FISCAL YEAR 2015 ANNUAL PERFORMANCE REPORT
NEW BRIGHTON/ARDEN HILLS SUPERFUND SITE

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must be referred to:

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Arden Hills, Minnesota 55112

Prepared for:

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Arden Hills, Minnesota 55112

WENCK ASSOCIATES, INC.
ORBITAL ATK
GHD

August 2016
Final Report

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

August 9, 2016

REPLY TO THE ATTENTION OF: SR-6J

Michael R. Fix
Commander's Representative
Twin Cities Army Ammunition Plant
4761 Hamline Avenue
Arden Hills, MN 55112

RE: Consistency Test for the Fiscal Year 2015 Annual Performance Report, New Brighton./Arden Hills Superfund Site, Arden Hills, Minnesota

Dear Mr. Fix:

Staff at the U.S. Environmental Protection Agency (U.S. EPA) and the Minnesota Pollution Control Agency (MPCA) have completed review of the Fiscal Year 2015 Annual Performance Report for the New Brighton/Arden Hills Superfund Site (FY15 APR). Our review of the FY15 APR included the following documents and communications:

- Fiscal Year 2015 Annual Performance Report, New Brighton/Arden Hills Superfund Site, Draft Report, Prepared for the Commander, Twin Cities Army Ammunition Plant by Wenck Associates, Inc., Alliant Techsystems, Inc., Conestoga-Rovers, Inc., February 2016;
- U.S. EPA comments on the Draft FY15 APR (March 29, 2016);
- MPCA comments on the Draft FY15 APR (July 13, 2016);
- U.S. Army (Army) responses to U.S. EPA and MPCA comments and redline changes (July 26, 2016).

Based upon our review, you are hereby advised that, in accordance with Chapter XIV of the Federal Facility Agreement, the Fiscal Year 2015 Annual Performance Report passes the Consistency Test.

If you have any questions, please contact Amy Hadiaris at (651) 757-2402 or Tom Barounis at (312) 353-5577.

Sincerely

Tom Barounis

Tom Barounis
Remedial Project Manager
U.S. Environmental Protection Agency
Region 5

Tom Barounis
for Amy Hadiaris
Project Manager
Remediation Division
Minnesota Pollution Control Agency

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Fiscal Year 2015 Annual Performance Report

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APPENDICES

List of Acronyms

AHATS	-	Arden Hills Army Training Site
ATK	-	Alliant Techsystems Inc. (now Orbital ATK)
APR	-	Annual Performance Report
Army	-	United States Army
Barr	-	Barr Engineering
BGRS	-	Boundary Groundwater Recovery System
BRAC	-	Base Realignment And Closure Division
COC	-	Chemical of Concern
CRA	-	Conestoga-Rovers & Associates, Inc. (now GHD)
DNAPL	-	Dense Non-Aqueous Phase Liquid
EBS	-	Environmental Baseline Survey
EE/CA	-	Engineering Evaluation/Cost Analysis
ERIS	-	Environmental Restoration Information System
ESD	-	Explanation of Significant Difference
EW	-	Extraction Well
FFA	-	Federal Facility Agreement
FS	-	Feasibility Study
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
LUCRD	-	Land Use Control Remedial Design
MCES	-	Metropolitan Council Environmental Services

List of Acronyms (Cont.)

MCLs	-	Maximum Contaminant Levels
MCLGs	-	Maximum Contaminant Level Goals
MDH	-	Minnesota Department of Health
MDL	-	Method Detection Limit
MNA	-	Monitored Natural Attenuation
MOS	-	TGRS Micro Operation Strategy
MNARNG	-	Minnesota Army National Guard
MPCA	-	Minnesota Pollution Control Agency
MW	-	Monitoring Well
NB/AH	-	New Brighton/Arden Hills
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
RAB	-	Restoration Advisory Board

List of Acronyms (Cont.)

RAWP	-	Remedial Action Work Plan
RD/RA	-	Remedial Design/Remedial Action
ROD	-	Record of Decision
scfm	-	Standard Cubic Feet per Minute
SDWA	-	Safe Drinking Water Act
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 Command
USACHPPM	-	US Army Center for Health Promotion & Preventive Medicine
USEPA	-	United States Environmental Protection Agency
VIC	-	Voluntary Investigation and Cleanup
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
CHCL3 - Chloroform

List of Chemical Abbreviations (Cont.)

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 2015 (FY 2015) Annual Performance Report (APR):

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

for each of the three operable units related to the New Brighton/Arden Hills Superfund Site. Figure 2-1 shows the approximate locations of the three operable units. Fiscal Year 2015 is defined as the period from October 1, 2014 through September 30, 2015.

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 2007, 2009, 2012, and 2014
- OU3 ROD signed 1992, Amended 2006

The RODs, and subsequent Amendments and Explanations of Significant Differences, 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 summarizes the status of remedial actions at the end of FY 2015. Following are highlights of the accomplishments for each operable unit, as well as other activities during FY 2015.

Operable Unit 1 (OU1)

OU1 consists of the “north” plume of Volatile Organic Compound (VOC) groundwater contamination. The final remedy for OU1 consists of pumping from six municipal wells (New Brighton Municipal wells NBM #3, #4, #5, #6, #14, and #15) and treating the extracted groundwater through the Permanent Granular Activated Carbon (PGAC) system. Treated water is normally 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 2015 are:

- Routine OU1 remedy pumping was ceased on April 15, 2015, with notice to the USEPA/MPCA, due to detection of 1,4-dioxane in the Prairie du Chien and Jordan Aquifer municipal wells. Since the PGAC does not remove 1,4-dioxane, New Brighton is preferentially pumping deep aquifer wells that have no detectable 1,4-dioxane while they evaluate the feasibility of 1,4-dioxane removal technologies. This has been referred to as a “remedy time-out,” and normal OU1 remedy pumping will not be resumed until a technology is selected and modification of the New Brighton treatment system is designed and constructed, such that both VOCs and 1,4-dioxane are removed. The Fridley Interconnection was also closed on April 15, 2015.
- 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 2015, there were no new recommendations for abandonment or alternate water supply.
- The PGAC treated 0.6 billion gallons of water and removed 187 pounds of VOCs during FY 2015. Approximately 23,644 pounds of VOCs have been removed since system startup. The volume of water removed by the system and the pounds of VOCs removed by the system decreased significantly in FY 2015 solely due to the system being shut down in April 2015.

- The effluent of the PGAC was in compliance with the applicable Safe Drinking Water Act criteria for the OU1 chemicals of concern.
- Prior to ceasing OU1 remedy pumping on April 15, 2015, the treated groundwater was beneficially used in the New Brighton and Fridley municipal water supply systems.
- FY 2015 was a major sampling event. The statistical trend analysis, as developed by the OU1 Technical Group, indicates that aquifer restoration is occurring.

Operable Unit 2 (OU2)

OU2 is defined as the area occupied by TCAAP in 1983, when the New Brighton/Arden Hills Superfund Site was placed on the National Priorities List. The remedial action requirements were set forth in the OU2 ROD (1997), ROD Amendment #1 related to Site C-2 (2007), ROD Amendment #2 related to Site I groundwater (2009), ROD Amendment #3 related to various soil sites (2009), Explanation of Significant Differences #1 related to groundwater (2009), Explanation of Significant Differences #2 related to various soil sites (2009), ROD Amendment #4 related to Building 102 shallow groundwater, aquatic sites, and various soil sites (2012), and ROD Amendment #5 related to various soil sites (2014). Highlights for activities within OU2 during FY 2015 are:

- Shallow Soil Sites
    - No activities other than ongoing Army implementation of land use controls.

- Deep Soil Sites
    - No activities other than ongoing Army implementation of land use controls.

- Site A Shallow Groundwater
  - In accordance with the “Site A Shallow Groundwater: 10-Year Evaluation Report” (July 2008), and with regulatory approval, the groundwater extraction system was shut down on September 24, 2008, in order to evaluate Monitored Natural Attenuation (through abiotic degradation) as a potential remedy component in lieu of groundwater extraction and discharge. The groundwater system has remained in stand-by mode in the event that MNA does not adequately control plume migration and one or more extraction wells need to be restarted. In late 2015, following review of FY 2015 groundwater monitoring results, MNA has been deemed an acceptable remedy by the USEPA and MPCA. The Army, USEPA, and MPCA will prepare a ROD amendment in FY 2016 to document the change in this remedy component.
  - Monitoring results from the four contingency wells located along the north side of County Road I did not exceed the approved trigger levels.
  - The MDH Special Well Construction Area remains in effect. In FY 2015, there were no locations identified in need of well abandonment or alternate water supply.
  - Monitoring wells were sampled to determine if 1,4-dioxane was present in Site A shallow groundwater. The sampling results suggest 1,4-dioxane is not present at Site A.

- Site C Shallow Groundwater
  - In accordance with the “Site C Groundwater Extraction System Evaluation Report” (November 2008), and with regulatory approval, the groundwater extraction system was shut down on November 13, 2008. System operation was ceased because the area of lead concentrations that exceeded the groundwater cleanup level was no longer reaching the extraction wells.
  - Only the monitoring wells located near the source area still exceeded the groundwater cleanup level for lead in FY 2015.

  - None of the groundwater or surface water contingency locations exceeded the approved trigger levels in FY 2015.
  - Continued monitoring is recommended prior to any decision on whether or not to formally change the remedy to eliminate the groundwater extraction component.

- Site I Shallow Groundwater
  - All Site I Unit 1 monitoring wells were abandoned in FY 2014; therefore, no new groundwater quality data are available to evaluate.
  - Previous investigations indicate the Unit 1 groundwater is discontinuous and does not extend beyond Site I; rather, the Unit 1 contaminants leak downward into Unit 3, which is hydraulically contained by the TGRS.
  - Monitoring well 01U667 will be reinstalled following Building 502 demolition and planned soil remediation. The well is scheduled to be reinstalled in spring 2016.

- Site K Shallow Groundwater
  - At Site K, the groundwater extraction trench and treatment system continued to operate as designed. The system captured and treated 5,444,776 gallons of water and maintained a continuous zone of capture downgradient of the former Building 103. A total of 11.59 pounds of VOCs were removed in FY 2015.
  - Groundwater samples were collected from all eight wells scheduled for sampling in FY 2015. With the exception of relatively stable trichloroethene concentrations in 01U615, the overall trend throughout Site K Unit 1 monitoring wells continues to show a gradual decrease in trichloroethene concentrations over the last twenty years of sampling.
  - The extracted water was treated and discharged to Rice Creek in compliance with all discharge criteria except for one sample for zinc in March 2015. The

effluent was resampled in April 2015 and zinc was below the effluent limit. The reason for the higher zinc concentration was not determined.

- Fifteen Unit 1 wells at Site K were abandoned as part of the site redevelopment activities in FY 2014; three of these wells are scheduled to be reinstalled in spring 2016.
- After the Building 103 concrete slab was removed, Orbital ATK voluntarily conducted a geoprobe groundwater investigation in September 2014 to better define the width of the plume. The results were reported by letter to the USEPA/MPCA in FY 2015. Based on the groundwater sample results, the TRCLE plume is wider than originally estimated but still within the capture width of the groundwater collection trench. Groundwater samples collected down gradient of monitoring well 01U603 showed that high TRCLE concentrations are localized and did not migrate from the immediate vicinity of the well.
- Samples collected in 2015 for 1,4-dioxane contained low concentrations (less than 1.5 μg/L) in Unit 1 wells sampled. A concentration of 7.3 μg/L was reported for Unit 3 well 03U621.

- Building 102 shallow groundwater
  - VOC concentrations were generally similar to those observed in the prior year.
  - The well adjacent to Rice Creek continued to show that shallow groundwater discharging to Rice Creek was below the cleanup levels for this site.
  - Monitoring wells were sampled to determine if 1,4-dioxane was present in Building 102 shallow groundwater. The sampling results suggest 1,4-dioxane is not present at Building 102.

- Aquatic Sites
  - Due to the new concern regarding the presence of 1,4-dioxane at some TCAAP sites, surface water samples were voluntarily collected by the Army from Rice Creek. No 1,4-dioxane or VOCs were detected.

- 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 2015, the total extraction well water pumped averaged 1,751 gpm, which is greater than the Global Operation Strategy (GOS) Operating Minimum (OM) (1,745 gpm).
  - In FY 2015, the TGRS extracted and treated approximately 920,197,600 gallons of water. The mass of VOCs removed was 1,748 pounds and is 272 pounds less than that achieved in FY 2014. The total VOC mass removed by the TGRS through FY 2015 is 213,030 pounds.
  - 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.
  - A majority of the monitoring wells sampled (51 of 76) had 1,4-dioxane concentrations exceeding 1.0 μg/L with the highest concentrations found in the samples at 03U094 (281 μg/L) and 03U021 (133 μg/L).

Operable Unit 3 (OU3)

OU3 consists of the “south” plume of VOC groundwater contamination. Highlights for FY 2015 are:

- Groundwater monitoring in FY 2015 was conducted during the annual event. Overall, the statistical evaluation indicated stable to declining trends in concentration at the center and edge of the South Plume. In addition, there is evidence of the North Plume mingling with the South Plume at the boundary between the two plumes and perhaps even toward the center of the South Plume.
- The 2015 1,4-dioxane concentrations were lower (less than 1.0 µg/L) near the center and eastern side of the OU3 area and higher (greater than 3.0 µg/L) along the western edge.

Other Investigation and/or Remediation Activities Not Prescribed by a Current ROD

- Round Lake Supplemental Remedial Investigation and Feasibility Study
  - Through the process of submitting multiple earlier drafts of the FS, it became clear that the Army, USEPA, and MPCA did not agree on the ecological risks and commensurate remedy associated with Round Lake. In early FY 2014, the Army submitted a Supplemental RI and FS for Round Lake which incorporated a Supplemental Ecological Risk Assessment prepared by the Environmental Sciences Division at the Oak Ridge National Laboratory (ORNL). Comments received from the USEPA and MPCA in March 2014 indicated that significant disagreement remained. In April 2014, the Army notified the USEPA and MPCA that their findings were being disputed by the Army. Efforts to resolve this dispute continued through the end of FY 2015.

Table 1-1
Status of Remedial Actions

Fiscal Year 2015

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:	Extract Groundwater	Yes	No	No	NBCGRS pumping has temporarily been suspended (referred to as a "Remedy Time-out") to allow the City of New Brighton to design and construct a 1,4-dioxane treatment system, which will allow a return to normal pumping.
#4:	Removal of VOCs by GAC (Discharge Quality)	Yes	No	No	See comment for Remedy Component #3.
#5:	Discharge of Treated Water	Yes	No	No	See comment for Remedy Component #3.
#6:	Groundwater Monitoring with Verification of Continuing Aquifer Restoration	Yes	Yes	No	
Overall Remedy		Yes	Yes	No	
Operable Unit 2: Shallow Soil Sites					
#1-7:	Soil Remediation				
	Site A	Yes	Yes	Yes	
	Site C	Yes	Yes	Yes	
	Site E	Yes	Yes	Yes	
	Site H	Yes	Yes	Yes	
	Site 129-3	Yes	Yes	Yes	
	Site 129-5	Yes	Yes	Yes	

Table 1-1 (continued)
Status of Remedial Actions

Fiscal Year 2015

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)				
Grenade Range	Yes	Yes	Yes	
Outdoor Firing Range	Yes	Yes	Yes	
135 PTA Stormwater Ditch	Yes	Yes	Yes	
535 Primer/Tracer Area	Yes	Yes	Yes	
Site K Soils	Yes	Yes	Yes	
Water Tower Area	Yes	Yes	Yes	
Soil AOCs (Site A, 135 PTA, EBS Areas)	Yes	Yes	Yes	
#8: Groundwater Monitoring	Yes	Yes	Yes	
#9: Characterization of Dumps				
Site B	Yes	Yes	Yes	
Site 129-15	Yes	Yes	Yes	
#10: Land Use Controls	Yes	Yes	No	Implementation of the OU2 Land Use Control Remedial Design (OU2 LUCRD) is an ongoing requirement.
Overall Remedy	Yes	Yes	Partially	

Table 1-1 (continued)
Status of Remedial Actions

Fiscal Year 2015

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	Yes	
#2: Restrict Site Access During Remediation	Yes	Yes	Yes	Long-term land use controls are addressed by Remedy Component #8.
#3: SVE Systems	Yes	Yes	Yes	
#4: Enhancements to SVE Systems	Yes	Yes	Yes	Neither system required operation with enhancements. Both SVE systems have been dismantled.
#5: Maintain Existing Site Caps	Yes	Yes	Yes	This remedy component was intended to minimize short-circuiting of airflow when the SVE systems were operating. The long-term land use controls for the cap/cover that must be maintained at Sites D and G (due to shallow soil contamination at Site D and the Site G dump) are addressed by Remedy Component #8.
#6: Maintain Surface Drainage Controls	Yes	Yes	Yes	
#7: Characterize Shallow Soils and Dump	Yes	Yes	Yes	
#8: Land Use Controls	Yes	Yes	No	Implementation of the OU2 Land Use Control Remedial Design (OU2 LUCRD) is an ongoing requirement.
Overall Remedy	Yes	Yes	Partially	

Table 1-1 (continued)
Status of Remedial Actions

Fiscal Year 2015

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	The groundwater extraction system was shut off on 9/24/08 and was in standby while implementation of MNA was evaluated. In late 2015, MNA was deemed an acceptable remedy, and therefore a ROD amendment will be prepared in FY2016 to document the change in this remedy component.
#3A Land Use Controls	Yes	Yes	No	Implementation of the OU2 Land Use Control Remedial Design (OU2 LUCRD) is an ongoing requirement.
#3B: Drilling Advisory/Alternate Water Supply/Well Abandonment	Yes	Yes	No	
#4: Discharge of Extracted Water	Yes	Yes	No	See comment for Remedy Component #2.
#5: Source Characterization/Remediation	Yes	Yes	Yes	
Overall Remedy	Yes	Yes	No	

Table 1-1 (continued)
Status of Remedial Actions

Fiscal Year 2015

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 C Shallow Groundwater				
#1: Groundwater and Surface Water Monitoring	Yes	Yes	No	
#2: Groundwater Containment	Yes	Yes	No	Since the lead plume no longer extends to the extraction wells, the groundwater extraction system was shut off on 11/13/08. Future monitoring will determine whether a ROD modification will be prepared to document the change in this remedy component, or whether the Site can be closed.
#3: Discharge of Extracted Water	Yes	Yes	No	See comment for Remedy Component #2.
#4: Land Use Controls	Yes	Yes	No	Implementation of the OU2 Land Use Control Remedial Design (OU2 LUCRD) is an ongoing requirement.
Overall Remedy	Yes	Yes	No	
Operable Unit 2: Site I Shallow Groundwater				
#1: Groundwater Monitoring	Yes	Yes	No	
#2: Additional Investigation	Yes	Yes	Yes	
#3: Land Use Controls	Yes	Yes	No	Implementation of the OU2 Land Use Control Remedial Design (OU2 LUCRD) is an ongoing requirement.
Overall Remedy	Yes	Yes	No	

Table 1-1 (continued)
Status of Remedial Actions

Fiscal Year 2015

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 K Shallow Groundwater				
#1: Groundwater Monitoring	Yes	Yes	No	
#2: Sentinel Wells	Yes	Yes	Yes	
#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	
#8: Land Use Controls	Yes	Yes	No	Implementation of the OU2 Land Use Control Remedial Design (OU2 LUCRD) is an ongoing requirement.
Overall Remedy	Yes	Yes	No	
Operable Unit 2: Building 102 Shallow Groundwater				
#1: Monitored Natural Attenuation	Yes	Yes	No	
#2: Groundwater Monitoring	Yes	Yes	No	
#3: Land Use Controls	Yes	Yes	No	Implementation of the OU2 Land Use Control Remedial Design (OU2 LUCRD) is an ongoing requirement.
Overall Remedy	Yes	Yes	No	

Table 1-1 (continued)
Status of Remedial Actions

Fiscal Year 2015

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: Aquatic Sites				
#1: Pond G Surface Water Treatment	Yes	Yes	Yes	
#2: Pond G Surface Water Monitoring	Yes	Yes	Yes	
Overall Remedy	Yes	Yes	Yes	
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: Land Use Controls	Yes	Yes	No	Implementation of the OU2 Land Use Control Remedial Design (OU2 LUCRD) is an ongoing requirement.
#5: Review of New Technologies	Yes	Yes	No	
#6: Groundwater Monitoring	Yes	Yes	No	
Overall Remedy	Yes	Yes	No	

Table 1-1 (continued)
Status of Remedial Actions

Fiscal Year 2015

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 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 2015 Annual Performance Report (APR) is intended to:

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

for remedial actions at the New Brighton/Arden Hills Superfund Site (NB/AH Site). Fiscal Year 2015 (FY 2015) extended from October 1, 2014 through September 30, 2015.

The NB/AH Superfund Site has been divided into three areas designated "Operable Units." Operable Unit 1 (OU1) encompasses deep groundwater sometimes referred to as the "North Plume." Operable Unit 2 (OU2) includes soil, sediment, surface water, and groundwater contamination on the area that comprised the Twin Cities Army Ammunition Plant (TCAAP) in 1983, when the NB/AH Site was placed on the National Priorities List (NPL). OU2 also includes the Site A groundwater plume that extends off the north end of the federally-owned property. Operable Unit 3 (OU3) consists of the deep groundwater sometimes referred to as the "South Plume." Figure 2-1 shows the approximate locations of the three operable units.

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 2007, 2009, 2012, and 2014
- OU3 ROD signed 1992, Amended 2006

The RODs, and subsequent Amendments and Explanations of Significant Differences (ESDs), present the major components of the final remedies for the media of concern.

Monitoring activities and submittal of this report are in fulfillment of the Federal Facility Agreement (FFA) signed in 1987 between the United States Army (Army), United States Environmental Protection Agency (USEPA), and Minnesota Pollution Control Agency (MPCA).

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 performing as required?*

To address these two questions, this report is broken into the three Operable Units. Using each ROD (along with subsequent modifications), the report addresses 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 and/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.

With the performance standards identified, this report then addresses the two questions described above, often through a series of sub-questions. The questions are written in the text in an attempt to make the report focused and user friendly. To the extent possible, answers are in the form of figures, graphs, etc.

In addition to reporting on FY 2015, this document presents proposed monitoring for future years (Appendix A). Monitoring locations or frequencies that are new in this year’s report are shown highlighted in yellow in this appendix. The monitoring plan shows FY 2015 through FY 2019. The monitoring plan covers a moving 5-year time span (i.e., next year FY 2015 will drop off and FY 2020 will be added).

This report represents the collaboration of work performed by the Army and Orbital ATK (formerly Alliant Techsystems). On behalf of the Army, Wenck Associates, Inc. (Wenck) prepared Sections 2.0 through 7.0, 10.0, 11.0 and 14.0 of this report. On behalf of Orbital ATK, GHD (formerly Conestoga-Rovers & Associates, Inc.) prepared Sections 8.0, 9.0, 12.0 and 13.0. Wenck and GHD both contributed to Section 1.0.

2.2 BRIEF OVERVIEW OF TCAAP

TCAAP was constructed between August 1941 and January 1943 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).

TCAAP primarily produced and proof-tested small-caliber ammunition and related materials for the Army. Other uses included manufacture of munitions-related components, handling/storage of strategic and critical materials for other government agencies, and various non-military tenant activities. Production began in 1942 and then alternated between periods of activity and standby related to wars. The last manufacturing operations ceased in 2005.

During periods of activity, solvents were utilized as part of some manufacturing operations. Disposal of solvents and other wastes at the TCAAP property resulted in soil contamination and also groundwater contamination, which has migrated beyond the original TCAAP boundary. Groundwater contamination was first discovered in July 1981, which led to investigation of the soil and groundwater on and off the TCAAP property. It was determined that TCAAP was the source of contamination, and so the TCAAP property and area of affected groundwater contamination was placed on the National Priorities List (NPL) in 1983 as the New Brighton/Arden Hills Superfund Site.

A number of known and potential contaminant source areas were initially 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). The 1997 OU2 ROD specified requirements for all of these sites except Site F (which was remediated prior to 1997) and Site J (a sewer line that was determined not to have a release of contamination). Other areas have also undergone investigation and/or remediation, namely the Grenade Range, Outdoor Firing Range, Trap Range, 135 Primer/Tracer Area (and adjacent stormwater ditch), 535 Primer/Tracer Area, Water Tower Area, EBS Areas, and Building 102. These areas are also shown on Figure 2-2.

Since 1983, when the NB/AH Site was placed on the NPL, the size of TCAAP has periodically shrunk as a result of property transfers. Some property has been transferred out of federal-ownership to Ramsey County and the City of Arden Hills. Other property is still owned by the federal government, but control has been reassigned to the Army Reserve or the National Guard Bureau. The National Guard Bureau has licensed the property it controls to the Minnesota Army National Guard. Figure 2-3 shows the property presently under federal ownership, along with the organizations responsible for control. The majority of the remaining TCAAP property that was controlled by the Base Realignment And Closure (BRAC) Division of the U.S. Army was transferred to Ramsey County in 2013 for redevelopment. At this point, the minimal remaining TCAAP (BRAC-controlled) property is also in the process of being transferred out of federal ownership. It is likely that within the next few years, there will no longer be an organization or property called TCAAP. These property transfers do not alter the responsibilities of the U.S. Army under the FFA.

2.3 HYDROGEOLOGIC UNITS AND WELL NOMENCLATURE

For purposes of studies and work related to the NB/AH Superfund Site, four hydrogeologic units have been designated: 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 is included in Table B-1 in this appendix. The well index includes all wells that are owned by or have been used by the Army in the past to gather groundwater elevation or water quality data, sorted by Minnesota unique number. Well information in this appendix includes the Army designation (IRDMIS number), Minnesota unique number, and any other name(s) the wells may have. This appendix also includes information about each well. Locations of wells that are included in the monitoring plan are shown on Figure B-2 (OU1/OU3 wells) and Figure B-3 (OU2 wells) in this appendix. 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 information concerning a well, including well logs and other information, can be viewed in the Appendix B Attachment, which is sorted by Minnesota unique number.

See the instructions in the Appendix B attachment for more information on using this appendix.

2.4 DATA COLLECTION, MANAGEMENT, AND PRESENTATION

Performance monitoring data was collected in accordance with the:

- FY 2015 Monitoring Plan for Groundwater Monitoring Wells
- FY 2015 Monitoring Plan for Remedial Treatment Systems
- FY 2015 Monitoring Plan for Surface Water
- New Brighton Water System Sampling and Analysis Plan

Data was collected principally by three parties: Wenck on behalf of the Army; GHD on behalf of Orbital ATK; 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 through FY 2015 are contained in Appendix D.1.

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 2015 Monitoring Plan. Data was collected, verified, and validated in accordance with two separate Quality Assurance Project Plans (QAPPs): "QAPP for Performance Monitoring" (Wenck, Revision 13, February 28, 2014) and "QAPP for Monitored Natural Attenuation of Building 102 Groundwater" (Wenck, Revision 7, February 28, 2014), and also in accordance with QAPP Addendum #1 (Wenck, May 21, 2015), which addresses the additional sampling and analysis for 1,4-dioxane. The Building 102 QAPP is applicable to only that specific site, and all other sites are covered by the Performance Monitoring QAPP.

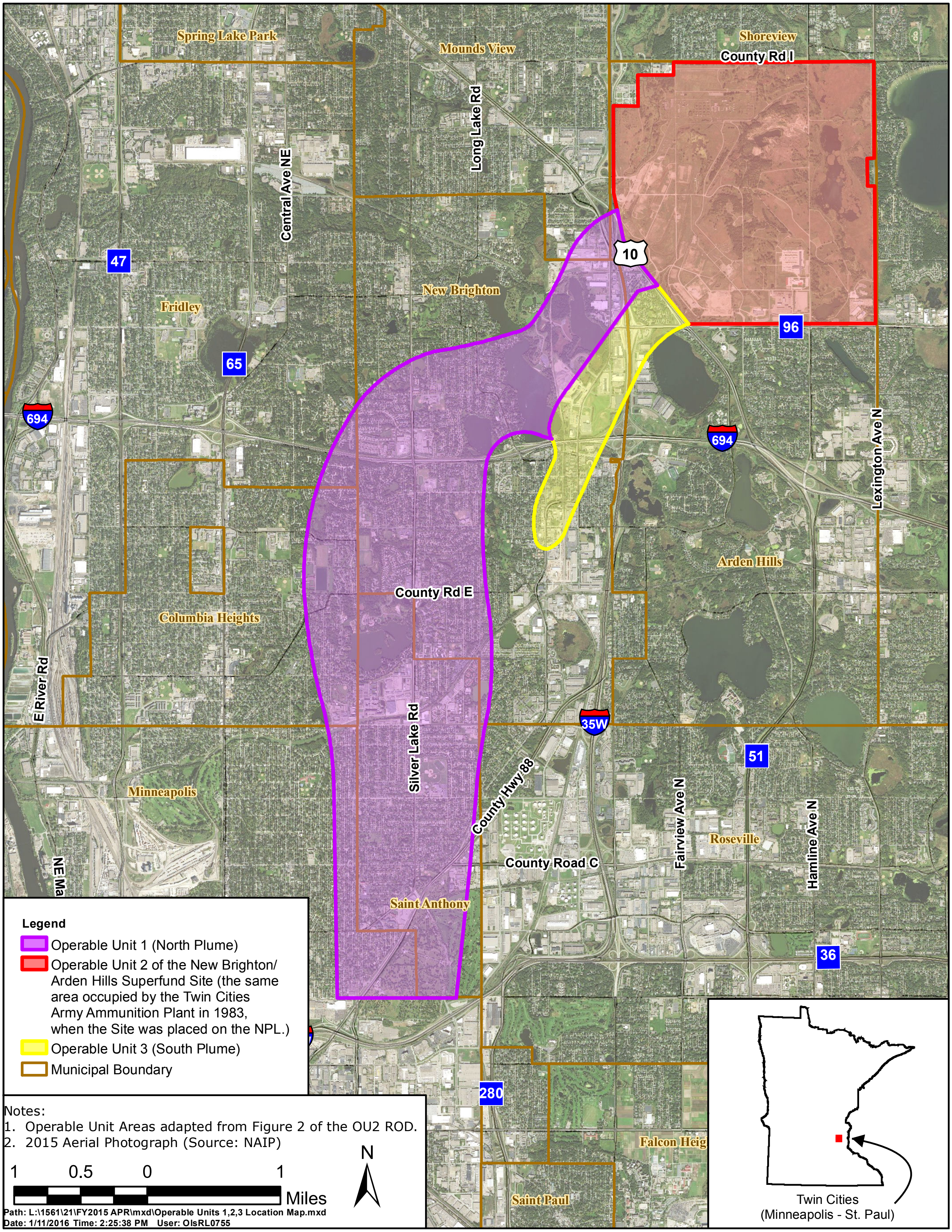
The data tables in the various report sections and the comprehensive water quality databases (Appendix D.1) show the data qualifiers that were assigned to the data as a result of data verification and/or data validation. The data qualifiers assigned to FY 2015 data are explained in the footnotes of the data tables in the various report sections. Data verification (performed on 100 percent of the data) and data validation (performed on a minimum of 10 percent of the data) were provided to the USEPA and MPCA via submittal of quarterly Data Usability Reports (DURs) covering the data collected in FY 2015. The final MPCA/USEPA approval letter for the FY 2015 DURs is included in Appendix C.3.

With regard to completeness, Appendix C.2 summarizes any deviations from the FY 2015 Monitoring Plan. There were substantial changes in FY 2015, primarily due to emergence of the 1,4-dioxane issue in early 2015. The field and laboratory completeness goals for performance monitoring are both 95%, except that the completeness goals for TGRS effluent, Site K effluent, and well inventory are 100%. With the exception of one missed 1,4-dioxane sample due to a broken bottle, actual field and laboratory completeness were both 100%, meeting the overall completeness goals (wells that were dry, frozen or inoperative were not considered as missed samples, nor were well inventory locations where the well owner refused sample collection or was nonresponsive). Also, the actual field and laboratory completeness for the subset of samples with 100% completeness goals was 100%, meeting this goal. For Building 102 shallow groundwater, the field and laboratory completeness goals are both 95%, except that the completeness goals for well 01U048 (adjacent to Rice Creek) are 100%. Actual field and laboratory completeness were 100%, meeting the completeness goals.

With regard to QC samples, both QAPPs and Addendum #1 specify that field duplicates, equipment rinse blanks, and matrix spike/matrix spike duplicates are to be collected at overall frequencies of 10%, 10%, and 5%, respectively. Actual QC sample frequencies met these goals, with respective frequencies of 15%, 10% and 11% for VOCs in the performance monitoring; 11%, 11% and 8% for 1,4-dioxane in the performance monitoring: and 18%, 18% and 9% (the same for both VOCs and 1,4-dioxane) in the Building 102 shallow groundwater monitoring.

With regard to data validation, the performance monitoring QAPP specifies that data validation be completed at an overall rate of 10%, with 100% validation of Site A antimony data and well inventory samples. The actual validation rate for VOCs was 61%, and all of the data requiring 100% data validation was fully validated, meeting the specified validation rates for performance monitoring. For Building 102 shallow groundwater, the QAPP specifies a 100% data validation rate, and all of the VOC data was fully validated. Lastly, QAPP Addendum #1 specifies that 100% of the 1,4-dioxane data be validated, and all of the 1,4-doxane data was fully validated.

The data for FY 2015 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 verification and data validation; and 3) comparability to historical results (any substantial deviations from historical and/or anticipated results are discussed within the site-specific sections of this report).



Notes:
1. Operable Unit Areas adapted from Figure 2 of the OU2 ROD.
2. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Operable Units 1,2,3 Location Map.mxd
Date: 1/11/2016 Time: 2:25:38 PM User: OlsRL0755

ANNUAL PERFORMANCE REPORT

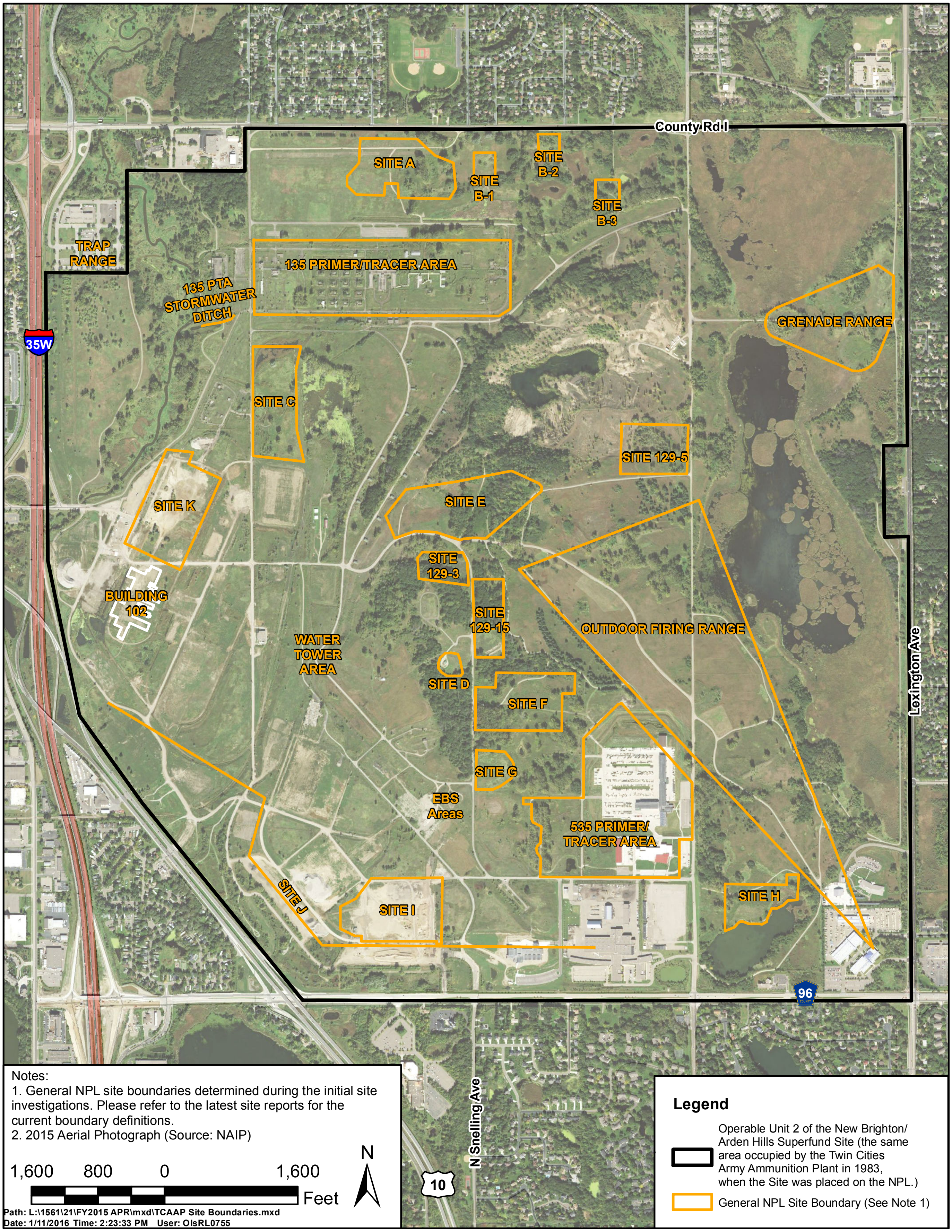
Conceptual Illustration of Operable Units

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

FY 2015

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. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\TCAAP Site Boundaries.mxd
Date: 1/11/2016 Time: 2:23:33 PM User: OlsRL0755

Legend

▭	Operable Unit 2 of the New Brighton/ Arden Hills Superfund Site (the same area occupied by the Twin Cities Army Ammunition Plant in 1983, when the Site was placed on the NPL.)
▭	General NPL Site Boundary (See Note 1)

ANNUAL PERFORMANCE REPORT

Operable Unit 2 Site Boundaries

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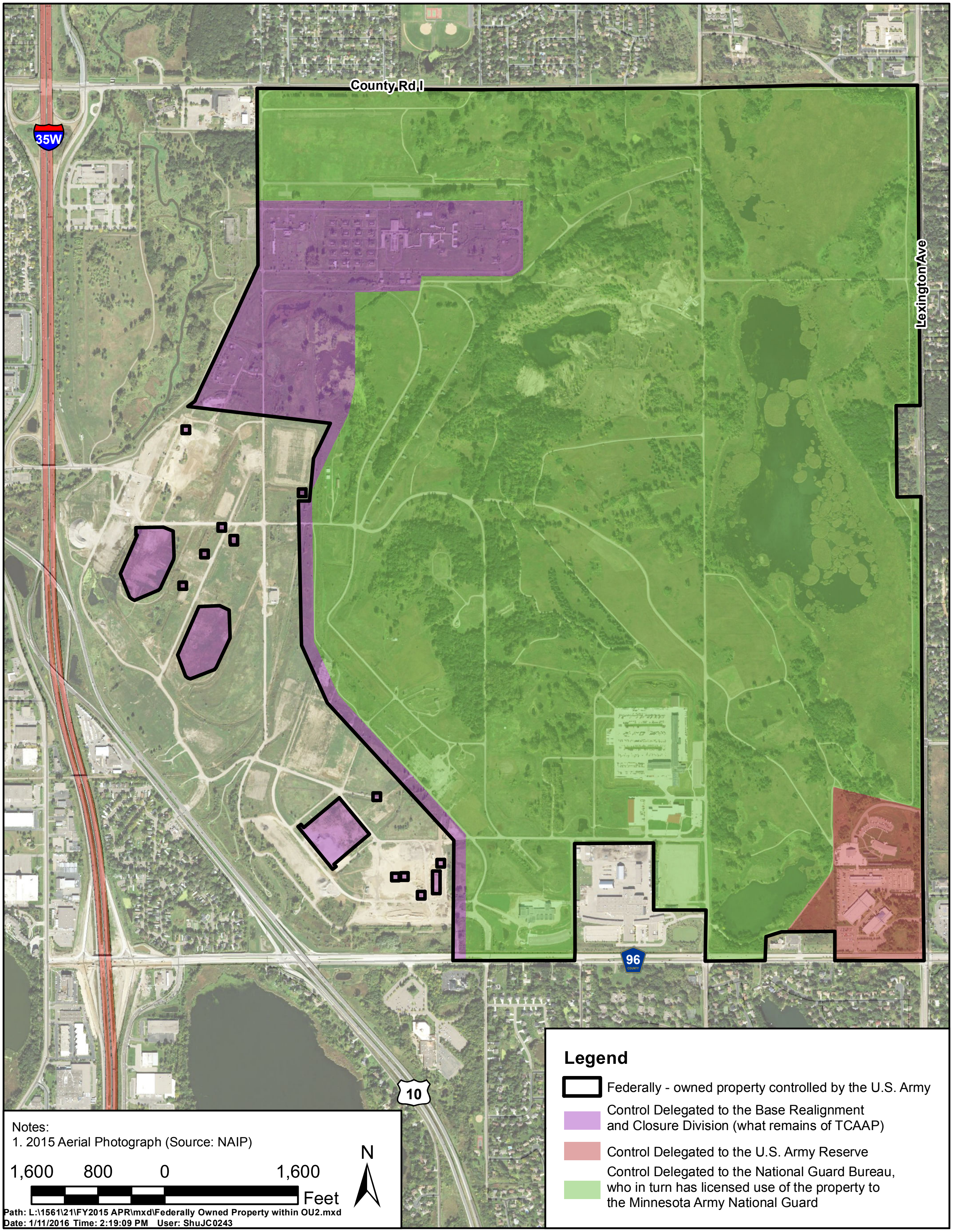
FY 2015

Figure 2-2



Notes:
1. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Federally Owned Property within OU2.mxd
Date: 1/11/2016 Time: 2:19:09 PM User: ShuJC0243

Legend

- ☐ Federally - owned property controlled by the U.S. Army
- 🟪 Control Delegated to the Base Realignment and Closure Division (what remains of TCAAP)
- 🟥 Control Delegated to the U.S. Army Reserve
- 🟩 Control Delegated to the National Guard Bureau, who in turn has licensed use of the property to the Minnesota Army National Guard

ANNUAL PERFORMANCE REPORT

Federally - Owned Property Within Operable Unit 2

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FY 2015

Figure 2-3

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) is 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 is conducted annually and is reported in the Annual Performance Reports.

Groundwater extraction is provided by six municipal wells: New Brighton Municipal (NBM) #3, #4, #5, #6, #14, and #15. 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 through #6 were pre-existing wells. NBM #14 and NBM #15 began pumping in December 1996 and March 1998, respectively.

The remedy also relies on provision of an alternate water supply and/or well abandonment, as necessary, to manage risks for existing private water supply wells, and land use controls (drilling advisory) to prevent new water supply wells from being constructed into the affected portion of the aquifer.

The OU1 remedy encountered a new and substantial issue in FY 2015 that has affected remedy performance. In early 2015, the City of New Brighton was notified by the Minnesota Department of Health (MDH) that an emerging contaminant, 1,4-dioxane, had been detected in New Brighton’s water supply. All of the NBCGRS wells extract groundwater from the Prairie du Chien and/or Jordan Aquifers (Upper and Lower Unit 4, respectively). 1,4-Dioxane can be present in some chlorinated solvents as a stabilizer, as well as other manufactured products. Confirmation sampling conducted by the City confirmed the presence of 1,4-dioxane in all of the NBCGRS wells, with detections ranging up to 6.8 µg/L. The City also sampled all their deeper aquifer municipal wells (Mt. Simon Aquifer) and found no detectable 1,4-dioxane. There is no federal drinking water standard for 1,4-dioxane; however, there is a state (MDH) Health Risk Limit (HRL) of 1 µg/L, and most of the NBCGRS wells were found to exceed this limit. Routine pumping of the NBCGRS was then ceased on April 15, 2015, with notice to the USEPA/MPCA. The Fridley Interconnection was also closed on April 15, 2015. Since the granular activated carbon (GAC) treatment does not remove 1,4-dioxane, the City is preferentially pumping their deep aquifer wells that have no detectable 1,4-dioxane while they evaluate the feasibility of 1,4-dioxane removal technologies. This has been referred to as a “remedy time-out,” and normal pumping of the NBCGRS will not be resumed until a technology is selected and modification of the NBCGRS is designed and constructed, such that both VOCs and 1,4-dioxane are removed.

The six major components of the remedy prescribed by the amended ROD are evaluated in the following sections, including discussion of the effects of the remedy time-out noted above.

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.

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 OU2, as shown on Figures E-2 and E-3 in Appendix E; and

    ii. The well is completed in an affected aquifer; and

    iii. The well contains detectable concentrations of the New Brighton/Arden Hills Superfund Site-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 <u>all</u> 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 OU2; and
    ii. The well is completed in an affected aquifer; and
    iii. The well contains detectable concentrations of the New Brighton/Arden Hills Superfund Site-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.

- Also, note that per Appendix E, program requirements for both alternate water supply and well abandonment have been clarified such that a well should contain an exceedance of a cleanup level (or an additivity of 1.0, similar to the MDH Hazard Index calculation), rather than merely “detectable concentrations” as noted above. On a case-by-case basis, review by the Army, USEPA, and MPCA could lead to an Army offer for alternate water supply and/or well abandonment for a given well with detectable concentrations that do not exceed a cleanup level (or additivity criteria), particularly if that well is used to supply drinking water.

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” (information on the well inventory is presented in Appendix E). The well inventory is a database that was initially developed in 1992, and which has been periodically updated since then (now annually as part of the Annual Performance Report). 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 2015, as defined by the 1 µg/L contour line?

No, the area of concern (the 1 µg/L contour line) did not change during FY 2015, with the exception of a very slight northward shift in the Upper Unit 4 contour line on the north side, due to slight increases in trichloroethene concentrations in wells 04U855, 04U879, and 04U839. The well inventory study area encompasses the FY 2015 area of concern.

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 2015 (outside of those included in the OU1 performance monitoring plan)? If yes, what were the findings?

Yes. Nine water supply wells within the area of concern for OU1 were sampled during FY 2015. Some water supply wells that were scheduled to be sampled in FY 2015 were not sampled because the well owner refused to provide access or did not respond to the request for access. Of the nine wells sampled, none had VOC detections. Four wells had detections of 1,4-dioxane with two of these wells having detections that were below the MDH HRL of 1 µg/L, and two having detections above the MDH HRL. The two wells with detections above the MDH HRL will be part of the “major” event that the Army intends to conduct in FY 2016. Neither of these two wells are utilized for consumption purposes, and their uses are listed below:

234421	BioClean	Industrial Use (Truck Washing)
537801	Midway Industrial	Irrigation

Were any well owners offered an alternate water supply and/or well abandonment during FY 2015? 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?
Yes. The next “major” event that was previously scheduled was to be in FY 2017; however, due to the discovery of 1,4-dioxane in deep groundwater, an unscheduled “major” event was conducted in FY 2015 and will be repeated by the Army in FY 2016 (Appendix A.1).

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):
For initial implementation, when the MDH has issued a Special Well Construction Area Advisory (SWCA). Implementation will continue until such time that the groundwater concentrations are below the cleanup levels.

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 SWCA 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 SWCA 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: EXTRACT GROUNDWATER

Description: "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." (2006 OU1 ROD Amendment, page 5-2 & 5-3)

Through January 2008, the remedy component consisted of recovering deep (Unit 4) groundwater using three primary City of New Brighton municipal wells (NBM #4, #14, and #15) with three alternate wells (NBM #3, #5, and #6). NBM #3 and #4 were existing wells completed in both the Prairie du Chien and Jordan. NBM #5 and #6 were existing wells completed in the 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.

The extracted groundwater is used as part of the New Brighton water supply system (with the exception of the current remedy time-out), 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 federal government 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.5 (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.

The revised pumping approach does not affect the approved statistical analysis used to evaluate the effectiveness of the remedy as set forth by the OU1 ROD Amendment. 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 2015, did the OU1 extraction system operate according to the New Brighton operational plan and consistent with past operations?
No. Due to detections of 1,4-dioxane in the NBCGRS wells, the NBCGRS was shut down on April 15, 2015, including the Fridley Interconnection. Based on past operations, the target average daily pumping rate is 3.168 million gallons per day (MGD) as shown in Appendix A.5. In FY 2015, the volume of water pumped by the NBCGRS was 602 million gallons (Table 3-1), which translates to a daily average of 1.6 MGD. Hence, the pumping in FY 2015 did not meet the pumping target during this remedy time-out period.

Are any changes or additional actions required for this remedy component?
Yes. The City of New Brighton will continue with their process of selecting a 1,4-dioxane removal technology, and then designing and constructing the modifications to the treatment system so that this groundwater extraction remedy component can be resumed.

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 (relative to VOCs) during FY 2015 up until the system was shut down on April 15, 2015, due to detections of 1,4-dioxane in the NBCGRS wells. There is no federal MCL or MCLG for 1,4-dioxane; however, there is a state (MDH) HRL of 1 µg/L that was found to be exceeded in most of the NBCGRS wells (with detections up to 6.8 µg/L). Since GAC is not effective for removal of 1,4-dioxane, the PGAC does not provide an adequate level of treatment. Following the April 15, 2015 shut down, the NBCGRS wells were not utilized for water supply during FY 2015. Some very limited pumping of the wells occurred for non-supply plant operations (e.g., filter backwashing).

Treatment of extracted groundwater in the PGAC water treatment facility (remedy component #4) continued to provide effective treatment for VOCs prior to its discharge into the City of New Brighton municipal water distribution system (remedy component #5). The treatment system is comprised of eight GAC vessels plumbed in parallel. Another eight GAC vessels are plumbed in series with the first eight to provide back-up treatment. The GAC vessels are labeled A or B and water 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). Routine sampling occurs between the two sets of GAC vessels, such that when a detection occurs, a clean set of GAC vessels is present downstream of the sampling point. Upon detection, change-out of carbon in the "lead" vessels is conducted as soon as possible (typically about 1 to 2 months later). Upon changing carbon, the direction of flow is reversed so that the eight vessels with the new carbon become the downstream vessels (the “clean” vessels are always rotated into the downstream position).

Table 3-2 shows that one carbon change-out occurred in FY 2015 in September - October 2014.

Is any sampling of the treated water proposed prior to the next report?
When needed, given the limited pumping during the remedy time-out, 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?
Yes. The City of New Brighton will continue with their process of selecting a 1,4-dioxane removal technology, and then designing and constructing the modifications to the treatment system so that this water treatment remedy component can be resumed. Note that this remedy component will eventually need to be modified in a ROD amendment or ESD such that “removal of VOCs by GAC” will become “removal of VOCs and 1,4-dioxane by [the selected treatment technology].”

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?
No. Up until April 15, 2015, treated water was being discharged to the New Brighton municipal

distribution system. After detections of 1,4-dioxane in the NBCGRS wells, the NBCGS was shut down and no water was being treated or discharged through the PGAC system.

Are any changes or additional actions required for this remedy component?
Yes. The City of New Brighton will continue with their process of selecting a 1,4-dioxane removal technology, and then designing and constructing the modifications to the treatment system so that this treated water discharge remedy component can be resumed.

3.6 REMEDY COMPONENT #6: GROUNDWATER MONITORING WITH VERIFICATION OF CONTINUING AQUIFER RESTORATION

Description: "Monitoring the groundwater to verify the effectiveness of the remedy through measurement of overall plume shrinkage (geographically) and decreasing contaminant concentrations." (2006 OU1 ROD Amendment, page 5-3)

Performance Standard (how do you know when you're done):
When performance groundwater monitoring verifies aquifer restoration.

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 #6. 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 2015 was a "major" sampling year for the groundwater monitoring wells. Also, with the detection of 1,4-dioxane in the NBCGRS wells, the USEPA and MPCA requested that the Army analyze groundwater samples for 1,4-dioxane at all scheduled OU1 sampling locations during the FY 2015 sampling event conducted in June, which was done. The USEPA and MPCA also requested that the list of wells to be sampled in a "major" well inventory sampling event be

sampled in June of FY 2015, which was done (nine water supply wells within the area of concern for OU1 were sampled, as discussed previously).

Is any groundwater monitoring proposed prior to the next report?

Yes, including the following:

- When operating, monthly monitoring of the extraction wells and treatment system effluent is performed by the City of New Brighton in accordance with the "New Brighton Water System Sampling and Analysis Plan," June 1997. However, the OU1 extraction system is not anticipated to be restarted within FY 2016 and therefore no such monitoring is anticipated to occur.
- Other groundwater monitoring will be in accordance with the Groundwater Monitoring Plan included as Appendix A.1. Given the arrival of the 1,4-dioxane issue in FY 2015, the Army plans to conduct a "major" sampling event in June of FY 2016 (in essence repeating the FY 2015 sampling event), to include both VOC and 1,4-dioxane analyses at all sampling locations. FY 2016 would otherwise have been a "minor" sampling event. The Army also plans to conduct a "major" well inventory sampling event again, to include both VOC and 1,4-dioxane analyses at all locations that allow access for sampling. Lastly, The Army also plans to conduct a limited OU1 sampling event in January 2016, for both VOCs and 1,4-dioxane, at the wells identified in Appendix A.1. The 14 OU1 wells to be sampled were identified in an October 22, 2015 Wenck Technical Memorandum that was approved by the MPCA and USEPA in November 2015. These wells are located along the west edge of the OU1 plume, and also along the axis of the plume, and are intended to monitor for any potential westward shifting of the plume in response to shutting down the NBCGRS.

Does groundwater monitoring show aquifer restoration is occurring?

Yes. Trend graphs for trichloroethene concentrations in NBM #3, #4, #5, #6, #14, and #15 are shown in Figure 3-2. Historical water quality values for the wells can be found in Appendix D. At both NBM #3 and NBM #4, trichloroethene significantly decreased between the start of pumping and 1998, increased slightly until approximately 2010, and have been relatively stable to slightly decreasing since then. At NBM #5, trichloroethene appears to be relatively stable since 2013, after earlier decreases. At NBM #6, trichloroethene also appears to be relatively stable since 2013, with a gradually declining trend overall. At NBM #14, the trichloroethene trend remained at or below the cleanup level for OU1 (5 µg/L), with the exception of the April 2015 sampling event. At NBM #15, after earlier declines, the trichloroethene trend appeared to be relatively stable since 2009; however, it appears to be trending slightly upward in FY 2015. Overall, the water quality data from the extraction wells supports the interpretation that the system is providing aquifer restoration.

Figure 3-3, Figure 3-4, and Figure 3-5 show the trichloroethene plumes in the Upper Unit 3, Lower Unit 3, and Upper Unit 4 portions of the aquifer for FY 2015, along with cross-section lines, based on the June 2015 sampling event. Cross-sections showing the plumes are presented in Figure 3-6, Figure 3-7, and Figure 3-8. These figures show both the OU1 and OU3 plumes, which overlap to some extent and should be viewed together. Figure 3-1 shows the 1 µg/L trichloroethene contour for Upper Unit 4 in 1990, 1999, 2009, and 2015 to help illustrate how the edge of the plume has changed over this time. Figure 3-9 shows how the 100 µg/L trichloroethene contour in Upper Unit 4 has changed over the same time period. In general, the plumes show no trend or stable concentrations (see the statistical analysis below) while, as Figure 3-1 and Figure 3-9 show, the plume foot print remains similar to 2009. A slight northward shift of the 1 µg/L trichloroethene contour, north of the NBCGRS, can be seen on the northwest edge of the plume, and this may be a result of the NBCGRS system being shut down in April, prior to the June sampling. Additional sampling will be needed to see if the trend continues, and also to see if the west edge of the plume in the areas south of the NBCGRS might also begin to show a shift. The water level data from June 2015 for Upper Unit 4 is presented as a potentiometric map on Figure 3-10.

The OU1 Technical Memorandum was prepared to develop statistical methods specifically selected to evaluate the long-term progress of remediation, plume evolution, and aquifer restoration 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). Table D.2.8 in Appendix D.2 shows the factors to consider and potential additional actions that may be implemented if statistical threshold is triggered. As Table D.2.8 shows, a threshold trigger initiates a closer look at the data and the context of the data in terms of remedy performance or potential risk. A threshold trigger does not automatically require any specific action. 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 located within OU2 are included in Group 5 to support the contouring near the OU2 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 2015 was a major sampling year, so new comprehensive plume mapping was completed (Figures 3-3 through 3-8). Table 3-4 presents the FY 2015 groundwater quality data for OU1. These data were collected to support the statistical analysis developed by the OU1TG. Historical trichloroethene concentrations at any well can be viewed in the Appendix D Groundwater Quality: Organic Data spreadsheet included on the FY 2015 APR CD-ROM.

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, from Appendix D.2, reflecting the data collected through FY 2015. 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 for the North Plume sub-group, with a no trend outcome. The Area Weighted Concentration (AWC) concentration for the Group 1 North Plume was 37 µg/L in FY 2015, down slightly from 45 µg/L in FY 2014. This value represents a weighted estimate of the average total VOC concentration just downgradient of the TGRS.

The Group 1 (downgradient of the TGRS) response threshold *was* triggered for the South Plume sub-group, with a stable outcome. The AWC for the South Plume was 4 µg/L and has been 4 µg/L over the analysis period (since 2007).

Group 2:

Six wells exhibited "increasing" or "no trend" trends in FY 2015, which triggered the thresholds identified for Group 2. Below is additional discussion of these six wells, in the order they are presented in Table 3-5:

409549 (Increasing): Concentrations increased from 28 µg/L in FY 2005 to 66 µg/L in FY 2015. The trend statistics indicate high confidence the trend is upward, though the trend appears somewhat more stable since 2011. This well is in the more central part of the north plume and the trend most likely reflects slight plume shifts. The historical high concentration at the well was 220 µg/L in FY 1988.

409557 (Increasing): Concentrations increased from 27 µg/L in FY 2005 to 77 µg/L in FY 2015. This well is in the Unit 3 between the North and South Plumes and the trend most likely reflects lateral dispersion between the plumes. This dispersion can be reasonably expected as the plume ages and pumping patterns change.

03U805 (Increasing): Concentrations fell slightly from 19 µg/L in FY 2013 to 12 µg/L in FY 2015. The trend still indicates a high confidence the trend is upward, but most likely reflects slight plume shifts. This well is part of the TGRS deep groundwater monitoring and is located on the southern edge of the north plume immediately down gradient of the TGRS.

04U832 (No Trend): Concentrations have ranged between 46 and 56 µg/L since 2007, and hence are relatively stable. This well is located on the southern edge of the south plume.

04U843 (Increasing): Concentrations at this well have been erratic but generally increasing since its installation in 1987. As shown on the OU1 plume map (Figure 3-5), this well is in the more central part of the north plume not far downgradient of the TGRS. It is located just downgradient of the VOC “hot spot” at 04U847. Since the 04U847 area is outside of the TGRS capture zone, this well can be expected to increase as migration of the hot spot continues. This well has not approached the magnitude of 04U847, which has exceeded 1,000 µg/L over most of its history. This suggests that the hot spot is attenuated as it migrates and/or is located just east of 04U843. The long-term trend for this well is unusual compared to overall decreases throughout the plume. Given that well 04U843 is near the core of the plume, the trend most likely indicates long-term redistribution of the plume in this area.

04U846 (Increasing): Concentrations fluctuated between 4.2 µg/L and 25 µg/L from FY 2005 to FY 2015. The trend statistics indicate high confidence the trend is upward, though the trend appears somewhat more stable since 2011. Historically this well has been erratic with a maximum concentration of 120 µg/L in FY 1988. It is located towards the south side of the North Plume in an unusually tight bend in the plume as it enters the immediate hydraulic influence of the NBCGRS. The erratic trend seems to reflect the unusual plume shape in this area. The proximity to the NBCGRS has likely created varying flow patterns in this area suggesting the erratic trend history reflects redistribution of the plume over time.

The key factors that apply to Group 2 (from Table D.2.8, Appendix D) are contaminant concentrations, risk to human health and urgency of response needed. Except for 04U843, the data are generally well within historical ranges, and all locations are within the capture zones of the remedial systems. The trend at 04U843 is consistent with the migration of the hot spot upgradient of that well. These trends are not dramatic enough to suggest an expansion of the plume, so an immediate response is not needed. Human health is protected by the remedial systems and the Special Well Construction Area. In the larger context, the overall trends continue to be downward suggesting that these anomalies, while worth monitoring, are not indicative of a larger issue with long-term plume control by the TGRS. The current sampling frequency is adequate to continue to monitor the trends in these wells.

Group 3 and Group 5:

The trend in the Area Weighted Concentration (AWC) for the Group 3 (downgradient sentinel wells) was stable. The Group 3 AWC was 19 µg/L in FY 2015, the same results as in FY 2013. The trend in the Group 5 (global plume mass wells) was no trend with an AWC of 41 µg/L, a decrease from the FY 2013 result, but above the calculated mean value of 38 µg/L from 2005 to 2013. The AWC represents a weighted average of the overall Unit 4 plume concentration. For further explanation of how the AWC is calculated see Appendix D.2.

Group 5 Unit 3 Wells:

The Unit 3 portion of Group 5 is presented in Table 3-5. Wells already in Group 2 were not included. Three wells in this group triggered a threshold: 409550, 03U822, and 03L809. Other wells included in this group had a MAROS conclusion of decreasing, with the exception of the three abandoned wells included in the group (409597, 409596, and 03U831).

409550 (Stable): This well is located on the north edge of the north plume. Concentrations steadily decreased from 3,200 µg/L in 1991 and have been relatively stable since 2009 with a value of 35 µg/L in FY 2015. The raw trend for this well is decreasing.

03U822 (No Trend): Concentrations were measured slightly over the 2005-2015 mean of 145 µg/L with a value of 150 µg/L in FY 2015. However, the concentrations have been between 120 µg/L and 160 µg/L since FY 2005. The raw trend for this well is increasing; however, the well is located in the center of the north plume, and therefore the increasing raw trend most likely reflects slight plume shifts consistent with the migration of the hotspot.

03L809 (Stable): The raw trend for this well is decreasing. Concentrations have been between 90 and 150 µg/L since FY 2009 and appear to be relatively stable over that time. The well is located in the north plume just down gradient of the TGRS.

Group 4:

In Group 4, four wells exceeded the trichloroethene cleanup level during FY 2015: 03L811 at 7.6 µg/L; 04U855 at 7.4 µg/L; 04U879 at 7.0 µg/L; and 04U839 at 15 µg/L. In all but 04U879, there were slight increases already evident in FY 2011 and FY 2013, though in all cases the FY 2013 results had remained below the trichloroethene cleanup level. In 04U879, prior results had been consistently at or near non-detect. The four wells are all located on the west/northwest edge of the plume between TCAAP and the NBCGRS. The higher detections in FY 2015 may have been influenced by shutting down the NBCGRS, which may allow a slight shifting and/or widening of the plume to the west. The more dramatic changes in two of these wells (04U839 and 04U879) may correlate with these two wells being closest to the NBCGRS, versus the other two wells that are located further upgradient. As noted previously, the Army is conducting additional OU1 well sampling in January 2016, including wells that are located along the west edge of the OU1 plume (and also along the axis of the plume), which is intended to monitor for any potential westward shifting and/or widening of the plume in response to shutting down the NBCGRS. Only 04U839 and 04U879 will be included in this January sampling event, given their closer proximity to the NBCGRS. All four of these wells will be sampled again in June 2016.

All other Group 4 wells were below the trichloroethene cleanup level during FY 2015.

<u>Group 6</u>:

The three wells installed and sampled since FY 2005 provide additional data points between OU2 and the NBCGRS to help complete the understanding of the extent and magnitude of VOC concentrations in the Jordan portion of the aquifer. In total, eight OU1 Jordan wells exhibited “Stable”, “No Trend”, or “Increasing” trends in FY 2015, which triggered the thresholds identified for Group 6. Below is additional discussion of these eight wells:

04J822 (Stable): This well is located near the center of the plume, just downgradient from the TGRS. Since 2011, trichloroethene concentrations have been between 40 µg/L and 47 µg/L with a concentration of 42 µg/L in FY 2015. The raw trend for this well is decreasing.

Two Jordan wells near the NBCGRS (04J836, 04J838) show No Trend and Increasing results, respectively. These results are not of concern, given that they are likely due to the variability of pumping rates at the NBCGRS wells, which can cause substantial variability in the concentrations in the adjacent area. Also, the Jordan well in this area that had the historically highest concentrations (04J837) shows an overall downward trend from 147 µg/L in FY 1998 to 2.2 µg/L in FY 2013, before a slight rebound to 12 µg/L in FY 2015. The very close proximity of all three of these wells to the NBCGRS wells, which were shut off approximately two months prior to the FY 2015 sampling event, were likely influenced by the shutdown.

04J839 (Stable): Concentrations are below 5 µg/L, so the “stable” outcome is not significant. The FY 2015 result was 2.1 µg/L.

04J847 (No Trend): This well is located just downgradient of the TGRS. To examine the history more thoroughly a second trend was run utilizing ten rounds of data collected since 2006. This represents the entire history of sampling at this well. This ‘extended trend’ is included in

Appendix D. The extended trend shows no trend. Also, the results since 2012 do appear to have stabilized between 790 and 880 µg/L. Continued annual monitoring is appropriate at this well given its central location in the plume.

04J849 (No Trend): This well has historically been a non-detect well while the nested Unit 4 well has shown an increasing trend. The concentration of 0.42 µg/L in FY 2015 is still well below the trichloroethene cleanup level.

04J708 (Stable): Since FY 2001 concentrations have been below 5 µg/L except for the FY 2013 and FY 2015 concentrations. The FY 2015 concentration was 6.8 µg/L. Given that this well is located along the line of TGRS boundary wells, slight plume shifts are likely and a stable trend is acceptable.

The Group 6 nested Unit 4 wells are also shown on Table 3-5 and generally correlate with their Jordan partners. This history suggests the NBCGRS is helping to reduce the Jordan concentrations in this area and thus is providing similar long-term improvement. In FY 2015, nine nested Unit 4 wells exhibited “Stable”, “No Trend”, or “Increasing” trends which triggered the thresholds identified for Group 6. Below is additional discussion of these nine wells:

04U702 (No Trend): All concentrations are below 3 µg/L, so “no trend” is not significant.

04U713 (Stable): All concentrations are below 1 µg/L, so “stable” is not significant. There was no detection in FY 2015.

04U836 (No Trend): The well is located in close proximity to the NBCGRS, so greater variability is expected, especially in FY 2015 and forward given the April 2015 shutdown of the NBCGRS.

04U837 (No Trend): The well is located in close proximity to the NBCGRS, so greater variability is expected, especially in FY 2015 and forward given the April 2015 shutdown of the NBCGRS. The raw trend is decreasing.

04U838 (No Trend): The well is located in close proximity to the NBCGRS, so greater variability is expected, especially in FY 2015 and forward given the April 2015 shutdown of the NBCGRS. Concentrations spiked at 48 µg/L in FY 2007, but have been less than 3 µg/L since 2009 (the four most recent sampling events). The raw trend is decreasing.

04U839 (Increasing): The well is located in close proximity to the NBCGRS, so greater variability is expected, especially in FY 2015 and forward given the April 2015 shutdown of the NBCGRS. The well is located on the west/northwest edge of the plume and has historically had concentrations below 3 µg/L; however the concentration increased substantially to 15 µg/L in FY 2015, and may have been influenced by the NBCGRS being shut down in April 2015. Further monitoring will be needed to determine whether a shifting and/or widening of the plume to the west is occurring. As noted previously, this well will be included in the January 2016 sampling event.

04U847 (Stable): The well is located at the VOC “hot spot” just downgradient of the TGRS, and hence greater variability is expected due to slight plume shifts. The raw trend is decreasing.

04U849 (Increasing): This well shows an increasing trend. Concentrations at this well have been erratic but generally increasing. The well is located near the center of the North Plume, downgradient from the VOC “hot spot” at 04U847, and hence greater variability is expected due to slight plume shifts. It appears to be relatively stable since FY 2011.

04U882 (No Trend): This well is located downgradient of the St. Anthony municipal wells, and shows no trend, while the nested Jordan well 04J882 remains non-detect. The raw trend is decreasing.

The New Brighton Municipal well trends were analyzed using a linear regression for data since 1998 (see Appendix D.2.5). Due to the large number of data points, regression was considered superior to the Mann-Kendall analysis. Data from FY 1998 were used to reflect the approximate time window used throughout the statistical analysis and to avoid skewing the analysis from the earlier high concentrations. All the New Brighton wells showed downward concentration trends, except NBM #3 and #4, which show a slight upward trend (likely the result of gradual plume shifting due to changes in NBCGRS pumping). This suggests that, overall; concentrations are decreasing at the New Brighton municipal well field, which agrees with the decreasing mass removal observed over the life of the system.

Overall Statistical Assessment:

There were individual threshold triggers identified in FY 2015. These triggers highlight specific areas of the plume that are changing over time. This type of behavior is expected in a large complex flow system such as OU1. The thresholds triggered do not suggest any problems with the remedial systems, but suggest movement within the established plumes. The area weighted analysis for Group 1 shows continuing overall improvement or stability in the plume. Overall, therefore, the FY 2015 monitoring data indicates that aquifer restoration is occurring in the Prairie du Chien and Jordan.

Overall, the data meet the statistical criteria developed in this document for assessing the remedial progress in the OU1 aquifers. The data show continuing improvement in the OU1 plume through FY 2015. The statistical behavior of the OU3 plume is addressed in Section 13.0.

Lastly, there were potentially a few well trends that may have been influenced by the NBCGRS shutdown on April 15, 2015; however, future monitoring results will need to be reviewed to determine whether a shifting and/or widening of the OU1 plume to the west is occurring, and whether any other plume changes are occurring in response to the NBCGRS remedy time-out.

How much VOC mass has been removed (at each well and total)?

Table 3-1 shows that the NBCGRS removed 187 pounds of VOCs during FY 2015. The total cumulative VOCs removed by the NBCGRS is 23,644 pounds. The relative contribution from each extraction well is also shown on Table 3-1.

Figure 3-11 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 2015 decreased significantly compared to FY 2014, which can be attributed to the shutdown of the NBCGRS system on April 15, 2015 when 1,4-dioxane was discovered in the NBCGRS wells. The trend in annual mass removal per unit volume pumped increased slightly in FY 2008 from FY 2007, but has essentially been on a gradually decreasing trend since then. More generally, the mass removal has been on a decreasing trend since FY 1998, when the last extraction well was brought online (NBM #15). This overall decline in the mass removal trend agrees with the trichloroethene trends in OU1 deep groundwater, which generally show a decreasing trend and suggests that aquifer restoration is progressing.

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

As noted previously, future monitoring results will need to be reviewed to determine whether a shifting and/or widening of the OU1 plume to the west is occurring, and whether any other plume changes are occurring in response to the NBCGRS remedy time-out. The Army has increased the amount of monitoring in FY 2016, with an added OU1 sampling event in January 2016 and also with a “major” OU1 sampling event to be conducted in June 2016, rather than what would have been a “minor” event. Another “major” well inventory sampling event in June 2016 has also been added. Both VOCs and 1,4-dioxane will be analyzed at all of these locations.

Table 3-1
OU1 Pumping / VOC Mass Removal Data

Fiscal Year 2015

	WELL #3			WELL #4			WELL #5			WELL #6			WELL #14			WELL #15			System Totals	
MONTH	VOC (µg/L)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	VOC (µg/L)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	VOC (µg/L)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	VOC (µg/L)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	VOC (µg/L)	WATER TREATED (mgallons)	VOC Mass Removed (lbs)	VOC (µg/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, 2014																			27,656	23,457
OCTOBER	62	23.026	11.915	56	3.513	1.642	49	4.632	1.894	39	2.742	0.893	2.6	0.147	0.003	16	41.583	5.553	76	21.90
NOVEMBER	62	16.049	8.305	61	15.001	7.637	49	22.016	9.004	0	0.000	0.000	2.3	0.185	0.004	24	24.000	4.808	77	29.76
DECEMBER	72	1.750	1.052	66	14.337	7.897	42	21.567	7.560	0	0.000	0.000	2.0	19.628	0.328	26	43.193	9.373	100	26.21
JANUARY	65	13.409	7.274	67	17.968	10.047	41	17.868	6.114	0	8.518	0.000	3.1	0.211	0.005	33	42.761	11.777	101	35.22
FEBRUARY	70	12.543	7.328	74	17.586	10.861	47	11.292	4.429	43	13.893	4.986	2.7	0.199	0.004	30	35.923	8.994	91	36.61
MARCH	63	3.733	1.963	0	0.000	0.000	45	20.299	7.624	40	22.862	7.632	2.1	28.615	0.502	25	36.270	7.568	112	25.29
APRIL	65	0.116	0.063	0	0.000	0.000	47	5.196	2.038	37	5.834	1.802	10.0	13.670	1.141	49	17.496	7.155	42	12.20
MAY	0	0.000	0.000	0	0.000	0.000	0	0.234	0.000	0	0.000	0.000	0.0	0.000	0.000	0	0.000	0.000	0	0.00
JUNE	0	0.000	0.000	0	0.000	0.000	0	0.001	0.000	0	0.000	0.000	0.0	0.214	0.000	0	0.000	0.000	0	0.00
JULY	0	0.122	0.000	0	0.026	0.000	0	0.434	0.000	0	0.000	0.000	0.0	0.000	0.000	0	0.000	0.000	1	0.00
AUGUST	0	0.000	0.000	0	0.000	0.000	0	0.420	0.000	0	0.000	0.000	0.0	0.000	0.000	0	0.000	0.000	0	0.00
SEPTEMBER	0	0.138	0.000	0	0.194	0.000	0	0.289	0.000	0	0.085	0.000	0.0	0.176	0.000	0	0.154	0.000	1	0.00
Subtotal			37.900			38.084			38.663			15.313			1.987			55.228		
% of Total Mass			20.2			20.3			20.7			8.2			1.1			29.5		
TOTAL GALLONS TREATED AND VOC'S REMOVED FOR FISCAL YEAR 2015																			602	187.19
TOTAL GALLONS TREATED AND VOC'S REMOVED SINCE SYSTEM START UP																			28,259	23,644

Note: Routine pumping of the NBCGRS was ceased on April 15, 2015, with notice to the USEPA/MPCA, due to detection of 1,4-dioxane in the Prairie du Chien and Jordan Aquifer municipal wells. Since the granular activated carbon (GAC) does not remove 1,4-dioxane, New Brighton is preferentially pumping deep aquifer wells that have no detectable 1,4-dioxane while the City evaluates the feasibility of 1,4-dioxane removal technologies. This has been referred to as a “Remedy Time-Out,” and normal pumping of the NBCGRS will not be resumed until a technology is selected and modification of the NBCGRS is designed and constructed. Limited, intermittent pumping of the NBCGRS wells will occur only when necessary to provide the incremental volume of water (beyond what deep aquifer pumping can provide) that is necessary to meet peak demand periods in the summer. The Fridley Interconnection was also closed on April 15, 2015.

Table 3-2
OU1, PGAC Effluent Water Quality

Fiscal Year 2015

	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
GAC replaced in contactors 1A, 2A, 3A, 4A, 5A, 6A, 7A, 8A September 16 - October 3, 2014. "B" Vessels become the Lead Vessels.																						
6-Oct-14	62	56	49	39	3	16	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
3-Nov-14	62	61	49	NS	2	24	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
1-Dec-14	72	66	42	NS	2	26	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
12-Jan-15	65	67	41	NS	3	33	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
2-Feb-15	70	74	47	43	3	30	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
2-Mar-15	63	NS	45	40	2	25	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
6-Apr-15	65	NS	47	37	10	49	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0	NS	0
See Note 3 with regard to the discovery of 1,4-dioxane in the NBCGRS wells.																						
May-15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Jun-15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Jul-15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Aug-15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Sep-15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Notes:

1) All water quality results shown are for Total VOCs (µg/L).

2) NS = Not Sampled.

3) Routine pumping of the NBCGRS was ceased on April 15, 2015, with notice to the USEPA/MPCA, due to detection of 1,4-dioxane in the Prairie du Chien and Jordan Aquifer municipal wells. Since the granular activated carbon (GAC) does not remove 1,4-dioxane, New Brighton is preferentially pumping deep aquifer wells that have no detectable 1,4-dioxane while the City evaluates the feasibility of 1,4-dioxane removal technologies. This has been referred to as a “Remedy Time-Out,” and normal pumping of the NBCGRS will not be resumed until a technology is selected and modification of the NBCGRS is designed and constructed. Limited, intermittent pumping of the NBCGRS wells will occur only when necessary to provide the incremental volume of water (beyond what deep aquifer pumping can provide) that is necessary to meet peak demand periods in the summer. The Fridley Interconnection was also closed on April 15, 2015.

Table 3-3
Summary of OU1 Monitoring Requirements

Fiscal Year 2015

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 Performance 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: Extract Groundwater	a. Pumping volume and rates for each extraction well for comparison to target flowrates	New Brighton	New Brighton Water System Sampling and Analysis Plan
	b. Water levels from monitoring wells to draw contour maps, if desired	Army	OU1 Groundwater Monitoring Plan in the Annual Performance Report
	c. Water quality, to assist in evaluation of statistical improvements in groundwater quality	Army	OU1 Groundwater Monitoring Plan in the Annual Performance 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 with Verification of Continuing Aquifer Restoration	a. Water quality, to assist in evaluation of statistical improvements in groundwater quality.	Army	OU1 Groundwater Monitoring Plan in the Annual Performance Report
	b. Water quality data throughout the North Plume to evaluate remedial progress	Army	OU1 Groundwater Monitoring Plan in the Annual Performance Report

Table 3-4
OU1 Groundwater Quality Data

Fiscal Year 2015

			Trichloro-ethene (µg/L)	1,1,1-Trichloro-ethane (µg/L)	1,4 Dioxane (µg/L)	1,1-Dichloro-ethene (µg/L)	cis-1,2-Dichloro-ethene (µg/L)	1,1,2-Trichloro-ethane (µg/L)	1,1-Dichloro-ethane (µg/L)
OU1 Cleanup Level (1)			5	200	---	6	70	3	70
MDH HRL (2)			---	---	1	---	---	---	---
03U811		6/10/15	<1	<1	**11.4**	<1	<1	<1	<1
03U821		6/17/15	**14**	JP 0.74	**11.3**	JP 0.77	<1	<1	JP 0.56
03U822		6/23/15	**150**	1.3	**14.7**	4.5	1.7	<1	6.3
03M843		6/10/15	<1	<1	**11.8**	<1	<1	<1	<1
03L811		6/12/15	**7.6**	<1	**15.9**	1.0	<1	<1	JP 0.86
03L822		6/23/15	**190**	3.0	**15**	5.0	2.8	<1	3.3
03L832		6/16/15	1.5	<1	0.20	<1	<1	<1	<1
03L841		6/10/15	<1	<1	**2.1**	JP 0.38	JP 0.81	<1	<1
03L846		6/10/15	JP 0.55	<1	**15.3**	**12**	35	<1	14
04U821		6/18/15	**20**	1.0	**12.5**	1.3	<1	<1	1.3
04U834		6/8/15	<1	<1	JP 0.046 UFB0.036	<1	<1	<1	<1
04U836		6/9/15	**77**	2.6	**6.8**	**6.1**	2.2	<1	4.9
04U837		6/10/15	**6.6**	<1	0.79	JP 0.53	JP 0.47	<1	JP 0.58
04U838		6/10/15	2.7	<1	0.31	<1	JP 0.47	<1	<1
04U839		6/9/15	**15**	JP 0.57	**1.6**	1.2	<1	<1	1.0
04U841		6/17/15	**15**	1.6	**4.0**	2.0	JP 0.68	<1	1.5
04U843		6/23/15	**180** JMS135	11 JMS126	**14.7**	**16**	2.0	<1	10
04U844		6/23/15	**220**	16	**11.9**	**19**	4.2	<1	13
04U846		6/17/15	**25**	<1	**15**	**6.4**	13	<1	10
04U847		6/24/15	**940**	11	**50.2**	**51**	7.9	<2	45
04U847	D	6/24/15	**960**	12	**60.4**	**53**	8.3	<2	45
04U849		6/22/15	**79**	3.5	**9.0**	**6.7**	JP 0.96	<1	5.1
04U849	D	6/22/15	**85**	3.7	**9.4**	**7.2**	1.1	<1	5.5
04U850		6/22/15	**45**	JP 0.63	**4.6**	3.2	3.3	<1	3.2
04U855		6/16/15	**7.4**	<1	**1.6**	JP 0.39	<1	<1	JP 0.45
04U871		6/17/15	**19**	JP 0.89	**2.9**	1.3	<1	<1	2.5

Table 3-4
OU1 Groundwater Quality Data

Fiscal Year 2015

			Trichloro-ethene (µg/L)	1,1,1-Trichloro-ethane (µg/L)	1,4 Dioxane (µg/L)	1,1-Dichloro-ethene (µg/L)	cis-1,2-Dichloro-ethene (µg/L)	1,1,2-Trichloro-ethane (µg/L)	1,1-Dichloro-ethane (µg/L)
OU1 Cleanup Level (1)			5	200	---	6	70	3	70
MDH HRL (2)			---	---	1	---	---	---	---
04U872		6/16/15	3.1	<1	0.59	<1	<1	<1	<1
04U872	D	6/16/15	3.1	<1	0.58	<1	<1	<1	<1
04U875		6/5/15	<1	<1	JP 0.058	<1	<1	<1	<1
04U877		6/8/15	JP 0.34	<1	0.31	<1	<1	<1	<1
04U877	D	6/8/15	<1	<1	0.28	<1	<1	<1	<1
04U879		6/11/15	**7.0**	<1	1.0	JP 0.56	<1	<1	JP 0.46
04U879	D	6/11/15	**6.9**	<1	1.0	JP 0.52	<1	<1	JP 0.49
04U880		6/5/15	<1	<1	JP 0.048 UFB0.036	<1	<1	<1	<1
04U881		6/16/15	**13**	JP 0.49	**1.4**	JP 0.93	<1	<1	1.3
04U882		6/17/15	**20**	1.1	**1.5**	1.3	<1	<1	1.1
04U883		6/5/15	<1	<1	JP 0.036	<1	<1	<1	<1
04J822		6/18/15	**42**	7.0	**2.0**	**7.1**	1.3	<1	4.5
04J834		6/4/15	<1	<1	<0.07	<1	<1	<1	<1
04J836		6/9/15	**23**	JP 0.78	**2.9**	1.7	JP 0.45	<1	1.5
04J837		6/15/15	**12**	<1	**1.7**	JP 0.82	JP 0.81	<1	1.2
04J838		6/17/15	**42**	JP 0.62	**1.8**	2.2	JP 0.37	<1	2.0
04J839		6/9/15	2.1	<1	0.086 UFB0.036	<1	<1	<1	<1
04J847		6/24/15	**840**	32	**39.3**	**57**	8.9	<2	43
04J849		6/11/15	JP 0.42	JP 0.40	0.22	JP 0.30	<1	<1	<1
04J882		6/4/15	<1	<1	<0.07	<1	<1	<1	<1
PJ#318		6/10/15	1.2	<1	0.11 UFB0.041	<1	<1	<1	<1
200154		6/18/15	JP 0.37	<1	0.085	<1	<1	<1	<1
234546		6/25/15	**8.8**	<1	1.0	JP 0.45	<1	<1	JP 0.74
409547		6/22/15	2.7	1.6	**5.0**	3.5	1.4	<1	4.6
409548		6/12/15	JP 0.76	<1	**3.1**	<1	JP 0.79	<1	JP 0.38
409549		6/19/15	**66**	3.5	**8.7**	5.7	JP 0.89	<1	4.7

Table 3-4
OU1 Groundwater Quality Data

Fiscal Year 2015

			Trichloro-ethene (µg/L)	1,1,1-Trichloro-ethane (µg/L)	1,4 Dioxane (µg/L)	1,1-Dichloro-ethene (µg/L)	cis-1,2-Dichloro-ethene (µg/L)	1,1,2-Trichloro-ethane (µg/L)	1,1-Dichloro-ethane (µg/L)
OU1 Cleanup Level (1)			5	200	---	6	70	3	70
MDH HRL (2)			---	---	1	---	---	---	---
409550		6/19/15	**35**	2.0	**7.4**	JP 0.61	<1	<1	<1
409555		6/4/15	<1	<1	0.098 UFB0.036	<1	<1	<1	<1
409556		6/8/15	<1	<1	<0.07	<1	<1	<1	<1
409556	D	6/8/15	<1	<1	<0.07	<1	<1	<1	<1
409557		6/12/15	**77**	5.9	**12.3**	**17**	4.5	<1	15
512761		6/18/15	2.9	<1	0.26	<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.

(2) No OU1 cleanup level has been established for 1,4-dioxane. For reference, the Minnesota Department of Health (MDH) Health Risk Limit (HRL) for 1,4-dioxane is 1 µg/L. Bolding (in red color) indicates exceedance of the HRL.

D Duplicate sample.

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

JP The value is below the Reporting Limit, but above the Method Detection Limit. Results should be considered estimated.

