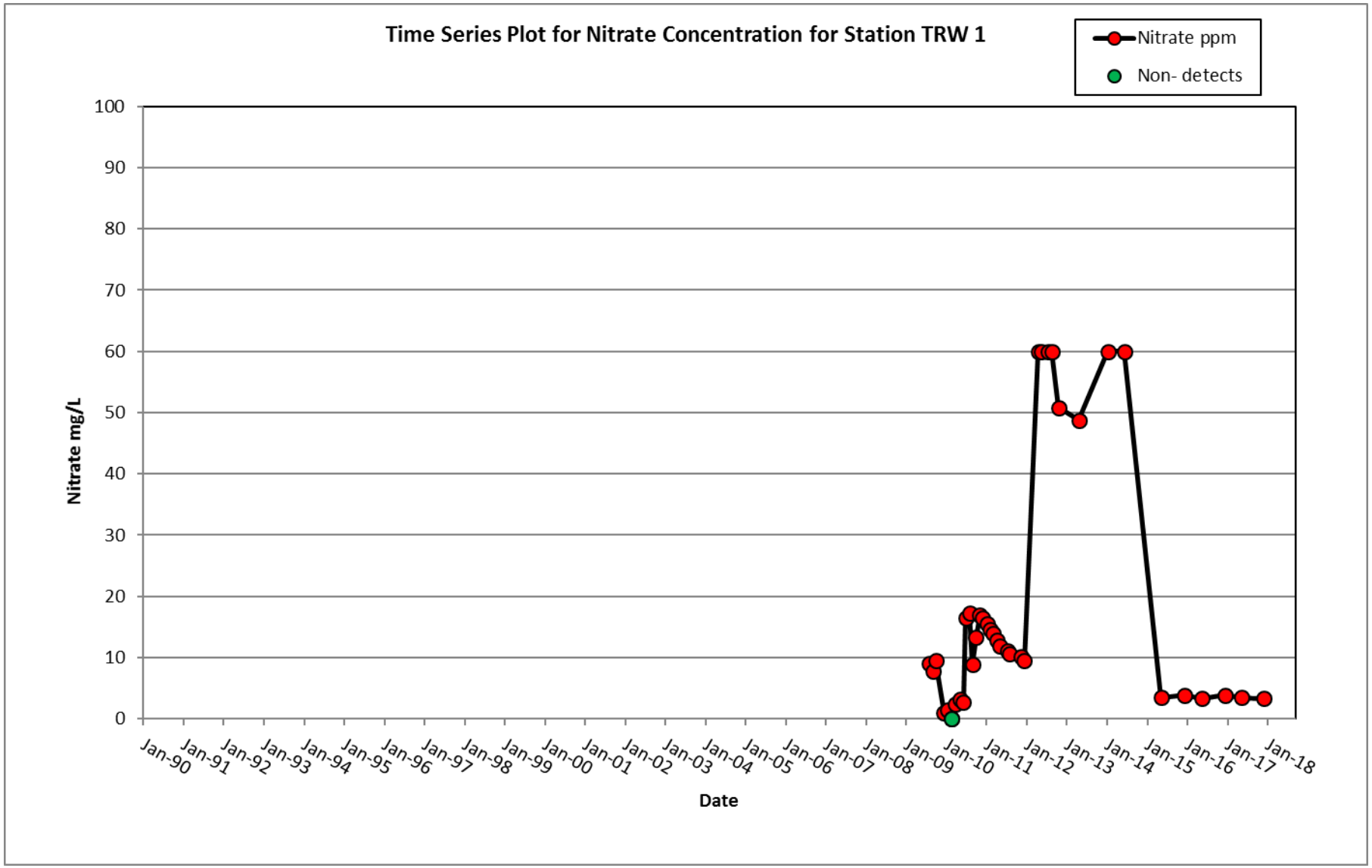
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TRW 1
Nitrate ppm
Non- detects
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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Jan-03
Jan-04
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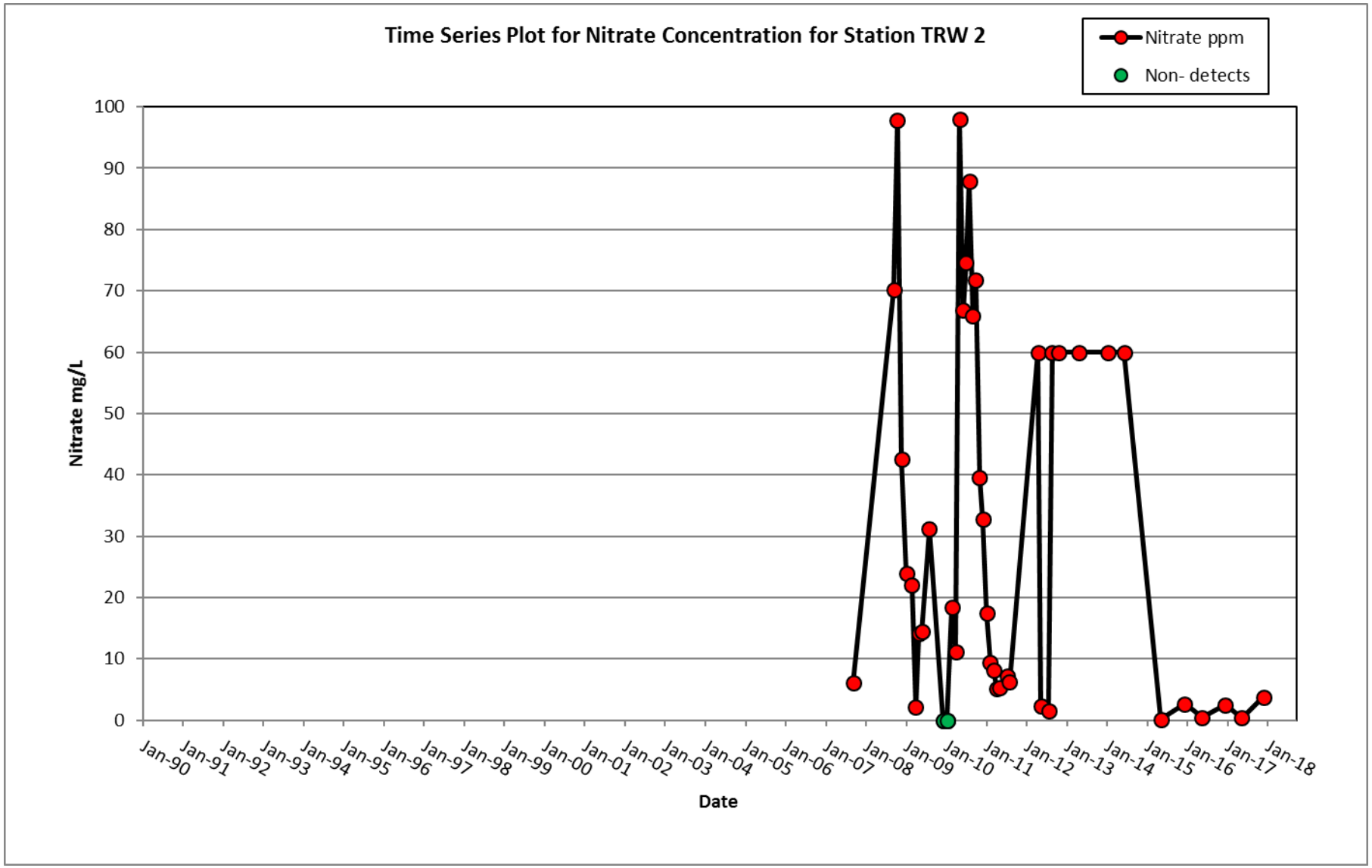
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TRW 2
Nitrate ppm
Non- detects
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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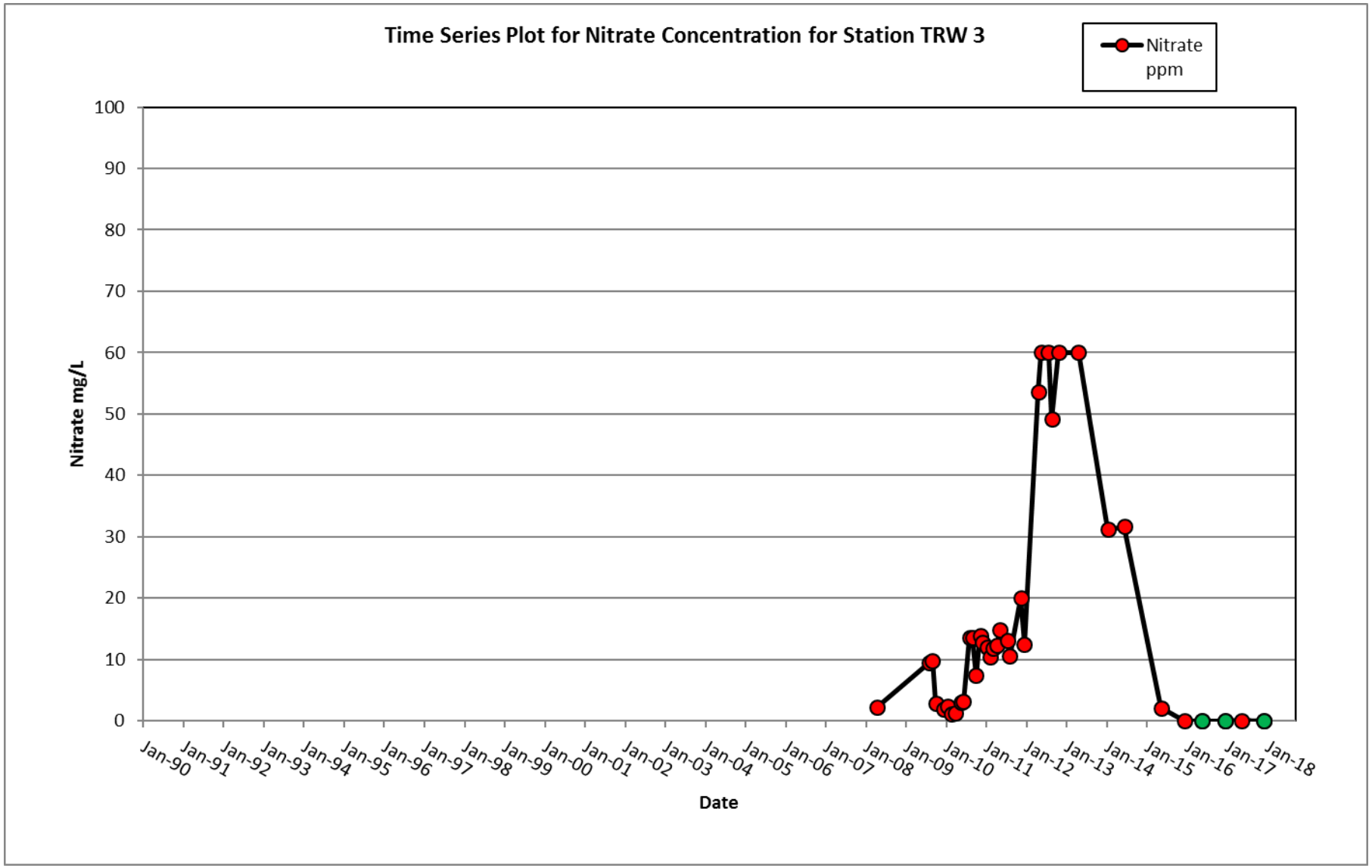
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TRW 3
Nitrate ppm
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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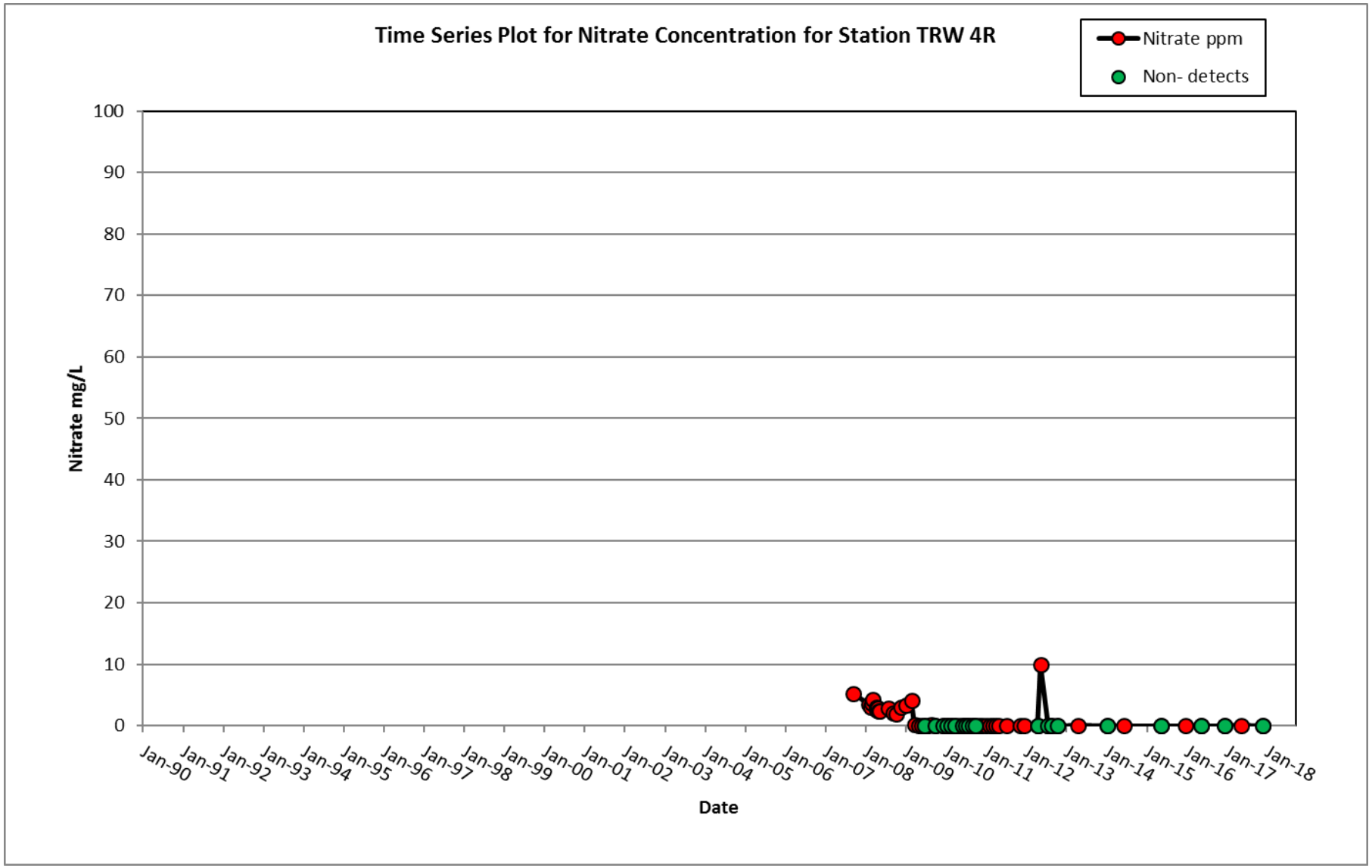
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TRW 4R
Nitrate ppm
Non- detects
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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Jan-03
Jan-04
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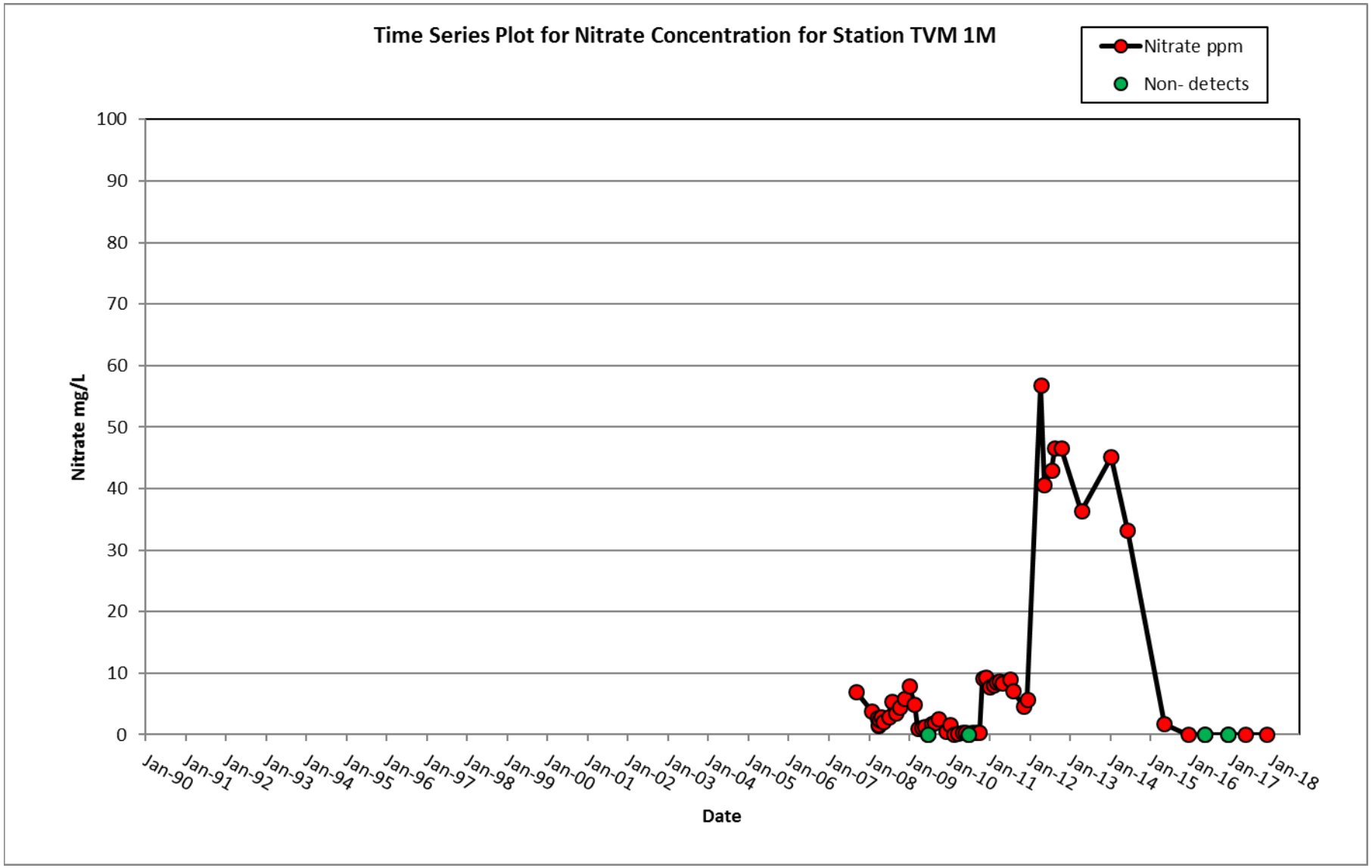
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TVM 1M
Nitrate ppm
Non- detects
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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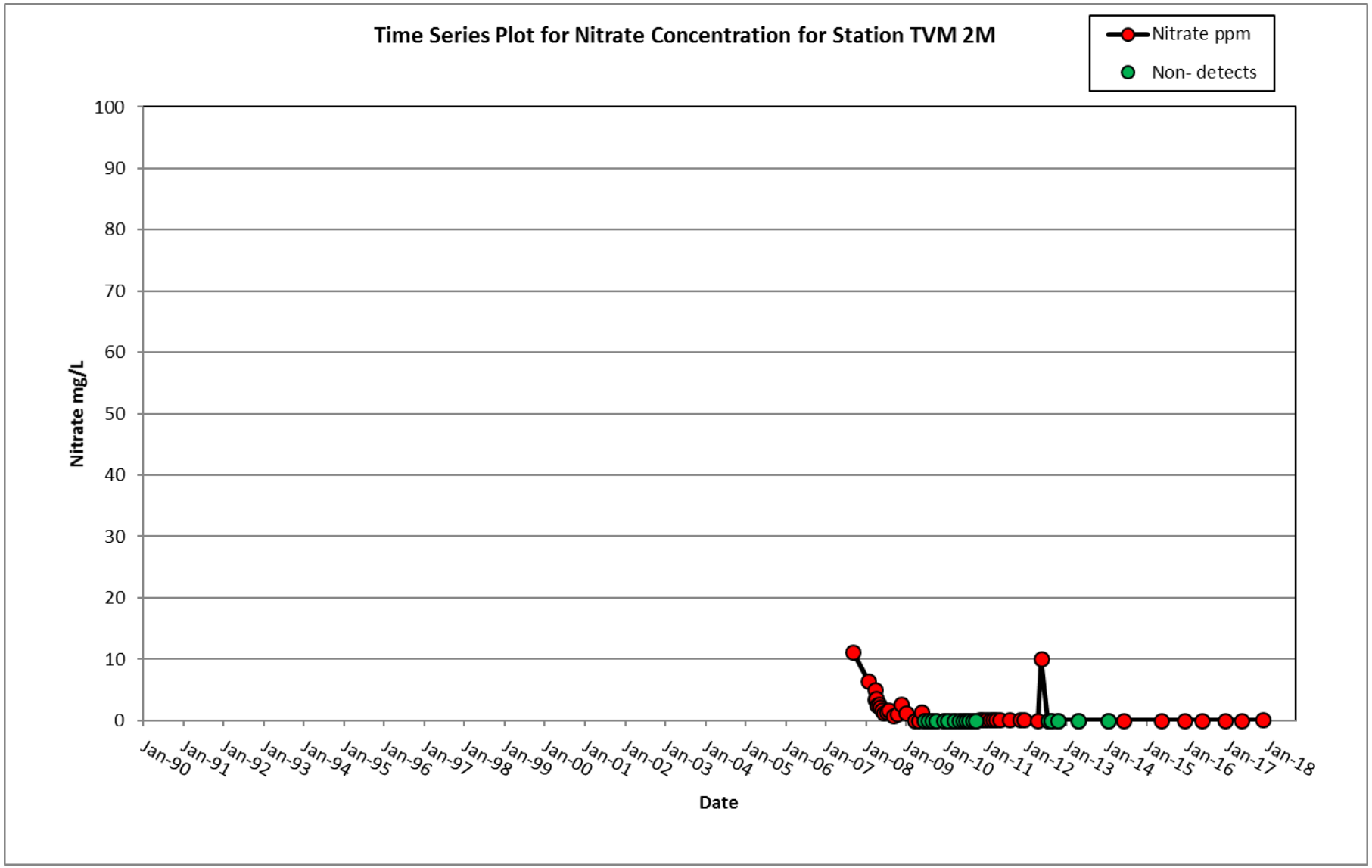
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TVM 2M
Nitrate ppm
Non- detects
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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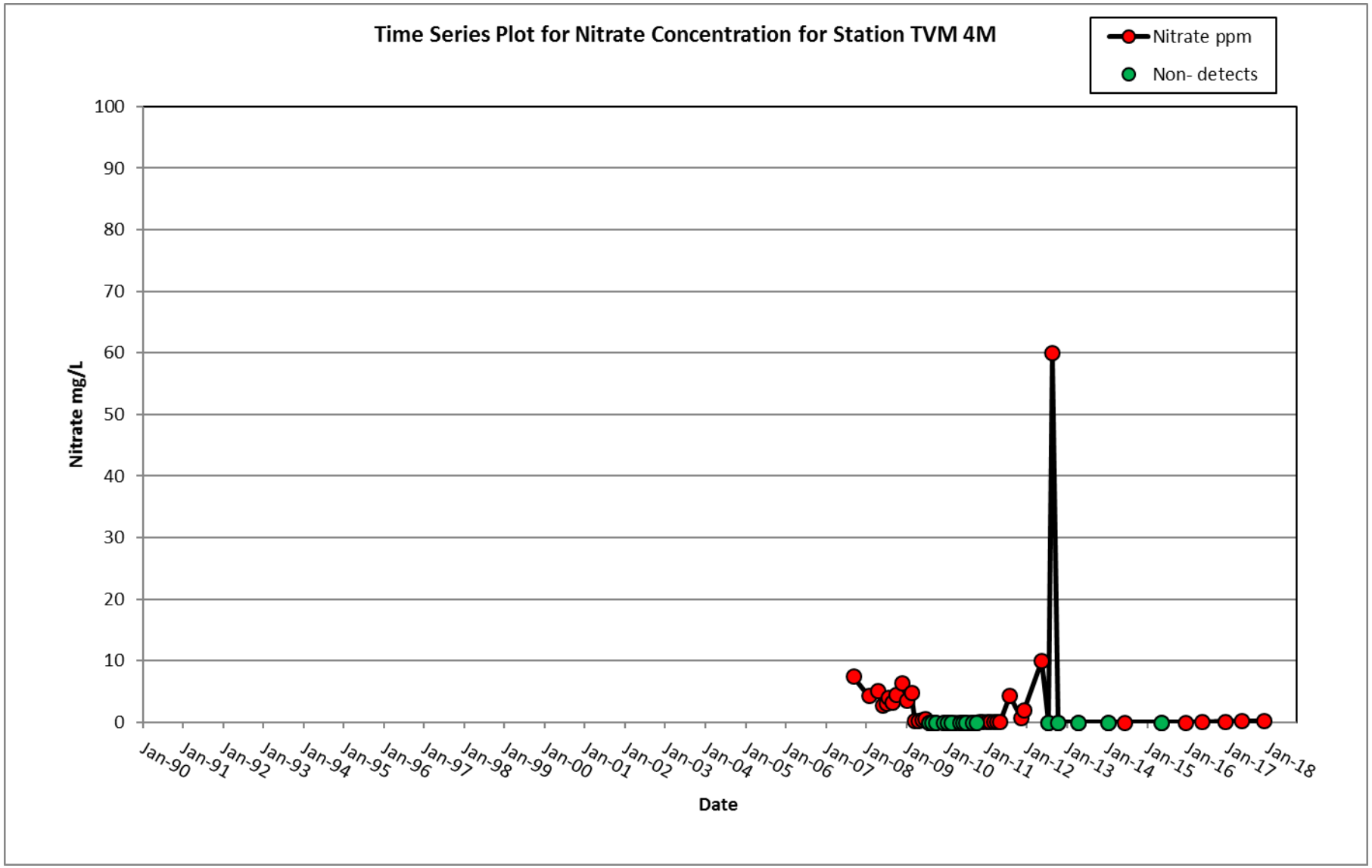
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TVM 4M
Nitrate ppm
Non- detects
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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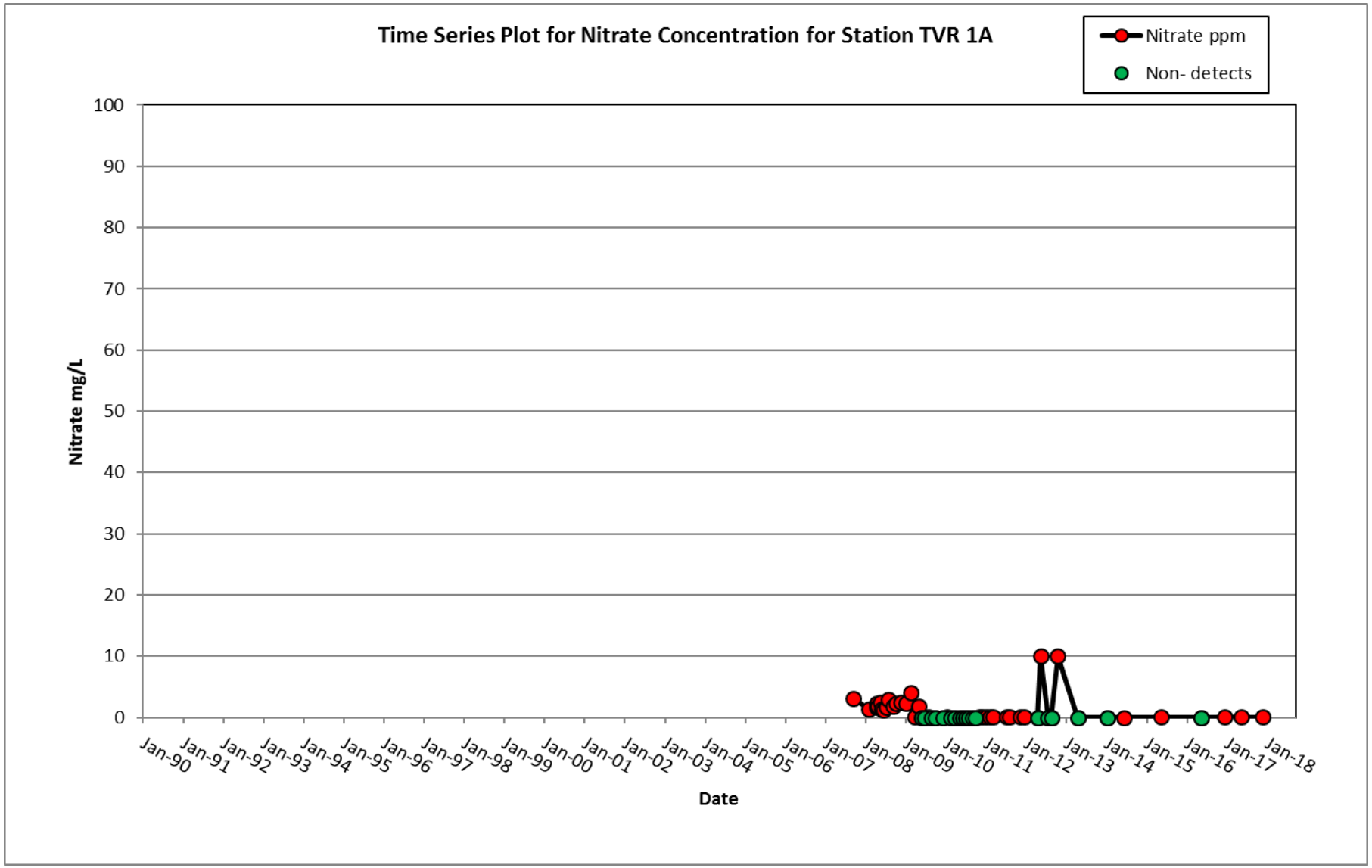
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate Concentration for Station TVR 1A
Nitrate ppm
Non- detects
Nitrate mg/L
100
90
80
70
60
50
40
30
20
10
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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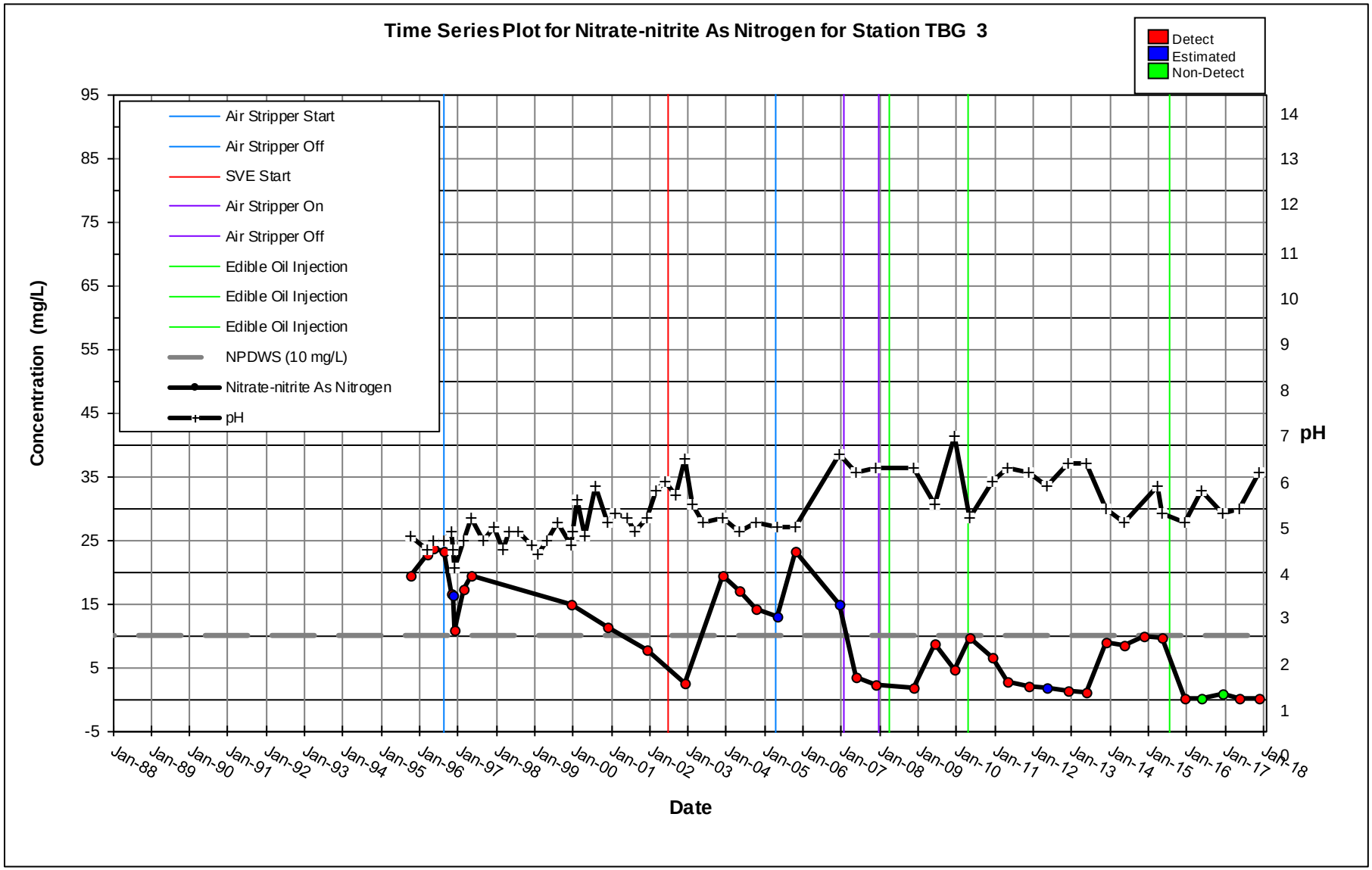
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Nitrate-nitrite As Nitrogen for Station TBG 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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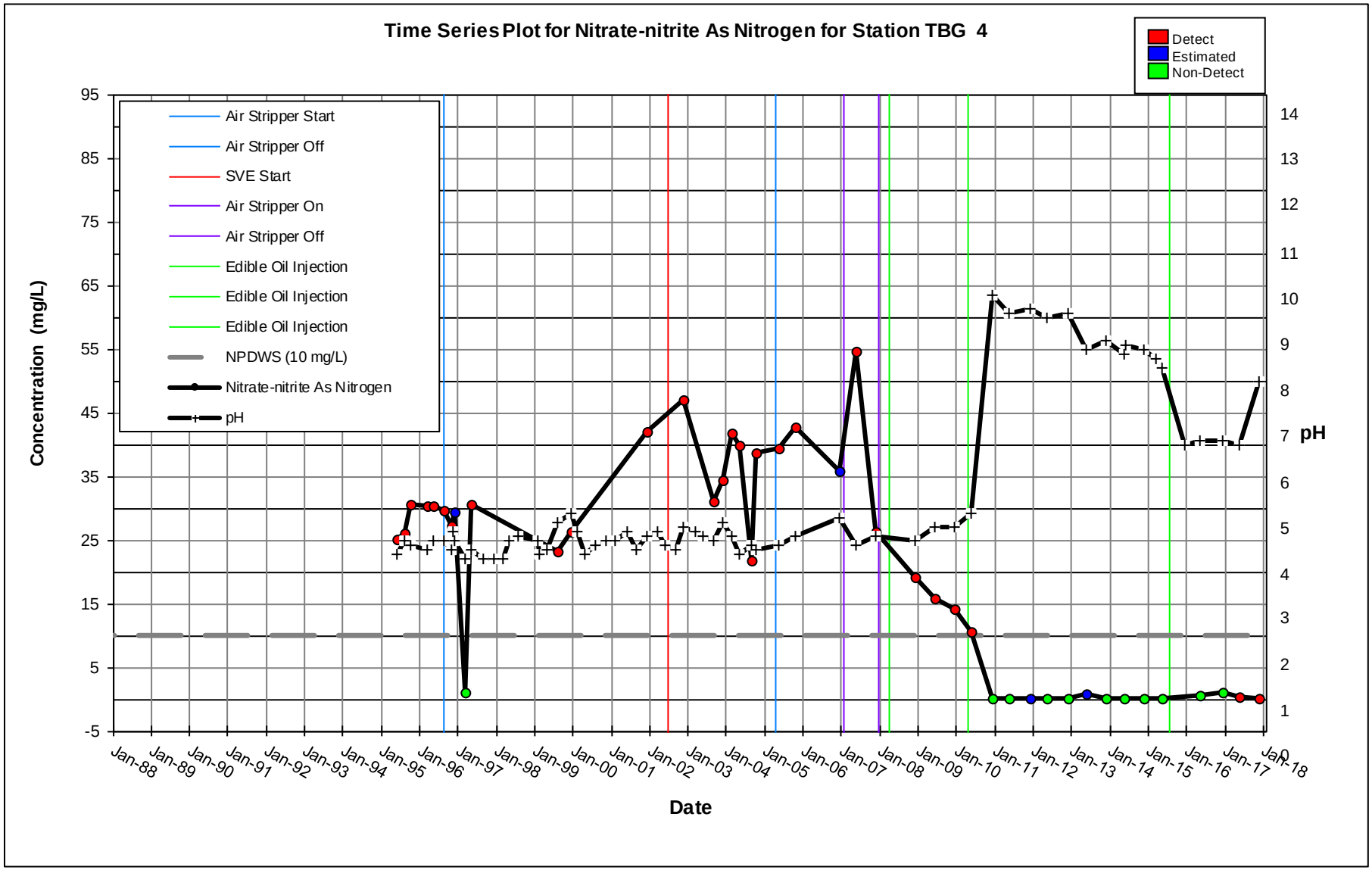
Jan-16
Jan-17
Jan-18


Time Series Plot for Nitrate-nitrite As Nitrogen for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
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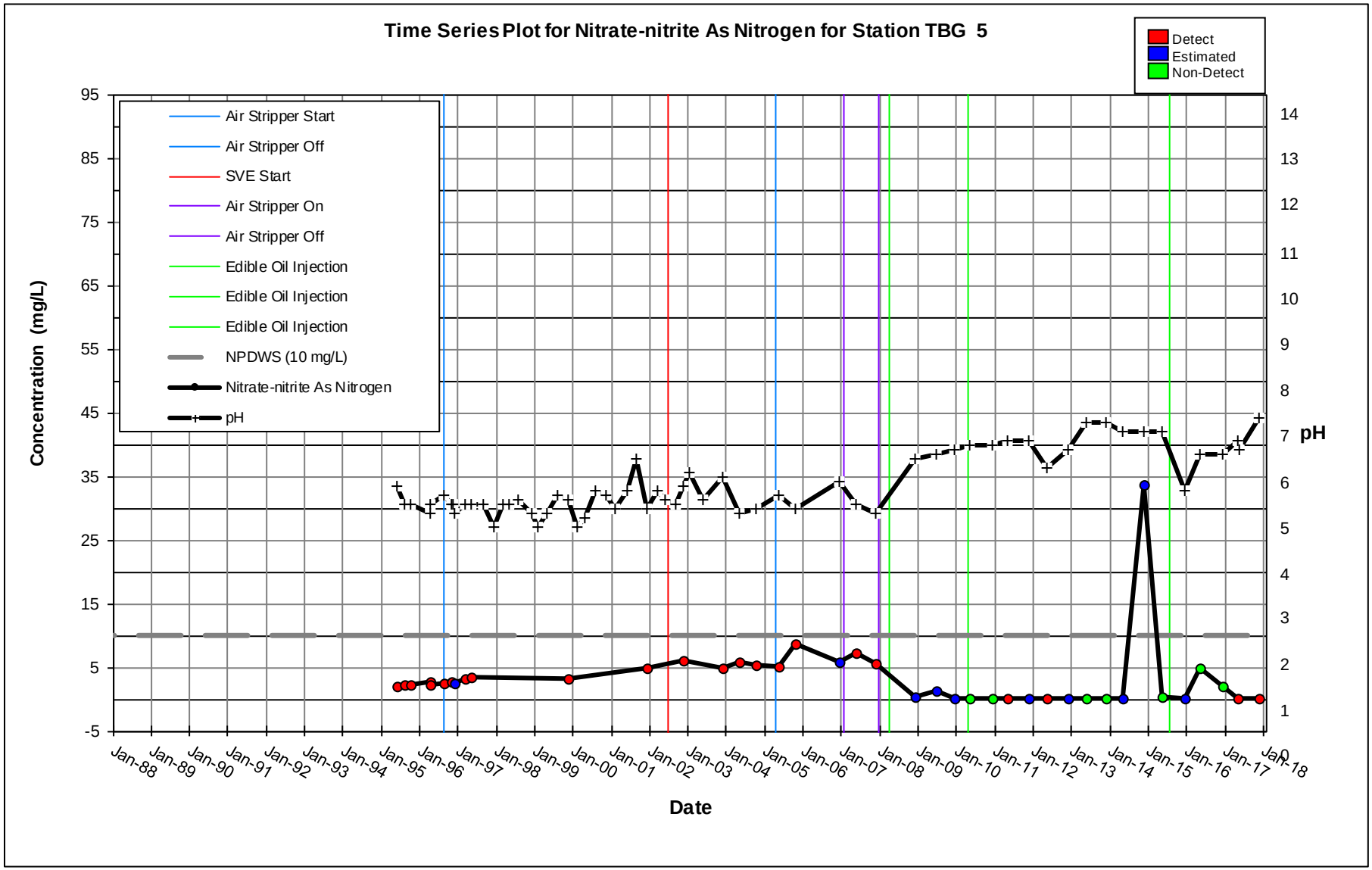
Jan-15
Jan-16
Jan-17
Jan-18


Time Series Plot for Nitrate-nitrite As Nitrogen for Station TBG 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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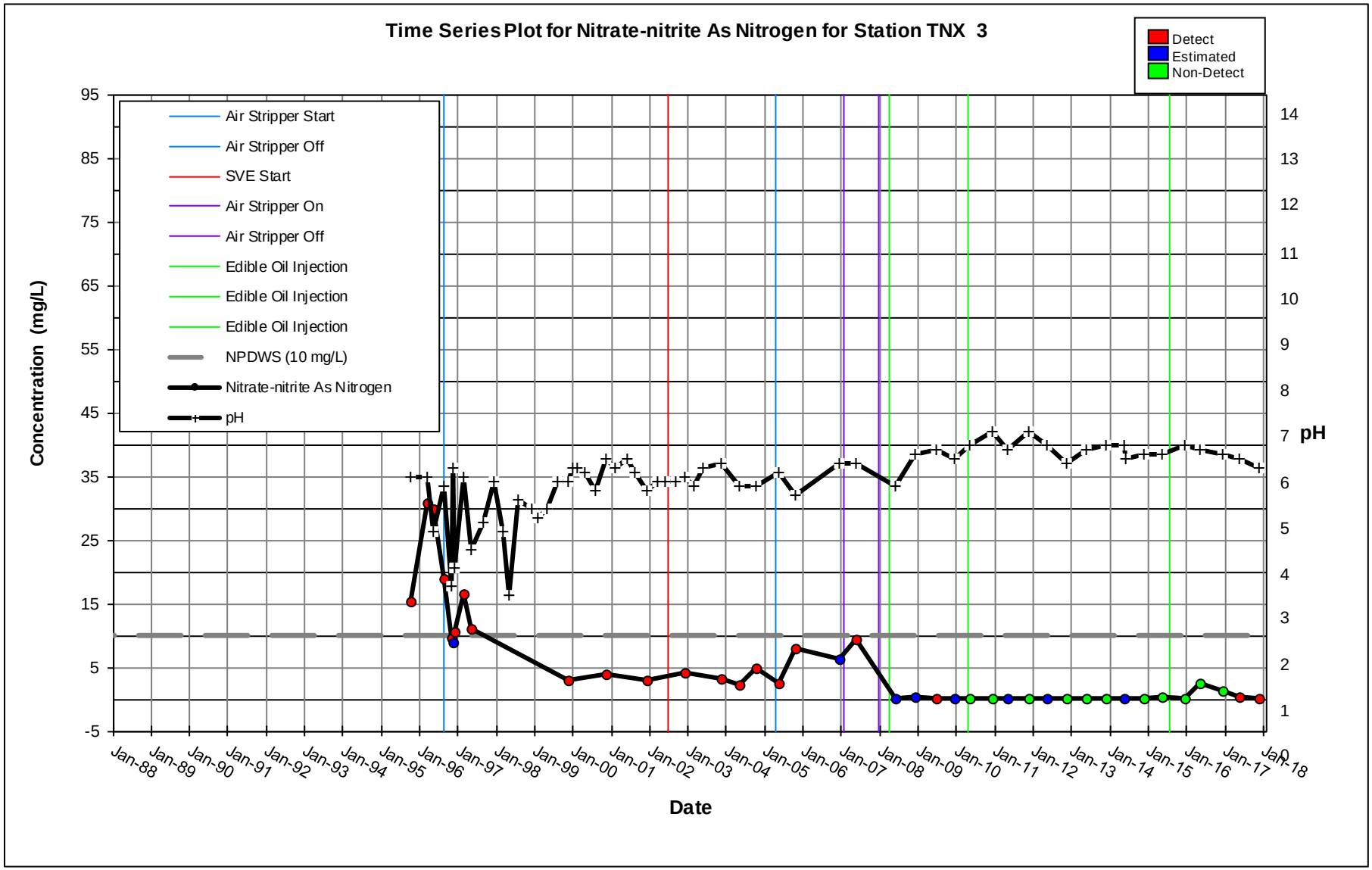
Jan-16
Jan-17
Jan-18


Time Series Plot for Nitrate-nitrite As Nitrogen for Station TNX 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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Jan-99
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Jan-01
Jan-02
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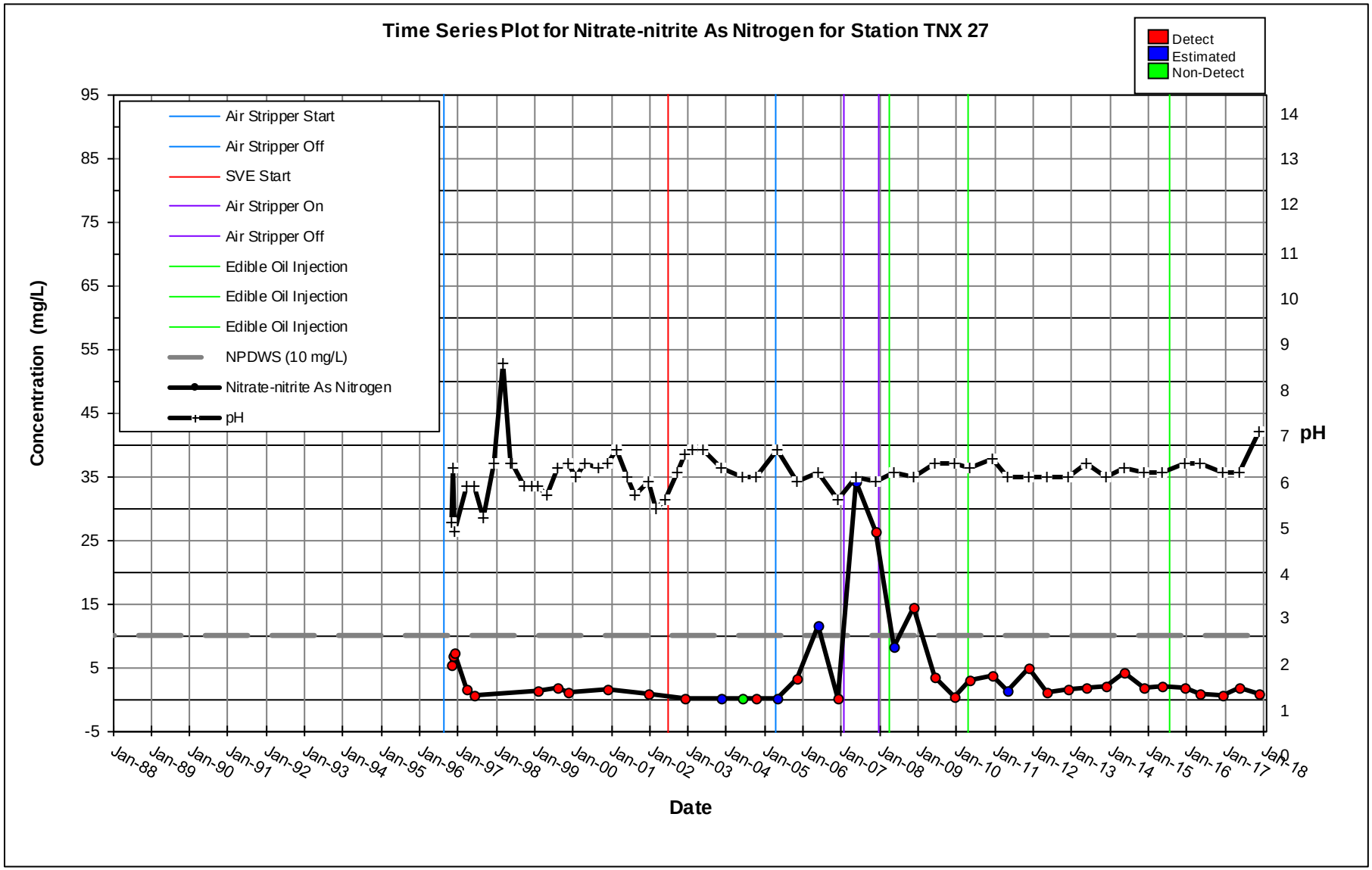
Time Series Plot for Nitrate-nitrite As Nitrogen for Station TNX 27
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
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Jan-88
Jan-89
Jan-90
Jan-91
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Jan-93
Jan-94
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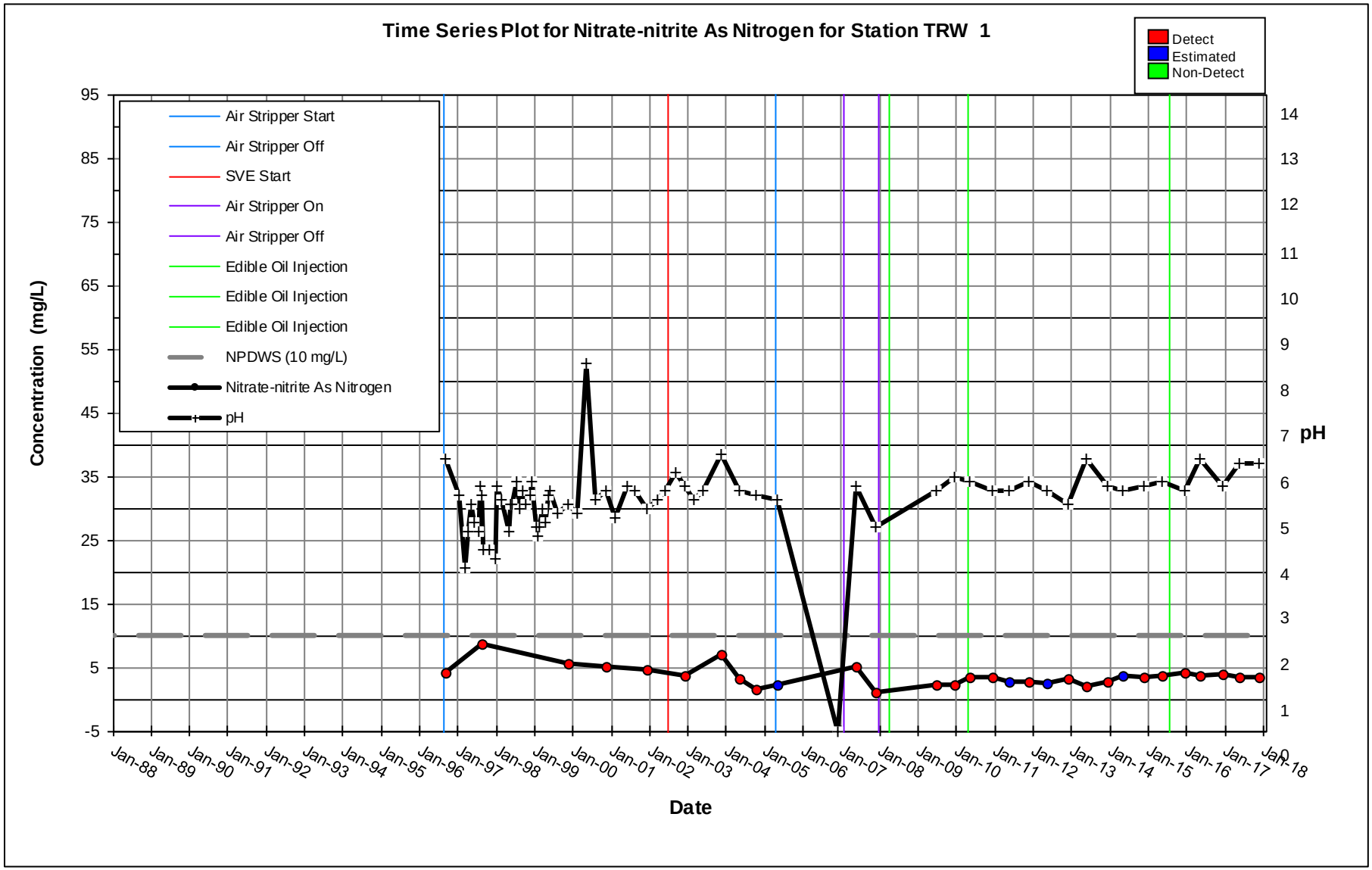
Jan-18


