INSTALLATION RESTORATION PROGRAM
TWIN CITIES ARMY AMMUNITION PLANT

FISCAL YEAR 2008 ANNUAL PERFORMANCE REPORT

Prepared for:

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STANTEC CONSULTING CORPORATION

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FINAL REPORT

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APPENDICES

List of Acronyms

Alliant	-	Alliant Techsystems Inc.
APR	-	Annual Performance Report
Army	-	United States Army
Barr	-	Barr Engineering
BGRS	-	Boundary Groundwater Recovery System
COC	-	Chemical of Concern
CRA	-	Conestoga-Rovers & Associates, Inc.
DNAPL	-	Dense Non-Aqueous Phase Liquid
EE/CA	-	Engineering Evaluation/Cost Analysis
ERIS	-	Environmental Restoration Information System
EW	-	Extraction Well
FFA	-	Federal Facilities Agreement
FY	-	Fiscal Year
GAC	-	Granular Activated Carbon
GOS	-	TGRS Global Operation Strategy
gpm	-	gallons per minute
HBV	-	Health Based Value
HRC	-	Hydrogen Release Compound™
HRL	-	Health Risk Limits
IRA	-	Interim Remedial Action
LUC	-	Land Use Control
LUCIP	-	Land Use Control Implementation Plan
LUCRD	-	Land Use Control Remedial Design
MCES	-	Metropolitan Council Environmental Services
MCLs	-	Maximum Contaminant Levels
MCLGs	-	Maximum Contaminant Level Goals
MDH	-	Minnesota Department of Health

List of Acronyms (Cont.)

MDL	-	Method Detection Limit
MNA	-	Monitored Natural Attenuation
MOS	-	TGRS Micro Operation Strategy
MPCA	-	Minnesota Pollution Control Agency
MW	-	Monitoring Well
NBCGRS	-	New Brighton Contaminated Groundwater Recovery System
NBM	-	New Brighton Municipal
O&M	-	Operation and Maintenance
OM	-	Operating Minimum
OS	-	TGRS Operating Strategy
OU	-	Operable Unit
OU1TG	-	OU1 Technical Group
PAR	-	Performance Assessment Report
PCBs	-	Polychlorinated Biphenyls
PGAC	-	Permanent Granular Activated Carbon
PGRS	-	Plume Groundwater Recovery System
PLC	-	Programmable Logic Controller
PM	-	Preventative Maintenance
POTW	-	Publicly-Owned Treatment Works
ppb	-	parts per billion
QAPP	-	Quality Assurance Project Plan
RD/RA	-	Remedial Design/Remedial Action
ROD	-	Record of Decision
scfm	-	Standard Cubic Feet per Minute
SDWA	-	Safe Drinking Water Act
Stantec	-	Stantec Consulting Corporation (formerly SECOR International, Inc.)

List of Acronyms (Cont.)

Shaw	-	Shaw Environmental & Infrastructure, Inc. (formerly Stone & Webster)
SVE	-	Soil Vapor Extraction
SW	-	Surface Water
TCAAP	-	Twin Cities Army Ammunition Plant
TGRS	-	TCAAP Groundwater Recovery System
TWISS	-	Tecumseh/Wenck Installation Support Services
µg/L	-	Micrograms per liter
USAEC	-	United States Army Environmental Center
USACHPPM	-	US Army Center for Health Promotion & Preventive Medicine
USEPA	-	United States Environmental Protection Agency
VOC	-	Volatile Organic Compound
Wenck	-	Wenck Associates, Inc.
WWP	-	Wet Well Pump

List of Chemical Abbreviations

Note: The abbreviations below are those that were required for data entry into the U.S. Army Environmental Center (USAEC) Installation Restoration Data Management Information System (IRDMIS), which was replaced by the USAEC Environmental Restoration Information System (ERIS) in November 2001. These abbreviations, though not used in ERIS, are still used in some tables and appendices presented in this report.

111TCE	-	1,1,1-Trichloroethane
112TCE	-	1,1,2-Trichloroethane
11DCE	-	1,1-Dichloroethene
11DCLE	-	1,1-Dichloroethane
12DCE	-	1,2-Dichloroethenes (*cis* and *trans* isomers)
12DCLB	-	1,2-Dichlorobenzene
12DCLE	-	1,2-Dichloroethane
12DCLP	-	1,2-Dichloropropane
13DCLB	-	1,3-Dichlorobenzene
14DCLB	-	1,4-Dichlorobenzene
2CLEVE	-	2-Chloroethyl vinyl ether
AG	-	Silver
BRDCLM	-	Bromodichloromethane
C12DCE	-	cis-1,2-Dichloroethene
C13DCP	-	cis-1,3-Dichloropropene
C2H3CL	-	Vinyl chloride
C2H5CL	-	Chloroethane
C6H6	-	Benzene
CCL3F	-	Trichlorofluoromethane
CCL4	-	Carbon tetrachloride
CH2CL2	-	Methylene chloride
CH3CL	-	Chloromethane
CHBR3	-	Bromoform

List of Chemical Abbreviations (Cont.)

CHCL3	-	Chloroform
CLC6H5	-	Chlorobenzene
CU	-	Copper
CYN	-	Cyanide
DBRCLM	-	Dibromochloromethane
EDTA	-	Ethylenediaminetetraacetic Acid
ETC6H5	-	Ethylbenzene
HG	-	Mercury
MEC6H5	-	Toluene
P4	-	Phosphorus
PB	-	Lead
SB	-	Antimony
T12DCE	-	trans-1,2-Dichloroethene
T13DCP	-	trans-1,3-Dichloropropene
TCLEA	-	Tetrachloroethane
TCLEE	-	Tetrachloroethene
TCLTFE	-	1,1,2-Trichloro-1,2,2-trifluoroethane
TRCLE	-	Trichloroethene
XYLEN	-	Xylenes
ZN	-	Zinc

1.0 Executive Summary

This Fiscal Year 2008 (FY 2008) Annual Performance Report:

- Summarizes the status of remedy implementation; and
- Addresses how the remedies are performing,

for each of the three operable units related to the Twin Cities Army Ammunition Plant (TCAAP). Fiscal Year 2008 is defined as the period from October 1, 2007 through September 30, 2008.

Records of Decision (RODs) have been signed for each of the three operable units (OUs):

- OU1 ROD signed 1993, Amended 2006
- OU2 ROD signed 1997, Amended (to include Site C-2) 2007
- OU3 ROD signed 1992, Amended 2006

The RODs present the major components of the final remedies for the media of concern. This report looks at each of the major components and addresses:

1. *Are the remedies being implemented? (Compliance check with the RODs and ROD Amendments)*
2. *Are the remedies doing what they are supposed to?*

Table 1-1, at the end of this section, summarizes the status of remedial actions at the end of FY 2008. Following are highlights of the accomplishments for each operable unit.

Operable Unit 1 (OU1): Deep Groundwater

OU1 consists of the "north" plume of Volatile Organic Compound (VOC) groundwater contamination off the TCAAP installation. The final remedy for OU1 consists of pumping three primary municipal wells (New Brighton Municipal wells NBM #4, #14, and #15) and treating the extracted groundwater through the Permanent Granular Activated Carbon (PGAC) system. Treated water is piped to the New Brighton water supply system for distribution as potable water. Other remedy components include providing alternate water supply and/or well abandonment to affected private wells, and drilling advisories for new well construction. Highlights for FY 2008 are:

- The Minnesota Department of Health (MDH) Special Well Construction Area remains in effect. The MDH has the regulatory responsibility to assure that wells constructed in the advisory area meet appropriate well construction and human health requirements. In FY 2008, there were no new recommendations for abandonment or alternate water supply needed.
- In 2006, the United States Environmental Protection Agency (USEPA) and the Minnesota Pollution Control Agency (MPCA) signed the OU1 ROD Amendment. The ROD amendment formalized the use of the statistical analysis of groundwater quality trends included in the Annual Performance Reports since FY 2003. The amended ROD requires demonstration of decreasing contaminant trends and a stable or shrinking geographic extent of the plume using the statistical analysis developed by the OU1 Technical Group (OU1TG) in 2003.

Highlights of the OU1 remediation activities are:

- The Army and New Brighton agreed to changes in pumping limits and priority proposed by New Brighton. The changes were given consistency approval in November 2007. Briefly, the changes allow New Brighton to utilize the Jordan aquifer well NBM #5 and NBM #6 for a greater portion of water supply. The change is expected to improve VOC mass removal. The changes do not affect the methods or criteria used in the statistical analysis of the clean up progress.

- The PGAC treated 1.43 billion gallons of water and removed 753 pounds of VOCs during FY 2008. Approximately 20,321 pounds of VOCs have been removed since system startup.
- The effluent of the PGAC was in compliance with the applicable Safe Drinking Water Act criteria for the OU1 chemicals of concern.
- The treated groundwater was beneficially used in the New Brighton and Fridley municipal water supply systems.
- The limited FY 2008 chemical monitoring data, using the statistical trend analysis as developed by the OU1TG, indicate that aquifer restoration is occurring, and that the extent and magnitude of contamination in the Prairie du Chien aquifer are stable or improving. Trends in the Jordan aquifer improved in FY 2008 but a stable trend remains at one Jordan well requiring continued evaluation.

<u>Operable Unit 2 (OU2): On-Site Contamination</u>

OU2 is defined as the original TCAAP property, including the groundwater beneath it. The OU2 ROD, signed in 1997, documents the final remedies. ROD Amendments and Explanations of Significant Differences (ESDs) are being prepared for individual sites within OU2. The ROD Amendments await resolution of land use controls related to the re-development portions of TCAAP.

Highlights for activities within OU2 during FY 2008 are:

- Shallow Soil Sites
  - Closeout Reports for Sites A (including VOC-contaminated soils), E, H, 129-3, 129-5, and 129-15 (which received regulatory approval prior to

FY 2005) continued to await final consistency based on resolution of land use controls.

- Except for Site H, the final year of the required 5 year groundwater monitoring period was completed in FY 2007. Site H groundwater continues to be monitored to address copper detected in groundwater above surface water standards.
- In FY 2004, the USEPA, MPCA, and United States Army (Army) agreed to incorporate the shallow groundwater response action at Site C into the TCAAP Federal Facilities Agreement (FFA). In 2007, an amendment to the Record of Decision (ROD) for Operable Unit 2 was signed. The amendment modified the soil, sediment, surface water, and groundwater remedies. The modified remedy included filling in the drainage ditches west and north of the Site to eliminate the surface water exposure points and cover contaminated sediment to prevent direct exposure. Construction was completed near the end of FY 2007 so FY 2008 was the first year of operation under the modified remedy.
- In 2007, the groundwater extraction system extracted 376,475 gallons of groundwater and removed 0.02 pounds of lead. The total lead mass removed is 101.81 pounds. The monitoring requirements for demonstrating containment were met.

- Deep Soil Sites
  - The Site D Closeout Report received regulatory approval (in FY 2004), but final consistency will not be provided until concurrence of the land use control section of the report is reached between the Army and the regulators. A modification to the OU2 ROD documenting the remedy selection for Site D shallow soils was pending at the end of FY 2008.
  - Cover construction was completed over the Site G dump in early FY 2004. The Site G Closeout Report received regulatory approval (in FY 2004), but

final consistency will not be provided until concurrence of the land use control section of the report is reached between the Army and the regulators. A modification to the OU2 ROD documenting the remedy selection for Site G was pending at the end of FY 2008.

- Site A Shallow Groundwater
  - Four extraction wells provided containment and mass removal.
  - The system pumped at an average rate of 16.8 gallons per minute (gpm), above the 15 gpm target rate.
  - The system removed approximately 3.43 pounds of VOCs during FY 2008, with a cumulative mass removal of 54.85 pounds since system start-up on May 31, 1994.
  - The extracted water was discharged to the sanitary sewer system in compliance with all discharge criteria.
  - In July 2008 the Army submitted a report titled "Site A Shallow Groundwater: 10-Year Evaluation Report," prepared by Wenck Associates, July 2008. This report received consistency approval from the USEPA and MPCA in a letter dated July 9, 2008. The report recommended shutting the system down and utilizing Monitored Natural Attenuation for addressing the remaining groundwater plume. Subsequently, in September 2008, the Site A Shallow Groundwater Monitoring and Contingency Plan was approved and the groundwater pumping system shut down on September 24, 2008.

- Site I Shallow Groundwater
  - Sampling at Site I indicated no significant changes in VOC concentrations in Unit 1 monitoring wells in FY 2008. USEPA requested the inclusion of monitoring well 01U632 to the annual water quality sampling plan during FY 2007. Four of the nine wells scheduled for sampling and hydraulic monitoring were dry. One other well did not contain sufficient water volume

for collecting a sample. Therefore, groundwater samples were collected from four of the nine wells scheduled for sampling in FY 2008.

  - A Five-Year Review was performed during FY 2004. The review concluded that the remedy was functioning as intended, and that the components of the remedy remain protective of human health and the environment.

- Site K Shallow Groundwater
  - At Site K, the groundwater extraction trench and treatment system continued to operate as designed. The system captured and treated 5,990,410 gallons of water and maintained a continuous zone of capture downgradient of Building 103. A total of 18.2 pounds of VOCs were removed in FY 2008.
  - The extracted water was treated and discharged to Rice Creek in compliance with all discharge criteria.
  - A Five-Year Review was performed during FY 2004. The review concluded that the remedy was functioning as intended, and that the components of the remedy remain protective of human health and the environment.

- Deep Groundwater
  - The TCAAP Groundwater Recovery System (TGRS) operated in accordance with the OU2 ROD.
  - The TGRS operated at a rate sufficient to support the conclusion that the 5 μg/L TRCLE contour is hydraulically contained. In FY 2008, the total extraction well water pumped averaged 1,790 gpm, greater than the Global Operation Strategy (GOS) Operating Minimum (OM) (1,745 gpm).
  - In FY 2008, the TGRS extracted and treated approximately 943,318,161 gallons of water. The mass of VOCs removed was 2,292 pounds and is slightly less than that achieved in FY 2007. The total VOC mass removed by the TGRS through FY 2008 is 199,282 pounds.
  - The TGRS Operating Strategy (OS) was approved by the regulatory agencies and finalized in FY 2003 with the latest modification (#3) implemented in

2004. The OS presents a Global Operation Strategy (GOS) for the entire TGRS extraction system and a Micro Operation Strategy (MOS) for well groups.

- Groundwater analytical data of the source area shows a general decrease in TRCLE concentration. This demonstrates that the TGRS is effectively removing VOC mass from the aquifer.
- Effluent VOC concentrations were below contaminant-specific requirements for all sampling events.

Operable Unit 3 (OU3): Deep Groundwater

- Groundwater monitoring in FY 2008 was conducted during this annual event. Overall, the statistical evaluation showed the South Plume is decreasing in concentration at its center and stable at its edge. In addition, there is evidence of the North Plume commingling with the South Plume at the boundary between the two plumes.

Building 102 Groundwater Monitoring

Building 102 is not part of the OU2 ROD or Quality Assurance Project Plan (QAPP), so there are no specific requirements for the Site for FY 2008. Quarterly monitoring was started in June 2006 to begin creating a groundwater database on the Unit 1 VOC plume at Building 102. An Engineering Evaluation/Cost Analysis (EE/CA) was completed in FY 2008, and the QAPP was finalized in early FY 2009 to address the monitoring and remedial requirements at this Site.
FY 2009 will be the first year of monitoring under the Monitored Natural Attenuation (MNA) remedy selected in the EE/CA.

Table 1-1

Status of Remedial Actions: FY 2008

Remedy Component		Is the component being implemented?	Is the component doing what it is supposed to?	Has the component undergone final closeout?	Comments
Operable Unit 1: Deep Groundwater					
#1:	Alternate Water Supply/Well Abandonment	Yes	Yes	No	
#2:	Drilling Advisories	Yes	Yes	No	
#3:	Extracting Groundwater from the North Plume using the NBCGRS	Yes	Yes	No	Consistent with 2006 ROD Amendment
#4:	Removal of VOCs by GAC (Discharge Quality)	Yes	Yes	No	
#5:	Discharge of Treated Water	Yes	Yes	No	
#6:	Groundwater Monitoring	Yes	Yes	No	
Overall Remedy		Yes	Yes	No	
Operable Unit 2: Shallow Soil Sites					
#1-7:	Soil Remediation				
	Site A	Yes	Yes	Partially	Closeout Report for metals was partially approved; however, see Note 1 at the end of the OU2 section of this table. See OU2 Site A Shallow Groundwater (below) for status on VOC soils.
	Site C	Yes	Partially	No	A ROD amendment to include the groundwater remediation under OU2 was signed in July 2007. Remedy construction (filling the ditches) was completed in late FY 2007. The system operated in FY 2008 under the existing agreements with the MPCA. The system was shut down in early FY 2009 and the Monitoring and Contingency Plan was revised (to be reported in FY 2009).
	Site E	Yes	Yes	Partially	Closeout Report was partially approved; however, see Note 1 at the end of the OU2 section of this table.

Table 1-1 (continued)

Status of Remedial Actions: FY 2008

Remedy Component	Is the component being implemented?	Is the component doing what it is supposed to?	Has the component undergone final closeout?	Comments
Operable Unit 2: Shallow Soil Sites (continued)				
#1-7: Soil Remediation (continued)				
Site H	Yes	Yes	Partially	Closeout Report was partially approved; however, see Note 1 at the end of the OU2 section of this table.
Site 129-3	Yes	Yes	Partially	Closeout Report was partially approved; however, see Note 1 at the end of the OU2 section of this table.
Site 129-5	Yes	Yes	Partially	Closeout Report was partially approved; however, see Note 1 at the end of the OU2 section of this table.
#8: Groundwater Monitoring	Yes	Yes	No	The 5-year monitoring ended in FY 2007. Site H monitoring to continue to address copper.
#9: Characterization of Dumps:				
Site B	Yes	Yes	Yes	
Site 129-15	Yes	Yes	Partially	Closeout Report was partially approved in FY 2003; however, see Note 1 at the end of the OU2 section of this table.
Overall Remedy	Yes	Yes	Partially	

Note 1: *Closeout report has been approved, but final consistency will not be provided until concurrence on the land use control section of the report has been reached between the Army and the regulators.*

Table 1-1 (continued)

Status of Remedial Actions: FY 2008

Remedy Component	Is the component being implemented?	Is the component doing what it is supposed to?	Has the component undergone final closeout?	Comments
Operable Unit 2: Deep Soil Sites				
#1: Groundwater Monitoring	Yes	Yes	No	
#2: Restrict Site Access	Yes	Yes	No	
#3: SVE Systems (Deep)	NA	NA	Partially	Deep SVE systems will not be required at Sites D or G. The Site D VOC Closeout Report received consistency in FY 2002. The Site G VOC Closeout Report is in progress.
#4: Enhancements to SVE Systems	NA	NA	Yes	Neither system required operation with enhancements. The Site D SVE system was dismantled in FY 2001. The Site G SVE was dismantled in FY 2003.
#5: Maintain Existing Site Caps	Yes	Yes	No	
#6: Maintain Surface Drainage Controls	Yes	Yes	No	
#7: Characterize Shallow Soils and Dump	Yes	Partially	No	For Site D and G, a Closeout Report and a modification to the ROD were pending at the end of FY 2008. For Site G, cover construction was completed in FY 2004.
Overall Remedy	Yes	Yes	No	

Table 1-1 (continued)

Status of Remedial Actions: FY 2008

Remedy Component		Is the component being implemented?	Is the component doing what it is supposed to?	Has the component undergone final closeout?	Comments
Operable Unit 2: Site A Shallow Groundwater					
#1:	Groundwater Monitoring	Yes	Yes	No	
#2:	Groundwater Containment/Mass Removal	Yes	Yes	No	Subject to ten year review in FY 2008. The system was shut down near the end of FY 2008. FY 2009 will be the first year of monitoring for the approved monitored natural attenuation remedy.
#3:	Drilling Advisory/Alternate Water Supply/Well Abandonment	Yes	Yes	No	
#4:	Discharge of Extracted Water	Yes	Yes	No	
#5:	Source Characterization/Remediation	Yes	Yes	No	SVE system operation was ceased near the end of FY 2002, due to minimal VOC removal rates. In FY 2003, a work plan to excavate the contaminated soil received regulatory approval. The SVE system was removed and 688 cubic yards of contaminated soil were excavated and transported off-site for disposal. A Closeout Report for the Former 1945 Trench soils received regulatory approval in FY 2004.
Overall Remedy		Yes	Yes	No	

Table 1-1 (continued)

Status of Remedial Actions: FY 2008

Remedy Component		Is the component being implemented?	Is the component doing what it is supposed to?	Has the component undergone final closeout?	Comments
Operable Unit 2: Site I Shallow Groundwater					
#1:	Groundwater Monitoring	Yes	Yes	No	
#2:	Groundwater Extraction	No	No	No	Pilot study determined that extraction remedies are not feasible. An amendment to the OU2 ROD is being pursued to change to a monitoring based remedy.
#3:	POTW Discharge	No	No	No	See above.
#4:	Additional Investigation	NA	NA	No	See above.
Overall Remedy		NA	NA	No	See above.
Operable Unit 2: Site K Shallow Groundwater					
#1:	Groundwater Monitoring	Yes	Yes	No	
#2:	Sentinel Wells	Yes	Yes	NA	
#3:	Hydraulic Containment	Yes	Yes	No	
#4:	Groundwater Treatment	Yes	Yes	No	
#5:	Treated Water Discharge	Yes	Yes	No	
#6:	Discharge Monitoring	Yes	Yes	No	
#7:	Additional Investigation	Yes	Yes	Yes	Well 03U621 was added as a sentinel well and is sampled annually, as listed in the monitoring plan.
Overall Remedy		Yes	Yes	No	

Table 1-1 (continued)

Status of Remedial Actions: FY 2008

Remedy Component		Is the component being implemented?	Is the component doing what it is supposed to?	Has the component undergone final closeout?	Comments
Operable Unit 2: Deep Groundwater					
#1:	Hydraulic Containment and Contaminant Mass Removal	Yes	Yes	No	
#2:	Groundwater Treatment	Yes	Yes	No	
#3:	Treated Water Discharge	Yes	Yes	No	
#4:	Institutional Controls	Yes	Yes	No	
#5:	Review of New Technologies	Yes	Yes	No	
#6:	Groundwater Monitoring	Yes	Yes	No	
Overall Remedy		Yes	Yes	No	
Operable Unit 3: Deep Groundwater					
#1:	Monitored Natural Attenuation	Yes	Yes	No	
#2:	Groundwater Monitoring	Yes	Yes	No	
#3:	Drilling Advisories	Yes	Yes	No	
Overall Remedy		Yes	Yes	No	

2.0 Introduction

2.1 PURPOSE

This Fiscal Year 2008 Annual Performance Report is intended to:

- Summarize the status of remedy implementation; and
- Address how the remedies are doing,

for remedial actions at the New Brighton/Arden Hills Superfund Site. Fiscal Year 2008 (FY 2008) extended from October 1, 2007 through September 30, 2008.

For purposes of remediation, the areas contaminated by activities at TCAAP have been divided into three areas designated “Operable Units.” Operable Unit 1 (OU1) encompasses the deep groundwater “North Plume” of off-TCAAP contaminated groundwater. Operable Unit 2 (OU2) includes all soil, sediment, and groundwater contamination on the original TCAAP property. OU2 also includes the shallow Site A plume that extends off the north end of TCAAP in the Unit 1 aquifer. Operable Unit 3 (OU3) consists of the deep groundwater “South Plume” of off-TCAAP contaminated groundwater.

The report addresses remedial actions for the following media as prescribed in the Record of Decision (ROD) for each Operable Unit:

- Operable Unit 1
  - Deep Groundwater

- Operable Unit 2
  - Shallow Soil Sites
  - Deep Soil Sites
  - Site A Shallow Groundwater
  - Site C-2 Shallow Groundwater
  - Site I Shallow Groundwater
  - Site K Shallow Groundwater
  - Deep Groundwater

- Operable Unit 3
  - Deep Groundwater

Monitoring activities and submittal of this report are in fulfillment of the Federal Facilities Agreement (FFA) signed August 12, 1987, between the United States Army (Army), United States Environmental Protection Agency (USEPA), and Minnesota Pollution Control Agency (MPCA). These parties agreed to minor modifications to the FFA on:

- October 12, 1990
- February 5, 1992
- March 3, 1992
- November 23, 1993
- January 9, 1998
- May 12, 1998
- June 30, 1998

The requirements have been fulfilled for FFA Attachment 2 (Interim Remedial Actions), Attachment 3 (Remedial Investigation), and Attachment 4 (Feasibility Study). Activities are now geared towards fulfilling the requirements of FFA Attachment 5 (Remedial Design and Remedial Action).

Assessment of performance is answered with two questions:

1. *Are all of the remedies being implemented? (Compliance check with the RODs)*
2. *Are the remedies doing what they are supposed to? (performance standards)*

To address these questions, this report is broken into the three Operable Units. Based on each ROD, the report is broken down to the major components of the selected remedy for each media. Performance standards are then presented for each of the major remedy components. The performance standards are used to determine when a remedy component has been successfully implemented or completed.

For some of the remedy components, the performance standards are clearly defined in the RODs (e.g., soil or groundwater cleanup levels). For other remedy components (e.g., alternate water supply) the performance standards are less clear in the RODs, but may have been agreed to through Work Plans or design documents.

The report then addresses the two questions described above, often through a series of sub-questions. To the extent possible, answers are in the form of pictures (figures, graphs, etc.) versus words.

In addition to reporting on the current fiscal year, this document presents proposed monitoring for future years (Appendix A). Monitoring locations or frequencies that are new in this year's report are shown in red color. The monitoring plan shows FY 2008 through FY 2012. The FY 2008 monitoring plan indicates the work that generated the results presented in this report. The monitoring plan covers a moving 5-year time span (i.e., next year FY 2008 will be cut and FY 2013 will be added).

This report represents work performed by the Army and Alliant Techsystems Inc. (Alliant). On behalf of the Army, Wenck Associates, Inc. (Wenck) prepared Sections 2.0 through 7.0, 12.0, and 13.0 of this report. On behalf of Alliant, Stantec Consulting Corporation (Stantec) prepared

Sections 8.0 and 9.0, and Conestoga-Rovers & Associates, Inc. (CRA) prepared Sections 10.0 and 11.0. Wenck, Stantec, and CRA all contributed to Section 1.0.

2.2 SITE DESCRIPTION

The Twin Cities Army Ammunition Plant is a government-owned facility located in the northern portion of the Minneapolis – St. Paul metropolitan area, in Ramsey County, and is surrounded by the cities of New Brighton, Arden Hills, Mounds View, and Shoreview, Minnesota (Figure 2-1). For purposes of the Army's restoration program for the New Brighton/Arden Hills Superfund Site, TCAAP formerly occupied an approximately four square mile area immediately east of U.S. Interstate Highway 35W and north of Ramsey County Highway 96 (i.e., this was TCAAP at the time the New Brighton/Arden Hills Superfund Site was placed on the National Priorities List in 1983). Alliant has been the prime tenant on the installation; however, they discontinued manufacturing operations at TCAAP in 2004.

TCAAP was constructed between August 1941 and January 1943, and formerly included 323 buildings with associated utilities and services to support production activities. TCAAP produced small-caliber ammunition and related materials, proof-tested small-caliber ammunition and items as required, and handled/stored strategic and critical materials for other government agencies. Production began in 1941 and then alternated between periods of activity and standby. The size of TCAAP has periodically shrunk as a result of property transfers. Since placement on the NPL, over 1,500 acres have been reassigned to the National Guard Bureau and U.S. Army Reserve and more than 270 acres have transferred to state, county, and municipal governments. The remaining 585 acres of TCAAP have been determined to be surplus to the needs of the federal government and are in the process of being transferred out of federal control.

During periods of activity, solvents were utilized as part of the manufacturing process. Disposal of solvents and other wastes at the TCAAP site resulted in soil contamination and also groundwater contamination, which has migrated beyond the site boundary. Groundwater contamination was first discovered in July 1981, and the site was placed on the National Priorities List (NPL) in 1983.

A number of known and potential contaminant source areas have been identified on the TCAAP property: Sites A, B, C, D, E, F, G, H, I, J, K, 129-3, 129-5, and 129-15 (see Figure 2-2 for locations). Site F was remediated and Site J was determined not to have a release prior to the 1997 OU2 ROD, while the remaining sites are addressed in the OU2 ROD. Surface water and sediment on TCAAP are being addressed separately from the OU2 ROD.

Five other sites (the Grenade Range, the Outdoor Firing Range, the Trap Range, and the 135 and 535 Primer/Tracer Areas) are being addressed as Removal Actions separate from the OU2 ROD. These sites are expected to be included in the OU2 ROD under pending ROD amendment #3.

2.3 HYDROGEOLOGIC UNITS AND WELL NOMENCLATURE

On- and off-post wells have been installed in four hydrogeologic units beneath the site: Unit 1 through Unit 4. Descriptions of these four units are presented in Appendix B, along with a description of the nomenclature system used for well designations (e.g., 03U704). A well-designation cross-reference guide (sorted two different ways) is included in Tables B-1 and B-2 in Appendix B. The well index lists wells of concern, including the TCAAP designation, Minnesota unique number, and any other name(s) the wells may have. Locations of wells that are included in the TCAAP monitoring plan are shown on Figure B-2 (off-TCAAP wells) and Figure B-3 (on-TCAAP wells) in Appendix B (on the included CD). With a known well name, the location of that well can be determined using the “Edit, Find” or “Edit, Search” function and typing in the well name, which will highlight the desired well name on the figure. Available well logs can be viewed by selecting the well of interest in Table B-3 (on-TCAAP wells) and Table B-4 (off-TCAAP wells) in Appendix B (click on the well name with the mouse).

See the instructions on the attached CD for more information on using Appendix B.

2.4 DATA COLLECTION, MANAGEMENT, AND PRESENTATION

Performance monitoring data was collected in accordance with the:

- FY 2008 Monitoring Plan for Groundwater Monitoring Wells
- FY 2008 Monitoring Plan for Remedial Treatment Systems
- New Brighton Water System Sampling and Analysis Plan

Data was collected principally by four parties: Wenck on behalf of the Army, Stantec, and CRA on behalf of Alliant, and Barr Engineering (Barr) on behalf of the City of New Brighton. Appendix C presents information on data collection, management, and presentation. Data tables are presented following the text at the end of each section in which it is referenced. The comprehensive groundwater level and groundwater quality databases from 1987 to present are contained in Appendix D.1. Groundwater quality trend graphs for the primary chemical of concern (trichloroethene) can be viewed by selecting the well of interest on Figure B-2 (off-TCAAP wells) and B-3 (on-TCAAP wells) in Appendix B (click on the well name with the mouse). The trend graphs for Site A also include tetrachloroethene and cis-1,2-dichloroethene, in addition to trichloroethene.

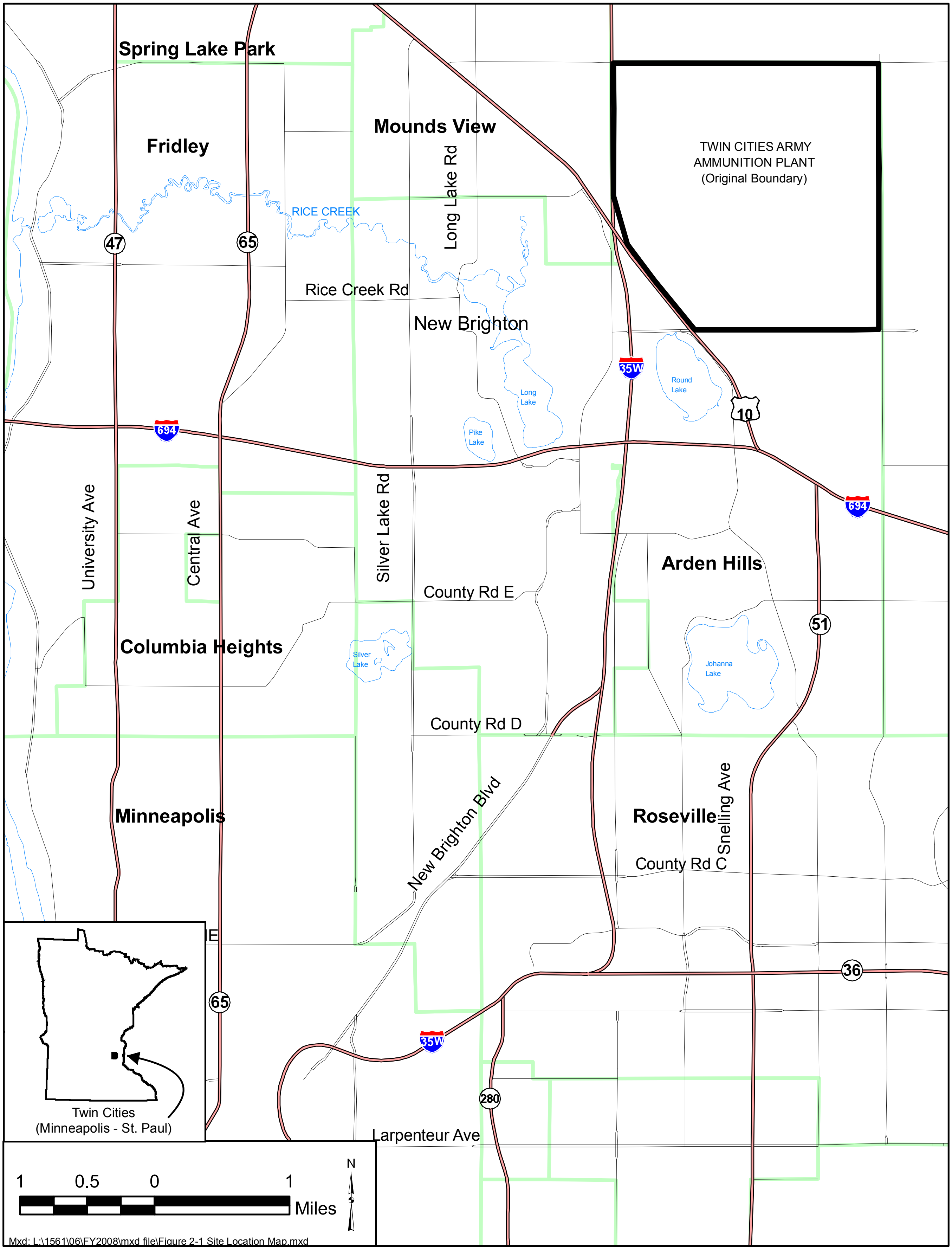
Is the data complete and representative (are we making decisions based on complete and technically-sound information)?
Yes. The data was collected in accordance with the FY 2008 Monitoring Plan. Data was collected, assessed, and validated in accordance with the "Quality Assurance Project Plan for Performance Monitoring, Revision 3, December 10, 2003, (TWISS, 2003).

The data tables in the various report sections and the comprehensive water quality databases (Appendix D.1) show the data qualifiers and flagging codes that were assigned to the data as a result of data assessment/validation. The data qualifiers and flagging codes applied to FY 2008 data are explained in footnotes on the data tables in the various report sections. Data assessments (performed on 100 percent of the data) and "full validation" (performed on at least 10 percent of the data) were provided to the USEPA and MPCA in submittals during FY 2008. USEPA and MPCA approval letters for these submittals are included in Appendix C.3.

With regard to completeness, Appendix C.2 summarizes any deviations from the FY 2008 Monitoring Plan. The completeness goals are the same in both the 1996 and 2003 Quality Assurance Project Plans (QAPPs). Field completeness for FY 2008 was 100% and laboratory completeness was 100% (wells that were dry or inoperative were not considered as missed samples), meeting the QAPP completeness goal of 95%. Field duplicates, equipment rinse blanks, and matrix spike/matrix spike duplicates were collected at overall frequencies exceeding the QAPP-specified frequencies of 10%, 10%, and 5%, respectively. For the subset of metals analyses, matrix spike/matrix spike duplicates were collected at an overall frequency of 13.8%, also meeting the QAPP-specified frequency. Data validation was performed on 19.1% of the data, exceeding the QAPP-specified requirement of 10%. No problems with analytical procedures/reporting were identified in the data validations.

The 2003 QAPP additionally identified critical samples and set a completeness goal of 100%. The critical samples are: TGRS effluent, Site K effluent, and well inventory sampling. These were all complete in FY 2008.

The data for FY 2008 is deemed to be representative and meet data quality objectives based on: 1) adherence to QAPP-specified sampling and laboratory analytical procedures; 2) completion of data assessments and data validation; and 3) comparability to historical results (any substantial deviations from historical/anticipated results are discussed within the site-specific sections of this report).



TWIN CITIES ARMY AMMUNITION PLANT

Site Location Map

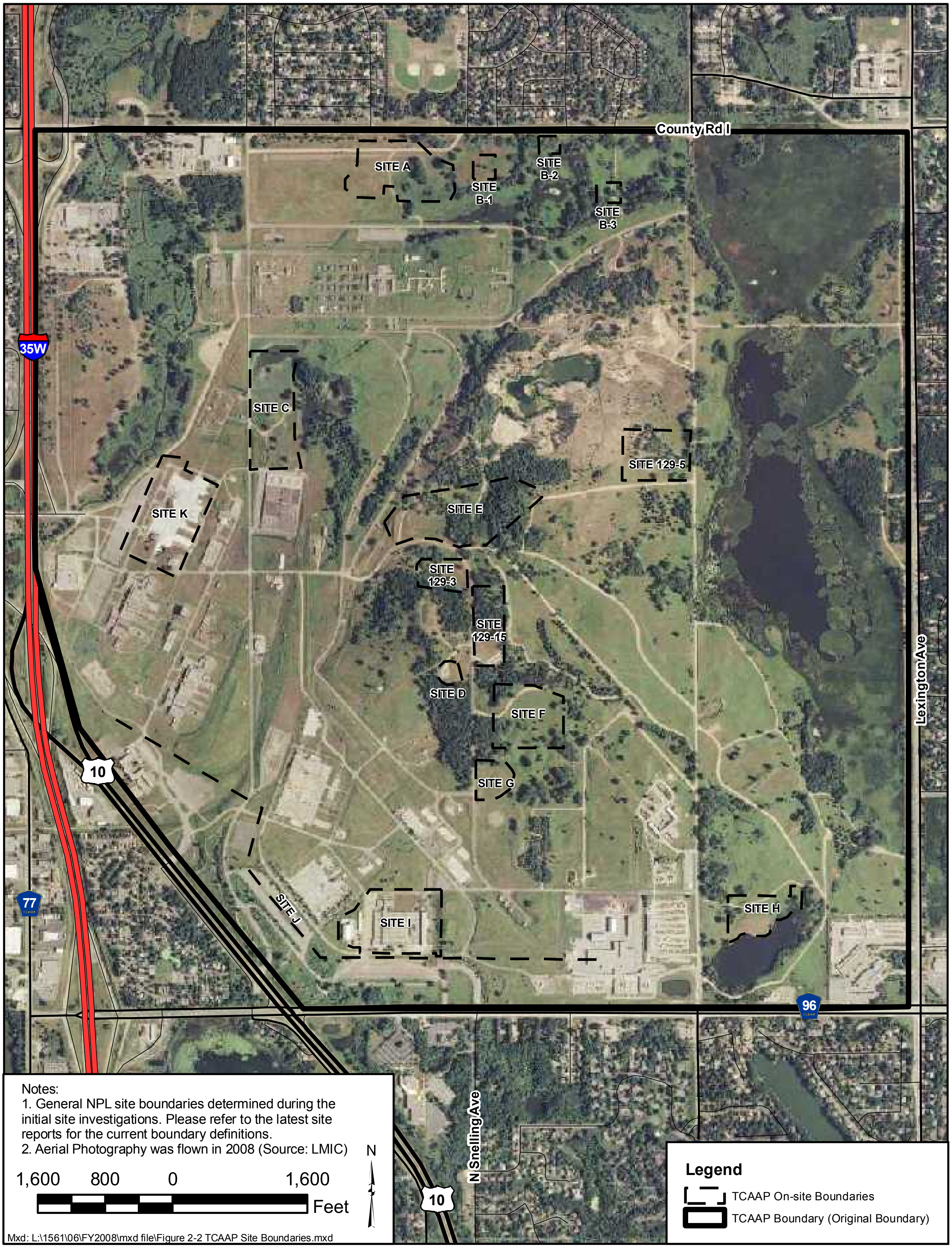
Wenck

Wenck Associates, Inc. Environmental Engineers

1800 Pioneer Creek Center Maple Plain, MN 55359-0429

FY 2008

Figure 2-1



Notes:
1. General NPL site boundaries determined during the initial site investigations. Please refer to the latest site reports for the current boundary definitions.
2. Aerial Photography was flown in 2008 (Source: LMIC)

Mxd: L:\1561\06\FY2008\mxd file\Figure 2-2 TCAAP Site Boundaries.mxd

TWIN CITIES ARMY AMMUNTION PLANT

TCAAP Site Boundaries

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Wenck

Wenck Associates, Inc. 1800 Pioneer Creek Center
Environmental Engineers Maple Plain, MN 55359-0429

FY 2008

Figure 2-2

3.0 Operable Unit 1: Deep Groundwater

The reference for the OU1 ROD is:

RECORD OF DECISION
Groundwater Remediation
Operable Unit 1
At New Brighton/Arden Hills Superfund Site
1993, Amended 2006

The 2006 ROD amendment formalized the adoption of the statistical analysis of groundwater quality presented in the Annual Performance Reports since FY 2003.

Following are the six primary elements of the amended ROD, with the changed elements shown in italics:

1. Providing alternate water supplies to residents with private wells within the North Plume.

2. Implementing drilling advisories that would regulate the installation of new private wells within the North Plume as a Special Well Construction Area.

3. *Extracting groundwater from the North Plume using the New Brighton Contaminated Groundwater Recovery System (NBCGRS), subject to the following:*

   a. the initial aggregate groundwater extraction rate shall be consistent with the long-term operating history of the NBCGRS;

   b. future decreases in the aggregate extraction rate shall be determined by *the Army, USEPA, and MPCA using a transparent public process and rational engineering, scientific, and economic analyses at least as rigorous as those employed in the feasibility study that was the basis for the original remedy selection;*

c. future changes to the aggregate or individual well extraction rates shall be made so as to assure that the rate of restoration of the aquifer will not be slowed or result in a duration of remedy longer than was contemplated by the original ROD;

d. the facilities comprising the NBCGRS may be modified as necessary to assure the restoration of the full areal and vertical extent of the aquifer in a timeframe as contemplated in 3.c, above.

4. Pumping the extracted groundwater to the PGAC Water Treatment Facility in New Brighton for removal of VOCs by a pressurized granular activated carbon (GAC) system.

5. Discharging all of the treated water to the New Brighton municipal distribution system.

6. *Monitoring the groundwater to verify effectiveness of the remedy through measurement of overall plume shrinkage (geographically) and decreasing contaminant concentrations*.

The last requirement (No. 6) will be met by evaluating the groundwater chemical data according to statistical methods contained in the "OU1 Technical Group Technical Memorandum Statistical Evaluation Method For Water Quality Data, Operable Unit 1", dated December 2004 (and any subsequent addendums or revisions approved by the USEPA and MPCA). The statistical analysis will be conducted annually and will be reported in the Annual Performance Reports.

Groundwater containment is provided by three primary municipal wells: New Brighton Municipal (NBM) #4, #14, and #15. NBM #3, which is located next to NBM #4, also contributes to containment, especially when one of the other three wells is off. The extracted water is treated in the Permanent Granular Activated Carbon (PGAC) treatment facility for removal of VOCs, and is then used as part of the municipal water supply. NBM #3 and #4 were pre-existing wells. NBM #14 and NBM #15 began pumping in December 1996 and March 1998, respectively.

The remedy also relies on institutional controls (drilling advisory, alternate water supply, and well abandonment) to manage risks, including downgradient of the containment system.

Section 1.4 of the ROD prescribes six major components of the remedy, which are described and evaluated in the following sections.

3.1 REMEDY COMPONENT #1: ALTERNATE WATER SUPPLY/WELL ABANDONMENT

Description: "Providing an alternative water supply to residents with private wells within the North Plume." (OU1 ROD, page 2)

- Clarified by the OU1 Alternate Water Supply Plan (Montgomery Watson, October 1995) to delete "residents with" since the remedy applies to other wells in addition to residential wells. This plan also identifies the criteria for determining what wells are eligible for an alternate water supply.
- Clarified by the OU1 Alternate Water Supply Plan to also include well abandonment.
- Clarified by the OU1 Alternate Water Supply Plan (page i-2) to also encompass OU3 and the OU2 Site A shallow groundwater plume.

Additional information on the well inventory is presented in Appendix E.

Performance Standard (how do you know when you're done):

- For alternate water supply, when the owners of all wells that meet all of the following criteria have been offered and provided with an alternate water supply (or when the well owners have rejected the offers):

  i. The well is located within the area affected by groundwater plumes that originate at TCAAP, as shown on Figures E-2 and E-3; and
  ii. The well is completed in an affected aquifer; and
  iii. The well contains detectable concentrations of the TCAAP-related chemicals of concern identified on page 18 of the OU1 ROD (or page 26 of the OU3 ROD, or Table 1 of the OU2 ROD, as appropriate for the well location); and
  iv. The well is used in a manner to cause exposure (uses are defined in the Alternate Water Supply Plan); and
  v. The well owner does not already have an alternate water supply.

  If eligible well owners refuse the offer to have an alternate water supply provided, this also satisfies the performance standard.

- For well abandonment, when the owners of all wells that meet all of the following criteria have been offered and provided abandonment (or when the well owners have rejected the offers):

  i. The well is located within the area affected by groundwater plumes that originate at TCAAP; and
  ii. The well is completed in an affected aquifer; and
  iii. The well contains detectable concentrations of the TCAAP-related chemicals of concern identified on page 18 of the OU1 ROD (or page 26

of the OU3 ROD, or Table 1 of the OU2 ROD, as appropriate for the well location); and

iv. The well was constructed prior to the MDH Special Well Construction Area advisory; and

v. The well is being used by the well owner or use was discontinued due to contamination; and

vi. The well is used in a manner to cause exposure (uses are defined in the Alternate Water Supply Plan).

If eligible well owners refuse the offer for abandonment, this also satisfies the performance standard. An exception to abandonment would be if the well is needed for groundwater monitoring.

Is this remedy component being implemented?

Yes. The Alternate Water Supply and Well Abandonment Program has been implemented and is an ongoing program maintained by the Army. The process of identifying wells eligible for alternate water supply and/or abandonment is accomplished by maintaining a "well inventory." The well inventory is a database that was initially developed in 1992, and which has been periodically updated since then. For the purposes of the well inventory, a study area was established which encompasses the groundwater plume (the study area boundary is the same as the MDH Special Well Construction Area). The well inventory is intended to include all wells within the study area. Within the study area, areas of concern are defined by the edge of the groundwater plume, plus additional buffer area. The wells are grouped into categories based on factors such as location relative to the area of concern, type of use, active/non-active status, sealed, etc. Wells in categories with the potential to be impacted are periodically sampled to see if they qualify for alternate water supply and/or abandonment.

Thus, maintenance of the well inventory consists of the following tasks:

1. Check if the area of concern needs to be adjusted based on the extent of contamination,
2. Check if there are any previously unknown wells to be added to the database (in coordination with the MDH as described in Appendix E),
3. Sample wells on a prescribed schedule,
4. Take the appropriate course of action depending on the results,
5. Update the well inventory database with any new information (e.g., water quality results, owner information, construction information, well re-categorizing),
6. Report findings through the Annual Performance Report.

The following questions and answers summarize developments since the last Annual Performance Report with respect to Operable Unit 1.

Did the area of concern within OU1 change during FY 2008, as defined by the 1 μg/L contour line?
No. There was not a comprehensive groundwater sampling round conducted in FY 2008. The 1 μg/L contour line is assumed to have remained essentially the same as in FY 2007, which was the last comprehensive sampling round (see Figure 3-1).

Were any additional water supply wells discovered within the area of concern for OU1 that are completed within an aquifer of concern?
No (see Appendix E for additional information).

Were any water supply wells within the area of concern for OU1 sampled during FY 2008 (outside of those included in the OU1 performance monitoring plan)? If yes, what were the findings? No.

Were any well owners offered an alternate water supply and/or well abandonment during FY 2008? No.

For OU1, are there any well owners that meet the criteria, but have not yet been provided an alternate water supply? No.

For OU1, are there any wells that meet the criteria, but have not yet been abandoned? No.

Is any sampling of water supply wells (excluding those included in the OU1 performance monitoring plan) proposed prior to the next report?
The next major sampling event is in FY 2009.

Are there any changes or additional actions required for this remedy component? No.

3.2 REMEDY COMPONENT #2: DRILLING ADVISORIES

Description: "Implementing drilling advisories that would regulate the installation of new private wells within the North Plume as a Special Well Construction Area." (OU1 ROD, page 2)

Performance Standard (how do you know when you're done):
When the MDH has issued a Special Well Construction Area Advisory.

Has the MDH issued a Special Well Construction Area Advisory?
Yes. It was issued in June 1996. In addition to covering OU1, the Special Well Construction Area also encompasses OU3 and the OU2 Site A shallow groundwater plume. In June 1999, the MPCA requested that the MDH extend the boundary of the Special Well Construction Area further to the southwest to the Mississippi River and Marshall Avenue to ensure that the southern

boundary fully encompassed the plume. The MDH revised the Special Well Construction Area in December 1999. The current boundary is shown on Figure E-1 (Appendix E).

Are any changes or additional actions required for this remedy component? No.

3.3 REMEDY COMPONENT #3: GROUNDWATER RECOVERY

Description: "Extracting groundwater at the containment boundary in the North Plume near County Road E." (OU1 ROD, page 2)

- Through January 2008, the remedy component consisted of recovering deep (Unit 4) groundwater using three City of New Brighton municipal wells: NBM #4, #14, and #15. New Brighton municipal well #4 (NBM #4) was an existing well completed in both the Prairie du Chien and Jordan. NBM #14 and NBM #15 were constructed in the Prairie du Chien as part of the remedy and began pumping in December 1996 and March 1998, respectively. The locations of the recovery wells are shown on Figure 3-1.
- NBM #3 has been designated as an alternate containment/production well for times when one of the three primary wells is not in operation. NBM #5 and NBM #6 are considered secondary alternates.
- The extracted groundwater is used as part of the New Brighton water supply system, and as such, New Brighton took the lead on design and construction of the system, and is responsible for operation of the system. New Brighton contracted Barr Engineering to provide design and construction oversight services. The Army is paying for the OU1 remedy.

In 2006, New Brighton proposed to the Army modifying the agreement between the two parties to allow more flexibility in how they operate the NBCGRS, and to increase removal of contaminant mass from the aquifer. In November 2007, the USEPA and MPCA provided consistency approval of the revised pumping rates. Appendix A.6 (Table D-1 and Table D-2 from the settlement agreement between the Army and New Brighton) presents the new pumping rates in effect as of January 2008. Following is additional background discussion that explains the scope of the changes.

New Brighton expressed interest in pumping from wells NBM #5 and/or NBM #6, completed in the Jordan aquifer. New Brighton indicated they do not want to sacrifice cleanup in the Prairie du Chien; rather, they want to supplement these efforts with additional pumping in the Jordan. They observed that contaminant concentrations have declined in the Prairie du Chien wells to the point where the contamination is now higher in Jordan wells #5 and #6.

New Brighton proposed the pumping rates in Appendix A.6. The tables show a column for "Normal Operation" that has the revised lower and upper limits for pumping, along with the "priority" for each well. Well NBM #15 is considered the highest priority because it is located near the center of the plume and has the highest contaminant concentrations of the wells completed in the Prairie du Chien. Well pair NBM #3/4 is the second priority because it has the next highest concentrations in the Prairie du Chien. New Brighton deems Jordan well pair NBM #5/6 as the next highest priority because these wells have the highest contaminant concentrations of all the extraction wells.

Finally, well NBM #14 was assigned the lowest priority because it is near the edge of the plume in the Prairie du Chien with relatively low contaminant concentrations. The priorities reflect New Brighton's desire to still focus on the core of the Prairie du Chien plume (wells NBM #15 and NBM #3/4), while starting to enhance mass removal in the Jordan (well pair NBM #5/6). The lower limit for well NBM #14 is zero. New Brighton proposed this in anticipation that this well will likely be the first to reach remediation goals, and its use could be discontinued for remediation purposes. In practice, New Brighton intends to keep pumping from well #14 (albeit at a lower rate than previously) in order to meet their water supply demand.

There will be no change to the approved statistical analysis used to evaluate the effectiveness of the remedy as set forth by the OU1 ROD Amendment. The Army believes that the changes should enhance the overall aquifer restoration by re-allocating some pumping to wells with higher contaminant concentrations. Nevertheless, the Army has made it clear to New Brighton that if the changes somehow cause statistical evaluation results that are not in compliance with the OU1 ROD Amendment, then the pumping allocations will revert back to the previous scheme.

Performance Standard (how do you know when you're done):
When the NBCGRS is operating consistent with long term NBCGRS operating rates.

During FY 2008, did the OU1 extraction system operate according to the New Brighton operational plan and consistent with past operations?
Yes. The NBCGRS is operated by the City of New Brighton according to an operational plan designed to meet both municipal water needs and the remediation needs. Following is a discussion of the NBCGRS operation in FY 2008:

<u>Pumping Rates</u>
Table 3-1 presents the monthly pumping volumes for each extraction well and Figure 3-2 illustrates the average monthly pumping rate targets and actual monthly volumes pumped for NBM #3/4, #15, and #14 (west to east order). The pumping targets were derived by Barr Engineering (Barr) based on their Final Conceptual Design Report, Containment/Production Wells (Barr, 1995). The operating system devised by Barr includes different operational conditions (named A thru G), which were designed to respond to maintenance issues by altering the target rates at each extraction well. As of FY 2008 the operating conditions have not been modified to address the new pumping rate targets discussed above. However, the operating conditions remain generally relevant and are discussed here as in previous annual reports.

Condition A is the normal operating condition for when NBM #4, #14, and #15 are all in operation, and has pumping targets above the lower limits. Conditions B through F have different pumping targets for when different wells are out of service:

Well	Condition A Normal Operation		Condition B Well 3 and/or 4 Out-of Service		Condition C Well 5 and/or 6 Out-of Service		Condition D Well 14 Out-of Service	
All units in mgd	Lower Limit RPR	Upper Limit RPR	Lower Limit RPR	Upper Limit RPR	Lower Limit RPR	Upper Limit RPR	Lower Limit RPR	Upper Limit RPR
Well 3 & 4	1.152	1.872	0.000	0.000	1.440	1.872	1.152	1.872
Well 5 & 6	0.864	2.160	1.728	2.160	0.000	0.000	0.864	2.160
Well 14	0.000	1.440	1.152	1.440	1.152	1.440	0.000	0.000
Well 15	1.152	1.440	1.152	1.440	1.520	1.440	1.152	1.440
Total	3.168	6.912	4.032	5.040	4.112	4.752	3.168	5.472

Condition E Well 15 Out-of Service		Condition F Carbon Transfer (half of normal)		Condition G Special (see note 4)	
Lower Limit RPR	Upper Limit RPR	Lower Limit RPR	Upper Limit RPR	Lower Limit RPR	Upper Limit RPR
1.440	1.872	0.000	1.872	0.000	1.872
1.728	2.160	0.000	2.160	0.000	2.160
0.720	1.152	0.000	1.440	0.000	1.440
0.000	0.000	0.000	1.440	0.000	1.440
3.888	5.184	1.584	6.912	0.000	6.912

Condition G is unique from the other conditions because it does not have a pumping target (i.e., the targets for all wells are zero). Condition G primarily applies during carbon change-outs for the GAC treatment system. Hence, the daily pumping targets can vary depending on what operating condition the system is in. The targets depicted on Figure 3-2 represent a collective or cumulative monthly target based on the daily operating conditions.

For FY 2008, the New Brighton Contaminated Groundwater Recovery System (NBCGRS) was in the normal operating condition (Condition A) approximately 70 percent of the time. The system was in Condition G (primarily for carbon change-outs) for 11 percent of the time, and Condition E and F the remaining 19 percent of the time.

Figure 3-2 indicates that the NBCGRS wells, substantially, exceeded the monthly targets during FY 2008. The total NBCGRS pumping volume for FY 2008 of 1.43 billion gallons, the average monthly pumping volume (if pumping was at a uniform rate) would be about 119 million gallons. Compared with the typical monthly pumping target of about 100 million gallons (for the normal operating condition), it is clear that the NBCGRS pumped substantially more than the minimum target rate.

The overall adherence to the pumping targets supports the interpretation that the extraction system is operating in compliance with the amended ROD and is providing substantial containment in the Prairie du Chien by maintaining the historical pumping rates at the NBCGRS.

Extraction Well Water Quality

Trend graphs for trichloroethene in NBM #3, #4, #5, #6, #14, and #15 are shown on Figure 3-3. At both NBM #3 and NBM #4, trichloroethene decreased dramatically between 1991 and 1998, and has been relatively stable since then. NBM #5 and #6 remained stable with the increased pumping at these wells. The shorter term stability needs to be observed in the context of the overall plume behavior discussed in Section 3.7.

Water Level Contour Analysis

FY 2008 was a non-sampling year so water level contours were not prepared.

NBCGRS VOC Mass Removal

NBCGRS VOC mass removal is shown on Figure 3-4. The trend in mass removal rate has been downward through approximately 2004 and fairly stable since then.

Monitoring Well Water Quality

As discussed above, the OU1TG developed and reported a method for analyzing groundwater quality trends over time. Section 3.7 below, presents a discussion of the statistical analysis and presents the FY 2008 monitoring well data.

Are any changes or additional actions required for this remedy component? No.

3.4 REMEDY COMPONENT #4: REMOVAL OF VOCS BY GAC

Description: "Pumping the extracted groundwater to the Permanent Granular Activated Carbon (PGAC) Water Treatment Facility in New Brighton for removal of VOCs by a pressurized GAC system." (OU1 ROD, page 2)

- Treatment by the PGAC (along with iron and manganese removal and chlorination) makes the recovered groundwater suitable for municipal drinking water purposes. The PGAC is located approximately one-third mile south of Interstate 694 near Silver Lake Road. The City of New Brighton is responsible for operation and maintenance of the PGAC, with cost reimbursement from the Army for the operations related to the remedy.

Performance Standard (how do you know when you're done):

When the treated water meets the Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) established by the Safe Drinking Water Act (SDWA) for the chemicals of concern, as identified on page 18 of the OU1 ROD.

Did the treated water meet the MCLs and non-zero MCLGs established by the SDWA for the OU1 chemicals of concern?

Yes. Table 3-2 shows that the PGAC effluent met the performance standard during FY 2008.

Each of the 8 pairs of GAC Contractors (labeled A and B) is normally run in series (i.e., water passes through A then B, or B then A, depending on whether the most recent carbon change-out was the A or B vessel). The sampling data is not from a combined effluent after the GAC vessels; instead, it is from sampling ports between the lead and lag GAC vessel *and/or* after the lag GAC vessel for each of the 8 GAC vessel pairs in the PGAC. The sampling between the lead and lag vessels is performed every month and determines when breakthrough of the lead GAC vessels has occurred. When there are no contaminant detections between the lead and lag vessels, there is no reason to sample after the lag vessels. When breakthrough of a lead vessel has occurred, a carbon change-out of all 8 lead vessels is scheduled. Until the change-out occurs, monthly samples are collected after each lag vessel (in addition to the monthly between-vessel samples) to ensure that water leaving the PGAC meets the treatment requirements. When the carbon change-out of the lead vessels is completed, the lead vessels are switched to the lag position and vice versa. Monthly sampling then reverts to only between the lead and lag vessels until a contaminant detection occurs, whereupon the process repeats.

Table 3-2 shows that two carbon change-outs occurred in FY 2008: one in April and one in October. Both were triggered by breakthrough detections. The sampling results that represent PGAC effluent water quality are highlighted in Table 3-2 for ease of viewing the compliance portion of the data.

Is any sampling of the treated water proposed prior to the next report?
Yes. Sampling will continue to be performed by the City of New Brighton or their contractor.

Are any changes or additional actions required for this remedy component? No.

3.5 REMEDY COMPONENT #5: DISCHARGE OF TREATED WATER

Description: "Discharging all of the treated water to the New Brighton municipal distribution system." (OU1 ROD, page 2)

Performance Standard (how do you know when you're done):
When the connection to the New Brighton municipal supply system has been completed and water is being discharged.

Is the treated water being discharged to the New Brighton municipal distribution system?
Yes.

Are any changes or additional actions required for this remedy component? No.

3.6 REMEDY COMPONENT #6: GROUNDWATER MONITORING

Description: "Monitoring the groundwater to verify the effectiveness of the remedy." (OU1 ROD, page 2)

Performance Standard (how do you know when you're done):
When a performance groundwater monitoring program has been established and ongoing monitoring is in compliance with the program.

Is this remedy component being implemented?
Yes. Performance monitoring programs have been established to collect the data required to verify the effectiveness of remedy components #1 through #5. Table 3-3 summarizes the performance monitoring requirements, implementing parties, and the specific documents that contain the monitoring plans.

Were the groundwater monitoring requirements for this remedy met?
Yes. FY 2008 was a minor sampling year.

Is any groundwater sampling proposed prior to the next report? Yes.

- Monitoring of the extraction wells and treatment system effluent will be performed by the City of New Brighton in accordance with the "New Brighton Water System Sampling and Analysis Plan," June 1997.
- Other groundwater monitoring will be in accordance with the Groundwater Monitoring Plan included as Appendix A.1. The next major event is in FY 2009.

Are any changes or additional actions required for this remedy component? No.

3.7 OVERALL REMEDY FOR OU1 DEEP GROUNDWATER

Has the OU1 remedy been completed (i.e., have the cleanup levels on page 18 of the OU1 ROD been attained throughout the areal and vertical extent of the North Plume)? No.

What impact is the groundwater extraction system having on contaminant concentrations?
As discussed in Section 3.3 above, the OU1 Technical Memorandum was prepared to develop statistical methods specifically selected to evaluate the long-term progress of remediation and plume evolution in OU1. The OU1 Technical Memorandum states the objective of the statistical evaluation as follows:

> "Verify progress in cleanup of the plume through measurement of overall geographic plume shrinkage and decreasing contaminant concentrations."

The OU1TG identified five issues that need to be statistically addressed, now and over time, to achieve this objective:

1. Measure changing concentrations immediately downgradient of the TGRS, as this area is the first to be affected by any potential escape of contaminants from TCAAP.

2. Measure changes in the geographical size of the plume over time.

3. Measure changes in concentrations immediately downgradient of the NBCGRS, as this is the first area to be affected by any potential escape of contaminants from NBCGRS capture.

4. Measure any unforeseen changes in plume configuration. This addresses the possibility that changing flow patterns may cause a shift in the plume but not necessarily any change in size. A plume shift may require a redistribution of pumping.

5. Measure the long-term trends in overall VOC concentrations (as an indicator of contaminant mass). This provides an overall picture of remedial progress.

The OU1TG developed a series of five well groups designed to address each of the issues listed above. For each group, the appropriate statistical tools were specified and the statistical response threshold was identified that would trigger closer scrutiny by the Army and regulators (USEPA and MPCA). The five groups, corresponding to the five issues discussed above, are:

1. Group 1: Downgradient of the TGRS. This zone is the area downgradient of the TGRS capture zone. This zone should show overall reductions over time in response to TGRS mass removal and containment. However, it is also the stagnation zone of the TGRS so groundwater velocities are reduced and response may be slow. Furthermore, individual wells near the stagnation zone may show increases in contaminant concentrations during some points in time, as the plume shifts in response to changes in pumping.

2. Group 2: Plume Edge Wells. This zone includes wells that define the edges of the plume downgradient of the TGRS. These are wells with low concentrations of VOCs (<100 μg/L) that will indicate a reduction in overall plume size if VOC concentrations continue to decline.

3. Group 3: Downgradient Sentinel Wells. This is a zone downgradient of the NBCGRS stagnation zone. This group includes three wells but more accurately is defined as a geographic area immediately downgradient of the NBCGRS. This group should help demonstrate improvement due to the VOC mass removal by the NBCGRS over time, analogous to Group 1 and the TGRS.

4. Group 4: Lateral Sentinel Wells. These are "clean" wells downgradient of the TGRS that are beyond the current plume boundaries. These wells should help identify large, unexpected, lateral changes in plume configuration, such as a shifting or expansion of the plume boundary.

5. Group 5: Global Plume Mass Wells. This group includes all the monitoring wells necessary to construct a contour map of the VOC plume. Production wells are not used in Group 5 since the data may not be comparable to monitoring well data. Some wells on TCAAP are included in Group 5 to support the contouring near the TCAAP boundary. This group reflects the overall VOC mass in the aquifer and should show an overall reduction in VOC mass over time.

In October 2005, the Army received a consistency determination on:

Modification #1 to:
OU1 Technical Group Technical Memorandum Statistical Evaluation Method For Water Quality Data, Operable Unit 1" prepared by the Army, Dated December 2004.

This modification created well Group 6 to address the Jordan portion of the Unit 4 aquifer.

6. Group 6: Jordan Wells. The group includes all Jordan monitoring wells, the Prairie du Chien wells nested with them, and New Brighton Municipal Wells 3, 4, 5, and 6. The inclusion of the Prairie du Chien wells is to facilitate comparing the trends between it and the Jordan at these locations. This group will help identify any changes in the plume occurring in the Jordan portion of the aquifer.

Additional detail on the well groups and analysis is presented in the OU1 Technical Memorandum, Modification #1 and Appendix D.2.

FY 2008 was a minor sampling year, so new comprehensive plume mapping was not completed. Six wells were sampled in FY 2008, in support of continuing data needs for statistical Group 6 and eleven wells were sampled for Group 1. Table 3-4 presents groundwater quality data for OU1. Graphs of historical trichloroethene concentrations at any well can be viewed from Figure B-2 (Appendix B). The graphs help illustrate the long-term changes that have occurred throughout OU1 and provide a visual aid for examining the trichloroethene history at any well.

The statistical analysis in Appendix D.2 follows the format described in the OU1 Technical Memorandum and Modification #1.

Table 3-5 presents a summary of the statistical results for all groups evaluated in FY 2008, from Appendix D.2, reflecting the data collected through FY 2008. Table 3-5 includes an assessment of the statistical thresholds that were triggered in the analysis and brief comments addressing these threshold triggers. Further discussion is presented below.

Group 1:

The Group 1 (downgradient of the TGRS) response threshold was triggered due to a stable outcome of the north plume and south plume analysis. Both trends remained downward but the confidence in the trends were below the threshold to conclude a decreasing trend. In the south plume the AWG has been 4 or 5 μg/L for all the rounds in the trend analysis. The north plume has remained at 49 μg/L for the last two years. The stability appears to suggest the plume is stagnant overall in this area. Although, the individual well concentrations have shown variability, these trends appear stable for both plumes. There is no reason to suspect any problems with the remedial system and continued monitoring is the appropriate response.

Group 2:

No statistical analyses were performed for Group 2 in FY 2008.

Group 3:

No statistical analyses were performed for Group 3 in FY 2008.

Group 4:

No statistical analyses were performed for Group 4 in FY 2008.

Group 5:

No statistical analyses were performed for Group 5 in FY 2008.

Group 6:

With respect to the Jordan, the three new wells installed in FY 2005 were the only wells scheduled for statistical analysis in FY 2008. These wells provide additional data points between TCAAP and the NBCGRS to help complete the understanding of the extent and magnitude of VOC concentrations in the Jordan.

This, the fourth year of Group 6 analysis, shows improved results. Well 04J822 showed a “no trend” in FY 2008, reflecting the decreasing statistical confidence in upward trend in the raw data, as compared to FY 2007.

Well 04J847 shows a stable trend (which triggered the threshold). This well shows a raw trend of decreasing and the statistical confidence in the trend improved slightly from 71% in FY 2007 to 76% in FY 2008.

04J849 shows No Trend, which triggered the threshold for group six. However, all the concentrations except one are non-detect with one detection of less than 0.5 µg/L in FY 2008. The apparent trend is an artifact of analytical variability at these low concentrations.

Since there was (minor) improvement in the trends in FY 2008, the annual monitoring planned for these wells through FY 2009 remains appropriate to further examine these trends. FY 2009 is a comprehensive sampling round and statistics for all groups will be evaluated.

Overall Statistical Assessment:
Overall, the limited data collected in FY 2008 data meet the statistical criteria developed in this document for assessing the remedial progress in the off-TCAAP aquifers with the continued monitoring and analysis recommended above. The data show continuing improvement in the OU1 plume through 2008. The OU3 plume statistics are addressed in Section 11.0.

How much VOC mass has been removed (at each well and total)?
Table 3-1 shows that the NBCGRS removed 753 pounds of VOCs during FY 2008. The total cumulative VOCs removed by the NBCGRS is 20,321 pounds. The relative contribution from each extraction well is also shown on Table 3-1.

Figure 3-4 shows the annual VOC mass removed (listed at the top of the graph), annual pumping volumes, and the trend in annual mass removal per unit volume pumped since FY 1997 (when NBM #14 was brought online). The mass removal in FY 2008 slightly increased to 753 pounds from 658 pounds in FY 2007. The trend in annual mass removal has been on a decreasing trend since FY 1997 (1,548 pounds removed), when the last extraction well was brought online (NBM #15). The slight increase over the year reflects the change in pumping priority implemented by New Brighton, which increased pumping at NBM #5 and NBM #6. The overall decline in the mass removal since 1998 agrees with the trichloroethene trends in OU1 deep groundwater, which generally show a decreasing trend, and suggests that aquifer restoration is progressing.

Besides the changes already discussed, are any other changes or additional actions required for OU1? No.

Table 3-1
OU1 Pumping / VOC Mass Removal Data

FISCAL YEAR 2008

	WELL #3			WELL #4			WELL #5			WELL #6			WELL #14			WELL #15			System Totals	
MONTH	VOC (ug/l)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	VOC (ug/l)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	VOC (ug/l)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	VOC (ug/l)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	VOC (ug/l)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	VOC (ug/l)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	TOTAL WATER TREATED BY EXTRACTION SYSTEM (Mgallons)	TOTAL VOC'S REMOVED BY EXTRACTION SYSTEM (lbs)
TOTAL GALLONS PUMPED AND VOC'S REMOVED THROUGH SEPTEMBER 30, 2007																			18,685.784	19,567
OCTOBER	31	5.583	1.444	38	33.000	10.466	150	0.410	0.513	103	1.428	1.228	27	23.549	5.307	81	22.507	15.215	86.477	34.18
NOVEMBER	43	0.917	0.329	44	41.457	15.224	120	0.645	0.646	86	0.644	0.462	26	38.011	8.248	73	38.160	23.249	119.834	48.16
DECEMBER	52	4.865	2.111	43	44.585	16.001	160	11.035	14.736	95	11.141	8.833	26	11.323	2.457	65	24.754	13.429	107.703	57.57
JANUARY	52	0.000	0.000	53	24.870	11.001	150	10.069	12.605	89	11.613	8.626	19	23.206	3.680	50	41.814	17.449	111.572	53.37
FEBRUARY	52	1.863	0.809	61	13.502	6.874	150	12.088	15.133	85	14.246	10.106	28	36.529	8.536	59	33.523	16.507	111.751	57.97
MARCH	67	7.341	4.105	55	41.931	19.248	160	24.629	32.889	85	24.648	17.486	8.0	23.955	1.599	59	0.000	0.000	122.504	75.33
APRIL	71	3.579	2.121	65	37.191	20.176	150	6.922	8.666	88	10.997	8.077	7.9	3.606	0.238	59	35.283	17.374	97.578	56.65
MAY	70	7.813	4.565	55	42.938	19.710	160	14.801	19.765	86	29.471	21.153	5.3	1.180	0.052	46	43.347	16.642	139.550	81.89
JUNE	75	12.794	8.008	56	42.342	19.790	170	9.727	13.801	95	30.668	24.316	5.8	0.273	0.013	46	42.930	16.482	138.734	82.42
JULY	76	7.995	5.071	56	42.796	20.002	180	5.140	7.722	96	31.959	25.606	5.7	12.680	0.603	42	45.360	15.900	145.930	74.91
AUGUST	62	1.606	0.831	54	44.005	19.832	160	0.155	0.207	88	35.922	26.383	11	25.500	2.341	65	44.454	24.116	151.642	73.72
SEPTEMBER	55	1.260	0.578	56	35.009	16.362	170	0.131	0.186	95	25.339	20.091	7.7	2.882	0.185	68	35.088	19.913	99.709	57.32
Subtotal			29.973			194.685			126.868			172.366			33.260			196.276		
% of Total Mass			4.0			25.8			16.8			22.9			4.4			26.1		
TOTAL GALLONS TREATED AND VOC'S REMOVED FOR FISCAL YEAR 2008																			1,432.984	753.48
TOTAL GALLONS TREATED AND VOC'S REMOVED SINCE SYSTEM START UP																			20,118.768	20,321

Note: The mass of VOCs removed from Well No. 14 in December 2007 were calculated using analytical results from the previous month (November).
Note: The mass of VOCs removed from Well No. 3 in January 2008 were calculated using analytical results from the previous month (December).
Note: The mass of VOCs removed from Well No. 3 in February 2008 were calculated using analytical results from the previous month (December).
Note: The mass of VOCs removed from Well No. 15 in March 2008 were calculated using analytical results from the previous month (February).

Table 3-2

OU1, PGAC Effluent Water Quality
Fiscal Year 2008

	Influent Well Monitoring						Operational Performance Monitoring															
Sampling	Well	Well	Well	Well	Well	Well	Contactor #1		Contactor #2		Contactor #3		Contactor #4		Contactor #5		Contactor #6		Contactor #7		Contactor #8	
Date	#3	#4	#5	#6	#14	#15	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
"A" Vessels are the Lead Vessels.																						
1-Oct-07	31	38	150	103	27	81	0	NS	1.7	NS	1.7	NS	1.8	NS	2.2	NS	0	NS	1.6	NS	1.7	NS
GAC replaced in contactors 1A, 2A, 3A, 4A, 5A, 6A, 7A, 8A between October 2, 2007 and October 26, 2007. "B" Vessels become the Lead Vessels.																						
6-Nov-07	43	44	120	86	26	73	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
18-Dec-07	52	43	160	95	26	65	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
7-Jan-08	52	53	150	89	19	50	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
6-Feb-08	52	61	150	85	28	59	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
18-Mar-08	67	55	160	85	8	59	NS	0	NS	0	NS	0	NS	0	NS	1.6	NS	0	NS	0	NS	1.1
7-Apr-08	71	65	150	88	8	59	NS	1.0	NS	1.0	NS	1.2	NS	2.1	NS	2.0	NS	0	NS	1.4	NS	1.5
GAC replaced in contactors 1B, 2B, 3B, 4B, 5B, 6B, 7B, 8B between April 8, 2008 and April 25, 2008. "A" Vessels become the Lead Vessels.																						
5-May-08	70	55	160	86	5	46	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS
2-Jun-08	75	56	170	95	6	46	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS
1-Jul-08	76	56	180	96	6	42	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS
13-Aug-08	62	54	160	88	11	65	0	NS	1.3	NS	2.1	NS	1.9	NS	1.5	NS	0	NS	1.4	NS	1.1	NS
9-Sep-08	55	56	170	95	8	68	0	0	2	0	2.5	0	2.3	0	2	0	0	0	1.5	0	1.4	0

Notes:

1) All water quality results shown are for Total VOCs (ug/l).

2) NS = Not Sampled.

3) The highlighted results indicate those results that are representative of effluent water quality for the given pair of contactor vessels (only the A or B vessel result is highlighted since vessels are operating in series).

Table 3-3

Summary of OU1 Monitoring Requirements
Fiscal Year 2008

Remedy Component		Monitoring Requirements		Implementing Party	Documents Containing the Monitoring Plan
#1:	Alternate Water Supply/Well Abandonment	a.	Water quality data for the perimeter of the plume to define the area of concern	Army	OU1 Groundwater Monitoring Plan in the Annual Report
		b.	Water quality data for water supply wells to determine eligibility for alternate supply/abandonment	Army	Well Inventory Report
#2:	Drilling Advisories	a.	Verification that drilling advisories are in place and functioning as intended	Army/MDH	N/A
#3:	Extracting Groundwater with the NBCGRS	a.	Pumping volume and rates for each extraction well for comparison to design flowrates	New Brighton	New Brighton Water System Sampling and Analysis Plan
		b.	Water levels from monitoring wells to draw contour maps showing the influences of pumping	Army	OU1 Groundwater Monitoring Plan in the Annual Report
		c.	Water quality, to assist in evaluation of statistical improvements in groundwater quality.	Army	OU1 Groundwater Monitoring Plan in the Annual Report
#4:	Removal of VOCs	a.	Effluent water quality to demonstrate compliance with the Safe Drinking Water Act	New Brighton	New Brighton Water System Sampling and Analysis Plan
#5:	Discharge of Treated Water	a.	Verification of discharge	New Brighton	N/A
#6:	Groundwater Monitoring		Outlined above and below		
OR:	Overall Remedy (Attainment of cleanup goals)	a.	Water quality data throughout the North Plume to evaluate remedial progress	Army	OU1 Groundwater Monitoring Plan in the Annual Report

Table 3-4
OU1 Groundwater Quality Data

Fiscal Year 2008

			Trichloro-ethene (ug/l)	1,1-Dichloro-ethene (ug/l)	cis-1,2-Dichloro-ethene (ug/l)	1,1,1-Trichloro-ethane (ug/l)	1,1,2-Trichloro-ethane (ug/l)	1,1-Dichloro-ethane (ug/l)
OU1 Cleanup Level [(1)]			5	6	70	200	3	70
04U871		6/25/08	**17**	1.2	JP 0.19	JP 0.92	<1	2.9
04U871	D	6/25/08	**17**	1.3	JP 0.23	JP 0.94	<1	2.9
04U872		6/24/08	**5.7**	JP 0.30	<1	<1	<1	JP 0.36
04U877		6/24/08	JP 0.68	<1	<1	<1	<1	JP 0.21
04J822		6/25/08	**77**	**13**	1.8	16	<1	9.1
04J847		6/25/08	**820**	**58**	8.8	50	JP 0.47	40
04J849		6/24/08	<1	<1	<1	<1	<1	<1

Notes:

(1) Cleanup levels for OU1 deep groundwater are from page 18 of the OU1 ROD. Bolding (in red color) indicates exceedance of the cleanup level.

D Duplicate sample.

JP The value is below the reporting level, but above the method detection limit. Results should be considered estimated.

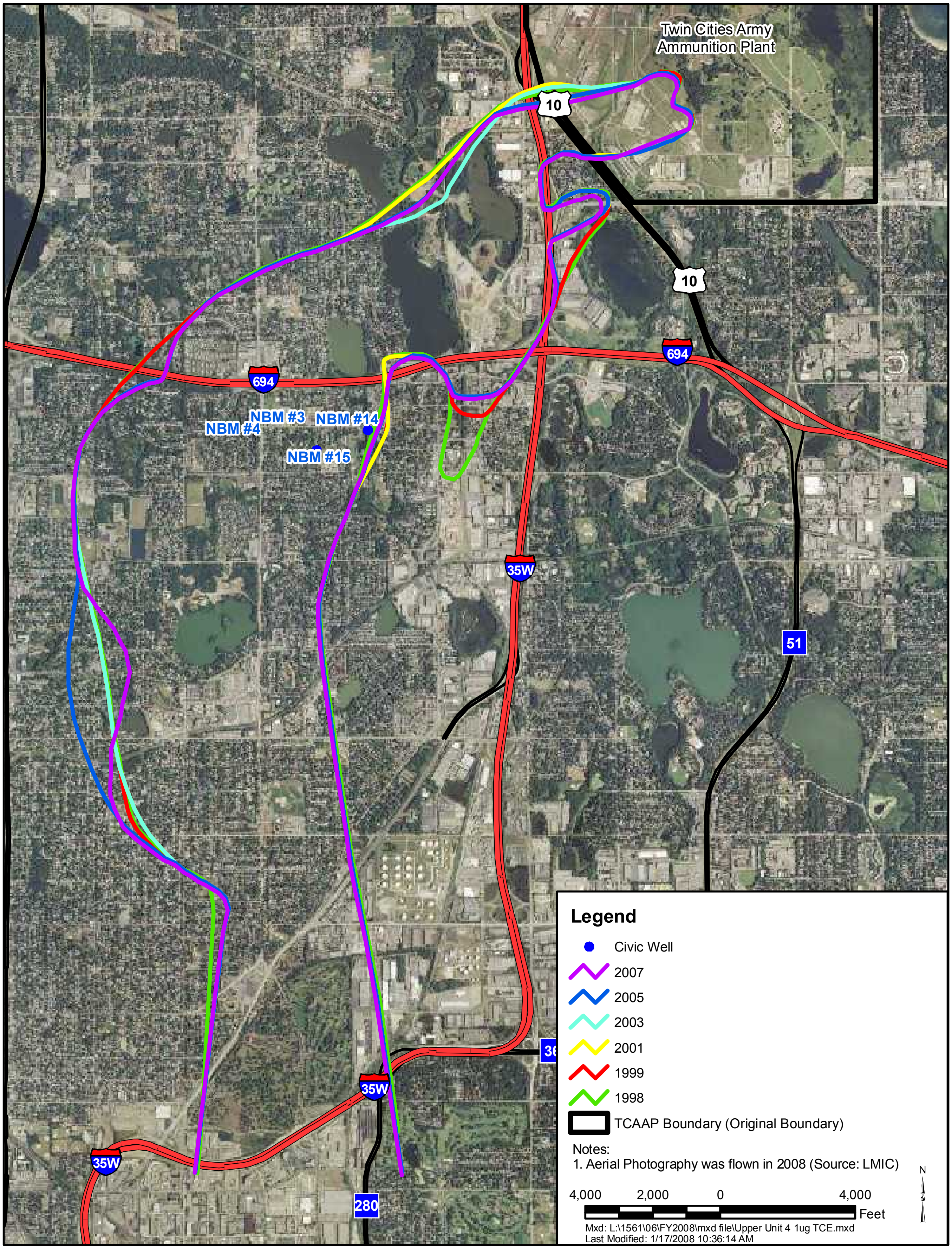
Table 3-5
Group 1, 2, 3, 5 and 6 Mann-Kendall Summary and MAROS Conclusion

Group	Kendall S	N	Raw Trend	Confidence	COV	Raw Trend Decision	MAROS Conclusion	Threshold Triggered?	Comments
Group 2	--	--	--	--	--	--	--	--	Not sampled in FY 2008
Group 3	--	--	--	--	--	--	--	--	Not sampled in FY 2008
Group 5	--	--	--	--	--	--	--	--	Not sampled in FY 2008
Group 1 NP	-7	6	Decreasing	86.00%	0.3534	S or NT	**Stable**	yes	Stable
Group 1 SP	-3	6	Decreasing	68.00%	0.0845	S or NT	**Stable**	yes	Stable
Group 6 OU1 Jordan Wells:									
04J822	3	6	Increasing	64.00%	0.3238	S or NT	**No Trend**	Yes	Improved from increasing in FY2007
04J847	-5	6	Decreasing	76.00%	0.1133	S or NT	**Stable**	Yes	Confidence in decrease improved sir
04J849	3	6	Increasing	64.00%	2.4495	S or NT	**No Trend**	Yes	All detection below 0.5 ug/l

Notes:
S or NT = Stable or No Trend
N = number of data points
COV = Coefficient of Variance

MAROS Decsion Matrix

M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing



TWIN CITIES ARMY AMMUNTION PLANT

Upper Unit 4,
1 ug/l Trichloroethene Isoconcentration Map

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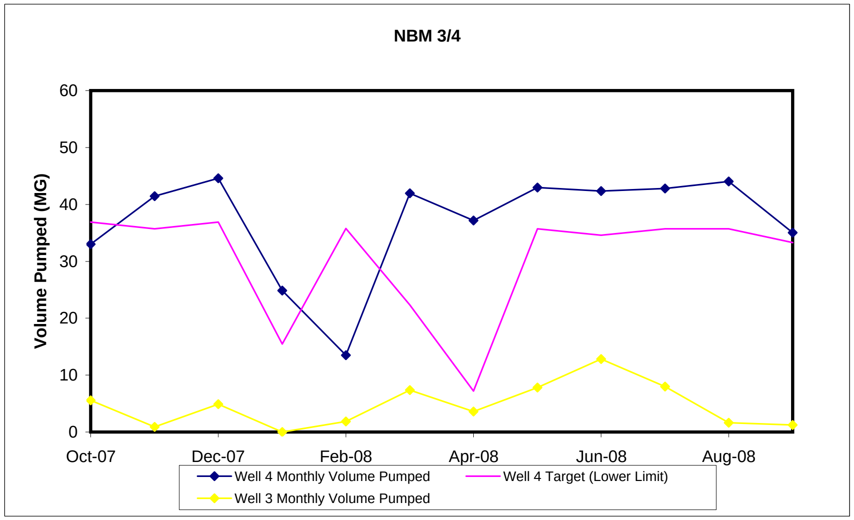
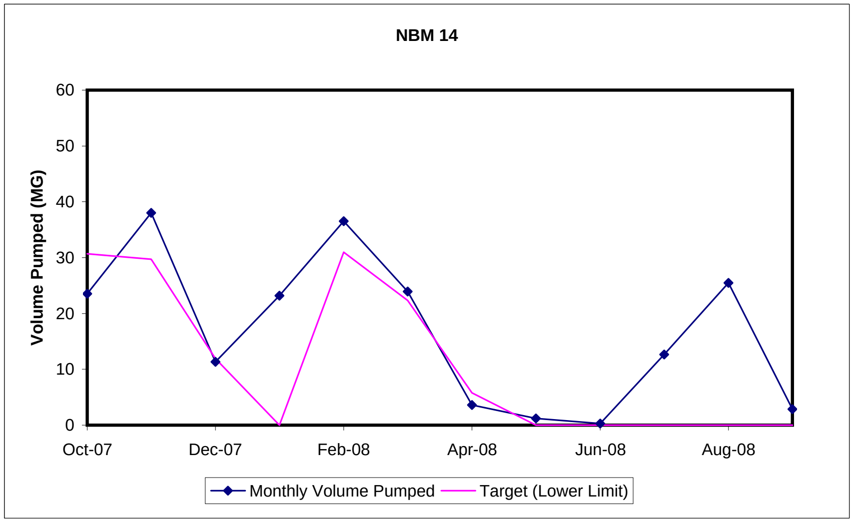
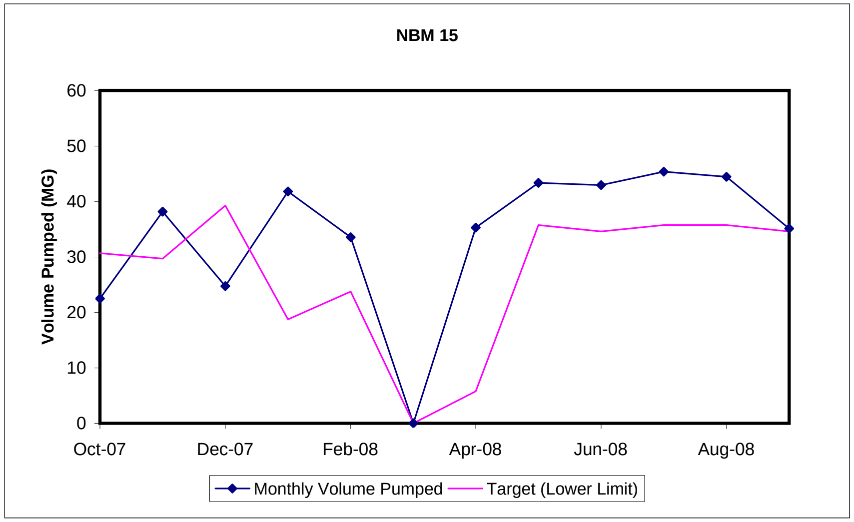
FY 2008

Figure 3-1

FIGURE 3-2
OU1 WELL PUMPING RATES VS. TARGETS
TWIN CITIES ARMY AMMUNITION PLANT







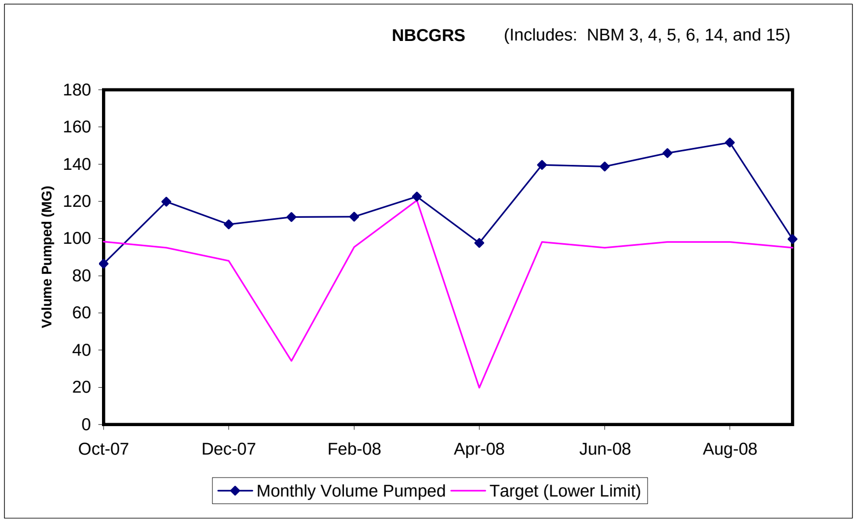


FIGURE 3-3
NEW BRIGHTON MUNICIPAL WELLS: TRICHLOROETHENE WATER QUALITY TRENDS
TWIN CITIES ARMY AMMUNITION PLANT

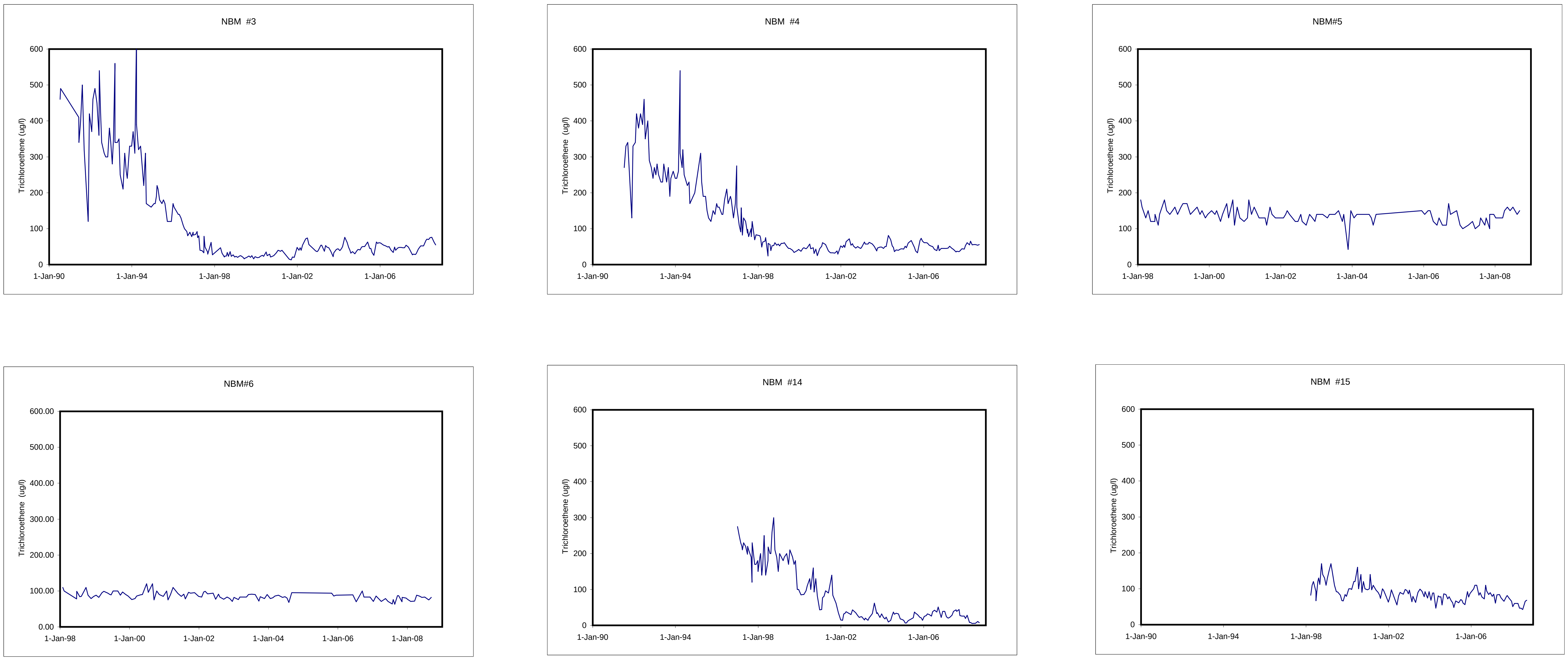
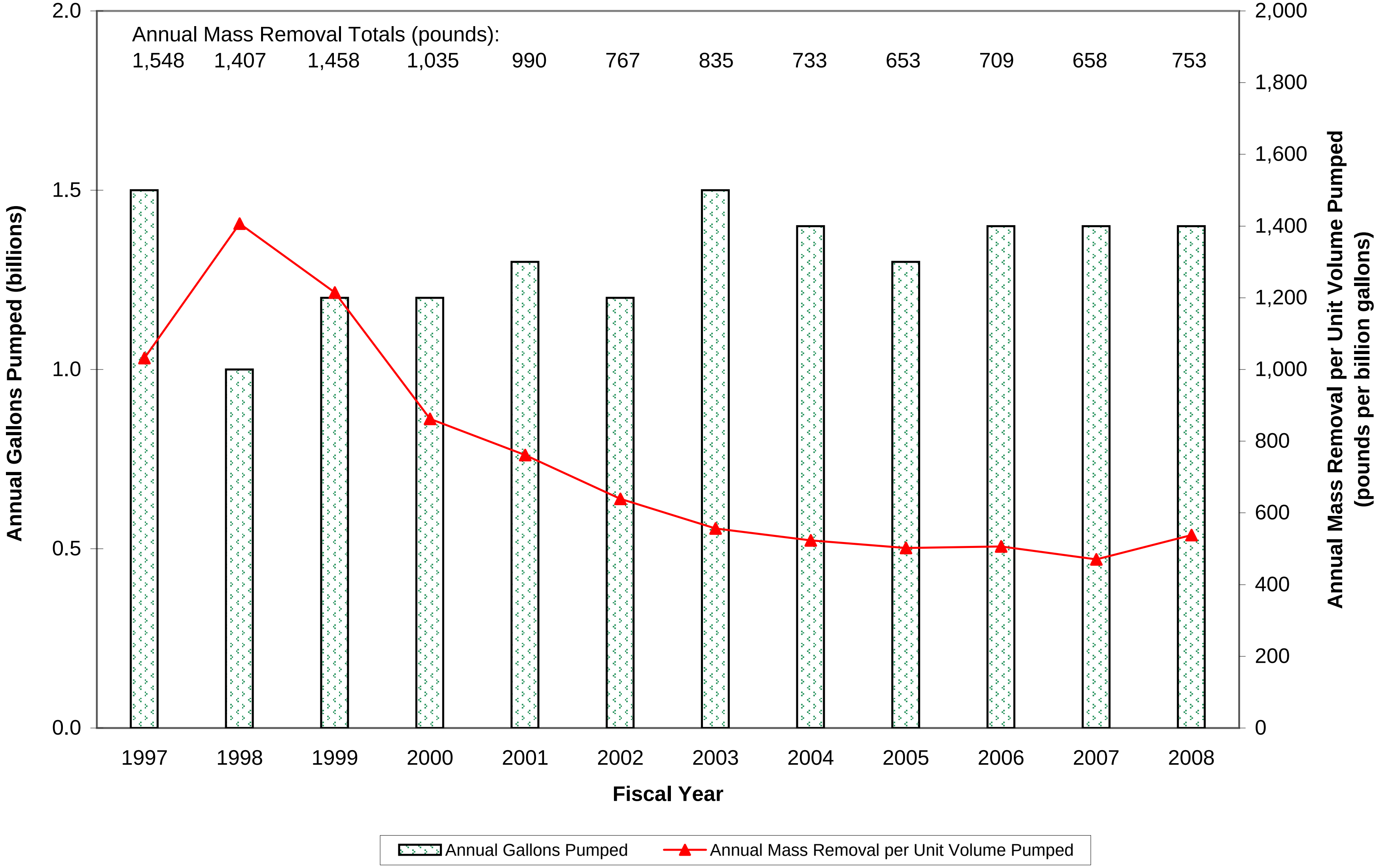


FIGURE 3-4
OU1, NBCGRS MASS REMOVAL HISTORY
Twin Cities Army Ammunition Plant



T:\1561 TCAAP\FY 2008 APR\Final\Figures\Figure 3-4

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4.0 Operable Unit 2: Shallow Soil Sites

The reference for the OU2 ROD is:

Twin Cities Army Ammunition Plant
New Brighton/Arden Hills Superfund Site
Operable Unit 2
RECORD OF DECISION
1997, Amended 2007

The 2007 ROD Amendment pertains to Site C, discussed in Section 7.0.

Section 1.4 of the ROD prescribes major remedy components for each of four media as described in Sections 4.0 through 9.0 of this report. Section 4.0 addresses the shallow soil sites.

Through the Remedial Investigation/Feasibility Study (RI/FS) process, Sites A, C, E, H, 129-3, and 129-5 were found to have inorganic and/or organic contaminants above the cleanup goals specified in Table 1 of the OU2 ROD. Unpermitted landfills, or dumps, were identified within Sites A, B, E, H, and 129-15. The OU2 ROD (page 2) describes nine remedy components to address the shallow soil sites. Site C is addressed separately in Section 7.0.

4.1 REMEDY COMPONENTS #1 THROUGH 7: SOIL REMEDIATION

Description: These seven components collectively address the characterization, excavation, sorting, treatment, disposal, site restoration, and site access restrictions for the shallow soils and dumps at Sites A, E, H, 129-3, and 129-5.

Performance Standard (how do you know when you're done):

When the soils at these sites have been remediated such that the contaminant concentrations are below the cleanup levels specified in Table 1 of the OU2 ROD.

Are these remedy components being implemented?

Yes. Soil remediation field work was completed at Sites A, E, H, 129-3, and 129-5 prior to FY 2005. The Closeout Reports for each of these sites (prepared by Shaw Environmental & Infrastructure, Inc. (Shaw)) has received regulatory approval, but final consistency will not be provided until concurrence on the land use control section of each report has been reached between the Army and the regulators (see Section 12.0 for information on land use controls).

Are any changes or additional actions required for this remedy component?

Yes. Land use control issues need to get resolved in order to complete final consistency approval on the various closeout reports.

4.2 REMEDY COMPONENT #8: GROUNDWATER MONITORING

Description: "Five-year period of groundwater monitoring to verify no adverse remedy impacts at Sites A, C, E, H, 129-3, and 129-5." (OU2 ROD, page 2)

Performance Standard (how do you know when you're done):

When five years have elapsed with groundwater monitoring results below the groundwater cleanup levels.

Is this remedy component being implemented?

Yes. The intent of this remedy component is to verify that soil remediation activities did not somehow cause impacts to groundwater. As such, the five-year monitoring period was intended to start after completion of remedy components #1 through #7 described in the previous section. The shallow soil remediation has been completed and this groundwater monitoring component was started in FY 2003. As discussed in Section 5.7, shallow soil remediation work was also completed at Site D (for non-VOC contaminants) in early FY 2003, and Site D was, therefore, added to the list of sites to be monitored under this remedy component.

Monitoring at Sites A, D, E, 129-3, or 129-5 was completed in FY 2007. The results were below the screening criteria and this remedy component is now complete for these sites.

Monitoring at Site H was continued in FY 2007 due to the exceedance of the surface water criterion for copper.

Monitoring Plan:

Site H

Monitoring point: 01U060

Rationale for selected location: Well is on the downgradient edge of Site H and is also the only available Unit 1 monitoring well at the Site.

Parameters: Antimony, arsenic, copper, lead, manganese

Frequency: Annual

Monitoring Results for FY 2008:

Results for the June 2008 sampling event are summarized in Table 4-1 (see Section 7.0 for discussion of Site C). At Site H, copper exceeded the background value (12.2 µg/L versus background of 4 µg/L). This well showed similar results in the past (e.g., 9.38 µg/L in FY 2006 and 8.48 µg/L in FY 2007). The Health Risk Limits (HRL) for copper is 1,000 µg/L. The surface water chronic standard falls between 6.3 and 23 µg/L, depending on hardness. In FY 2008, a hardness sample was collected from Sunfish Lake at the time of the groundwater sampling. The hardness was 59.7 milligrams per liter (mg/L), yielding a surface water chronic standard of 7.13. Thus, the groundwater results are above the surface water chronic standard in FY 2008.

The Tier II Ecological Risk Assessment Report (USACHPPM, Final Report, December 2004) evaluated metals, including copper in Sunfish Lake (the surface water body at Site H). Copper was eliminated as a contaminant of concern based on water and sediment sampling in Sunfish Lake. Other metals that were retained were eliminated as concerns later in the Tier II Assessment.

Although the Tier II Risk Assessment did not show evidence of any copper related effects in Sunfish Lake, the surface water chronic standard still applies. Copper in groundwater will continue to be monitored.

Similar to FY 2007, manganese was above the Minnesota HRL at Site H, but well below the background for the Unit 1 aquifer at TCAAP.

Are any changes or additional actions required for this remedy component?
Yes. Monitoring at Site H will continue due to the exceedances of surface water criteria for copper. Hardness will be included in the analytical methods to determine if the surface water criterion is actually being exceeded.

4.3 REMEDY COMPONENT #9: CHARACTERIZATION OF DUMPS

Description: "Characterization of dumps at Sites B and 129-15 to determine their contents. If contents are found to be toxic, hazardous, or contaminated, then a remedy for the landfill will be utilized and documented through a post-ROD amendment. If the contents are not toxic, hazardous or contaminated, a no further action remedy would be employed." (OU2 ROD, page 2)

Performance Standard (how do you know when you're done):
When characterization has been sufficient to determine if the contents are toxic, hazardous, or contaminated, and if they are, when the remedy is in place.

Is this remedy component being implemented?

Yes. Field work was performed at both sites in early FY 1999. At Site B, characterization revealed that a no further action remedy was appropriate. A Closeout Report (prepared by Stone & Webster) received consistency in FY 2001 ("Site B Dump Investigation, Characterization, and Closeout Report"). At Site 129-15, characterization led to construction of a soil cover in FY 2002. The Closeout Report for Site 129-15 (prepared by Shaw) received regulatory approval in FY 2003, but final consistency will not be provided until concurrence on the land use control section of each report has been reached between the Army and the regulators (see Section 12.0 for information on land use controls). A modification to the ROD that will document the remedy selection for Site 129-15 was still pending at the end of FY 2008.

Are any changes or additional actions required for this remedy component? No.

Table 4-1
Groundwater Quality Data for OU2 Shallow Soil Site
5-Year Groundwater Monitoring

Fiscal Year 2008

	Site H		TCAAP	
	01U060 6/27/08	01U060 D 6/27/08	Unit 1 Groundwater Background (1)	MDH HRL
Antimony	3.42	2.85	<10	6 (2)
Arsenic	B 1.86	B 1.33	6.80	(Note 3)
Copper	**11.9** (JE15)	**12.2** (JE15)	4	1000*
Lead	B 0.140 (UB0.12)	B 0.149 (UB0.12)	4.2	15 (4)
Manganese	1380 (JE11)	1470 (JE11)	7,500	1,000*

Sunfish Lake Hardness:	59.7 mg/L
copper chonic standard	7.13 ug/L
lead chronic standard	1.65 ug/L

Notes:

All Results in ug/l.
MDH HRL = Minnesota Department of Health, Health Risk Limit (* indicates a Health Based Value, rather than a HRL)
(1) Background values for Unit 1 groundwater from Appendix C, Table 6 in the OU2 ROD.
Bolding (in red color) indicates exceedance of the respective background value.
(2) For Site A Shallow Groundwater, this is also the Cleanup level from Table 1 of the OU2 ROD.
(3) No HRL has been established for this analyte.
(4) No HRL has been established for this analyte. MDH utilizes 15 ug/l as the Action Level "at the tap".
D Duplicate sample.
B The value is below the reporting level, but above the method detection limit. Results should be considered estimated.
JE The serial dilution was above the QC limit (the result for percent difference is listed after the "JE").
Result should be considered estimated.
UB The sample result was less than 5 times the level detected in a blank (the result for the blank is listed after "UB").
The sample result can be considered non detect at an elevated detection limit.

5.0 Operable Unit 2: Deep Soil Sites

Sites D and G were impacted primarily by VOC contaminants at depths extending to between 50 and 170 feet. Some additional shallow soil contaminants were also present at Site D, and Site G also contains a dump. The OU2 ROD (pages 2-3) describes seven remedy components for these two sites. The final remedy incorporated the use of existing soil vapor extraction (SVE) systems and site caps, which were installed in 1986.

5.1 REMEDY COMPONENT #1: GROUNDWATER MONITORING

Description: "Groundwater Monitoring." (OU2 ROD, page 2)

Performance Standard (how do you know when you're done):
When groundwater monitoring results from wells adjacent to each site are below the cleanup levels for deep groundwater specified in Table 1 of the OU2 ROD, and shown on Table 5-1 in this report.

Is this remedy component being implemented? Yes.

Were the groundwater monitoring requirements of this remedy met?
Yes. Samples were collected and analyzed from the wells that are nearest to Sites D and G in accordance with the FY 2008 Monitoring Plan.

What impact did the SVE systems have on contaminant concentrations in groundwater adjacent to Sites D and G?

Figure 5-1 shows the wells nearest to Sites D and G. Figure 5-2 and Figure 5-3 present trichloroethene trend graphs for these wells. Trichloroethene trends in other nearby wells can also be viewed from Figure B-3 (Appendix B).

Downgradient of Site D, at 03U093 (Figure 5-2), the concentrations over the past five years show a stable trend through FY 2008.

Downgradient of Site G, at 03U094 (Figure 5-3), the concentrations over the past five years show a slightly decreasing trend through FY 2008.

Table 5-1 presents the FY 2008 data for the deep groundwater chemicals of concern for the two wells nearest to Sites D and G. The table shows that these wells still exceed the cleanup level for trichloroethene. There are no other cleanup level exceedances among these wells.

During the years of SVE operation (1986 to 1998), trichloroethene concentrations in groundwater near Sites D and G decreased from 10,000's of µg/L to less than 100 µg/L. The most dramatic improvement has been at 03U093 (Figure 5-2). Overall, these results indicate that SVE systems at Sites D and G effectively minimized (or eliminated) further contamination of the deep groundwater beneath these sites. However, the contaminant concentrations are still greater than the cleanup levels. Any residual source has not been defined and could be in either the saturated or unsaturated zone. It is possible that natural attenuation will cause reductions in contaminant concentrations in the future, as suggested by the findings of the USEPA's Natural Attenuation Study (U.S. EPA 2001. "Evaluation of the Protocol for Natural Attenuation of Chlorinated Solvents: Case Study at the Twin Cities Army Ammunition Plant. Office of Research and Development, Washington DC EPA/600/R-01/025).

Is any groundwater sampling proposed prior to the next report?

Yes. As shown in Appendix A.1, wells 03U093 (Site D) and 03U094 (Site G) will be sampled in June 2009 for VOC analysis.

Are any changes or additional actions required for this remedy component? No.

5.2 REMEDY COMPONENT #2: RESTRICT SITE ACCESS

Description: "Restrict site access and use during remedy implementation." (OU2 ROD, page 2)

Performance Standard (how do you know when you're done):

When site access is adequately restricted to protect human health.

Is this remedy component being implemented?

Yes (see Section 12.0 for information on land use controls).

Are any changes or additional actions required for this remedy component? No.

5.3 REMEDY COMPONENT #3: SVE SYSTEMS

Description: "Install and operate deep soil vapor extraction (SVE) systems with modified shallow SVE." (OU2 ROD, page 2)

SVE systems were installed at Sites D and G in 1986 as Interim Remedial Actions to address soil contamination, which were then incorporated into the final remedy. The Site D system included 39 shallow vents (depths of 33-54 feet) and one deep vent (depth of 150 feet). The Site G system included 89 shallow vents (depths of 23-55 feet). The systems removed a combined total of over

220,000 pounds of VOCs from both shallow and deep soils between startup in 1986 and shutdown in 1998 (116,199 pounds for Site D and 104,418 pounds for Site G).

Performance Standard (how do you know when you're done):
When the soil concentrations are below the cleanup levels specified in Table 8 of the OU2 ROD.

Is this remedy component being implemented?
This remedy component has been completed. The Site D SVE system was dismantled in FY 2001, and the Site G SVE system was dismantled in FY 2003. The Site D Shallow and Deep Soil VOC Investigation and Closeout Report received regulatory approval in FY 2002. The Site G Closeout Report received regulatory approval in FY 2005.

Are any changes or additional actions required for this remedy component? No.

5.4 REMEDY COMPONENT #4: ENHANCEMENTS TO THE SVE SYSTEMS

Description: "Evaluate and potentially use enhancements to the SVE systems." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When an adequate evaluation has been completed.

Is this remedy component being implemented?
This remedy component has been completed. No enhancements to either SVE system were required, since soil cleanup levels were reached without the need for any such modifications.

Are any changes or additional actions required for this remedy component? No.

5.5 REMEDY COMPONENT #5: MAINTAIN EXISTING SITE CAPS

Description: "Maintain existing site caps." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the cap is maintained in adequate condition.

Is this remedy component being implemented?
Yes. The caps for Sites D and G were originally intended to minimize infiltration of precipitation and to minimize short-circuiting of air during SVE system operation. With achievement of the soil cleanup goals at Site D, there is no longer a need for a cap relative to VOCs in the soil. At Site G, the revised cleanup goal for trichloroethene was based on maintaining a cap with a specified permeability over the area with trichloroethene contamination (see Section 12.0 for information on land use controls and long-term operation and maintenance (O&M)). An annual inspection of the cap was performed on July 23, 2008 (see Appendix J). There was no erosion or other damage observed that would necessitate any repairs to the cap.

Are any changes or additional actions required for this remedy component? No.

5.6 REMEDY COMPONENT #6: MAINTAIN SURFACE DRAINAGE CONTROLS

Description: "Maintain surface [drainage] controls." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When surface water does not pond on the cap, and surface water flows off at a rate that does not cause erosion problems with the cap.

Is this remedy component being implemented?

Yes. As discussed above, drainage controls are no longer required for Site D relative to VOCs in the soil, but still apply for Site G (see Section 12.0 for information on land use controls and long-term O&M).

Are any changes or additional actions required for this remedy component? No.

5.7 REMEDY COMPONENT #7: CHARACTERIZE SHALLOW SOILS AND DUMP

Description: "Following completion of SVE remediation of deep soils, characterize Site D shallow soils and Site G dump to determine appropriate action." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):

When the characterizations have provided answers necessary to determine if additional remediation is required, and if remediation is required, when it has been completed.

Is this remedy component being implemented?

Yes. For Site D, shallow soil characterization work was completed in FY 2002. In FY 2003, 1,381 cubic yards of soil contaminated with metals and nitroglycerin were excavated by Shaw and transported off-site for disposal at a permitted disposal facility. The Site D Closeout Report received regulatory approval in FY 2004, but final consistency will not be provided until concurrence of the land use control section of the report is reached between the Army and the regulators. A modification to the OU2 ROD documenting the remedy selection for Site D shallow soils was being prepared at the end of FY 2007.

For Site G, a technical memorandum recommending improvements to the Site G cover received regulatory approval in FY 2003. A work plan for the cover design also received regulatory approval in FY 2003. Cover construction was completed over the Site G dump in early FY 2005. The Site G Closeout Report received regulatory approval, but final consistency will not be provided until concurrence of the land use control section of the report is reached between the Army and the regulators. A modification to the OU2 ROD documenting the remedy selection for Site G was still pending at the end of FY 2008.

Are any changes or additional actions required for this remedy component? No.

5.8 OVERALL REMEDY FOR DEEP SOIL SITES

Has the SVE remediation been completed (i.e., have the soil cleanup levels in Table 8 of the OU2 ROD been attained throughout the areal and vertical extent of Sites D and G)?
Yes, subject to the revised Site G cleanup levels cited previously.

Has it been determined that remediation of shallow soils at Site D and/or the dump at Site G is not required, or if required, has the remediation been completed?
For Site D, the additional soil removal that was determined to be required has been completed. For Site G, construction of the improvements to the cover were completed in FY 2004.

Table 5-1

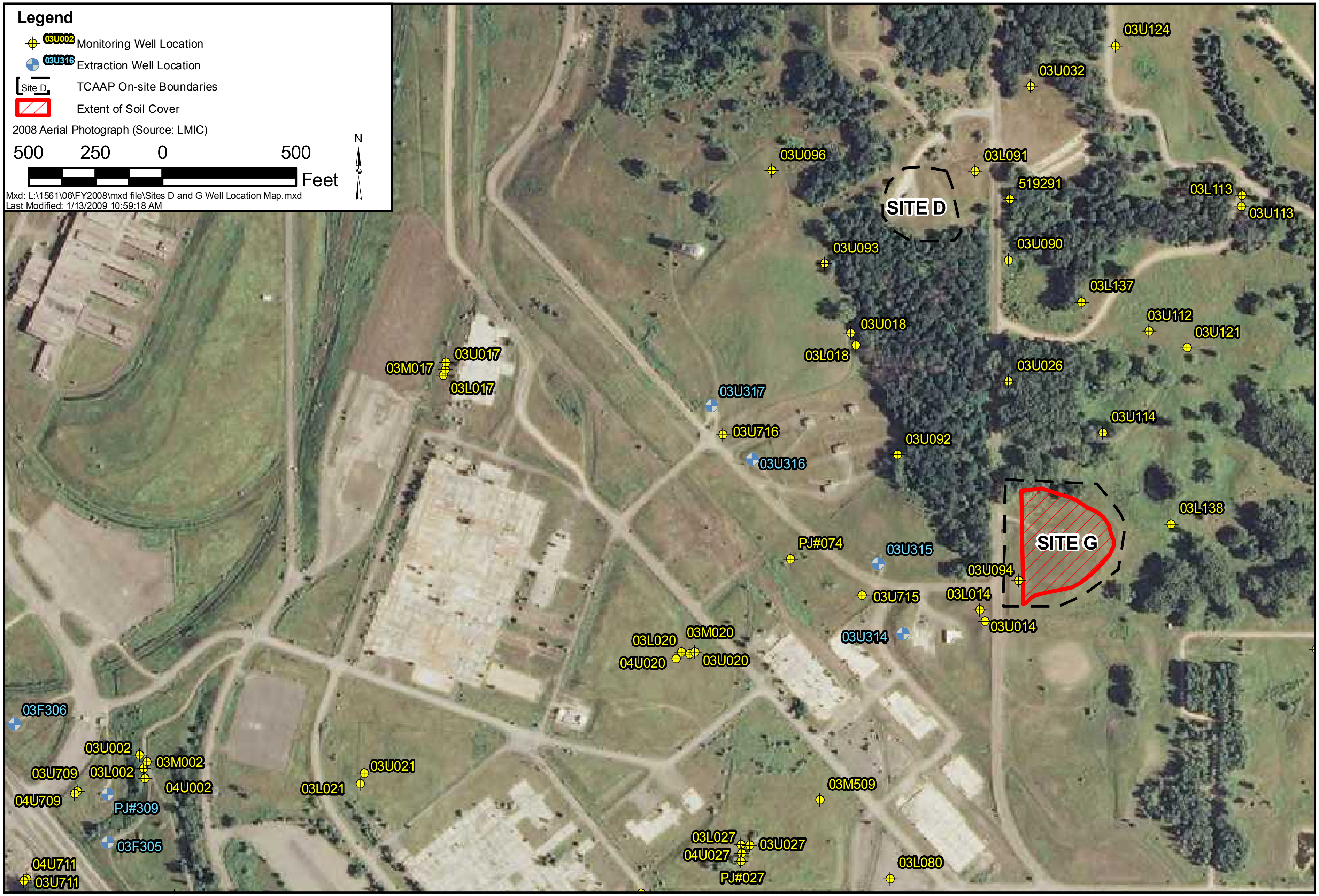
Deep Groundwater Data Near Sites D and G
Fiscal Year 2008

		Tetrachloro-ethene (ug/l)	Trichloro-ethene (ug/l)	1,1-Dichloro-ethene (ug/l)	cis-1,2-Dichloro-ethene (ug/l)	1,1-Dichloro-ethane (ug/l)	1,1,1-Trichloro-ethane (ug/l)	1,2-Dichloro-ethane (ug/l)
OU2 Cleanup Level (1)		5	5	6	70	70	200	4
Site D								
03U093	6/18/08	<1	**82**	3.9	2.3	0.38JP	57	<1
Site G								
03U094	6/18/08	<1	**110**	4.1	3.7	4.0	36	<1

Notes:

(1) Cleanup levels for Deep Groundwater are from Table 1 of the OU2 ROD. Bolding (in red color) indicates exceedance of the cleanup level.

JP The value is below the reporting level, but above the method detection limit. Results should be considered estimated.



TWIN CITIES ARMY AMMUNITION PLANT

Location of Wells Nearest to Sites D and G

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Environmental Engineers

1800 Pioneer Creek Center
Maple Plain, MN 55359-0429

FY 2008

Figure 5-1

FIGURE 5-2
SITE D, WELL 03U093, TRICHLOROETHENE WATER QUALITY TRENDS
TWIN CITIES ARMY AMMUNITION PLANT

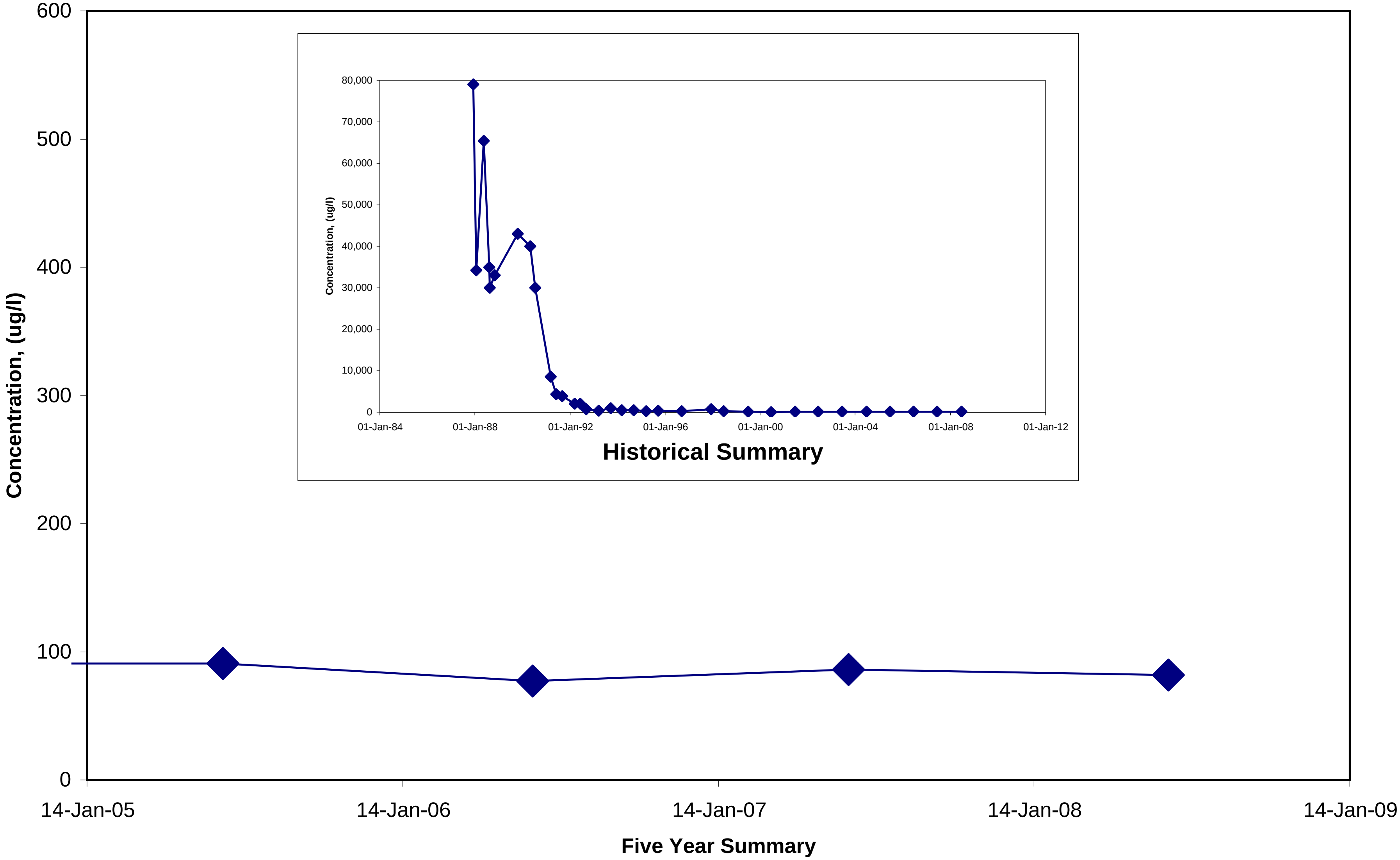
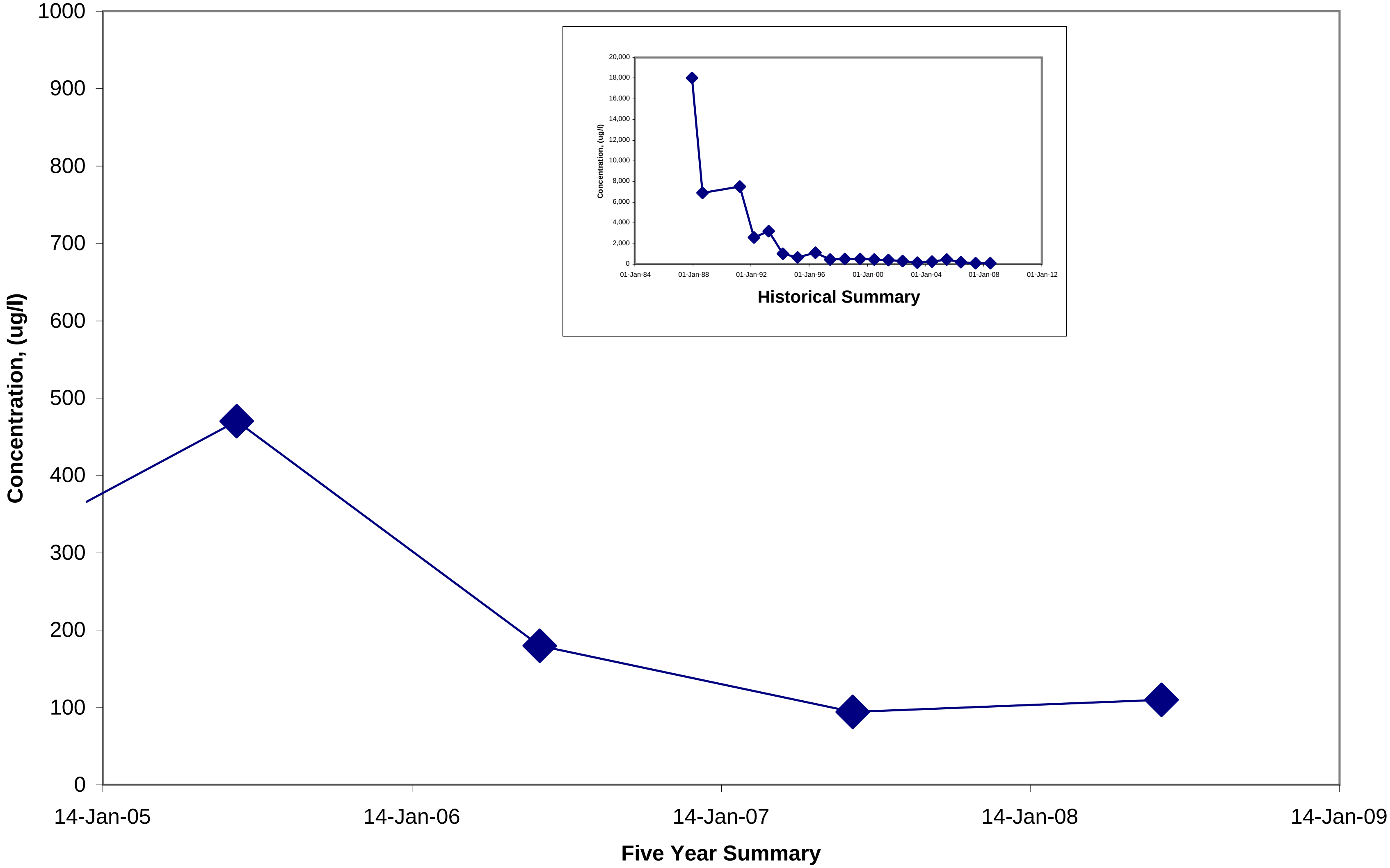


FIGURE 5-3
SITE G, WELL 03U094, TRICHLOROETHENE WATER QUALITY TRENDS
TWIN CITIES ARMY AMMUNITION PLANT



T:\1561 TCAAP\FY 2008 APR\Final\Figures\Figure 5-3

Wenck Associates, Inc.

6.0 Operable Unit 2: Site A Shallow Groundwater

Shallow groundwater at Site A has been impacted by VOCs and antimony. The selected remedy in the OU2 ROD incorporates the use of a groundwater extraction system, which began operation May 31, 1994. Extracted groundwater is discharged to the sanitary sewer for treatment at a Publicly-Owned Treatment Works (POTW). The ROD prescribes five major components of the remedy that are described and evaluated in the following sections.

In July 2008 the Army submitted a report titled "Site A Shallow Groundwater: 10-Year Evaluation Report," prepared by Wenck Associates, July 2008. This report received consistency approval from the USEPA and MPCA in a letter dated July 9, 2008. This report evaluated alternatives for continuing the groundwater remedy in accordance with the provision in the ROD for a reevaluation after 10 years of operation. The report recommended shutting the system down and utilizing Monitored Natural Attenuation for addressing the remaining groundwater plume. Subsequently, in September 2008 the Site A Shallow Groundwater Monitoring and Contingency Plan was approved and the groundwater pumping system shut down on September 24, 2008.

This section documents the data collected during FY 2008 for Site A. The 10-year review report presented a thorough discussion of the groundwater extraction system performance. FY 2009 will be the first year of operation under the newly approved Monitored Natural Attenuation remedy. The report format in FY 2009 will be modified to address the new monitoring and contingency requirements.

6.1 REMEDY COMPONENT #1: GROUNDWATER MONITORING

Description: "Groundwater monitoring to track plume migration and remedy performance." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When a performance groundwater monitoring program has been established and ongoing monitoring is in compliance with the program.

Is this remedy component being implemented?
Yes. Table 6-1 summarizes the performance monitoring requirements, the implementing parties, and the documents that contain the monitoring plans. The FY 2008 Monitoring Plan is included in Appendix A. Figure 6-1 illustrates the wells and piezometers associated with Site A, and highlights the wells that were sampled in FY 2008.

Were the groundwater monitoring requirements for this remedy met? Yes.

Is any groundwater sampling proposed prior to the next report? Yes.

- Groundwater sampling of water supply wells related to alternate water supply and well abandonment will be in accordance with recommendations in Appendix E. The next "major" event will be in FY 2009.
- Other groundwater monitoring will be in accordance with the Site A Shallow Groundwater Monitoring and Contingency Plan (for evaluating the MNA remedy), included in Appendix A.1.

Are any changes or additional actions required for this remedy component? No.

6.2 REMEDY COMPONENT #2: GROUNDWATER CONTAINMENT AND MASS REMOVAL

Description: "Use of existing gradient control wells to contain the contaminant plume and remove mass." (OU2 ROD, page 3)

- Eight extraction wells (EWs), 01U351 – 01U358 (EW-1 – EW-8), were installed in two capture lines as shown on Figure 6-1. Seven of the eight extraction wells fully penetrate the Unit 1 aquifer and range in depth from 31 to 48 feet, as shown in cross-sectional view on Figure 6-2. The one partially penetrating well, 01U353 (EW-3), was completed in silt to sandy clay units that were resistant to drilling and determined to be the top of Unit 2 by the field geologist.
- Wells 01U355 – 01U358 (EW-5 – EW-8), the line of extraction wells downgradient of the "first line" of extraction wells, were shut off (with regulatory approval) on July 11, 2000. The remaining wells operated through September 2008, when they were shut down as a interim measure as part of the approved MNA remedy.

Performance Standard (how do you know when you're done):
When the extraction system is providing complete capture of all groundwater exceeding the cleanup levels specified in Table 1 of the OU2 ROD, and shown in Table 6-2 of this report.

Is the Site A groundwater extraction system providing complete capture of all groundwater exceeding the cleanup levels specified in Table 1 of the OU2 ROD?
Yes. Table 6-3 shows the monthly average pumping rate for each extraction well and the combined system total, along with the target pumping rate for containment. The original target pumping rate for wells 01U351 – 01U355 (EW-1 – EW-5) was 15 gpm. The average pumping rate for FY 2008 was 16.8 gpm, above the target. The system was shut down September 24, 2008.

Table 6-2 shows that the locations where groundwater exceeds cleanup levels to be at two monitoring wells 01U350 and 01U352. These wells exceeded the cleanup level for tetrachloroethene and cis-1,2-dichloroethene, respectively.

Water level data collected at Site A in June 2008, is shown in Table 6-4.

Were there any significant operation and maintenance problems (greater than 24-hour shutdown)?

Yes. Table 6-5 summarizes O&M notes for FY 2008.

Are any changes or additional actions required for this remedy component?

No. This component of the remedy is no longer active

6.3 REMEDY COMPONENT #3: DRILLING ADVISORY/ALTERNATE WATER SUPPLY/WELL ABANDONMENT

Description: "Institutional controls to restrict new well installations and provide alternate water supplies and well abandonment as necessary." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):

When the MDH has issued a Special Well Construction Area Advisory and when well owners who qualify have been offered and provided with alternate water supply and/or have had their wells abandoned (or the offers have been rejected).

Is the remedy component being implemented?

Yes. The OU1 Alternate Water Supply and Well Abandonment Program is underway and was expanded to cover the area affected by the OU2 Site A shallow groundwater plume. See Section 3.1 of this report for more information on this program.

Has the MDH issued a Special Well Construction Area Advisory for the area impacted by Site A?

Yes, it was issued in June 1996 and revised in December 1999; however, this revision did not affect the boundary for the Site A vicinity.

Did the boundary of the Site A plume get any bigger during FY 2008, as defined by the 1 μg/L contour?

No. Figure 6-2 and Figure 6-3 shows the FY 2008 plume at Site A.

Were any additional water supply wells discovered within the area of concern for the Site A plume that are completed within the aquifer of concern? No.

Were any water supply wells within the Site A plume sampled during FY 2008? If yes, what were the findings? No.

Were any well owners offered an alternate supply and/or well abandonment in FY 2008? No.

Within the Site A plume, are there any well owners that meet the criteria, but have not yet been provided an alternate water supply? No.

Within the Site A plume, are there any wells that meet the criteria, but have not yet been abandoned? No.

Is any sampling of water supply wells proposed prior to the next report? No.

Are any changes or additional actions required for this remedy component? No.

6.4 REMEDY COMPONENT #4: DISCHARGE OF EXTRACTED WATER

Description: "Discharge of extracted groundwater to a publicly-owned treatment works (POTW)." (OU2 ROD, page 3)

- The recovered groundwater is piped to a sewer discharge manhole (Shoreview sanitary sewer discharge manhole #229) located approximately 150 feet north of the TCAAP boundary as shown on Figure 6-1. The recovered groundwater is conveyed via a City of Shoreview sanitary sewer to the Metropolitan Council Environmental Services (MCES) Treatment Plant located at 2400 Childs Road in St. Paul, Minnesota. Discharge is in accordance with Industrial Discharge Permit Number 2194 from the MCES.

Performance Standard (how do you know when you're done):
When the concentrations of contaminants in the extracted groundwater and the flow rate are below the criteria in the Industrial Discharge Permit, as shown in Table 6-6.

During FY 2008, was the discharge water in compliance with the Industrial Discharge Permit requirements?
Yes. Table 6-6 shows that the effluent water quality was below the discharge criteria in every month of FY 2008.

Is any sampling of the discharge water proposed prior to the next report?
No. Discharge has ceased as discussed above.

Are any changes or additional actions required for this remedy component?
No. This component of the remedy is no longer active.

6.5 REMEDY COMPONENT #5: SOURCE CHARACTERIZATION/ REMEDIATION

Description: "Source characterization/remediation." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
For characterization, when the investigation has answered the questions needed to prepare remedial design documents. For remediation, when the contaminant concentrations in soil are below the cleanup levels specified in Table 1 of the OU2 ROD.

Is this remedy component being implemented?
Yes. Characterization work has been completed. Stone & Webster performed investigation work in 1997 and the final "Site A Investigation Report" was issued December 12, 1997. The report delineated the extent of both VOC-contaminated and metal-contaminated soils requiring remediation.

Remediation has been completed. Shaw completed removal of metal-contaminated soils in FY 1999. Construction of an air sparging/soil vapor extraction (AS/SVE) system to remediate VOC-contaminated soils was completed by Stone & Webster in FY 2000, which began operation in early FY 2001. The AS system was shut off permanently in June 2001 due to a lack of increase in SVE VOC levels and due to concern regarding potential plume spreading. The AS system was being implemented voluntarily and was not a requirement of the OU2 ROD. Soil samples were collected within the source area in July 2002 (and previously in August 2001). In both events, the results showed minimal reduction in soil VOC concentrations. Since it appeared that many years of SVE system operation would be required before cleanup levels would be reached (if ever), the Army ceased SVE system operation on August 21, 2002, and submitted a work plan clarification to the USEPA and MPCA for excavation of the VOC-contaminated soils in the source area. The work plan clarification received regulatory approval in early FY 2003, and 688 cubic yards of contaminated soil were excavated by Shaw and transported off-site to a permitted disposal facility. The Site A Former 1945 Trench Closeout Report (prepared by Shaw) received regulatory consistency in FY 2004.

Are any changes or additional actions required for this remedy component? No.

6.6 OVERALL REMEDY FOR SITE A SHALLOW GROUNDWATER

Performance Standard (how do you know when you're done):
When the cleanup levels in Table 1 of the OU2 ROD have been attained throughout the areal and vertical extent of the Site A plume within the anticipated ten-year lifespan of the remedy. If the remedy has not been completed within ten years, additional remedial measures will be addressed (OU2 ROD, page 54).

Has the Site A shallow groundwater remedy been completed (i.e., have the cleanup levels in Table 1 of the OU2 ROD been attained throughout the areal and vertical extent of the Site A plume)?
No. Table 6-2 shows the exceedances in wells at Site A during FY 2008. FY 2009 will be the first year of operation under the newly approved Monitored Natural Attenuation remedy. The report format in FY 2009 will be modified to address the new monitoring and contingency requirements.

What impact is the groundwater extraction system having on contaminant concentrations?
Groundwater contaminant concentrations at Site A were generally comparable to last year's data, with the cis-1,2-dichloroethene and tetrachloroethene concentrations decreasing slightly at monitoring wells 01U108, 01U350, and 01U126. Extraction well 01U352 increased, with the overall plume extent remaining about the same.

How much VOC mass has been removed?

Based on the calculated VOC mass removal rates for the total effluent, the groundwater extraction system removed approximately 3.43 pounds of VOCs in FY 2008, with a cumulative VOC mass removal of approximately 53.85 pounds since system startup on May 31, 1994 (Table 6-7).

Has 10 years elapsed since signing of the OU2 ROD? Yes. The June 2007 sampling event was within the ninth year of extraction system operation, and December 2007 marked ten years since the signing of the OU2 ROD. The ROD states, "should aquifer restoration not be attained within the anticipated ten-year lifespan of the remedy, additional remedial measures will be addressed". Based on the FY 2008 sampling events, cleanup levels have not been completely reached throughout the areal extent of the plume and the approved monitored natural attenuation remedy is appropriate.

Do additional remedial measures need to be addressed?

No. FY 2009 will be the first year on the newly approved monitored natural attenuation remedy.

6.7 OTHER ACTIVITIES IN FY 2008

There we no other activities conducted at Site A in FY 2008. Site A is not part of the Land Use Control Implementation Plan (LUCIP).

Table 6-1

Summary of Site A Shallow Groundwater Monitoring Requirements
Fiscal Year 2008

Remedy Component		Monitoring Requirements		Implementing Party	Documents Containing the Monitoring Plan
#1:	Groundwater Monitoring		Outlined below		
#2:	Containment and Mass Removal	a.	Pumping volumes and rates for each extraction well for comparison to design flowrates for containment	Army	Site A Monitoring Plan in the Annual Report
		b.	Water levels from monitoring wells to draw contour maps showing the influences of pumping	Army	Site A Monitoring Plan in the Annual Report
		c.	Water quality data for each extraction well to determine VOC mass removal	Army	Site A Monitoring Plan in the Annual Report
#3:	Drilling Advisory/Alternate Water Supply/Well Abandonment		See OU1, Remedy Component #1 which also includes the area north of Site A		
#4:	Discharge of Extracted Water	a.	Water quality data for total system effluent to demonstrate compliance with the Industrial Discharge Permit	Army	Site A Monitoring Plan in the Annual Report
#5:	Source Characterization/ Remediation	a.	AS/SVE system flowrates and air quality data to evaluate system effectiveness and emissions (this system was permanently shut down on August 21, 2001)	Army	Site A Monitoring Plan in the Annual Report
OR:	Overall Remedy (Attainment of cleanup goals)	a.	Water quality data throughout the Site A plume to evaluate attainment	Army	Site A Monitoring Plan in the Annual Report

Table 6-2
Site A Groundwater Quality Data

Fiscal Year 2008

			Tetra-chloro-ethene (ug/l)	Tri-chloro-ethene (ug/l)	1,1-Di-chloro-ethene (ug/l)	1,2-Di-chloro-ethane (ug/l)	cis-1,2-Di-chloro-ethene (ug/l)	Chloro-form (ug/l)	Benzene (ug/l)	Antimony (ug/l)
Site A Cleanup Level [1]			7	30	6	4	70	60	10	6
01U039		6/17/08	<1	<1	<1	<1	<1	<1	<1	
01U102		6/17/08	JP 0.58	JP 0.21	<1	<1	1.1	<1	<1	
01U103		6/18/08	<1	<1	<1	<1	<1	<1	<1	2.17 (UB0.48)
01U108		6/18/08	3.5	JP 0.66	<1	<1	JP 0.46	<1	<1	
01U108	D	6/18/08	3.9	JP 0.64	<1	<1	JP 0.47	<1	<1	
01U115		6/17/08	<1	<1	<1	<1	JP 0.21	<1	<1	
01U116		6/17/08	<1 (JS67)	<1	<1	<1	JP 0.26	<1	<1	
01U117		6/18/08	3.6	1.0	<1	<1	11	<1	<1	
01U126		6/17/08	6.6	<1	<1	<1	<1	<1	<1	
01U127		6/17/08	<1	<1	<1	<1	<1	<1	<1	
01U138		6/17/08	<1	<1	<1	<1	<1	<1	<1	
01U139		6/17/08	<1	JP 0.18	<1	<1	21	<1	JP 0.99	
01U139	D	6/17/08	<1	<1	<1	<1	19	<1	JP 0.96	
01U140		6/17/08	<1	JP 0.21	<1	<1	2.4	<1	JP 0.56	
01U157		6/17/08	<1	JP 0.47	<1	<1	1.0	<1	<1	
01U158		6/17/08	<1 (JS67)	JP 0.34	<1	<1	1.2	<1	<1	
01U350		6/18/08	**11**	2.1	<1	<1	4.6	JP 0.18	<1	
01U901		6/19/08	<1	<1	<1	<1	JP 0.53	<1	<1	
01U902		6/19/08	<1	JP 0.17	<1	<1	5.0	<1	<1	<2
01U902	D	6/19/08	<1	JP 0.20	<1	<1	5.0	<1	<1	B 0.506 (UB0.48)
01U903		6/19/08	<1	<1	<1	<1	JP 0.23	<1	<1	
01U904		6/19/08	<1	<1	<1	<1	JP 0.91	<1	<1	B 0.302 (UB0.48)

Table 6-2
Site A Groundwater Quality Data

Fiscal Year 2008

		Tetra-chloro-ethene (ug/l)	Tri-chloro-ethene (ug/l)	1,1-Di-chloro-ethene (ug/l)	1,2-Di-chloro-ethane (ug/l)	cis-1,2-Di-chloro-ethene (ug/l)	Chloro-form (ug/l)	Benzene (ug/l)	Antimony (ug/l)
Site A Cleanup Level (1)		7	30	6	4	70	60	10	6
Extraction Wells:									
01U351	6/18/08	JP 0.34	JP 0.65	<1	<1	2.5	<1	<1	
01U352	6/18/08	JP 0.25	1.2	JP 0.42	<1	**350**	<1	**12**	
01U353	6/18/08	<1	JP 0.70	<1	<1	4.3	<1	<1	
01U354	6/18/08	<1	JP 0.36	<1	<1	JP 0.78	<1	<1	

Notes:

(1) Cleanup levels for Site A Shallow Groundwater are from Table 1 of the OU2 ROD. Bolding (in red color) indicates exceedance of the cleanup level.

D Duplicate sample.

B The value is below the reporting level, but above the method detection limit. Results should be considered estimated.

JP The value is below the reporting level, but above the method detection limit. Results should be considered estimated.

JS The percent recovery for the matrix spike was outside QC limits (the percent recovery is listed after "JS"). The sample result could be biased high if the recovery is above 100%, or biased low if the recovery is below 100%.

UB The sample result was less than 5 times the level detected in a blank (the result for the blank is listed after "UB"). The sample result can be considered non detect at an elevated detection limit.

Table 6-3

Site A Removal Action Pumping Data
Fiscal Year 2008

Month	01U351	01U352	01U353	01U354	01U351-354 Subtotal
				Target Flowrate (gpm):	**15.0**
	Average Flowrate (gpm)				
Oct-07	5.8	1.9	2.0	5.5	15.2
Nov-07	7.8	1.7	1.6	4.5	15.7
Dec-07	7.4	4.5	1.6	5.9	19.4
Jan-08	7.3	6.4	1.5	6.6	21.8
Feb-08	6.8	4.3	1.5	6.6	19.2
Mar-08	8.3	1.2	1.1	5.8	16.5
Apr-08	7.4	4.7	0.9	5.2	18.2
May-08	7.5	2.7	0.6	3.9	14.6
Jun-08	8.3	1.0	0.0	3.3	12.6
Jul-08	6.3	2.2	0.0	3.3	11.7
Aug-08	6.4	5.9	0.0	6.3	18.6
Sep-08	5.7	5.6	0.0	6.7	18.0
FY08 Average	**7.1**	**3.5**	**0.9**	**5.3**	**16.8**

Table 6-4

Site A Groundwater Level Data
Fiscal Year 2008

Well ID	TOS	Stickup	18-Jun-08		Sept. 12, 2008	
	(ft)	(ft)	GW Meas. (ft.)	GW elev. (ft)	GW Meas. (ft.)	GW elev. (ft)
O1U038	900.30	1.69	10.56	891.43	12.71	889.28
O1U039	897.50	2.23	16.26	883.47	17.32	882.41
O1U040	892.54	2.43	11.15	883.82	13.14	881.83
O1U041	898.33	2.25	7.96	892.62	10.99	889.59
O1U063	892.61	2.40	10.93	884.08	14.26	880.75
O1U067	897.40	2.76	6.83	893.33	10.24	889.92
O1U102	905.20	2.28	19.48	888.00	20.43	887.05
O1U103	904.14	2.48	17.26	889.36	18.68	887.94
O1U104	899.12	2.41	9.30	892.23	12.19	889.34
O1U105	901.39	2.40	10.21	893.58	13.39	890.4
O1U106	896.80	2.88	11.00	888.68	12.4	887.28
O1U107	899.16	1.69	10.21	890.64	11.91	888.94
O1U108	904.30	2.14	17.49	888.95	18.75	887.69
O1U110	897.22	2.63	5.24	894.61	9.26	890.59
O1U115	900.33	1.67	17.00	885.00	18.07	883.93
O1U116	902.71	1.85	19.61	884.95	20.58	883.98
O1U117	902.69	1.81	18.49	886.01	19.55	884.95
O1U118	901.79	1.94	15.54	888.19	16.51	887.22
O1U119	898.08	2.00	8.43	891.65	10.99	889.09
O1U120	902.15	1.81	15.45	888.51	16.74	887.22
O1U126	903.34	2.33	18.34	887.33	19.39	886.28
O1U127	902.93	2.35	16.29	888.99	17.6	887.68
O1U133	900.73	2.46	12.40	890.79	14.29	888.9
O1U135	899.94	1.94	19.17	882.71	19.92	881.96
O1U136	898.84	2.42	21.53	879.73	22.83	878.43
O1U137	900.51	2.12	15.65	886.98	16.44	886.19
O1U138	904.38	2.14	21.69	884.83	22.89	883.63
O1U139	901.15	2.10	18.59	884.66	19.44	883.81
O1U140	898.83	1.82	16.86	883.79	17.5	883.15
O1U141	897.74	1.91	14.55	885.10	15.37	884.28
O1U145	902.56	2.57	18.71	886.42	19.56	885.57
O1U146	902.89	2.53	21.00	884.42	22.03	883.39

Table 6-4

Site A Groundwater Level Data
Fiscal Year 2008

Well ID	TOS	Stickup	18-Jun-08		Sept. 12, 2008	
	(ft)	(ft)	GW Meas. (ft.)	GW elev. (ft)	GW Meas. (ft.)	GW elev. (ft)
O1U147	902.80	2.44	19.67	885.57	20.61	884.63
O1U148	902.60	2.65	20.08	885.17	21.1	884.15
O1U149	901.30	2.71	18.83	885.18	19.86	884.15
O1U150	901.30	2.27	18.70	884.87	19.86	883.71
O1U151	904.70	2.49	roots	roots	roots	roots
O1U152	901.00	2.80	18.98	884.82	19.87	883.93
O1U153	899.90	2.69	18.17	884.42	18.88	883.71
O1U154	898.90	2.51	17.38	884.03	18.08	883.33
O1U155	897.90	3.09	17.69	883.30	18.32	882.67
O1U156	897.80	2.48	17.38	882.90	18.04	882.24
O1U157	901.90	2.78	19.77	884.91	20.83	883.85
O1U158	901.10	2.48	19.11	884.47	19.99	883.59
O1U351	904.00	2.70	27.71	878.99	26.22	880.48
O1U352	901.00	3.33	19.82	884.51	23.91	880.42
O1U353	902.00	2.82	19.85	884.97	20.98	883.84
O1U354	903.80	3.22	23.46	883.56	25.96	881.06
O1U901	901.48	2.79	22.20	882.07	22.89	881.38
O1U902	901.29	2.25	19.33	884.21	19.99	883.55
O1U903	903.70	3.04	21.18	885.56	22.05	884.69
O1U904	899.40	2.56	18.99	882.97	19.62	882.34

TOS = Top of Surface which represents the ground surface elevation in feet above mean sea level (MSL). The TOS elevations were retrieved from USAEC IRDMIS.

roots = Roots in the well casing prevented water levels from being taken.

Table 6-5

Site A Removal Action Monthly Operation and Maintenance Notes
Fiscal Year 2008

October
During the month of October, operational parameters were recorded daily on business days.
10/1/07; EW-352. Cleaned flow meter. EW-352 down time: 1 hour.
10/18-20/07; System being acid washed. Down time: 52 hours.
10/20/07; EW-351 pump is inoperable. Replaced with new pump and motor. EW-351 down time: none (already down due to system acid washing).

November
During the month of November, operational parameters were recorded daily on business days.
11/28/07; EW-352. Cleaned flow meter. EW-352 down time: 1 hour.

December
During the month of December, operational parameters were recorded daily on business days.
12/03-10/07; EW-352; The pitless adapter at EW-352 appears to be leaking. Notified well maintenance operator. EW-352 down time: none.
12/10-14/07; System being acid-washed and repairs made to EW-352 pitless adaptor. System down time: 98 hours.

January
During the month of January, operational parameters were recorded daily on business days.

February
During the month of February, operational parameters were recorded daily on business days.
2/4/08; EW-352 and EW353; Washed flow meters. EW-352 and EW-353 down time: 1 hour.
2/26-27/08; System being acid washed. System down time: 30 hours.
2/26-27/08; System being acid washed. System down time: 30 hours.
2/28-29/08; EW-352; pump was off on arrival. Upstream valve was closed. Reset fuse and attempted to restart pump. Fuse tripped, pump motor may be inoperable. Called Glacier for replacement/repair. EW-352 downtime: 56 hours.

March
During the month of March, operational parameters were recorded daily on business days.
3/1-24/08; EW-352; pump motor is inoperable. Replacement pump motor was delayed and upon receipt was installed in the well. EW-352 down time: 564 hours.

April
During the month of April, operational parameters were recorded daily on business days.

Table 6-5

Site A Removal Action Monthly Operation and Maintenance Notes
Fiscal Year 2008

May

During the month of May, operational parameters were recorded daily on business days.
5/5-31/08; EW-353 pump unable to push any water. Well, pump, and discharge line are severely fouled with iron bacteria and sediment, requiring significant maintenance and redevelopment to bring back online. The well will remain off-line in anticipation of the impending shut down of the system. EW-353 down time: 631 hours.
5/16-19/08; System being acid washed. System down time: 75 hours.

June

During the month of June, operational parameters were recorded daily on business days.
6/1-30/08; EW-353 pump unable to push any water. Well, pump, and discharge line are severely fouled with iron bacteria and sediment, requiring significant maintenance and redevelopment to bring back online. EW-353 will remain off-line in anticipation of the impending system shut down. EW-353 down time: 720 hours.

July

During the month of July, operational parameters were recorded daily on business days.
7/1-31/08; EW-353 pump unable to push any water. Well, pump, and discharge line are severely fouled with iron bacteria and sediment, requiring significant maintenance and redevelopment to bring back online. EW-353 will remain off-line in anticipation of the impending system shut down. EW-353 down time: 744 hours.
7/21-23/08; System being acid washed. System down time: 46 hours.

August

During the month of August, operational parameters were recorded daily on business days.
8/1-31/08; EW-353 pump unable to push any water. Well, pump, and discharge line are severely fouled with iron bacteria and sediment, requiring significant maintenance and redevelopment to bring back online. EW-353 will remain off-line in anticipation of the impending system shut down. EW-353 down time: 744 hours.

September

During the month of September, operational parameters were recorded daily on business days.
9/1-24/08; EW-353 pump unable to push any water. Well, pump, and discharge line are severely fouled with iron bacteria and sediment, requiring significant maintenance and redevelopment to bring back online. EW-353 will remain off-line in anticipation of the impending system shut down. EW-353 down time: 569 hours.
9/17-18/08; System being acid washed. System down time: 29 hours.
9/24/08; System shut-down indefinitely per MPCA and EPA approval.

Table 6-6
Site A Effluent Water Quality

Fiscal Year 2008

	cis-1,2-Dichloroethene (ug/l)	trans-1,2-Dichloroethene (ug/l)	Trichloroethene (ug/l)	1,1,1-Trichloroethane (ug/l)	Mercury (ug/l)
Discharge Limits:	3000	3000	3000	3000	2
30-Oct-07	19	JP 0.34	JP 0.44	<1	B 0.0589 UB0.03
29-Nov-07	15	<1	JP 0.36	<1	<0.100
19-Dec-07	58	JP 0.81	JP 0.67	<1	<0.100
24-Jan-08	37	JP 0.73	JP 0.58	<1	<0.100
5-Feb-08	42	JP 0.71	JP 0.57	<1	<0.100
26-Mar-08	84	JP 0.90	JP 0.61	<1	<0.100
22-Apr-08	44	JP 0.84	JP 0.58	<1	<0.100
22-May-08	39	JP 0.49	JP 0.52	<1	<0.100
19-Jun-08	26	JP 0.33	JP 0.53	<1	<0.100
29-Jul-08	76	1.1	JP 0.64	<1	B 0.0410 UB0.08
27-Aug-08	58	1.1	JP 0.62	<1	B 0.0300 UB0.04
16-Sep-08	52	1.0	JP 0.56	<1	B 0.0630 UB0.06

Notes:

JP The value is below the reporting limit, but above the method detection limit. Results should be considered estimated.

B The value is below the reporting limit, but above the method detection limit. Results should be considered estimated.

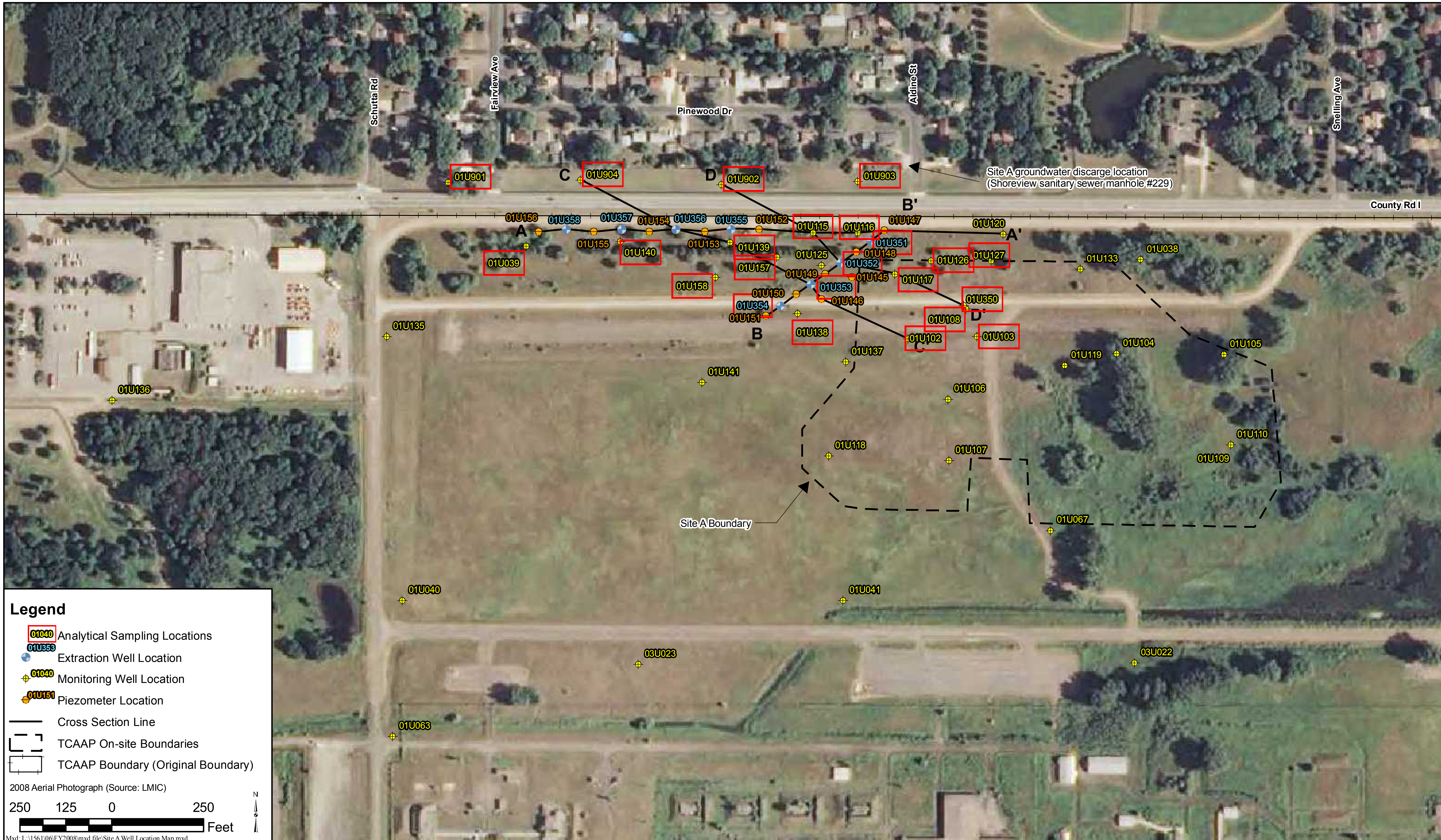
UB The sample result was less than 5 times the level detected in a blank (the result for the blank is listed after "UB"). The sample result can be considered non detect at an elevated detection limit.

Table 6-7
Site A Removal Action Monthly VOC Remova

Fiscal Year 2008

MONTH	1,2-DCE (ug/l)	TRCLE (ug/l)	TOTAL VOC EFFLUENT (ug/l)	CONVERSION FACTOR (l*lb)/(ug*gal)	WATER PUMPED (gallons)	TOTAL VOC'S REMOVED BY EXTRACTION SYSTEM (lbs)
TOTAL GALLONS PUMPED AND VOC'S REMOVED THROUGH SEPTEMBER 30, 2007					163,826,879	51.42
OCTOBER	19.34	0.44	19.78	8.35E-09	717,038	0.12
NOVEMBER	15.00	0.36	15.36	8.35E-09	677,207	0.09
DECEMBER	58.81	0.67	59.48	8.35E-09	869,377	0.43
JANUARY	37.73	0.58	38.31	8.35E-09	978,752	0.31
FEBRUARY	42.71	0.57	43.28	8.35E-09	803,568	0.29
MARCH	84.90	0.61	85.51	8.35E-09	734,768	0.52
APRIL	44.84	0.58	45.42	8.35E-09	789,077	0.30
MAY	39.49	0.52	40.01	8.35E-09	637,376	0.21
JUNE	26.33	0.53	26.86	8.35E-09	556,205	0.12
JULY	77.10	0.64	77.74	8.35E-09	525,009	0.34
AUGUST	59.10	0.62	59.72	8.35E-09	771,746	0.38
SEPTEMBER	53.00	0.56	53.56	8.35E-09	680,271	0.30
TOTAL GALLONS PUMPED AND VOC'S REMOVED FOR FISCAL YEAR 2008					8,740,394	3.43
TOTAL GALLONS TREATED AND VOC'S REMOVED SINCE SYSTEM START UP					172,567,273	54.85

<u>Notes:</u>
1) VOC concentrations do not include estimated concentrations for compounds detected below the reporting limit.



TWIN CITIES ARMY AMMUNITION PLANT

Site A, Well Location Map

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1800 Pioneer Creek Center Maple Plain, MN 55359-0429

FY 2008

Figure 6-1

TWIN CITIES ARMY AMMUNITION PLANT

Site A, Unit 1, cis-1,2-Dichloroethene Isoconcentration Map, Summer 2008

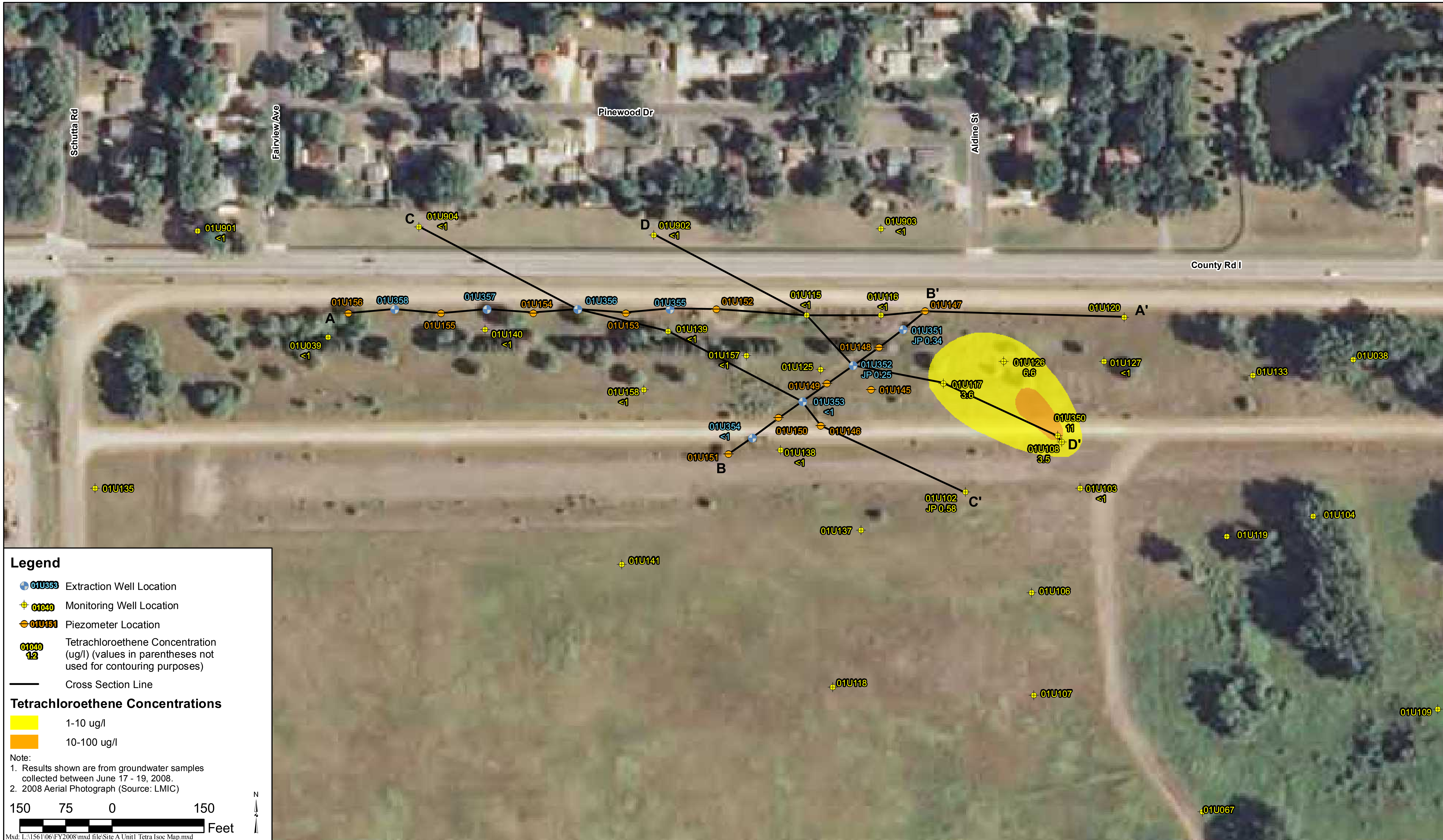
Wenck

Wenck Associates, Inc. Environmental Engineers

1800 Pioneer Creek Center Maple Plain, MN 55359-0429

FY 2008

Figure 6-2



TWIN CITIES ARMY AMMUNITION PLANT

Site A, Unit 1 Tetrachloroethene Isocentration Map, Summer 2008

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FY 2008

Figure 6-3

7.0 Site C Groundwater Response Action

The reference for the OU2 ROD is:

Twin Cities Army Ammunition Plant
New Brighton/Arden Hills Superfund Site
Operable Unit 2
RECORD OF DECISION
1997, Amended 2007

The 2007 ROD amendment modified the soil, sediment, surface water, and groundwater remedies for Site C-2 (Site) on TCAAP. The modified remedy included filling in the drainage ditches west and north of the Site to eliminate the surface water exposure points and cover contaminated sediment to prevent direct exposure. Construction was completed near the end of FY 2007. FY 2008 was the first year of operation under the modified remedy.

7.1 BACKGROUND

This site had been used for burning of scrap wooden boxes, solvents, oils, and production materials, and also had been used for land disposal and open storage. The remedial investigation/feasibility study process conducted for Site C, as documented in the OU2 ROD, identified six chemicals of concern (COCs) in Site C soils (antimony, arsenic, beryllium, lead, manganese, and thallium, with lead having the highest concentration and most prevalent detection), but did not identify any groundwater COCs.

In FY 1997, the U.S. Army Environmental Center (USAEC) funded a technology demonstration study of phytoremediation of contaminated soil at Site C. Corn and mustard crops were planted and harvested during the two growing seasons in FY 1998 and FY 1999. During the growing seasons, EDTA was applied to the soils to improve the metals uptake by the crops, and had the unintended consequence of causing migration of lead from the soils into the shallow groundwater, which is present within a few feet from the ground surface. On August 10, 2000, the MPCA issued a Notice of Violation to the Army for the impacts to Site C shallow groundwater caused by the phytoremediation demonstration project, requiring that the Army implement corrective actions.

At Site C, Unit 1 contains groundwater, but the aquifer yield is low and the water is not used as a municipal water supply source by any of the surrounding communities. Groundwater in Unit 1 generally flows north beneath Site C and then turns westward, ultimately discharging to Rice Creek. Unit 2 lies beneath Unit 1 and is a glacial till deposit that behaves as an aquitard at TCAAP, preventing downward migration of contaminants. Additional hydrogeologic information is presented in "Hydrogeologic Investigation of Site C", by Shaw Environmental & Infrastructure, March 9, 2001.

The Army installed a groundwater recovery trench to contain the plume, which was operated between November 2000 and July 2001. On July 6, 2001, the Army began operating three extraction wells, located as shown on Figure 7-1, to contain the plume (replacing recovery trench operation). At the start of extraction well operation, extracted groundwater met the MCES requirements for direct discharge to the sanitary sewer (without treatment). On July 15, 2002, due to elevated lead concentrations in EW-3, the Army began pre-treating water from EW-3 using two types of filter media, and has continued to discharge extracted groundwater to the sanitary sewer under an MCES permit.

Man-made ditches were present north and west of the phytoremediation demonstration plot area, and were monitored, as shown on Figure 7-2. Before they were filled in FY 2007, the ditches discharged into Rice Creek.

Figures 7-3 and 7-4 present cross-sections showing the geological features of the shallow soil and aquifer (the cross-section alignments are shown on Figure 7-1). The cross-sections show the complex geology of the Site, including significant accumulations of peat, consistent with the nearby wetlands and location in a drainage area.

In February 2002, a contingency plan was prepared to address the operation of the groundwater response action. The monitoring requirements are driven by the contingency plan. The monitoring plan for Site C is presented in Appendix A.5. It includes 16 monitoring wells and three extraction wells, as shown on Figure 7-1, and 8 surface water sampling locations, as shown on Figure 7-2.

The parameters being monitored at this site are copper, lead, total hardness, and EDTA, which were all cited in the Notice of Violation. Lead is the primary chemical of concern (COC) in both the soil and groundwater. Five of the six COCs in Site C soils (antimony, arsenic, beryllium, manganese, and thallium) are not currently being monitored. These analytes were routinely monitored in groundwater and surface water through April 2002; however, since this monitoring data indicated that these analytes were not of concern, the MPCA approved discontinuing monitoring of these five analytes. Copper has continued to be monitored because concentrations have exceeded the respective surface water standard near the phytoremediation demonstration area at Site C. The complete historical water quality database is presented in Appendix D.3 (during FY 2004 and prior thereto, the historical water quality database was included with the Site C monthly data reports that were submitted electronically by the Army to the USEPA and MPCA).

The action levels for lead and copper are the State of Minnesota surface water standards (chronic), as defined in Minnesota Rules Chapter 7050.0222, that are applicable to the ditches and Rice Creek. The action levels are different for the ditches and Rice Creek because the standard is dependent on the ambient hardness of the surface water. These action levels are based on total hardness levels of 257 and 155 milligrams per liter (mg/L) for the ditches and Rice Creek, respectively. Thus, hardness itself does not have an action level, but is monitored annually in surface water to document these values in relation to the values that were used in calculating the lead and copper standards. EDTA is monitored because its concentrations are known to be elevated in groundwater; however, there are no applicable surface water or groundwater standards, and no decisions are being made based on the data. The EDTA data are thus considered “screening data” that are being collected for informational purposes only.

7.2 REMEDY COMPONENT #1: GROUNDWATER MONITORING

Description: Monitor groundwater to track progress of the remedy and identify potential exceedances at compliance points.

Performance Standard (how do you know when you’re done):
When a performance groundwater monitoring program has been established and ongoing monitoring is in compliance with the program.

Is this remedy component being implemented?
Yes. The groundwater monitoring program is ongoing. The Monitoring Plan for Site C is included in Appendix A.5.

7.3 REMEDY COMPONENT #2: SURFACE WATER MONITORING

Description: Monitor surface water to identify potential exceedances of the chronic standards.

Performance Standard (how do you know when you’re done):
When a performance surface water monitoring program has been established and ongoing monitoring is in compliance with the program.

Is this remedy component being implemented?
Yes. The surface water monitoring program is ongoing. The Monitoring Plan for Site C is included in Appendix A.5.

7.4 REMEDY COMPONENT #3: GROUNDWATER CONTAINMENT

Description: Operate extraction wells to contain the lead plume.

Performance Standard (how do you know when you're done):
When a groundwater containment system is operating consistent with the requirements of the "Groundwater Extraction and Remediation System Design," by Shaw Environment and Infrastructure (Draft), and the concentrations at specified monitoring points are within the requirements of the contingency plan.

Is this remedy component being implemented?
Yes. Three extraction wells (EW-1, EW-2, and EW-3) operated in FY 2008. After the system was started, Shaw developed an operating criteria that specified that the pumping water levels in the extraction wells be maintained at least 14 feet below the top of casing. This criteria was agreed to with the MPCA. These drawdowns are being achieved.

Figure 7-5 presents the groundwater contours from June 2008. Appendix D.3 includes the historical groundwater level database for Site C. The hydraulic effect of the extraction well operation can be seen in the northern portion of the Site. The groundwater contours for the Site are complex, likely related to the heterogeneous nature of the geology (see cross-sections). In addition, the previously used groundwater extraction trench may be having a local influence on groundwater flow. The trench is aligned roughly parallel to the groundwater flow and upgradient of the extraction wells. Because of this alignment it does not pose a risk to capture and containment but does appear to influence the groundwater contours immediately around it.

Figure 7-6 presents the lead data from June 2008. The areas of exceedances are upgradient of the extraction wells and within the likely area of capture shown on Figure 7-5. The lack of lead exceedances in surface water (see discussions below) indicates that the system is capturing groundwater effectively.

7.5 REMEDY COMPONENT #4: EXTRACTED WATER TREATMENT AND DISCHARGE

Performance Standard (how do you know when you're done):
When the extracted groundwater is treated to meet the requirements of the MCES discharge permit.

Are the permit discharge requirements being met?
Yes. Table 7-1 presents the effluent analytical results for FY 2008 and the MCES discharge limits. The combined effluent is labeled "Effluent-C" on Table 7-1. The MCES requirements, which apply to the combined effluent, for lead, mercury, and pH were met. The other compounds listed are not regulated in the MCES permit.

7.6 REMEDY COMPONENT #5: CONTINGENCY PLAN FOR GROUNDWATER

Description: Contain and treat groundwater if trigger points are exceeded.

Performance Standard (how do you know when you're done):
The triggers for implementing contingency actions with respect to groundwater at Site C are:

- When the groundwater sample results from monitoring wells MW-6, MW-12, and MW-16 at the north end of the site are above the surface water chronic standard for the ditch during the same sampling event, or
- When the groundwater sample results from monitoring wells MW-4, MW-8, MW-9, MW-10, and MW-11 are above the surface water chronic standard for the ditch during the same sampling event.

If one of the triggers discussed above is met, the extraction system will be modified to increase the total volume of water extracted. The extraction and treatment system will continue to operate in the contingency plan mode (i.e., increased extracted water) until the hydraulic containment is re-evaluated.

Have groundwater concentrations remained below the trigger points?

Yes. Table 7-2 presents the FY 2008 analytical results for groundwater. In FY 2008, the lead chronic standard for the ditch was 6.9 µg/L. There were no exceedances of the triggers in FY 2008. Appendix D.3 presents the historical database for groundwater. In addition, lead trend graphs for the individual monitoring wells are presented in Appendix B (Figure B-3).

7.7 REMEDY COMPONENT #6: CONTINGENCY PLAN FOR SURFACE WATER

Description: Contain and treat surface water if trigger points are exceeded.

Performance Standard (how do you know when you're done):

When a contingency plan for surface water is in place and monitoring is in compliance with the program.

The triggers for implementation of contingency actions with respect to surface water at Site C are:

- When the average concentration of the 3-day monthly sampling event at sample location SW-6 is above the current surface water chronic standard for the ditch for one quarter (i.e., three consecutive months).
- When the average concentration of the 3-day monthly sampling event is above the surface water chronic standard for Rice Creek at sample location SW-8. The surface water chronic standard for Rice Creek is 4.0 µg/L.

If the trigger at SW-6 or SW-8 is met, then the surface water at SW-6 will be contained and collected. Collected surface water will be treated, if necessary, and discharged to the sanitary sewer. The surface water at SW-6 will continue to be contained and collected until the average concentration of the 3-day monthly sampling event at sample location SW-6 is below the current surface water chronic standard for one quarter (i.e., three consecutive months).

Have surface water concentrations remained below the trigger points?

Yes. Table 7-3 presents the FY 2008 analytical results for surface water. The surface water chronic standard for the ditch (SW-6) is 6.9 μg/L and the chronic standard for Rice Creek is 4 μg/L. No surface water triggers were exceeded in FY 2008. Appendix D.3 presents the historical database for surface water samples.

7.8 OVERALL REMEDY FOR SITE C SHALLOW GROUNDWATER

Table 7-4 presents a summary of the lead mass removal and pumped volumes through FY 2008. In FY 2008, the system treated 376,475 gallons of water and removed 0.02 pounds of lead. The lead mass removal has decreased significantly from 2.42 pounds of lead in FY 2006. Overall, the system has treated 11.168 million gallons of water and removed 101.8 pounds of lead.

Are any changes proposed for the remedy?

Yes. In fall 2008 the "TCAAP Site C Groundwater Extraction System Evaluation Report, Final, November 2008" received consistency approval. As a result, the groundwater extraction system was shut down and a monitoring program implemented. The FY 2009 report will address the details of the shut down and monitoring under the new monitoring plan.

Table 7-1
Site C Extraction Well/Effluent Data
FY 2008

Sample Location	Collection Date	Collection Time	Total Lead (MCES Discharge Limit: 1) mg/L		Data Qualifier	Mercury (MCES Discharge Limit: 0.002) mg/L	pH (MCES Discharge Limit: 5-11) pH	COD (MCES Discharge Limit: 250) mg/L	TSS mg/L	EDTA as EDTA mg/L
EW1	10/26/2007	9:10	0.0018							
EW2	10/26/2007	9:15	0.0011							
EW3	10/26/2007	9:20	0.00011	B						
AFTERVA	10/30/2007	8:25	0.055							
AFTERVB	10/30/2007	8:25	0.089							
EFFLUENT-C	10/30/2007	8:25	0.037			<0.00020	6.9			
EW1	11/26/2007	3:15	0.0015							
EW2	11/26/2007	3:20	0.00080	B						
EW3	11/26/2007	3:25	0.0285							
AFTERVA	11/29/2007	11:00	0.010							
AFTERVB	11/29/2007	11:00	0.014							
EFFLUENT-C	11/29/2007	11:00	<0.0030			<0.00020	6.7			
EFFLUENT-C	12/19/2007	9:45	0.0059			<0.00020	7.0			
EW1	12/21/2007	11:30	0.0005	B						
EW2	12/21/2007	11:35	0.00031	B						
EW3	12/21/2007	11:40	0.0188							
EW1	1/27/2008	11:30	0.00018	B	UB0.35					
EW2	1/27/2008	11:35	0.00075	B	UB0.35					
EW3	1/27/2008	11:40	0.0195							
EFFLUENT-C	1/29/2008	1:30	0.016			<0.00020	7.0			
EFFLUENT-C	2/5/2008	10:00	0.0060			<0.00020	7.0			
EW1	2/6/2008	1:30	0.00018	B	JK-0.036					
EW2	2/6/2008	1:35	0.00052	B						
EW3	2/6/2008	1:40	0.0173							
EW1	3/26/2008	12:20	0.00052	B						
EW2	3/26/2008	12:25	0.0115	B						
EW3	3/26/2008	12:30	0.0129							
EFFLUENT-C	3/27/2008	12:45	<0.0030			<0.00020	6.8			
EW1	4/22/2008	1:50	0.00044	B						
EW2	4/22/2008	1:55	0.00097	B						

Table 7-1
Site C Extraction Well/Effluent Data
FY 2008

Sample Location	Collection Date	Collection Time	Total Lead (MCES Discharge Limit: 1) mg/L		Data Qualifier	Mercury (MCES Discharge Limit: 0.002) mg/L	pH (MCES Discharge Limit: 5-11) pH	COD (MCES Discharge Limit: 250) mg/L	TSS mg/L	EDTA as EDTA mg/L
EW3	4/22/2008	2:00	0.0109							
EFFLUENT-C	4/22/2008	13:45	<0.0030			<0.00020	7.1	69	18	
EFFLUENT-C	5/14/2008	18:30								120
EW1	5/22/2008	4:25	0.00018	B						
EW2	5/22/2008	4:30	0.00056	B						
EW2D	5/22/2008		0.00054	B						
EW3	5/22/2008	4:35	0.0124							
EFFLUENT-C	5/27/2008	3:30	<0.0030			<0.00020	7.1			
EW1	6/20/2008	9:00	0.00019	B						
EW2	6/20/2008	9:05	0.00054	B						
EW3	6/20/2008	9:10	0.0111							
EFFLUENT-C	6/23/2008	3:20	0.0030			<0.00020	7.1			
EFFLUENT-C	7/25/2008	10:00	0.029			<0.00020	7.0			
EW1	7/29/2008	1:30	0.00005							
EW2	7/29/2008	1:35	0.00015	B	UB0.13					
EW3	7/29/2008	1:40	0.0109							
EFFLUENT-C	8/27/2008	10:20	0.041			<0.00020	7.2			
EW1	8/27/2008	10:00	0.000013	U						
EW2	8/27/2008	10:05	0.000070	B						
EW3	8/27/2008	10:10	0.0126							
EFFLUENT-C	9/16/2008	3:00	0.028			<0.00020	7.1			
EW1	9/16/2008	14:25	0.00013	B						
EW2	9/16/2008	14:30	0.00067	B						
EW3	9/16/2008	14:35	0.0117							
EW3D	9/16/2008		0.0114							

Table 7-2
Water Quality Data for Site C Groundwater
FY 2008

Sample Location	Date Collected	Lead (Dissolved) (ug/l)		
			L	D
Groundwater Cleanup Level(1):		15		
Monitoring Wells:				
MW 1	10/25/07	1.0		
MW 1D	10/25/07	0.025	B	UB0.03
MW 1	1/27/08	0.027	U	JK-0.028, JD26
MW 1	6/20/08	0.050	U	
MW 2	10/25/07	**18.7**		
MW 2	1/27/08	0.027	U	JK-0.028, JD26
MW 2	6/20/08	0.050	U	
MW 3	10/26/07	**38.8**		
MW 3	1/28/08	**44.6**		
MW 3	6/20/08	**80.3**		
MW 4	10/25/07	0.088	B	UB0.03
MW 4	11/27/07	0.018	B	UB0.25
MW 4	12/21/07	0.008	U	JK-0.035
MW 4D	12/21/07	0.008	U	JK-0.035
MW 4	1/27/08	0.027	U	JK-0.028, JD26
MW 4	2/6/08	0.027	U	JK-0.036
MW 5	10/25/07	0.043	B	UB0.03
MW 5	1/27/08	0.50	B	JD26
MW 5D	1/27/08	0.027	U	JK-0.028
MW 6	10/26/07	0.009	B	UB0.03
MW 6	11/26/07	0.018	B	UB0.25
MW 6	12/21/07	0.008	U	JK-0.035
MW 6	1/27/08	0.027	U	JK-0.028, JD26
MW 6	2/6/08	0.027	U	JK-0.036
MW 6D	2/6/08	0.027	U	JK-0.036
MW 6	6/20/08	0.050	U	
MW 7	10/26/07	0.33	B	
MW 7	1/27/08	0.027	U	JK-0.028, JD26
MW 8	10/25/07	1.0		
MW 8	11/27/07	0.099	B	UB0.25
MW 8	12/21/07	0.008	U	JK-0.035
MW 8D	12/21/07	0.008	U	JK-0.035
MW 8	1/27/08	0.027	U	JK-0.028, JD26
MW 8	2/6/08	0.027	U	JK-0.036

Table 7-2
Water Quality Data for Site C Groundwater
FY 2008

Sample Location	Date Collected	Lead (Dissolved) (ug/l)	L	D
Groundwater Cleanup Level[(1)]:		15		
MW 9	10/25/07	3.9		
MW 9	11/27/07	0.058	B	UB0.25
MW 9	12/21/07	0.008	U	JK-0.035
MW 9	1/27/08	0.027	U	JK-0.028, JD26
MW 9	2/6/08	0.027	U	JK-0.036
MW 10	10/25/07	0.31	B	
MW 10	11/27/07	0.041	B	UB0.25
MW 10D	11/27/07	0.021	B	UB0.25
MW 10	12/21/07	0.008	U	JK-0.035
MW 10	1/27/08	0.068	B	JK-0.028, JD26
MW 10	2/6/08	0.027	U	JK-0.036
MW 10	6/20/08	0.082	B	UB0.11
MW 11	10/25/07	0.45	B	
MW 11	11/27/07	0.070	B	UB0.25
MW 11	12/21/07	0.15	B	UB0.1
MW 11	1/27/08	0.027	U	JK-0.028, JD26
MW 11	2/6/08	0.027	U	JK-0.036
MW 11	6/18/08	0.17	B	UB0.11
MW 12	10/26/07	0.012	B	UB0.03
MW 12	11/26/07	0.008	U	
MW 12	12/21/07	0.030	B	UB0.1
MW 12	1/27/08	0.027	U	JK-0.028, JD26
MW 12	2/6/08	0.027	U	JK-0.036
MW 12	6/20/08	0.050	U	
MW 13	10/26/07	**130**		
MW 13	1/28/08	**277**		
MW 13	6/20/08	**229**		
MW 14	10/26/07	5.2		
MW 14D	10/26/07	5.2		
MW 14	1/28/08	2.7		
MW 14D	1/28/08	2.6		
MW 14	6/20/08	10.6		
MW 14D	6/20/08	10.1		
MW 15	10/26/07	3.5		
MW 15	1/28/08	5.2		
MW 15	6/20/08	11.2		JD45
MW 15D	6/20/08	7.1		JD45

Table 7-2
Water Quality Data for Site C Groundwater
FY 2008

Sample Location	Date Collected	Lead (Dissolved) (ug/l)		
			L	D
Groundwater Cleanup Level(1):		15		
MW 16	10/26/07	0.058	B	UB0.03
MW 16	11/26/07	0.048	B	UB0.25
MW 16D	11/26/07	0.055	B	UB0.25
MW 16	12/21/07	0.025	B	UB0.1
MW 16	1/27/08	0.027	U	JK-0.028, JD26
MW 16	2/6/08	0.027	U	JK-0.036
MW 16D	2/6/08	0.027	U	JK-0.036
MW 16	6/20/08	0.050	U	
01U085	3/26/08	0.062	B	UB0.04
01U085D	3/26/08	0.029	U	
01U085	6/20/08	0.050	U	
Extraction Wells:				
EW 1	10/26/07	1.8		
EW 1	11/26/07	1.5		
EW 1	12/21/07	0.50	B	
EW 1	1/27/08	0.18	B	UB0.35
EW 1	2/6/08	0.18	B	JK-0.036
EW 1	3/26/08	0.52	B	
EW 1	4/22/08	0.44	B	
EW 1	5/22/08	0.18	B	
EW 1	6/20/08	0.19	B	UB0.11
EW 1	7/29/08	0.050	U	
EW 1	8/27/08	0.013	U	
EW 1	9/16/08	0.13	B	
EW 2	10/26/07	1.1		
EW 2	11/26/07	0.80	B	UB0.25
EW 2	12/21/07	0.31	B	UB0.1
EW 2	1/27/08	0.75	B	UB0.35
EW 2	2/6/08	0.52	B	
EW 2	3/26/08	11.5		
EW 2	4/22/08	0.97	B	
EW 2	5/22/08	0.56	B	
EW 2D	5/22/08	0.54	B	
EW 2	6/20/08	0.54	B	
EW 2	7/29/08	0.15	B	UB0.13
EW 2	8/27/08	0.070	B	UB0.03
EW 2	9/16/08	0.67	B	

Table 7-2
Water Quality Data for Site C Groundwater
FY 2008

Sample Location	Date Collected	Lead (Dissolved) (ug/l)	L	D
Groundwater Cleanup Level[1]:		15		
EW 3	10/26/07	0.11	B	
EW 3	11/26/07	**28.5**		
EW 3	12/21/07	**18.8**		
EW 3	1/27/08	**19.5**		
EW 3	2/6/08	**17.3**		
EW 3	3/26/08	12.9		
EW 3	4/22/08	10.9		
EW 3D	4/22/08	11.3		
EW 3	5/22/08	12.4		
EW 3	6/20/08	11.1		
EW 3	7/29/08	10.9		
EW 3	8/27/08	12.6		
EW 3	9/16/08	11.7		
EW 3D	9/16/08	11.4		

Notes:

Laboratory Concentration Qualifiers (L):

U Analyte was not detected above the Instrument Detection Limit (IDL).

B Reported value is between the Instrument Detection Limit (IDL) and the Reporting Limit (RL).

Data Validation Qualifiers (D):

JD The relative percent difference (rpd) for a duplicate was above the QC limit (the result for the rpd is listed after "JD"). If no number appears after the "JD", then the +/- RL criteria was not met. Result should be considered estimated.

JK The sample result was less than 5 times the absolute value of a negative detection in a blank (the result for the blank is listed after "JK"). Result should be considered estimated.

UB The sample result was less than 5 times the level detected in a blank (the result for the blank is listed after "UB"). The sample result can be considered non detect at an elevated detection limit.

Other Notes:

D Duplicate

(1) The cleanup level for Site C Groundwater is from Table 1 of the 2007 OU2 ROD Amendment. Bolding (in red color) indicates exceedance of the cleanup level.

Table 7-3
Water Quality Data for Site C Surface Water
FY 2008

Sample Location	Date Collected	Lead (Dissolved) (ug/l)		
			L	D
Surface Water Cleanup Level[(1)]:		6.9		
SW 5	10/23/07	0.24	B	UB0.51
SW 5	10/24/07	0.22	B	UB0.51
SW 5	10/25/07	0.50	B	UB0.51
SW 05	3/25/08	0.66	B	
SW 05D	3/25/08	0.60	B	
SW 05	3/26/08	0.68	B	
SW 05	3/27/08	0.49	B	UB0.12
SW 05	6/18/08	0.37	B	UB0.16
SW 05D	6/18/08	0.27	B	UB0.16
SW 05	6/19/08	0.27	B	UB0.16
SW 05	6/20/08	0.35	B	UB0.16
SW 05	9/16/08	0.56	B	
SW 05	9/17/08	0.33	B	
SW 05	9/18/08	0.21	B	UB0.05
SW 05D	9/18/08	0.14	B	UB0.05
SW 6	10/23/07	0.10	B	UB0.51
SW 6	10/24/07	0.17	B	UB0.51
SW 6D	10/24/07	0.10	B	UB0.51
SW 6	10/25/07	0.21	B	UB0.51
SW 06	3/25/08	0.44	B	UB0.12
SW 06	3/26/08	0.61	B	
SW 06	3/27/08	0.36	B	UB0.12
SW 06	6/18/08	0.078	B	UB0.16
SW 06	6/19/08	0.15	B	UB0.16
SW 06	6/20/08	0.077	B	UB0.16
SW 06	9/16/08	0.41	B	
SW 06	9/17/08	0.19	B	UB0.05
SW 06	9/18/08	0.16	B	UB0.05
SW 7	10/23/07	0.18	B	UB0.51
SW 7D	10/23/07	0.20	B	UB0.51
SW 7	10/24/07	0.46	B	UB0.51
SW 7	10/25/07	0.20	B	UB0.51
SW 8	10/23/07	0.21	B	UB0.51
SW 8	10/24/07	0.48	B	UB0.51
SW 8	10/25/07	0.25	B	UB0.51

Table 7-3
Water Quality Data for Site C Surface Water
FY 2008

Sample Location	Date Collected	Lead (Dissolved) (ug/l)	L	D
Surface Water Cleanup Level[(1)]:		6.9		
NE Wetland	3/25/08	0.40	B	UB0.12
NE Wetland	3/26/08	0.16	B	UB0.12
NE Wetland	3/27/08	0.26	B	UB0.12
NE Wetland	6/18/08	0.077	B	UB0.16
NE Wetland	6/19/08	0.13	B	UB0.16
NE Wetland	6/20/08	0.090	B	UB0.16
NE Wetland	9/16/08	0.14	B	UB0.05
NE Wetland	9/17/08	0.16	B	UB0.05
NE Wetland	9/18/08	0.18	B	UB0.05

Notes:

Laboratory Concentration Qualifiers (L):

U — Analyte was not detected above the Instrument Detection Limit (IDL).

B — Reported value is between the Instrument Detection Limit (IDL) and the Reporting Limit (RL).

Data Validation Qualifiers (D):

UB — The sample result was less than 5 times the level detected in a blank (the result for the blank is listed after "UB"). The sample result can be considered non detect at an elevated detection limit.

Other Notes:

D — Duplicate

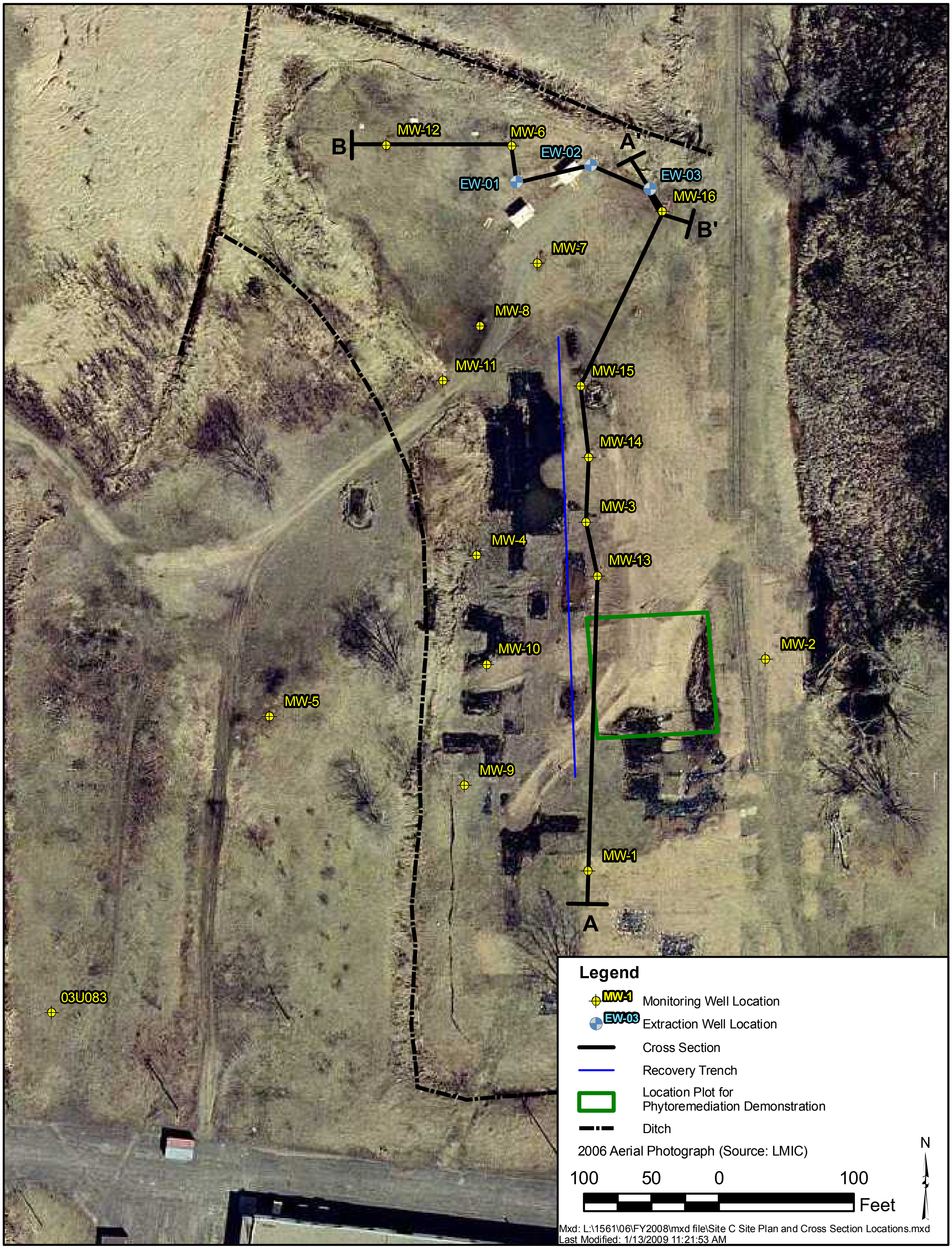
(1) — The cleanup level for Site C Surface Water is from Table 1 of the 2007 OU2 ROD Amendment.

Table 7-4
Site C Removal Action Monthly Lead Removal

Fiscal Year 2008

MONTH	EW-3		CONVERSION FACTOR	TOTAL LEAD REMOVED BY EXTRACTION SYSTEM (EW-3)	SYSTEM EFFLUENT
	Average Lead Concentration (mg/L)	Volume (gallons)	(l*lb)/(mg*gal)	(lbs)	Volume (gallons)
WATER AND LEAD REMOVED (TO 9/30/07)		3,572,198		101.79	10,791,687
OCTOBER	0.0001	4,383	8.35E-06	0.00	20,148
NOVEMBER	0.0285	9,779	8.35E-06	0.00	38,681
DECEMBER	0.0188	6,956	8.35E-06	0.00	26,964
JANUARY	0.0195	11,190	8.35E-06	0.00	37,737
FEBRUARY	0.0173	11,843	8.35E-06	0.00	34,119
MARCH	0.0129	11,329	8.35E-06	0.00	37,049
APRIL	0.0109	11,018	8.35E-06	0.00	35,668
MAY	0.0124	12,126	8.35E-06	0.00	31,207
JUNE	0.0111	13,917	8.35E-06	0.00	30,029
JULY	0.0109	3,457	8.35E-06	0.00	24,754
AUGUST	0.0410	13,318	8.35E-06	0.00	31,709
SEPTEMBER	0.0280	13,420	8.35E-06	0.00	28,410
WATER AND LEAD REMOVED (FY 2008)		122,736		0.02	376,475
WATER AND LEAD REMOVED (TOTAL)		3,694,934		101.81	11,168,162

Notes:
1) EW-1 and EW-2 remain at or near non-detect lead levels and do not provide a significant source of removed lead.
2) This summary table began in June 2002



TWIN CITIES ARMY AMMUNITION PLANT

Site C: Site Plan and Cross Section Locations

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FY 2008

Figure 7-1

TWIN CITIES ARMY AMMUNITION PLANT

Surface Water Monitoring Locations Related to Site C

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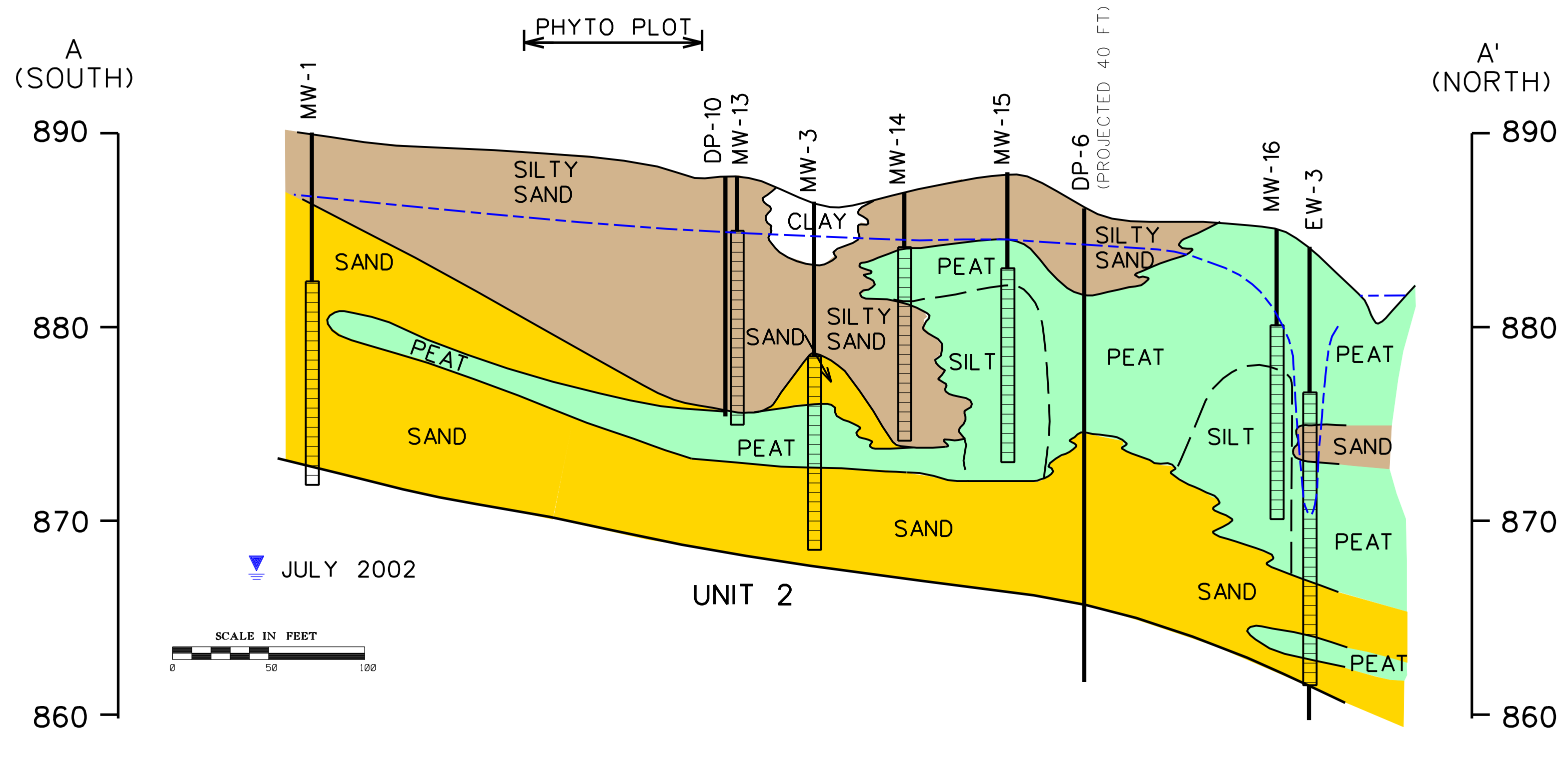
FY 2008

Figure 7-2



M:/1561/2008/NO-SO-XSEC.DGN

TWIN CITIES ARMY AMMUNITION PLANT

Cross-Section A-A'

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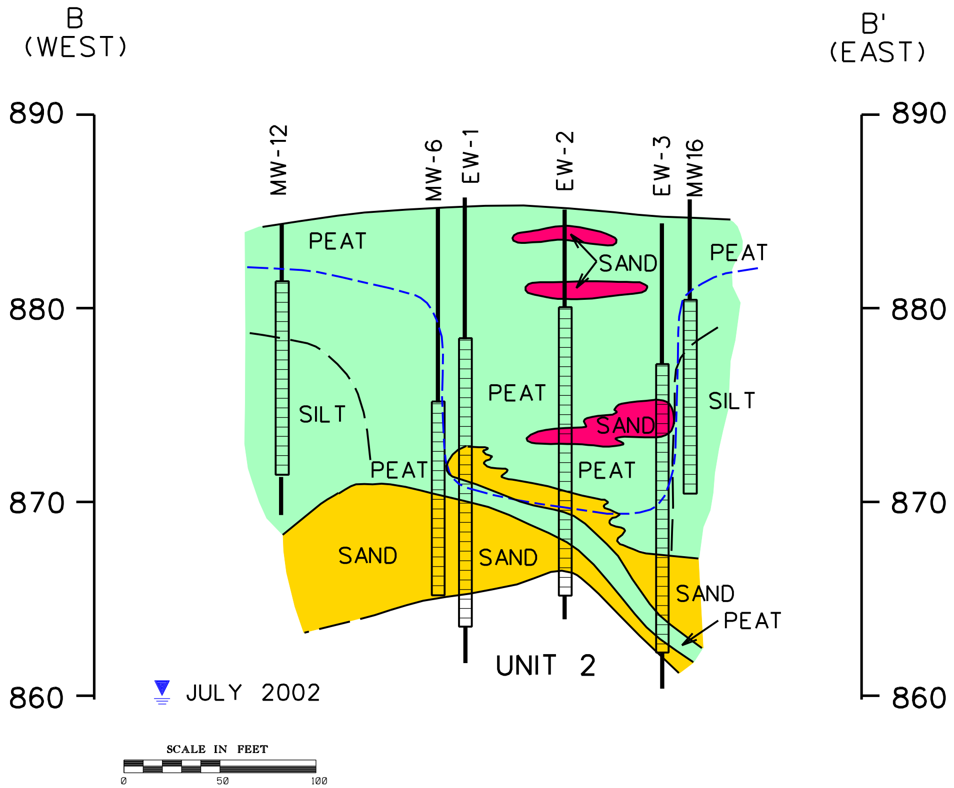
FY 2008

Fig. 7-3



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TWIN CITIES ARMY AMMUNITION PLANT

Cross-Section B-B'

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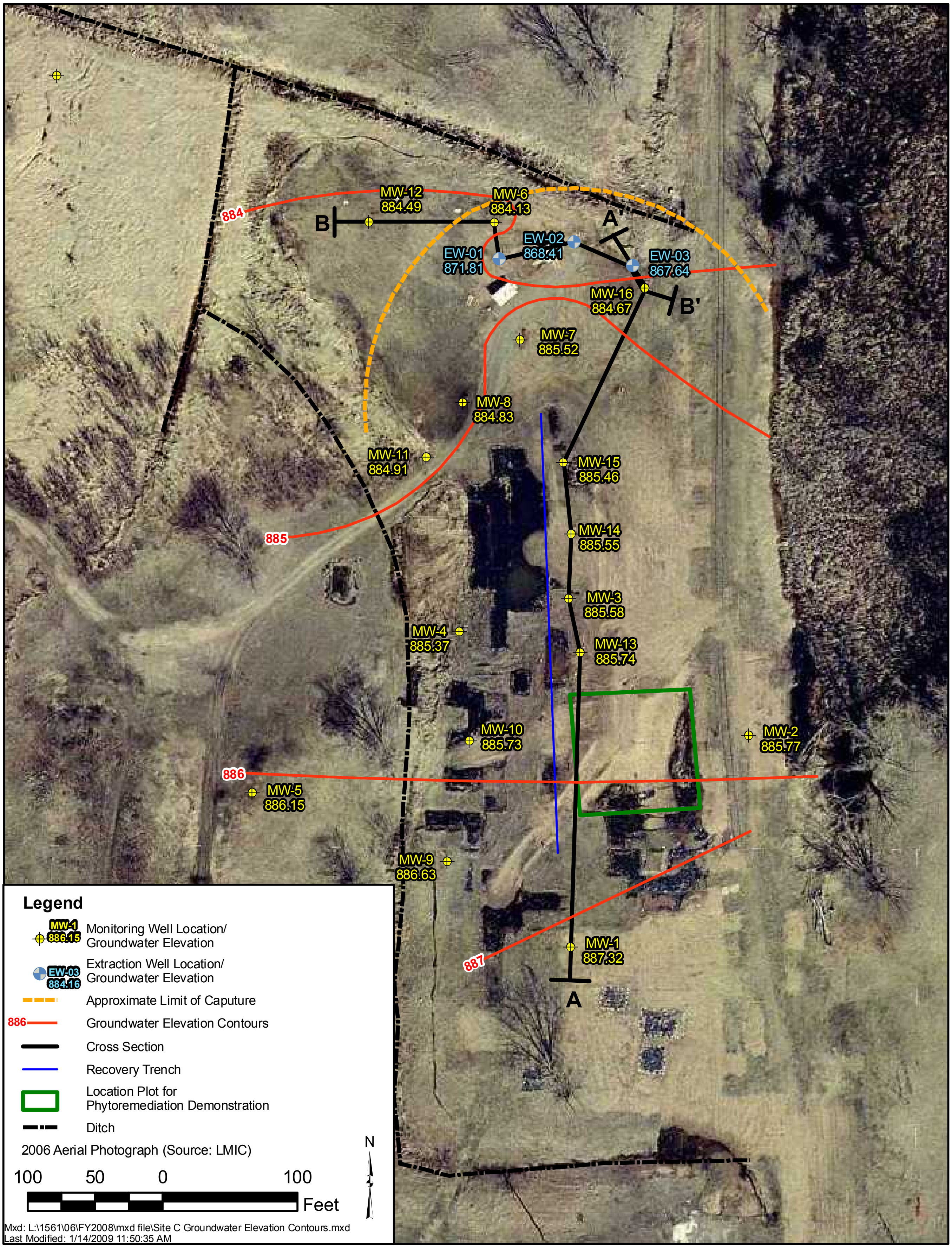
FY 2008

Fig. 7-4



TWIN CITIES ARMY AMMUNITION PLANT

Site C: June 2008

Groundwater Elevation Contours

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FY 2008

Figure 7-5

TWIN CITIES ARMY AMMUNITION PLANT

Site C: Lead in Groundwater, June 2008

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FY 2008

Figure 7-6

8.0 Operable Unit 2: Site I Shallow Groundwater

VOCs have been identified in the Unit 1 groundwater at Site I. Polychlorinated biphenyls (PCBs) have been identified in soils east of Building 502.

PCB-contaminated soils east of Building 502 were excavated in 1986. These soils were stored in a storage building built as part of the PCB Interim Remedial Action (IRA) at Site I. During August and September 1996, these soils were removed and disposed of at a Toxic Substances Control Act (TSCA) landfill with approval of the MPCA and USEPA. Groundwater monitoring was conducted for PCBs through FY 1997. PCBs were not detected in groundwater and the monitoring was discontinued. Information on this work is included in the OU2 Remedial Investigation (Argonne National Laboratory 1991).

Monitoring in FY 2008 addressed the VOCs identified in the Unit 1 groundwater beneath the western portion of Building 502. The selected remedy in the OU2 ROD consists of four components that incorporate the use of an existing well for groundwater extraction as well as additional investigation beneath the building slab. The additional investigation and Predesign Investigation Work Plan (Work Plan) were completed in FY 2000. Based on these documents, the selected remedy was modified to consist of a dual-phase vacuum extraction system, which combines groundwater extraction with soil vapor extraction, to be installed beneath Building 502. A pilot test of dual-phase extraction subsequently determined that the technology was not feasible due to the low permeability of the Unit 1 aquifer beneath the building.

A ROD Amendment was initiated in FY 2008 to discontinue the ROD requirement for pumping and treatment of Site I groundwater. A requirement for Land Use Controls (LUCs) will be included in the ROD Amendment. The ROD Amendment is currently on hold pending resolution of LUC issues and will likely be finalized in FY 2009.

8.1 REMEDY COMPONENT #1: GROUNDWATER MONITORING

Description: "Groundwater monitoring to track remedy performance." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When a monitoring plan has been established and ongoing monitoring is in compliance with the plan.

Is the remedy component being implemented?
Yes. Monitoring at Site I in FY 2008 was conducted according to the monitoring plan for FY 2008. Appendix A summarizes the FY 2008 monitoring plan and any deviations are explained in Appendix C.2.

Monitoring was performed in accordance with the TCAAP Remedial Design/Remedial Action (RD/RA) QAPP (1996) and a new QAPP. The *IRP-QAPP for Performance Monitoring*, TWISS, dated May 10, 2007, was accepted by the USEPA and MPCA as passing the Consistency Test on August 21, 2007. The new QAPP was implemented at the beginning of the 1st quarter FY 2008.

Nine Unit 1 monitoring wells were planned for sampling at Site I (Building 502) during FY 2008. These wells were 01U064, 01U632, 01U636, 01U639, 01U640, I01MW, I02MW, I04MW, and I05MW. Figure 8-1 shows these well locations. For FY 2008, both monitoring wells 01U639 and 482089 (I04MW) were included on the list of monitoring locations. Of the two wells, well 01U639 is the primary sampling location and 482089 (I04MW) is the alternate sampling location in the event monitoring well 01U639 is dry. If it is not possible to collect a groundwater sample from 01U639, then an attempt will be made to collect a sample from 482089 (I04MW). Well 01U639 is selected as the primary location because there are more years of analytical data associated with this location.

Wells 01U632, 01U639, I01MW, and I02MW were dry at the time of sampling and hydraulic monitoring (June, 2008). Wells 01U064, I04MW, and I05MW bailed dry after collecting between one and two well volumes; however, there was sufficient groundwater to collect samples for analysis. Monitoring well 01U640 did not have sufficient groundwater to collect samples for analysis. Groundwater samples were analyzed using EPA Method 8260 for VOCs.

What were the monitoring results for FY 2008?

Table 8-1 presents the results of the FY 2008 analyses. Groundwater was present in sufficient volumes to collect groundwater monitoring samples from four Site I monitoring wells (01U064, 01U636, I04MW, and I05MW).

Monitoring well 01U064 continues to exhibit consistently low concentrations of trichloroethene from the last four annual monitoring events that are estimated to be below the laboratory reporting limits and below the cleanup standards for Site I. Trichloroethene concentrations at well 01U064 have generally exhibited a decreasing trend over the last 20 annual monitoring events. Concentrations of 1,2-dichloroethene from 01U064 have remained consistent over the last eight annual monitoring events and continue to be below the cleanup standards for Site I. The concentrations of vinyl chloride in 01U064; although decreasing over time, remain above the cleanup standards for Site I of 0.2 µg/L. The 2008 vinyl chloride concentrations in 01U064 was 1.9 µg/L.

Monitoring well I04MW continues to exhibit a minor decreasing trend in concentrations of trichloroethene over the last five annual monitoring events; however, the 2008 trichloroethene concentration of 44 µg/L remains above the cleanup standard of 30 µg/L for Site I.

Monitoring well I05MW continues to exhibit consistently low concentrations of trichloroethene and 1,2-dichloroethene from the last seven annual monitoring events; however, concentrations of both analytes remain below the cleanup standards for Site I.

Monitoring well 01U636 did not contain analytes at concentrations above laboratory reporting limits.

Figure 8-2 presents the groundwater elevations.

8.2 REMEDY COMPONENT #2: GROUNDWATER EXTRACTION

Description: "Use of an existing well to remove impacted groundwater." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the equipment has been installed and is operating according to the Remedial Design approved by the regulators.

Has the remedy component been implemented?
No. The report on the dual-phase vacuum extraction pilot test was submitted to the Agencies and received a consistency determination on March 16, 2000. The report concluded that neither dual-phase extraction nor groundwater extraction is feasible. The pilot test found that the soil permeability is low. As a result, the test yielded only approximately 1 gallon per hour. The report recommended that no further remedial action is considered until the building is demolished.

8.3 REMEDY COMPONENT #3: POTW DISCHARGE

Description: "POTW discharge of extracted groundwater." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the discharge component has been implemented.

Has the remedy component been implemented?
No. As discussed above, the report on dual-phase vacuum extraction determined that extraction remedies are not currently feasible.

8.4 REMEDY COMPONENT #4: ADDITIONAL INVESTIGATION

Description: "Additional characterization of the Unit 1 and Unit 2 soil and groundwater." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the work has been completed according to an Agency approved work plan.

Has the remedy component been implemented?
Yes. The results of the additional investigation were included in the Work Plan. The additional investigation resulted in a pilot study to evaluate the applicability of dual-phase vacuum extraction technology to the site.

Overall Remedy for Site I Shallow Groundwater
The remedy specified in the OU2 ROD was modified in the RD work plan. Based on the results presented in the dual-phase pilot test report, the preferred remedy is in need of further modification so as to only consist of groundwater monitoring. This is acceptable, in large part, due to the fact that groundwater in the Unit 1 aquifer does not flow off-site. Contaminants from the Unit 1 leak downward into the Unit 3. The deeper Unit 3 aquifer is hydraulically contained by the TGRS. A ROD Amendment has been initiated to eliminate the ROD requirement for extraction and treatment of the Unit 1 groundwater at Site I.

Monitoring in FY 2008 was consistent with the FY 2008 monitoring plan. The following conclusions are made for FY 2008:

- VOCs continue to be present in the Unit 1 aquifer beneath the western portion of Building 502.
- The additional investigation work identified the sources of VOCs in the Unit 1 aquifer beneath Building 502 and allowed for an evaluation of dual-phase vacuum extraction

technology to be completed. The evaluation determined that extraction technologies are not feasible beneath the building.

Is additional monitoring proposed prior to the next report?

Yes. Table 8-2 presents a summary of the monitoring requirements for Site I.

8.5 OTHER ACTIVITY

During FY 2004, a Five-Year Review of the remedy was performed. The review concluded that the remedy was functioning as intended, and that the components of the remedy remain protective of human health and the environment. The Review also recommended:

- Monitoring the trichloroethene HRL for any changes due to the USEPA's potential update of the trichloroethene health risk assessment; and
- Preparing a ROD Amendment for the change from a pump and treat remedy to a monitoring based remedy.

Eight monitoring wells (01U004, 01U054, 01U634, 01U635, 01U638, 01U642, 01U652, and 01U675) were abandoned in FY 2004. Well abandonment is documented in the *Well Abandonment Report, Sites I and K, TCAAP*, SECOR, dated December 15, 2003.

TABLE 8-1

GROUNDWATER QUALITY DATA
FISCAL YEAR 2008
SITE I, TCAAP
ARDEN HILLS, MINNESOTA

Location	Date	*1,1,1-Trichloroethane* 111TCE	*1,1,2-Trichloroethane* 112TCE	*1,1-Dichloroethene* 11DCE	*1,1-Dichloroethane* 11DCA	*cis-1,2-Dichloroethene* C12DCE	*Vinyl chloride* C2H3CL	*Chloroform* CHCL3	*trans-1,2-Dichloroethene* T12DCE	*Tetrachloroethene* TCLEE	*Trichloroethene* TRCLE	*1,2-Dichloroethane* 12DCLE
01U064	6/3/2008	<1	<1	0.17 (J)	0.35 (J)	39	1.9	<1	2.2	<1	0.53 (J)	<1
01U064 D	6/3/2008	<1	<1	0.21 (J)	0.39 (J)	42	2.1	<1	2.4	<1	0.65 (J)	<1
01U632	6/3/2008	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
01U636	6/3/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
01U639	6/3/2008	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
01U640	6/3/2008	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
482086 (I01MW)	6/3/2008	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
482088 (I02MW)	6/3/2008	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
482089 (I04MW)	6/3/2008	<1	<1	<1	<1	1.7	<1	<1	<1	<1	44	<1
482087 (I05MW)	6/3/2008	<1	<1	<1	<1	1.4	<1	<1	<1	<1	3.1	<1

Notes:
Concentrations in ug/L.
J - Value is estimated.

TABLE 8-2

SUMMARY OF GROUNDWATER MONITORING REQUIREMENTS
FISCAL YEAR 2008
SITE I, TCAAP
ARDEN HILLS, MINNESOTA

	Remedy Component		Monitoring Requirements	Responsible Party	Document Containing the Monitoring Plan
#1	Groundwater Monitoring	a.	Groundwater quality and water levels to track remedy progress.	Alliant	Site I Monitoring Plan in Annual Performance Report
#2	Groundwater Extraction (1)	a.	Extracted water volumes and rates.	Alliant	Not applicable (1)
#3	POTW Discharge (1)	a.	Water quality data for system effluent to demonstrate compliance with discharge requirement.	Alliant	Not applicable (1)
#4	Additional Investigation	a.	As per work plan (completed).	Alliant	Not applicable
	Overall Remedy	a.	Water quality data to evaluate attainment.	Alliant	Site I Monitoring Plan in Annual Performance Report

Note:
(1) Currently there is no pumping required based on results of additional investigation and pilot test results.

Legend

MONITORING WELL LOCATION

NOTE:

WELL NOMENCLATURE:
ERIS OR MN UNIQUE # NAME
(COMMON NAME)

Geographic Information Systems

Stantec 4463 White Bear Parkway, Suite 106, White Bear Lake, MN 55328 Phone 651.653.9112 www.stantec.com

PREPARED FOR:
TWIN CITY ARMY AMMUNITION PLANT
ARDEN HILLS, MINNESOTA

SITE I, UNIT 1
GROUNDWATER QUALITY
MONITORING LOCATIONS

FIGURE: 8-1

JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:
03OT.18508.00	TF	AG	AG	12/18/08

Legend

MONITORING WELL LOCATION

(948.38) GROUNDWATER ELEVATION

NOTE:

WELL NOMENCLATURE:
ERIS OR MN UNIQUE # NAME
(COMMON NAME)

0 37.5 75 150 225 300
Feet

N W E S

Geographic Information Systems

Stantec

4463 White Bear Parkway, Suite 106, White Bear Lake, MN 55328 Phone 651.653.9112 www.stantec.com

PREPARED FOR:			
TWIN CITY ARMY AMMUNITION PLANT ARDEN HILLS, MINNESOTA	SITE I, UNIT 1 GROUNDWATER ELEVATION MAP 06/02/08	FIGURE: 8-2	
JOB NUMBER: 03OT.18508.00	DRAWN BY: TF	CHECKED BY: AG	APPROVED BY: AG
DATE: 12/18/08			

9.0 Operable Unit 2: Site K Shallow Groundwater

VOC contamination has been identified in the Unit 1 (perched aquifer) at Building 103. The limits of the VOC plume in the perched groundwater have been defined to be beneath and immediately northwest of Building 103.

The remedy selected in the OU2 ROD consists of seven components that incorporate the existing groundwater extraction trench and air stripper, which began operation in August 1986. The remedy also includes additional investigation of the unsaturated soils beneath the building slab.

9.1 REMEDY COMPONENT #1: GROUNDWATER MONITORING

Description: "Groundwater monitoring to track remedy performance." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When a monitoring plan is established and monitoring is in compliance with the plan.

Is the remedy component being implemented?
Yes. Appendix A summarizes the FY 2008 monitoring plan and any deviations are explained in Appendix C.2.

Monitoring was performed in accordance with the TCAAP RD/RA QAPP (1996) and a new QAPP. The *IRP-QAPP for Performance Monitoring*, TWISS, dated May 10, 2007, was accepted by the USEPA and MPCA as passing the Consistency Test on August 21, 2007. The new QAPP was implemented at the beginning of the 1st quarter FY 2008.

Water levels are collected annually from the monitoring wells and bundle piezometers in the vicinity of the groundwater collection and treatment system. FY 2008 monitoring was performed in accordance with the Monitoring Plan included as Appendix A. The comprehensive monitoring well sampling round was conducted in June 2008. Figure 9-1 presents the sampling and water level monitoring locations. Figure 9-1 also shows the cross-section alignment.

9.2 REMEDY COMPONENT #2: SENTINEL WELLS

Description: "Installation of sentinel wells at the bottom of Unit 1 and top of Unit 3." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the wells have been installed according to a regulator approved work plan.

Is the remedy component being implemented?
Yes. The OU2 ROD was signed in December 1997 (FY 1998). The Predesign Investigation Work Plan for Site K was approved in February 1999. The upper Unit 3 sentinel well was installed in February 2000.

Existing piezometers were used to accomplish the deep Unit 1 sentry monitoring. Piezometers 01U625D, 01U626D, 01U627D, and 01U628D were used since they monitor the base of the Unit 1 aquifer near the trench. The issue is the potential for Dense Non-Aqueous Phase Liquids (DNAPLs) to migrate beneath the trench along the Unit 1/Unit 2 interface. These four piezometers are screened at that interface.

Figure 9-1 shows the location of the upper Unit 3 sentinel well (03U621) and the piezometers. The sentinel well was installed to monitor the potential for VOCs to migrate through the Unit 2 till and into the Unit 3 aquifer.

What are the results of the Unit 1 piezometer and Unit 3 sentinel well sampling?
The piezometers (Unit 1 sentinel wells) were sampled in March 2000 and the results were discussed in the FY 2000 APR. The results did not indicate the presence of DNAPLs at the Unit 2/Unit 3 interface. This was a one-time sampling event, as required by the MPCA/USEPA approved Predesign Investigation Work Plan, Site K, TCAAP, CRA, February 1999, and as documented in the Predesign Investigation Report, Site K, TCAAP, CRA, December 2001, for which concurrence was received.

The Unit 3 sentinel well (03U621) was sampled in March, July, and September 2000, of FY 2000, and in January 2001 for the quarterly sampling required by the Work Plan. After that, the well was incorporated into the regular TCAAP monitoring plan. The well was sampled in June 2008 for FY 2008. The results of the sample collected during FY 2008 are presented in Table 9-1. VOCs were not detected in the Unit 3 sentinel well at a concentration above the laboratory reporting limit.

9.3 REMEDY COMPONENT #3: HYDRAULIC CONTAINMENT

Description: "Use of existing interceptor/recovery trench to contain the plume and remove impacted groundwater." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the trench is operating as designed and capturing all groundwater exceeding the cleanup levels presented in Table 1 of the OU2 ROD, as described below.

Is the remedy component being implemented?
Yes. The groundwater collection system continues to provide capture (as described later) of the Unit 1 groundwater, upgradient of the trench and beneath the Building 103 slab, as designed.

Is the system providing hydraulic capture of the plume?

Yes. Water level data are presented in Table 9-2. Figure 9-2 presents a plan view of the groundwater contours from the June 2008 round of groundwater level measurements. At nested wells, the numerically lowest water elevation was used to create the plan view contours. Monitoring wells downgradient of the extraction trench show consistently higher water levels than those near and upgradient of the trench. This demonstrates that the horizontal hydraulic gradient has been reversed toward the extraction trench due to system operation.

Vertical capture was also effective as illustrated on Figure 9-3. As seen in the figure, groundwater both upgradient and downgradient of the trench is captured and collected. The upward gradient beneath the trench indicates that groundwater does not migrate below the trench. The monitoring coverage provided by the bundle piezometers, demonstrates complete vertical and horizontal hydraulic capture.

Figure 9-4 presents the trichloroethene concentrations from the June 2008 annual sampling event. Trichloroethene concentrations range from non-detect to 5,700 μg/L. The FY 2008 concentrations at wells 01U615 and 01U611, which monitor the core of the plume, showed a decrease from 6,500 μg/L to 4,400 μg/L in 01U615 and a decrease from 6,800 μg/L to 5,700 μg/L in 01U611 compared to the concentrations measured in FY 2007. The FY 2008 concentration of trichloroethene in 01U615 compares with historical concentrations from the last ten years of sampling, which have ranged from 1,800 μg/L to 7,100 μg/L. The overall trend continues to show a gradual decrease in trichloroethene concentrations over the last fifteen years of sampling. Water levels measured during the FY 2008 monitoring were 0.53 feet higher at 01U615 and 0.05 feet lower at 01U611 compared to FY 2007 elevations. These wells have historically exhibited fluctuating groundwater elevations.

Comparison of Figure 9-4 to the groundwater contour maps indicates that the VOC plume is hydraulically contained by the treatment system. Table 9-1 presents the monitoring well sampling data. The plume was originally defined based on data from all of the monitoring wells. The current monitoring well network is used to confirm the plume contours and measure the progress of remediation. Thus, the contours on Figure 9-4 were drawn with consideration of the extensive historical data.

Three wells (01U128, 01U617, and 01U621) continue to exhibit low concentrations of 1,2-dichloroethene downgradient of the groundwater collection system's capture zone. Two of these wells (01U128 and 01U617) have exhibited relatively consistent concentrations of 1,2-dichloroethene since 1987. The third well, 01U621, has exhibited 1,2-dichloroethene since September 1993. The concentrations at these wells were consistent with those measured in FY 2007 and previous years and are below the cleanup standards for Site K.

9.4 REMEDY COMPONENT #4: GROUNDWATER TREATMENT

Description: "Treatment of contaminated groundwater using air stripping."
(OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the air stripping facility is treating water to the cleanup standards.

Is the remedy component being implemented?
Yes. See discussion below.

Were there any major operational changes during the year?
No. The original air stripping tower and controls were replaced with a new fluidized bed type air stripper system on June 21, 1999. During FY 2008, the treatment system functioned properly. The new air stripper is less prone to fouling and requires less maintenance. The treatment system was operational 96.3% of the time in FY 2008. The operational efficiency in FY 2008 was primarily affected by system down time between March 11, 2008 and March 18, 2008, as a result of a pump failure and subsequent pump replacement. During FY 2008, a regular maintenance

schedule was maintained. Appendix F.1 summarizes operational data and events at the groundwater extraction and treatment system.

9.5 REMEDY COMPONENT #5: TREATED WATER DISCHARGE

Description: "Discharge of treated groundwater to Rice Creek." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the system is operating as designed with treated water discharge to the storm sewer that, in turn, discharges to Rice Creek. The water is required to meet the substantive requirements of Document No. MNU000579 (MPCA), which contains the state-accepted discharge limits for surface water. Sampling and analysis are performed to monitor performance (see below).

Is the remedy component being implemented?
Yes. See discussion in Section 9.6.

9.6 REMEDY COMPONENT #6: DISCHARGE MONITORING

Description: "Monitoring to track compliance with discharge requirements."
(OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When a monitoring plan is established and is being implemented in accordance with the plan.

Is the remedy component being implemented?
Yes. Treatment system monitoring consisted of quarterly influent and effluent sampling. Influent and effluent analytical results are presented in Table 9-3 and Table 9-4. The discharge met all the treatment requirements.

Table 9-5 presents the VOC mass removal and monthly flow rates. The treatment system captured and treated 5,990,410 gallons of water resulting in the removal of 18.2 pounds of VOCs from the aquifer in FY 2008. The cumulative mass removal is 219 pounds of VOCs.

9.7 REMEDY COMPONENT #7: ADDITIONAL INVESTIGATION

Description: "Additional characterization of the unsaturated Unit 1 soil." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the additional investigation has been completed according to a regulator approved work plan.

Is the remedy component being implemented?
Yes. The Work Plan was approved in FY 1999. Work began in February 2000. A report of the investigation results was submitted in November 2001 and received a consistency determination from the Agencies on December 6, 2001. The report defined the extent of VOC contaminated soils beneath Building 103 and refined the location of the source area. The report and subsequent follow up sampling resolved anomalous dissolved zinc, lead, and nickel data at two monitoring wells. Zinc, lead, and nickel are no longer groundwater concerns.

9.8 OVERALL REMEDY FOR SITE K

Overall, the remedy for Site K continued to operate consistent with past years and in compliance with the required performance criteria.

Is additional monitoring proposed prior to the next report?
Yes. Table 9-6 presents a summary of the monitoring requirements for Site K.

9.9 OTHER ACTIVITY

Alliant conducted pilot scale tests of two new technologies at Site K. These are Hydrogen Release Compound™ (HRC), and direct hydrogen injection with gas-permeable membranes. Both technologies are intended to enhance natural anaerobic degradation of chlorinated VOCs. These tests were completed in late FY 2000 and a report of the results was issued in FY 2001. The report determined that HRC was not effective under the specific conditions beneath the building slab at Site K. The direct hydrogen injection test yielded promising results but more research is needed for full-scale operation.

In FY 2002, no research field work was conducted; however, Alliant allowed the University of Minnesota to continue its research into direct hydrogen injection by making the test plot available for its use.

In June 2002, a Remedial Action Report for Site K, TCAAP, CRA, was submitted to the USEPA and MPCA. The purpose of the report was to document the remedial action implementation as required by the FFA. The report discussed implementation of the components required by the TCAAP OU2 ROD. A consistency letter for this report was received in FY 2003.

Two monitoring wells (01U622 and 01U623) were abandoned in FY 2004. Well abandonment is documented in the *Well Abandonment Report, Sites I and K, TCAAP,* SECOR, dated December 15, 2003.

During FY 2004, a Five-Year Review of the remedy was performed. The review concluded that the remedy was functioning as intended, and that the components of the remedy remain protective of human health and the environment. The Review also recommended monitoring the trichloroethene HRL for any changes due to the USEPA's potential update of the trichloroethene health risk assessment.

During FY 2005, the groundwater collection system trench was cleaned using a high-pressure water jetting technique. Pre-cleaning and post-cleaning video documentation was used to assess the effectiveness of the high pressure jetting. Pre-cleaning (June 2005) and post-cleaning (November 2005) groundwater contouring and groundwater elevations were used to further assess the trench cleanings effectiveness on hydraulic containment within the VOC plume. Results of both effectiveness assessments indicate that the jet cleaning improved the hydraulic containment compared to pre-cleaned conditions.

During FY 2006, Building 103 was demolished, leaving in place the concrete slab (floor) of the building. The Building 103 concrete slab will remain in place and continue to act as a Site K cap.

During FY 2008, an Engineering Evaluation/Cost Analysis (EE/CA) for Site K received consistency determination from USEPA and MPCA. The Army signed an Action Memorandum in October 2008 selecting the removal action alternative for Site K soils.

TABLE 9-1

GROUNDWATER QUALITY DATA
FISCAL YEAR 2008
SITE K, TCAAP
ARDEN HILLS, MINNESOTA

		Trichloroethene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	1,1-Dichloroethene	1,1-Dichloroethane	cis-1,2-Dichloroethene	Vinyl chloride	Chloroform	trans-1,2-Dichloroethene	Tetrachloroethene	1,2-Dichloroethane
Location	**Date**	**TRCLE**	**111TCE**	**112TCE**	**11DCE**	**11DCLE**	**C12DCE**	**C2H3CL**	**CHCL3**	**T12DCE**	**TCLEE**	**12DCLE**
01U128	6/5/2008	<1	<1	<1	<1	<1	3.3	<1	<1	0.38 (J)	<1	<1
OW103 (01U603)	6/4/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
01U604	6/4/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
OW111 (01U611) (1)	6/5/2008	5700 (2)	<10	<10	<10	<10	790	11	<10	620	<10	<10
OW115 (01U615) (1)	6/4/2008	4400 (2)	<10	<10	<10	<10	1300	<10	<10	90	<10	<10
OW117 (01U617)	6/4/2008	<1	<1	<1	<1	<1	2.8	<1	<1	0.48 (J)	<1	<1
OW118 (01U618)	6/4/2008	0.61 (J)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
OW119 (01U619)	6/4/2008	0.63 (J)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
OW119 (01U619) D	6/4/2008	0.62 (J)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
OW121 (01U621)	6/4/2008	0.29 (J)	<1	<1	<1	<1	1.7	<1	<1	0.19 (J)	<1	<1
03U621	6/5/2008	0.20 (J)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
03U621 D	6/5/2008	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
482083 (K04MW)	6/4/2008	1.3	<1	<1	<1	1.8	<1	<1	<1	<1	<1	<1

Notes:
Concentrations in ug/L.
D - Duplicate analysis.
J - Value is estimated.

Sample dilution = 1, unless noted otherwise.
(1) Sample dilution = 10
(2) Sample dilution = 100.

TABLE 9-2

GROUNDWATER ELEVATION MONITORING
SITE K, TCAAP
ARDEN HILLS, MINNESOTA

Well ID	*TOC Elevation*	*Depth to Water (ft BGS)*	*Groundwater Elevation 6/2/2008*
01U047	880.31	5.98	874.33
01U048	885.32	10.56	874.76
01U052	886.51	11.21	875.30
01U065	883.90	9.77	874.13
01U128	883.69	8.70	874.99
01U601	892.68	7.61	885.07
01U602	889.35	4.34	885.01
01U603	887.31	9.40	877.91
01U604	888.98	12.06	876.92
01U605	887.76	9.56	878.20
01U607	891.01	5.88	885.13
01U608	889.30	3.84	885.46
01U609	889.33	3.80	885.53
01U611	889.29	4.26	885.03
01U612	886.91	8.68	878.23
01U613	892.07	7.21	884.86
01U615	888.66	12.39	876.27
01U616	890.37	10.06	880.31
01U617	887.72	10.58	877.14
01U618	891.52	11.66	879.86
01U619	891.75	7.67	884.08
01U620	888.65	9.98	878.67
01U621	886.57	8.30	878.27
01U622	889.43	Monitoring Well Abandoned	
01U623	889.44	Monitoring Well Abandoned	
01U624A	889.88	11.57	878.31
01U624B	889.88	11.58	878.30
01U624C	889.91	11.60	878.31
01U624D	889.89	11.58	878.31
01U625A	886.92	9.82	877.10
01U625B	886.91	9.90	877.01
01U625C	886.91	9.88	877.03
01U625D	886.92	9.90	877.02
01U626A	886.87	9.84	877.03
01U626B	886.88	10.35	876.53
01U626C	886.88	10.28	876.60
01U626D	886.88	10.21	876.67
01U627A	886.46	8.35	878.11
01U627B	886.47	9.53	876.94
01U627C	886.47	9.64	876.83
01U627D	886.48	9.63	876.85
01U628A	887.82	9.73	878.09
01U628B	887.83	10.04	877.79
01U628C	887.82	10.56	877.26
01U628D	887.84	10.55	877.29
482085 (K01MW)	891.24	4.99	886.25
482084 (K02MW)	891.35	5.72	885.63
482083 (K04MW)	887.66	6.31	881.35
03U621	887.01	34.88	852.13

Notes:
ft BGS - feeg below ground surface

TABLE 9-3

TREATMENT SYSTEM CONCENTRATIONS (ORGANICS)
FISCAL YEAR 2008
SITE K, TCAAP
ARDEN HILLS, MINNESOTA

Location	Sample Date	1,1-Dichloroethane 11DCLE		1,1-Dichloroethene 11DCE		1,2-Dichloroethane 12DCLE		cis-1,2-Dichloroethene C12DCE		trans-1,2-Dichloroethene T12DCE		Trichloroethene TRCLE		Vinyl chloride C2H3CL	
Effluent	12/14/2007	ND		ND		ND		0.6	J	ND		0.85	J	ND	
Effluent	12/14/2007	ND	D	ND	D	ND	D	0.7	JD	ND	D	0.98	JD	ND	D
Effluent	3/18/2008	ND		ND		ND		ND		ND		ND		ND	
Effluent	3/18/2008	ND		ND		ND		ND		ND		ND		ND	
Effluent	6/5/2008	ND		ND		ND		6.6		0.17	J	5.9		ND	
Effluent	6/5/2008	ND	D	ND	D	ND	D	6.7	D	0.16	JD	6.7	D	ND	D
Effluent	9/17/2008	ND		ND		ND		0.99	J	ND		1.1		ND	
Effluent	9/17/2008	ND	D	ND	D	ND	D	0.87	JD	ND	D	0.92	JD	ND	D
Influent	12/14/2007	ND		ND		ND		140		13		270		0.69	J
Influent	3/18/2008	ND		ND		ND		3.9		1		11		ND	
Influent	6/5/2008	ND		ND		ND		140		11		260		0.64	J
Influent	9/17/2008	ND		0.26	J	ND		170		14		290		0.81	J
MDL	12/14/07, 3/18/08	0.344		0.234		0.308		0.269		0.229		0.247		0.316	
MDL	6/5/2008, 9/17/08	0.0834		0.136		0.134		0.0903		0.0840		0.170		0.215	
CRDL		1		1		1		1		1		1		1	
REQ.		--		7.0		3.8		70		100		10		0.18	

Notes:
Results are reported in µg/L unless otherwise noted.
RL - Reporting Limit
D - Duplicate Analysis
J - Value Estimated
B - Value is between the MDL and RL
MDL - Method Detection Limit
ND - Not Detected
REQ - Substantive Requirement Document Concentration Limit, Maximum Daily Concentration

TABLE 9-4

TREATMENT SYSTEM CONCENTRATIONS (INORGANICS)
FISCAL YEAR 2008
SITE K, TCAAP
ARDEN HILLS, MINNESOTA

Location	***Sample Date***	***Phosphorus Total***		***Copper***		***Cyanide***		***Lead***		***Mercury***		***Silver***		***Zinc***	
Effluent	12/14/08	719		12.70	JE21	ND	U	3.98		ND	U	ND	U	71	JE21
Effluent	3/18/08	570		8.24	JE12	ND		3.2		ND	U	0.335	UCB.328	75.9	JE13
Effluent	6/5/08	430	B, UB450	9.85		ND	U	3.79	UCB1.6	ND	U	0.107	B, UB0.17	41.2	
Effluent	9/17/08	823	JS2.3	8.20	JE13	ND	U	1.9	B	0.051	B, UB.033	ND	U	40.1	
MDL	12/14/08	153.0		0.243		1.36		0.0726		0.0158		0.250		0.692	
MDL	3/18/08	153.0		0.154		1.36		0.0405		0.0202		0.042		0.568	
MDL	6/5/08	92.8		0.154		5.99		0.0512		0.0202		0.0418		0.0568	
MDL	9/17/08	0.0928		0.154		3.93		0.0512		0.0202		0.0418		0.568	
RL		400		5		10		2		0.100		2		5	
RL	9/17/08	0.50		2		10		2		0.100		2		3	
REQ.		1000		21		17		106		0.2		3.4		134	

Notes:
Results are reported in ug/L unless otherwise noted.
RL - Reporting Limit
MDL - Method Detection Limit
ND - Not Detected
U - Not detected at or above the MDL
B - Value is between the MDL and RL

REQ - Substantive Requirement Document Concentration Limit, Maximum Daily Conc.
JE#- Serial dilution percent difference out of control limits; # = %difference
UCB# - Contamination present in calibration blanks; # = concentration present in Blanks
JS#- Matrix Spike recoveries out of control limit; # = %recovery
UB# - Analytes reported as contamination in the preperation blank; # = value of the blank corrected to the units of the sample

TABLE 9-5

SUMMARY OF MONTHLY VOC REMOVAL
FISCAL YEAR 2008
SITE K, TCAAP
ARDEN HILLS, MINNESOTA

Month	Total Monthly Flow (million gallons)	Total VOC Influent Concentration	Total VOC Effluent Concentration	Total VOCs in Treatment Center Discharge (g)	Total VOC Mass Removed (g)	Total VOC Mass Removed (lb)
Cumulative As Of September 2007 (FY07)						200.8
October[(1)]	0.68568	423.69	1.45	3.76	1094.39	2.41
November[(1)]	0.61582	423.69	1.45	3.38	982.89	2.16
December	0.45832	423.69	1.45	2.51	731.51	1.61
January[(1)]	0.38141	15.90	0	0.00	22.92	0.05
February[(1)]	0.29955	15.90	0	0.00	18.00	0.04
March	0.24852	15.90	0	0.00	14.94	0.03
April[(1)]	0.45398	411.00	13.4	22.99	682.29	1.50
May[(1)]	0.68868	411.00	13.4	34.88	1035.04	2.28
June	0.66824	411.00	13.4	33.85	1004.31	2.21
July[(1)]	0.56140	475.07	2.09	4.44	1003.70	2.21
August[(1)]	0.48522	475.07	2.09	3.83	867.51	1.91
September	0.44360	475.07	2.09	3.50	793.09	1.75
Totals - FY08	5.99041			113.1	8250.6	18.2
Cumulative To Date						219.0

Notes:
[(1)] Influent and Effluent VOC concentrations from 12/10/07, 03/18/08, 06/5/08 and 09/17/08 quarterly samples, respectively.
Calculations based on compounds with concentrations above the CRDL only.
Analytical data has not received Level IV review and may be revised after completion of review.

TABLE 9-6

SUMMARY OF GROUNDWATER MONITORING REQUIREMENTS
FISCAL YEAR 2008
SITE K, TCAAP
ARDEN HILLS, MINNESOTA

	Remedy Component		Monitoring Requirements	Responsible Party	Documents Containing the Monitoring Plan
#1	Groundwater Monitoring		Outlined below	Alliant	Site K Monitoring Plan in Annual Performance Report
#2	Sentinel Wells	a.	Water quality to monitor potential migration.	Alliant	Site K Monitoring Plan in Annual Performance Report
#3	Hydraulic Containment	a.	Water levels for use in drawing contour maps showing capture.	Alliant	Site K Monitoring Plan in Annual Performance Report
		b.	Pumping volumes and rates for reporting and mass removal calculation.	Alliant	Site K Monitoring Plan in Annual Performance Report
#4	Groundwater Treatment		None	Alliant	Site K Monitoring Plan in Annual Performance Report
#5	Treated Water Discharge		None	Alliant	Site K Monitoring Plan in Annual Performance Report
#6	Discharge Monitoring	a.	Treated effluent water quality for comparison to substantive requirements criteria for discharge maximum daily concentration.	Alliant	Site K Monitoring Plan in Annual Performance Report
#7	Additional Investigation	a.	As per work plan (completed).	Alliant	Site K Monitoring Plan in Annual Performance Report

Legend

- MONITORING WELL LOCATION
- ANNUAL MONITORING LOCATION
- UNIT 3 SENTINEL WELL
- TRENCH LOCATION
- CROSS SECTION LOCATION

NOTE:

1) WELL NOMENCLATURE:
ERIS OR MN UNIQUE # NAME
(COMMON NAME)

2) BUILDING 103 DEMOLISHED IN 2006; CONCRETE SLAB REMAINS

N
W E
S

0 50 100 200 300 400

Feet

Geographic Information Systems

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4463 White Bear Parkway, Suite 106, White Bear Lake, MN 55328 Phone 651.653.9112 www.stantec.com

PREPARED FOR:					FIGURE:
TWIN CITY ARMY AMMUNITION PLANT ARDEN HILLS, MINNESOTA		SITE K, UNIT 1 AND UNIT 3 GROUNDWATER MONITORING LOCATIONS MAP			9-1
JOB NUMBER: 03OT.18508.00	DRAWN BY: TF	CHECKED BY: AG	APPROVED BY: AG		DATE: 12/18/08

Legend

- MONITORING WELL LOCATION
- ANNUAL MONITORING LOCATION
- UNIT 3 SENTINEL WELL
- TRENCH LOCATION
- GROUNDWATER ELEVATION CONTOUR
- (885.46) GROUNDWATER ELEVATION

NOTE:

1) WELL NOMENCLATURE:
ERIS OR MN UNIQUE # NAME
(COMMON NAME)

2) BUILDING 103 DEMOLISHED
IN 2006; CONCRETE SLAB
REMAINS

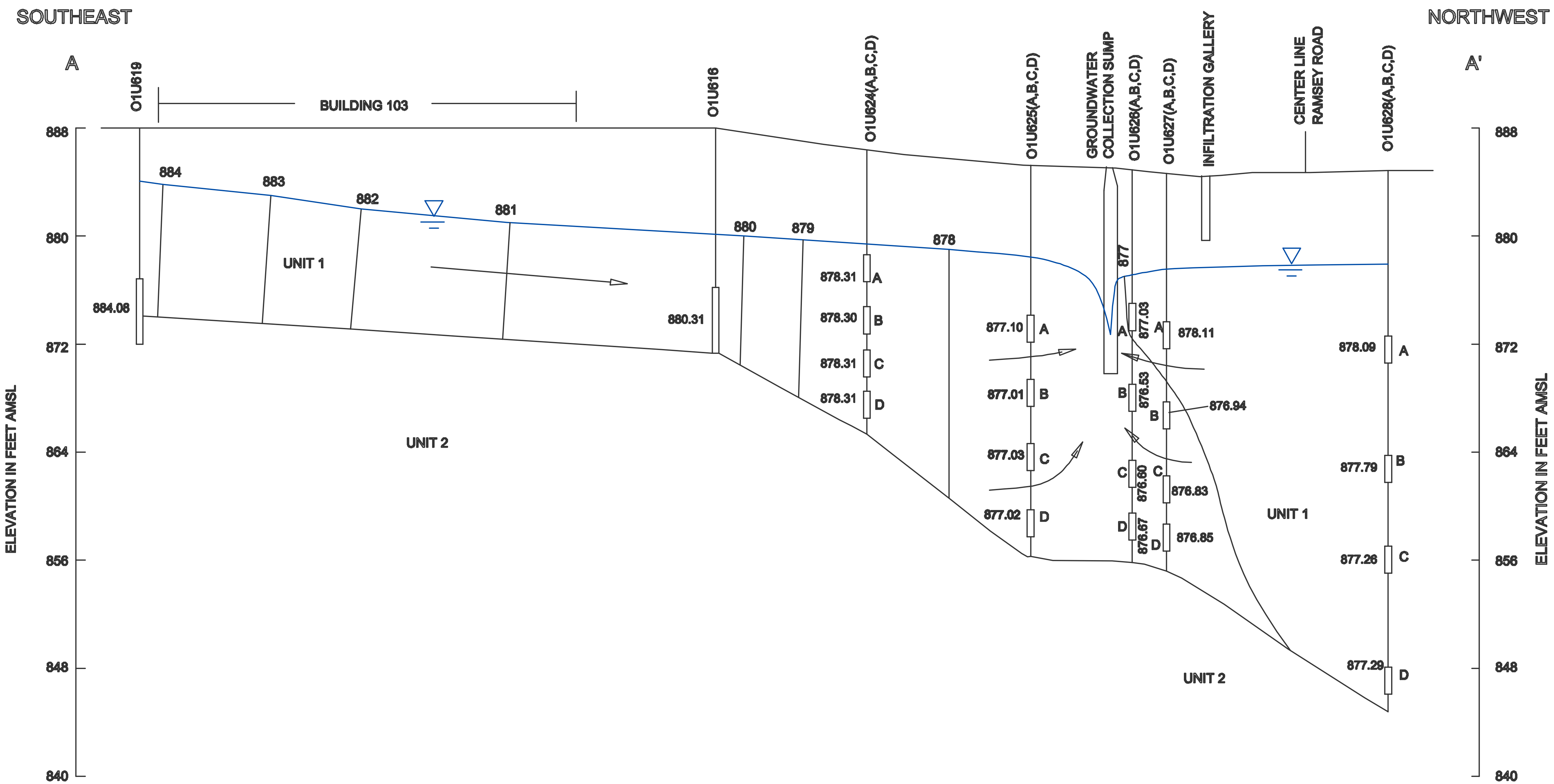
N W E S

0 50 100 200 300 400
Feet

Geographic Information Systems

Stantec 4463 White Bear Parkway, Suite 106, White Bear Lake, MN 55328 Phone 651.653.9112 www.stantec.com

PREPARED FOR: TWIN CITY ARMY AMMUNITION PLANT ARDEN HILLS, MINNESOTA		SITE K, UNIT 1 AND UNIT 3 GROUNDWATER ELEVATION DATA 06/02/08	FIGURE: 9-2
JOB NUMBER: 03OT.18508.00	DRAWN BY: TF	CHECKED BY: AG	APPROVED BY: AG	DATE: 12/18/08



LEGEND:

WATER TABLE

VERTICAL SCALE
1"=8'
8 16
APPROXIMATE SCALE (FEET)

HORIZONTAL SCALE
1"=40'
40 80
APPROXIMATE SCALE (FEET)

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PREPARED FOR: TWIN CITY ARMY AMMUNITION PLANT ARDEN HILLS, MINNESOTA		SITE K HYDROGEOLOGIC CROSS SECTION A-A' 06/02/08 (Q99)		FIGURE: 9-3
JOB NUMBER: 03OT.18508.00	DRAWN BY: TF	CHECKED BY: AG	APPROVED BY: AG	DATE: 12/18/08

Legend

- MONITORING WELL LOCATION
- ANNUAL MONITORING LOCATION
- UNIT 3 SENTINEL WELL
- TRENCH LOCATION
- TRICHLOROETHENE CONCENTRATION CONTOUR
- (4400) TRICHLOROETHENE CONCENTRATION
- (ND) NOT DETECTED
- J VALUE IS ESTIMATED

NOTE:

1) WELL NOMENCLATURE:
ERIS OR MN UNIQUE # NAME
(COMMON NAME)

2) BUILDING 103 DEMOLISHED IN 2006; CONCRETE SLAB REMAINS

N W E S

0 50 100 200 300 400

Feet

Geographic Information Systems

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PREPARED FOR:		FIGURE:
TWIN CITY ARMY AMMUNITION PLANT ARDEN HILLS, MINNESOTA	SITE K, UNIT 1 AND UNIT 3 TCE CONCENTRATION MAP 06/04/08 (Q99)	9-4

JOB NUMBER:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:
03OT.18508.00	TF	AG	AG	12/18/08

10.0 Operable Unit 2: Deep Groundwater

The selected remedy for the Deep Groundwater in the OU2 ROD consists of five remedial components that include continued use of the TGRS, with modifications to improve VOC contaminant removal from the source area. It also includes an annual review of new and emerging technologies potentially applicable to the Deep Groundwater. This report documents all performance and monitoring data collected from October 2007 through September 2008.

<u>Historical Design and Evaluation of TGRS Remedial Action</u>

In September 1987, a Record of Decision (1987 ROD) was prepared by the USEPA in order to implement the Interim Response Action Plan (IRAP) for TCAAP. The 1987 ROD provided specific criteria for the Boundary Groundwater Recovery System (BGRS). Following extensive interagency negotiations on the FFA and the ROD, the BGRS was started on October 19, 1987.

The BGRS consisted of six Unit 3 extraction wells (B1 through B6), that were connected by a forcemain to an air stripping treatment facility. The initial six BGRS extraction wells (B1 through B6) were installed and pumping tests were conducted prior to startup of the BGRS. These pumping tests were documented in the BGRS Extraction Well Pumping Test Report.

Following the initial 90-day operation of the BGRS, the IRA–BGRS Performance Assessment Report (PAR) was prepared. The PAR assessed the hydraulic and treatment performance of the BGRS. The PAR presented an extensive database collected during the initial 90-day period of BGRS operation and prior pertinent data. The PAR also included a summary of the geology, hydrogeology, and remediation history for TCAAP. The PAR was subsequently approved by the MPCA and USEPA.

A pumping test on well B9 was conducted in August 1988 and formed the basis of the final design of the TGRS. This test, and the previous pumping tests, were utilized to determine the pumping rate required to achieve the necessary zone of capture for the TGRS; based on the plume size at that time. The PAR stated that the overall pumping rate needed for the 17 extraction wells was 2,450 gpm. During the detailed design of the TGRS, the system was designed with the capacity to operate at a maximum theoretical rate of 2,900 gpm. The additional pumpage was included to provide a safety margin for the calculations and to allow for fluctuations in system operation.

The PAR made recommendations for expansion of the BGRS into the TGRS in order to meet the Phase II remediation criteria established in the 1987 ROD. These modifications were completed and the expanded system began operation on January 31, 1989.

The 1989 Annual Monitoring Report was the first report covering the fully configured TGRS. It concluded that the TGRS developed a continuous zone of capture that was approximately 4,500 feet wide at the TCAAP boundary. The zone of capture widened to approximately 8,300 feet upgradient of the boundary. This zone of capture was demonstrated at average system pumping rates of 2,400 to 2,700 gpm.

The 1989 Annual Monitoring Report was wider in scope than subsequent annual monitoring reports for the TGRS. The 1989 report was both a performance assessment report and a monitoring report. The 1989 report represented the first year of operation of the expanded TGRS. Thus, a more detailed and exhaustive performance assessment was appropriate and possible, as there were data available from non-pumping conditions for detailed comparison with pumping conditions. Between 1990 and 2002, the system continued to operate at an essentially steady state condition, so the TGRS was evaluated by comparing the pumping rates to those achieved for the 1989 evaluation.

In FY 2003, the Army received agency approval on the TGRS Operating Strategy (OS) document. The OS was based in part on findings from the 1989 Annual Monitoring Report and presented a Global Operation Strategy (GOS) for the entire TGRS extraction system and a Micro Operation Strategy (MOS) for selected well groups. Evaluations now consider and compare actual pumping rates to the GOS and MOS rates presented in the Final TGRS OS.

TGRS Modifications

Since 1990, a number of modifications have been made to the TGRS operation in response to changes in plume configuration or operational issues. A brief summary of the major changes is presented below:

1. Source control well SC4 was shut down in November 1996 in response to insignificant VOC mass removal by this well. SC4 operated at an average extraction rate of 29 gpm in 1989 and 45 gpm prior to shut down.
2. Boundary extraction well B12 was shut down in November 1996. The plume in the B12 area had dropped below cleanup standards for several years. Well B12 operated at an average extraction rate of 139 gpm in 1989 and 190 gpm prior to shut down.
3. As per the OS, boundary extraction well B2 was shutdown and replaced with well B13 that began production in December 2002. The well screen in B2 became fouled and flow rates decreased from an average of nearly 200 gpm in the early 1990s to 52 gpm in 2002. During FY 2003, well B13 operated at maximum pumping capacity of nearly 100 gpm. The original design capacity for B13 was 200 gpm.
4. As per the OS, boundary extraction wells B7 and B10, and source control well SC3 were officially shut down in December 2002 due to the low TRCLE concentrations.
5. As per the OS, a larger capacity pump was installed at well B9 in December 2002 to raise the pumping rate from 150 gpm to approximately 300 gpm.
6. In July 2004, the TGRS was modified (Modification #3) as approved by the Agencies in May 2004. Pumps in Wells B1 and B13 were replaced and the pump in Well B13 was lowered to allow pumping below the well screen.
7. Flow rates at individual wells have been modified from time to time due to plume configuration changes, operational issues, and to maintain the OS.

10.1 REMEDY COMPONENT #1: HYDRAULIC CONTAINMENT AND CONTAMINANT REMOVAL FROM THE SOURCE AREA

Description: "Groundwater extraction to hydraulically contain the contaminated source area to the 5 μg/L TRCLE concentration contour and optimize the removal of contaminants from the source area through pumping of select wells." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the TGRS is containing the contaminated source area to the 5 μg/L TRCLE contour and the system is operated to maximize the contaminant removal from the source area.

Is the remedy component being implemented?
Yes. The TGRS was operated in FY 2008 consistent with the requirements of the OU2 ROD. Table 10-1 presents the cleanup requirements for the TGRS from the OU2 ROD.

During FY 2008, the average extraction well water pumped was approximately 1,790 gpm. The total extraction well water pumping rate was above the GOS Total System Operational Minimum (1,745 gpm) where the Army and the agencies agree that OU2 ROD requirements are met with an adequate safety factor. Additionally, all of the individual well groupings were above their respective MOS minimums for FY 2008.

How is the system operated and what preventative maintenance measures were conducted during the year?

Summary of Operations

Beginning in FY 2003, the system operation changed to conform to the OS. Under the OS, groundwater is extracted from 8 wells along the southwest boundary of TCAAP (B1, B3 through B6, B8, B9, B11, and B13) and three wells downgradient of interior source areas on TCAAP (SC1, SC2, and SC5). Prior to this, wells B2, B7, B10, and SC3 were also operating components of the system. Submersible pumps in the extraction wells discharge into a common pressurized forcemain that carries the water to the treatment system. The treatment system is located adjacent to Building 116. The TGRS layout is presented on Figure 10-1.

The TGRS was designed and constructed with three options for treated water discharge: recharge at the Arsenal Sand and Gravel Pit, discharge to Rice Creek, and discharge to the TCAAP elevated water tank. Water stored in the elevated tank was "softened" and then "polished" with granular activated carbon (GAC) prior to distribution at TCAAP. Due to the Army discontinuing all non-environmental services at TCAAP in September 2007, the elevated water tank and the water softening and polishing equipment is no longer used. As such, the Arsenal Sand and Gravel Pit option is utilized for all of the extracted and treated water from the TGRS.

<u>System Operation Specifications</u>

In general, the influent and effluent water flow rates at the treatment plant are designed to be equal, thereby providing continuous operation of all processes and equipment. The following is a summary of the system design parameters:

- The groundwater extraction system, including the treatment center and 17 TGRS extraction wells, was originally designed to provide a theoretical hydraulic capacity of 2,900 gpm and a sustained daily average capacity of 2,730 gpm.
- The influent to the treatment plant is divided between Towers 1 and 2, each receiving up to a maximum of 1,450 gpm.
- Wet Well Pumps 1 and 2 (WWP#1 and WWP#2 located in Wet Wells 1 and 2) transfer water to Towers 4 and 3, respectively. Each pump and tower handles up to a maximum of 1,450 gpm.
- Wet Well Pumps 3 and 4 (WWP#3 and WWP#4 located in Wet Well 3) discharge treated water to an end use at a combined rate of up to a maximum of 2,900 gpm.

- Air blowers provide air to the towers. The blowers for Towers 1 and 2 are designed to provide 6,000 – 7,000 standard cubic feet per minute (scfm) each. The blowers for Towers 3 and 4 are designed to provide 9,000 – 14,000 scfm each.

Water level sensors within the wet wells communicate with the programmable logic controller (PLC) according to changing water levels. A complete and balanced operation should provide continuing water levels above the low-level sensors and below the high-level sensors. However, given the probability of unbalanced flows for any number of reasons (e.g., changing hydraulic heads, maintenance, repairs, temporary malfunctions), the PLC has provisions within its program to cycle-off the extraction well(s) or wet well pumps according to high water levels occurring in the wet wells; and in turn, cycle-off the wet well pumps according to low levels occurring within these wet wells.

The system operates such that the wet well pumps cycle rather than the extraction well pumps. The rationale behind this is that there are a relatively small number of motors, starters and electrically controlled valves associated with the wet wells when compared with the extraction well field. This also provides for more continuous and complete hydraulic capture within the aquifer units. However, the extraction well field will cycle if necessary, starting with the least contaminated extraction well, B7 (if operating), and followed by the other extraction wells in a predetermined sequence.

In summary, the priority of operation is as follows:

- Maintain constant operation of all extraction wells and air stripping towers above the operating minimum;
- Maintain the desired flow rates at individual wells;
- Maintain treatment center WWP#1 and WWP#2 pumping rate equal to or slightly above the combined pumping rate of the extraction well field; and

- Maintain treatment center WWP#3 and WWP#4 pumping rate equal to or slightly above WWP#1 and WWP#2.

FY 2008 Maintenance and Inspection Activity

During FY 2008, the following inspection and maintenance activities occurred:

Preventive Maintenance (PM): The extensive PM program allowed the operations staff to identify and repair or replace equipment to avoid a down time failure. The program consists of monthly, quarterly, and annual maintenance tasks. When required, further repair work was scheduled rather than waiting for the failure to occur. A broad range of system-specific information was collected during this year's PM. This information is used to direct future repair work.

Electrical Inspection and Temperature Survey: A system-wide electrical inspection and infrared temperature survey was performed to identify loose connections and overheating components. Component overheating often precedes equipment failure. Electrical components that were identified as failing were replaced.

Verification of Flow Meters: As part of the routine PM, flow meters in the pumphouses were compared to a factory-calibrated flow meter. Flow volume measurements before and after conducting maintenance on the meters were compared to verify the consistency of measurements. Meters found to be out of calibration were replaced or recalibrated.

Daily Tracking of Flow Rates: Pumphouse and treatment center meter readings were recorded in the course of the daily inspections. Daily meter readings were tabulated and the flow rates were calculated and reviewed by the operations staff. Early detection of changes in flow rate was critical in early identification of failing equipment. By early detection of flow rate changes, equipment repair was typically scheduled before a failure occurred.

Did the system operate at a rate sufficient for complete capture?

Yes. At 1,790 gpm, the total extraction well water pumped was above the GOS Total System Operational Minimum (1,745 gpm) where the Army and the agencies agree that capture is achieved with an adequate safety factor. Figure 10-2 plots the daily average flow rate since October 1, 2007, and shows that the TGRS operated above the OM for the majority of the time (313 days or 85.5 percent of the time) in FY 2008. On a monthly basis, total TGRS extraction rates were below 1,745 gpm only during July 2008. The July 2008 extraction rate was 1,707 gpm. The slightly lower flow was due to several power outages during the month. Appendix F.2 provides additional information on the various down times throughout FY 2008.

The monthly and annual volume of water pumped is presented in Table 10-2 and 10-3. Table 10-2 presents the pumphouse metered monthly flow volumes of each extraction well. The individual pumphouse flow meters are used to determine the amount of groundwater extracted from the various MOS well groups, individual extraction wells, and the total amount of groundwater extracted during the fiscal year. Table 10-3 presents the combined pumphouse-metered flow volume (extraction wells) and the flow volumes metered at various stages in the treatment center along with historical data. These flow meters are used to evaluate the flow of water through the treatment process to ensure proper system operation. In addition, treatment center meters #1 and #2, located after the first set of air stripping towers, are used as a check on the total extracted groundwater calculation.

As shown on Table 10-3, the TGRS successfully captured and treated approximately 943,318,161 gallons of contaminated water from October 2007 through September 2008, based on the sum of the individual pumphouse flow meters. This converts to an average flow rate of 1,790 gpm.

The TGRS as a whole was operational 97.1 percent of the time (i.e., 355.5 days out of 366 days in FY 2008).

Monthly Flow Reports

Each month a Monthly Flow Report is prepared. The report includes the month's meter totalizer readings, calculated flow volumes, and operational notes. Flow volumes are presented on a daily basis and are totaled to provide a monthly flow volume. A compilation of FY 2008 operational notes is presented in Appendix F.2. During FY 2008, the sum of the individual pumphouse flow meters was used to measure total flow volumes in monthly reports for comparison with Operating Strategy limits. Daily variation in readings at individual wells is primarily due to differences in the time of day when meter readings were taken.

How much down time occurred during the year?

The down time for each extraction well, over the last five years, is presented in Table 10-4. A summary of average down time for the pumphouses and the treatment center by the category of failure is presented in Table 10-5. A description of each down time event, organized chronologically, is presented in Appendix F.2. The same descriptions organized by affected pumphouse, treatment center, and forcemain is presented in Appendix F.3.

Treatment center and extraction well down times resulted primarily from failure and subsequent repair of components in the pumphouses, treatment center, and electrical service. The treatment center and extraction wells were shut down for repairs slightly more in FY 2008 than they were in FY 2007. The increased down time is primarily due to an increase in interruptions to electrical service from 1.4 days in FY 2007 to 3.9 days in FY 2008.

Description of Down Time Categories

Pumphouse component failures accounted for an average of 5.8 days down time per pumphouse. There was approximately the same amount of down time due to pumphouse maintenance in FY 2008 as there was in FY 2007. The major pumphouse repairs causing down time were:

- Motor failure and replacement at Pumphouses B3 and B4;
- Replacement of riser pipe at Pumphouse B4;

- Repairs to worn pump and motor parts at Pumphouse B8; and
- Well redevelopment at Pumphouses B13 and SC2.

Treatment center component failures and repairs that caused pumphouse down time consisted of electric check valve maintenance, malfunctions and repairs, and electrical control equipment failures and subsequent repairs. Treatment center component failures, repairs, and adjustments accounted for an average of 0.5 days down time per pumphouse. The major treatment center repairs causing substantial down time were the inspection and subsequent replacement of ECV-3 in July and August and repairs to ECV-2 in December.

Electrical service system failures accounted for an average of 3.9 days down time per pumphouse. Electrical storm damage and power grid failures were the primary causes of down time.

Preventative maintenance procedures accounted for an average of 0.0 days of down time per pumphouse. Preventative maintenance procedures are described in the project Operation and Maintenance Manual.

System modifications accounted for an average of 0.3 days down time per pumphouse due to installing a blind flange on a portion of the influent pipe in Building 116 in October 2007.

Forcemain issues accounted for an average of 0.0 days down time per pumphouse. There was no down time due to forcemain issues in FY 2008.

Were there any major operational changes during the year? No.

Did the system achieve hydraulic capture?
Yes. The total extraction well water pumped was above the GOS Operational Minimum (1,745 gpm) where the Army and the agencies agree that capture is achieved with an adequate safety

factor. A positive sign with respect to capture is the generally stable or decreasing TRCLE concentrations evident at many wells across the TGRS boundary since FY 2001.

Groundwater elevation measurements were collected in June 2008. Appendix D contains the water level database for the monitoring wells.

How much VOC mass was removed by the system and how is it changing with time?
As discussed above, the TGRS extracted and treated approximately 943,318,161 gallons of water from October 2007 through September 2008. Based on the monthly influent and effluent VOC concentrations and the monthly flow totals as measured by the extraction well flow meters, the TGRS removed a total of 2,292 pounds of VOCs from October 2007 through September 2008. The VOC mass removal in FY 2007 was 2,507 pounds. The decrease in FY 2008 reflects an overall decrease in plume concentration.

Average VOC influent concentrations decreased from 308 µg/L in FY 2007 to 291 µg/L in FY 2008 (5.5 percent lower). Table 10-6 summarizes the individual VOC mass contribution of each extraction well and the entire system. Overall, the TGRS has removed nearly 100 tons (199,282 lbs) of VOCs from the aquifers since 1987 and 9.6 tons of VOCs since the end of FY 2001 (the TGRS OS was based on data through 2001). If the annual VOC mass removal from the TGRS is less than 1,709 pounds (50 percent of the FY 2001 mass removal) then the Army and agencies have agreed that review of the OS operating minimum rates should be conducted and potentially reduced. At 2,292 pounds in FY 2008, the VOC mass removal from the TGRS is at 67 percent of the FY 2001 mass removal.

The total mass removed is based on the monthly TGRS influent and effluent sampling and flow through the treatment system. The monthly sampling of the treatment system provides the best estimate of overall mass removal, compared to the individual extraction well sampling, due to the larger number of samples and consistency in the month-to-month analytical results. The percent contributions for each well are based on the average flows from each well and the semi-annual VOC results from each well.

VOC samples were collected semi-annually from the operating extraction wells that comprise the TGRS. Well B2 is shut down, but was temporarily operated for June 2008 sampling. Wells B7, B10, B12, SC3, and SC4 are shut down, and were not sampled, as they are now sampled biennially (next event in June 2009). Table 10-7 presents a summary of the sampling results for the extraction wells. Variations in detection limits from round to round are the result of varying sample dilution performed by the laboratory. Dilutions are required due to the high concentrations of some analytes. The locations of the extraction wells are presented on Figure 10-1.

Appendix G.1 presents TRCLE versus time graphs for each extraction well. As shown, TRCLE concentrations have declined in each well and now many wells appear to be stable or still declining. Since FY 2001, the following extraction wells have shown the most improvement (greater than 50 percent reduction) in TRCLE concentrations:

- SC2 (100 μg/L in FY 2001 to 41 μg/L in FY 2008);
- B11 (4.8 μg/L in FY 2001 to 1.8 μg/L in FY 2008);
- B6 (230 μg/L in FY 2001 to 85 μg/L in FY 2008);
- B5 (410 μg/L in FY 2001 to 150 μg/L in FY 2008); and
- B4 (500 μg/L in FY 2001 to 160 μg/L in FY 2008).

These trends reflect the overall decline in OU2 deep groundwater contaminant concentrations. In addition, as discussed below, there has been a reduction in overall TGRS influent concentrations over the previous several years.

As Table 10-6 illustrates, eight wells, B1, B4, B5, B6, B9, B13, SC1, and SC5, that are located in the center of the plume, achieve the largest rates of VOC removal. These eight wells together accounted for nearly 99 percent of the VOC mass removed.

The source control wells, SC1 through SC5, together accounted for over 69 percent of the VOC mass removed while accounting for only 8.3 percent of the water pumped by the system. SC5, in particular, removed almost 66 percent of the total VOC mass at a rate of only approximately 101 gpm (5.7 percent of the total water pumped by the system). This illustrates the efficiency of extracting groundwater from near the source areas.

What do the long-term trends in the monitoring wells show?

Appendix B presents the TRCLE graphs over time for monitoring wells on and off TCAAP. Although a formal statistical analysis has not been conducted, the large majority of these graphs reflect downward trends in TRCLE concentration, indicating an overall improvement in water quality both upgradient and downgradient of the TGRS. Due to the complexity of the flow system, changes in flow direction over time, and the variation in chemical transport properties across the study area, the graphs may not reflect a uniform or easily predictable pattern.

Several wells were identified in previous Annual Performance Reports (APRs) or when reviewing the FY 2008 database that have inconsistent or upward trends in TRCLE concentrations that warrant further observation and discussion:

Well	**Trend Observation**
03L806	Trend identified in FY 2001 APR. Dropped from 1000's of ppb in early 1990s. TRCLE decreased steadily from 410 ppb in 2001 to 140 ppb in 2005. Has showed upward trend recently (160 ppb in 2006, 220 ppb in 2007, and 240 ppb in 2008). Maintain annual sampling frequency.

Well	Trend Observation
04U806	Trend identified in FY 2001 APR. Dropped from 1000's of ppb in early to mid 1990s. TRCLE decreased steadily from 470 ppb in 2001 to 96 ppb in 2007. Increased to 380 ppb in 2008. Maintain annual sampling frequency.
03U094	Trend identified during FY 2004 data review. Increased from 170 ppb in 2003 to 470 ppb in 2005, and down to 119 ppb in 2008. Appears to be stabilizing in low 100's of ppb. Maintain annual sampling frequency.
03M806	Trend identified during FY 2003 data review. Dropped from near 900 ppb in 1987, to below 100 ppb from 1993 through 1996. Increased to 1300 ppb, a historical high concentration, in 2003. Decreased to 910 ppb in 2006 and 520 ppb in 2007. Up slightly in 2008 to 680 ppb. Maintain annual sampling frequency.
03U711	Trend identified in FY 2001 APR. Dropped from near 1000 ppb in 1994, to 75 ppb in 1999, increased to 250 ppb in 2004, and has decreased to 90 ppb in 2008. Maintain annual sampling frequency.
03L809	Trend identified in FY 2001 APR. Dropped from over 3000 ppb to 67 ppb through 1998, at 220 ppb in 2007. Maintain biennial sampling frequency (next event 2009).

Well	Trend Observation
04U843	Trend identified in FY 2001 APR. Below 15 ppb from late 1980s through 1997, increased to between 22 ppb and 38 ppb from 1998 through 2001, dropped to below 1 ppb in 2003, and recently peaked at 87 ppb in 2007. Maintain biennial sampling frequency (next event 2009).
04U841	Trend identified in FY 2001 APR. Below 10 ppb through 1995, increased to 25 ppb in 2001, decreased to 5 ppb in 2003, and increased to 24 ppb in 2007. Maintain biennial sampling frequency (next event 2009).
03U822	Trend identified during FY 2003 data review. Below 25 ppb through 1998, peaked at 375 ppb in 1999, decreased to 140 ppb in 2007. Maintain biennial sampling frequency (next event 2009).
03L822	Trend identified in FY 2001 APR. Increased from below 5 ppb during early 1990s to over 600 ppb from 1999 through 2003. Decreased to 280 ppb in 2007. Approximately 1 mile from TGRS. Well historically showed 1,1,1-trichloroethane as major contaminant. Maintain biennial sampling frequency (next event 2009).

10.2 REMEDY COMPONENT # 2: GROUNDWATER TREATMENT

Description: "Groundwater treatment using air stripping." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):
When the air stripping treatment facility is treating water and meeting the cleanup requirements in Table 1 of the OU2 ROD.

Is the remedy component being implemented?
Yes. The air stripping treatment facility has been operating since 1986.

Did the treatment system meet the treatment requirements in the OU2 ROD?
Yes. Influent and effluent water was sampled on a monthly basis during FY 2008. The influent/effluent database for FY 2008 is contained in Appendix G.2. Figure 10-3 presents a graph of influent TRCLE versus time. This graph is cumulative and includes data from before 1989, when the system consisted of only six extraction wells. The average FY 2008 influent TRCLE concentration was 228 μg/L, down from 239 μg/L in FY 2007. FY 2008 represents the sixth year since the TGRS was reconfigured to achieve greater pumping in the centers of the VOC plumes and less pumping on the edges of the plumes where VOC concentrations are much lower. The decreasing TRCLE concentration could be due in part to the overall decrease in plume concentration.

Figure 10-3 also presents a graph of the effluent TRCLE concentration versus time. As indicated, the effluent was below 5 μg/L TRCLE for all sampling events in FY 2008. A review of the FY 2008 database indicates that the effluent has also remained below the treatment requirements for all other VOC compounds specified in the OU2 ROD. Comparison of influent and effluent TRCLE concentrations indicates average removal efficiency 99.9 percent.

What was the mass of VOCs emitted into the air?

The air stripping towers remove VOCs with an efficiency of approximately 99.9 percent. Thus, the air emissions are essentially equal to the VOC mass removal rates presented in Table 10-6. Air emissions therefore averaged 6.3 pounds/day based on the VOC mass removal rates. The total VOC emissions from October 2007 through September 2008 were 2,292 pounds.

10.3 REMEDY COMPONENT #3: TREATED WATER DISCHARGE

Description: "Discharge of treated water to the on-site gravel pit." (OU2 ROD, page 3)

Performance Standard (how do you know when you're done):

When the gravel pit is accommodating the discharge from the treatment system and allowing it to recharge to the aquifer.

Is the remedy component being implemented?

Yes. Based on visual observation during FY 2008, there were no noticeable changes in Gravel Pit performance. The Gravel Pit is accommodating the TGRS discharge as designed.

10.4 REMEDY COMPONENT #4: INSTITUTIONAL CONTROLS

Description: "Institutional controls to restrict access to contaminated aquifers and prevent exposure to contaminated groundwater." (OU2 ROD, page 4)

Performance Standard (how do you know when you're done):

When a special well construction area and alternate water supply have been established and private wells in impacted areas have been sealed.

Is the remedy component being implemented?

Yes, although, the institutional controls have not been formally adopted for OU2. There are no private users of groundwater on TCAAP and the TCAAP potable water supply is treated by the TGRS prior to distribution. TCAAP is a government reservation, is fenced, and access is restricted to authorized personnel.

10.5 REMEDY COMPONENT #5: REVIEW OF NEW TECHNOLOGIES

Description: "Reviews of new and emerging technologies that have the potential to cost-effectively accelerate the timeframe for aquifer restoration. Reviews shall be performed by the Army and reported annually in accordance with the consistency provisions of the TCAAP FFA." (OU2 ROD, page 4)

- The intent is to consider new technologies of merit, which is not on any set schedule. To have merit, a new technology must have promise in reducing cost and the time for cleanup. There may be years where no technologies are considered. It is envisioned that at any time, any interested party (Army, USEPA, and MPCA) can suggest new technologies for consideration. At a minimum, the Technical Review Committee meetings can serve as a forum for discussion of possible technologies. If a technology is agreed to have merit by the Army, USEPA, and MPCA, then the Army will evaluate the technology. The level of effort for evaluations can range from simple literature searches to extensive treatability studies. On an annual basis, the Army will report on:

  – Whether or not any new technologies were identified and considered to have merit that year,

  – The progress or results of any evaluations during that year, and

  – Any planned evaluations for the following year.