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

Table 3-5
Group 1, 2, 3, and 5 Mann-Kendall Summary and MAROS Conclusion for OU1

Group	Kendall S	N	Raw Trend	Confidence	COV	Raw Trend Decision	MAROS Conclusion	Threshold Triggered?	Comments
Group 2 Wells:									
409549	12	6	Increasing	98.66%	0.4806	Definite	**Increasing**	Yes	Near plume center, looks stable since 2011
409557	13	6	Increasing	99.17%	0.3777	Definite	**Increasing**	Yes	Near plume center, plume shifted slightly
03L673	-12	6	Decreasing	98.66%	0.1974	Definite	**Decreasing**	No	
03L833	-9	6	Decreasing	93.20%	0.4422	Probable	**Decreasing**	No	
03L848	-11	6	Decreasing	97.20%	0.1059	Definite	**Decreasing**	No	
03L859	-11	6	Decreasing	97.20%	0.1622	Definite	**Decreasing**	No	
03U677	0	6	Zero	41.78%	NA	S or NT	**NA**	No	All ND
03U805	9	6	Increasing	93.20%	1.1801	Probable	**Increasing**	Yes	Near plume center, plume shifted slightly
04U673	-15	6	Decreasing	99.86%	0.2162	Definite	**Decreasing**	No	
04U821	-6	6	Decreasing	81.38%	0.1564	S or NT	**Stable**	No	
04U832	3	6	Increasing	64.00%	0.0795	S or NT	**No Trend**	Yes	Between 46 and 56 µg/L since 2007
04U833	-11	6	Decreasing	97.20%	0.6368	Definite	**Decreasing**	No	
04U841	-8	6	Decreasing	89.62%	0.1161	S or NT	**Stable**	No	
04U843	15	6	Increasing	99.86%	0.3938	Definite	**Increasing**	Yes	Near plume center, plume shifted slightly
04U845	-6	6	Decreasing	81.38%	0.3126	S or NT	**Stable**	No	See OU3 Discussion
04U846	14	6	Increasing	99.46%	0.5965	Definite	**Increasing**	Yes	Near plume center, looks stable since 2011
04U849									See Group 6 summary
04U854	-10	6	Decreasing	95.38%	0.1304	Definite	**Decreasing**	No	
04U859	-14	6	Decreasing	99.46%	0.2031	Definite	**Decreasing**	No	
04U861 (abandoned)	11	6	Increasing	97.00%	1.0198	Definite	**NA**	NA	Abandoned after 2006 sample, in New Brighton Development
04U875	-8	6	Decreasing	89.62%	0.9556	S or NT	**Stable**	No	
04U877	-2	6	Decreasing	57.46%	0.5951	S or NT	**Stable**	No	
206688	-4	6	Decreasing	70.66%	0.0719	S or NT	**Stable**	No	Well not in operation in 2015 sampling
Group 1 NP	1	6	Increasing	50.00%	0.1434	S or NT	**No Trend**	Yes	Between 36 and 51 µg/L since 2007
Group 1 SP	0	6	Zero	41.78%	0.0000	S or NT	**Stable**	Yes	Stable, but avgerage is <5 µg/L
Group 3	-6	6	Decreasing	81.38%	0.0915	S or NT	**Stable**	Yes	Raw trend is decreasing
Group 5	5	6	Increasing	76.50%	0.0928	S or NT	**No Trend**	Yes	Between 33 and 43 µg/L since 2003

Notes:

S or NT = Stable or No Trend
N = Number of data points
COV = Coefficient of Variance
NA = Not Applicable
Response Threshold triggers are defined in Table D.2.3

MAROS Decision 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

Table 3-5
Group 5 Unit 3 Mann-Kendall Summary and MAROS Conclusion for OU1

Group	Kendall S	N	Raw Trend	Confidence	COV	Raw Trend Decision	MAROS Conclusion	Threshold Triggered?	Comments
Group 5 Unit 3 Wells:									
409550	-6	6	Decreasing	81.38%	0.4240	S or NT	**Stable**	Yes	Raw trend is decreasing
409597 (abandoned)	-11	6	Decreasing	99.00%	0.3885	Definite	**NA**	NA	Abandoned due to constr. after 2007 sampling
409596 (abandoned)	-8	6	Decreasing	90.10%	0.6714	Probable	**NA**	NA	Abandoned due to constr. after 2007 sampling
03U831 (abandoned)	9	6	Increasing	93.20%	1.5885	Probable	**NA**	NA	Abandoned due to constr. after 2006 sampling
03U821	-14	6	Decreasing	99.46%	0.1131	Definite	**Decreasing**	No	
03U822	1	6	Increasing	50.00%	0.1046	S or NT	**No Trend**	Yes	Between 120 and 160 µg/L since 2003
03L822	-11	6	Decreasing	97.20%	0.3259	Definite	**Decreasing**	No	
03L809	-8	6	Decreasing	89.62%	0.6854	S or NT	**Stable**	Yes	Raw trend is decreasing

Notes:

S or NT = Stable or No Trend

N = Number of data points

COV = Coefficient of Variance

NA = Not Applicable

Response Threshold triggers are defined in Table D.2.3

MAROS Decision 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

Table 3-5
Group 6 Mann-Kendall Summary and MAROS Conclusion for OU1

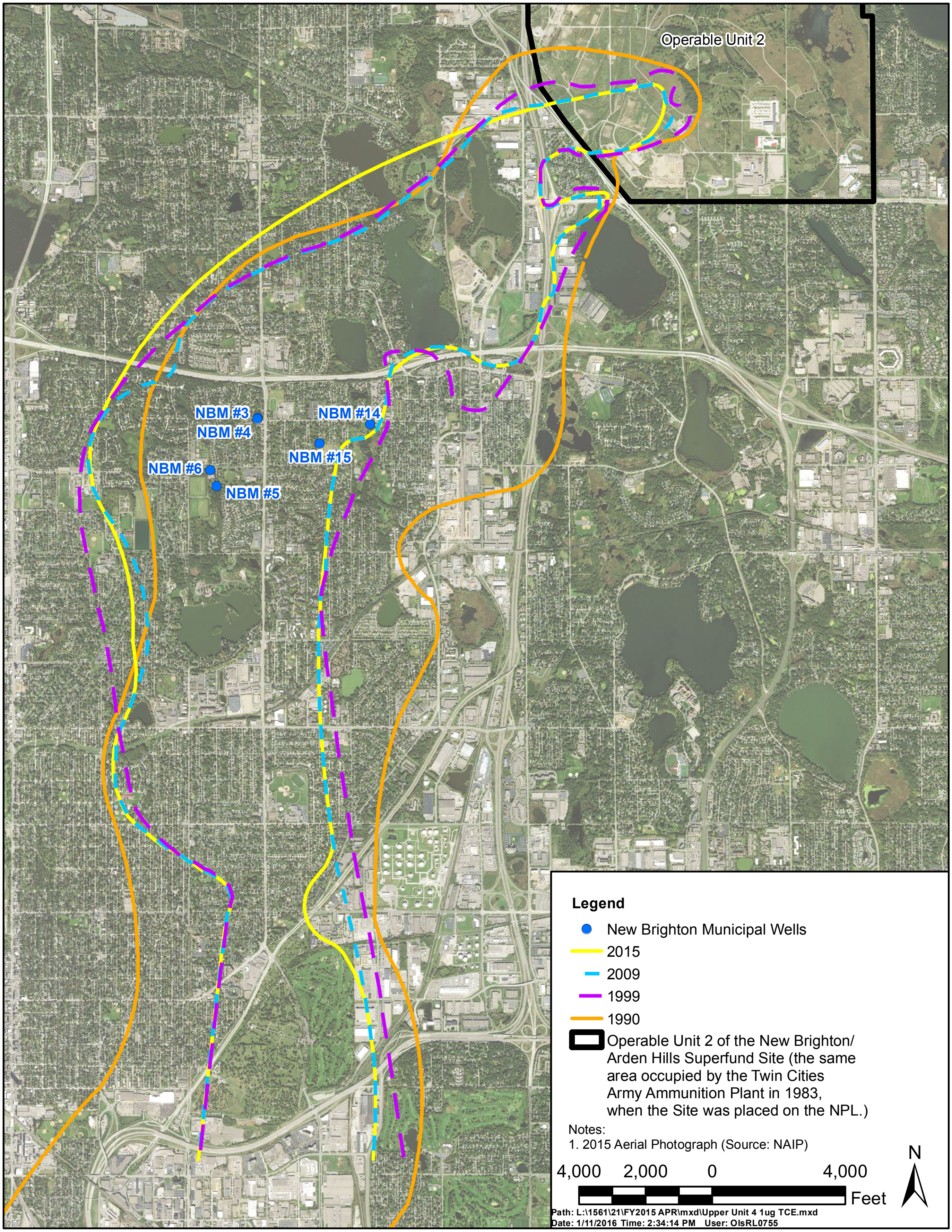
Group	Kendall S	N	Raw Trend	Confidence	COV	Raw Trend Decision	MAROS Conclusion	Threshold Triggered?	Comments
Group 6 OU1 Jordan Wells:									
04J822	-4	6	Decreasing	70.66%	0.1237	S or NT	**Stable**	Yes	Raw trend is decreasing
04J834	-12	6	Decreasing	98.66%	0.8300	Definite	**Decreasing**	No	All detection below 0.38 µg/L
04J836	6	6	Increasing	81.38%	1.1467	S or NT	**No Trend**	Yes	Close proximity to NBCGRS wells (& shutdown)
04J838	13	6	Increasing	99.17%	0.1568	Definite	**Increasing**	Yes	Close proximity to NBCGRS wells (& shutdown)
04J837	-5	6	Decreasing	76.50%	0.8138	S or NT	**Stable**	Yes	Raw trend is decreasing
04J839	-3	6	Decreasing	64.00%	0.2728	S or NT	**Stable**	Yes	All detections below 4 µg/L
04J847	3	6	Increasing	64.00%	0.0988	S or NT	**No Trend**	Yes	Near plume center, looks stable since 2012
04J849	5	6	Increasing	76.50%	2.4495	S or NT	**No Trend**	Yes	All detection below 0.42 µg/L
04J882	0	6	Zero	41.78%	NA	S or NT	**NA**	No	All ND
04J077	-9	6	Decreasing	93.20%	0.4863	Probable	**Decreasing**	No	
04J702	-15	6	Decreasing	99.86%	0.9248	Definite	**Decreasing**	No	
04J708	7	6	Increasing	86.40%	0.2563	S or NT	**No Trend**	Yes	Close proximity to TGRS wells (plume shift)
04J713	0	6	Zero	41.78%	NA	S or NT	**NA**	No	All ND
Group 6 Nested Unit 4 wells:									
04U077	-15	6	Decreasing	99.86%	0.4286	Definite	**Decreasing**	No	
04U702	2	6	Increasing	57.46%	0.2144	S or NT	**No Trend**	Yes	Detections below 2.1 µg/L since 2005
04U708	-12	6	Decreasing	98.66%	0.9072	Definite	**Decreasing**	No	
04U713	-6	6	Decreasing	81.38%	0.6583	S or NT	**Stable**	Yes	All detections below 0.6 µg/L
04U834	-15	6	Decreasing	99.86%	0.9445	Definite	**Decreasing**	No	
04U836	1	6	Increasing	50.00%	0.4578	S or NT	**No Trend**	Yes	Close proximity to NBCGRS wells (& shutdown)
04U837	-5	6	Decreasing	76.50%	1.1592	S or NT	**No Trend**	Yes	Raw trend is decreasing
04U838	-2	6	Decreasing	57.46%	1.5423	S or NT	**No Trend**	Yes	Detections below 3 µg/L since 2009
04U839	9	6	Increasing	93.20%	1.6379	Probable	**Increasing**	Yes	Close proximity to NBCGRS wells (& shutdown)
04U847	-1	6	Decreasing	50.00%	0.2427	S or NT	**Stable**	Yes	Raw trend is decreasing
04U849	11	6	Increasing	97.20%	0.3423	Definite	**Increasing**	Yes	Near plume center, looks stable since 2011
04U882	-4	6	Decreasing	70.66%	0.1708	S or NT	**No Trend**	Yes	Raw trend is decreasing

Notes:

S or NT = Stable or No Trend
N = Number of data points
COV = Coefficient of Variance
NA = Not Applicable
Response Threshold triggers are defined in Table D.2.3

MAROS Decision 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

T:\1561 TCAAP\APR\FY15 APR\Report\Appendices\App D\App D.2.3 FY15\mannkendallsix2015



Path: L:\1561\21\FY2015 APR\mxd\Upper Unit 4 1ug TCE.mxd
Date: 1/11/2016 Time: 2:34:14 PM User: OlsRL0755

ANNUAL PERFORMANCE REPORT

Upper Unit 4,

1 µg/LTrichloroethene Isoconcentration Map

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FY 2015

Figure 3-1

FIGURE 3-2
NEW BRIGHTON MUNICIPAL WELLS: TRICHLOROETHENE WATER QUALITY TRENDS

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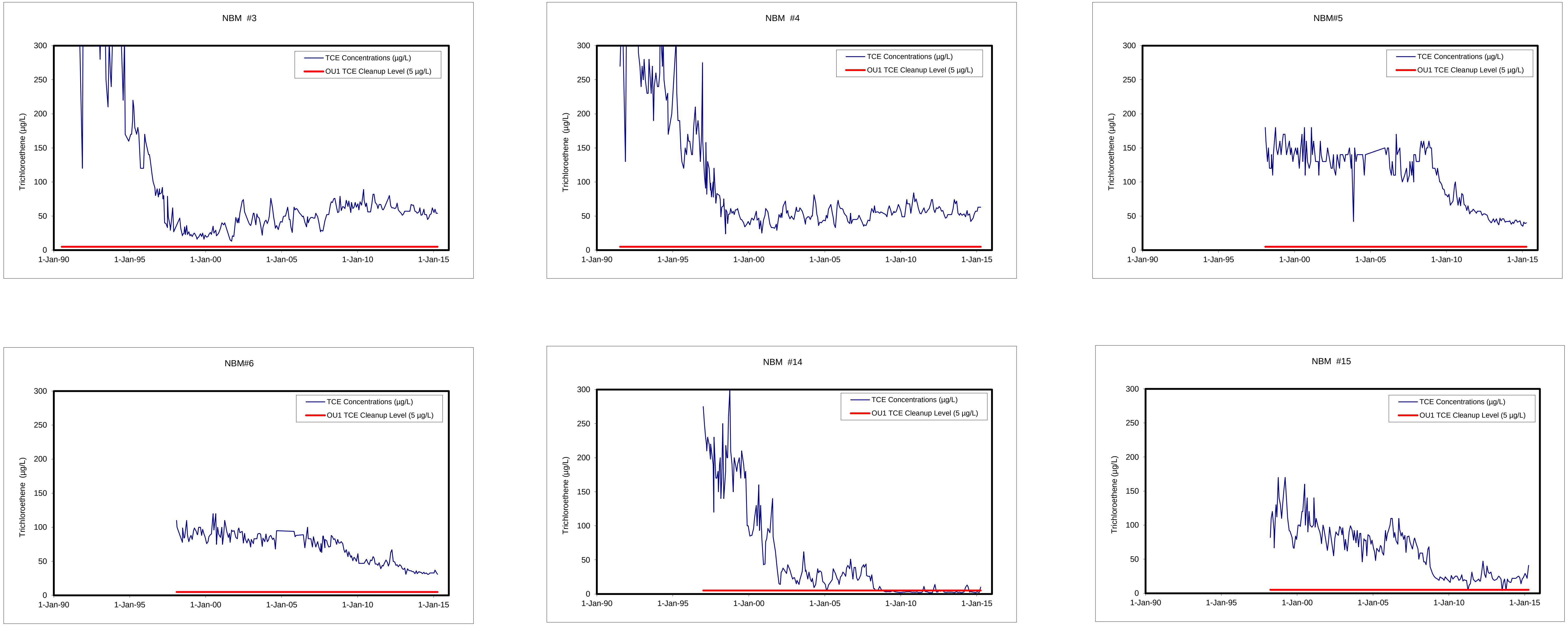
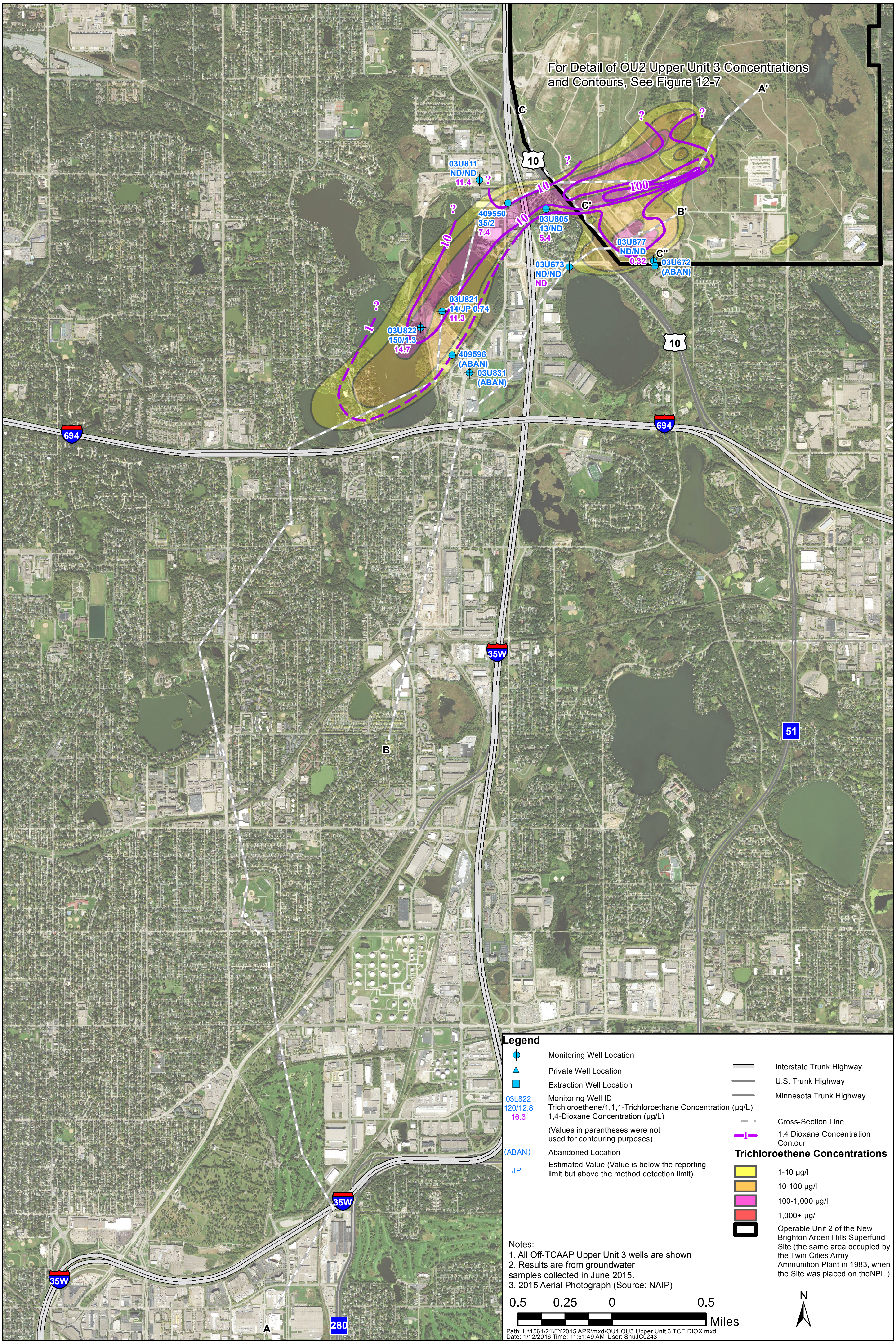


Note: Routine pumping of the NBCGRS was ceased on April 15, 2015, with notice to the USEPA/MPCA, due to detection of 1,4-dioxane in the Prairie du Chien and Jordan Aquifer municipal wells. Since the granular activated carbon (GAC) does not remove 1,4-dioxane, New Brighton is preferentially pumping deep aquifer wells that have no detectable 1,4-dioxane while the City evaluates the feasibility of 1,4-dioxane removal technologies. This has been referred to as a “Remedy Time-Out,” and normal pumping of the NBCGRS will not be resumed until a technology is selected and modification of the NBCGRS is designed and constructed. The Fridley Interconnection was also closed on April 15, 2015.



Notes:
1. All Off-TCAAP Upper Unit 3 wells are shown
2. Results are from groundwater samples collected in June 2015.
3. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\OU1 OU3 Upper Unit 3 TCE DIOX.mxd
Date: 1/12/2016 Time: 11:51:49 AM User: ShuJC0243

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OU1 & OU3, Upper Unit 3, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June 2015

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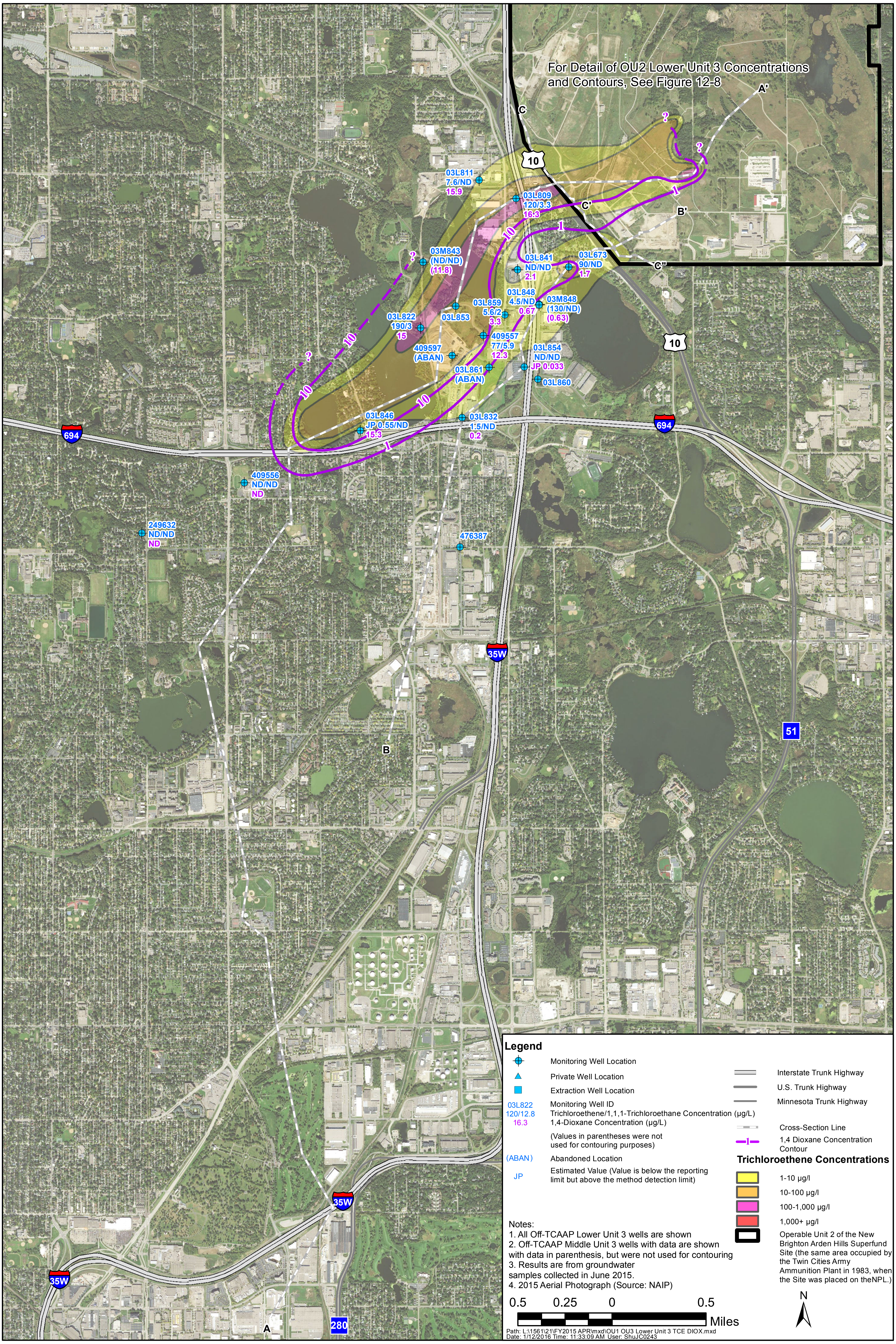
Figure 3-3



Notes:
1. All Off-TCAAP Lower Unit 3 wells are shown
2. Off-TCAAP Middle Unit 3 wells with data are shown with data in parenthesis, but were not used for contouring
3. Results are from groundwater samples collected in June 2015.
4. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\OU1 OU3 Lower Unit 3 TCE DIOX.mxd
Date: 1/12/2016 Time: 11:33:09 AM User: ShuJC0243

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OU1 & OU3, Lower Unit 3, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June 2015

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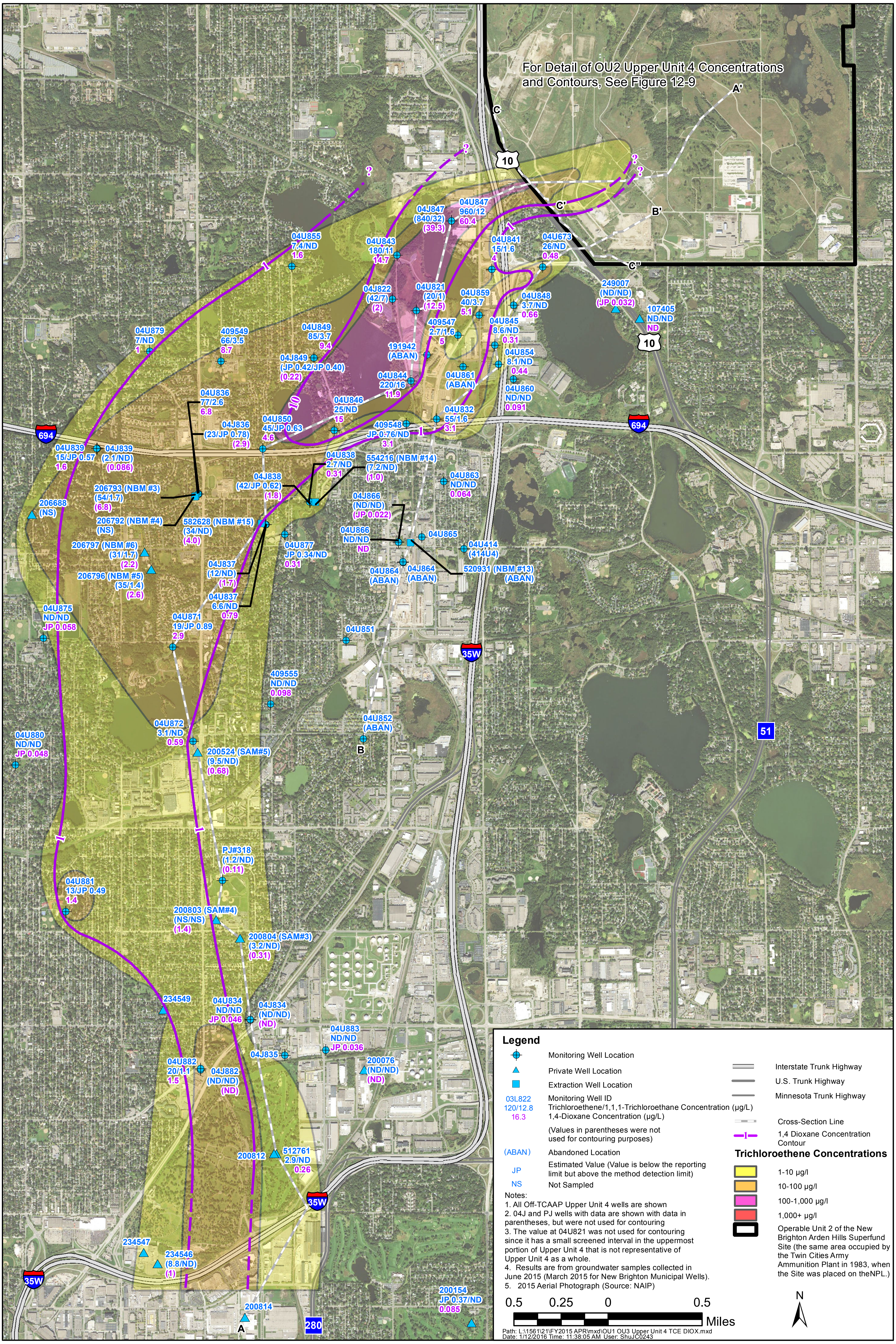
Figure 3-4



Legend

⊕	Monitoring Well Location
▲	Private Well Location
■	Extraction Well Location
03L822 120/12.8 16.3	Monitoring Well ID Trichloroethene/1,1,1-Trichloroethane Concentration (µg/L) 1,4-Dioxane Concentration (µg/L)
	(Values in parentheses were not used for contouring purposes)
(ABAN)	Abandoned Location
JP	Estimated Value (Value is below the reporting limit but above the method detection limit)
NS	Not Sampled

═	Interstate Trunk Highway
━	U.S. Trunk Highway
─	Minnesota Trunk Highway
┄	Cross-Section Line
━ ━	1,4 Dioxane Concentration Contour

Trichloroethene Concentrations

🟨	1-10 µg/l
🟧	10-100 µg/l
🟪	100-1,000 µg/l
🟥	1,000+ µg/l
▭	Operable Unit 2 of the New Brighton Arden Hills Superfund Site (the same area occupied by the Twin Cities Army Ammunition Plant in 1983, when the Site was placed on theNPL.)

Notes:
1. All Off-TCAAP Upper Unit 4 wells are shown
2. 04J and PJ wells with data are shown with data in parentheses, but were not used for contouring
3. The value at 04U821 was not used for contouring since it has a small screened interval in the uppermost portion of Upper Unit 4 that is not representative of Upper Unit 4 as a whole.
4. Results are from groundwater samples collected in June 2015 (March 2015 for New Brighton Municipal Wells).
5. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\OU1 OU3 Upper Unit 4 TCE DIOX.mxd
Date: 1/12/2016 Time: 11:38:05 AM User: ShuJC0243

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OU1 & OU3, Upper Unit 4, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June 2015

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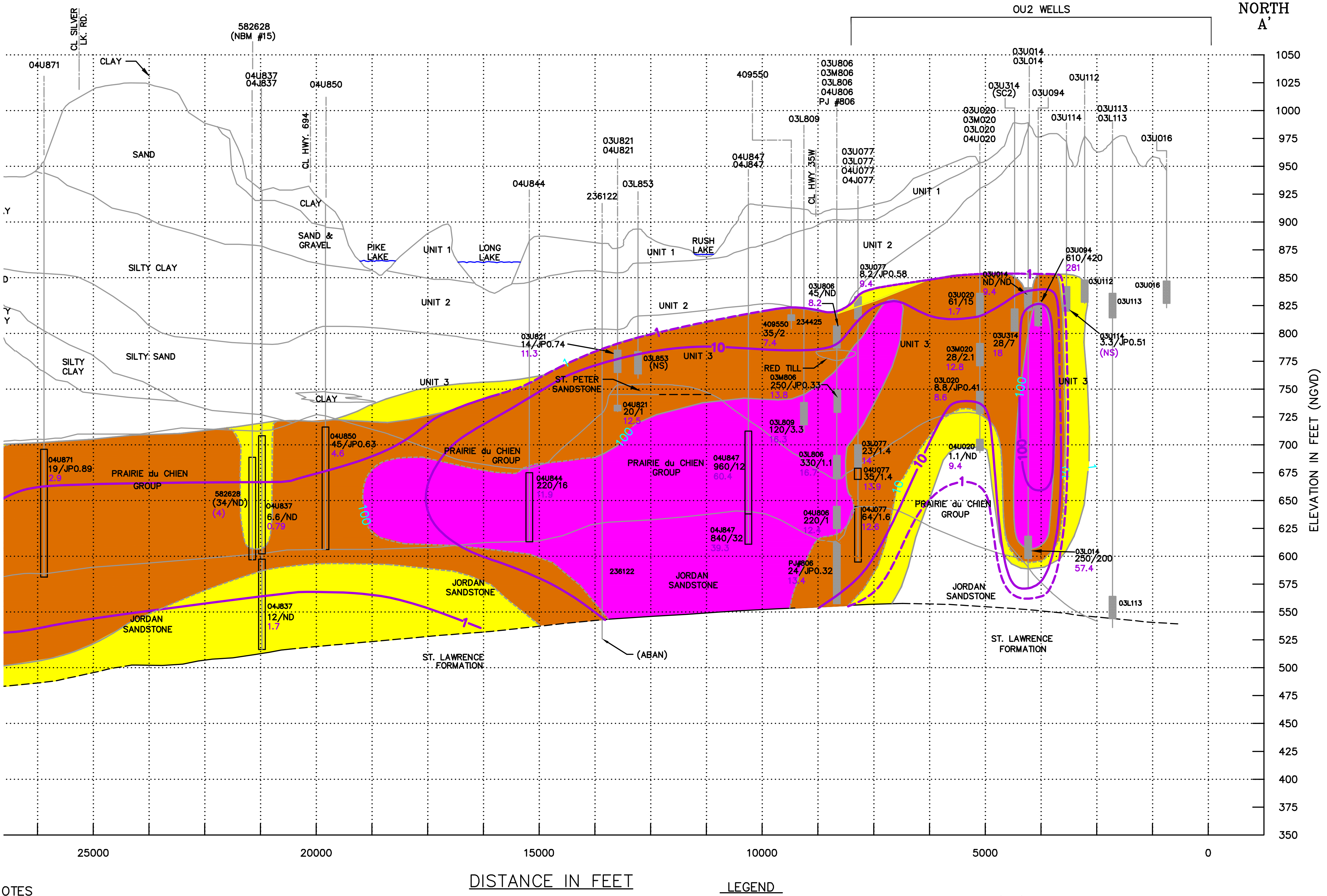
Figure 3-5



NOTES

(1) CROSS SECTION: TOPOGRAPHY CONSTRUCTED WITH DATA FROM U.S.G.S. NEW BRIGHTON 7.5 MINUTE SERIES QUAD MAP DATED 1967 (PHOTOREVISED 1972, AND 1980); WELL LOCATIONS AND THE "LINE" OF SECTION ARE SHOWN ON FIGURES 3-3 THROUGH 3-5.

(2) WELL NESTS, CONSISTING OF INDIVIDUAL WELLS IN THE SAME PROXIMITY, ARE REPRESENTED ON THE CROSS SECTION BY A SINGLE LINE WITH MULTIPLE WELL SCREENS

LEGEND

∼	GEOLOGIC CONTACT
- - -	INFERRED GEOLOGIC CONTACT
▮	SCREENED INTERVAL OF WELL
▯	OPEN HOLE INTERVAL OF WELL
04U872 1.2/ND 0.11	MONITORING WELL ID TRICHLORETHENE/1,1,1-TRICHLORETHANE CONCENTRATION (µg/L) 1,4-DIOXANE CONCENTRATION (µg/L) (VALUES IN PARENTHESES WERE NOT USED FOR CONTOURING PURPOSES)
(ABAN)	ABANDONED
—1—	1,4 DIOXANE ISOCONCENTRATION CONTOUR
JP	THE VALUE IS ESTIMATED BECAUSE THE VALUE IS BELOW THE REPORTING LIMIT, BUT ABOVE THE METHOD DETECTION LEVEL.
(NS)	NOT SAMPLED
	(ESTIMATED CONTOURS SHOWN AS DASHED)

TRICHLOROETHENE CONCENTRATIONS

🟨	1-10 µg/L
🟧	10-100 µg/L
🟥	100-1,000 µg/L
🟪	1,000+ µg/L

M: /1561/2013/SUMMER 2013.DWG

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OU2/OU1 TRICHLOROETHENE CROSS-SECTION A-A' (NORTH HALF), JUNE 2015

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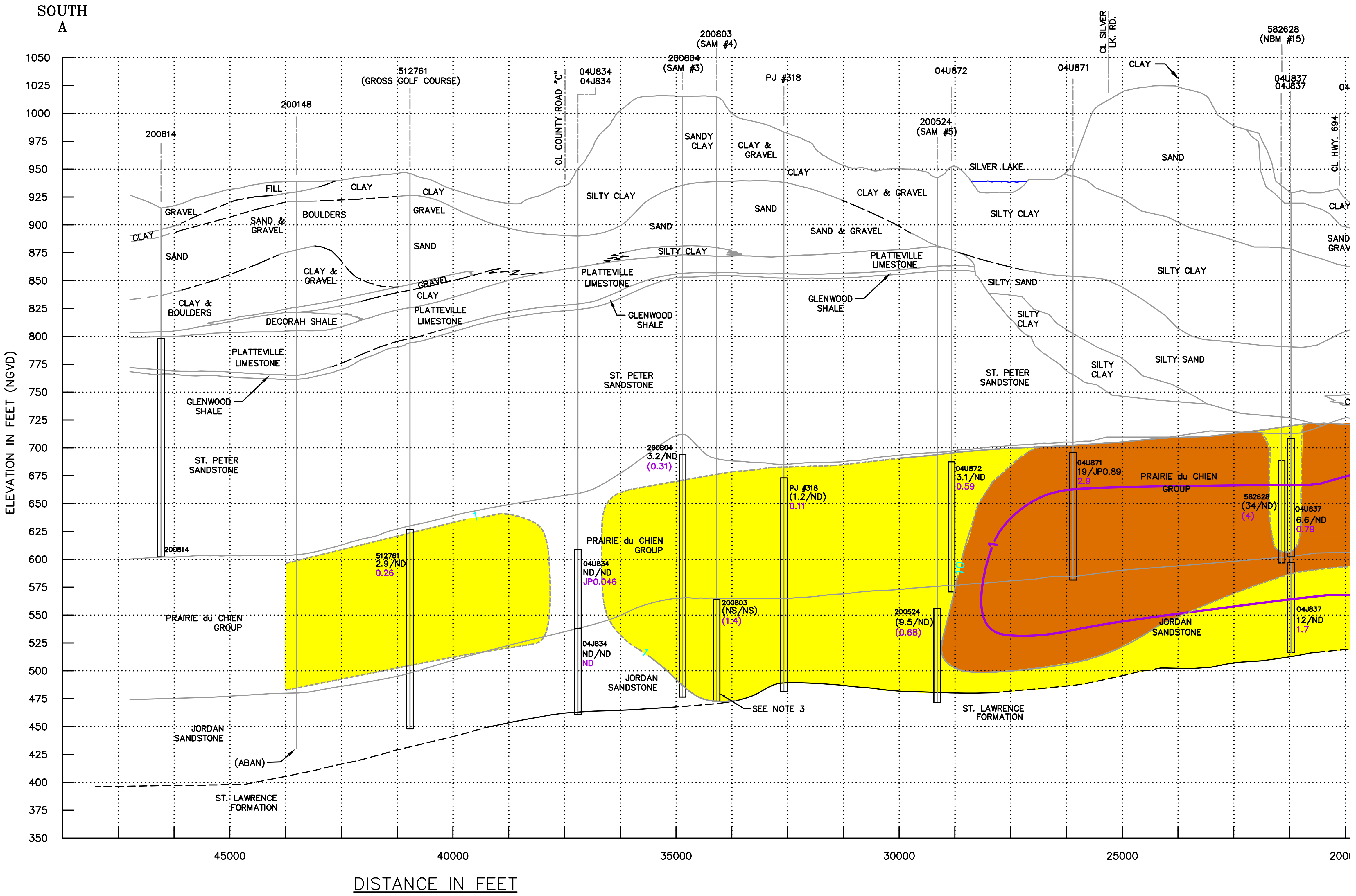
FY 2015

FIGURE 3-6



NOTES

(1) CROSS SECTION: TOPOGRAPHY CONSTRUCTED WITH DATA FROM U.S.G.S. NEW BRIGHTON 7.5 MINUTE SERIES QUAD MAP DATED 1967 (PHOTOREVISED 1972, AND 1980); WELL LOCATIONS AND THE "LINE" OF SECTION ARE SHOWN ON FIGURES 3-3 THROUGH 3-5.

(2) WELL NESTS, CONSISTING OF INDIVIDUAL WELLS IN THE SAME PROXIMITY, ARE REPRESENTED ON THE CROSS SECTION BY A SINGLE LINE WITH MULTIPLE WELL SCREENS

(3) NO INFORMATION WAS PROVIDED ON THE WELL LOG FOR 200803 (SAM #4) CONCERNING WELL CONSTRUCTION DETAILS, ESPECIALLY THE OPEN HOLE INTERVAL. AS THIS IS REFERRED TO AS A JORDAN WELL, THE OPEN HOLE WAS ASSUMED TO EXTEND FROM THE TOP OF THE JORDAN TO THE BOTTOM OF THE BOREHOLE.

LEGEND

～	GEOLOGIC CONTACT
- - -	INFERRED GEOLOGIC CONTACT
▮	SCREENED INTERVAL OF WELL
▯	OPEN HOLE INTERVAL OF WELL
04U872	MONITORING WELL ID
1.2/ND	TRICHLOROETHENE/1,1,1–TRICHLOROETHANE CONCENTRATION (µg/L)
0.11	1,4–DIOXANE CONCENTRATION (µg/L) (VALUES IN PARENTHESES WERE NOT USED FOR CONTOURING PURPOSES)
(ABAN)	ABANDONED
—1—	1,4 DIOXANE ISOCONCENTRATION CONTOUR
JP	THE VALUE IS ESTIMATED BECAUSE THE VALUE IS BELOW THE REPORTING LIMIT, BUT ABOVE THE METHOD DETECTION LEVEL.
(NS)	NOT SAMPLED
	(ESTIMATED CONTOURS SHOWN AS DASHED)

TRICHLOROETHENE CONCENTRATIONS

🟨	1–10 µg/L
🟧	10–100 µg/L
🟥	100–1,000 µg/L
🟪	1,000+ µg/L

M:/1561/2011/SUMMER 2011.DWG

ANNUAL PERFORMANCE REPORT

OU1 TRICHLOROETHENE CROSS–SECTION A–A' (SOUTH HALF), JUNE 2015

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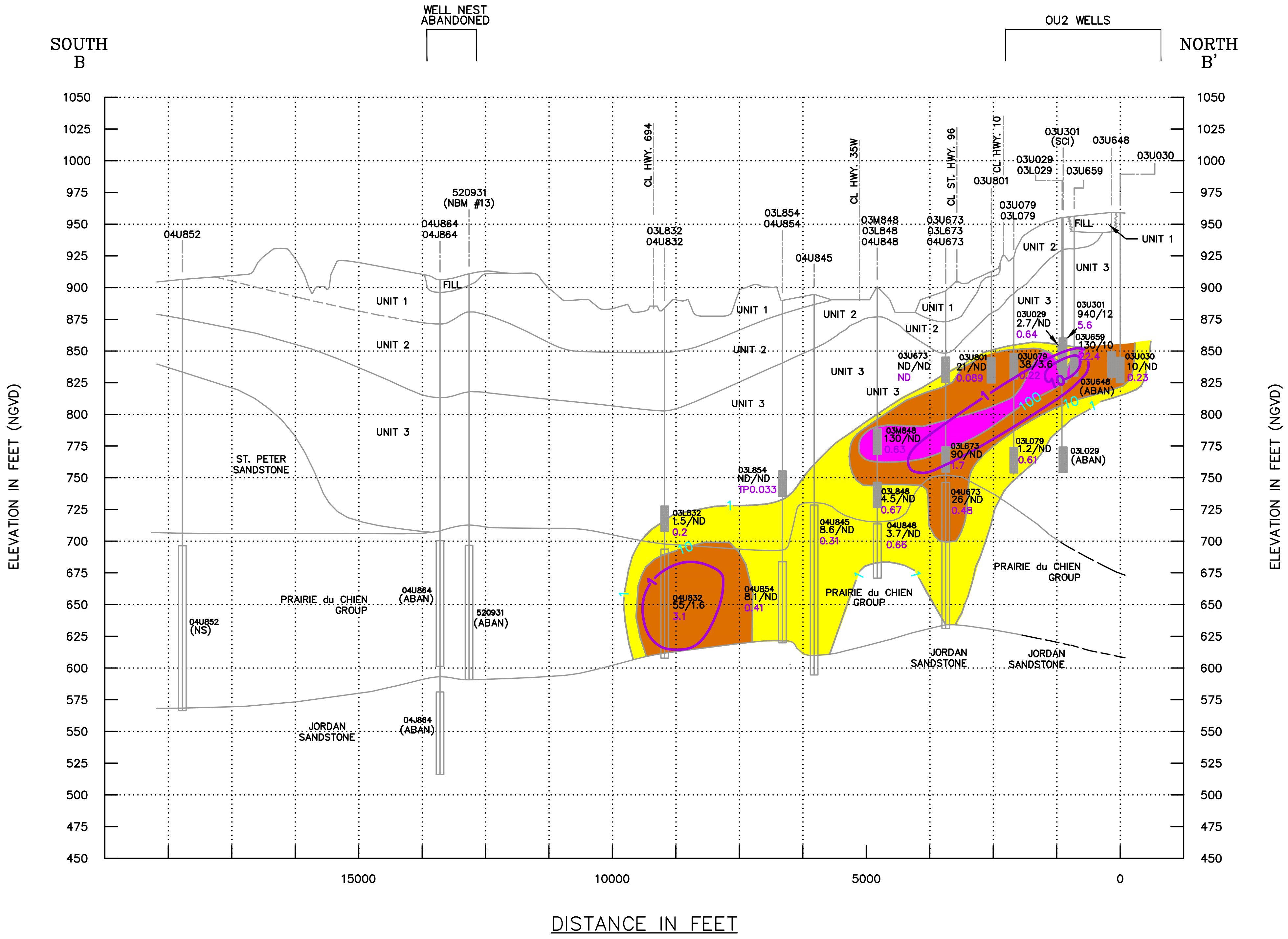
FY 2015

FIGURE 3–7



NOTES

(1) CROSS SECTION: TOPOGRAPHY CONSTRUCTED WITH DATA FROM U.S.G.S. NEW BRIGHTON 7.5 MINUTE SERIES QUAD MAP DATED 1967 (PHOTOREVISED 1972, AND 1980); WELL LOCATIONS AND THE "LINE" OF SECTION ARE SHOWN ON FIGURES 3-3 THROUGH 3-5.

(2) WELL NESTS, CONSISTING OF INDIVIDUAL WELLS IN THE SAME PROXIMITY, ARE REPRESENTED ON THE CROSS SECTION BY A SINGLE LINE WITH MULTIPLE WELL SCREENS

(3) NO INFORMATION WAS AVAILABLE ON THE WELL LOG FOR 03U029 AND 03U673 CONCERNING WELL CONSTRUCTION DETAILS, ESPECIALLY THE SCREENED INTERVALS. THE SCREENED INTERVALS FOR THESE WELLS WERE ASSUMED TO BE SIMILAR TO OTHER NEARBY UPPER UNIT 3 WELLS.

LEGEND

⁀	GEOLOGIC CONTACT
- - -	INFERRED GEOLOGIC CONTACT
▮	SCREENED INTERVAL OF WELL
▯	OPEN HOLE INTERVAL OF WELL
04U872	MONITORING WELL ID
1.2/ND	TRICHLORETHENE/1,1,1-TRICHLORETHANE CONCENTRATION (µg/L)
0.11	1,4-DIOXANE CONCENTRATION (µg/L) (VALUES IN PARENTHESES WERE NOT USED FOR CONTOURING PURPOSES)
(ABAN)	ABANDONED
— 1 —	1,4 DIOXANE ISOCONCENTRATION CONTOUR
JP	THE VALUE IS ESTIMATED BECAUSE THE VALUE IS BELOW THE REPORTING LIMIT, BUT ABOVE THE METHOD DETECTION LEVEL.
(NS)	NOT SAMPLED
	(ESTIMATED CONTOURS SHOWN AS DASHED)

TRICHLOROETHENE CONCENTRATIONS

🟨	1–10 µg/L
🟧	10–100 µg/L
🟥	100–1,000 µg/L
🟪	1,000+ µg/L

M:/1561/2011/SUMMER 2011.DWG

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OU2/OU3 TRICHLOROETHENE CROSS-SECTION B-B', JUNE 2015

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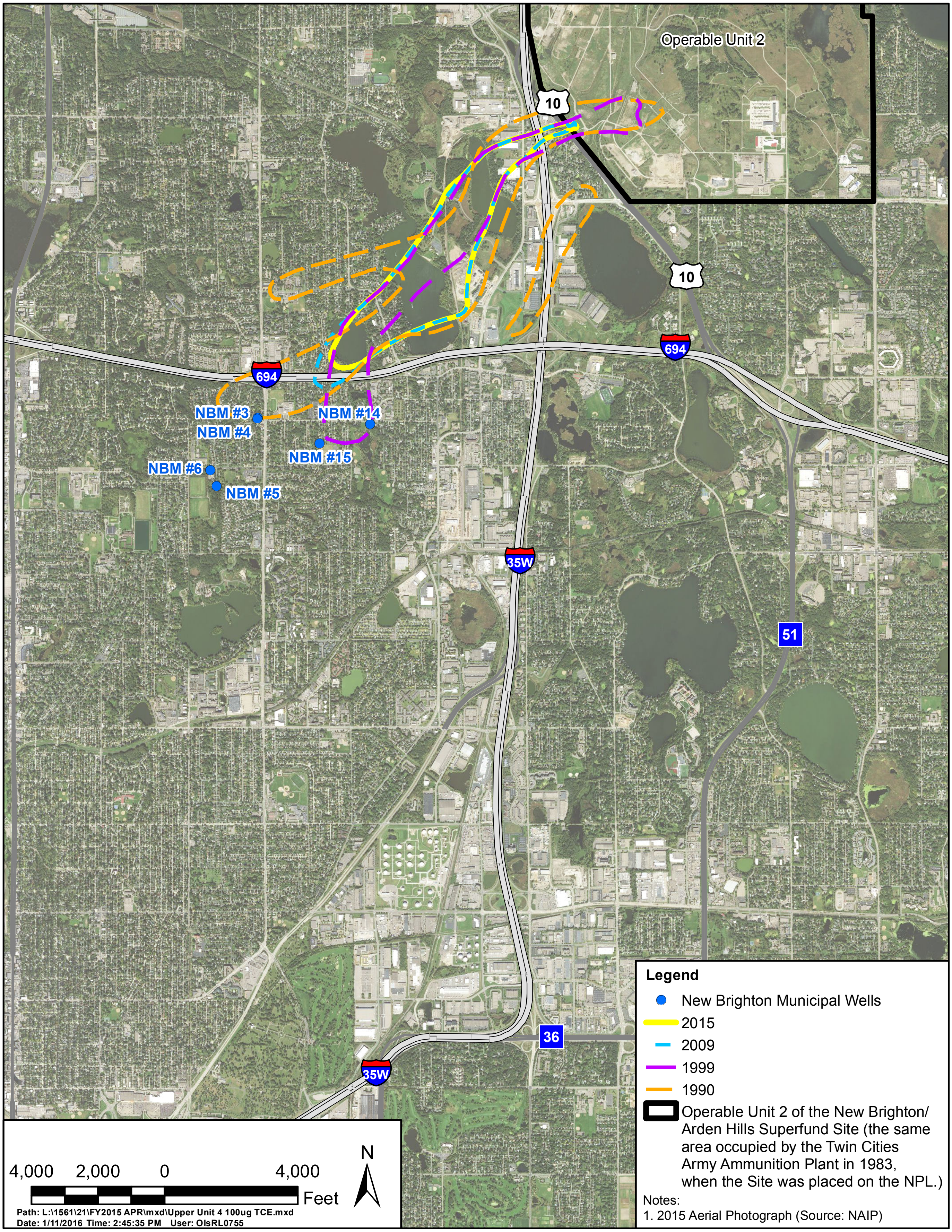
Maple Plain, MN 55339

FY 2015

FIGURE 3-8



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Upper Unit 4,
100 µg/L Trichloroethene Isoconcentration Map

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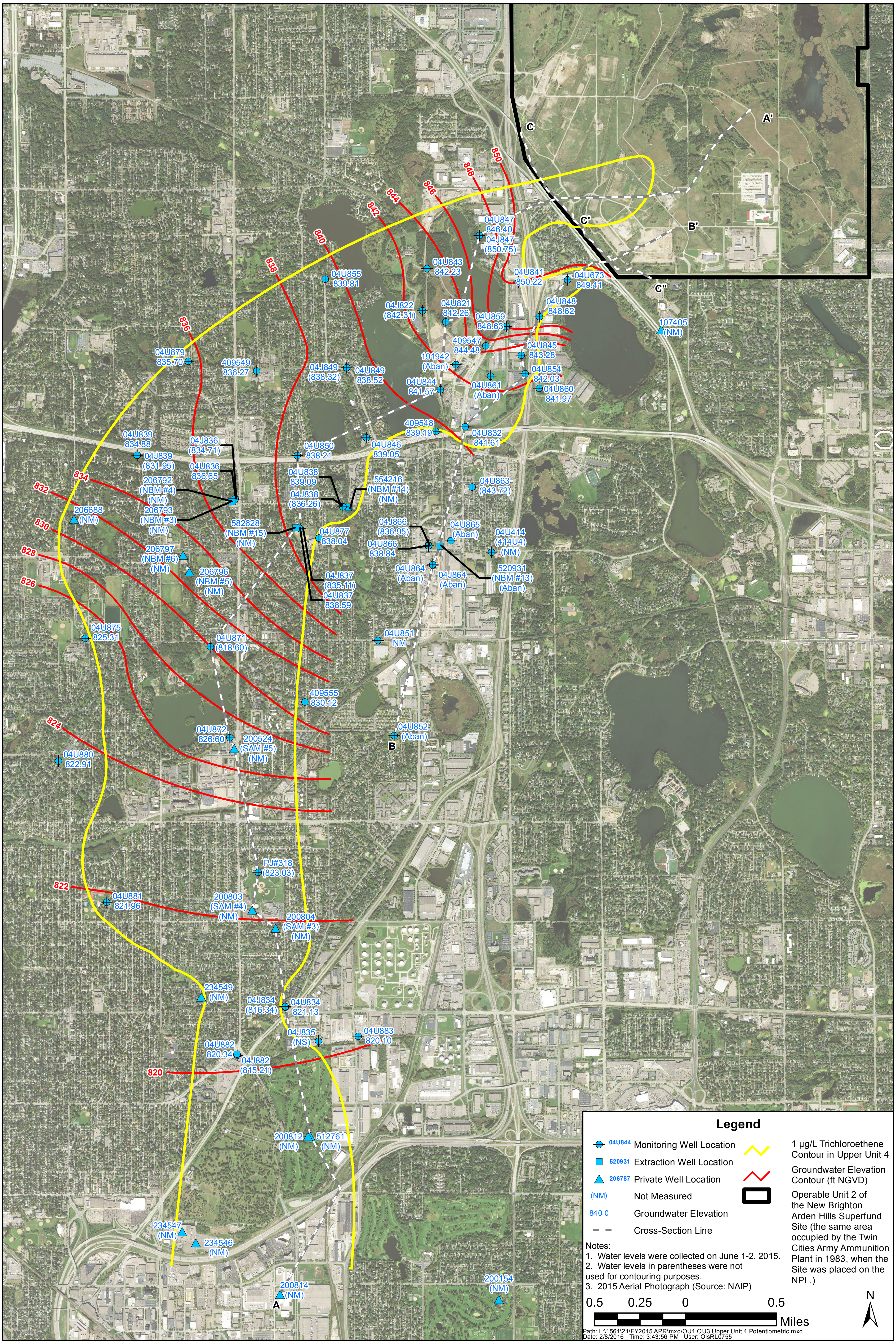
FY 2015

Figure 3-9



Notes:
1. Water levels were collected on June 1-2, 2015.
2. Water levels in parentheses were not used for contouring purposes.
3. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\OU1 OU3 Upper Unit 4 Potentiometric.mxd
Date: 2/8/2016 Time: 3:43:56 PM User: OlsRL0755

ANNUAL PERFORMANCE REPORT

OU1 & OU3, Upper Unit 4,
Potentiometric Map, June 2015

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Figure 3-10

FIGURE 3-11
OU1, NBCGRS MASS REMOVAL HISTORY

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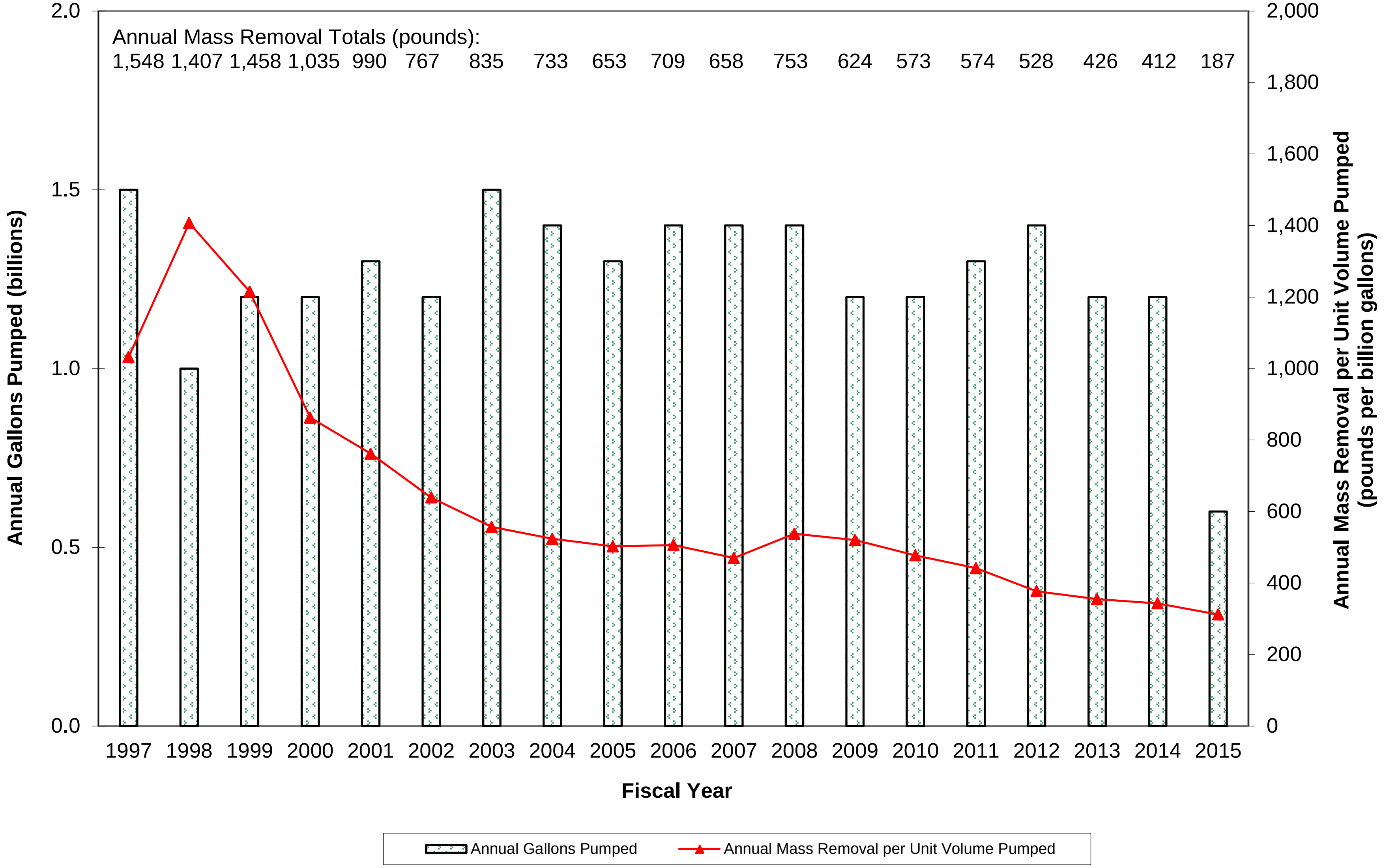

T:\1561 TCAAP\APR\FY15 APR\Report\Figures\Section 3\Figure 3-11 FY15

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4.0 Operable Unit 2: Shallow Soil and Dump 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
Amendment #1: 2007
Amendment #2 and #3: 2009
ESD #1 and #2: 2009
Amendment #4: 2012
Amendment #5: 2014

Sections 4.0 through 12.0 of this report address the various media and requirements prescribed by the OU2 ROD and/or subsequent Amendments and ESDs. This section specifically addresses the shallow soil and dump sites.

Through the OU2 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 and dump sites.

The requirements for Site C-2 soil and sediment were later modified through ROD Amendment #1 (note that Site C groundwater and surface water is addressed separately in Section 7.0). Because the depth to groundwater is shallow at Site C-2, it was not feasible to remove all of the contaminated soil and sediment. The Amendment modified remedy component #2 related to excavation of soil, to allow the placement of a 4-foot thick soil cover

over areas where contamination remains in-place above the cleanup levels. ROD Amendment #1 also specified land use controls as an additional remedy component for Site C-2.
OU2 ROD Amendment #2 addressed shallow groundwater at Site I, which is discussed in Section 8.0.

OU2 ROD Amendment #3 affected the shallow soil and dump sites in four principal ways:

- The Amendment documented as final remedies the additional actions performed for shallow soil at Site D and the dump at Site G, after completion of the deep soil requirements set forth for these two sites in the OU2 ROD (see Section 5.0 of this report for discussion of the deep soil).
- The Amendment documented the use of soil covers as part of the final remedy at Sites E, G, H, and 129-15.
- The Amendment documented final remedies for five sites with soil contamination that were not originally included in the OU2 ROD: Grenade Range, Outdoor Firing Range, 135 Primer/Tracer Area Stormwater Ditch, Trap Range, and Water Tower Area. At these sites, either previous removal actions had been completed that reduced soil contamination to below cleanup levels, or investigations had determined that no action or no further action was needed. The Amendment incorporated the remedies for these sites into the overall remedy for OU2.
- The Amendment specified land use controls as an additional remedy component for shallow soil and dump Sites D, E, G, H, 129-15, Grenade Range, and Outdoor Firing Range. Land use controls are not needed for the 135 Primer/Tracer Area Stormwater Ditch or Trap Range because contamination levels are suitable for unlimited use/ unrestricted exposure. The water tower area is also suitable for unlimited use/ unrestricted exposure; however, it is located within the area having blanket land use restrictions as specified in the LUCRD.

ESD #1 is discussed in Section 6.0 (Site A shallow groundwater), Section 9.0 (Site K shallow groundwater), and Section 12.0 (OU2 deep groundwater).

ESD #2 specified land use controls as an additional remedy component for Sites A, C-1, 129-3, and 129-5. ESD #2 also documented that no further action is required at Site B. Site B is located within the area having blanket land use restrictions.

ROD Amendment #4 was signed in January 2012. This ROD amendment documents previously-completed soil removal actions conducted at two sites: the 535 Primer/Tracer Area and Site K. No further action is required for the soils located in the vicinity of the excavation areas at these two sites; though the excavation area for the 535 Primer/Tracer Area is located within the area of AHATS that has restricted commercial use. This ROD amendment also addressed Building 102 shallow groundwater, discussed in Section 10.0, and OU2 aquatic sites, discussed in Section 11.0.

ROD Amendment #5 was signed in March 2014. This ROD amendment documents previously-completed soil removal actions conducted at soil areas of concern at three sites: Site A, the eastern portion of the 135 Primer/Tracer Area, and the MNARNG EBS Areas. It also documents that land use controls are required at these sites.

4.1 REMEDY COMPONENTS #1 THROUGH #9: SOIL REMEDIATION

The nine remedy components specified in the OU2 ROD (page 2) have been completed for the shallow soils and dumps at Sites A, C, D, E, G, H, K, 129-3, 129-5, 129-15, Grenade Range, Outdoor Firing Range, 135 Primer/Tracer Area Stormwater Ditch, the eastern portion of the 135 Primer/Tracer Area, 535 Primer Tracer Area, MNARNG EBS Areas, and Water Tower Area. Remedy Components #1 through #8 addressed the characterization, excavation, sorting, treatment, disposal, site restoration, site access restrictions (during remedial actions), and limited period of post-remediation groundwater monitoring. Remedy Component #9 addressed the characterization of dumps at Sites B and 129-15. The characterization work at both sites led to a determination that no further action was required at Site B and construction of a cover at

Site 129-15, which were documented through ESD #2 and OU2 ROD Amendment #3, respectively.

4.2 REMEDY COMPONENT #10: LAND USE CONTROLS

Description: OU2 ROD Amendments and ESDs made land use controls a part of the remedy for shallow soil and dump sites where contamination remains in-place above levels that allow for unlimited use and unrestricted exposure. Land use controls are also necessary to protect the integrity of the soil covers constructed at various sites.

Performance Standard (how do you know when you're done):
Initial implementation was done when the USEPA and MPCA have provided consistency approval for an OU2 Land Use Control Remedial Design (LUCRD) document. Implementation will continue indefinitely unless further action is taken that would allow for unlimited use and unrestricted exposure.

Has a LUCRD document been approved to address land use control (LUC) issues for OU2, and is it being implemented?
Yes. The USEPA and MPCA provided consistency approval for the OU2 LUCRD in September 2010 and it is being implemented by the Army. Revision 3 of the OU2 LUCRD was approved by the USEPA and MPCA in March 2015; however, this revision did not affect land use controls for shallow soil sites.

Was an annual site inspection for land use controls conducted in FY 2015?
Yes. On July 23, 2015, the Army, National Guard, and Wenck conducted the annual inspection of OU2 sites. The checklist that was completed during the inspection is included as Appendix I.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs? No.

5.0 Operable Unit 2: Deep Soil Sites

For purposes of the OU2 ROD, Sites D and G were considered deep soil sites because VOC contamination extended to depths 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 to be implemented for these two sites:

- Remedy Component #1: Groundwater Monitoring
- Remedy Component #2: Restrict Site Access (During Remedial Actions)
- Remedy Component #3: SVE Systems
- Remedy Component #4: Enhancements to the SVE Systems
- Remedy Component #5: Maintain Existing Site Caps
- Remedy Component #6: Maintain Surface Drainage Controls
- Remedy Component #7: Characterize Shallow Soils and Dump

For Remedy Component #1, ongoing groundwater monitoring in the vicinity of these two sites is completed as part of OU2 deep groundwater monitoring (Section 12.0) and is not discussed separately in this section.

Remedy Components #2 to #6 were related to continued operation of the SVE systems that had been installed in 1986, along with modifications to those systems to enhance performance. The caps were in-place primarily to minimize short-circuiting of air flow, and also to minimize infiltration. Studies conducted after the 1997 ROD showed that enhancements to the SVE systems were not necessary, and in fact, the soil VOC concentrations had achieved the soil VOC cleanup levels. The systems were turned off in 1998 and were subsequently removed, hence completing Remedy Components #2 to #6 related to deep soil.

Regarding Remedy Component #7, additional shallow soil investigation work (for non-VOC contaminants) was completed at Site D, and characterization work of the dump was completed at Site G, which completed this remedy component. The investigation/characterization work led to removal of shallow soils at Site D and construction of a cover at Site G, which were documented through OU2 ROD Amendment #3.

In summary, the deep soil requirements of the OU2 ROD have been completed. There are ongoing land use control requirements for the shallow soil at Site D and the dump at Site G, as discussed in Section 4.0.

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. When operating, this system discharged the extracted groundwater to the sanitary sewer for treatment at a Publicly-Owned Treatment Works (POTW). However, as further discussed below, the groundwater system was shut off (with regulatory approval) on September 24, 2008, while implementation of Monitored Natural Attenuation (MNA) was being evaluated as a potential remedy component in lieu of groundwater extraction and discharge. In late 2015, the Army received approval from the USEPA and MPCA to formally change the remedy to MNA. The ROD prescribes five major components of the remedy, and until a ROD amendment can be prepared and finalized, the original components of the ROD will be retained in this section (with discussion that is appropriate to the MNA remedy).

The original 8-well groundwater extraction system that was selected in the OU2 ROD began operation May 31, 1994. On July 11, 2000, with regulatory approval, EW-5 through 8 (the “second line” of extraction wells) were shut down due to their VOC concentrations having declined below cleanup levels. In July 2008, the USEPA and MPCA approved the “Site A Shallow Groundwater: 10-Year Evaluation Report.” The 10-Year Report was prepared to fulfill a requirement of the ROD, which states that for shallow groundwater contamination at Site A, “should aquifer restoration not be attained within the ten-year lifespan of the remedy, additional remedial measures will be addressed”. Since the 10-year mark had been reached and contamination was still present above the cleanup levels, the 10-Year Report was prepared to discuss the status of the site and to evaluate any potential changes to the remedy that would be beneficial. MNA (through abiotic degradation) was the recommended alternative for Site A that was approved by the USEPA and MPCA.

In September 2008, the USEPA and MPCA approved the “Site A Shallow Groundwater: Monitoring and Contingency Plan,” and EW-1 through 4 (the “first line” of extraction wells) were then shut off on September 24, 2008. The Monitoring and Contingency Plan presented the monitoring plan to be implemented at the point that the extraction wells were shut off, and presented the contingency actions that will be taken by the Army if groundwater monitoring indicates that any of the identified trigger points are exceeded. These monitoring and contingency actions were incorporated into the APR, and thus any changes to monitoring and contingency actions must be approved by the USEPA and MPCA through revisions to the APR.

The decision to proceed with MNA was based in part on the MPCA and USEPA natural attenuation study at this site (2000), and also on follow-up MPCA/USEPA microcosm studies that have verified that abiotic degradation of VOCs in Site A groundwater is occurring at substantial rates. Such degradation acts to reduce contaminant mass and mobility by breaking down the contaminants as they move downgradient. The decision to proceed with MNA was also based on the absence of any likely receptors. The closest potential groundwater receptor is located approximately 1,000 feet downgradient from 01U352 (EW-2) and 01U353 (EW-3), and this domestic well has not been operable for many years (and even when it was, the water was only used for irrigation purposes). Beyond this unlikely receptor, there are no other existing downgradient receptors between it and Rice Creek, which is approximately 1,800 feet away.

Based on a November 11, 2015 Technical Memorandum submitted by the Army, which documented the FY 2015 monitoring results and recommended changing the remedy to MNA, the USEPA and MPCA have approved changing the remedy to MNA in lieu of groundwater extraction and discharge. In FY 2016, a proposed plan and ROD amendment will be prepared by the Army, USEPA, and MPCA to formally document this change. Since the extraction wells are still included in the monitoring plan for Site A, they will not be sealed.

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 2015 Monitoring Plan is included in Appendix A, and the FY 2015 water quality monitoring locations and frequencies are also summarized on Figure 6-1. Any deviations are explained in Appendix C.2. Figure 6-2 presents groundwater elevation contours based on measurements in June 2015.

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

Is any groundwater sampling proposed prior to the next report?
Yes, including the following:

- 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 that was previously scheduled was to be in FY 2017; however, due to the discovery of 1,4-dioxane in deep groundwater, an unscheduled "major" event was conducted in FY 2015 and will be repeated by the Army in FY 2016.
- Other groundwater monitoring at Site A will be in accordance with the monitoring plan shown in Appendix A.1.

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

Yes. Refer to Section 6.7 regarding returning the sampling frequency to annual for all wells, beginning in FY 2016 and regarding including 1,4-dioxane in the June 2016 sampling event. Also, given that wells 01U350, 01U351, and 01U354 are essentially redundant monitoring points to nearby wells 01U108, 01U116, and 01U138, respectively, monitoring of 01U350, 01U351, and 01U354 should be ceased beginning in FY 2017 until Site A nears the point of closure.

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)

Is this remedy component being implemented?

No. As discussed previously, since the groundwater extraction system has been shut off to allow evaluation of MNA, this remedy component is not currently being implemented. After a ROD amendment is completed by the Army, USEPA, and MPCA in FY 2016, this remedy component will be eliminated.

6.3 REMEDY COMPONENT #3A: LAND USE CONTROLS

Description: The OU2 ROD (page 3) listed the following: "Institutional controls to restrict new well installations and provide alternate water supplies and well abandonment as necessary." For ease of discussion, the requirement has been broken into two pieces, with this section focusing on the land use controls. OU2 ESD #1 clarified the land use control component to include protection of the groundwater monitoring and extraction system infrastructure.

Performance Standard (how do you know when you're done):
For initial implementation, when the MDH has issued a Special Well Construction Area Advisory, and when the USEPA and MPCA have provided consistency approval for an OU2 Land Use Control Remedial Design (LUCRD) document. Implementation will continue until such time that the groundwater concentrations are below the cleanup levels.

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.

Has a LUCRD document been approved to address land use control (LUC) issues for OU2, including Site A groundwater, and is it being implemented?
Yes. The USEPA and MPCA provided consistency approval for the OU2 LUCRD in September 2010 and it is being implemented by the Army. Revision 3 of the OU2 LUCRD was approved by the USEPA and MPCA in March 2015; however, this revision did not affect land use controls for Site A.

Was an annual site inspection for land use controls conducted in FY 2015?
Yes. On July 23, 2015, the Army, National Guard, and Wenck conducted the annual inspection of OU2 sites. The checklist that was completed during the inspection is included as Appendix I.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs? No.

6.4 REMEDY COMPONENT #3B: ALTERNATE WATER SUPPLY/WELL ABANDONMENT

Description: The OU2 ROD (page 3) listed the following: “Institutional controls to restrict new well installations and provide alternate water supplies and well abandonment as necessary.” For ease of discussion, the requirement has been broken into two pieces, with this section focusing on the alternate water supplies and well abandonment.

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

Did the boundary of the Site A plume get any bigger during FY 2015, as defined by the 1 μg/L contour?
No. Table 6-2 presents the FY 2015 groundwater quality data for Site A. Using this data, Figure 6-3 shows the tetrachloroethene concentrations and Figure 6-4 shows the cis-1,2-dichloroethene concentrations. The latter is a degradation product of the former, and represents the larger areal footprint. The footprints did not increase in size from the previous year.

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 2015? If yes, what were the findings? No wells were sampled.

Were any well owners offered an alternate supply and/or well abandonment in FY 2015?
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. There are no water supply wells in the Site A vicinity that require sampling.

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

6.5 REMEDY COMPONENT #4: DISCHARGE OF EXTRACTED WATER

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

Is this remedy component being implemented?
No. As discussed previously, since the groundwater extraction system has been shut off to allow evaluation of MNA, this remedy component is not currently being implemented. After a ROD amendment is completed by the Army, USEPA, and MPCA in FY 2016, this remedy component will be eliminated.

6.6 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. The source of VOC-contaminated soils was found to be the “1945 Trench”.

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 by the Army 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 soil 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 (see Figure 6-3 and 6-4 for the location of the soil excavation area at the former 1945 Trench). 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.

6.7 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 (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 presents the FY 2015 groundwater quality data and highlights the values that exceed a cleanup level. With the exception of cis-1,2-dichloroethene, none of the other contaminants of concern (COCs) exceeded their respective cleanup levels in in the FY 2015. Only three wells exceeded the cleanup level of 70 µg/L for cis-1,2-dichloroethene in FY 2015: 01U139 (December: 240 µg/L, June: 310 µg/L), 01U353/EW-3 (June: 95 µg/L), and 01U356/EW-6 (December: 260 µg/L, June: 220 µg/L).

What impact is MNA having on contaminant concentrations?
As evident in Table 6-2, and on Figure 6-3 and 6-4, tetrachloroethene and trichloroethene continue to be degraded to cis-1,2-dichloroethene via natural attenuation. This degradation generally occurs within the distance between the source area and the first line of extraction wells (EW-1 through EW-4), with primarily only cis-1,2-dichloroethene being detected downgradient of the first line of extraction wells. Figure 6-5 shows the cis-1,2-dichloroethene concentrations plotted on geologic cross sections to illustrate the vertical extent of contamination (the cross section locations are illustrated on Figure 6-4). Cis-1,2-dicholorethene continues to be degraded as the plume migrates via an abiotic process. The MPCA and USEPA initially evaluated

attenuation at this Site using computer modeling of contaminant degradation, as documented in "Evaluation of Natural Attenuation of Chlorinated Solvents in Ground Water at the Twin Cities Army Ammunition Plant", MPCA and USEPA, June 2000. The MPCA conducted a follow-on microcosm study (unpublished) using samples collected from Site A, the results of which were presented to the Army, MPCA, and USEPA on April 10, 2007. The work conducted in this study showed that the degradation being observed at Site A was an abiotic process (not biological), which likely involves the presence of the mineral magnetite in soils at Site A. Note that the predominant degradation process does not "degrade through" vinyl chloride, which is no longer monitored at this site given the historical lack of detections that led to the OU2 ROD *not* selecting this compound as a COC.

Since September 2008 when the "first line" of extraction wells was shut off, some wells have shown decreased concentrations while others have, in some periods, shown increased concentrations (see Figure 6-6, 6-7, 6-8, and 6-9). Collectively, the cis-1,2-dichloroethene water quality trends evident on Figures 6-6 through 6-9 indicate that the plume has essentially stabilized at this point in time. Most importantly, the contingency locations (the four 900-series wells located along the north side of County Road I) have peaked and now show stable or decreasing trends at concentrations below the cis-1,2-dichloroethene cleanup level of 70 µg/L (Figure 6-9). Specifically, 01U901 and 01U903 have been at or near non-detect since 2008 and basically throughout their history. 01U902 has stabilized between 15 and 20 µg/L since June 2013. 01U904, which increased to a peak of 57 µg/L in June 2013, has decreased steadily since then, declining to a concentration of 21/22 µg/L in June 2015. 01U904 is located directly downgradient of the two highest-concentration wells in June 2015: EW-6 and 01U139.

In EW-5 through 8 (Figure 6-8), EW8 has been stable near non-detect since December 2012. EW-5 and EW-7, after an initial December 2012 result just above the cleanup level, have both steadily declined to their June 2015 concentrations of 22 and 17 µg/L, respectively. Only EW-6 has a less definitive trend. Although it may have peaked in December 2014 at 260 µg/L, given the slightly lower concentration of 220 µg/L in June 2015, this is not certain, and it may still be exhibiting a slightly increasing trend (see later discussion).

In the monitoring wells located between the two rows of extraction wells (Figure 6-7), concentrations appear to have stabilized or to be on a declining trend. 01U139, currently the highest-concentration well at Site A, had a peak concentration of 510 µg/L in June 2013, but then stabilized at lower concentrations between 240 and 350 µg/L in the next four sampling events. 01U140, after showing three slight exceedances of the cleanup level in 2011 and 2012, has shown a steadily declining concentration to 9.9 µg/L in June 2015. 01U157 had two slight exceedances of the cleanup level in 2011 and 2012, but then stabilized at lower concentrations between 18 and 25 µg/L in the four most-recent sampling events. 01U158 had a peak concentration of 410 µg/L in April 2011, but then stabilized at lower concentrations between 28 and 67 µg/L in the seven most-recent sampling events.

In EW-1 through 4 (Figure 6-6), the outermost wells EW-1 and EW-4 have been at or near non-detect since 2010 or earlier. EW2 has generally been below 20 µg/L since the extraction wells were shut off in 2008, and has been below 10 µg/L in the six most-recent sampling events. EW3 had a peak concentration of 950 µg/L in December 2009, but then declined to 170 µg/L in April 2011 and has shown somewhat variable concentrations since that time (but not exceeding 170 µg/L).

In summary, the cis-1,2-dichloroethene plume has essentially stabilized following shutdown of EW-1 through 4 in 2008. Although one well, EW-6, has not definitively stabilized, it is in the middle of the plume and is surrounded by wells with stable or decreasing trends. Most importantly, the contingency locations along the north side of County Road I show stable or decreasing trends at concentrations below the cis-1,2-dichloroethene cleanup level of 70 µg/L (and with 01U904 being located directly downgradient of EW6). Hence the collective trend suggests that the slight uptrend at EW-6 merely reflects a slight shifting of the axis of the plume in the “cross-plume” direction, something that likely explains the greater variability that is also evident in the two other mid-plume wells that are near the axis of the plume (EW-3 and 01U139).

Were any trigger levels exceeded at any of the contingency locations?

No. The four contingency locations are 01U901, 902, 903 and 904, which are the four monitoring wells located along the north side of County Road I. The trigger level is equal to groundwater cleanup levels and no COCs at Site A exceeded their respective cleanup levels in these four wells in FY 2015 (Table 6-2). As noted previously, 01U901 and 01U903 have been at or near non-detect since 2008 and basically throughout their history, and concentrations of cis-1,2-dichloroethene in 01U902 and 01U904 have peaked and now show stable or decreasing trends at concentrations below the cis-1,2-dichloroethene cleanup level of 70 µg/L.

The September 2008 Monitoring and Contingency Plan noted that if the groundwater trigger is exceeded, three key contingency actions were required:

1. Army will contact the well owner at 1783 Pinewood Drive to verify the well remains out of service (and will do this annually for as long as the trigger is being exceeded);

2. Army will prepare and submit a plan to address the exceedance to the USEPA and MPCA for approval; and

3. Army will prepare and submit a plan to evaluate the indoor air pathway.

The third action was perhaps the most critical item, as no soil vapor sampling had ever been conducted at Site A, and increasing VOC groundwater concentrations in any of the wells north of County Road I would raise the question of whether these increases could cause an increase in soil gas VOC concentrations leading to a vapor intrusion risk. A vapor intrusion report had been prepared previously: “Off-TCAAP Vapor Intrusion Pathway Analysis, Operable Unit 1, Operable Unit 3, and Operable Unit 2 (Site A)” prepared by Tecumseh/Wenck Installation Support Services, May 2005. This report concluded that the vapor intrusion pathway for the offsite Site A plume was incomplete, since the concentrations in groundwater were below the USEPA generic screening criteria. However, no actual soil vapor sampling was conducted for that report. In December 2012, the MPCA requested that soil vapor sampling be conducted since their 2008/2010 vapor intrusion guidance is newer than the 2005 report, and since that guidance states that groundwater screening levels should not be used as a single line of evidence for decisions regarding vapor intrusion risk. Based on this MPCA request, the Army prepared an investigation QAPP, which was approved by the USEPA and MPCA in June 2013, and then conducted the vapor intrusion investigation work in July 2013. This work was documented in "Site A Vapor Intrusion Investigation Report", prepared by Wenck, February 2014, which received regulatory consistency approval in FY 2014. The report concluded that no significant VOC concentrations are present in soil gas in the vicinity of the 14 samples collected (10 of which were located along the north side of County Road I), and that there is no significant soil vapor risk. Hence, the third contingency action has already been completed and was ultimately found not to be of concern.

With regard to the first contingency action, the Army attempted to contact the well owner at 1783 Pinewood Drive in FY 2014, even though the trigger had not been exceeded. While there is no reason to believe the owner will ever put this well back into service (and it would be physically difficult based on prior conversation), if this intention could be reconfirmed with the well owner, the well should be properly sealed. The Army was willing to voluntary conduct the sealing work. While it remains a very unlikely receptor, sealing of this well would eliminate the only known groundwater receptor between Site A and Rice Creek. Unfortunately, the resident did not respond to the two letters mailed to this address and it appears the Army will be unable to obtain approval to conduct this work.

If a trigger level should be exceeded, the only remaining contingency action would be the second one. However, the need to "address the exceedance" would have been driven primarily by either a groundwater receptor or a vapor receptor, and since these pathways have been eliminated as discussed above (or deemed not to be of concern, in the case of a nonresponsive and unlikely groundwater receptor), a slight exceedance of the trigger may not require any specific remedial action, *especially given* the strong degradation evident at the site (i.e., the distance any slight exceedance would carry downgradient from the "900" wells would be expected to be minimal).

Can it be determined whether MNA is an adequate long-term remedy for Site A in lieu of groundwater extraction and discharge? (If MNA is determined to be adequate, a recommendation to formally change the remedy should be made.)

Yes. In the November 11, 2015 Technical Memorandum, the Army recommended that MNA be implemented as the long-term remedy for Site A in lieu of groundwater extraction and discharge. This recommendation was made in consideration of three key facts: 1) that the vapor intrusion investigation concluded that there is no significant soil vapor risk north of County Road I; 2) that the only known groundwater receptor between Site A and Rice Creek (1783 Pinewood Drive) is not believed to be operable, was only used for irrigation purposes when it was operable, and now has an unresponsive resident to a voluntary Army offer to seal this well; and 3) that 1,4-dioxane was not found to be present in Site A shallow groundwater. Since the USEPA and MPCA have approved this recommendation, a ROD amendment will be completed by the Army, USEPA, and MPCA in FY 2016 to formally change the remedy to MNA.

With regard to the third key fact noted above, as a result of discovery of 1,4-dioxane within the OU1 plume, the USEPA and MPCA requested sampling for the presence of 1,4-dioxane at all sites where VOCs are present (including Site A shallow groundwater) during the FY 2015 sampling event. As shown in Table 6-2, there was only one low “detection” of 1,4-dioxane in Site A shallow groundwater in the June 2015 sampling event, and this “detection” was qualified to be usable as a non-detect result given detection of 1,4-dioxane at a similar level in an associated field blank. These results support the conclusion that 1,4-dioxane is not present in shallow groundwater at Site A. However, to provide confirmation of this conclusion, the Army will include 1,4-dioxane as an analyte for all Site A wells sampled in June 2016. Upon confirmation of this conclusion, no further 1,4-dioxane monitoring will be conducted at Site A.

Lastly, note that the November 11, 2015 Technical Memorandum recommended that the monitoring frequency at all Site A wells be returned to annual beginning in FY 2016. The USEPA and MPCA have approved this recommendation.

Do additional remedial measures need to be addressed?

As noted above, a ROD amendment will be completed by the Army, USEPA, and MPCA in FY 2016 to formally change the remedy to MNA in lieu of groundwater extraction and discharge.

Table 6-1
Summary of Site A Shallow Groundwater Monitoring Requirements

Fiscal Year 2015

Remedy Component		Monitoring Requirements	Implementing Party	Documents Containing the Monitoring Plan
#1:	Groundwater Monitoring	Outlined below		
#2:	Containment and Mass Removal	a. None. The groundwater extraction system was shut down in September 2008 allowing implementation of Monitored Natural Attenuation (MNA) to be evaluated. In late 2015, MNA was deemed an acceptable remedy, and therefore a ROD amendment will be prepared in FY2016 to document the change in this remedy component.		
#3A:	Land Use Controls	a. None		
#3B:	Alternate Water Supply/Well Abandonment	a. See OU1, Remedy Component #1 which also includes the area north of Site A		
#4:	Discharge of Extracted Water	a. None (see #2 above).		
#5:	Source Characterization/ Remediation	a. None. VOC-contaminated soils in the source area (1945 Trench) were excavated and transported to a permitted offsite disposal facility in FY 2003.		
OR:	Overall Remedy (Attainment of cleanup goals)	a. Water quality data throughout the Site A plume to evaluate attainment and to verify that Natural Attenuation is adequately controlling plume migration.	Army	Site A Monitoring Plan in the Annual Performance Report

Table 6-2
Site A Groundwater Quality Data

Fiscal Year 2015

			Tetra-chloro-ethene (µg/L)	Tri-chloro-ethene (µg/L)	1,4 Dioxane (µg/L)	cis-1,2-Di-chloro-ethene (µg/L)	1,1-Di-chloro-ethene (µg/L)	1,2-Di-chloro-ethane (µg/L)	Chloro-form (µg/L)	Benzene (µg/L)	Antimony (µg/L)
Site A Cleanup Level (1)			7	30	---	70	6	4	60	10	6
MDH HRL (2)			---	---	1	---	---	---	---	---	---
01U039		12/8/14	<1	<1	---	<1	<1	<1	<1	<1	---
01U039		6/29/15	<1	<1	<0.07	<1	<1	<1	<1	<1	---
01U102		6/25/15	JP 0.44	<1	<0.07	<1	<1	<1	<1	<1	---
01U103		6/26/15	<1	<1	<0.07	<1	<1	<1	<1	<1	3.8
01U108		6/25/15	JP 0.37	<1	<0.07	<1	<1	<1	<1	<1	---
01U115		6/26/15	<1	JP 0.43	<0.07	1.7	<1	<1	<1	<1	---
01U116		6/26/15	<1	JP 0.90	<0.07	JP 0.54	<1	<1	<1	<1	---
01U117		6/25/15	1.6	1.8	<0.07	18	<1	<1	<1	<1	---
01U126		6/25/15	2.6	JP 0.58	<0.07	<1	<1	<1	<1	<1	---
01U138		6/25/15	<1	JP 0.37	<0.07	<1	<1	<1	<1	<1	---
01U139		12/8/14	<1	JP 0.56	---	**240**	<1	<1	<1	4.1	---
01U139		6/30/15	<1	JP 0.43	<0.07	**310**	JP 0.35	<1	<1	4.9	---
01U140		12/8/14	<1	<1	---	15	<1	<1	<1	JP 0.35	---
01U140	D	12/8/14	<1	<1	---	14	<1	<1	<1	JP 0.30	---
01U140		6/30/15	<1 JMS70	<1	<0.07 JMS67	9.9	<1	<1	<1	JP 0.38	---
01U140	D	6/30/15	<1	<1	<0.07	9.8	<1	<1	<1	JP 0.39	---
01U157		12/8/14	<1	JP 0.86	---	25	<1	<1	<1	<1	---
01U157		6/26/15	<1	JP 0.72	<0.07	21	<1	<1	<1	<1	---
01U158		12/8/14	<1	JP 0.93	---	28	<1	<1	<1	JP 0.38	---
01U158		6/30/15	<1	JP 0.86	<0.07	42	<1	<1	<1	JP 0.37	---
01U350		6/25/15	1.6	JP 0.36	<0.07	<1	<1	<1	<1	<1	---
01U901		12/10/14	<1	<1	---	<1	<1	<1	<1	<1	---
01U901		6/30/15	<1	<1	JP 0.032 UFB0.044	<1	<1	<1	<1	<1	---
01U902		12/10/14	<1	<1	---	19	<1	<1	<1	JP 0.31	---
01U902	D	12/10/14	<1	<1	---	20	<1	<1	<1	JP 0.35	---
01U902		6/30/15	<1	<1	<0.07	18	<1	<1	<1	JP 0.30	<2
01U903		6/30/15	<1	<1	<0.07	<1	<1	<1	<1	<1	---
01U904		12/10/14	<1	<1	---	26	<1	<1	<1	<1	---
01U904		6/30/15	<1	<1	<0.07	21	<1	<1	<1	<1	<2
01U904	D	6/30/15	<1	<1	<0.07	22	<1	<1	<1	<1	<2

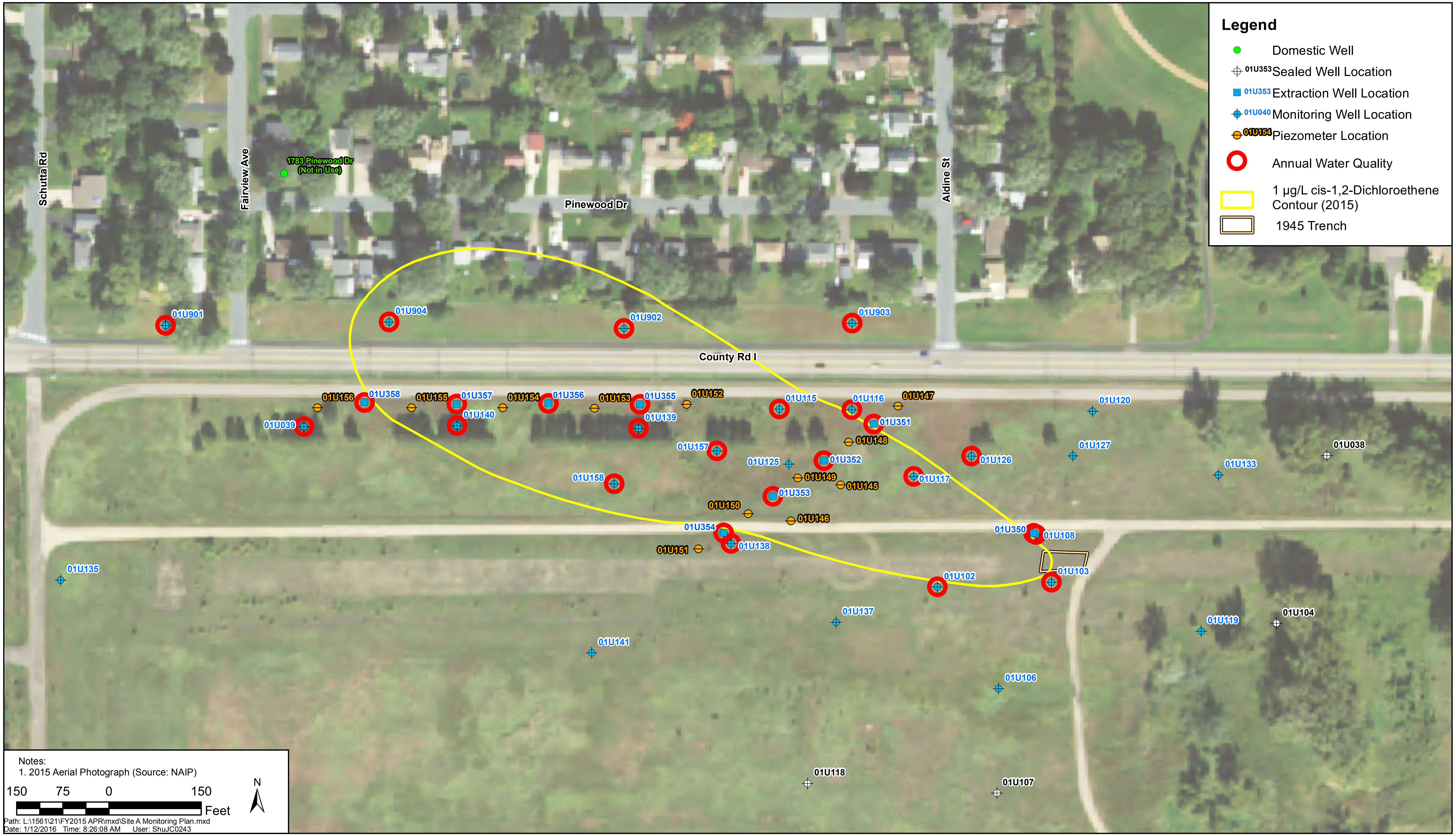
Table 6-2
Site A Groundwater Quality Data

Fiscal Year 2015

			Tetra-chloro-ethene (µg/L)	Tri-chloro-ethene (µg/L)	1,4 Dioxane (µg/L)	cis-1,2-Di-chloro-ethene (µg/L)	1,1-Di-chloro-ethene (µg/L)	1,2-Di-chloro-ethane (µg/L)	Chloro-form (µg/L)	Benzene (µg/L)	Antimony (µg/L)
Site A Cleanup Level (1)			7	30	---	70	6	4	60	10	6
MDH HRL (2)			---	---	1	---	---	---	---	---	---
Extraction Wells (3) :											
01U351 (EW-1)		6/26/15	<1	<1	<0.07	JP 0.42	<1	<1	<1	<1	---
01U352 (EW-2)		12/10/14	<1	<1	---	5.5	<1	<1	<1	<1	---
01U352 (EW-2)		6/26/15	<1	<1	<0.07	6.7	<1	<1	<1	<1	---
01U353 (EW-3)		12/10/14	<1	<1	---	28	<1	<1	<1	JP 0.40	---
01U353 (EW-3)		6/29/15	<1	<1	<0.07	**95**	<1	<1	<1	3.1	---
01U354 (EW-4)		12/10/14	<1	<1	---	<1	<1	<1	<1	<1	---
01U354 (EW-4)		6/25/15	<1	JP 0.59	<0.07	<1	<1	<1	<1	<1	---
01U355 (EW-5)		12/9/14	<1	JP 0.49	---	30	<1	<1	<1	JP 0.87	---
01U355 (EW-5)		6/29/15	<1	JP 0.46	<0.07	22	<1	<1	<1	JP 0.66	---
01U356 (EW-6)		12/9/14	<1	JP 0.83	---	**260**	<1	<1	<1	1.7	---
01U356 (EW-6)		6/29/15	<1	JP 0.62	<0.07	**220**	<1	<1	<1	1.5	---
01U357 (EW-7)		12/9/14	<1	<1	---	19	<1	<1	<1	JP 0.63	---
01U357 (EW-7)		6/29/15	<1	<1	<0.07	17	<1	<1	<1	JP 0.64	---
01U357 (EW-7)	D	6/29/15	<1	<1	<0.07	17	<1	<1	<1	JP 0.63	---
01U358 (EW-8)		12/9/14	<1	<1	---	JP 0.37	<1	<1	<1	<1	---
01U358 (EW-8)		6/29/15	<1	<1	<0.07	JP 0.33	<1	<1	<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.
(2)	No Site A cleanup level has been established for 1,4-dioxane. For reference, the Minnesota Department of Health (MDH) Health Risk Limit (HRL) for 1,4-dioxane is 1 µg/L. Bolding (in red color) indicates exceedance of the HRL.
(3)	The extraction wells are currently in standby (not operating) while Monitored Natural Attenuation (MNA) is being evaluated.
---	Not Sampled.
D	Duplicate sample.
JP	The value is below the Reporting Limit, but above the Method Detection Limit. Results should be considered estimated.
JMS	The percent recovery for the matrix spike was above or below the QC limits (the percent recovery is listed after "JMS"). The sample result could be biased high (if over 100 percent recovery) or low (if below 100 percent recovery).
UFB	The sample result was less than 5 times the level detected in a field blank (the result for the blank is listed after "UFB"). The sample result can be considered non detect at an elevated detection limit.