Time Series Plot for Nitrate-nitrite As Nitrogen for Station TRW 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
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Jan-01
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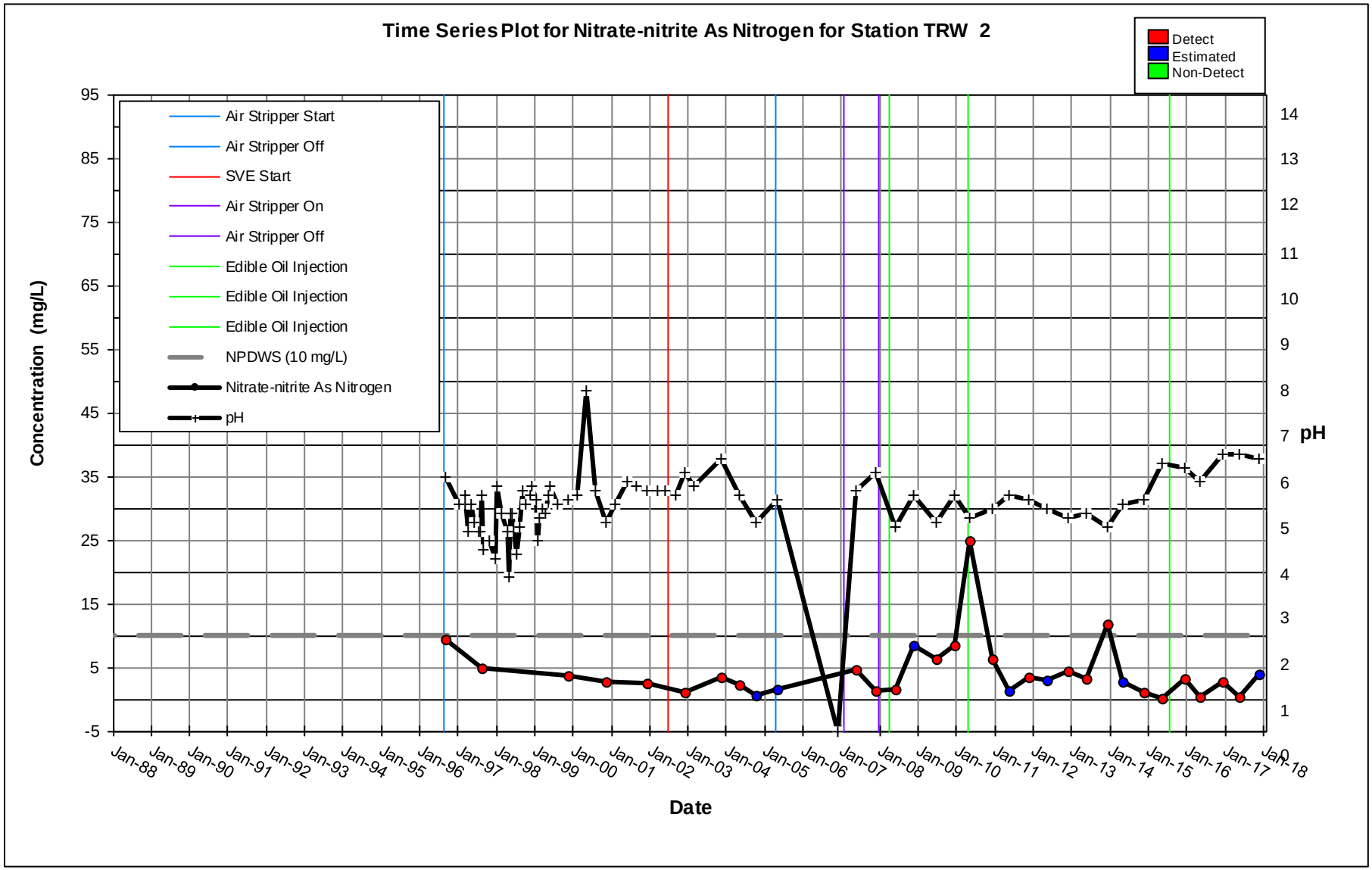
Time Series Plot for Nitrate-nitrite As Nitrogen for Station TRW 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
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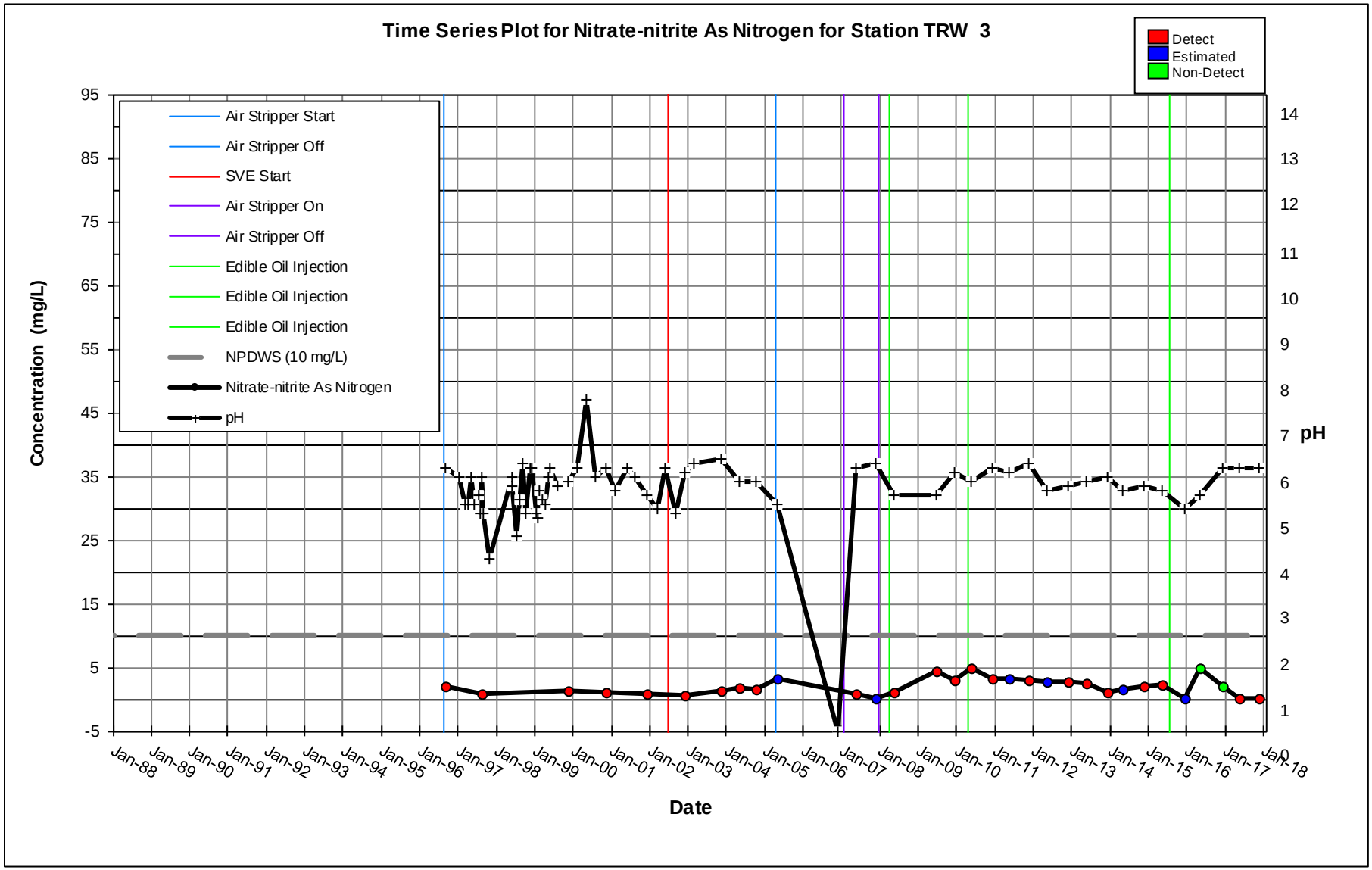
Time Series Plot for Nitrate-nitrite As Nitrogen for Station TRW 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-88
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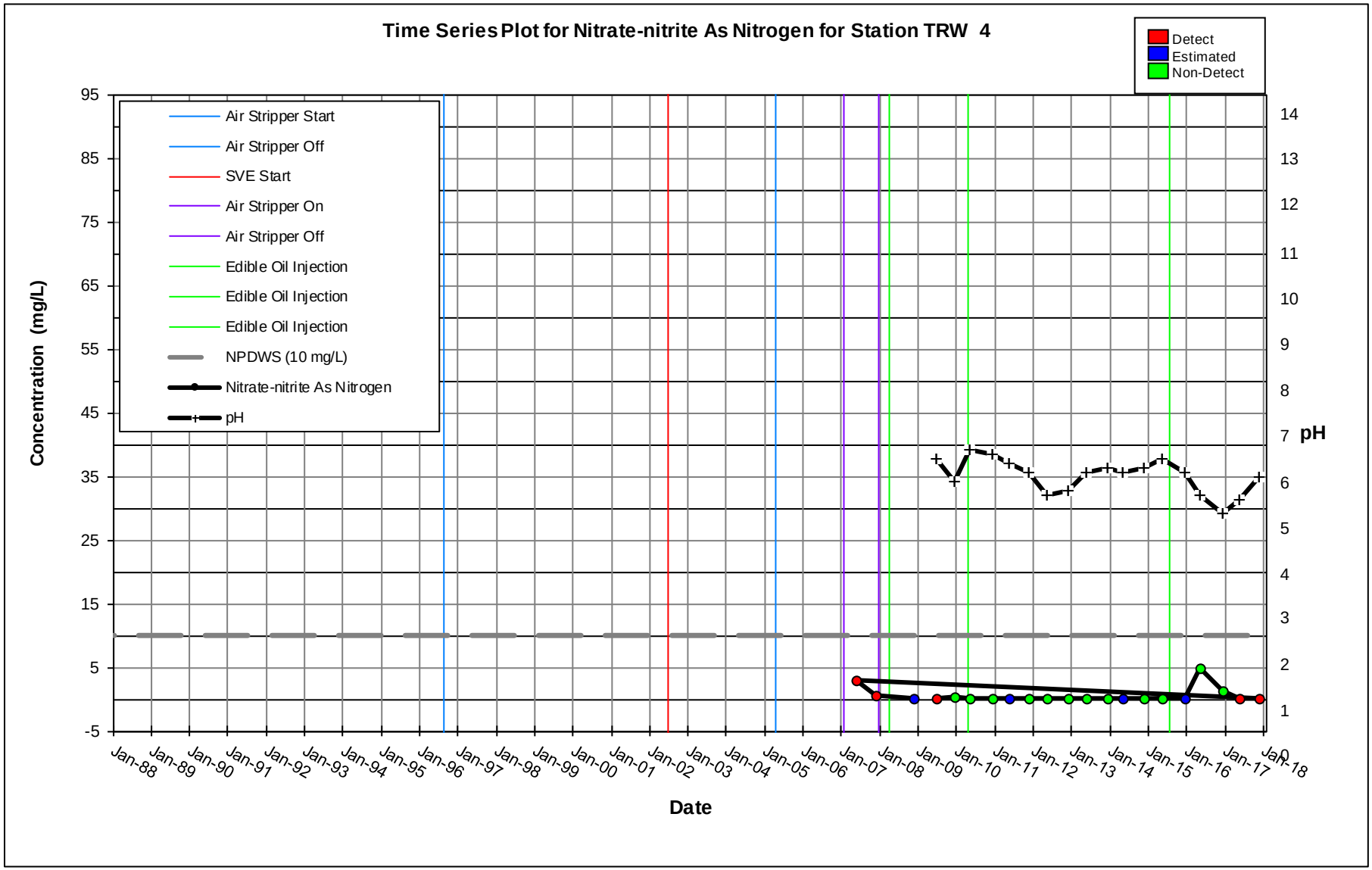
Time Series Plot for Nitrate-nitrite As Nitrogen for Station TRW 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-88
Jan-89
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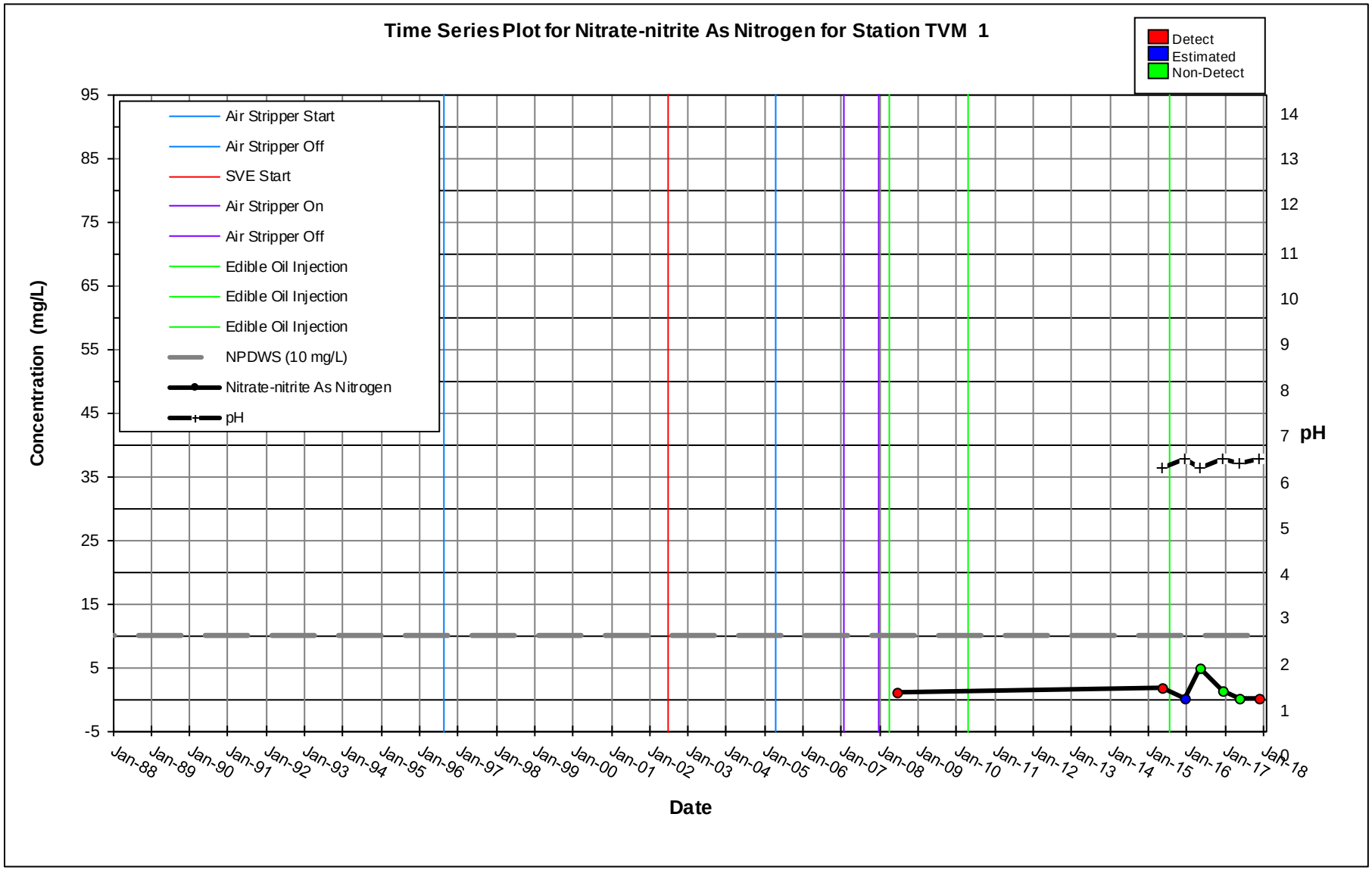
Time Series Plot for Nitrate-nitrite As Nitrogen for Station TVM 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Jan-88
Jan-89
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Jan-95
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Jan-01
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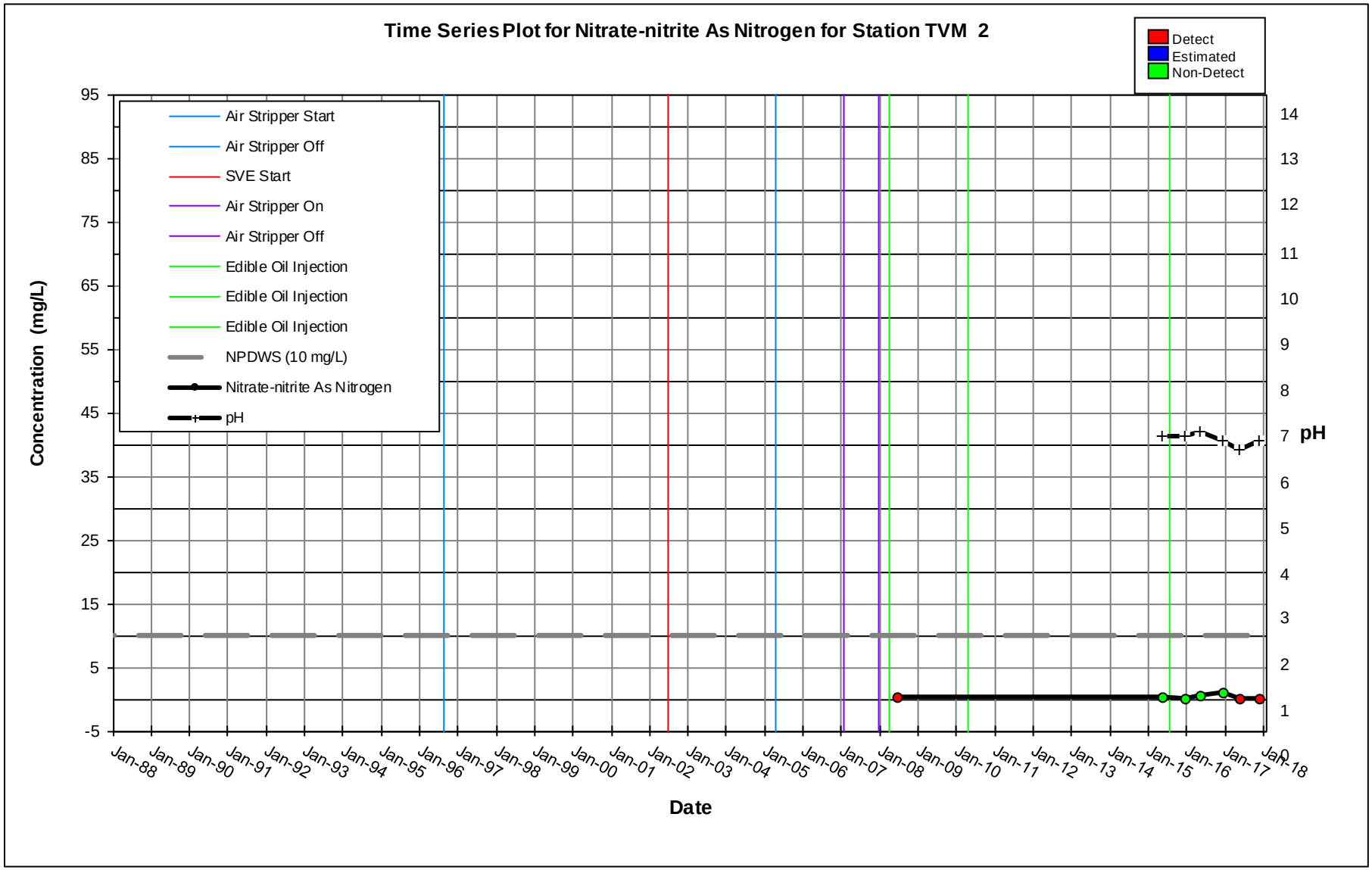
Time Series Plot for Nitrate-nitrite As Nitrogen for Station TVM 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
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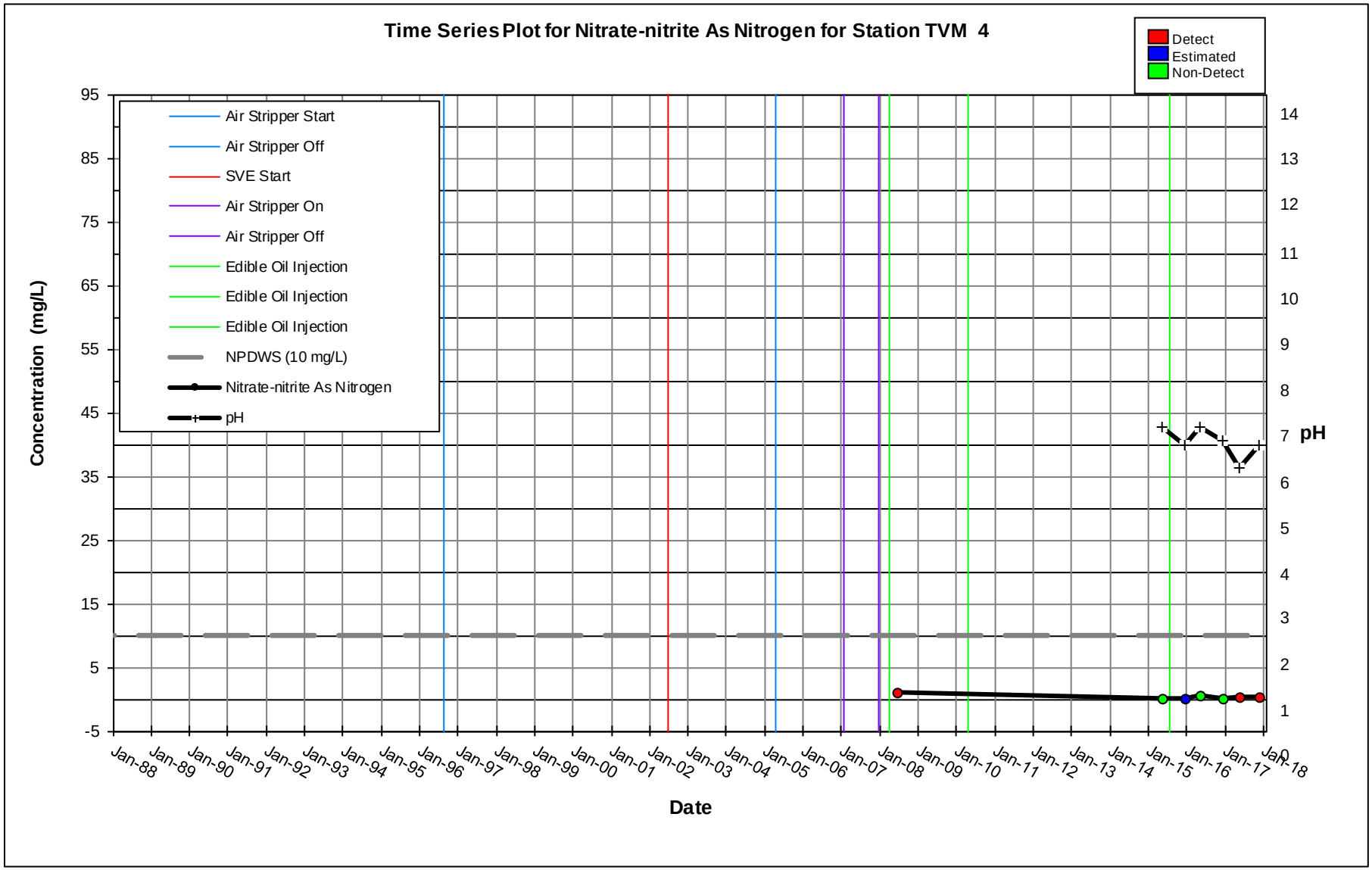
Time Series Plot for Nitrate-nitrite As Nitrogen for Station TVM 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
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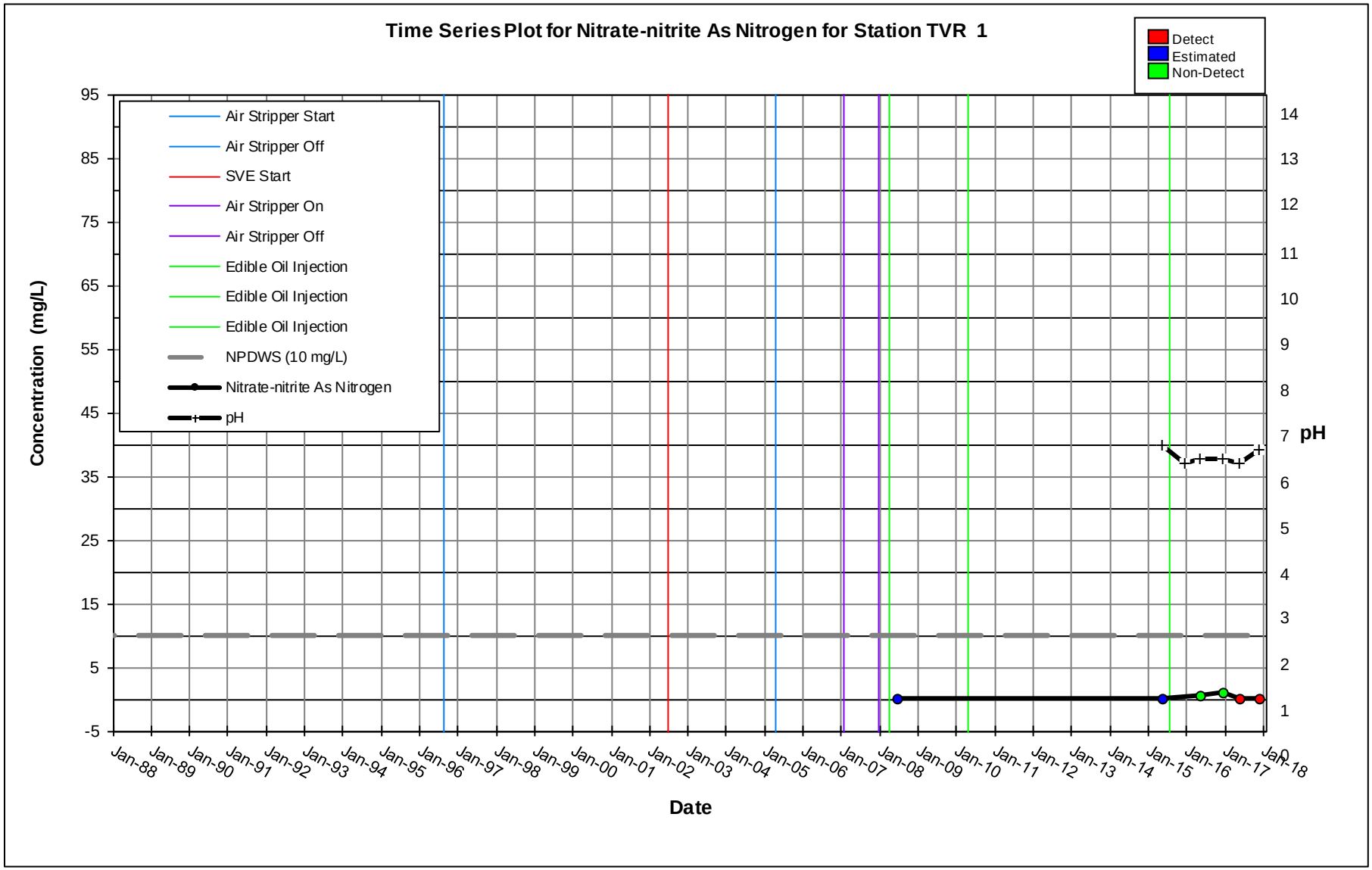
Time Series Plot for Nitrate-nitrite As Nitrogen for Station TVR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (10 mg/L)
Nitrate-nitrite As Nitrogen
pH
Concentration (mg/L)
pH
Date
95
85
75
65
55
45
35
25
15
5
-5
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
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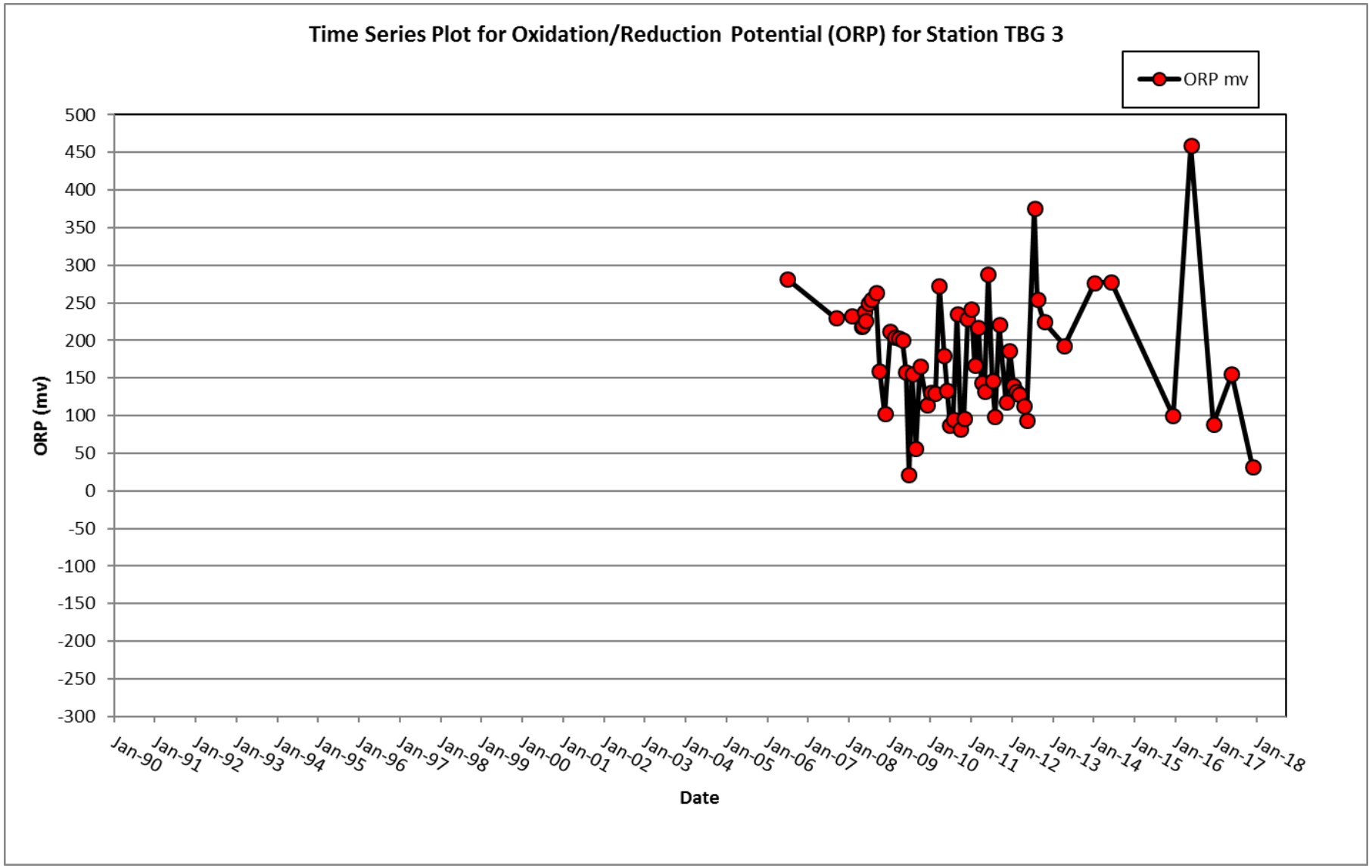
Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TBG 3
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
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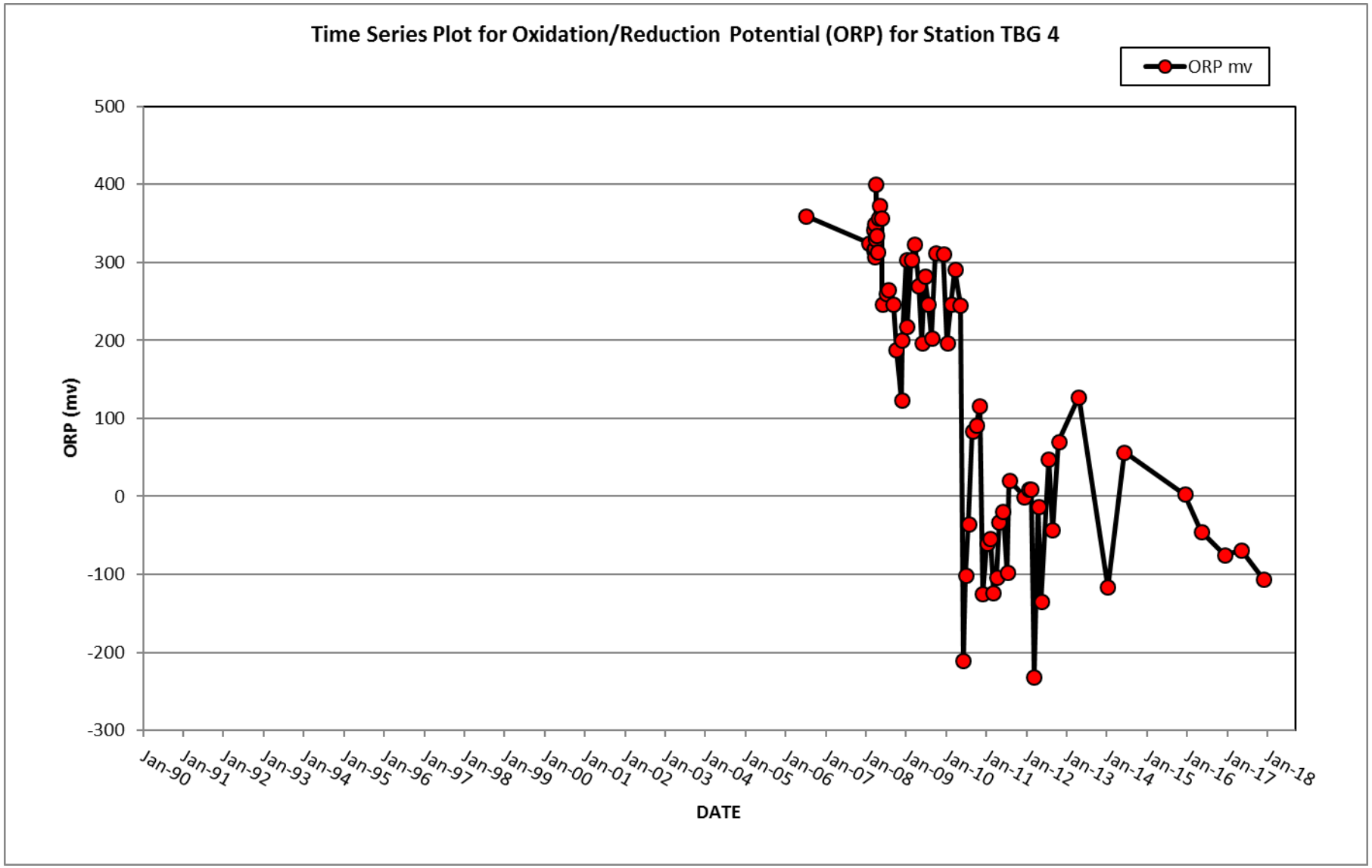
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TBG 4
ORP mv
ORP (mv)
500
400
300
200
100
0
-100
-200
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
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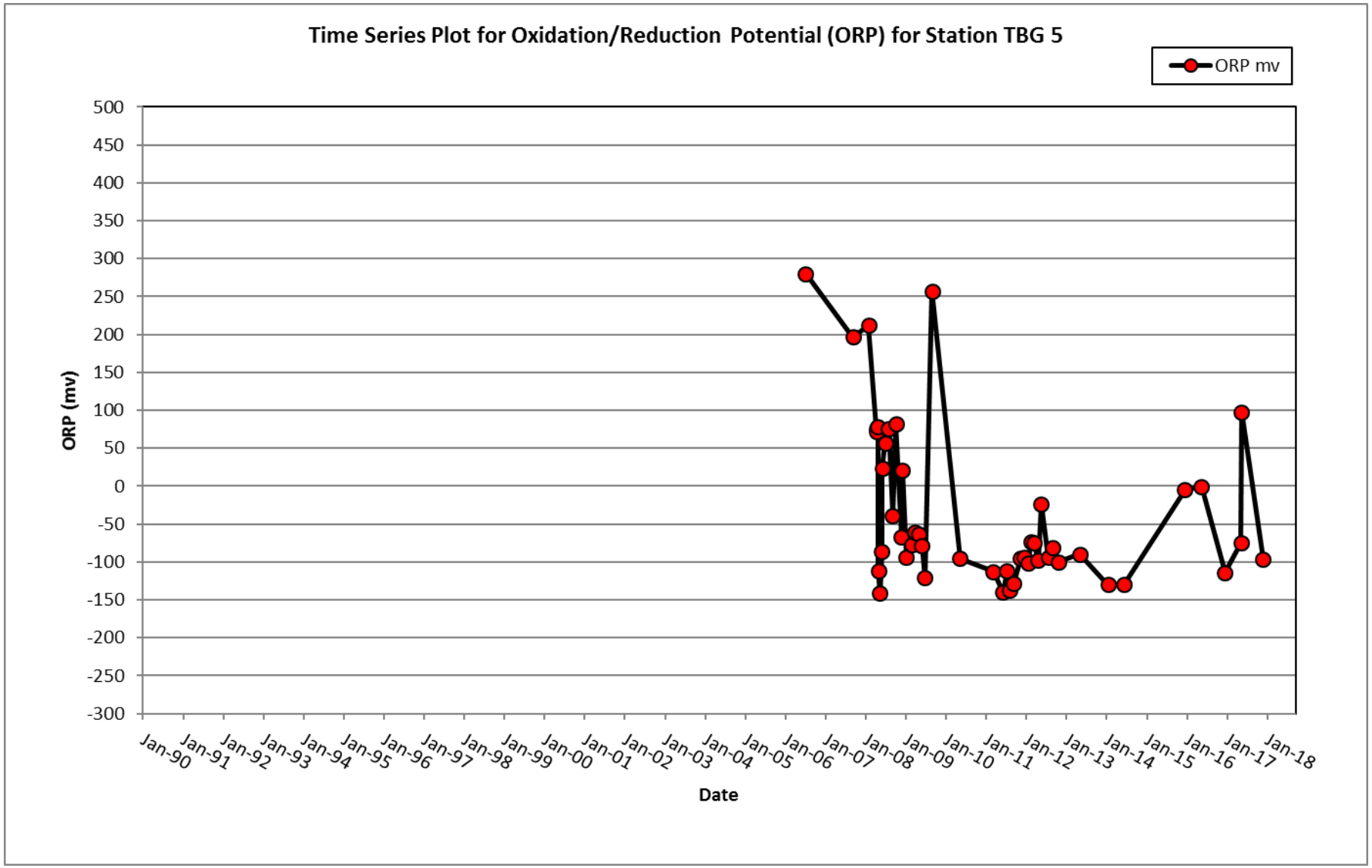
Jan-16
Jan-17
Jan-18
DATE