Performance Standard (how do you know when you're done):
When the Army reports on the status of any reviews of emerging technologies in the annual monitoring report.

Is the remedy component being implemented?
Yes. Beginning with the FY 1997 Annual Performance Report, the Army reports annually on the status of any reviews of emerging technologies.

- In September 2002, the MPCA and USEPA announced they would be conducting a natural attenuation microcosm study using carbon dating. In October 2002, Army drilled a boring at Site G to collect soil for the study. The study results were published in 2004.
- "New technologies" is an ongoing agenda item for the monthly Technical Review Committee meetings between the Army, USEPA, and MPCA. No emerging technologies were identified through the process during FY 2008.
- The MPCA identified a study involving the addition of vegetable oil to groundwater that is being monitored at the Navy site in Fridley, Minnesota, as a potential technology of interest.

Were any new technologies identified and considered to have merit during FY 2008?
No. The Army's review did not identify any new or emerging technologies that have the potential to cost-effectively accelerate the timeframe for aquifer restoration.

What is the status and/or findings of any previously initiated reviews of emerging technologies?
MPCA continued its research into natural attenuation processes at TCAAP. The MPCA and USEPA published the results of the microcosm study for deep groundwater sediments in 2004 showing that abiotic degradation of cis-DCE is an important factor contributing to the natural attenuation of this compound at the site. (*Non-biological Removal of cis-dichloroethylene and*

1,1-dichloroethylene in aquifer sediment containing magnetite. Environmental Science and Technology, 38: 1746-1752.)

Are any new reviews planned at this time for the coming year?

No. The Army will continue to have new technologies on the agenda for the quarterly Technical Review Committee meeting, and attend conferences that highlight emerging and new technologies. However, reviews of specific technologies are not planned in FY 2009.

10.6 REMEDY COMPONENT #6: GROUNDWATER MONITORING

Description: "Groundwater monitoring to track remedy performance." (OU2 ROD, page 4)

Performance Standard (how do you know when you're done):

When a regulator approved monitoring plan is in place and monitoring is conducted according to the plan.

Is the remedy component being implemented?

Yes. Monitoring in FY 2008 was consistent with the OU2 ROD. Water level measurements and water quality samples were collected as stated in Appendix A.1. Appendix A summarizes the FY 2008 monitoring plan and any deviations are explained in Appendix C.2. Monitoring was as follows:

<u>Groundwater</u>

TGRS groundwater level measurements were collected during December 2007 and June 2008 according to the monitoring plan. Appendix D contains the comprehensive groundwater quality and water level database for the TGRS monitoring wells. Water quality samples were collected from TGRS wells according to the monitoring plan. Groundwater samples were collected at wells stated in Appendix A.1. All wells were sampled for volatile organic compound (VOC)

(8260B) analysis. FY 2008 was a “small round” year in the biennial sample program, so only a select list of wells was sampled. Table 10-8 presents the groundwater quality data for FY 2008.

Results from the 2008 groundwater sampling showed that many of the wells continued to have declining or stable TRCLE concentrations. The most notable decreases were at 03U708 (steady decrease from 270 μg/L in 2002 to 41 μg/L in 2008) and 03U711 (steady decrease from 250 μg/L in 2004 to 90 μg/L in 2008). Several wells showed a slight increase in TRCLE concentration in 2008; however, the general trend at these wells since 1999 appears to be declining or stable. The increases were most notable at 03U801 (15 μg/L in 2007 to 47 μg/L in 2008), 04U806 (96 μg/L in 2007 to 380 μg/L in 2008), and 03M806 (520 μg/L in 2007 to 680 μg/L in 2008).

The TGRS OS estimated the width of the 5 μg/L TRCLE plume at the source area to be 3,600 feet based on FY 2001 analytical data. Since that time, 9.6 tons of VOCs have been removed from the groundwater. TRCLE concentrations are decreasing across the site, especially those at the following wells that are now below 5 μg/L since 2001: B10, 03L833, 04U833, 04U702, 04J702, 03U701, and 04U701. Monitoring well 03U672 along the southern end outside 5 μg/L TRCLE plume has decreased from 3.1 μg/L to not detectable (below 1 μg/L) in 2007.

Treatment System

The TGRS treatment system influent and effluent was sampled monthly during FY 2008 in accordance with the FY 2008 monitoring plan. Groundwater samples from the extraction wells were collected in December 2007 and June 2008 in accordance with the FY 2008 monitoring plan.

Is additional monitoring proposed prior to the next report?

No additional monitoring for FY 2009 is proposed beyond that presented in the Monitoring Plan (Appendix A) of the FY 2007 APR. Table 10-9 and Appendix A of this report provide FY 2009 monitoring requirements.

10.7 OVERALL REMEDY FOR DEEP GROUNDWATER

Did the TGRS meet the requirements of the OU2 ROD? Yes.

- Hydraulic capture in Unit 3 extends beyond the 5 μg/L TRCLE contour. This meets the VOC capture criterion in the OU2 ROD. Hydraulic capture in Unit 4 extends beyond the 5 μg/L TRCLE contour. This meets the VOC capture criterion in the OU2 ROD.
- The total extraction well water pumped was above the Total System Operational Minimum (1,745 gpm). The FY 2008 extraction well water pumped was approximately 1,790 gpm.
- The TGRS extracted and treated 943,318,161 gallons of water and removed 2,292 pounds of VOCs from October 2007 to September 2008. Average VOC influent concentrations decreased by 5.5% from FY 2007.
- Groundwater analytical data of the source area shows a general decrease in TRCLE concentration. This demonstrates that the TGRS is effectively removing VOC mass from the aquifer.
- Effluent VOC concentrations were below contaminant-specific requirements for all sampling events.

Do any additional measures need to be addressed?
Not at this time.

TABLE 10-1

GROUNDWATER CLEANUP LEVELS
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Substance	***Expected Level in Discharge (ppb)***	***Operable Unit 2 Rod Requirements (ppb)***
Volatile Organic Compounds (VOCs)		
cis-1,2-Dichloroethene plus trans-1,2-Dichloroethene	<1	70
1,1-Dichloroethene	<1	6
1,1,1-Trichloroethane	<1	200
1,2-Dichloroethane	<1	4
Trichloroethene	<5	5
1,1-Dichloroethane	<1	70
Tetrachloroethene	<1	5

TABLE 10-2

EXTRACTION WELL WATER PUMPED
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

	Volume of Water Pumped (gallons)												
	B1	***B3***	***B4***	***B5***	***B6***	***B8***	***B9***	***B11***	***B13***	***SC1***	***SC2***	***SC5***	***TOTAL***
October 2007	10,279,700	7,894,300	9,407,400	8,960,300	8,741,800	4,844,500	13,189,600	4,248,100	5,018,000	1,108,600	948,100	4,821,300	79,461,700
(gpm)	230	177	211	201	196	109	295	95	112	25	21	108	1,780
November 2007	10,129,700	7,515,800	7,832,200	8,778,400	8,483,600	6,712,800	13,167,900	4,014,400	4,964,900	1,014,600	898,000	4,744,200	78,256,500
(gpm)	234	174	181	203	196	155	305	93	115	23	21	110	1,811
December 2007	10,102,000	7,787,700	9,596,200	9,029,500	8,472,100	6,889,400	13,413,900	3,929,700	5,141,900	1,134,800	803,000	4,777,600	81,077,800
(gpm)	226	174	215	202	190	154	300	88	115	25	18	107	1,816
January 2008	10,601,100	8,110,300	4,580,900	9,486,800	9,031,600	7,195,000	13,855,300	4,497,400	5,406,400	1,521,800	669,300	4,636,400	79,592,300
(gpm)	237	182	103	213	202	161	310	101	121	34	15	104	1,783
February 2008	9,900,000	7,669,100	5,804,800	8,728,200	8,328,300	7,947,200	13,021,900	4,171,500	5,012,300	1,390,700	537,700	4,332,600	76,844,300
(gpm)	237	184	139	209	199	190	312	100	120	33	13	104	1,840
March 2008	10,222,800	7,846,300	10,589,400	8,922,600	8,580,900	5,270,900	13,447,100	4,187,500	3,622,000	1,054,500	481,600	4,533,300	78,772,000
(gpm)	229	176	237	200	192	118	301	94	81	24	11	102	1,765
April 2008	9,839,600	7,500,300	9,191,300	8,552,500	8,273,800	9,155,300	13,048,100	4,031,400	3,165,800	927,100	238,100	4,435,300	78,358,600
(gpm)	228	174	213	198	192	212	302	93	73	21	6	103	1,814
May 2008	10,063,600	7,736,700	9,421,300	8,771,900	10,599,300	8,027,500	13,380,200	4,143,800	3,086,400	949,800	424,200	4,632,400	81,237,100
(gpm)	225	173	211	197	237	180	300	93	69	21	10	104	1,820
June 2008	9,532,600	7,482,500	9,696,200	8,542,800	9,575,100	5,621,100	12,986,900	3,933,500	4,417,400	880,900	1,312,500	4,272,900	78,254,400
(gpm)	221	173	224	198	222	130	301	91	102	20	30	99	1,811
July 2008	9,237,600	7,915,300	8,893,400	8,168,300	9,974,200	6,026,000	11,391,000	3,428,400	4,384,400	829,300	1,890,100	4,079,100	76,217,100
(gpm)	207	177	199	183	223	135	255	77	98	19	42	91	1,707
August 2008	9,779,600	6,678,100	9,793,200	9,404,200	10,842,500	5,828,900	9,786,400	4,249,864	4,521,100	1,000,917	2,471,145	4,206,736	78,562,661
(gpm)	219	150	219	211	243	131	219	95	101	22	55	94	1,760
September 2008	9,432,300	6,985,600	10,295,700	8,867,400	10,477,400	6,117,500	9,191,500	4,140,600	4,536,100	967,800	1,710,700	3,961,100	76,683,700
(gpm)	218	162	238	205	243	142	213	96	105	22	40	92	1,775
TOTAL FY 2008	**119,120,600**	**91,122,000**	**105,102,000**	**106,212,900**	**111,380,600**	**79,636,100**	**149,879,800**	**48,976,164**	**53,276,700**	**12,780,817**	**12,384,445**	**53,432,936**	**943,318,161**
Operational Minimum (gpm)	225	170	195	195	210	135	275	80	110	20	30	100	1,745

	B11, B1, B13	B4, B5, B6	B4, B5, B6, B8, B9	Total System
FY08 Average Flow Rate (gpm)	420	612	1048	1,790
MOS Operational Minimum (gpm)	415	600	1,010	1,745

TABLE 10-3

TREATMENT CENTER WATER METER TOTALS
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

	Volume of Water Pumped (gallons)									
	Extraction Wells	*Meter 1*	*Meter 2*	*Total Meters 1 & 2*	*Meter 3*	*Meter 4*	*Total Meters 3 & 4*	*Meter 5*	*Meter 6*	*Total Meters 5 & 6*
October 2007	79,461,700	37,739,000	41,552,000	79,291,000	21,153,000	63,051,000	84,204,000	0	0	0
November 2007	78,256,500	36,335,000	41,558,000	77,893,000	18,600,000	63,503,000	82,103,000	0	0	0
December 2007	81,077,800	37,361,000	42,816,000	80,177,000	17,067,000	67,739,000	84,806,000	0	0	0
January 2008	79,592,300	36,511,000	41,642,000	78,153,000	18,511,000	64,264,000	82,775,000	0	0	0
February 2008	76,844,300	34,921,000	40,619,000	75,540,000	17,909,000	62,187,000	80,096,000	0	0	0
March 2008	78,772,000	36,556,000	43,192,000	79,748,000	17,559,000	67,040,000	84,599,000	0	0	0
April 2008	78,358,600	36,299,000	42,465,000	78,764,000	16,955,000	66,683,000	83,638,000	0	0	0
May 2008	81,237,100	34,051,000	47,496,000	81,547,000	16,188,000	70,805,000	86,993,000	0	0	0
June 2008	78,254,400	31,665,000	46,284,000	77,949,000	16,785,000	66,280,000	83,065,000	0	0	0
July 2008	76,217,100	32,676,000	43,133,000	75,809,000	17,395,000	63,482,000	80,877,000	0	0	0
August 2008	78,562,661	35,845,615	41,159,095	77,004,709	18,749,430	63,737,620	82,487,050	0	0	0
September 2008	76,683,700	34,330,000	40,718,000	75,048,000	20,263,000	59,946,000	80,209,000	0	0	0
TOTAL FY 2008	943,318,161	424,289,615	512,634,095	936,923,709	217,134,430	778,717,620	995,852,050	0	0	0

TABLE 10-3

TREATMENT CENTER WATER METER TOTALS
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

	Volume of Water Pumped (gallons)									
	Extraction Wells	*Meter 1*	*Meter 2*	*Total Meters 1 & 2*	*Meter 3*	*Meter 4*	*Total Meters 3 & 4*	*Meter 5*	*Meter 6*	*Total Meters 5 & 6*
FY89	1,033,353,676	501,826,000	560,836,000	1,062,662,000	383,736,000	587,596,000	971,332,000	493,681,000	582,955,000	1,076,636,000
FY90	1,008,415,750	493,915,000	526,417,000	1,020,332,000	371,391,000	588,642,000	960,033,000	487,946,000	543,726,000	1,031,672,000
FY91	1,382,327,590	666,166,000	708,313,000	1,374,479,000	523,702,000	789,947,000	1,313,649,000	601,307,000	649,621,000	1,250,928,000
FY92	1,401,346,600	68,289,000	724,328,000	1,407,227,000	557,169,000	772,509,000	1,329,678,000	767,707,000	677,735,000	1,445,442,000
FY93	1,388,206,172	666,814,000	725,341,000	1,392,155,000	504,027,000	651,149,000	1,155,176,000	729,078,000	762,791,000	1,491,869,000
FY94	1,245,663,275	660,700,000	659,953,000	1,320,653,000	457,210,000	715,668,000	1,172,878,000	653,913,000	550,131,000	1,204,044,000
FY95	1,369,361,500	706,114,000	683,982,000	1,390,096,000	500,275,000	739,744,000	1,240,019,000	495,616,000	274,507,000	770,123,000
FY96	1,341,763,220	734,443,000	629,327,000	1,363,770,000	503,518,000	754,399,000	1,257,917,000	4,000	600,035,000	600,039,000
FY97	1,213,035,110	688,312,000	568,804,600	1,257,116,600	538,625,000	586,515,000	1,125,140,000	13,000	578,900,000	578,913,000
FY98	1,196,007,900	624,784,000	540,353,000	1,220,604,000	511,065,000	603,871,000	1,114,936,000	58,000	178,076,000	178,134,000
FY99	1,158,224,870	623,500,000	496,773,200	1,177,206,200	398,620,000	718,384,000	1,117,004,000	26,000	17,000	43,000
FY 2000	1,148,448,350	635,724,000	489,669,000	1,183,258,000	389,709,000	663,807,000	1,053,516,000	0	0	0
FY 2001	1,113,163,360	614,341,000	443,167,000	1,113,164,000	318,517,000	718,661,000	1,037,178,000	0	0	0
FY 2002	917,318,879	491,082,800	434,959,700	926,042,500	225,460,000	650,839,000	876,299,000	0	0	0
FY 2003	904,295,450	545,281,000	345,993,000	891,274,000	125,965,000	750,518,000	876,483,000	0	0	0
FY 2004	908,718,760	518,391,900	376,889,660	895,281,560	216,177,000	680,633,000	896,810,000	0	0	0
FY 2005	895,339,710	520,073,000	363,275,000	883,348,000	224,823,000	658,405,000	883,228,000	0	0	0
FY 2006	929,715,590	534,305,000	377,499,000	911,804,000	266,299,000	669,900,000	936,199,000	0	0	0
FY 2007	945,317,300	447,901,000	487,701,000	935,602,000	281,061,000	833,161,000	1,114,222,000	0	0	0
FY 2008	943,318,161	424,289,615	512,634,095	936,923,709	217,134,430	778,717,620	995,852,050	0	0	0

TABLE 10-4

PUMPHOUSE DOWN TIME (DAYS)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Well Name	*FY08 Down Time (Days)*	*FY07 Down Time (Days)*	*FY06 Down Time (Days)*	*FY05 Down Time (Days)*	*FY04 Down Time (Days)*
B1	4.4	10.6	6.9	11.5	7.1
B2	(1)	(1)	(1)	(1)	(1)
B3	9.5	6.4	23.5	34.0	11.3
B4	34.7	6.0	10.4	26.2	7.6
B5	3.4	1.3	27.1	13.9	7.6
B6	4.5	2.2	11.9	15.6	15.4
B7	(1)	(1)	(1)	(1)	(1)
B8	21.7	8.6	34.6	18.5	10.0
B9	5.4	10.2	20.8	23.1	8.4
B10	(1)	(1)	(1)	(1)	(1)
B11	6.0	12.4	24.9	22.7	15.5
B12	(1)	(1)	(1)	(1)	(1)
B13	15.2	6.2	14.1	13.7	12.8
SC1	5.8	8.9	13.4	21.8	17.8
SC2	11.9	21.8	17.5	13.9	11.4
SC3	(1)	(1)	(1)	(1)	(1)
SC4	(1)	(1)	(1)	(1)	(1)
SC5	3.9	18.5	37.1	11.9	24.8

Note:
(1) The extraction well was not in operation during the fiscal year.

TABLE 10-5

DOWN TIME (DAYS) BY CATEGORY
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Category	*Down Time (Days)*
Pumphouse Component	5.8
Treatment Center Component	0.5
Electrical Service	3.9
Miscellaneous	0.0
Preventive Maintenance	0.0
System Modification	0.3
Forcemain	0.0
Total System Equivalent	10.5
Anticipated Down Time for Fiscal Year 2009	
Pumphouse Component	3.5
Treatment Center Component	3.0
Electrical Service	1.0
Miscellaneous	0.1
Preventive Maintenance	3.5
System Modification	1.0
Forcemain	2.0

TABLE 10-6

VOC MASS LOADING SUMMARY
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Well	*Percent Contribution to VOC Mass Removal*	*FY 2008 Total Pounds VOCs Mass Removed*
B1	5.1%	117.9
B2[1]	0.0%	0.0
B3	0.3%	5.9
B4	6.8%	156.8
B5	6.0%	137.1
B6	3.3%	75.6
B7[1]	0.0%	0.0
B8	0.7%	15.4
B9	5.5%	126.6
B10[1]	0.0%	0.0
B11	0.0%	0.7
B12[1]	0.0%	0.0
B13	3.0%	67.7
SC1	3.3%	75.8
SC2	0.2%	4.3
SC3[1]	0.0%	0.0
SC4[1]	0.0%	0.0
SC5	65.8%	1,508
Fiscal Year 2008 Total (lbs)		***2,292***
Daily Average (lbs/day)		***6.3***

[1] Extraction well was not in operation during the fiscal year.

HISTORICAL TOTAL

Fiscal Year		*Pounds VOC Mass Removed*
2008		2,292
2007		2,507
2006		2,552
2005		2,663
2004		3,291
2003		3,041
2002		2,852
2001		3,418
2000		4,499
1999		4,878
1998		6,132
1997		6,210
1996		10,655
1995		13,355
1994		15,070
1993		20,165
1992		24,527
1991		26,760
1990		18,005
1989	(First year of full scale system)	19,510
1988		4,800
1987		2,100
Total		***199,282***

TABLE 10-7

VOC CONCENTRATIONS IN TGRS EXTRACTION WELLS (µg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Location	*Alias*	*Date*	*Dup*	*1,1,1-Trichloroethane* *µg/L*	*1,1,2-Trichloroethane* *µg/L*	*1,1-Dichloroethane* *µg/L*	*1,1-Dichloroethene* *µg/L*	*1,2-Dichloroethane* *µg/L*	*Carbon Tetrachloride* *µg/L*	*Chloroform* *µg/L*
03F302	B1	12/13/07		6.6	0.47 JP	1.4	2	< 1	< 1	< 1
03F302	B1	12/13/07	D	6.8	0.45 JP	1.5	2.1	< 1	< 1	< 1
03F302	B1	6/11/08		7.5	0.45 JP	1.5	2.1	< 1	< 1	0.19 JP
03F303	B2	6/18/08		< 1	1.9	0.4 JP	0.96 JP	< 1	< 1	< 1
03F304	B3	12/13/07		0.7 JP	< 1	0.85 JP	1	< 1	< 1	< 1
03F304	B3	6/11/08		0.92 JP	< 1	1	1.2	< 1	< 1	< 1
03F305	B4	12/13/07		13	< 1	10	9.1	< 1	< 1	< 1
03F305	B4	6/11/08		14	< 1	9.8	9.4	< 1	< 1	0.26 JP
03F306	B5	12/13/07		5.8	< 1	4.8	4.4	< 1	< 1	< 1
03F306	B5	6/11/08		6.3	< 1	5.1	5	< 1	< 1	< 1
03F307	B6	12/13/07		1.5	< 1	2.3	2.3	< 1	< 1	< 1
03F307	B6	6/11/08		1.6	< 1	2.5	2.4	< 1	< 1	< 1
03F312	B11	12/13/07		< 1	< 1	< 1	< 1	< 1	< 1	< 1
03F312	B11	6/11/08		< 1	< 1	0.17 JP	< 1	< 1	< 1	< 1

TABLE 10-7

VOC CONCENTRATIONS IN TGRS EXTRACTION WELLS (µg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Location	Alias	Date	Dup	*1,1,1-Trichloroethane* µg/L		*1,1,2-Trichloroethane* µg/L		*1,1-Dichloroethane* µg/L		*1,1-Dichloroethene* µg/L		*1,2-Dichloroethane* µg/L		*Carbon Tetrachloride* µg/L		*Chloroform* µg/L	
03F319	B13	12/13/07		3.7		< 1		1.3		1.3		< 1		< 1		< 1	
03F319	B13	6/11/08		5.1		< 1		1.7		1.8		< 1		< 1		< 1	
03U301	SC1	12/13/07		11	JS141, JD21	< 2		1.3	JS127	2.5	JS142, JS23	< 2		< 2	JD28	< 2	
03U301	SC1	6/11/08		9.1		< 2		1.2	JP	1.9	JP	< 2		< 2		0.36	JP
03U314	SC2	12/13/07		6		< 1		1.2		1.3		< 1		< 1		< 1	
03U314	SC2	6/11/08		3.6		< 1		0.9	JP	0.65	JP	< 1		< 1		< 1	
03U317	SC5	12/13/07		990		1.7	JP	23		68		< 5		< 5		< 5	
03U317	SC5	6/11/08		830		1.7	JP	19		42		< 5		< 5		< 5	
03U317	SC5	6/11/08	D	850		1.6	JP	20		41		< 5		< 5		< 5	
PJ#309	B8	12/13/07		1.6		< 1		0.94	JP	1.1		< 1		< 1		< 1	
PJ#309	B8	6/11/08		2.3		< 1		1.3		1.6		< 1		< 1		< 1	
PJ#310	B9	12/13/07		8.4		< 1		6.3		6.5		< 1		< 1		< 1	
PJ#310	B9	6/11/08		9.5		< 1		7.2		7.7		< 1		< 1		< 1	

TABLE 10-7

VOC CONCENTRATIONS IN TGRS EXTRACTION WELLS (µg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Location	*Alias*	*Date*	*Dup*	*cis-1,2-Dichloroethene*	*Freon 113*	*Methylene Chloride*	*Tetrachloroethene*	*trans-1,2-Dichloroethene*	*Trichloroethene*	*Vinyl Chloride*
				µg/L	*µg/L*	*µg/L*	*µg/L*	*µg/L*	*µg/L*	*µg/L*
03F302	B1	12/13/07		6.8	< 1	< 1	2.7	< 1	110	< 1
03F302	B1	12/13/07	D	6.9	< 1	< 1	2.9	< 1	110	< 1
03F302	B1	6/11/08		6.7	< 1	< 1	2.6 JC 23.0	< 1	130	< 1
03F303	B2	6/18/08		1.5	< 1	< 1	0.49 JP	< 1	22	< 1
03F304	B3	12/13/07		0.35 JP	< 1	< 1	< 1	< 1	5.7	< 1
03F304	B3	6/11/08		0.25 JP	< 1	< 1	< 1 JC 23.0	< 1	6.4	< 1
03F305	B4	12/13/07		5.3	< 1	< 1	< 1	< 1	190	< 1
03F305	B4	6/11/08		4.6	< 1	< 1	< 1 JC 23.0	0.16 JP	160	< 1
03F306	B5	12/13/07		1.1	< 1	< 1	6.6	< 1	150	< 1
03F306	B5	6/11/08		1	< 1	< 1	6.2 JC 23.0	< 1	170	< 1
03F307	B6	12/13/07		0.57 JP	< 1	< 1	< 1	< 1	85	< 1
03F307	B6	6/11/08		0.59 JP	< 1	< 1	< 1 JC 23.0	< 1	93	< 1
03F312	B11	12/13/07		< 1	< 1	< 1	< 1	< 1	1.9	< 1
03F312	B11	6/11/08		< 1	< 1	< 1	< 1 JC 23.0	< 1	1.8	< 1

TABLE 10-7

VOC CONCENTRATIONS IN TGRS EXTRACTION WELLS (µg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Location	*Alias*	*Date*	*Dup*	*cis-1,2-Dichloroethene* µg/L		*Freon 113* µg/L		*Methylene Chloride* µg/L		*Tetrachloroethene* µg/L		*trans-1,2-Dichloroethene* µg/L		*Trichloroethene* µg/L		*Vinyl Chloride* µg/L	
03F319	B13	12/13/07		6.9		< 1		< 1		0.85	JP	< 1		160		< 1	
03F319	B13	6/11/08		8.2		< 1		< 1		0.94	JC 23.0,JP	< 1		170		< 1	
03U301	SC1	12/13/07		78		< 2	JD37	< 2		< 2	JD37	0.73	JS131	800	JS161, JD25	< 2	JD23
03U301	SC1	6/11/08		60		< 2		< 2		< 2	JC 23.0	0.62	JP	700		< 2	
03U314	SC2	12/13/07		0.55	JP	< 1		< 1		< 1		< 1		45		< 1	
03U314	SC2	6/11/08		0.45	JP	< 1		< 1		< 1	JC 23.0 JS 73.3	< 1		41		< 1	
03U317	SC5	12/13/07		2.6	JP	14		< 5	UB1.1	7		< 5		3200		< 5	
03U317	SC5	6/11/08		2.3	JP	12		< 5	UB 0.71,JP	4.3	JC 23.0,JP	< 5		2900		< 5	
03U317	SC5	6/11/08	D	2.4	JP	13		< 5	UB 0.71,JP	5.1	JC 23.0	< 5		2600		< 5	
PJ#309	B8	12/13/07		0.38	JP	< 1		< 1		< 1		< 1		19		< 1	
PJ#309	B8	6/11/08		0.53	JP	< 1		< 1		< 1	JC 23.0	< 1		26		< 1	
PJ#310	B9	12/13/07		2.4		< 1		< 1		< 1		< 1		90		< 1	
PJ#310	B9	6/11/08		2.5		< 1		< 1		< 1	JC 23.0	< 1		100		< 1	

Notes:
D - Field Duplicate
JP - Result is qualified as estimated since the detection is below the laboratory quantitation limit.
JS - Result is qualified as estimated due to MS/MSD % recoveries above the upper control limit.
JD - Result is qualified as estimated due to relative percent difference (RPD) above the control limit.
JC- Result is qualified as estimated due to calibration verification % D outside the control limit.
UB - Result is qualified nondetect based on associated blank detection.

TABLE 10-8

GROUNDWATER QUALITY DATA (µg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Location	*Date*	*Dup*	*1,1,1-Trichloroethane*	*1,1,2-Trichloroethane*	*1,1-Dichloroethane*	*1,1-Dichloroethene*	*1,2-Dichloroethane*
TGRS Cleanup Level [1]			*200 µg/L*	*µg/L*	*70 µg/L*	*6 µg/L*	*4 µg/L*
03L802	6/16/08		< 1	< 1	< 1	< 1	< 1
03L806	6/13/08		2	0.65 JP	47	35	< 1
03L806	6/13/08	D	2.1	0.64 JP	45	34	< 1
03M802	6/16/08		< 1	< 1	< 1	< 1	< 1
03M806	6/13/08		0.42 JP	< 1	85	43	< 1
03U003	8/21/08		24	< 1	2.3	4.1	< 1
03U093	6/18/08		57	< 1	0.38 JP	3.9	< 1
03U094	6/18/08		36	< 1	4	4.1	< 1
03U099	6/16/08		2.4	< 1	< 1	0.22 JP	< 1
03U708	6/13/08		5.4	< 1	1 JP	1.7	< 1

TABLE 10-8

GROUNDWATER QUALITY DATA (µg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

				1,1,1-Trichloroethane			1,1,2-Trichloroethane			1,1-Dichloroethane		1,1-Dichloroethene		1,2-Dichloroethane
TGRS Cleanup Level [1]				200						70		6		4
				µg/L			µg/L			µg/L		µg/L		µg/L
Location	*Date*	*Dup*												
03U711	6/16/08			11		<	1			3.3		4.2	<	1
03U801	6/16/08		<	1		<	1		<	1	<	1	<	1
03U806	6/13/08		<	1		<	1			2.2		1.5	<	1
04J077	6/13/08			16		<	1			24		21	<	1
04U711	6/16/08		<	1		<	1		<	1	<	1	<	1
04U802	6/16/08		<	1		<	1		<	1	<	1	<	1
04U806	6/13/08			3.7			0.47	JP		44		36	<	1
04U833	6/13/08		<	1		<	1		<	1	<	1	<	1
PJ#806	6/13/08			0.7	JP	<	1			3.8		2.9	<	1

TABLE 10-8

GROUNDWATER QUALITY DATA (µg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Location	*Date*	*Dup*		*Carbon Tetrachloride*			*Chloroform*			*cis-1,2-Dichloroethene*			*Freon 113*		*Methylene Chloride*	
TGRS Cleanup Level (1)										70						
				µg/L			*µg/L*			*µg/L*			*µg/L*		*µg/L*	
03L802	6/16/08		<	1	<	1		<	1		<	1	<	1		
03L806	6/13/08		<	1	<	1			3.8		<	1	<	1		
03L806	6/13/08	D	<	1	<	1			3.8		<	1	<	1		
03M802	6/16/08		<	1	<	1			0.7	JP	<	1	<	1		
03M806	6/13/08		<	1	<	1			8		<	1	<	1		
03U003	8/21/08		<	1	<	1	UB 0.33, JP		7.8		<	1	<	1	UB 0.64, JP	
03U093	6/18/08		<	1		0.17	JP		2.3		<	1	<	1		
03U094	6/18/08		<	1		0.37	JP		3.7		<	1	<	1		
03U099	6/16/08		<	1	<	1		<	1		<	1	<	1		
03U708	6/13/08		<	1		1.4			0.59	JP	<	1	<	1		

TABLE 10-8

GROUNDWATER QUALITY DATA (µg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

			Carbon Tetrachloride	Chloroform	cis-1,2-Dichloroethene	Freon 113	Methylene Chloride
TGRS Cleanup Level [1]					70		
			µg/L	µg/L	µg/L	µg/L	µg/L
Location	*Date*	*Dup*					
03U711	6/16/08		< 1	0.31 JP	1.3	< 1	< 1
03U801	6/16/08		< 1	< 1	0.81 JP	< 1	< 1
03U806	6/13/08		< 1	< 1	0.36 JP	< 1	< 1
04J077	6/13/08		< 1	< 1	7.1	< 1	< 1
04U711	6/16/08		< 1	< 1	< 1	< 1	< 1
04U802	6/16/08		< 1	< 1	< 1	< 1	< 1
04U806	6/13/08		< 1	< 1	4.5	< 1	< 1 UB 0.24,JP
04U833	6/13/08		< 1	< 1	< 1	< 1	< 1
PJ#806	6/13/08		< 1	< 1	0.37 JP	< 1	< 1

TABLE 10-8

GROUNDWATER QUALITY DATA (µg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Location	*Date*	*Dup*		*Tetrachloroethene*			*trans-1,2-Dichloroethene*		*Trichloroethene*		*Vinyl Chloride*	
TGRS Cleanup Level [(1)]				*5*					*5*			
				µg/L			*µg/L*		*µg/L*		*µg/L*	
03L802	6/16/08		<	1		<	1		3.2	<	1	
03L806	6/13/08			0.58	JP	<	1		240		0.39	JP
03L806	6/13/08	D		0.56	JP	<	1		240		0.4	JP
03M802	6/16/08		<	1		<	1		8.5	<	1	
03M806	6/13/08		<	1			0.35	JP	680		3	
03U003	8/21/08		<	1		<	1		150	<	1	
03U093	6/18/08		<	1		<	1		82	<	1	
03U094	6/18/08		<	1		<	1		110	<	1	
03U099	6/16/08		<	1	JS 65.2	<	1		5.5	<	1	
03U708	6/13/08			1.5		<	1		41	<	1	

TABLE 10-8

GROUNDWATER QUALITY DATA (μg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

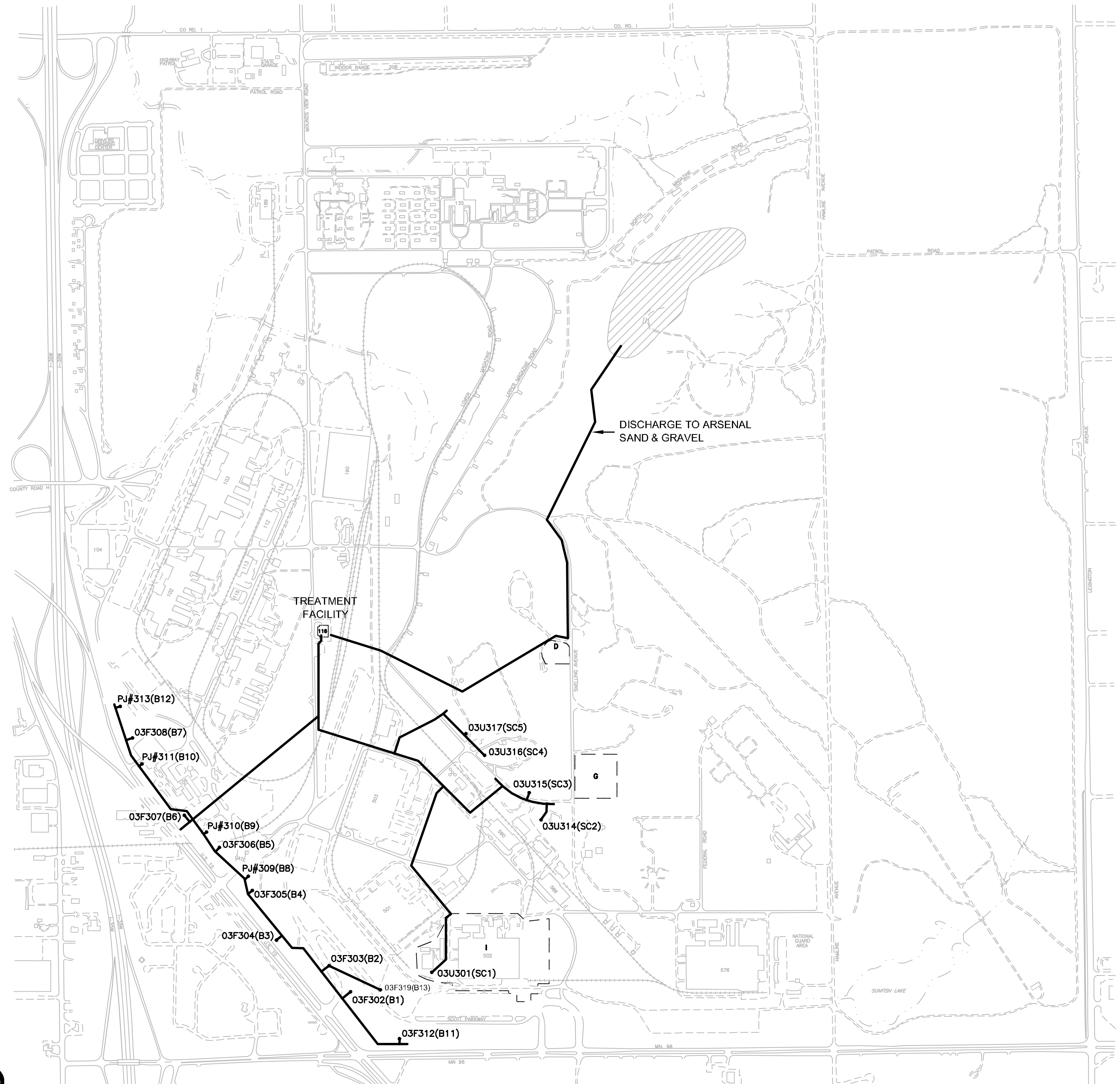
				Tetrachloroethene			*trans-1,2-Dichloroethene*		*Trichloroethene*			*Vinyl Chloride*	
TGRS Cleanup Level [1]				5					5				
				μg/L			*μg/L*		*μg/L*			*μg/L*	
Location	*Date*	*Dup*											
03U711	6/16/08			0.91	JP	<	1		90		<	1	
03U801	6/16/08		<	1		<	1		47			0.5	JP
03U806	6/13/08			1.3		<	1		76		<	1	
04J077	6/13/08			0.32	JP	<	1		200		<	1	
04U711	6/16/08		<	1		<	1		0.62	JP	<	1	
04U802	6/16/08		<	1		<	1		0.51	JP	<	1	
04U806	6/13/08			0.69	JP	<	1		380			0.63	JP
04U833	6/13/08		<	1		<	1		1.7		<	1	
PJ#806	6/13/08		<	1		<	1		44		<	1	

Notes:
(1) Cleanup levels for TGRS are from the OU2 ROD. Shading indicates exceedence of the cleanup level.
D - Field Duplicate
JP - Result is qualified as estimated since the detection is below the laboratory quantitation limit
JS - Result is qualified as estimated due to MS/MSD % recoveries above the upper control limit.
UB - Result is qualified nondetect based on associated blank detection.

TABLE 10-9

SUMMARY OF OU2 DEEP GROUNDWATER MONITORING REQUIREMENTS
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Remedy Component	*Monitoring Requirements*	*Implementing Party*	*Documents Containing the Monitoring Plan*
#1 Hydraulic Containment and Mass Removal	a. Water levels to draw contour maps showing hydraulic zone of capture	Alliant/Army	Deep groundwater monitoring plan in Annual Report
	b. Pumping volumes and rates for comparison to design rates	Alliant/Army	Deep groundwater monitoring plan in Annual Report
	c. Influent and extraction well water quality for overall mass removal calculations	Alliant/Army	Deep groundwater monitoring plan in Annual Report
#2 Groundwater Treatment	• Outlined below	Alliant/Army	Deep groundwater monitoring plan in Annual Report
#3 Treated Water Discharge	• Effluent monitoring to verify attainment of treatment requirements	Alliant/Army	Deep groundwater monitoring plan in Annual Report
#4 Institutional Controls	• None	Alliant/Army	Deep groundwater monitoring plan in Annual Report
#5 Review of New Technologies	• None	Alliant/Army	Deep groundwater monitoring plan in Annual Report
#6 Groundwater Monitoring	• As above	Alliant/Army	Deep groundwater monitoring plan in Annual Report
Overall Remedy	a. Groundwater quality to verify attainment of clean up goals	Alliant/Army	Deep groundwater monitoring plan in Annual Report



N

0 400 1200ft

LEGEND

PRIMARY ROAD
SECONDARY ROAD
RAILROAD
DRAINAGE
BUILDING
BUILDING REMOVED
SOURCE AREA
WELL LOCATION

EXTRACTION WELL NAME CROSS REFERENCE

B1	03F302
B2	03F303
B3	03F304
B4	03F305
B5	03F306
B6	03F307
B7	03F308
B8	PJ#309
B9	PJ#310
B10	PJ#311
B11	03F312
B12	PJ#313
B13	03F319
SC1	03U301
SC2	03U314
SC3	03U315
SC4	03U316
SC5	03U317

figure 10-1

TGRS LAYOUT
TWIN CITIES ARMY AMMUNITION PLANT
Arden Hills, Minnesota

051119--43(004)GN-SP001 Dec 05/2008

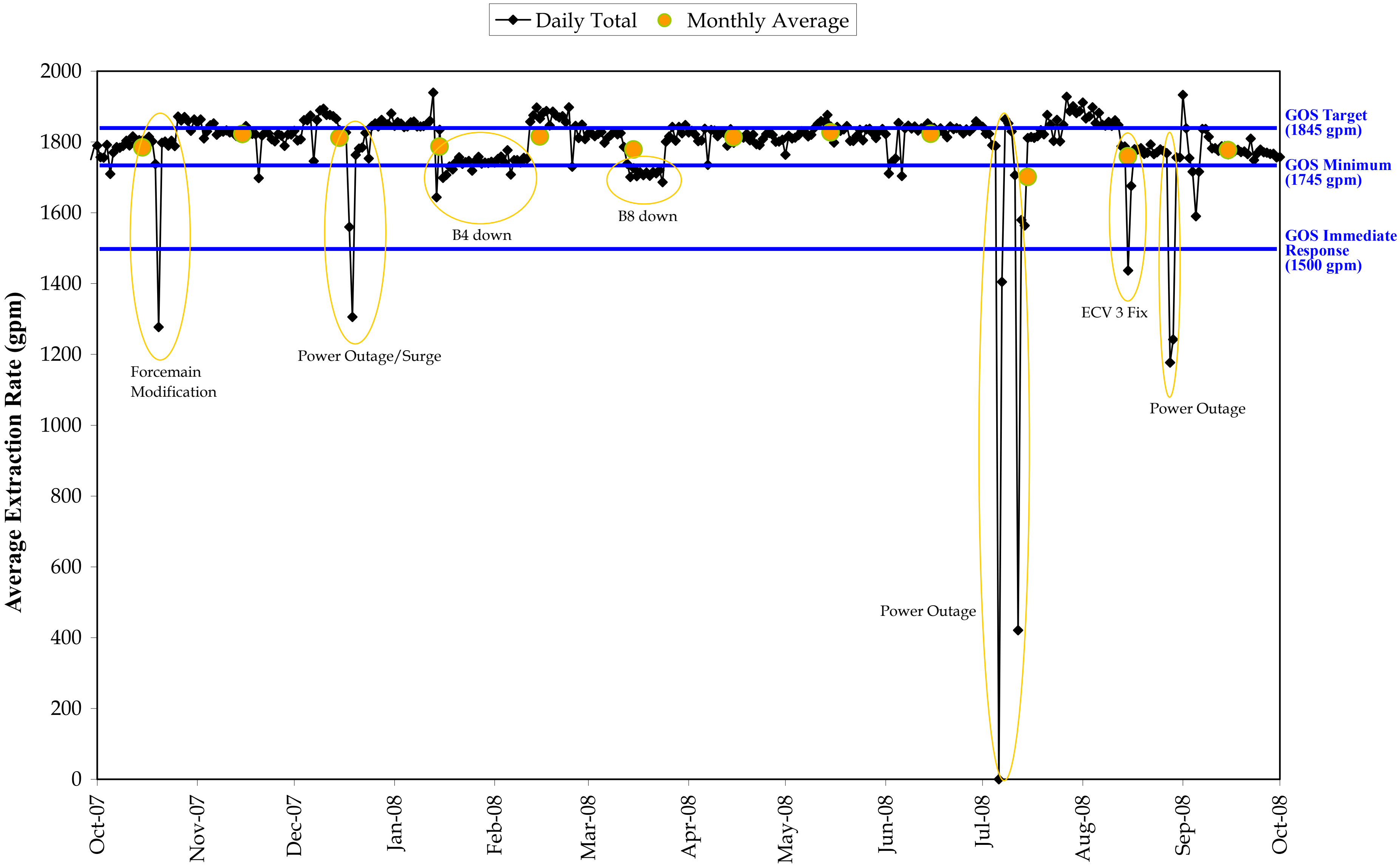
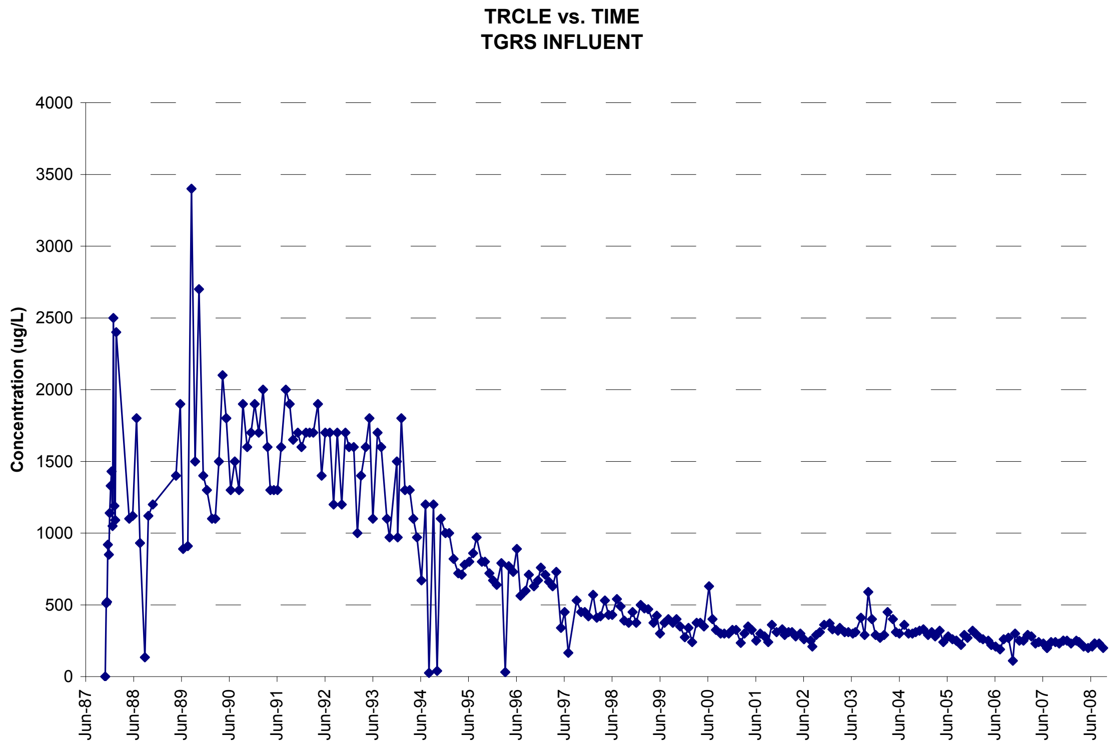
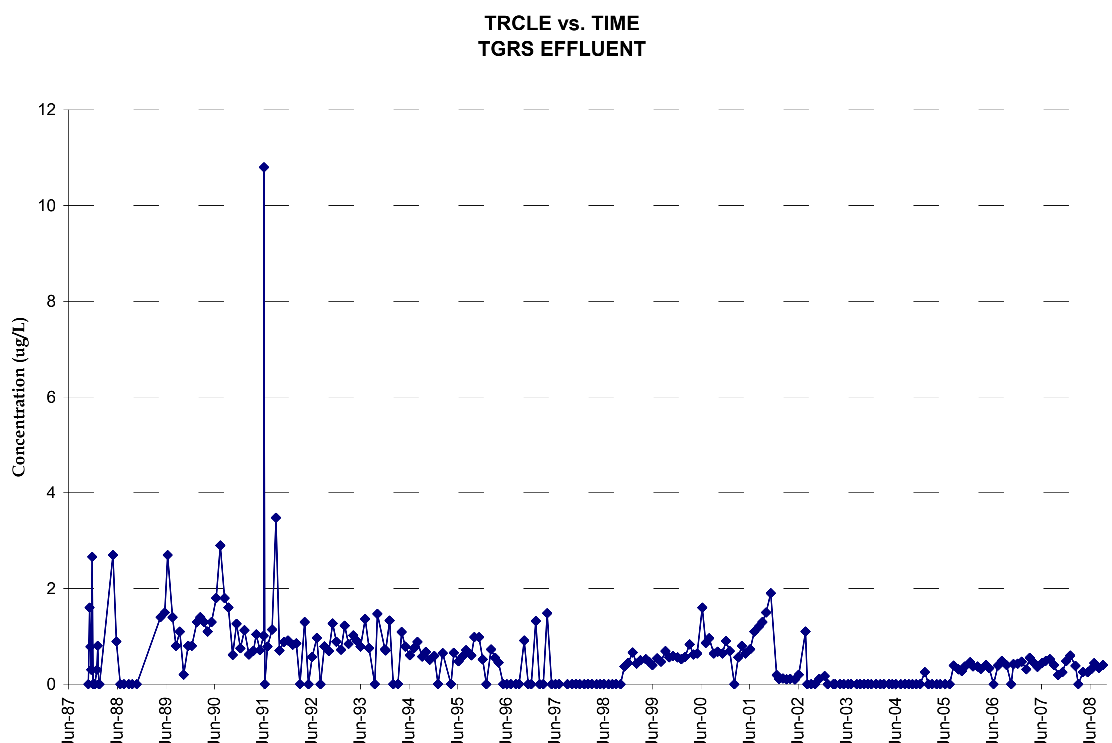


figure 10-2

TGRS FY2008 TOTAL DAILY FLOW RATES
TWIN CITIES ARMY AMMUNITION PLANT
Arden Hills, Minnesota

51119-43(004)GIS-SP001 DEC 4/2008





NOTE: SAMPLES REPORTING CONCENTRATIONS OF NON-DETECT WERE PLOTTED AS ZERO. WHEN DUPLICATE SAMPLES WERE COLLECTED, THE HIGHER CONCENTRATION WAS REPORTED.

figure 10-3

TGRS TREATMENT SYSTEM PERFORMANCE
TWIN CITIES ARMY AMMUNITION PLANT
Arden Hills, Minnesota

51119-43(004)GIS-SP002 DEC 4/2008

11.0 Operable Unit 3: Deep Groundwater

RECORD OF DECISION
Groundwater Remediation
Operable Unit 3
at New Brighton/Arden Hills Superfund Site
September 1992

RECORD OF DECISION AMENDMENT
For Operable Unit 3
New Brighton/Arden Hills Superfund Site
August 2006

A ROD Amendment was finalized in August 2006 that significantly changed the remedy for OU3. The basis for the OU3 ROD Amendment was the "Groundwater Statistical Evaluation, OU3" technical memorandum, which received consistency on May 2, 2005. This document presented a statistical evaluation showing that the South Plume has been receding since at least 1996, including the period after the Plume Groundwater Recovery System (PGRS) was shut off in 2001. The South Plume had receded well upstream of the PGRS and the PGRS was basically pumping clean water. The ROD Amendment removed the need for a pump and treat remedy, eliminating the PGRS extraction well and treatment train.

The PGRS was an off-post groundwater extraction and treatment system and municipal potable water supply. The PGRS consisted of New Brighton Municipal Well #13 (NBM #13) and a GAC treatment plant. New Brighton used the water for municipal supply. The PGRS was designed to contain the South Plume of VOC contamination emanating from TCAAP and to prevent further downgradient migration. Recovered groundwater was treated and used by the City of New Brighton to fulfill its municipal water supply demand. Figure 11-1 presents an OU3 site plan.

The PGRS began operating on May 3, 1994. In 1997, the PGRS influent dropped to below the ROD required limits for all VOCs. In December 1999, under an agreement with the Agencies, the PGRS pumping rate was reduced from a nominal rate of 1,000 gpm to 400 gpm to help determine if the reductions in concentration were the result of actual plume decreases or the result of dilution from over pumping. In conjunction with the flow rate decrease, a quarterly monitoring program was undertaken to monitor for potential “rebound” in VOC concentrations. As of the end of FY 2000, no rebound was observed and a review of the historical database for all of OU3 and the associated source area in OU2 revealed that the entire South Plume had dramatically decreased in size and concentration since the early 1990s. The concentration decreases were such that the leading edge of the South Plume, at the PGRS, dropped below the ROD requirements.

The results of this evaluation were presented to the Agencies on September 6, 2000, and a report titled “Plume History Evaluation, Operable Unit 3”, CRA, was submitted to the Agencies on October 10, 2000. The report documents the history of plume size and concentration reductions throughout OU3. Based on the dramatic reductions in plume size and concentration, the report recommended shutting down the PGRS. The Agencies subsequently accepted the recommendation. The City of New Brighton stopped significant pumping in August 2001 and the PGRS was maintained in standby status. During the period May 2003 through September 2003, the PGRS was operated solely to satisfy peak water supply demands and then was placed back into standby status. The PGRS remained in standby status throughout FY 2004, FY 2005, and FY 2006. The City conducted an evaluation of its municipal system to, in part, determine the future use of the PGRS extraction well and treatment system. The City decided the PGRS treatment system and well NBM #13 were not part of the City’s long-term water supply plan. During FY 2007 the PGRS treatment system was dismantled and NBM #13 was abandoned.

11.1 REMEDY COMPONENT #1: MONITORED NATURAL ATTENUATION

Description: "Monitored natural attenuation." (OU3 ROD Amendment, page 17)

Performance Standard (how do you know when you're done):
When a monitoring program is established and monitoring is in compliance with the regulator approved Annual Monitoring Plan.

Is the remedy component being implemented?
Yes. Appendix A summarizes the FY 2008 monitoring plan and any deviations are explained in Appendix C.2. Details of the groundwater monitoring program are discussed in Section 11.2.

11.2 REMEDY COMPONENT #2: GROUNDWATER MONITORING

Description: "Monitoring of the groundwater for VOCs to verify the effectiveness of the selected remedy and the natural attenuation of the South Plume." (OU3 ROD Amendment, page 17)

Performance Standard (how do you know when you're done):
When a monitoring program is established and monitoring is in compliance with the regulator approved Annual Monitoring Plan.

Is the remedy component being implemented?
Yes. Appendix A summarizes the FY 2008 monitoring plan and any deviations are explained in Appendix C.2.

Groundwater samples were collected from four OU3 wells in FY 2008 as part of the OU1, OU2, and OU3 annual sampling round. Samples were collected as specified in the monitoring plan and analyzed for VOCs by method SW846 8260. Well locations are shown on Figure 11-1. The specific purpose of monitoring each well is provided in Appendix A. Water elevations were also measured during the monitoring event and are presented in Appendix D.1.

Table 11-1 presents a summary of the analytical results. TRCLE concentrations in the downgradient sentry well, 04U863, remained less than 1.0 µg/L, as it has been since December 1999. TRCLE concentrations in the other three wells remained above the cleanup standard of 5 µg/L, ranging from 15 µg/L to 130 µg/L.

1,1,1-Trichloroethane and its degradation product 1,1-dichloroethane and 1,1-dichloroethene were present in the one well that was monitored at the boundary between OU1 and OU3 (04U832), indicating a commingling of the North Plume and the South Plume at these locations.

What were the results of the Statistical Analyses?

The Mann-Kendall statistical analysis was updated for three wells sampled in FY 2008, two edge-of-plume wells (04U832 and 04U845) and one center-of-plume well (03M848). A summary of the statistical analysis is presented in Table 11-2. Individual spreadsheets and graphs presenting the Mann-Kendall test results for each well are provided in Appendix H.

The trend for 03M848, which has historically been the center of the South Plume, continued to be definitely decreasing. The TRCLE concentration has decreased from 700 µg/L in FY 1999 to 130 µg/L in FY 2008. Well 03M848 had the highest TRCLE concentration in the South Plume in FY 2008, at a concentration much lower than historic concentrations. The decrease in concentration at the core of the South Plume seems to indicate that the south plume continues to dissipate.

The trend for well 04U845 changed from stable to no trend. Review of the data in Appendix H for this well, shows stable concentrations of TRCLE in the past three years (14 µg/L or 15 µg/L) that are lower than all other historical TRCLE concentrations at this well, except for FY 2001 and FY 2003 when TRCLE concentrations were unusually low.

The statistical conclusion for 04U832 was increasing for the second straight year; however, the concentration of TRCLE decreased from 56 µg/L in 2007 to 48 µg/L in FY 2008. The long-term trend (beyond the six sample events included in the statistical evaluation) of 04U832 is very consistent, with results between 29 µg/L and 56 µg/L since 1991, except for results in FY 2001 and FY 2003 of approximately 4 µg/L that cause the increasing statistical evaluation. If future results are consistent with the longer term results (excluding 2001 and 2003 data) the statistical analysis for 04U832 should change to stable once the 2001 and 2003 data is no longer included in the statistical evaluation. Once again, 1,1,1-trichloroethane and its degradation products were present in 04U832, which they historically have been, indicating that the North Plume is commingling with the South Plume at this well, which may be a factor in the statistical trends.

In summary, based on the data collected in FY 2008, the center of the South Plume, represented by 03M848, exhibits a strong trend of decreasing concentrations, while the edge of the South Plume appears stable. A stable trend at the edge of the plume indicates that the South Plume is not expanding. In addition, the presence of 1,1,1-trichloroethane, and its degradation products near the OU1-OU3 boundary indicates that the North Plume is commingling with the South Plume and may be a factor in the trends noted at the wells near the boundary.

Are contingency actions warranted?

The OU3 ROD Amendment requires contingency actions to be considered when the Mann-Kendall statistical analysis shows that a well at the edge of the South Plume has an increasing trend. The edge-of-plume and center-of-plume wells analyzed in FY 2008 are identified on Table 11-2.

Wells 04U832 and 04U845 were sampled as a contingency action during the annual sampling rounds of FY 2006 and FY 2008 because of an increasing trend observed at 04U832. Because the FY 2009 groundwater monitoring event will be a comprehensive biennial event, no contingency sampling is needed. After the FY 2009 biennial sampling event is complete these two wells will have been sampled for five consecutive years, providing enough data to determine if the low concentrations observed in FY 2001 and FY 2003 were an aberration.

What groundwater monitoring is proposed before the next report?

The OU3 monitoring requirements presented in Table 11-3 are proposed. Appendix A presents the FY 2008 – FY 2012 monitoring plan.

11.3 REMEDY COMPONENT #3: DRILLING ADVISORIES

Description: "Continued implementation of the drilling advisories that regulates the installation of new private wells within OU3 as a Special Well Construction Area."
(OU3 ROD Amendment, page 17)

Performance Standard (how do you know when you're done):

When the Minnesota Department of Health (MDH) has issued a Special Well Construction Area Advisory.

Has the MDH issued a Special Well Construction Area Advisory?

Yes. It was issued in June 1996. The Special Well Construction Area encompasses OU1, OU3, and the OU2 Site A shallow groundwater plume. In June 1999, the MPCA requested that the MDH extend the boundary of the Special Well Construction Area further to the southwest to the Mississippi River and Marshall Avenue to ensure that the southern boundary fully encompassed the plume. The MDH revised the Special Well Construction Area in December 1999. The current boundary is shown on Figure E-1 (Appendix E).

Are any changes or additional actions required for this remedy component? No.

11.4 OVERALL REMEDY FOR OU3

Is the Remedy for OU3 Operating in Compliance with the OU3 ROD and OU3 ROD Amendment?

Yes. In FY 2008, groundwater monitoring took place as prescribed in the Annual Monitoring Plan. The limited annual sampling round of FY 2008 indicates that the South Plume footprint remains stable, with decreasing concentrations at the center of the plume.

Are any changes or additional actions required for OU3?

No. A comprehensive biennial groundwater sampling event will take place in FY 2009 as planned.

Four OU3 wells that were recommended for abandonment in FY 2007 were not abandoned in FY 2008. These four wells (04U852, 04U864, 04U865, and 04J864) will be abandoned in FY 2009.

Monitoring well 04U861 was abandoned in February 2006 at the request of the City of New Brighton to allow for property redevelopment. The Army has committed to replacing 04U861 when the City completes property redevelopment. The schedule for redevelopment is uncertain; however, redevelopment is not expected to progress enough to allow for a replacement well to be installed in FY 2009.

TABLE 11-1

GROUNDWATER QUALITY DATA (μg/L)
OPERABLE UNIT 3, TCAAP
FISCAL YEAR 2008

Well	Date		Trichloroethene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride	Chloroform	Tetrachloroethene	trans-1,2-Dichloroethene	1,2-Dichloroethane
OU3 Cleanup Level (1)			*5*	*200*	*3*	*70*	*6*	*70*					
03M848	6/18/08		130	< 1	< 1	0.62 JP	0.56 JP	6.1	< 1	< 1	0.26 JP	0.089 JP	< 1
04U832	6/17/08		48	2.5	< 1	3.1	3.7	2.9	< 1	< 1	< 1	< 1	< 1
04U845	6/17/08		15	< 1	< 1	< 1	< 1	0.68 JP	< 1	< 1	< 1	< 1	< 1
04U863	6/17/08		0.39 JP	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
04U863	6/17/08	D	0.33 JP	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1

Notes:
(1) Cleanup levels for OU3 are from the OU3 ROD. Shading indicates exceedance of the cleanup level.
D - Duplicate analysis.
JP - Results are less than the reporting limit, but greater than the instrument detection limit. Value is estimated.

TABLE 11-2

MANN-KENDALL STATISTICAL SUMMARY
OPERABLE UNIT 3, TCAAP
FISCAL YEAR 2008

Well	*Kendall S*	*Number of Data Points*	*Raw Trend*	*Confidence*	*Coefficient of Varience*	*Raw Trend Decision*	*MAROS Conclusion*	*June 2008 TRCLE Conc.*
Edge of Plume Wells								
04U832	11	6	Increasing	97.20%	0.7057	Definite	Increasing	48
04U845	6	6	Increasing	81.00%	0.5369	Stable or No Trend	No Trend	15
Center of Plume Wells								
03M848	-13	6	Decreasing	99.17%	0.5078	Definite	Decreasing	130

TABLE 11-3

SUMMARY OF GROUNDWATER MONITORING REQUIREMENTS
OPERABLE UNIT 3, TCAAP

FISCAL YEAR 2008

	Remedy Component		Monitoring Requirements	Implementing Party	Documents Containing the Monitoring Plan
#1	Monitored Natural Attenuation		Outlined below.		
#2	Groundwater Monitoring	a.	Water levels for use in drawing contour maps.	Alliant	OU3 Monitoring Plan in Annual Report
		b.	Groundwater sampling to track progress of clean-up and attenuation of plume.	Alliant	OU3 Monitoring Plan in Annual Report
#3	Drilling Advisories	a.	Verification that drilling advisories are in place and functioning as intended.	Army/MDH	NA
OR:	Overall Remedy	a.	Water quality monitoring to verify attainment of clean-up goals.	Alliant	OU3 Monitoring Plan in Annual Report

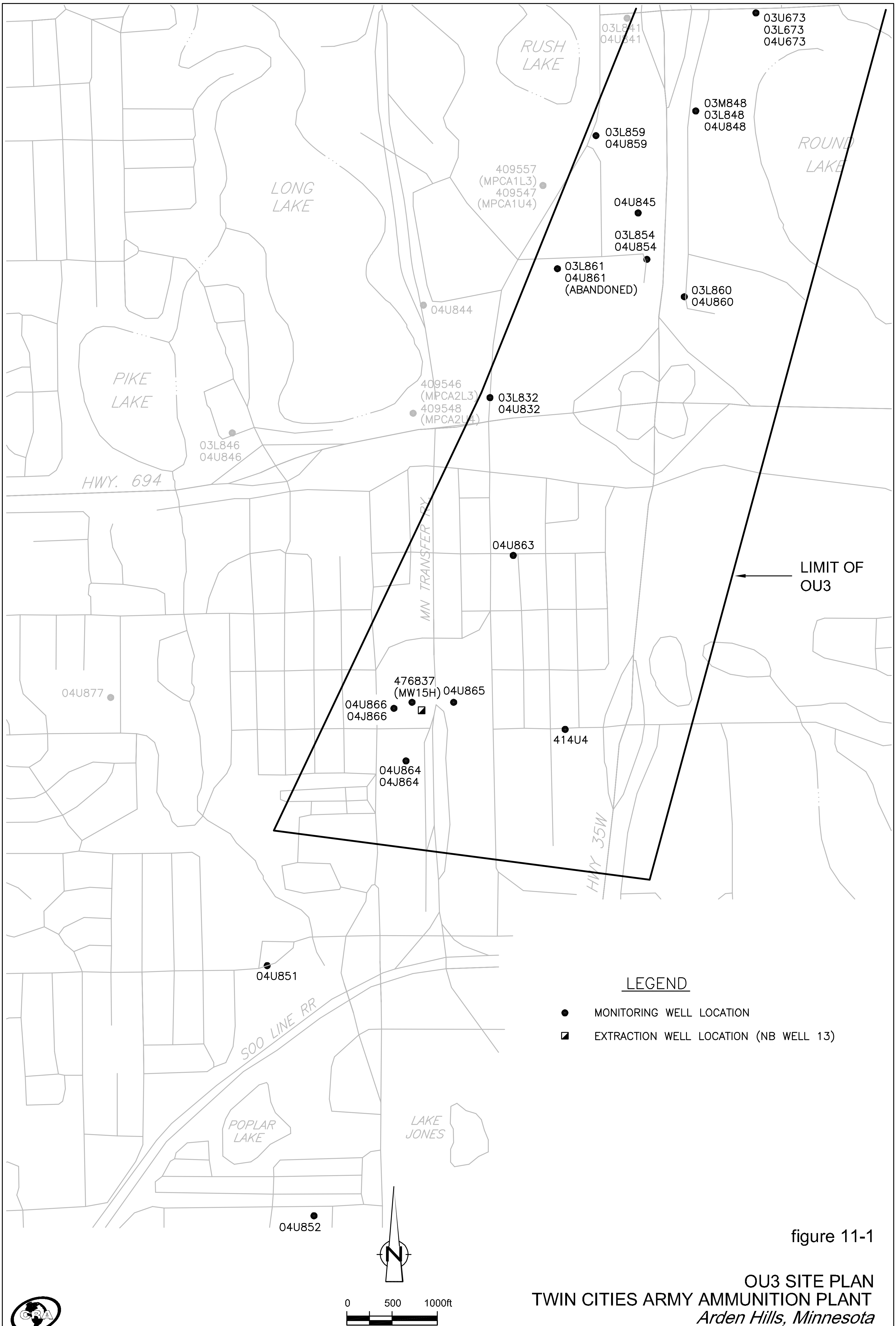


figure 11-1

OU3 SITE PLAN
TWIN CITIES ARMY AMMUNITION PLANT
Arden Hills, Minnesota

47533-43(002)GN-SP003 Jan 09/2008

12.0 Land Use Controls

Has a Land Use Control Remedial Design (LUCRD) document been approved to address land use control (LUC) issues for OU2, and is it being implemented?

During FY 2008, the Army was preparing a LUCRD to address the LUCs proposed in ROD Amendments #2 and #3, along with ESDs #1 and #3. It is expected that the LUCRD will be approved in FY 2009. In the meantime, the Army continued to implement land use controls for the remedial action sites, following the draft Land Use Control Implementation Plan that was prepared in 2003, but not approved by the MPCA or USEPA. When approved, the LUCRD will supersede the draft LUCIP.

Was an annual site inspection for land use controls conducted in FY 2008?

On July 23, 2008, the Army, National Guard, and Wenck conducted the annual inspection of TCAAP sites. The checklist that was completed during the inspection is included as Appendix J.

Were any items requiring additional actions identified in the annual site inspection?

It was noted that signs will need to be installed around the soil cover at Site C once the final area is approved through the LUCRD. Also, one sign at Site H needed to be re-installed, which was completed by the National Guard.

13.0 Other Installation Restoration Activities During FY 2008

Appendix I briefly summarizes the status of other activities at TCAAP that are related to the Installation Restoration Program, but are not required in the RODs for OU1 through OU3.

13.1 REGULATORY STATUS BUILDING 102

In FY 2005, a report was prepared documenting the existence of a VOC plume in the Unit 1 aquifer at Building 102 (Wenck & Keres, 2006). Figure 13-1 shows the location of Building 102 at TCAAP.

It was agreed to by the Army, USEPA, and MPCA that quarterly groundwater monitoring would be conducted beginning in June 2006. Monitoring continued through FY 2008 while the Army, USEPA and MPCA pursued a Engineering Evaluation/Cost Analysis to select a remedy. In FY 2008 there was not an official remedy in place for Building 102 and it is not addressed in the OU2 ROD or the OU2 QAPP.

The EE/CA was completed in July 2008 (Wenck). The EE/CA selected a Non-Time Critical Removal Action Remedy for Building 102. The remedy selected is Monitored Natural Attenuation (MNA) for the groundwater plume.

An Army Action Memorandum , documenting the selection of the remedy, and the QAPP for the MNA remedy were being prepared at the end of FY 2008. Both were subsequently completed and the QAPP received consistency approval in fall FY 2009, (during preparation of this APR). For FY 2008, this section is intended only to document the progress of the remedy selection and the FY 2008 sampling results. The first year of MNA monitoring and reporting under the approved remedy will be in FY 2009.

13.2 FY 2008 MONITORING DATA

Four rounds of samples were collected in FY 2008. Table 13-1 presents the groundwater monitoring data for FY 2008 and Figure 13-2 shows the VOC plume, represented by trichloroethene, from the first quarter of FY 2008 (December 2007). Figure 13-3 shows the groundwater elevation contours. The VOC plume exists within the Unit 1 aquifer at Building 102.

The plume shown on Figure 13-1 represents the highest concentrations observed during the four rounds of sampling in FY 2008. The data shown in Table 13-1 shows that the source area well 01U851 dropped from 13,000 µg/L trichloroethene in December 2007 to 640 µg/L in September 2008. The other wells exhibiting VOC detections remained relatively stable during the year. The overall size and extent of the plume did not change significantly in FY 2008.

TABLE 13-1
BUILDING 102 GROUNDWATER QUALITY DATA

Fiscal Year 2008

			Trichloroethene (ug/l)	cis-1,2-Dichloroethene (ug/l)	1,1-Dichloroethene (ug/l)	Vinyl Chloride (ug/l)	Vinyl Chloride[2] (ug/l)
Building 102 Cleanup Level [1]			5	70	6	0.18	0.18
01U578		12/6/07	<1	<1	<1	<1	---
01U578		2/7/08	<1	<1	<1	<1	---
01U578		6/26/08	<1	<1	<1	<1	---
01U578		9/25/08	<1	<1	<1	<1	---
01U579		12/6/07	**21**	3.0	<1	<1	---
01U579		2/7/08	**23**	3.6	<1	<1	---
01U579	D	2/7/08	**23**	3.5	<1	<1	---
01U579		6/26/08	**48**	7.0	<1	<1	---
01U579	D	6/26/08	**47**	6.6	<1	<1	---
01U579		9/25/08	**19**	2.3	<1	<1	---
01U580		12/6/07	**13,000**	**4,400**	<20	<20	---
01U580	D	12/6/07	**13,000**	**4,200**	<20	<20	---
01U580		2/7/08	**17,000**	**5,200**	**JP 8.6**	<25	---
01U580		6/26/08	**2,900**	**1,100**	JP 1.2	<5	---
01U580		9/25/08	**640**	**170**	<1	<1	---
01U580	D	9/25/08	**560**	**180**	<1	<1	---
01U581		12/6/07	1.3 (UB 0.3)	8.8	<1	<1	---
01U581		2/7/08	<1	1.9	<1	<1	---
01U581		6/26/08	<1	JP 0.50	<1	<1	---
01U581		9/25/08	1.5	7.8	<1	<1	---
01L581		12/6/07	**8.3**	7.3	<1	<1	---
01L581	D	12/6/07	**8.4**	7.3	<1	<1	---
01L581		2/7/08	**9.4**	7.9	<1	<1	---
01L581		6/26/08	**9.1**	7.4	<1	**JP 0.27** (JC43)	---
01L581		9/25/08	**8.8**	8.3	<1	<1	---
01U582		12/5/07	<1	<1	<1	<1	<0.05
01U582		2/7/08	<1	<1	<1	<1	<0.05
01U582		6/26/08	<1	<1	<1	<1	<0.05
01U582		9/25/08	<1	<1	<1	<1	<0.05
01L582		12/5/07	<1	21	<1	<1	**0.33**
01L582		2/7/08	<1	22	<1	<1	**0.37**
01L582		6/26/08	<1	23	<1	**JP 0.28** (JC43)	**0.24**
01L582		9/25/08	<1	24	<1	<1	**0.27**
01U583		12/6/07	<1	<1	<1	<1	---
01U583		2/7/08	<1	<1	<1	<1	---
01U583		6/26/08	JP 0.48	<1	<1	<1	---
01U583		9/25/08	JP 0.41	<1	<1	<1	---
01L583		12/6/07	<1	<1	<1	<1	---
01L583		2/7/08	<1	<1	<1	<1	---
01L583	D	2/7/08	<1	<1	<1	<1	---
01L583		6/26/08	<1	<1	<1	<1	---
01L583		9/25/08	<1	<1	<1	<1	---
01U584		12/6/07	<1	<1	<1	<1	---

TABLE 13-1
BUILDING 102 GROUNDWATER QUALITY DATA

Fiscal Year 2008

			Trichloroethene (ug/l)	cis-1,2-Dichloroethene (ug/l)	1,1-Dichloroethene (ug/l)	Vinyl Chloride (ug/l)	Vinyl Chloride(2) (ug/l)
Building 102 Cleanup Level (1)			5	70	6	0.18	0.18
01U584		2/7/08	<1	<1	<1	<1	---
01U584		6/26/08	<1	<1	<1	<1	---
01U584		9/25/08	<1	<1	<1	<1	---
01L584		12/6/07	<1	<1	<1	<1	---
01L584		2/7/08	<1	<1	<1	<1	---
01L584		6/26/08	<1	JP 0.22	<1	<1	---
01L584		9/25/08	<1	<1	<1	<1	---
01L584	D	9/25/08	<1	<1	<1	<1	---
01U048		12/6/07	<1	<1	<1	<1	JP 0.031
01U048		2/7/08	<1	<1	<1	<1	JP 0.029
01U048		6/26/08	<1	<1	<1	<1 (JS73D21)	JP 0.041
01U048	D	6/26/08	---	---	---	---	JP 0.041
01U048		9/25/08	<1	<1	<1	<1	JP 0.028 (JQ)
01U048	D	9/25/08	---	---	---	---	JP 0.027 (JQ)
03U001		6/26/08	JP 0.78	<1	<1	<1	---
03U001	D	6/26/08	JP 0.77	<1	<1	<1	---
03U076		6/26/08	1.5	<1	<1	<1	---

Notes:

(1) Cleanup levels for Building 102 Groundwater are from Table 3-5 of the Building 102 Groundwater EE/CA. Bolding (in red color) indicates exceedance of the cleanup level.

(2) This analysis of vinyl chloride is by Method 8260-SIM to obtain a lower reporting limit for vinyl chloride.

--- Not sampled.

D Duplicate sample.

JC Data is qualified as estimated due to exceedance of percent difference criteria in the continuing calibration (the percent difference is listed after "JC").

JD Data is qualified as estimated due to exceedance of the relative percent difference criteria for a duplicate (the percent difference is listed after "JD").

JP The value is below the reporting level, but above the method detection limit. Results should be considered estimated.

JQ The value is considered estimated due to poor spectral confirmation on the presence of this analyte.

JS The percent recovery for the matrix spike was outside QC limits (the percent recovery is listed after "JS"). The sample result could be biased high if the recovery is above 100%, or biased low if the recovery is below 100%.

UB The sample result was less than 5 times the level detected in a blank (the result for the blank is listed after "UB"). The sample result can be considered non detect at an elevated detection limit.

TWIN CITIES ARMY AMMUNITION PLANT

Location of Building 102

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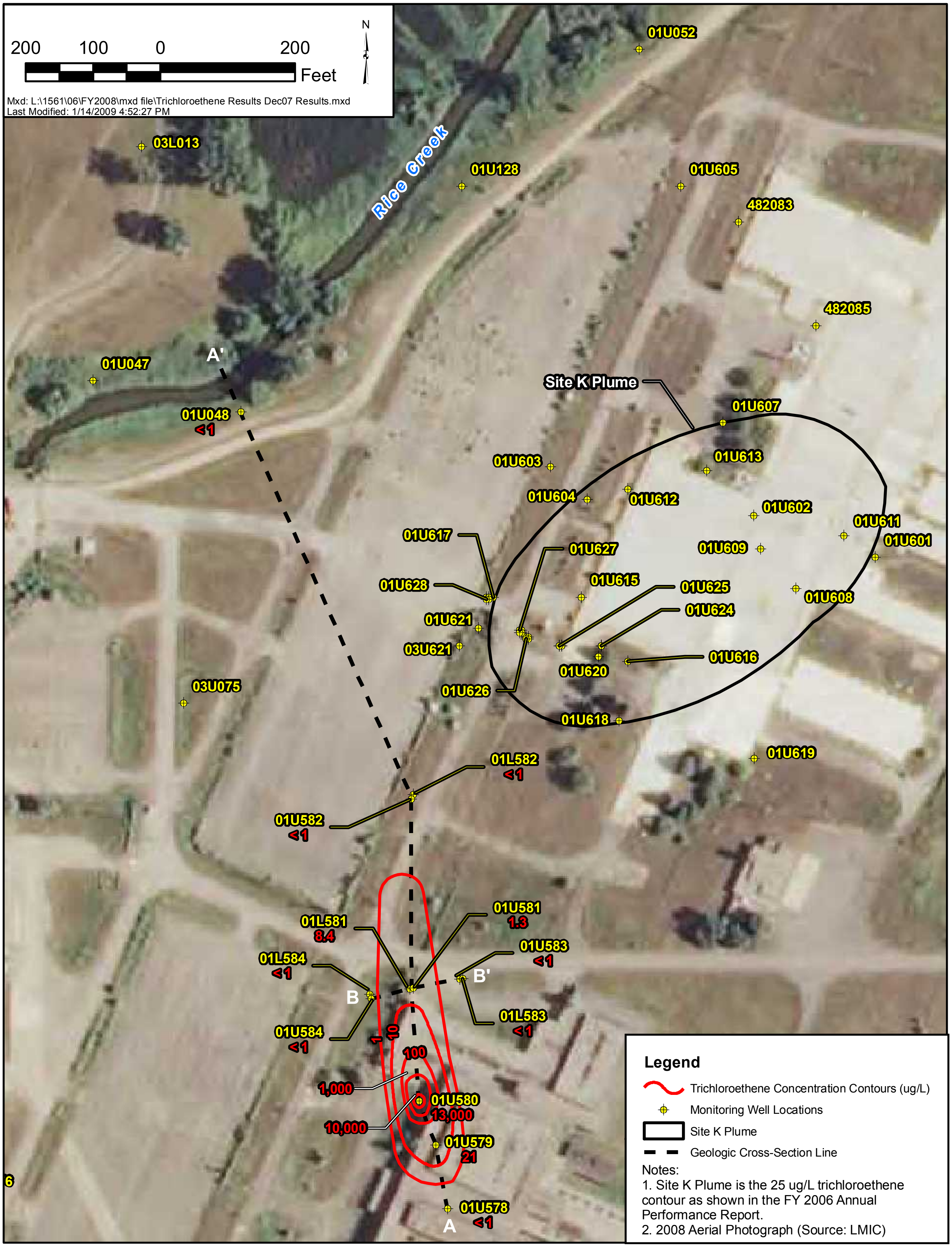
Wenck

Wenck Associates, Inc. 1800 Pioneer Creek Center
Environmental Engineers Maple Plain, MN 55359-0429

FY 2008

Figure 13-1



TWIN CITIES ARMY AMMUNITION PLANT

Trichloroethene Results

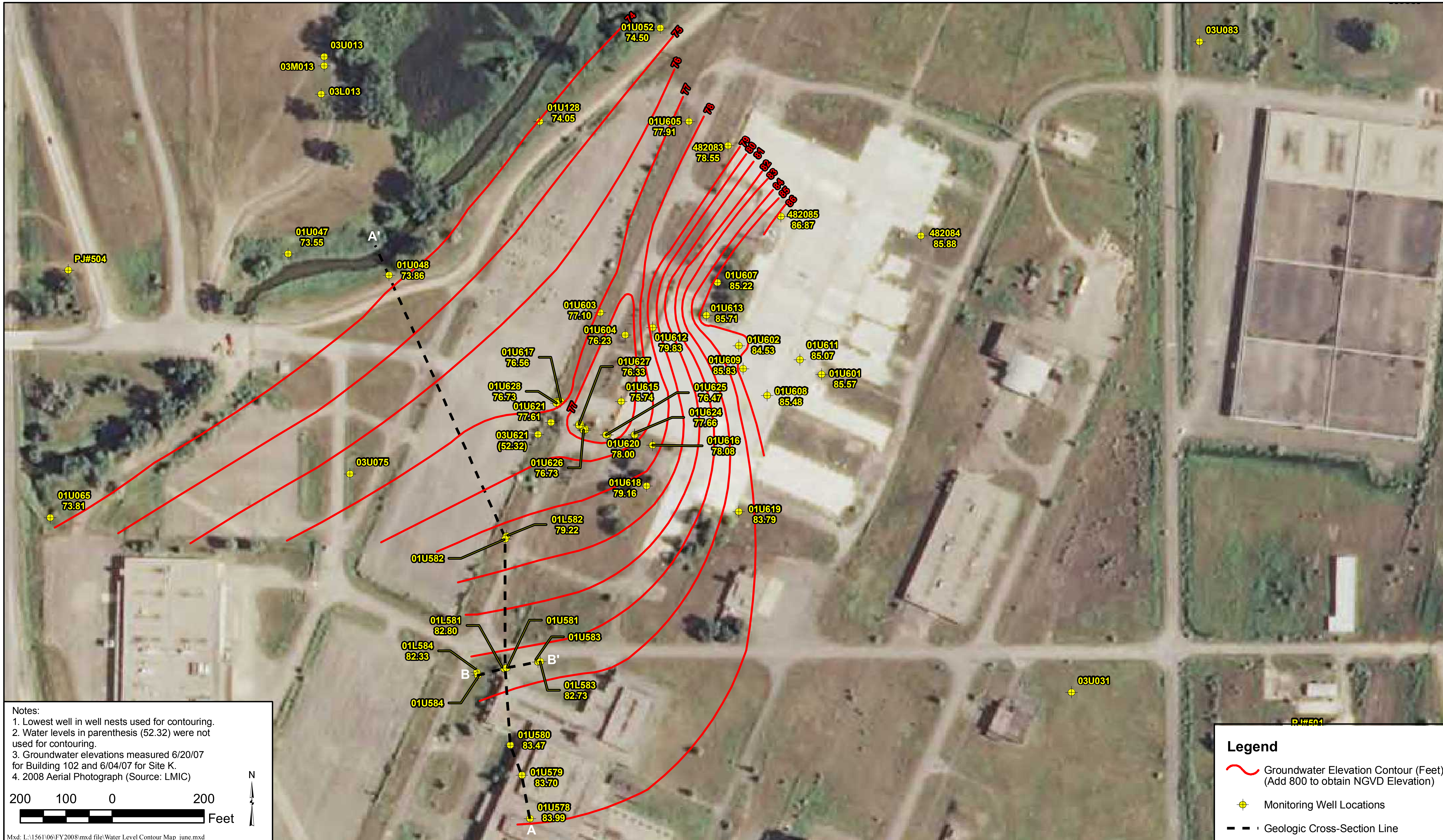
Wenck

Wenck Associates, Inc.
Environmental Engineers

1800 Pioneer Creek Center
Maple Plain, MN 55359-0429

FY 2008

Figure 13-2



TWIN CITIES ARMY AMMUNITION PLANT

Building 102 Groundwater Elevation Contours

Wenck Associates, Inc. Environmental Engineers
1800 Pioneer Creek Center Maple Plain, MN 55359-0429

FY 2008

Figure 13-3

14.0 References

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Appendix A

FY 2008 – FY 2012 Monitoring Plans

A.1 Groundwater Monitoring Wells

APPENDIX A.1
FY 2008 – FY 2012 MONITORING PLAN
FOR GROUNDWATER MONITORING WELLS

Unit Designations:

01U	- Upper Fridley Formation	03L	- Lower Hillside Formation	SL	- St. Lawrence
01L	- Lower Fridley Formation	SP	- St. Peter	UNK	- Unknown
03U	- Upper Hillside Formation	PC	- Prairie du Chien		
03M	- Middle Hillside Formation	J	- Jordan		

Notes:

(A) Indicates that the monitoring is the responsibility of Alliant.
(B) Indicates that the monitoring is the responsibility of the Army.
(1) "L (A or B)" denotes a water level measurement by the appropriate party.
(2) "Q (A or B)" denotes a water quality sampling by the appropriate party. The required analyte list for each specific site is shown in Appendix A.4.
(3) The designations refer to the following purposes:

- ❖ Operable Unit 1 Water Quality
  - 1.a = To contour the perimeter of the plume which defines the area of concern for alternate water supply/well abandonment
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Operable Unit 1 Water Levels
  - 3.b = To contour water levels for evaluation of containment
- ❖ Site A Water Quality
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Site A Water Levels
  - 2.b = To contour water levels for evaluation of flow during MNA remedy (FY 2009-?)
- ❖ Site I Water Quality
  - 1.a = To track remedy progress
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Site I Water Levels
  - 1.a = To track remedy progress
- ❖ Site K Water Quality
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Site K Water Levels
  - 3.a = To contour water levels for evaluation of containment
- ❖ TGRS Water Quality
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ TGRS Water Levels
  - 1.a = To contour water levels for evaluation of containment
- ❖ Operable Unit 3 Water Quality
  - OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Operable Unit 3 Water Levels
  - 2.a = To contour water levels for evaluation of MNA remedy

(4) Sample if in production at time of sample collection.
(5) Sample extraction well annually or biennially, as shown, since it is no longer being pumped.
(6) Wells 04U414 and 04U851 monitored every 5 years during event preceding 5-year review
(7) Sample annually for five years (FY 2003 through FY 2007) to verify that there have been no adverse impacts to groundwater due to shallow soil remediation work.
(8) Of the two wells, well 01U639 will be the primary sampling location and 482089 (I04MW) will be the alternate sampling location. If it is not possible to collect a groundwater sample from 01U639, then an attempt will be made to collect a sample from 482089 (I04MW).

APPENDIX A.1

FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
Operable Unit 1			Note: Changes from the monitoring plan presented in the previous Annual Performance Report are highlighted in this appendix.								
03U	03U811			---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
03U	03U821			---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
03U	03U822			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03U	03U831			---	---	---	---	---		None	abandoned 2006
03U	409550	PCA 6U3		---	Q,L(B)	---	Q,L(B)	---	OR	None	
03U	409596	BS118U3		---	Q,L(B)	---	Q,L(B)	---	OR	None	
03M	03M843			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03L	03L811			---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
03L	03L822			---	Q,L(B)	---	Q,L(B)	---	OR	None	
03L	03L832			---	Q,L(B)	---	Q,L(B)	---	OR	None	
03L	03L841			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03L	03L846			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03L	03L853			---	---	---	---	---	OR	None	
03L	409556	PCA4L3		---	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03L	409557	PCA1L3		---	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03L	409597	BS118L3		---	Q,L(B)	---	Q,L(B)	---	OR	None	
PC	04U821			---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U834			---	Q,L(B)	---	Q,L(B)	---	OR	None	
PC	04U836	MW-1		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U837	MW-3		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U838	MW-5		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U839	MW-7		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U841			---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U843			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	3.b	
PC	04U844			---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U846			---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U847			---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U849			---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U850			---	Q,L(B)	---	Q,L(B)	---	OR	3.b	

FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
PC	04U855			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	3.b	
PC	04U871			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
PC	04U872			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
PC	04U875			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	3.b	
PC	04U877			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
PC	04U879			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	3.b	
PC	04U880			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	3.b	
PC	04U881			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
PC	04U882			---	Q,L(B)	---	Q,L(B)	---	OR	None	
PC	04U883			---	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
PC	191942	BS118U4		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	200154	UM Golf Course		---	Q(B)	---	Q(B)	---	1.a, OR	---	
PC	200814	American Linen		---	---	---	---	---	---	---	
PC	206688	Cloverpond		---	Q(B)	---	Q(B)	---	1.a, OR	---	
PC	234547	Honywell Ridgway		---	---	---	---	---	---	---	
PC	409547	PCA1U4		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	409548	PCA2U4		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	409549	PCA3U4		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	409555	PCA5U4		---	Q,L(B)	---	Q,L(B)	---	1.a, OR	3.b	
PC	512761	Gross Golf Course #2		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	554216	New Brighton #14									See Appendix A.2
PC	582628	New Brighton #15									See Appendix A.2
J	04J822			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
J	04J834			---	Q,L(B)	---	Q,L(B)	---	OR	None	
J	04J835			---	---	---	---	---	---	---	
J	04J836	MW-2		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
J	04J837	MW-4		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
J	04J838	MW-6		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
J	04J839	MW-8		---	Q,L(B)	---	Q,L(B)	---	OR	3.b	
J	04J847			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
J	04J849			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	
J	04J882			---	Q,L(B)	---	Q,L(B)	---	OR	None	
J	200524	St. Anthony #5	(4)	---	Q(B)	---	Q(B)	---	OR	---	Army gets St. Anthony Data
J	200803	St. Anthony #4	(4)	---	Q(B)	---	Q(B)	---	OR	---	Army gets St. Anthony Data

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Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
J	206796	New Brighton #5									See Appendix A.2
J	206797	New Brighton #6									See Appendix A.2
PC/J	200804	St. Anthony #3	(4)	---	Q(B)	---	Q(B)	---	OR	---	Army gets St. Anthony Data
PC/J	200812	Gross Golf #1		---	---	---	---	---	---	---	
PC/J	206792	New Brighton #4									See Appendix A.2
PC/J	206793	New Brighton #3									See Appendix A.2
PC/J	233221	R&D Systems, N. Well		---	---	---	---	---	---	---	
PC/J	234549	Reiner		---	---	---	---	---	1.a, OR	---	Well out of service
PC/J	PJ#318			---	Q,L(B)	---	Q,L(B)	---	OR	None	
UNK	234546	Honywell Ridgway		---	Q(B)	---	Q(B)	---	OR	---	

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Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments

Operable Unit 2

Site A Removal Action

Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
01U	01U038			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U039			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U040			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U041			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U063			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U067			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U102			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U103			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U104			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U105			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U106			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U107			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U108			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U110			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U115			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U116			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U117			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U118			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U119			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U120			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U125			---	---	---	---	---	OR	2.b	
01U	01U126			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U127			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U133			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U135			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U136			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U137			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	

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FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
01U	01U138			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U139			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U140			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U141			L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U145	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U146	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U147	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U148	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U149	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U150	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U151	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U152	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U153	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U154	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U155	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U156	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	2.b	
01U	01U157			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U158			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U350			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U351	EW-1									See Appendix A.2
01U	01U352	EW-2									See Appendix A.2
01U	01U353	EW-3									See Appendix A.2
01U	01U354	EW-4									See Appendix A.2
01U	01U355	EW-5		---	---	---	---	---	---	---	
01U	01U356	EW-6		---	---	---	---	---	---	---	
01U	01U357	EW-7		---	---	---	---	---	---	---	
01U	01U358	EW-8		---	---	---	---	---	---	---	
01U	01U901			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U902			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U903			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	
01U	01U904			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	2.b	

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Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
Site I Remedial Action											
01U	01U064			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	1a, OR	1a, OR	
01U	01U632			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	1a, OR	1a, OR	
01U	01U636			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	1a, OR	1a, OR	
01U	01U639		(8)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	1a, OR	1a, OR	
01U	01U640			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	1a, OR	1a, OR	
01U	01U666			L(A)	L(A)	L(A)	L(A)	L(A)	---	1a, OR	
01U	01U667			L(A)	L(A)	L(A)	L(A)	L(A)	---	1a, OR	
01U	01U668			L(A)	L(A)	L(A)	L(A)	L(A)	---	1a, OR	
01U	482086	I01MW		Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	1a, OR	1a, OR	
01U	482087	I05MW		Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	1a, OR	1a, OR	
01U	482088	I02MW		Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	1a, OR	1a, OR	
01U	482089	I04MW	(8)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	1a, OR	1a, OR	
01U	482090	I03MW		L(A)	L(A)	L(A)	L(A)	L(A)	---	1a, OR	

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
Site K Remedial Action											
01U	01U047			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U048			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U052			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U065			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U128			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U601			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U602			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U603			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U604			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U605			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U607			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U608			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U609			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U611			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U612			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U613			L(A)	L(A)	L(A)	L(A)	L(A)	OR	3.a	
01U	01U615			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U616			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U617			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U618			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U619			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U620			L(A)	L(A)	L(A)	L(A)	L(A)	OR	3.a	
01U	01U621			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U624			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U625			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U626			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U627			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U628			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	

APPENDIX A.1

FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
01U	482083	K04-MW		Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	482084	K02-MW		L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	482085	K01-MW		L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
03U	03U621			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	

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FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments

TCAAP Groundwater Recovery System

Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
03F	03F302	B1									See Appendix A.2
03F	03F303	B2	(5)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03F	03F304	B3									See Appendix A.2
03F	03F305	B4									See Appendix A.2
03F	03F306	B5									See Appendix A.2
03F	03F307	B6									See Appendix A.2
03F	03F308	B7	(5)	---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03F	03F312	B11									See Appendix A.2
03F	03F319	B13									See Appendix A.2
03U	03U001			---	L(A)	---	L(A)	---	---	1.a	
03U	03U002			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U003			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U004			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U005			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U007			---	Q,L(A)	---	Q,L(A)	---	Background	1.a	
03U	03U008			---	L(A)	---	L(A)	---	---	1.a	
03U	03U009			---	Q,L(A)	---	Q,L(A)	---	Background	1.a	
03U	03U010			---	L(A)	---	L(A)	---	---	1.a	
03U	03U011			---	L(A)	---	L(A)	---	---	1.a	
03U	03U012			---	L(A)	---	L(A)	---	---	1.a	
03U	03U013			---	L(A)	---	L(A)	---	---	1.a	
03U	03U014			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U015			---	L(A)	---	L(A)	---	---	1.a	
03U	03U016			---	L(A)	---	L(A)	---	---	1.a	
03U	03U017			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U018			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U019			---	L(A)	---	L(A)	---	---	1.a	
03U	03U020			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	

APPENDIX A.1

FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
03U	03U021			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U022			---	L(A)	---	L(A)	---	---	1.a	
03U	03U023			---	L(A)	---	L(A)	---	---	1.a	
03U	03U024			---	L(A)	---	L(A)	---	---	1.a	
03U	03U025			---	L(A)	---	L(A)	---	---	1.a	
03U	03U026			---	L(A)	---	L(A)	---	---	1.a	
03U	03U027			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U028			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U029			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U030			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U031			---	L(A)	---	L(A)	---	---	1.a	
03U	03U032			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U075			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U076			---	L(A)	---	L(A)	---	---	1.a	
03U	03U077			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U078			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U079			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U082			---	L(A)	---	L(A)	---	---	1.a	
03U	03U083			---	L(A)	---	L(A)	---	---	1.a	
03U	03U084			---	L(A)	---	L(A)	---	---	1.a	
03U	03U087			---	L(A)	---	L(A)	---	---	1.a	
03U	03U088			---	L(A)	---	L(A)	---	---	1.a	
03U	03U089			---	L(A)	---	L(A)	---	---	1.a	
03U	03U090			---	L(A)	---	L(A)	---	---	1.a	
03U	03U092			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U093			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	03U094			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	03U096			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U097			---	---	---	---	---	---	---	
03U	03U099			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	03U111			---	L(A)	---	L(A)	---	---	1.a	

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FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
03U	03U112			---	L(A)	---	L(A)	---	---	1.a	
03U	03U113			---	L(A)	---	L(A)	---	---	1.a	
03U	03U114			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U121			---	---	---	---	---	---	---	
03U	03U129			---	---	---	---	---	---	---	
03U	03U301	SC1									See Appendix A.2
03U	03U314	SC2									See Appendix A.2
03U	03U315	SC3	(5)	---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U316	SC4	(5)	---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U317	SC5									See Appendix A.2
03U	03U521			---	---	---	---	---	---	---	
03U	03U647			---	L(A)	---	L(A)	---	---	1.a	
03U	03U648			---	L(A)	---	L(A)	---	---	1.a	
03U	03U658			---	L(A)	---	L(A)	---	---	1.a	
03U	03U659			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U671			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U672			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U674			---	L(A)	---	L(A)	---	---	1.a	
03U	03U675			---	---	---	---	---	---	---	
03U	03U676			---	L(A)	---	L(A)	---	---	1.a	
03U	03U701			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U702			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U703			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U704			---	L(A)	---	L(A)	---	---	1.a	
03U	03U705			---	L(A)	---	L(A)	---	---	1.a	
03U	03U706			---	L(A)	---	L(A)	---	---	1.a	
03U	03U707			---	L(A)	---	L(A)	---	---	1.a	
03U	03U708			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	03U709			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U710			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U711			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	

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FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
03U	03U715			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U716			---	L(A)	---	L(A)	---	---	1.a	
03U	03U801			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	03U803			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U804			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U805			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03U	03U806			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03U	519288	E101-MW		---	---	---	---	---	---	---	
03U	519289	E102-MW		---	---	---	---	---	---	---	
03U	519290	E103-MW		---	---	---	---	---	---	---	
03M	03M001			---	L(A)	---	L(A)	---	---	1.a	
03M	03M002			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03M	03M003			---	L(A)	---	L(A)	---	---	1.a	
03M	03M004			---	L(A)	---	L(A)	---	---	1.a	
03M	03M005			---	L(A)	---	L(A)	---	---	1.a	
03M	03M007			---	L(A)	---	L(A)	---	---	1.a	
03M	03M010			---	L(A)	---	L(A)	---	---	1.a	
03M	03M012			---	L(A)	---	L(A)	---	---	1.a	
03M	03M013			---	L(A)	---	L(A)	---	---	1.a	
03M	03M017			---	L(A)	---	L(A)	---	---	1.a	
03M	03M020			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03M	03M713			---	L(A)	---	L(A)	---	---	1.a	
03M	03M802			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03M	03M806			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03L	03L001			---	L(A)	---	L(A)	---	---	1.a	
03L	03L002			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L003			---	L(A)	---	L(A)	---	---	1.a	
03L	03L004			---	L(A)	---	L(A)	---	---	1.a	
03L	03L005			---	L(A)	---	L(A)	---	---	1.a	

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FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
03L	03L007			---	Q,L(A)	---	Q,L(A)	---	Background	1.a	
03L	03L010			---	L(A)	---	L(A)	---	---	1.a	
03L	03L012			---	L(A)	---	L(A)	---	---	1.a	
03L	03L013			---	L(A)	---	L(A)	---	---	1.a	
03L	03L014			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L017			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L018			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L020			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L021			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L027			---	L(A)	---	L(A)	---	---	1.a	
03L	03L028			---	L(A)	---	L(A)	---	---	1.a	
03L	03L029			---	L(A)	---	L(A)	---	---	1.a	
03L	03L077			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L078			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L079			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L080			---	L(A)	---	L(A)	---	---	1.a	
03L	03L081			---	L(A)	---	L(A)	---	---	1.a	
03L	03L084			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L113			---	L(A)	---	L(A)	---	---	1.a	
03L	03L802			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03L	03L806			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03L	03L809			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
03L	03L833			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC	04U001			---	L(A)	---	L(A)	---	---	1.a	
PC	04U002			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC	04U003			---	L(A)	---	L(A)	---	---	1.a	
PC	04U007			---	Q,L(A)	---	Q,L(A)	---	Background	1.a	
PC	04U012			---	L(A)	---	L(A)	---	---	1.a	
PC	04U020			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC	04U027			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	

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FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
PC	04U077			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC	04U510			---	Q,L(A)	---	Q,L(A)	---	Background	1.a	
PC	04U701			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC	04U702			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC	04U708			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC	04U709			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC	04U711			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
PC	04U713			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC	04U714			---	L(A)	---	L(A)	---	---	1.a	
PC	04U802			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
PC	04U806			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
PC	04U833			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
J	04J077			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
J	04J702			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
J	04J708			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
J	04J713			---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
J	04J714			---	L(A)	---	L(A)	---	---	1.a	
PC/J	PJ#003			---	L(A)	---	L(A)	---	---	1.a	
PC/J	PJ#027			---	L(A)	---	L(A)	---	---	1.a	
PC/J	PJ#309	B8									See Appendix A.2
PC/J	PJ#310	B9									See Appendix A.2
PC/J	PJ#311	B10	(5)	---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC/J	PJ#313	B12	(5)	---	Q,L(A)	---	Q,L(A)	---	OR	1.a	
PC/J	PJ#802			---	L(A)	---	L(A)	---	---	1.a	
PC/J	PJ#806			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
---	Staff Gauges			---	L(A)	---	L(A)	---	---	---	

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FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
Unit 1 Wells											
01U	01U035			---	---	---	---	---	---	---	
01U	01U043			---	---	---	---	---	---	---	
01U	01U044			---	---	---	---	---	---	---	
01U	01U045			---	---	---	---	---	---	---	
01U	01U046			---	---	---	---	---	---	---	
01U	01U060		(7)	Q(B)	Q(B)	Q(B)	Q(B)	Q(B)	(Note 7)	---	Monitoring continued after 2007
01U	01U072			---	---	---	---	---	---	---	
01U	01U085			---	---	---	---	---	---	---	

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FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
Operable Unit 3											
03U	03U673			---	Q,L(A)	---	Q,L(A)	---	OR	2.a	
03M	03M848			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	2.a	
03L	03L673			---	Q,L(A)	---	Q,L(A)	---	OR	2.a	
03L	03L832			---	L(A)	---	L(A)	---	---	2.a	
03L	03L848			---	Q,L(A)	---	Q,L(A)	---	OR	2.a	
03L	03L854			---	Q,L(A)	---	Q,L(A)	---	OR	2.a	
03L	03L859			---	Q,L(A)	---	Q,L(A)	---	OR	2.a	
03L	03L860			---	L(A)	---	L(A)	---	---	2.a	
03L	03L861			---	---	---	---	---	---	---	Abandoned FY06
03L	476837	MW15H		---	---	---	---	---	---	---	
PC	04U414	414U4	(6)	---	Q,L(A)	---	---	---	OR	2.a	
PC	04U673			---	Q,L(A)	---	Q,L(A)	---	OR	2.a	
PC	04U832			Q,L(A)	Q,L(A)	---	Q,L(A)	---	OR	2.a	Contingency Action for FY08
PC	04U845			Q,L(A)	Q,L(A)	---	Q,L(A)	---	OR	2.a	Contingency Action for FY08
PC	04U848			---	Q,L(A)	---	Q,L(A)	---	OR	2.a	
PC	04U851		(6)	---	Q,L(A)	---	---	---	OR	2.a	
PC	04U852			---	---	---	---	---	---	---	Proposed for Abandonment
PC	04U854			---	Q,L(A)	---	Q,L(A)	---	OR	2.a	
PC	04U859			---	Q,L(A)	---	Q,L(A)	---	OR	2.a	
PC	04U860			---	Q,L(A)	---	Q,L(A)	---	OR	2.a	
PC	04U861			---	---	---	---	---	---	---	Abandoned FY06
PC	04U863	323U4		Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	2.a	
PC	04U864	324U4		--	--	--	--	--	--	--	Proposed for Abandonment
PC	04U865	325U4		--	---	--	---	--	---	---	Proposed for Abandonment
PC	04U866	326U4		--	Q,L(A)	--	Q,L(A)	--	OR	2.a	
PC	520931	NBM #13		--	--	--	--	--	--	--	Abandoned FY07

APPENDIX A.1

FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
J	04J864	324 J		--	--	--	--	--	--	--	Proposed for Abandonment
J	04J866	326 J		--	Q,L(A)	--	Q,L(A)	--	OR	2.a	

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments

Other Installation Restoration Activities

TCAAP Well Inventory

(Entries under "Notes" refer to the well inventory category)

---	249608	Rapit Printing, Inc	1a	---	Q(B)	---	---	---	Well Inventory	---	2520 Larpenteur Ave
---	433298	Town & Cntry Golf Crse	1a	---	Q(B)	---	---	---	Well Inventory	---	2279 Marshall Ave
---	509052	Shriners Hospital	1a	---	Q(B)	---	---	---	Well Inventory	---	2025 E River Rd
---	S00311	Vogel, Bob & Christie	1a	---	Q(B)	---	---	---	Well Inventory	---	1390 Silver Lake Rd
---	S00444	Mnpls Parks & Rec Dept	1a	---	Q(B)	---	---	---	Well Inventory	---	Ontario & E River Rd
---	200173	KSTP Radio TV	1b	---	Q(B)	---	---	---	Well Inventory	---	3415 University Ave
---	200180	Town & Cntry Golf Crse	1b	---	Q(B)	---	---	---	Well Inventory	---	2279 Marshal Ave
---	234338	Bosell	1b	---	Q(B)	---	---	---	Well Inventory	---	1575 14th Ave NW
---	234421	BioClean (BioChem)	1b	---	Q(B)	---	---	---	Well Inventory	---	2151 Mustang Dr
---	234469	Palwski, T.	1b	---	Q(B)	---	---	---	Well Inventory	---	2816 Hwy 88
---	234544	R&D Systems	1b	---	Q(B)	---	---	---	Well Inventory	---	2201 Kennedy St NE
---	249632	Montzka, Harold	1b	---	Q(B)	---	---	---	Well Inventory	---	2301 N Upland Crest NE
---	200522	Pemtom	1c	---	Q(B)	---	---	---	Well Inventory	---	Silver Lake Rd
---	200523	Pemtom	1c	---	Q(B)	---	---	---	Well Inventory	---	Silver Lake Rd & Co Rd E
---	756236	Pechiney Plastic Pckging	1c	---	Q(B)	---	---	---	Well Inventory	---	150 26th Ave SE
---	S00437	Northern Star Co.	1c	---	Q(B)	---	---	---	Well Inventory	---	3171 5th St SE
---	107405	Anderson, Paul	2a	---	Q(B)	---	---	---	Well Inventory	---	4355 Hwy 10
---	249113	Wyttenbach, Daniel	2a	---	Q(B)	---	---	---	Well Inventory	---	990 11th Ave NW
---	200176	Waldorf Paper Products	2b	---	Q(B)	---	---	---	Well Inventory	---	2236 Myrtle Ave
---	249007	Walton, Reggie	2b	---	Q(B)	---	---	---	Well Inventory	---	4453 Hwy 10
---	537801	Midway Industrial	2b	---	Q(B)	---	---	---	Well Inventory	---	4759 Old Hwy 8
---	S00002	Midland Hills Cntry Club	2b	---	Q(B)	---	---	---	Well Inventory	---	2001 N Fulham St
---	200076	Old Dutch Foods, Inc.	2c	---	Q(B)	---	---	---	Well Inventory	---	2375 Terminal Rd

APPENDIX A.1

FY 2008 - FY 2012 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 08	June 09	June 10	June 11	June 12	Water Quality	Water Level	Comments
---	236029	R&D Systems, S. Well	2c	---	Q(B)	---	---	---	Well Inventory	---	2201 Kennedy St NE
---	236439	Waldorf Paper Products	2c	---	Q(B)	---	---	---	Well Inventory	---	2250 Wabash Ave
---	249185	Novotny, Mark	4a	---	Q(B)	---	---	---	Well Inventory	---	1706 Malvern St
---	S00295	Alfson, Loren	4a	---	Q(B)	---	---	---	Well Inventory	---	2351 Summer St
---	---	Amundsen, Jason & Lucy	4a	---	Q(B)	---	---	---	Well Inventory	---	2816 St. Anthony Blvd.
---	---	Bryant Jr., James	4a	---	Q(B)	---	---	---	Well Inventory	---	615 12th Ave NW
---	---	Burton, Jason	4a	---	Q(B)	---	---	---	Well Inventory	---	2073 Tenth St NW
---	---	City of New Brighton	4a	---	Q(B)	---	---	---	Well Inventory	---	19 14th St NW
---	---	Cuddihy, Michael & Amy	4a	---	Q(B)	---	---	---	Well Inventory	---	2933 Troseth Rd
---	---	Hermes	4a	---	Q(B)	---	---	---	Well Inventory	---	2935 Old Hwy 8
---	---	Olson, Nathan	4a	---	Q(B)	---	---	---	Well Inventory	---	4439 Old Hwy 10
---	---	Tabaika, Dorothy	4a	---	Q(B)	---	---	---	Well Inventory	---	2512 27th Ave NE
---	---	Weisenberger, Heidi	4a	---	Q(B)	---	---	---	Well Inventory	---	2816 Silver Lake Rd
---	---	Willig, Allan	4a	---	Q(B)	---	---	---	Well Inventory	---	2600 Pahl Ave

Grenade Range

---	653903	GR1-1		---	---	---	---	---	OR	---	
---	653904	GR1-2		---	---	---	---	---	OR	---	
---	653905	GR2-1		---	---	---	---	---	OR	---	
---	675976	GR-DF1		---	---	---	---	---	OR	---	

A.2 Remedial Treatment Systems

APPENDIX A.2
FY 2008 - FY 2012 MONITORING PLAN
FOR REMEDIAL TREATMENT SYSTEMS

OU1: DEEP GROUNDWATER (1)

Location	Sampling Frequency	Parameters
• Extraction Wells NBM#4, #14, and #15	- Monthly	- Pumping Volumes
(and also NBM#3, #5, and #6)	- Monthly	- Water Quality (2)
• PGAC Effluent	- Monthly	- Water Quality (2)

OU2: SITE A SHALLOW GROUNDWATER

Location	Sampling Frequency	Parameters
• Extraction Wells (EW1 through EW4)	none	system shut down
• Extraction/Discharge System Effluent	none	system shut down

OU2: SITE K REMEDIAL ACTION

Location	Sampling Frequency	Parameters
• Extracted Groundwater	- Monthly	- Pumping Volume
• Treatment System Effluent [Outfall 391 (010)]	- See Appendix A.3	- See Appendix A.3

OU2: TCAAP GROUNDWATER RECOVERY SYSTEM (TGRS)

Location	Sampling Frequency	Parameters
• Extraction Wells	- Monthly	- Pumping Volumes
	- Semi-Annually	- Water Levels
	- Semi-Annually	- Water Quality (2)
• Treatment System Influent	- Monthly	- Pumping Volumes
	- Monthly	- Water Quality (2)
• Treatment System Effluent	- Monthly	- Water Quality (2)

Notes:

(1) Performed by the City of New Brighton using their Sampling and Analysis Plan.

(2) The required analyte list for each specific site is presented in Appendix A.4.

A.3 Surface Water

APPENDIX A.3
FY 2008 - FY 2012 MONITORING PLAN
FOR SURFACE WATER

Analysis	Analytical Method	Units	Site K Effluent (Outfall 010)
Flow Rate	- -	M gal/day	Continuous
Total Flow	- -	M gal	M
pH	(field)	(pH)	Q
Cyanide	9012A	µg/l	Q
Copper	6020	µg/l	Q
Lead	6020	µg/l	Q
Mercury	7470A	µg/l	Q
Phosphorus (Total)	365.4	µg/l	Q
Silver	6020	µg/l	Q
Zinc	6020	µg/l	Q
Trichloroethene	8260C	µg/l	Q
1,1-Dichloroethene	8260C	µg/l	Q
1,1-Dichloroethane	8260C	µg/l	Q
Cis-1,2-Dichloroethene	8260C	µg/l	Q
Trans-1,2-Dichloroethene	8260C	µg/l	Q
Vinyl Chloride	8260C	µg/l	Q
1,2-Dichloroethane	8260C	µg/l	Q

Notes:

M = Measurement required once per month

Q = Analysis required once per quarter

A.4 Site Specific Lists of Required Analytes

APPENDIX A.4
SITE SPECIFIC LISTS OF REQUIRED ANALYTES

<u>Note:</u> Cleanup levels (in ug/l) from each Record of Decision are shown below for use in determining the required method detection limits. Also note that these lists represent the <u>minimum</u> list of analytes. A larger analyte list may be utilized by the monitoring organization, if so desired.

<u>OU1 (DEEP GROUNDWATER) (1)</u>

1,1-Dichloroethane	70
1,1-Dichloroethene	6
cis-1,2-Dichloroethene	70
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	3
Trichloroethene	5

<u>SITE A (SHALLOW GROUNDWATER) (2)</u>

Antimony*	6
1,1-Dichloroethene	6
1,2-Dichloroethane	4
Benzene	10
Chloroform	60
cis-1,2-Dichloroethene	70
Tetrachloroethene	7
Trichloroethene	30

*Antimony is only monitored at these wells:
01U103, 01U902 and 01U904.

<u>SITE I (SHALLOW GROUNDWATER) (2)</u>

1,2-Dichloroethene (cis and trans)	70
Trichloroethene	30
Vinyl Chloride	0.2

<u>SITE K (SHALLOW GROUNDWATER) (2)</u>

1,2-Dichloroethene (cis and trans)	70
Trichloroethene	30

<u>OU2 (DEEP GROUNDWATER) (2)</u>

1,1,1-Trichloroethane	200
1,1-Dichloroethane	70
1,1-Dichloroethene	6
1,2-Dichloroethane	4
cis-1,2-Dichloroethene	70
Tetrachloroethene	5
Trichloroethene	5

<u>OU3 (DEEP GROUNDWATER) (3)</u>

1,1-Dichloroethane	70
1,1-Dichloroethene	6
cis-1,2-Dichloroethene	70
1,1,1-Trichloroethane	200
1,1,2-Trichloroethane	3
Trichloroethene	5

<u>Notes:</u>

(1) From page 18 of the OU1 Record of Decision.
(2) From Table 1 of the OU2 Record of Decision.
(3) From Page 26 of the OU3 Record of Decision.

Analytical Methods:
VOCs: SW-846 Method 8260C
Antimony: SW-846 Method 6020

APPENDIX A.4 (cont'd)
SITE SPECIFIC LISTS OF REQUIRED ANALYTES

OTHER INSTALLATION RESTORATION ACTIVITIES

WELL INVENTORY SAMPLING

VOCs (report full VOC list)

OU2 SHALLOW SOIL SITE 5-YEAR GROUNDWATER MONITORING

01U060 (Site H) Metals (antimony, arsenic, copper, lead, manganese)

Analytical Methods:
VOCs: SW-846 Method 8260C
Metals: SW-846 Method 6020

A.5 Site C Monitoring Plan

Appendix A.5
Site C-2 Monitoring Plan

	Monitoring Locations		Contingency Roles	
	Water Levels [1]	Analytical Sampling Locations [2]	Surface Water Compliance Points	
MW1	A	A		
MW2	A	A		
MW3	A	A		
MW4	A			
MW5	A			
MW6	A	A	X	
MW7	A			
MW8	A			
MW9	A			
MW10	A	A		
MW11	A	A		
MW12	A	A	X	
MW13	A	A		
MW14	A	A		
MW15	A	A		
MW16	A	A		
01U085	A	A [3]	X	
O1U045	A			
O1U046	A			
EW-01	M	M		
EW-02	M	M		
EW-03	M	M		
SW5 [4][5]		A	X	
SW6 [4][5]		A	X	
NE Wetland [4][5]		A	X	

NOTES:

(1) Water levels will be measured at the monitoring wells in March, June, and September 2008, then annually thereafter.
(2) Analytical parameters are: lead and pH.
(3) Well O1U085 will be sampled in March 2008, then annually thereafter.
(4) Sampling will be performed on 3 consecutive days and results will be averaged.
(5) Surface water will be sampled in March, June, and September 2008, then annually thereafter.

A = Annually, in June
M = Monthly

A.6 New Brighton Operating Rates

Table D-1
Remedial Production Ranges for Normal Operation
(Effective January 2008)

NBCGRS Well	Estimated Physical Capacity Range			Remedial Production Range		Flow Rate Equivalents (24-hr Production Basis)	
	Normal Individual Low (gpm)	Normal Individual High (gpm) (See Note 1)	Peak Combined High (gpm) (See Note 1)	Lower Limit (MGD)	Upper Limit (MGD)	Lower Limit (gpm)	Upper Limit (gpm)
3 (See Note 2)	300	600	400	0.000	0.576	0	400
4 (See Note 2)	500	1,100	900	1.152	1.296	800	900
3 + 4 (See Note 2)	800	n/a	1,300	1.152	1.872	800	1,300
5	400	850	750	0.864	1.080	600	750
6	400	850	750	0.000	1.080	0	750
5 + 6 (See Note 3)	800	1,700	1,500	0.864	2.160	600	1,500
14	500	1,200	1,000	0.000	1.440	0	1,000
15	500	1,200	1,000	1.152	1.440	800	1,000
TOTAL WELL CAPACITY	2,600	n/a	4,800	**3.168**	**6.912**	**2,200**	**4,800**
TREATMENT CAPACITY		3,200	5,000				
NBCGRS SYSTEM LIMIT		3,200	4,800				

NOTES:

1. During peak production periods with all wells running, individual well capacities are limited by interference, high drawdown, and high system head losses
2. While shown individually to illustrate normal operational intent, enforceable target is for combined Well 3 plus Well 4 since the wells are located in close proximity and effectively operate as a single point source. Wells 3 and 4 can be used interchangeably to produce total daily target.
3. While shown individually to illustrate normal operational intent, enforceable target is for combined Well 5 plus Well 6 since the wells are located in close proximity and effectively operate as a single point source. Wells 5 and 6 can be used interchangeably to produce total daily target.

15 FEB 2008
Michael R. Fix
Twin Cities Army Ammunition Plant

2/15/08
Grant M. Wyffels
City of New Brighton

Table D-2
Alternate Remedial Production Ranges for Contingent Events
(Effective January 2008)

Event	Normal Operation			Well 3 and/or 4 Down			Well 5 and/or 6 Down			Well 14 Down			Well 15 Down		
Well / Pair	Priority	Lower Limit (MGD)	Upper Limit (MGD)	Priority	Lower Limit (MGD)	Upper Limit (MGD)	Priority	Lower Limit (MGD)	Upper Limit (MGD)	Priority	Lower Limit (MGD)	Upper Limit (MGD)	Priority	Lower Limit (MGD)	Upper Limit (MGD)
3 + 4	2	1.152	1.872	NA	**0.000**	**0.000**	2	1.440	1.872	2	1.152	1.872	1	1.440	1.872
5 + 6	3	0.864	2.160	2	1.728	2.160	NA	**0.000**	**0.000**	3	0.864	2.160	2	1.728	2.160
14	4	0.000	1.440	3	1.152	1.440	3	1.152	1.440	NA	**0.000**	**0.000**	3	0.720	1.152
15	1	1.152	1.440	1	1.152	1.440	1	1.152	1.440	1	1.152	1.440	NA	**0.000**	**0.000**
Total		3.168	6.912		4.032	5.040		3.744	4.752		3.168	5.472		3.888	5.184

Appendix B

Description of Hydrogeologic Units/Well Nomenclature and Trichloroethene Trends

(Trichloroethene Trend Graphs are located at the end of this Appendix)

APPENDIX B
DESCRIPTION OF HYDROGEOLOGIC UNITS/WELL NOMENCLATURE AND TRICHLOROETHENE TRENDS

On- and off-TCAAP wells have been installed in four hydrogeologic units beneath the site. These hydrogeologic units, as referred to in this report, are conceptually illustrated on Figure B-1 and are described below:

Unit 1: This unit, referred to as the Fridley Formation, consists of alluvium and lacustrine deposits above the Twin Cities Formation (Unit 2). The formation is made up of fine- to medium-grained sand and clayey silt, which acts as an unconfined aquifer with an estimated hydraulic conductivity of 8.3×10^{-3} cm/sec (International Technology Corp. 1992). The Unit 1 deposits are discontinuous at TCAAP and ranges in thickness from zero to 50 feet. They are predominantly limited to the north, east, and southwest portions of the site. Groundwater in Unit 1 is also discontinuous.

Unit 2: Known as the Twin Cities Formation, Unit 2 consists of Quaternary aged glacial till and, similar to Unit 1, is discontinuous at TCAAP. Unit 2 is generally regarded as an aquitard to vertical migration of groundwater; however, sand and gravel lenses may contain water.

Unit 3: This unit consists primarily of the Quaternary aged Hillside Sand Formation, which is continuous beneath TCAAP. Near the center of TCAAP, the Hillside Sand Formation is overlain by the Arsenal Sand, which forms a kame. There is no distinct lithologic contact between the Hillside Sand and the Arsenal Sand, and both are considered included in Unit 3. Unit 3 ranges in thickness from 25 to 450 feet. For monitoring purposes, the Unit 3 aquifer thickness has been arbitrarily subdivided into thirds designated as upper, middle, and lower.

Unit 4: This unit consists collectively of bedrock from the Prairie du Chien Group and Jordan Formation (Ordovician and Cambrian periods, respectively). For monitoring purposes, the Prairie du Chien Group is referred to as Upper Unit 4, while the Jordan Formation is Lower Unit 4. The Jordan Formation varies from fine- to coarse-grained quartz sandstone. The Prairie du Chien Group in the TCAAP area consists of a finely crystalline dolomite of the Oneota Formation, as well as quartz sandstone and dolomite members of the Shakopee Formation. A more detailed description of the bedrock geology can be found in the Remedial Investigation Report (Argonne National Laboratory, 1991).

In order to identify the hydrogeologic unit in which each well is completed, the United States Army Environmental Center (USAEC), formerly the United States Army Toxic and Hazardous Materials Agency (USATHAMA), developed a standardized identification system for wells at TCAAP (referred to as the IRDMIS number). Well designations consist of six characters, such as 03U093. The first two characters represent the hydrogeologic unit in which the well is completed, as follows:

01	-	Unit 1
03	-	Unit 3
04	-	Unit 4: Prairie du Chien Group or Jordan Formation
PJ	-	Unit 4: Prairie du Chien Group and Jordan Formation

The third character represents the relative position of the well screen or open hole within the specified hydrogeologic unit, as follows:

U	-	upper portion
M	-	middle portion
L	-	lower portion
J	-	Jordan Sandstone
F	-	fully penetrating Unit 3
#	-	open hole (total or partial thickness)

The remaining three characters represent the well number, as follows:

001 thru 500	USAEC wells and additional wells installed by others adjacent to an existing well with the 001-500 designation.
501 thru 600	TCAAP wells.
601 thru 800	On-post Alliant wells.
801 thru 999	Off-post Alliant wells.

Off-TCAAP wells installed by parties other than USAEC, TCAAP, or Alliant are designated by their Minnesota unique number. For reference, a well-designation cross-reference guide is included as Tables B-1 and B-2, which lists all wells of concern, the Minnesota unique number, the IRDMIS number, and any other name(s) the wells may have. Table B-1 is sorted by unique number and Table B-2 is sorted by IRDMIS number. The well type in these two tables is abbreviated as follows:

UN	-	Unknown
MUNI	-	Municipal
MON	-	Monitoring
DOM	-	Domestic
IND	-	Industrial
P.S.	-	Public Supply
COM	-	Commercial
IRR	-	Irrigation
ABAND	-	Abandoned
PIEZ.	-	Piezometer
REM	-	Remedial

Tables B-3 and B-4, which contain the same list of wells as Table B-2 (i.e., a listing that is sorted by IRDMIS number), can be used to view the boring log for a given well, if available. To view the well log, click on the desired well name in the table with the mouse. Table B-3 provides the boring logs for on-TCAAP wells and Table B-4 provides the boring logs for off-TCAAP wells.

Figures B-2 and B-3 show locations for off- and on-TCAAP wells, respectively. With a known well name, the location of that well can be determined using the "Edit, Find" or "Edit, Search" function and then typing in the desired well name, which will highlight this well name on the figure. Using either of the figures, the trichloroethene trend graph for a specific well can be viewed by clicking on the desired well name with the mouse. Some of the wells do not have trend graphs available (primarily sealed wells). Refer to the historical water quality database in Appendix D for this information.

TABLE B-1
TCAAP WELL INDEX
SORTED BY UNIQUE NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
107405		ROEBKE	OFF	UN		
110485		NEW BRIGHTON #12	OFF	MUNI		
114410	03U521		OFF	MON		
122210		ST. PAUL PORT AUTH. #3	OFF	IND		
127537		MIDWEST ASPHALT	OFF	DOM		
134318		LORENZ W SEUTTER	OFF	DOM		
139035		WATERGATE MARINA	OFF	P.S.		
151568		ARDEN MANOR MOBILE HOME	OFF	P.S.		
161432		NEW BRIGHTON #10	OFF	MUN		
191942		118PDC/MODEL STONE	OFF	MON		
194701	01U620	OW120U1	ON	MON		
194702	01U621	PW121U1	ON	MON		
194703	01U622	OW122U1	ON	MON	✓	
194704	01U623	OW123U1	ON	MON	✓	
194716	01U634	OW504U1	ON	MON	✓	
194717	01U638	OW508U1		MON	✓	
194718	01U639	OW509U1	ON	MON		
194719	01U640	OW510U1	ON	MON		
194720	01U631	OW501U1	ON	MON		
194721	01U632	OW502U1		MON		
194722	01U635	OW505U1	ON	MON	✓	
194723	01U636	OW506U1	ON	MON.		
194724	01U642	OW512U1	ON	MON	✓	
194725	01U612	OW112U1	ON	MON		194758
194726	01U613		ON	MON		194759
194727	01U615	OW115U1	ON	MON		194760
194728	01U616	OW116U1	ON	MON		194761
194729	01U617	OW117U1	ON	MON		194770
194730	01U618	OW118U1	ON	MON		194771
194772	01U619	PW119U1	ON	MON		
200070		RUAN TRANSPORT	OFF	COM	✓	
200071		PRESTRESSED CONCRETE	OFF	IND	✓	
200072		WITTE TRANSPORTATION	OFF	IND	✓	
200073		WILSON TRANSFER & STORAGE	OFF	IND		
200074		ASBESTOS PROD	OFF	IND	✓	
200075		PHILLIPS PETROLEUM	OFF	IND	✓	
200076		OLD DUTCH FOODS INC	OFF	IND		
200077		JOHN CONLIN	OFF	DOM	✓	
200078		WILLIAM CLASS	OFF	DOM		
200079		LAWRENCE SCHOENING	OFF	DOM		
200080		CARL A OSTROM & SON	OFF	DOM		
200081		A. O. LIEBIG	OFF	DOM		
200082		2196 MARION ROAD	OFF	DOM		
200148		PAPER CALMERSON	OFF	IND	✓	
200154		U OF M GOLF COURSE	OFF	IRR		
200167		KOPPERS COKE #1	OFF	IND		
200171		PLATING INC	OFF	IND		
200197		SNOW FLAKE DAIRY	OFF	COM		
200264		1620 CENTRAL	OFF	IND		

TABLE B-1
TCAAP WELL INDEX
SORTED BY UNIQUE NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
200384		METALLURGICAL INC. WELL #1	OFF	IND		
200524		ST. ANTHONY #5	OFF	MUNI		
200525		PLETSCHER	OFF	UN		
200531		NAZARETH	OFF	UN		
200599		CEDAR AVE. TRIANGLE	OFF	P.S.		
200602		ATKINSON MILL CO.	OFF	IND		
200629		GENERAL MILLS	OFF	IND		
200803		ST. ANTHONY #4	OFF	P.S.		
200804		ST. ANTHONY #3	OFF	MUNI		
200812		GROSS GOLF COURSE #1	OFF	COM		
200814		AMERICAN LINEN	OFF	IND		
201074		GLEASSON MORTUARY	OFF	COM		
201082		NORTHWESTERN HOSPITAL	OFF	P.S.		
206669		FRIDLEY #8	OFF	MUNI		
206672		FRIDLEY #9	OFF	MUNI		
206673		FRIDLEY #6	OFF	MUNI		
206688		CLOVERPOND WELL	OFF	DOM		
206689		JAMES K. O'NEIL	OFF	UN		
206693		FERNELIUS	OFF	UN		
206702		MINN E.S.	OFF	UN		
206720		MOUNDSVIEW	OFF	MUNI		
206722		M0UNDSVIEW #5	OFF	MUNI		
206724	PJ#504	TWIN CITIES ARSENAL	OFF	ABAND	✓	
206725	03L523	ARSENAL GRAVEL PIT	ON	ABAND	✓	
206750		SHORE #4	OFF	MUNI		
206753	PJ#506	TWIN CITIES ARSENAL NO. 6	ON		✓	
206754	PJ#501	TWIN CITIES ARSENAL NO. 1	ON	P.S.	✓	
206755	PJ#507	TWIN CITIES ARSENAL NO. 7	ON	ABAND	✓	
206756	PJ#502	TWIN CITIES ARSENAL NO. 2	ON	IND	✓	
206758	PJ#503	TWIN CITIES ARSENAL NO. 3	ON	IND	✓	
206759	PJ#508	TWIN CITIES ARSENAL NO. 8	ON	ABAND	✓	
206760	03M509		ON		✓	
206760	PJ#509	TWIN CITIES ARSENAL NO.9	ON	DOM	✓	
206787		MOUNDSVIEW H.S.	OFF	P.S.		
206789		NEW BRIGHTON #1	OFF	MUNI	✓	
206791		NEW BRIGHTON #7	OFF	MUNI		
206792		NEW BRIGHTON #4				
206793		NEW BRIGHTON #3	OFF	MUNI		
206794		NEW BRIGHTON #9	OFF	MUNI		
206795		NEW BRIGHTON #8	OFF	MUNI		
206796		NEW BRIGHTON #5	OFF	MUNI		
206797		NEW BRIGHTON #6	OFF	MUNI		
206798		NEW BRIGHTON #2	OFF	MUNI	✓	
223844		KURTH MALTING CO EAST WL	OFF	IND		
223992		BOOM ISLAND	OFF	IND		
225886		FRANKLIN STEEL SQUARE	OFF	P.S.		
225905		ST PAUL TERM. WAREHOUSE	OFF	IND		
225906		ST PAUL TERM. WAREHOUSE	OFF	IND		
231741		LABELLE	OFF	UN		

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Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
231742	04U510	GRENADE PLANT PROOF RANGES	ON	IND		
231845		MNDOT CIVIL DEFENSE TRAIN.	ON/OFF	P.S.		
231854	03L522	ARSENAL GRAVEL PIT	ON	ABAND 8/9	✓	
231857	03M505			ABAND	✓	
231878		MENGELKOCH #2	OFF	UN		
232067		NBR 135	OFF	UN		
232069		UHIL	OFF	UN		
233221		REUBEN MEAT	OFF	DOM		
233222		LOWRY GROVE TRAILER	OFF	ABAND	✓	
233241		KOZAH'S MARKET	OFF	UN	✓	
233520		MCGILLIS	OFF	UN		
233533		ROSELAWN CEMETARY	OFF	IRR		
233763		P. L. MORGAN	OFF	DOM		
233806		2581 NORTH CLEVELAND	OFF	DOM		
234135	03U001	S1U3	ON	MON		
234136	03M001	S1M3	ON	MON		
234137	03L001	S1L3	ON	MON		
234138	04U001	S1U4	ON	MON		
234139	03U002	S2U3	ON	MON		
234140	03M002	S2M3	ON	MON		
234141	03L002	S2L3	ON	MON		
234142	03U003	S3U3	ON	MON		
234143	03M003	S3M3	ON	MON		
234144	03L003	S3L3	ON	MON		
234145	03U004	S4U3	ON	MON		
234146	03M004	S4M3	ON	MON		
234147	03L004	S4L3	ON	MON		
234148	03U005	S5U3	ON	MON		
234149	03U006	S6U3	ON	MON	✓	
234150	03U007	S7U3	ON	MON		
234151	03M007	S7M3	ON	MON		
234152	03L007	S7L3	ON	MON		
234153	03U008	S8U3	ON	MON		
234154	03U009	S9U3	ON	MON		
234155	03U010	S10U3	ON	MON		
234156	03M010	S10M3	ON	MON		
234157	03L010	S10L3	ON	MON		
234158	03U011	S11U3	ON	MON		
234159	03U012	S12U3	ON	MON		
234160	03M012	S12M3	ON	MON		
234161	03L012	S12L3	ON	MON		
234162	03U013	S13U3	ON	MON		
234163	03M013	S13M3	ON	MON		
234164	03L013	S13L3	ON	MON		
234165	03U014	S14U3	ON	MON		
234166	03U015	S15U3	ON	MON		
234167	03U016	S16U3	ON	MON		
234168	03U017	S17U3	ON	MON		
234169	03M017	S17M3	ON	MON		

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Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
234170	03L017	S17L3	ON	MON		
234171	03U018	S18U3	ON	MON		
234172	03U019	S19U3	ON	MON		
234173	03U020	S20U3	ON	MON		
234174	03M020	S20M3	ON	MON		
234175	03L020	S20L3	ON	MON		
234176	03U021	S21U3	ON	MON		
234193	04U003	S3U4	ON	MON		
234194	04U002	S2U4	ON	MON		
234195	04U007	S7U4	ON	MON		
234196	04U012	S12U4	ON	MON		
234197	04U020	S20U4	ON	MON		
234198	01U004	S4U1	ON	MON	✓	
234199	01U011	S11U1	ON	MON	✓	
234200	01U012	S12U1	ON	MON	✓	
234201	01U022	S22U1	ON	MON	✓	
234202	01U033	S33U1	ON	MON	✓	
234204	01U034	S34U1	ON	MON	✓	
234205	01U035	S35U1	ON	TEST		
234206	01U036	S36U1	ON	MON	✓	
234207	01U037	S37U1		MON	✓	
234208	01U038	S38U1		MON		
234209	01U039	S39U1	ON	MON		
234210	01U040	S40U1	ON	MON		
234211	01U041	S41U1	ON	MON		
234212	01U044	S44U1	ON	MON		
234215	01U045	S45U1	ON	MON		
234216	01U046	S46U1	ON	MON		
234217	01U047	S47U1	ON	MON		
234218	01U048	S48U1		MON		
234221	01U050	S50AU1		MON	✓	
234222	01U051	S51U1	ON	MON	✓	
234223	01U052	S52U1	ON	MON		
234225	01U053	S53AU1	ON	MON	✓	
234227	01U054	S54AU1		MON	✓	
234235	01U060	S60U1	ON	MON		
234237	01U062	S62U1	ON	MON	✓	
234239	01U063	S63U1	ON	MON		
234240	01U064	S64U1	ON	MON		
234241	01U065	S65U1	ON	MON		
234243	01U067	S67U1	ON	MON		
234250	01U072	S72AU1	ON	MON		
234301		DEWITT	OFF	UN	✓	
234305		GLENN BEGGIN	OFF	UN		
234319		HIDE & TALLOW #1	OFF	UN		
234327		BRESKE	OFF	UN		
234335		MENGELKOCH #1	OFF	UN		
234337		MENGELKOCH #3	OFF	UN	✓	
234350		GORDON	OFF	UN		

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Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
234351		YEMPA	OFF	UN		
234352		1206 12TH AV NW	OFF	UN	✓	
234353		LENTSCH'S ICE WK.	OFF	UN		
234355		KINGDOM HALL	OFF	UN		
234356		NORDQUIST P43	OFF	UN		
234357		PHILLIPS PET P46	OFF	UN		
234386		ZELL OLS.	OFF	UN		
234391		SHERER L.	OFF	UN		
234396		DEWITT	OFF	UN	✓	
234406		KLAPP	OFF	UN	✓	
234409		HIDE & TALLOW	OFF	UN		
234425		KEN GEREBI	OFF	UN	✓	
234430		CMIEL	OFF	UN	✓	
234431		HARSTAD	OFF	UN		
234463		KEN SOLIE	OFF	UN		
234546		HONEYWELL RIDGEWAY	OFF	UN		
234547		HONEYWELL RIDGEWAY	OFF	UN		
234549		REINER	OFF	IRR		
235539		OLD HOTEL	OFF	UN		
235557		HIDDEN FALLS PARK W.WELL	OFF	P.S.		
235565	PJ#074	S74PJ		MON	✓	
235619		SHRINERS HOSPITAL	OFF	P.S.		
235735		FLOUR CITY ARCHITECTURAL	OFF	COM		
235748	03L014	S14L3	ON	MON		
235749	03L018	S18L3	ON	MON		
235750	03L021	S21L3	ON	MON		
235751	03L027	S27L3	ON	MON		
235752	03L028	S28L3		MON		
235753	03L029	S29L3		MON		236066
236066	03U094	S94U3	ON	MON		
236067	03L091	S91L3	ON	MON	✓	
236068	03L086	S86L3	ON	MON	✓	
236069	03U084	S84U3	ON	MON		
236070	03L081	S81L3	ON	MON		
236071	03L080	S80L3	ON	MON		
236072	03U079	S79U3	ON	MON		
236073	03U078	S78U3	ON	MON		
236074	03L078	S78L3	ON	MON		
236075	03U077	S77U3	ON	MON		
236076	03L077	S77L3	ON	MON		
236077	03U076	S76U3	ON	MON		
236078	03U075	S75U3	ON	MON		
236079	03L005	S5L3	ON	MON		
236080	03L113	WF1L3	ON	MON		
236122		NWR	OFF	ABAND		
236176	01U003	S3U1	ON	MON	✓	
236177	01U043	S43AU1		MON		
236178	03U022	S22U3		MON		
236179	03U023	S23U3		MON		

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Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
236180	03U024	S24U3		MON		
236181	03U025	S25U3		MON		
236182	03U026	S26U3	ON	MON		
236183	03U027	S27U3		MON		
236184	03U028	S28U3		MON		
236185	03U029	S29U3		MON		
236186	03U030	S30U3		MON		
236187	03U031	S31U3		MON		
236188	03U032	S32U3		MON		
236189	01U601	OW101U1	ON	MON		
236190	01U602	OW102U1	ON	MON		
236191	01U603	OW103U1	ON	MON		
236192	01U604	OW104U1	ON	MON		
236193	01U605	OW10571	ON	MON		
236194	01U524	FA4U1	ON	PIEZ.	✓	
236195	01U527	FV8U1	ON	PIEZ.	✓	
236196	01U525	FW5U1	ON	PIEZ.	✓	
236197	01U526	FV12U1	ON	PIEZ.	✓	
236437	PJ#802	T2PJ	OFF	MON		421437
236449	03U801	T1U3	OFF	MON		
236450	04U802	T2U4	OFF	MON		
236452	01U803	T3U1	OFF	TEST	✓	424053
236453	03U803	T3U3	OFF	MON		421434
236455	03U804	T4U3	OFF	MON		421433
236457	01U805	T5U1	OFF	MON	✓	424060
236458	03U805	T5U3	OFF	MON		421432
236460	01U806	T6U1	OFF	MON	✓	424058
236461	03U806	T6U3	OFF	MON		421431
236462	03M806	T6M3	OFF	MON		421430
236463	03L806	T6L3	OFF	MON		421429
236464	04U806	T6U4	OFF	MON		421428
236465	PJ#806	T6PJ	OFF	MON		421427
236468	PJ#003	S3PJ	ON	MON		
236469	PJ#027	S27PJ	ON	MON		
236471	01U807	T7U1	OFF	TEST	✓	424059
236476	03U082	S82U3	ON	MON		
236478	03U083	S83U3	ON	MON		
236479	01U085	S85U1	ON	MON		
236480	03U087	S87U3	ON	MON		
236482	03U088	S88U3	ON	MON		
236483	03U089	S89U3	ON	MON		
236485	03U090	S90U3	ON	MON		
236487	03U092	S92U3	ON	MON		
236489	03U093	S93U3	ON	MON		
236491	03U096	S96U3	ON	MON		
236493	03U097	S97U3	ON	MON		
236494	01U098	S98U1	ON	MON	✓	
236495	03U099	S99U3	ON	MON		
236497	01U100	S100U1	ON	MON	✓	

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Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
236498	01U101	S101U1	ON	MON	✓	
236499	01U102	S102U1	ON	MON		
236500	01U103	S103U1	ON	MON		
236501	01U104	S104U1	ON	MON		
236502	01U105	S105U1	ON	MON		
236503	01U106	S106U1	ON	MON		
236504	01U107	S107U1	ON	MON		
236505	01U108	S108U1	ON	MON		
236506	01U109	S109U1	ON	MON	✓	
236507	01U110	S11OU1	ON	MON		
236508	03U111	S111U3	ON	MON		
236510	03U112	S112U3	ON	MON		
242124	03U113	WF1U3	ON	MON		
242125	03U114	WF2U3	ON	MON		
242127	01U607	OW107U1	ON	MON		
242128	01U608	OW108U1	ON	MON		
242129	01U609	OW109U1	ON	MON		
242130	01U610	OW110U1	ON	MON		
242131	01U611	OW111U1	ON	MON		
242132	03U647	OW517U3	ON	MON		
242133	03U648	OW518U3	ON	MON		
242134	01U652	OW522U1	ON	MON	✓	
242135	01U666	OW536U1	ON	MON		
242136	01U667	OW537U1	ON	MON		
242137	01U668	OW538U1	ON	MON		
242138	04U027	S27U4		MON		
242153	01U813	H3U1	OFF	MON	✓	
242160	03L079	S79L3	ON	MON		
242162		301PB	OFF	UN		
242182	01U624A	BP185A	ON	PIEZ		
242183	01U624B	BP185B	ON	PIEZ		
242184	01U624C	BP185C	ON	PIEZ		
242185	01U624D	BP185D	ON	PIEZ		
242186	01U625A	BP285A	ON	PIEZ		
242187	01U625B	BP285B	ON	PIEZ		
242188	01U625C	BP285C	ON	PIEZ		
242189	01U625D	BP285D	ON	PIEZ		
242190	01U626A	BP385A	ON	PIEZ		
242191	01U626B	BP385B	ON	PIEZ		
242192	01U626C	BP385C	ON	PIEZ		
242193	01U626D	BP385D	ON	PIEZ		
242194	01U627A	BP485A	ON	PIEZ		
242195	01U627B	BP485B	ON	PIEZ		
242196	01U627C	BP485C	ON	PIEZ		
242197	01U627D	BP485D	ON	PIEZ		
242198	01U628A	BP585A	ON	PIEZ		
242199	01U628B	BP585B	ON	PIEZ		
242200	01U628C	BP585C	ON	PIEZ		
242201	01U628D	BP585D	ON	PIEZ		

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Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
242207		SUNSET MEMORIAL CEMETARY	OFF	UN		
249152		BOYLE	OFF	DOM		
265735		FLOUR CITY ARCH	OFF	UN		
322664		ABBOTT NW HOSP	OFF	UN		
405651		METAL-MATIC INC.	OFF	IND		
406198	04U851	311U4	OFF	MON		
409546		PCA2L3	OFF	TEST	✓	
409547		PCA1U4	OFF	TEST		
409548		PCA2U4	OFF	TEST		
409549		PCA3U4	OFF	TEST		
409550		PCA6U3	OFF	TEST		
409555		PCA5U4	OFF	TEST		
409556		PCA4L3	OFF	TEST		
409557		PCA1L3	OFF	TEST		
409595		B109U3	OFF	ABAND		
409596		B118U3	OFF	MON		
409597		B118L3	OFF	IND		
409598		B117U3	OFF	ABAND		
416051	03M848	308M3	OFF	MON		
416078	04U848	308U4	OFF	TEST		
416080	04U852	312U4	OFF	MON		
416081	03L858	318L3	OFF	MON	✓	
416082	04U849	309U4	OFF	MON		
416143			OFF	ABAND		
416198		311U4	OFF	MON		
416199	03L848	308L3	OFF	MON		
416200	04U850	310U4	OFF	MON		
420713		HERBST LANDFILL	OFF	MON		
421425	03U659	OW529U3	ON	MON		
421426	03U658	OW528U3	ON	MON		
421438	03U671	PO-1	ON	MON		
421440	03U672	PD2U3	OFF	MON		
421441	03U673	PD3U3	OFF	MON		
424052	01L822	NW2L1	OFF	TEST	✓	
424054	01L821	NW1L1	OFF	TEST	✓	
424055	01L811	H1L1; MDNR Well	OFF	TEST		
424056	01L816	H6L1	OFF	ABAND	✓	
424057	01U808	T8U1	ON	MON	✓	
424061	01L823	NW3L1	OFF	TEST	✓	
424062	01L813	H3L1	OFF	TEST	✓	
426808	03U811	H1U3	OFF	TEST		
426809	03L811	H1L3	OFF	TEST		
426810	03U821	NW1U3	OFF	TEST		
426811	04U821	NW1U4	OFF	TEST		
426812	03U822	NW2U3	OFF	TEST		
426813	03L822	NW2L3	OFF	TEST		
426814	03U824	NW4U3	OFF	TEST	✓	
426815	03L673	PD3L3	OFF	TEST		
426816	03L813	H3L3	OFF	TEST	✓	

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Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
426817	03L802	T2L3	OFF	TEST		
426818	03M802	T2M3	OFF	TEST		
426842	03F302	B1	ON	REM		
426843	03F303	B2	ON	REM		
426844	03F304	B3	ON	REM		
426845	03F305	B4	ON	REM		
426846	03F306	B5	ON	REM		
426847	03F307	B6	ON	REM		
426848	03U701	701U3	ON	MON		
426849	04U701	701U4	ON	MON		
426850	03U702	702U3	ON	MON		
426851	04U841	301U4	OFF	TEST		
426852	03M843	303M3	OFF	TEST		
426853	04U843	303U4	OFF	TEST		
426854	04U844	304U4	OFF	TEST		
426855	04U845	305U4	OFF	MON		
426856	04U846	306U4	OFF	MON		
426857	04U847	307U4	OFF	MON		
426858	03L853	313L3	OFF	MON		
426859	03L854	314L3	OFF	MON		
426860	04U855	315U4	OFF	MON		
426861	03L856	316L3	OFF	MON	✓	
426862	03U815	H5U3	OFF	TEST	✓	
426863	03U831	OM1U3	OFF	TEST		
426864	03U832	OM2U3	OFF	TEST	✓	
426865	03L832	OM2L3	OFF	TEST		
426866	04U832	OM2U4	OFF	TEST		
426867	04U673	PD3U4	OFF	TEST		
426868	03L809	T9L3	OFF	MON		
426876	04U702	702U4	ON	MON		
426877	04U077	ST77U4	ON	MON		
426878	03U703	703U3		MON		
426879	03U708	708U3	ON	MON		
426880	04U708	708U4	ON	MON		
426881	03U709	709U3	ON	MON		
426882	04U709	709U4	ON	MON		
426883	03U704	704U3	ON	MON		
426884	03U705	705U3	ON	MON		
426885	03U706	706U3	ON	MON		
426886	03U707	707U3	ON	MON		
427410	01U120		ON	MON		
427411	01U115		ON	MON		
427412	01U116		ON	MON		
427413	01U117		ON	MON		
427414	01U118		ON	MON		
427415	01U119		ON	MON		
434031	04U711	711U4	OFF	MON		
434032	03U710	71OU3	ON	MON		
434033	03U711	711U3	OFF	MON		

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Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
434034	04U861	321U4	OFF	MON		
434035	04U860	320U4	OFF	MON		
434036	04U859	319U4	OFF	MON		
434037	03L841	301L3	OFF	MON		
434038	03L860	320L3	OFF	MON		
434039	03L861	321L3	OFF	MON		
434040	03L859	319L3	OFF	MON		
439701	04U854	314U4	OFF	MON		
440884	03U121		ON	MON		
440885	03M005	ST-5-M3	ON	MON		
440886	03U129		ON	MON		
440887	03L084	ST84L3	ON	MON		
440888	01U122		ON	MON	✓	
440889	01U125		ON	MON		
440890	01U126		ON	MON		
440891	01U127		ON	MON		
440892	01U128		ON	MON		
440893	01U133		ON	MON		
440894	01U134		OFF	MON		
440895	01U130		ON	MON	✓	
440896	03U124		ON	MON	✓	
447889	04U871	401U4	OFF	MON		
447890	04U882	412U4	OFF	MON		
447891	04U881	411U4	OFF	MON		
447892	04U883	413U4	OFF	MON		
447893	01U350		ON	MON		
447894	PJ#318	318U4	OFF	MON		
447895	04U880	410U4	OFF	MON		
447896	04U877	407U4	OFF	MON		
447898	04U875	405U4	OFF	MON		
447899	03L846	306L3	OFF	MON		
447900	04U879	409U4	OFF	MON		
447988	04U872	402U4	OFF	MON		
447998	01U135		ON	MON		
447999	01U136		ON	MON		
453821	03U317	SC-5	ON	REM		
453822	03U316	SC-4	ON	REM		
453823	03F308	B7	ON	REM		
453824	03F312	B11	ON	REM		
453825	PJ#309	B8	ON	REM		
453826	PJ#310	B9	ON	REM		
453827	PJ#311	B10	ON	REM		
453828	PJ#313	B12	ON	REM		
453829	04J708		ON	MON		
453830	04J713		ON	MON		
453831	03M713		ON	MON		
453832	04U714		ON	MON		
453833	03U715	SM1	ON	MON		
453834	03U716	SM2	ON	MON		

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Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
471394	04U863	323U4	OFF	MON		
476387		MW15H	OFF	MON		
482083		K04-MW	ON	MON		
482084		K02-MW	ON	MON		
482085		K01-MW	ON	MON		
482086		I01-MW	ON	MON		
482087		I05-MW	ON	MON		
482088		I02-MW	ON	MON		
482089		I04-MW	ON	MON		
482090		I03-MW	ON	MON		
482707	04J882		OFF	MON		
482708	04J835		OFF	MON		
482709	04J834		OFF	MON		
500691	04U414	414U4/EZ SELF SERVICE	OFF	MON		
500694	03L137		ON	MON	✓	
505189	01U137		ON	MON		
505190	01U138		ON	MON		
505191	01U139		ON	MON		
505192	01U140		ON	MON		
505193	01U141		ON	MON		
505209	01U902		OFF	MON		
505210	01U901	H3U1	OFF	MON		
505618	03L138		ON	MON	✓	
508115	04U322	322U4	OFF	MON		
508117	04J702		ON	MON		
508118	04J077		ON	MON		
508119	04U713		ON	MON		
508120	04J714		ON	MON		
508122	03U314	SC-2	ON	REM		
509083		NEW BRIGHTON #11	OFF	MUNI		
512761		GROSS GOLF #2	OFF	IRR		
519288		E101-MW	ON	MON		
519289		E102-MW	ON	MON		
519290		E103-MW	ON	MON		
519291		129-1501-MW	ON	MON	✓	
519836	04U834		OFF	MON		
519956	03L833		OFF	MON		
519957	04U833		OFF	MON		
520931		NEW BRIGHTON #13	OFF	MUNI		
524047	04U865	325U4	OFF	MON		
524048	04J866	326J	OFF	MON		
524049	04U866	326U4	OFF	MON		
524050	04U864	324U4	OFF	MON		
524051	04J864	324J	OFF	MON		
538039	01U145		ON	PIEZ.		
538040	01U146		ON	PIEZ.		
538041	01U147		ON	PIEZ.		
538042	01U148		ON	PIEZ.		
538043	01U149		ON	PIEZ.		

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TCAAP WELL INDEX
SORTED BY UNIQUE NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
538044	01U150		ON	PIEZ.		
538045	01U151		ON	PIEZ.		
538046	01U152		ON	PIEZ.		
538047	01U153		ON	PIEZ.		
538048	01U154		ON	PIEZ.		
538049	01U155		ON	PIEZ.		
538050	01U156		ON	PIEZ.		
538051	01U351	EW1	ON	REM		
538052	01U352	EW2	ON	REM		
538053	01U353	EW3	ON	REM		
538054	01U354	EW4	ON	REM		
538055	01U355	EW5	ON	REM		
538056	01U356	EW6	ON	REM		
538057	01U357	EW7	ON	REM		
538058	01U358	EW8	ON	REM		
538059	01U904		OFF	MON		
538060	01U903		OFF	MON		
538062	01U157		ON	MON		
538063	01U158		ON	MON		
554216		NEW BRIGHTON #14	OFF	MUNI		
582628		NEW BRIGHTON #15	OFF	MUNI		
589650		CM1MW	ON	MON		
596628	04U836	MW-1	OFF	MON		
596629	04J836	MW-2	OFF	MON		
596630	04U837	MW-3	OFF	MON		
596631	04J837	MW-4	OFF	MON		
596632	04U838	MW-5	OFF	MON		
596633	04J838	MW-6	OFF	MON		
596634	04U839	MW-7	OFF	MON		
596635	04J839	MW-8	OFF	MON		
616601		CM2MW	ON	MON		
616602		CM3MW	ON	MON		
624019		CM5MW	ON	MON		
643379			ON	PIEZ.	✓	
643380			ON	PIEZ.	✓	
643381			ON	PIEZ.	✓	
643382			ON	PIEZ.	✓	
653903		GR1-1	ON	MON		
653904		GR1-2	ON	MON		
653905		GR2-1	ON	MON		
675976		GR-DF1	ON	MON		
687112	03F319	B13	ON	REM		
706043	04J822		OFF	MON		
706044	04J849		OFF	MON		
706045	04J947		OFF	MON		
	01U131				✓	
	01U132					
	01U142				✓	
	01U143				✓	

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TCAAP WELL INDEX
SORTED BY UNIQUE NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
	01U144				✓	
	01U653			MON		
	01U675				✓	
	03L306		ON	MON		
	03L843	303L3	OFF	MON		
	03U301	SC-1	ON	REM		
	03U315	SC-3		REM		
	03U674	OW541U3	ON	MON		
	03U675					
	03U676	OW543U3	ON	MON		
	04U842			MON		
	PJ#006		ON	MON		
		MW15D	OFF	MON		
		MW15S	OFF	MON		

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TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
424055	01L811	H1L1; MDNR Well	OFF	TEST		
424062	01L813	H3L1	OFF	TEST	✓	
424056	01L816	H6L1	OFF	ABAND	✓	
424054	01L821	NW1L1	OFF	TEST	✓	
424052	01L822	NW2L1	OFF	TEST	✓	
424061	01L823	NW3L1	OFF	TEST	✓	
236176	01U003	S3U1	ON	MON	✓	
234198	01U004	S4U1	ON	MON	✓	
234199	01U011	S11U1	ON	MON	✓	
234200	01U012	S12U1	ON	MON	✓	
234201	01U022	S22U1	ON	MON	✓	
234202	01U033	S33U1	ON	MON	✓	
234204	01U034	S34U1	ON	MON	✓	
234205	01U035	S35U1	ON	TEST		
234206	01U036	S36U1	ON	MON	✓	
234207	01U037	S37U1		MON	✓	
234208	01U038	S38U1		MON		
234209	01U039	S39U1	ON	MON		
234210	01U040	S40U1	ON	MON		
234211	01U041	S41U1	ON	MON		
236177	01U043	S43AU1		MON		
234212	01U044	S44U1	ON	MON		
234215	01U045	S45U1	ON	MON		
234216	01U046	S46U1	ON	MON		
234217	01U047	S47U1	ON	MON		
234218	01U048	S48U1		MON		
234221	01U050	S50AU1		MON	✓	
234222	01U051	S51U1	ON	MON	✓	
234223	01U052	S52U1	ON	MON		
234225	01U053	S53AU1	ON	MON	✓	
234227	01U054	S54AU1		MON	✓	
234235	01U060	S60U1	ON	MON		
234237	01U062	S62U1	ON	MON	✓	
234239	01U063	S63U1	ON	MON		
234240	01U064	S64U1	ON	MON		
234241	01U065	S65U1	ON	MON		
234243	01U067	S67U1	ON	MON		
234250	01U072	S72AU1	ON	MON		
236479	01U085	S85U1	ON	MON		
236494	01U098	S98U1	ON	MON	✓	
236497	01U100	S100U1	ON	MON	✓	
236498	01U101	S101U1	ON	MON	✓	
236499	01U102	S102U1	ON	MON		
236500	01U103	S103U1	ON	MON		
236501	01U104	S104U1	ON	MON		
236502	01U105	S105U1	ON	MON		
236503	01U106	S106U1	ON	MON		
236504	01U107	S107U1	ON	MON		
236505	01U108	S108U1	ON	MON		

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SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
236506	01U109	S109U1	ON	MON	✓	
236507	01U110	S11OU1	ON	MON		
427411	01U115		ON	MON		
427412	01U116		ON	MON		
427413	01U117		ON	MON		
427414	01U118		ON	MON		
427415	01U119		ON	MON		
427410	01U120		ON	MON		
440888	01U122		ON	MON	✓	
440889	01U125		ON	MON		
440890	01U126		ON	MON		
440891	01U127		ON	MON		
440892	01U128		ON	MON		
440895	01U130		ON	MON	✓	
	01U131				✓	
	01U132					
440893	01U133		ON	MON		
440894	01U134		OFF	MON		
447998	01U135		ON	MON		
447999	01U136		ON	MON		
505189	01U137		ON	MON		
505190	01U138		ON	MON		
505191	01U139		ON	MON		
505192	01U140		ON	MON		
505193	01U141		ON	MON		
	01U142				✓	
	01U143				✓	
	01U144				✓	
538039	01U145		ON	PIEZ.		
538040	01U146		ON	PIEZ.		
538041	01U147		ON	PIEZ.		
538042	01U148		ON	PIEZ.		
538043	01U149		ON	PIEZ.		
538044	01U150		ON	PIEZ.		
538045	01U151		ON	PIEZ.		
538046	01U152		ON	PIEZ.		
538047	01U153		ON	PIEZ.		
538048	01U154		ON	PIEZ.		
538049	01U155		ON	PIEZ.		
538050	01U156		ON	PIEZ.		
538062	01U157		ON	MON		
538063	01U158		ON	MON		
447893	01U350		ON	MON		
538051	01U351	EW1	ON	REM		
538052	01U352	EW2	ON	REM		
538053	01U353	EW3	ON	REM		
538054	01U354	EW4	ON	REM		
538055	01U355	EW5	ON	REM		
538056	01U356	EW6	ON	REM		

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TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
538057	01U357	EW7	ON	REM		
538058	01U358	EW8	ON	REM		
236194	01U524	FA4U1	ON	PIEZ.	✓	
236196	01U525	FW5U1	ON	PIEZ.	✓	
236197	01U526	FV12U1	ON	PIEZ.	✓	
236195	01U527	FV8U1	ON	PIEZ.	✓	
236189	01U601	OW101U1	ON	MON		
236190	01U602	OW102U1	ON	MON		
236191	01U603	OW103U1	ON	MON		
236192	01U604	OW104U1	ON	MON		
236193	01U605	OW10571	ON	MON		
242127	01U607	OW107U1	ON	MON		
242128	01U608	OW108U1	ON	MON		
242129	01U609	OW109U1	ON	MON		
242130	01U610	OW110U1	ON	MON		
242131	01U611	OW111U1	ON	MON		
194725	01U612	OW112U1	ON	MON		194758
194726	01U613		ON	MON		194759
194727	01U615	OW115U1	ON	MON		194760
194728	01U616	OW116U1	ON	MON		194761
194729	01U617	OW117U1	ON	MON		194770
194730	01U618	OW118U1	ON	MON		194771
194772	01U619	PW119U1	ON	MON		
194701	01U620	OW120U1	ON	MON		
194702	01U621	PW121U1	ON	MON		
194703	01U622	OW122U1	ON	MON	✓	
194704	01U623	OW123U1	ON	MON	✓	
242182	01U624A	BP185A	ON	PIEZ		
242183	01U624B	BP185B	ON	PIEZ		
242184	01U624C	BP185C	ON	PIEZ		
242185	01U624D	BP185D	ON	PIEZ		
242186	01U625A	BP285A	ON	PIEZ		
242187	01U625B	BP285B	ON	PIEZ		
242188	01U625C	BP285C	ON	PIEZ		
242189	01U625D	BP285D	ON	PIEZ		
242190	01U626A	BP385A	ON	PIEZ		
242191	01U626B	BP385B	ON	PIEZ		
242192	01U626C	BP385C	ON	PIEZ		
242193	01U626D	BP385D	ON	PIEZ		
242194	01U627A	BP485A	ON	PIEZ		
242195	01U627B	BP485B	ON	PIEZ		
242196	01U627C	BP485C	ON	PIEZ		
242197	01U627D	BP485D	ON	PIEZ		
242198	01U628A	BP585A	ON	PIEZ		
242199	01U628B	BP585B	ON	PIEZ		
242200	01U628C	BP585C	ON	PIEZ		
242201	01U628D	BP585D	ON	PIEZ		
194720	01U631	OW501U1	ON	MON		
194721	01U632	OW502U1		MON		

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TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
194716	01U634	OW504U1	ON	MON	✓	
194722	01U635	OW505U1	ON	MON	✓	
194723	01U636	OW506U1	ON	MON.		
194717	01U638	OW508U1		MON	✓	
194718	01U639	OW509U1	ON	MON		
194719	01U640	OW510U1	ON	MON		
194724	01U642	OW512U1	ON	MON	✓	
242134	01U652	OW522U1	ON	MON	✓	
	01U653			MON		
242135	01U666	OW536U1	ON	MON		
242136	01U667	OW537U1	ON	MON		
242137	01U668	OW538U1	ON	MON		
	01U675				✓	
236452	01U803	T3U1	OFF	TEST	✓	424053
236457	01U805	T5U1	OFF	MON	✓	424060
236460	01U806	T6U1	OFF	MON	✓	424058
236471	01U807	T7U1	OFF	TEST	✓	424059
424057	01U808	T8U1	ON	MON	✓	
242153	01U813	H3U1	OFF	MON	✓	
505210	01U901	H3U1	OFF	MON		
505209	01U902		OFF	MON		
538060	01U903		OFF	MON		
538059	01U904		OFF	MON		
426842	03F302	B1	ON	REM		
426843	03F303	B2	ON	REM		
426844	03F304	B3	ON	REM		
426845	03F305	B4	ON	REM		
426846	03F306	B5	ON	REM		
426847	03F307	B6	ON	REM		
453823	03F308	B7	ON	REM		
453824	03F312	B11	ON	REM		
687112	03F319	B13	ON	REM		
234137	03L001	S1L3	ON	MON		
234141	03L002	S2L3	ON	MON		
234144	03L003	S3L3	ON	MON		
234147	03L004	S4L3	ON	MON		
236079	03L005	S5L3	ON	MON		
234152	03L007	S7L3	ON	MON		
234157	03L010	S10L3	ON	MON		
234161	03L012	S12L3	ON	MON		
234164	03L013	S13L3	ON	MON		
235748	03L014	S14L3	ON	MON		
234170	03L017	S17L3	ON	MON		
235749	03L018	S18L3	ON	MON		
234175	03L020	S20L3	ON	MON		
235750	03L021	S21L3	ON	MON		
235751	03L027	S27L3	ON	MON		
235752	03L028	S28L3		MON		
235753	03L029	S29L3		MON		236066

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TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
236076	03L077	S77L3	ON	MON		
236074	03L078	S78L3	ON	MON		
242160	03L079	S79L3	ON	MON		
236071	03L080	S80L3	ON	MON		
236070	03L081	S81L3	ON	MON		
440887	03L084	ST84L3	ON	MON		
236068	03L086	S86L3	ON	MON	✓	
236067	03L091	S91L3	ON	MON	✓	
236080	03L113	WF1L3	ON	MON		
500694	03L137		ON	MON	✓	
505618	03L138		ON	MON	✓	
	03L306		ON	MON		
231854	03L522	ARSENAL GRAVEL PIT	ON	ABAND	✓	
206725	03L523	ARSENAL GRAVEL PIT	ON	ABAND	✓	
426815	03L673	PD3L3	OFF	TEST		
426817	03L802	T2L3	OFF	TEST		
236463	03L806	T6L3	OFF	MON		421429
426868	03L809	T9L3	OFF	MON		
426809	03L811	H1L3	OFF	TEST		
426816	03L813	H3L3	OFF	TEST	✓	
426813	03L822	NW2L3	OFF	TEST		
426865	03L832	OM2L3	OFF	TEST		
519956	03L833		OFF	MON		
434037	03L841	301L3	OFF	MON		
	03L843	303L3	OFF	MON		
447899	03L846	306L3	OFF	MON		
416199	03L848	308L3	OFF	MON		
426858	03L853	313L3	OFF	MON		
426859	03L854	314L3	OFF	MON		
426861	03L856	316L3	OFF	MON	✓	
416081	03L858	318L3	OFF	MON	✓	
434040	03L859	319L3	OFF	MON		
434038	03L860	320L3	OFF	MON		
434039	03L861	321L3	OFF	MON		
234136	03M001	S1M3	ON	MON		
234140	03M002	S2M3	ON	MON		
234143	03M003	S3M3	ON	MON		
234146	03M004	S4M3	ON	MON		
440885	03M005	ST-5-M3	ON	MON		
234151	03M007	S7M3	ON	MON		
234156	03M010	S10M3	ON	MON		
234160	03M012	S12M3	ON	MON		
234163	03M013	S13M3	ON	MON		
234169	03M017	S17M3	ON	MON		
234174	03M020	S20M3	ON	MON		
231857	03M505			ABAND	✓	
206760	03M509		ON		✓	
453831	03M713		ON	MON		
426818	03M802	T2M3	OFF	TEST		

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TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
236462	03M806	T6M3	OFF	MON		421430
426852	03M843	303M3	OFF	TEST		
416051	03M848	308M3	OFF	MON		
234135	03U001	S1U3	ON	MON		
234139	03U002	S2U3	ON	MON		
234142	03U003	S3U3	ON	MON		
234145	03U004	S4U3	ON	MON		
234148	03U005	S5U3	ON	MON		
234149	03U006	S6U3	ON	MON	✓	
234150	03U007	S7U3	ON	MON		
234153	03U008	S8U3	ON	MON		
234154	03U009	S9U3	ON	MON		
234155	03U010	S10U3	ON	MON		
234158	03U011	S11U3	ON	MON		
234159	03U012	S12U3	ON	MON		
234162	03U013	S13U3	ON	MON		
234165	03U014	S14U3	ON	MON		
234166	03U015	S15U3	ON	MON		
234167	03U016	S16U3	ON	MON		
234168	03U017	S17U3	ON	MON		
234171	03U018	S18U3	ON	MON		
234172	03U019	S19U3	ON	MON		
234173	03U020	S20U3	ON	MON		
234176	03U021	S21U3	ON	MON		
236178	03U022	S22U3		MON		
236179	03U023	S23U3		MON		
236180	03U024	S24U3		MON		
236181	03U025	S25U3		MON		
236182	03U026	S26U3	ON	MON		
236183	03U027	S27U3		MON		
236184	03U028	S28U3		MON		
236185	03U029	S29U3		MON		
236186	03U030	S30U3		MON		
236187	03U031	S31U3		MON		
236188	03U032	S32U3		MON		
236078	03U075	S75U3	ON	MON		
236077	03U076	S76U3	ON	MON		
236075	03U077	S77U3	ON	MON		
236073	03U078	S78U3	ON	MON		
236072	03U079	S79U3	ON	MON		
236476	03U082	S82U3	ON	MON		
236478	03U083	S83U3	ON	MON		
236069	03U084	S84U3	ON	MON		
236480	03U087	S87U3	ON	MON		
236482	03U088	S88U3	ON	MON		
236483	03U089	S89U3	ON	MON		
236485	03U090	S90U3	ON	MON		
236487	03U092	S92U3	ON	MON		
236489	03U093	S93U3	ON	MON		

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TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
236066	03U094	S94U3	ON	MON		
236491	03U096	S96U3	ON	MON		
236493	03U097	S97U3	ON	MON		
236495	03U099	S99U3	ON	MON		
236508	03U111	S111U3	ON	MON		
236510	03U112	S112U3	ON	MON		
242124	03U113	WF1U3	ON	MON		
242125	03U114	WF2U3	ON	MON		
440884	03U121		ON	MON		
440896	03U124		ON	MON	✓	
440886	03U129		ON	MON		
	03U301	SC-1	ON	REM		
508122	03U314	SC-2	ON	REM		
	03U315	SC-3		REM		
453822	03U316	SC-4	ON	REM		
453821	03U317	SC-5	ON	REM		
114410	03U521		OFF	MON		
242132	03U647	OW517U3	ON	MON		
242133	03U648	OW518U3	ON	MON		
421426	03U658	OW528U3	ON	MON		
421425	03U659	OW529U3	ON	MON		
421438	03U671	PO-1	ON	MON		
421440	03U672	PD2U3	OFF	MON		
421441	03U673	PD3U3	OFF	MON		
	03U674	OW541U3	ON	MON		
	03U675					
	03U676	OW543U3	ON	MON		
426848	03U701	701U3	ON	MON		
426850	03U702	702U3	ON	MON		
426878	03U703	703U3		MON		
426883	03U704	704U3	ON	MON		
426884	03U705	705U3	ON	MON		
426885	03U706	706U3	ON	MON		
426886	03U707	707U3	ON	MON		
426879	03U708	708U3	ON	MON		
426881	03U709	709U3	ON	MON		
434032	03U710	71OU3	ON	MON		
434033	03U711	711U3	OFF	MON		
453833	03U715	SM1	ON	MON		
453834	03U716	SM2	ON	MON		
236449	03U801	T1U3	OFF	MON		
236453	03U803	T3U3	OFF	MON		421434
236455	03U804	T4U3	OFF	MON		421433
236458	03U805	T5U3	OFF	MON		421432
236461	03U806	T6U3	OFF	MON		421431
426808	03U811	H1U3	OFF	TEST		
426862	03U815	H5U3	OFF	TEST	✓	
426810	03U821	NW1U3	OFF	TEST		
426812	03U822	NW2U3	OFF	TEST		

TABLE B-2
TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
426814	03U824	NW4U3	OFF	TEST	✓	
426863	03U831	OM1U3	OFF	TEST		
426864	03U832	OM2U3	OFF	TEST	✓	
508118	04J077		ON	MON		
508117	04J702		ON	MON		
453829	04J708		ON	MON		
453830	04J713		ON	MON		
706043	04J822		OFF	MON		
508120	04J714		ON	MON		
482709	04J834		OFF	MON		
482708	04J835		OFF	MON		
596629	04J836	MW-2	OFF	MON		
596631	04J837	MW-4	OFF	MON		
596633	04J838	MW-6	OFF	MON		
596635	04J839	MW-8	OFF	MON		
706045	04J847		OFF	MON		
706044	04J840		OFF	MON		
524051	04J864	324J	OFF	MON		
524048	04J866	326J	OFF	MON		
482707	04J882		OFF	MON		
234138	04U001	S1U4	ON	MON		
234194	04U002	S2U4	ON	MON		
234193	04U003	S3U4	ON	MON		
234195	04U007	S7U4	ON	MON		
234196	04U012	S12U4	ON	MON		
234197	04U020	S20U4	ON	MON		
242138	04U027	S27U4		MON		
426877	04U077	ST77U4	ON	MON		
508115	04U322	322U4	OFF	MON		
500691	04U414	414U4/EZ SELF SERVICE	OFF	MON		
231742	04U510	GRENADE PLANT PROOF RANGES	ON	IND		
426867	04U673	PD3U4	OFF	TEST		
426849	04U701	701U4	ON	MON		
426876	04U702	702U4	ON	MON		
426880	04U708	708U4	ON	MON		
426882	04U709	709U4	ON	MON		
434031	04U711	711U4	OFF	MON		
508119	04U713		ON	MON		
453832	04U714		ON	MON		
236450	04U802	T2U4	OFF	MON		
236464	04U806	T6U4	OFF	MON		421428
426811	04U821	NW1U4	OFF	TEST		
426866	04U832	OM2U4	OFF	TEST		
519957	04U833		OFF	MON		
519836	04U834		OFF	MON		
596628	04U836	MW-1	OFF	MON		
596630	04U837	MW-3	OFF	MON		
596632	04U838	MW-5	OFF	MON		
596634	04U839	MW-7	OFF	MON		

TABLE B-2
TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
426851	04U841	301U4	OFF	TEST		
	04U842			MON		
426853	04U843	303U4	OFF	TEST		
426854	04U844	304U4	OFF	TEST		
426855	04U845	305U4	OFF	MON		
426856	04U846	306U4	OFF	MON		
426857	04U847	307U4	OFF	MON		
416078	04U848	308U4	OFF	TEST		
416082	04U849	309U4	OFF	MON		
416200	04U850	310U4	OFF	MON		
406198	04U851	311U4	OFF	MON		
416080	04U852	312U4	OFF	MON		
439701	04U854	314U4	OFF	MON		
426860	04U855	315U4	OFF	MON		
434036	04U859	319U4	OFF	MON		
434035	04U860	320U4	OFF	MON		
434034	04U861	321U4	OFF	MON		
471394	04U863	323U4	OFF	MON		
524050	04U864	324U4	OFF	MON		
524047	04U865	325U4	OFF	MON		
524049	04U866	326U4	OFF	MON		
447889	04U871	401U4	OFF	MON		
447988	04U872	402U4	OFF	MON		
447898	04U875	405U4	OFF	MON		
447896	04U877	407U4	OFF	MON		
447900	04U879	409U4	OFF	MON		
447895	04U880	410U4	OFF	MON		
447891	04U881	411U4	OFF	MON		
447890	04U882	412U4	OFF	MON		
447892	04U883	413U4	OFF	MON		
236468	PJ#003	S3PJ	ON	MON		
	PJ#006		ON	MON		
236469	PJ#027	S27PJ	ON	MON		
235565	PJ#074	S74PJ		MON	✓	
453825	PJ#309	B8	ON	REM		
453826	PJ#310	B9	ON	REM		
453827	PJ#311	B10	ON	REM		
453828	PJ#313	B12	ON	REM		
447894	PJ#318	318U4	OFF	MON		
206754	PJ#501	TWIN CITIES ARSENAL NO. 1	ON	P.S.	✓	
206756	PJ#502	TWIN CITIES ARSENAL NO. 2	ON	IND	✓	
206758	PJ#503	TWIN CITIES ARSENAL NO. 3	ON	IND	✓	
206724	PJ#504	TWIN CITIES ARSENAL	OFF	ABAND	✓	
206753	PJ#506	TWIN CITIES ARSENAL NO. 6	ON		✓	
206755	PJ#507	TWIN CITIES ARSENAL NO. 7	ON	ABAND	✓	
206759	PJ#508	TWIN CITIES ARSENAL NO. 8	ON	ABAND	✓	
206760	PJ#509	TWIN CITIES ARSENAL NO.9	ON	DOM	✓	
236437	PJ#802	T2PJ	OFF	MON		421437
236465	PJ#806	T6PJ	OFF	MON		421427

TABLE B-2
TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
107405		ROEBKE	OFF	UN		
110485		NEW BRIGHTON #12	OFF	MUNI		
122210		ST. PAUL PORT AUTH. #3	OFF	IND		
127537		MIDWEST ASPHALT	OFF	DOM		
134318		LORENZ W SEUTTER	OFF	DOM		
139035		WATERGATE MARINA	OFF	P.S.		
151568		ARDEN MANOR MOBILE HOME	OFF	P.S.		
161432		NEW BRIGHTON #10	OFF	MUNI		
191942		118PDC/MODEL STONE	OFF	MON		
200070		RUAN TRANSPORT	OFF	COM	✓	
200071		PRESTRESSED CONCRETE	OFF	IND	✓	
200072		WITTE TRANSPORTATION	OFF	IND	✓	
200073		WILSON TRANSFER & STORAGE	OFF	IND		
200074		ASBESTOS PROD	OFF	IND	✓	
200075		PHILLIPS PETROLEUM	OFF	IND	✓	
200076		OLD DUTCH FOODS INC	OFF	IND		
200077		JOHN CONLIN	OFF	DOM	✓	
200078		WILLIAM CLASS	OFF	DOM		
200079		LAWRENCE SCHOENING	OFF	DOM		
200080		CARL A OSTROM & SON	OFF	DOM		
200081		A. O. LIEBIG	OFF	DOM		
200082		2196 MARION ROAD	OFF	DOM		
200148		PAPER CALMERSON	OFF	IND	✓	
200154		U OF M GOLF COURSE	OFF	IRR		
200167		KOPPERS COKE #1	OFF	IND		
200171		PLATING INC	OFF	IND		
200197		SNOW FLAKE DAIRY	OFF	COM		
200264		1620 CENTRAL	OFF	IND		
200384		METALLURGICAL INC. WELL #1	OFF	IND		
200524		ST. ANTHONY #5	OFF	MUNI		
200525		PLETSCHER	OFF	UN		
200531		NAZARETH	OFF	UN		
200599		CEDAR AVE. TRIANGLE	OFF	P.S.		
200602		ATKINSON MILL CO.	OFF	IND		
200629		GENERAL MILLS	OFF	IND		
200803		ST. ANTHONY #4	OFF	P.S.		
200804		ST. ANTHONY #3	OFF	MUNI		
200812		GROSS GOLF COURSE #1	OFF	COM		
200814		AMERICAN LINEN	OFF	IND		
201074		GLEASSON MORTUARY	OFF	COM		
201082		NORTHWESTERN HOSPITAL	OFF	P.S.		
206669		FRIDLEY #8	OFF	MUNI		
206672		FRIDLEY #9	OFF	MUNI		
206673		FRIDLEY #6	OFF	MUNI		
206688		CLOVERPOND WELL	OFF	DOM		
206689		JAMES K. O'NEIL	OFF	UN		
206693		FERNELIUS	OFF	UN		
206702		MINN E.S.	OFF	UN		
206720		MOUNDSVIEW	OFF	MUNI		

TABLE B-2
TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
206722		M0UNDSVIEW #5	OFF	MUNI		
206750		SHORE #4	OFF	MUNI		
206787		MOUNDSVIEW H.S.	OFF	P.S.		
206789		NEW BRIGHTON #1	OFF	MUNI	✓	
206791		NEW BRIGHTON #7	OFF	MUNI		
206792		NEW BRIGHTON #4				
206793		NEW BRIGHTON #3	OFF	MUNI		
206794		NEW BRIGHTON #9	OFF	MUNI		
206795		NEW BRIGHTON #8	OFF	MUNI		
206796		NEW BRIGHTON #5	OFF	MUNI		
206797		NEW BRIGHTON #6	OFF	MUNI		
206798		NEW BRIGHTON #2	OFF	MUNI	✓	
223844		KURTH MALTING CO EAST WL	OFF	IND		
223992		BOOM ISLAND	OFF	IND		
225886		FRANKLIN STEEL SQUARE	OFF	P.S.		
225905		ST PAUL TERM. WAREHOUSE	OFF	IND		
225906		ST PAUL TERM. WAREHOUSE	OFF	IND		
231741		LABELLE	OFF	UN		
231845		MNDOT CIVIL DEFENSE TRAIN.	ON/OFF	P.S.		
231878		MENGELKOCH #2	OFF	UN		
232067		NBR 135	OFF	UN		
232069		UHIL	OFF	UN		
233221		REUBEN MEAT	OFF	DOM		
233222		LOWRY GROVE TRAILER	OFF	ABAND	✓	
233241		KOZAH'S MARKET	OFF	UN	✓	
233520		MCGILLIS	OFF	UN		
233533		ROSELAWN CEMETARY	OFF	IRR		
233763		P. L. MORGAN	OFF	DOM		
233806		2581 NORTH CLEVELAND	OFF	DOM		
234301		DEWITT	OFF	UN	✓	
234305		GLENN BEGGIN	OFF	UN		
234319		HIDE & TALLOW #1	OFF	UN		
234327		BRESKE	OFF	UN		
234335		MENGELKOCH #1	OFF	UN		
234337		MENGELKOCH #3	OFF	UN	✓	
234350		GORDON	OFF	UN		
234351		YEMPA	OFF	UN		
234352		1206 12TH AV NW	OFF	UN	✓	
234353		LENTSCH'S ICE WK.	OFF	UN		
234355		KINGDOM HALL	OFF	UN		
234356		NORDQUIST P43	OFF	UN		
234357		PHILLIPS PET P46	OFF	UN		
234386		ZELL OLS.	OFF	UN		
234391		SHERER L.	OFF	UN		
234396		DEWITT	OFF	UN	✓	
234406		KLAPP	OFF	UN	✓	
234409		HIDE & TALLOW	OFF	UN		
234425		KEN GEREBI	OFF	UN	✓	
234430		CMIEL	OFF	UN	✓	

TABLE B-2
TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
234431		HARSTAD	OFF	UN		
234463		KEN SOLIE	OFF	UN		
234546		HONEYWELL RIDGEWAY	OFF	UN		
234547		HONEYWELL RIDGEWAY	OFF	UN		
234549		REINER	OFF	IRR		
235539		OLD HOTEL	OFF	UN		
235557		HIDDEN FALLS PARK W.WELL	OFF	P.S.		
235619		SHRINERS HOSPITAL	OFF	P.S.		
235735		FLOUR CITY ARCHITECTURAL	OFF	COM		
236122		NWR	OFF	ABAND		
242162		301PB	OFF	UN		
242207		SUNSET MEMORIAL CEMETARY	OFF	UN		
249152		BOYLE	OFF	DOM		
265735		FLOUR CITY ARCH	OFF	UN		
322664		ABBOTT NW HOSP	OFF	UN		
405651		METAL-MATIC INC.	OFF	IND		
409546		PCA2L3	OFF	TEST	✓	
409547		PCA1U4	OFF	TEST		
409548		PCA2U4	OFF	TEST		
409549		PCA3U4	OFF	TEST		
409550		PCA6U3	OFF	TEST		
409555		PCA5U4	OFF	TEST		
409556		PCA4L3	OFF	TEST		
409557		PCA1L3	OFF	TEST		
409595		B109U3	OFF	ABAND		
409596		B118U3	OFF	MON		
409597		B118L3	OFF	IND		
409598		B117U3	OFF	ABAND		
416143			OFF	ABAND		
416198		311U4	OFF	MON		
420713		HERBST LANDFILL	OFF	MON		
476387		MW15H	OFF	MON		
482083		K04-MW	ON	MON		
482084		K02-MW	ON	MON		
482085		K01-MW	ON	MON		
482086		I01-MW	ON	MON		
482087		I05-MW	ON	MON		
482088		I02-MW	ON	MON		
482089		I04-MW	ON	MON		
482090		I03-MW	ON	MON		
509083		NEW BRIGHTON #11	OFF	MUNI		
512761		GROSS GOLF #2	OFF	IRR		
519288		E101-MW	ON	MON		
519289		E102-MW	ON	MON		
519290		E103-MW	ON	MON		
519291		129-1501-MW	ON	MON	✓	
520931		NEW BRIGHTON #13	OFF	MUNI		
554216		NEW BRIGHTON #14	OFF	MUNI		
582628		NEW BRIGHTON #15	OFF	MUNI		

TABLE B-2
TCAAP WELL INDEX
SORTED BY IRDMIS NUMBER

Minnesota Unique #	IRDMIS #	Common Name	Well Location	Well Type	Well Sealed	Second Unique #
589650		CM1MW	ON	MON		
616601		CM2MW	ON	MON		
616602		CM3MW	ON	MON		
624019		CM5MW	ON	MON		
643379			ON	PIEZ.	✓	
643380			ON	PIEZ.	✓	
643381			ON	PIEZ.	✓	
643382			ON	PIEZ.	✓	
653903		GR1-1	ON	MON		
653904		GR1-2	ON	MON		
653905		GR2-1	ON	MON		
675976		GR-DF1	ON	MON		
		MW15D	OFF	MON		
		MW15S	OFF	MON		

Appendix B: Table B-3

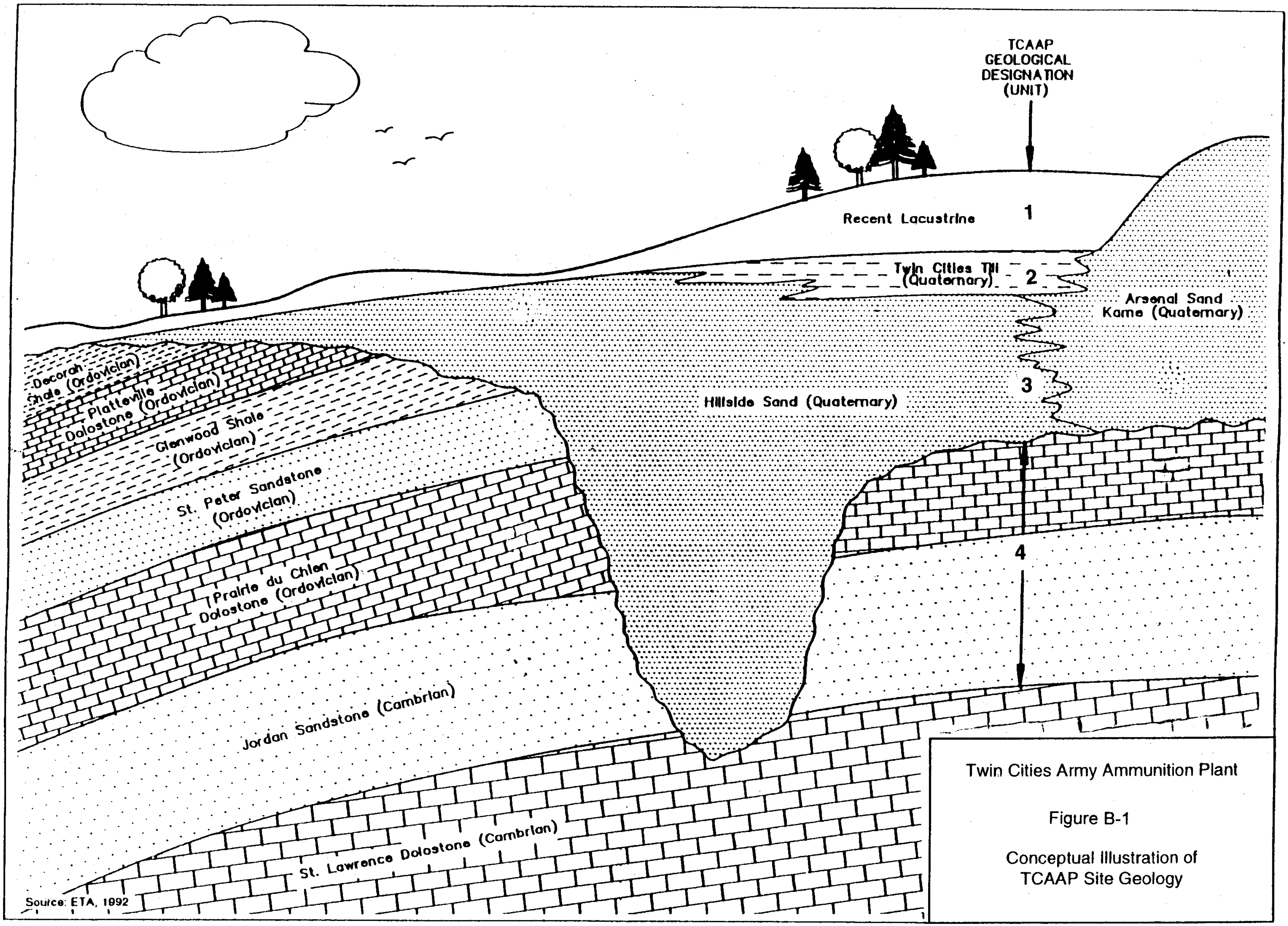
Boring Logs On-TCAAP Wells
Sorted by IRDMIS Number

TCAAP Well Boring Logs are included on this DVD as Table B-3

Appendix B: Table B-4

Boring Logs Off-TCAAP Wells
Sorted by IRDMIS Number

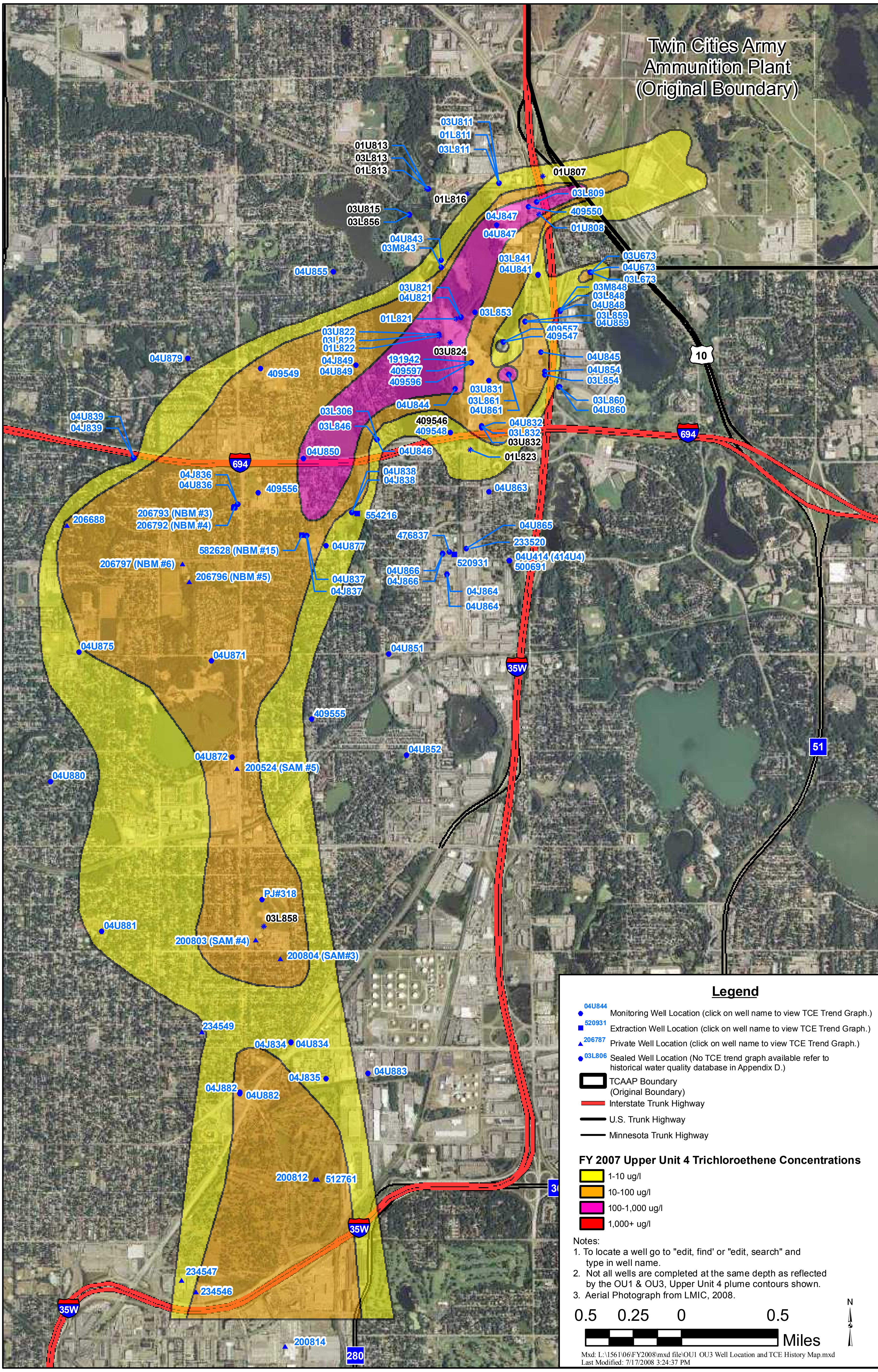
TCAAP Well Boring Logs are included on this DVD as Table B-4



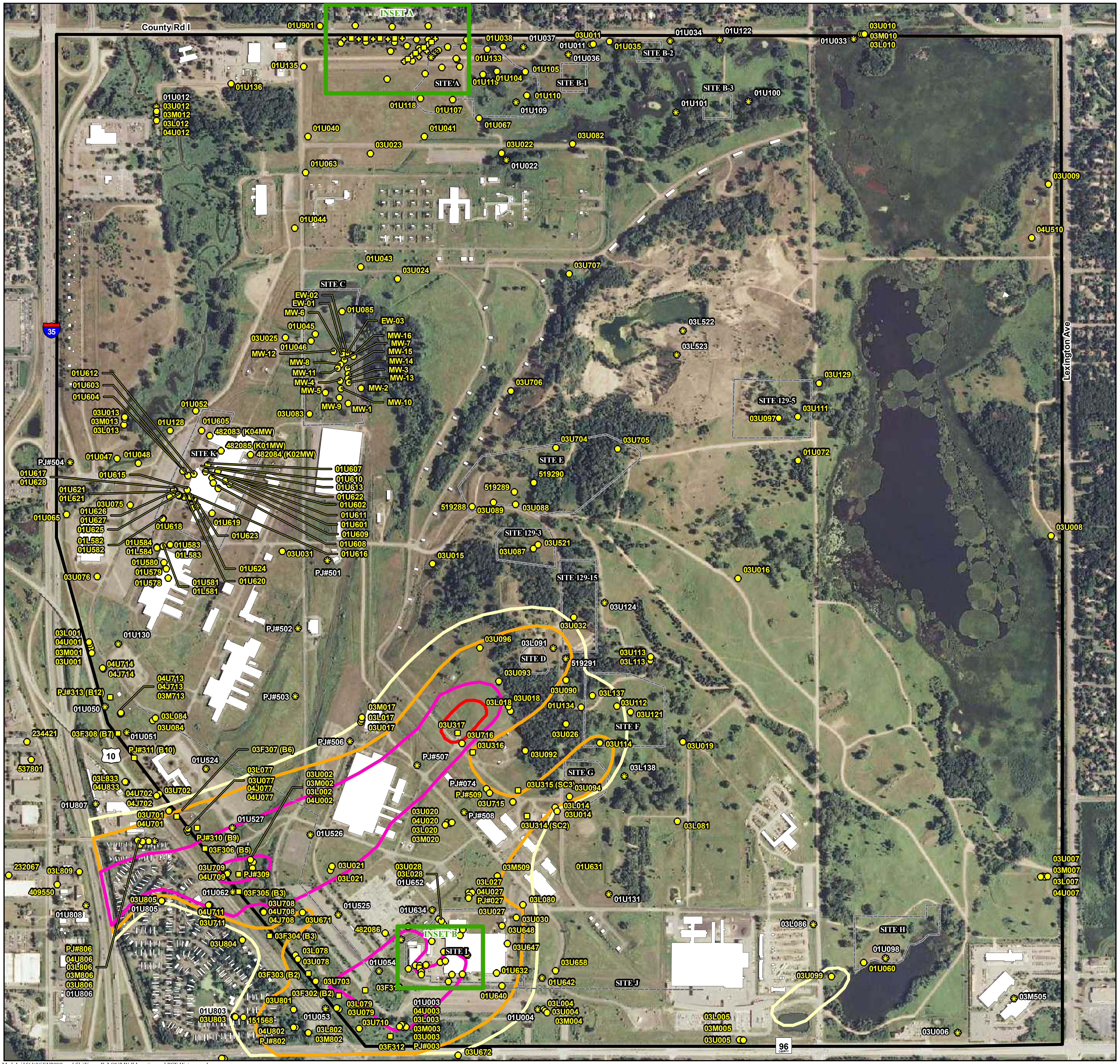
Twin Cities Army Ammunition Plant

Figure B-1

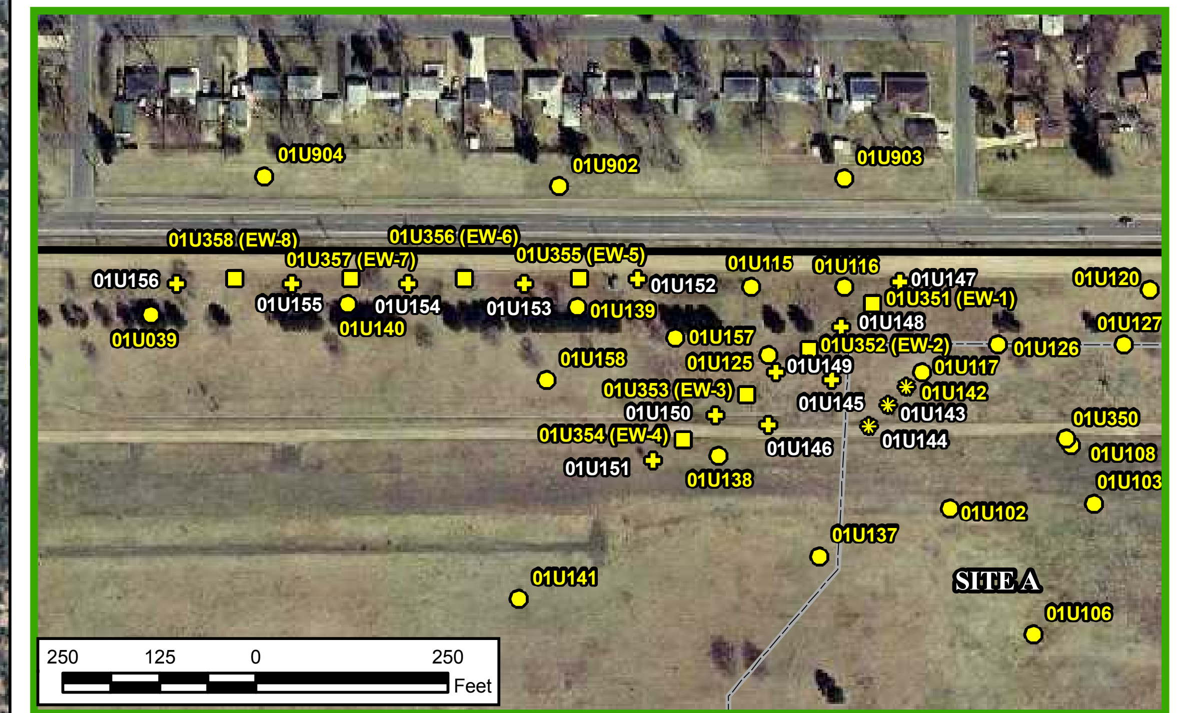
Conceptual Illustration of TCAAP Site Geology



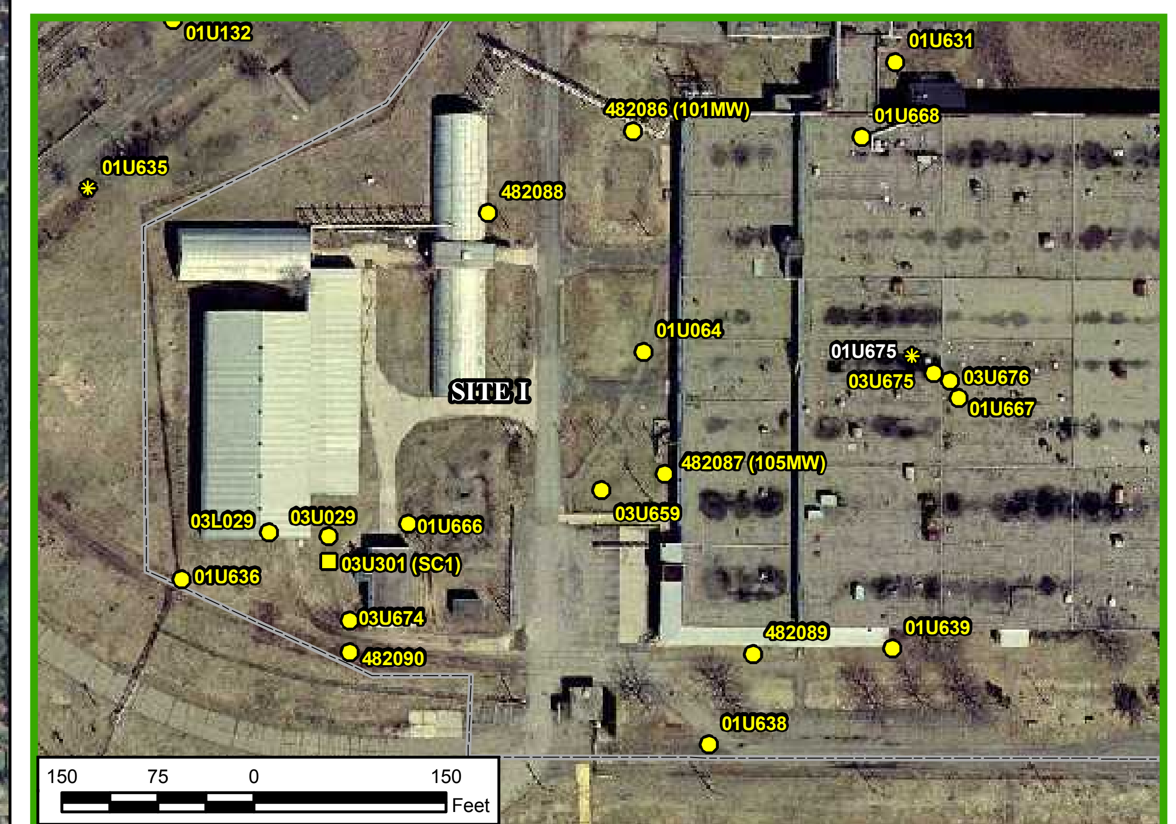
TWIN CITIES ARMY AMMUNTION PLANT	COPYRIGHT Wenck	FY 2008
OU1 & OU3 Well Location and TCE History Map	Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359-0429	Figure B-2



INSET A



INSET B



Legend

- Monitoring Well Location (click on well name to view TCE trend graph)
- Extraction Well Location (click on well name to view TCE trend graph)
- Piezometer Location (for groundwater elevation only; no water quality data is collected.
- Sealed Well Location (No TCE trend graph available; refer to historical water quality database in Appendix D.)

FY2007 Upper Unit 3 Trichloroethene Concentrations

- 1 ug/l
- 10 ug/l
- 100ug/l
- 1,000 ug/l

- Buildings
- Site Boundaries
- TCAAP Boundary (Original Boundary)

Notes:
1. To locate a well go to "edit, find" or "edit, search" and type in well name.
2. 2008 Aerial Photograph (Source: LMIC), 2006 Aerial Photograph shown on insets.
3. Not all wells are completed at the same depth as reflected by the OU2, Upper Unit 3 plume contours shown.

1,600 800 0 1,600
Feet

N

Mxd: L:\1561\06\FY2008\mxd file\Figure B-3 OU2 Well Location and TCE History.mxd

TWIN CITIES ARMY AMMUNITION PLANT	Wenck	FY 2008
OU2 Well Location and TCE History Map	Wenck Associates, Inc. Environmental Engineers — 1800 Pioneer Creek Center Maple Plain, MN 55359-0429	Figure B-3

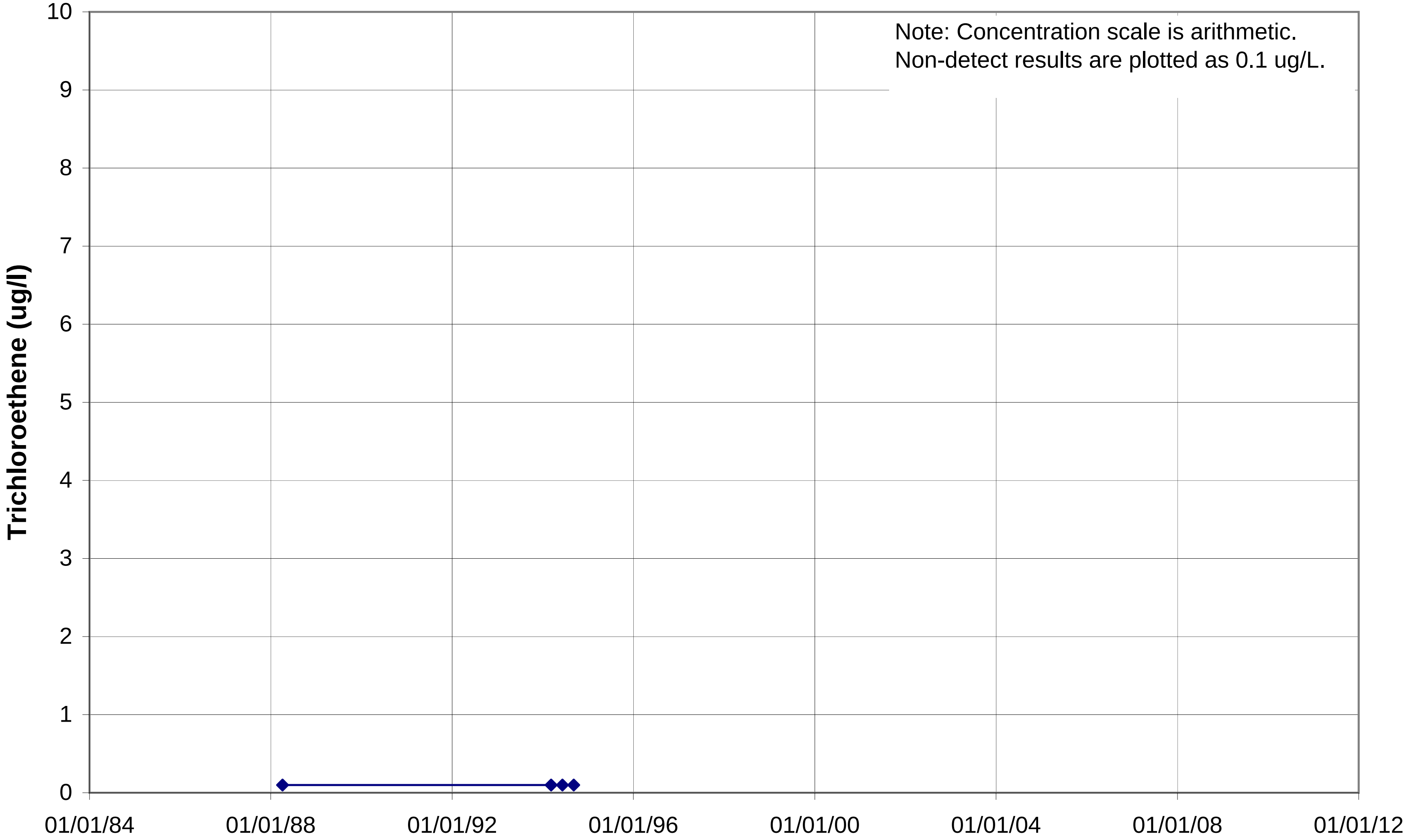
Trend Graph Not Available,
Well No Longer Routinely Sampled

TO RETURN TO MAP: Click on "Go to Previous View" Button in the Tool Bar

Monitoring Well Has Been Sealed

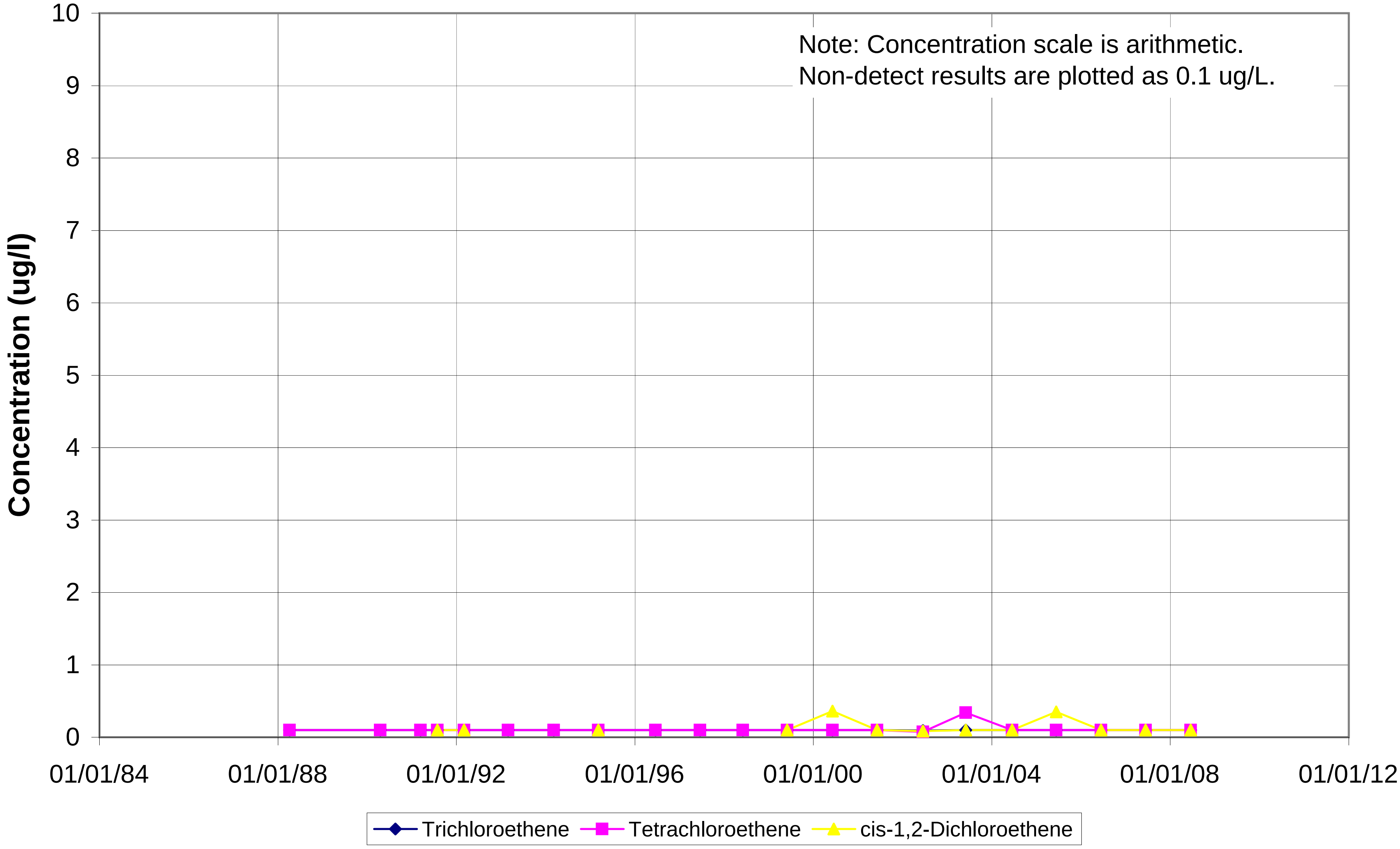
TO RETURN TO MAP: Click on "Go to Previous View" Button in the Tool Bar

01U038

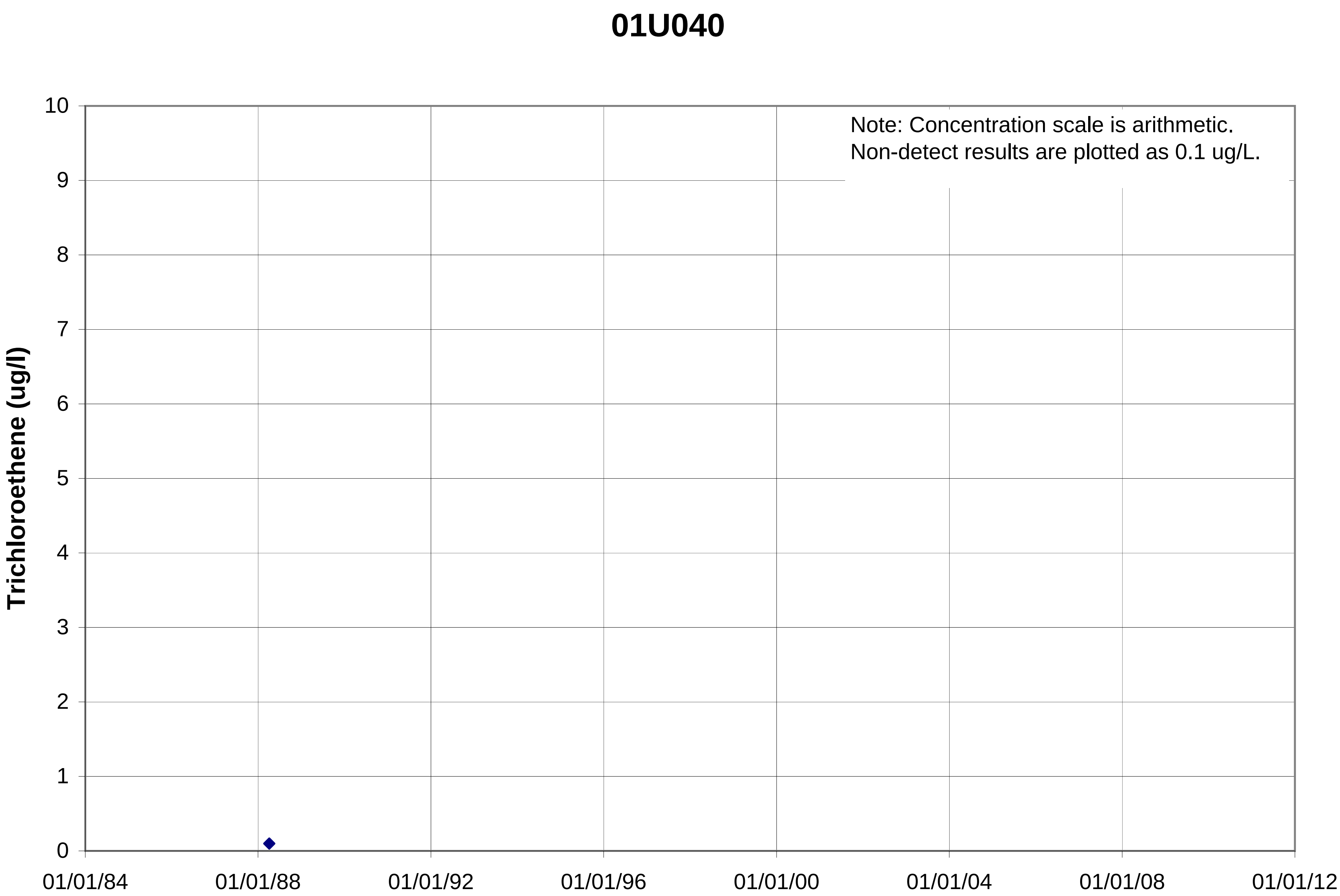


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

01U039



TO RETURN TO MAP: Click on "Go to Previous View" Button in the Tool Bar



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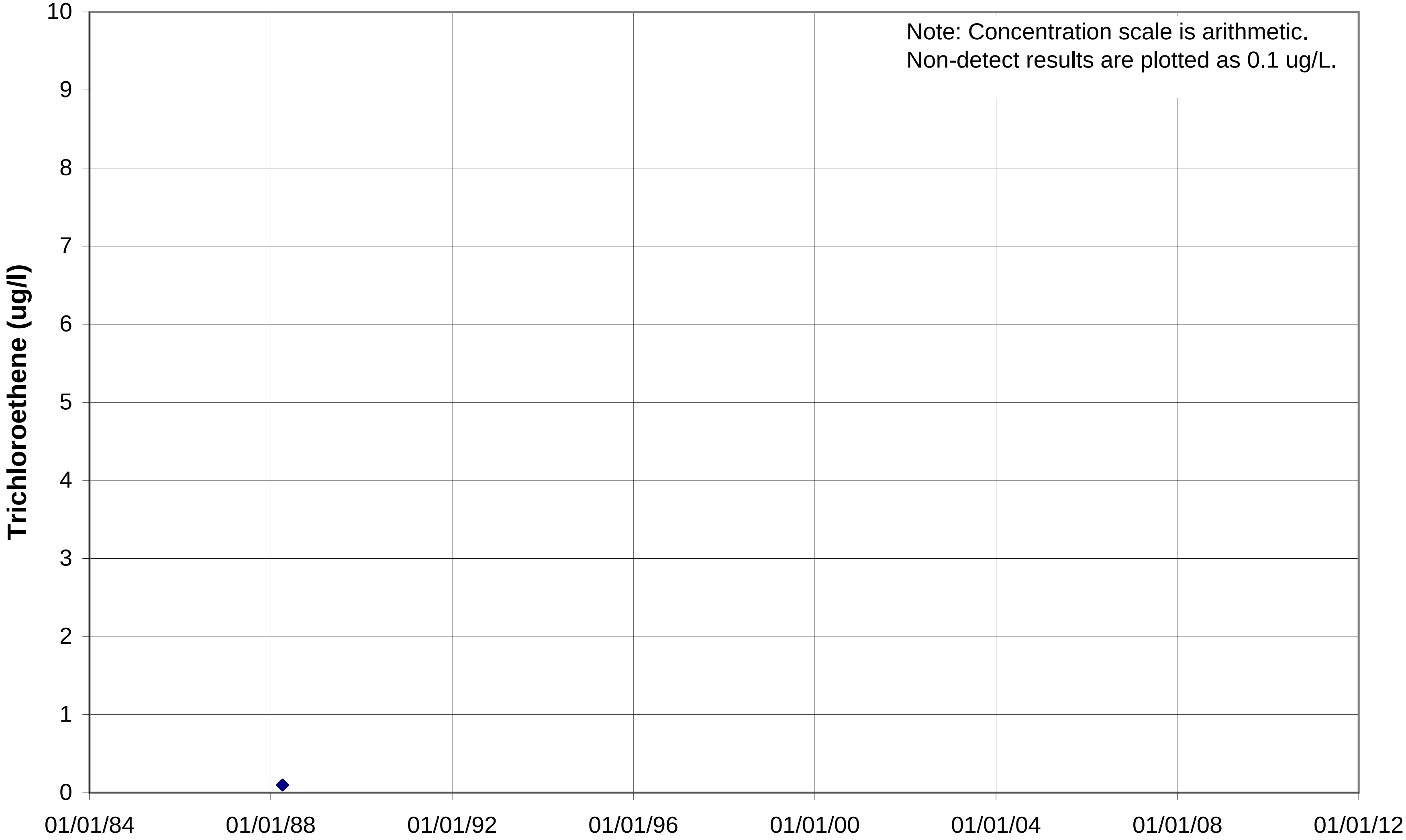
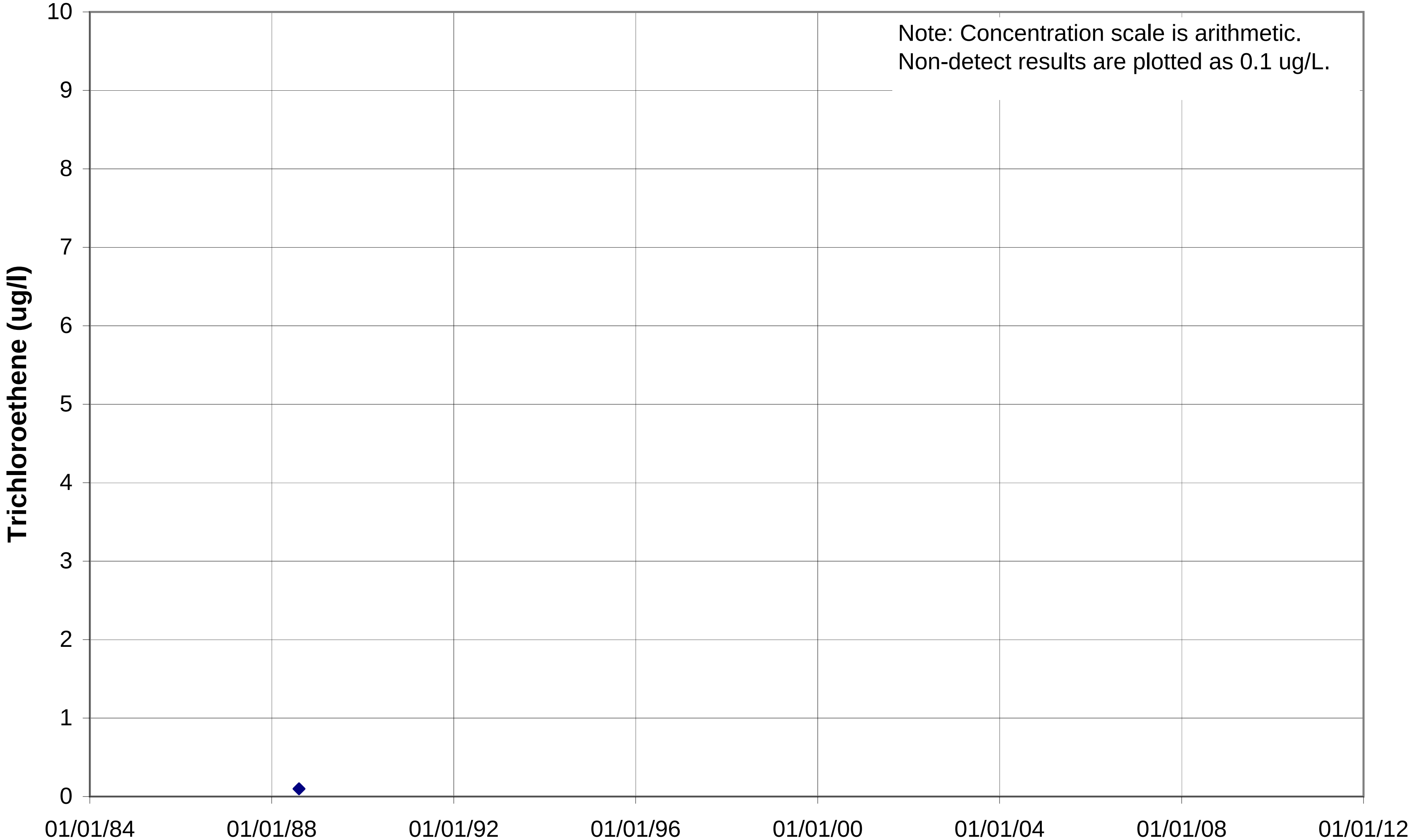
01U041



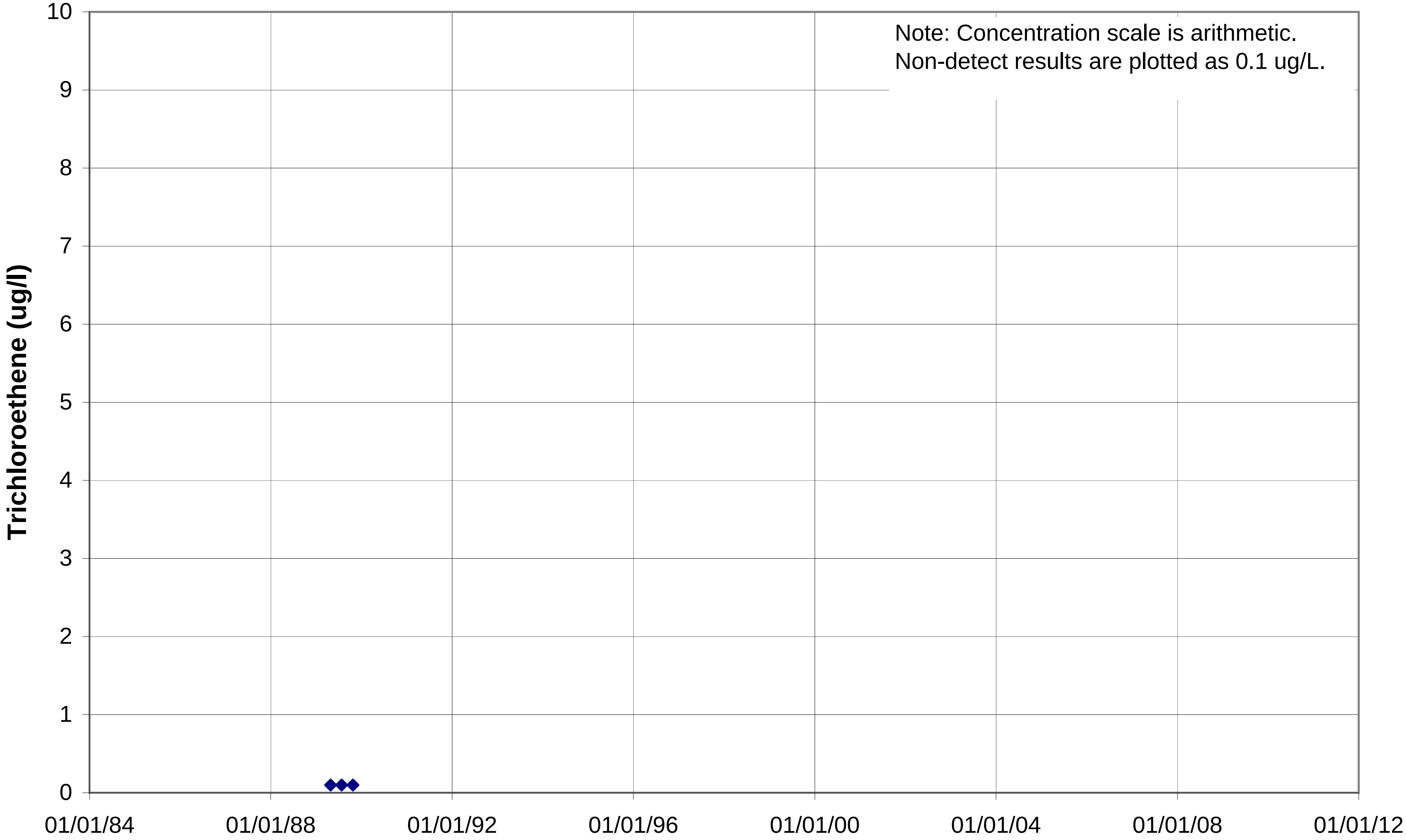
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

01U045



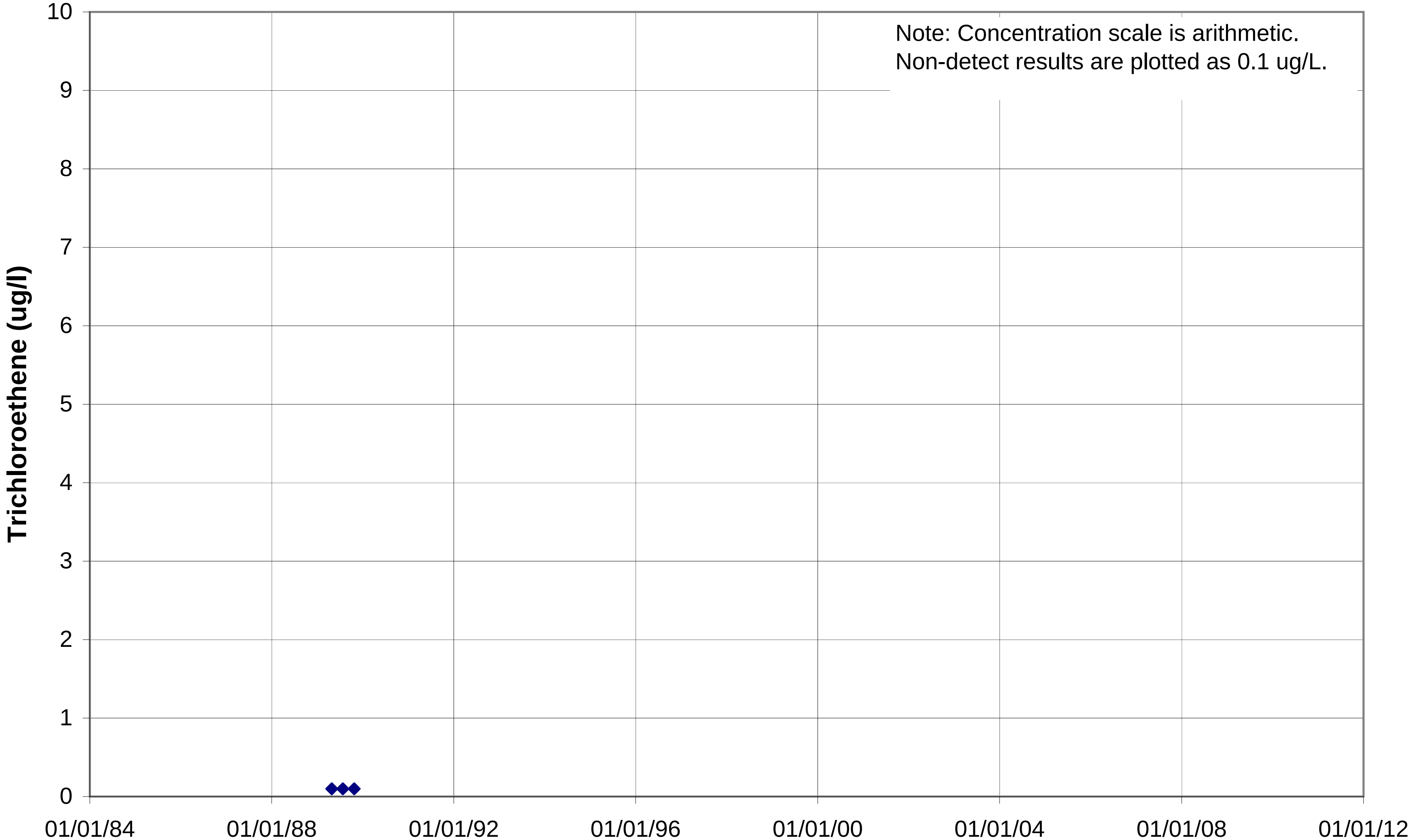
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

01U047



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

01U052



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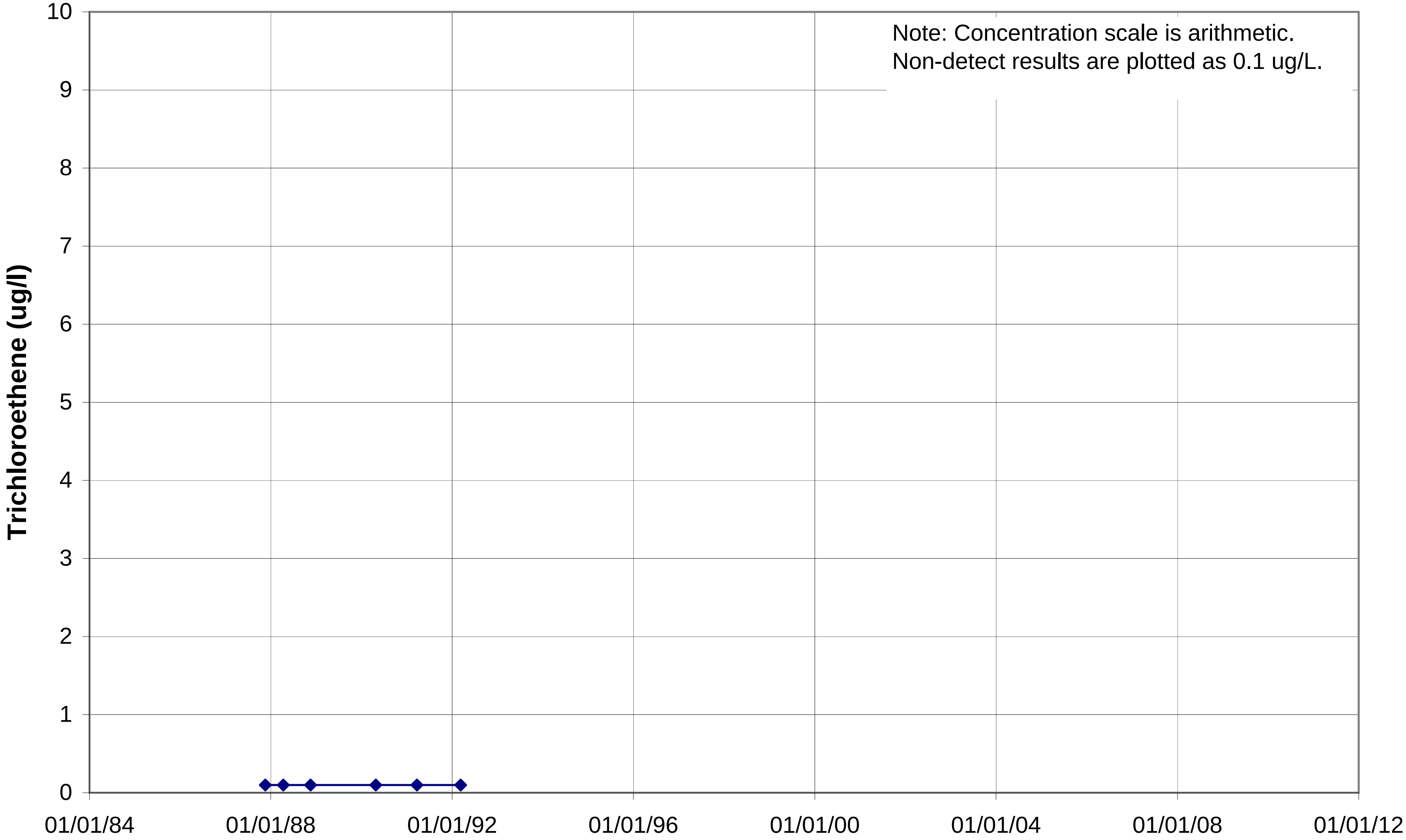
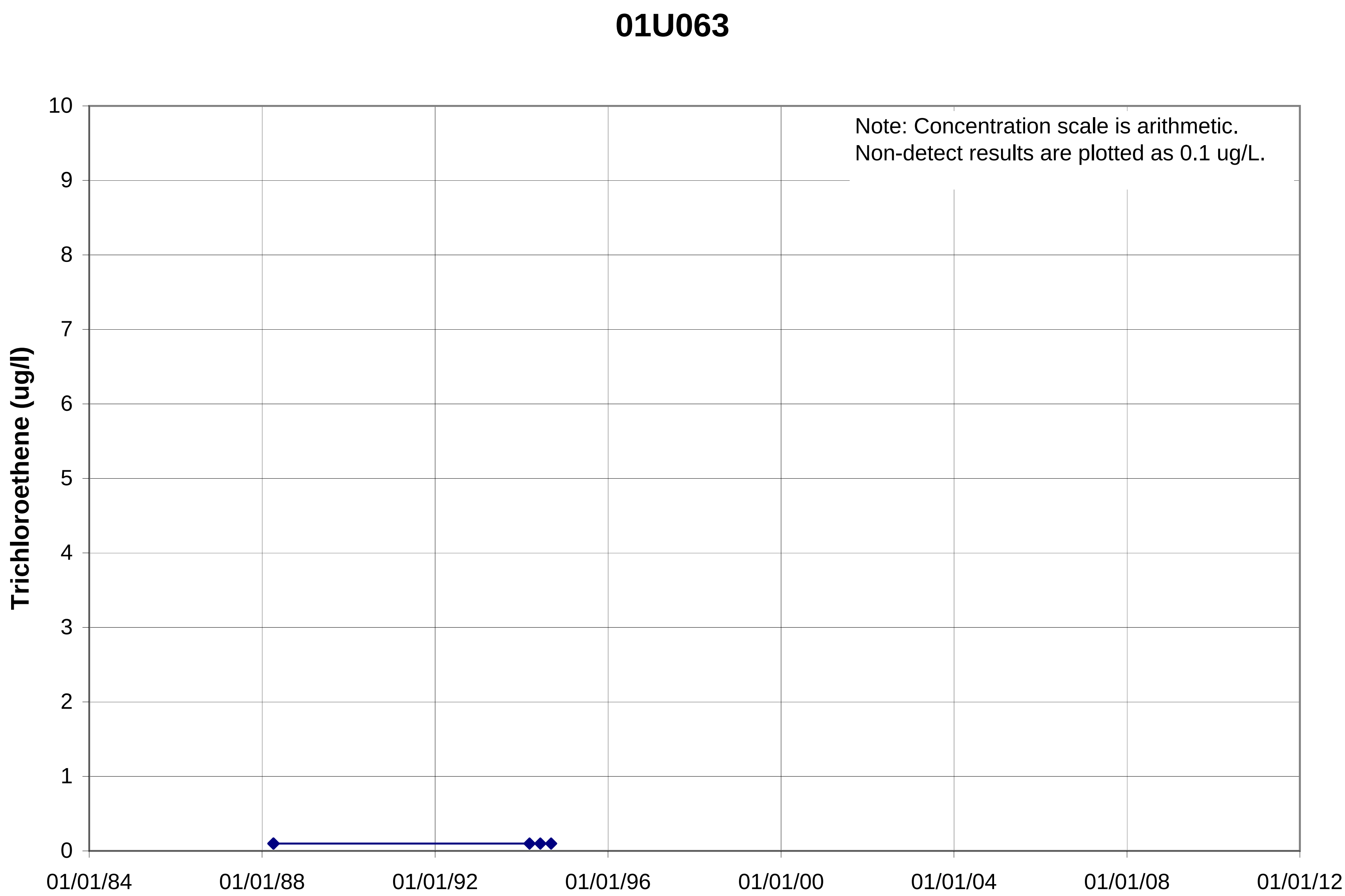
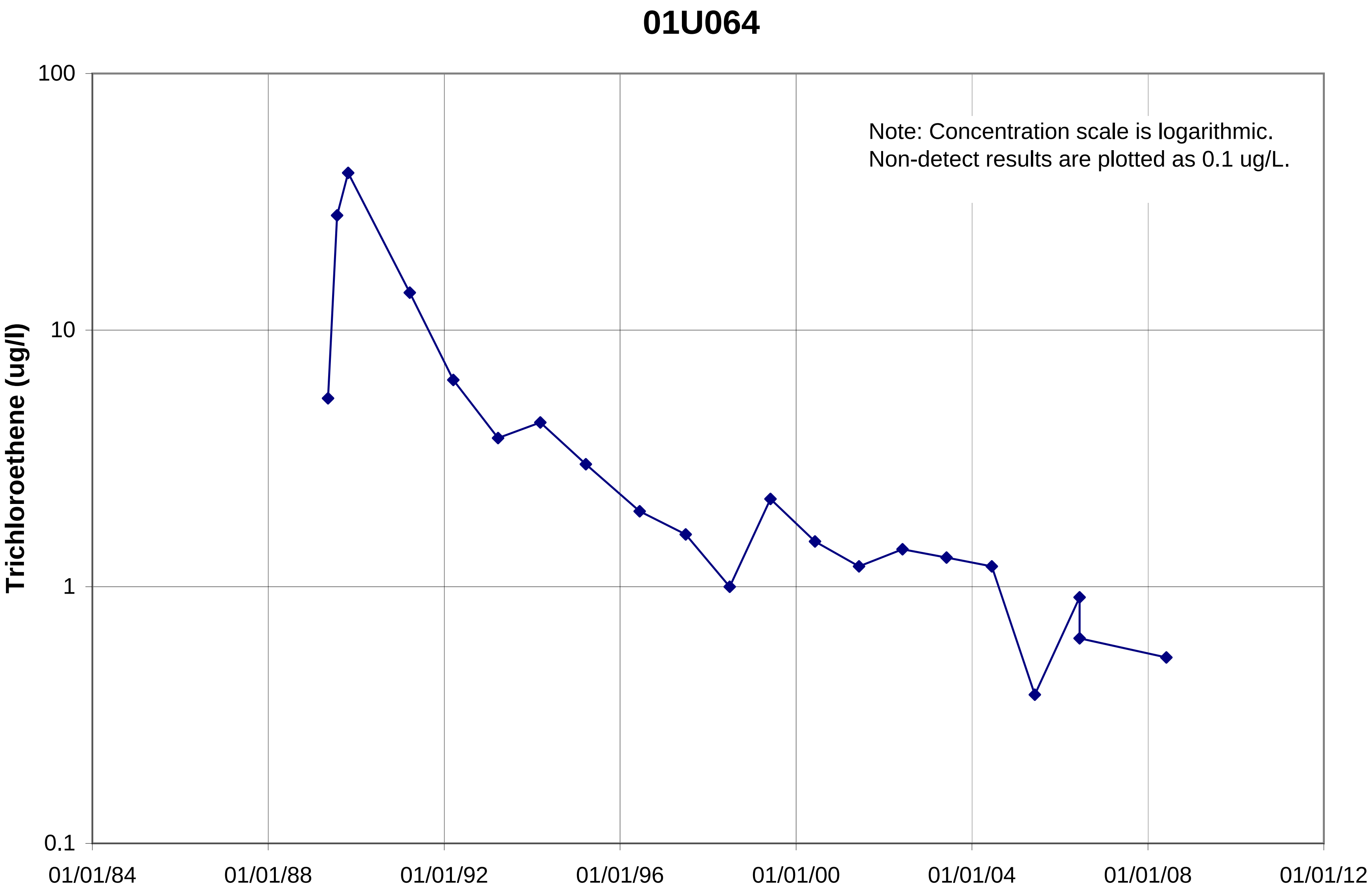
01U060



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar



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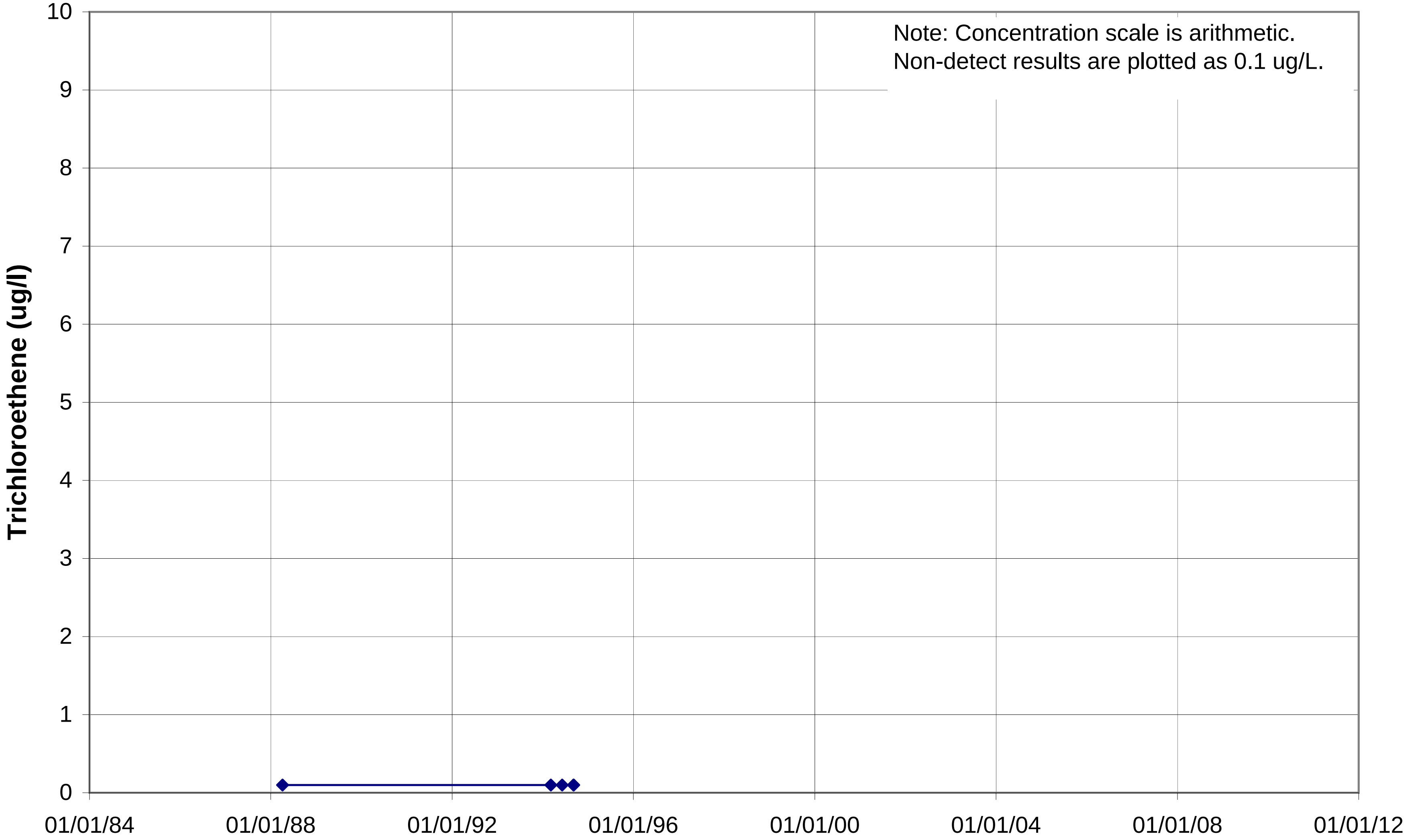
01U067



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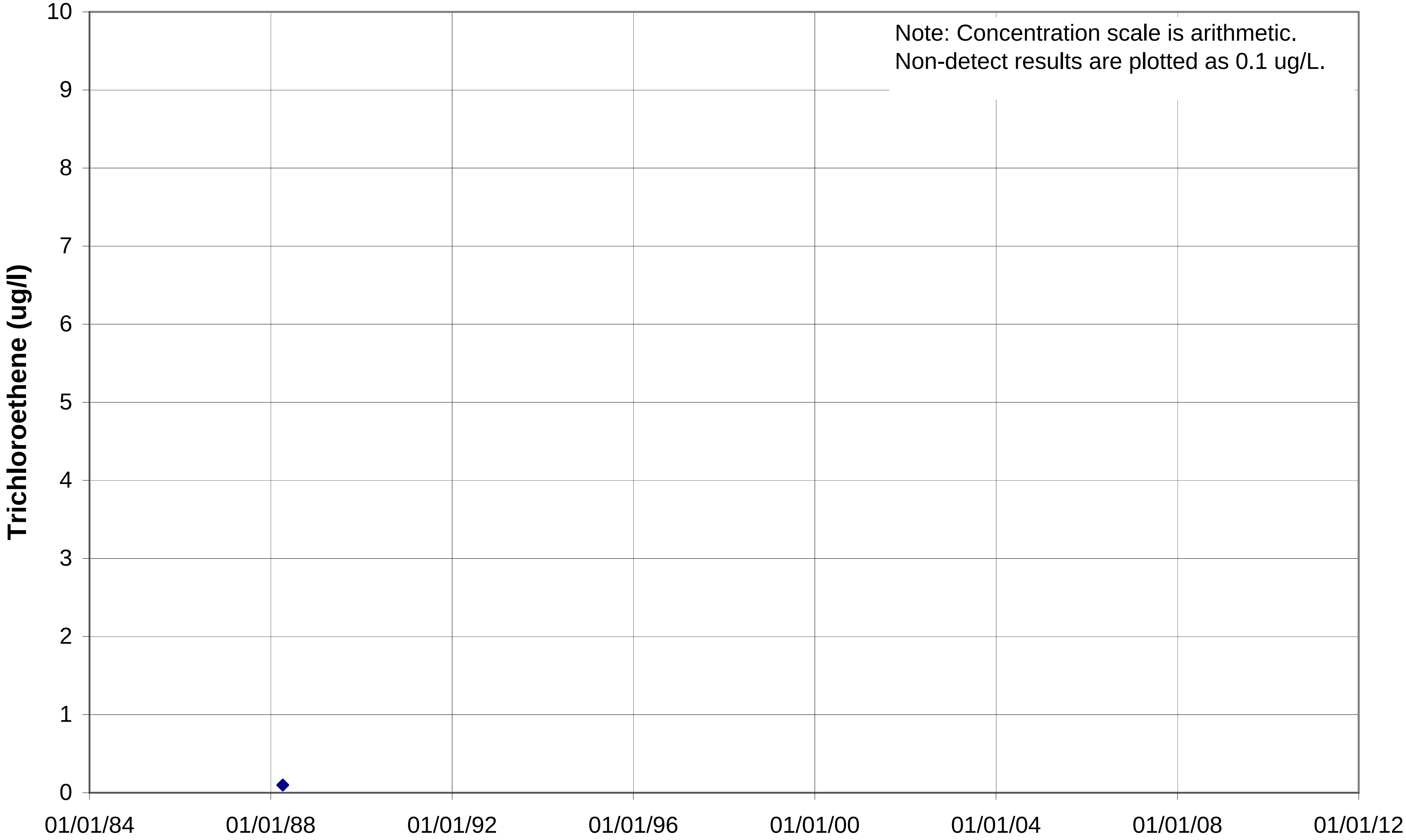
01U072



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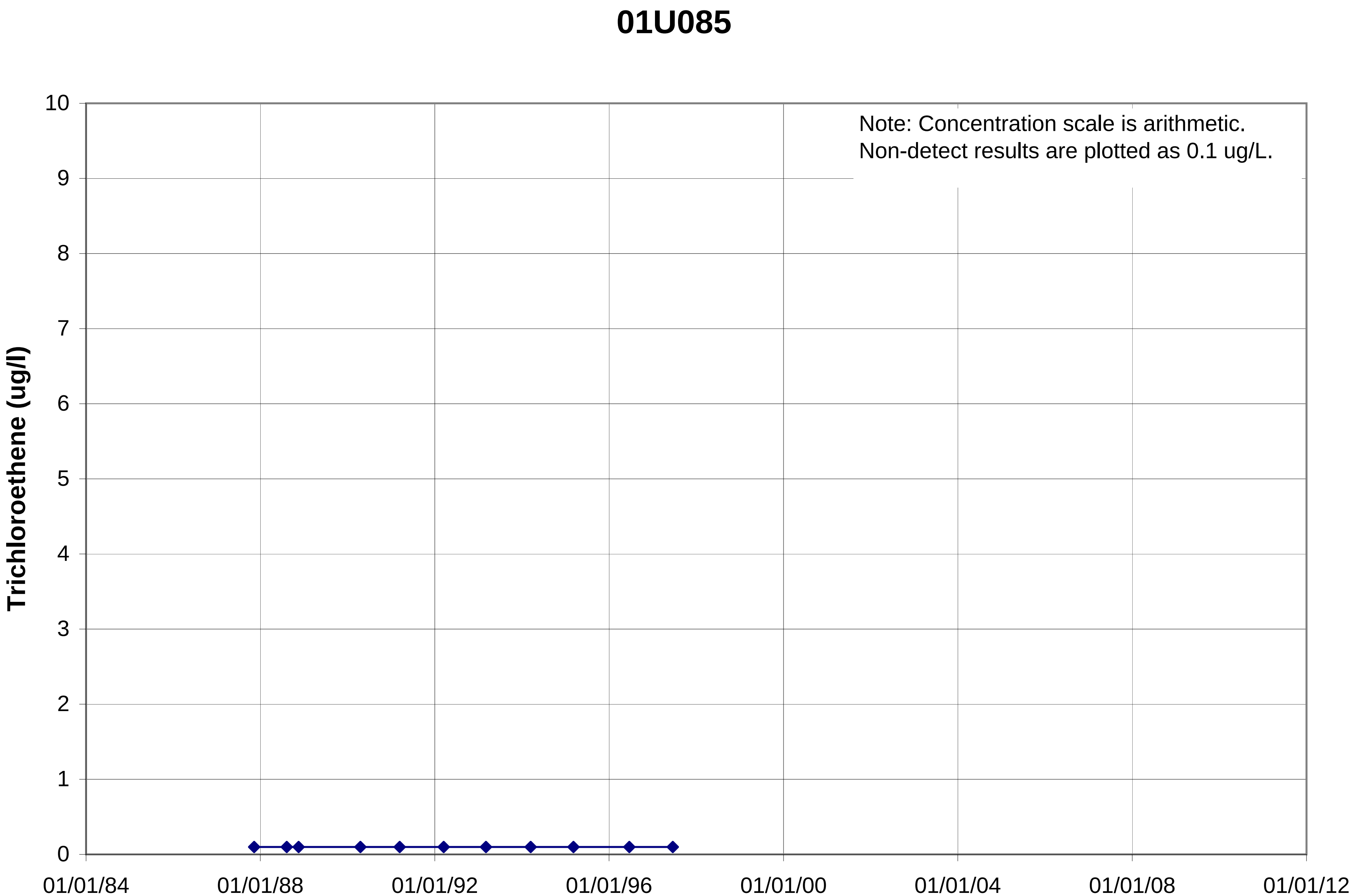

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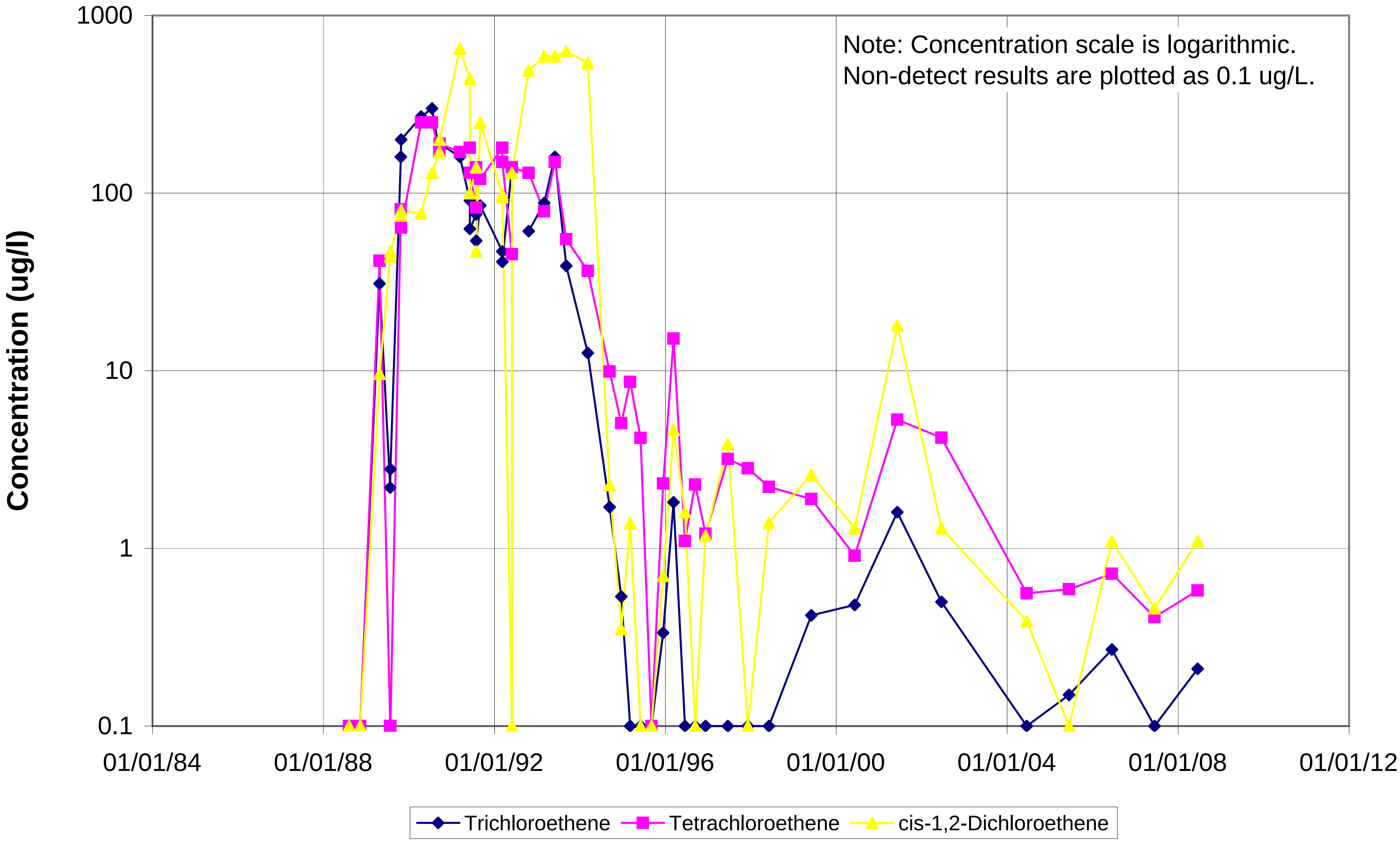

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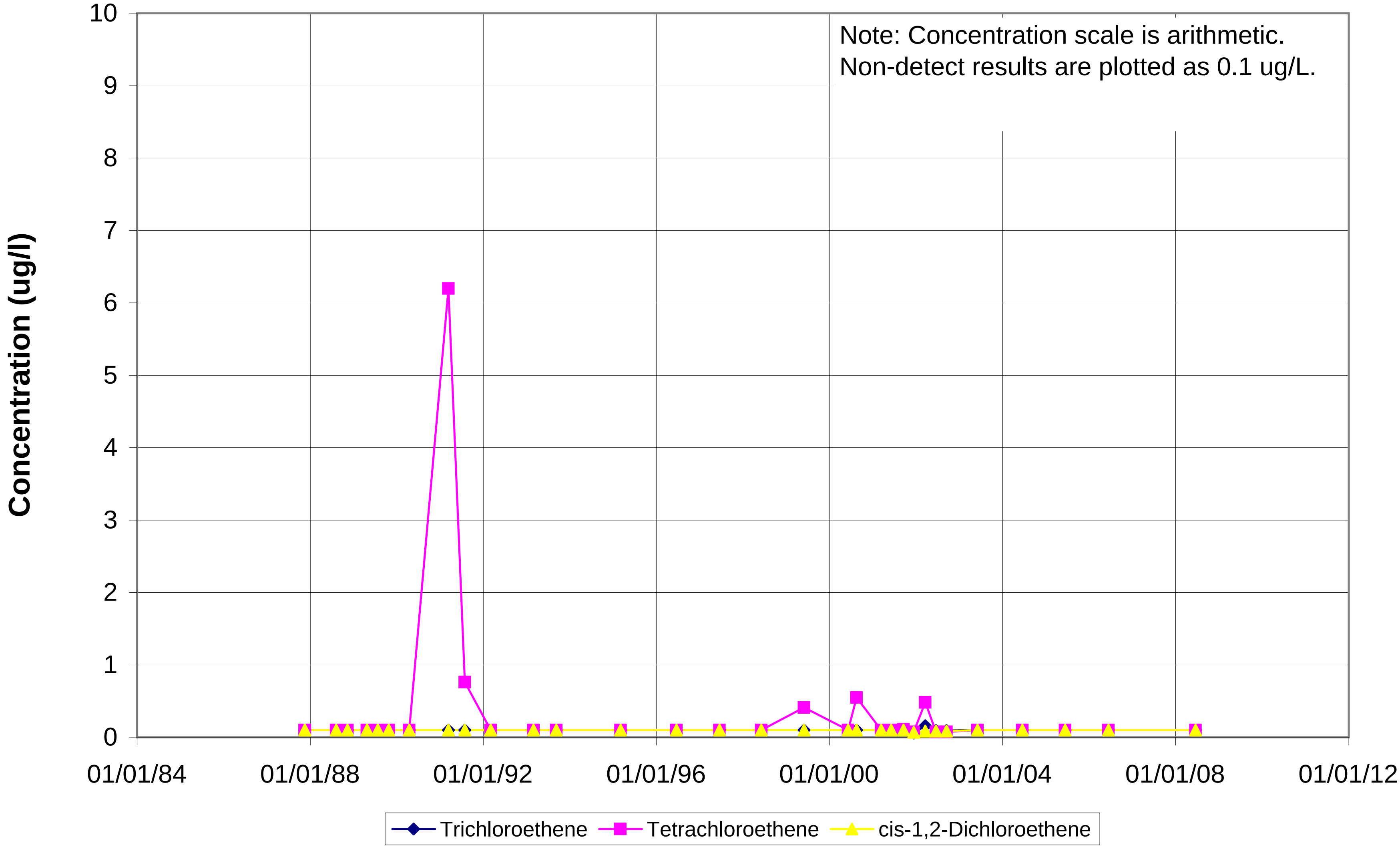

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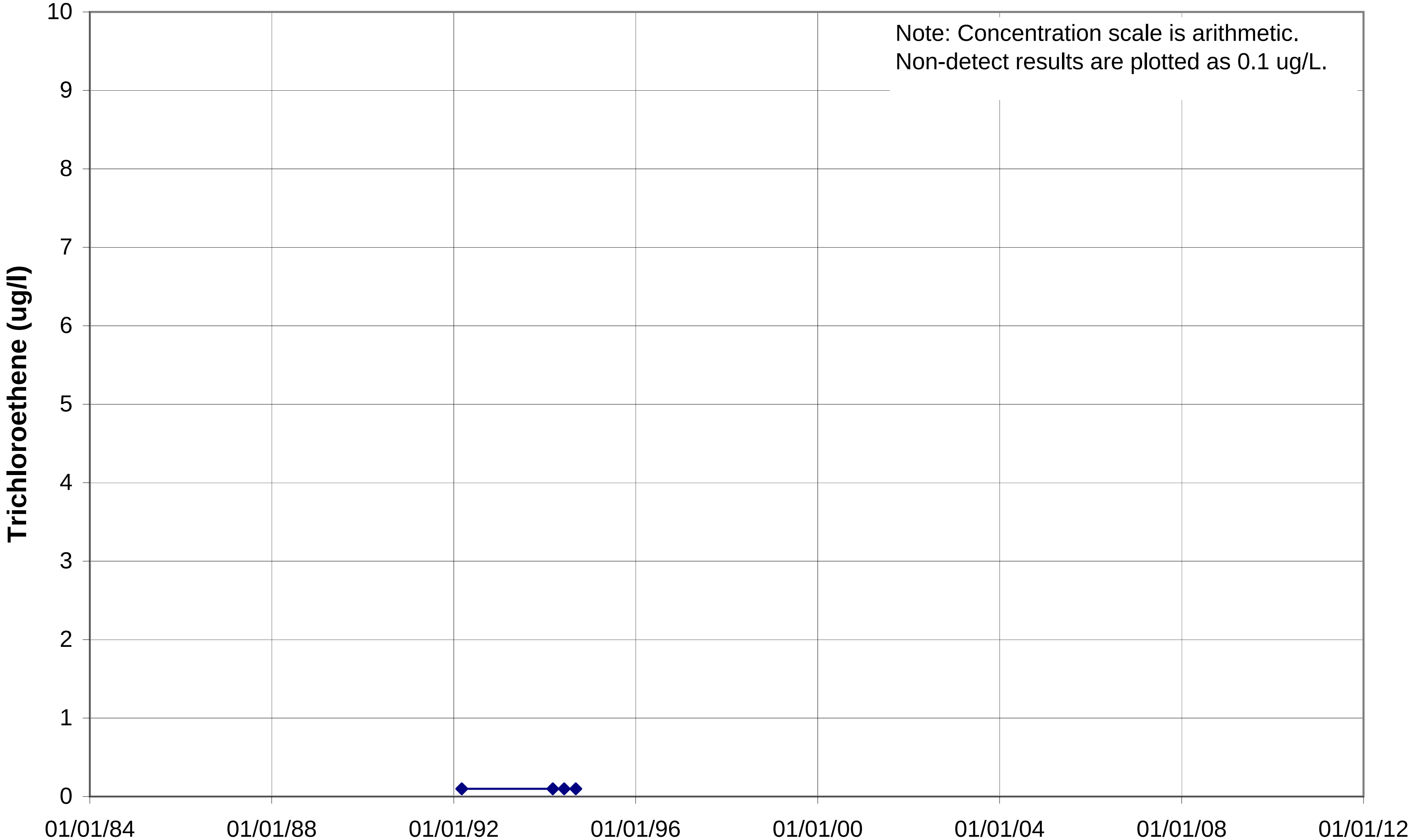

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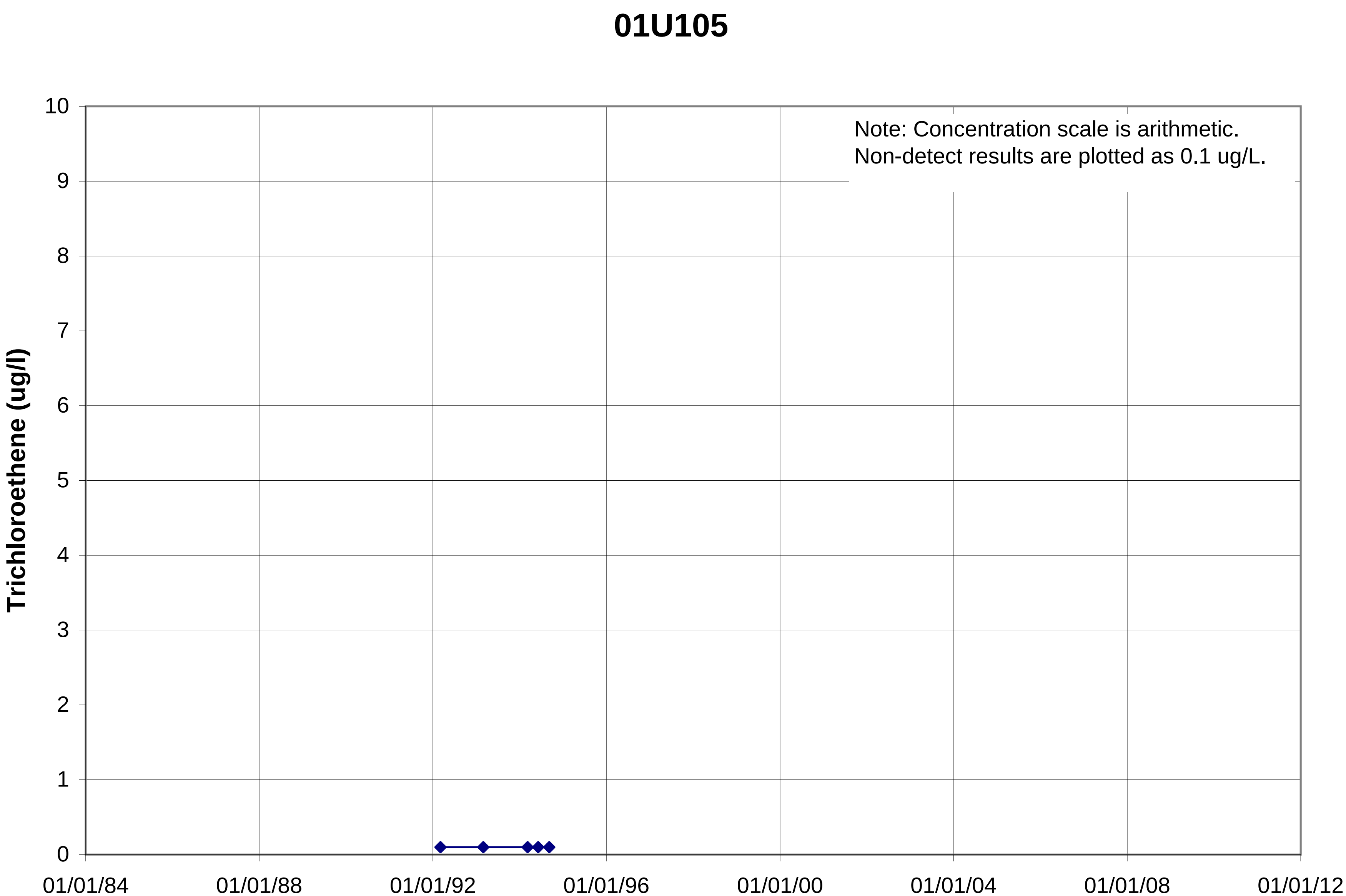

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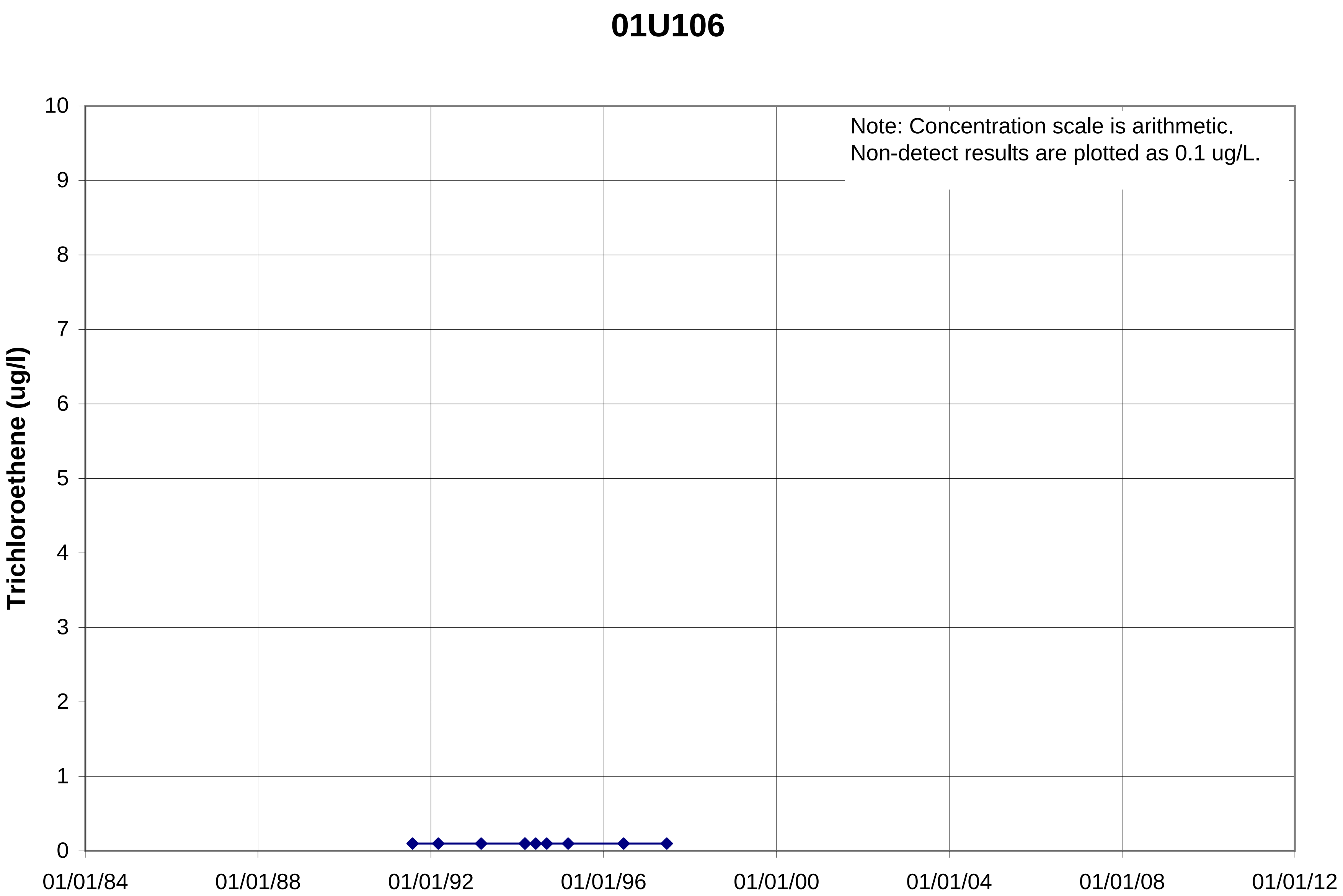

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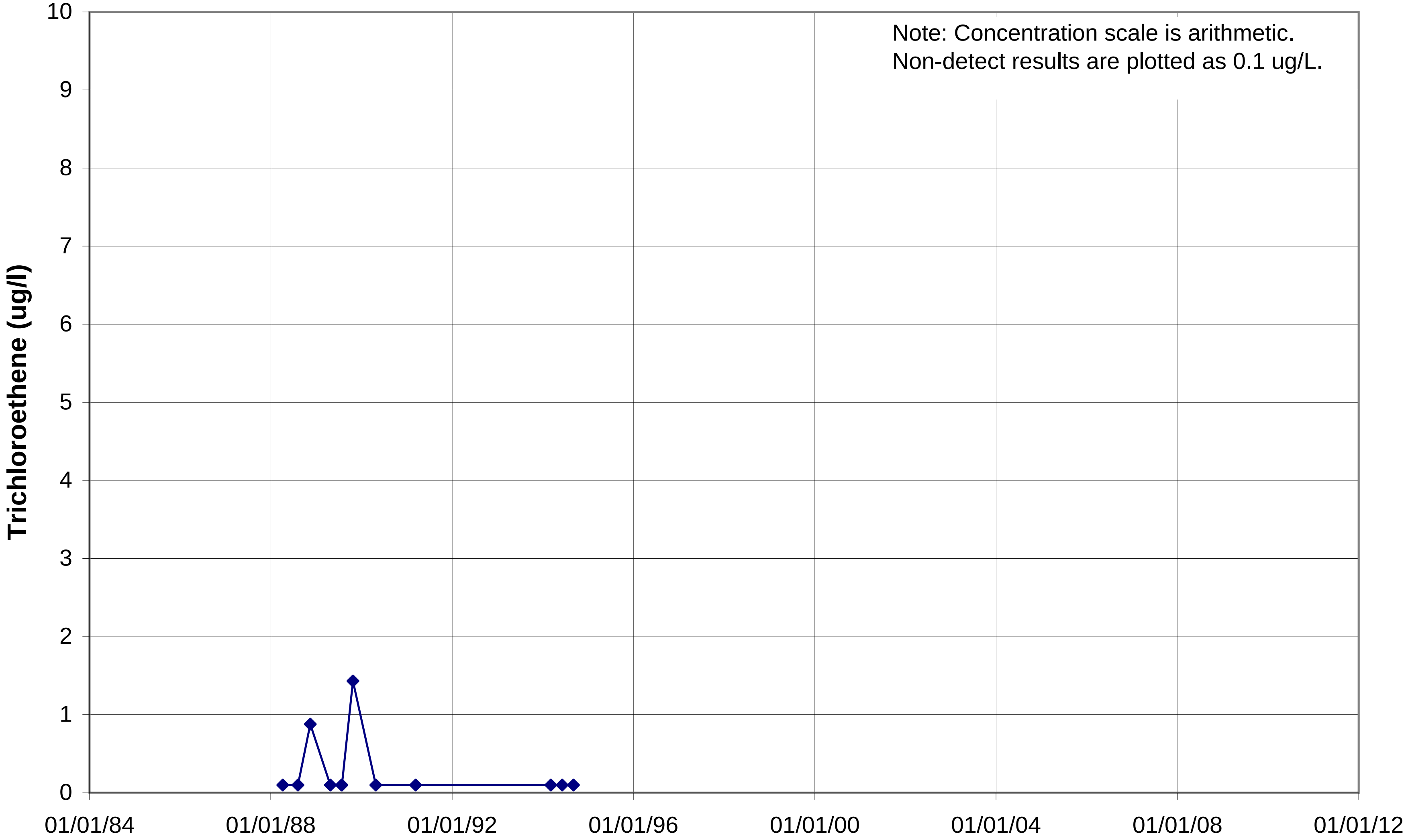