Notes:
1. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Site A Monitoring Plan.mxd
Date: 1/12/2016 Time: 8:26:08 AM User: ShuJC0243

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Site A, Groundwater Monitoring Plan

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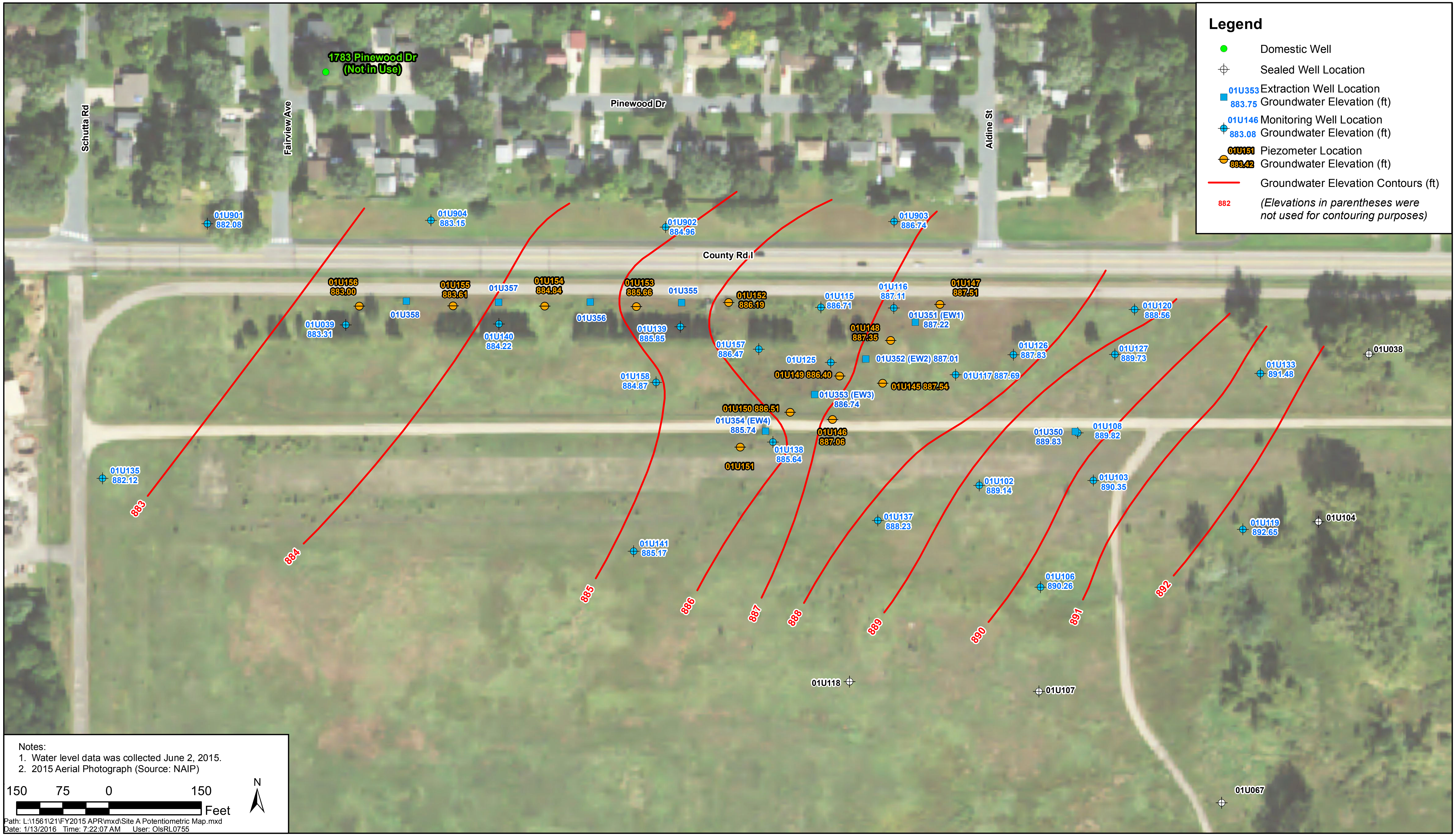
Figure 6-1



Notes:
1. Water level data was collected June 2, 2015.
2. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Site A Potentiometric Map.mxd
Date: 1/13/2016 Time: 7:22:07 AM User: OlsRL0755

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Site A, Unit 1, Potentiometric Map, June 2015

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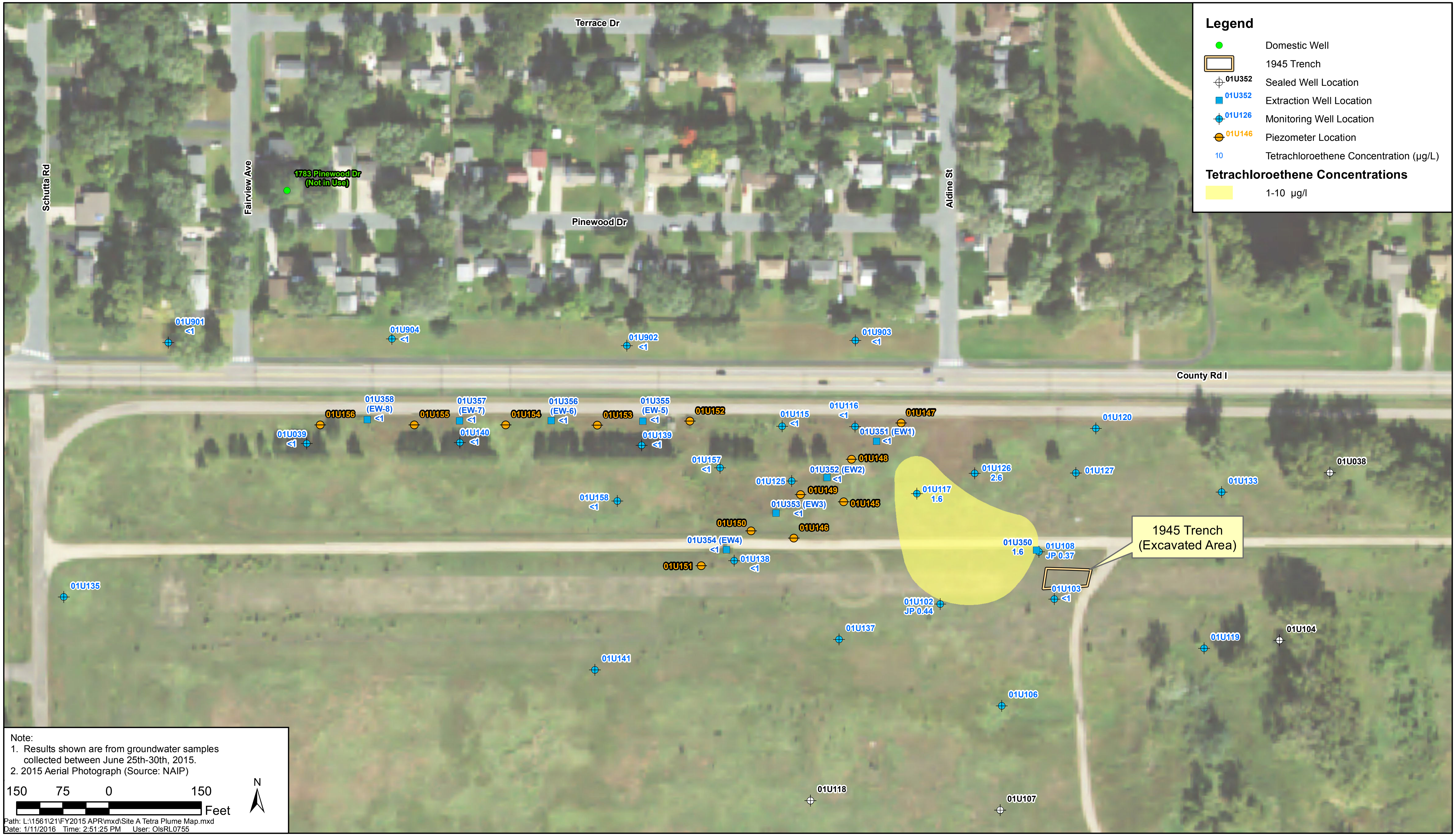
Figure 6-2



Note:
1. Results shown are from groundwater samples collected between June 25th-30th, 2015.
2. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Site A Tetra Plume Map.mxd
Date: 1/11/2016 Time: 2:51:25 PM User: OlsRL0755

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Site A, Unit 1, Tetrachloroethene Isoconcentration Map, June 2015

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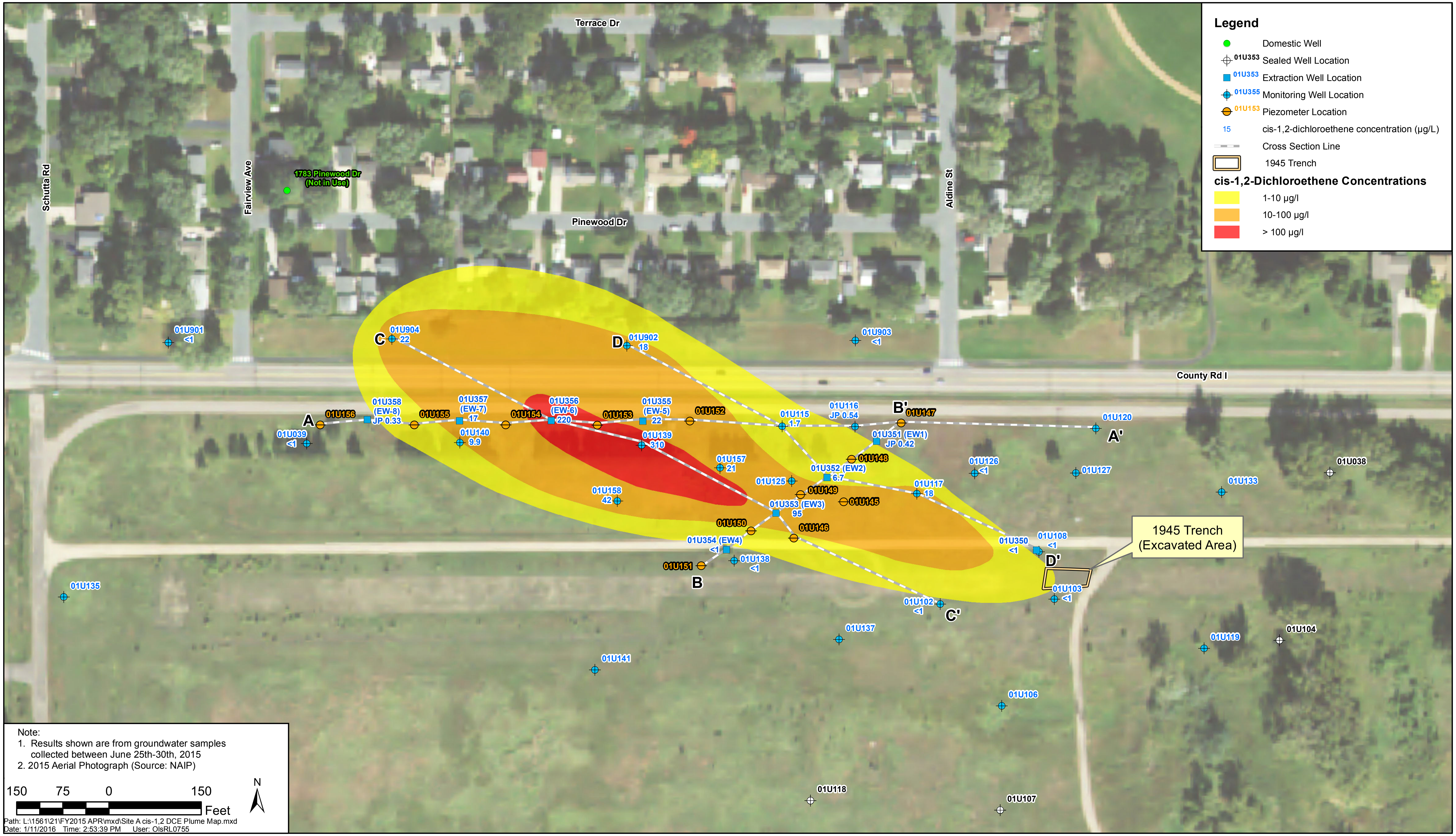
Figure 6-3



Note:
1. Results shown are from groundwater samples collected between June 25th-30th, 2015
2. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Site A cis-1,2 DCE Plume Map.mxd
Date: 1/11/2016 Time: 2:53:39 PM User: OlsRL0755

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Site A, Unit 1, cis-1,2-Dichloroethene Isoconcentration Map, June 2015

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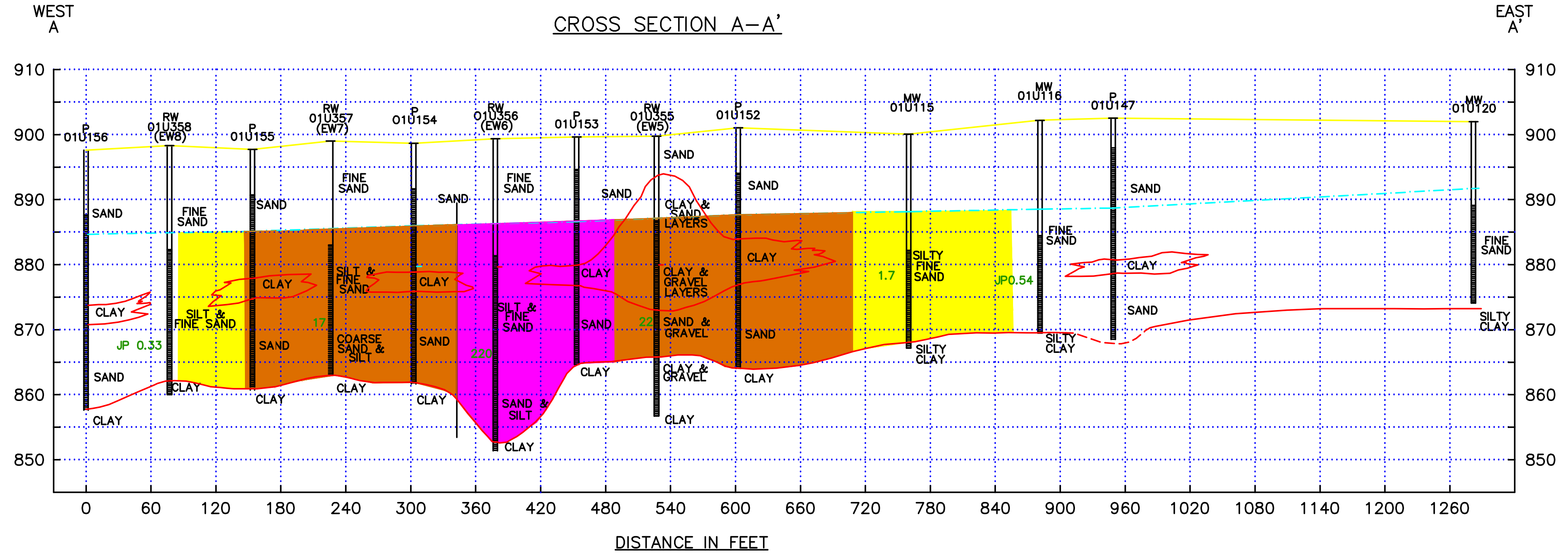
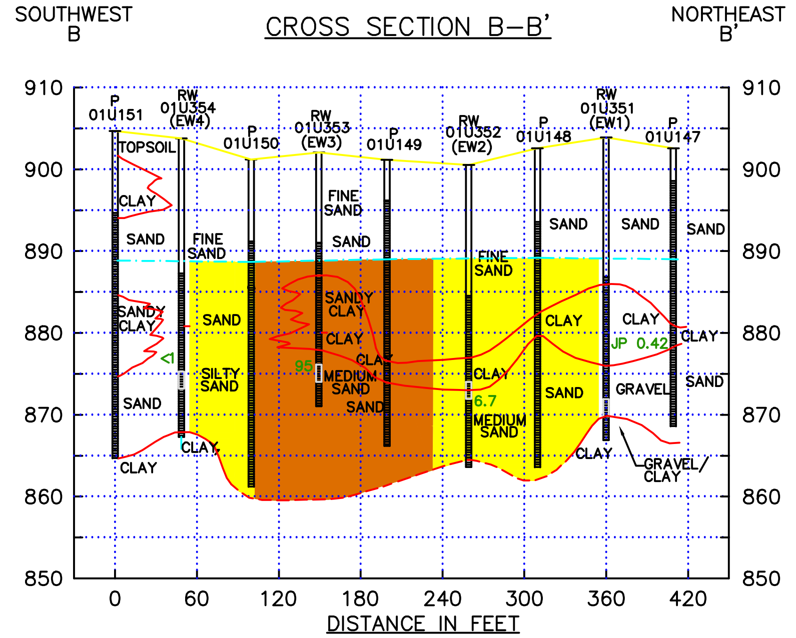
Figure 6-4

Plot Date & Time:28 December 2015 11:51 AM

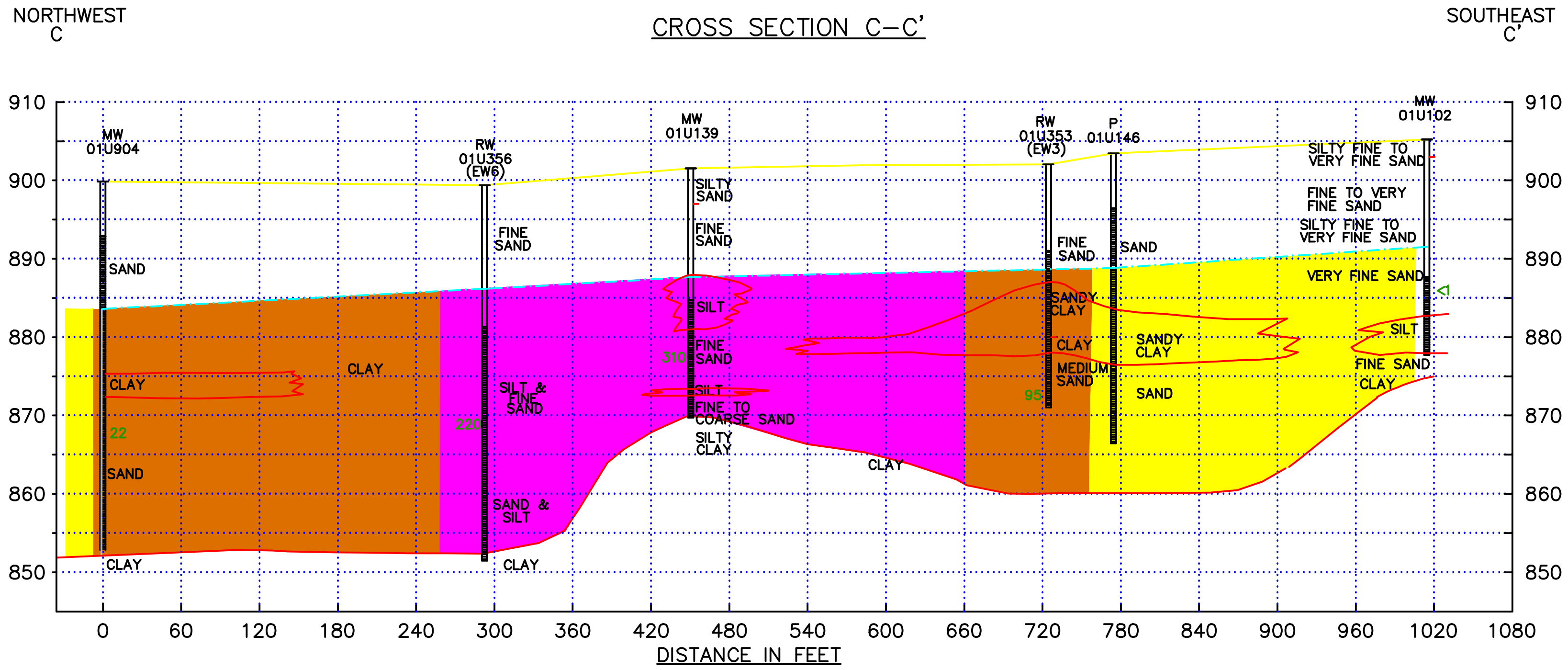
CROSS SECTION A–A'



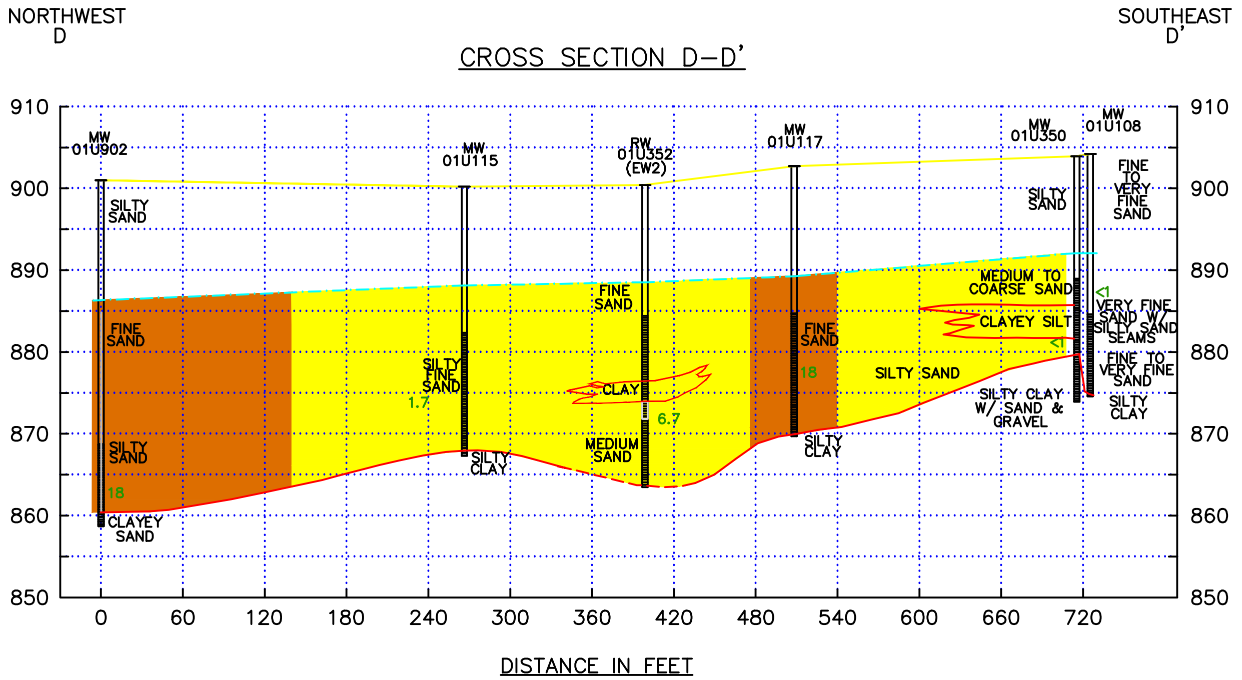
CROSS SECTION B–B'



CROSS SECTION C–C'



CROSS SECTION D–D'



NOTES:

1. RESULTS ARE FROM GROUNDWATER SAMPLES COLLECTED BETWEEN JUNE 25 AND JUNE 30, 2015.
2. CONSTRUCTION INFORMATION ON RECOVERY WELLS AND PIEZOMETERS WAS GENERATED BY DAHL AND ASSOCIATES, INC. AS PART OF THE SITE A REMOVAL ACTION SYSTEM CONSTRUCTION. CONSTRUCTION INFORMATION ON MONITORING WELLS WAS PROVIDED BY FEDERAL CARTRIDGE COMPANY.

SCALE
V.E. = 6X

LEGEND

GEOLOGIC CONTACT
INFERRED GEOLOGIC CONTACT
SCREENED INTERVAL OF WELL
PUMP LOCATION
885.0 WATER LEVEL SURFACE
SLIGHT CHANGE IN GEOLOGIC UNIT (MARK LOCATED ALONG WELL STAFF)
MW MONITORING WELL
RW RECOVERY WELL
P PIEZOMETER

MW 01U117 12 cis–1,2–DICHLOROETHENE CONCENTRATION (µg/l)

cis–1,2–DICHLOROETHENE CONCENTRATIONS
🟨 1–10 µg/l
🟧 10–100 µg/l
🟪 >100 µg/l

REV | REVISION DESCRIPTION | DWN | APP | REV DATE

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MAPLE PLAIN, MINNESOTA
PH. 763–470–4200
FAX 763–479–4242

DWN BY JVB
CHK'D MH
APP'D MH
DWG DATE JAN. 2016
SCALE AS NOTED
PROJECT FY 2015 ANNUAL PERFORMANCE REPORT
CLIENT U.S. ARMY–TCAAP
SHEET TITLE cis–1,2–DICHLOROETHENE CROSS–SECTIONS A, B, C, D
PROJECT NO. 1561–21
SHEET NO. FIGURE 6–5
REV NO.

M:\1561\2015\Tcax02b6.dwg

FIGURE 6-6
SITE A, cis-1,2-DICHLOROETHENE WATER QUALITY TRENDS: EXTRACTION WELLS 1 - 4

FY 2015 ANNUAL PERFORMANCE REPORT

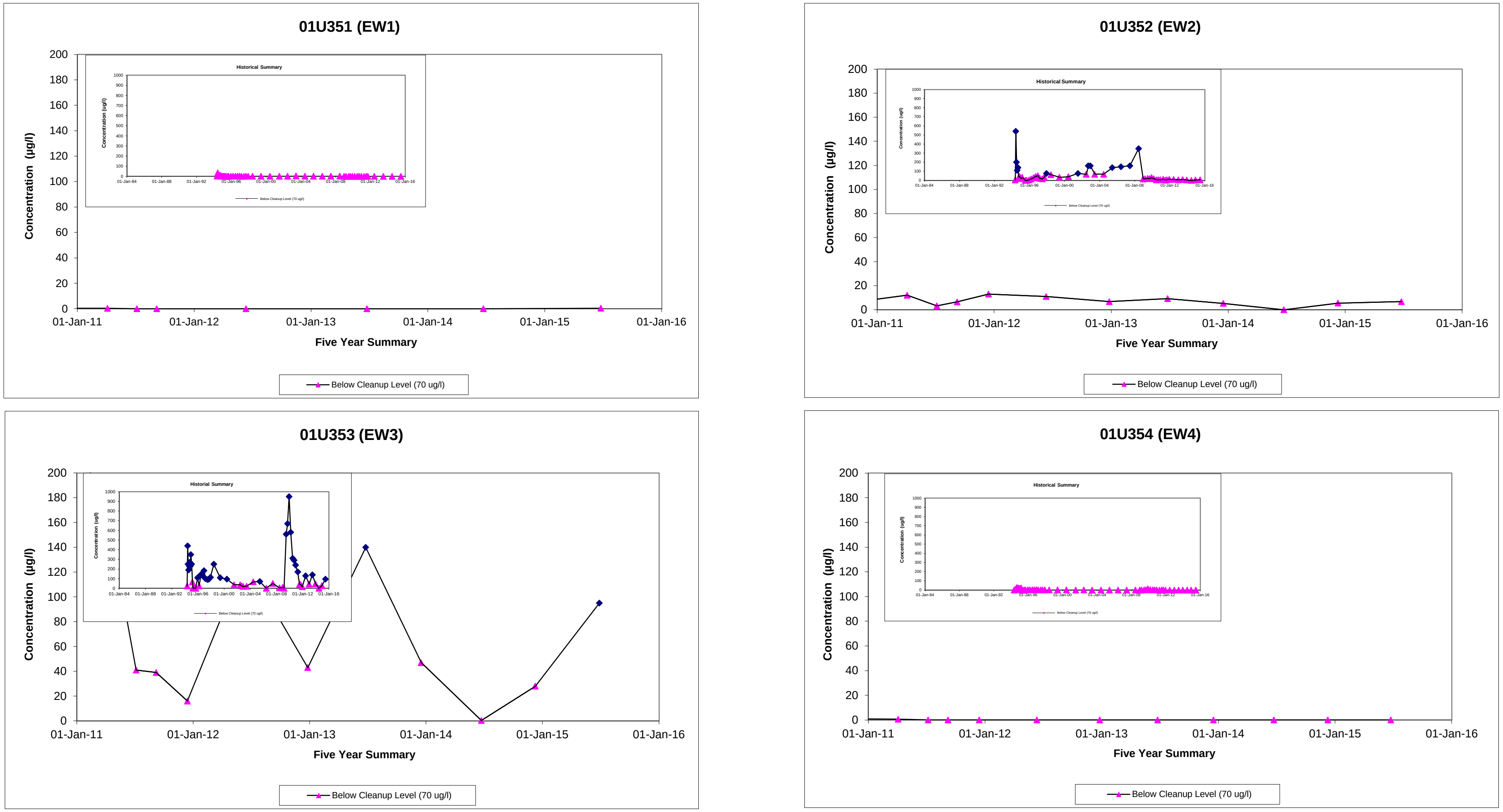


FIGURE 6-7
SITE A, cis-1,2-DICHLOROETHENE WATER QUALITY TRENDS: MONITORING WELLS

FY 2015 ANNUAL PERFORMANCE REPORT

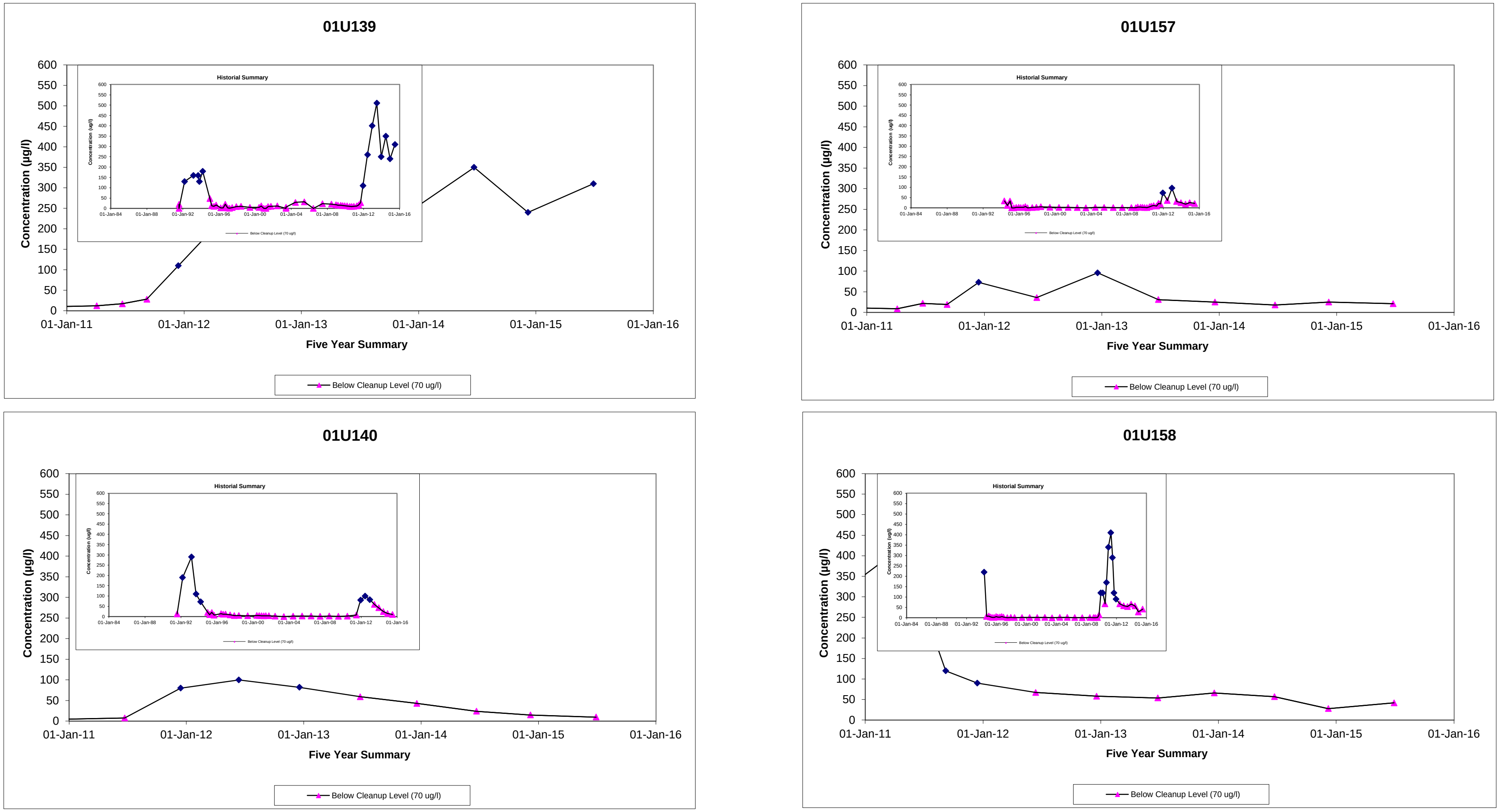


FIGURE 6-8
SITE A, cis-1,2-DICHLOROETHENE WATER QUALITY TRENDS: EXTRACTION WELLS 5 - 8

FY 2015 ANNUAL PERFORMANCE REPORT

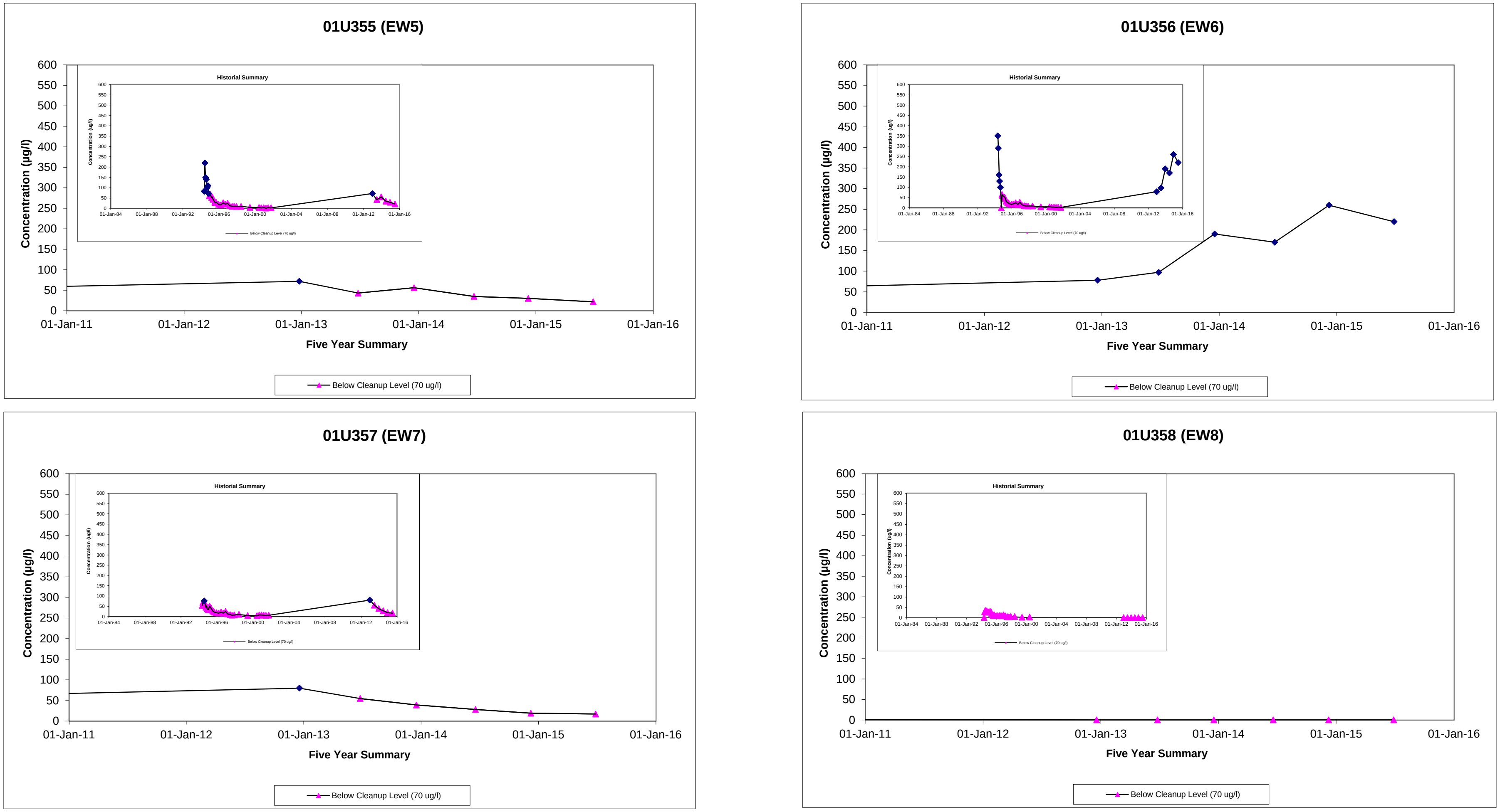
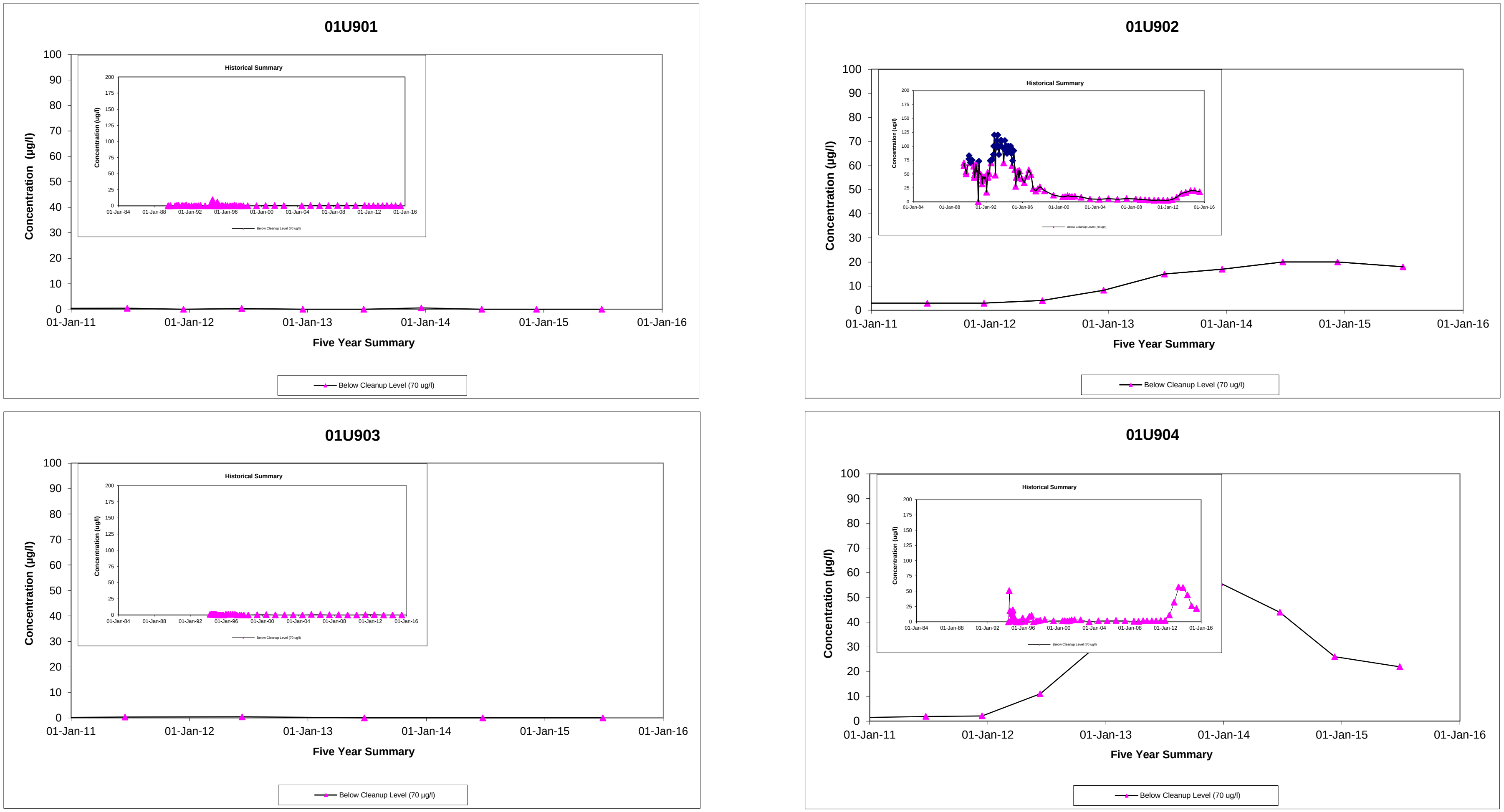


FIGURE 6-9
SITE A, cis-1,2-DICHLOROETHENE WATER QUALITY TRENDS: CONTINGENCY LOCATIONS

FY 2015 ANNUAL PERFORMANCE REPORT



7.0 Operable Unit 2: Site C Shallow Groundwater

Impacts to Site C shallow groundwater had not occurred at the time of the OU2 ROD (1997). In FY 1997, the U.S. Army Environmental Command (USAEC) sponsored a technology demonstration project to phytoremediate lead-contaminated soil at Site C. During the growing seasons, ethylenediaminetetraacetic acid (EDTA) and acetic acid were 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 at Site C, which is present within a few feet from the ground surface. In FY 2000, the MPCA took enforcement action, requiring that the Army implement corrective actions. Initially, the Army installed a groundwater recovery trench to contain the lead plume (operated between November 2000 and July 2001). On July 6, 2001, the Army began operating three extraction wells to contain the plume (replacing recovery trench operation), with discharge of extracted groundwater (treated as necessary) to a POTW. In FY 2004, a Stipulation Agreement was signed which resolved the enforcement action and directed that response actions be conducted under the authority of the FFA. The 2007 OU2 ROD Amendment #1 incorporated the existing groundwater extraction system as the final remedy.

On November 13, 2008, the groundwater system was shut off (with regulatory approval), since the lead concentrations in the three extraction wells had been below the groundwater cleanup level since March 2008 (i.e., the area of lead concentrations that exceeded the groundwater cleanup level was not even reaching the extraction wells, so operation of the extraction system was no longer required to contain the plume). The recommendation to shut the extraction system off was presented in the “Site C Groundwater Extraction System Evaluation Report,” which was approved by the USEPA and MPCA in November 2008. The 2007 ROD Amendment #1 prescribes four major components of the remedy, and until a decision is made to formally change the remedy, the original components of ROD Amendment #1 will be retained in this section (with discussion that is appropriate to the current remedy implementation status).

The Evaluation Report also presented the monitoring plan to be implemented at the point that the extraction wells were shut off, and presented the contingency actions that will be taken by the Army if groundwater and/or surface water monitoring indicates that any of the stated trigger points are exceeded. These monitoring and contingency actions have been incorporated into the APR, and thus any changes to monitoring and contingency actions must be approved by the USEPA and MPCA through revisions to the APR.

At some point, the remedy could be formally changed. This change would presumably require an Explanation of Significant Difference (ESD), at a minimum, or possibly a ROD amendment. However, given that groundwater cleanup levels may be reached throughout Site C within a few years, it may not be necessary to go through the process of formally changing the remedy. Evaluation in future APRs will ultimately determine whether the USEPA, MPCA, and Army should formally change the remedy or, possibly, whether the Site should just be closed.

7.1 REMEDY COMPONENT #1: GROUNDWATER AND SURFACE WATER MONITORING

Description: "The existing Site C groundwater monitoring program will be revised as needed."
"A new surface water monitoring plan will be prepared."
(OU2 ROD Amendment #1, page 39-40)

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

Is this remedy component being implemented?
Yes. Table 7-1 summarizes the performance monitoring requirements, the implementing parties, and the documents that contain the monitoring plans. FY 2015 monitoring was conducted in accordance with the Monitoring Plans included in Appendix A. The water quality monitoring

locations and frequencies are also summarized on Figure 7-1, and any deviations are explained in Appendix C.2.

Were the monitoring requirements for this remedy met? Yes.

Is any sampling proposed prior to the next report?
Yes. Groundwater and surface water monitoring at Site C will be in accordance with the monitoring plans shown in Appendix A.1 and A.3, respectively.

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

7.2 REMEDY COMPONENT #2: GROUNDWATER CONTAINMENT

Description: "Three extraction wells, EW-1 through EW-3, will continue collecting contaminated groundwater." (OU2 ROD Amendment #1, page 38)

Is this remedy component being implemented?
No. As discussed previously, since the area of lead concentrations that exceed the groundwater cleanup level no longer extends to the extraction wells, the extraction system is no longer operating and this remedy component is not currently being implemented.

7.3 REMEDY COMPONENT #3: DISCHARGE OF EXTRACTED WATER

Description: "Extracted groundwater will be pretreated onsite (as necessary) to meet the sanitary sewer discharge limit." (OU2 ROD Amendment #1, page 38)

Is this remedy component being implemented?

No. As discussed previously, since the area of lead concentrations that exceed the groundwater cleanup level no longer extends to the extraction wells, the extraction system is no longer operating and this remedy component is not currently being implemented.

7.4 REMEDY COMPONENT #4: LAND USE CONTROLS

Description: "LUCs will be established to protect the groundwater extraction, treatment, and monitoring system and to prohibit the drilling of water supply wells within the contaminated portion of the Unit 1 aquifer." (OU2 ROD Amendment #1, page 39)

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

For initial implementation, when the USEPA and MPCA have provided consistency approval for an OU2 Land Use Control Remedial Design (LUCRD) document. Implementation will continue until such time that the groundwater concentrations are below the cleanup levels.

Has a LUCRD document been approved to address land use control (LUC) issues for OU2, including Site C groundwater, and is it being implemented?

Yes. The USEPA and MPCA provided consistency approval for the OU2 LUCRD in September 2010 and it is being implemented by the Army. Revision 3 of the OU2 LUCRD was approved by the USEPA and MPCA in March 2015; however, this revision did not affect land use controls at Site C.

Was an annual site inspection for land use controls conducted in FY 2015?

Yes. On July 23, 2015, the Army, National Guard, and Wenck conducted the annual inspection of OU2 sites. The checklist that was completed during the inspection is included as Appendix I.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs? No.

7.5 OVERALL REMEDY FOR SITE C SHALLOW GROUNDWATER

Performance Standard (how do you know when you're done):
When the cleanup levels in Table 1 of OU2 ROD Amendment #1 have been attained throughout the areal and vertical extent of the Site C plume.

Has the Site C shallow groundwater remedy been completed (i.e., have the cleanup levels in Table 1 of the OU2 ROD Amendment #1 been attained throughout the areal and vertical extent of the Site C plume)?
No. Table 7-2 and 7-3 present the FY 2015 groundwater and surface water quality data, respectively, and highlight the values that exceed the lead cleanup level. Figure 7-2 presents groundwater elevation contours based on measurements in June 2015. Figure 7-3 shows the lead results for groundwater and surface water. Figure 7-4 and 7-5 show the lead concentrations plotted on geologic cross sections for Site C to illustrate the vertical extent of contamination (the cross section locations are illustrated on Figure 7-3).

In June 2015, lead exceeded the groundwater cleanup level of 15 µg/L in the four monitoring wells located near the source area. The water quality trends (dissolved lead) for MW-3, 13, 14, and 15 are shown on Figure 7-6. From closest to the source area and then moving downgradient, these four results were 390 µg/L (MW-13), 18 µg/L (MW-3), 200/1100 µg/L (MW-14), and 380/370 µg/L (MW-15). However, upon initial review of the sample results, it was discovered that the June 2015 samples were not field filtered (i.e., these were total lead results rather than the desired dissolved lead results). A decision was made to resample the four wells that had higher concentrations of lead, specifically, those that exceeded the groundwater cleanup level of 15 µg/L (since it is reasonable to assume that where total lead results were below the cleanup level, the dissolved lead results would also be below the cleanup level). The dissolved lead results from the resampling showed exceedances in only two of the four wells that had originally exceeded the cleanup level. The results for the four wells were 31 µg/L (MW-13), 1.5 µg/L (MW-3), 21/6.5 µg/L (MW-14), and 14/13 µg/L (MW-15). Surface water monitoring results were all below the surface water cleanup level in FY 2015 (lead was not detected in any surface water sample).

Looking at the water quality trends (dissolved lead) for the wells located just downgradient of the source area (Figure 7-6), the results for MW-3, MW-13, and MW-14 significantly decreased versus the June 2014 results. The results for MW-15 also decreased versus the June 2014 results. Overall, the decrease in dissolved lead concentrations shows substantial progress towards reaching the groundwater cleanup levels.

Were any trigger levels exceeded at any of the contingency locations?

No. The Site C contingency locations and trigger levels are shown in Table 7-4. Depending on the location, the trigger level is either equal to the groundwater cleanup level or a surface water cleanup level. The groundwater results (Table 7-2) and surface water results (Table 7-3) show that none of the trigger levels were exceeded in FY 2015. If a trigger level were to be exceeded, the Army would implement the contingency action(s) specified in the footnotes to Table 7-4.

Can it be determined whether a formal change to the remedy should be made (to eliminate the groundwater extraction and discharge components) or, possibly, whether the Site should just be closed?

No, the determination cannot be made yet. Although the FY 2015 results in the wells near the source area indicate that groundwater cleanup levels have nearly been met (Figure 7-6), two wells still exceeded the cleanup level. Additional monitoring should be conducted before this determination is made.

Do additional remedial measures need to be addressed?

No. Continued monitoring will provide the additional data needed to determine whether a formal change to the remedy should be made or, possibly, whether the Site should just be closed.

Table 7-1
Summary of Site C Shallow Groundwater Monitoring Requirements

Fiscal Year 2015

Remedy Component		Monitoring Requirements	Implementing Party	Documents Containing the Monitoring Plan
#1:	Groundwater and Surface Water Monitoring	Outlined below		
#2:	Groundwater Containment	a. None. The groundwater extraction system was shut down in November 2008, since the area of groundwater that exceeded the groundwater cleanup level no longer extended to the extraction wells.		
#3:	Discharge of Extracted Water	a. None (see #2 above).		
#4:	LUCs to Restrict Well Installation and to Protect the Remedy Infrastructue	a. None.		
OR:	Overall Remedy (Attainment of cleanup goals)	a. Groundwater quality data throughout the Site C plume to evaluate attainment and to verify that operation of a groundwater extraction system is not required. Also surface water data in the plume vicinity to verify that groundwater does not impact surface water above surface water standards.	Army	Site C Monitoring Plan in the Annual Performance Report

Table 7-2
Water Quality Data for Site C Groundwater

Fiscal Year 2015

Sample Location		Date Collected	Lead (Total) (μg/L)	Lead (Dissolved) (μg/L)(2)	L	D
Groundwater Cleanup Level(1):			15	15		
01U561 (MW1)		6/23/15	0.30		U	
01U562 (MW2)		6/23/15	0.30		U	
01U563 (MW3)		6/23/15	**18**			
01U563 (MW3)		7/31/15		1.5		
01U564 (MW4)		6/23/15	0.30		U	
01U567 (MW7)		6/23/15	3.0			
01U571 (MW11)		6/23/15	0.61		J	
01U573 (MW13)		6/23/15	**390**			
01U573 (MW13)		7/31/15		**31**		
01U574 (MW14)		6/23/15	**200**			JFD138
01U574 (MW14)	D	6/23/15	**1100**			JFD138
01U574 (MW14)		7/31/15		**21**		JFD105
01U574 (MW14)	D	7/31/15		6.5		JFD105
01U575 (MW15)		6/23/15	**380**			
01U575 (MW15)	D	6/23/15	**370**			
01U575 (MW15)		7/31/15		14		
01U575 (MW15)	D	7/31/15		13		
01U576 (MW16)		6/24/15	0.82		J	
01U046		6/24/15	0.30		J	

Notes:

Laboratory Concentration Qualifiers (L):

U	Analyte was not detected above the Method Detection Limit (MDL).
J	Reported value is between the Method Detection Limit (MDL) and the Reporting Limit (RL).

Data Validation Qualifiers (D):

JFD	The relative percent difference (rpd) for the field duplicate exceeded the QC limit (the rpd is listed after "JFD"). The result should be considered estimated.

Other Notes:

D	Duplicate
(1)	The cleanup level for Site C Groundwater is from Table 1 of OU2 ROD Amendment #1. Bolding (in red color) indicates exceedance of the cleanup level.
(2)	The June 2015 samples were inadvertently not field-filtered. Since dissolved lead was the desired parameter, those samples that exceeded the cleanup level were resampled (with field filtering) in July 2015.

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

Fiscal Year 2015

Sample Location		Date Collected	Lead (Dissolved) (µg/L)	L	D
Surface Water Cleanup Level$^{(1)}$:			6.9		
SW 05		6/29/15	0.30	U	
SW 05		6/30/15	0.30	U	
SW 05		7/1/15	0.30	U	
SW 06		6/29/15	0.30	U	
SW 06		6/30/15	0.30	U	
SW 06		7/1/15	0.30	U	
NE Wetland		6/29/15	0.30	U	
NE Wetland		6/30/15	0.30	U	
NE Wetland		7/1/15	0.30	U	
NE Wetland	D	7/1/15	0.30	U	

Notes:

Laboratory Concentration Qualifiers (L):

U	Analyte was not detected above the Method Detection Limit (MDL).
J	Reported value is between the Method Detection Limit (MDL) and the Reporting Limit (RL).

Data Validation Qualifiers (D):

(None)

Other Notes:

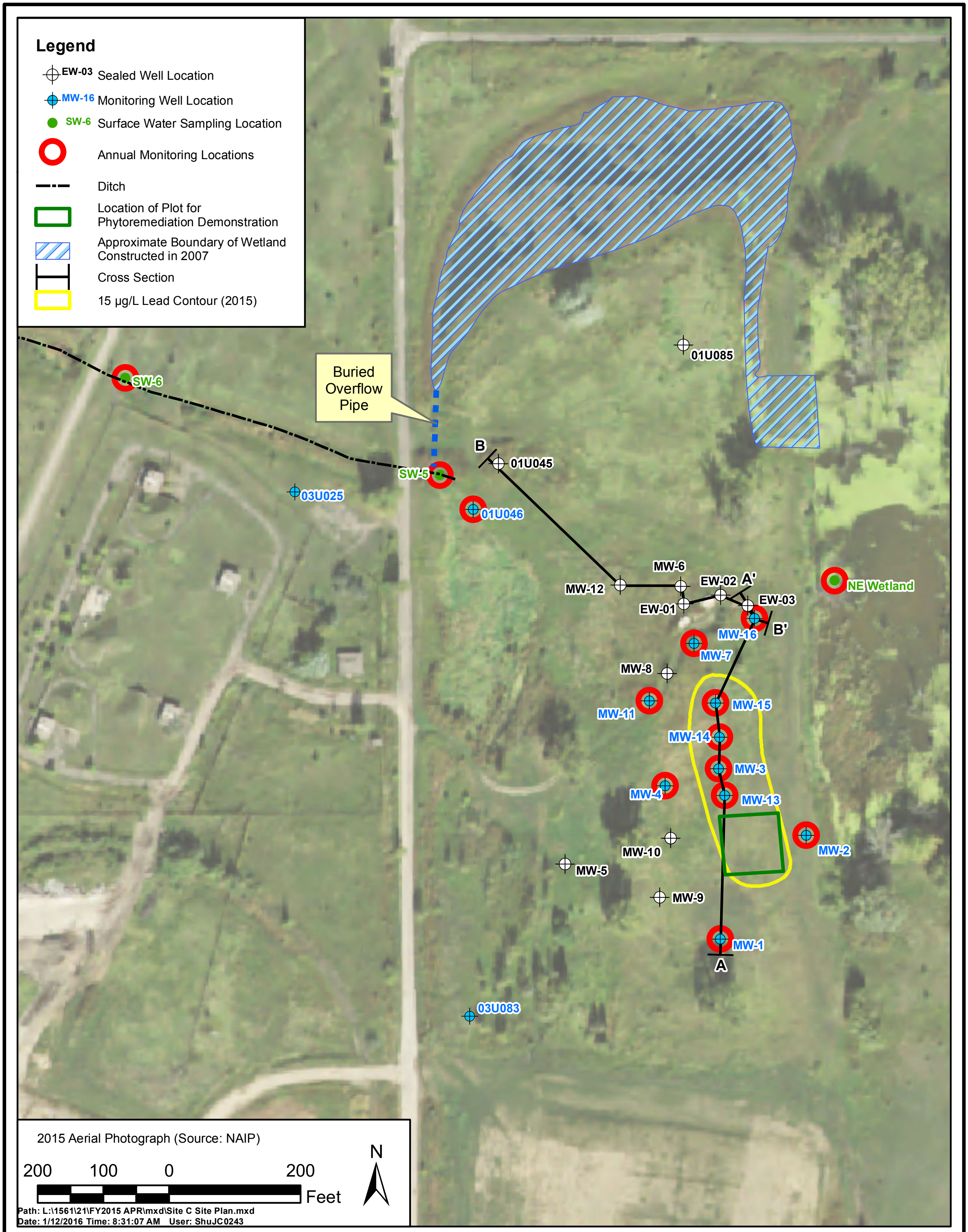
D	Duplicate
(1)	The cleanup level for Site C Surface Water is from Table 1 of OU2 ROD Amendment #1.

Table 7-4
Contingency Locations for Site C Monitoring

	CONTINGENCY ROLE	
	Trigger for Contingency Action[1]	Contingency Action
MW-4	If 3-event moving average > 15 µg/L	Note 3
MW-7	If 3-event moving average > 15 µg/L	Note 3
MW-11	If 3-event moving average > 15 µg/L	Note 3
MW-16	If 3-event moving average > 15 µg/L	Note 3
01U046	If 3-event moving average > 6.9 µg/L	Note 4
SW5 (2)	If one sampling event > 6.9 µg/L	Note 4
SW6 (2)	If one sampling event > 6.9 µg/L	Note 5
NE Wetland (2)	If one sampling event > 6.9 µg/L	Note 4

Notes:

1) Water quality monitoring is for dissolved lead in monitoring wells and surface water.
2) Surface water sampling is performed on three consecutive days and results are averaged for comparison to the trigger.
3) Army notify USEPA/MPCA within 1 week from receipt of data and submit an evaluation report within 30 days from notification.
4) Army notify USEPA/MPCA within 1 week from receipt of data; initiate monthly sampling of SW-5, SW-6, the NE Wetland, and the replacement wetland; and submit an evaluation report within 30 days from notification.
5) Army notify USEPA/MPCA within 1 week from receipt of data; initiate monthly sampling of SW-5, SW-6, the NE Wetland, and the replacement wetland; and submit an evaluation report within 30 days from notification. If SW-6 exceedance continues for 3 consecutive months, contain the surface water at SW-6, treat (if necessary) and discharge to sanitary sewer.



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Site C Monitoring Plan

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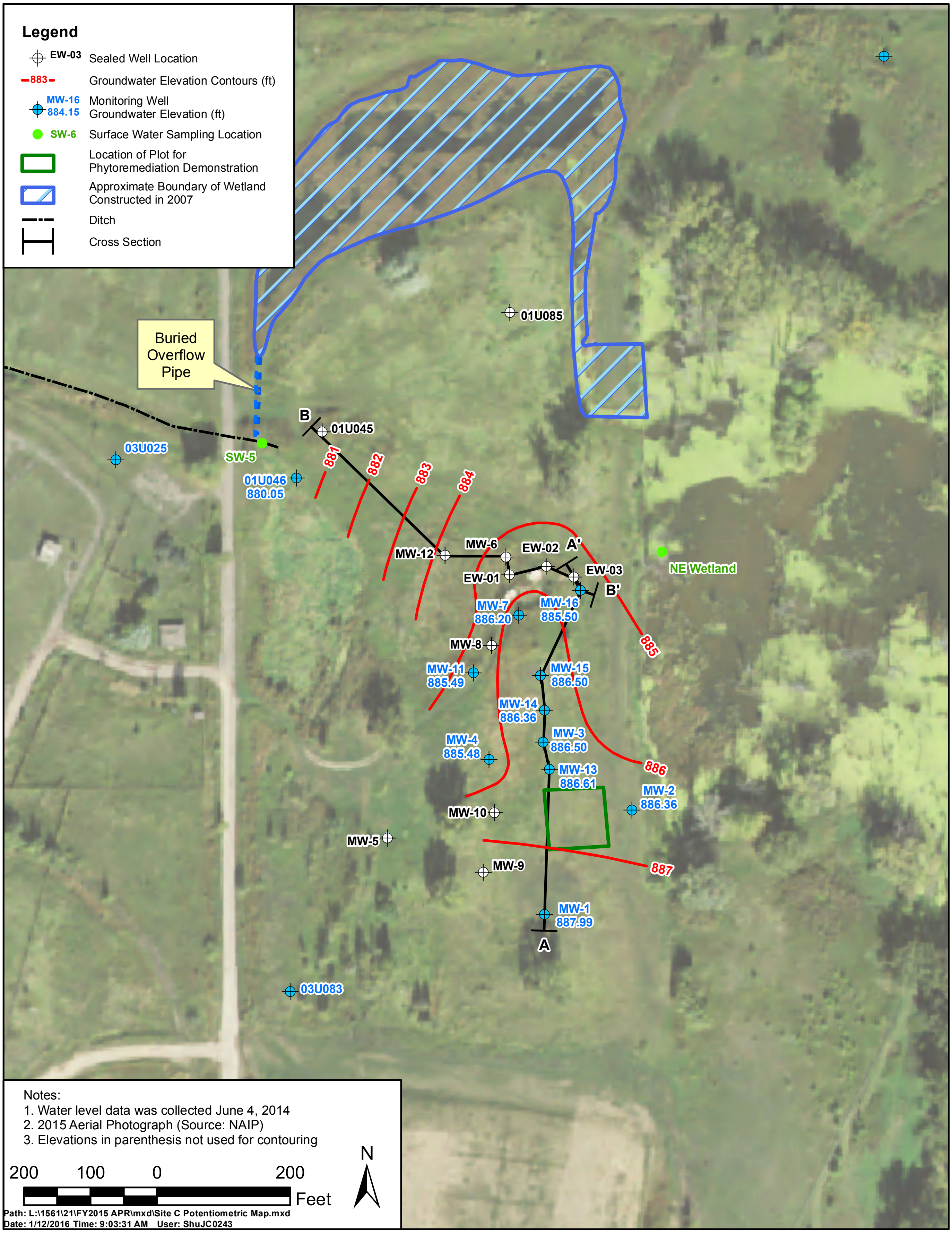
Figure 7-1



Notes:
1. Water level data was collected June 4, 2014
2. 2015 Aerial Photograph (Source: NAIP)
3. Elevations in parenthesis not used for contouring

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Site C, Unit 1, Potentiometric Map, June 2015

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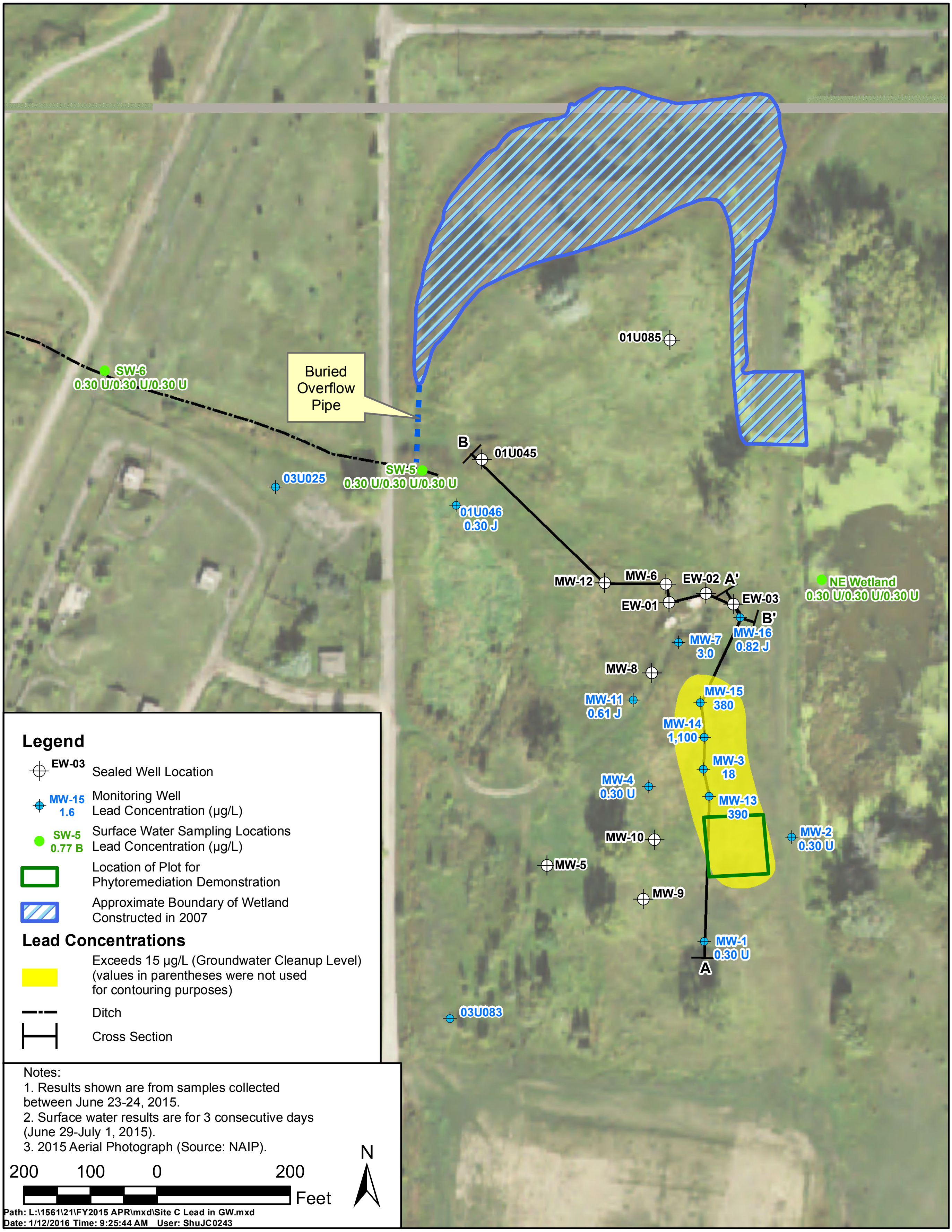
Figure 7-2



Notes:
1. Results shown are from samples collected between June 23-24, 2015.
2. Surface water results are for 3 consecutive days (June 29-July 1, 2015).
3. 2015 Aerial Photograph (Source: NAIP).

Path: L:\1561\21\FY2015 APR\mxd\Site C Lead in GW.mxd
Date: 1/12/2016 Time: 9:25:44 AM User: ShuJC0243

ANNUAL PERFORMANCE REPORT
Site C, Unit 1, Lead Results,
June 2015

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FY 2015

Figure 7-3

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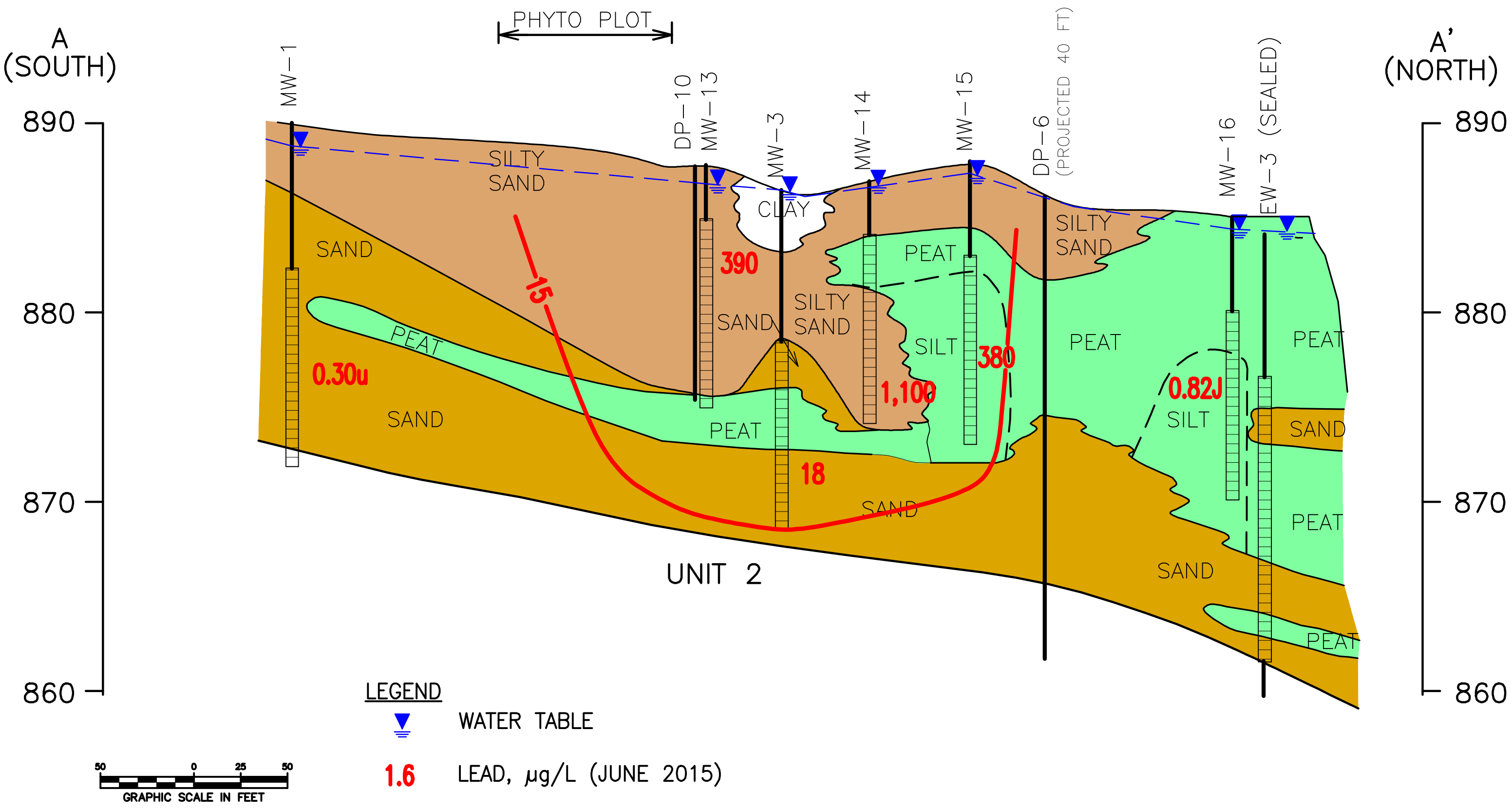

LEGEND

▼ WATER TABLE

1.6 LEAD, µg/L (JUNE 2015)

—15— 15 µg/L DISSOLVED LEAD CONCENTRATION CONTOUR
(GROUNDWATER CLEANUP LEVEL)

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CLIENT
U.S. ARMY-TCAAP

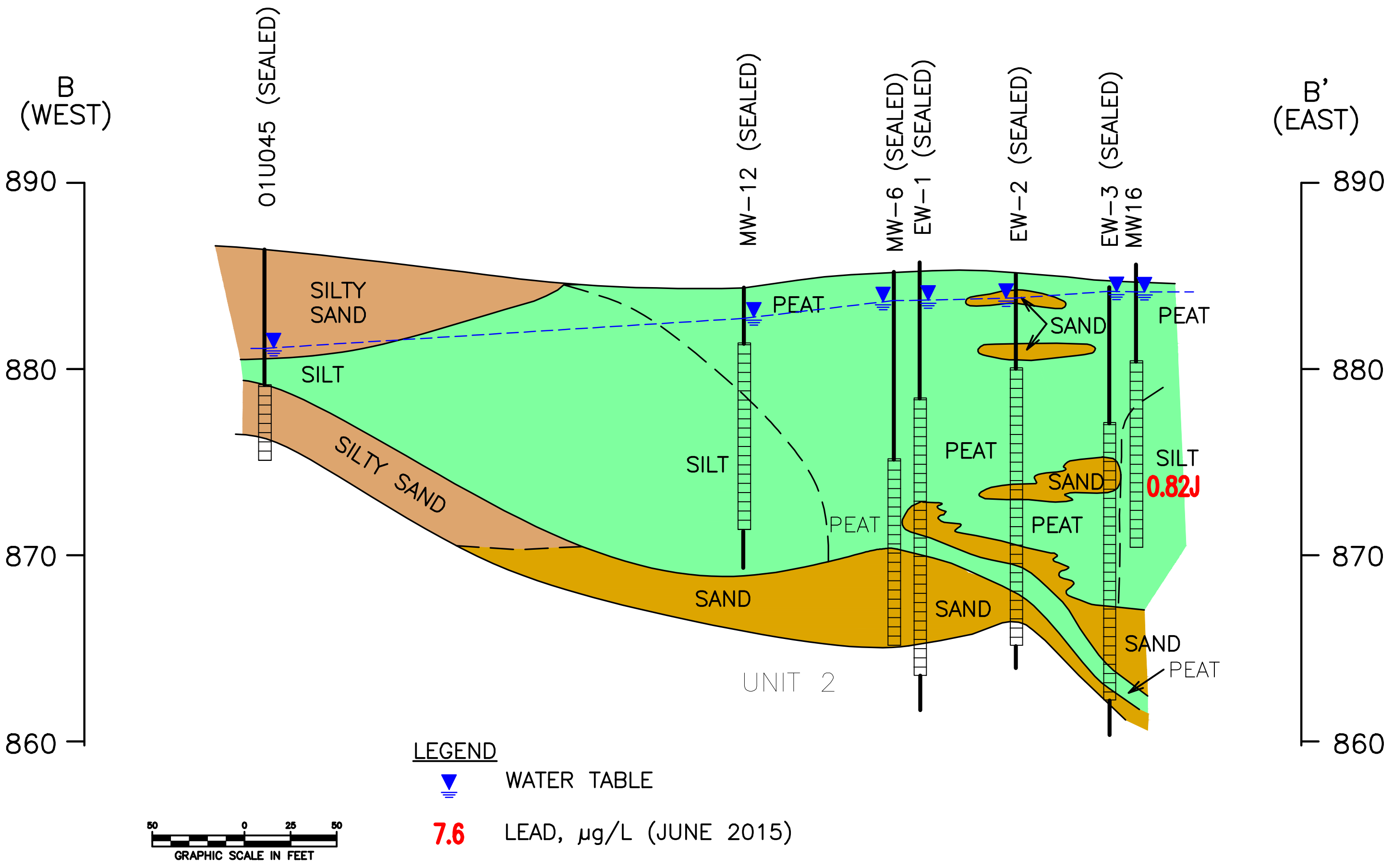
PROJECT
FY 2015 ANNUAL
PERFORMANCE REPORT

SHEET TITLE
SITE C
CROSS-SECTION A-A'

REV	DWN	APP	REV DATE	DWN BY	CHK'D	APP'D	DWG DATE	JAN. 2016	PROJECT NO.	SHEET NO.	REV NO.
				CVE	MH	MH	SCALE	AS NOTED	1561-21	FIGURE 7-4	

M:\1561\2015\e-w xsec_rev1.dwg

Plot Date & Time:6 January 2016 9:31 AM



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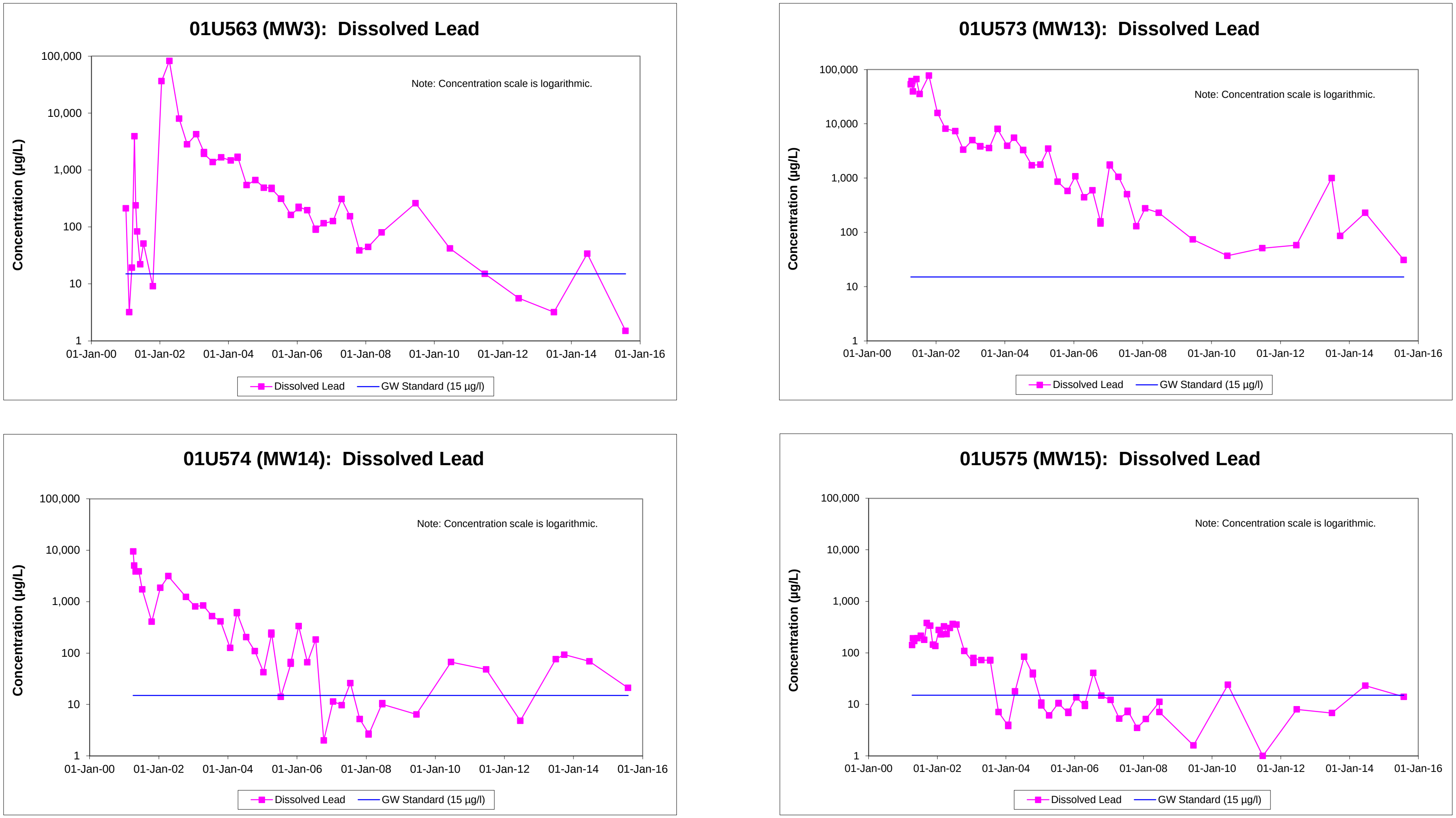
CLIENT	U.S. ARMY-TCAAP		PROJECT	FY 2015 ANNUAL PERFORMANCE REPORT						
			SHEET TITLE	SITE C CROSS-SECTION B-B'						
REV	DWN	APP	REV DATE	DWN BY	CHK'D	APP'D	DWG DATE	PROJECT NO.	SHEET NO.	REV NO.
				CVE	MH	MH	JAN. 2016	1561-21	FIGURE 7-5	
							SCALE AS NOTED			

FIGURE 7-6
SITE C, LEAD WATER QUALITY TRENDS: MONITORING WELLS

FY 2015 ANNUAL PERFORMANCE REPORT



8.0 Operable Unit 2: Site I Shallow Groundwater

VOCs have been identified in the Unit 1 (perched aquifer) at Site I. The selected remedy in the OU2 ROD (1997) consisted of four components:

- Groundwater monitoring
- Groundwater extraction
- POTW discharge
- Additional characterization

The additional investigation and Predesign Investigation Work Plan (Work Plan) were completed in FY 2000. Based on these documents, the remedy was proposed to consist of a dual-phase vacuum extraction system, which combined 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.

OU2 ROD Amendment #2 (2009) revised the requirements for shallow groundwater to the following:

- Groundwater monitoring
- Additional characterization
- Land use controls

These three major remedy components are evaluated in the following sections.

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. Table 8-1 summarizes the performance monitoring requirements, the implementing parties, and the documents that contain the monitoring plans. Appendix A summarizes the FY 2015 monitoring plan and any deviations are explained in Appendix C.2.

As previously approved by the USEPA/MPCA, all Site I (Building 502) Unit 1 monitoring wells were abandoned in FY 2014 prior to the demolition of Building 502. Only well 01U667 is scheduled to be replaced following the completion of Building 502 demolition and planned soil remediation. Well 01U667 was not replaced in FY 2015, so no groundwater sampling was conducted during FY 2015. Once reinstalled, monitoring well 01U667 will be sampled annually in accordance with the FY 2015 – FY 2019 Monitoring Plan (see Appendix A.1). Figure 8-1 presents a site plan for Site I, including the former locations of the now-abandoned monitoring wells, and the location of the geologic cross-section presented on Figure 8-2.

Is any groundwater sampling proposed prior to the next report? Yes. Monitoring well 01U667 is expected to be reinstalled in spring 2016 with groundwater monitoring resuming in June 2016. Groundwater monitoring at Site I will be in accordance with the monitoring plan shown in Appendix A.1.

Are any changes or additional actions required for this remedy component? Yes. Remedy Component #1 will require modification due to the abandonment of the Unit 1 monitoring wells.

8.2 REMEDY COMPONENT #2: 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. The report concluded that neither dual-phase extraction nor groundwater extraction is feasible at Site I. The May 2009 OU2 ROD Amendment removed the groundwater extraction and POTW discharge component of the remedy.

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

8.3 REMEDY COMPONENT #3: LAND USE CONTROLS

Description: "LUCs will be established to protect the groundwater extraction, treatment, and monitoring system and to prohibit the drilling of water supply wells within the contaminated portion of the Unit 1 aquifer." (OU2 ROD Amendment #1, page 39)

Performance Standard (how do you know when you're done):
Implementation of the land use controls will continue until such time that the groundwater concentrations are below the cleanup levels.

Has a LUCRD document been approved to address land use control (LUC) issues for OU2, including Site I groundwater, and is it being implemented?

Yes. The USEPA and MPCA provided consistency approval for the Revision 2, OU2 LUCRD in June 2011 and it is being implemented by the Army.

Was an annual site inspection for land use controls conducted in FY 2015?

On July 23, 2015, the Army, National Guard, and Wenck conducted the annual inspection of OU2 sites. The checklist that was completed during the inspection is included as Appendix I.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs? No.

8.4 OVERALL REMEDY FOR SITE I 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 I plume (OU2 ROD, page 55).

Has the Site I 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 I plume)?

No. Groundwater monitoring was not conducted in FY 2015 due to the approved abandonment of all Unit 1 wells and Site I demolition activities; however, the most recent groundwater quality data (from FY 2013) suggests that cleanup levels have not been attained. Table 8-2 presents the most recent groundwater quality data (from FY 2013) and highlights the values that exceeded a cleanup level. The concentration of trichloroethene in former well 01U632 had decreased over time, but was still above the cleanup level in FY 2013. Results from the sampling of well 01U667 indicated concentrations of 1,2-dichloroethene and vinyl chloride remained above the cleanup levels. Figure 8-3 presents the FY 2013 Site I shallow groundwater trichloroethene and vinyl chloride sample results.

Do additional remedial measures need to be addressed? Yes. As requested by Orbital ATK in their letter dated August 12, 2013 and approved by the USEPA and MPCA by letter dated August 14, 2013, all Unit 1 monitoring wells were abandoned in 2014, resulting in the need for modifications to the Groundwater Monitoring Remedy Component. In accordance with the Orbital ATK request and agency approval, monitoring well 01U667 will be reinstalled at the same location and depth following completion of Building 502 demolition and planned soil remediation (expected installation to be in spring 2016). Monitoring well 01U667 will be sampled annually in accordance with the FY 2015 – FY 2019 Monitoring Plan (see Appendix A.1).

Table 8-1

Summary Of Groundwater Monitoring Requirements
Fiscal Year 2015
Site I, OU2
Arden Hills, Minnesota

Remedy Component		Monitoring Requirements	Responsible Party	Documents Containing the Monitoring Plan
#1	Groundwater Monitoring	a. Groundwater quality and water levels to track remedy progress	Orbital ATK	Site I Monitoring Plan in Annual Performance Report
#2	Additional Investigation	a. None (completed)		
#3	Land Use Controls	a. None		
OR	Overall Remedy	a. Water quality data to evaluate attainment	Orbital ATK	Site I Monitoring Plan in Annual Performance Report

Table 8-2

Most Recent Groundwater Quality Data (FY 2013)
Site I, OU2
Arden Hills, Minnesota

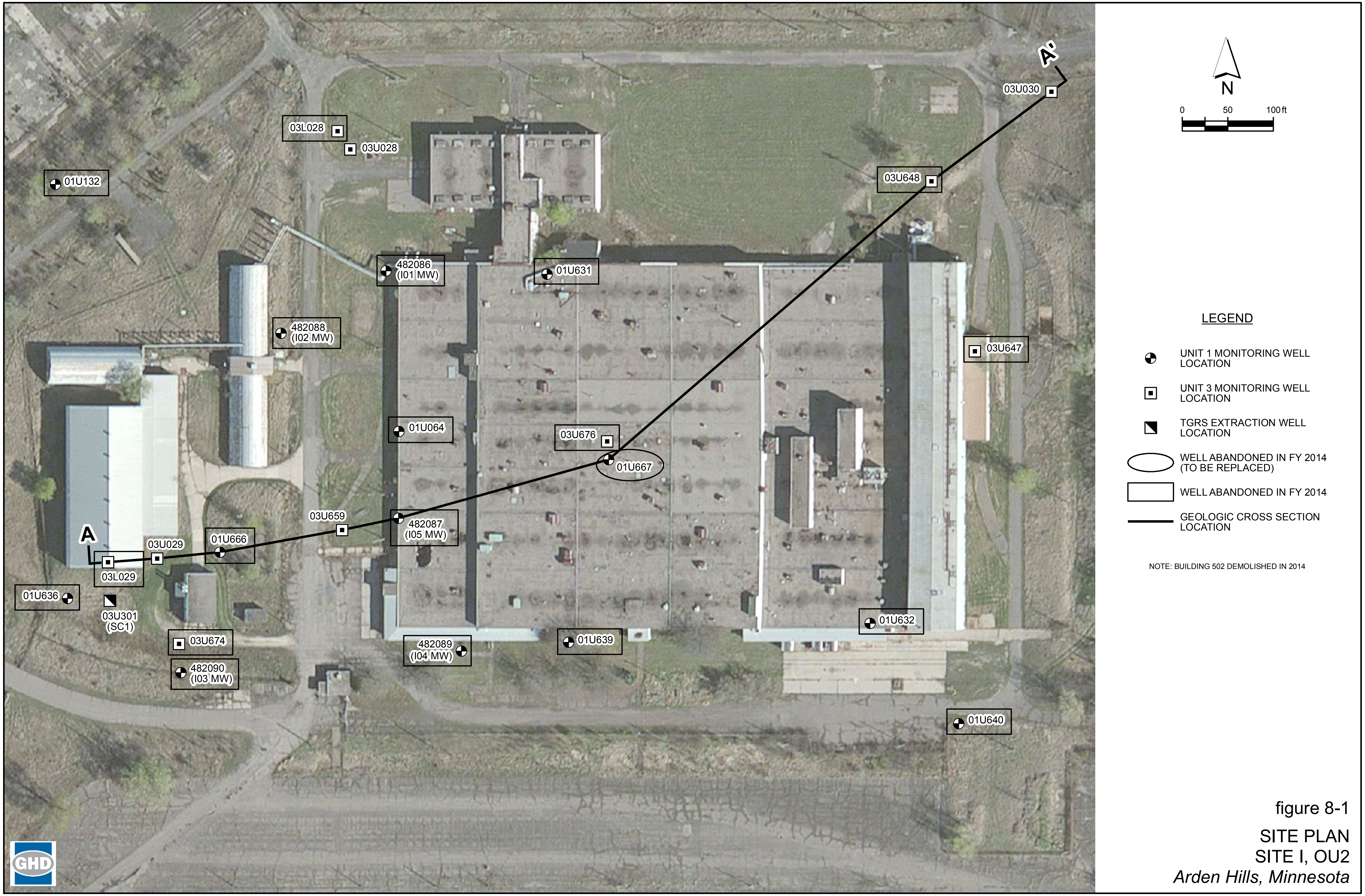
			cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Trichloroethene	Vinyl Chloride
Site I Cleanup Level(1)			**70 (total)**		**30**	**0.20**
Location	**Date**	**Dup**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
01U064	4/26/2013		4.2	< 1.0	0.94 JP	< 1.0
01U632	4/26/2013		27	0.35 JP	120	< 1.0
01U636	4/26/2013		< 1.0	< 1.0	< 1.0	< 1.0
01U639	4/26/2013		< 1.0	< 1.0	9.5	< 1.0
01U640	4/26/2013		< 1.0	< 1.0	< 1.0	< 1.0
I01MW	4/26/2013		< 1.0	< 1.0	0.33 JP	< 1.0
I02MW	4/26/2013		< 1.0	< 1.0	0.62 JP	< 1.0
I02MW	4/26/2013	D	< 1.0	< 1.0	0.76 JP	< 1.0
I05MW	4/26/2013		< 1.0	< 1.0	1.6	< 1.0
01U667	8/13/2013		500	1.4	4.7	300

Notes:

(1) Cleanup levels for Site I 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.

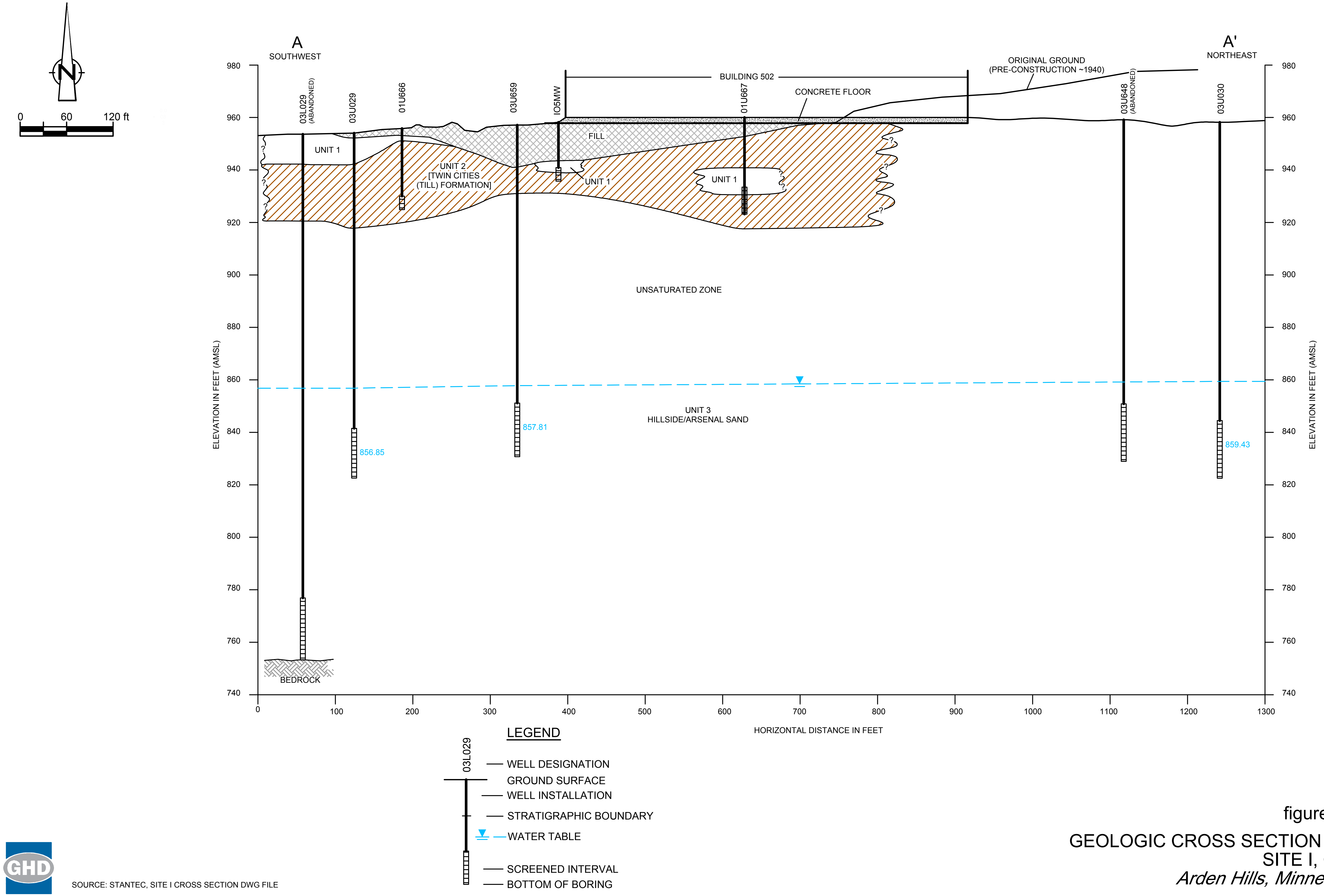


NOTE: BUILDING 502 DEMOLISHED IN 2014

figure 8-1

SITE PLAN
SITE I, OU2
Arden Hills, Minnesota

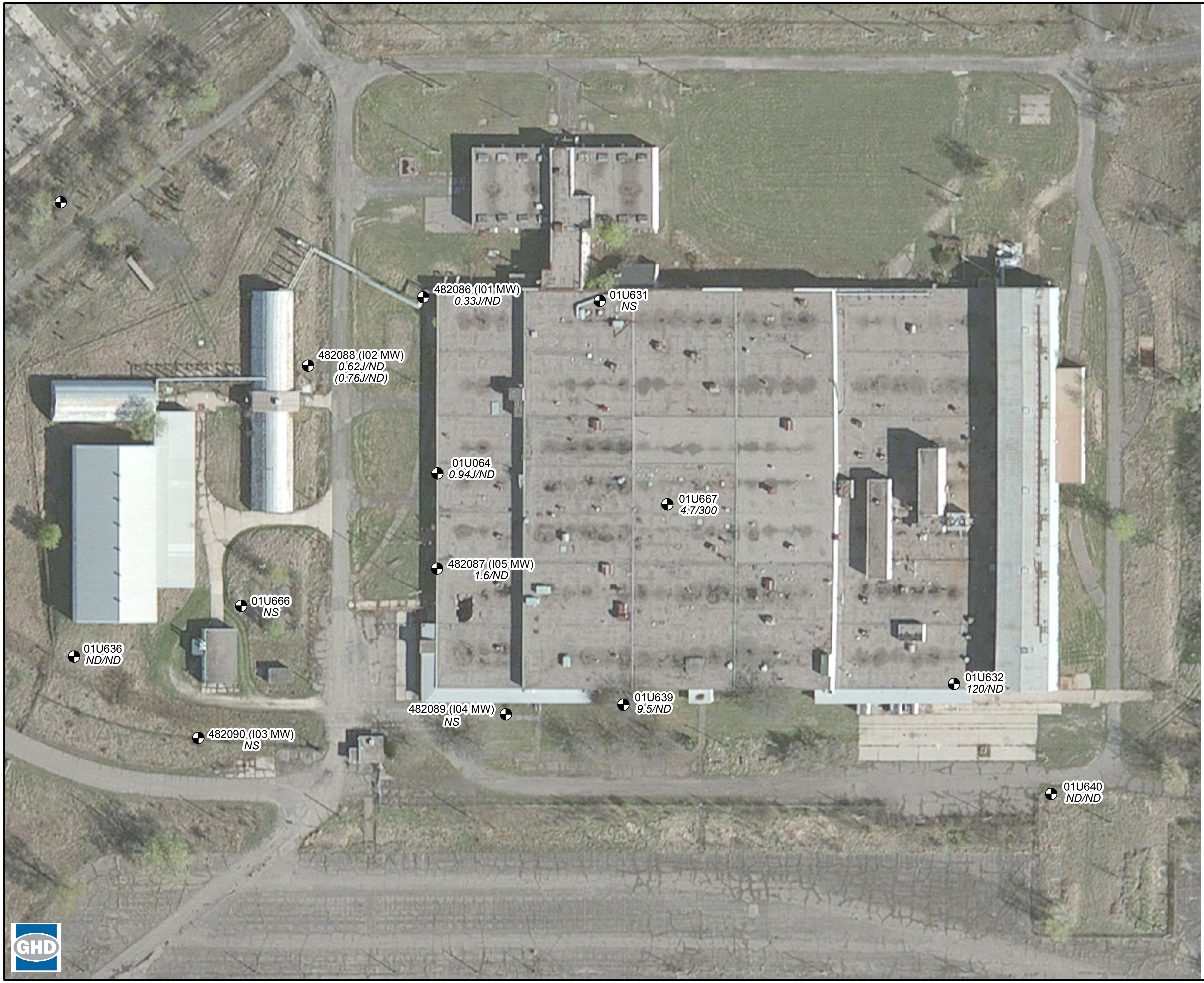
11114607-43(001)GIS-SP003 JAN 07/2016



SOURCE: STANTEC, SITE I CROSS SECTION DWG FILE

figure 8-2

GEOLOGIC CROSS SECTION A-A'
SITE I, OU2
Arden Hills, Minnesota



N

0 50 100 ft

LEGEND

4.7/300	FY 2013 TRCLE / C2H3CL CONCENTRATION (µg/L)
J	ESTIMATED CONCENTRATION
( )	DUPLICATE RESULTS
ND	ANALYTE NOT DETECTED
NS	WELL NOT SAMPLED
◕	UNIT 1 MONITORING WELL

figure 8-3

TRCLE AND C2H3CL
CONCENTRATIONS - FY 2013
SITE I, OU2
Arden Hills, Minnesota

11114607-43(001)GIS-SP004 JAN 07/2016

9.0 Operable Unit 2: Site K Shallow Groundwater

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

The remedy selected in the OU2 ROD consisted of seven components that incorporated the existing groundwater extraction trench and air stripper, which began operation in August 1986. The remedy also included additional investigation of the unsaturated soils beneath the building slab. OU2 ESD #1 added land use controls as a remedy component in 2009.

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. Table 9-1 summarizes the performance monitoring requirements, the implementing parties, and the documents that contain the monitoring plans. Appendix A summarizes the FY 2015 monitoring plan and any deviations are explained in Appendix C.2.

Water levels are collected annually from the monitoring wells and bundle piezometers in the vicinity of the groundwater collection and treatment system. In FY 2014, 15 Unit 1 monitoring wells were permanently abandoned, as approved by the USEPA/MPCA on August 14, 2013 and May 7, 2014. The monitoring wells currently included in the Site K Monitoring Plan were sampled in June 2015. Figure 9-1 presents the sampling and water level monitoring locations, as well as the location of the monitoring wells abandoned in FY 2014. Figure 9-1 also shows the cross-section alignment. Three of the wells abandoned in 2014 (01U608, 01U609, and 01U611) will be reinstalled in spring 2016 and will have the same monitoring requirements they had prior to abandonment. Wells 01U608 and 01U609, once reinstalled, will be added to the water level monitoring list and well 01U611 will be added to the annual water quality sampling list.

Is any groundwater sampling proposed prior to the next report? Yes. Groundwater monitoring at Site K will be in accordance with the monitoring plan shown in Appendix A.1.

Are any changes or additional actions required for this remedy component? Yes. Wells 01U608, 01U609, and 01U611, which were abandoned in 2014, are scheduled to be reinstalled in spring 2016. The replacement wells will be added to the monitoring plan and monitored for water level (01U608, 01U609, and 01U611) and water quality (01U611).

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 upper Unit 3 sentinel well was installed in February 2000. The sentinel well was installed to monitor the potential for VOCs to migrate through the Unit 2 till aquitard and into the Unit 3 aquifer.

Existing piezometers were used to accomplish the deep Unit 1 sentry monitoring. Piezometers 01U625D, 01U626D, 01U627D, and 01U628D were used because 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.

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 2015 for FY 2015. The results of the sample collected during FY 2015 are presented in Table 9-2. There were no COCs detected in the Unit 3 sentinel well at concentrations above the method detection limit. Although not a COC for Site K, a 1,4-dioxane concentration of 7.3 μg/L was reported for the well 03U621 sample. The Minnesota Department of Health (MDH), established a health risk limit (HRL) value of 1.0 μg/L for 1,4-dioxane.

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

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 former Building 103 footprint, as designed. In FY 2014, the Building 103 slab was removed as part of the site redevelopment activities.

Is the system providing hydraulic capture of the plume?
Yes. Water level data are presented in Table 9-3. Figure 9-2 presents a plan view of the groundwater contours from the June 2015 round of groundwater level measurements. At nested wells, the numerically lowest water elevation was used to create the plan view contours. Monitoring wells downgradient (i.e. 01U627) of the extraction trench show consistently higher water levels than those near of the trench (i.e. 01U626). 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 exhibited on the downward gradient side of 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.

It is noted that an upgradient well (01U625C) is obstructed. The cause of the obstruction is unknown. An attempt to remove the obstruction will occur in spring 2016. Well 01U625C is not considered critical in the collection trench flow evaluation. Historically, this well has maintained a similar groundwater elevation as 01U625B and 01U625D (see Appendix D). Based on 2015 groundwater elevation data showing the return to typical levels, replacement of 01U625C is not recommended.

Figure 9-4 presents the trichloroethene concentrations from the June 2015 annual sampling event. The plume was originally defined based on data from all of the monitoring wells. The plume was then refined based on the results of the 2014 geoprobe investigation. 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, specifically the 2014 data from the geoprobe investigation.