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TBG 5
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
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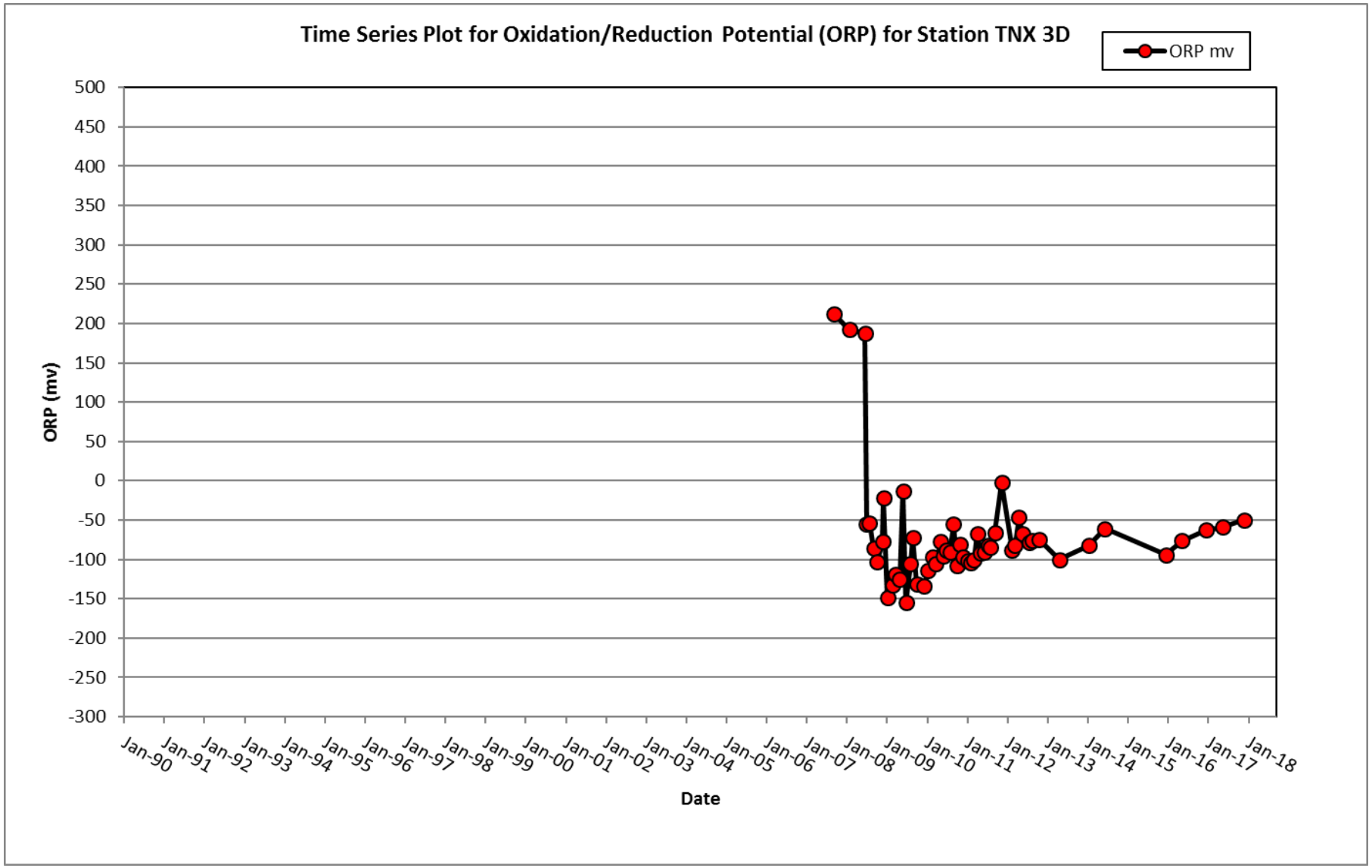
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TNX 3D
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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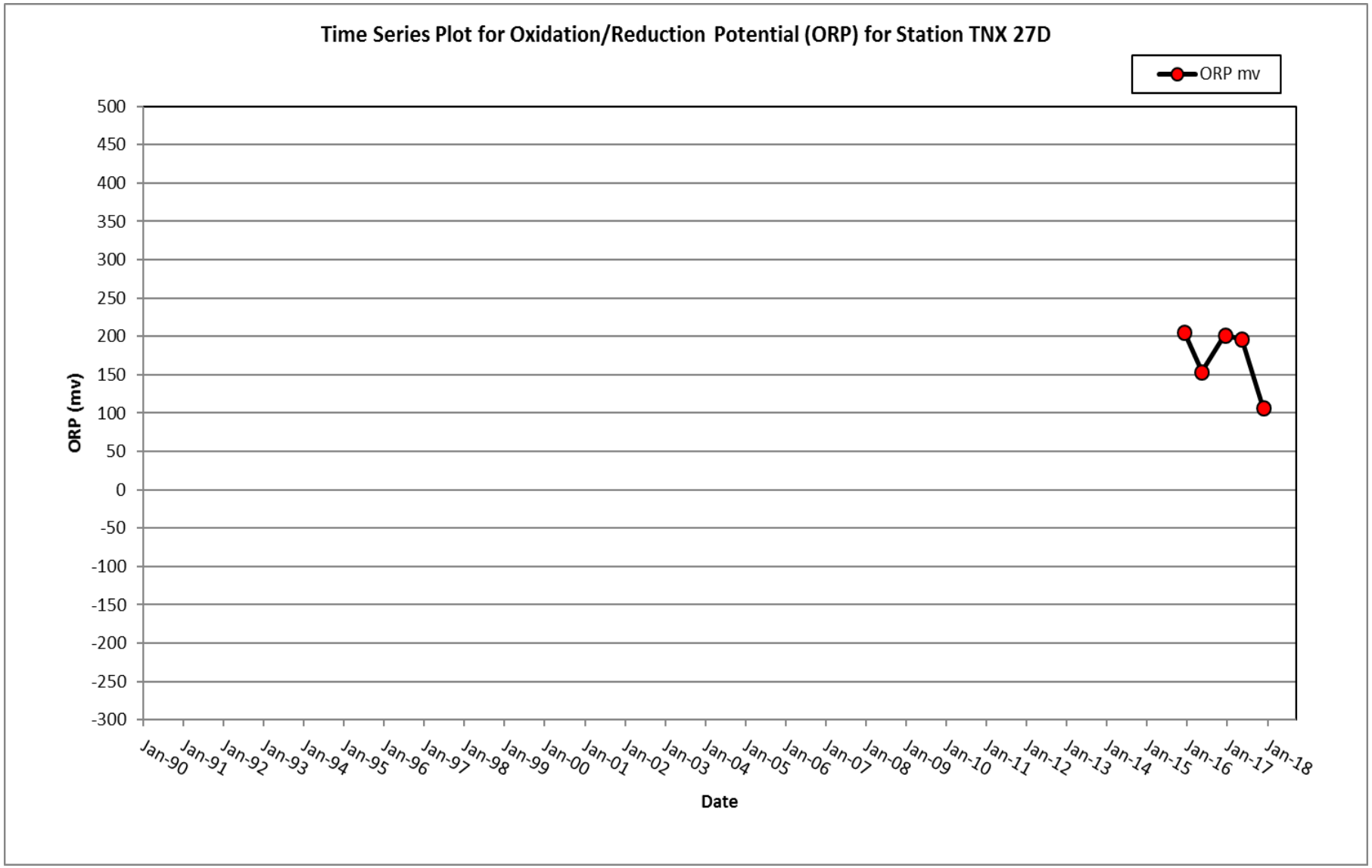
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TNX 27D
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
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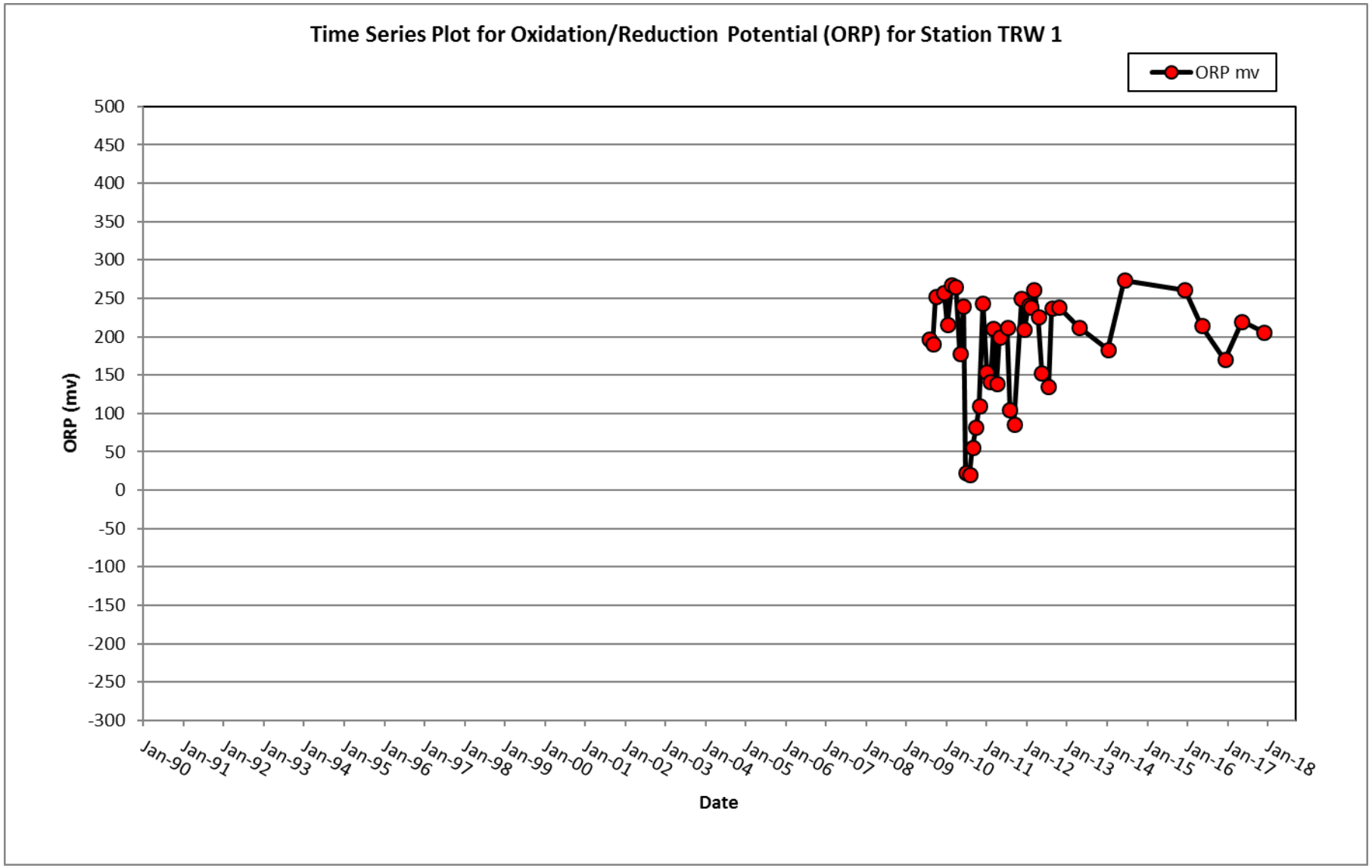
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TRW 1
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
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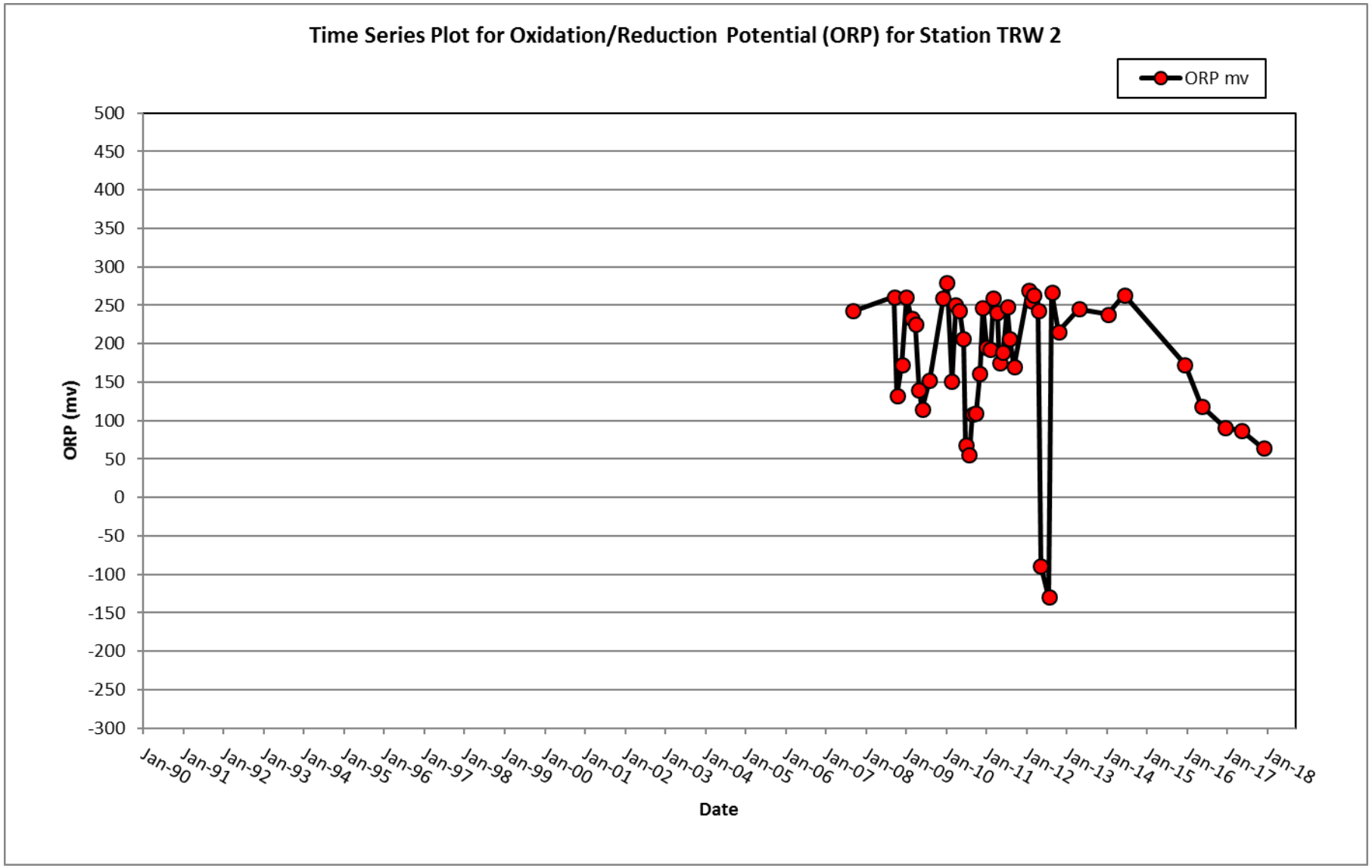
Jan-17
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TRW 2
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
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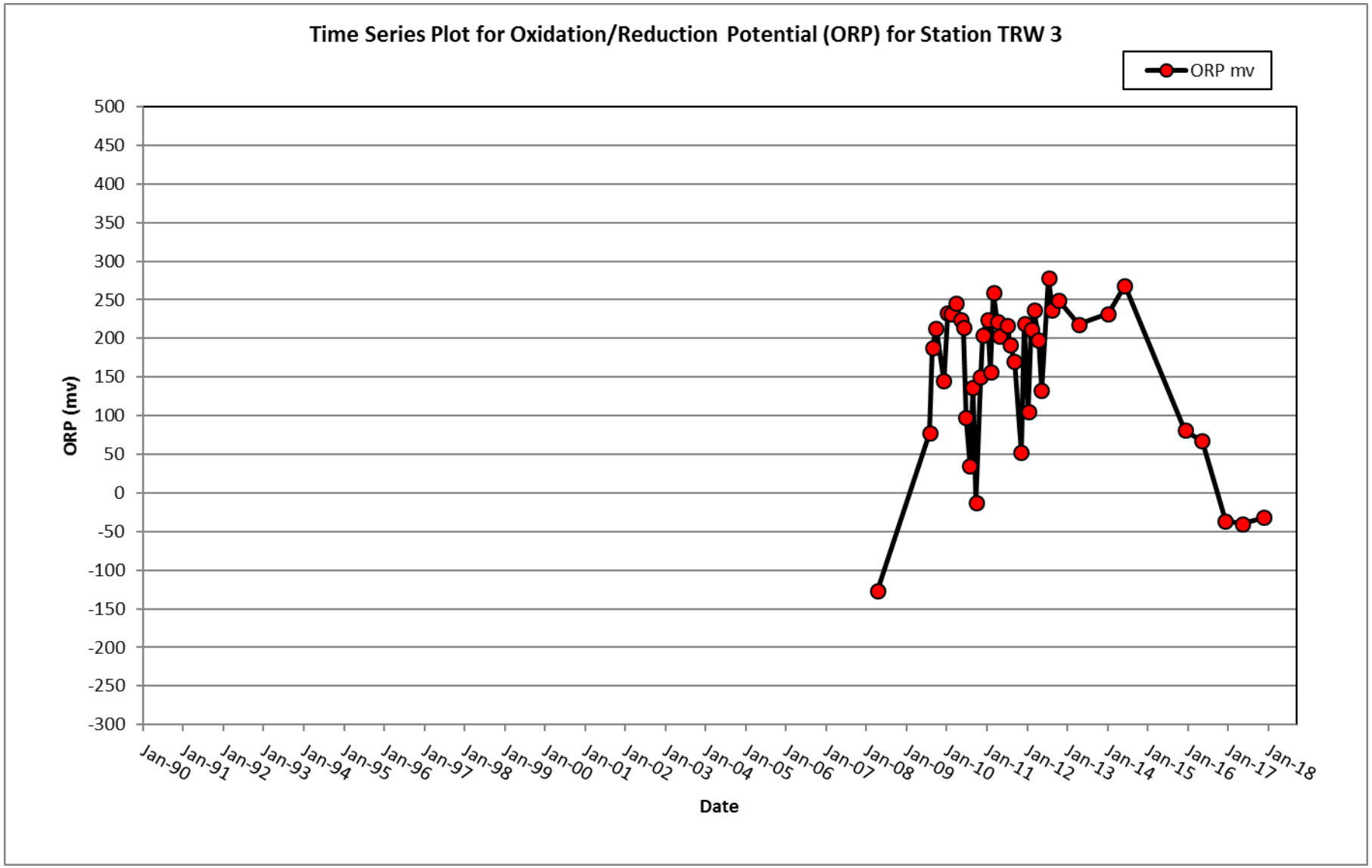
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TRW 3
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
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Jan-95
Jan-96
Jan-97
Jan-98
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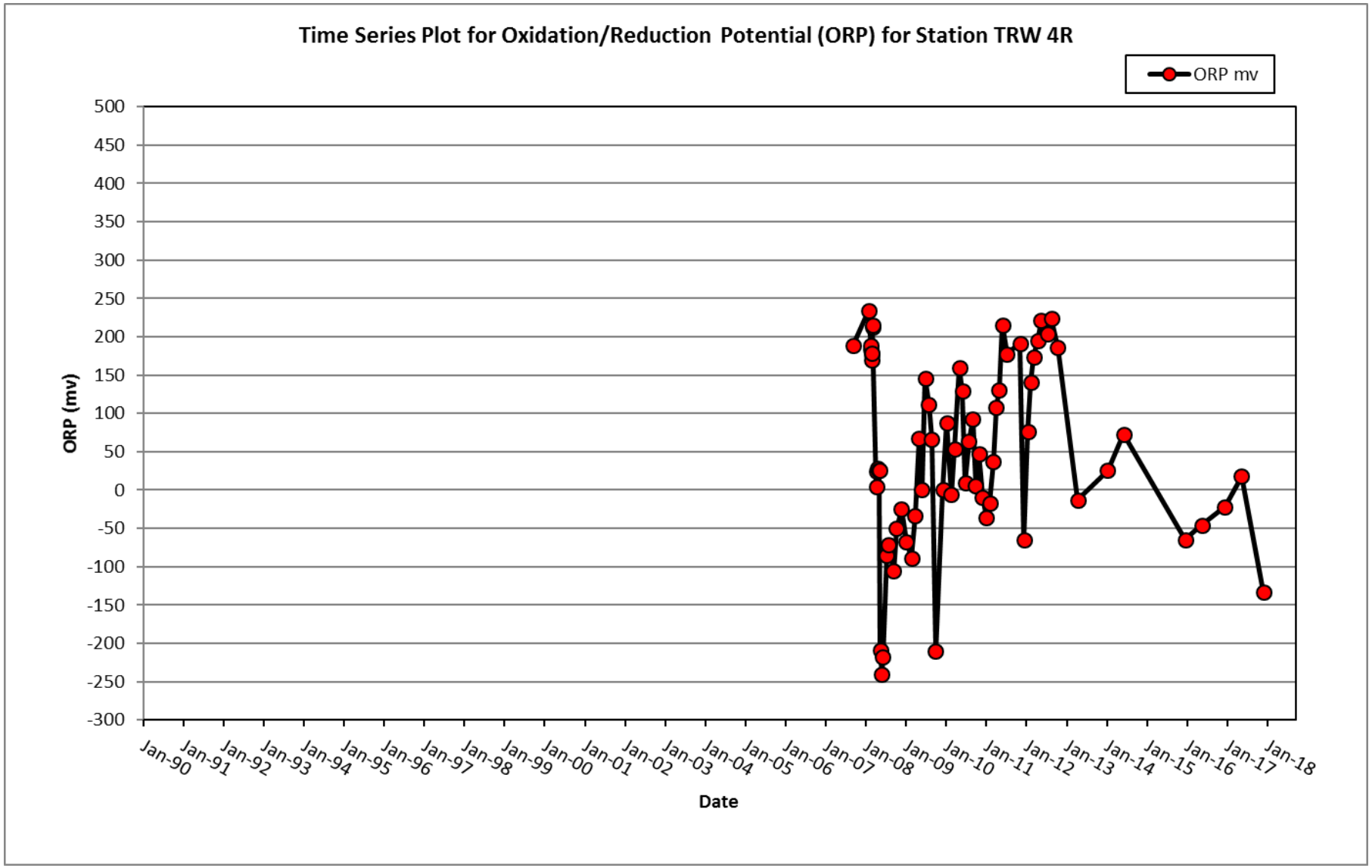
Jan-17
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TRW 4R
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
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Jan-06
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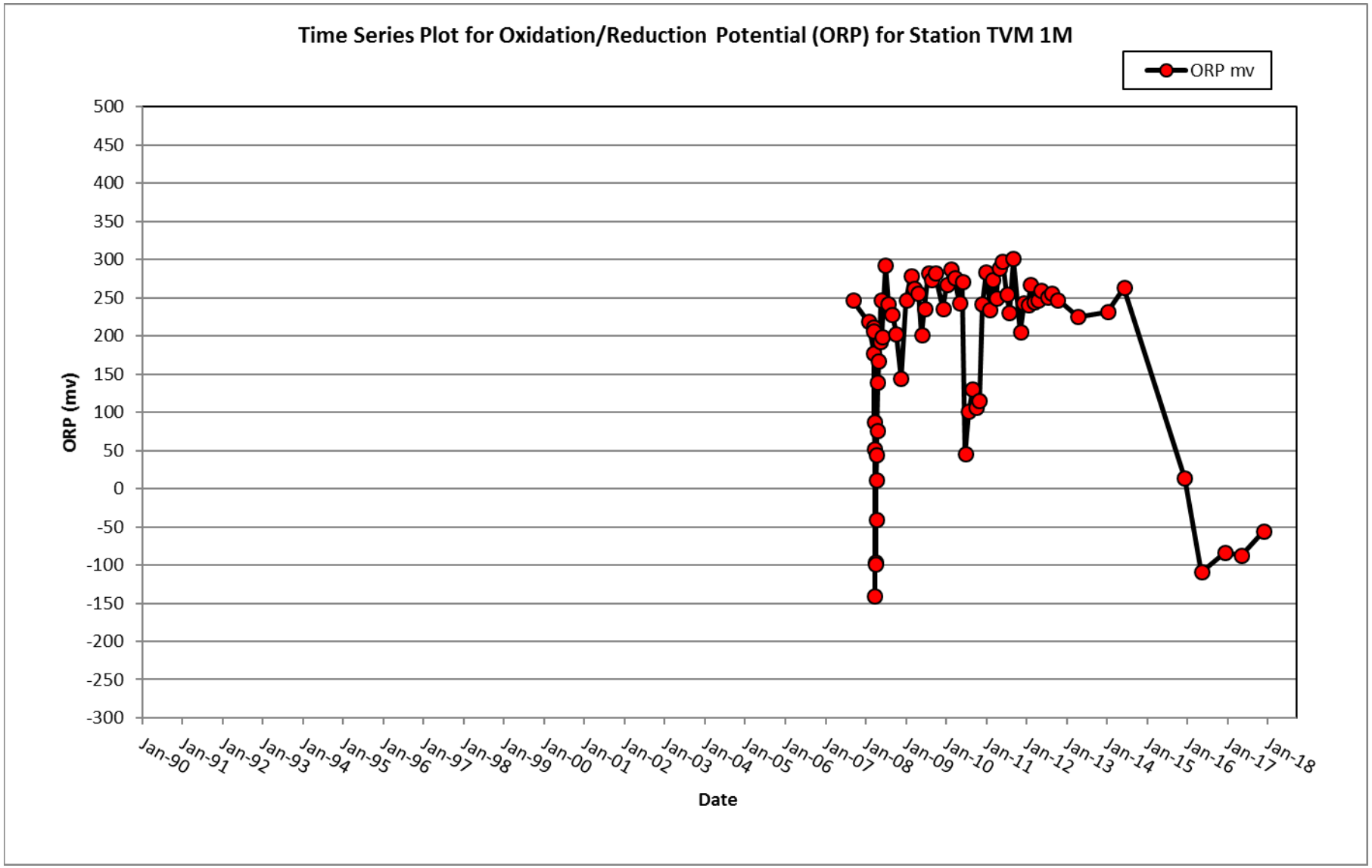
Jan-17
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TVM 1M
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
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Jan-13
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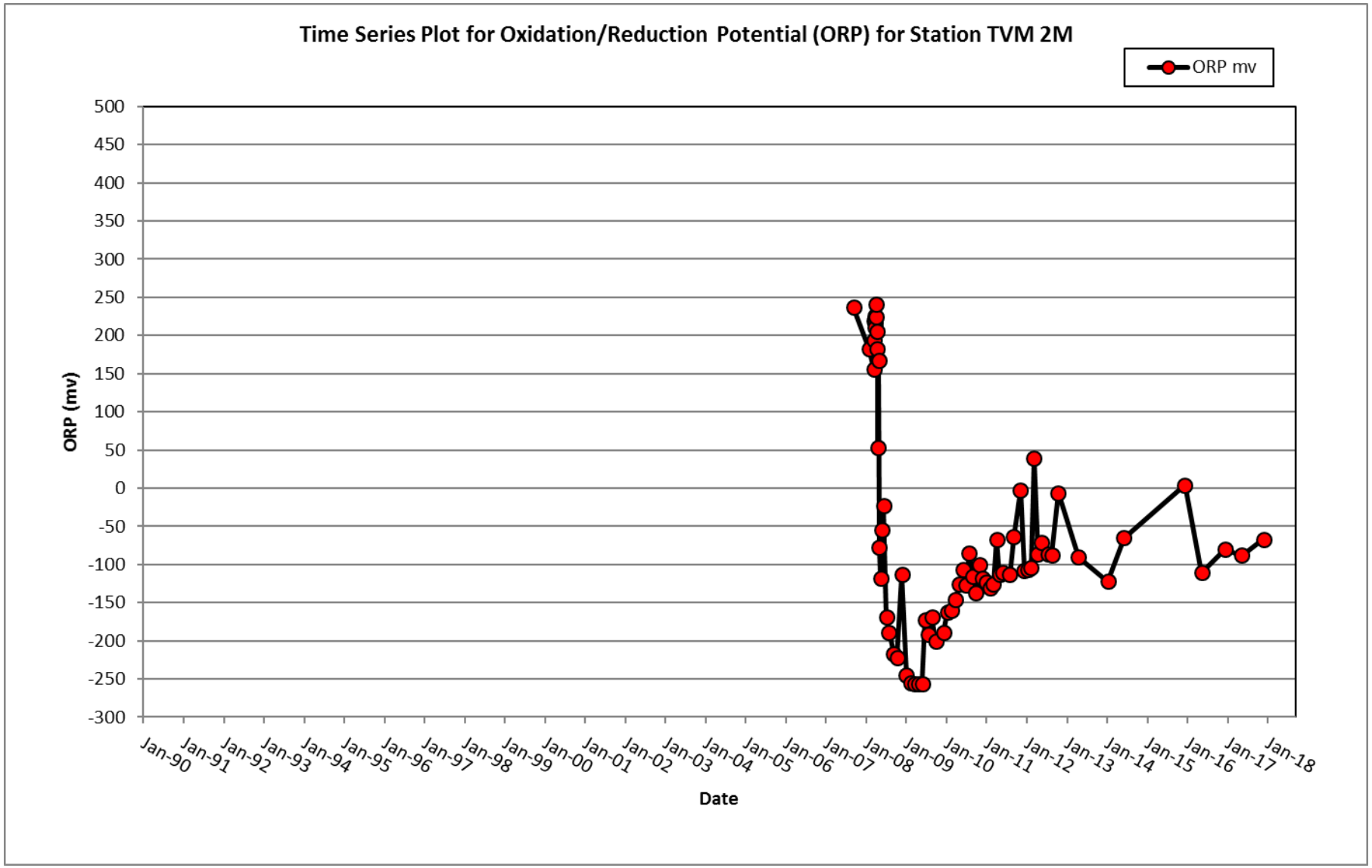
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TVM 2M
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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Jan-98
Jan-99
Jan-00
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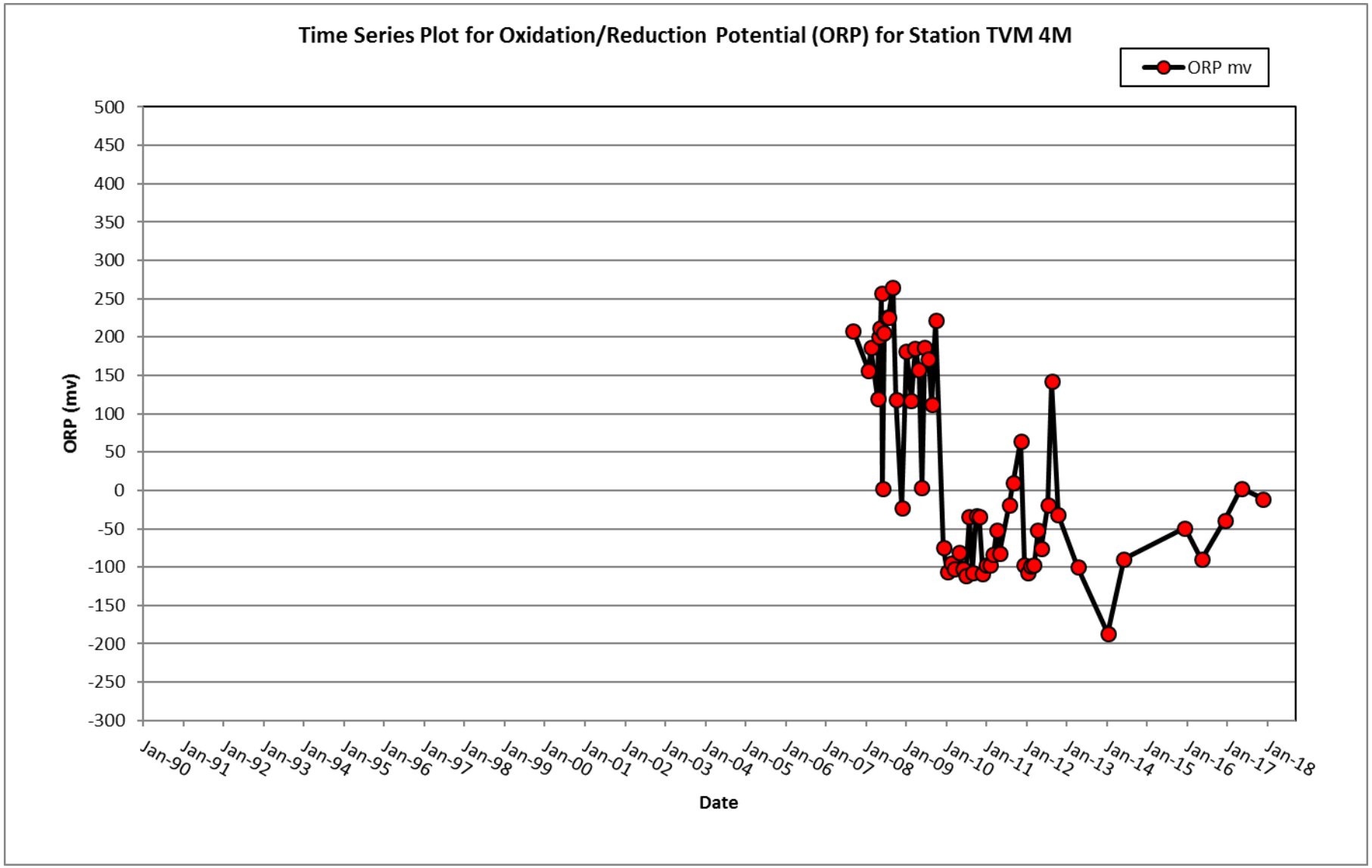
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TVM 4M
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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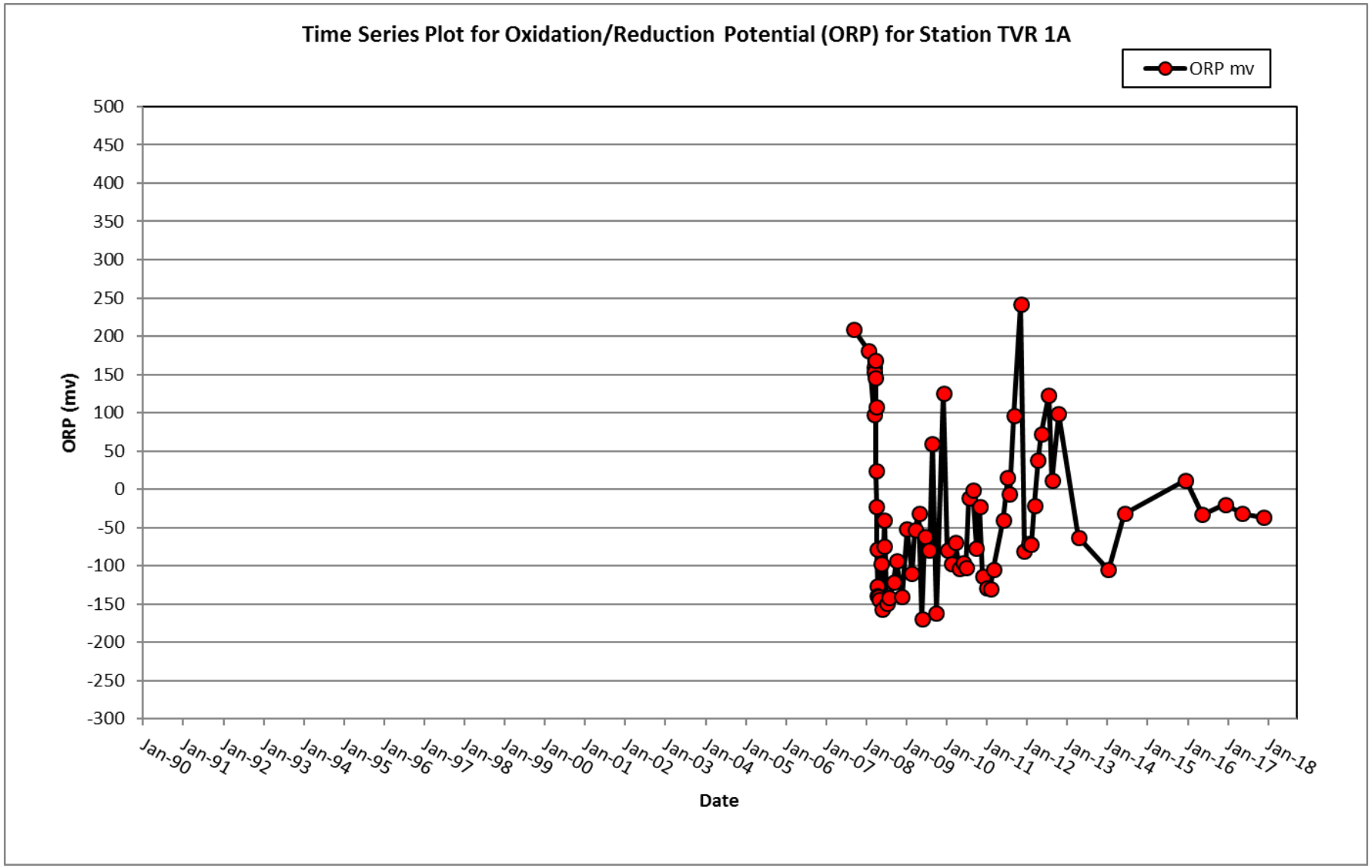
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Oxidation/Reduction Potential (ORP) for Station TVR 1A
ORP mv
ORP (mv)
500
450
400
350
300
250
200
150
100
50
0
-50
-100
-150
-200
-250
-300
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
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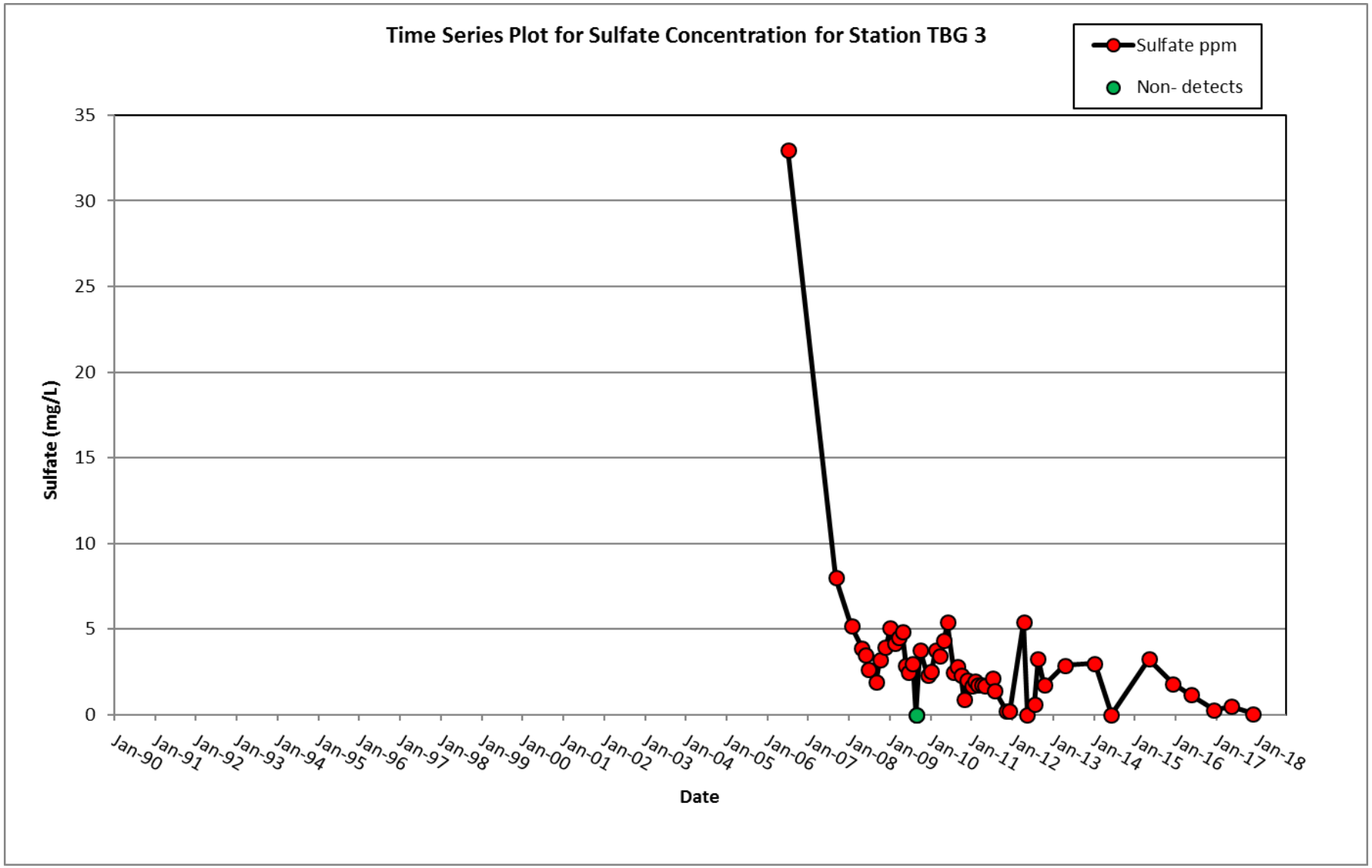
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TBG 3
Sulfate ppm
Non- detects
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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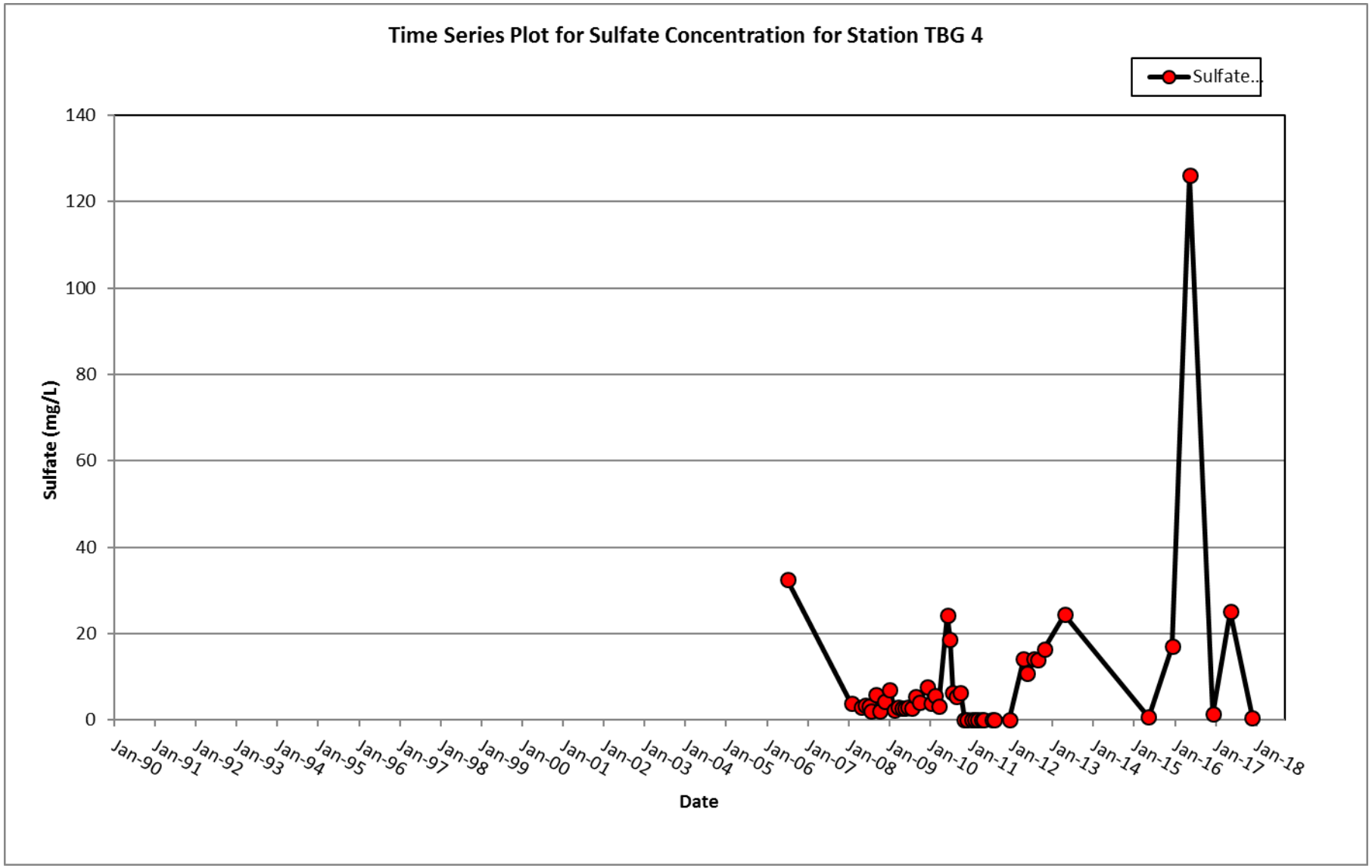
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TBG 4
Sulfate...
Sulfate (mg/L)
140
120
100
80
60
40
20
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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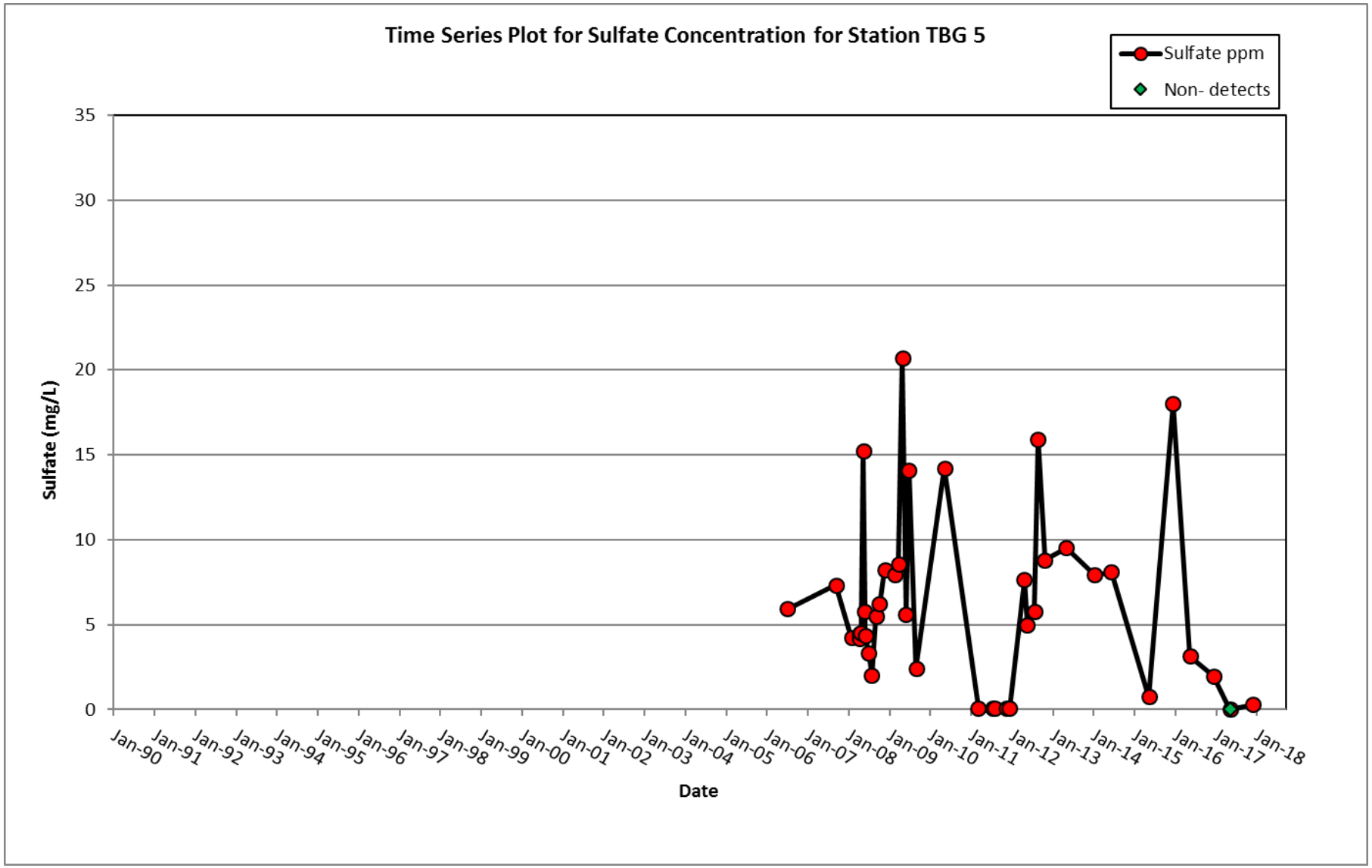
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TBG 5
Sulfate ppm
Non- detects
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
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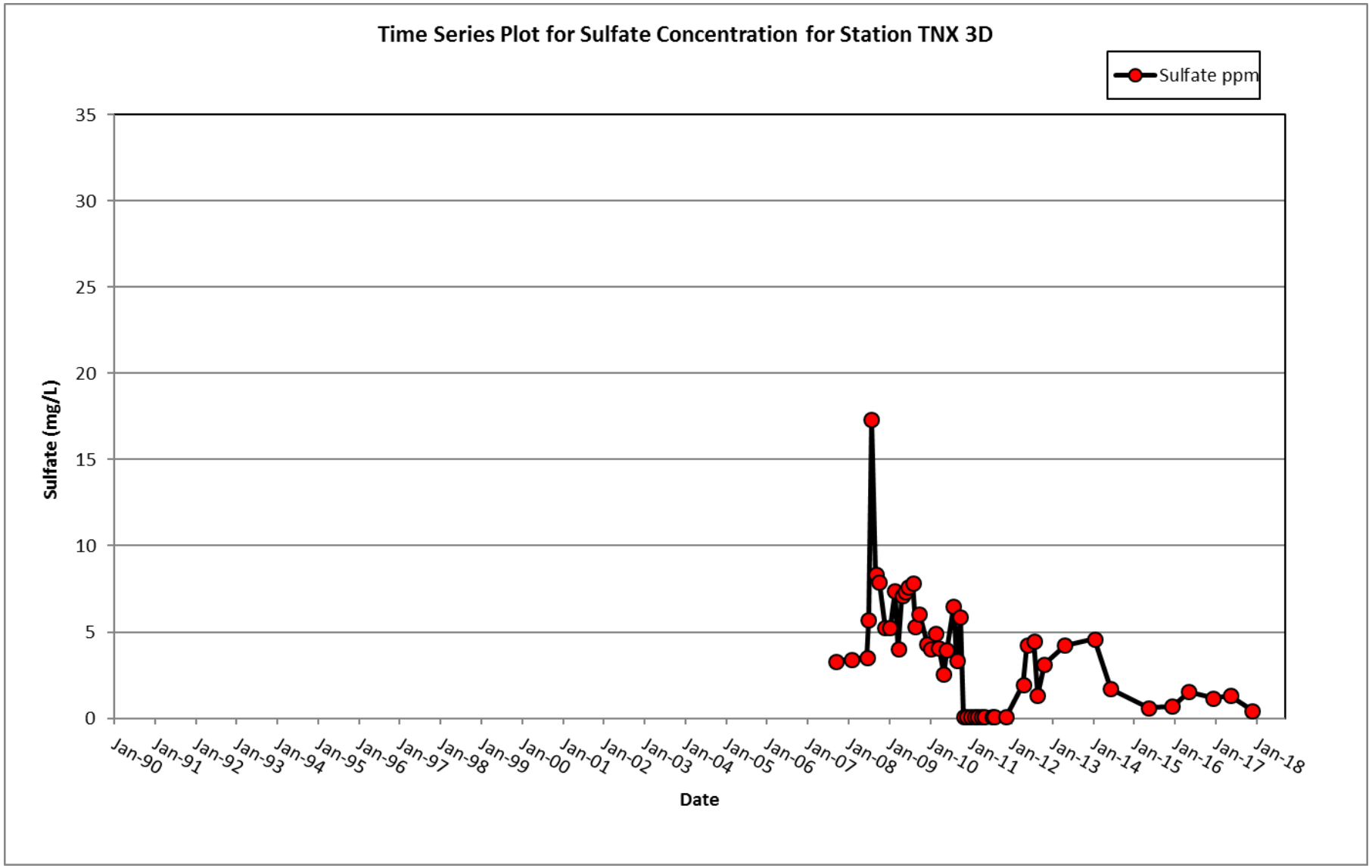
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TNX 3D
Sulfate ppm
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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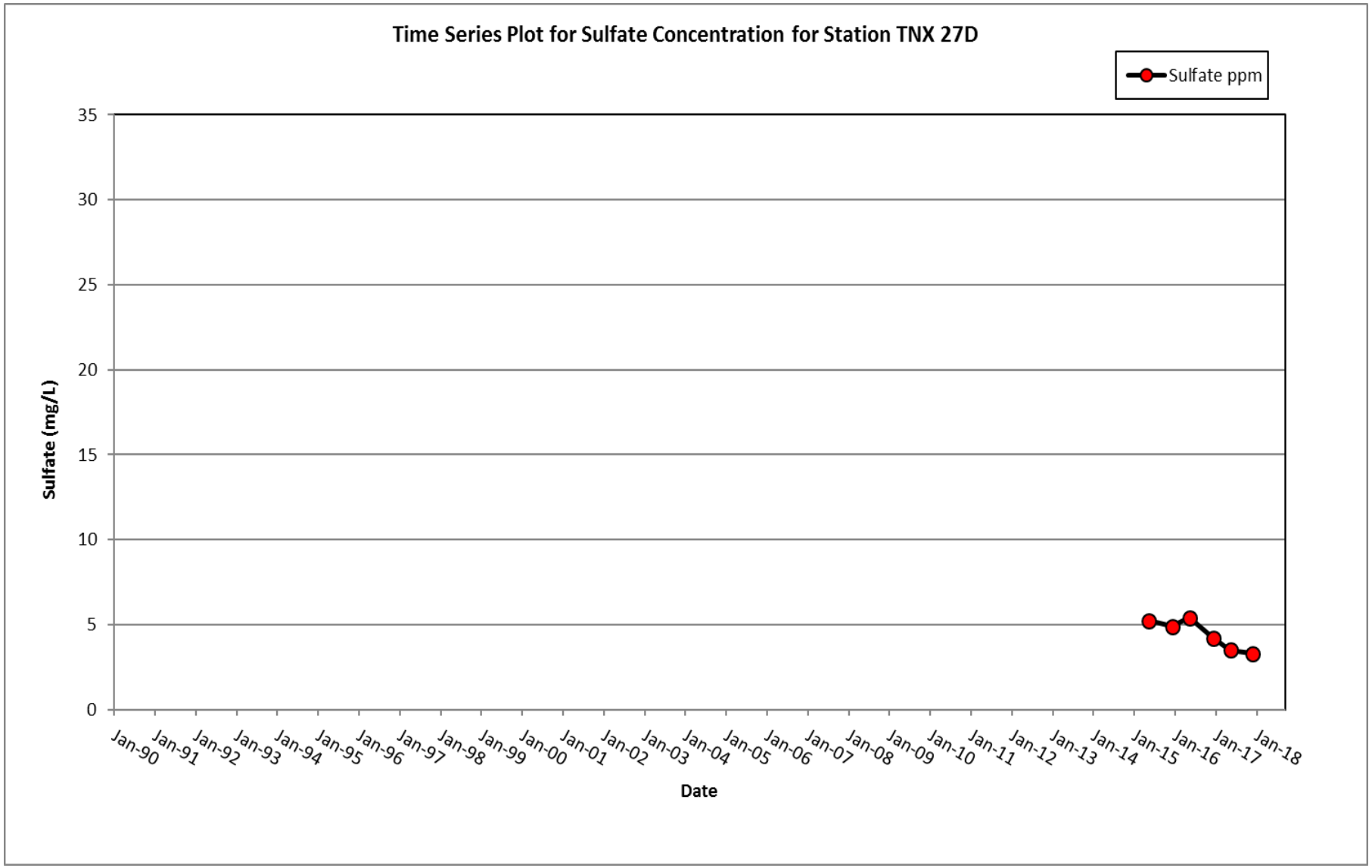
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TNX 27D
Sulfate ppm
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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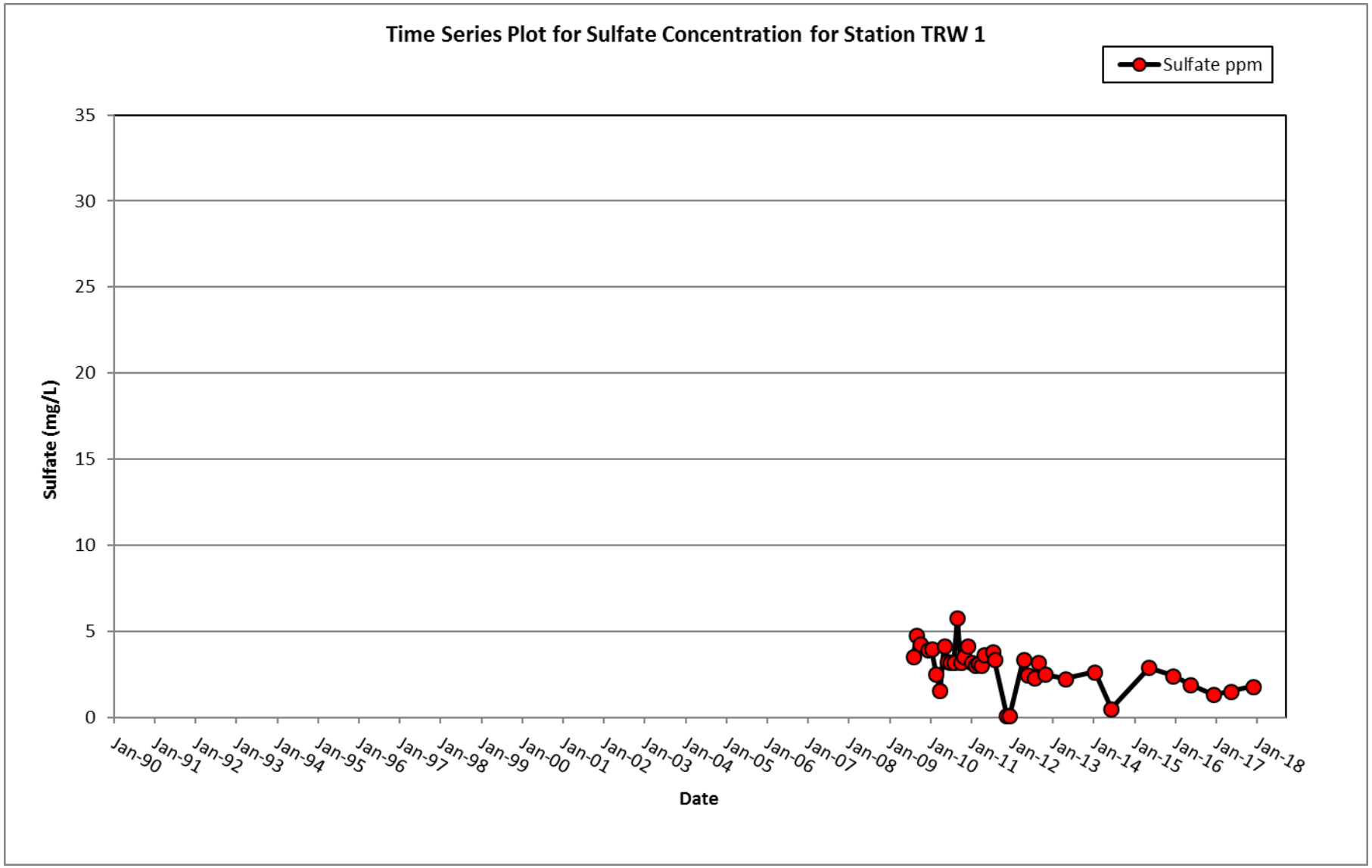
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TRW 1
Sulfate ppm
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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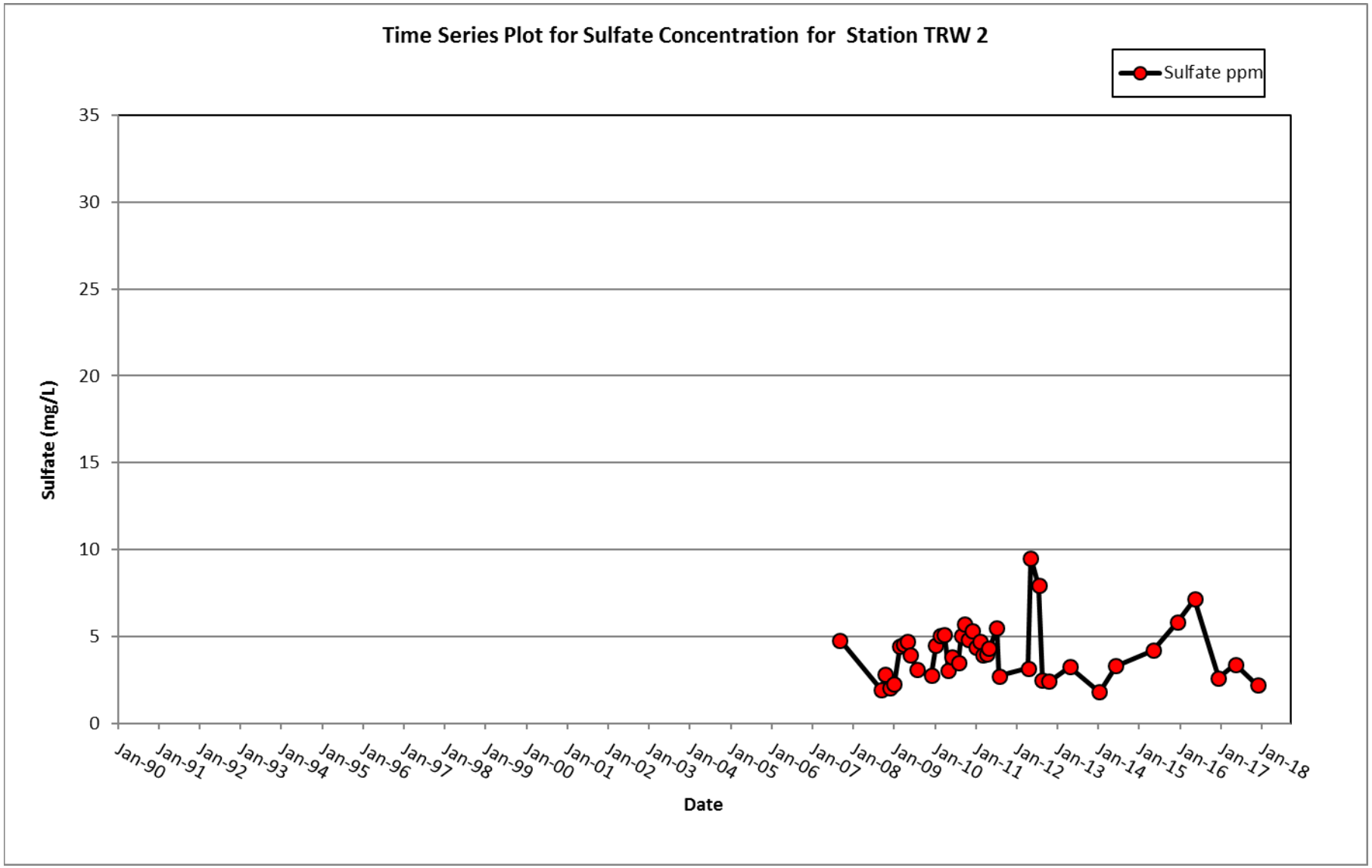
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TRW 2
Sulfate ppm
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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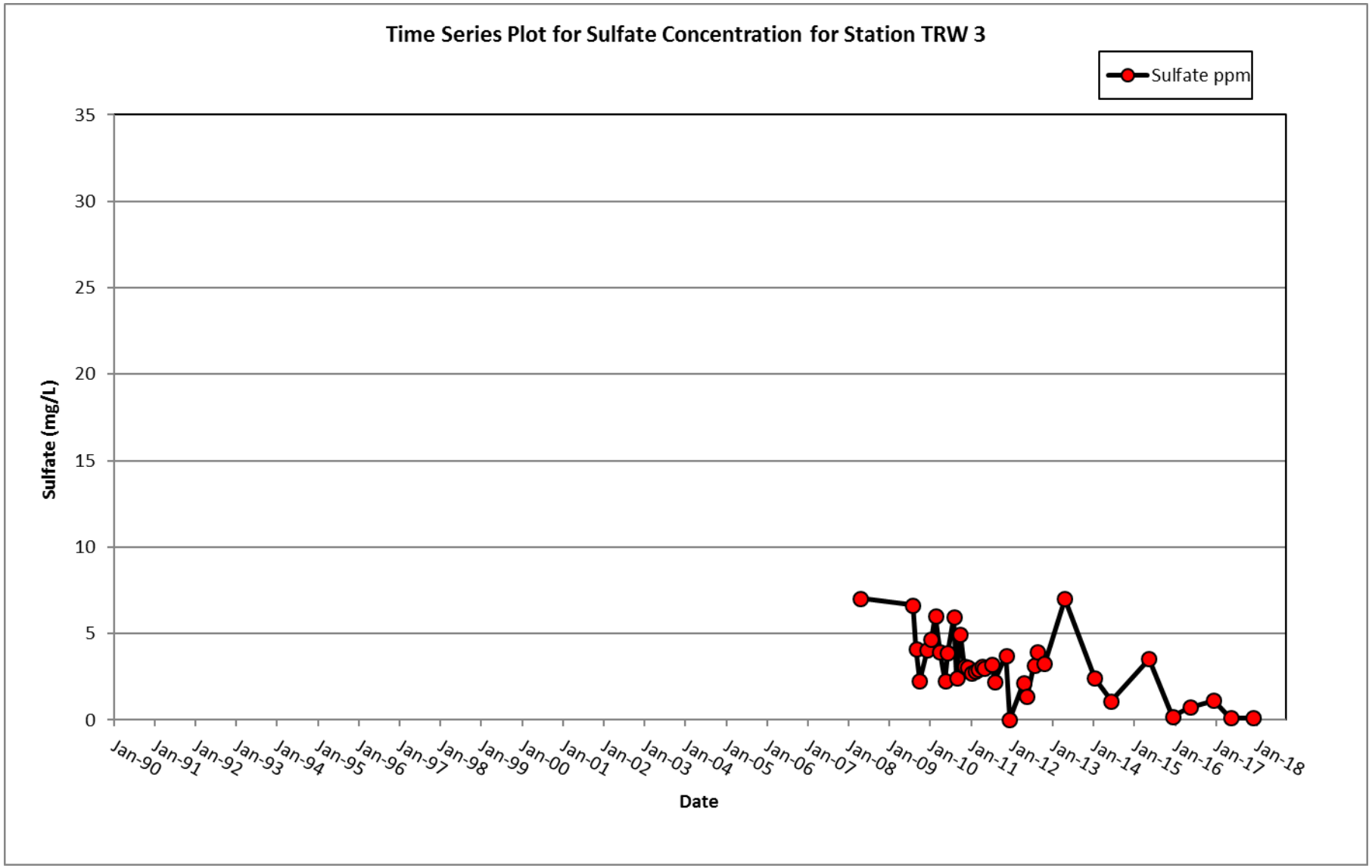
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TRW 3
Sulfate ppm
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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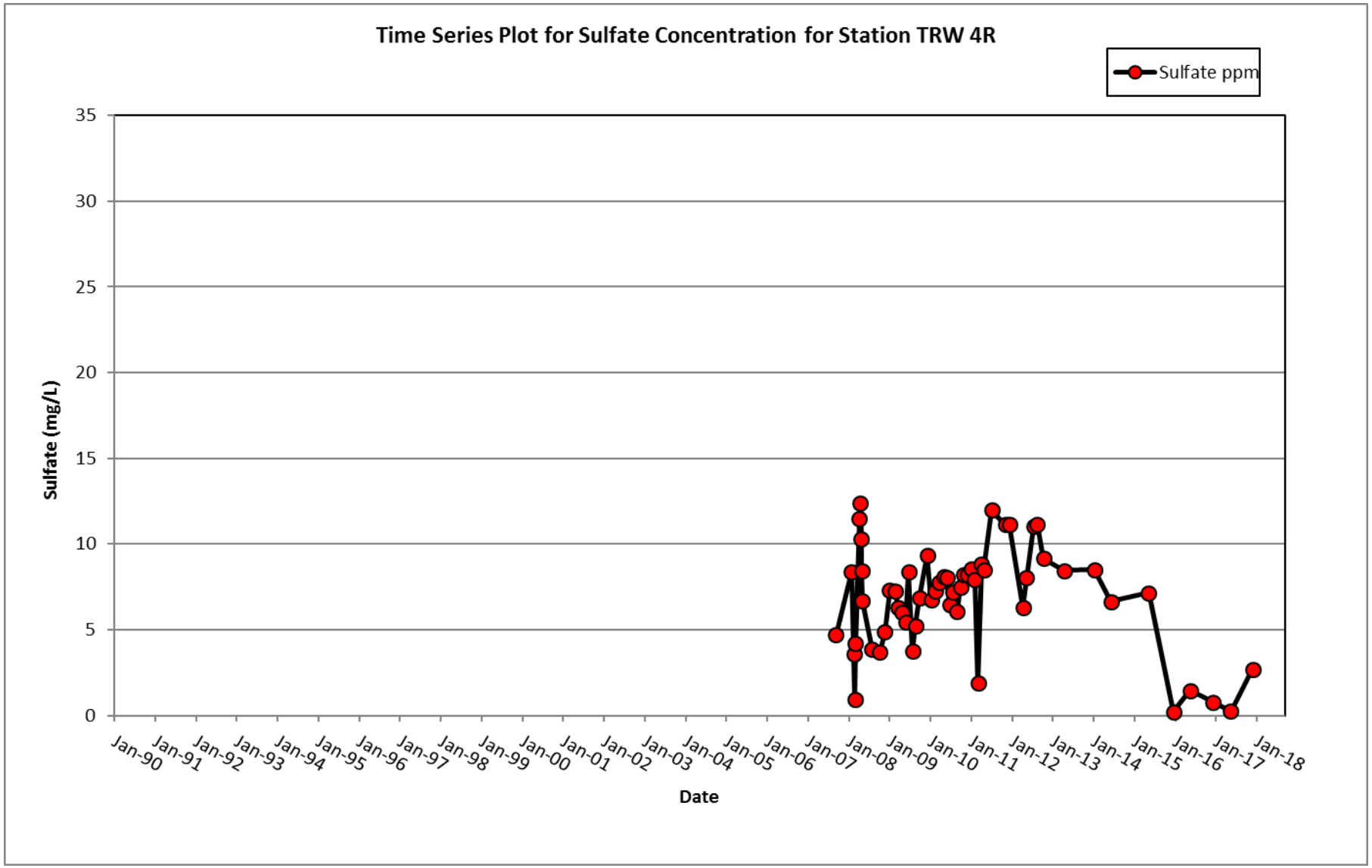
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TRW 4R
Sulfate ppm
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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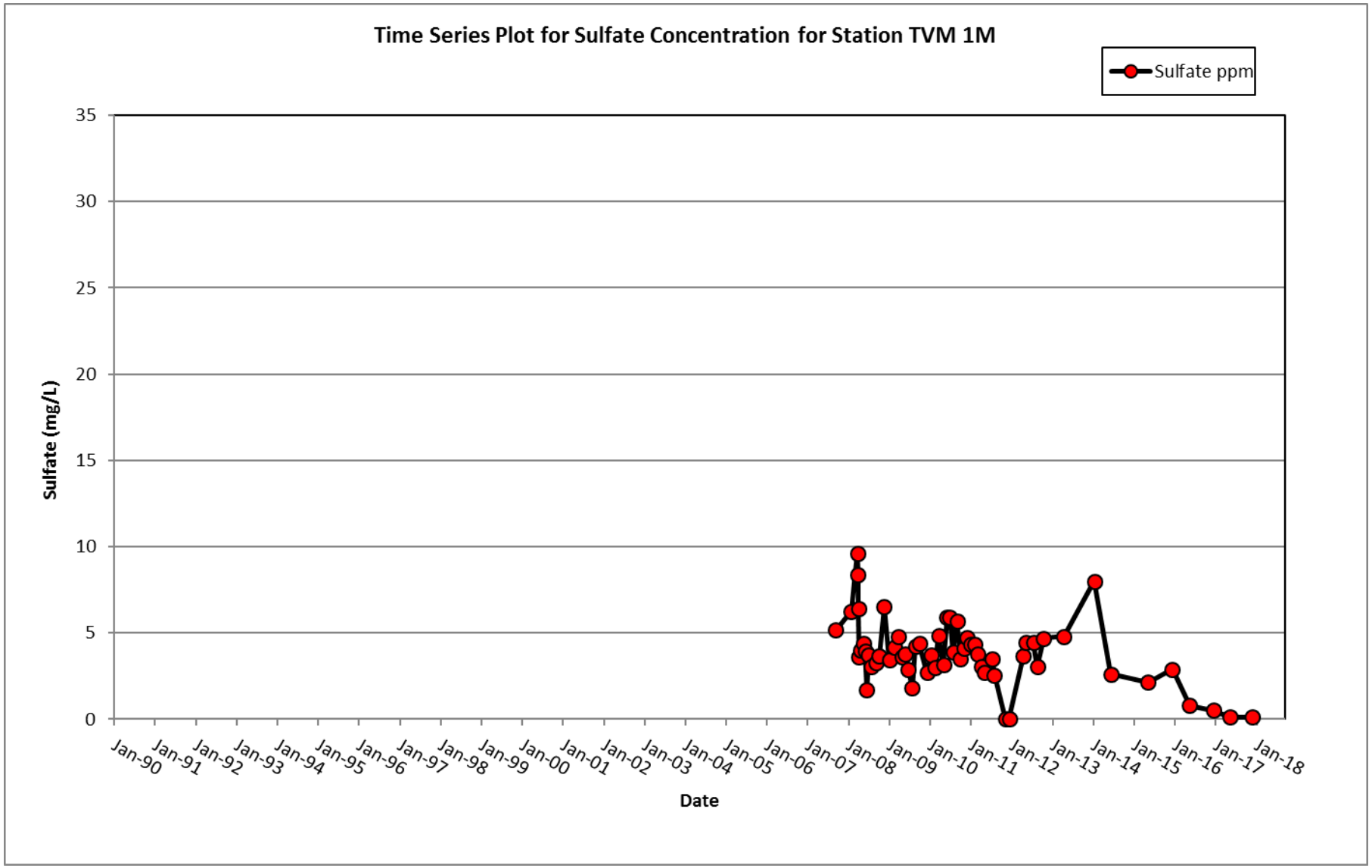
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TVM 1M
Sulfate ppm
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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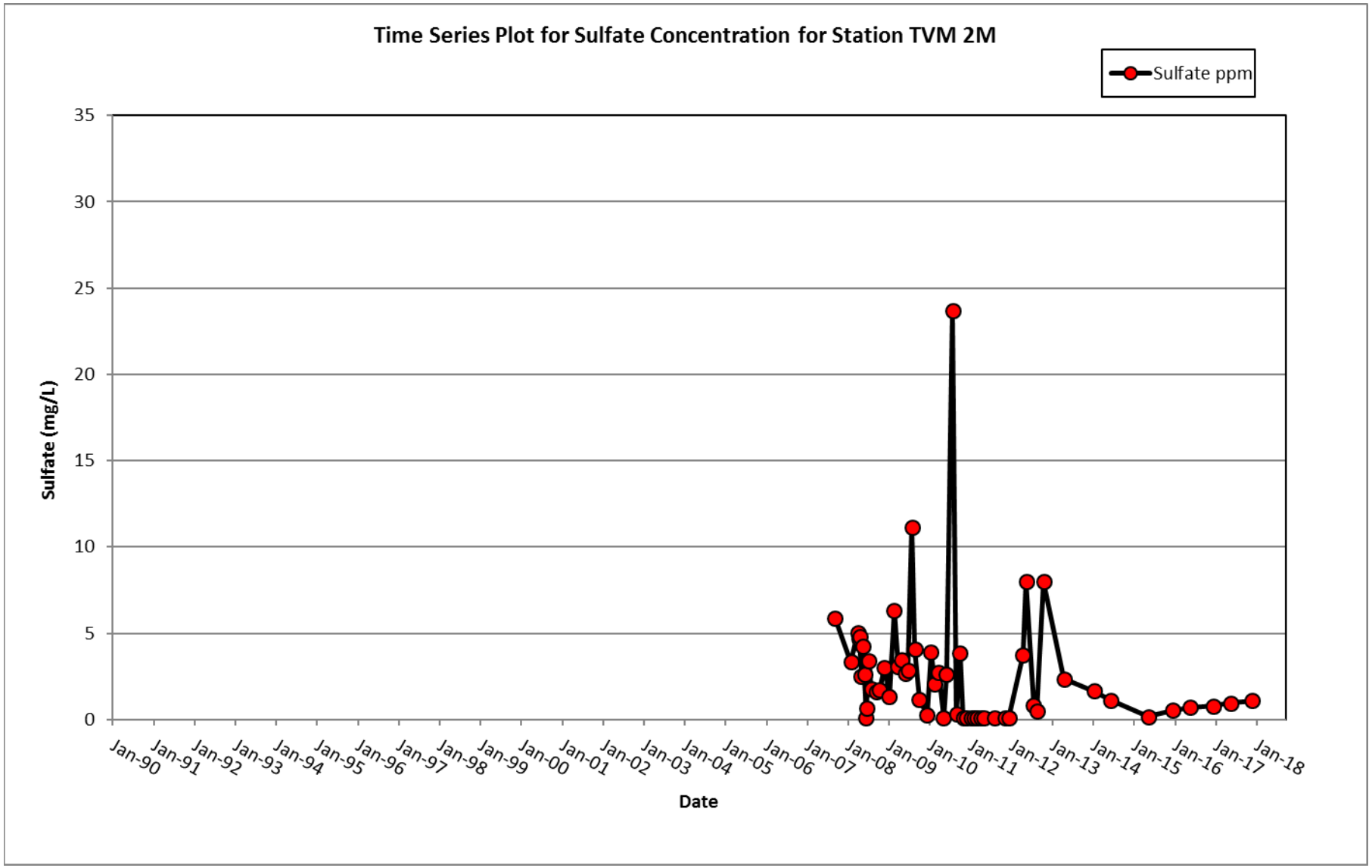
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TVM 2M
Sulfate ppm
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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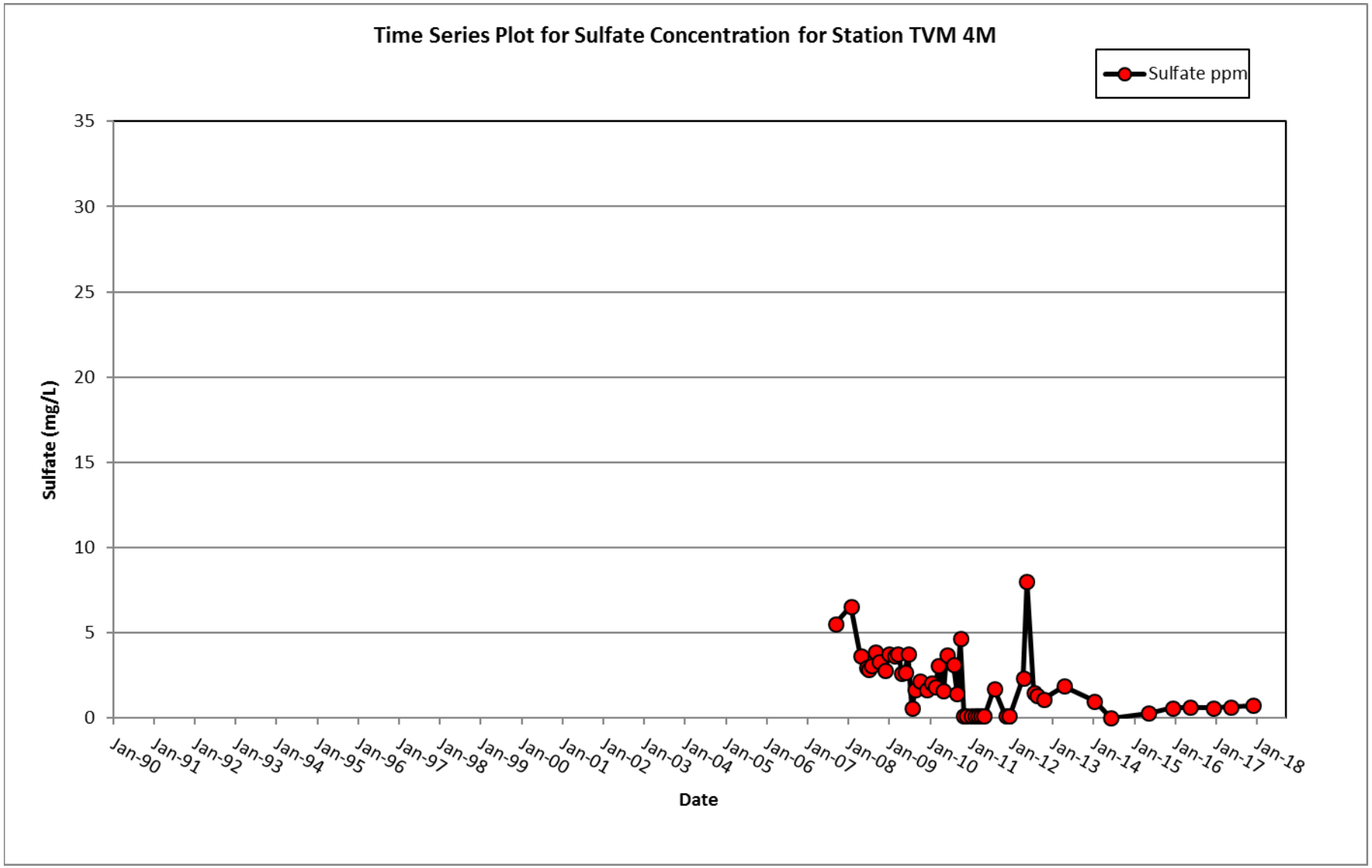
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TVM 4M
Sulfate ppm
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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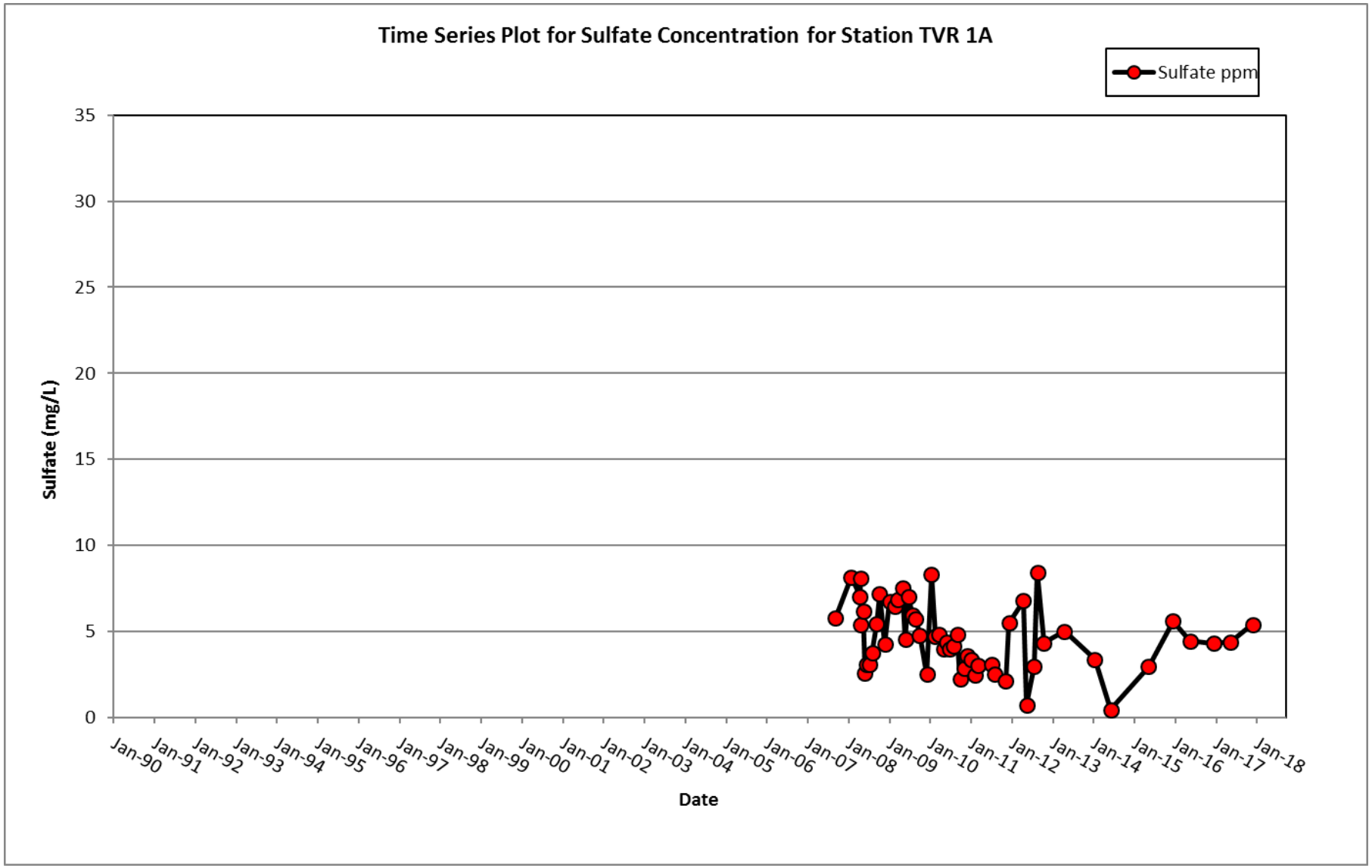
Jan-17
Jan-18
Date