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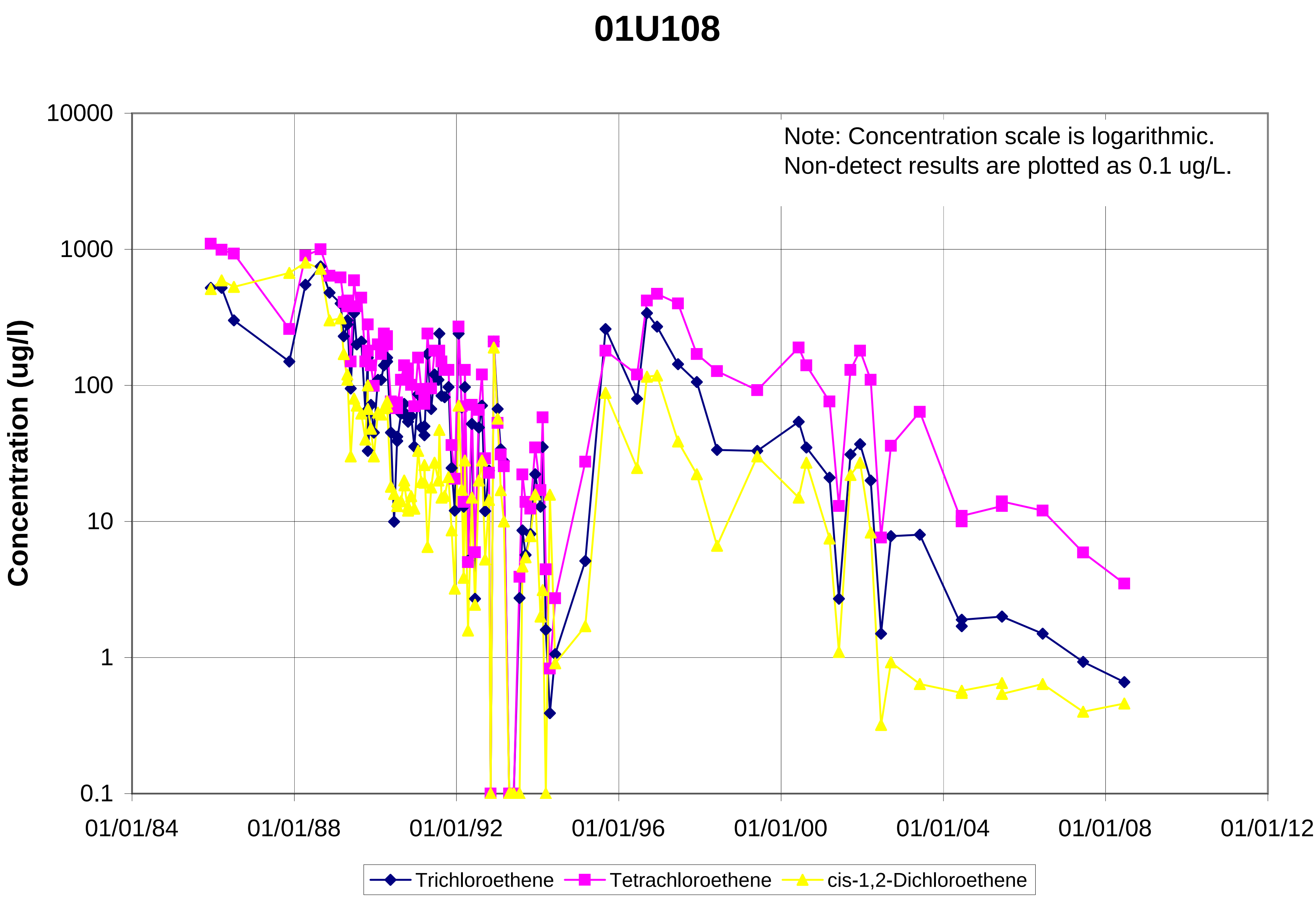

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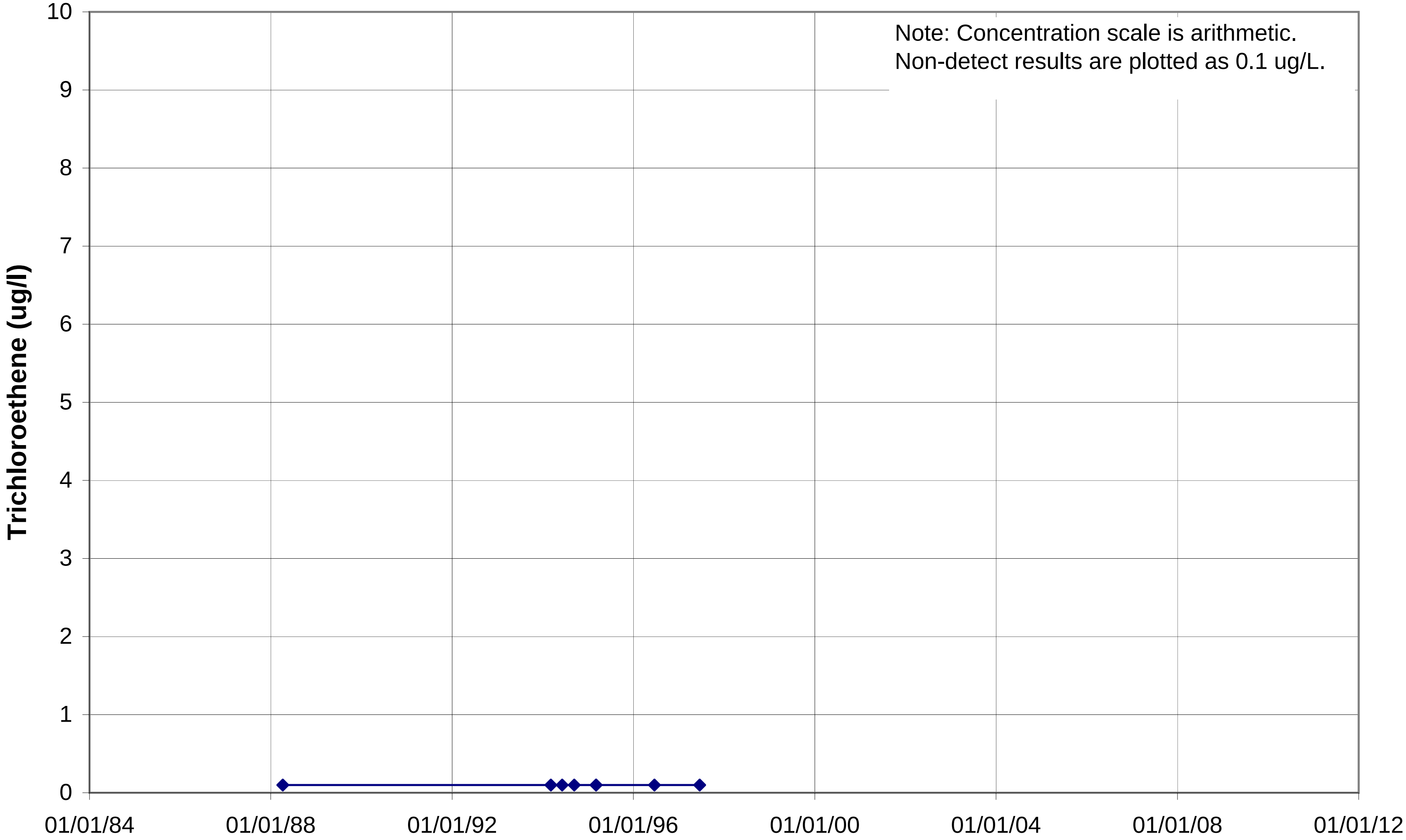
01U110



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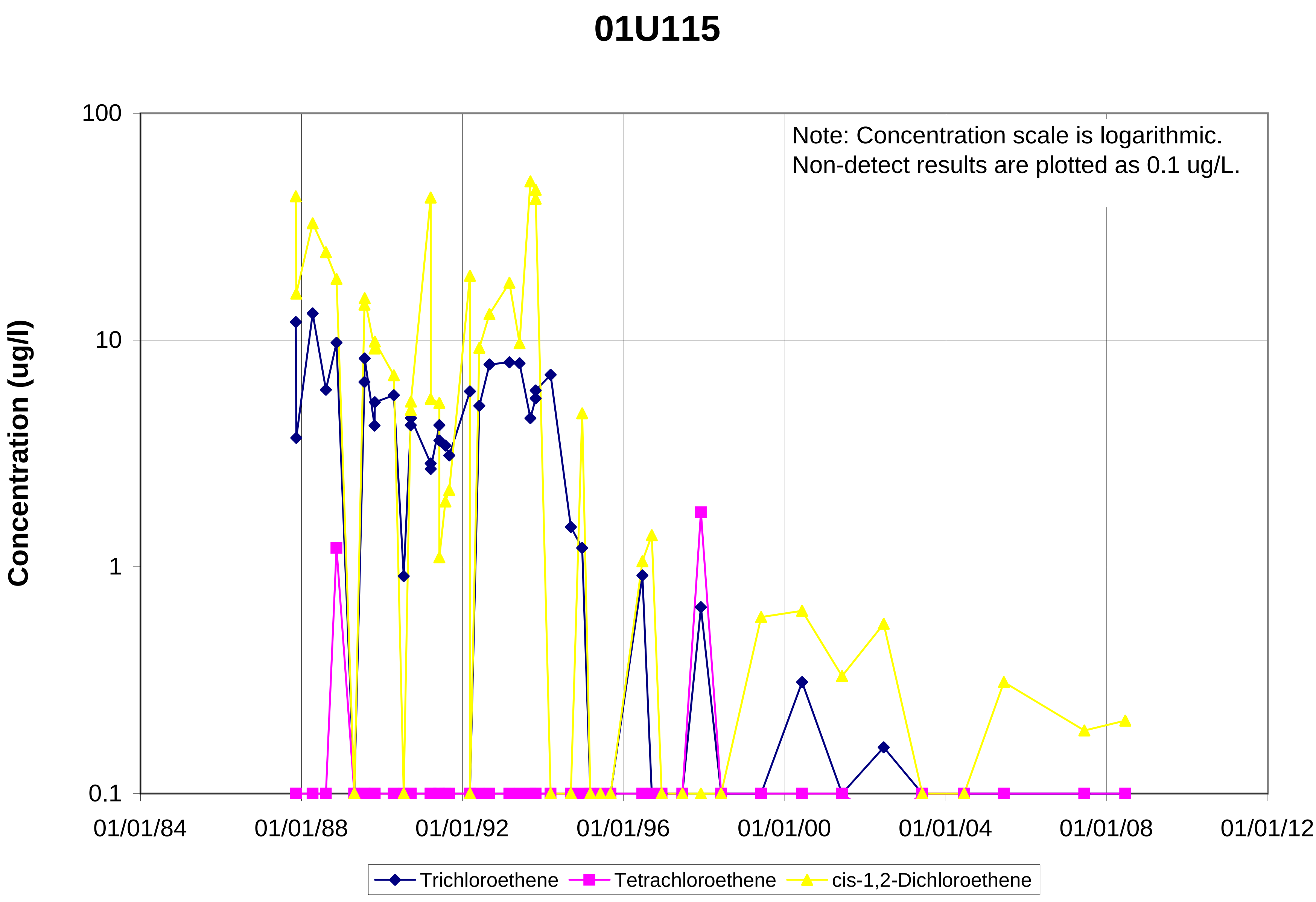

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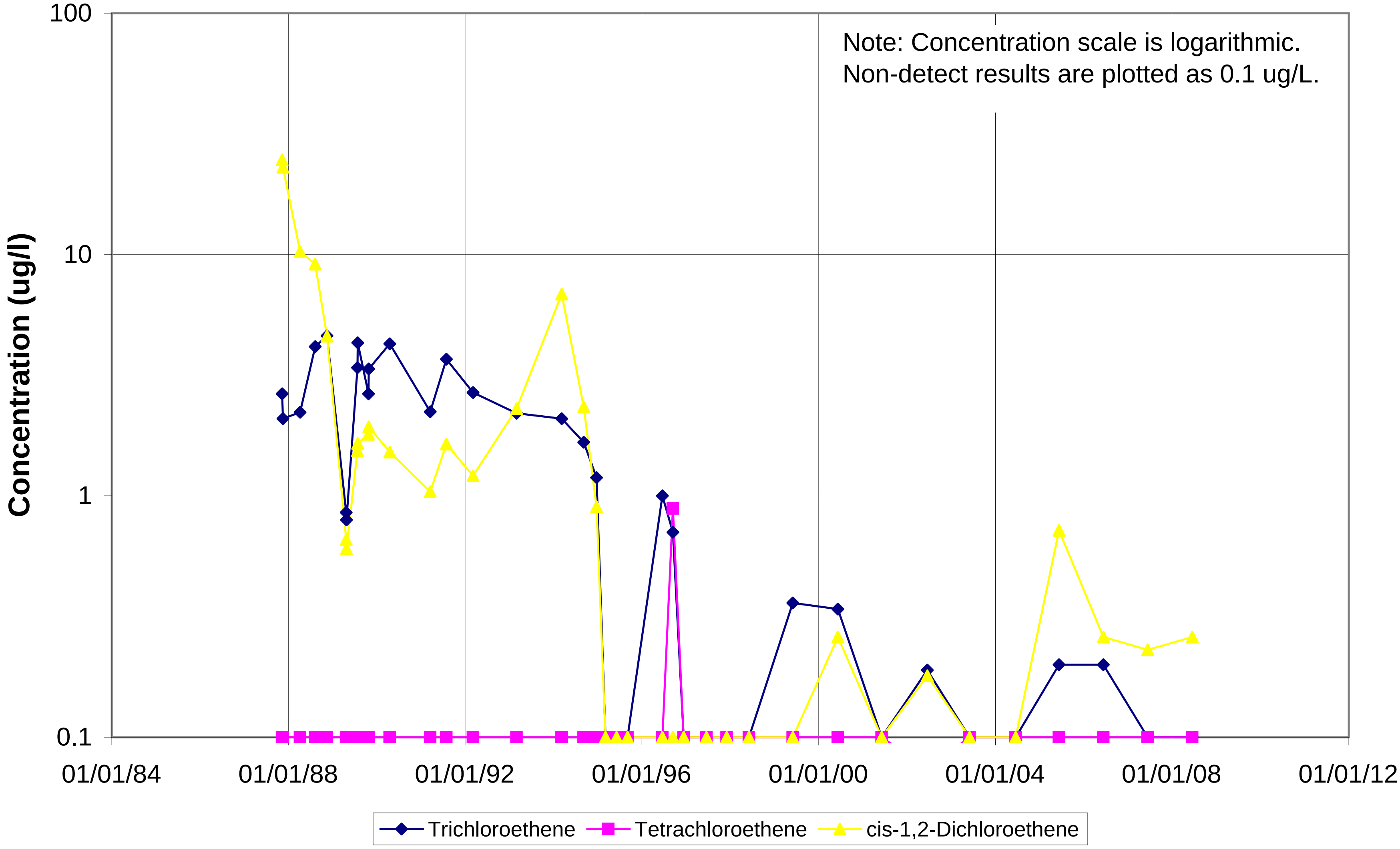

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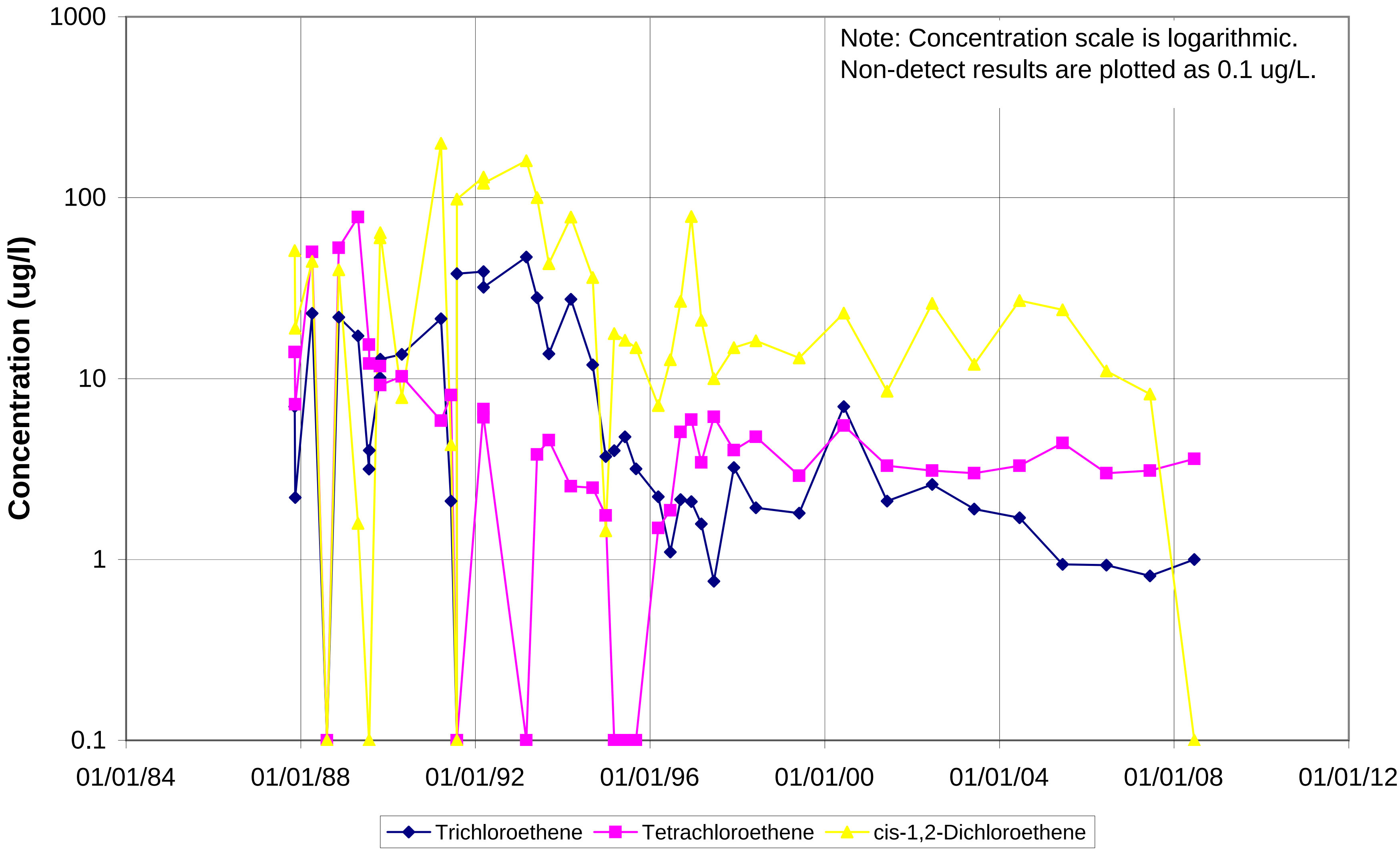

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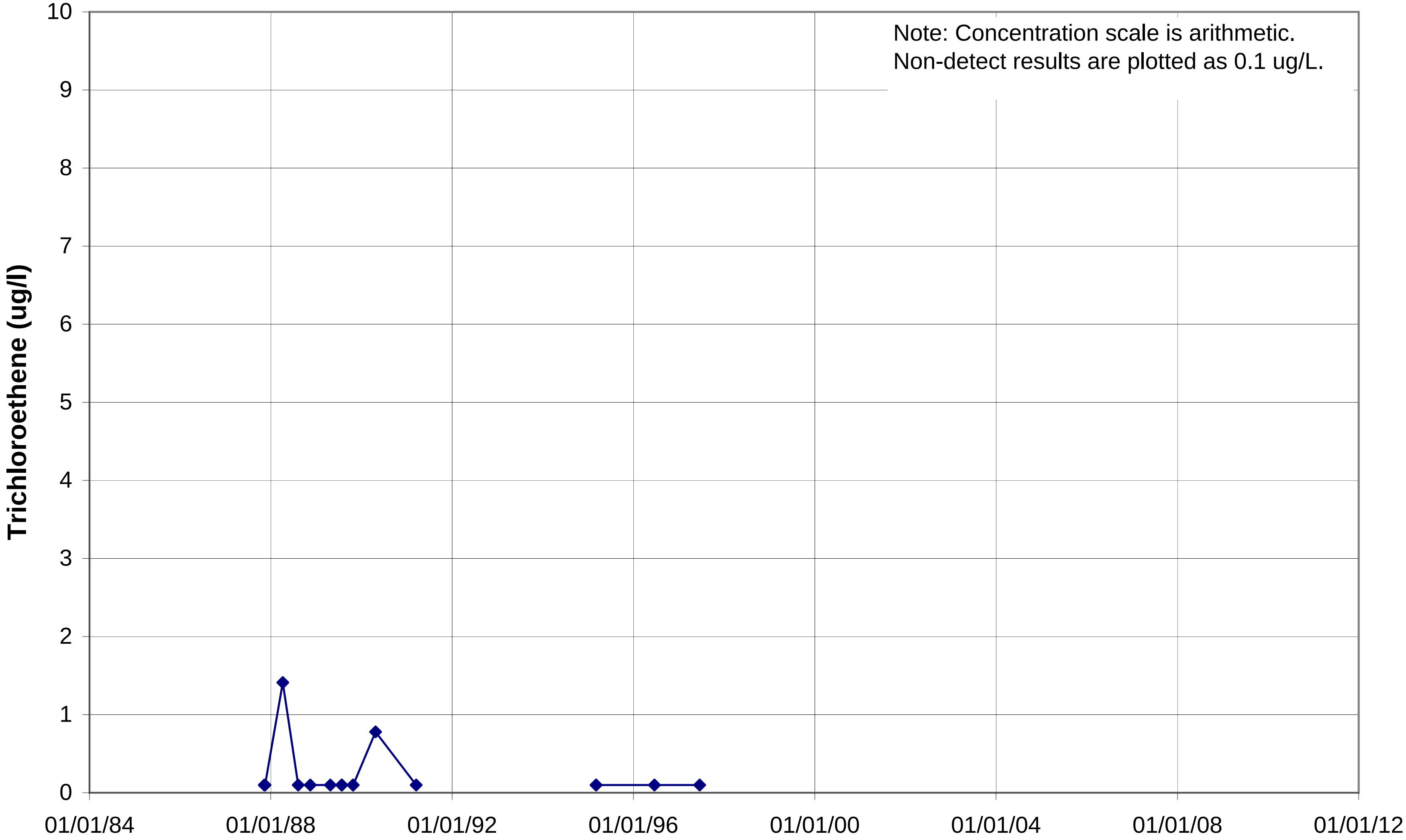

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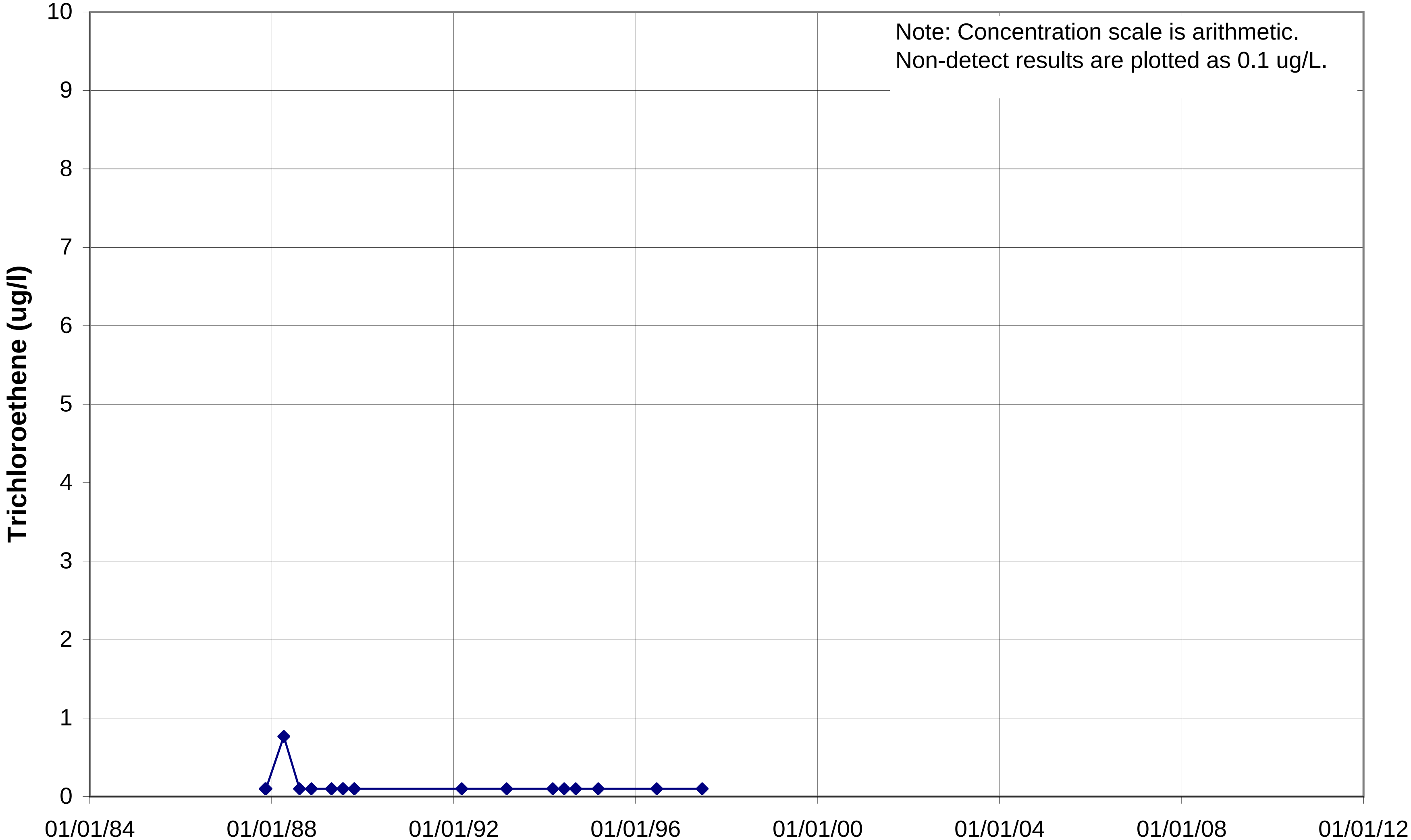

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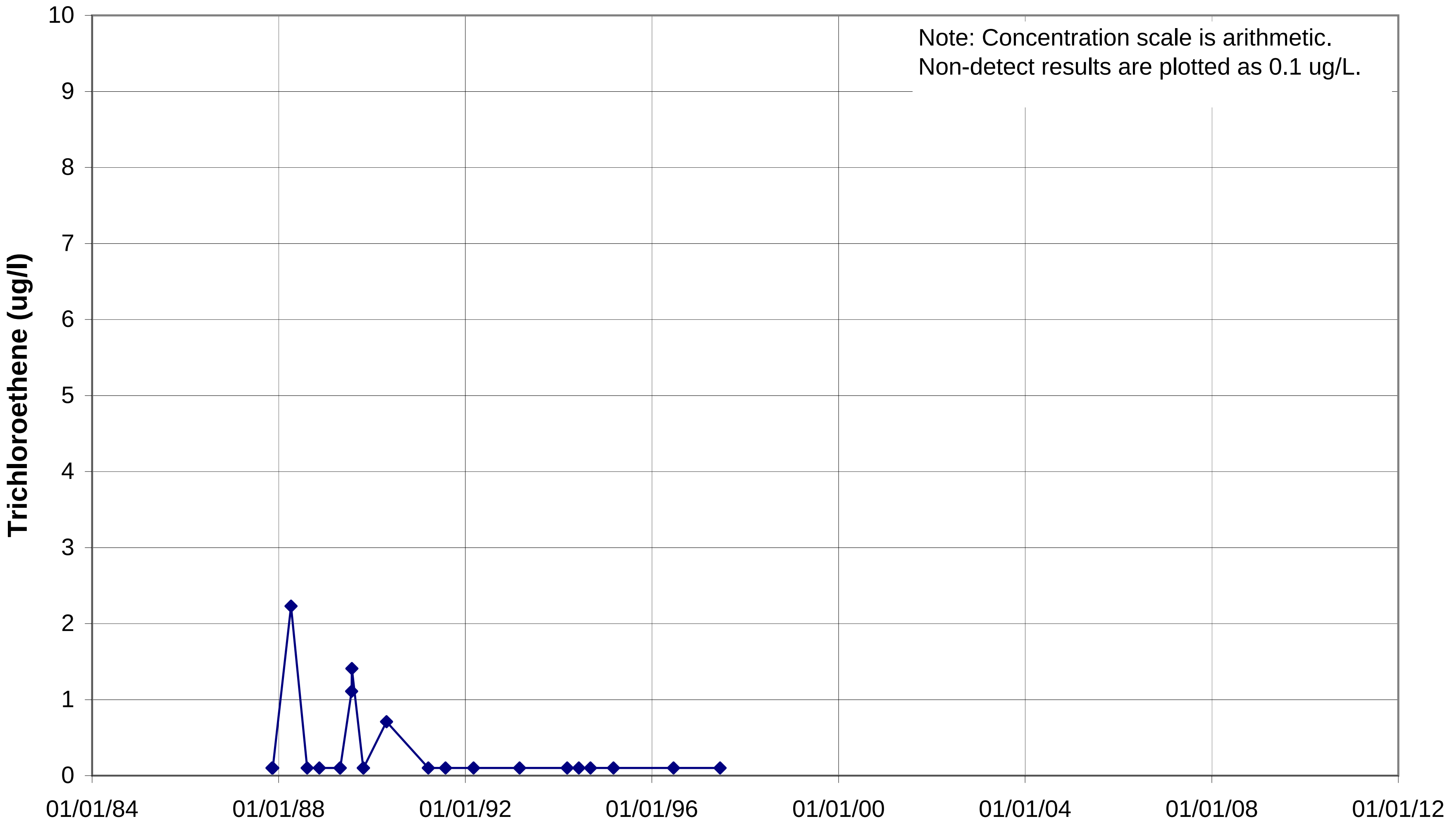

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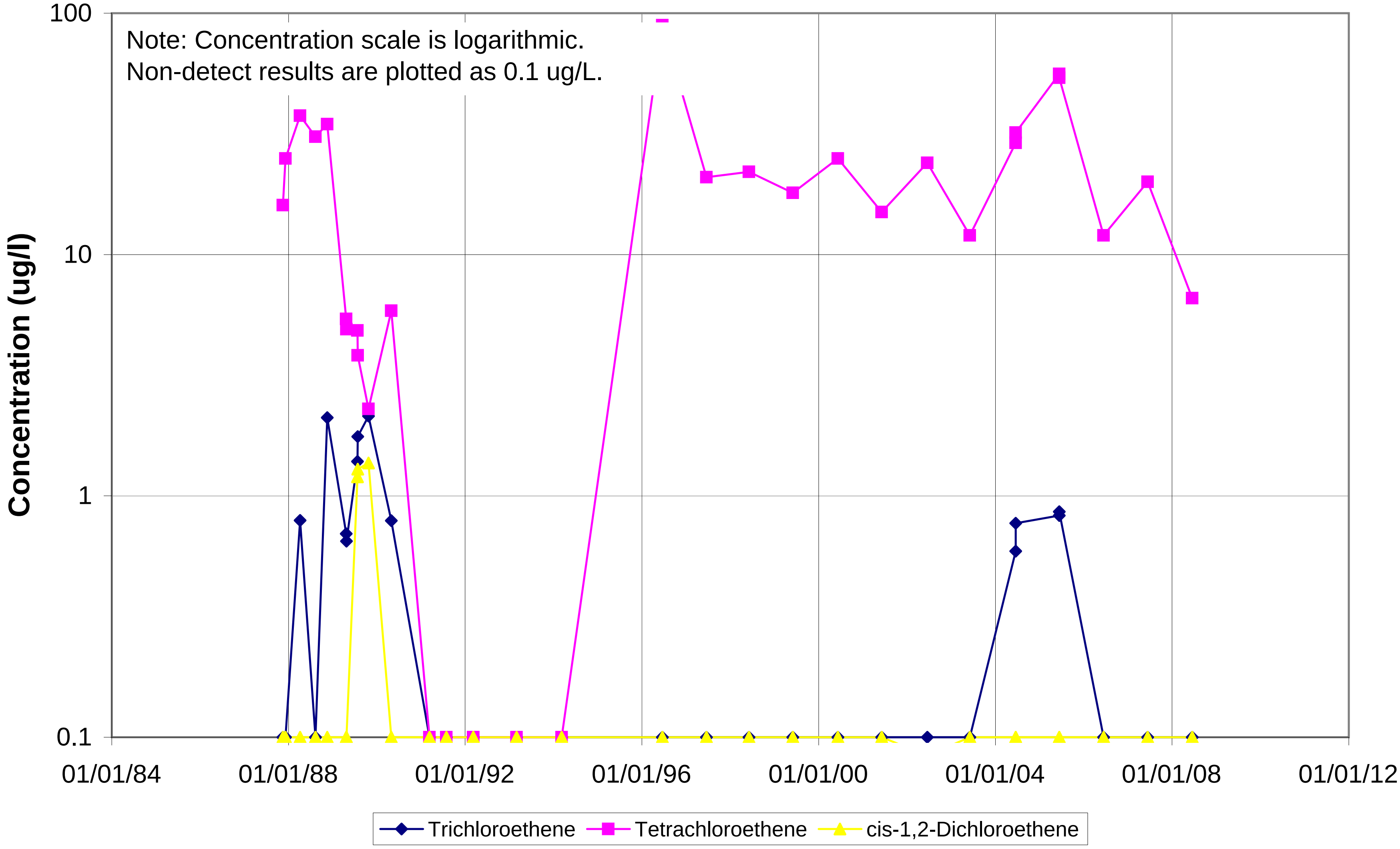

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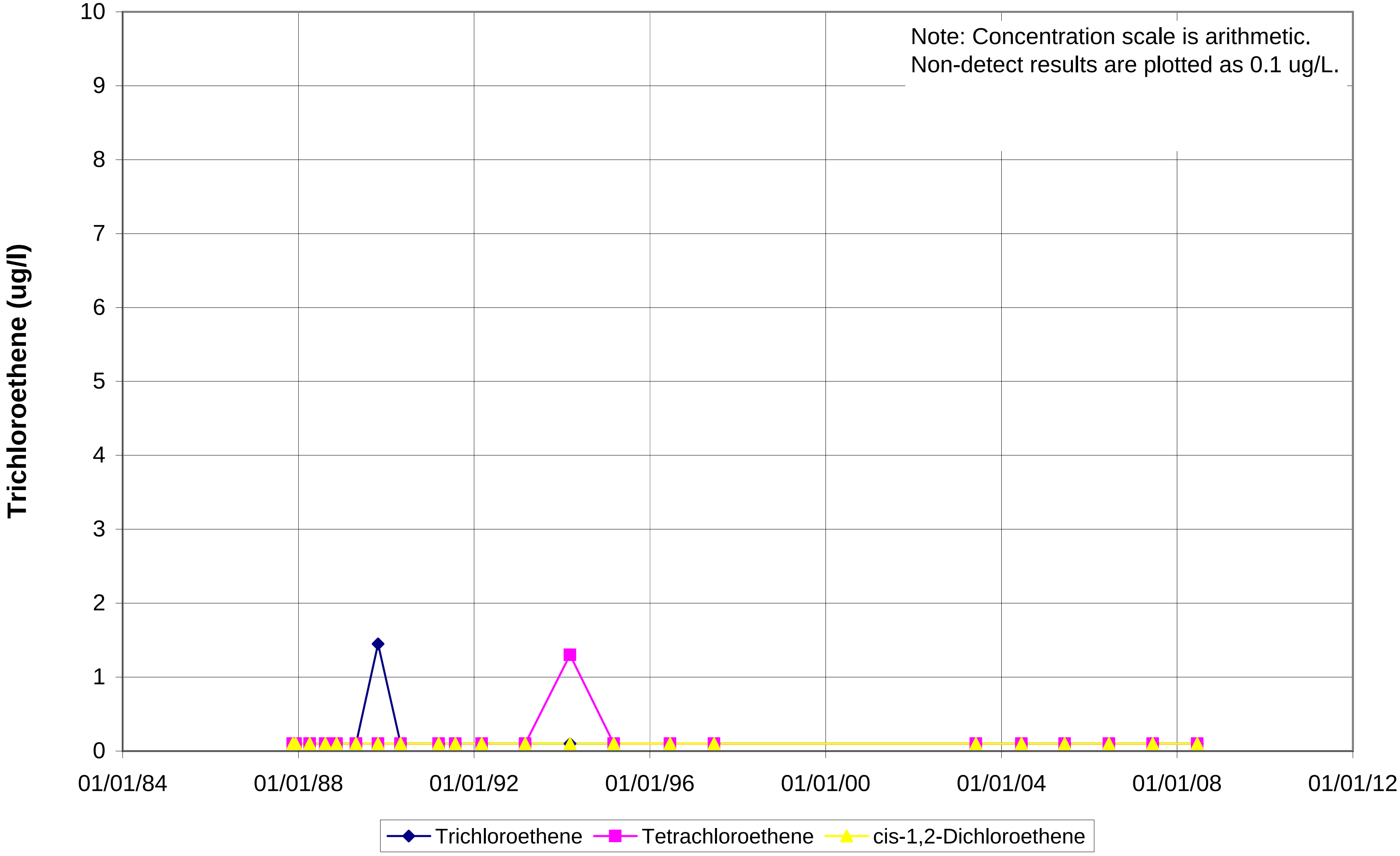
01U127



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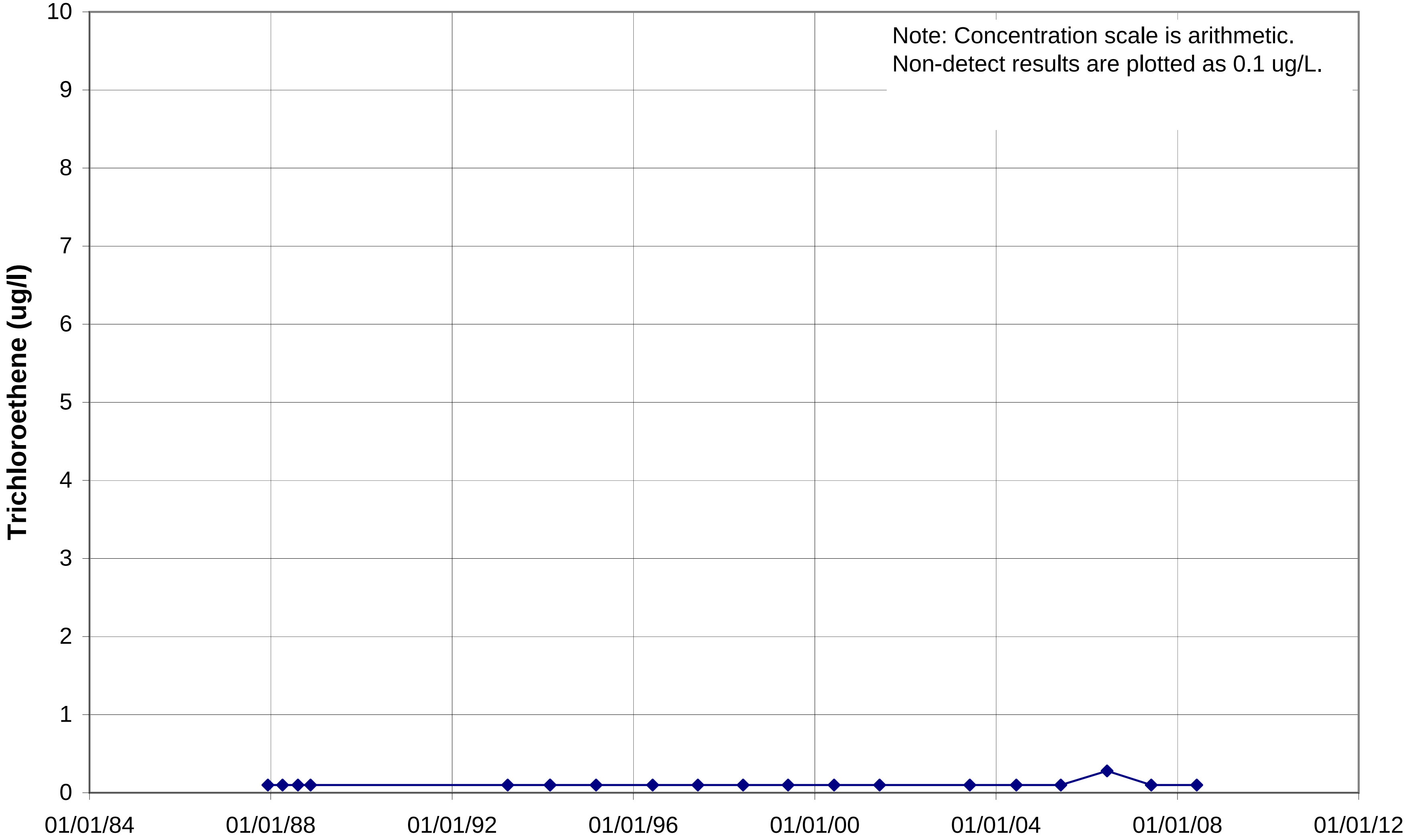

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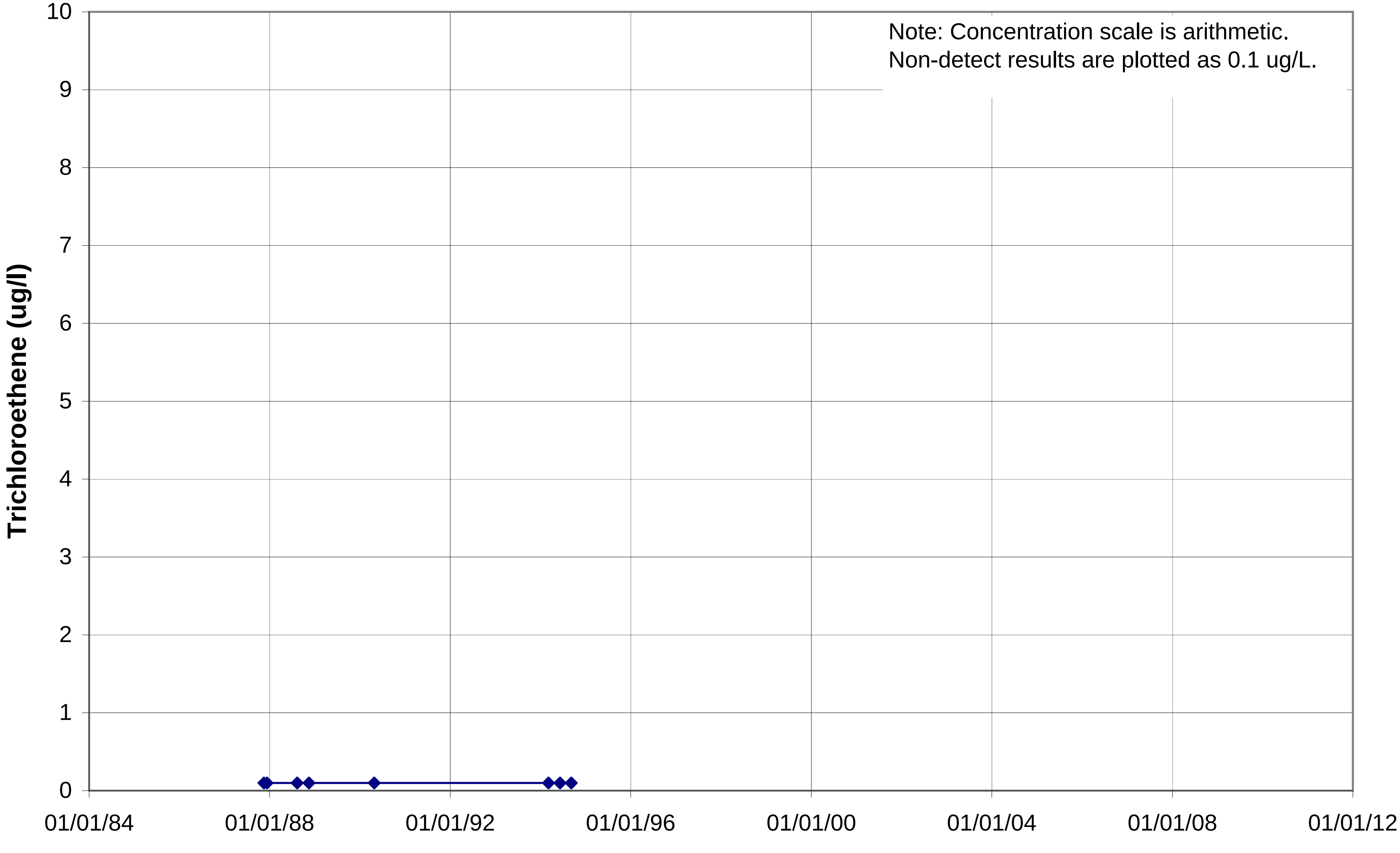
01U133



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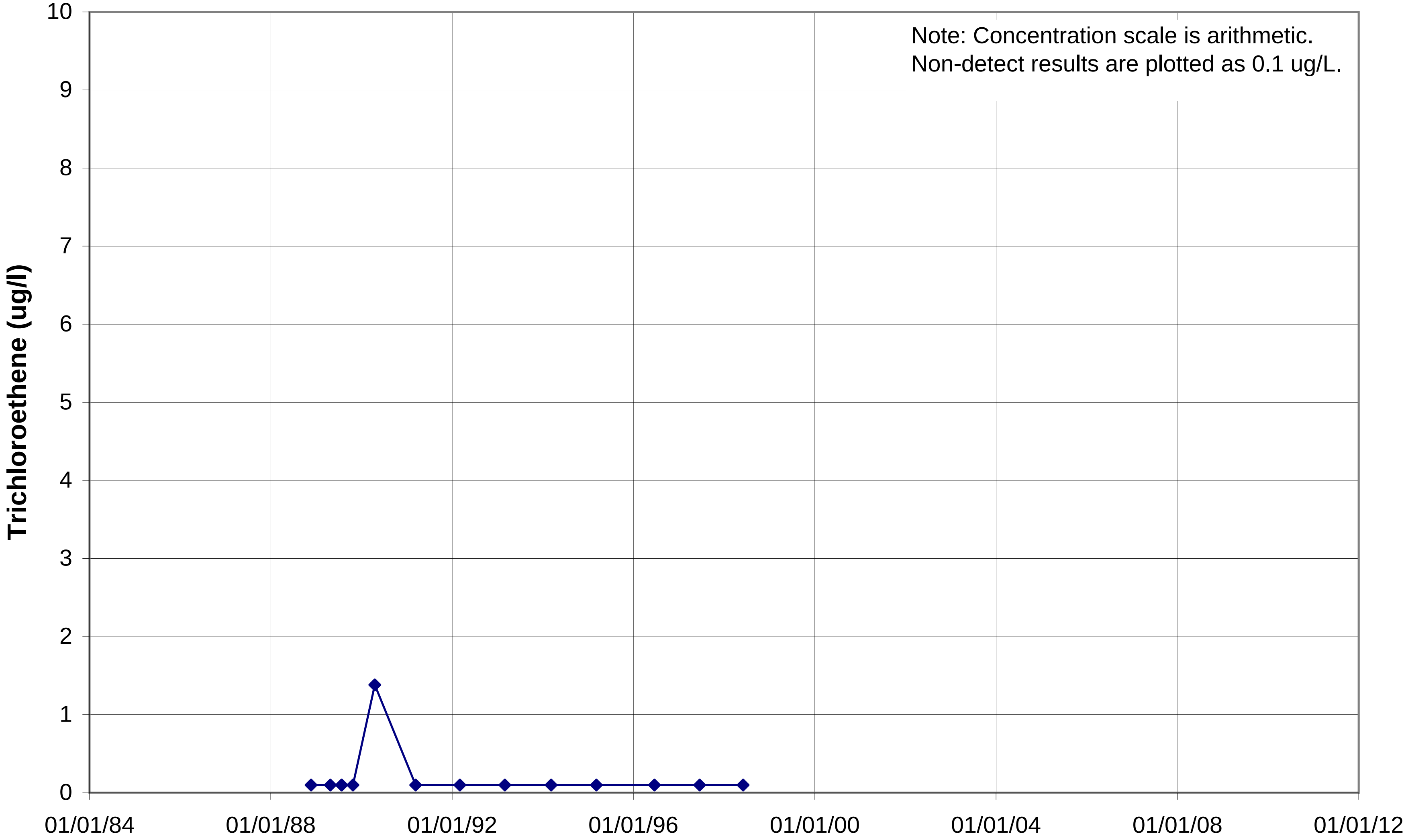

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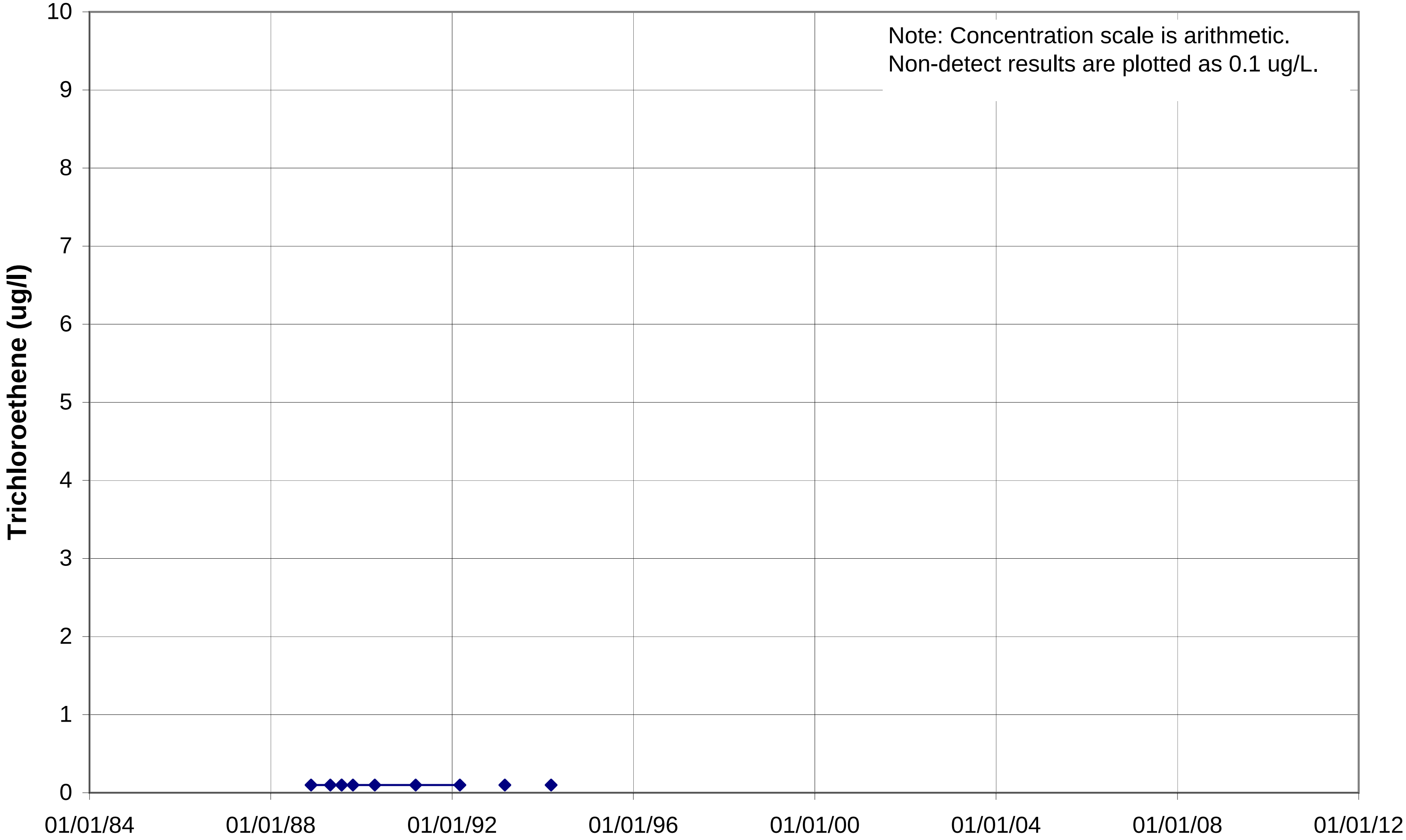

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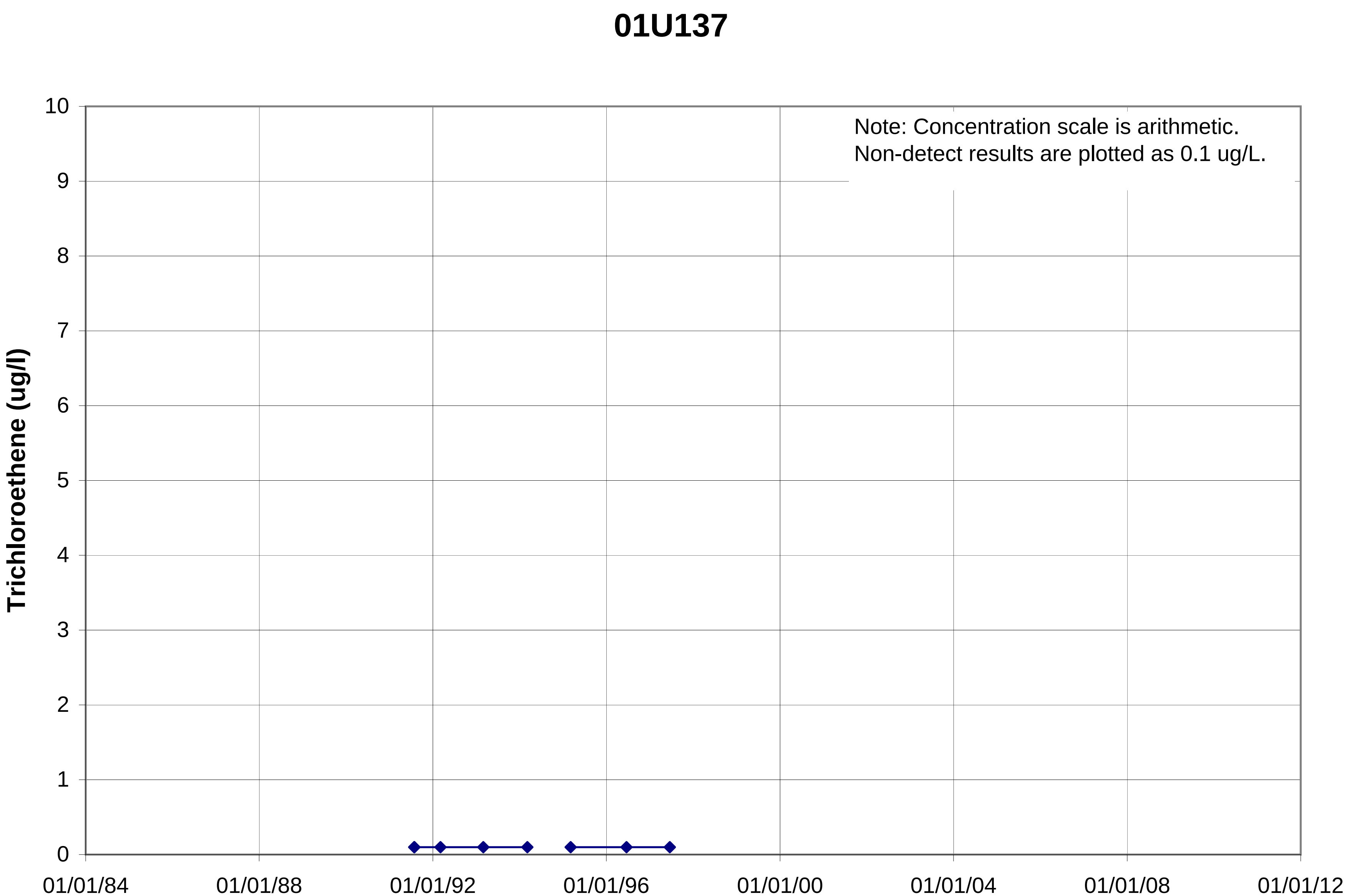

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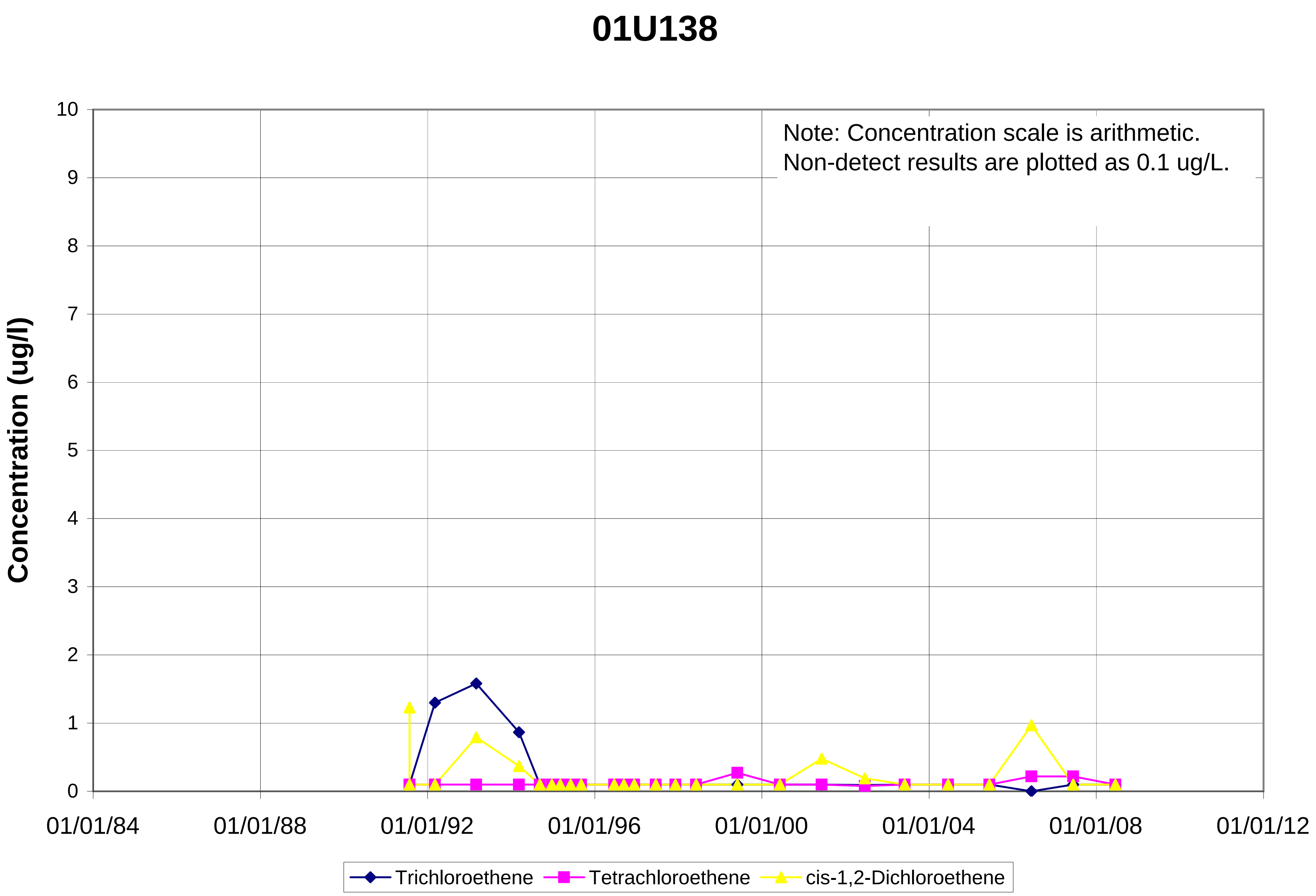

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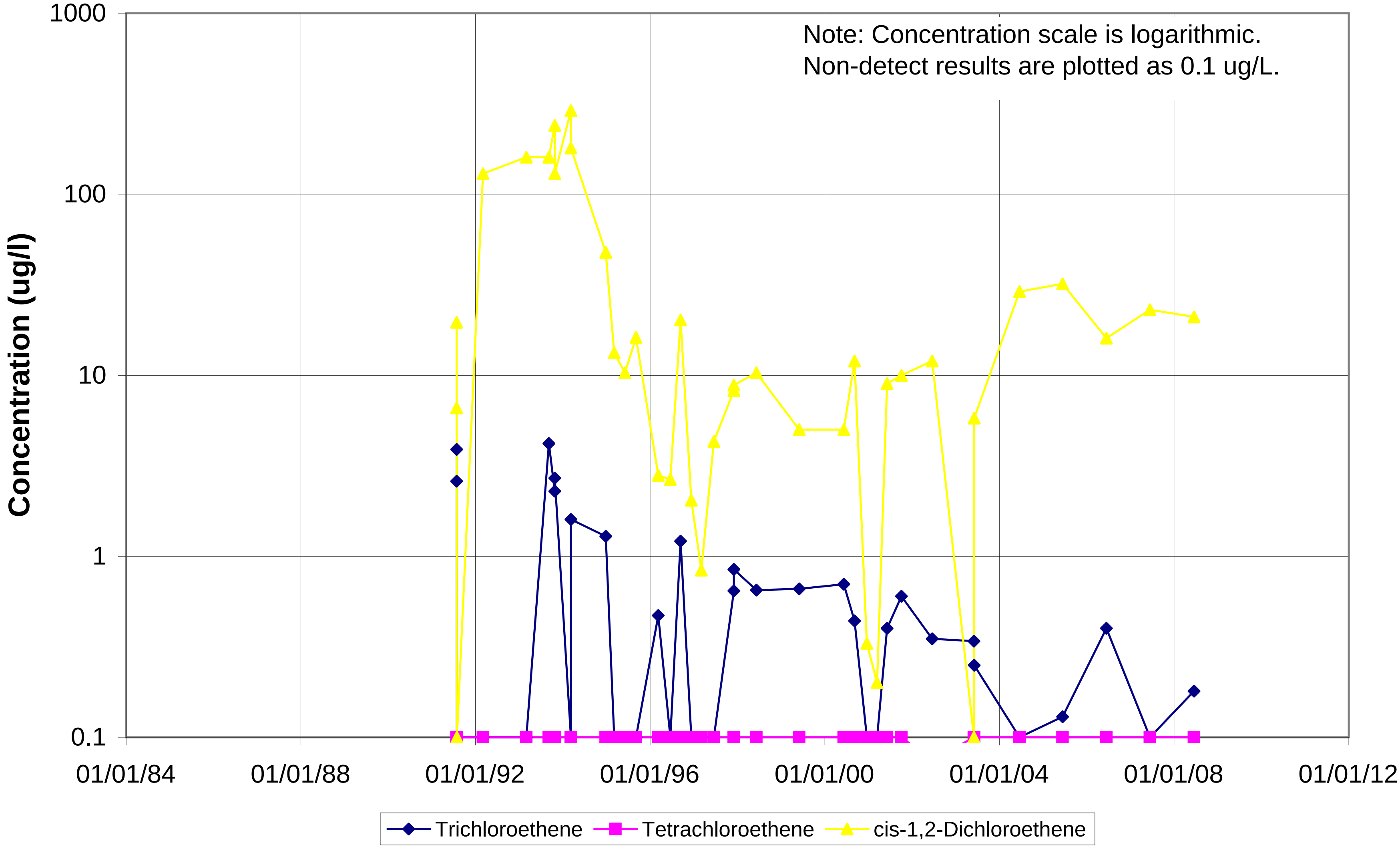

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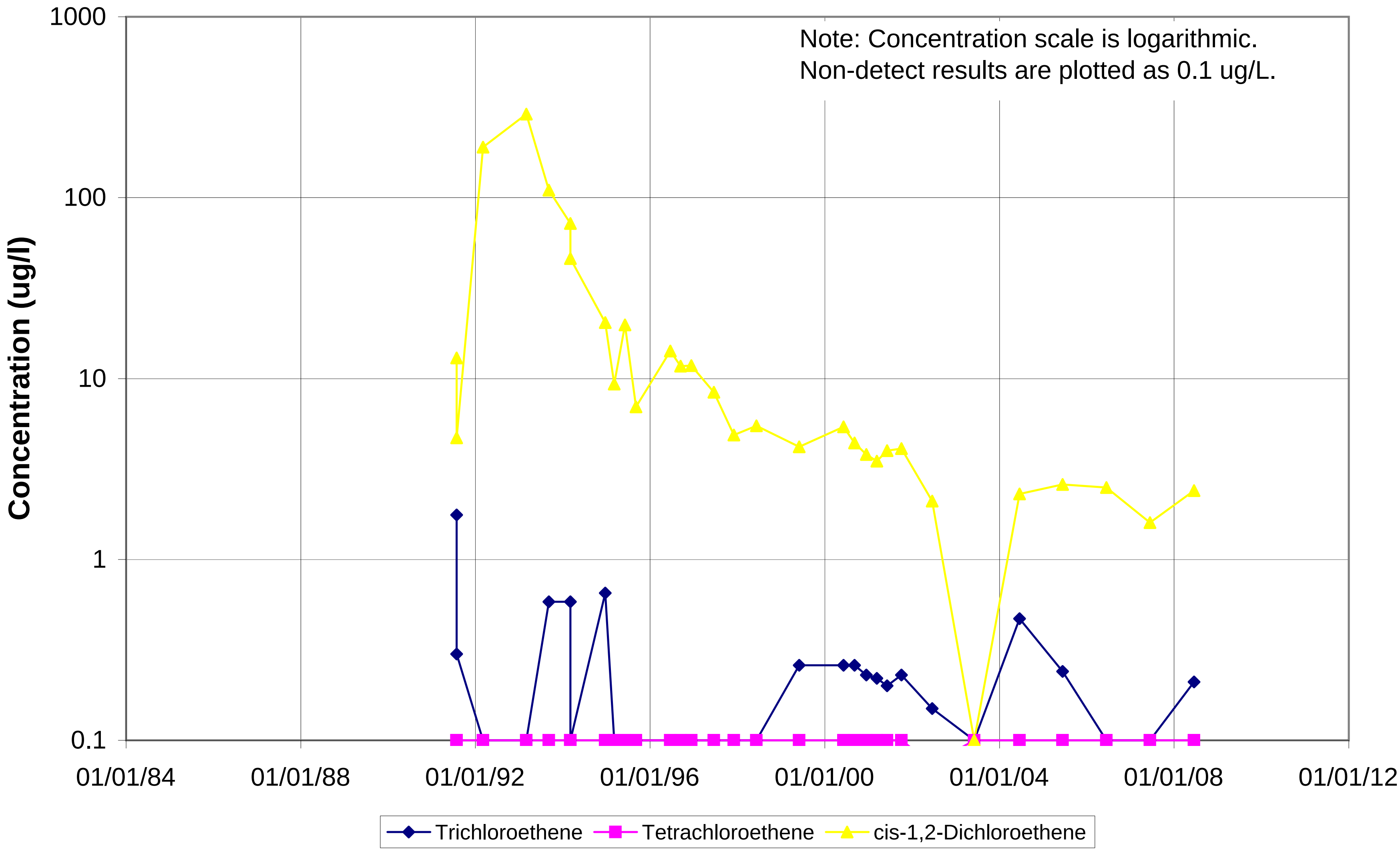

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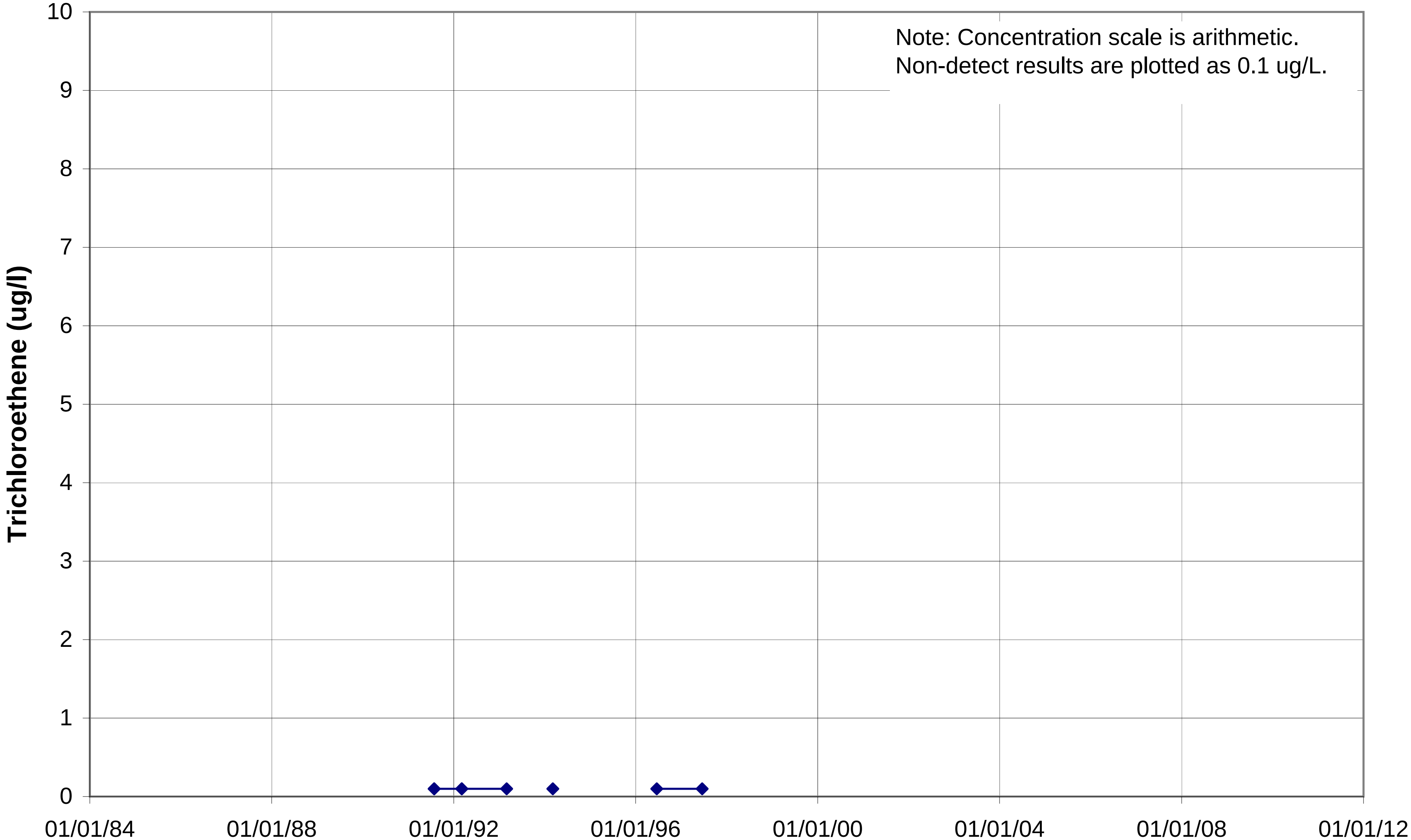

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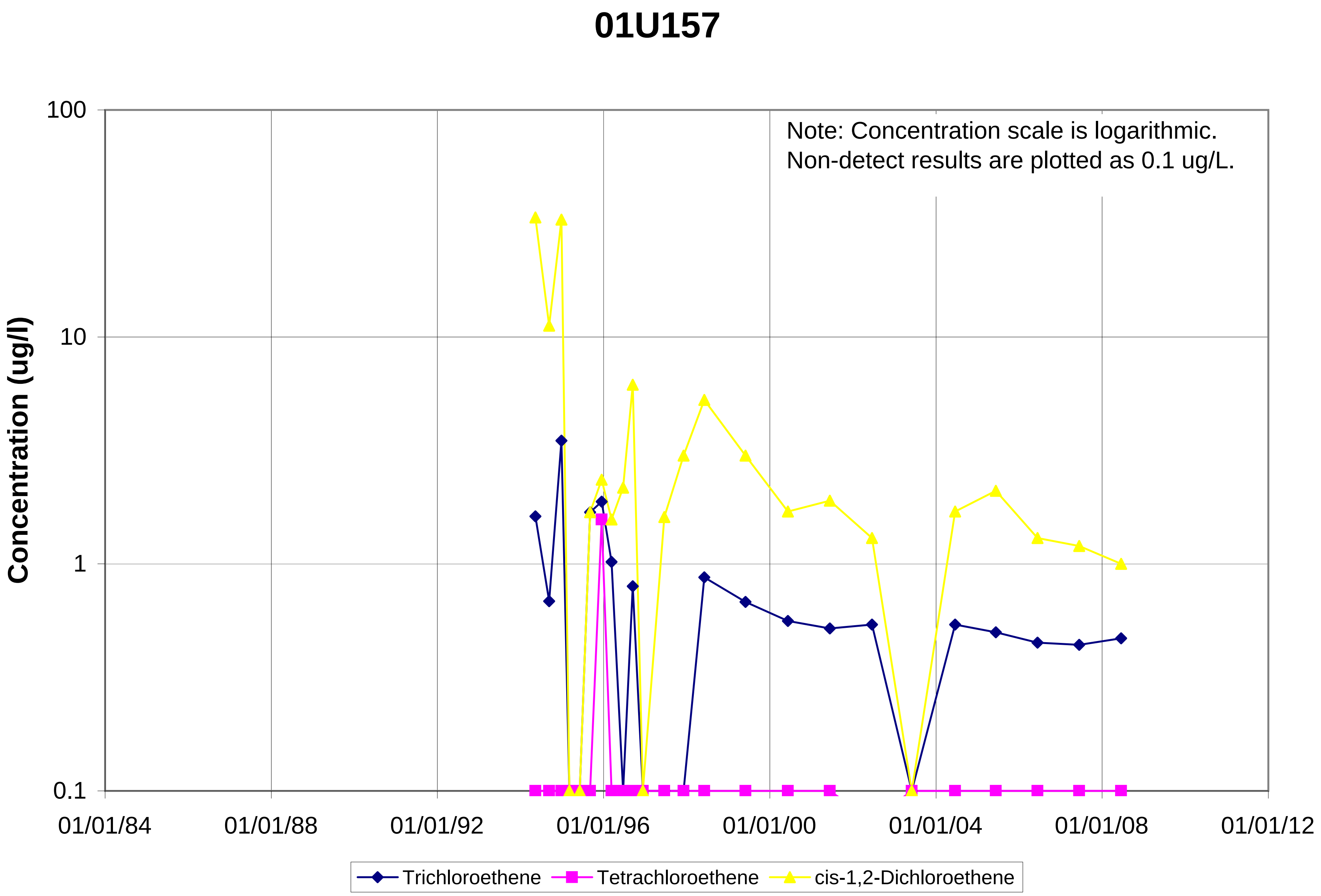

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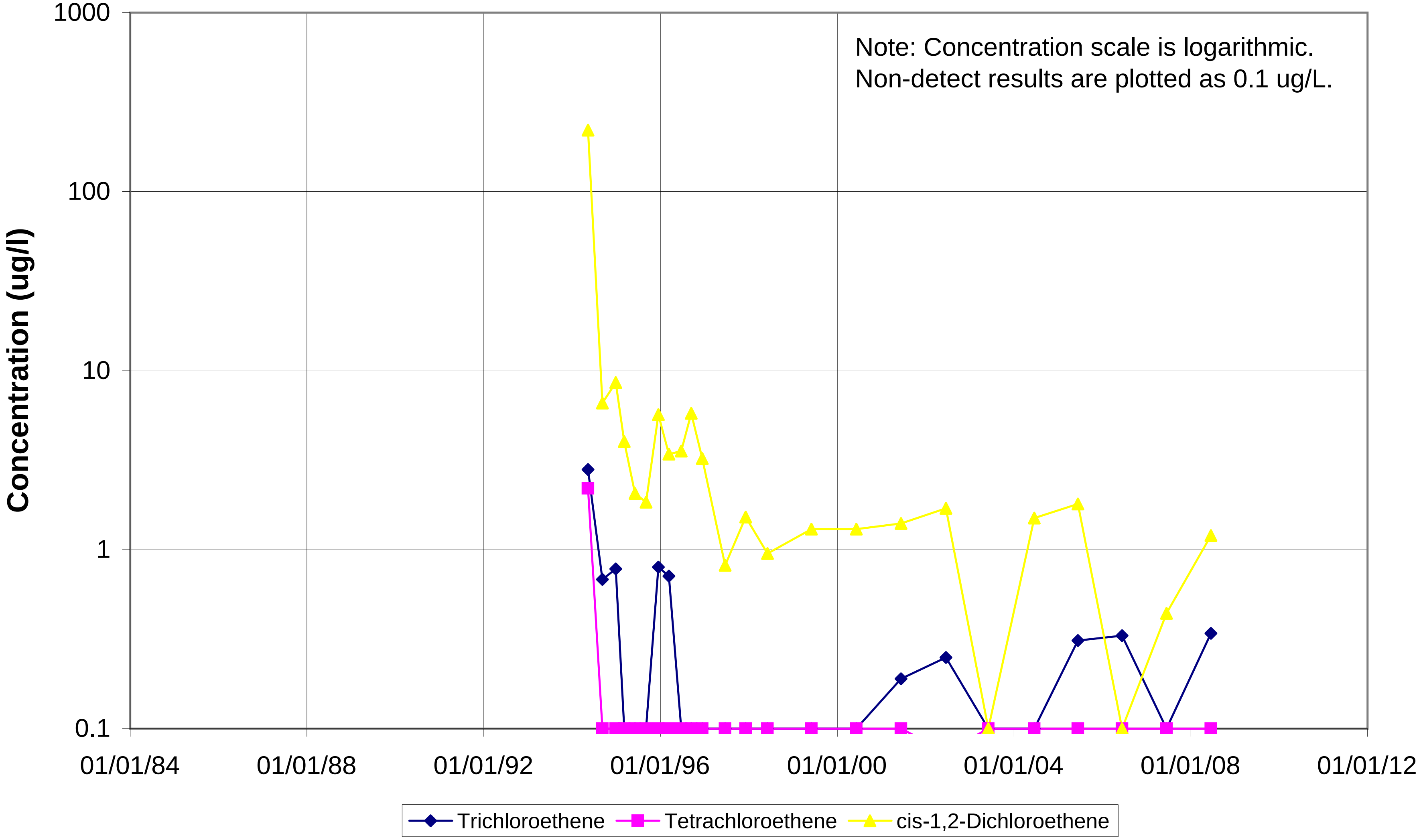

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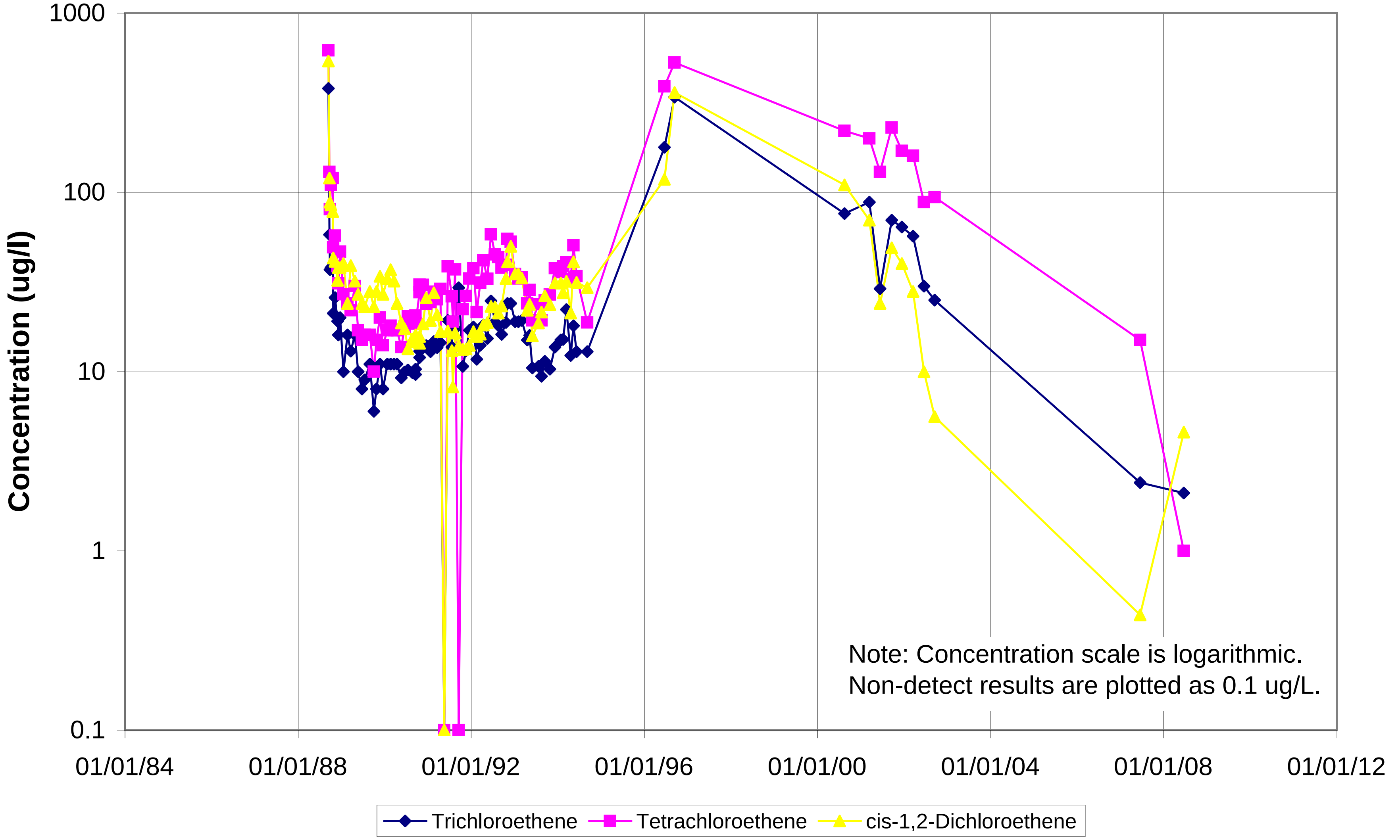

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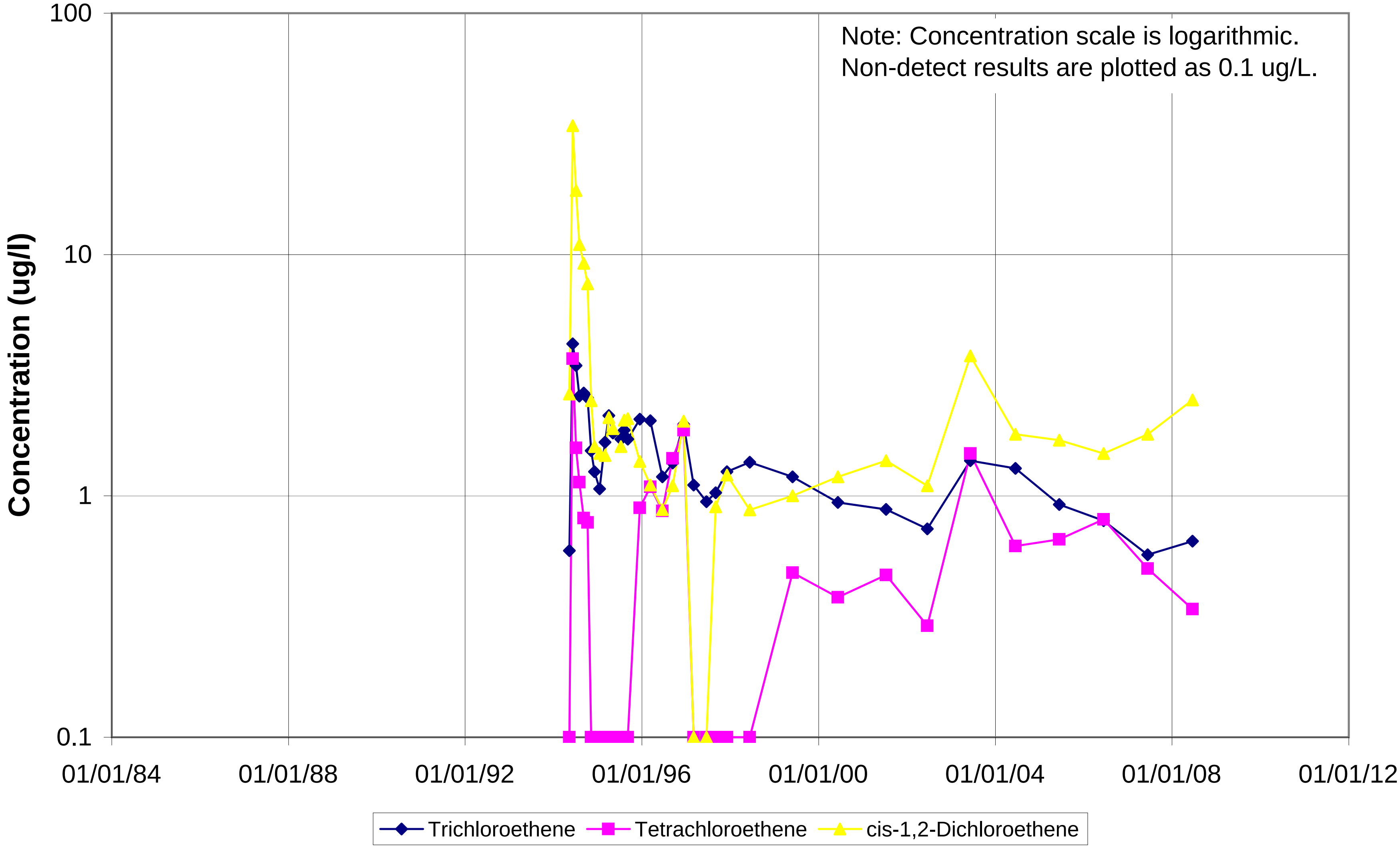
01U351 (EW-1)



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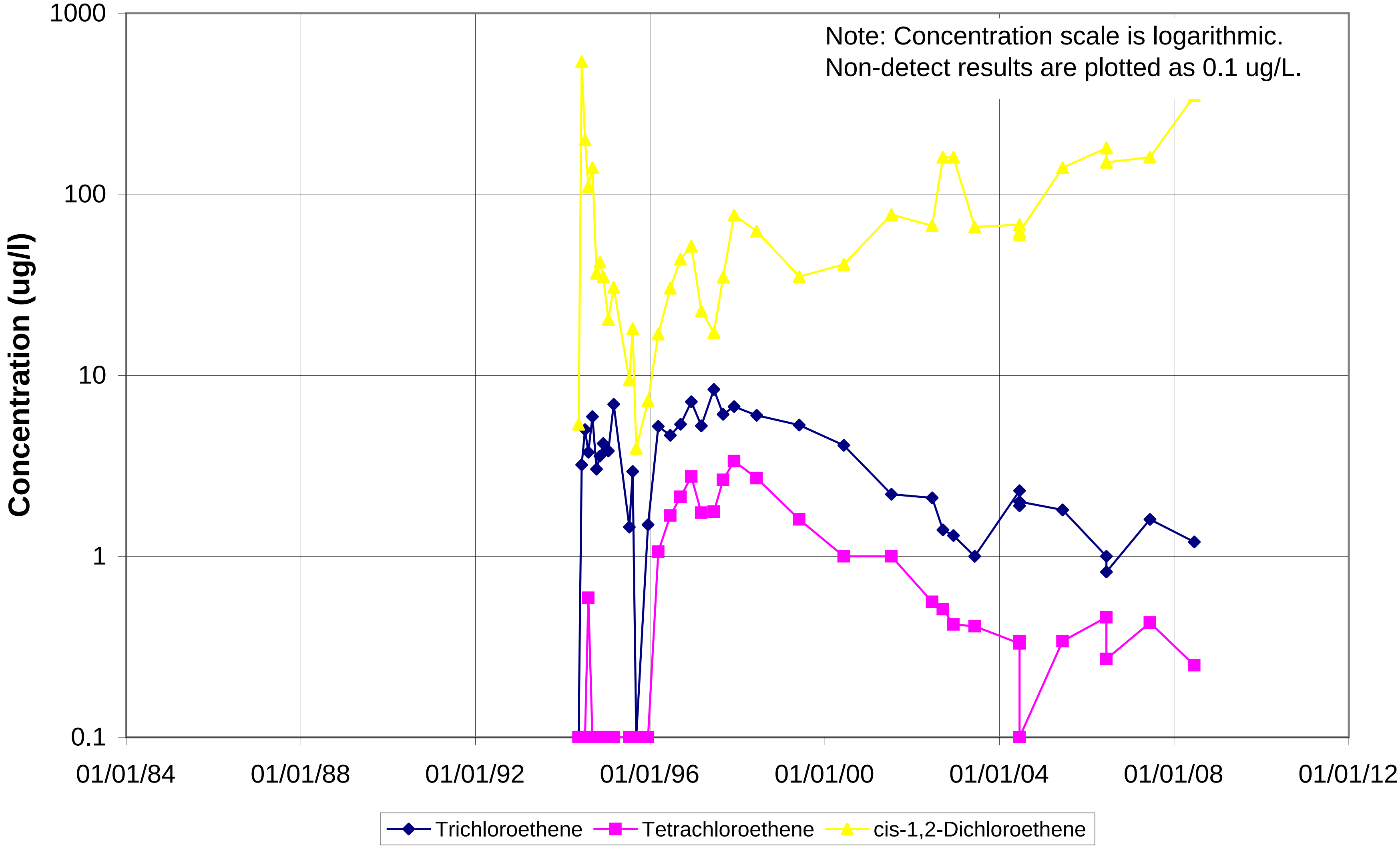

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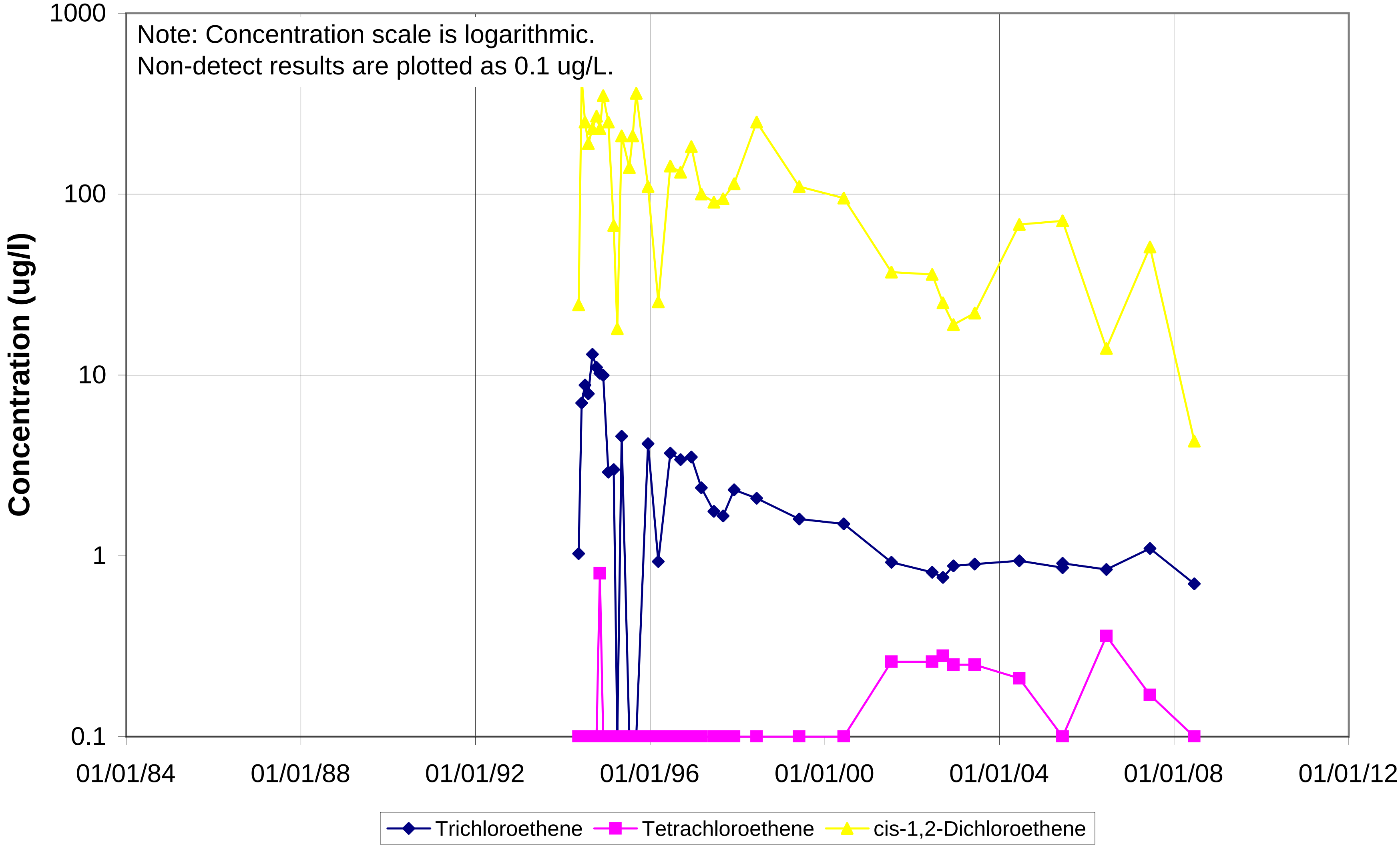

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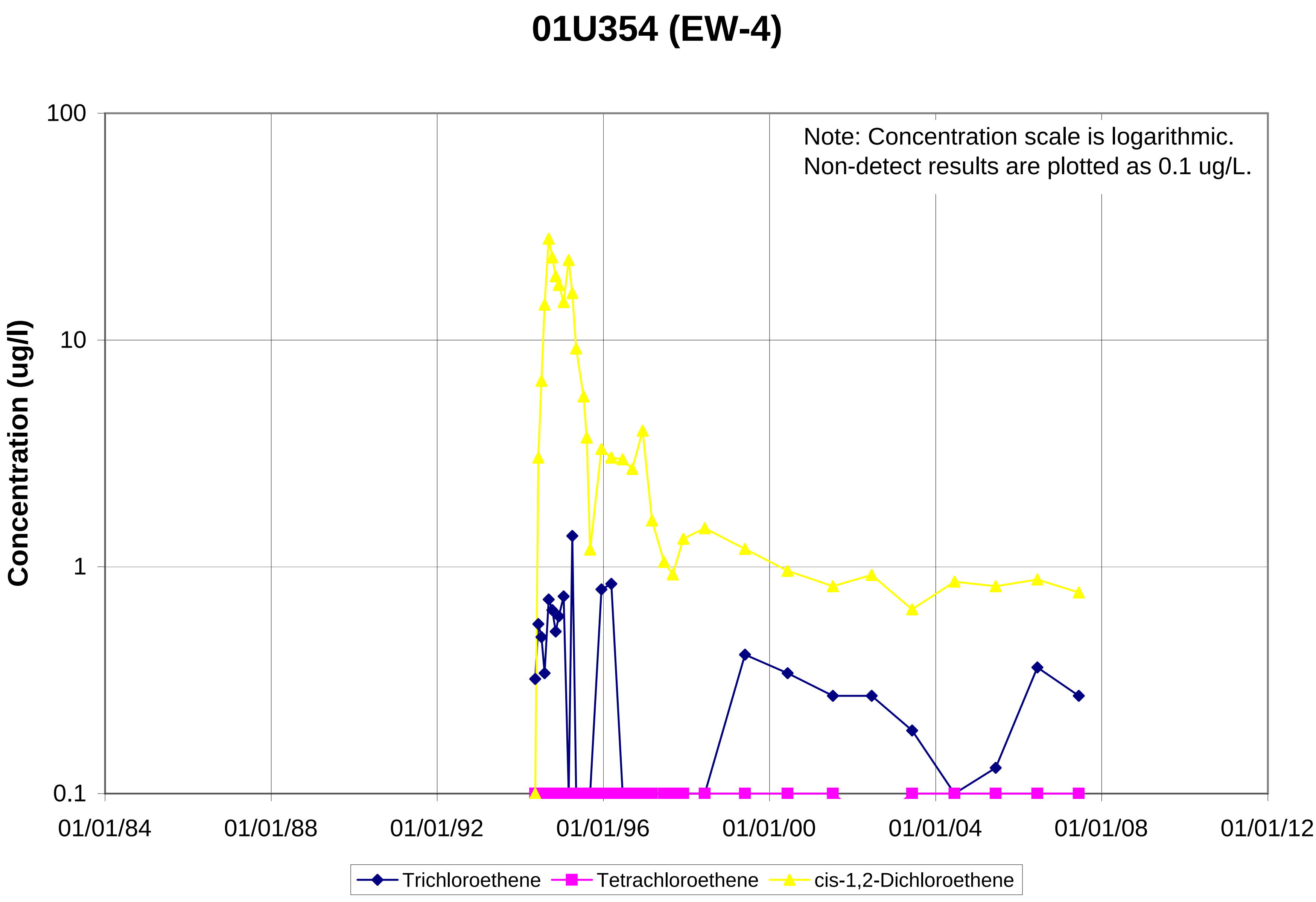

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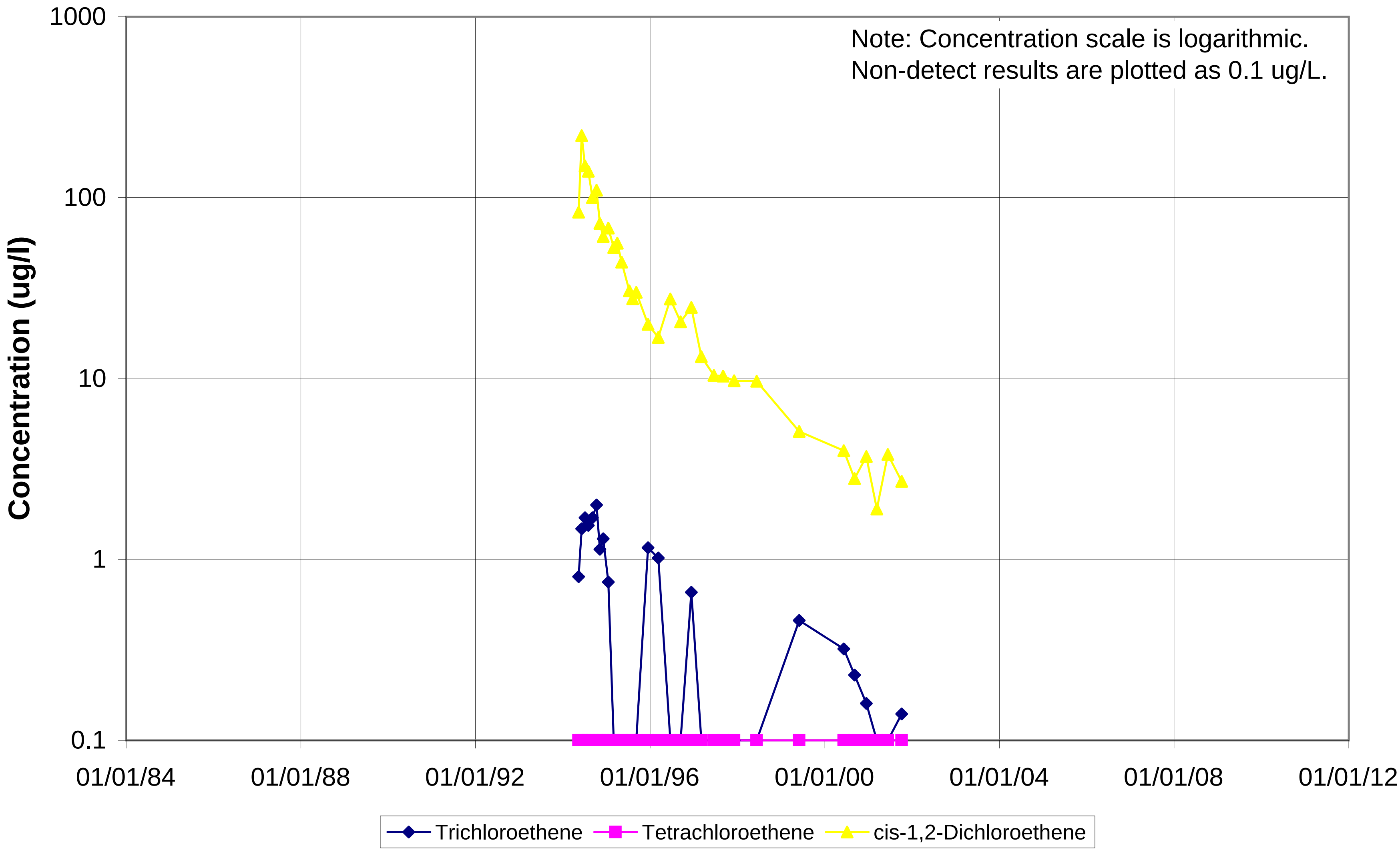

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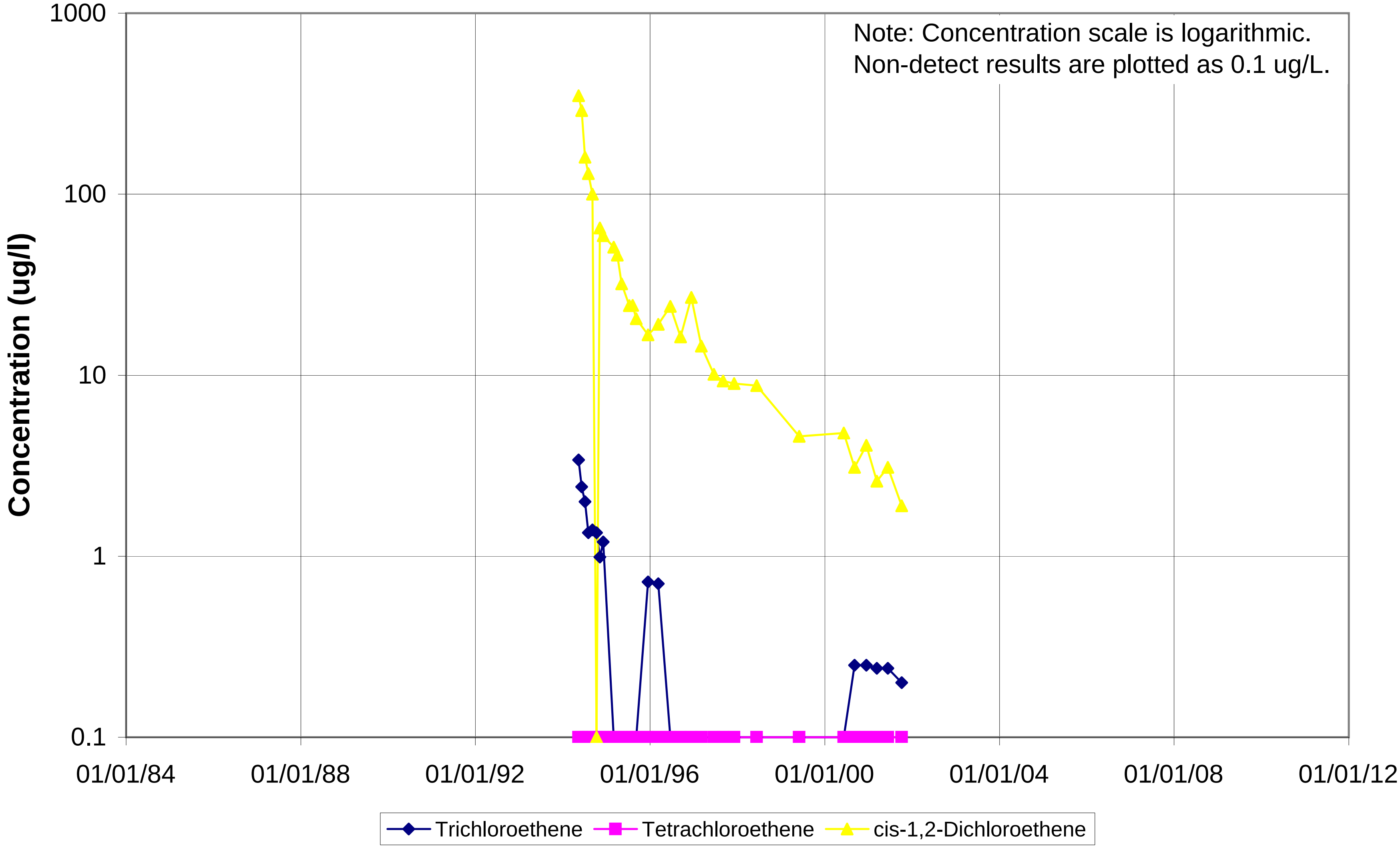

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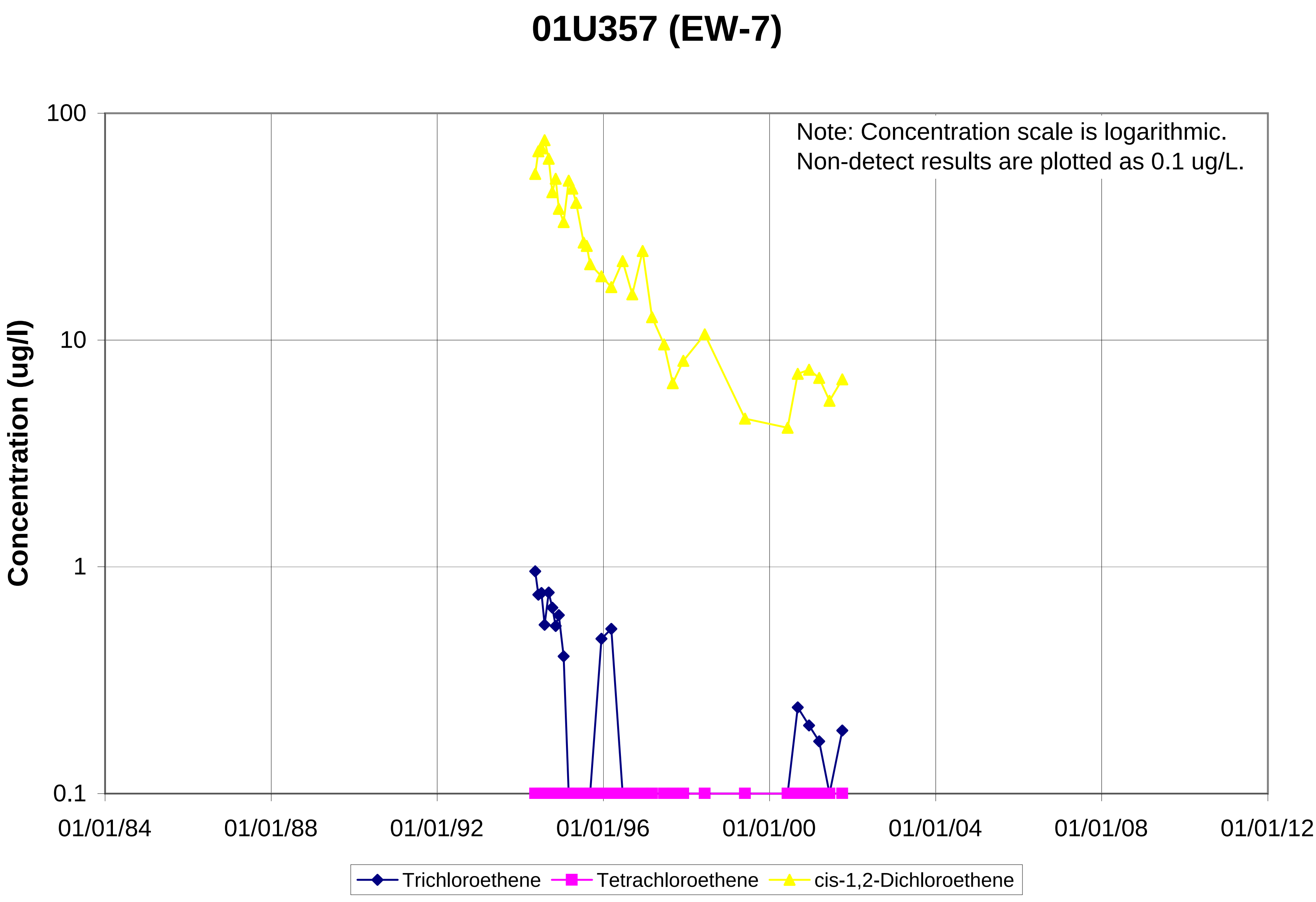

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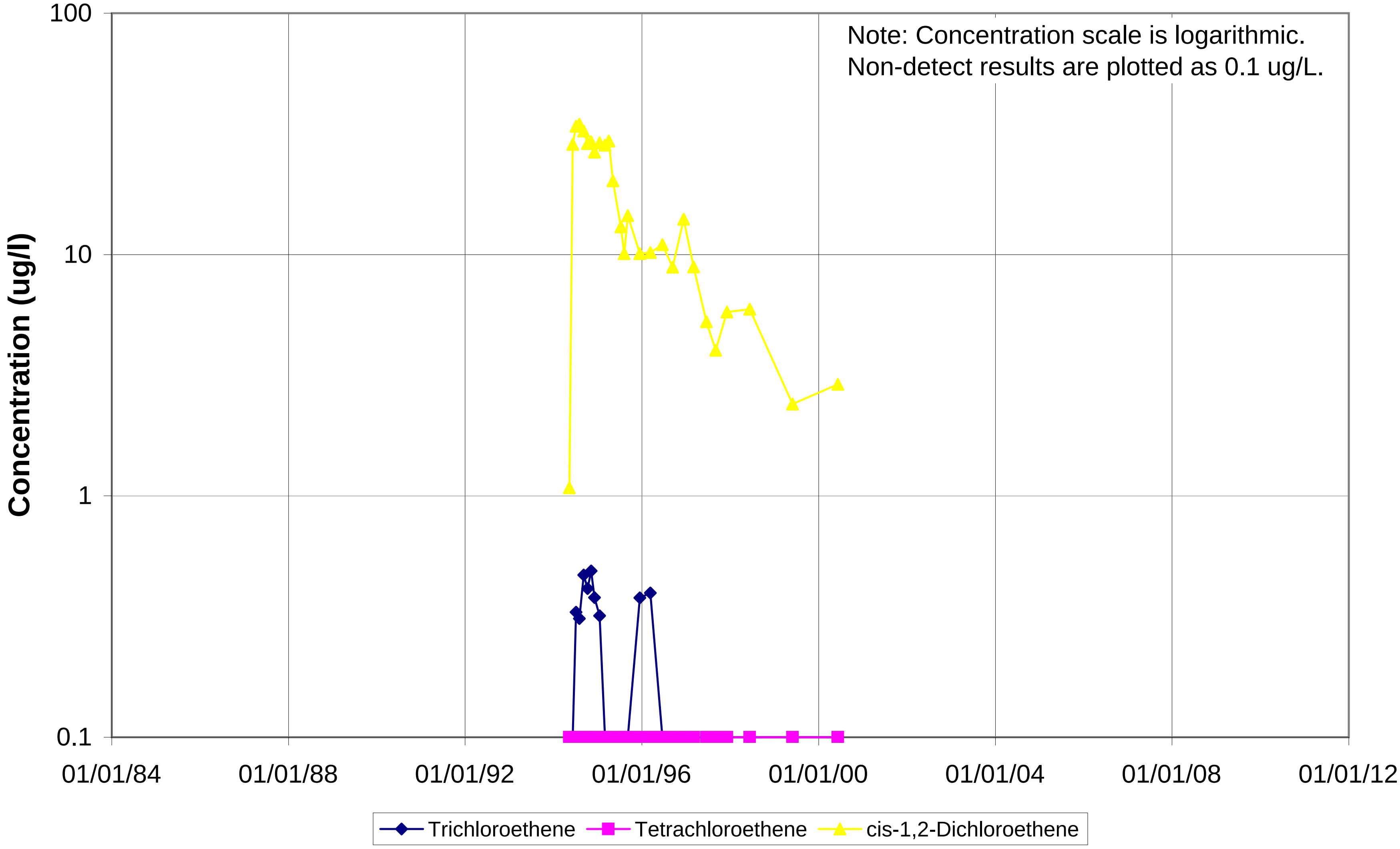

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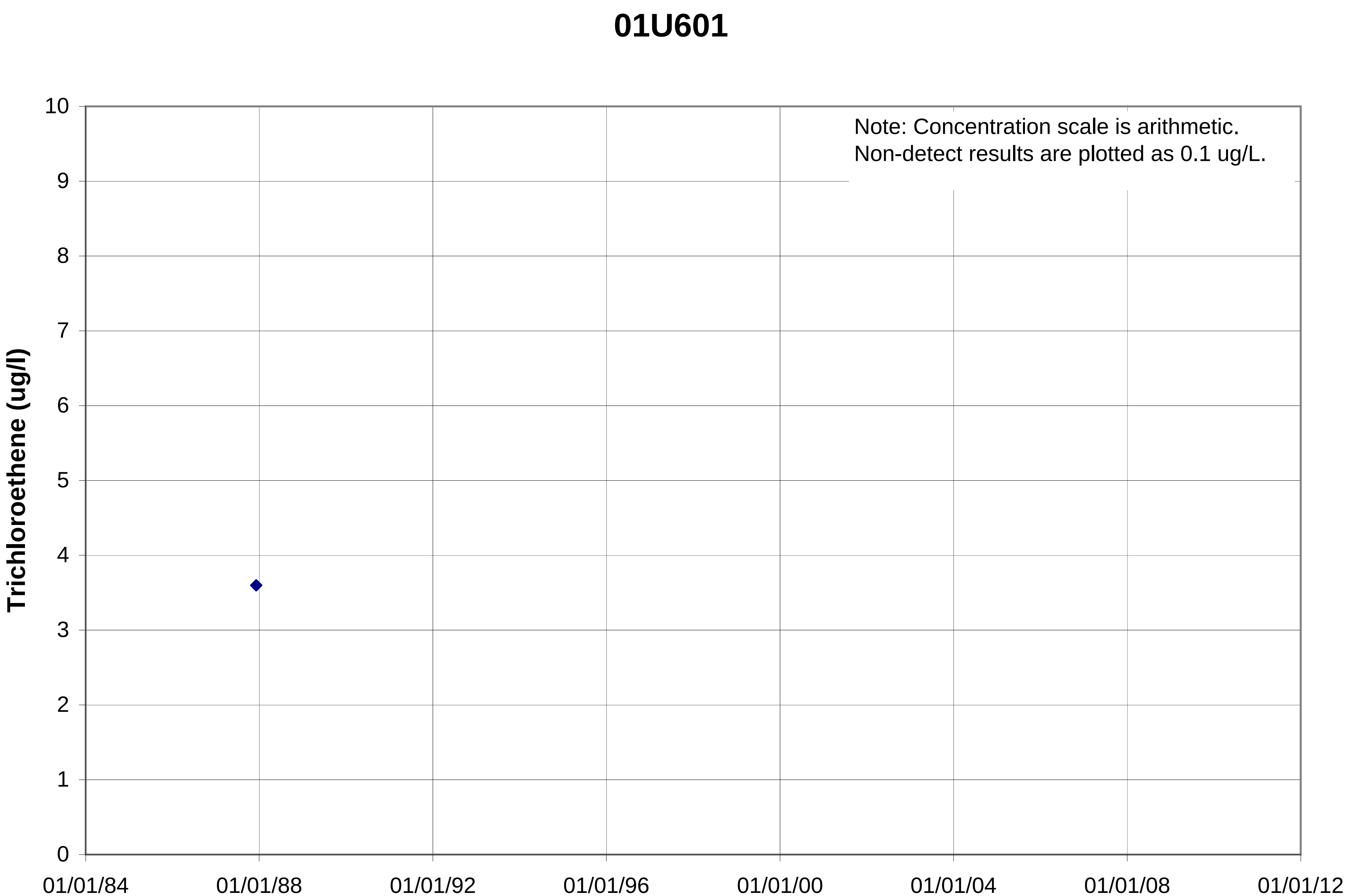

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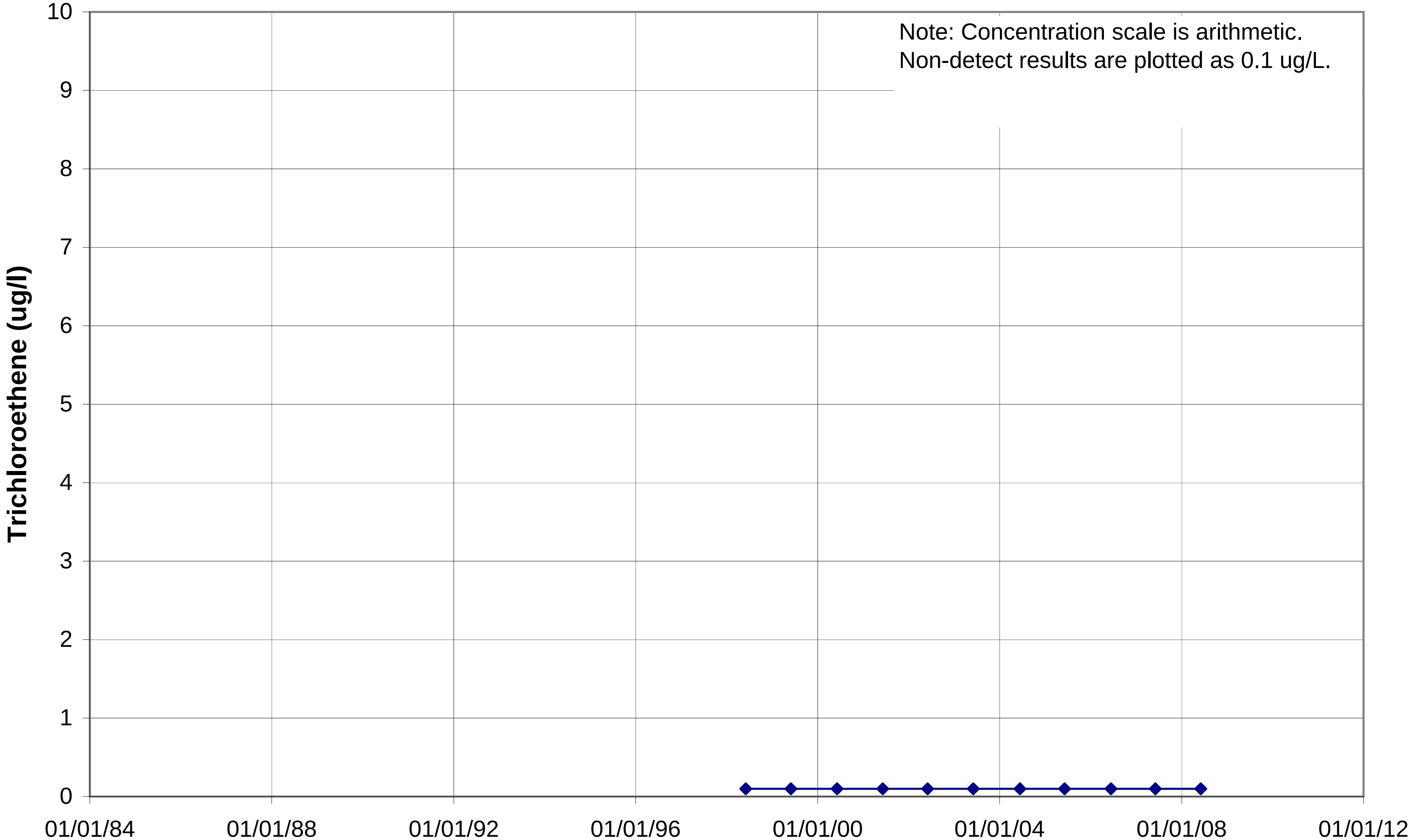

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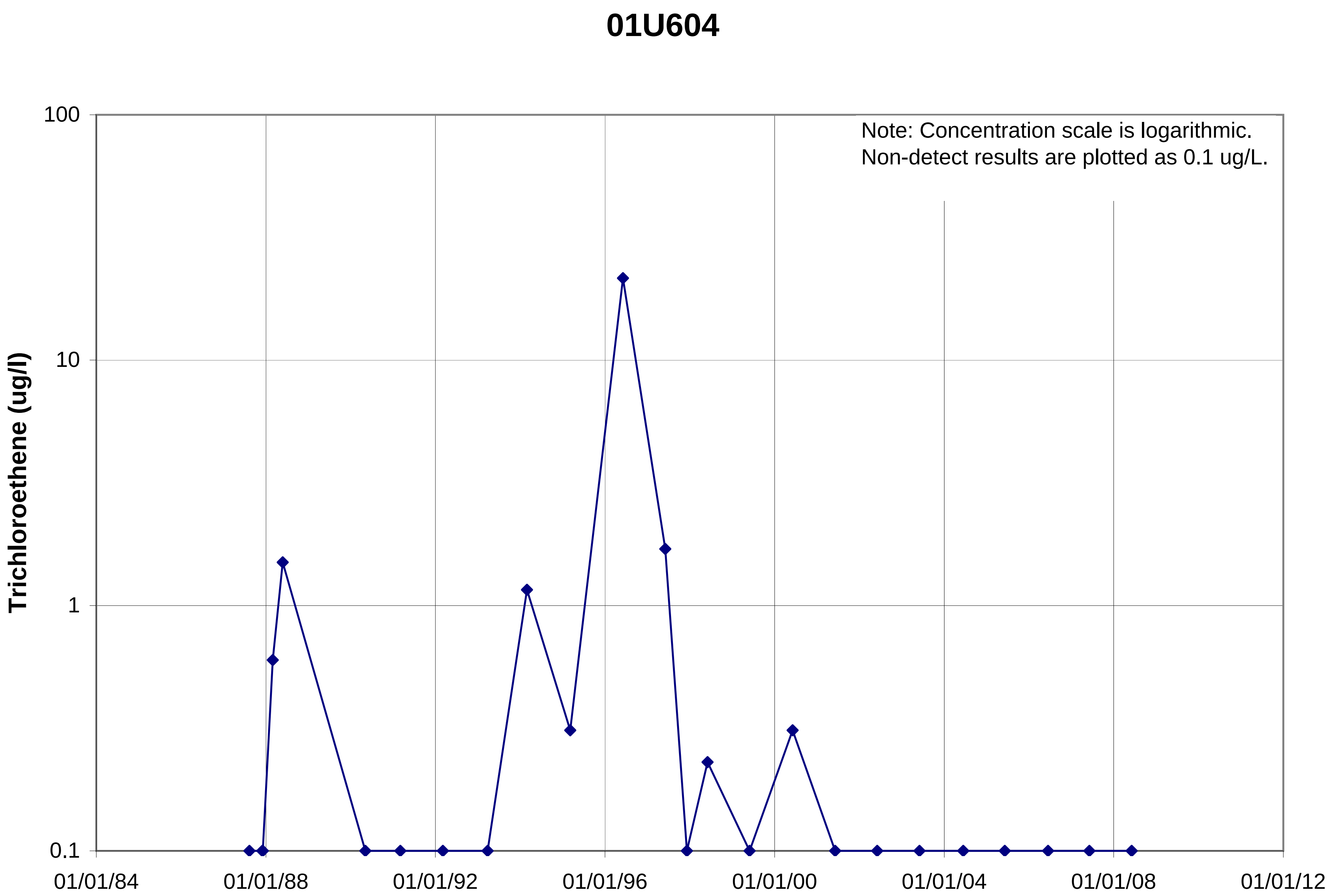

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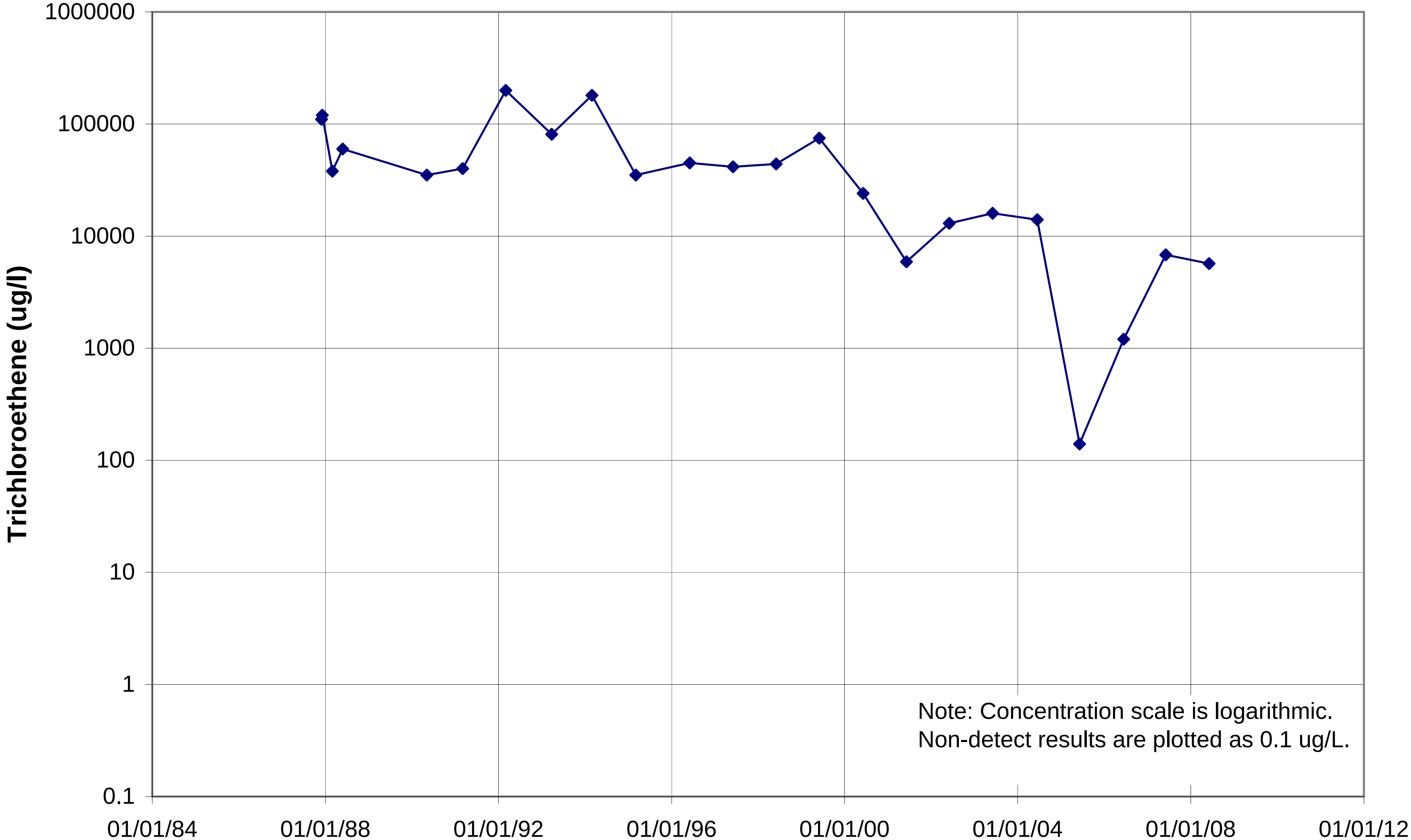

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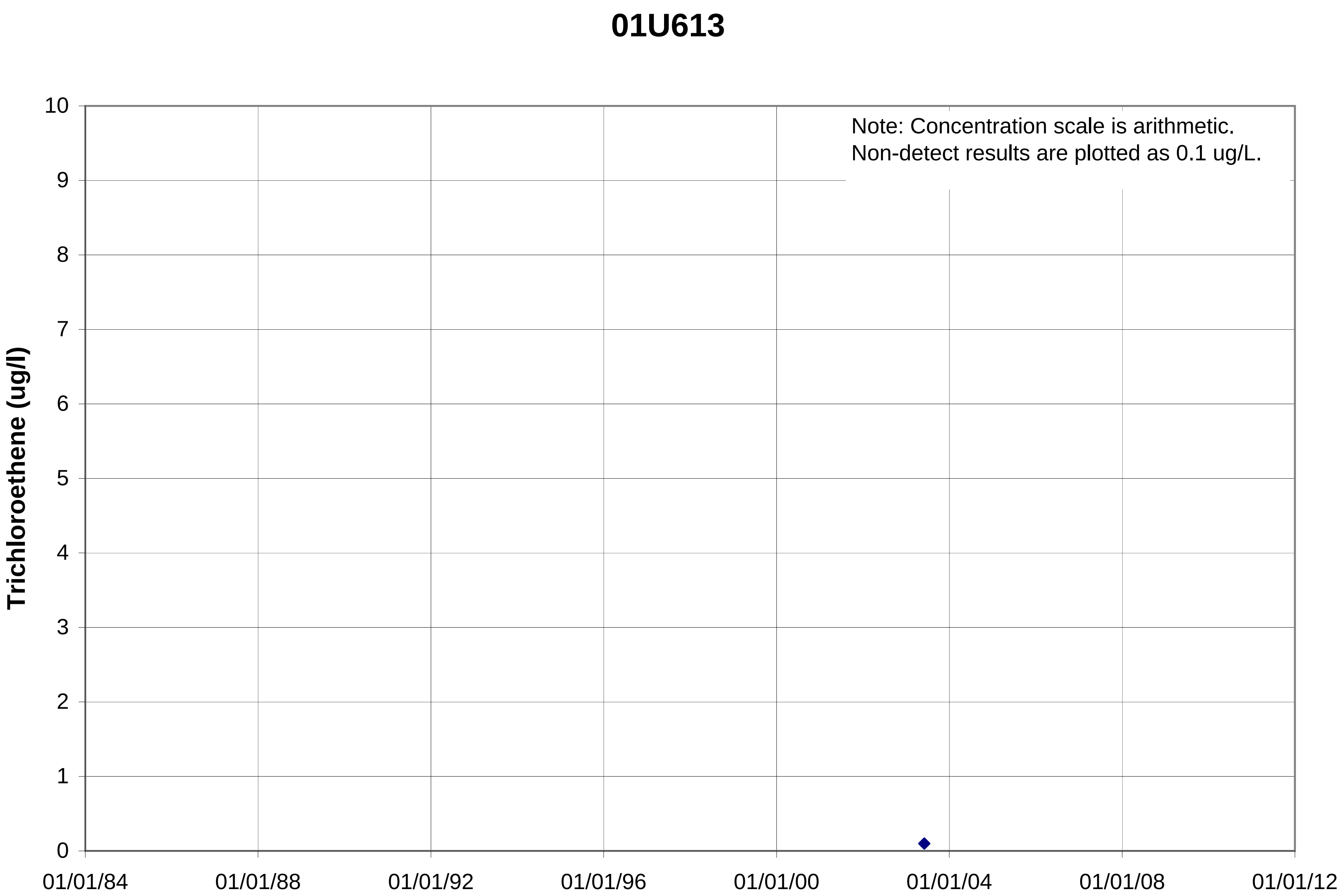

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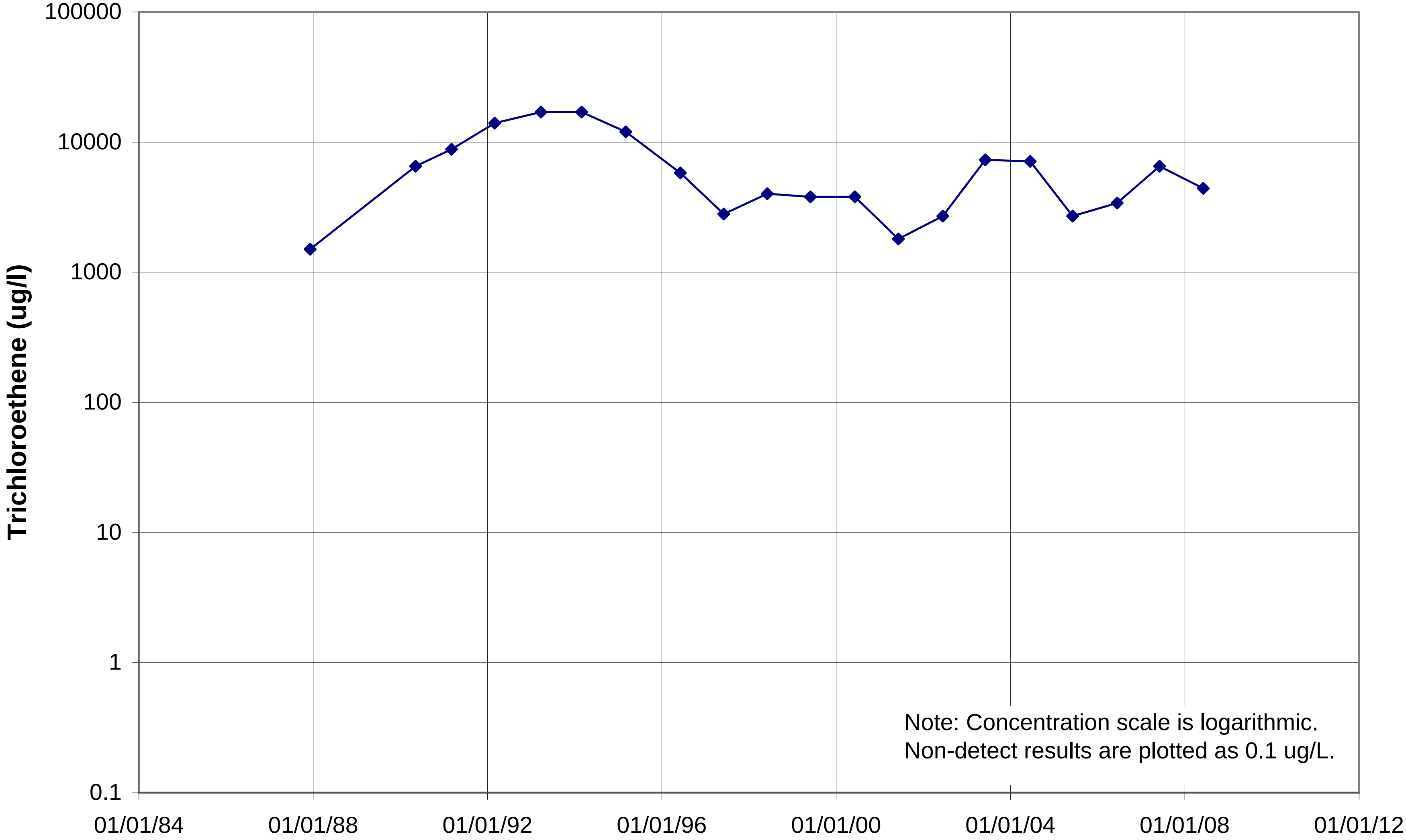

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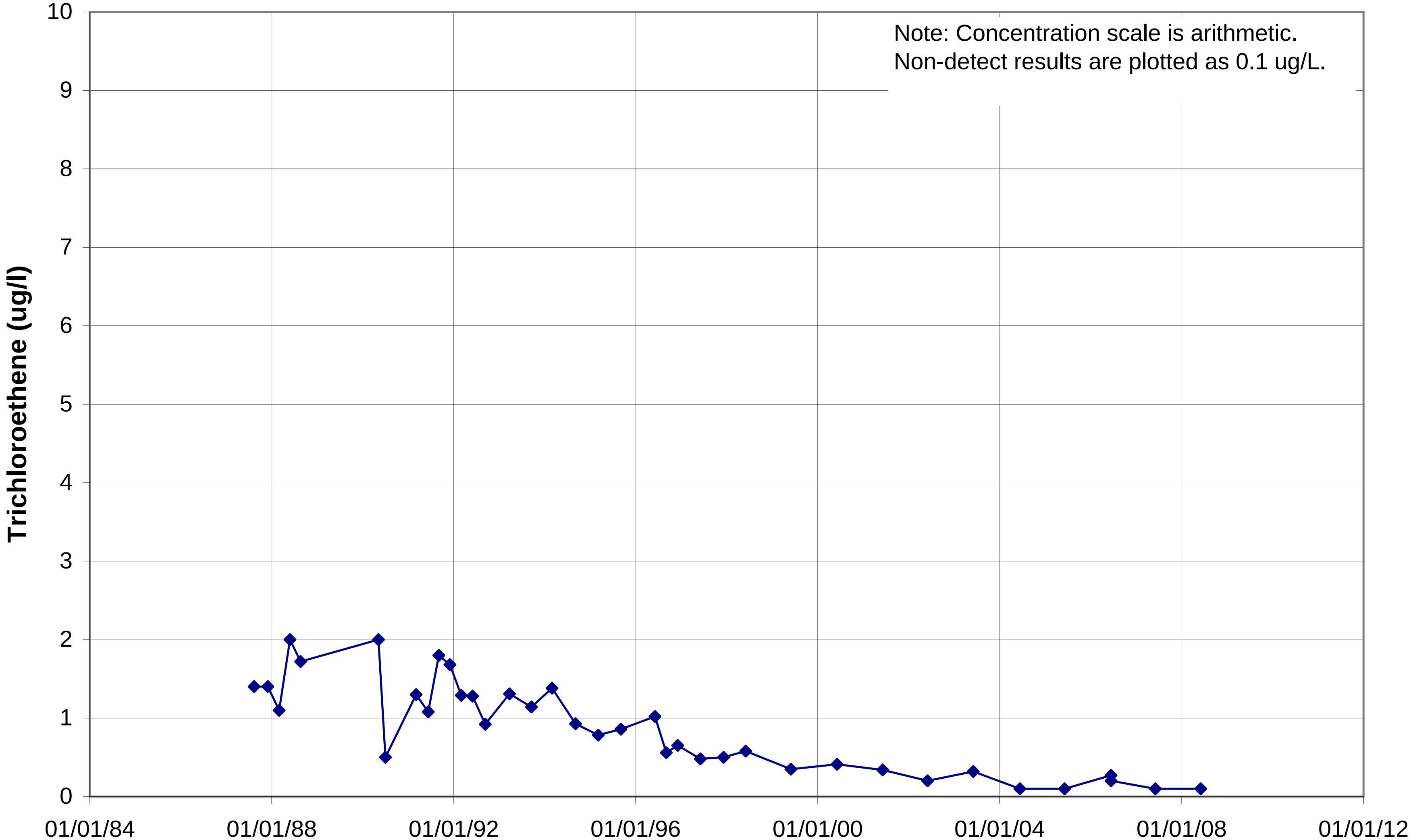

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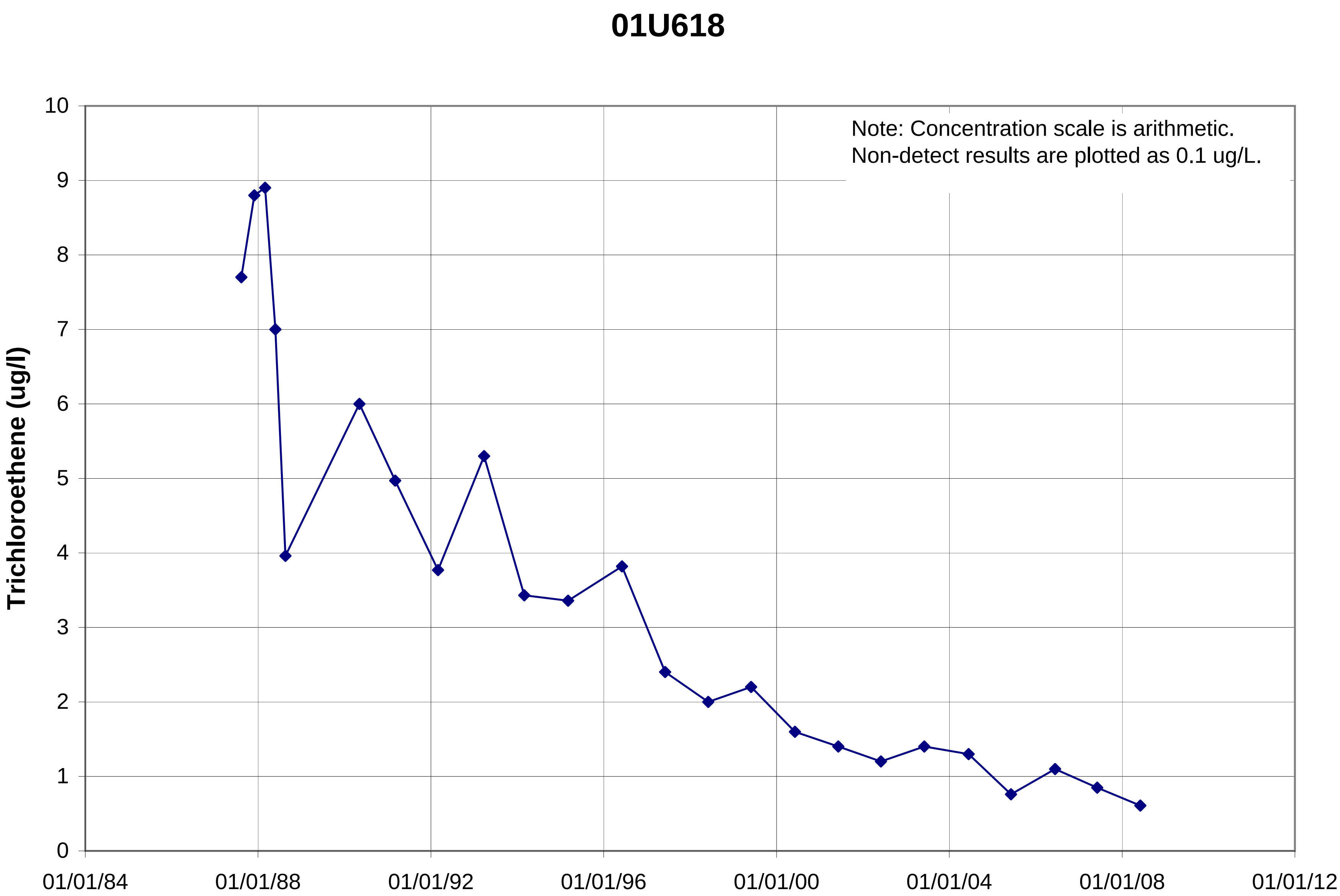

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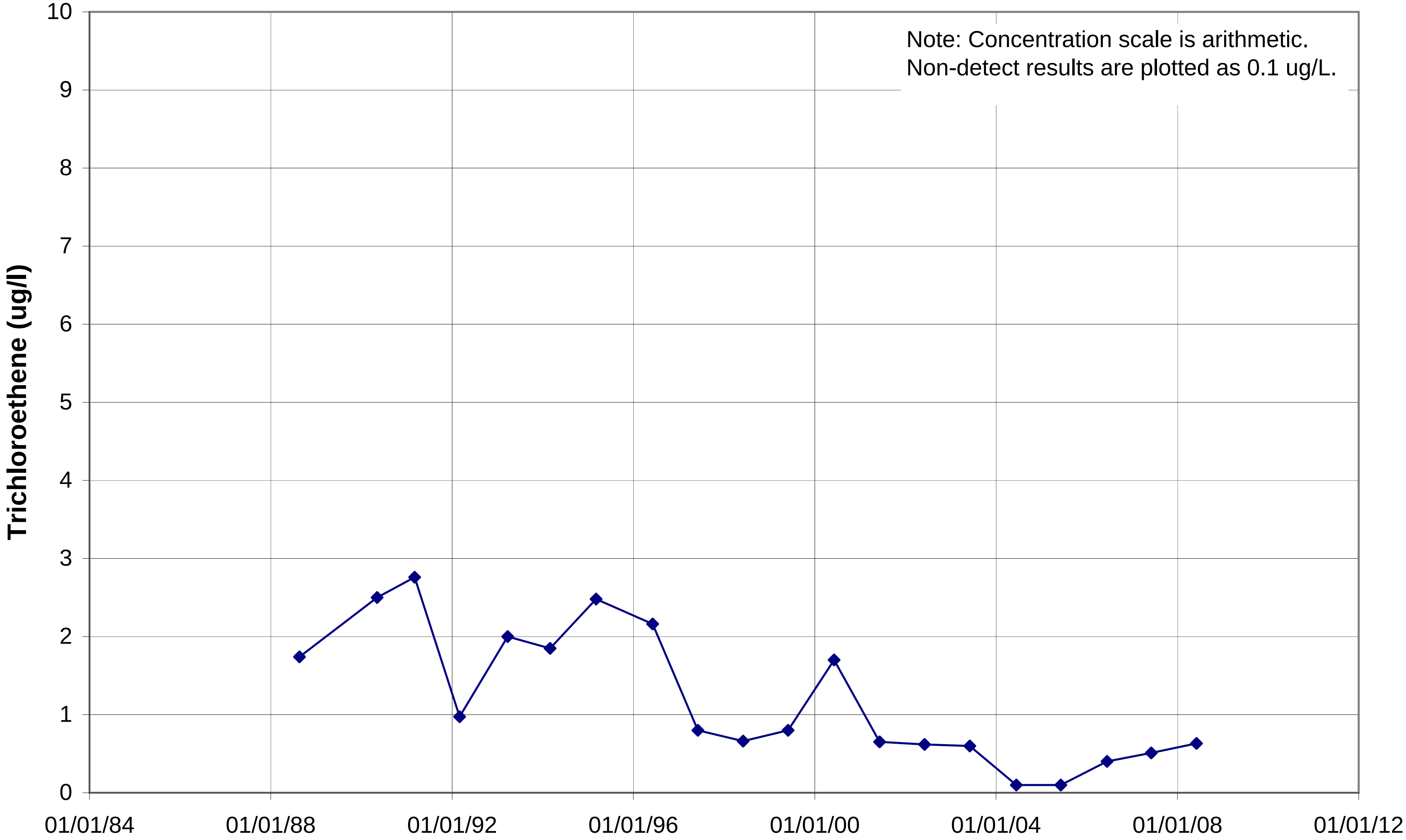

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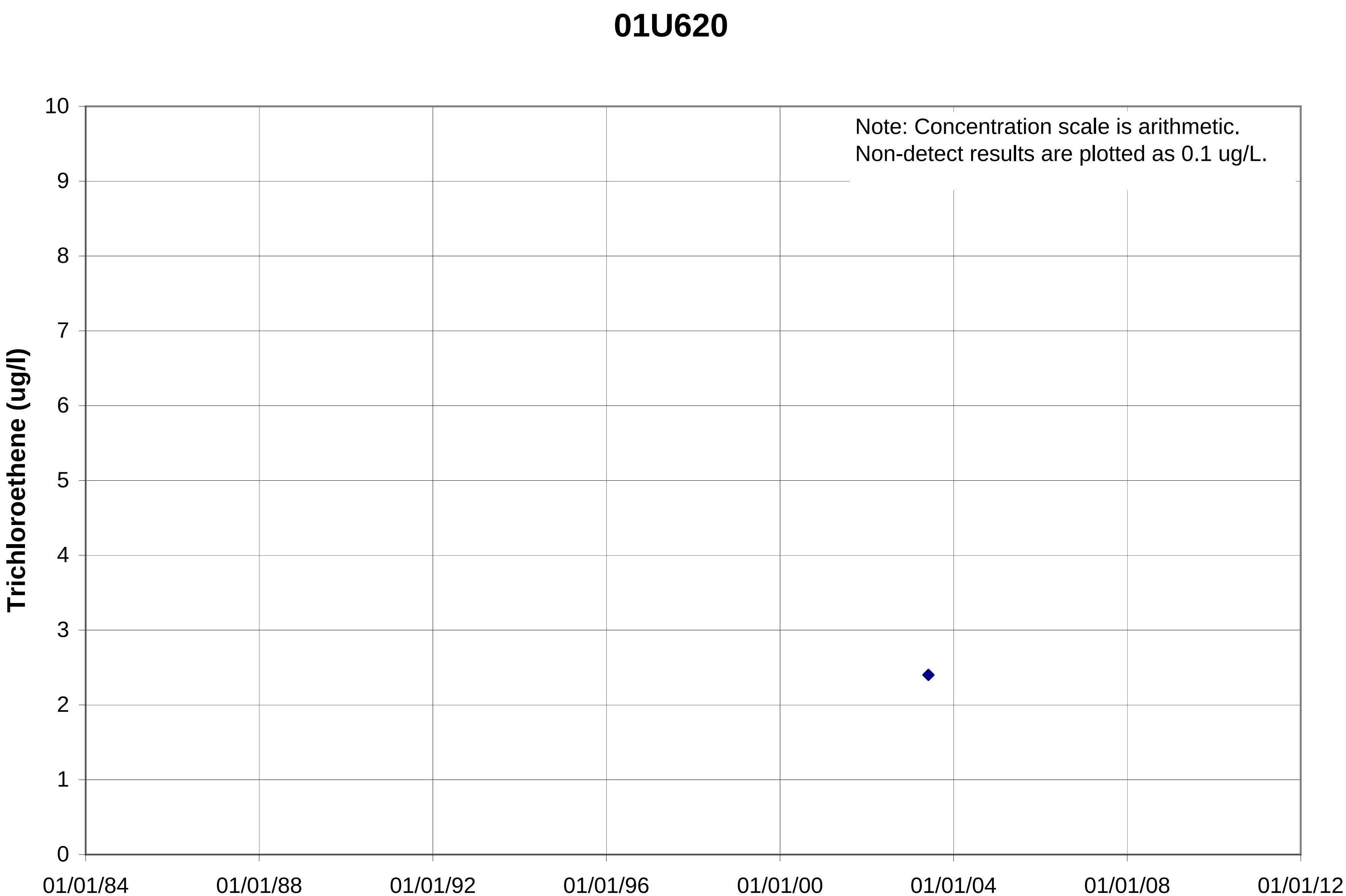

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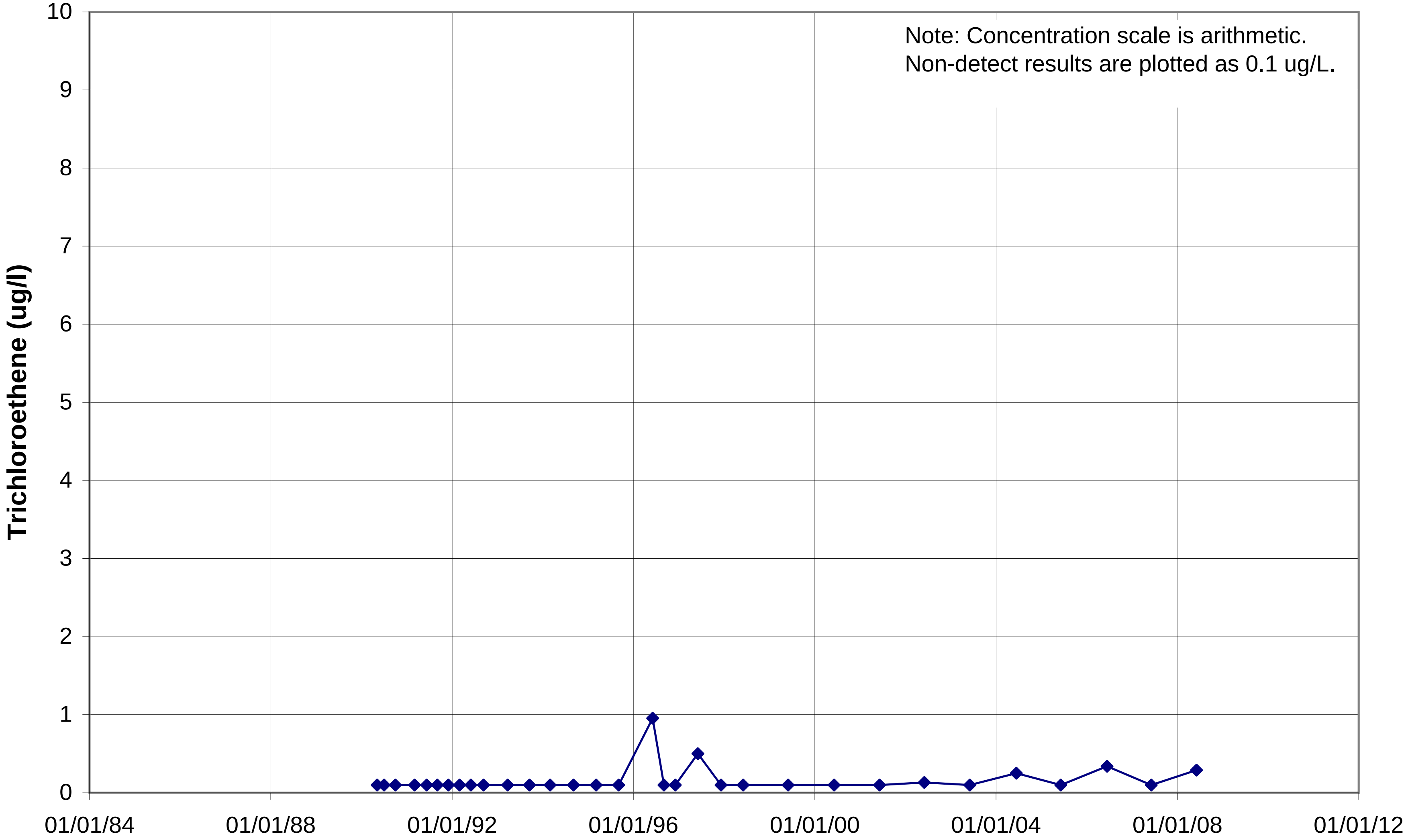

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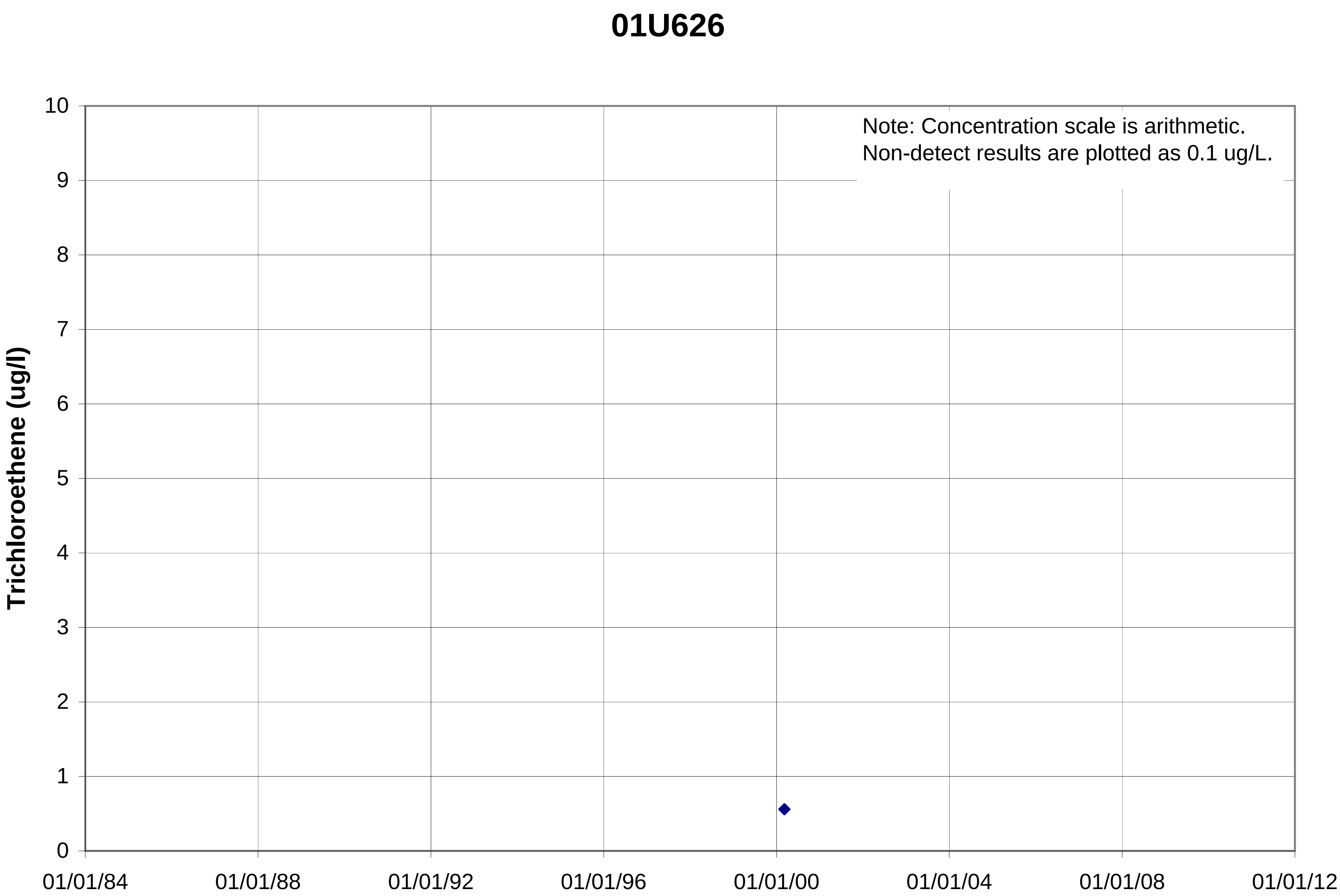

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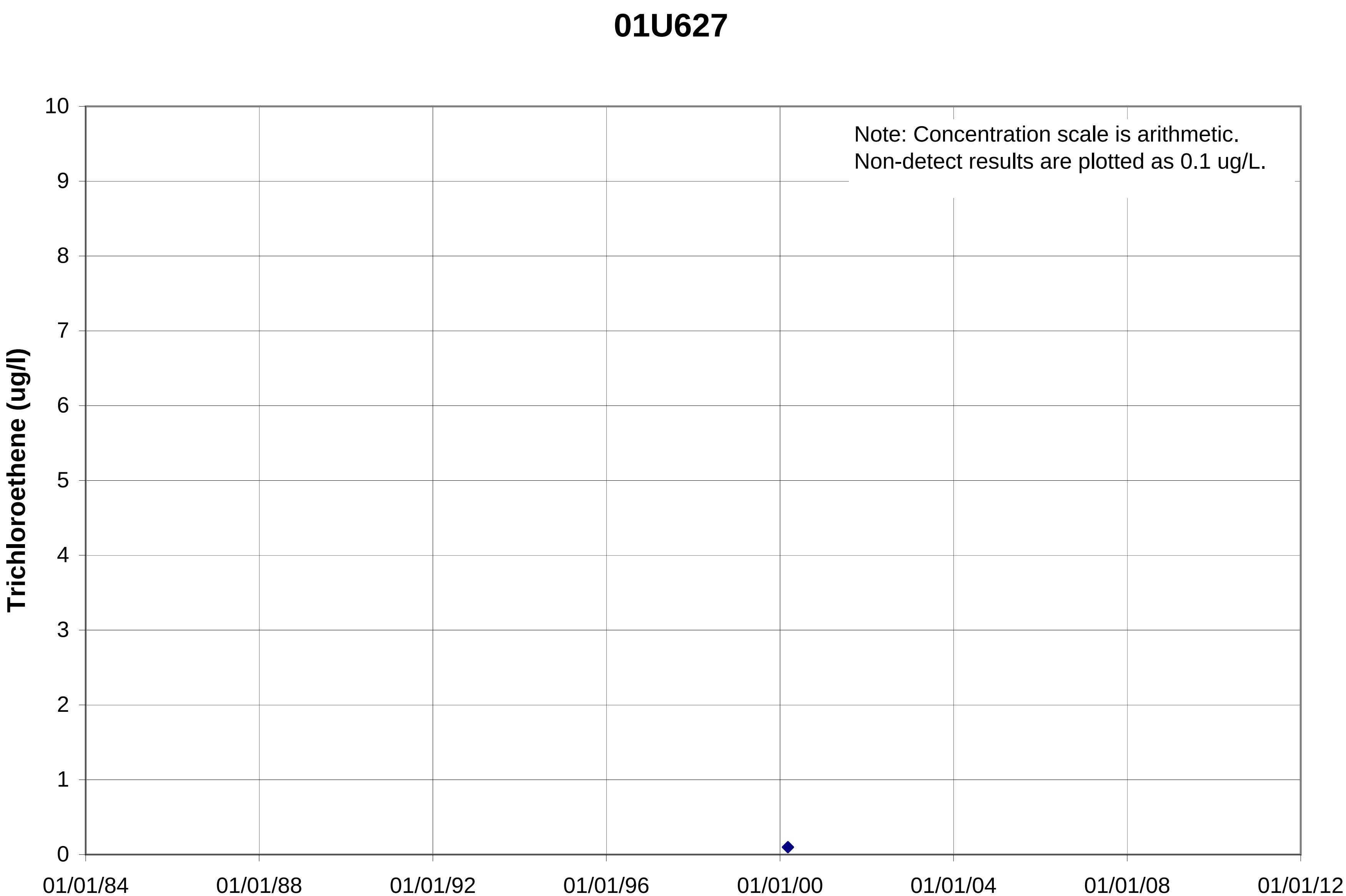

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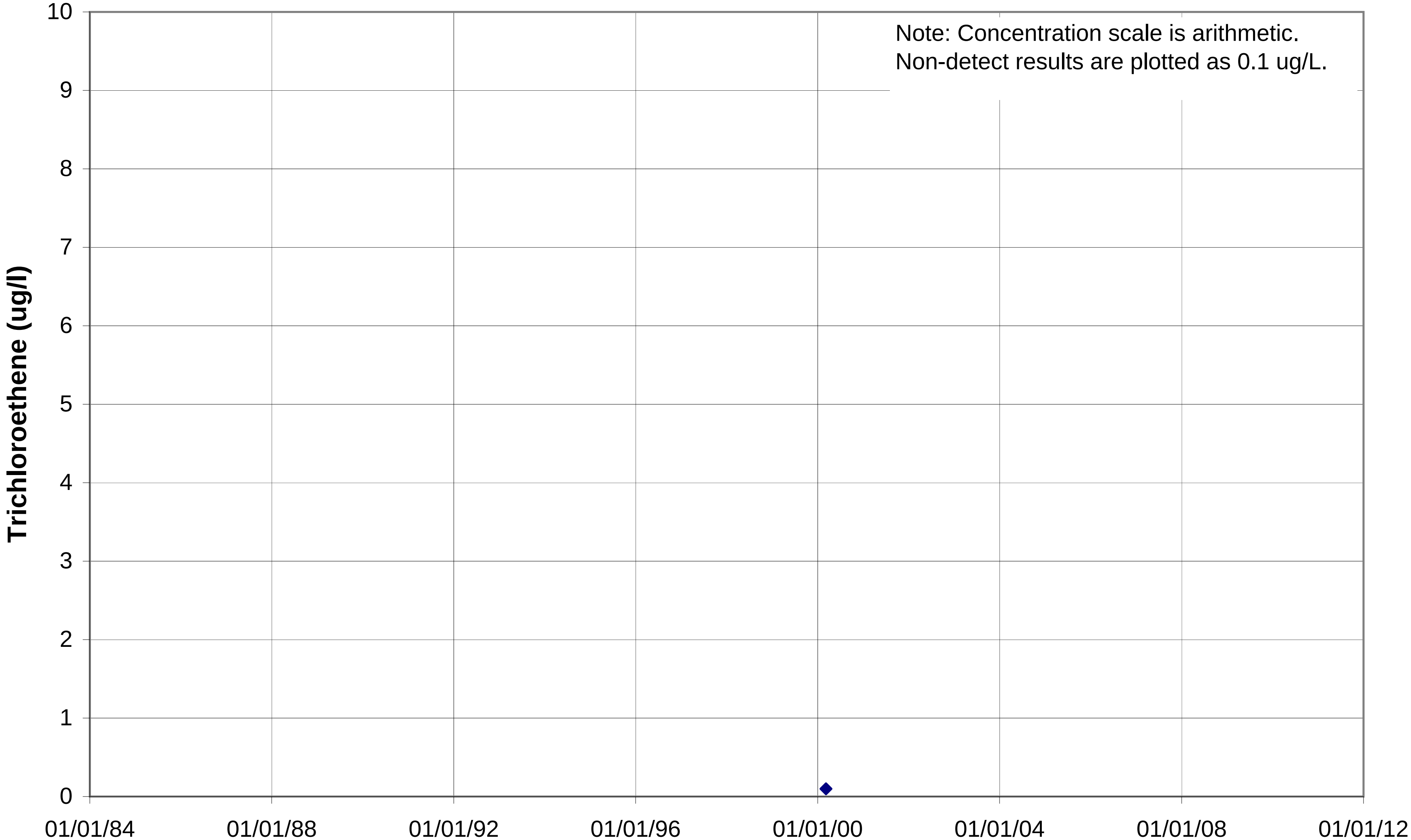

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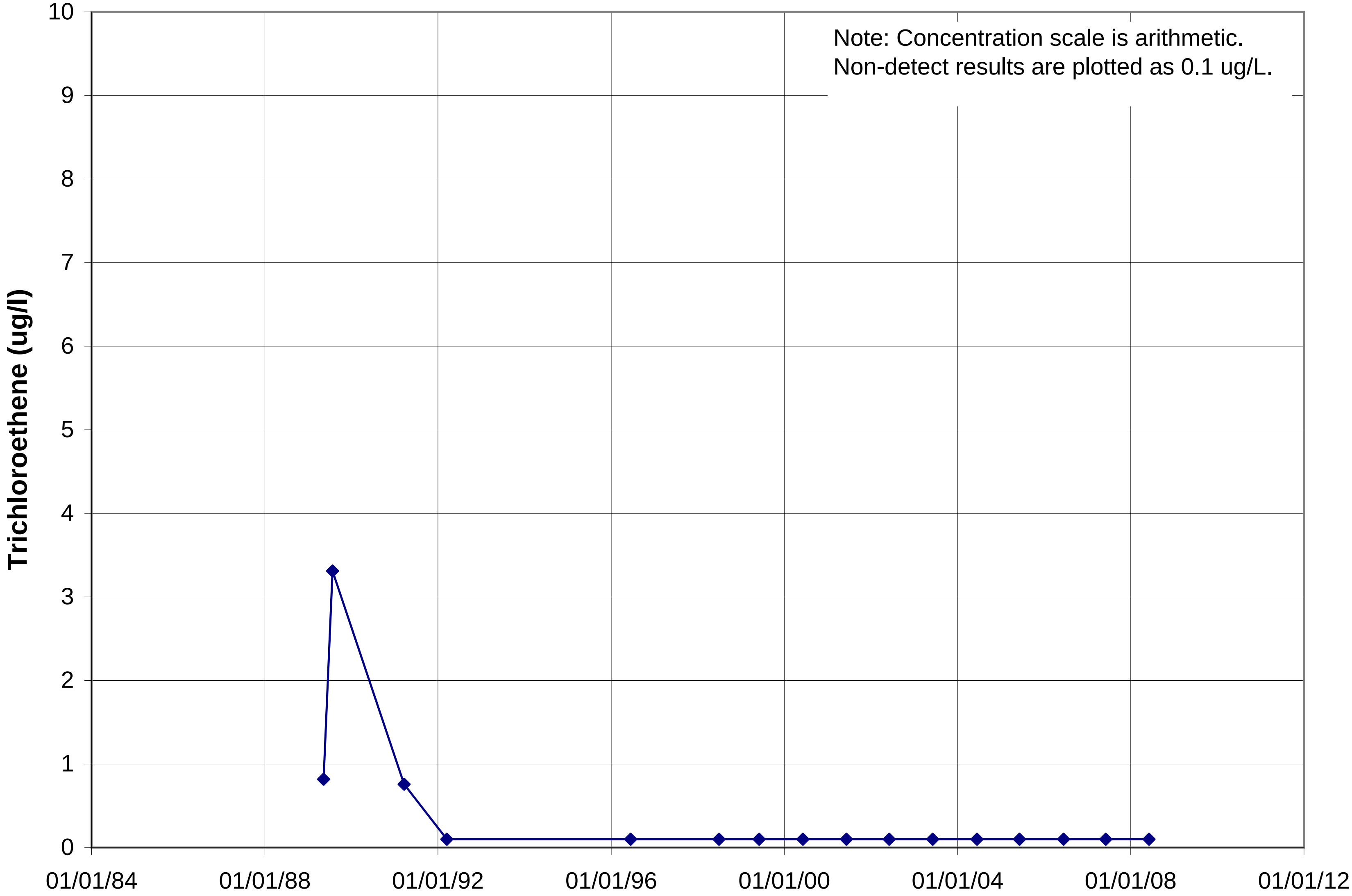

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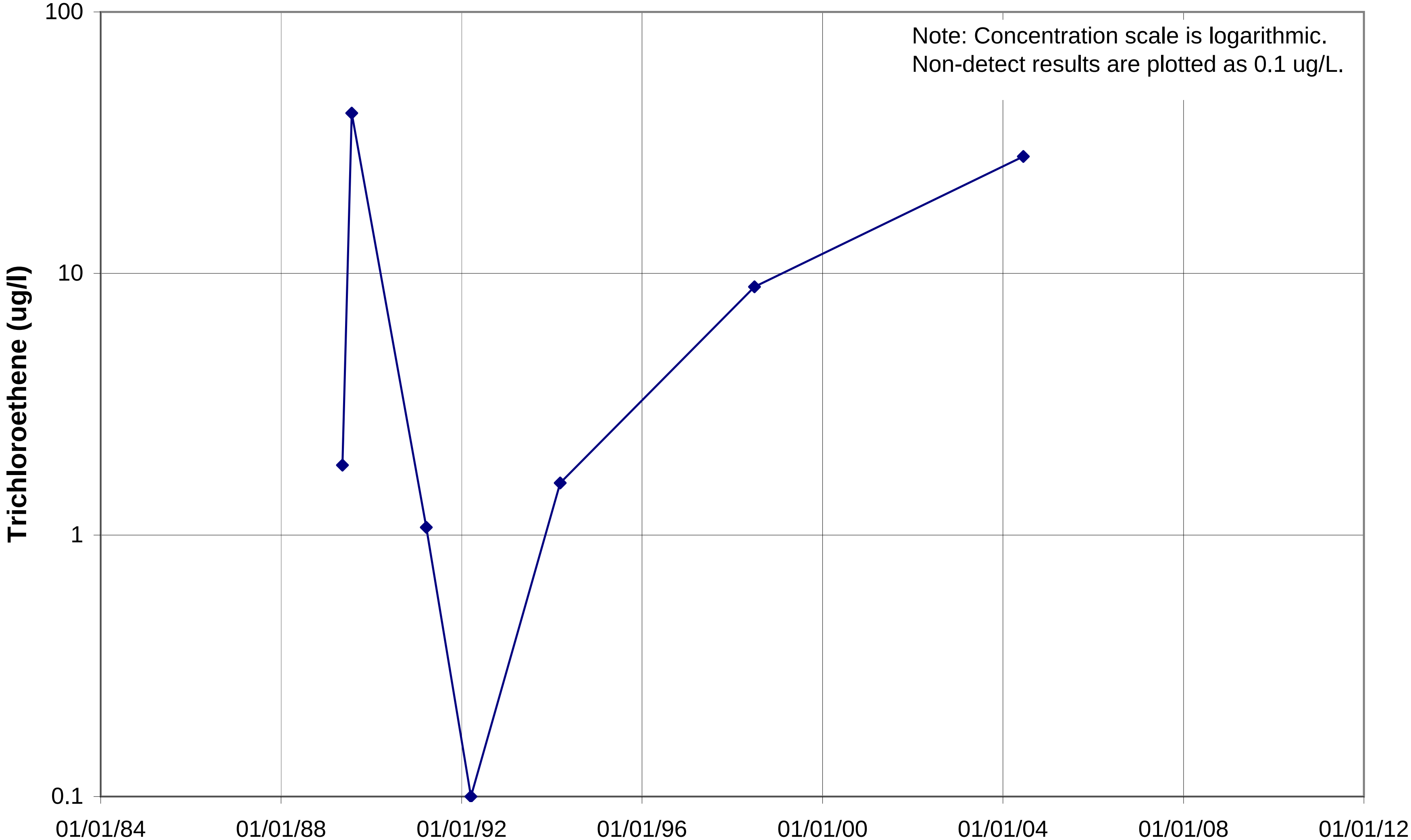

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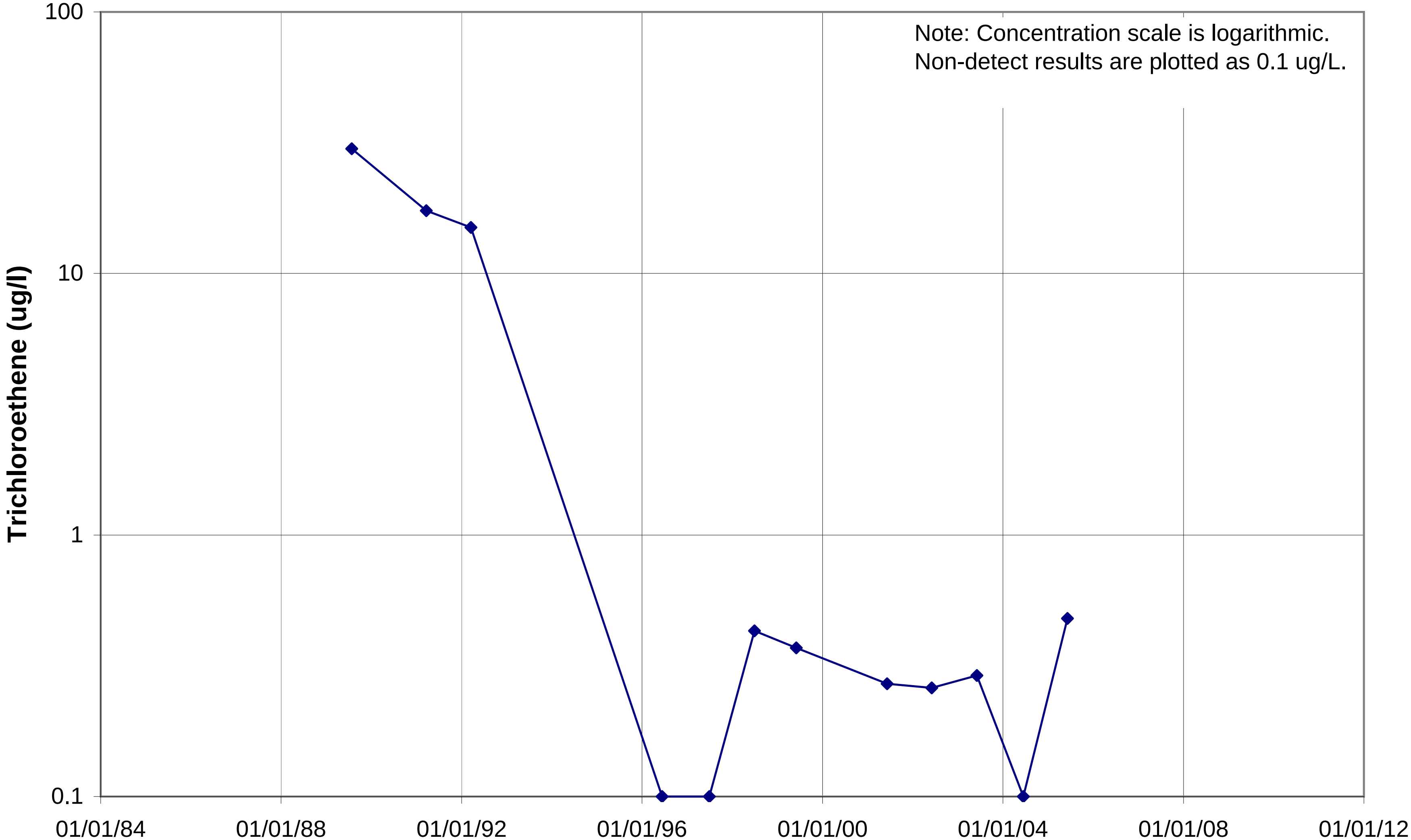

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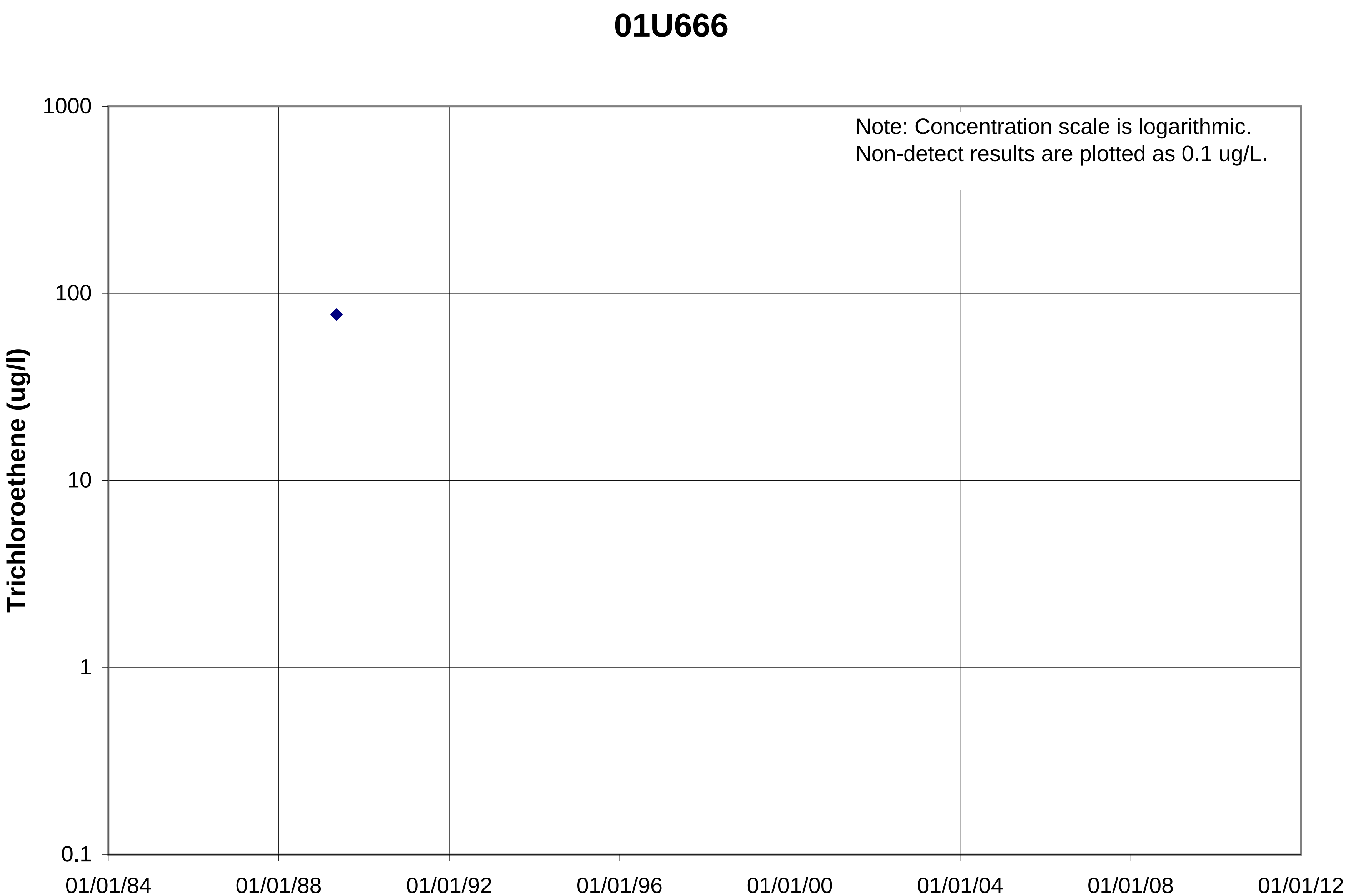

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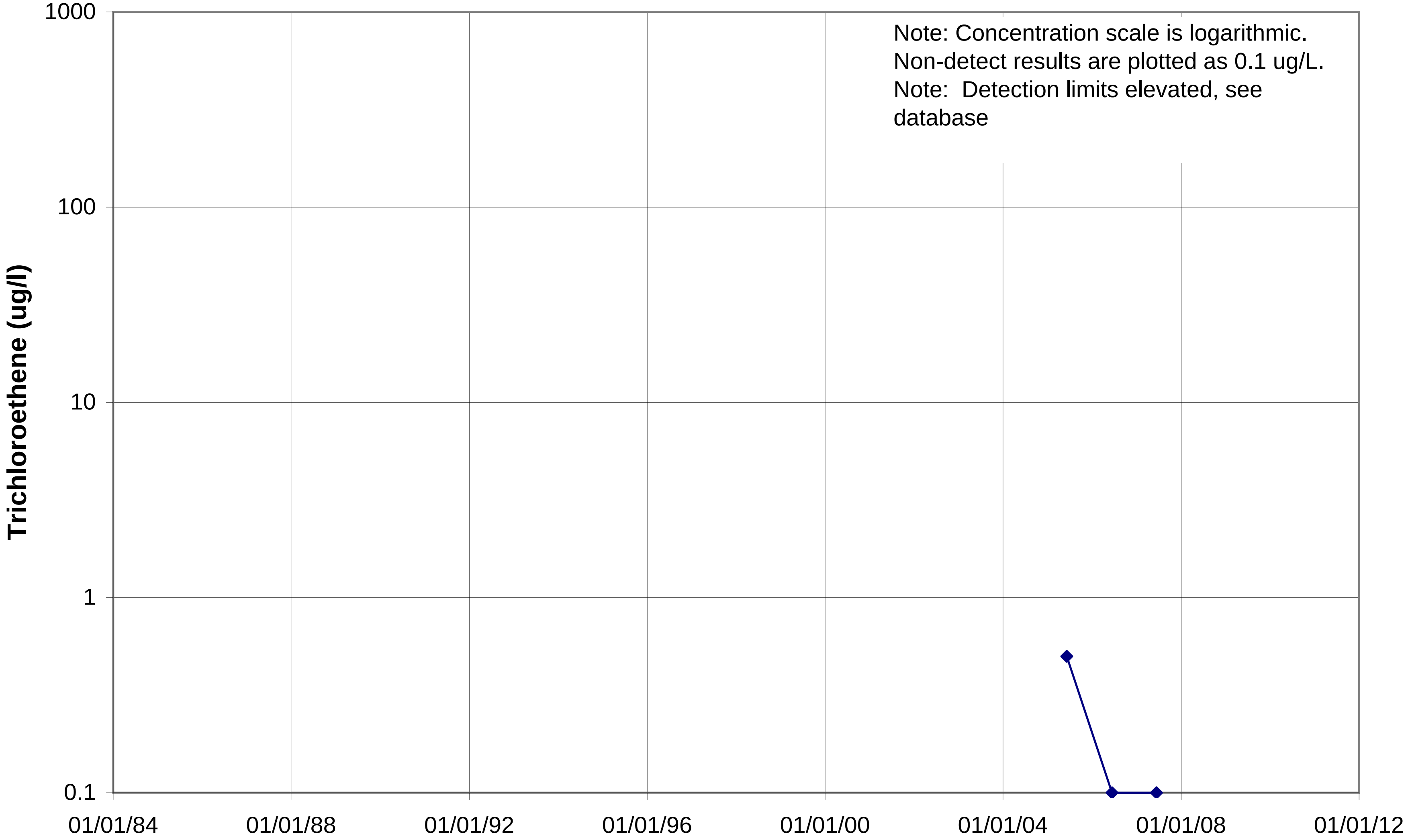

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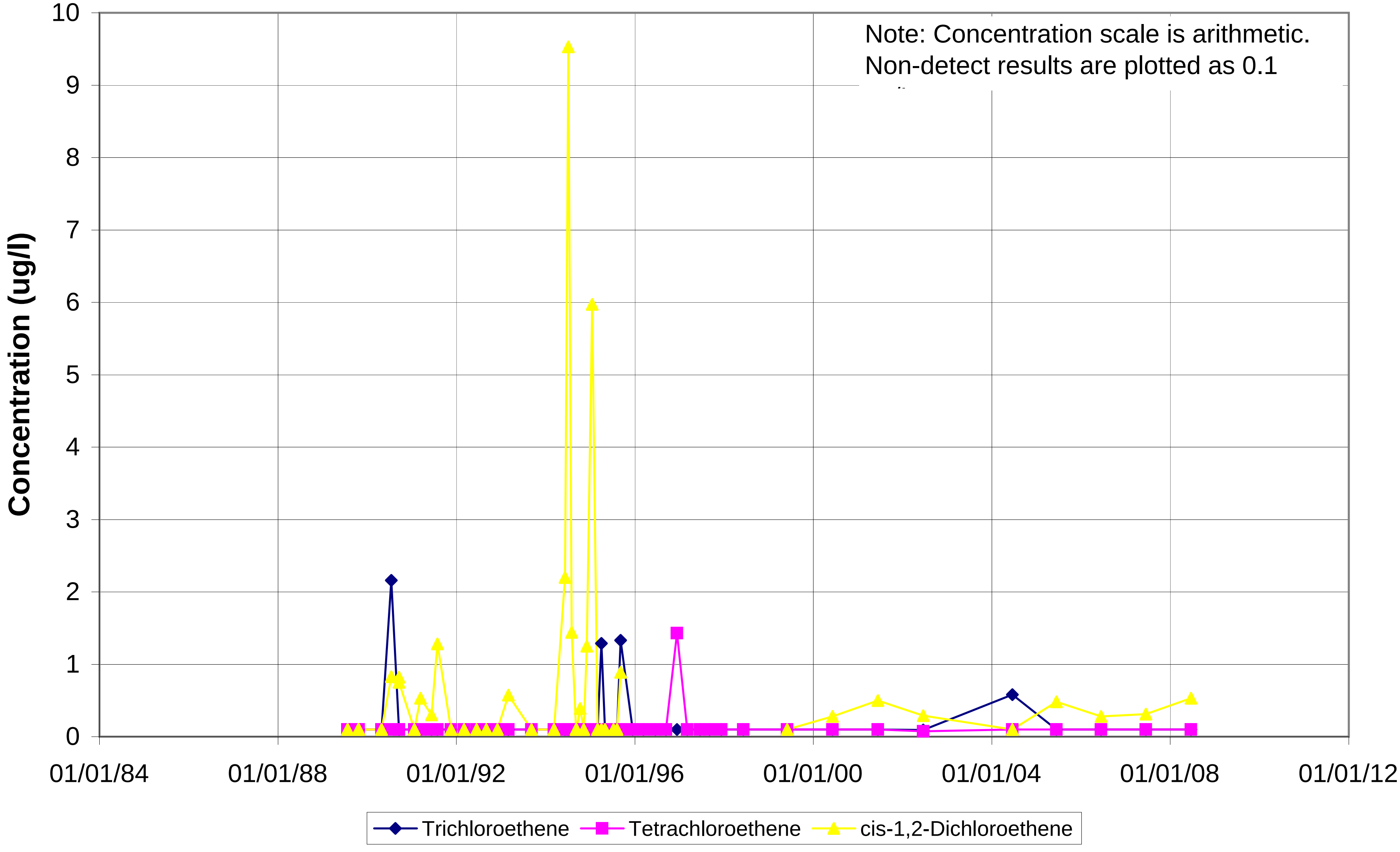

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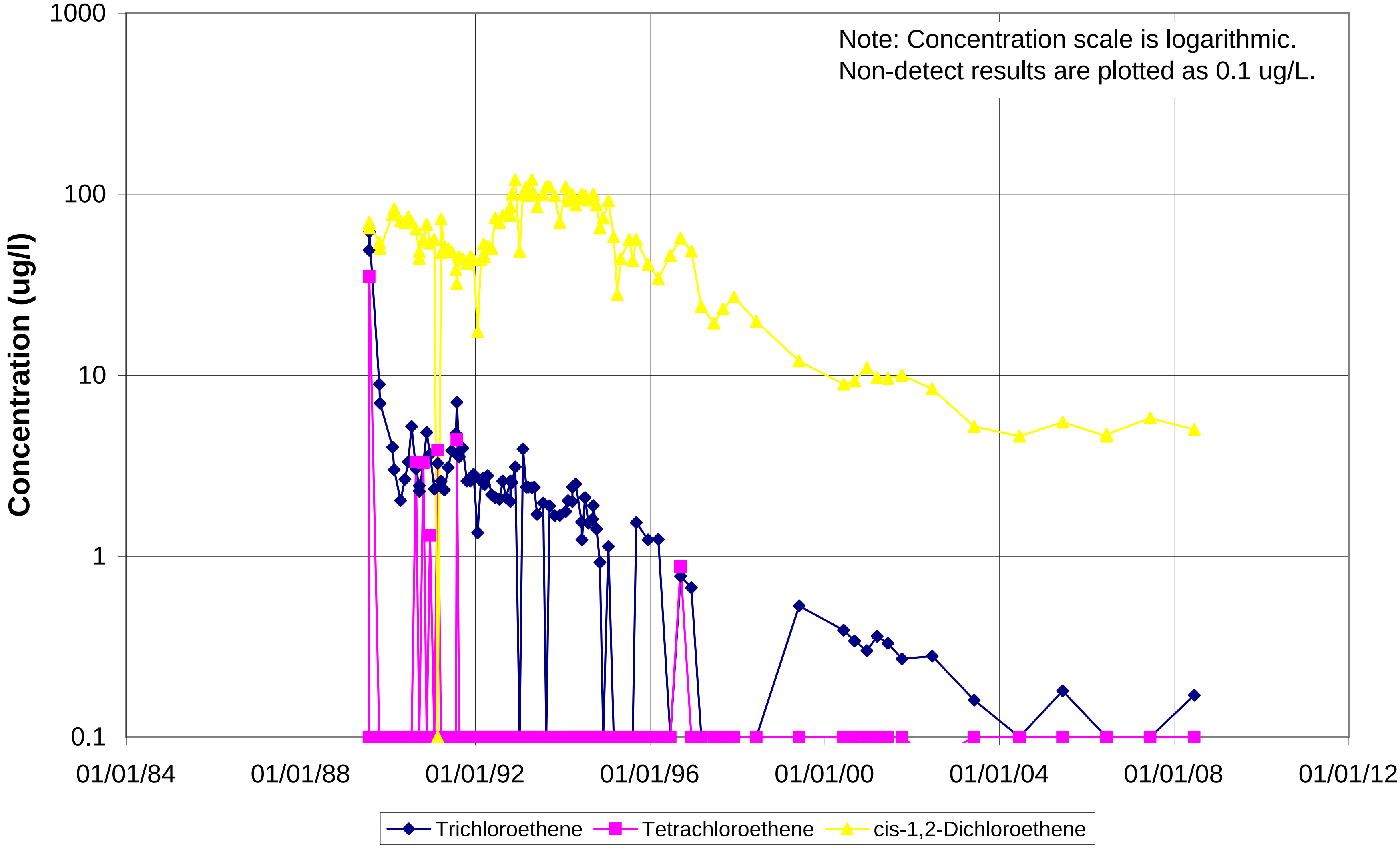

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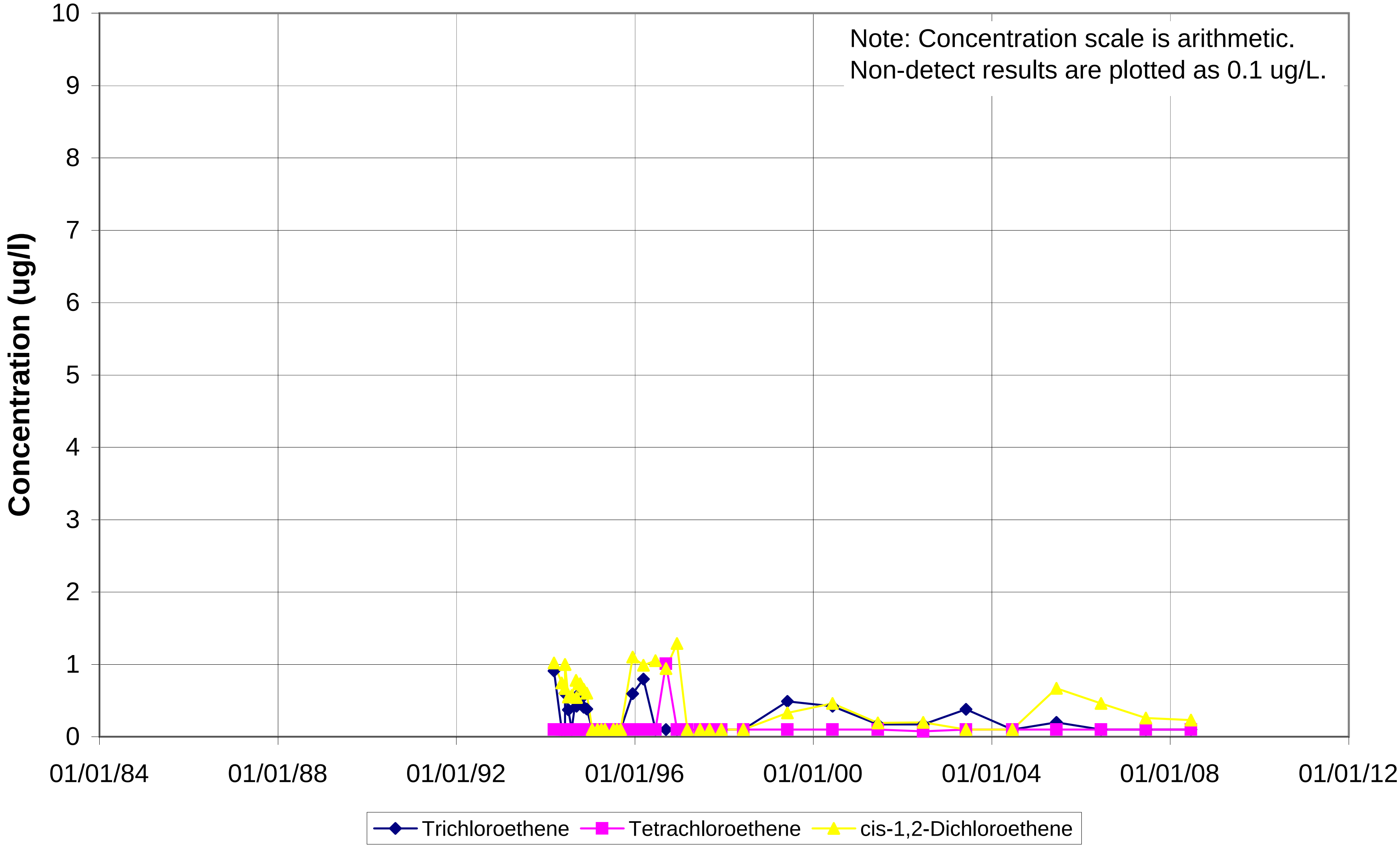
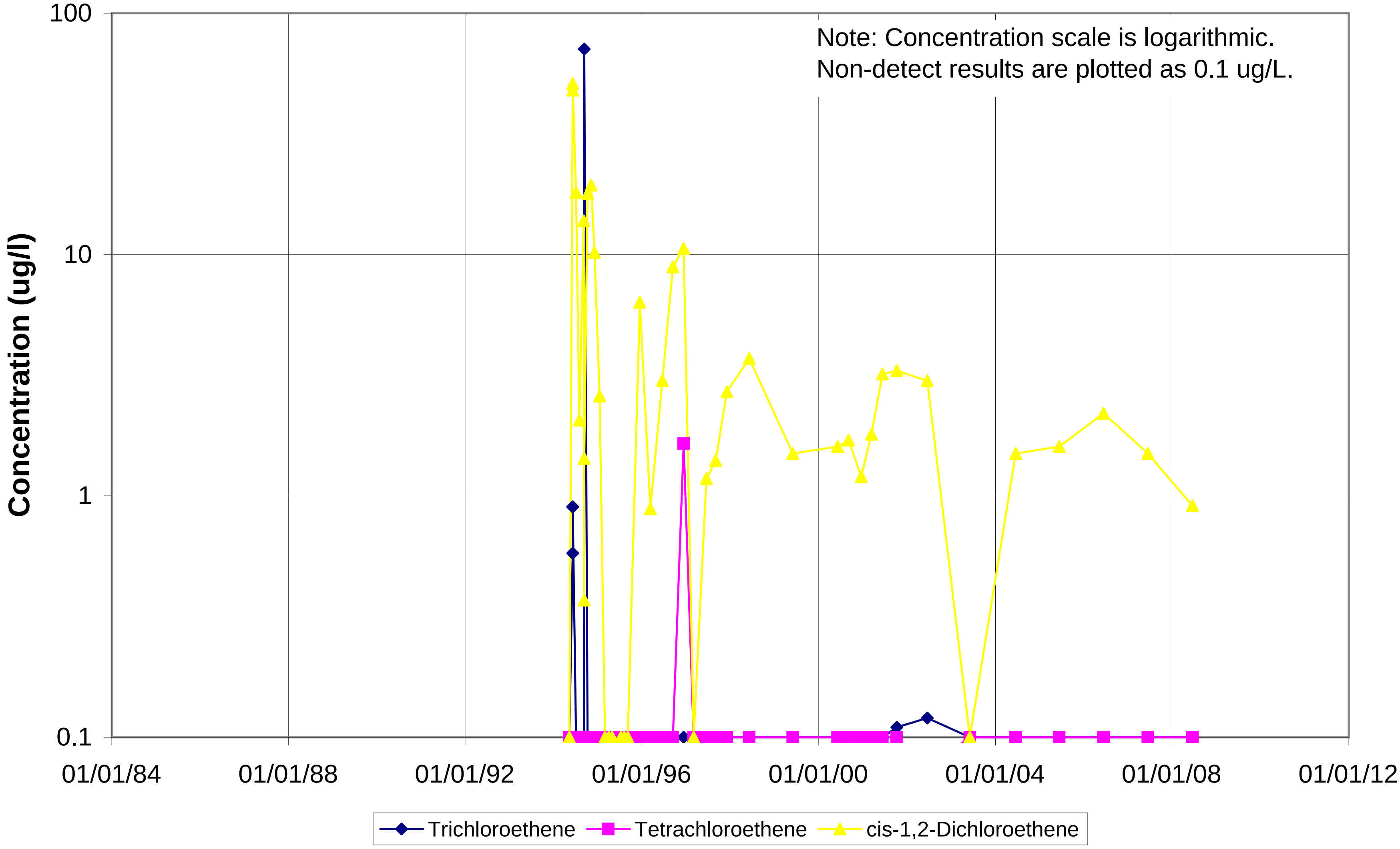


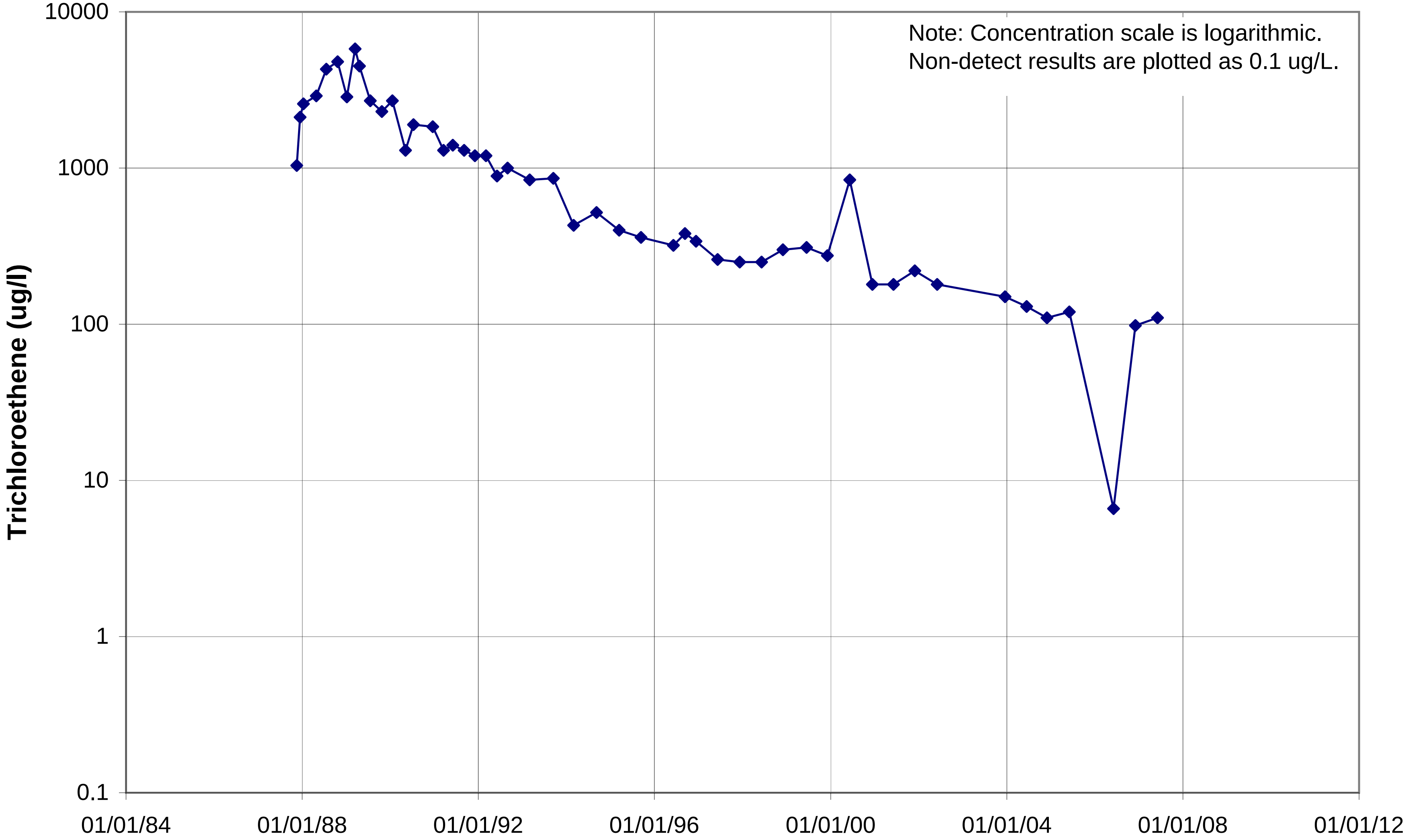
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

01U904

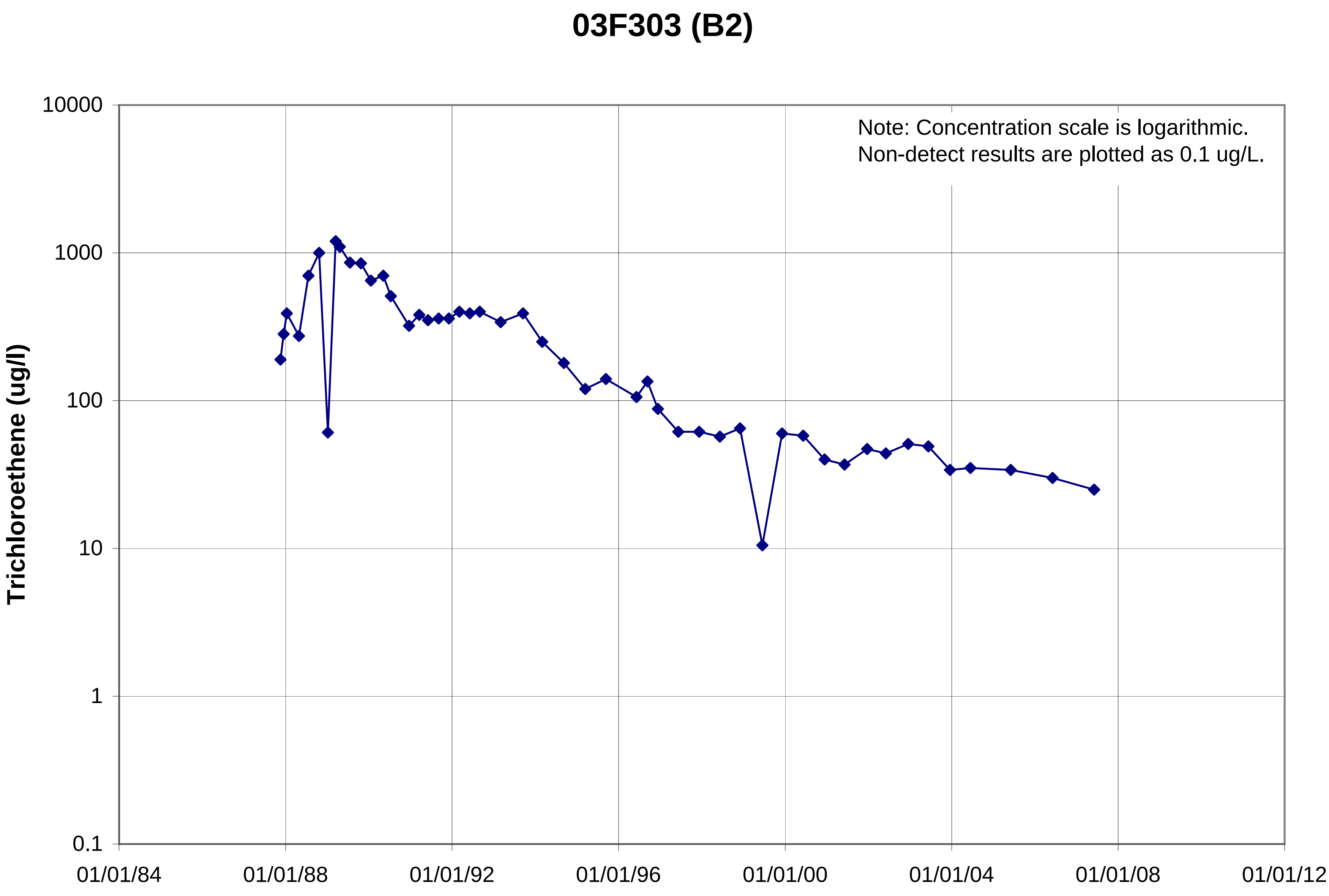


TO RETURN TO MAP: Click on "Go to Previous View" Button in the Tool Bar

03F302 (B1)



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar



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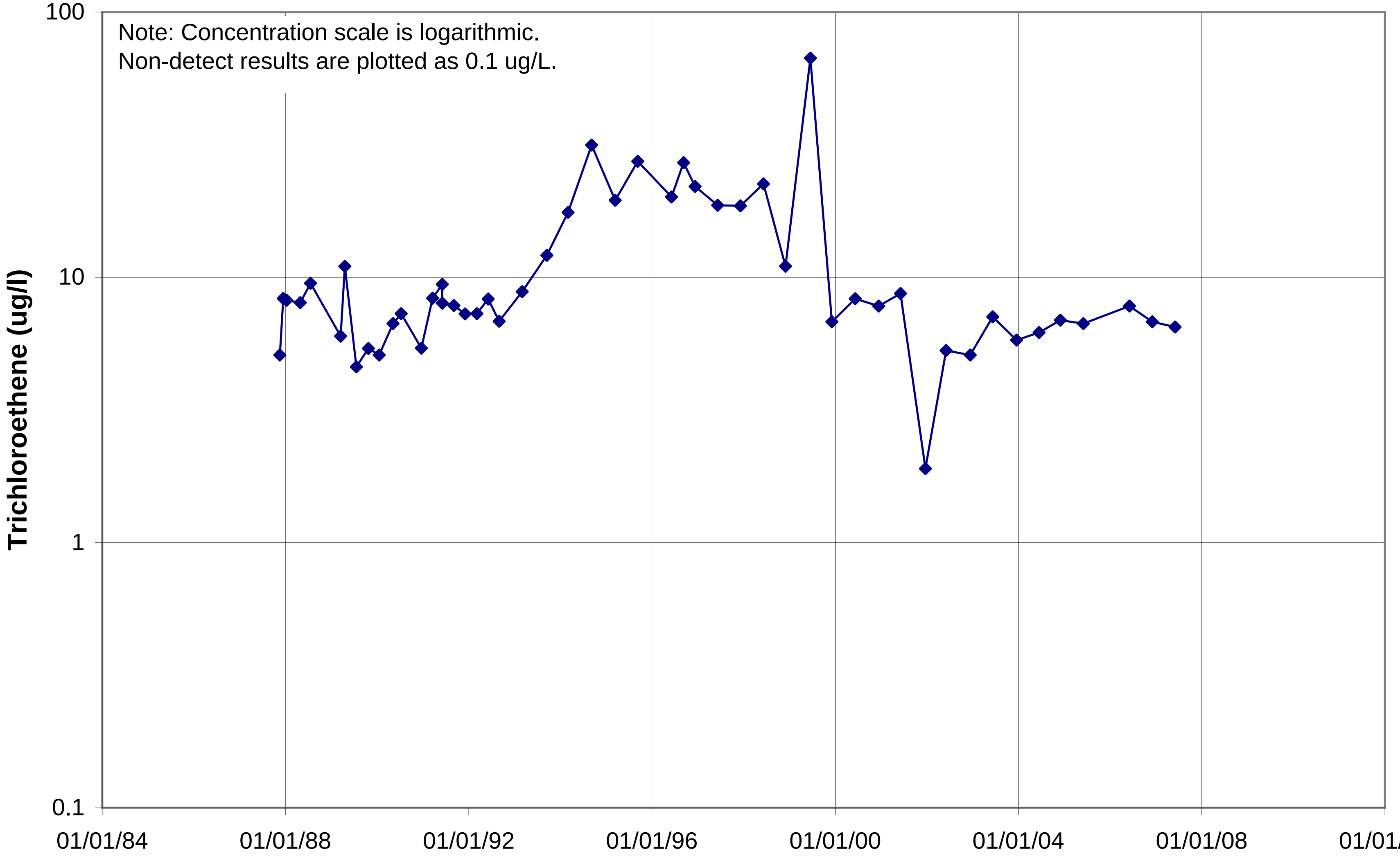

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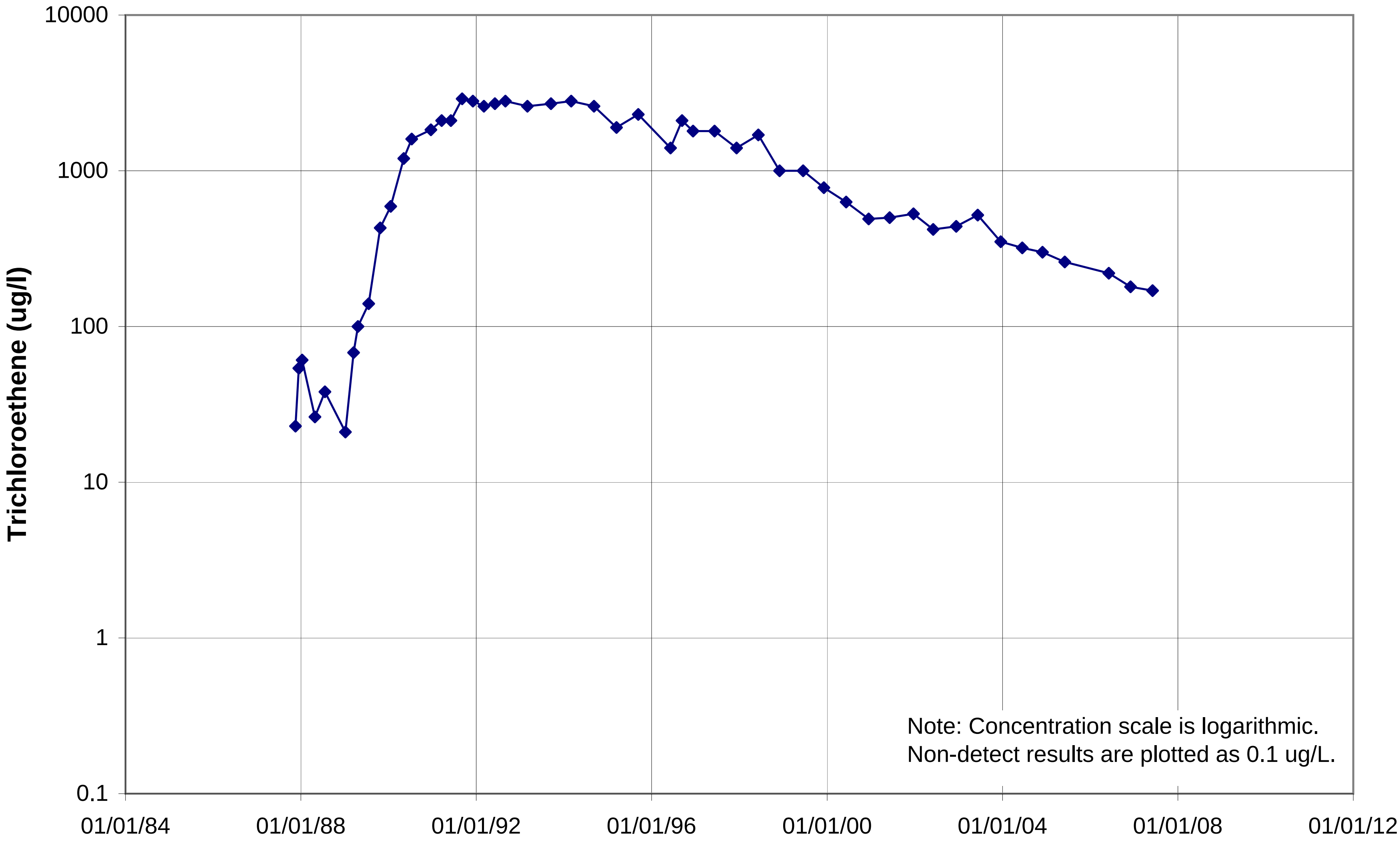

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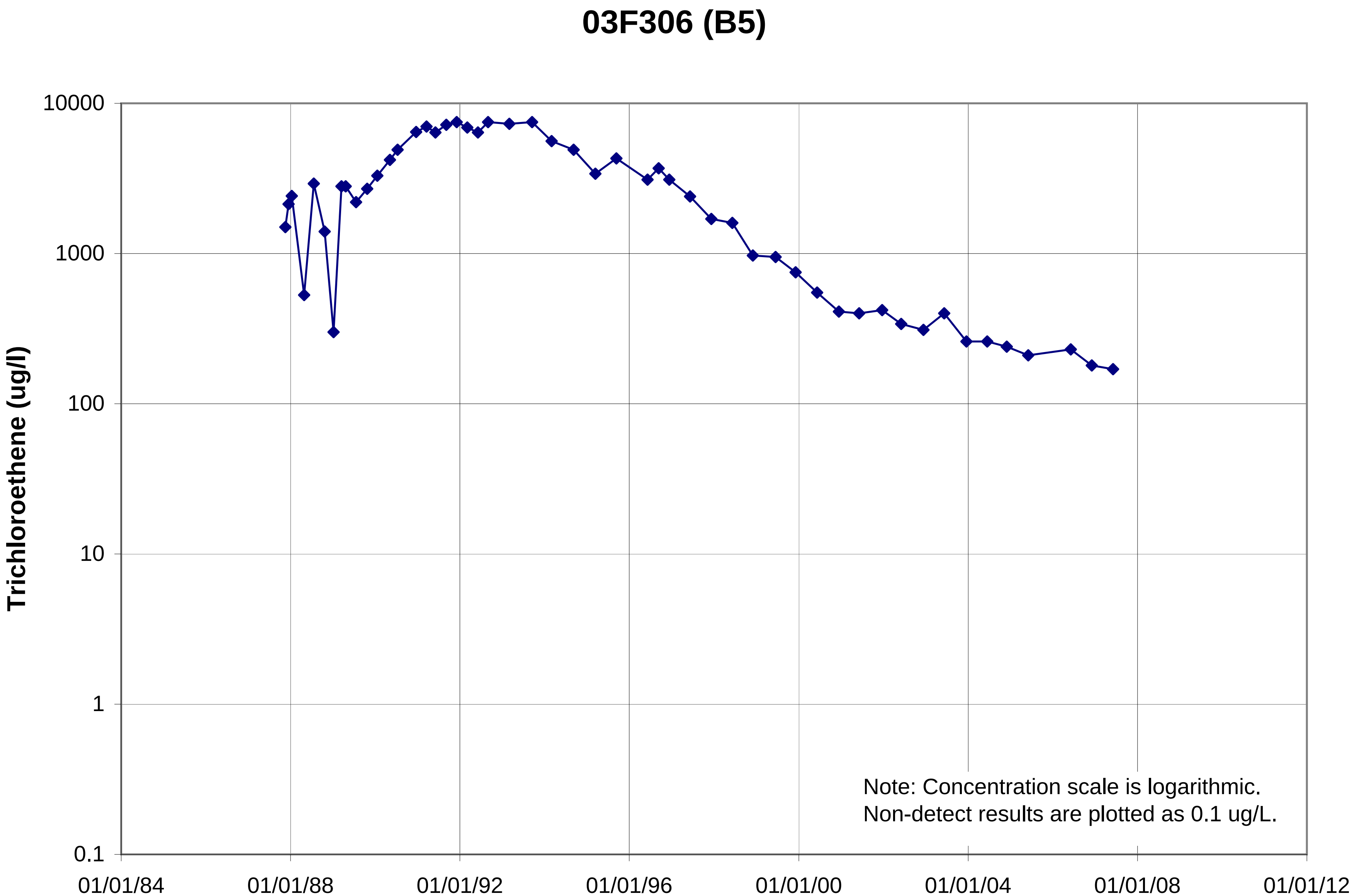

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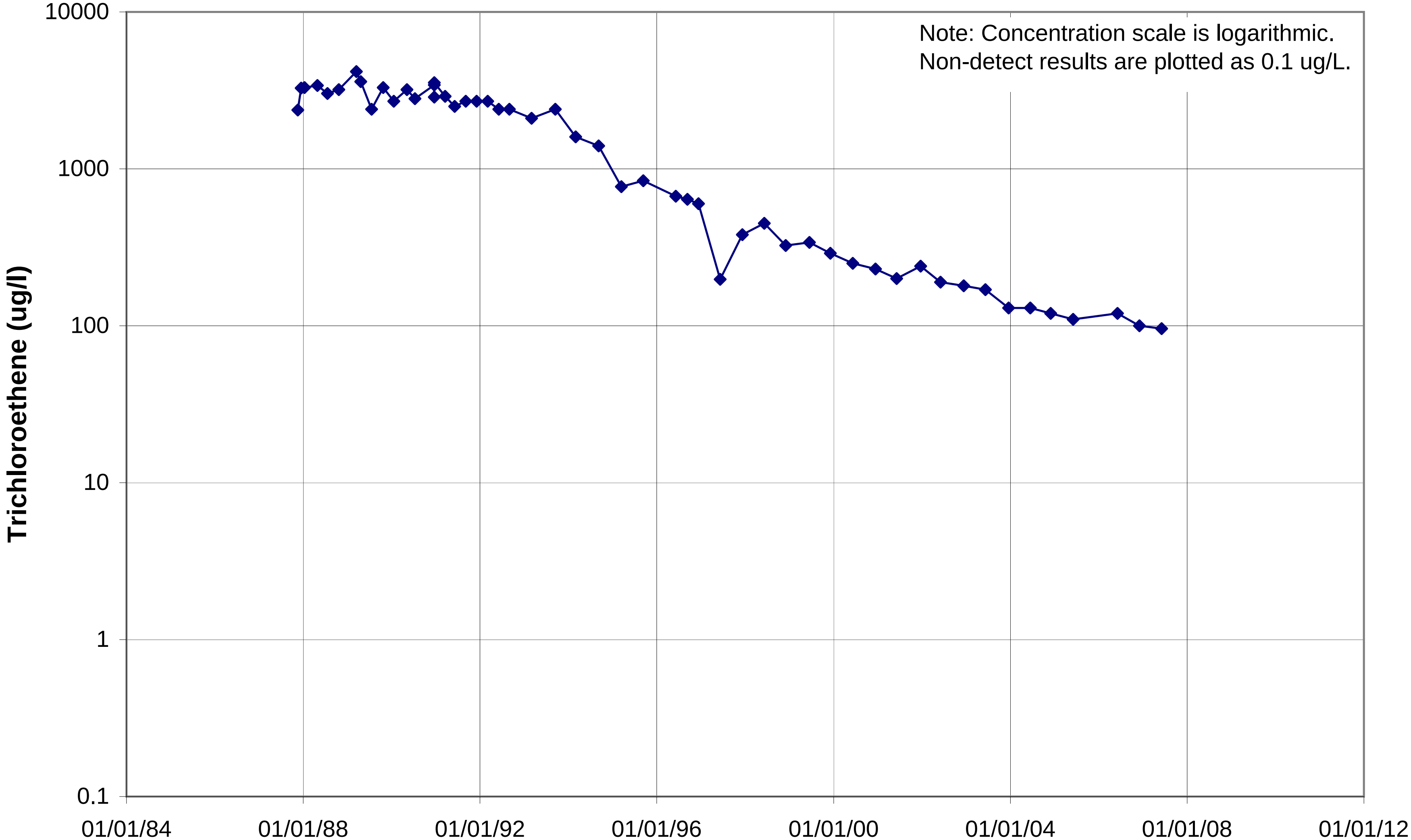

TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

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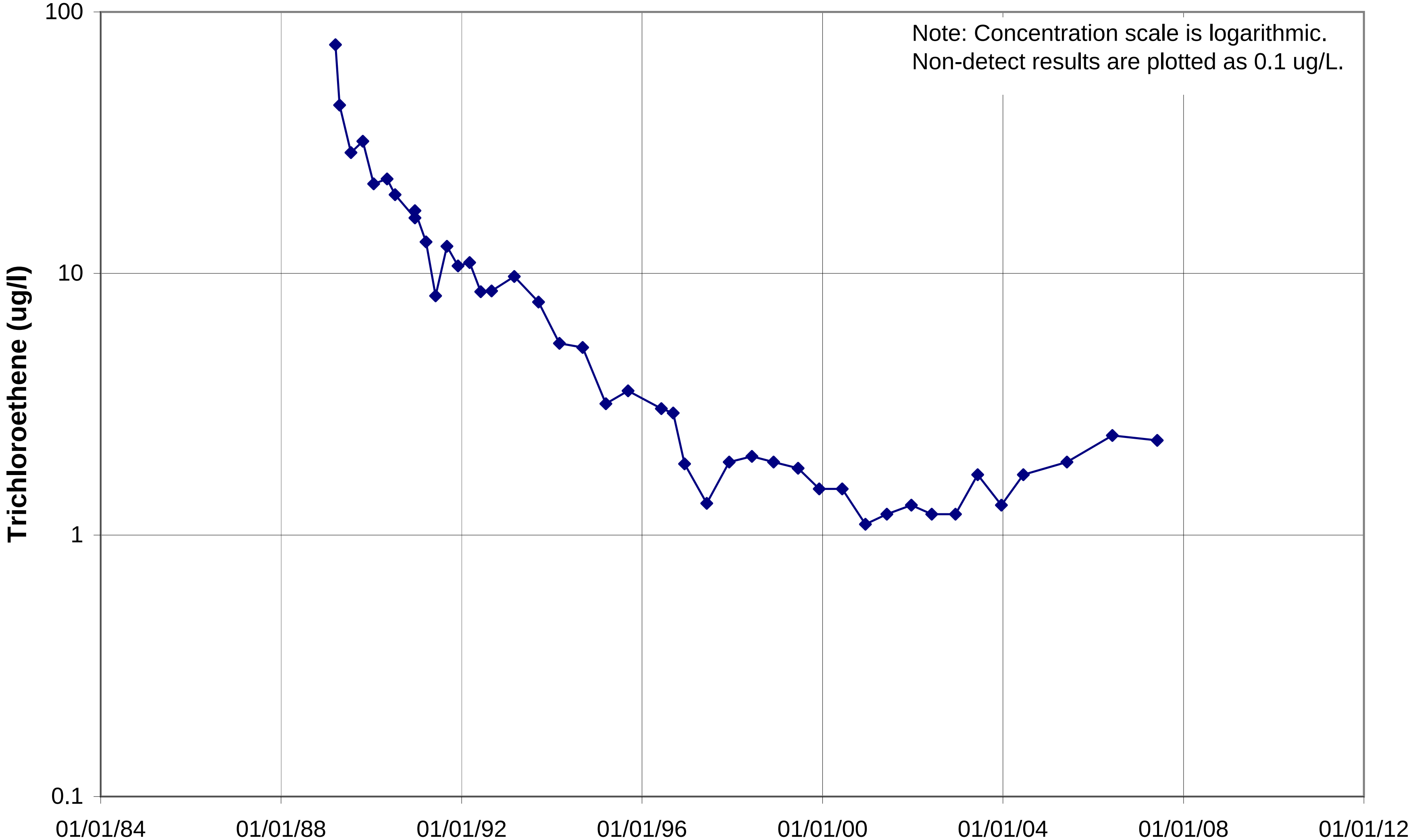

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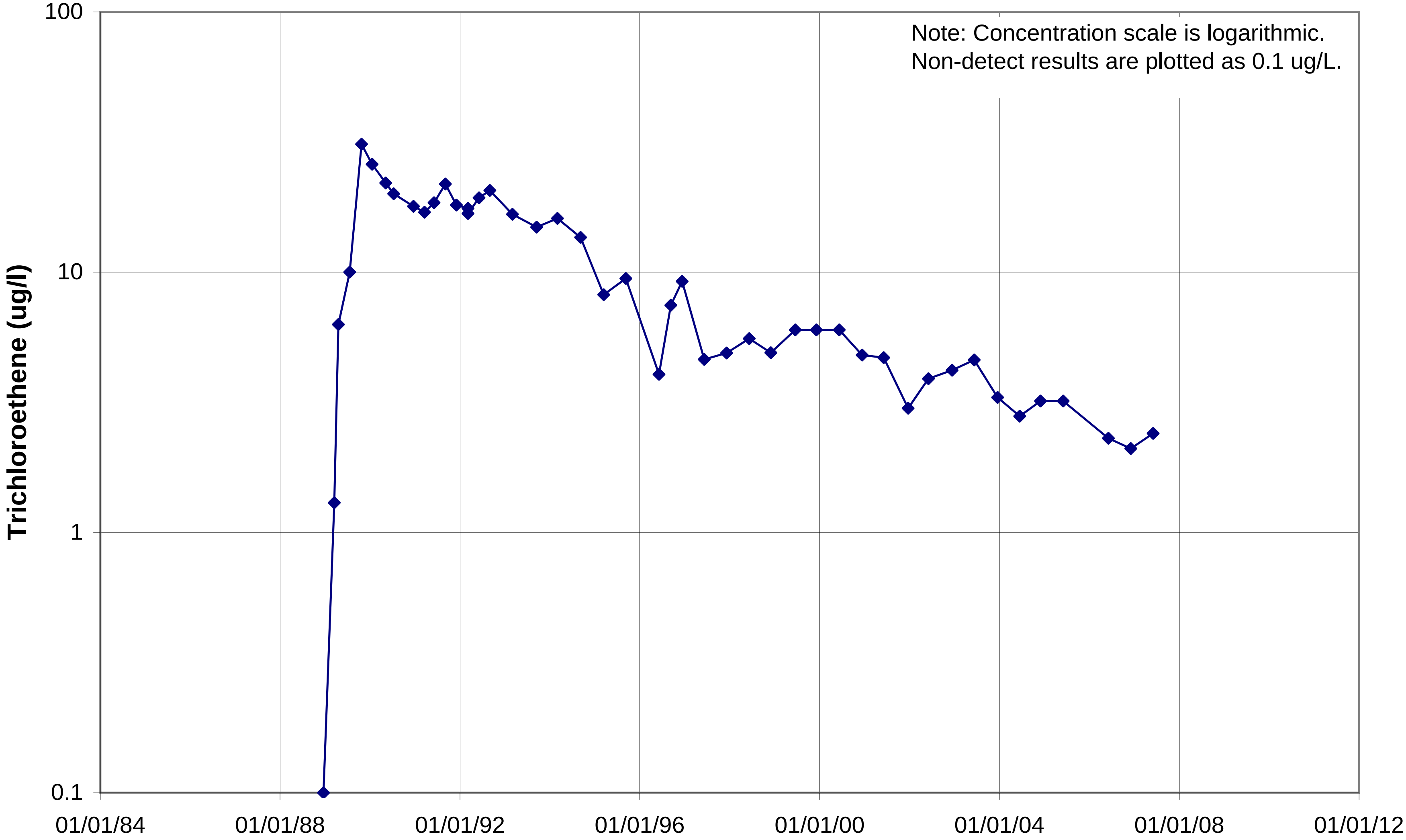

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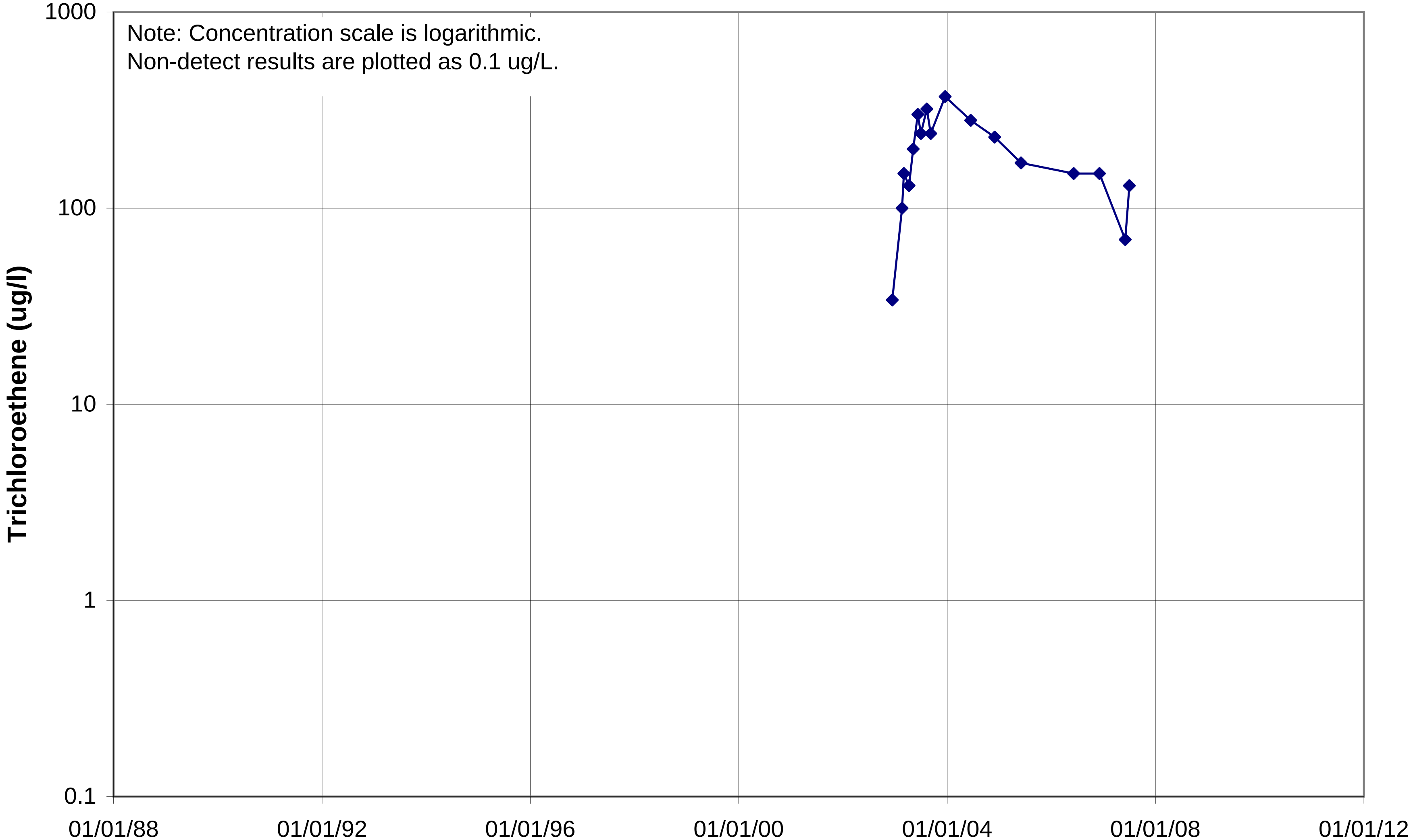
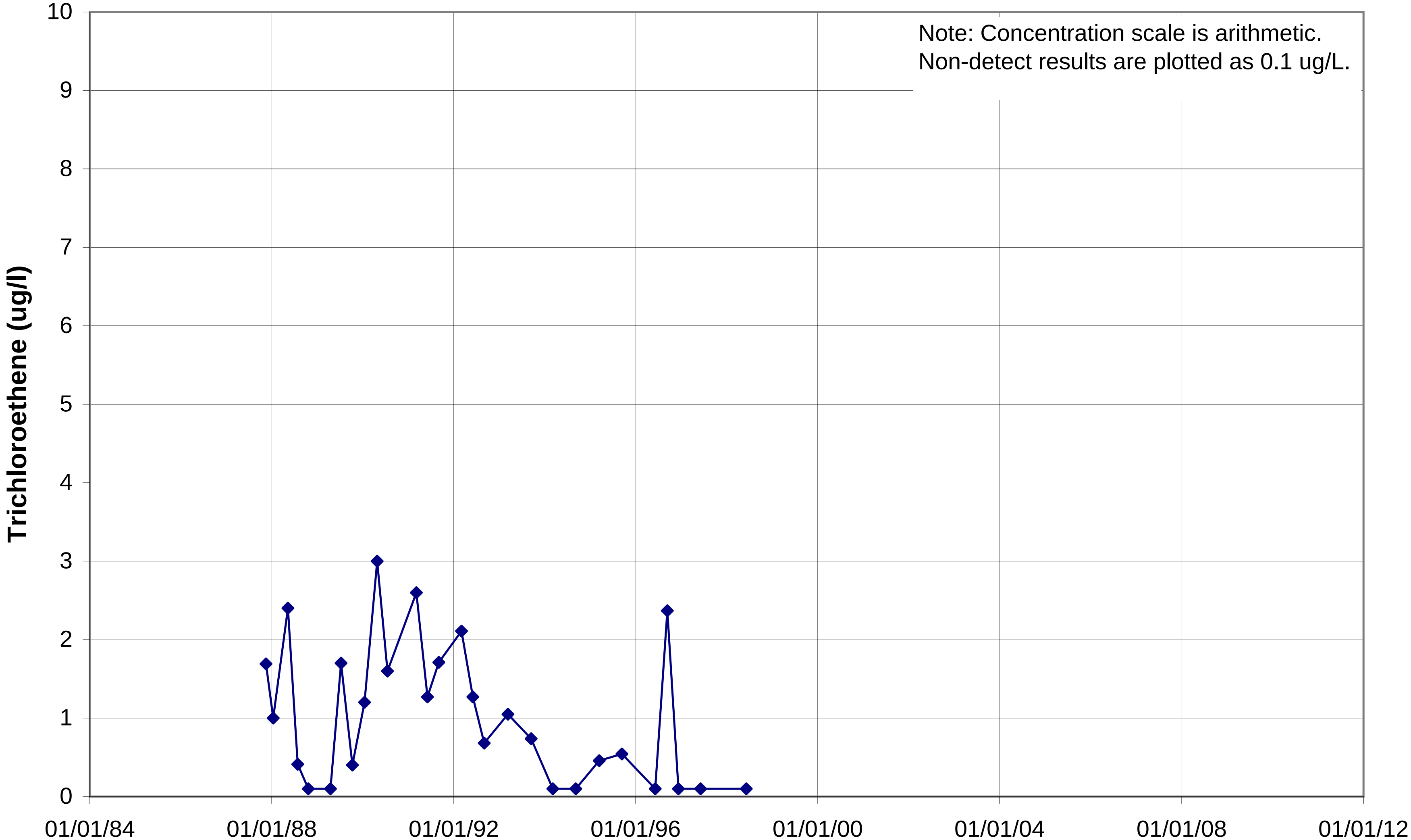


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

03L001



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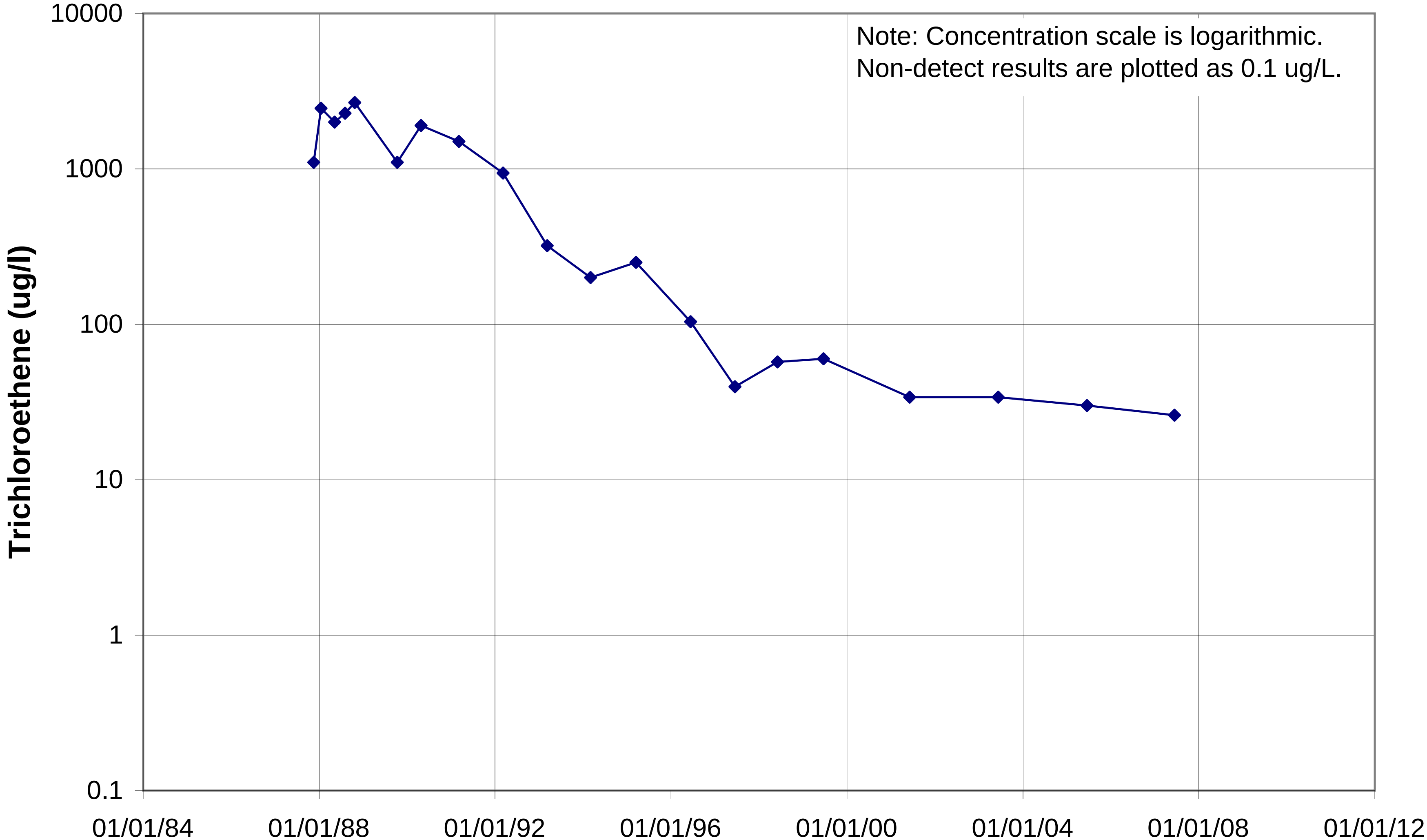
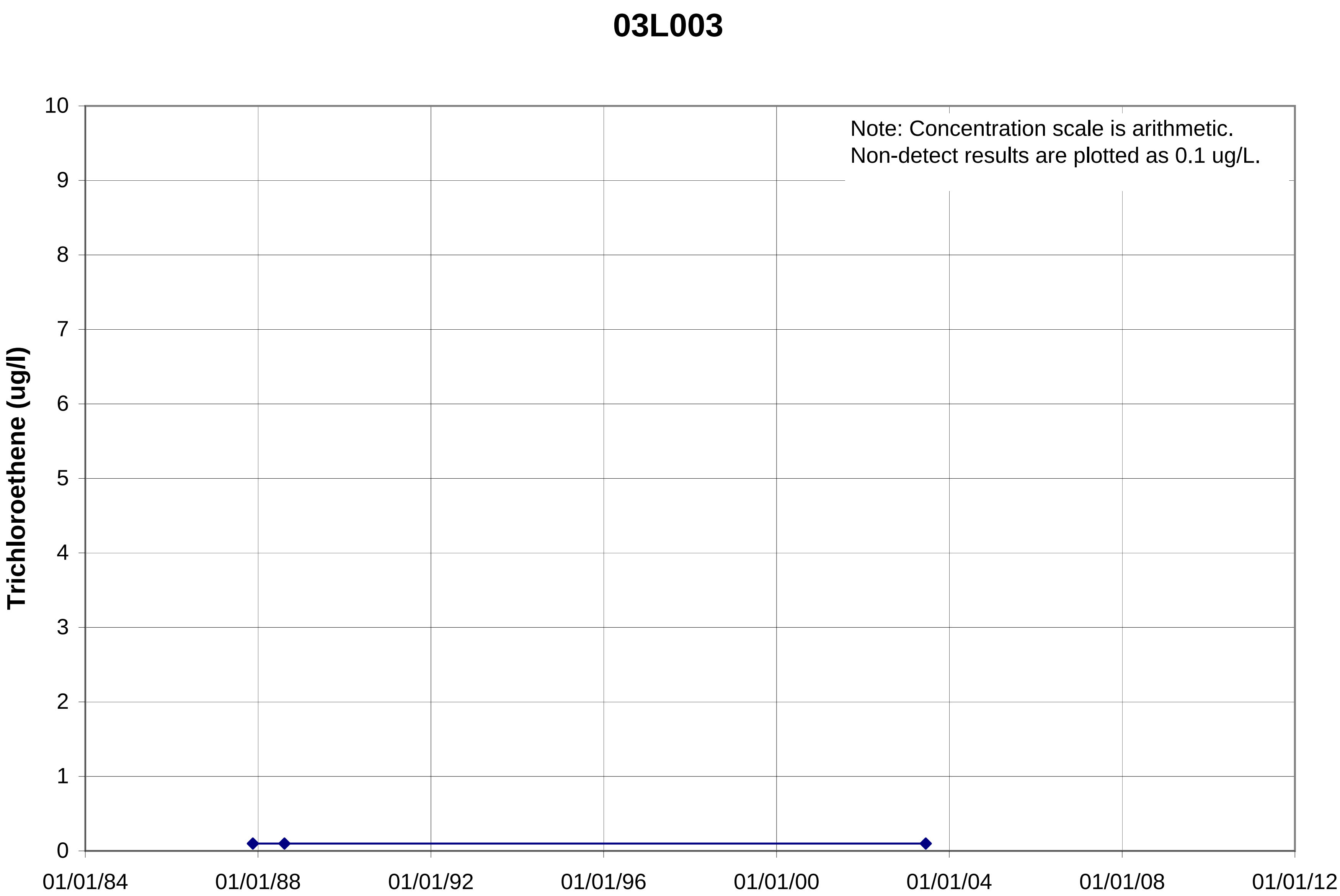
03L002



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar



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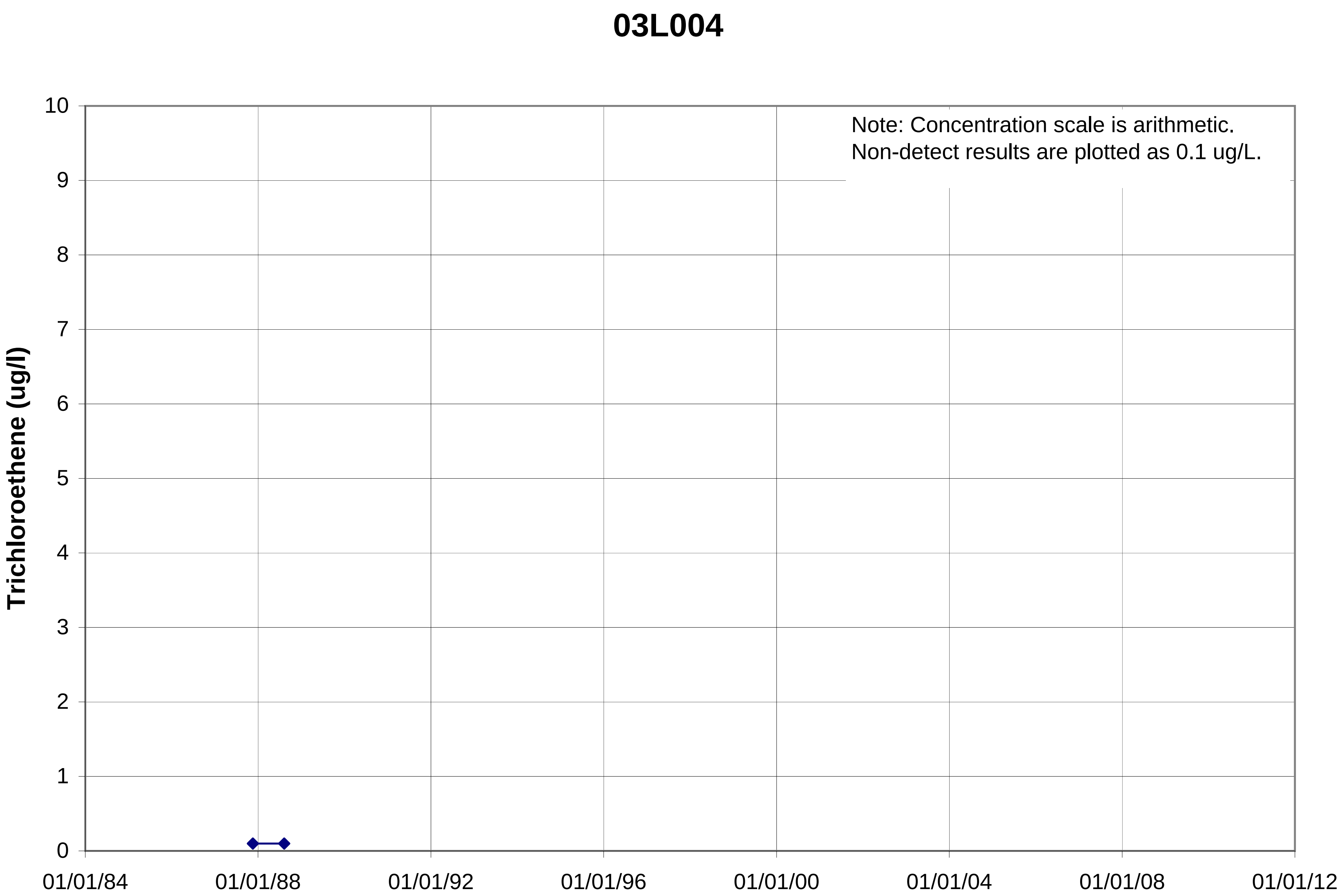

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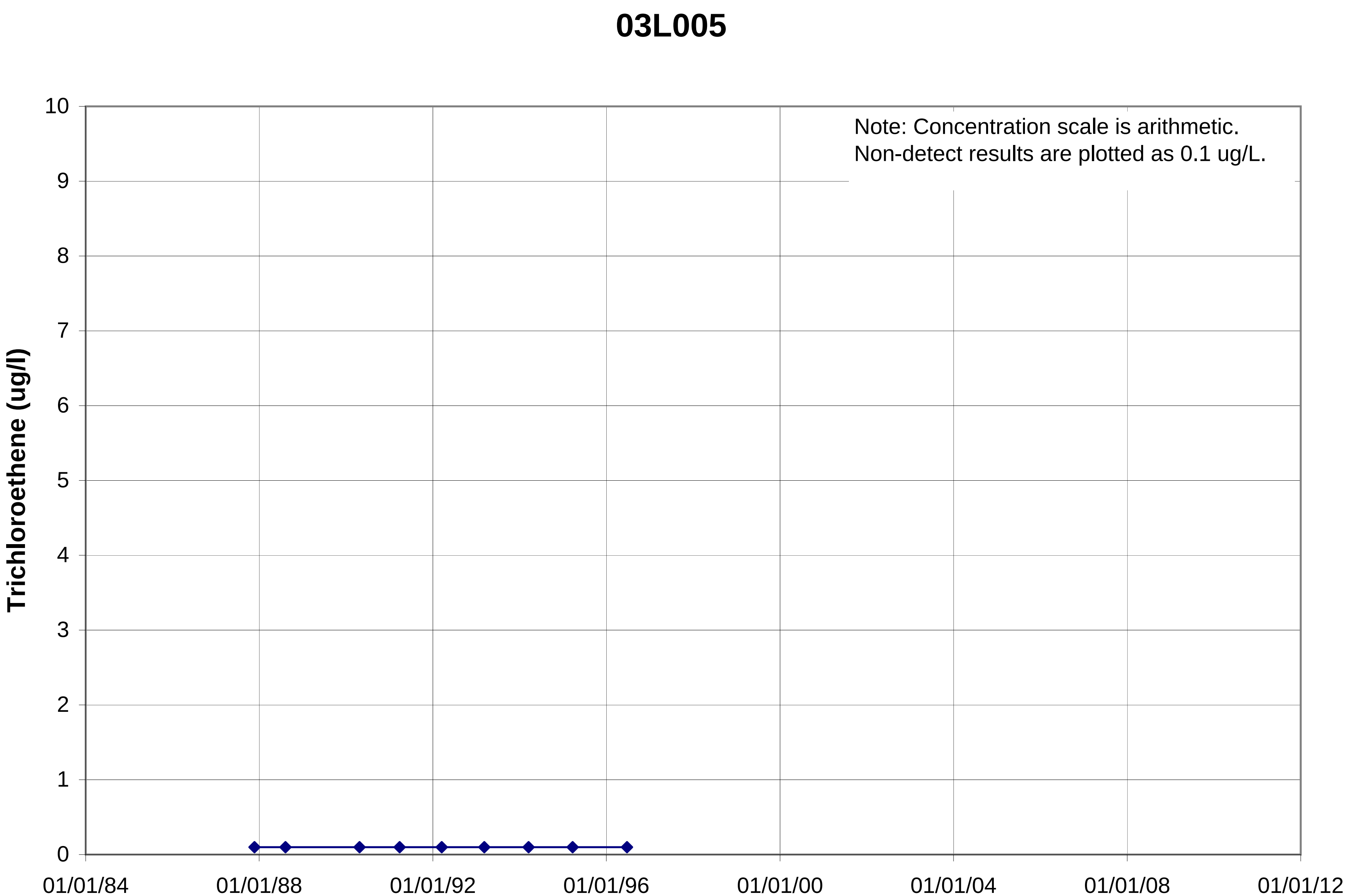
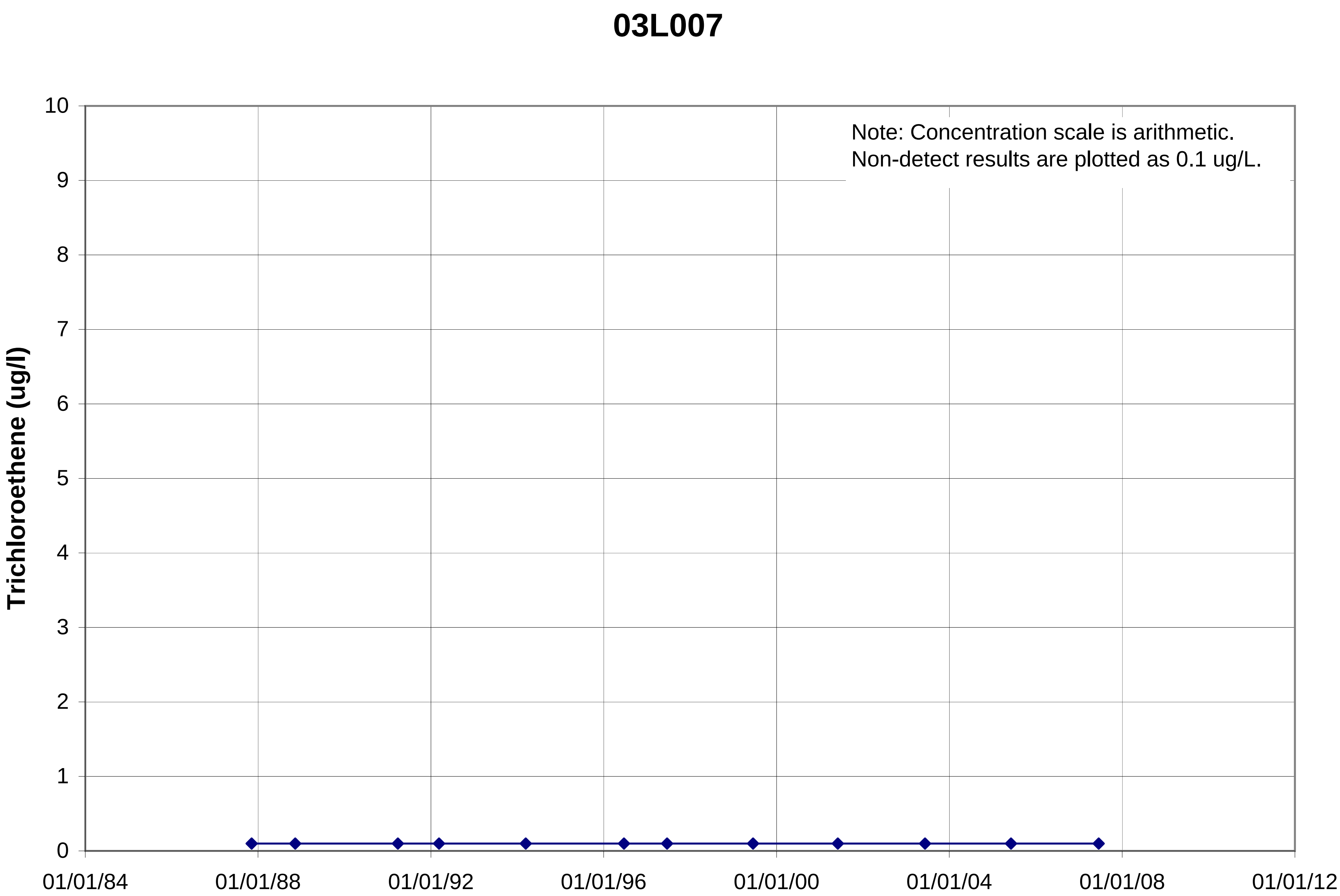


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar



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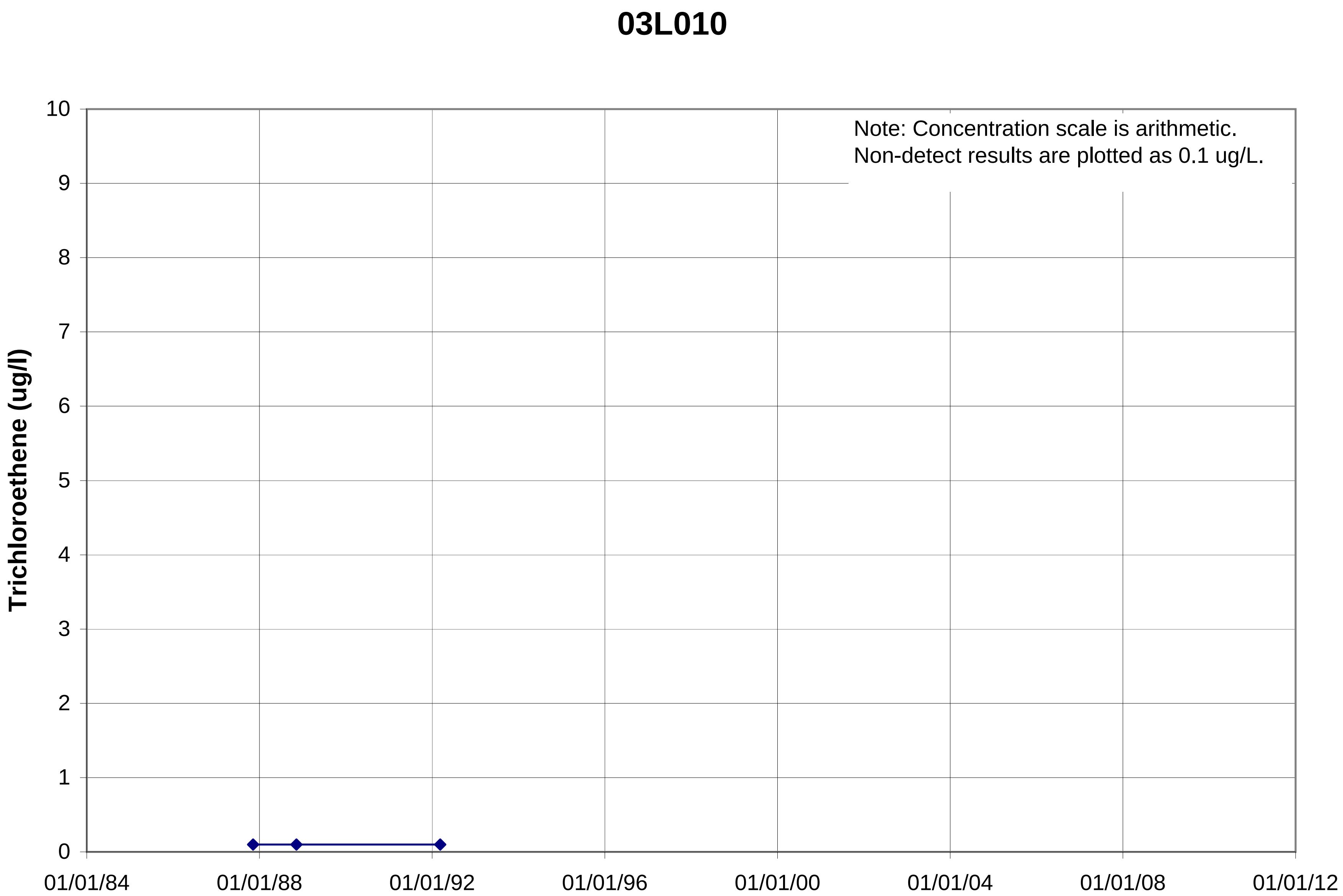

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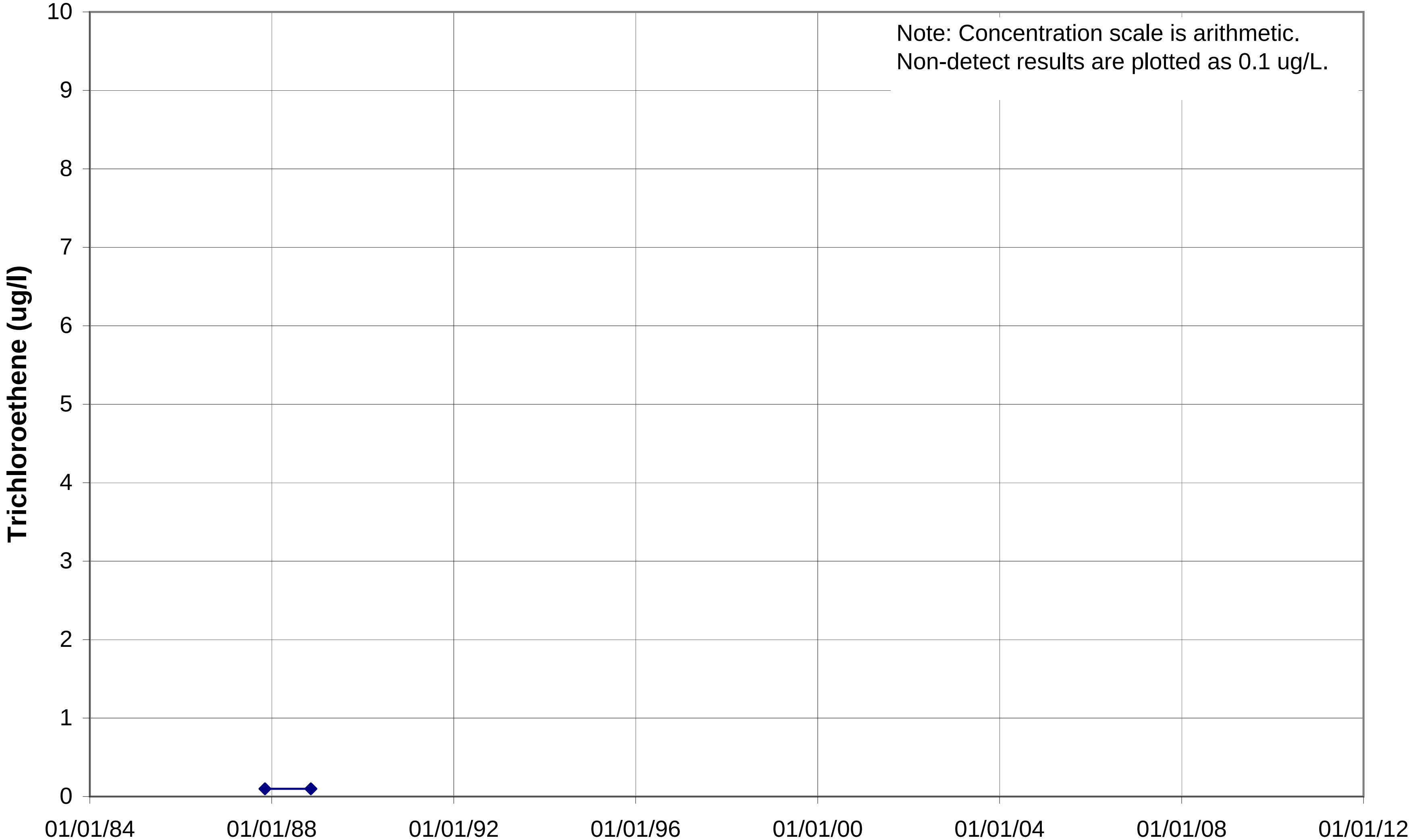
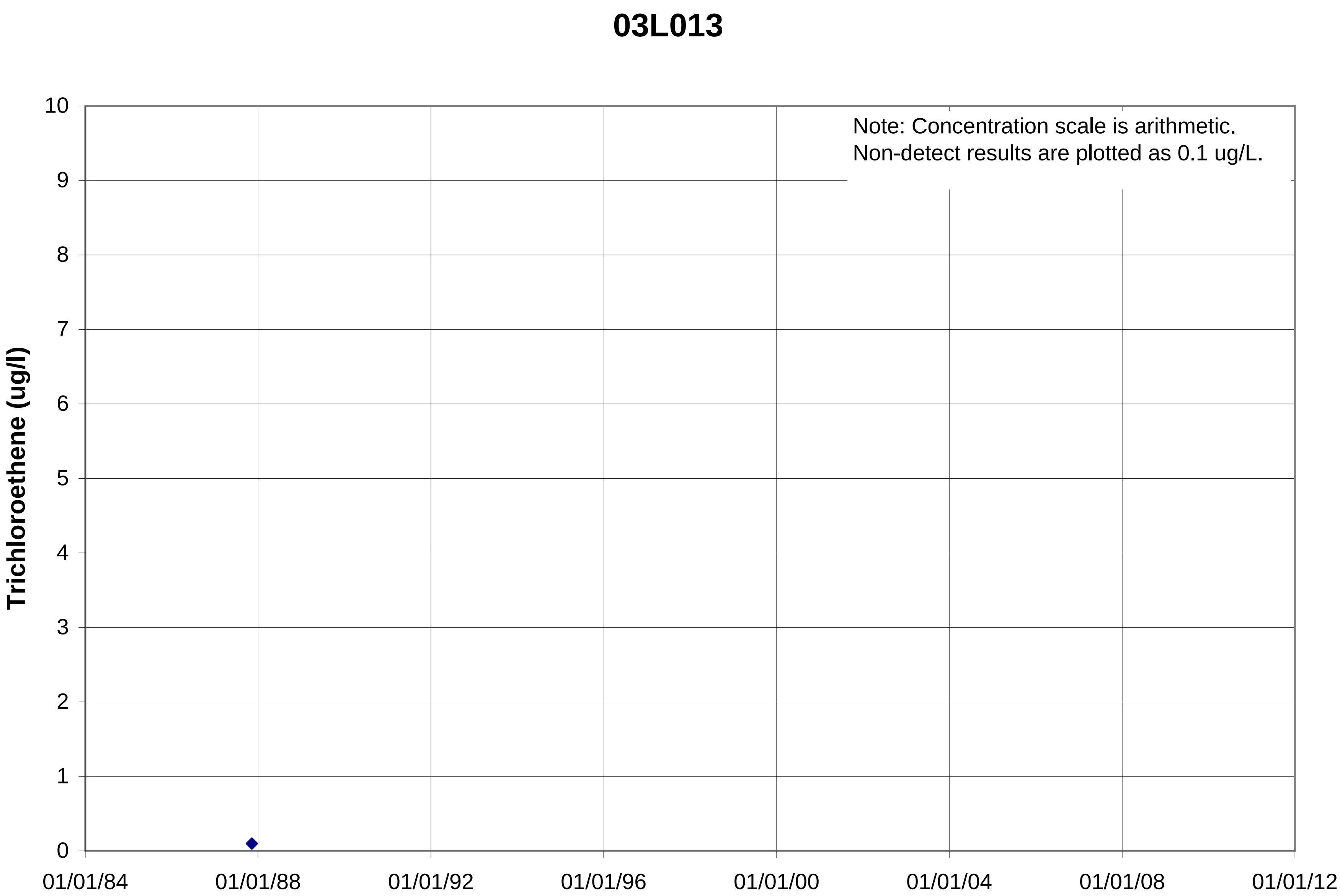
03L012



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar



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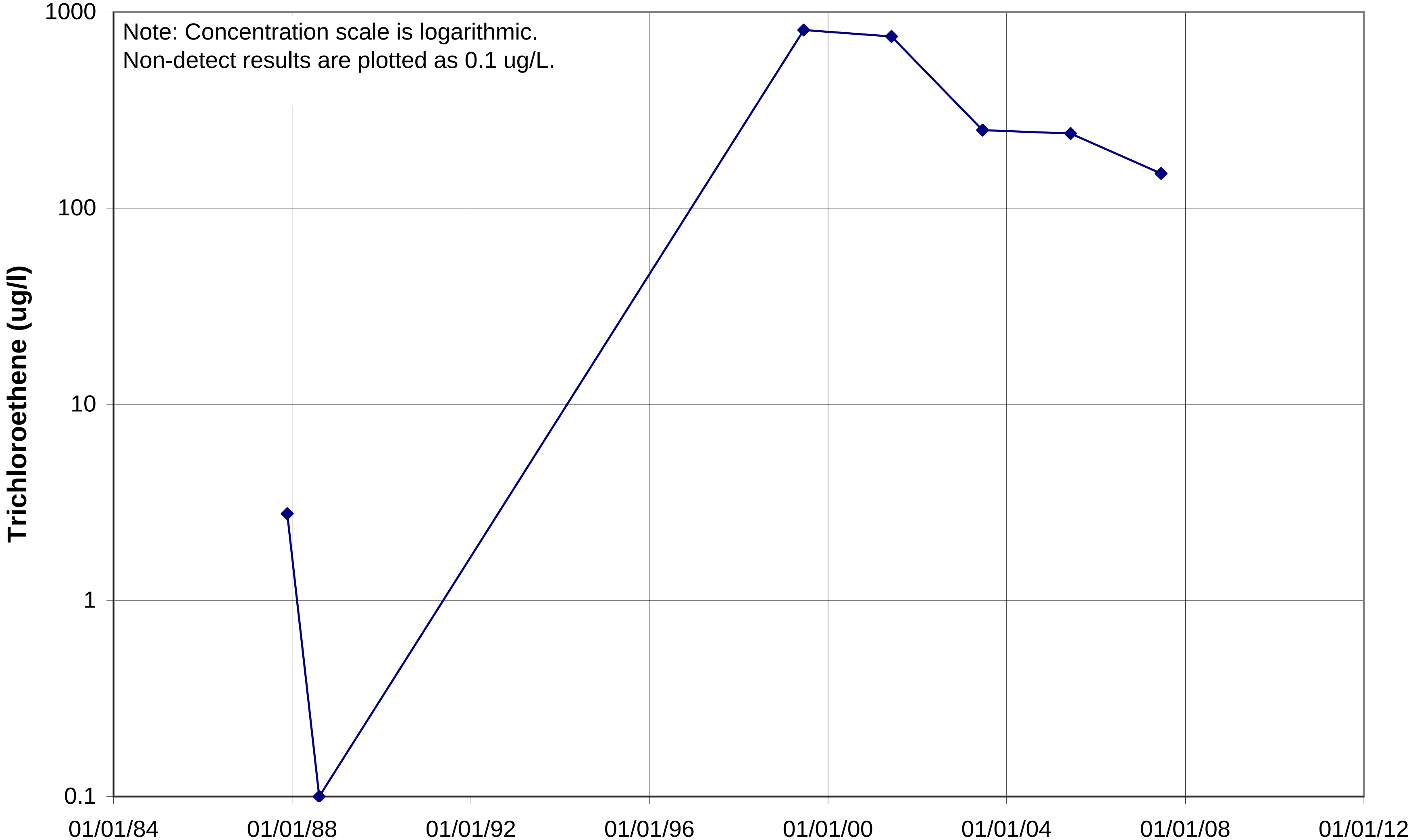

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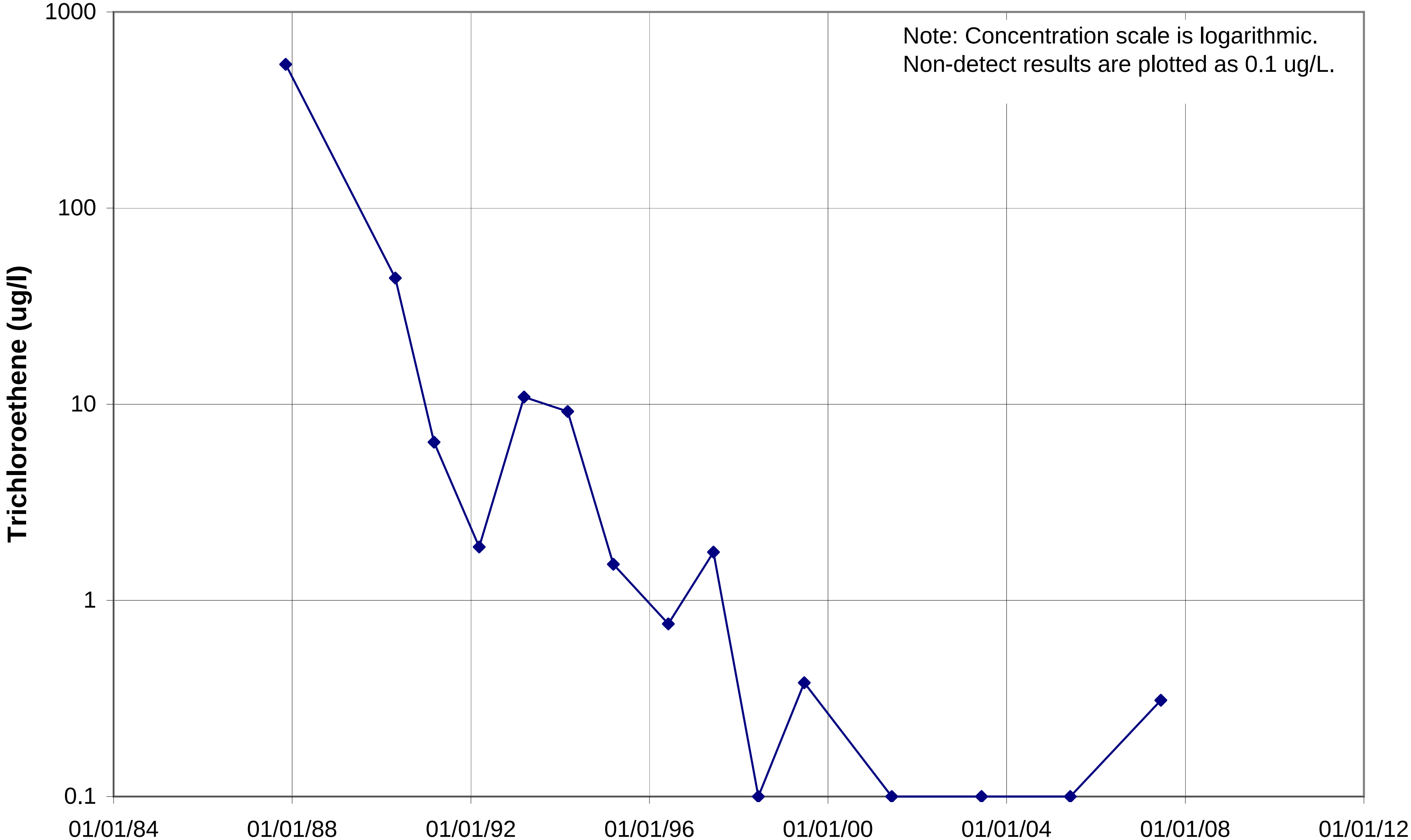

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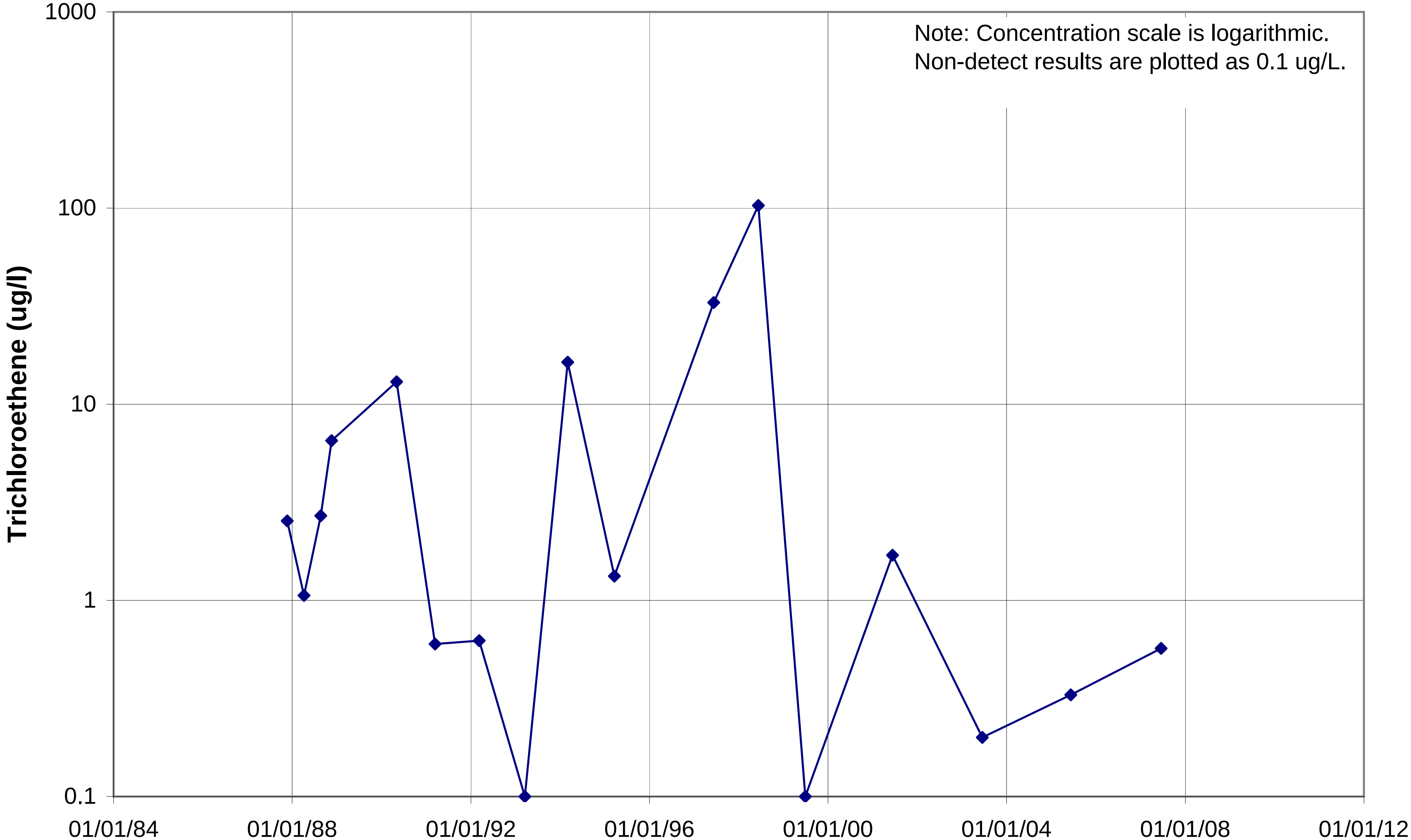