Are any changes or additional actions required for this remedy component? Not at this time. Two monitoring wells (01U604 and 01U628) historically used to monitor hydraulic capture were abandoned in 2014 as a result of site redevelopment activities. However, existing wells (e.g., 01U603, 01U612, 01U615, 01U617, 01U621, 01U625, 01U626 and 01U627) located up gradient and down gradient of the collection trench provide adequate coverage to continue hydraulic and water quality monitoring of the shallow groundwater, and verify hydraulic containment at Site K. Additional monitoring (including the need for additional monitoring wells) will be evaluated upon completion of redevelopment plans for the area.

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. During FY 2015, the treatment system functioned and was operational 95.9% of the time. During FY 2015, a regular maintenance schedule was maintained. Appendix F.1 summarizes operational data and events at the groundwater extraction and treatment system.

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

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.

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

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 9-4 (organics) and Table 9-5 (inorganics). The discharge met all the treatment requirements during FY 2015, with the exception of zinc in the effluent sample collected on March 5, 2015. The discharge concentration of zinc exceeded the substantive requirements document effluent concentration limit; and therefore, the discharge was resampled on April 3, 2015 per the requirements of the project Data Quality Objectives (Performance Monitoring QAPP, Rev. 12; Table 2e). The concentration of zinc collected from the treatment system discharge on April 3, 2015 was below the defined effluent concentration limit.

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

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. A report of the investigation results 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.

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

9.8 REMEDY COMPONENT #8: LAND USE CONTROLS

Description: "LUCs will be established to protect the groundwater extraction, treatment, and monitoring system and to prohibit the drilling of water supply wells within the contaminated portion of the Unit 1 aquifer." (OU2 ROD Amendment #1, page 39)

Performance Standard (how do you know when you're done):
Implementation of the land use controls will continue until such time that the groundwater concentrations are below the cleanup levels.

Has a LUCRD document been approved to address land use control (LUC) issues for OU2, including Site K groundwater, and is it being implemented?
Yes. The USEPA and MPCA provided consistency approval for the Revision 2, OU2 LUCRD in June 2011 and it is being implemented by the Army.

Was an annual site inspection for land use controls conducted in FY 2015?
On July 23, 2015, the Army, National Guard, and Wenck conducted the annual inspection of OU2 sites. The checklist that was completed during the inspection is included as Appendix I.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs? No.

9.9 OVERALL REMEDY FOR SITE K

Performance Standard (how do you know when you're done):
Once the cleanup levels in Table 1 of the OU2 ROD have been attained throughout the areal and vertical extent of the Site K plume (OU2 ROD, page 55).

Has the Site K 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 K plume)?
No. Overall, the remedy for Site K continued to operate consistent with past years and in compliance with the required performance criteria.

Table 9-6 presents the VOC mass removal and monthly flow rates. The treatment system captured and treated 5,444,776 gallons of water resulting in the removal of 11.59 pounds of VOCs from the aquifer in FY 2015. The cumulative mass removal is 363.4 pounds of VOCs.

As shown on Figure 9-4, trichloroethene concentrations range from non-detect to 2,400 µg/L. Monitoring wells 01U611 and 01U615 monitor the core of the plume. Well 01U611 was abandoned in 2014 for site redevelopment activities and is scheduled to be reinstalled in spring 2016, so no data are available for FY 2015. Prior to abandonment, trichloroethene concentrations at monitoring well 01U611 had been relatively stable over the previous seven years, ranging from 4,900 µg/L to 11,000 µg/L. The FY 2015 concentration at well 01U615 showed a decrease from 3,400 µg/L to 2,400 µg/L compared to the concentration measured in FY 2014. The FY 2015 concentration of trichloroethene at 01U615 is a ten year low, but is comparable with historical concentrations from the last ten years of sampling, which have ranged from 2,400 µg/L to 6,500 µg/L. Figure 9-5 shows trichloroethene and total 1,2-dichloroethene versus time for 01U615. Water levels measured during the FY 2015 monitoring were 3.11 feet lower at 01U615 compared to FY 2014 elevations, which had historically high levels. This well has historically exhibited fluctuating groundwater elevations.

Monitoring well 01U603 had always been non-detect (less than 1.0 µg/L) for trichloroethene. However, in May 2014 01U603 contained trichloroethene at 2,000 µg/L. Well 01U603 was resampled in July 2014 (5,600 µg/L) and September 2014 (4,600 µg/L). The July and September results confirmed that elevated concentrations of trichloroethene and other VOCs are present in the well. However, groundwater samples collected downgradient of 01U603 as part of a Site K geoprobe investigation in September 2014 were non-detect for trichloroethene and confirmed capture by the collection trench. The FY 2015 trichloroethene concentration at well 01U603 decreased to 1,200 µg/L.

Well 01U617 continues to exhibit low and relatively consistent concentrations of 1,2-dichloroethene downgradient of the groundwater collection system's capture zone. The concentration at this well was consistent with those measured in FY 2014 and previous years. The detected 1,2-dichloroethene concentration is below the cleanup level for Site K.

Do additional remedial measures need to be addressed? No.

9.10 OTHER RELATED ACTIVITY IN FY 2014

As a result of site redevelopment and the removal of the Building 103 concrete slab, Orbital ATK voluntarily conducted a geoprobe groundwater investigation to better define the width of the plume. The work was conducted in September 2014 and included the installation of 25 temporary PVC wells to depths between 10 and 15 feet below the ground surface using direct push technology. Groundwater samples were collected from each temporary well and analyzed for VOCs. The results of the groundwater investigation were reported to USEPA and MPCA in FY 2015 in a letter dated February 3, 2015. The study determined that trichloroethene plume is wider than originally estimated, but still within the capture width of the groundwater collection trench. It also showed that recent elevated trichloroethene concentrations at well 01U603 are localized and have not migrated from the immediate vicinity of the well.

In March 2015, the USEPA and MPCA requested sampling and analysis for 1,4-dioxane to be included in the June 2015 annual sampling event for Site K. The analysis was added to all regularly scheduled monitoring wells. Table 9-7 presents the results of the 1,4-dioxane sampling. No Federal MCL has been established for 1,4-dioxane; however, the Minnesota Department of Health established a Health Risk Limit (HRL) value of 1.0 µg/L. Two of the Site K sampling locations (wells 01U603 and 03U621) had 1,4-dioxane concentrations exceeding the HRL. Well 01U603 was slightly above the HRL at 1.4 µg/L and was the only Unit 1 well to exceed the HRL. Unit 3 monitoring well 03U621 had a 1,4-dioxane concentration of 7.3 µg/L. The low levels of 1,4-dioxane in the Unit 1 wells indicate that the higher concentration in the Unit 3 well is unrelated to Site K activities.

Table 9-1

Summary Of Groundwater Monitoring Requirements
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

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

Table 9-2

Groundwater Quality Data
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

			cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Trichloroethene
Site K Cleanup Level[1]			**70 (Total DCE)**		**30**
Location	**Date**	**Dup**	**µg/L**	**µg/L**	**µg/L**
01U128	6/3/2015		0.64 JP	0.30 JP	< 1.0
01U603	6/4/2015		56	12	1200
01U615	6/4/2015		680	440	2400
01U617	6/4/2015		10	0.79 JP	< 1.0
01U618	6/3/2015		4.2	0.79 JP	4.4
01U621	6/3/2015		0.30 JP	< 1.0	< 1.0
03U621	6/3/2015		< 1.0	< 1.0	< 1.0
K04-MW (482083)	6/4/2015		< 1.0	< 1.0	< 1.0

Notes:

(1) Cleanup levels for Site K 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.

Table 9-3

Groundwater Elevation Monitoring
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

Well ID	Groundwater Elevation (May 15, 2014)	Groundwater Elevation (Historical Maximum)	Groundwater Elevation (June 1, 2015)
01U047	875.75	875.75	873.96
01U048	876.61	876.61	874.93
01U052	876.64	876.64	875.61
01U065	874.90	874.91	874.13
01U128	877.07	877.07	875.25
01U601	Abandoned	886.65	Abandoned
01U602	Abandoned	886.37	Abandoned
01U603	882.86	882.86	880.54
01U604	Abandoned	879.79	Abandoned
01U605	Abandoned	879.61	Abandoned
01U607	887.56	887.56	887.00
01U608	888.06	888.06	Abandoned
01U609	886.83	886.83	Abandoned
01U611	887.16	887.16	Abandoned
01U612	884.70	884.70	882.16
01U613	Abandoned	886.15	Abandoned
01U615	883.71	883.71	880.60
01U616	Abandoned	882.75	Abandoned
01U617	883.22	883.22	880.53
01U618	885.58	885.58	883.30
01U619	Abandoned	886.60	Abandoned
01U620	Abandoned	881.93	Abandoned
01U621	883.87	883.87	881.41
01U624A	Abandoned	881.66	Abandoned
01U624B	Abandoned	881.63	Abandoned
01U624C	Abandoned	881.64	Abandoned
01U624D	Abandoned	881.64	Abandoned
01U625A	883.95	883.95	881.19
01U625B	883.90	883.90	881.19
01U625C	884.73	887.91	Obstructed
01U625D	883.91	883.91	881.19
01U626A	882.77	882.77	880.60
01U626B	883.50	883.50	880.85
01U626C	883.58	883.58	880.90
01U626D	883.61	883.61	880.93
01U627A	882.67	882.67	880.73
01U627B	883.57	883.57	880.94
01U627C	883.56	883.56	880.90
01U627D	883.57	883.57	880.91
01U628A	Abandoned	880.39	Abandoned
01U628B	Abandoned	880.34	Abandoned
01U628C	Abandoned	880.25	Abandoned
01U628D	Abandoned	880.25	Abandoned
482085 (K01MW)	Abandoned	887.09	Abandoned
482084 (K02MW)	Abandoned	887.41	Abandoned
482083 (K04MW)	885.38	885.38	884.82
03U621	855.51	856.63	856.63

Table 9-4

Treatment System Concentrations (Organics)
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

			1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Trichloroethene	Vinyl chloride
	Effluent Limit(1)		**--**	**7.0**	**3.8**	**70**	**100**	**10**	**0.18**
Location	**Date**		**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Effluent	12/4/2014		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Effluent	3/5/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Effluent	3/5/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Effluent	6/3/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 JC
Effluent	6/3/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 JC
Effluent	9/9/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Influent	12/4/2014		< 1.0	< 1.0	< 1.0	96	14	180	0.49 JP
Influent	12/4/2014		< 1.0	< 1.0	< 1.0	96	14	180	0.43 JP
Influent	3/5/2015		< 1.0	< 1.0	< 1.0	110	24	140	0.47 JP
Influent	6/3/2015		< 1.0	< 1.0	< 1.0	42	6.7	180	0.30 JL,JC
Influent	9/9/2015		< 1.0	< 1.0	< 1.0	100	17	110	0.47 JP
Influent	9/9/2015	D	< 1.0	< 1.0	< 1.0	100	17	110	0.45 JP

Notes:

(1) Substantive Requirement Document Concentration Limit, Maximum Daily Effluent Concentration

D - Field Duplicate

JC - Result is qualified as estimated since the % difference is outside the laboratory control limit

JL - Result is qualified as estimated since the LCS % recovery is outside the laboratory control limit

JP - Result is qualified as estimated since the detection is below the laboratory quantitation limit

Table 9-5

Treatment System Concentrations (Inorganics)
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

			Copper	Cyanide	Lead	Mercury	Silver	Zinc	Total Phosphorus
	Effluent Limit[1]		**21**	**17**	**106**	**0.20**	**3.4**	**134**	**1.0**
Location	**Date**		**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**mg/L**
Effluent	12/4/2014		8.1	< 10	0.57 JP	< 0.10	< 1.0	130	0.41 JP
Effluent	3/5/2015		5.4	< 10	6.1	< 0.10	< 1.0	610	1.8
Effluent	4/3/2015	RS						24	
Effluent	6/3/2015		4.5	< 10	< 1.0	< 0.25	< 1.0	9.2	< 0.50
Effluent	9/9/2015		3.5	< 10	< 1.0	< 0.10	< 1.0	10	0.18 JP

Notes:

(1) Substantive Requirement Document Concentration Limit, Maximum Daily Effluent Concentration

RS - Effluent was resampled for zinc on April 3rd due to exceedance of the effluent limit on March 5th

JP - Result is qualified as estimated since the detection is below the laboratory quantitation limit.

Table 9-6

Summary Of Monthly VOC Removal
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

Month	Total Monthly Flow (gallons)	Total VOC Influent (μg/L)	Total VOC Effluent (μg/L)	Total VOCs Treated (lbs)	Total VOCs Remaining (lbs)	Total VOC Mass Removed (lbs)
Cumulative as of September 30, 2014						351.9
October(1)	570,376	290	0	1.38	0.00	1.38
November(1)	460,418	290	0	1.12	0.00	1.12
December	505,846	290	0	1.23	0.00	1.23
January(1)	429,912	274	0	0.98	0.00	0.98
February(1)	333,664	274	0	0.76	0.00	0.76
March	334,174	274	0	0.77	0.00	0.77
April(1)	434,160	229	0	0.83	0.00	0.83
May(1)	466,791	229	0	0.89	0.00	0.89
June	448,417	229	0	0.86	0.00	0.86
July(1)	491,528	227	0	0.93	0.00	0.93
August(1)	475,199	227	0	0.90	0.00	0.90
September	494,291	227	0	0.94	0.00	0.94
Total - FY 2015						11.59
Cumulative To Date						363.4

Notes:

(1) Influent and Effluent VOC concentrations from the quarterly VOC samples collected on 12/4/2014, 3/5/2015, 6/3/2015, and 9/9/2015

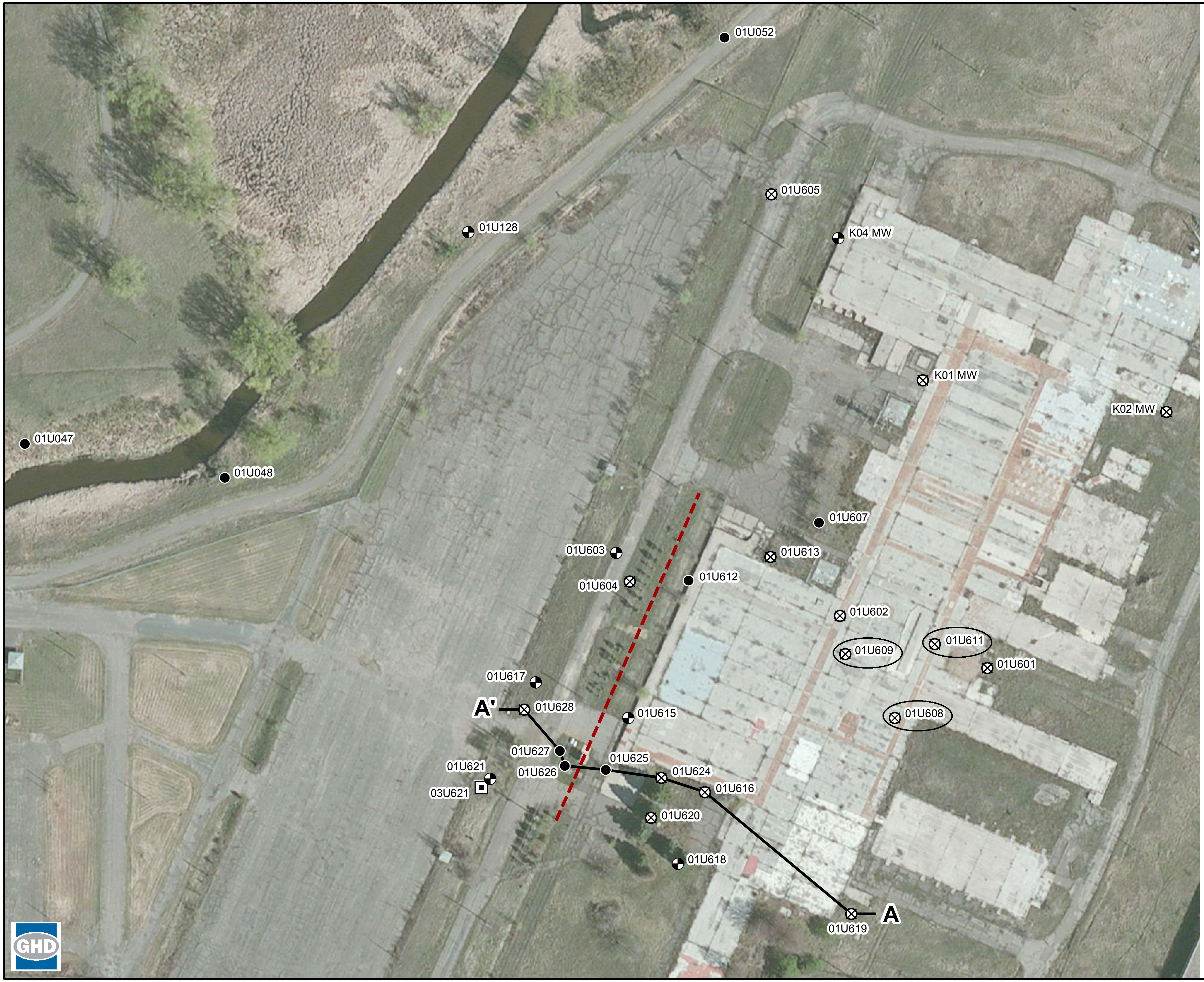
Table 9-7

1,4-Dioxane Groundwater Sampling Results
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

			1,4-Dioxane
Screening Criteria (HRL)			**1.0**
Location	**Date**	**Dup**	**µg/L**
01U128	6/10/2015		0.14
01U603	6/4/2015		1.4
01U615	6/4/2015		0.44
01U617	6/4/2015		0.47
01U618	6/3/2015		0.35
01U621	6/3/2015		0.034 JP
03U621	6/3/2015		7.3
K04-MW (482083)	6/4/2015		0.35
Effluent	6/3/2015		0.29
Effluent	6/3/2015	D	0.28
Influent	6/3/2015		0.30

Notes:

HRL	Health Risk Limit (Minnesota Department of Health). Shading indicates exceedence of the HRL.
D	Field Duplicate
JP	Result is qualified as estimated since the detection is below the laboratory quantitation limit.



LEGEND

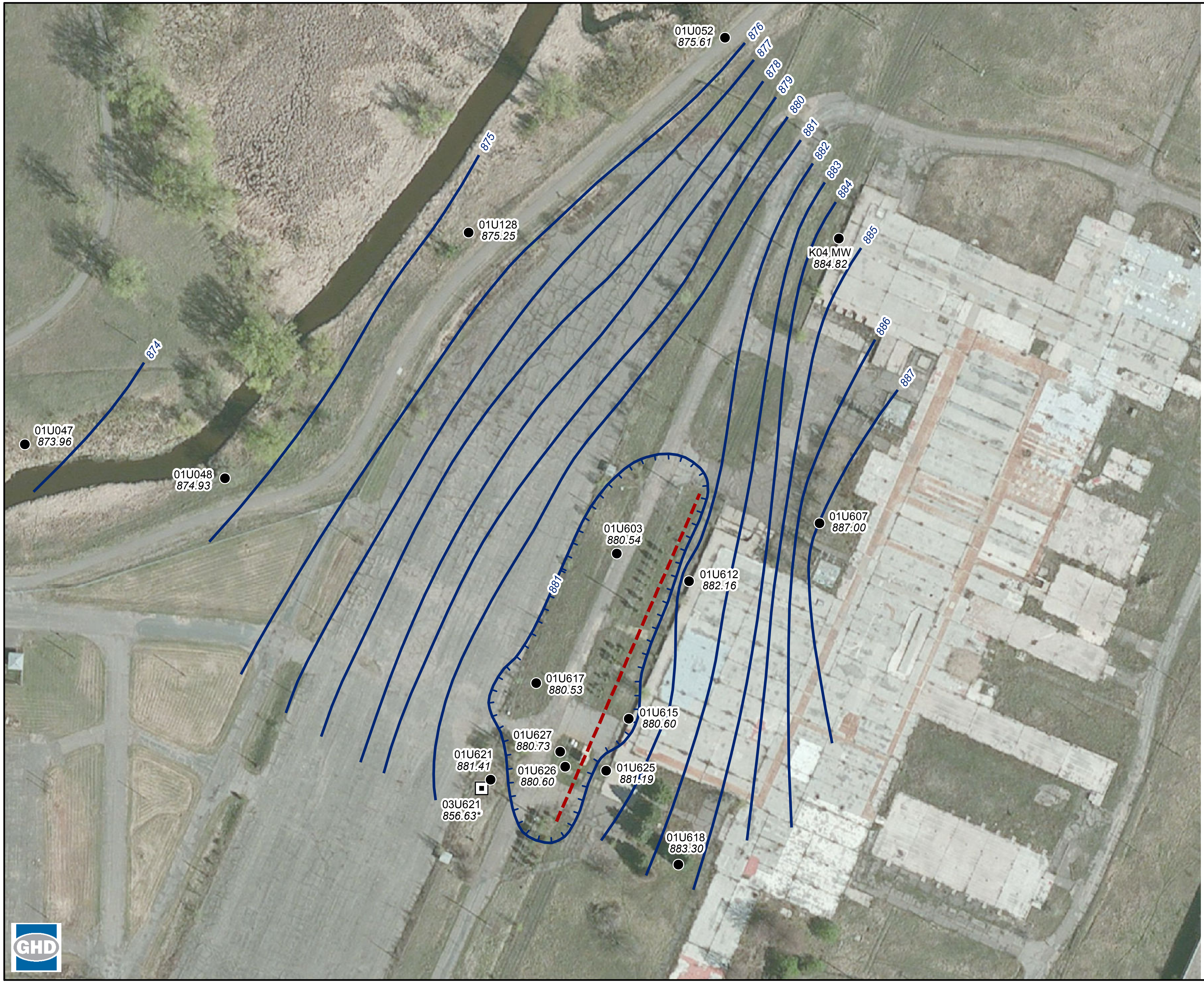
- ◕ ANNUAL UNIT 1 WATER QUALITY MONITORING WELL LOCATION
- ● ANNUAL UNIT 1 WATER LEVEL MONITORING WELL LOCATION
- ▣ UNIT 3 SENTINAL WELL LOCATION
- ⊗ WELL ABANDONED IN FY 2014
- ◯ ABANDONED WELL TO BE REPLACED IN FY 2016
- - - SITE K COLLECTION TRENCH LOCATION
- — HYDROGEOLOGIC CROSS SECTION LOCATION

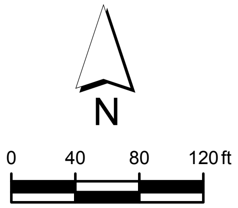
NOTE:
BUILDING 103 DEMOLISHED IN 2006;
CONCRETE SLAB REMOVED IN 2014

figure 9-1

SITE PLAN
SITE K, OU2
Arden Hills, Minnesota

11114607-43(001)GIS-SP005 JAN 11/2016





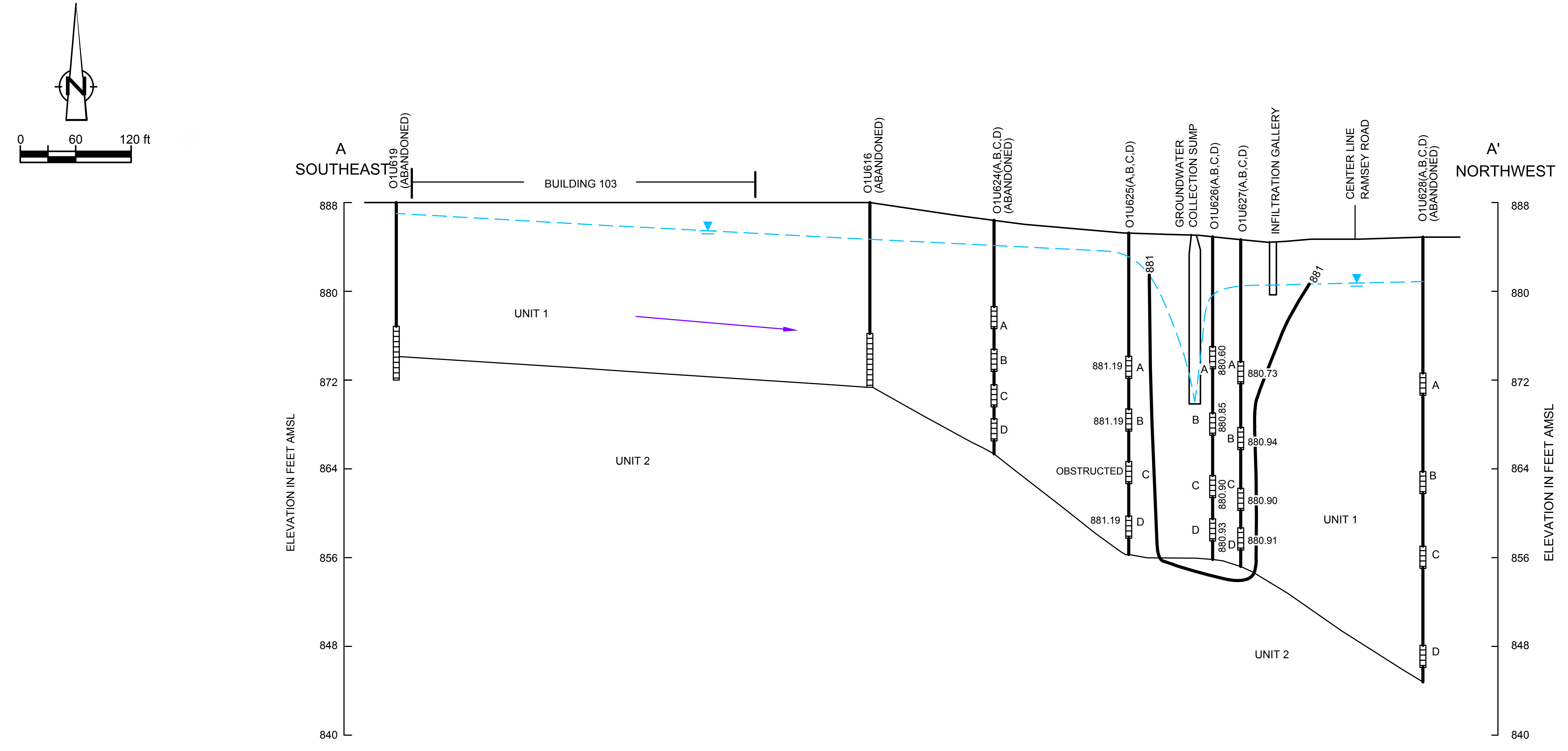
LEGEND

882.16	GROUNDWATER ELEVATION
*	NOT USED FOR CONTOURING
—	GROUNDWATER ELEVATION CONTOUR
●	ANNUAL UNIT 1 WATER LEVEL MONITORING WELL LOCATION
▣	UNIT 3 SENTINAL WELL LOCATION
- - -	SITE K COLLECTION TRENCH LOCATION

NOTE:
BUILDING 103 DEMOLISHED IN 2006;
CONCRETE SLAB REMOVED IN 2014

figure 9-2

GROUNDWATER CONTOURS
UNIT 1 - JUNE 1, 2015
SITE K, OU2
Arden Hills, Minnesota



SOURCE: STANTEC, SITE K CROSS SECTION DWG FILE

figure 9-3

HYDROGEOLOGIC CROSS SECTION A-A'
6/1/2015 (Q127)
SITE K, OU2
Arden Hills, Minnesota

11114607-43(001)GN-WA012 JAN 11, 2016

NOTE:
BUILDING 103 DEMOLISHED IN 2006;
CONCRETE SLAB REMOVED IN 2014

figure 9-4

TRCLE CONCENTRATIONS
UNIT 1 - JUNE 2015
SITE K, OU2
Arden Hills, Minnesota

GHD

11114607-43(001)GIS-SP007 JAN 11/2016

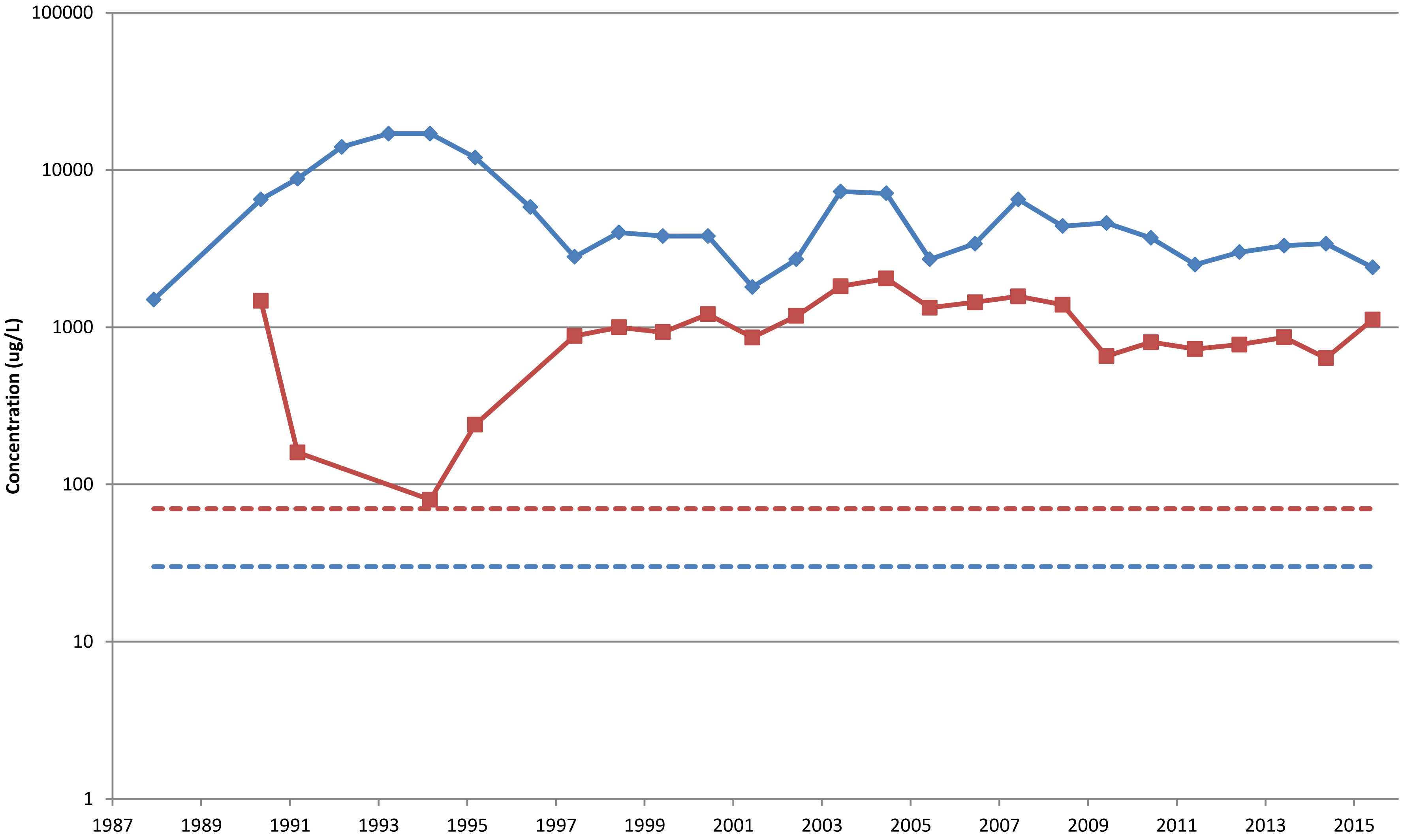


figure 9-5

VOC CONCENTRATIONS OVER TIME
WELL 01U615
SITE K, OU2
Arden Hills, Minnesota

10.0 Operable Unit 2: Building 102 Shallow Groundwater

The former Building 102, located as shown on Figure 10-1, was constructed in 1942 and used periodically until the 1980s for the production of small caliber ammunition and various other munitions components. Between March 2002 and February 2004, shallow (Unit 1) groundwater contamination was discovered emanating from beneath Building 102 (discovered during the Phase I and Phase II Environmental Site Assessment in support of the future transfer of the remaining TCAAP property).

Additional groundwater investigation was conducted and is documented in a Groundwater Investigation Report approved by the USEPA and MPCA in FY 2006. The Army then proceeded to address the remedy for Building 102 shallow groundwater as a non-time critical removal action under CERCLA. To support the EE/CA, additional groundwater investigation was conducted in FY 2007 and FY 2008 to further define the extent and magnitude of groundwater contamination. Delineation was completed and COCs were identified, including trichloroethene and related chlorinated VOCs (trichloroethene was found to be degrading to cis-1,2-dichloroethene and vinyl chloride through abiotic degradation). The EE/CA documenting the additional investigation work and recommending a remedy for the Building 102 shallow groundwater was approved by the USEPA and MPCA in FY 2008.

The Army Action Memorandum documenting the final remedy selection for Building 102 groundwater (monitored natural attenuation) was signed early in FY 2009. The remedy also includes LUCs to prohibit installation of water supply wells into the contaminated portion of the Unit 1 aquifer and to protect the groundwater monitoring system infrastructure (i.e., monitoring wells). OU2 ROD Amendment #4 formally documented selection of MNA and LUCs for the Building 102 groundwater remedy and thereby added this Site to the OU2 remedy.

The decision to proceed with MNA was based on the strong evidence from water quality monitoring (i.e., degradation products) and on MPCA microcosm studies that have verified that abiotic degradation of VOCs in Building 102 groundwater is occurring at substantial rates. Such degradation acts to reduce contaminant mass and mobility by breaking down the contaminants as they move downgradient. The decision to proceed with MNA was also based on the absence of any groundwater receptors.

10.1 REMEDY COMPONENT #1: MONITORED NATURAL ATTENUATION

Description: "Use of naturally-occurring abiotic degradation to limit plume mobility and to ultimately restore the aquifer." (OU2 ROD Amendment #4, page 4-1)

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 2015 monitoring plan and any deviations are explained in Appendix C.2. Details of the groundwater monitoring program are discussed in the next section.

10.2 REMEDY COMPONENT #2: GROUNDWATER MONITORING

Description: "Groundwater monitoring to track remedy performance and to verify that groundwater reaching Rice Creek does not exceed state surface water standards." (OU2 ROD Amendment #4, page 4-1)

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 10-1 summarizes the performance monitoring requirements, the implementing parties, and the documents that contain the monitoring plans. The FY 2015 Monitoring Plan is included in Appendix A, documenting the water quality monitoring locations and frequencies. Building 102 groundwater level data collected in June 2015 is shown as groundwater elevation contours on Figure 10-2. Site K water levels are also contoured on this same figure to provide a more complete water level map in the Site vicinity. Groundwater quality data collected in FY 2015 is shown in Table 10-2. Groundwater quality data for FY 2015 is also shown on plume maps for three of the chemicals of concern: trichloroethene (Figure 10-3), cis-1,2-dichlororethene (Figure 10-4), and vinyl chloride (Figure 10-5). The FY 2015 results for vinyl chloride (the chemical that has historically had the largest areal extent) are shown on geologic cross-sections A-A’ (Figure 10-6) and B-B’ (Figure 10-7).

Also, as a result of discovery of 1,4-dioxane within the OU1 plume, the USEPA and MPCA requested sampling for the presence of 1,4-dioxane at all sites where VOCs are present (including Building 102 shallow groundwater) during the FY 2015 sampling event. As shown in Table 10-2, there were only two low “detections” of 1,4-dioxane in Building 102 shallow groundwater in the June 2015 sampling event, and these “detections” were qualified to be usable as a non-detect results given detection of 1,4-dioxane at a similar level in an associated field blank. These results support the conclusion that 1,4-dioxane is not present in Building 102 shallow groundwater. However, to provide confirmation of this conclusion, the Army will include 1,4-dioxane as an analyte for all Building 102 wells sampled in June 2016. Upon confirmation of this conclusion, no further 1,4-dioxane monitoring will be conducted for Building 102 shallow groundwater.

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

Is any groundwater sampling proposed prior to the next report?
Yes. Groundwater monitoring at Building 102 will be in accordance with the monitoring plan shown in Appendix A.1.

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

10.3 REMEDY COMPONENT #3: LAND USE CONTROLS

Description: "LUCs to restrict installation of water supply wells into the contaminated portion of the Unit 1 aquifer and to protect the infrastructure related to this alternative (monitoring wells)." (OU2 ROD Amendment #4, page 4-2)

Performance Standard (how do you know when you're done):
Implementation of the land use controls will continue until such time that the groundwater concentrations are below the cleanup levels.

Has a LUCRD document been approved to address land use control (LUC) issues for OU2, including Building 102 groundwater, and is it being implemented?
Yes. The USEPA and MPCA provided consistency approval for the OU2 LUCRD in September 2010 and it is being implemented by the Army. Revision 3 of the OU2 LUCRD was approved by the USEPA and MPCA in March 2015; however, this revision did not affect land use controls for Building 102.

Was an annual site inspection for land use controls conducted in FY 2015?
Yes. On July 23, 2015, the Army, National Guard, and Wenck conducted the annual inspection of OU2 sites. The checklist that was completed during the inspection is included as Appendix I.

Did the inspection identify any follow-up actions needed to maintain the protectiveness of the LUCs? No.

10.4 OVERALL REMEDY FOR BUILDING 102 SHALLOW GROUNDWATER

Performance Standard (how do you know when you're done):
When the cleanup levels in OU2 ROD Amendment #4 have been attained throughout the areal and vertical extent of the Building 102 plume (OU2 ROD Amendment #4, page 2-13).

Has the Building 102 shallow groundwater remedy been completed (i.e., have the cleanup levels in the table on Page 2-13 of OU2 ROD Amendment #4 been attained throughout the areal and vertical extent of the Building 102 plume)?
No. As shown in Table 10-2, cleanup levels have not been reached throughout the areal extent of the plume and the site cannot be closed. Trichloroethene concentrations exceed the cleanup level in four of the monitoring wells, and vinyl chloride concentrations exceed the cleanup level in two of the monitoring wells.

What impact is MNA having on contaminant concentrations?
Natural attenuation continues to occur at this site, with trichloroethene being the primary VOC present in the source area vicinity, and with primarily degradation products being present in downgradient wells (e.g., primarily cis-1,2-dichloroethene and vinyl chloride in 01L582, and only vinyl chloride in 01U048). Significant changes that were noted in the FY 2015 groundwater quality results include:

- 01U579 and 01U580 (source area): The trichloroethene concentration decreased in 01U579 and slightly increased in 01U580. Historically, the concentrations in these two wells have shown relatively large increases and decreases.
- 01L582 (further downgradient of the source area): The concentration of cis-1,2-dichloroethene decreased significantly (73 to 38 µg/L) and vinyl chloride also decreased slightly, continuing the decreasing trend that was observed from FY 2013 to FY 2014.
- 01U048 (adjacent to Rice Creek): Vinyl chloride was the only VOC detected in this well. Vinyl chloride decreased slightly from 0.057 to 0.043 µg/L.

The FY 2011/2012 results for 01U/01L584 and 01L582 were not consistent with historical results, which had been very stable prior to FY 2011, and appeared possibly to be the result of historically high groundwater levels observed in June 2011 and June 2012. Given the unexpected VOC increases in these wells, in December 2012 the MPCA and the USEPA requested that the Army conduct supplemental groundwater investigation work. The purpose of the investigation was to acquire additional VOC data in groundwater at a location approximately halfway between 01L582 and 01U048, which is located adjacent to Rice Creek. 01L582 had been functioning as a “mid-sentinel well” before Rice Creek; however, the increasing VOC concentrations in 01L582 in FY 2011/2012 caused increased concern regarding whether an acceptable level of attenuation was still occurring prior to groundwater reaching Rice Creek. Given the sale of the property to Ramsey County and their desire to minimize permanent wells that would complicate their redevelopment plans, geoprobe methods were utilized to collect the necessary groundwater samples. This investigation work was conducted in July 2013. Nine geoprobe locations were installed on 50-foot centers approximately halfway between 01L582 and 01U048. The entire line of geoprobes was oriented perpendicular to (and approximately centered on) the axis of 01L582 and 01U048. Vertical profiling (multiple sampling depths) was conducted at four of the locations (every other location). This work was documented in “Supplemental Investigation Report for Building 102 Groundwater”, prepared by Wenck, March 2014, which received regulatory consistency approval in FY 2014. The report concluded that a significant level of attenuation of the VOCs in shallow groundwater is occurring prior to reaching the line of geoprobes (i.e., prior to travelling half the distance from 01L582 to Rice Creek).

Were any trigger levels exceeded at the contingency location?

No. The contingency location is 01U048, located next to Rice Creek. The trigger level is equal to groundwater cleanup levels and no chemicals of concern for Building 102 groundwater exceeded their respective cleanup levels in FY 2015 (Table 10-2). The concentration of the only detected chemical of concern in this well, vinyl chloride, decreased slightly in comparison to the FY 2014 concentration, as noted above. The FY 2015 vinyl chloride result of 0.043 µg/L was substantially below the cleanup level (trigger level) of 0.18 µg/L.

Do additional remedial measures need to be addressed?

No. However, it should be noted that as part of Ramsey County's site redevelopment work, Ramsey County will be relocating a section of Rice Creek to create more space for construction of a new I-35W / County Road H interchange. The relocation work will place Rice Creek much closer to the west side of the Building 102 plume. While the impacts to groundwater flow are not yet known, given that Unit 1 groundwater discharges to Rice Creek, it is a possible that the new location could cause contaminated groundwater to begin flowing in a more westerly direction, and could potentially discharge into the creek in its revised location rather than continuing to discharge into the creek in the vicinity of 01U048. With this potential adverse outcome in mind, in early FY 2016 Ramsey County will be installing two nested monitoring wells adjacent to the revised creek location, on the east side of the creek near the point of potential groundwater discharge. Ramsey County intends to sample the new wells prior to beginning construction of the creek relocation, which is anticipated to begin in early 2016 (winter construction). The MPCA has indicated to Ramsey County that if Ramsey County's actions cause a shift in the Building 102 plume and resultant exceedance of an action level in a Ramsey County Rice Creek monitoring well, it will be Ramsey County's responsibility to address that situation.

Table 10-1
Summary of Building 102 Shallow Groundwater Monitoring Requirements

Fiscal Year 2015

Remedy Component		Monitoring Requirements	Implementing Party	Documents Containing the Monitoring Plan
#1:	Monitored Natural Attenuation (abiotic degradation)	a. Outlined below		
#2:	Groundwater Monitoring	a. Outlined below		
#3:	LUCs to Restrict Well Installation and to Protect the Remedy Infrastructue	a. None.		
OR:	Overall Remedy (Attainment of cleanup goals)	a. Groundwater quality data throughout the Building 102 plume to evaluate attainment and to verify that groundwater reaching Rice Creek does not exceed state surface water standards.	Army	Building 102 Monitoring Plan in the Annual Performance Report

Table 10-2
Building 102 Groundwater Quality Data

Fiscal Year 2015

			Trichloroethene (µg/L)	1,4 Dioxane (µg/L)	cis-1,2-Dichloroethene (µg/L)	1,1-Dichloroethene (µg/L)	Vinyl Chloride (µg/L)	Vinyl Chloride(3) (µg/L)
Building 102 Cleanup Level (1)			5	---	70	6	0.18	0.18
MDH HRL (2)			---	1	---	---	---	---
01U048		6/30/15	<1	<0.07	<1	<1	<1	JP 0.043
01U579		6/29/15	**23**	<0.07	43	<1	**4.2**	---
01U580		6/29/15	**27**	JP 0.055 UFB0.029	3.4	<1	<1	---
01U581		6/30/15	5.0	JP 0.029 UFB0.029	26	<1	<1	---
01L581		6/30/15	**8.4**	<0.07	5.3	<1	<1	---
01L581	D	6/30/15	**8.0**	<0.07	5.1	<1	<1	---
01U582		6/30/15	1.1	<0.07	4.2	<1	<1	<0.05
01L582		6/30/15	JP 0.44	<0.07	38	<1	**JP 0.44**	**0.41** JMS127
01L582	D	6/30/15	---	---	---	---	---	**0.41**
01U583		6/24/15	<1	<0.07	<1	<1	<1	---
01L583		6/30/15	<1	<0.07	<1	<1	<1	---
01L583	D	6/30/15	<1	<0.07	<1	<1	<1	---
01U584		6/30/15	JP 0.69	<0.07	<1	<1	<1	---
01L584		6/30/15	**32**	<0.07	11	<1	<1	---

Notes:

(1) Cleanup levels for Building 102 Groundwater are from page 2-13 of OU2 ROD Amendment #4. Bolding (in red color) indicates exceedance of the cleanup level.

(2) No Building 102 cleanup level has been established for 1,4-dioxane. For reference, the Minnesota Department of Health (MDH) Health Risk Limit (HRL) for 1,4-dioxane is 1 µg/L. Bolding (in red color) indicates exceedance of the HRL.

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

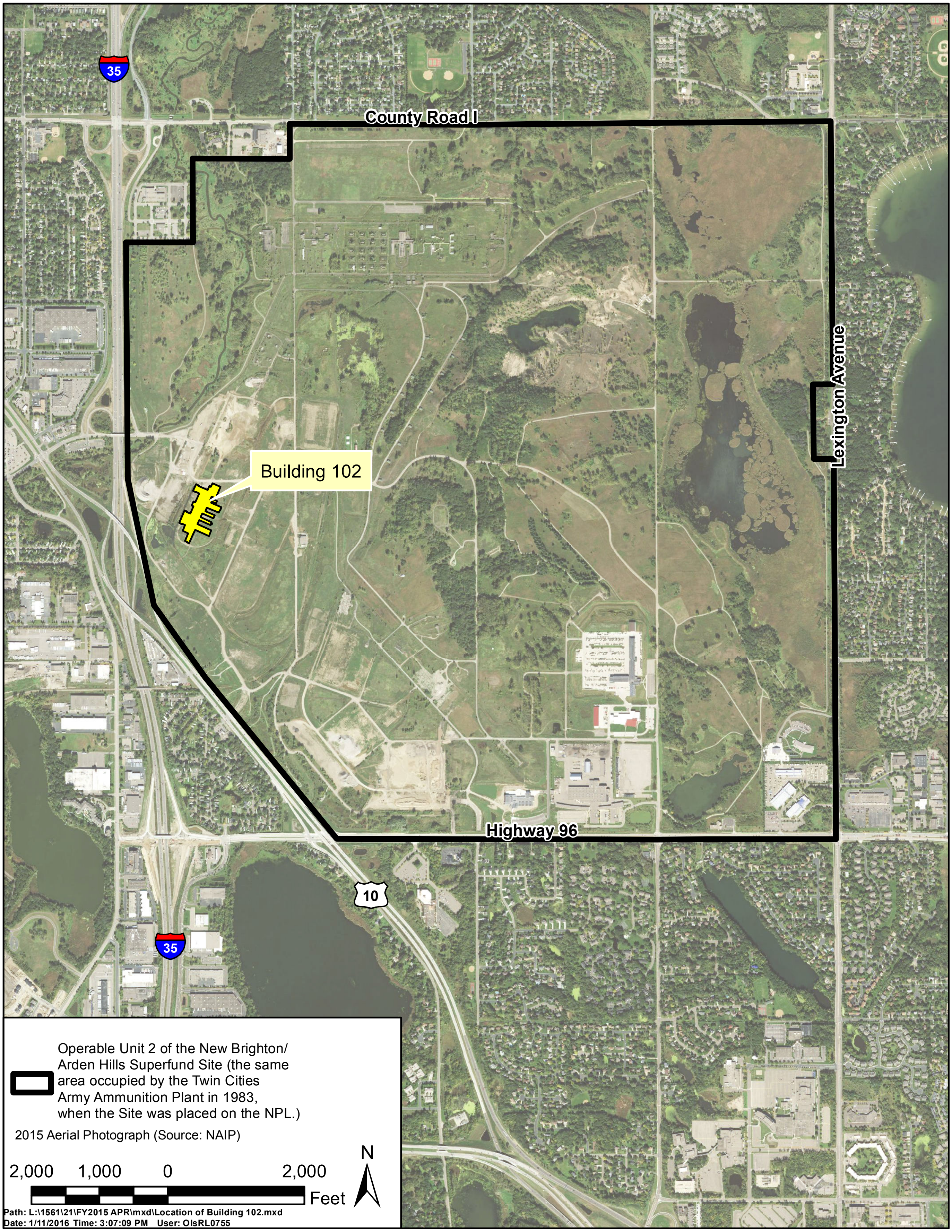
--- Not sampled.

D Duplicate sample.

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

JP The value is below the Reporting Limit, but above the Method Detection Limit. Results should be considered estimated.

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



Operable Unit 2 of the New Brighton/ Arden Hills Superfund Site (the same area occupied by the Twin Cities Army Ammunition Plant in 1983, when the Site was placed on the NPL.)

2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Location of Building 102.mxd
Date: 1/11/2016 Time: 3:07:09 PM User: OlsRL0755

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Location of Building 102

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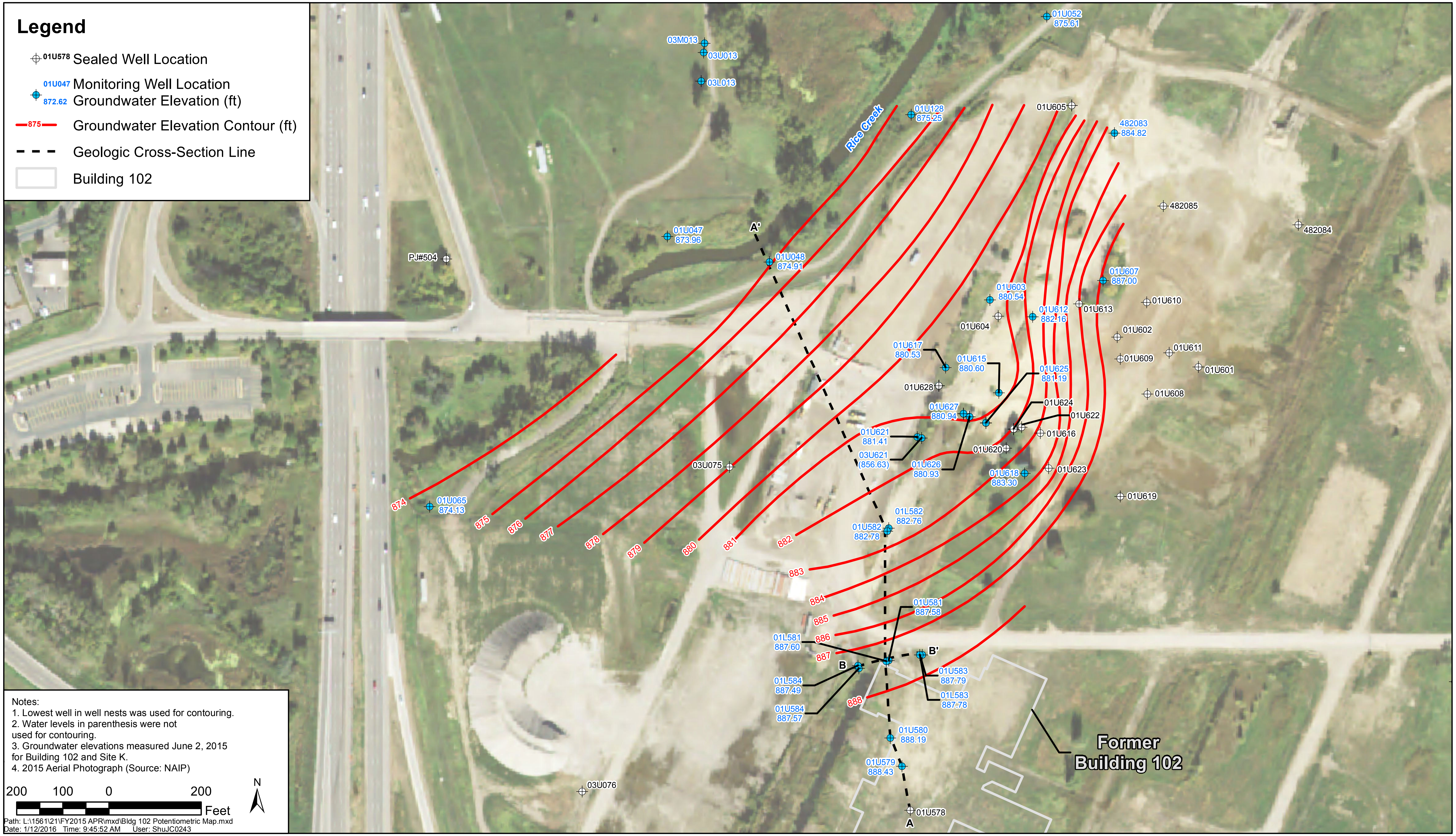
Figure 10-1



Legend

01U578 Sealed Well Location

01U047 Monitoring Well Location
872.62 Groundwater Elevation (ft)

875 Groundwater Elevation Contour (ft)

Geologic Cross-Section Line

Building 102

Notes:
1. Lowest well in well nests was used for contouring.
2. Water levels in parenthesis were not used for contouring.
3. Groundwater elevations measured June 2, 2015 for Building 102 and Site K.
4. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Bldg 102 Potentiometric Map.mxd
Date: 1/12/2016 Time: 9:45:52 AM User: ShuJC0243

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Building 102, Unit 1, Potentiometric Map, June 2015

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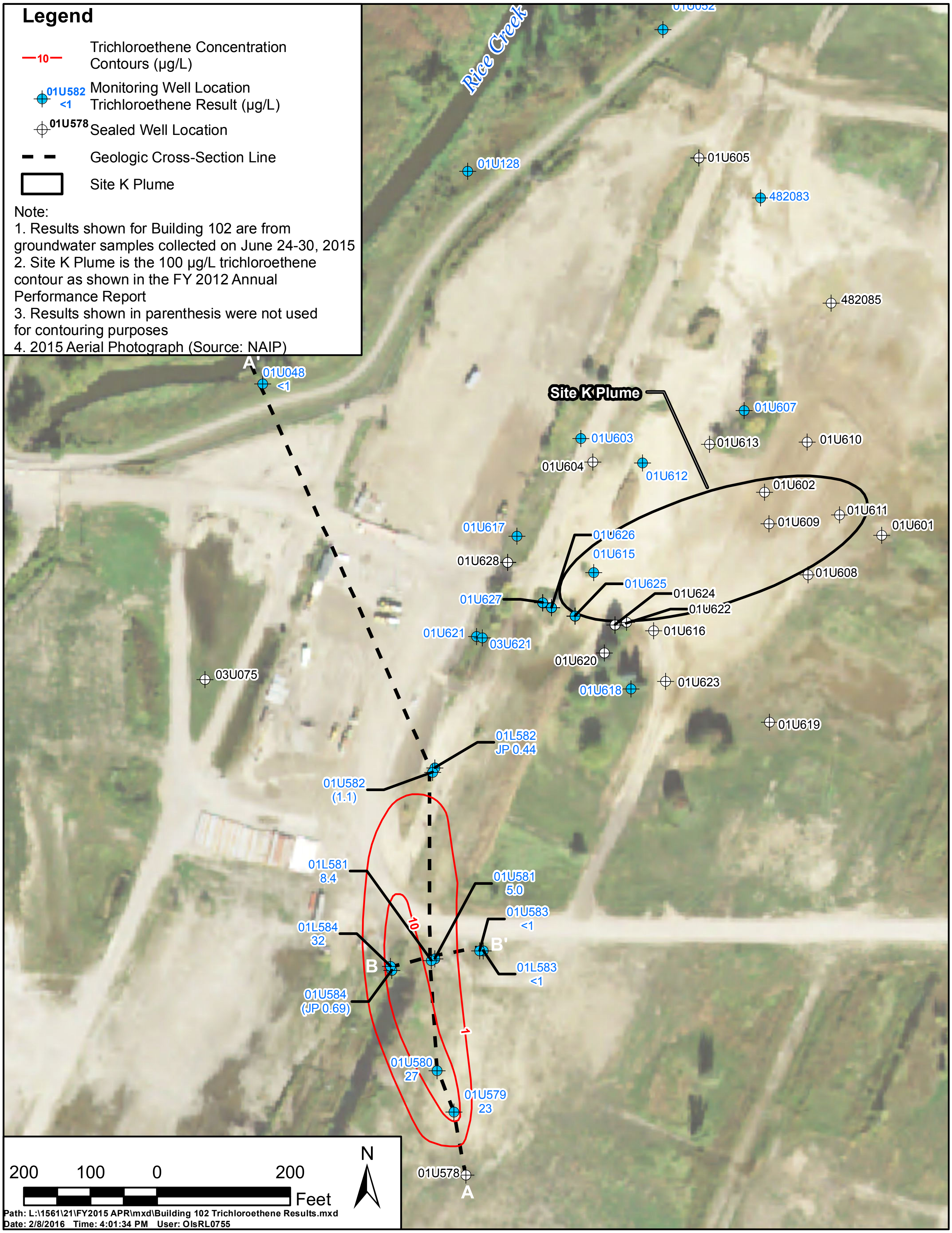
Figure 10-2



Note:
1. Results shown for Building 102 are from groundwater samples collected on June 24-30, 2015
2. Site K Plume is the 100 µg/L trichloroethene contour as shown in the FY 2012 Annual Performance Report
3. Results shown in parenthesis were not used for contouring purposes
4. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Building 102 Trichloroethene Results.mxd
Date: 2/8/2016 Time: 4:01:34 PM User: OlsRL0755

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Building 102, Unit 1, Trichloroethene Results, June 2015

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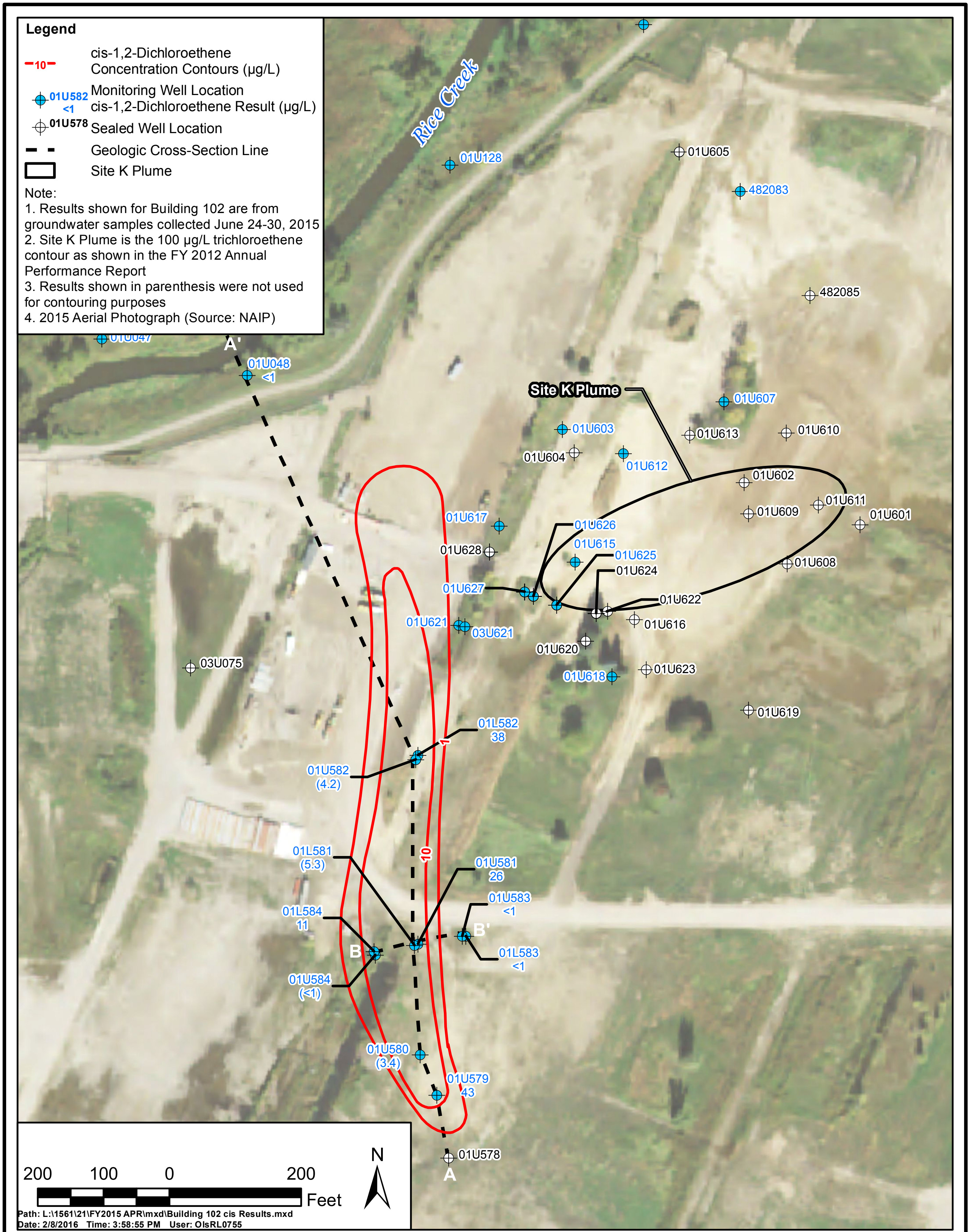
FIGURE 10-3



Note:
1. Results shown for Building 102 are from groundwater samples collected June 24-30, 2015
2. Site K Plume is the 100 µg/L trichloroethene contour as shown in the FY 2012 Annual Performance Report
3. Results shown in parenthesis were not used for contouring purposes
4. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Building 102 cis Results.mxd
Date: 2/8/2016 Time: 3:58:55 PM User: OlsRL0755

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Building 102, Unit 1,
cis-1,2-Dichloroethene Results, June 2015

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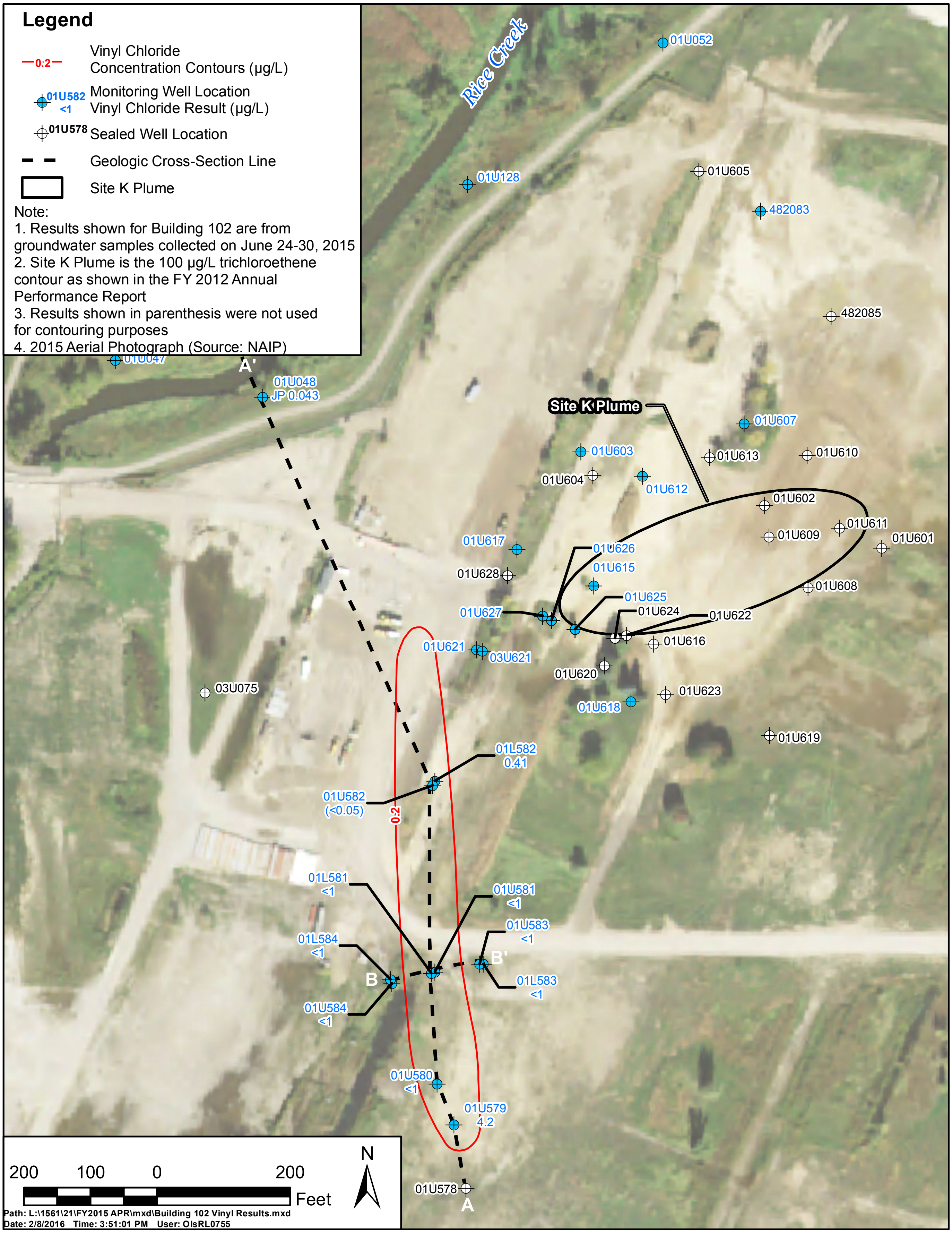
FIGURE 10-4



Legend

—0.2—	Vinyl Chloride Concentration Contours (µg/L)
⊕ 01U582 <1	Monitoring Well Location Vinyl Chloride Result (µg/L)
⊕ 01U578	Sealed Well Location
- -	Geologic Cross-Section Line
▭	Site K Plume

Note:
1. Results shown for Building 102 are from groundwater samples collected on June 24-30, 2015
2. Site K Plume is the 100 µg/L trichloroethene contour as shown in the FY 2012 Annual Performance Report
3. Results shown in parenthesis were not used for contouring purposes
4. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Building 102 Vinyl Results.mxd
Date: 2/8/2016 Time: 3:51:01 PM User: OlsRL0755

ANNUAL PERFORMANCE REPORT

Building 102, Unit 1, Vinyl Chloride Results, June 2015

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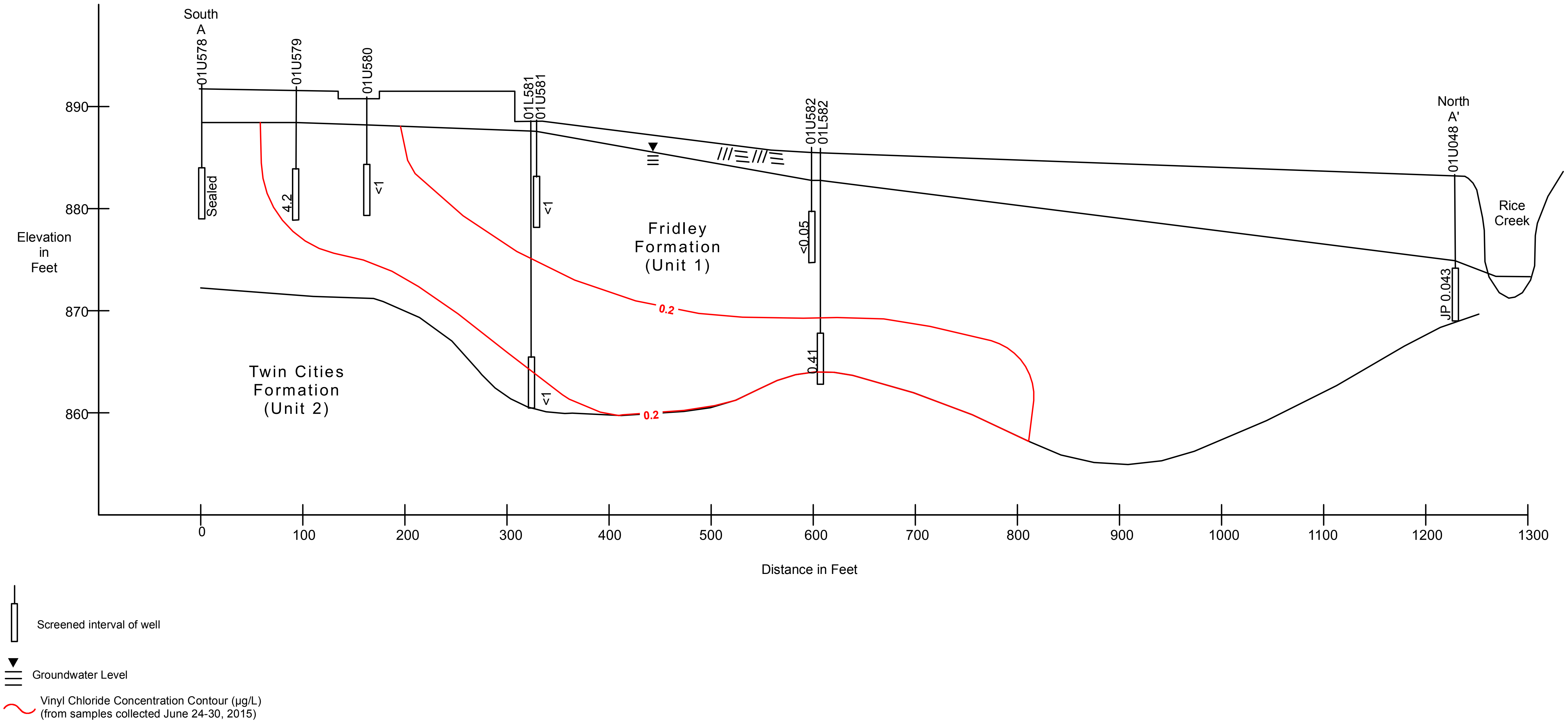
FIGURE 10-5



Path: L:\1561\21\FY2015 APR\mxd\Building 102 Geologic Cross Section A-A'.mxd
Date: 1/13/2016 Time: 7:17:00 AM User: OlsRL0755

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Building 102, Vinyl Chloride Cross Section A-A', June 2015

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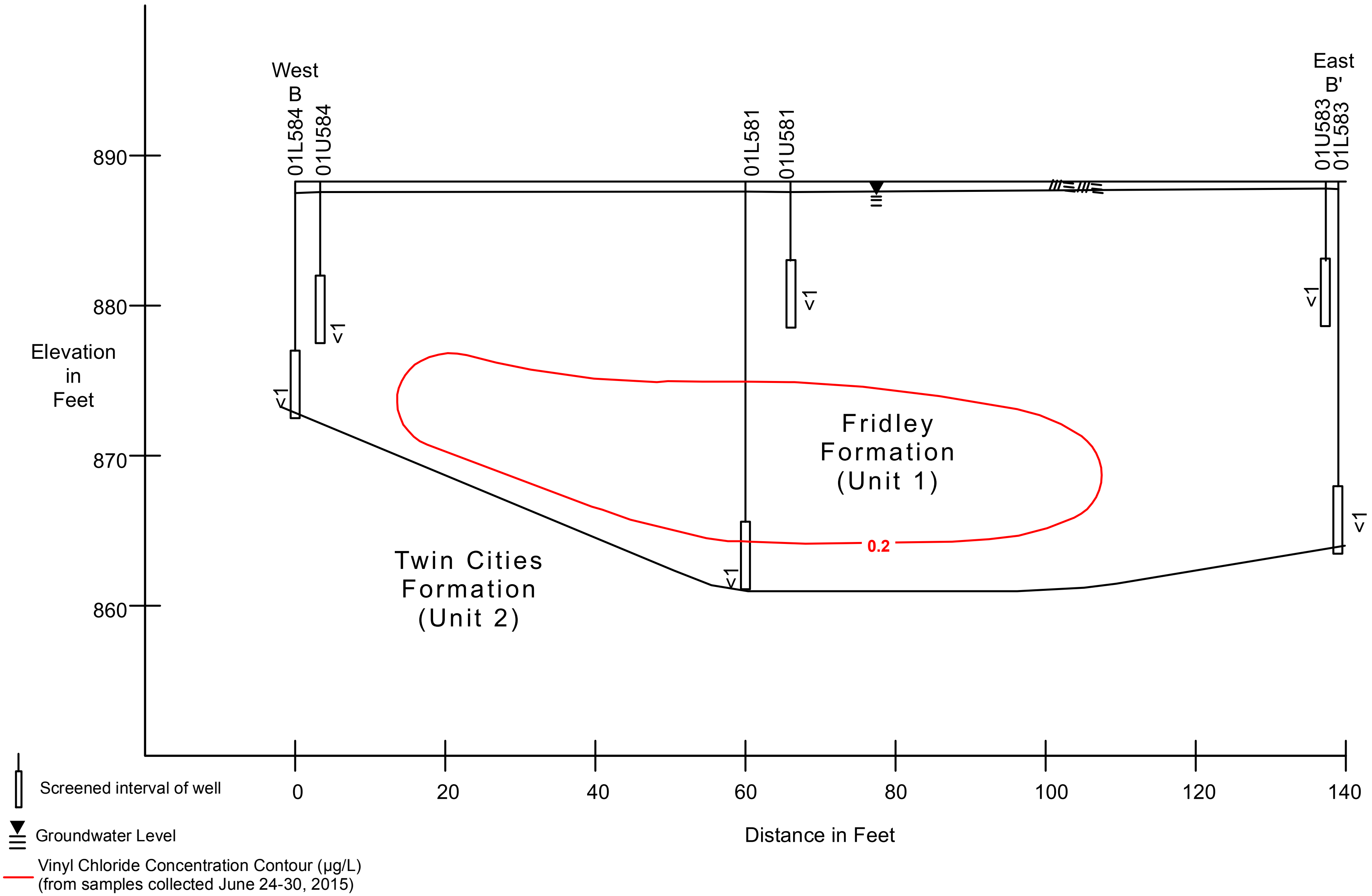
Figure 10-6



Path: L:\1561\21\FY2015 APR\mxd\Building 102 Geologic Cross Section B-B'.mxd
Date: 1/12/2016 Time: 10:21:48 AM User: ShuJC0243

ANNUAL PERFORMANCE REPORT

Building 102, Vinyl Chloride Cross Section B-B', June 2015

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Figure 10-7

11.0 Operable Unit 2: Aquatic Sites

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) for aquatic sites to support the risk management decisions 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, which was completed in 2008. Revised draft FS versions were submitted in January 2009, and then in April 2010. After review of the 2010 draft FS, the USEPA and MPCA requested that the Army prepare a work plan for collection of additional Round Lake sediment data (Round Lake is located off the southwest corner of OU2). Given the time required to collect the additional data, the Army, USEPA, and MPCA agreed to separate the FS into two documents: one for Round Lake and one for the OU2 aquatic sites, i.e., Rice Creek, Sunfish Lake, Marsden Lake North, Marsden Lake South, and Pond G. These sites are located as shown on Figure 11-1.

The USEPA and MPCA provided consistency for the Rice Creek, Sunfish Lake, Marsden Lake, and Pond G Feasibility Study in January 2011. No Action was recommended for Rice Creek, Sunfish Lake, Marsden Lake North, and Marsden Lake South. A remedy was recommended for Pond G (surface water hardness adjustment) in order to attain compliance with the Minnesota surface water standard for lead (Class 2Bd chronic standard). OU2 ROD Amendment #4, which documents selection of the recommended alternative, was signed in January 2012.

The USEPA and MPCA provided consistency for the Pond G RD/RA Work Plan in March 2012, and the pond was treated in June 2012. The pond surface water was then monitored in 2012 and 2013, and these results verified compliance with the surface water standard for lead. The completed Pond G remedial action work and surface water monitoring results were documented in the “Remedial Action Completion and Close Out Report, Pond G,” prepared by Wenck, November 2013, which received regulatory consistency approval in FY 2014. This report recommended that the Pond G site be closed with no long-term maintenance, monitoring, or LUC requirements. The 2014 CERCLA five-year review also indicated final concurrence regarding the adequacy of the Pond G remedy, and the Pond G site has been closed. Since the completed remedy does not result in hazardous substances remaining onsite above levels that allow for unlimited use and unrestricted exposure, future CERCLA 5-year reviews are not required for Pond G and, as noted above, there are no monitoring or LUC requirements.

As a result of discovery of 1,4-dioxane within the OU1 plume, the USEPA and MPCA requested sampling for the presence of 1,4-dioxane at all sites where VOCs are present. Rice Creek, which does not have any ongoing Army monitoring requirements, was also included in this additional sampling effort. Figure 11-1 shows the three Rice Creek sampling locations. As shown in Table 11-1, VOCs and 1,4-dioxane were not found to be present in Rice Creek during the June 2015 sampling event.

Table 11-1
Water Quality Data for Rice Creek

Fiscal Year 2015

			OU1 / OU3 COCs:						*Other Analytes:*			
Surface Water Location Number	Location Description	Sampling Date	Trichloroethene	1,1-Dichloroethene	cis-1,2-Dichloroethene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,4 Dioxane	1,1,2,2-Tetrachloroethane	1,2-Dichloroethane	1,2-Dichloropropane
20700	Entering OU2 (North side of County Road I)	6/30/15	<1	<1	<1	<1	<1	<1	<0.07	<1	<1	<1
---	Within OU2 (North side of County Road H)	6/30/15	<1	<1	<1	<1	<1	<1	<0.07	<1	<1	<1
20800	Leaving OU2 (West side of I-35W)	6/30/15	<1	<1	<1	<1	<1	<1	<0.07	<1	<1	<1

Table 11-1
Water Quality Data for Rice Creek

Fiscal Year 2015

			Other Analytes:											
Surface Water Location Number	Location Description	Sampling Date	2-Hexanone	Acetone	Benzene	Bromodichloro-methane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chloroethane	Chloroform	Chloromethane
20700	Entering OU2 (North side of County Road I)	6/30/15	<5	<5 JL49C-51	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
---	Within OU2 (North side of County Road H)	6/30/15	<5	<5 JL49C-51	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
20800	Leaving OU2 (West side of I-35W)	6/30/15	<5	<5 JL49C-51MS51	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Table 11-1
Water Quality Data for Rice Creek

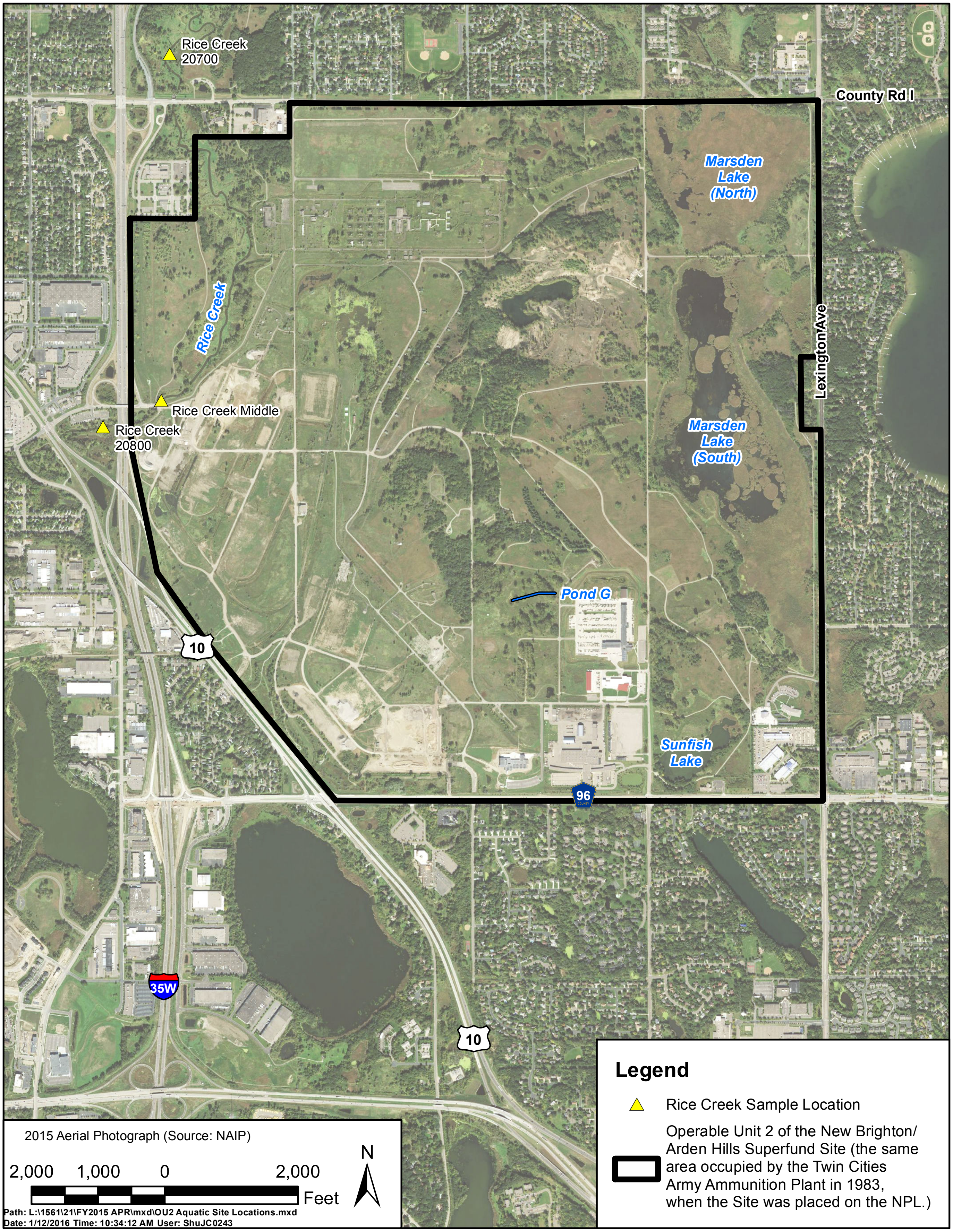
Fiscal Year 2015

			Other Analytes:													
Surface Water Location Number	Location Description	Sampling Date	cis-1,3-Dichloropropene	Dibromochloro-methane	Ethylbenzene	m,p-Xylene	Methyl ethyl ketone	Methyl isobutyl ketone	Methylene chloride	o-Xylene	Styrene	Tetrachloroethene	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Vinyl chloride
20700	Entering OU2 (North side of County Road I)	6/30/15	<1	<1	<1	<2	<5 JL70	<5	<1	<1	<1	<1	<1	<1	<1	<1
---	Within OU2 (North side of County Road H)	6/30/15	<1	<1	<1	<2	<5 JL70	<5	<1	<1	<1	<1	<1	<1	<1	<1
20800	Leaving OU2 (West side of I-35W)	6/30/15	<1	<1	<1	<2	<5 JL70MS67	<5	<1	<1	<1	<1	<1	<1	<1	<1

Notes:

All Results in µg/L

D	Duplicate sample.
JC	The percent difference criterion for continuing calibration exceeded the QC limit (the percent difference is listed after "JC"). The result should be considered estimated.
JL	The percent recovery for the laboratory control sample was above or below the QC limits (the percent recovery is listed after "JL"). The sample result could be biased high (if over 100 percent recovery) or low (if below 100 percent recovery).
JMS	The percent recovery for the matrix spike was above or below the QC limits (the percent recovery is listed after "JMS"). The sample result could be biased high (if over 100 percent recovery) or low (if below 100 percent recovery).
JP	The value is below the reporting level, but above the method detection limit. Results should be considered estimated.



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OU2 Aquatic Sites and Sampling Locations

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Figure 11-1

12.0 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 2014 through September 2015.

Historical Design and Evaluation of TGRS Remedial Action

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 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 start up 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 shut down 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. In March 2011, the TGRS was modified to allow for 2 air stripping tower treatment instead of the original design of 4 air stripping tower treatment. Wet Well Pumps 1 and 2 (WWP#1 and WWP#2 located in Wet Wells 1 and 2) and blowers 1 and 2 were shut down and the valves to Towers 1 and 2 were closed. Groundwater is effectively treated by air stripping Towers 3 and 4 while Towers 1 and 2 remain in standby.
8. Boundary extraction well B11 was shut down on February 7, 2013 as approved by the Agencies in their letter dated February 5, 2013. The plume in the B11 area had dropped below cleanup standards for several years. Well B11 operated at an average extraction rate of 178 gpm in 1989 and at approximately 100 gpm prior to shutdown.

Flow rates at individual wells have been modified from time to time due to plume configuration changes, operational issues, and to maintain the OS.

12.1 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 2015 consistent with the requirements of the OU2 ROD. Table 12-1 presents the cleanup requirements for the TGRS from the OU2 ROD.

During FY 2015, the TGRS average extraction rate was approximately 1,751 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 (based on the larger width of the TRCLE source area plume in 2001). Two of the three individual well groupings were above their respective MOS minimums for FY 2015. The B1, B11, B13 well grouping was below the MOS minimum of 415 gpm because B11 was shut down in February 2013. B11 will continue to be monitored to verify containment.

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 was extracted from 9 wells along the southwest boundary of TCAAP (B1, B3, B4, B5, B6, B8, B9, B11, and B13) and three wells downgradient of interior source areas on TCAAP (SC1, SC2, and SC5). In February 2013, the Agencies approved the shutdown of B11 leaving 11 wells currently operating. Prior to the current configuration, wells B2, B7, B10, B12, SC3, and SC4 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 12-1.

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 elevated water tank. Water stored in the elevated tank was “softened” and then “polished” with granular activated carbon (GAC) prior to distribution at the Facility. Due to the Army discontinuing all non-environmental services at the Facility in September 2007, the elevated water tank and the water softening and polishing equipment are no longer used. As such, the Arsenal Sand and Gravel Pit receives all of the extracted and treated water from the TGRS.

System Operation Specifications

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.

As stated earlier, the TGRS was modified to allow for 2 air stripping tower treatment instead of the original design of 4 air stripping tower treatment. This modification resulted in a reduction of energy use while still meeting the effluent discharge limit of 5 µg/L TRCLE. Wet Well Pumps 1 and 2 (40 horsepower each) and blowers 1 and 2 (5 horsepower each) were shut down and the valves to Towers 1 and 2 were closed. Since March 2010, groundwater has been effectively treated by air stripping Towers 3 and 4 while Towers 1 and 2 remain in standby.

Water level sensors within the wet wells communicate with the programmed 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;
- If operating in four tower mode, maintain the 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 the WWP#1 and #2 pumping rate (if operating in four tower mode) or slightly above the combined pumping rate of the extraction well field (if operating in two tower mode).

FY 2015 Maintenance and Inspection Activity

During FY 2015, 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 downtime 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 1,751 gpm, the total extraction well pumping rate 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 (based on the larger width of the TRCLE plum in 2001). Figure 12-2 plots the daily average flow rate from October 1, 2014 through September 30, 2015, and shows that the TGRS operated above the OM for the majority of the time (282 days or 77 percent of the time) in FY 2015. On a monthly basis, total TGRS extraction rates were below 1,745 gpm during the following months:

- April 2015 (1,702 gpm, lower flow rate due to B11 shutdown, damage to communication wires due to site redevelopment activities, and interruptions to electrical service)
- June 2015 (1,737 gpm, lower flow rate due to B11 shutdown, cleaning mineral buildup and replacing the flow meter at SC2, and communication problems due to electrical storms)
- July 2015 (1,709 gpm, lower flow rate due to B11 shutdown, replacement of motor at WWP#4, and communication problems due to electrical storms)
- August 2015 (1,619 gpm, lower flow rate due to B11 shutdown, blown electrical transformer, and damage to equipment caused by power surges from the electric utility)
- September 2015 (1,743 gpm, lower flow rate due to B11 shutdown, communication problems due to electrical storms, and PLC troubleshooting at B6)

Appendix F.2 provides additional information on the various downtimes throughout FY 2015.

The monthly and annual volume of water pumped is presented in Table 12-2 and 12-3. Table 12-2 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 12-3 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.

As shown on Table 12-3, the TGRS successfully captured and treated approximately 920,197,600 gallons of contaminated water from October 2014 through September 2015 based on the sum of the individual pumphouse flow meters. This volume converts to an average flow rate of 1,751 gpm.

The TGRS as a whole was operational 98.4 percent of the time (i.e., 359 days out of 365 days in FY 2015).

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 2015 operational notes is presented in Appendix F-2. During FY 2015, 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 12-4. A summary of average down time for the pumphouses and the treatment center by the category of failure is presented in Table 12-5. 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 less in FY 2015 than they were in FY 2014 (from 6.4 days in FY 2014 to 6.0 days in FY 2015). The decreased downtime is primarily due to less downtime in the pumphouse category, which includes downtime due to repairs and troubleshooting of equipment located within the individual pumphouses. Pumphouse category down time decreased from 3.3 days in FY 2014 to 1.9 days in FY 2015.

Description of Down Time Categories

Pumphouse component failures accounted for an average of 1.9 days down time per pumphouse. There was less down time due to pumphouse maintenance in FY 2015 than there was in FY 2014. The major pumphouse repairs causing down time were:

- Pump replacement at Pumphouse B5
- Rewiring at Pumphouse B5
- Riser pipe replacement at Pumphouse B8
- Output card replacement at Pumphouse B13

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 0.6 days down time per pumphouse. The major treatment center repair causing substantial down time was the replacement of WWP#4.

Electrical service system failures accounted for an average of 3.2 days down time per pumphouse. Electrical storm damage and power grid failures were the primary causes of down time.

Preventative maintenance procedures accounted for less than 1 day of down time in FY 2015. For the most part, preventative maintenance was able to be performed without interruptions to the treatment system. Preventative maintenance procedures are described in the project Operation and Maintenance Manual.

System modifications did not account for any days of down time in FY 2015.

Forcemain issues accounted for 0.1 days down time per pumphouse. A leaking gate valve in the forcemain near Pumphouse B12 was replaced in May 2015, causing downtime.

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 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 2015. Appendix D contains the water level database for the monitoring wells. Figures 12-3 through 12-5 present the groundwater elevations for Upper Unit 3, Lower Unit 3, and Unit 4 during this time period. These figures present the potentiometric contours from three vertical portions of the aquifer. The groundwater elevation contours and limits of capture in the three portions of the aquifer are similar to those observed in FY 2003 after the modification to the OS was implemented. The zone of capture created by the TGRS extends beyond the 5 µg/L TRCLE contour, in both the Unit 3 and the Unit 4 aquifers.

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 920,197,600 gallons of water from October 2014 through September 2015. 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 1,748 pounds of VOCs from October 2014 through September 2015. The VOC mass removal in FY 2014 was 2,020 pounds. The decrease in FY 2015 reflects an overall decrease in plume concentration.

Average VOC influent concentrations decreased from 260 µg/L in FY 2014 to 229 µg/L in FY 2015 (11.9 percent lower). Table 12-6 summarizes the individual VOC mass contribution of each extraction well and the entire system. Overall, the TGRS has removed over 106 tons (213,030 lbs) of VOCs from the aquifers since 1987 and 16.5 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 1,748 pounds in FY 2015, the VOC mass removal from the TGRS is at 51 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. Wells B2, B7, B10, B11, B12, SC3, and SC4 are shut down, but were temporarily operated for June 2015 sampling. Table 12-7 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 12-1.

Appendix G-1 presents TRCLE versus time graphs for each extraction well. As shown, TRCLE concentrations have declined in each well and now at many wells, the TRCLE concentrations 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:

- B11 (4.8 µg/L in FY 2001 to non-detect in FY 2015 – 100% reduction)
- SC3 (5.5 µg/L in FY 2001 to 0.44 µg/L in FY 2015 – 92% reduction)
- B10 (5.1 µg/L in FY 2001 to 0.44 µg/L in FY 2015 – 91% reduction)
- B6 (230 µg/L in FY 2001 to 29 µg/L in FY 2015 – 87% reduction)
- B4 (500 µg/L in FY 2001 to 86 µg/L in FY 2015 – 83% reduction)
- B5 (410 µg/L in FY 2001 to 72 µg/L in FY 2015 – 82% reduction)
- B1 (180 µg/L in FY 2001 to 35 µg/L in FY 2015 – 81% reduction)
- SC2 (100 µg/L in FY 2001 to 28 µg/L in FY 2015 – 72% reduction)
- B3 (8.7 µg/L in FY 2001 to 2.4 µg/L in FY 2015 – 72% reduction)
- B9 (110 µg/L in FY 2001 to 42 µg/L in FY 2015 – 62% reduction)
- SC4 (6.9 µg/L in FY 2001 to 2.6 µg/L in FY 2015 – 62% reduction)
- B8 (21 µg/L in FY 2001 to 10 µg/L in FY 2015 – 52% reduction)

In fact, only 3 wells (B2, SC5, and SC1) have shown less than a 50 percent reduction in TRCLE concentrations since FY 2001. 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 12-6 illustrates, eight wells, B1, B4, B5, B6, B9, B13, SC1 and SC5, that are located in the centers of the plume, achieve the largest rates of VOC removal. These eight wells together accounted for over 99 percent of the VOC mass removed.

The source control wells, SC1 through SC5, together accounted for over 79 percent of the VOC mass removed while accounting for only 10.1 percent of the water pumped by the system. SC5, in particular, removed over 72 percent of the total VOC mass at a rate of only approximately 122 gpm (7.0 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?

A majority of wells on and off TCAAP exhibit decreasing 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 trends may not reflect a uniform or easily predictable pattern.

Several wells were identified in previous APRs, or when reviewing the FY 2015 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 1,000’s of µg/L in early 1990s. TRCLE decreased steadily from 410 µg/L in 2001 to 140 µg/L in 2005. From 2006 to 2011, TRCLE concentrations varied between 120 µg/L and 240 µg/L with no apparent trend. TRCLE increased to 490 µg/L in 2012 and 620 µg/L in 2013. Decreased to 440 µg/L in 2014 and 330 µg/L in 2015. The overall increase since 2012 is reflected with a decrease in TRCLE concentration at well 03M806. Maintain annual sampling frequency.

Well	***Trend Observation***
04U806	Trend identified in FY 2001 APR. Dropped from 1,000’s of µg/L in early to mid 1990s. TRCLE decreased steadily from 470 µg/L in 2001 to 96 µg/L in 2007. In 2008, TRCLE spiked at 380 µg/L, but concentrations decreased the next year and have varied between 130 µg/L and 220 µg/L since 2009 with no apparent trend (220 µg/L in 2015). Maintain annual sampling frequency.
03U094	Trend identified during FY 2004 data review. TRCLE increased from 170 µg/L in 2003 to 470 µg/L in 2005. From 2005 to 2013, TRCLE concentrations overall had been decreasing and had decreased to 80 µg/L in 2013, a historical low concentration. Increased to 610 µg/L in 2015, the highest concentration since 1996. Maintain biennial sampling frequency (next event 2016).
03M806	Trend identified during FY 2003 data review. TRCLE concentrations dropped from near 900 µg/L in 1987, to below 100 µg/L from 1993 through 1996. Increased to 1,300 µg/L, a historical high concentration, in 2003. TRCLE concentrations have decreased from 680 µg/L in 2008 to 250 µg/L in 2015. Maintain annual sampling frequency.
03U711	Trend identified in FY 2001 APR. TRCLE concentrations decreased from near 1,000 µg/L in 1994 to 75 µg/L in 1999, but rebounded to 250 µg/L by 2004. Since 2004, concentrations have steadily decreased and were down to 39 µg/L in 2015. Maintain biennial sampling frequency (next event 2016).
03L809	Trend identified in FY 2001 APR. TRCLE concentrations decreased from over 3,000 µg/L to 67 µg/L through 1998, but rebounded to 520 µg/L by 2001. Since 2001, concentrations have decreased overall to 120 µg/L in 2015. Maintain biennial sampling frequency (next event 2016).