Time Series Plot for Sulfate Concentration for Station TVR 1A
Sulfate ppm
Sulfate (mg/L)
35
30
25
20
15
10
5
0
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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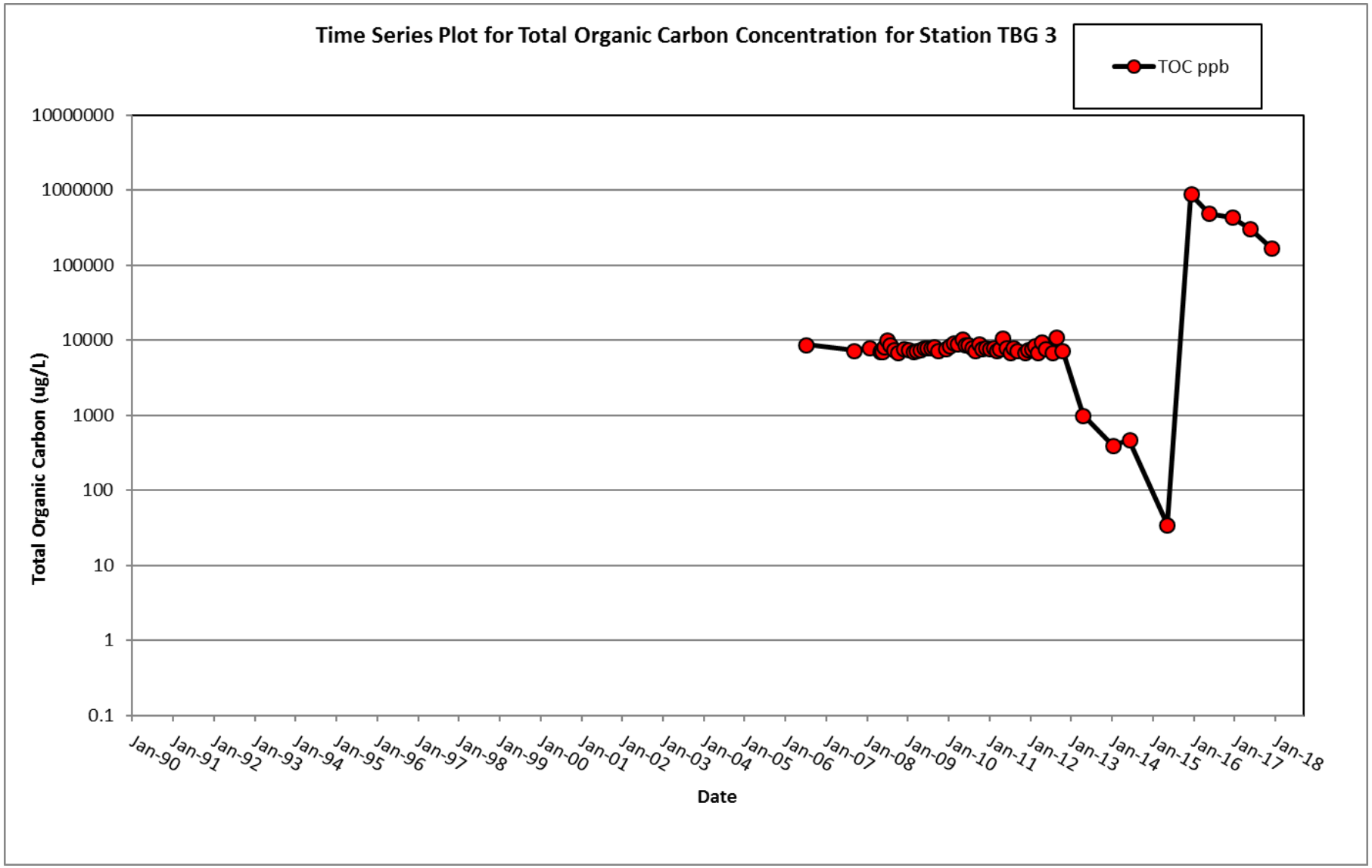
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TBG 3
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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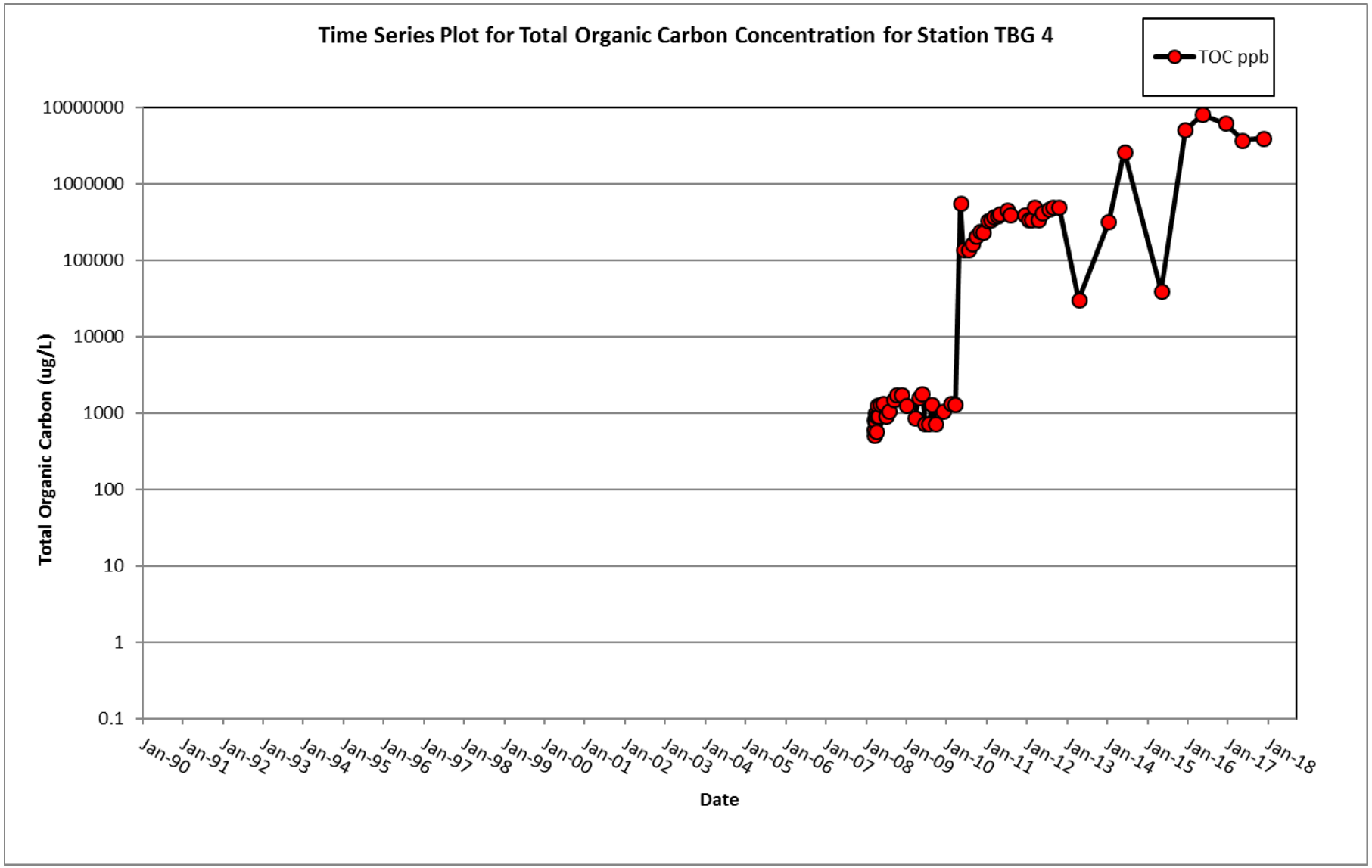
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TBG 4
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
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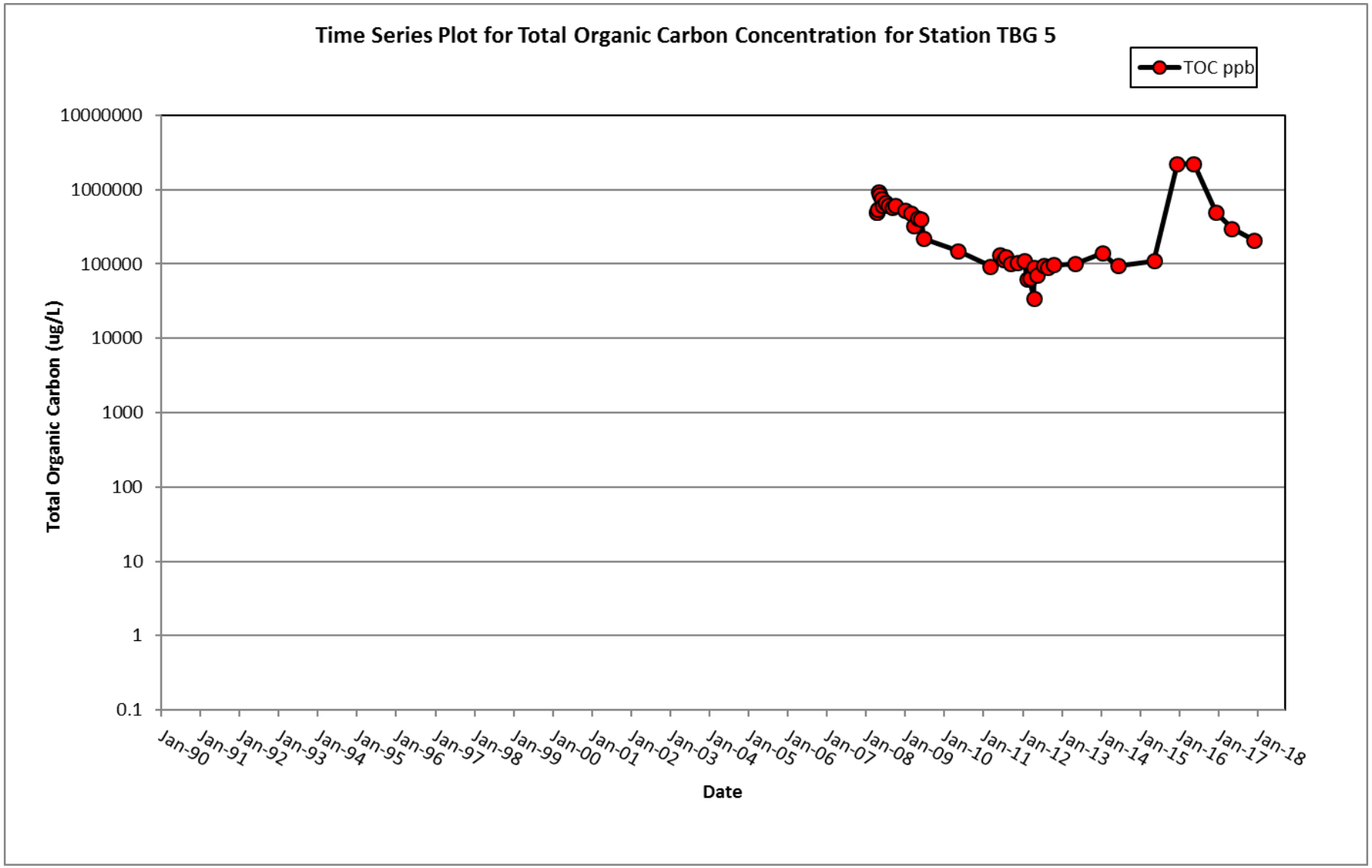
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TBG 5
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
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Jan-05
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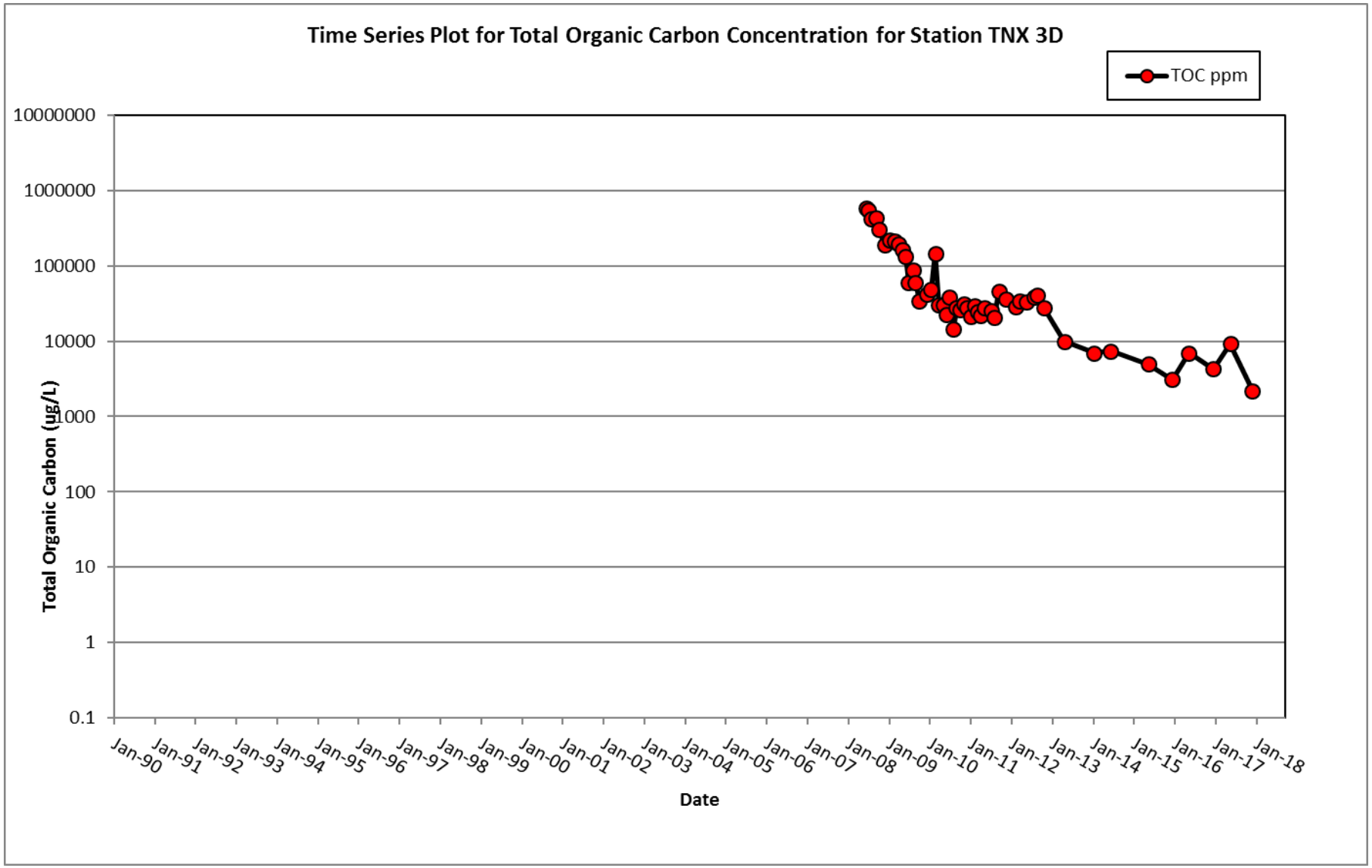
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TNX 3D
TOC ppm
10000000
1000000
100000
10000
1000
100
10
1
0.1
Total Organic Carbon (µg/L)
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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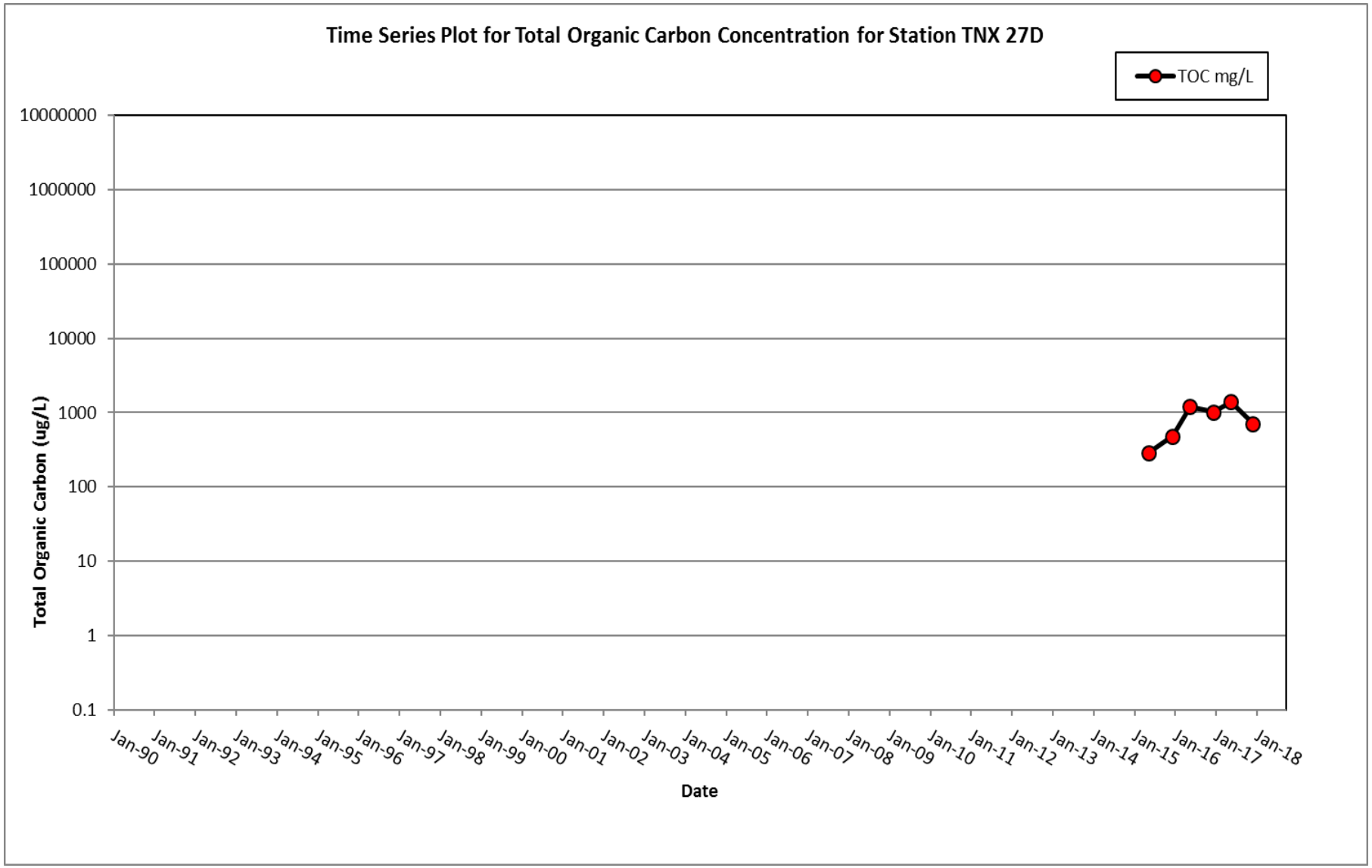
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TNX 27D
TOC mg/L
10000000
1000000
100000
10000
1000
100
10
1
0.1
Total Organic Carbon (ug/L)
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
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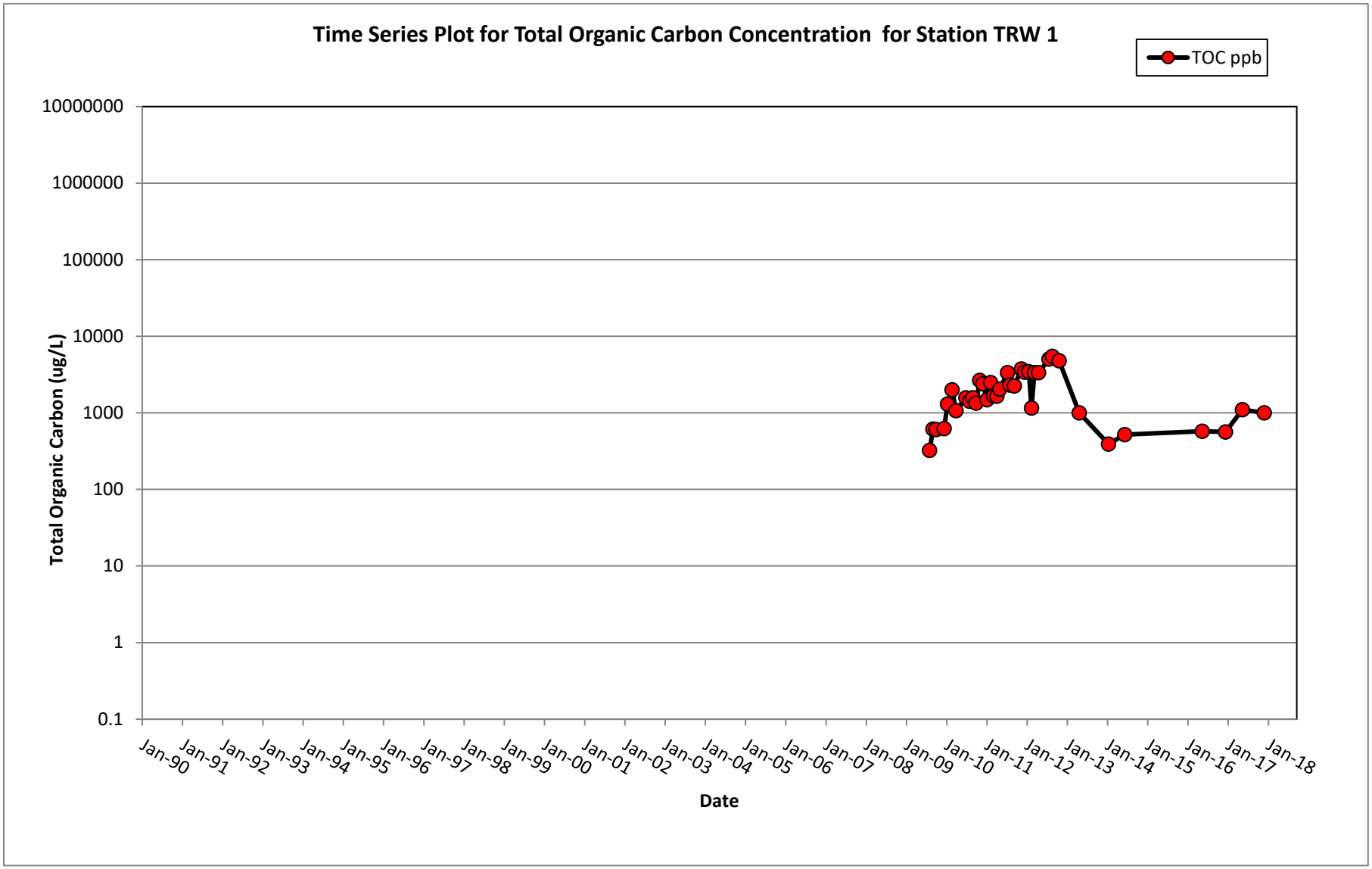
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TRW 1
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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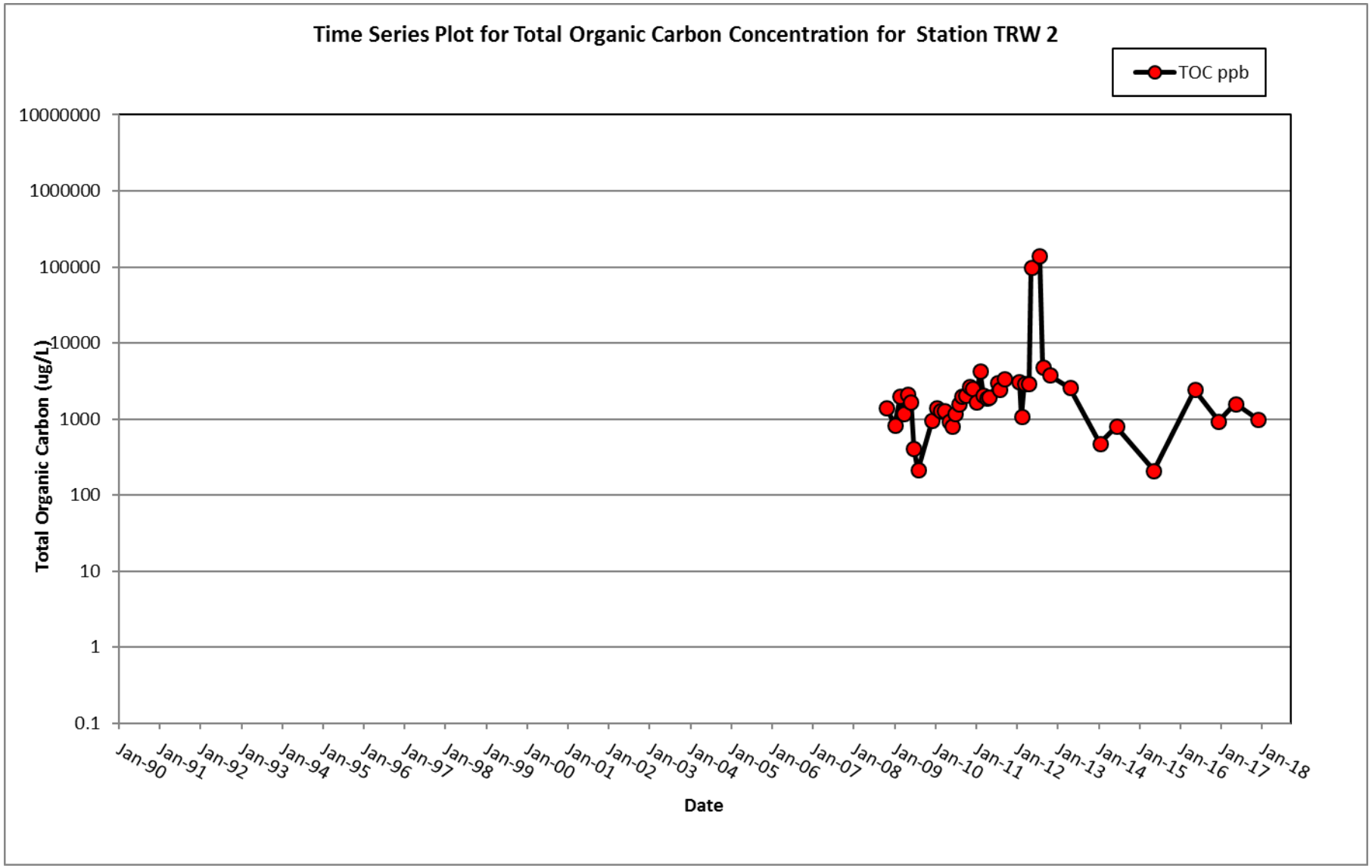
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TRW 2
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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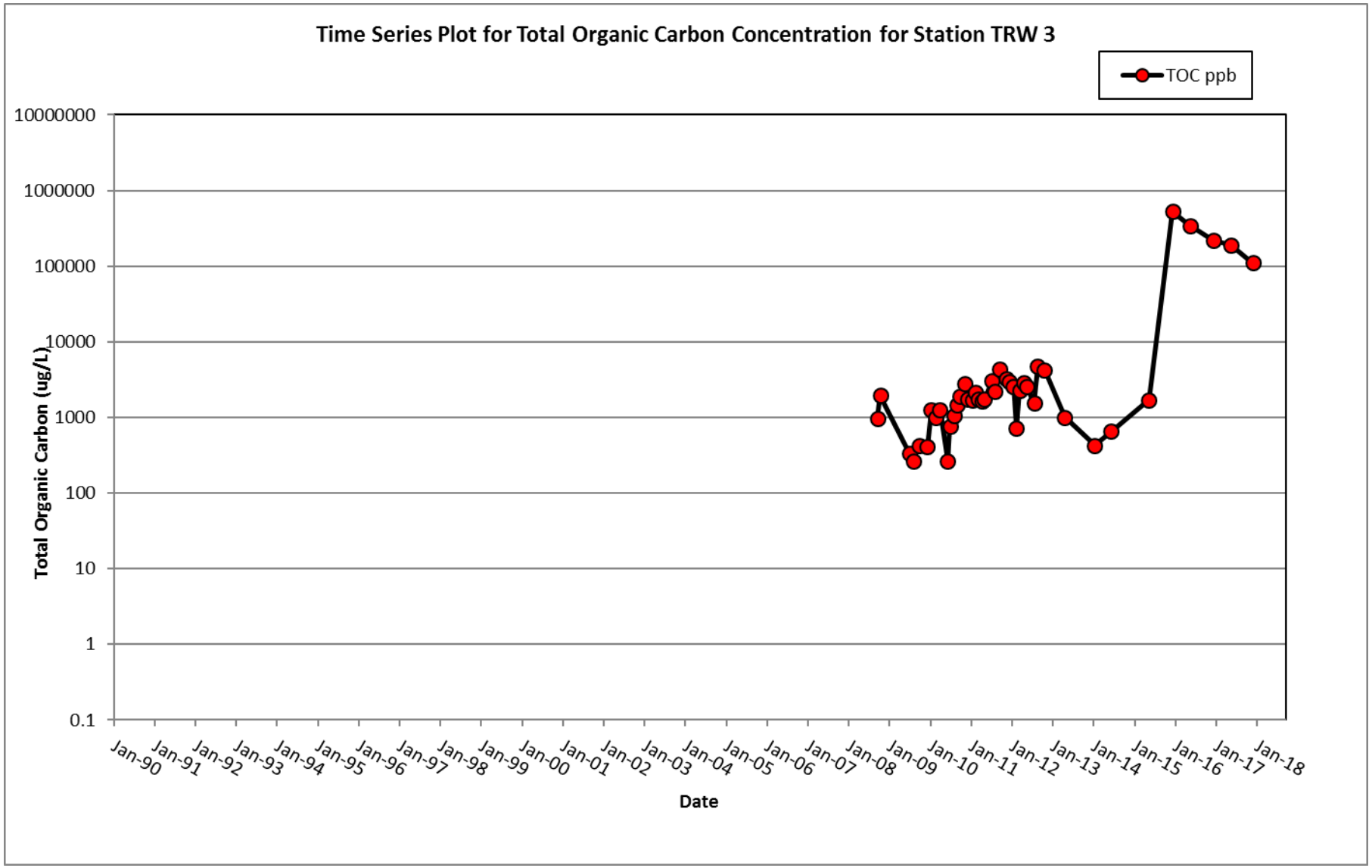
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TRW 3
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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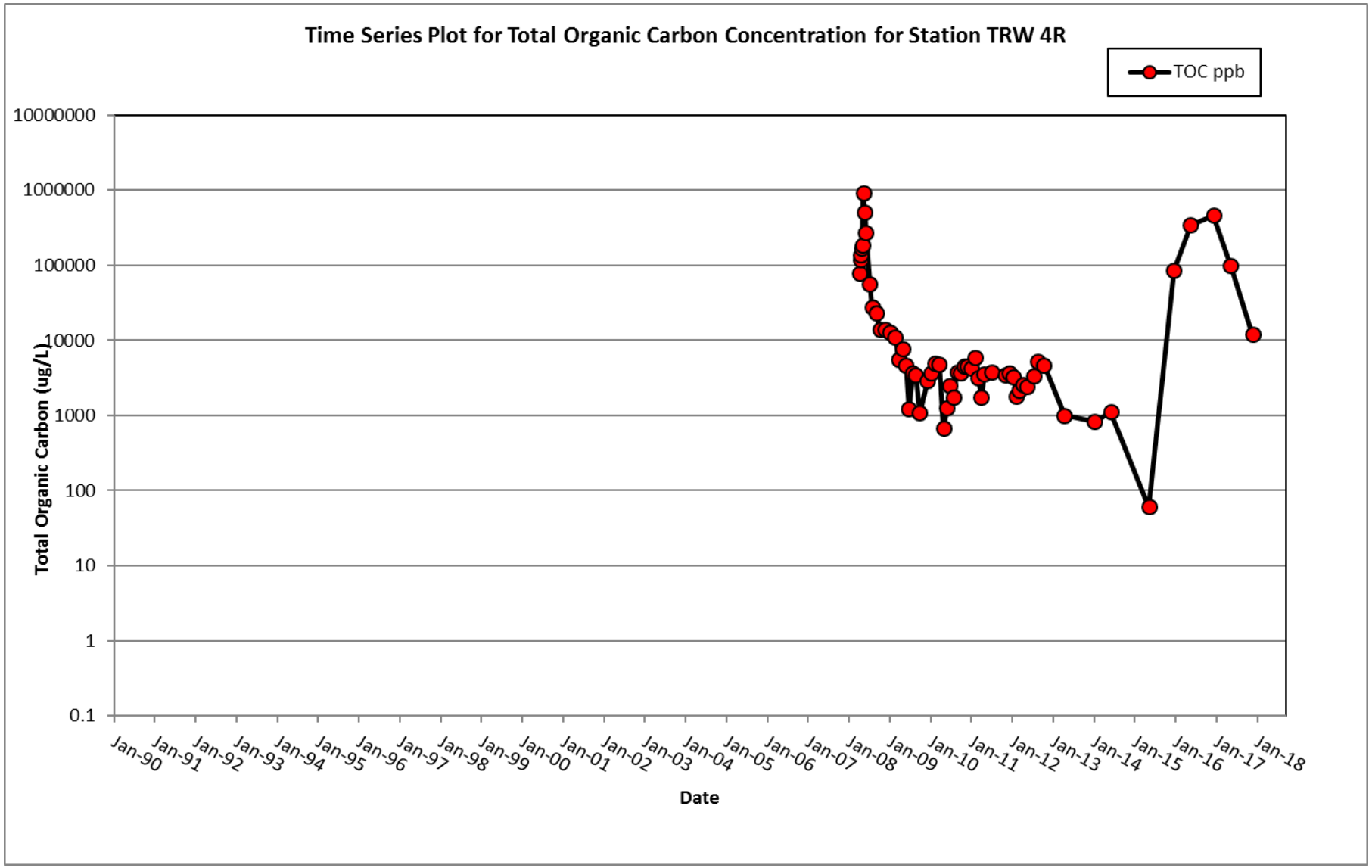
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TRW 4R
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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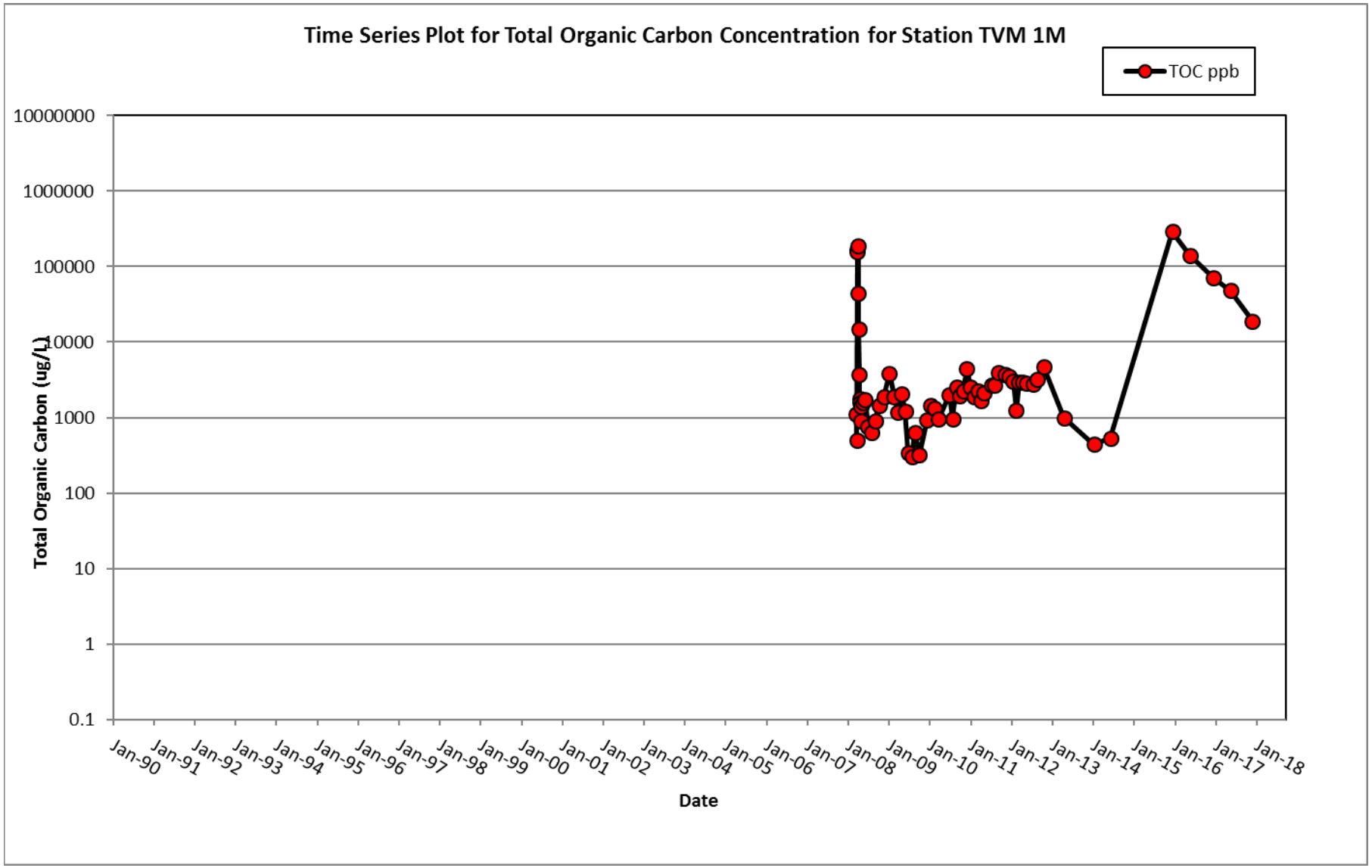
Jan-17
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TVM 1M
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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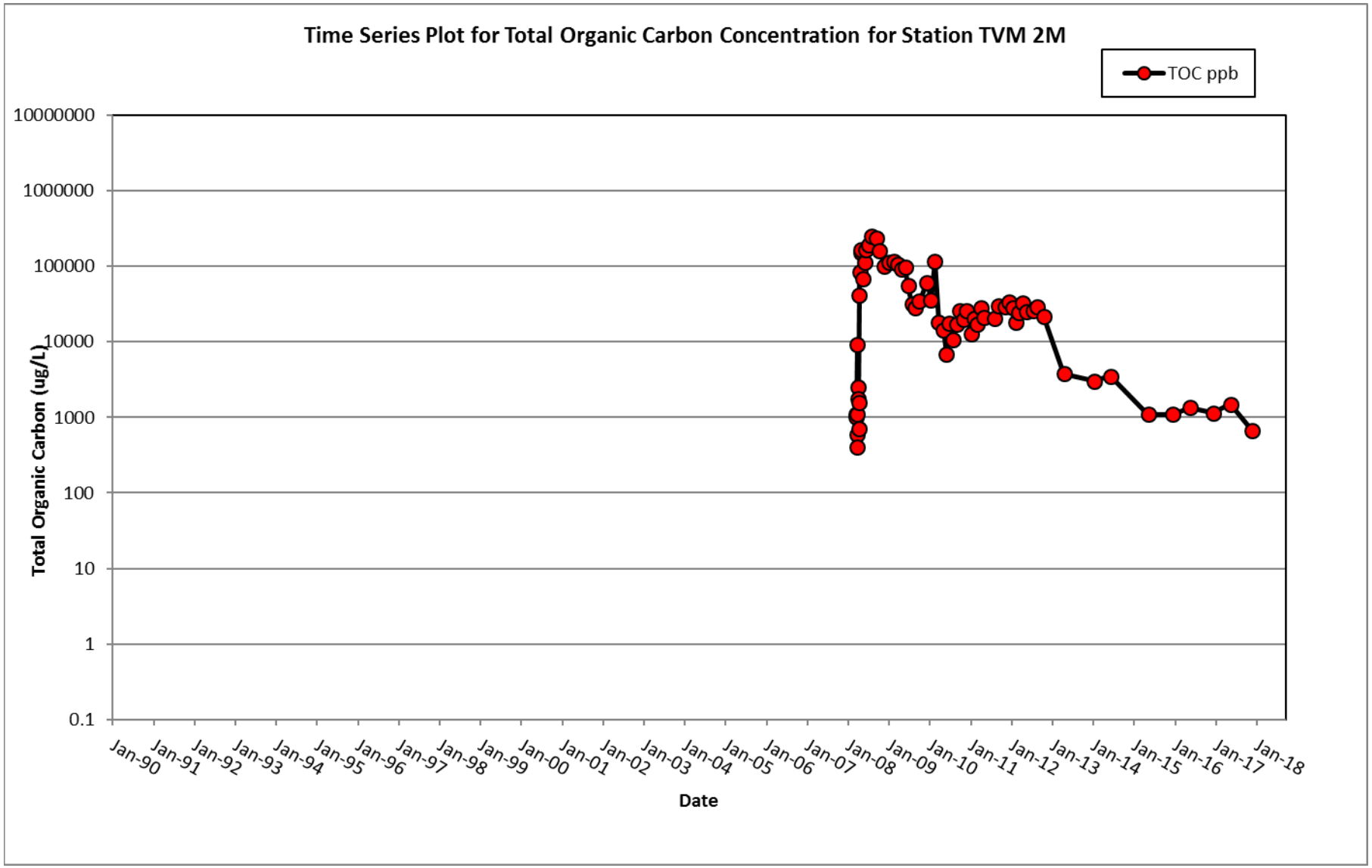
Jan-17
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TVM 2M
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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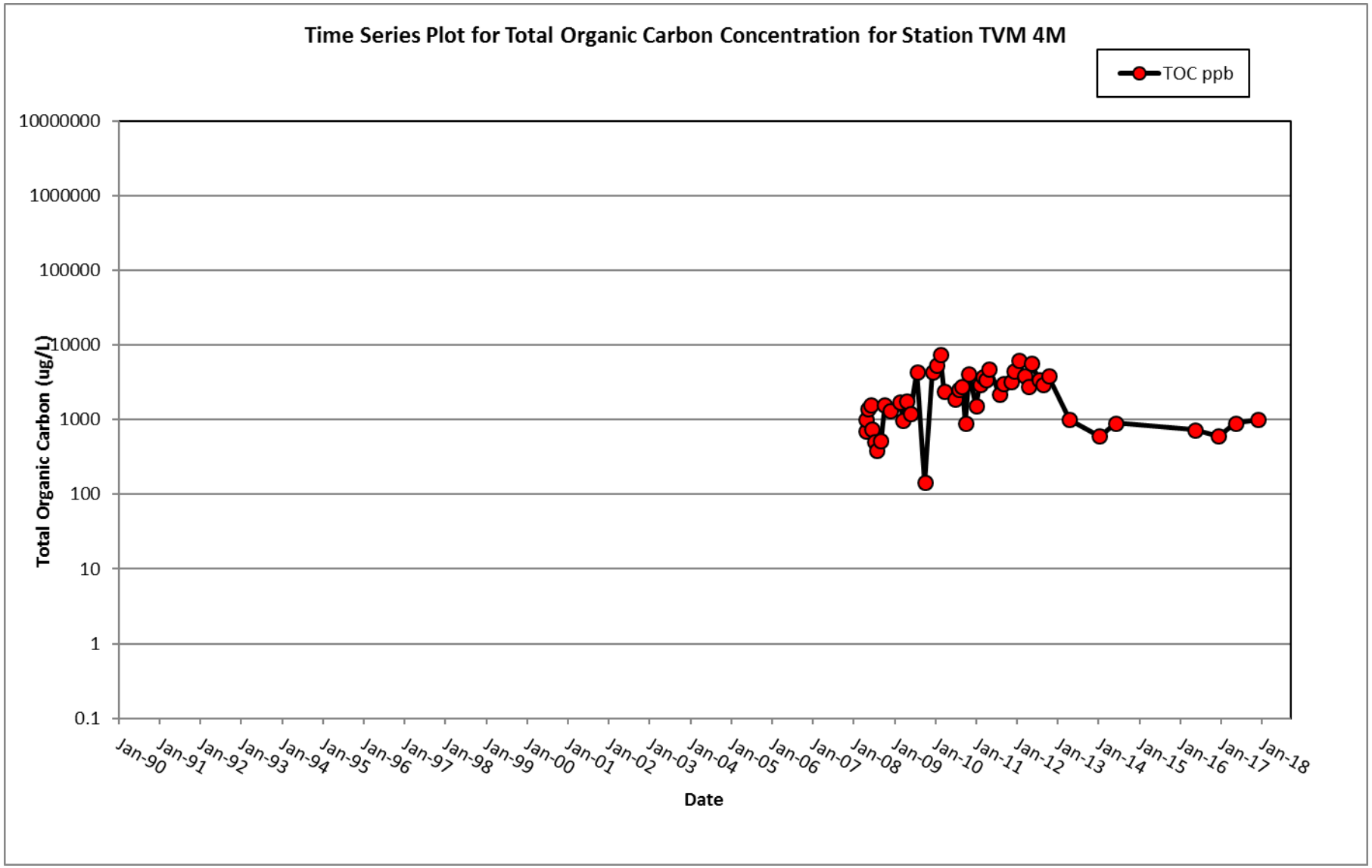
Jan-18
Date