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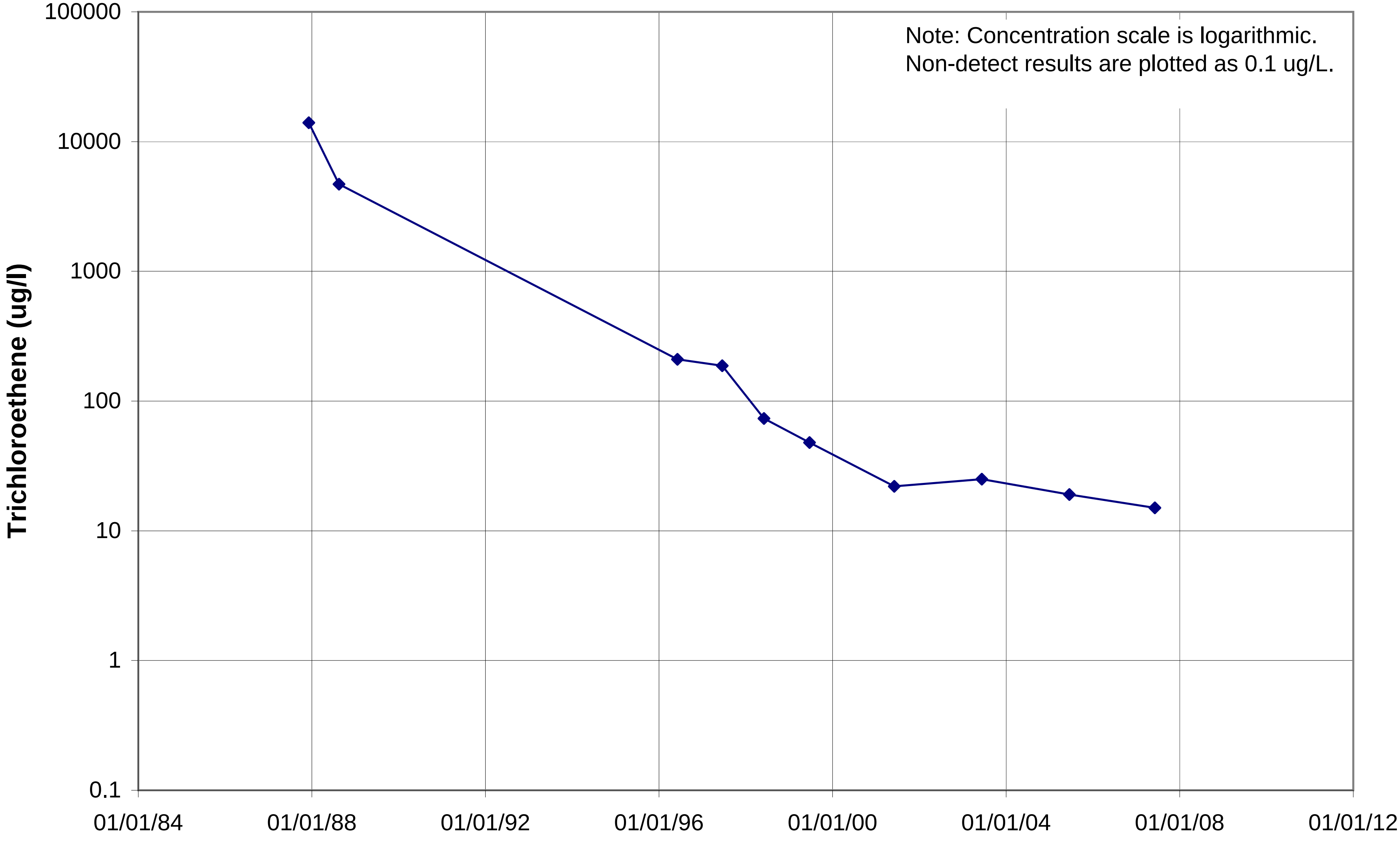

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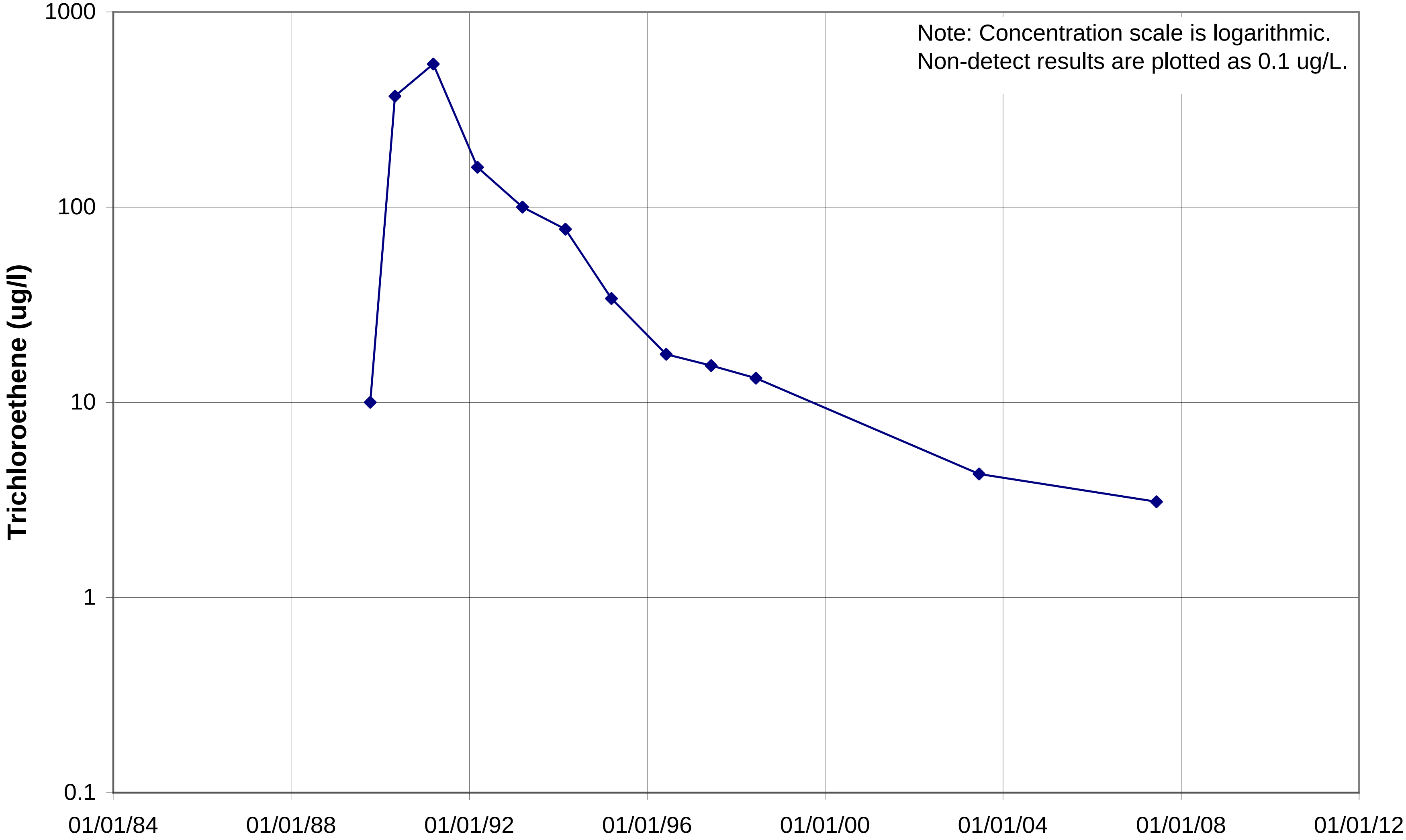

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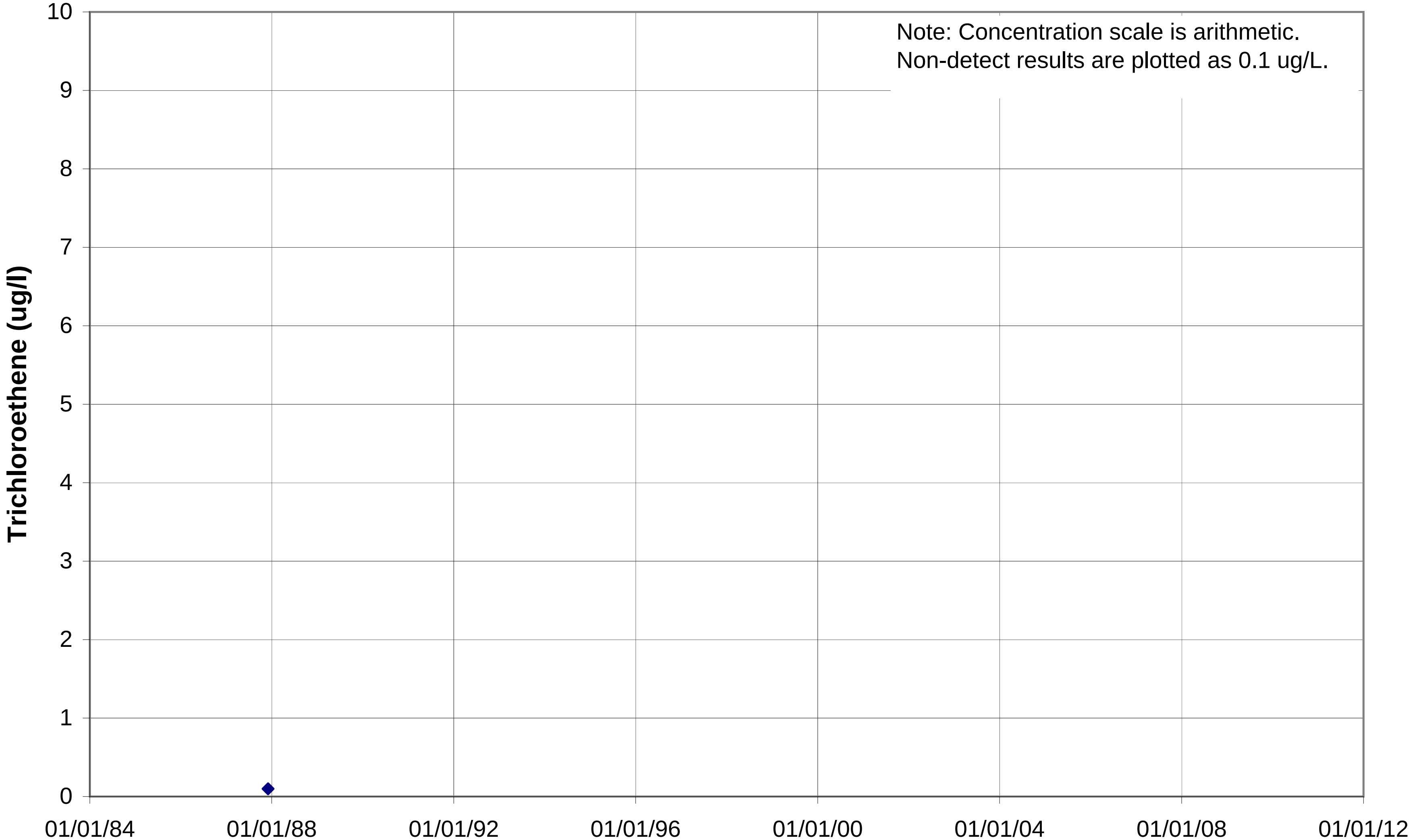

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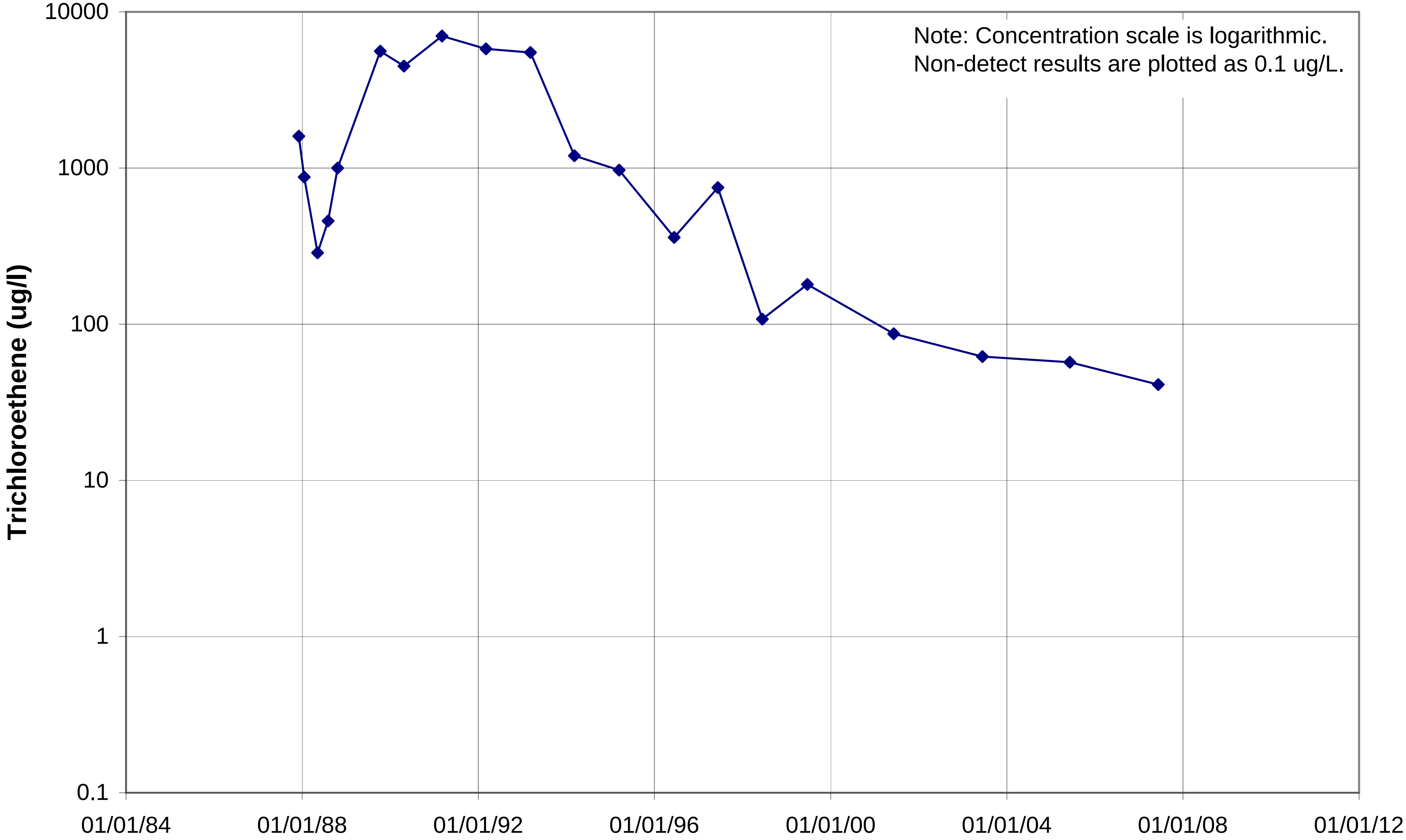
03L077



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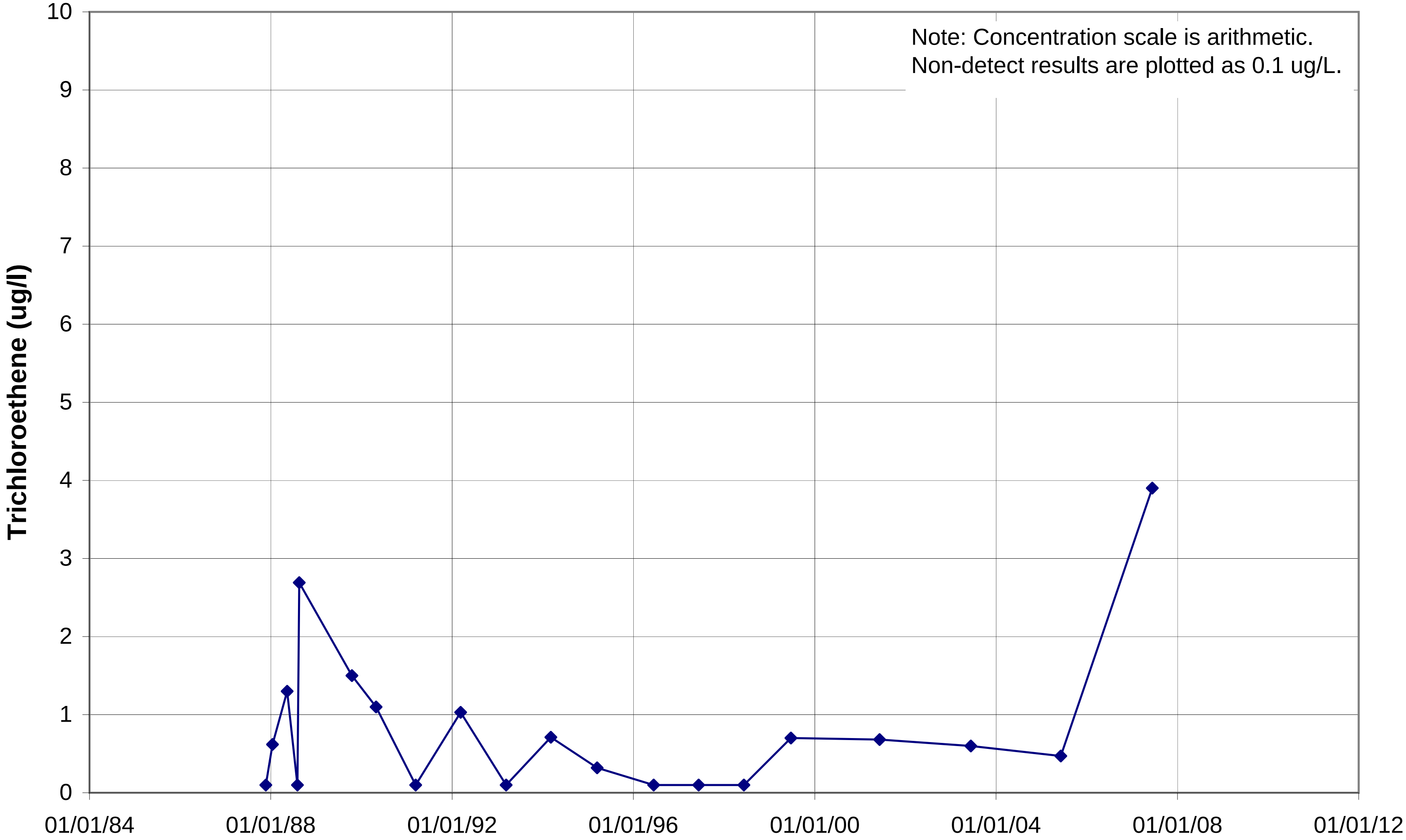

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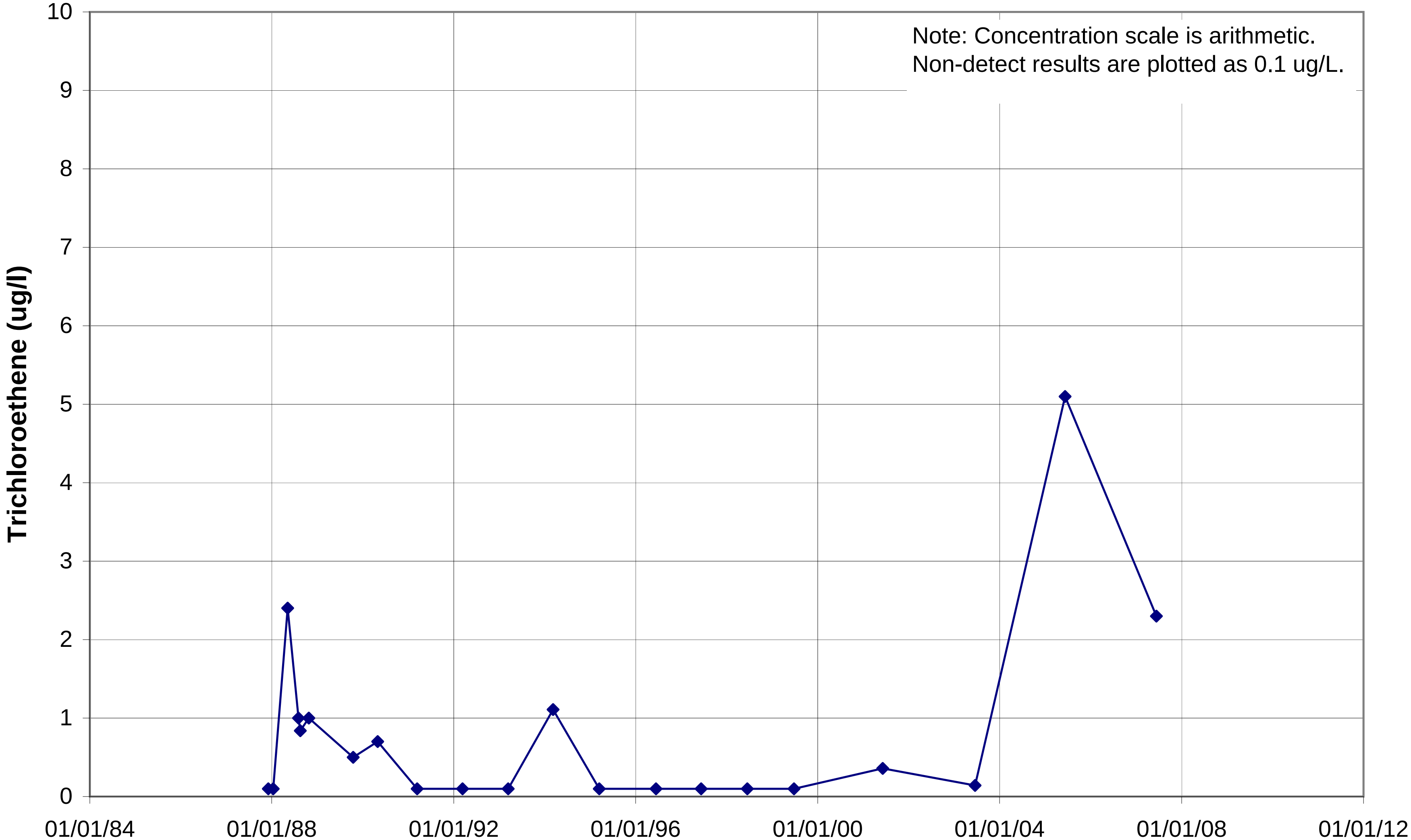

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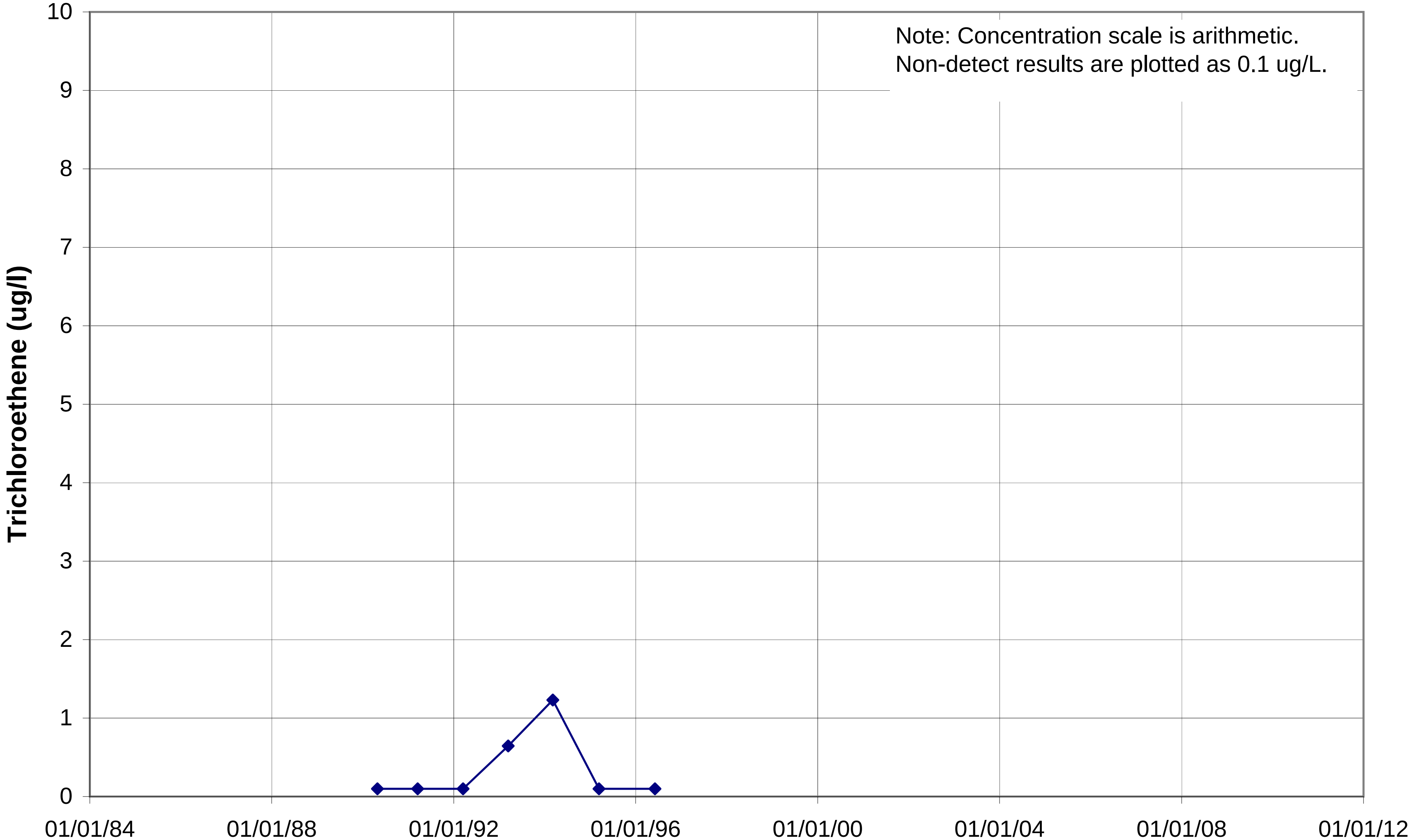

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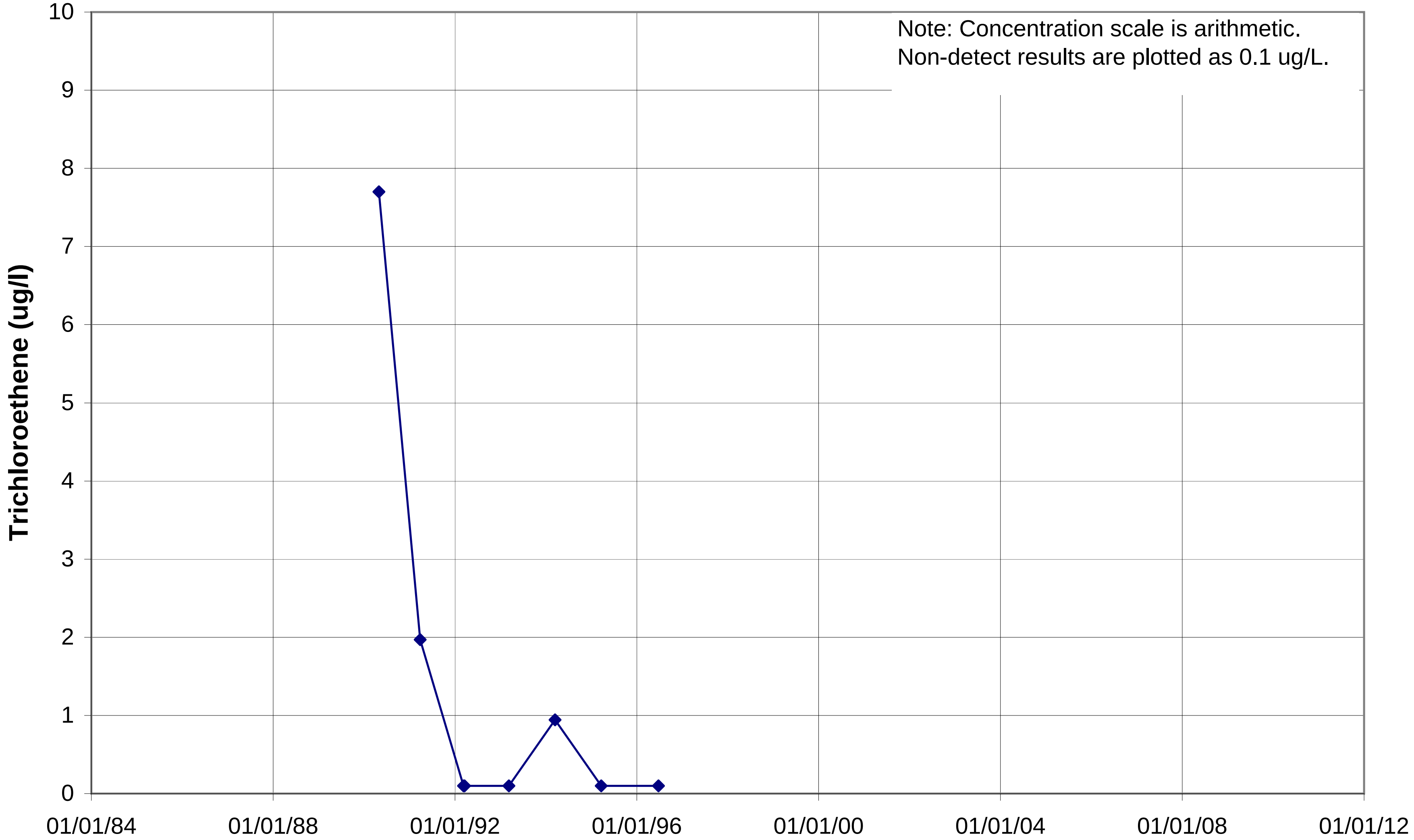

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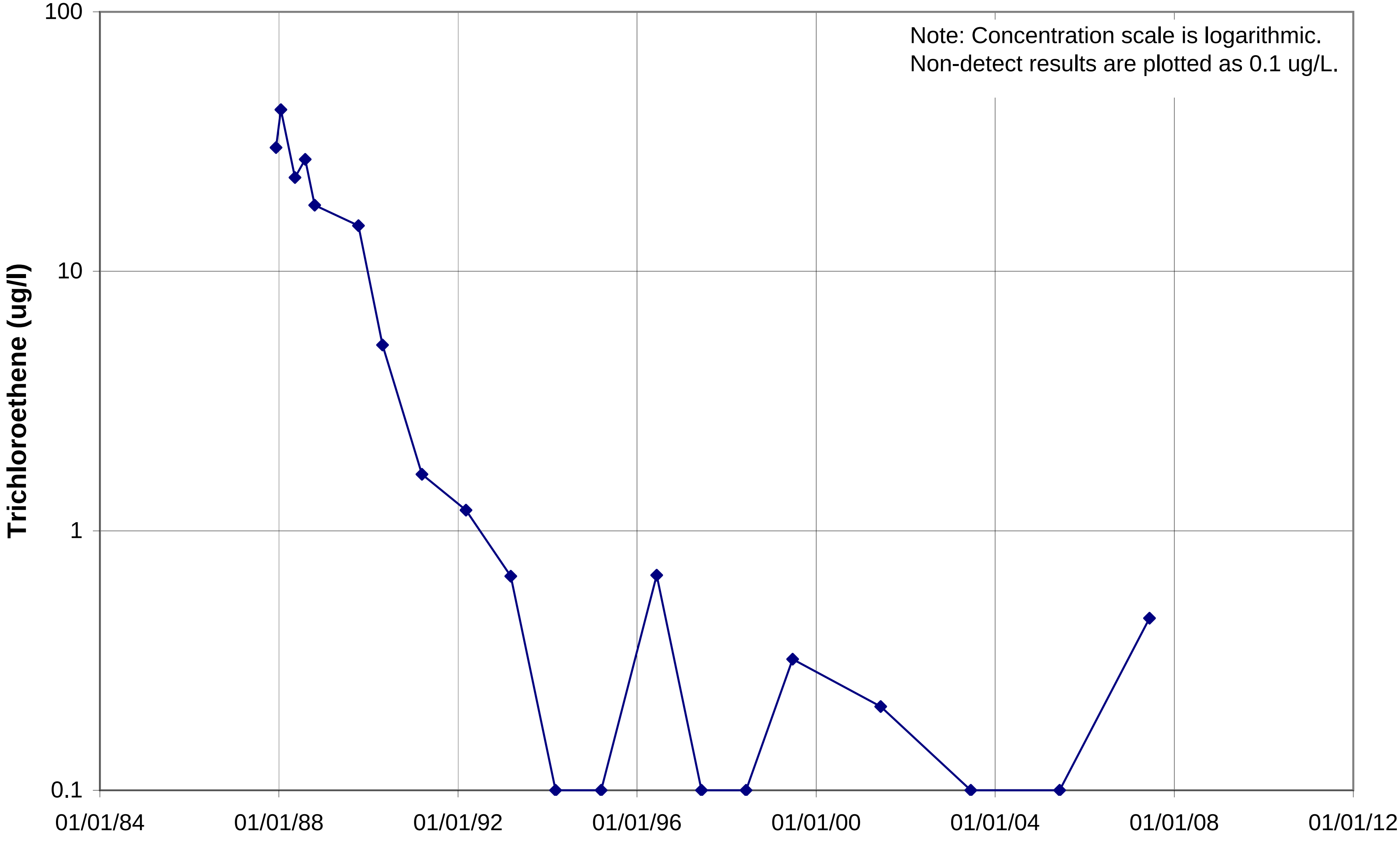

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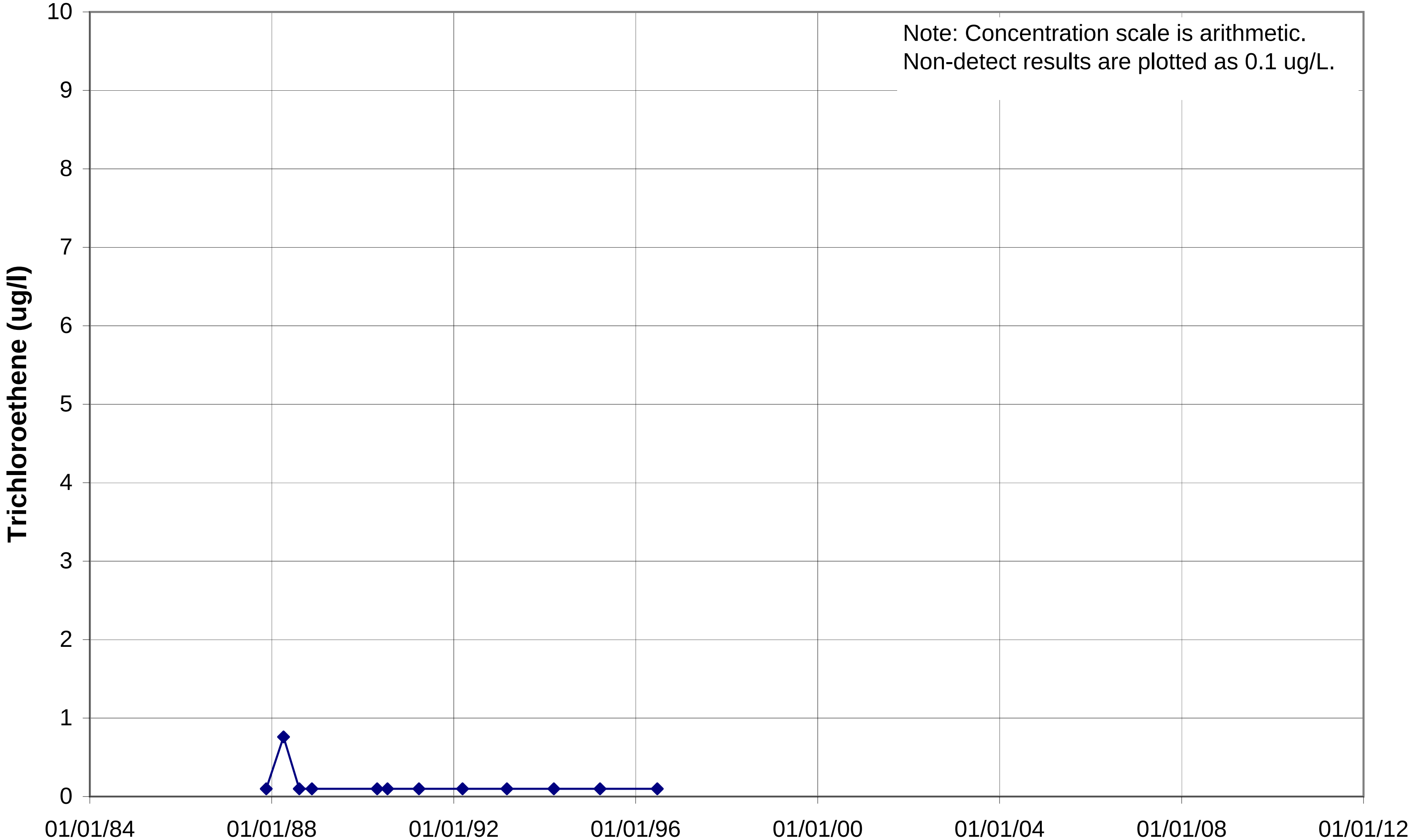
03L113



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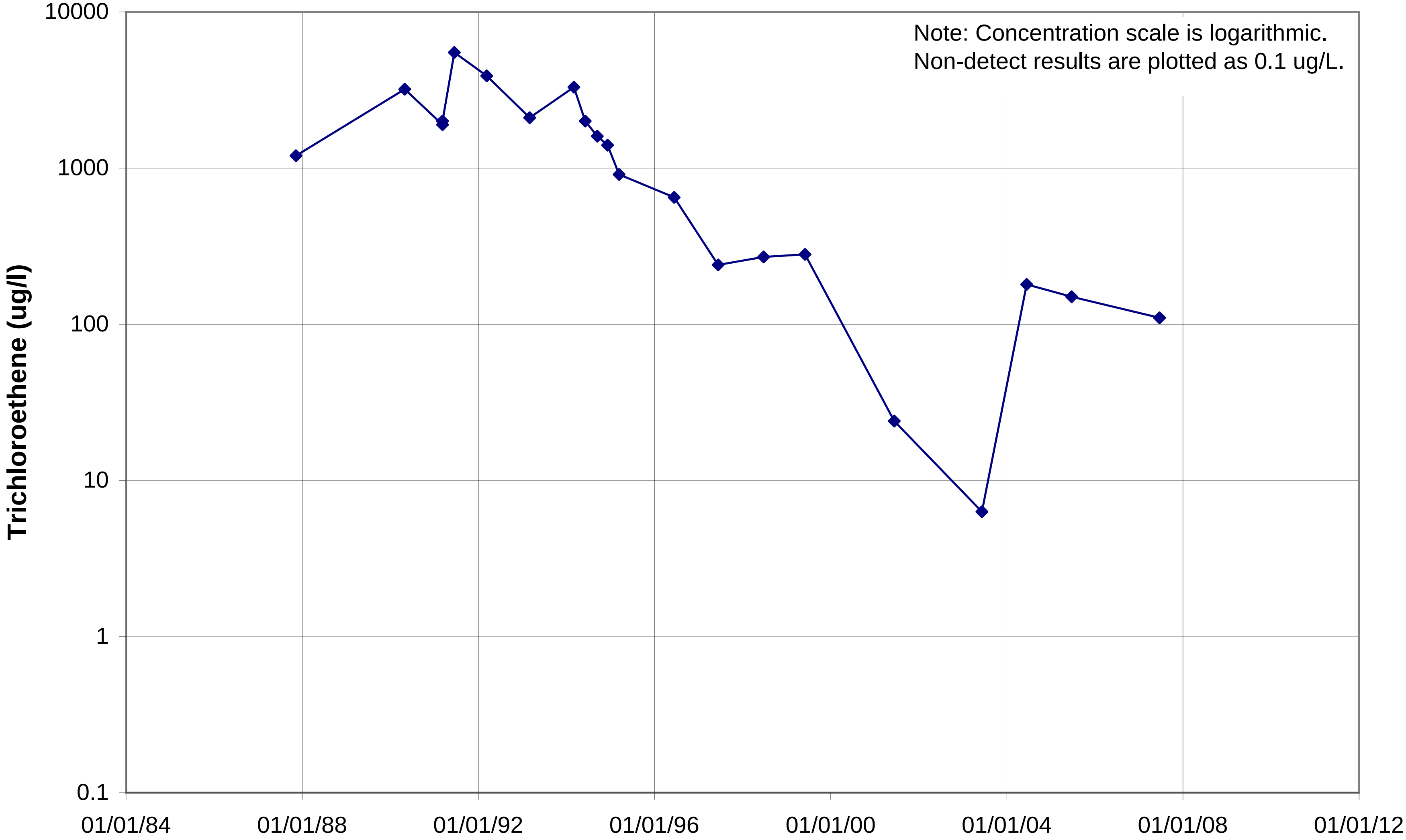

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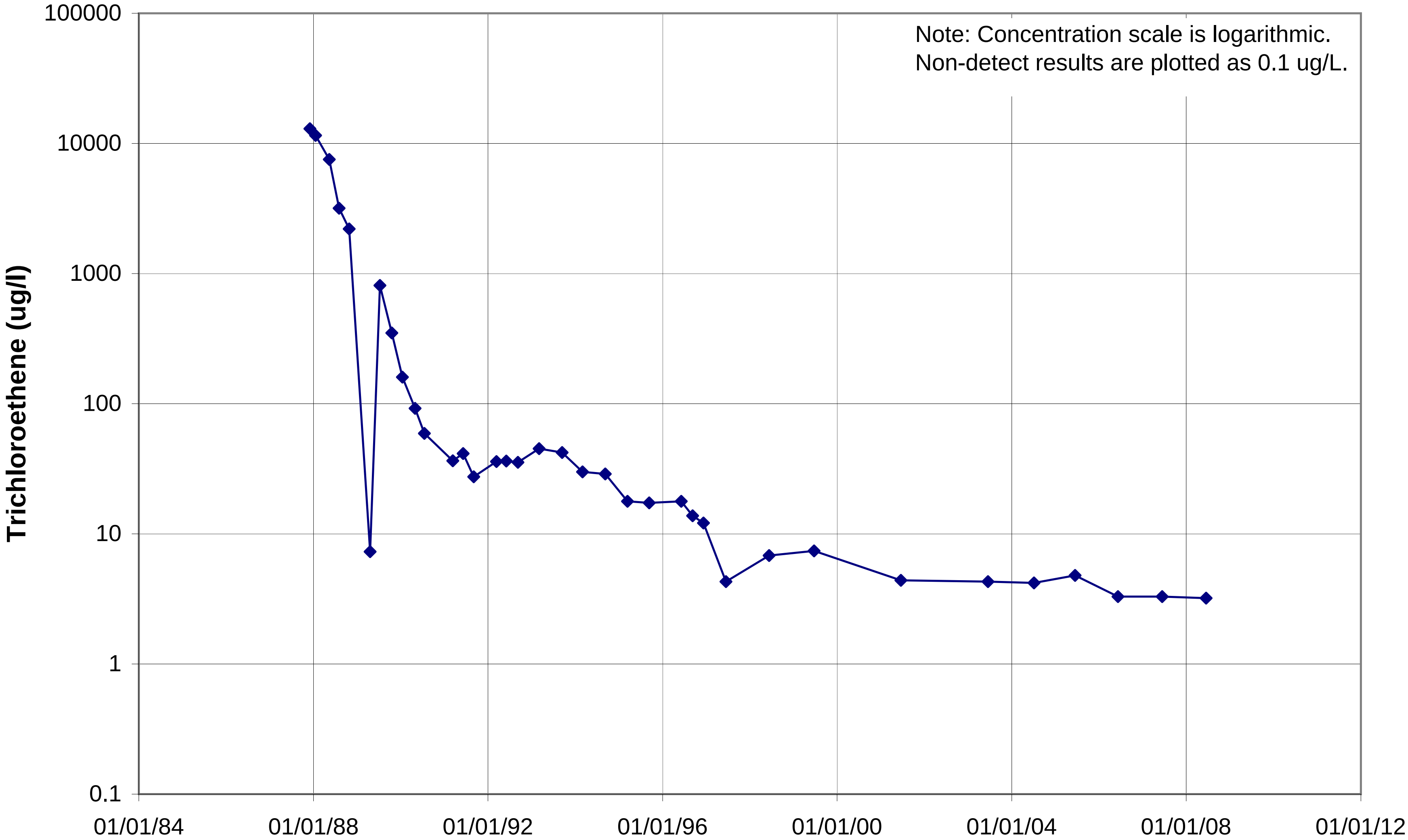

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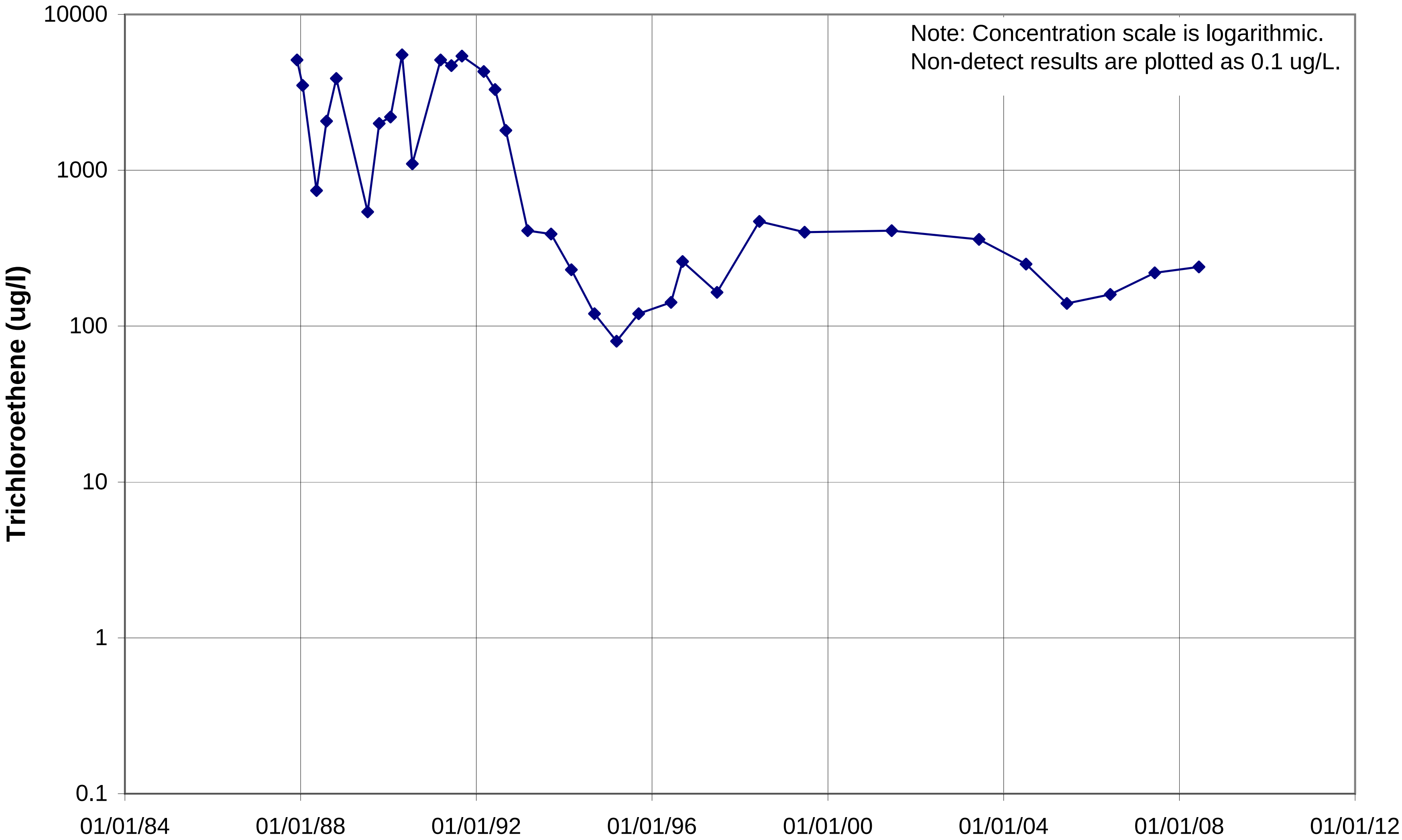

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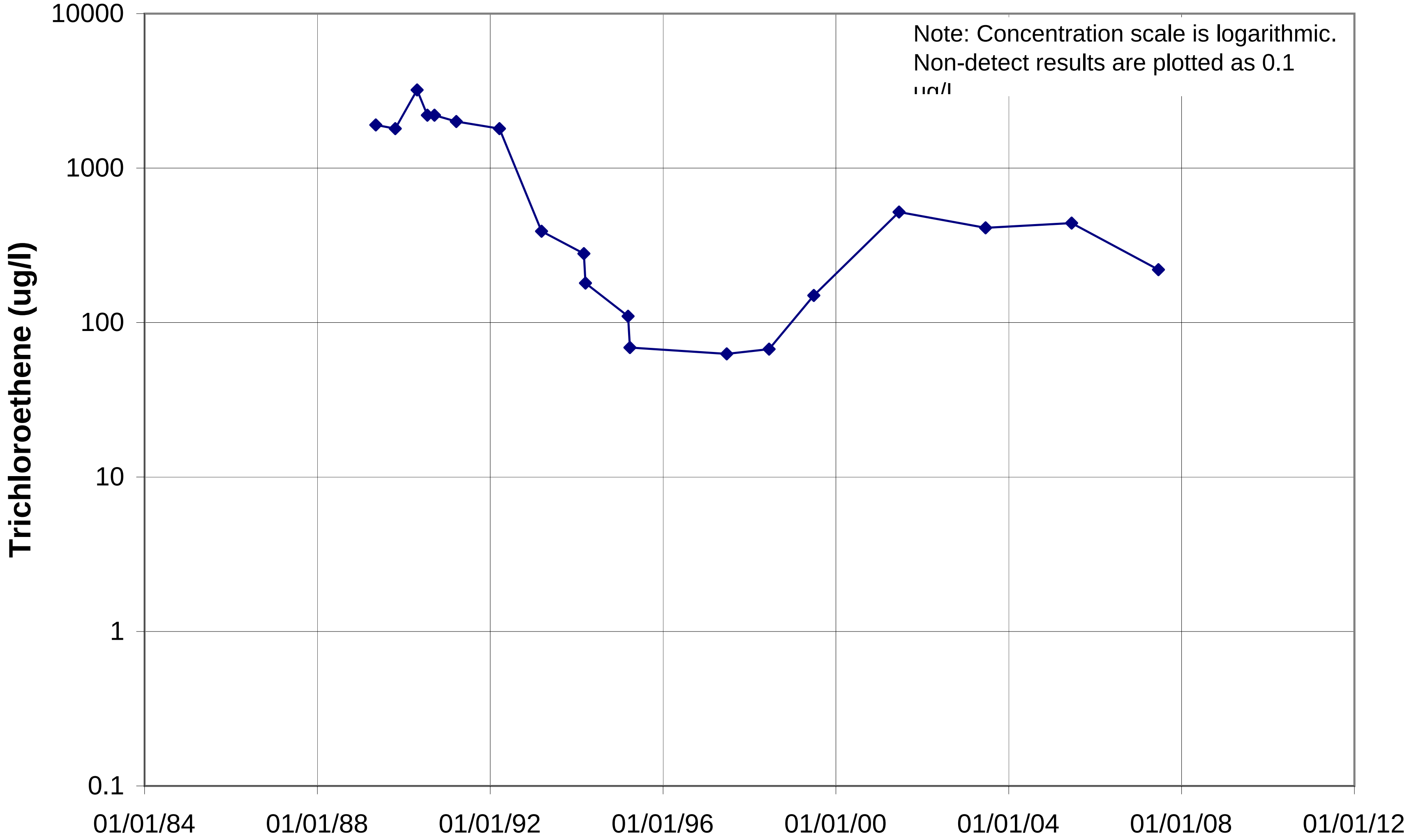

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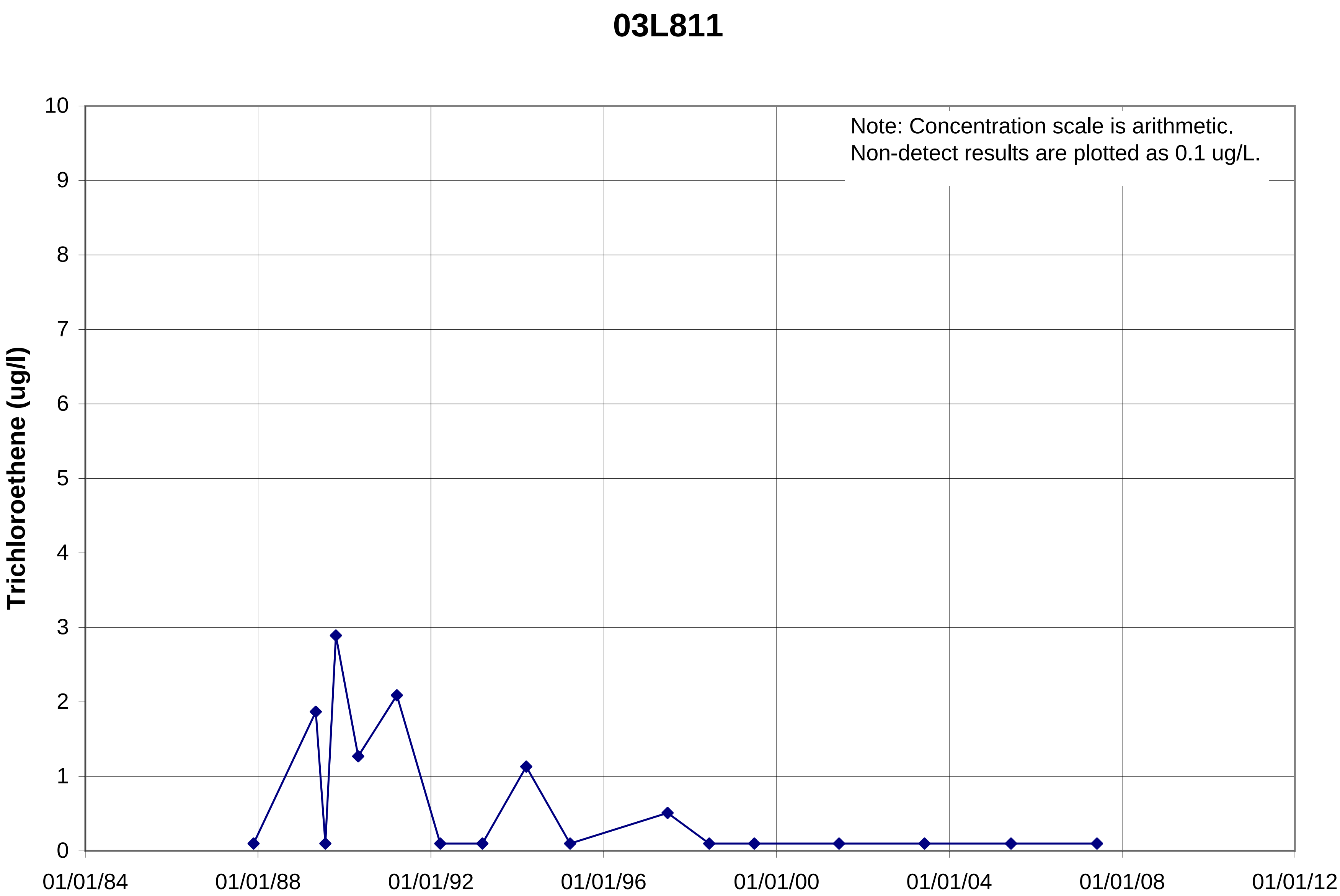

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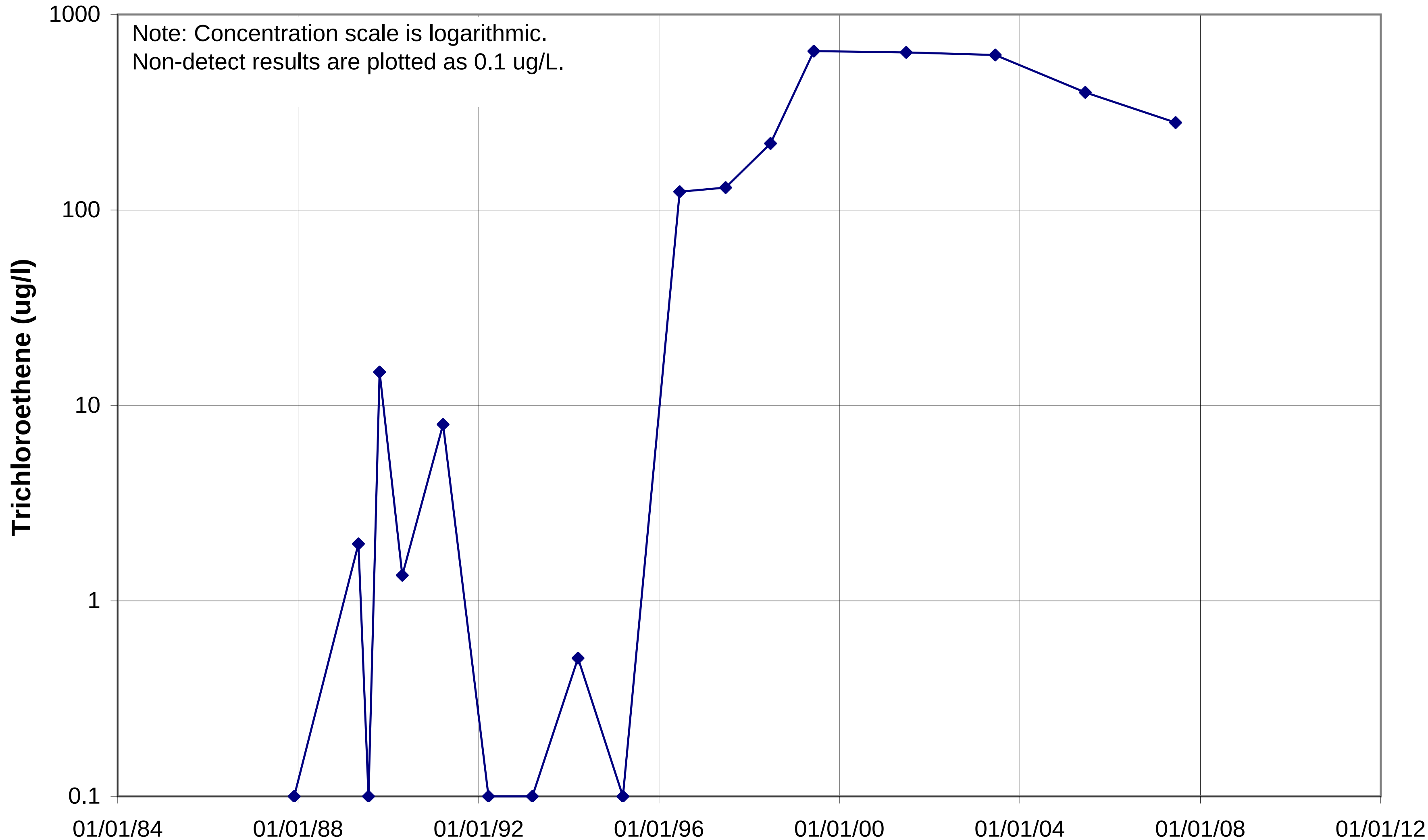

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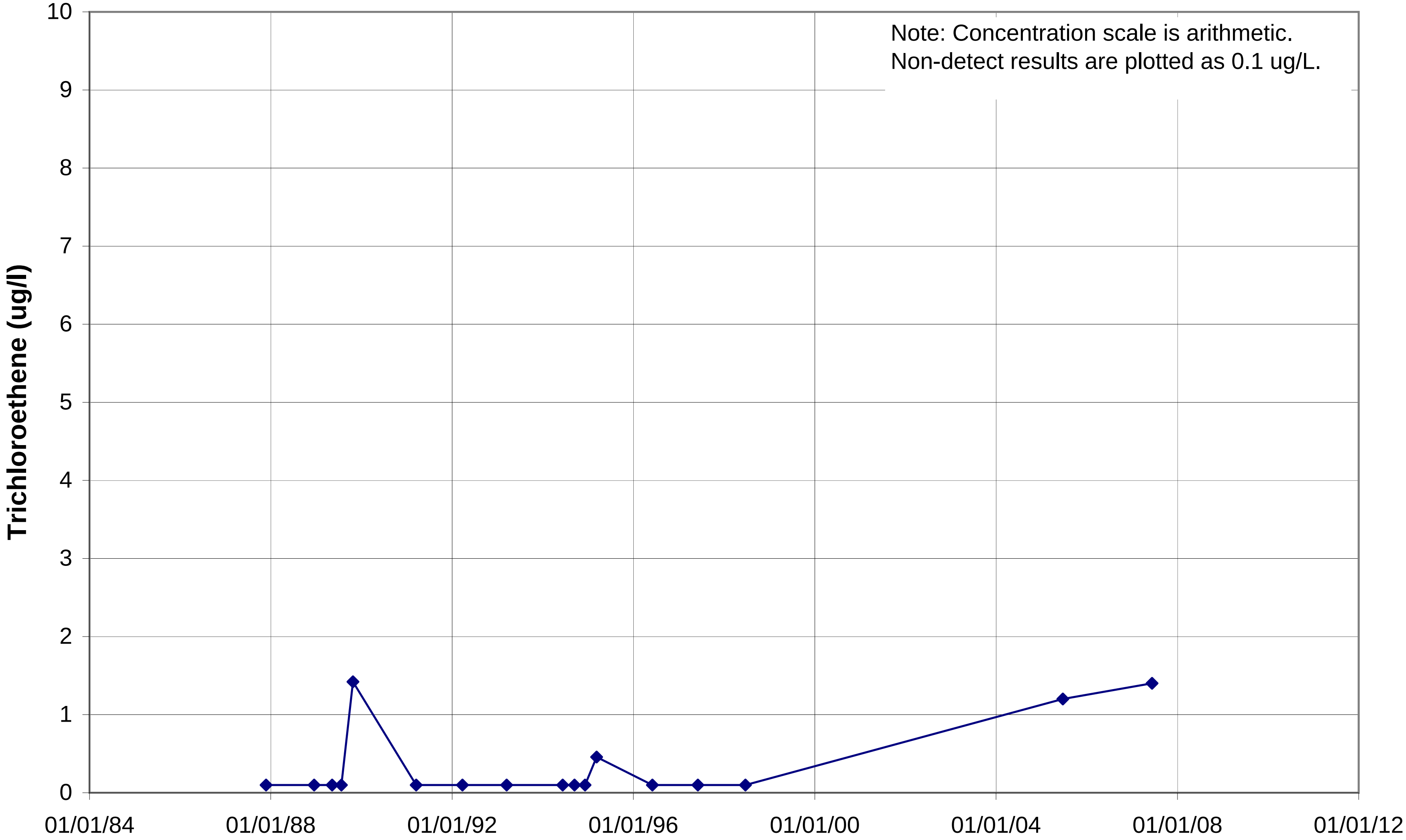

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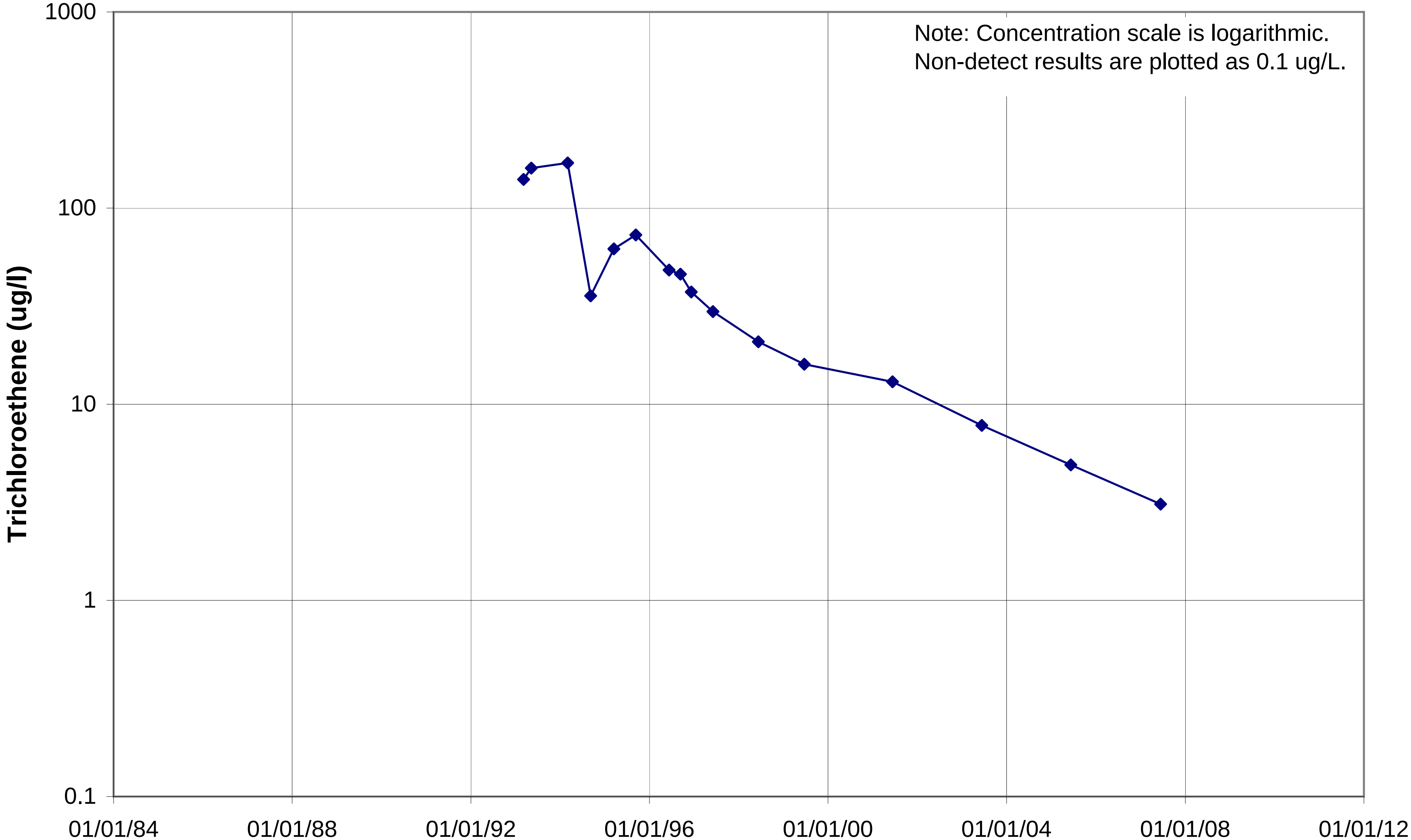

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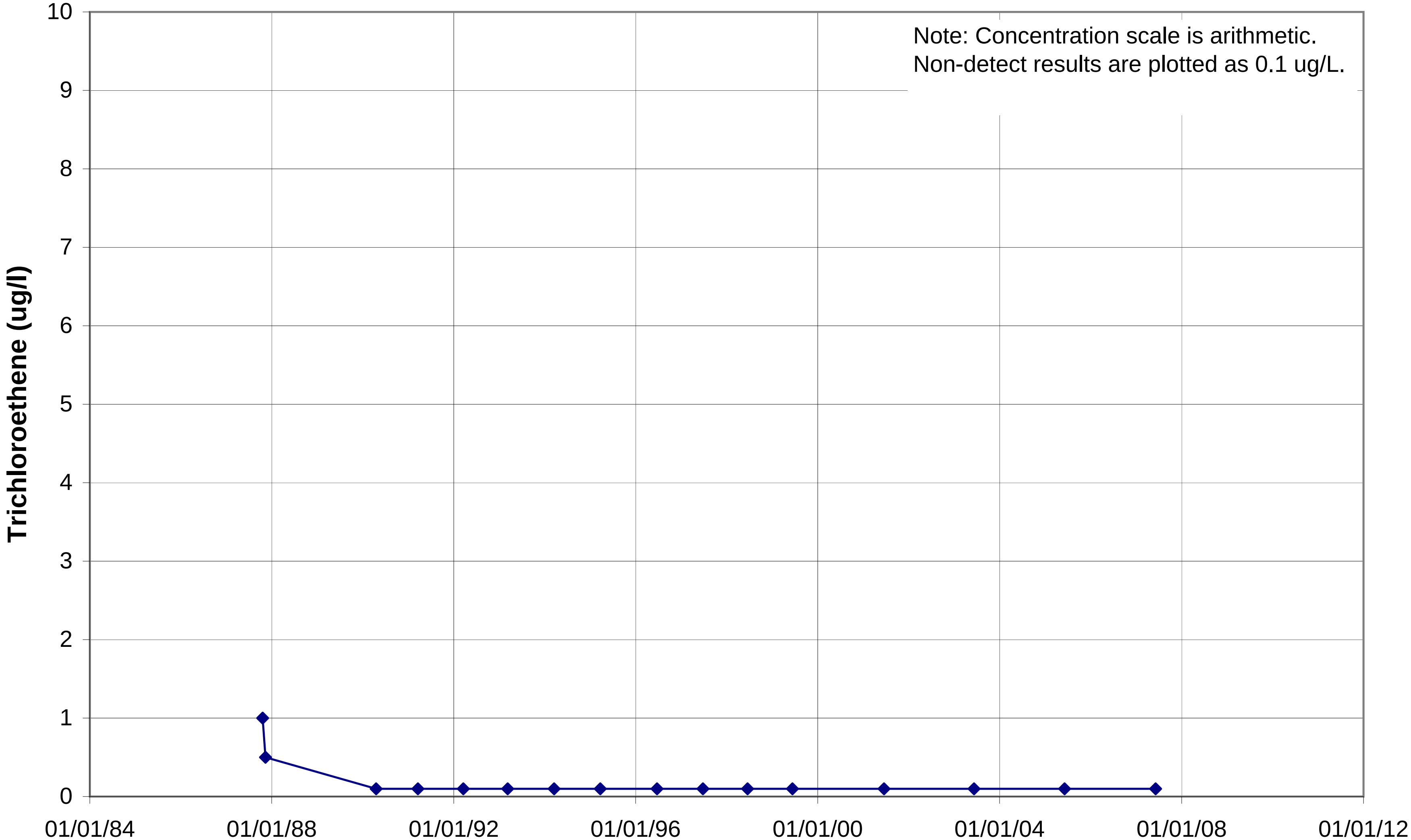

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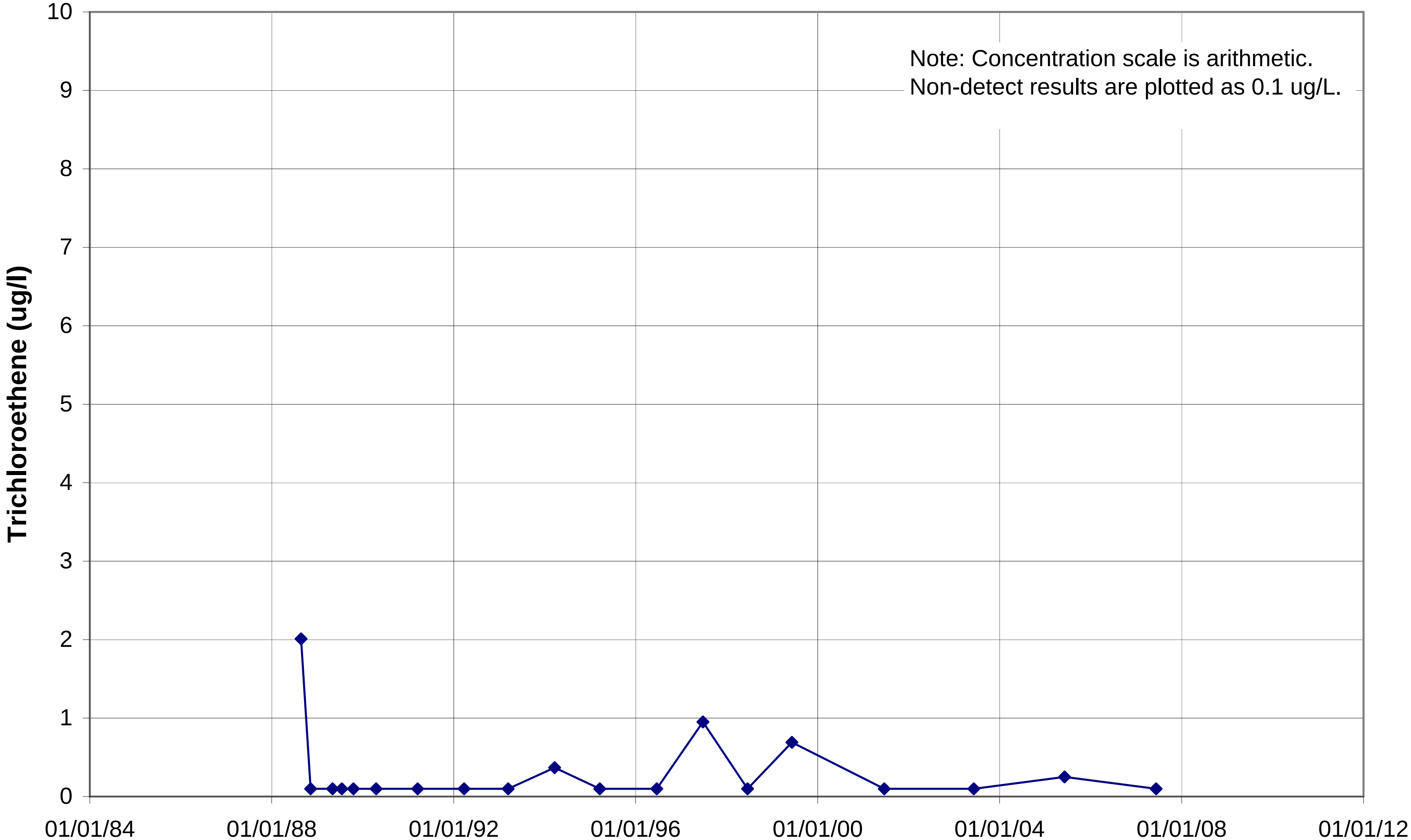

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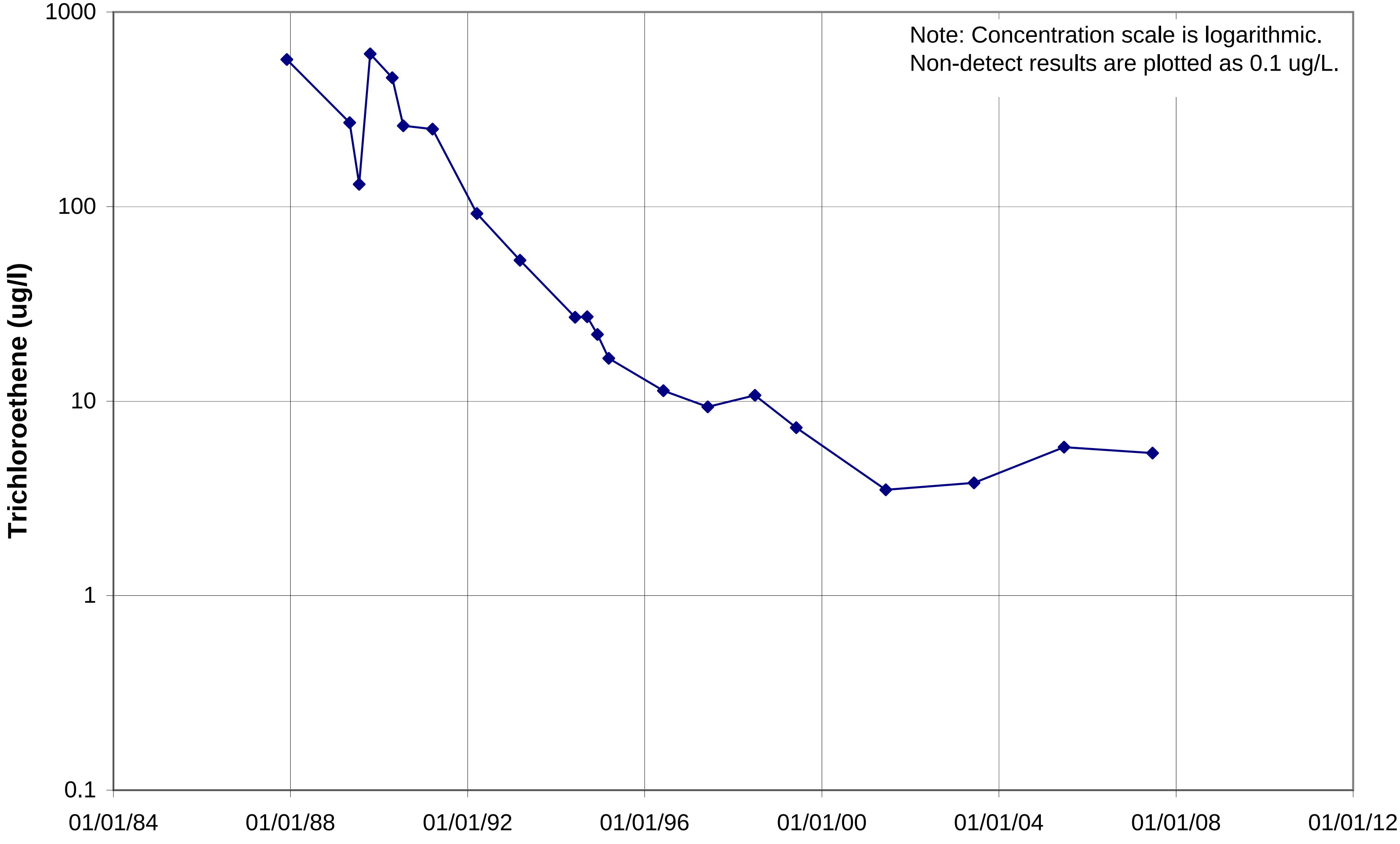

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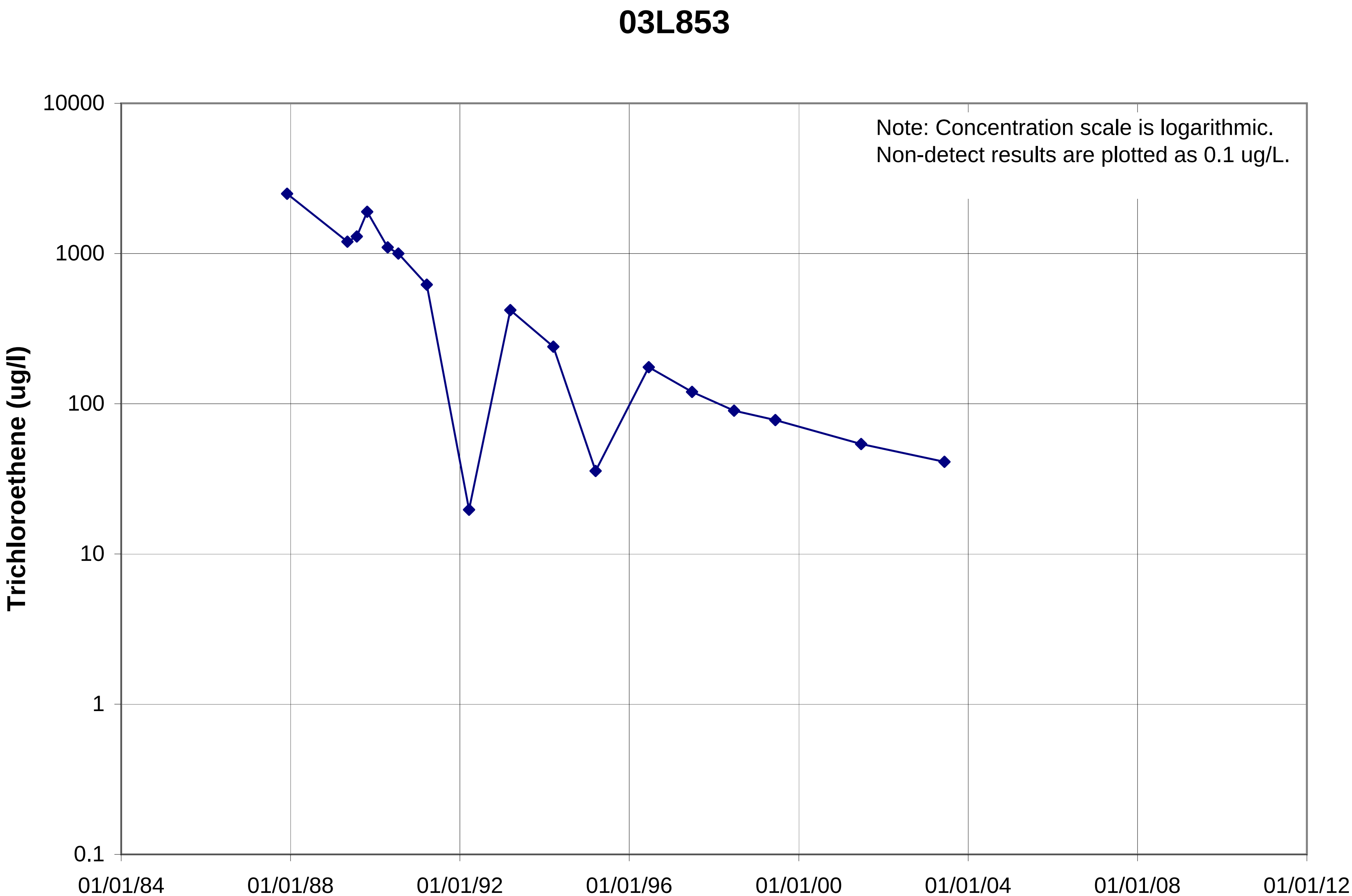

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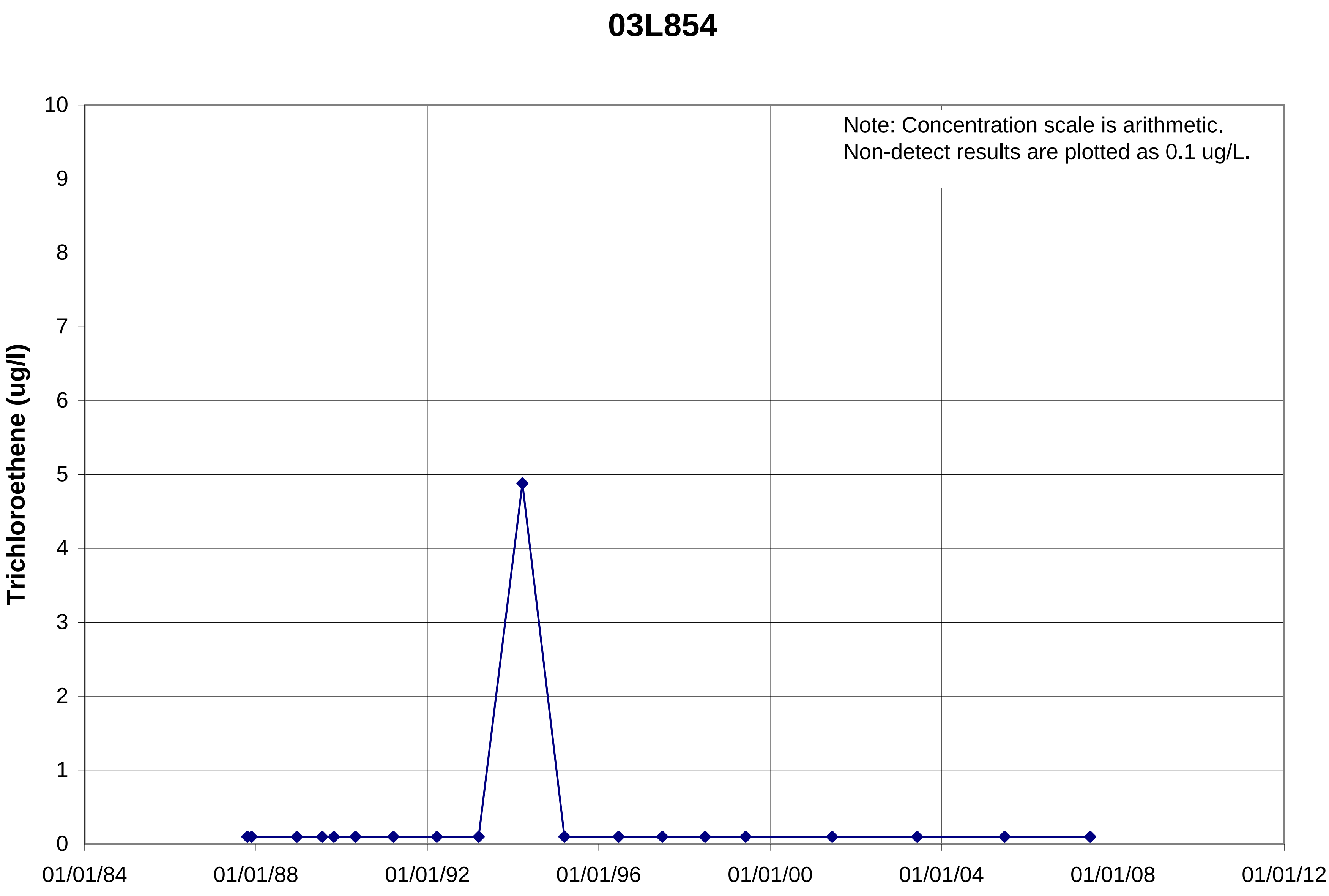

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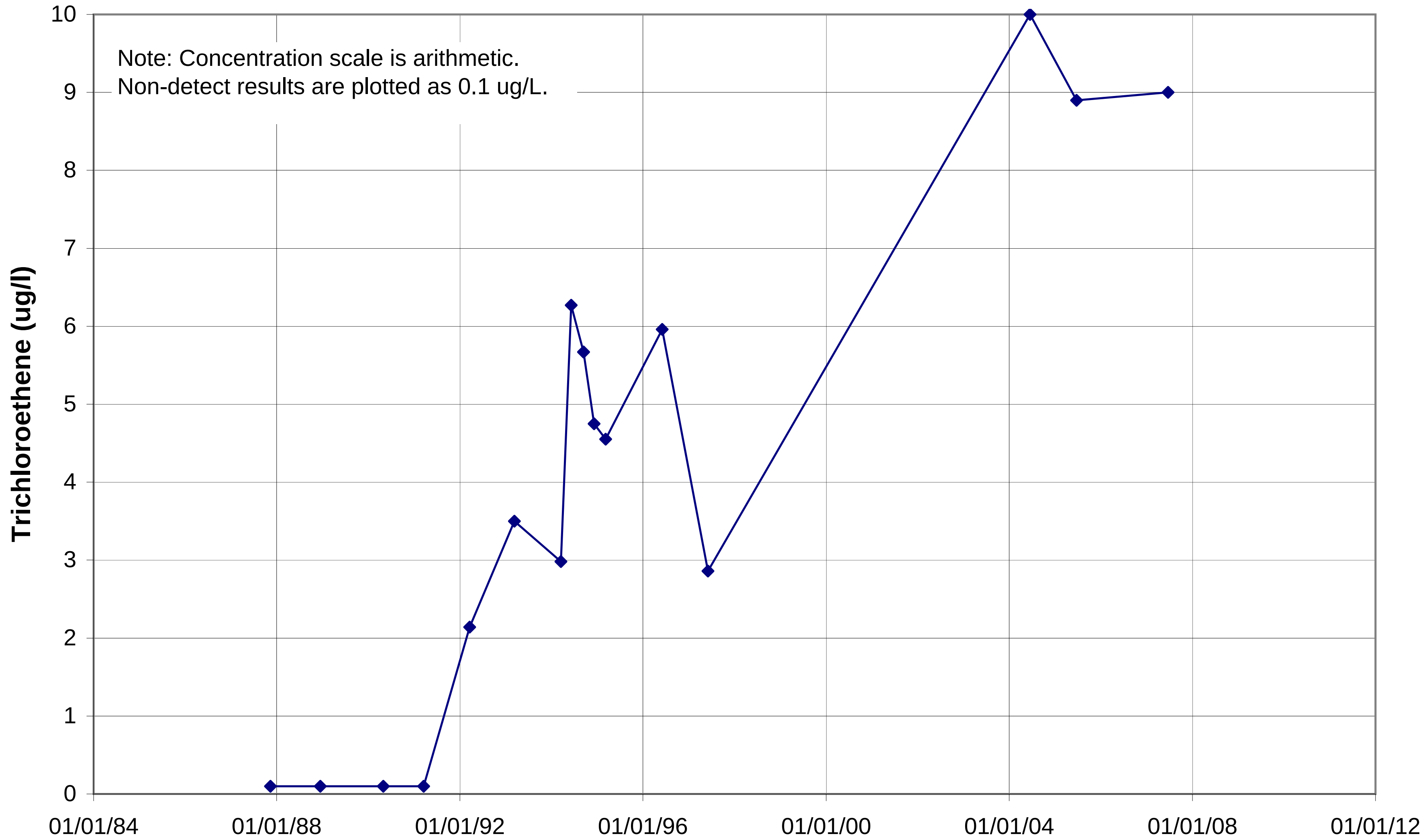
03L859



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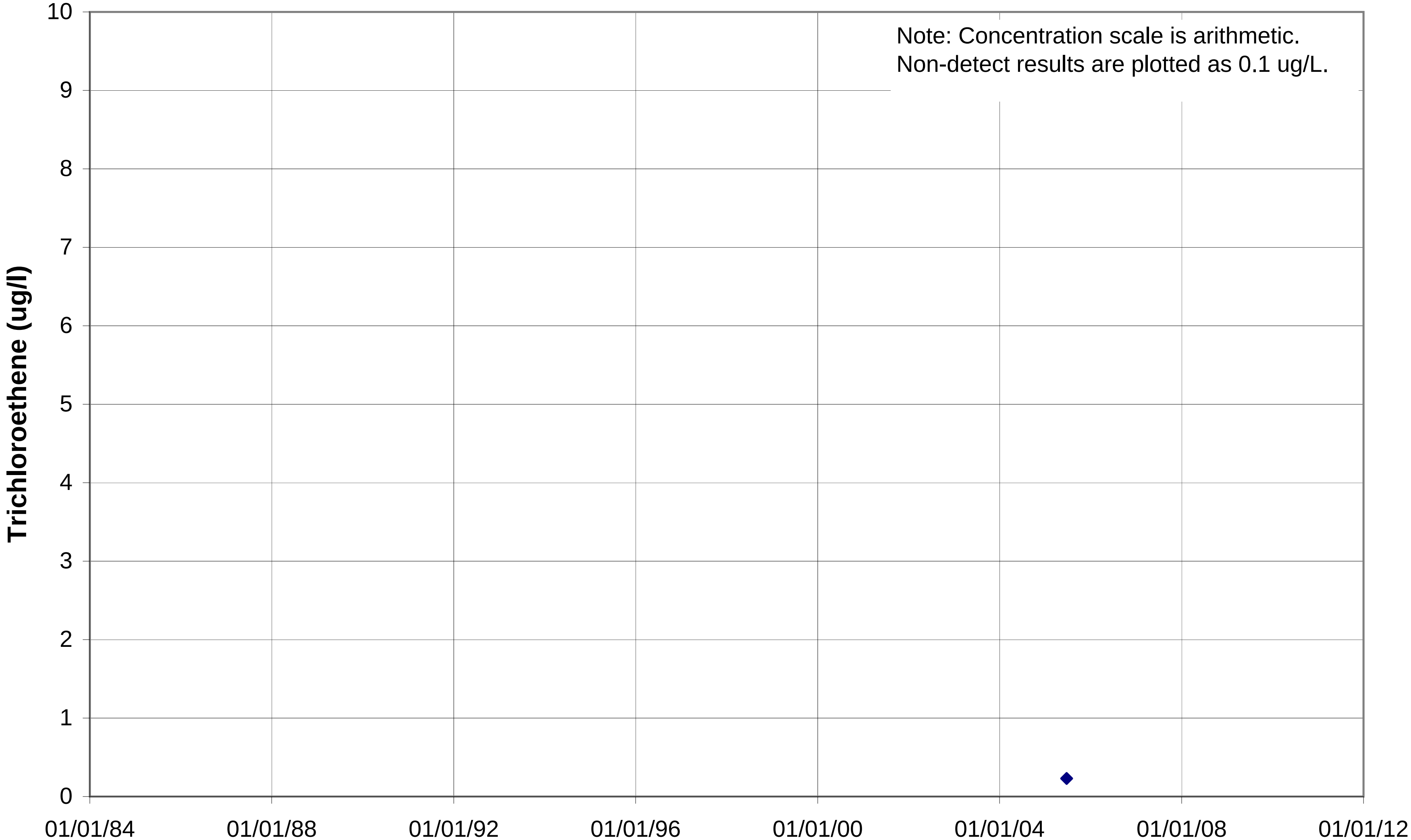

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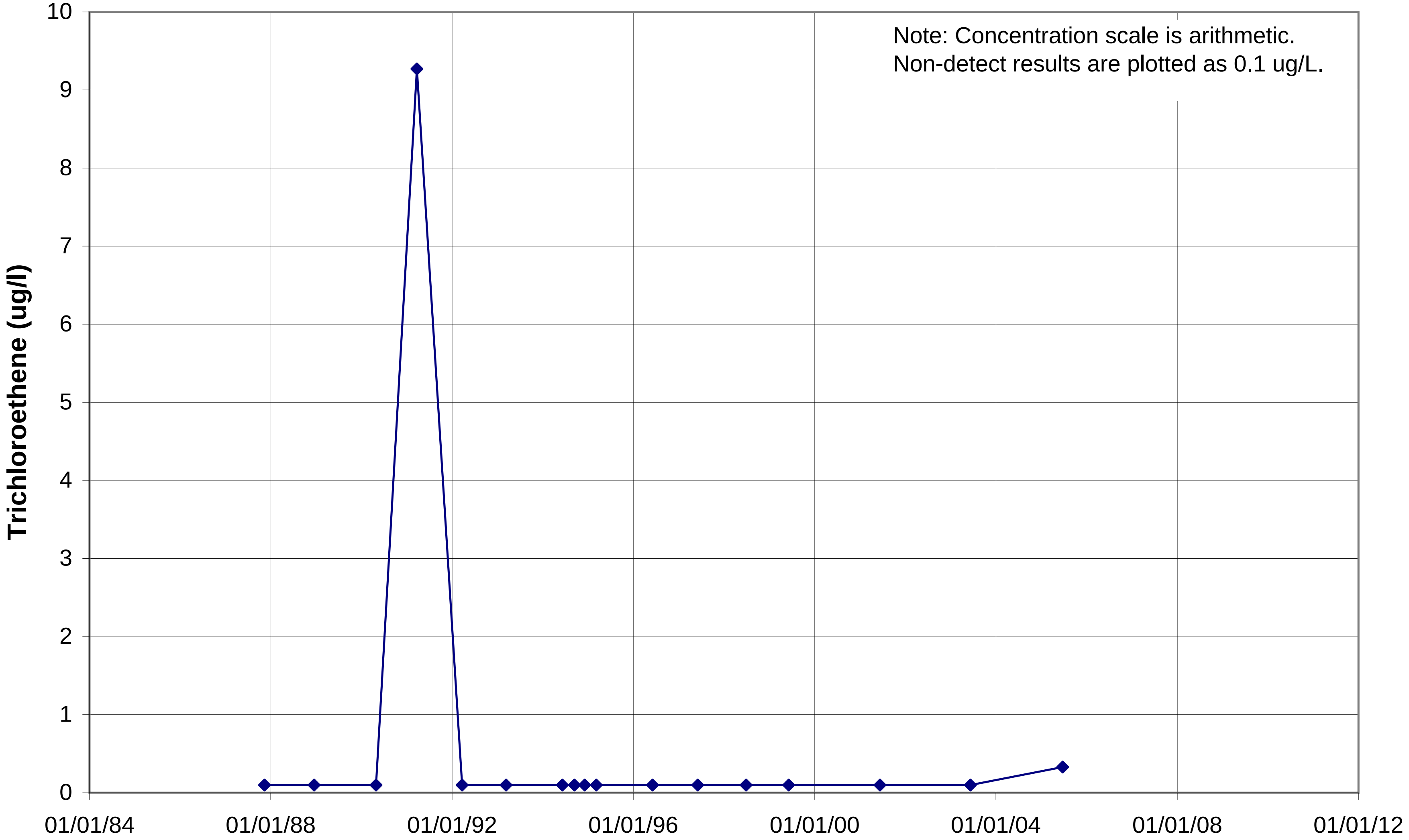
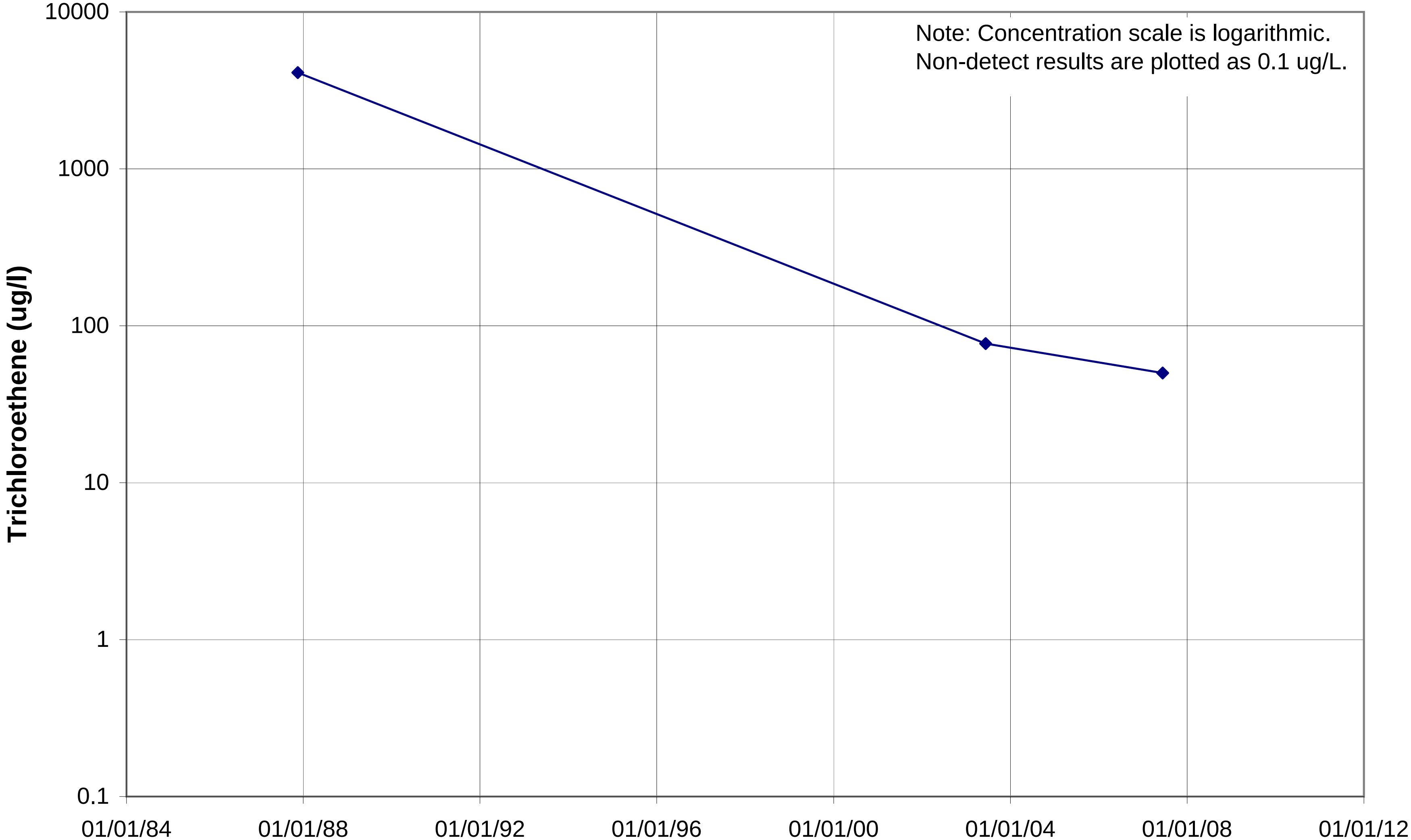
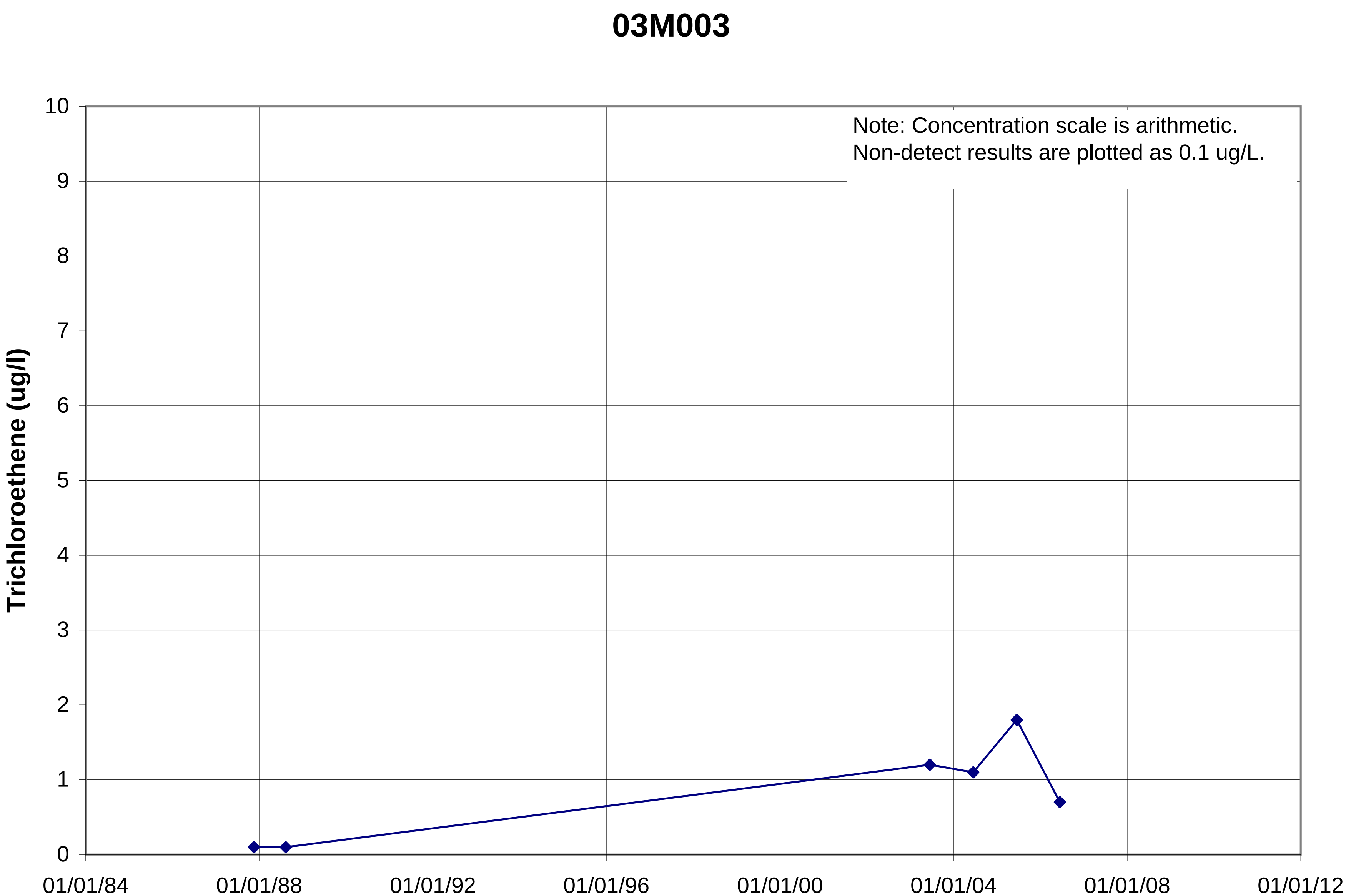


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

03M002



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar



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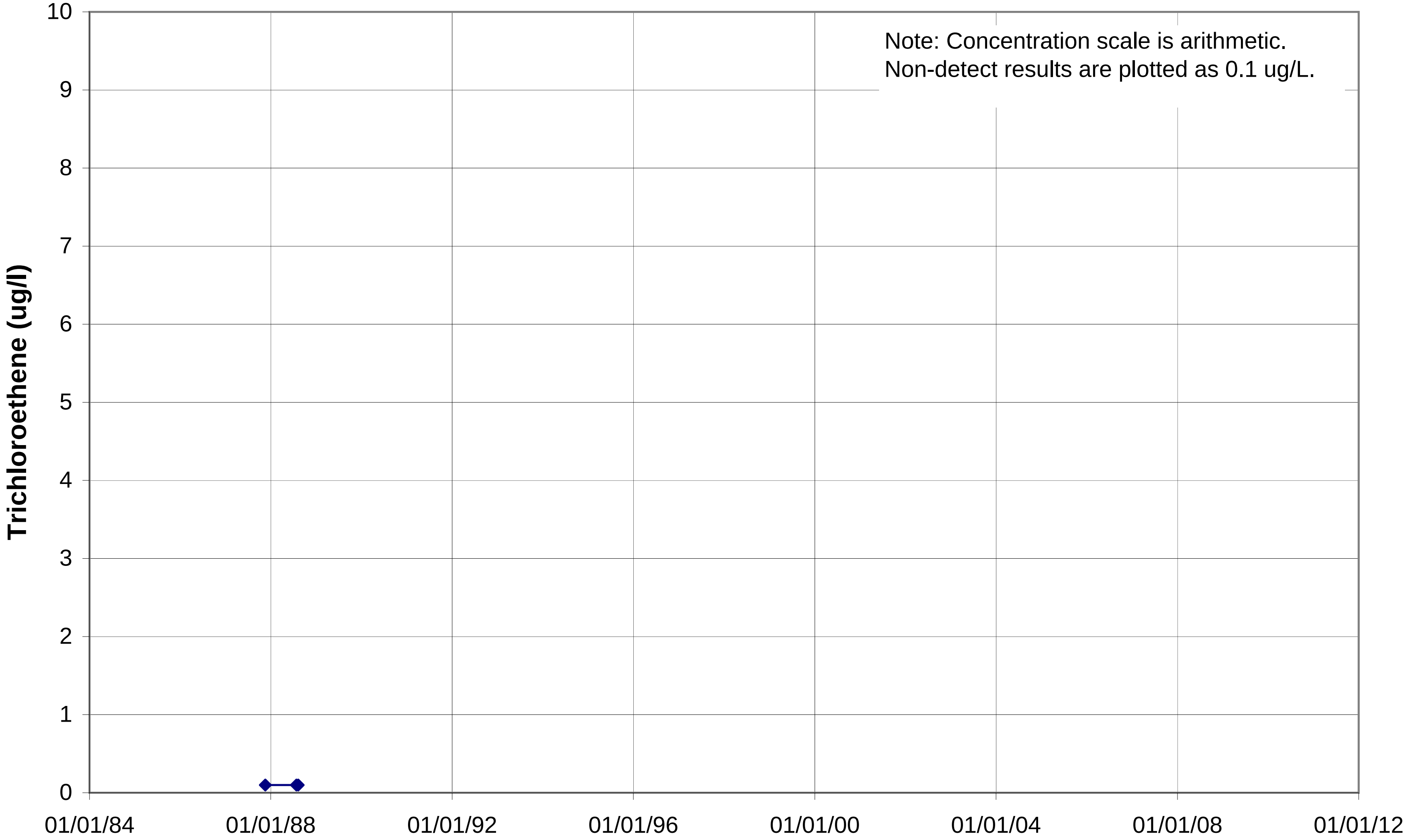

TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

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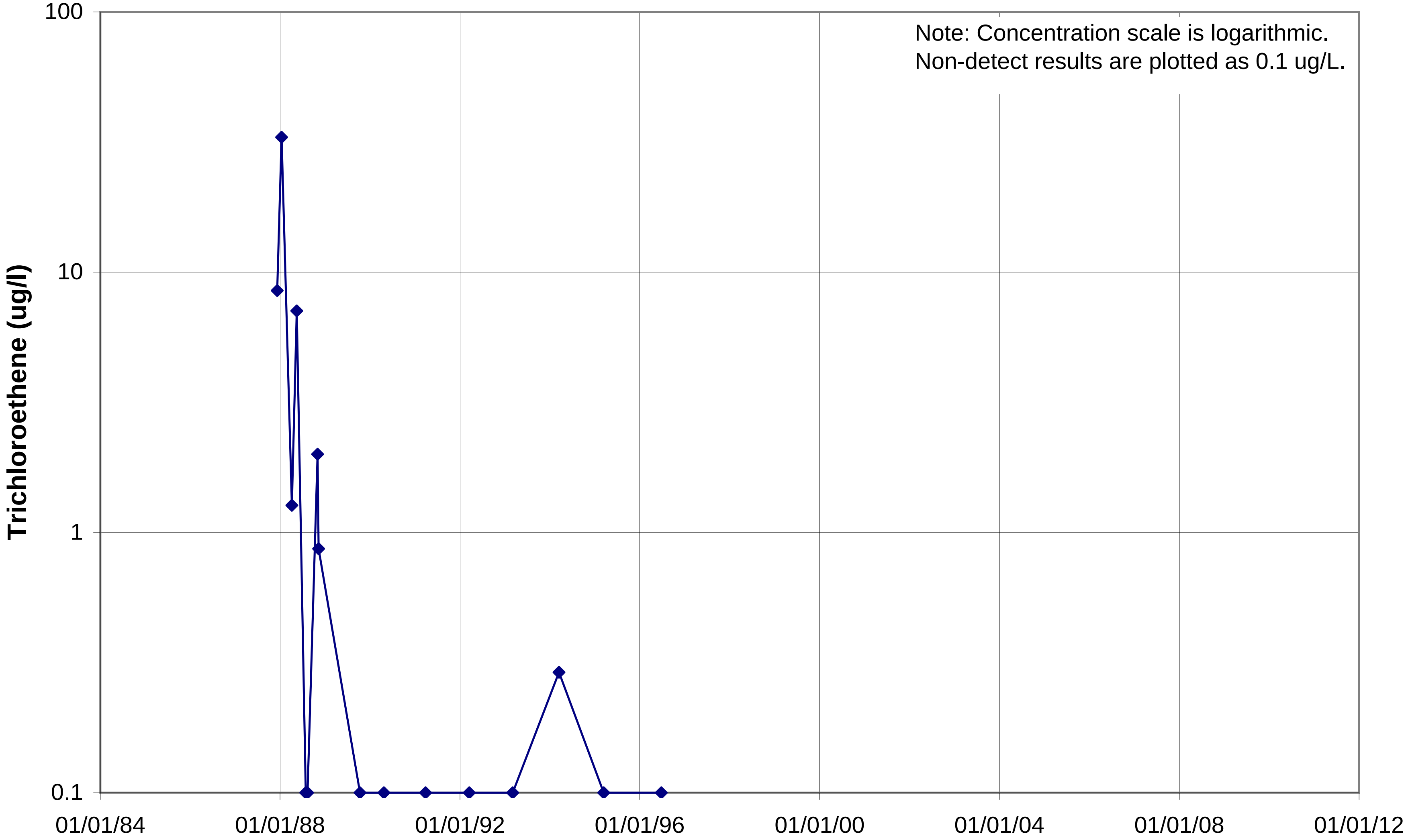
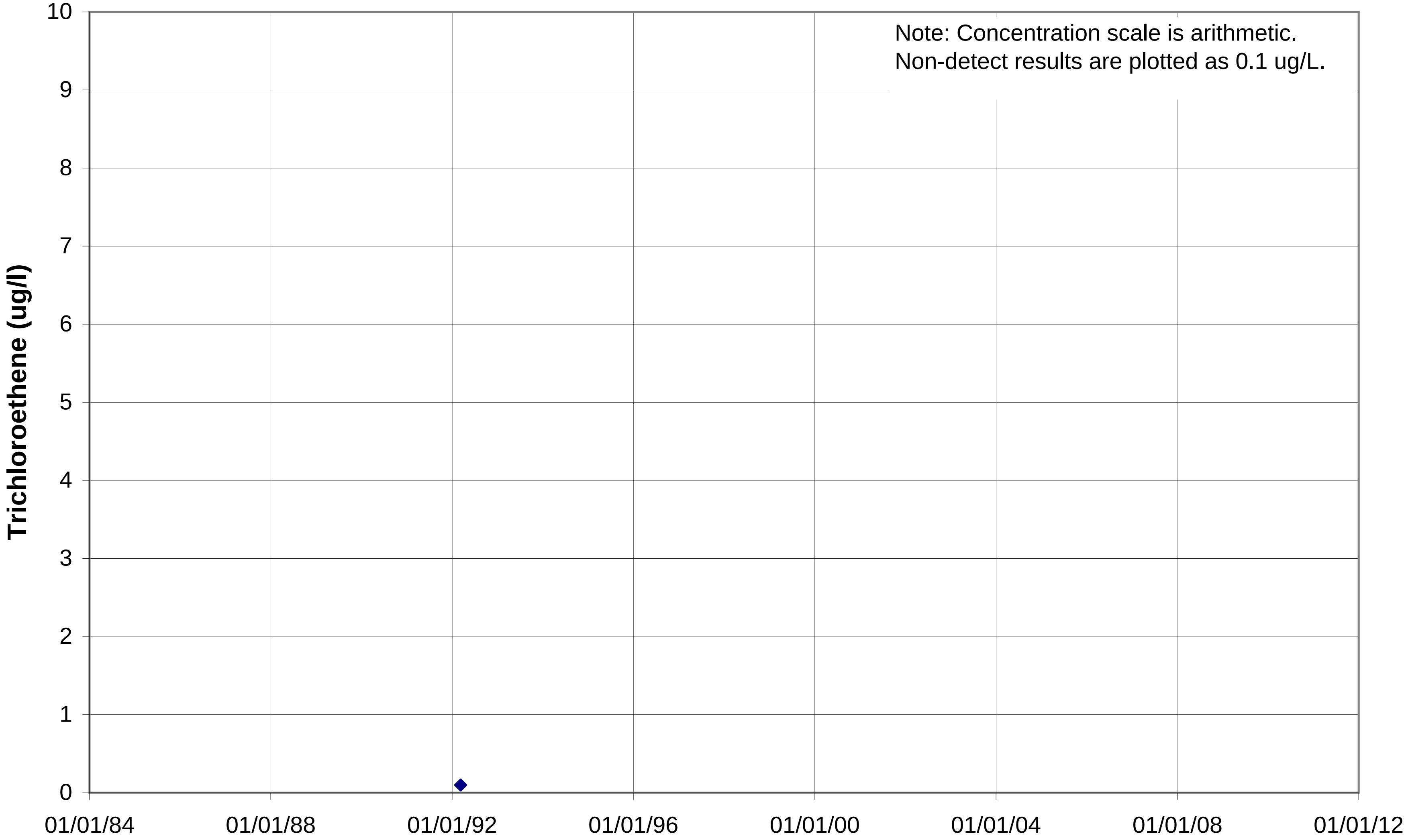


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

03M010



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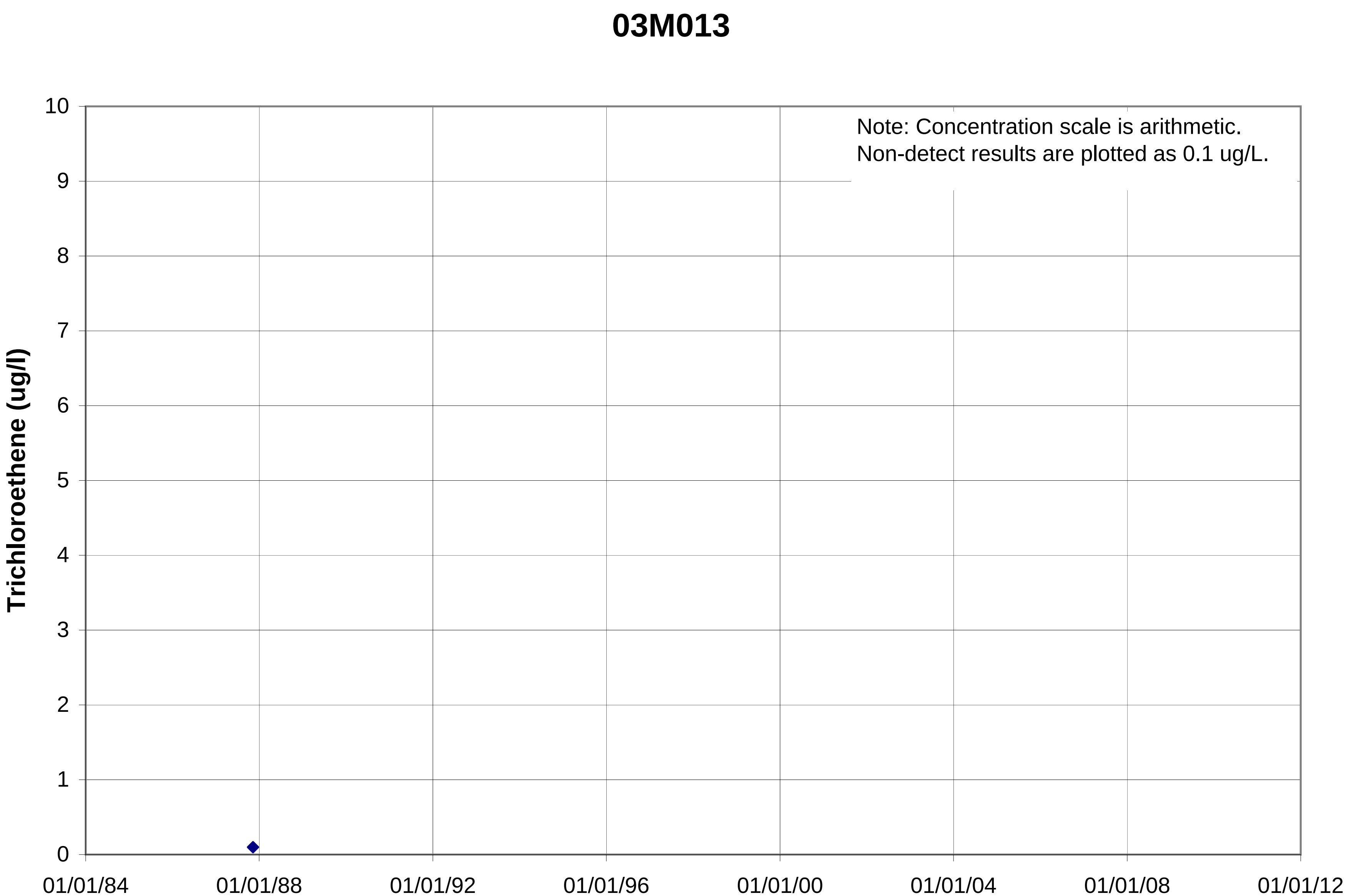

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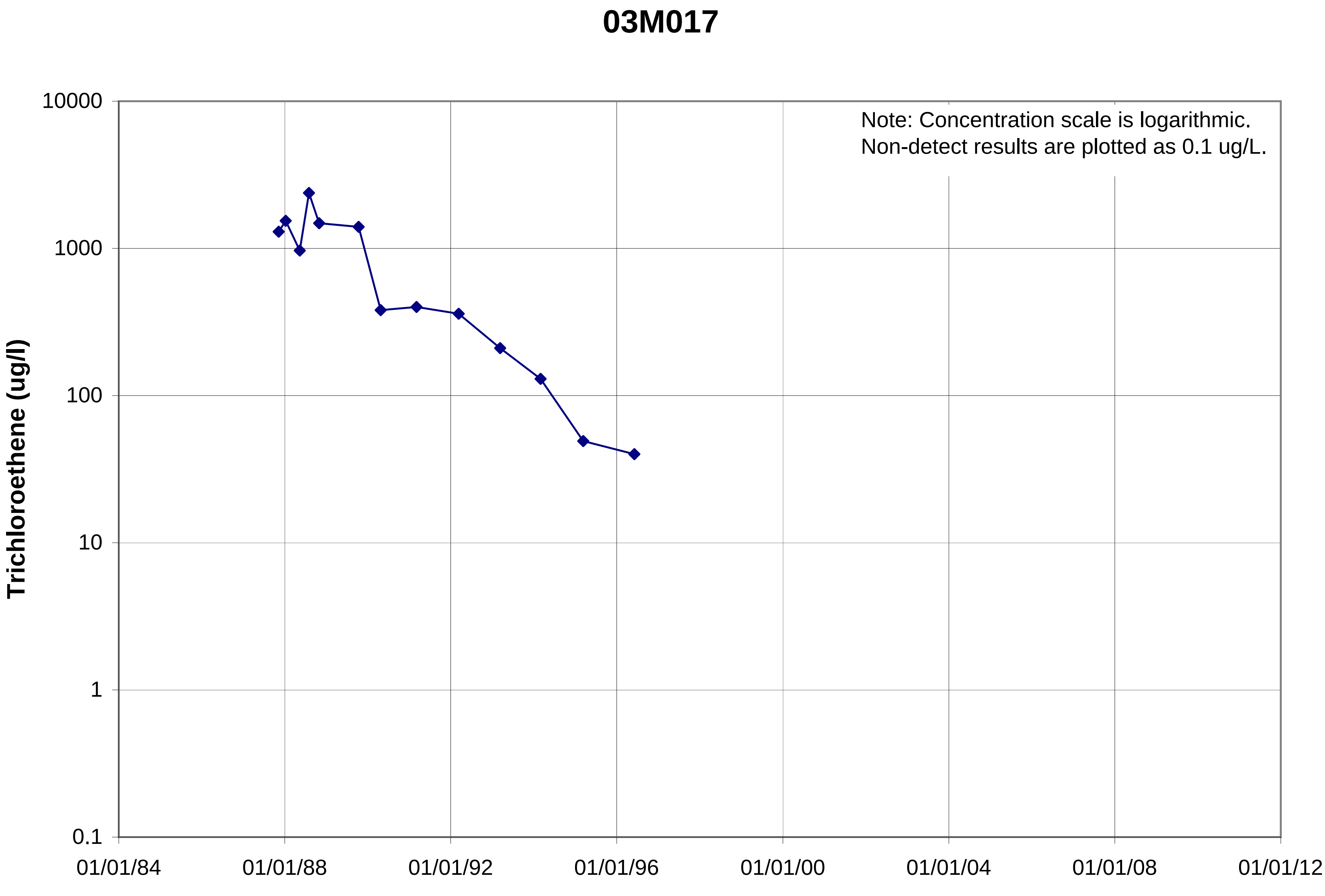

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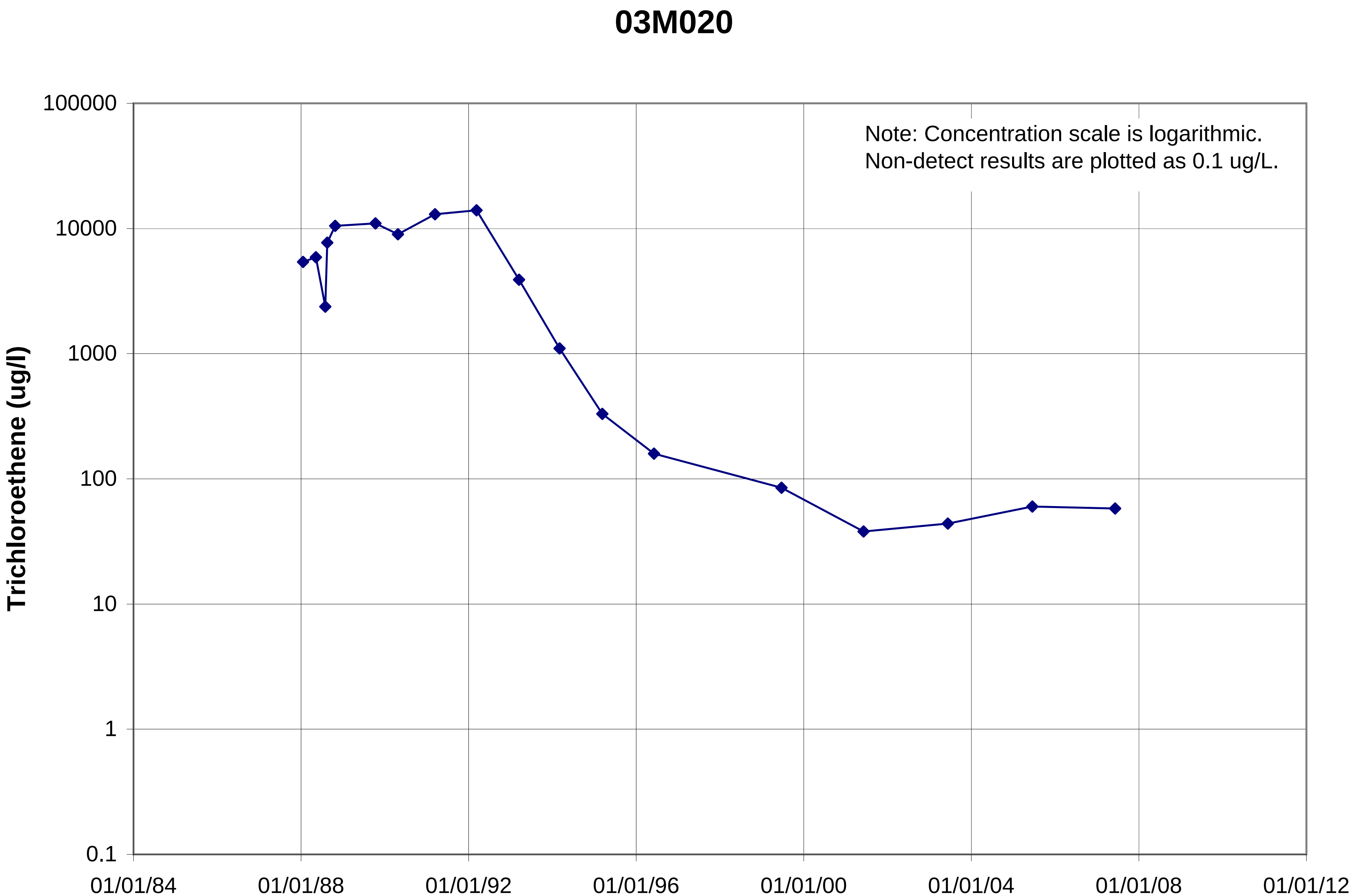

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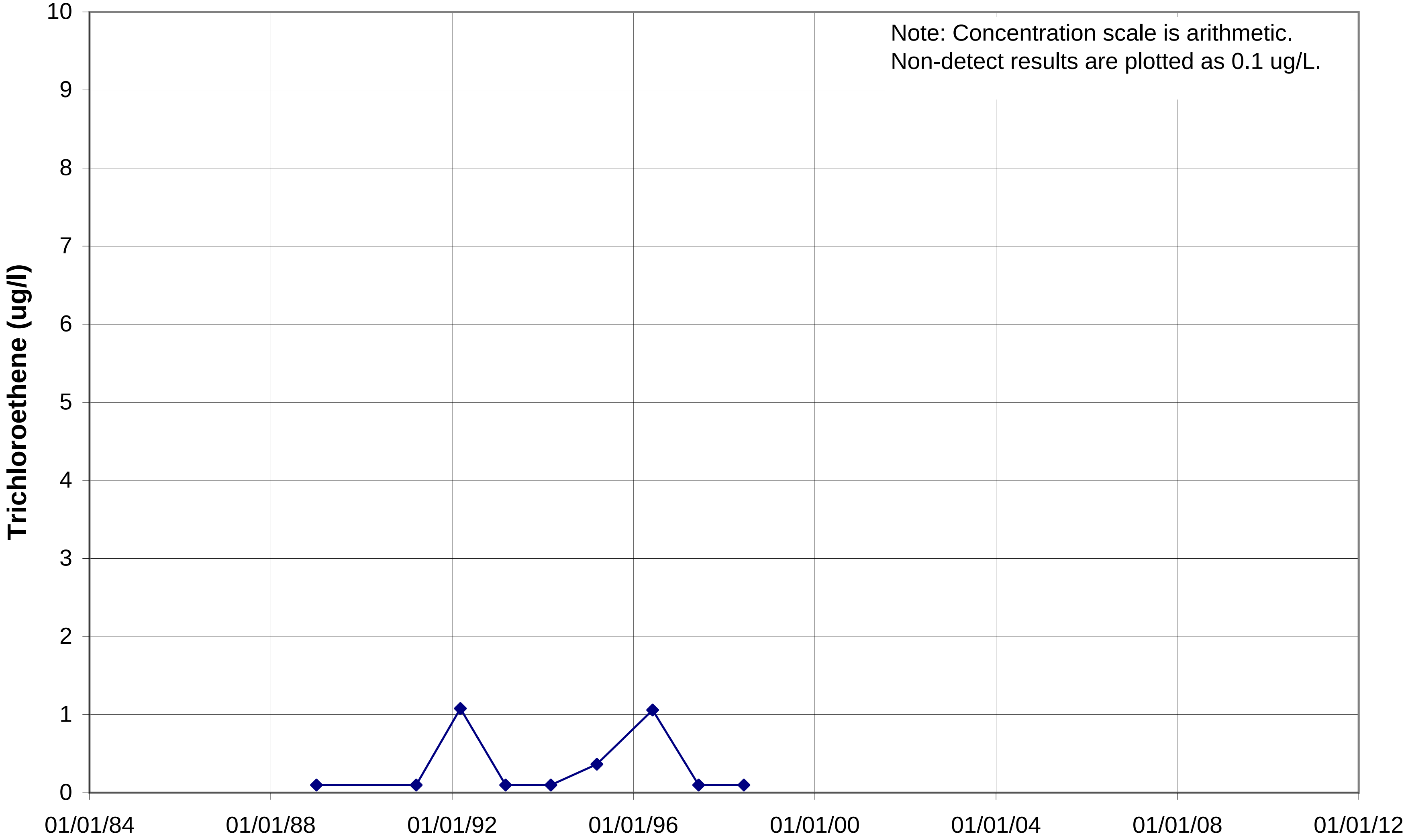
03M713



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

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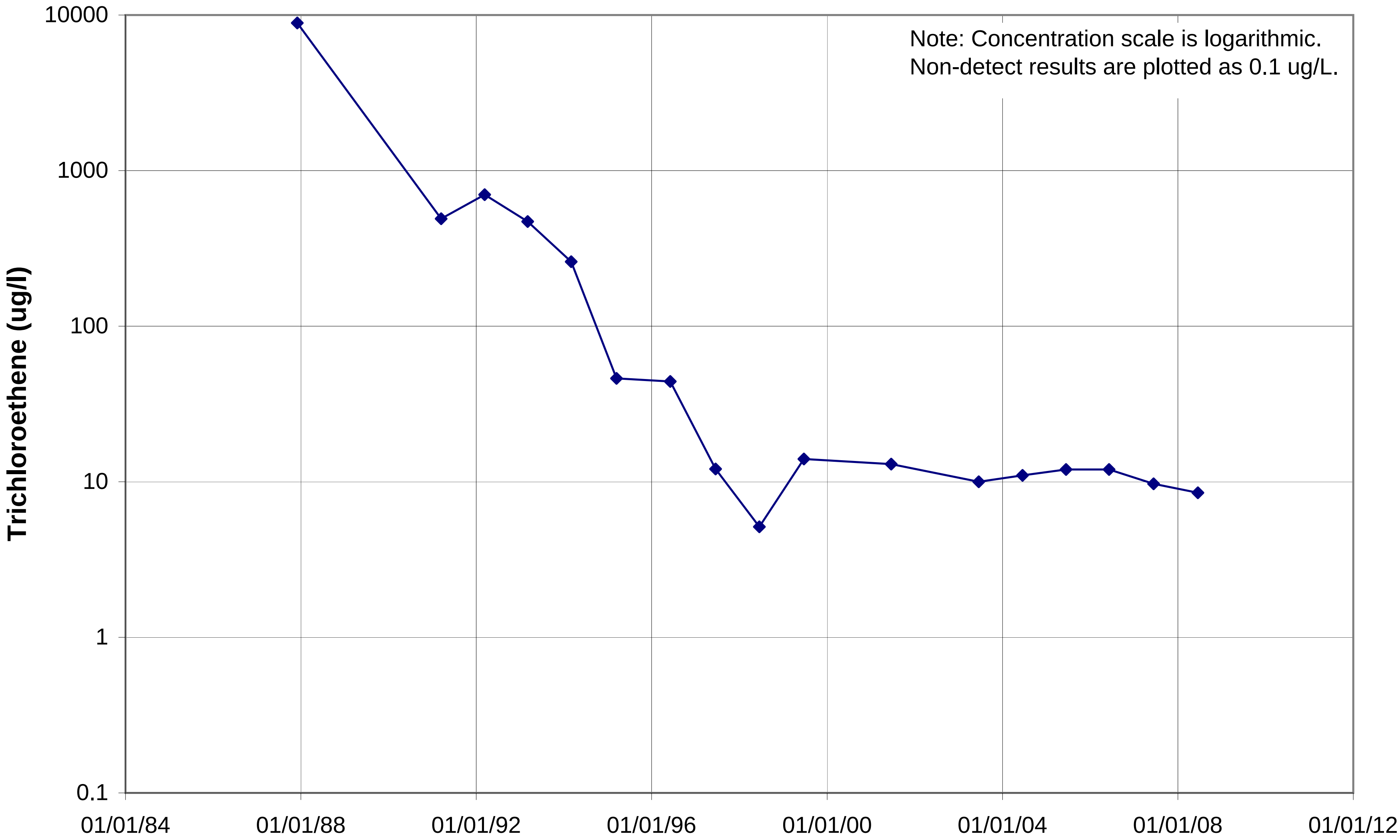
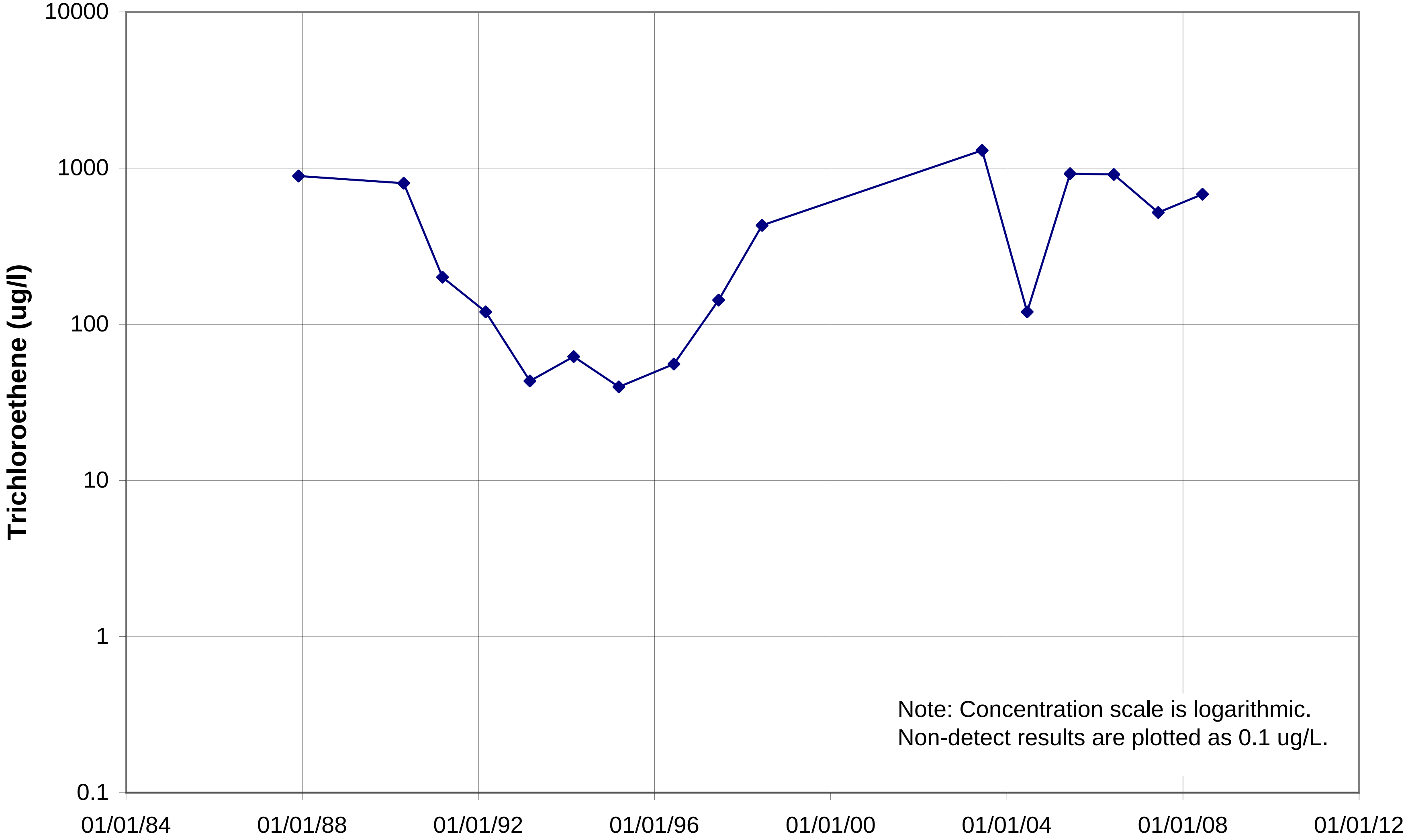
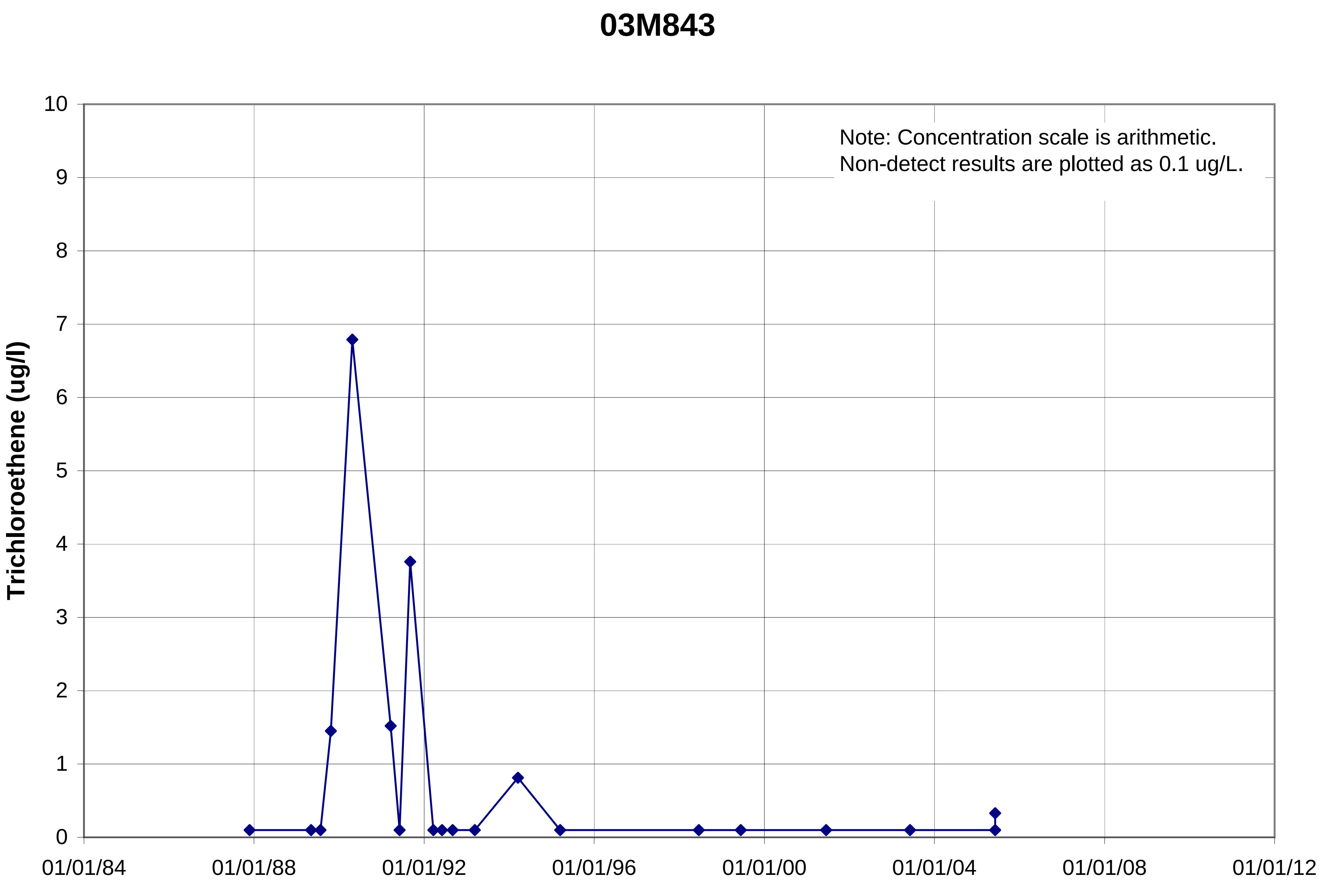


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

03M806



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar



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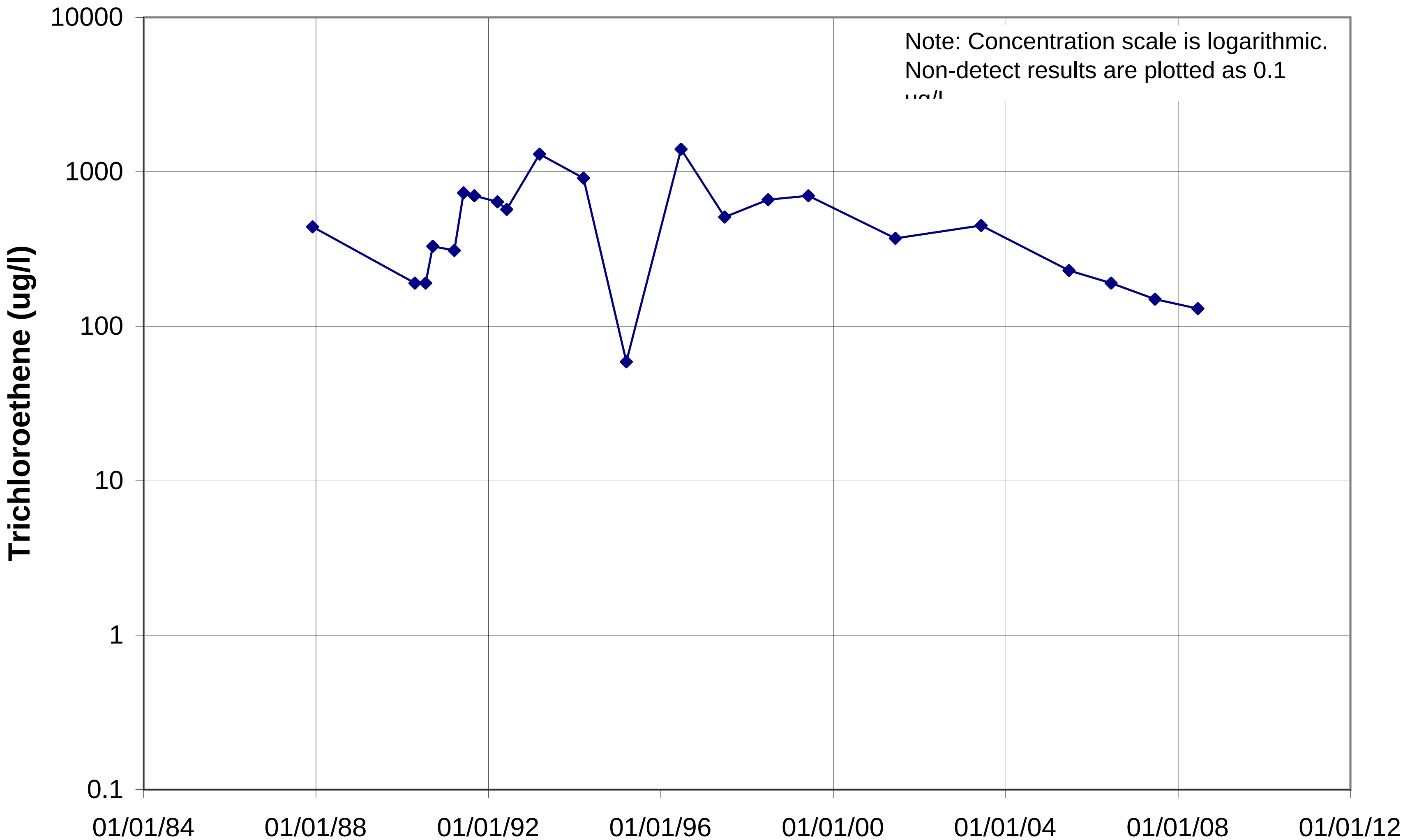
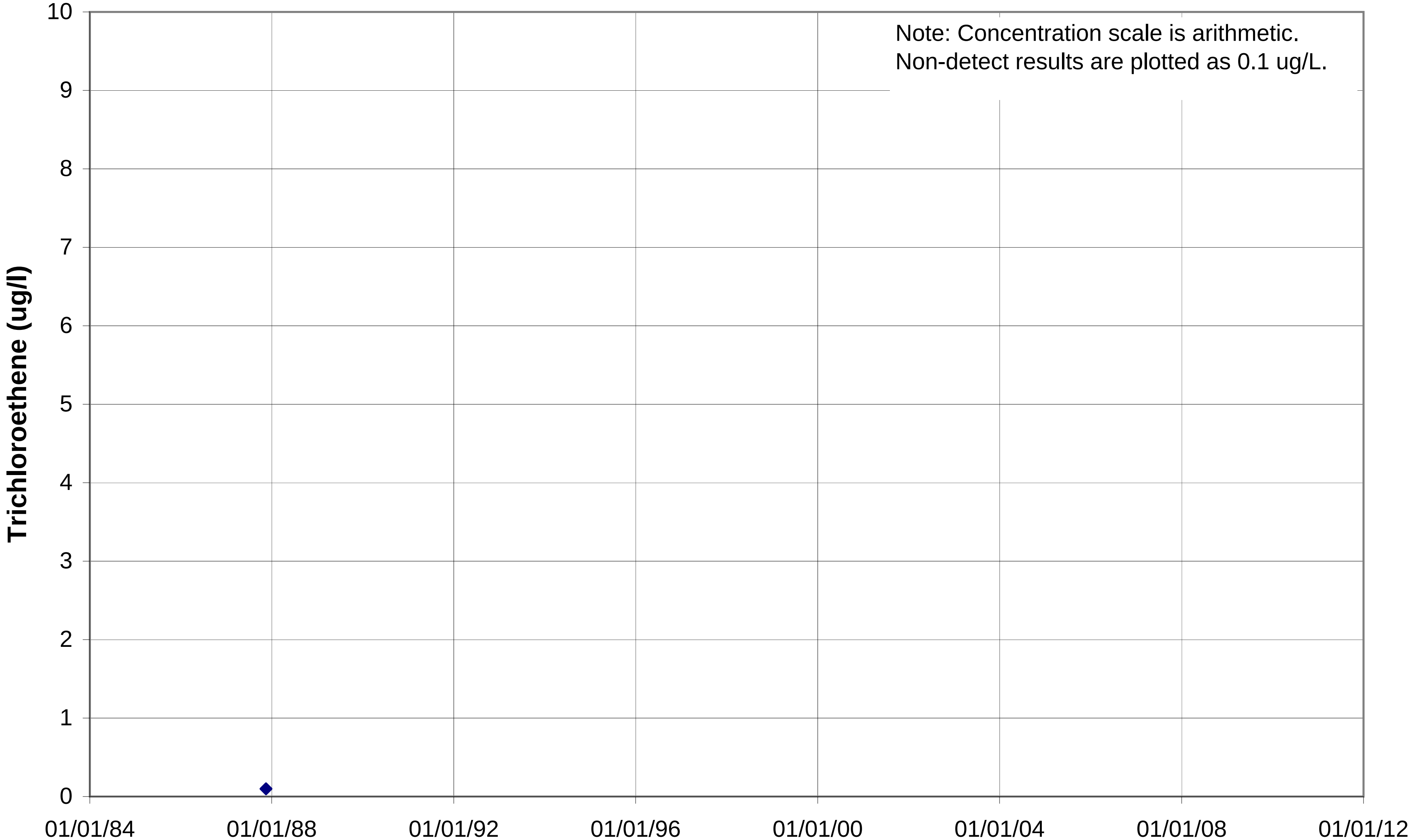
03M848



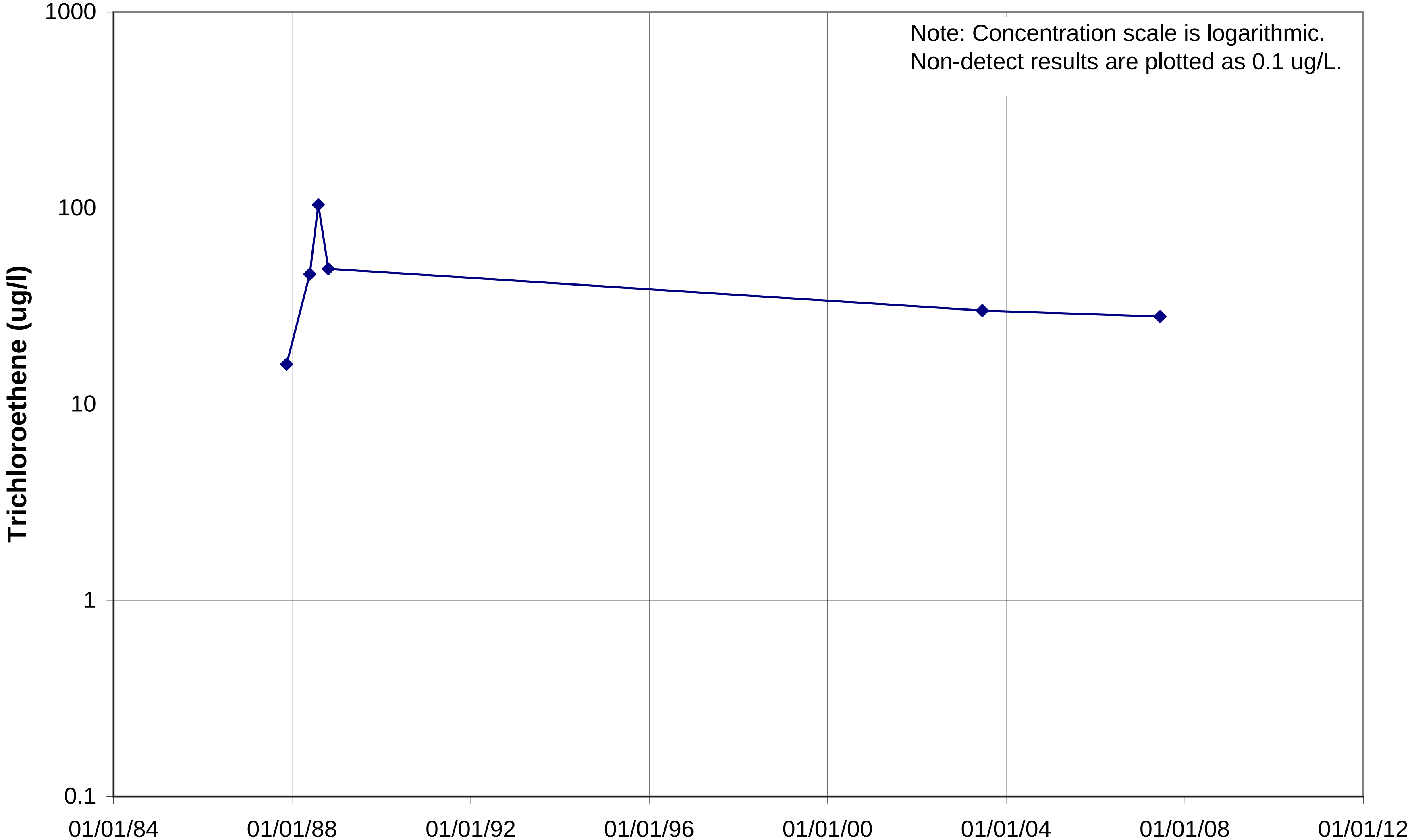
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

03U001



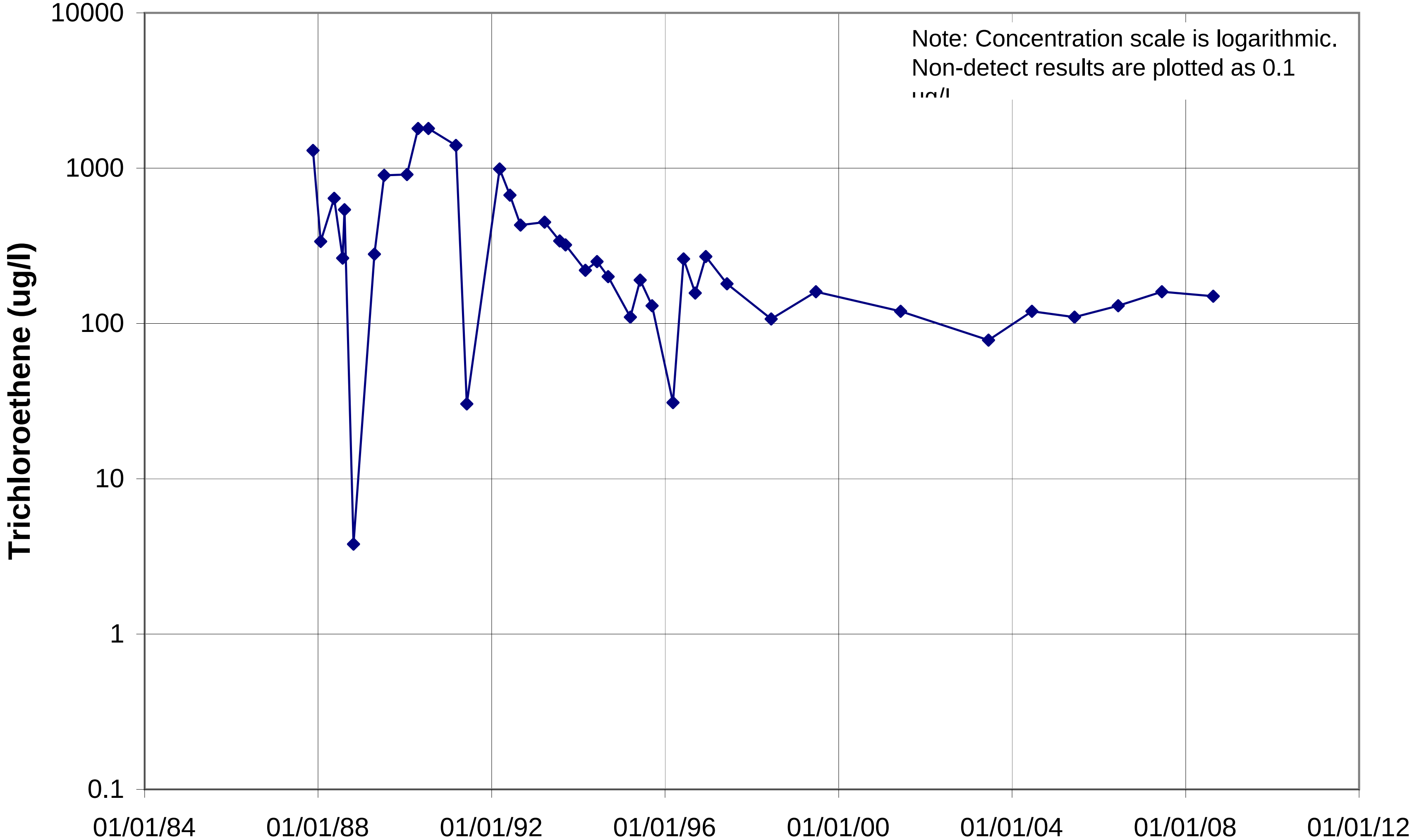
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

03U002



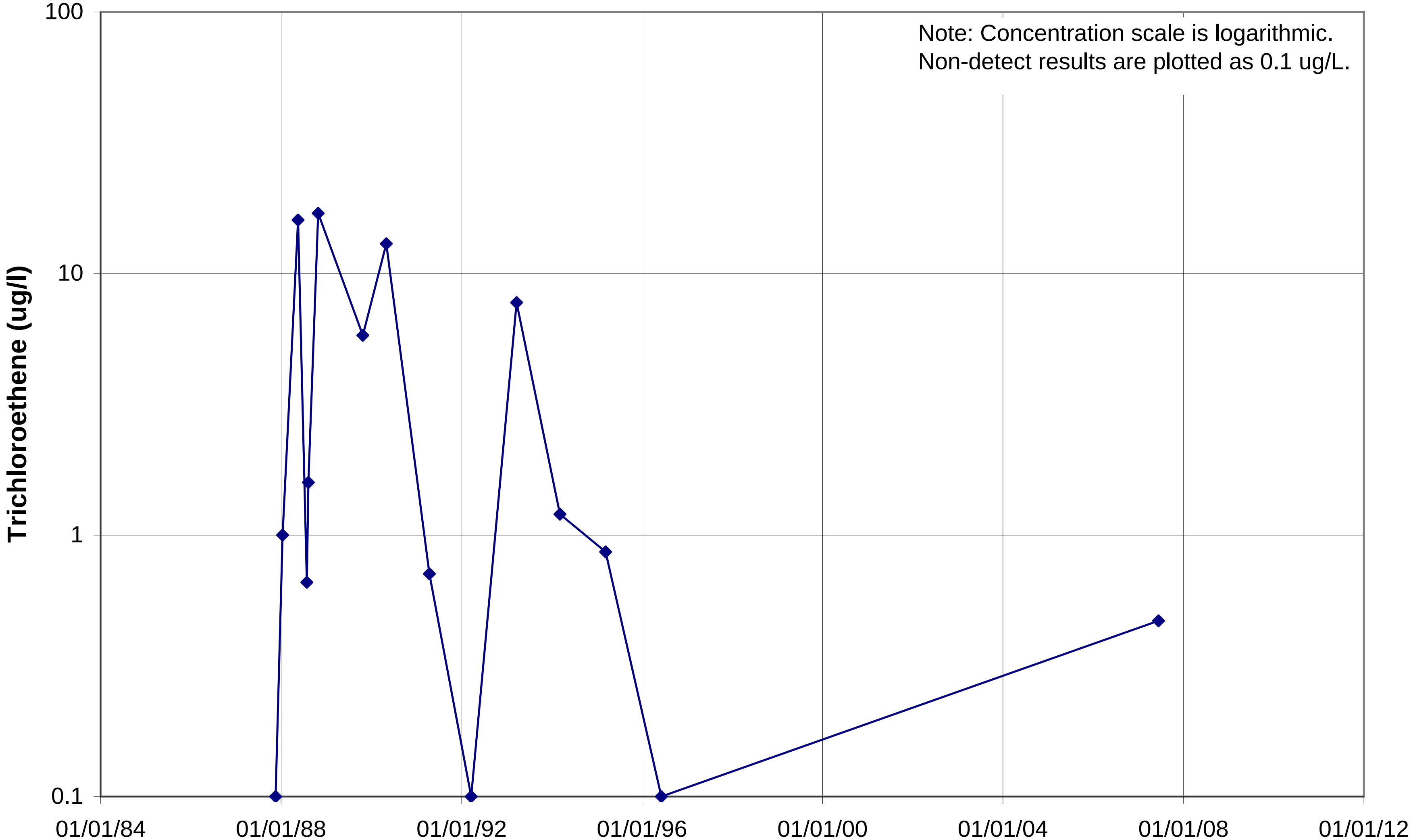
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

03U003



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

03U004



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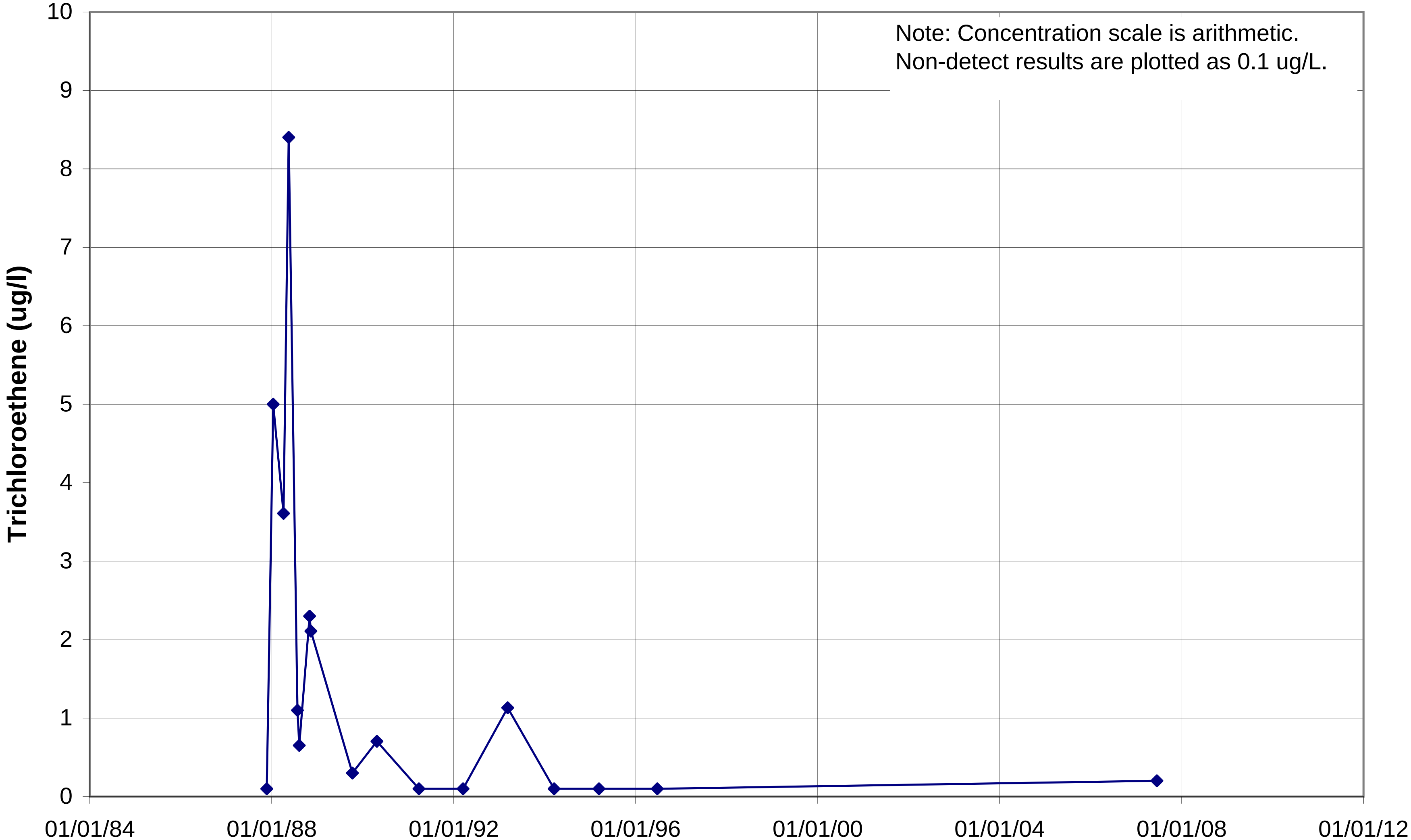
03U005



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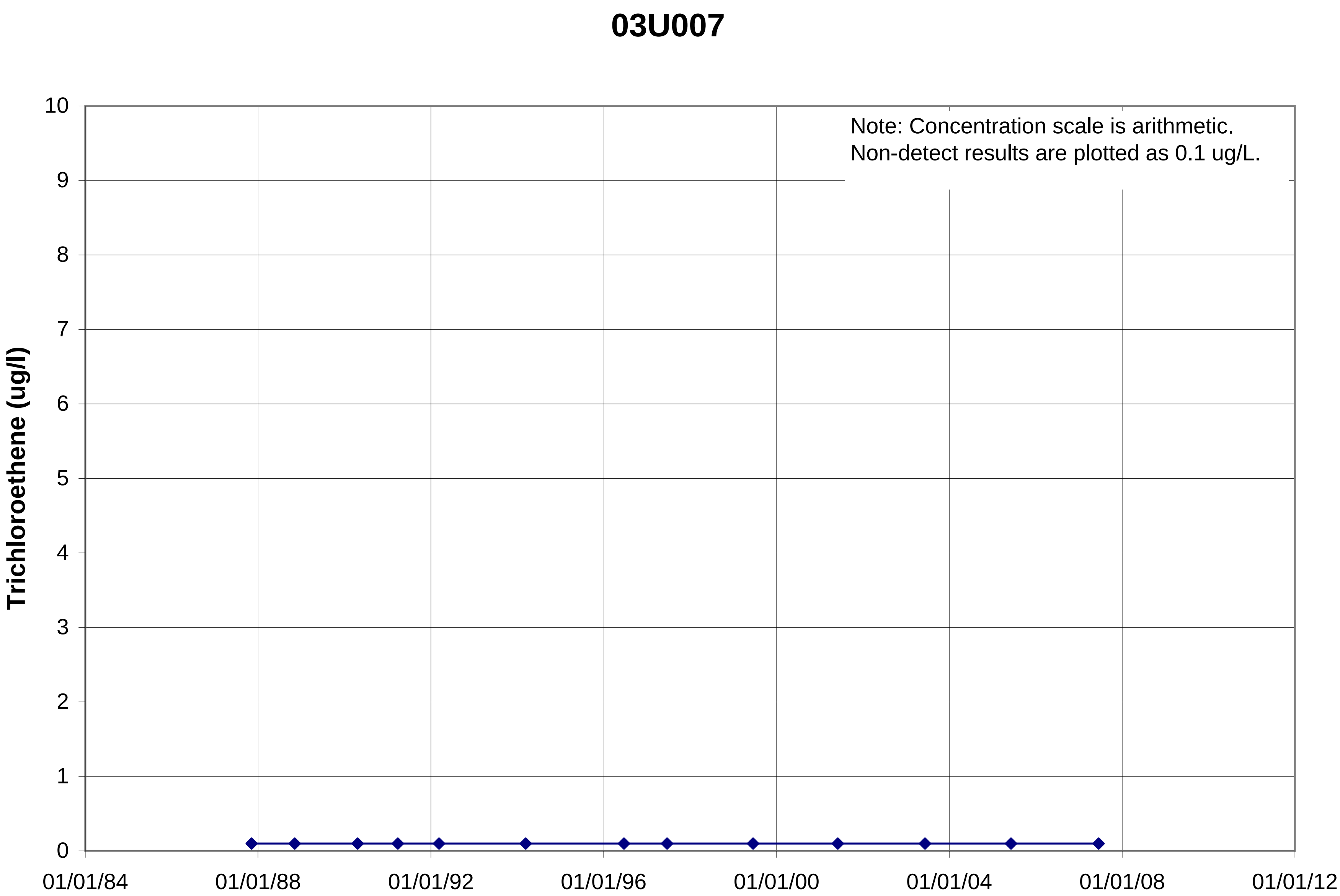

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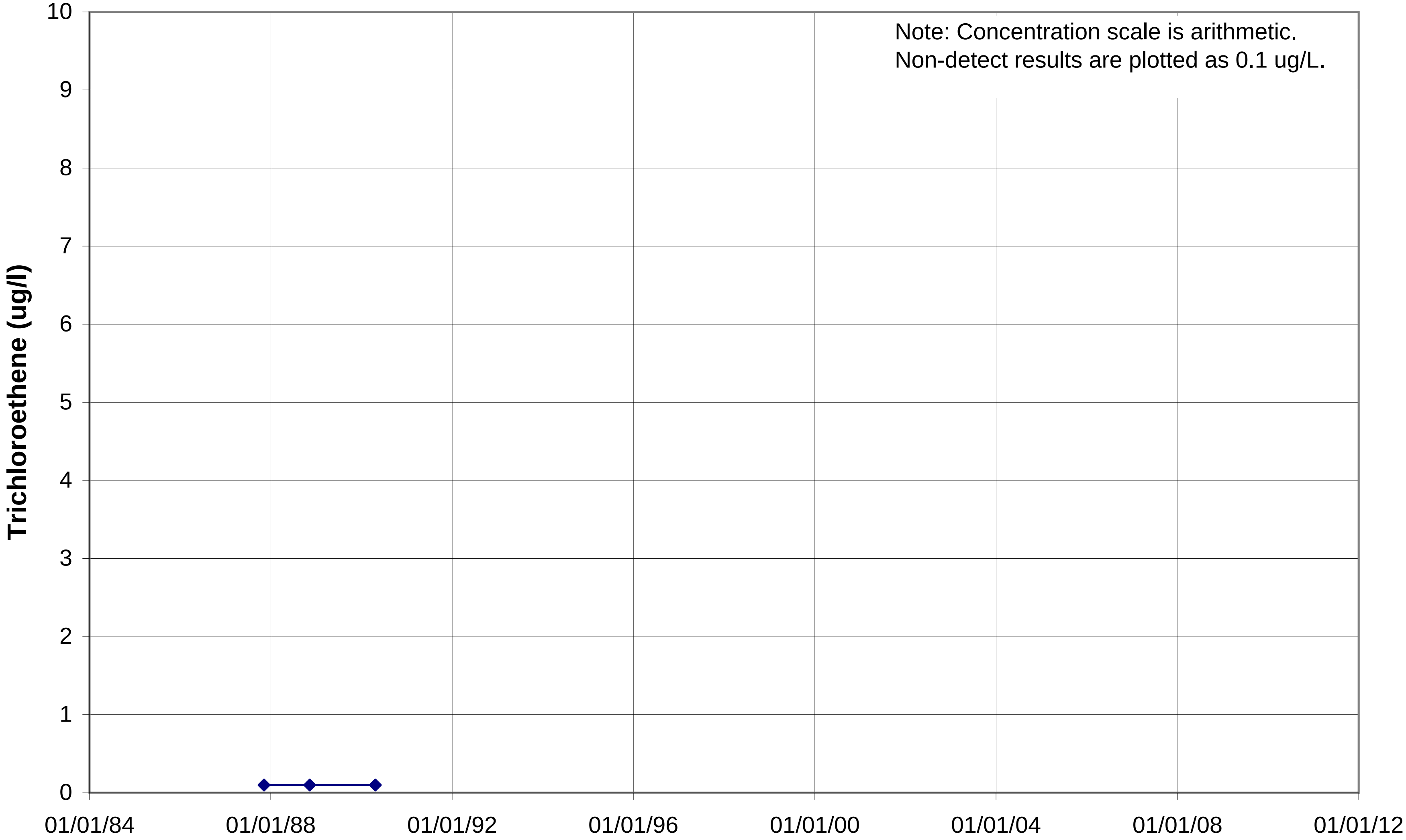

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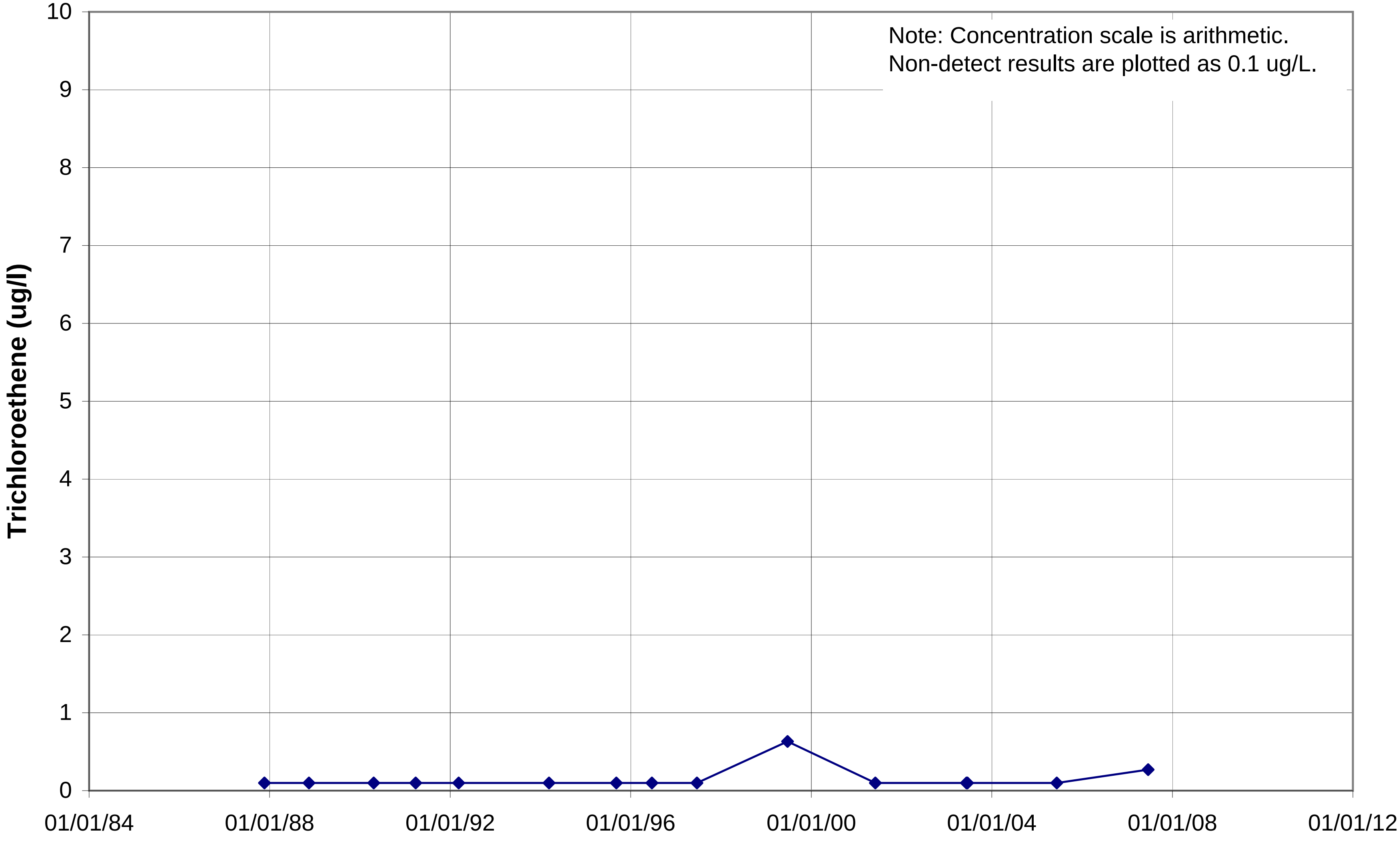

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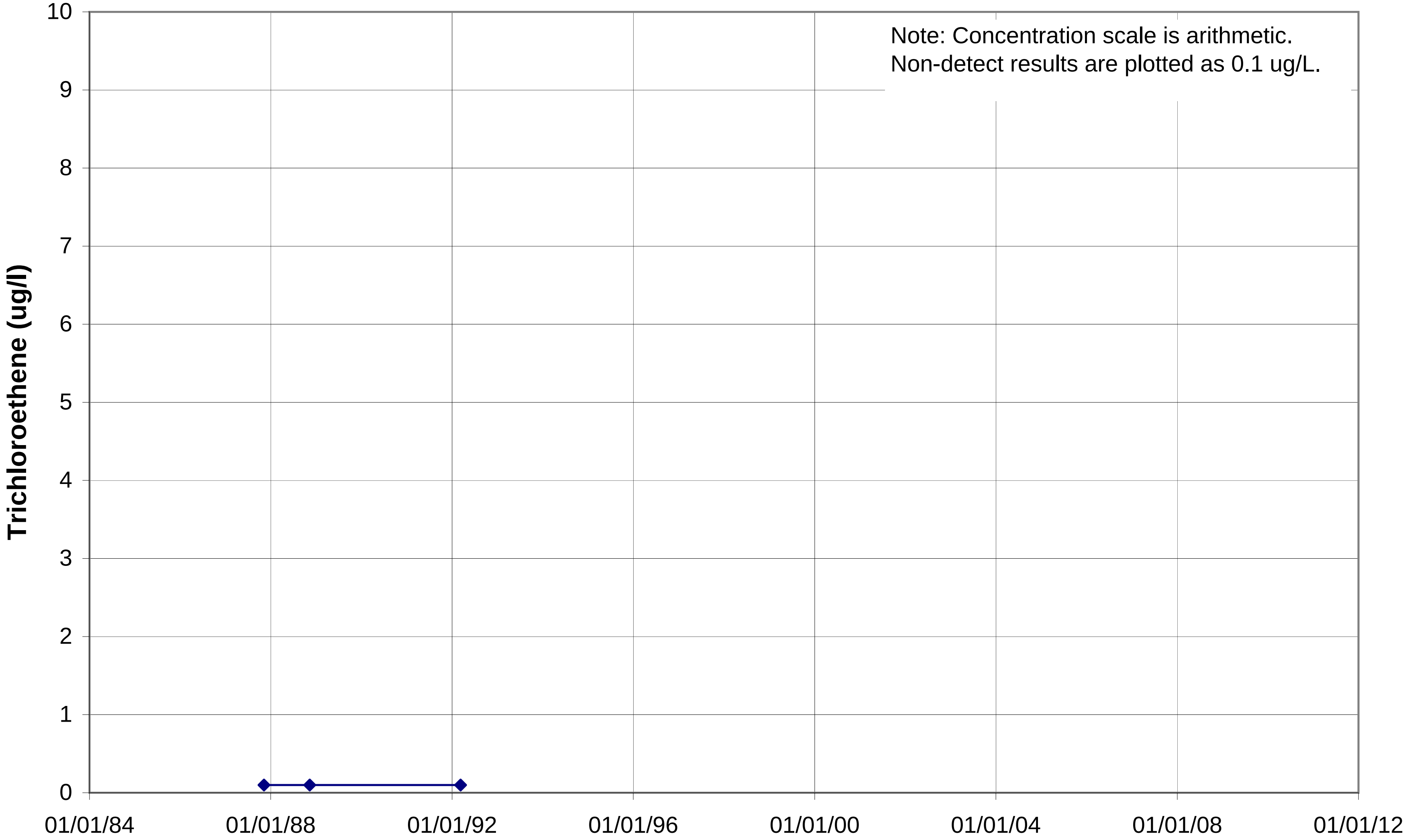

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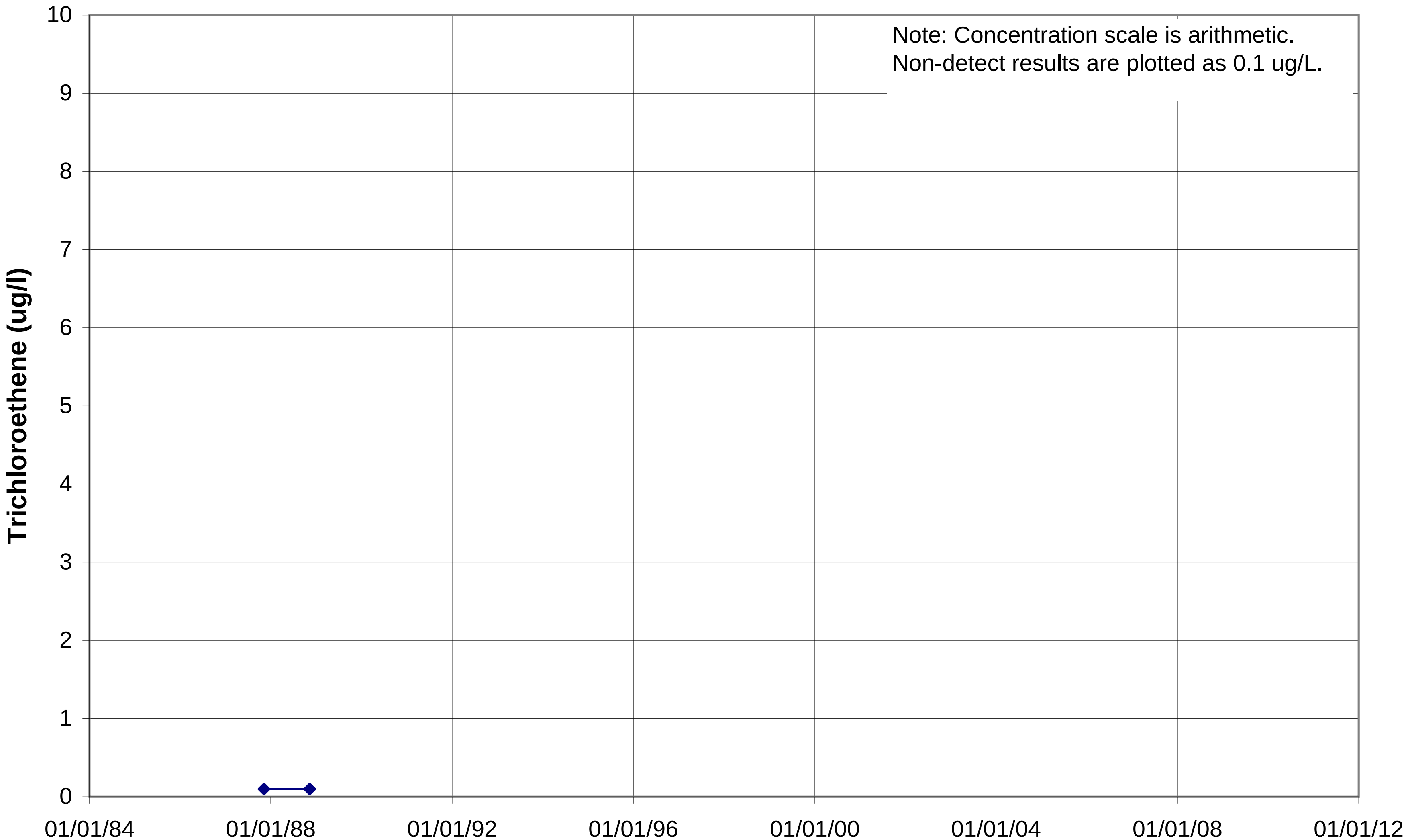

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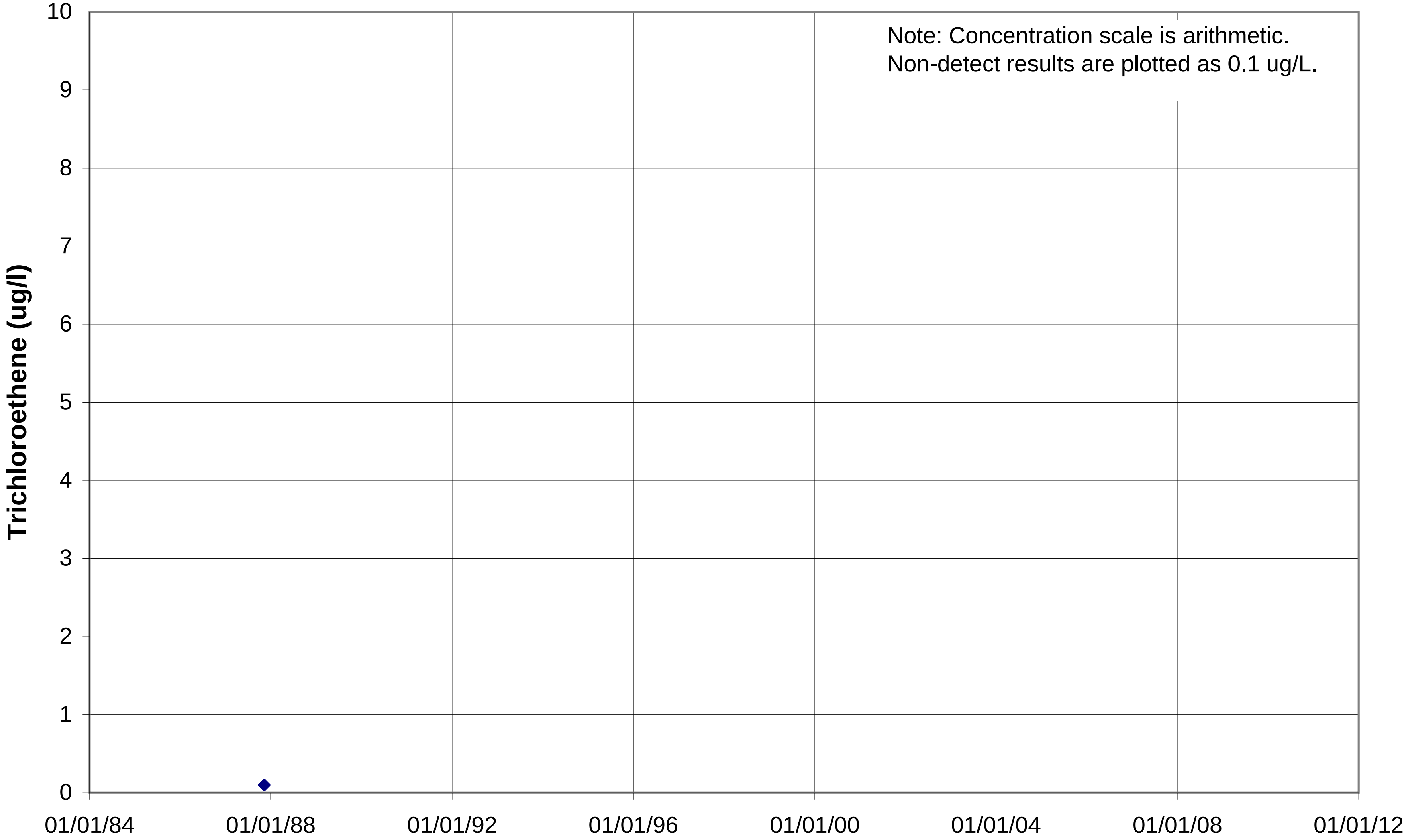

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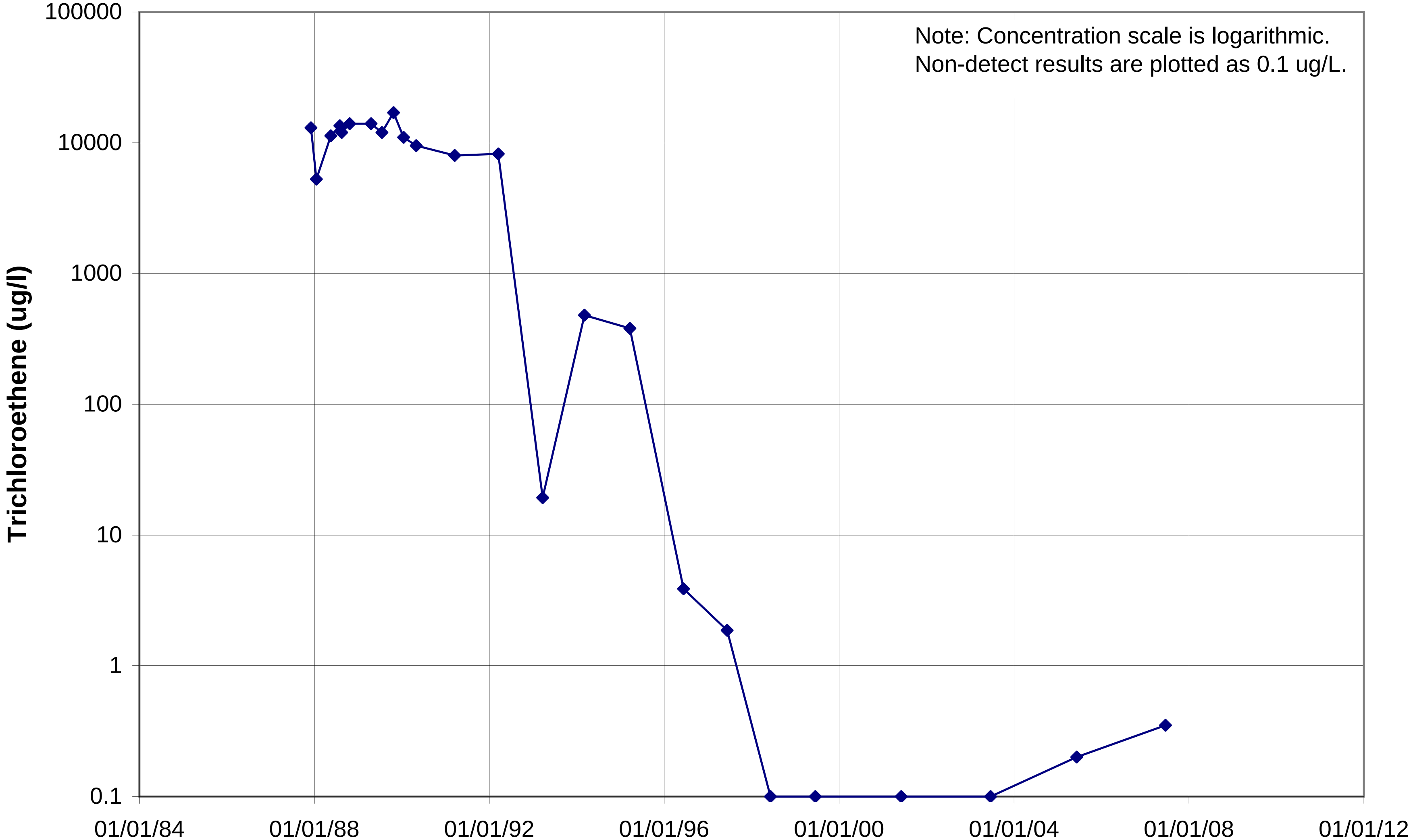

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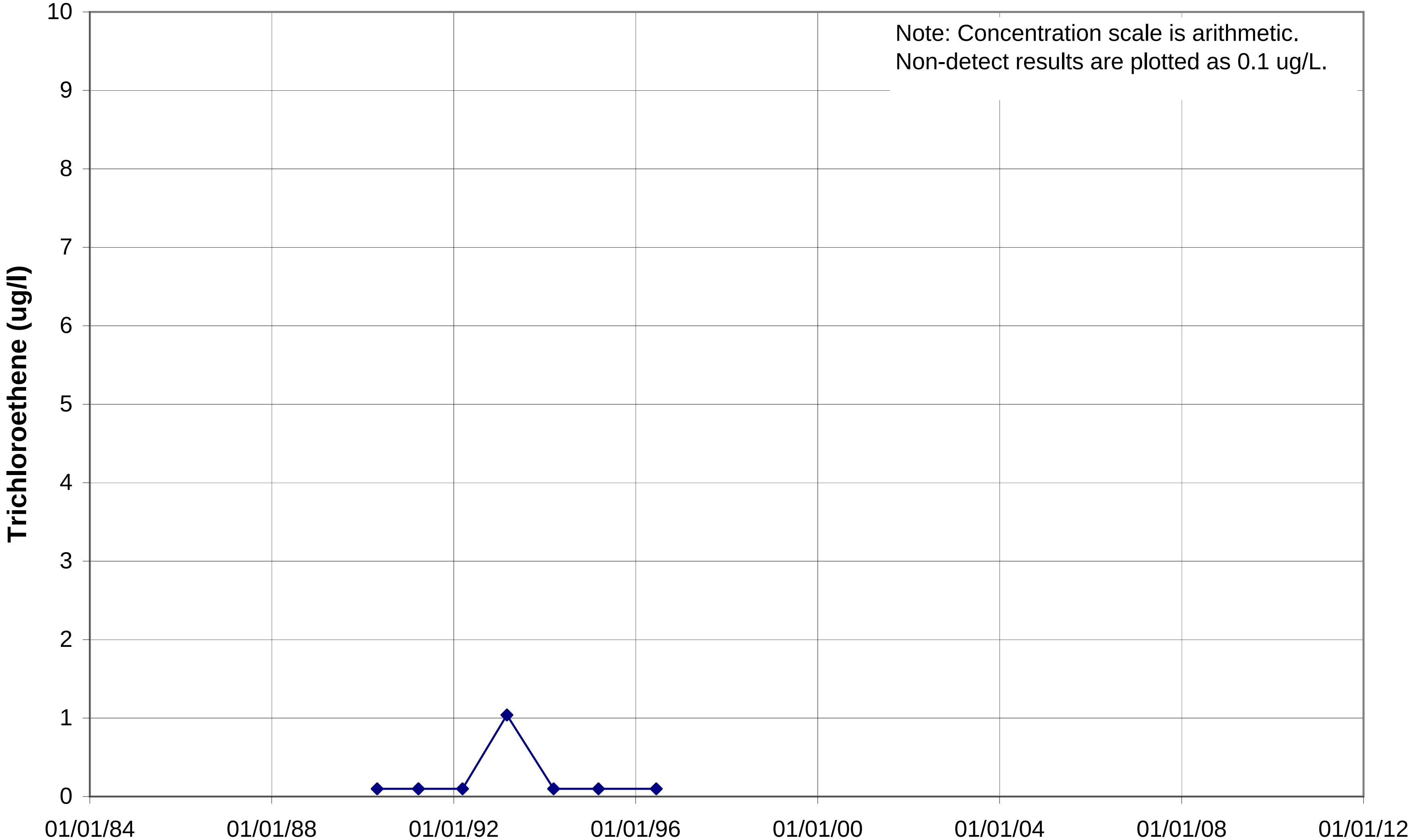

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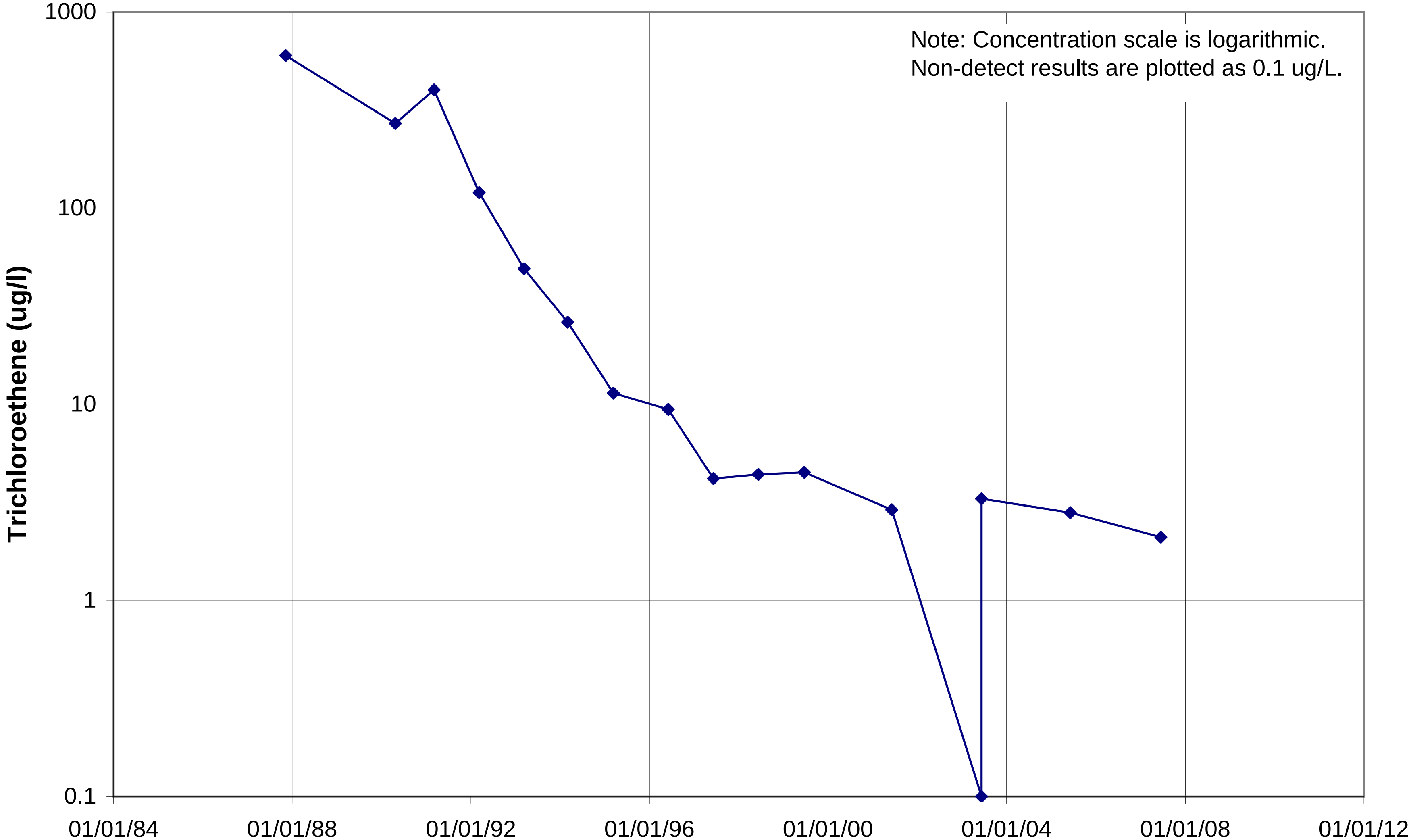

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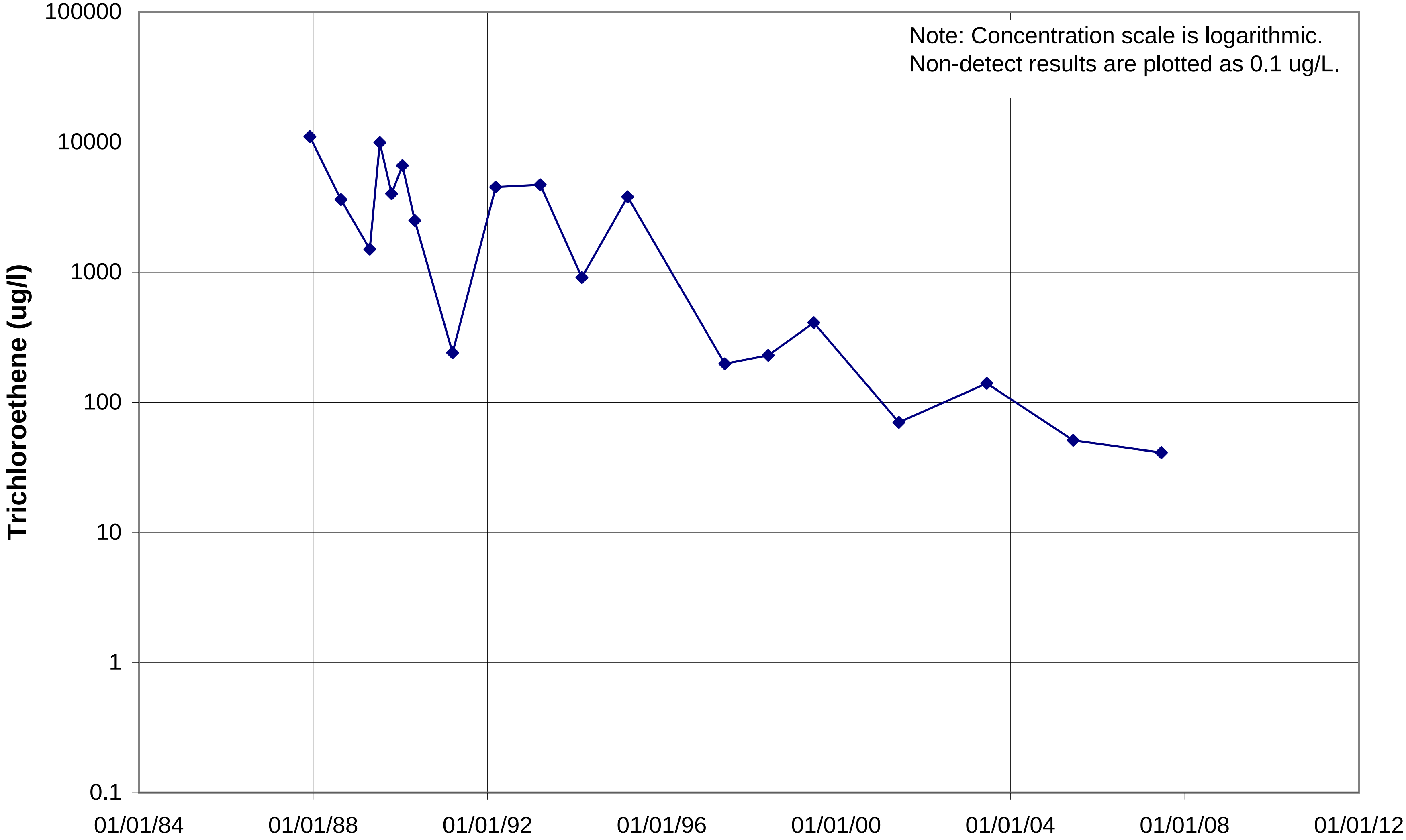

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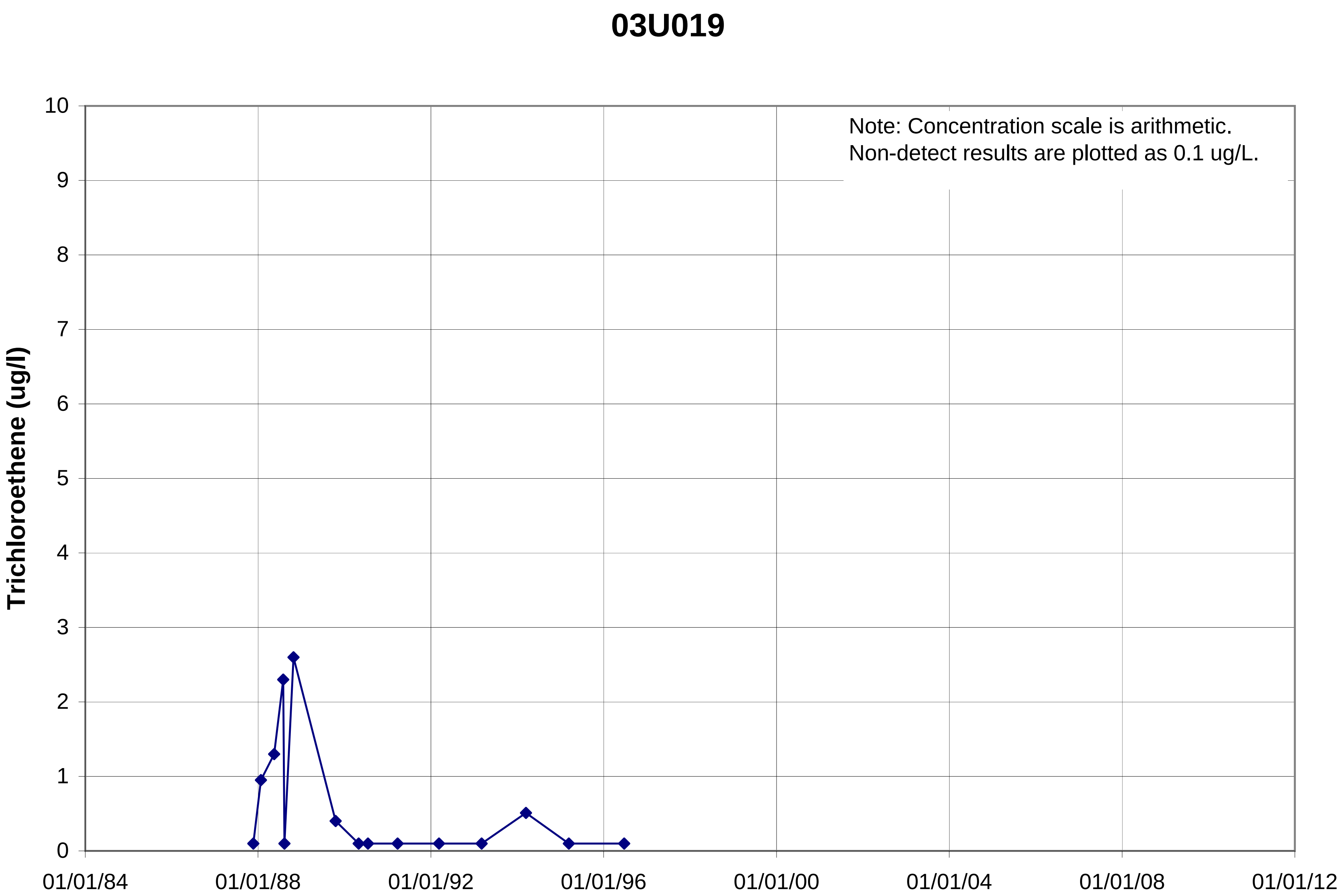

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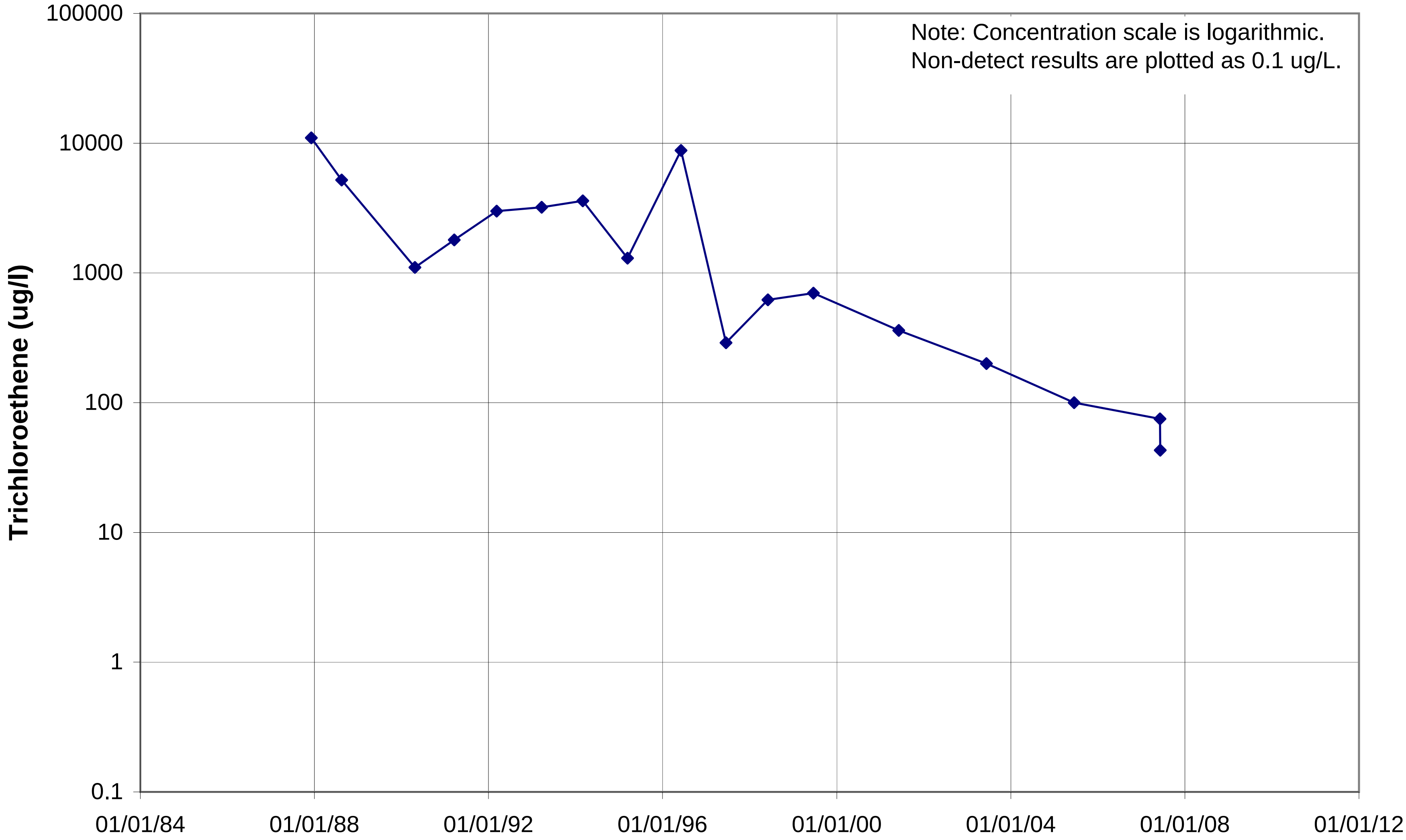

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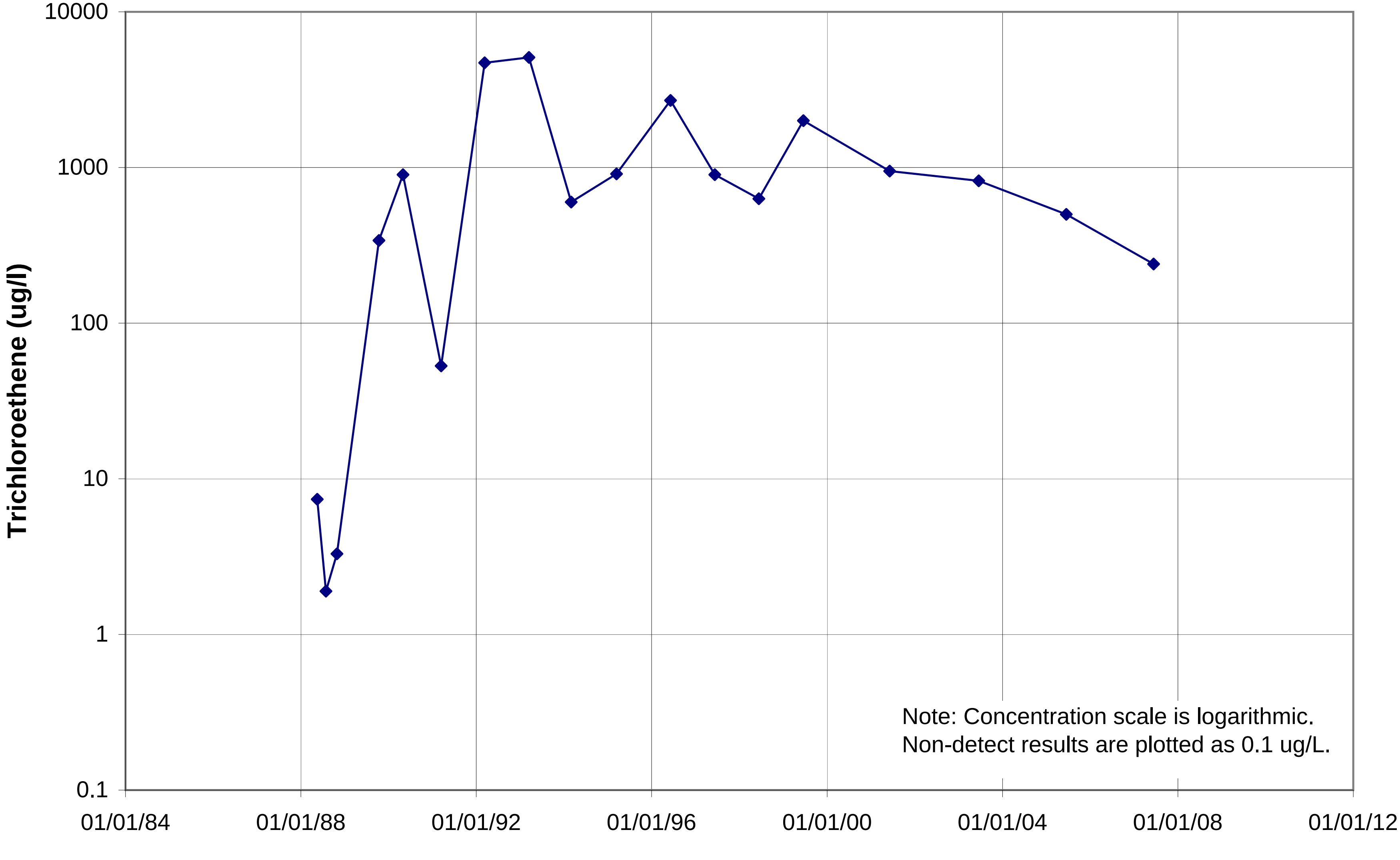

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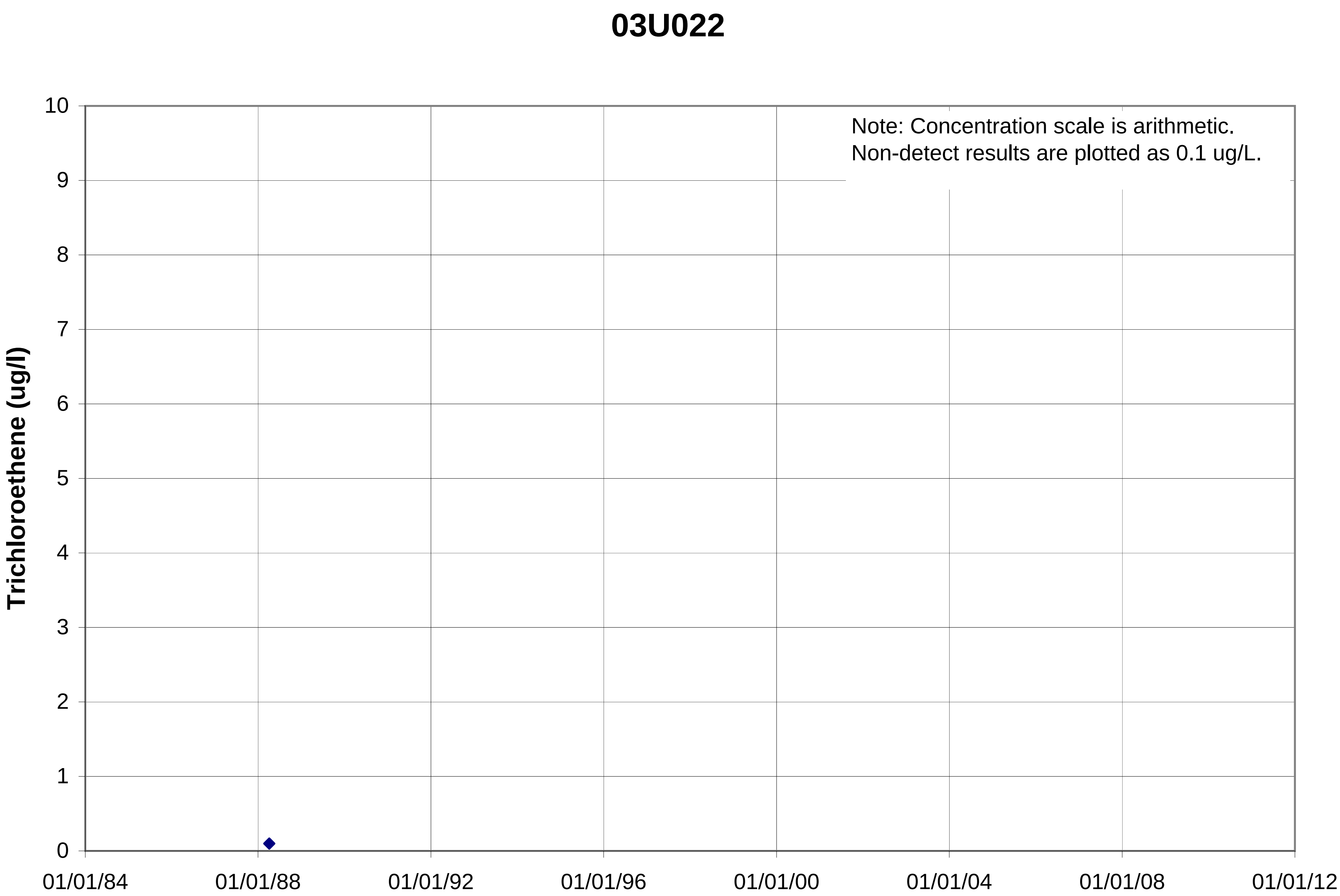

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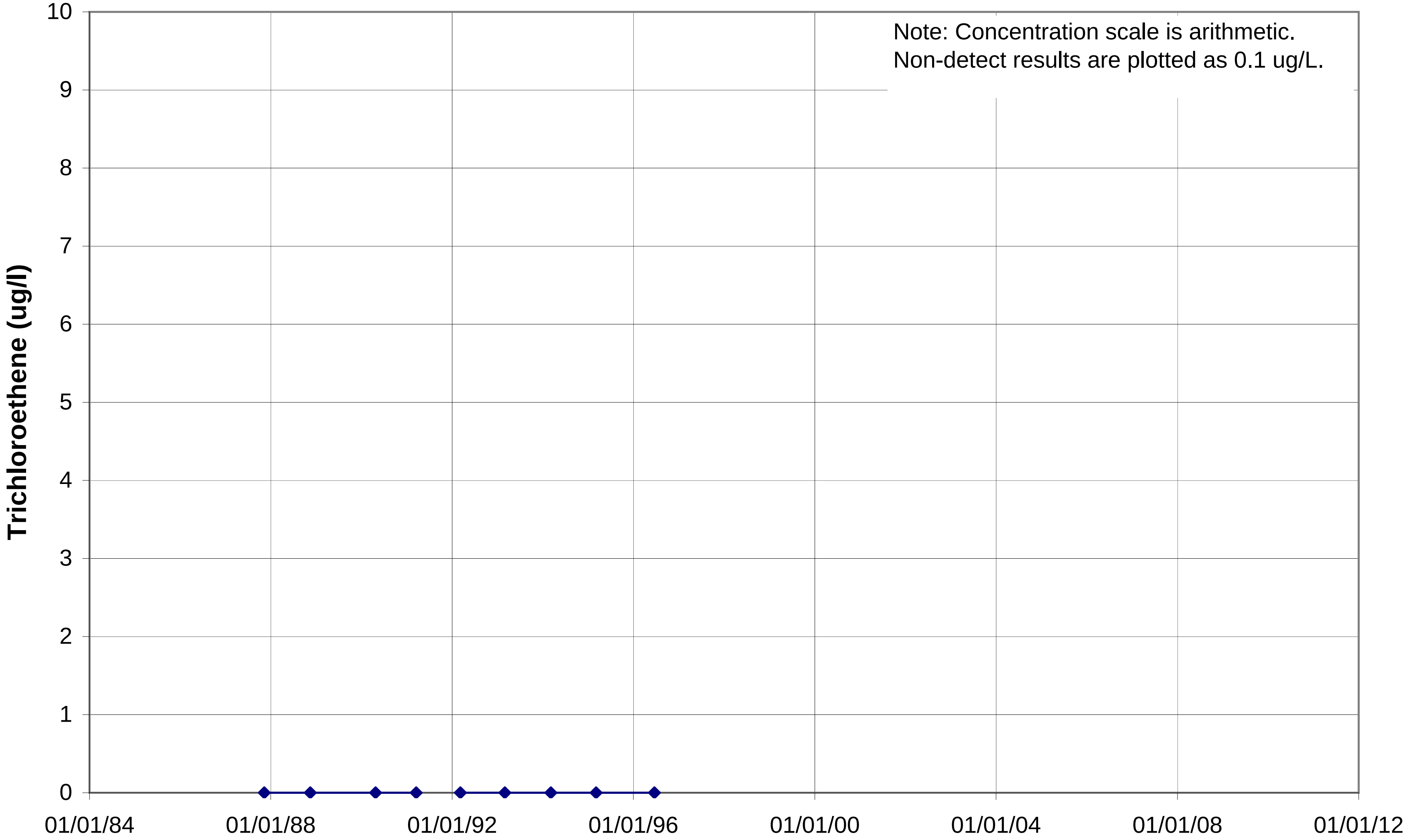

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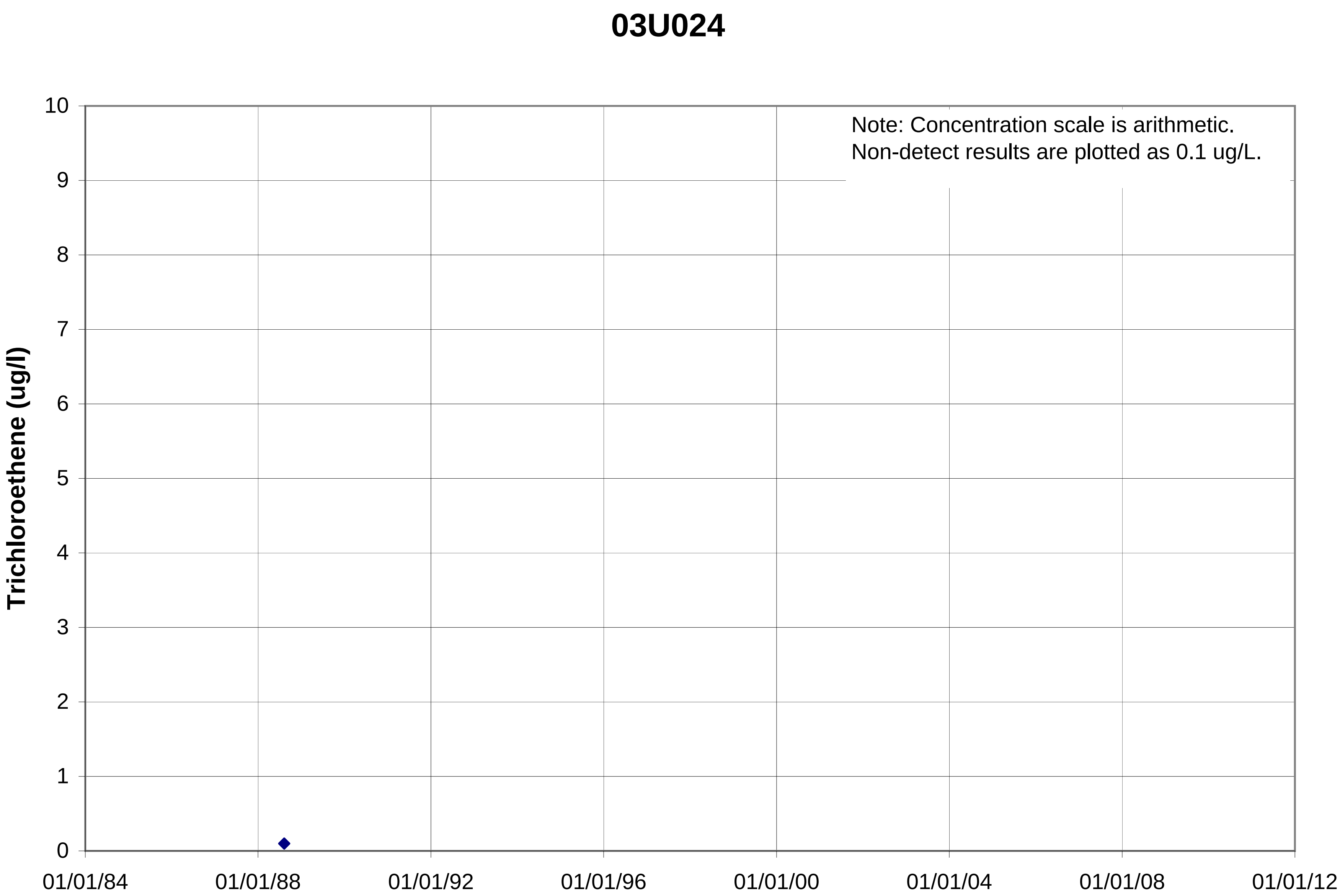

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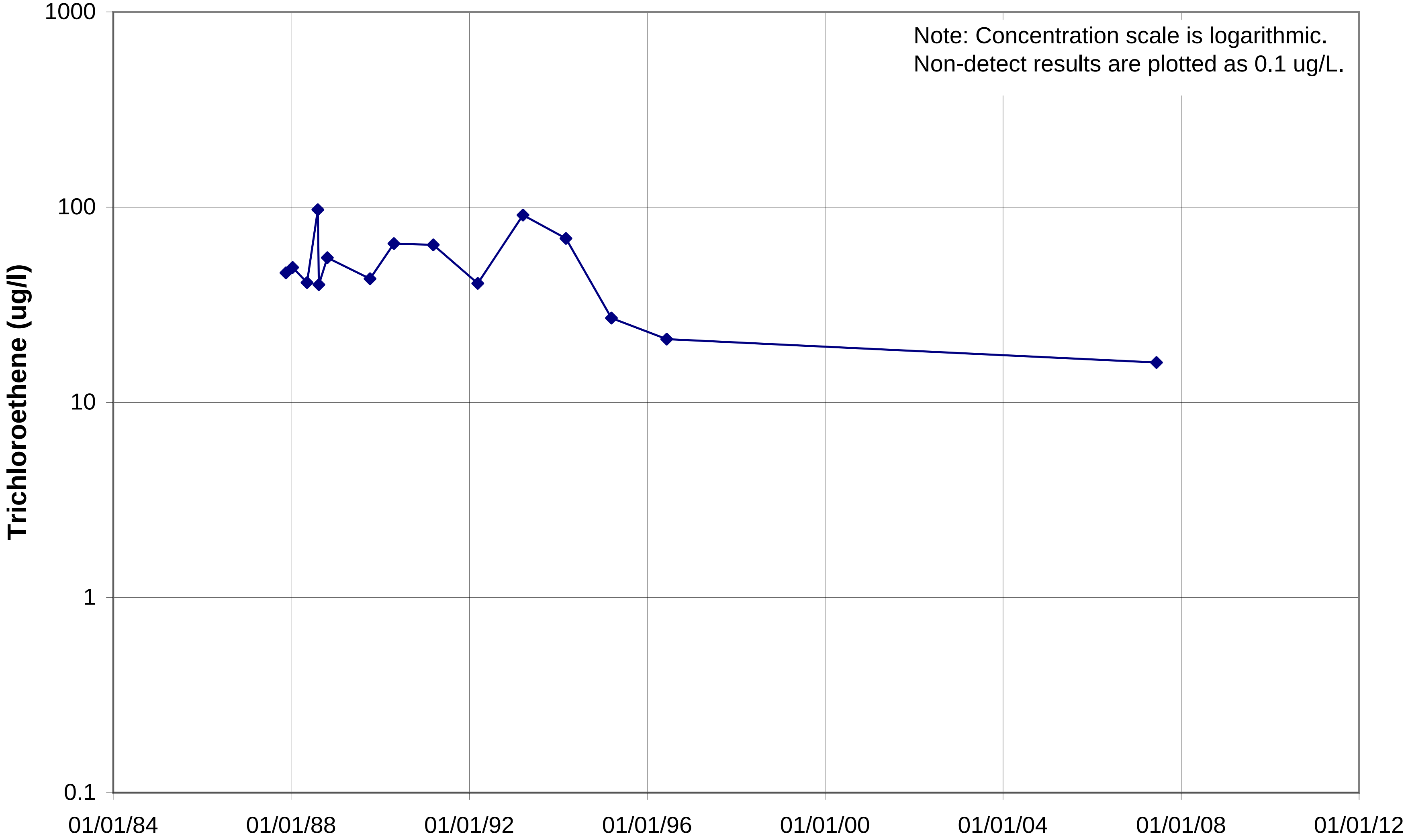

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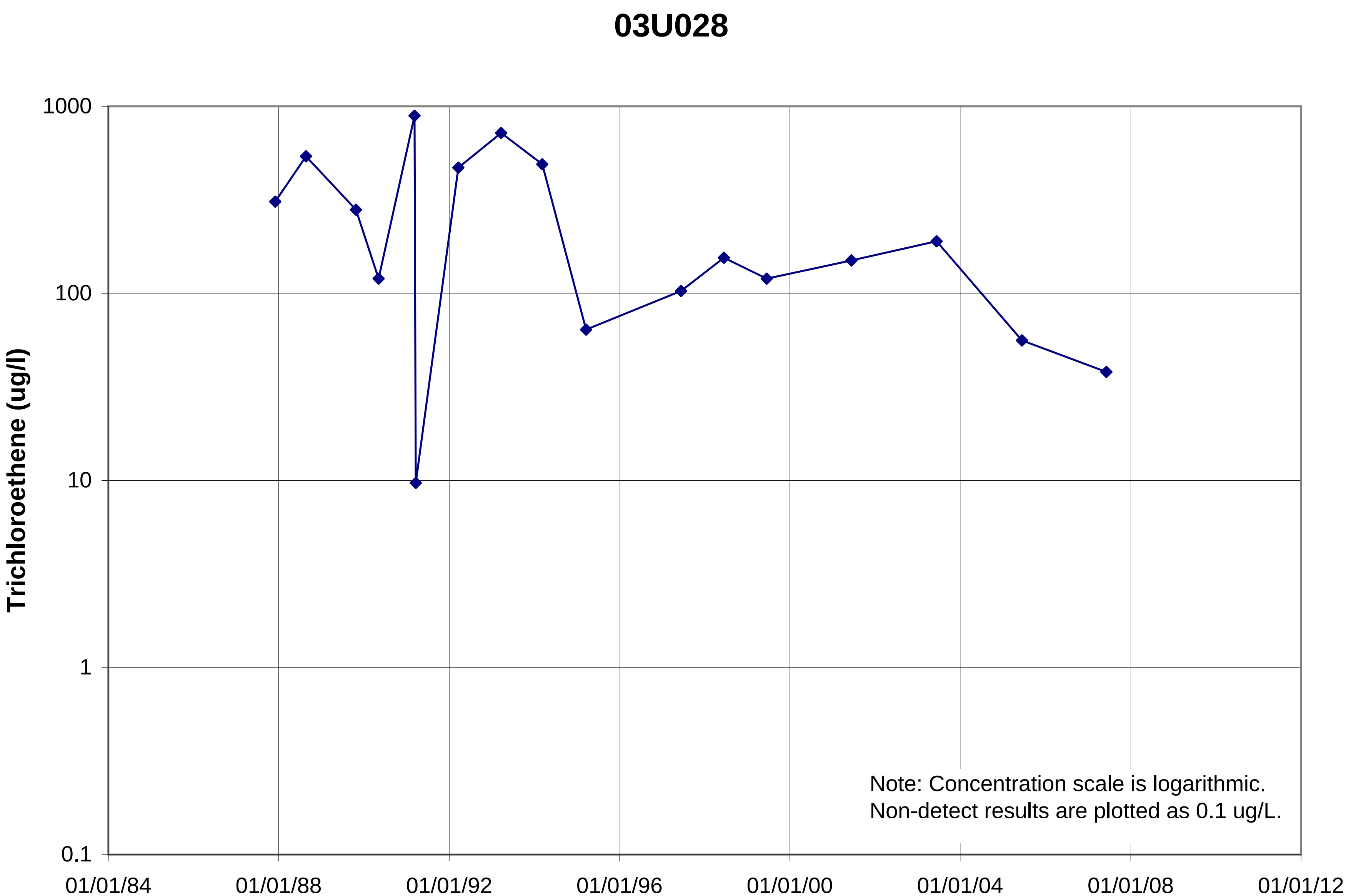

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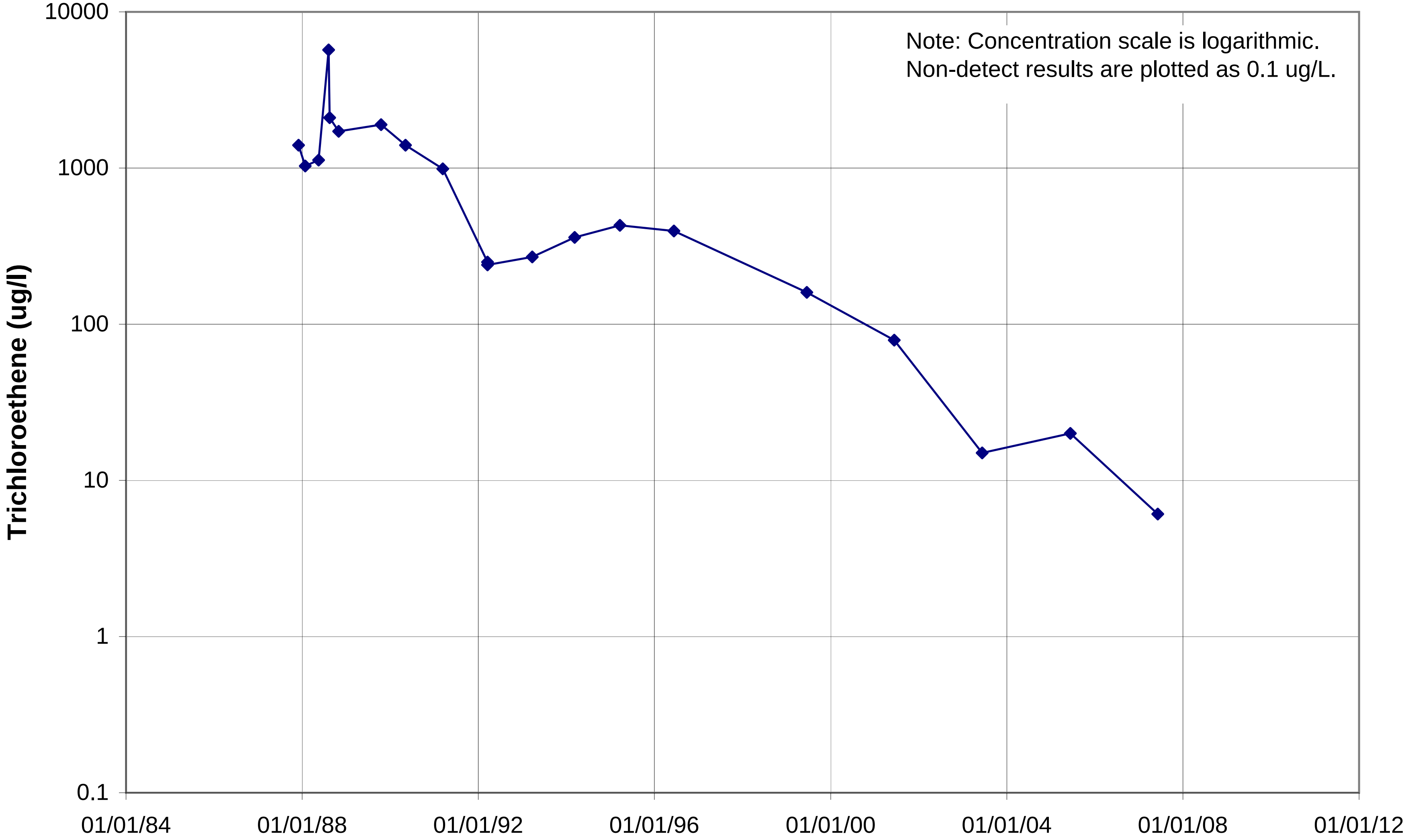

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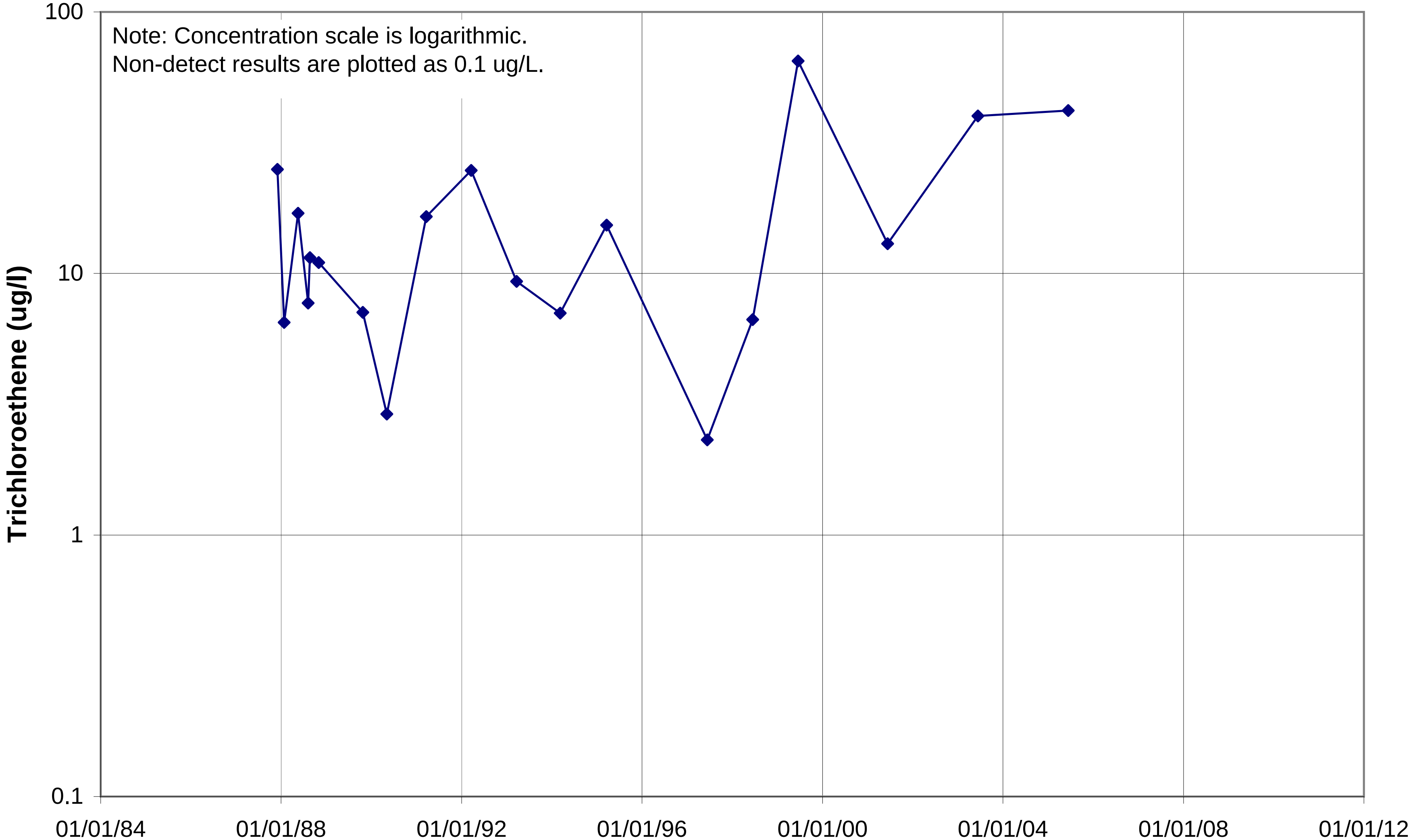

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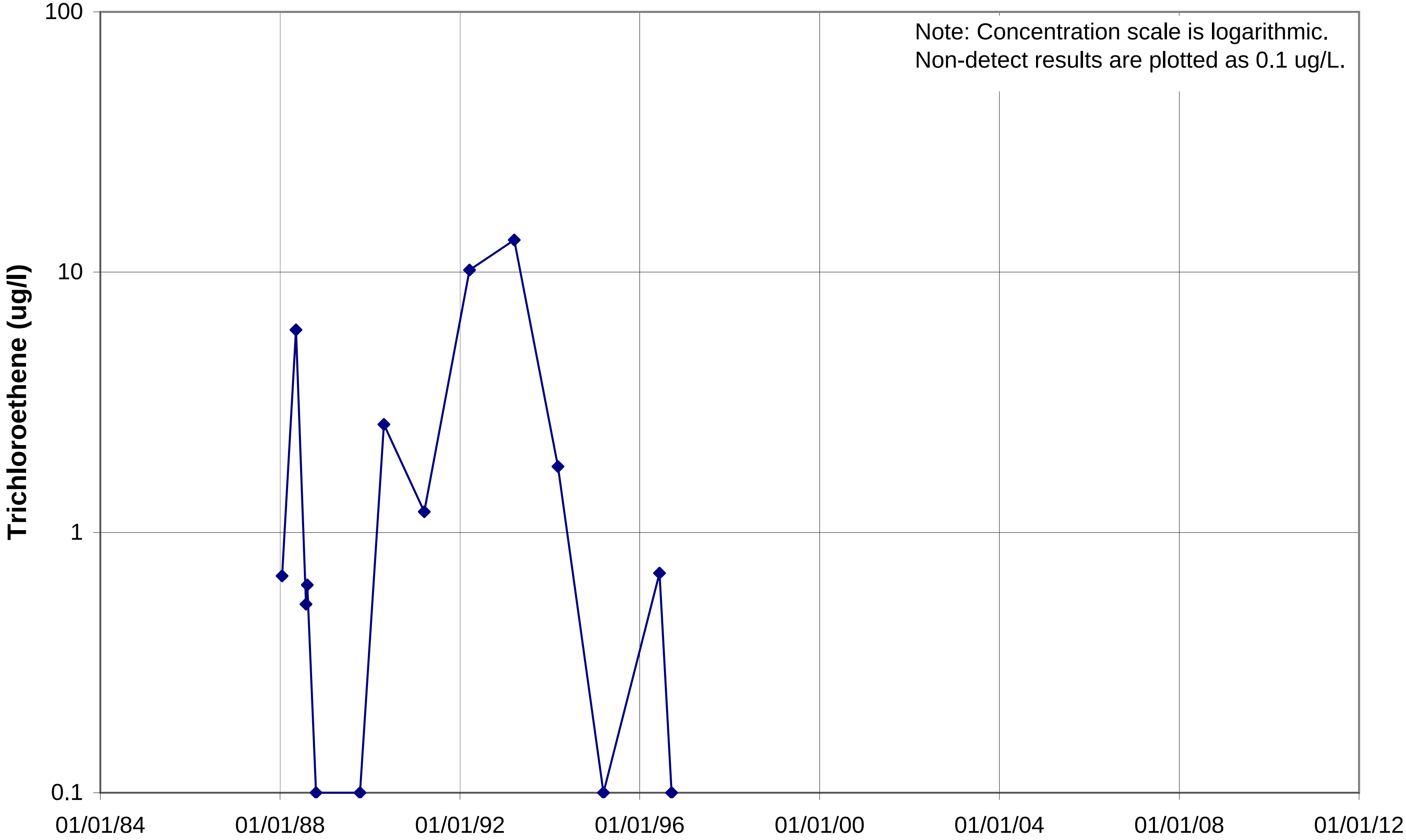

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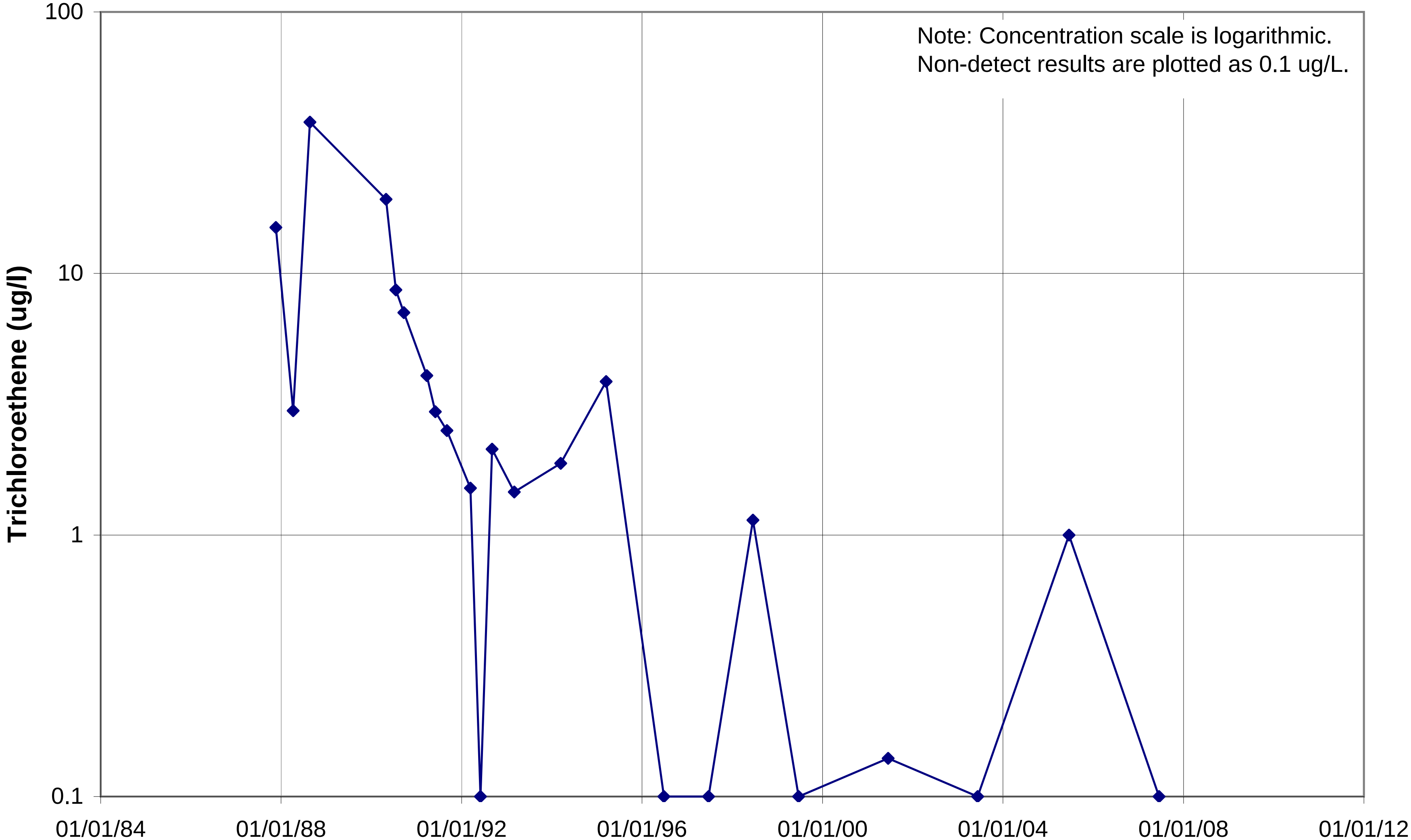

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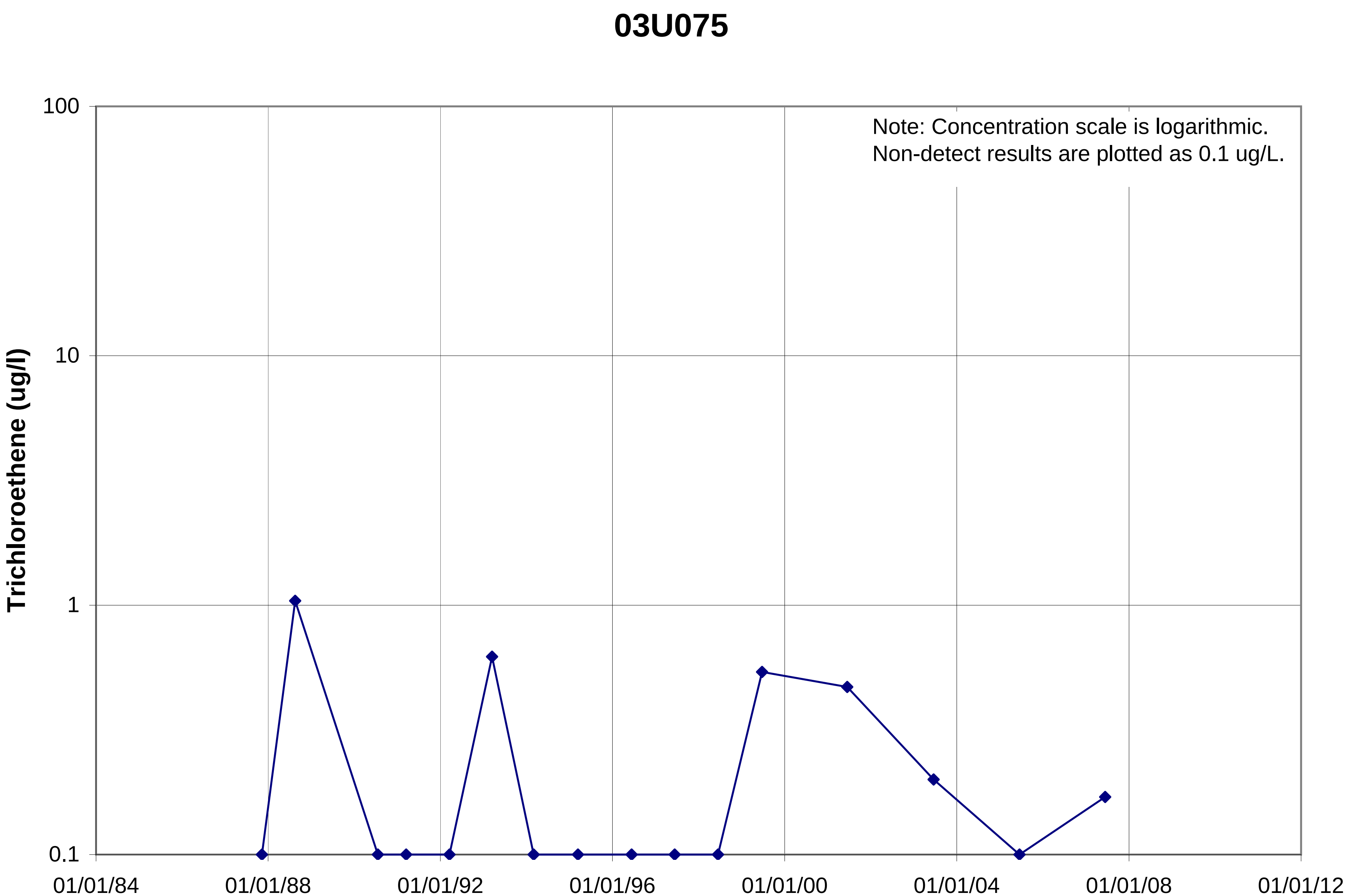

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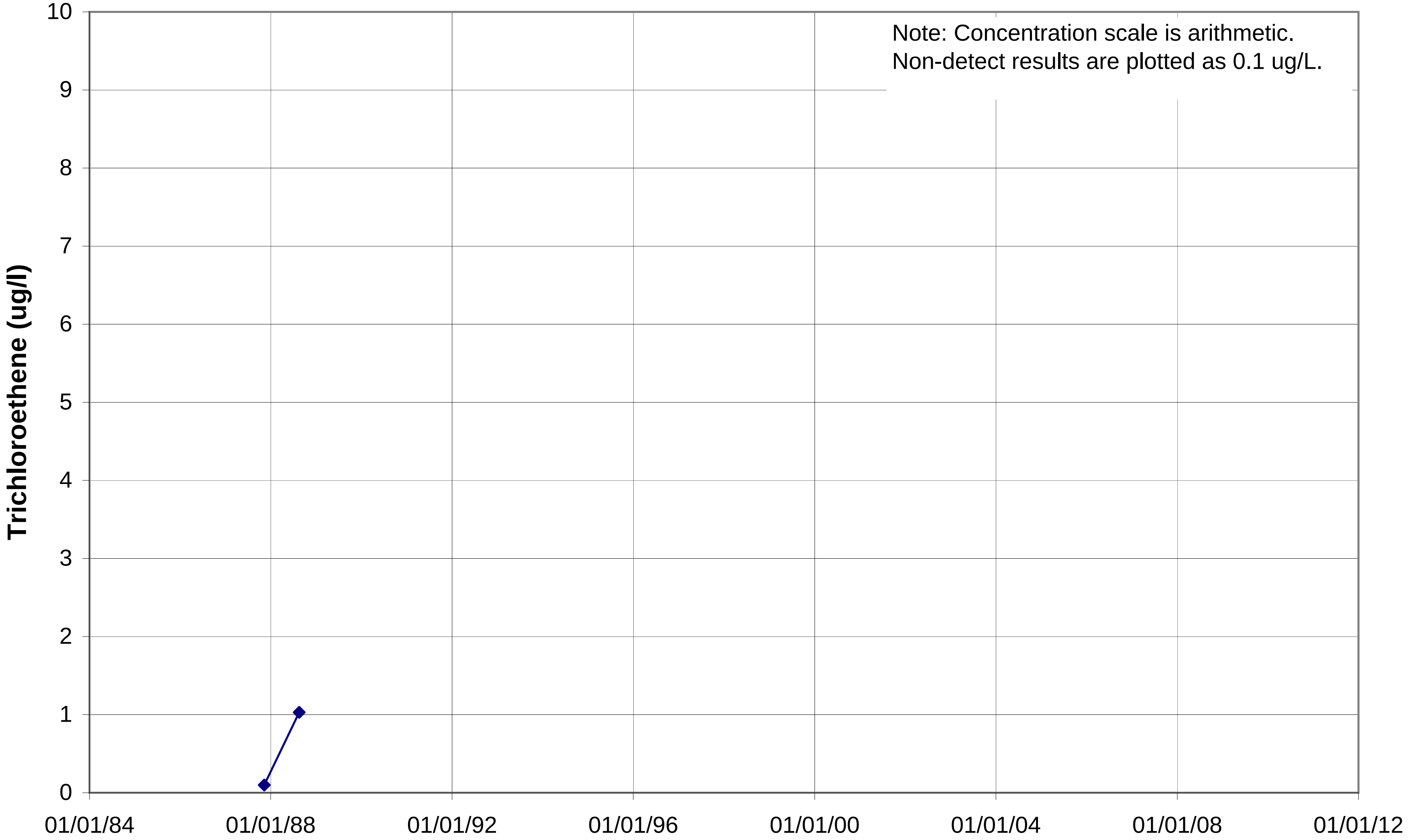

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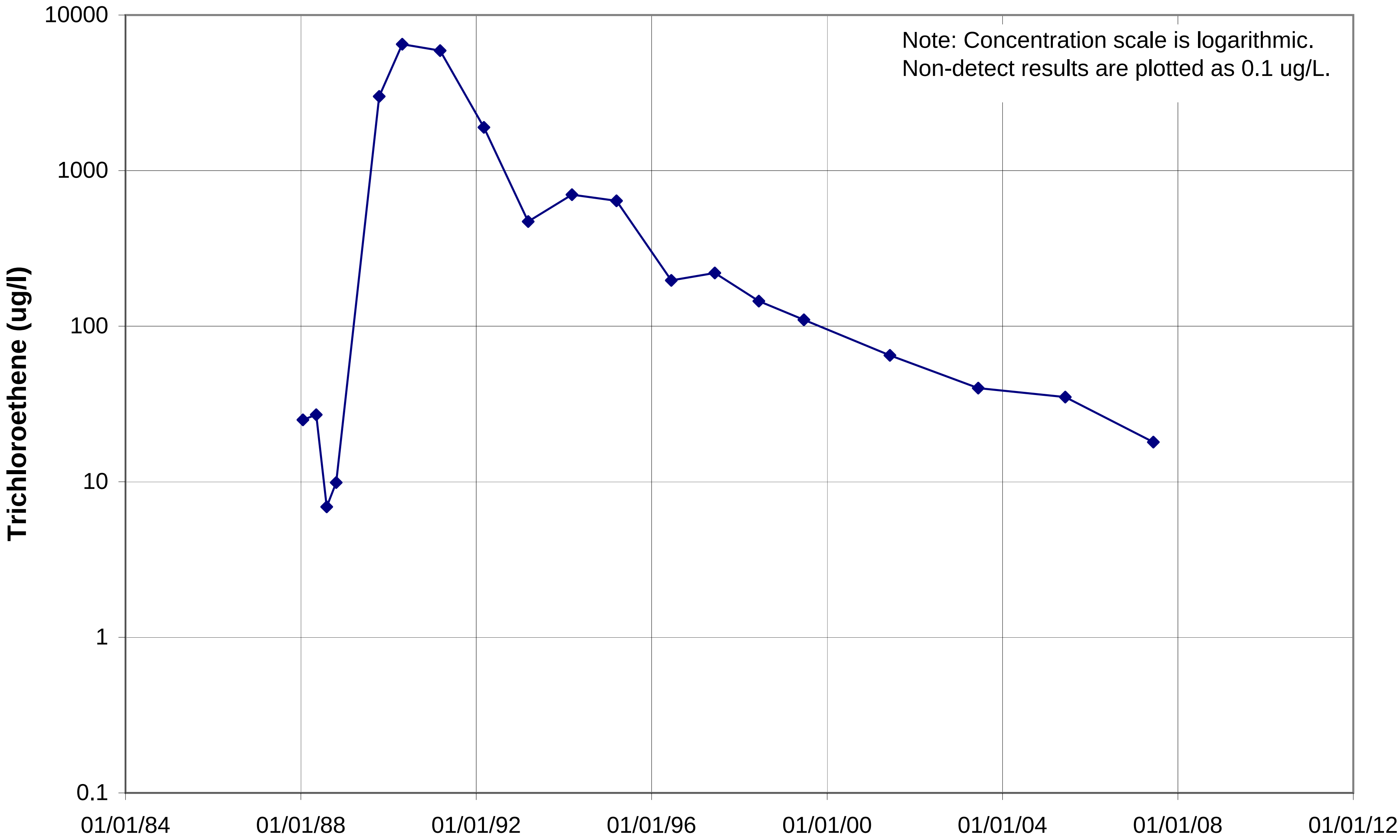

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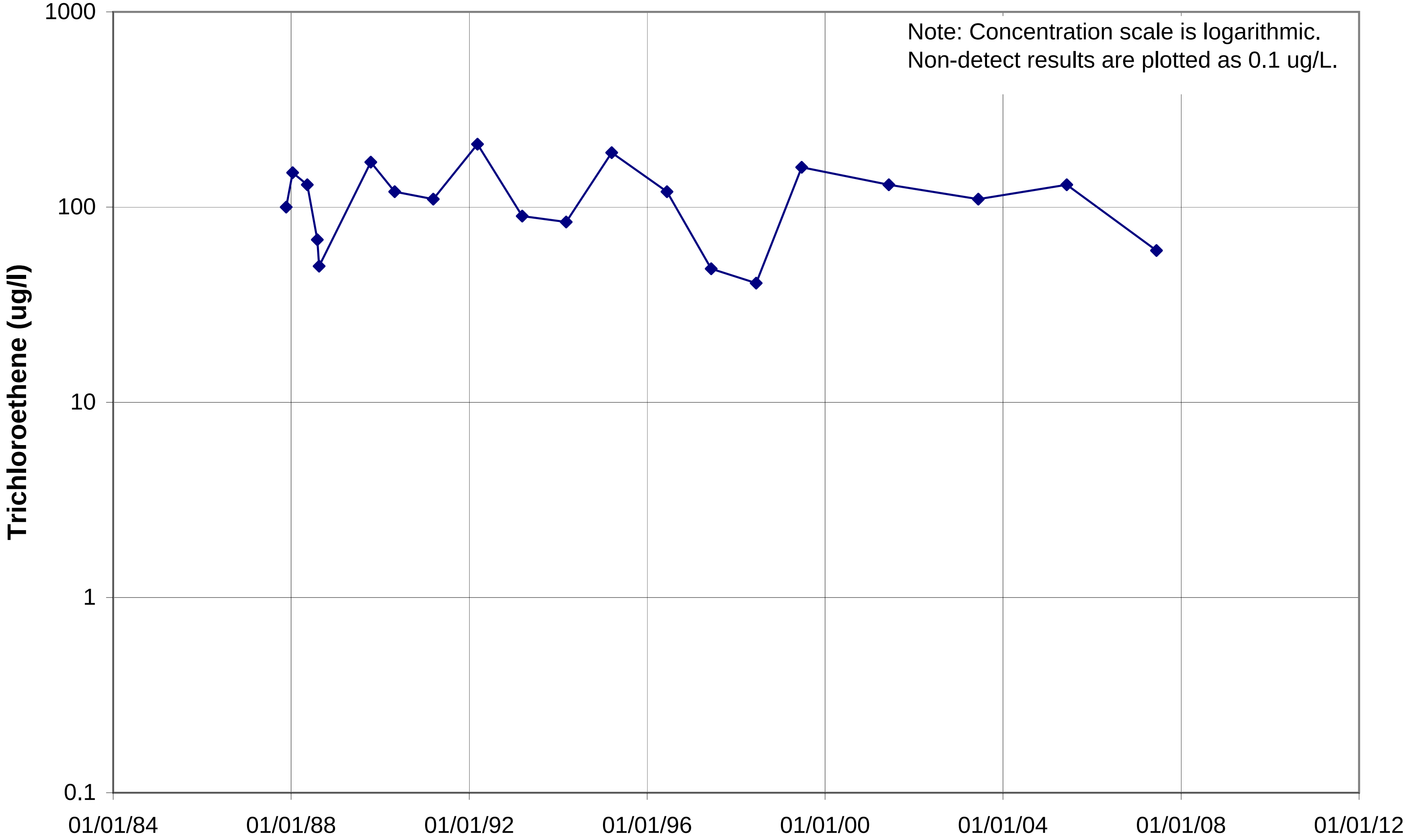

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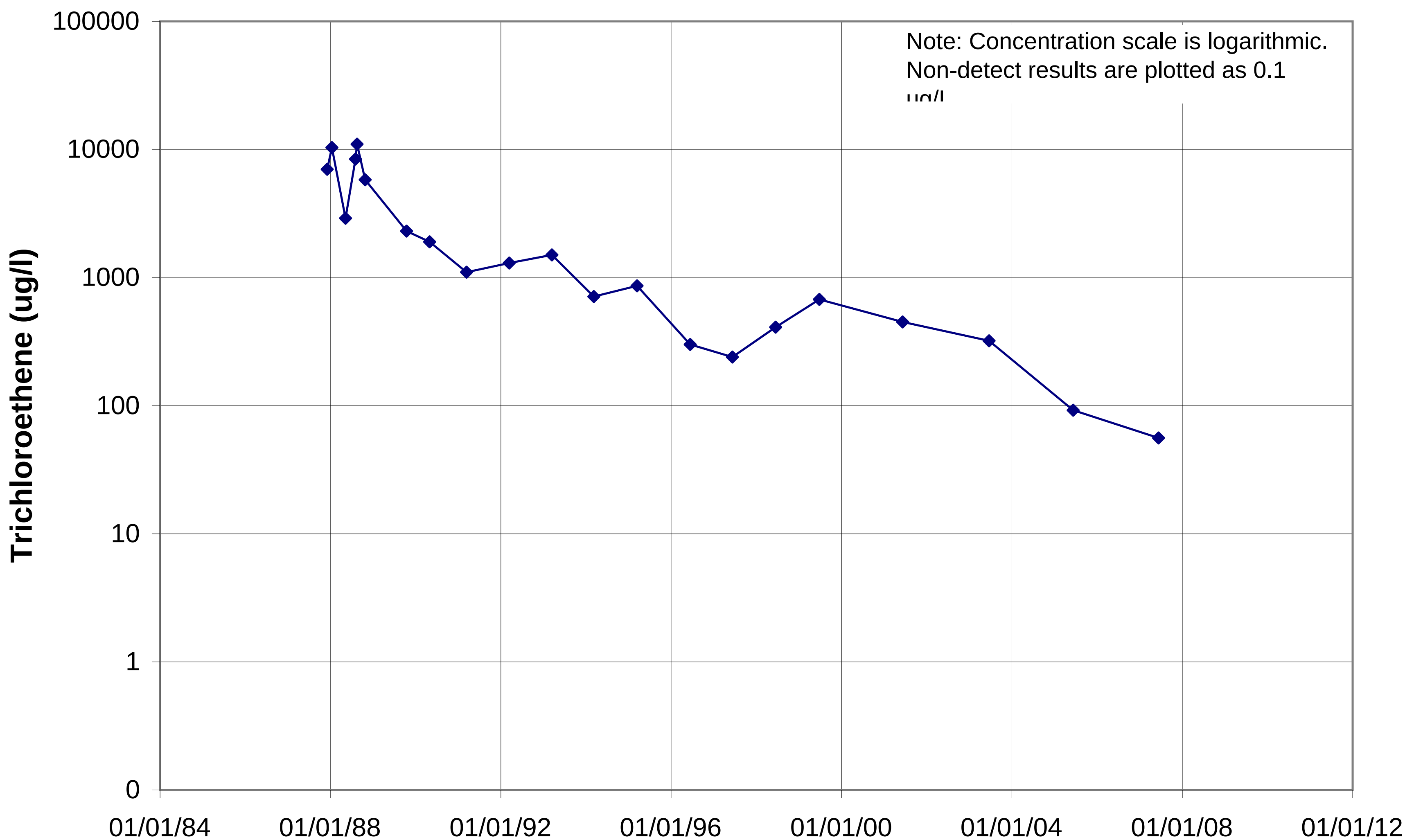

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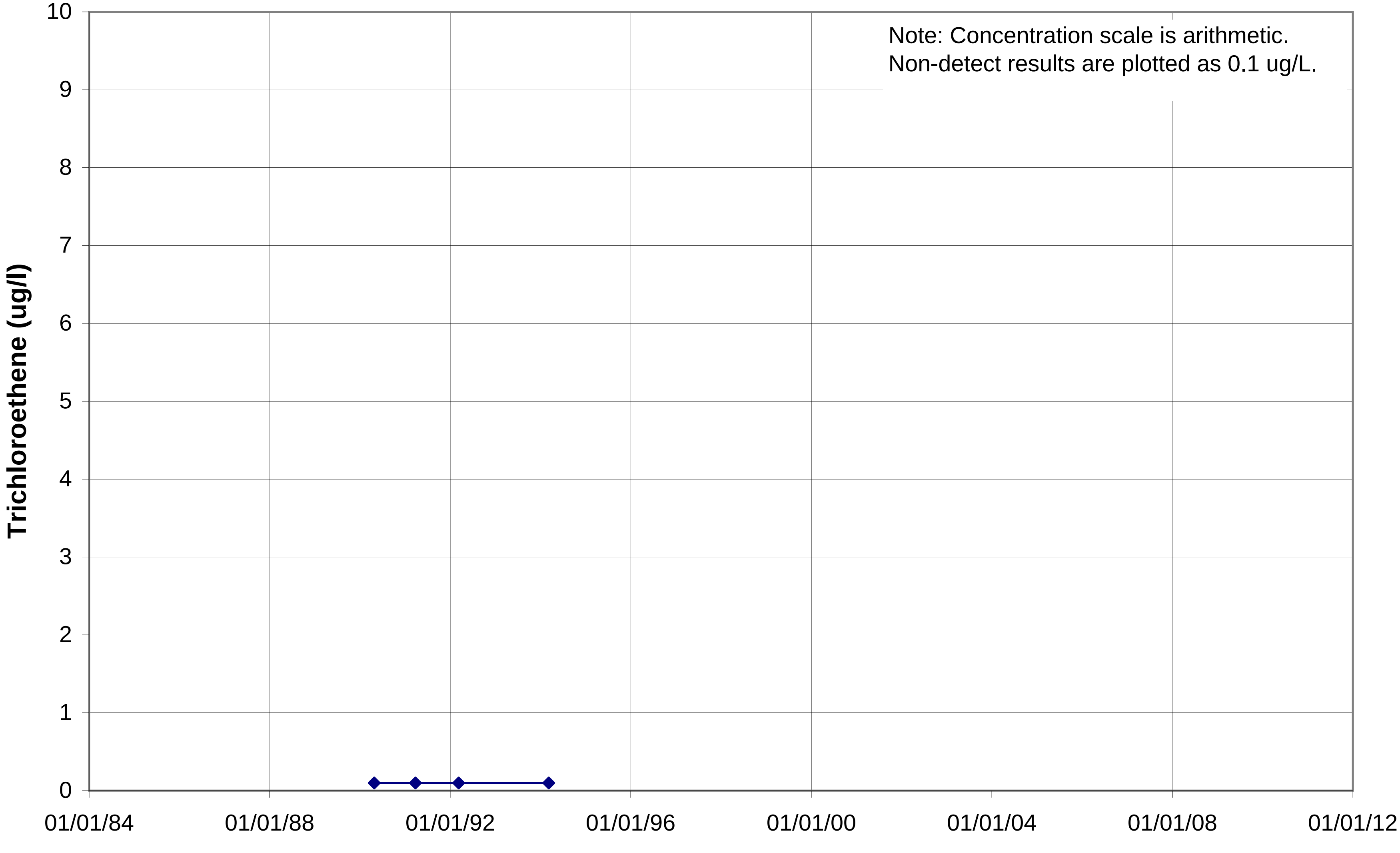

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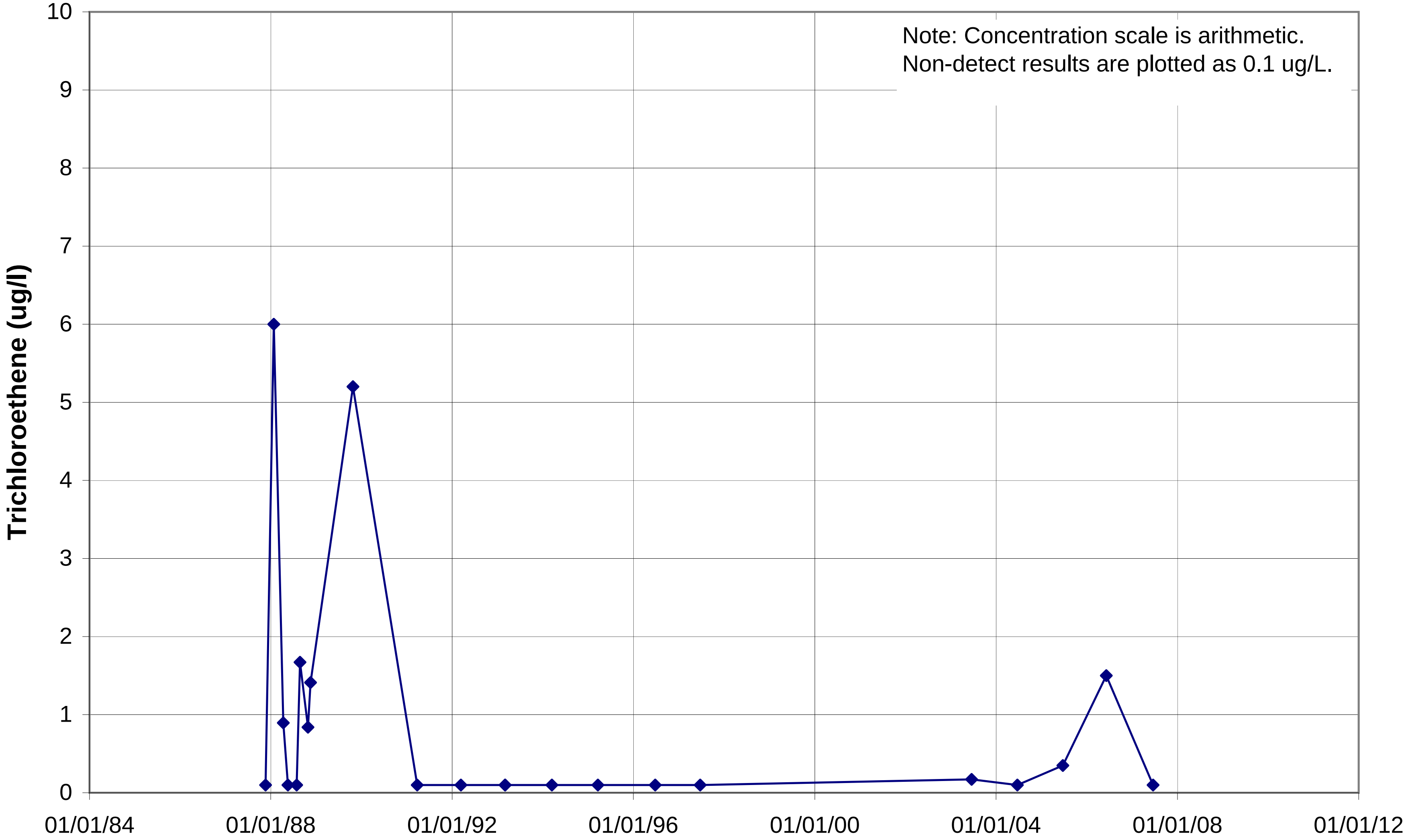

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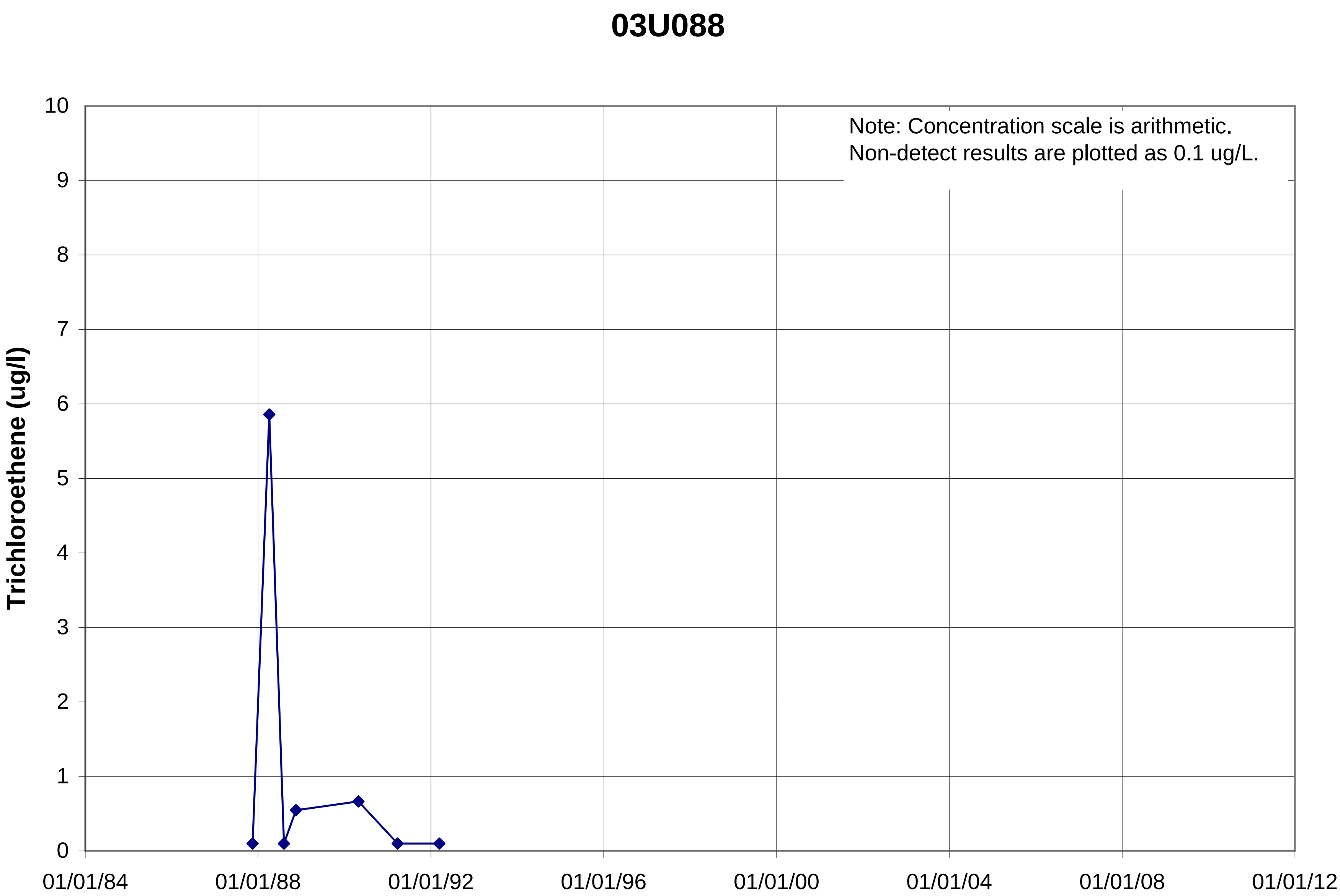