Well	***Trend Observation***
04U843	Trend identified in FY 2001 APR. TRCLE concentrations were below 15 µg/L from late 1980s through 1997, and then increased to between 22 µg/L and 38 µg/L from 1998 through 2001. In 2003, TRCLE dropped to below 1 µg/L, but has been steadily increasing since and is at 180 µg/L in 2015. Well is nearly 1 mile from TGRS and is part of the OU1 sampling program; therefore, see also Section 3. Maintain biennial sampling frequency (next event 2016).
04U841	Trend identified in FY 2001 APR. TRCLE concentrations were below 10 µg/L through 1995, and then increased to 25 µg/L in 2001. In 2003, TRCLE decreased to 5 µg/L, but rebounded to 19 µg/L in 2005. TRCLE appears to be stabilizing around 20 µg/L, with concentrations ranging between 15 and 24 µg/L since 2005 (15 µg/L in 2015). Well is nearly 0.5 mile from TGRS and is part of the OU1 sampling program; therefore, see also Section 3. Maintain biennial sampling frequency (next event 2016).
03U822	Trend identified during FY 2003 data review. TRCLE concentrations were below 25 µg/L through 1998, and then peaked at 375 µg/L in 1999. Concentrations have ranged between 120 and 160 µg/L from 2005 to 2015 (150 µg/L in 2015). Well is approximately 1 mile from TGRS and is part of the OU1 sampling program; therefore, see also Section 3. Maintain biennial sampling frequency (next event 2016).

Well	*Trend Observation*
03L822	Trend identified in FY 2001 APR. TRCLE concentration increased from below 5 µg/L during early 1990s to over 600 µg/L from 1999 through 2003. Concentrations steadily decreased from 620 µg/L in 2003 to 180 µg/L in 2011, but rebounded slightly in 2013 to 220 µg/L. Concentration decreased slightly in 2015 to 190 µg/L. Well is approximately 1 mile from TGRS and is part of the OU1 sampling program; therefore, see also Section 3. Well historically showed 1,1,1-trichloroethane as major contaminant. Maintain biennial sampling frequency (next event 2016).

12.2 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 clean up 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 were sampled on a monthly basis during FY 2015. The influent/effluent database for FY 2015 is contained in Appendix G-2. Figure 12-6 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 2015 influent TRCLE concentration was 184 µg/L, down from 208 µg/L in FY 2014. FY 2015 represents the

thirteenth 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 influent TRCLE concentrations had been steadily decreasing for several years, likely due to the overall decrease in plume concentration, but increased in FY 2013 and remained above the FY 2012 concentration in FY 2014. However, as stated earlier, the increased influent TRCLE concentrations observed in FYs 2013 and 2014 are due, in part, to the higher extraction rate at well SC5 that resulted from the cleaning of the forcemain in April 2013, and from the shutdown of well B11 in February 2013, which was pumping clean water into the treatment system. The FY 2015 influent concentration nearly decreased to the FY 2012 concentration of 180 µg/L, while the SC5 extraction rate remained higher and B11 remained off, likely indicating a continuing overall decrease in plume concentration.

Figure 12-6 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 2015. A review of the FY 2015 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 concentrations for all specified VOC compounds indicates an average removal efficiency of 99.4 percent. As expected, effluent concentrations of TRCLE increased slightly after the treatment was changed to two tower operation (two tower operation was tested in February 2011 and went into full operation in March 2011). The maximum effluent TRCLE concentration in FY 2015 was 1.7 µg/L and the average was 1.4 µg/L, both of which are well below the discharge limit.

What was the mass of VOCs emitted into the air?

The air stripping towers remove VOCs with an efficiency of approximately 99.4 percent. The air emissions are equal to the VOC mass removal rates presented in Table 12-6. Air emissions averaged 4.8 pounds per day based on the VOC mass removal rates. The total VOC emissions from October 2014 through September 2015 were 1,748 pounds.

12.3 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 2015, there were no noticeable changes in Gravel Pit performance. The Gravel Pit is accommodating the TGRS discharge as designed.

12.4 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. There are no private users of groundwater on the property and the potable water supply is no longer used. The property is a government reservation, is fenced, and access is restricted to authorized personnel.

Are any changes or additional actions required for this remedy component?
Yes. Though actually an FY 2016 occurrence, note that on April 20, 2016, the Minnesota Department of Health (MDH) issued a memorandum updating the Special Well and Boring

Construction Area (SWBCA) that updated the SWBCA boundary to include all of the OU2 area, and was prompted by the recent establishment of concurrent jurisdiction (versus the previous, exclusively federal jurisdiction). All wells and borings constructed or modified within the SWBCA, which now includes OU2, must first be approved by the MDH.

12.5 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. 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
- 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.
- 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 2015?

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 look for emerging and new technologies, and attend relevant conferences that highlight emerging and new technologies. However, reviews of specific technologies are not planned in FY 2016.

12.6 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 2015 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 2015 monitoring plan and any deviations are explained in Appendix C.2. Monitoring was as follows:

Groundwater
TGRS groundwater level measurements were collected during December 2014 and June 2015 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 VOC (8260B) analysis. FY 2015 was a "big round" year in the biennial sample program, so samples were collected for the full list of wells. Table 12-8 presents the groundwater quality data for FY 2015. Figures 12-7 through 12-9 present plan views of the TRCLE plumes and Figure 12-10 and Figure 12-11 present a cross sectional view of the plume along the property boundary.

Results from the 2015 groundwater sampling showed that most of the wells sampled continued to have declining or stable TRCLE concentrations. Notable steadily decreasing trends are observed at 03U030 (steady decrease from 43 µg/L in 2007 to 10 µg/L in 2015), 03U709 (steady decrease from 61 µg/L in 2005 to 17 µg/L in 2015), 03U711 (steady decrease from 250 µg/L in 2004 to 39 µg/L in 2015), and 04U077 (steady decrease from 98 µg/L in 2005 to 35 µg/L in

2015). Another notable decreasing trend is at 03M806, which had a TRCLE concentration of 680 µg/L as recently as 2008, but has decreased to 250 µg/L in 2015. There was also a notable decrease at 03L806 (620 µg/L in 2013, 440 µg/L in 2014, and 330 µg/L in 2015), ending a steady upward trend observed since 2010 when this well had decreased to 120 µg/L. Both 03M806 and 03L806 are likely located in a hydraulic stagnation zone, which may explain their shifting upward and downward trends, as discussed in more detail earlier in Section 12.1.

Although the general trend at most wells since 1999 appears to be declining or stable, the monitoring wells listed below had notable increases in TRCLE concentration since 2013:

- 03L014 (89 µg/L in 2013 to 250 µg/L in 2015)
- 03U003 (41 µg/L in 2011, 56 µg/L in 2013, and 140 µg/L in 2015)
- 03U094 (80 µg/L in 2013 to 610 µg/L in 2015)
- 03U659 (41 µg/L in 2011, 87 µg/L in 2013, and 130 µg/L in 2015)

Well 03U094 was discussed earlier in Section 12.1. The increases in the remaining wells listed are generally within historical ranges within the last 10 years. All of these wells will continue to be monitored and no further sampling beyond the scheduled events is necessary at this time.

Estimated TRCLE Plume Width

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, 16.5 tons of VOCs have been removed from the groundwater. TRCLE concentrations are decreasing across the site, especially at the following wells that have been below 5 µg/L since 2001: B10, SC4, 03L021, 03L833, 03U701, 04J702, 04U701, 04U702, and 04U833. Monitoring well 03U672, which was along the southern end outside 5 µg/L TRCLE plume, decreased from 3.1 µg/L in 2001 to not detectable (below 1 µg/L) from 2003 until it was abandoned in 2014. The replacement well for 03U672, 03U677 (installed in September 2014), has also never contained detectable concentrations of VOCs (including TRCLE). In addition, B11, which is no longer operated, reported a June 2015 TRCLE concentration of not detectable.

As a result, the width of TRCLE plume is narrowing. Figure 12-12 shows FY 2015 TRCLE data with the 5 µg/L TRCLE contours for FY 2001 and FY 2015. Based on these contours, the estimated width of the source area TRCLE plume has decreased approximately 17 percent from 3,600 feet to 3,000 feet or approximately 83 percent of the FY 2001 width. According to the TGRS OS, overall TGRS operating goals will be reviewed if the source area plume width shrinks to 75 percent of the FY 2001 width (2,700 feet). At the boundary, the TRCLE plume narrowing is more pronounced, having decreased approximately 24 percent from 4,600 to 3,500 feet, which represents a decrease of approximately 76 percent of the FY 2001 width. Based on discussions and correspondence with MPCA and EPA staff, the Agencies may be receptive to changes in the operating strategy earlier than that stated in the current TGRS OS.

Treatment System

The TGRS treatment system influent and effluent was sampled monthly during FY 2015 in accordance with the FY 2015 monitoring plan. The extraction wells were sampled in December 2014 and June 2015 in accordance with the FY 2015 monitoring plan.

Is additional monitoring proposed prior to the next report?

Given the arrival of the 1,4-dioxane issue in FY 2015, a "big round" sampling event in June of FY 2016 (in essence repeating the FY 2015 sampling event) is proposed to include both VOC and 1,4-dioxane analyses at all sampling locations. FY 2016 would otherwise have been a “minor” sampling event. Table 12-9 and Appendix A of this report provide FY 2016 monitoring requirements. Also, 30 TGRS monitoring wells are proposed for sampling 1,4-dioxane and VOCs in FY 2016 (January) to delineate areas around the perimeter of the plume where the 1 contour for 1,4-dioxane was not clearly defined in the June 2015 sampling event.

12.7 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 2015 annual average extraction rate was 1,751 gpm.
- The TGRS extracted and treated 920,197,600 gallons of water and removed 1,748 pounds of VOCs from October 2014 to September 2015. Average VOC influent concentrations decreased by 11.9% from FY 2014.
- Groundwater analytical data of the source area show 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.

12.8 OTHER RELATED ACTIVITY IN FY 2015

In March 2015, USEPA and MPCA requested sampling and analysis for 1,4-dioxane to be included in the June 2015 annual sampling event for TGRS wells. The analysis was added to all regularly scheduled monitoring and extraction wells. Table 12-10 presents the results of the 1,4-dioxane sampling for the TGRS influent, effluent, and extraction wells. No Federal MCL has been established for 1,4-dioxane; however, the Minnesota Department of Health has established a Health Risk Limit (HRL) value of 1.0 µg/L. All locations sampled except two of the extraction wells (B1 and B11) had 1,4-dioxane concentrations exceeding the HRL. The TGRS influent and effluent were sampled three times (April, June, and July). The 1,4-dioxane concentrations were virtually identical in the influent and effluent samples on a monthly basis, indicating no reduction from the treatment system. The results of the monitoring well sampling are presented on Table 12-11. A majority of the monitoring wells sampled (51 of 76) had 1,4-dioxane concentrations exceeding the HRL, with the highest concentrations found in the samples at 03U094 (281 µg/L) and 03U021 (133 µg/L). Figure 12-13 shows the 1,4-dioxane concentrations in plan view for the west portion of OU2. Figures 12-7 through 12-9 present plan views of the

1,4-dioxane plumes and Figures 12-14 and 12-15 present cross sectional views of the plume along the property boundary.

Table 12-1

Groundwater Cleanup Levels
TGRS, OU2
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	<1.0	70
1,1-Dichloroethene	<1.0	6.0
1,1,1-Trichloroethane	<1.0	200
1,2-Dichloroethane	<1.0	4.0
Trichloroethene	<5.0	5.0
1,1-Dichloroethane	<1.0	70
Tetrachloroethene	<1.0	5.0

Table 12-2

Extraction Well Water Pumped
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

	Volume of Water Pumped (gallons)												
	B1	**B3**	**B4**	**B5**	**B6**	**B8**	**B9**	**B11**	**B13**	**SC1**	**SC2**	**SC5**	**Total**
October 2014	9,015,900	7,412,800	9,903,500	8,403,900	10,419,600	7,662,100	13,080,700	0	5,411,400	1,129,800	1,947,700	5,693,900	80,081,300
(gpm)	202	166	222	188	233	172	293	0	121	25	44	128	1,794
November 2014	8,724,500	7,036,100	9,617,200	11,201,600	9,585,200	6,889,900	12,344,000	0	5,325,400	1,129,500	2,087,300	5,638,800	79,579,500
(gpm)	202	163	223	259	222	159	286	0	123	26	48	131	1,842
December 2014	8,787,300	7,123,100	9,702,300	10,282,300	9,554,000	6,679,500	12,251,900	0	5,392,100	1,134,900	2,163,300	5,825,700	78,896,400
(gpm)	197	160	217	230	214	150	274	0	121	25	48	131	1,767
January 2015	9,019,600	7,149,200	9,909,200	10,335,600	9,876,500	7,401,200	12,464,500	0	5,465,200	1,172,000	2,039,300	6,085,000	80,917,300
(gpm)	202	160	222	232	221	166	279	0	122	26	46	136	1,813
February 2015	8,225,500	6,675,800	8,385,000	9,617,500	8,614,200	5,236,500	11,496,900	0	4,665,600	1,066,100	1,122,300	5,614,000	70,719,400
(gpm)	204	166	208	239	214	130	285	0	116	26	28	139	1,754
March 2015	9,170,400	7,235,800	8,587,200	10,334,400	9,685,700	6,702,400	12,735,600	0	5,530,900	1,213,300	1,296,300	6,126,400	78,618,400
(gpm)	205	162	192	232	217	150	285	0	124	27	29	137	1,761
April 2015	8,355,400	6,068,700	8,789,900	10,695,300	9,008,100	7,323,600	12,214,100	0	4,028,600	1,113,600	1,183,300	4,749,300	73,529,900
(gpm)	193	140	203	248	209	170	283	0	93	26	27	110	1,702
May 2015	8,903,900	6,072,500	9,351,000	11,387,000	9,543,900	8,558,000	13,475,100	0	4,269,700	1,206,700	1,137,700	5,080,800	78,986,300
(gpm)	199	136	209	255	214	192	302	0	96	27	25	114	1,769
June 2015	8,567,600	5,626,000	8,971,900	10,875,200	8,879,700	8,256,600	12,846,800	0	4,110,000	1,164,200	965,300	4,778,600	75,041,900
(gpm)	198	130	208	252	206	191	297	0	95	27	22	111	1,737
July 2015	9,209,600	5,218,800	9,595,700	11,544,300	9,428,700	7,933,100	11,885,800	0	4,434,200	1,193,200	882,300	4,954,700	76,280,400
(gpm)	206	117	215	259	211	178	266	0	99	27	20	111	1,709
August 2015	8,729,200	5,786,900	7,231,900	10,970,600	9,833,800	7,524,500	11,855,100	0	4,105,800	1,014,400	510,400	4,691,400	72,254,000
(gpm)	196	130	162	246	220	169	266	0	92	23	11	105	1,619
September 2015	8,547,700	6,116,300	9,088,000	10,821,200	9,795,900	7,854,400	13,012,800	0	3,840,100	1,015,900	421,200	4,779,300	75,292,800
(gpm)	198	142	210	250	227	182	301	0	89	24	10	111	1,743
Total FY 2015	**105,256,600**	**77,522,000**	**109,132,800**	**126,468,900**	**114,225,300**	**88,021,800**	**149,663,300**	**0**	**56,579,000**	**13,553,600**	**15,756,400**	**64,017,900**	**920,197,600**
Operational Minimum (gpm)	225	170	195	195	210	135	275	80	110	20	30	100	1,745

	B1, B11, B13	B4, B5, B6	B4, B5, B6, B8, B9	Total System
FY15 Average Flow Rate (gpm)	308	666	1,118	1,751
MOS Operational Minimum (gpm)	415	600	1,010	1,745

Table 12-3

Treatment Center Water Meter Totals
Fiscal Year 2015
TGRS, OU2
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 2014	80,081,300	0	0	0	2,000	68,808,000	68,810,000	0	0	0
November 2014	79,579,500	0	0	0	402,000	65,428,000	65,830,000	0	0	0
December 2014	78,896,400	0	0	0	11,000	60,671,000	60,682,000	0	0	0
January 2015	80,917,300	0	0	0	441,000	61,002,000	61,443,000	0	0	0
February 2015	70,719,400	0	0	0	0	53,696,000	53,696,000	0	0	0
March 2015	78,618,400	0	0	0	167,000	60,463,000	60,630,000	0	0	0
April 2015	73,529,900	0	0	0	773,000	59,037,000	59,810,000	0	0	0
May 2015	78,986,300	0	0	0	0	63,680,000	63,680,000	0	0	0
June 2015	75,041,900	0	0	0	12,000	59,941,000	59,953,000	0	0	0
July 2015	76,280,400	0	0	0	5,841,000	55,822,000	61,663,000	0	0	0
August 2015	72,254,000	0	0	0	126,000	56,820,000	56,946,000	0	0	0
September 2015	75,292,800	0	0	0	347,000	58,957,000	59,304,000	0	0	0
Total FY 2015	**920,197,600**	**0**	**0**	**0**	**8,122,000**	**724,325,000**	**732,447,000**	**0**	**0**	**0**

Table 12-3

Treatment Center Water Meter Totals
Fiscal Year 2015
TGRS, OU2
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
FY 1989	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
FY 1990	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
FY 1991	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
FY 1992	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
FY 1993	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
FY 1994	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
FY 1995	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
FY 1996	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
FY 1997	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
FY 1998	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
FY 1999	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
FY 2009	925,232,745	357,698,000	552,505,000	910,203,000	173,004,000	795,057,000	968,061,000	0	0	0
FY 2010	933,789,205	368,260,000	556,160,000	924,420,000	61,957,000	894,152,000	956,109,000	0	0	0
FY 2011	952,379,000	183,460,000	268,747,000	452,207,000	15,479,000	890,850,000	906,329,000	0	0	0
FY 2012	964,996,900	0	0	0	695,000	848,465,000	849,160,000	0	0	0
FY 2013	924,550,600	0	0	0	5,503,000	883,772,000	891,338,000	0	0	0
FY 2014	937,934,854	0	0	0	3,956,000	895,176,000	899,132,000	0	0	0
FY 2015	920,197,600	0	0	0	8,122,000	724,325,000	732,447,000	0	0	0

Table 12-4

Pumphouse Down Time
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

Well Name	FY15 Down Time (Days)	FY14 Down Time (Days)	FY13 Down Time (Days)	FY12 Down Time (Days)	FY11 Down Time (Days)
B1	2.7	3.4	10.7	1.5	6.2
B2	(1)	(1)	(1)	(1)	(1)
B3	5.4	3.0	4.3	1.6	26.4
B4	10.2	9.2	4.0	6.0	6.4
B5	8.7	2.0	13.0	2.0	4.5
B6	2.4	9.6	2.8	1.9	5.7
B7	(1)	(1)	(1)	(1)	(1)
B8	8.5	2.4	2.9	3.7	4.2
B9	9.5	6.8	9.4	3.6	21.1
B10	(1)	(1)	(1)	(1)	(1)
B11	(1)	(1)	16.4(2)	9.5	3.1
B12	(1)	(1)	(1)	(1)	(1)
B13	4.5	2.9	9.3	7.4	6.4
SC1	2.6	17.0	14.0	7.6	17.8
SC2	4.4	4.4	20.3	35.0	37.0
SC3	(1)	(1)	(1)	(1)	(1)
SC4	(1)	(1)	(1)	(1)	(1)
SC5	6.6	9.4	32.5	7.3	33.3

Note:

(1) The extraction well was not in operation during the fiscal year.
(2) The extraction well was in operation for only part of the fiscal year.

Table 12-5

Down Time By Category
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

Category	**Down Time (Days)**
Pumphouse Component	1.9
Treatment Center Component	0.6
Electrical Service	3.2
Miscellaneous	0.1
Preventive Maintenance	0.0
System Modification	0.0
Forcemain	0.1
Total System Equivalent	6.0
Anticipated Down Time for Fiscal Year 2016	
Pumphouse Component	4.0
Treatment Center Component	1.5
Electrical Service	2.0
Miscellaneous	1.0
Preventive Maintenance	1.0
System Modification	0.5
Forcemain	1.0

Table 12-6

VOC Mass Loading Summary
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

Well	Percent Contribution to VOC Mass Removal	FY 2015 Total Pounds VOCs Mass Removed
B1	2.0%	34.7
B2[1]	0.0%	0.00
B3	0.1%	1.66
B4	5.0%	87.3
B5	4.9%	85.4
B6	1.6%	28.3
B7[1]	0.0%	0.00
B8	0.5%	8.30
B9	3.5%	60.5
B10[1]	0.0%	0.00
B11[1]	0.0%	0.00
B12[1]	0.0%	0.00
B13	3.2%	56.4
SC1	6.3%	110
SC2	0.3%	5.56
SC3[1]	0.0%	0.00
SC4[1]	0.0%	0.00
SC5	72.6%	1,270
Fiscal Year 2015 Total (lbs)		**1,748**
Daily Average (lbs/day)		**4.8**

Notes:

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

Table 12-6

VOC Mass Loading Summary
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

HISTORICAL TOTAL

Fiscal Year		Pounds VOC Mass Removed
2015		1,748
2014		2,020
2013		2,082
2012		1,801
2011		1,834
2010		2,096
2009		2,167
2008		2,292
2007		2,507
2006		2,552
2005		2,663
2004		3,291
2003	(First year of reconfigured system)	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		**213,030**

Table 12-7

VOC Concentrations in TGRS Extraction Wells
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

Location	Alias	Date	Dup	1,1,1-Trichloroethane µg/L	1,1-Dichloroethane µg/L	1,1-Dichloroethene µg/L	1,2-Dichloroethane µg/L	cis-1,2-Dichloroethene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L
03F302	B1	12/4/2014		1.9	0.35 JP	0.56 JP	< 1.0	2.0	1.1	38
03F302	B1	6/5/2015		1.9	0.37 JP	0.64 JP	< 1.0	1.9	1.3	35
03F302	B1	6/5/2015	D	1.8	0.36 JP	0.71 JP	< 1.0	1.8	1.1	34
03F303	B2	6/5/2015		< 1.0	< 1.0	0.88 JP	0.37 JP	1.1	1.0	27
03F304	B3	12/4/2014		< 1.0	< 1.0	0.41 JP	< 1.0	< 1.0	< 1.0	2.6
03F304	B3	6/5/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.4
03F305	B4	12/4/2014		6.8	3.2	3.0	< 1.0	2.0	< 1.0	88
03F305	B4	6/5/2015		7.4	3.0	3.4	< 1.0	1.9	< 1.0	86
03F306	B5	12/4/2014		2.5	2.4	2.3	< 1.0	0.60 JP	4.3	76
03F306	B5	6/4/2015		2.6	2.2	2.4	< 1.0	0.68 JP	4.9	72
03F307	B6	12/4/2014		0.57 JP	0.39 JP	0.48 JP	< 1.0	< 1.0	< 1.0	32
03F307	B6	6/4/2015		0.55 JP	< 1.0	0.48 JP	< 1.0	< 1.0	< 1.0	29
03F308	B7	6/4/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.2
03F312	B11	12/31/2014		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03F312	B11	6/5/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03F319	B13	12/4/2014		3.3	0.95 JP	0.74 JP	< 1.0	6.6	0.42 JP	120
03F319	B13	6/5/2015		3.5	0.87 JP	1.2	< 1.0	5.6	0.48 JP	110
03U301	SC1	12/4/2014		10	1.1 JP	1.7 JP	< 2.0	62	< 2.0	970
03U301	SC1	6/5/2015		12	1.3 JP	3.2	< 2.0	75	< 2.0	940
03U314	SC2	12/4/2014		12	0.95 JP	0.78 JP	< 1.0	0.95 JP	< 1.0	34
03U314	SC2	6/5/2015		7.0	0.88 JP	1.1	< 1.0	0.82 JP	< 1.0	28

Table 12-7

VOC Concentrations in TGRS Extraction Wells
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

Location	Alias	Date	Dup	1,1,1-Trichloroethane µg/L	1,1-Dichloroethane µg/L	1,1-Dichloroethene µg/L	1,2-Dichloroethane µg/L	cis-1,2-Dichloroethene µg/L	Tetrachloroethene µg/L	Trichloroethene µg/L
03U315	SC3	6/5/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.44 JP
03U316	SC4	6/5/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.6
03U317	SC5	12/4/2014		540	15	24	< 5.0	2.8 JP	3.4 JP	1800
03U317	SC5	12/4/2014	D	530	14	23	< 5.0	2.6 JP	3.3 JP	1800
03U317	SC5	6/5/2015		650	15	56	< 5.0	4.0 JP	4.4 JP	2000
PJ#309	B8	12/4/2014		0.61 JP	0.44 JP	0.56 JP	< 1.0	< 1.0	< 1.0	11
PJ#309	B8	6/5/2015		0.59 JP	0.42 JP	0.60 JP	< 1.0	< 1.0	< 1.0	10
PJ#310	B9	12/4/2014		2.3	2.7	2.9	< 1.0	1.0	< 1.0	44
PJ#310	B9	6/4/2015		2.4	2.2	2.7	< 1.0	1.2	< 1.0	42
PJ#311	B10	6/4/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.44 JP
PJ#313	B12	6/4/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Notes:

D - Field Duplicate

JP - Result is qualified as estimated since the detection is below the laboratory quantitation limit.

Table 12-8

Groundwater Quality Data
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

			1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
TGRS Cleanup Level[(1)]			**200**	**70**	**6.0**	**4.0**	**70**	**5.0**	**5.0**
Location	**Date**	**Dup**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
03L002	6/18/2015		0.61 JP	0.41 JP	0.75 JP	< 1.0	< 1.0	< 1.0	16
03L007	6/17/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03L014	7/1/2015		200	2.4	7.2	< 1.0	0.96 JP	< 1.0	250
03L017	6/18/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03L018	7/1/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03L020	6/25/2015		0.41 JP	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	8.8
03L021	6/18/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.9
03L077	6/29/2015		1.4	< 1.0	0.83 JP	< 1.0	< 1.0	< 1.0	23
03L078	6/23/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03L079	6/17/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.2
03L802	6/16/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.7
03L806	6/15/2015		1.1	16	15	< 1.0	4.0	< 1.0 JL	330
03L809	6/15/2015		3.3	2.4	2.5	< 1.0	0.94 JP	< 1.0 JL	120
03L833	6/12/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 JL	2.1
03M002	6/18/2015		1.2 JMS	1.3	1.5	< 1.0	< 1.0	< 1.0	23
03M020	6/25/2015		2.1	0.48 JP	0.45 JP	< 1.0	< 1.0	< 1.0	28
03M802	6/16/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	5.4
03M806	6/15/2015		0.33 JP	30	15	< 1.0	4.3	< 1.0 JL	250
03U002	6/5/2015		1.8	0.54 JP	0.70 JP	< 1.0	< 1.0	< 1.0	17
03U003	6/25/2015		46	4.5	8.7	< 1.0	16	< 1.0	140
03U005	6/17/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03U005	6/17/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03U007	6/17/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03U009	7/7/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03U014	7/1/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03U017	6/18/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.3
03U018	7/1/2015		18	0.95 JP	1.8	< 1.0	7.0	< 1.0	39
03U020	6/25/2015		15	1.1	3.1	< 1.0	0.81 JP	< 1.0	61
03U021	6/18/2015		58	6.2	11	< 1.0	4.3	< 1.0	230
03U027	6/25/2015		0.81 JP	< 1.0	< 1.0	< 1.0	0.83 JP	< 1.0	12
03U028	6/25/2015		1.8	< 1.0	0.47 JP	< 1.0	3.2	< 1.0	42
03U029	6/30/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.7

Table 12-8

Groundwater Quality Data
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

			1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
TGRS Cleanup Level$^{(1)}$			**200**	**70**	**6.0**	**4.0**	**70**	**5.0**	**5.0**
Location	**Date**	**Dup**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
03U030	6/25/2015		< 1.0	< 1.0	< 1.0	< 1.0	0.60 JP	< 1.0	10
03U032	7/7/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03U077	6/29/2015		0.58 JP	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	8.2
03U078	6/23/2015		2.4	< 1.0	1.0	< 1.0	1.5	18 JMS	84
03U079	6/17/2015		3.6	< 1.0	0.80 JP	< 1.0	0.96 JP	< 1.0	38
03U092	7/7/2015		< 1.0	< 1.0	< 1.0	< 1.0	1.4	< 1.0	11
03U093	7/7/2015		36	< 1.0	2.9	< 1.0	1.2	< 1.0	69
03U094	7/7/2015		420	24	12	< 1.0	42	0.36 JP	610
03U096	7/7/2015		3.1	0.58 JP	0.66 JP	< 1.0	< 1.0	< 1.0	11
03U099	7/1/2015		0.88 JP	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.2
03U114	7/7/2015		0.51 JP	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.3
03U659	6/30/2015		10	2.3	1.8	< 1.0	29	< 1.0	130
03U671	6/30/2015		1.7	< 1.0	0.45 JP	< 1.0	< 1.0	10	34
03U677	6/16/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03U701	7/1/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.68 JP
03U702	6/30/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.47 JP
03U703	6/23/2015		1.5	< 1.0	0.36 JP	< 1.0	1.4	7.5	24
03U708	6/29/2015		2.4	0.30 JP	0.86 JP	< 1.0	0.36 JP	1.8	31
03U709	6/30/2015		1.5	0.51 JP	0.58 JP	< 1.0	< 1.0	< 1.0	17
03U710	6/17/2015		2.5	< 1.0	0.67 JP	< 1.0	0.66 JP	< 1.0	26
03U711	6/12/2015		3.8	1.1	1.6	< 1.0	0.52 JP	0.54 JL	39
03U715	7/7/2015		5.8	< 1.0	0.80 JP	< 1.0	< 1.0	< 1.0	29
03U801	6/16/2015		< 1.0	< 1.0	< 1.0	< 1.0	0.71 JP	< 1.0	21
03U803	6/16/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03U804	6/15/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 JL	< 1.0
03U805	6/16/2015		< 1.0	11	8.3	< 1.0	3.4	0.86 JP	12
03U805	6/16/2015	D	< 1.0	12	8.1	< 1.0	3.5	0.94 JP	13
03U806	6/15/2015		< 1.0	0.65 JP	0.56 JP	< 1.0	< 1.0	0.82 JL	45
04J077	6/29/2015		1.6	4.0	3.7	< 1.0	1.1	< 1.0	64 JMS
04J702	6/30/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1
04J708	6/29/2015		0.57 JP	0.79 JP	0.59 JP	< 1.0	< 1.0	< 1.0	6.8
04J713	6/23/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Table 12-8

Groundwater Quality Data
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

			1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
TGRS Cleanup Level(1)			**200**	**70**	**6.0**	**4.0**	**70**	**5.0**	**5.0**
Location	**Date**	**Dup**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
04U002	6/18/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1
04U002	6/18/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.3
04U007	6/17/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
04U020	6/25/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1
04U077	6/29/2015		1.4	0.96 JP	1.5	< 1.0	0.55 JP	< 1.0	35
04U510	7/1/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
04U701	7/1/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	2.4
04U702	6/30/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.4
04U708	6/29/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
04U709	6/30/2015		0.67 JP	0.45 JP	0.96 JP	< 1.0	< 1.0	< 1.0	14
04U711	6/12/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 JL	< 1.0
04U711	6/12/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 JL	< 1.0
04U713	6/23/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
04U802	6/16/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	0.43 JP
04U806	6/15/2015		1.0	28	19	< 1.0	3.8	< 1.0 JL	220
04U833	6/12/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0 JL	0.66 JP
PJ#806	6/15/2015		0.32 JP	1.4	1.1	< 1.0	< 1.0	< 1.0 JMS, JL	24

Notes:

(1) Cleanup levels for TGRS are from the OU2 ROD. Shading indicates exceedence of the cleanup level.

D - Field Duplicate

JL - Result is qualified as estimated since the LCS % recovery is outside the laboratory control limit

JP - Result is qualified as estimated since the detection is below the laboratory quantitation limit.

JMS - Result is qualified as estimated due to low matrix spike recovery (<75%).

Table 12-9

Summary Of OU2 Deep Groundwater Monitoring Requirements
TGRS, OU2
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	Orbital ATK/Army	Deep groundwater monitoring plan in Annual Report
		b.	Pumping volumes and rates for comparison to design rates	Orbital ATK/Army	Deep groundwater monitoring plan in Annual Report
		c.	Influent and extraction well water quality for overall mass removal calculations	Orbital ATK/Army	Deep groundwater monitoring plan in Annual Report
#2	Groundwater Treatment	•	Outlined below		
#3	Treated Water Discharge	•	Effluent monitoring to verify attainment of treatment requirements	Orbital ATK/Army	Deep groundwater monitoring plan in Annual Report
#4	Land Use Controls	•	None		
#5	Review of New Technologies	•	None		
#6	Groundwater Monitoring	a.	Water levels to draw contour maps showing hydraulic zone of capture	Orbital ATK/Army	Deep groundwater monitoring plan in Annual Report
		b.	Groundwater quality to verify attainment of clean up goals	Orbital ATK/Army	Deep groundwater monitoring plan in Annual Report
	Overall Remedy	a.	Groundwater quality to verify attainment of clean up goals	Orbital ATK/Army	Deep groundwater monitoring plan in Annual Report

Table 12-10

1,4-Dioxane Concentrations in TGRS and Extraction Wells
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

				1,4-Dioxane
			Screening Criteria (HRL)	**1.0**
Location	**Alias**	**Date**	**Dup**	**µg/L**
03F302	B1	6/5/2015		0.83
03F302	B1	6/5/2015	D	0.76
03F303	B2	6/5/2015		2.5
03F304	B3	6/5/2015		6.2
03F305	B4	6/5/2015		32.5
03F306	B5	6/4/2015		11.3
03F307	B6	6/4/2015		10.6
03F308	B7	6/4/2015		10.6
03F312	B11	6/5/2015		0.35
03F319	B13	6/5/2015		2.4
03U301	SC1	6/5/2015		5.6
03U314	SC2	6/5/2015		18
03U315	SC3	6/5/2015		7.6
03U316	SC4	6/5/2015		8.0
03U317	SC5	6/5/2015		14.3
PJ#309	B8	6/5/2015		10
PJ#310	B9	6/4/2015		12.7
PJ#311	B10	6/4/2015		11.5
PJ#313	B12	6/4/2015		4.6
TGRSE		4/23/2015		12.3
TGRSE		6/4/2015		11.2
TGRSE		6/4/2015	D	11.1
TGRSE		7/6/2015		13.2
TGRSE		7/6/2015	D	12.9
TGRSI		4/23/2015		12.8
TGRSI		6/4/2015		11.2 JMS
TGRSI		7/6/2015		13.4

Notes:

HRL	Health Risk Limit (Minnesota Department of Health). Shading indicates exceedence of the HRL.
D	Field Duplicate
JMS	Result is qualified as estimated due to low matrix spike recovery (<75%).

Table 12-11

1,4-Dioxane Groundwater Sampling Results
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

			1,4-Dioxane
Screening Criteria (HRL)			1.0
Location	**Date**	**Dup**	**µg/L**
03L002	6/18/2015		14.3
03L007	6/17/2015		0.037 JP
03L014	7/1/2015		57.4
03L017	6/18/2015		14
03L018	7/1/2015		10.2
03L018	7/1/2015	D	10.3
03L020	6/25/2015		8.6
03L021	6/18/2015		12.1
03L077	6/29/2015		14
03L078	6/23/2015		3.6
03L079	6/17/2015		0.61
03L802	6/16/2015		0.20
03L806	6/15/2015		16.7
03L809	6/15/2015		16.3
03L833	6/12/2015		13.9
03M002	6/18/2015		15.5
03M020	6/25/2015		12.8
03M802	6/16/2015		0.11
03M806	6/15/2015		13.8
03U002	6/5/2015		7.1
03U003	6/25/2015		1.3
03U005	6/17/2015		< 0.070
03U005	6/17/2015	D	< 0.070
03U007	6/17/2015		< 0.070
03U009	7/2/2015		0.024 JP
03U009	7/2/2015	D	< 0.070
03U014	7/1/2015		9.4
03U017	6/18/2015		12.6
03U018	7/1/2015		0.40
03U020	6/25/2015		1.7
03U021	6/18/2015		133

Table 12-11

1,4-Dioxane Groundwater Sampling Results
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

			1,4-Dioxane
	Screening Criteria (HRL)		1.0
Location	**Date**	**Dup**	**µg/L**
03U027	6/25/2015		0.052 JP
03U028	6/25/2015		0.10
03U029	6/30/2015		0.64
03U029	6/30/2015	D	0.60
03U030	6/25/2015		0.23
03U030	6/25/2015	D	0.23
03U032	7/2/2015		5.5
03U077	6/29/2015		9.4
03U078	6/23/2015		0.58
03U079	6/17/2015		0.22
03U092	7/2/2015		6.0
03U093	7/2/2015		1.8
03U094	7/2/2015		281
03U096	7/2/2015		7.2
03U099	7/1/2015		< 0.070
03U659	6/30/2015		22.4
03U671	6/30/2015		< 0.12
03U677	6/16/2015		0.32
03U701	7/1/2015		9.1
03U702	6/30/2015		9.2
03U703	6/23/2015		0.097
03U708	6/29/2015		2.1
03U709	6/30/2015		7.3
03U710	6/17/2015		0.14
03U711	6/12/2015		2.7
03U715	7/2/2015		15.2
03U801	6/16/2015		0.089
03U803	6/16/2015		0.051 JP
03U804	6/15/2015		0.063 JP
03U805	6/16/2015		5.4
03U805	6/16/2015	D	5.3

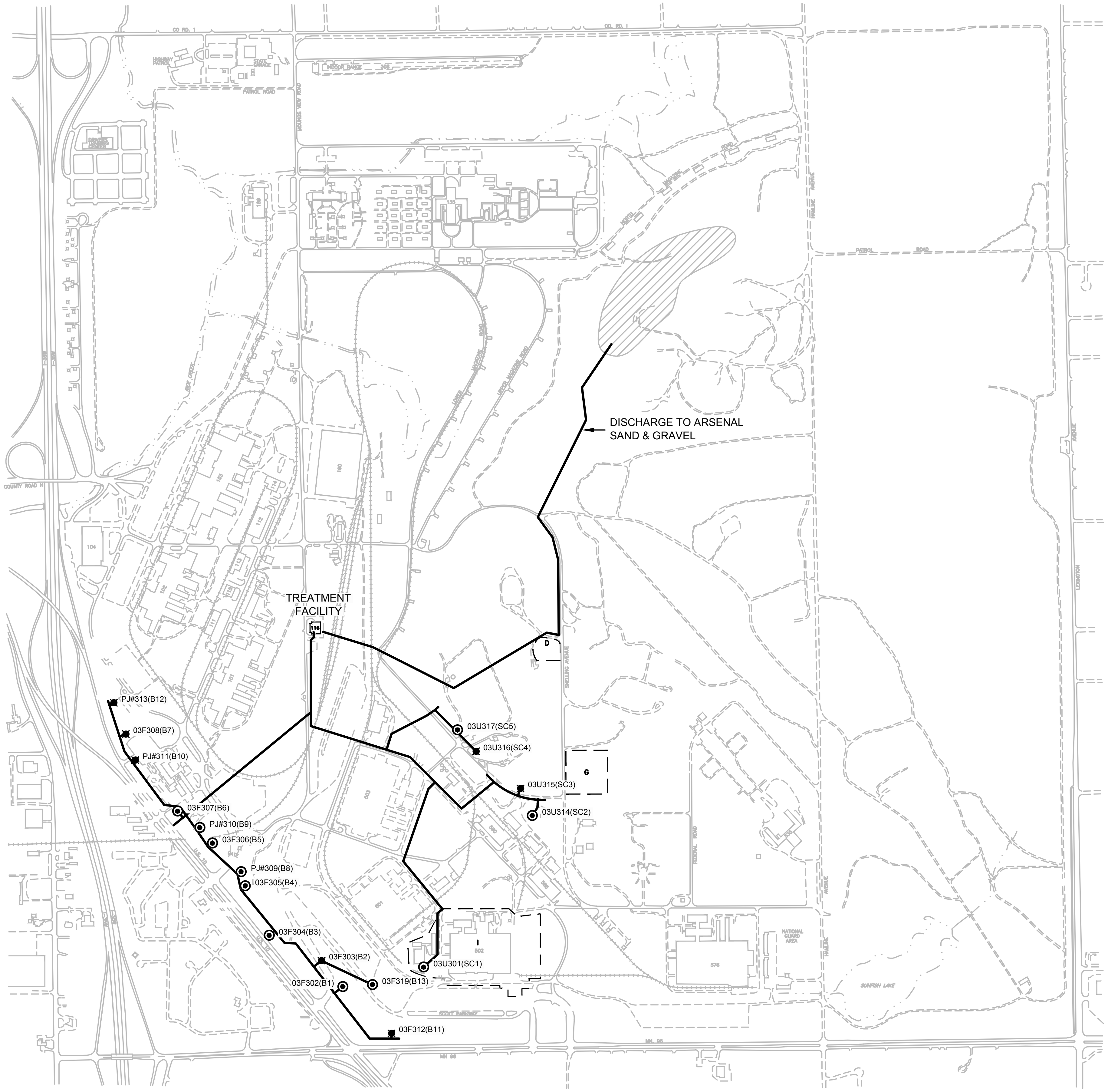
Table 12-11

1,4-Dioxane Groundwater Sampling Results
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

			1,4-Dioxane
Screening Criteria (HRL)			**1.0**
Location	**Date**	**Dup**	**µg/L**
03U806	6/15/2015		8.2
04J077	6/29/2015		12.6
04J702	6/30/2015		12.3
04J708	6/29/2015		7.4
04J713	6/23/2015		6.3
04U002	6/18/2015		13.1
04U002	6/18/2015	D	11.9
04U007	6/17/2015		< 0.070
04U020	6/25/2015		9.4
04U077	6/29/2015		13.9
04U510	7/1/2015		< 0.070
04U701	7/1/2015		11.8
04U702	6/30/2015		10.9
04U708	6/29/2015		8.1
04U709	6/30/2015		11.9
04U711	6/12/2015		9.1
04U711	6/12/2015	D	9.0
04U713	6/23/2015		12.4
04U802	6/16/2015		0.32
04U806	6/15/2015		12.4
04U833	6/12/2015		11.5
PJ#806	6/15/2015		13.4

Notes:

HRL	Health Risk Limit (Minnesota Department of Health). Shading indicates exceedence of the HRL.
D	Field Duplicate
JP	Result is qualified as estimated since the detection is below the laboratory quantitation limit.



LEGEND

PRIMARY ROAD
SECONDARY ROAD
RAILROAD
DRAINAGE
BUILDING
BUILDING REMOVED
SOURCE AREA
◉ ACTIVE EXTRACTION WELL LOCATION
✱ INACTIVE EXTRACTION 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 12-1

TGRS LAYOUT
OPERABLE UNIT 2
Arden Hills, Minnesota

GHD

11114607-43(001)GN-SP001 Jan 11/2016

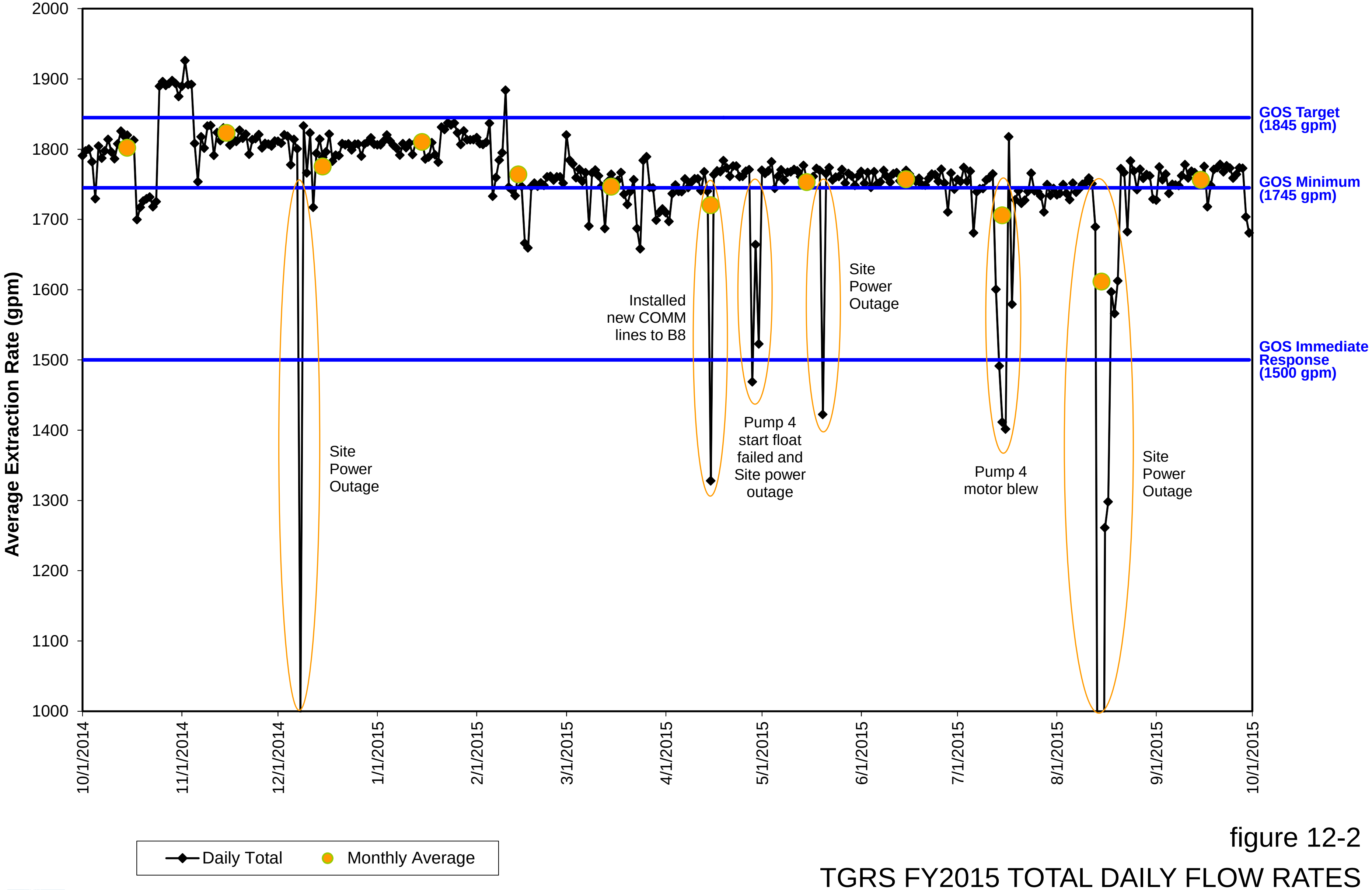
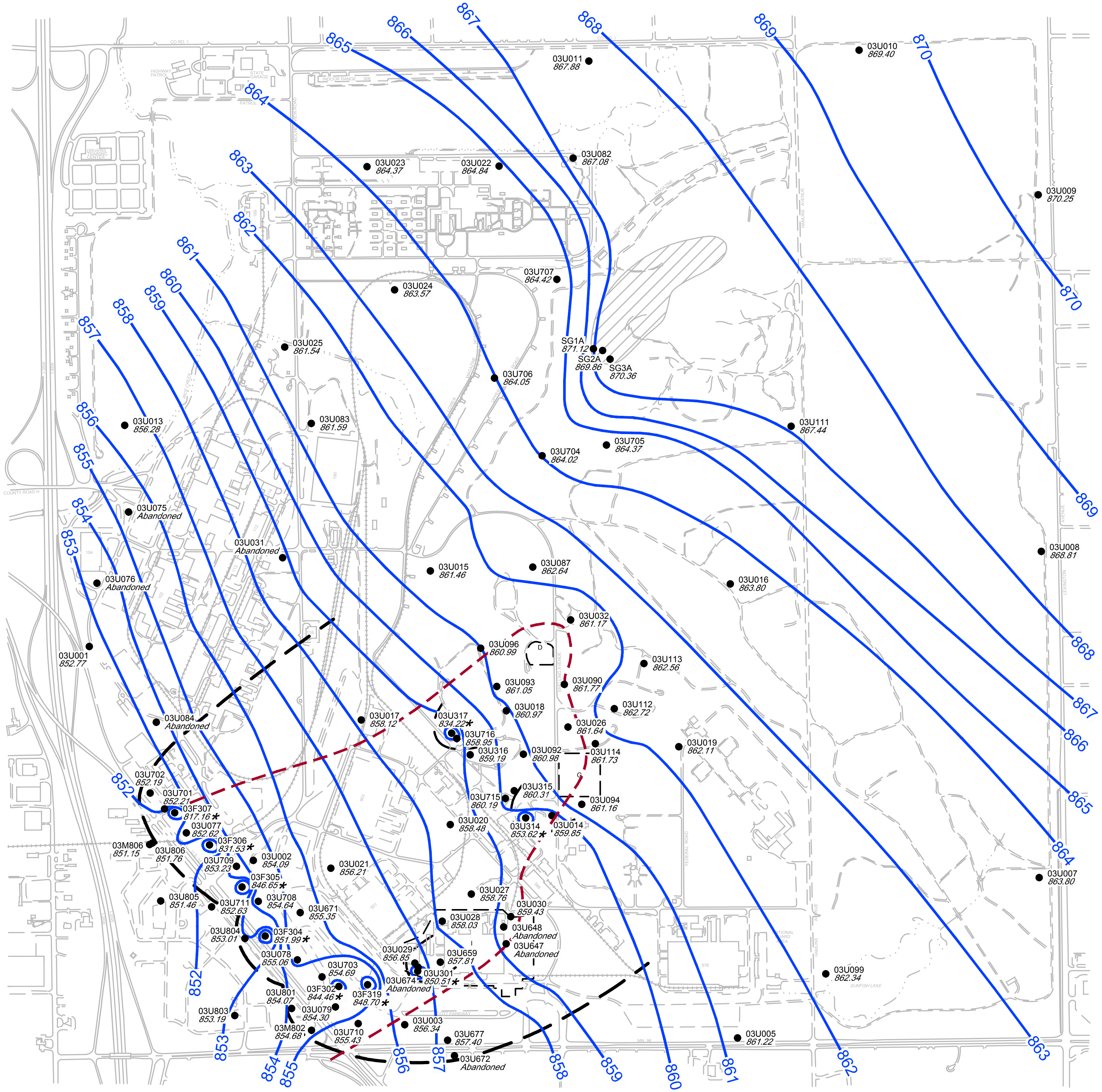


figure 12-2

TGRS FY2015 TOTAL DAILY FLOW RATES
OPERABLE UNIT 2
Arden Hills, Minnesota

11114607-43(001)GIS-SP001 JAN 07/2016



N

0 600 1200 ft

LEGEND

- PRIMARY ROAD
- SECONDARY ROAD
- RAILROAD
- DRAINAGE
- BUILDING
- BUILDING REMOVED
- SOURCE AREA
- ● WELL LOCATION
- 862.56 GROUNDWATER ELEVATION IN FEET AMSL
- 861 GROUNDWATER CONTOUR
- ← DIRECTION OF GROUNDWATER FLOW
- LIMIT OF CAPTURE
- NOTE: GROUNDWATER CONTOURS ARE INTERPOLATED FROM THE DATA POINTS SHOWN.
- * GROUNDWATER ELEVATION NOT USED IN CONTOURING
- ▨ ARSENAL SAND AND GRAVEL PIT TREATED WATER DISCHARGE AREA. (APPROXIMATE BOUNDARIES)
- 5 µg/L TCE PLUME BOUNDARY

EXTRACTION WELL NAME CROSS REFERENCE

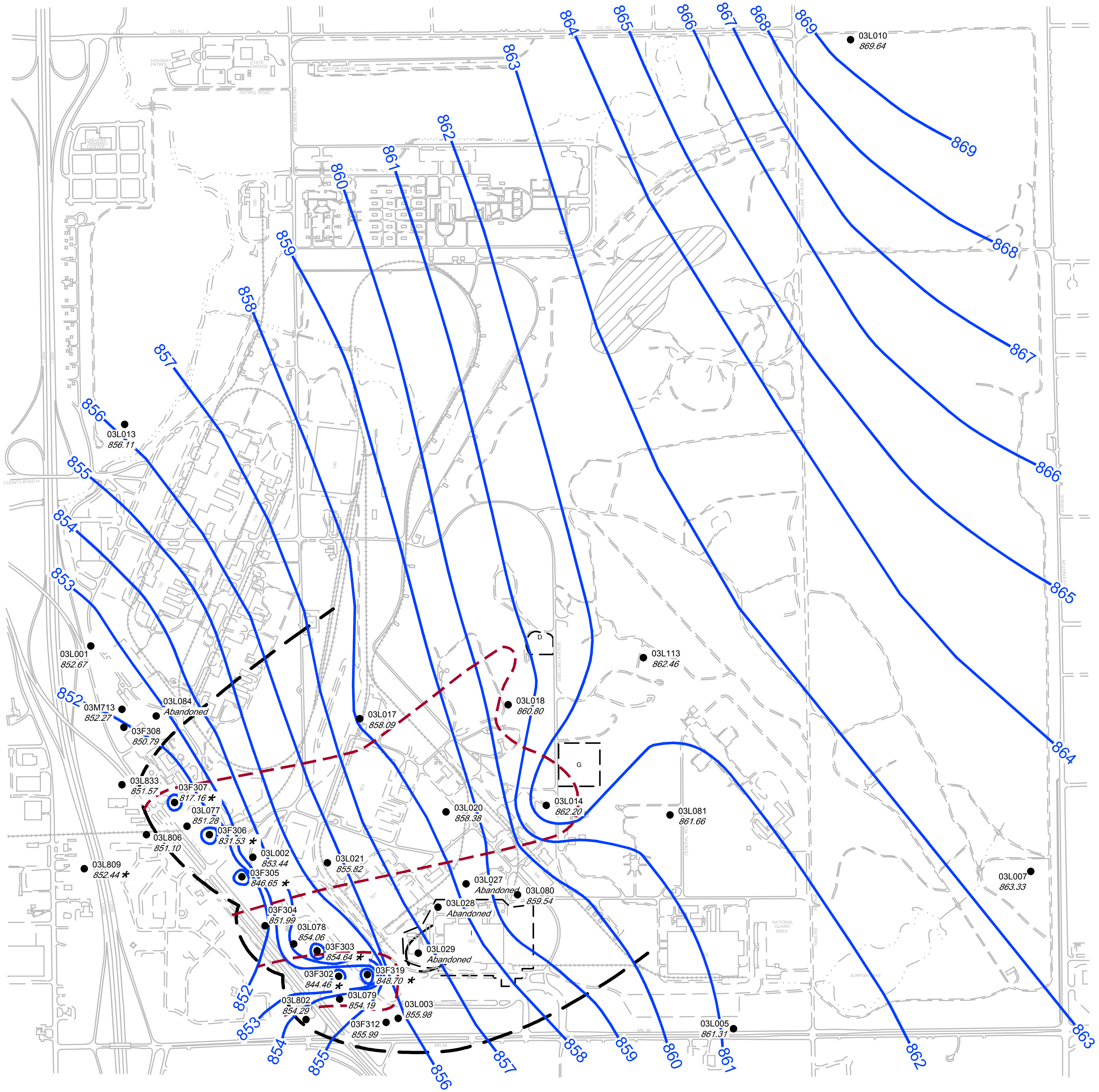
B1	03F302
B2	03F303
B3	03F304
B4	03F305
B5	03F306
B6	03F307
B7	03F308
B8	PJ#309
B9	PJ#310
B10	PJ#311
B11	03F312
B12	PJ#313
B13	03F319
SC1	03U301
SC2	03U314
SC3	03U315
SC4	03U316
SC5	03U317

GHD

figure 12-3

OU2, UPPER UNIT 3, POTENTIOMETRIC MAP
6/2/2015 (Q127)
OPERABLE UNIT 2
Arden Hills, Minnesota

11114607-43(001)GN-WA002 JUL 20, 2016



N

0 600 1200 ft

LEGEND

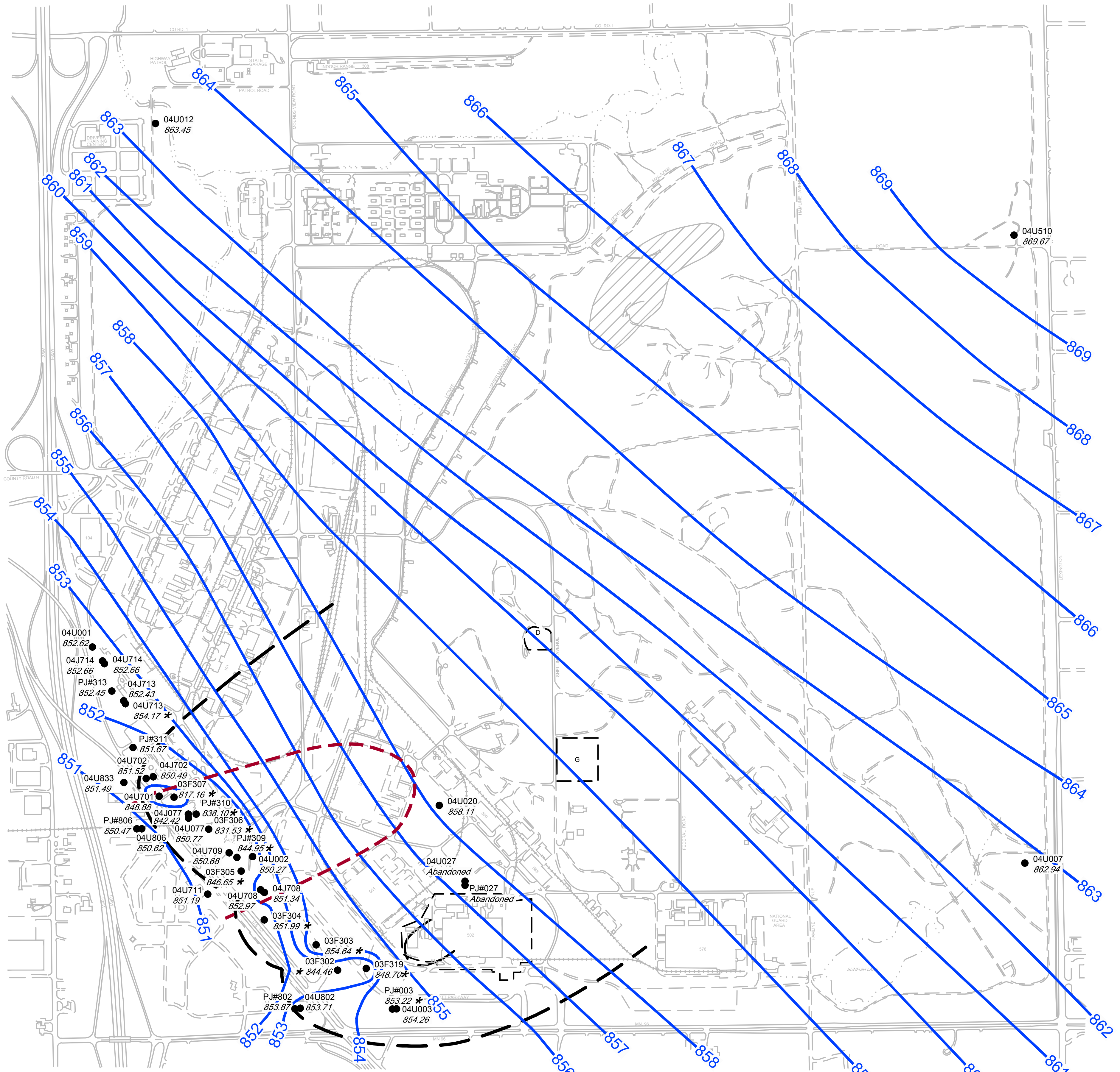
PRIMARY ROAD
SECONDARY ROAD
RAILROAD
DRAINAGE
BUILDING
BUILDING REMOVED
SOURCE AREA
● WELL LOCATION
862.46 GROUNDWATER ELEVATION IN FEET AMSL
861 GROUNDWATER CONTOUR
← DIRECTION OF GROUNDWATER FLOW
LIMIT OF CAPTURE
NOTE: GROUNDWATER CONTOURS ARE INTERPOLATED FROM THE DATA POINTS SHOWN.
* GROUNDWATER ELEVATION NOT USED IN CONTOURING
▨ ARSENAL SAND AND GRAVEL PIT TREATED WATER DISCHARGE AREA. (APPROXIMATE BOUNDARIES)
5 µg/L TCE PLUME BOUNDARY

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 12-4

OU2, LOWER UNIT 3, POTENTIOMETRIC MAP
6/2/2015 (Q127)
OPERABLE UNIT 2
Arden Hills, Minnesota



0 600 1200 ft

LEGEND

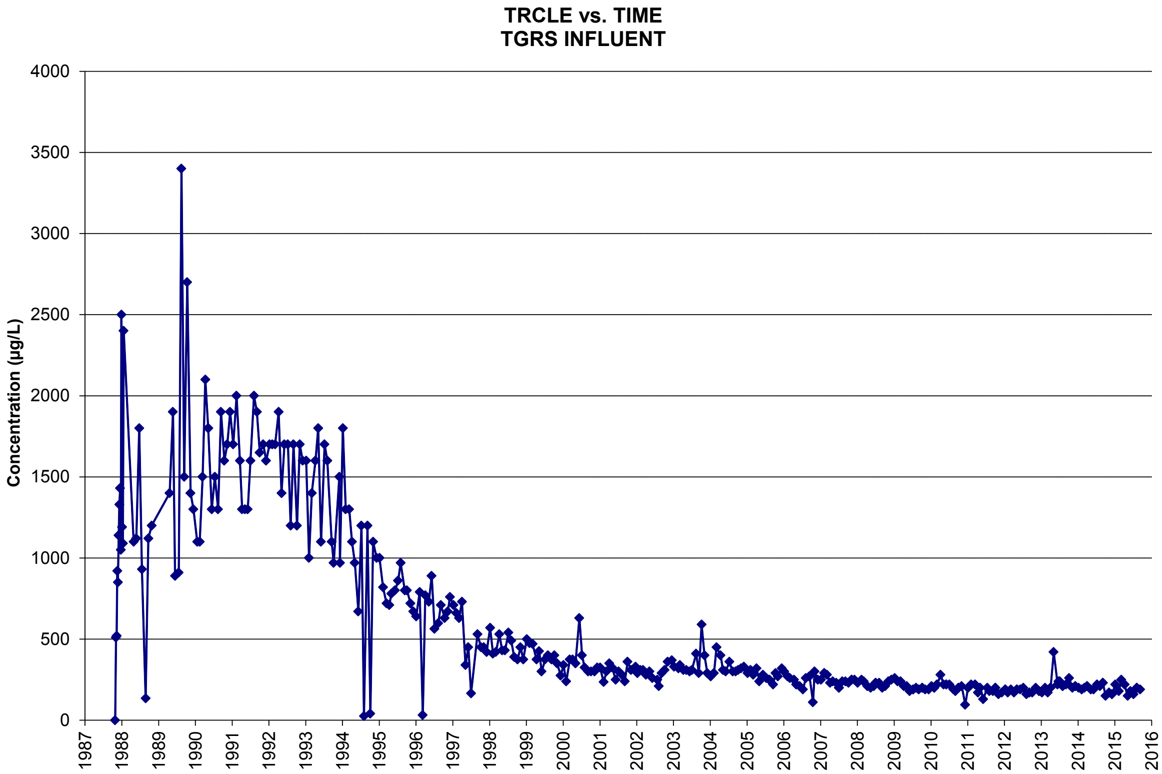
	PRIMARY ROAD
	SECONDARY ROAD
	RAILROAD
	DRAINAGE
	BUILDING
	BUILDING REMOVED
	SOURCE AREA
●	WELL LOCATION
869.67	GROUNDWATER ELEVATION IN FEET AMSL
858	GROUNDWATER CONTOUR
	DIRECTION OF GROUNDWATER FLOW
	LIMIT OF CAPTURE
	NOTE: GROUNDWATER CONTOURS ARE INTERPOLATED FROM THE DATA POINTS SHOWN.
*	GROUNDWATER ELEVATION NOT USED IN CONTOURING
▨	ARSENAL SAND AND GRAVEL PIT TREATED WATER DISCHARGE AREA. (APPROXIMATE BOUNDARIES)
	5 µg/L TCE PLUME BOUNDARY

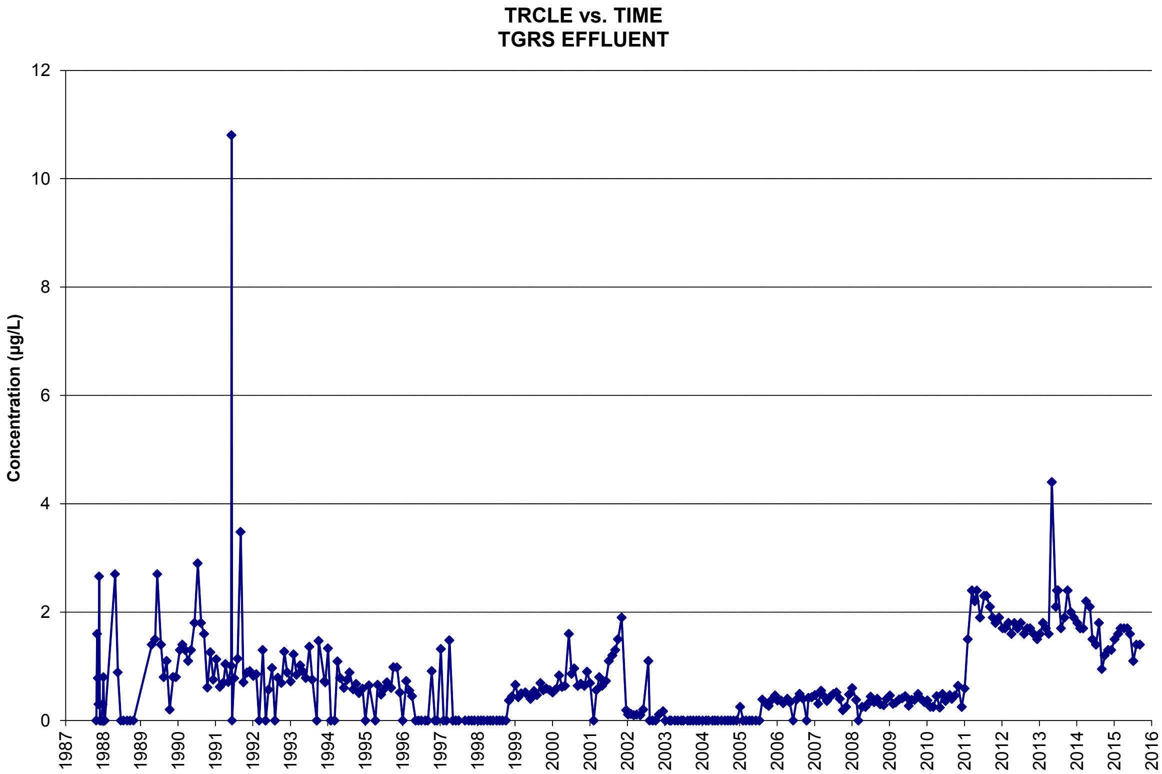
EXTRACTION WELL NAME CROSS REFERENCE

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 12-5

OU2, UPPER UNIT 4, POTENTIOMETRIC MAP
6/2/2015 (Q127)
OPERABLE UNIT 2
Arden Hills, Minnesota





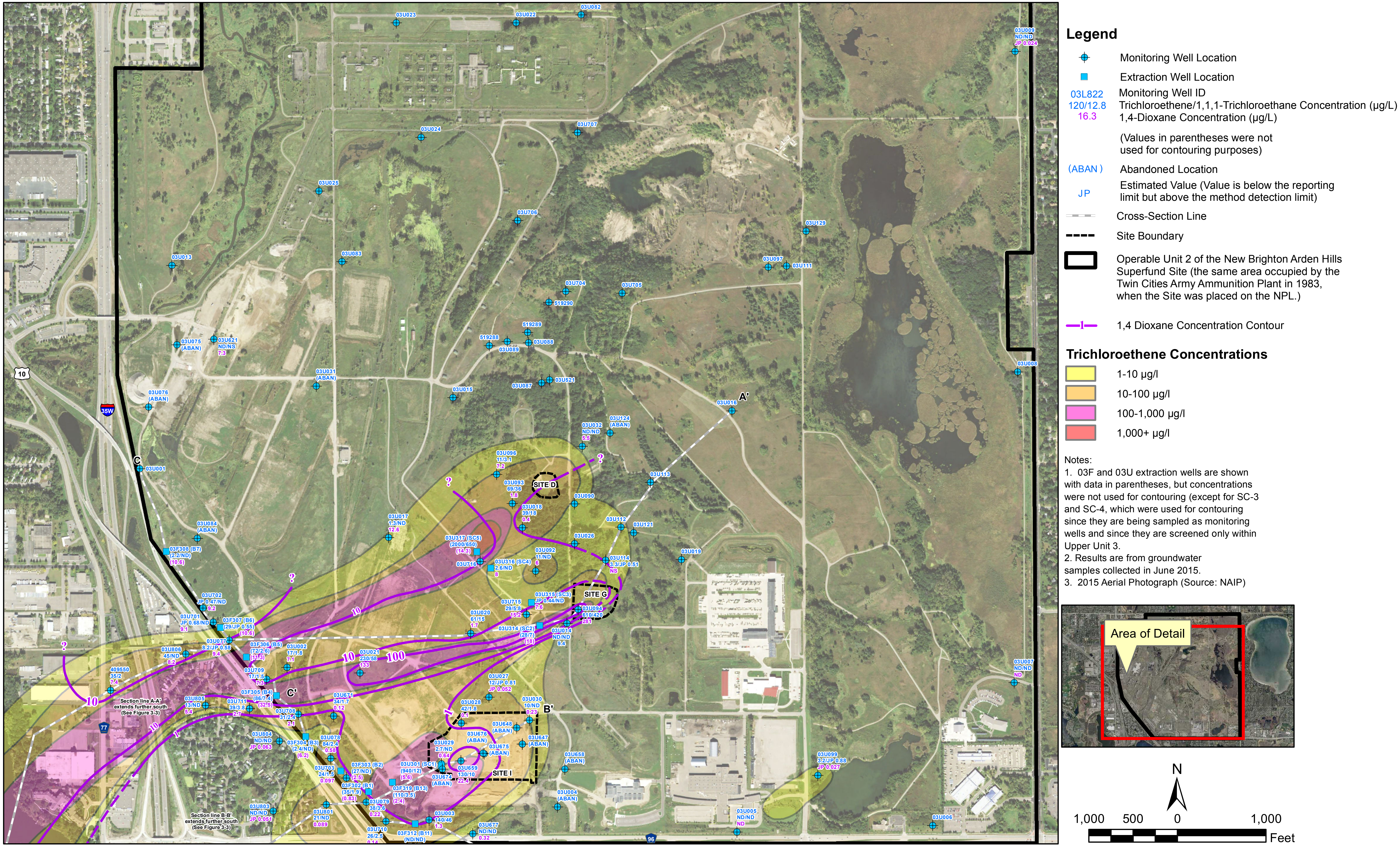
NOTE: SAMPLES REPORTING CONCENTRATIONS OF NON-DETECT WERE PLOTTED AS ZERO. WHEN DUPLICATE SAMPLES WERE COLLECTED, THE HIGHER CONCENTRATION WAS REPORTED.

figure 12-6

TGRS TREATMENT SYSTEM PERFORMANCE
OPERABLE UNIT 2

Arden Hills, Minnesota

GHD



Legend

⌖ Monitoring Well Location

■ Extraction Well Location

03L822 Monitoring Well ID
120/12.8 Trichloroethene/1,1,1-Trichloroethane Concentration (µg/L)
16.3 1,4-Dioxane Concentration (µg/L)

(Values in parentheses were not used for contouring purposes)

(ABAN) Abandoned Location

JP Estimated Value (Value is below the reporting limit but above the method detection limit)

Cross-Section Line

Site Boundary

Operable Unit 2 of the New Brighton Arden Hills Superfund Site (the same area occupied by the Twin Cities Army Ammunition Plant in 1983, when the Site was placed on the NPL.)

1,4 Dioxane Concentration Contour

Trichloroethene Concentrations

🟨 1-10 µg/l

🟧 10-100 µg/l

🟪 100-1,000 µg/l

🟥 1,000+ µg/l

Notes:
1. 03F and 03U extraction wells are shown with data in parentheses, but concentrations were not used for contouring (except for SC-3 and SC-4, which were used for contouring since they are being sampled as monitoring wells and since they are screened only within Upper Unit 3.
2. Results are from groundwater samples collected in June 2015.
3. 2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\OU2 Upper Unit 3 TCE DIOX_map.mxd

ANNUAL PERFORMANCE REPORT

OU2, Upper Unit 3, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June 2015

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

FY 2015

Figure 12-7

Legend

⊕ Monitoring Well Location

■ Extraction Well Location

03L822	Monitoring Well ID
120/12.8	Trichloroethene/1,1,1-Trichloroethane Concentration (µg/L)
16.3	1,4-Dioxane Concentration (µg/L)
	(Values in parentheses were not used for contouring purposes)
(ABAN)	Abandoned Location
JP	Estimated Value (Value is below the reporting limit but above the method detection limit)

- - - Cross-Section Line

- - - Site Boundary

▭ Operable Unit 2 of the New Brighton Arden Hills Superfund Site (the same area occupied by the Twin Cities Army Ammunition Plant in 1983, when the Site was placed on the NPL.)

—1— 1,4 Dioxane Concentration Contour

Trichloroethene Concentrations

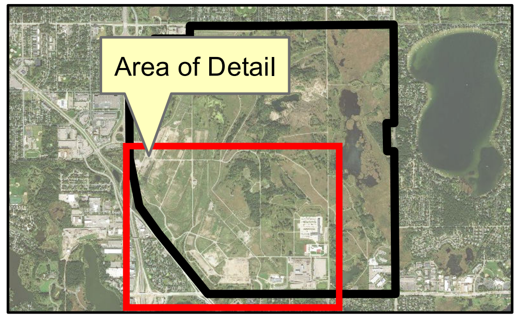
🟨 1-10 µg/l

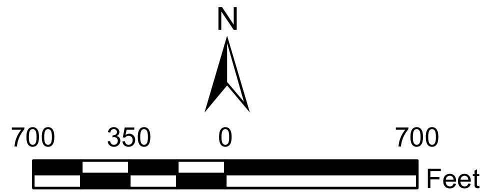
🟧 10-100 µg/l

🟪 100-1,000 µg/l

🟥 1,000+ µg/l

Notes:
1. Middle Unit 3 wells with data are shown with data in parentheses, but were not used for contouring.
2. 03F extraction wells are shown with data in parentheses, but were not used for contouring.
3. Results are from groundwater samples collected in June 2015.
4. 2015 Aerial Photograph (Source: NAIP)





Path: L:\1561\21\FY2015 APR\mxd\OU2 Lower Unit 3 TCE DIOX_map.mxd

ANNUAL PERFORMANCE REPORT

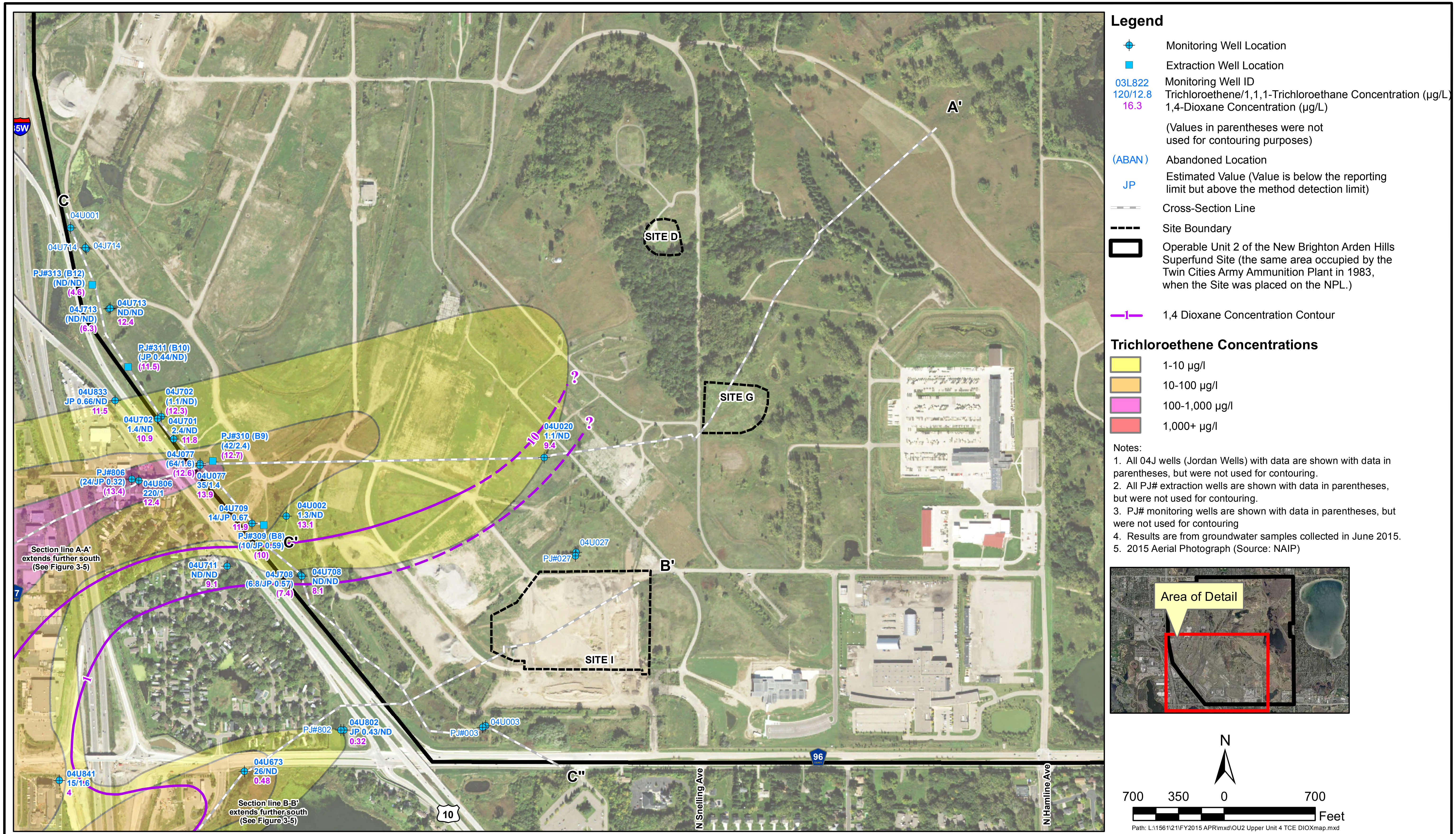
OU2, Lower Unit 3, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June 2015

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

FY 2015

Figure 12-8



Legend

⌖ Monitoring Well Location

■ Extraction Well Location

03L822	Monitoring Well ID
120/12.8	Trichloroethene/1,1,1-Trichloroethane Concentration (µg/L)
16.3	1,4-Dioxane Concentration (µg/L)
	(Values in parentheses were not used for contouring purposes)
(ABAN)	Abandoned Location
JP	Estimated Value (Value is below the reporting limit but above the method detection limit)

- - - Cross-Section Line

---- Site Boundary

▭ Operable Unit 2 of the New Brighton Arden Hills Superfund Site (the same area occupied by the Twin Cities Army Ammunition Plant in 1983, when the Site was placed on the NPL.)

—1— 1,4 Dioxane Concentration Contour

Trichloroethene Concentrations

🟨	1-10 µg/l
🟧	10-100 µg/l
🟪	100-1,000 µg/l
🟥	1,000+ µg/l

Notes:

1. All 04J wells (Jordan Wells) with data are shown with data in parentheses, but were not used for contouring.
2. All PJ# extraction wells are shown with data in parentheses, but were not used for contouring.
3. PJ# monitoring wells are shown with data in parentheses, but were not used for contouring
4. Results are from groundwater samples collected in June 2015.
5. 2015 Aerial Photograph (Source: NAIP)

ANNUAL PERFORMANCE REPORT

OU2, Upper Unit 4, Trichloroethene and 1,4-Dioxane Isoconcentration Map, June 2015

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

FY 2015

Figure 12-9

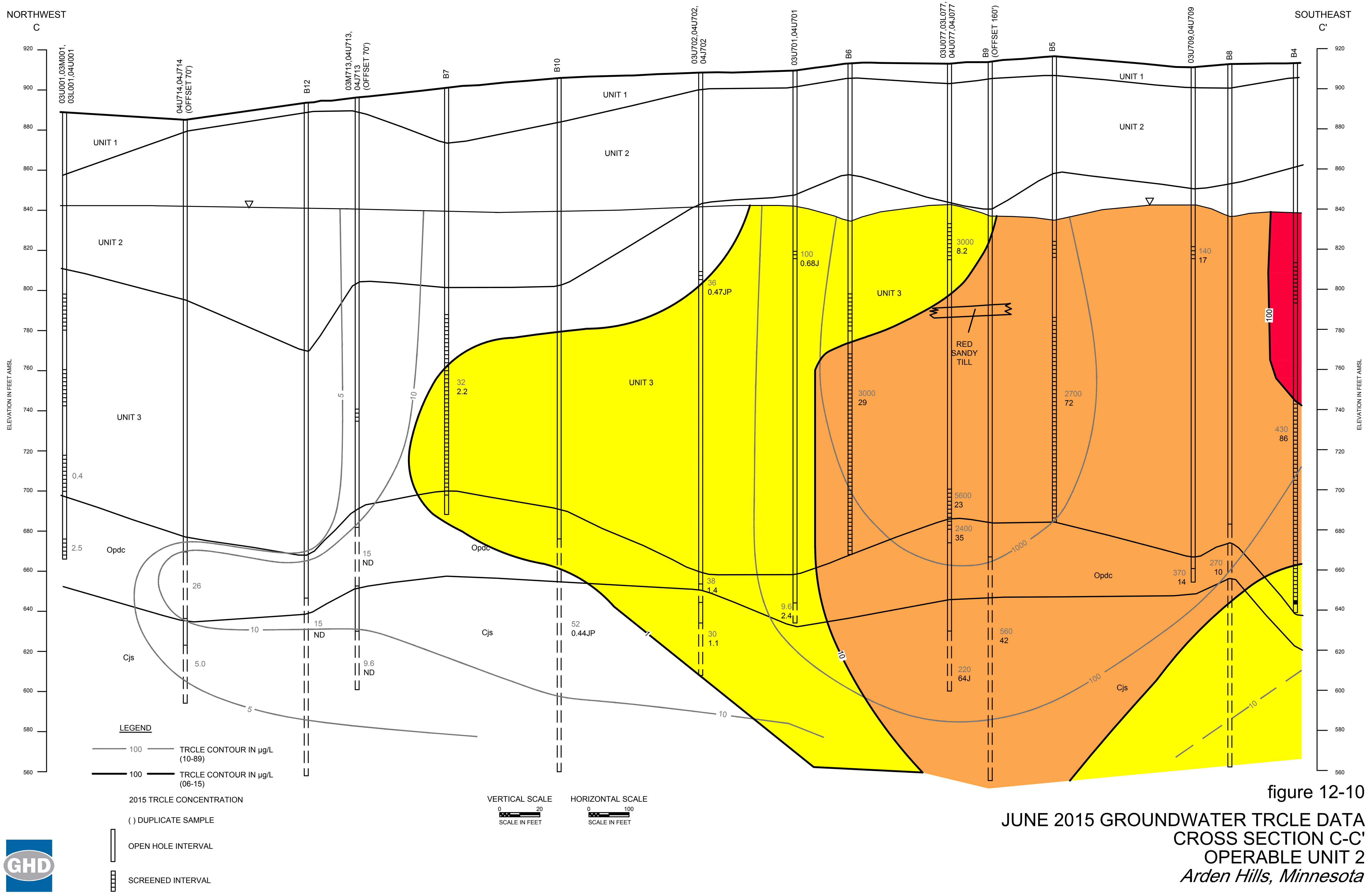


figure 12-10

JUNE 2015 GROUNDWATER TRCLE DATA
CROSS SECTION C-C'
OPERABLE UNIT 2
Arden Hills, Minnesota

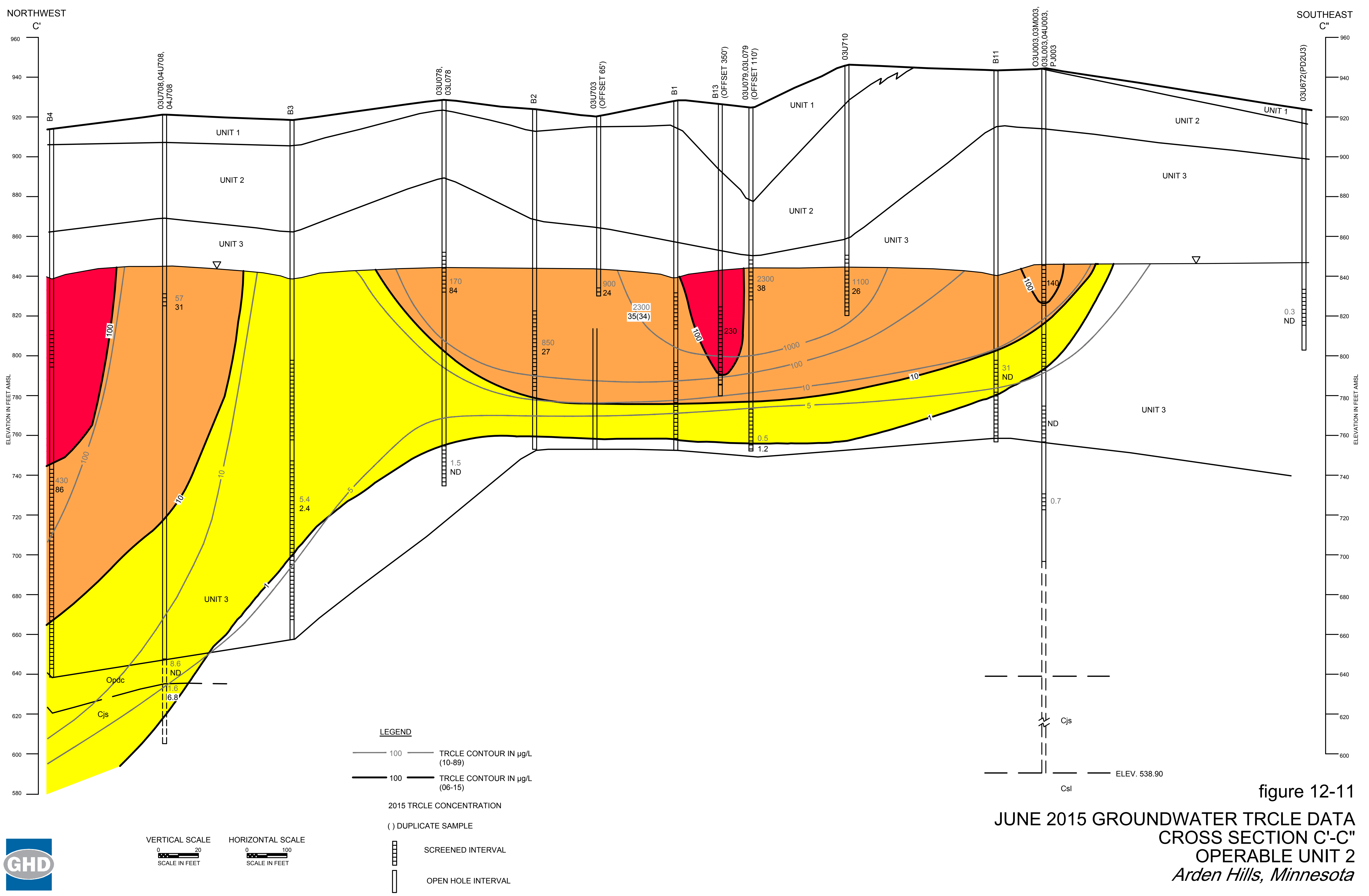
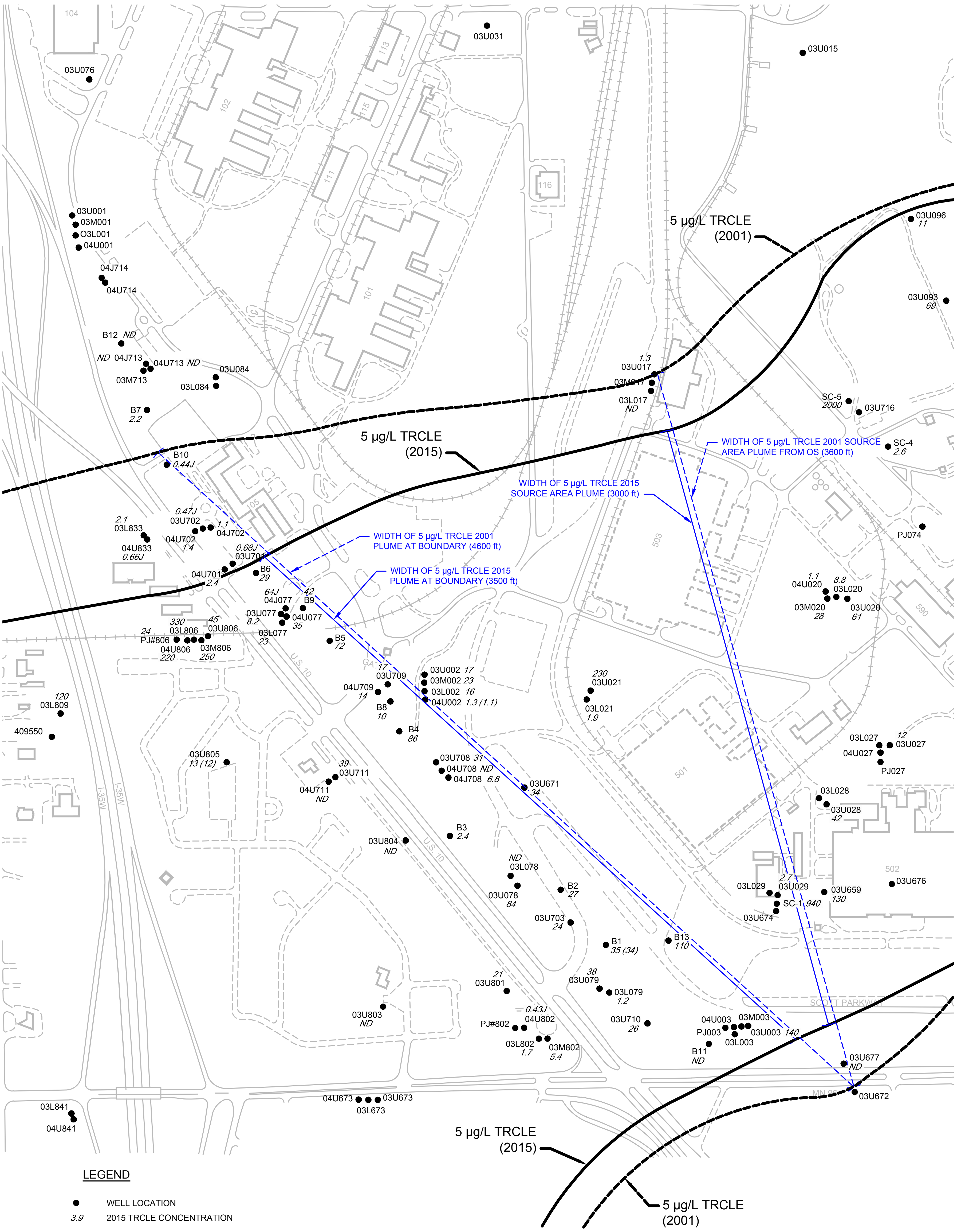


figure 12-11

JUNE 2015 GROUNDWATER TRCLE DATA
CROSS SECTION C'-C"
OPERABLE UNIT 2
Arden Hills, Minnesota



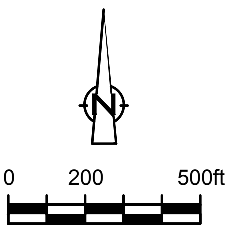
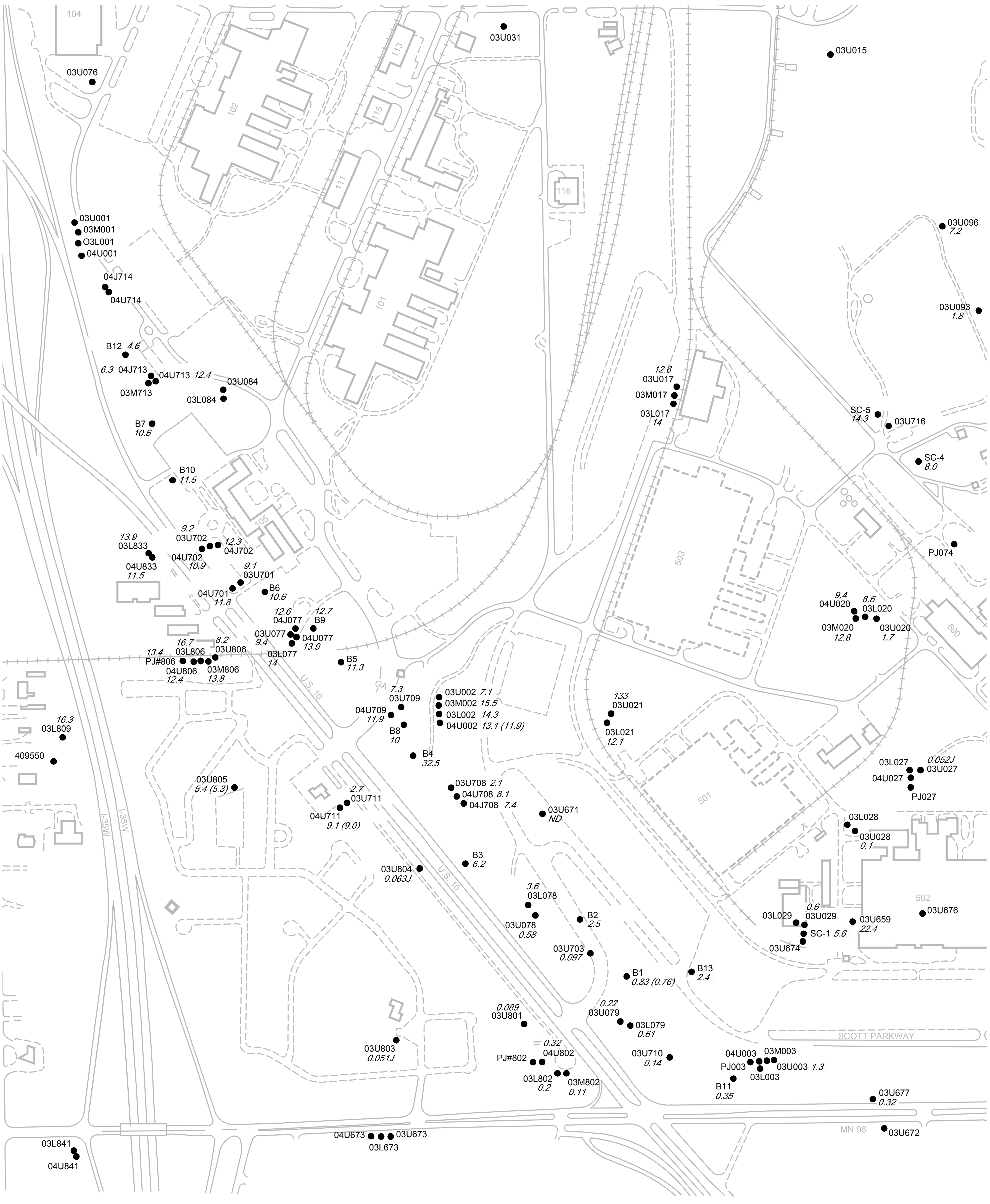


figure 12-12

TGRS ANNUAL MONITORING DATA - WEST PORTION TRCLE CONCENTRATIONS (µg/L) JUNE 2015 OPERABLE UNIT 2

Arden Hills, Minnesota

11114607-43(001)GN-SP002 Jan 11/2016



LEGEND

●	WELL LOCATION
3.9	2015 1,4-DIOXANE CONCENTRATION

0 200 500ft

figure 12-13

TGRS ANNUAL MONITORING DATA - WEST PORTION
1,4-DIOXANE CONCENTRATIONS (µg/L) JUNE 2015
OPERABLE UNIT 2
Arden Hills, Minnesota

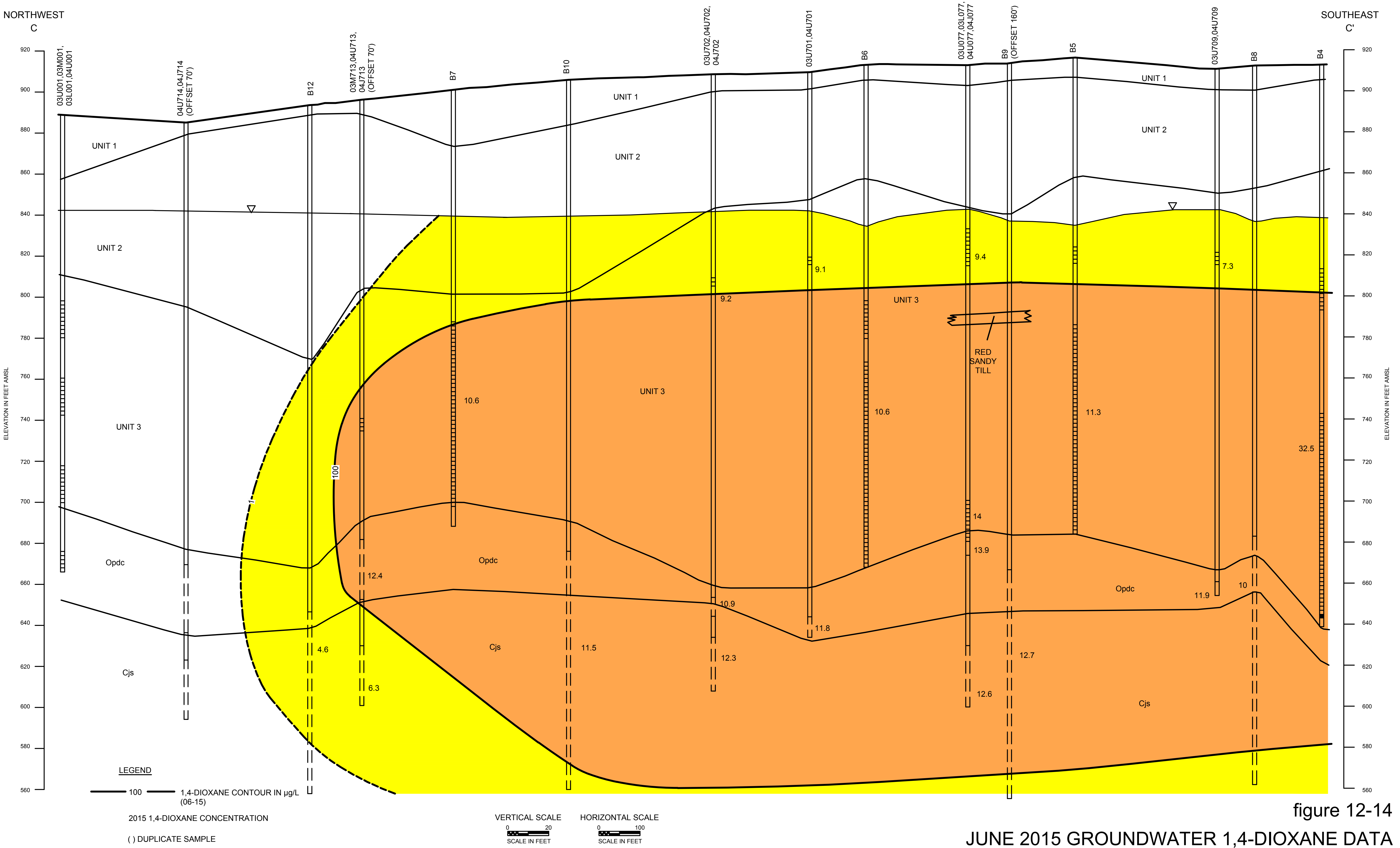
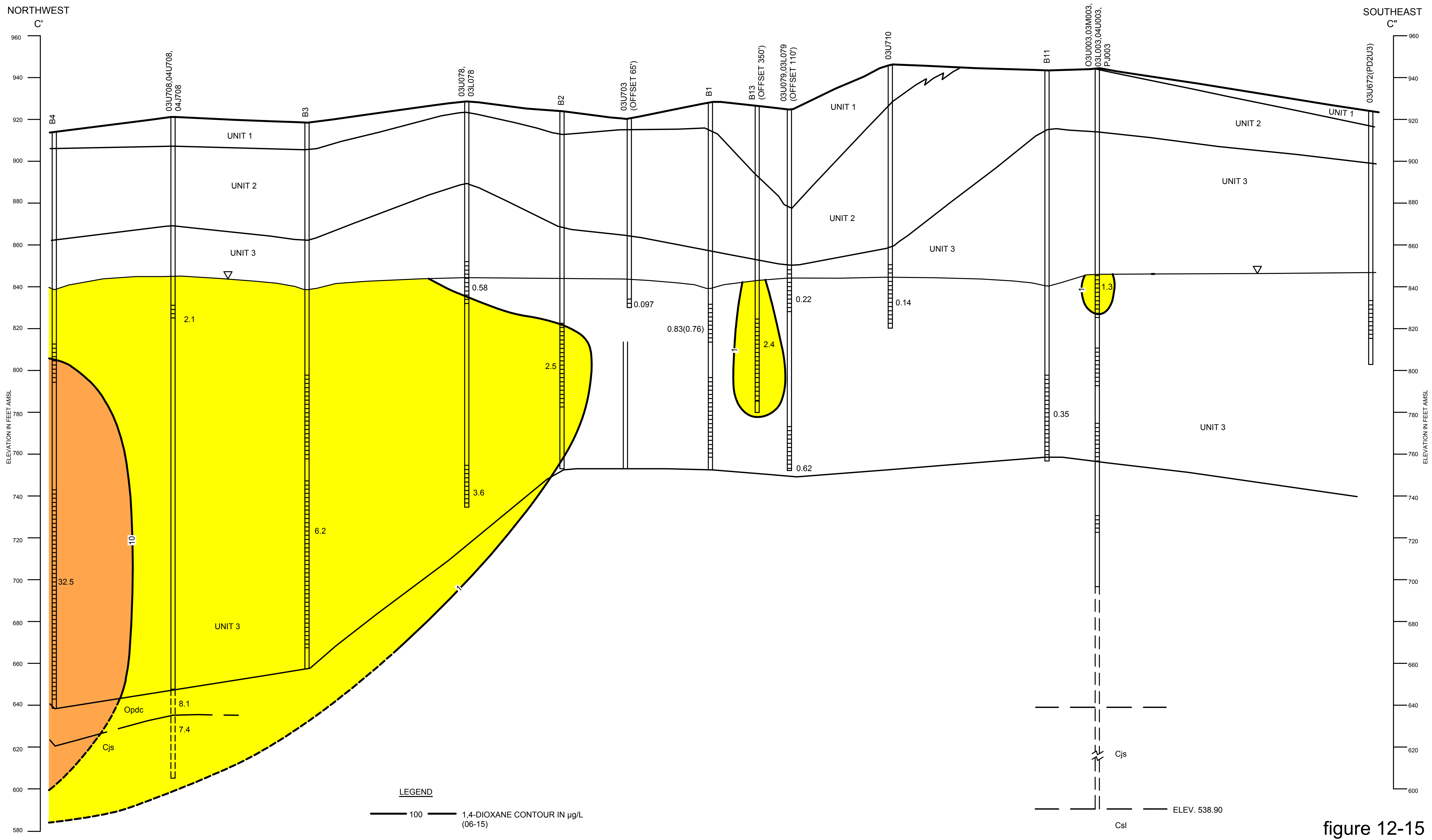


figure 12-14

JUNE 2015 GROUNDWATER 1,4-DIOXANE DATA
CROSS SECTION C-C'
OPERABLE UNIT 2
Arden Hills, Minnesota



LEGEND

100 1,4-DIOXANE CONTOUR IN µg/L (06-15)

2015 1,4-DIOXANE CONCENTRATION

( ) DUPLICATE SAMPLE

SCREENED INTERVAL

OPEN HOLE INTERVAL

VERTICAL SCALE
0 20
SCALE IN FEET

HORIZONTAL SCALE
0 100
SCALE IN FEET

figure 12-15

JUNE 2015 GROUNDWATER 1,4-DIOXANE DATA
CROSS SECTION C'-C"
OPERABLE UNIT 2
Arden Hills, Minnesota

GHD

11114607-43(001)GN-WA011 JAN 11, 2016

13.0 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 the former TCAAP property 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 13-1 presents an OU3 site plan.