Time Series Plot for Total Organic Carbon Concentration for Station TVM 4M
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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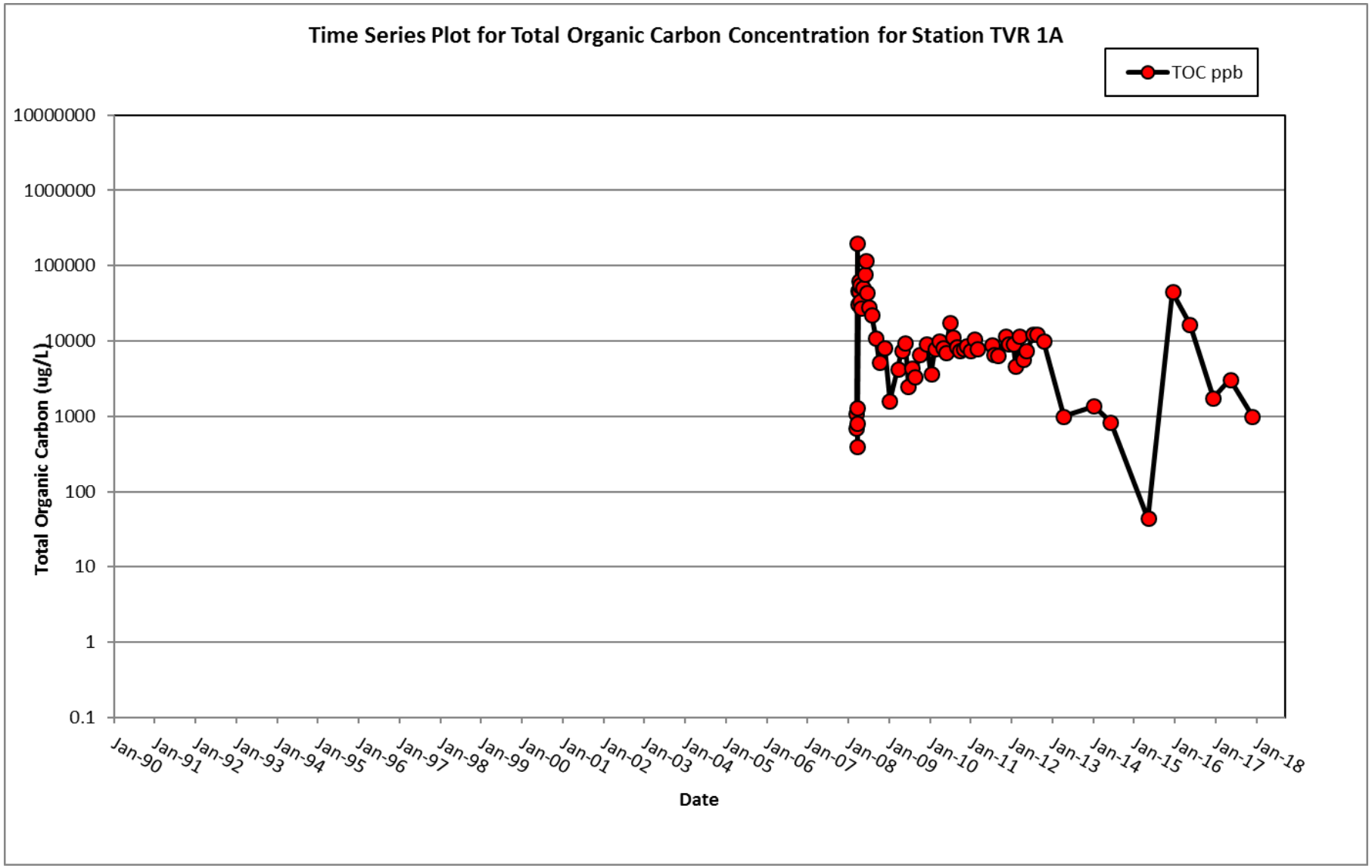
Date


Time Series Plot for Total Organic Carbon Concentration for Station TVR 1A
TOC ppb
Total Organic Carbon (ug/L)
10000000
1000000
100000
10000
1000
100
10
1
0.1
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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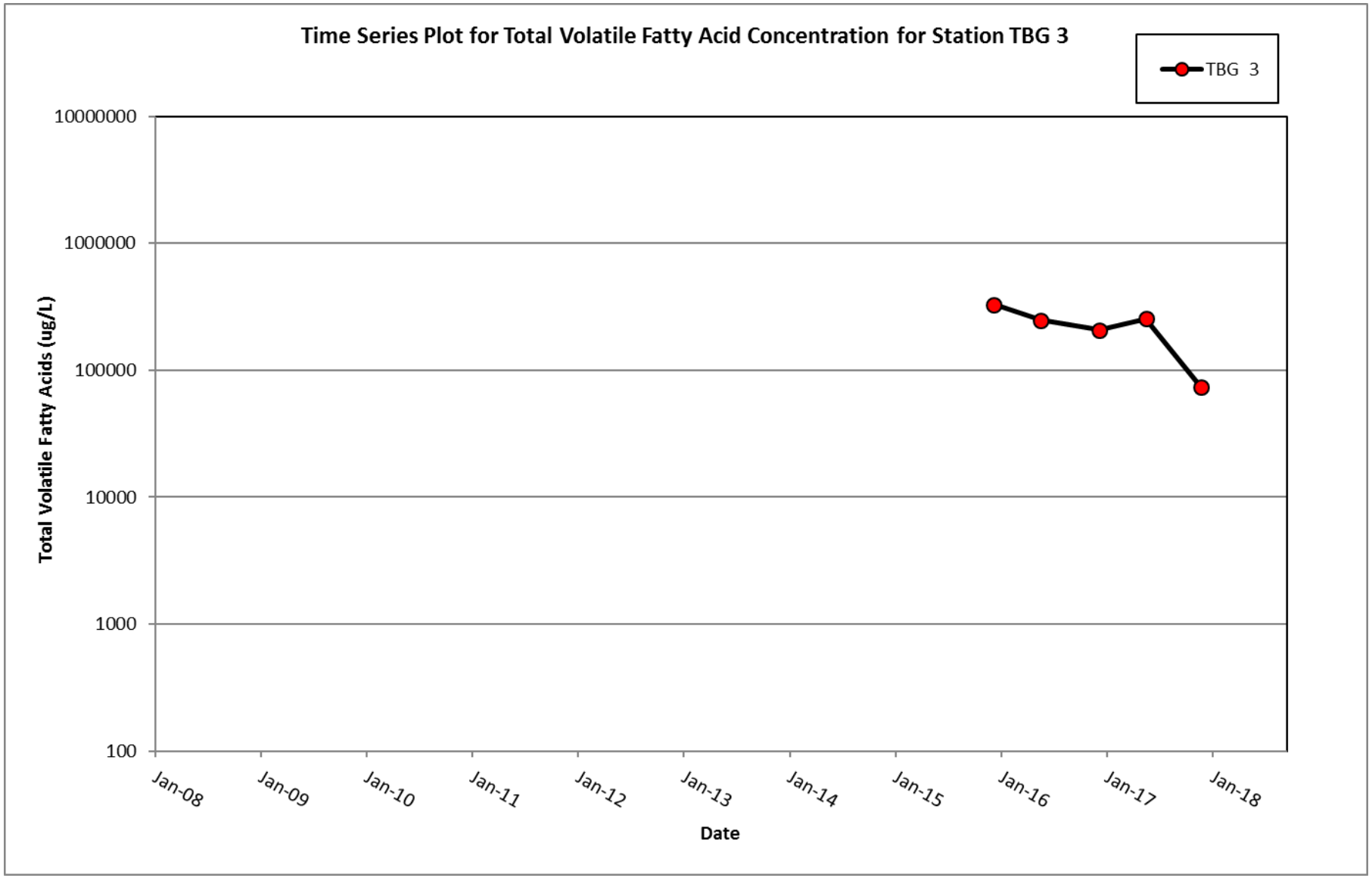
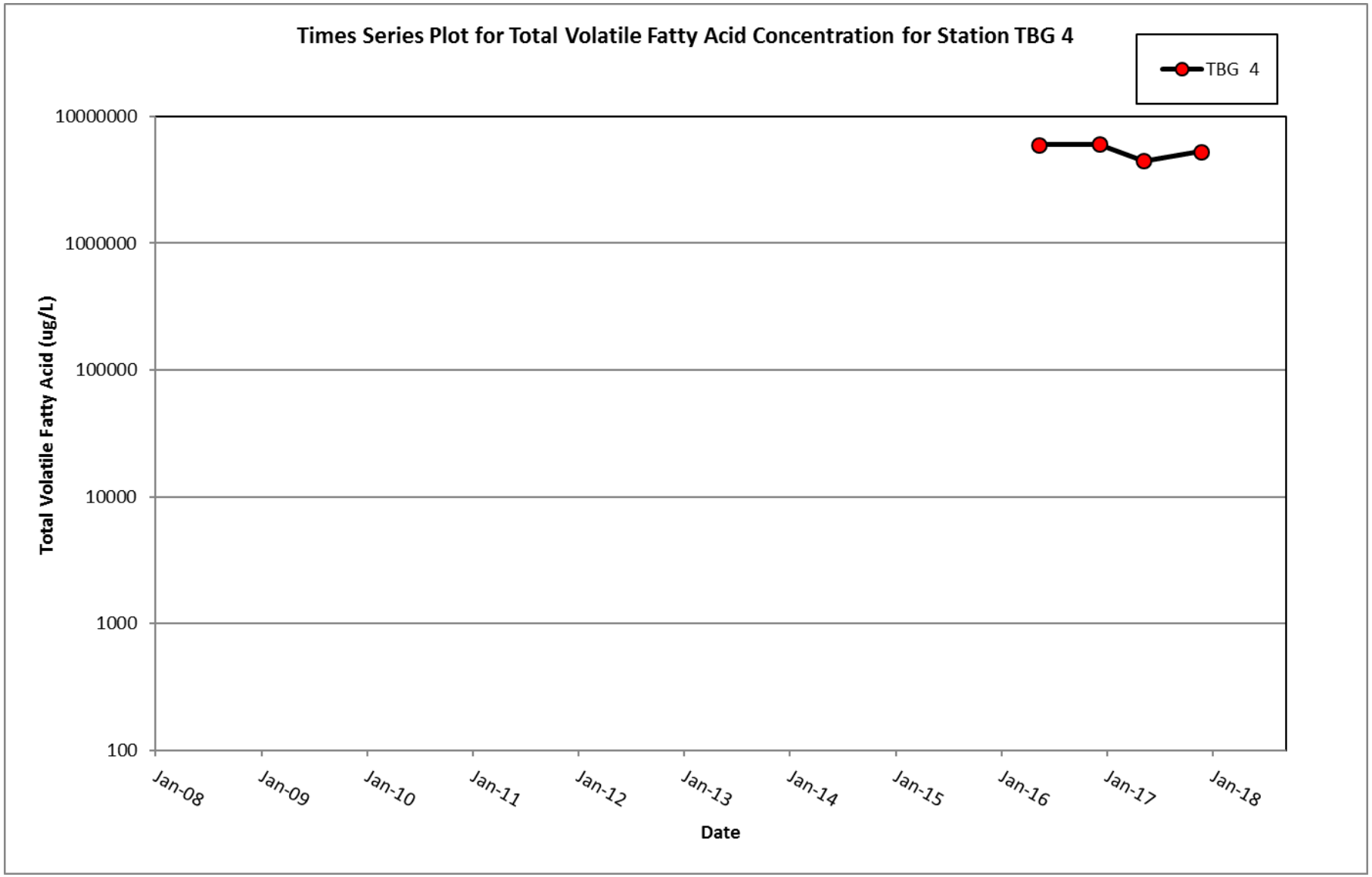
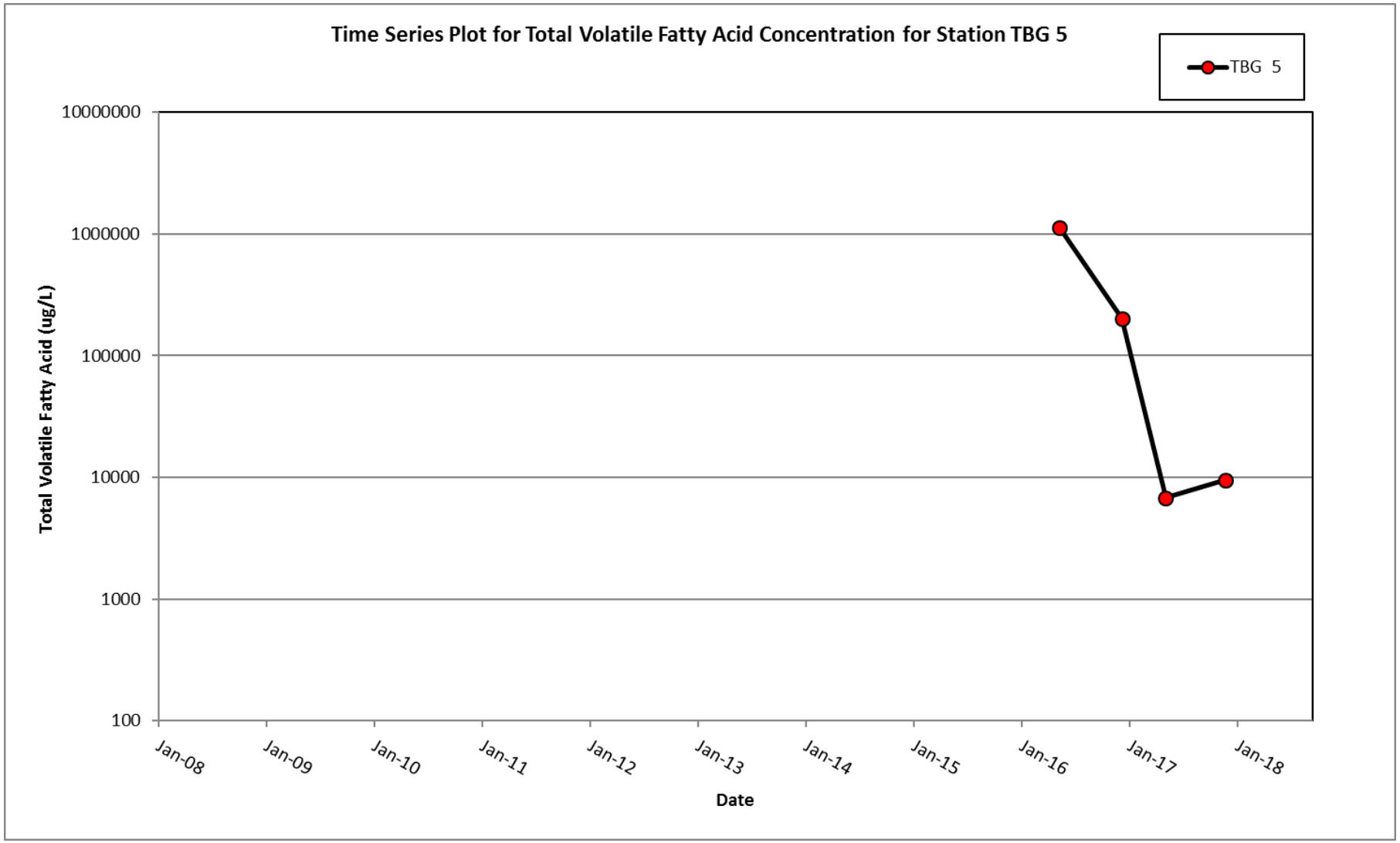
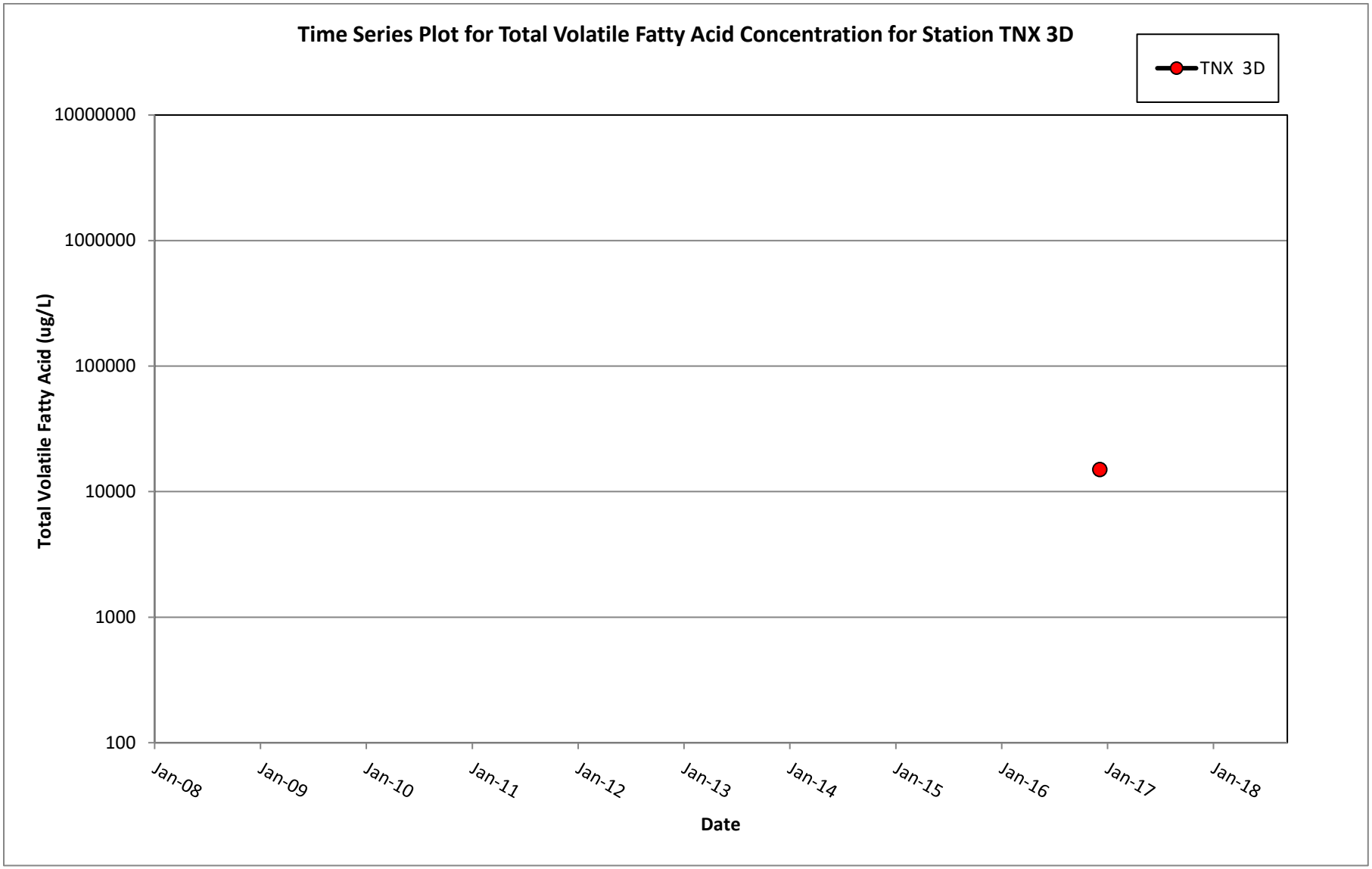
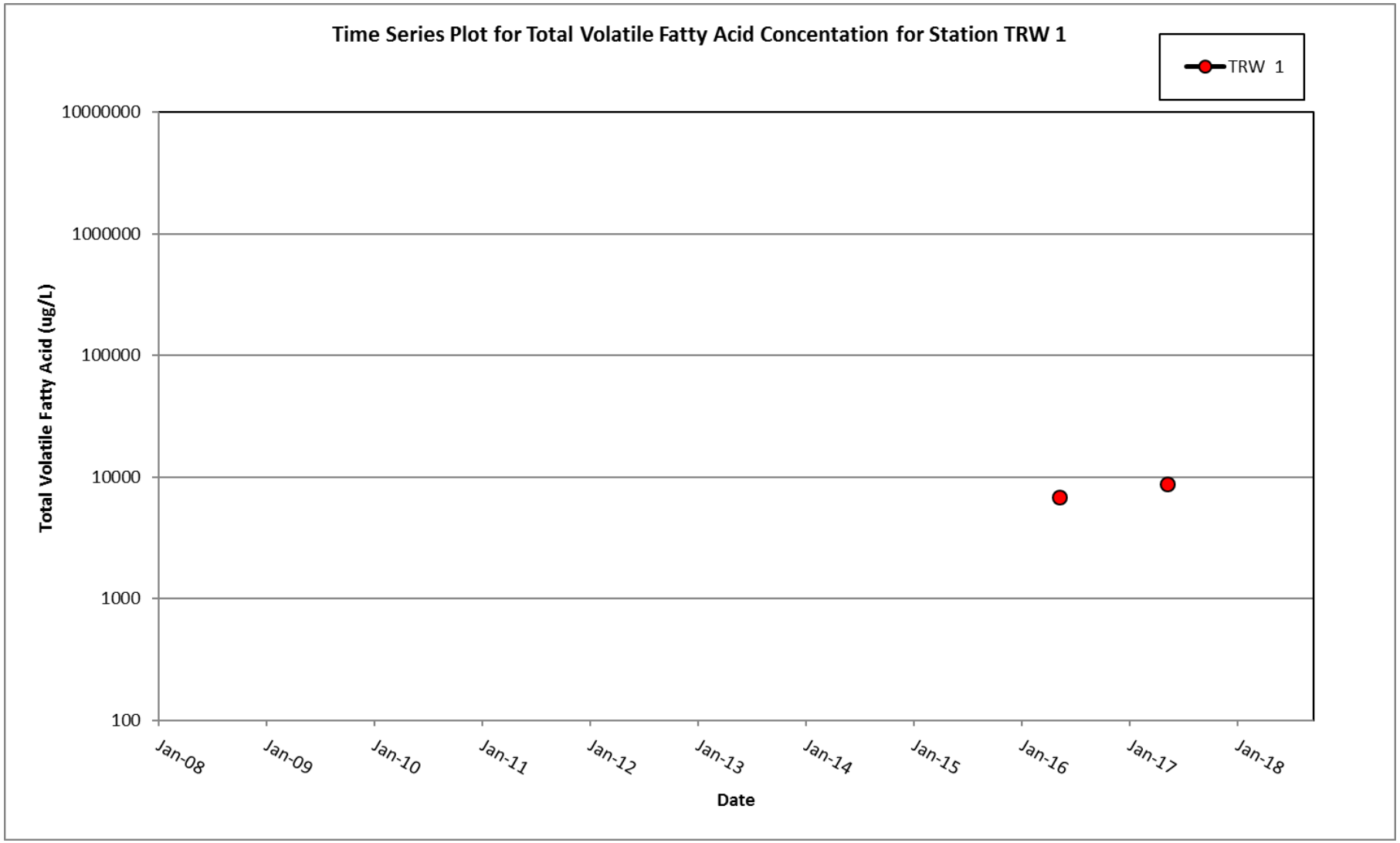
Jan-18
Date

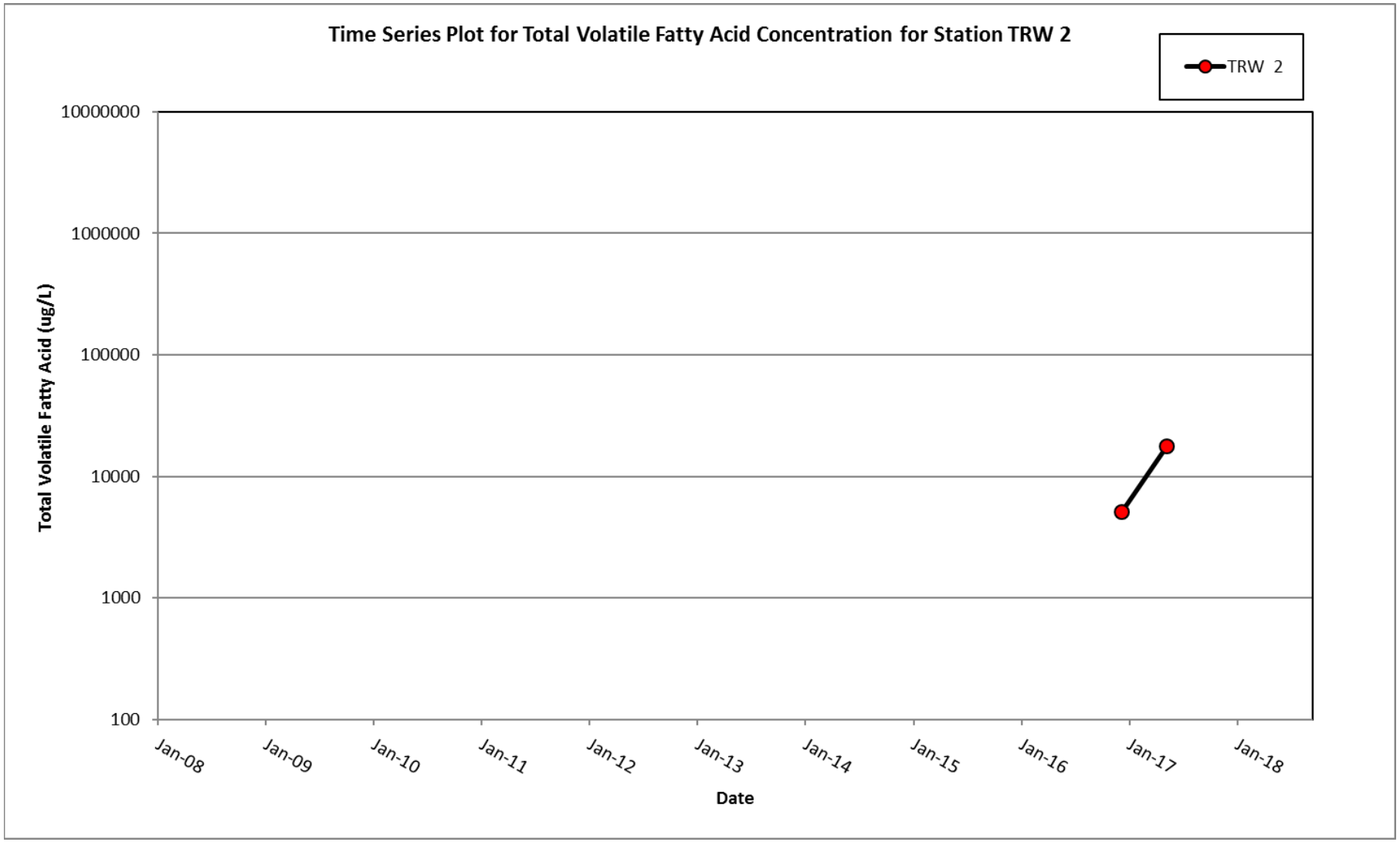

Time Series Plot for Total Volatile Fatty Acid Concentration for Station TBG 3
TBG 3
Total Volatile Fatty Acids (ug/L)
10000000
1000000
100000
10000
1000
100
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date

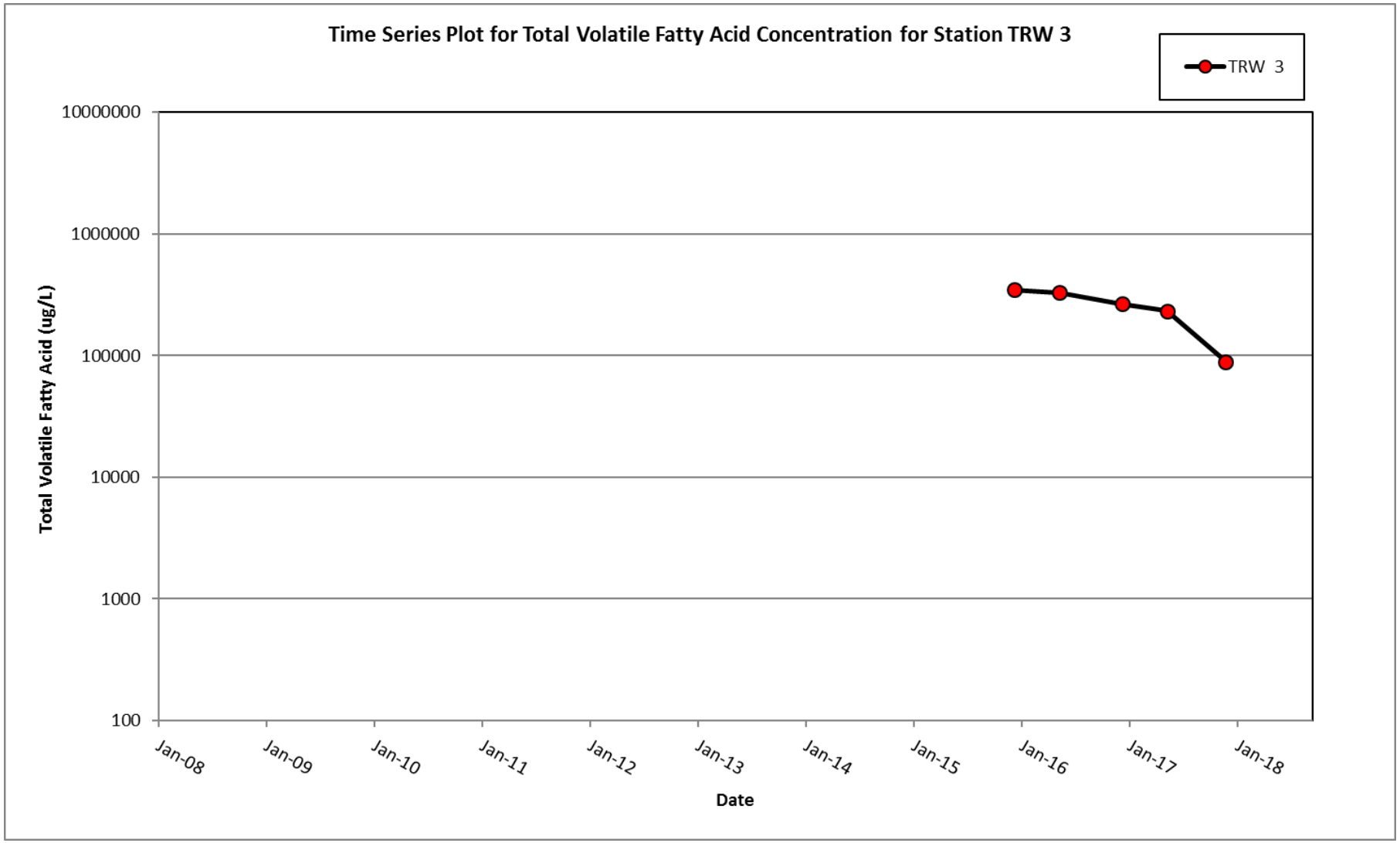

Times Series Plot for Total Volatile Fatty Acid Concentration for Station TBG 4
TBG 4
10000000
1000000
100000
10000
1000
100
Total Volatile Fatty Acid (ug/L)
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date

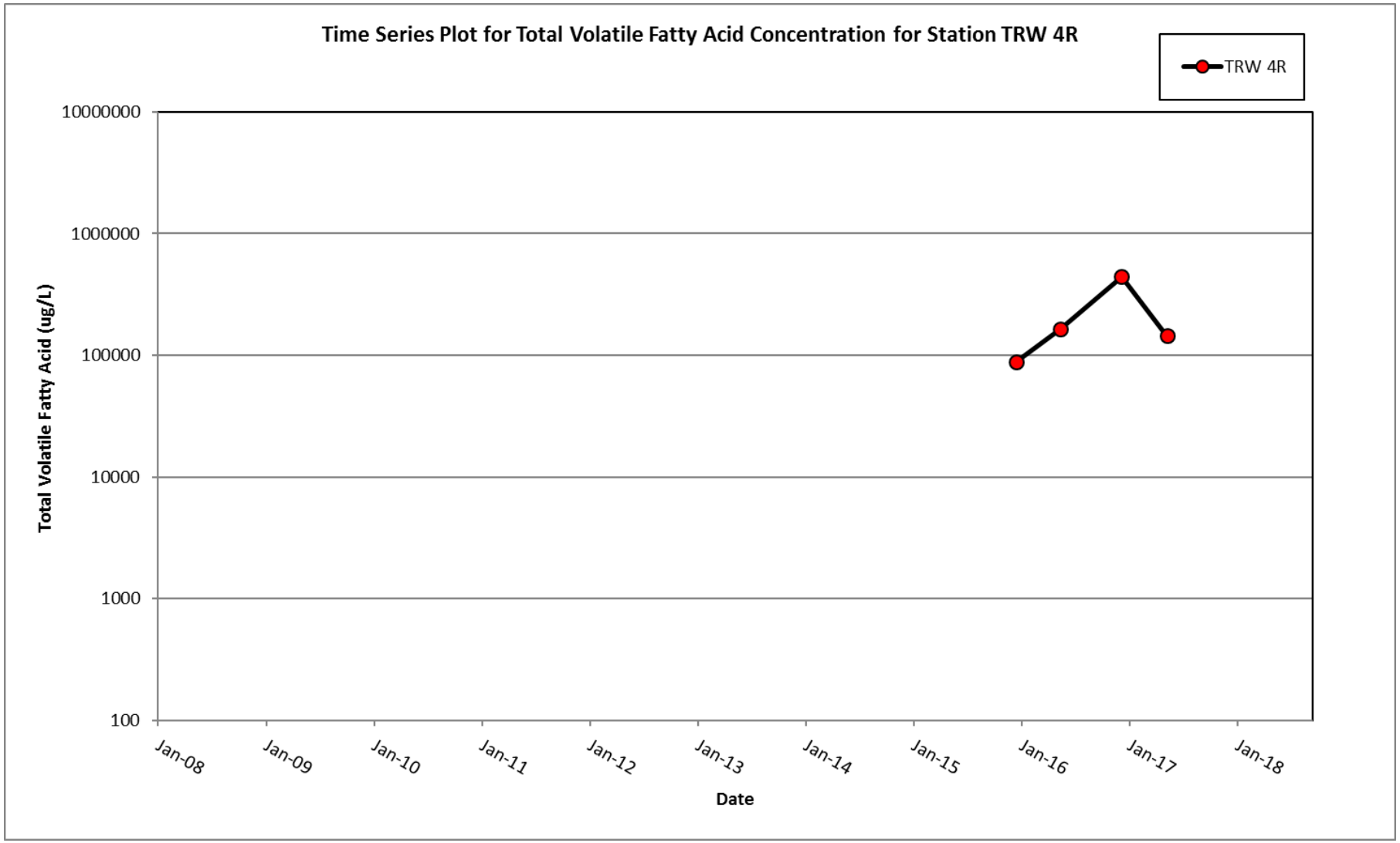

Time Series Plot for Total Volatile Fatty Acid Concentration for Station TBG 5
TBG 5
Total Volatile Fatty Acid (ug/L)
10000000
1000000
100000
10000
1000
100
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date

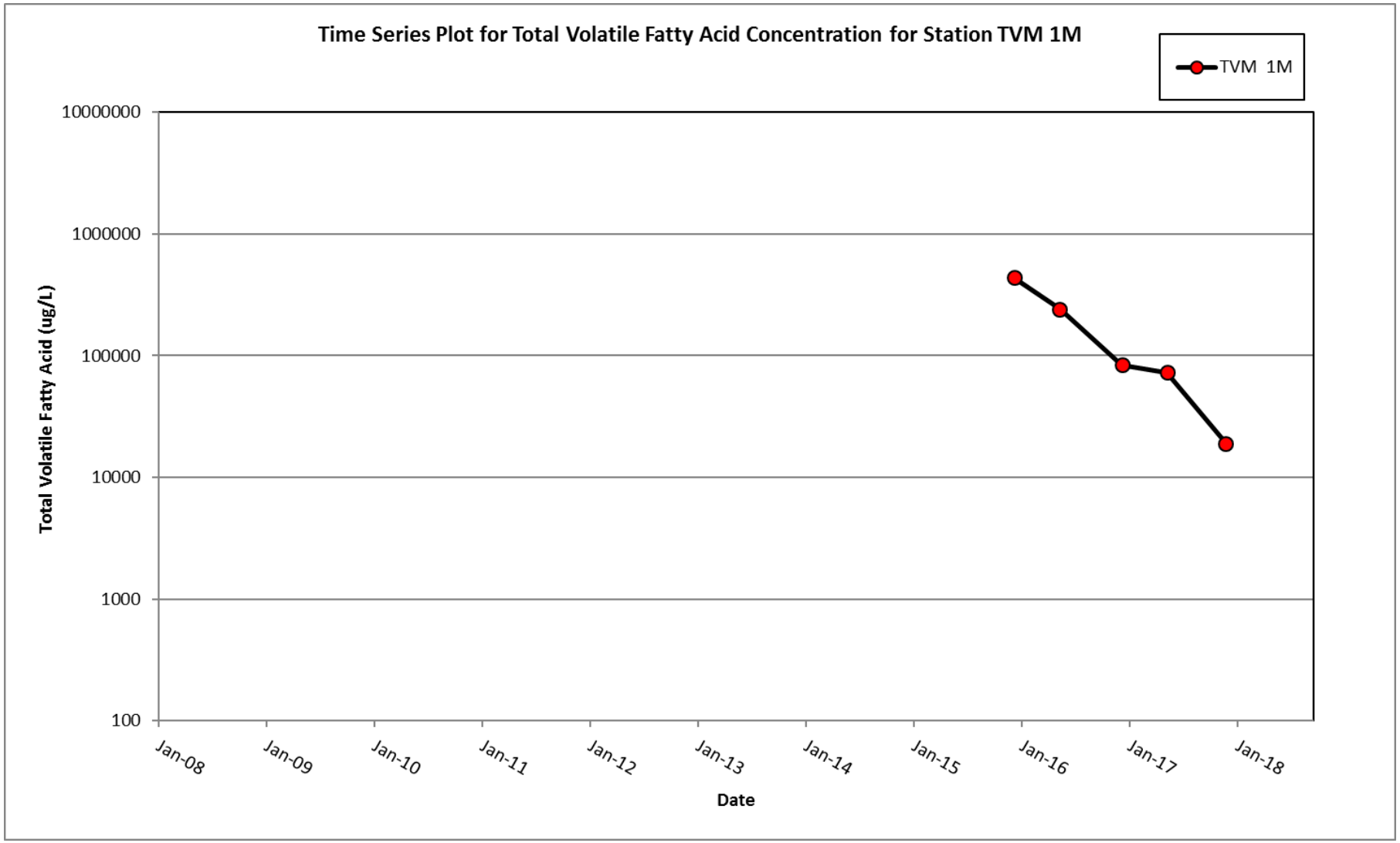

Time Series Plot for Total Volatile Fatty Acid Concentration for Station TNX 3D
TNX 3D
Total Volatile Fatty Acid (ug/L)
10000000
1000000
100000
10000
1000
100
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date