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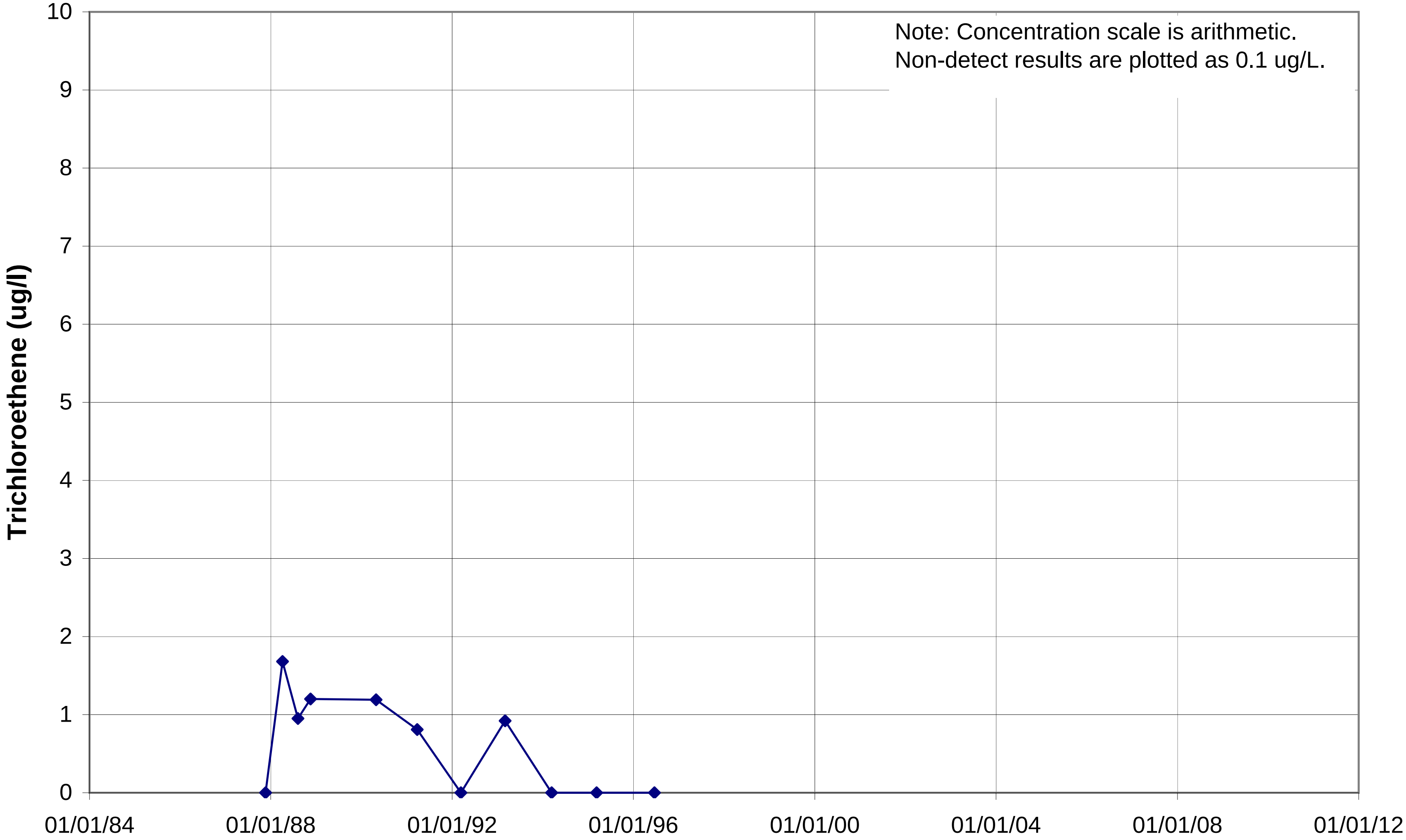

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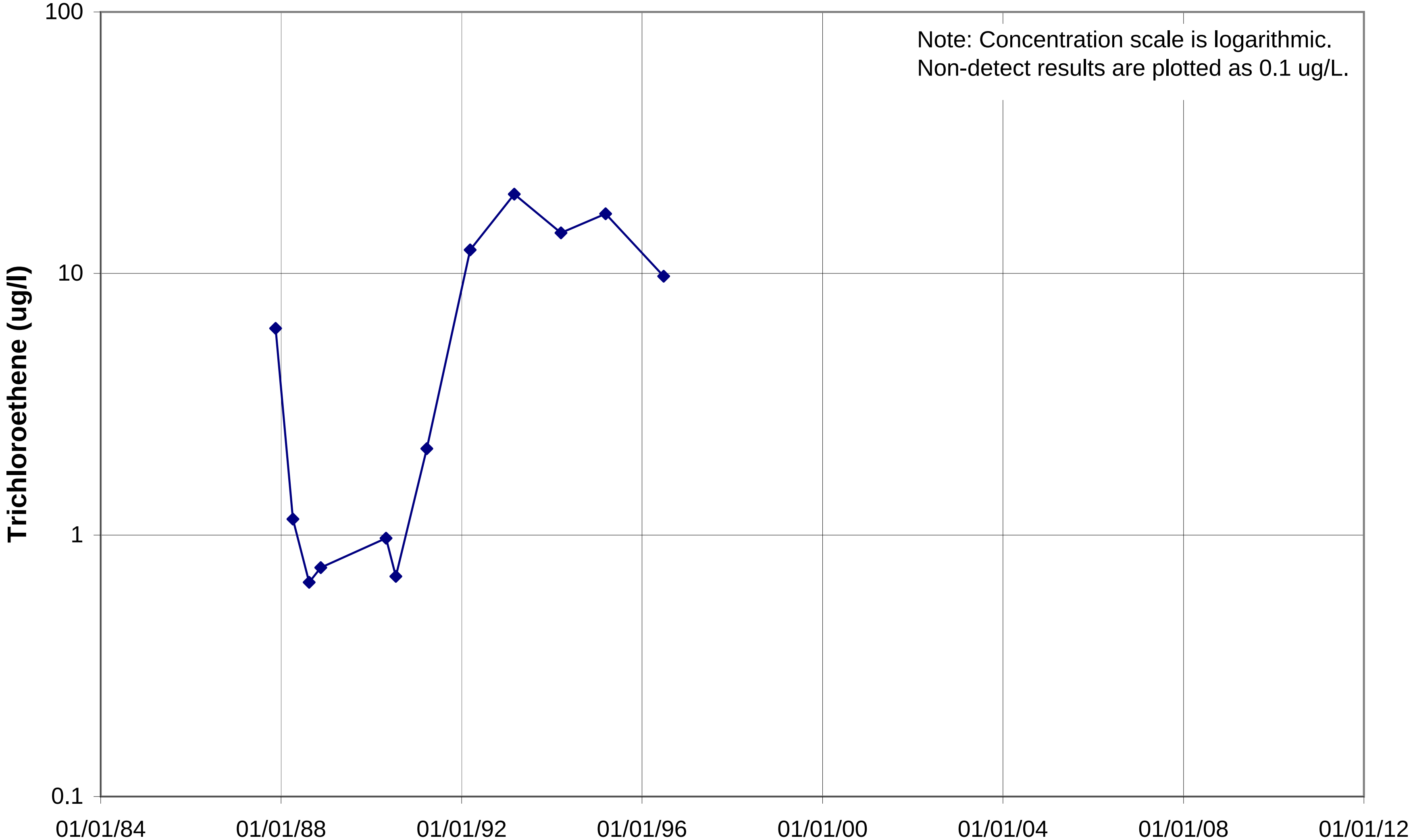

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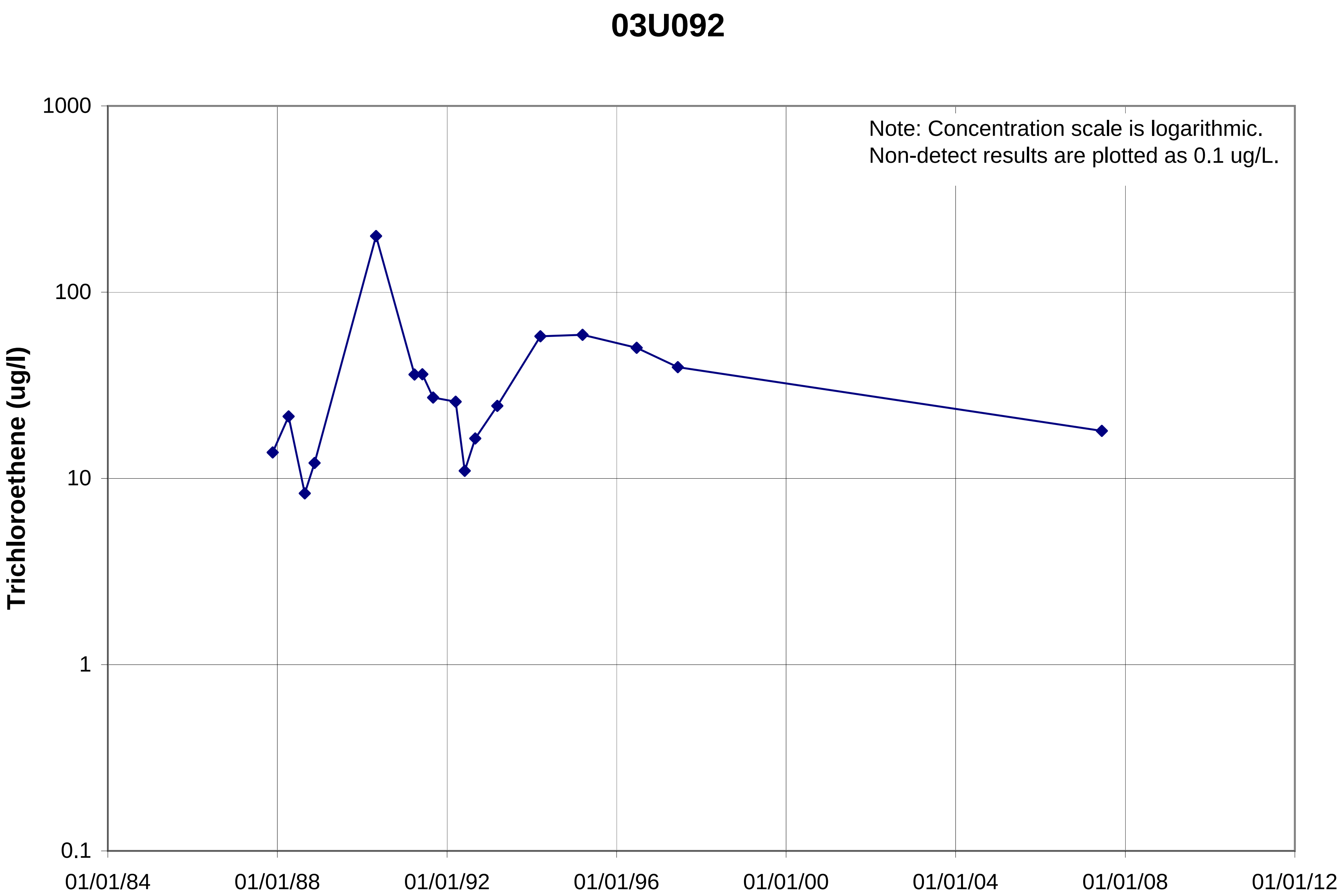

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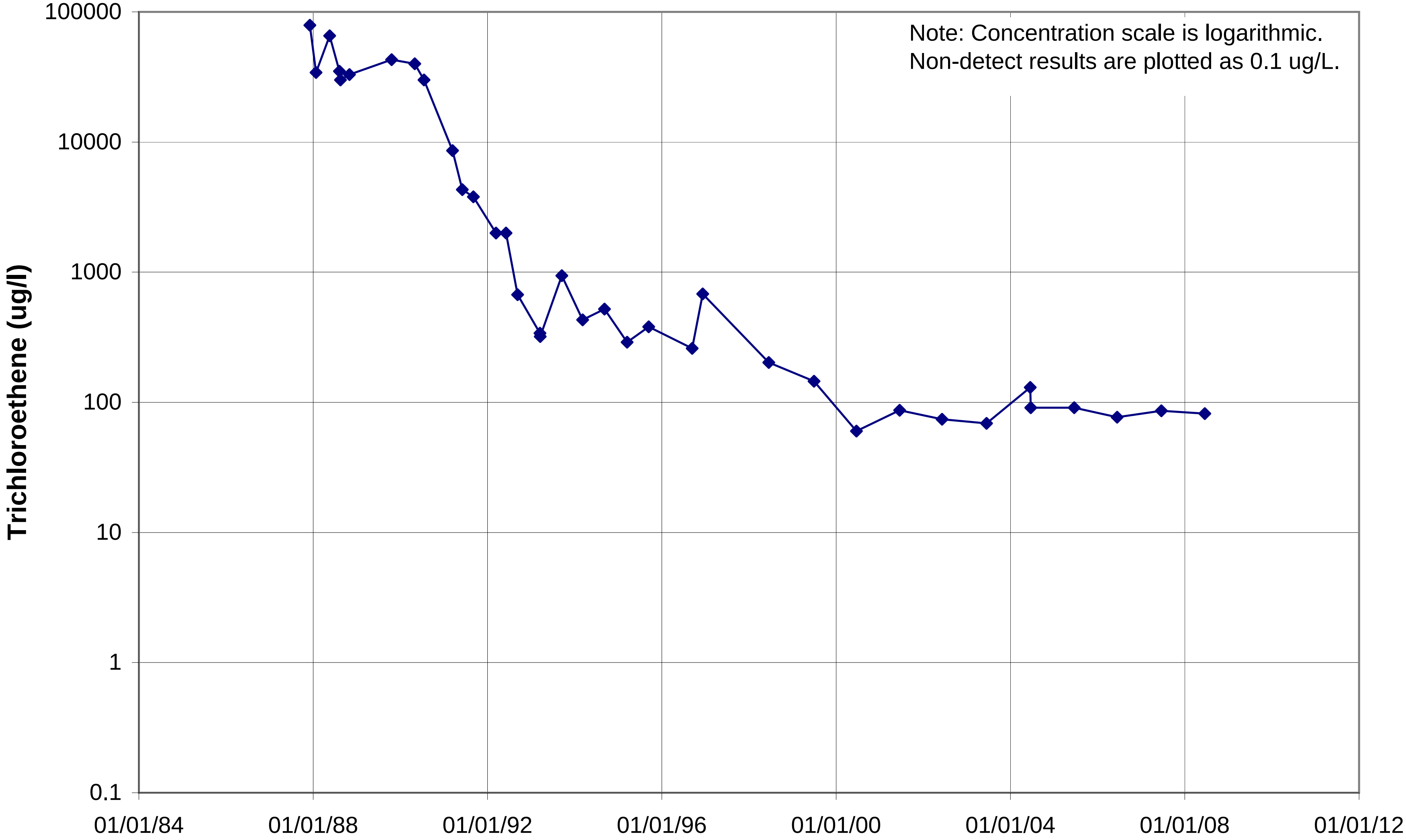

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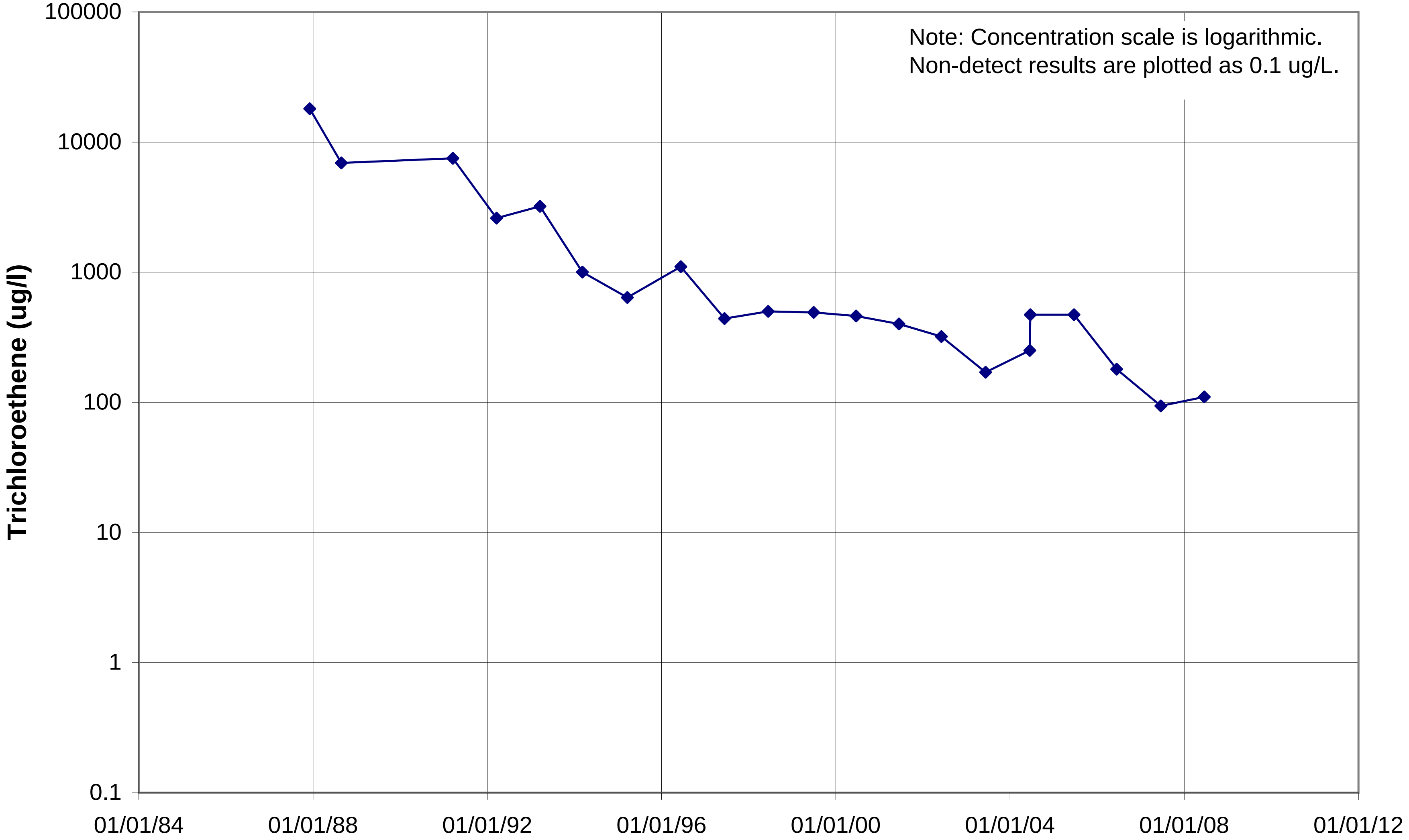

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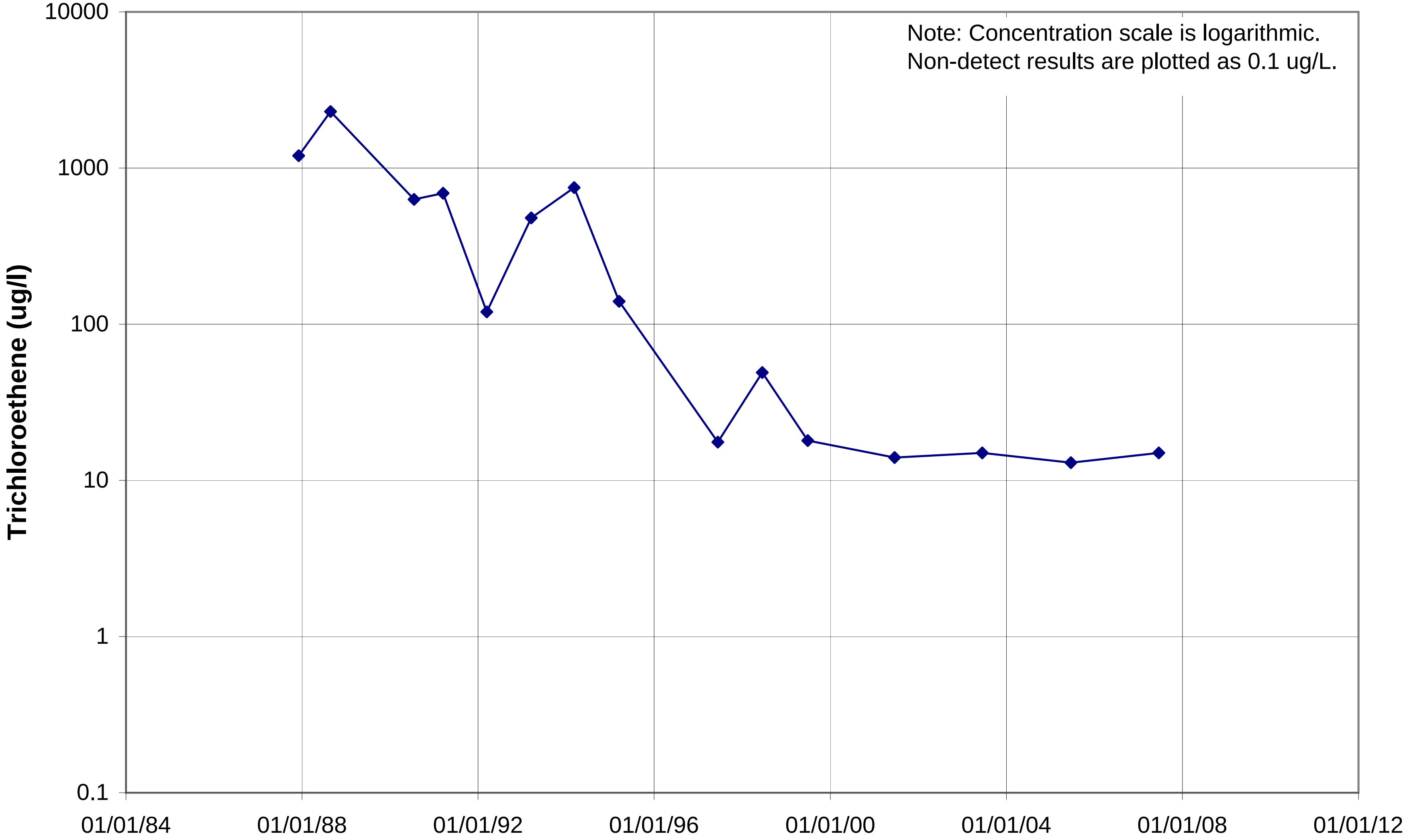

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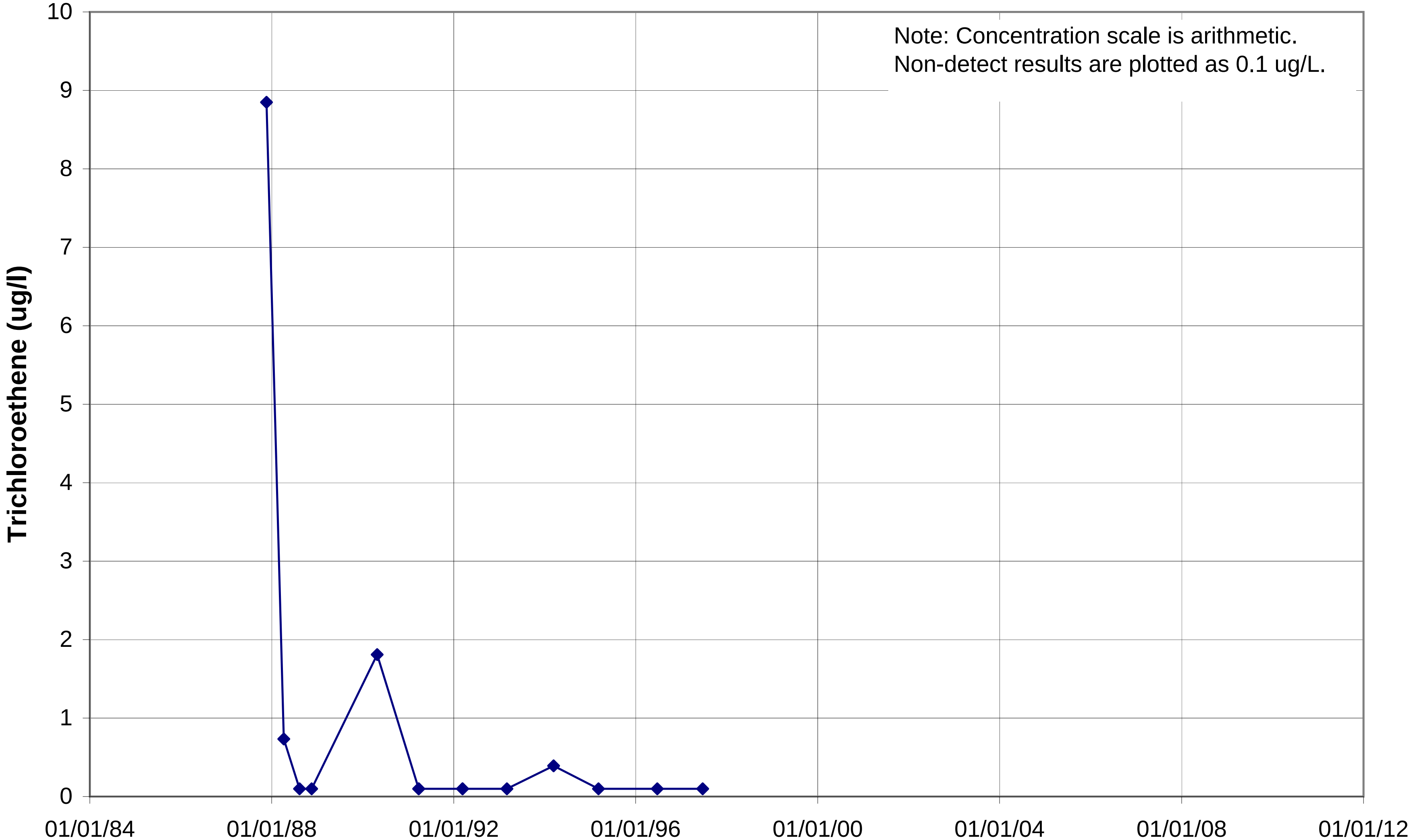

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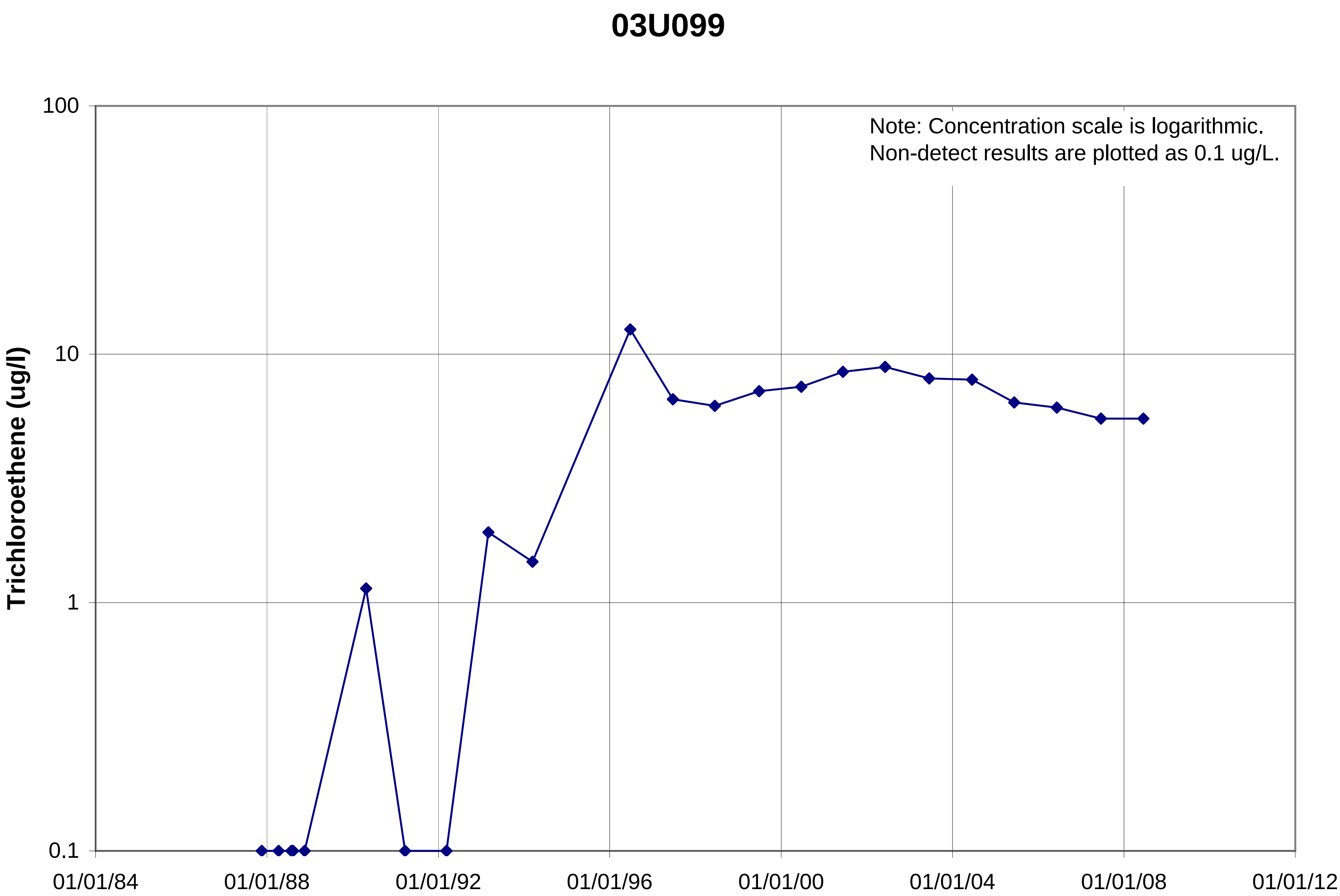

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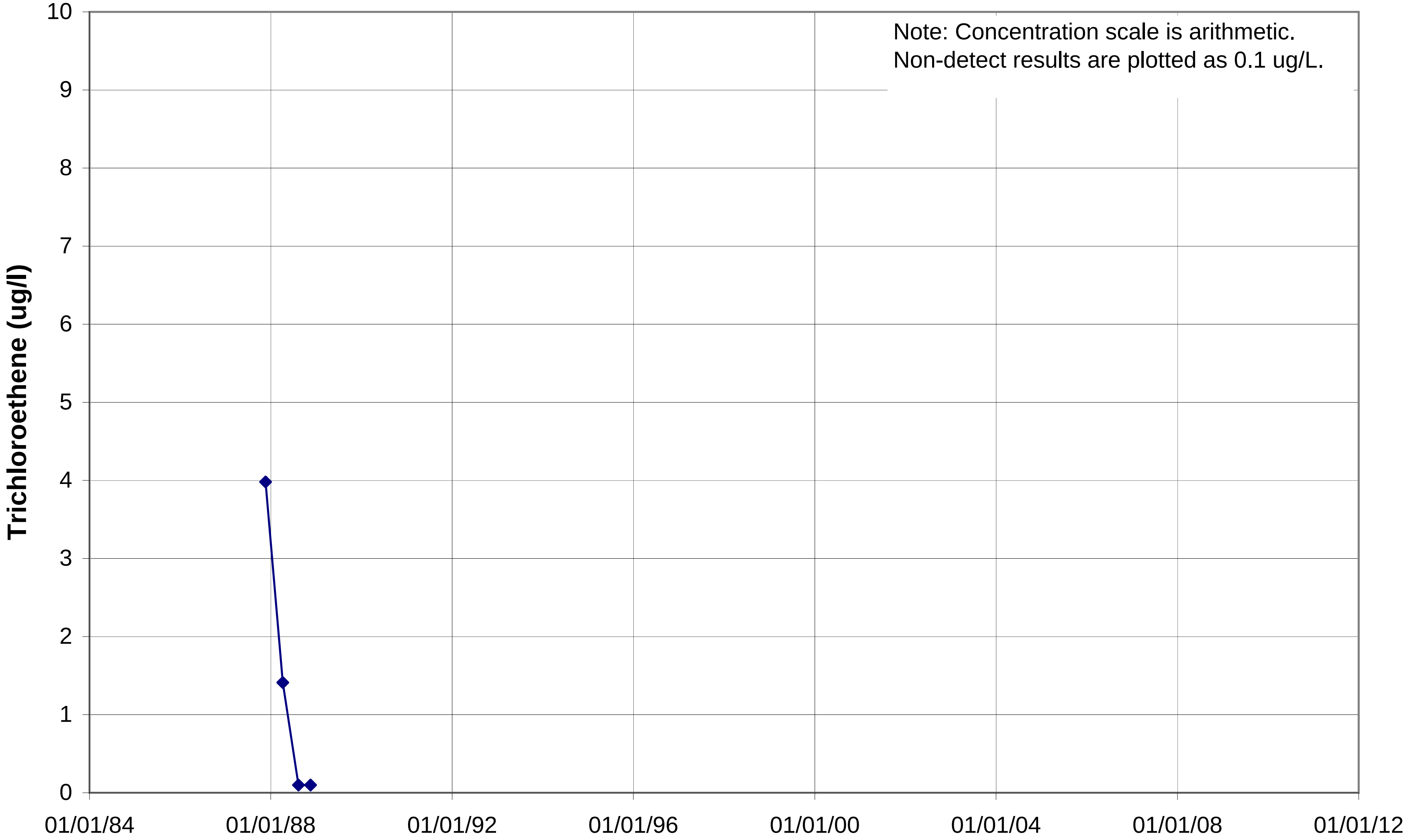

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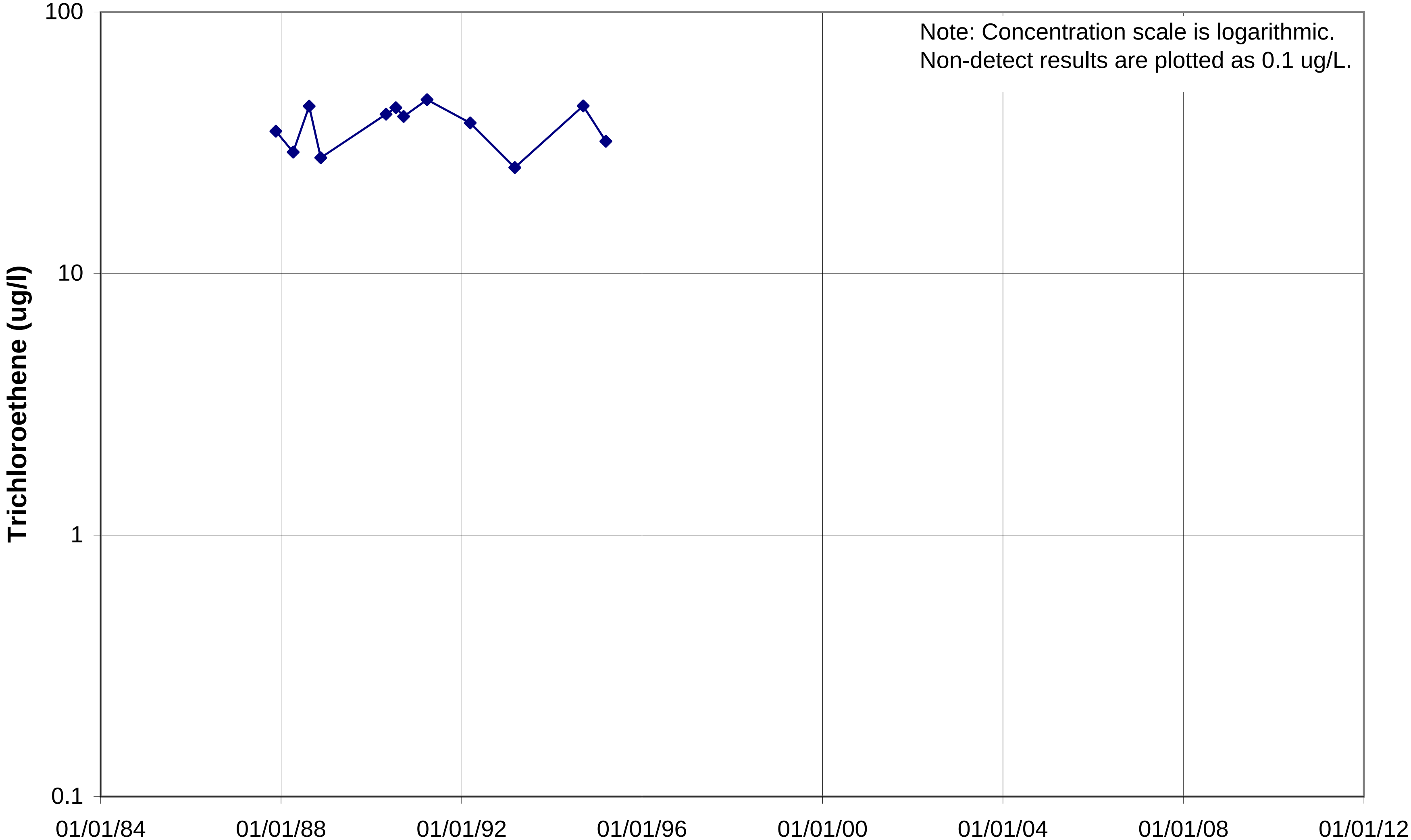

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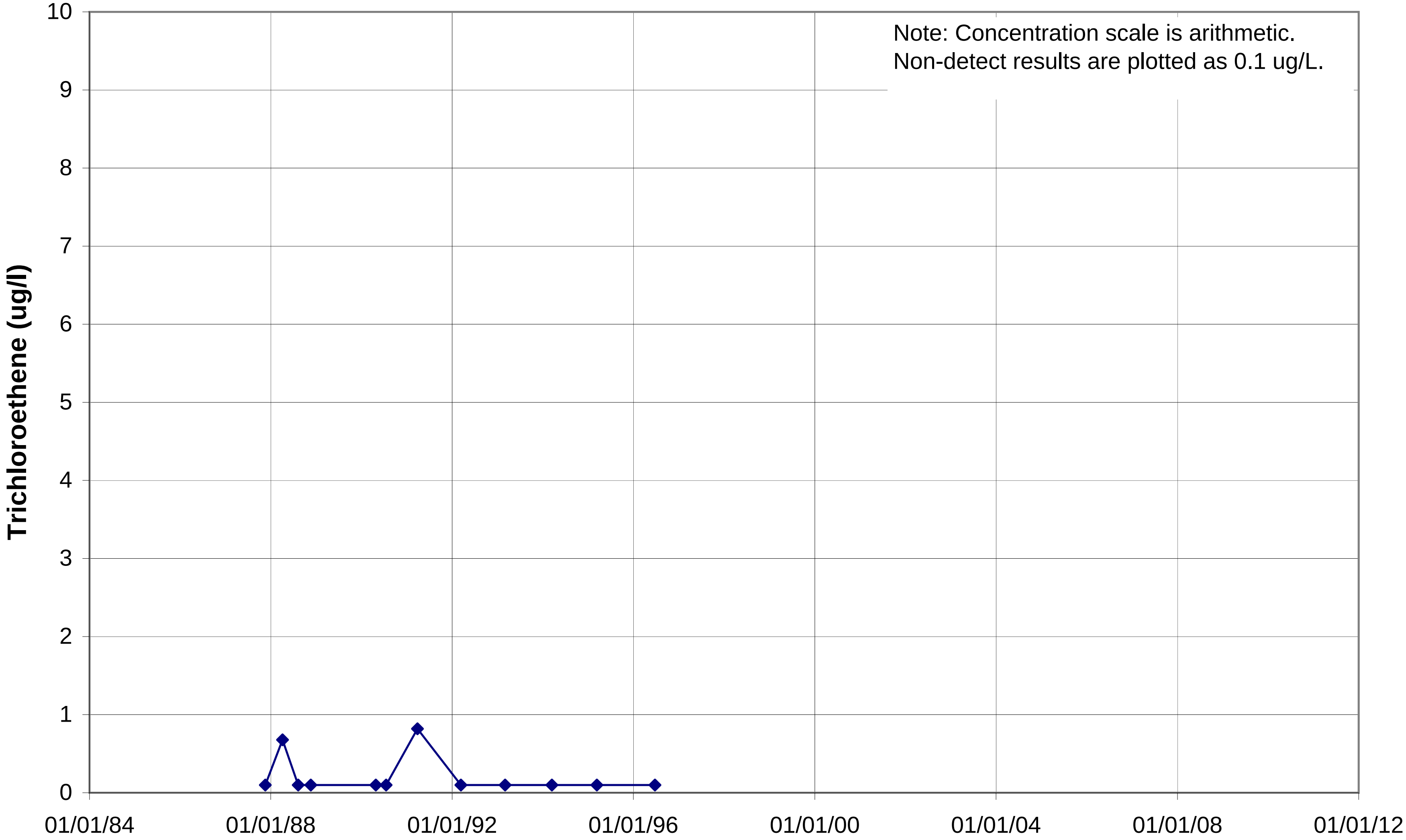

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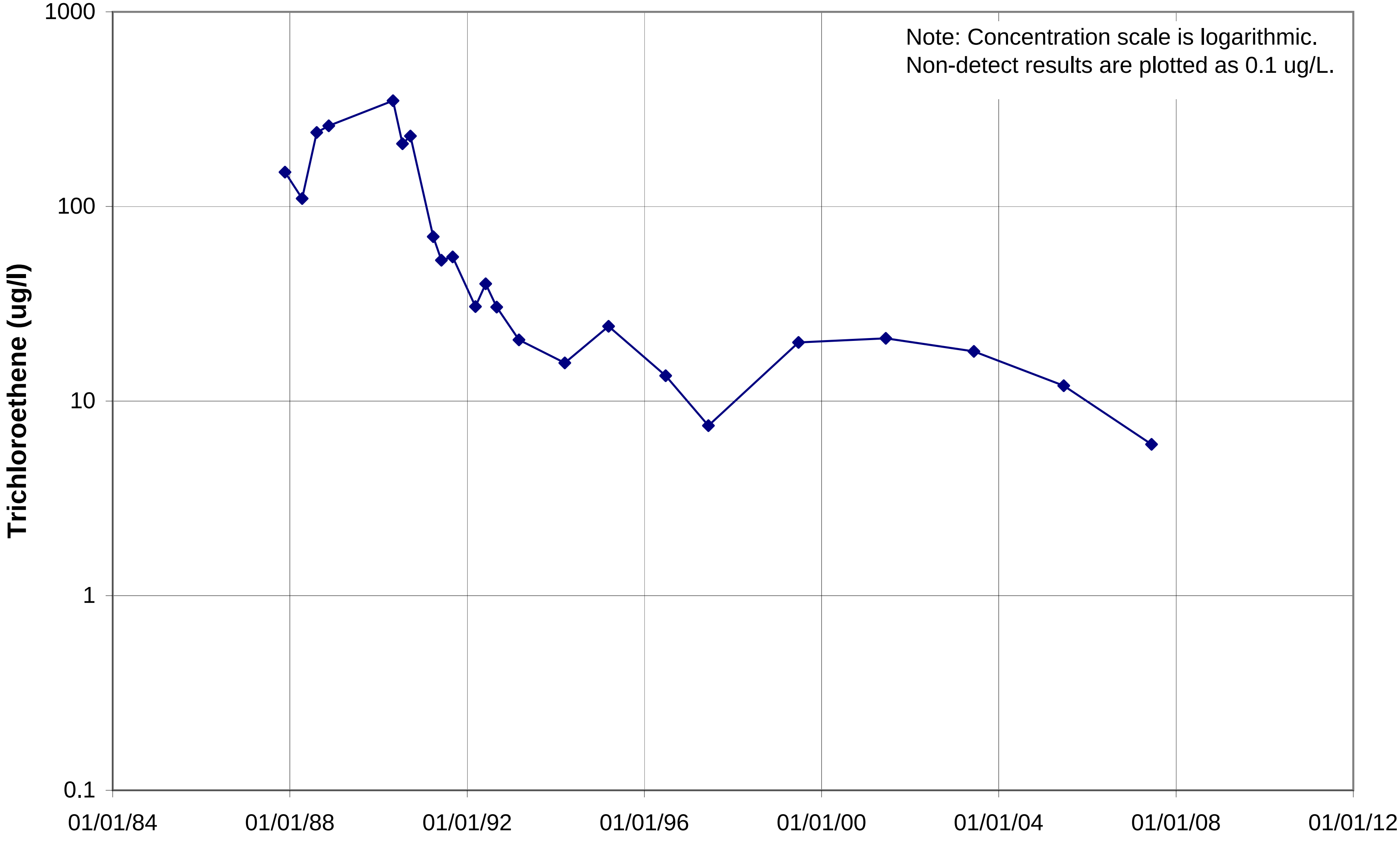

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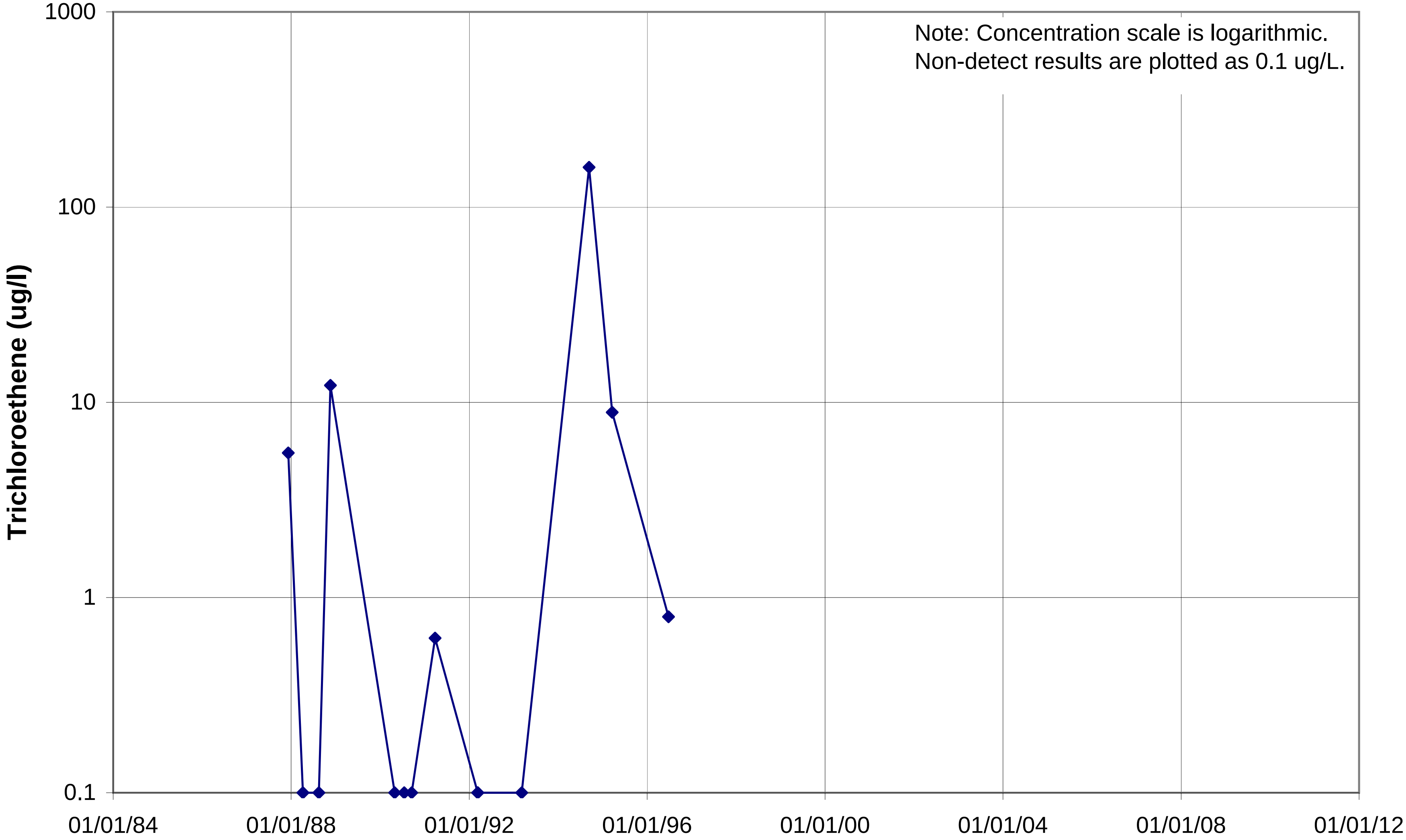

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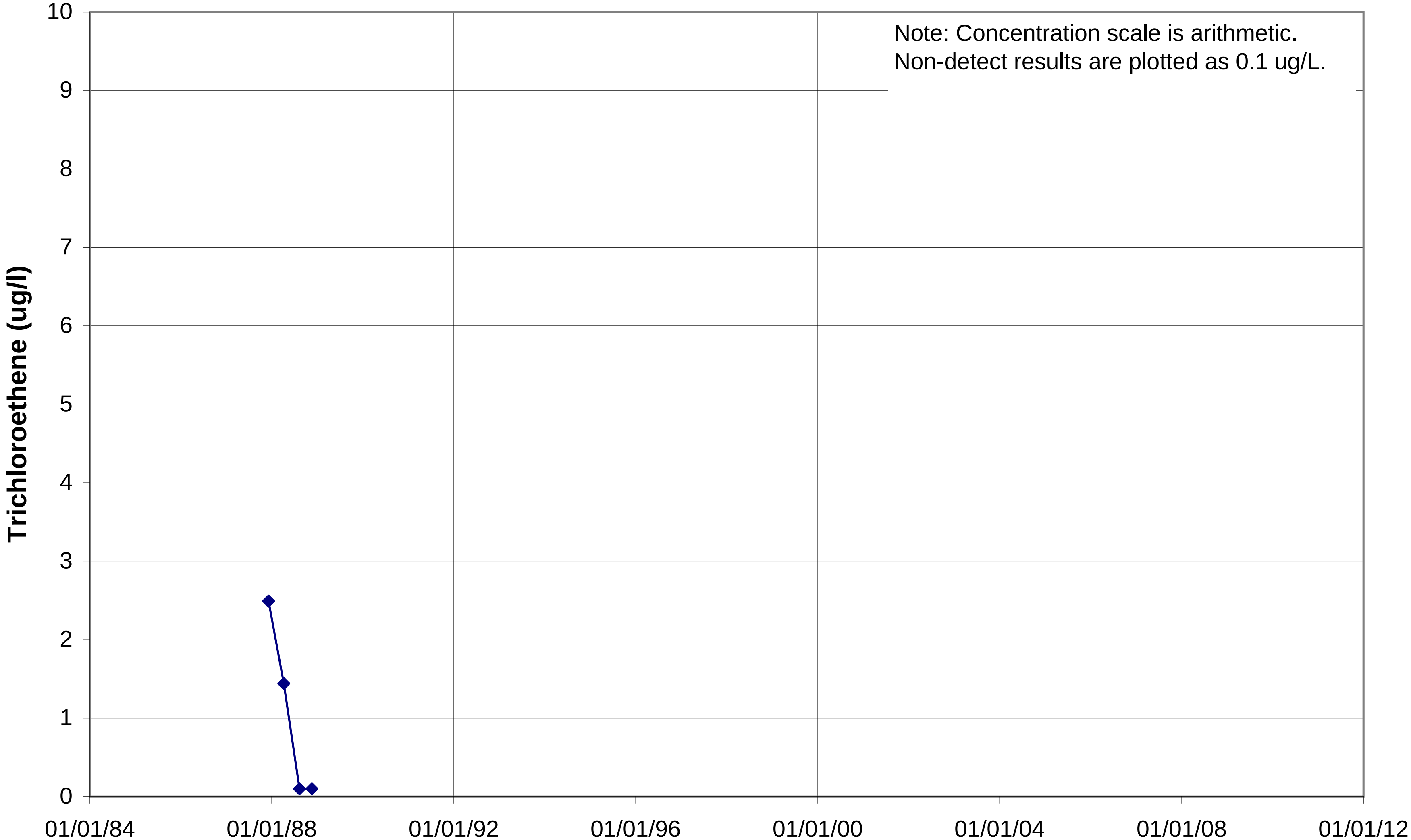

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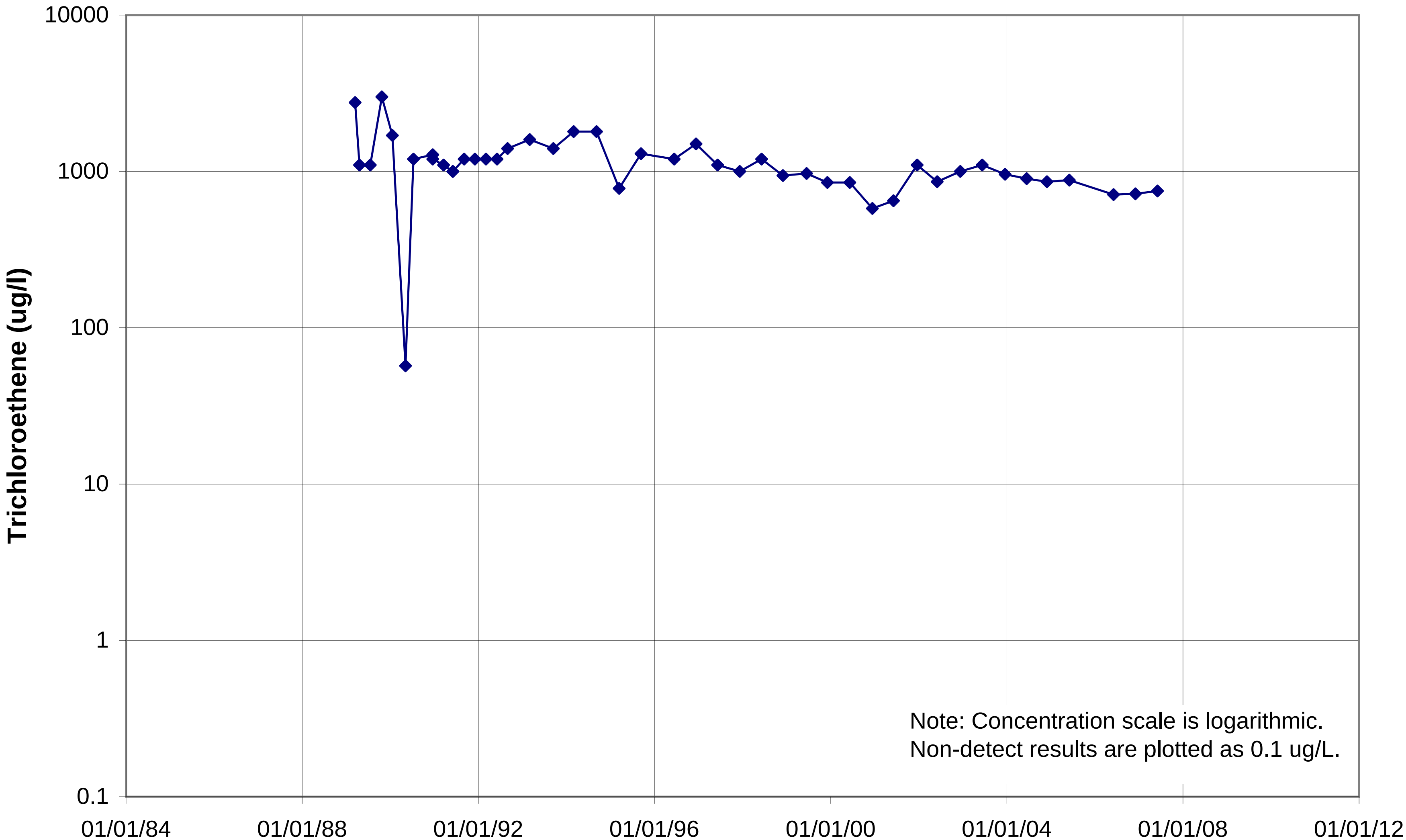
03U301 (SC1)



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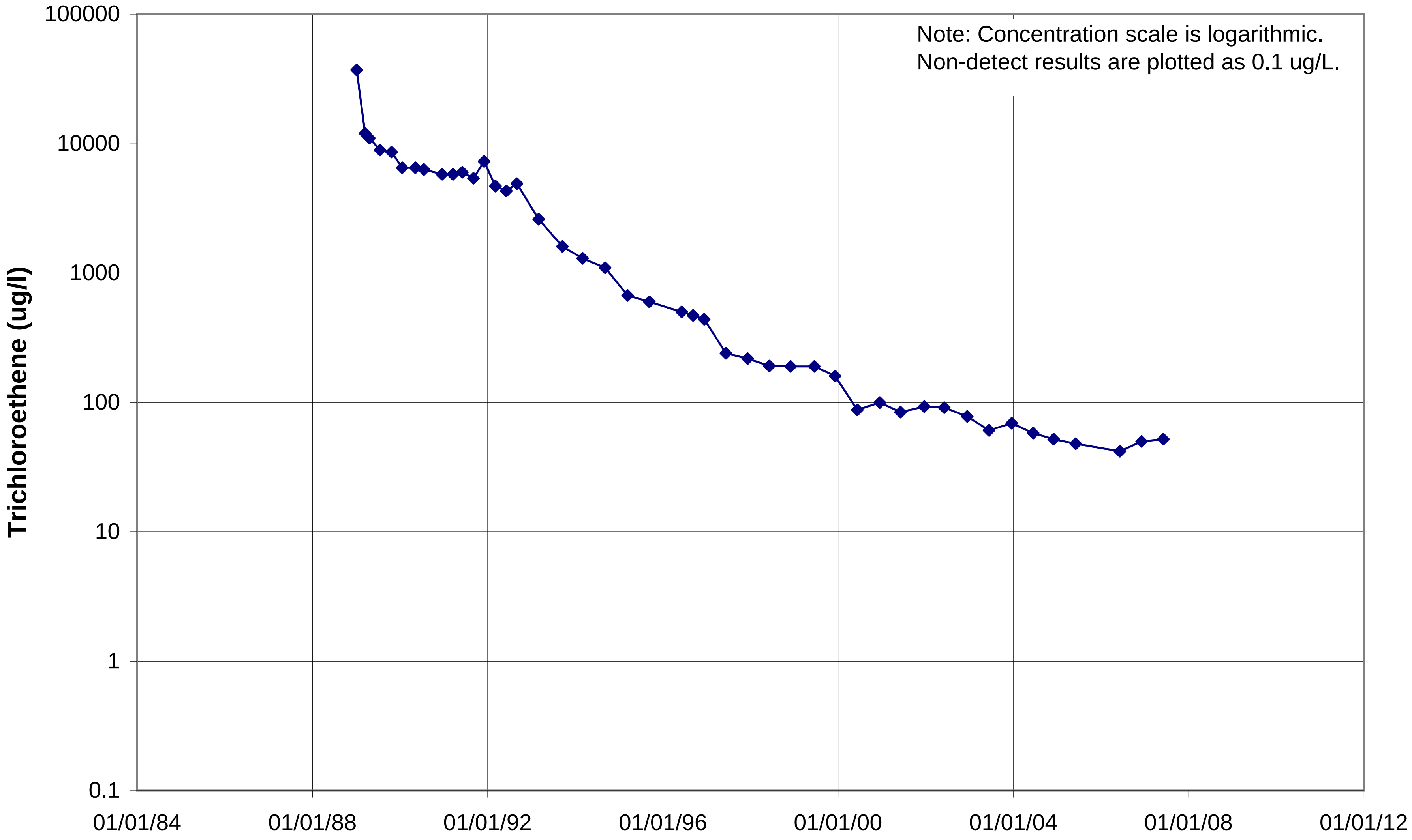

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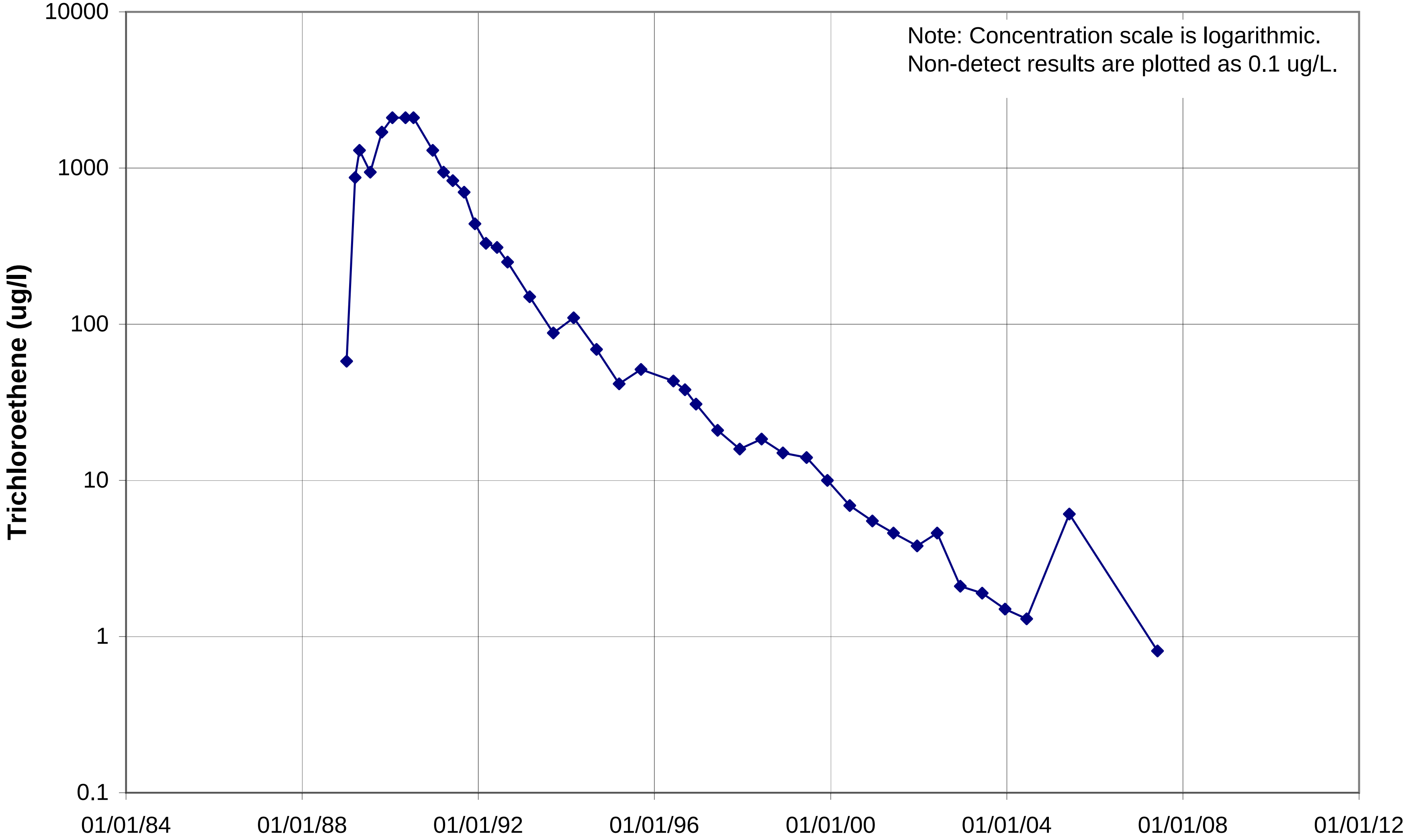

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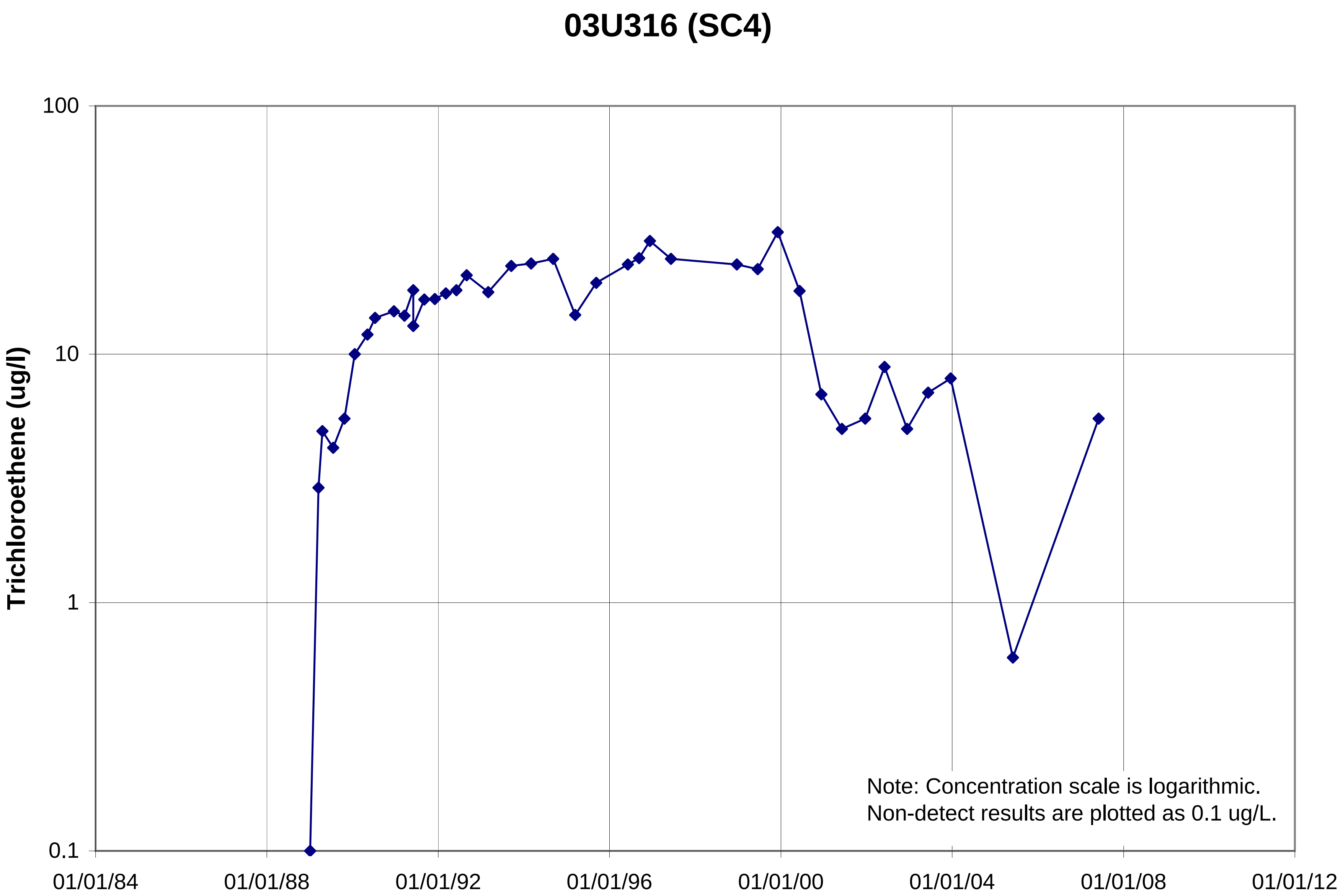

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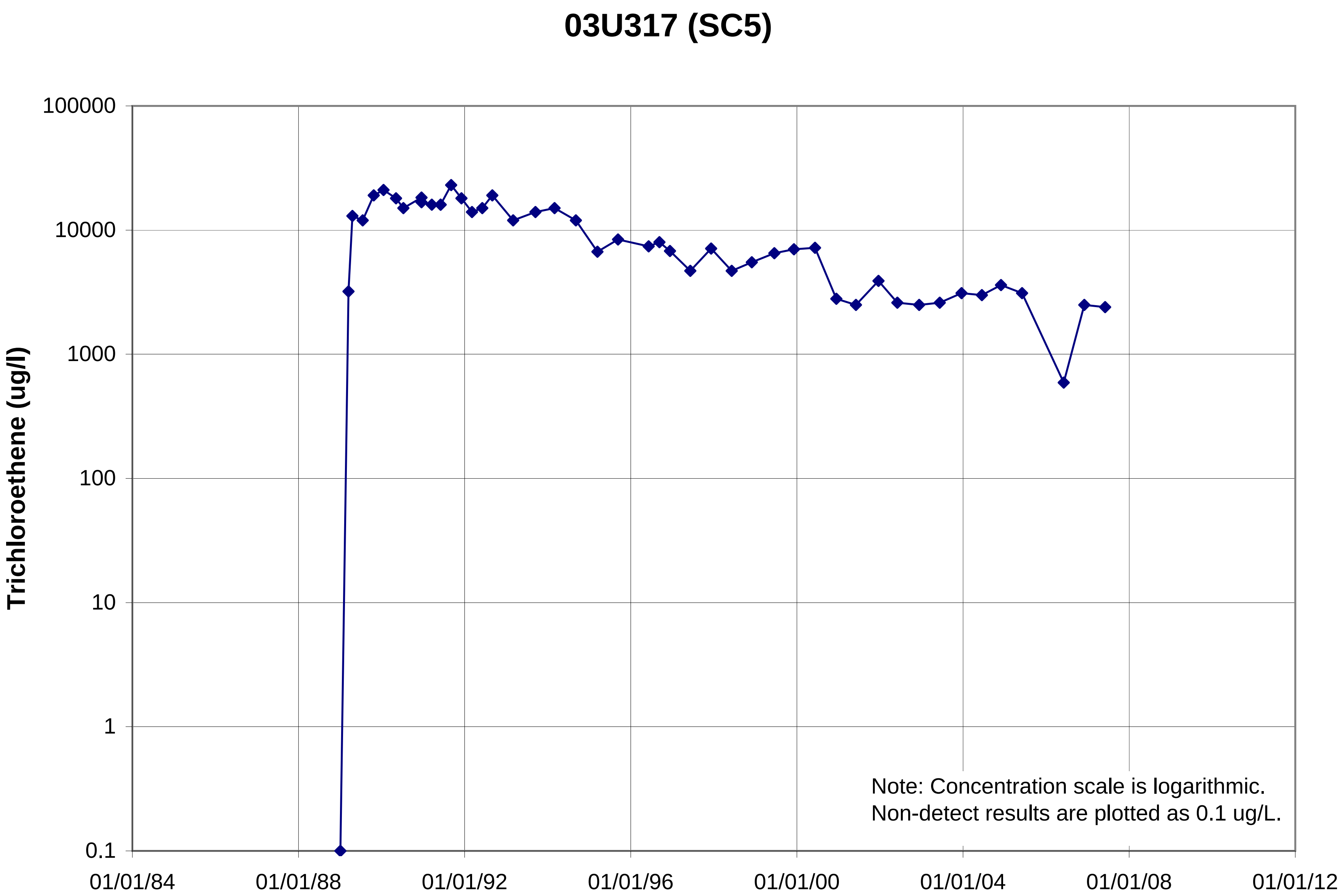

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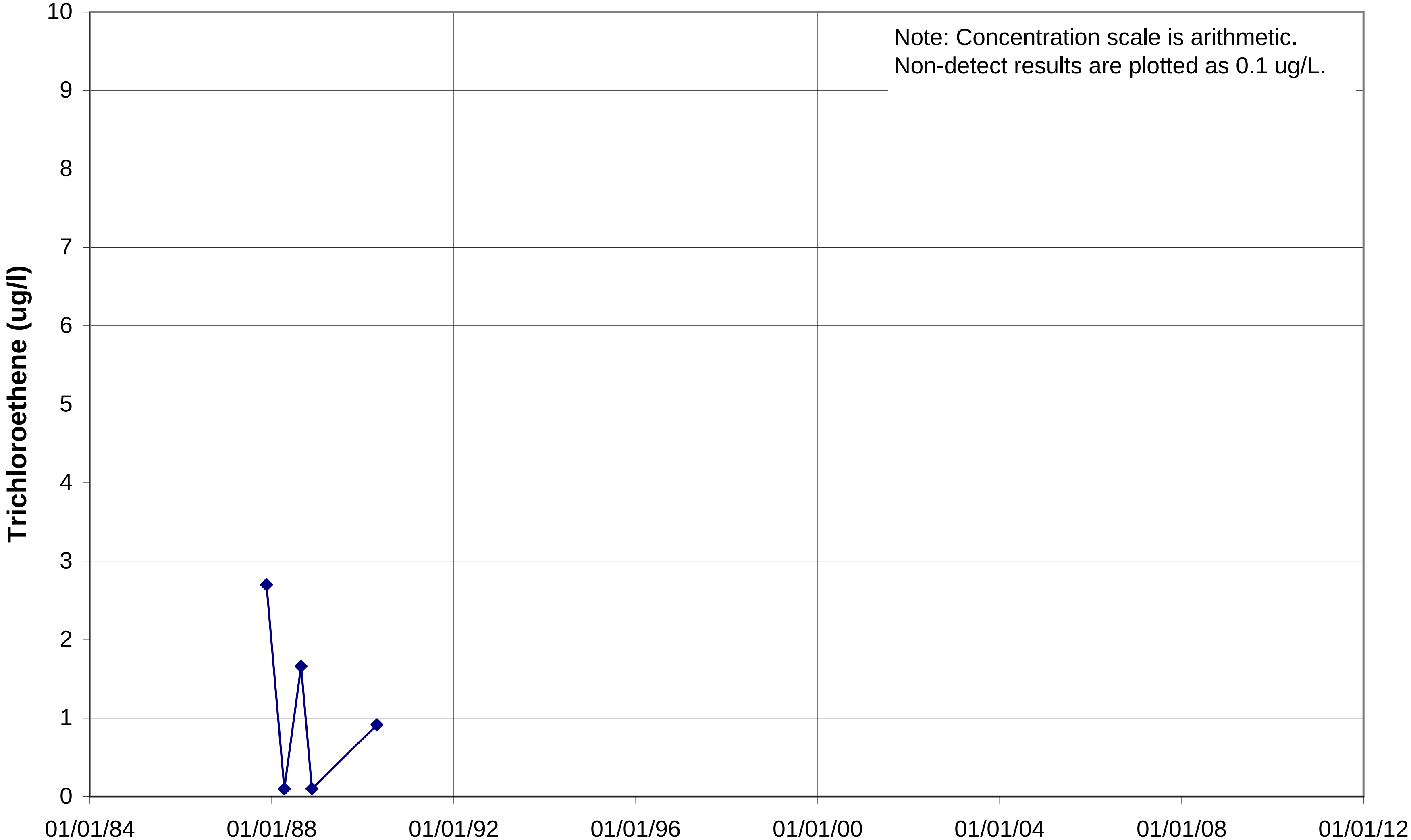

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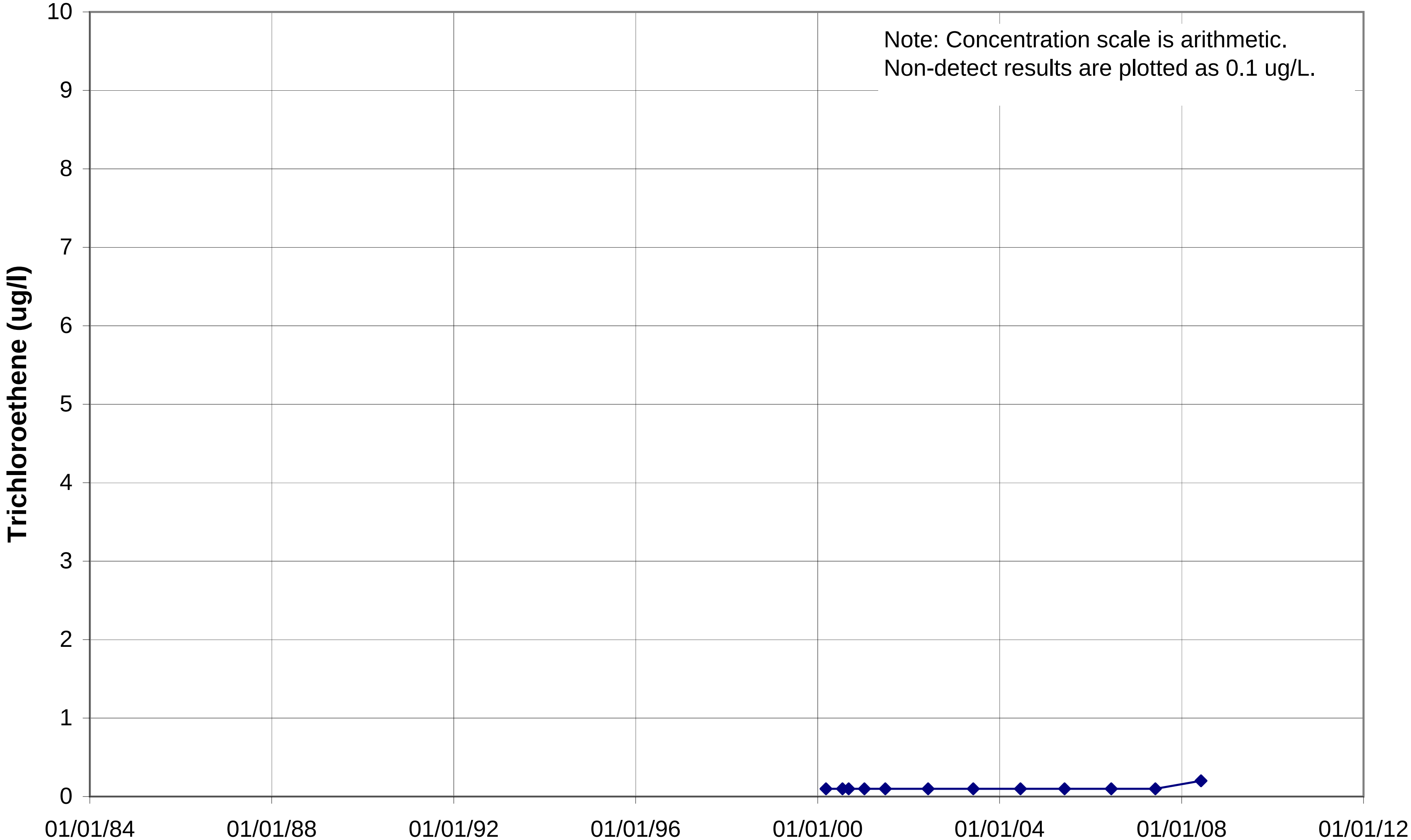

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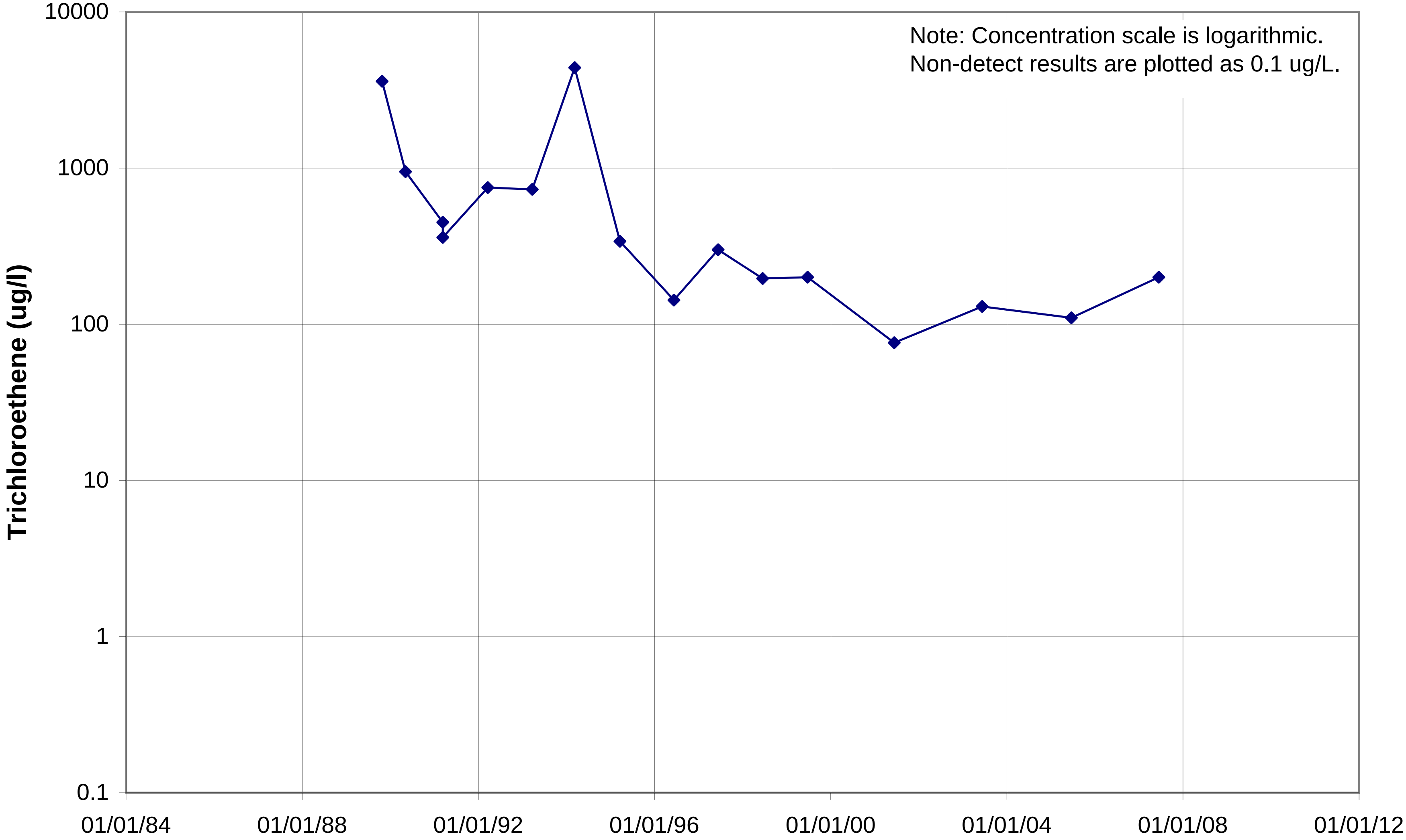
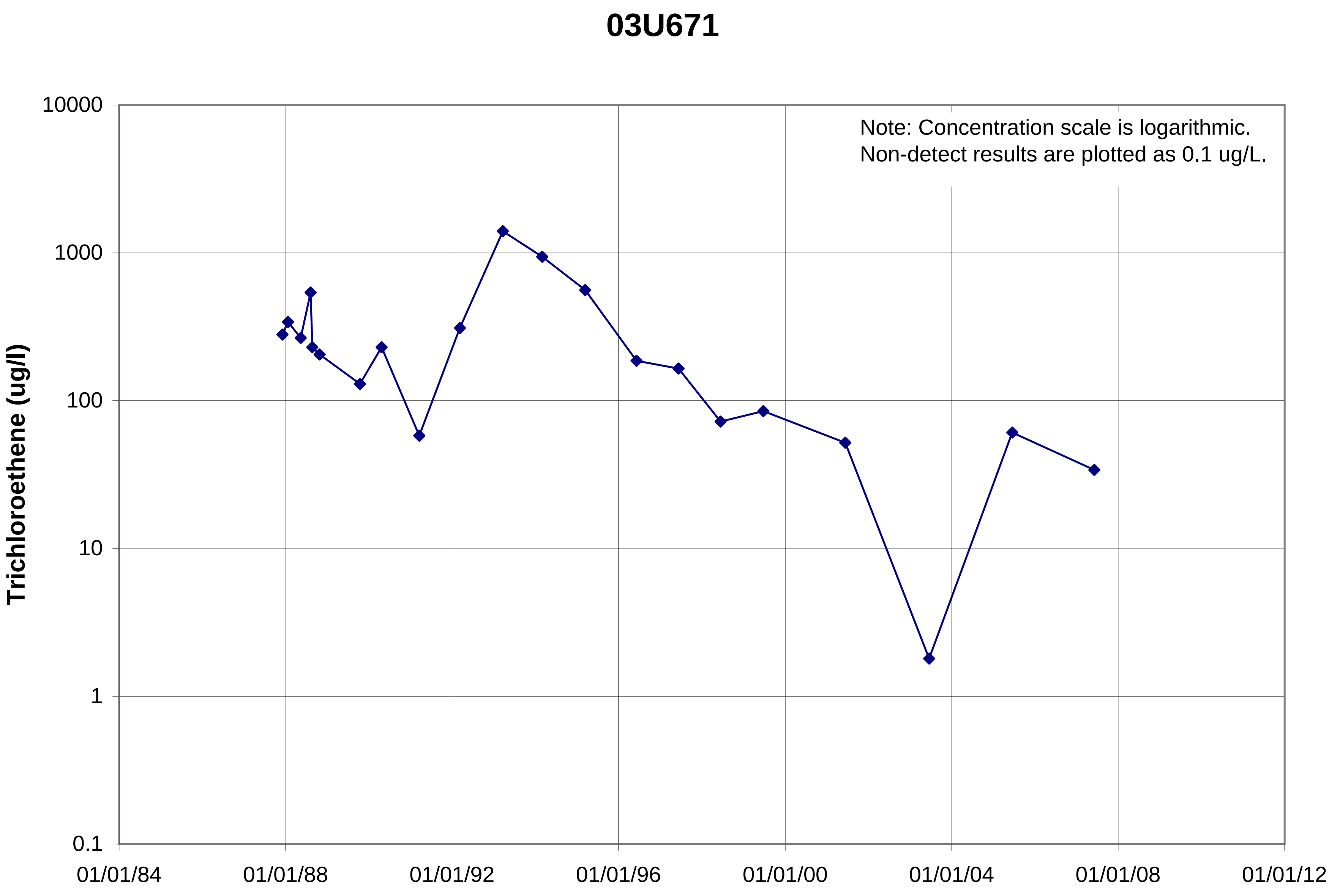


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar



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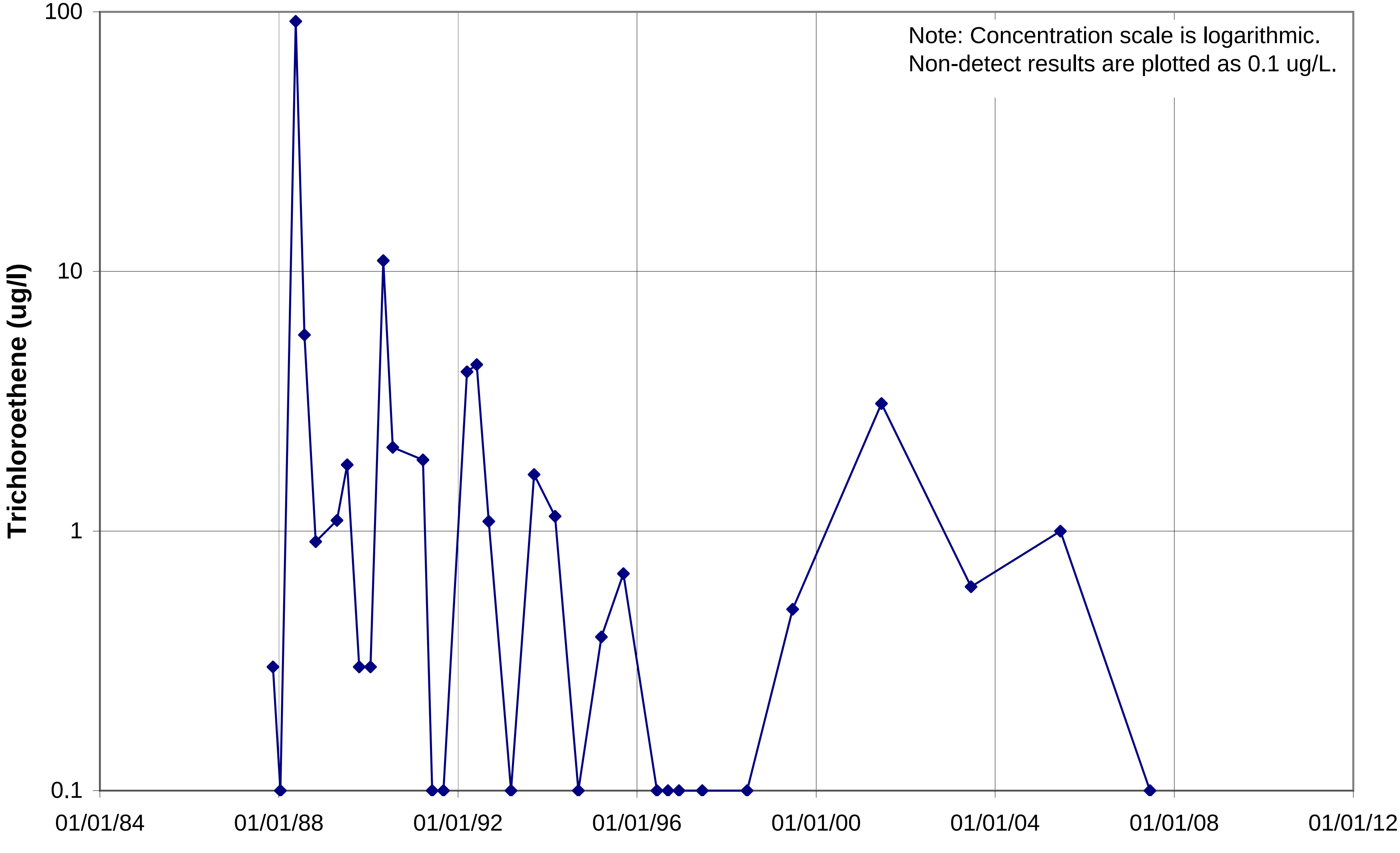

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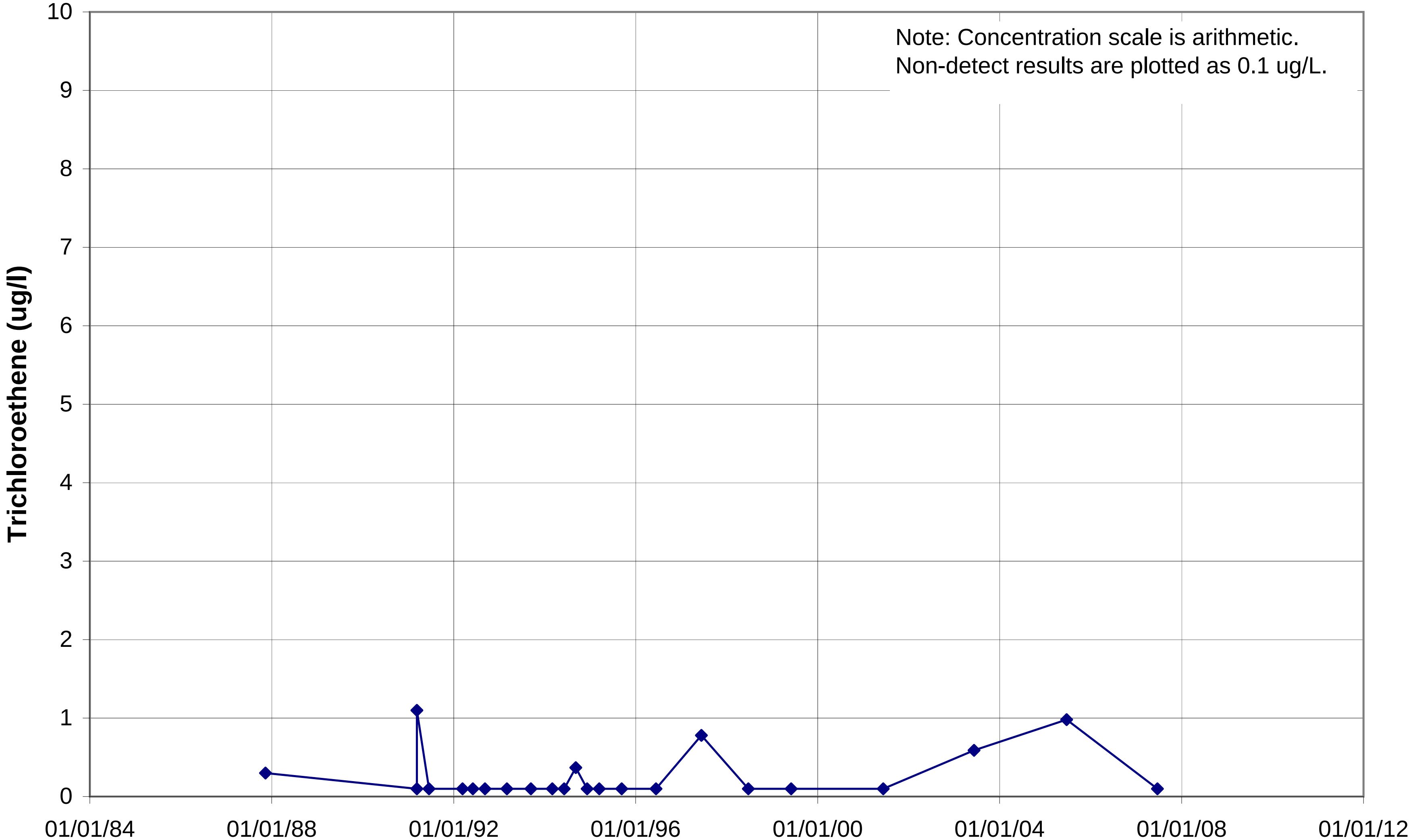
03U673



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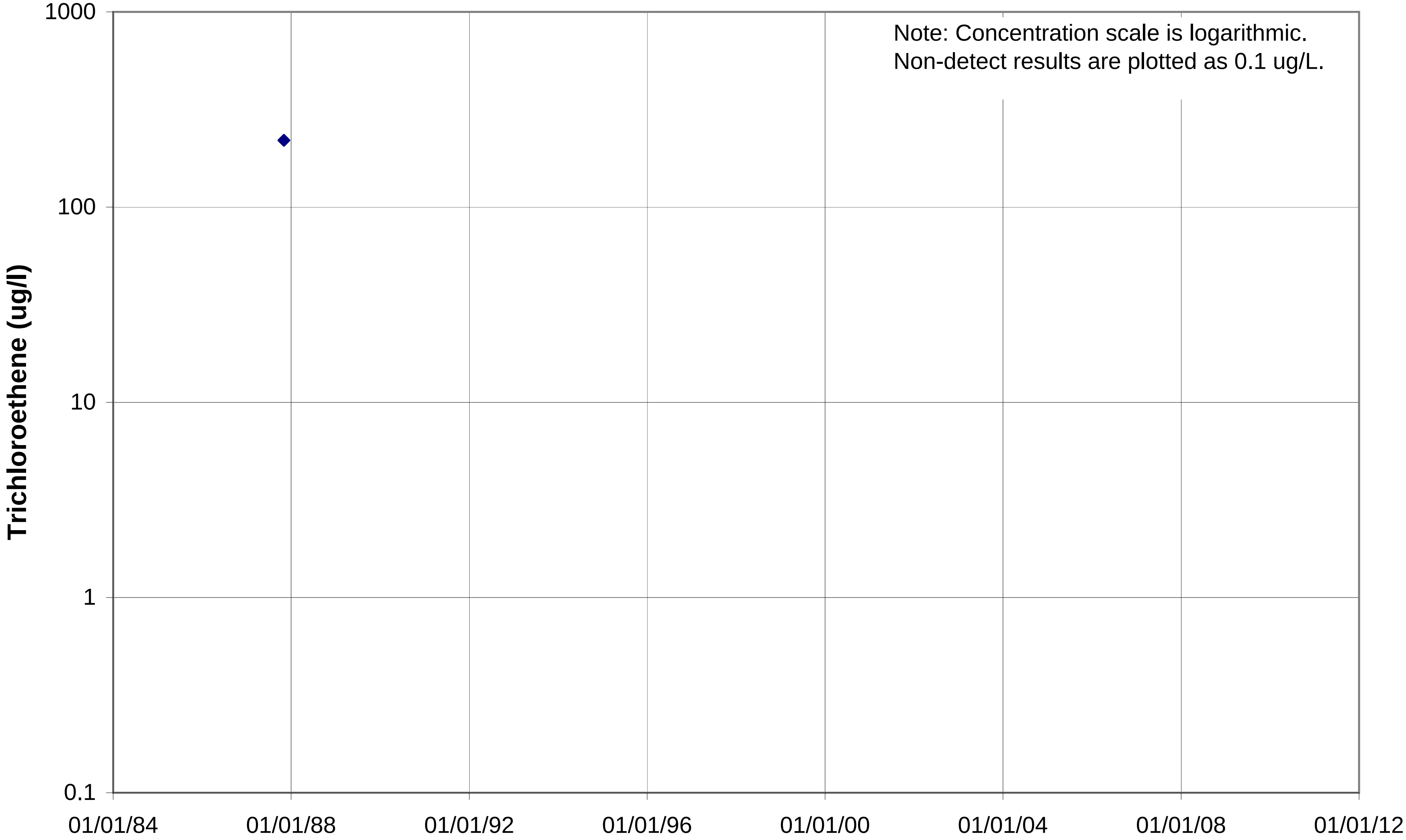

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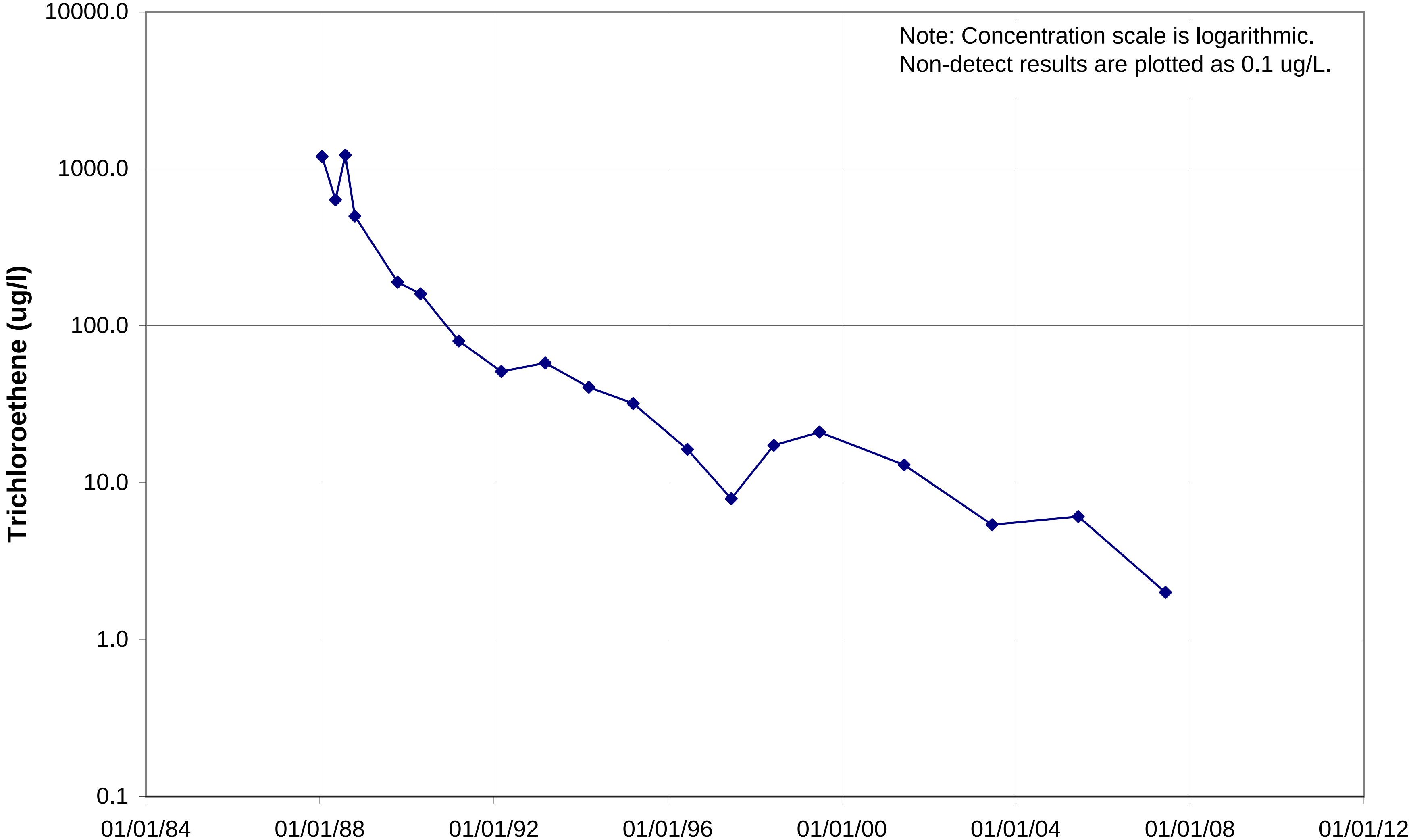

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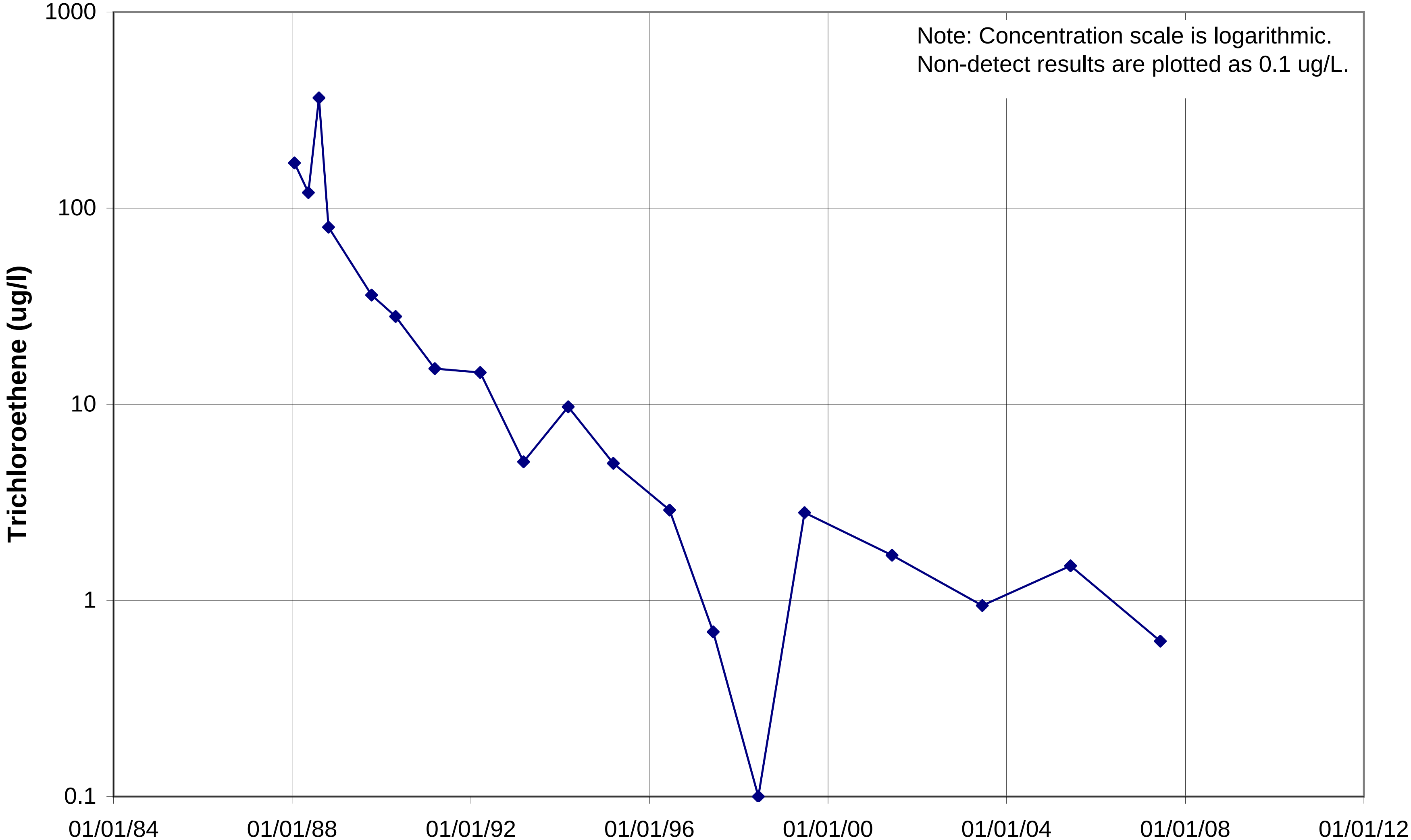

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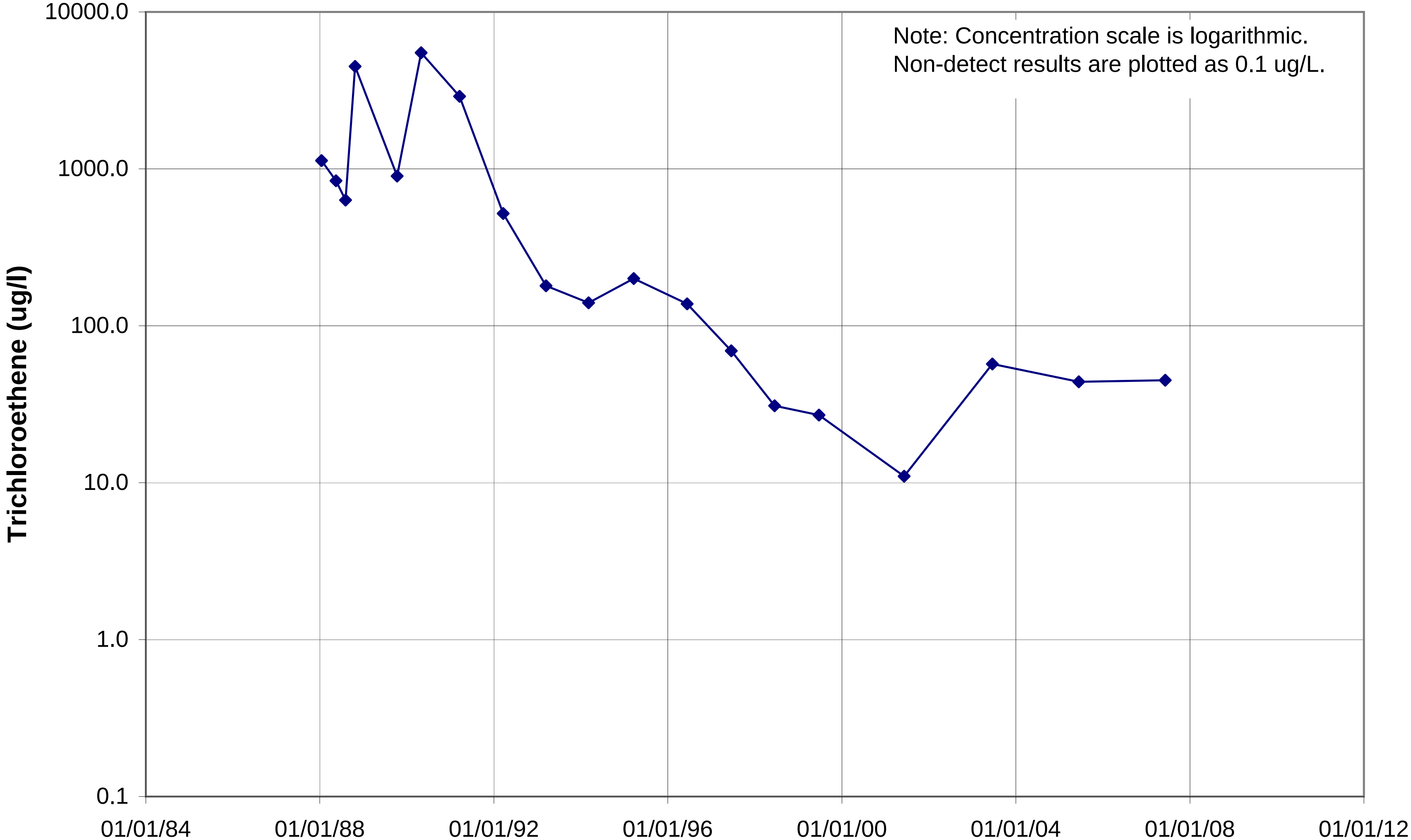

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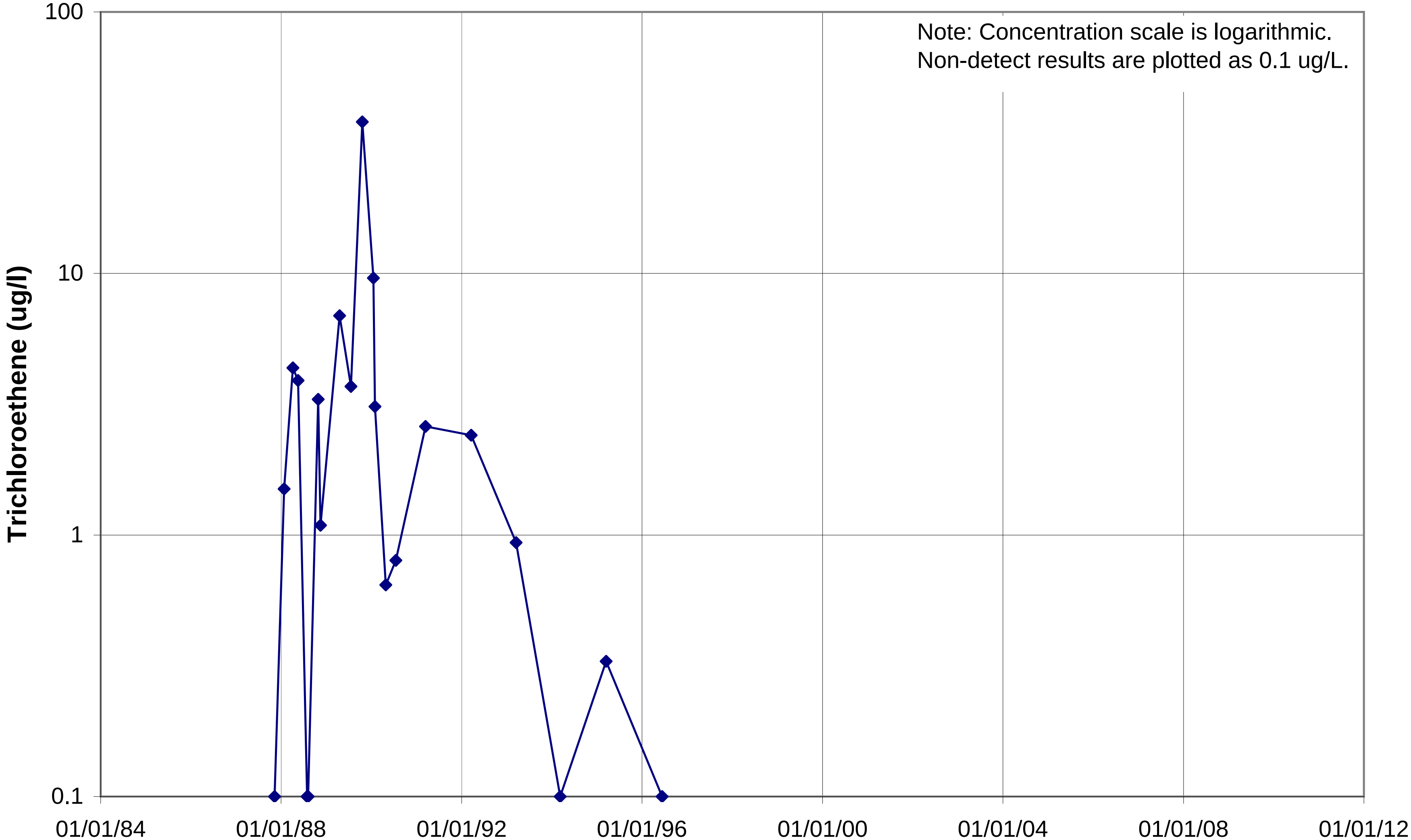

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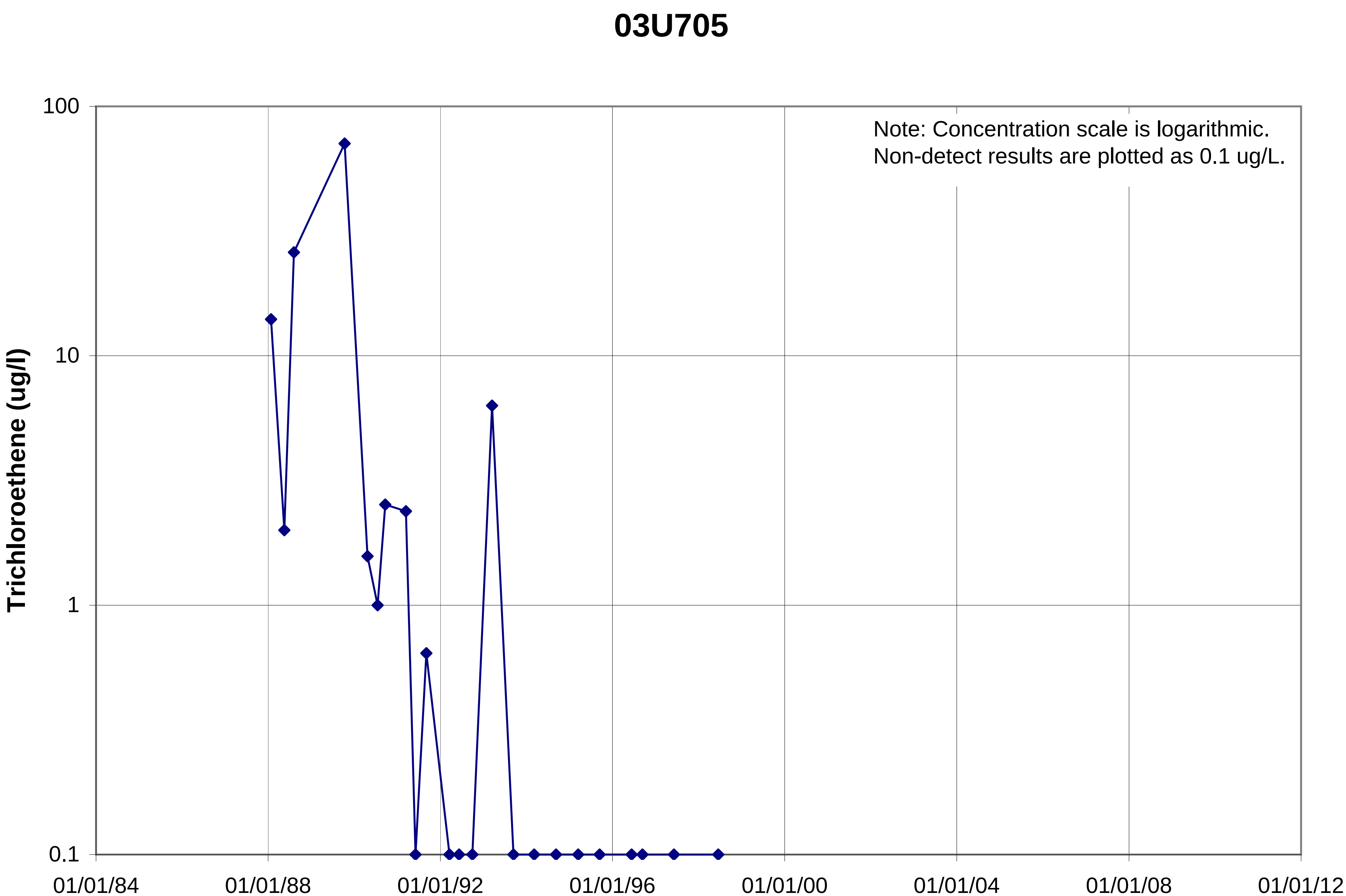

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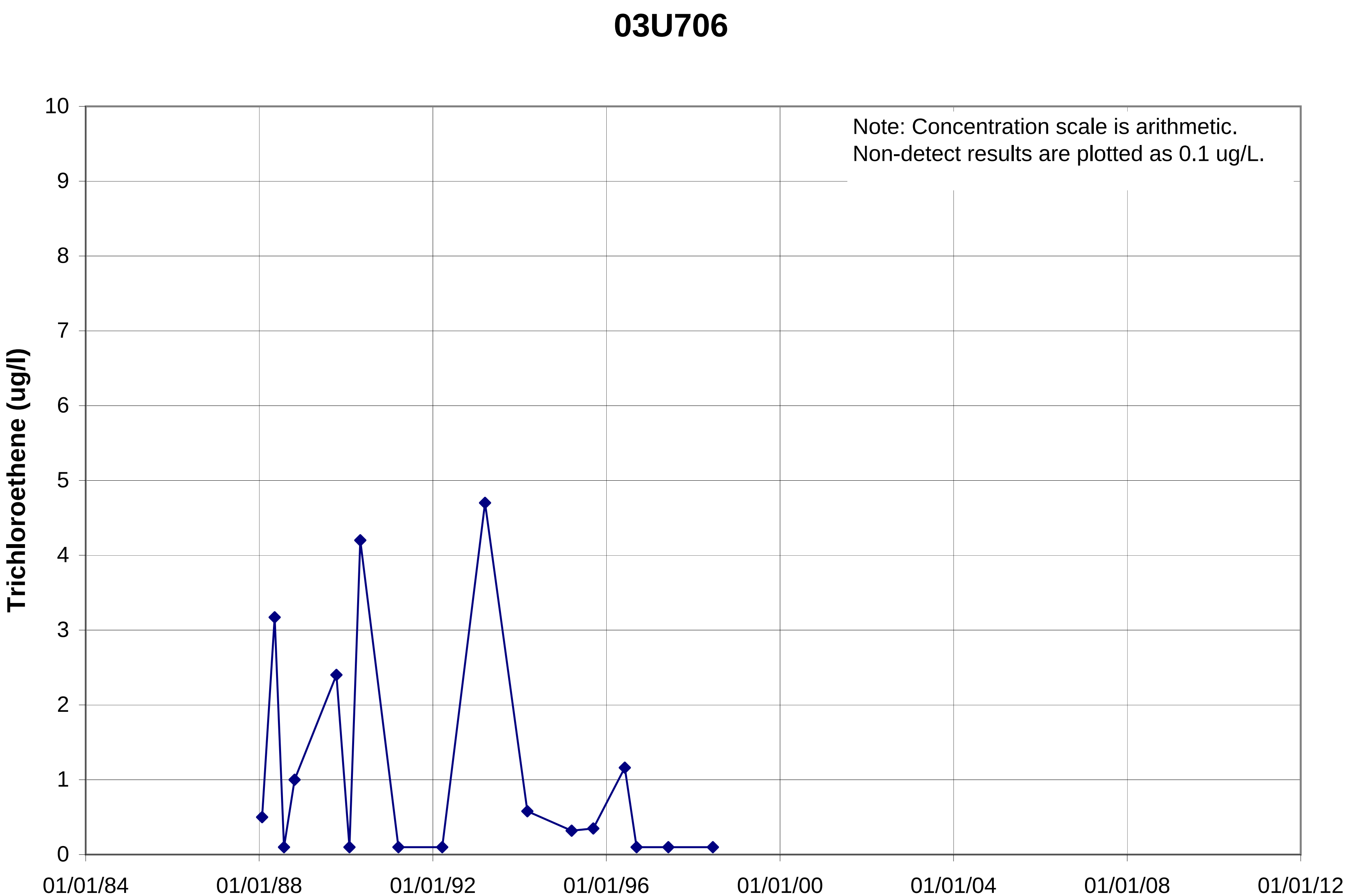

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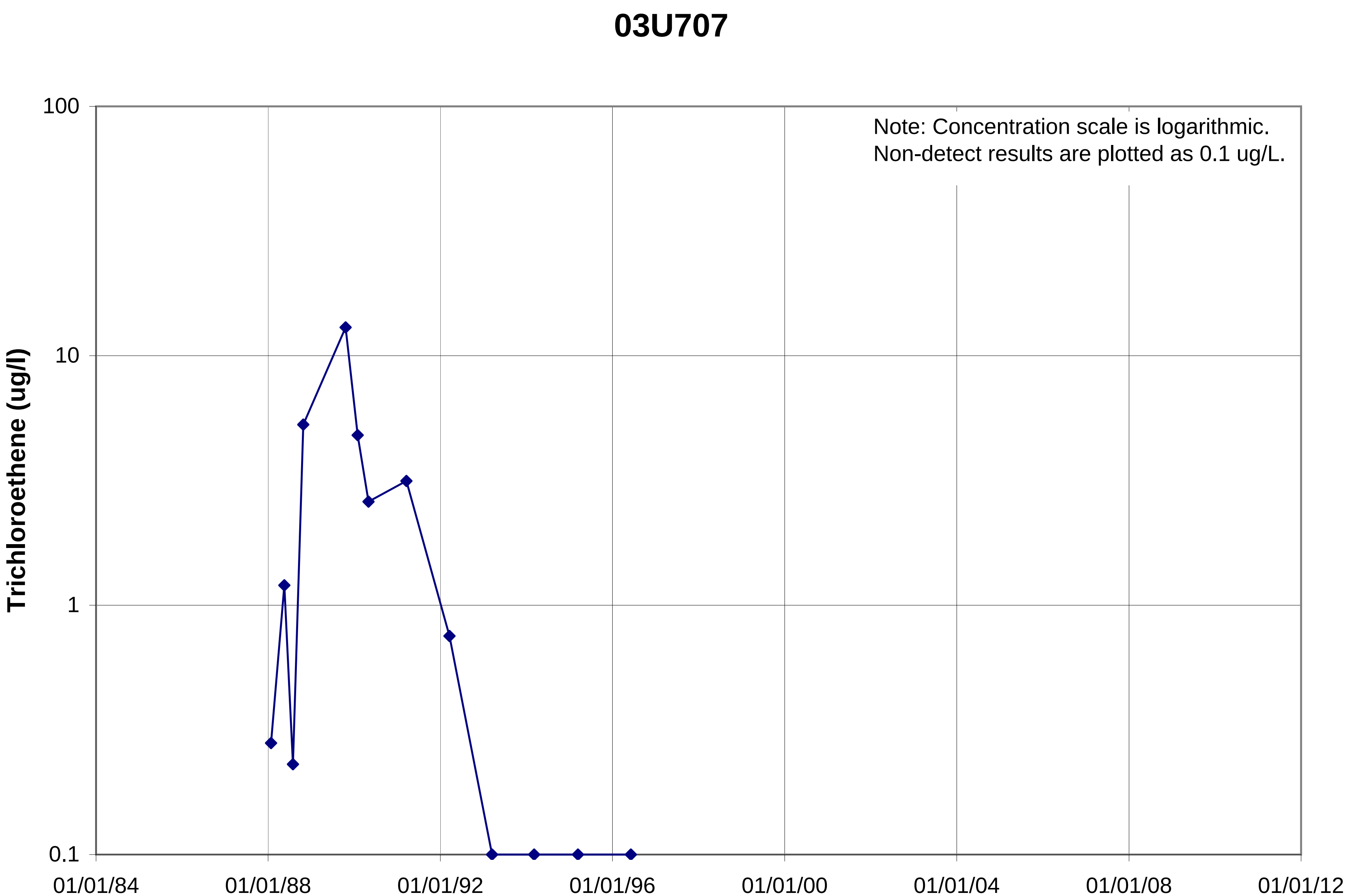

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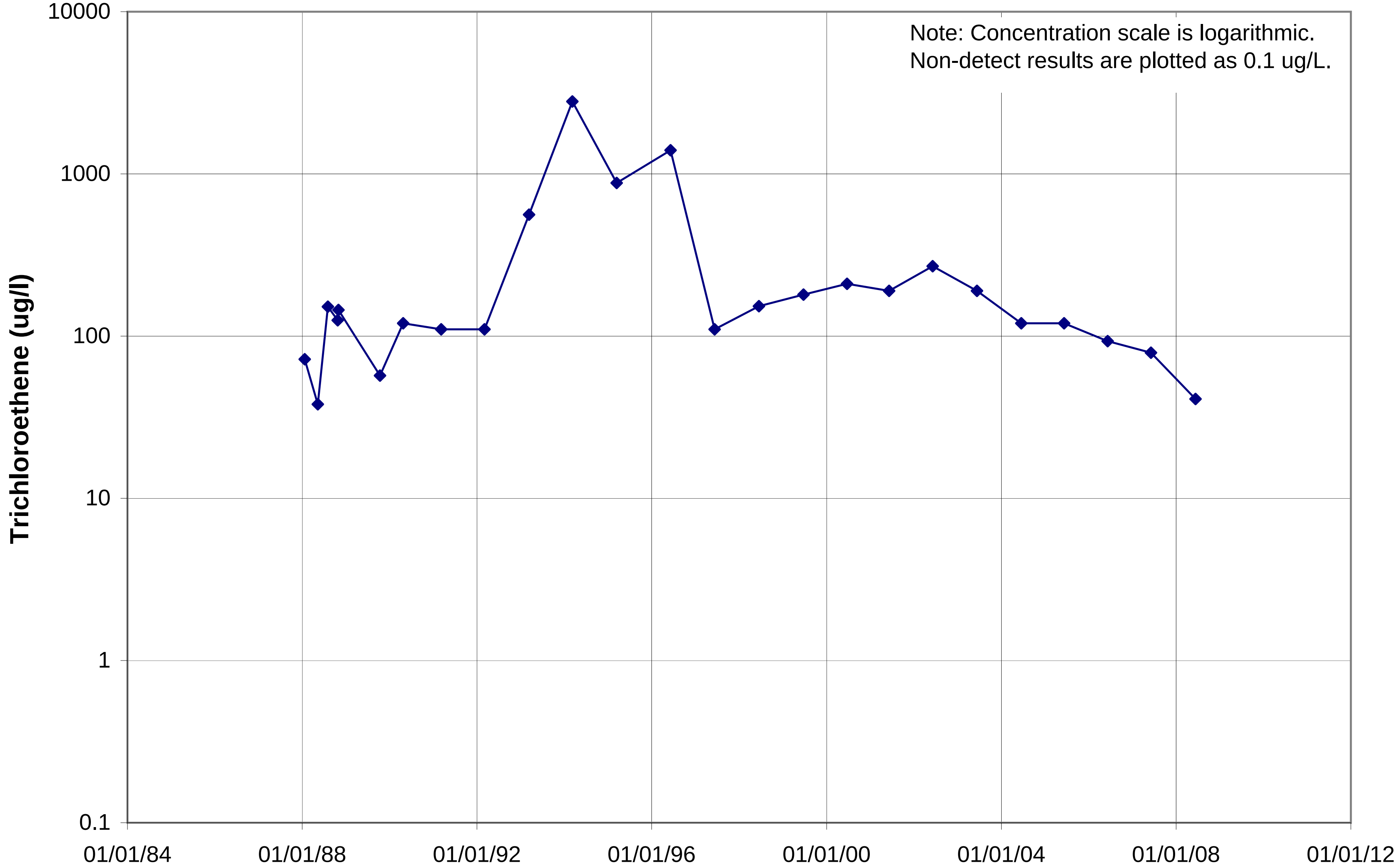

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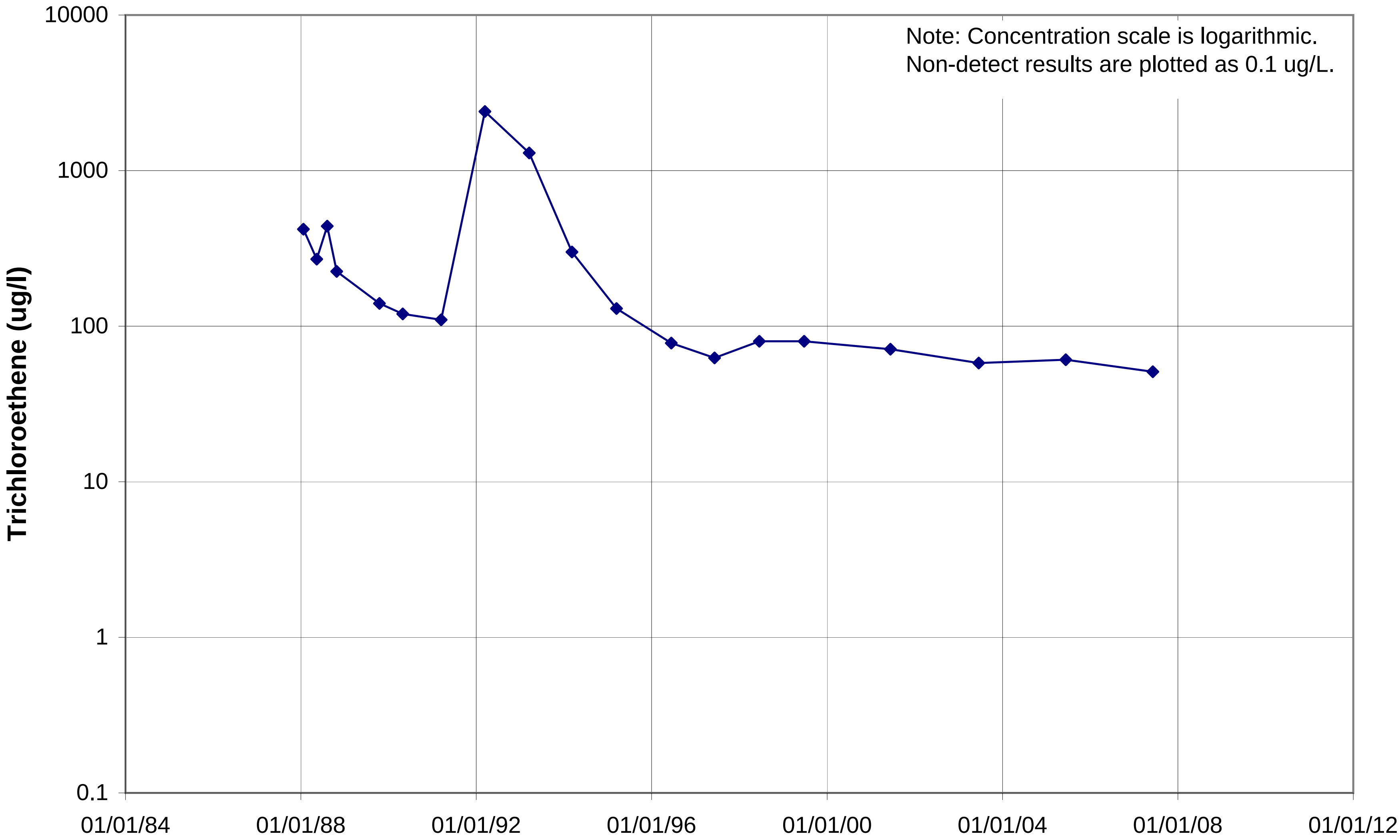

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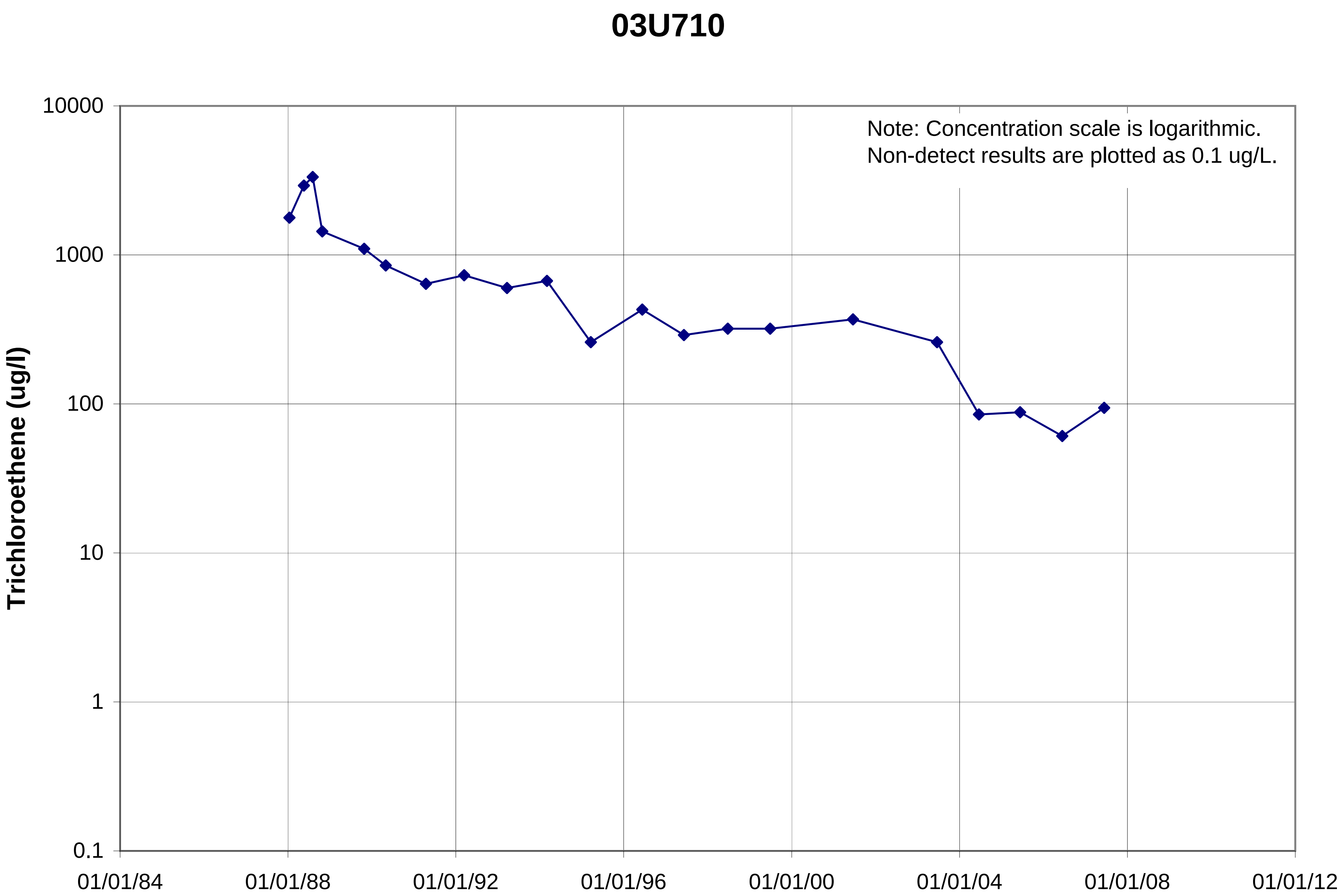

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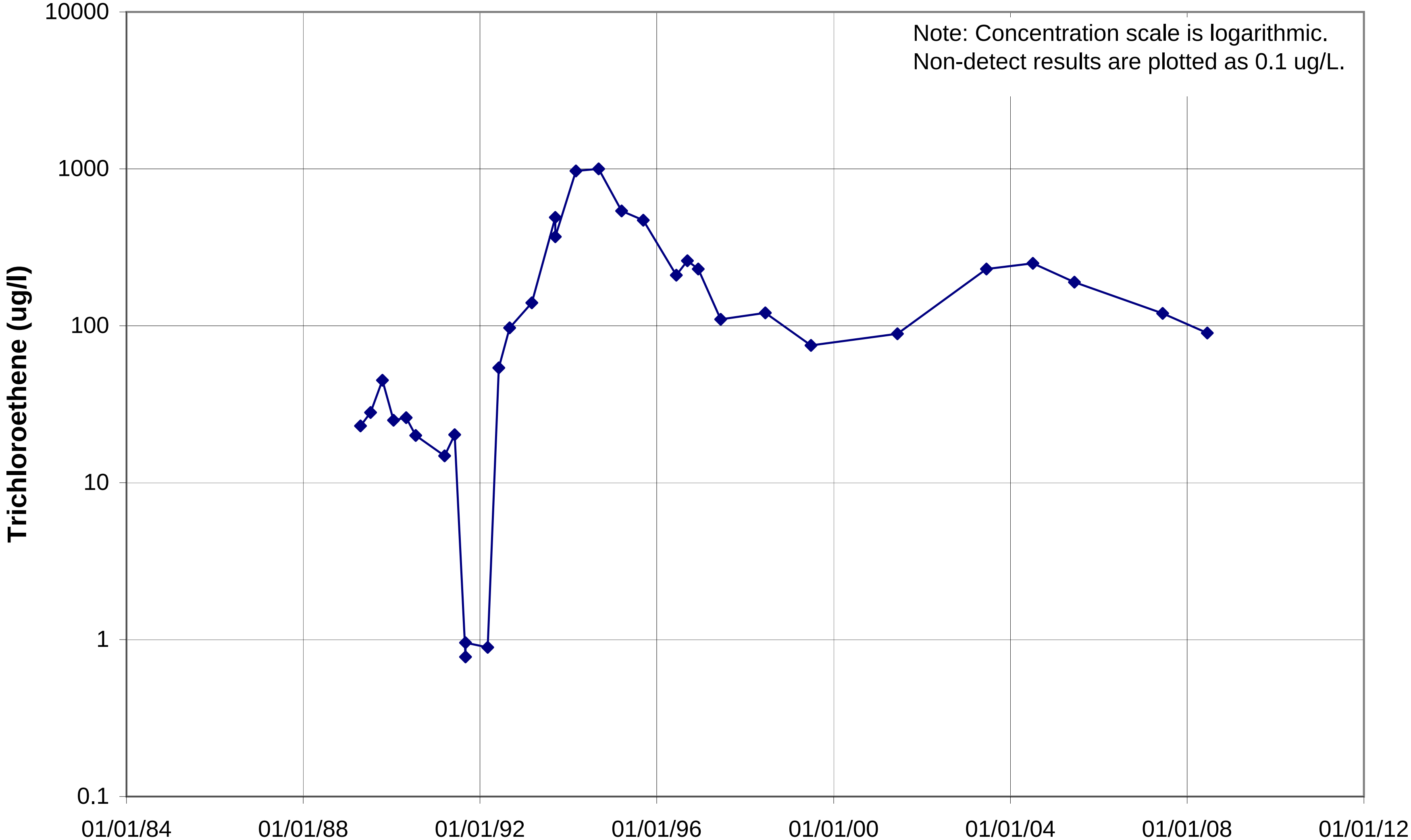

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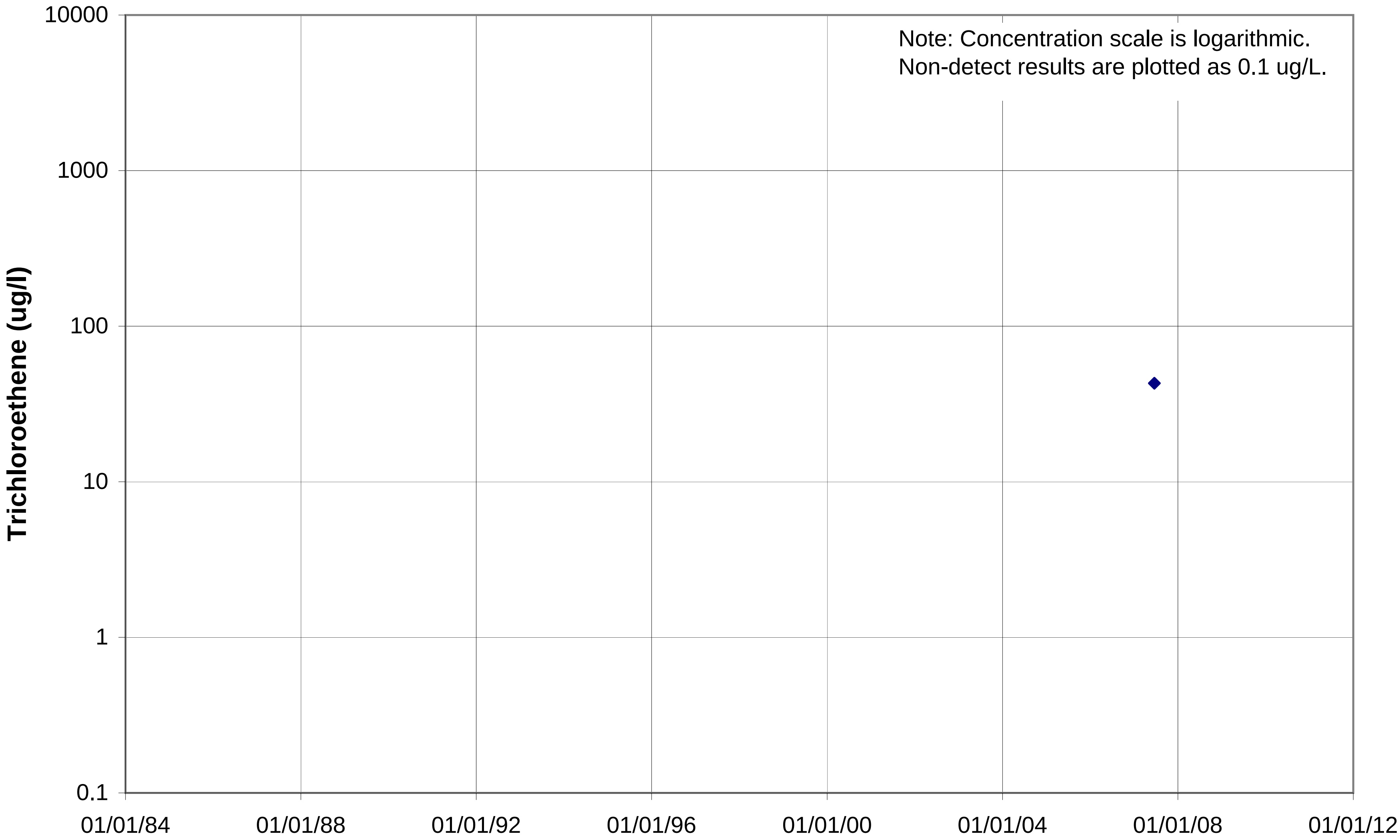

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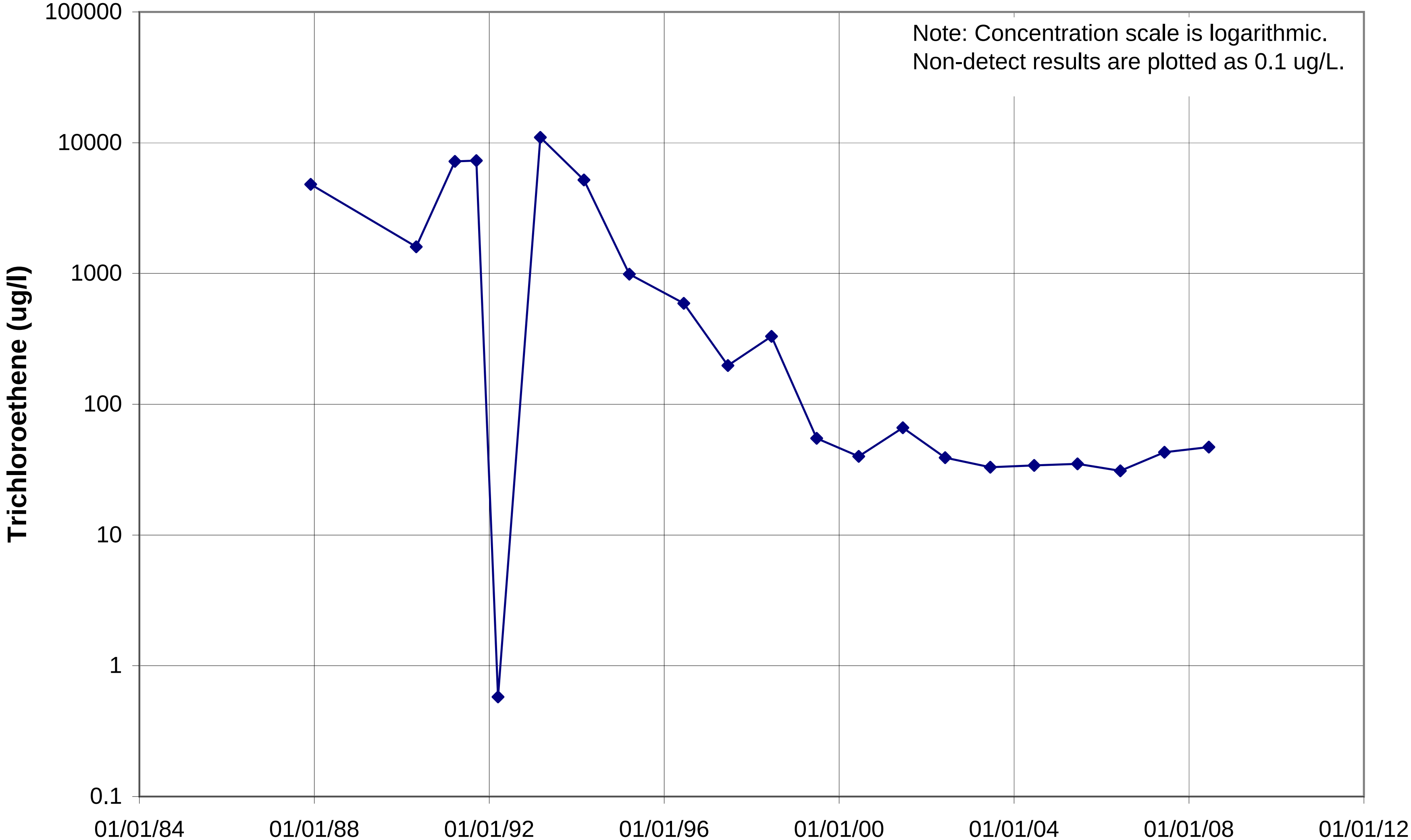

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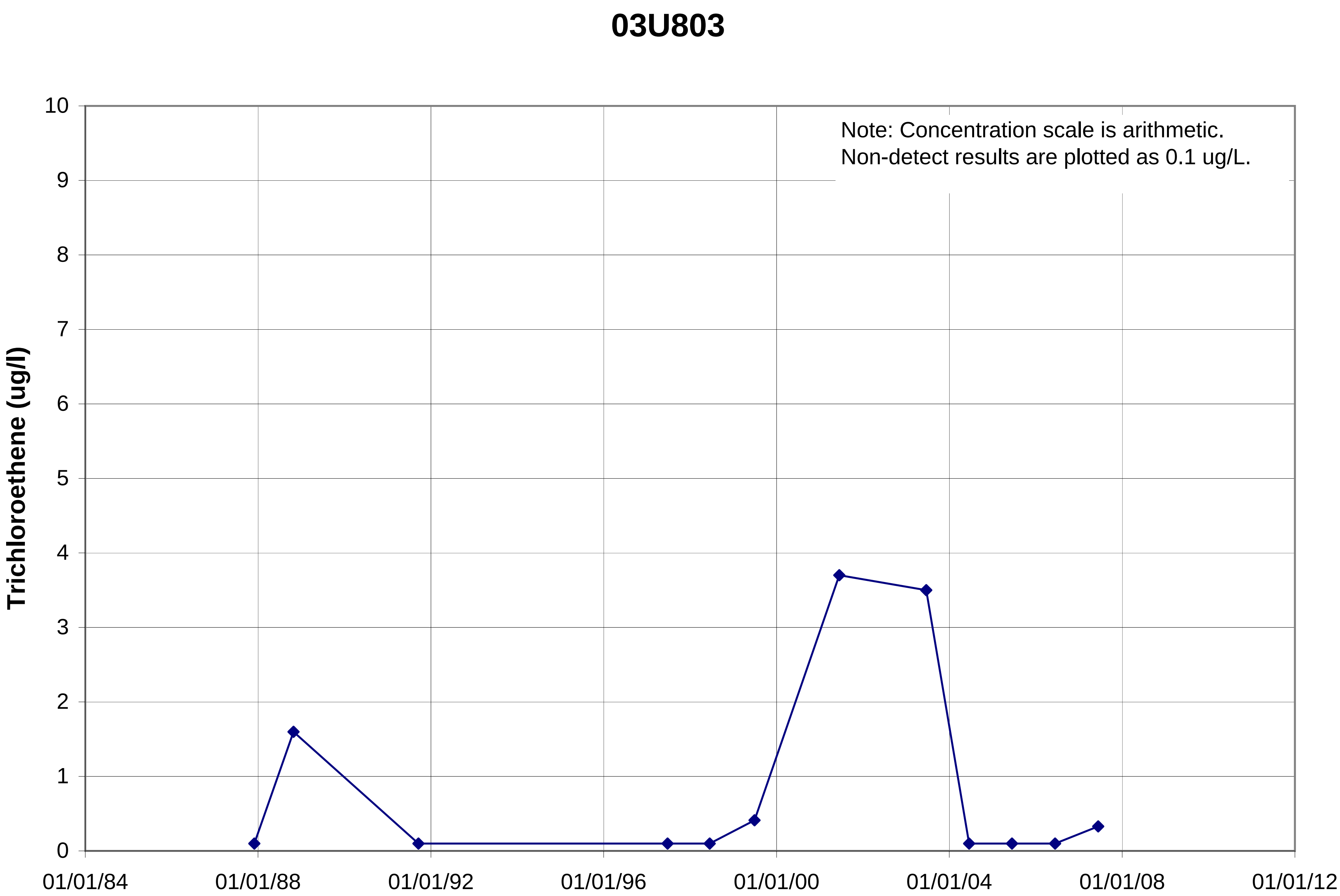

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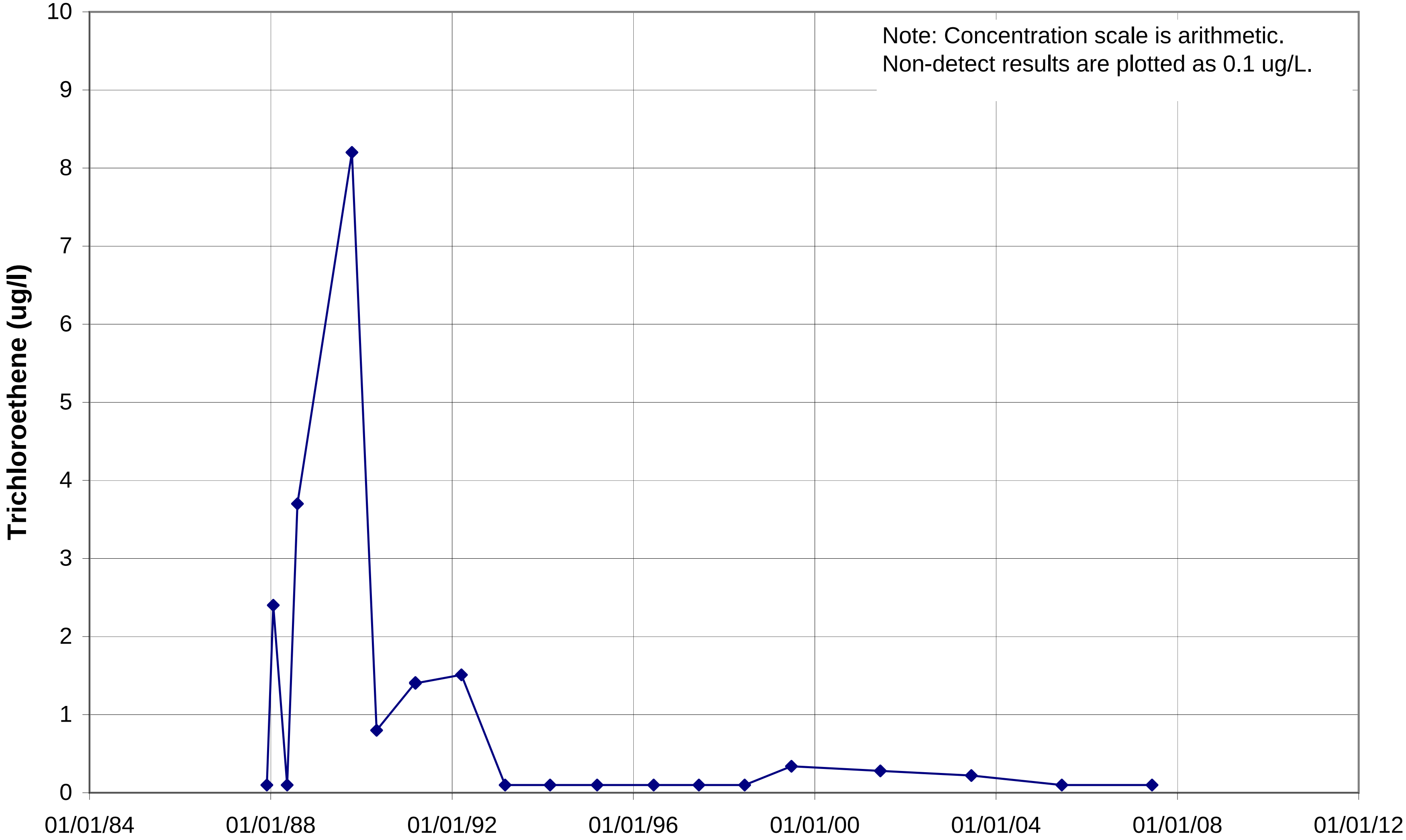

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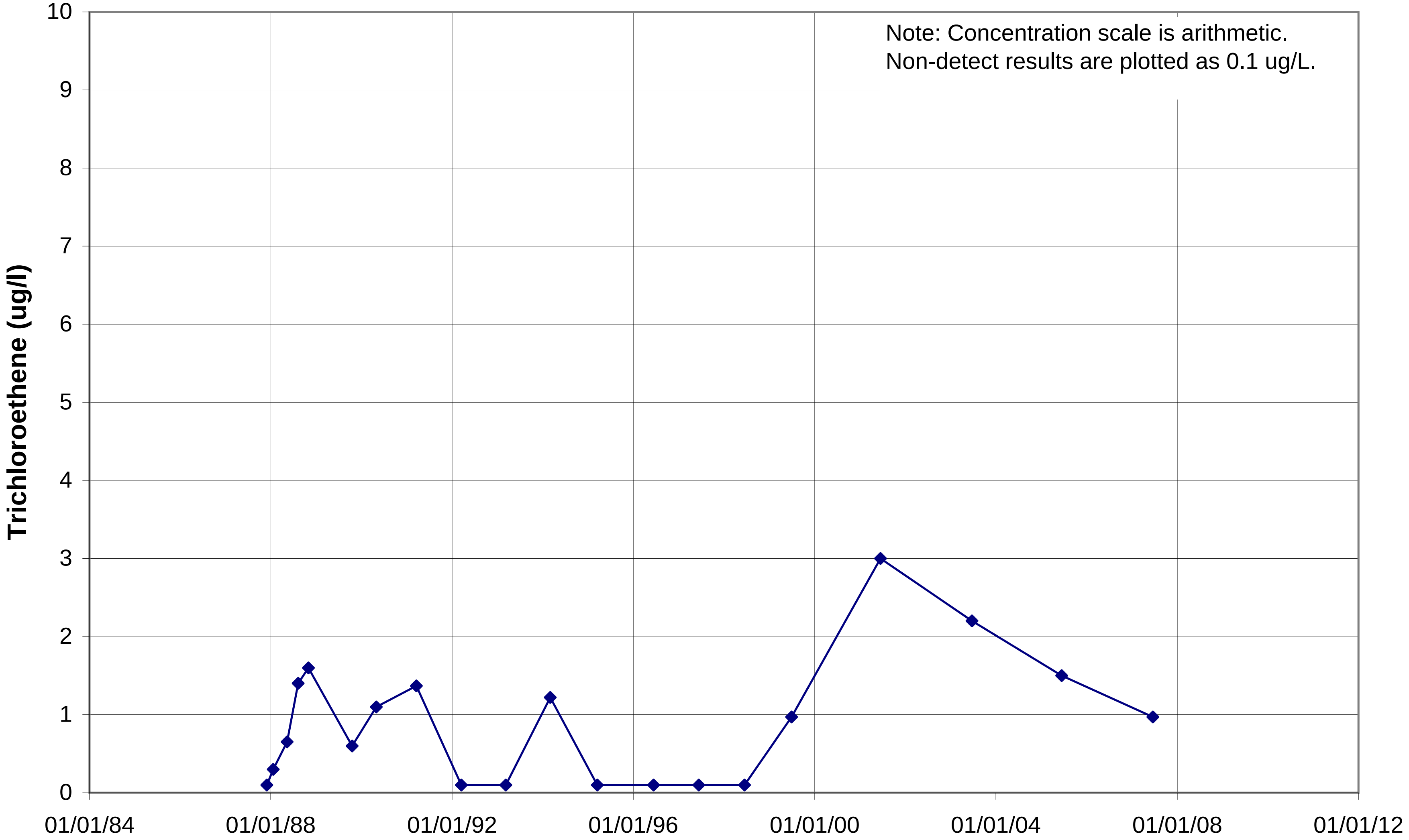

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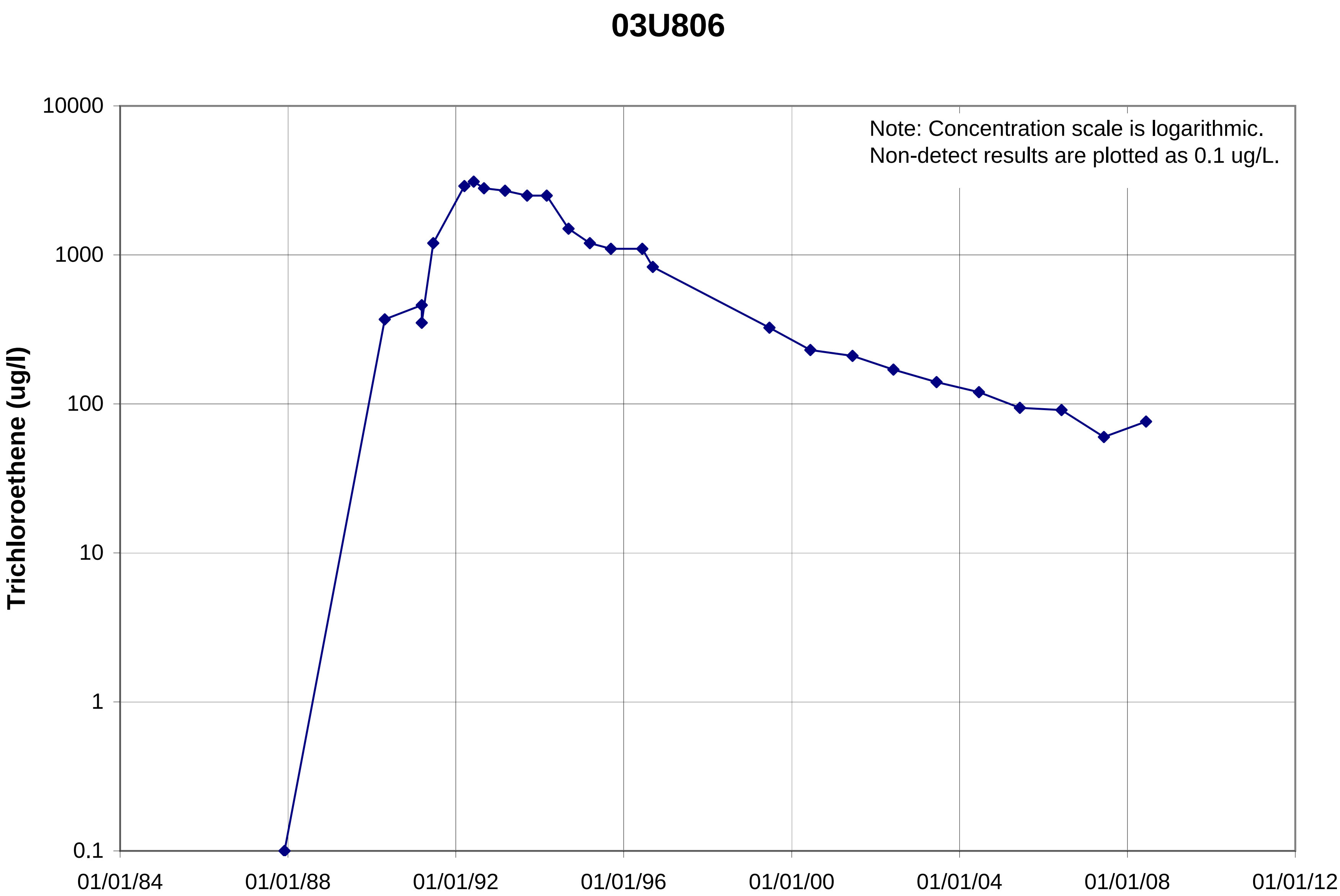

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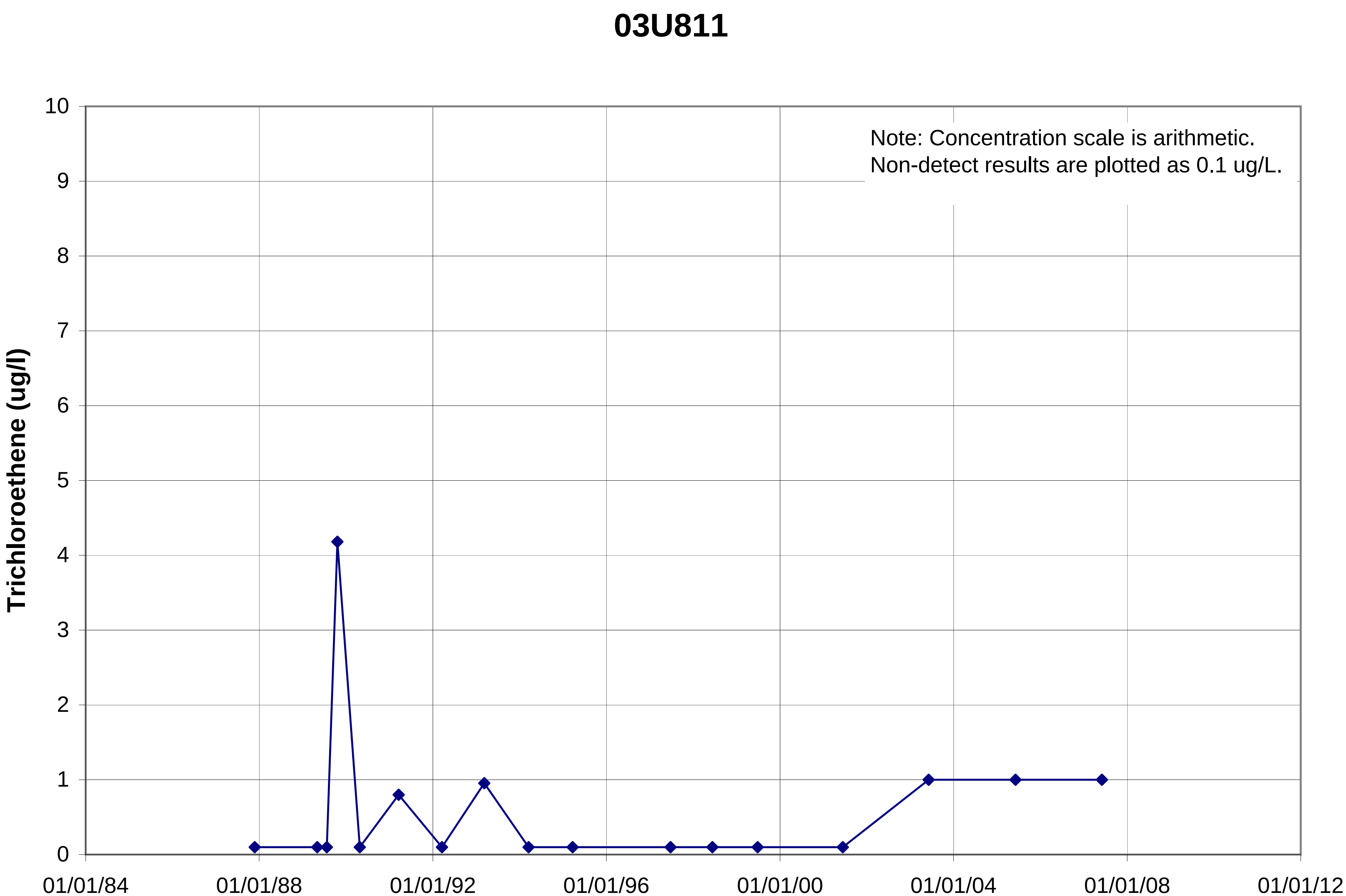

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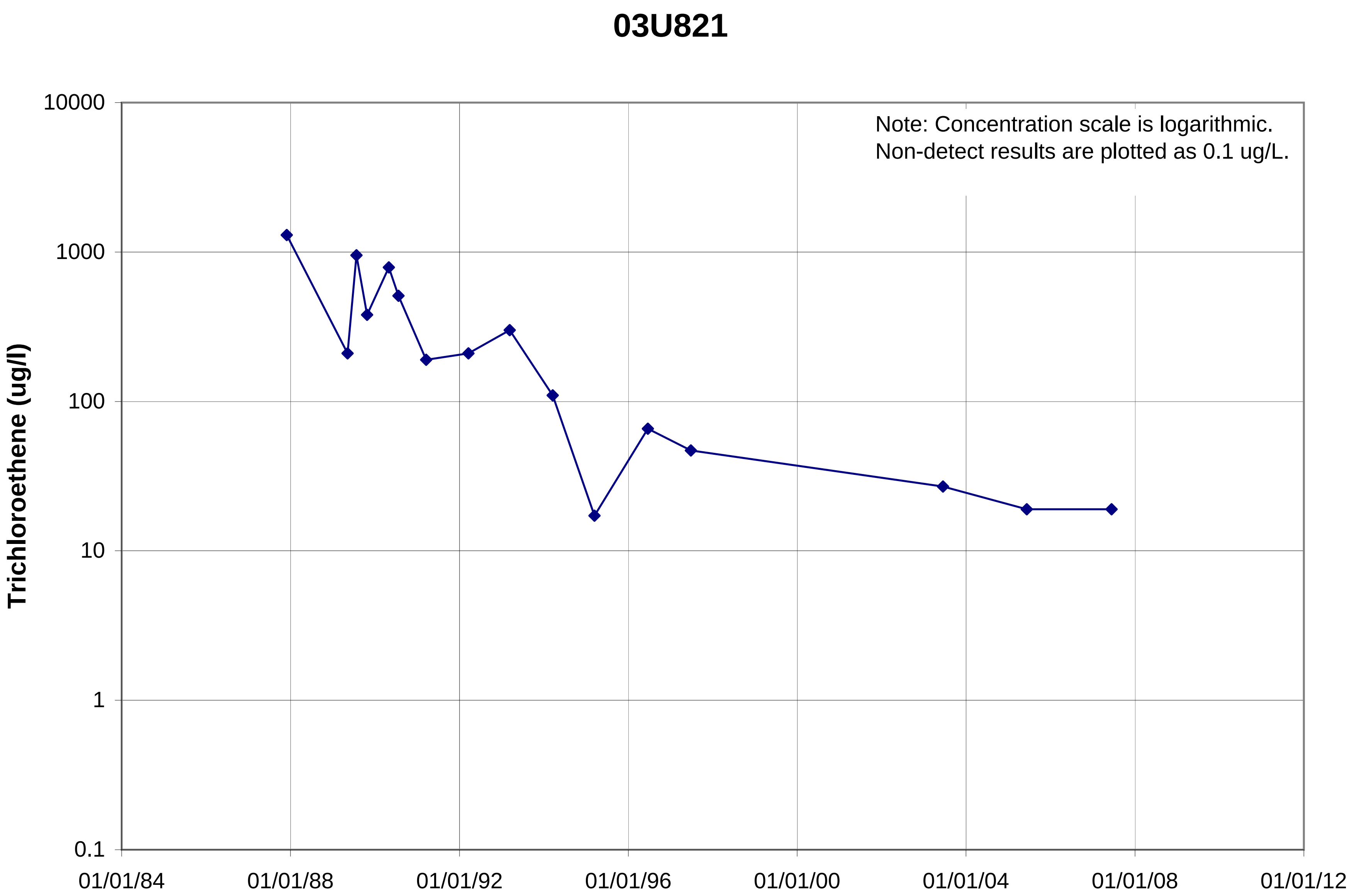

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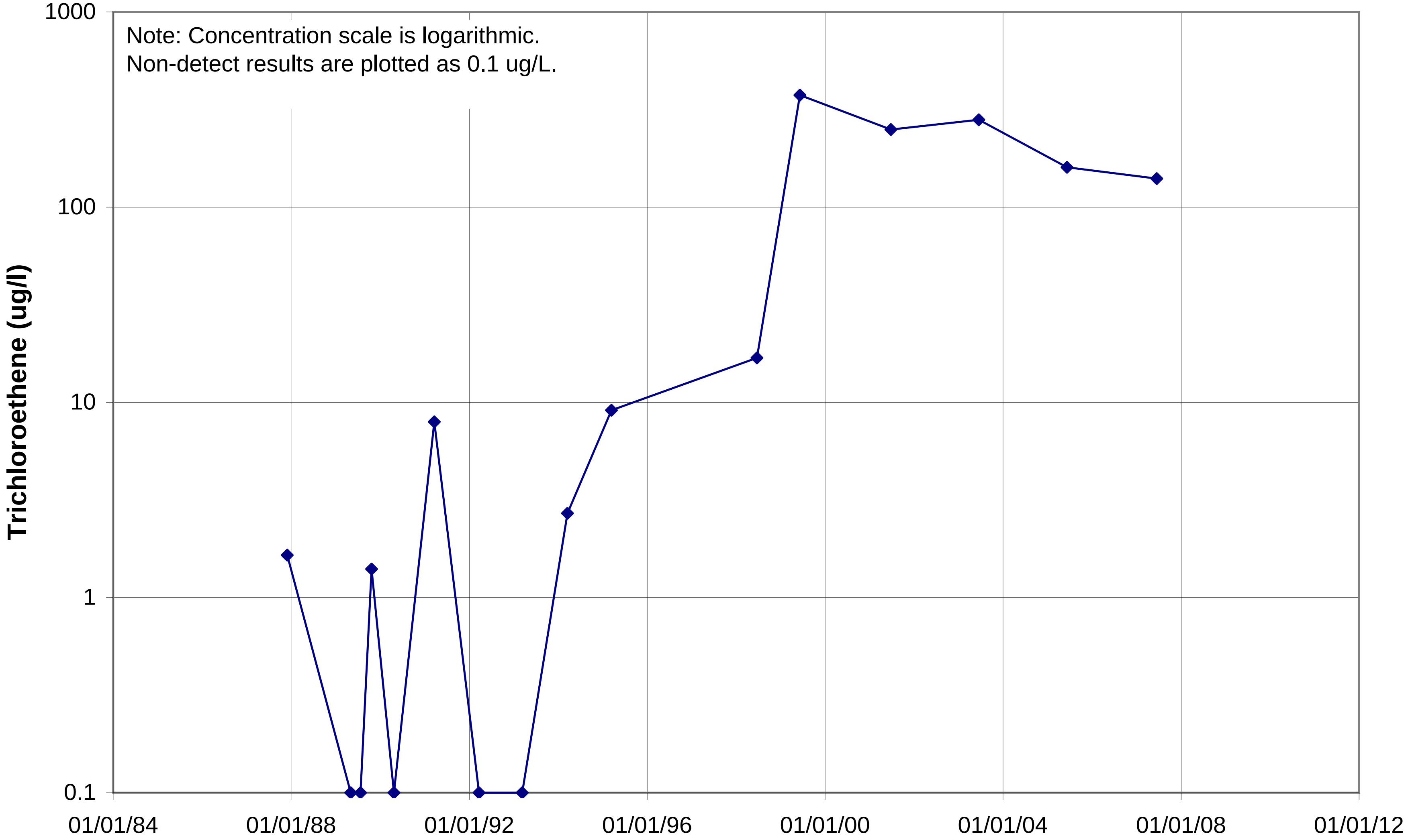

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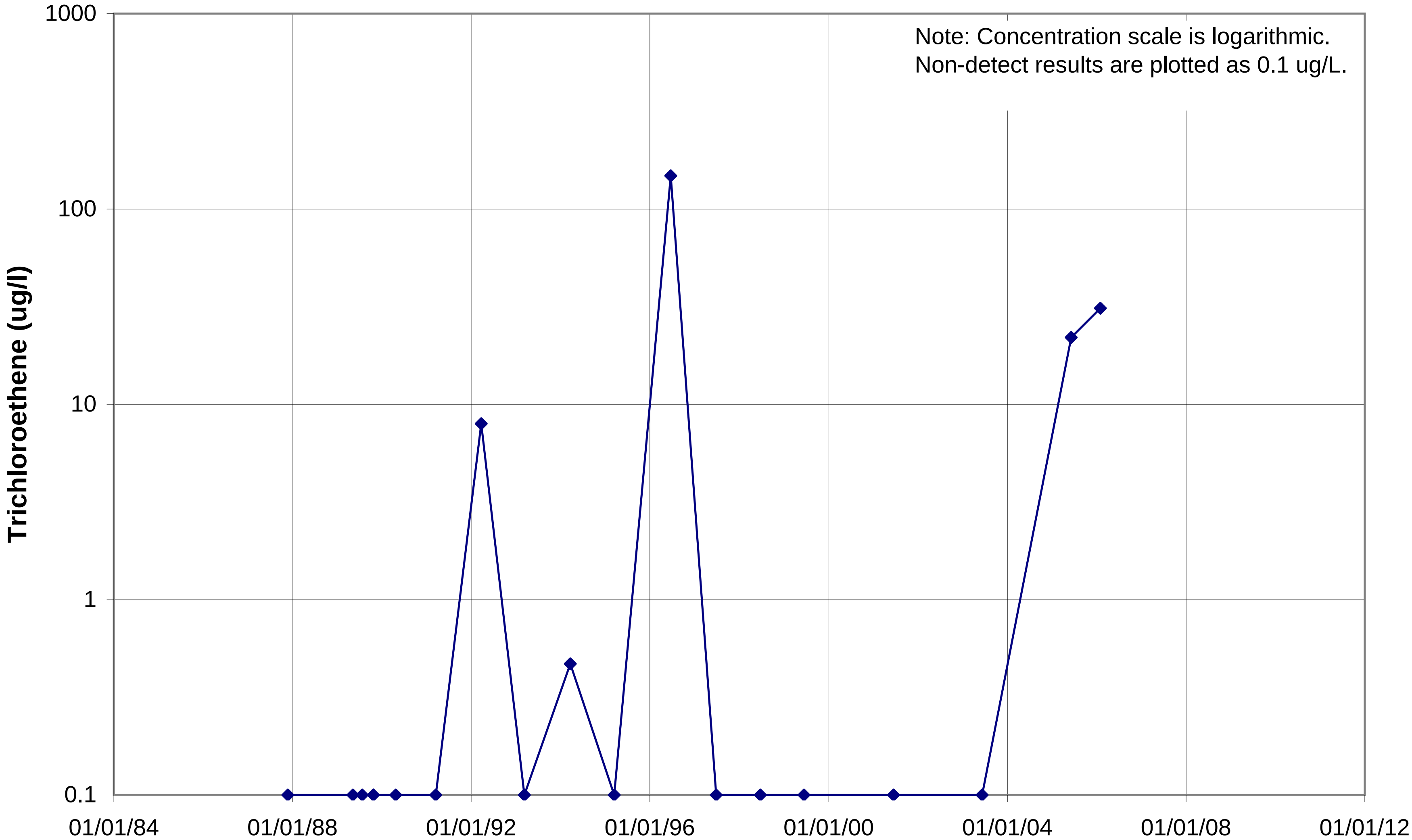

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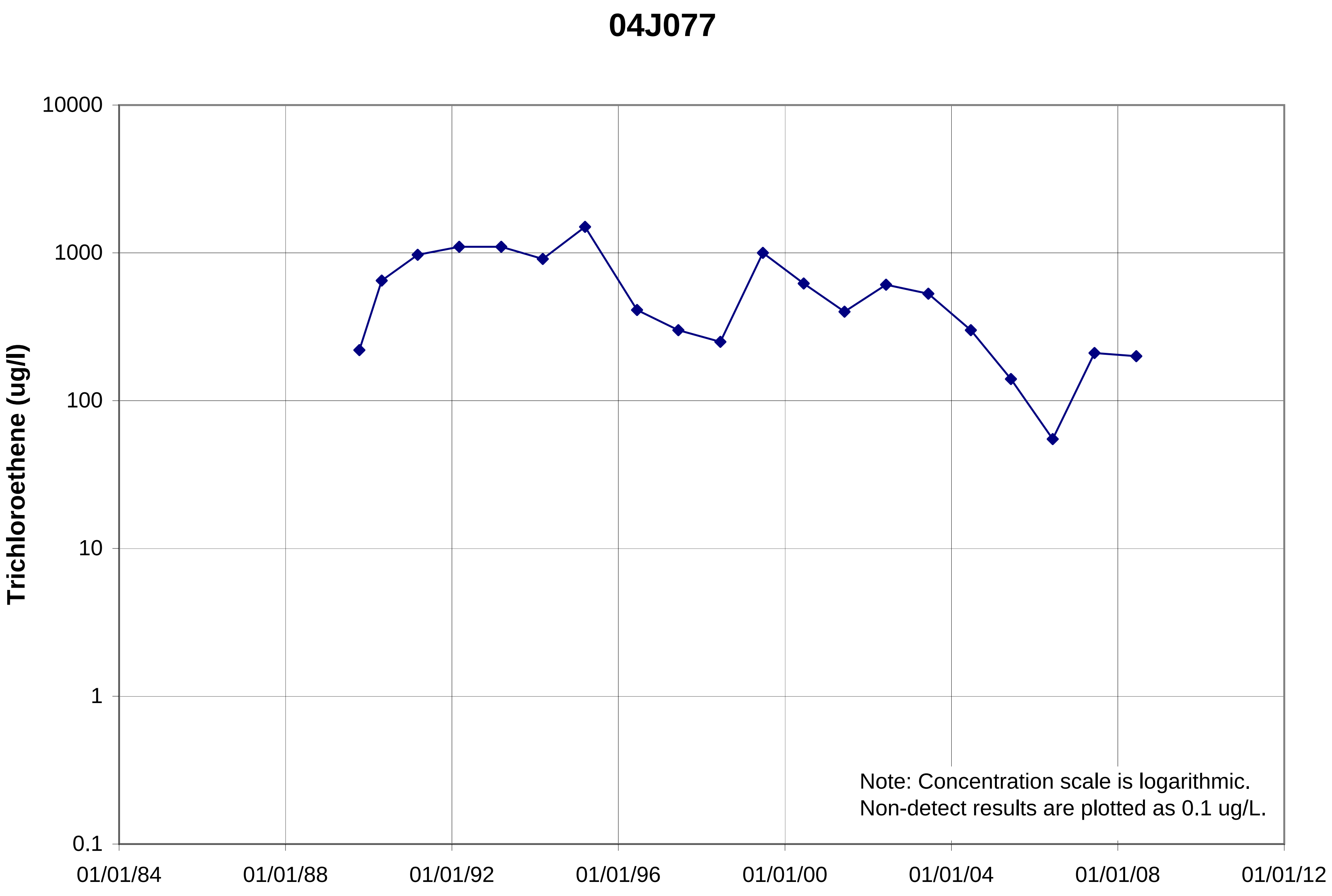

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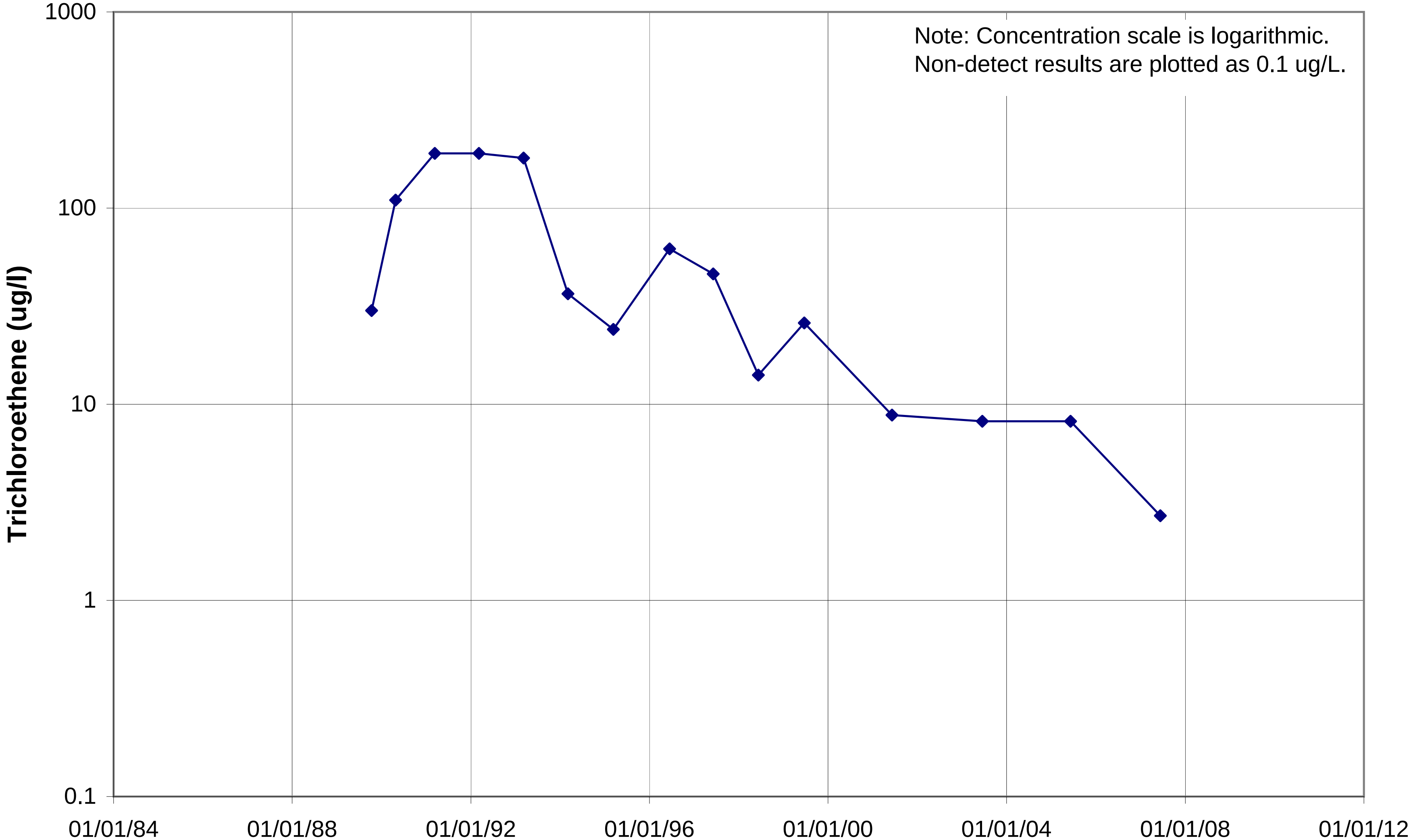

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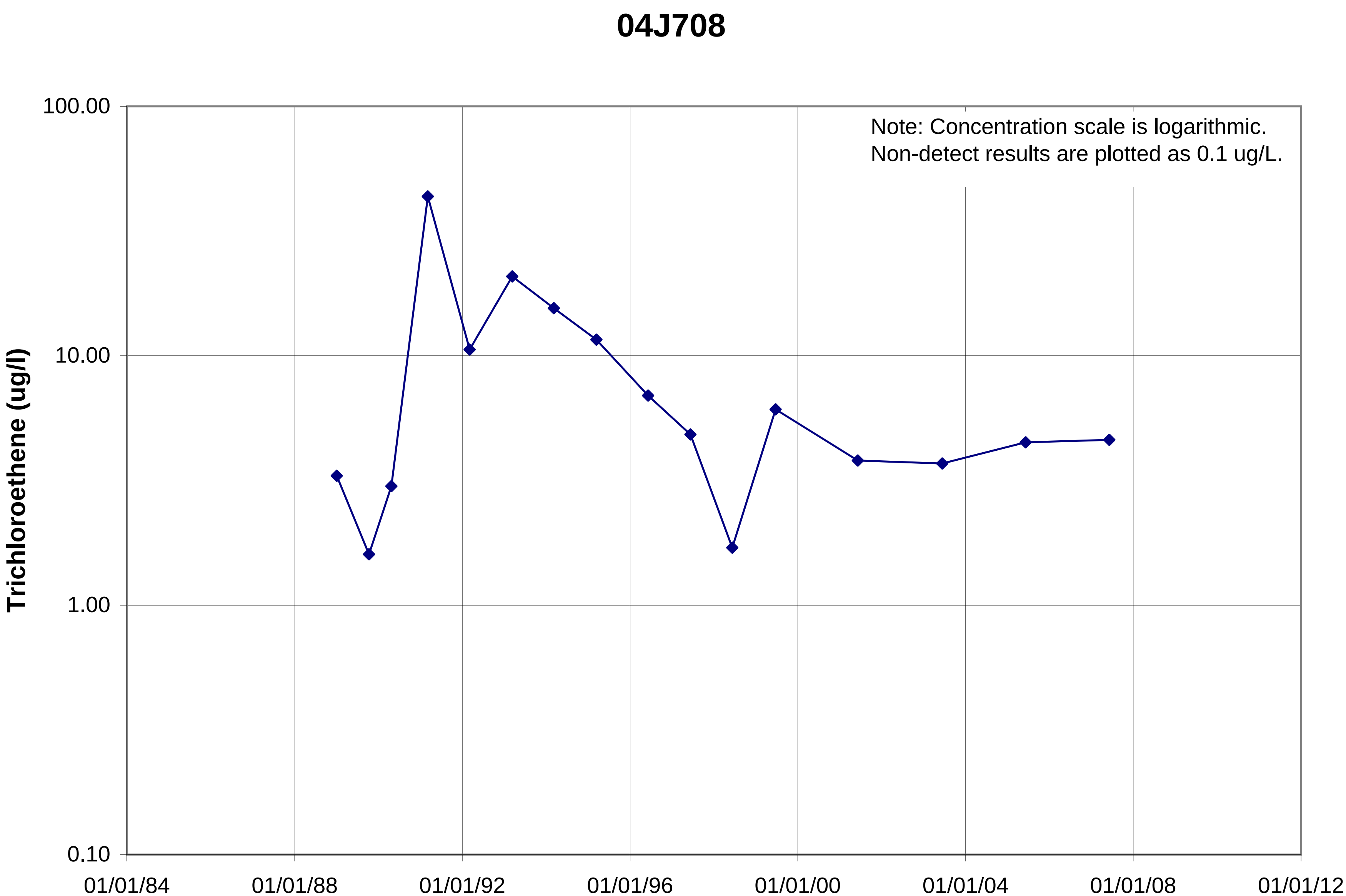

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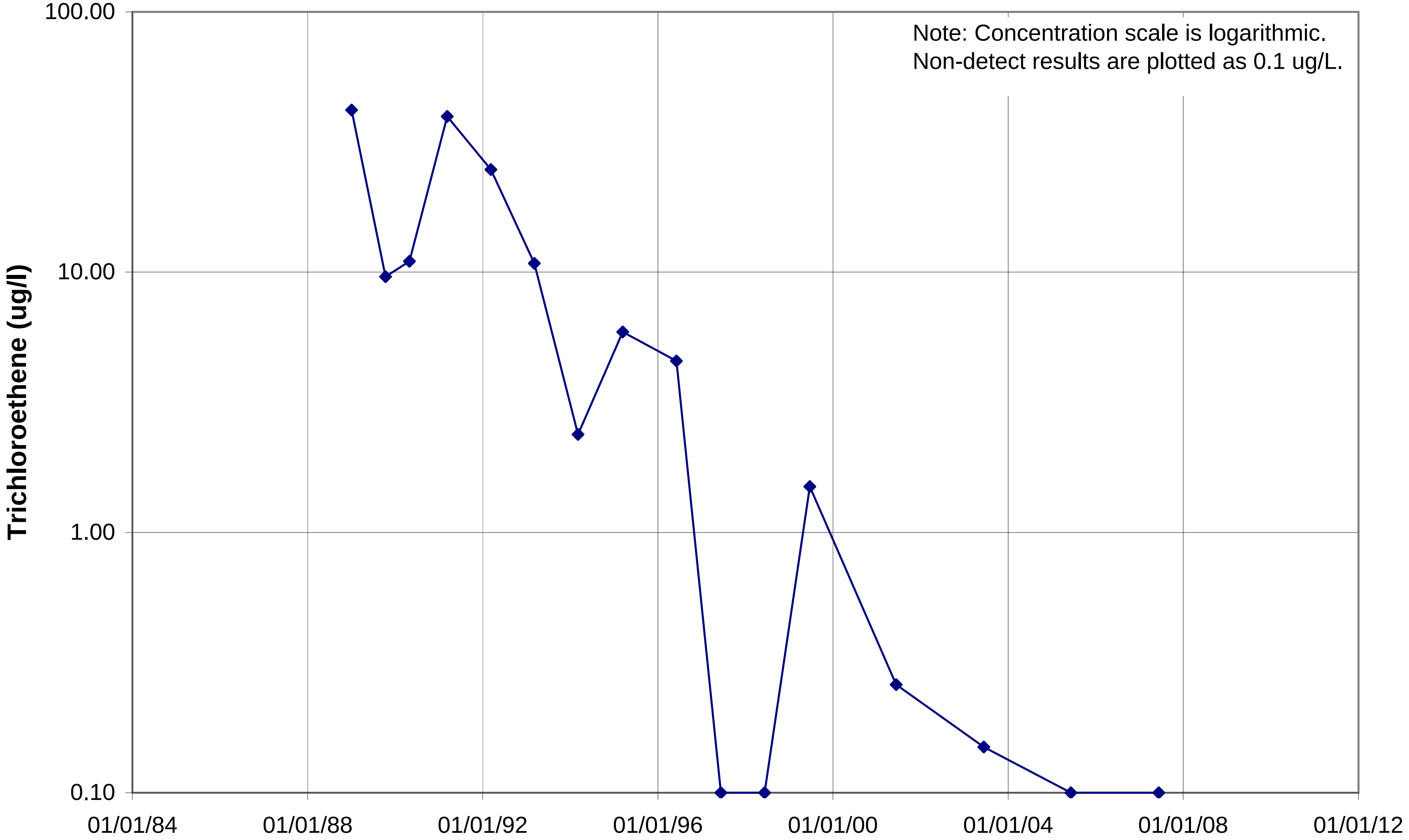

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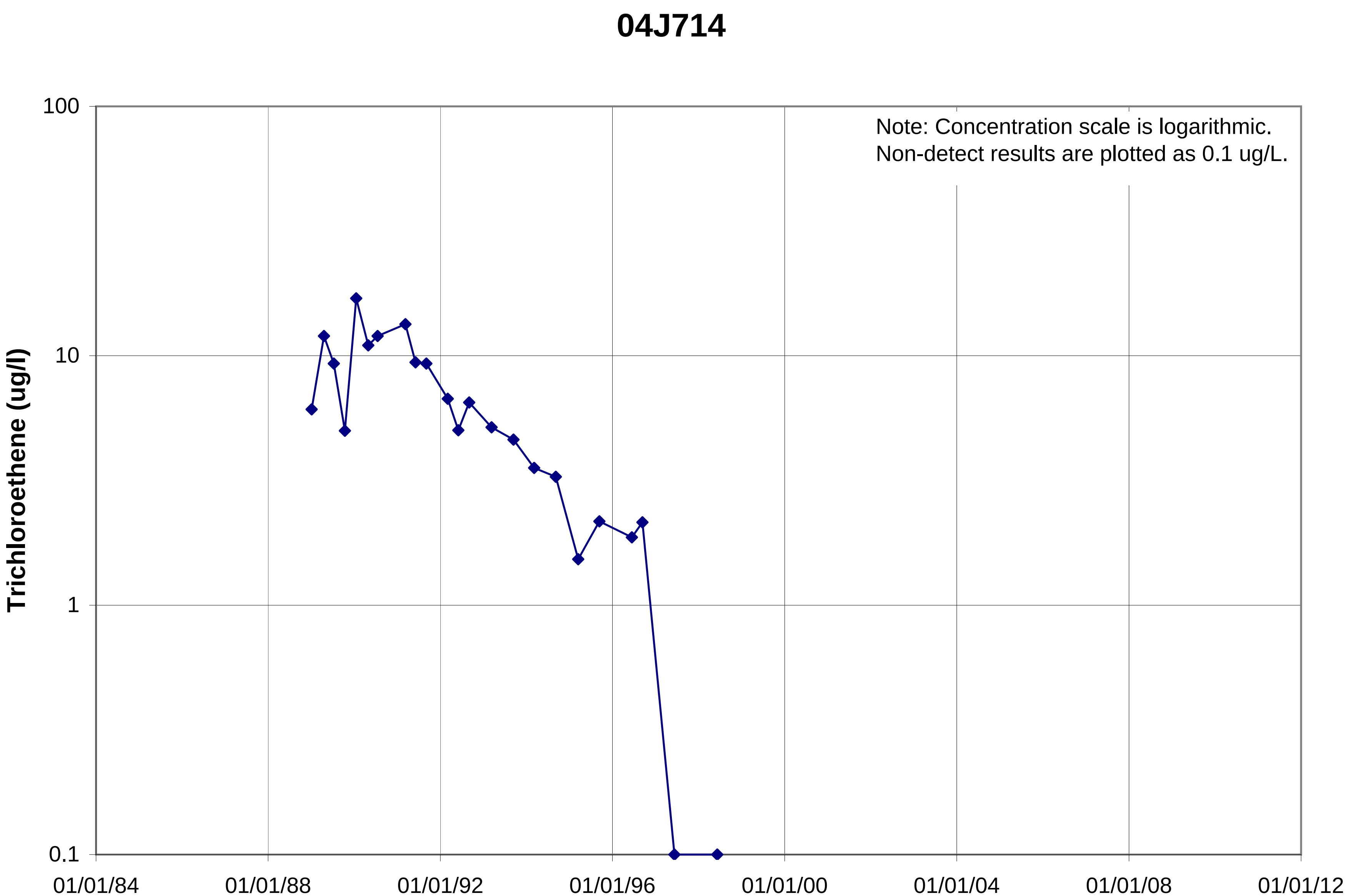

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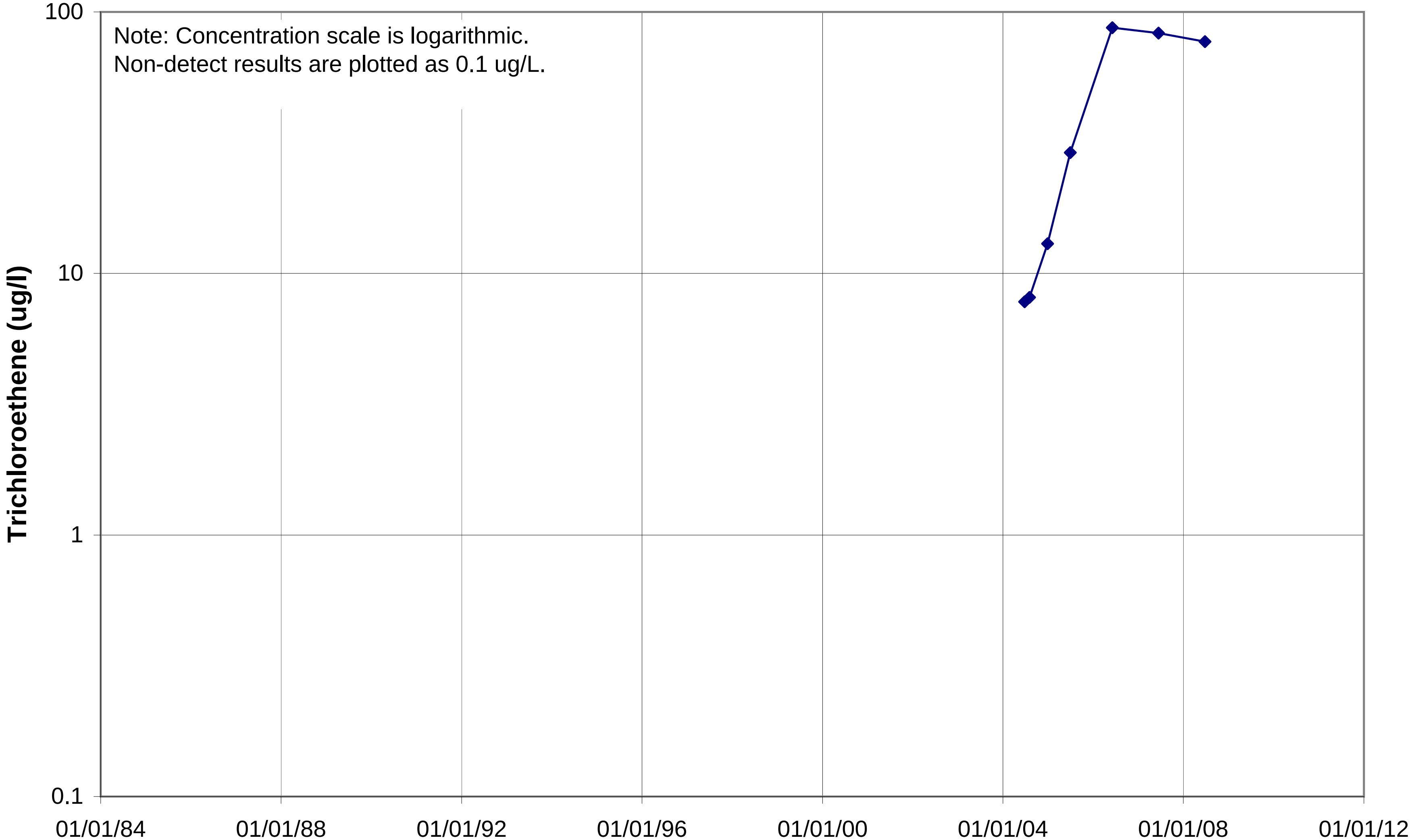

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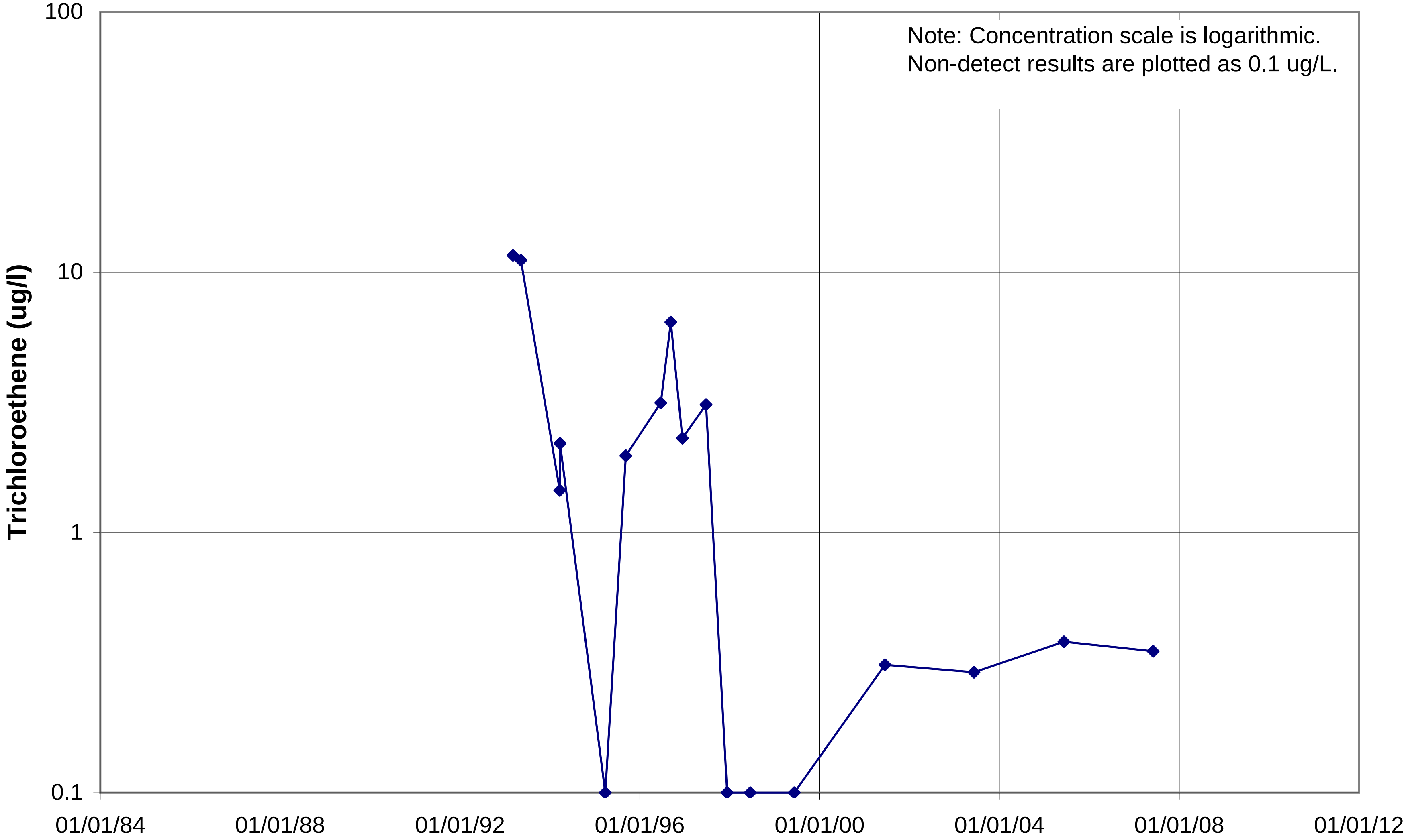

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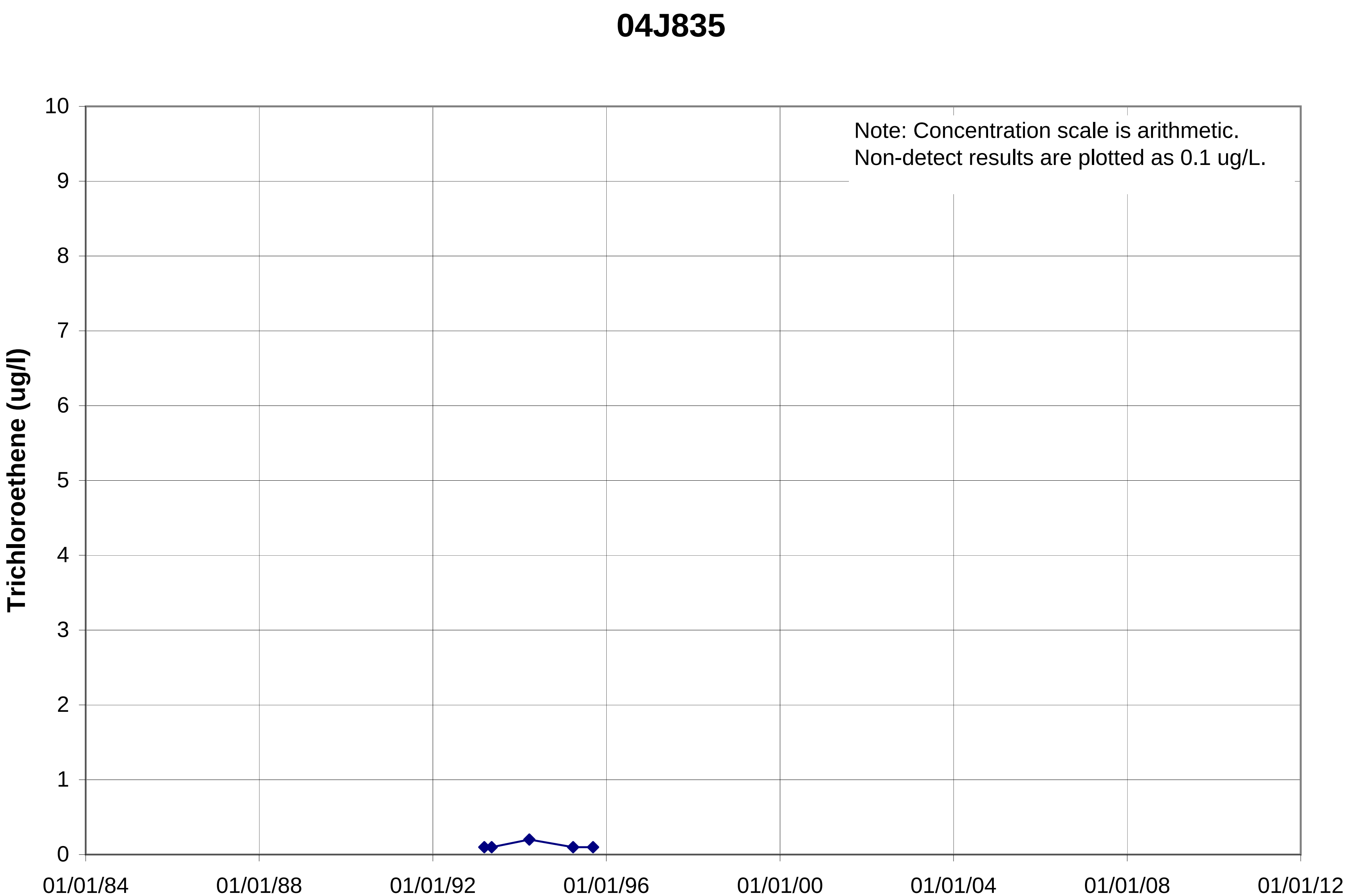

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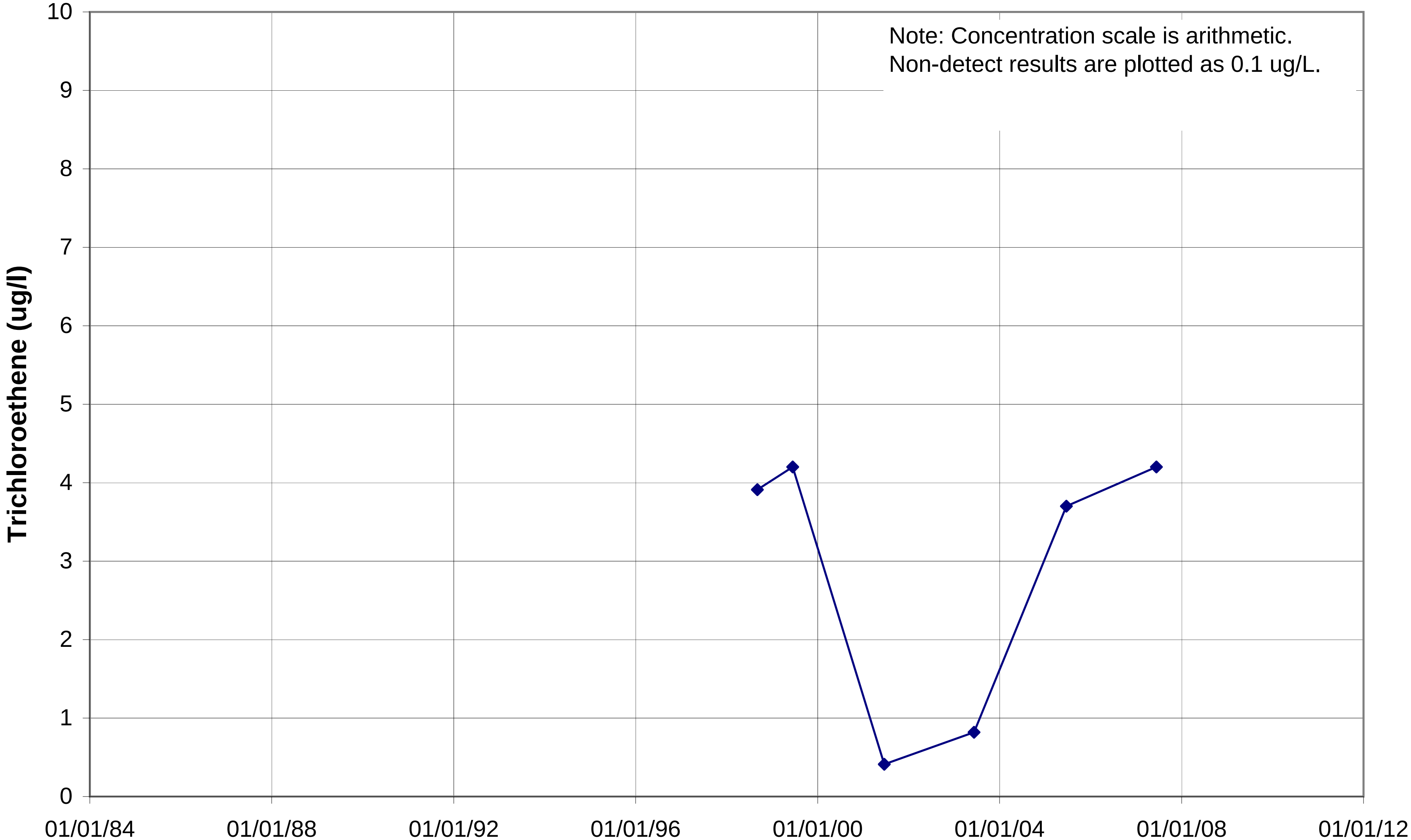

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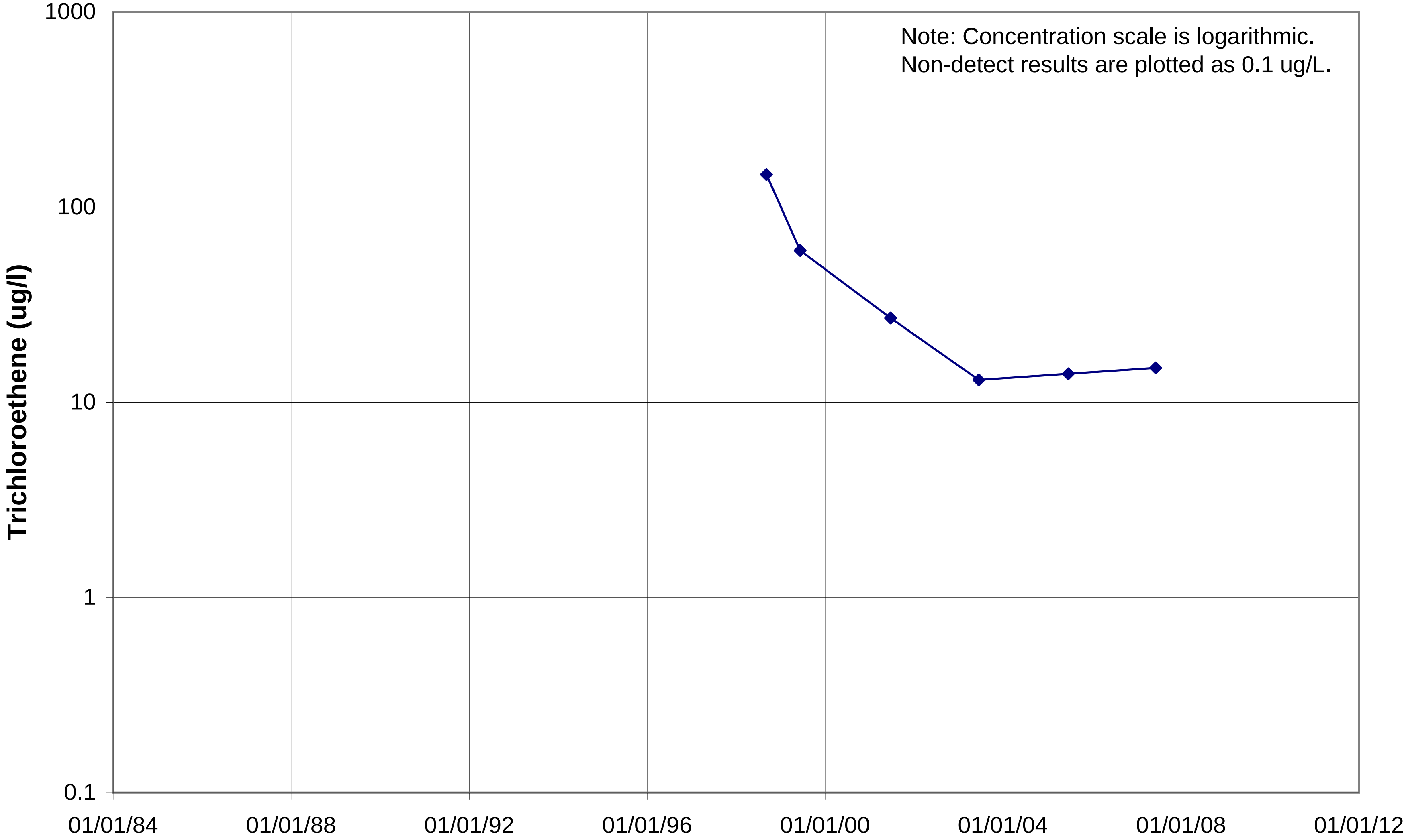

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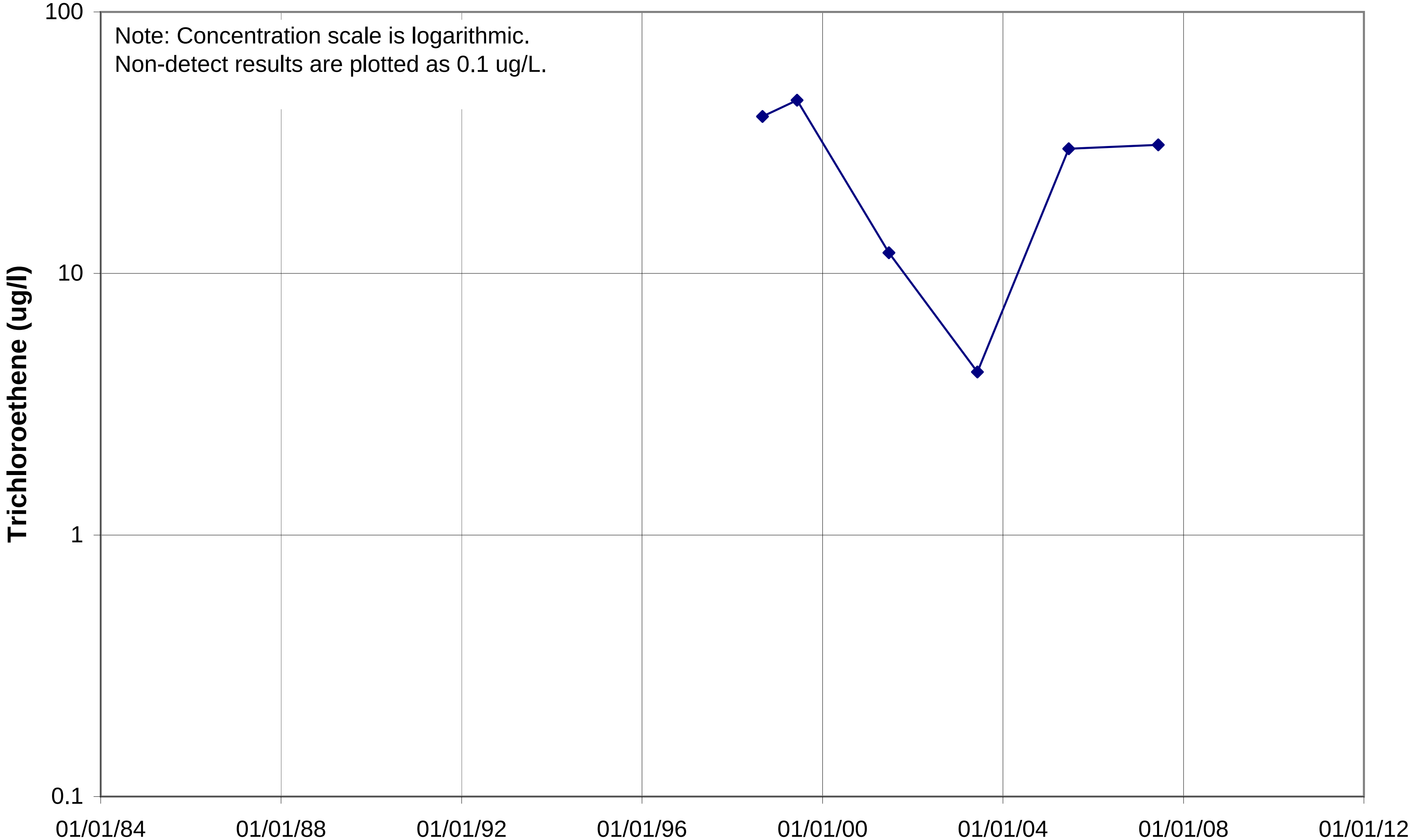

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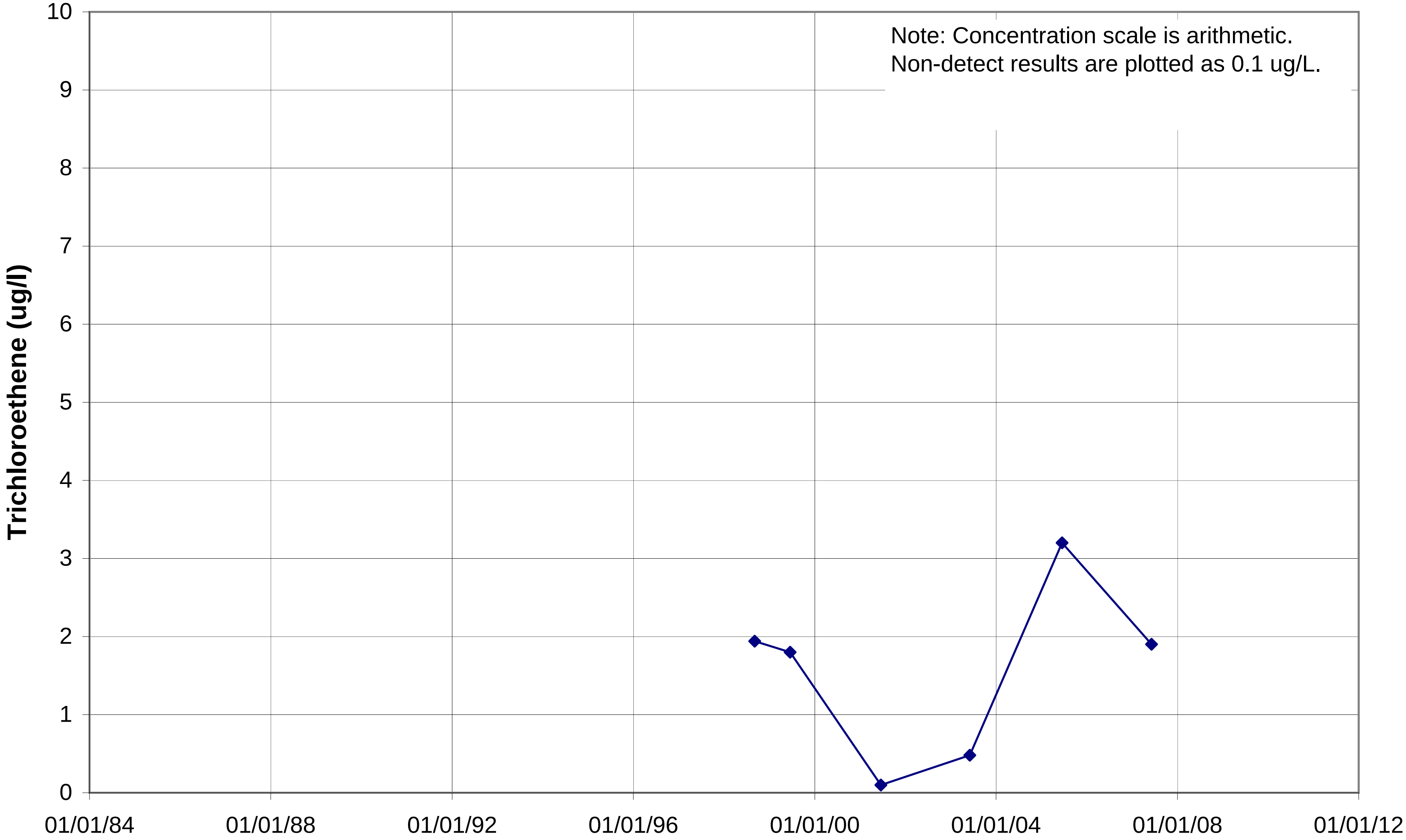

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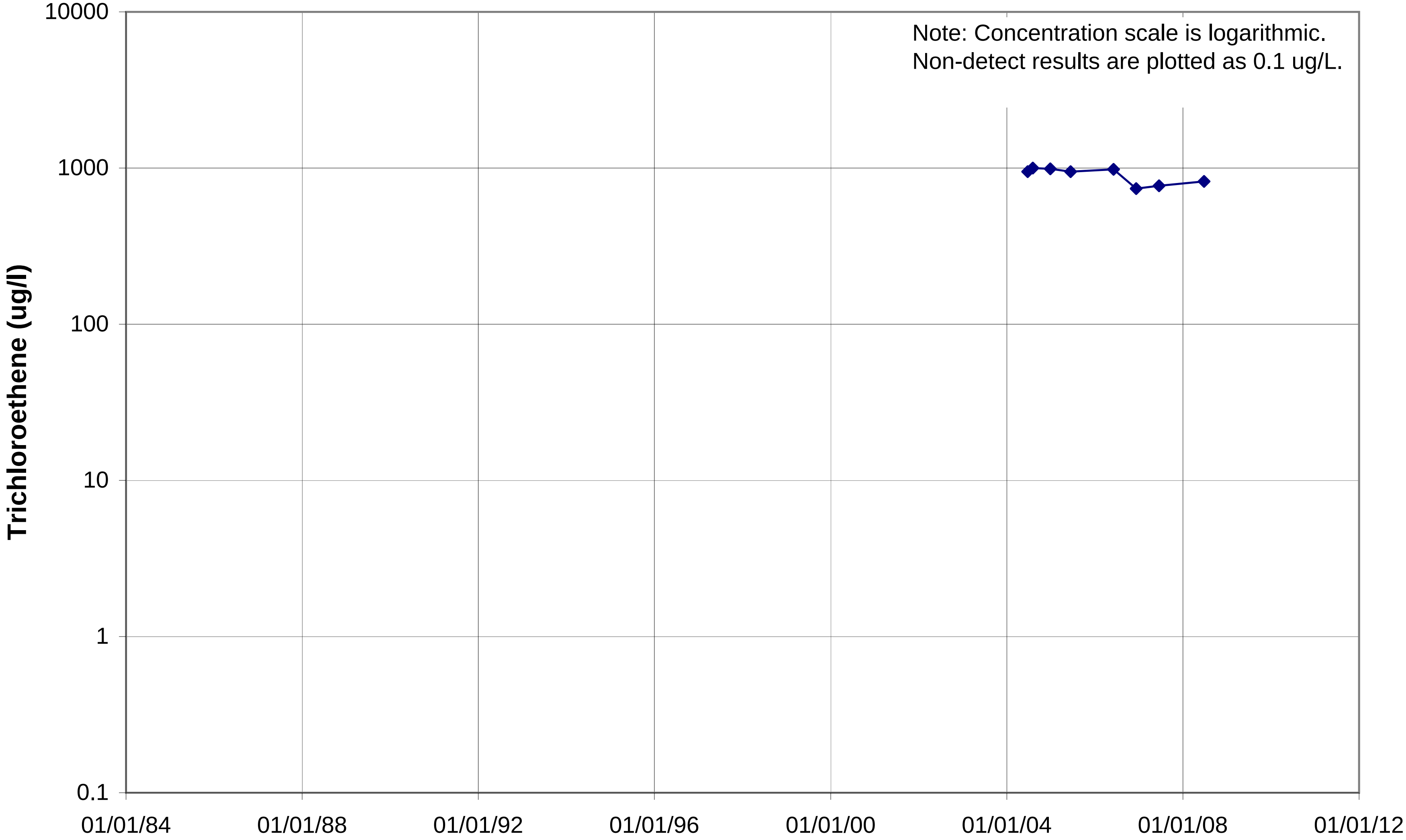

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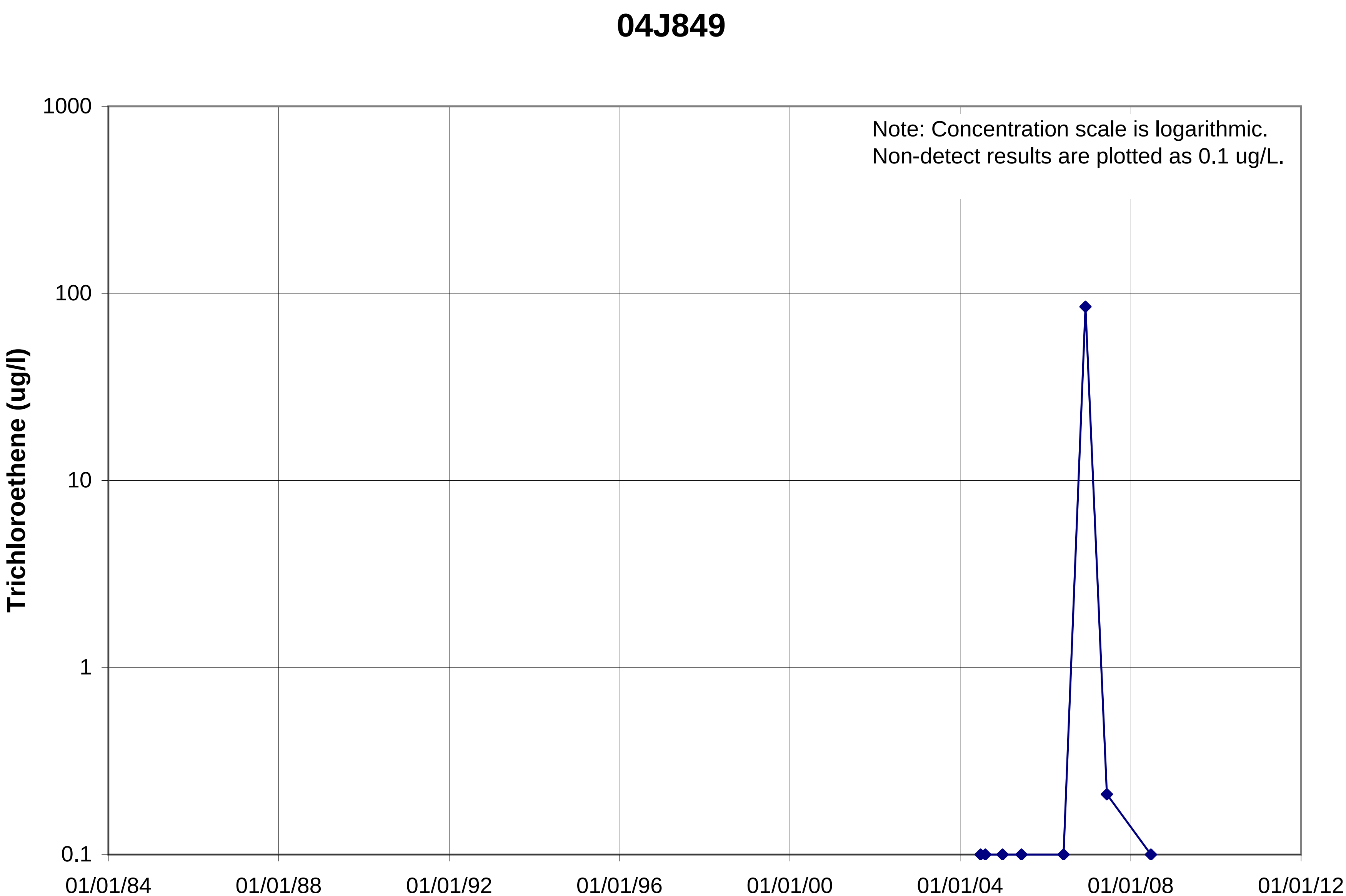

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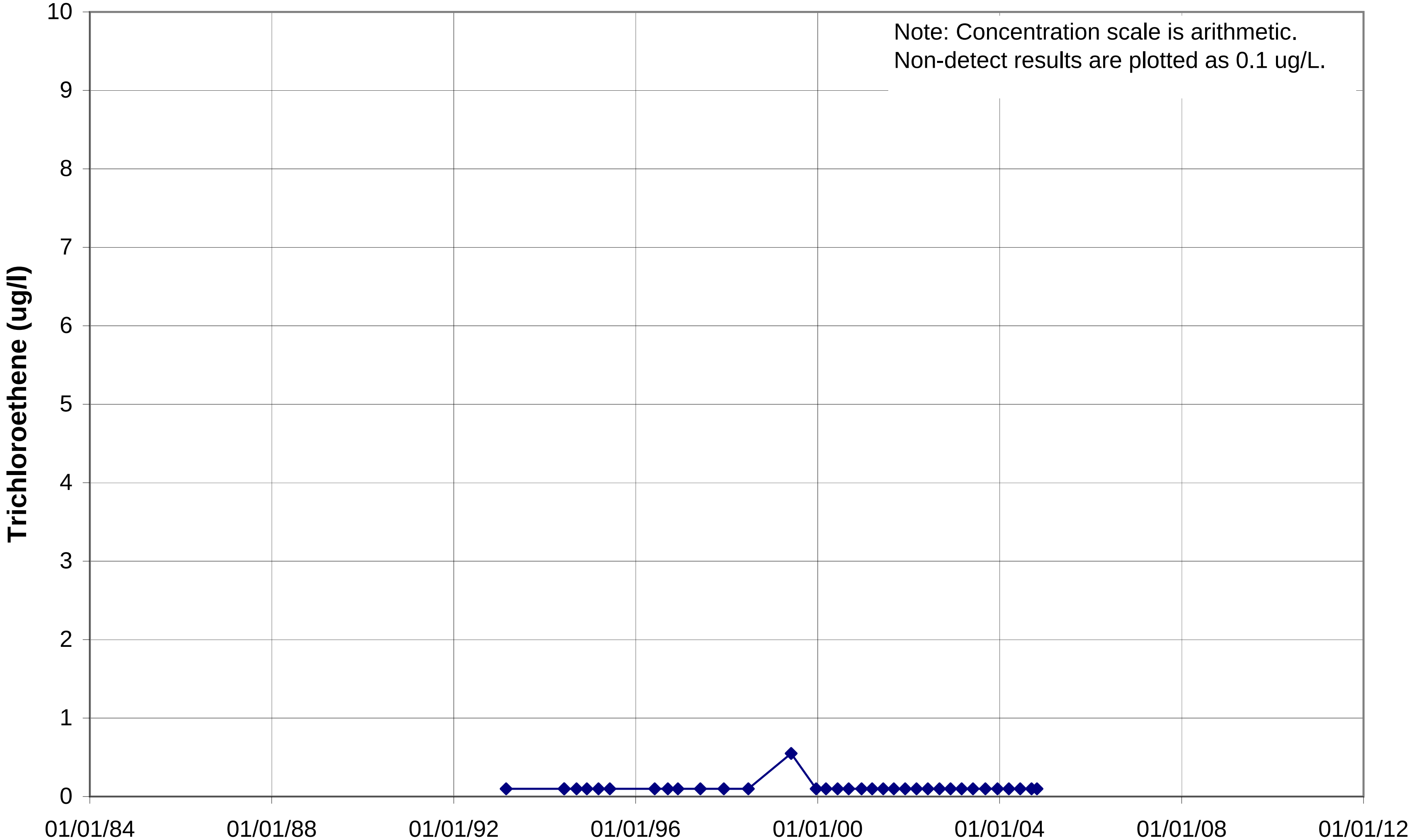

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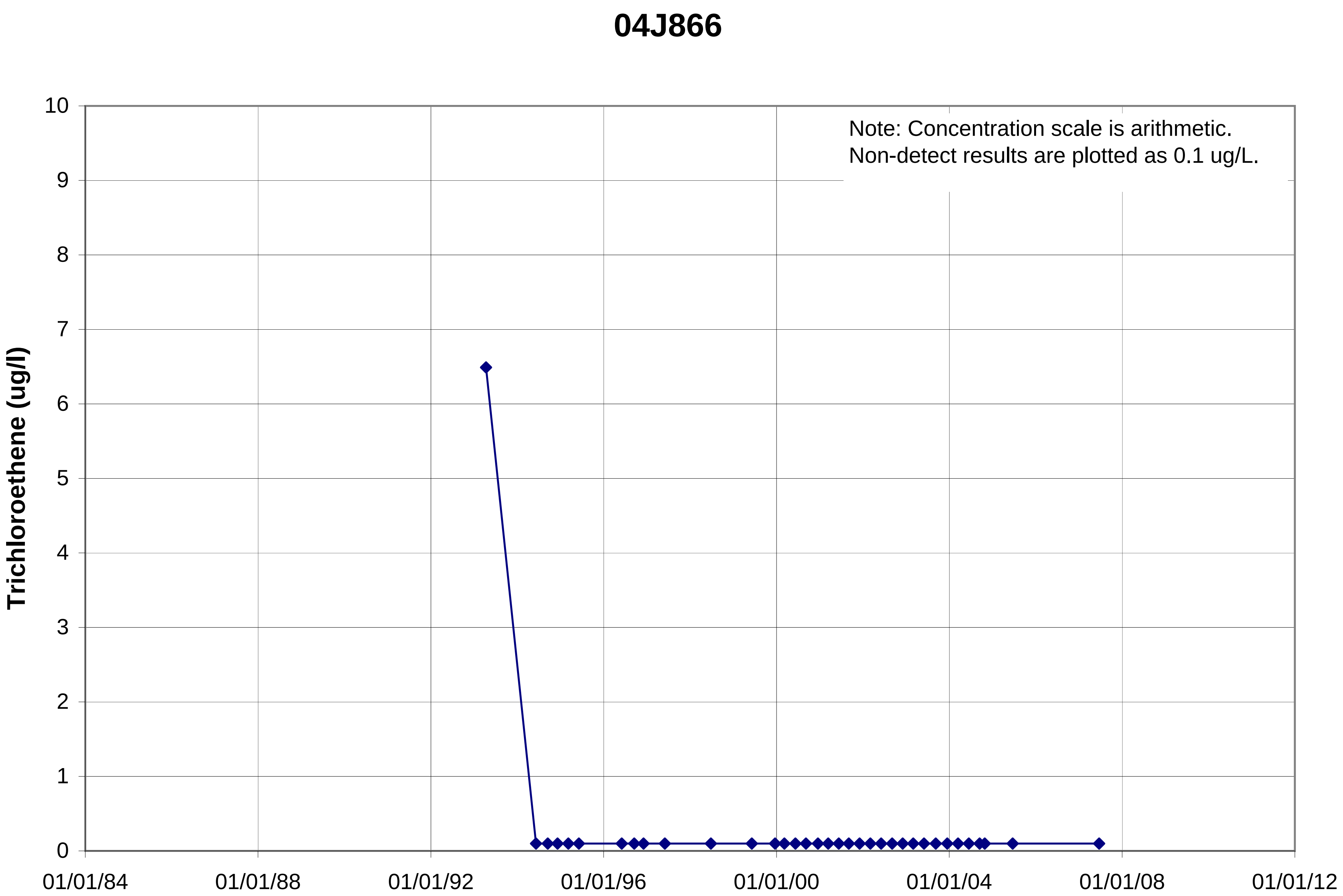

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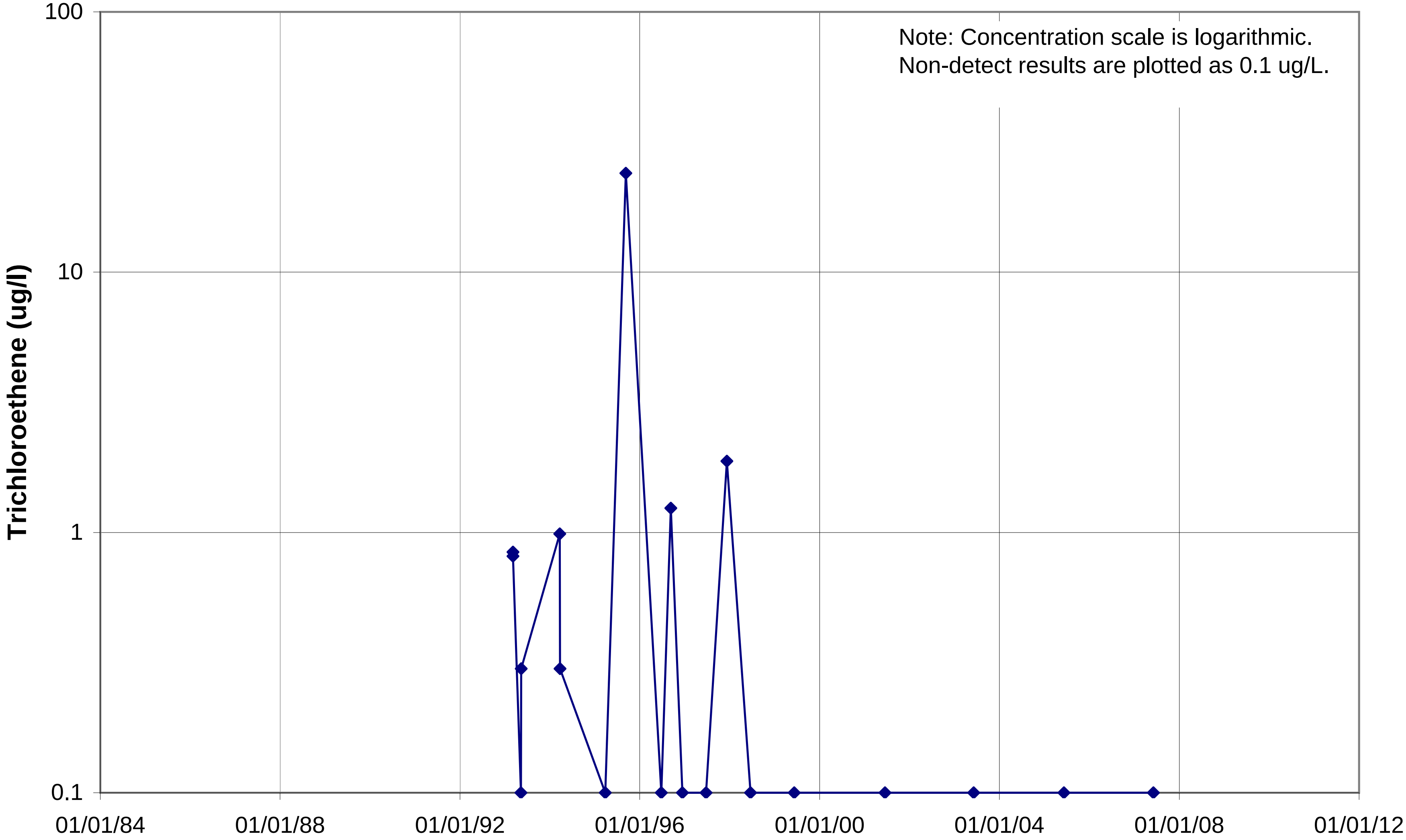

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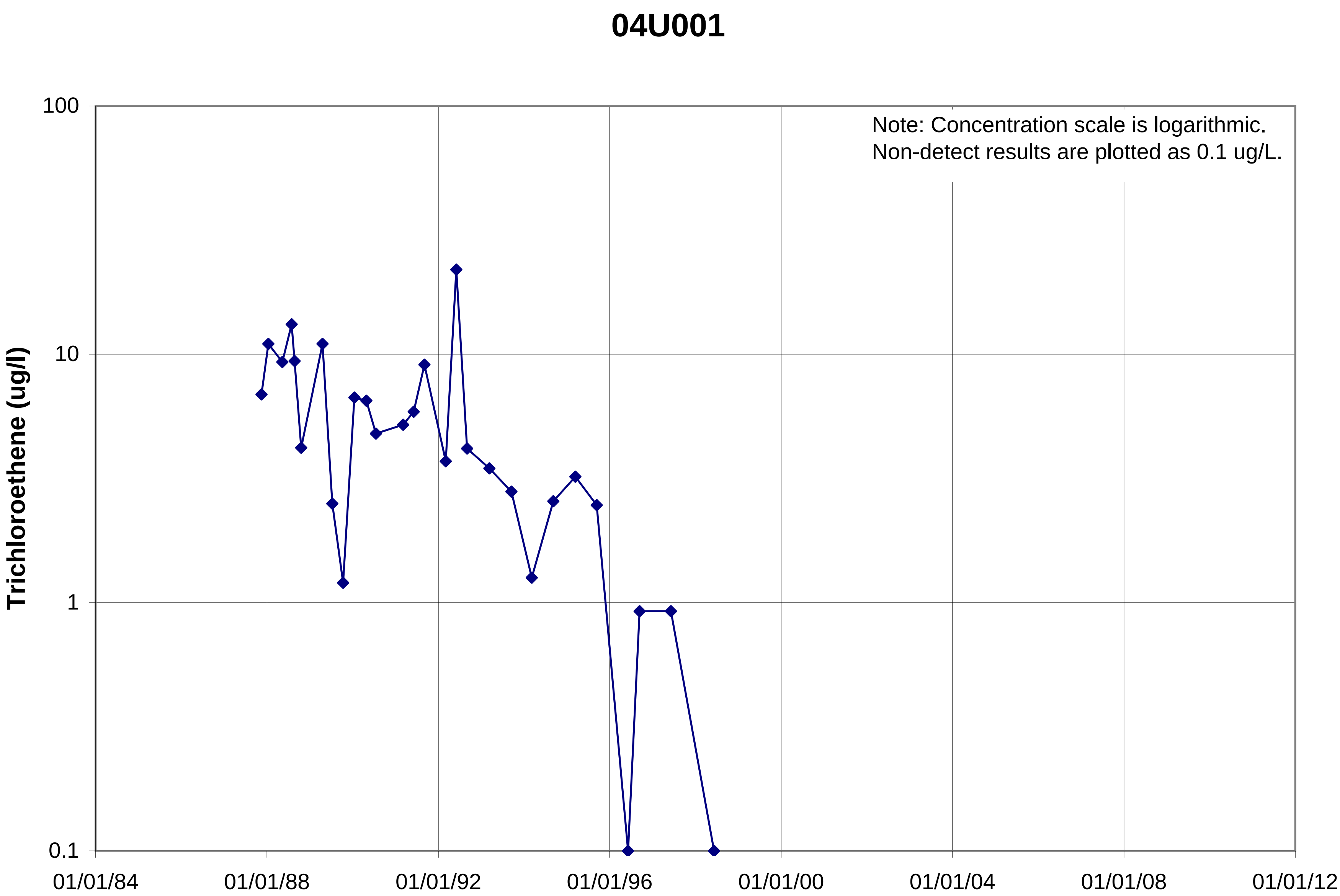

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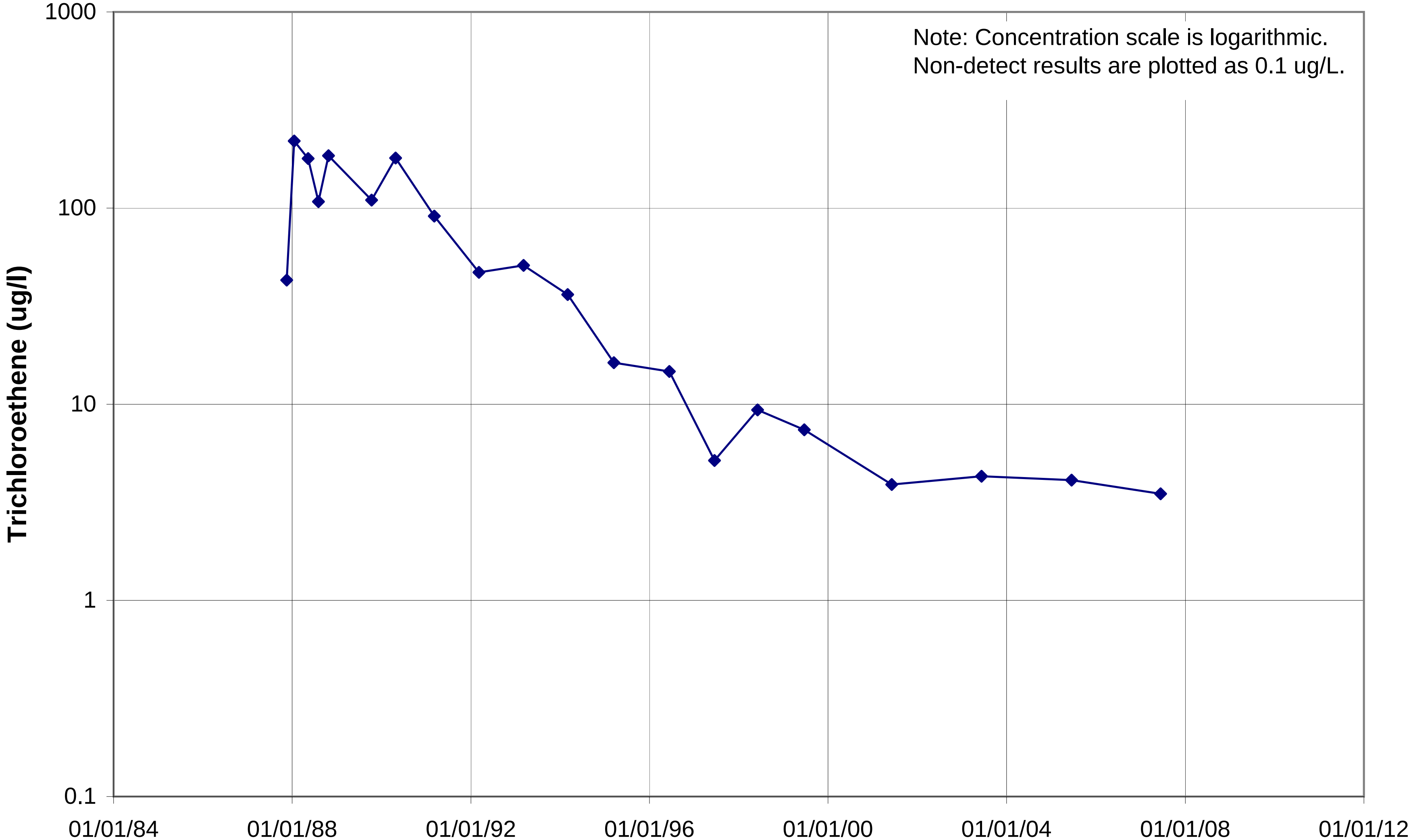

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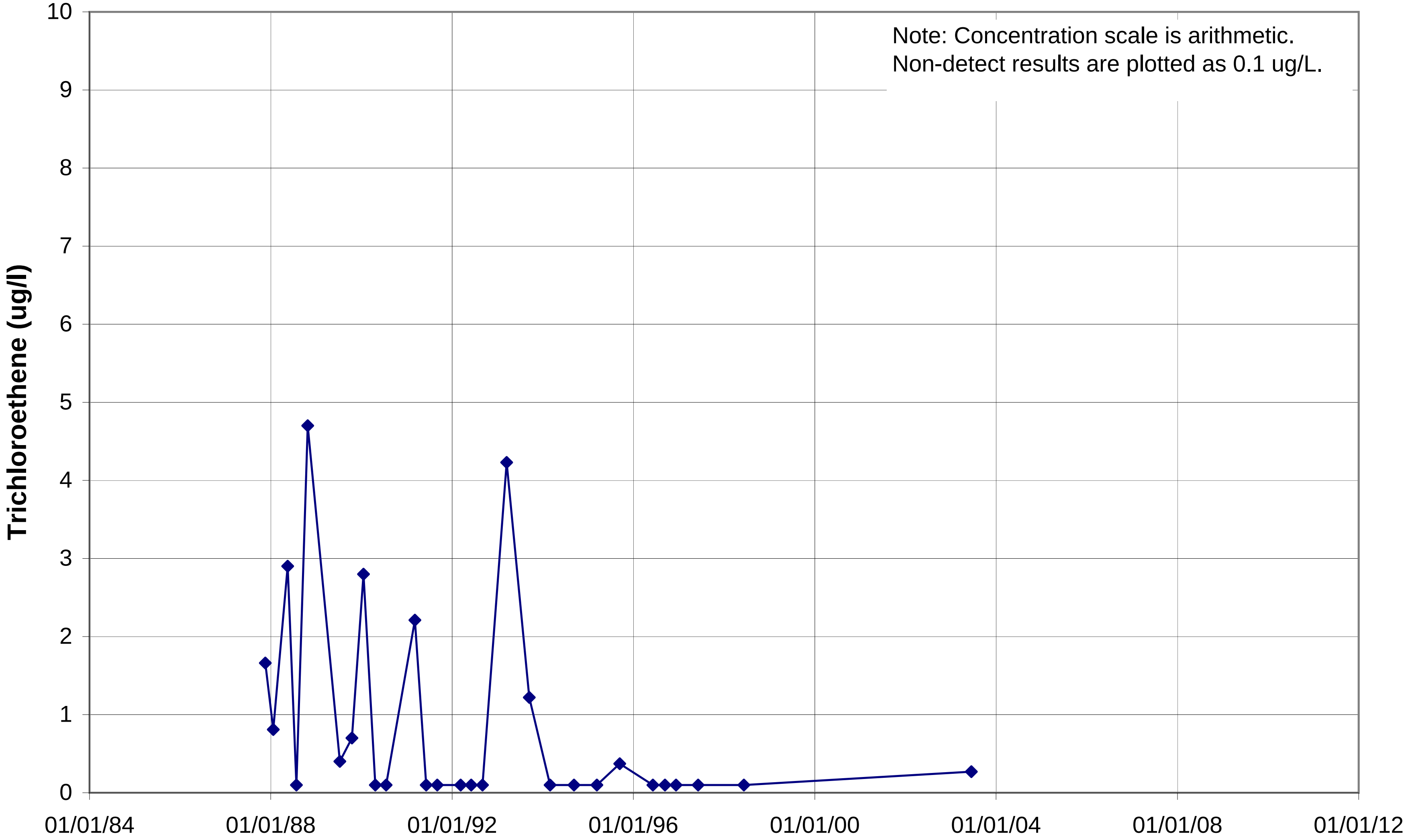

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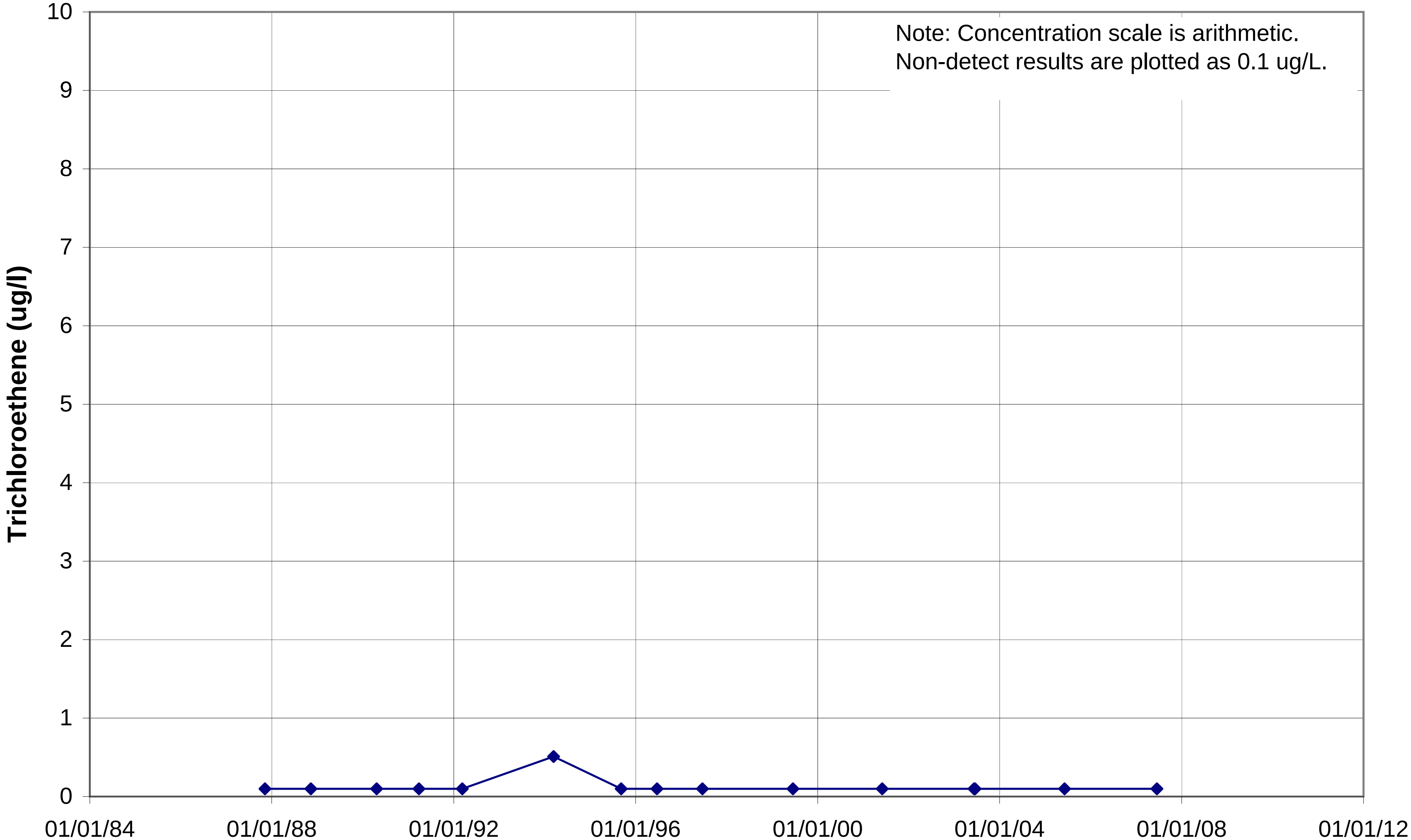

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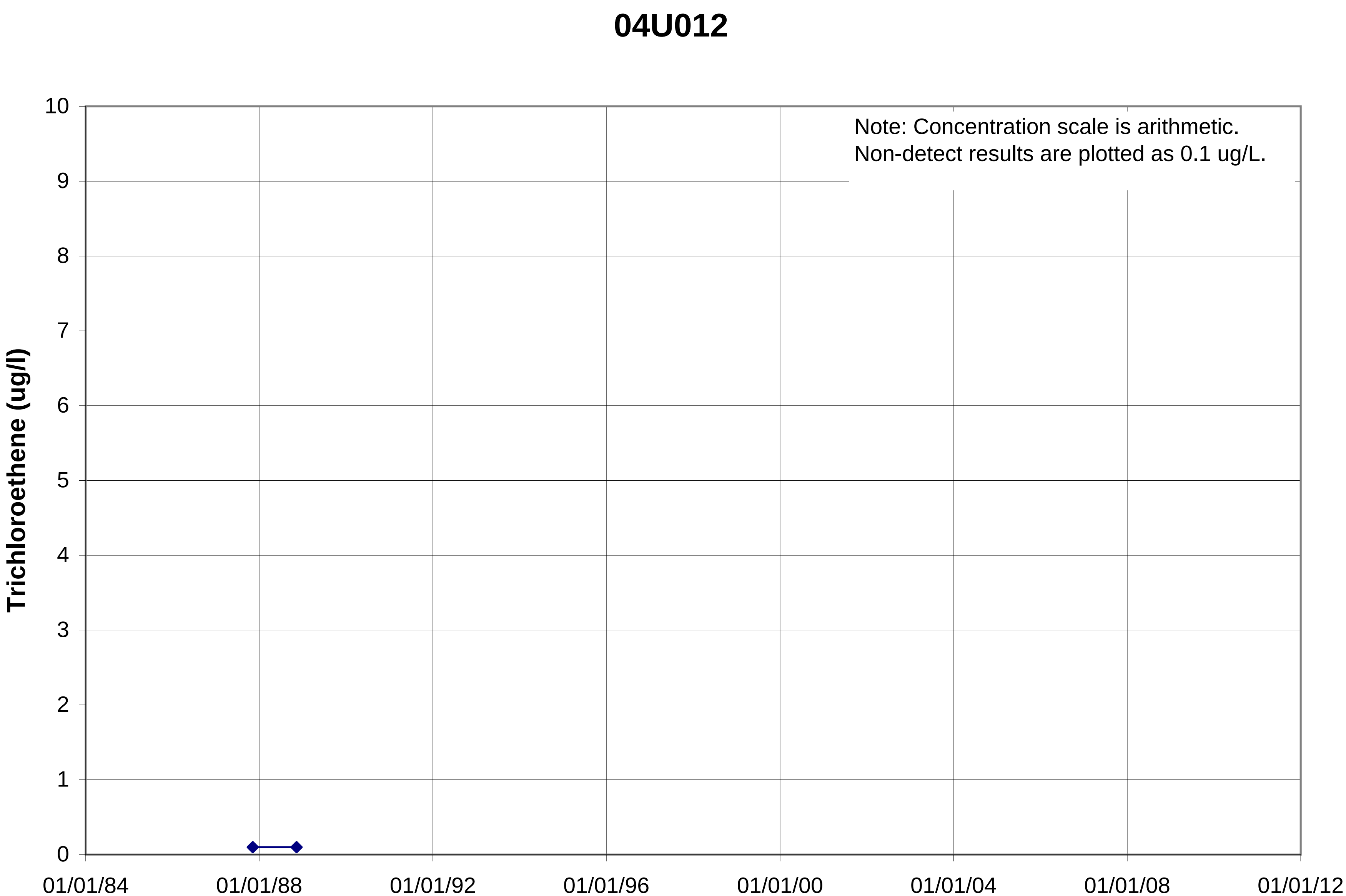

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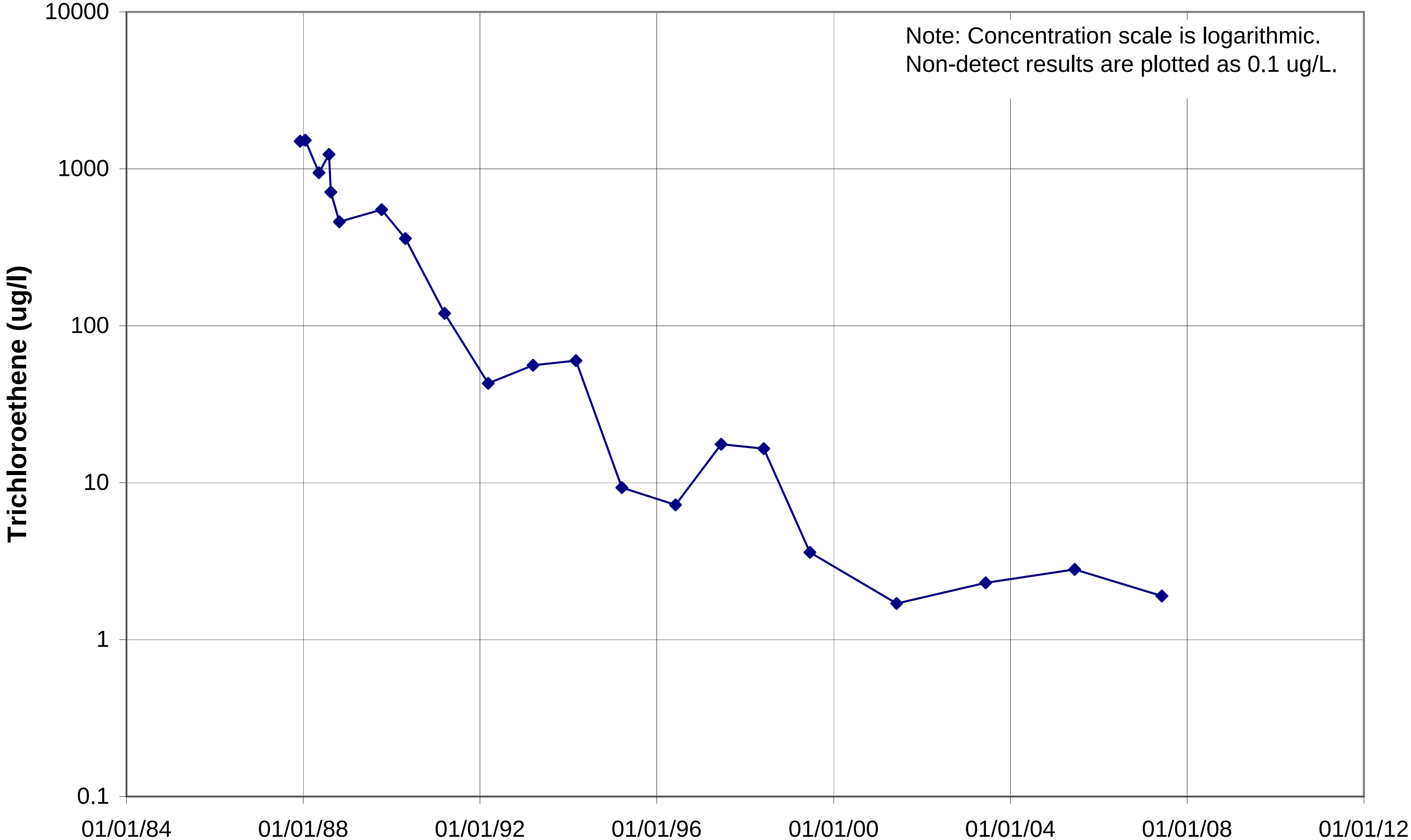

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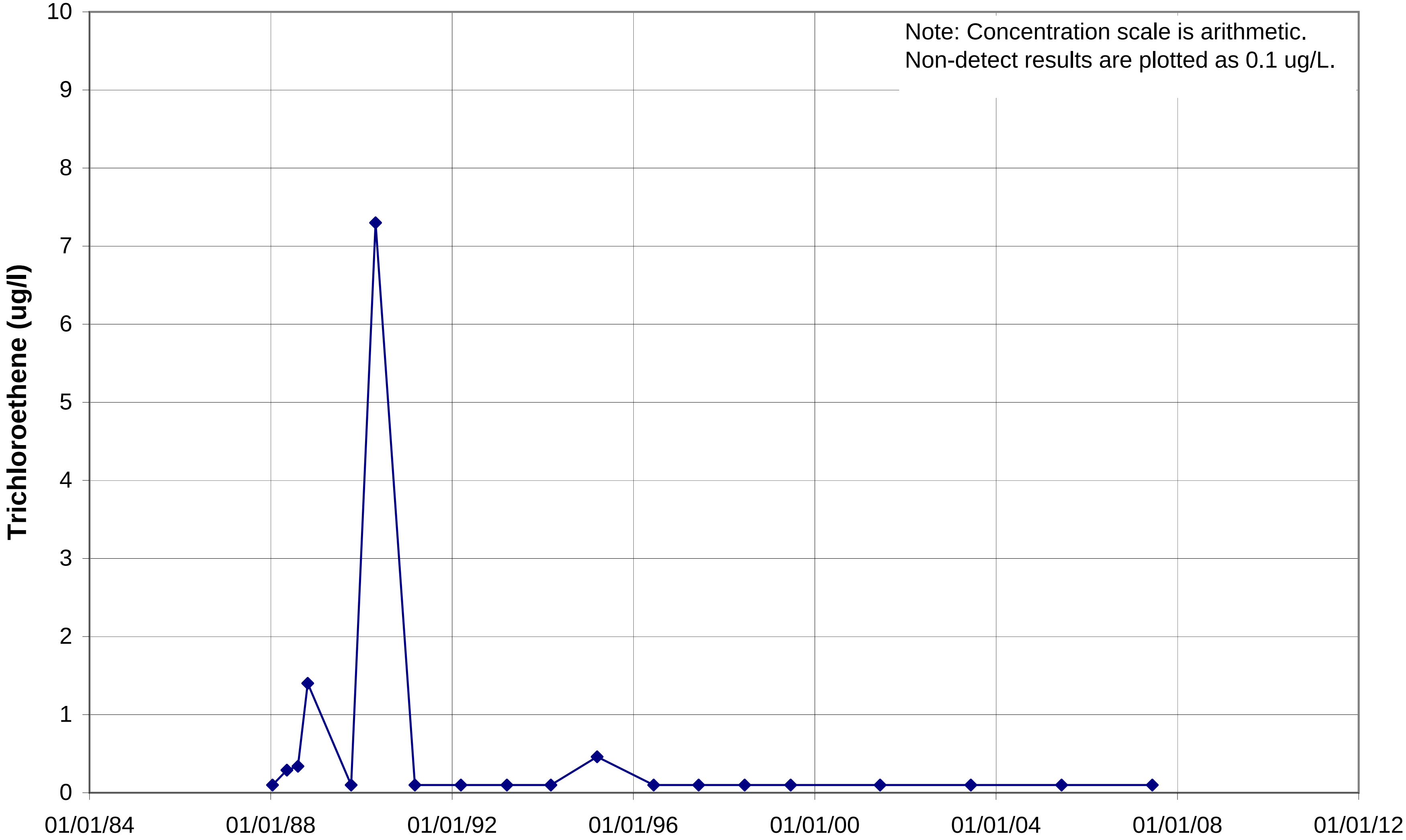

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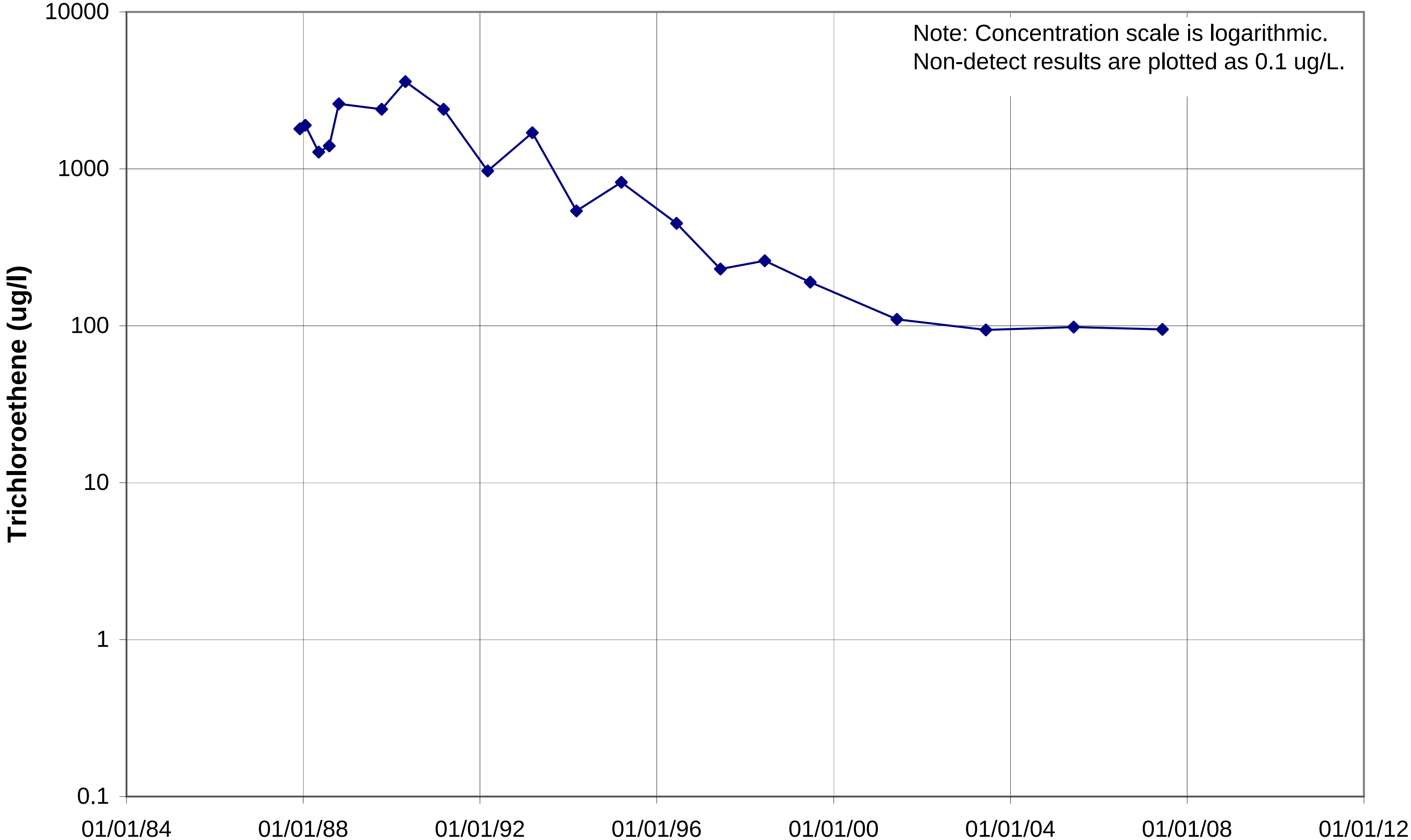

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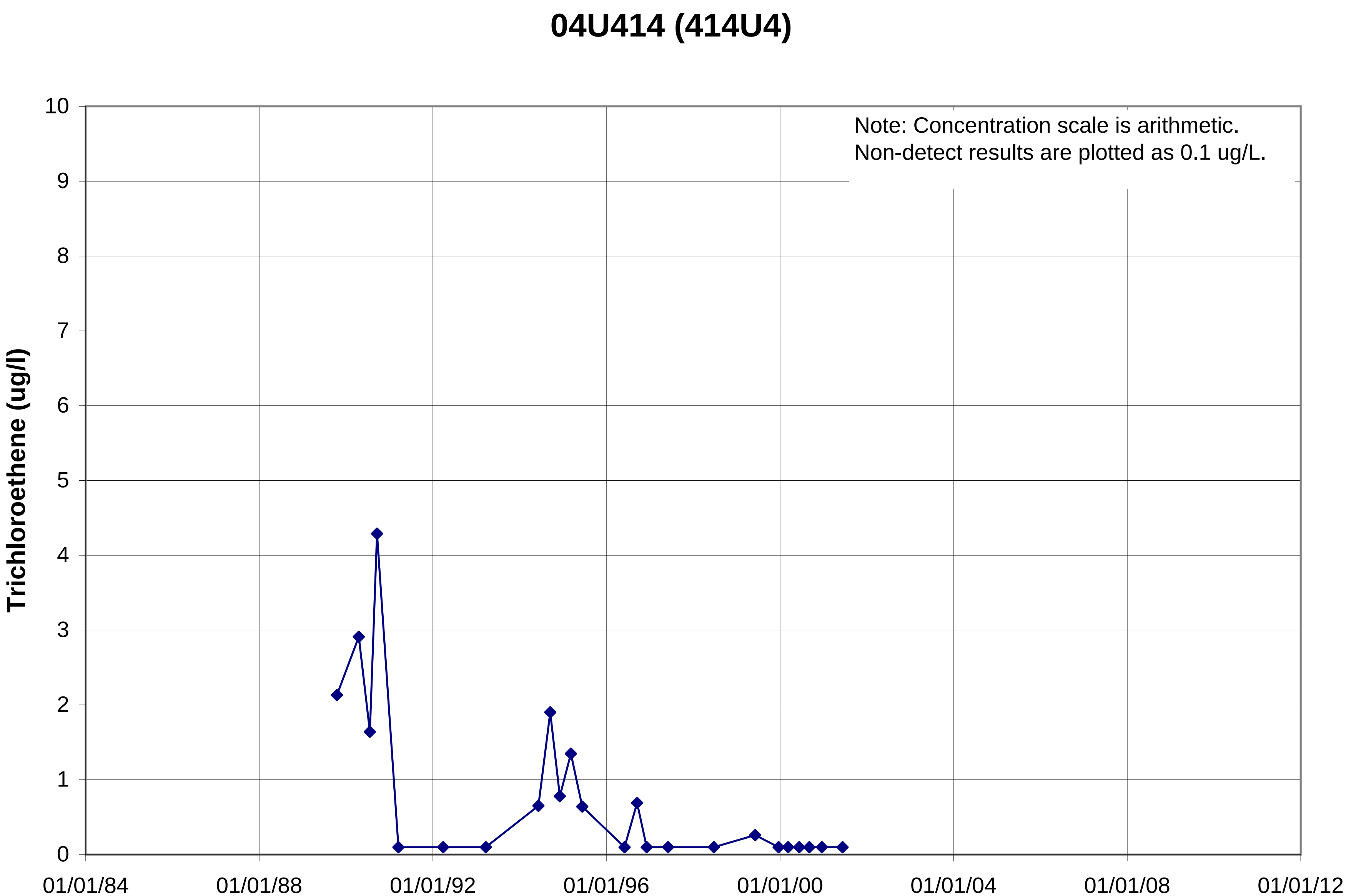

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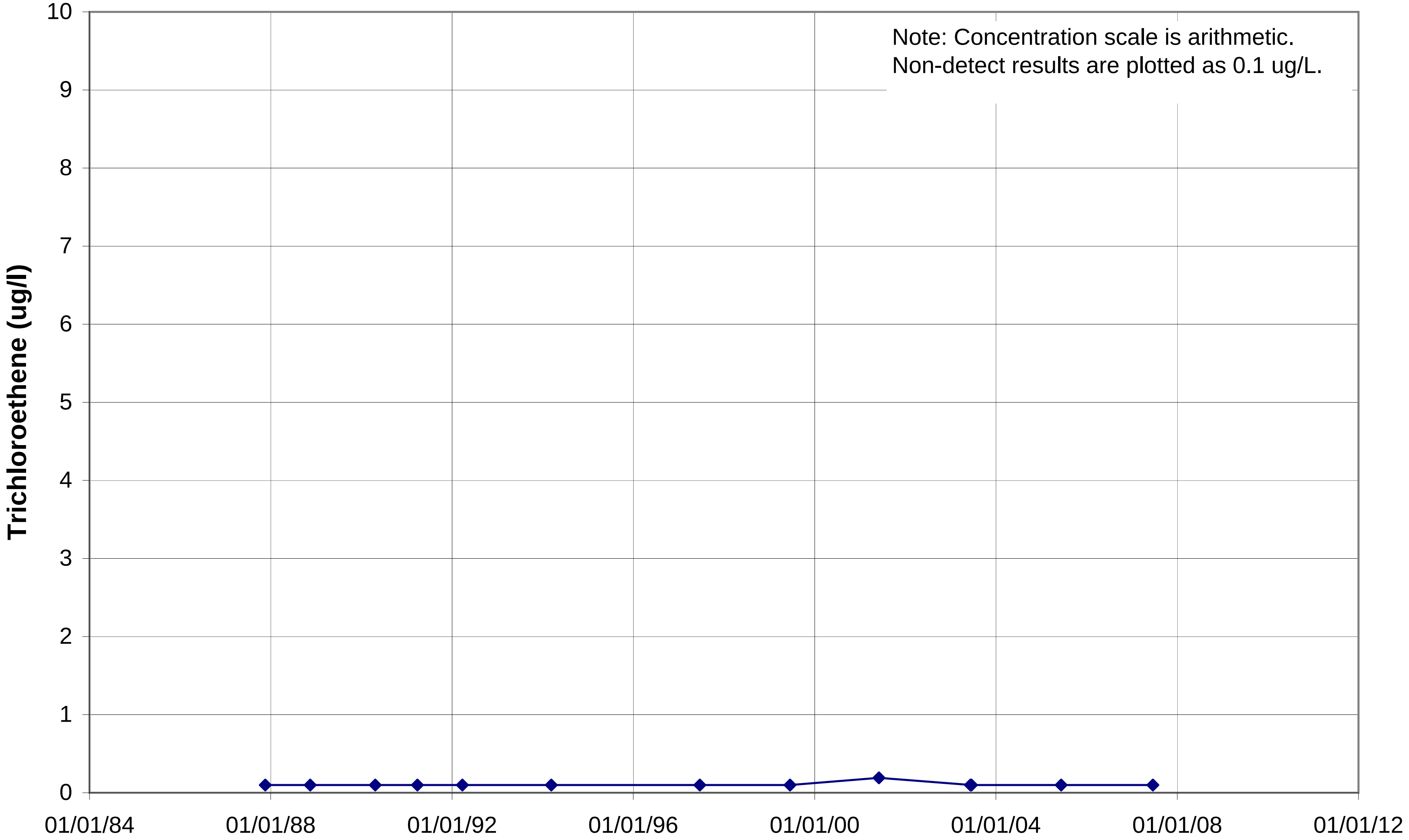