The PGRS began operating on May 3, 1994. In 1997, the PGRS influent dropped 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 VOC 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. By 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 VOC 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.

13.1 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 2015 monitoring plan and any deviations are explained in Appendix C.2. Details of the groundwater monitoring program are discussed in Section 13.2.

13.2 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 2015 monitoring plan and any deviations are explained in Appendix C.2.

Groundwater samples were collected from 16 OU3 wells in FY 2015 as part of the OU1, OU2, and OU3 comprehensive biennial 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 13-1. 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 13-1 presents a summary of the analytical results. All of the wells sampled contained TRCLE concentrations similar to those reported for the previous sampling event (either 2013 or 2014). The TRCLE concentration in the downgradient sentry well, 04U863, remained not detectable (less than 1.0 µg/L) for the third consecutive year, after rising above 1.0 µg/L for the first time since December 1999 in 2012 (1.2 µg/L). TRCLE concentrations were also less than 1.0 µg/L in wells 03L854, 03U673, 04J866, 04U860, and 04U866. Two wells, 03L848 and 04U848, had TRCLE concentrations greater than 1.0 µg/L, but below the cleanup standard of 5 µg/L. The other eight wells had TRCLE concentrations above the cleanup standard of 5 µg/L, ranging from 5.6 µg/L to 130 µg/L.

1,1,1-Trichloroethane or its degradation products, 1,1-dichloroethane and 1,1-dichloroethene, were present in three wells at the boundary between OU1 and OU3 (03L859, 04U859, and 04U832), indicating a mingling of the North Plume and the South Plume in this area. These parameters have also been detected at low concentrations at 03M848 and 03L673, center-of-plume wells, for several years, including FY 2015.

What were the results of the Statistical Analyses?

The Mann-Kendall statistical analysis was updated for ten edge-of-plume and center-of-plume wells sampled in FY 2015. A summary of the statistical analyses is presented in Table 13-2. A spreadsheet and graph presenting the Mann-Kendall test results for the wells are provided in Appendix H.

The trend for 03M848, which has historically been the center of the South Plume, changed from no trend to stable as concentrations have decreased slightly over the last three sampling events after increasing slightly for several sampling events. The TRCLE concentrations at 03M848 have steadily decreased from 1,400 µg/L (FY 1996) to 700 µg/L (FY 1999) to 450 µg/L

(FY 2003) to the current concentration of 130 µg/L in FY 2015. However, TRCLE concentrations at 03M848 have ranged only between 130 µg/L and 190 µg/L for the last ten years indicating that the TRCLE concentration at the well is likely stabilizing. Recent low-level detections of 1,1,1-trichloroethane and/or its degradation products at 03M848, may indicate that the North Plume is not only beginning to mingle with the South Plume at the OU1-OU3 boundary, but may be present even toward the center of the South Plume. The possible mingling of these two plumes at this well may be a factor in the statistical trends.

The statistical analysis for well 04U859, which is classified as a center-of-plume well and is at the boundary with OU1, shows a definitely decreasing trend. It had previously showed a stable trend. The presence of 1,1,1-trichloroethane, and its degradation products, which have historically been present in 04U859, indicates that the North Plume is present at this location and may be a factor in the statistical analysis.

The trends for wells 03L848, 04U832, and 04U848 located at the edge-of-plume changed since the last statistical analysis. Well 03L848 changed from stable to definitely decreasing, while well 04U832 changed from stable to no trend, and well 04U848 changed from no trend to probably decreasing. The trends for wells 03L673, 03L859, 04U673, and 04U854 remained unchanged from the last statistical analysis with a definitely decreasing trend. A stable trend was again noted at well 04U845.

In summary, based on the data collected in FY 2015, the center of the South Plume, represented by 03M848, appears to indicate stable concentrations; however, wells 03L859 and 04U859, also classified as center-of-plume wells, indicate definitely decreasing trends. The edge of the South Plume appears to be decreasing or stable. A stable or decreasing 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 may be mingling with the South Plume and may be a factor in the trends noted at the wells near the boundary. Recent data show that the North Plume may be present even toward the center of the South Plume and may also be a factor in the trends noted there.

Are contingency actions warranted?

No. 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. No edge-of-plume wells analyzed in FY 2015 showed an increasing trend.

What groundwater monitoring is proposed before the next report?

Given the arrival of the 1,4-dioxane issue in FY 2015, a "major" sampling event in June of FY 2016 (in essence repeating the FY 2015 sampling event) is proposed to include both VOC and 1,4-dioxane analyses at all sampling locations. FY 2016 would otherwise have been a "minor" sampling event. The proposed OU3 monitoring requirements are presented in Table 13-3 and Appendix A.

13.3 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.

13.4 OVERALL REMEDY FOR OU3

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

Yes. In FY 2015, groundwater monitoring took place as prescribed in the Annual Monitoring Plan. The comprehensive biennial sampling round of FY 2015 indicates that the South Plume footprint appears to be decreasing or at least stable, with a stable to decreasing trend at the center of the plume.

Are any changes or additional actions required for OU3?

No. A "major" sampling event is now planned in June of FY 2016, as noted previously. No additional actions are necessary because no increasing trends at the edge of the plume were identified by the statistical analysis.

13.5 OTHER RELATED ACTIVITY IN FY 2015

In March 2015, USEPA and MPCA requested sampling and analysis for 1,4-dioxane to be included in the June 2015 annual sampling event for OU3. The analysis was added to all regularly scheduled monitoring wells. Table 13-4 presents the results of the 1,4-dioxane sampling. No Federal MCL has been established for 1,4-dioxane; however, the Minnesota Department of Health has established a Health Risk Limit (HRL) value of 1.0 µg/L. Four of the sixteen locations sampled (03L673, 03L859, 04U832, and 04U859) had 1,4-dioxane concentrations exceeding the HRL. The highest concentration was detected at 04U859 at

5.1 µg/L. Ten of the monitoring wells sampled had 1,4-dioxane detections below the HRL and 1,4-dioxane was not detected at two wells. Figures 3-3 through 3-5 present plan views of the 1,4-dioxane plumes in the OU3 area. The 2015 1,4-dioxane concentrations were lower (less than 1.0 µg/L) near the center and eastern side of the OU3 area and higher (greater than 3.0 µg/L) along the western edge.

Table 13-1

Groundwater Quality Data
Fiscal Year 2015
Operable Unit 3

			1,1,1-Trichloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	cis-1,2-Dichloroethene	Trichloroethene
OU3 Cleanup Level(1)			**200**	**3.0**	**70**	**6.0**	**70**	**5.0**
Location	**Date**	**Dup**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
03L673	6/12/2015		< 1.0	< 1.0	< 1.0	0.38 JP	5.0	90
03L848	6/11/2015		< 1.0	< 1.0	< 1.0	< 1.0	0.62 JP	4.4
03L848	6/11/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	0.57 JP	4.5
03L854	6/11/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
03L859	6/10/2015		2.0	< 1.0	5.6	7.6	1.2	5.6
03M848	6/11/2015		< 1.0	< 1.0	0.58 JP	0.76 JP	7.4	130
03U673	6/12/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
04J866	6/10/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
04U673	6/12/2015		< 1.0	< 1.0	< 1.0	< 1.0	0.91 JP	26
04U832	6/10/2015		1.6	< 1.0	3.6	4.5	3.5	55
04U845	6/11/2015		< 1.0	< 1.0	< 1.0	< 1.0	0.48 JP	8.6
04U848	6/11/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	3.7
04U854	6/11/2015		< 1.0	< 1.0	< 1.0	< 1.0	0.43 JP	8.1
04U859	6/10/2015		3.7	< 1.0	4.0	5.1	1.6	40
04U860	6/11/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
04U863	6/10/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
04U863	6/10/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
04U866	6/10/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Notes:

(1) Cleanup levels for OU3 are from the OU3 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.

Table 13-2

Mann-Kendall Statistical Summary
Fiscal Year 2015
Operable Unit 3

Well	Kendall S	Number of Data Points	Raw Trend	Confidence	Coefficient of Variance	Raw Trend Decision	MAROS Conclusion	TRCLE Concentration June 2015
Edge of Plume Wells								
03L673	-12	6	Decreasing	98.19%	0.1974	Definite	Decreasing	90
03L848	-12	6	Decreasing	98.19%	0.1100	Definite	Decreasing	4.5
04U673	-15	6	Decreasing	99.86%	0.2162	Definite	Decreasing	26
04U832	3	6	Increasing	64.00%	0.0795	Stable or No Trend	No Trend	55
04U845	-6	6	Decreasing	81.46%	0.3126	Stable or No Trend	Stable	8.6
04U848	-9	6	Decreasing	93.20%	0.1453	Probable	Decreasing	3.7
04U854	-10	6	Decreasing	95.20%	0.1304	Definite	Decreasing	8.1
Center of Plume Wells								
03L859	-11	6	Decreasing	97.20%	0.1622	Definite	Decreasing	5.6
03M848	-3	6	Decreasing	64.00%	0.1468	Stable or No Trend	Stable	130
04U859	-14	6	Decreasing	99.51%	0.2031	Definite	Decreasing	40

Table 13-3

Summary Of Groundwater Monitoring Requirements
Operable Unit 3

	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.	Orbital ATK	OU3 Monitoring Plan in Annual Report
		b.	Groundwater sampling to track progress of clean-up and attenuation of plume.	Orbital ATK	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.	Orbital ATK	OU3 Monitoring Plan in Annual Report

Table 13-4

1,4-Dioxane Groundwater Sampling Results
Fiscal Year 2015
Operable Unit 3

			1,4-Dioxane
Screening Criteria (HRL)			1.0
Location	**Date**	**Dup**	**µg/L**
03L673	6/12/2015		1.7
03L848	6/11/2015		0.67
03L848	6/11/2015	D	0.65
03L854	6/11/2015		0.033 JP
03L859	6/10/2015		3.3
03M848	6/11/2015		0.63
03U673	6/12/2015		< 0.070
04J866	6/10/2015		0.022 JP
04U673	6/12/2015		0.48
04U832	6/10/2015		3.1
04U845	6/11/2015		0.31
04U848	6/11/2015		0.66
04U854	6/11/2015		0.44
04U859	6/10/2015		5.1
04U860	6/11/2015		0.091
04U863	6/10/2015		0.064 JP
04U863	6/10/2015	D	0.037 JP
04U866	6/10/2015		< 0.070

Notes:

HRL	Health Risk Limit (Minnesota Department of Health). Shading indicates exceedence of the HRL.
D	Field Duplicate
JP	Result is qualified as estimated since the detection is below the laboratory quantitation limit.

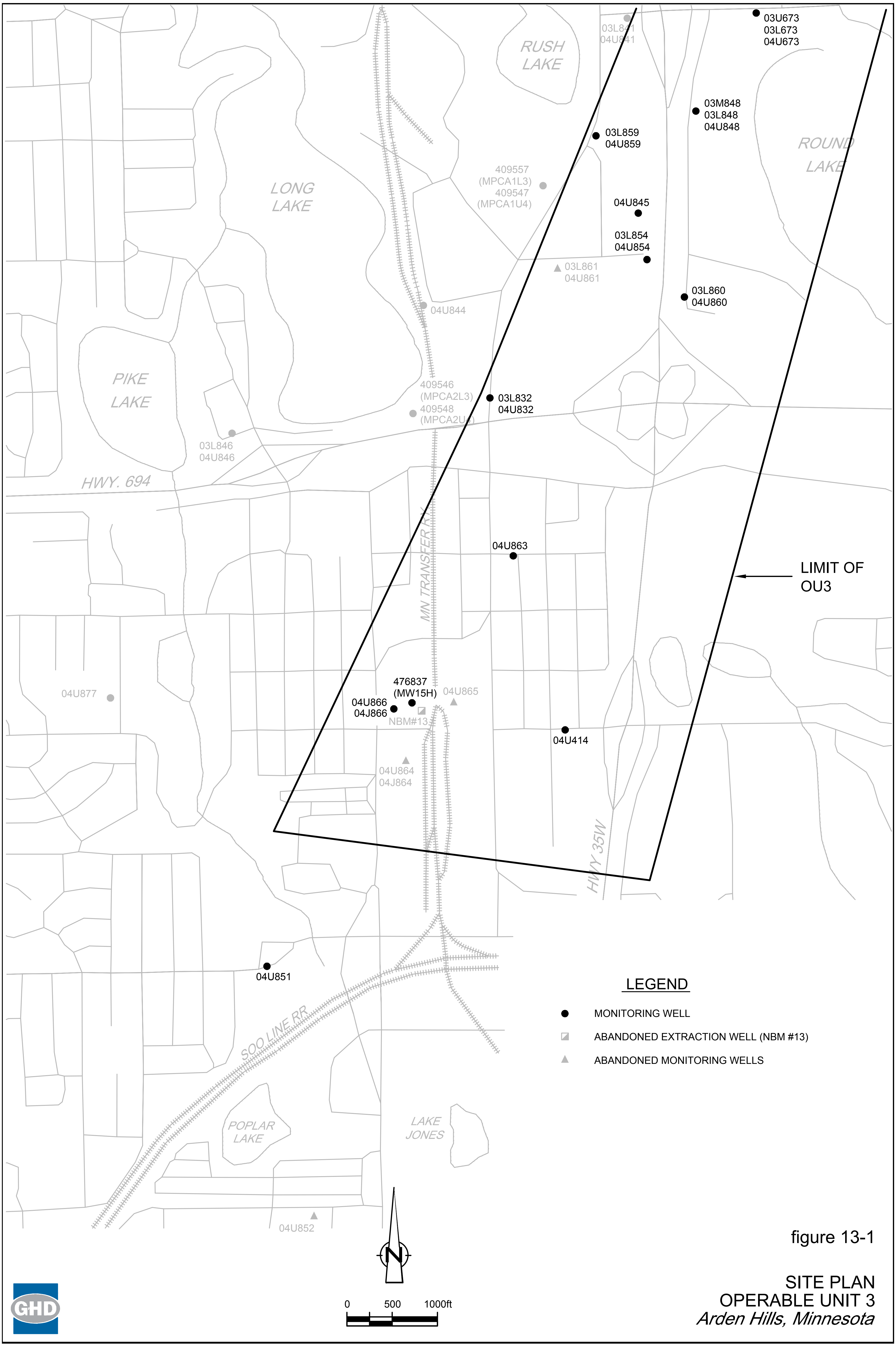


figure 13-1

SITE PLAN
OPERABLE UNIT 3
Arden Hills, Minnesota

14.0 Other Installation Restoration Activities During FY 2015

This section summarizes the status of other activities that are related to the Installation Restoration Program, but are not required in the RODs for OU1 through OU3.

14.1 DEEP GROUNDWATER BACKGROUND MONITORING

The Army voluntarily conducts monitoring at locations near the upgradient side of OU2 (the northeast corner and east side) to assess the quality of deep groundwater entering the operable unit. The five wells that are sampled for this purpose include 03U007, 03U009, 03L007, 04U007, and 04U510. Locations of these wells are shown on Figure B-3 in Appendix B. The FY 2015 results were:

Well	Trichloroethene	1,4-Dioxane
03U007	<1	<0.07
03U009	<1	JP 0.024
03L007	<1	JP 0.037
04U007	<1	<0.07
04U510	<1	<0.07

The two low-level detections of 1,4-dioxane are similar to levels detected in field blanks, and therefore 1,4-dioxane is likely not present in either of these two wells.

14.2 ROUND LAKE

The Tier II Ecological Risk Assessment Report for aquatic sites (including Round Lake), 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) for aquatic sites to support the risk management decisions 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, which was completed in 2008. A revised FS was submitted in January 2009. Based on comments received and resolution thereof, the Army then submitted a revised (redlined) FS in April 2010. After review of this report, USEPA and MPCA requested that the Army prepare a work plan for collection of additional Round Lake sediment data. Given the time required to collect the additional data, the Army, USEPA, and MPCA agreed to separate the FS for aquatic sites into two documents: one for Round Lake, and one for Rice Creek, Sunfish Lake, Marsden Lake, and Pond G.

The USEPA and MPCA provided consistency for the QAPP for Round Lake Sediment Investigation in January 2011. The sediment sampling work was completed in January – February 2011. A Draft Summary of Investigation Findings was submitted in May 2011, and a meeting between Army, USEPA, MPCA, MN DNR, USFWS, and the TCAAP RAB was held in June 2011 for preliminary discussion of the findings. Final core dating results were distributed in February 2012. In March 2012, the Army provided responses to the stakeholder comments on the Round Lake portion of the April 2010 FS, which had been placed on hold pending collection and evaluation of the 2011 sediment data. A comment resolution meeting was then held in April 2012, and a TCAAP Restoration Advisory Board meeting was held in May 2012, primarily to discuss the status of the Round Lake FS.

With USEPA and MPCA agreement, the Army then initiated a strategy to revise the FS in segments, with the intent to gain agreement/approval at key steps along the way. In accordance with this strategy, the Army submitted revised Sections 1 through 5 of the Round Lake FS in

August 2012, and the USEPA and MPCA provided comments in September 2012. The Army sought clarifications on these comments, and ultimately submitted responses to those comments and the proposed redlines to Sections 1 through 5 in January 2013. The USEPA and MPCA provided comments to that submittal in March 2013. Through this process (and the multiple earlier drafts of the FS), it became clear that the Army, USEPA, and MPCA did not agree on the ecological risks and commensurate remedy associated with Round Lake. Given the difficulty reaching a consensus, the United States Army Environmental Command (USAEC) desired a fresh look at the ecological risk by someone who has national experience with such matters and obtained the assistance of the Risk and Regulatory Analysis Team of the Environmental Sciences Division at the Oak Ridge National Laboratory (ORNL). In early FY 2014, the Army submitted a Supplemental RI and FS for Round Lake which incorporated a Supplemental Ecological Risk Assessment prepared by ORNL. Comments received from the USEPA and MPCA in March 2014 indicated that significant disagreement remained. In April 2014, the Army notified the USEPA and MPCA that their findings were being disputed by the Army. Efforts to resolve this dispute continued through the end of FY 2015.

14.3 135 PRIMER/TRACER AREA

The Preliminary Assessment report received regulatory approval in FY 2002. It was recommended that a Site Inspection be conducted. The Site Inspection (SI) investigation report received MPCA and USEPA approval in FY 2005. The SI report recommended that an Engineering Evaluation/Cost Analysis (EE/CA) be conducted to determine what, if any, remediation is required to address contamination observed in the soil. The 135 Primer/Tracer Area (PTA) is on property that is proposed to be transferred out of federal ownership. The Army is anticipating transfer of the 135 PTA to Ramsey County. Currently, it is anticipated that the western portion of the 135 PTA would be utilized for purposes of a public trail corridor, and the eastern portion would be utilized for other development purposes.

For the western portion, in anticipation of the property transfer, Ramsey County conducted soil investigation work on this portion of the 135 PTA in early FY 2012. A Draft Phase II Environmental Site Assessment report documenting this work was submitted to the MPCA Voluntary Investigation and Cleanup (VIC) Program in December 2011.

For the eastern portion, additional soil investigation to support preparation of an EE/CA was conducted in March-June 2012. The EE/CA received consistency approval from the USEPA and MPCA in November 2012, and the EE/CA recommended soil excavation and offsite disposal. The Army published legal notices in newspapers regarding the availability of the EE/CA for public comment and established a 30-day public comment period beginning on November 7, 2012. No comments were received. The Army selected the EE/CA-recommended remedy in an Action Memorandum signed on December 18, 2012. The Army then prepared a Removal Action Work Plan to describe the implementation procedures for the soil excavation and offsite disposal. The Work Plan received consistency approval from the USEPA and MPCA in March 2013. The soil excavation and offsite disposal work was implemented in May-June 2013, with a total of 1,846 tons of contaminated soil removed from the various soil areas of concern, collectively (i.e., Site A, the eastern portion of the 135 PTA, and the MNARNG environmental baseline survey [EBS] areas). The Removal Action Completion Report documenting implementation of this work received consistency approval from the USEPA and MPCA in November 2013. OU2 ROD Amendment #5, signed in March 2014, documented that the soil removal actions were the final remedies for these sites and incorporated these remedies into OU2. Discussion of the eastern portion of the 135 PTA is now being included in Section 4.0.

14.4 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 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. Originally, it was proposed to transfer approximately 585 acres through a negotiated sale with the City of Arden Hills, who in turn had an agreement with a developer. In FY 2007, the developer collected additional samples of various media on the property proposed for transfer to Arden Hills. In FY 2009, the developer withdrew from its agreement with Arden Hills, who in turn withdrew its offer to purchase with the federal government. The federal government was then working towards a public auction of the remaining TCAAP property; however, in FY 2011, Ramsey County initiated discussions with the federal government regarding purchase of the property for the potential purpose of locating a new Minnesota Vikings stadium (and other development). Although the final decision placed the Vikings stadium in Minneapolis, Ramsey County then sought to purchase 427 acres of the TCAAP property even without locating the stadium on it. Ultimately, this deal was closed in April 2013, which initially transferred ownership of approximately 397 acres to Ramsey County and provided a lease to Ramsey County for the balance of the property (approximately 30 acres) in order to allow Ramsey County to clean up these portions of the property that had known exceedances of the MPCA industrial cleanup standards (cleanup of such exceedances must be completed before the federal government can transfer these areas to Ramsey County).

Ramsey County contracted Carl Bolander & Sons, Co. (who teamed with Wenck) to conduct contaminated soil cleanup on the 427 acre property, as well as other site work in preparation for future development (i.e., building abatement/removal, road/parking lot removal, utility removal, etc.). Ramsey County has enrolled in the MPCA VIC Program to conduct this work. The VIC Program has primary oversight responsibility, in conjunction with USEPA review of certain key elements of the work. Ramsey County intends to conduct soil cleanup work to meet MPCA residential cleanup standards (unrestricted use), though development is anticipated to be mixed use (residential, recreational, and commercial/industrial). The contaminated soil cleanup work is also intended to fulfill the Army's obligation under the Federal Facility Agreement (FFA) to remediate soils to industrial cleanup standards.

In early FY 2014, a QAPP for conducting soil sampling was approved by the MPCA and USEPA, and various Response Action Plans (RAPs) were also approved during FY 2014. As of the end of FY 2015, the demolition-type site work in preparation for future development had been completed (i.e., building abatement/removal, road/parking lot removal, utility removal, etc.), and nearly all of the investigative soil sampling and contaminated soil excavation had also been completed. Most of the documentation reports for site work were also submitted by the end of FY 2015. The remaining work, including finalizing all documentation reports, is anticipated to be completed in the first half of FY 2016. Also, the 30 acres of leased property will be fully transferred to Ramsey County, and an OU2 LUCRD revision to document the property's suitability for unlimited use and unrestricted exposure (with respect to soils) is anticipated to be completed in the first half of FY 2016.

15.0 References

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Appendix A

FY 2015 – FY 2019 Monitoring Plans

A.1 Groundwater Monitoring Wells

APPENDIX A.1
FY 2015 – FY 2019 MONITORING PLAN
FOR GROUNDWATER MONITORING WELLS

Unit Designations:

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

Notes:

(A) Indicates that the monitoring is the responsibility of Orbital ATK.
(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
  - – OR = Overall remedy. To evaluate groundwater flow direction relative to plume location
- ❖ Site C Water Quality
  - – OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Site C Water Levels
  - – OR = Overall remedy. To evaluate groundwater flow direction relative to plume location
- ❖ 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
- ❖ Building 102 Water Quality
  - – OR = Overall remedy. To evaluate attainment of the cleanup levels throughout the plume
- ❖ Building 102 Water Levels
  - – OR = Overall remedy. To evaluate groundwater flow direction relative to plume location
- ❖ 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) Sampling performed by the City of Saint Anthony. Army collects sample only if in production and not being sampled by City of Saint Anthony; otherwise Army uses Saint Anthony data.
(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 OU1 private water supply well as late as September 30, if necessary due to temporary inaccessibility.

APPENDIX A.1

FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	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)	---	Q,L(B)	---	OR	3.b	
03U	03U821			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
03U	03U822			Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03U	03U831			---	---	---	---	---	---	---	abandoned 2006
03U	409550	PCA 6U3		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	None	
03U	409596	BS118U3		---	---	---	---	---	---	---	abandoned 2007, may need replacement
03M	03M843			Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03L	03L811			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
03L	03L822			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	None	
03L	03L832			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	None	
03L	03L841			Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03L	03L846			Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03L	03L853			---	---	---	---	---	---	---	
03L	409556	PCA4L3		Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03L	409557	PCA1L3		Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
03L	409597	BS118L3		---	---	---	---	---	---	---	abandoned 2007, may need replacement
PC	04U821			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U834			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	None	
PC	04U836	MW-1		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	Also sample in January 2016
PC	04U837	MW-3		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	Also sample in January 2016
PC	04U838	MW-5		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U839	MW-7		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	Also sample in January 2016
PC	04U841			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U843			Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	3.b	
PC	04U844			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U846			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U847			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U849			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U850			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	04U855			Q,L(B)	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	Also sample in January 2016
PC	04U872			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	3.b	Also sample in January 2016
PC	04U875			Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	3.b	Also sample in January 2016
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)	---	Q,L(B)	---	1.a, OR	3.b	Also sample in January 2016
PC	04U880			Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	3.b	Also sample in January 2016
PC	04U881			Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	Also sample in January 2016
PC	04U882			Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	None	
PC	04U883			Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	None	
PC	191942	BS118U4		---	---	---	---	---	---	---	abandoned 2007, may need replacement

APPENDIX A.1

FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
PC	200154	UM Golf Course	(7)	Q(B)	Q(B)	---	Q(B)	---	1.a, OR	---	
PC	200814	American Linen		---	---	---	---	---	---	---	
PC	206688	Cloverpond	(7)	Q(B)	Q(B)	---	Q(B)	---	1.a, OR	---	Also sample in January 2016
PC	234547	Honeywell Ridgeway		---	---	---	---	---	---	---	
PC	409547	PCA1U4		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	409548	PCA2U4		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	409549	PCA3U4		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
PC	409555	PCA5U4		Q,L(B)	Q,L(B)	---	Q,L(B)	---	1.a, OR	3.b	
PC	512761	Gross Golf Course #2	(7)	Q,L(B)	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)	---	Q,L(B)	---	OR	None	
J	04J835			---	---	---	---	---	---	---	
J	04J836	MW-2		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	Also sample in January 2016
J	04J837	MW-4		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	Also sample in January 2016
J	04J838	MW-6		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	
J	04J839	MW-8		Q,L(B)	Q,L(B)	---	Q,L(B)	---	OR	3.b	Also sample in January 2016
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)	---	Q,L(B)	---	OR	None	
J	200524	St. Anthony #5	(4)	Q(B)	Q(B)	---	Q(B)	---	OR	---	Army gets St. Anthony Data
J	200803	St. Anthony #4	(4)	Q(B)	Q(B)	---	Q(B)	---	OR	---	Army gets St. Anthony Data
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)	---	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)	---	Q,L(B)	---	OR	None	Also sample in January 2016
UNK	234546	Honeywell Ridgeway	(7)	Q(B)	Q(B)	---	Q(B)	---	OR	---	

APPENDIX A.1

FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
Operable Unit 2											
Site A Shallow Groundwater											
01U	01U038			---	---	---	---	---	---	---	abandoned FY14
01U	01U039			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U040			---	---	---	---	---	---	---	abandoned FY14
01U	01U041			---	---	---	---	---	---	---	abandoned FY14
01U	01U063			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U067			---	---	---	---	---	---	---	abandoned FY14
01U	01U102			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U103			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	Including antimony
01U	01U104			---	---	---	---	---	---	---	abandoned FY14
01U	01U105			---	---	---	---	---	---	---	abandoned FY14
01U	01U106			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U107			---	---	---	---	---	---	---	abandoned FY14
01U	01U108			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U110			---	---	---	---	---	---	---	abandoned FY14
01U	01U115			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U116			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U117			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U118			---	---	---	---	---	---	---	abandoned FY14
01U	01U119			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U120			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U125			---	---	---	---	---	---	---	
01U	01U126			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U127			L(B)	L(B)	L(B)	L(B)	L(B)	OR	OR	
01U	01U133			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U135			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U136			---	---	---	---	---	---	---	abandoned FY14
01U	01U137			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U138			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U139			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U140			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U141			L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U145	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U146	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U147	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U148	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U149	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	

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FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
01U	01U150	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U151	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U152	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U153	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U154	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U155	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U156	Piezometer		L(B)	L(B)	L(B)	L(B)	L(B)	---	OR	
01U	01U157			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U158			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U350			Q,L(B)	Q,L(B)	---	---	---	OR	OR	Annual through FY16, then cease sampling
01U	01U351	EW-1		Q,L(B)	Q,L(B)	---	---	---	OR	OR	Annual through FY16, then cease sampling
01U	01U352	EW-2		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U353	EW-3		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U354	EW-4		Q,L(B)	Q,L(B)	---	---	---	OR	OR	Annual through FY16, then cease sampling
01U	01U355	EW-5		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U356	EW-6		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U357	EW-7		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U358	EW-8		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U901			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U902			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	Including antimony
01U	01U903			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U904			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	Including antimony

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FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
Site C Shallow Groundwater											
01U	01U045			---	---	---	---	---	---	---	abandoned FY14
01U	01U046			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U085			---	---	---	---	---	---	---	abandoned FY14
01U	01U551	EW-1		---	---	---	---	---	---	---	abandoned FY14
01U	01U552	EW-2		---	---	---	---	---	---	---	abandoned FY14
01U	01U553	EW-3		---	---	---	---	---	---	---	abandoned FY14
01U	01U561	MW-1		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U562	MW-2		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U563	MW-3		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U564	MW-4		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U565	MW-5		---	---	---	---	---	---	---	abandoned FY14
01U	01U566	MW-6		---	---	---	---	---	---	---	abandoned FY14
01U	01U567	MW-7		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U568	MW-8		---	---	---	---	---	---	---	abandoned FY14
01U	01U569	MW-9		---	---	---	---	---	---	---	abandoned FY14
01U	01U570	MW-10		---	---	---	---	---	---	---	abandoned FY14
01U	01U571	MW-11		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U572	MW-12		---	---	---	---	---	---	---	abandoned FY14
01U	01U573	MW-13		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U574	MW-14		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U575	MW-15		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U576	MW-16		Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	

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FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
Site I Shallow Groundwater											
01U	01U064			---	---	---	---	---	---	---	abandoned FY14
01U	01U631			---	---	---	---	---	---	---	abandoned FY 14
01U	01U632			---	---	---	---	---	---	---	abandoned FY14
01U	01U636			---	---	---	---	---	---	---	abandoned FY14
01U	01U639			---	---	---	---	---	---	---	abandoned FY14
01U	01U640			---	---	---	---	---	---	---	abandoned FY14
01U	01U666			---	---	---	---	---	---	---	abandoned FY14
01U	01U667			---	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	OR	abandoned FY14, replace in Spring 2016
01U	482086	I01MW		---	---	---	---	---	---	---	abandoned FY14
01U	482087	I05MW		---	---	---	---	---	---	---	abandoned FY14
01U	482088	I02MW		---	---	---	---	---	---	---	abandoned FY14
01U	482089	I04MW		---	---	---	---	---	---	---	abandoned FY14
01U	482090	I03MW		---	---	---	---	---	---	---	abandoned FY14

All of the Site I shallow groundwater wells were sealed in FY14. Following soil remediation under Building 502, only 01U667 will be re-installed (with annual sampling).

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FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
Site K Shallow Groundwater											
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			---	---	---	---	---	---	---	abandoned FY14
01U	01U602			---	---	---	---	---	---	---	abandoned FY14
01U	01U603			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U604			---	---	---	---	---	---	---	abandoned FY14
01U	01U605			---	---	---	---	---	---	---	abandoned FY14
01U	01U607			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U608			---	L(A)	L(A)	L(A)	L(A)	---	---	abandoned FY14, replace in Spring 2016
01U	01U609			---	L(A)	L(A)	L(A)	L(A)	---	---	abandoned FY14, replace in Spring 2016
01U	01U611			---	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	---	---	abandoned FY14, replace in Spring 2016
01U	01U612			L(A)	L(A)	L(A)	L(A)	L(A)	---	3.a	
01U	01U613			---	---	---	---	---	---	---	abandoned FY14
01U	01U615			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U616			---	---	---	---	---	---	---	abandoned FY14
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			---	---	---	---	---	---	---	abandoned FY14
01U	01U620			---	---	---	---	---	---	---	abandoned FY14
01U	01U621			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	
01U	01U624			---	---	---	---	---	---	---	abandoned FY14
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			---	---	---	---	---	---	---	abandoned FY14
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		---	---	---	---	---	---	---	abandoned FY14
01U	482085	K01-MW		---	---	---	---	---	---	---	abandoned FY14
03U	03U621			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	3.a	

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Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
Building 102 Shallow Groundwater											
01U	01U048			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U578			---	---	---	---	---	---	---	abandoned FY14
01U	01U579			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U580			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U581			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U582			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U583			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01U	01U584			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01L	01L581			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01L	01L582			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01L	01L583			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	
01L	01L584			Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	Q,L(B)	OR	OR	

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FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
Deep Groundwater (TGRS)											
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(B)	---	Q,L(A)	---	OR	1.a	
03F	03F312	B11	(5)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	
03F	03F319	B13									See Appendix A.2
03U	03U001			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U002			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U003			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U004			---	---	---	---	---	---	---	Abandoned FY13
03U	03U005			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U007			Q,L(A)	Q,L(B)	---	Q,L(A)	---	Background	1.a	
03U	03U008			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U009			Q,L(A)	Q,L(B)	---	Q,L(A)	---	Background	1.a	
03U	03U010			L(A)	L(B)	---	L(A)	---	---	1.a	
03U	03U011			L(A)	L(B)	---	L(A)	---	---	1.a	
03U	03U012			L(A)	L(B)	---	L(A)	---	---	1.a	
03U	03U013			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U014			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U015			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U016			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U017			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U018			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U019			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U020			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U021			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U022			L(A)	L(B)	---	L(A)	---	---	1.a	
03U	03U023			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U024			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U025			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)

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Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
03U	03U026			L(A)	L(B)	---	L(A)	---	---	1.a	
03U	03U027			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U028			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U029			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U030			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U031			---	---	---	---	---	---	---	abandoned FY14
03U	03U032			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U075			---	---	---	---	---	---	---	abandoned FY14
03U	03U076			---	---	---	---	---	---	---	abandoned FY14
03U	03U077			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U078			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U079			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U082			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U083			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U084			---	---	---	---	---	---	---	abandoned FY14
03U	03U087			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U088			L(A)	L(B)	---	L(A)	---	---	1.a	
03U	03U089			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U090			L(A)	L(B)	---	L(A)	---	---	1.a	
03U	03U092			Q,L(A)	Q,L(B)	---	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(B)	---	Q,L(A)	---	OR	1.a	
03U	03U096			Q,L(A)	Q,L(B)	---	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(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U112			L(A)	L(B)	---	L(A)	---	---	1.a	
03U	03U113			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U114			Q,L(A)	Q,L(B)	---	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(B)	---	Q,L(A)	---	OR	1.a	
03U	03U316	SC4	(5)	Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U317	SC5									See Appendix A.2
03U	03U521			---	---	---	---	---	---	---	
03U	03U647			---	---	---	---	---	---	---	abandoned FY14
03U	03U648			---	---	---	---	---	---	---	abandoned FY14
03U	03U658			---	---	---	---	---	---	---	abandoned FY13

APPENDIX A.1

FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
03U	03U659			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U671			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U672			---	---	---	---	---	---	---	abandoned FY14, replaced by 03U677
03U	03U674			---	---	---	---	---	---	---	abandoned FY14
03U	03U675			---	---	---	---	---	---	---	
03U	03U676			---	---	---	---	---	---	---	abandoned FY14
03U	03U677			Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	Q,L(A)	OR	1.a	constructed FY14
03U	03U701			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U702			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U703			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U704			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U705			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U706			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03U	03U707			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
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(B)	---	Q,L(A)	---	OR	1.a	
03U	03U710			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U711			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U715			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U716			L(A)	L(B)	---	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(B)	---	Q,L(A)	---	OR	1.a	
03U	03U804			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03U	03U805			Q,L(A)	Q,L(B)	---	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(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03M	03M002			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03M	03M003			L(A)	L(B)	---	L(A)	---	---	1.a	
03M	03M004			---	---	---	---	---	---	---	Abandoned FY13
03M	03M005			L(A)	L(B)	---	L(A)	---	---	1.a	
03M	03M007			L(A)	L(B)	---	L(A)	---	---	1.a	
03M	03M010			L(A)	L(B)	---	L(A)	---	---	1.a	
03M	03M012			L(A)	L(B)	---	L(A)	---	---	1.a	
03M	03M013			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03M	03M017			L(A)	L(B)	---	L(A)	---	---	1.a	
03M	03M020			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03M	03M713			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)

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FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
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(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03L	03L002			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03L	03L003			L(A)	L(B)	---	L(A)	---	---	1.a	
03L	03L004			---	---	---	---	---	---	---	Abandoned FY13
03L	03L005			L(A)	L(B)	---	L(A)	---	---	1.a	
03L	03L007			Q,L(A)	Q,L(B)	---	Q,L(A)	---	Background	1.a	
03L	03L010			L(A)	L(B)	---	L(A)	---	---	1.a	
03L	03L012			L(A)	L(B)	---	L(A)	---	---	1.a	
03L	03L013			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03L	03L014			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03L	03L017			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03L	03L018			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03L	03L020			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03L	03L021			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03L	03L027			---	---	---	---	---	---	---	abandoned FY14
03L	03L028			---	---	---	---	---	---	---	abandoned FY14
03L	03L029			---	---	---	---	---	---	---	abandoned FY14
03L	03L077			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03L	03L078			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03L	03L079			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
03L	03L080			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03L	03L081			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
03L	03L084			---	---	---	---	---	---	---	abandoned FY14
03L	03L113			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
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(B)	---	Q,L(A)	---	OR	1.a	
03L	03L833			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
PC	04U001			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
PC	04U002			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
PC	04U003			L(A)	L(B)	---	L(A)	---	---	1.a	
PC	04U007			Q,L(A)	Q,L(B)	---	Q,L(A)	---	Background	1.a	

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FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
PC	04U012			L(A)	L(B)	---	L(A)	---	---	1.a	
PC	04U020			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
PC	04U027			---	---	---	---	---	---	---	abandoned FY14
PC	04U077			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
PC	04U510			Q,L(A)	Q,L(B)	---	Q,L(A)	---	Background	1.a	
PC	04U701			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
PC	04U702			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
PC	04U708			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
PC	04U709			Q,L(A)	Q,L(B)	---	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(B)	---	Q,L(A)	---	OR	1.a	
PC	04U714			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
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(B)	---	Q,L(A)	---	OR	1.a	
J	04J708			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
J	04J713			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
J	04J714			L(A)	L(B)	---	L(A)	---	---	1.a	Also sample in January 2016 (Army)
PC/J	PJ#003			L(A)	L(B)	---	L(A)	---	---	1.a	
PC/J	PJ#027			---	---	---	---	---	---	---	abandoned FY14
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(B)	---	Q,L(A)	---	OR	1.a	
PC/J	PJ#313	B12	(5)	Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	1.a	
PC/J	PJ#802			L(A)	L(B)	---	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(B)	---	L(A)	---	---	---	
Unit 1 Wells											
01U	01U035			---	---	---	---	---	---	---	
01U	01U043			---	---	---	---	---	---	---	
01U	01U044			---	---	---	---	---	---	---	
01U	01U045			---	---	---	---	---	---	---	
01U	01U046			---	---	---	---	---	---	---	
01U	01U060			---	---	---	---	---	---	---	
01U	01U072			---	---	---	---	---	---	---	
01U	01U085			---	---	---	---	---	---	---	

APPENDIX A.1

FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
Operable Unit 3											
03U	03U673			Q,L(A)	Q,L(B)	---	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(B)	---	Q,L(A)	---	OR	2.a	
03L	03L832			L(A)	L(B)	---	L(A)	---	---	2.a	
03L	03L848			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	2.a	
03L	03L854			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	2.a	
03L	03L859			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	2.a	
03L	03L860			L(A)	L(B)	---	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(B)	---	Q,L(A)	---	OR	2.a	
PC	04U832			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	2.a	Contingency Action for FY08
PC	04U845			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	2.a	Contingency Action for FY08
PC	04U848			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	2.a	
PC	04U851		(6)	---	---	---	Q,L(A)	---	OR	2.a	
PC	04U852			---	---	---	---	---	---	---	Abandoned FY09
PC	04U854			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	2.a	
PC	04U859			Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	2.a	
PC	04U860			Q,L(A)	Q,L(B)	---	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		---	---	---	---	---	---	---	Abandoned FY09
PC	04U865	325U4		---	---	---	---	---	---	---	Abandoned FY09
PC	04U866	326U4		Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	2.a	
PC	520931	NBM #13		---	---	---	---	---	---	---	Abandoned FY07
J	04J864	324 J		---	---	---	---	---	---	---	Abandoned FY09
J	04J866	326 J		Q,L(A)	Q,L(B)	---	Q,L(A)	---	OR	2.a	

APPENDIX A.1

FY 2015 - FY 2019 MONITORING PLAN FOR GROUNDWATER MONITORING WELLS

Well Information									Purpose For Monitoring (3)		
Unit	Well I.D.	Common Name	Notes	June 15	June 16	June 17	June 18	June 19	Water Quality	Water Level	Comments
Well Inventory											
(Entries under "Notes" refer to the well inventory category)											
---	249608	Rapit Printing Inc	1a	Q(B)	Q(B)	---	---	---	Well Inventory	---	2520 Larpenteur Ave
---	S00444	Minneapolis Parks & Rec Dep	1a	Q(B)	Q(B)	---	---	---	Well Inventory	---	Ontario & E River Rd (Erie), Dartmoth Triangle
---	200173	KSTP Radio TV	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	3415 University Ave
---	200180	Town & Country Golf Course	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	2279 Marshal Ave
---	200522	Windsor Green	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	Silver Lake Rd & Cty Rd E
---	200523	Windsor Green	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	Silver Lake Rd & Cty Rd E
---	234338	Bosell	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	1575 14th Ave NW
---	234421	BioClean (BioChem)	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	2151 Mustang Dr
---	234469	Palkowski, T.	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	2816 Hwy 88
---	234544	R&D Systems	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	2201 Kennedy St NE
---	249632	Montzka, Harold	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	2301 N Upland Crest NE
---	433298	Town & Country Golf Course	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	2279 Marshall Ave
---	509052	Shriners Hospital	1b	Q(B)	Q(B)	---	---	---	Well Inventory	---	2025 E River Rd
---	756236	Alcan	1c	Q(B)	Q(B)	---	---	---	Well Inventory	---	150 26th Ave SE
---	S00437	Northern Star Co	1c	Q(B)	Q(B)	---	---	---	Well Inventory	---	3171 5th St SE
---	107405	Dimmick, Kay	2a	Q(B)	Q(B)	---	---	---	Well Inventory	---	4355 Hwy 10
---	200176	Waldorf Paper Products	2b	Q(B)	Q(B)	---	---	---	Well Inventory	---	2236 Myrtle Ave
---	249007	Walton, Toni	2b	Q(B)	Q(B)	---	---	---	Well Inventory	---	4453 Old Hwy 10
---	537801	Midway Industrial	2b	Q(B)	Q(B)	---	---	---	Well Inventory	---	4759 Old Hwy 8
---	S00002	Midland Hills Country Club	2b	Q(B)	Q(B)	---	---	---	Well Inventory	---	2001 N Fulham St
---	200076	Old Dutch Foods, Inc	2c	Q(B)	Q(B)	---	---	---	Well Inventory	---	2375 Terminal Rd
---	236029	R&D Systems, South Well	2c	Q(B)	Q(B)	---	---	---	Well Inventory	---	2201 Kennedy St NE
---	236439	Waldorf Paper Products	2c	Q(B)	Q(B)	---	---	---	Well Inventory	---	2250 Wabash Ave
---	249185	Novotny, Mark	4a	Q(B)	Q(B)	---	---	---	Well Inventory	---	1706 Malvern St
---	UNK0515425	O'Neill, Julie	4a	---	Q(B)	---	---	---	Well Inventory	---	1412 Long Lake Rd
---		Amundsen, Jason & Lucy	4a	Q(B)	Q(B)	---	---	---	Well Inventory	---	2816 St. Anthony Blvd
---		Hermes, Margo	4a	Q(B)	Q(B)	---	---	---	Well Inventory	---	2935 Old Hwy 8

The next major sampling event for Well Inventory will be in June 2020 (conducted every 4 years)

A.2 Remedial Treatment Systems

APPENDIX A.2
FY 2015 - FY 2019 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 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 (subject to the remedy time-out for the 1,4-dioxane issue).

(2) The required analyte list for each specific site is presented in Appendix A.4.

A.3 Surface Water

APPENDIX A.3
FY 2015 - FY 2019 MONITORING PLAN
FOR SURFACE WATER

			Site K	Site C		
	Analytical		Effluent	Surface Water Locations		
Analysis	Method	Units	(Outfall 010)	(SW-5)	(SW-6)	(NE Wetland)
Flow Rate	---	gal/day	Continuous			
Total Flow	---	gal	M			
pH	(field)	(pH)	Q			
Hardness	(field)	(pH)	Q			
Cyanide	9012A	µg/L	Q			
Copper	6020	µg/L	Q			
Lead	6020	µg/L	Q	A	A	A
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 = Annually in June

A.4 Site Specific Lists of Required Analytes

APPENDIX A.4
SITE SPECIFIC LISTS OF REQUIRED ANALYTES

Note: Cleanup Levels (in µg/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 minimum list of analytes. A larger analyte list may be utilized by the monitoring organization, if so desired. In FY 2015 and FY 2016 (at a minimum), 1,4-dioxane (Method 522) is also being analyzed at all June VOC sampling locations (and also the January 2016 OU1/OU2 sampling locations). December TGRS extraction well sampling and treatment system influent/effluent sampling in months other than June will be VOCs only.

OU1 (DEEP GROUNDWATER) (1)

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

SITE A (SHALLOW GROUNDWATER) (2)

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 3 wells:
01U103, 01U902 and 01U904 (June only)

SITE C (SHALLOW GROUNDWATER) (3)

Lead	15

SITE I (SHALLOW GROUNDWATER) (2)

1,2-Dichloroethene (cis and trans)	70
Trichloroethene	30
Vinyl Chloride	0.2

BLDG 102 SHALLOW GROUNDWATER (4)

Vinyl Chloride(5)	0.18
cis-1,2-Dichloroethene	70
Trichloroethene	5
1,1-Dichloroethene	6

SITE K (SHALLOW GROUNDWATER) (2)

1,2-Dichloroethene (cis and trans)	70
Trichloroethene	30

OU2 (DEEP GROUNDWATER) (2)

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

OU3 (DEEP GROUNDWATER) (6)

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

WELL INVENTORY SAMPLING

VOCs (report full VOC list)

Notes:

(1) From Page 18 of the OU1 Record of Decision.
(2) From Table 1 of the OU2 Record of Decision.
(3) From Table 1 of Amendment #1 to the OU2 Record of Decision.
(4) From Page 2-13 of Amendment #4 to the OU2 Record of Decision.
(5) Vinyl chloride is also analyzed by SW-846 Method 8260C - SIM at wells 01U048, 01U582, and 01L582.
(6) From Page 26 of the OU3 Record of Decision.

Analytical Methods:

VOCs: SW-846 Method 8260C
Antimony & Lead: SW-846 Method 6020

A.5 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

FY 2015 Well Index

APPENDIX B
WELL INDEX FOR NEW BRIGHTON/ARDEN HILLS SUPERFUND SITE

FISCAL YEAR 2015

Purpose

The purpose of the well index is to identify all wells, both past and present, that:

- Have been used to collect water quality data or groundwater elevations in regard to work at the New Brighton/Arden Hills Superfund Site (including private wells and offsite monitoring wells sampled by the Army); or
- Are owned by the Army; or
- Are located within the boundaries of OU2 (the former TCAAP property)

In addition, the well index aims to identify the current status (in use, sealed, abandoned, etc.) of these wells.

The well index does not include wells identified in the Well Inventory Update (Appendix E) that have not been sampled by the Army at any point in history.

The list contained in the well index is by no means a compilation of all available data. Other data may exist regarding an individual well that was not discovered or searched out during the course of this effort. The list is intended to be a reasonable effort to gather the data concerning the wells that is readily available. Therefore, if additional data is desired concerning a certain well, it may be possible to search out and obtain that data from records not searched during the course of the investigation.

Background

OU2 and OU1/OU3 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 x 10^{-3} cm/sec (International Technology Corp. 1992). The Unit 1 deposits are discontinuous at the New Brighton/Arden Hills Superfund Site (NB/AH Site) and range 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 the NB/AH Site. 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 OU2. Near the center of OU2, 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 NB/AH Site 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 the NB/AH Site (referred to as the Army Designation or 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	NB/AH Site wells.
601 thru 800	OU2 Alliant Techsystems wells.
801 thru 999	OU1/OU3 Alliant Techsystems wells.

OU1/OU3 wells installed by parties other than USAEC, the Army, or Alliant Techsystems are designated by their Minnesota unique number. Table B-1 is sorted by unique number, but includes the IRDMIS number and any other name(s) the wells may have. The well type in this table 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

In recent years, as property transfer of the remaining land that is still identified as TCAAP has progressed (and is now nearing completion), it became apparent that an updated well index with more information concerning each well would be of importance to pass on to future land owners. In addition, as groundwater quality continues to improve and contaminant plumes continue to shrink in vertical and horizontal extent, the index will function as a check to make sure that all Army owned wells are sealed and that all traces of the wells are removed from the area.

The FY 2015 Appendix B Table B-1 shows the most current well index. The well index continues to be a work in progress. Additional records regarding individual wells continue to become available as new wells are drilled and older unneeded wells are sealed and removed.

Figures B-2 and B-3 show the location of wells identified in Table B-1. 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.

The Appendix B Attachment contains available documentation for each well, including boring logs (if available). The attachment is sorted by Minnesota unique number. To view the information concerning a well, click on the desired well number in the bookmarks.

FY 2015 Update

No significant changes were made compared with the FY 2014 version of the index.

Ongoing Efforts to Update Appendix B

- The well index, Table B-1, has been compared with the wells identified in Appendix D, which contains historical water quality and groundwater elevation data. A number of wells were identified in Appendix D that do not exist in the well index. Ongoing efforts will be made to add information, as possible, concerning the location and status of these wells to the well index in Appendix B.

- The repository at the TCAAP office will continue to be utilized to obtain additional well information, where possible.

Appendix B Table B-1 and Attachment

Available Well Information
Sorted by Minnesota Unique Well Number

Appendix B Table B-1 contains a summary of all information available concerning a certain well, and is sorted by Minnesota unique well number.

To search for detailed records regarding a well, open the appropriate file below and select the bookmark corresponding to the Minnesota unique well number of the well being searched. If the unique number is unknown for a well, it is included and sorted in the Appendix B Attachment by IRDMIS name or OTHER. Records included in the Appendix B Attachment that may or may not be available for each well include:

- The County Well Index well log,
- Access agreement(s),
- Correspondence related to the well,
- Field notes and boring logs,
- Well construction diagrams,
- Documentation of well modifications, and
- Sealing records.

Appendix B Attachment

1. Wells Numbered 104772 through 194772

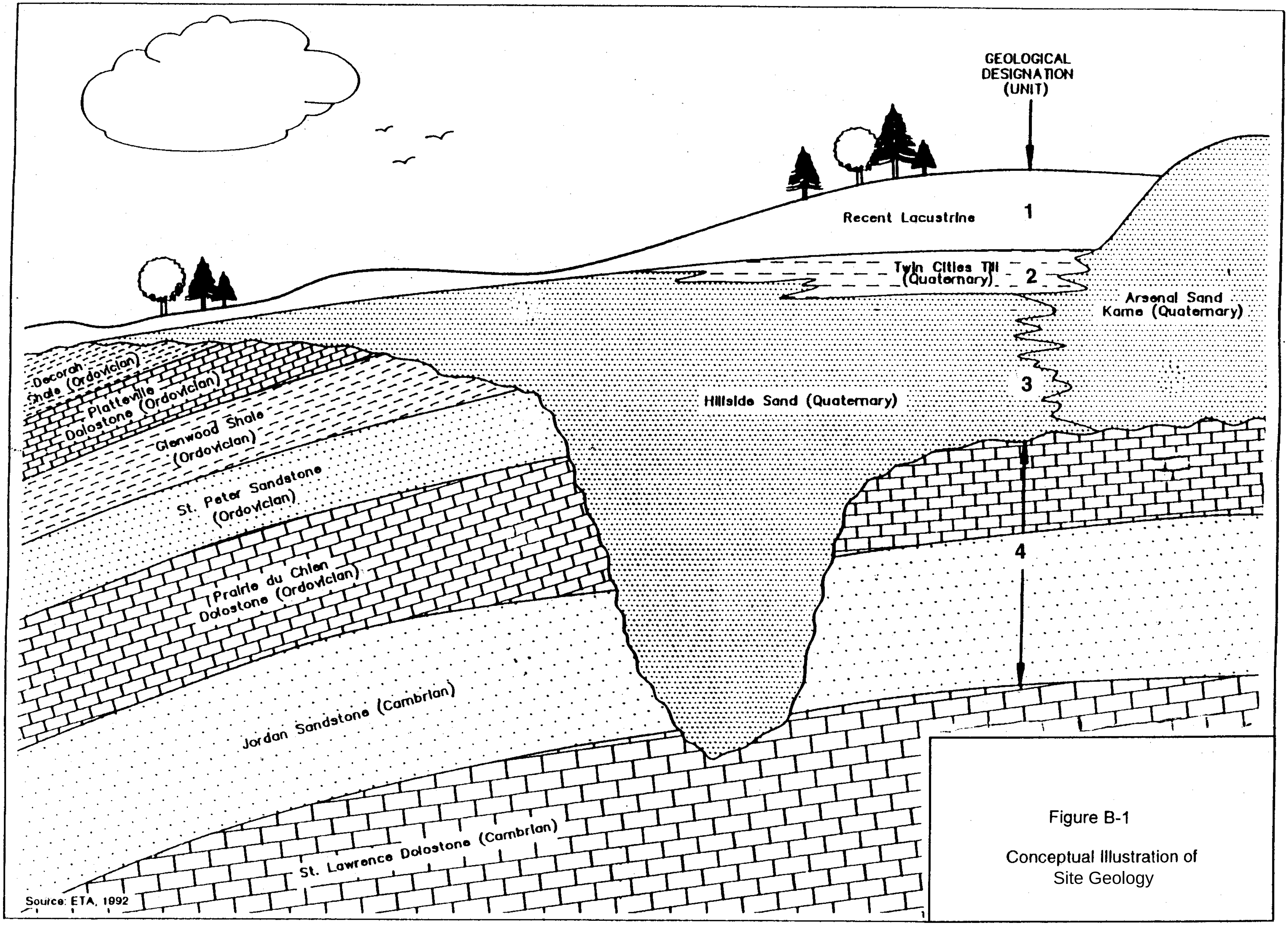
2. Wells Numbered 200070 through 225906

3. Wells Numbered 231741 through 235753

4. Wells Numbered 236066 through 257443

5. Wells Numbered 265735 through 482709

6. Wells Numbered 500248 through IRDMIS and OTHER



Source: ETA, 1992

Figure B-1

Conceptual Illustration of Site Geology

Notes:
1. To locate a well go to "edit, find' or "edit, search" and type in well name.
2. Not all wells are completed at the same depth as reflected by the OU1 & OU3, Upper Unit 4 plume contours shown.
3. Aerial Photograph from NAIP, 2015.

Path: L:\1561\21\FY2015 APR\mxd\OU1 OU3 Well Location and TCE History Map_b1 wells.mxd
Date: 1/12/2016 Time: 11:57:21 AM User: ShuJC0243

ANNUAL PERFORMANCE REPORT

OU1 & OU3 Well Location

WENCK
ASSOCIATES
Responsive partner. Exceptional outcomes.

FY 2015

Figure B-2

ANNUAL PERFORMANCE REPORT

OU2 Well Location

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

FY 2015

Figure B-3

Appendix C

FY 2015 Data Collection and Management

C.1 Data Collection, Management, and Presentation

APPENDIX C.1
DATA COLLECTION, MANAGEMENT, AND PRESENTATION

FISCAL YEAR 2015

1.0 INTRODUCTION

A groundwater monitoring program was initiated in January 1984 to obtain water level and water quality data at OU1, OU2 and OU3. Each year has been divided into quarters with each quarter assigned a number. Accordingly, FY 2015 was comprised of Quarter 125 (October through December), Quarter 126 (January through March), Quarter 127 (April through June), and Quarter 128 (July through September). Water sampling, water level measurements, and laboratory analyses were conducted in accordance with two separate Quality Assurance Project Plans (QAPPs): “QAPP for Performance Monitoring” (Wenck, Revision 13, February 28, 2014) and “QAPP for Monitored Natural Attenuation of Building 102 Groundwater” (Wenck, Revision 7, February 28, 2014). The Building 102 QAPP is applicable to only that specific site, and all other sites are covered by the Performance Monitoring QAPP.

Prior to November 1, 2001, data collected from OU1, OU2 and OU3 was stored in the U.S. Army Environmental Command (USAEC) Installation Restoration Data Management Information System (IRDMIS). 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. The Army has continued to enter data into ERIS; however, ERIS is not being used as the primary database for the OU1, OU2 and OU3 data. The historical databases in Appendix D.1 are the primary databases.

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 2015 Annual Monitoring Plan (Appendix A), which established the monitoring responsibilities for both the Army and Orbital ATK (formerly Alliant Techsystems). In addition, on March 26, 2015, the Minnesota Pollution Control Agency (MPCA) and U.S. Environmental Protection Agency (USEPA) requested that the Army and Orbital ATK include sampling and analysis for 1,4-dioxane in the scheduled June 2015 sampling event. The request was made in response to detection of 1,4-Dioxane in the City of New Brighton municipal wells at levels that exceeded the Minnesota Department of Health (MDH) Health Risk Limit (HRL) of 1 µg/L. The 1,4-dioxane sampling and analysis was conducted in accordance with QAPP Addendum #1 (Wenck, May 21, 2015). Water level monitoring and water sampling were conducted by Wenck for the Army and by GHD (formerly CRA) for Orbital ATK. Laboratory analysis of VOC samples from all sites was performed by ALS Laboratory Group, Salt Lake City, Utah. Laboratory analysis of 1,4-dioxane samples from all sites was performed by ALS Laboratory Group, Middletown, Pennsylvania. 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. At sites other than Site C, halogenated volatile organic compounds are the parameters of primary interest, though some of the sites (or specific wells at a site) are sampled for aromatic volatile organic compounds and/or metals. At Site C, dissolved lead is the only chemical of concern. Appendix C.2 presents deviations from the FY 2015 Annual Monitoring Plan.

Data verification and validation was conducted in accordance with procedures and requirements outlined in the two QAPPs and Addendum #1. Data qualifiers assigned to data through data verification and/or data validation appear in the data tables included within the individual sections of this report, with qualifier definitions given in footnotes to the tables. Data qualifiers are also included in the historical databases (Appendix D.1), which include a database of organic water quality, a database of inorganic water quality (excluding Site C), and a database for Site C water quality (for both groundwater and surface water). Data verification was performed by

Wenck for the Wenck-collected data and by GHD for the GHD-collected data. Data validation was performed by Diane Short & Associates for the Wenck-collected data and by GHD for the GHD-collected data. Data verification and validation information from the two sampling firms was compiled by Wenck into quarterly Data Usability Reports (DURs) that were submitted to the MCPA and USEPA for review. If any MPCA/USEPA-requested revisions were necessary, a final DUR was resubmitted. The final MPCA/USEPA approval letter for the FY 2015 DURs is included in Appendix C.3.

For water level measurements, the depth to water from the surveyed top of the well casing elevation was measured. Groundwater elevations were calculated by subtracting the depth to water from the surveyed top of the well casing elevation and are included in the historical water elevation database (Appendix D.1).

2.2 Groundwater Elevation Contour Maps

The most extensive water level monitoring event performed during FY 2015 was in June (Quarter 127). This data was used to prepare groundwater elevation contour maps for deep groundwater at OU1, OU2, and OU3, and for shallow groundwater at Sites A, C, K and Building 102. Groundwater elevation contour maps are included within the individual sections of this report. There is not a comprehensive water level event for shallow groundwater at Site I, given the well sealing that has been done.

2.3 Groundwater Quality Contour Maps and Cross-Sections

The most extensive sampling event performed during FY 2015 was in June (Quarter 127). This data was used to prepare groundwater quality isoconcentration contour maps and/or cross-sections for deep groundwater at OU1/OU3 and OU2 (OU3 is shown on the same figure as OU1 in the OU1 section of this report), and shallow groundwater at Site A, Site C, Site K and Building 102. Site I is excluded, given the well sealing that has been done. 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 deep groundwater at OU1/OU3 and OU2, isoconcentration maps and cross-sections are provided for trichloroethene, since this is the primary chemical of concern on a concentration basis. For FY 2015, 1,4-dioxane concentrations and contours were also added. These isoconcentration maps include individual maps for Upper Unit 3, Lower Unit 3, and Upper Unit 4. To complement the isoconcentration maps, cross-sections were prepared to illustrate the vertical distribution of trichloroethene and 1,4-dioxane. One section line passes through the source area at Site G in OU2 and follows the north plume (OU1) 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 in OU2 and follows the south plume (OU3).

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 located 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 shallow groundwater, an isoconcentration map is provided for cis-1,2-dichloroethene, since this is the chemical of concern with the largest aerial extent at Site A, and also for tetrachloroethene, which illustrates the source area and contaminant degradation. Cross-sections were also prepared for Site A to illustrate the vertical distribution of 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 C shallow groundwater, an isoconcentration map is provided for dissolved lead, since this is the only chemical of concern at Site C. Results for surface water monitoring is also shown on this same map to show that impacts to surface water are not occurring as a result of the shallow groundwater contamination. Cross-sections were also prepared for Site C to illustrate the vertical distribution of dissolved lead. The isoconcentration map for Site C was prepared only for Unit 1, since this is the only contaminated aquifer.

For Site K shallow groundwater, an isoconcentration map is provided for trichloroethene, since this is the primary chemical of concern on a concentration basis. The isoconcentration map for Site K was prepared only for Unit 1, since this is the only contaminated aquifer.

For Building 102 shallow groundwater, an isoconcentration map is provided for vinyl chloride, since this is the chemical of concern that has historically had the largest aerial extent at Building 102, and also for trichloroethene and cis-1,2-dichloroethene, which illustrates the source area and contaminant degradation. Cross-sections were also prepared for Building 102 to illustrate the vertical distribution of vinyl chloride. The isoconcentration maps for Building 102 were 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 generally 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. Contaminant concentrations for recovery wells that are not actively pumping are fully utilized for purposes of contouring.

C.2 Deviations from Monitoring Program

APPENDIX C.2
DEVIATIONS FROM MONITORING PROGRAM

Fiscal Year 2015

All Shallow and Deep Groundwater VOC Sites

June 2015:	At all well locations where VOC samples were scheduled to be collected, samples for 1,4-dioxane were also collected at the same time, as requested by the USEPA and MPCA, in accordance with QAPP Addendum #1 (Wenck, May 21, 2015).

OU1 Deep Groundwater

June 2015:

206688:	No sample collected, since the well was not operational.

OU2: Site C Shallow Groundwater

June 2015:

01U563:	Resampled in July 2015 due to an unusually high result in June 2015. Initial sample was inadvertently not field filtered.
01U573:	Same as above.
01U574:	Same as above.
01U575:	Same as above.

OU2: Deep Groundwater

June 2015:

03U114:	The well was sampled, but was only analyzed for VOCs. Analysis for 1,4-dioxane, though intended, could not be performed due to sample bottle breakage in transit.

Well Inventory

June 2015:	Although a major sampling event was not scheduled for FY 2015, the Army conducted the major sampling event given the 1,4-dioxane issue.

Rice Creek

June 2015:	Although no Rice Creek surface water sampling was scheduled for FY 2015 (and is not routinely done), the Army sampled Rice Creek at three locations given the 1,4-dioxane issue.

C.3 Regulatory Approvals of Data Usability Reports

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

January 11, 2016

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 55126-3218

Subject: **Approval of Data Usability Reports Numbers 85, 86, 87 and 88**

Dear Mr. Fix:

This letter shall serve to document that the U.S. Environmental Protection Agency (EPA) and the Minnesota Pollution Control Agency (MPCA) received and reviewed draft versions of Data Usability Reports (DURs) 85, 86, 87 and 88. EPA and MPCA provided the U.S. Army (Army) with comments on the DURs. The DURs were revised to the satisfaction of EPA and MPCA and the following final DURs were received:

- Data Usability Report Number 85 (**DUR 85**), TCAAP FY 2015 Performance Monitoring Program, 1st Quarter Monitoring (October – December, 2014), May 14, 2015;
- Data Usability Report Number 86 (**DUR 86**), TCAAP FY 2015 Performance Monitoring Program, 2nd Quarter Monitoring (January – March, 2015), August 25, 2015;
- Data Usability Report Number 87 (**DUR 87**), TCAAP FY 2015 Performance Monitoring Program, 3rd Quarter Monitoring (April – June, 2015), December 14, 2015;
- Data Usability Report Number 88 (**DUR 88**), TCAAP FY 2015 Performance Monitoring Program, 4th Quarter Monitoring (July – September, 2015), January 5, 2016.

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 81, 82, 83 and 84. If you have any questions, please contact Tom Barounis of the EPA at (312) 353-5577 or Amy Hadiaris of the MPCA at (651) 757-2402.

Sincerely,

Tom Barounis

Tom Barounis
Remedial Project Manager
U.S. Environmental Protection Agency
Region 5

Tom Barounis for

Amy Hadiaris, P.G.
Project Manager
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 databases are located on this CD in a folder named Appendix D.1. This folder contains four Microsoft Excel files:

File	Contents
Compelev_FY15	Groundwater elevations
Comporwq _FY15	Groundwater quality: organic data
Compinwq _FY15	Groundwater quality: inorganic data (excluding Site C)
Site C wq _FY15	Groundwater quality: inorganic data (Site C only)

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 out of service
03L673	04U845	04U846	04U849
03L833	04U854	04U861 abandoned	04U821
03L859	04U859	409549	191942 abandoned

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 abandoned	03L841	409547	04J839
03M843	03L811	04U863	03U677

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 out of service
04U002	04U834	04U864 abandoned	409547
04U020	04U841	04U865 abandoned	409548
04U027abandoned	04U843	04U866	409549
04U077	04U844	04U871	409555
04U673	04U845	04U872	512761
04U701	04U846	04U875	PJ#318

Group 5 Unit 3 wells (evaluated as individual trends)

03L822	03U821	03U822	03L822
409550	409596	409597	03U831abandoned

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

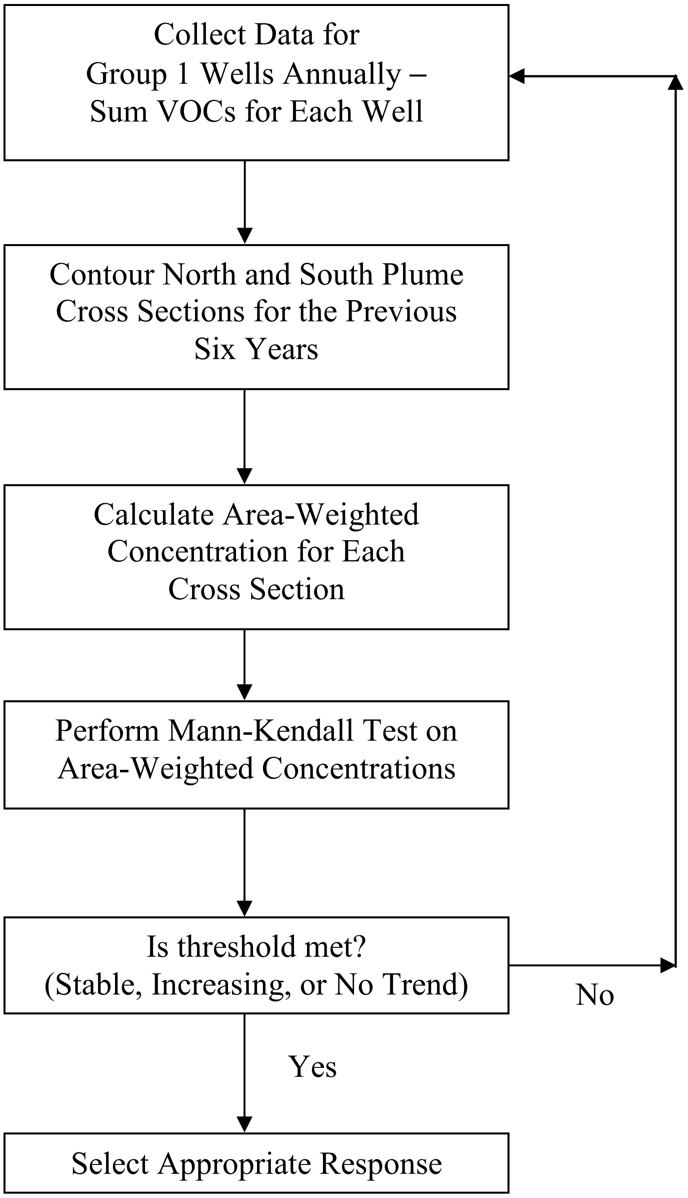


Table D.2.5
Group 2 – Areal Extent of Plume, Evaluation Process

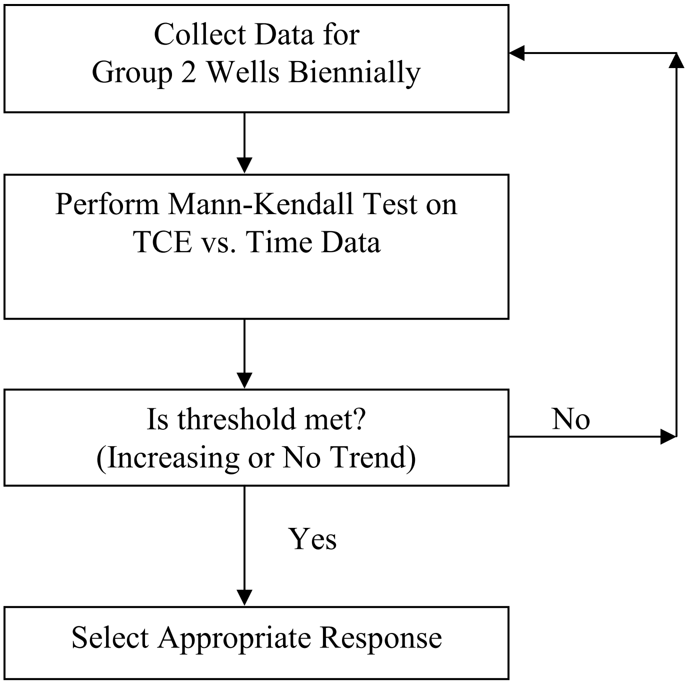


Table D.2.6
Group 3 and Group 5 – Downgradient Sentinel and Global Plume, Evaluation Processes

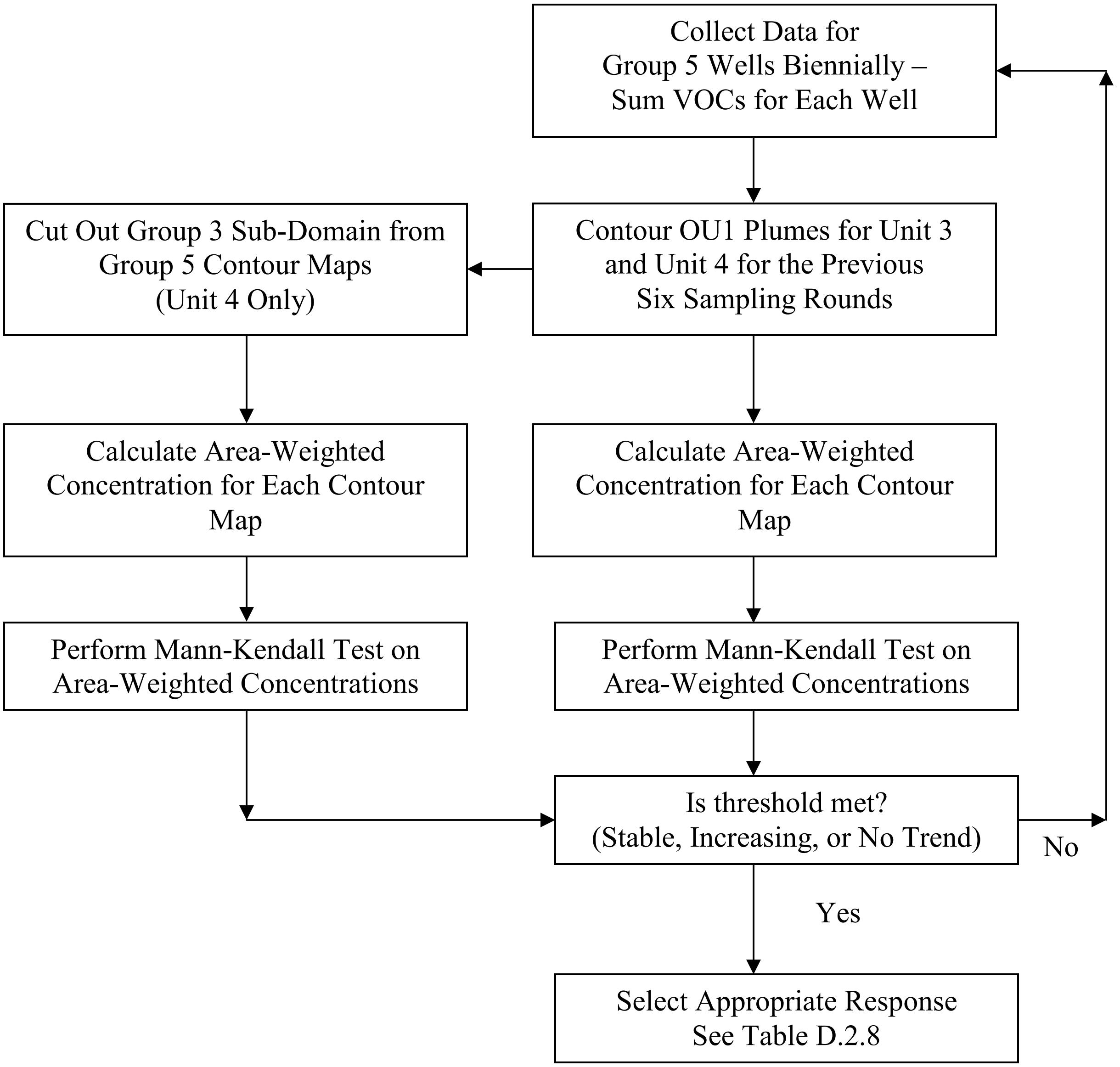


Table D.2.7
Group 4 – Lateral Sentinel Wells, Evaluation Process

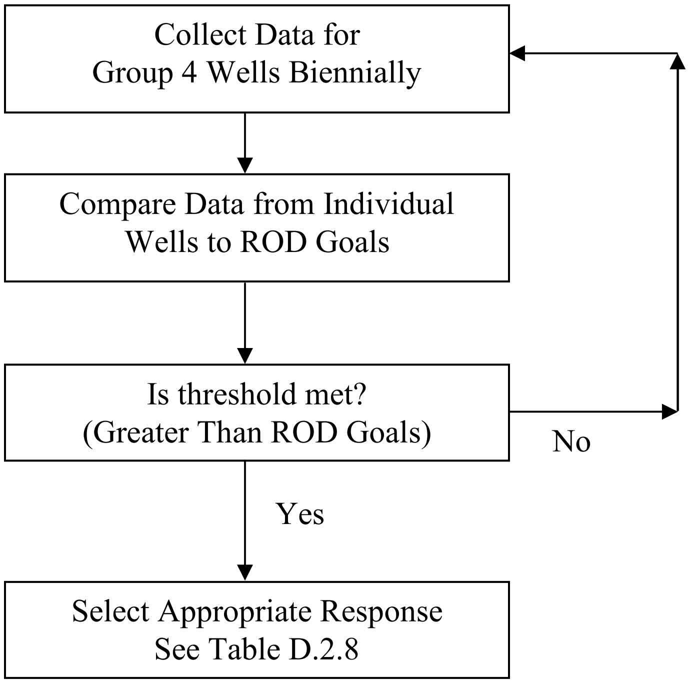


Table D.2.8

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)

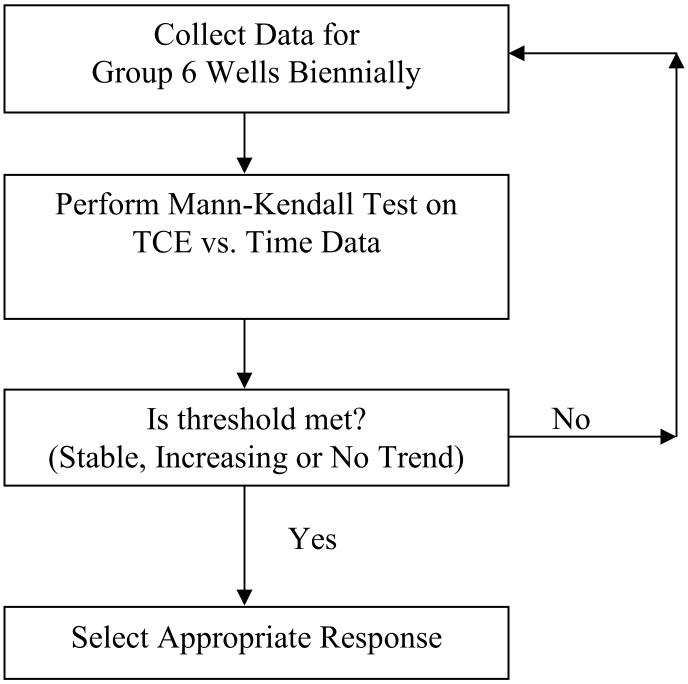
Possible Long-Term Responses

- 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

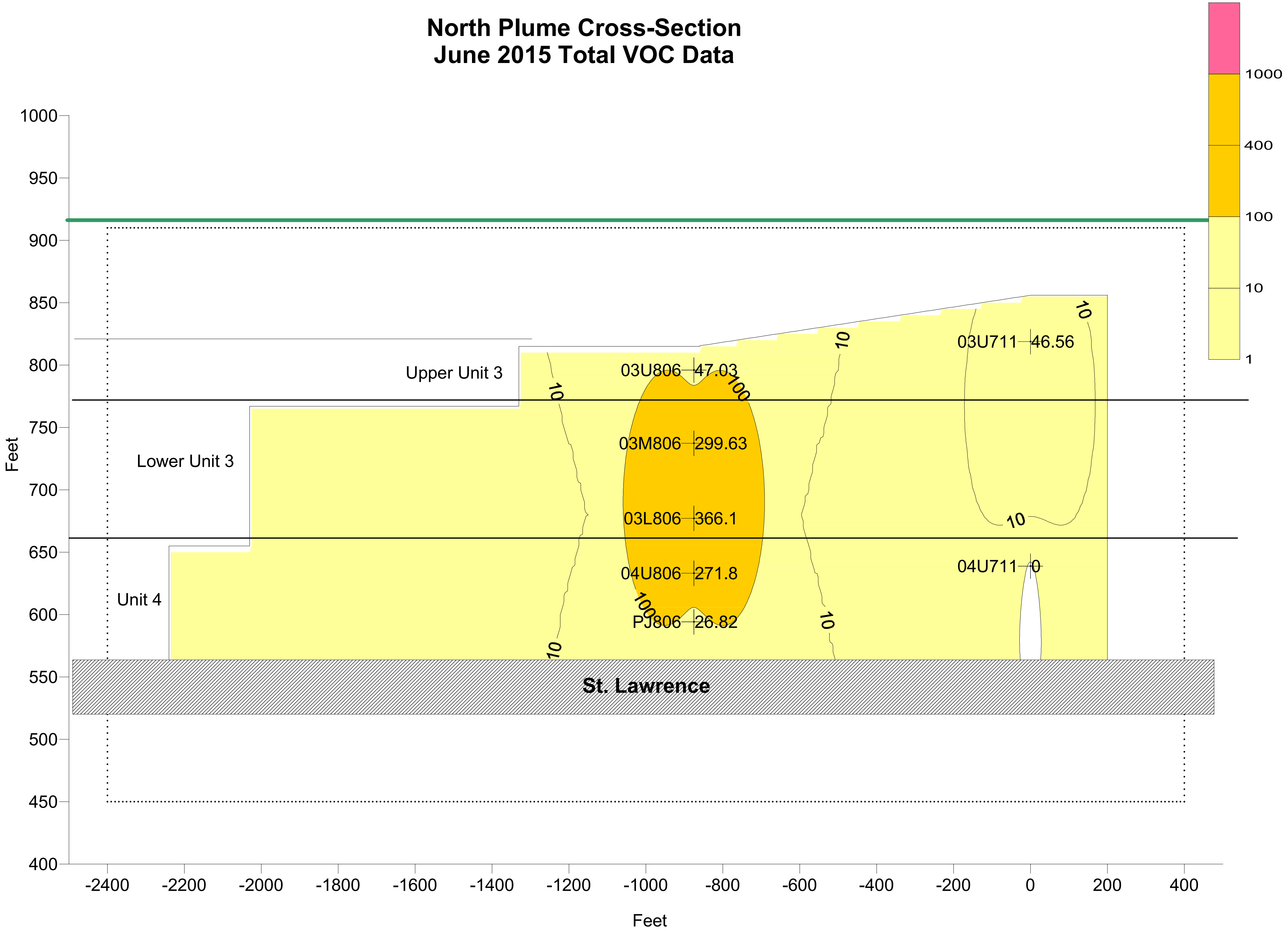
Group 6 – Jordan Aquifer, Evaluation Process



D.2.2 Group 1 Kriging Evaluation

2015

North Plume Cross-Section
June 2015 Total VOC Data



South Plume Cross-Section
June 2015 Total VOC Data

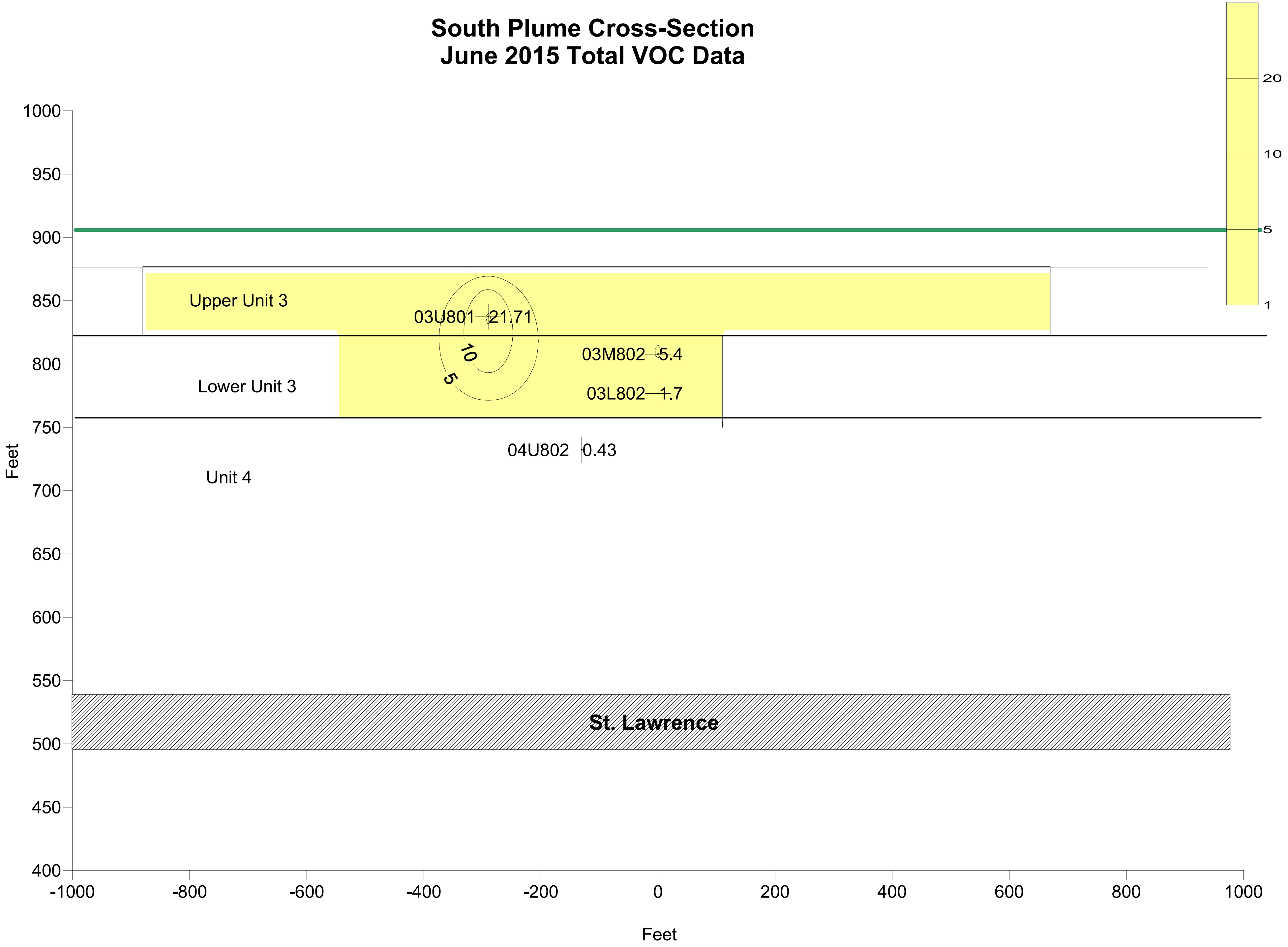


TABLE 1

VOC CONCENTRATIONS IN TGRS MONITORING WELLS

		1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene	
Location	**Date**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**Total VOCs**
03L802	6/16/15	ND	ND	ND	ND	ND	ND	1.70	1.7
03M802	6/16/15	ND	ND	ND	ND	ND	ND	5.40	5.4
03U801	6/16/15	ND	ND	ND	ND	0.71	ND	21.00	21.71
04U802	6/16/15	ND	ND	ND	ND	ND	ND	0.43	0.43
03L806	6/15/15	1.1	16	15	ND	4	ND	330	366.1
03M806	6/15/15	0.33	30	15	ND	4.3	ND	250	299.63
03U711	6/12/15	3.8	1.1	1.6	ND	0.52	0.54	39	46.56
03U806	6/15/15	ND	0.65	0.56	ND	ND	0.82	45	47.03
04U711	6/12/15	ND	ND	ND	ND	ND	ND	ND	0
04U806	6/15/15	1	28	19	ND	3.8	ND	220	271.8
PJ#806	6/15/15	0.32	1.4	1.1	ND	ND	ND	24	26.82

Notes:

🟨 South Plume

🟦 North Plume

ND=Non-detect

Assumptions:

non-detect values were treated as 0

Any value with a data qualifier (e.g. JP) treated as the detection.