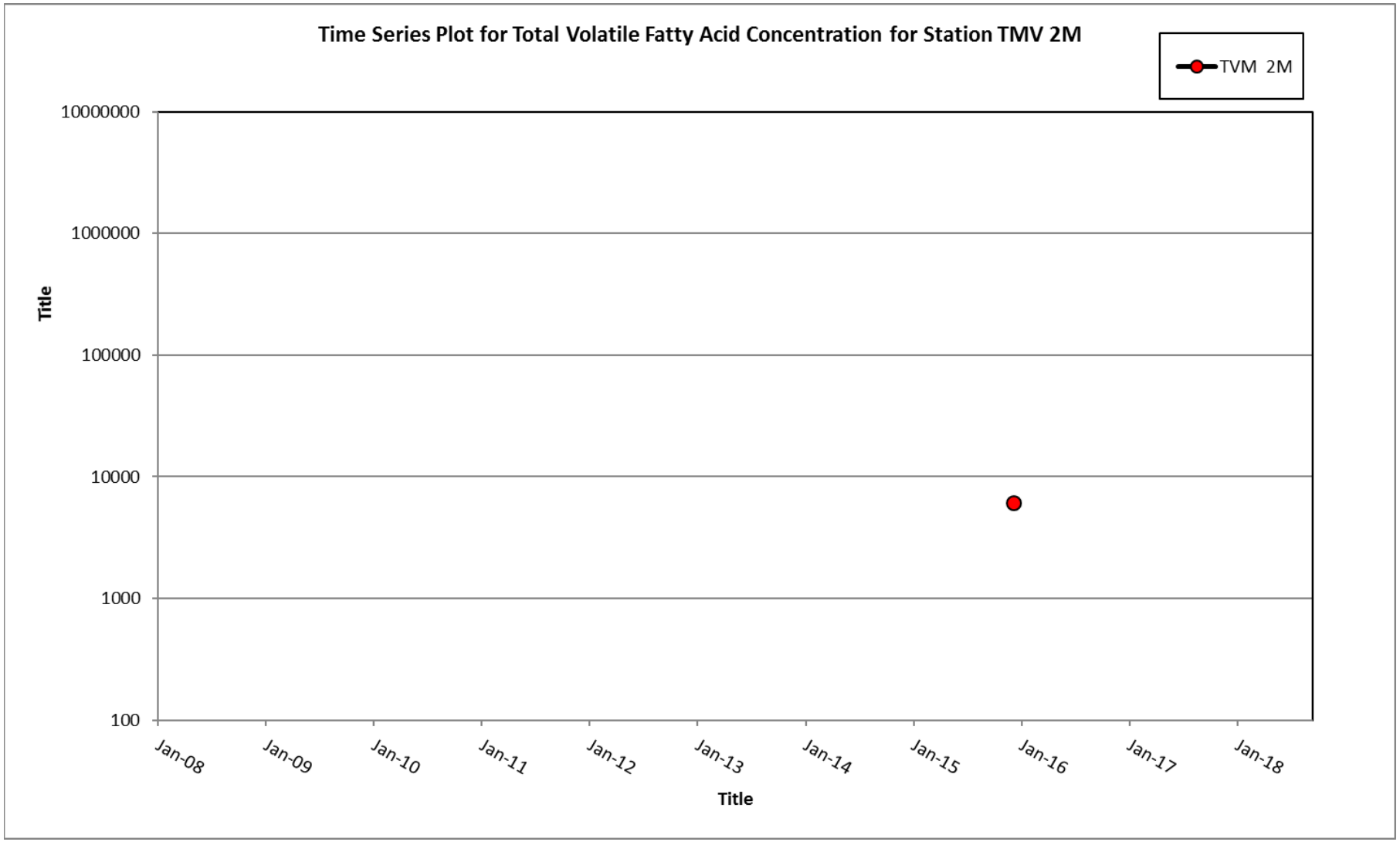

Time Series Plot for Total Volatile Fatty Acid Concentation for Station TRW 1
TRW 1
Total Volatile Fatty Acid (ug/L)
10000000
1000000
100000
10000
1000
100
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Volatile Fatty Acid Concentration for Station TRW 2
TRW 2
Total Volatile Fatty Acid (ug/L)
10000000
1000000
100000
10000
1000
100
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Volatile Fatty Acid Concentration for Station TRW 3
TRW 3
10000000
1000000
100000
10000
1000
100
Total Volatile Fatty Acid (ug/L)
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Volatile Fatty Acid Concentration for Station TRW 4R
TRW 4R
Total Volatile Fatty Acid (ug/L)
10000000
1000000
100000
10000
1000
100
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Volatile Fatty Acid Concentration for Station TVM 1M
TVM 1M
Total Volatile Fatty Acid (ug/L)
10000000
1000000
100000
10000
1000
100
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Total Volatile Fatty Acid Concentration for Station TMV 2M
TVM 2M
10000000
1000000
100000
10000
1000
100
Title
Jan-08
Jan-09
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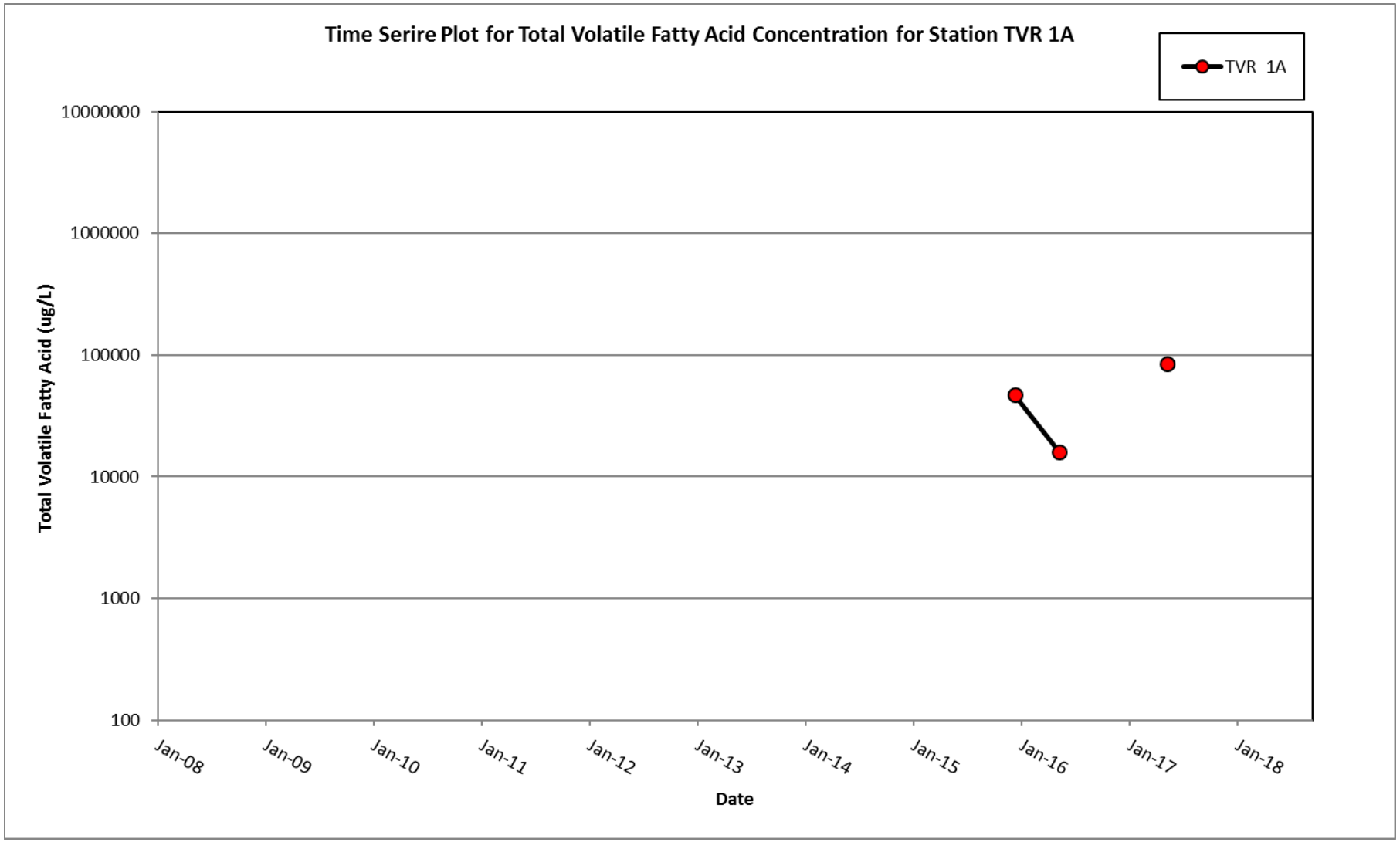
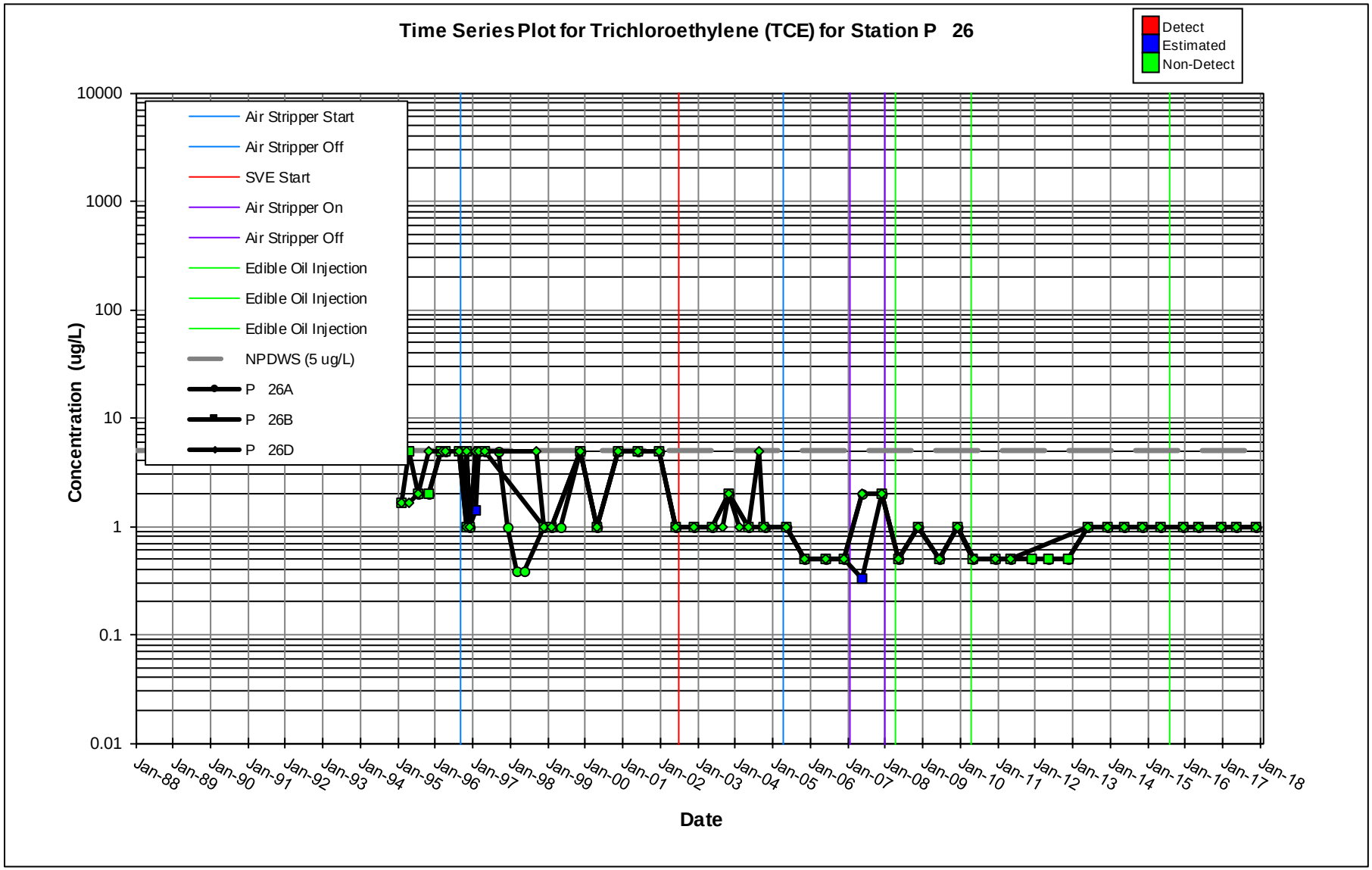
Jan-17
Jan-18
Title


Time Serire Plot for Total Volatile Fatty Acid Concentration for Station TVR 1A
TVR 1A
Total Volatile Fatty Acid (ug/L)
10000000
1000000
100000
10000
1000
100
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station P 26
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
P 26A
P 26B
P 26D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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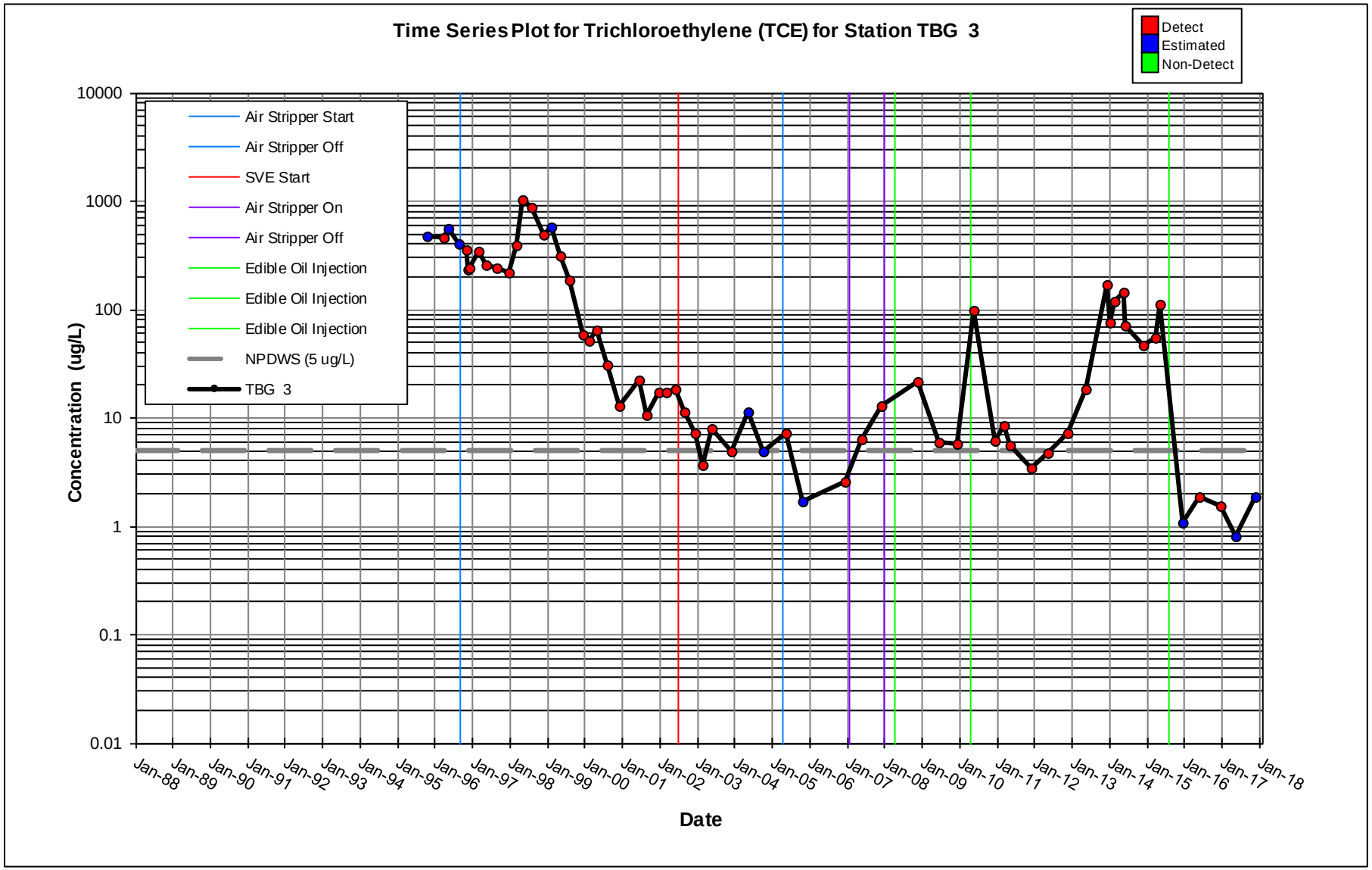
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TBG 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TBG 3
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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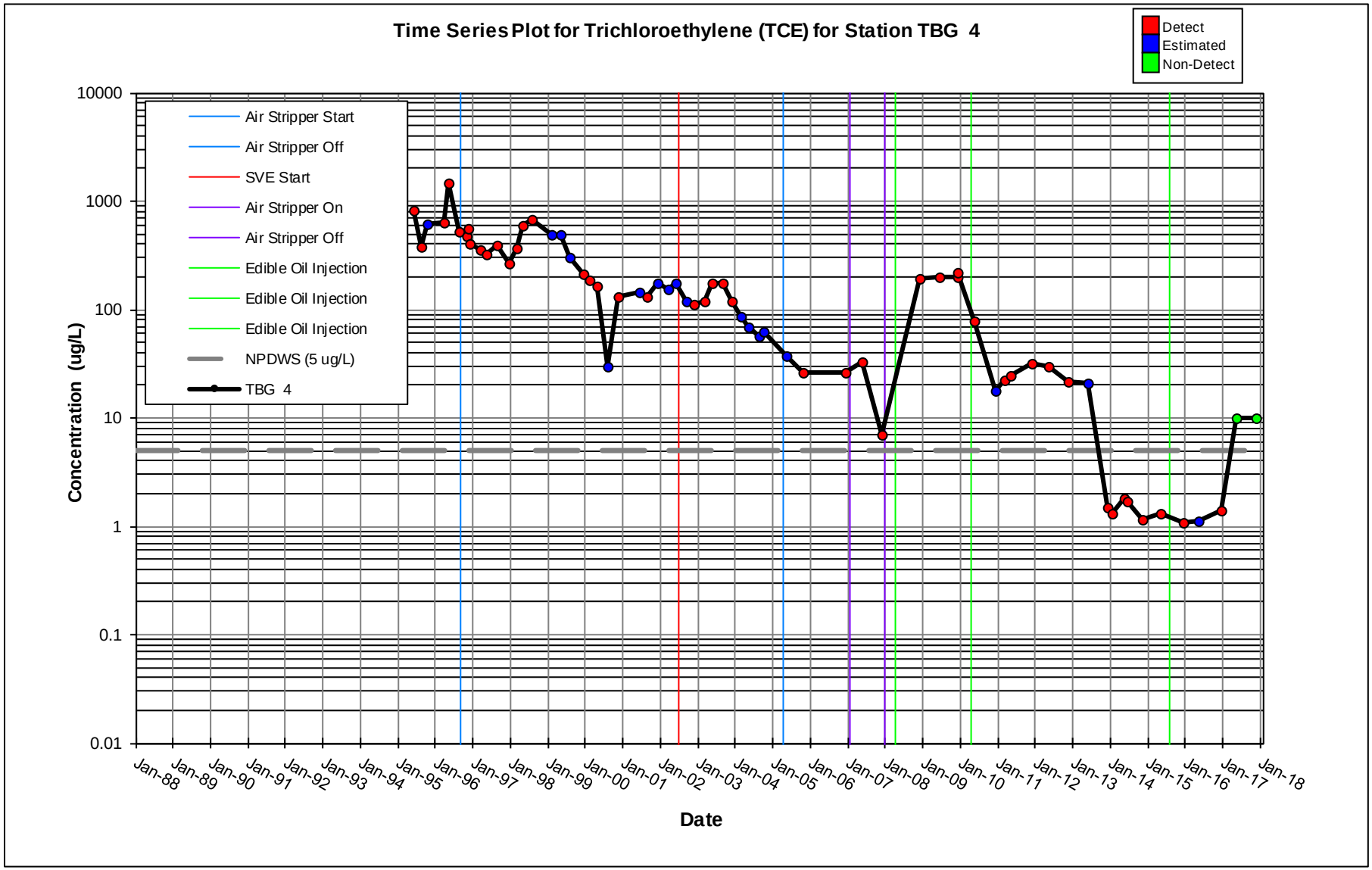
Jan-17
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TBG 4
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
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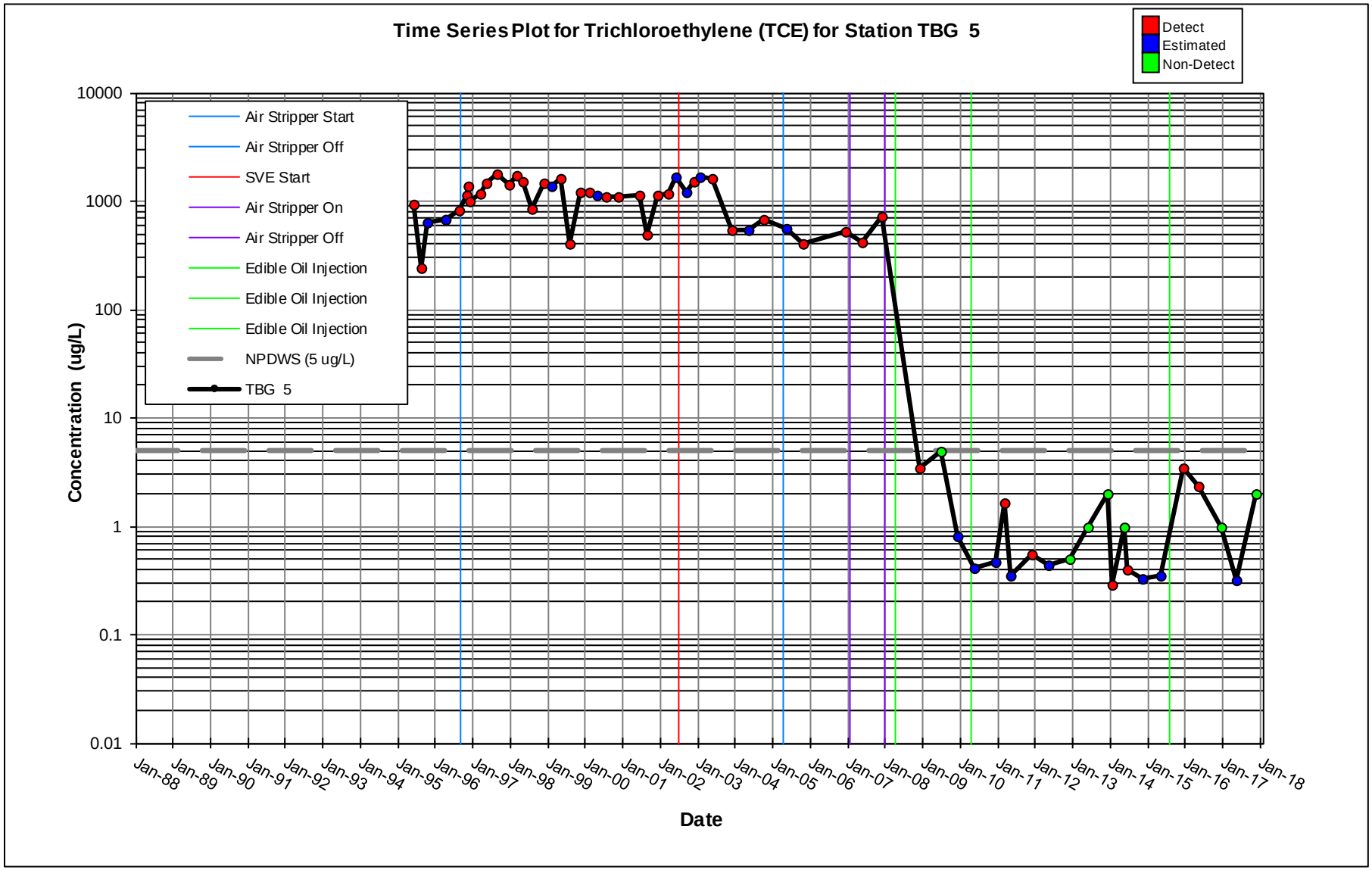
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TBG 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TBG 5
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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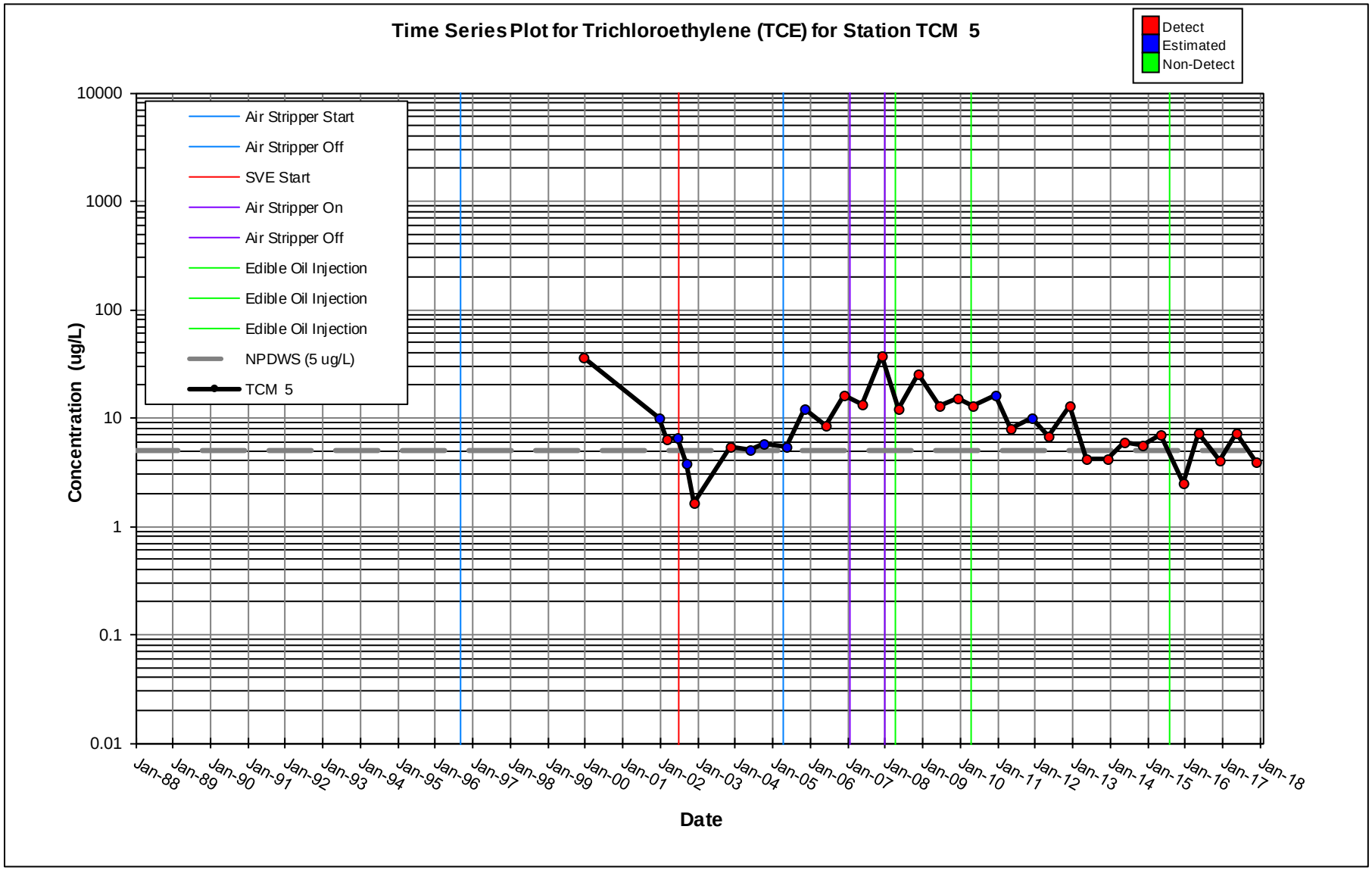
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TCM 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TCM 5
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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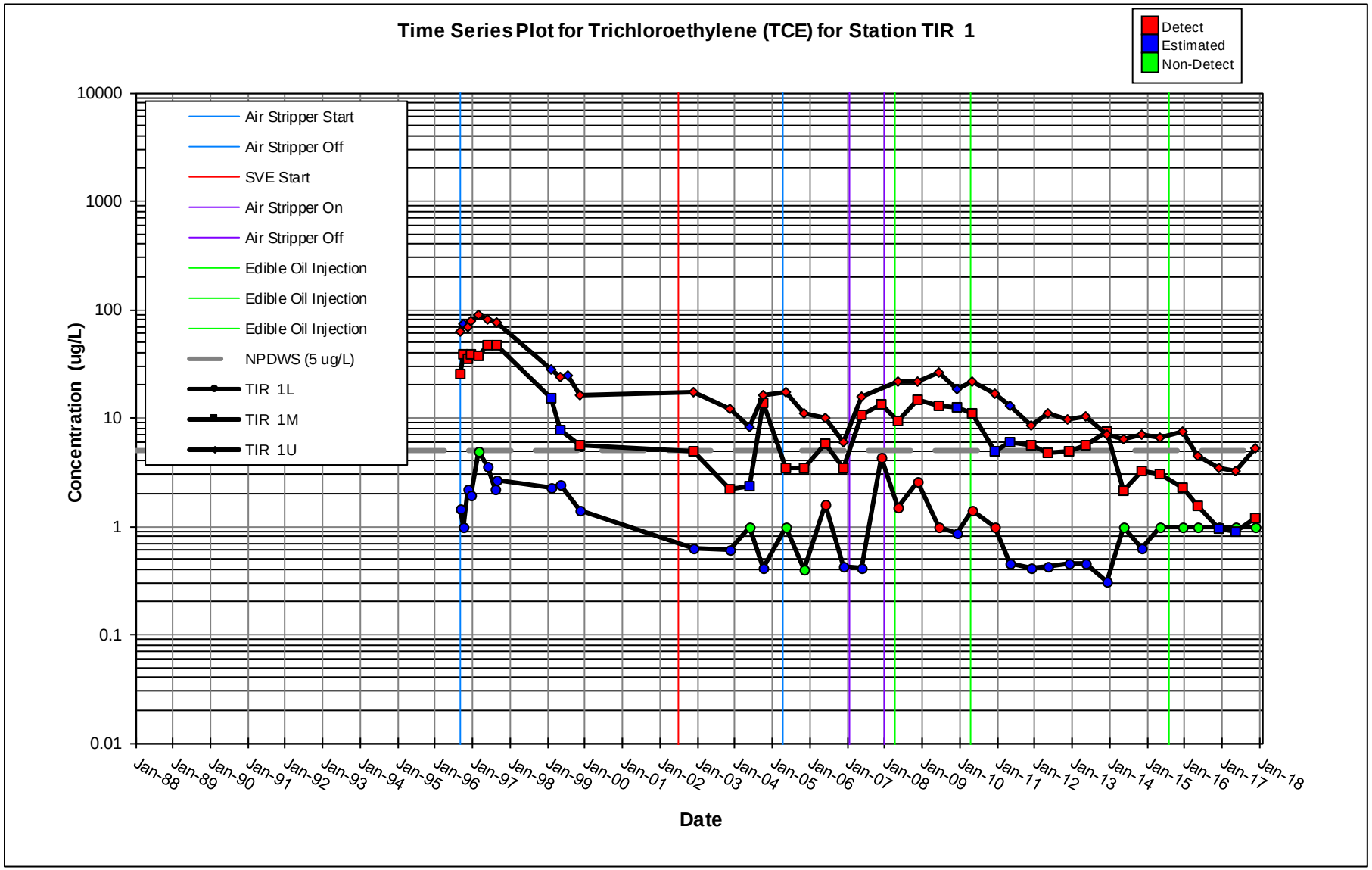
Jan-17
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TIR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TIR 1L
TIR 1M
TIR 1U
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
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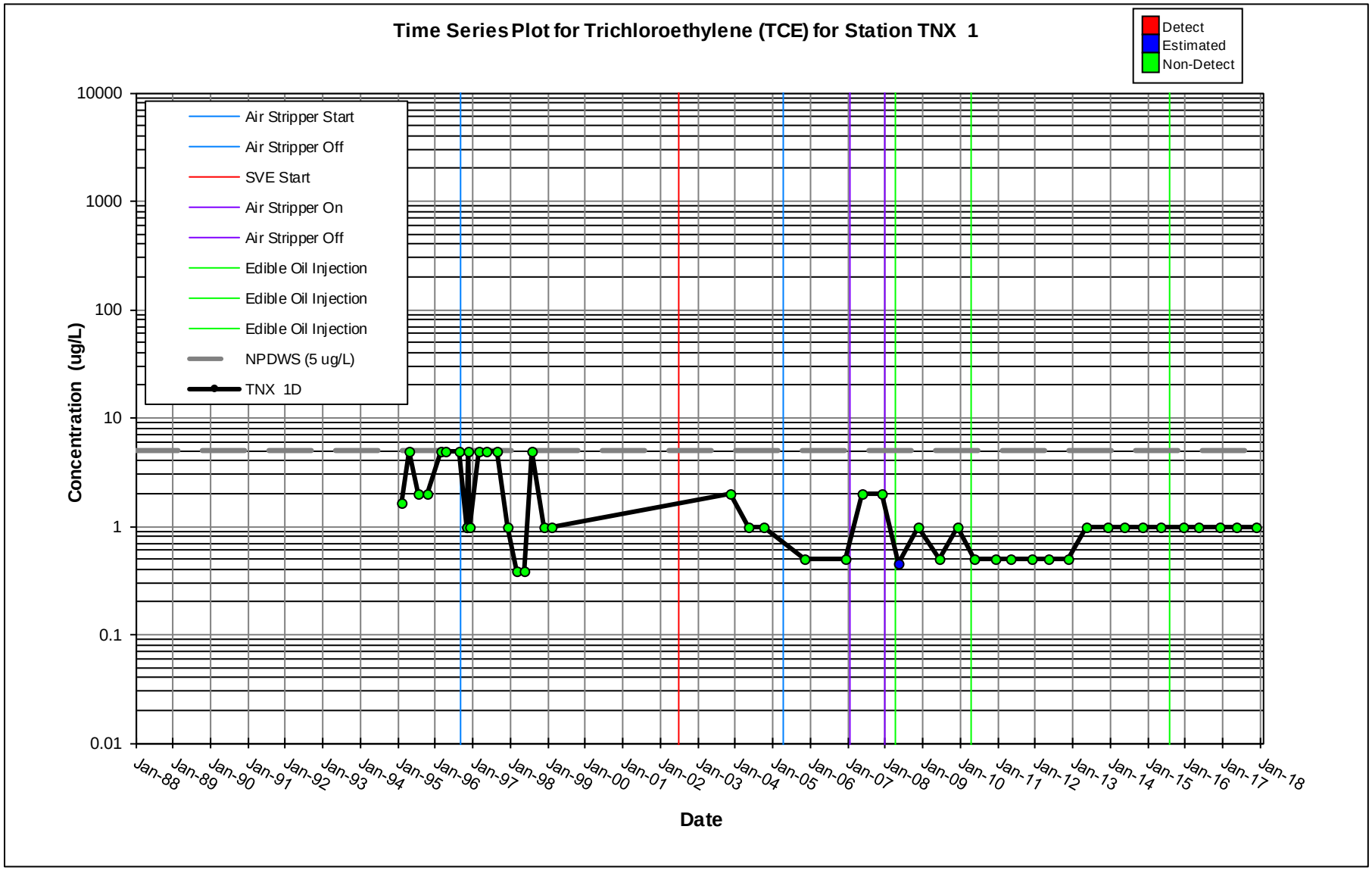
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TNX 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 1D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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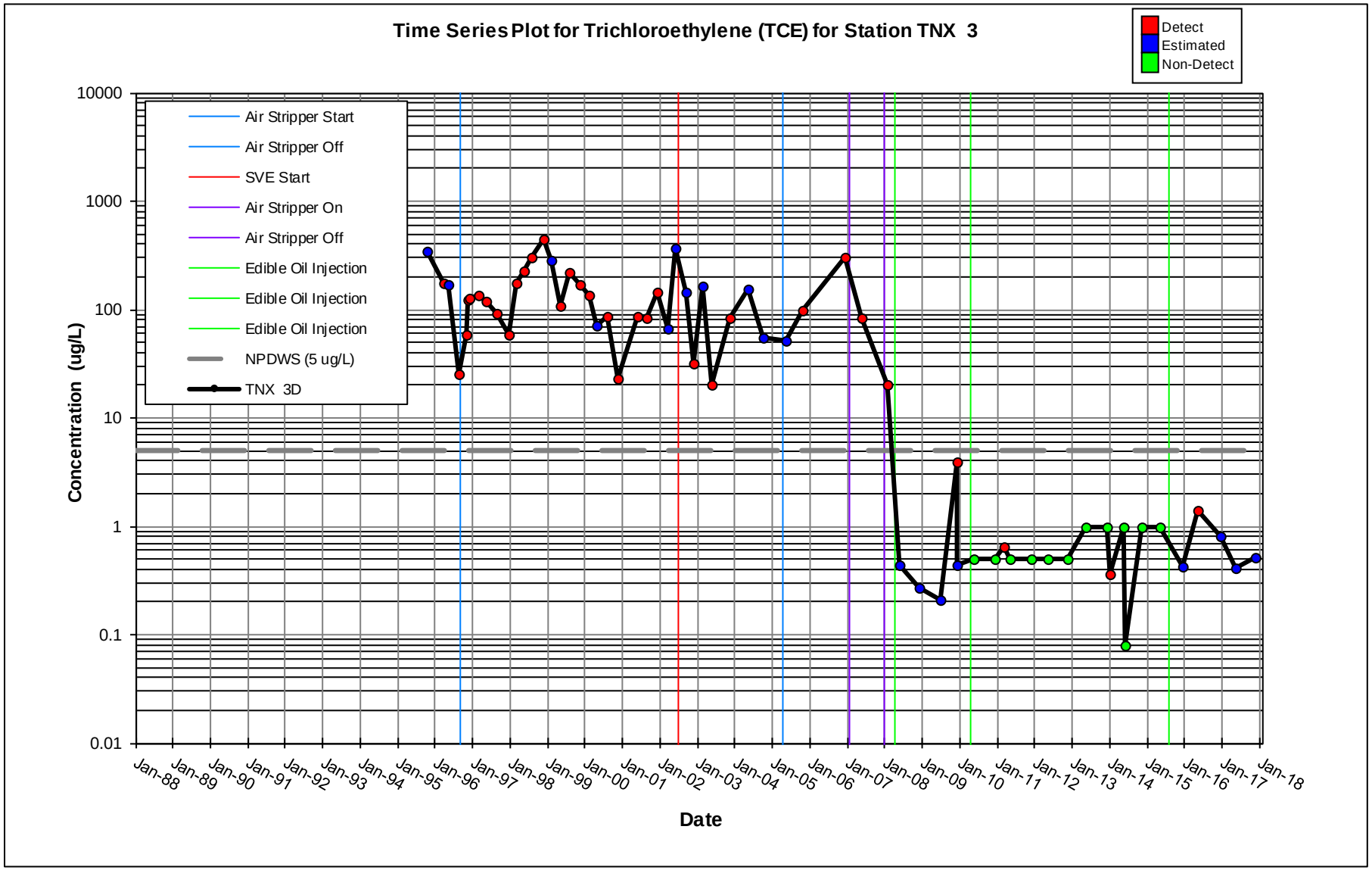
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TNX 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 3D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
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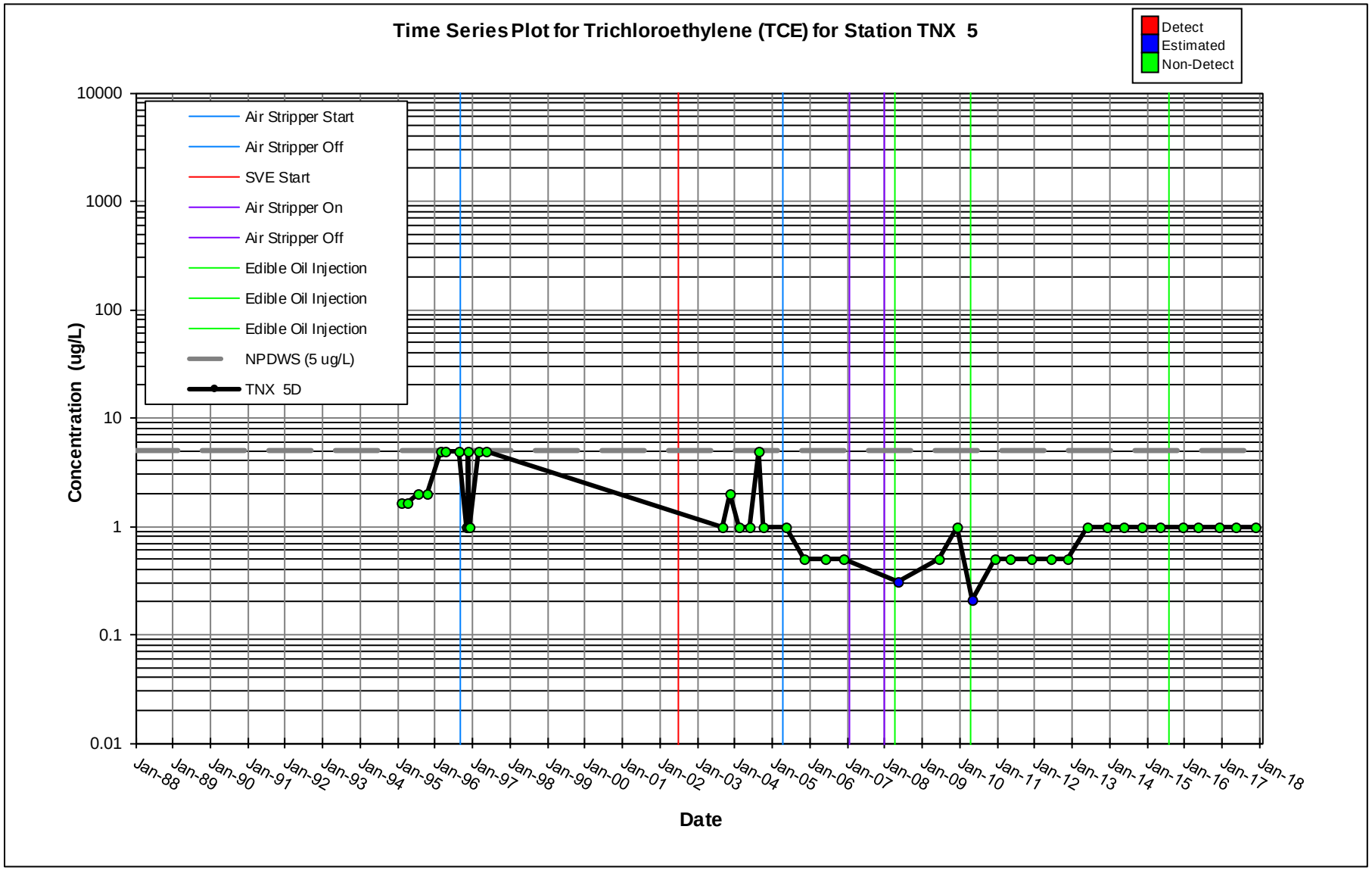
Jan-17
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TNX 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 5D
Concentration (ug/L)
10000
1000
100
10
1
0.1
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Jan-88
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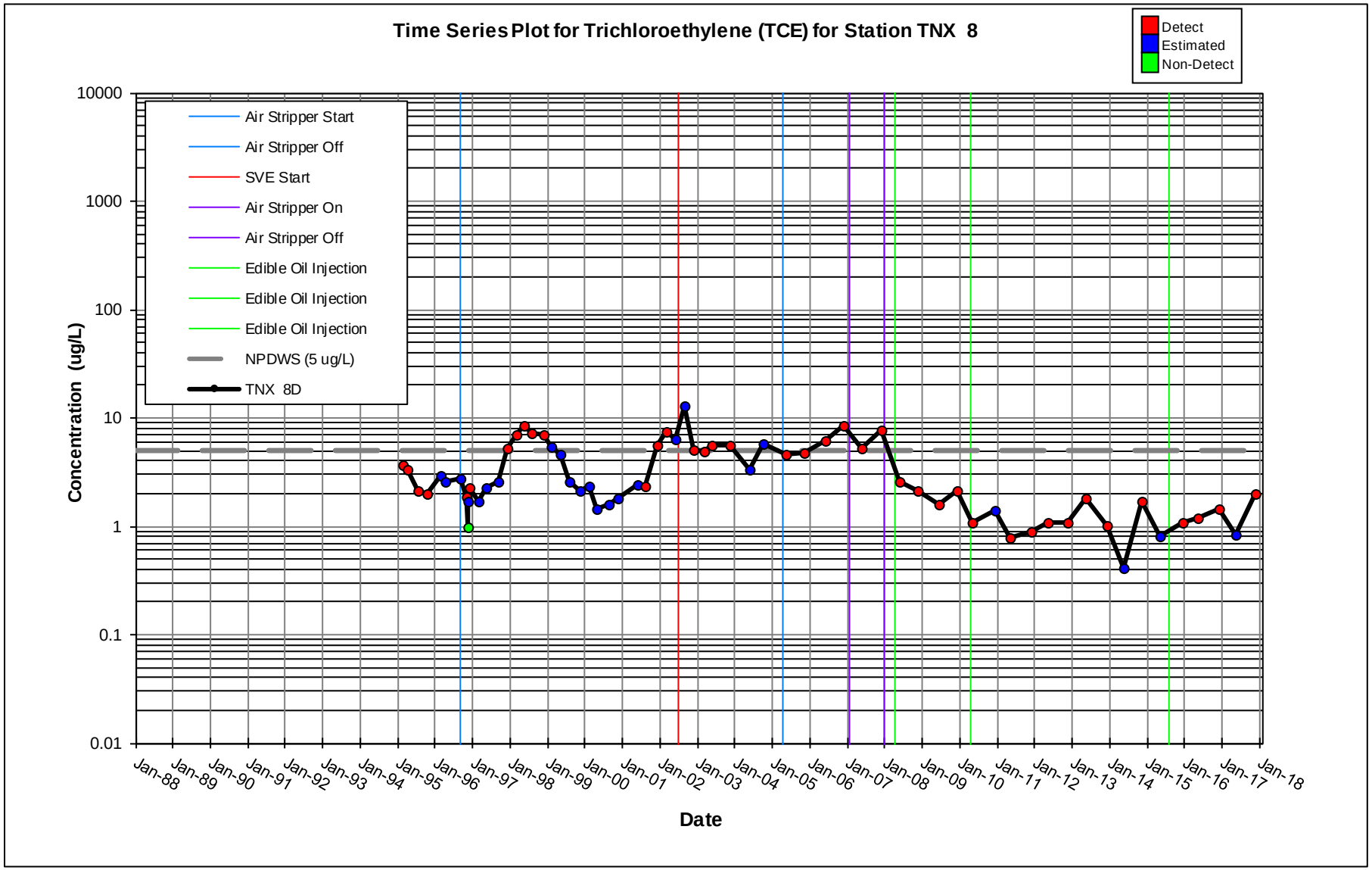
Date


Time Series Plot for Trichloroethylene (TCE) for Station TNX 8
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 8D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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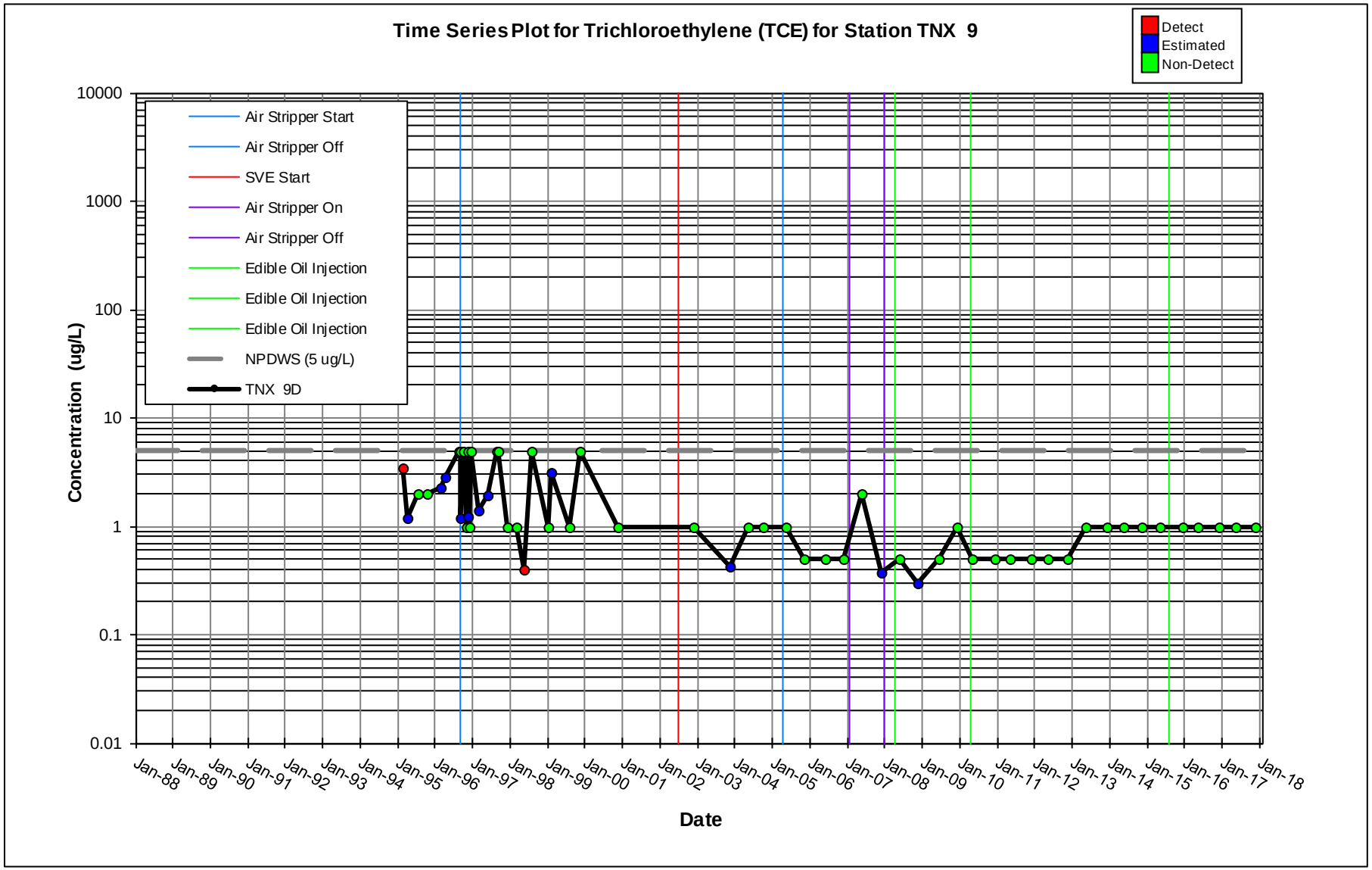
Date