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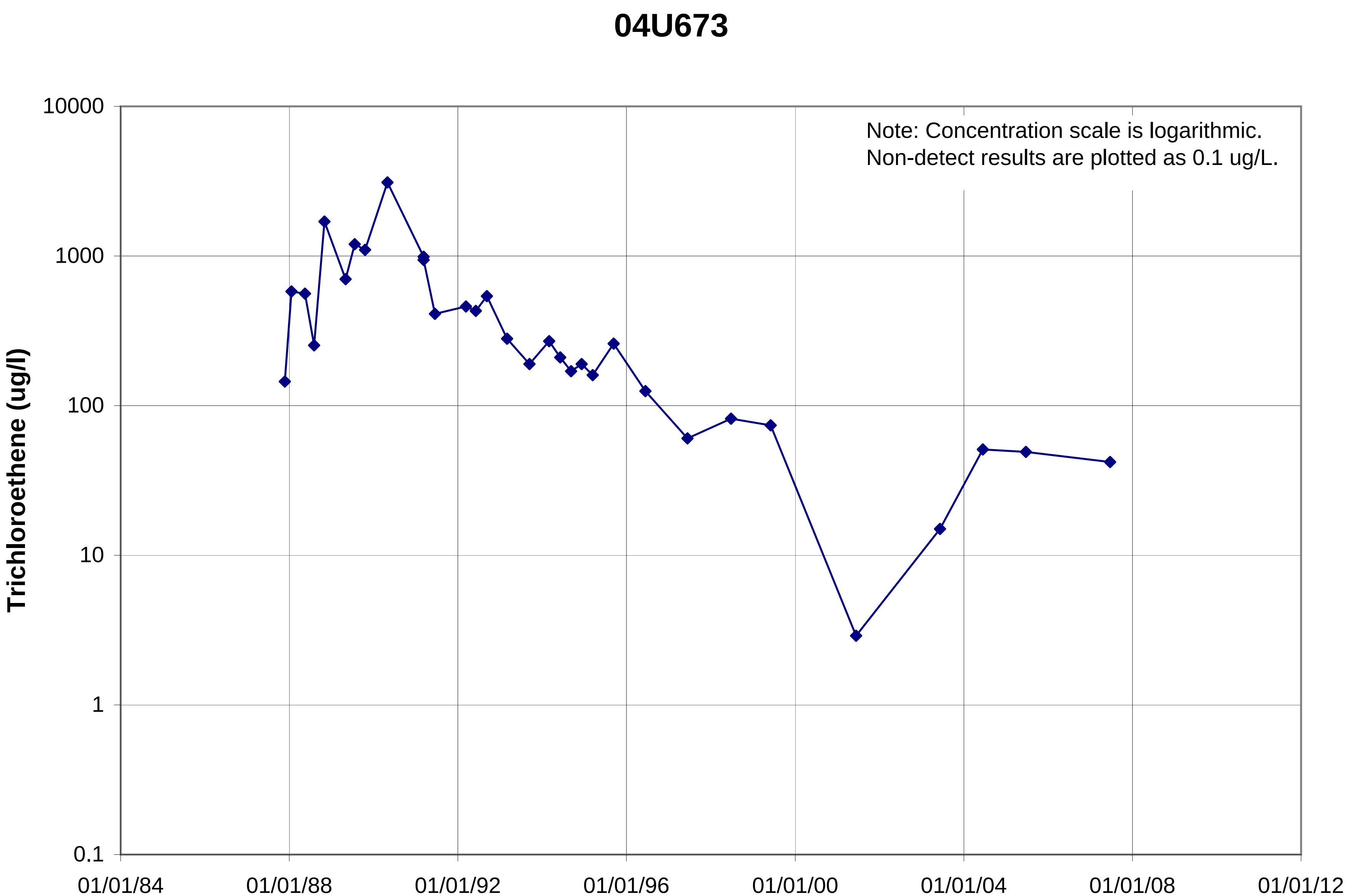

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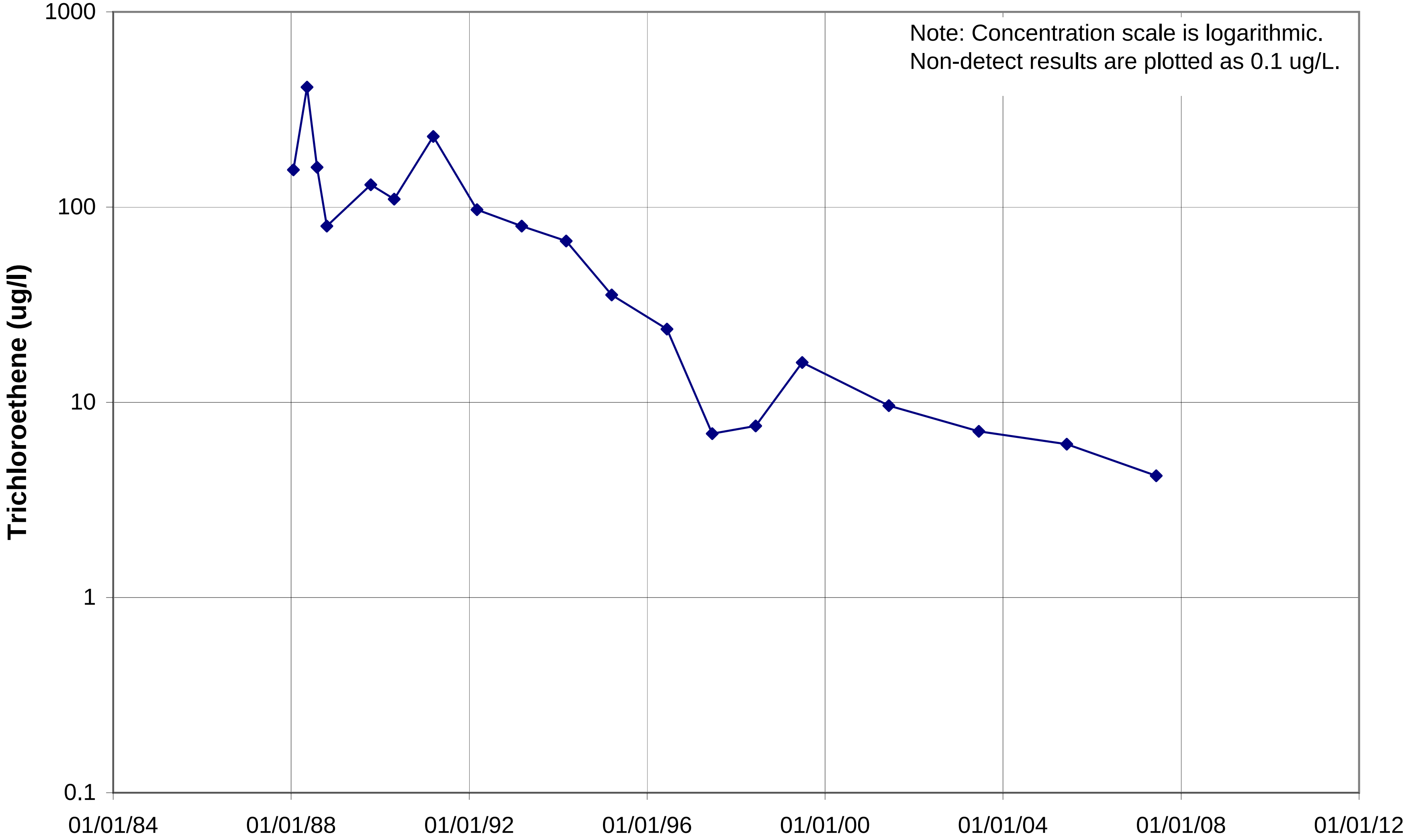

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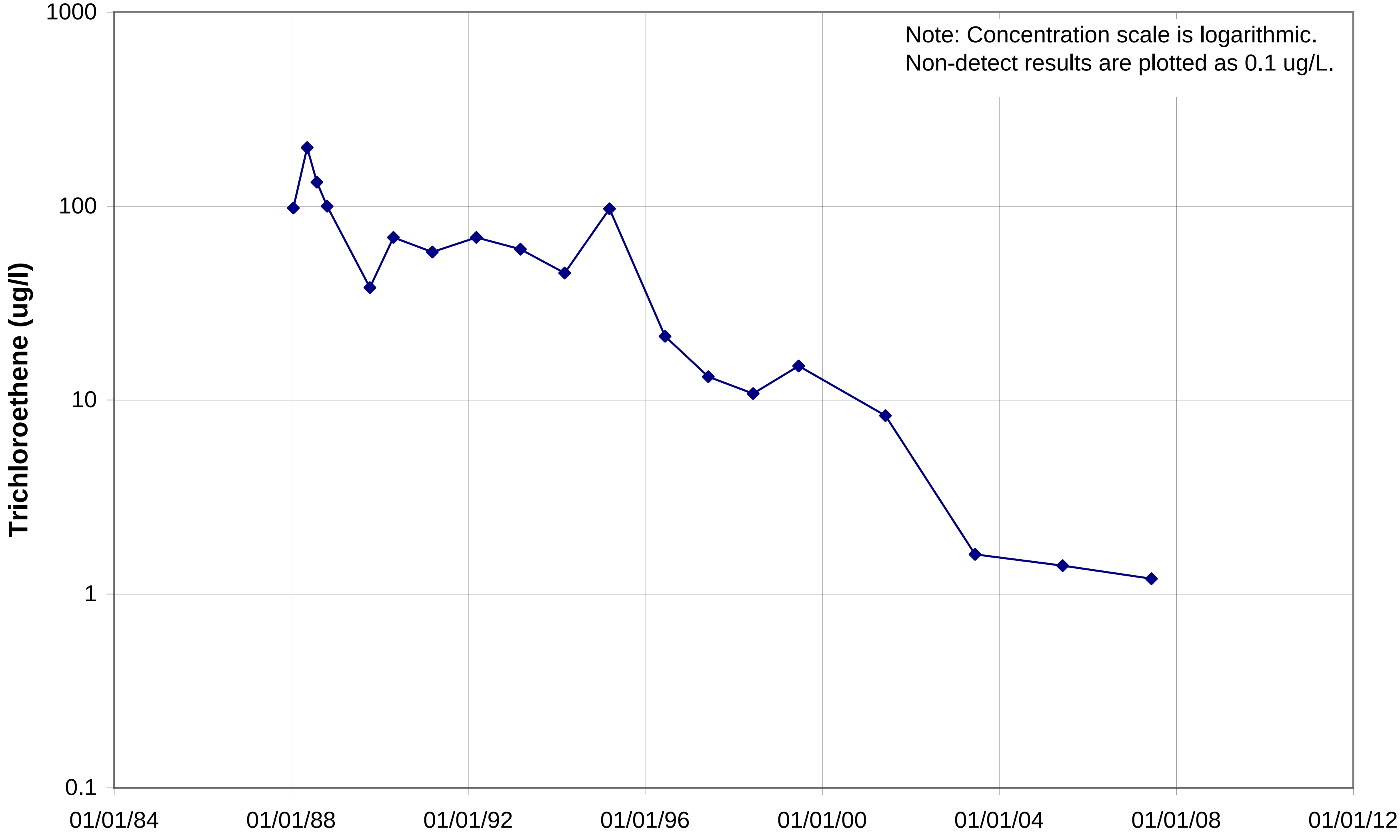

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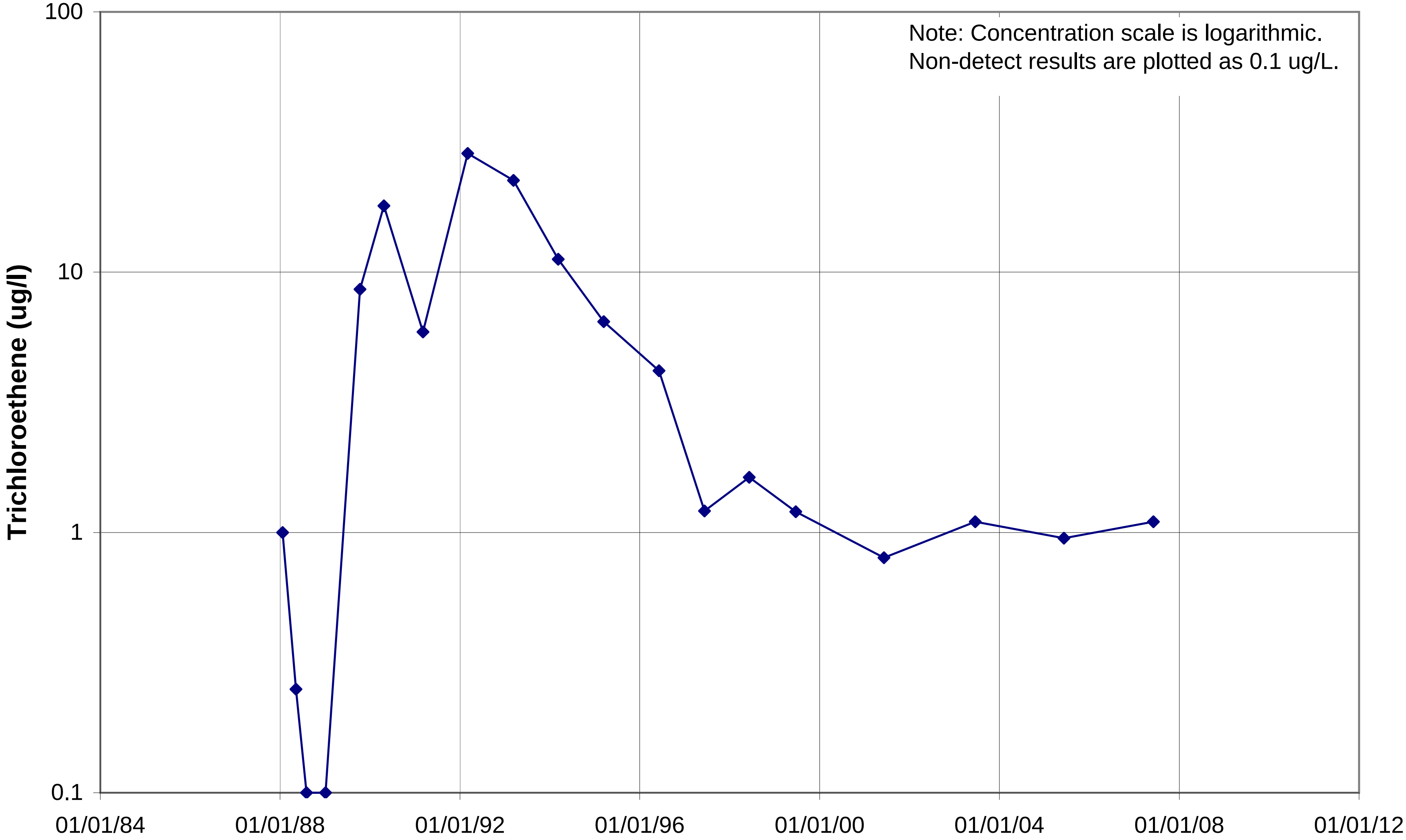

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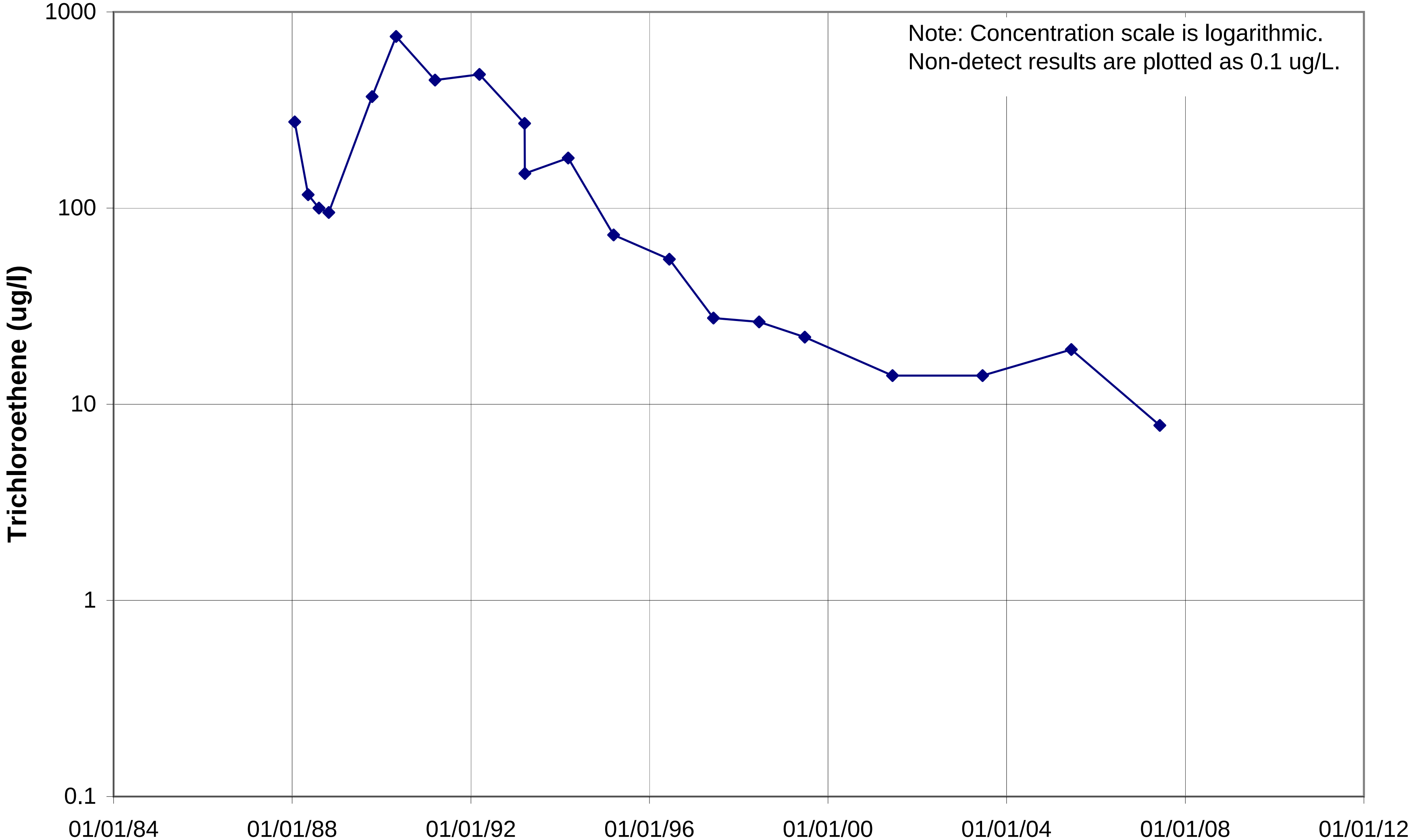

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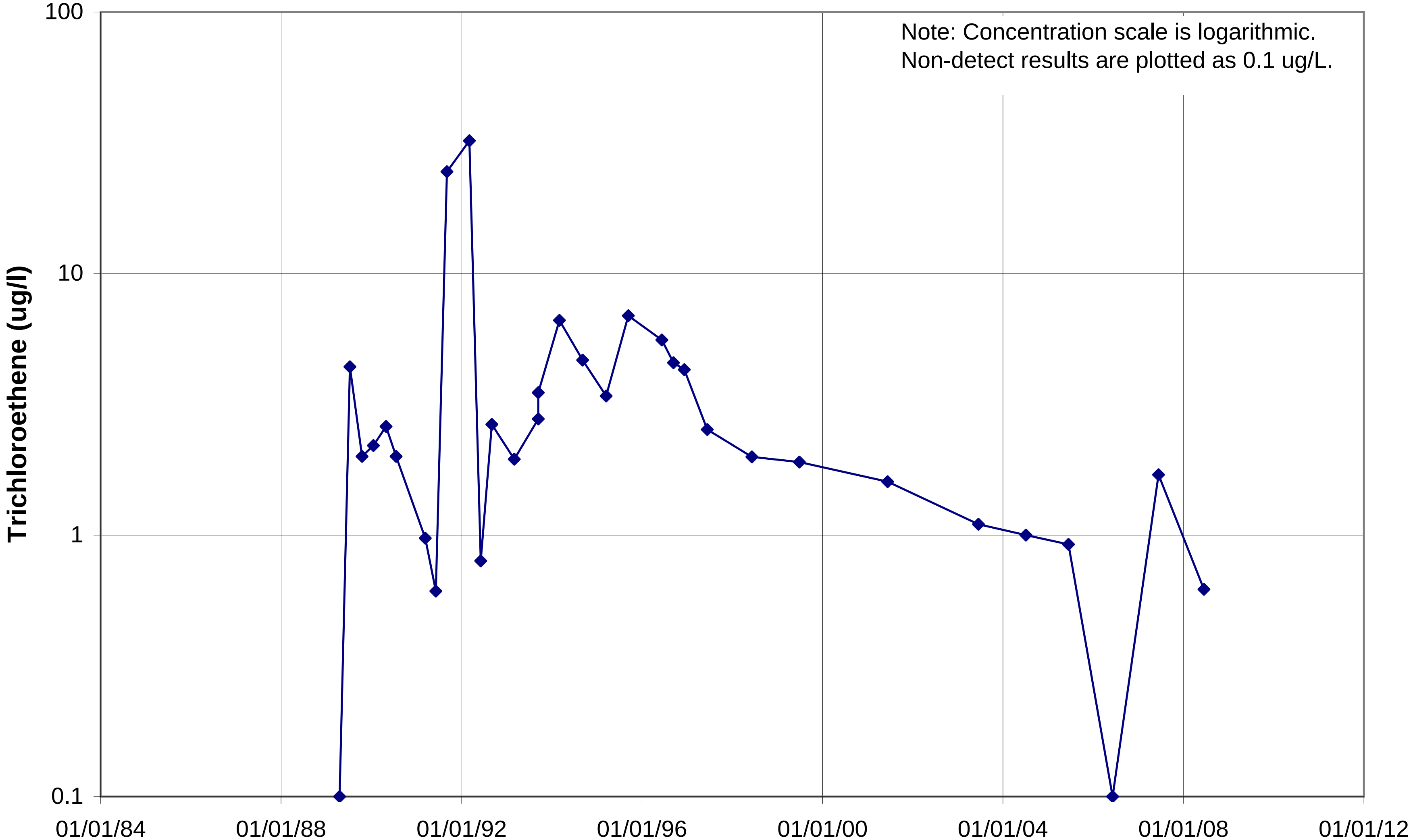

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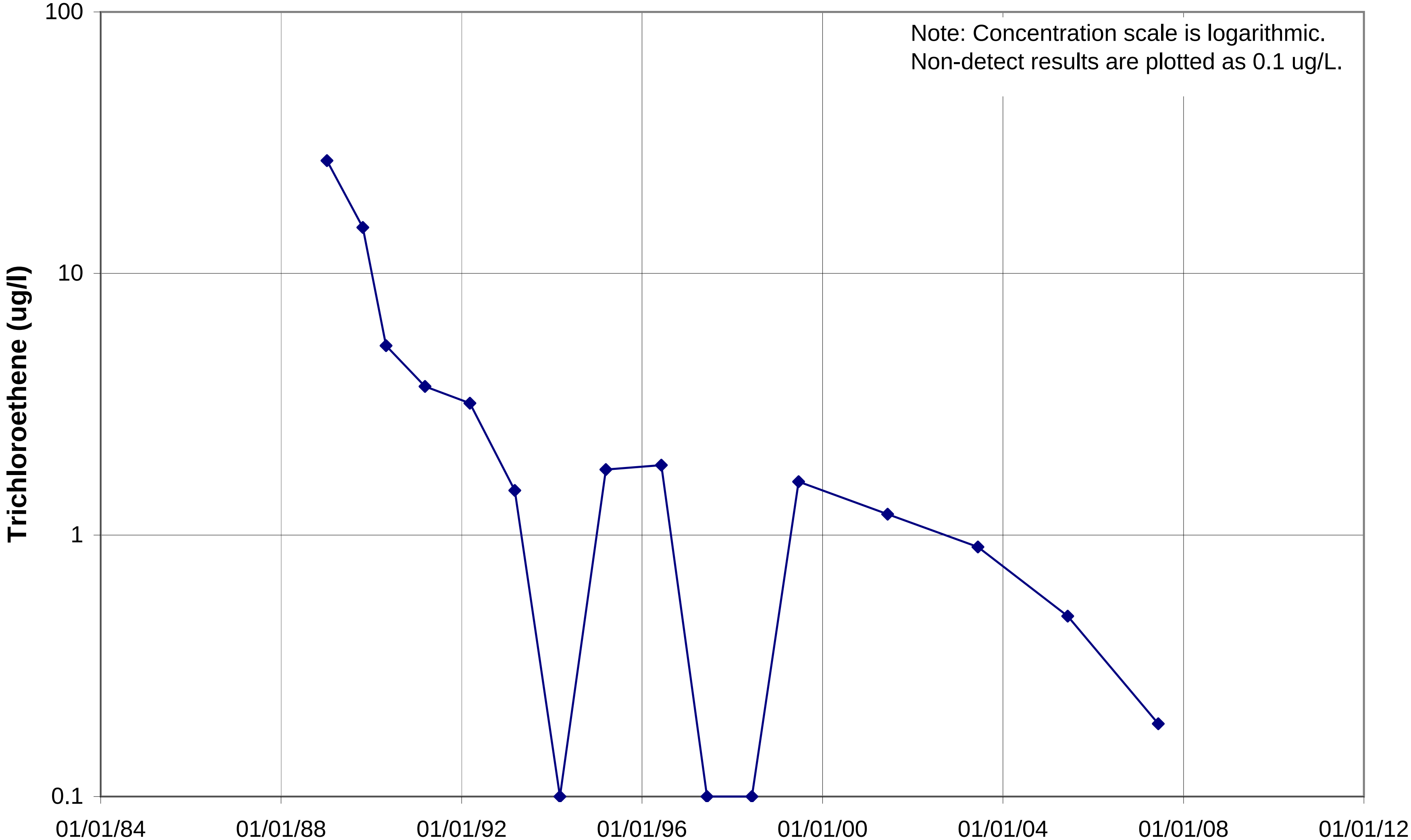

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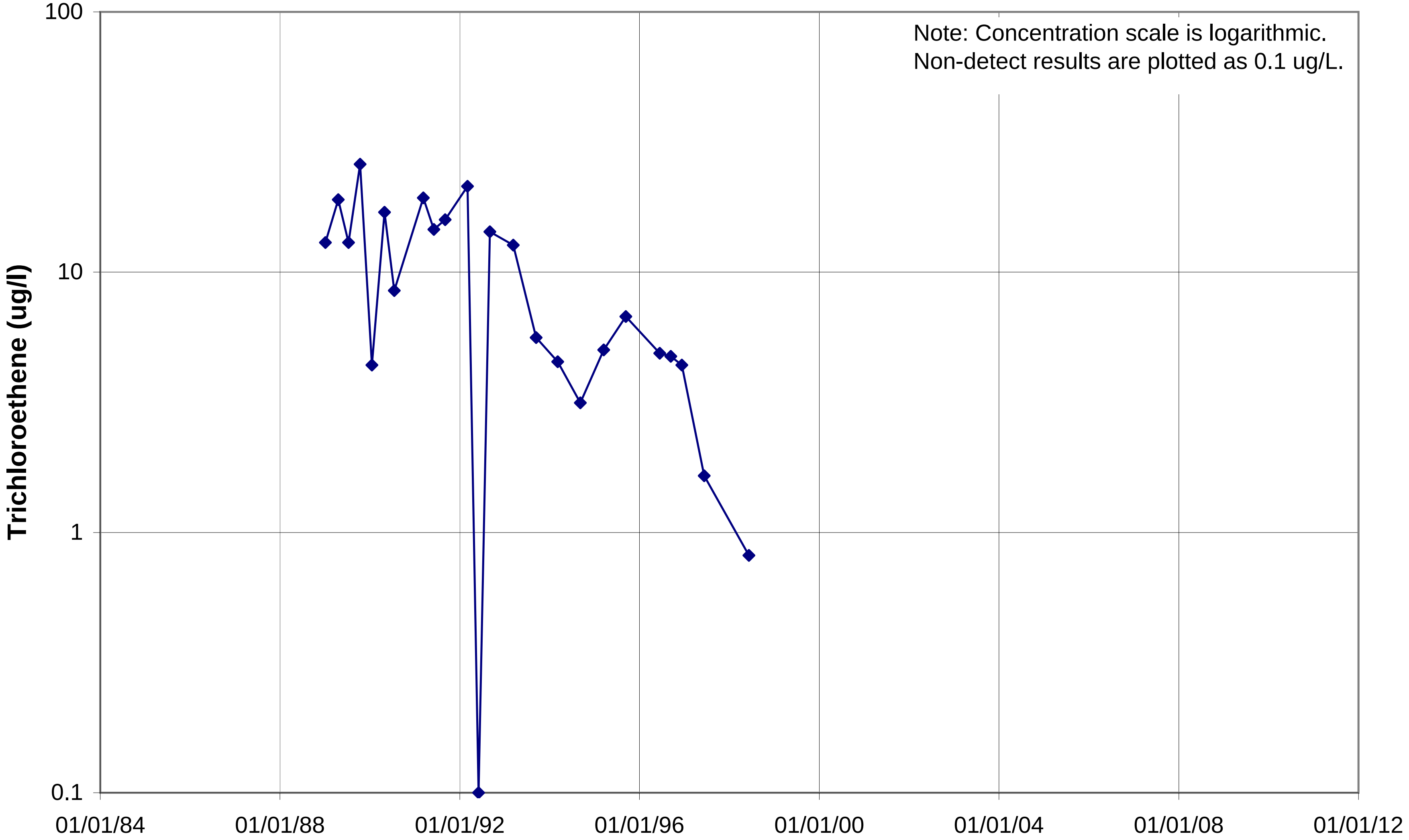

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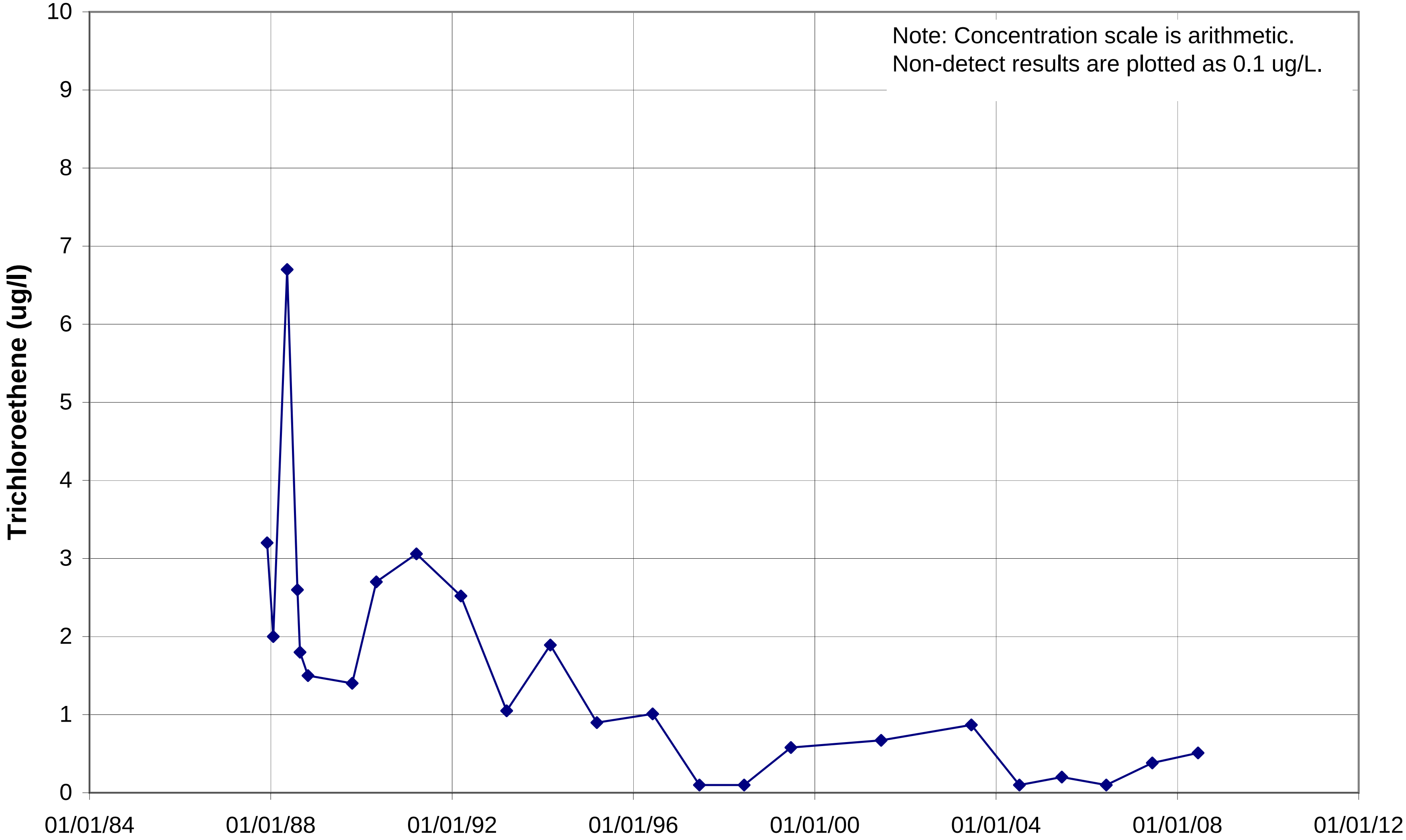

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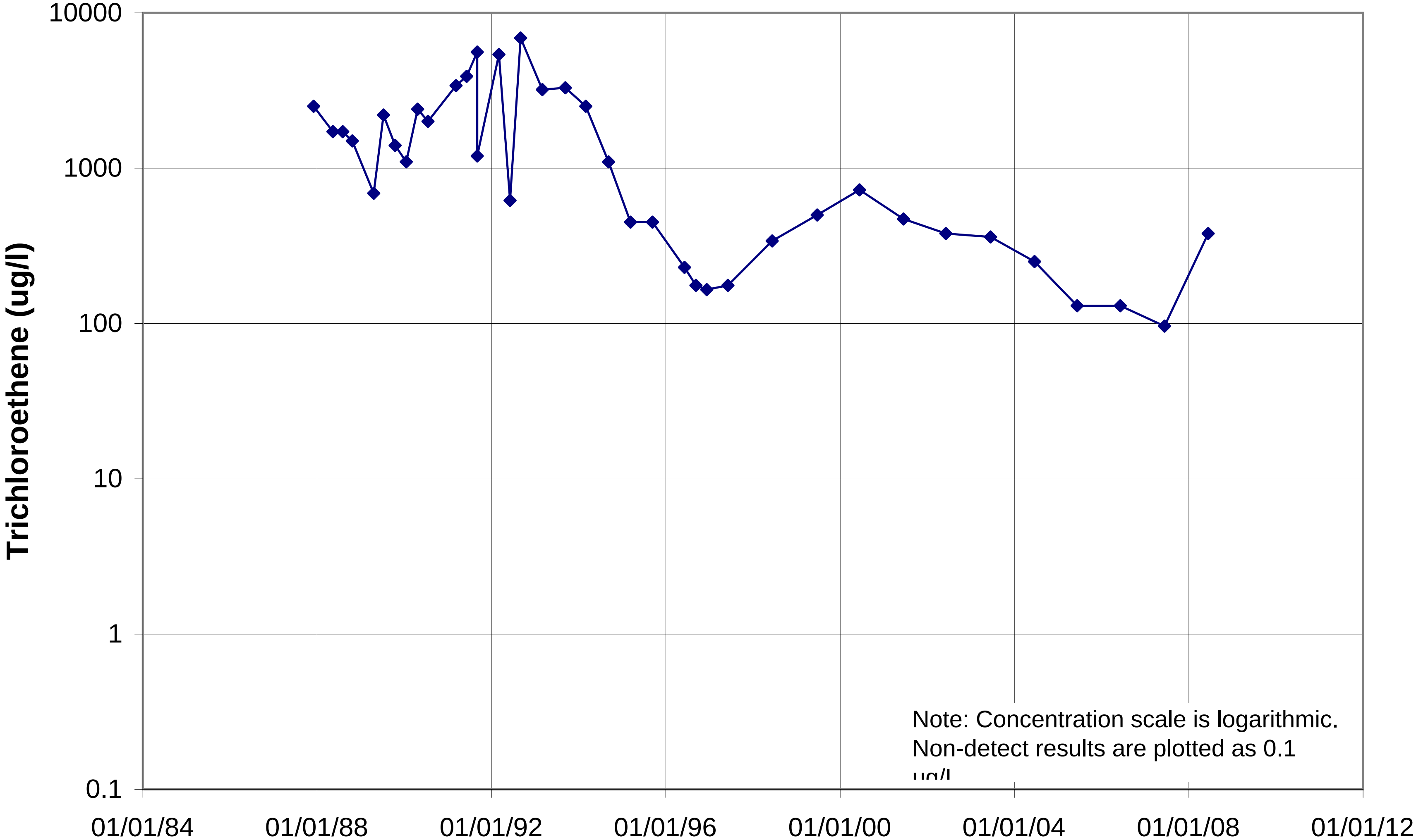

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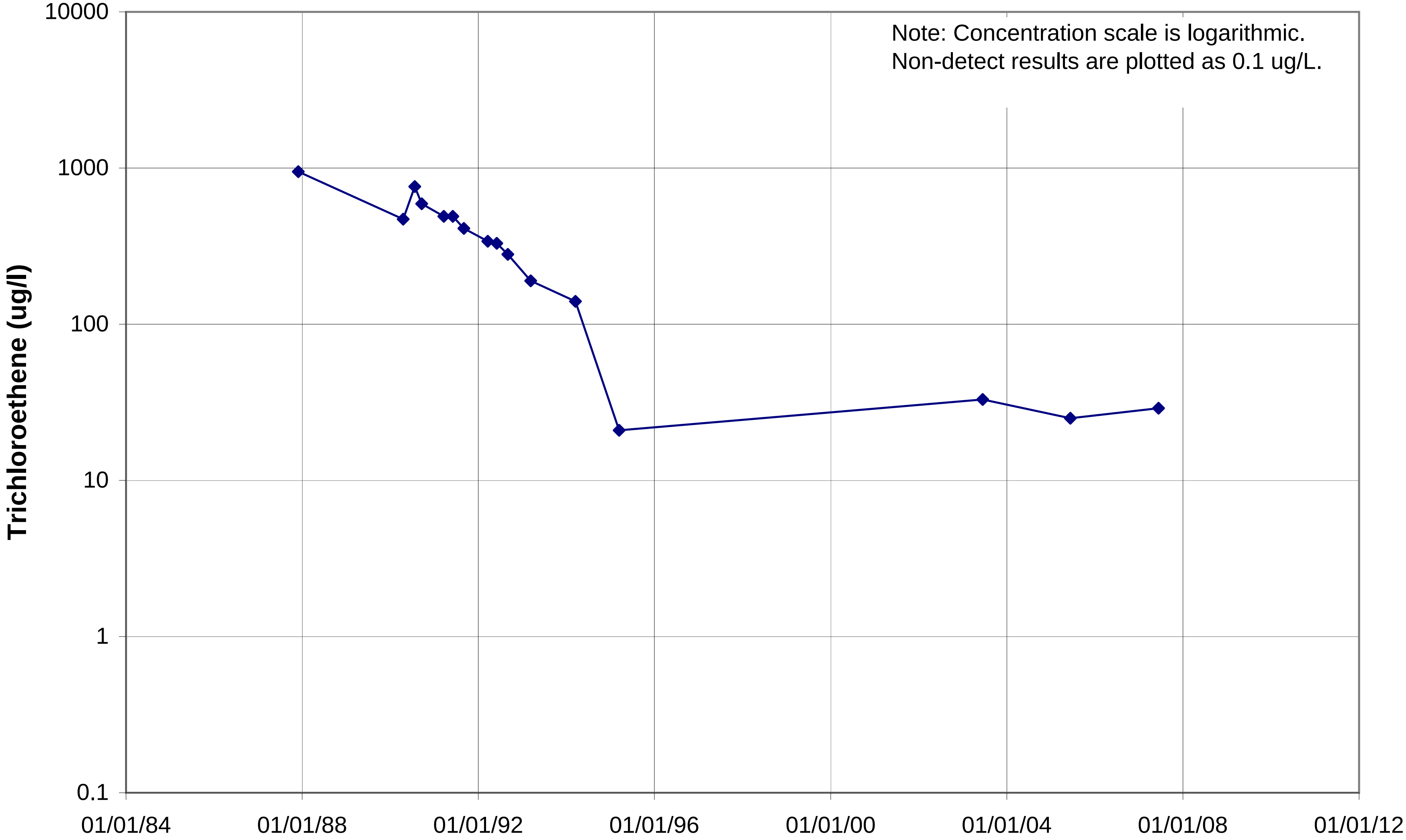

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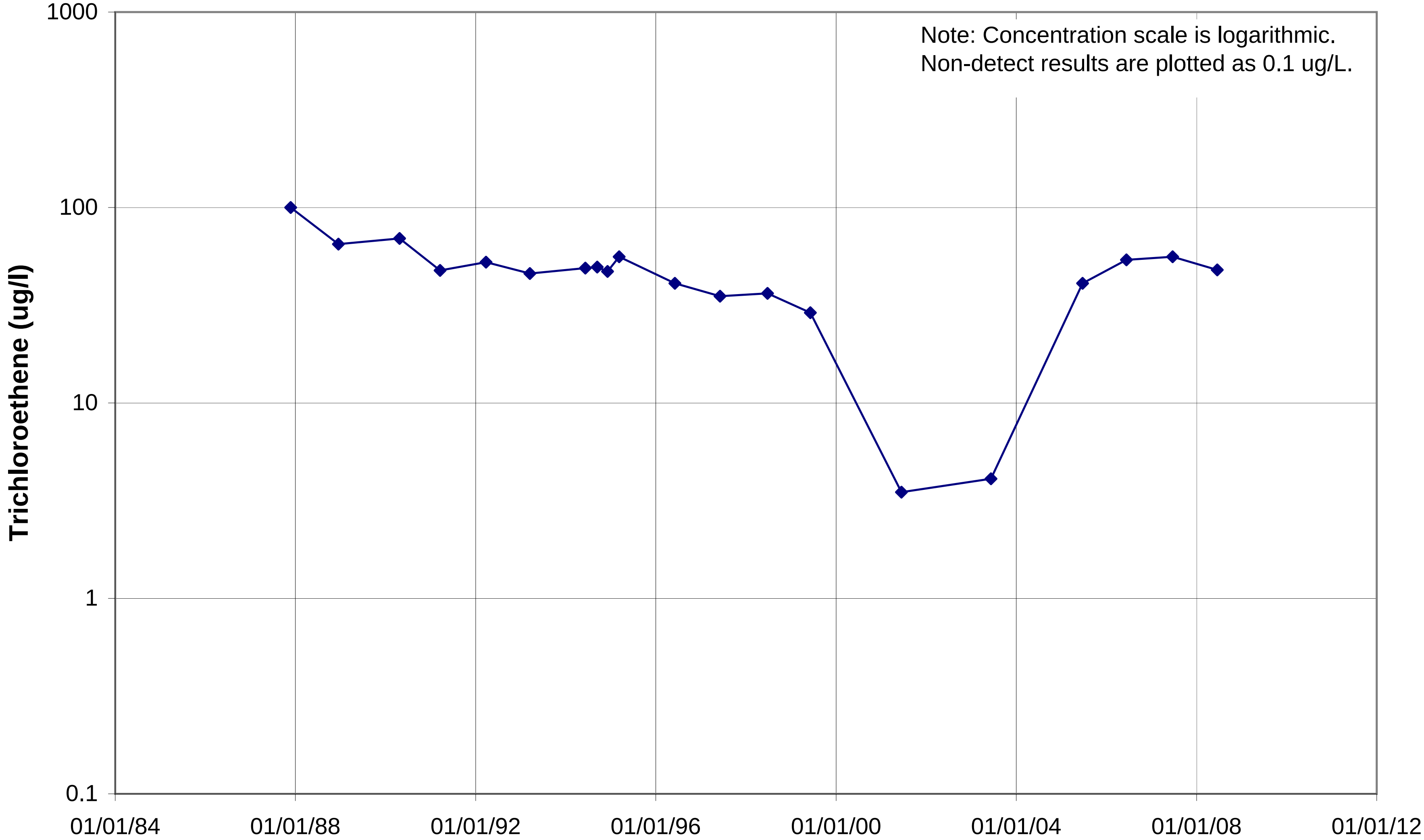

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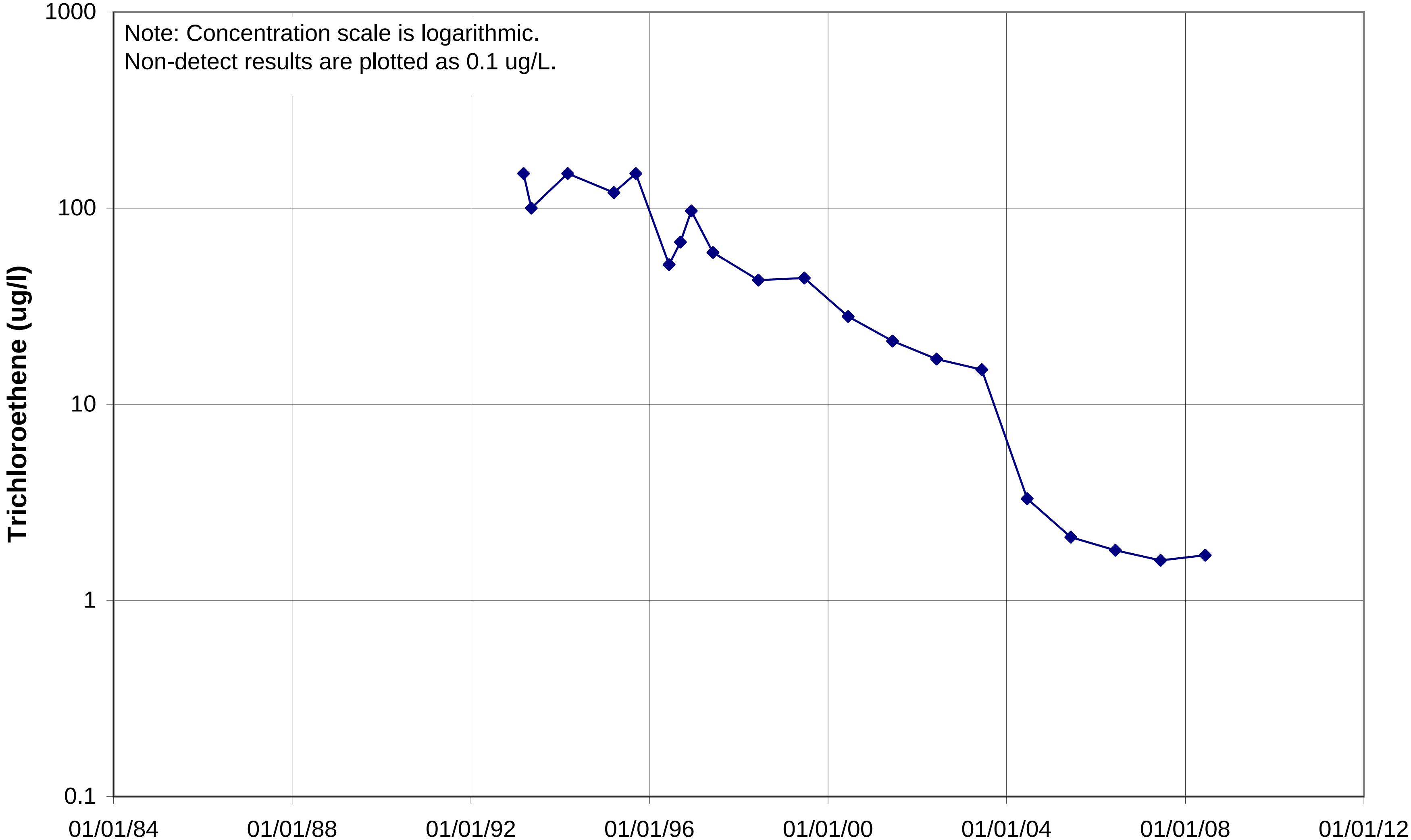

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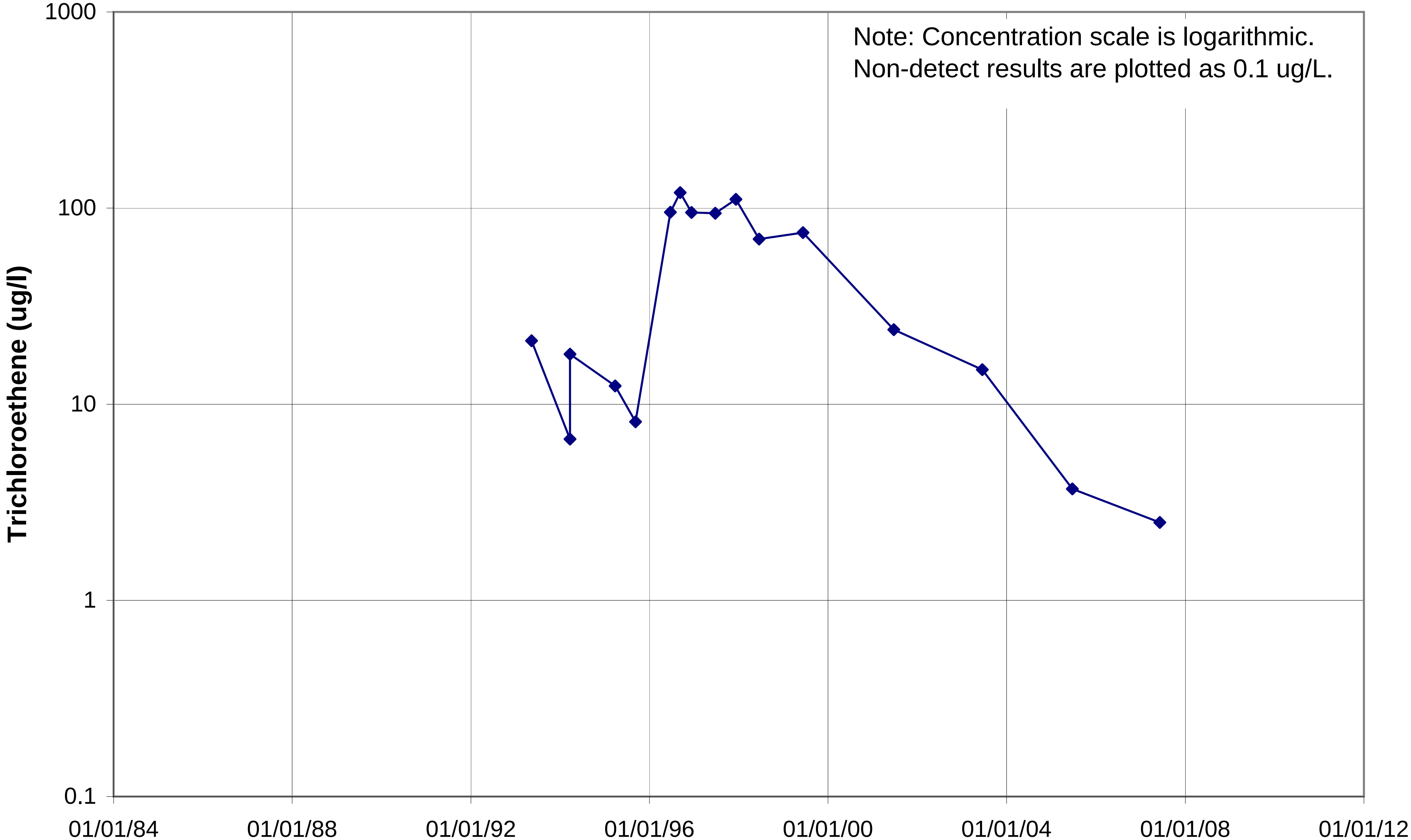

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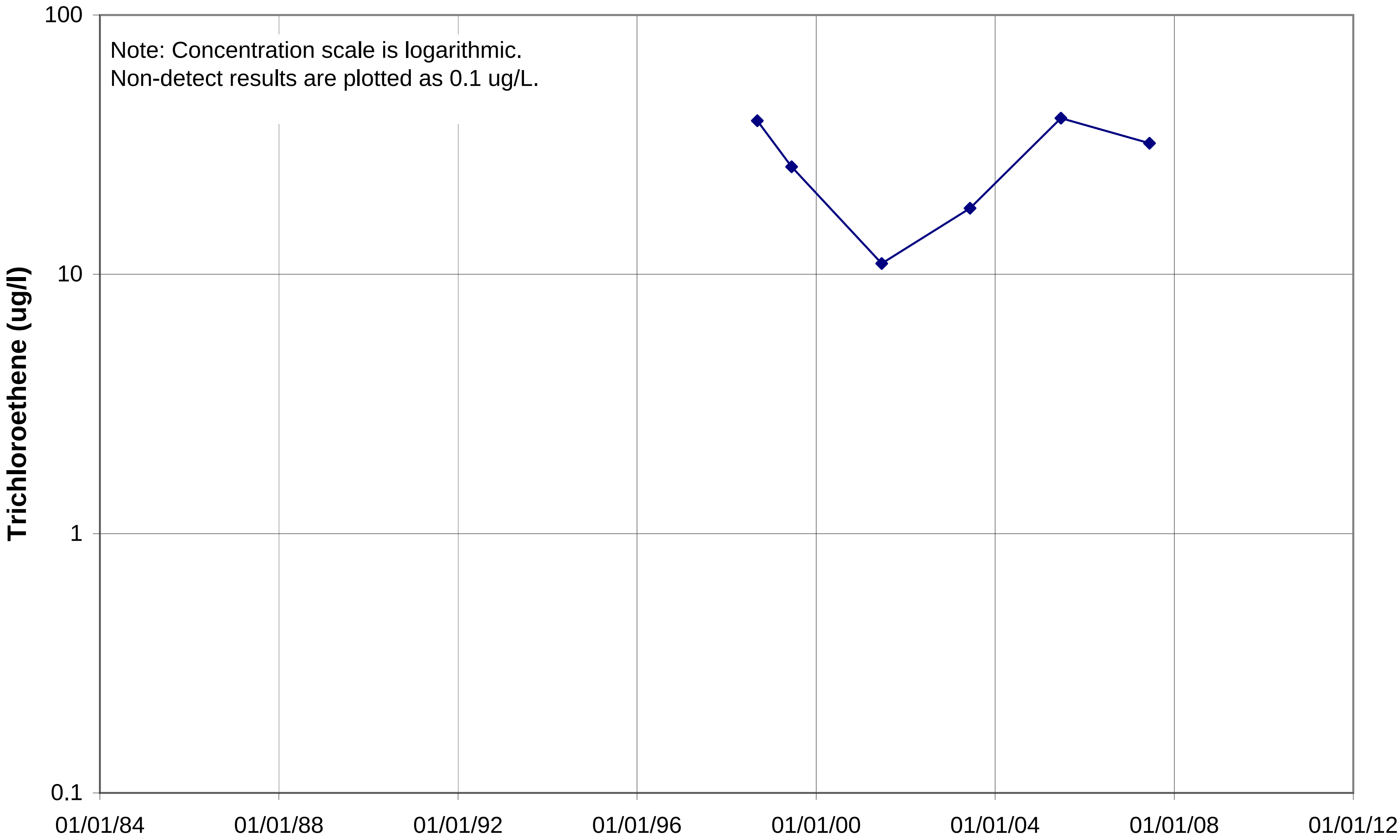

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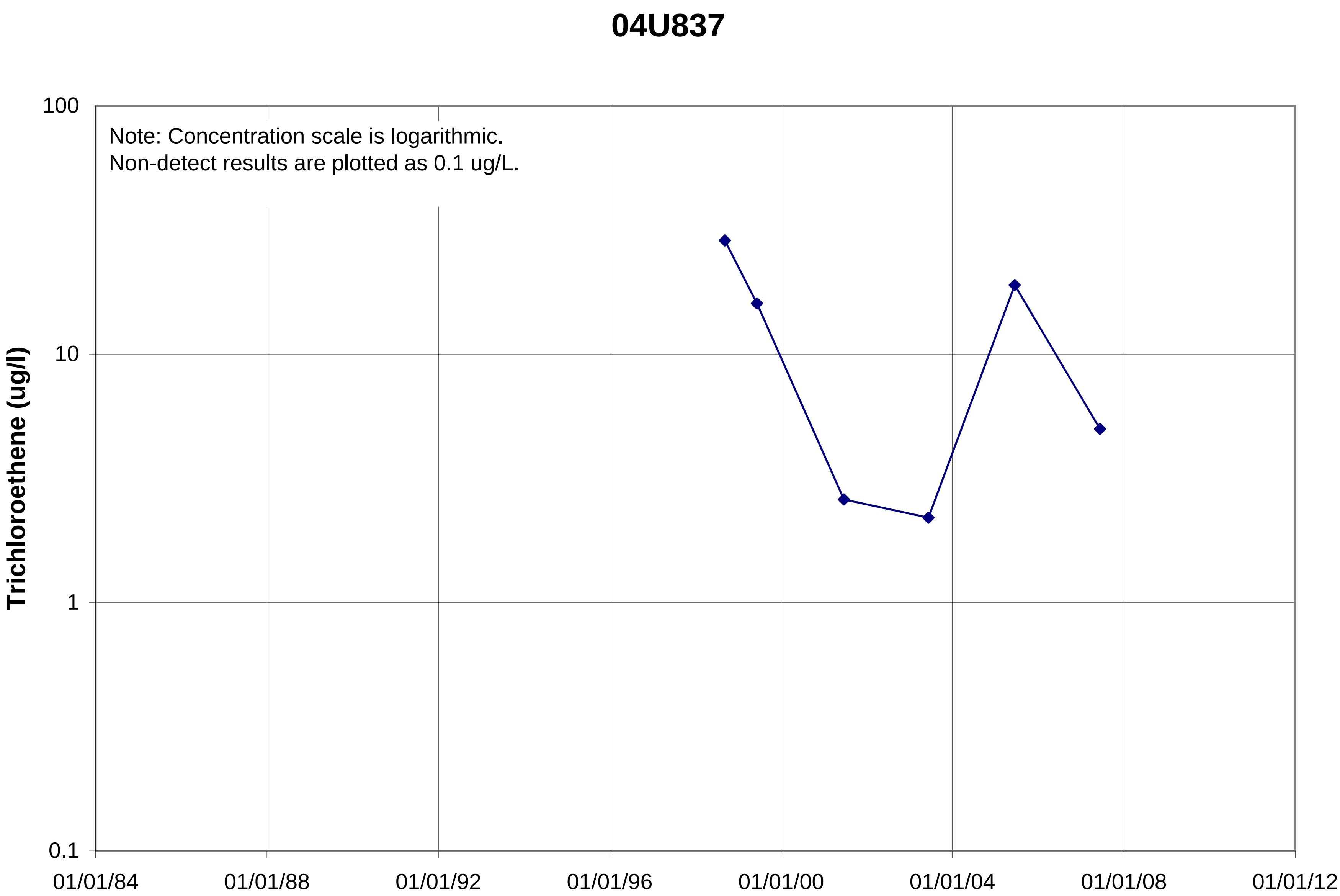

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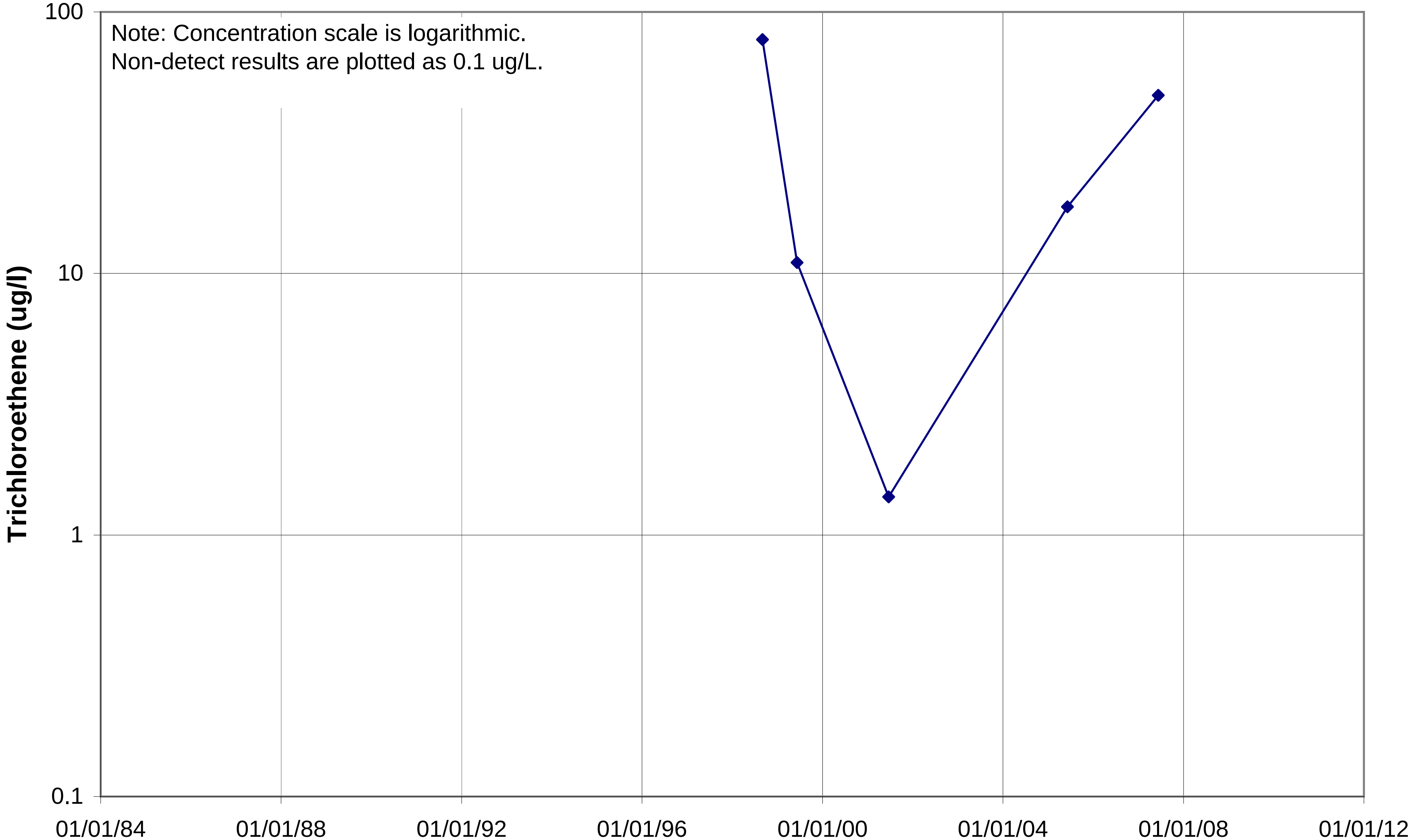

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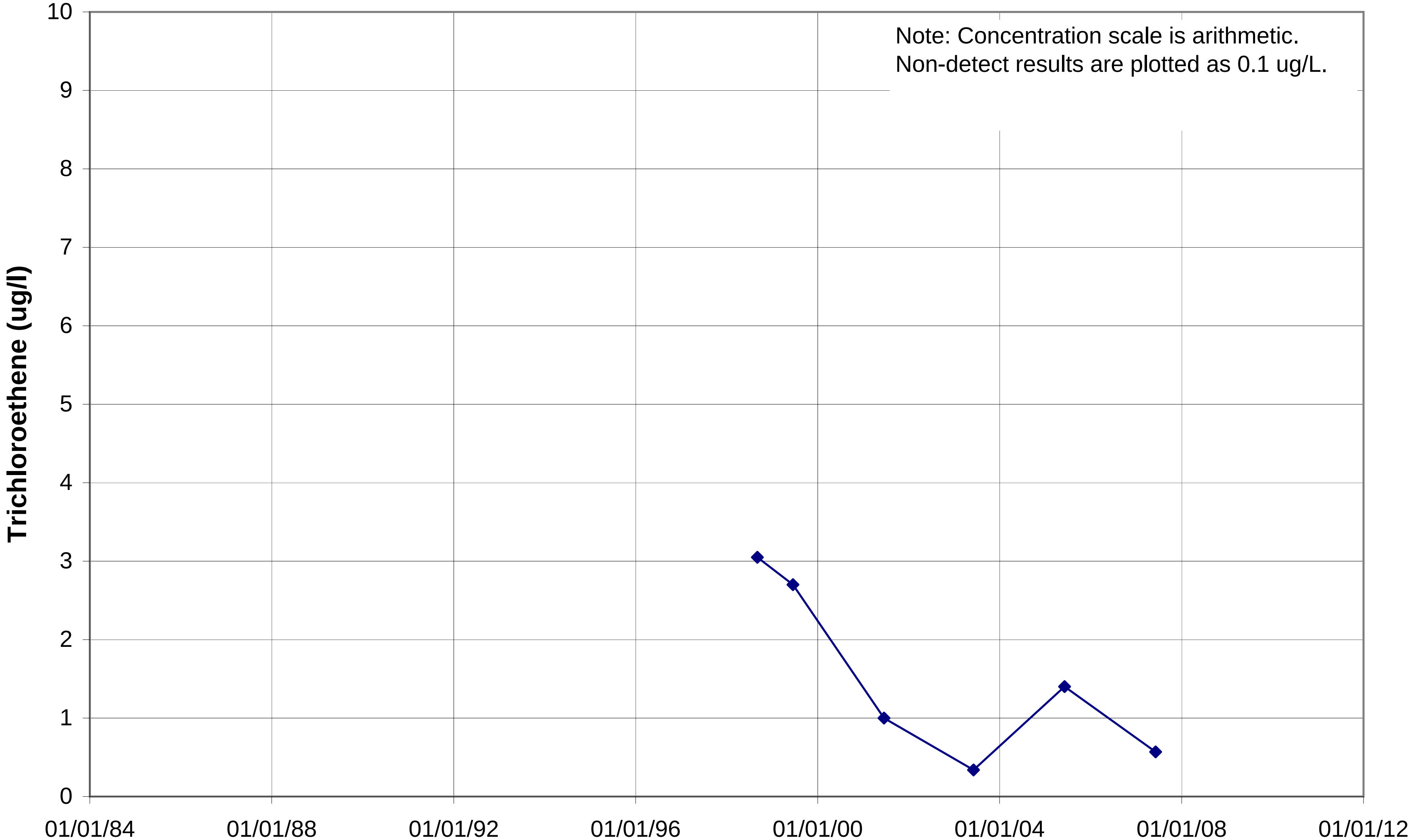

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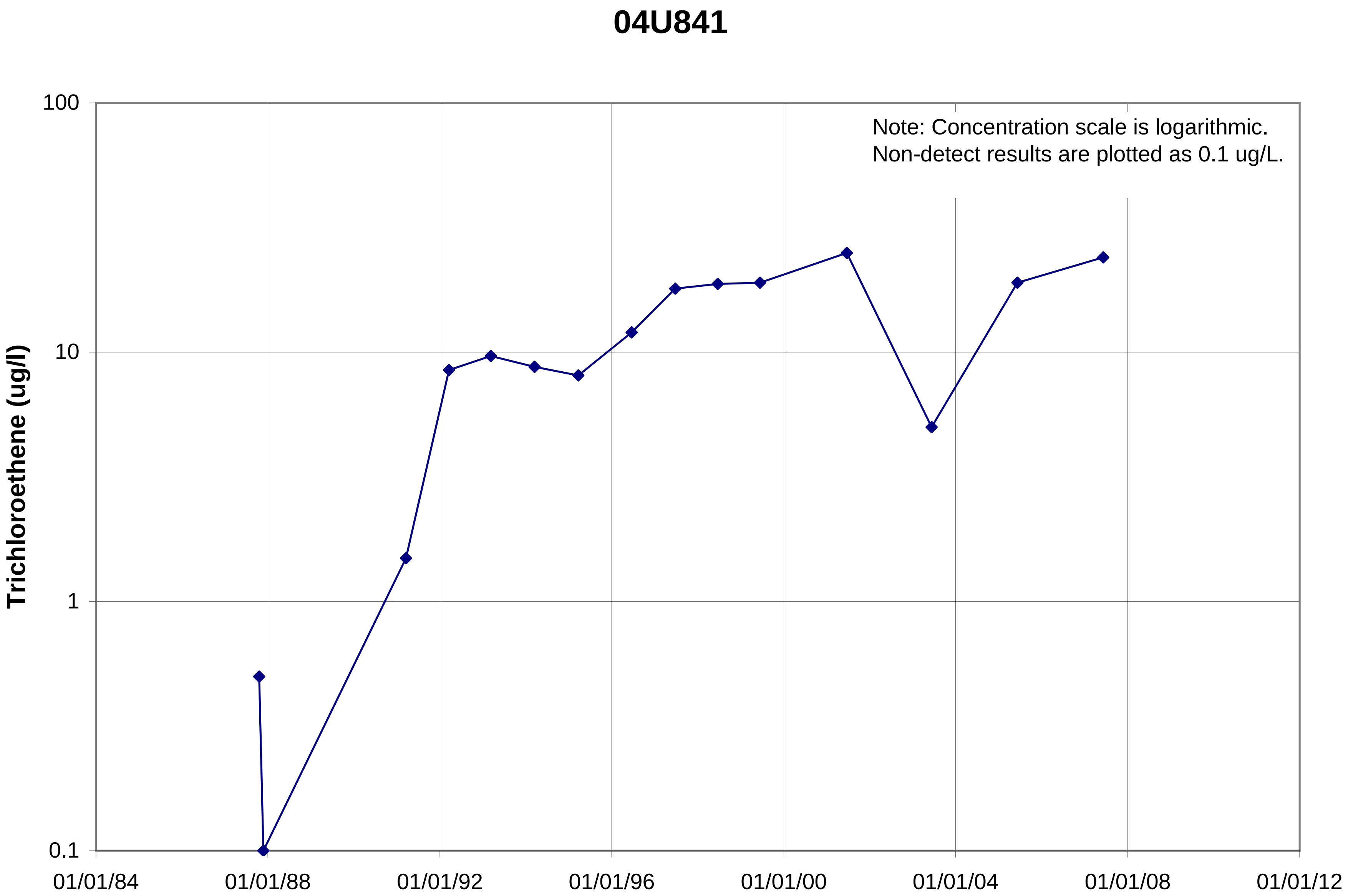

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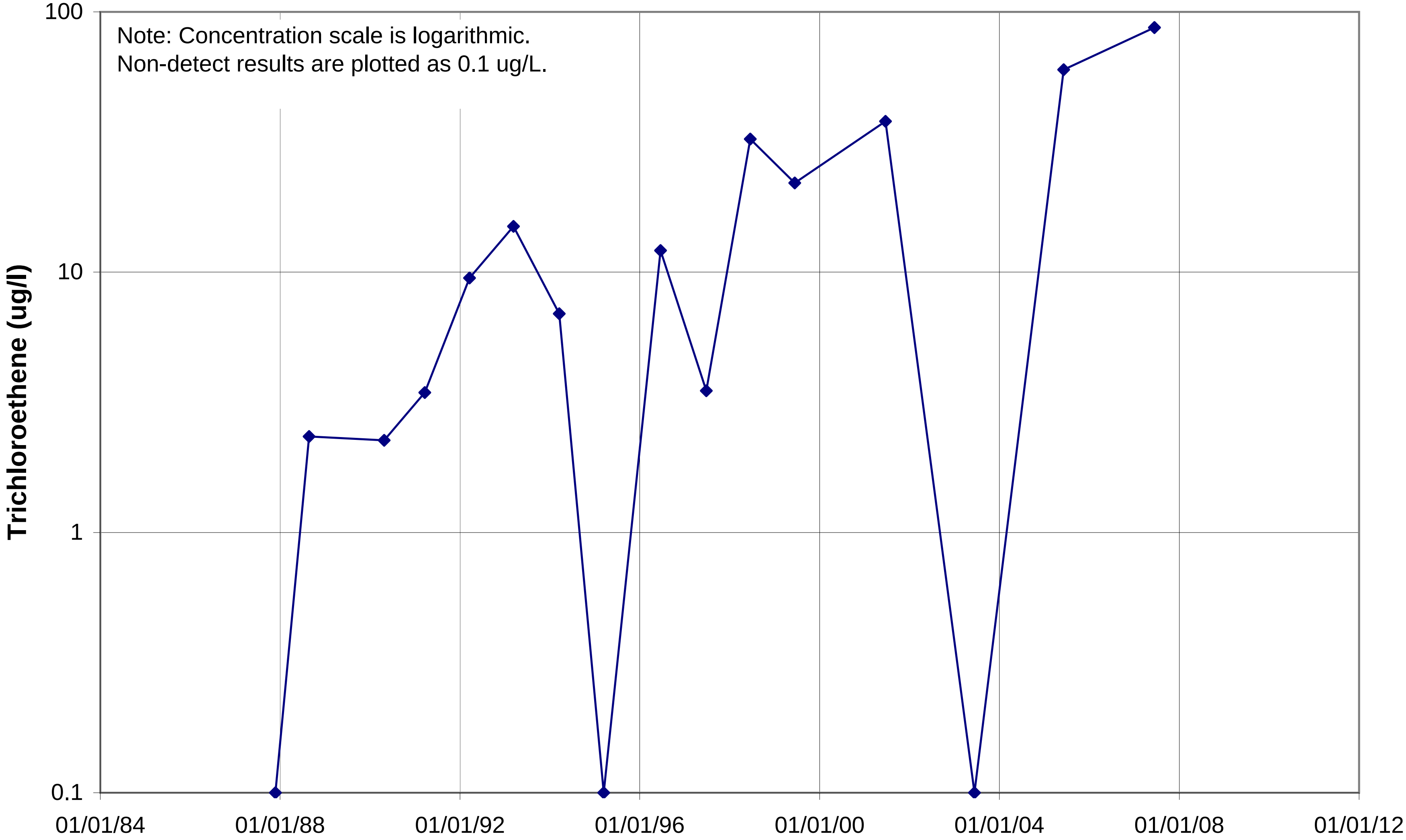

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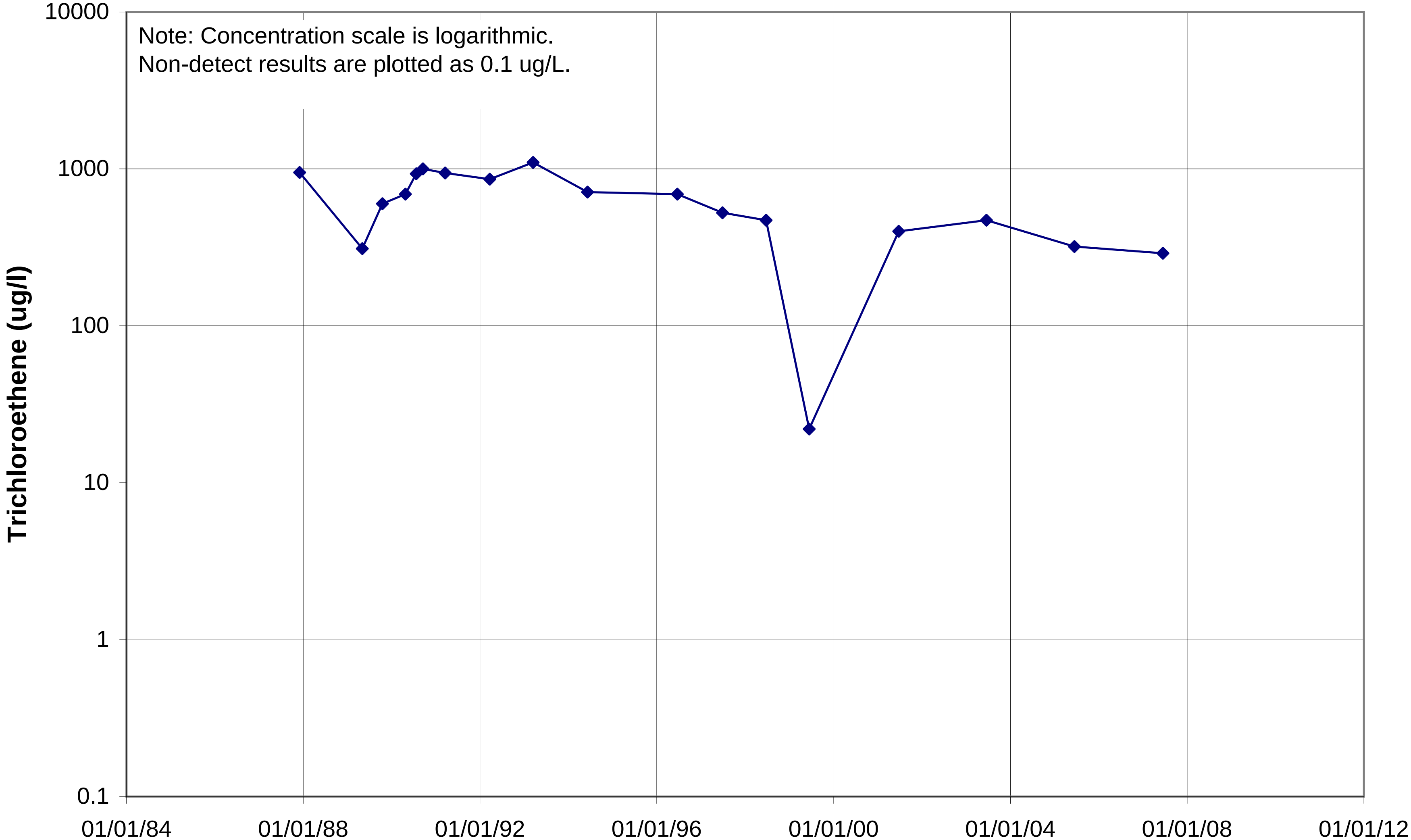

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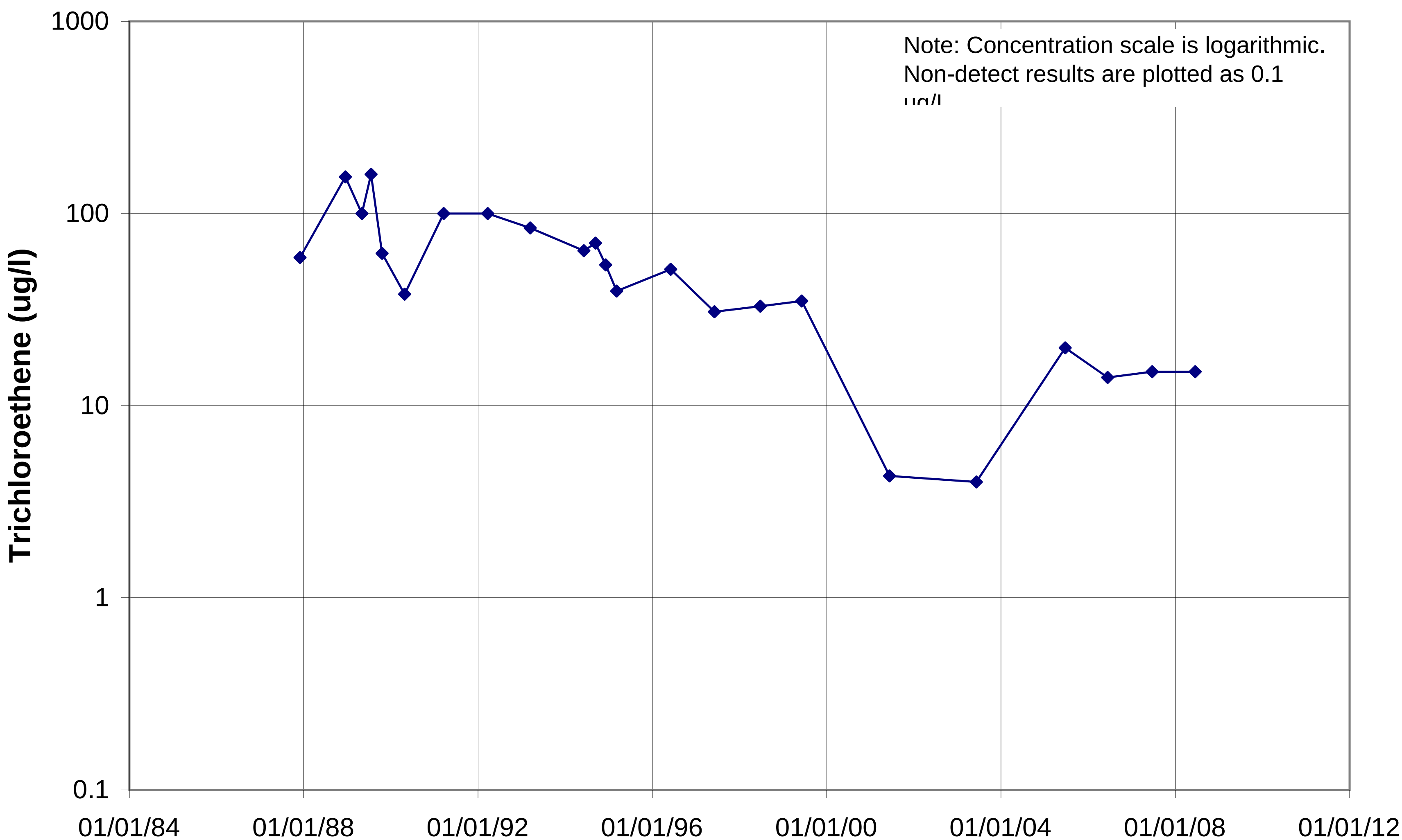

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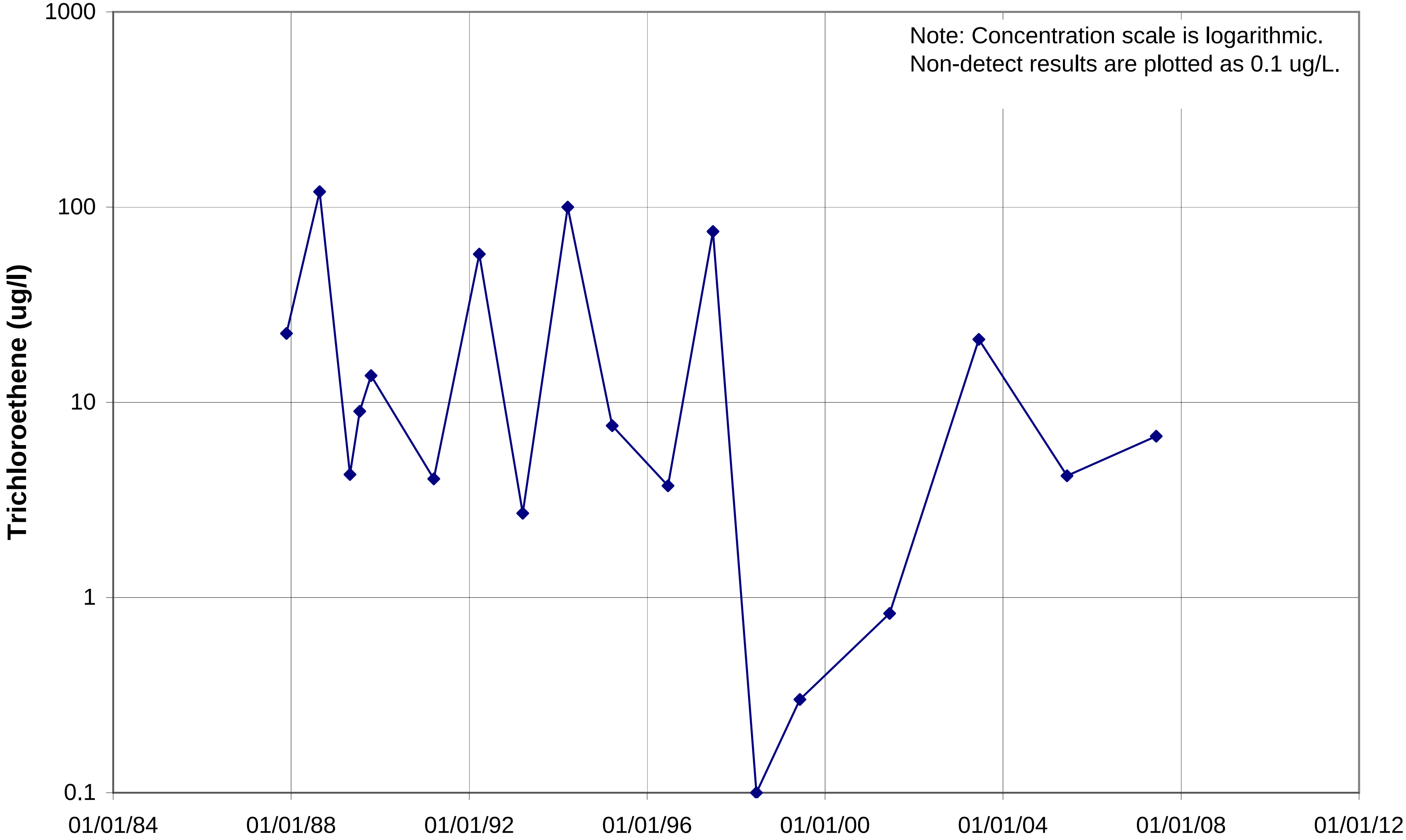

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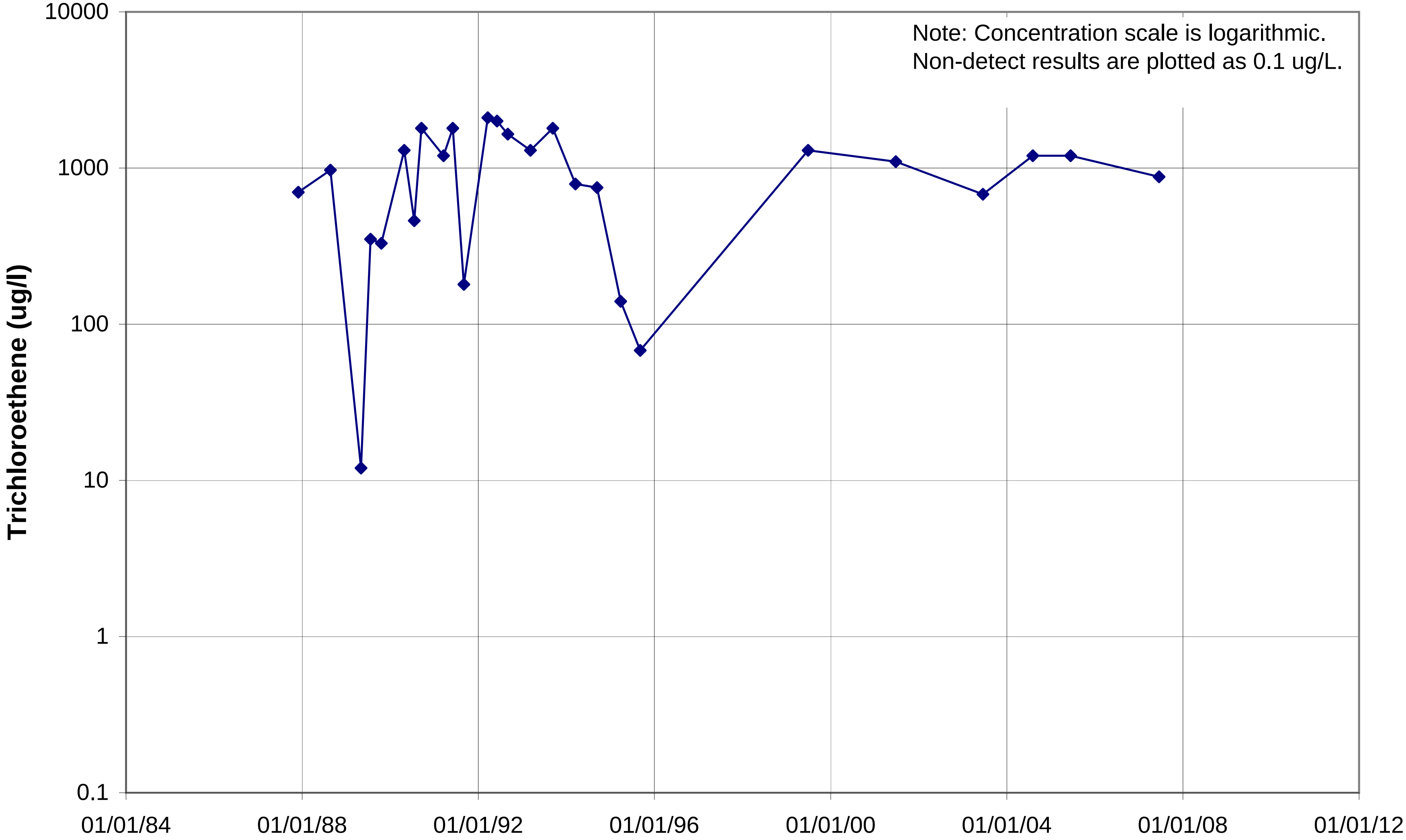

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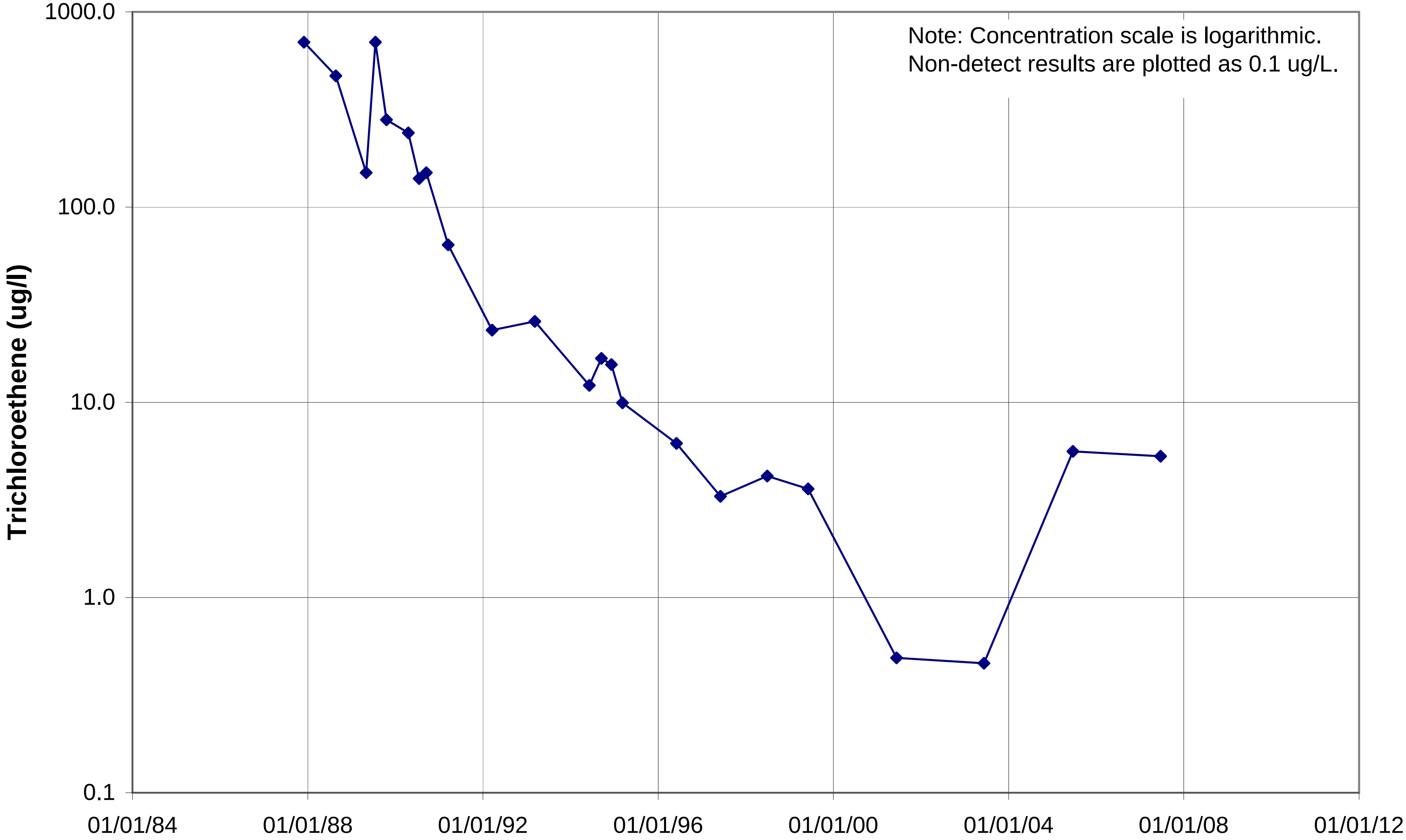

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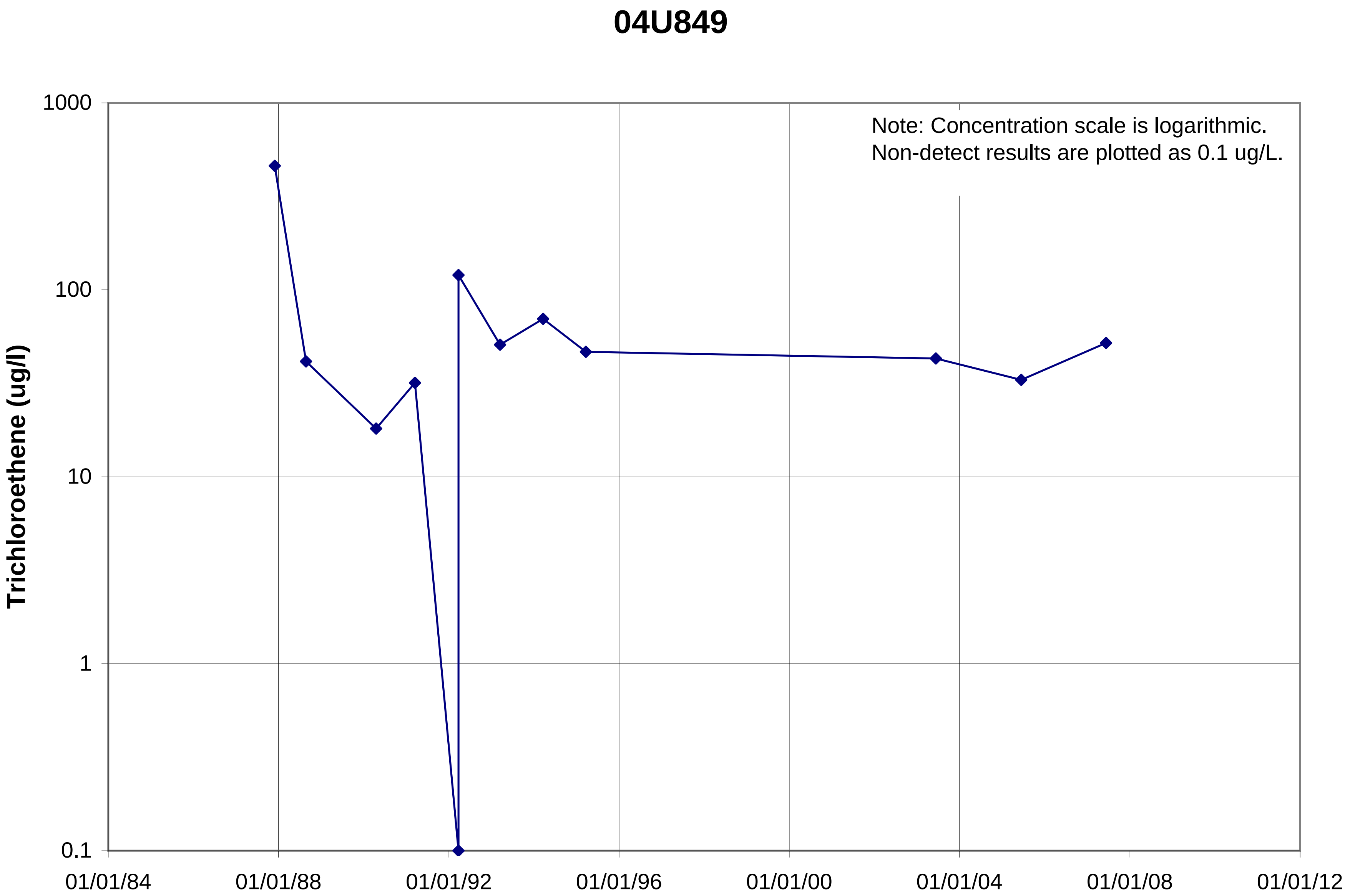

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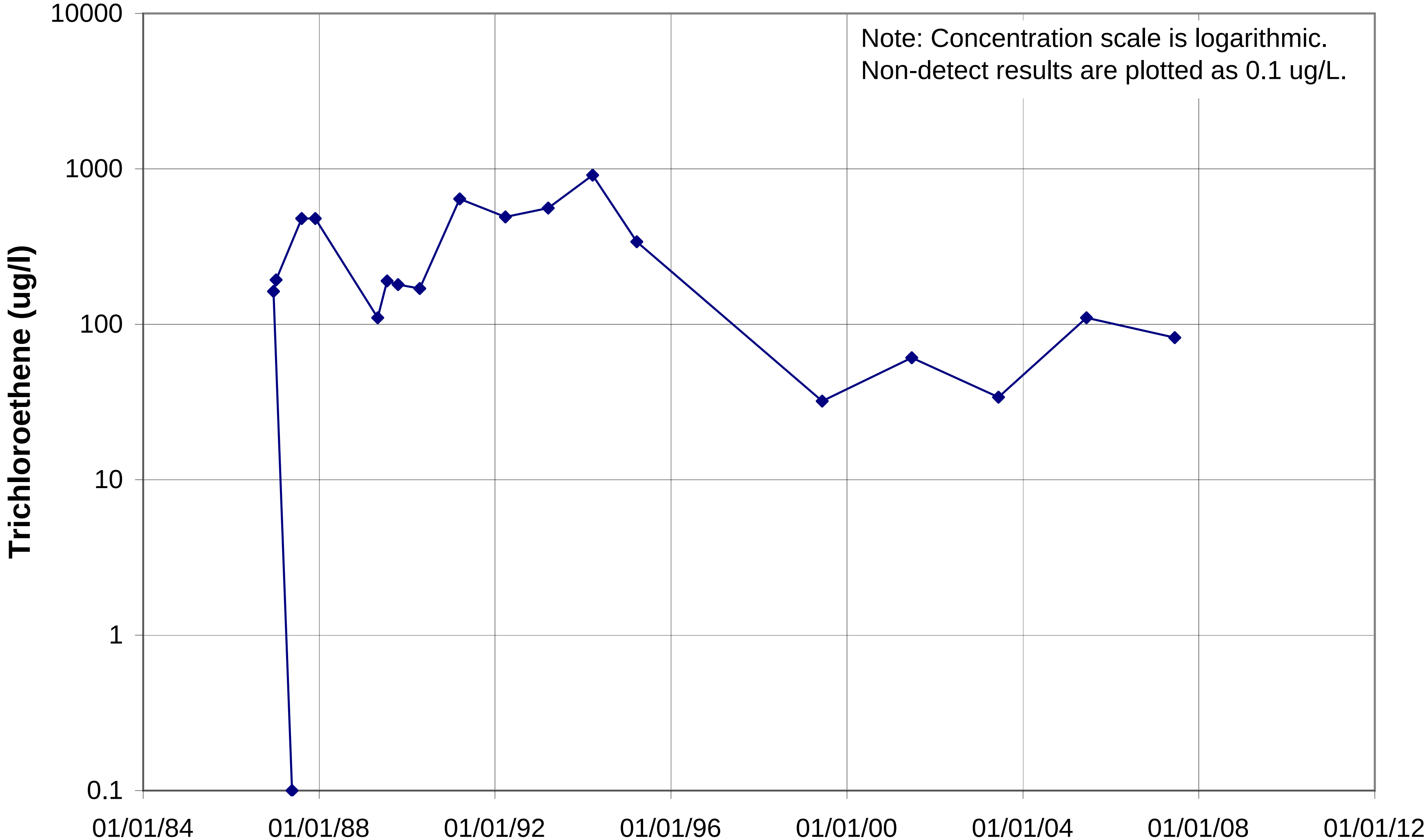

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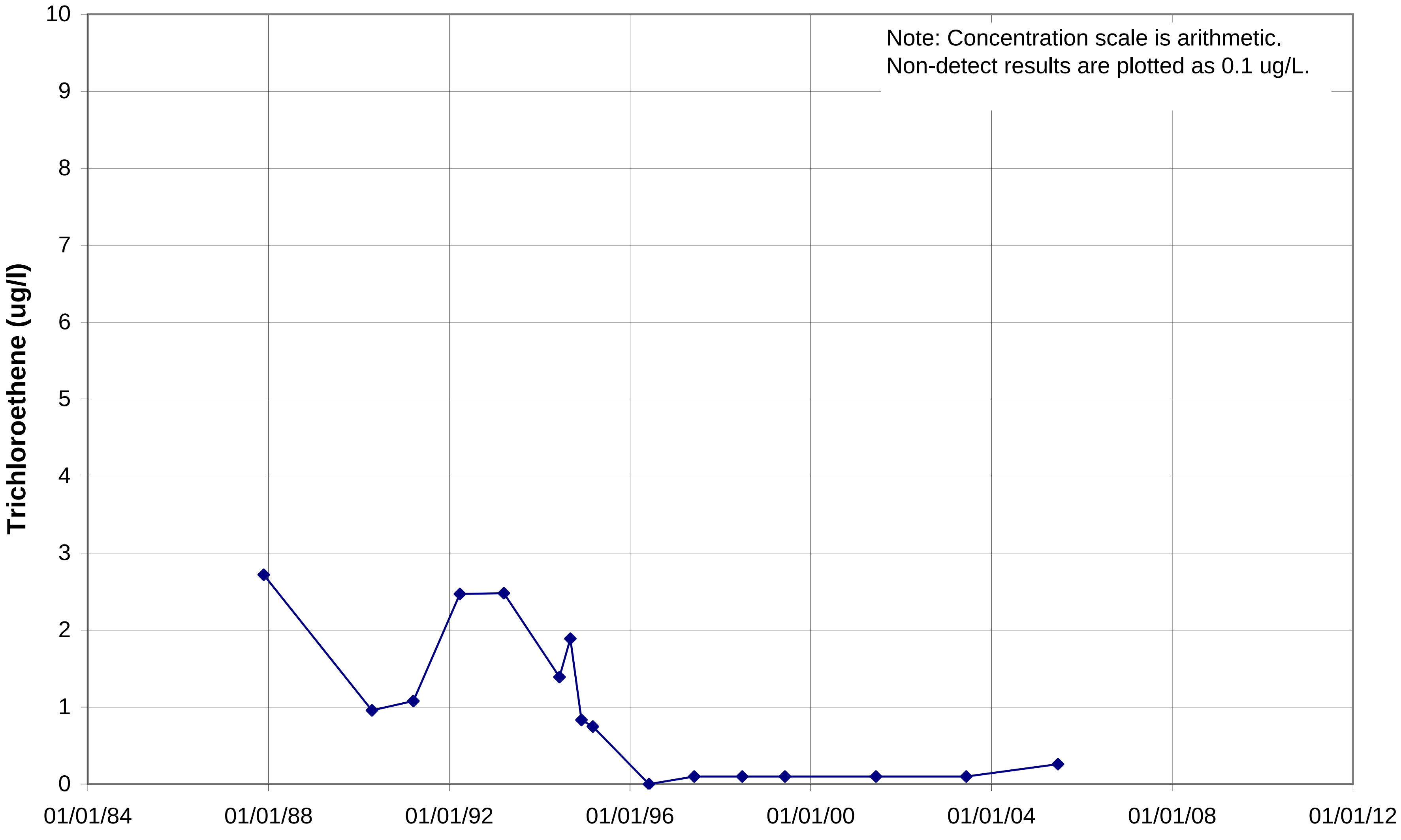

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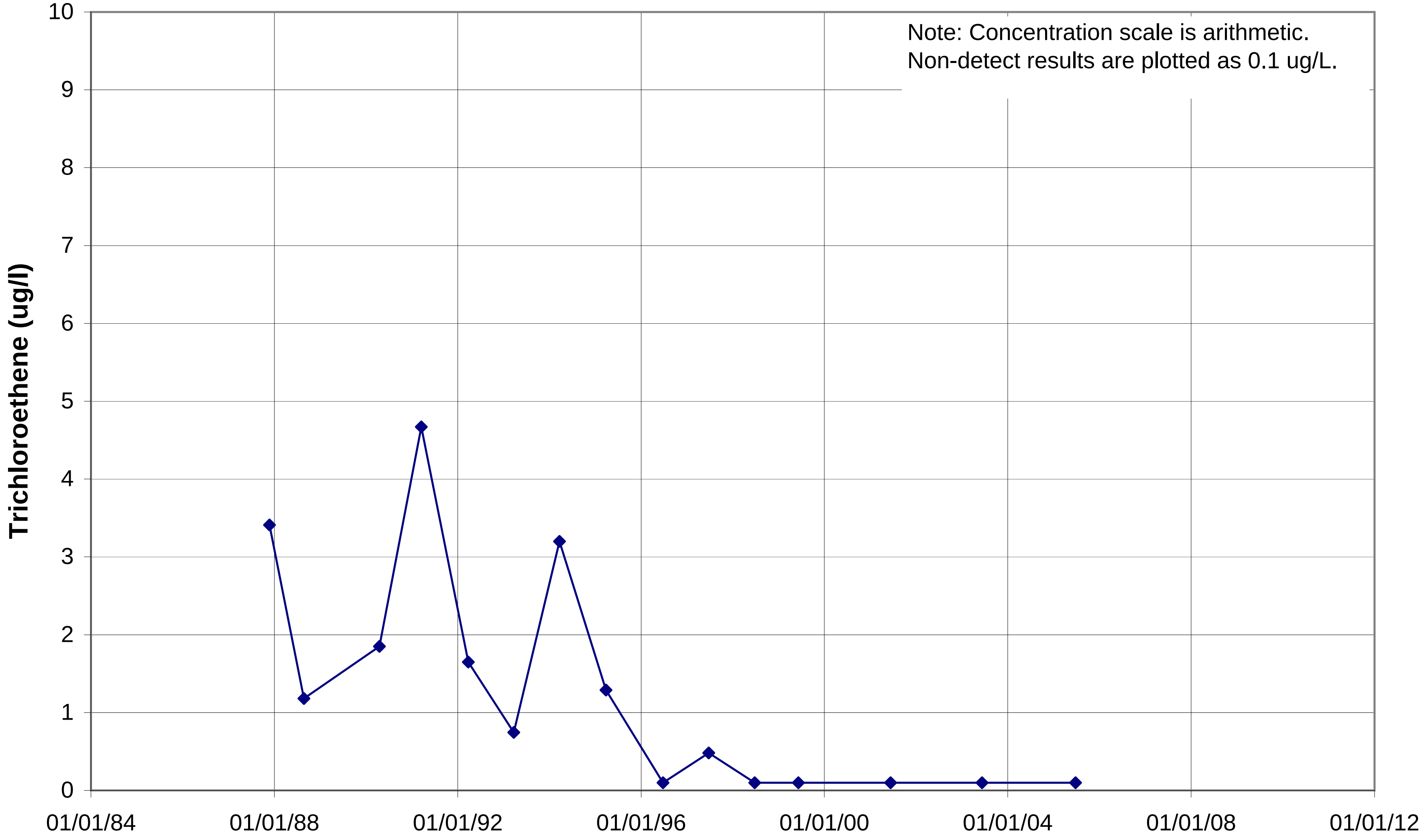

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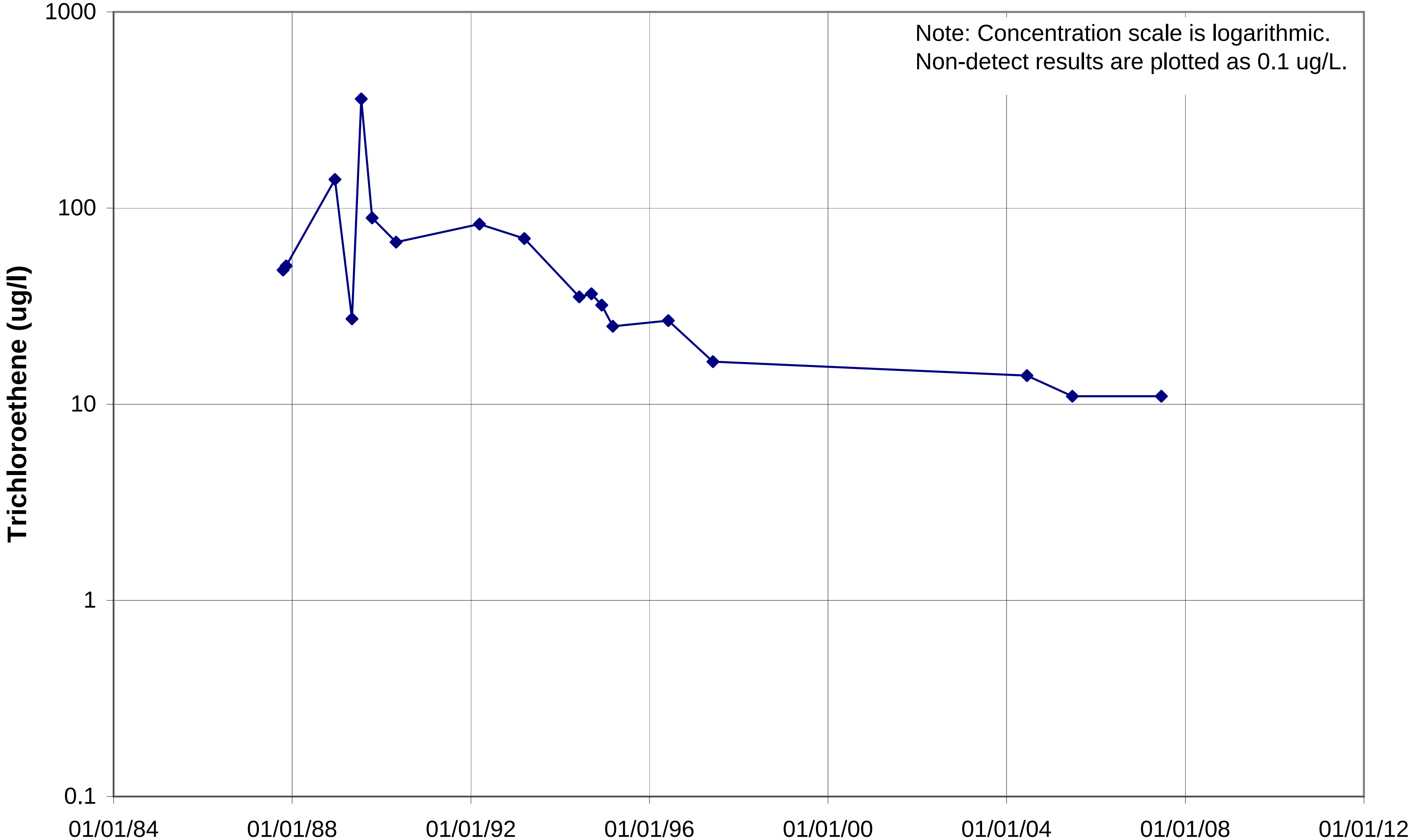

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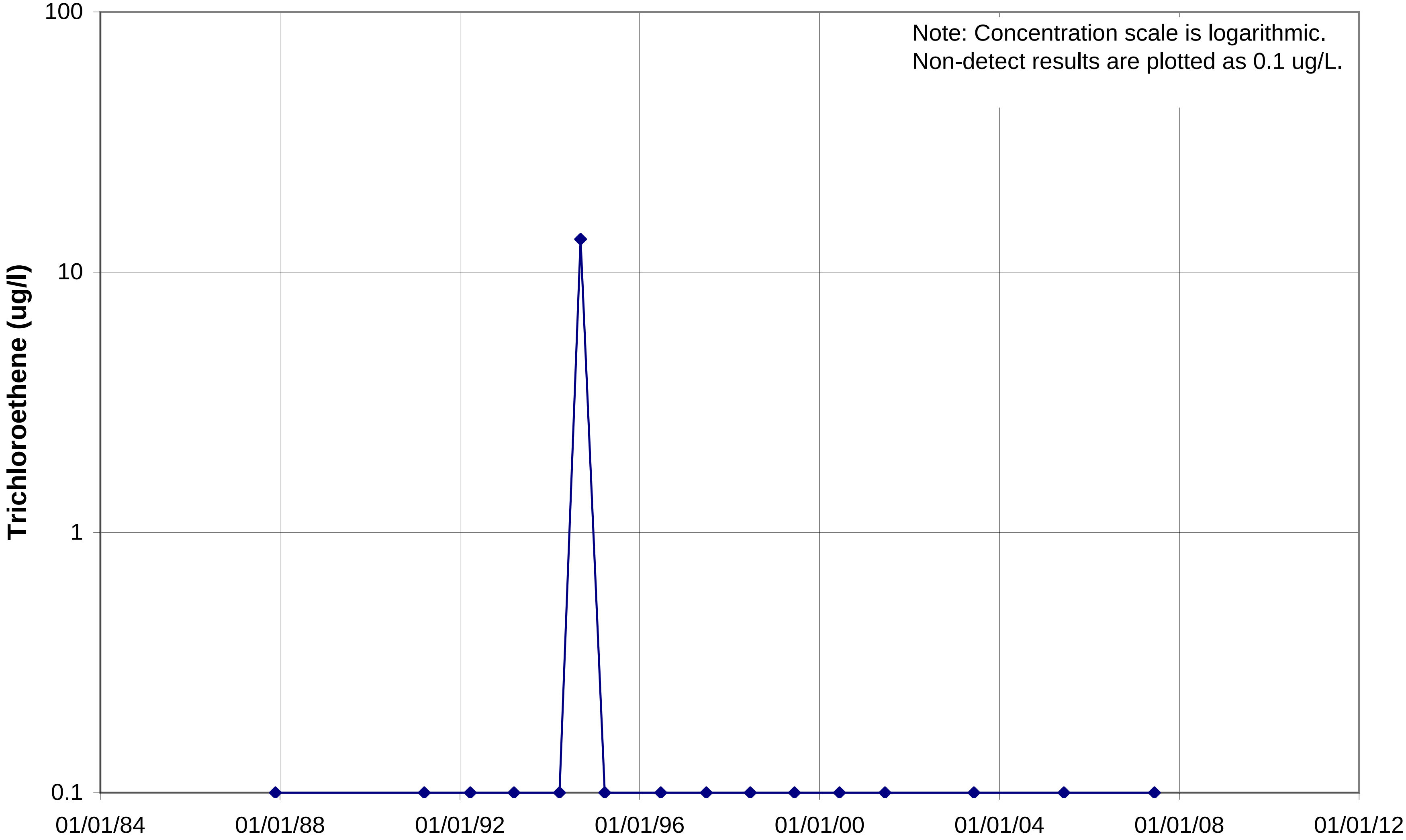

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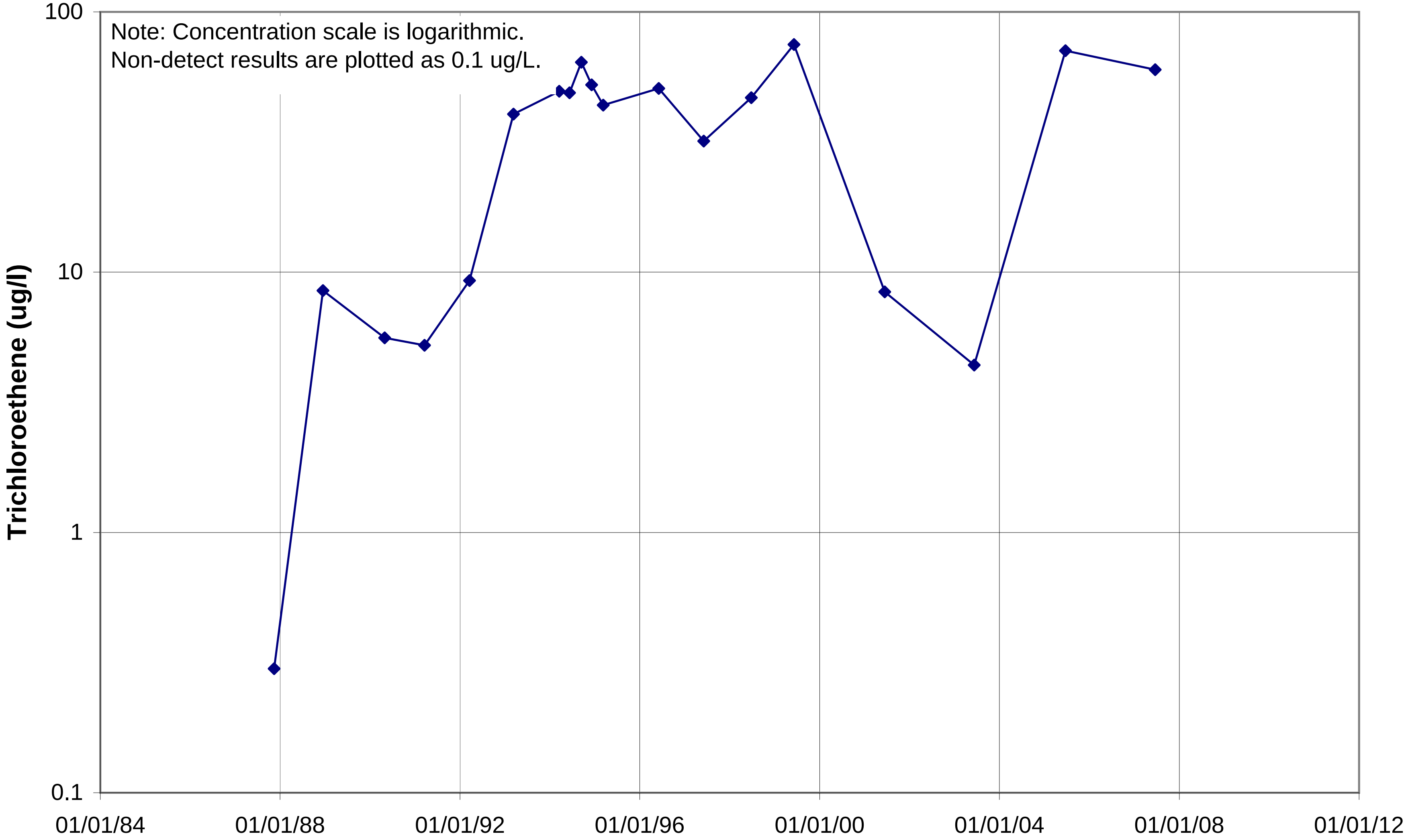

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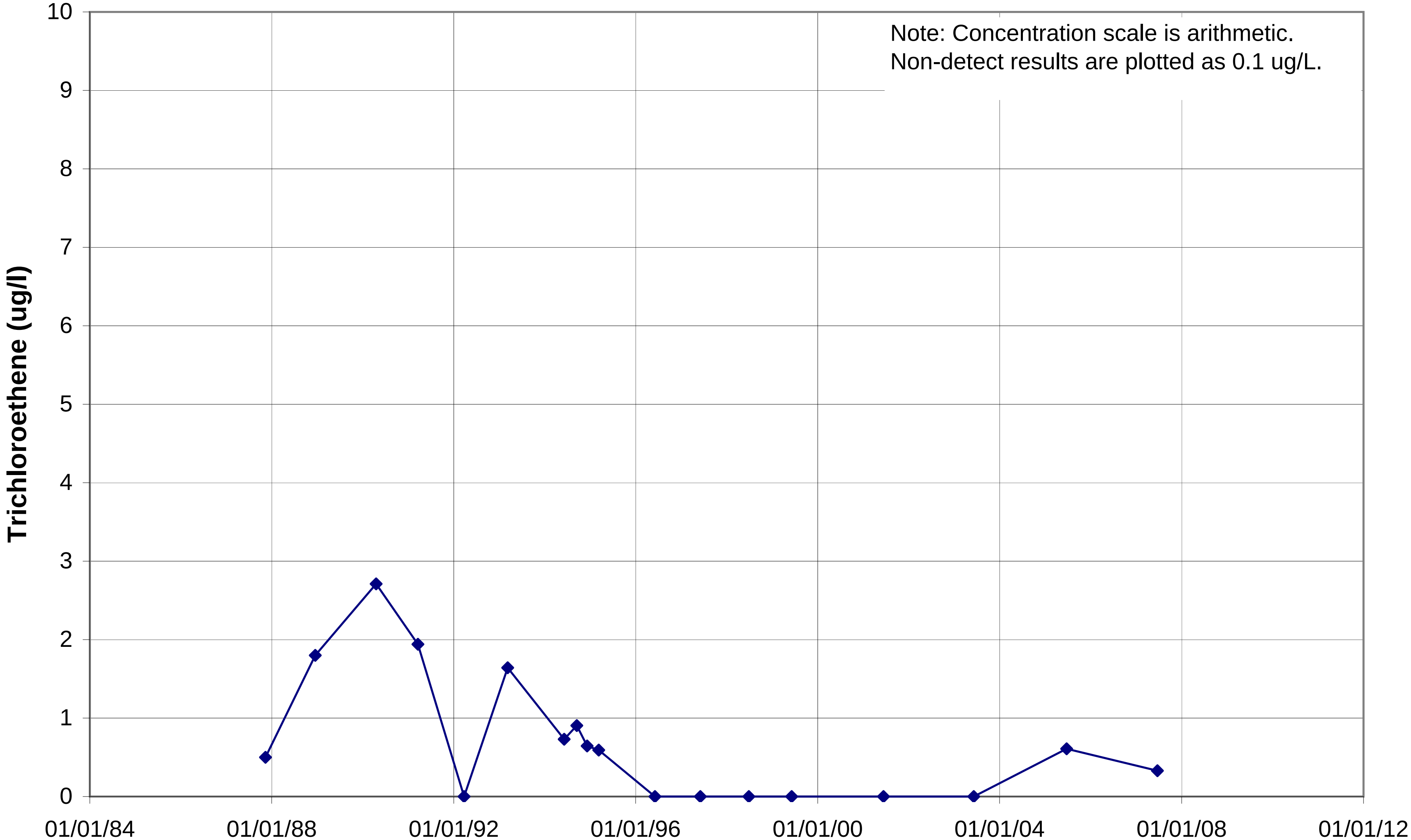

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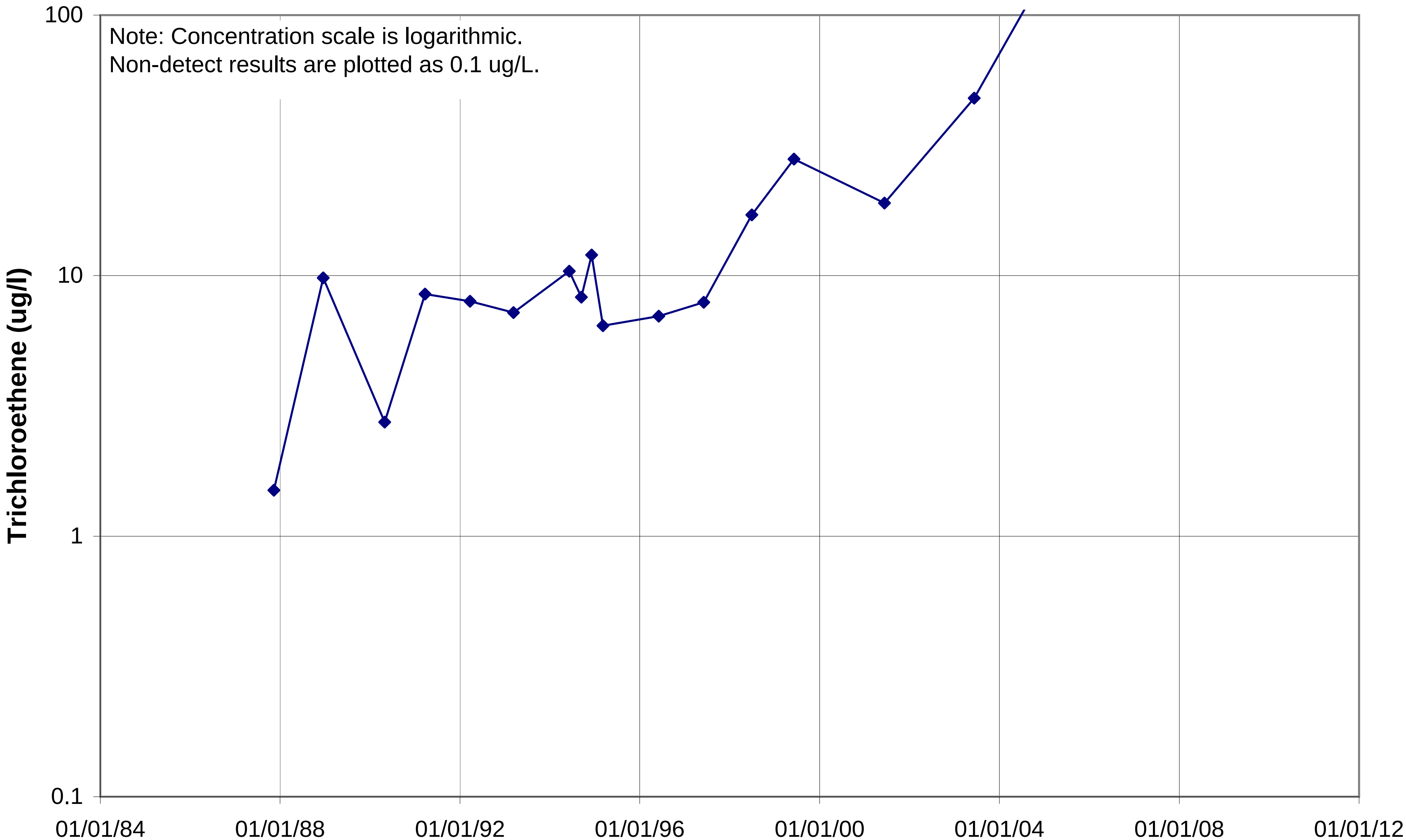

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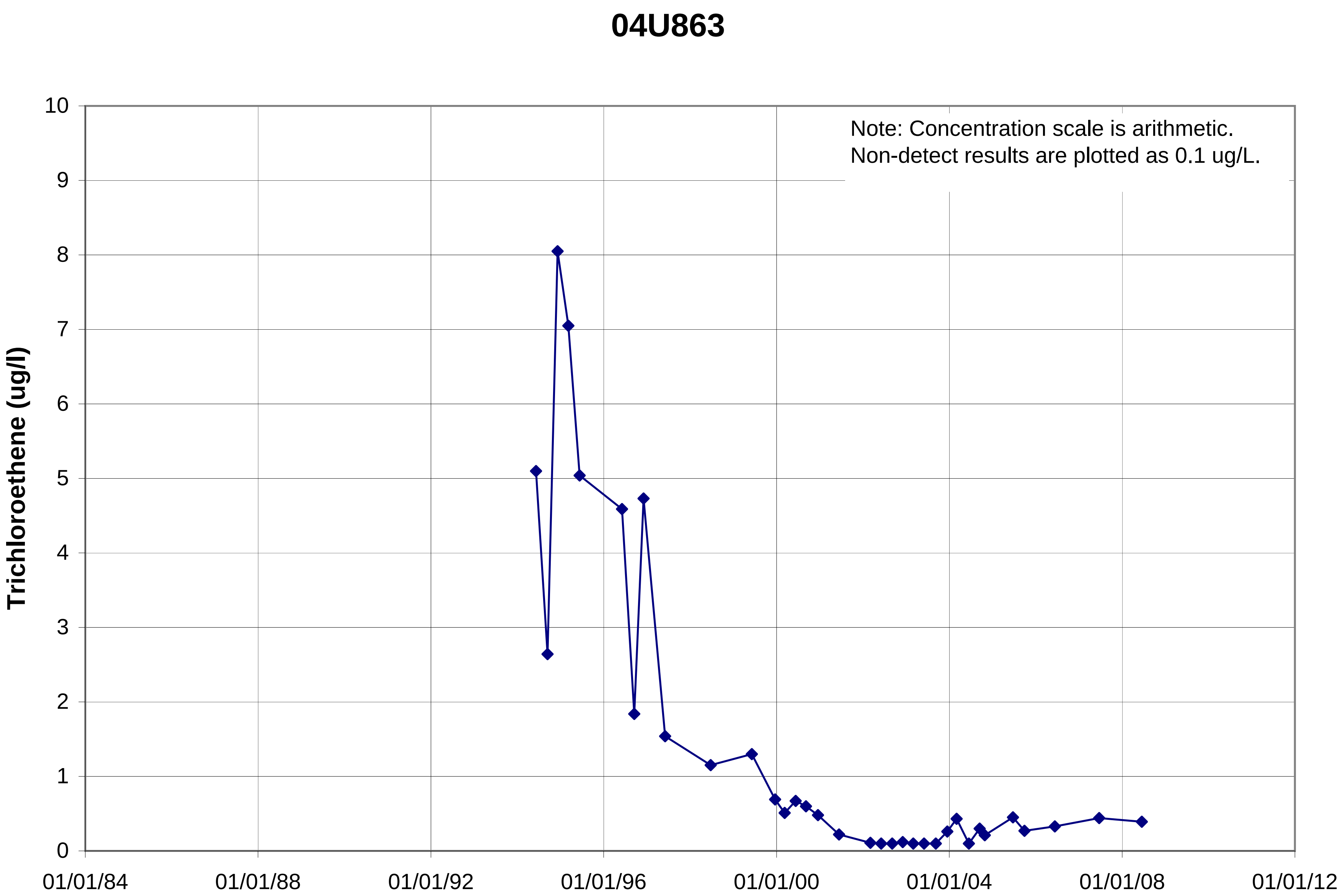

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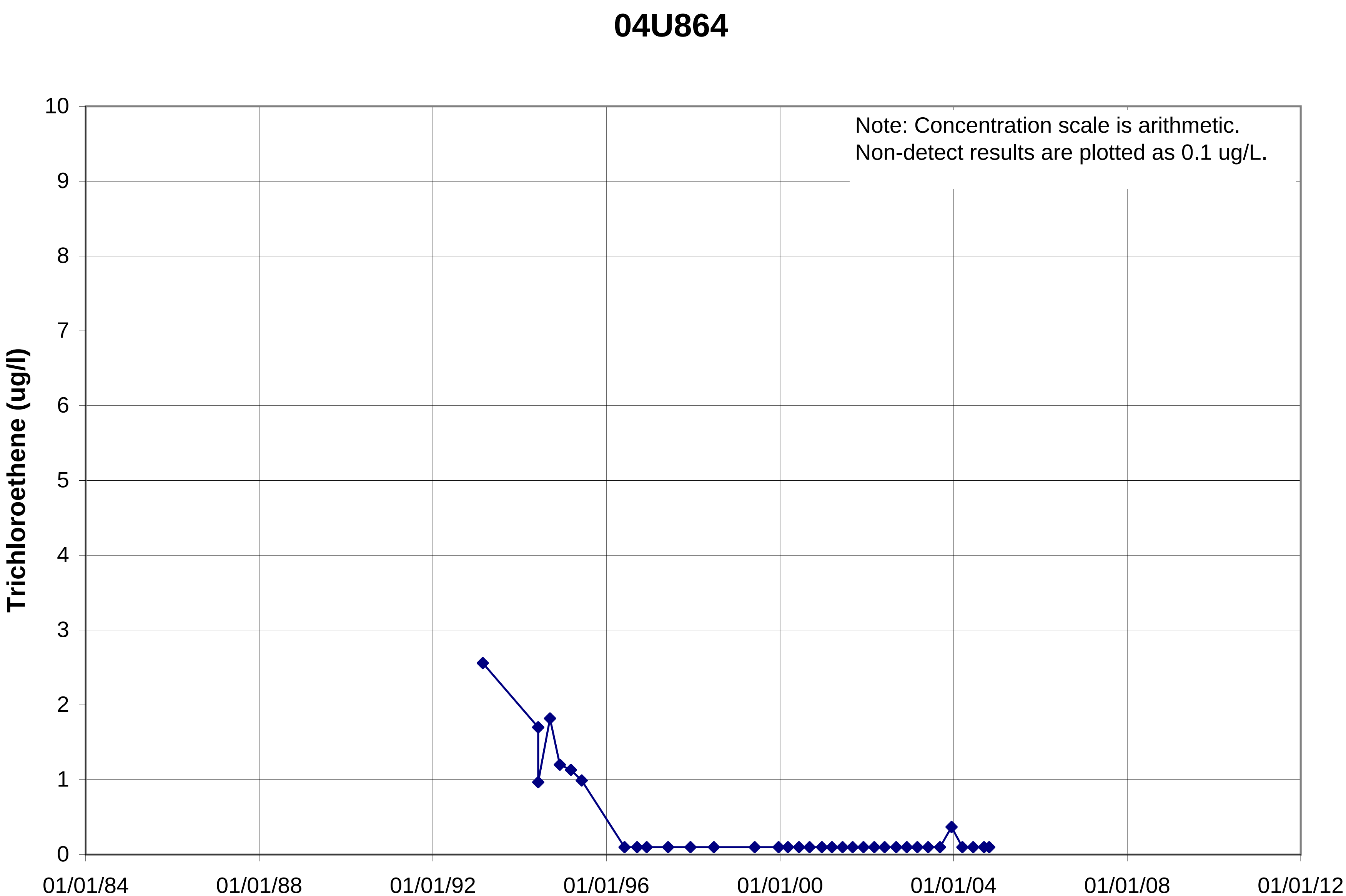

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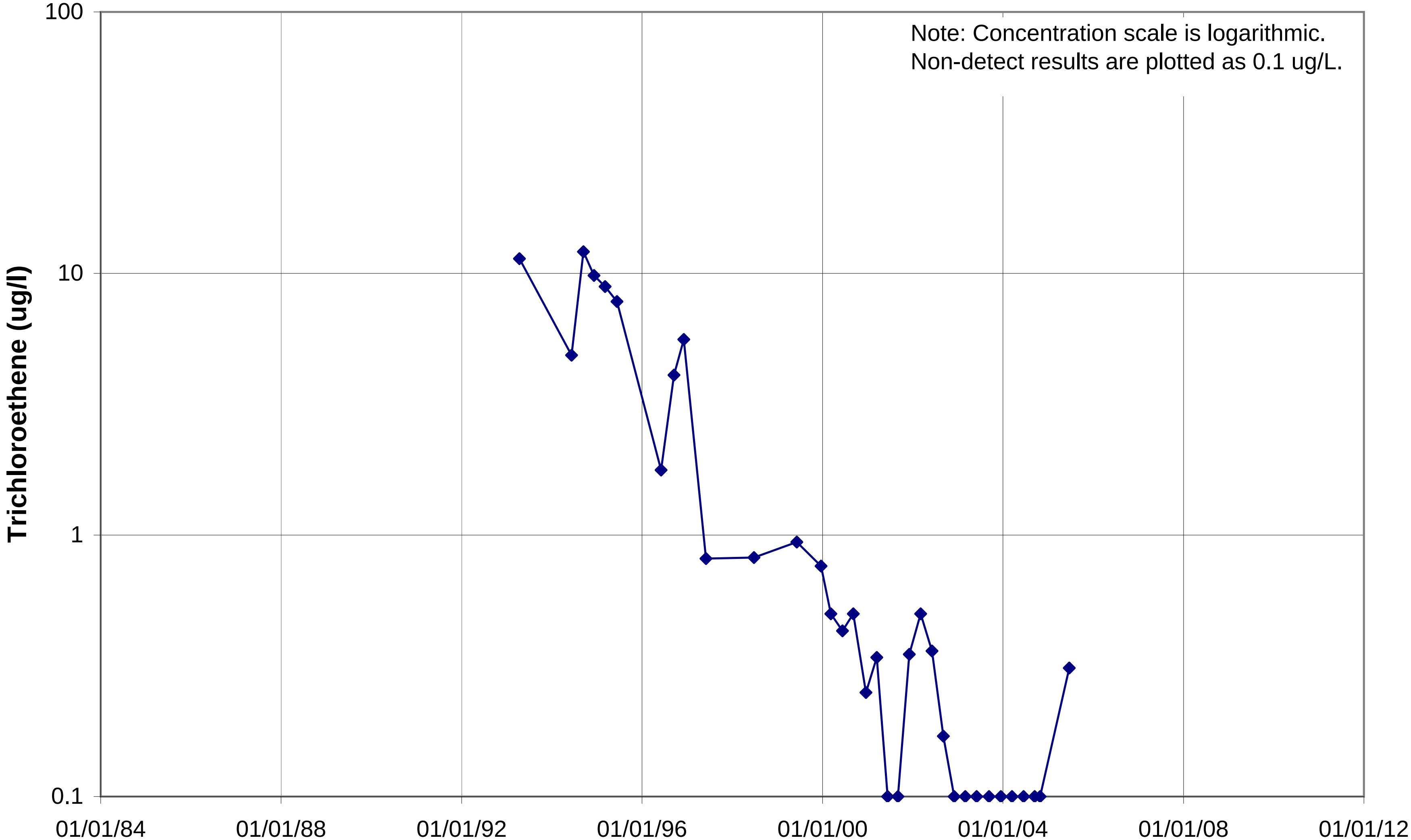

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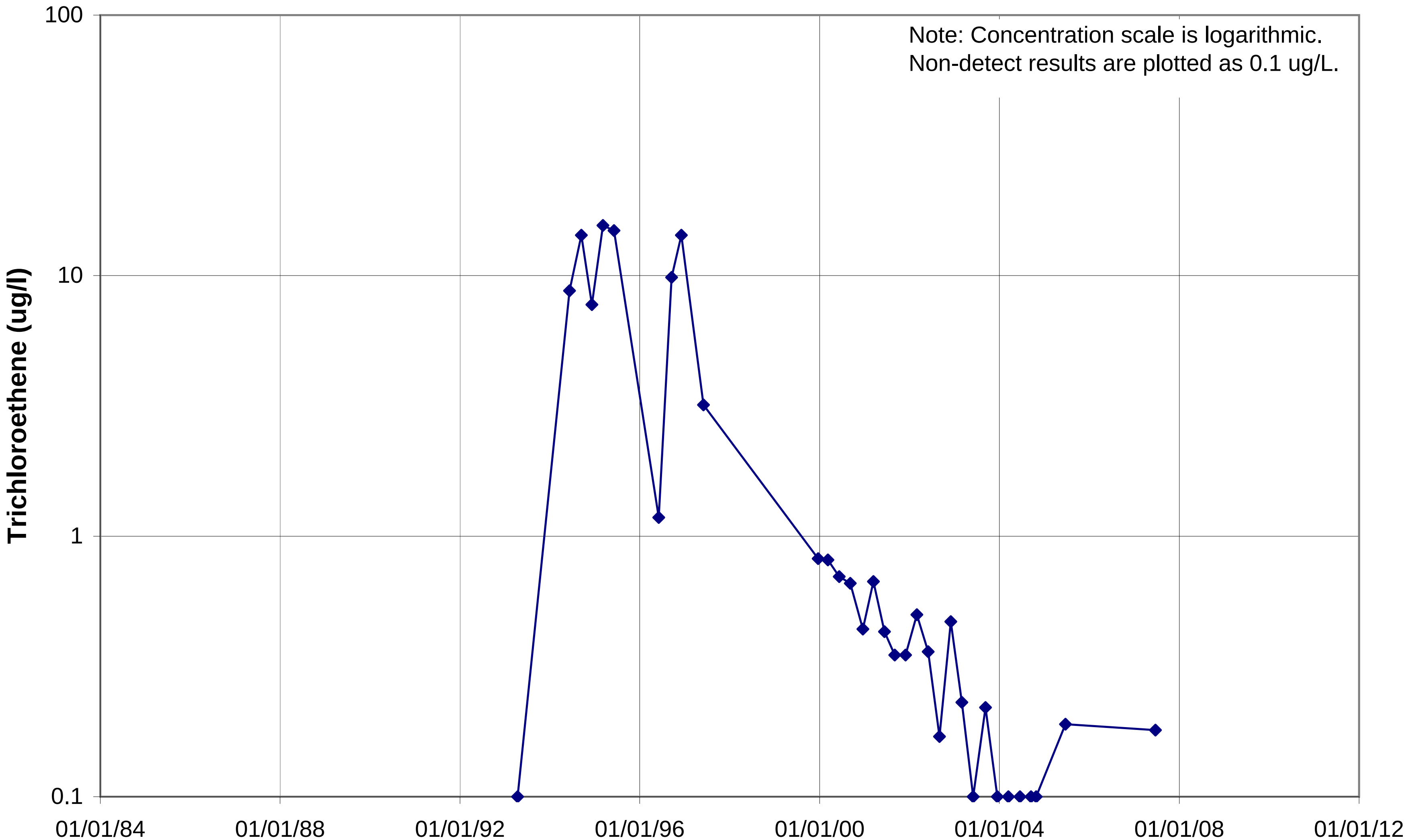

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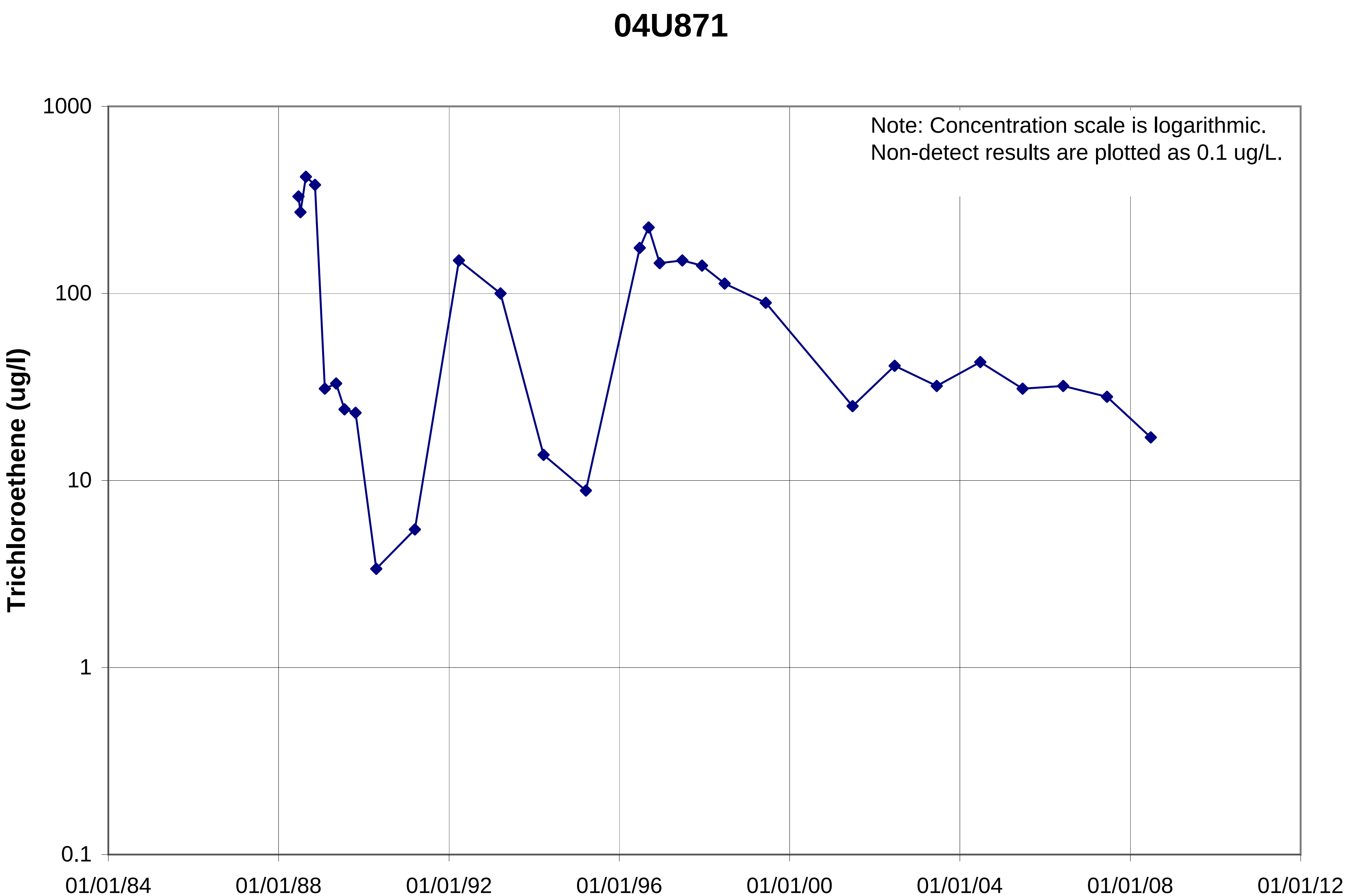

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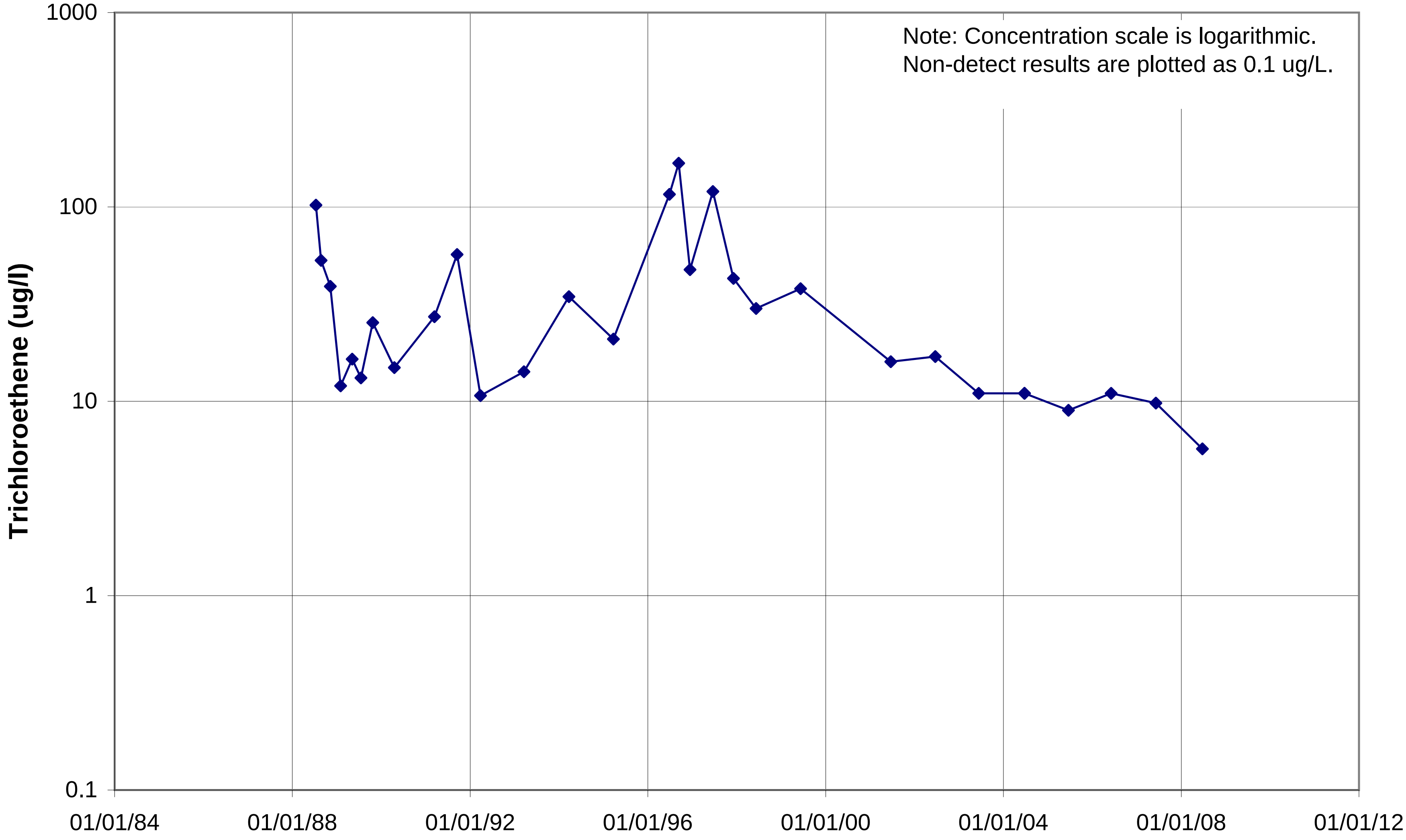

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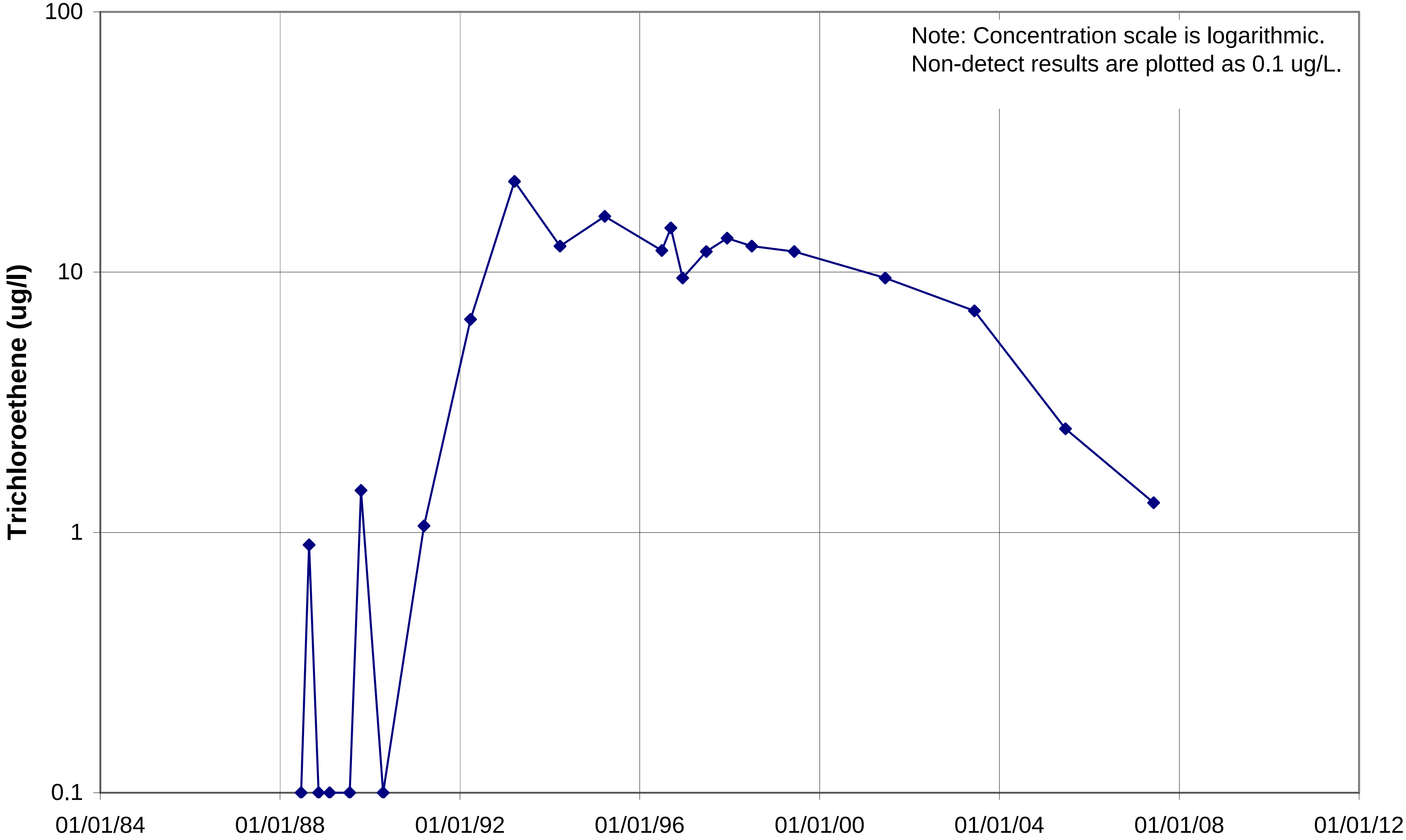

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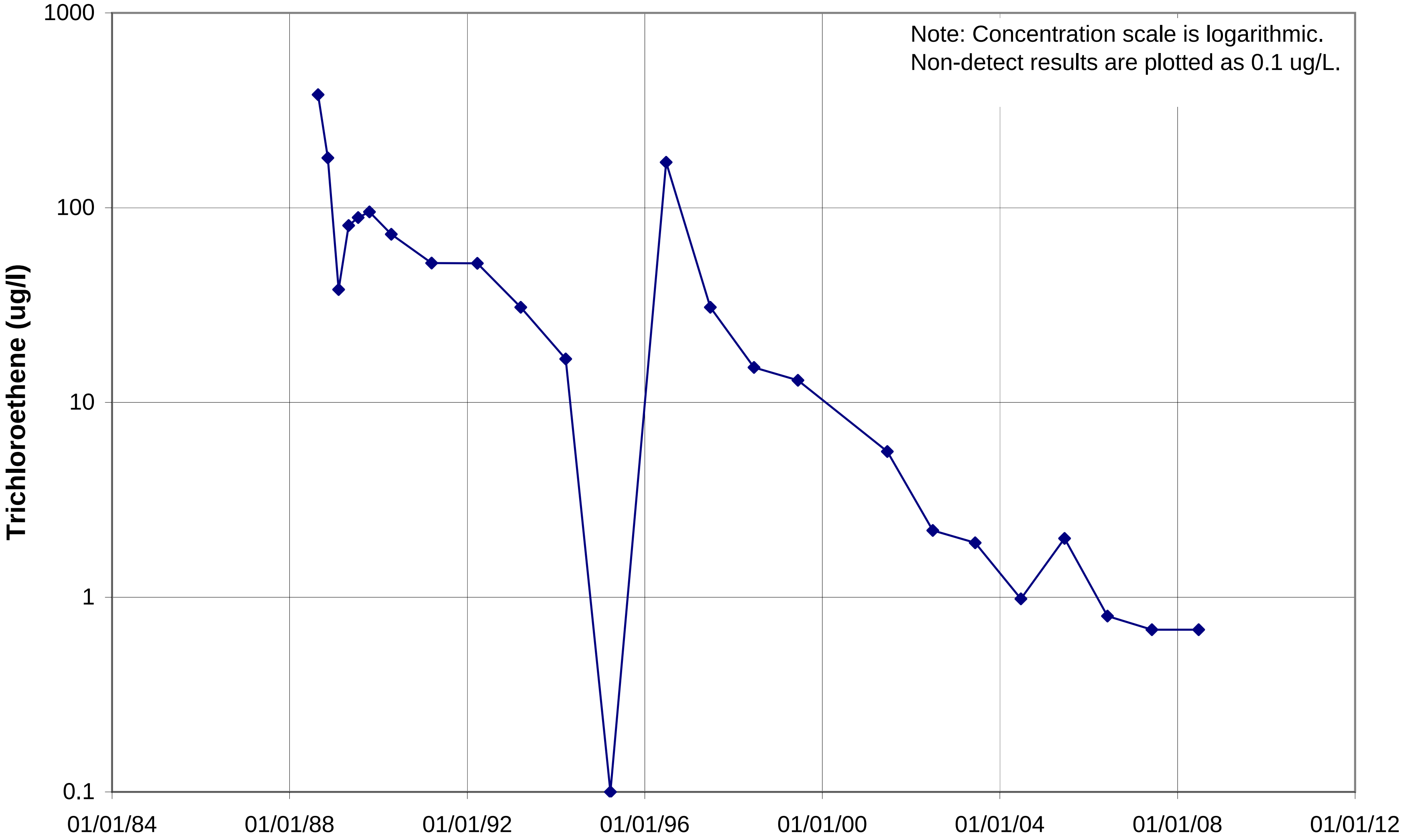

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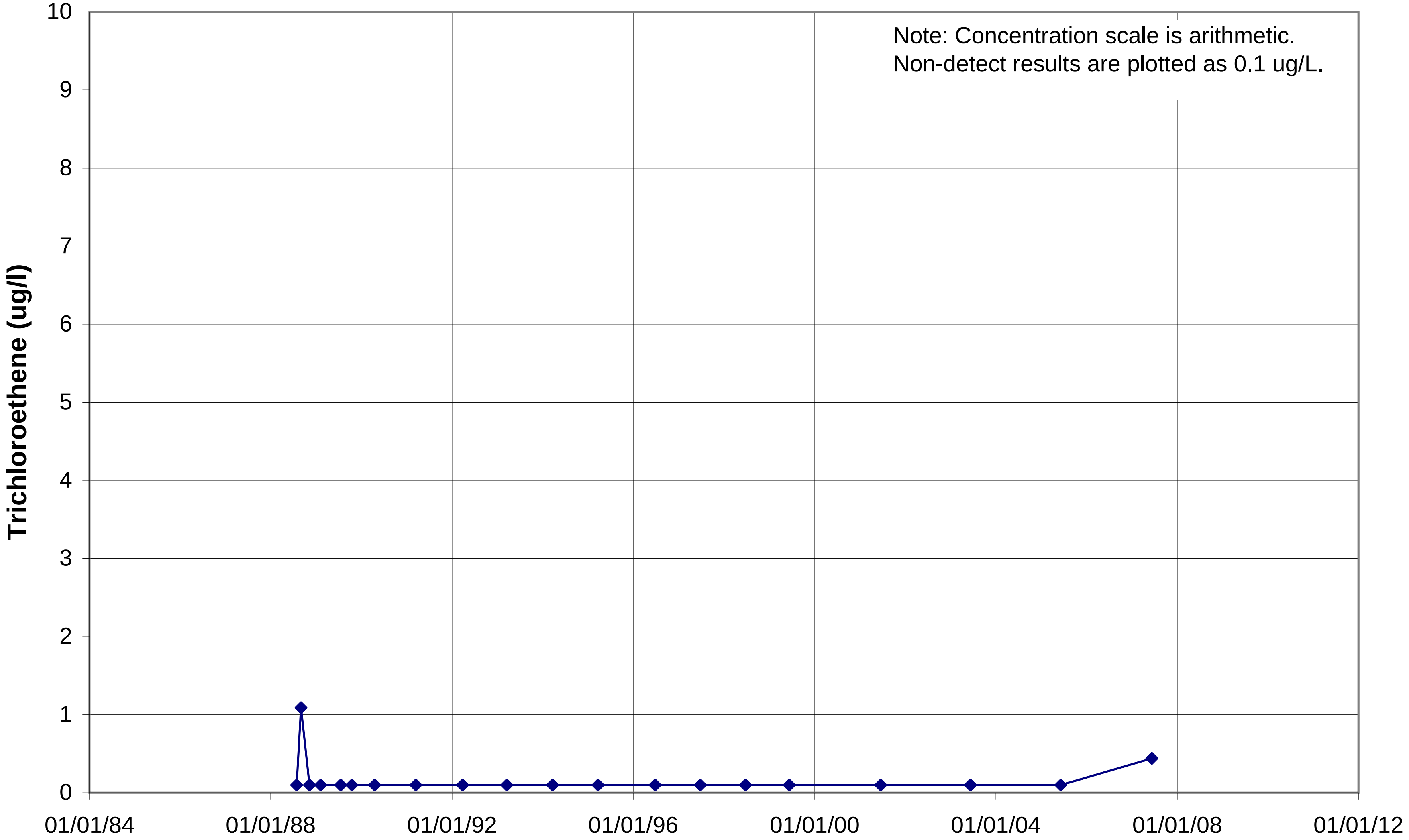

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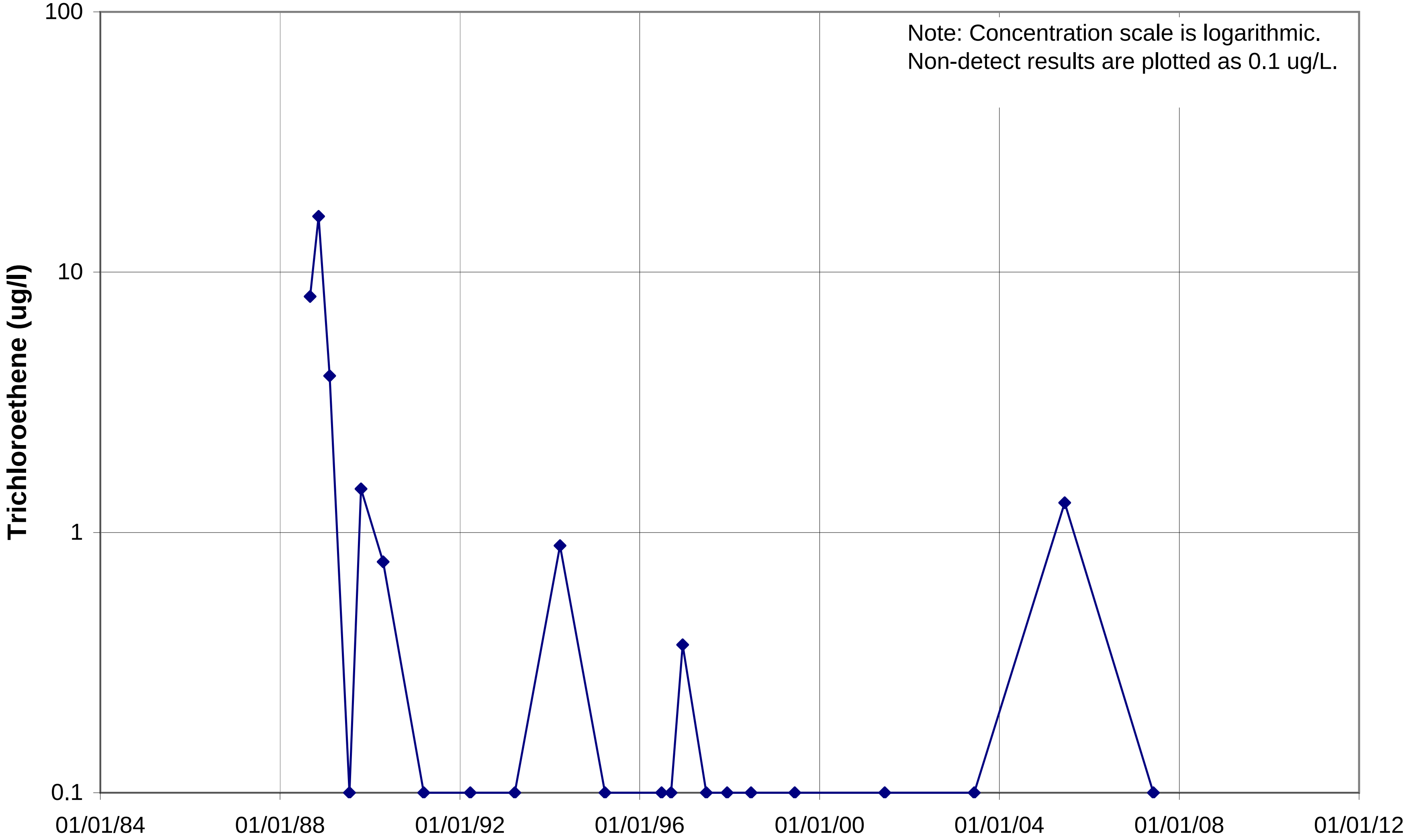

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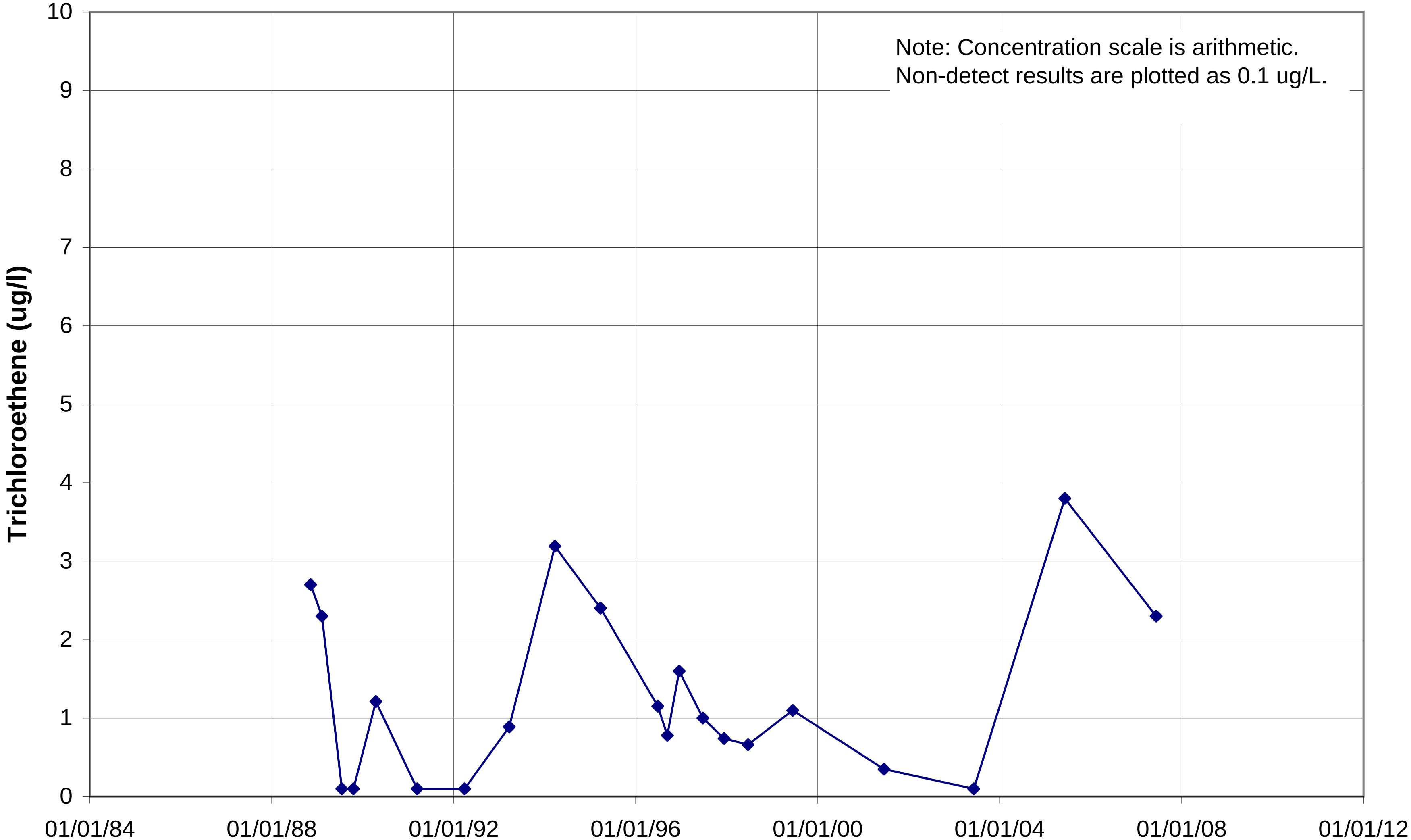

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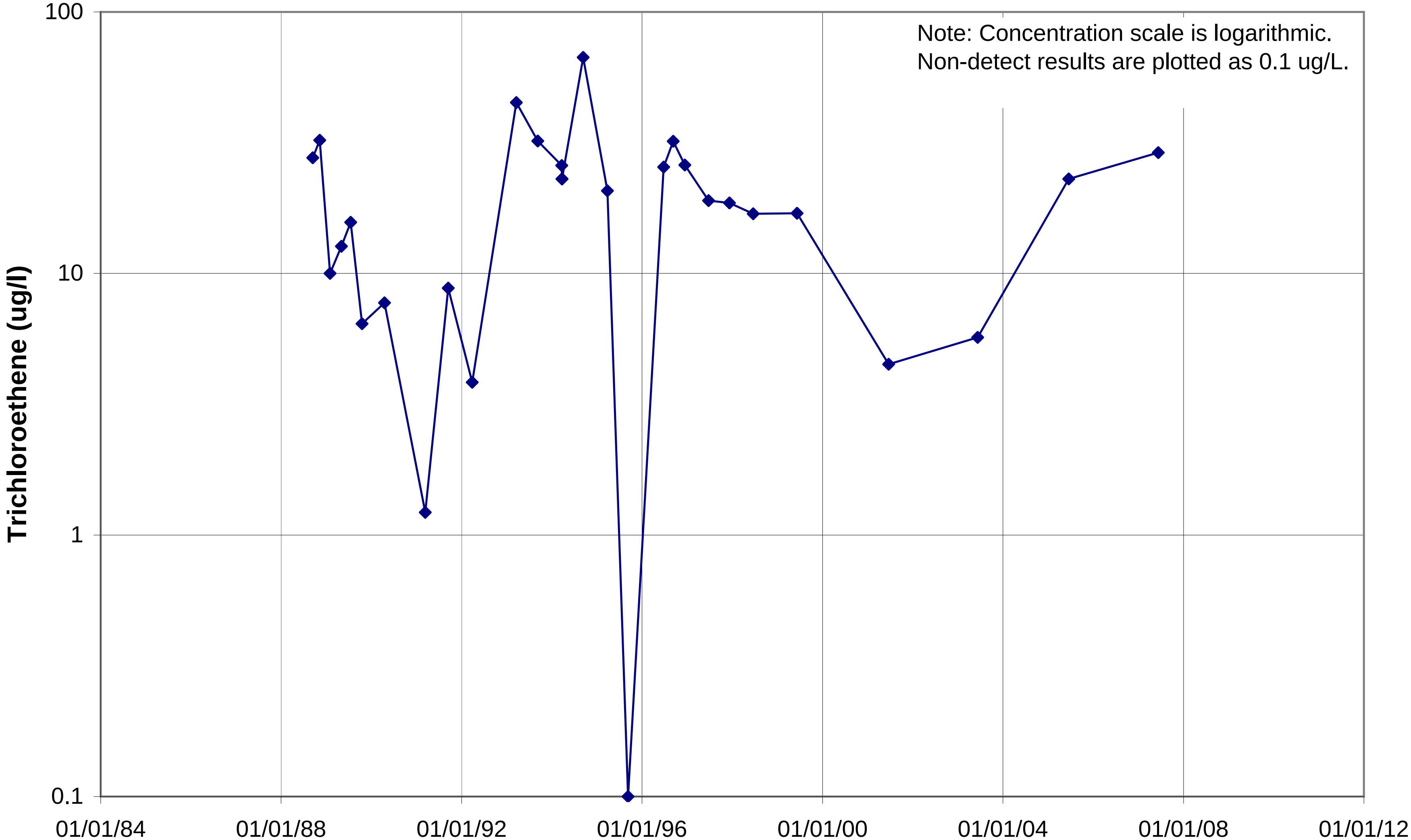

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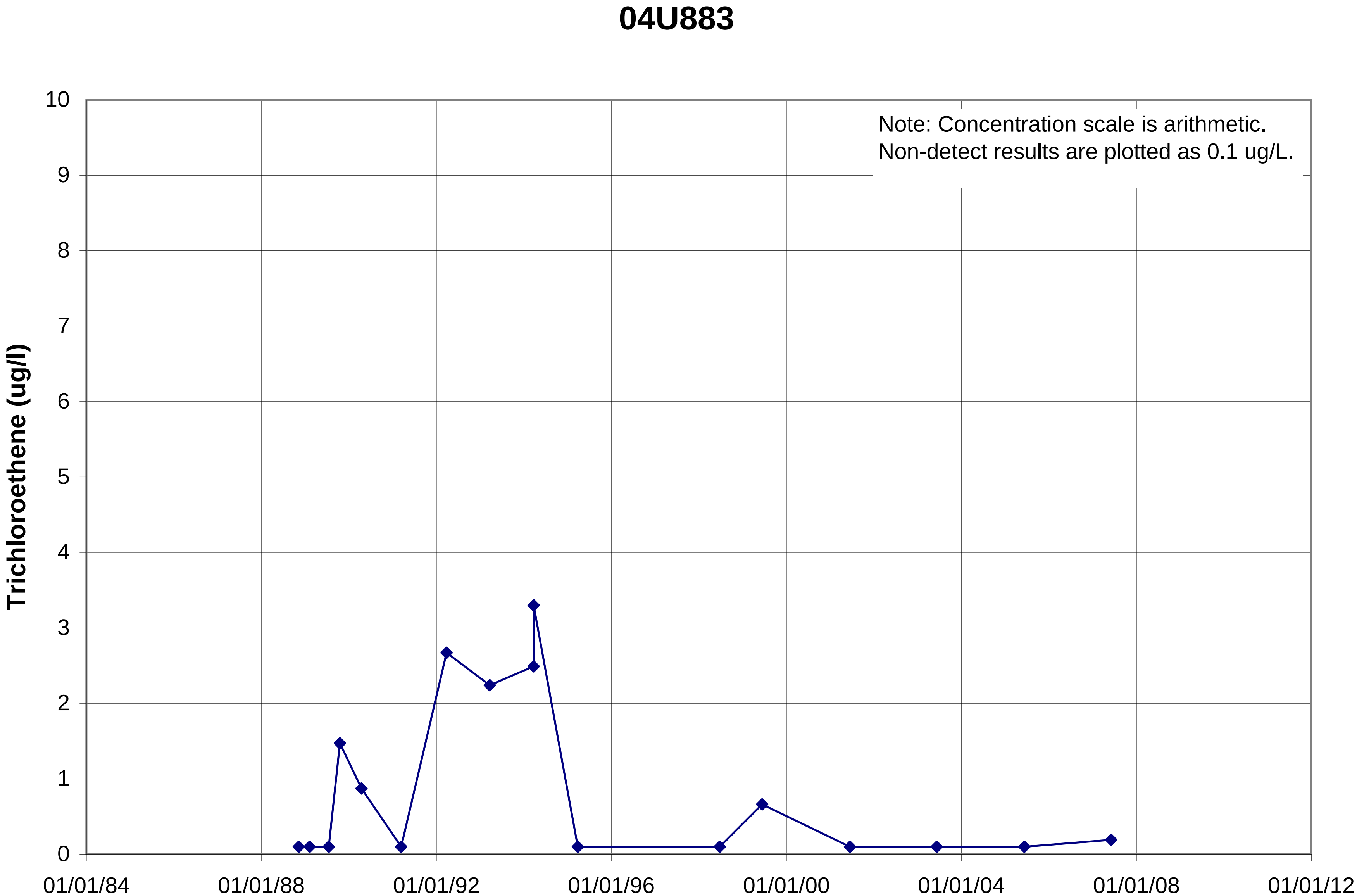

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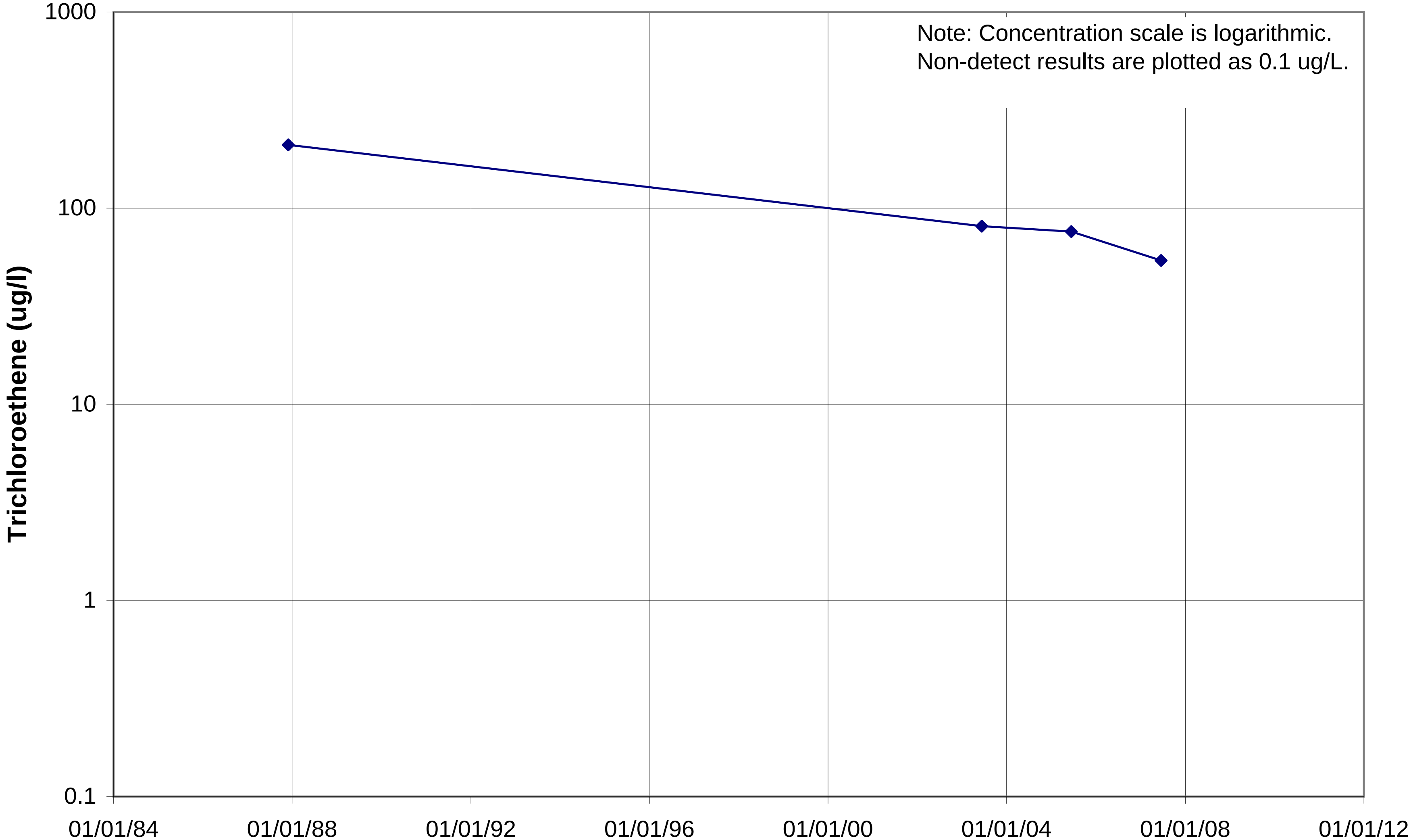

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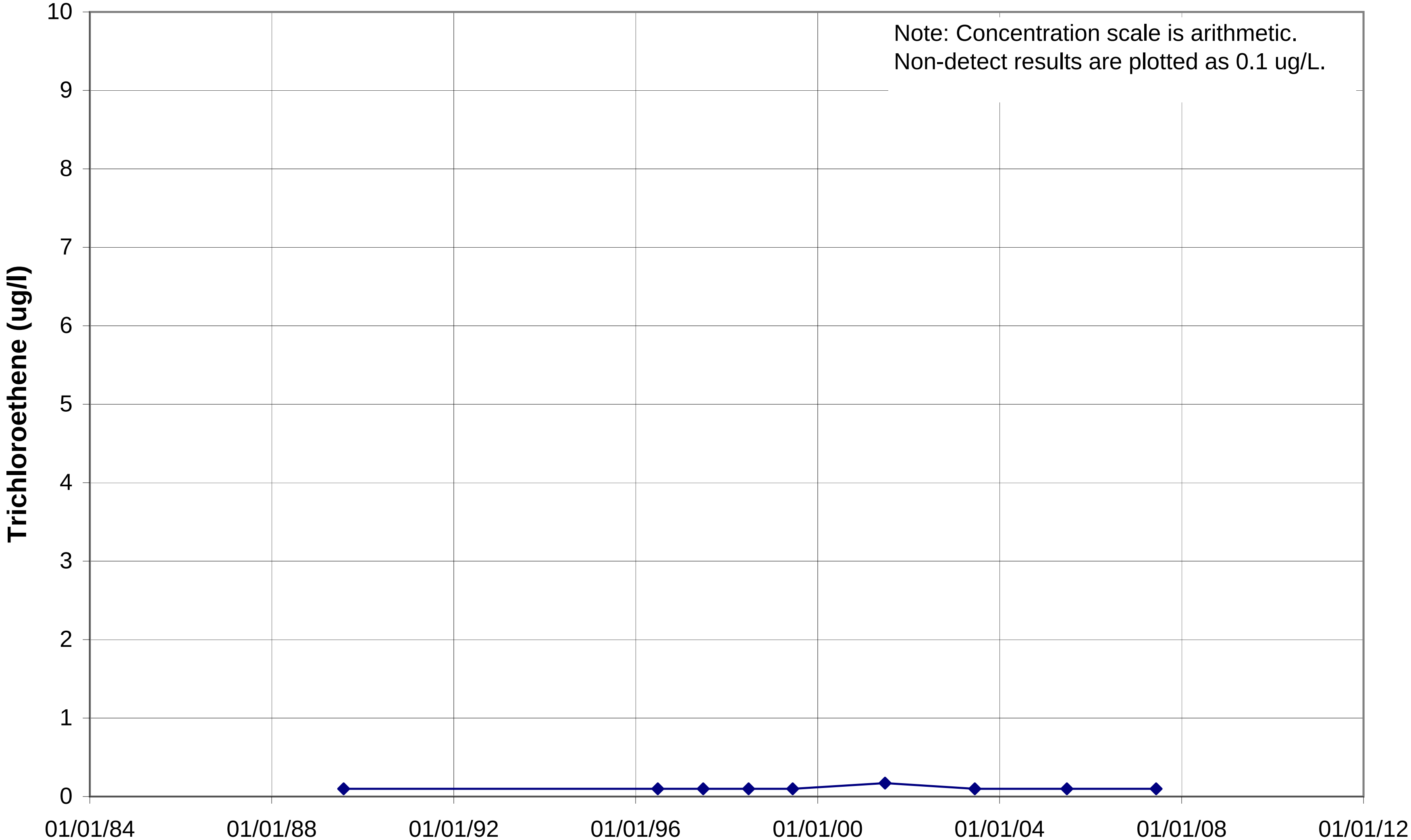

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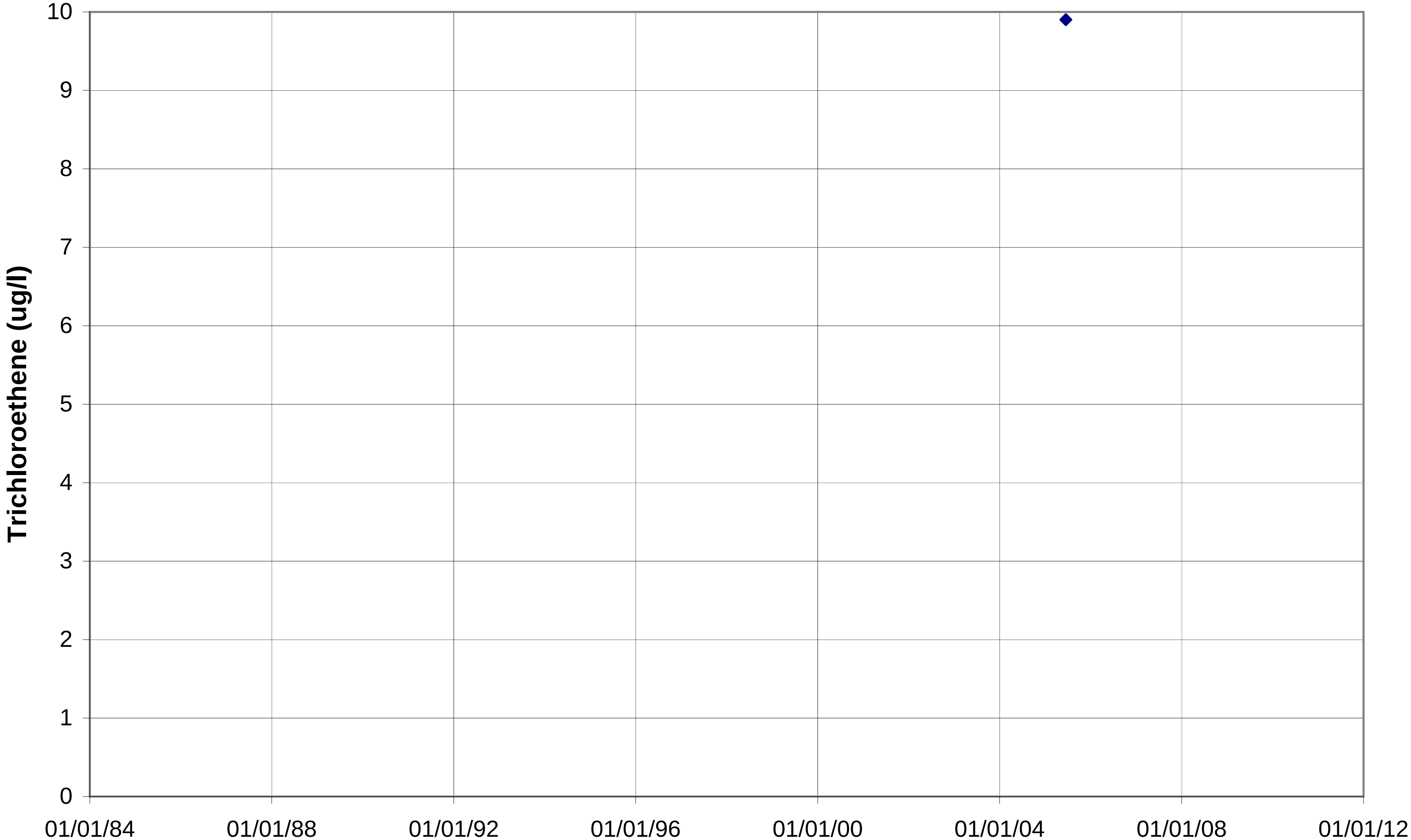
200524

Note: Concentration scale is arithmetic.
Non-detect results are plotted as 0.1 ug/L.



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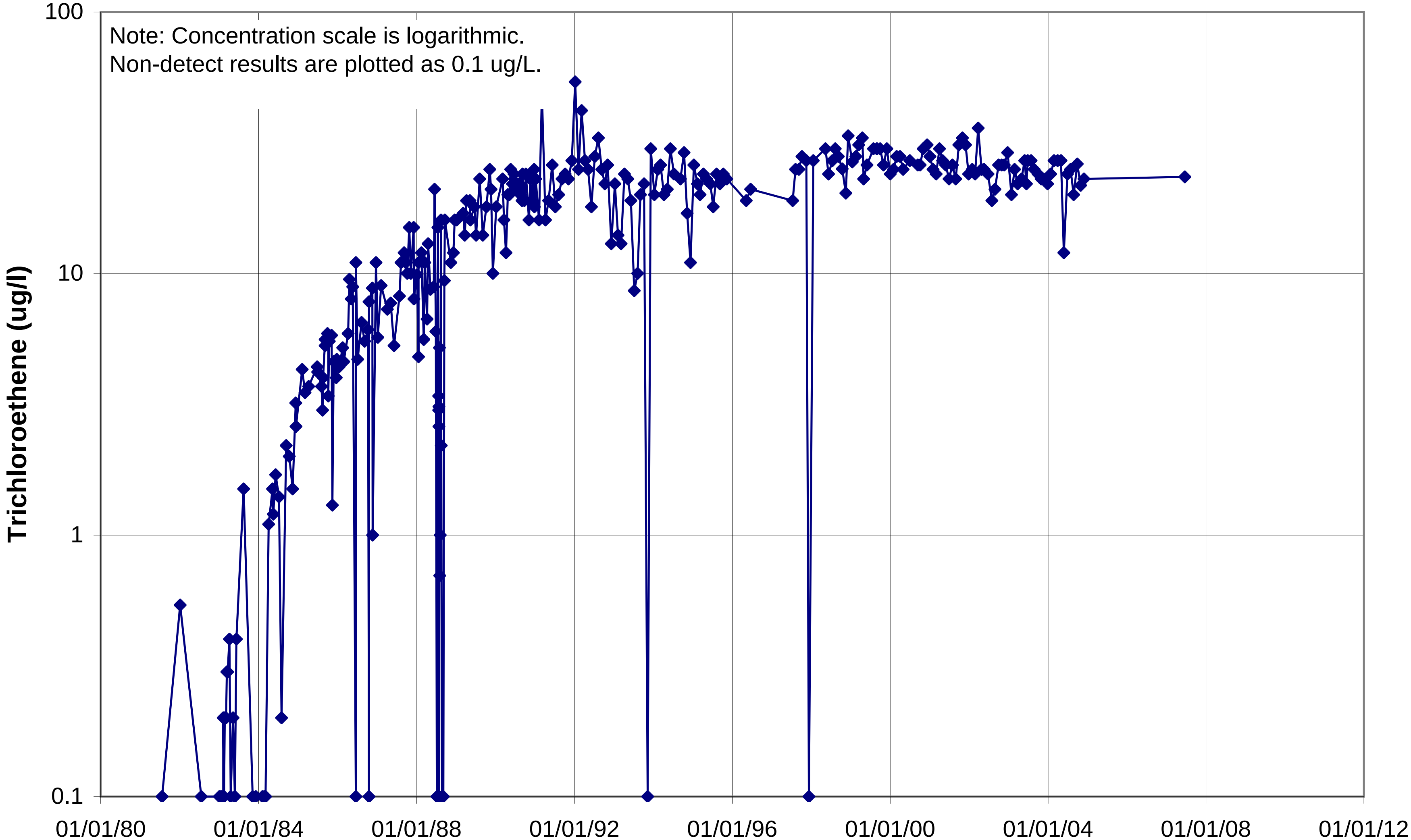
200803 (SAM#4)



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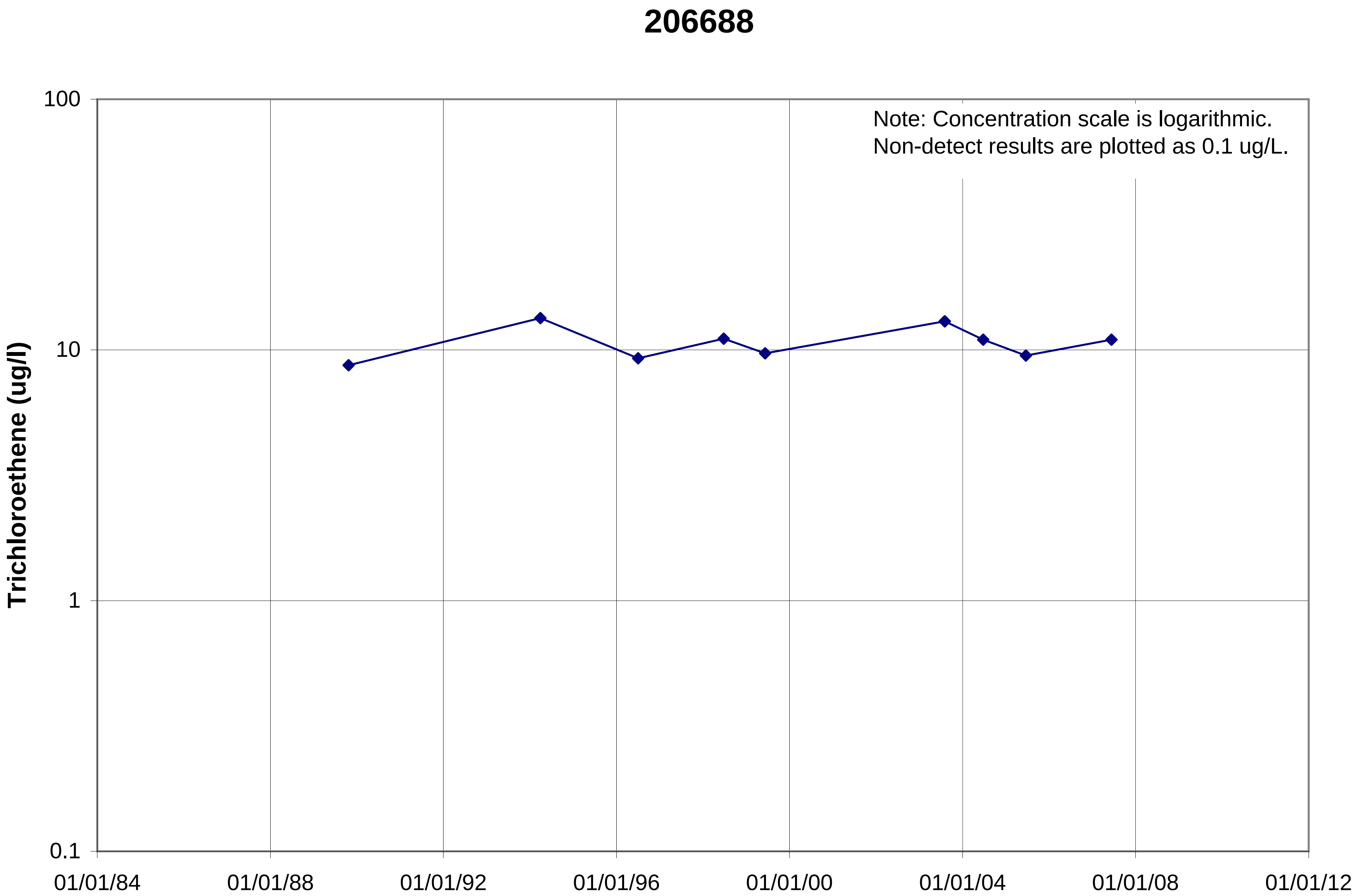

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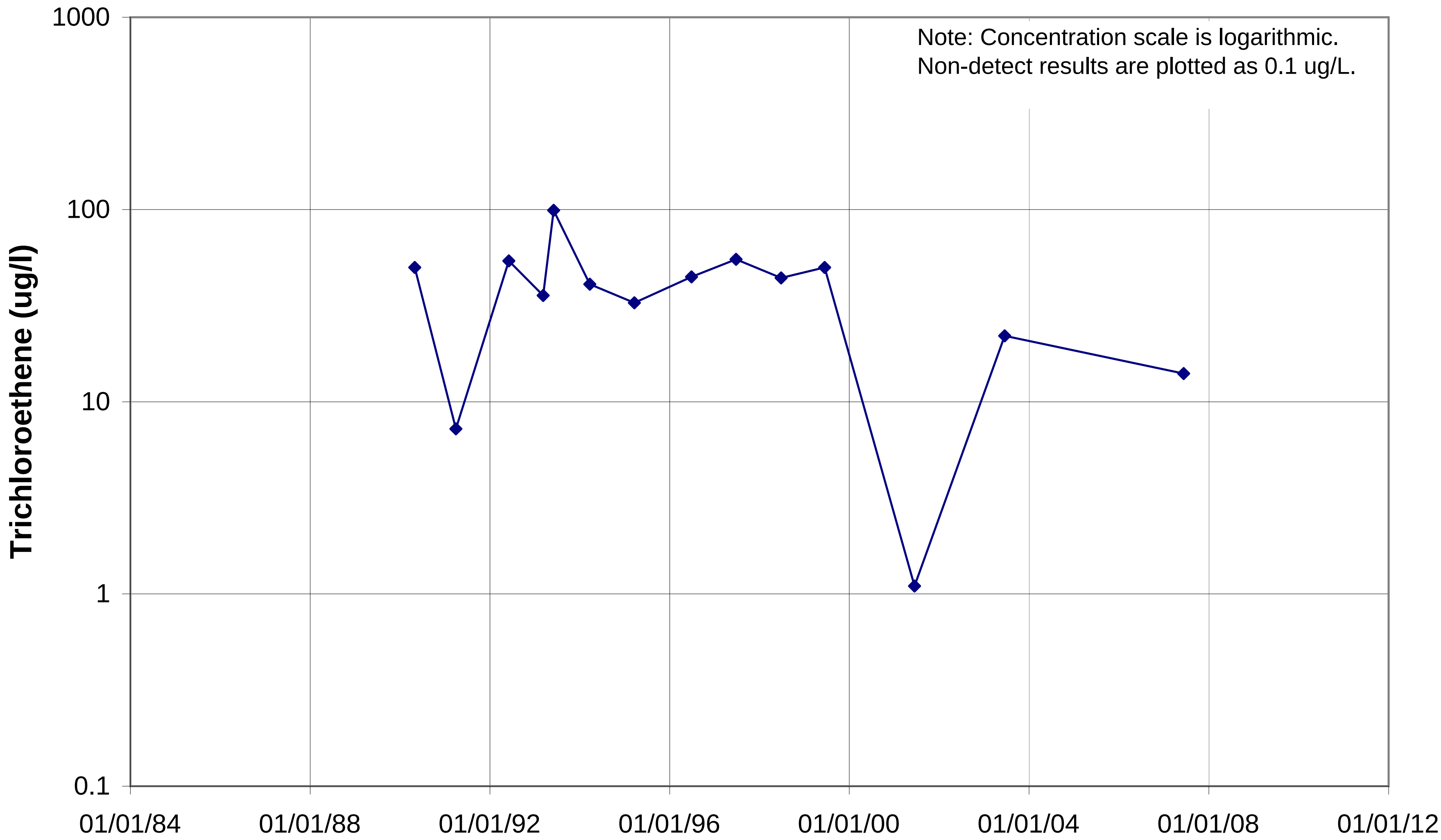

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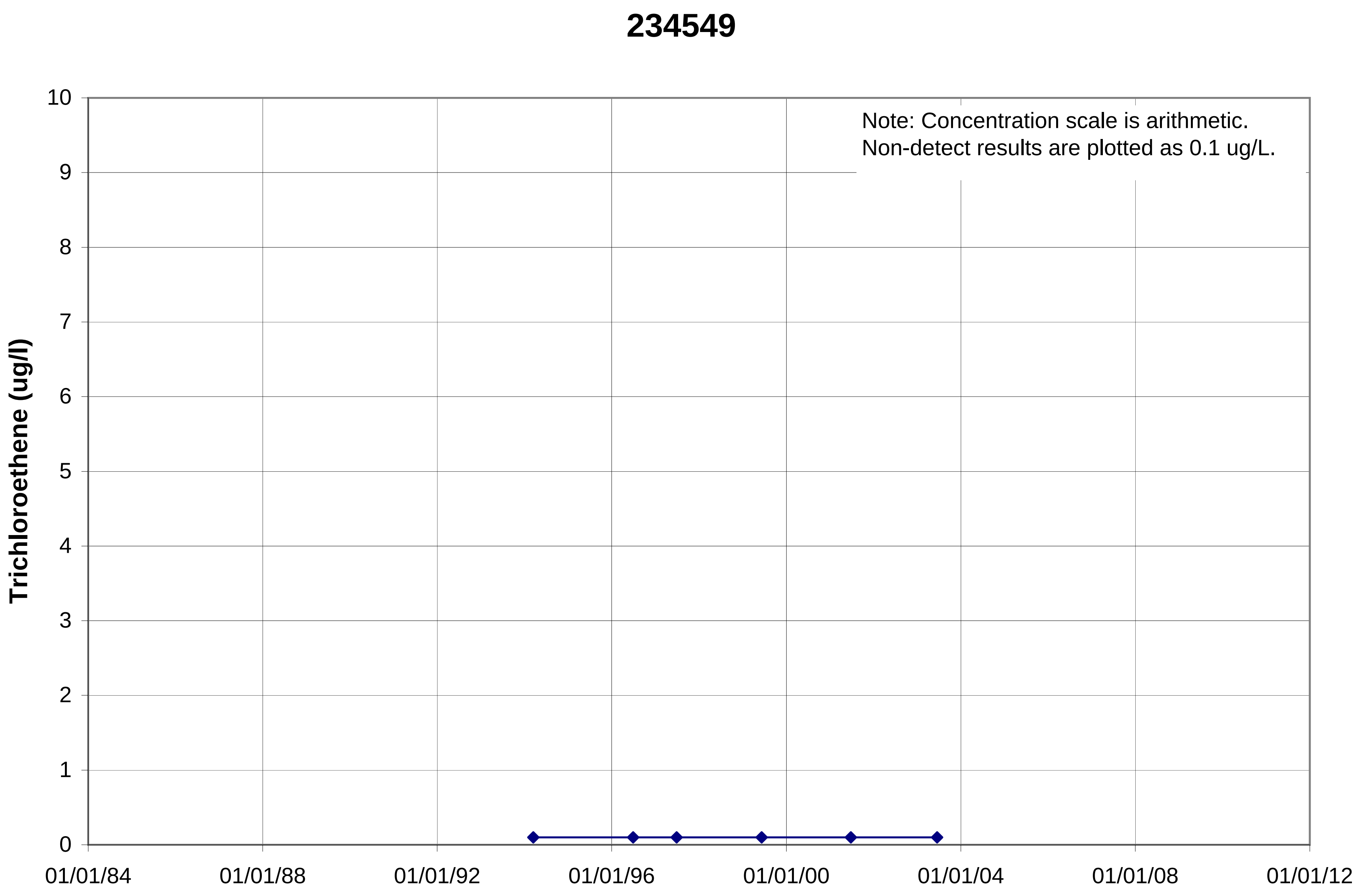

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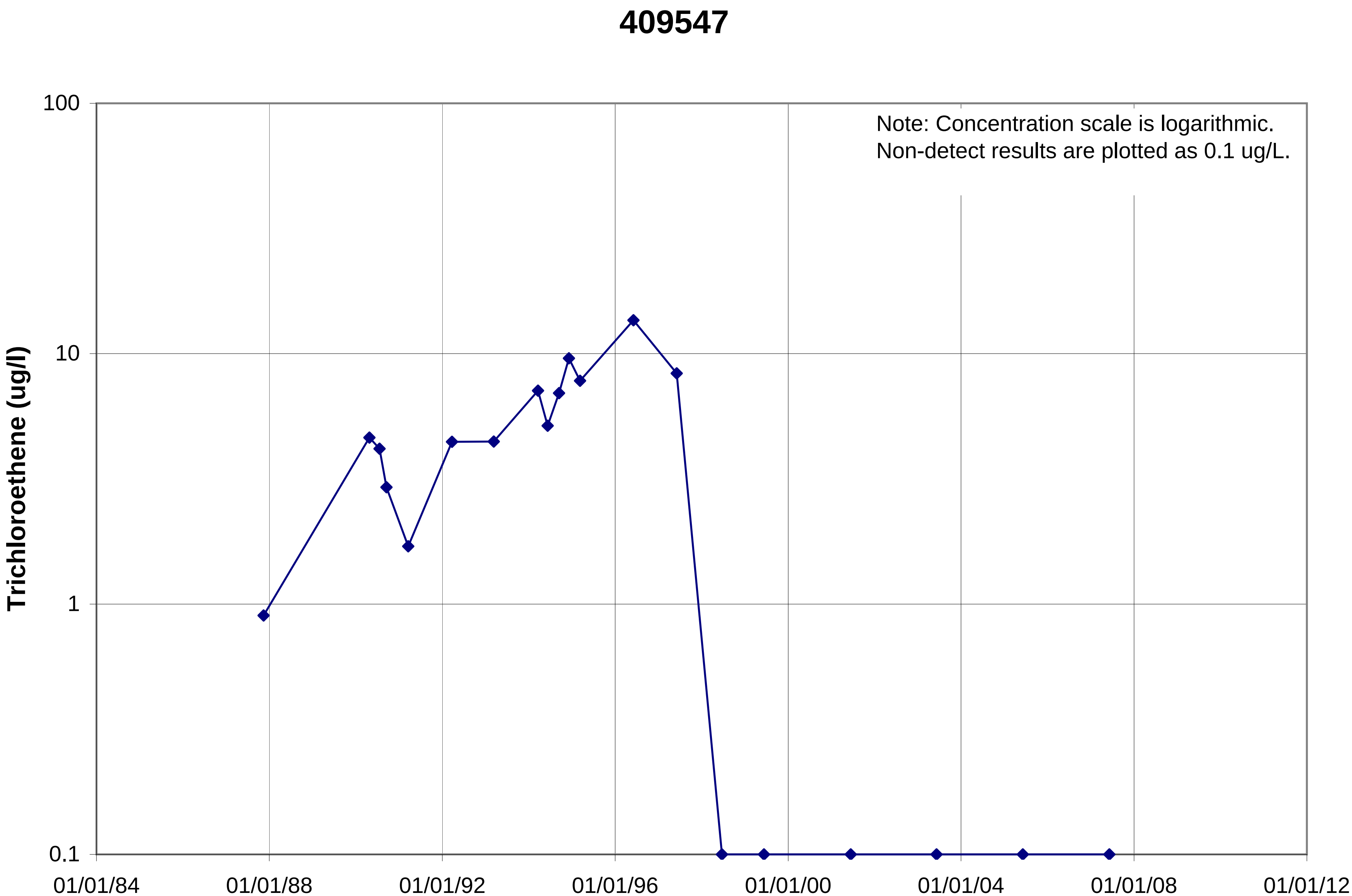

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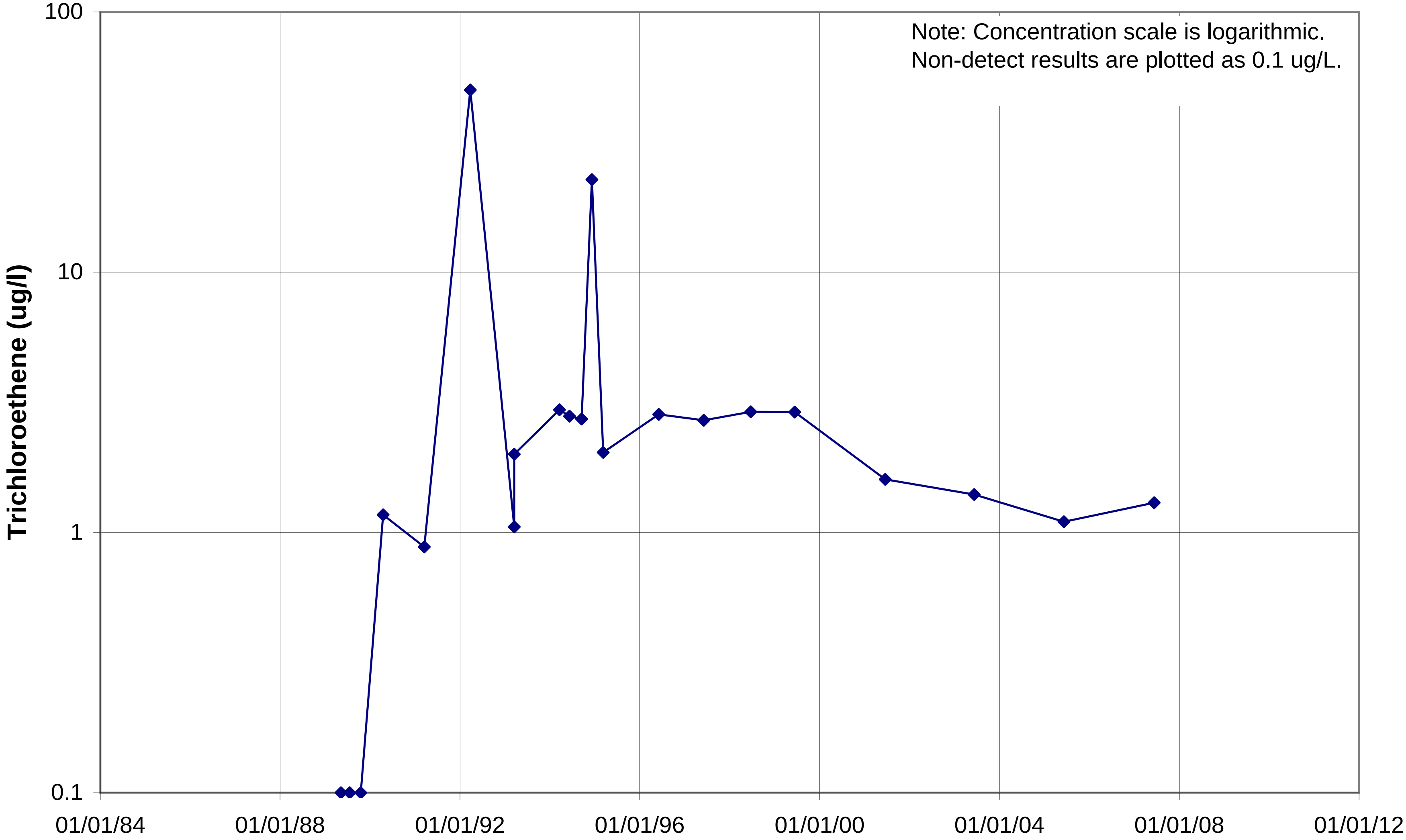

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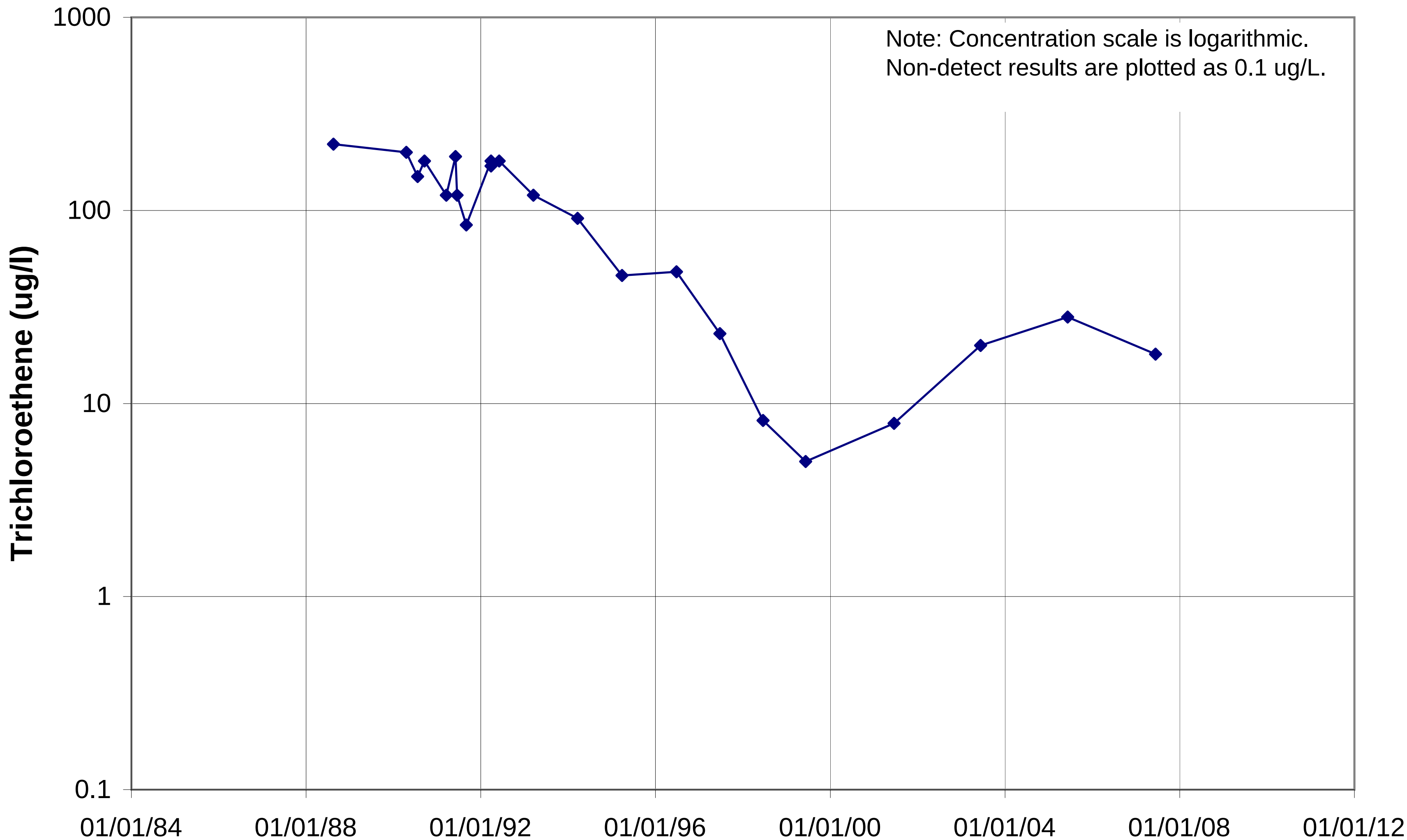

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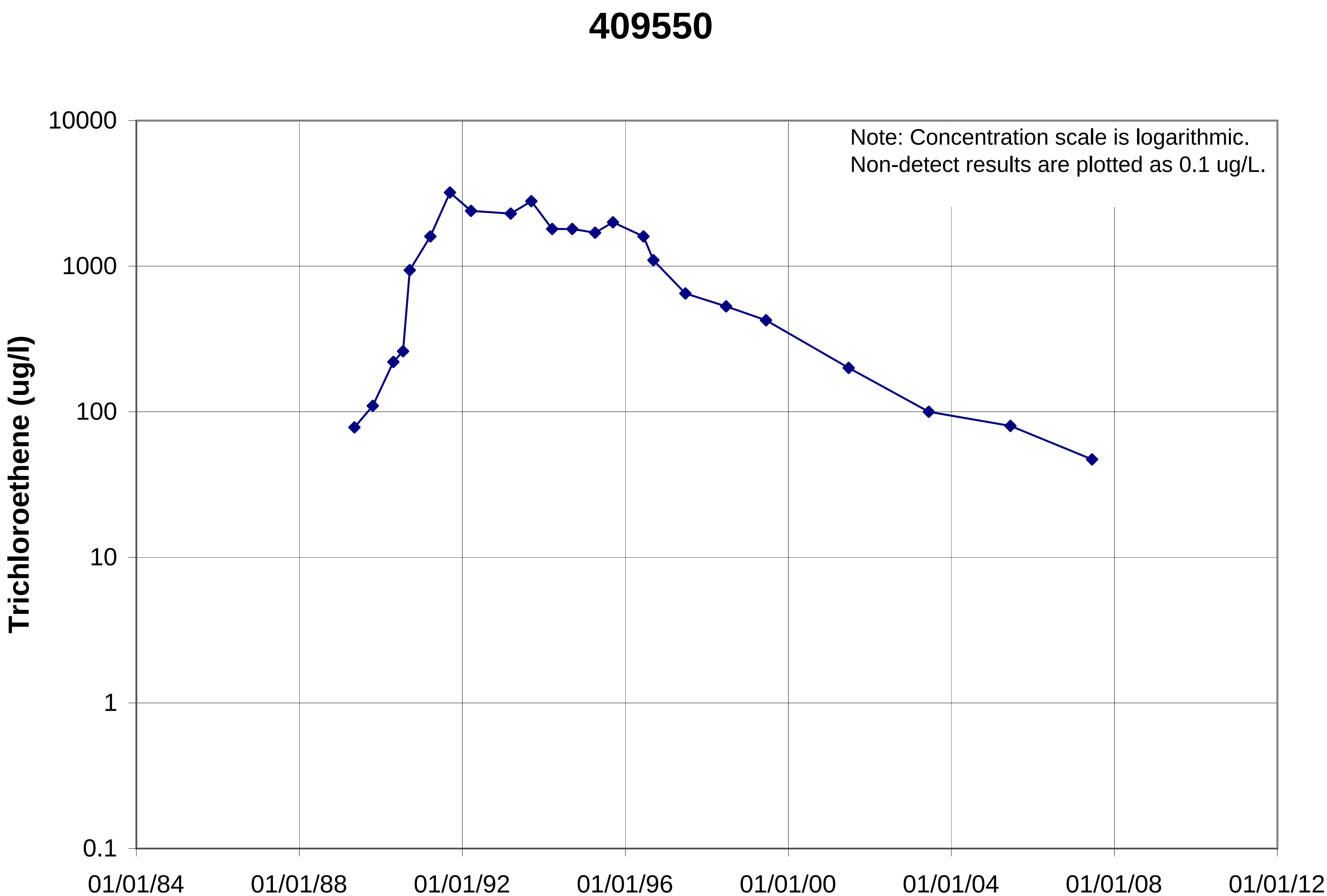

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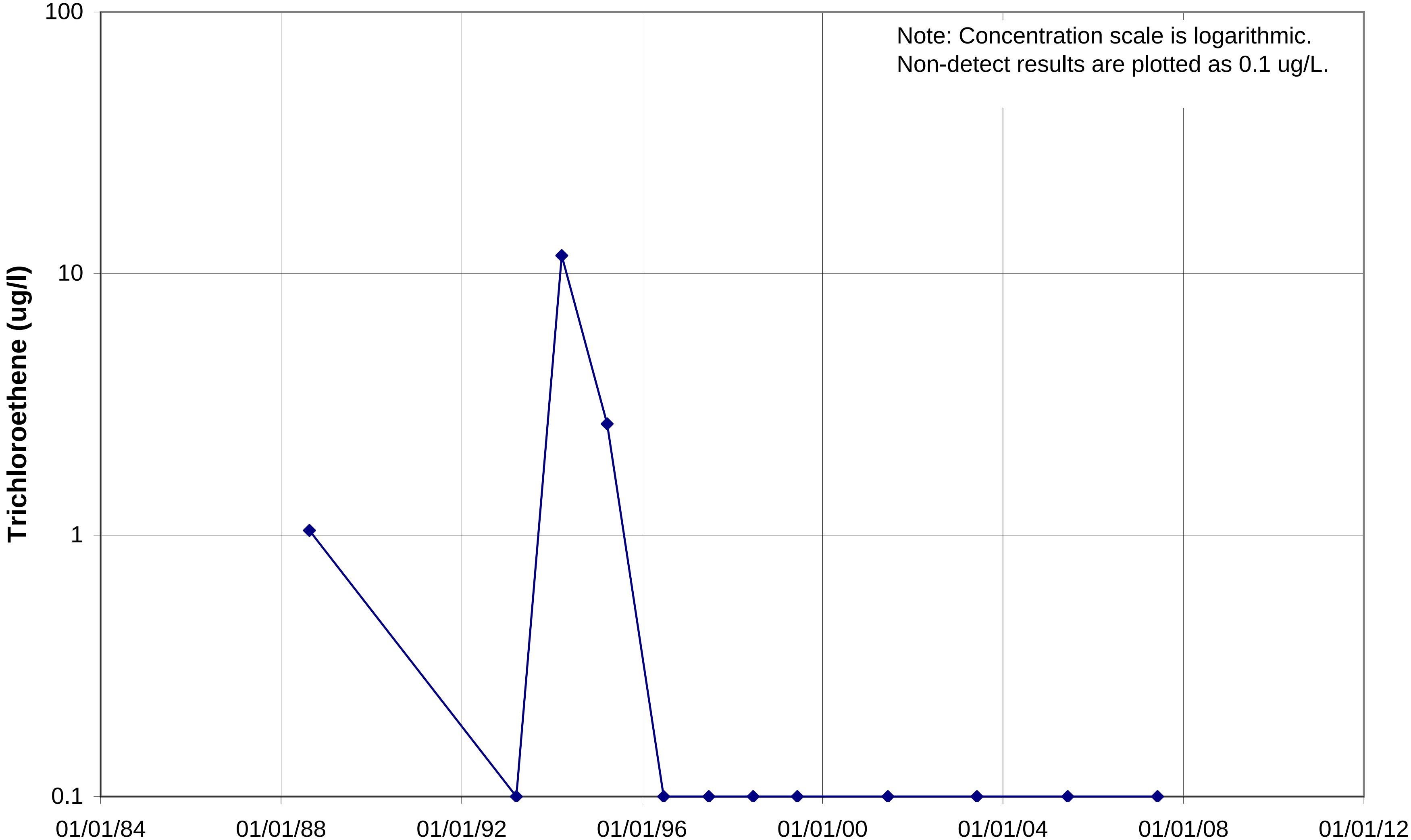

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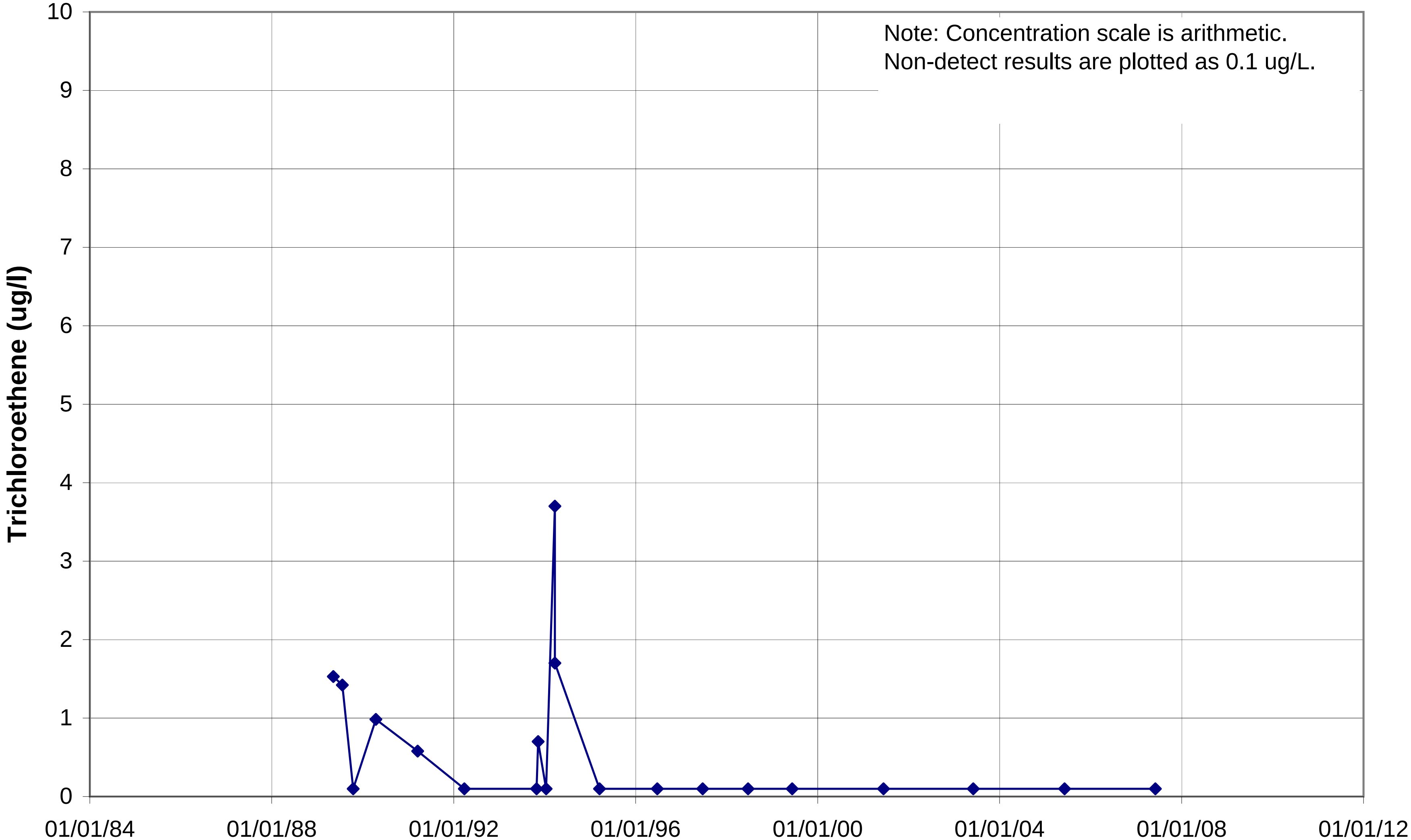

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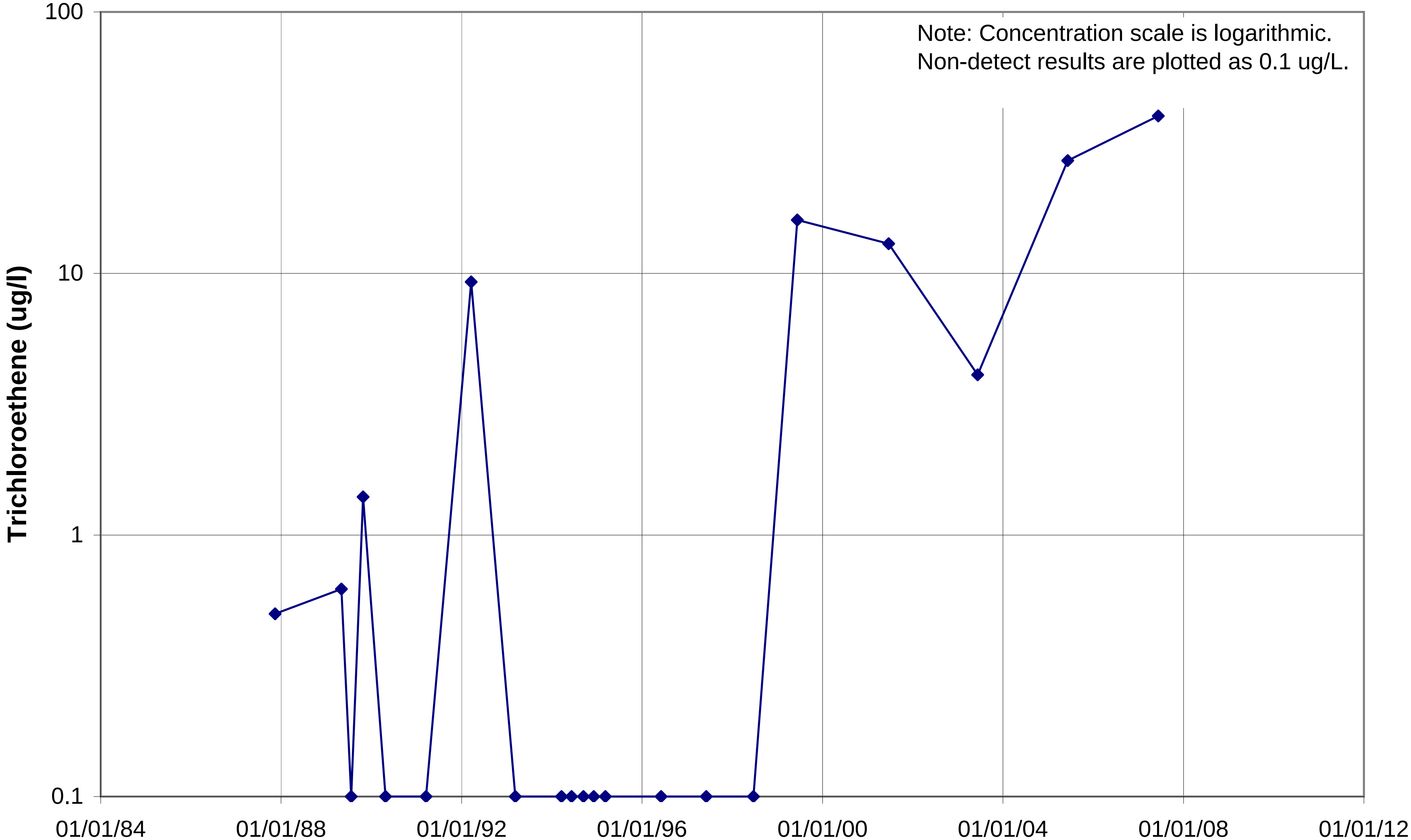

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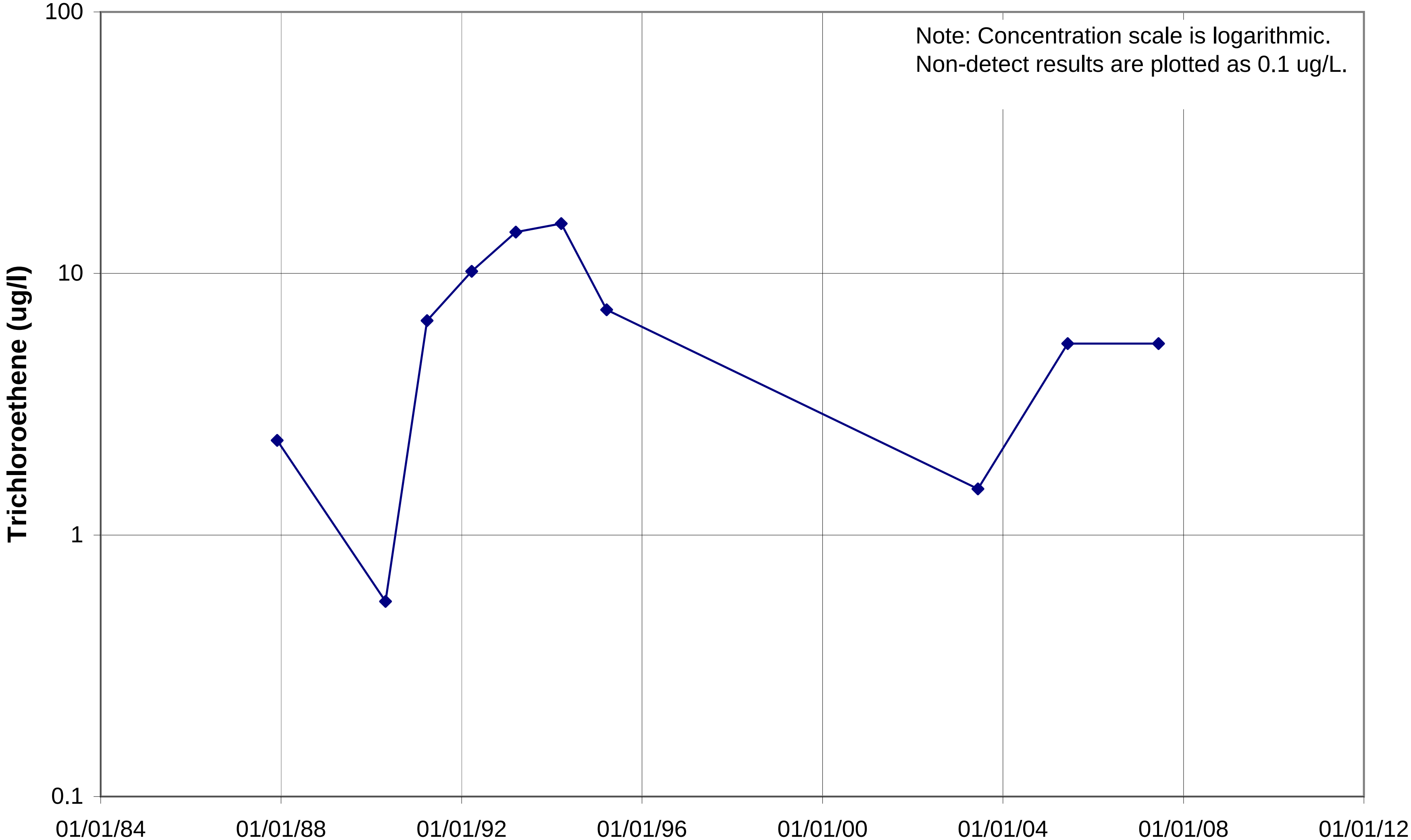

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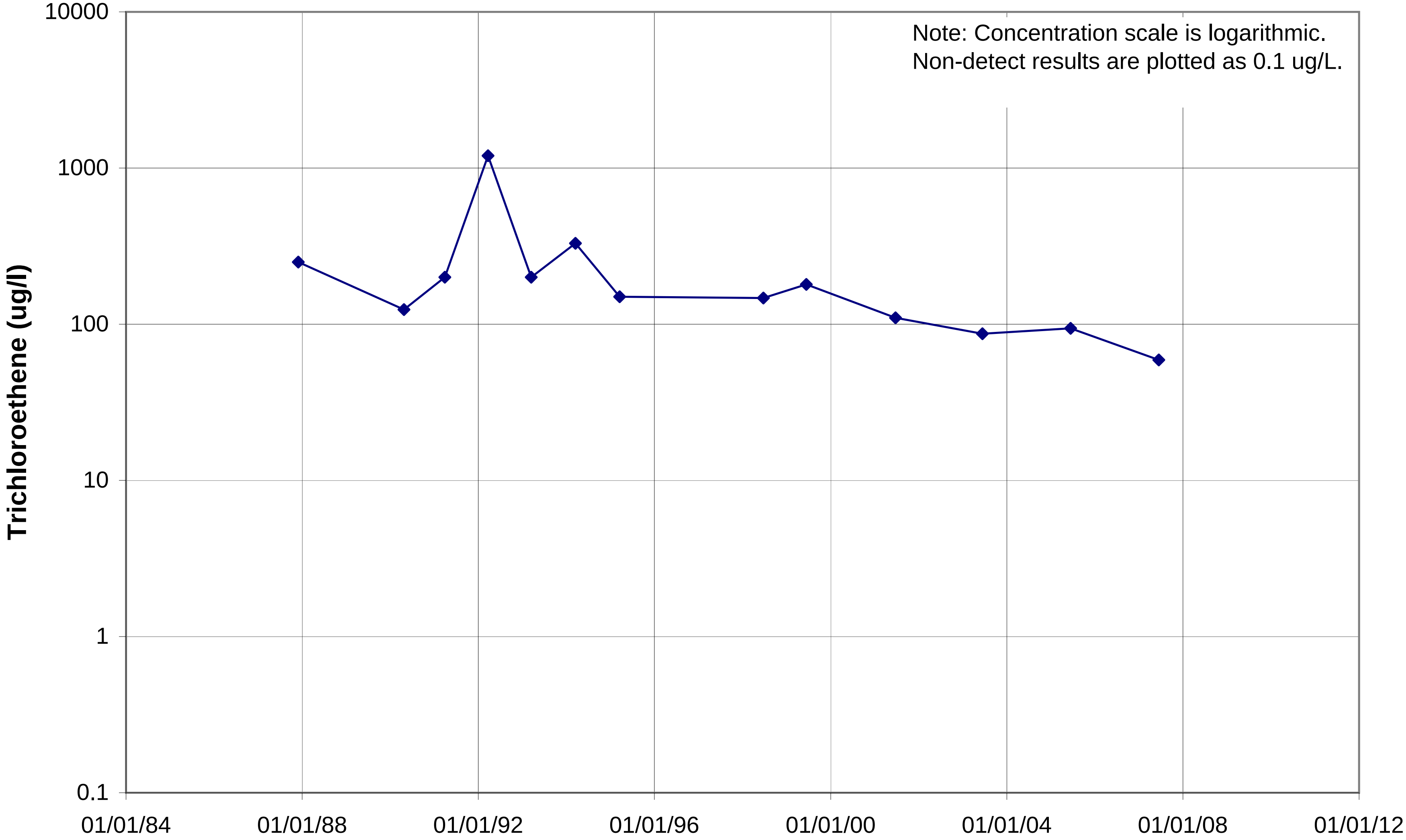

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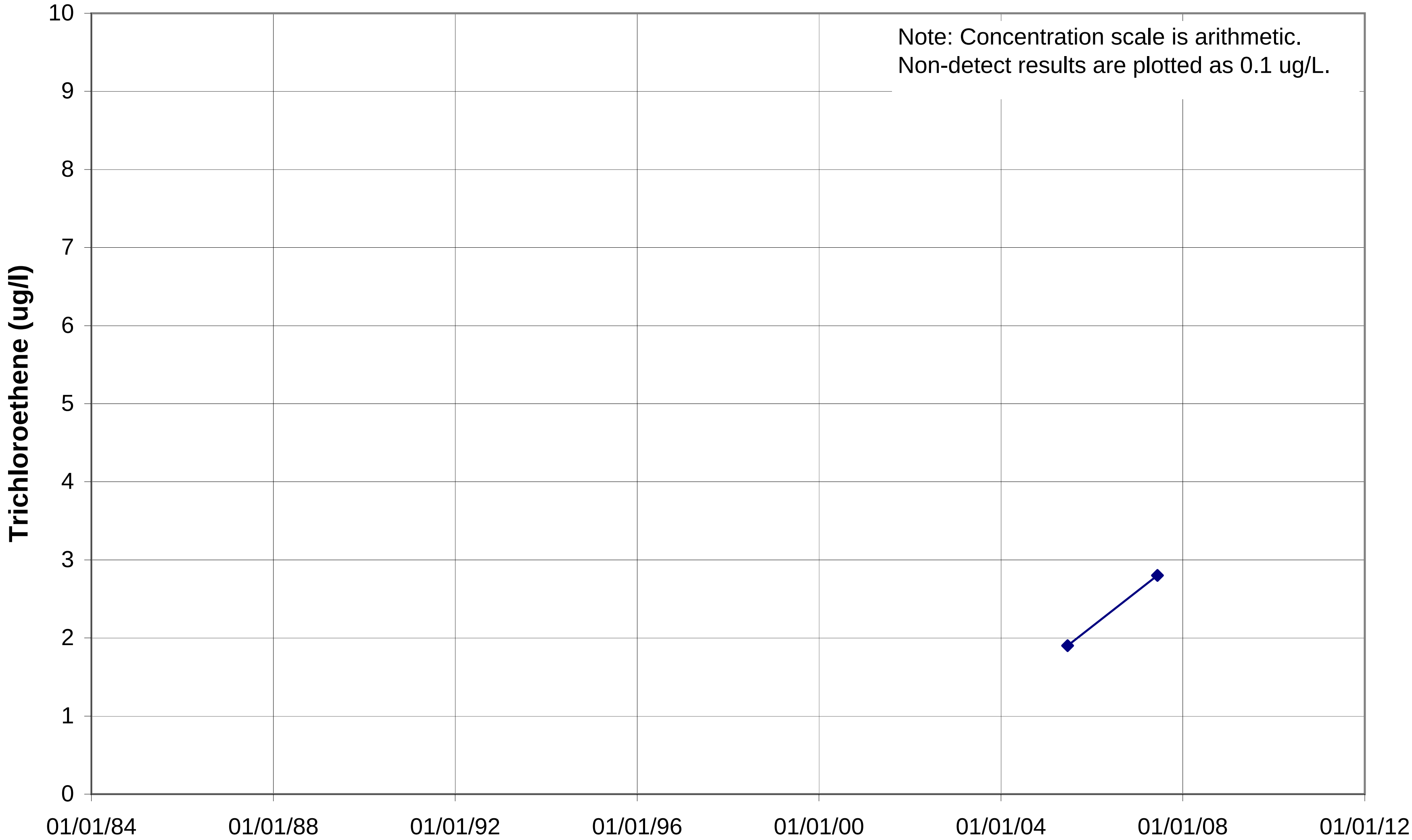

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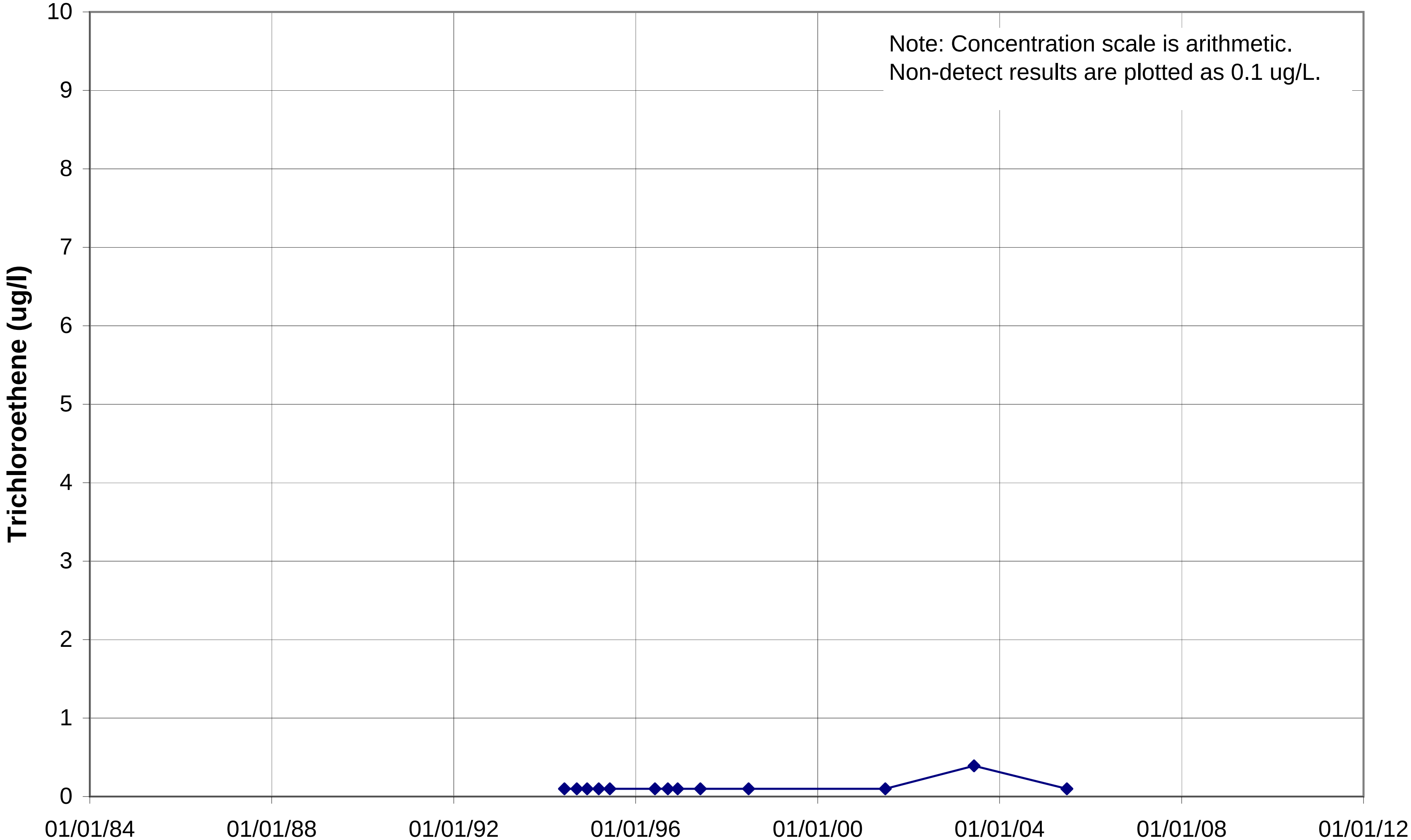
476837 (MW15H)



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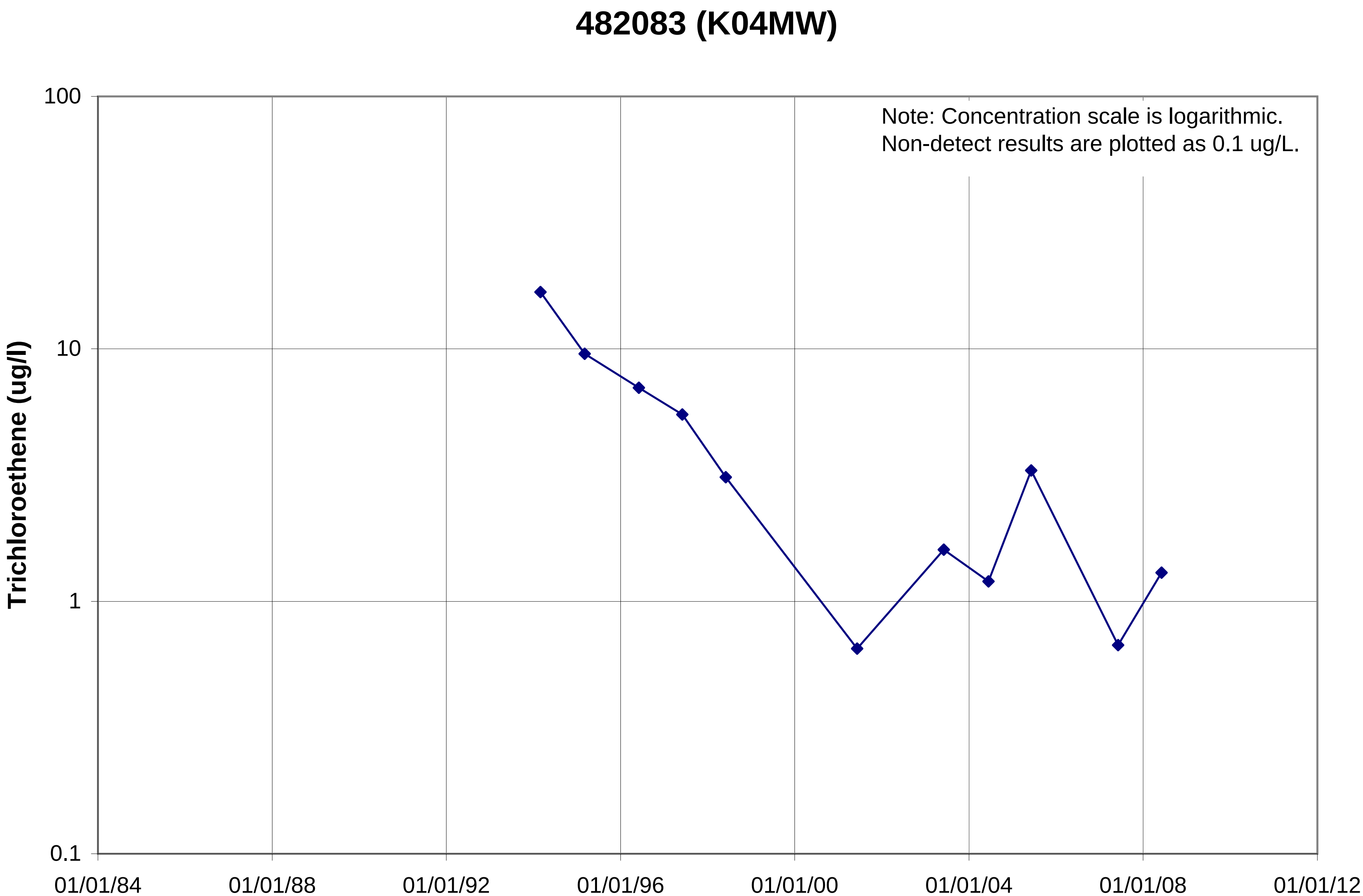

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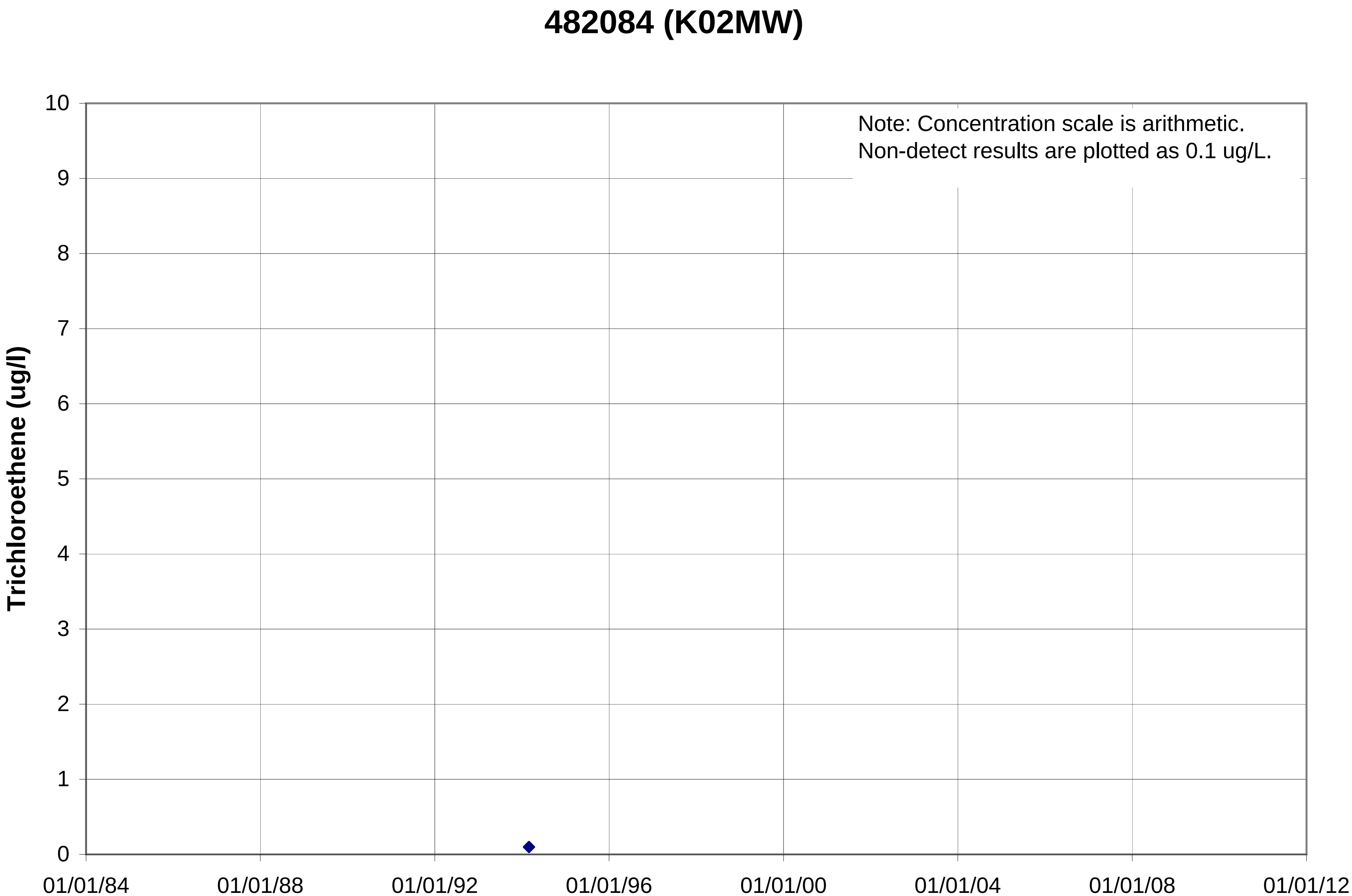

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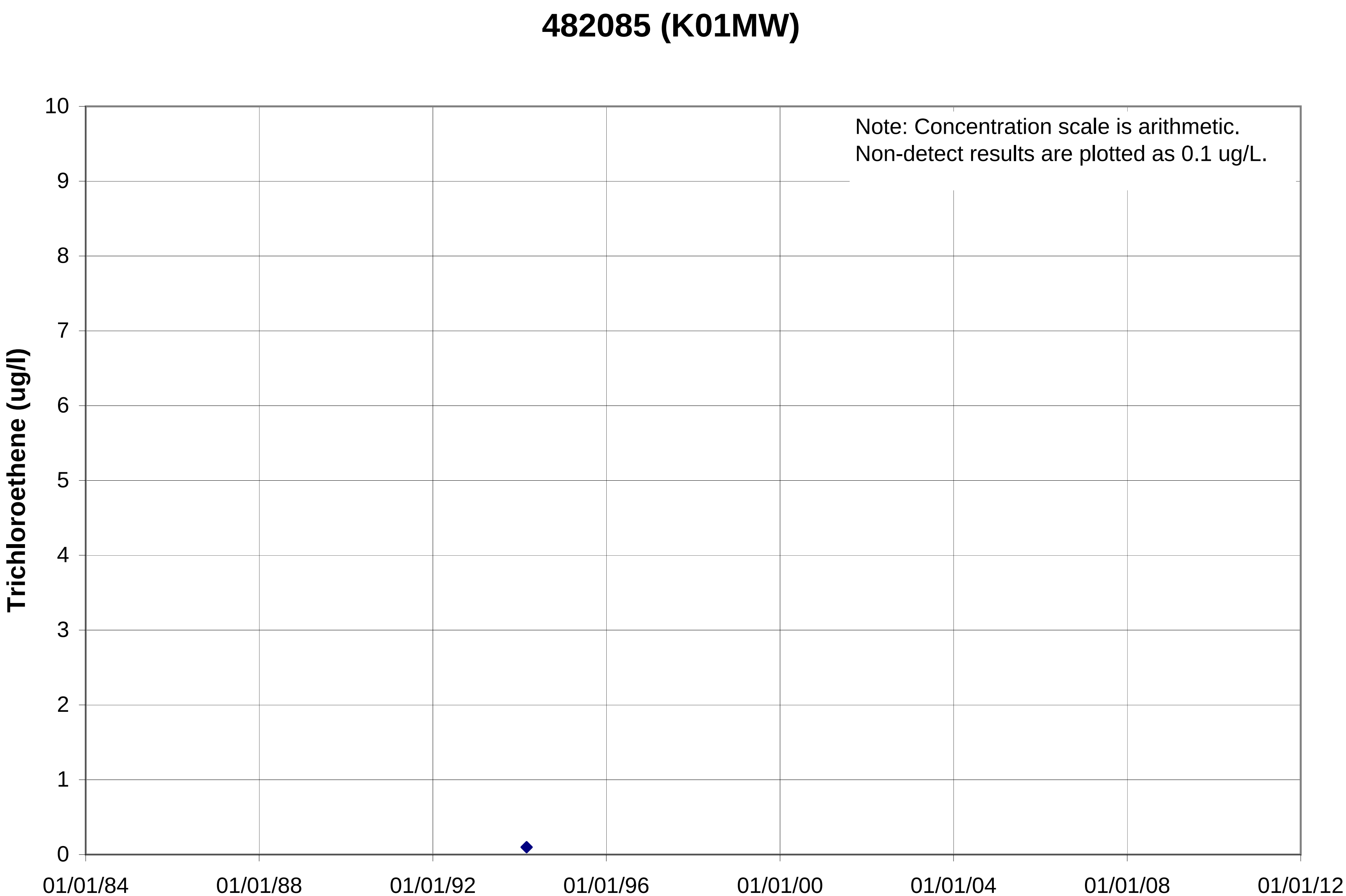

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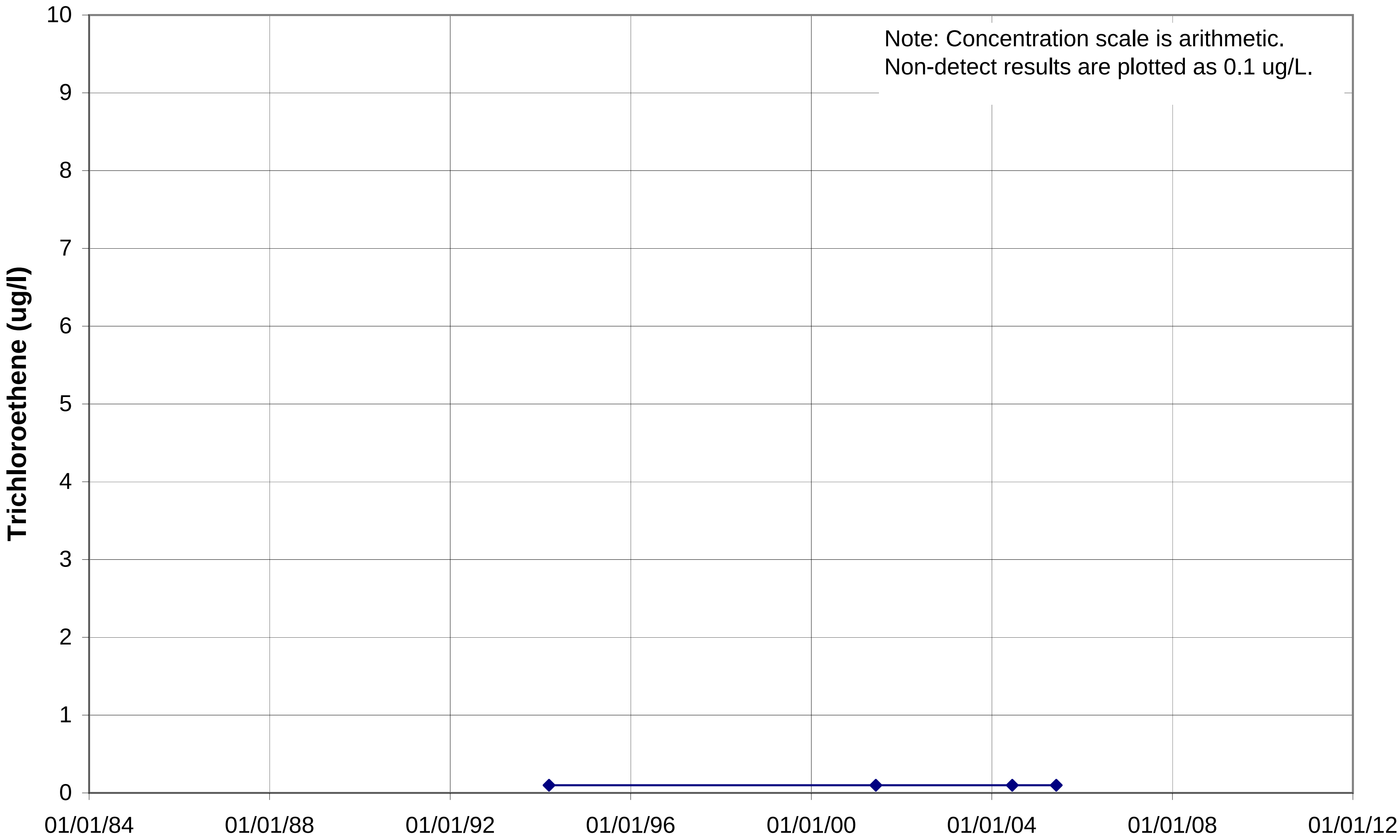

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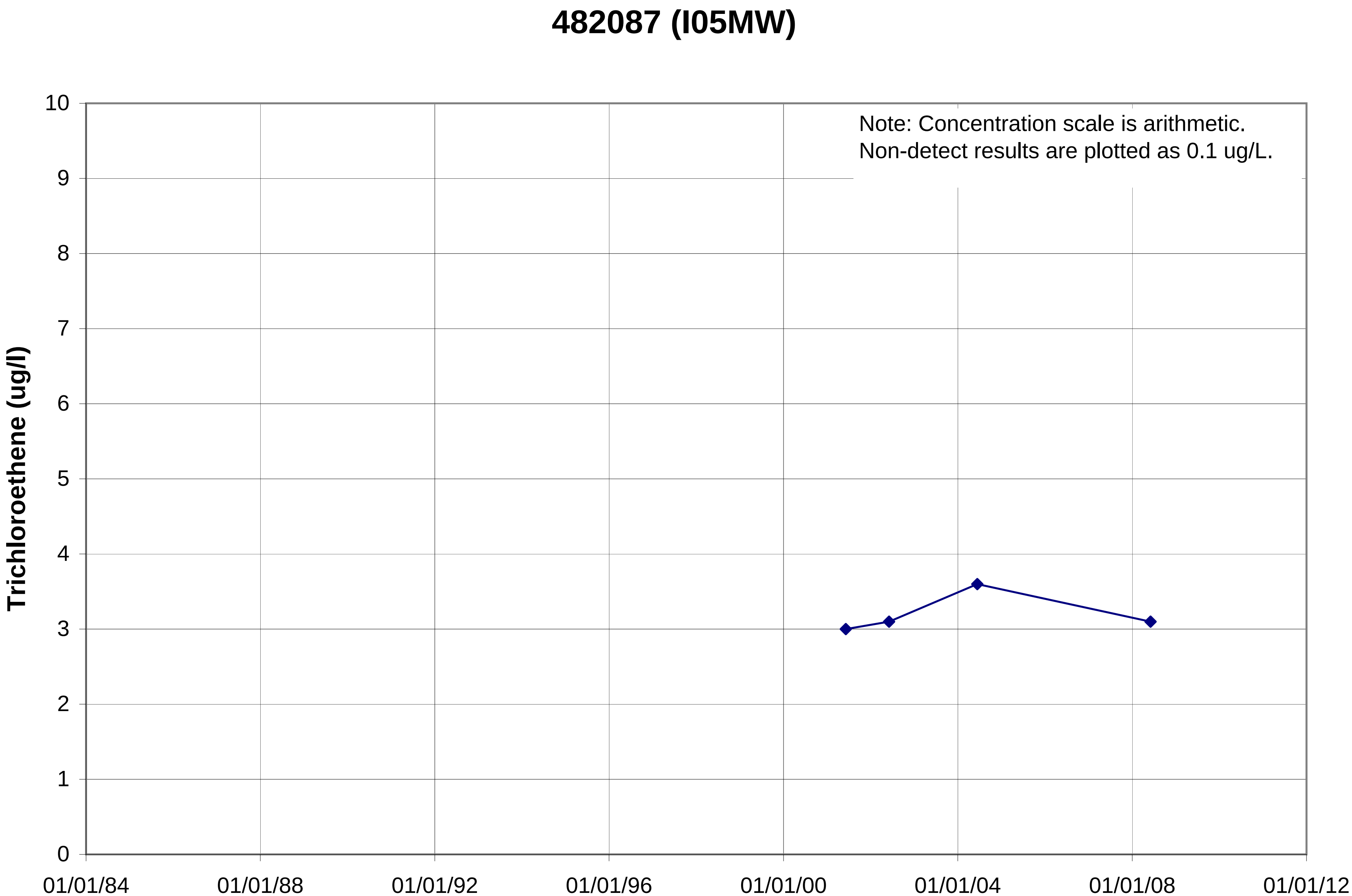

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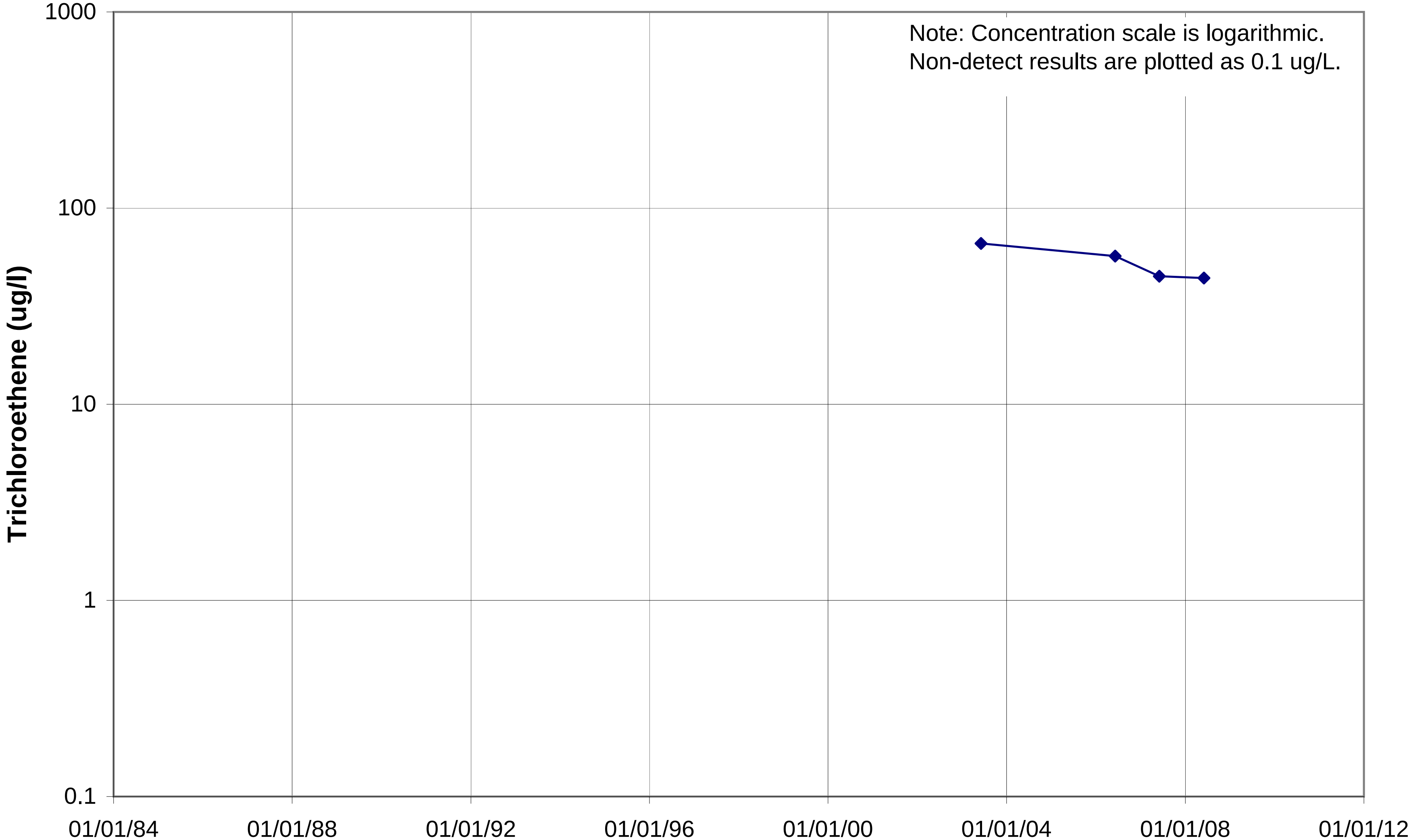

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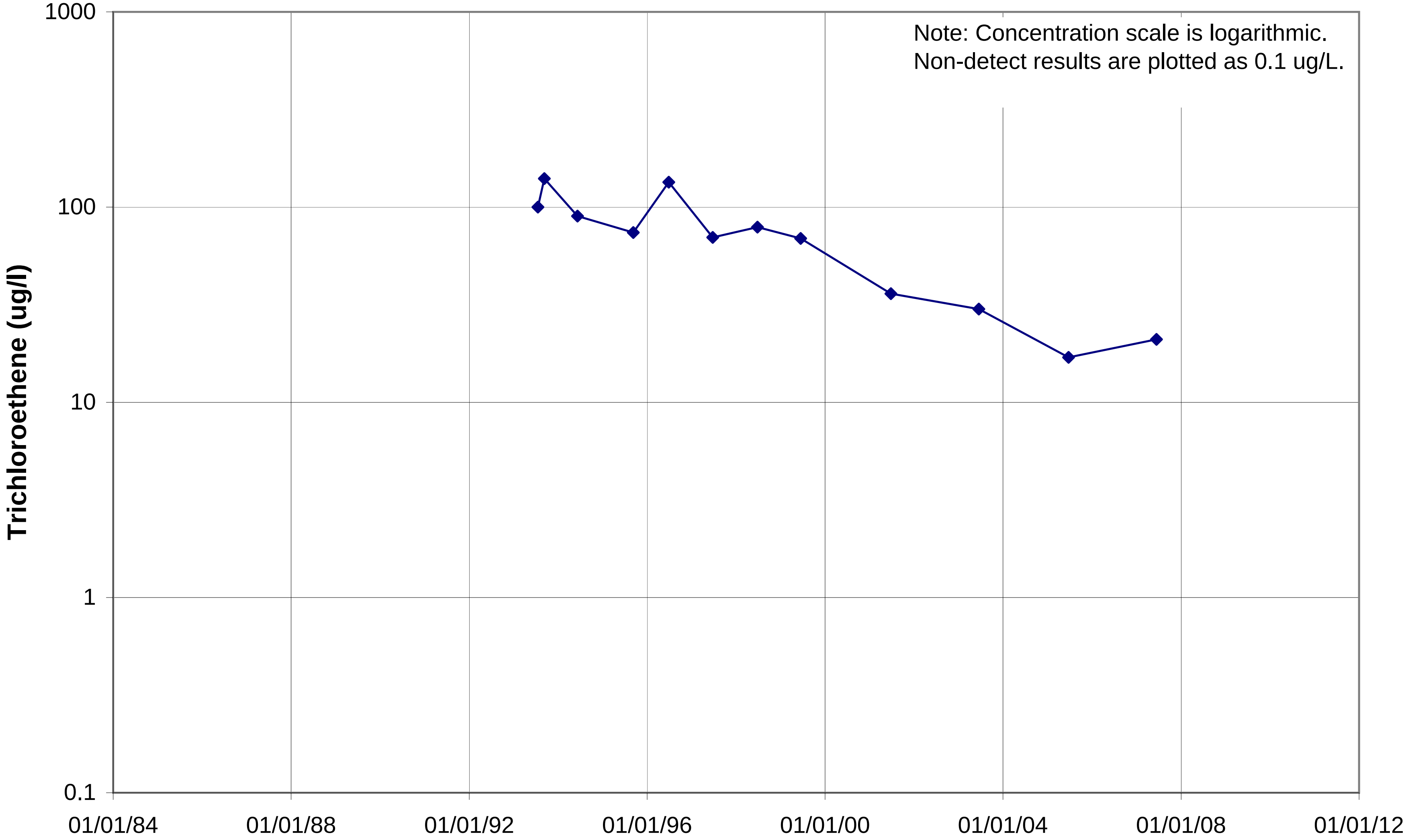

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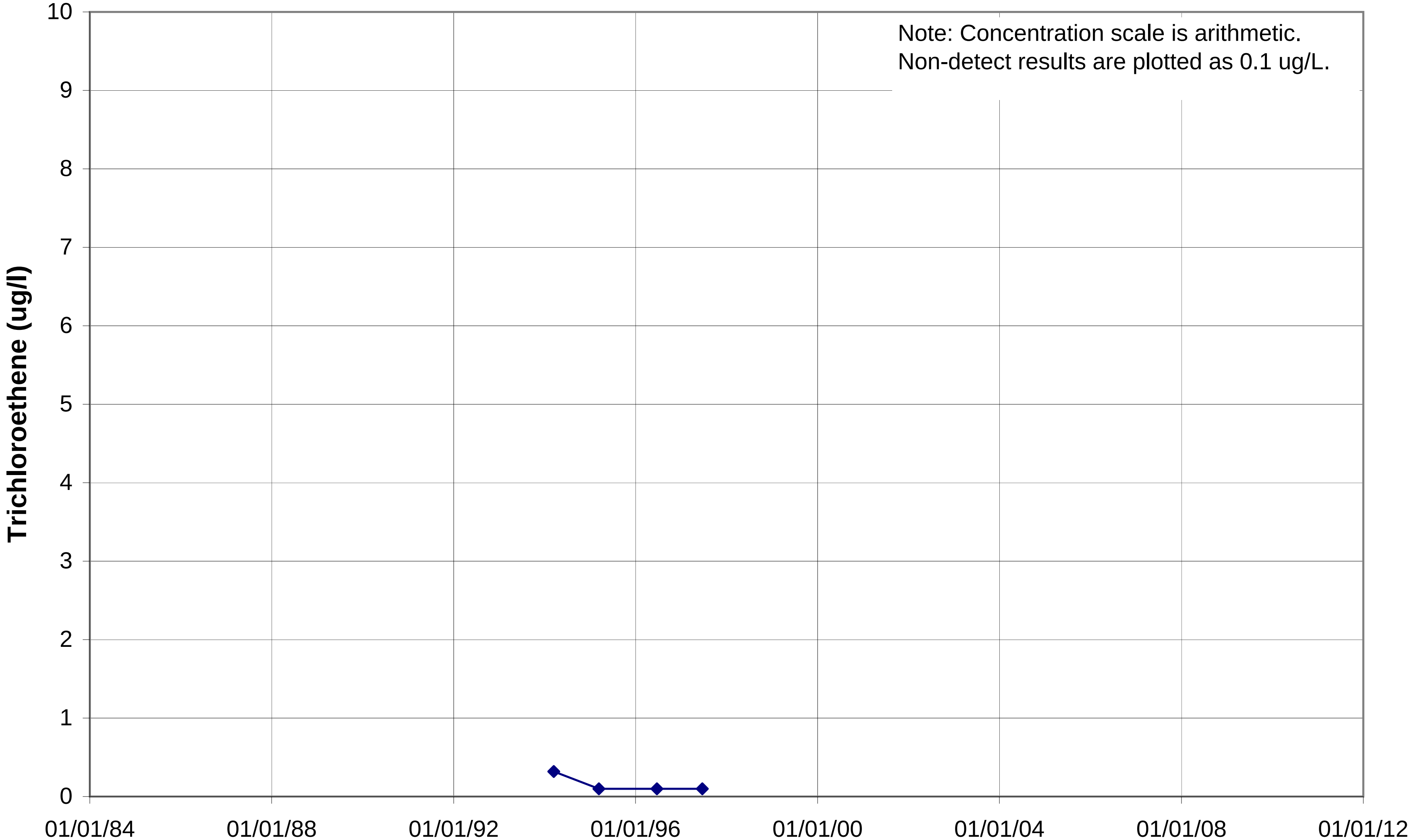