North Plume
Total VOC Concentration Calculations
Vertical Cross-Section
Expanded Contouring and Blanking
TCAAP
June 2015

Concentration	Positive Planar Area (ft2)
Plume to 1	568844
Plume to 5	258223
Plume to 10	224735
Plume to 50	129060
Plume to 100	63487
Plume to 200	19775
Plume to 300	4532
Plume to 400	0
Plume to 500	0
Plume to 600	0
Plume to 700	0
Plume to 800	0

TCE (ug/L)	Avg TCE (ug/L)	Area (ft2)	Areal Conc (ug*ft2/L)
1 to 5	3	310621	931862
5 to 10	7.5	33488	251160
10 to 50	30	95675	2870245
50 to 100	75	65574	4918016
100 to 200	150	43711	6556725
200 to 300	250	15244	3810886
300 to 400	350	4532	1586031
400 to 500	450	0	0
500 to 600	550	0	0
600 to 700	650	0	0
700 to 800	750	0	0
	Sum	568844	20924925

Area Wtd Conc	37	ug/L

South Plume
Total VOC Concentration Calculations
Vertical Cross-Section
Contouring and Blanking
TCAAP
June 2015

Concentration	**Positive Planar Area (ft2)**
Plume to 1	115236
Plume to 5	13226
Plume to 10	4319
Plume to 25	0
Plume to 50	0
Plume to 75	0

Total VOCs (ug/L)	**Avg Total VOCs (ug/L)**	**Area (ft2)**	**Areal Conc (ug*ft2/L)**
1 to 5	3	102011	306032
5 to 10	7.5	8907	66802
10 to 25	17.5	4319	75575
25 to 50	37.5	0	0
50 to 75	62.5	0	0
	Sum	115236	448409

Area Wtd Conc	4	ug/L

D.2.3 Group 1, 2, 3, 5, and 6 Mann-Kendall Evaluations

Summary Table

Table 3-5
Group 1, 2, 3, and 5 Mann-Kendall Summary and MAROS Conclusion for OU1

Group	Kendall S	N	Raw Trend	Confidence	COV	Raw Trend Decision	MAROS Conclusion	Threshold Triggered?	Comments
Group 2 Wells:									
409549	12	6	Increasing	98.66%	0.4806	Definite	**Increasing**	Yes	Near plume center, looks stable since 2011
409557	13	6	Increasing	99.17%	0.3777	Definite	**Increasing**	Yes	Near plume center, plume shifted slightly
03L673	-12	6	Decreasing	98.66%	0.1974	Definite	**Decreasing**	No	
03L833	-9	6	Decreasing	93.20%	0.4422	Probable	**Decreasing**	No	
03L848	-11	6	Decreasing	97.20%	0.1059	Definite	**Decreasing**	No	
03L859	-11	6	Decreasing	97.20%	0.1622	Definite	**Decreasing**	No	
03U677	0	6	Zero	41.78%	NA	S or NT	**NA**	No	All ND
03U805	9	6	Increasing	93.20%	1.1801	Probable	**Increasing**	Yes	Near plume center, plume shifted slightly
04U673	-15	6	Decreasing	99.86%	0.2162	Definite	**Decreasing**	No	
04U821	-6	6	Decreasing	81.38%	0.1564	S or NT	**Stable**	No	
04U832	3	6	Increasing	64.00%	0.0795	S or NT	**No Trend**	Yes	Between 46 and 56 µg/L since 2007
04U833	-11	6	Decreasing	97.20%	0.6368	Definite	**Decreasing**	No	
04U841	-8	6	Decreasing	89.62%	0.1161	S or NT	**Stable**	No	
04U843	15	6	Increasing	99.86%	0.3938	Definite	**Increasing**	Yes	Near plume center, plume shifted slightly
04U845	-6	6	Decreasing	81.38%	0.3126	S or NT	**Stable**	No	See OU3 Discussion
04U846	14	6	Increasing	99.46%	0.5965	Definite	**Increasing**	Yes	Near plume center, looks stable since 2011
04U849									See Group 6 summary
04U854	-10	6	Decreasing	95.38%	0.1304	Definite	**Decreasing**	No	
04U859	-14	6	Decreasing	99.46%	0.2031	Definite	**Decreasing**	No	
04U861 (abandoned)	11	6	Increasing	97.00%	1.0198	Definite	**NA**	NA	Abandoned after 2006 sample, in New Brighton Development
04U875	-8	6	Decreasing	89.62%	0.9556	S or NT	**Stable**	No	
04U877	-2	6	Decreasing	57.46%	0.5951	S or NT	**Stable**	No	
206688	-4	6	Decreasing	70.66%	0.0719	S or NT	**Stable**	No	Well not in operation in 2015 sampling
Group 1 NP	1	6	Increasing	50.00%	0.1434	S or NT	**No Trend**	Yes	Between 36 and 51 µg/L since 2007
Group 1 SP	0	6	Zero	41.78%	0.0000	S or NT	**Stable**	Yes	Stable, but avgerage is <5 µg/L
Group 3	-6	6	Decreasing	81.38%	0.0915	S or NT	**Stable**	Yes	Raw trend is decreasing
Group 5	5	6	Increasing	76.50%	0.0928	S or NT	**No Trend**	Yes	Between 33 and 43 µg/L since 2003

Notes:

S or NT = Stable or No Trend
N = Number of data points
COV = Coefficient of Variance
NA = Not Applicable
Response Threshold triggers are defined in Table D.2.3

MAROS Decision 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

Table 3-5
Group 5 Unit 3 Mann-Kendall Summary and MAROS Conclusion for OU1

Group	Kendall S	N	Raw Trend	Confidence	COV	Raw Trend Decision	MAROS Conclusion	Threshold Triggered?	Comments
Group 5 Unit 3 Wells:									
409550	-6	6	Decreasing	81.38%	0.4240	S or NT	**Stable**	Yes	Raw trend is decreasing
409597 (abandoned)	-11	6	Decreasing	99.00%	0.3885	Definite	**NA**	NA	Abandoned due to constr. after 2007 sampling
409596 (abandoned)	-8	6	Decreasing	90.10%	0.6714	Probable	**NA**	NA	Abandoned due to constr. after 2007 sampling
03U831 (abandoned)	9	6	Increasing	93.20%	1.5885	Probable	**NA**	NA	Abandoned due to constr. after 2006 sampling
03U821	-14	6	Decreasing	99.46%	0.1131	Definite	**Decreasing**	No	
03U822	1	6	Increasing	50.00%	0.1046	S or NT	**No Trend**	Yes	Between 120 and 160 µg/L since 2003
03L822	-11	6	Decreasing	97.20%	0.3259	Definite	**Decreasing**	No	
03L809	-8	6	Decreasing	89.62%	0.6854	S or NT	**Stable**	Yes	Raw trend is decreasing

Notes:

S or NT = Stable or No Trend

N = Number of data points

COV = Coefficient of Variance

NA = Not Applicable

Response Threshold triggers are defined in Table D.2.3

MAROS Decision 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

Table 3-5
Group 6 Mann-Kendall Summary and MAROS Conclusion for OU1

Group	Kendall S	N	Raw Trend	Confidence	COV	Raw Trend Decision	MAROS Conclusion	Threshold Triggered?	Comments
Group 6 OU1 Jordan Wells:									
04J822	-4	6	Decreasing	70.66%	0.1237	S or NT	**Stable**	Yes	Raw trend is decreasing
04J834	-12	6	Decreasing	98.66%	0.8300	Definite	**Decreasing**	No	All detection below 0.38 µg/L
04J836	6	6	Increasing	81.38%	1.1467	S or NT	**No Trend**	Yes	Close proximity to NBCGRS wells (& shutdown)
04J838	13	6	Increasing	99.17%	0.1568	Definite	**Increasing**	Yes	Close proximity to NBCGRS wells (& shutdown)
04J837	-5	6	Decreasing	76.50%	0.8138	S or NT	**Stable**	Yes	Raw trend is decreasing
04J839	-3	6	Decreasing	64.00%	0.2728	S or NT	**Stable**	Yes	All detections below 4 µg/L
04J847	3	6	Increasing	64.00%	0.0988	S or NT	**No Trend**	Yes	Near plume center, looks stable since 2012
04J849	5	6	Increasing	76.50%	2.4495	S or NT	**No Trend**	Yes	All detection below 0.42 µg/L
04J882	0	6	Zero	41.78%	NA	S or NT	**NA**	No	All ND
04J077	-9	6	Decreasing	93.20%	0.4863	Probable	**Decreasing**	No	
04J702	-15	6	Decreasing	99.86%	0.9248	Definite	**Decreasing**	No	
04J708	7	6	Increasing	86.40%	0.2563	S or NT	**No Trend**	Yes	Close proximity to TGRS wells (plume shift)
04J713	0	6	Zero	41.78%	NA	S or NT	**NA**	No	All ND
Group 6 Nested Unit 4 wells:									
04U077	-15	6	Decreasing	99.86%	0.4286	Definite	**Decreasing**	No	
04U702	2	6	Increasing	57.46%	0.2144	S or NT	**No Trend**	Yes	Detections below 2.1 µg/L since 2005
04U708	-12	6	Decreasing	98.66%	0.9072	Definite	**Decreasing**	No	
04U713	-6	6	Decreasing	81.38%	0.6583	S or NT	**Stable**	Yes	All detections below 0.6 µg/L
04U834	-15	6	Decreasing	99.86%	0.9445	Definite	**Decreasing**	No	
04U836	1	6	Increasing	50.00%	0.4578	S or NT	**No Trend**	Yes	Close proximity to NBCGRS wells (& shutdown)
04U837	-5	6	Decreasing	76.50%	1.1592	S or NT	**No Trend**	Yes	Raw trend is decreasing
04U838	-2	6	Decreasing	57.46%	1.5423	S or NT	**No Trend**	Yes	Detections below 3 µg/L since 2009
04U839	9	6	Increasing	93.20%	1.6379	Probable	**Increasing**	Yes	Close proximity to NBCGRS wells (& shutdown)
04U847	-1	6	Decreasing	50.00%	0.2427	S or NT	**Stable**	Yes	Raw trend is decreasing
04U849	11	6	Increasing	97.20%	0.3423	Definite	**Increasing**	Yes	Near plume center, looks stable since 2011
04U882	-4	6	Decreasing	70.66%	0.1708	S or NT	**No Trend**	Yes	Raw trend is decreasing

Notes:
S or NT = Stable or No Trend
N = Number of data points
COV = Coefficient of Variance
NA = Not Applicable
Response Threshold triggers are defined in Table D.2.3

MAROS Decision Matrix

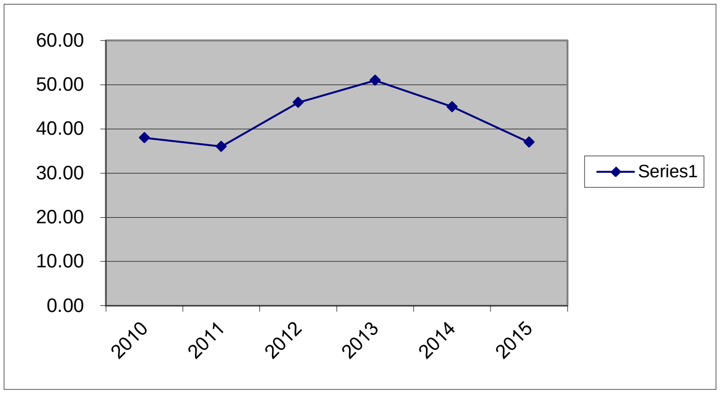
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Mann-Kendall Plots

Well: **Group 1 NP**

Date	TVOC (µg/L)	Mann-Kendall Calculation:						
6/16/2010	38.00	1						
6/9/2011	36.00	1	-1					
6/25/2012	46.00	1	1	1				
6/12/2013	51.00	1	1	1	1			
6/4/2014	45.00	1	1	1	-1	-1		
6/20/2015	37.00	1	-1	1	-1	-1	-1	
	N	6	5	4	3	2	1	15
	sum		1	4	-1	-2	-1	1
	Possibles	15						

Mean	42.17
STNDEV	6.047038
COV	0.143408
Trend:	Positive
Confidence (lookup)	50.0%



S	1
tau	0.066667

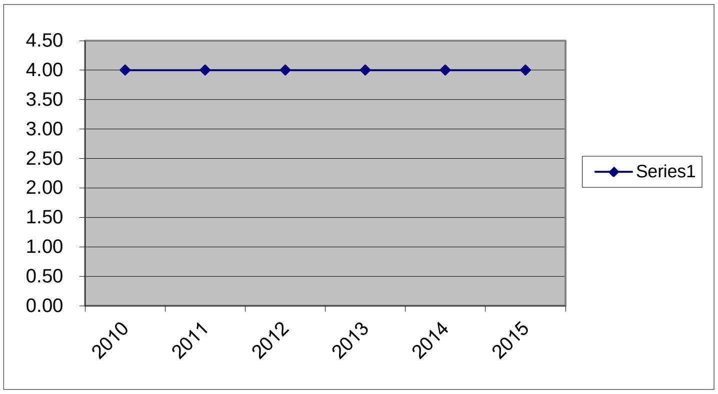
Decision Matrix

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	TVOC (µg/L)	Mann-Kendall Calculation:						
6/11/2010	4.00	1						
6/9/2011	4.00	1	0					
6/25/2012	4.00	1	0	0				
6/28/2013	4.00	1	0	0	0			
6/4/2014	4.00	1	0	0	0	0		
6/20/2015	4.00	1	0	0	0	0	0	
	N	6	5	4	3	2	1	15
	sum		0	0	0	0	0	0
	Possibles	15						

Mean	4.00
STNDEV	0
COV	0
Trend:	Zero
Confidence (lookup)	41.8%



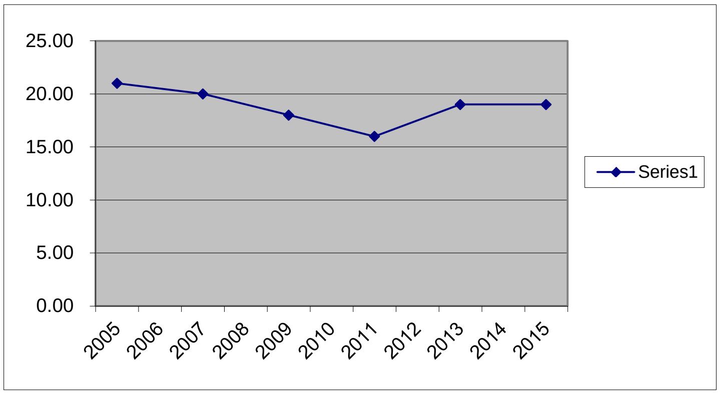
S	0
tau	0

Decision 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 3**

Date	TVOC (µg/L)		Mann-Kendall Calculation:					
6/18/2005	21.00	1						
6/11/2007	20.00	1	-1					
6/11/2009	18.00	1	-1	-1				
6/29/2011	16.00	1	-1	-1	-1			
6/27/2013	19.00	1	-1	-1	1	1		
6/20/2015	19.00	1	-1	-1	1	1	0	
	N	6	5	4	3	2	1	15
		sum	-5	-4	1	2	0	-6
	Possibles	15						



Mean	18.83
STNDEV	1.722401
COV	0.091455
Trend:	Negative
Confidence (lookup)	81.4%

S	-6
tau	-0.4

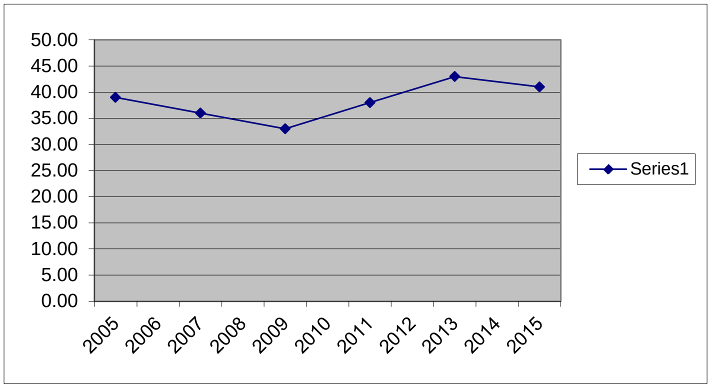
Decision Matrix

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 5**

Date	TVOC (µg/L)	Mann-Kendall Calculation:					
6/18/2005	39.00	1					
6/18/2007	36.00	1	-1				
6/18/2009	33.00	1	-1	-1			
6/29/2011	38.00	1	-1	1	1		
6/27/2013	43.00	1	1	1	1	1	
6/20/2015	41.00	1	1	1	1	1	-1

N		6	5	4	3	2	1	0	-1	-2	-3	-4	5
	sum		-1	2	3	2	-1	0	0	0	0	0	5
Possibles		15											



Mean	38.33
STNDEV	3.55903
COV	0.09284
Trend:	Positive
Confidence (lookup)	76.5%

S	5
tau	0.33333

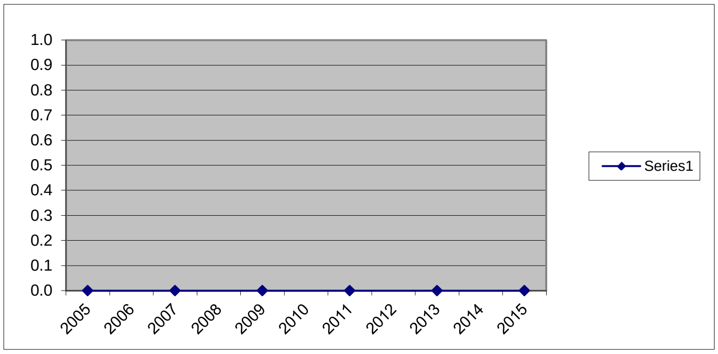
Decision Matrix

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: 03U677

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/17/2005	0.0	1						
6/18/2007	0.0	1	0					
6/15/2009	0.0	1	0	0				
6/13/2011	0.0	1	0	0	0			
6/24/2013	0.0	1	0	0	0	0		
6/16/2015	0.0	1	0	0	0	0	0	
	N	6	5	4	3	2	1	15
	sum		0	0	0	0	0	0
	Possibles	15						

Mean	0.00
STNDEV	0
COV	#DIV/0!
Trend:	Zero
Confidence (lookup)	41.8%



S	0
tau	0

Decision Matrix

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

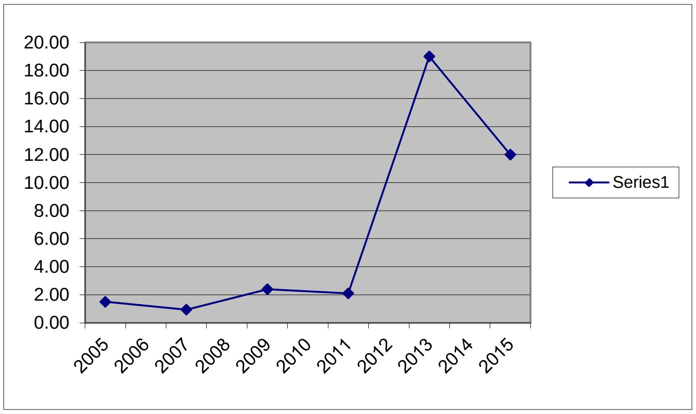
* Well was previously identified as 03U672 but was sealed without permission by MnDOT in 2013 following sampling. 03U677 was installed as a replacement well.

Well: 03U805

Date	TCE (µg/L)		Mann-Kendall Calculation:				
6/15/2005	1.50	1					
6/20/2007	0.94	1	-1				
6/15/2009	2.40	1	1	1			
6/9/2011	2.10	1	1	1	-1		
6/24/2013	19.00	1	1	1	1	1	
6/16/2015	12.00	1	1	1	1	1	-1

N		6	5	4	3	2	1	15
	sum		3	4	1	2	-1	9
Possibles		15						

Mean	6.32
STNDEV	7.4618541
COV	1.1800507
Trend:	Positive
Confidence (lookup)	93.2%



S	9
tau	0.6

Decision Matrix

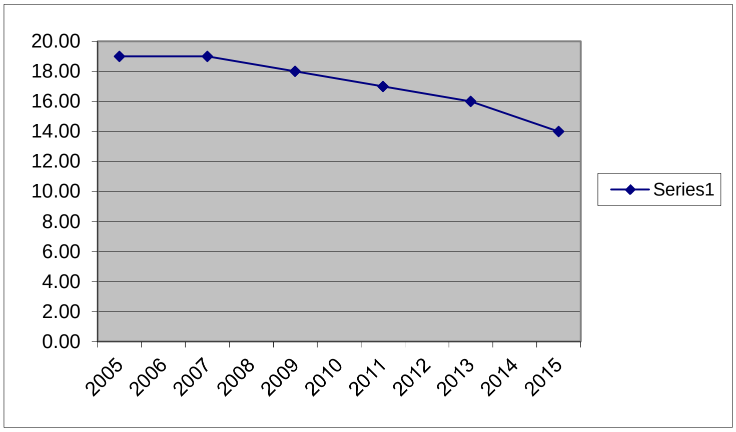
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: 03U821

Date	TCE (µg/L)		Mann-Kendall Calculation:				
6/10/2005	19.00	1					
6/13/2007	19.00	1	0				
6/11/2009	18.00	1	-1	-1			
6/16/2011	17.00	1	-1	-1	-1		
6/13/2013	16.00	1	-1	-1	-1	-1	
6/17/2015	14.00	1	-1	-1	-1	-1	-1

N	6	5	4	3	2	1	15
	sum	-4	-4	-3	-2	-1	-14
Possibles	15						

Mean	17.17
STNDEV	1.94079
COV	0.113056
Trend:	Negative
Confidence (lookup)	99.5%



S	-14
tau	-0.93333

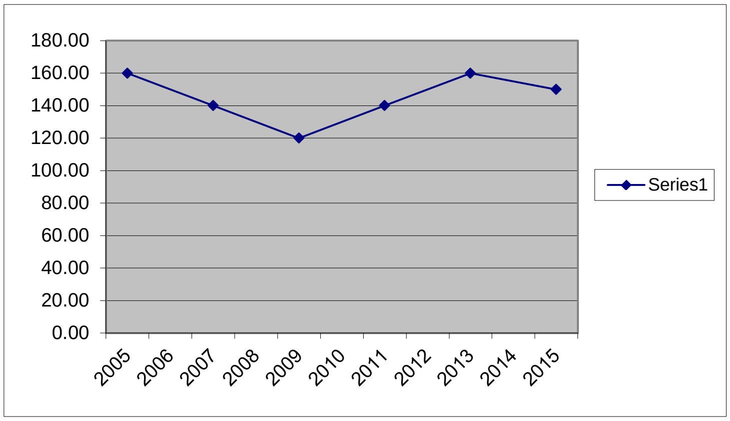
Decision Matrix

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: **03U822**

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/10/2005	160.00	1						
6/15/2007	140.00	1	-1					
6/17/2009	120.00	1	-1	-1				
6/29/2011	140.00	1	-1	0	1			
6/17/2013	160.00	1	0	1	1	1		
6/23/2015	150.00	1	-1	1	1	1	-1	
	N	6	5	4	3	2	1	15
	sum		-4	1	3	2	-1	1
	Possibles	15						

Mean	145.00
STNDEV	15.16575
COV	0.104591
Trend:	Positive
Confidence (lookup)	50.0%



S	1
tau	0.066667

Decision 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: **03U831 (abandoned)**

Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/23/1998	0.00	1					
6/15/1999	0.00	1	0				
6/15/2001	0.00	1	0	0			
6/9/2003	0.00	1	0	0	0		
6/7/2005	22.00	1	1	1	1	1	
2/1/2006	32.00	1	1	1	1	1	1
Abandoned							

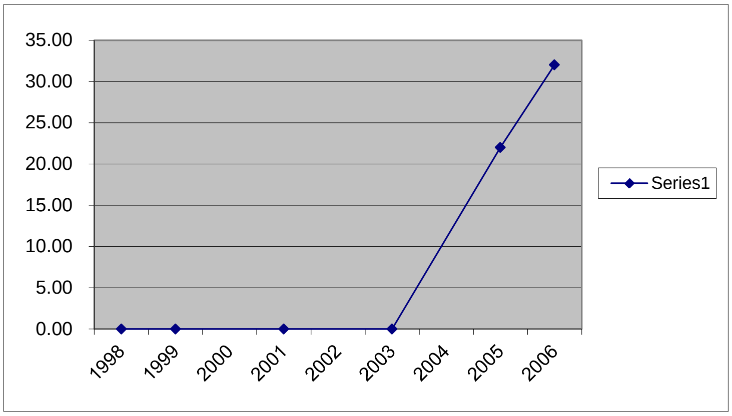
N		6	5	4	3	2	1	15
	sum		2	2	2	2	1	9
Possibles		15						

S	9
tau	0.6

Mean	9.00
STNDEV	14.2969
COV	1.58854

Trend: Positive

Confidence (lookup) 93.20%



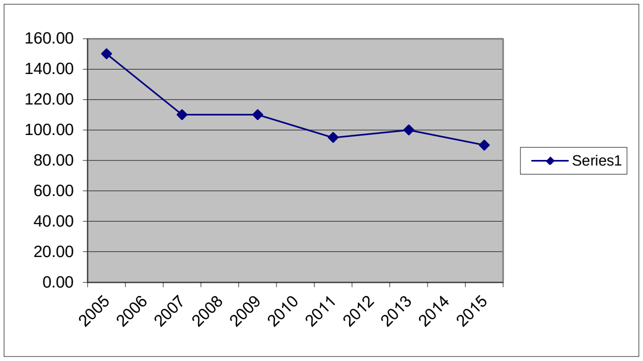
Decision Matrix

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: **03L673**

Date	TCE (µg/L)		Mann-Kendall Calculation:						
6/22/2005	150.00	1							
6/21/2007	110.00	1	-1						
6/18/2009	110.00	1	-1	0					
6/24/2011	95.00	1	-1	-1	-1				
6/27/2013	100.00	1	-1	-1	-1	1			
6/12/2015	90.00	1	-1	-1	-1	-1	-1		
	N	6	5	4	3	2	1	0	15
	sum		-5	-3	-3	0	-1	0	-12
	Possibles	15							

Mean	109.17
STNDEV	21.544528
COV	0.1973545
Trend:	Negative
Confidence (lookup)	98.7%



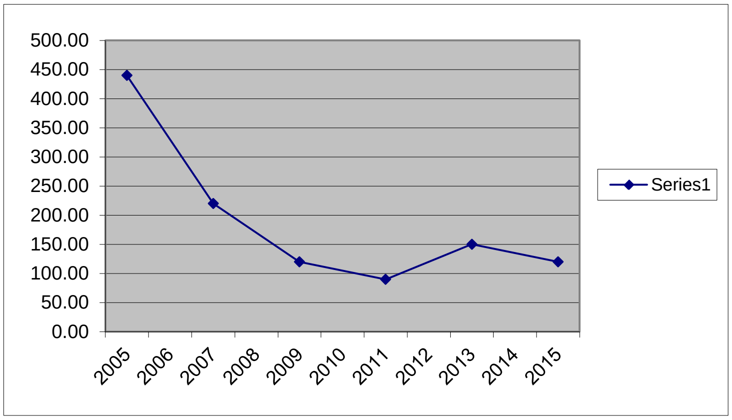
S	-12
tau	-0.8

Decision Matrix

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

Well: **03L809**

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/9/2005	440.00	1						
6/20/2007	220.00	1	-1					
6/12/2009	120.00	1	-1	-1				
6/13/2011	90.00	1	-1	-1	-1			
6/28/2013	150.00	1	-1	-1	1	1		
6/15/2015	120.00	1	-1	-1	0	1	-1	
	N	6	5	4	3	2	1	15
	sum		-5	-4	0	2	-1	-8
	Possibles	15						



Mean	190.00
STNDEV	130.2306
COV	0.685424
Trend:	Negative
Confidence (lookup)	89.6%

S	-8
tau	-0.53333

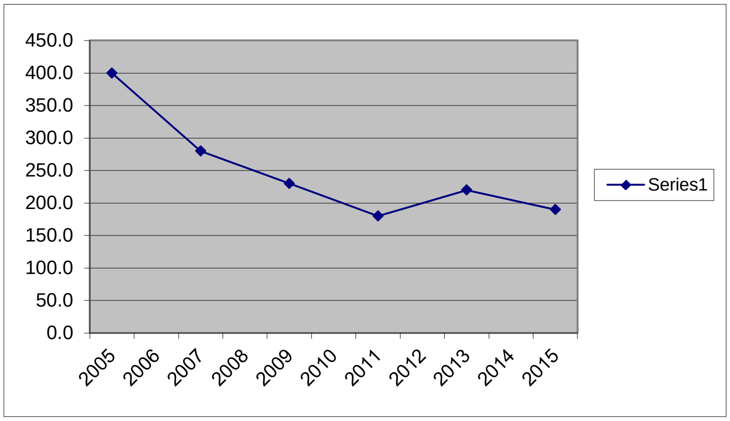
Decision Matrix

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: 03L822

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/14/2005	400.0	1						
6/15/2007	280.0	1	-1					
6/17/2009	230.0	1	-1	-1				
6/29/2011	180.0	1	-1	-1	-1			
6/17/2013	220.0	1	-1	-1	-1	1		
6/23/2015	190.0	1	-1	-1	-1	1	-1	
	N	6	5	4	3	2	1	15
	sum		-5	-4	-3	2	-1	-11
	Possibles	15						

Mean	250.00
STNDEV	81.4862
COV	0.325945
Trend:	Negative
Confidence (lookup)	97.2%



S	-11
tau	-0.73333

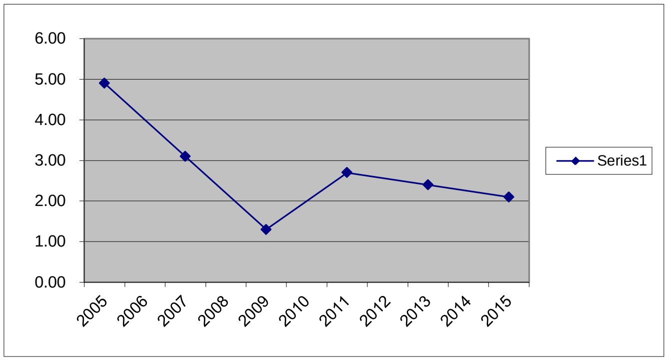
Decision Matrix

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: 03L833

Date	TCE (µg/L)	Mann-Kendall Calculation:							
6/9/2005	4.90	1							
6/14/2007	3.10	1	-1					29.70	
6/12/2009	1.30	1	-1	-1				20.80	
6/9/2011	2.70	1	-1	-1	1			16.00	
6/11/2013	2.40	1	-1	-1	1	-1		13.00	
6/12/2015	2.10	1	-1	-1	1	-1	-1	7.80	
	N	6	5	4	3	2	1		15
	sum		-5	-4	3	-2	-1		-9
	Possibles	15							

Mean	2.75
STNDEV	1.21614
COV	0.44223
Trend:	Negative
Confidence (lookup)	93.2%



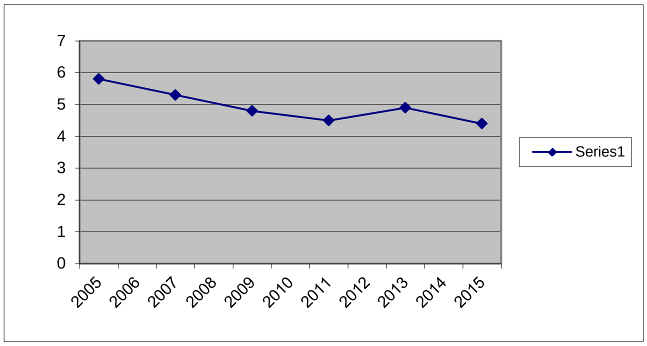
S	-9
tau	-0.6

Decision Matrix

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

Well: 03L848

Date	TCE (µg/L)		Mann-Kendall Calculation:						
#######	5.8	1							
#######	5.3	1	-1						
#######	4.8	1	-1	-1					
#######	4.5	1	-1	-1	-1				
#######	4.9	1	-1	-1	1	1			
#######	4.4	1	-1	-1	-1	-1	-1		
	N	6	5	4	3	2	1	0	15
	sum		-5	-4	-1	0	-1	0	-11
	Possibles	15							



Mean	4.95
STNDEV	0.5244044
COV	0.1059403
Trend:	Negative
Confidence (lookup)	97.2%

S	-11
tau	-0.73333

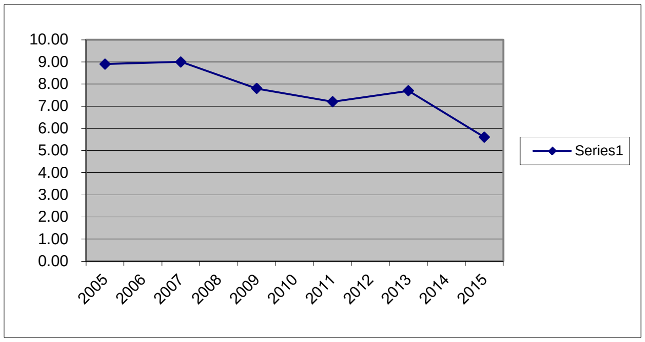
Decision Matrix

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

Well: 03L859

Date	TCE (µg/L)		Mann-Kendall Calculation:					
#######	8.90	1						
#######	9.00	1	1					
#######	7.80	1	-1	-1				
#######	7.20	1	-1	-1	-1			
#######	7.70	1	-1	-1	-1	1		
#######	5.60	1	-1	-1	-1	-1	-1	
	N	6	5	4	3	2	1	15
	sum		-3	-4	-3	0	-1	-11
	Possibles	15						

Mean	7.70
STNDEV	1.2489996
COV	0.1622077
Trend:	Negative
Confidence (lookup)	97.2%



S	-11
tau	-0.73333

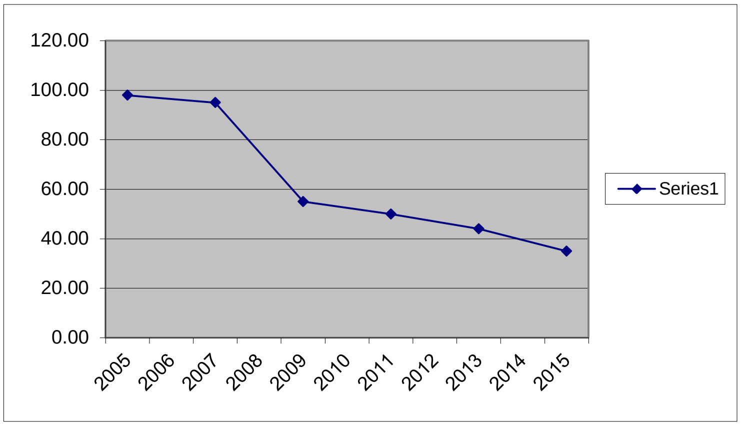
Decision Matrix

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

Well: 04U077

Date	TCE (µg/L)		Mann-Kendall Calculation:					
6/7/2005	98.00	1						
6/12/2007	95.00	1	-1					
6/9/2009	55.00	1	-1	-1				
6/15/2011	50.00	1	-1	-1	-1			
6/10/2013	44.00	1	-1	-1	-1	-1		
6/29/2015	35.00	1	-1	-1	-1	-1	-1	
	N	6	5	4	3	2	1	15
	sum		-5	-4	-3	-2	-1	-15
	Possibles	15						

Mean	62.83
STNDEV	26.93263
COV	0.428636
Trend:	Negative
Confidence (lookup)	99.9%



S	-15
tau	-1

Decision Matrix

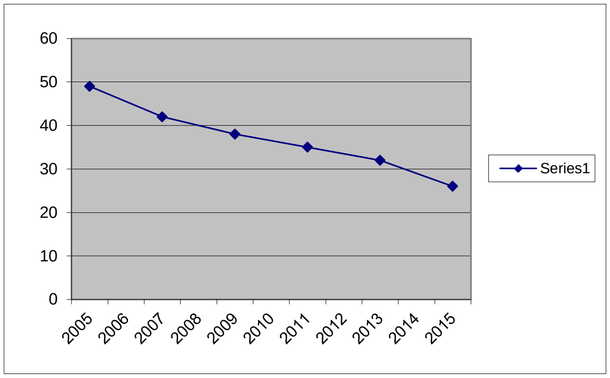
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: **04U673**

Date	TCE (µg/L)		Mann-Kendall Calculation:				
6/22/2005	49	1					
6/21/2007	42	1	-1				
6/18/2009	38	1	-1	-1			
6/24/2011	35	1	-1	-1	-1		
6/27/2013	32	1	-1	-1	-1	-1	
6/12/2015	26	1	-1	-1	-1	-1	-1

N		6	5	4	3	2	1	15
	sum		-5	-4	-3	-2	-1	-15
Possibles		15						

Mean	37.00
STNDEV	8
COV	0.2162162
Trend:	Negative
Confidence (lookup)	99.9%



S	-15
tau	-1

Decision Matrix

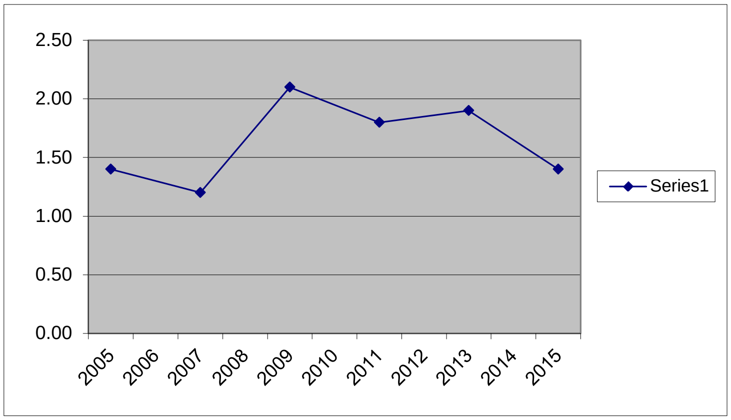
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Prob. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Prob Decr.
S < 0	>95%	na	Decreasing

Well: **04U702**

Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/8/2005	1.40	1					
6/11/2007	1.20	1	-1				
6/10/2009	2.10	1	1	1			
6/6/2011	1.80	1	1	1	-1		
6/11/2013	1.90	1	1	1	-1	1	
6/30/2015	1.40	1	0	1	-1	-1	-1

N		6	5	4	3	2	1	15
	sum		2	4	-3	0	-1	2
Possibles		15						

Mean	1.63
STNDEV	0.35024
COV	0.21443
Trend:	Positive
Confidence (lookup)	57.5%



S	2
tau	0.13333

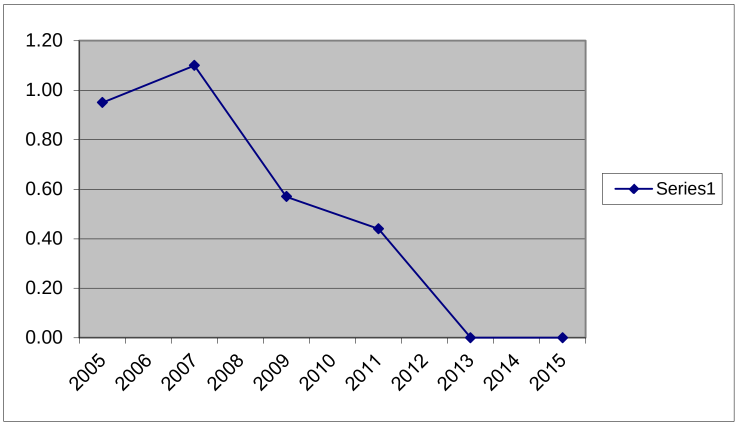
Decision Matrix

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: 04U708

Date	TCE (µg/L)		Mann-Kendall Calculation:					
6/9/2005	0.95	1						
6/11/2007	1.10	1	1					
6/3/2009	0.57	1	-1	-1				
6/7/2011	0.44	1	-1	-1	-1			
6/10/2013	0.00	1	-1	-1	-1	-1		
6/29/2015	0.00	1	-1	-1	-1	-1	0	
	N	6	5	4	3	2	1	15
	sum		-3	-4	-3	-2	0	-12
	Possibles	15						

Mean	0.51
STNDEV	0.462688
COV	0.907231
Trend:	Negative
Confidence (lookup)	98.7%



S	-12
tau	-0.8

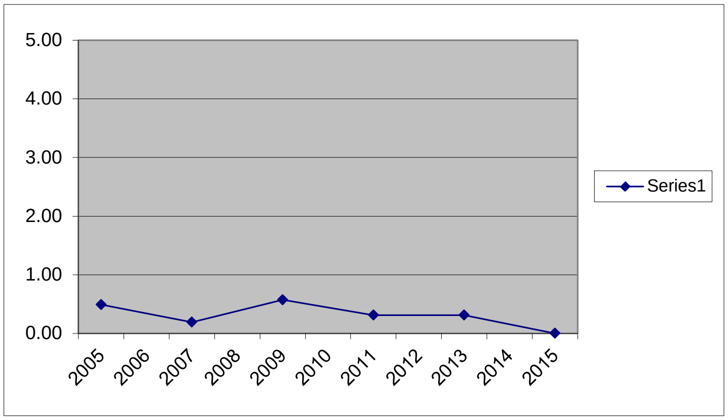
Decision Matrix

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: **04U713**

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/9/2005	0.49	1						
6/11/2007	0.19	1	-1					
6/10/2009	0.57	1	1	1				
6/7/2011	0.31	1	-1	1	-1			
6/12/2013	0.31	1	-1	1	-1	0		
6/23/2015	0.00	1	-1	-1	-1	-1	-1	
	N	6	5	4	3	2	1	15
	sum		-3	2	-3	-1	-1	-6
	Possibles	15						

Mean	0.31
STNDEV	0.20517
COV	0.65831
Trend:	Negative
Confidence (lookup)	81.4%



S	-6
tau	-0.4

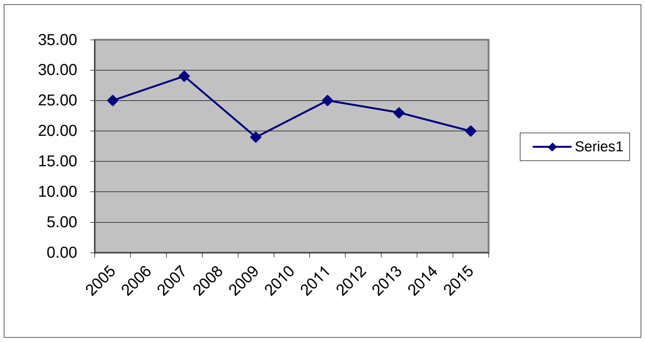
Decision Matrix

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: **04U821**

Date	TCE (µg/L)		Mann-Kendall Calculation:						
#######	25.00		1						
#######	29.00		1	1					
#######	19.00		1	-1	-1				
#######	25.00		1	0	-1	1			
#######	23.00		1	-1	-1	1	-1		
#######	20.00		1	-1	-1	1	-1	-1	
	N		6	5	4	3	2	1	15
		sum		-2	-4	3	-2	-1	-6
	Possibles		15						

Mean	23.50
STNDEV	3.6742346
COV	0.1563504
Trend:	Negative
Confidence (lookup)	81.4%



S	-6
tau	-0.4

Decision Matrix

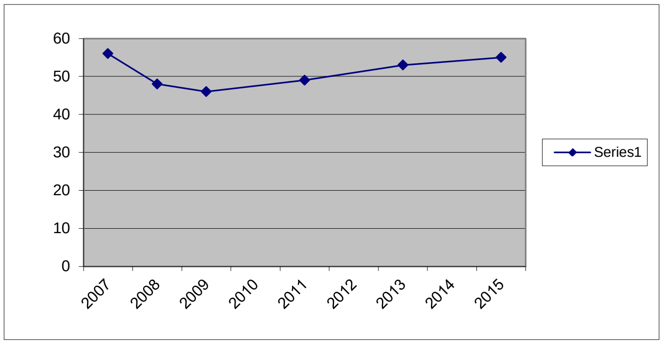
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Prob. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Prob Decr.
S < 0	>95%	na	Decreasing

Well: 04U832

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/22/2007	56	1						
6/17/2008	48	1	-1					
6/19/2009	46	1	-1	-1				
6/23/2011	49	1	-1	1	1			
6/27/2013	53	1	-1	1	1	1		
6/10/2015	55	1	-1	1	1	1	1	

N		6	5	4	3	2	1	0	15
	sum		-5	2	3	2	1	0	3
Possibles		15							

Mean	51.17
STNDEV	4.070217
COV	0.0795482
Trend:	Positive
Confidence (lookup)	64.0%



S	3
tau	0.2

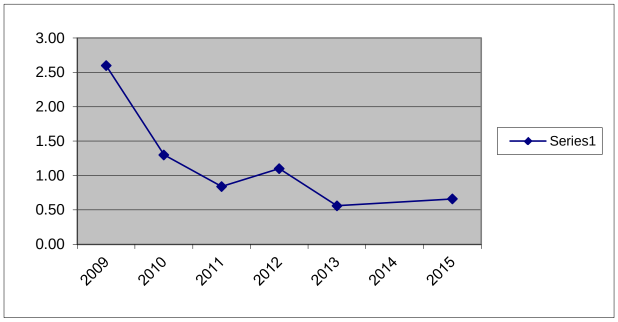
Decision Matrix

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

Well: 04U833

Date	TCE (µg/L)		Mann-Kendall Calculation:					
6/12/2009	2.60	1						
6/3/2010	1.30	1	-1					
6/9/2011	0.84	1	-1	-1				
5/31/2012	1.10	1	-1	-1	1			
6/11/2013	0.56	1	-1	-1	-1	-1		
6/12/2015	0.66	1	-1	-1	-1	-1	1	
	N	6	5	4	3	2	1	15
	sum		-5	-4	-1	-2	1	-11
	Possibles	15						

Mean	1.18
STNDEV	0.7493375
COV	0.6368307
Trend:	Negative
Confidence (lookup)	97.2%



S	-11
tau	-0.73333

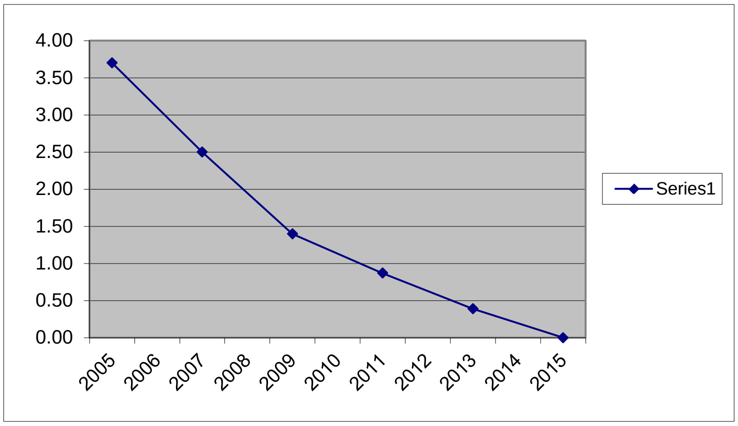
Decision Matrix

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

Well: **04U834**

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/21/2005	3.70	1						
6/7/2007	2.50	1	-1					
6/12/2009	1.40	1	-1	-1				
6/9/2011	0.87	1	-1	-1	-1			
6/12/2013	0.39	1	-1	-1	-1	-1		
6/8/2015	0.00	1	-1	-1	-1	-1	-1	
	N	6	5	4	3	2	1	15
	sum		-5	-4	-3	-2	-1	-15
	Possibles	15						

Mean	1.48
STNDEV	1.394685
COV	0.944482
Trend:	Negative
Confidence (lookup)	99.9%



S	-15
tau	-1

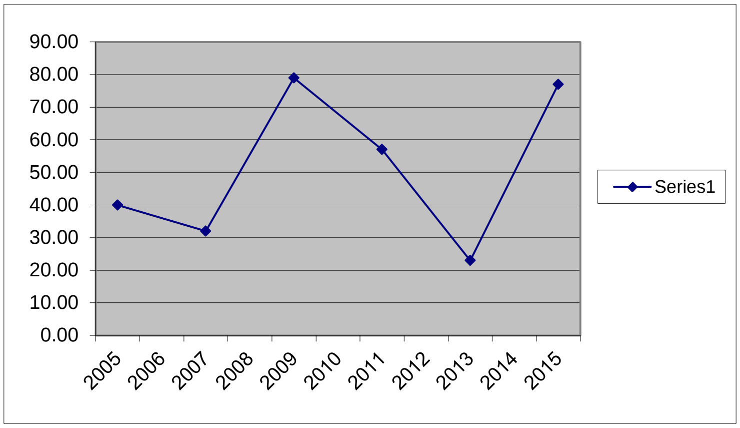
Decision Matrix

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: **04U836**

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/21/2005	40.00	1						
6/15/2007	32.00	1	-1					
6/23/2009	79.00	1	1	1				
6/22/2011	57.00	1	1	1	-1			
6/5/2013	23.00	1	-1	-1	-1	-1		51.33
6/9/2015	77.00	1	1	1	-1	1	1	
	N	6	5	4	3	2	1	15
	sum		1	2	-3	0	1	1
	Possibles	15						

Mean	51.33
STNDEV	23.50035
COV	0.457799
Trend:	Positive
Confidence (lookup)	50.0%



S	1
tau	0.066667

Decision 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: 04U837

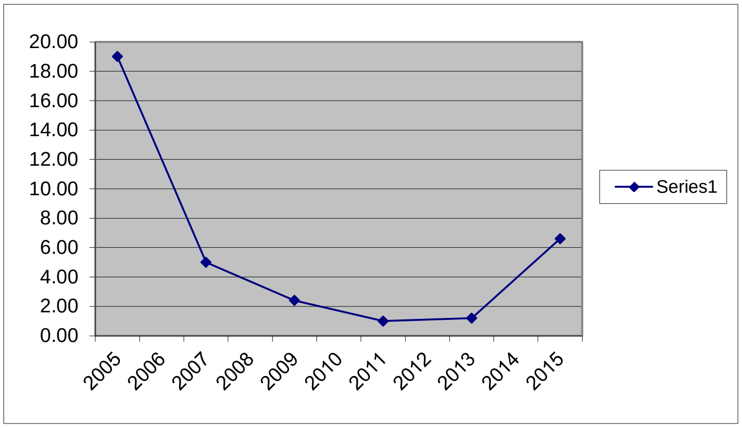
Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/15/2005	19.00	1					
6/12/2007	5.00	1	-1				
6/18/2009	2.40	1	-1	-1			
6/14/2011	1.00	1	-1	-1	-1		
6/11/2013	1.20	1	-1	-1	-1	1	
6/10/2015	6.60	1	-1	1	1	1	1

N		6	5	4	3	2	1	15
	sum		-5	-2	-1	2	1	-5
Possibles		15						

Mean	5.87
STNDEV	6.800784
COV	1.159225

Trend: Negative

Confidence (lookup) 76.5%



S	-5
tau	-0.33333

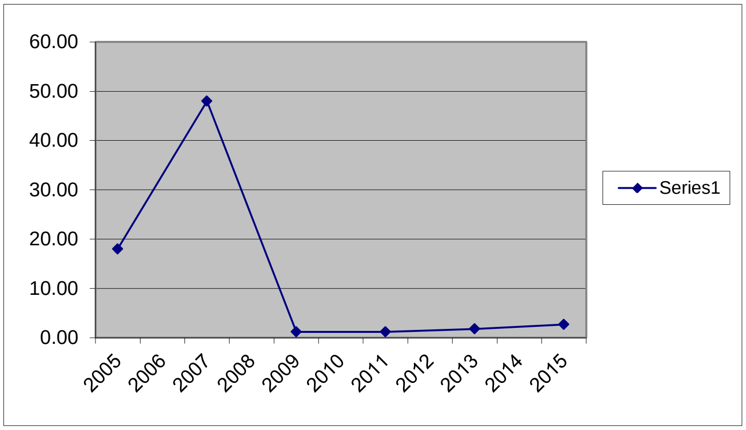
Decision Matrix

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: 04U838

Date	TCE (µg/L)		Mann-Kendall Calculation:					
6/7/2005	18.00	1						
6/12/2007	48.00	1	1					
6/23/2009	1.20	1	-1	-1				
6/8/2011	1.20	1	-1	-1	0			
6/10/2013	1.80	1	-1	-1	1	1		
6/10/2015	2.70	1	-1	-1	1	1	1	
	N	6	5	4	3	2	1	15
	sum		-3	-4	2	2	1	-2
	Possibles	15						

Mean	12.15
STNDEV	18.7386
COV	1.542271
Trend:	Negative
Confidence (lookup)	57.5%



S	-2
tau	-0.13333

Decision Matrix

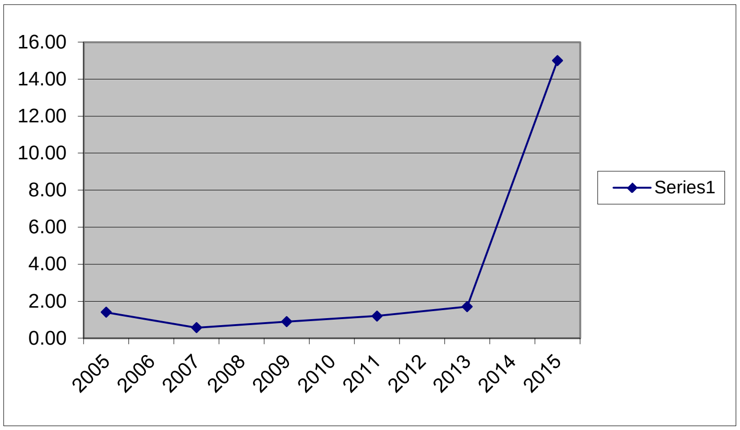
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: **04U839**

Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/7/2005	1.40	1					
6/8/2007	0.57	1	-1				
6/9/2009	0.89	1	-1	1			
6/8/2011	1.20	1	-1	1	1		
6/13/2013	1.7	1	1	1	1	1	
6/9/2015	15	1	1	1	1	1	1

N		6	5	4	3	2	1	15
	sum		-1	4	3	2	1	9
Possibles		15						

Mean	3.46
STNDEV	5.667052
COV	1.637876
Trend:	Positive
Confidence (lookup)	93.2%



S	9
tau	0.6

Decision Matrix

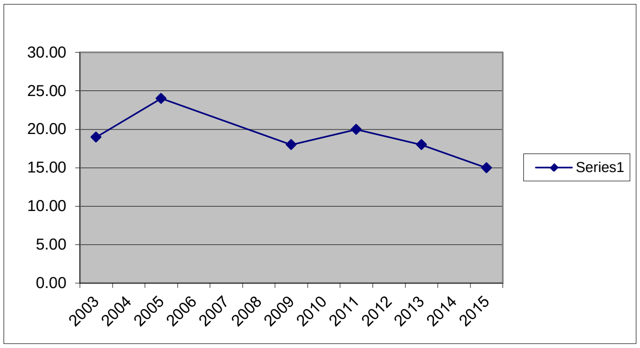
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: 04U841

Date	TCE (µg/L)		Mann-Kendall Calculation:				
6/11/2003	19.00	1					
6/9/2005	24.00	1	1				
6/9/2009	18.00	1	-1	-1			
6/16/2011	20.00	1	1	-1	1		
6/13/2013	18.00	1	-1	-1	0	-1	
6/17/2015	15.00	1	-1	-1	-1	-1	-1

N		6	5	4	3	2	1	15
	sum		-1	-4	0	-2	-1	-8
Possibles		15						

Mean	17.75
STNDEV	2.0615528
COV	0.1161438
Trend:	Negative
Confidence (lookup)	89.6%



S	-8
tau	-0.53333

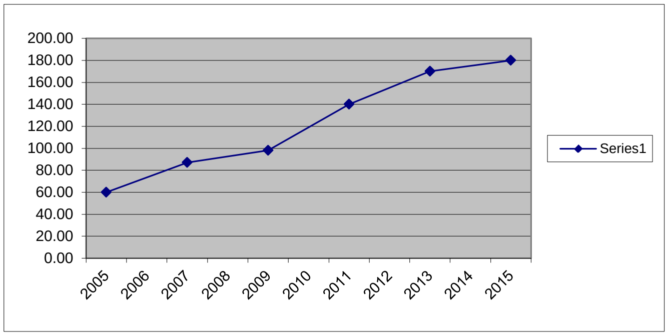
Decision Matrix

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

Well: 04U843

Date	TCE (µg/L)		Mann-Kendall Calculation:							
6/7/2005	60.00	1								
6/14/2007	87.00	1	1							
6/15/2009	98.00	1	1	1						
6/28/2011	140.00	1	1	1	1					
6/18/2013	170.00	1	1	1	1	1				
6/23/2015	180.00	1	1	1	1	1	1		0	
	N	6	5	4	3	2	1			15
		sum	5	4	3	2	1			15
	Possibles	15								

Mean	122.50
STNDEV	48.2400249
COV	0.39379612
Trend:	Positive
Confidence (lookup)	99.9%



S	15
tau	1

Decision Matrix

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

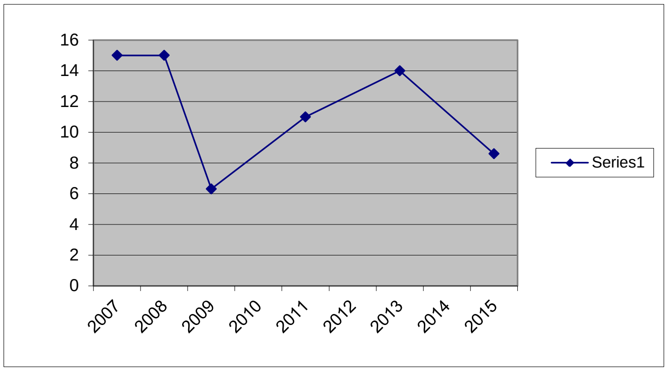
Well: 04U845

Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/22/2007	15	1					
6/17/2008	15	1	0				
6/13/2009	6.3	1	-1	-1			
6/23/2011	11	1	-1	-1	1		
6/25/2013	14	1	-1	-1	1	1	
6/11/2015	8.6	1	-1	-1	1	-1	-1

N		6	5	4	3	2	1	15
	sum		-4	-4	3	0	-1	-6
Possibles		15						

Mean	11.65
STNDEV	3.6418402
COV	0.3126043

Trend:	Negative
Confidence (lookup)	81.4%



S	-6
tau	-0.4

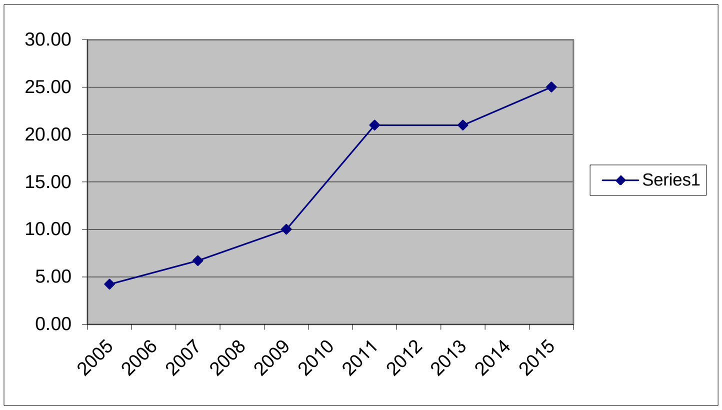
Decision Matrix

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

Well: **04U846**

Date	TCE (µg/L)		Mann-Kendall Calculation:							
6/10/2005	4.20		1							
6/12/2007	6.70		1	1						
6/9/2009	10.00		1	1	1					
6/15/2011	21.00		1	1	1	1				
6/12/2013	21.00		1	1	1	1	0			
6/17/2015	25.00		1	1	1	1	1	1		
	N		6	5	4	3	2	1	-1	14
		sum		5	4	3	1	1	0	14
	Possibles		15							

Mean	14.65	
STNDEV	8.73836369	
COV	0.59647534	
Trend:		Positive
Confidence (lookup)		99.5%



S	14
tau	0.933333

Decision Matrix

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

Well: **04U847**

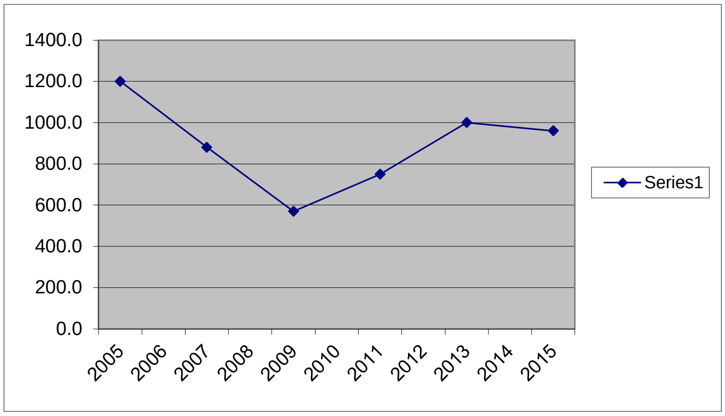
Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/15/2005	1200.0	1					
6/18/2007	880.0	1	-1				
6/19/2009	570.0	1	-1	-1			
6/29/2011	750.0	1	-1	-1	1		
6/19/2013	1000.0	1	-1	1	1	1	
6/24/2015	960.0	1	-1	1	1	1	-1

N		6	5	4	3	2	1	15
	sum		-5	0	3	2	-1	-1
Possibles		15						

Mean	893.33
STNDEV	216.856
COV	0.24275

Trend: Negative

Confidence (lookup) 50.0%



S	-1
tau	-0.06667

Decision 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: **04U849**

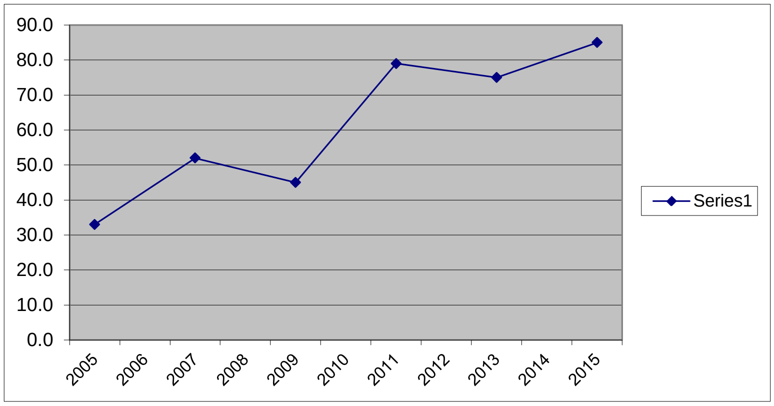
Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/16/2005	33.0	1					
6/11/2007	52.0	1	1				
6/12/2009	45.0	1	1	-1			
6/21/2011	79.0	1	1	1	1		
6/17/2013	75.0	1	1	1	1	-1	
6/22/2015	85.0	1	1	1	1	1	1

N		6	5	4	3	2	1	15
	sum		5	2	3	0	1	11
Possibles		15						

Mean	61.50
STNDEV	21.0499
COV	0.34228

Trend: Positive

Confidence (lookup) 97.2%



S	11
tau	0.73333

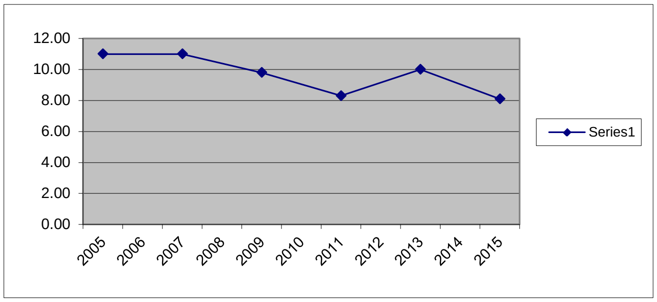
Decision Matrix

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: 04U854

Date	TCE (µg/L)		Mann-Kendall Calculation:					
6/23/2005	11.00	1						
6/21/2007	11.00	1	0					
6/18/2009	9.80	1	-1	-1				
6/23/2011	8.30	1	-1	-1	-1			
6/25/2013	10.00	1	-1	-1	1	1		
6/11/2015	8.10	1	-1	-1	-1	-1	-1	
	N	6	5	4	3	2	1	15
	sum		-4	-4	-1	0	-1	-10
	Possibles	15						

Mean	9.70
STNDEV	1.2649111
COV	0.1304032
Trend:	Negative
Confidence (lookup)	95.4%



S	-10
tau	-0.66667

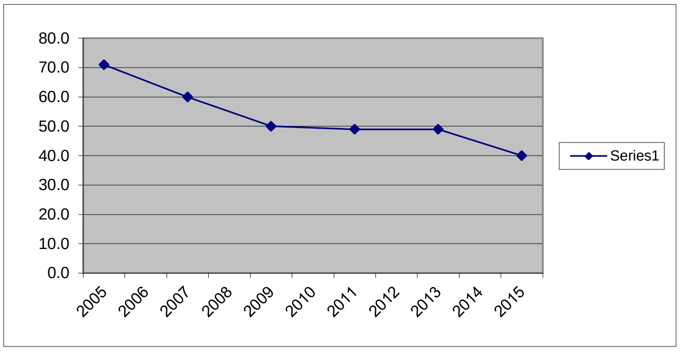
Decision Matrix

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

Well: **04U859**

Date	TCE (µg/L)		Mann-Kendall Calculation:					
6/22/2005	71.0	1						
6/21/2007	60.0	1	-1					
6/18/2009	50.0	1	-1	-1				
6/24/2011	49.0	1	-1	-1	-1			
6/27/2013	49.0	1	-1	-1	-1	0		
6/10/2015	40.0	1	-1	-1	-1	-1	-1	
	N	6	5	4	3	2	1	15
		sum	-5	-4	-3	-1	-1	-14
	Possibles	15						

Mean	53.17
STNDEV	10.7966044
COV	0.20307093
Trend:	Negative
Confidence (lookup)	99.5%



S	-14
tau	-0.93333

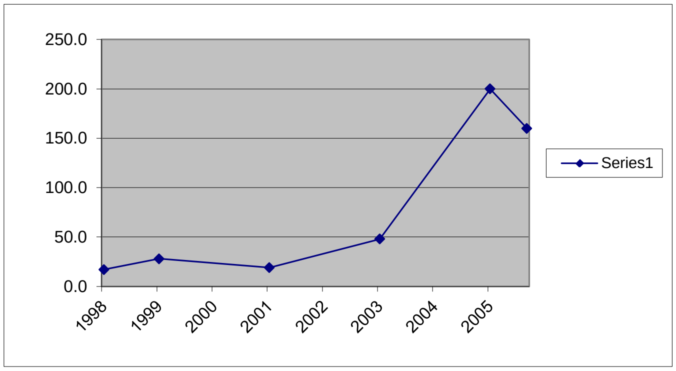
Decision Matrix

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

Well: **04U861 (abandoned)**

Date	TCE (µg/L)		Mann-Kendall Calculation:						
6/29/1998	17.1		1						
6/7/1999	28.0		1	1					
6/11/2001	19.0		1	1	-1				
6/1/2003	48.0		1	1	1	1			
6/23/2005	200.0		1	1	1	1	1		
2/8/2006	160.0		1	1	1	1	1	-1	
Abandoned									
	N		6	5	4	3	2	1	15
		sum		5	2	3	2	-1	11
	Possibles		15						

Mean	78.68
STNDEV	80.24339
COV	1.019827
Trend:	Positive
Confidence (lookup)	97.00%



S	11
tau	0.733333

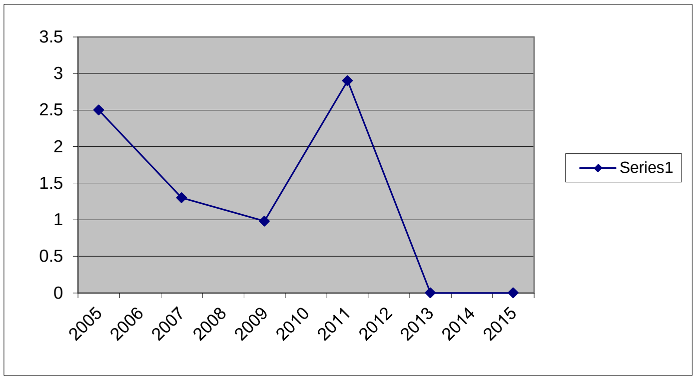
Decision Matrix

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

Well: **04U875**

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/22/2005	2.5	1						
6/7/2007	1.3	1	-1					
6/12/2009	0.98	1	-1	-1				
6/9/2011	2.9	1	1	1	1			
6/17/2013	0	1	-1	-1	-1	-1		
6/5/2015	0	1	-1	-1	-1	-1	0	
	N	6	5	4	3	2	1	15
	sum		-3	-2	-1	-2	0	-8
	Possibles	15						

Mean	1.28
STNDEV	1.2231108
COV	0.9555553
Trend:	Negative
Confidence (lookup)	89.6%



S	-8
tau	-0.53333

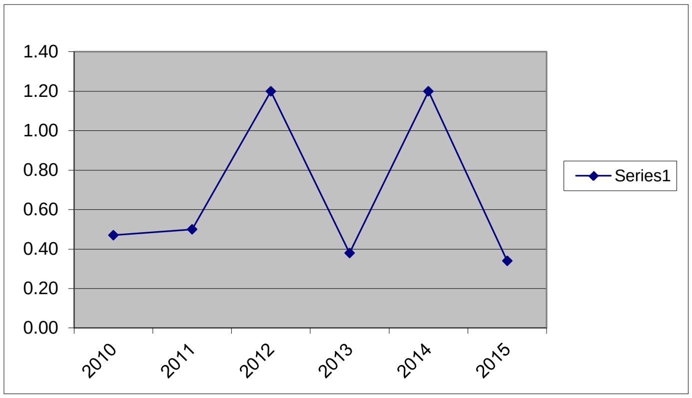
Decision Matrix

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

Well: 04U877

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/8/2010	0.47	1						
6/8/2011	0.50	1	1					
6/26/2012	1.20	1	1	1				
6/11/2013	0.38	1	-1	-1	-1			
6/11/2014	1.20	1	1	1	0	1		
6/8/2015	0.34	1	-1	-1	-1	-1	-1	
	N	6	5	4	3	2	1	15
		sum	1	0	-2	0	-1	-2
	Possibles	15						

Mean	0.68
STNDEV	0.4056805
COV	0.5951303
Trend:	Negative
Confidence (lookup)	57.5%



S	-2
tau	-0.13333

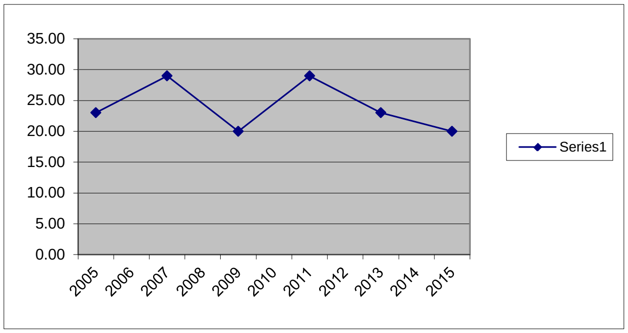
Decision Matrix

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

Well: 04U882

Date	TCE (µg/L)		Mann-Kendall Calculation:				
6/17/2005	23.00	1					
6/12/2007	29.00	1	1				
6/23/2009	20.00	1	-1	-1			
6/21/2011	29.00	1	1	0	1		
6/14/2013	23.00	1	0	-1	1	-1	
6/17/2015	20.00	1	-1	-1	0	-1	-1

N		6	5	4	3	2	1	15
	sum		0	-3	2	-2	-1	-4
Possibles		15						



Mean	24.00
STNDEV	4.0987803
COV	0.1707825
Trend:	Negative
Confidence (lookup)	70.7%

S	-4
tau	-0.26667

Decision Matrix

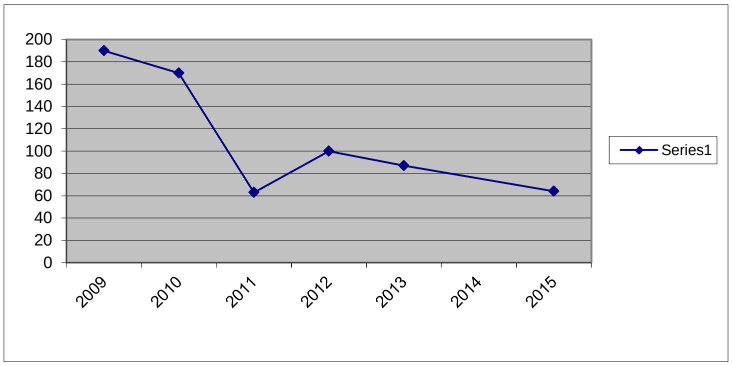
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Prob. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Prob Decr.
S < 0	>95%	na	Decreasing

Well: 04J077

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/9/2009	190	1						
6/3/2010	170	1	-1					
6/15/2011	63	1	-1	-1				
5/30/2012	100	1	-1	-1	1			
6/10/2013	87	1	-1	-1	1	-1		
6/29/2015	64	1	-1	-1	1	-1	-1	
	N	6	5	4	3	2	1	15
	sum		-5	-4	3	-2	-1	-9
	Possibles	15						

S	-9
tau	-0.6

Mean	112.33
STNDEV	54.62844
COV	0.486307
Trend:	Negative
Confidence (lookup)	93.2%



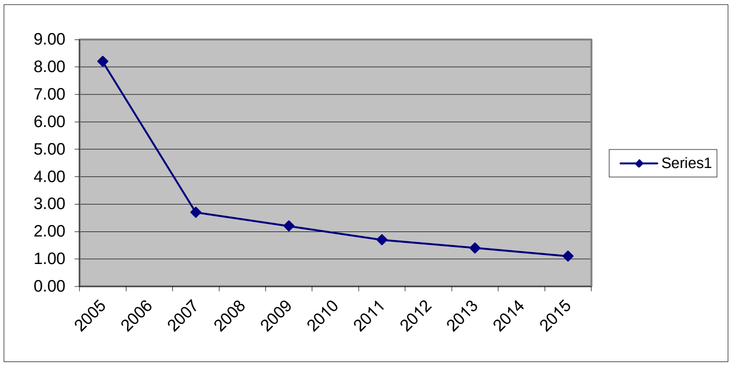
Decision Matrix

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: 04J702

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/8/2005	8.20	1						
6/11/2007	2.70	1	-1					
6/10/2009	2.20	1	-1	-1				
6/6/2011	1.70	1	-1	-1	-1			
6/11/2013	1.40	1	-1	-1	-1	-1		
6/30/2015	1.10	1	-1	-1	-1	-1	-1	
	N	6	5	4	3	2	1	15
	sum		-5	-4	-3	-2	-1	-15
	Possibles	15						

Mean	2.88
STNDEV	2.666396
COV	0.924762
Trend:	Negative
Confidence (lookup)	99.9%



S	-15
tau	-1

Decision Matrix

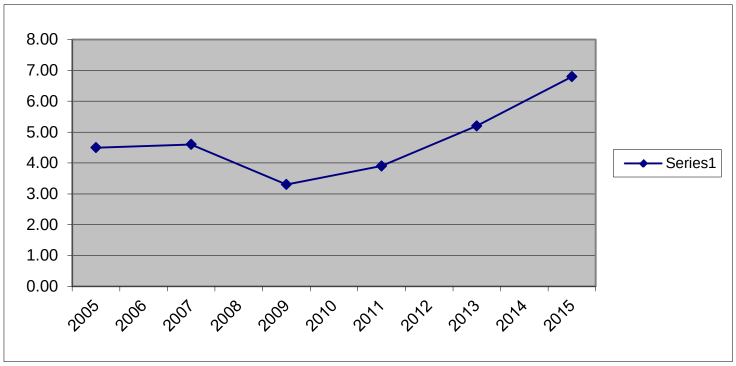
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: **04J708**

Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/9/2005	4.50	1					
6/6/2007	4.60	1	1				
6/3/2009	3.30	1	-1	-1			
6/7/2011	3.90	1	-1	-1	1		
6/10/2013	5.20	1	1	1	1	1	
6/29/2015	6.80	1	1	1	1	1	1

N	6	5	4	3	2	1	15
sum		1	0	3	2	1	7
Possibles	15						

Mean	4.72
STNDEV	1.208994
COV	0.256324
Trend:	Positive
Confidence (lookup)	86.4%



S	7
tau	0.466667

Decision Matrix

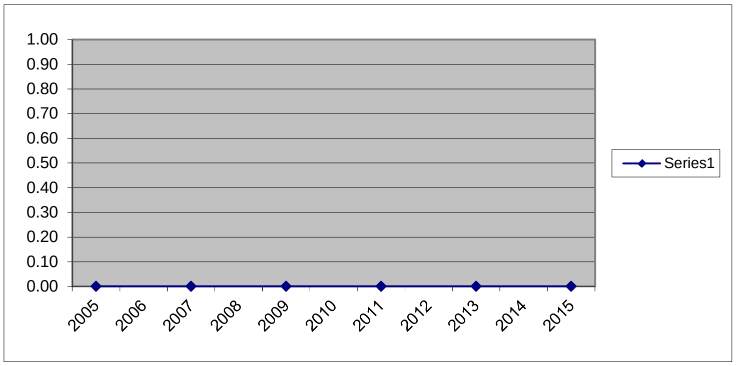
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: 04J713

Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/9/2005	0.00	1					
6/11/2007	0.00	1	0				
6/10/2009	0.00	1	0	0			
6/7/2011	0.00	1	0	0	0		
6/12/2013	0.00	1	0	0	0	0	
6/23/2015	0.00	1	0	0	0	0	0

N		6	5	4	3	2	1	15
	sum		0	0	0	0	0	0
Possibles		15						

Mean	0.00
STNDEV	0
COV	#DIV/0!
Trend:	Zero
Confidence (lookup)	41.8%



S	0
tau	0

Decision Matrix

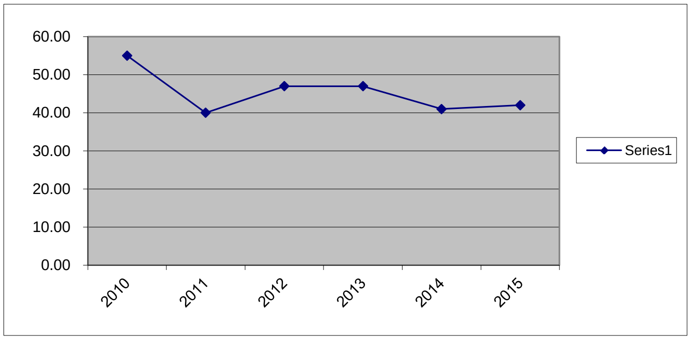
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: 04J822

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/9/2010	55.00	1						
6/28/2011	40.00	1	-1					
6/25/2012	47.00	1	-1	1				
6/17/2013	47.00	1	-1	1	0			
6/10/2014	41.00	1	-1	1	-1	-1		45.33
6/18/2015	42.00	1	-1	1	-1	-1	1	

N		6	5	4	3	2	1	15
	sum		-5	4	-2	-2	1	-4
Possibles		15						

Mean	45.33
STNDEV	5.60951572
COV	0.12373932
Trend:	Negative
Confidence (lookup)	70.7%



S	-4
tau	-0.26667

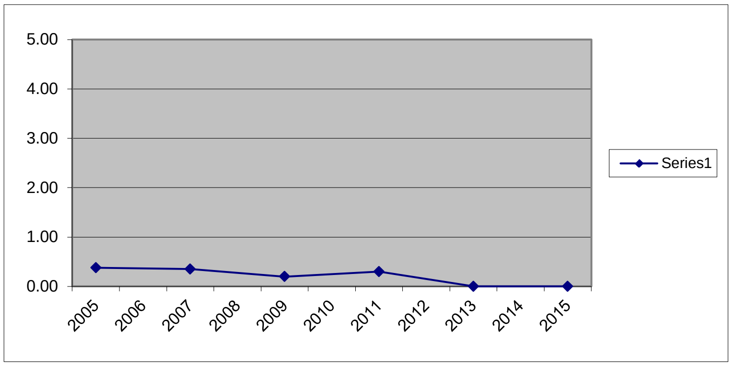
Decision Matrix

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: 04J834

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/8/2005	0.38	1						
6/4/2007	0.35	1	-1					
6/4/2009	0.20	1	-1	-1				
6/3/2011	0.30	1	-1	-1	1			
6/6/2013	0.00	1	-1	-1	-1	-1		
6/4/2015	0.00	1	-1	-1	-1	-1	0	
	N	6	5	4	3	2	1	15
	sum		-5	-4	-1	-2	0	-12
	Possibles	15						

Mean	0.21
STNDEV	0.170147
COV	0.829985
Trend:	Negative
Confidence (lookup)	98.7%



S	-12
tau	-0.8

Decision Matrix

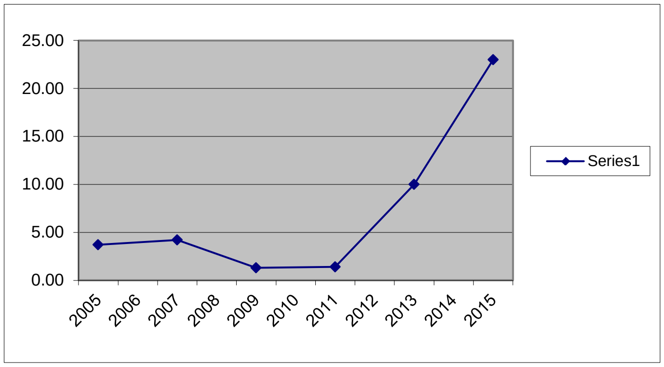
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: **04J836**

Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/21/2005	3.70	1					
6/13/2007	4.20	1	1				
6/22/2009	1.30	1	-1	-1			
6/22/2011	1.40	1	-1	-1	1		
6/5/2013	10.00	1	1	1	1	1	
6/9/2015	23.00	1	1	1	1	1	1

N		6	5	4	3	2	14
	sum		1	0	3	2	6
Possibles		15					

Mean	7.27
STNDEV	8.332507
COV	1.146675
Trend:	Positive
Confidence (lookup)	81.4%



S	6
tau	0.4

Decision Matrix

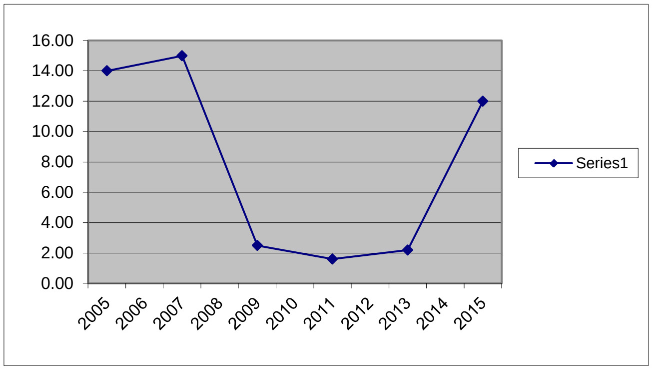
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: 04J837

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/20/2005	14.00	1						
6/8/2007	15.00	1	1					
6/19/2009	2.50	1	-1	-1				
6/15/2011	1.60	1	-1	-1	-1			
6/12/2013	2.20	1	-1	-1	-1	1		
6/15/2015	12.00	1	-1	-1	1	1	1	
	N	6	5	4	3	2	1	15
	sum		-3	-4	-1	2	1	-5
	Possibles	15						

S	-5
tau	-0.33333

Mean	7.88
STNDEV	6.415112
COV	0.813756
Trend:	Negative
Confidence (lookup)	76.5%



Decision 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

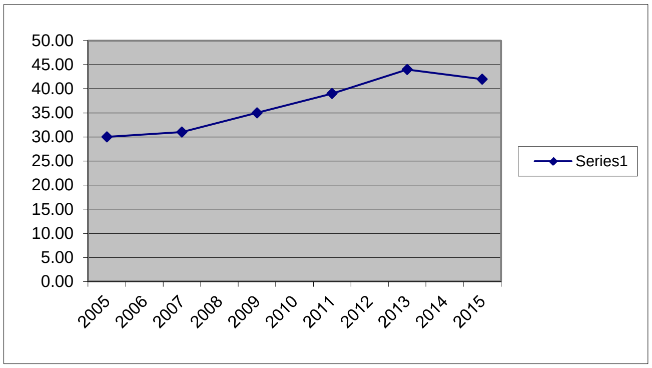
Well: **04J838**

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/17/2005	30.00	1						
6/12/2007	31.00	1	1					
6/22/2009	35.00	1	1	1				
6/21/2011	39.00	1	1	1	1			
6/14/2013	44.00	1	1	1	1	1		
6/17/2015	42.00	1	1	1	1	1	-1	
	N	6	5	4	3	2	1	15
	sum		5	4	3	2	-1	13
	Possibles	15						

Mean	36.83
STNDEV	5.776389
COV	0.156825

Trend: Positive

Confidence (lookup) 99.2%



S	13
tau	0.866667

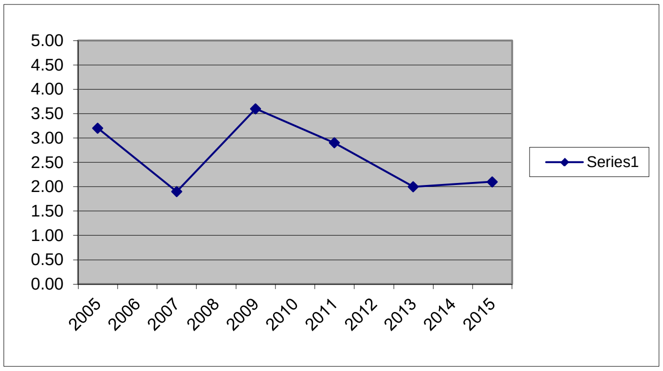
Decision Matrix

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: 04J839

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/17/2005	3.20	1						
6/8/2007	1.90	1	-1					
6/10/2009	3.60	1	1	1				
6/15/2011	2.90	1	-1	1	-1			
6/13/2013	2.00	1	-1	1	-1	-1		
6/9/2015	2.10	1	-1	1	-1	-1	1	
	N	6	5	4	3	2	1	15
	sum		-3	4	-3	-2	1	-3
	Possibles	15						

Mean	2.62
STNDEV	0.713909
COV	0.272832
Trend:	Negative
Confidence (lookup)	64.0%



S	-3
tau	-0.2

Decision 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

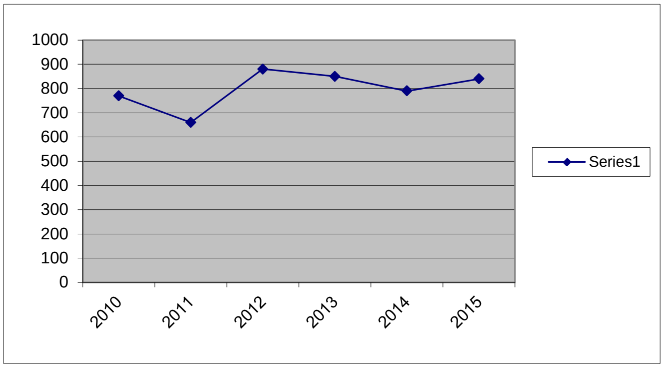
Well: **04J847**

Date	TCE (µg/L)		Mann-Kendall Calculation:						
6/10/2010	770	1							
6/30/2011	660	1	-1						
6/25/2012	880	1	1	1					
6/19/2013	850	1	1	1	-1				
6/11/2014	790	1	1	1	-1	-1		798	
6/24/2015	840	1	1	1	-1	-1	1		
	N	6	5	4	3	2	1		15
	sum		3	4	-3	-2	1		3
	Possibles	15							

Mean	798.33
STNDEV	78.8458
COV	0.09876

Trend: Positive

Confidence (lookup) 64.0%



S	3
tau	0.2

Decision 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

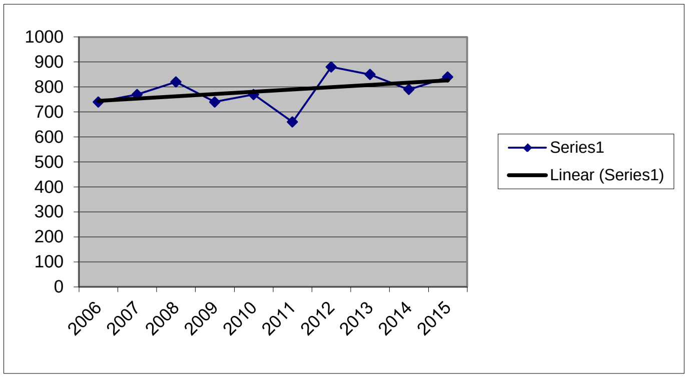
Well: **04J847 (ext.)**

Date	TCE (ug/l)		Mann-Kendall Calculation:									
12/11/2006	740	1										
6/18/2007	770	1	1									
6/25/2008	820	1	1	1								
6/18/2009	740	1	0	-1	-1							
6/10/2010	770	1	1	0	-1	1						
6/30/2011	660	1	-1	-1	-1	-1	-1					
6/25/2012	880	1	1	1	1	1	1	1				
6/19/2013	850	1	1	1	1	1	1	1	-1			
6/11/2014	790	1	1	1	-1	1	1	1	-1	-1		
6/24/2015	840	1	1	1	1	1	1	1	-1	-1	1	
	N	10	9	8	7	6	5	4	3	2	1	45
	sum		6	3	-1	4	3	4	-3	-2	1	15
	Possibles	45										

Mean	786.00
STNDEV	64.6701
COV	0.08228

Trend: Positive

Confidence (lookup)



S	15
tau	0.33333

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**

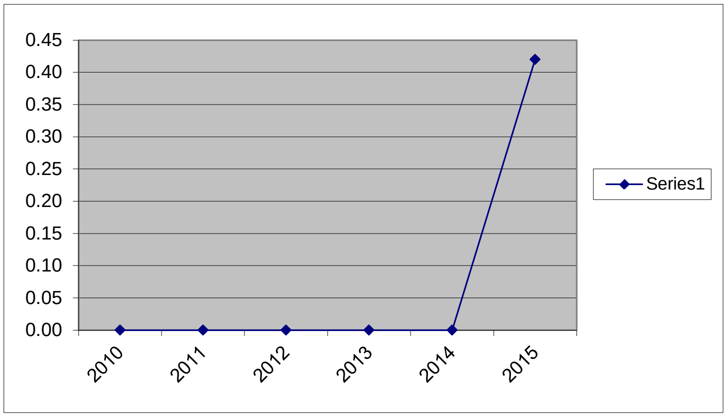
Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/8/2010	0.00	1					
6/14/2011	0.00	1	0				
6/25/2012	0.00	1	0	0			
6/11/2013	0.00	1	0	0	0		
6/10/2014	0.00	1	0	0	0	0	
6/11/2015	0.42	1	1	1	1	1	1

N	6	5	4	3	2	1	15
sum		1	1	1	1	1	5
Possibles	15						

Mean	0.07
STNDEV	0.17146
COV	2.44949

Trend: Positive

Confidence (lookup) 76.5%



S	5
tau	0.33333

Decision Matrix

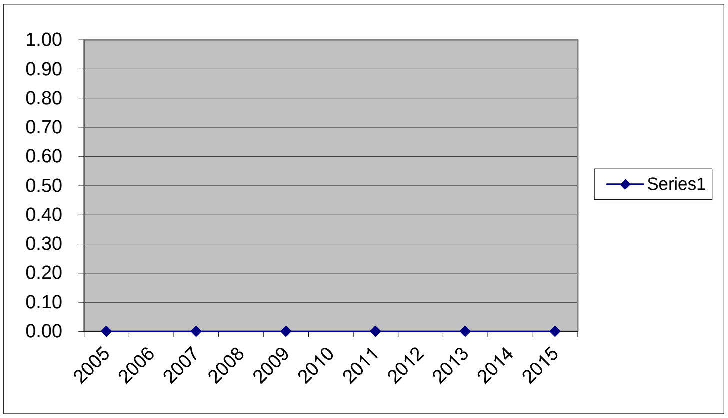
M-K S	Confidence	COV	Trend
S > 0	> 95%	na	Increasing
S > 0	90-95%	na	Pr. Incr.
S > 0	< 90%	na	No Trend
S</= 0	< 90%	>/= 1	No Trend
S </= 0	< 90%	< 1	Stable
S < 0	90-95%	na	Pr. Decr.
S < 0	>95%	na	Decreasing

Well: 04J882

Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/8/2005	0.00	1					
6/6/2007	0.00	1	0				
6/5/2009	0.00	1	0	0			
6/3/2011	0.00	1	0	0	0		
6/10/2013	0.00	1	0	0	0	0	
6/4/2015	0.00	1	0	0	0	0	0

N		6	5	4	3	2	1	15
	sum		0	0	0	0	0	0
Possibles		15						

Mean	0.00
STNDEV	0
COV	#DIV/0!
Trend:	Zero
Confidence (lookup)	41.8%



S	0
tau	0

Decision 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

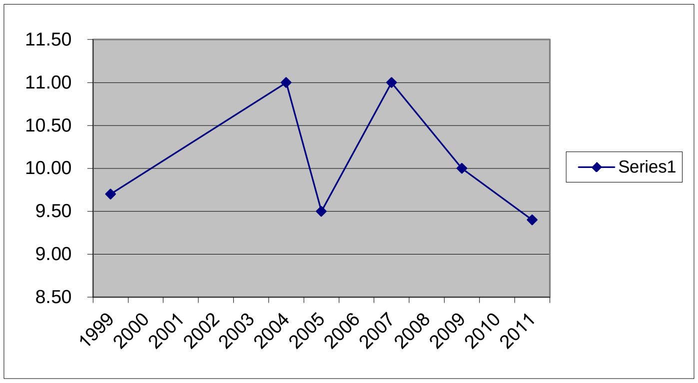
Well: 206688

Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/9/1999	9.70	1					
6/23/2004	11.00	1	1				
6/6/2005	9.50	1	-1	-1			
6/11/2007	11.00	1	1	0	1		
6/19/2009	10.00	1	1	-1	1	-1	
6/23/2011	9.40	1	-1	-1	-1	-1	-1

No sample could be collected in 2015: power to the well pump had been disconnected.