Time Series Plot for Trichloroethylene (TCE) for Station TNX 9
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 9D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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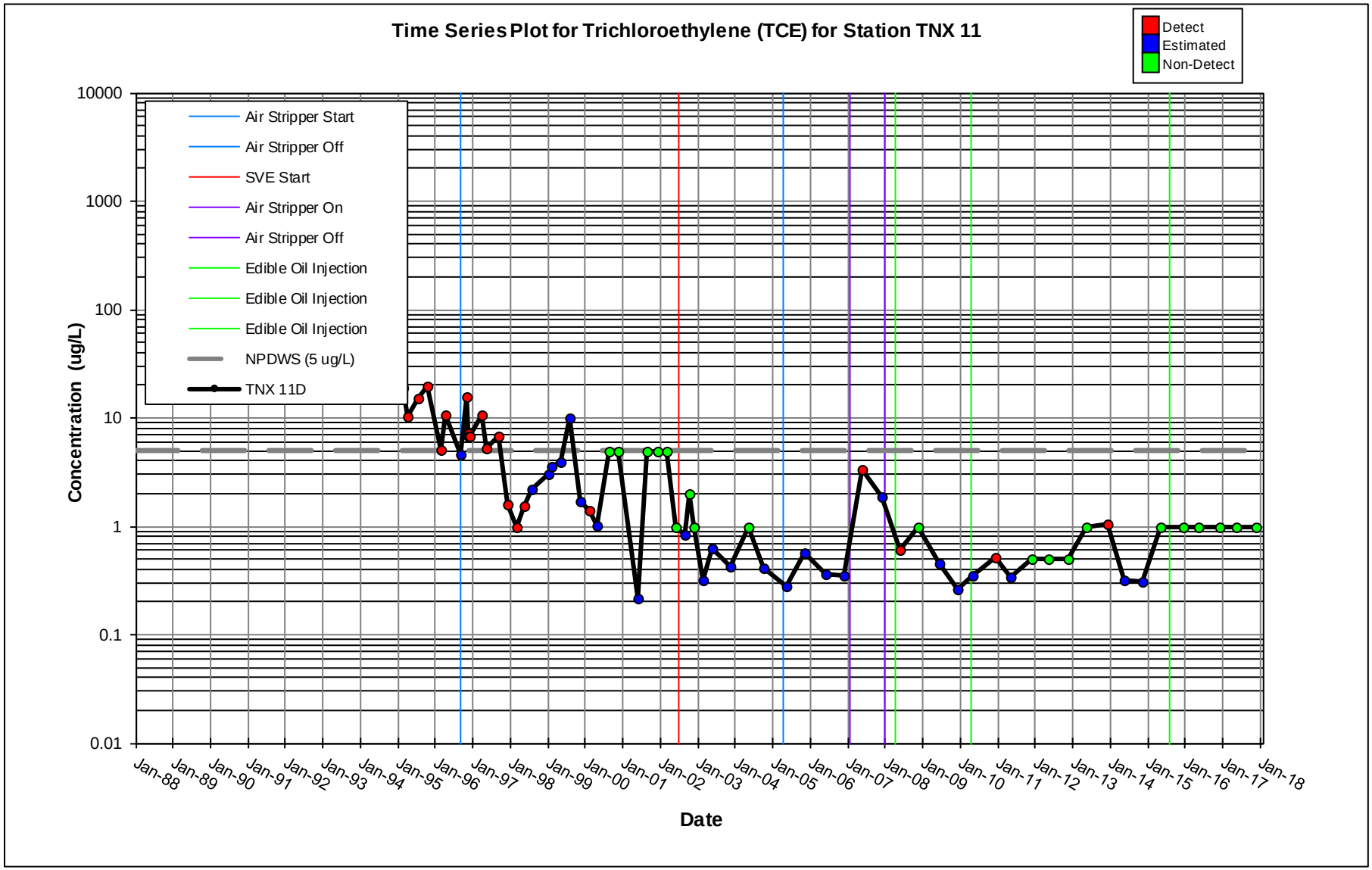
Time Series Plot for Trichloroethylene (TCE) for Station TNX 11
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 11D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
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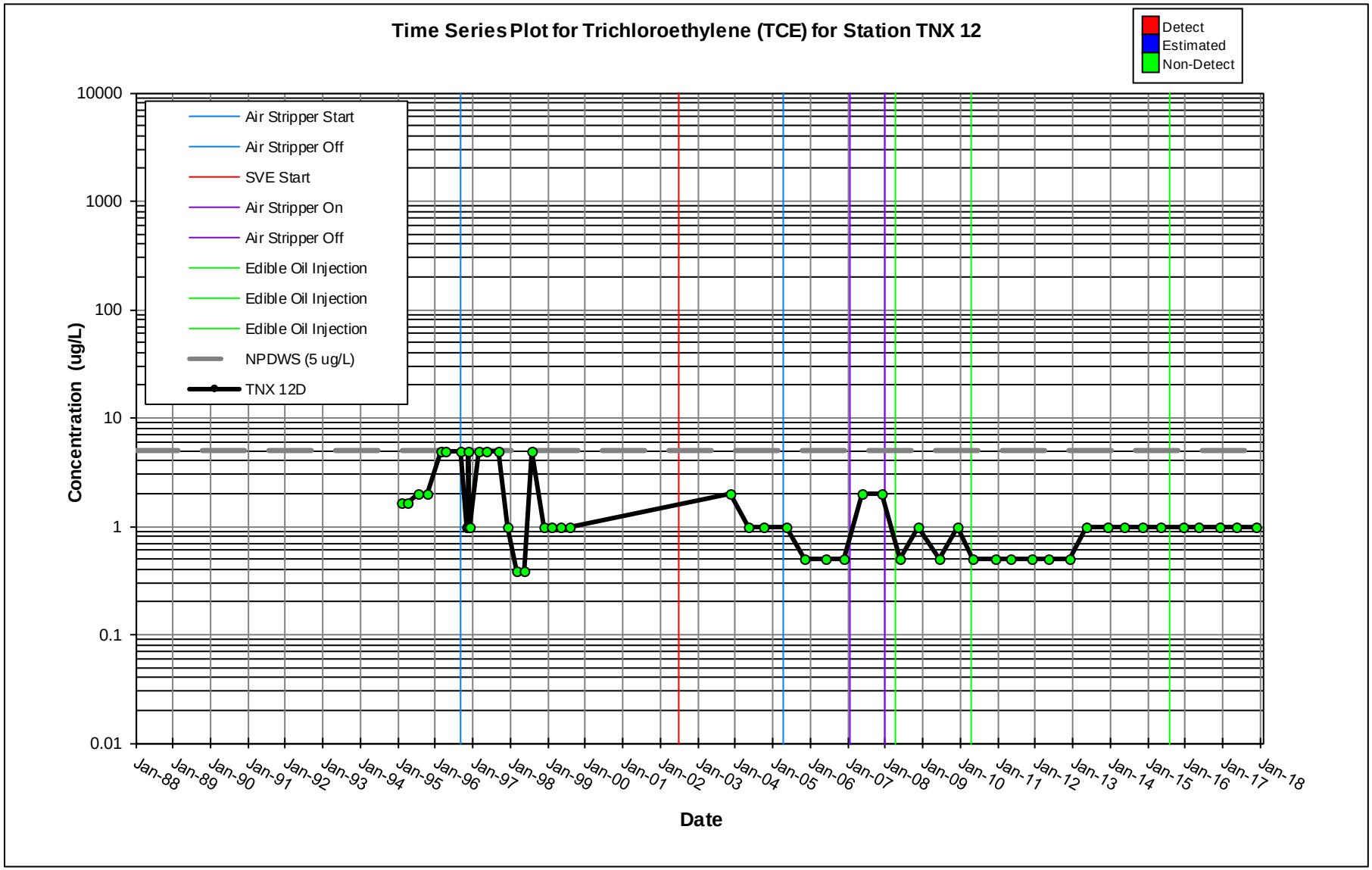
Date


Time Series Plot for Trichloroethylene (TCE) for Station TNX 12
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 12D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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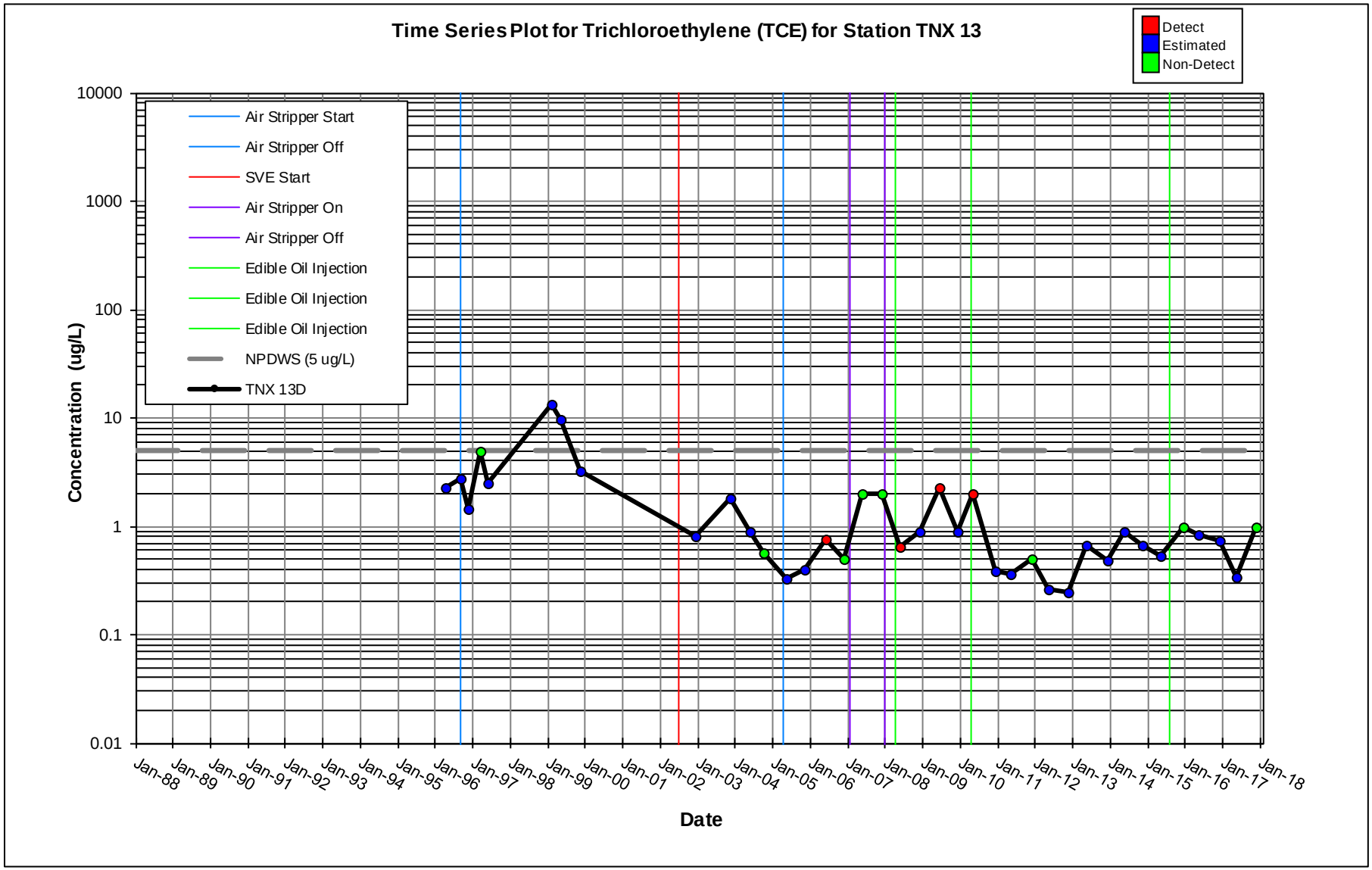
Time Series Plot for Trichloroethylene (TCE) for Station TNX 13
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 13D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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Jan-90
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Jan-93
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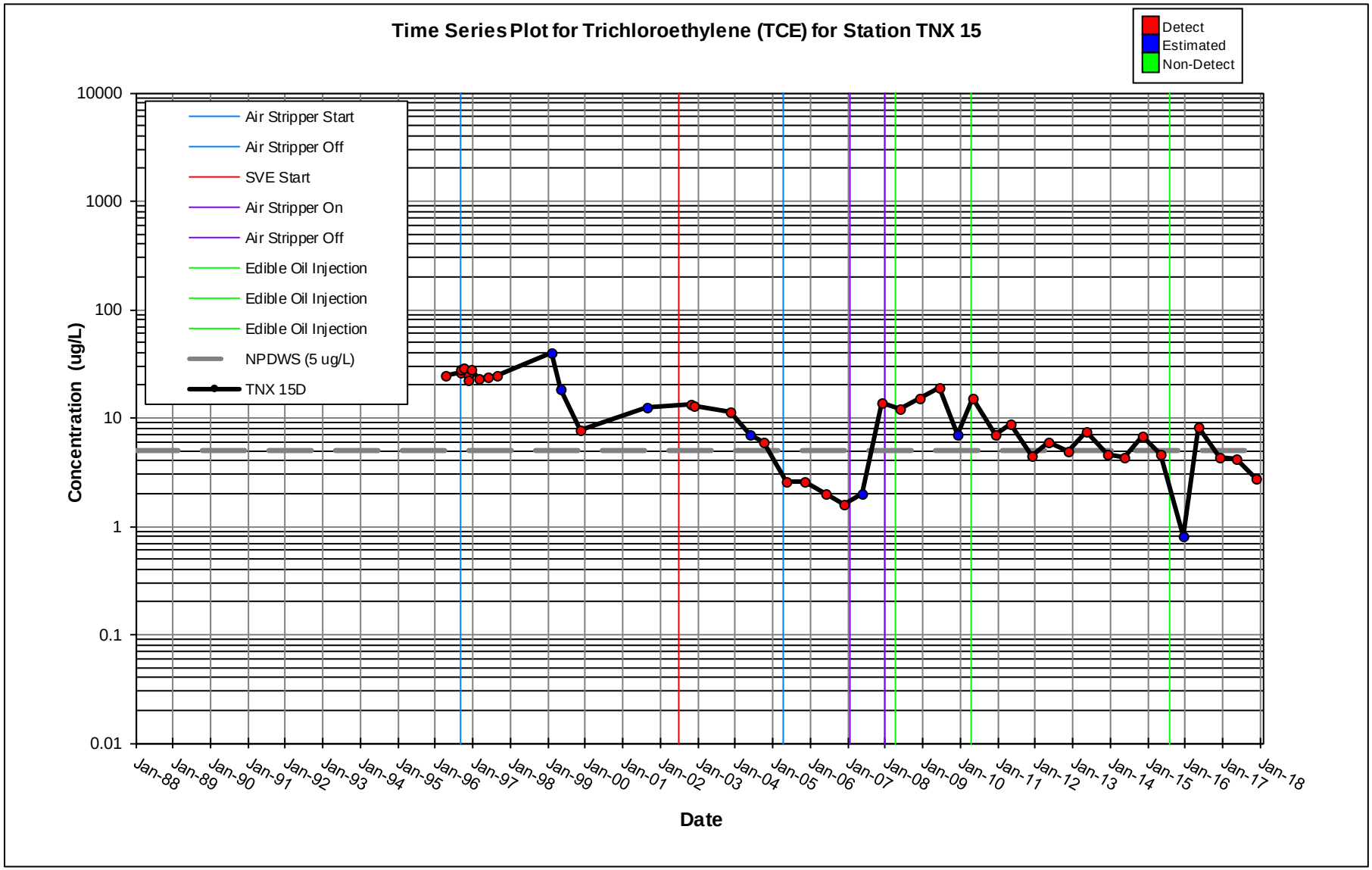
Time Series Plot for Trichloroethylene (TCE) for Station TNX 15
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 15D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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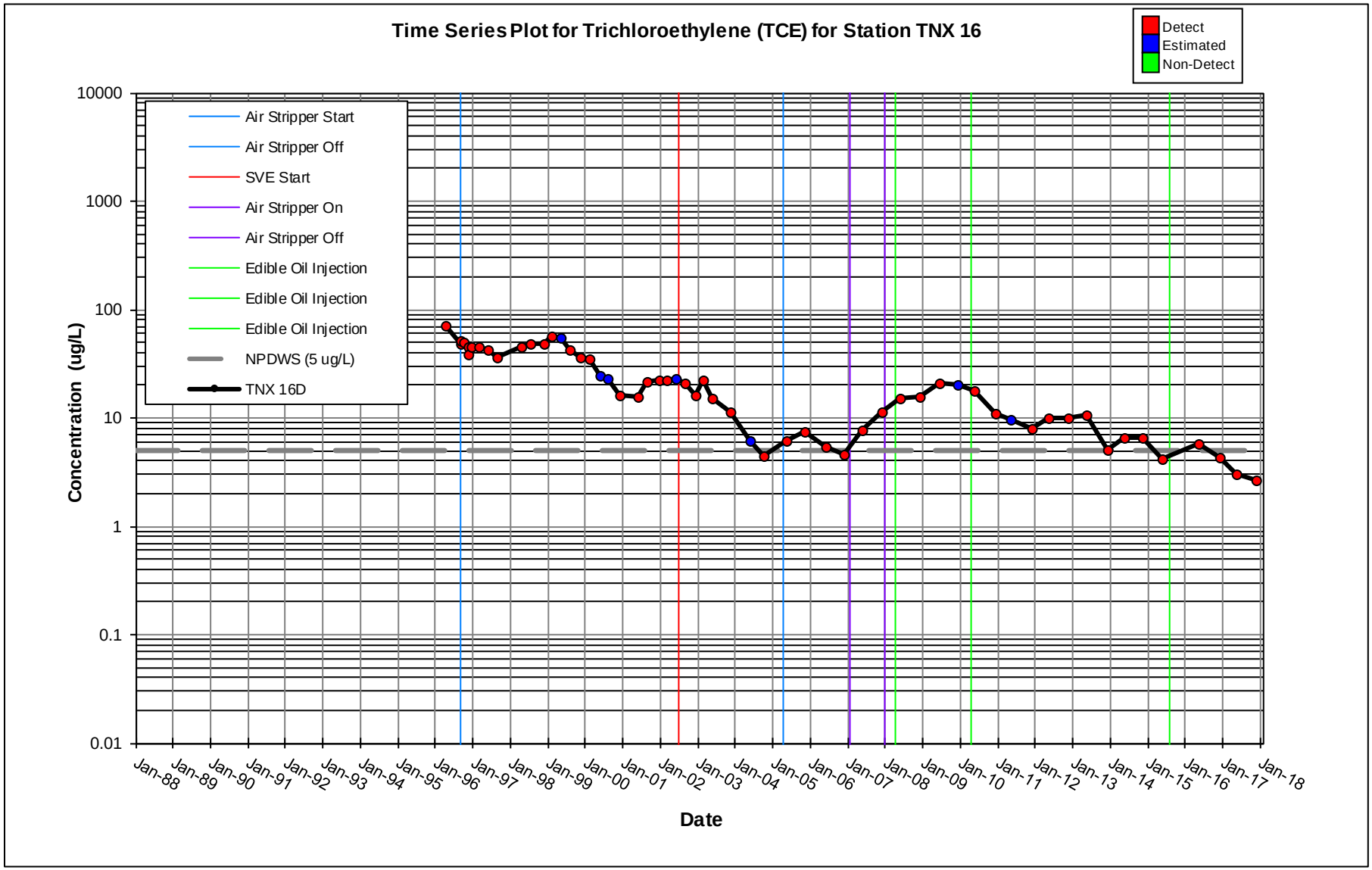
Time Series Plot for Trichloroethylene (TCE) for Station TNX 16
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 16D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
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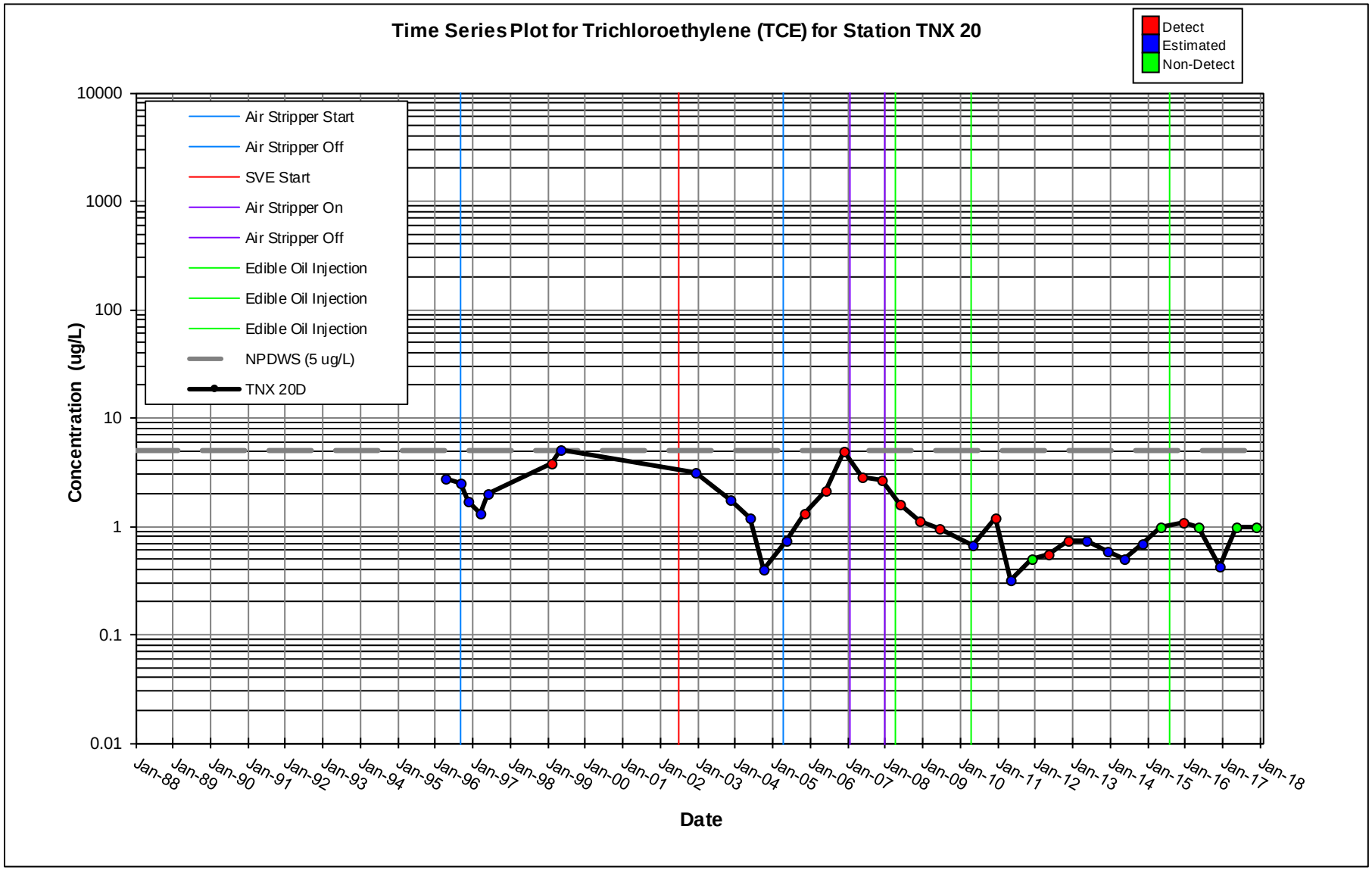
Time Series Plot for Trichloroethylene (TCE) for Station TNX 20
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 20D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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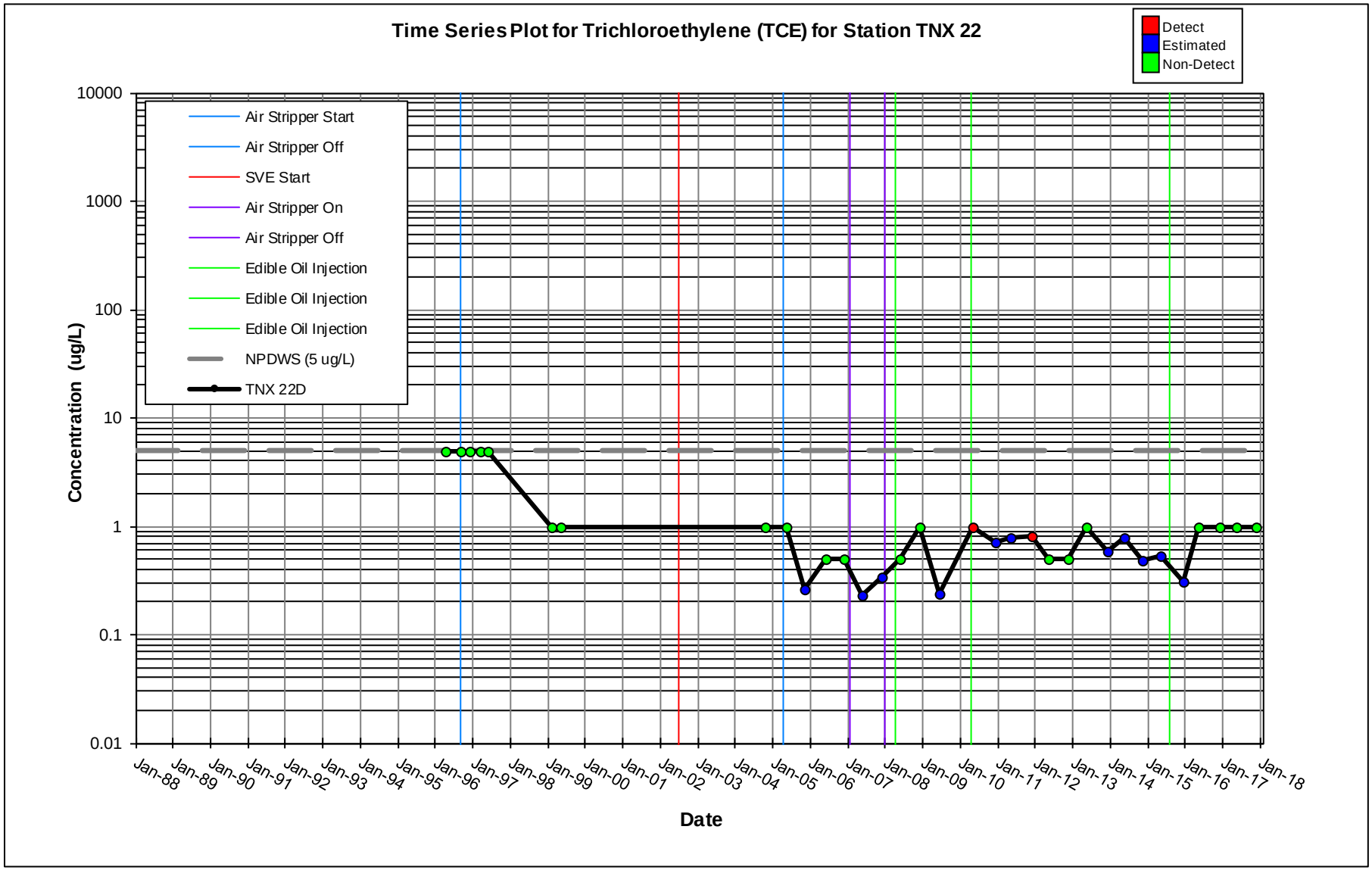
Time Series Plot for Trichloroethylene (TCE) for Station TNX 22
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 22D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
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Jan-91
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Jan-93
Jan-94
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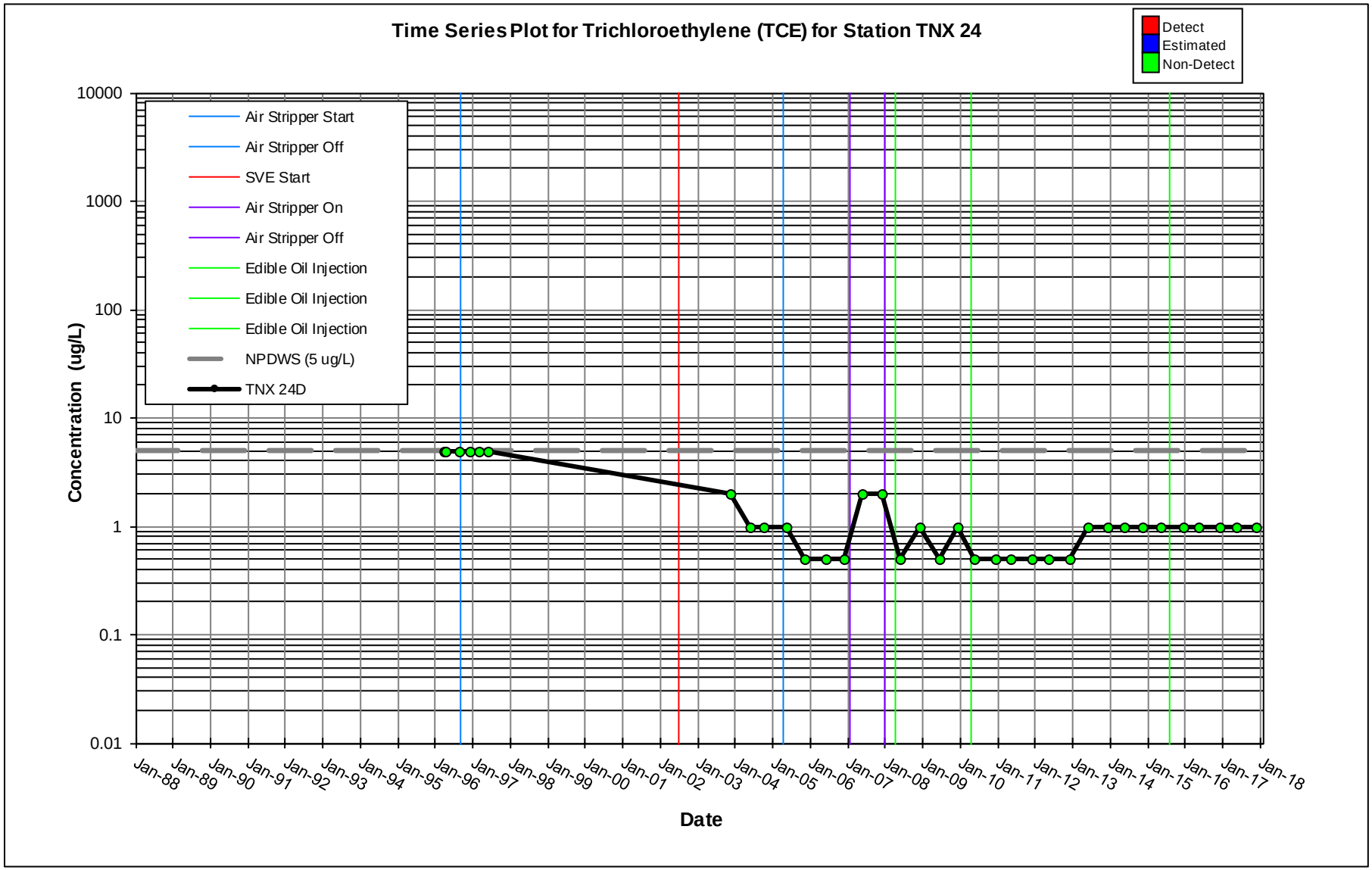
Time Series Plot for Trichloroethylene (TCE) for Station TNX 24
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 24D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
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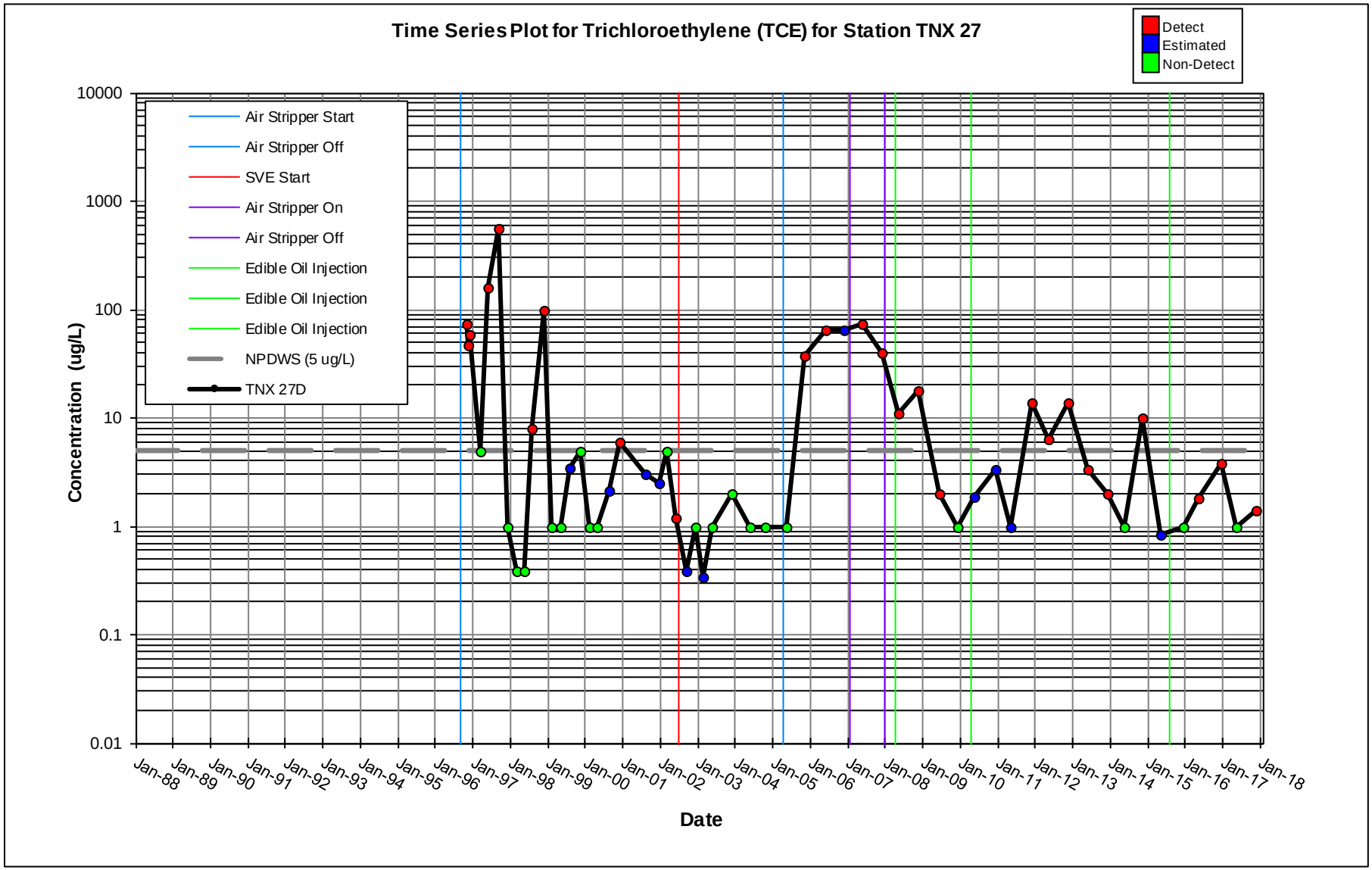
Time Series Plot for Trichloroethylene (TCE) for Station TNX 27
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 27D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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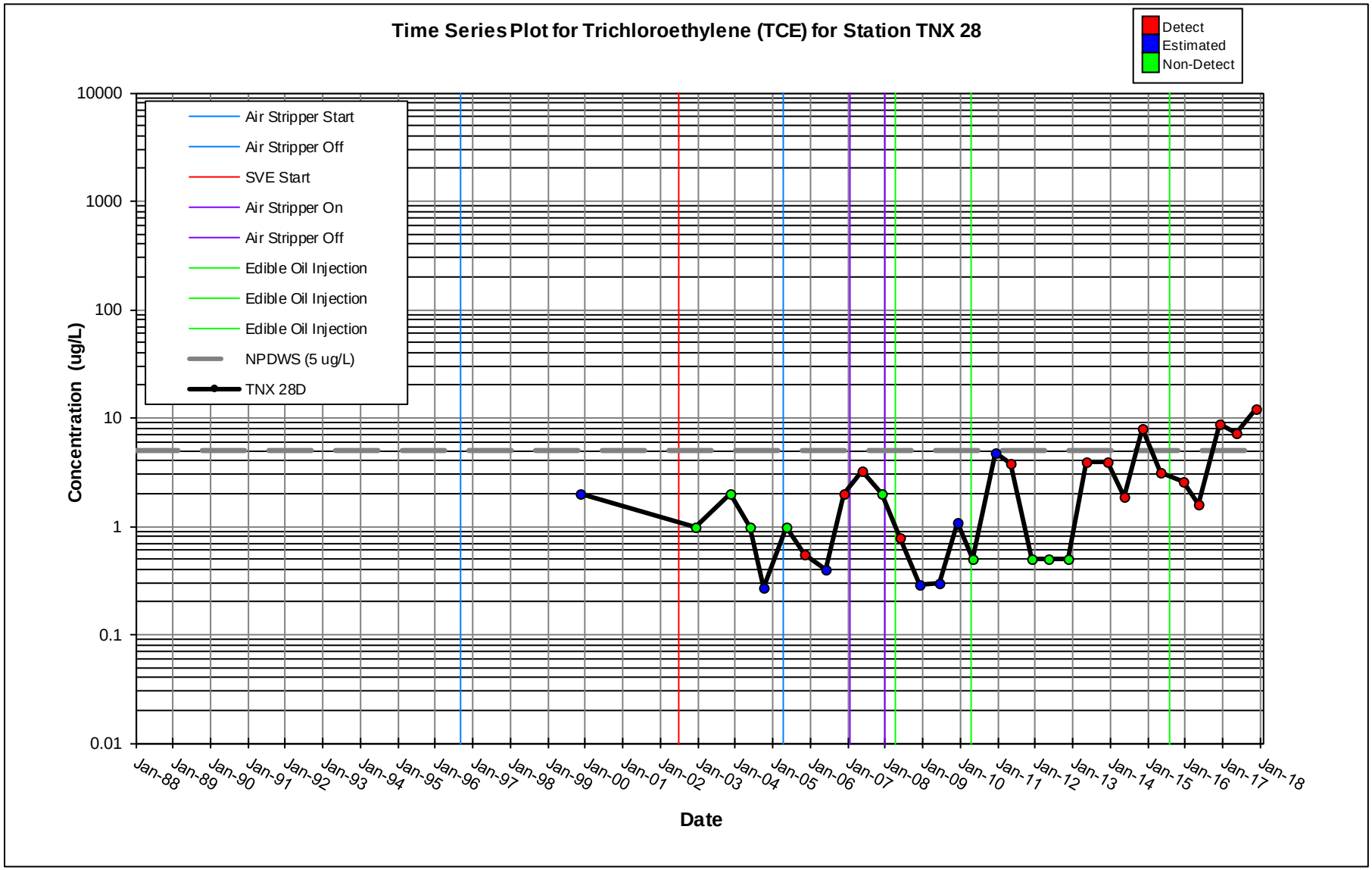
Time Series Plot for Trichloroethylene (TCE) for Station TNX 28
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 28D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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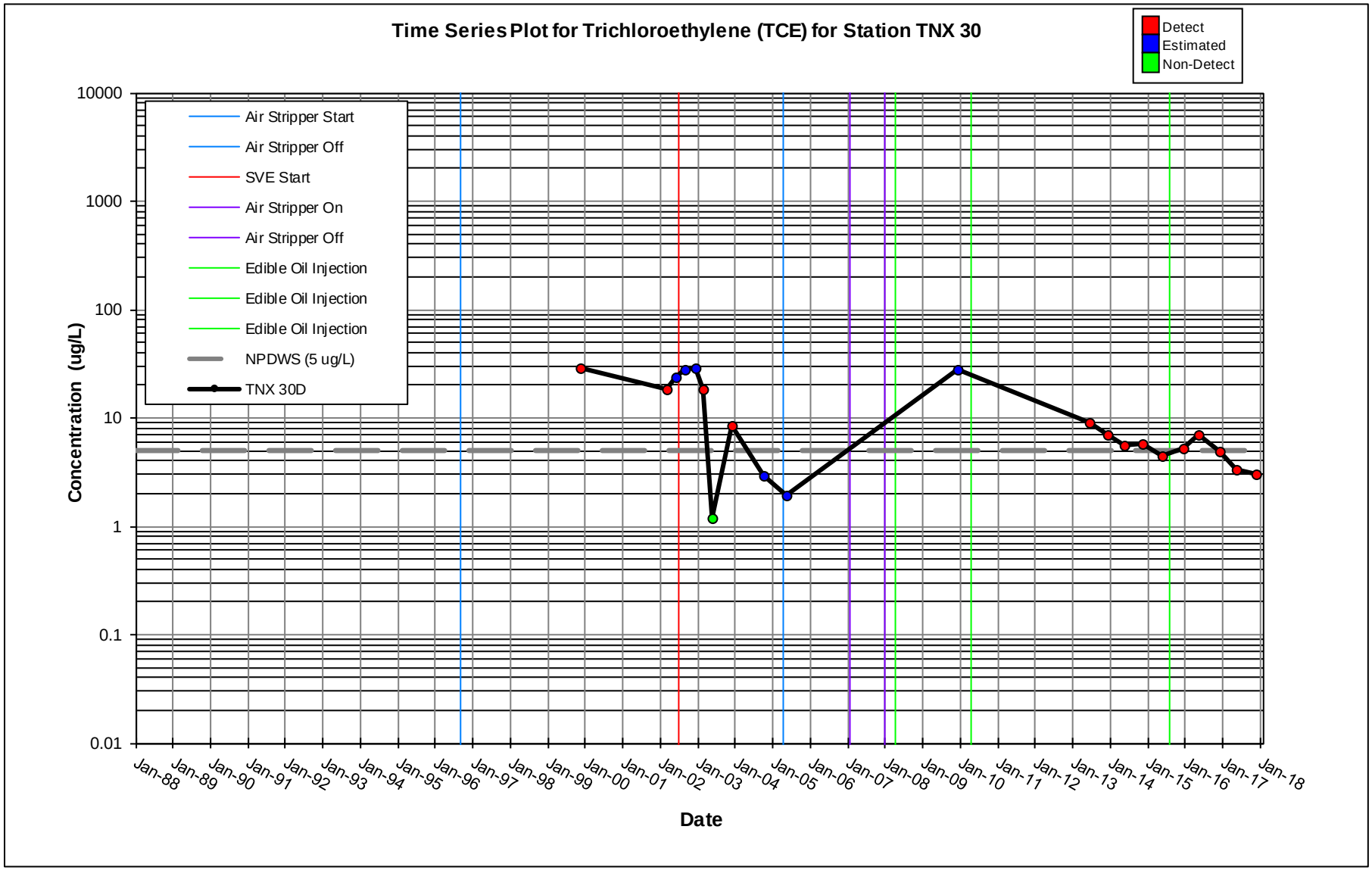
Time Series Plot for Trichloroethylene (TCE) for Station TNX 30
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 30D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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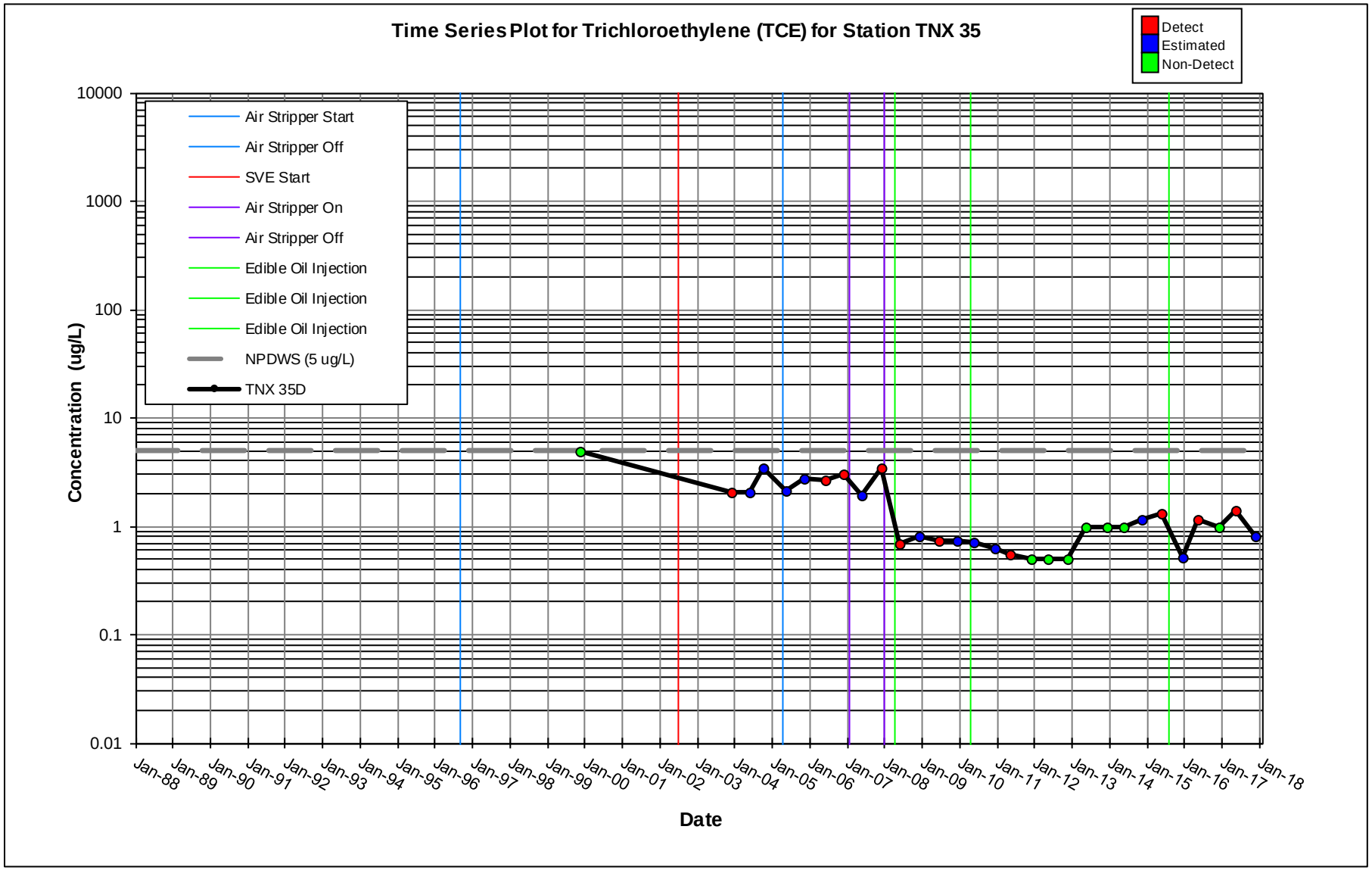
Time Series Plot for Trichloroethylene (TCE) for Station TNX 35
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 35D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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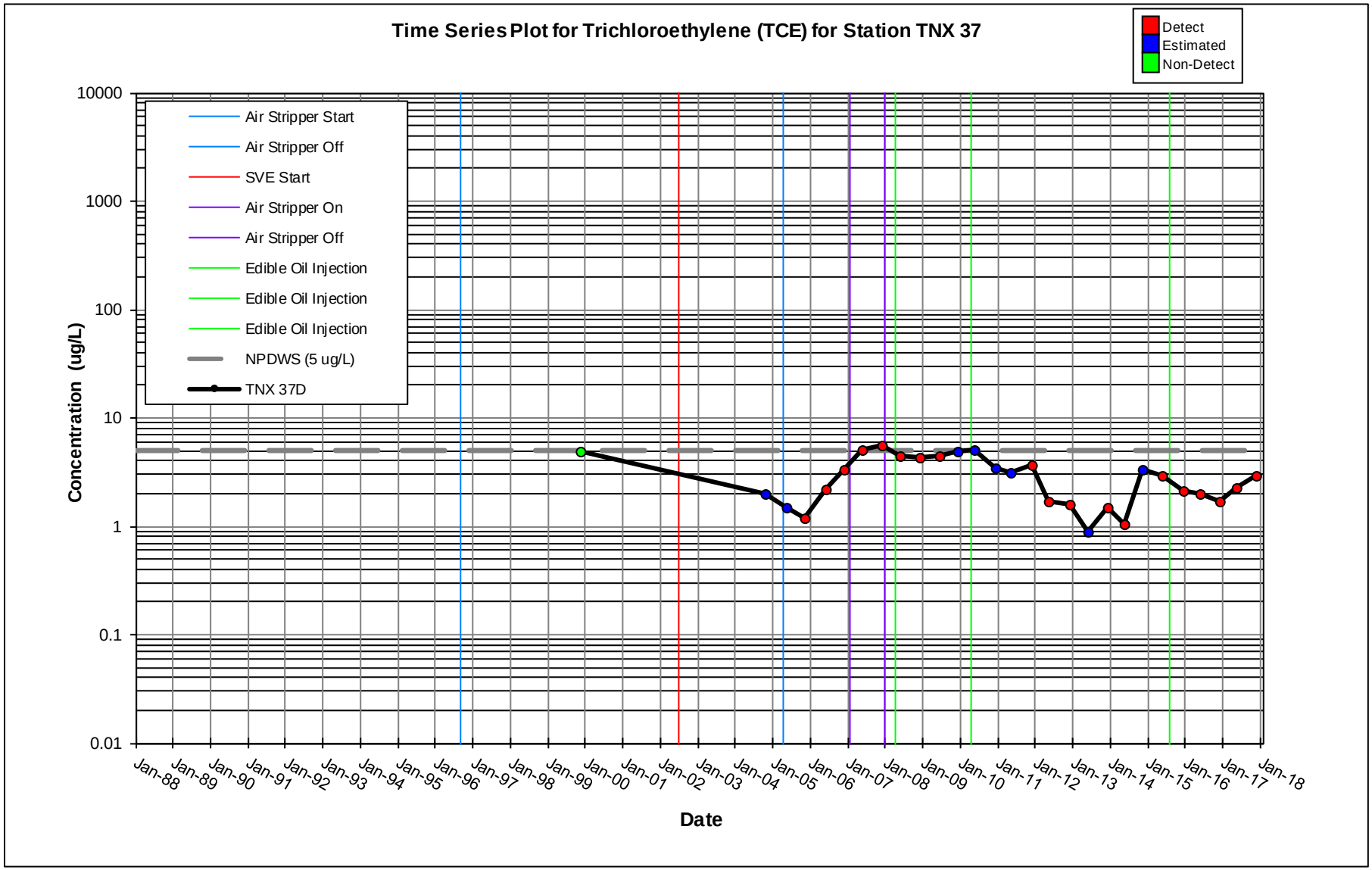
Time Series Plot for Trichloroethylene (TCE) for Station TNX 37
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 37D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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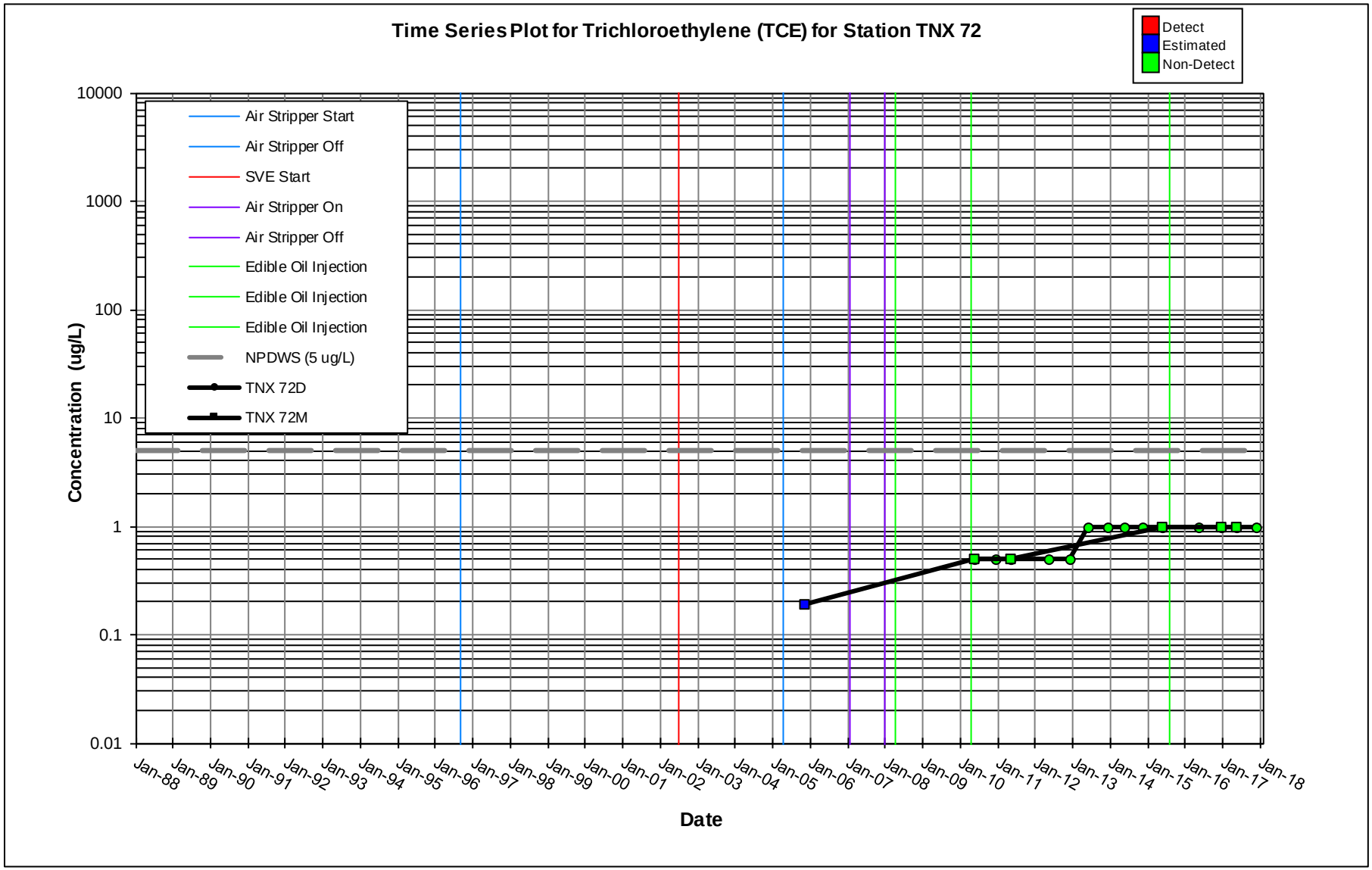
Time Series Plot for Trichloroethylene (TCE) for Station TNX 72
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX 72D
TNX 72M
Concentration (ug/L)
10000
1000
100
10
1
0.1
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Jan-88
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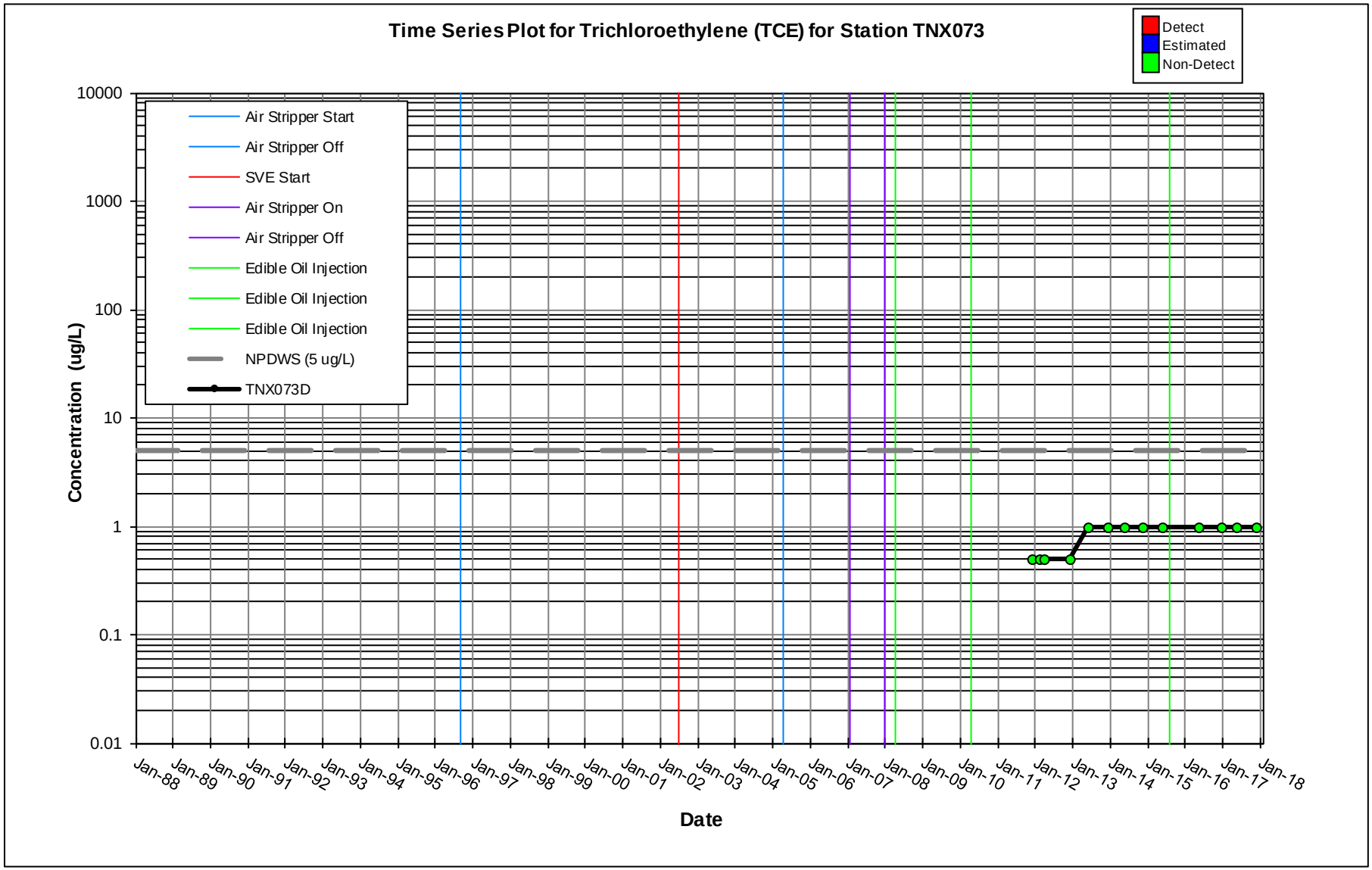
Time Series Plot for Trichloroethylene (TCE) for Station TNX073
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX073D
Concentration (ug/L)
10000
1000
100
10
1
0.1
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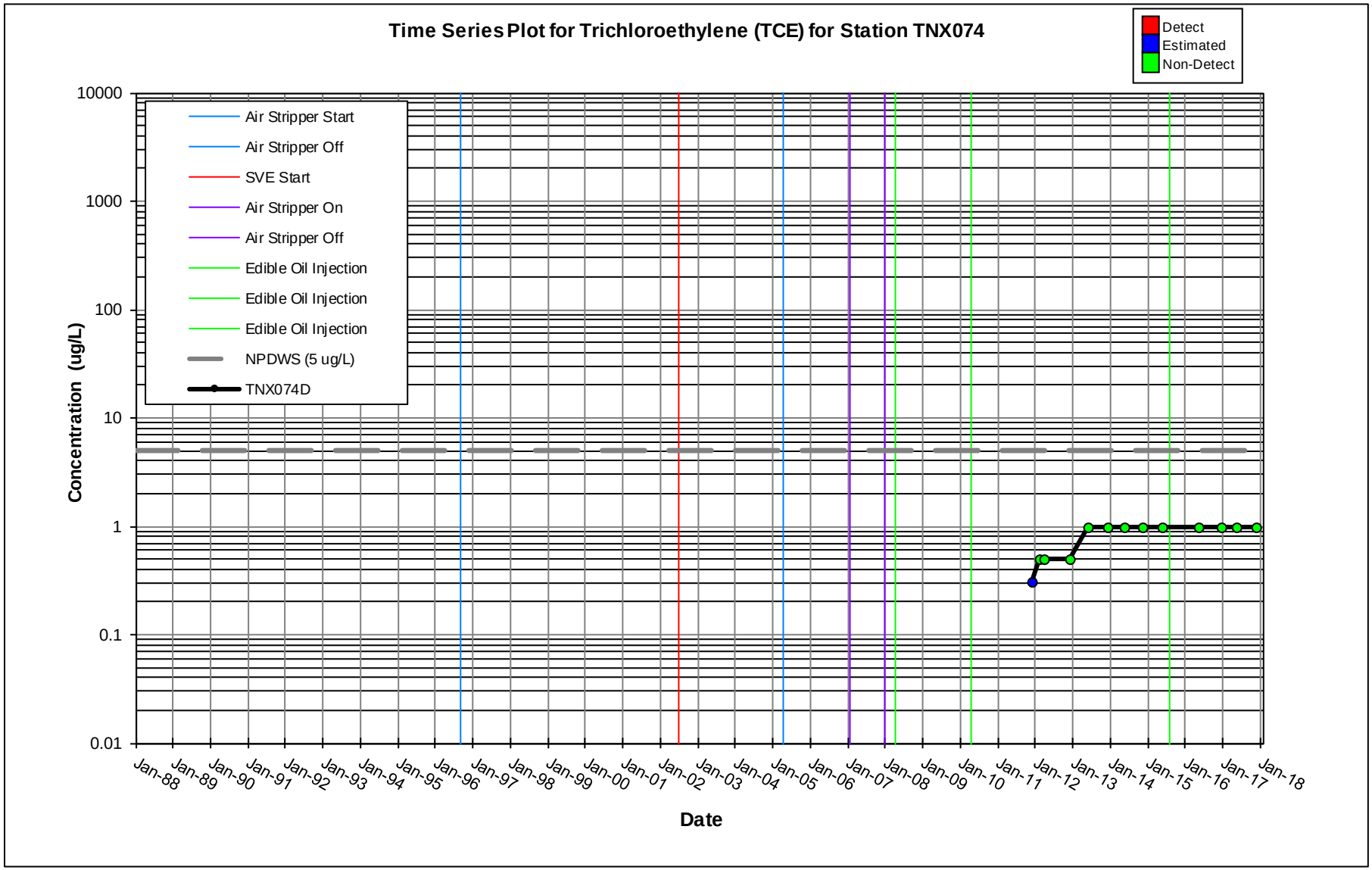
Time Series Plot for Trichloroethylene (TCE) for Station TNX074
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX074D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
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Jan-16
Jan-17
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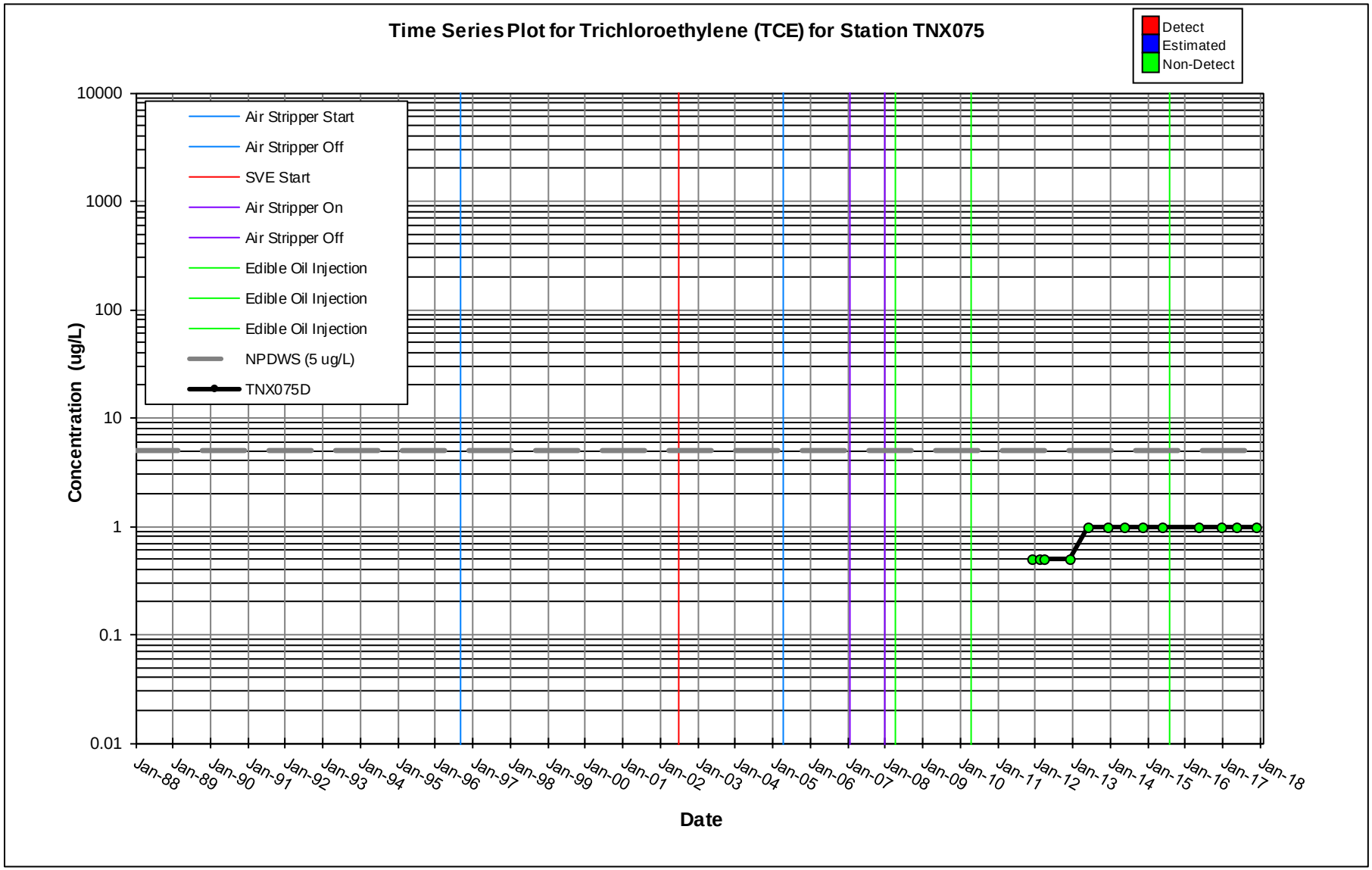
Date