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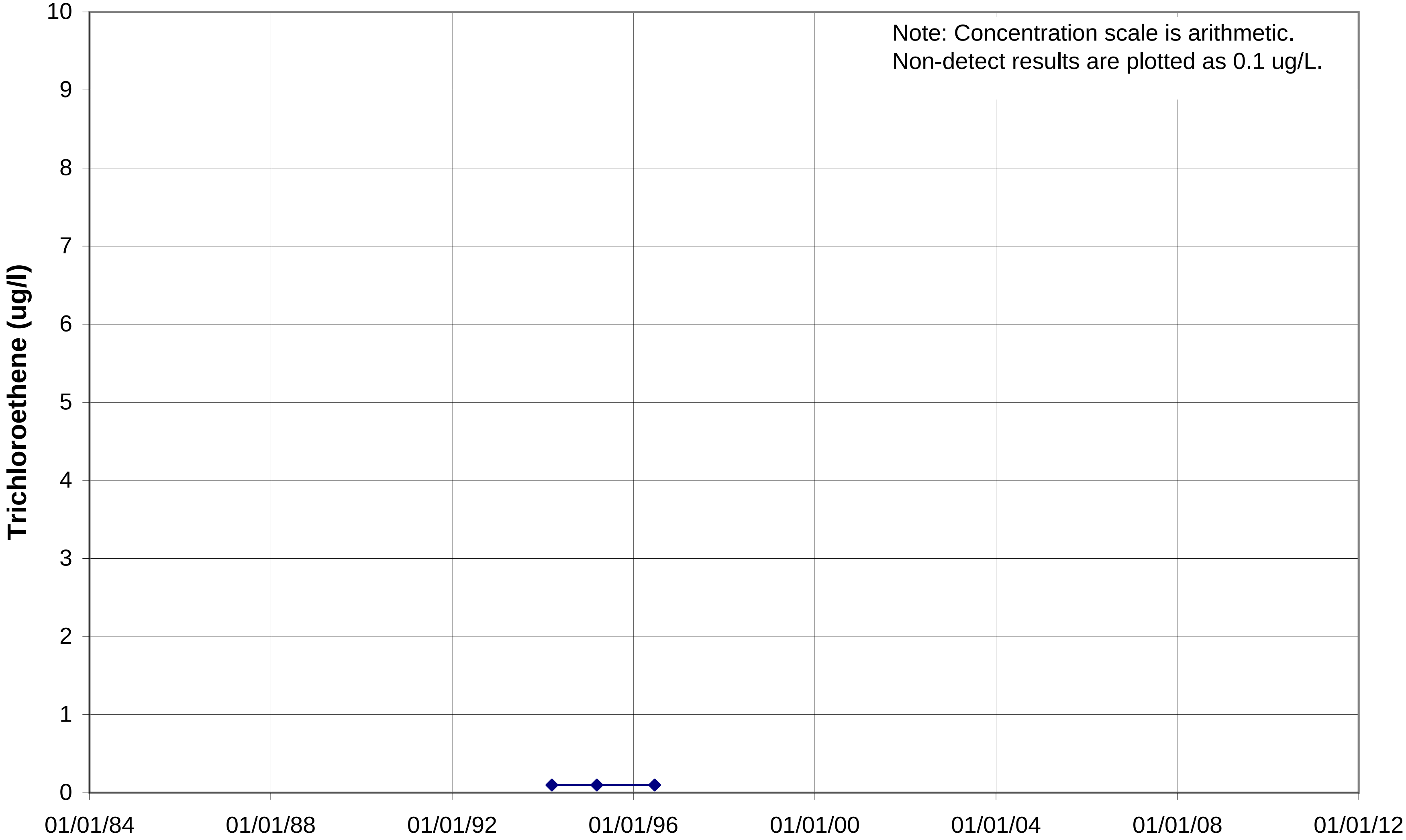

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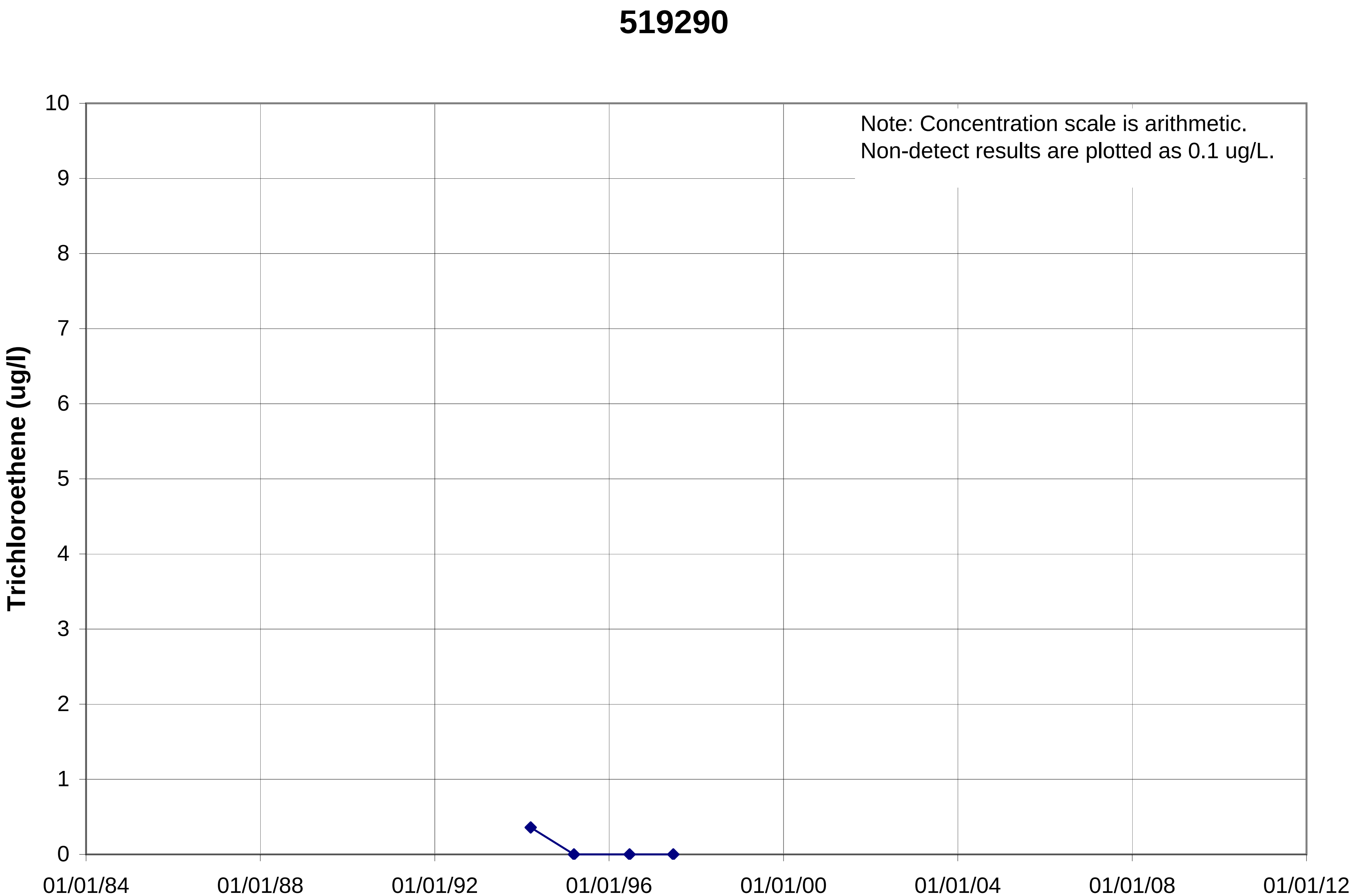

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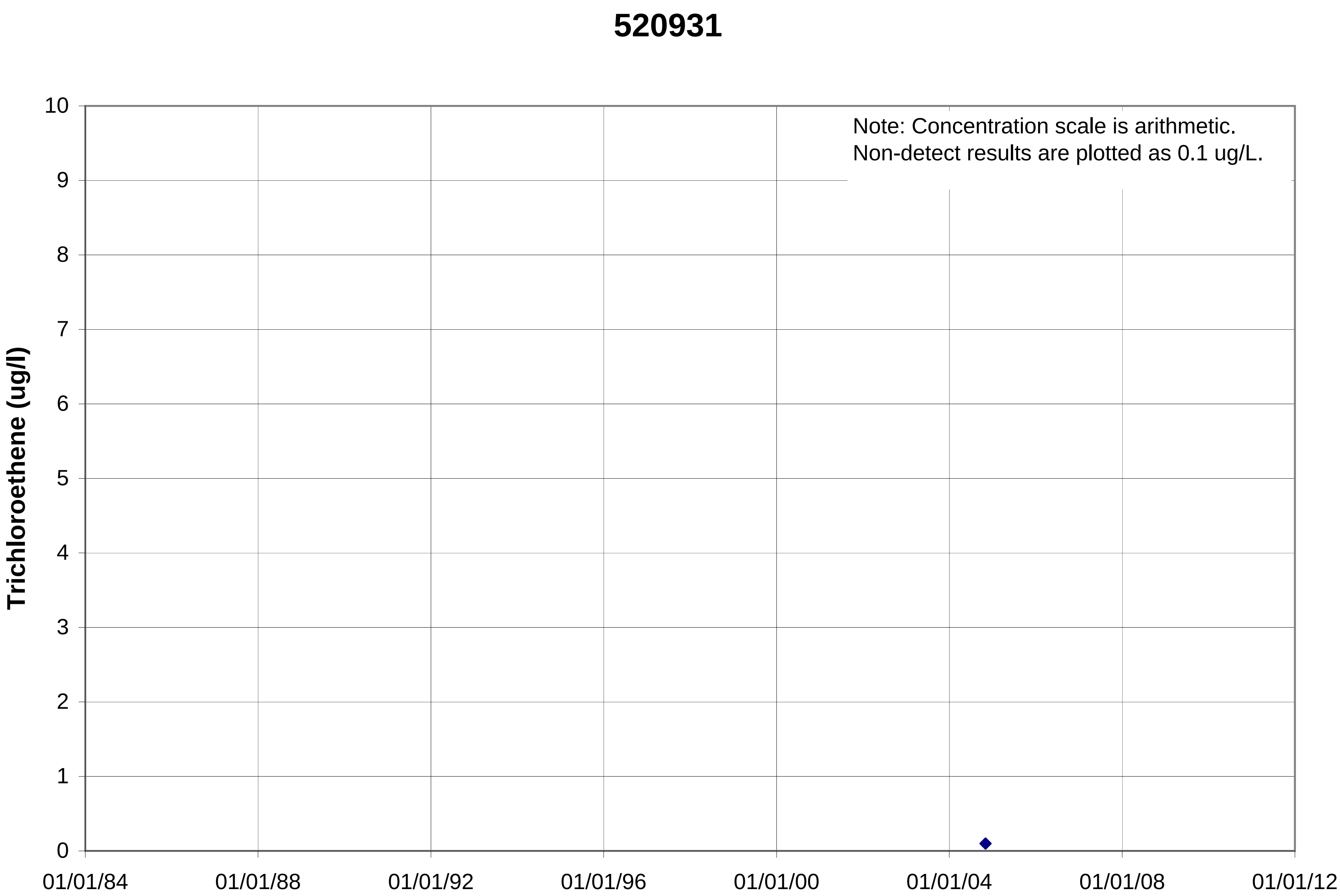

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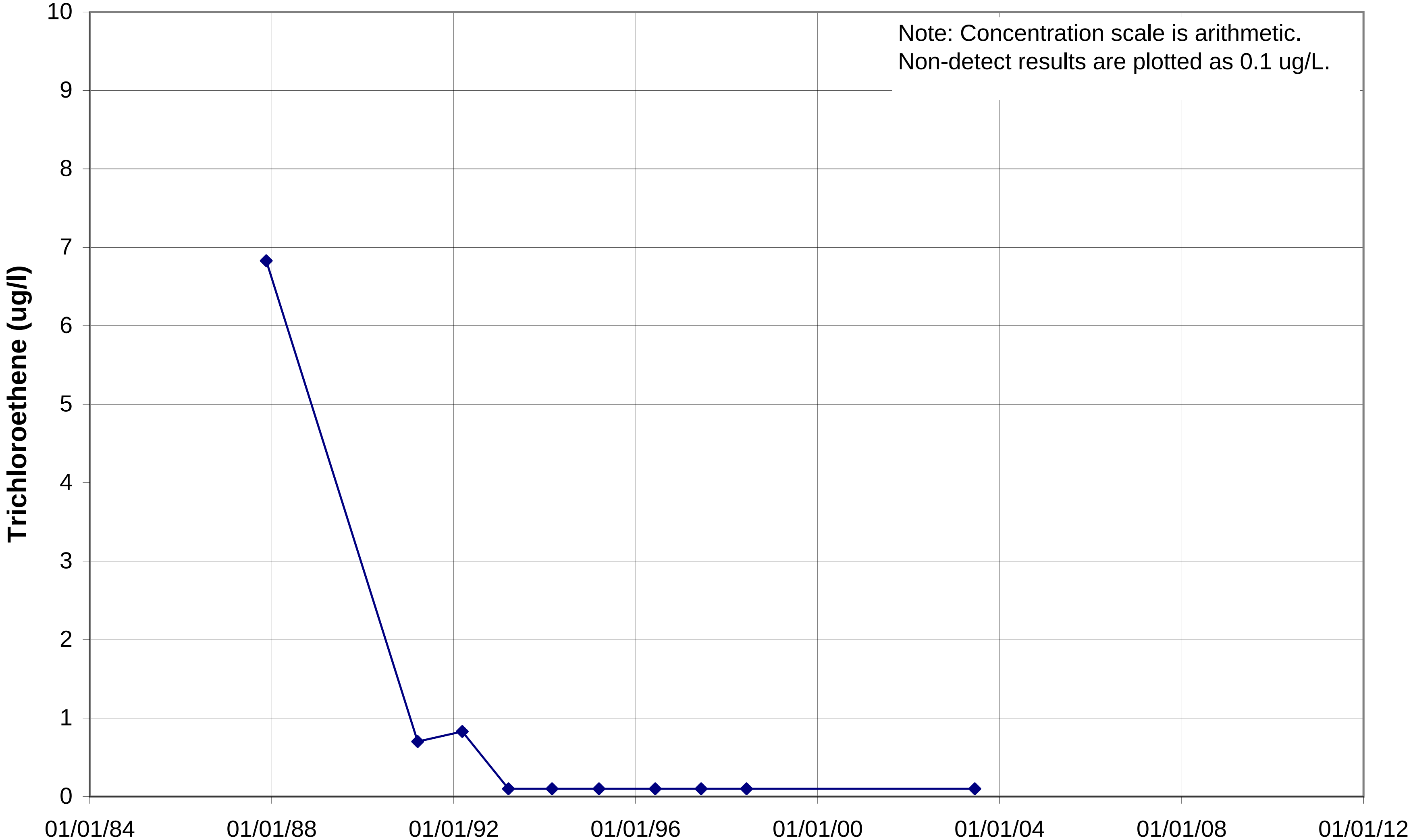
PJ#003



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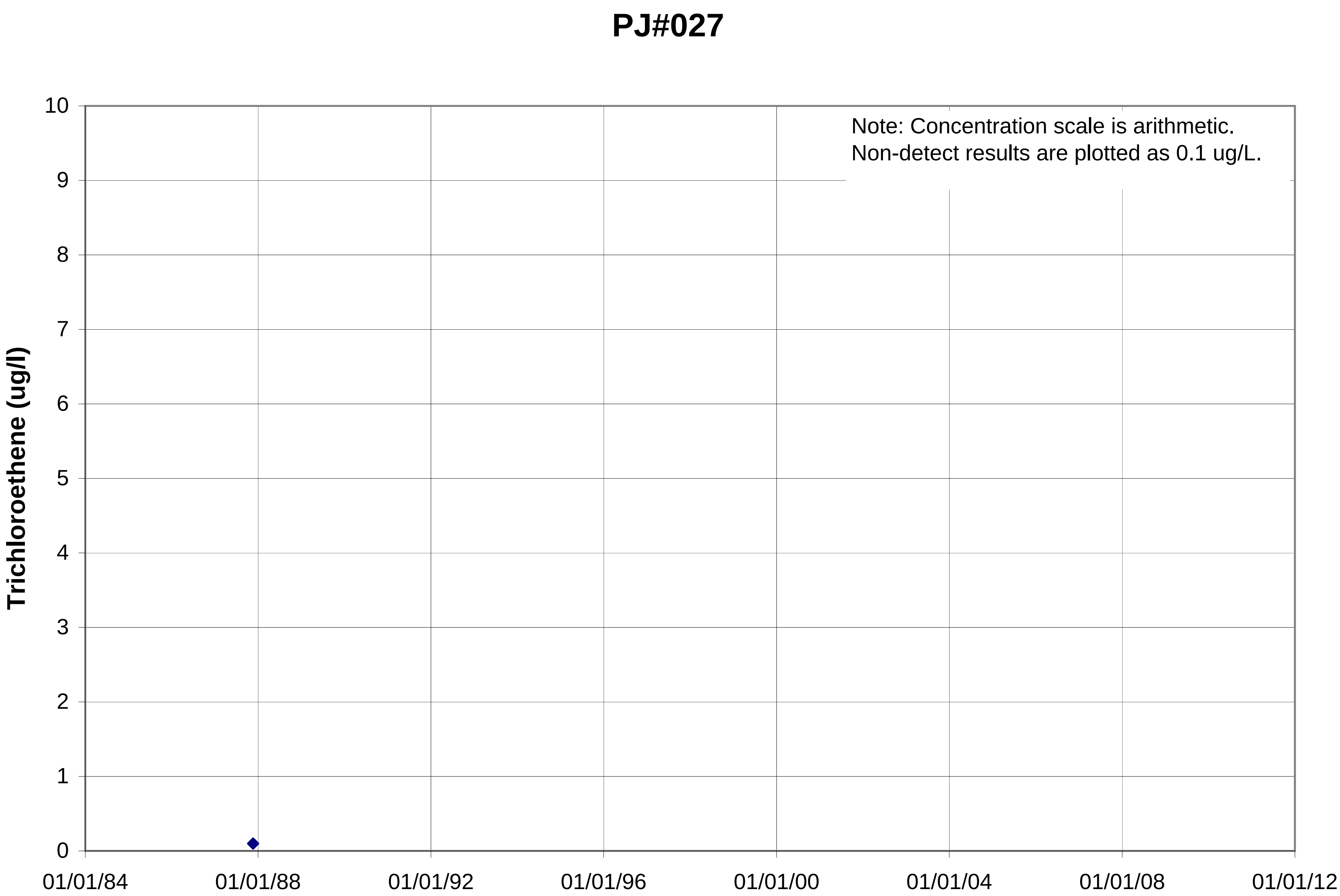

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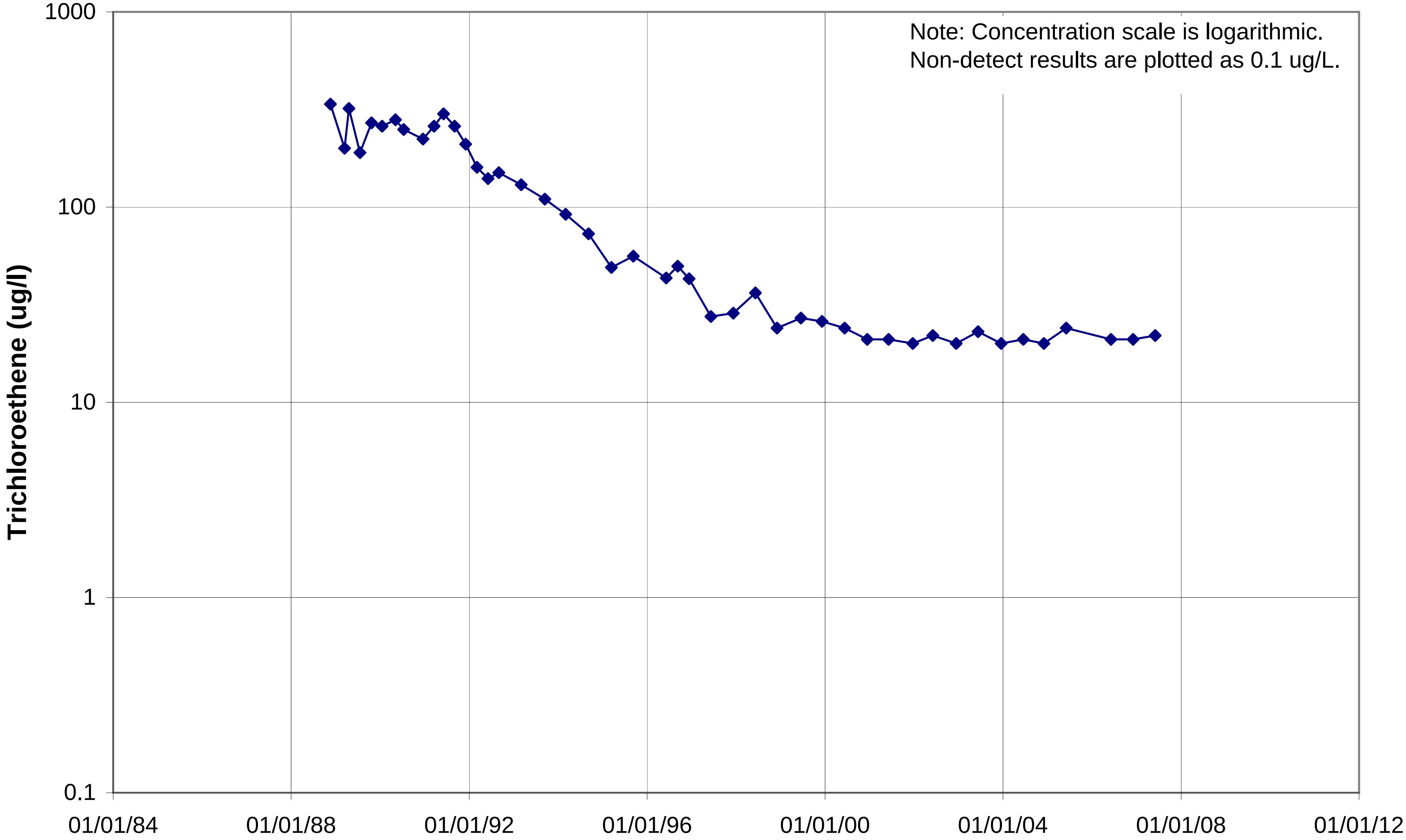
PJ#309 (B8)



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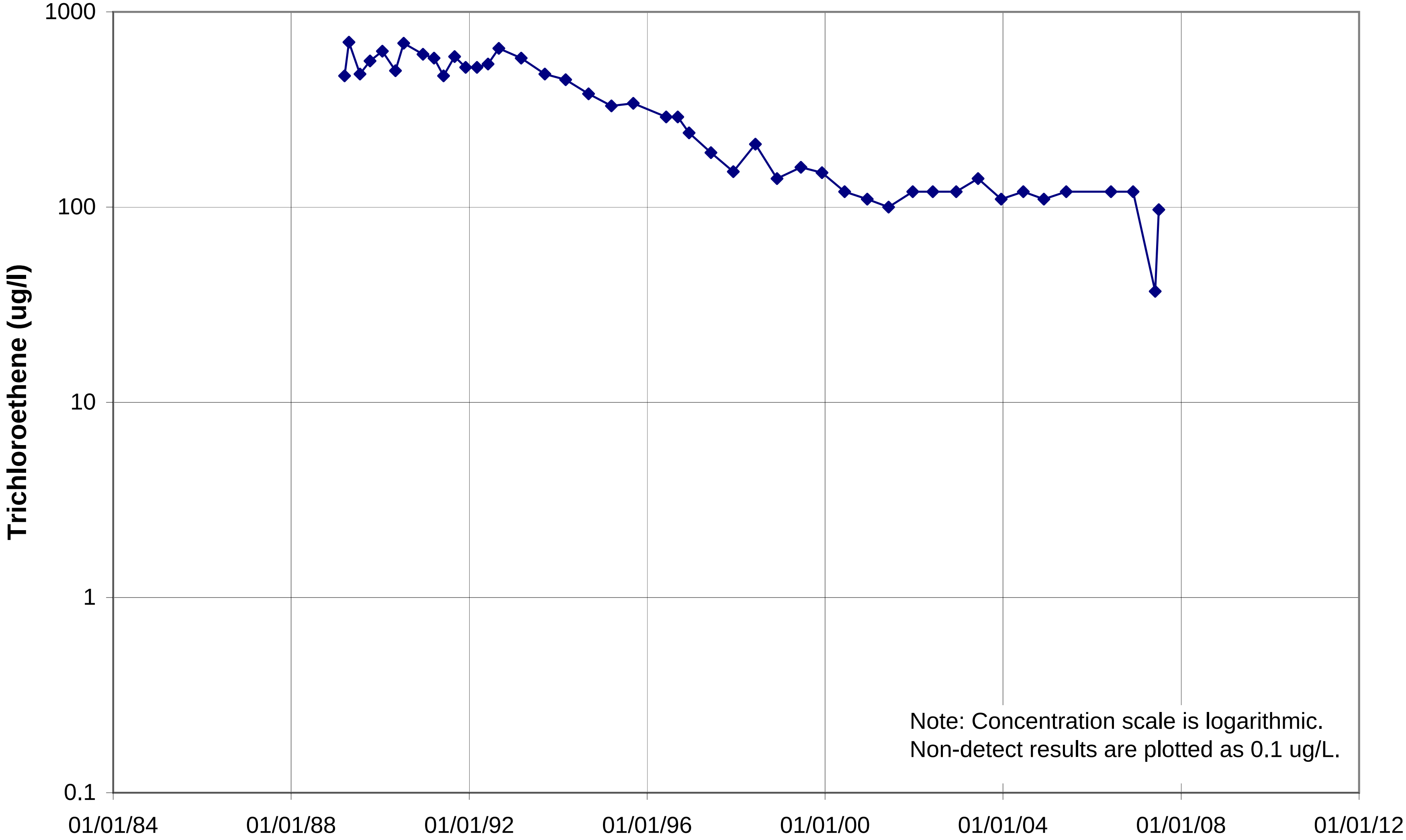
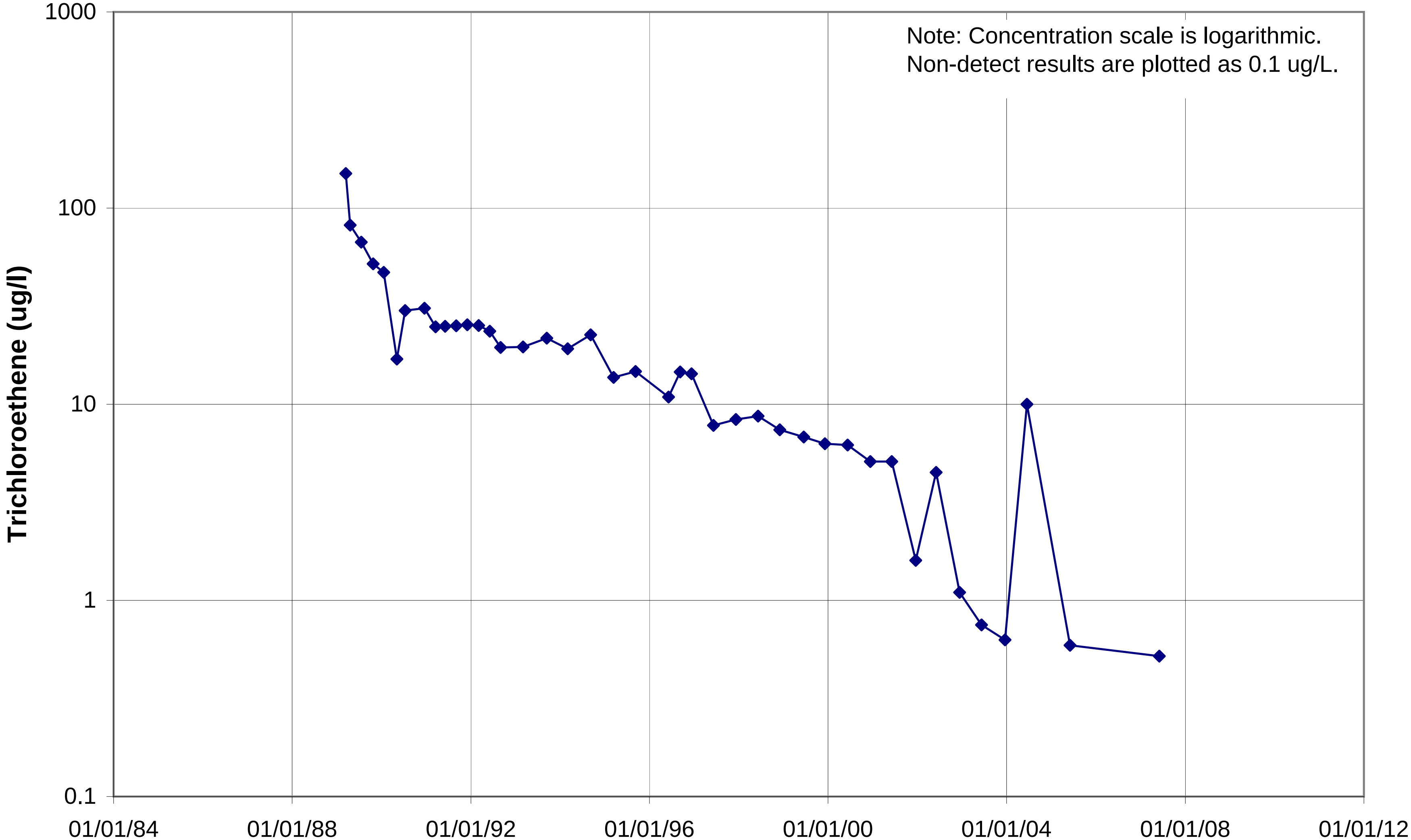
PJ#310 (B9)



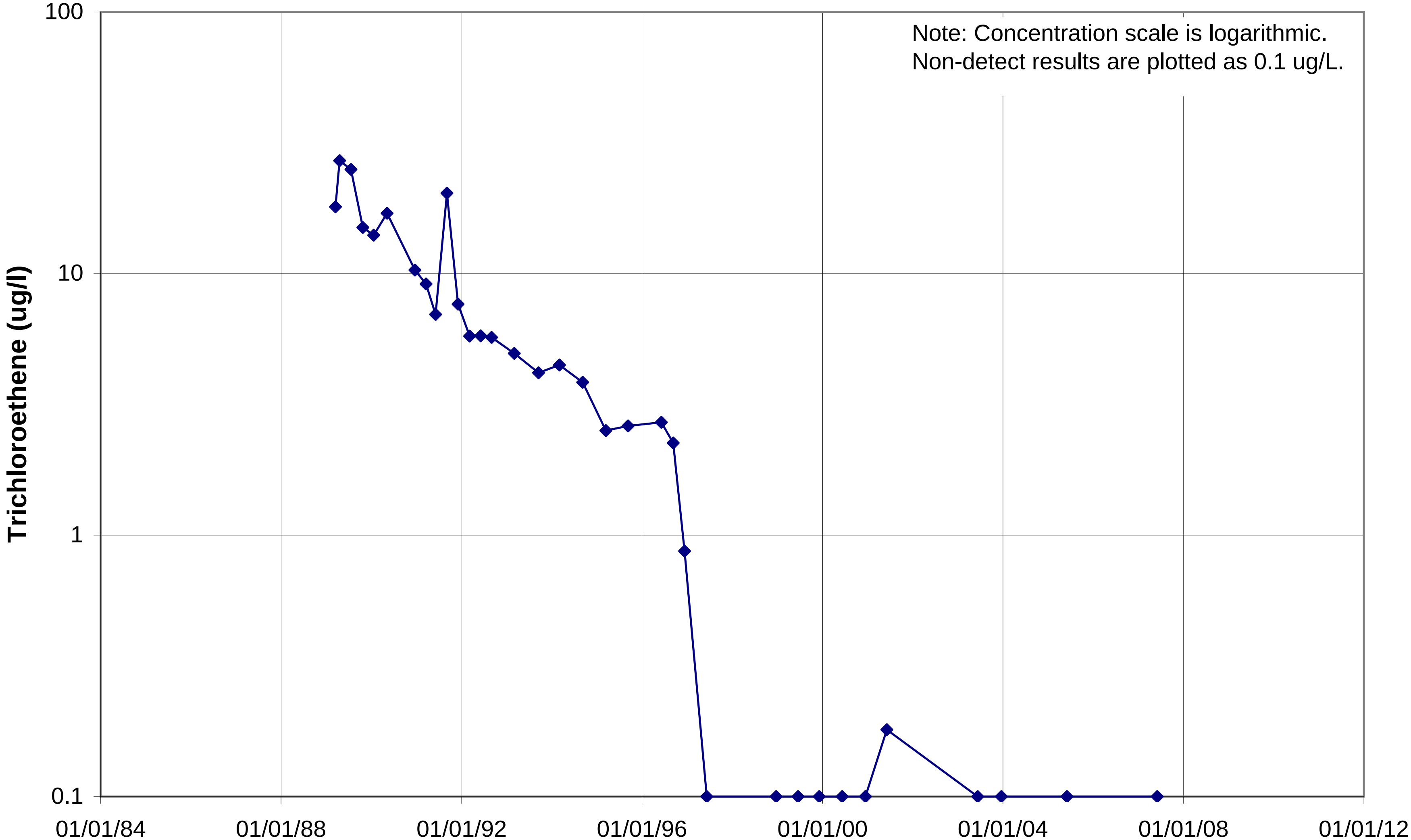
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

PJ#311 (B10)



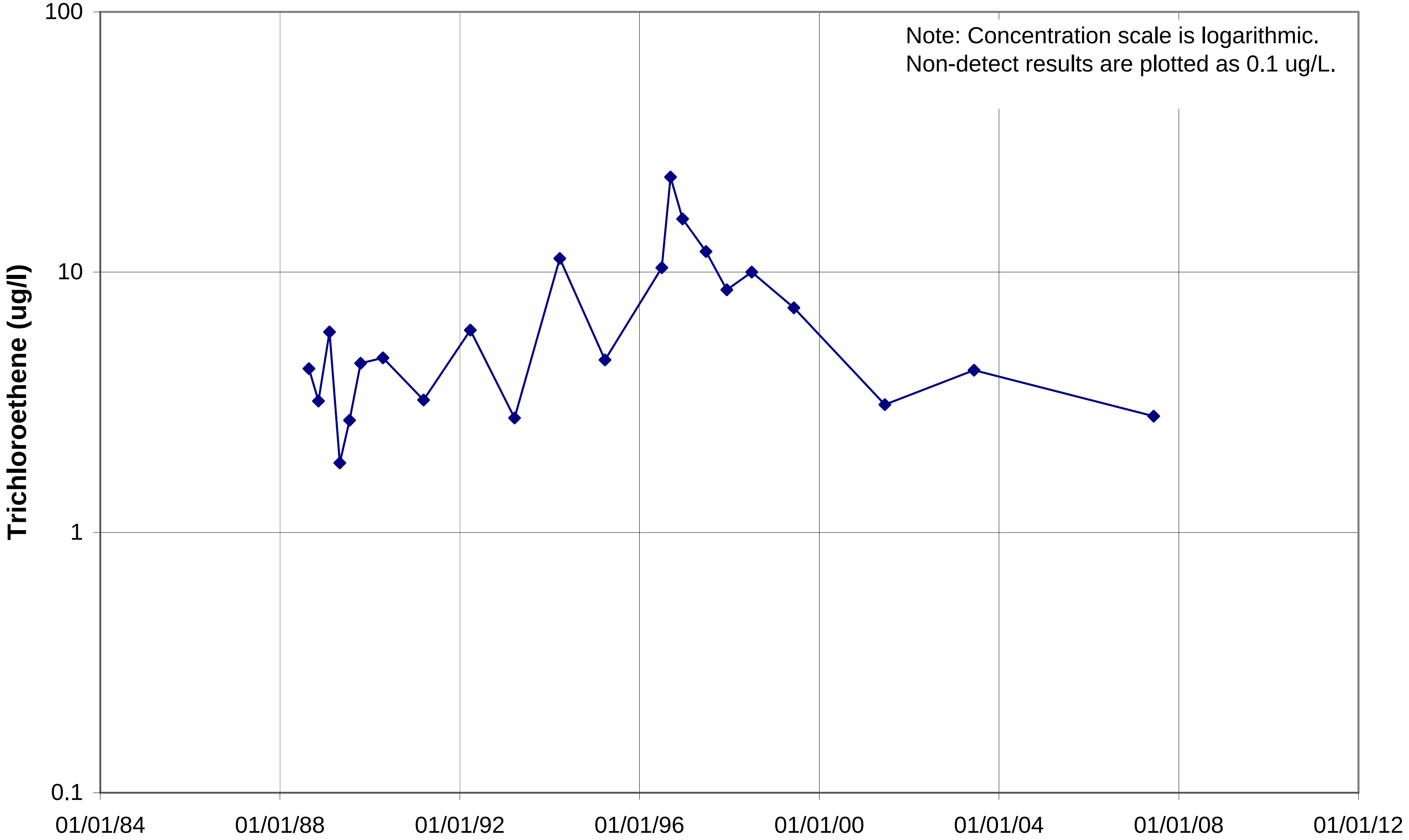
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

PJ#313 (B12)



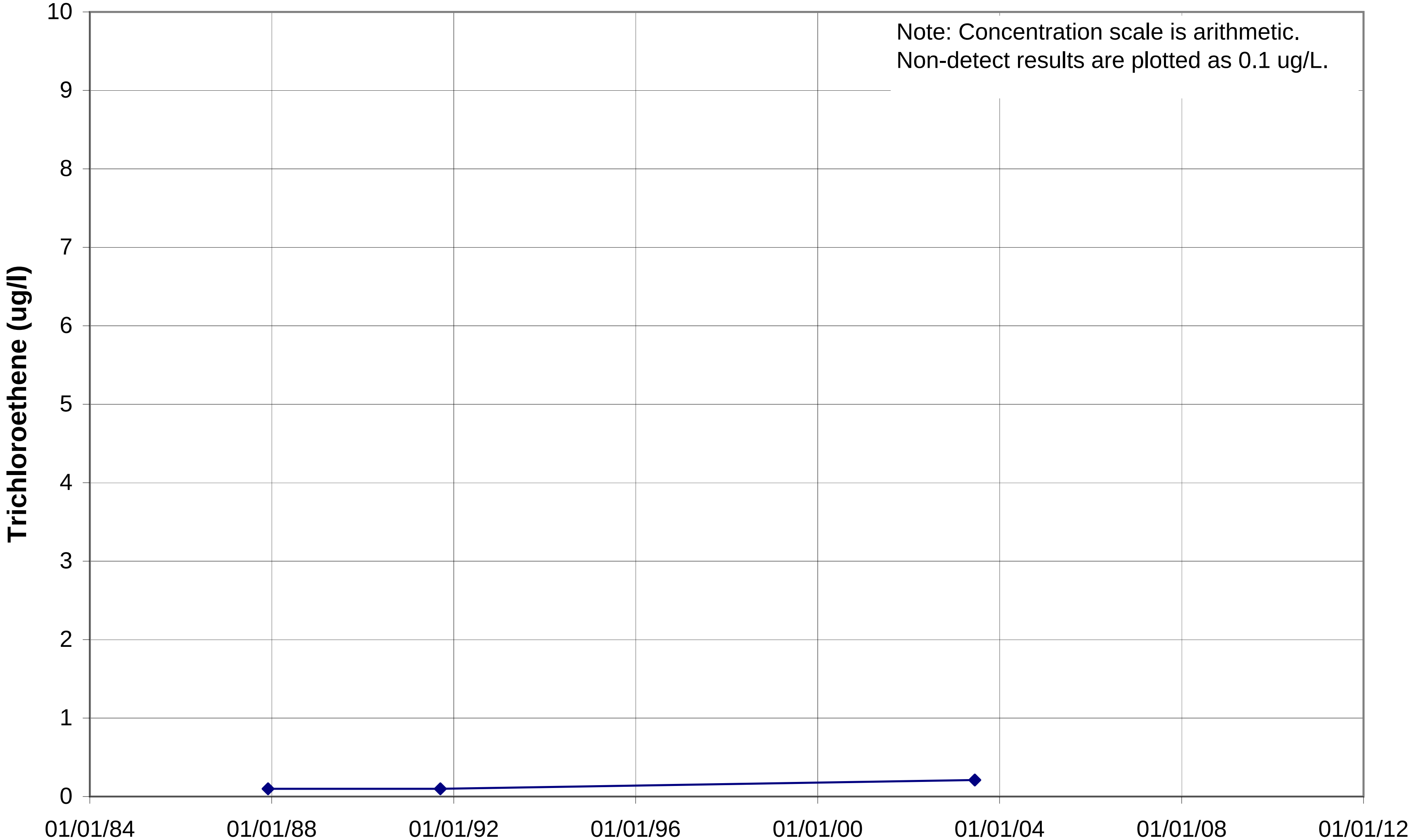
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

PJ#318



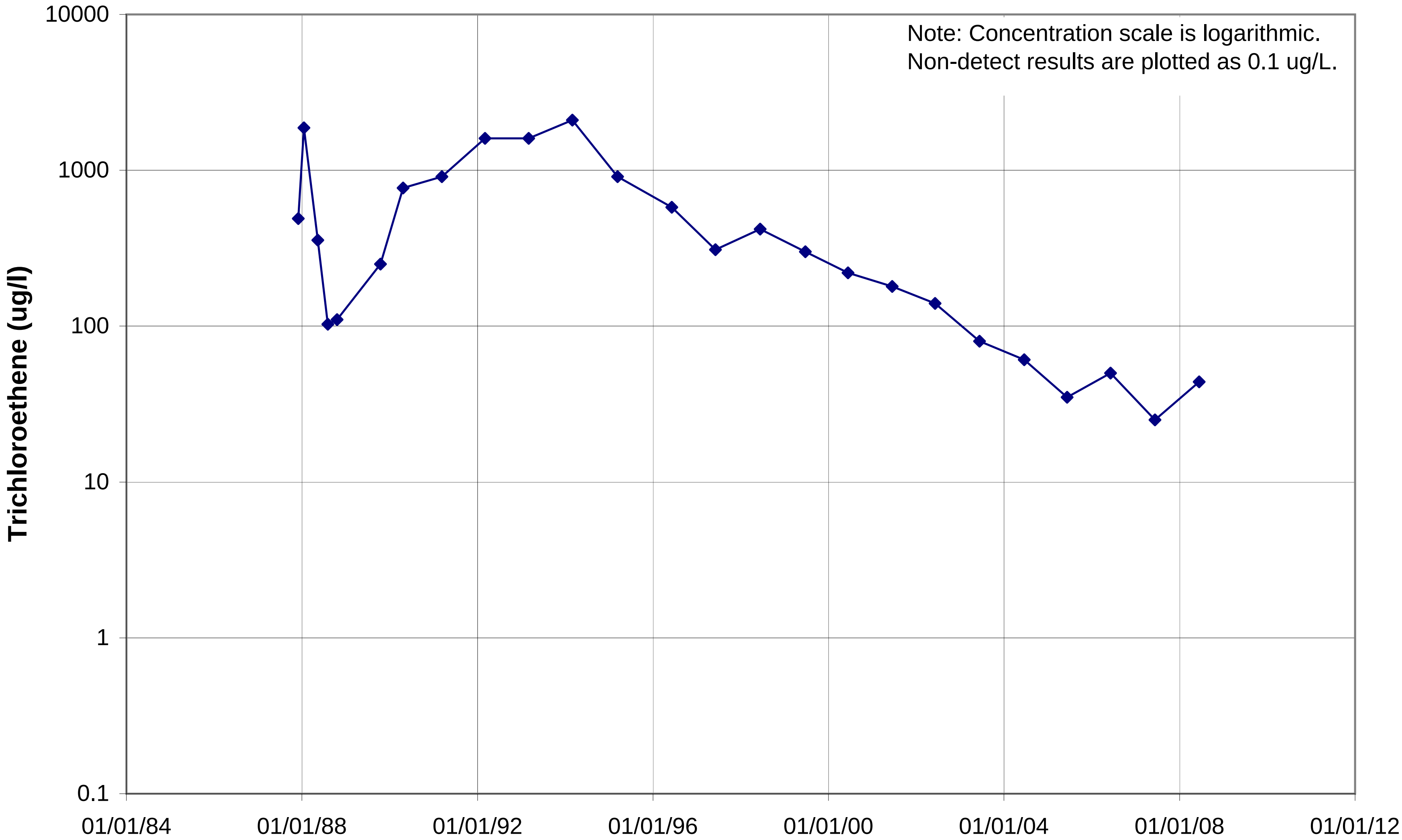
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

PJ#802

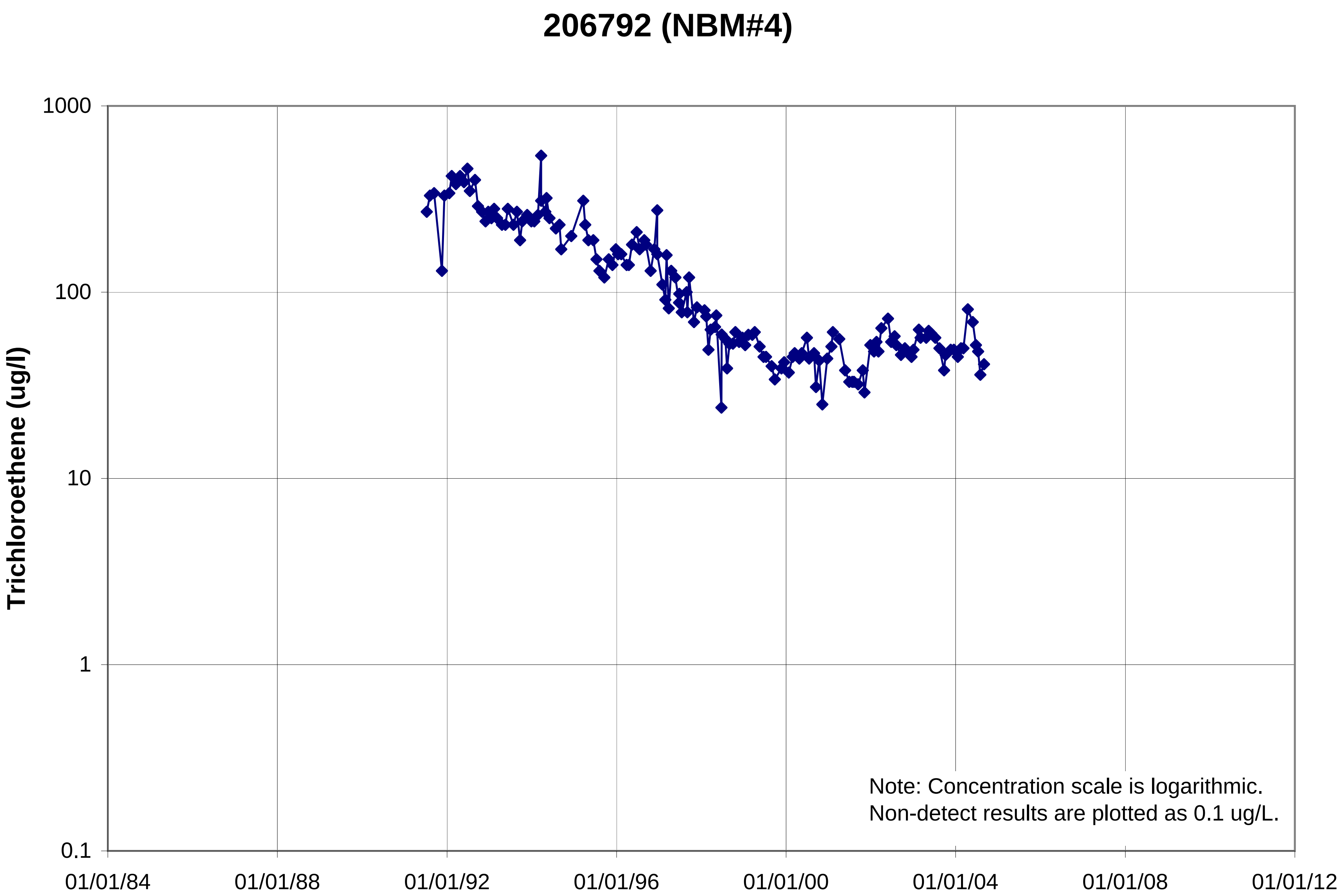


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

PJ#806

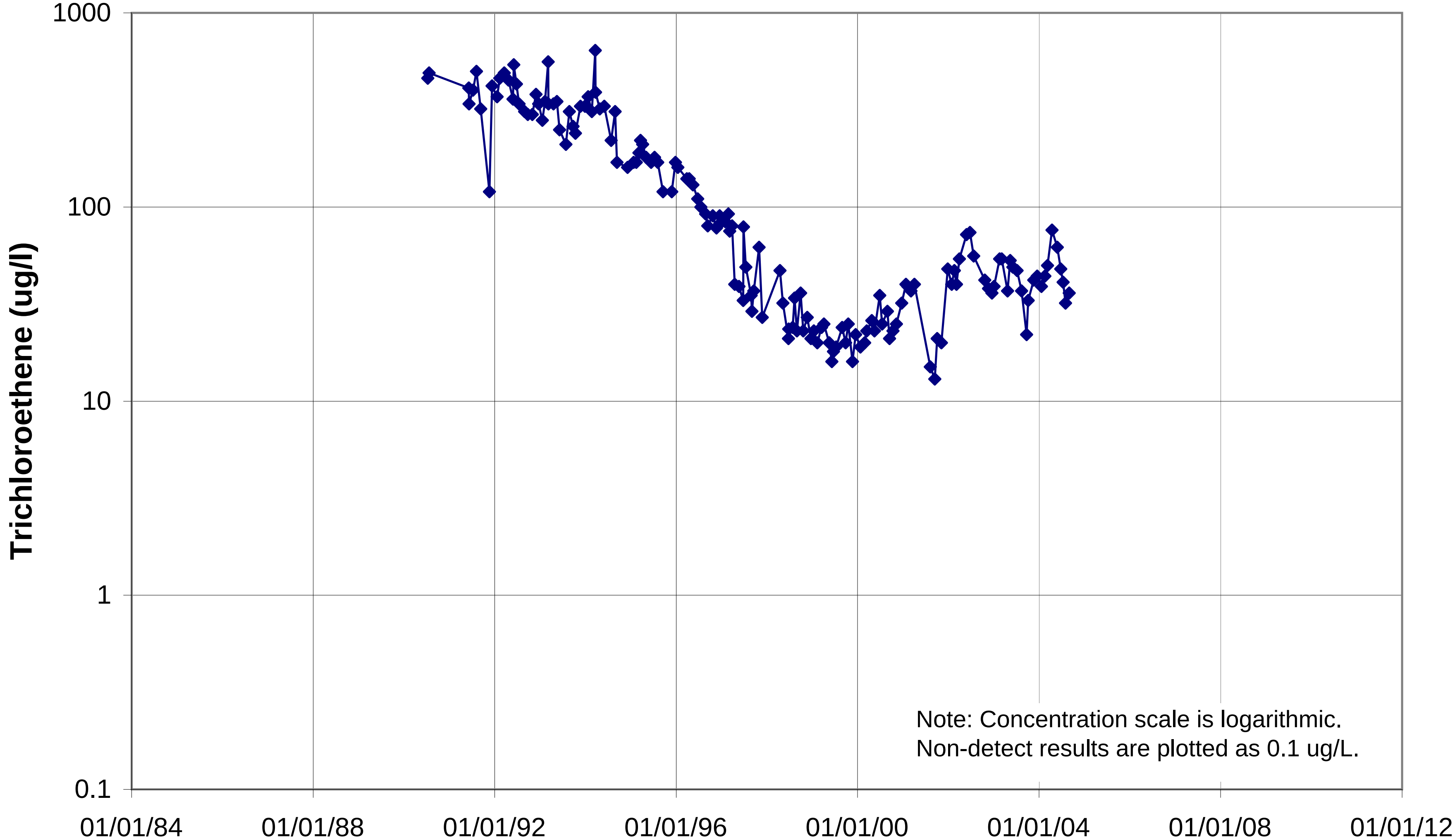


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

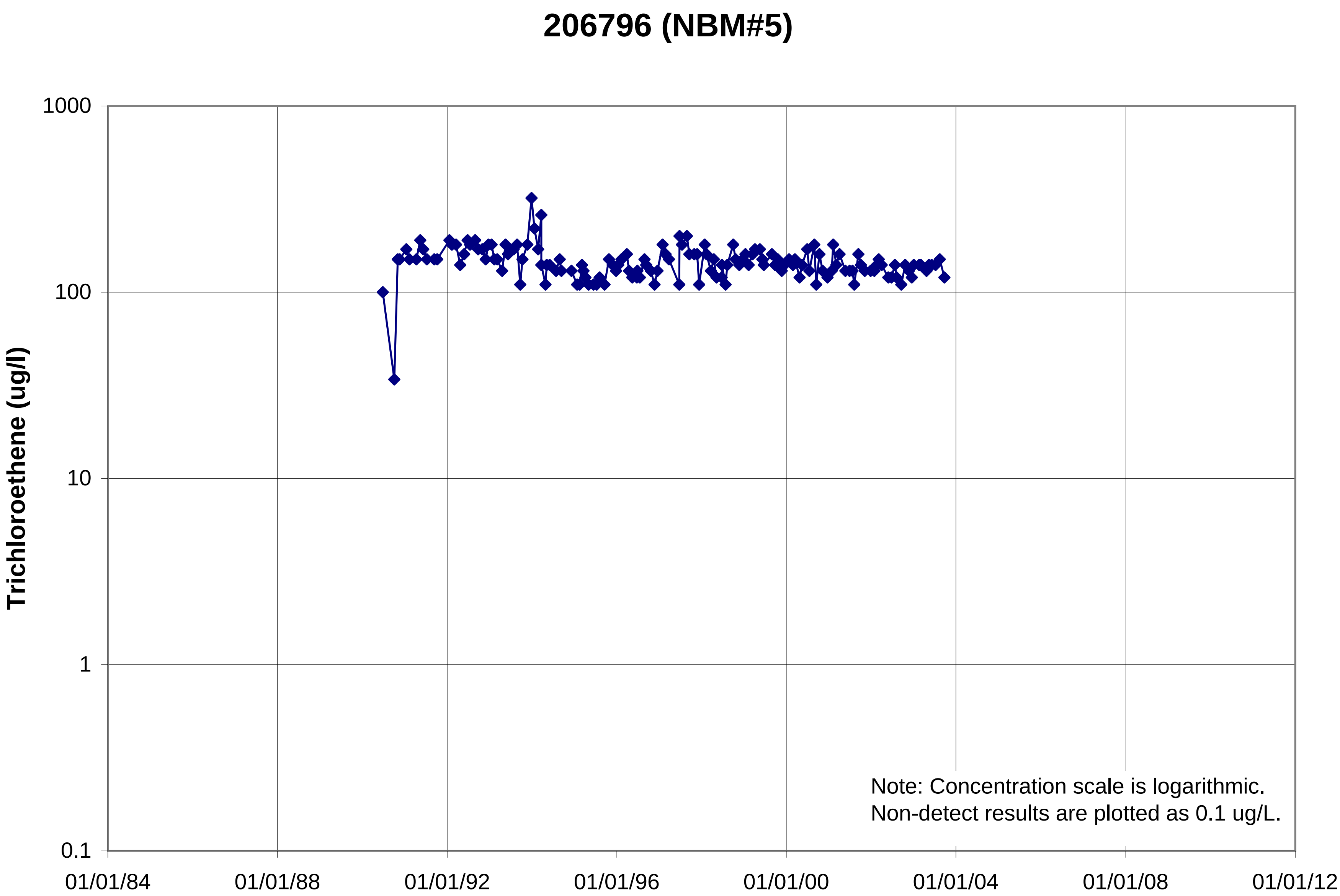


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

206793 (NBM#3)

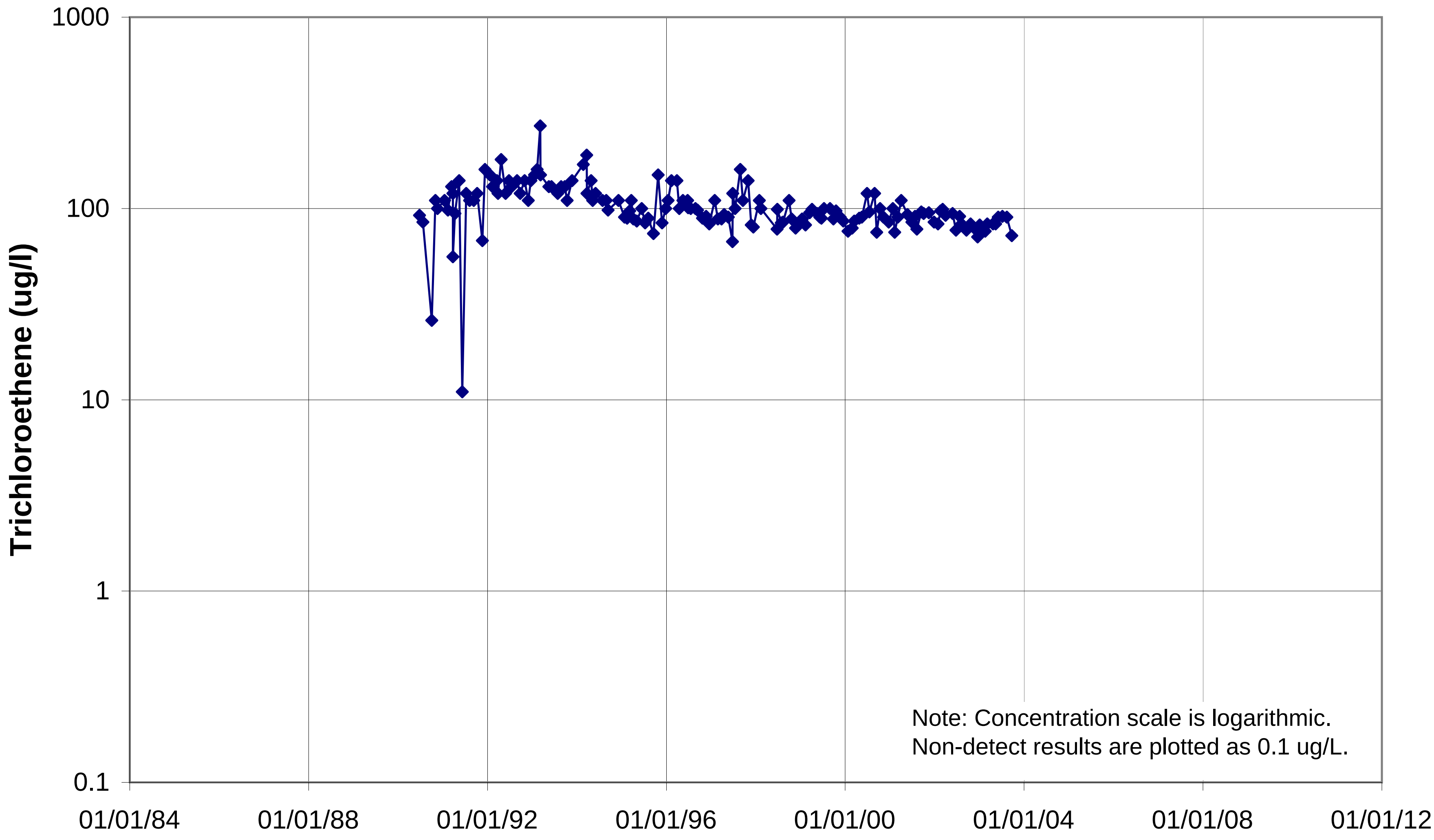


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar



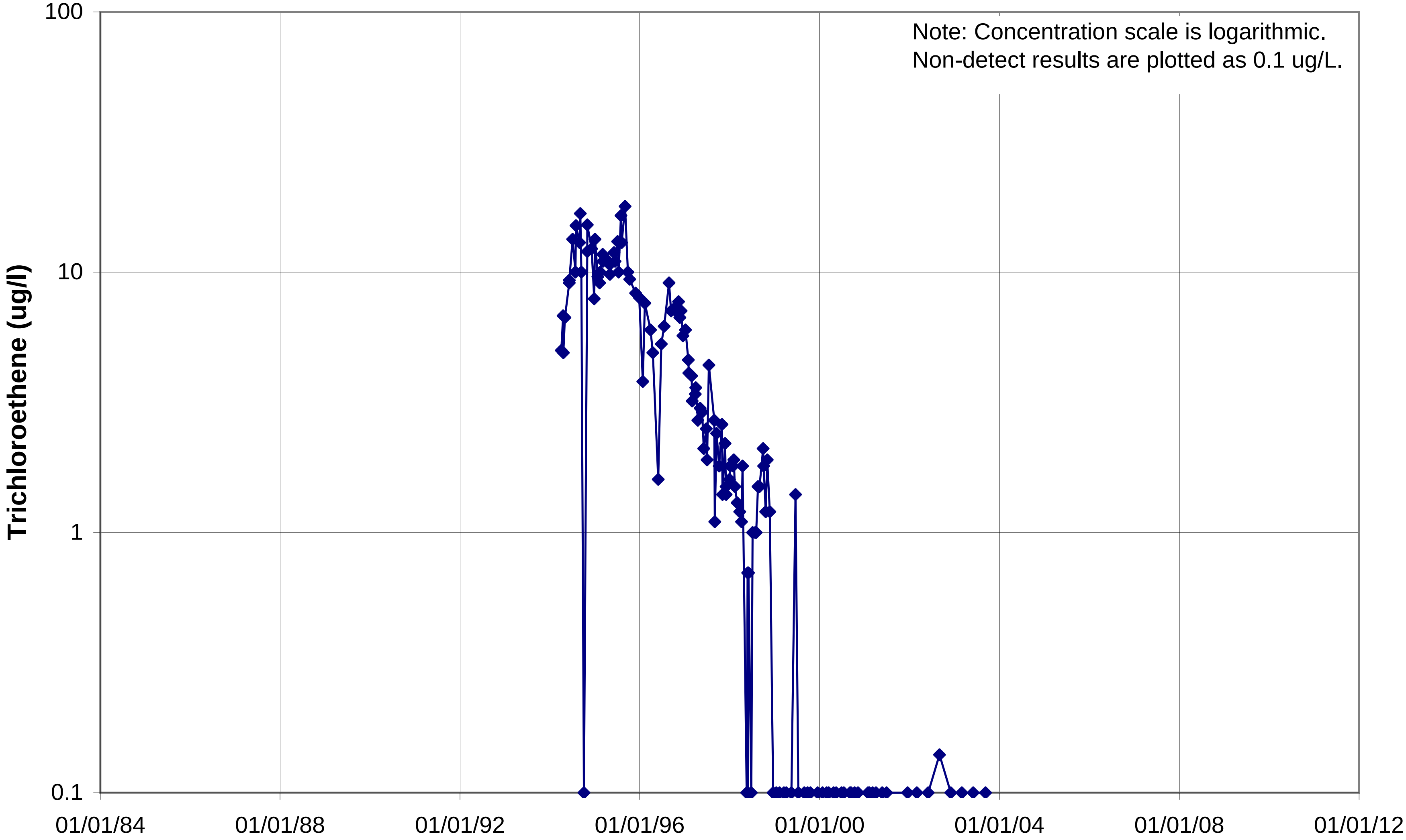
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

206797 (NBM#6)



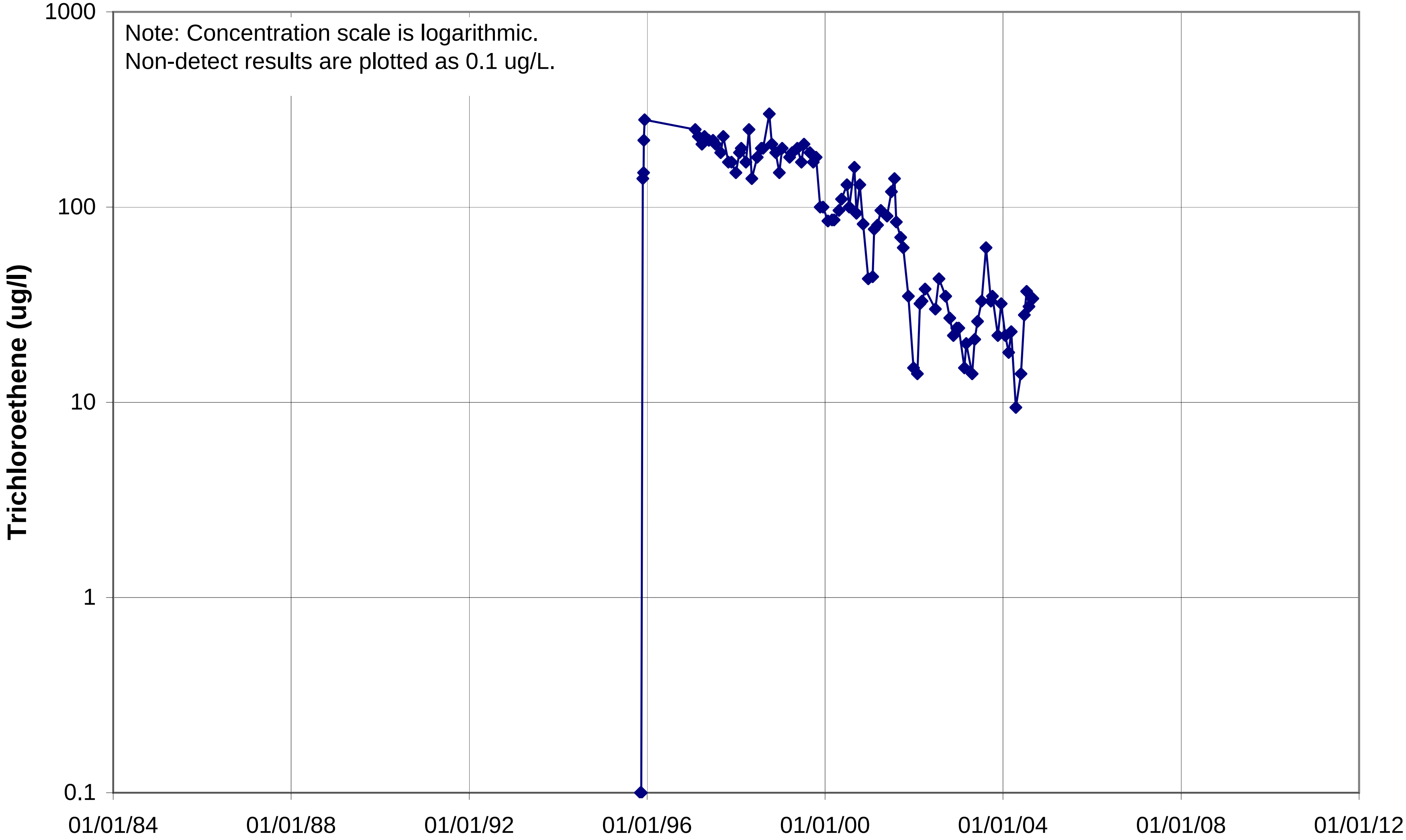
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

520931 (NBM#13)



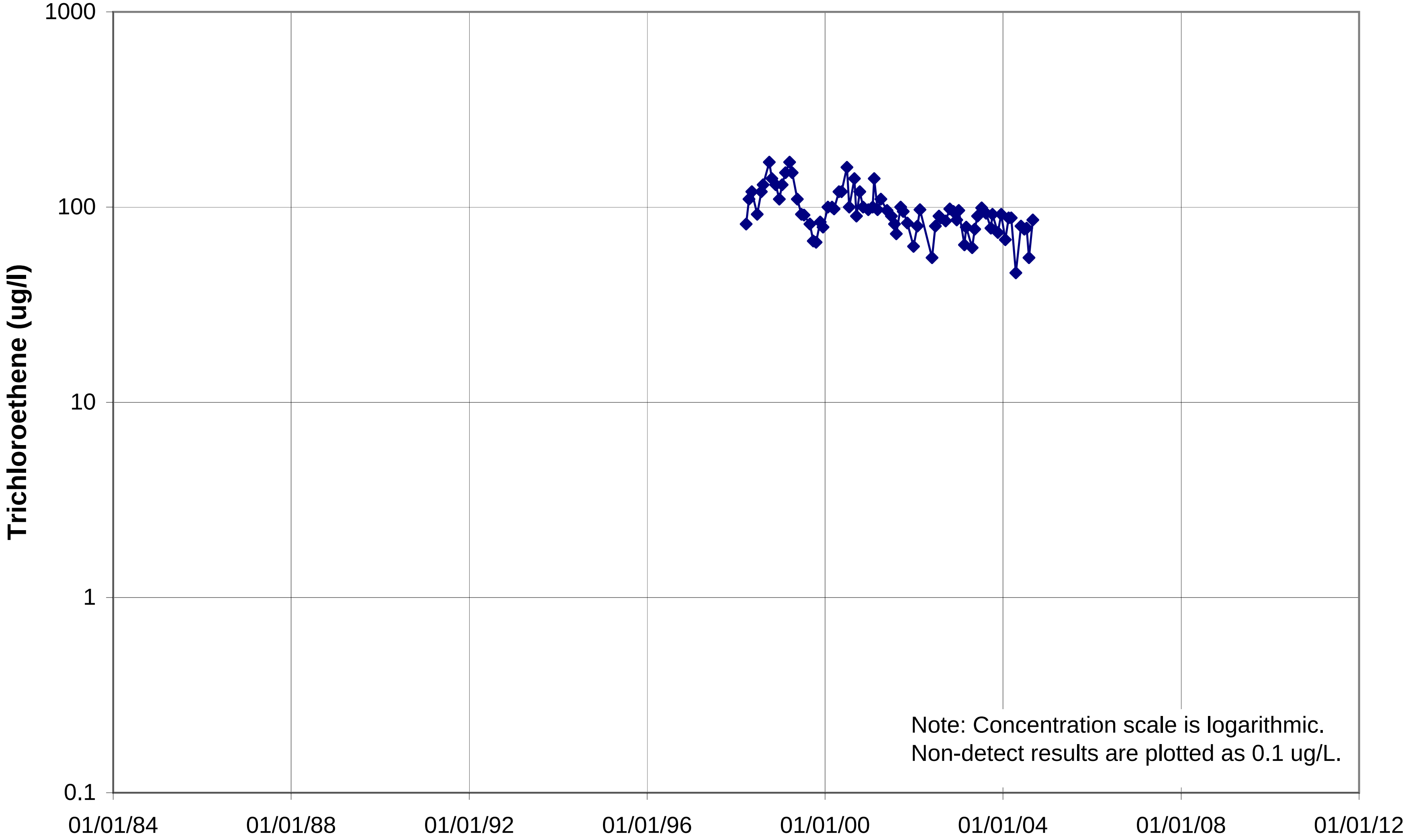
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

554216 (NBM#14)

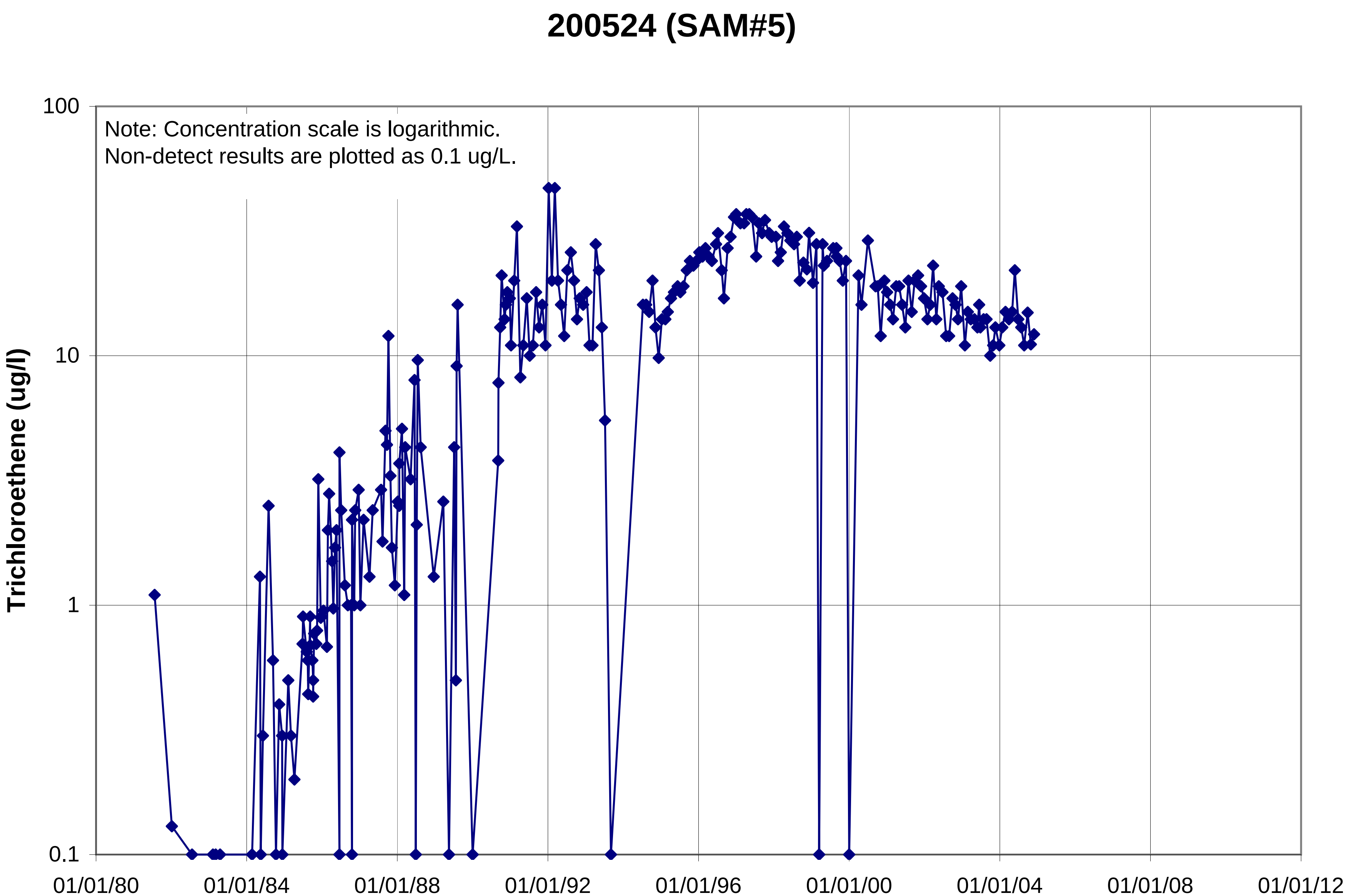


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

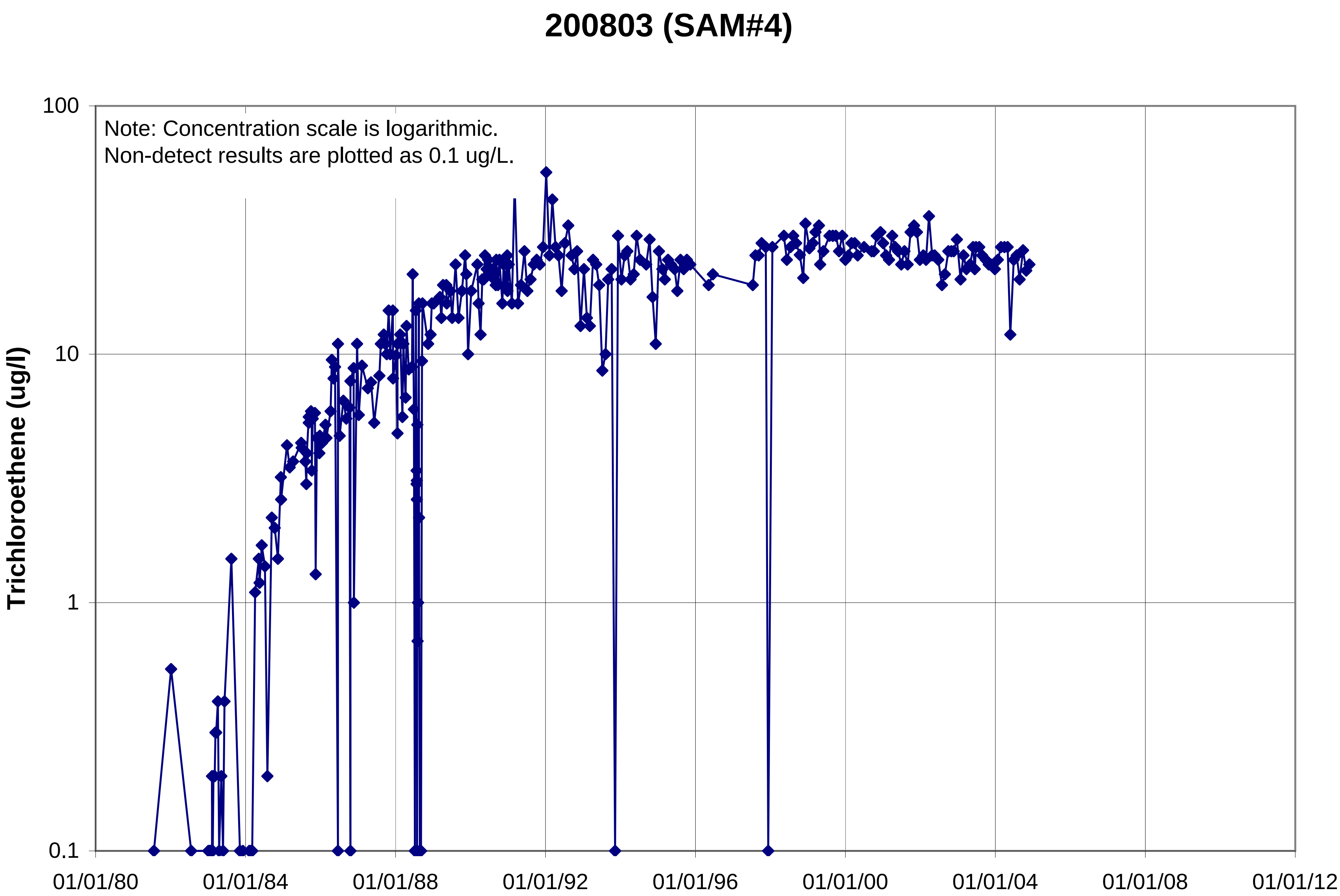
582628 (NBM#15)



TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

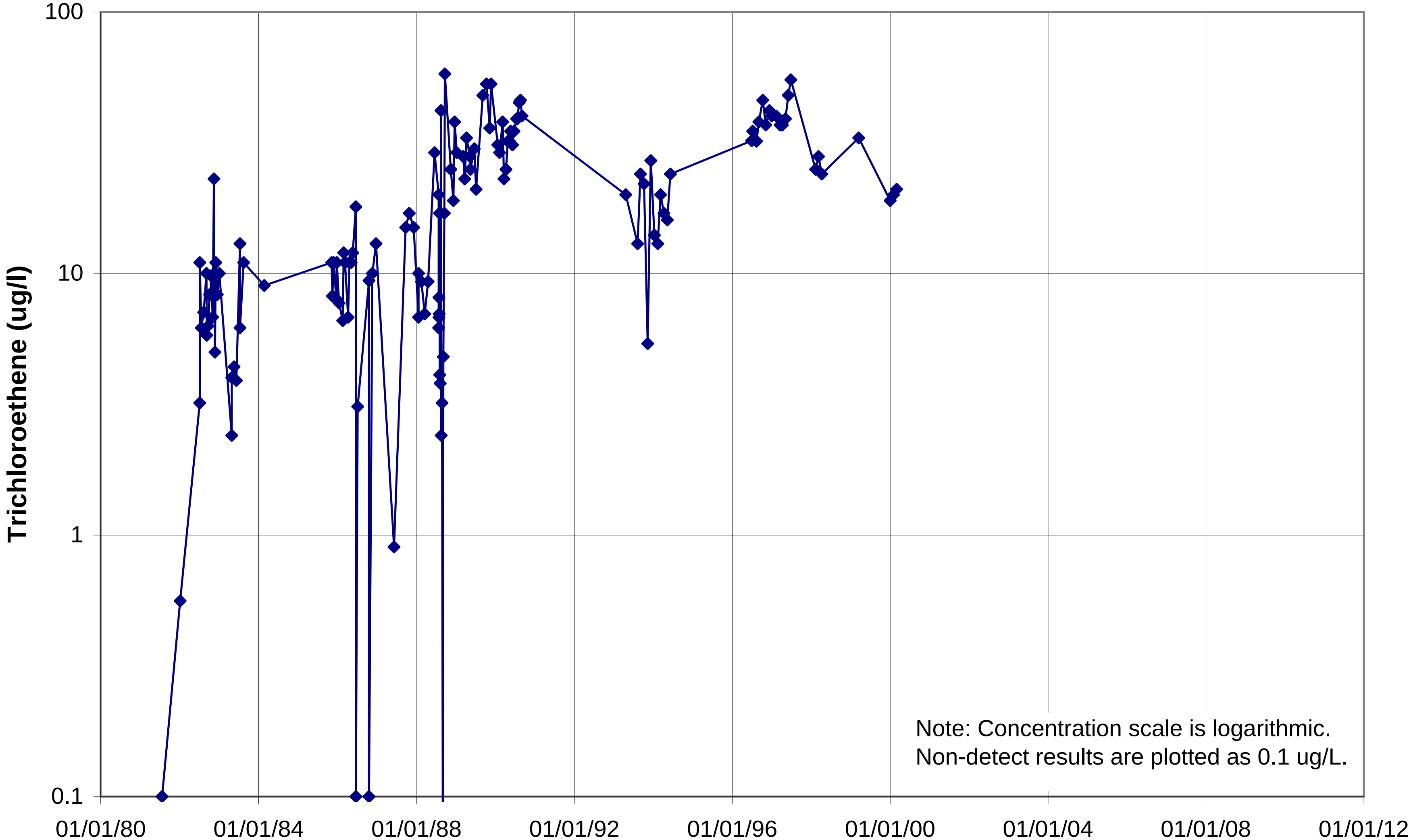


TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

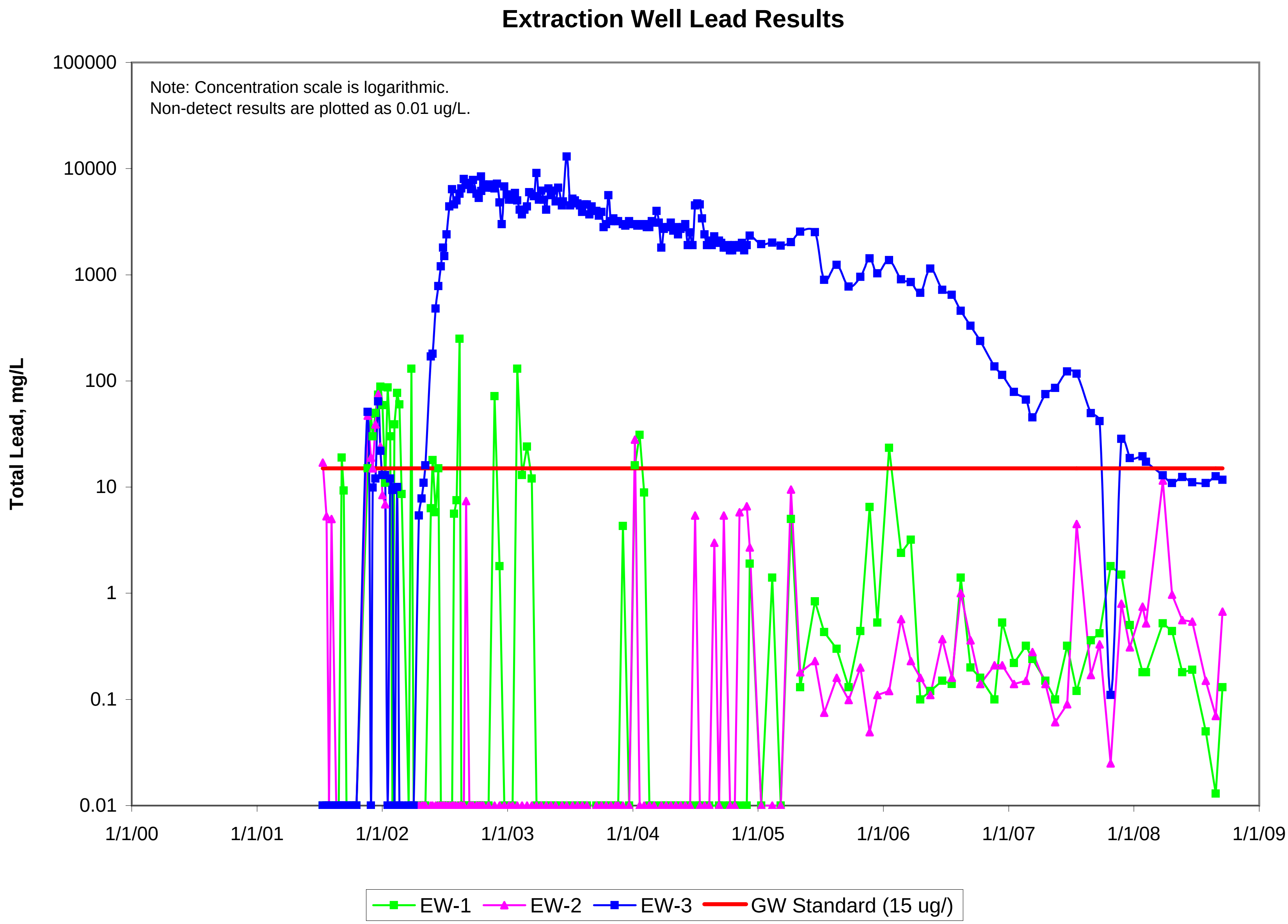


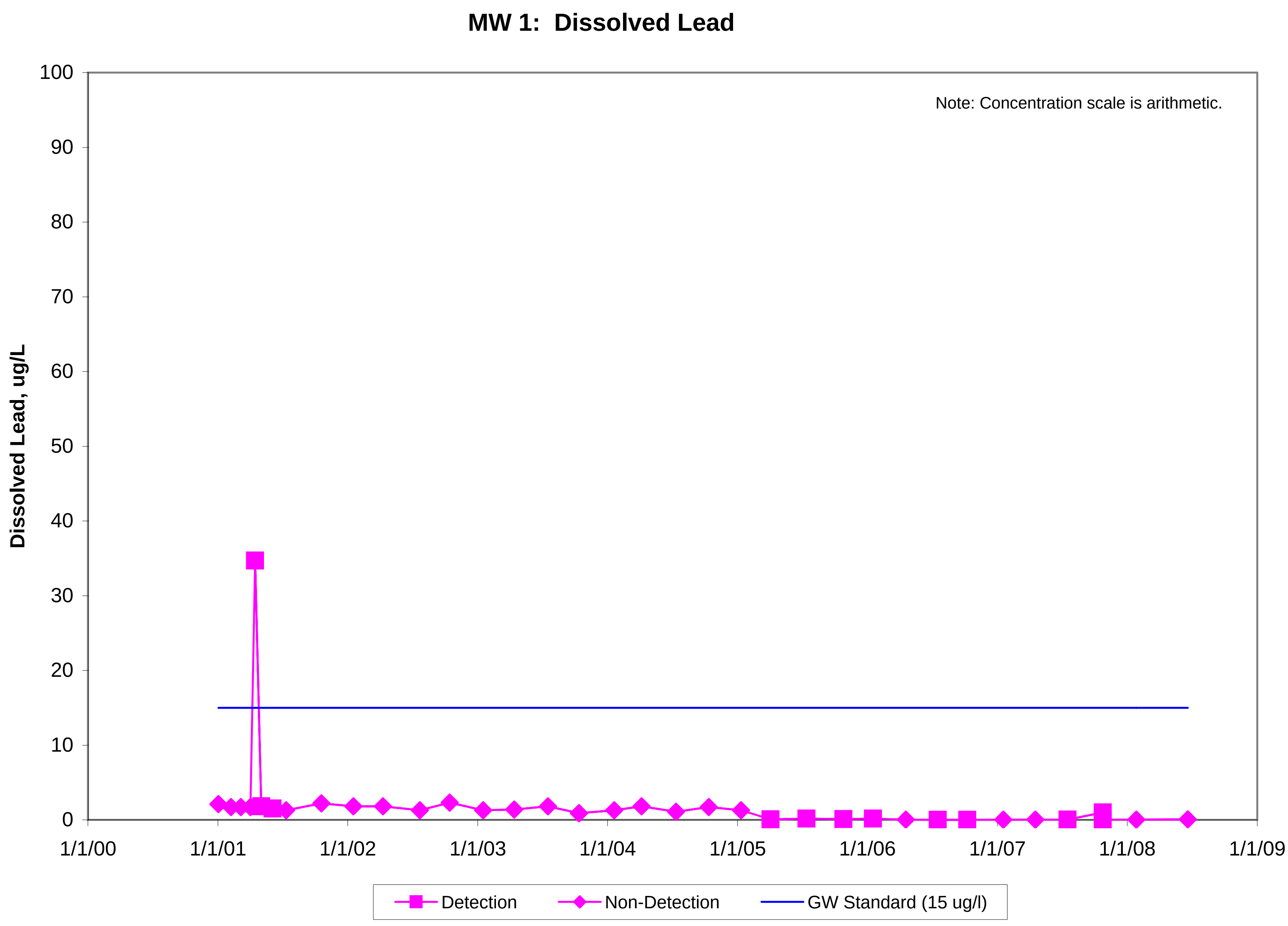
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar

200804 (SAM#3)

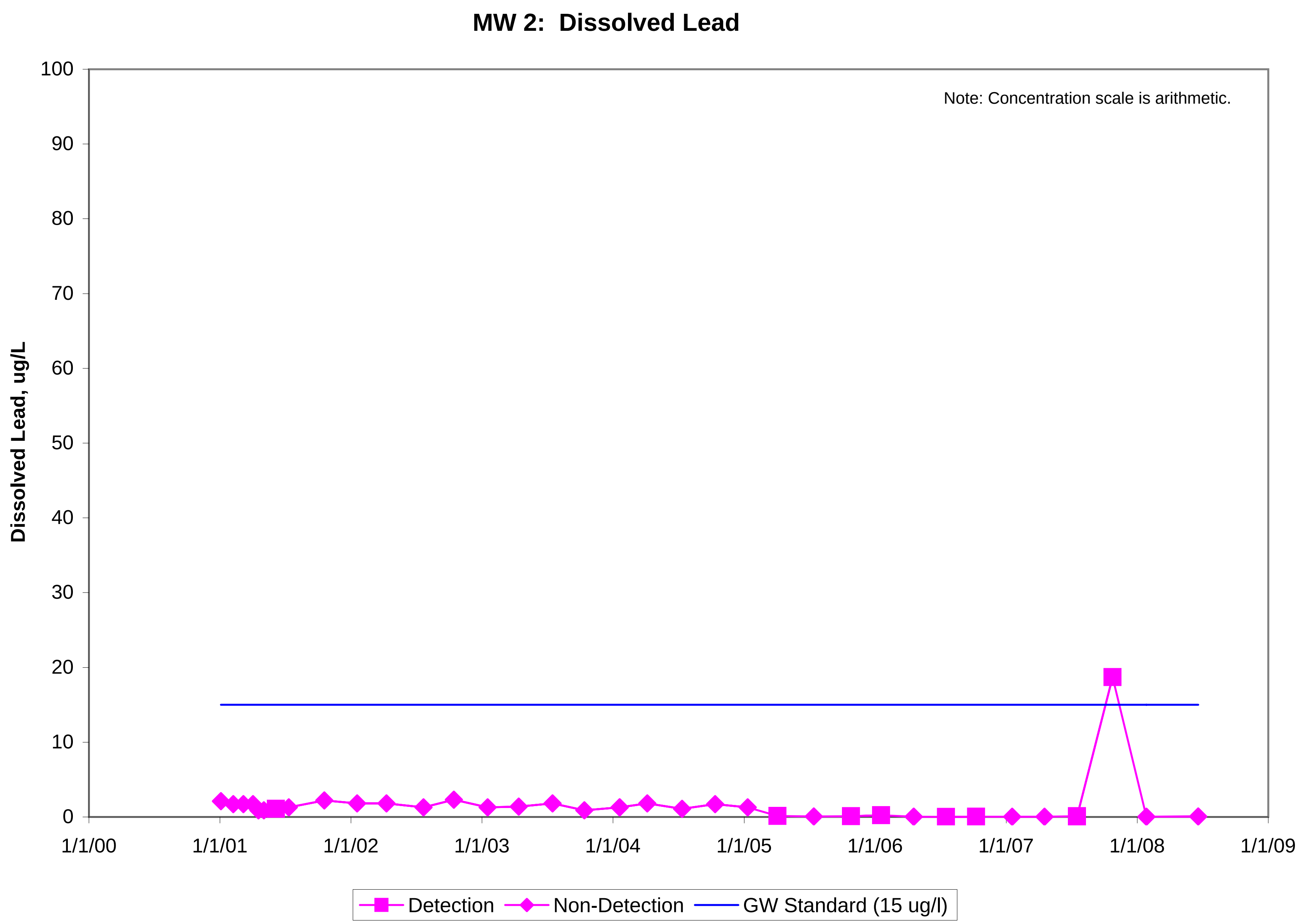


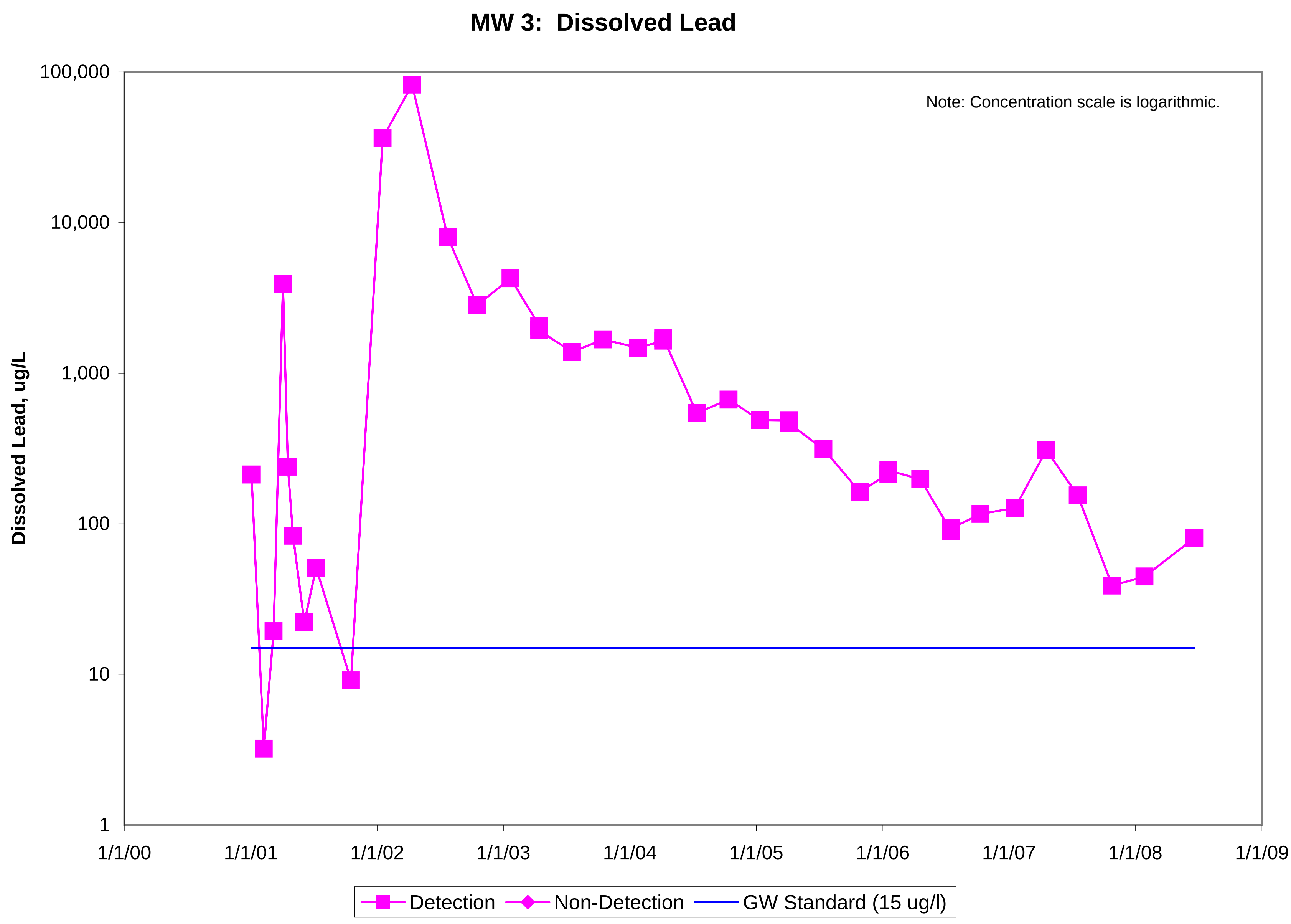
TO RETURN TO MAP: Click on "Go To Previous View" Button in the Tool Bar


Extraction Well Lead Results
Note: Concentration scale is logarithmic.
Non-detect results are plotted as 0.01 ug/L.
Total Lead, mg/L
100000
10000
1000
100
10
1
0.1
0.01
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
EW-1
EW-2
EW-3
GW Standard (15 ug/)

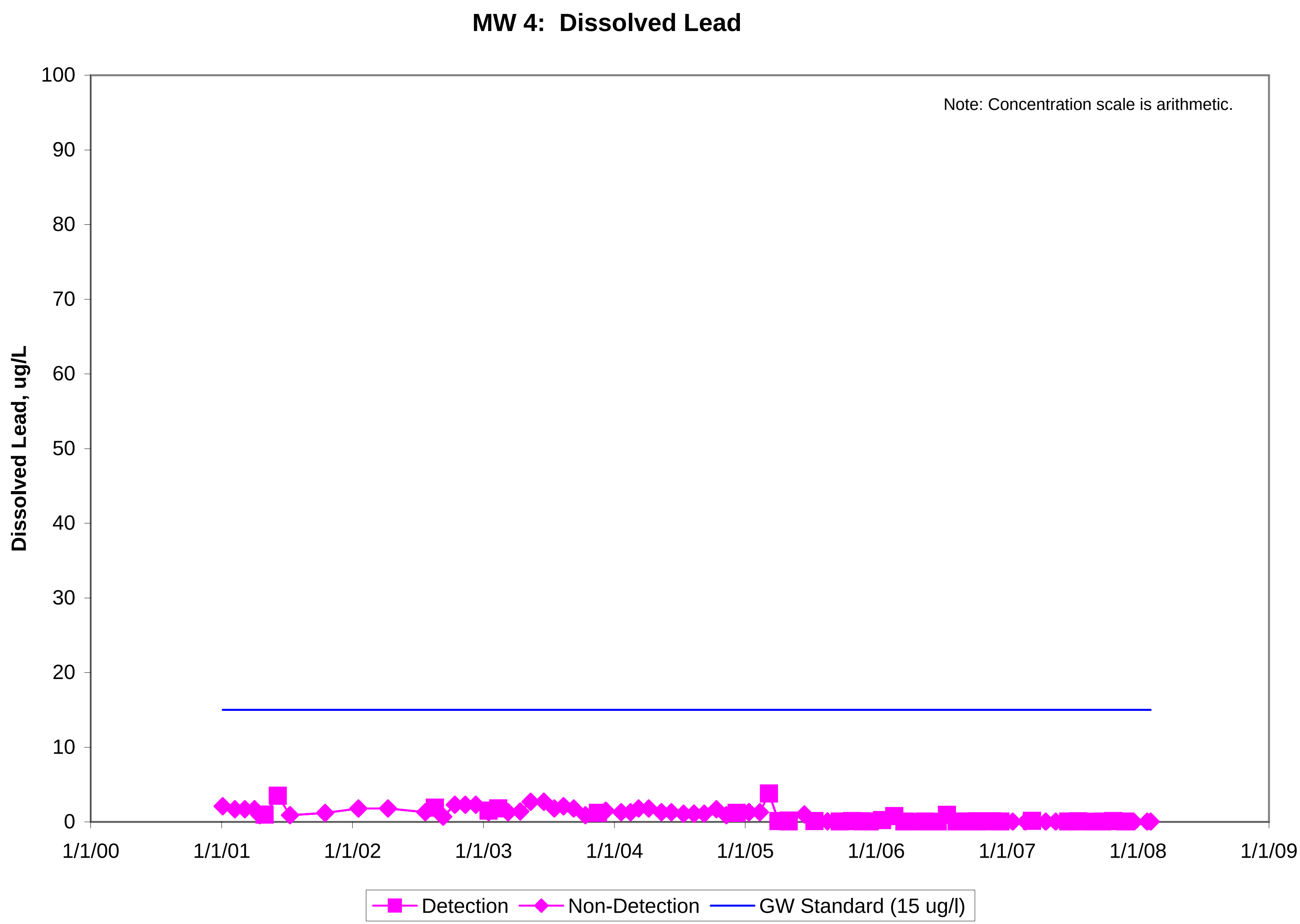


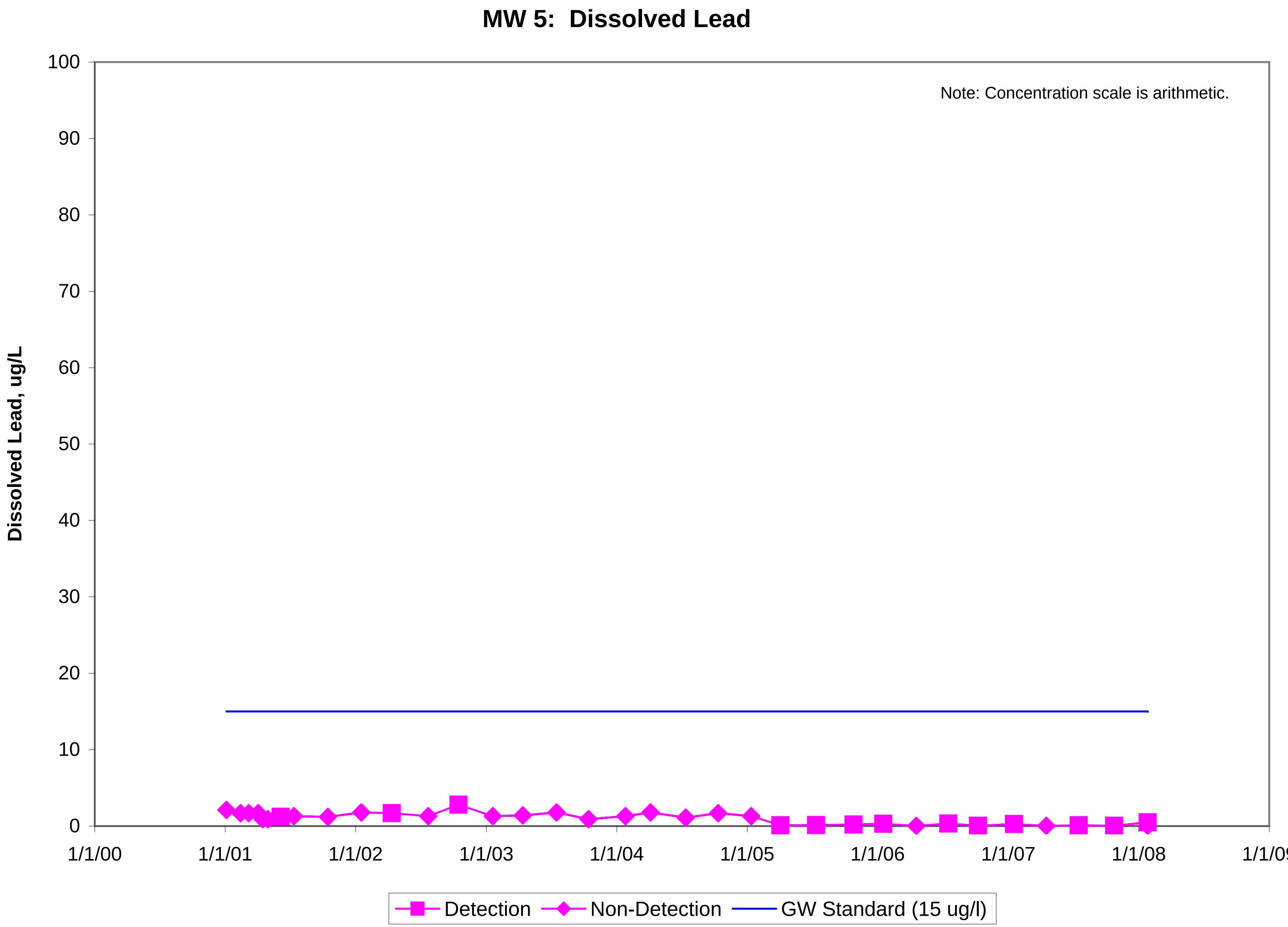
MW 1: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

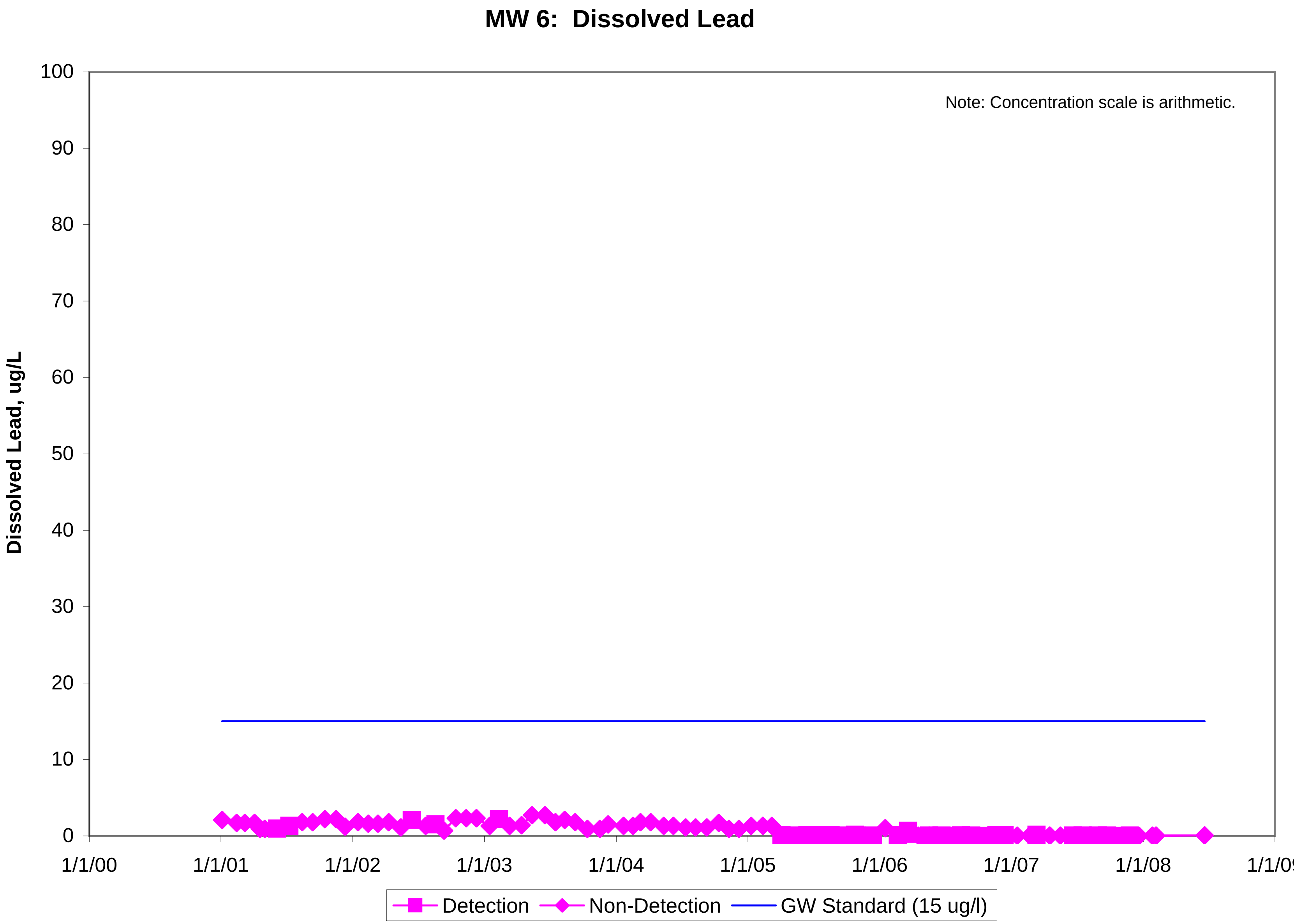

MW 2: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

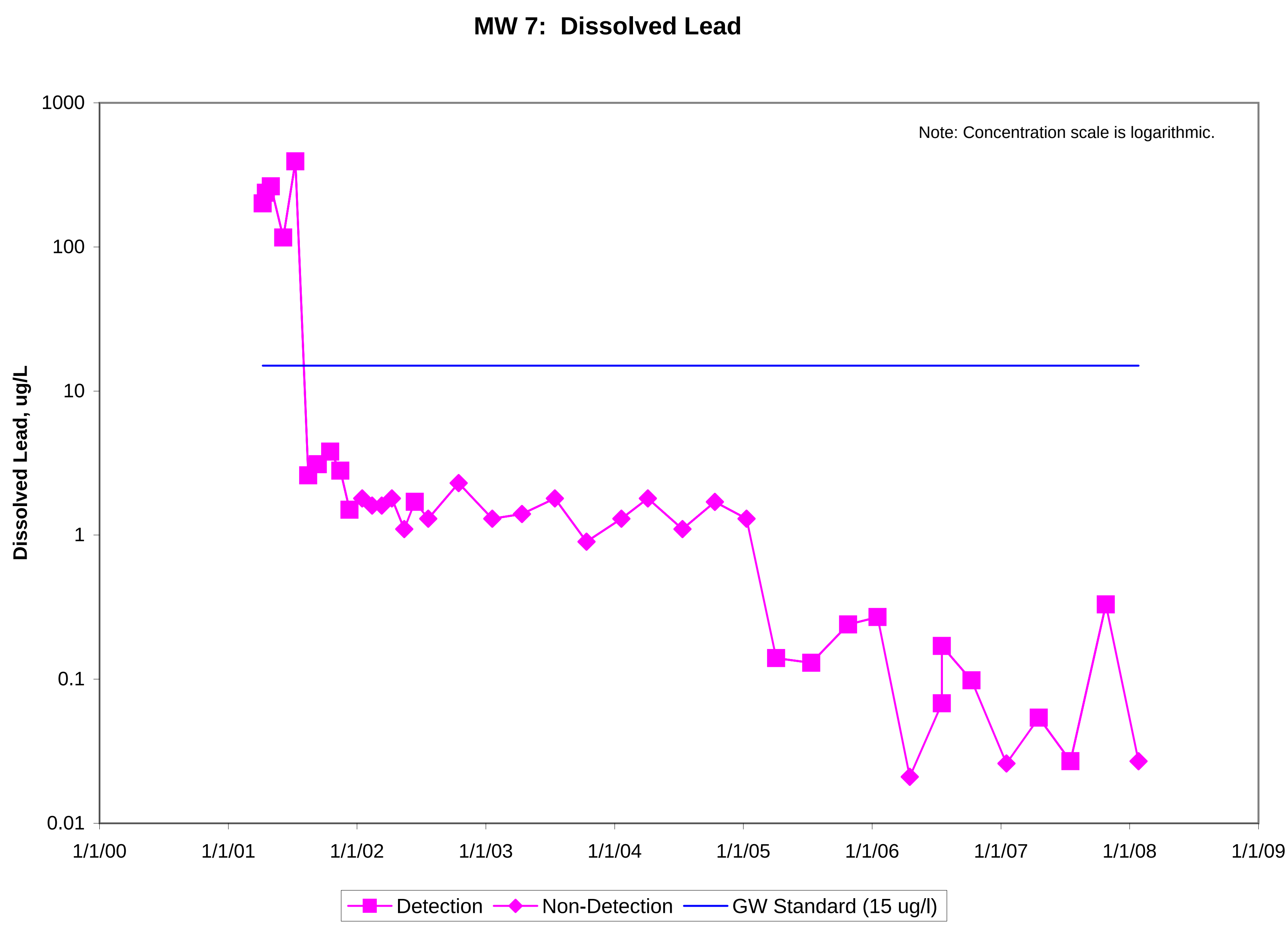


MW 3: Dissolved Lead
Dissolved Lead, ug/L
100,000
10,000
1,000
100
10
1
Note: Concentration scale is logarithmic.
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

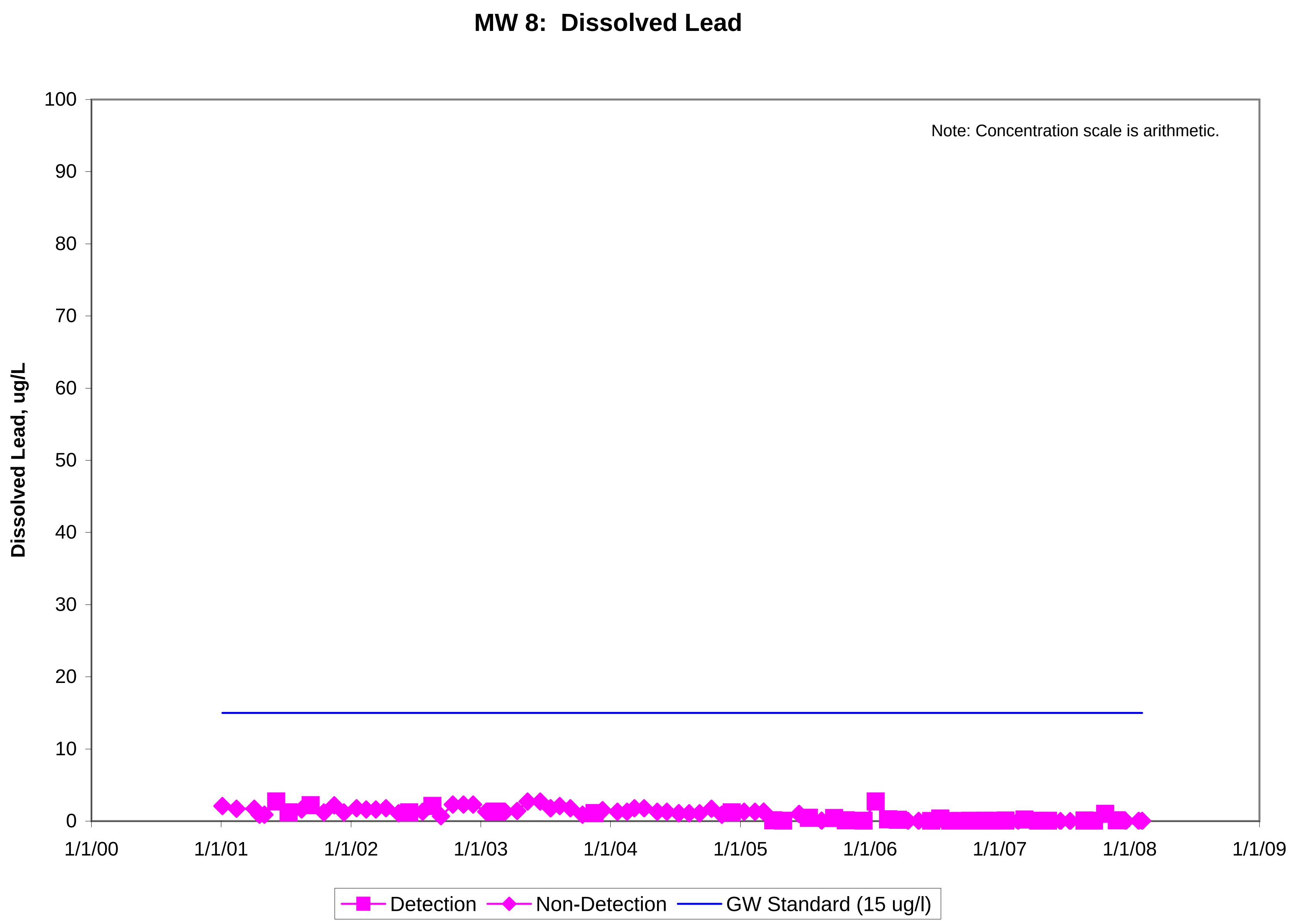

MW 4: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)


MW 5: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

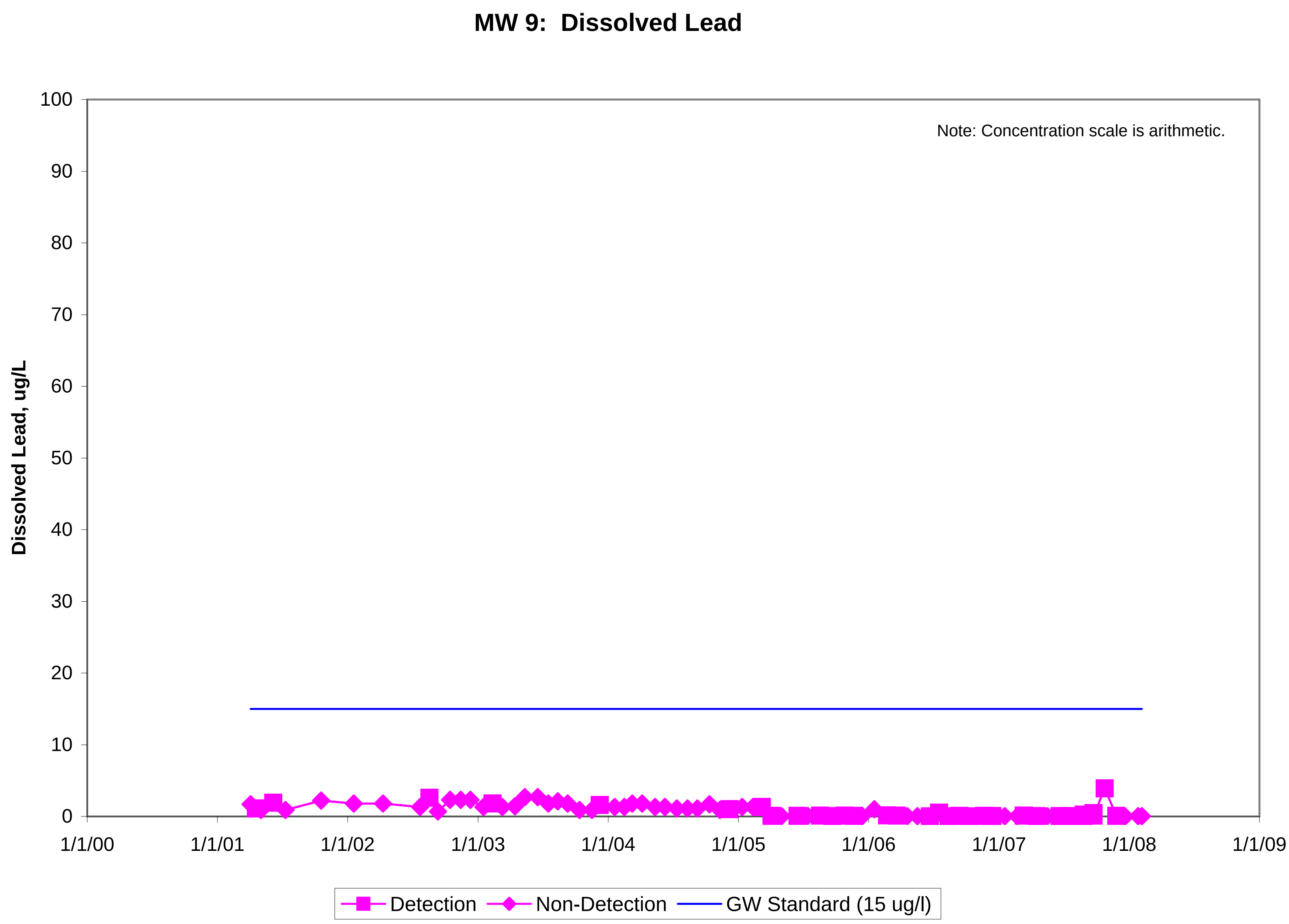

MW 6: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

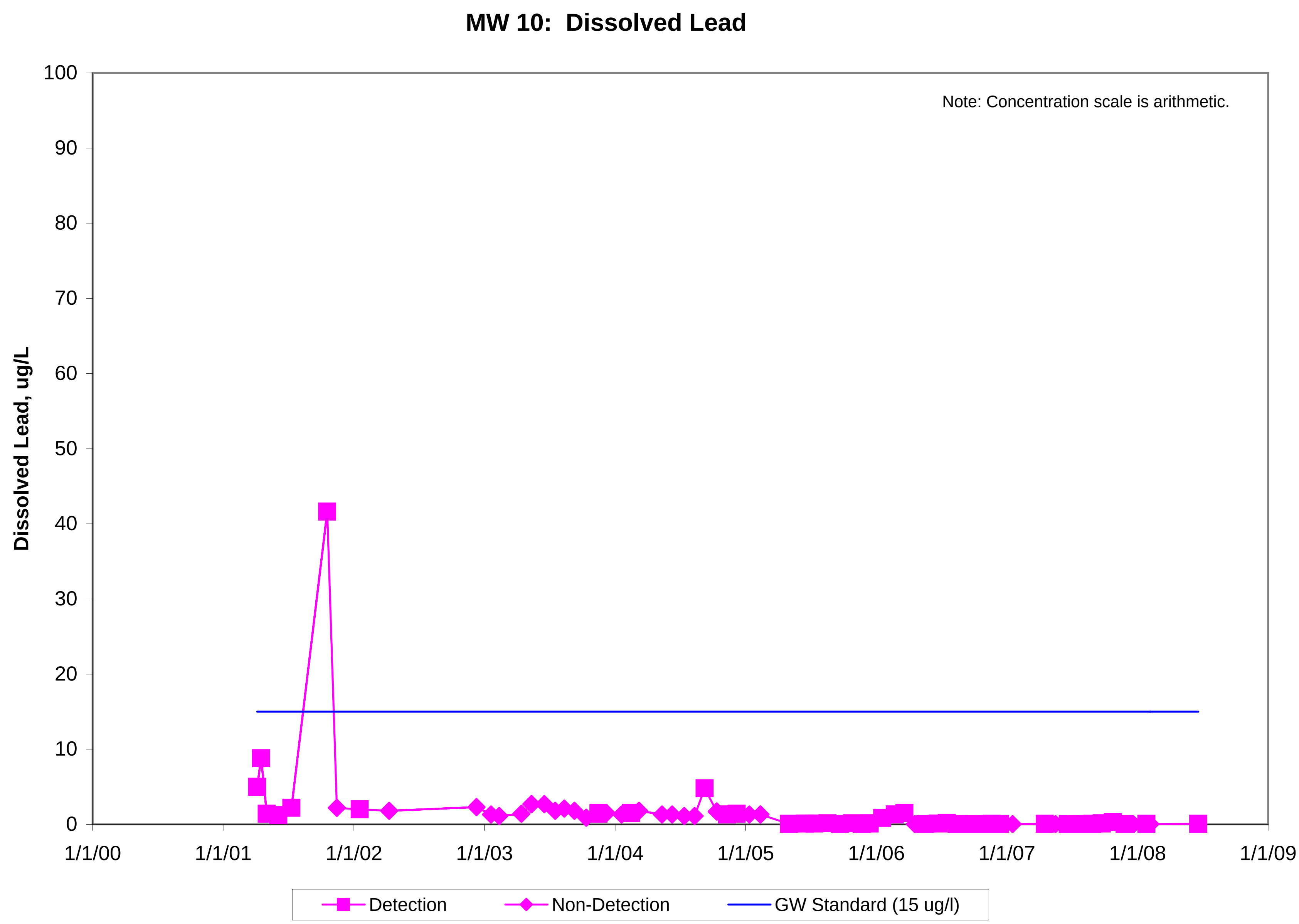


MW 7: Dissolved Lead
Note: Concentration scale is logarithmic.
Dissolved Lead, ug/L
1000
100
10
1
0.1
0.01
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

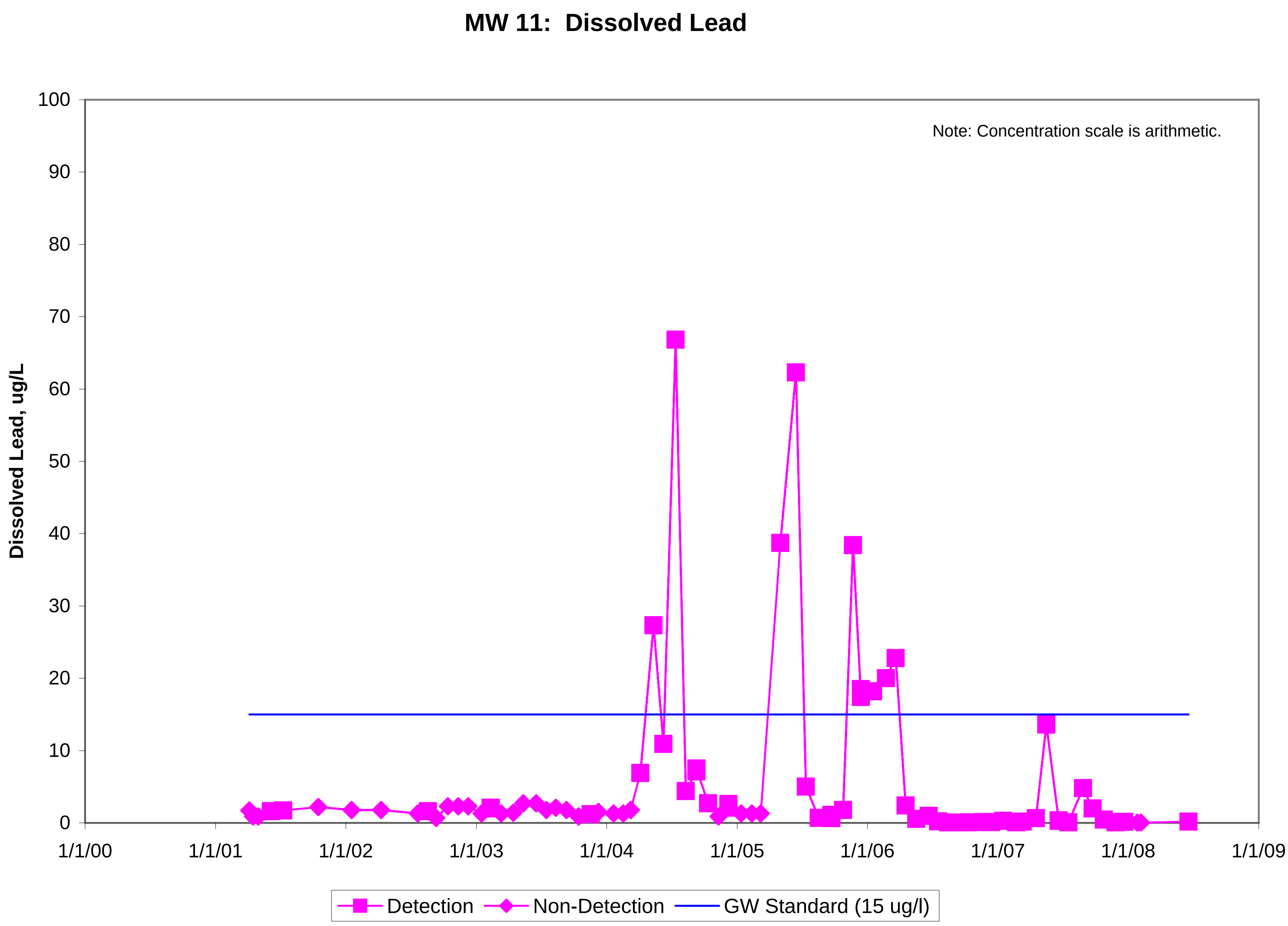


MW 8: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

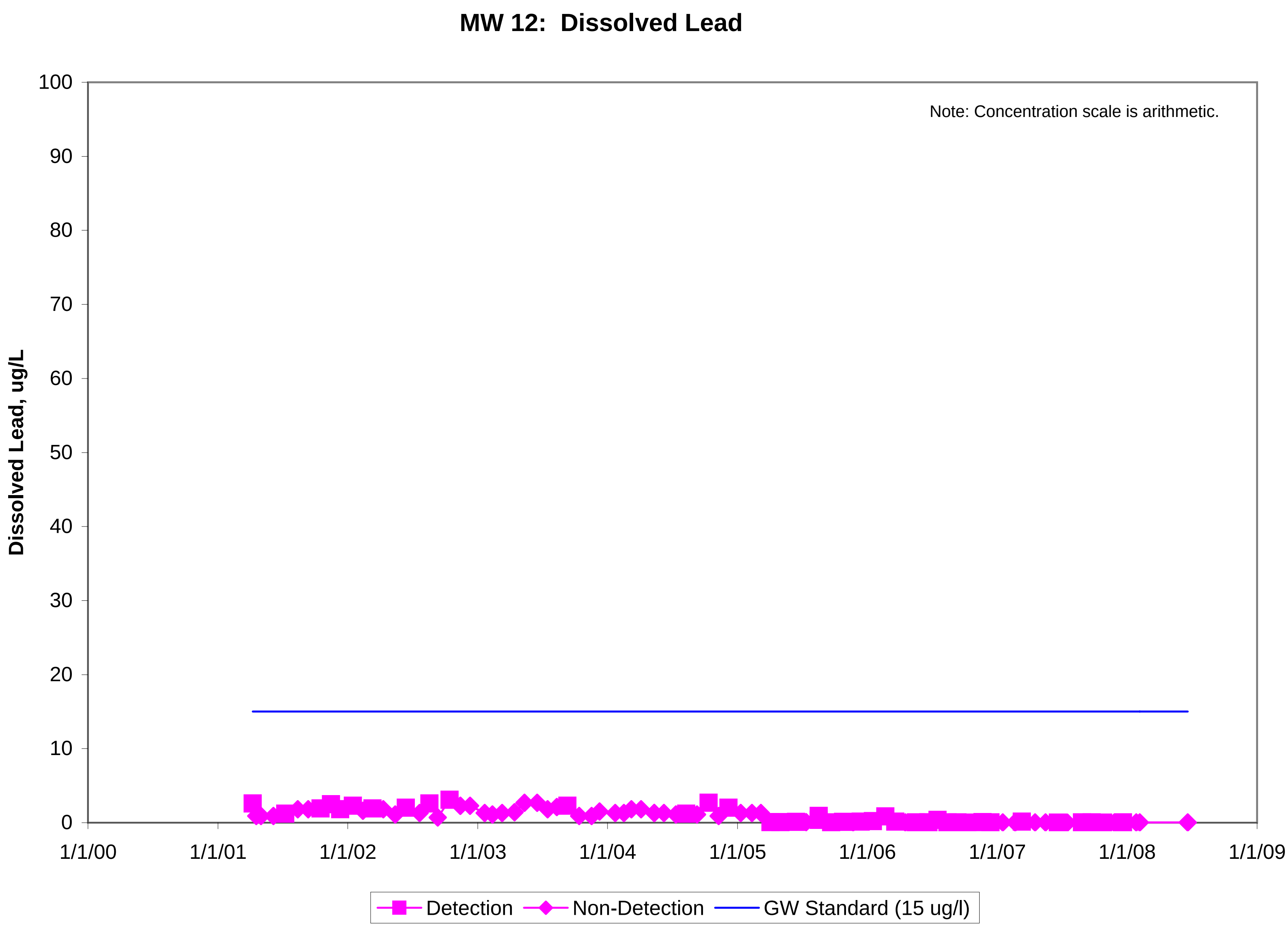

MW 9: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)



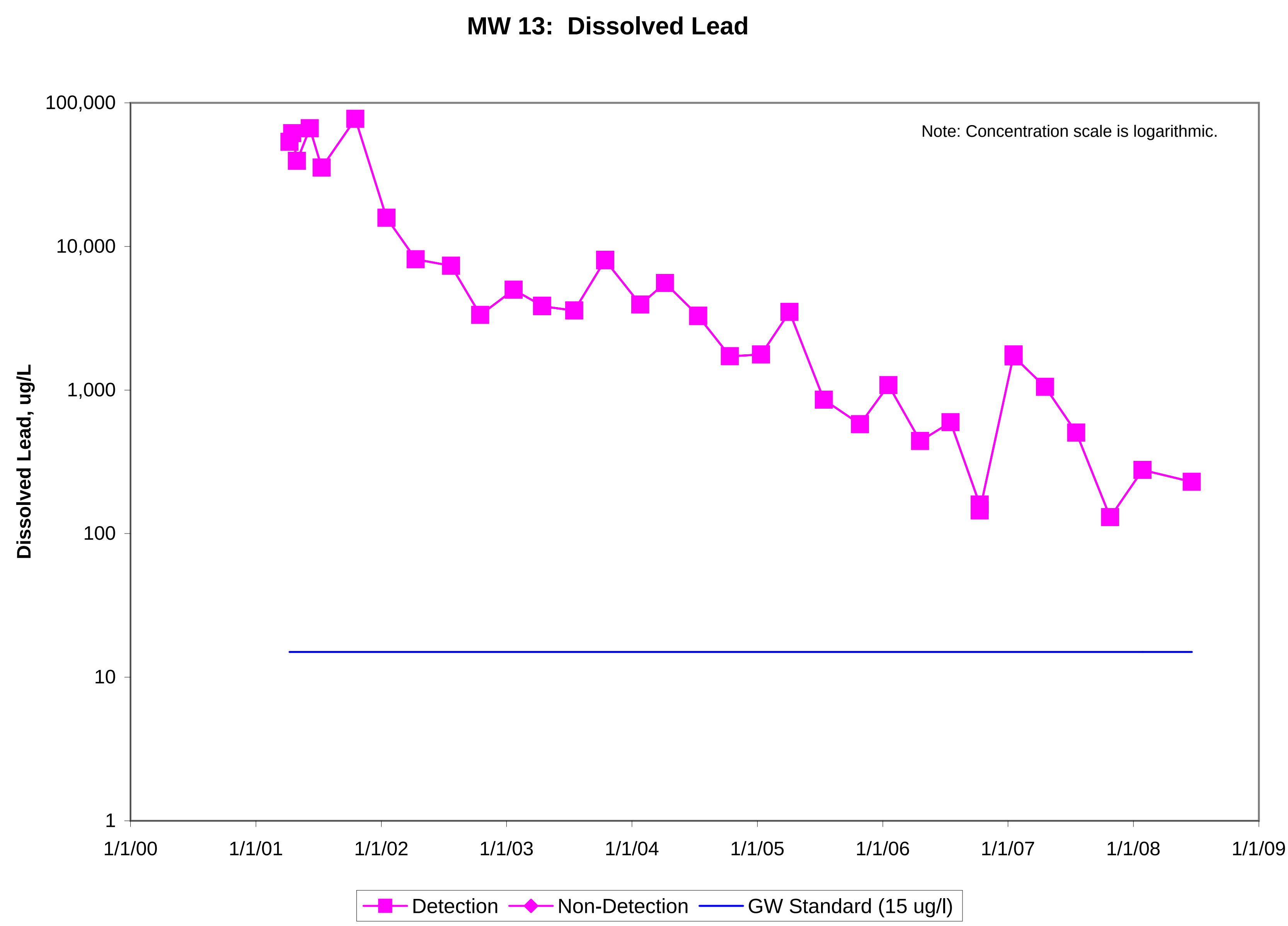
MW 10: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

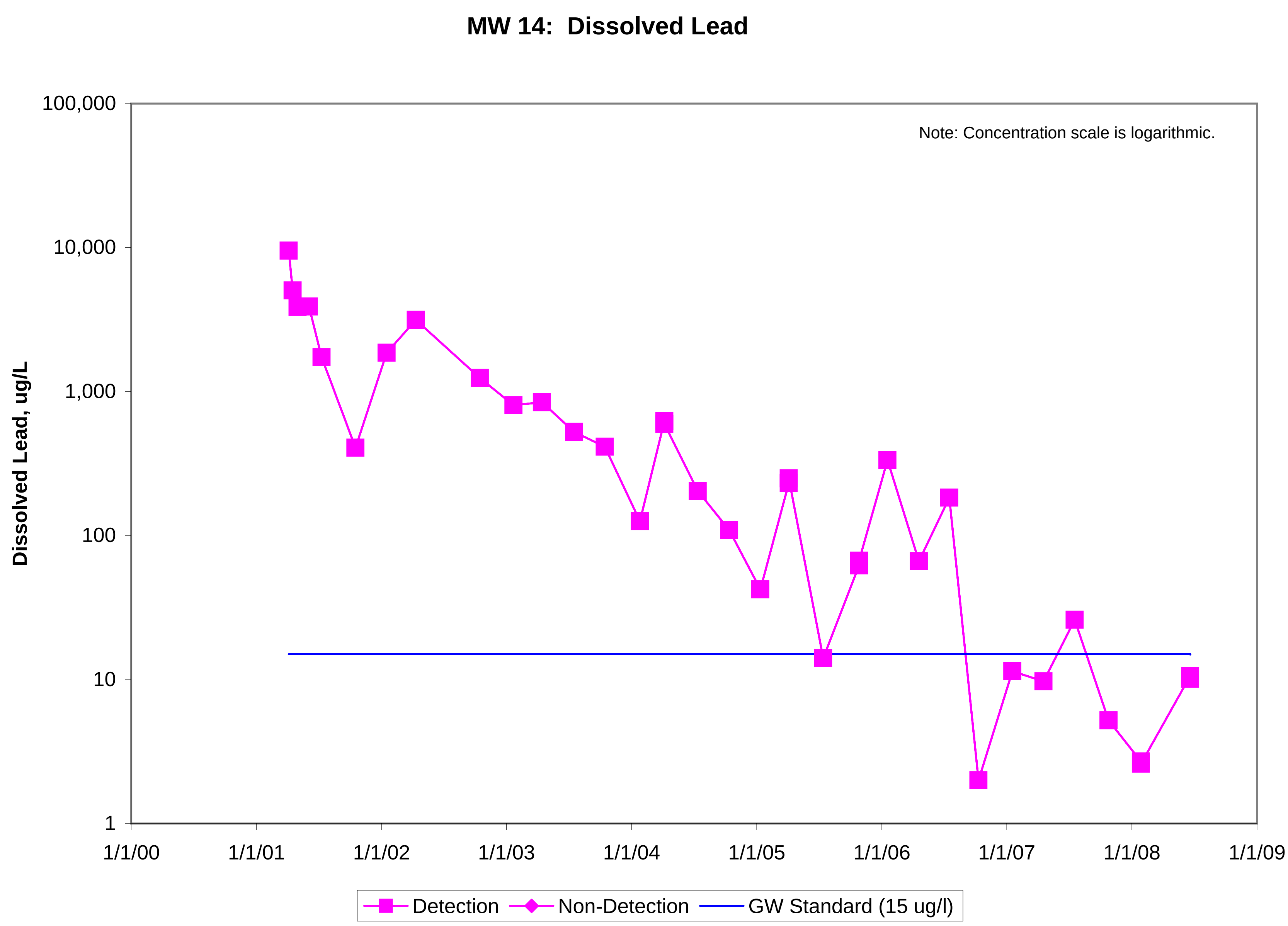


MW 11: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

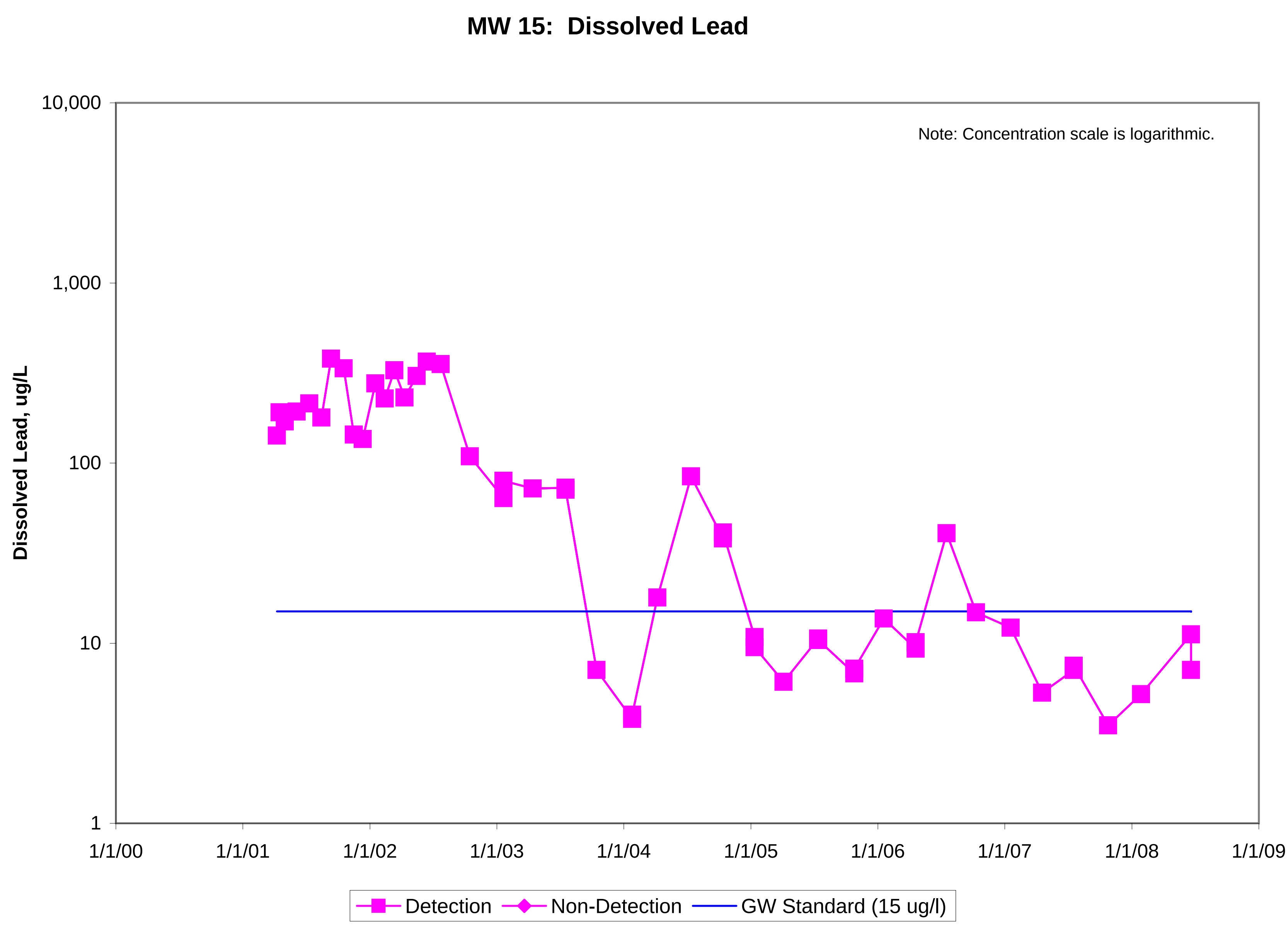


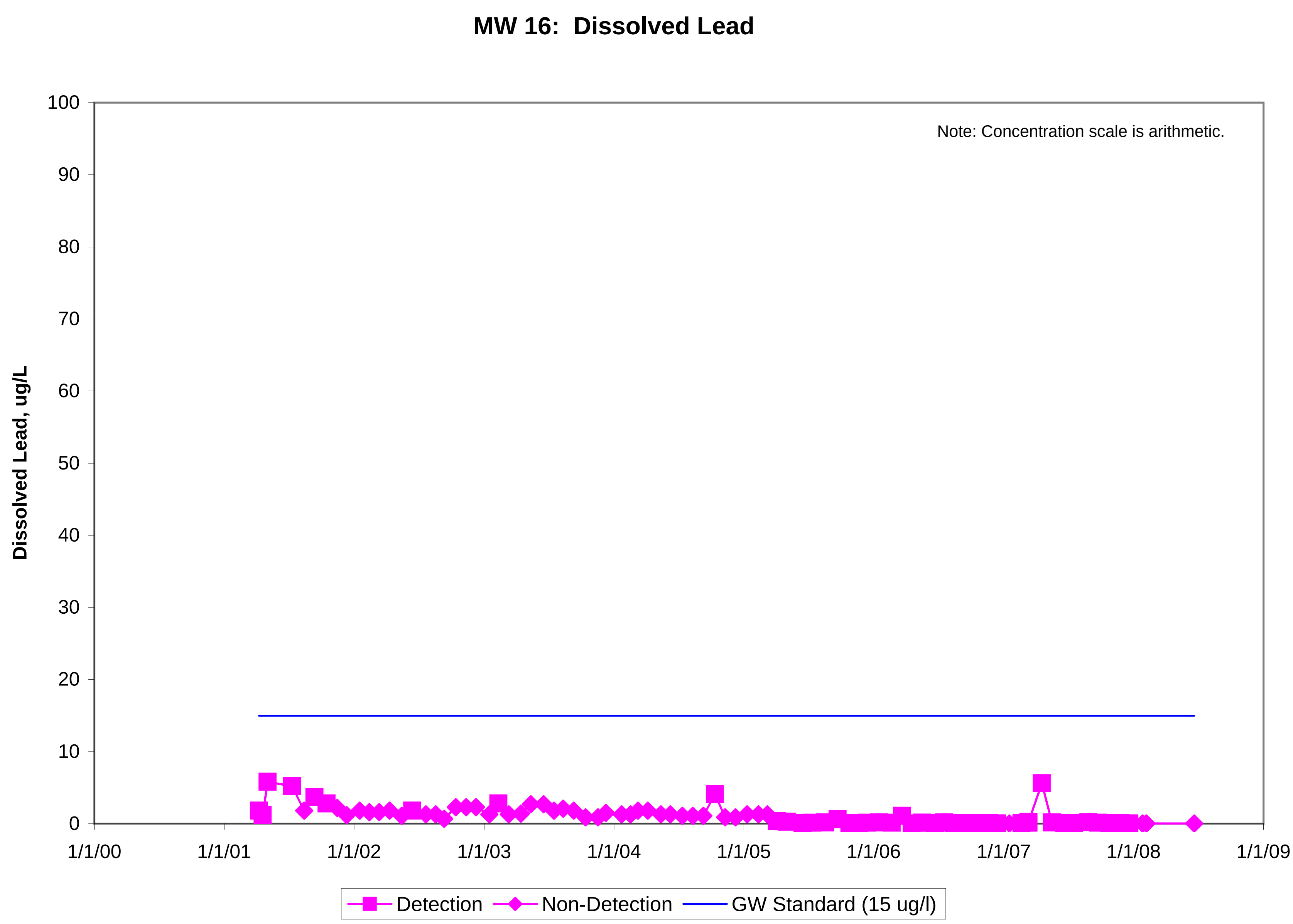
MW 12: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)


MW 13: Dissolved Lead
Note: Concentration scale is logarithmic.
Dissolved Lead, ug/L
100,000
10,000
1,000
100
10
1
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

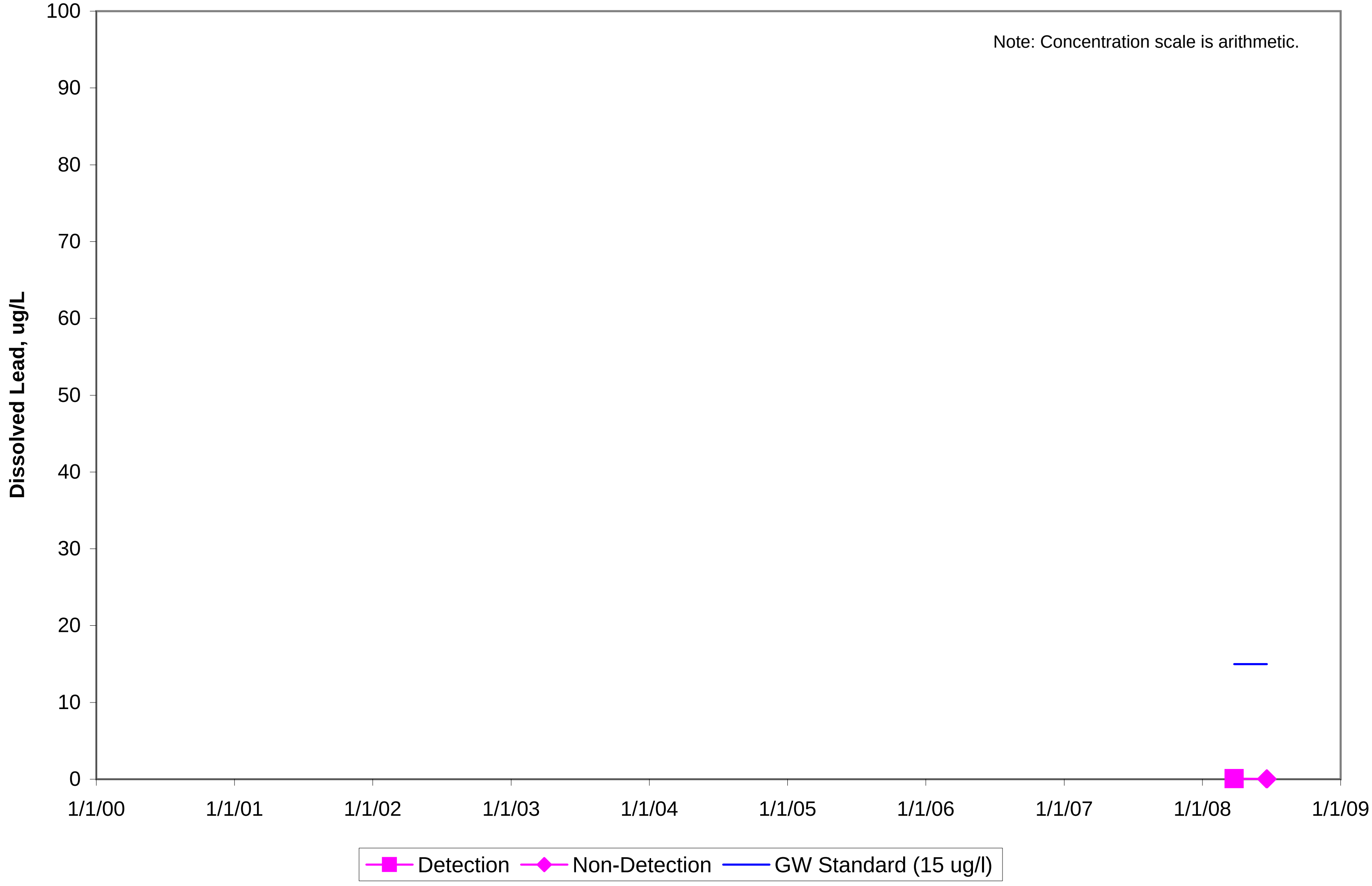


MW 14: Dissolved Lead
Note: Concentration scale is logarithmic.
Dissolved Lead, ug/L
100,000
10,000
1,000
100
10
1
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)


MW 15: Dissolved Lead
Note: Concentration scale is logarithmic.
Dissolved Lead, ug/L
10,000
1,000
100
10
1
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)


MW 16: Dissolved Lead
Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

01U085



Note: Concentration scale is arithmetic.
Dissolved Lead, ug/L
100
90
80
70
60
50
40
30
20
10
0
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
1/1/09
Detection
Non-Detection
GW Standard (15 ug/l)

Appendix C

FY 2008 Data Collection and Management

C.1 Data Collection, Management, and Presentation

APPENDIX C.1

DATA COLLECTION, MANAGEMENT, AND PRESENTATION

1.0 INTRODUCTION

A groundwater monitoring program was initiated in January 1984 to obtain water level and water quality data at TCAAP. Each year has been divided into quarters with each quarter assigned a number. Accordingly, FY 2008 was comprised of Quarter 97 (October through December), Quarter 98 (January through March), Quarter 99 (April through June), and Quarter 100 (July through September). Water sampling, water level measurements, and laboratory analysis were conducted in accordance with the TCAAP "Remedial Design/Remedial Action, Quality Assurance Project Plan" (Montgomery Watson, 1996).

Prior to November 1, 2001, data collected at TCAAP was stored in the U.S. Army Environmental Center (USAEC) Installation Restoration Data Management Information System (IRDMIS). The IRDMIS was managed by Potomac Research, Inc. (PRI) on behalf of the USAEC. USAEC replaced the IRDMIS System on November 1, 2001, with a new system, the Environmental Restoration Information System (ERIS), which incorporated all of the data that had previously been entered into IRDMIS.

2.0 GROUNDWATER LEVELS AND GROUNDWATER QUALITY

2.1 Data Collection and Management

Groundwater level and groundwater quality data were collected in accordance with the FY 2008 Annual Monitoring Plan (Appendix A), which established the monitoring responsibilities for both the Army and Alliant. Water level monitoring and water sampling were conducted by Wenck for the Army and by Stantec and CRA for Alliant. For all samples, laboratory analysis was performed by DataChem Laboratories, Salt Lake City, Utah.

Appendix A.4 contains lists of required analytes, as referenced by the monitoring plans in Appendix A. The lists are site-specific, based on the chemicals of concern. Halogenated volatile organic compounds were the parameters of primary interest, while select wells were sampled for aromatic volatile organic compounds, metals, and explosives. Appendix C.2 presents clarifications and deviations from the FY 2008 Annual Monitoring Plan.

Data assessment and validation was conducted in accordance with procedures and requirements outlined in the TCAAP QAPP. Flagging codes and data qualifiers assigned to data through data assessment/validation appear in the data tables included within the individual sections of this report (see table footnotes for definitions) and also in the historical databases (Appendix D). Data assessment and validation information was submitted to the MCPA and USEPA for review. Regulatory approvals for these submittals are included in Appendix C.3.

For water level measurements, the depth to water from the surveyed top of the well casing was measured. Groundwater elevations were calculated and data tables are included within the individual sections of this report and also in the historical database (Appendix D).

2.2 Groundwater Elevation Contour Maps

The most extensive water level monitoring event performed during FY 2008 was in June (Quarter 99). This data was used to prepare groundwater elevation contour maps for OU1, OU2, OU3, Building 102, Sites A, C, and K shallow groundwater. These maps are included within the individual sections of this report.

2.3 Groundwater Quality Contour Maps and Cross-Sections

The most extensive sampling event performed during FY 2008 was in June (Quarter 99). This data was used to prepare groundwater quality isoconcentration contour maps and/or cross-sections for OU1/OU3 deep groundwater, OU2 deep groundwater, Building 102 shallow groundwater, and Sites A and K shallow groundwater. Contour maps were generated by hand, based on the observed contaminant concentrations and the extent of past site contamination. These maps are included within the individual sections of this report.

For OU1/OU3 deep groundwater and OU2 deep groundwater, isoconcentration maps and cross-sections are provided for trichloroethene, as this is the principal contaminant on a concentration basis. Isoconcentration maps were prepared for OU1/OU3 deep groundwater (combined) and OU2 deep groundwater, with individual maps for Upper Unit 3, Lower Unit 3, and Upper Unit 4. To complement the isoconcentration maps, cross-sections have been prepared to illustrate the vertical distribution of trichloroethene. One section line passes through the source area at Site G and follows the north plume (OU1) off-TCAAP through well 582628 (NBM#15) of the New Brighton Contaminated Groundwater Recovery System (NBCGRS). A second section line passes through the source area at Site I and traces the south plume (OU3) off-TCAAP through the Plume Groundwater Recovery System (PGRS).

Contaminant concentrations for Middle Unit 3 wells and wells that fully penetrate Unit 3 (03F) (including any recovery wells that fully penetrate Unit 3 and that are being sampled as a monitoring well) are shown in parentheses on the Lower Unit 3 isoconcentration maps, but were not used for contouring purposes except when no Lower Unit 3 wells are in the vicinity. Similarly, wells completed in the Jordan aquifer (04J) and wells completed as open holes intersecting both the Prairie du Chien and Jordan aquifers (PJ#) are shown with the data in parentheses on the Upper Unit 4 isoconcentration maps, but were not used for contouring purposes.

For Site A, isoconcentration maps were developed for cis-1,2-dichloroethene, since this is the most widespread contaminant at Site A, and also for tetrachloroethene, which illustrates the source area. Site A cross-sections were also prepared which illustrate cis-1,2-dichloroethene. The isoconcentration maps for Site A were prepared only for Unit 1, since this is the only contaminated aquifer.

For Site K, an isoconcentration map was developed for trichloroethene (the primary contaminant). The map for Site K was prepared only for Unit 1, since this is the only contaminated aquifer.

Contaminant concentrations for recovery wells that are actively pumping are shown in parentheses on the isoconcentration maps. These values were considered, but were not used alone to prepare the isoconcentration contours. Concentrations of recovery wells generally represent an average contaminant value for all groundwater being drawn to the well; hence, the concentrations do not necessarily represent a discrete location or depth.

C.2 Deviations from Monitoring Program

APPENDIX C.2
DEVIATIONS FROM MONITORING PROGRAM

Fiscal Year 2008

<u>OU2 Site I</u>

June 2008:

Well 01U064: Bailed dry after 2 gallons removed (just over 1.5 well volumes).
Well I01MW: No sample collected, well was dry.
Well I05MW: Very little water in well, 0.88 ft. Removed one well volume and sampled immediately.
Well 01U639: No sample collected, well was dry. A groundwater sample was collected from the alternate sampling location well I04MW.
Well I04MW: Well bailed dry after 0.5 gallons removed (just over 2 well volumes).
Well 01U632: No sample collected, well was dry.
Well I02MW: No sample collected, well was dry.
Well 01U640: Insufficient water in well to collect sample (0.30 ft. water in well).

<u>OU2 Site K</u>

June 2008:

Well 01U611: Bailed dry after 1 gallon removed (just over 1 well volume).
Well 01U617: Bailed dry after 6 gallons removed (just over 1 well volume).
Well 01U618: Bailed dry after 2 gallons removed (just over 1 well volume).
Well 01U603: Bailed dry after 0.5 gallons removed (just over 1 well volume).
Well 01U604: Bailed dry after 2 gallons removed (just over 2 well volumes).
Well 01U615: Bailed dry after 2.5 gallons removed (just over 1 well volume).

C.3 Regulatory Approvals for Data Assessments and Validation

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

March 30, 2009

REPLY TO THE ATTENTION OF: SR-6J

Mr. Michael R. Fix
Commander's Representative
Twin Cities Army Ammunition Plant
470 West Highway 96 - Suite 100
Shoreview, MN 55126

Subject: **Approval of Data Usability Report Numbers 57, 58, 59 and 60**

Dear Mr. Fix:

This letter shall serve to document that the U.S. Environmental Protection Agency (EPA) and the Minnesota Pollution Control Agency (MPCA) have completed their review of the U.S. Army's (Army) subject Data Usability Reports (DURs) Numbers 57, 58, 59, and 60. USEPA and MPCA review included review of the following:

- Data Usability Report Number 57 (**DUR 57**), TCAAP FY 2008 Performance Monitoring Program, 1st Quarter Monitoring (October – December, 2007), March 20, 2008; EPA comments (April 24, 2008) and MPCA comments (April 24, 2008); Army responses to comments (July 8, 2008); additional USEPA comments (August 8, 2008); additional Army responses to comments (September 9, 2008);

- Data Usability Report Number 58 (**DUR 58**), TCAAP FY 2008 Performance Monitoring Program, 2nd Quarter Monitoring (January – March, 2008) , June 11, 2008; EPA comments (July 11, 2008) and MPCA comments (September 5, 2008); Army responses (September 10, 2008);

- Data Usability Report Number 59 (**DUR 59**), TCAAP FY 2008 Performance Monitoring Program, 3rd Quarter Monitoring (April – June, 2008), November 24, 2008; EPA comments (December 30, 2008) and MPCA comments (February 2, 2009); Army responses to comments (February 4, 2009);

- Data Usability Report Number 60 (**DUR 60**), TCAAP FY 2008 Performance Monitoring Program, 4th Quarter Monitoring (July – September, 2008); MPCA comments (January 2, 2009) and EPA comments (January 15, 2009); Army responses to comments (February 12, 2009); additional MPCA comments (February 12, 2009) and EPA comments (February 19, 2009); additional Army response (March 3, 2009).

Based upon our review of the information provided by the Army, USEPA and MPCA agree that the subject DURs are acceptable. You are hereby advised that the USEPA and the MPCA approve Data Usability Report Numbers 57, 58, 59, 60.

If you have any questions, please contact Tom Barounis of the EPA at (312) 353-5577 or Dagmar Romano of the MPCA at (651) 757-2676.

Sincerely,

Tom Barounis

Tom Barounis
Remedial Project Manager
U.S. Environmental Protection Agency
Region 5

Tom Barounis for

Dagmar Romano
Superfund Unit 2
Superfund, RCRA and VIC Section
Remediation Division
Minnesota Pollution Control Agency

Appendix D

Comprehensive Groundwater Quality and Groundwater Level Databases

D.1 Comprehensive Groundwater Quality and Groundwater Level Databases

APPENDIX D.1
COMPREHENSIVE GROUNDWATER QUALITY AND GROUNDWATER LEVEL DATABASES

The historical groundwater tables are located on this DVD in a directory named Appendix D. This directory contains three Microsoft Excel files:

File	Contents
Compelev.xls	Groundwater elevations
Comporwq.xls	Groundwater quality: organic data
Compinwq.xls	Groundwater quality: inorganic data

D.2 Operable Unit 1 Statistical Analysis

D.2.1 Well Groups and Statistical Evaluation Criteria Tables

Table D.2.1
Statistical Evaluation
Well Groups

Group 1 – Downgradient of TGRS

03U806	04U806	03L802	03U801
03M806	PJ#806	04U802	03U711
03L806	03M802	PJ#802*	04U711

Group 2 – Areal Extent of Plume

03U805	409557	04U841	04U875
03U672	04U673	04U843	04U877
03L848	04U832	04U833	206688
03L673	04U845	04U846	04U849
03L833	04U854	04U861	04U821
03L859	04U859	409549	191942

Group 3 ** – Downgradient Sentinel

04U871	04U875	04U851	

Group 4 – Lateral Sentinel

03U831 abandoned	03L846	409556	409548
03U811	03L832	04U855	04U839
03U804	03L861 abandoned	04U879	04U838
03U673	03L854	04U860	04U848
03U672	03L841	409547	04J839
03M843	03L811	04U863	

Group 5 – Global Plume

04J077	04U702	04U848	04U877
04J702	04U709	04U851	04U879
04J708	04U711	04U852 abandoned	04U880
04J713	04U713	04U855	04U881
04J834	04U802	04U859	04U882
04J864 abandoned	04U806	04U860	200154
04J866	04U832	04U861 abandoned	234546
04J882	04U833	04U863	234549
04U002	04U834	04U864 abandoned	409547
04U020	04U841	04U865 abandoned	409548
04U027	04U843	04U866	409549
04U077	04U844	04U871	409555
04U673	04U845	04U872	512761
04U701	04U846	04U875	PJ#318

Group 6 – Jordan Aquifer

04J077	04J838	04U713	04U882
04J702	04J839	04U834	NBM#3
04J708	04J882	04U836	NBM#4
04J713	04J847	04U837	NBM#5
04J822	04J849	04U838	NBM#6
04J834	04U077	04U839	
04J836	04U702	04U847	
04J837	04U708	04U849	

* PJ#802 will not be monitored or used for evaluation unless 04U802 shows TCE concentrations greater than 1 ppb.

** Group 3 is analyzed as a rectangular area taken from the Group 5 contouring.

Table D.2.2

MAROS Decision Matrix

Mann-Kendall S	Confidence	Coefficient of Variance	Trend Conclusion
S > 0	> 95%	NA	Increasing
S > 0	90-95%	NA	Probably Increasing
S > 0	< 90%	NA	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	NA	Probably Decreasing
S < 0	>95%	NA	Decreasing

Table D.2.3
Summary of Groups, Purpose, and Statistical Tests

Well Group	**Purpose**	**Measure**	**Time Window/ Monitoring Frequency**	**Test**	**Response Threshold**
Group 1	AWC Immediately Downgradient of TGRS	AWC Trend	6 years/annual	Mann-Kendall and MAROS	Stable, Increasing, or No Trend
Group 2	Defining Plume Size (Low Concentration Edges)	Individual Well Trend for TCE	12 years/biennial	Mann-Kendall and MAROS	Increasing or No Trend
Group 3	AWC Immediately Downgradient of NBCGRS	AWC Trend	12 years/biennial	Mann-Kendall and MAROS	Stable, Increasing, or No Trend
Group 4	Lateral (Clean) Sentinel Wells	Individual Well Concentration	12 years/biennial	Individual Concentrations	Greater than ROD goals
Group 5	Global Plume Mass Reduction	AWC Trend	12 years/biennial	Mann-Kendall and MAROS	Stable, Increasing, or No Trend
Group 6	Evaluating and comparing trends in Jordan Aquifer	Individual Well Trend for TCE	12 years/biennial	Mann-Kendall and MAROS	Stable, Increasing or No Trend

Note: A Response Threshold is the test result(s) that triggers further response. See text for additional explanation of response process.

AWC = Area-Weighted Concentration.

Table D.2.4
Group 1 – Downgradient of TGRS, Evaluation Process

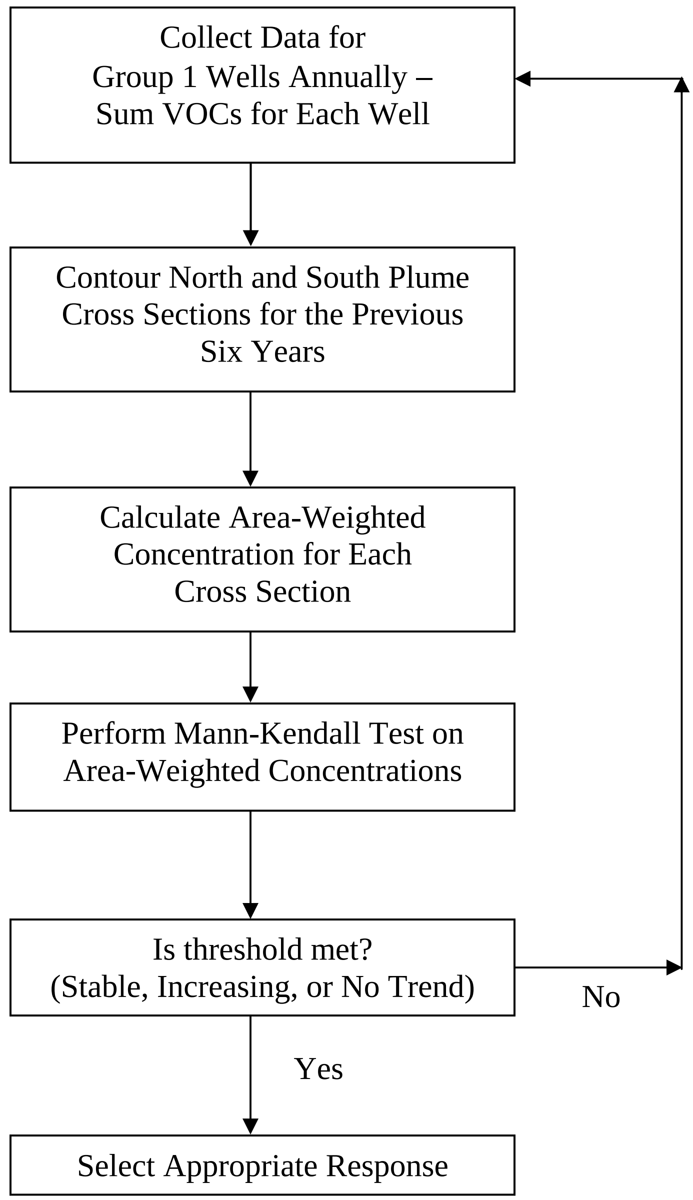


Table D.2.5
Group 2 – Areal Extent of Plume, Evaluation Process

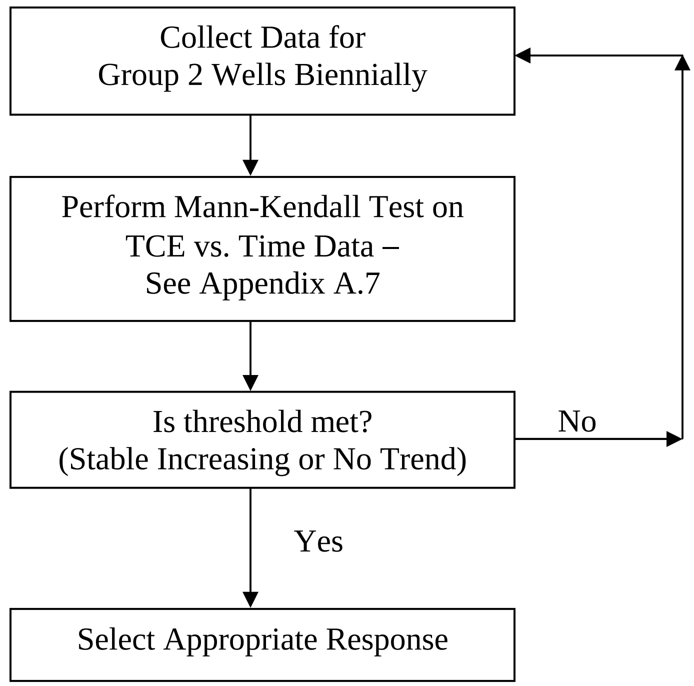


Table D.2.6

Group 3 and Group 5 – Downgradient Sentinel and Global Plume, Evaluation Processes

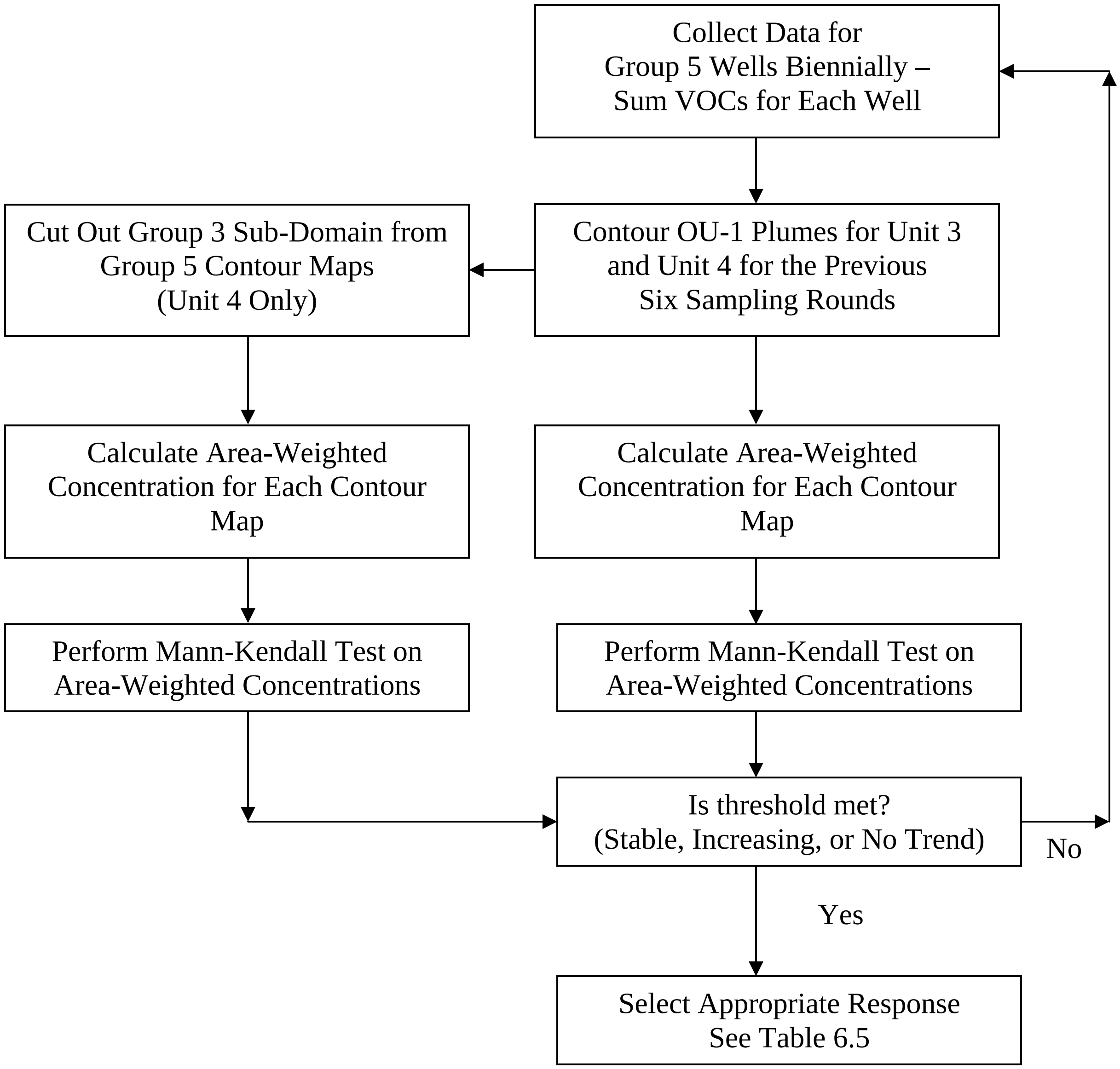


Table D.2.7
Group 4 – Lateral Sentinel Wells, Evaluation Process

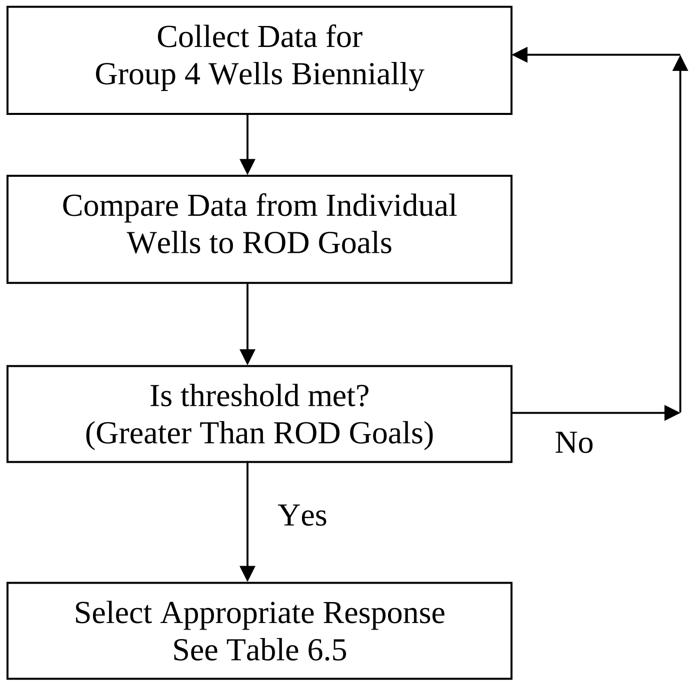


Table D.2.8

Responses to Threshold Indicators

Factors to Consider

- Contaminant concentrations
- Location (vertical and horizontal)
- Surrounding data
- Risks to human health or the environment
- Need for urgency in response

Possible Evaluation Responses

- Perform additional or confirmation sampling
- Write up in the Annual Performance Report
- Perform separate evaluation and write-up (Tech Memo)

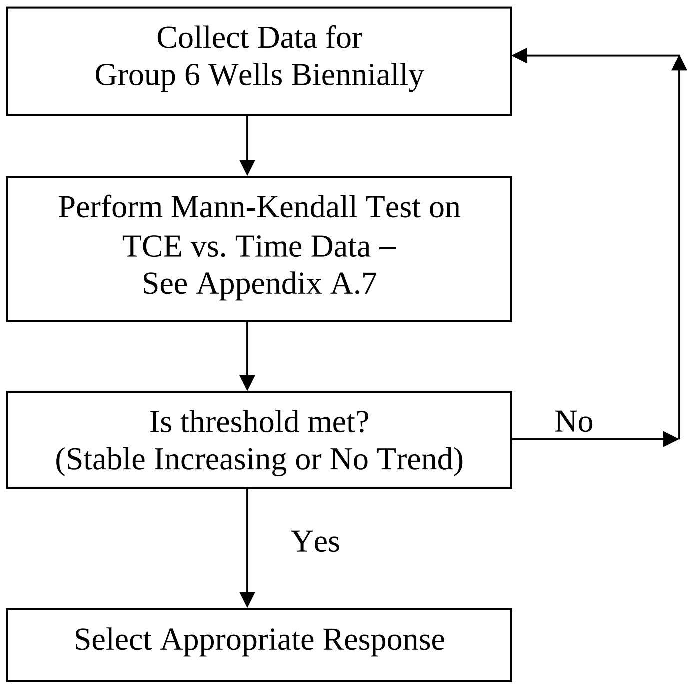
Possible Long-Term Responses

- Increase sampling frequency
- Modify operation of remedial system(s)
- Perform new remedy evaluation
- Install additional monitoring well(s)
- Modify the Special Well Construction Area
- Control risk at the receptors

Note: Threshold responses to be described and evaluated in the Annual Performance Reports.

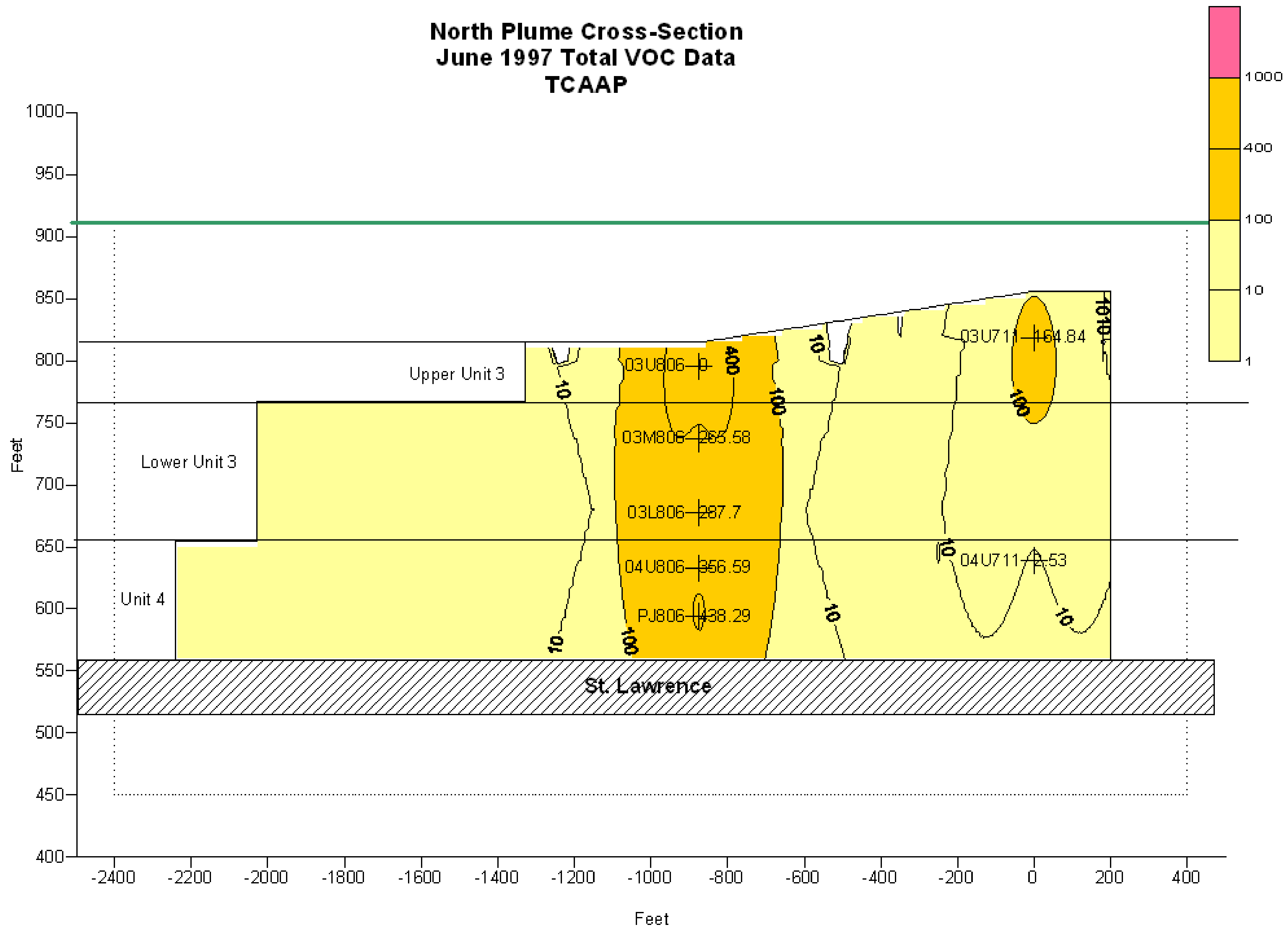
Table D.2.9

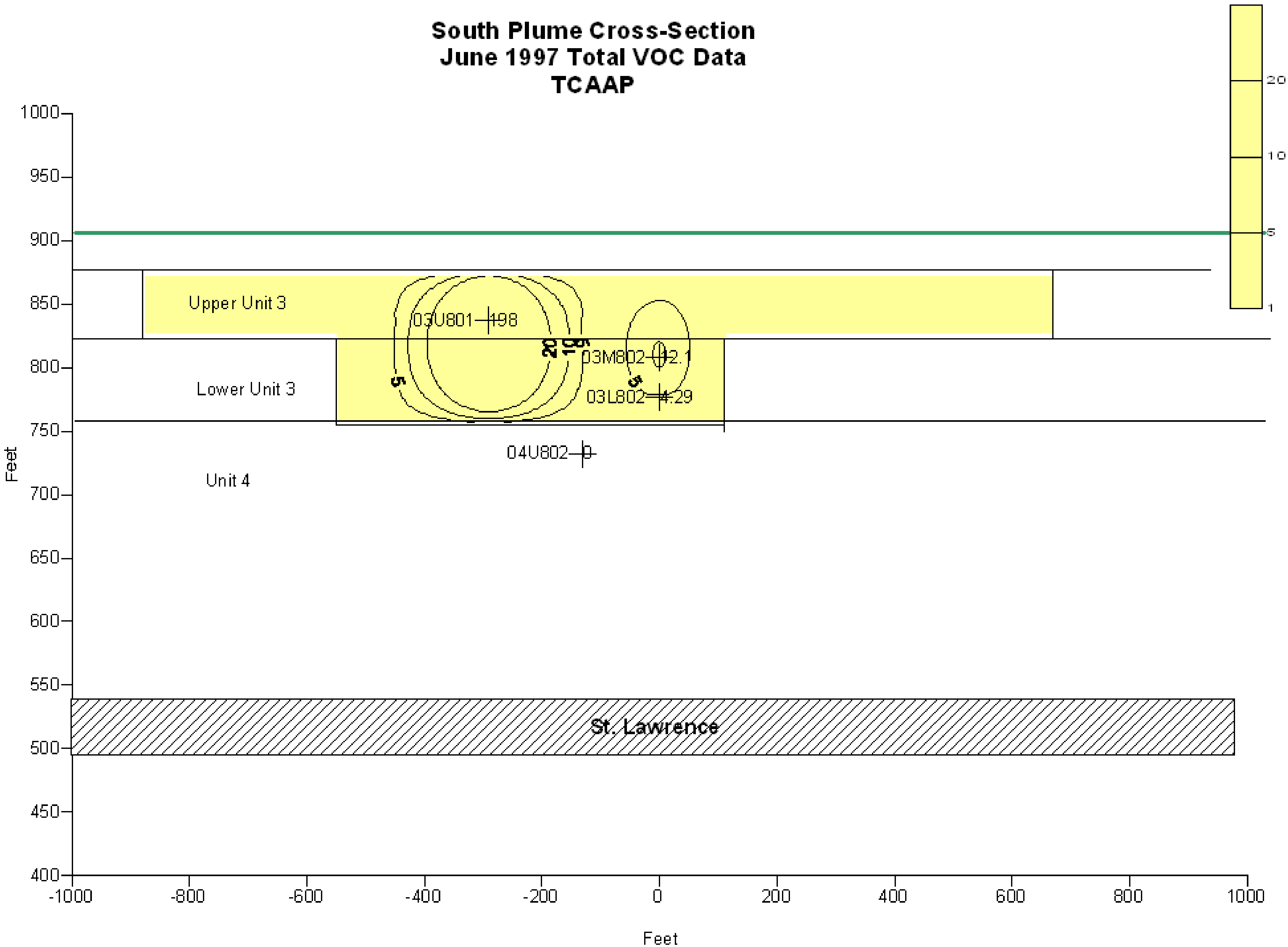
Group 6 – Jordan Aquifer, Evaluation Process



D.2.2 Group 1 Kriging Evaluation

1997


North Plume Cross-Section
June 1997 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U806 0
03M806 265.58
03L806 287.7
04U806 356.59
PJ806 438.29
03U711 164.84
04U711 2.53
1000
400
100
10
1
Feet
Feet


South Plume Cross-Section
June 1997 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
03U801
198
03M802
12.1
03L802
4.29
04U802
0
St. Lawrence
20
10
5
1
Feet
Feet
1000
950
900
850
800
750
700
650
600
550
500
450
400
-1000
-800
-600
-400
-200
0
200
400
600
800
1000

Groundwater Quality Data (Organics) - 1997

Well	Date	TOTAL VOCs (ug/l)
03L806	6/25/1997	287.70
03M806	6/17/1997	265.58
03U711	6/13/1997	164.84
03U806*		986.00
04U711	6/13/1997	2.53
04U806	6/5/1997	356.59
PJ#806	6/5/1997	438.29
03L802	6/16/1997	4.29
03M802	6/16/1997	12.10
03U801	6/17/1997	201.66
04U802	6/16/1997	0.00

* Interpolated
South Plume
North plume

North Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June 1997

Concentration	Positive Planar Area (ft2)
Plume to 1	570490
Plume to 5	288525
Plume to 10	269887
Plume to 50	165775
Plume to 100	113709
Plume to 200	74691
Plume to 300	43287
Plume to 400	12634
Plume to 500	6612
Plume to 600	3768
Plume to 700	2021
Plume to 800	917
Plume to 900	191
Plume to 1000	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	281964	845893
5 to 10	7.5	18638	139786
10 to 50	30	104112	3123373
50 to 100	75	52065	3904904
100 to 200	150	39018	5852772
200 to 300	250	31404	7850995
300 to 400	350	30653	10728491
400 to 500	450	6022	2709721
500 to 600	550	2845	1564609
600 to 700	650	1746	1135058
700 to 800	750	1105	828667
800 to 900	850	725	616459
900 to 1000	950	191	181775
	Sum	570490	39482503

Area Wtd Conc	69	ug/L

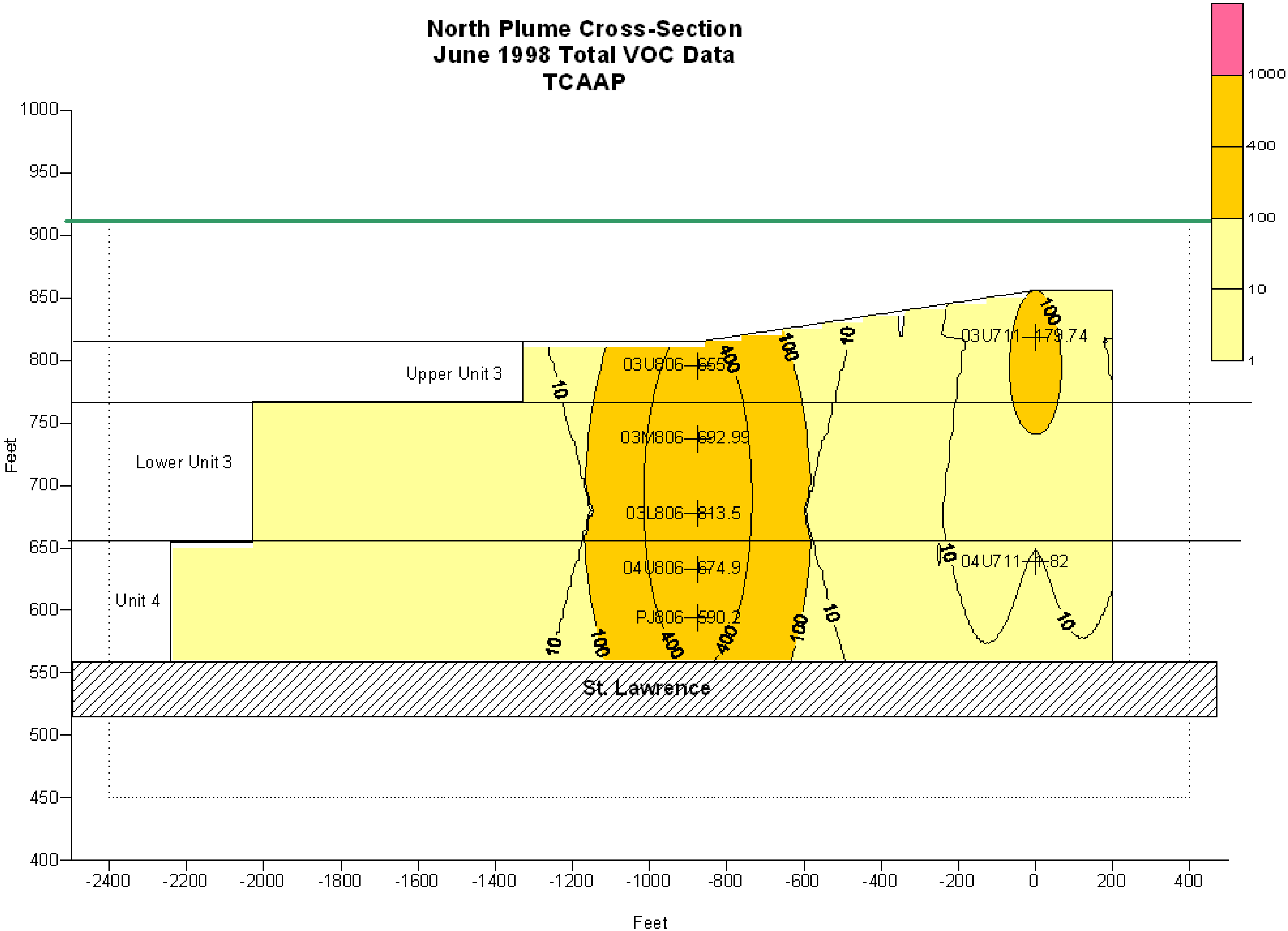
South Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June 1997

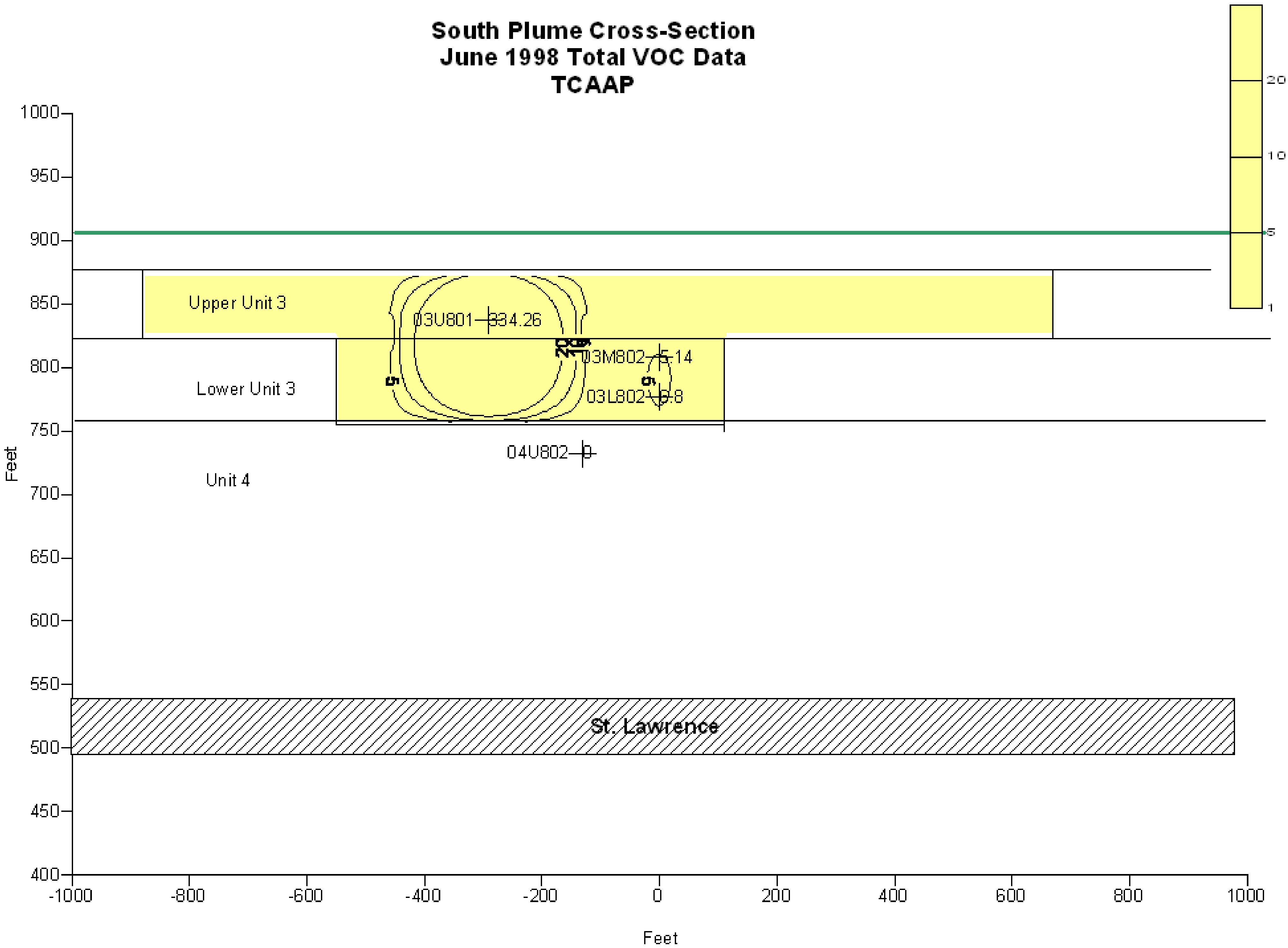
Concentration	Positive Planar Area (ft2)
Plume to 1	115236
Plume to 5	40363
Plume to 10	26616
Plume to 25	15757
Plume to 50	8734
Plume to 100	2906
Plume to 200	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	74873	224619
5 to 10	7.5	13748	103107
10 to 25	17.5	10858	190020
25 to 50	37.5	7023	263376
50 to 100	75	5828	437100
100 to 200	150	2906	435878
	Sum	115236	1654100

Area Wtd Conc	14	ug/L

1998


North Plume Cross-Section
June 1998 Total VOC Data
TCAAP
1000
950
900
850
800
750
700
650
600
550
500
450
400
Feet
-2400
-2200
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
Feet
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U806
03M806
03L806
04U806
PJ806
03U711
179.74
04U711
82
10
100
400
1000
400
100
10
1


South Plume Cross-Section
June 1998 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
03U801
334.26
03M802
5.14
03L802
6.8
04U802
0
St. Lawrence
Feet
Feet
1000
950
900
850
800
750
700
650
600
550
500
450
400
-1000
-800
-600
-400
-200
0
200
400
600
800
1000
20
10
5
1

Groundwater Quality Data (Organics) - 1998

Well	Date	TOTAL VOCs (ug/l)
03L806	6/12/1998	813.50
03M806	6/12/1998	692.99
03U711	6/16/1998	179.74
03U806*		655.00
04U711	6/9/1998	1.82
04U806	6/12/1998	674.90
PJ#806	6/12/1998	590.20
03L802	6/11/1998	6.80
03M802	6/17/1998	5.14
03U801	6/17/1998	334.26
04U802	6/11/1998	0.00

* Interpolated

South Plume

North plume

North Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June 1998

Concentration	Positive Planar Area (ft2)
Plume to 1	572327
Plume to 5	291283
Plume to 10	275277
Plume to 50	200943
Plume to 100	151271
Plume to 200	102729
Plume to 300	78851
Plume to 400	58828
Plume to 500	39484
Plume to 600	22174
Plume to 700	6155
Plume to 800	71
Plume to 900	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	281044	843132
5 to 10	7.5	16006	120046
10 to 50	30	74334	2230032
50 to 100	75	49671	3725356
100 to 200	150	48542	7281374
200 to 300	250	23877	5969303
300 to 400	350	20024	7008373
400 to 500	450	19344	8704734
500 to 600	550	17310	9520603
600 to 700	650	16018	10411811
700 to 800	750	6084	4563319
800 to 900	850	71	60279
	Sum	572327	60438362

Area Wtd Conc	106	ug/L

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South Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June 1998

Concentration	Positive Planar Area (ft2)
Plume to 1	115236
Plume to 5	37221
Plume to 10	30498
Plume to 25	20858
Plume to 50	13520
Plume to 100	6920
Plume to 200	1673
Plume to 300	75
Plume to 400	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	78015	234045
5 to 10	7.5	6723	50426
10 to 25	17.5	9640	168693
25 to 50	37.5	7339	275194
50 to 100	75	6599	494951
100 to 200	150	5248	787167
200 to 300	250	1597	399360
300 to 400	350	75	26341
	Sum	115236	2436177

Area Wtd Conc	21	ug/L

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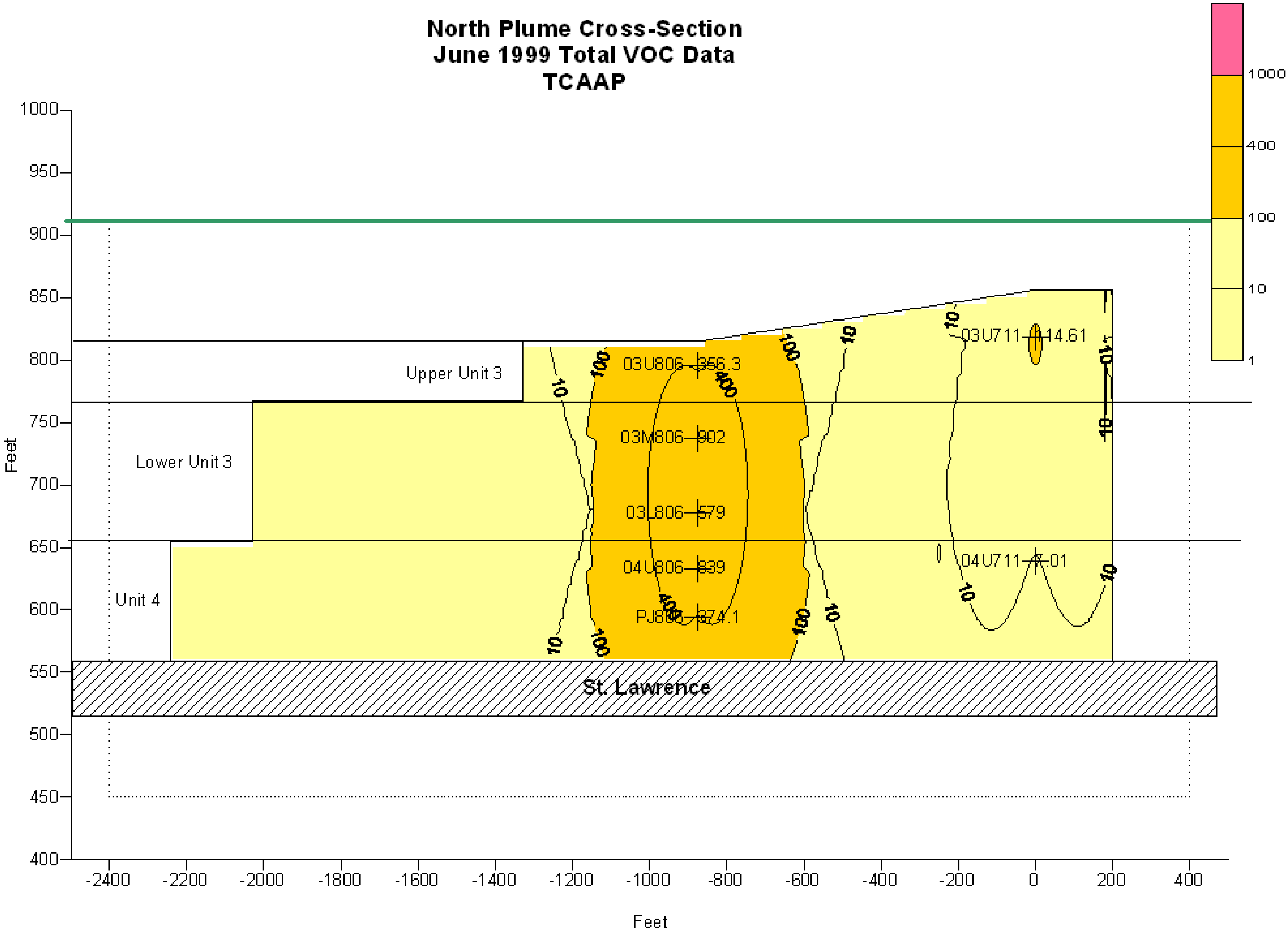
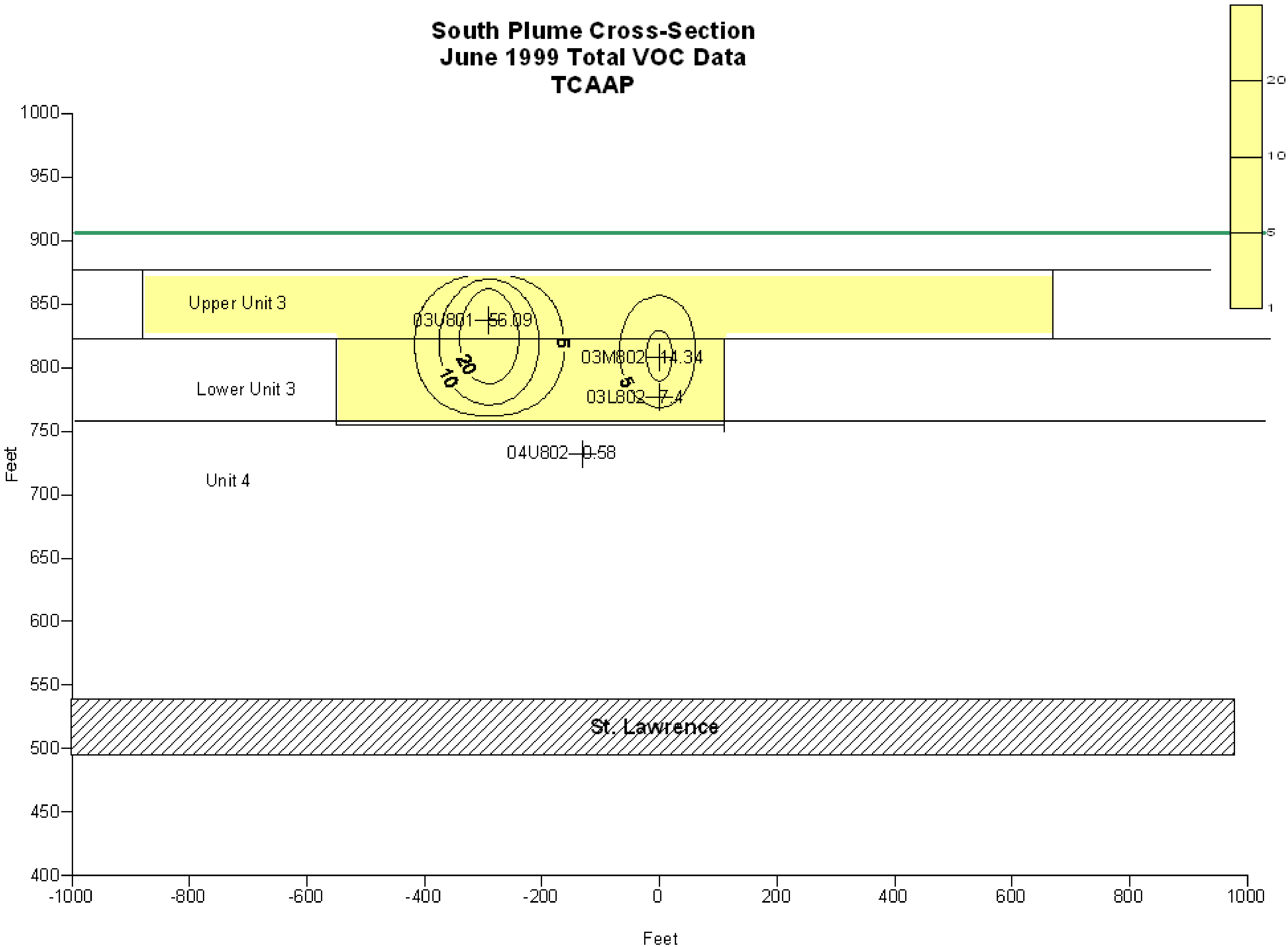
1999

North Plume Cross-Section
June 1999 Total VOC Data
TCAAP





South Plume Cross-Section
June 1999 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U801 56.09
03M802 14.34
03L802 7.4
04U802 0.58
5
10
20
Feet
Feet
1000
950
900
850
800
750
700
650
600
550
500
450
400
-1000
-800
-600
-400
-200
0
200
400
600
800
1000
1
5
10
20

Groundwater Quality Data (Organics) - 1999

Well	Date	TOTAL VOCs (ug/l)
03L802	6/23/1999	7.40
03M802	6/23/1999	14.34
03U801	6/29/1999	56.09
04U802	6/23/1999	0.58
03L806	6/23/1999	579.00
03M806*		902.00
03U711	6/28/1999	114.61
03U806	6/23/1999	356.30
04U711	6/28/1999	7.01
04U806	6/23/1999	839.00
PJ#806	6/23/1999	374.10

* Interpolated
South Plume
North plume

North Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June 1999

Concentration	Positive Planar Area (ft2)
Plume to 1	572514
Plume to 5	294922
Plume to 10	270495
Plume to 50	183129
Plume to 100	138286
Plume to 200	99392
Plume to 300	70102
Plume to 400	44570
Plume to 500	27825
Plume to 600	15887
Plume to 700	4664
Plume to 800	783
Plume to 900	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	277592	832777
5 to 10	7.5	24427	183204
10 to 50	30	87366	2620971
50 to 100	75	44843	3363213
100 to 200	150	38894	5834158
200 to 300	250	29290	7322437
300 to 400	350	25532	8936067
400 to 500	450	16746	7535697
500 to 600	550	11937	6565574
600 to 700	650	11223	7294904
700 to 800	750	3881	2910574
800 to 900	850	783	665891
	Sum	572514	54065467

Area Wtd Conc	94	ug/L

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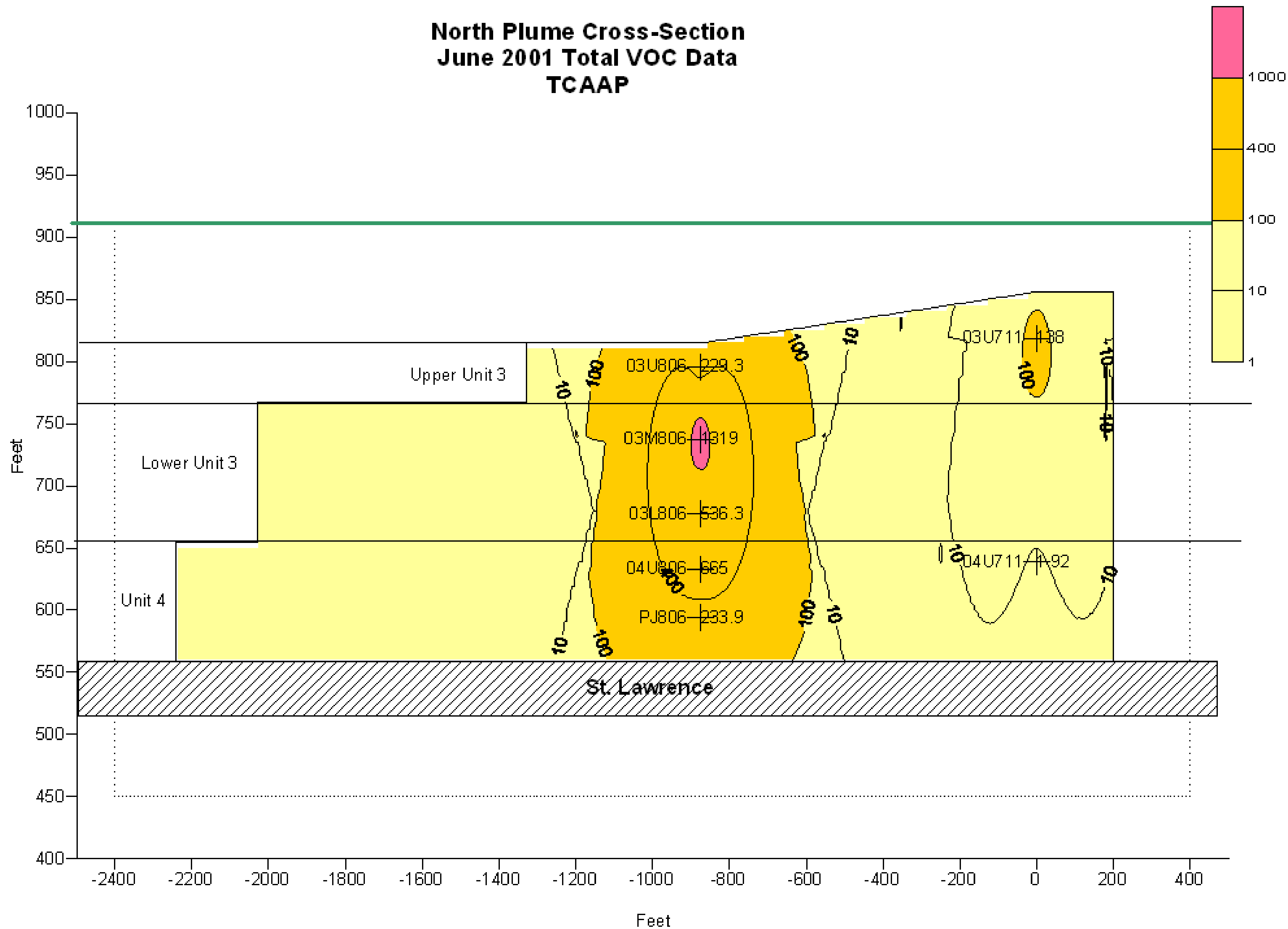
South Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June 1999

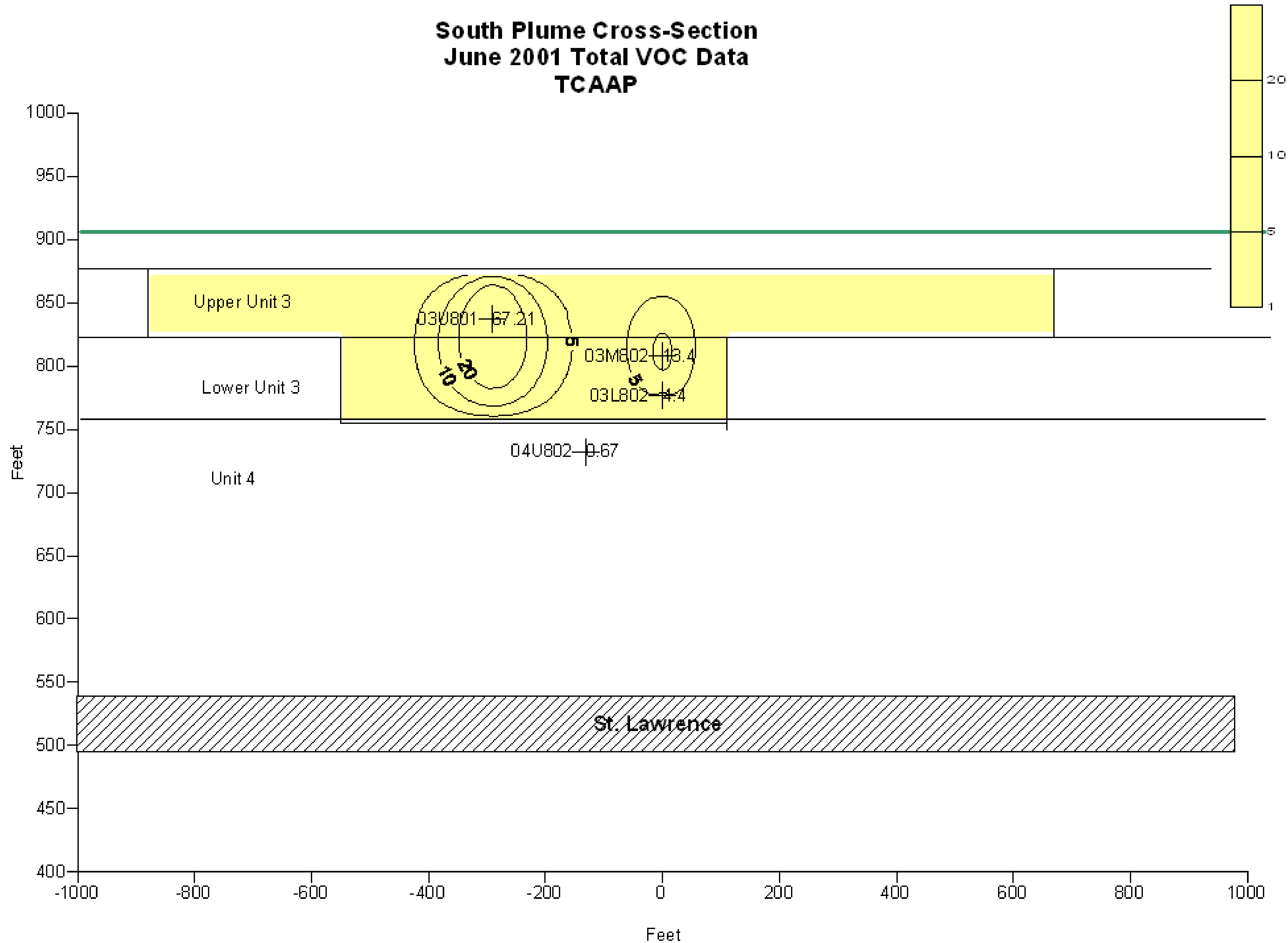
Concentration	Positive Planar Area (ft2)
Plume to 1	115236
Plume to 5	32196
Plume to 10	14726
Plume to 25	3947
Plume to 50	94
Plume to 100	0

TCE (ug/L)	Avg TCE (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	83040	249120
5 to 10	7.5	17470	131025
10 to 25	17.5	10779	188629
25 to 50	37.5	3854	144519
50 to 100	75	94	7016
	Sum	115236	720309

Area Wtd Conc	6	ug/L

2001


North Plume Cross-Section
June 2001 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U806 229.3
03M806 1319
03L806 536.3
04U806 665
PJ806 233.9
03U711 138
04U711 92
Feet
Feet
1000
400
100
10
1



South Plume Cross-Section
June 2001 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
03U801 67.21
03M802 18.4
03L802 4.4
04U802 0.67
St. Lawrence
Feet
Feet

Groundwater Quality Data (Organics) - 2001		
Well	**Date**	**TOTAL VOCs (ug/l)**
03L806	6/15/2001	536.30
03M806*		1319.00
03U711	6/12/2001	138.00
03U806	6/15/2001	229.30
04U711	6/12/2001	1.92
04U806	6/15/2001	665.00
PJ#806	6/15/2001	233.90
03L802	6/19/2001	4.40
03M802	6/19/2001	13.40
03U801	6/18/2001	67.21
04U802	6/19/2001	0.67

* Interpolated

South Plume

North plume

North Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June 2001

Concentration	Positive Planar Area (ft2)
Plume to 1	572398
Plume to 5	288569
Plume to 10	267944
Plume to 50	191092
Plume to 100	143221
Plume to 200	103426
Plume to 300	65435
Plume to 400	42734
Plume to 500	28083
Plume to 600	16350
Plume to 700	9048
Plume to 800	5367
Plume to 900	3079
Plume to 1000	1615
Plume to 1100	697
Plume to 1200	184
Plume to 1300	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	283829	851488
5 to 10	7.5	20624	154683
10 to 50	30	76853	2305575
50 to 100	75	47871	3590299
100 to 200	150	39795	5969323
200 to 300	250	37991	9497682
300 to 400	350	22701	7945227
400 to 500	450	14651	6593110
500 to 600	550	11733	6453374
600 to 700	650	7302	4746206
700 to 800	750	3680	2760309
800 to 900	850	2288	1944735
900 to 1000	950	1465	1391325
1000 to 1100	1050	918	963849
1100 to 1200	1150	513	589863
1200 to 1300	1250	184	229853
	Sum	572398	55986901

Area Wtd Conc	98	ug/L

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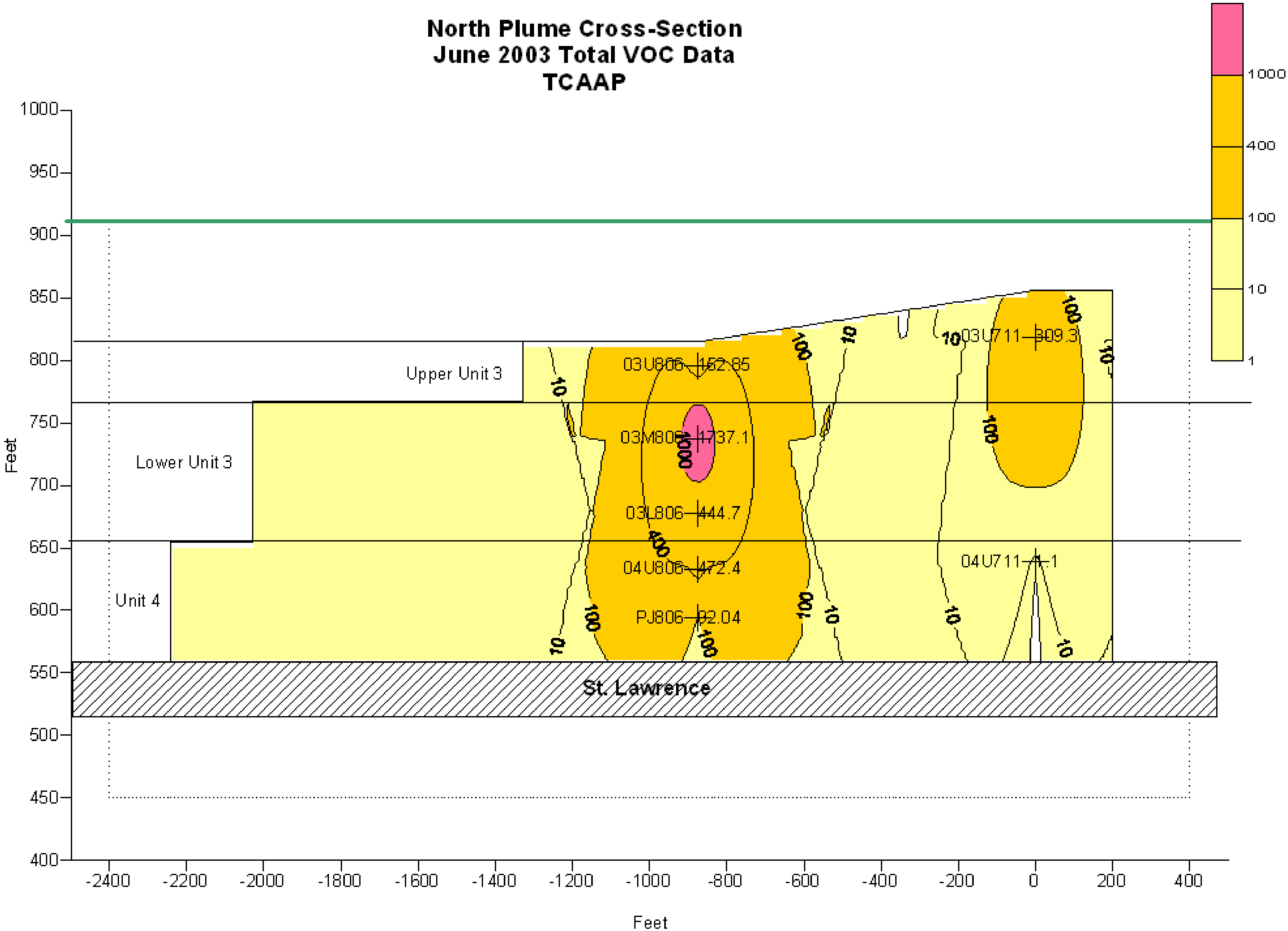
South Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June 2001

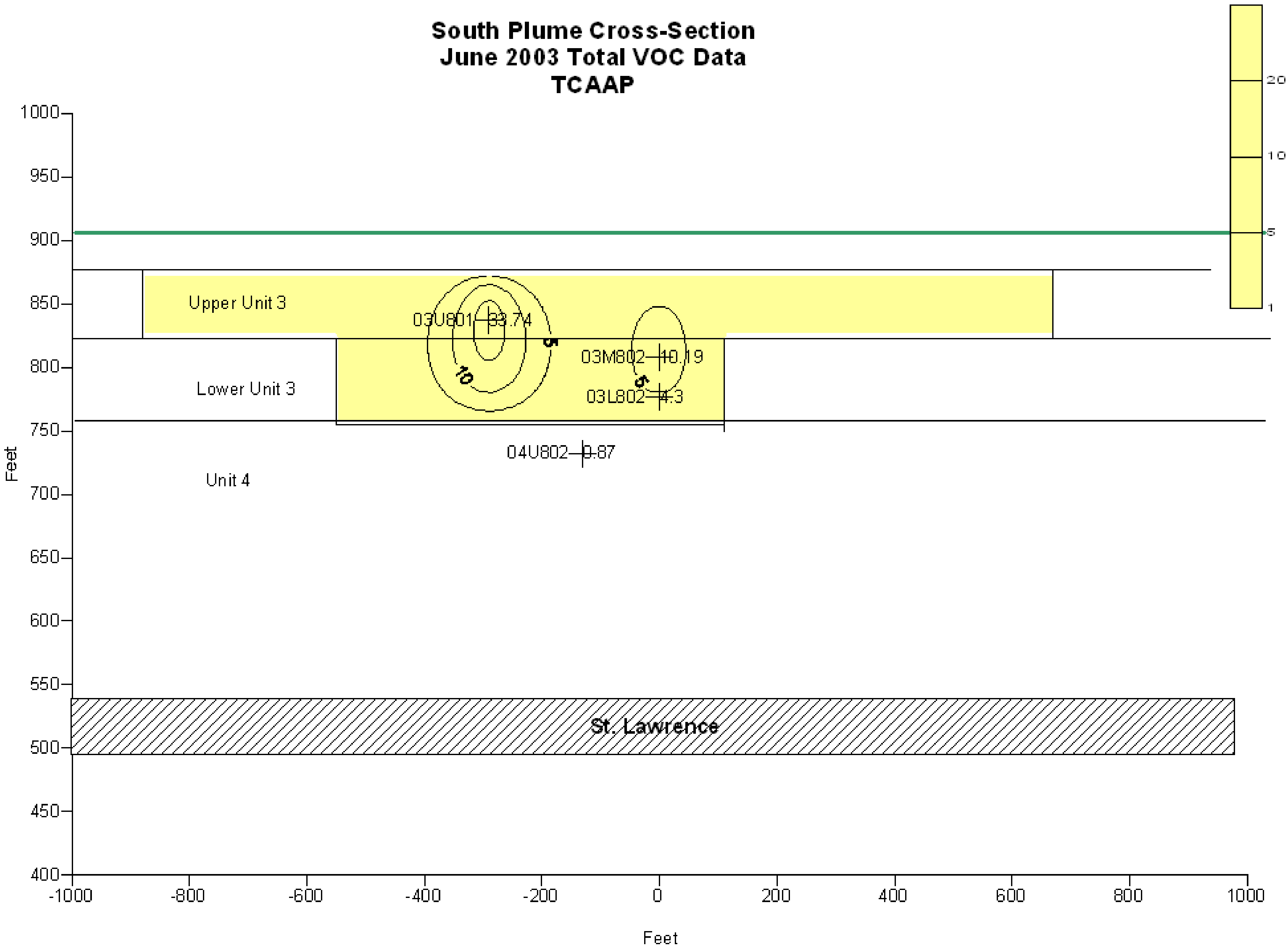
Concentration	Positive Planar Area (ft2)
Plume to 1	115236
Plume to 5	32494
Plume to 10	15927
Plume to 25	5422
Plume to 50	638
Plume to 100	0

TCE (ug/L)	Avg TCE (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	82743	248228
5 to 10	7.5	16567	124253
10 to 25	17.5	10505	183839
25 to 50	37.5	4783	179368
50 to 100	75	638	47878
	Sum	115236	783566

Area Wtd Conc	7	ug/L

2003


North Plume Cross-Section
June 2003 Total VOC Data
TCAAP
Feet
Feet
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U806 152.85
03M806 1737.1
03L806 444.7
04U806 472.4
PJ806 92.04
03U711 309.3
04U711 1
1000
400
100
10
1


South Plume Cross-Section
June 2003 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U801
33.74
03M802
10.19
03L802
4.3
04U802
0.87
10
5
5
1000
950
900
850
800
750
700
650
600
550
500
450
400
-1000
-800
-600
-400
-200
0
200
400
600
800
1000
Feet
Feet
20
10
5
1

Groundwater Quality Data (Organics) - 2003

Well	Date	TOTAL VOCs (ug/l)
03L806	6/12/2003	444.70
03M806	6/12/2003	1737.10
03U711	6/17/2003	309.30
03U806	6/16/2003	152.85
04U711	6/17/2003	1.10
04U806	6/16/2003	472.40
PJ#806	6/12/2003	92.04
03L802	6/17/2003	4.30
03M802	6/17/2003	10.19
03U801	6/17/2003	33.74
04U802	6/17/2003	0.87

South Plume

North plume

North Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June 2003

Concentration	Positive Planar Area (ft2)
Plume to 1	570970
Plume to 5	293399
Plume to 10	285615
Plume to 50	226380
Plume to 100	172784
Plume to 200	104726
Plume to 300	62076
Plume to 400	41078
Plume to 500	26311
Plume to 600	17751
Plume to 700	12321
Plume to 800	8684
Plume to 900	6147
Plume to 1000	4318
Plume to 1100	2971
Plume to 1200	1969
Plume to 1300	1227
Plume to 1400	687
Plume to 1500	318
Plume to 1600	93
Plume to 1700	0

TCE (ug/L)	Avg TCE (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	277571	832713
5 to 10	7.5	7784	58377
10 to 50	30	59235	1777060
50 to 100	75	53596	4019665
100 to 200	150	68058	10208666
200 to 300	250	42650	10662576
300 to 400	350	20998	7349150
400 to 500	450	14767	6645320
500 to 600	550	8560	4708004
600 to 700	650	5430	3529256
700 to 800	750	3638	2728383
800 to 900	850	2537	2156220
900 to 1000	950	1829	1737148
1000 to 1100	1050	1348	1414965
1100 to 1200	1150	1002	1151948
1200 to 1300	1250	742	927859
1300 to 1400	1350	539	728236
1400 to 1500	1450	369	534776
1500 to 1600	1550	226	349576
1600 to 1700	1650	93	153324
	Sum	570970	61673222

Area Wtd Conc	108	ug/L

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South Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June 2003

Concentration	Positive Planar Area (ft2)
Plume to 1	115236
Plume to 5	22810
Plume to 10	8328
Plume to 25	701
Plume to 50	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	92426	277278
5 to 10	7.5	14482	108617
10 to 25	17.5	7627	133469
25 to 50	37.5	701	26296
	Sum	115236	545660

Area Wtd Conc	5	ug/L

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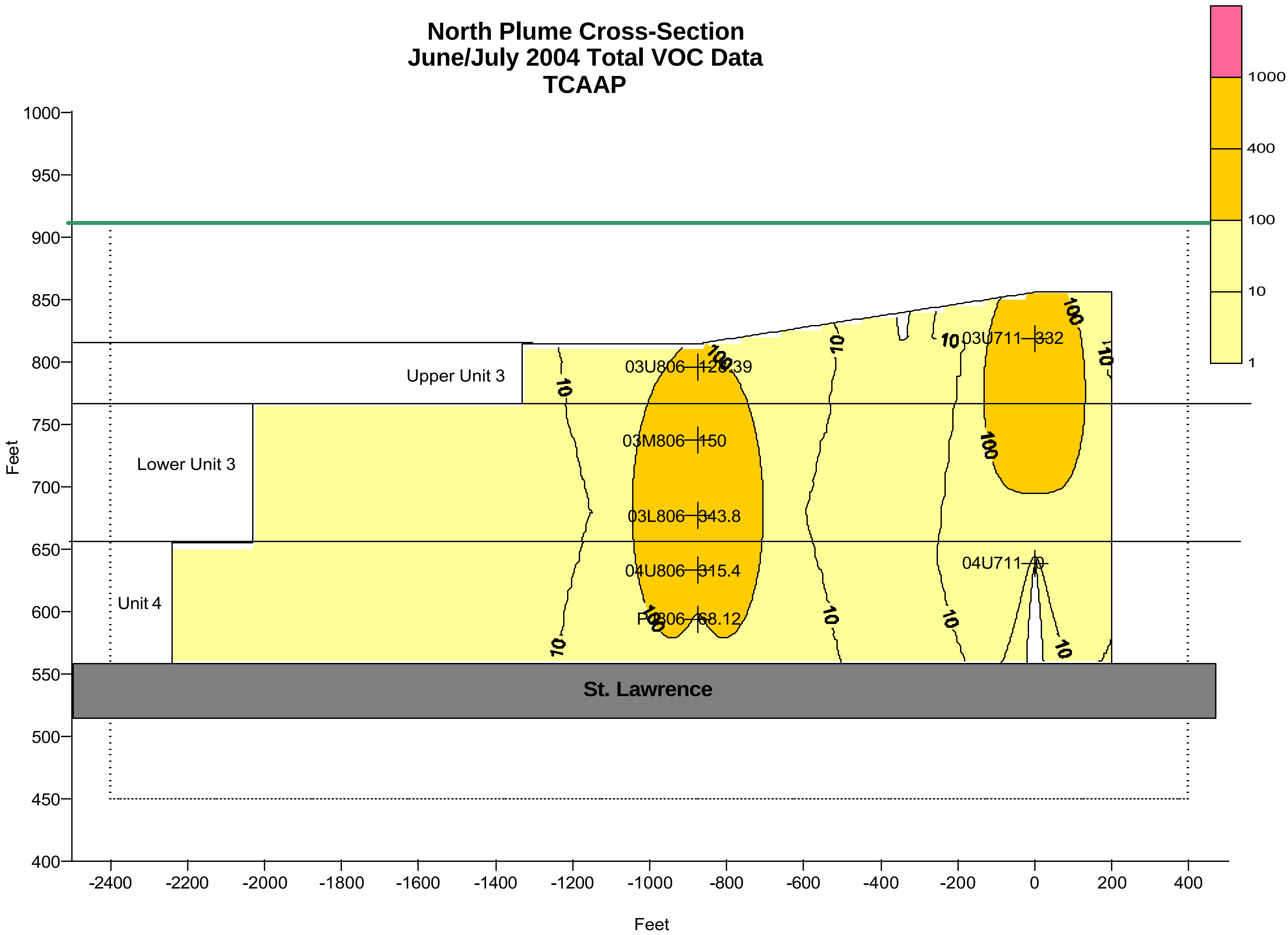
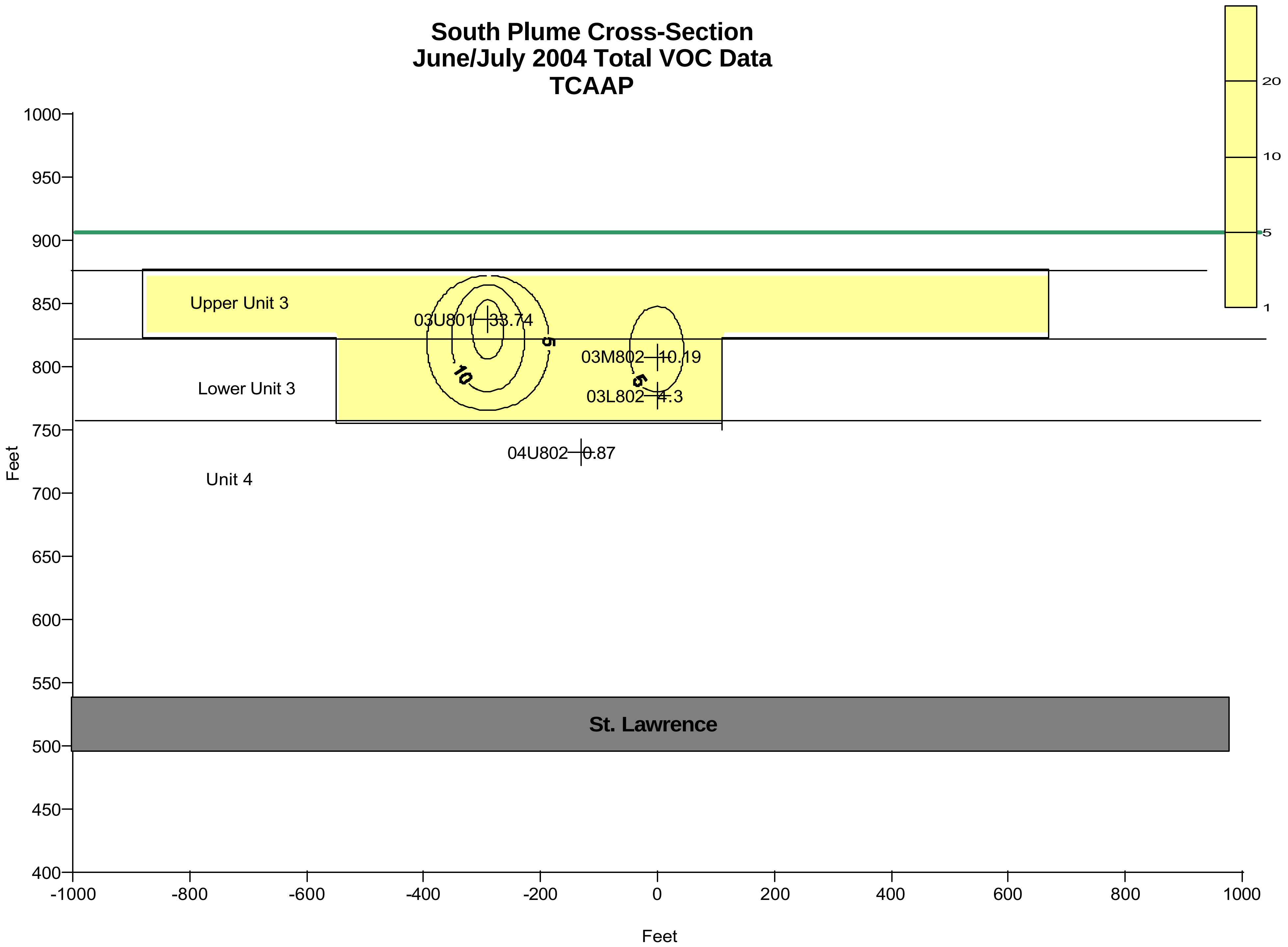
2004



North Plume Cross-Section
June/July 2004 Total VOC Data
TCAAP
1000
400
100
10
1
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U806
03M806
150
03L806
04U806
03U711
332
04U711
Feet
Feet


South Plume Cross-Section
June/July 2004 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
03U801 33.74
03M802 10.19
03L802 4.3
04U802 0.87
10
5
5
St. Lawrence
20
10
5
1
Feet
Feet
1000
950
900
850
800
750
700
650
600
550
500
450
400
-1000
-800
-600
-400
-200
0
200
400
600
800
1000

Groundwater Quality Data
Fiscal Year 2004
TGRS, TCAAP
Arden Hills, Minnesota

		1,1,1-Trichloroethane	*1,1-Dichloroethane*	*1,1-Dichloroethene*	*1,2-Dichloroethane*	*cis-1,2-Dichloroethene*	*Tetrachloroethene*	*Trichloroethene*	***Total VOCs***
TGRS Cleanup Level(1)		200	70	6	4	70	5	5	
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Location	***Date***								
03L802	7/7/04	<1	<1	<1	<1	<1	<1	4.2	4.2
03M802	6/17/04	<1	<1	<1	<1	<1	<1	11	11
03U801	6/17/04	<1	<1	<1	<1	0.6P	<1	34	34.61
04U802	7/7/04	<1	<1	<1	<1	<1	<1	<1	0
03L806	7/7/04	37	29	25	<1	2.8	<1	250	343.8
03M806	6/18/04	<1	19	9.9	<1	1.1	<1	120	150
03U711	7/6/04	51	10	14	<1	4.6	2.4	250	332
03U806	6/18/04	<1	3.6	2.9	<1	0.6P	1.3	120	128.39
04U711	7/6/04	<1	<1	<1	<1	<1	<1	<1	0
04U806	6/17/04	18	24	20	<1	3.4	<1	250	315.4
PJ#806	6/17/04	1.4	2.9	2.4	<1	0.4P	<1	61	68.12

Notes:
(1) Cleanup levels for TGRS are from the OU2 ROD. Shading indicates exceedence of the cleanup level.
D - Duplicate Analysis
J - Value is estimated
P - Results less than reporting level but greater than instrument detection limit.
South Plume
North Plume

Assumptions:
(<) values were treated as 0
any value with a text before or after number was treated as the detection.

North Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June/July 2004

Concentration	Positive Planar Area (ft2)
Plume to 1	569991
Plume to 5	288686
Plume to 10	271528
Plume to 50	186104
Plume to 100	120640
Plume to 200	51763
Plume to 300	26657
Plume to 400	15227
Plume to 500	9171
Plume to 600	5618
Plume to 700	3378
Plume to 800	1909
Plume to 900	950
Plume to 1000	358
Plume to 1100	52
Plume to 1200	0

TCE (ug/L)	Avg TCE (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	281305	843916
5 to 10	7.5	17158	128682
10 to 50	30	85425	2562744
50 to 100	75	65463	4909742
100 to 200	150	68878	10331672
200 to 300	250	25105	6276324
300 to 400	350	11430	4000556
400 to 500	450	6056	2725346
500 to 600	550	3553	1954040
600 to 700	650	2240	1455778
700 to 800	750	1469	1101604
800 to 900	850	960	815703
900 to 1000	950	591	561797
1000 to1100	1050	306	321663
1100 to1200	1150	52	59923
	Sum	569991	38049490

Area Wtd Conc	67	ug/L

South Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June/July 2004

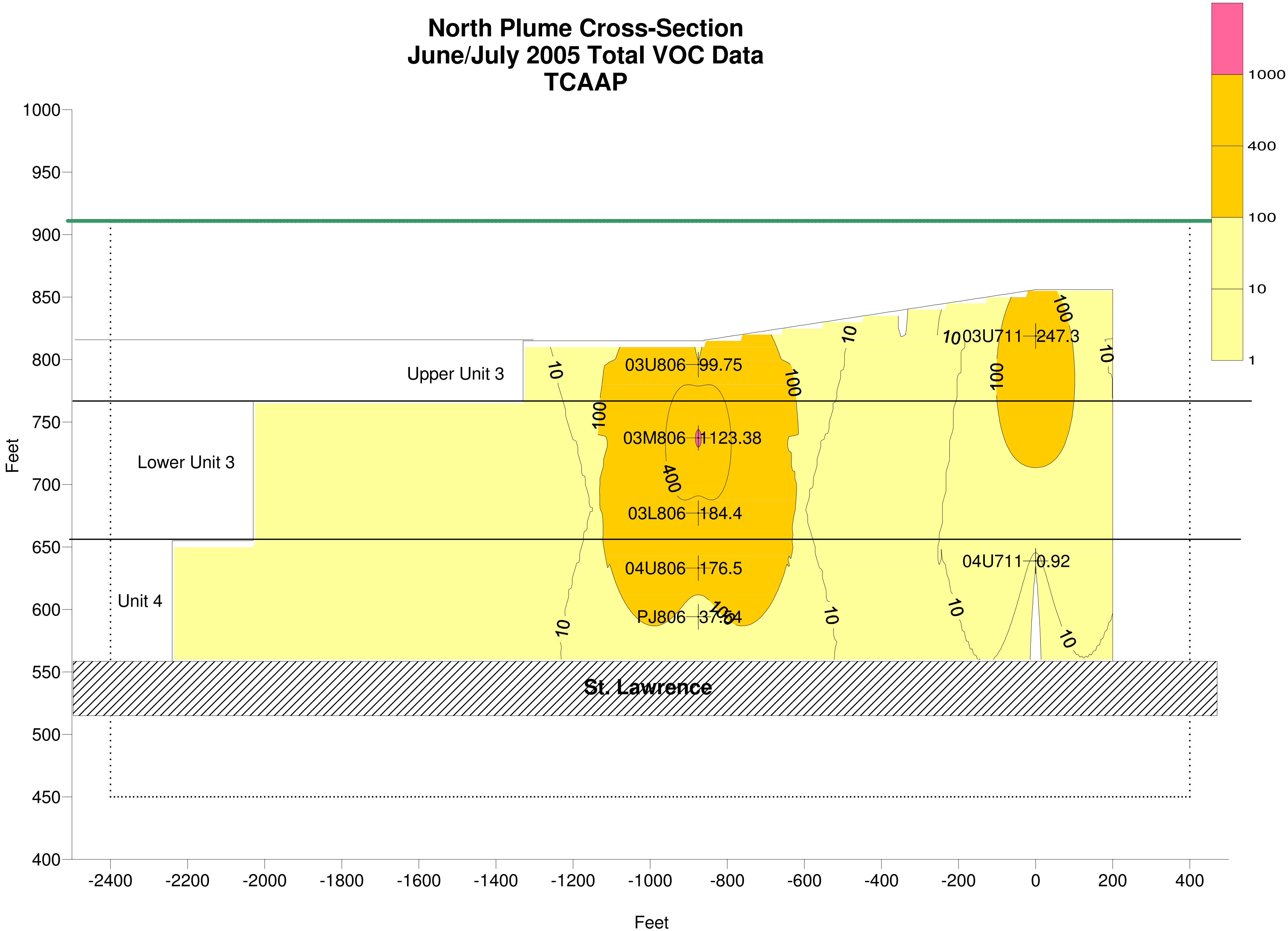
Concentration	Positive Planar Area (ft2)
Plume to 1	115236
Plume to 5	26387
Plume to 10	9922
Plume to 25	705
Plume to 50	0

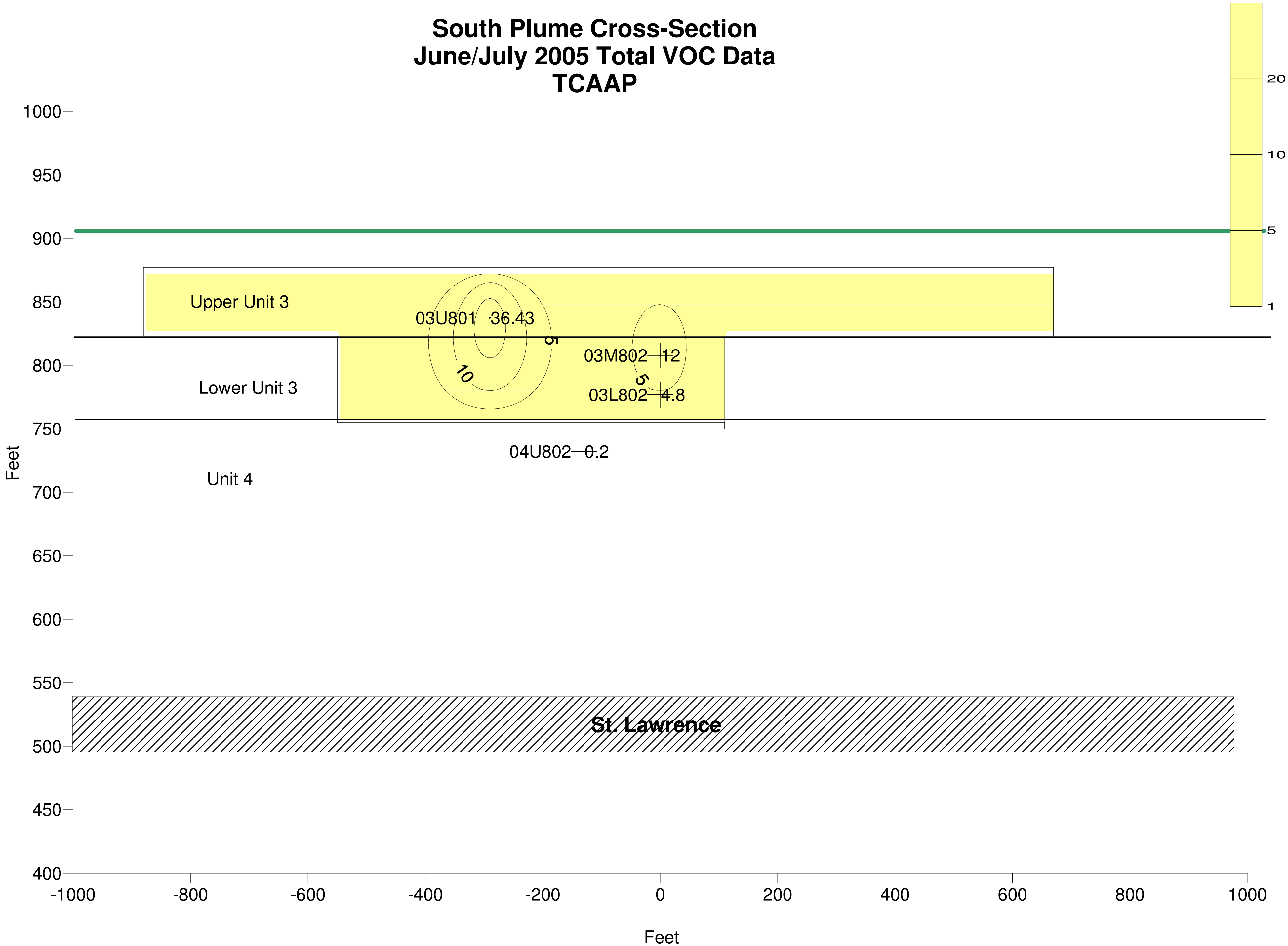
Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	88849	266548
5 to 10	7.5	16465	123487
10 to 25	17.5	9217	161298
25 to 50	37.5	705	26443
	Sum	115236	577775

Area Wtd Conc	5	ug/L

2005

North Plume Cross-Section
June/July 2005 Total VOC Data
TCAAP




South Plume Cross-Section
June/July 2005 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U801 36.43
03M802 12
03L802 4.8
04U802 0.2
10
5
5
20
10
5
1
Feet
Feet
1000
950
900
850
800
750
700
650
600
550
500
450
400
-1000
-800
-600
-400
-200
0
200
400
600
800
1000

North Plume Cross Section Data

well	June 2005 - Total VOC Conc (ug/L)
03L806	184.4
03M806	1123.4
03U711	247.3
03U806	99.8
04U711	0.9
04U806	176.5
PJ806	37.5

North Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June 2005

Concentration	Positive Planar Area (ft2)
Plume to 1	570939
Plume to 5	291677
Plume to 10	280513
Plume to 50	197699
Plume to 100	127405
Plume to 200	49292
Plume to 300	24075
Plume to 400	13538
Plume to 500	8008
Plume to 600	4780
Plume to 700	2761
Plume to 800	1459
Plume to 900	638
Plume to 1000	174
Plume to 1100	0

TCE (ug/L)	Avg TCE (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	279263	837788
5 to 10	7.5	11164	83727
10 to 50	30	82814	2484409
50 to 100	75	70294	5272047
100 to 200	150	78113	11716958
200 to 300	250	25217	6304365
300 to 400	350	10537	3687899
400 to 500	450	5530	2488435
500 to 600	550	3228	1775257
600 to 700	650	2020	1312854
700 to 800	750	1302	976374
800 to 900	850	821	697839
900 to 1000	950	464	440980
1000 to1100	1050	174	182396
	Sum	570939	38261328

Area Wtd Conc	67	ug/L

South Plume Cross Section Data

well	June 2005 - Total VOC Conc (ug/L)
03L802	4.8
03M802	12
03U801	36.43
04U802	0.2

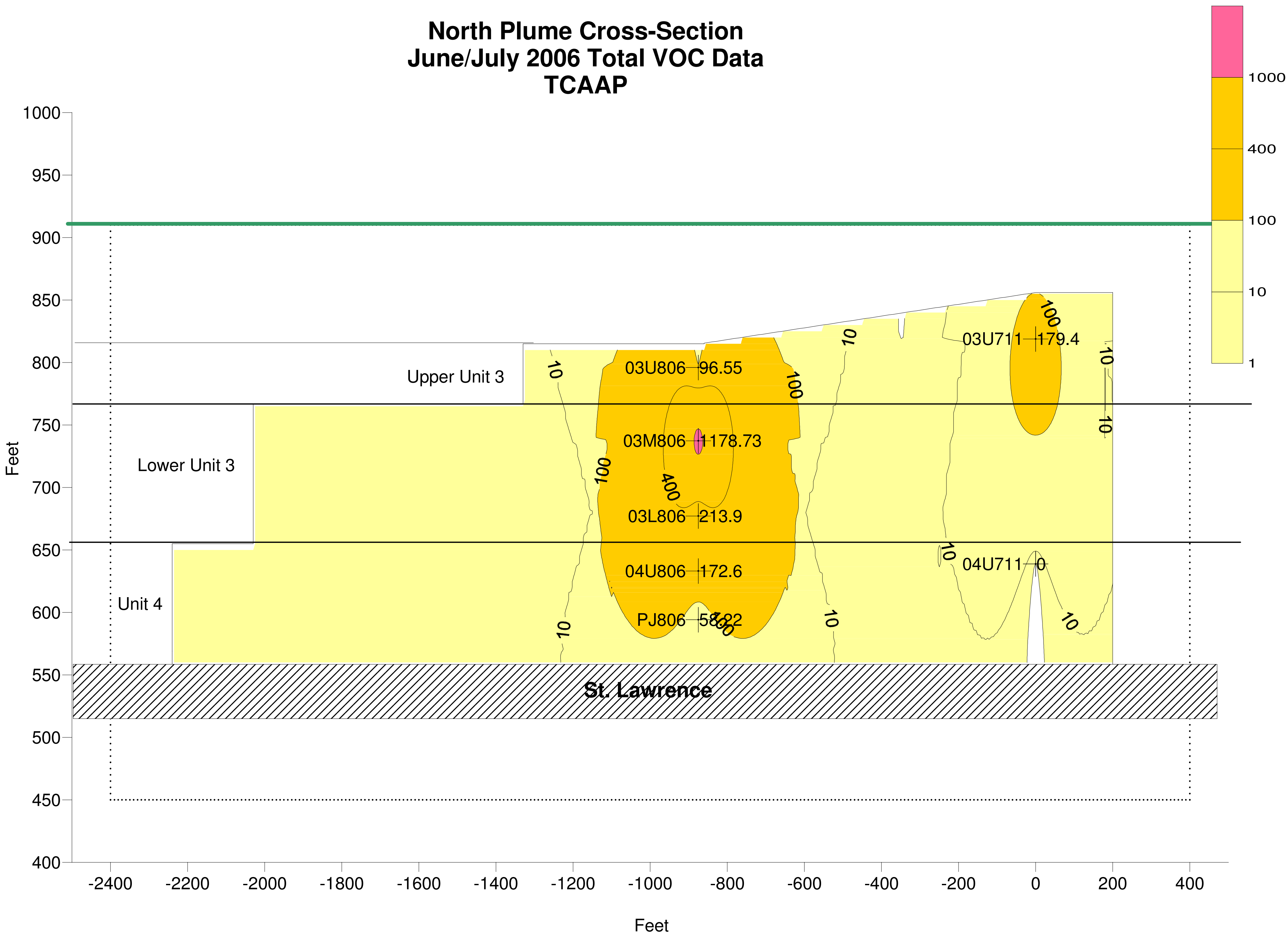
South Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June/July 2005

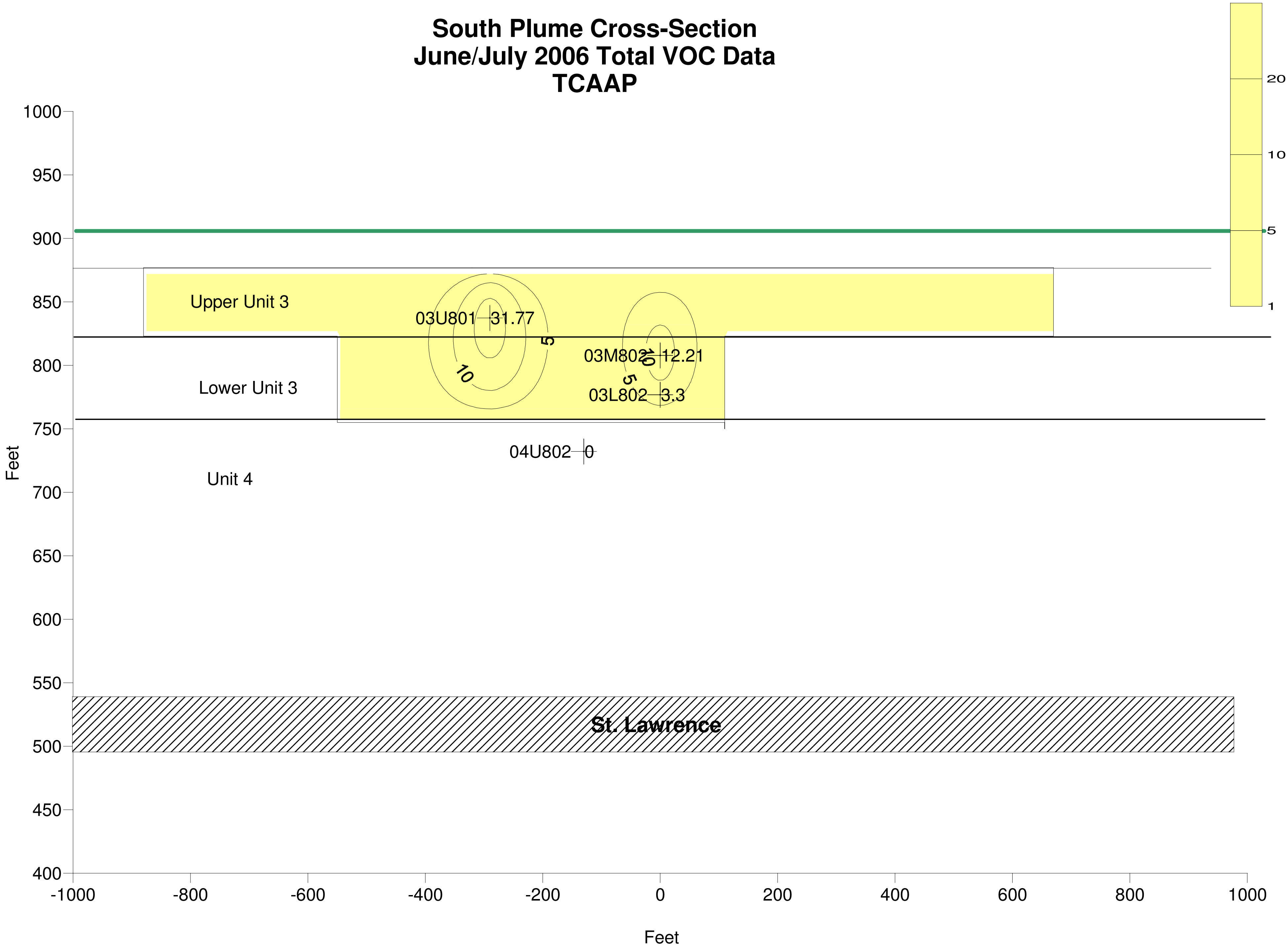
Concentration	Positive Planar Area (ft2)
Plume to 1	115236
Plume to 5	25368
Plume to 10	9422
Plume to 25	1068
Plume to 50	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	89869	269606
5 to 10	7.5	15946	119592
10 to 25	17.5	8354	146200
25 to 50	37.5	1068	40035
	Sum	115236	575434

Area Wtd Conc	5	ug/L

2006


North Plume Cross-Section
June/July 2006 Total VOC Data
TCAAP
Feet
Feet
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U806 96.55
03M806 1178.73
03L806 213.9
04U806 172.6
PJ806 58.22
03U711 179.4
04U711 0
1000
400
100
10
1


South Plume Cross-Section
June/July 2006 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U801 31.77
03M802 12.21
03L802 3.3
04U802 0
Feet
Feet
20
10
5
1

North Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June/July 2006

Concentration	Positive Planar Area (ft2)
Plume to 1	569991
Plume to 5	288686
Plume to 10	271528
Plume to 50	186104
Plume to 100	120640
Plume to 200	51763
Plume to 300	26657
Plume to 400	15227
Plume to 500	9171
Plume to 600	5618
Plume to 700	3378
Plume to 800	1909
Plume to 900	950
Plume to 1000	358
Plume to 1100	52
Plume to 1200	0

TCE (ug/L)	Avg TCE (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	281305	843916
5 to 10	7.5	17158	128682
10 to 50	30	85425	2562744
50 to 100	75	65463	4909742
100 to 200	150	68878	10331672
200 to 300	250	25105	6276324
300 to 400	350	11430	4000556
400 to 500	450	6056	2725346
500 to 600	550	3553	1954040
600 to 700	650	2240	1455778
700 to 800	750	1469	1101604
800 to 900	850	960	815703
900 to 1000	950	591	561797
1000 to1100	1050	306	321663
1100 to1200	1150	52	59923
	Sum	569991	38049490

Area Wtd Conc	67	ug/L

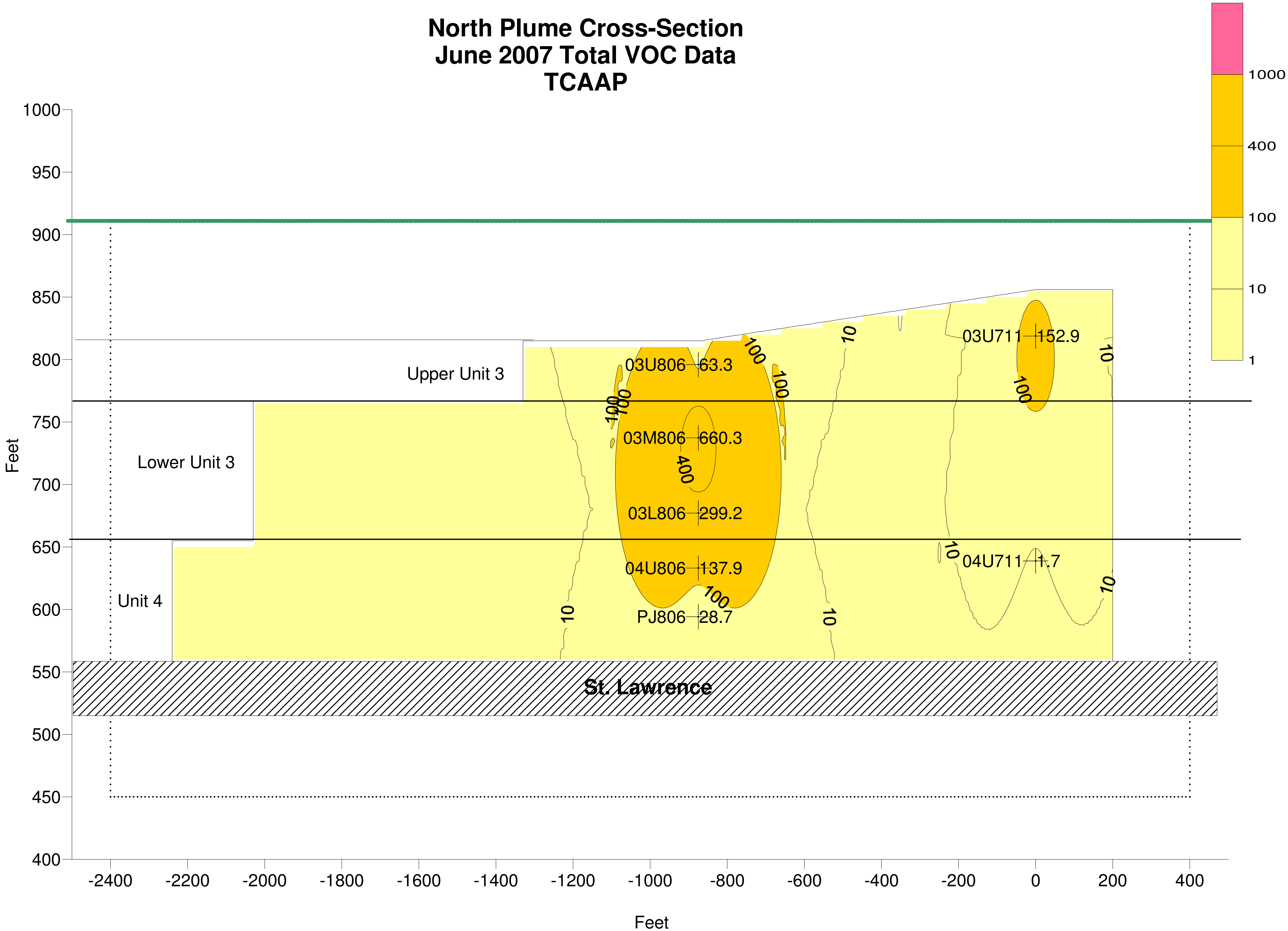
South Plume
Average Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June/July 2006

Concentration	Positive Planar Area (ft2)
Plume to 1	115236
Plume to 5	26387
Plume to 10	9922
Plume to 25	705
Plume to 50	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	88849	266548
5 to 10	7.5	16465	123487
10 to 25	17.5	9217	161298
25 to 50	37.5	705	26443
	Sum	115236	577775

Area Wtd Conc	5	ug/L

2007


North Plume Cross-Section
June 2007 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U806 63.3
03M806 660.3
03L806 299.2
04U806 137.9
PJ806 28.7
03U711 152.9
04U711 1.7
Feet
1000
400
100
10
1

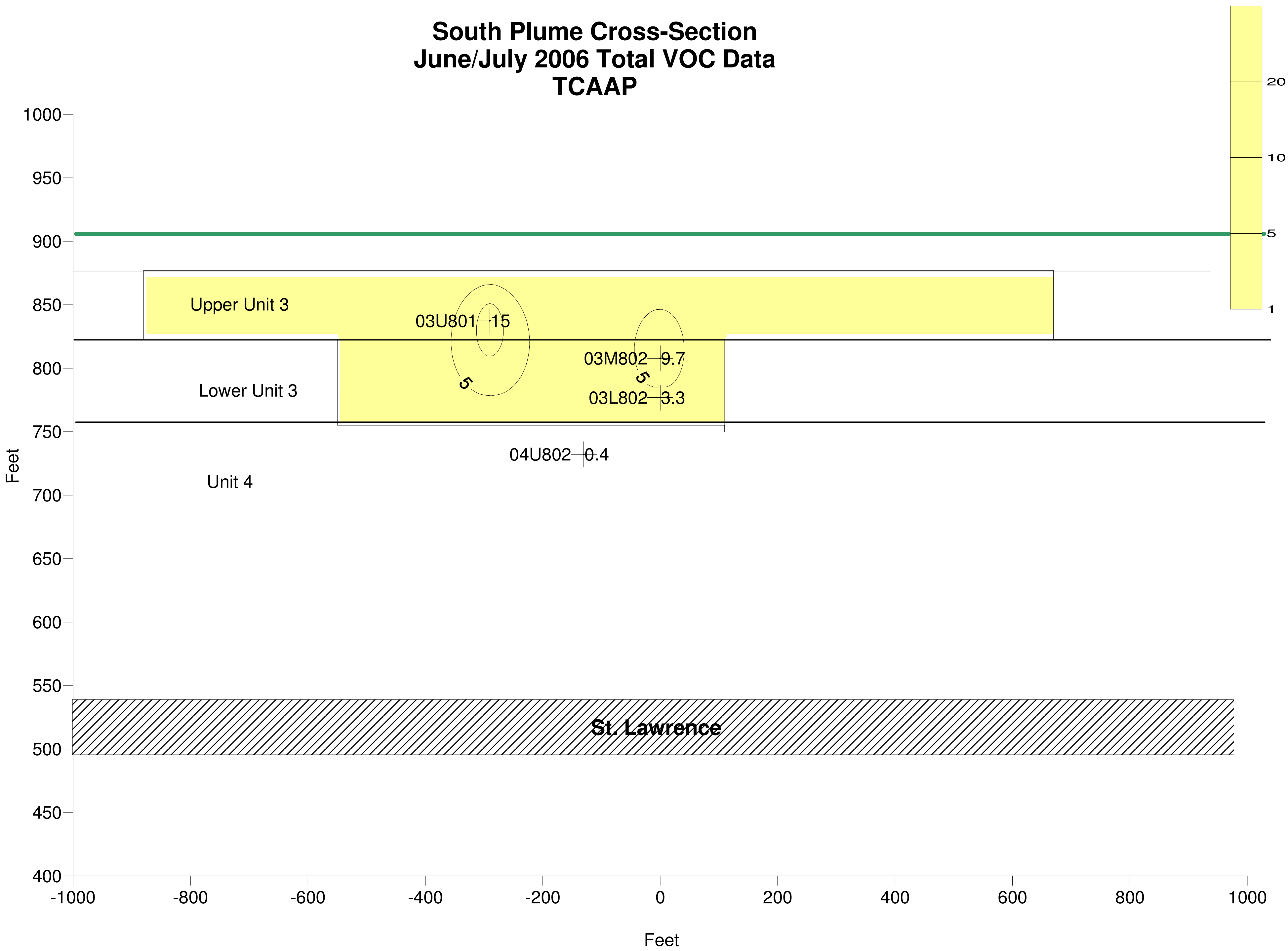

South Plume Cross-Section
June/July 2006 Total VOC Data
TCAAP
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U801 15
03M802 9.7
03L802 3.3
04U802 0.4
5
5
Feet
Feet
1000
950
900
850
800
750
700
650
600
550
500
450
400
-1000
-800
-600
-400
-200
0
200
400
600
800
1000
20
10
5
1

TABLE 1

VOC CONCENTRATIONS IN TGRS MONITORING WELLS
FY 2006--THROUGH 3rd QUARTER

Location	Date	1,1,1-Trichloroethane µg/L	1,1-Dichloroethane µg/L	1,1-Dichloroethene µg/L	cis-1,2-Dichloroethene µg/L	Trichloroethene µg/L	Total VOCs
03L802	6/14/07	< 1	< 1	< 1	< 1	3.3	3.3
03M802	6/14/07	< 1	< 1	< 1	< 1	9.7	9.7
03U801	6/11/07	< 1	< 1	< 1	< 1	15	15
04U802	6/14/07	< 1	< 1	< 1	< 1	0.38 JP	0.4
03L806	6/12/07	3.6	41	31	3.6	220	299.2
03M806	6/12/07	< 2	93	42	5.3	520	660.3
03U711	6/14/07	19	5.5	6.5	1.9	120	152.9
03U806	6/12/07	< 1	2.1	1.2	< 1	60	63.3
04U711	6/14/07	< 1	< 1	< 1	< 1	1.7	1.7
04U806	6/12/07	3.5	23	14	1.4	96	137.9
PJ#806	6/12/07	0.6 JP	1.9	1.2	< 1	25	28.7

Notes:

South Plume (yellow)

North Plume (blue)

Assumptions:

(<) values were treated as 0

Any value with a text before or after number was treated as the detection.

North Plume
Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June 2007

Concentration	Positive Planar Area (ft2)
Plume to 1	572436
Plume to 5	288683
Plume to 10	268876
Plume to 50	165604
Plume to 100	86995
Plume to 200	29700
Plume to 300	12406
Plume to 400	5027
Plume to 500	1606
Plume to 600	190
Plume to 700	0

TCE (ug/L)	Avg TCE (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	283753	851259
5 to 10	7.5	19808	148559
10 to 50	30	103272	3098155
50 to 100	75	78609	5895680
100 to 200	150	57295	8594261
200 to 300	250	17294	4323421
300 to 400	350	7379	2582629
400 to 500	450	3421	1539433
500 to 600	550	1416	778920
600 to 700	650	190	123391
	Sum	572436	27935709

Area Wtd Conc	49	ug/L

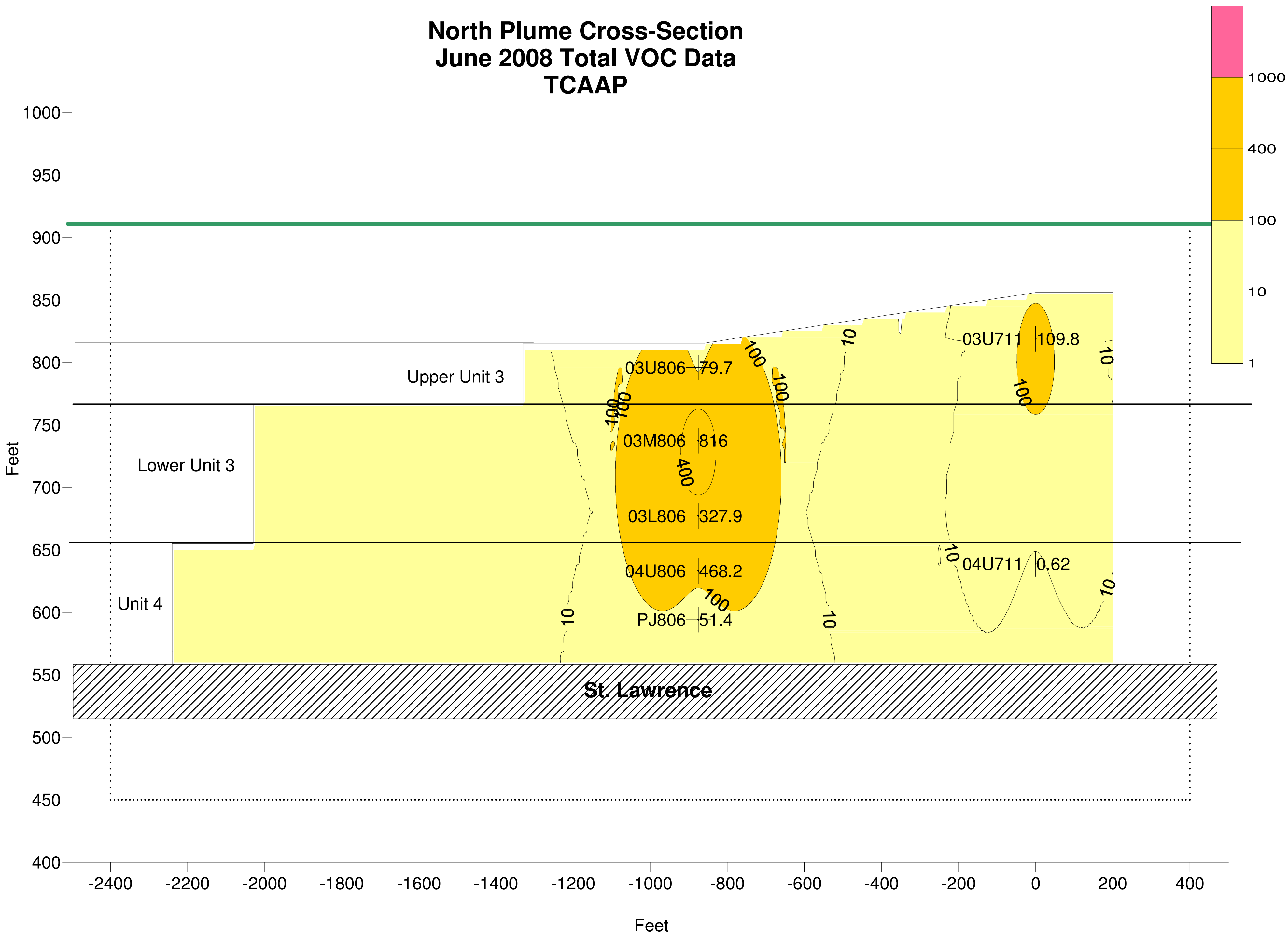
South Plume
Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June 2007

Concentration	Positive Planar Area (ft2)
Plume to 1	115236
Plume to 5	13400
Plume to 10	1496
Plume to 25	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	101836	305508
5 to 10	7.5	11904	89283
10 to 25	17.5	1496	26180
	Sum	115236	420971

Area Wtd Conc	4	ug/L

2008


North Plume Cross-Section
June 2008 Total VOC Data
TCAAP
1000
950
900
850
800
750
700
650
600
550
500
450
400
Feet
Upper Unit 3
Lower Unit 3
Unit 4
St. Lawrence
03U806 79.7
03M806 816
03L806 327.9
04U806 468.2
PJ806 51.4
03U711 109.8
04U711 0.62
10
100
400
-2400
-2200
-2000
-1800
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
Feet
1000
400
100
10
1

South Plume Cross-Section
June 2008 Total VOC Data
TCAAP

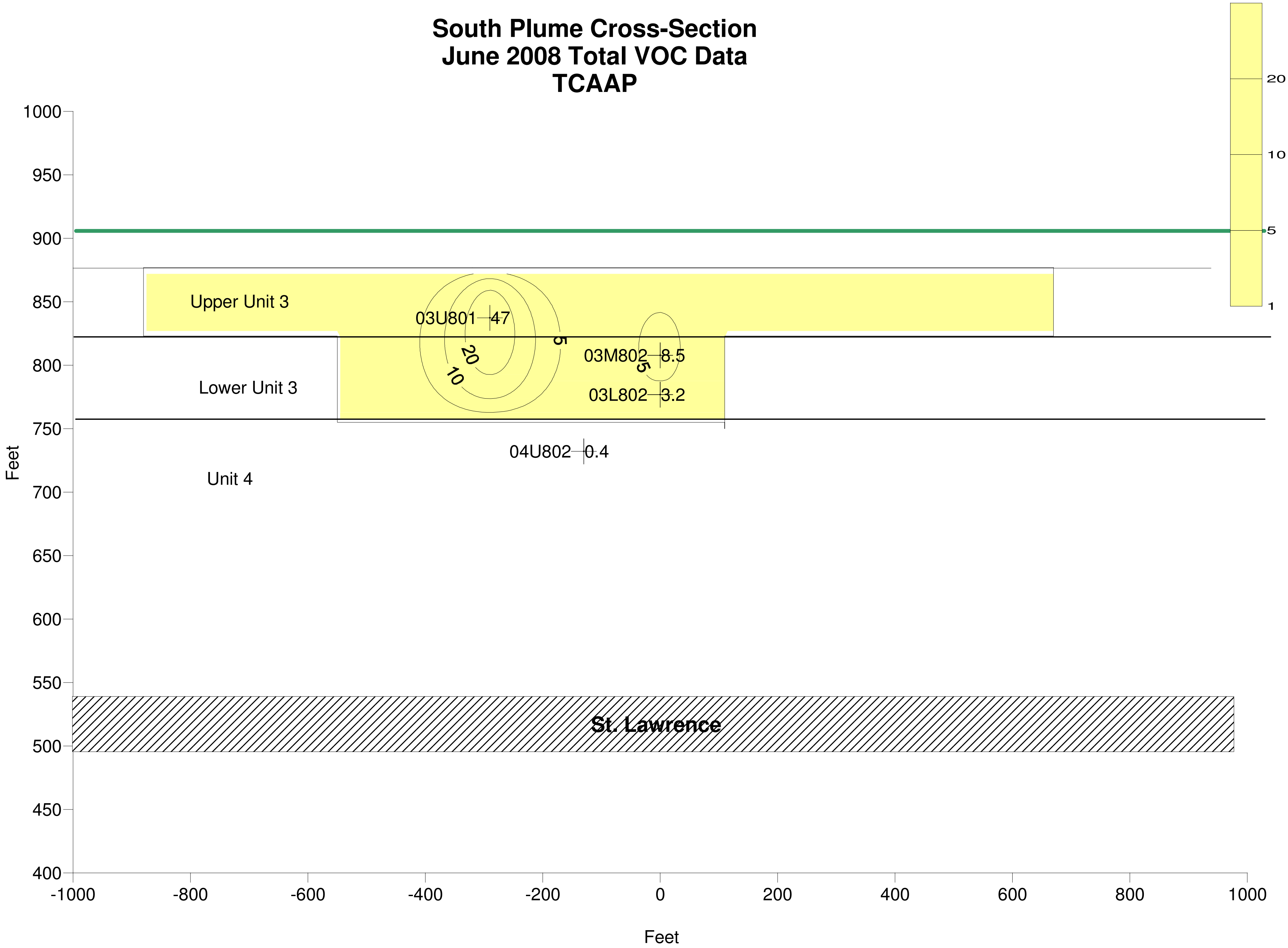


TABLE 1

VOC CONCENTRATIONS IN TGRS MONITORING WELLS

Location	Date	1,1,1-Trichloroethane µg/L	1,1-Dichloroethane µg/L	1,1-Dichloroethene µg/L	cis-1,2-Dichloroethene µg/L	Trichloroethene µg/L	Total VOCs
03L802	6/16/08	< 1	< 1	< 1	< 1	3.2	3.2
03M802	6/16/08	< 1	< 1	< 1	0.7 JP	8.5	8.5
03U801	6/16/08	< 1	< 1	< 1	0.8 JP	47	47
04U802	6/16/08	< 1	< 1	< 1	< 1	0.51 JP	0.4
03L806	6/13/08	2.1	47	35	3.8	240	327.9
03M806	6/13/08	0.42	85	43	8	680	816
03U711	6/16/08	11	3.3	4.2	1.3	90	109.8
03U806	6/13/08	< 1	2.2	1.5	0.4 JP	76	79.7
04U711	6/16/08	< 1	< 1	< 1	< 1	0.6	0.6
04U806	6/13/08	3.7	44	36	4.5	380	468.2
PJ#806	6/13/08	0.7 JP	3.8	2.9	0.4 JP	44	51.4

Notes:

South Plume

North Plume

Assumptions:

(<) values were treated as 0

Any value with a text before or after number was treated as the detection.