Time Series Plot for Trichloroethylene (TCE) for Station TNX075
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TNX075D
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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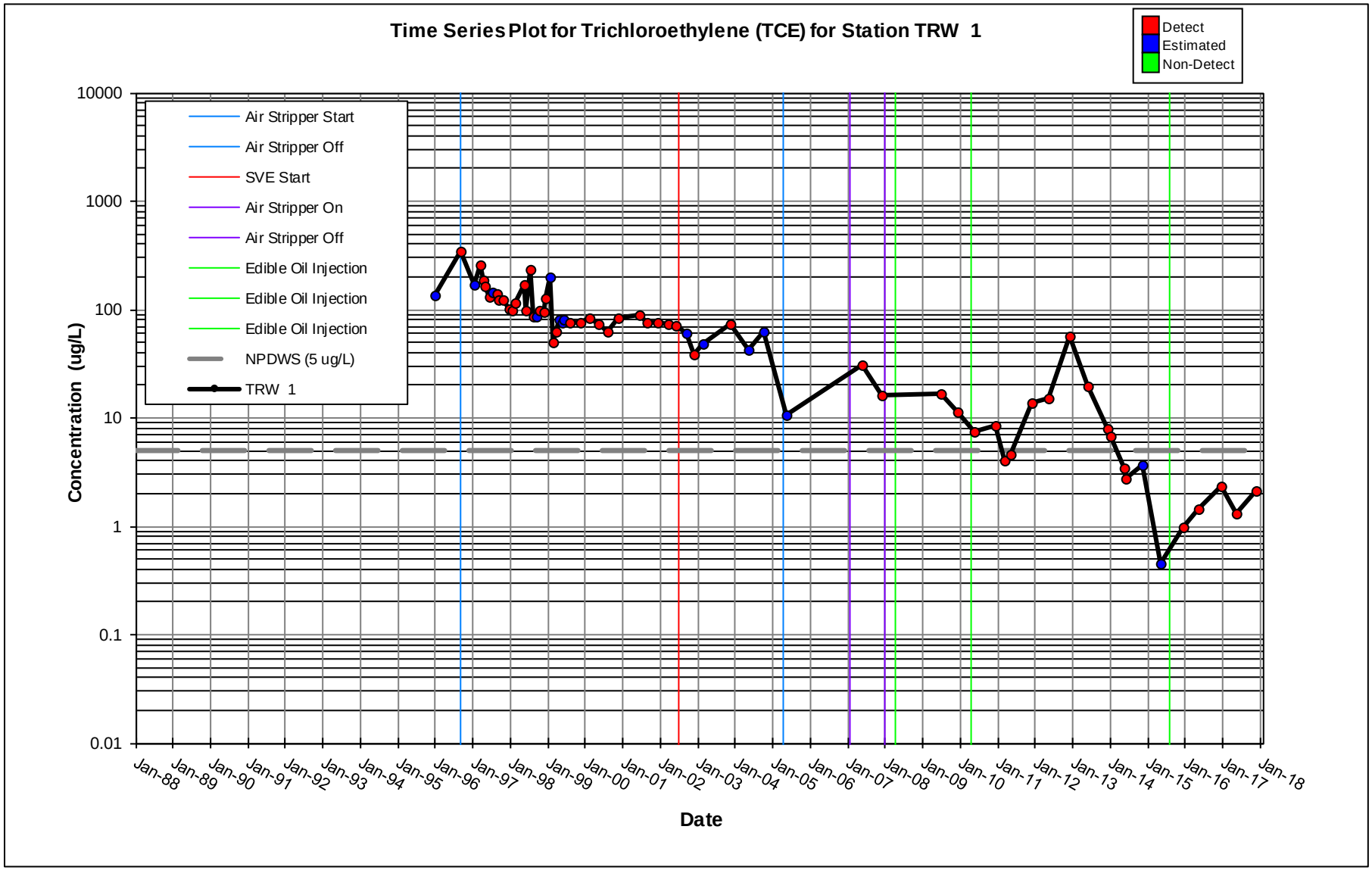
Date


Time Series Plot for Trichloroethylene (TCE) for Station TRW 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TRW 1
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
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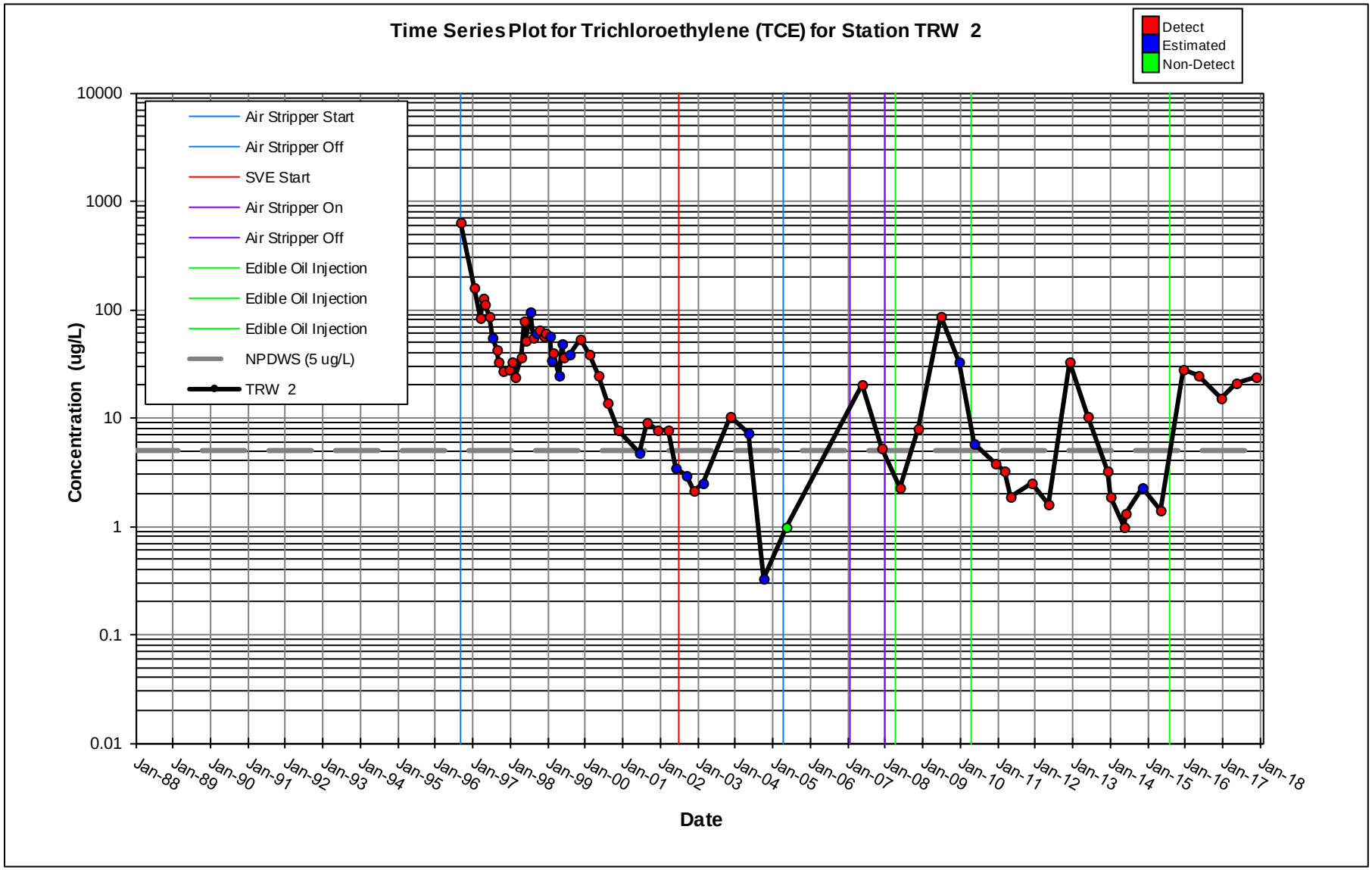
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TRW 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TRW 2
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
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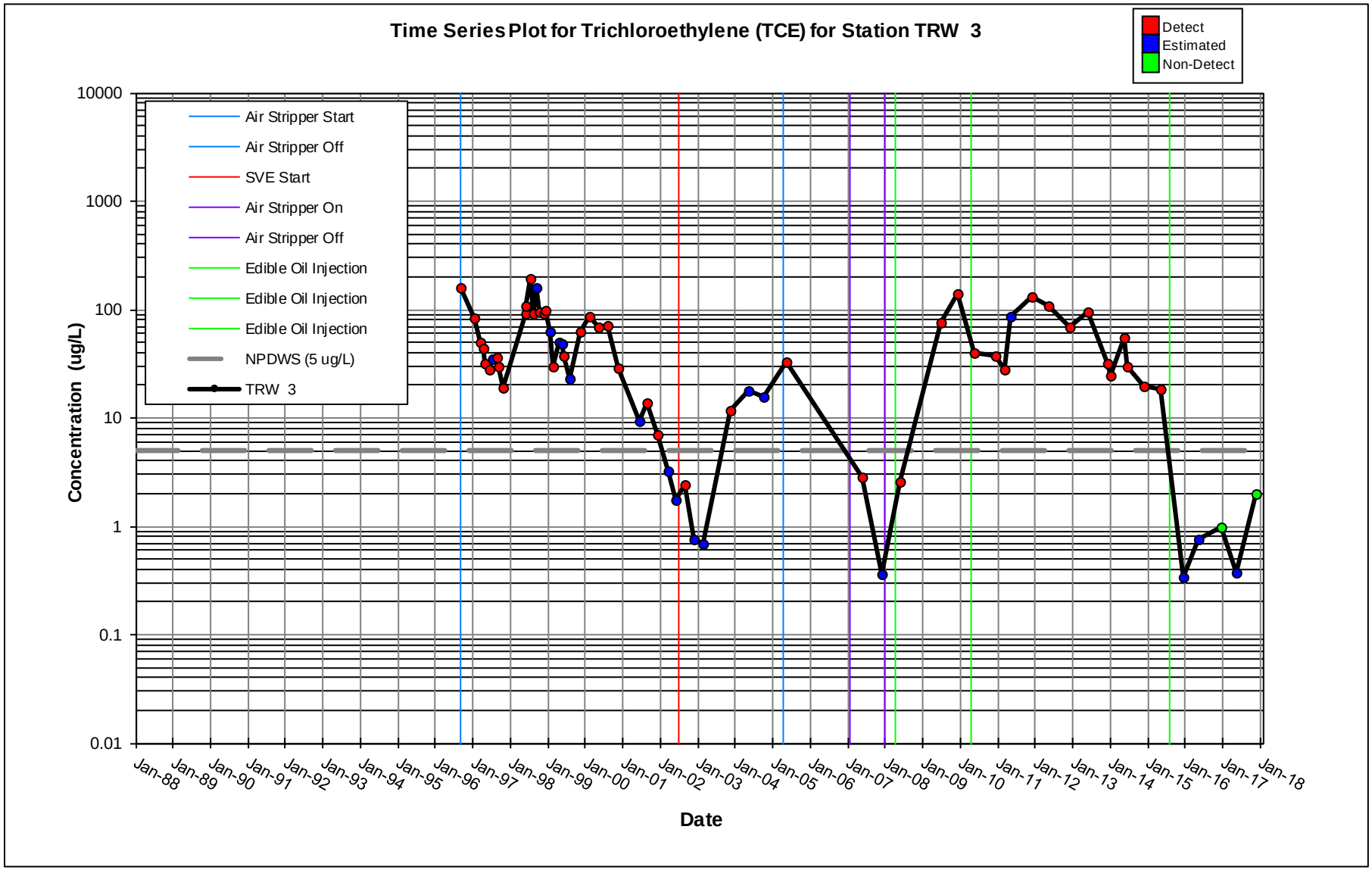
Jan-16
Jan-17
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TRW 3
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TRW 3
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
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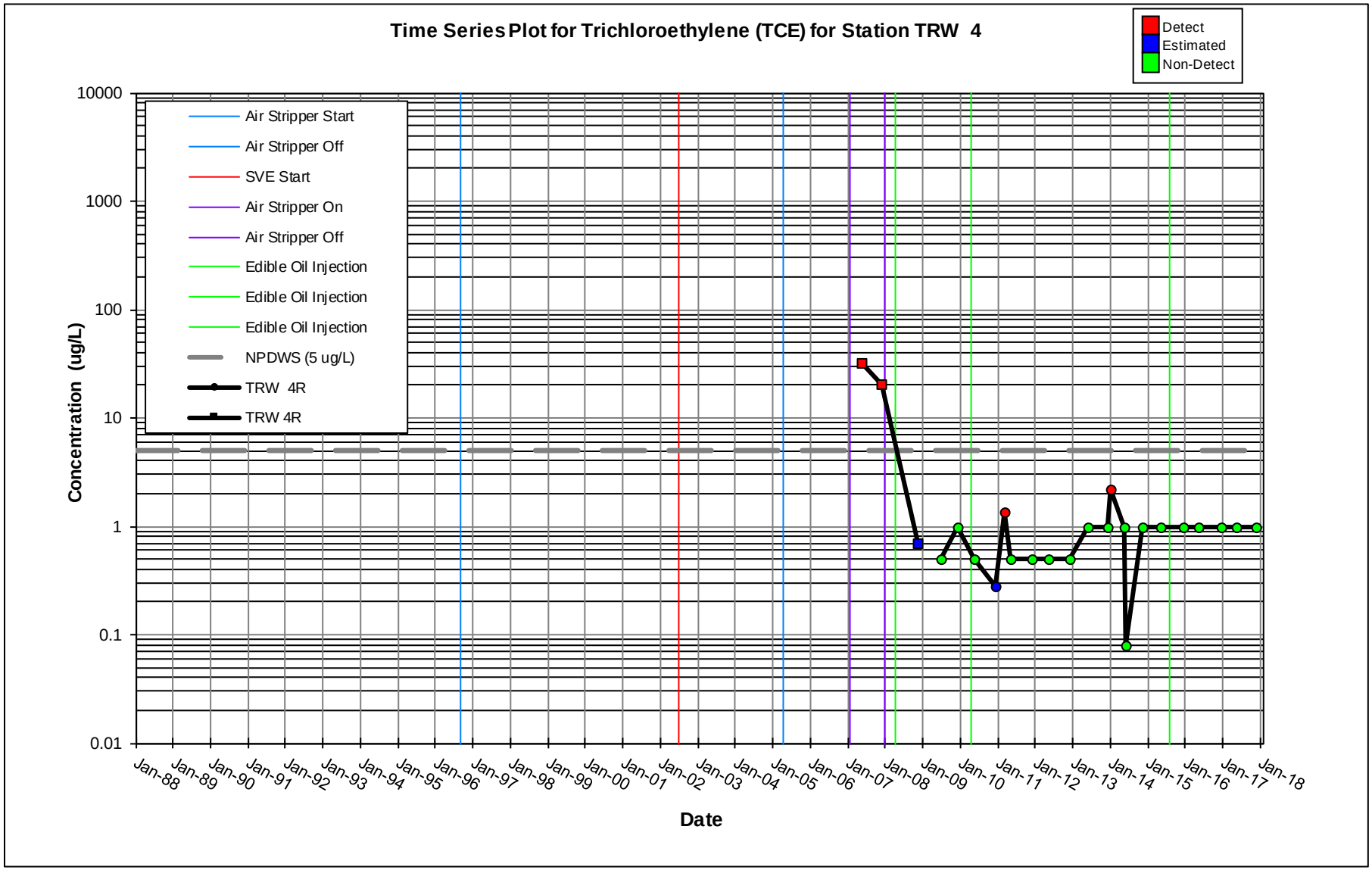
Jan-17
Jan-18
Date


Time Series Plot for Trichloroethylene (TCE) for Station TRW 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TRW 4R
TRW 4R
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
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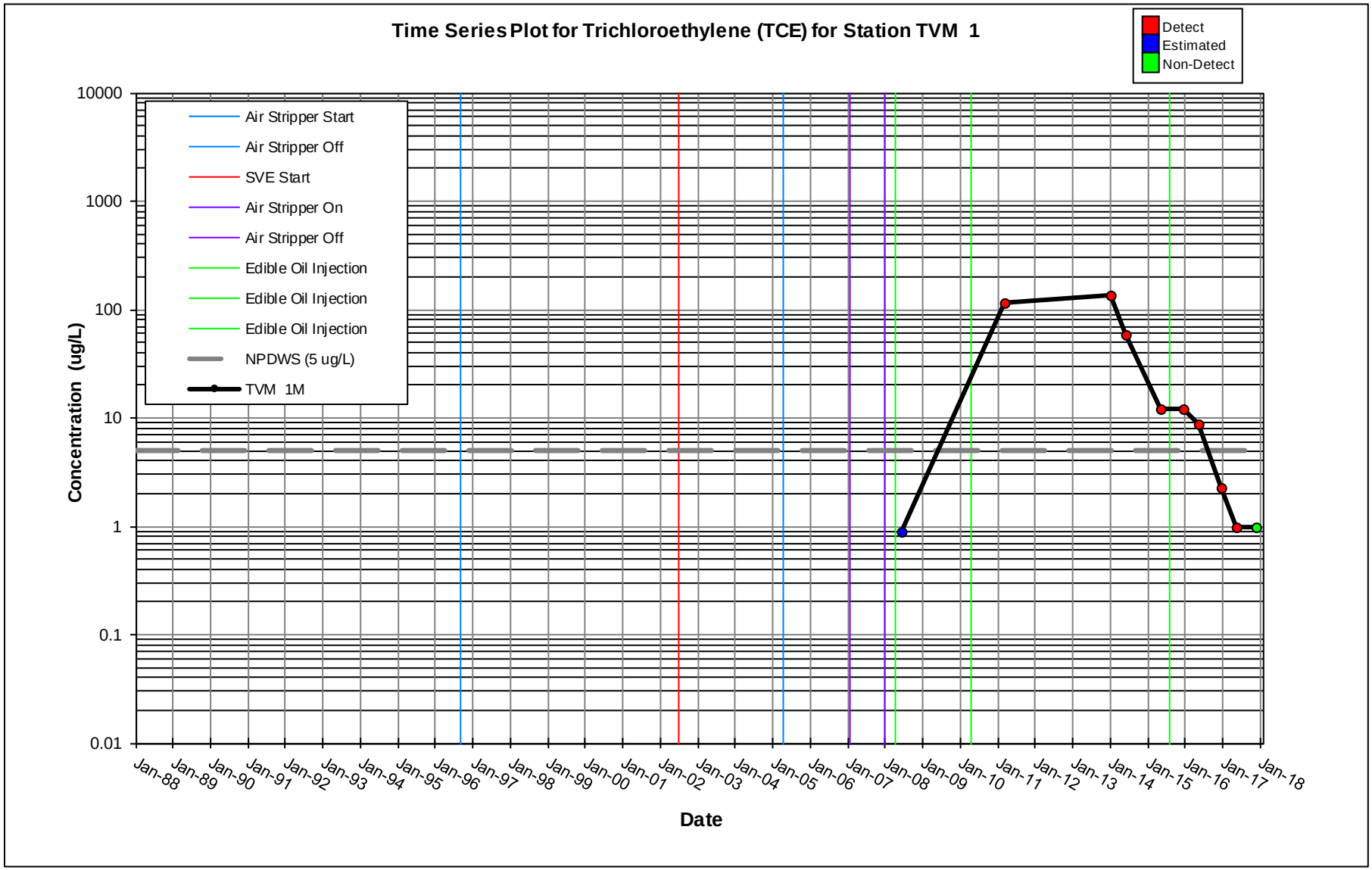
Date


Time Series Plot for Trichloroethylene (TCE) for Station TVM 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TVM 1M
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
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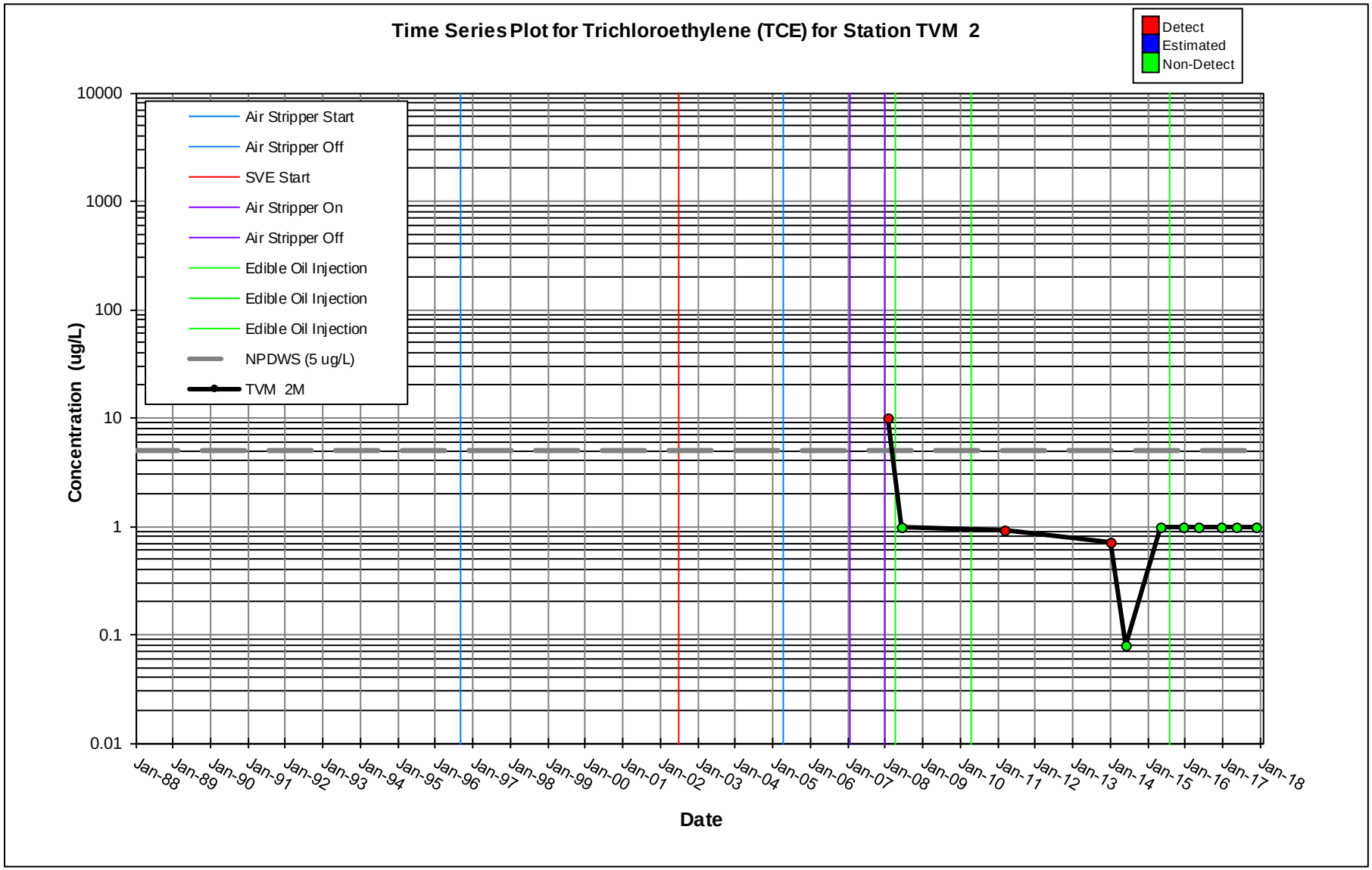
Date


Time Series Plot for Trichloroethylene (TCE) for Station TVM 2
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TVM 2M
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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Jan-01
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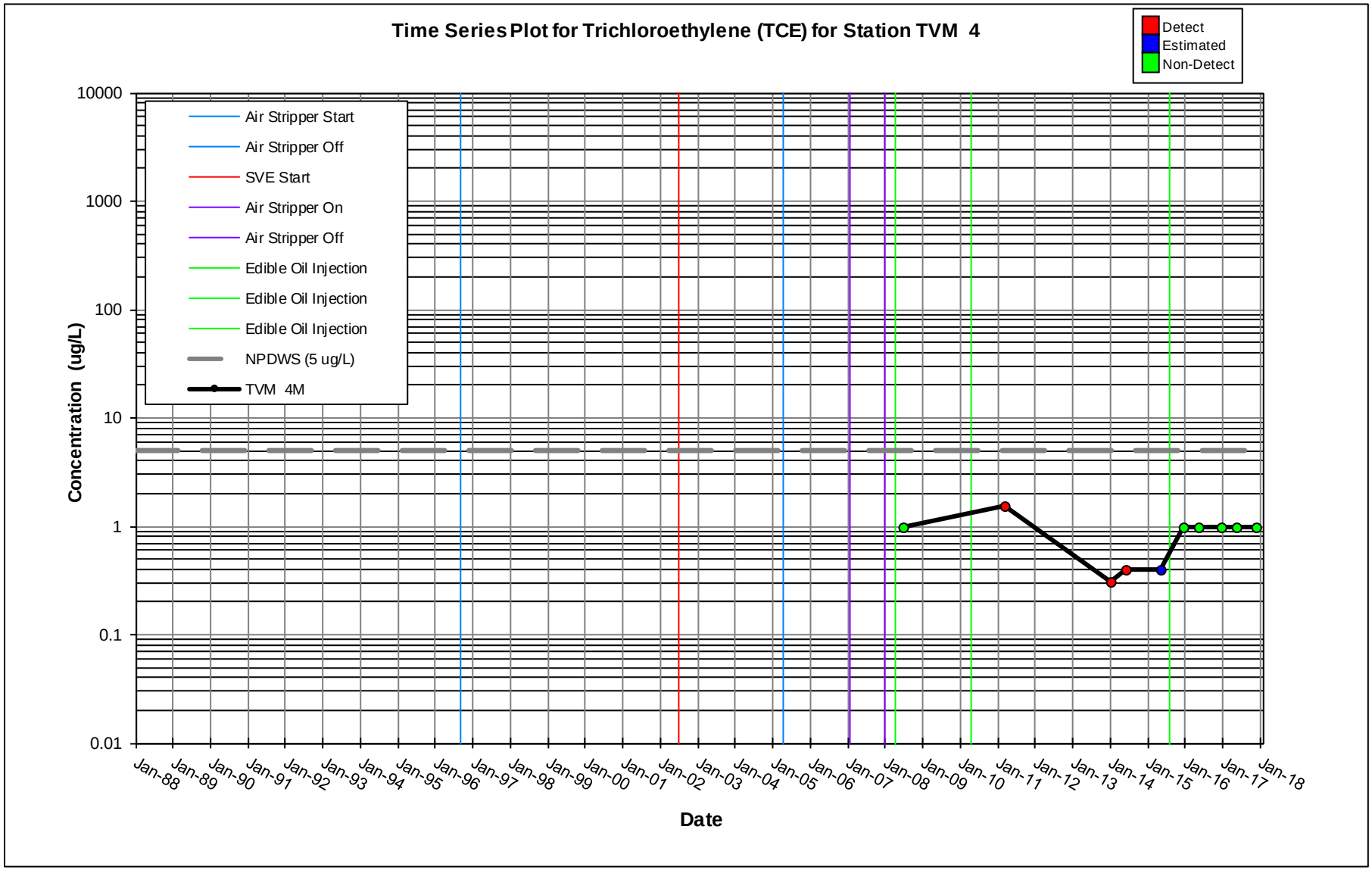
Date


Time Series Plot for Trichloroethylene (TCE) for Station TVM 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TVM 4M
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
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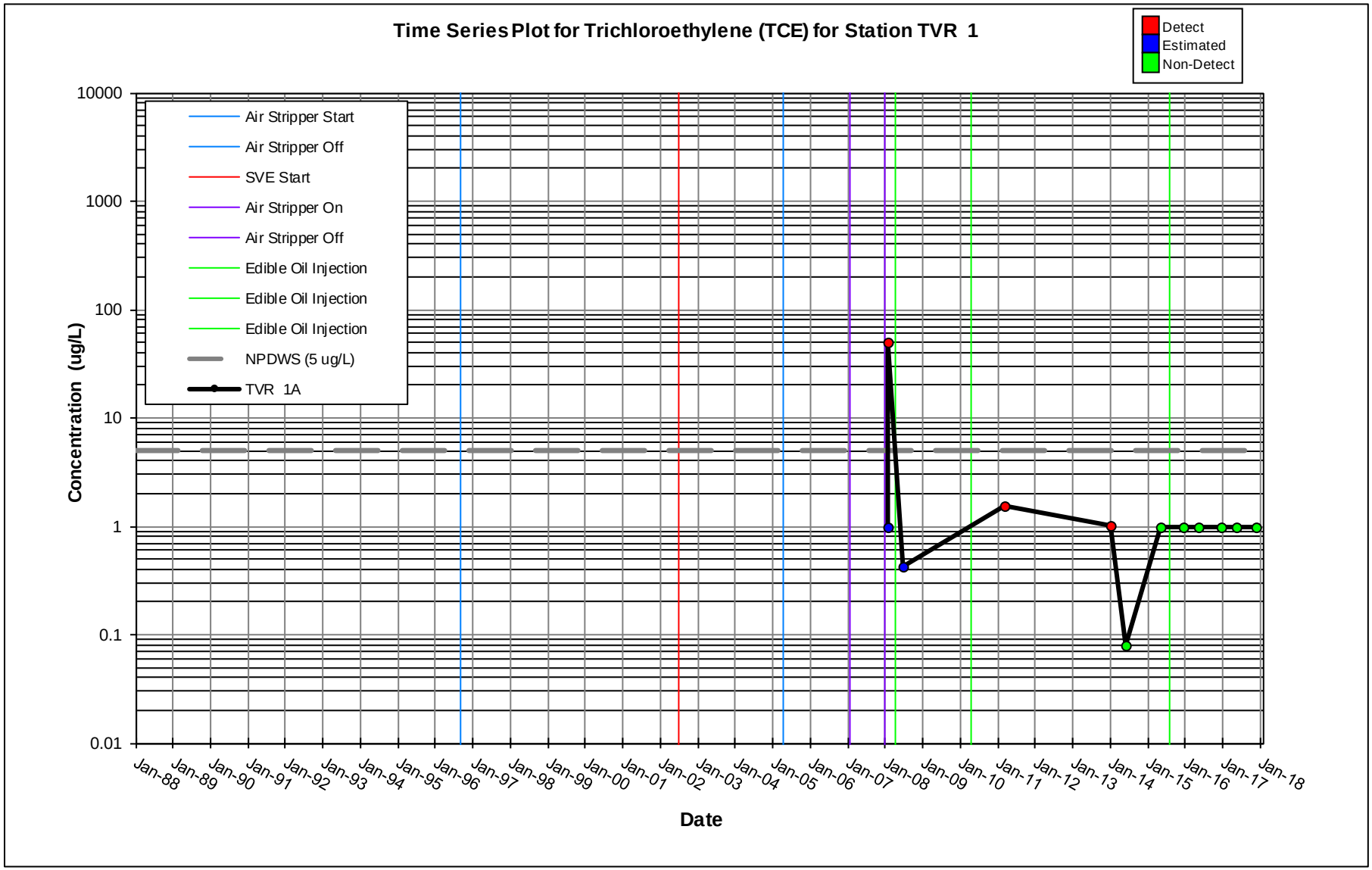
Date


Time Series Plot for Trichloroethylene (TCE) for Station TVR 1
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (5 ug/L)
TVR 1A
Concentration (ug/L)
10000
1000
100
10
1
0.1
0.01
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
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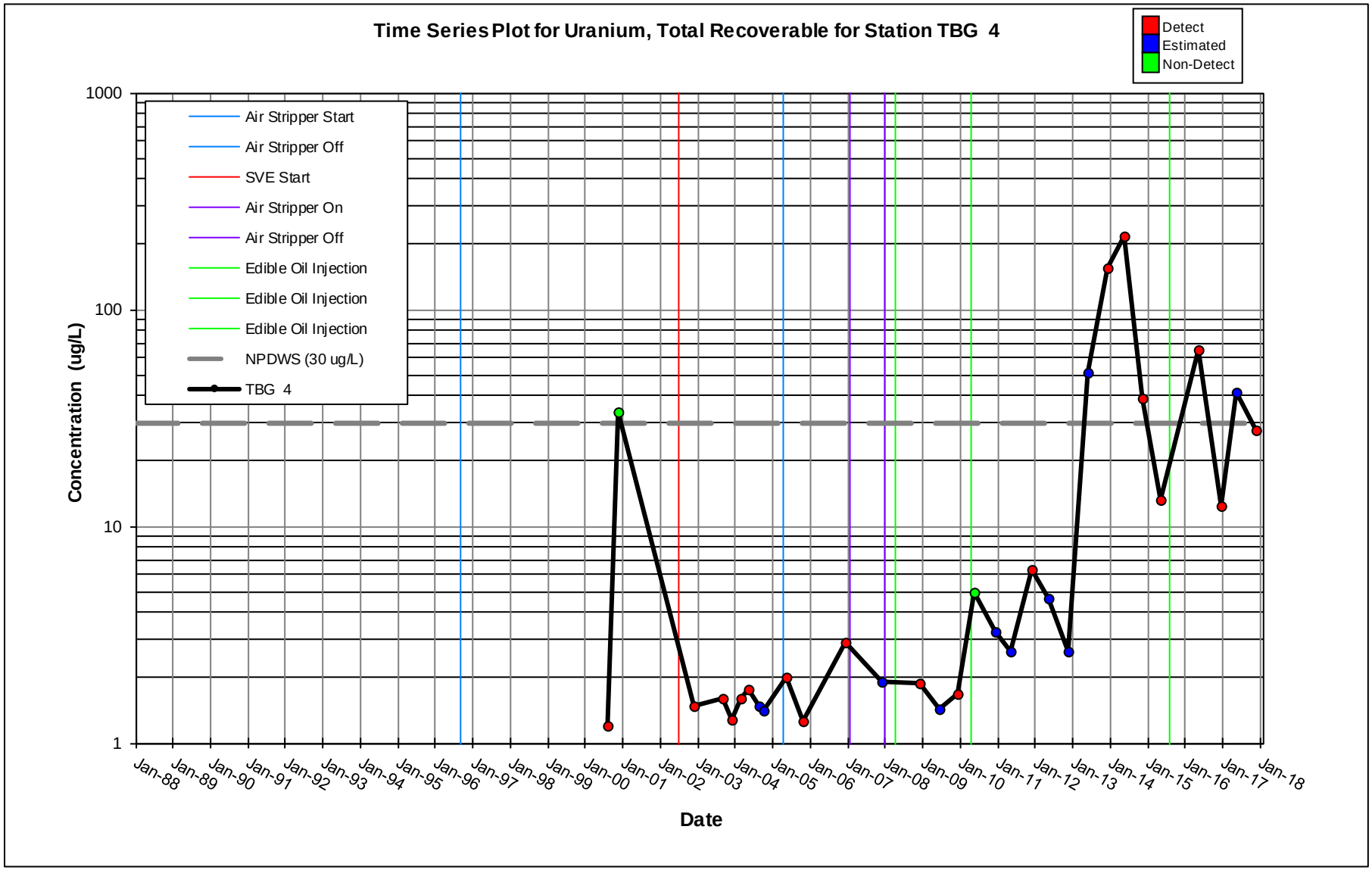
Date


Time Series Plot for Uranium, Total Recoverable for Station TBG 4
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (30 ug/L)
TBG 4
Concentration (ug/L)
1000
100
10
1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
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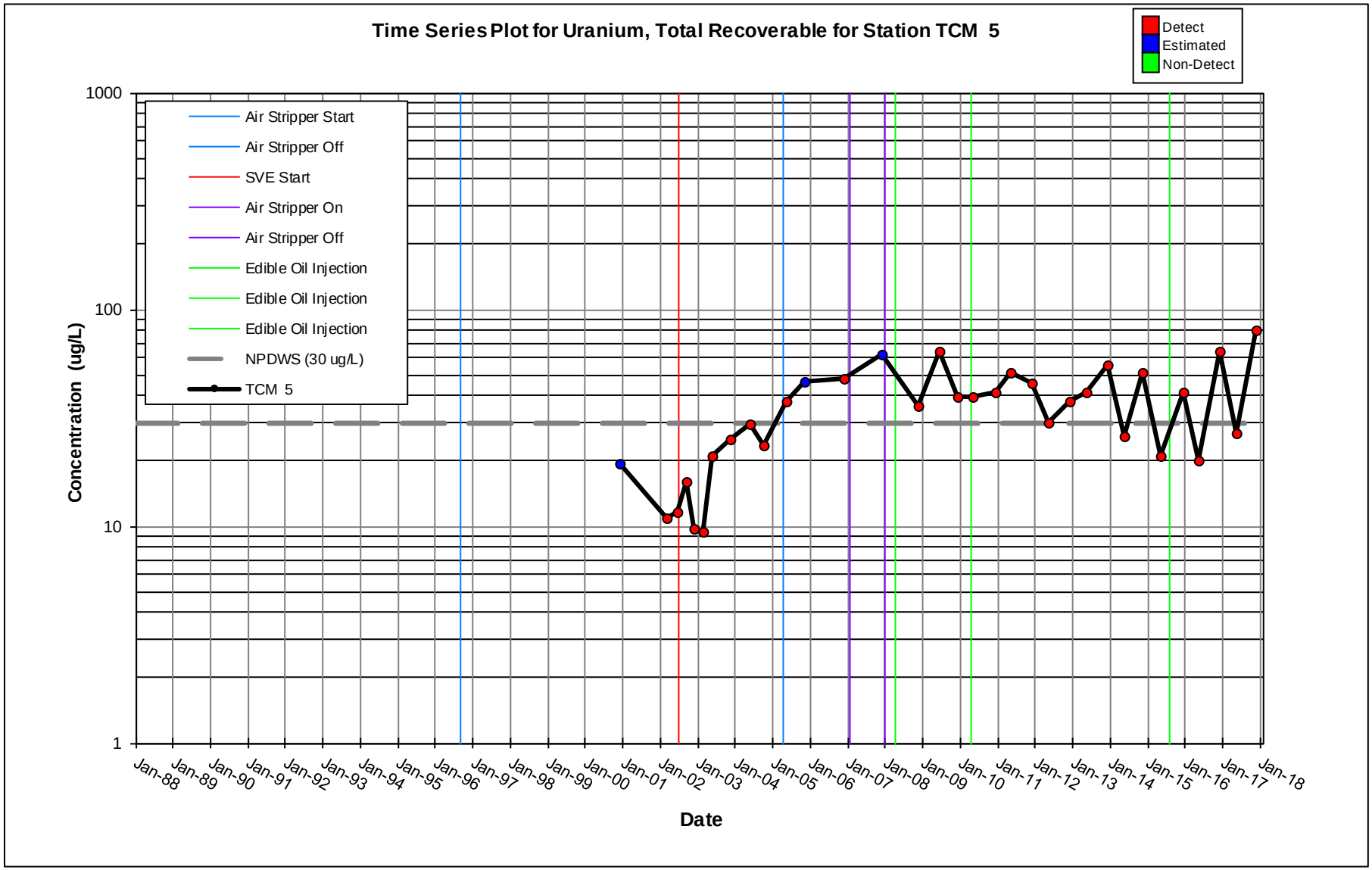
Time Series Plot for Uranium, Total Recoverable for Station TCM 5
Detect
Estimated
Non-Detect
Air Stripper Start
Air Stripper Off
SVE Start
Air Stripper On
Air Stripper Off
Edible Oil Injection
Edible Oil Injection
Edible Oil Injection
NPDWS (30 ug/L)
TCM 5
Concentration (ug/L)
1000
100
10
1
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
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