North Plume
Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June 2008

Concentration	Positive Planar Area (ft2)
Plume to 1	572436
Plume to 5	288682
Plume to 10	268876
Plume to 50	165604
Plume to 100	86995
Plume to 200	29700
Plume to 300	12406
Plume to 400	5027
Plume to 500	1606
Plume to 600	190
Plume to 700	0

TCE (ug/L)	Avg TCE (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	283755	851264
5 to 10	7.5	19806	148543
10 to 50	30	103272	3098159
50 to 100	75	78609	5895680
100 to 200	150	57295	8594261
200 to 300	250	17294	4323421
300 to 400	350	7379	2582629
400 to 500	450	3421	1539433
500 to 600	550	1416	778920
600 to 700	650	190	123391
	Sum	572436	27935703

Area Wtd Conc	49	ug/L

South Plume
Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June 2008

Concentration	Positive Planar Area (ft2)
Plume to 1	115236
Plume to 5	24477
Plume to 10	11570
Plume to 25	2633
Plume to 50	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	90759	272277
5 to 10	7.5	12907	96803
10 to 25	17.5	8937	156397
25 to 50	37.5	2633	98743
	Sum	115236	624221

Area Wtd Conc	5	ug/L

D.2.3 Group 1, 2, 3, 5, and 6 Mann-Kendall Evaluations

Summary Table

Group 1, 2, 3, and 5 Mann-Kendall Summary and MAROS Conlusion

Group	Kendall S	N	Raw Trend	Confidence	COV	Raw Trend Decision	MAROS Conclusion	Threshold Triggered?	Comments
Group 2	--	--	--	--	--	--	--	--	Not sampled in FY 2008
Group 3	--	--	--	--	--	--	--	--	Not sampled in FY 2008
Group 5	--	--	--	--	--	--	--	--	Not sampled in FY 2008
Group 1 NP	-7	6	Decreasing	86.00%	0.3534	S or NT	**Stable**	yes	Stable
Group 1 SP	-3	6	Decreasing	68.00%	0.0845	S or NT	**Stable**	yes	Stable

Notes:
S or NT = Stable or No Trend
N = number of data points
COV = Coefficient of Variance

MAROS Decsion Matrix

M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Group 6 Mann-Kendall Summary and MAROS Conlusion

Group	Kendall S	N	Raw Trend	Confidence	COV	Raw Trend Decision	MAROS Conclusion	Threshold Triggered?	Comments
Group 6 OU1 Jordan Wells:									
04J822	3	6	Increasing	64.00%	0.3238	S or NT	**No Trend**	Yes	Improved from increasing in FY2007 to no trend
04J847	-5	6	Decreasing	76.00%	0.1133	S or NT	**Stable**	Yes	Confidence in decrease improved since 2007
04J849	3	6	Increasing	64.00%	2.4495	S or NT	**No Trend**	Yes	All detection below 0.5 ug/l

Notes:
S or NT = Stable or No Trend
N = number of data points
COV = Coefficient of Variance

MAROS Decsion Matrix

M-K S	Confidence	Trend
S > 0	> 95%	Increasing
S > 0	90-95%	Pr. Incr.
S > 0	< 90%	No Trend
S</= 0	< 90%	No Trend
S </= 0	< 90%	Stable
S < 0	90-95%	Pr. Decr.
S < 0	>95%	Decreasing

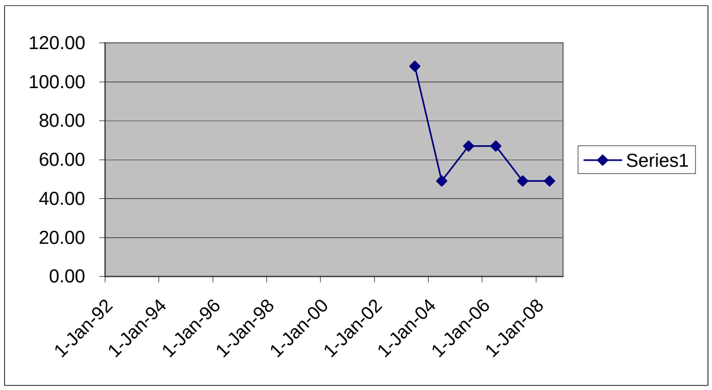
Mann-Kendall Plots

Well: Group 1 NP

Date	TCE (ug/l)	Mann-Kendall Calculation:					
6/18/2003	108.00	1					
6/18/2004	49.00	1	-1				
6/18/2005	67.00	1	-1	1			
6/8/2006	67.00	1	-1	1	0		
6/11/2007	49.00	1	-1	0	-1	-1	
6/16/2008	49.00	1	-1	0	-1	-1	0

N		6	5	4	3	2	1	15
	sum		-5	2	-2	-2	0	-7
Possibles		15						

Mean	64.83
STNDEV	22.91215
COV	0.353401
Trend:	Negative
Confidence (lookup)	86.00%



S	-7
tau	-0.466667

Decsion Matrix

M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: Group 1 SP

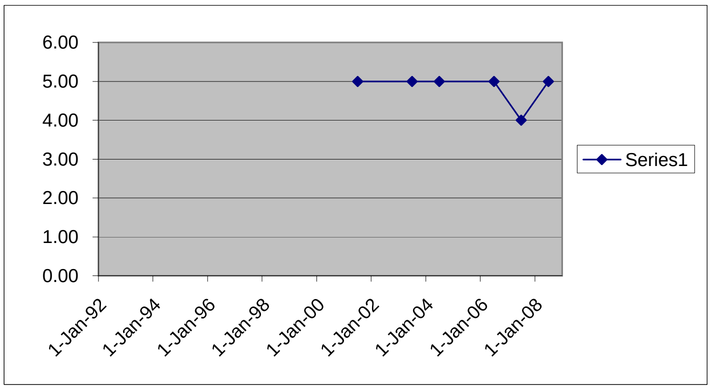
Date	TCE (ug/l)	Mann-Kendall Calculation:					
6/18/2001	5.00	1					
6/18/2003	5.00	1	0				
6/18/2004	5.00	1	0	0			
6/8/2006	5.00	1	0	0	0		
6/11/2007	4.00	1	-1	-1	-1	-1	
6/16/2008	5.00	1	0	0	0	0	1

N		6	5	4	3	2	1	15
	sum		-1	-1	-1	-1	1	-3
Possibles		15						

Mean	4.83
STNDEV	0.408248
COV	0.084465

Trend: Negative

Confidence (lookup) 68.00%



S	-3
tau	-0.2

Decsion Matrix

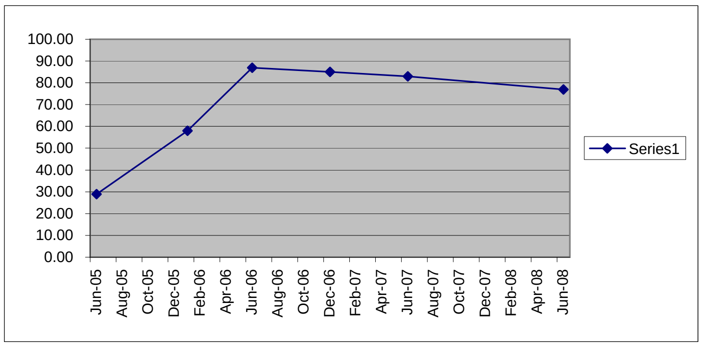
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: **04J822**

Date	TCE (ug/l)	Mann-Kendall Calculation:					
6/30/2005	29.00	1					
1/11/2006	58.00	1	1				
6/6/2006	87.00	1	1	1			
12/11/2006	85.00	1	1	1	-1		
6/13/2007	83.00	1	1	1	-1	-1	
6/25/2008	77.00	1	1	1	-1	-1	-1

N		6	5	4	3	2	1	15
	sum		5	4	-3	-2	-1	3
Possibles		15						

Mean	69.83
STNDEV	22.6134178
COV	0.32381983
Trend:	Positive
Confidence (lookup)	64.00%



S	3
tau	0.2

Decsion Matrix

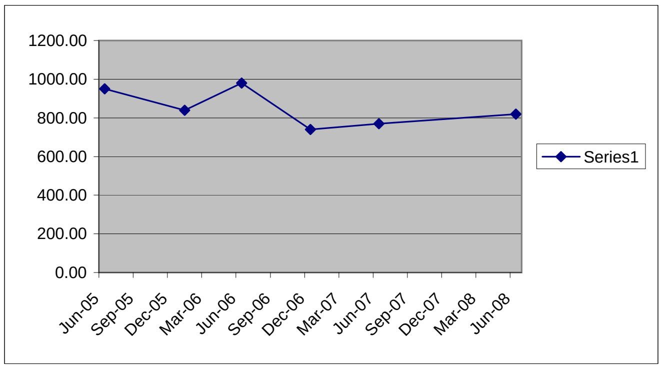
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: 04J847

Date	TCE (ug/l)	Mann-Kendall Calculation:					
6/15/2005	950.00	1					
1/11/2006	840.00	1	-1				
6/6/2006	980.00	1	1	1			
12/11/2006	740.00	1	-1	-1	-1		
6/18/2007	770.00	1	-1	-1	-1	1	
6/25/2008	820.00	1	-1	-1	-1	1	1

N		6	5	4	3	2	1	15
	sum		-3	-2	-3	2	1	-5
Possibles		15						

Mean	850.00
STNDEV	96.33276
COV	0.113333
Trend:	Negative
Confidence (lookup)	76.00%



S	-5
tau	-0.333333

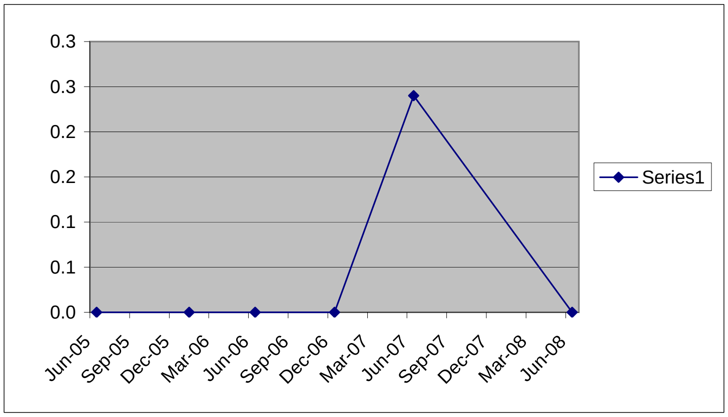
Decsion Matrix

M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: 04J849

Date	TCE (ug/l)	Mann-Kendall Calculation:					
6/9/2005	0.0	1					
1/11/2006	0.0	1	0				
6/5/2006	0.0	1	0	0			
12/11/2006	0.0	1	0	0	0		
6/12/2007	0.24	1	1	1	1	1	
6/25/2008	0.0	1	0	0	0	0	-1

N		6	5	4	3	2	1	15
	sum		1	1	1	1	-1	3
Possibles		15						



Mean	0.04
STNDEV	0.09798
COV	2.44949
Trend:	Positive
Confidence (lookup)	64.00%

S	3
tau	0.2

Decsion Matrix

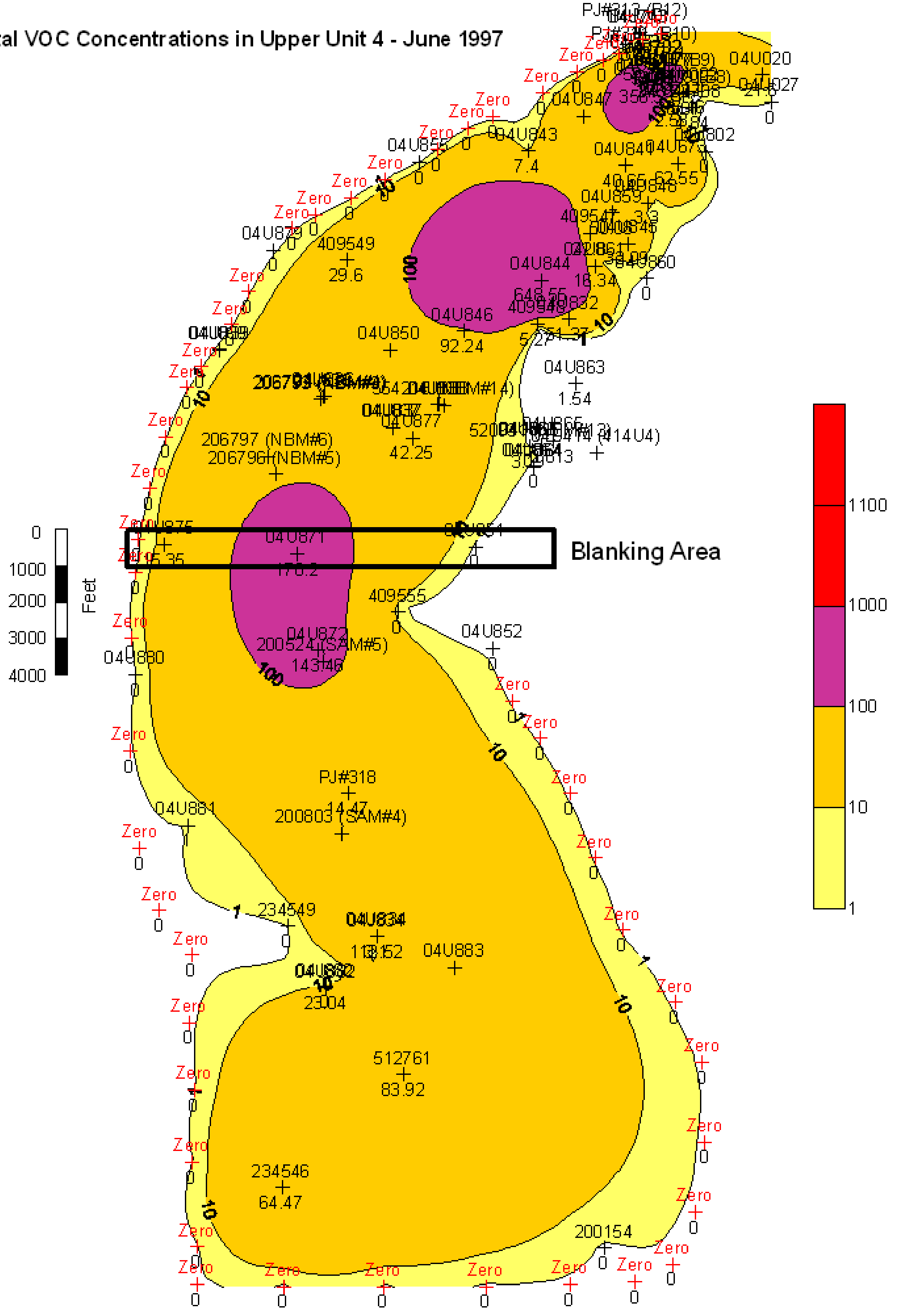
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

D.2.4 Group 3 and Group 5 Kriging Evaluation

Group 5

1997

Total VOC Concentrations in Upper Unit 4 - June 1997



Groundwater Quality Data (Organics) - 1997

Well	Date	TOTAL VOCs (ug/l)
04J077	6/10/97	346.57
04J702	6/6/97	53.83
04J708	6/11/97	4.84
04J713	6/10/97	0.00
04J834	6/24/97	3.10
04J864	6/3/97	0.00
04J866	6/2/97	0.00
04J882	6/24/97	0.00
04U002	6/16/97	5.16
04U020	6/16/97	21.60
04U027	6/10/97	0.00
04U077	6/10/97	273.72
04U673	6/12/97	62.55
04U701	6/18/97	6.92
04U702	6/6/97	14.71
04U709	6/9/97	28.01
04U711	6/13/97	2.53
04U713	6/10/97	0.00
04U802	6/16/97	0.00
04U806	6/5/97	356.59
04U832	6/4/97	51.37
04U833	6/5/97	59.30
04U834	6/24/97	112.52
04U841	6/24/97	40.65
04U843	6/25/97	7.40
04U844	6/27/97	648.55
04U845	6/5/97	32.09
04U846	6/25/97	92.24
04U848	6/5/97	3.30
04U851	6/4/97	0.00
04U852	6/24/97	0.00
04U855	6/26/97	0.00
04U859	6/4/97	50.08
04U860	6/5/97	0.00
04U861	6/4/97	16.34
04U863	6/3/97	1.54
04U864	6/3/97	0.00
04U865	6/3/97	0.81
04U866	6/2/97	3.19
04U871	6/25/97	178.20
04U872	6/19/97	143.46
04U875	6/26/97	15.35
04U877	6/23/97	42.25
04U879	6/25/97	0.00
04U880	6/26/97	0.00
04U881	6/24/97	1.00
04U882	6/24/97	23.04
200154	6/27/97	0.00
234546	6/24/97	64.47
234549	6/27/97	0.00
409547	6/5/97	22.80
409548	6/4/97	5.27
409549	6/23/97	29.60
409555	6/26/97	0.00
512761	6/24/97	83.92
PJ#318	6/26/97	14.47

North Plume
Average Total VOC Concentration Calculations
Group 5
TCAAP
June 1997

Concentration	Positive Planar Area (m2)
Plume to 1	32684921
Plume to 5	29464761
Plume to 10	26448984
Plume to 50	10398696
Plume to 100	3199895
Plume to 200	745654
Plume to 300	317170
Plume to 400	127939
Plume to 500	32208
Plume to 600	100
Plume to 700	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	3220160	9660479
5 to 10	7.5	3015777	22618327
10 to 50	30	16050289	481508657
50 to 100	75	7198801	539910067
100 to 200	150	2454241	368136114
200 to 300	250	428484	107121047
300 to 400	350	189231	66230926
400 to 500	450	95731	43078773
500 to 600	550	32107	17659116
600 to 700	650	100	65324
	Sum	32684921	1655988831

Area Wtd Conc	51	ug/L

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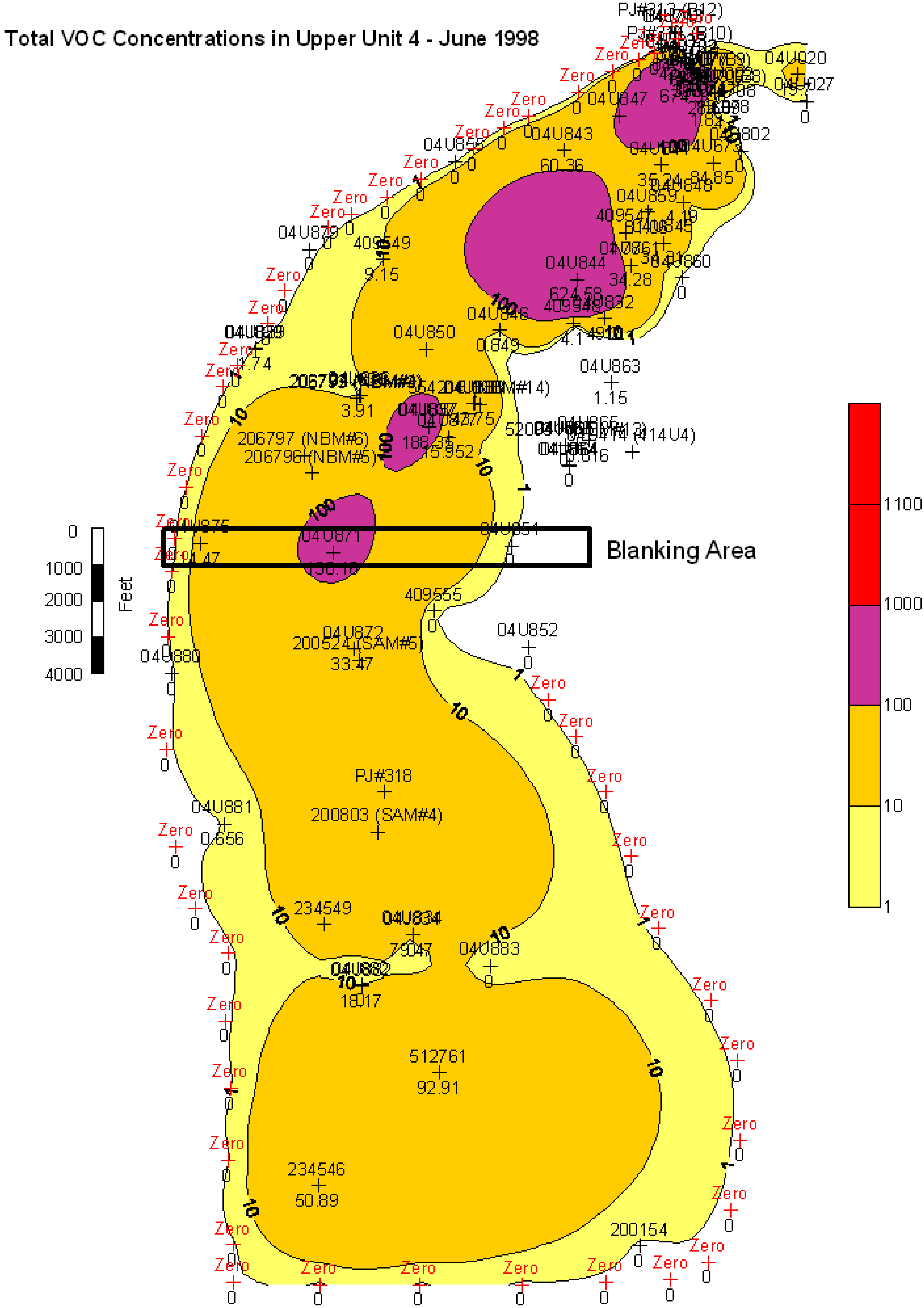
1998


Total VOC Concentrations in Upper Unit 4 - June 1998
Blanking Area
0
1000
2000
3000
4000
Feet
1100
1000
100
10
1
04U871
04U875
04U851
04U852
04U850
04U863
04U844
04U843
04U847
04U855
04U879
04U880
04U881
04U872
200524 (SAM#5)
33.47
409555
PJ#318
200803 (SAM#4)
234549
04U834
79.47
04U883
04U882
18.17
512761
92.91
234546
50.89
200154
206797 (NBM#6)
206796 (NBM#5)
409549
9.15
04U020
04U027
04U802
60.36
34.28
0.849
1.15
0.656

Groundwater Quality Data (Organics) - 1998

Well	Date	TOTAL VOCs (ug/l)
04J077	6/15/98	318.11
04J702	6/11/98	15.26
04J708	6/9/98	1.70
04J713	6/10/98	0.00
04J834	6/18/98	0.00
04J836	9/4/98	3.91
04J837	9/8/98	188.35
04J838	9/3/98	43.75
04J839	9/4/98	1.74
04J864	6/25/98	0.00
04J866	6/26/98	0.00
04J882	6/19/98	0.00
04U002	6/5/98	12.08
04U020	6/4/98	19.70
04U027	6/16/98	0.00
04U077	6/12/98	307.74
04U673	6/25/98	84.85
04U701	6/10/98	7.56
04U702	6/11/98	11.85
04U709	6/16/98	28.61
04U711	6/9/98	1.82
04U713	6/10/98	0.00
04U802	6/11/98	0.00
04U806	6/12/98	674.90
04U832	6/25/98	49.20
04U833	6/11/98	42.90
04U834	6/18/98	79.47
04U841	6/19/98	35.24
04U843	6/18/98	60.36
04U844	6/23/98	624.58
04U845	6/25/98	34.31
04U846	6/17/98	0.85
04U848	6/29/98	4.19
04U851	6/26/98	0.00
04U852	6/26/98	0.00
04U855	6/18/98	0.00
04U859	6/25/98	81.06
04U860	6/29/98	0.00
04U861	6/29/98	34.28
04U863	6/25/98	1.15
04U864	6/25/98	0.00
04U865	6/25/98	0.82
04U871	6/23/98	138.16
04U872	6/9/98	33.47
04U875	6/29/98	14.47
04U877	6/19/98	15.95
04U879	6/24/98	0.00
04U880	6/24/98	0.00
04U881	6/23/98	0.66
04U882	6/19/98	18.17
04U883	6/24/98	0.00
200154	6/26/98	0.00
234546	6/25/98	50.89
409547	6/22/98	1.77
409548	6/22/98	4.10
409549	6/19/98	9.15
409555	6/19/98	0.00
512761	6/25/98	92.91

North Plume
Average Total VOC Concentration Calculations
Group 5
TCAAP
June 1998

Concentration	Positive Planar Area (m2)
Plume to 1	32092171
Plume to 5	27662632
Plume to 10	23087160
Plume to 50	7346565
Plume to 100	2377485
Plume to 200	787450
Plume to 300	352369
Plume to 400	134661
Plume to 500	25717
Plume to 600	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	4429539	13288616
5 to 10	7.5	4575472	34316037
10 to 50	30	15740596	472217867
50 to 100	75	4969080	372680972
100 to 200	150	1590035	238505230
200 to 300	250	435081	108770344
300 to 400	350	217708	76197641
400 to 500	450	108945	49025219
500 to 600	550	25717	14144095
	Sum	32092171	1379146020

Area Wtd Conc	43	ug/L

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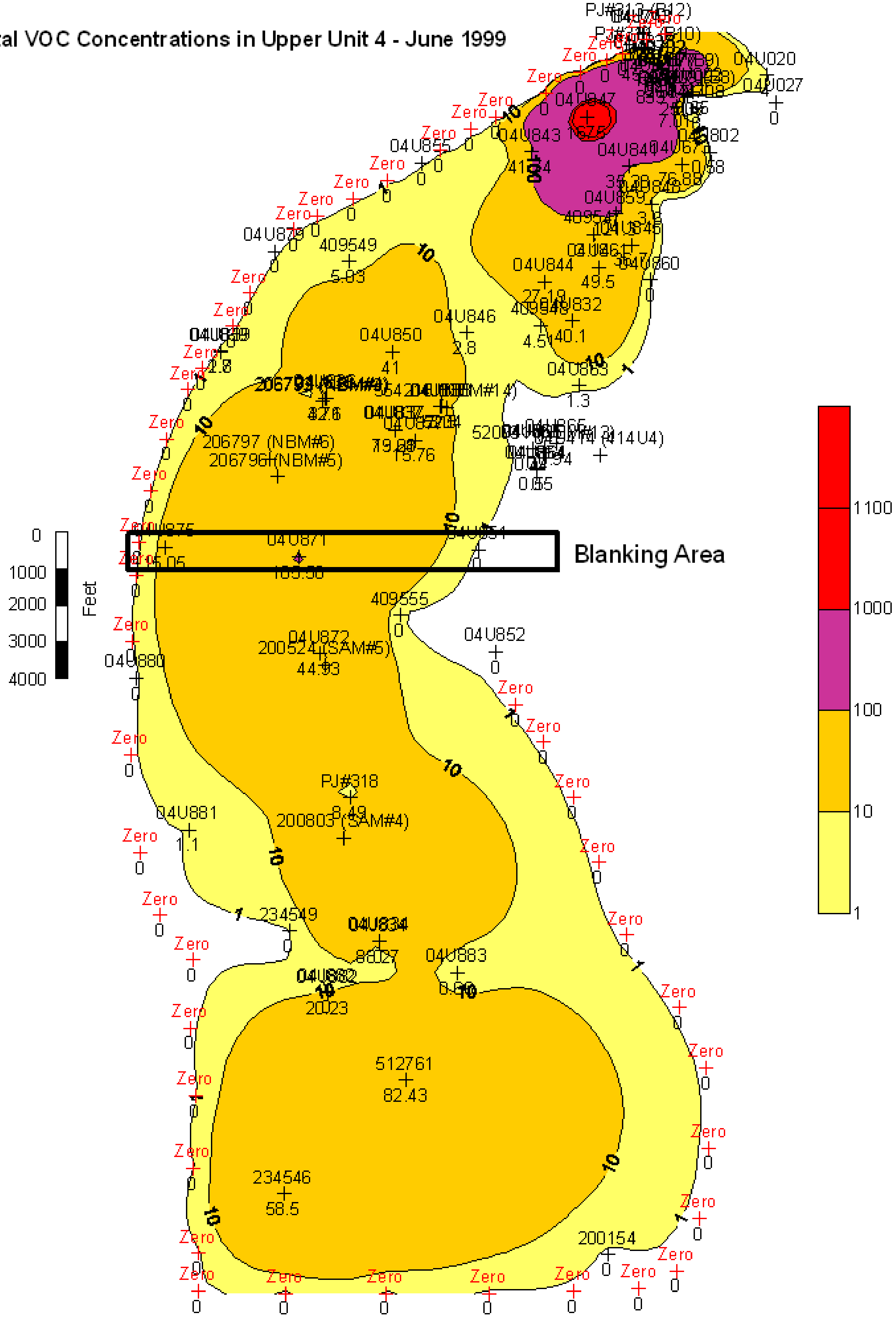
1999

Total VOC Concentrations in Upper Unit 4 - June 1999



Groundwater Quality Data (Organics) - 1999

Well	Date	TOTAL VOCs (ug/l)
04J077	6/22/99	1314.00
04J702	6/21/99	30.20
04J708	6/23/99	8.00
04J713	6/22/99	1.50
04J834	6/10/99	0.00
04J836	6/16/99	4.71
04J837	6/10/99	73.61
04J838	6/10/99	52.50
04J839	6/17/99	1.80
04J864	6/4/99	0.55
04J866	6/7/99	0.00
04J882	6/10/99	0.00
04U002	6/21/99	9.65
04U020	6/21/99	4.00
04U027	6/22/99	0.00
04U077	6/22/99	214.70
04U673	6/4/99	76.88
04U701	6/28/99	17.80
04U702	6/21/99	16.84
04U709	6/25/99	25.05
04U711	6/28/99	7.01
04U713	6/22/99	1.60
04U802	6/23/99	0.58
04U806	6/23/99	839.00
04U832	6/7/99	40.10
04U833	6/22/99	45.47
04U834	6/10/99	88.27
04U836	6/16/99	32.60
04U837	6/10/99	19.28
04U838	6/10/99	13.04
04U839	6/17/99	2.70
04U841	6/14/99	35.38
04U843	6/14/99	41.74
04U844	6/15/99	27.19
04U845	6/7/99	36.70
04U846	6/9/99	2.80
04U847	6/29/99	1675.00
04U848	6/4/99	3.60
04U850	6/9/99	41.00
04U851	6/8/99	0.00
04U852	6/8/99	0.00
04U855	6/11/99	0.00
04U859	6/7/99	121.30
04U860	6/7/99	0.00
04U861	6/7/99	49.50
04U863	6/7/99	1.30
04U864	6/4/99	0.00
04U865	6/8/99	0.94
04U866	12/18/00	0.44
04U871	6/11/99	105.58
04U872	6/9/99	44.93
04U875	6/9/99	15.05
04U877	6/14/99	15.76
04U879	6/11/99	0.00
04U880	6/14/99	0.00
04U881	6/15/99	1.10
04U882	6/10/99	20.23
04U883	6/14/99	0.66
200154	6/15/99	0.00
234546	6/15/99	58.50
234549	6/9/99	0.00
409547	6/11/99	3.14
409548	6/14/99	4.51
409549	6/11/99	5.03
409555	6/11/99	0.00
512761	6/15/99	82.43
PJ#318	6/10/99	8.49

North Plume
Average Total VOC Concentration Calculations
Group 5
TCAAP
June 1999

Concentration	Positive Planar Area (m2)
Plume to 1	32152197
Plume to 5	26871107
Plume to 10	21286747
Plume to 50	5028631
Plume to 100	1308233
Plume to 200	945626
Plume to 300	751118
Plume to 400	607728
Plume to 500	499154
Plume to 600	402501
Plume to 700	306873
Plume to 800	206371
Plume to 900	147267
Plume to 1000	102626
Plume to 1100	68502
Plume to 1200	43348
Plume to 1300	23382
Plume to 1400	1580
Plume to 1500	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	5281090	15843270
5 to 10	7.5	5584361	41882705
10 to 50	30	16258115	487743458
50 to 100	75	3720399	279029890
100 to 200	150	362607	54391038
200 to 300	250	194508	48627018
300 to 400	350	143390	50186427
400 to 500	450	108574	48858241
500 to 600	550	96653	53159057
600 to 700	650	95628	62158118
700 to 800	750	100502	75376593
800 to 900	850	59104	50238740
900 to 1000	950	44641	42409035
1000 to 1100	1050	34124	35830376
1100 to 1200	1150	25154	28927105
1200 to 1300	1250	19966	24957475
1300 to 1400	1350	21802	29432460
1400 to 1500	1450	1580	2290660
	Sum	32152197	1431341667

Area Wtd Conc	45	ug/L

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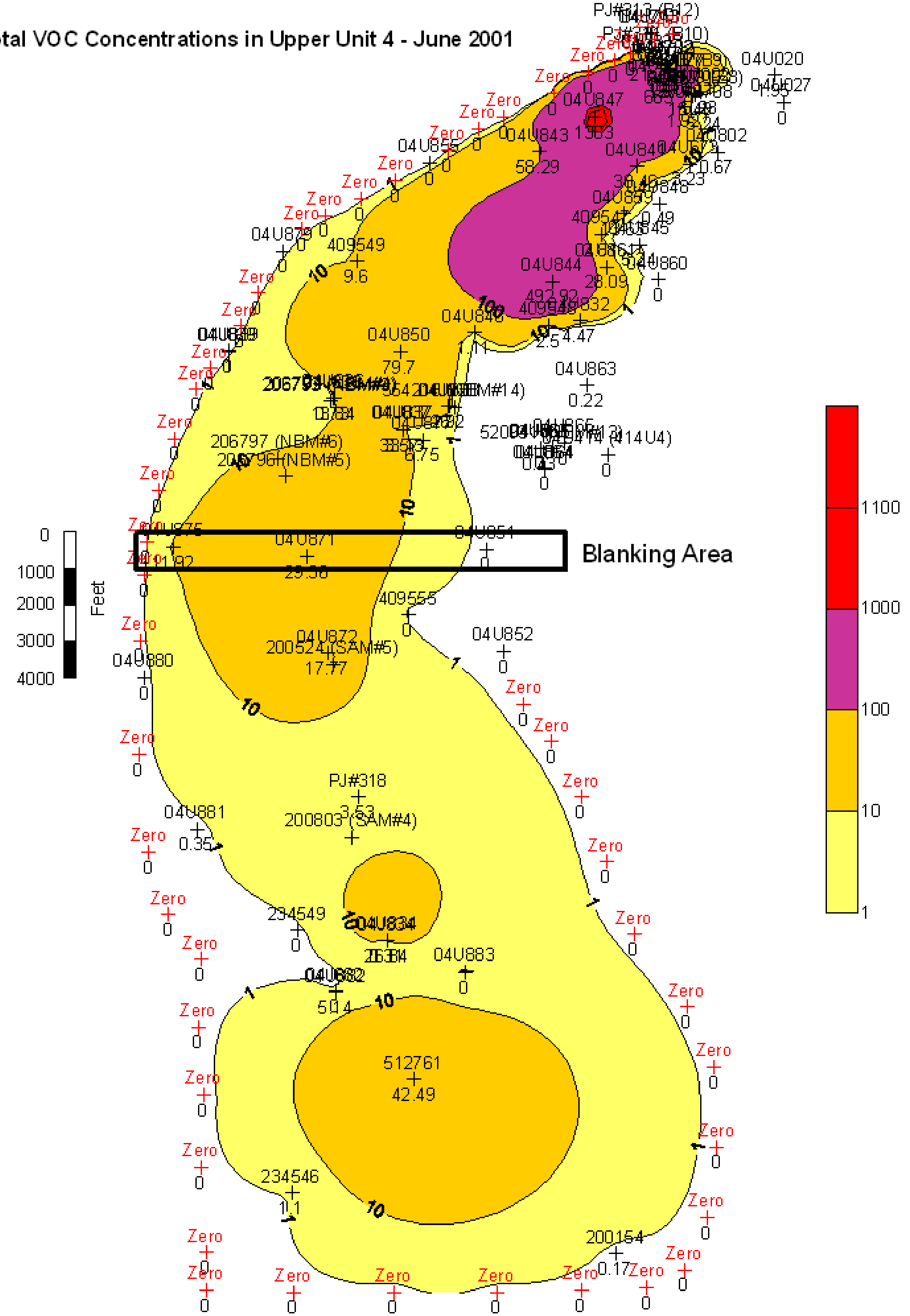
2001

Total VOC Concentrations in Upper Unit 4 - June 2001



Groundwater Quality Data (Organics) - 2001		
Well	Date	TOTAL VOCs (ug/l)
04J077	6/8/01	571.00
04J702	6/7/01	9.97
04J708	6/7/01	5.24
04J713	6/12/01	0.26
04J834	6/15/01	0.31
04J836	6/20/01	0.73
04J837	6/23/01	33.13
04J838	6/23/01	16.20
04J839	6/18/01	0.00
04J864	6/11/01	0.00
04J866	6/11/01	0.00
04J882	6/15/01	0.00
04U002	6/6/01	5.23
04U020	6/5/01	1.95
04U027	6/11/01	0.00
04U077	6/8/01	127.46
04U414 (414U4)	6/11/01	0.00
04U673	6/12/01	3.23
04U701	6/7/01	10.68
04U702	6/7/01	9.31
04U709	6/13/01	16.43
04U711	6/12/01	1.92
04U713	6/12/01	1.35
04U802	6/19/01	0.67
04U806	6/15/01	665.00
04U832	6/14/01	4.47
04U833	6/13/01	21.78
04U834	6/23/01	26.84
04U836	6/20/01	13.84
04U837	6/21/01	3.57
04U838	6/20/01	2.92
04U839	6/18/01	1.00
04U841	6/21/01	38.46
04U843	6/21/01	58.29
04U844	6/23/01	492.92
04U845	6/13/01	5.24
04U846	6/15/01	1.11
04U847	6/25/01	1383.00
04U848	6/12/01	0.49
04U850	6/22/01	79.70
04U851	6/12/01	0.00
04U852	6/12/01	0.00
04U855	6/15/01	0.00
04U859	6/13/01	13.63
04U860	6/13/01	0.00
04U861	6/11/01	28.09
04U863	6/14/01	0.22
04U864	6/11/01	0.00
04U865	6/12/01	0.00
04U866	6/11/01	0.43
04U871	6/25/01	29.36
04U872	6/21/01	17.77
04U875	6/19/01	11.92
04U877	6/20/01	6.75
04U879	6/18/01	0.00
04U880	6/14/01	0.00
04U881	6/18/01	0.35
04U882	6/21/01	5.14
04U883	6/15/01	0.00
200154	6/25/01	0.17
234546	6/15/01	1.10
234549	6/25/01	0.00
409547	6/14/01	2.81
409548	6/19/01	2.50
409549	6/19/01	9.60
409555	6/14/01	0.00
512761	6/25/01	42.49
PJ#318	6/19/01	3.53

North Plume
Average Total VOC Concentration Calculations
Group 5
TCAAP
June 2001

Concentration	Positive Planar Area (m2)
Plume to 1	28115641
Plume to 5	19249812
Plume to 10	12948481
Plume to 50	3342924
Plume to 100	2196190
Plume to 200	1277869
Plume to 300	771564
Plume to 400	512338
Plume to 500	375231
Plume to 600	257607
Plume to 700	174105
Plume to 800	115542
Plume to 900	71537
Plume to 1000	41011
Plume to 1100	17338
Plume to 1200	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	8865830	26597489
5 to 10	7.5	6301331	47259979
10 to 50	30	9605557	288166702
50 to 100	75	1146734	86005059
100 to 200	150	918321	137748138
200 to 300	250	506305	126576320
300 to 400	350	259226	90729057
400 to 500	450	137107	61698046
500 to 600	550	117625	64693598
600 to 700	650	83502	54276144
700 to 800	750	58563	43922147
800 to 900	850	44005	37403841
900 to 1000	950	30526	28999732
1000 to 1100	1050	23673	24856763
1100 to 1200	1150	17338	19939076
	Sum	28115641	1138872092

Area Wtd Conc	41	ug/L

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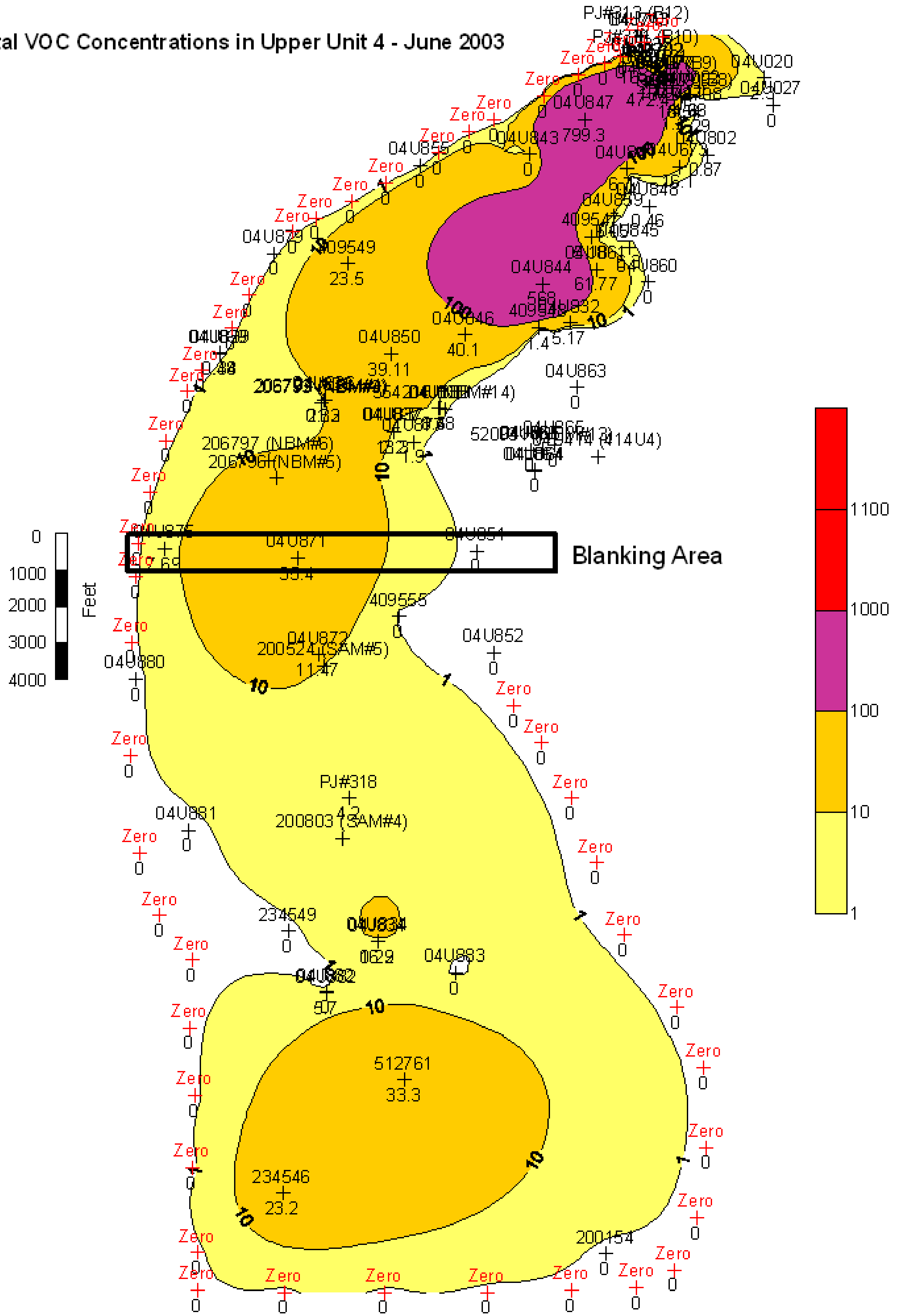
2003

Total VOC Concentrations in Upper Unit 4 - June 2003



Groundwater Quality Data (Organics) - 2003

Well	Date	TOTAL VOCs (ug/l)
04J077	6/13/03	747.00
04J702	6/16/03	9.07
04J708	6/12/03	4.29
04J713	6/12/03	0.15
04J834	6/9/03	0.29
04J836	6/10/03	0.82
04J837	6/16/03	13.30
04J838	6/9/03	8.58
04J839	6/5/03	0.48
04J864	6/3/03	0.00
04J866	6/3/03	0.00
04J882	6/6/03	0.00
04U002	6/11/03	4.63
04U020	6/11/03	2.30
04U027	6/12/03	0.00
04U077	6/13/03	107.93
04U673	6/10/03	16.10
04U701	6/16/03	7.79
04U702	6/16/03	1.60
04U709	6/19/03	16.54
04U711	6/17/03	1.10
04U713	6/12/03	0.90
04U802	6/17/03	0.87
04U806	6/16/03	472.40
04U832	6/11/03	5.17
04U833	6/13/03	16.34
04U834	6/16/03	16.20
04U836	6/10/03	21.30
04U837	6/10/03	2.20
04U838	6/9/03	1.43
04U839	6/6/03	0.34
04U841	6/11/03	6.77
04U843	6/12/03	0.00
04U844	6/17/03	568.00
04U845	6/9/03	6.30
04U846	6/9/03	40.10
04U847	6/17/03	799.30
04U848	6/11/03	0.46
04U850	6/12/03	39.11
04U851	6/11/03	0.00
04U852	6/11/03	0.00
04U855	6/9/03	0.00
04U859	6/11/03	6.05
04U860	6/9/03	0.00
04U861	6/10/03	61.77
04U863	6/3/03	0.00
04U864	6/3/03	0.00
04U865	6/3/03	0.00
04U866	6/3/03	0.00
04U871	6/17/03	35.40
04U872	6/13/03	11.47
04U875	6/12/03	7.69
04U877	6/13/03	1.90
04U879	6/10/03	0.00
04U880	6/11/03	0.00
04U881	6/9/03	0.00
04U882	6/11/03	5.70
04U883	6/11/03	0.00
200154	6/16/03	0.00
234546	6/17/03	23.20
234549	6/17/03	0.00
409547	6/9/03	5.18
409548	6/11/03	1.40
409549	6/11/03	23.50
409555	6/5/03	0.00
512761	6/17/03	33.30
PJ#318	6/12/03	4.20

North Plume
Average Total VOC Concentration Calculations
Group 5
TCAAP
June 2003

Concentration	Positive Planar Area (m2)
Plume to 1	28791345
Plume to 5	18699650
Plume to 10	12798074
Plume to 50	3142883
Plume to 100	2173590
Plume to 200	1123881
Plume to 300	608059
Plume to 400	280353
Plume to 500	90384
Plume to 600	31815
Plume to 700	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	10091695	30275084
5 to 10	7.5	5901576	44261822
10 to 50	30	9655191	289655727
50 to 100	75	969293	72696966
100 to 200	150	1049709	157456333
200 to 300	250	515822	128955417
300 to 400	350	327707	114697415
400 to 500	450	189969	85486073
500 to 600	550	58569	32212909
600 to 700	650	31815	20679505
	Sum	28791345	976377251

Area Wtd Conc	34	ug/L

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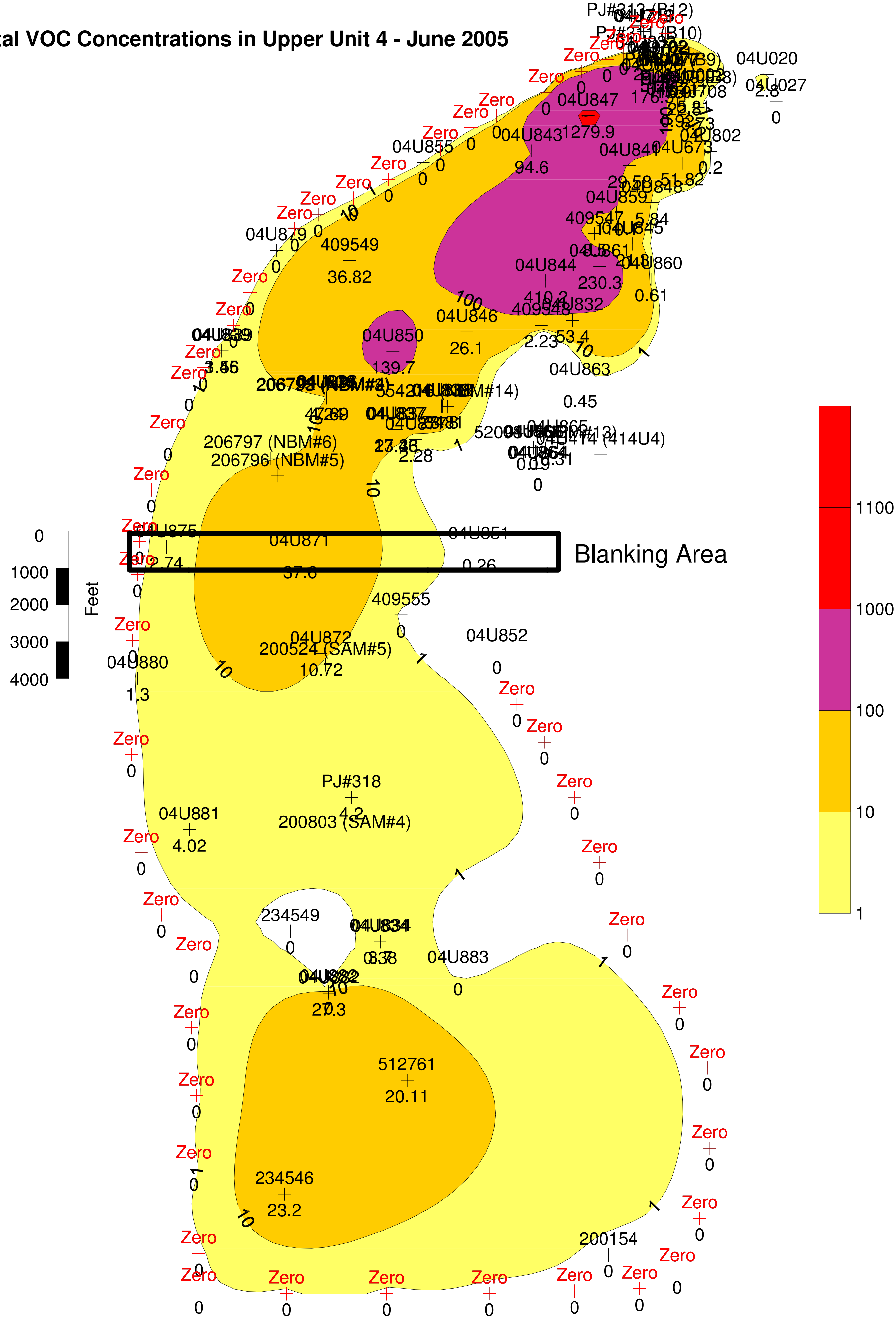
2005

Total VOC Concentrations in Upper Unit 4 - June 2005



Group 3 & 5 Total VOCs 2005		
Well	Date	Total VOCs for Surfer
04J077	6/7/05	175.0
04J702	6/8/05	9.5
04J708	6/9/05	6.7
04J713	6/9/05	0.0
04J834	6/8/05	0.4
04J836	6/21/05	4.2
04J837	6/20/05	17.4
04J838	6/17/05	34.8
04J839	6/17/05	3.5
04J864	10/27/04	0.0
04J866	6/21/05	0.0
04J882	6/8/05	0.0
04U002	6/16/05	5.2
04U020	6/16/05	2.8
04U027	6/13/05	0.0
04U077	6/7/05	116.9
04U673	6/22/05	51.8
04U701	6/8/05	51.8
04U702	6/8/05	1.4
04U709	6/13/05	22.8
04U711	6/15/05	0.9
04U713	6/9/05	0.5
04U802	6/15/05	0.2
04U806	6/10/05	176.5
04U832	6/23/05	53.4
04U833	6/9/05	2.1
04U834	6/21/05	3.7
04U836	6/21/05	47.7
04U837	6/15/05	23.4
04U838	6/7/05	23.8
04U839	6/7/05	1.6
04U841	6/9/05	29.6
04U843	6/7/05	94.6
04U844	6/14/05	410.2
04U845	6/22/05	21.3
04U846	6/10/05	26.1
04U847	6/15/05	1279.9
04U848	6/21/05	5.8
04U850	6/13/05	139.7
04U851	6/22/05	0.3
04U852	6/24/05	0.0
04U855	6/8/05	0.0
04U859	6/22/05	110.1
04U860	6/23/05	0.6
04U861	6/23/05	230.3
04U863	6/22/05	0.5
04U864	10/27/04	0.0
04U865	6/22/05	0.3
04U866	6/22/05	0.2
04U871	6/22/05	37.6
04U872	6/20/05	10.7

Well	Date	Total VOCs for Surfer
04U875	6/22/05	**2.7**
04U877	6/16/05	**2.3**
04U879	6/8/05	**0.0**
04U880	6/16/05	**1.3**
04U881	6/9/05	**4.0**
04U882	6/17/05	**27.3**
04U883	6/10/05	**0.0**
200154	6/24/05	**0.0**
234546	June 2003	**23.2**
234549	June 2003	**0.0**
409547	6/6/05	**8.5**
409548	6/8/05	**2.2**
409549	6/10/05	**36.8**
409555	6/8/05	**0.0**
512761	6/23/05	**20.1**
PJ#318	June 2003	**4.2**

North Plume
Average Total VOC Concentration Calculations
Group 5
TCAAP
June 2005

Concentration	Positive Planar Area (m2)
Plume to 1	28416504
Plume to 5	18057961
Plume to 10	12905641
Plume to 50	4370262
Plume to 100	2524385
Plume to 200	1170045
Plume to 300	577584
Plume to 400	357818
Plume to 500	255077
Plume to 600	178064
Plume to 700	120431
Plume to 800	75158
Plume to 900	41900
Plume to 1000	17798
Plume to 1100	841
Plume to 1200	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	10358544	31075631
5 to 10	7.5	5152320	38642403
10 to 50	30	8535378	256061350
50 to 100	75	1845877	138440801
100 to 200	150	1354340	203150983
200 to 300	250	592461	148115197
300 to 400	350	219766	76917976
400 to 500	450	102742	46233743
500 to 600	550	77013	42357132
600 to 700	650	57633	37461543
700 to 800	750	45272	33954190
800 to 900	850	33258	28269487
900 to 1000	950	24102	22897095
1000 to 1100	1050	16957	17804642
1100 to 1200	1150	841	967443
	Sum	28416504	1122349616

Area Wtd Conc	39	ug/L

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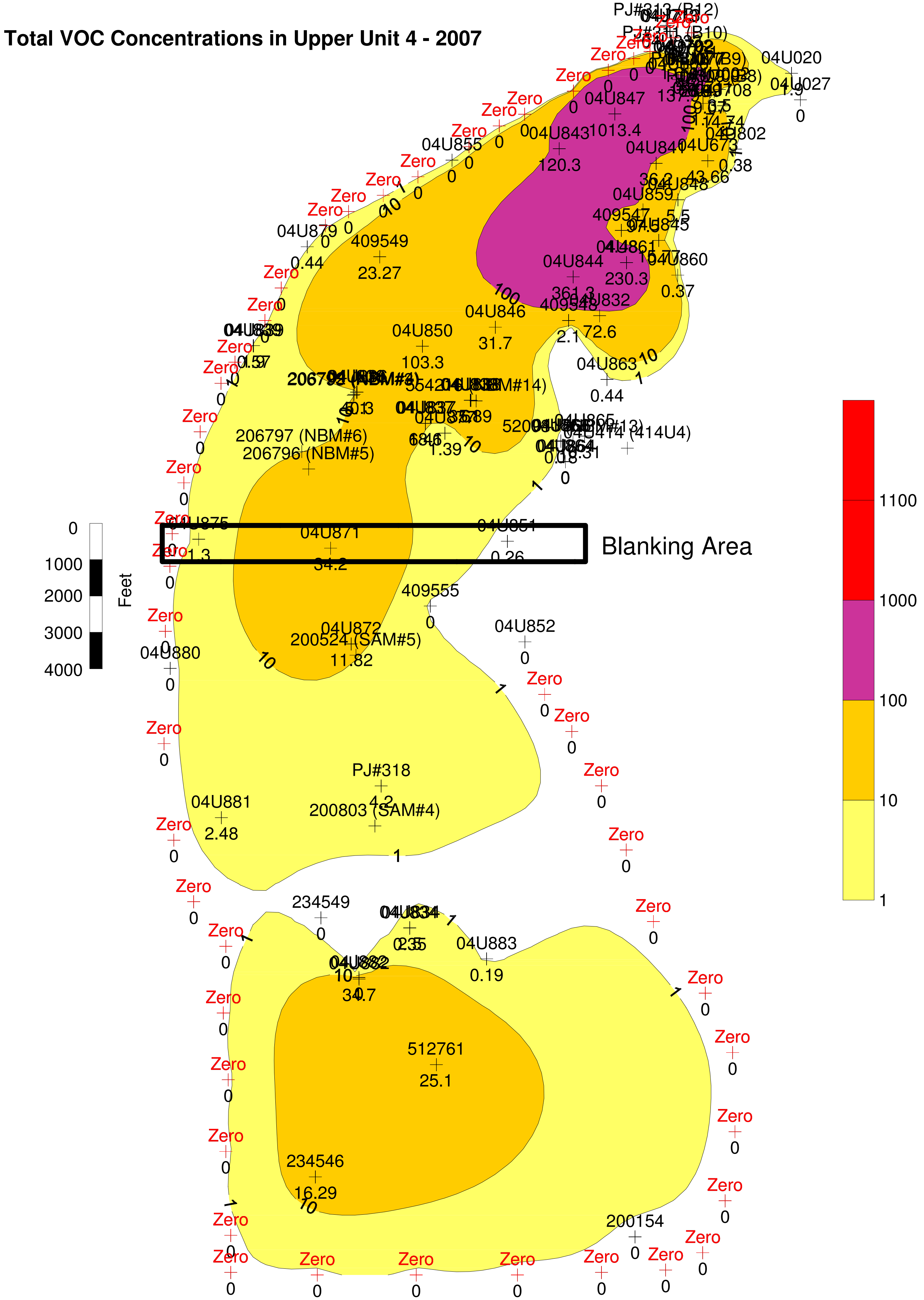
2007



Total VOC Concentrations in Upper Unit 4 - 2007
Blanking Area
Feet
0
1000
2000
3000
4000
1
10
100
1000
1100

North Plume
Total VOC Concentration Calculations
Group 5
TCAAP
June 2007

Concentration	Positive Planar Area (m2)
Plume to 1	28567397
Plume to 5	18652728
Plume to 10	13282790
Plume to 50	4101237
Plume to 100	2234071
Plume to 200	979407
Plume to 300	434983
Plume to 400	262135
Plume to 500	164639
Plume to 600	96406
Plume to 700	48281
Plume to 800	16534
Plume to 900	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	9914669	29744007
5 to 10	7.5	5369938	40274538
10 to 50	30	9181553	275446590
50 to 100	75	1867166	140037434
100 to 200	150	1254664	188199591
200 to 300	250	544424	136105884
300 to 400	350	172848	60496852
400 to 500	450	97496	43873096
500 to 600	550	68234	37528435
600 to 700	650	48125	31281521
700 to 800	750	31747	23810133
800 to 900	850	16534	14053609
	Sum	28567397	1020851690

Area Wtd Conc	36	ug/L

2008

No Sampling for Groups 3 and5 in FY2008

Group 3 Blanking Area

North Plume
Average Total VOC Concentration Calculations
Group 3 Blanked Area
TCAAP
June 1996

Concentration	Positive Planar Area (m2)
Plume to 1	592601
Plume to 5	570392
Plume to 10	545894
Plume to 50	419898
Plume to 100	291064
Plume to 200	36252
Plume to 300	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	22209	66628
5 to 10	7.5	24498	183736
10 to 50	30	125996	3779882
50 to 100	75	128834	9662522
100 to 200	150	128834	19325043
200 to 300	250	254812	63702970
	Sum	685183	96720781

Area Wtd Conc	141	ug/L

North Plume
Average Total VOC Concentration Calculations
Group 3 Blanked Area
TCAAP
June 1997

Concentration	Positive Planar Area (m2)
Plume to 1	596512
Plume to 5	562636
Plume to 10	526681
Plume to 50	356729
Plume to 100	210760
Plume to 200	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	33877	101630
5 to 10	7.5	35954	269658
10 to 50	30	169953	5098579
50 to 100	75	145968	10947626
100 to 200	150	210760	31614023
	Sum	596512	48031516

Area Wtd Conc	81	ug/L

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North Plume
Average Total VOC Concentration Calculations
Group 3 Blanked Area
TCAAP
June 1998

Concentration	Positive Planar Area (m2)
Plume to 1	594793
Plume to 5	557997
Plume to 10	519880
Plume to 50	320227
Plume to 100	129750
Plume to 200	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	36796	110387
5 to 10	7.5	38118	285882
10 to 50	30	199653	5989581
50 to 100	75	190477	14285783
100 to 200	150	129750	19462464
	Sum	594793	40134097

Area Wtd Conc	67	ug/L

North Plume
Average Total VOC Concentration Calculations
Group 3 Blanked Area
TCAAP
June 1999

Concentration	Positive Planar Area (m2)
Plume to 1	593106
Plume to 5	551228
Plume to 10	507677
Plume to 50	278285
Plume to 100	138
Plume to 200	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	41877	125632
5 to 10	7.5	43551	326636
10 to 50	30	229392	6881769
50 to 100	75	278147	20861018
100 to 200	150	138	20657
	Sum	593106	28215713

Area Wtd Conc	48	ug/L

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North Plume
Average Total VOC Concentration Calculations
Group 3 Blanked Area
TCAAP
June 2001

Concentration	Positive Planar Area (m2)
Plume to 1	585543
Plume to 5	516681
Plume to 10	442357
Plume to 50	5028
Plume to 100	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	68862	206585
5 to 10	7.5	74324	557434
10 to 50	30	437329	13119874
50 to 100	75	5028	377079
	Sum	585543	14260972

Area Wtd Conc	24	ug/L

North Plume
Average Total VOC Concentration Calculations
Group 3 Blanked Area
TCAAP
June 2003

Concentration	Positive Planar Area (m2)
Plume to 1	558061
Plume to 5	458092
Plume to 10	367139
Plume to 50	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	99969	299907
5 to 10	7.5	90953	682144
10 to 50	30	367139	11014170
	Sum	558061	11996221

Area Wtd Conc	21	ug/L

North Plume
Average Total VOC Concentration Calculations
Group 3 Blanked Area
TCAAP
June 2005

Concentration	Positive Planar Area (m2)
Plume to 1	517277
Plume to 5	405408
Plume to 10	323683
Plume to 50	0

Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	111868	335604
5 to 10	7.5	81725	612940
10 to 50	30	323683	9710493
	Sum	517277	10659037

Area Wtd Conc	21	ug/L

\\stp_fs1\stpaul\0000-dan\total vocs\group3and5\2003\2003 conc group 3 and 5.xls

North Plume
Average Total VOC Concentration Calculations
Group 3 Blanked Area
TCAAP
June 2007

Concentration	Positive Planar Area (m2)
Plume to 1	533438
Plume to 5	401087
Plume to 10	311924
Plume to 50	0

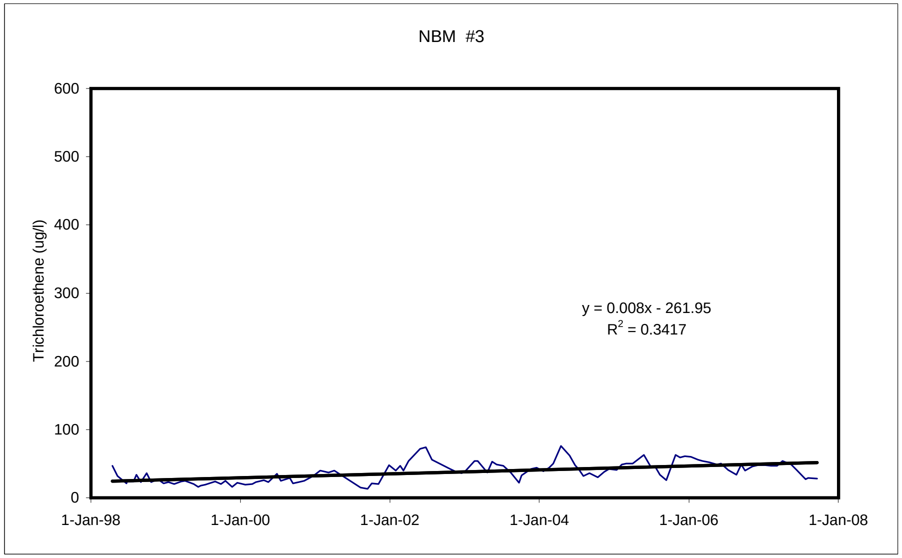
Total VOCs (ug/L)	Avg Total VOCs (ug/L)	Area (m2)	Areal Conc (ug*m2/L)
1 to 5	3	132351	397053
5 to 10	7.5	89163	668723
10 to 50	30	311924	9357707
	Sum	533438	10423483

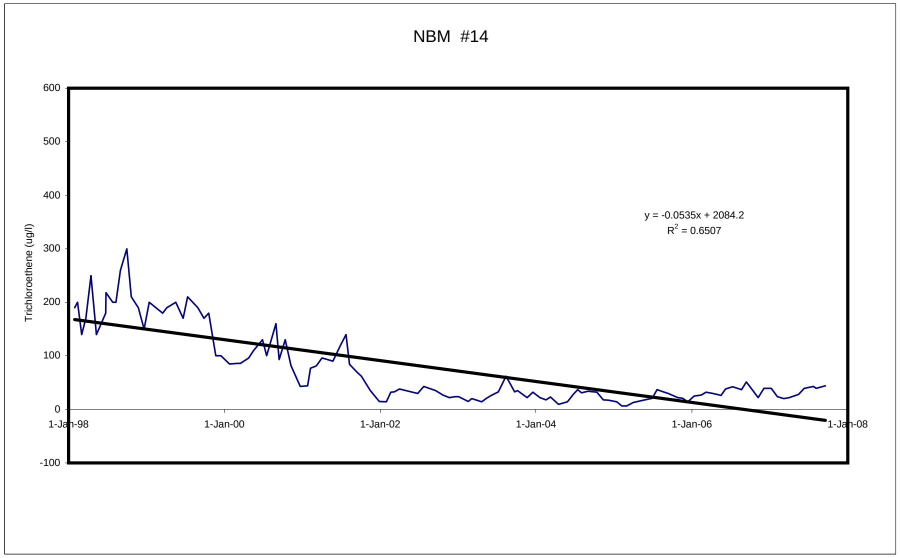
Area Wtd Conc	20	ug/L

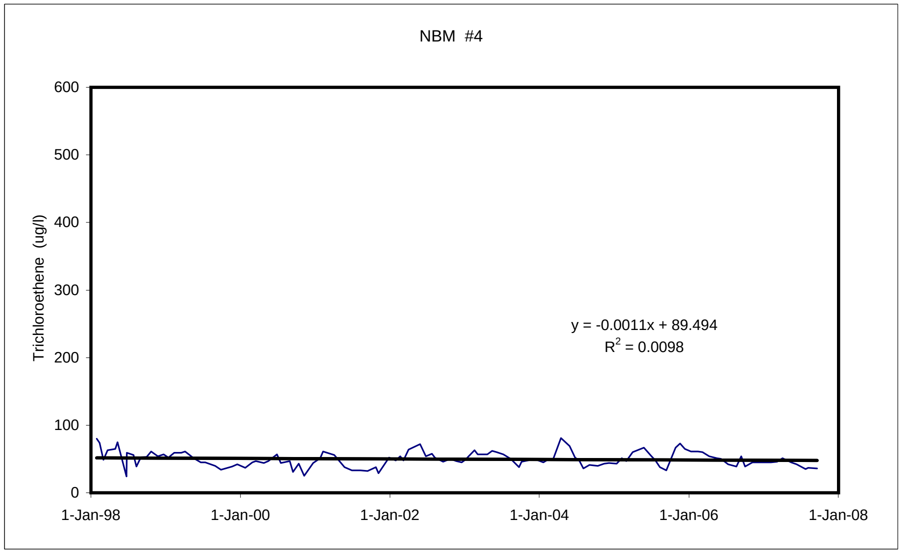
D.2.5 Group 6 New Brighton Municipal Well Regression Analysis

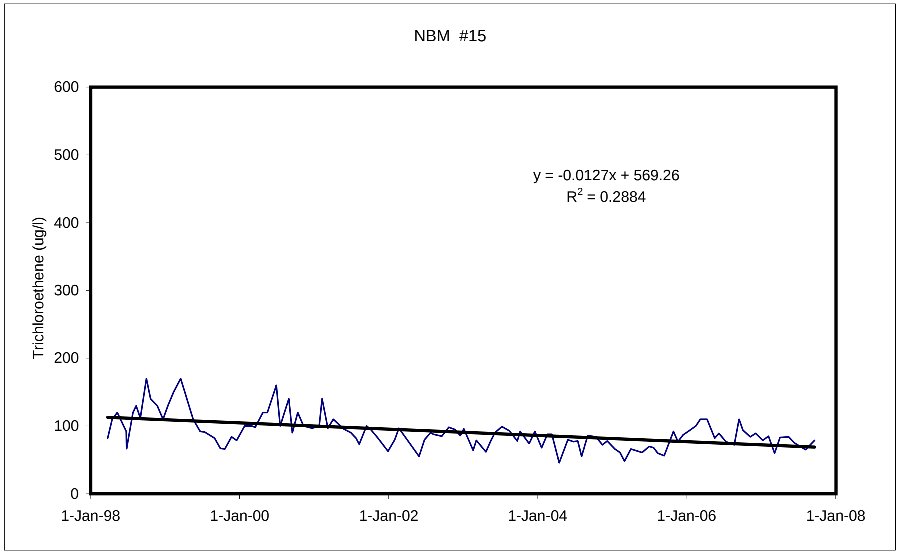
NEW BRIGHTON MUNICIPAL WELLS: Regression Analysis Since 1998: TRICHLOROETHENE

TWIN CITIES ARMY AMMUNITION PLANT



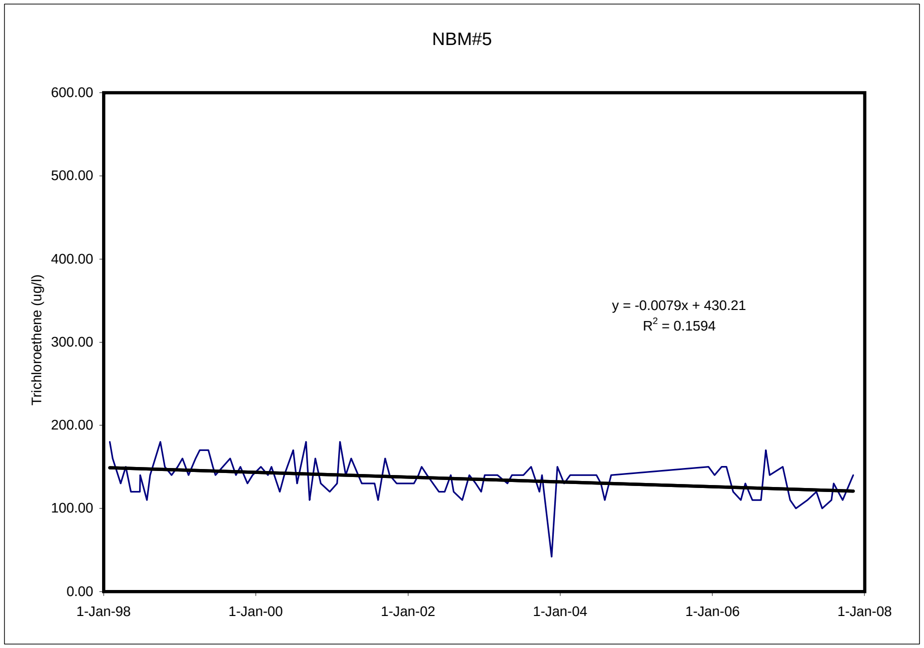


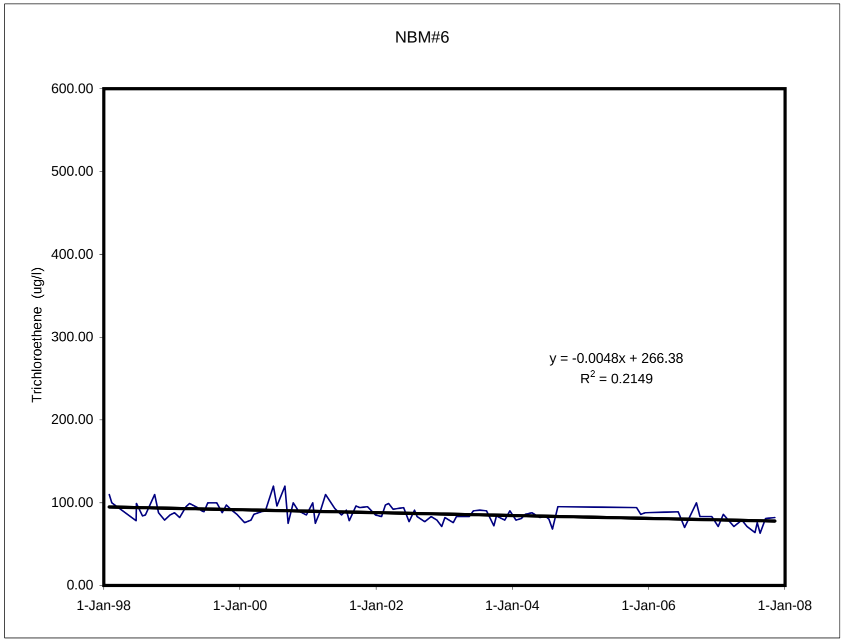




NEW BRIGHTON MUNICIPAL WELLS: Regression Analysis Since 1998: TRICHLOROETHENE

TWIN CITIES ARMY AMMUNITION PLANT





D.3 Site C Analytical and Water Level Database

APPENDIX D.3
SITE C ANALYTICAL AND WATER LEVEL DATABASE

The TCAAP Site C Analytical and Water Level Database is located on this DVD in the following Microsoft Excel file:

App D3_Site C Chemical Database September 2008.xls

Appendix E

TCAAP Well Inventory Update, FY 2008

APPENDIX E
TCAAP WELL INVENTORY UPDATE

FISCAL YEAR 2008

Purpose

The purpose of well inventory is to identify wells that have been impacted by contaminants from TCAAP or that could potentially be impacted by TCAAP contaminants.

Background

Developing and maintaining the well inventory is a process that was initiated in 1991, with the work efforts documented in several update reports since that time. Beginning in FY 1999, the update reporting was incorporated into the Annual Performance Reports.

The well inventory "study area," as defined by the Minnesota Pollution Control Agency, is shown on Figure E-1, and coincides with the Minnesota Department of Health (MDH) Special Well Construction Area.

The aquifers of concern are defined by the 1 μg/L trichloroethene contour for the Unit 3 and Unit 4 aquifers, and the 1 μg/L cis-1,2-dichloroethene contour for the Unit 1 aquifer north of TCAAP.

The "area of concern" for the Unit 3 and Unit 4 aquifers is created by adding a quarter mile buffer area outside the 1 μg/L trichloroethene contour. The area of concern for the Unit 3 and Unit 4 aquifers is shown on Figure E-2.

The area of concern for the Unit 1 aquifer north of TCAAP is delineated by city streets. The area of concern for the Unit 1 aquifer is shown on Figure E-3.

Wells within the study area are categorized based on location, depth/aquifer, and use. Well categories for the well inventory are described in Table E-1.

Program Requirements

The well inventory program requirements have evolved over time, with changes documented through the update reports. A flowchart that describes the annual requirements for maintaining the TCAAP well inventory database is shown on Figure E-4. Requirements are summarized below.

Near the beginning of each fiscal year, a database of study area wells is acquired from the MDH. This MDH database query is limited to study area wells that were constructed, sealed, or disclosed in the previous fiscal year. The MDH database consists of three lists:

1. Constructed Wells (generated through drillers submitting Water Well Records);
2. Sealed Wells (generated through drillers submitting Well Sealing Records); and
3. Disclosed Wells (made known through property transfer).

With the new MDH information, the TCAAP well inventory database is updated by recategorizing wells, as necessary, and by adding any new wells that are within the study area. Any new wells found in Categories 1a, 1b, 1c, 2a, 2b, 2c, or 4a are targeted for sampling in that fiscal year; however, an attempt to reclassify any new category 4a wells will be made prior to sampling. Wells that are not sampled due to non-responsive well owners are targeted for sampling in the next major sampling event.

Category 4 wells are those with an unknown depth or unknown location, or both. Ideally, there should be no wells in Category 4. Each year, an attempt is made to reclassify Category 4 wells into one of the other categories. This is accomplished through phone calls, letters, and/or site visits in an attempt to obtain additional information. Any wells which are re-classified as Category 1a, 1b, 1c, 2a, 2b, or 2c are targeted for sampling in that fiscal year.

"Major" well inventory sampling events occur every four years and are shown in Appendix A.1. The major sampling events are scheduled to coincide with the biennial sampling events for performance purposes as delineated in the APR. For each major event, all wells in Categories 1a, 1b, 1c, 2a, 2b, 2c, and 4a are targeted for sampling. After every sampling event, each well owner is mailed a copy of their testing results. Wells that are not sampled due to non-responsive well owners are targeted for sampling in the next major sampling event.

For each sampling event, if any well has a detection which exceeds the applicable TCAAP groundwater cleanup level for that contaminant (or an additivity of 1.0, similar to the MDH Hazard Index calculation), the well is evaluated using the flow chart presented in Figure E-4 to determine the timing of additional sampling. Wells that are used for drinking water are sampled again within one month of data validation. Wells that are not used for drinking water, but have possible contact exposure risks, are sampled the next fiscal year. If a cleanup level exceedance is confirmed (two consecutive events), and the contaminant concentrations in the well are proportional to contaminant concentrations of the TCAAP OU1 plume, the Army offers to abandon the well and/or provide an alternate water supply.

The annual reporting requirements for the TCAAP well inventory will include:

- A list of any wells found or reclassified.
- Analytical results and a summary of sampling efforts from that fiscal year.
- Recommendations for participation in the Well Abandonment/Alternate Water Supply Program.
- An updated well inventory database that lists wells by well category.
- An updated database listing water quality of wells.

FY 2008 Update

The updated MDH database was provided to Wenck on January 10, 2008. MDH generates the database from specific Township, Range, and Section data. This comprehensive database was screened to extract the lists of wells that were constructed, disclosed, or sealed between October 1, 2006 and September 30, 2007. Further investigative efforts were primarily focused on determining each well's location (inside or outside the study area and/or area of concern), status (active, inactive, or sealed), and water use (supply/non-supply).

Newly constructed active and inactive wells, and wells of unknown status that were determined to be located within the study area, are presented in Table E-3. All but one of the 34 newly constructed wells were monitoring wells and were classified into Category 6. Unique Well No. 200180 required reconstruction as a 12" casing was cemented within the broken existing 16" casing. This golf course irrigation well was changed from a Category 1c to 1b since it is now able to be used and has potential for human contact.

Disclosed wells that were identified as being in use, inactive, or of unknown status (but not sealed) and that were determined to be located within the study area are identified in Table E-4. Three of these 4 wells were outside of the area or aquifer of concern and were classified into Category 3. One well could not be located during a site visit and was classified into Category 4b.

Sealed wells were found by reviewing the MDH sealed well list, by screening the MDH disclosed and new construction lists (which also contain sealed wells), and by talking with well owners. Wells identified as sealed are shown in Table E-5. Disclosed wells that were located within the area of concern and that the MDH identified as having a change in status from active or inactive to sealed were further investigated for confirmation of their sealed status. Any wells that were already in the TCAAP well inventory database that the MDH identified as having a change in status from active or inactive to sealed are shown in Table E-5 with strikeouts through the old well category entry. Wells identified as sealed in the MDH database updates were assigned to Category 7a (documented as sealed/abandoned). Wells that were determined to be sealed through conversations with well owners were assigned to Category 7b (undocumented as sealed, or improperly abandoned).

Thirty-four Category 4 wells were field studied in FY 2008. This field study was accomplished through telephone calls, letters, and/or site visits in an attempt to reclassify Category 4 wells that were in the existing TCAAP well inventory database into one of the other categories. Contact information was updated, however due to lack of information and/or response, no wells could be re-classified out of Category 4. One well was added to Category 4b and one well was found to be a duplicate entry and was removed from the main database. A field investigation and sampling summary is included in Table E-6.

Through the FY 2008 well inventory update effort, no wells were sampled.

Information contained in Tables E-3 through E-6 has been updated in the well inventory database (Filename "Well Inventory Main Database 2008", an Excel file included on this DVD).

Recommendations

- At this time no wells are recommended for the Army to offer alternate water supply or well abandonment.
- FY 2009 is a "major" sampling event. Wells to be sampled in FY 2009 are:
  - All wells in Categories 1a, 1b, 1c, 2a, 2b, 2c, and 4a
  - Any previously undiscovered wells determined to be in Categories 1a, 1b, 1c, 2a, 2b, 2c, or 4a based on the FY 2008 review of the MDH database.
  - Any Category 4b wells that are determined, from further investigation, to be in Category 1a, 1b, 1c, 2a, 2b, or 2c.

TABLE E-1
WELL INVENTORY CATEGORY DESCRIPTIONS

Category	*Subcategory*	*Explanation*
1		Water supply wells screened in an aquifer of concern, inside the 1 μg/l contour. Wells are divided into the following subcategories:
	1a	• Drinking water well
	1b	• Nondrinking but possible contact water
	1c	• Nondrinking, noncontact water
	1d	• Well is inoperable or has not been used for several years
	1e	• Well for which the owner has refused (or has been unresponsive to) an Army offer for abandonment, or for which the water use has been deemed acceptable
2		Water supply wells in an area of concern, inside the buffer lines, but outside the 1 μg/l contour, screened in an aquifer of concern. Wells are divided into the following subcategories:
	2a	• Drinking water well
	2b	• Nondrinking but possible contact water
	2c	• Nondrinking, noncontact water
	2d	• Well is inoperable or has not been used for several years
3		Water supply wells within the Study Area that are either outside the area of concern, or are within the area of concern but are not screened in an aquifer of concern.
4		Water supply wells with missing information, divided into the following subcategories:
	4a	• Unknown depth or aquifer, but located in the area of concern.
	4b	• Unknown location, but potentially located within the Study Area. Wells with both an unknown depth and an unknown location are included in 4b.
5		Wells that are in the study area, but that have been field checked and not located. No further action is recommended for these wells.
6		Nonsupply wells (primarily monitoring wells).
7		Sealed or abandoned wells. Wells are divided into the following subcategories:
	7a	• Documented as sealed/abandoned
	7b	• Undocumented as sealed, or improperly abandoned

TABLE E-2

WELL INVENTORY SAMPLING RESULTS
Fiscal Year 2008

No sampling conducted in FY08

TABLE E-3
CONSTRUCTED WELLS

Unique Number	Category	Last Name or Business Name	Street	City	Use	Depth	Date Drilled
200180	~~1c,~~ 1b	Town And Country Club	300 Mississippi River Boulevard N	St. Paul	Irrigation	500	3/1/2007
727774	6	U Of M	2030 University Avenue	Minneapolis	Monitoring	111	2/1/2007
733246	6	Bodycote Thermal Processing	900 E Hennepin		Monitoring	41	6/1/2006
733247	6	Bodycote Thermal Processing	900 E Hennepin		Monitoring	53	6/1/2006
733248	6	Bodycote Thermal Processing	900 E Hennepin		Monitoring	46	6/1/2006
733249	6	Bodycote Thermal Processing	900 Sixth Avenue Se	Minneapolis	Monitoring	41	6/1/2006
740244	6	Frost	1209 Tyler Street Ne	Minneapolis	Monitoring	23	10/1/2006
743452	6	Bodycote Thermal Processing	900 Sixth Avenue Se	Minneapolis	Monitoring	55	6/1/2006
743482	6	Bodycote Thermal Processing	900 E Hennepin		Monitoring	46	11/1/2006
743483	6	Bodycote Thermal Processing	900 E Hennepin		Monitoring	33	10/1/2006
743484	6	Bodycote Thermal Processing	900 E Hennepin		Monitoring	48	10/1/2006
745607	6	U Of M TCF Stadium			Dewatering	30	5/1/2007
747713	6	Speedway Superamerica	1130 73rd Avenue Ne	Fridley	Monitoring	17	3/1/2007
747714	6	MN PCA	1227 Central Avenue Ne	Minneapolis	Monitoring	28	3/1/2007
747715	6	MN PCA	1227 Central Avenue Ne	Minneapolis	Monitoring	19	3/1/2007
748181	6	Canadian Pacific Railway	2800 Central Avenue Ne	Minneapolis	Monitoring	60	11/1/2006
748182	6	Ashland	2913 Central Avenue Ne	Minneapolis	Monitoring	66	3/1/2007
748183	6	Ashland	2907 Central Avenue Ne	Minneapolis	Monitoring	75	12/1/2006
748184	6	Ashland	2900 Central Avenue	Minneapolis	Recovery	65	11/1/2006
749674	6	Viacom	2303 Kennedy Street Ne	Minneapolis	Monitoring	20	12/1/2006
749675	6	Viacom	2303 Kennedy Street Ne	Minneapolis	Monitoring	20	12/1/2006
751301	6	Ashland	1301 Fillmore Street Ne	Minneapolis	Monitoring	250	6/1/2007
751346	6	CP Rail	2800 Central Avenue Ne	Minneapolis	Monitoring	60	7/1/2007
751347	6	CP Rail	2800 Central Avenue Ne	Minneapolis	Monitoring	60	7/1/2007
751348	6	CP Rail	2800 Central Avenue Ne	Minneapolis	Monitoring	175	7/1/2007
751349	6	CP Rail	2800 Central Avenue Ne	Minneapolis	Recovery	110	7/1/2007
751350	6	CP Rail	2800 Central Avenue Ne	Minneapolis	Recovery	65	7/1/2007
752178	6	Vopak Usa	2206 California Street Ne	Minneapolis	Monitoring	17	5/1/2007
752179	6	Vopak Usa	2126 Grand Street Ne	Minneapolis	Monitoring	16	5/1/2007
752180	6	Vopak Usa	2000 Grand Street Ne	Minneapolis	Monitoring	23	5/1/2007
752181	6	Vopak Usa	2000 Grand Street Ne	Minneapolis	Monitoring	16	5/1/2007
752182	6	Vopak Usa	1820 Second Street Ne	Minneapolis	Monitoring	19	5/1/2007
755058	6	CP Rail	2800 Central Avenue Ne	Minneapolis	Recovery	65	7/1/2007
755059	6	CP Rail	2800 Central Avenue Ne	Minneapolis	Recovery	175	7/1/2007

TABLE E-4
WELLS DISCLOSED THROUGH PROPERTY TRANSFER

Unique Number	Category	Last Name or Business Name	Street	City	Use	Status	Date Sealed	Depth	Aquifer	Date Drilled
234474	3	~~Hodson,~~ Brama	2601 Silver Lane Ne	St. Anthony	Irrigation	In Use				
249003	3	~~Gaffy,~~ Liendeman	1725 Oakwood Drive	Shoreview		In Use				
	3	Qwest Corp.	3755 Dunlap Street N	Arden Hills		Not In Use				
	4a	Ras Pac Holdings (Pacal Steel)	2500 W County Road B	Roseville		Not In Use				

TABLE E-5
SEALED WELLS

Unique Number	***Category***	***Last Name or Business Name***	***Street***	***City***	***Status***	***Date Sealed***
520931	~~1a,~~ 7a	~~City of New Brighton,~~ Alliant Tech Systems	700 Fifth Street Nw	New Brighton	Sealed	5/18/2007
191942	~~6,~~ 7a	~~Trio Solvents,~~ Midwest Asphalt	1400 Old Highway 8	New Brighton	~~Active,~~ Sealed	6/28/2007
409596	~~6,~~ 7a	~~Trio Solvents,~~ Midwest Asphalt	1400 Old Highway 8	New Brighton	~~Active,~~ Sealed	6/28/2007
409597	~~6,~~ 7a	~~Trio Solvents,~~ Midwest Asphalt	1400 Old Highway 8	New Brighton	~~Active,~~ Sealed	6/28/2007
479762	~~6,~~ 7a	~~Waldorf Corp.,~~ Rock Tenn	2250 Wabash Avenue	St. Paul	~~Active,~~ Sealed	8/29/2007
533627	~~6,~~ 7a	Pennzoil Quaker State Co.	7000 Highway 65 Ne	Fridley	~~Active,~~ Sealed	5/31/2007
661569	~~6,~~ 7a	~~Partnership 4,~~ Roseville Properties	2118 Myrtle Avenue	St. Paul	~~Active,~~ Sealed	6/18/2007
661571	~~6,~~ 7a	~~Partnership 4,~~ Roseville Properties	2118 Myrtle Avenue	St. Paul	~~Active,~~ Sealed	6/18/2007
674779	~~6,~~ 7a	~~U of MN,~~ Ausen	Fifth St Se And Oak Street	Minneapolis	~~Active,~~ Sealed	8/8/2007
674781	~~6,~~ 7a	U Of M	2005 Fourth Street Se	Minneapolis	~~Active,~~ Sealed	7/27/2007
674782	~~6,~~ 7a	U Of M	2005 Fourth Street Se	Minneapolis	~~Active,~~ Sealed	7/27/2007
674783	~~6,~~ 7a	U Of M	2005 Fourth Street Se	Minneapolis	~~Active,~~ Sealed	7/27/2007
680613	~~6,~~ 7a	Roseville Properties	2118 Myrtle Avenue	St. Paul	~~Active,~~ Sealed	6/18/2007
680614	~~6,~~ 7a	Roseville Properties	2118 Myrtle Avenue	St. Paul	~~Active,~~ Sealed	6/18/2007
680615	~~6,~~ 7a	Roseville Properties	2108 University Avenue	St. Paul	~~Active,~~ Sealed	6/18/2007
704818	~~6,~~ 7a	U Of M Regents	2221 University Avenue Se	Minneapolis	~~Active,~~ Sealed	5/22/2007
704819	~~6,~~ 7a	U Of M	2221 University Avenue Se	Minneapolis	~~Active,~~ Sealed	7/27/2007
729330	~~6,~~ 7a	U Of M	2001 Sixth Street Se	Minneapolis	Sealed	6/11/2007
729332	~~6,~~ 7a	U Of M	~~Huron Blvd.,~~ 2001 Sixth Street Se	Minneapolis	Sealed	7/27/2007
200811	7a	Lemon	2509 St. Anthony Boulevard	Minneapolis	Sealed	9/27/2007
257443	7a	Midwest Asphalt	1400 Old Highway 8	New Brighton	Sealed	6/28/2007
477182	7a	~~Amoco Oil Company,~~ Showalter	2441 Fairview Avenue W	Roseville	Sealed	10/24/2006
477183	7a	~~Amoco Oil Company,~~ Showalter	2441 Fairview Avenue N	Roseville	Sealed	10/24/2006
477184	7a	~~Amoco Oil Company,~~ Showalter	2441 Fairview Avenue N	Roseville	Sealed	10/24/2006
477185	7a	~~Amoco Oil Company,~~ Showalter	2441 Fairview Avenue N	Roseville	Sealed	10/24/2006
477186	7a	~~Amoco Oil Company,~~ Showalter	2441 Fairview Avenue N	Roseville	Sealed	10/24/2006
494683	7a	~~Amoco Oil Company,~~ Showalter	2441 Fairview Avenue N	Roseville	Sealed	10/24/2006
494684	7a	~~Amoco Oil Company,~~ Showalter	2441 Fairview Avenue N	Roseville	Sealed	10/24/2006
494685	7a	~~Amoco Oil Company,~~ Showalter	2441 Fairview Avenue N	Roseville	Sealed	10/24/2006
494686	7a	~~Amoco Oil Company,~~ Showalter	2441 Fairview Avenue N	Roseville	Sealed	10/24/2006
494687	7a	~~Amoco Oil Company,~~ Showalter	2441 Fairview Avenue N	Roseville	Sealed	10/24/2006
509590	7a	Rock Tenn	693 Raymond Avenue	St. Paul	Sealed	8/29/2007
509591	7a	Rock Tenn	693 Raymond Avenue	St. Paul	Sealed	8/29/2007
509592	7a	Rock Tenn	693 Raymond Avenue	St. Paul	Sealed	8/29/2007
518536	7a	Cp Rail	2800 Central Avenue	Minneapolis	Sealed	7/26/2007
557519	7a	Determan Brownie	1241 72nd Avenue Ne	Fridley	Sealed	7/5/2007
557520	7a	Determan Brownie	1241 72nd Avenue Ne	Fridley	Sealed	7/5/2007
557521	7a	Determan Brownie	1241 72nd Avenue Ne	Fridley	Sealed	7/5/2007
557522	7a	Determan Brownie	1241 72nd Avenue Ne	Fridley	Sealed	7/5/2007
557524	7a	Determan Brownie	1241 72nd Avenue Ne	Fridley	Sealed	7/5/2007
557529	7a	Determan Brownie	1241 72nd Avenue Ne	Fridley	Sealed	7/5/2007
560633	7a	Determan Brownie	1241 72nd Avenue Ne	Fridley	Sealed	7/5/2007
577670	7a	Viacom Inc.	2303 Kennedy Street	Minneapolis	Sealed	10/13/2006

TABLE E-5
SEALED WELLS

Unique Number	Category	Last Name or Business Name	Street	City	Status	Date Sealed
581391	7a	U Of M		Minneapolis	Sealed	7/27/2007
581394	7a	U Of M	2001 Sixth Street Se	Minneapolis	Sealed	6/11/2007
581395	7a	U Of M		Minneapolis	Sealed	7/27/2007
586417	7a	Determan Brownie	1241 72nd Avenue Ne	Fridley	Sealed	7/5/2007
639758	7a	BNSR	113 27th Avenue Ne	Minneapolis	Sealed	8/6/2007
639760	7a	BNSR	113 27th Avenue Ne	Minneapolis	Sealed	8/6/2007
644912	7a	BNSR	113 27th Avenue Ne	Minneapolis	Sealed	8/6/2007
644913	7a	BNSR	113 27th Avenue Ne	Minneapolis	Sealed	8/6/2007
644914	7a	Burlington Northern Santa Fe Railway	113 27th Avenue Ne	Minneapolis	Sealed	7/29/2003
726487	7a	Rachel Contracting	2324 University Avenue Se	Minneapolis	Sealed	3/13/2007
726488	7a	Rachel Contracting	2324 University Avenue Se	Minneapolis	Sealed	3/13/2007
726489	7a	Rachel Contracting	2324 University Avenue Se	Minneapolis	Sealed	3/13/2007
729333	7a	U Of M	2001 Sixth Street Se	Minneapolis	Sealed	7/27/2007
730002	7a	Mn Utilities And Excavating	2500 University Avenue Se	Minneapolis	Sealed	1/29/2007
730003	7a	Mn Utilities And Excavating	2500 University Avenue	Minneapolis	Sealed	1/29/2007
730004	7a	Mn Utilities And Excavating	2500 University Avenue	Minneapolis	Sealed	1/29/2007
730005	7a	Mn Utilities And Excavating	2500 University Avenue	Minneapolis	Sealed	1/29/2007
733226	7a	U Of M Regents	2315 University Avenue Se	Minneapolis	Sealed	5/22/2007
733232	7a	U Of M Regents	800 23rd Avenue Se	Minneapolis	Sealed	11/6/2006
733233	7a	U Of M Regents	800 23rd Avenue Se	Minneapolis	Sealed	11/6/2006
733234	7a	U Of M Regents	800 23rd Avenue Se	Minneapolis	Sealed	11/6/2006
733235	7a	Regents of U of M	800 23rd Avenue Se	Minneapolis	Sealed	11/6/2006
745607	7a	U Of M			Sealed	9/18/2007
H0019286	7a	Leudtke	2521 County Road H	Mounds View	Sealed	10/24/2006
H0025189	7a	~~Johnson,~~ Brunelle	728 Ninth Avenue Nw	New Brighton	Sealed	9/26/1992
H0126234	7a	Fletcher	1660 29th Avenue Nw	New Brighton	Sealed	3/23/2007
H0160588	7a	~~Estate of Ruth Saba,~~ Tweeter	1485 73rd Avenue Ne	Fridley	Sealed	2/1/2007
H0222074	7a	~~Cutter,~~ Grove	1966 Eustis Street	Lauderdale	Sealed	10/6/2005
H0230741	7a	U Of M Regents	800 23rd Avenue S	Minneapolis	Sealed	11/9/2006
H0230750	7a	U Of M Regents	800 23rd Avenue S	Minneapolis	Sealed	11/6/2006
H0231295	7a	St. Paul Midway Residence	902 Hershey Street	St. Paul	Sealed	1/10/2007
H0232669	7a	Bank Partners	3130 Talmage Avenue Se	Minneapolis	Sealed	6/30/2006
H0232676	7a	La Fitness International	2420 Cleveland Avenue	Roseville	Sealed	10/25/2006
H0232699	7a	ISD 621	2300 Nw Seventh Street	New Brighton	Sealed	6/18/2007
H0235697	7a	Opus Northwest	2814 Cleveland Avenue N	Roseville	Sealed	9/19/2007
H0235706	7a		2161 County Road B W	Roseville	Sealed	5/23/2005
H0237006	7a	Downing	5071 Greenwood Drive	Mounds View	Sealed	5/10/2007
H0237008	7a	Bidon	3017 County Road H2	Mounds View	Sealed	5/31/2007
H0237837	7a	~~Steinberg,~~ Chandra	2088 Rosewood Lane S	Roseville	Sealed	9/16/2006
H0237848	7a	Tosi	1766 Millwood Avenue	Roseville	Sealed	9/7/2007
H0238688	7a	Gopher Oil Company	2428 Delaware Street	Minneapolis	Sealed	4/24/2007
H0238689	7a	Gopher Oil Company	2428 Delaware Street Se	Minneapolis	Sealed	4/24/2007
H0238690	7a	Gopher Oil Company	2428 Delaware Street Se	Minneapolis	Sealed	4/24/2007

TABLE E-5
SEALED WELLS

Unique Number	***Category***	***Last Name or Business Name***	***Street***	***City***	***Status***	***Date Sealed***
H0239631	7a	~~Hannah,~~ Martinson	2812 St. Anthony Boulevard	St. Anthony	Sealed	11/1/2006
H0239675	7a	Hedstrom	2056 Cedar Drive	New Brighton	Sealed	3/23/2007
H0240713	7a	~~Herschman,~~ Jonas	3105 39th Avenue Ne	St. Anthony	Sealed	3/30/2006
H0242078	7a	Carter	4937 Turtle Lake Road W	Shoreview	Sealed	10/25/2006
H0242456	7a	Hughes	360 W County Road B	Roseville	Sealed	10/25/2006
H0243652	7a	Petersen	1716 Lydia Avenue	Roseville	Sealed	10/23/2006
H0243672	7a	Collins	1015 Ruggles Street	Roseville	Sealed	9/7/2007
H0243683	7a	~~Graff,~~ Habig	3114 Wilder Street	Roseville	Sealed	10/23/2006
H0243698	7a	Guerrero	3061 Shorewood Lane		Sealed	9/20/2006
H0243699	7a	Guerrero	3061 Shorewood Lane	Roseville	Sealed	11/1/2006
H0244427	7a	~~Hudoba,~~ Hixon	1840 Lake Lane	Arden Hills	Sealed	10/23/2006
H0245507	7a	~~Peterson,~~ Wenyan	1974 Autumn Street	Falcon Heights	Sealed	10/25/2006
H0245547	7a	~~Vennerstrom,~~ Grayden	1901 Edgewater Avenue	Arden Hills	Sealed	10/19/2006
H0248588	7a	Isiminger	1615 14th Avenue	New Brighton	Sealed	11/15/2006
H0248770	7a	MN DOT		Minneapolis	Sealed	9/7/2006
H0248831	7a	Met Council		Minneapolis	Sealed	3/2/2007
H0248834	7a	FMC Trucking	400 First Street Sw	New Brighton	Sealed	3/16/2007
H0249531	7a	Jocobus	6562 Anoka Street Ne	Fridley	Sealed	9/4/2007
H0250194	7a	Wimsett	281 First Street Se	New Brighton	Sealed	10/26/2006
H0251522	7a	Ramsey County Parks And Recreation		Arden Hills	Sealed	12/13/2006
H0251523	7a	Ramsey County Parks And Recreation		Arden Hills	Sealed	12/13/2006
H0251549	7a	Ramsey County Parks And Recreation		Arden Hills	Sealed	12/12/2006
H0252151	7a	ISD 16	895 76th Avenue Ne	Fridley	Sealed	11/2/2006
H0252910	7a	Schweppe	1227 12th Avenue Nw	New Brighton	Sealed	11/21/2006
H0252919	7a	Anderberg	642 Cleveland Avenue S	New Brighton	Sealed	1/17/2007
H0252921	7a	Kahlhamer	5837 Arthur Street	Fridley	Sealed	3/20/2007
H0252922	7a	Zbikowski	1805 Sunnyside Terrace	New Brighton	Sealed	4/2/2007
H0253211	7a	Carlson	1791 Tatum Street	Falcon Heights	Sealed	12/14/2006
H0253220	7a	Brudlos	1798 Stanbridge Avenue	Roseville	Sealed	3/13/2007
H0253273	7a	Allenson	2257 Rainbow Avenue	New Brighton	Sealed	4/25/2007
H0253358	7a	Hassan	6599 Channel Road Ne	Fridley	Sealed	10/6/2006
H0253569	7a	Theisen	2034 Cleveland Avenue	Roseville	Sealed	5/19/2007
H0253691	7a	Dorso Building Co.	2814 Cleveland Avenue N	Roseville	Sealed	7/2/2007
H0253696	7a	Lit Midway	2210 Territorial Road	St. Paul	Sealed	7/5/2007
H0254051	7a	U Of M Regents	800 23rd Avenue S	Minneapolis	Sealed	11/6/2006
H0254183	7a	Mannes	1316 Fourth Street Se	Minneapolis	Sealed	12/5/2006
H0254200	7a	Lang	2416 27th Avenue Ne	St. Anthony	Sealed	2/1/2007
H0254235	7a	Ramsey County Publics Works Dept.	1425 Paul Kirkwold Drive	Arden Hills	Sealed	11/7/2006
H0254491	7a	Schindler Elevator	2338 Central Avenue Ne	Minneapolis	Sealed	1/19/2007
H0254492	7a	Schindler Elevator	2338 Central Avenue Ne	Minneapolis	Sealed	1/19/2007
H0254494	7a	Nielsen	4655 2½ Street Ne	Fridley	Sealed	1/26/2007
H0254500	7a	All City Elevator	2200 University Avenue Se	Minneapolis	Sealed	12/6/2006
H0255255	7a	Shore	5620 Aldine Street	Shoreview	Sealed	1/8/2007

TABLE E-5
SEALED WELLS

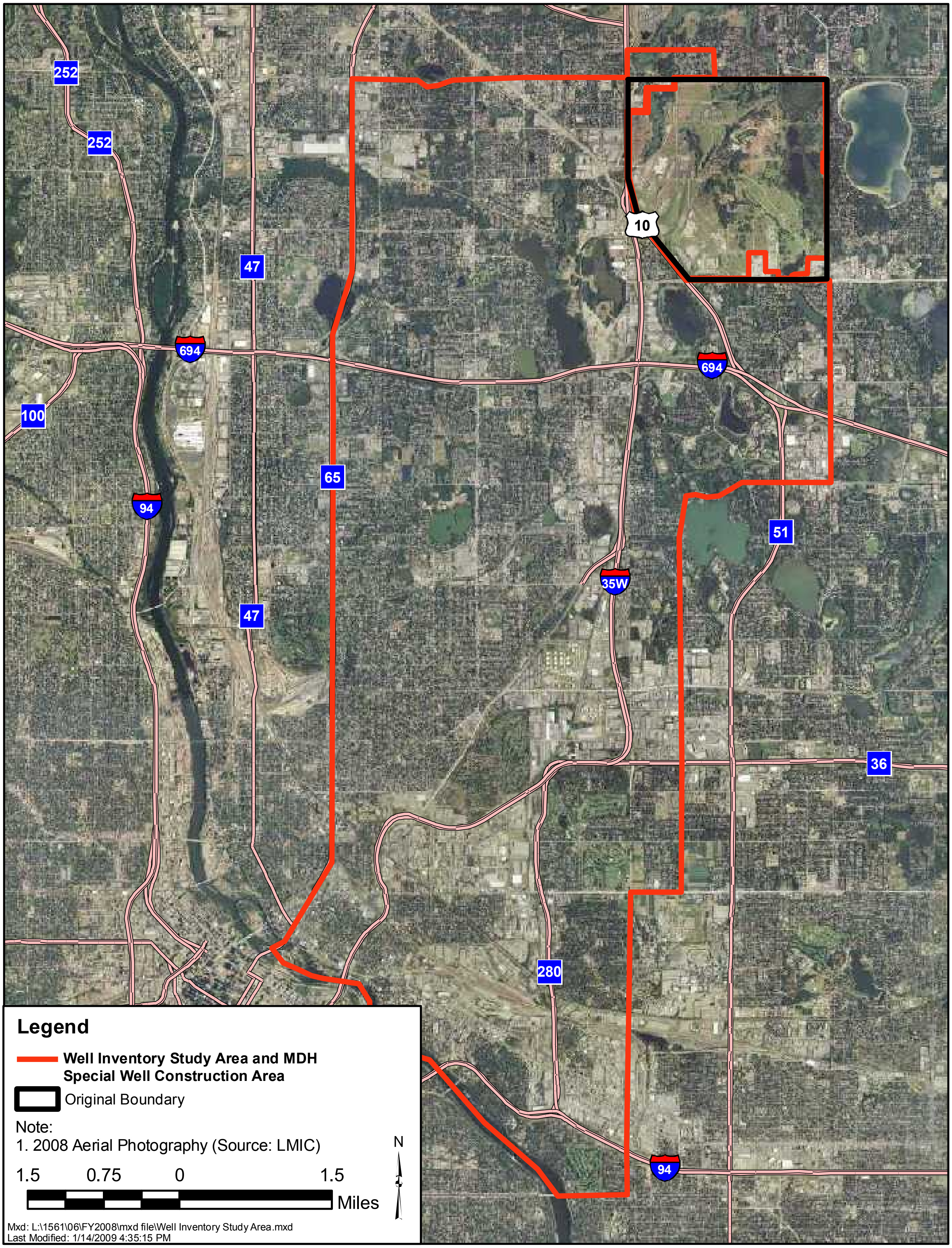
Unique Number	***Category***	***Last Name or Business Name***	***Street***	***City***	***Status***	***Date Sealed***
H0256053	7a	Bishop	1765 St. Marys Street	Falcon Heights	Sealed	1/4/2007
H0256090	7a	U Of M	106 Pleasant Street Se	Minneapolis	Sealed	1/30/2007
H0256091	7a	U Of M	106 Pleasant Street Se	Minneapolis	Sealed	1/30/2007
H0256151	7a	U Of M	515 Oak Street Se	Minneapolis	Sealed	12/28/2006
H0256153	7a	U Of M	811 Fulton Street	Minneapolis	Sealed	12/28/2006
H0256155	7a	Cg Rein And Co.	2216 W County Road D	Roseville	Sealed	1/4/2007
H0256718	7a	Speedway Superamerica	7299 Highway 6 Ne	Fridley	Sealed	1/17/2007
H0256719	7a	Speedway Superamerica		Fridley	Sealed	1/17/2007
H0256720	7a	Speedway Superamerica	1130 73rd Avenue Ne	Fridley	Sealed	1/17/2007
H0256751	7a	Superamerica	7299 Highway 65 Ne	Fridley	Sealed	2/8/2007
H0256800	7a	Cwp Properties	4423 Central Avenue Ne	Columbia Heights	Sealed	4/16/2007
H0257267	7a	U Of M			Sealed	3/19/2007
H0257275	7a	Lametti And Sons		Minneapolis	Sealed	4/16/2007
H0257351	7a	All City Elevator	2200 University Avenue Se	Minneapolis	Sealed	2/7/2007
H0257362	7a	C. W. Loft	730 Stinson Boulevard Ne	Minneapolis	Sealed	3/5/2007
H0257382	7a	Waks	7574 Fourth Street Ne	Fridley	Sealed	4/16/2007
H0257394	7a	Murphy	1491 Onondaga Street Ne	Fridley	Sealed	5/8/2007
H0257922	7a	TCAAP	4700 Highway 10	Arden Hills	Sealed	7/24/2007
H0258105	7a	Cunninen	2661 N Sheldon Road	Roseville	Sealed	6/18/2007
H0258107	7a	Johnson	5045 Rainbow Lane	Mounds View	Sealed	6/7/2007
H0258119	7a	Derauf	2569 Grotto Street	Roseville	Sealed	7/23/2007
H0258468	7a	Showronek	1930 County Road D W	Roseville	Sealed	5/21/2007
H0258607	7a	Jefferson Commons Berry	2703 Territorial Road	St. Paul	Sealed	5/2/2007
H0258613	7a	Koscheny	4322 Central Avenue	Columbia Heights	Sealed	5/10/2007
H0258626	7a	MN DOT		St. Paul	Sealed	5/18/2007
H0258704	7a	MN PCA			Sealed	4/9/2007
H0258715	7a	Wally McCarthy Cadillac Hummer	2775 Highway 35W N	Roseville	Sealed	4/19/2007
H0258742	7a	MN PCA		Minneapolis	Sealed	5/14/2007
H0258980	7a	Olson	1568 Ferndale Avenue Ne	Fridley	Sealed	7/11/2007
H0259615	7a	Rebber	7516 Tempo Terrace Ne	Fridley	Sealed	6/25/2007
H0260192	7a	Dillner	2192 Acorn Road	Roseville	Sealed	6/15/2007
H0260318	7a	St. Paul Ped	2286 Capp Road	St. Paul	Sealed	7/9/2007
H0260430	7a	Noriega	400 Rice Creek Terrace	Fridley	Sealed	8/7/2007
H0261665	7a	Al Amal School	1345 Gardena Avenue	Fridley	Sealed	7/11/2007
H0261713	7a	Nelson	5049 Washington Street Ne	Columbia Heights	Sealed	8/1/2007
H0261751	7a	Jefferson Commons Berry	2703 Territorial Road	St. Paul	Sealed	7/5/2007
H0261827	7a	Anderson	2500 W County Road C	Roseville	Sealed	8/13/2007
H0262304	7a	Wadi Investments	1617 Central Avenue Ne	Minneapolis	Sealed	7/18/2007
H0262343	7a	Wally Mccarthy Cadillac Hummer	2775 Highway 35W N	Roseville	Sealed	8/7/2007
H0262709	7a	Chohan	5300 Central Avenue Ne	Fridley	Sealed	8/29/2007
H0264159	7a	Minneapolis	1912 Fifth Street Se	Minneapolis	Sealed	6/19/2007
H0265315	7a	Cadwell	1688 Lois Drive	Shoreview	Sealed	10/5/2007
	7a	Onkka	1525 28th Avenue Nw	New Brighton	Sealed	10/23/2006

TABLE E-5
SEALED WELLS

Unique Number	Category	Last Name or Business Name	Street	City	Status	Date Sealed
	7a	Onkka	1525 28th Avenue Nw	New Brighton	Sealed	10/24/2006
	7a	Peterson	1659 Ridgewood Lane S	Roseville	Sealed	10/24/2006
	7a	Walker	1716 Millwood Avenue	Roseville	Sealed	3/20/2007
	7a	Bomberg	1781 Long Lake Road	New Brighton	Sealed	9/7/2007
	7a	Mayer	1831 Sunnyside Terrace	New Brighton	Sealed	10/25/2006
	7a	Franco	1860 Shryer Avenue W	Roseville	Sealed	10/23/2006
	7a	Qutob	1868 Howell Street N	Falcon Heights	Sealed	3/23/2007
	7a	Preiner	1883 County Road D W	Arden Hills	Sealed	9/7/2007
	7a	Ohlde	1975 Skillman Avenue W	Roseville	Sealed	9/7/2007
	7a	Koch	2001 County Road D W	Arden Hills	Sealed	3/19/2007
	7a	Providence Homes	2015 Thom Drive	Arden Hills	Sealed	3/23/2007
	7a	Morgan	3611 Hamline Avenue N	Arden Hills	Sealed	10/23/2006
	7a	Churchill	3991 Fairview Avenue N	Arden Hills	Sealed	10/25/2006
	7a	Yohan Holdings	4021 Macalaster Drive	St. Anthony	Sealed	9/7/2007
	7a	Thompson	4028 Fairview Avenue N	Arden Hills	Sealed	3/23/2007
	7a	Wegwerth	5119 Red Oak Drive	Mounds View	Sealed	10/23/2006
	7a	Gallop Solutions	704 Eighth Street Se	Minneapolis	Sealed	9/27/2007
	7a	University Carleton Development Phase II	765 Hampden Avenue	St. Paul	Sealed	10/23/2006
	7a	University Carleton Development Phase II	765 Hampden Avenue	St. Paul	Sealed	10/23/2006
	7a	University Carleton Development Phase II	765 Hampden Avenue	St. Paul	Sealed	10/23/2006
	7a	University Carleton Development Phase II	765 Hampden Avenue	St. Paul	Sealed	10/23/2006
	7a	Landmeier	778 Eighth Avenue Nw	New Brighton	Sealed	3/23/2007

TABLE E-6
FY 2008 FIELD INVESTIGATION AND SAMPLING SUMMARY

Unique Number	***Category***	***Last Name or Business Name***	***Street***	***City***	***Date Last Sampled***	***Status***	***Depth***	***Comments***
	4a	Amundsen	2816 St. Anthony Blvd	St. Anthony		Not in Use		Well remains inoperable per owner.
	4a	Bryant, Jr.	615 12th Ave NW	New Brighton		Not in Use		Well remains inoperable per owner.
	4a	Burton	2073 10th St NW	New Brighton		Inactive		Well remains inoperable per owner.
	4a	City of New Brighton	19 14th St NW	New Brighton		Active		Could not locate.
	4a	Cuddihy	2933 Troseth Road	Roseville		Not in Use		Well remains inoperable per owner.
	4a	Hermes	2935 Old Hwy 8	Roseville	6/22/2005	Active		Scheduled to sample in 2009.
	4a	Olson	4439 Old Hwy 10	Arden Hills		In Use		No response to letter or site visit.
	4a	Tabaika	2512 27th Ave NE	St. Anthony		Inactive		No response to letter or site visit.
	4a	Weisenberger	2816 Silver Lake Rd	St. Anthony		Inactive		No response to letter or site visit.
	4a	Willig	2600 Pahl Ave	St. Anthony		Inactive		Well remains inoperable per owner.
249185	4a	Novotny	1706 Malvern St	Lauderdale		Unknown		No response to letter or site visit.
S00295	4a	Alfson	2351 Summer St	Lauderdale		Unknown		No response to letter or site visit.
	4b	Meridian Properties Real Estate Dev., LLC.	3700 Silver Lake Rd	St. Anthony		Active		Could not locate.
	4b	New Brighton Alano Society, Inc.		Mounds View		Active		Could not locate.
	4b	New Brighton Alano Society, Inc.		Mounds View		Active		Could not locate.
	4b	Murray Heights				Not in Use		Could not locate.
	4b	Ras Pac Holdings (Pacal Steel)	2500 W County Road B	Roseville		Inactive		Fischer of Skyline Builders, 612-781-3184, he thinks there is a well on the property at Pacal Steel but it's inoperable- further calls were not returned. Site Visit could not locate well.
105242	4b	Weber, Nordeen Jr.				Active	214	Could not locate.
105271	4b	Nelson				Active	137	Could not locate.
126463	4b	B & M Construction	Nordeen Estates			Active	216	Could not locate.
130000	4b	550 Associates		Arden Hills		Inactive		Could not locate.
130000	4b	550 Associates		Arden Hills		Inactive		Duplicate entry. Delete from database.
180922	4b					Active		Could not locate.
192091	4b			Elmwood		Active		Could not locate.
201192	4b					Active		Could not locate.
234434	4b	Marquart		Arden Hills		Unknown		Could not locate.
234532	4b							Could not locate.
234537	4b							Could not locate.
234545	4b				PHASE I			Could not locate.
234568	4b	Thomsen	4 88th NE	Minneapolis			200	Could not locate.
234658	4b				6/7/1982			Could not locate.
239465	4b	Lennox				Active	256	Could not locate.
S00471	4b	R Komarek/Nelson-Miller Cons				Inactive		Could not locate.
S00551	4b	Tamarack Care Temp			2/17/1982	Unknown		Could not locate.
S00650	4b	CME		New Brighton	6/24/1984			Could not locate.



TWIN CITIES ARMY AMMUNITION PLANT

Well Inventory Study Area

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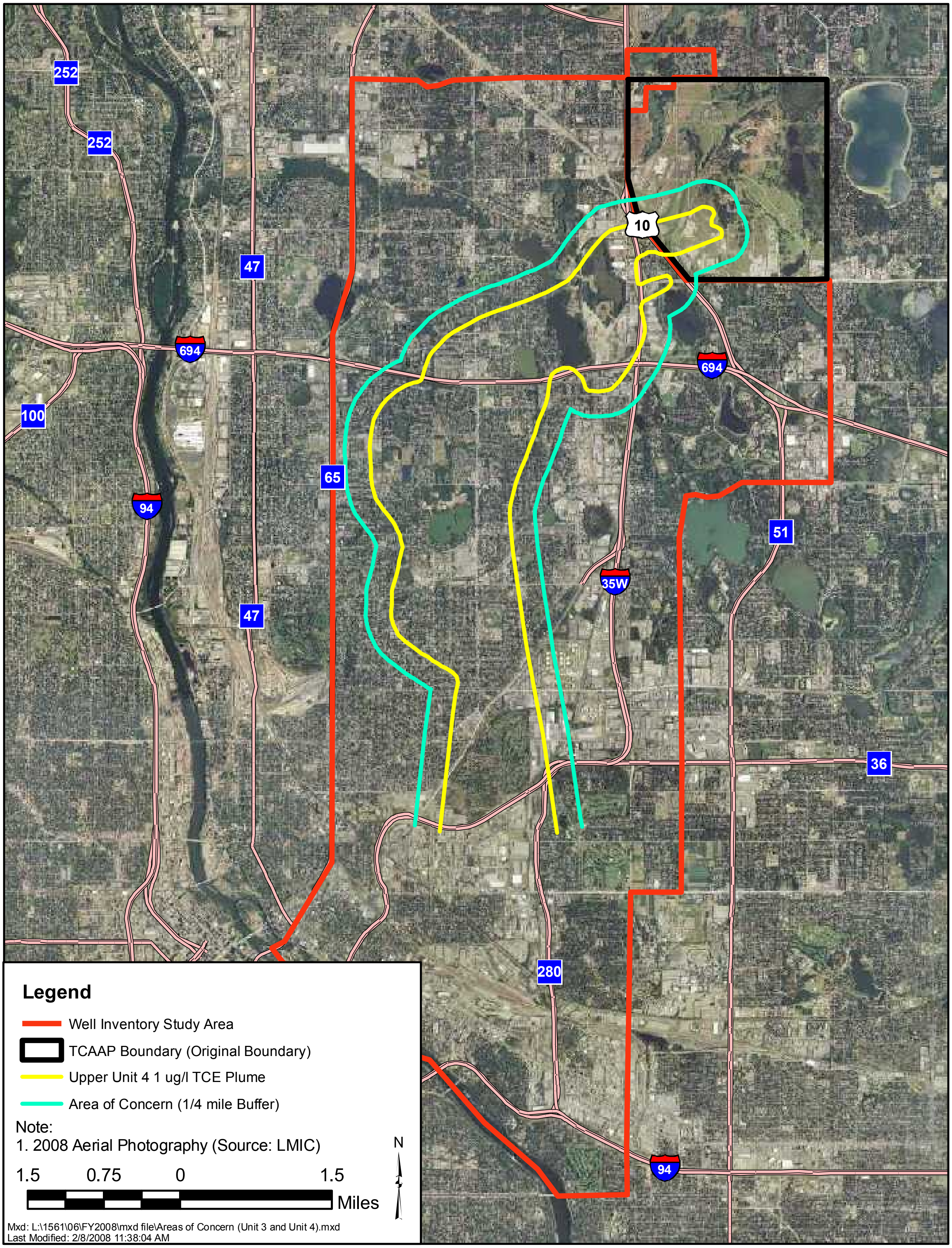
Wenck Associates, Inc.
Environmental Engineers

1800 Pioneer Creek Center
Maple Plain, MN 55359-0429

FY 2008

Figure E-1



TWIN CITIES ARMY AMMUNITION PLANT

Areas of Concern (Unit 3 and Unit 4)

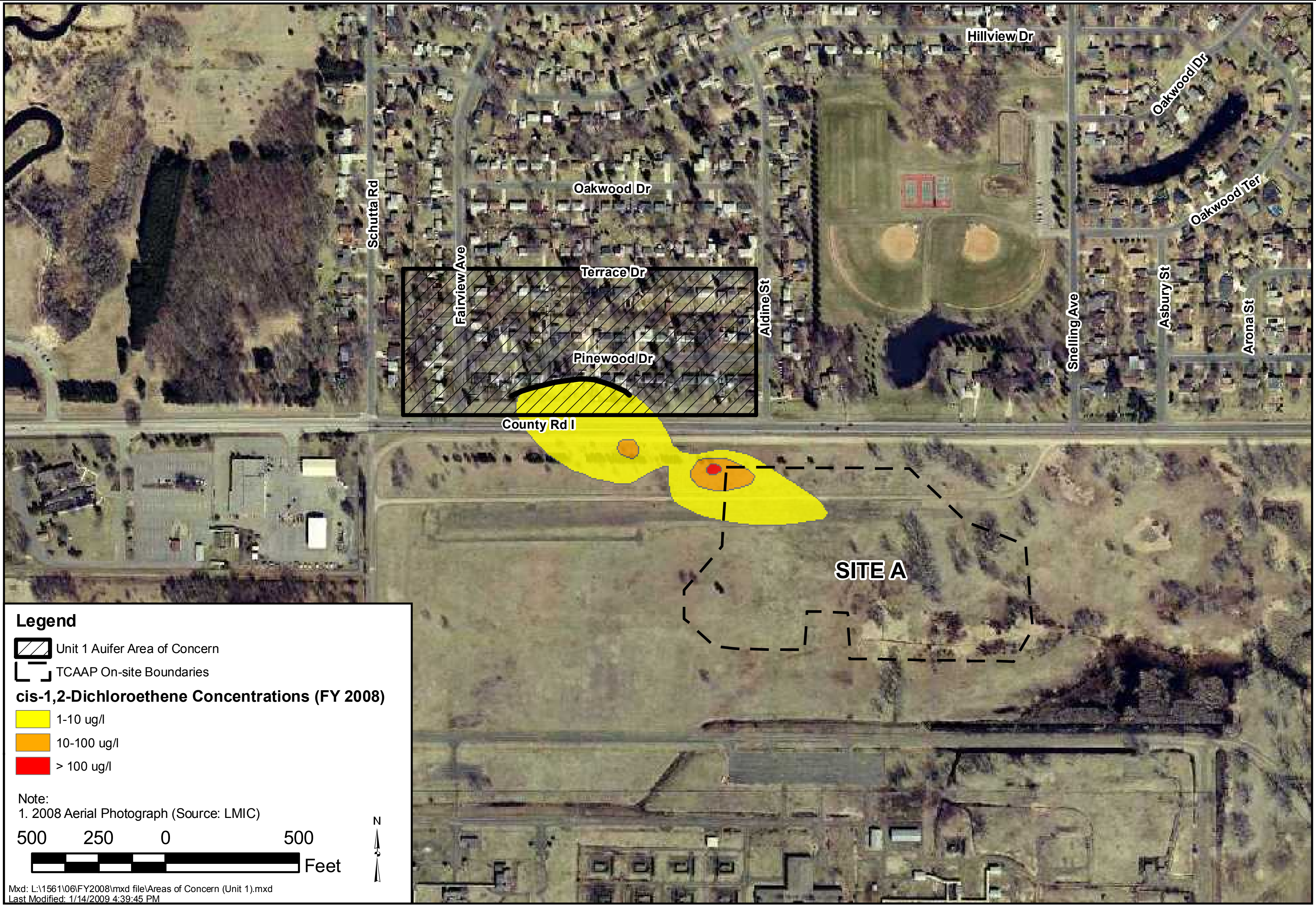
COPYRIGHT Wenck

Wenck Associates, Inc. Environmental Engineers

1800 Pioneer Creek Center Maple Plain, MN 55359-0429

FY 2008

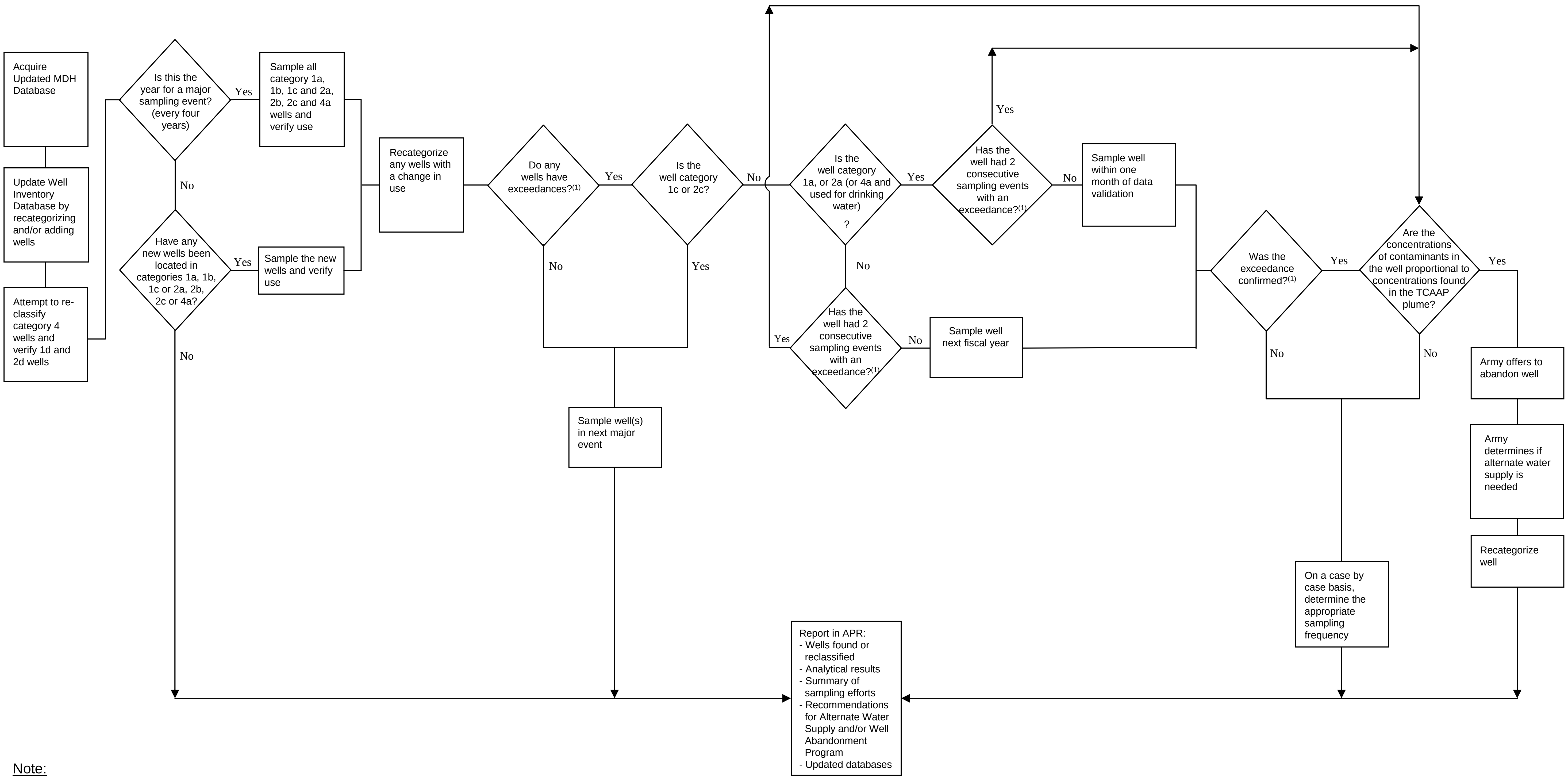
Figure E-2



TWIN CITIES ARMY AMMUNITION PLANT	Wenck Associates, Inc. Environmental Engineers — 1800 Pioneer Creek Center Maple Plain, MN 55359-0429	FY 2008
Area of Concern (Unit 1)		Figure E-3

Figure E-4

Annual Requirements for Maintaining TCAAP Well Inventory Database



Note:

(1) = Exceedance of a TCAAP Groundwater Cleanup Level

TCAAP WELL INVENTORY DATABASE

The TCAAP Well Inventory Database is located on
this DVD in the following Microsoft Excel file:

Well Inventory Main Database 2008.xls

Appendix F

Site K, TGRS, and PGRS Operational Data

F.1 Inspection and Maintenance Activities, Fiscal Year 2008, Site K, TCAAP

APPENDIX F.1

INSPECTION AND MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
SITE K, TCAAP
ARDEN HILLS, MINNESOTA

October 2007

1) 10/01/07 - Increased air flow from 21 inches to 24 inches H_2O

2) 10/03/07 - Increased groundwater flow to 16 gallons per minute (gpm)
10/03/07 - Increase air flow from 24 inches to 26 inches H_2O

3) 10/10/07 - Performed Monthly O&M, System down time- none

November 2007

1) 11/09/07 - Performed Monthly O&M, System down time - none

December 2007

1) 12/03/07 - In suspense, system O.K. Frozen lock resulted in difficulty entering building

2) 12/04/07 - Dis-assembled lock mechanism and lubricated

3) 12/06/07 - In suspense, system o.k. Performed monthly O&M

4) 12/21/07 - In suspense, system o.k.

5) 12/27/07 - In suspense, system o.k.

6) 12/31/07 - In suspense, system o.k.

January 2008

1) 01/10/08 - In suspense, system O.K.

2) 01/18/08 - In suspense, system O.K.

3) 01/22/08 - In suspense, system O.K.

4) 01/24/08 - In suspense, system O.K.

5) 01/25/08 - In suspense, system O.K.

INSPECTION AND MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
SITE K, TCAAP
ARDEN HILLS, MINNESOTA

February 2008

1) 02/05/08 - In suspense, system O.K.

2) 02/06/08 - Monthly O&M performed.

3) 02/08/08 - In suspense, system O.K.

4) 02/11/08 - Door lock frozen; could not enter building

5) 02/20/08 - Door lock frozen; could not enter building

6) 02/25/08 - In suspense, system O.K.

7) 02/27/08 - In suspense, system O.K.

8) 02/29/08 - In suspense, system O.K.

March 2008

1) 03/04/08 - In suspense, system O.K.

2) 03/05/08 - Monthly O&M performed.

3) 03/06/08 - In suspense, system O.K.

4) 03/07/08 - In suspense, system O.K.

5) 03/08/08 - In suspense, system O.K.

6) 03/11/08 - System down - pump not operational.

7) 03/18/08 - New pump installed, system resumes operation at 10:25 AM.

8) 03/21/08 - In suspense, system O.K.

9) 03/27/08 - In suspense, system O.K.

10) 03/31/08 - In suspense, system O.K.

April 2008

1) 4/4/08 - Performed monthly PM.

2) 4/14/08 - Low flow fault, system inoperative since approximately 4/12/08.

3) 4/15/08 - Connection between pump and hose repaired, system operational.

May 2008

1) 5/7/08 - Performed monthly PM. System downtime: None.

APPENDIX F.1

INSPECTION AND MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
SITE K, TCAAP
ARDEN HILLS, MINNESOTA

June 2008

1) 6/3/08 - In suspense. System OK.

2) 6/5/08 - Performed monthly PM. System downtime: None.

3) 6/11/08 - In suspense. System OK.

July 2008

1) 7/1/08 - Performed monthly PM. System downtime: None.

2) 7/8/08 - In suspense. System OK.

3) 7/16/08 - In suspense. System OK.

4) 7/17/08 - Reduced flow approximately 1 gallon per minute

5) 7/30/08 - In suspense. System OK.

August 2008

1) 8/11/08 - In suspense. System OK.

2) 8/15/08 - Performed monthly PM. System downtime: None.

3) 8/27/08 - In suspense. System OK.

September 2008

1) 9/5/08 - In suspense. System OK.

2) 9/8/08 - In suspense. System OK.

3) 9/9/08 - In suspense. System OK.

4) 9/10/08 - Performed monthly PM. System downtime: None.

5) 9/11/08 - In suspense. System OK.

6) 9/23/08 - In suspense. System OK.

7) 9/24/08 - Perform annual system cleaning. System downtime approximately 27 hours.

F.2 Maintenance Activities, Fiscal Year 2008, TGRS, TCAAP

APPENDIX F.2

MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

October 2007

10/2/2007	Pumphouse B9; Spraying sound coming from inside well casing; Replace all riser pipes, pump and motor. Down time: 4 hours.
10/3/2007	Pumphouse B1; Replace pump, motor and 3 riser pipes. Down time: 5 hours.
10/4/2007	Pumphouses B9 and SC1; Electrical storm blew a fuse in the output card at B11 which shut down the communications to SC1 and short circuited the I/O adapter card at B9; Replaced the fuse in the output card at B11 and restarted SC1 normally; Replaced the I/O card at B9 but the pump would only run for 1 minute and then shut down; Troubleshooting narrowed it down to a faulty I/O card; Replaced it with a new one and observed normal operation. Down time: B9 for 7 hours and SC1 for 6 hours.
10/8/2007	Treatment System: Laughlin Electric installed new heaters in the three control cabinets in Building 116. Down time: None.
10/8/2007	Pumphouse B6; Pump off to troubleshoot pumphouse B9 (swap out communication cards). Down time: 2 hours.
10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
10/25/2007	Pumphouse B8; Replace the pump with a new one. Down time: 2 hours.

APPENDIX F.2

MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

10/29/2007	Pumphouse B3; Pump off to work on the ECV. Down time: 2 hours.
10/29/2007	Pumphouse SC5; Laughlin Electric on site to repair lights in pumphouse. Down time: None.

November 2007

11/2/2007	Pumphouse B8; Increased the forcemain pressure from 92 psi to 115 psi to decrease the flow rate to around 155 gpm. Down time: None.
11/5/2007	Pumphouse B4; Deadhead pressure is at 200 psi; The pumping water level is at 84.7 feet btoc. Down time: None.
11/5/2007	Pumphouse B6; Deadhead pressure is at 116 psi. Down time: None.
11/5/2007	Pumphouse B8; Pumping water level is at 73.8 feet btoc at a flow rate of 156 gpm; The deadhead pressure is at 165 psi. Down time: None.
11/5/2007	Pumphouse B9; Deadhead pressure is at 200 psi. Down time: None.
11/12/2007	Building 116; Wrapped insulation around the pipe that stems off the influent pipe into Building 116. Down time: None.
11/20/2007	Treatment System; Reinstalled demister pads; performed maintenance on zerks fitting at pump 1; Changed oil at pump 4; Insulated door vents; Glazed edge of window in Building 116. Down time: 1.5 hours each at B1, B13, B3, B4 and B6.
11/21/2007	Pumphouse SC1; Disassembled and performed maintenance on cold water flow meter. Down time: None.

APPENDIX F.2

MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

11/28/2007	Treatment System; Call out from Time Communications-TGRS Fail; ECV3 would not open on command; Change filters, flush control piping, change out solenoid valve body and restart pump; Normal valve opening operation observed. Down time: None.
11/29/2007	Pumphouse B11; Water is leaking out of the ARV; Replace ARV and observe normal operation. Down time: None.

December 2007

12/3/2007	Pumphouse B4; T. L. Stevens on site to replace check valve 23 feet above the pump. Down time: 15 hours.
12/7/2007	Treatment System; Call from Time Communications, "Power is off at Building 116"; Contact Xcel energy and they arrive on site to restore power; Power restored at 16:15. Down time : 1 hour at B6 and 4 hours at SC2.
12/18/2007	Treatment System and Well Field; Power outage due to worn power lines at the substation near Lind Road; Xcel Energy on site to restore power. Down time: 3 hours at B1, B3, B5, B6, B8 and B9.
12/18/2007	Treatment system; Installed a cellular phone and connected it to the autodialer on site. Down time: None.
12/19/2007	Treatment System; Well field is cycling because pump 4 is off; Laughlin Electric on site to troubleshoot; Likely a power surge tripped the starter at the motor control center when Xcel Energy reconnected their connecting wires; Reset starter and pump 4 restarted normally. Down time: 7 hours at B1; 11 hours at B3; 2 hours at B4 and B5; 8 hours at B6; 4 hours at B8 and 9 hours at B11 and SC1.
12/19/2007	Treatment System; Power surge to Building 116 blew the transformers in the three 5KW electric heaters; Laughlin electric on site to troubleshoot. Down time: None.

APPENDIX F.2

MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

12/20/2007	Treatment System; Turned off pump 3 and removed a layer of packing from the gland shaft; Greased and replaced the layer with a new layer of packing. Down time: None.
12/20/2007	Treatment System; Created a fault at ECV 3 to test the cellular phone service with the autodialer; The autodialer called Time Communications and reported the alarm condition. Down time: None.
12/21/2007	Treatment System; Call from Time Communications "TGRS FAIL"; ECV 4 failed to open; Changed out operating solenoid valve, cycled valve and observed normal operation. Down time: None.
12/23/2007	Treatment System; B11 and SC1 lights are off on PLC; Well field is cycling due to ECV 2 not opening fully; Adjusted open speed control valve but valve still does not open smoothly; Change out relief pilot and operating solenoid valve; Cycled valve and observed normal operation. Down time: 7 hours at B6; 9 hours at B11; 2 hours at SC1.
12/25/2007	Treatment System and Well Field; The daily inspection was not performed due to the Christmas Day holiday. Down time: None.
12/27/2007	Treatment Center; Laughlin Electric on site to install new transformers in each 5000 watt electric heater in the treatment center; Additional troubleshooting indicates the electrical surge blew out the contactors in each heater; New contactors have been ordered. Down time: None.

January 2008

1/9/2008	Treatment Center; Laughlin Electric on site to install new contactors in the three 5000 watt heaters. Down time: None.
1/13/2008	Treatment System; Call from Time Communication-TGRS Fail; PDU 2 failed to open; Adjusted valves, flushed control piping and cycled valve; Normal operation observed. Down time: 2 hours at B1, B5, B6 and B8.

APPENDIX F.2

MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

1/15/2008	Pumphouse B4; Light flashing on PLC in Building 116; Reset PLC but B4 will not restart; Laughlin Electric on site to troubleshoot; Further inspection indicates the motor has failed; T. L. Stevens Well Company on site to replace motor; While removing riser pipe, the pump and motor fell to the bottom of the well. Fished the pump and motor from the bottom of the well. The reason for the failure is dissimilar metals (stainless steel pump attached to galvanized metal riser pipe). Ordered stainless steel pipe (delayed due to storm) and reset the pump and new motor. January Down time: 390 hours.
1/17/2008	Pumphouse SC4; Heater does not put out heat; Laughlin contacted, new heater purchased and installed. All normal. Down time: None.
1/28/2008	Pumphouse SC2; Flow meter will not total the flow; Replaced flow meter with new from stock; New totalizer in at 00001500 gallons. Down time: None

February 2008

2/1-11/2008	Pumphouse B4; Pump remains off while waiting for stainless steel riser pipe. Down time: 265 hours.
2/18/2008	Pumphouse B3; Flow rate fluctuates slightly due to ECV control piping. Down time: 1.5 hours.
2/24-25/2008	Pumphouse B4; Starter cycling rapidly due to incorrect setting on the submersible motors SubMonitor; Adjusted setting to correct value and observed normal operation. Down time: 22 hours.
2/25/2008	Pumphouse B3; Flow rate fluctuates slightly due to ECV control piping. Down time: 1.5 hours.

March 2008

3/6/2008	Pumphouse SC1; Xcel Energy and Laughlin Electric on site to reattach overhead power to adjacent corner of Bldg 960 and install new service meter. Down time: None.

APPENDIX F.2

MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

3/6/2008	Treatment System; Installed new gland packing in pump 1 gland shaft. Down time: B6 for 1 hour.
3/7/2008	Treatment System; ECV 3 failed to open on command; Flushed control piping, exercised opening and closing speed control valves and changed out pilot; Cycled valve three times; Normal operation observed. Down time: None.
3/12-24/2008	Pumphouse B8; Rattling noise coming from inside the well casing; T.L. Stevens Well Company on Site; Pull lift system and inspect all components; Pump and motor have worn; Repaired worn items and reinstalled the lift system; Normal operation observed. Down time: 286 hours.
3/13/2008	Treatment System; ECV 2 will not close properly; Flush control piping, change filter, adjust opening and closing speed control valves and change out solenoid valve; Cycled valve and valve closed properly. Down time: None.
3/26/2008	Pumphouse B3; Flow rate fluctuates slightly due to ECV control piping. Down time: 1.4 hours.

April 2008

4/3/2008	Pumphouse B13; Flow rate fluctuates slightly due to an inconsistent pilot. Down time: 1 hour
4/3-4/2008	Pumphouse B13; Pump is cavitating; Turned pump off to measure water levels and for evaluation; Turned pump back on and decreased flow rate to stop pump from cavitating; Scheduled the well for redevelopment. Down time: 20.4 hours.
4/7/2008	Pumphouse B13; Flow rate fluctuates slightly due to an inconsistent pilot. Down time: 1.5 hours
4/9/2008	Building 116; Autodialer will not call out; Contact AT&T to discuss; Reset performed on the cellular phone line; Normal operation resumes. Down time: None.

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MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
4/14/2008	Pumphouse B13; Decrease flow rate to minimize drawdown in the well. Down time: None.
4/15/2008	Pumphouse SC2; Flow meter does not total; Remove flow meter and flush the forcemain, pump and riser pipe; Re-install the flow meter and the flow meter totals, but very slowly. Down time: None.
4/22/2008	Pumphouse SC5; Light flashing on PLC in Building 116; Reset PLC and light stops flashing; Pump restarted normally. Down time: 10 hours.

May 2008

5/1-12/2008	Pumphouse B13; Remove and clean lift system; Redevelop well with acid; Reinstall lift system and restart pump. Down time: 237 hours.
5/1/2008	Pumphouse B6; Replace pump, motor, riser pipe and check valve and restart pump. Down time: 6 hours
5/12-22/2008	Pumphouse SC2; Remove and clean lift system; Redevelop well with acid; Reinstall lift system with new pump and motor and restart pump. Down time: 239 hours.
5/22/2008	Pumphouse B6; Replace pilot on electric check valve control piping. Down time: 2 hours.
5/29/2008	Pumphouse B8; Accidentally adjusted flow rate below operational minimum; Readjusted flow rate to normal flow rate. Down time: 1 hour.

APPENDIX F.2

MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

June 2008

6/2-4/2008	Pumphouse B3; Light flashing on PLC in Building 116; Reset PLC but light continues to flash; Troubleshooting indicates the submersible pump motor has blown, likely due to the lightning storm last night; T. L. Stevens Well Company replaces the bad motor. Down time: 61 hours.
6/2/2008	Pumphouse B4; Light flashing on PLC in Building 116; Reset PLC and pump restarted normally. Down time: 4 hours.
6/2/2008	Pumphouse B11; Light flashing on PLC in Building 116; Reset PLC and observed normal operation. Down time: 4 hours.
6/6/2008	Pumphouse B6; Light flashing on PLC in Building 116; Reset PLC and pump restarted normally. Down time: 22 hours.
6/6/2008	Treatment System; Replaced blower belt at blower #2. Down time: None.
6/19-20/2008	Pumphouse SC1; Laughlin Electric on site; Upgraded wiring in well head and control panel. Down time: 21.5 hours.
6/29-30/2008	Pumphouse SC2; The gate valve closed slightly causing a decrease in flow rate; Re-opened the gate valve to the proper flow rate. Down time: 7 hours.

July 2008

7/1/2008	Pumphouse B9; Decreased flow rate to approximately 270 gpm. Down time: None.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.

APPENDIX F.2

MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/7/2008	Pumphouse SC5; ECV will not respond to pilot adjustment; Remove, clean and reinstall pilot and piping; Pilot operates normally. Down time: None.
7/9/2008	Pumphouse B9; Unable to adjust flow rate; Replace pilot and adjust flow rate to 270 gpm. Down time: 2.5 hours.
7/11/2008	Treatment System; Opened ECV 3 and performed an inspection of the cylinder, the seals and the inside of the valve; One of the brass columns inside the valve has buckled outward rendering the valve unrepairable; Schedule replacement of ECV 3; Turned off B3, B8, B9 and B11 to minimize well field cycling. Down time: 3 hours at B3 and B11; 7 hours at B8; 8.5 hours at B9.
7/11/2008	Treatment System; Replaced the valve seals at ECV 4. Down time: None-downtime already accounted for from item 6 (ECV 3 inspection)
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
7/14/2008	Pumphouses B11 and SC1; The pumps operate in "Hand" but not "Auto"; The green light is flashing on the I/O adapter module in the B11 control panel; Reset power to pumphouse B11 and the green light illuminates steady as it should; Turn the switches to Auto and the pumps restart normally. Down time: None-downtime already accounted for from item 8 (lightning storm) above.

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MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

7/14/2008 Pumphouse B8; The pump is off and the red light on the I/O adapter module is on; Switch out I/O adapter module with new and the pump restarts normally.
Down time: None-downtime already accounted for from item 8 (lightning storm) above.

7/14/2008 Pumphouse B4; The 7/11/2008 lightning storm tripped the submonitor in B4; Reset the submonitor and the pump restarted normally.
Down time: None-downtime already accounted for from item 8 (lightning storm) above.

7/14/2008 Pumphouses B8, B9 and SC5; Adjusted the flow rates to their respective target flow rates.
Down time: None.

7/23/2008 Pumphouses SC2 and SC5; Power outage; Xcel Energy contacted and on site; They reset a tripped breaker at the the Lind Road power station.
Down time: 21 hours at SC5.

7/25/2008 Pumphouse B5; Light flashing on PLC in Building 116; Reset PLC but light begins flashing again; At pumphouse, flush control piping and opening and closing speed valves, clean strainer screen and adjust pilot; ECV now opens normally.
Down time: 18 hours.

August 2008

8/4/2008 Treatment System; Changed out the emergency solenoid at ECV 4.
Down time: None.

8/6/2008 Pumphouse B8; Changed out the pilot on the control piping.
Down time: None.

8/12/2008 Pumphouses B3 and B9; Increased the pressure to decrease the flow rates.
Down time: None.

8/14-15/2008 Treatment System; Replaced ECV 3 (10" angle valve) with new valve from inventory; Turned off B3, B8 and B9 to limit well field cycling.
Down time: B3 for 28.5 hours; B8 and B9 for 34 hours each.

8/22/2008 Treatment System; Zeroed the pressure gauges for blowers 1, 2 and 3.
Down time: None.

APPENDIX F.2

MAINTENANCE ACTIVITIES
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

8/28-31/2008	Pumphouses B1, B13, B3, B4, B8, B9, B11 and SC5; Lightning storm knocked out power to the pumphouses; Xcel Energy and Laughlin Electric contacted and responded replacing the meter and fusible switch; The I/O adapter modules were blown at B1, B8, B9 and B13; The input module, output module and DLP were blown in B4. Down time: 16 hours at B1, B9, B11 and SC5 each; 31 hours at B4, B8 and B13 each; 41 hours at B3.

September 2008

9/4-6/2008	Pumphouse B8; ECV will not open on command; Replace solenoid valve with new; Flush strainer screen and control piping and adjust speed control valve; Normal operation observed. Down time: 40 hours.
9/5/2008	Pumphouses B1, B13 and B3; Single phase power outage to the pumphouses; Contact Xcel energy and they replace a fuse on the power pole between pumphouses B2 and B3; Restart the pumps and normal operation observed. Down time: 15 hours at each well.
9/11/2008	Treatment System; The air release valve for pump 3 is leaking water while the pump is running; Installed a new air release valve and the new one operates normally. Down time: None.
9/12/2008	Treatment System; ECV 3 will not open or close properly; Installed a new check valve on the potable water line to ECVs 1 and 2, however additional troubleshooting is necessary. Down time: None.
9/30/2008	Treatment System; ECV 3 is not opening or closing properly; Perform troubleshooting work and install a check valve on the control piping; Normal operation observed. Down time: None.

F.3 Maintenance Activities by Location, Fiscal Year 2008, TGRS, TCAAP

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Pumphouse B1

10/3/2007	Pumphouse B1; Replace pump, motor and 3 riser pipes. Down time: 5 hours.
10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
11/20/2007	Treatment System; Reinstalled demister pads; performed maintenance on zerks fitting at pump 1; Changed oil at pump 4; Insulated door vents; Glazed edge of window in Building 116. Down time: 1.5 hours each at B1, B13, B3, B4 and B6.
12/18/2007	Treatment System and Well Field; Power outage due to worn power lines at the substation near Lind Road; Xcel Energy on site to restore power. Down time: 3 hours at B1, B3, B5, B6, B8 and B9.
12/19/2007	Treatment System; Well field is cycling because pump 4 is off; Laughlin Electric on site to troubleshoot; Likely a power surge tripped the starter at the motor control center when Xcel Energy reconnected their connecting wires; Reset starter and pump 4 restarted normally. Down time: 7 hours at B1; 11 hours at B3; 2 hours at B4 and B5; 8 hours at B6; 4 hours at B8 and 9 hours at B11 and SC1.
1/13/2008	Treatment System; Call from Time Communication-TGRS Fail; PDU 2 failed to open; Adjusted valves, flushed control piping and cycled valve; Normal operation observed. Down time: 2 hours at B1, B5, B6 and B8.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.

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MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
8/28-31/2008	Pumphouses B1, B13, B3, B4, B8, B9, B11 and SC5; Lightning storm knocked out power to the pumphouses; Xcel Energy and Laughlin Electric contacted and responded replacing the meter and fusible switch; The I/O adapter modules were blown at B1, B8, B9 and B13; The input module, output module and DLP were blown in B4. Down time: 16 hours at B1, B9, B11 and SC5 each; 31 hours at B4, B8 and B13 each; 41 hours at B3.
9/5/2008	Pumphouses B1, B13 and B3; Single phase power outage to the pumphouses; Contact Xcel energy and they replace a fuse on the power pole between pumphouses B2 and B3; Restart the pumps and normal operation observed. Down time: 15 hours at each well.

Pumphouse B3

10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
10/29/2007	Pumphouse B3; Pump off to work on the ECV. Down time: 2 hours.

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MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

11/20/2007	Treatment System; Reinstalled demister pads; performed maintenance on zerks fitting at pump 1; Changed oil at pump 4; Insulated door vents; Glazed edge of window in Building 116. Down time: 1.5 hours each at B1, B13, B3, B4 and B6.
12/18/2007	Treatment System and Well Field; Power outage due to worn power lines at the substation near Lind Road; Xcel Energy on site to restore power. Down time: 3 hours at B1, B3, B5, B6, B8 and B9.
12/19/2007	Treatment System; Well field is cycling because pump 4 is off; Laughlin Electric on site to troubleshoot; Likely a power surge tripped the starter at the motor control center when Xcel Energy reconnected their connecting wires; Reset starter and pump 4 restarted normally. Down time: 7 hours at B1; 11 hours at B3; 2 hours at B4 and B5; 8 hours at B6; 4 hours at B8 and 9 hours at B11 and SC1.
2/18/2008	Pumphouse B3; Flow rate fluctuates slightly due to ECV control piping. Down time: 1.5 hours.
2/25/2008	Pumphouse B3; Flow rate fluctuates slightly due to ECV control piping. Down time: 1.5 hours.
3/26/2008	Pumphouse B3; Flow rate fluctuates slightly due to ECV control piping. Down time: 1.4 hours.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
6/2-4/2008	Pumphouse B3; Light flashing on PLC in Building 116; Reset PLC but light continues to flash; Troubleshooting indicates the submersible pump motor has blown, likely due to the lightning storm last night; T. L. Stevens Well Company replaces the bad motor. Down time: 61 hours.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/11/2008	Treatment System; Opened ECV 3 and performed an inspection of the cylinder, the seals and the inside of the valve; One of the brass columns inside the valve has buckled outward rendering the valve unrepairable; Schedule replacement of ECV 3; Turned off B3, B8, B9 and B11 to minimize well field cycling. Down time: 3 hours at B3 and B11; 7 hours at B8; 8.5 hours at B9.
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
8/12/2008	Pumphouses B3 and B9; Increased the pressure to decrease the flow rates. Down time: None.
8/14-15/2008	Treatment System; Replaced ECV 3 (10" angle valve) with new valve from inventory; Turned off B3, B8 and B9 to limit well field cycling. Down time: B3 for 28.5 hours; B8 and B9 for 34 hours each.
8/28-31/2008	Pumphouses B1, B13, B3, B4, B8, B9, B11 and SC5; Lightning storm knocked out power to the pumphouses; Xcel Energy and Laughlin Electric contacted and responded replacing the meter and fusible switch; The I/O adapter modules were blown at B1, B8, B9 and B13; The input module, output module and DLP were blown in B4. Down time: 16 hours at B1, B9, B11 and SC5 each; 31 hours at B4, B8 and B13 each; 41 hours at B3.
9/5/2008	Pumphouses B1, B13 and B3; Single phase power outage to the pumphouses; Contact Xcel energy and they replace a fuse on the power pole between pumphouses B2 and B3; Restart the pumps and normal operation observed. Down time: 15 hours at each well.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Pumphouse B4

10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
11/5/2007	Pumphouse B4; Deadhead pressure is at 200 psi; The pumping water level is at 84.7 feet btoc. Down time: None.
11/20/2007	Treatment System; Reinstalled demister pads; performed maintenance on zerks fitting at pump 1; Changed oil at pump 4; Insulated door vents; Glazed edge of window in Building 116. Down time: 1.5 hours each at B1, B13, B3, B4 and B6.
12/3/2007	Pumphouse B4; T. L. Stevens on site to replace check valve 23 feet above the pump. Down time: 15 hours.
12/19/2007	Treatment System; Well field is cycling because pump 4 is off; Laughlin Electric on site to troubleshoot; Likely a power surge tripped the starter at the motor control center when Xcel Energy reconnected their connecting wires; Reset starter and pump 4 restarted normally. Down time: 7 hours at B1; 11 hours at B3; 2 hours at B4 and B5; 8 hours at B6; 4 hours at B8 and 9 hours at B11 and SC1.
1/15/2008	Pumphouse B4; Light flashing on PLC in Building 116; Reset PLC but B4 will not restart; Laughlin Electric on site to troubleshoot; Further inspection indicates the motor has failed; T. L. Stevens Well Company on site to replace motor; While removing riser pipe, the pump and motor fell to the bottom of the well. Fished the pump and motor from the bottom of the well. The reason for the failure is dissimilar metals (stainless steel pump attached to galvanized metal riser pipe). Ordered stainless steel pipe (delayed due to storm) and reset the pump and new motor. January Down time: 390 hours.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

2/1-11/2008	Pumphouse B4; Pump remains off while waiting for stainless steel riser pipe. Down time: 265 hours.
2/24-25/2008	Pumphouse B4; Starter cycling rapidly due to incorrect setting on the submersible motors SubMonitor; Adjusted setting to correct value and observed normal operation. Down time: 22 hours.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
6/2/2008	Pumphouse B4; Light flashing on PLC in Building 116; Reset PLC and pump restarted normally. Down time: 4 hours.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.
7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
7/14/2008	Pumphouse B4; The 7/11/2008 lightning storm tripped the submonitor in B4; Reset the submonitor and the pump restarted normally. Down time: None-downtime already accounted for from item 8 (lightning storm) above.
8/28-31/2008	Pumphouses B1, B13, B3, B4, B8, B9, B11 and SC5; Lightning storm knocked out power to the pumphouses; Xcel Energy and Laughlin Electric contacted and responded replacing the meter and fusible switch; The I/O adapter modules were blown at B1, B8, B9 and B13; The input module, output module and DLP were blown in B4. Down time: 16 hours at B1, B9, B11 and SC5 each; 31 hours at B4, B8 and B13 each; 41 hours at B3.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

Pumphouse B5

10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
12/18/2007	Treatment System and Well Field; Power outage due to worn power lines at the substation near Lind Road; Xcel Energy on site to restore power. Down time: 3 hours at B1, B3, B5, B6, B8 and B9.
12/19/2007	Treatment System; Well field is cycling because pump 4 is off; Laughlin Electric on site to troubleshoot; Likely a power surge tripped the starter at the motor control center when Xcel Energy reconnected their connecting wires; Reset starter and pump 4 restarted normally. Down time: 7 hours at B1; 11 hours at B3; 2 hours at B4 and B5; 8 hours at B6; 4 hours at B8 and 9 hours at B11 and SC1.
1/13/2008	Treatment System; Call from Time Communication-TGRS Fail; PDU 2 failed to open; Adjusted valves, flushed control piping and cycled valve; Normal operation observed. Down time: 2 hours at B1, B5, B6 and B8.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.
7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.

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7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
7/25/2008	Pumphouse B5; Light flashing on PLC in Building 116; Reset PLC but light begins flashing again; At pumphouse, flush control piping and opening and closing speed valves, clean strainer screen and adjust pilot; ECV now opens normally. Down time: 18 hours.

Pumphouse B6

10/8/2007	Pumphouse B6; Pump off to troubleshoot pumphouse B9 (swap out communication cards). Down time: 2 hours.
10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
11/5/2007	Pumphouse B6; Deadhead pressure is at 116 psi. Down time: None.
11/20/2007	Treatment System; Reinstalled demister pads; performed maintenance on zerks fitting at pump 1; Changed oil at pump 4; Insulated door vents; Glazed edge of window in Building 116. Down time: 1.5 hours each at B1, B13, B3, B4 and B6.
12/7/2007	Treatment System; Call from Time Communications, "Power is off at Building 116"; Contact Xcel energy and they arrive on site to restore power; Power restored at 16:15. Down time : 1 hour at B6 and 4 hours at SC2.

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12/18/2007	Treatment System and Well Field; Power outage due to worn power lines at the substation near Lind Road; Xcel Energy on site to restore power. Down time: 3 hours at B1, B3, B5, B6, B8 and B9.
12/19/2007	Treatment System; Well field is cycling because pump 4 is off; Laughlin Electric on site to troubleshoot; Likely a power surge tripped the starter at the motor control center when Xcel Energy reconnected their connecting wires; Reset starter and pump 4 restarted normally. Down time: 7 hours at B1; 11 hours at B3; 2 hours at B4 and B5; 8 hours at B6; 4 hours at B8 and 9 hours at B11 and SC1.
12/23/2007	Treatment System; B11 and SC1 lights are off on PLC; Well field is cycling due to ECV 2 not opening fully; Adjusted open speed control valve but valve still does not open smoothly; Change out relief pilot and operating solenoid valve; Cycled valve and observed normal operation. Down time: 7 hours at B6; 9 hours at B11; 2 hours at SC1.
1/13/2008	Treatment System; Call from Time Communication-TGRS Fail; PDU 2 failed to open; Adjusted valves, flushed control piping and cycled valve; Normal operation observed. Down time: 2 hours at B1, B5, B6 and B8.
3/6/2008	Treatment System; Installed new gland packing in pump 1 gland shaft. Down time: B6 for 1 hour.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
5/1/2008	Pumphouse B6; Replace pump, motor, riser pipe and check valve and restart pump. Down time: 6 hours
5/22/2008	Pumphouse B6; Replace pilot on electric check valve control piping. Down time: 2 hours.
6/6/2008	Pumphouse B6; Light flashing on PLC in Building 116; Reset PLC and pump restarted normally. Down time: 22 hours.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.

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7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.

Pumphouse B8

10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
10/25/2007	Pumphouse B8; Replace the pump with a new one. Down time: 2 hours.
11/2/2007	Pumphouse B8; Increased the forcemain pressure from 92 psi to 115 psi to decrease the flow rate to around 155 gpm. Down time: None.
11/5/2007	Pumphouse B8; Pumping water level is at 73.8 feet btoc at a flow rate of 156 gpm; The deadhead pressure is at 165 psi. Down time: None.
12/18/2007	Treatment System and Well Field; Power outage due to worn power lines at the substation near Lind Road; Xcel Energy on site to restore power. Down time: 3 hours at B1, B3, B5, B6, B8 and B9.

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12/19/2007	Treatment System; Well field is cycling because pump 4 is off; Laughlin Electric on site to troubleshoot; Likely a power surge tripped the starter at the motor control center when Xcel Energy reconnected their connecting wires; Reset starter and pump 4 restarted normally. Down time: 7 hours at B1; 11 hours at B3; 2 hours at B4 and B5; 8 hours at B6; 4 hours at B8 and 9 hours at B11 and SC1.
1/13/2008	Treatment System; Call from Time Communication-TGRS Fail; PDU 2 failed to open; Adjusted valves, flushed control piping and cycled valve; Normal operation observed. Down time: 2 hours at B1, B5, B6 and B8.
3/12-24/2008	Pumphouse B8; Rattling noise coming from inside the well casing; T.L. Stevens Well Company on Site; Pull lift system and inspect all components; Pump and motor have worn; Repaired worn items and reinstalled the lift system; Normal operation observed. Down time: 286 hours.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
5/29/2008	Pumphouse B8; Accidentally adjusted flow rate below operational minimum; Readjusted flow rate to normal flow rate. Down time: 1 hour.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.
7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/11/2008	Treatment System; Opened ECV 3 and performed an inspection of the cylinder, the seals and the inside of the valve; One of the brass columns inside the valve has buckled outward rendering the valve unrepairable; Schedule replacement of ECV 3; Turned off B3, B8, B9 and B11 to minimize well field cycling. Down time: 3 hours at B3 and B11; 7 hours at B8; 8.5 hours at B9.

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7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
7/14/2008	Pumphouse B8; The pump is off and the red light on the I/O adapter module is on; Switch out I/O adapter module with new and the pump restarts normally. Down time: None-downtime already accounted for from item 8 (lightning storm) above.
7/14/2008	Pumphouses B8, B9 and SC5; Adjusted the flow rates to their respective target flow rates. Down time: None.
8/6/2008	Pumphouse B8; Changed out the pilot on the control piping. Down time: None.
8/14-15/2008	Treatment System; Replaced ECV 3 (10" angle valve) with new valve from inventory; Turned off B3, B8 and B9 to limit well field cycling. Down time: B3 for 28.5 hours; B8 and B9 for 34 hours each.
8/28-31/2008	Pumphouses B1, B13, B3, B4, B8, B9, B11 and SC5; Lightning storm knocked out power to the pumphouses; Xcel Energy and Laughlin Electric contacted and responded replacing the meter and fusible switch; The I/O adapter modules were blown at B1, B8, B9 and B13; The input module, output module and DLP were blown in B4. Down time: 16 hours at B1, B9, B11 and SC5 each; 31 hours at B4, B8 and B13 each; 41 hours at B3.
9/4-6/2008	Pumphouse B8; ECV will not open on command; Replace solenoid valve with new; Flush strainer screen and control piping and adjust speed control valve; Normal operation observed. Down time: 40 hours.

Pumphouse B9

10/2/2007	Pumphouse B9; Spraying sound coming from inside well casing; Replace all riser pipes, pump and motor. Down time: 4 hours.

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10/4/2007	Pumphouses B9 and SC1; Electrical storm blew a fuse in the output card at B11 which shut down the communications to SC1 and short circuited the I/O adapter card at B9; Replaced the fuse in the output card at B11 and restarted SC1 normally; Replaced the I/O card at B9 but the pump would only run for 1 minute and then shut down; Troubleshooting narrowed it down to a faulty I/O card; Replaced it with a new one and observed normal operation. Down time: B9 for 7 hours and SC1 for 6 hours.
10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
11/5/2007	Pumphouse B9; Deadhead pressure is at 200 psi. Down time: None.
12/18/2007	Treatment System and Well Field; Power outage due to worn power lines at the substation near Lind Road; Xcel Energy on site to restore power. Down time: 3 hours at B1, B3, B5, B6, B8 and B9.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
7/1/2008	Pumphouse B9; Decreased flow rate to approximately 270 gpm. Down time: None.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.
7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.

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7/9/2008	Pumphouse B9; Unable to adjust flow rate; Replace pilot and adjust flow rate to 270 gpm. Down time: 2.5 hours.
7/11/2008	Treatment System; Opened ECV 3 and performed an inspection of the cylinder, the seals and the inside of the valve; One of the brass columns inside the valve has buckled outward rendering the valve unrepairable; Schedule replacement of ECV 3; Turned off B3, B8, B9 and B11 to minimize well field cycling. Down time: 3 hours at B3 and B11; 7 hours at B8; 8.5 hours at B9.
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
7/14/2008	Pumphouses B8, B9 and SC5; Adjusted the flow rates to their respective target flow rates. Down time: None.
8/12/2008	Pumphouses B3 and B9; Increased the pressure to decrease the flow rates. Down time: None.
8/14-15/2008	Treatment System; Replaced ECV 3 (10" angle valve) with new valve from inventory; Turned off B3, B8 and B9 to limit well field cycling. Down time: B3 for 28.5 hours; B8 and B9 for 34 hours each.
8/28-31/2008	Pumphouses B1, B13, B3, B4, B8, B9, B11 and SC5; Lightning storm knocked out power to the pumphouses; Xcel Energy and Laughlin Electric contacted and responded replacing the meter and fusible switch; The I/O adapter modules were blown at B1, B8, B9 and B13; The input module, output module and DLP were blown in B4. Down time: 16 hours at B1, B9, B11 and SC5 each; 31 hours at B4, B8 and B13 each; 41 hours at B3.

Pumphouse B11

10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.

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10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
11/29/2007	Pumphouse B11; Water is leaking out of the ARV; Replace ARV and observe normal operation. Down time: None.
12/19/2007	Treatment System; Well field is cycling because pump 4 is off; Laughlin Electric on site to troubleshoot; Likely a power surge tripped the starter at the motor control center when Xcel Energy reconnected their connecting wires; Reset starter and pump 4 restarted normally. Down time: 7 hours at B1; 11 hours at B3; 2 hours at B4 and B5; 8 hours at B6; 4 hours at B8 and 9 hours at B11 and SC1.
12/23/2007	Treatment System; B11 and SC1 lights are off on PLC; Well field is cycling due to ECV 2 not opening fully; Adjusted open speed control valve but valve still does not open smoothly; Change out relief pilot and operating solenoid valve; Cycled valve and observed normal operation. Down time: 7 hours at B6; 9 hours at B11; 2 hours at SC1.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
6/2/2008	Pumphouse B11; Light flashing on PLC in Building 116; Reset PLC and observed normal operation. Down time: 4 hours.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.
7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.

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7/11/2008	Treatment System; Opened ECV 3 and performed an inspection of the cylinder, the seals and the inside of the valve; One of the brass columns inside the valve has buckled outward rendering the valve unrepairable; Schedule replacement of ECV 3; Turned off B3, B8, B9 and B11 to minimize well field cycling. Down time: 3 hours at B3 and B11; 7 hours at B8; 8.5 hours at B9.
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
7/14/2008	Pumphouses B11 and SC1; The pumps operate in "Hand" but not "Auto"; The green light is flashing on the I/O adapter module in the B11 control panel; Reset power to pumphouse B11 and the green light illuminates steady as it should; Turn the switches to Auto and the pumps restart normally. Down time: None-downtime already accounted for from item 8 (lightning storm) above.
8/28-31/2008	Pumphouses B1, B13, B3, B4, B8, B9, B11 and SC5; Lightning storm knocked out power to the pumphouses; Xcel Energy and Laughlin Electric contacted and responded replacing the meter and fusible switch; The I/O adapter modules were blown at B1, B8, B9 and B13; The input module, output module and DLP were blown in B4. Down time: 16 hours at B1, B9, B11 and SC5 each; 31 hours at B4, B8 and B13 each; 41 hours at B3.

Pumphouse B13

10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
11/20/2007	Treatment System; Reinstalled demister pads; performed maintenance on zerks fitting at pump 1; Changed oil at pump 4; Insulated door vents; Glazed edge of window in Building 116. Down time: 1.5 hours each at B1, B13, B3, B4 and B6.

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4/3/2008	Pumphouse B13; Flow rate fluctuates slightly due to an inconsistent pilot. Down time: 1 hour
4/3-4/2008	Pumphouse B13; Pump is cavitating; Turned pump off to measure water levels and for evaluation; Turned pump back on and decreased flow rate to stop pump from cavitating; Scheduled the well for redevelopment. Down time: 20.4 hours.
4/7/2008	Pumphouse B13; Flow rate fluctuates slightly due to an inconsistent pilot. Down time: 1.5 hours
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
4/14/2008	Pumphouse B13; Decrease flow rate to minimize drawdown in the well. Down time: None.
5/1-12/2008	Pumphouse B13; Remove and clean lift system; Redevelop well with acid; Reinstall lift system and restart pump. Down time: 237 hours.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.
7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.

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8/28-31/2008	Pumphouses B1, B13, B3, B4, B8, B9, B11 and SC5; Lightning storm knocked out power to the pumphouses; Xcel Energy and Laughlin Electric contacted and responded replacing the meter and fusible switch; The I/O adapter modules were blown at B1, B8, B9 and B13; The input module, output module and DLP were blown in B4. Down time: 16 hours at B1, B9, B11 and SC5 each; 31 hours at B4, B8 and B13 each; 41 hours at B3.
9/5/2008	Pumphouses B1, B13 and B3; Single phase power outage to the pumphouses; Contact Xcel energy and they replace a fuse on the power pole between pumphouses B2 and B3; Restart the pumps and normal operation observed. Down time: 15 hours at each well.

Pumphouse SC1

10/4/2007	Pumphouses B9 and SC1; Electrical storm blew a fuse in the output card at B11 which shut down the communications to SC1 and short circuited the I/O adapter card at B9; Replaced the fuse in the output card at B11 and restarted SC1 normally; Replaced the I/O card at B9 but the pump would only run for 1 minute and then shut down; Troubleshooting narrowed it down to a faulty I/O card; Replaced it with a new one and observed normal operation. Down time: B9 for 7 hours and SC1 for 6 hours.
10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
11/21/2007	Pumphouse SC1; Disassembled and performed maintenance on cold water flow meter. Down time: None.

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12/19/2007	Treatment System; Well field is cycling because pump 4 is off; Laughlin Electric on site to troubleshoot; Likely a power surge tripped the starter at the motor control center when Xcel Energy reconnected their connecting wires; Reset starter and pump 4 restarted normally. Down time: 7 hours at B1; 11 hours at B3; 2 hours at B4 and B5; 8 hours at B6; 4 hours at B8 and 9 hours at B11 and SC1.
12/23/2007	Treatment System; B11 and SC1 lights are off on PLC; Well field is cycling due to ECV 2 not opening fully; Adjusted open speed control valve but valve still does not open smoothly; Change out relief pilot and operating solenoid valve; Cycled valve and observed normal operation. Down time: 7 hours at B6; 9 hours at B11; 2 hours at SC1.
3/6/2008	Pumphouse SC1; Xcel Energy and Laughlin Electric on site to reattach overhead power to adjacent corner of Bldg 960 and install new service meter. Down time: None.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
6/19-20/2008	Pumphouse SC1; Laughlin Electric on site; Upgraded wiring in well head and control panel. Down time: 21.5 hours.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.
7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.

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7/14/2008 Pumphouses B11 and SC1; The pumps operate in "Hand" but not "Auto"; The green light is flashing on the I/O adapter module in the B11 control panel; Reset power to pumphouse B11 and the green light illuminates steady as it should; Turn the switches to Auto and the pumps restart normally.
Down time: None-downtime already accounted for from item 8 (lightning storm) above.

Pumphouse SC2

10/15/2007 Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat.
Down time: None.

10/19/2007 Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116.
Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.

12/7/2007 Treatment System; Call from Time Communications, "Power is off at Building 116"; Contact Xcel energy and they arrive on site to restore power; Power restored at 16:15.
Down time : 1 hour at B6 and 4 hours at SC2.

1/28/2008 Pumphouse SC2; Flow meter will not total the flow; Replaced flow meter with new from stock; New totalizer in at 00001500 gallons.
Down time: None

4/14-15/2008 Laughlin performs annual electrical inspection work.
Down time: None.

4/15/2008 Pumphouse SC2; Flow meter does not total; Remove flow meter and flush the forcemain, pump and riser pipe; Re-install the flow meter and the flow meter totals, but very slowly.
Down time: None.

5/12-22/2008 Pumphouse SC2; Remove and clean lift system; Redevelop well with acid; Reinstall lift system with new pump and motor and restart pump.
Down time: 239 hours.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

6/29-30/2008	Pumphouse SC2; The gate valve closed slightly causing a decrease in flow rate; Re-opened the gate valve to the proper flow rate. Down time: 7 hours.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.
7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
7/23/2008	Pumphouses SC2 and SC5; Power outage; Xcel Energy contacted and on site; They reset a tripped breaker at the the Lind Road power station. Down time: 21 hours at SC5.

Pumphouse SC4

1/17/2008	Pumphouse SC4; Heater does not put out heat; Laughlin contacted, new heater purchased and installed. All normal. Down time: None.

Pumphouse SC5

10/15/2007	Prepare pumphouses for winter; Install insulation in door vents and electric fan vents and turn on electric heat. Down time: None.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
10/29/2007	Pumphouse SC5; Laughlin Electric on site to repair lights in pumphouse. Down time: None.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
4/22/2008	Pumphouse SC5; Light flashing on PLC in Building 116; Reset PLC and light stops flashing; Pump restarted normally. Down time: 10 hours.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.
7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/7/2008	Pumphouse SC5; ECV will not respond to pilot adjustment; Remove, clean and reinstall pilot and piping; Pilot operates normally. Down time: None.
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
7/14/2008	Pumphouses B8, B9 and SC5; Adjusted the flow rates to their respective target flow rates. Down time: None.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

7/23/2008	Pumphouses SC2 and SC5; Power outage; Xcel Energy contacted and on site; They reset a tripped breaker at the the Lind Road power station. Down time: 21 hours at SC5.
8/28-31/2008	Pumphouses B1, B13, B3, B4, B8, B9, B11 and SC5; Lightning storm knocked out power to the pumphouses; Xcel Energy and Laughlin Electric contacted and responded replacing the meter and fusible switch; The I/O adapter modules were blown at B1, B8, B9 and B13; The input module, output module and DLP were blown in B4. Down time: 16 hours at B1, B9, B11 and SC5 each; 31 hours at B4, B8 and B13 each; 41 hours at B3.

TREATMENT SYSTEM

10/8/2007	Treatment System: Laughlin Electric installed new heaters in the three control cabinets in Building 116. Down time: None.
10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.
11/12/2007	Building 116; Wrapped insulation around the pipe that stems off the influent pipe into Building 116. Down time: None.
11/20/2007	Treatment System; Reinstalled demister pads; performed maintenance on zerks fitting at pump 1; Changed oil at pump 4; Insulated door vents; Glazed edge of window in Building 116. Down time: 1.5 hours each at B1, B13, B3, B4 and B6.
11/28/2007	Treatment System; Call out from Time Communications-TGRS Fail; ECV3 would not open on command; Change filters, flush control piping, change out solenoid valve body and restart pump; Normal valve opening operation observed. Down time: None.
12/7/2007	Treatment System; Call from Time Communications, "Power is off at Building 116"; Contact Xcel energy and they arrive on site to restore power; Power restored at 16:15. Down time : 1 hour at B6 and 4 hours at SC2.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

12/18/2007	Treatment System and Well Field; Power outage due to worn power lines at the substation near Lind Road; Xcel Energy on site to restore power. Down time: 3 hours at B1, B3, B5, B6, B8 and B9.
12/18/2007	Treatment system; Installed a cellular phone and connected it to the autodialer on site. Down time: None.
12/19/2007	Treatment System; Well field is cycling because pump 4 is off; Laughlin Electric on site to troubleshoot; Likely a power surge tripped the starter at the motor control center when Xcel Energy reconnected their connecting wires; Reset starter and pump 4 restarted normally. Down time: 7 hours at B1; 11 hours at B3; 2 hours at B4 and B5; 8 hours at B6; 4 hours at B8 and 9 hours at B11 and SC1.
12/19/2007	Treatment System; Power surge to Building 116 blew the transformers in the three 5KW electric heaters; Laughlin electric on site to troubleshoot. Down time: None.
12/20/2007	Treatment System; Turned off pump 3 and removed a layer of packing from the gland shaft; Greased and replaced the layer with a new layer of packing. Down time: None.
12/20/2007	Treatment System; Created a fault at ECV 3 to test the cellular phone service with the autodialer; The autodialer called Time Communications and reported the alarm condition. Down time: None.
12/21/2007	Treatment System; Call from Time Communications "TGRS FAIL"; ECV 4 failed to open; Changed out operating solenoid valve, cycled valve and observed normal operation. Down time: None.
12/23/2007	Treatment System; B11 and SC1 lights are off on PLC; Well field is cycling due to ECV 2 not opening fully; Adjusted open speed control valve but valve still does not open smoothly; Change out relief pilot and operating solenoid valve; Cycled valve and observed normal operation. Down time: 7 hours at B6; 9 hours at B11; 2 hours at SC1.
12/25/2007	Treatment System and Well Field; The daily inspection was not performed due to the Christmas Day holiday. Down time: None.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

12/27/2007	Treatment Center; Laughlin Electric on site to install new transformers in each 5000 watt electric heater in the treatment center; Additional troubleshooting indicates the electrical surge blew out the contactors in each heater; New contactors have been ordered. Down time: None.
1/9/2008	Treatment Center; Laughlin Electric on site to install new contactors in the three 5000 watt heaters. Down time: None.
1/13/2008	Treatment System; Call from Time Communication-TGRS Fail; PDU 2 failed to open; Adjusted valves, flushed control piping and cycled valve; Normal operation observed. Down time: 2 hours at B1, B5, B6 and B8.
3/6/2008	Treatment System; Installed new gland packing in pump 1 gland shaft. Down time: B6 for 1 hour.
3/7/2008	Treatment System; ECV 3 failed to open on command; Flushed control piping, exercised opening and closing speed control valves and changed out pilot; Cycled valve three times; Normal operation observed. Down time: None.
3/13/2008	Treatment System; ECV 2 will not close properly; Flush control piping, change filter, adjust opening and closing speed control valves and change out solenoid valve; Cycled valve and valve closed properly. Down time: None.
4/9/2008	Building 116; Autodialer will not call out; Contact AT&T to discuss; Reset performed on the cellular phone line; Normal operation resumes. Down time: None.
4/14-15/2008	Laughlin performs annual electrical inspection work. Down time: None.
6/6/2008	Treatment System; Replaced blower belt at blower #2. Down time: None.
7/4/2008	Treatment System and Well Field; Independence Day, No daily inspection performed. Down time: None.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

7/5-6/2008	Treatment System and Well Field; Call from Time Communications-Power outage; Upon arrival, there is no power to Building 116 or the pumphouses; Fire department on site at the electrical substation across from Building 101; Apparently a transformer blew causing a power outage and a grass fire; Xcel Energy contacted and on site to make the necessary repairs. Down time: 33 hours at B1, B13, B5, B8 and SC1; 30 hours at B3, B4, B6, B9 and B11; 25.5 hours at SC2 and SC5.
7/11/2008	Treatment System; Opened ECV 3 and performed an inspection of the cylinder, the seals and the inside of the valve; One of the brass columns inside the valve has buckled outward rendering the valve unrepairable; Schedule replacement of ECV 3; Turned off B3, B8, B9 and B11 to minimize well field cycling. Down time: 3 hours at B3 and B11; 7 hours at B8; 8.5 hours at B9.
7/11/2008	Treatment System; Replaced the valve seals at ECV 4. Down time: None-downtime already accounted for from item 6 (ECV 3 inspection)
7/12-14/2008	Treatment System and Well Field; Lightning storm knocked out power to Building 116 and the well field. Down time: 15.5 hours at B1, B13, B5, B6, SC1 and SC5; 19.5 hours at B9; 65 hours at B4 and SC1; 70 hours at B8 and B11.
8/4/2008	Treatment System; Changed out the emergency solenoid at ECV 4. Down time: None.
8/14-15/2008	Treatment System; Replaced ECV 3 (10" angle valve) with new valve from inventory; Turned off B3, B8 and B9 to limit well field cycling. Down time: B3 for 28.5 hours; B8 and B9 for 34 hours each.
8/22/2008	Treatment System; Zeroed the pressure gauges for blowers 1, 2 and 3. Down time: None.
9/11/2008	Treatment System; The air release valve for pump 3 is leaking water while the pump is running; Installed a new air release valve and the new one operates normally. Down time: None.
9/12/2008	Treatment System; ECV 3 will not open or close properly; Installed a new check valve on the potable water line to ECVs 1 and 2, however additional troubleshooting is necessary. Down time: None.

APPENDIX F.3

MAINTENANCE ACTIVITIES BY LOCATION
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

9/30/2008	Treatment System; ECV 3 is not opening or closing properly; Perform troubleshooting work and install a check valve on the control piping; Normal operation observed. Down time: None.

FORCEMAIN

10/19/2007	Pumphouses B1, B13, B3, B4, B5, B6, B8, B9, B11, SC1, SC2 and SC5; Turned off the well field and treatment system to install a blind flange on a portion of the influent pipe in Building 116; Laughlin electric temporarily moves electric lines and installs heat tracing tape on another influent pipe in Building 116. Down time: 8 hours at B1, B13, B3, B4, B5, B6 and B8; 6 hours at B9 and SC5; 4 hours at B11; 2 hours at SC1 and 10 hours at SC2.

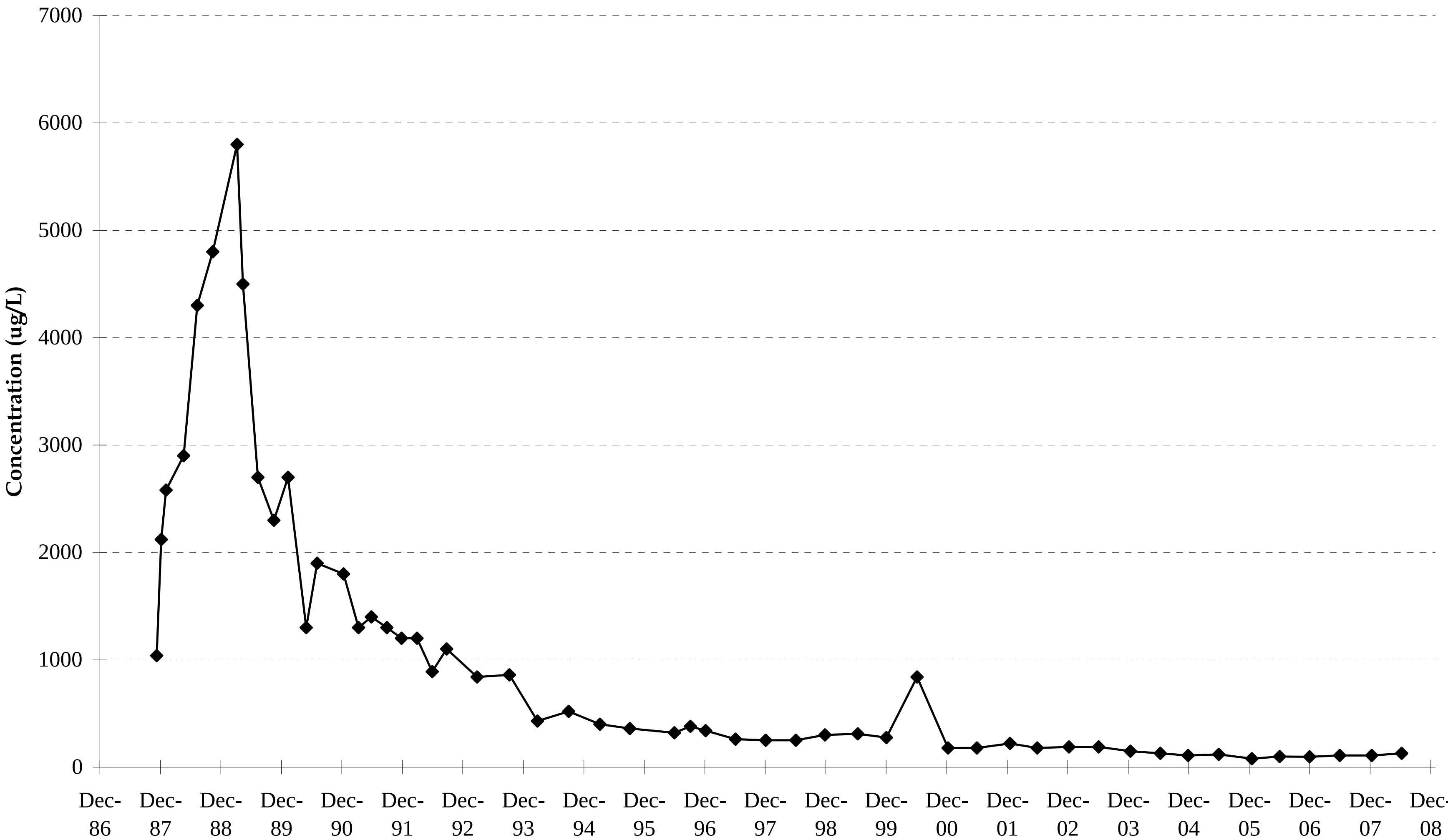
Appendix G

TGRS Chemical Data

G.1 TGRS Extraction Wells – TRCLE Versus Time

APPENDIX G-1

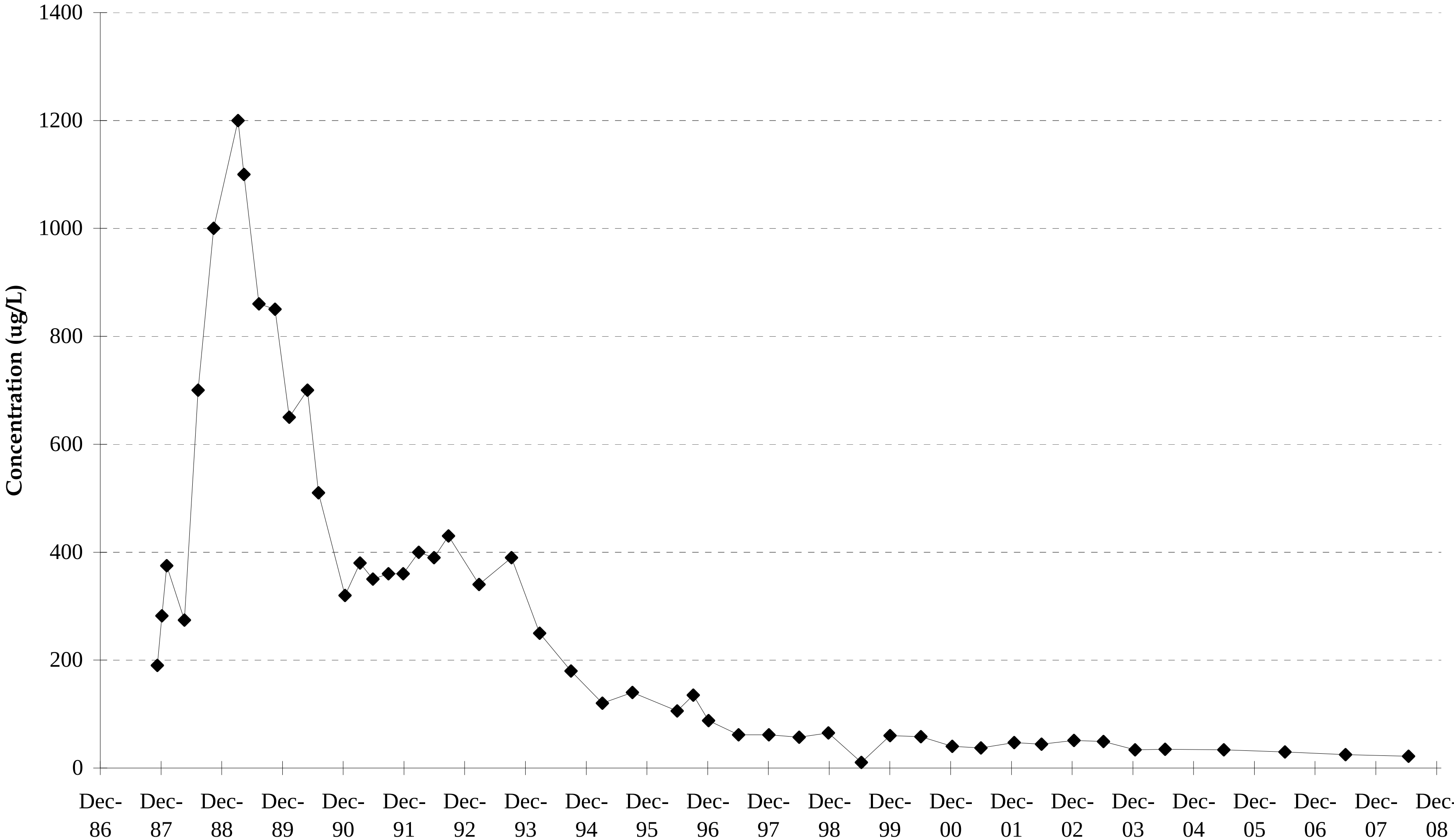
EXTRACTION WELL B1 - TRCLE VS.TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

APPENDIX G-1

EXTRACTION WELL B2 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

CRA 047533 (2)
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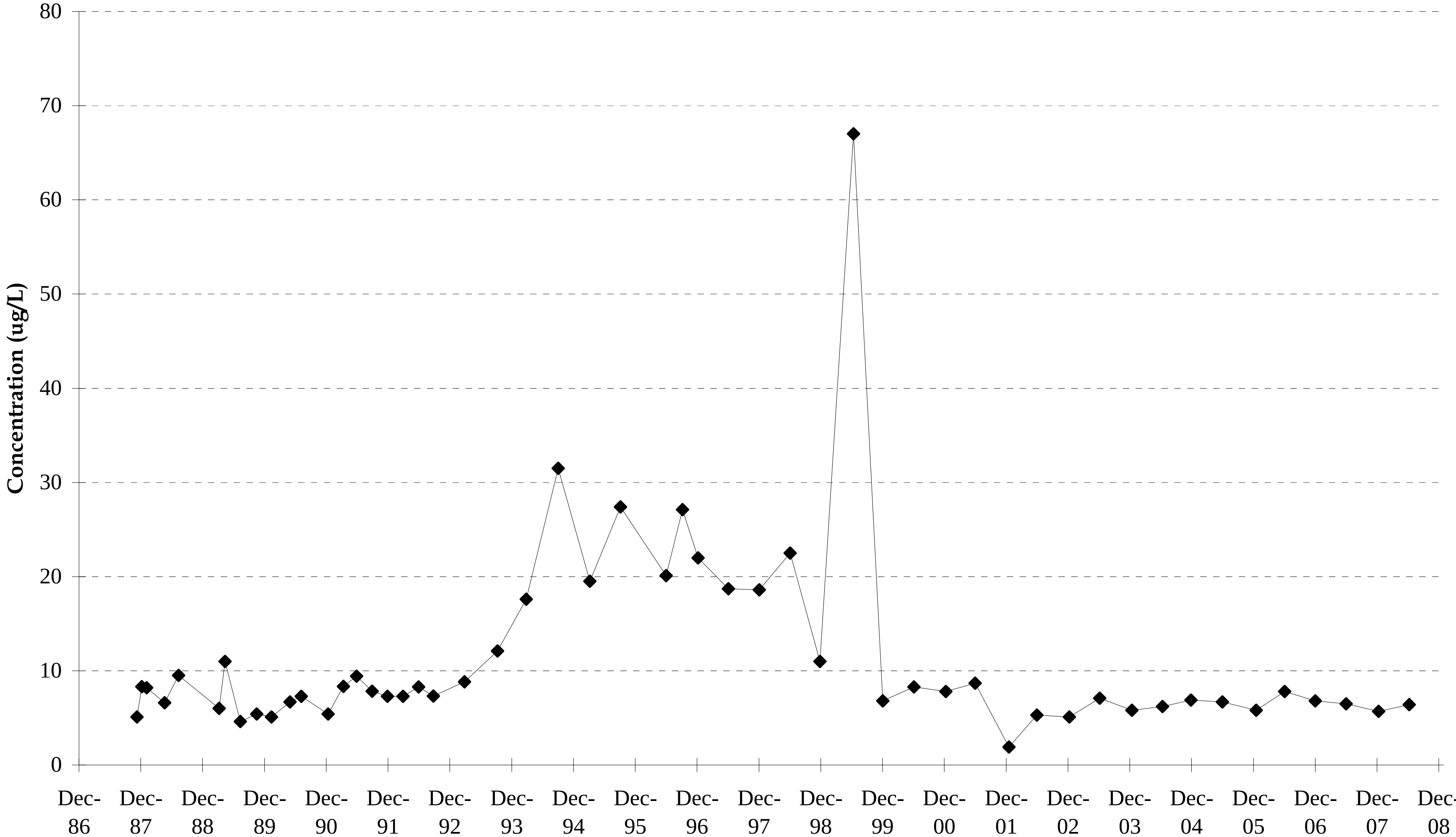
APPENDIX G-1

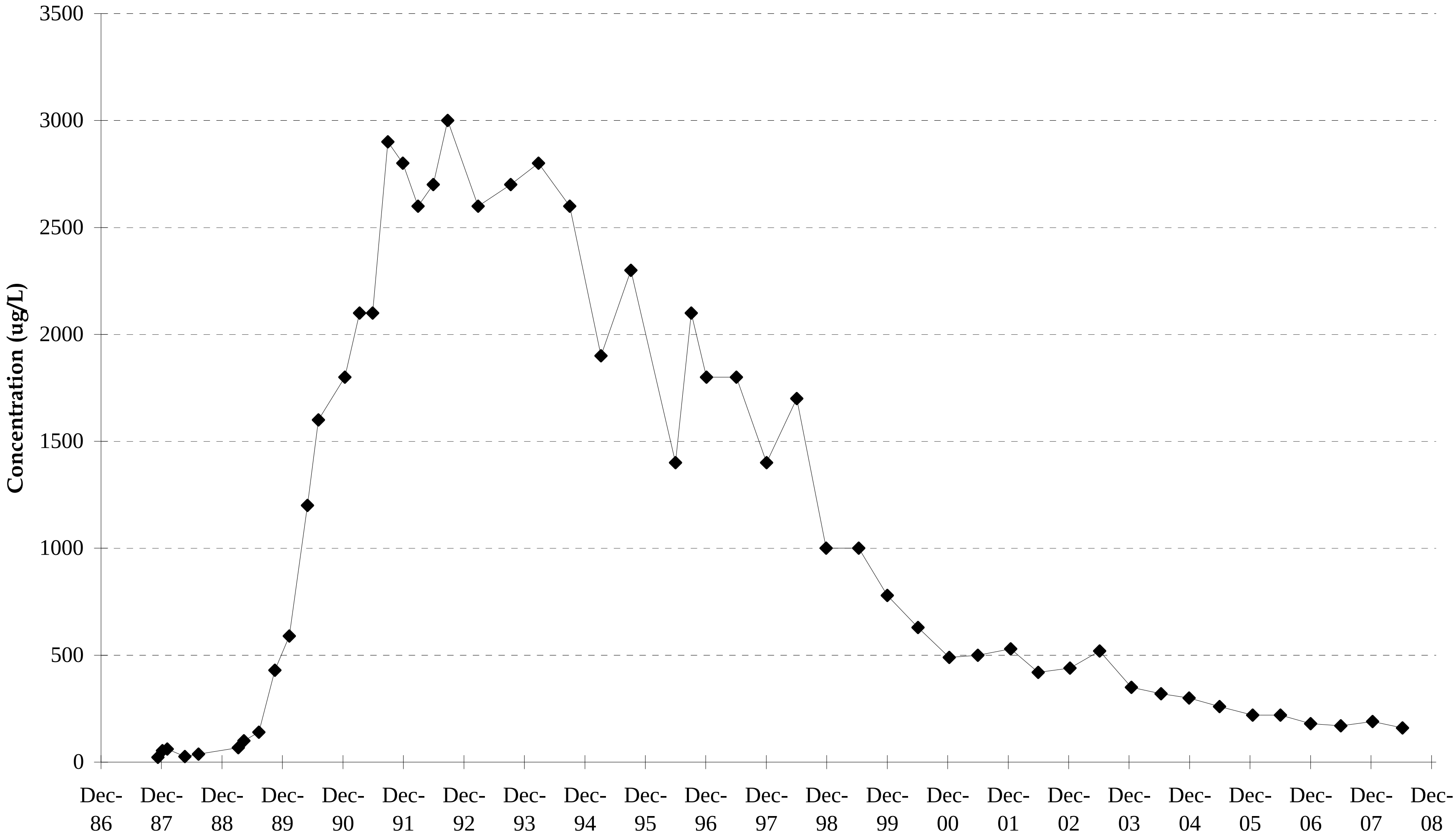
EXTRACTION WELL B3 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

APPENDIX G-1

EXTRACTION WELL B4 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

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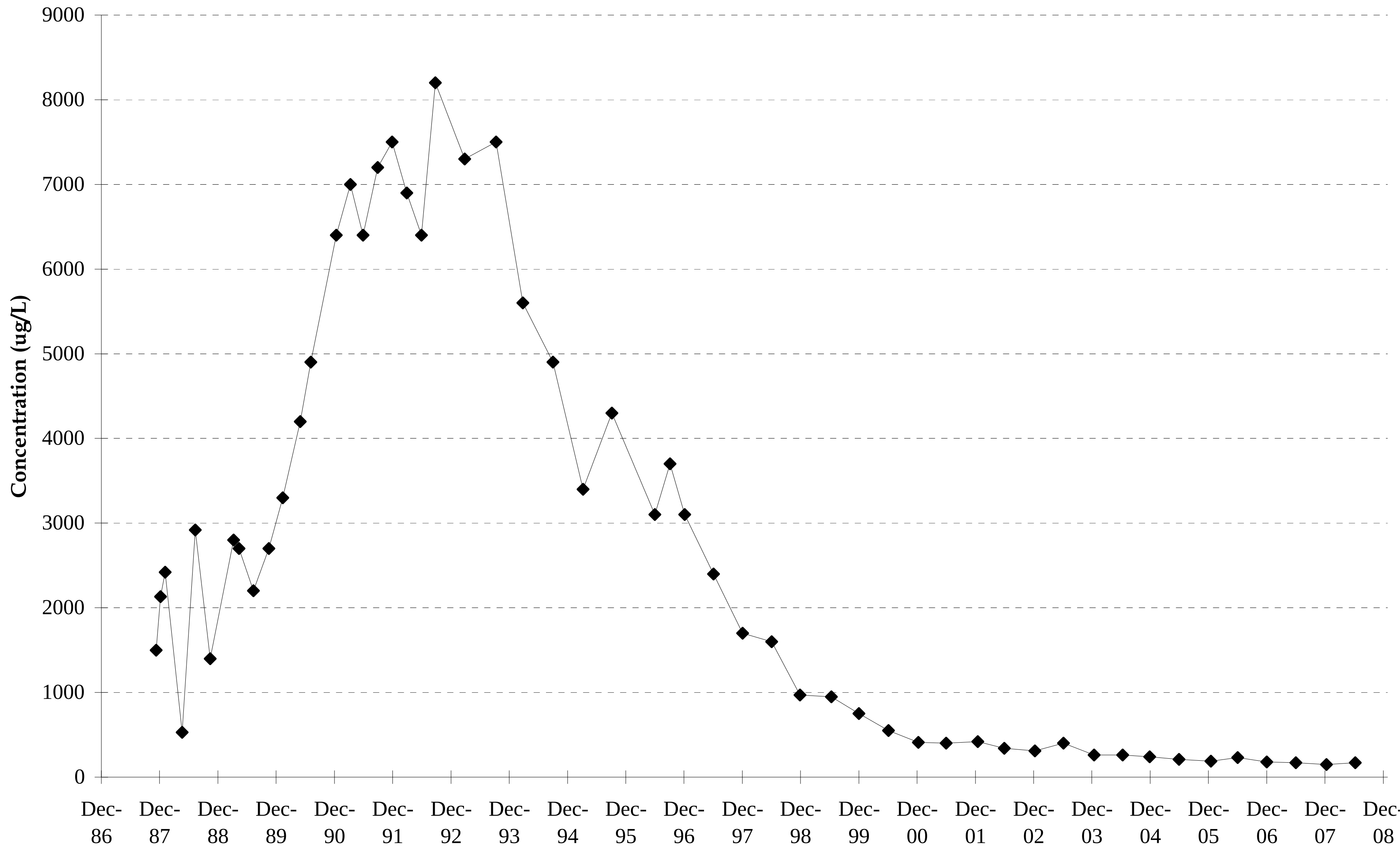
APPENDIX G-1

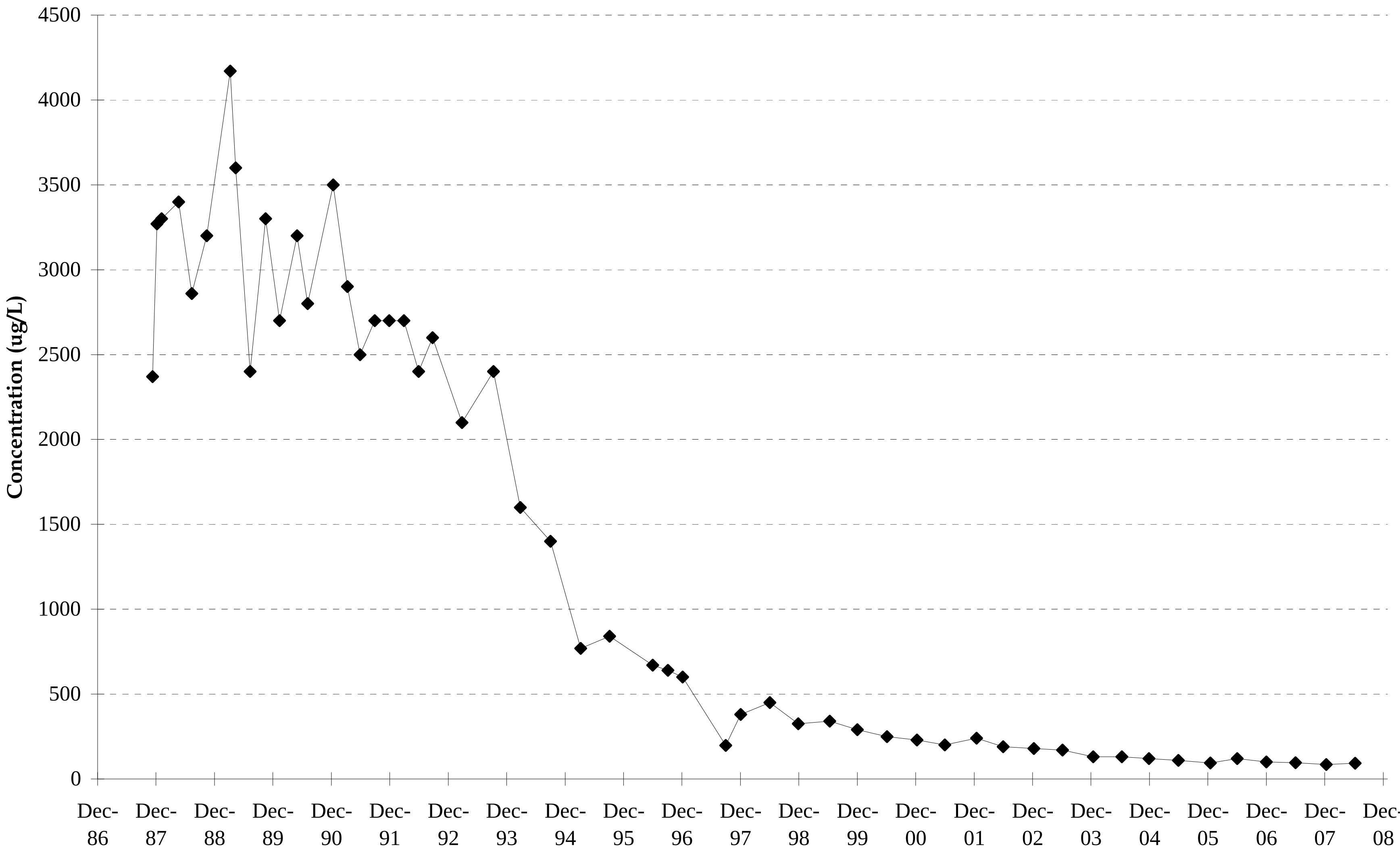
EXTRACTION WELL B5 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

APPENDIX G-1

EXTRACTION WELL B6 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

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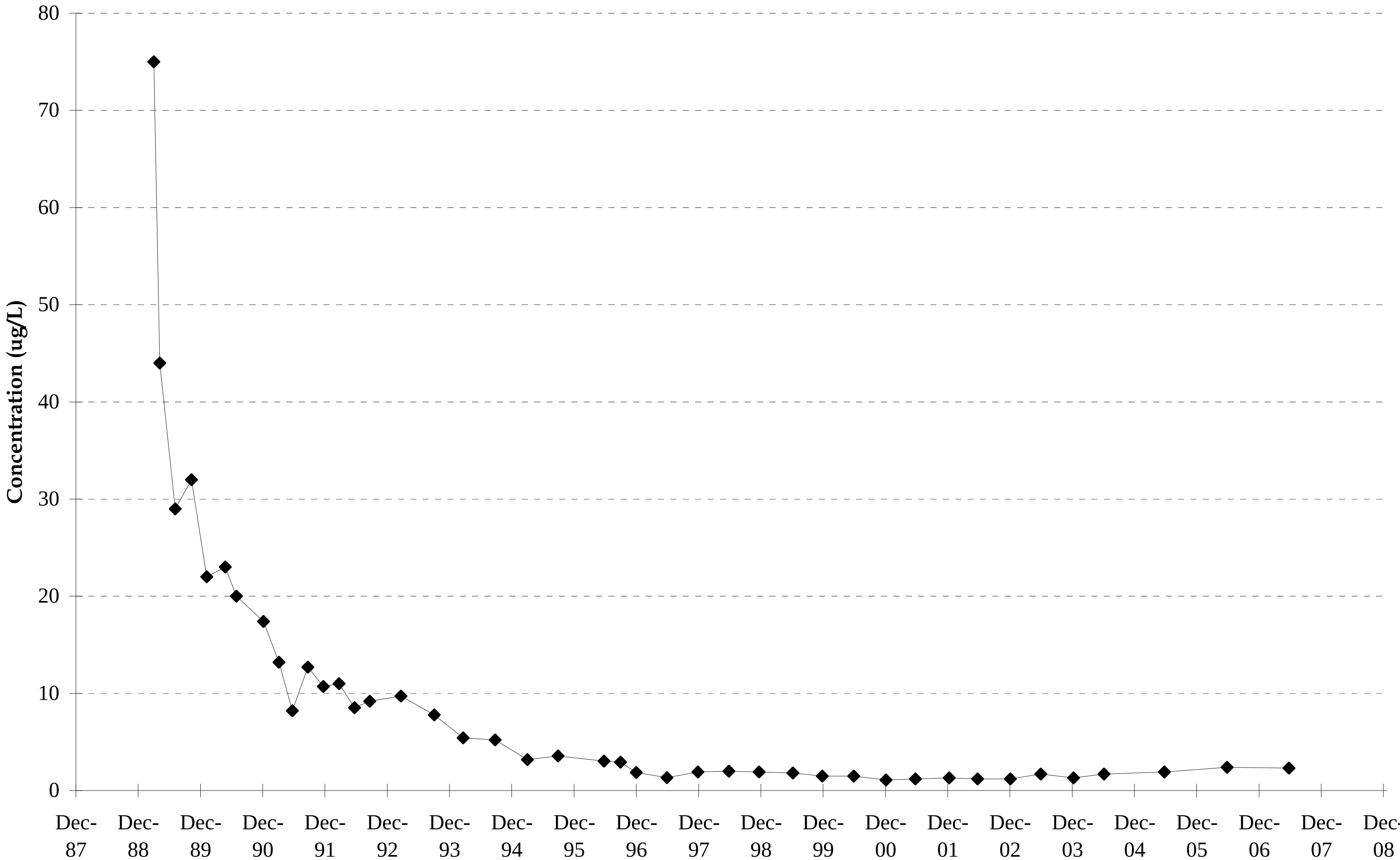
APPENDIX G-1

EXTRACTION WELL B7 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

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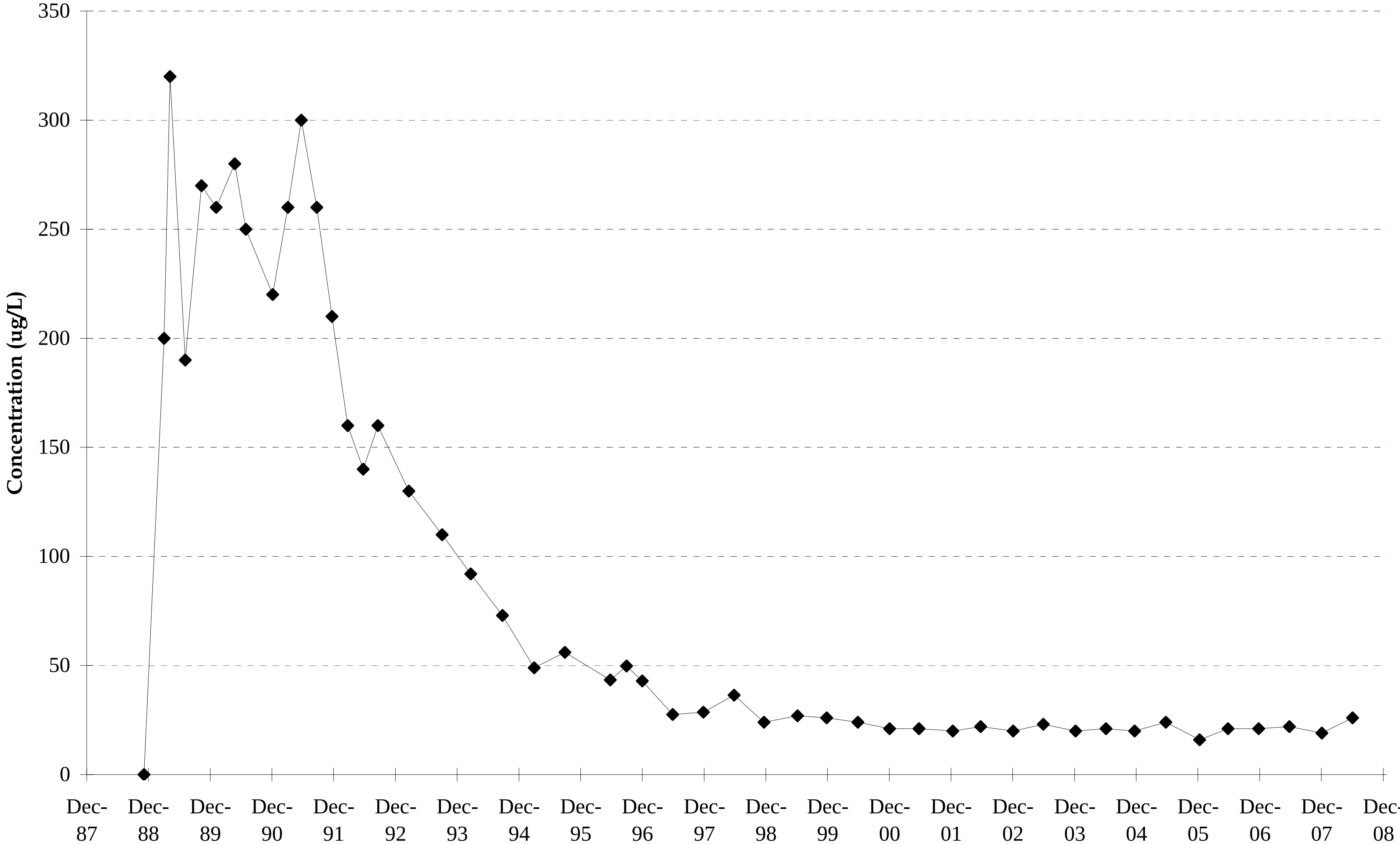
APPENDIX G-1

EXTRACTION WELL B8 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

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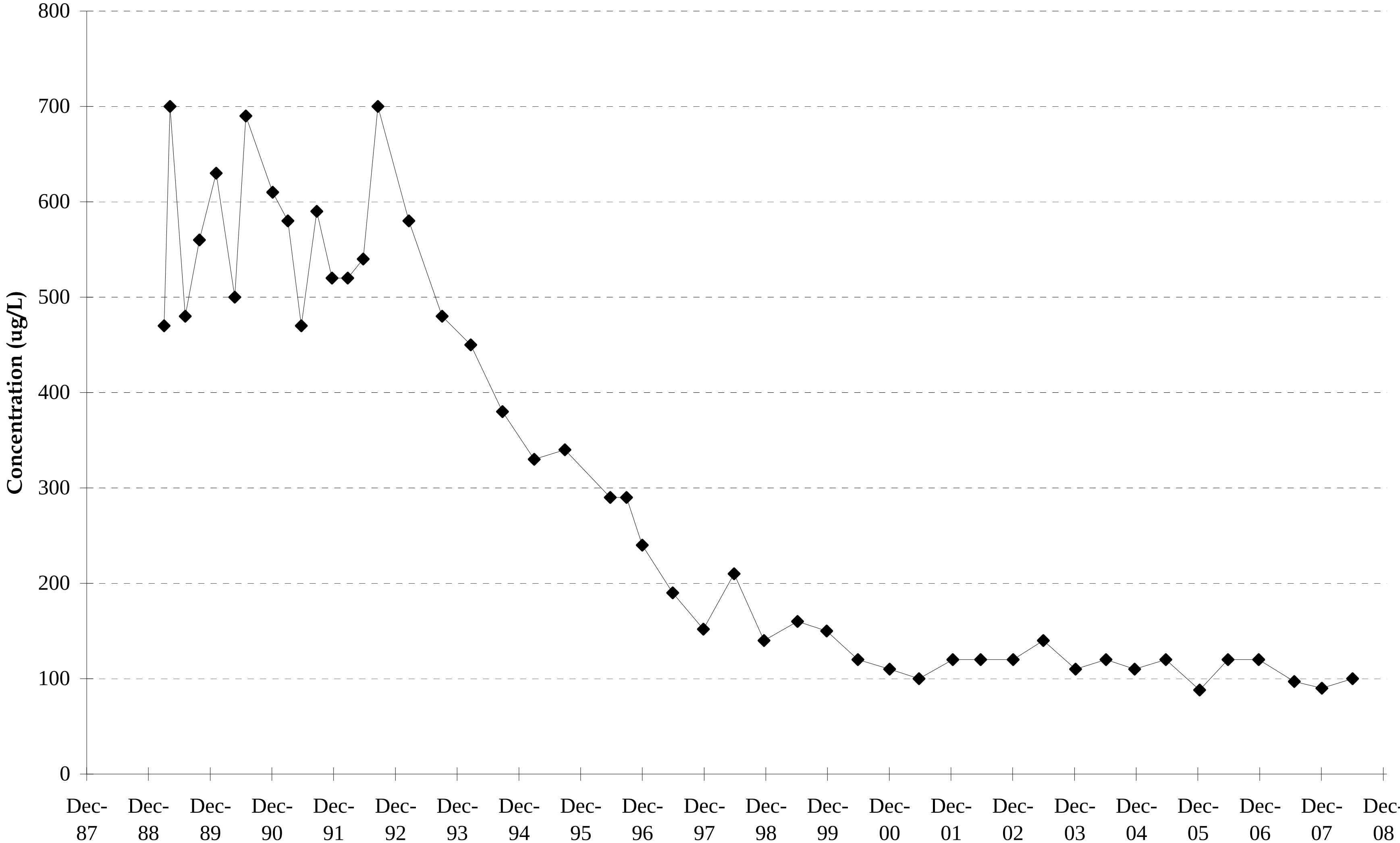
APPENDIX G-1

EXTRACTION WELL B9 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

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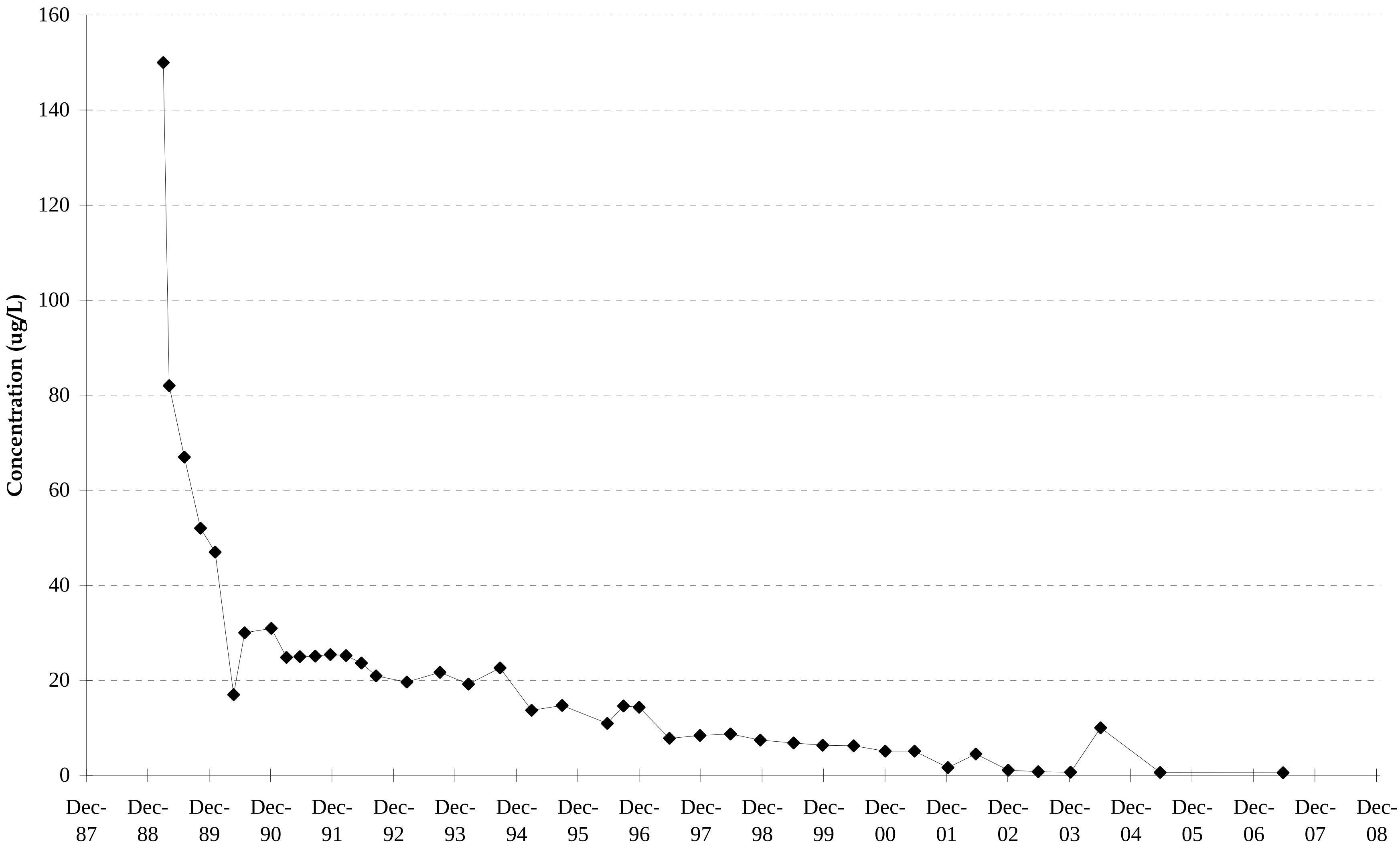
APPENDIX G-1

EXTRACTION WELL B10 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

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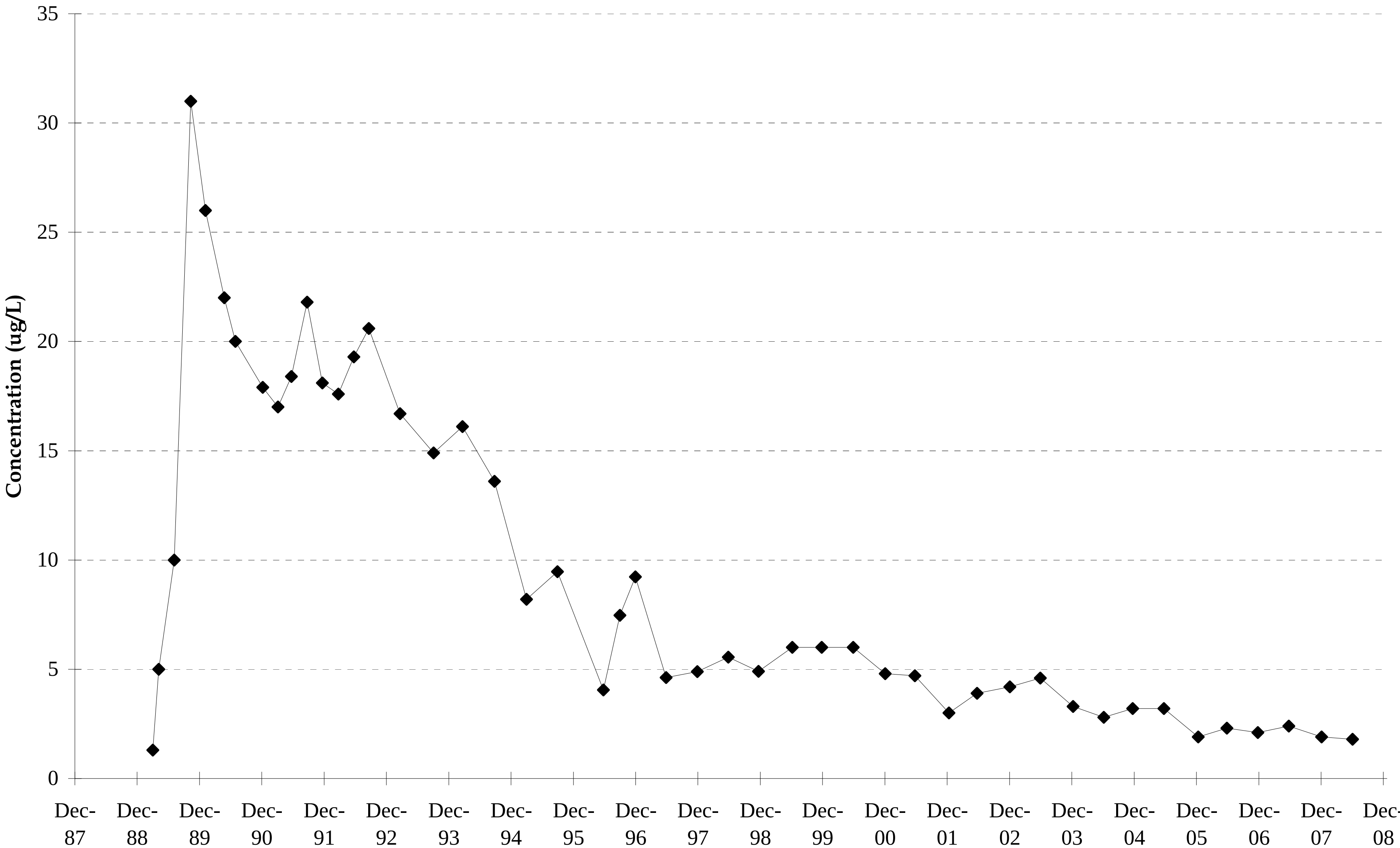
APPENDIX G-1

EXTRACTION WELL B11 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

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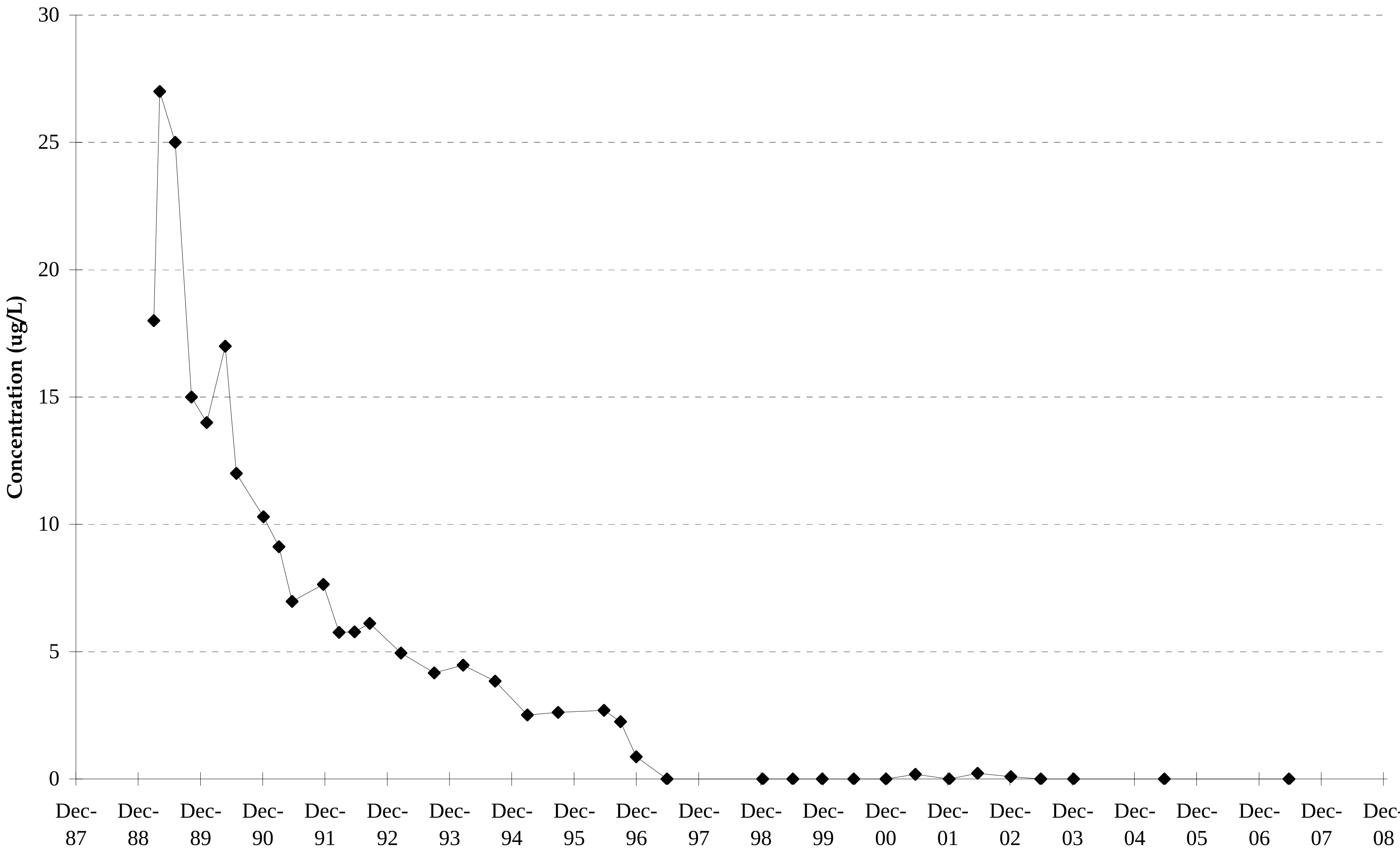
APPENDIX G-1

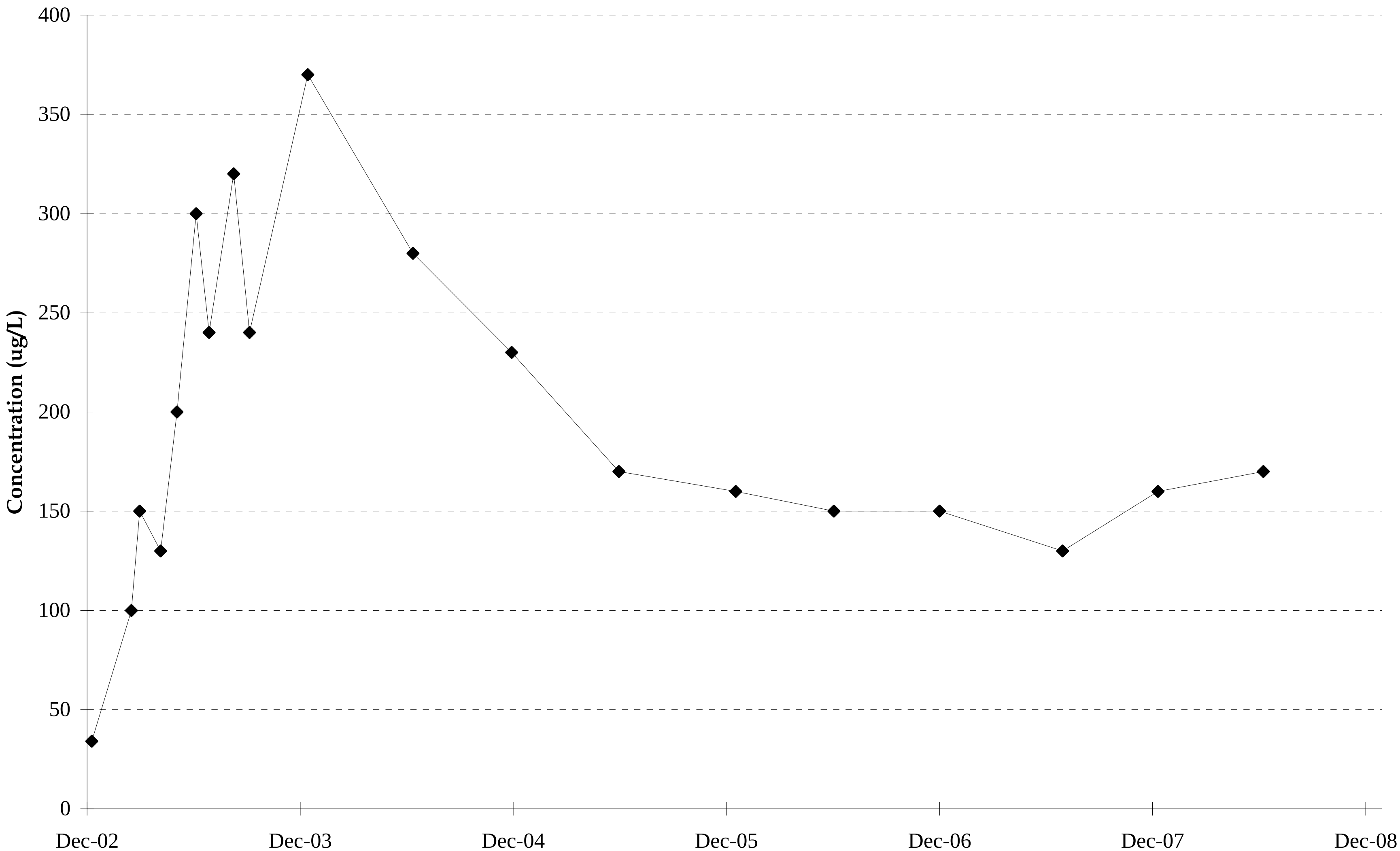
EXTRACTION WELL B12 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

APPENDIX G-1

EXTRACTION WELL B13 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

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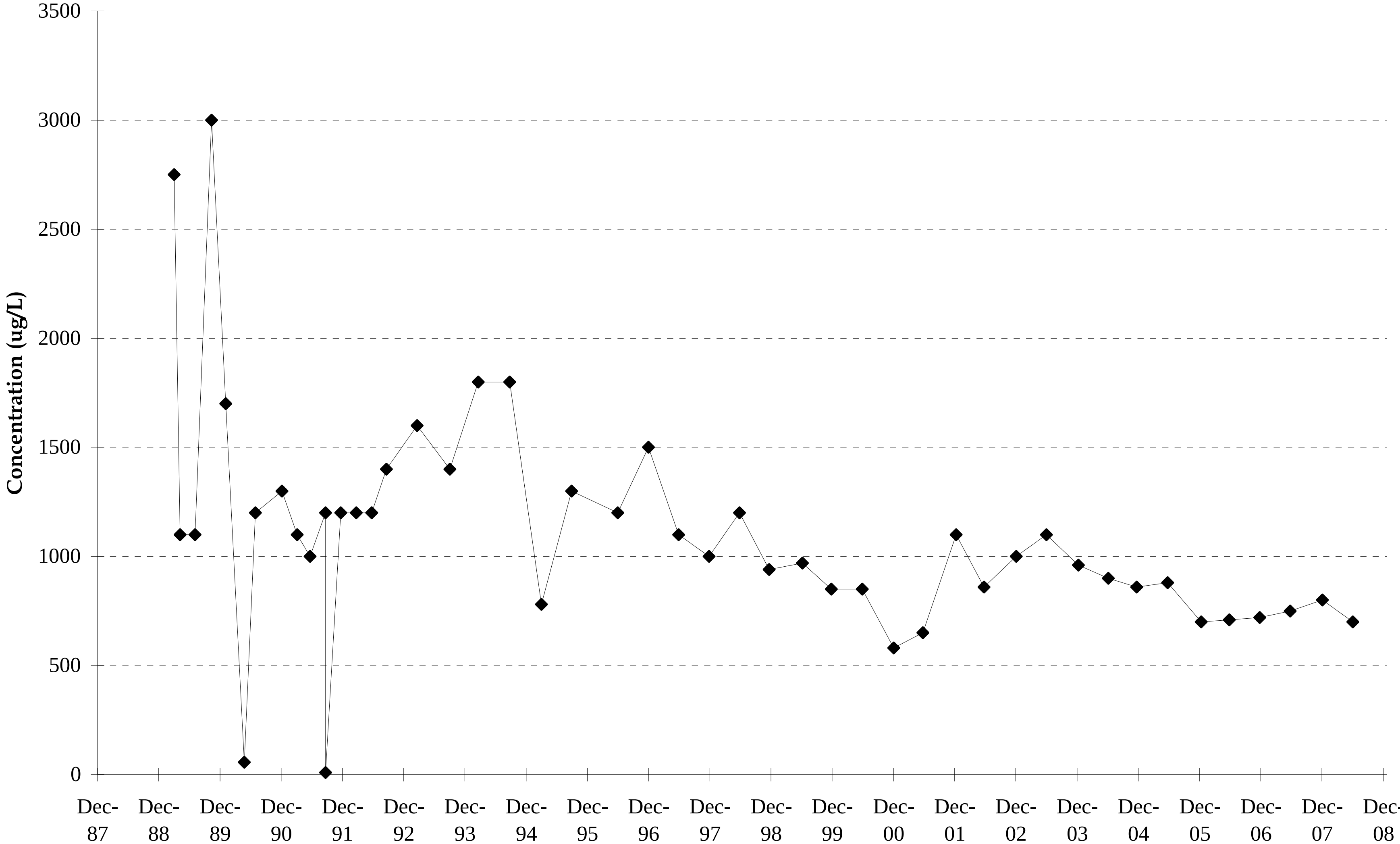
APPENDIX G-1

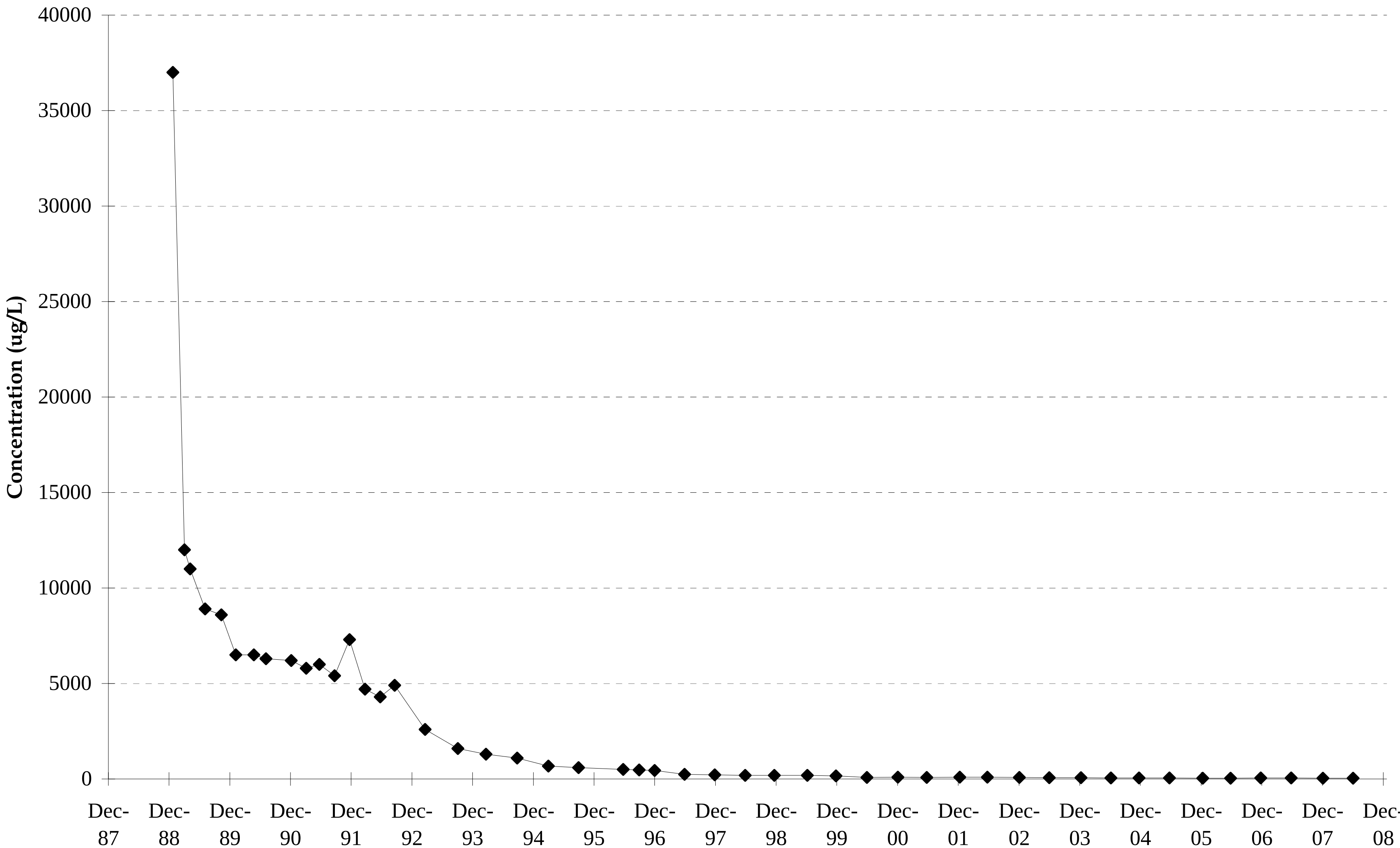
EXTRACTION WELL SC1 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

APPENDIX G-1

EXTRACTION WELL SC2 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

CRA 047533 (2)
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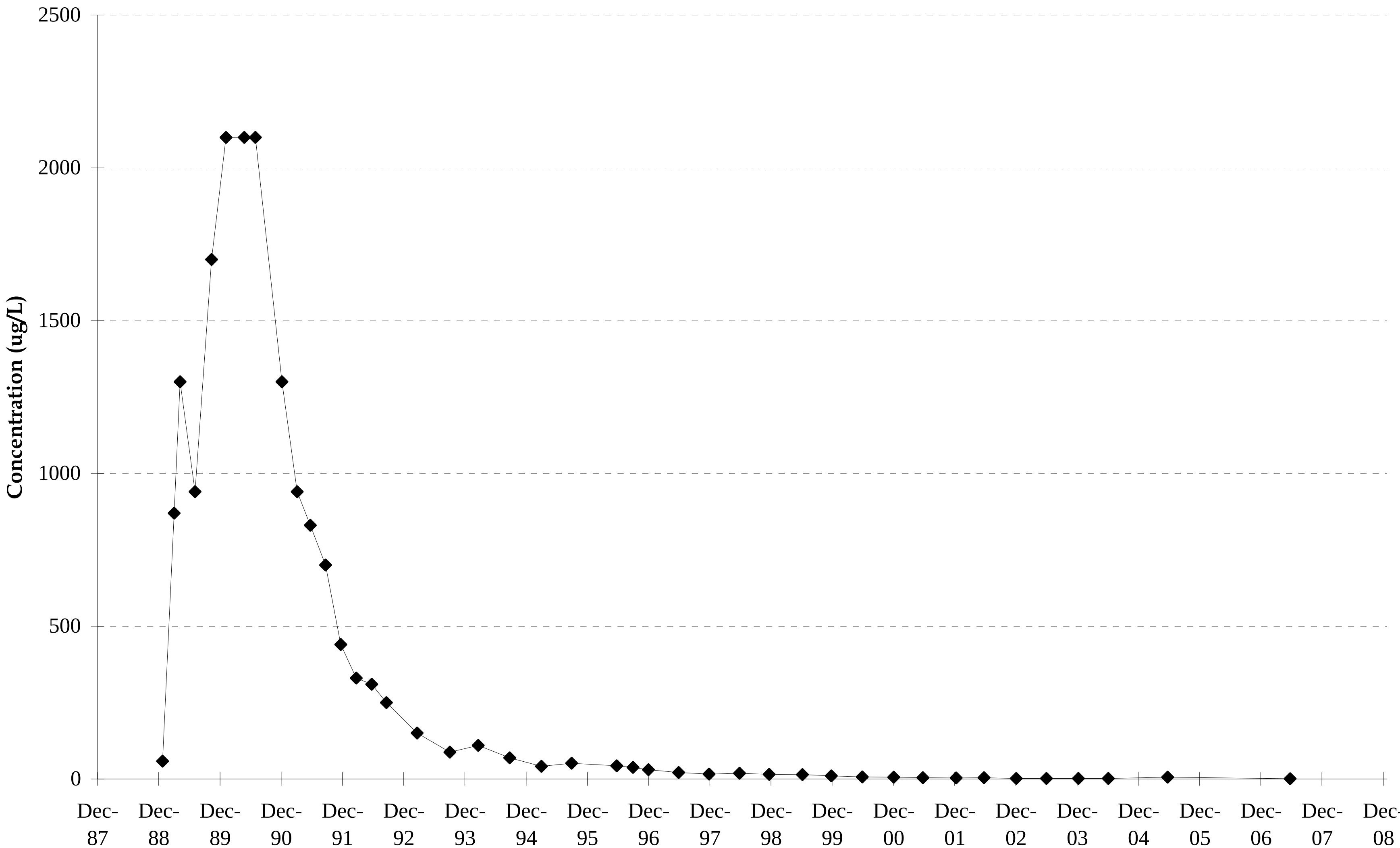
APPENDIX G-1

EXTRACTION WELL SC3 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

CRA 047533 (2)
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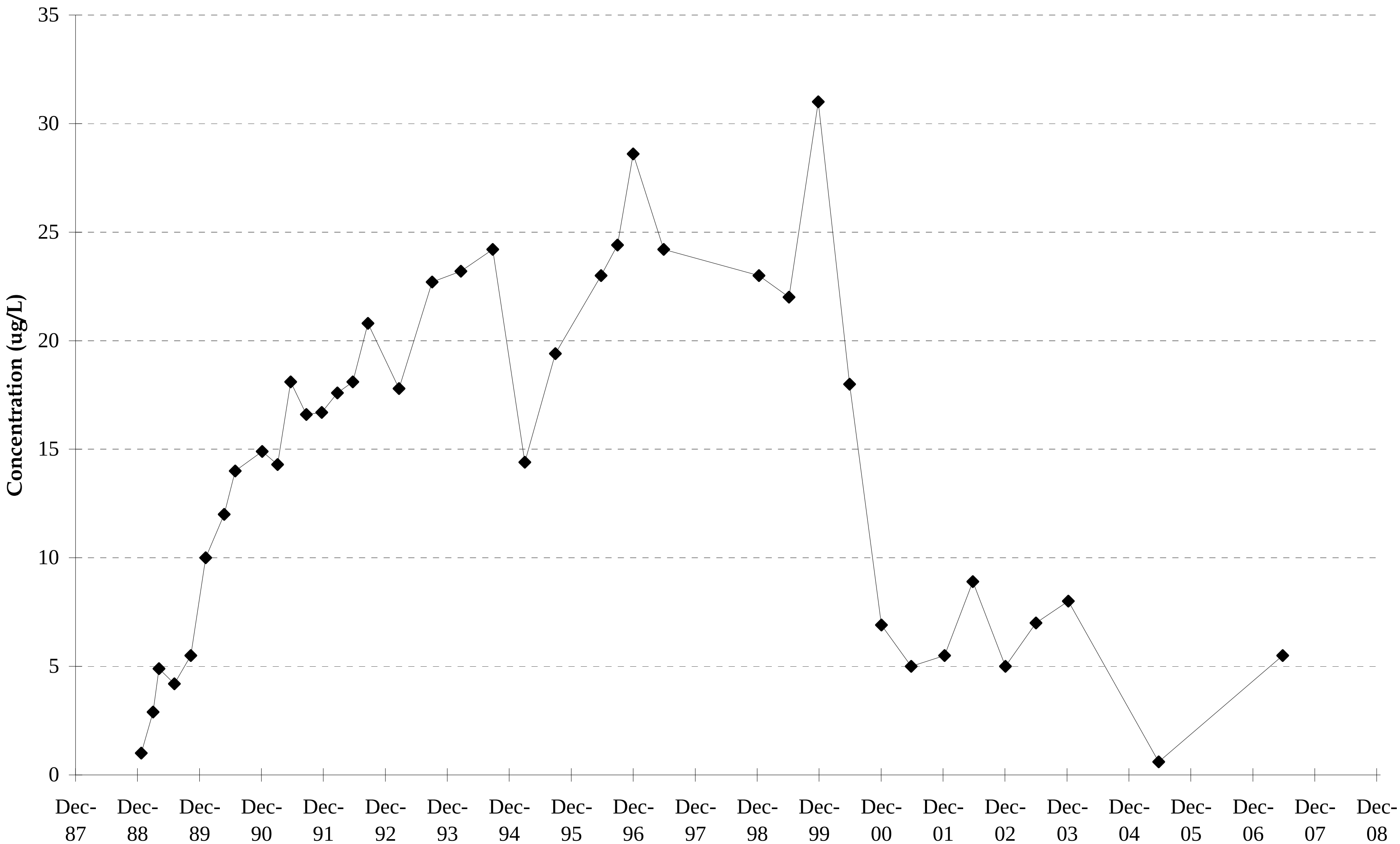
APPENDIX G-1

EXTRACTION WELL SC4 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

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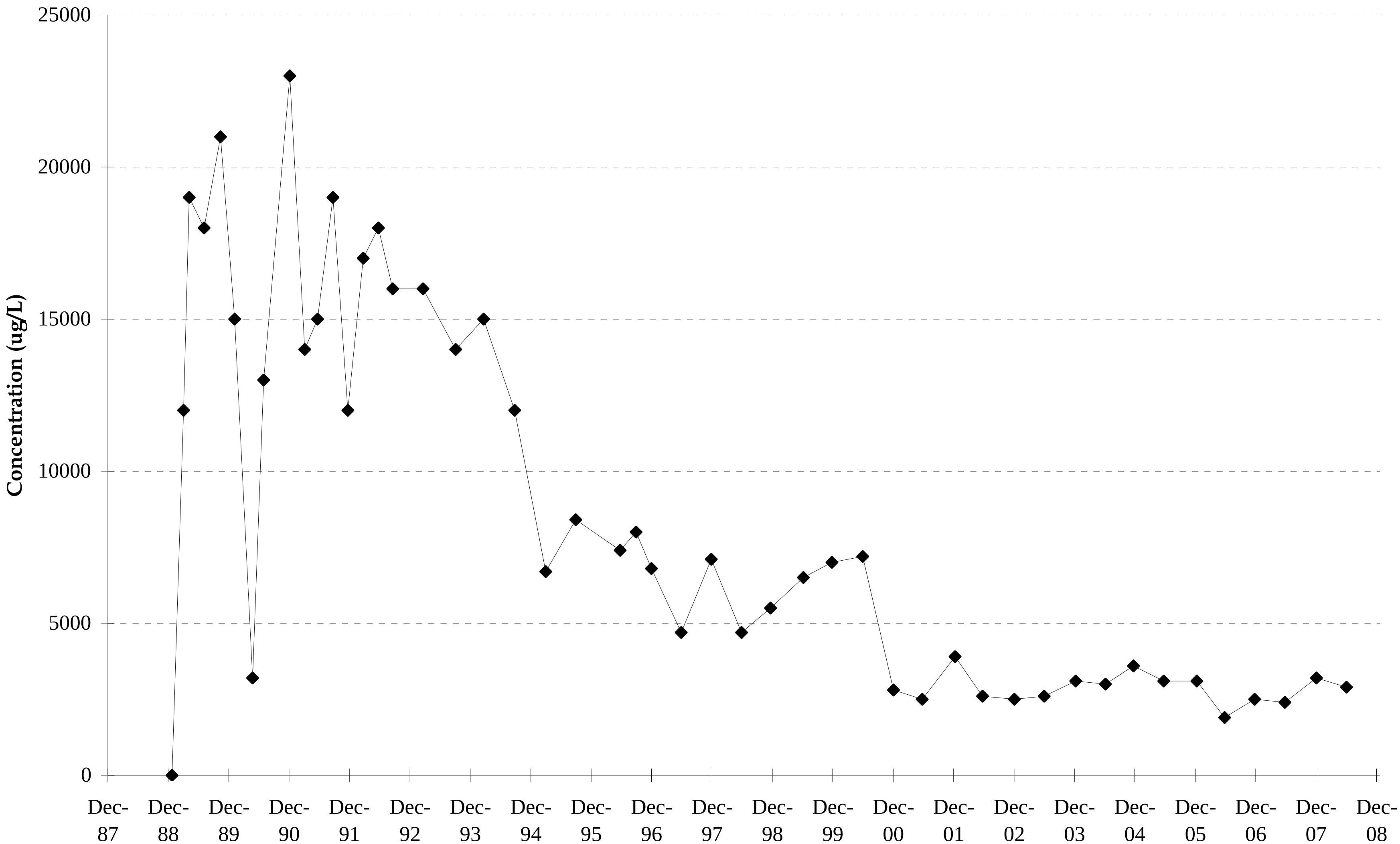
APPENDIX G-1

EXTRACTION WELL SC5 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as half the detection limit.

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G.2 Influent/Effluent Database, Fiscal Year 2008, TGRS, TCAAP

APPENDIX G-2

INFLUENT/EFFLUENT DATABASE (µg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

			1,1,1-Trichloroethane	*1,1,2-Trichloroethane*	*1,1-Dichloroethane*	*1,1-Dichloroethene*	*1,2-Dichloroethane*	*Carbon Tetrachloride*	*Chloroform*	*cis-1,2-Dichloroethene*	*Freon 113*	*Methylene Chloride*	*Tetrachloroethene*	
TGRS Cleanup Level [1]			**200**	**--**	**70**	**6**	**4**	**--**	**--**	**70**	**--**	**--**	**5**	
Location	*Date*													
TGRSE	10/4/07		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.2 UB 0.37	< 1	<
TGRSE	10/4/07	D	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	11/5/07		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1 UB 0.50	< 1	<
TGRSE	12/3/07		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	12/3/07	D	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	1/3/08		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	1/3/08	D	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	2/11/08		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	2/11/08	D	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	3/3/08		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	4/8/08		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	4/8/08	D	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	5/12/08		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	5/12/08	D	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	6/11/08		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1 JC 23.0	<
TGRSE	6/11/08	D	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1 JC 23.0	<
TGRSE	7/1/08		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	8/4/08		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	8/4/08	D	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	9/4/08		< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<
TGRSE	9/4/08	D	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	<

APPENDIX G-2

INFLUENT/EFFLUENT DATABASE (μg/L)
FISCAL YEAR 2008
TGRS, TCAAP
ARDEN HILLS, MINNESOTA

			1,1,1-Trichloroethane	*1,1,2-Trichloroethane*	*1,1-Dichloroethane*	*1,1-Dichloroethene*	*1,2-Dichloroethane*	*Carbon Tetrachloride*	*Chloroform*	*cis-1,2-Dichloroethene*	*Freon 113*	*Methylene Chloride*	*Tetrachloroethene*	
TGRS Cleanup Level [(1)]			***200***	***--***	***70***	***6***	***4***	***--***	***--***	***70***	***--***	***--***	***5***	
Location	***Date***													
TGRSI	10/4/07		51	< 1	4.7	5.1	< 1	< 1	< 1	3.3	0.54 JP	1.7	1.6	<
TGRSI	11/5/07		53	< 1	4.7	5.2	< 1	< 1	< 1	3.5	0.59 JP	< 1	1.4	<
TGRSI	11/5/07	D	50	< 1	4.7	4.9	< 1	< 1	< 1	3.3	0.63 JP	< 1	1.5	<
TGRSI	12/3/07		54	< 1	4.3	4.7	< 1	< 1	< 1	3.2	0.58 JP	< 1 UB 0.67	1.5	<
TGRSI	1/3/08		56	0.23 JP	4.9	6.2	< 1	< 1	< 1	3.6	0.92 JP	< 1	2.1	<
TGRSI	2/11/08		53	0.35 JP	4.5	5.1	< 1	< 1	< 1	3.4	0.62 JP	< 1	1.6	<
TGRSI	3/3/08		55	< 1	4.5	5	< 1	< 1	< 1	3.2	0.67 JP	< 1	1.4	<
TGRSI	3/3/08	D	57	< 1	4.5	5.2	< 1	< 1	< 1	3.2	0.6 JP	< 1	1.3	<
TGRSI	4/8/08		49	< 1	4.4	4.9	< 1	< 1	< 1	3.3	0.52 JP	< 1	1.4	<
TGRSI	5/12/08		45	0.25 JP	4.5	4.7	< 1	< 1	< 1	3.2	0.51 JP	< 1	1.4	<
TGRSI	6/11/08		48	< 1	5	6	< 1	< 1	< 1	3.5	0.67 JP	< 1	1.4 JC 23.0	<
TGRSI	7/1/08		47	< 1	4.7	6.1	< 1	< 1	< 1	3.6	0.86 JP	< 1	1.3	<
TGRSI	7/1/08	D	45	< 1	4.6	6.1	< 1	< 1	< 1	3.5	0.76 JP	< 1	1.3	<
TGRSI	8/4/08		37	< 1	4.3	4.4	< 1	< 1	< 1	3.5	0.54 JP	< 1	1.6	<
TGRSI	9/4/08		47	< 1	4.2	4.5	< 1	< 1	< 1	3.6	0.49 JP	< 1	1.9	<

Notes:
(1) Cleanup levels for TGRS are from the OU2 ROD.
D - Field Duplicate
JP - Result is qualified as estimated since the detection is below the laboratory quantitation limit.
JC- Result is qualified as estimated due to calibration verification % D outside the control limit.
UB - Result is qualified nondetect based on associated blank detection.

Appendix H

Operable Unit 3 Statistical Analysis

TABLE H.1

MAROS DECISION MATRIX

Kendall S	*Confidence*	*Coefficient of Varience*	*Trend*
S > 0	> 95%	NA	Definitely Increasing
S > 0	90-95%	NA	Probably Increasing
S > 0	< 90%	NA	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	NA	Probably Decreasing
S < 0	>95%	NA	Definitely Decreasing

TABLE H.2

CONFIDENCE VALUES FOR SIX DATA PAIRS

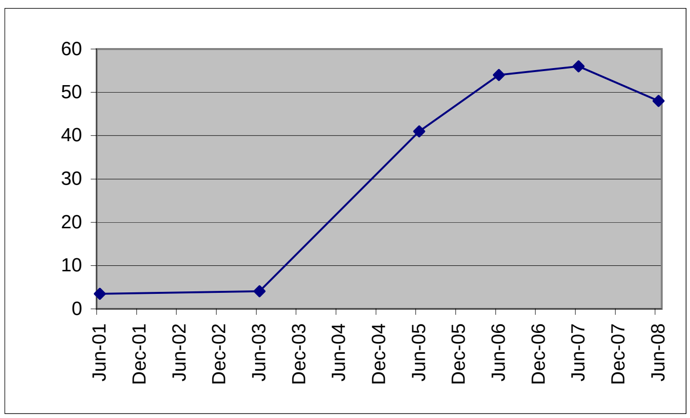
Kendall S	*Confidence*
1	50.00%
3	64.00%
5	76.50%
7	86.40%
9	93.20%
11	97.20%
13	99.17%
15	99.86%

WELL 04U832
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2008

Date	TCE (ug/l)	Mann-Kendall Calculation:					
6/14/2001	**3.50**	1					
Jun-03	**4.10**	1	1				
6/23/2005	**41**	1	1	1			
6/13/2006	**54**	1	1	1	1		
6/22/2007	**56**	1	1	1	1	1	
6/17/2008	**48**	1	1	1	1	-1	-1

N		6	5	4	3	2	1	0		15
	sum		5	4	3	0	-1	0	Kendall S	11
Possibles		15								
									Kendall tau	0.733333

Mean	34.43
STNDEV	24.29869681
COV	0.705673673
Trend:	Positive
Confidence (lookup)	97.20%



Raw Data 04U832	Date	TCE
	11/24/1987	**100.00**
	12/16/1988	**65.00**
	4/25/1990	**69.53**
	3/19/1991	**47.60**
	3/25/1992	**52.50**
	3/16/1993	42.00
	3/16/1993	**45.90**
	6/10/1994	49.00
	9/13/1994	**49.50**
	12/7/1994	43.30
	12/7/1994	47.10
	3/10/1995	**56.00**
	6/3/1996	**41.00**
	6/4/1997	**35.20**
	6/25/1998	**36.40**
	6/7/1999	**29.00**
	6/14/2001	**3.50**
	Jun-03	**4.10**
	6/23/2005	**41**
	6/13/2006	**54**
	6/22/2007	**56**
	6/17/2008	**48**

WELL 04U845
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2007

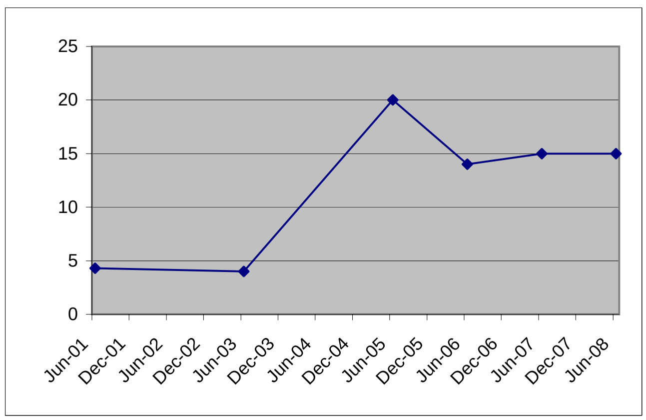
Date	TCE (ug/l)	Mann-Kendall Calculation:					
6/13/2001	**4.30**	1					
6/1/2003	**4.00**	1	-1				
6/22/2005	**20**	1	1	1			
6/13/2006	**14**	1	1	1	-1		
6/22/2007	**15**	1	1	1	-1	1	
6/17/2008	**15**	1	1	1	-1	1	0

N		6	5	4	3	2	1		15
	sum		3	4	-3	2	0	Kendall S	6
Possibles		15							
								Kendall tau	0.4

Mean	12.05
STNDEV	6.46954403
COV	0.53689162

Trend: Positive

Confidence (lookup) 81.00%



Raw Data	Date	TCE
04U845		
	12/1/1987	**59.00**
	12/16/1988	**155.00**
	5/4/1989	100.00
	7/20/1989	**160.00**
	10/20/1989	62.00
	4/26/1990	**38.00**
	3/20/1991	**100.00**
	3/23/1992	>50.10
	3/23/1992	**100.00**
	3/15/1993	**84.00**
	6/8/1994	64.00
	9/13/1994	**70.00**
	12/7/1994	54.00
	3/10/1995	**39.50**
	6/4/1996	**51.20**
	6/5/1997	**30.80**
	6/25/1998	**32.90**
	6/7/1999	**35.00**
	6/13/2001	**4.30**
	6/1/2003	**4.00**
	6/22/2005	**20**
	6/13/2006	**14**
	6/13/2006	14
	6/22/2007	**15**
	6/17/2008	**15**

WELL 03M848
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2007

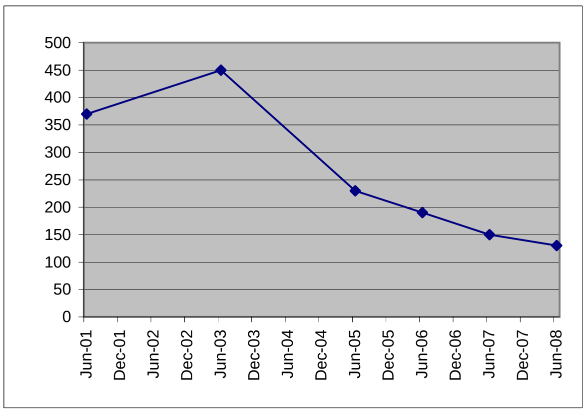
Date	TCE (ug/l)	Mann-Kendall Calculation:					
6/12/2001	**370**	1					
6/1/2003	**450**	1	1				
6/21/2005	**230**	1	-1	-1			
6/13/2006	**190**	1	-1	-1	-1		
6/21/2007	**150**	1	-1	-1	-1	-1	
6/18/2008	**130**	1	-1	-1	-1	-1	-1

N		6	5	4	3	2	1	0		15
	sum		-3	-4	-3	-2	-1	0	Kendall S	-13
Possibles		15								
									Kendall tau	-0.86667

Mean	253.33
STNDEV	128.633847
COV	0.50776519

Trend: Negative

Confidence (lookup) 99.17%



Raw Data	Date	TCE
03M848		
	12/2/1987	**440.00**
	4/19/1990	190.00
	7/19/1990	190.00
	9/17/1990	**330.00**
	3/18/1991	310.00
	6/4/1991	**730.00**
	9/3/1991	700.00
	3/18/1992	**640.00**
	6/3/1992	>50.10
	6/3/1992	570.00
	9/3/1992	>50.10
	3/9/1993	**1300**
	3/9/1993	970
	3/17/1994	**910**
	3/16/1995	**59**
	6/21/1996	**1400**
	6/26/1997	**510**
	6/29/1998	**660**
	6/4/1999	**700**
	6/4/1999	650
	6/12/2001	**370**
	6/1/2003	**450**
	6/21/2005	**230**
	6/13/2006	**190**
	6/21/2007	**150**
	6/18/2008	**130**

Appendix I

Other Installation Restoration Activities During FY 2008

APPENDIX I

OTHER INSTALLATION RESTORATION ACTIVITIES DURING FY 2008

This appendix is intended to give the reader a brief overview of other activities at TCAAP that are related to the Installation Restoration Program, but are not required by the RODs for OU1 through OU3.

A. DEEP GROUNDWATER BACKGROUND MONITORING

In order to assess the quality of deep groundwater flowing from off-site to beneath TCAAP, monitoring is performed at locations near the upgradient side of TCAAP (the northeast corner and east side). Locations of these wells are shown on Figure B-3 in Appendix B. The FY 2007 results were:

Well	Trichloroethene
03U007	<1.0
03U009	0.27 JP
03L007	<1.0
04U007	<1.0
04U510	<1.0

The results indicate that no significant contamination is flowing into TCAAP from off-site.

These locations will be sampled again in FY 2009 as shown in Appendix A.1 (the wells are listed under TCAAP Groundwater Recovery System in the appendix).

B. AQUATIC STUDIES

The Tier II Ecological Risk Assessment Report for aquatic sites, prepared by the U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM), was approved by the MPCA and USEPA in December 2004. In June 2005, the Army submitted a draft feasibility study (FS) to support the Risk Manager's decision with respect to "No Further Action" or "Implement a Remedy" for each aquatic site. As a result of comments on the draft FS, it was agreed to conduct additional sampling of Marsden Lake and Pond G. A Quality Assurance Project Plan was approved in FY 2007, and monthly sampling was conducted from Spring 2007 – Spring 2008. The sampling results are being incorporated into a revised feasibility study that was being prepared at the end of FY 2008.

C. GRENADE RANGE

The removal action to address contaminated soils was completed in early FY 2000. The Grenade Range Closeout Report received partial regulatory approval in FY 2002, with land use control issues still needing resolution. There was no activity related to this site in FY 2008.

D. OUTDOOR FIRING RANGE

The removal action to address metals-contaminated soils was completed in early FY 2000 and the Outdoor Firing Range Closeout Report received partial regulatory approval in FY 2002, with land use control issues still needing resolution. Construction was completed in October 2004 of a soil cover over a portion of the 1900-yard range that is contaminated with polynuclear aromatic hydrocarbons (PAHs). In FY 2006, the Army prepared an addendum (subsequently approved) to the above-referenced closeout report to document the work at the 1900-yard range. There was no activity related to this site in FY 2008.

E. 135 AND 535 PRIMER/TRACER AREAS

Preliminary Assessment reports for both of these sites received regulatory approval in FY 2002. It was recommended that a Site Inspection be conducted for both areas. The Site Inspection (SI) investigation report for each of these sites received MPCA and USEPA approval in FY 2005. The SI reports recommended that an Engineering Evaluation/Cost Analysis (EE/CA) be conducted for each of these areas to determine what, if any, remediation is required to address contamination observed in the soils. The 135 Primer/Tracer Area is on property that is proposed to be transferred to the City of Arden Hills. It is the Army's current intention to have the City, and/or its developer, conduct further work at this area as part of the transfer negotiations. At the 535 Primer/Tracer Area, the Army conducted additional soil sampling during FY 2008, which has delineated the approximate extent of two areas of shallow soil contamination: one with approximately 100 cubic yards of lead contaminated soil and one with approximately 530 cubic yards of PAH-contaminated soil. At the end of FY 2008, the draft EE/CA for the 535 Primer/Tracer Area was under regulatory review.

F. PROPERTY TRANSFER-RELATED ENVIRONMENTAL ACTIVITIES

In 2002, the remaining 774 acres that were still under the control of TCAAP, were declared excess to the needs of the Department of Defense. The Army Base Realignment and Closure Office funded environmental site assessment (ESA) work to collect reliable information regarding the environmental condition of the property in order to facilitate property transfer. The work included document reviews and field sampling of various media. The findings were published in "Environmental Site Assessment for 774-Acre Excess Parcel, Phase I and Phase II Report, Twin Cities Army Ammunition Plant" (Plexus Scientific Corporation, February 20, 2004, final report). Based on comments from the MPCA and USEPA, additional samples were collected and analyzed in FY 2005. The Army prepared an "ESA Addendum Report" that was approved in FY 2006. In FY 2007, a developer collected additional samples of various media on the property proposed for transfer to the City of Arden Hills. The data from this work has not yet been made available to the Army.

Appendix J

Annual Site Inspection Checklist for Land Use Controls

ANNUAL SITE INSPECTION CHECKLIST FOR LAND USE CONTROLS

Twin Cities Army Ammunition Plant

Date: July 23, 2008 Inspected By: Mike Fix (TCAAP), Dave Hamernick (Nat'l Guard), Keith Benker (Wenck)

Sites:	A	C	D	E	G	H	I	K
Site is located on property held by:	N.G.	BRAC	N.G.	N.G.	N.G.	N.G.	BRAC	BRAC
Is the current land use consistent with the land use scenario upon which the soil cleanup levels were based?	Yes	Yes	Yes	Yes	Yes	Yes	Note (1)	Note (1)
Has there been any excavation or other man-made soil disturbance at the site?	No	Yes (2)	No	No	No	No	No	No
If excavation or soil disturbance has occurred, was prior approval given by BRAC or National Guard?	N/A	Yes	N/A	N/A	N/A	N/A	N/A	N/A
If excavation or soil disturbance was authorized, was the work done in accordance with the approved plan?	N/A	Yes	N/A	N/A	N/A	N/A	N/A	N/A
Have any new structures or facilities (including new wells) been constructed on the site?	No	No	No	No	No	No	No	No
If new facilities or structures were constructed, was prior approval given by BRAC or National Guard?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
If new facilities or structures were authorized, was constuction in accordance with the approved plan?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
If a protective soil cover is present, is adequate vegetation present throughout the soil cover area?	N/A	Yes	Yes	Yes	Yes	Yes	N/A	N/A
If the soil cover has a permeability requirement, is there any woody vegetation > 2" diameter present?	N/A	N/A	N/A	N/A	No	N/A	N/A	N/A
If a protective soil cover is present, are run-on/runoff controls in good condition (swales, berms, riprap, etc.)?	N/A	Yes	Yes	Yes	Yes	Yes	N/A	N/A
If a protective soil cover is present, are signs marking the edge of the soil cover present and in good condition?	N/A	No (3)	Yes	Yes	Yes	No (5)	N/A	N/A
Are there any water supply wells constructed into the portion of the aquifer with concentrations above cleanup levels?	No	No	N/A	N/A	N/A	N/A	No	No
Has there been any damage to or removal/modification of groundwater remediation and/or monitoring systems?	No	Yes (4)	N/A	N/A	N/A	N/A	No	No
If such systems were removed or modified, was prior approval given by BRAC or National Guard?	N/A	Yes	N/A	N/A	N/A	N/A	N/A	N/A
If system removal/modification was authorized, was removal/modification in accordance with approved plan?	N/A	Yes	N/A	N/A	N/A	N/A	N/A	N/A

Comments (Attach additional pages as necessary):

(1) Soil contamination is known to exist, but cleanup levels have not yet been established through a Decision Document for this site. Likewise, there is no formal requirement for soil land use controls as the remedy selection has not been completed.

(2) Earthwork was performed in Fall 2007 as part of the remedy for this site.

(3) Signs will be installed once the final cover area is determined through the LUCRD.

(4) Some wells were extended upward to accomodate soil cover placement.

(5) One sign along the access road was inadvertently knocked down by road maintenance operations, and will be re-installed by the MN National Guard.

ANNUAL SITE INSPECTION CHECKLIST FOR LAND USE CONTROLS

Twin Cities Army Ammunition Plant

Sites:	129-3	129-5	129-15	Grenade Range	Outdoor Firing Rng	Bldg 135 P/T Area	Bldg 535 P/T Area	Bldg 102	Deep GW (TGRS)
Site is located on property held by:	N.G.	N.G.	N.G.	N.G.	N.G.	BRAC	N.G.	BRAC	BRAC/N.G.
Is the current land use consistent with the land use scenario upon which the soil cleanup levels were based?	Yes	Yes	Yes	Yes	Yes	Note (1)	Note (1)	N/A	N/A
Has there been any excavation or other man-made soil disturbance at the site?	No	No	No	No	No	No	Yes (6)	N/A	N/A
If excavation or soil disturbance has occurred, was prior approval given by BRAC or National Guard?	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A
If excavation or soil disturbance was authorized, was the work done in accordance with the approved plan?	N/A	N/A	N/A	N/A	N/A	N/A	Yes	N/A	N/A
Have any new structures or facilities (including new wells) been constructed on the site?	No	No	No	No	No	No	No	N/A	N/A
If new facilities or structures were constructed, was prior approval given by BRAC or National Guard?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
If new facilities or structures were authorized, was constuction in accordance with the approved plan?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
If a protective soil cover is present, is adequate vegetation present throughout the soil cover area?	N/A	N/A	Yes	N/A	Yes	N/A	N/A	N/A	N/A
If the soil cover has a permeability requirement, is there any woody vegetation > 2" diameter present?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
If a protective soil cover is present, are run-on/runoff controls in good condition (swales, berms, riprap, etc.)?	N/A	N/A	Yes	N/A	Yes	N/A	N/A	N/A	N/A
If a protective soil cover is present, are signs marking the edge of the soil cover present and in good condition?	N/A	N/A	Yes	N/A	Yes	N/A	N/A	N/A	N/A
Are there any water supply wells constructed into the portion of the aquifer with concentrations above cleanup levels?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	No
Has there been any damage to or removal/modification of groundwater remediation and/or monitoring systems?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No	No
If such systems were removed or modified, was prior approval given by BRAC or National Guard?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
If system removal/modification was authorized, was removal/modification in accordance with approved plan?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Comments (Attach additional pages as necessary):

(1) Soil contamination is known to exist, but cleanup levels have not yet been established through a Decision Document for this site. Likewise, there is no formal requirement for soil land use controls as the remedy selection has not been completed.

(6) Soil testing was performed in support of the EE/CA.