N		6	5	4	3	2	1	15
	sum		1	-3	1	-2	-1	-4
Possibles		15						

Mean	10.10
STNDEV	0.7266361
COV	0.0719442
Trend:	Negative
Confidence (lookup)	70.7%



S	-4
tau	-0.26667

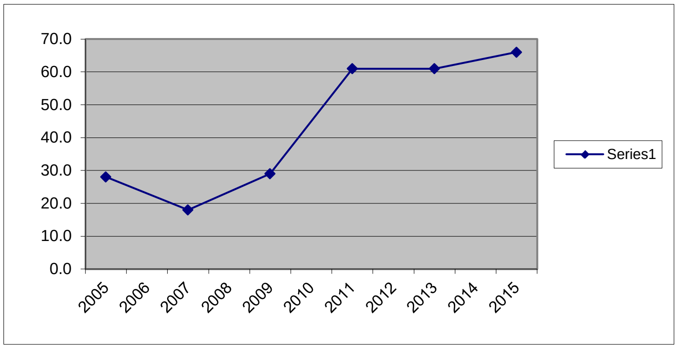
Decision Matrix

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

Well: **409549**

Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/10/2005	28.0	1					
6/13/2007	18.0	1	-1				
6/10/2009	29.0	1	1	1			
6/17/2011	61.0	1	1	1	1		
6/14/2013	61.0	1	1	1	1	0	
6/19/2015	66.0	1	1	1	1	1	1

N		6	5	4	3	2	1	15
	sum		3	4	3	1	1	12
Possibles		15						



Mean	43.83
STNDEV	21.06577
COV	0.480588

Trend: Positive

Confidence (lookup) 98.7%

S	12
tau	0.8

Decision Matrix

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

Well: 409550

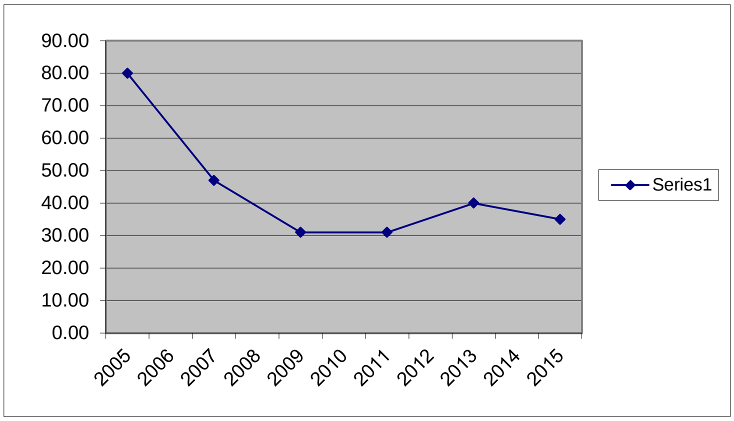
Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/14/2005	80.00	1					
6/15/2007	47.00	1	-1				
6/12/2009	31.00	1	-1	-1			
6/21/2011	31.00	1	-1	-1	0		
6/14/2013	40.00	1	-1	-1	1	1	
6/19/2015	35.00	1	-1	-1	1	1	-1

N		6	5	4	3	2	1	15
	sum		-5	-4	2	2	-1	-6
Possibles		15						

Mean	44.00
STNDEV	18.65476
COV	0.423972

Trend: Negative

Confidence (lookup) 81.4%



S	-6
tau	-0.4

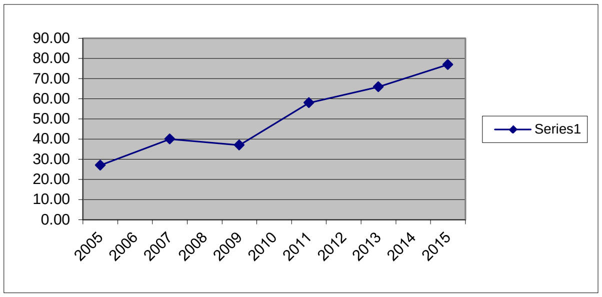
Decision Matrix

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: 409557

Date	TCE (µg/L)	Mann-Kendall Calculation:						
6/9/2005	27.00	1						
6/11/2007	40.00	1	1					
6/11/2009	37.00	1	1	-1				
6/21/2011	58.00	1	1	1	1			
6/14/2013	66.00	1	1	1	1	1		
6/12/2015	77.00	1	1	1	1	1	1	
	N	6	5	4	3	2	1	15
	sum		5	2	3	2	1	13
	Possibles	15						

Mean	50.83
STNDEV	19.1980902
COV	0.37766735
Trend:	Positive
Confidence (lookup)	99.2%



S	13
tau	0.866667

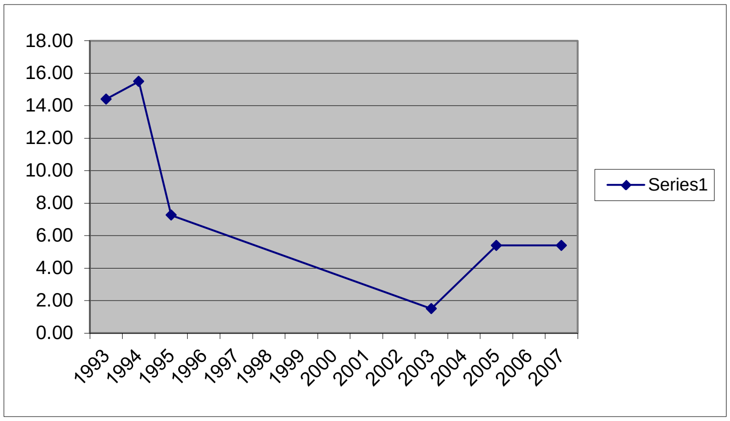
Decision Matrix

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

Well: 409596 (abandoned)

Date	TCE (µg/L)	Mann-Kendall Calculation:						
3/15/1993	14.40	1						
3/18/1994	15.50	1	1					
3/20/1995	7.26	1	-1	-1				
6/13/2003	1.50	1	-1	-1	-1			
6/9/2005	5.40	1	-1	-1	-1	1		
6/14/2007	5.40	1	-1	-1	-1	1	0	
abandoned								
	N	6	5	4	3	2	1	15
	sum		-3	-4	-3	2	0	-8
	Possibles	15						

Mean	8.24
STNDEV	5.534841
COV	0.671432
Trend:	Negative
Confidence (lookup)	90.10%



S	-8
tau	-0.53333

Decision 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: 409597 (abandoned)

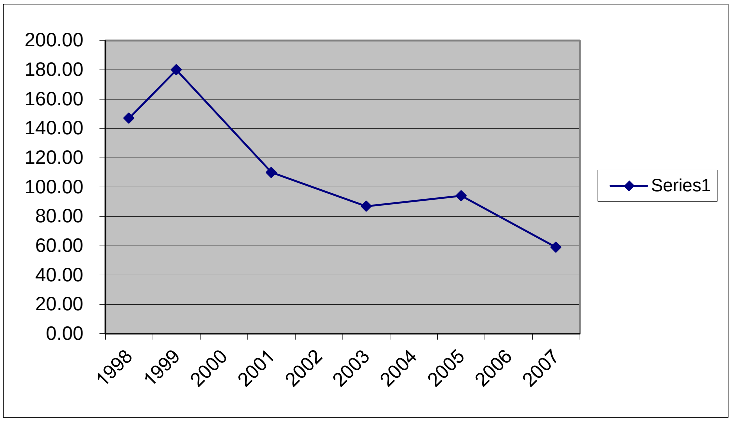
Date	TCE (µg/L)	Mann-Kendall Calculation:					
6/23/1998	147.00	1					
6/15/1999	180.00	1	1				
6/23/2001	110.00	1	-1	-1			
6/13/2003	87.00	1	-1	-1	-1		
6/14/2005	94.00	1	-1	-1	-1	1	
6/15/2007	59.00	1	-1	-1	-1	-1	-1
Abandoned							

N		6	5	4	3	2	1	15
	sum		-3	-4	-3	0	-1	-11
Possibles		15						

Mean	112.83
STNDEV	43.8334
COV	0.388479

Trend: Negative

Confidence (lookup) 99.00%



S	-11
tau	-0.73333

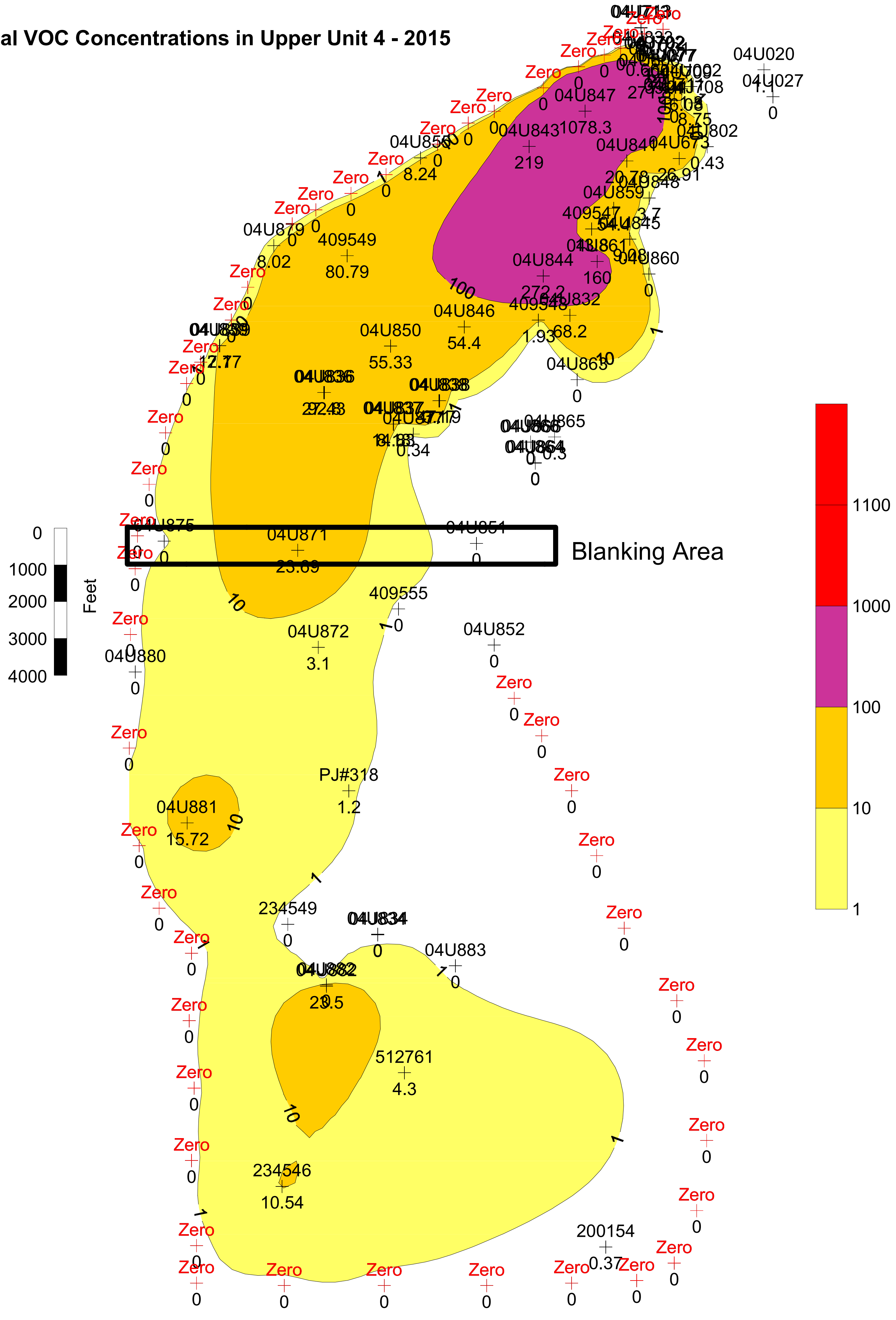
Decision Matrix

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

2015

Total VOC Concentrations in Upper Unit 4 - 2015



North Plume
Total VOC Cocentrations for Surfer Plots
FY 2015

Well	X_M (UTM 15)	Y_M (UTM 15)	Date	Total VOCs for Surfer
04J077	485620.000000	4992459.000000	6/29/15	**74.4**
04J702	485529.000000	4992570.000000	6/30/15	**1.1**
04J708	485855.100326	4992198.968425	6/29/15	**8.8**
04J713	485407.000000	4992821.000000	6/23/15	**0.0**
04J834	483225.000000	4985302.000000	6/4/15	**0.0**
04J836	482779.253823	4989797.569808	6/9/15	**27.4**
04J837	483355.560092	4989536.256948	6/15/15	**14.8**
04J838	483733.157540	4989729.703814	6/17/15	**47.2**
04J839	481912.296896	4990187.423585	6/9/15	**2.1**
04J864	484531.000000	4989216.478078	10/27/04	**0.0**
04J866	484492.872796	4989388.402812	6/10/15	**0.0**
04J882	482799.000000	4984887.000000	6/4/15	**0.0**
04U002	485822.000000	4992336.000000	6/18/15	**1.3**
04U020	486427.000000	4992473.000000	6/25/15	**1.1**
04U027	486502.000000	4992251.000000	6/17/13	**0.0**
04U077	485619.000000	4992460.000000	6/29/15	**39.4**
04U673	485725.000000	4991739.000000	6/12/15	**26.9**
04U701	485559.000000	4992516.000000	7/1/15	**2.4**
04U702	485521.000000	4992564.000000	6/30/15	**1.4**
04U709	485742.000000	4992319.000000	6/30/15	**16.1**
04U711	485684.000000	4992220.000000	6/12/15	**0.0**
04U713	485408.000000	4992825.000000	6/23/15	**0.0**
04U802	485958.000000	4991836.000000	6/16/15	**0.4**
04U806	485477.000000	4992420.000000	6/15/15	**271.8**
04U832	484819.000000	4990439.000000	6/10/15	**68.2**
04U833	485422.000000	4992608.000000	6/12/15	**0.7**
04U834	483225.000000	4985306.000000	6/8/15	**0.0**
04U836	482783.253823	4989798.569808	6/9/15	**92.8**
04U837	483358.560092	4989536.256948	6/10/15	**8.2**
04U838	483738.157540	4989729.703814	6/10/15	**3.2**
04U839	481916.296896	4990186.423585	6/9/15	**17.8**
04U841	485291.000000	4991718.000000	6/17/15	**20.8**
04U843	484480.000000	4991839.000000	6/23/15	**219.0**
04U844	484597.000000	4990765.000000	6/23/15	**272.2**
04U845	485315.000000	4991071.000000	6/11/15	**9.1**
04U846	483943.000000	4990343.000000	6/17/15	**54.4**
04U847	484945.000000	4992131.000000	6/24/15	**1078.3**
04U848	485475.000000	4991411.000000	6/11/15	**3.7**
04U850	483332.000000	4990183.000000	6/22/15	**55.3**
04U851	484044.000000	4988547.000000	6/25/13	**0.0**
04U852	484191.000000	4987704.000000	6/24/05	**0.0**
04U855	483579.000000	4991744.000000	6/16/15	**8.2**
04U859	485182.000000	4991326.000000	6/10/15	**54.4**
04U860	485473.000000	4990780.000000	6/11/15	**0.0**
04U861	485044.000000	4990885.000000	2/8/06	**160.0**
04U863	484879.000000	4989904.000000	6/10/15	**0.0**
04U864	484531.000000	4989213.478078	10/27/04	**0.0**
04U865	484692.000000	4989429.000000	6/22/05	**0.3**
04U866	484492.872796	4989385.402812	6/10/15	**0.0**

North Plume
Total VOC Cocentrations for Surfer Plots
FY 2015

Well	X_M (UTM 15)	Y_M (UTM 15)	Date	Total VOCs for Surfer
04U871	482562.000000	4988490.000000	6/17/15	**23.7**
04U872	482734.000000	4987685.000000	6/16/15	**3.1**
04U875	481455.000000	4988565.000000	6/5/15	**0.0**
04U877	483521.000000	4989454.000000	6/8/15	**0.3**
04U879	482365.000000	4991017.000000	6/11/15	**8.0**
04U880	481217.000000	4987481.000000	6/5/15	**0.0**
04U881	481646.000000	4986229.000000	6/16/15	**15.7**
04U882	482801.000000	4984875.000000	6/17/15	**23.5**
04U883	483870.000000	4985044.000000	6/5/15	**0.0**
200154	485116.000000	4982713.000000	6/18/15	**0.4**
234546	482433.000000	4983216.000000	6/25/15	**10.5**
234549	482481.000000	4985389.000000	6/17/2003	**0.0**
409547	484999.412497	4991154.295826	6/22/15	**13.8**
409548	484558.000000	4990399.000000	6/12/15	**1.9**
409549	482973.000000	4990933.000000	6/19/15	**80.8**
409555	483398	4988003	6/4/15	**0.0**
512761	483448.000000	4984157.000000	6/29/11	**4.3**
PJ#318	482986.000000	4986495.000000	6/10/2015	**1.2**

North Plume
Average Total VOC Concentration Calculations
Group 3 Blanked Area
June 2015

Concentration	Positive Planar Area (m^2)
Plume to 1	470031
Plume to 5	363942
Plume to 10	266124
Plume to 50	0

Total VOCs (µg/L)	Avg Total VOCs (µg/L)	Area (m^2)	Areal Conc (µg*m^2/L)
1 to 5	3	106089	318267
5 to 10	7.5	97818	733634
10 to 50	30	266124	7983713
	Sum	470031	9035615

Area Wtd Conc	19	µg/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 5 Blanked Area
June 2015

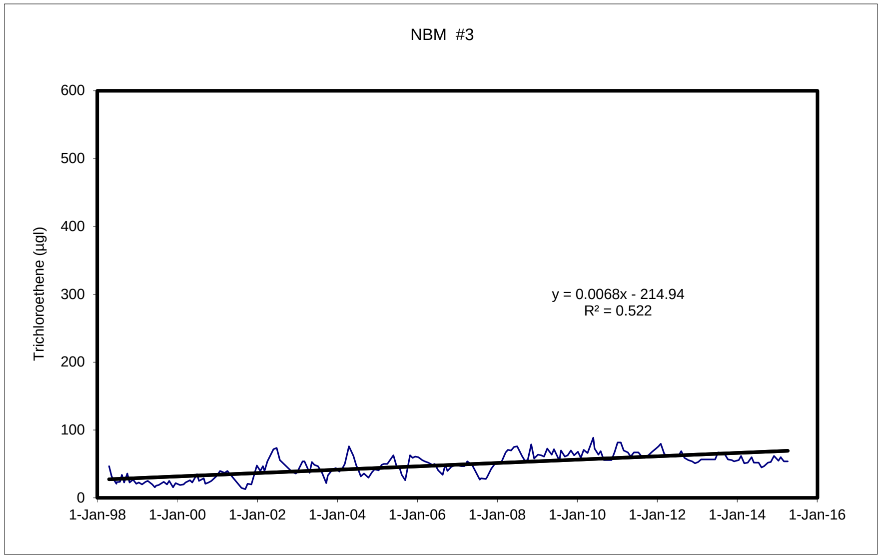
Concentration	Positive Planar Area (m^2)
Plume to 1	23742392
Plume to 5	15308101
Plume to 10	10197909
Plume to 50	4533936
Plume to 100	2320219
Plume to 200	963230
Plume to 300	497476
Plume to 400	323050
Plume to 500	208076
Plume to 600	128070
Plume to 700	71533
Plume to 800	33644
Plume to 900	2829
Plume to 1000	0

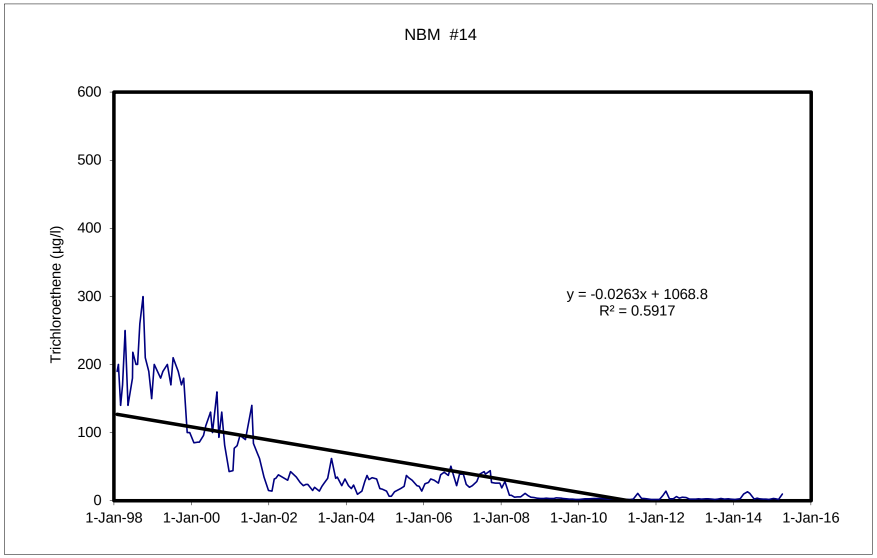
Total VOCs (µg/L)	Avg Total VOCs (µg/L)	Area (m^2)	Areal Conc (µg*m^2/L)
1 to 5	3	8434291	25302872
5 to 10	7.5	5110192	38326440
10 to 50	30	5663974	169919211
50 to 100	75	2213716	166028708
100 to 200	150	1356990	203548428
200 to 300	250	465754	116438420
300 to 400	350	174426	61049093
400 to 500	450	114974	51738352
500 to 600	550	80006	44003125
600 to 700	650	56538	36749592
700 to 800	750	37888	28416131
800 to 900	850	30816	26193515
900 to 1000	950	2829	2687127
	Sum	23742392	970401012

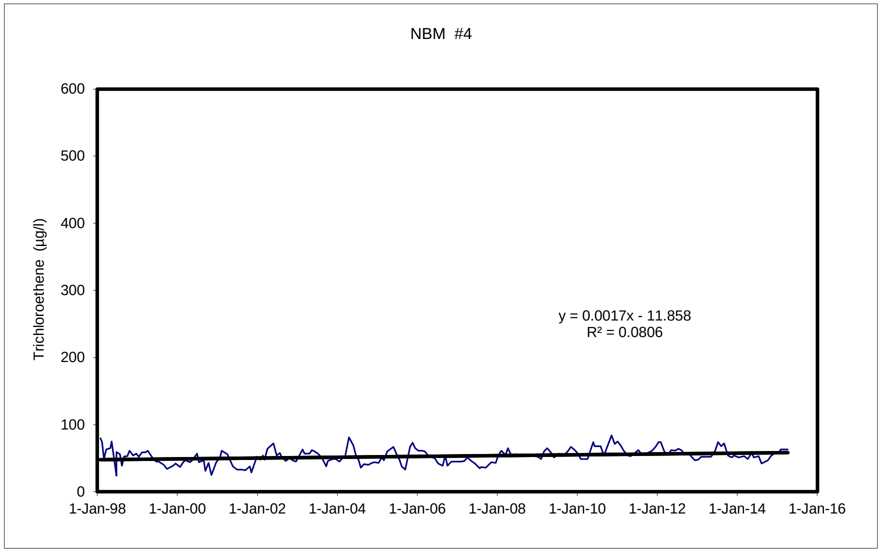
Area Wtd Conc	41	µg/L

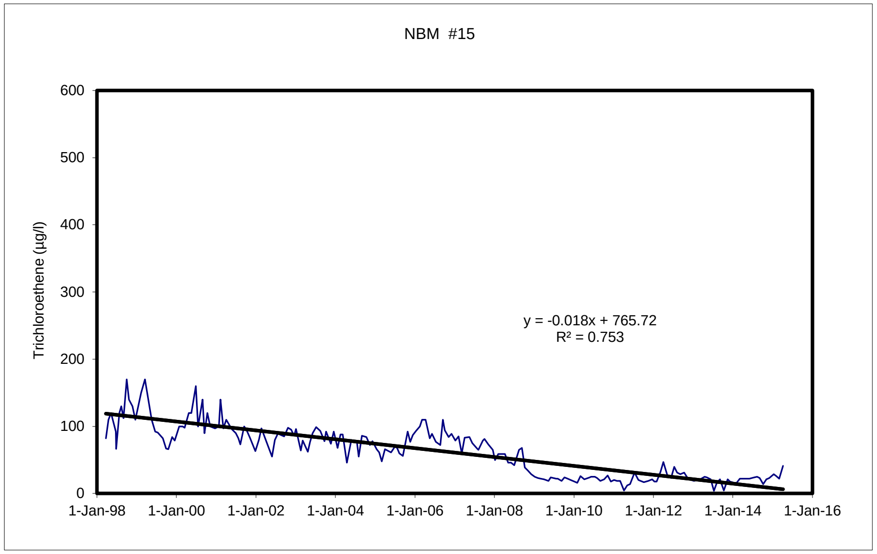
D.2.5 Group 6 New Brighton Municipal Well Regression Analysis

NEW BRIGHTON MUNICIPAL WELLS: Regression Analysis Since 1998: TRICHLOROETHENE



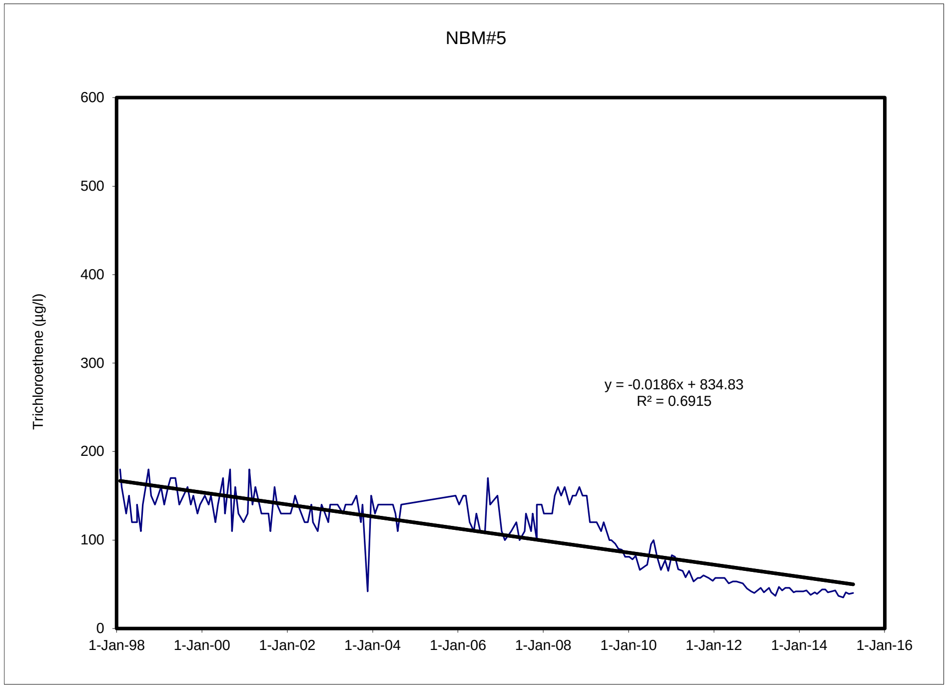


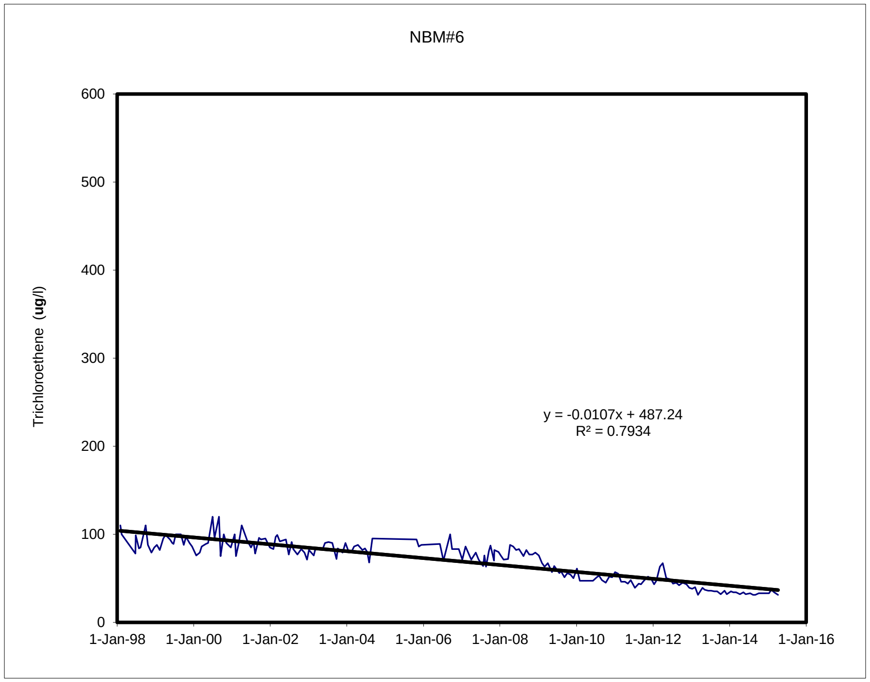




* New Brighton municipal wells were shut down in May 2015 after the discovery of 1,4 Dioxane in the wells. Therefore, no data is available for May through September 2015.

NEW BRIGHTON MUNICIPAL WELLS: Regression Analysis Since 1998: TRICHLOROETHENE





* New Brighton municipal wells were shut down in May 2015 after the discovery of 1,4 Dioxane in the wells. Therefore, no data is available for May through September 2015.

Appendix E

Well Inventory Update, FY 2015

APPENDIX E
WELL INVENTORY UPDATE

FISCAL YEAR 2015

Purpose

The purpose of well inventory is to identify wells that have been impacted or could potentially be impacted by contaminants from the New Brighton/Arden Hills Superfund Site.

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 at the north end of OU2.

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 on the north side of OU2 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 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 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 New Brighton/Arden Hills Superfund Site 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 New Brighton/Arden Hills Superfund Site OU1 plume, the Army offers to abandon the well and/or provide an alternate water supply.

The annual reporting requirements for the New Brighton/Arden Hills Superfund Site 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 2015 Update

The updated MDH database was provided to Wenck on November 21, 2014. 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, 2013 and September 30, 2014. 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. Twenty-four wells were identified within the study area. One of the wells was an elevator shaft borehole, one was an environmental borehole, and twenty-two were monitoring wells. All wells were classified into Category 6.

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. There were twelve wells disclosed during FY15 that are located within the study area, only one of which is within the area of concern and was initially classified into Category 4a. The others were classified into Category 3.

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 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).

Fourteen Category 4 wells were studied in FY 2015. This study was accomplished through mapping of well locations, internet searches, telephone calls, letters, and/or site visits in an attempt to reclassify Category 4 wells that were in the existing well inventory database into one of the other categories. Contact information was updated, if applicable. For FY 2015, none of the wells could be reclassified based on this effort, and one new well was added to Category 4a or 4b. Therefore, the total number of wells in Category 4 at the end of FY 2015 increased to fifteen. An investigation summary is included in Table E-6.

FY 2015 was not a “major” well inventory sampling event, which occur every four years and which target the wells in Categories 1a, 1b, 1c, 2a, 2b, 2c, and 4a. However, due to the discovery of 1,4-dioxane within the aquifer, the MPCA and EPA requested sampling be conducted at all wells in Categories 1a, 1b, 1c, 2a, 2b, 2c, and 4a. Nine wells were sampled in FY 2015. Any wells in the above categories that were not sampled were due to one of the following reasons: the well owner refused the offer to sample; the well owner did not respond to the request for access to sample; or the well was found to be abandoned, non-existent, or inoperable. The analytical data from the FY 2015 sampling effort are summarized in Table E-2. The locations of the wells sampled in FY 2015 are shown on Figure E-5.

Of the nine wells sampled, nine had no VOC detections and five had no 1,4-dioxane detection. Four of the wells had detections of 1,4-dioxane with two of the wells having detections that were below the MDH Health Risk Limit of 1 µg/L and the other two having detections above the MDH Health Risk Limit. As a result, the two wells with 1,4-dioxane detections above the MDH Health Risk Limit will be resampled again in FY 2016.

Information contained in Tables E-3 through E-6 has been updated in the well inventory database (Filename “Well Inventory Main Database FY 2015”, an Excel file included on this CD).

Recommendations

- At this time no wells are recommended for the Army to offer alternate water supply or well abandonment.
- The next “major” sampling event will be in FY 2016, as the Army has decided to conduct another “major” sampling event given the new 1,4-dioxane concern. Wells to be sampled in FY 2016 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 2013-FY 2016 review of the MDH database.
    - Any Category 4b wells that are determined, from further investigation, to be in Category 1a, 1b, 1c, 2a, 2b, 2c, or 4a.
- As part of the “major” sampling event in FY 2016, the two wells that had detections of 1,4-dioxane above the MDH Health Risk Limit in FY 2015 will be resampled in FY 2016, specifically for the purposes of confirming whether 1,4-dioxane exceeds the MDH HHL and, if so, whether the Army will make an offer for alternate water supply or well abandonment. The wells to be sampled in FY 2016 are:
    - MN Unique No. 234421
    - MN Unique No. 537801

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 2015

			OU1 / OU3 COCs:						*Other Analytes:*			
Unique Number	Address	Sampling Date	Trichloroethene	1,1-Dichloroethene	cis-1,2-Dichloroethene	1,1,1-Trichloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,4 Dioxane	1,1,2,2-Tetrachloroethane	1,2-Dichloroethane	1,2-Dichloropropane
		Cleanup Level(1)	5	6	70	200	3	70				
		MDH HRL(2)							1	2	4	5
107405	4355 Old Hwy 10	6/19/15	<1	<1	<1	<1	<1	<1	<0.07	<1	<1	<1
200076	2375 Terminal Rd	6/26/15	<1	<1	<1	<1	<1	<1	<0.07	<1	<1	<1
200522	Windsor Green East	6/19/15	<1	<1	<1	<1	<1	<1	0.56	<1	<1	<1
200523	Windsor Green South	6/19/15	<1	<1	<1	<1	<1	<1	<0.07	<1	<1	<1
234421	2151 Mustang Dr	6/24/15	<1	<1	<1	<1	<1	<1	**11.0**	<1	<1	<1
249007	4453 Old Hwy 10	6/19/15	<1	<1	<1	<1	<1	<1	JP 0.032 UFB0.049	<1	<1	<1
249632	2301 N Upland Crest NE	6/26/15	<1	<1	<1	<1	<1	<1	<0.07	<1	<1	<1
537801	4759 Old Hwy 8	6/24/15	<1	<1	<1	<1	<1	<1	**11.3**	<1	<1	<1
---	2935 Old Hwy 8	6/19/15	<1	<1	<1	<1	<1	<1	<0.07	<1	<1	<1
---	D 2935 Old Hwy 8	6/19/15	<1	<1	<1	<1	<1	<1	<0.07	<1	<1	<1

TABLE E-2
WELL INVENTORY SAMPLING RESULTS

Fiscal Year 2015

			Other Analytes:											
Unique Number	Address	Sampling Date	2-Hexanone	Acetone	Benzene	Bromodichloro-methane	Bromoform	Bromomethane	Carbon disulfide	Carbon tetrachloride	Chlorobenzene	Chloroethane	Chloroform	Chloromethane
		Cleanup Level[(1)] MDH HRL[(2)]	(Note 3)	4000	2	6	40	10	700	1	100	(Note 3)	30	(Note 3)
107405	4355 Old Hwy 10	6/19/15	<5	<5 JL70	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
200076	2375 Terminal Rd	6/26/15	<5	<5 JL70	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
200522	Windsor Green East	6/19/15	<5	<5 JL70	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
200523	Windsor Green South	6/19/15	<5	<5 JL70	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
234421	2151 Mustang Dr	6/24/15	<5	<5 JL70	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
249007	4453 Old Hwy 10	6/19/15	<5	<5 JL70	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
249632	2301 N Upland Crest NE	6/26/15	<5	<5 JL70	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
537801	4759 Old Hwy 8	6/24/15	<5	<5 JL70	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
---	2935 Old Hwy 8	6/19/15	<5 JMS74	<5 JL70MS53	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
---	D 2935 Old Hwy 8	6/19/15	<5	<5 JL70	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

TABLE E-2
WELL INVENTORY SAMPLING RESULTS

Fiscal Year 2015

			Other Analytes:													
Unique Number	Address	Sampling Date	cis-1,3-Dichloropropene	Dibromochloro-methane	Ethylbenzene	m,p-Xylene	Methyl ethyl ketone	Methyl isobutyl ketone	Methylene chloride	o-Xylene	Styrene	Tetrachloroethene	Toluene	trans-1,2-Dichloroethene	trans-1,3-Dichloropropene	Vinyl chloride
		Cleanup Level(1)														
		MDH HRL(2)	2	10	50	300	4000	300	5	300	(Note 3)	5	200	100	2	0.2
107405	4355 Old Hwy 10	6/19/15	<1	<1	<1	<2	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1
200076	2375 Terminal Rd	6/26/15	<1	<1	<1	<2	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1
200522	Windsor Green East	6/19/15	<1	<1	<1	<2	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1
200523	Windsor Green South	6/19/15	<1	<1	<1	<2	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1
234421	2151 Mustang Dr	6/24/15	<1	<1	<1	<2	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1
249007	4453 Old Hwy 10	6/19/15	<1	<1	<1	<2	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1
249632	2301 N Upland Crest NE	6/26/15	<1	<1	<1	<2	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1
537801	4759 Old Hwy 8	6/24/15	<1	<1	<1	<2	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1
---	2935 Old Hwy 8	6/19/15	<1	<1	<1	<2	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1
---	D 2935 Old Hwy 8	6/19/15	<1	<1	<1	<2	<5	<5	<1	<1	<1	<1	<1	<1	<1	<1

Notes:

All Results in µg/L

(1) Cleanup levels for OU1 deep groundwater are from page 18 of the OU1 ROD.

(2) Minnesota Department of Health (MDH) Health Risk Limit (HRL).

(3) No HRL has been established for this analyte.

D	Duplicate sample.
JL	The percent recovery for the laboratory control sample was above or below the QC limits (the percent recovery is listed after "JL"). The sample result could be biased high (if over 100 percent recovery) or low (if below 100 percent recovery).
JMS	The percent recovery for the matrix spike was above or below the QC limits (the percent recovery is listed after "JMS"). The sample result could be biased high (if over 100 percent recovery) or low (if below 100 percent recovery).
JP	The value is below the reporting level, but above the method detection limit. Results should be considered estimated.
UFB	The sample result was less than 5 times the level detected in a field blank (the result for the blank is listed after "UFB"). The sample result can be considered non detect at an elevated detection limit.

TABLE E-3
CONSTRUCTED WELLS

Unique Number	**Category**	**Last Name or Business Name**	**Street**	**City**	**Use**	**Depth**	**Date Drilled**
804277	6	MN PCA SUPERFUND PROGRAM		Fridley	Monitoring	30	1/16/2014
804278	6	MN PCA SUPERFUND PROGRAM		Fridley	Monitoring	60	1/15/2014
804279	6	MN PCA SUPERFUND PROGRAM		Fridley	Monitoring	30	1/14/2014
804280	6	MN PCA SUPERFUND PROGRAM		Fridley	Monitoring	72	1/14/2014
801475	6	MN PCA SUPERFUND PROGRAM	5110 MAIN STREET NE	Fridley	Monitoring	70	1/12/2014
804276	6	MN PCA SUPERFUND PROGRAM	5110 MAIN STREET NE	Fridley	Monitoring	58	1/10/2014
799879	6	DAVIS FROST, INC.		Minneapolis	Monitoring	25	12/5/2013
799877	6	DAVIS FROST, INC.		Minneapolis	Monitoring	23	12/3/2013
799878	6	DAVIS FROST, INC.		Minneapolis	Monitoring	23	12/3/2013
799301	6	U OF M		Minneapolis	Monitoring	23	10/2/2013
799302	6	U OF M		Minneapolis	Monitoring	20	10/1/2013
799303	6	U OF M		Minneapolis	Monitoring	28	10/1/2013
799306	6	U OF M		Minneapolis	Monitoring	29	10/2/2013
594761	6	CPM DEVELOPMENT	1018 ESSEX STREET SE	Minneapolis	Environmental Borehole	20	4/28/2014
802749	6	KUNZ OIL CO.	2280 W COUNTY ROAD I	Mounds View	Monitoring	20	6/19/2014
802750	6	KUNZ OIL CO.	2280 W COUNTY ROAD I	Mounds View	Monitoring	20	6/19/2014
804776	6	KUNZ OIL CO.	2280 W COUNTY ROAD I	Mounds View	Monitoring	20	6/18/2014
804777	6	KUNZ OIL CO.	2280 W COUNTY ROAD I	Mounds View	Monitoring	20	6/18/2014
804778	6	KUNZ OIL CO.	2280 W COUNTY ROAD I	Mounds View	Monitoring	20	6/19/2014
804779	6	KUNZ OIL CO.	2280 W COUNTY ROAD I	Mounds View	Monitoring	20	6/18/2014
806312	6	ALLIANT TECHSYSTEMS, INC.	1601 HIGHWAY 96 W	Arden Hills	Monitoring	121	8/25/2014
804246	6	SELA INVESTMENTS, LLP	700 UNIVERSITY AVENUE SE	Minneapolis	Elevator Shaft Boring	23	9/26/2014
804793	6	2407 UNIVERSITY INVESTMENTS, LLC	2407 UNIVERSITY AVENUE SE	Minneapolis	Monitoring	25	7/21/2014
804792	6	2407 UNIVERSITY INVESTMENTS, LLC	2407 UNIVERSITY AVENUE SE	Minneapolis	Monitoring	25	7/21/2014

🟨 Indicates wells that were both constructed and later sealed during FY 2014.

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***
740364	~~4a~~ 3	COLUMBIA HEIGHTS ECONOMIC DEVELOPMENT AUTHORITY	3927 CENTRAL AVENUE NE	Columbia Heights		In Use				
740366	~~4a~~ 3	GEM PROPERTIES	3905 CENTRAL AVENUE NE	Columbia Heights		Not In Use				
UNK0510435	~~4a~~ 3	BLUESTONE INVESTMENTS, LLC	2955 COUNTY ROAD H	New Brighton		In Use				
UNK0510789	~~4a~~ 3	BETTY ANN ADDISON	6581 CENTRAL AVENUE NE	Fridley		In Use				
UNK0511945	~~4a~~ 3	LOUISE A. ARBUCKLE	3029 FAIRVIEW AVENUE N	Roseville		Not In Use				
UNK0512015	~~4a~~ 3	SUNDAY OLATEJU	1150 MISSISSIPPI STREET NE	Fridley		Not In Use				
UNK0512949	~~4a~~ 3	BRICE HEMMER	2500 LONGVIEW DRIVE	New Brighton		In Use				
UNK0514418	~~4a~~ 3	KRISTIN J. BORDWELL	1769 PINEWOOD DRIVE	Shoreview		In Use				
UNK0514419	~~4a~~ 3	CINDI B. JOHNSON	2222 ROSEWOOD LANE S	Roseville		In Use				
UNK0514428	~~4a~~ 3	TOM TREMMEL	669 SIXTH AVENUE NW	New Brighton		In Use				
UNK0515425	4a	JULIE ONEILL	1412 LONG LAKE ROAD	New Brighton		Not In Use				
UNK0516447	~~4a~~ 3	BRIAN VICTOR EICHERS	5053 RAINBOW LANE	Mounds View		Not In Use				

🟨 Wells disclosed that were mapped ouside Study Area

TABLE E-5
SEALED WELLS

Unique Number	***Category***	***Last Name or Business Name***	***Street***	***City***	***Status***	***Date Sealed***
482084	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
482085	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
482086	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	8/7/2014
482087	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	8/7/2014
482088	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	8/7/2014
482089	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	8/7/2014
482090	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	8/7/2014
643884	~~6~~, 7a	US ARMY - TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
643885	~~6~~, 7a	US ARMY - TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/12/2014
643887	~~6~~, 7a	US ARMY - TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/12/2014
650820	~~6~~, 7a	US ARMY - TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
650832	~~6~~, 7a	US ARMY - TCAAP	4700 HIGHWAY 10	Arden Hills	Other	5/12/2014
650833	~~6~~, 7a	US ARMY - TCAAP	4700 HIGHWAY 10	Arden Hills	Other	5/12/2014
650834	~~6~~, 7a	US ARMY - TCAAP	4700 HIGHWAY 10	Arden Hills	Other	5/12/2014
658728	~~6~~, 7a	US ARMY - TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
658729	~~6~~, 7a	US ARMY - TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/12/2014
715626	~~6~~, 7a	US ARMY - TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
777179	~~6~~, 7a	NEW BRIGHTON, CITY OF	1369 OLD HIGHWAY 8	New Brighton	Monitoring	6/6/2014
777180	~~6~~, 7a	NEW BRIGHTON, CITY OF	1369 OLD HIGHWAY 8	New Brighton	Monitoring	6/6/2014
768547	~~6~~, 7a	ST. PAUL, CITY OF	RAYMOND AVENUE	St. Paul	Other	8/14/2014
768549	~~6~~, 7a	ST. PAUL, CITY OF	RAYMOND AVENUE	St. Paul	Other	8/14/2014
768550	~~6~~, 7a	ST. PAUL, CITY OF	RAYMOND AVENUE	St. Paul	Other	8/14/2014
783535	~~6~~, 7a	L AND H REAL ESTATE, LLC	2100 GILBERT AVENUE	St. Paul	Monitoring	7/31/2014
761427	7a	WAL MART STORES, INC.	1947 COUNTY ROAD C	Roseville	Monitoring	11/25/2013
761428	7a	WAL MART STORES, INC.	1947 COUNTY ROAD C	Roseville	Monitoring	11/25/2013
761429	7a	WAL MART STORES, INC.	1947 COUNTY ROAD C	Roseville	Monitoring	11/25/2013
761430	7a	WAL MART STORES, INC.	1947 COUNTY ROAD C	Roseville	Monitoring	11/25/2013
H000307577	7a	DAVIDSON COS., INC.	1201 COUNTY E	Arden Hills	Water Supply	11/19/2013
H000307578	7a	DAVISON COS., INC.	1201 COUNTY E	Arden Hills	Water Supply	10/29/2013
421440	7a	SHAFER CONTRACTING	1700 HIGHWAY 96 W	Arden Hills	Monitoring	10/3/2013
H000312294	7a	MANLEY OLSON	1974 SUMMER STREET	Falcon Heights	Water Supply	10/7/2013
440887	7a	US ARMY TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
236078	7a	US ARMY TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
194772	7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
194701	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
194728	~~6~~, 7a	RAMSEY COUNTY	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
194726	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
236193	7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
236189	7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
236190	7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
242182	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Other	10/21/2013

TABLE E-5
SEALED WELLS

Unique Number	***Category***	***Last Name or Business Name***	***Street***	***City***	***Status***	***Date Sealed***
242183	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
242184	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Other	10/21/2013
242185	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Other	10/21/2013
236192	7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	10/21/2013
242198	~~6~~, 7a	ALLIANT TECHSYSTEMS, INC.	4700 HIGHWAY 10	Arden Hills	Other	10/21/2013
H000314714	7a	OFFICE MAX INC.	7000 CENTRAL AVENUE NE	Fridley	Monitoring	10/22/2013
H000314713	7a	OFFICE MAX INC.	7000 CENTRAL AVENUE NE	Fridley	Monitoring	10/22/2013
H000314712	7a	OFFICE MAX INC.	7000 CENTRAL AVENUE NE	Fridley	Monitoring	10/22/2013
H000314711	7a	OFFICE MAX INC.	7000 CENTRAL AVENUE NE	Fridley	Monitoring	10/22/2013
H000314718	7a	OFFICE MAX INC.	1400 73RD AVENUE NE	Fridley	Monitoring	10/22/2013
H000314717	7a	OFFICE MAX INC.	1400 73RD AVENUE NE	Fridley	Monitoring	10/22/2013
H000314716	7a	OFFICE MAX INC.	1400 73RD AVENUE NE	Fridley	Monitoring	10/22/2013
H000314715	7a	OFFICE MAX INC.	1400 73RD AVENUE NE	Fridley	Monitoring	10/22/2013
H000310246	7a	ST. ANTHONY H AND R AUTHORITY	2500 39TH AVENUE NE	St. Anthony	Monitoring	10/18/2013
H000312296	7a	HOWARD THOMSON	7425 PLEASANTVIEW DRIVE	Mounds View	Other	10/22/2013
H000311740	7a	MARCY LUEDTKE	1905 W RYAN AVENUE	Roseville	Water Supply	10/29/2013
H000312687	7a	DAN WESTBERG	5601 SCHUTTA ROAD	Shoreview	Water Supply	11/5/2013
H000297424	7a	PAT FITZGERALD	1371 W FLORAL DRIVE	Arden Hills	Water Supply	11/5/2013
H000316946	7a	KEITH MALLOW	5800 JEFFERSON STREET NE	Fridley	Water Supply	11/11/2013
H000308494	7a	ST. ANTHONY REAL ESTATE CO.	2140 ENERGY PARK DRIVE	St. Paul	Env. Boring	11/12/2013
H000316999	7a	CUMMINS	1400 73RD AVENUE NE	Fridley	Monitoring	11/27/2013
H000317307	7a	KAREN UTHE	5493 ERICKSON ROAD	Mounds View	Water Supply	11/19/2013
H000317838	7a	DISTRESSED HOUSING INVESTMENTS, INC.	2585 HERSCHEL AVENUE	Roseville	Water Supply	11/22/2013
H000315696	7a	JOHN SOBIECK	2133 BELLE LANE	Mounds View	Water Supply	12/2/2013
H000318902	7a	DAVE ANDOW	1875 RYAN AVENUE	Roseville		12/12/2013
H000315747	7a	U OF M	1122 UNIVERSITY AVENUE SE	Minneapolis	Other	10/28/2013
H000318637	7a	NITTI ROLLOFF SERVICES	687 NINTH AVENUE NW	New Brighton	Water Supply	1/20/2014
H000309763	7a	No Owner Found	2407 UNIVERSITY AVENUE SE	Minneapolis	Monitoring	10/25/2013
H000318903	7a	RAY VANEK	1791 DUNLAP STREET	Roseville	Water Supply	1/8/2014
H000317019	7a	MN PCA	300 FIFTH AVENUE NW	New Brighton	Env. Boring	11/21/2013
H000319351	7a	HEALTH PARTNERS	2500 COMO AVENUE	St. Paul	Other	12/10/2013
H000318029	7a	ROBERT ANDERSON	3033 BRONSON DRIVE	Mounds View	Water Supply	2/5/2014
H000319802	7a	BRIAN LUETH	4408 HAMLINE AVENUE N	Arden Hills	Water Supply	2/19/2014
H000319676	7a	DAN JAEGER	4528 FOURTH STREET NE	Columbia Heights	Water Supply	3/5/2014
H000316763	7a	MINNEAPOLIS, CITY OF	WINTER STREET	Minneapolis	Other	10/2/2013
H000319714	7a	DIESEL DOGS FUEL SERVICE	2237 COMMONWEALTH AVENUE	St. Paul	Monitoring	3/14/2014
H000318031	7a	JIM ARBUCKLE	3029 N FAIRVIEW AVENUE	Roseville	Water Supply	4/29/2014
H000319274	7a	ROMAN ALVARADO	650 39TH AVENUE NE	Columbia Heights	Monitoring	3/31/2014
H000314096	7a	BLAIR WOLFSON	2155 HIGHWAY 10	Mounds View	Monitoring	4/3/2014
H000316157	7a	CURT WALLACE	7556 KNOLLWOOD DRIVE	Mounds View	Water Supply	4/15/2014
H000318034	7a	ESTATE OF KATHERINE LENZ	1708 STANBRIDGE AVENUE	Roseville	Water Supply	4/29/2014

TABLE E-5
SEALED WELLS

Unique Number	***Category***	***Last Name or Business Name***	***Street***	***City***	***Status***	***Date Sealed***
H000317564	7a	IH3 PROPERTY MINNESOTA, LP	6069 WOODY LANE NE	Fridley	Water Supply	4/30/2014
234208	~~6~~, 7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/9/2014
234210	~~6~~, 7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/9/2014
234211	~~6~~, 7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/9/2014
234243	~~6~~, 7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/9/2014
236501	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/9/2014
236502	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/9/2014
236504	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/9/2014
447999	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/9/2014
236479	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
242132	~~6~~, 7a	ALLIANT TECHSYSTEMS INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
242133	~~6~~, 7a	ALLIANT TECHSYSTEMS INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
235752	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/20/2014
235753	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
H000321852	7a	ALLIANT TECHSYSTEMS INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
235751	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
236469	~~6~~, 7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/12/2014
236069	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
236187	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
236077	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
H000320010	7a	LAKE PROPERTIES, LLC	4457 CENTRAL AVENUE NE	Columbia Heights	Monitoring	5/8/2014
H000319779	7a	ERIC OLLESTAD	1327 66TH AVENUE NE	Fridley	Water Supply	5/13/2014
H000319784	7a	DELORES HARRINGTON	1620 GARDENA AVENUE NE	Fridley	Water Supply	5/15/2014
H000320173	7a	BOB STRONG	7489 MELODY DRIVE NE	Fridley	Water Supply	5/28/2014
242131	7a	ALLIANT TECHSYSTEMS INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	5/20/2014
242129	7a	ALLIANT TECHSYSTEMS INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	5/20/2014
242128	7a	ALLIANT TECHSYSTEMS INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	5/20/2014
H000318036	7a	STEVE VODONICK	1723 GLENVIEW AVENUE	Arden Hills	Water Supply	5/21/2014
H000320877	7a	MN DOT	835 SECOND AVENUE NW	New Brighton	Monitoring	9/3/2014
H000320042	7a	HORTON, INC	2507 WALNUT STREET	Roseville	Monitoring	6/3/2014
H000320044	7a	PIKOVSKY MANAGEMENT, LLC	2690 PRIOR AVENUE	Roseville	Monitoring	6/5/2014
H000322763	7a	MIKE PATH	1754 LYDIA AVENUE W	Roseville	Water Supply	6/18/2014
H000322215	7a	JOYCE GRAFF	3524 FOSS ROAD NE	St. Anthony	Water Supply	6/18/2014
H000315390	7a	MIKE SHERMAN	6229 CENTRAL AVENUE NE	Fridley	Water Supply	6/17/2014
H000323110	7a	DAVID NELSON	1484 15TH TERRACE NW	New Brighton	Water Supply	6/18/2014
H000320065	7a	VOGEL SHEET METAL, INC.	2760 FAIRVIEW AVENUE N	Roseville	Monitoring	6/27/2014
H000323113	7a	LOREN MACK	2544 BEACON STREET	Roseville	Water Supply	6/28/2014
427414	~~6~~, 7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/9/2014
236507	7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/9/2014
H000322803	7a	PAUL PADRATZIK	7633 SPRING LAKE ROAD	Mounds View	Water Supply	7/8/2014
H000322804	7a	PAUL PADRATZIK	7633 SPRING LAKE ROAD	Mounds View	Water Supply	7/8/2014

TABLE E-5
SEALED WELLS

Unique Number	***Category***	***Last Name or Business Name***	***Street***	***City***	***Status***	***Date Sealed***
H000321291	7a	DAN SEABERG	3095 WHEELER STREET	Roseville	Water Supply	7/8/2014
H000322819	7a	THOMAS GILBERTSON	2000 CLEVELAND AVENUE N	Roseville	Water Supply	7/21/2014
H000319480	7a	DAVID ST. CROIX	2091 ENERGY PARK DRIVE	St. Paul	Env. Boring	7/24/2014
234215	~~6~~, 7a	US ARMY -TCAAP	4700 HIGHWAY 10	Arden Hills	Monitoring	5/13/2014
H000325054	7a	JAVELIN GROUP, THE	1300 GRAY FOX ROAD	Arden Hills	Monitoring	8/1/2014
206776	~~3~~, 7a	BRIAN MURPHY	3755 DUNLAP STREET N	Arden Hills	Water Supply	6/17/2014
H000325178	7a	MORROW PARTNERS, INC.	1788 LOIS DRIVE	Shoreview	Water Supply	8/4/2014
H000325177	7a	MORROW PARTNERS, INC.	1788 LOIS DRIVE	Shoreview	Water Supply	8/4/2014
H000323750	7a	FRIDLEY, CITY OF	7011 UNIVERSITY AVENUE NE	Fridley	Monitoring	8/12/2014
H000322966	7a	JIM SOLEM	1975 AUTUMN STREET	Falcon Heights	Water Supply	8/26/2014
194719	7a	ALLIANT TECHSYSTEMS INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	8/7/2014
194723	7a	ALLIANT TECHSYSTEMS INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	8/7/2014
242135	7a	ALLIANT TECHSYSTEMS INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	8/7/2014
194718	7a	ALLIANT TECHSYSTEMS INC.	4700 HIGHWAY 10	Arden Hills	Monitoring	8/7/2014
H000323265	7a	JUDY HELGEN	1934 SHRYER AVENUE W	Roseville	Water Supply	8/13/2014
H000318917	7a	VERNON SVAC	2599 N WHEELER	Roseville	Water Supply	8/13/2014
H000322553	7a	KELLY, HURL AND HALLMAN, LLP	446 ST. ANTHONY PARKWAY	Minneapolis	Monitoring	7/24/2014
H000317597	7a	LINDA HETLAND	1716 OAKCREST AVENUE	Roseville	Water Supply	8/27/2014
H000322466	7a	TIM EKLUND	1933 26TH AVENUE NW	New Brighton	Water Supply	8/18/2014
H000324720	7a	HANSON HOMETECH	4030 VALENTINE COURT	Arden Hills	Water Supply	8/25/2014
H000322469	7a	EDWARD KARN	1390 ONONDAGA STREET NE	Fridley	Water Supply	8/26/2014
H000325063	7a	AEON	2147 UNIVERSITY AVENUE W	St. Paul	Monitoring	8/29/2014
H000325459	7a	DAVE NORBY	4908 JEFFERSON STREET	Columbia Heights	Water Supply	9/15/2014
H000290658	7a	XCEL ENERGY			Env. Boring	2/12/2014
H000323186	7a	INGRID CRONIN	525 66TH AVENUE NE	Fridley	Water Supply	9/4/2014
H000325199	7a	JACQUELINE LEONG	3777 NEW BRIGHTON ROAD	Arden Hills	Water Supply	9/15/2014
H000307595	7a	NEW BRIGHTON, CITY OF	14TH STREET	New Brighton	Env. Boring	8/15/2014
H000323777	7a	RAMSEY COUNTY		Arden Hills	Monitoring	9/17/2014
H000325464	7a	JAMES JOHNSON	575 NINTH AVENUE NW	New Brighton	Water Supply	9/25/2014
H000321861	7a	SOO LINE RAILROAD CO.	630 30TH AVENUE NE	Minneapolis	Monitoring	5/15/2014
H000310263	7a	INTERSTATE PARTNERS	3200 COMO AVENUE SE	Minneapolis	Monitoring	1/4/2014
226102	~~3~~, 7a	MINNEAPOLIS PARK AND REC DEPT.	900 E RIVER PARK WAY	Minneapolis	Water Supply	4/7/2014
H000003701	7a	AMBER L. BROWN	2409 COUNTY ROAD H	Mounds View		Sealed
H000062705	7a	RICHARD J. RIPPLEY	1816 TATUM STREET	Roseville		Sealed
H000070018	7a	JAY MERRIGAN	4647 2½ STREET	Fridley		Sealed
H000133398	7a	ERIKKI DANIELS	2508 29TH AVENUE NE	St. Anthony		Sealed
H000142657	7a	PRIMITIVO QUEVEDO CORTES	1623 GARDENA AVENUE NE	Fridley		Sealed
H000243209	7a	T.H. CONSTRUCTION OF ANOKA, INC.	5965 NE OAKWOOD MANOR	Fridley		Sealed
H000306259	7a	SARAH GROEN	1859 STOWE AVENUE	Arden Hills		Sealed
H000318034	7a	DAVID G. KIRBY	1708 STANBRIDGE AVENUE	Roseville		Sealed
H000319784	7a	BLOMBERG PROFIT SHARING PLAN	1620 GARDENA AVENUE NE	Fridley		Sealed

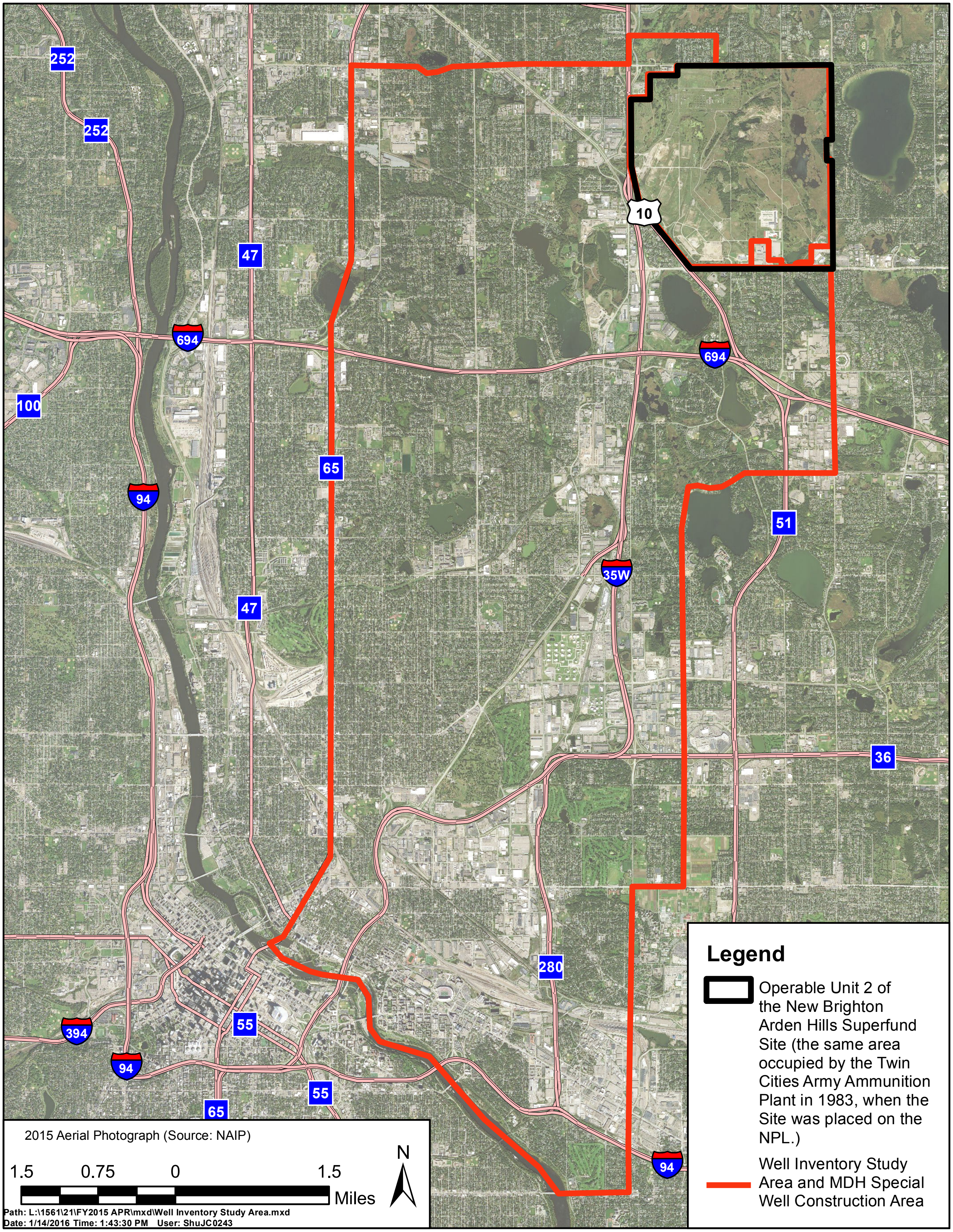
TABLE E-5
SEALED WELLS

Unique Number	Category	Last Name or Business Name	Street	City	Status	Date Sealed
H000315390	7a	KRISTA M. SULLIVAN	6229 CENTRAL AVENUE NE	Fridley		Sealed
UNK0515687	7a	DARYL CAROLLY	1327 66TH AVENUE NE	Fridley		Sealed
UNK0515979	7a	JASMINE J. ERBS	7633 SPRING LAKE ROAD	Mounds View		Sealed
UNK0515980	7a	JASMINE J. ERBS	7633 SPRING LAKE ROAD	Mounds View		Sealed
UNK0516296	7a	JIANJUN LI	1971 SHARONDALE AVENUE	Roseville		Sealed
UNK0516465	7a	ZACHARY E. NICHOLS	411 MISSISSIPPI STREET NE	Fridley		Sealed
UNK0516728	7a	JACOB K. OLSON	3095-3097 WHEELER STREET N	Roseville		Sealed

🟨 Sealed wells disclosed in FY14 that were already in well inventory database as sealed.

TABLE E-6
FY 2015 FIELD INVESTIGATION AND SAMPLING SUMMARY

Unique Number	Category	Last Name or Business Name	Street	City	Date Last Sampled	Status	Depth	Comments
	4a	Kallio	2816 St. Anthony Blvd	St. Anthony		Not in Use		Letter sent FY 2015.
	4a	Hermes	2935 Old Hwy 8	Roseville	6/24/2013	Active		Letter sent FY 2015.
249185	4a	Novotny	1706 Malvern St	Lauderdale		Unknown		Letter sent FY 2015.
UNK0515425	4a	Oneill	1412 Long Lake Road	New Brighton		Not in Use		Disclosed in FY 2015.
S00650	4b	CME		New Brighton	6/24/1984			No letter sent FY 2015.
239465	4b	Lennox				Active	256	No letter sent FY 2015.
234434	4b	Marquart		Arden Hills		Unknown		No letter sent FY 2015.
105271	4b	Nelson				Active	137	No letter sent FY 2015.
S00471	4b	R Komarek/Nelson-Miller Cons				Inactive		No letter sent FY 2015.
S00551	4b	Tamarack Care Temp			2/17/1982	Unknown		No letter sent FY 2015.
201192	4b					Unknown		No letter sent FY 2015.
234532	4b					Unknown		No letter sent FY 2015.
234537	4b					Unknown		No letter sent FY 2015.
234545	4b				PHASE I	Unknown		No letter sent FY 2015.
234658	4b				6/7/1982	Unknown		No letter sent FY 2015.



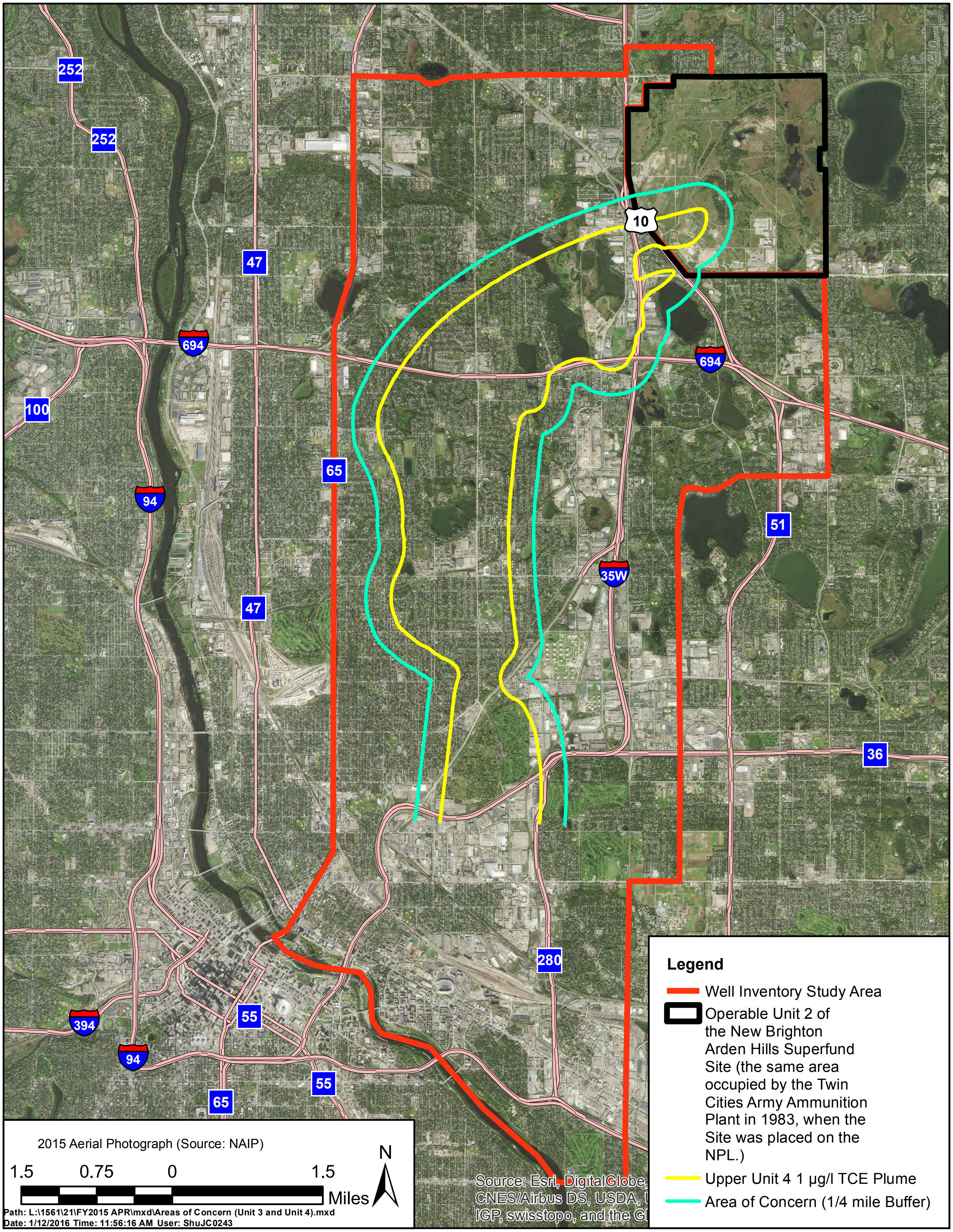
ANNUAL PERFORMANCE REPORT

Well Inventory Study Area

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

FY 2015

Figure E-1



ANNUAL PERFORMANCE REPORT

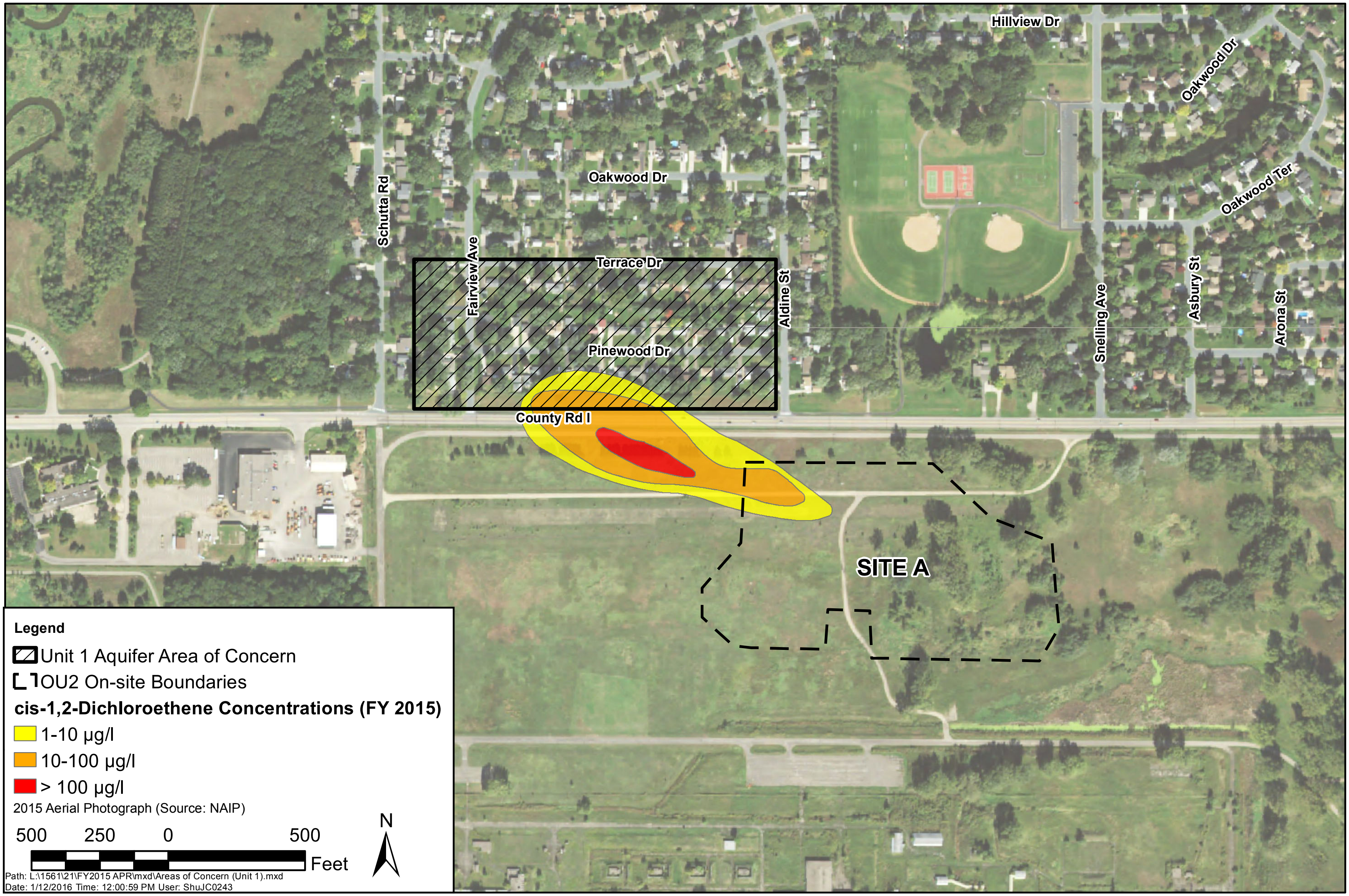
Areas of Concern (Unit 3 and Unit 4)

WENCK ASSOCIATES

Responsive partner. Exceptional outcomes.

FY 2015

Figure E-2



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Date: 1/12/2016 Time: 12:00:59 PM User: ShuJC0243

ANNUAL PERFORMANCE REPORT

Area of Concern (Unit 1)

WENCK ASSOCIATES

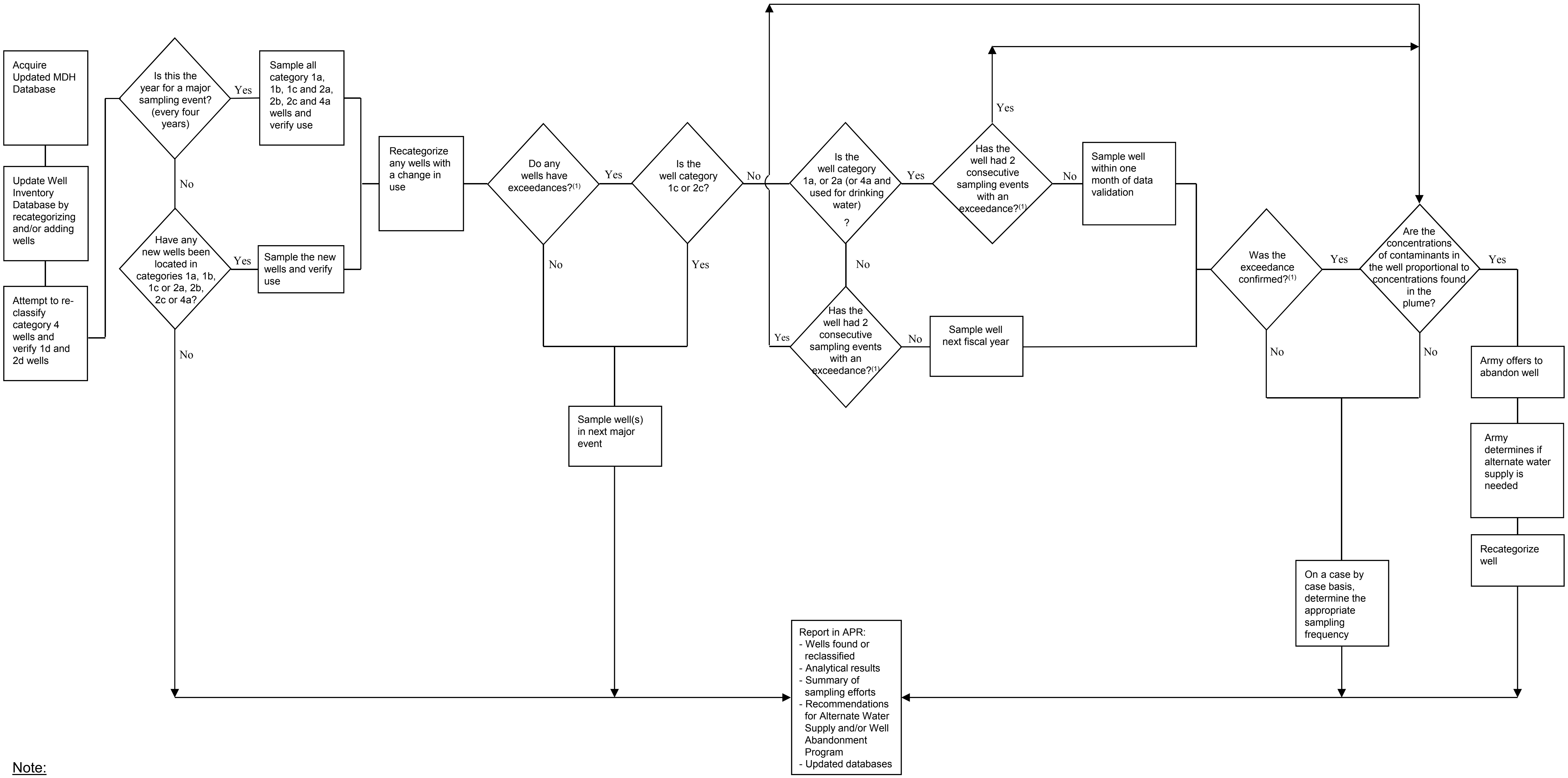
Responsive partner. Exceptional outcomes.

FY 2015

Figure E-3

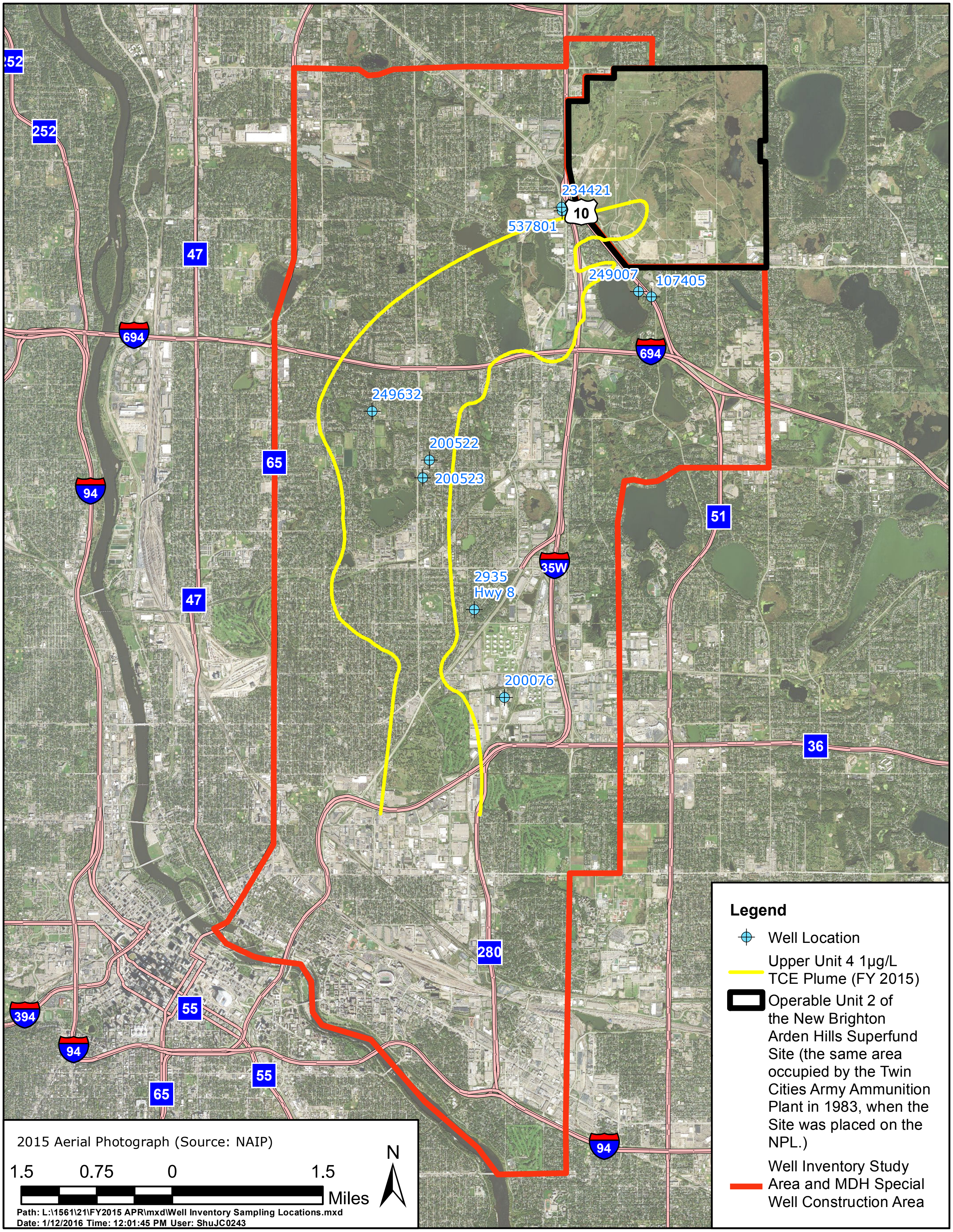
Figure E-4

Annual Requirements for Maintaining Well Inventory Database



Note:

$^{(1)}$ = Exceedance of a New Brighton/Arden Hills Superfund Site Groundwater Cleanup Level



2015 Aerial Photograph (Source: NAIP)

Path: L:\1561\21\FY2015 APR\mxd\Well Inventory Sampling Locations.mxd
Date: 1/12/2016 Time: 12:01:45 PM User: ShuJC0243

ANNUAL PERFORMANCE REPORT

FY 2015 Well Inventory Sampling Locations

WENCK ASSOCIATES
Responsive partner. Exceptional outcomes.

FY 2015

Figure E-5

WELL INVENTORY DATABASE

The Well Inventory Database is located on
this CD in the following Microsoft Excel file:

Well Inventory Main Database FY 2015.xls

Appendix F

Site K and TGRS Operational Data

F.1 Inspection and Maintenance Activities, Fiscal Year 2015, Site K, OU2

Appendix F-1

Inspection and Maintenance Activities
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

October 2014

10/2/2014	The sump level is above 6 inches. Opened the effluent discharge slightly. Down time: None.
10/3/2014	Unable to read the sump level in the site glass due to mineral build-up. Turned the treatment system off and cleaned the site glass with acid. Down time: 1 hour.
10/9/2014	The effluent ball valve is not working properly. Removed the old ball valve and replaced with a new ball valve. Unable to read the sump level in the site glass due to mineral build-up. Turned the treatment system off and cleaned the site glass with acid. Down time: 3 hours.
10/29/2014	Turned the treatment system off to perform the monthly maintenance work. Down time: 2.5 hours.

November 2014

11/12/2014	Cleaned the sump level site glass and the effluent ball valve. Down time: 1 hour.
11/20/2014	The sump level was at four inches. Closed the effluent ball valve slightly and set the sump level to six inches. Down time: None.
11/21/2014	The system was off upon arrival. The "Air Stripper low flow airflow" light was on. Reset the PLC and re-started the system. Down time: 15 hours.
11/25/2014	The system was off upon arrival. The "Air Stripper low flow airflow" light was on. Reset the PLC and re-started the system. Down time: 8 hours.
11/27/2014	Thanksgiving Day holiday. No inspection performed. Down time: None.
11/28/2014	The system was off upon arrival. The "Air Stripper low flow airflow" light was on. Reset the PLC and re-started the system. Down time: 43 hours.
11/30/2014	The system was off upon arrival. The "Air Stripper low flow airflow" light was on. Reset the PLC and re-started the system. Down time: 9 hours.

Appendix F-1

Inspection and Maintenance Activities
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

December 2014

12/1/2014	The system was off upon arrival due to "High/high airflow rate". Troubleshooting indicates the airflow rate is greater than the upper limit setting. Closed the inlet airflow baffle slightly and re-started the system. Normal operation observed. Down time: 23 hours.
12/8/2014	The system was off upon arrival due to a site wide power outage. Xcel Energy found the top of a power pole burnt off across Highway 10 from Scherer Brothers Lumber. Xcel Energy restored power to the site and the system was re-started. Normal operation observed. Down time: 11.5 hours.

January 2015

1/1/2015	No inspection due to the New Year's Day holiday. Down time: None.

February 2015

2/11/2015	The "flow meter low water flow rate" light was on. Reset the PLC and the system re-started normally. Down time: 19 hours.
2/23/2015	The "AST high water level" light was on. Reset the PLC and the system re-started normally. Down time: 9 hours.
2/28/2015	The treatment system had cycled off and was in suspense during the inspection. Down time: None.

March 2015

3/1/2015	System in suspense during the daily inspection. Down time: None.
3/5/2015	System in suspense during the daily inspection. Down time: None.
3/8/2015	System in suspense during the daily inspection. Down time: None.

Appendix F-1

Inspection and Maintenance Activities
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

3/10/2015	System in suspense during the daily inspection. Down time: None.
3/11/2015	System in suspense during the daily inspection. Down time: None.
3/22/2015	System in suspense during the daily inspection. Down time: None.
3/21-24/2015	The system was off on arrival and the "Pump Seal Fail" light was on. Laughlin Electric diagnosed the problem to be a bad seal in the sump pump. Removed the old pump and replaced it with a new one from inventory. Re-started the new pump and observed normal operation. Down time: 64.5 hours.

April 2015

4/3/2015	Re-sampled the effluent for zinc. Down time: None.
4/8/2015	Cleaned the sump site glass and performed treatment system maintenance. Down time: 1 hour.
4/16/2015	Turned the building heater off for the season. Increased the blower airflow from 17 cfm to 19 cfm. Down time: None.
4/20/2015	Influent flow is inconsistent. Performed valve maintenance and reset the influent flow rate. Down time: None.
4/23/2015	The sump level is higher than optimum. Performed effluent valve maintenance and reset the valve. Down time: None.

May 2015

5/2/2015	Turned the fresh air vent fan and exhaust air vent to on. Down time: None.
5/10/2015	The system was off upon arrival. The high/high water level light was on. Opened the outlet valve and re-started the system. Normal operation observed. Down time: 25 hours.

Appendix F-1

Inspection and Maintenance Activities
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

5/11/2015	The system was off upon arrival. The high/high water level light was on. Opened the outlet valve and re-started the system. Normal operation observed. Down time: 16 hours.

June 2015

6/14/2015	Increased the airflow rate and cleaned the blower inlet screen. Also increased the influent groundwater flow rate. Down time: None.
6/25/2015	Closed the effluent valve to increase the sump level. Down time: None.
6/26/2015	Performed the monthly maintenance work. Down time: None.

July 2015

7/5/2015	No inspection due to the Independence Day holiday. Down time: None.
7/7/2015	System was off on arrival. The "Air stripper High/High Water Level" light was on. Reset the PLC and re-started the system. The system re-started normally. Down time: 21 hours.
7/20/2015	Decreased the effluent flow rate slightly. Down time: None.
7/21/2015	Increased the influent flow rate and the effluent flow rate slightly. Down time: None.
7/22/2015	Decreased the effluent flow rate slightly. Down time: None.
7/23/2015	Increased the influent flow rate and the effluent flow rate slightly. Down time: None.

August 2015

8/3-4/2015	Disassembled and cleaned the majority of the treatment system. Removed the old packing material and installed new packing material. Down time: 25 hours.

Appendix F-1

Inspection and Maintenance Activities
Fiscal Year 2015
Site K, OU2
Arden Hills, Minnesota

8/7/2015	Low sump water level. Closed the effluent valve slightly. Down time: None.
8/13/2015	High sump water level. Opened the effluent valve slightly. Down time: None.
8/14-17/2015	No power to the treatment system. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired the new transformer incorrectly. A voltage spike blew the surge suppressor in the treatment system control panel. Xcel Energy re-wired the transformer correctly and restored power to the treatment system. Preferred Electric replaced the surge suppressor with a new one from inventory. Turned the treatment system on and the system operated normally. Down time: 59 hours.

September 2015

9/8/2015	Performed monthly maintenance. Down time: None.
9/9/2015	Performed treatment system quarterly sampling. Down time: None.
9/29/2015	Cleaned sump site glass, reset PLC, exercised flow valves and flushed piping, reset influent and effluent flow rates and field tested the effluent water for hardness. Result was 500 mg/L. Down time: None.

F.2 Maintenance Activities, Fiscal Year 2015, TGRS, OU2

Appendix F-2

Maintenance Activities
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

October 2014

10/2/2014	Treatment System; Removed, cleaned and repaired the tower 4 airflow bank. Re-installed the airflow bank and normal operation was observed. Down time: None.
10/5/2014	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the light came back on. At the pumphouse, normal pumping operation observed. Down time: 16 hours.
10/9/2014	Treatment System; Removed portions of ECV 4's control piping and cleaned/replaced as needed. Cycled ECV 4 and observed normal operation. Down time: None.
10/18-24/2014	Pumphouse B5; The pump is off and will not start after reset. Inspected the 50 amp fuses in breaker box and one appears blown. Replaced two of the three fuses and still no start up in "Auto" or "Hand". Thein Well pulled the lift system and the motor is good and the pump is worn but working. Laughlin Electric diagnosis bad wiring in the overhead conduit. Replaced the pump and the wiring and re-started the pump. Normal operation was observed. Down time: 159 hours.
10/27/2014	Pumphouse B5; Measured the new flow rates, pressures and pumping water levels since installing the new pump. Down time: None.
10/31/2014	Pumphouses B3 and B8; Changed out portions of the pressure gauge and ECV piping that was leaking. Down time: None.

November 2014

11/2/2014	Treatment System; Call from Time Communications that the TGRS had failed. At the site, the pump director unit showed that ECV 4 failed to open on command. Exercised the valves and flushed the control piping. Cycled the valve three times and the valve operated normally. Down time: B13 for 1 hour.
11/3/2014	Treatment System; Cycled ECV 3 and the valve would not close. Removed and cleaned portions of the control piping. Also exercised the control valves and flushed the control piping. Cycled the valve and observed normal operation. Down time: None.

Appendix F-2

Maintenance Activities
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

11/4/2014	Pumphouse SC5; The light was flashing on the well field panel. Reset the well field and the light came on steady. At the pumphouse, normal operation was observed. Down time: None.
11/6/2014	Pumphouse SC5; The light was flashing on the well field panel. Reset the well field and the light came on steady. At the pumphouse, normal operation was observed. Down time: 6 hours.
11/12/2014	Pumphouse B13; Water was leaking from a union on the control piping. Replaced the union and stopped the leak. Down time: None.

December 2014

12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
12/10/2014	Pumphouse B11; Closed the forcemain gate valve just west of pumphouse B1 to stop the flow of water to pumphouse B11 so the pumphouse will no longer need heat to keep the pipes from freezing. Down time: None.
12/11/2014	Treatment System; Removed and replaced the effluent pressure gauge. Down time: None.
12/11/2014	Treatment System; Removed and cleaned the airflow meters for blowers 3 and 4. Down time: None.
12/12/2014	Treatment System; Turned the TGRS off to change oil in the motor for pump 4. Down time: 1.5 hours at B1 and B3.
12/12/2014	Pumphouse B11; Removed portions of the piping to drain the piping and turned the heat off in the pumphouse. Down time: None.
12/17/2014	Treatment System; ECV 3 would not open on command; Removed and cleaned portions of the control piping. Down time: None.

Appendix F-2

Maintenance Activities
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

12/18/2014	Pumphouses SC2 and SC5; Power was off to the pumphouses. Called Xcel Energy. They found an electrical wire on the ground near the former location of Building 503. They re-strung the wire and repaired the problem. Down time: None.

January 2015

1/1/2015	The daily inspection was not performed due to the New Year's Day holiday. Down time: None.
1/7-8/2015	Treatment System; There was a leak coming from the pilot on the ECV 4 control piping; Removed the pilot and installed a new seal kit then re-installed the pilot back on the ECV 4 control piping. Down time: None.
1/11/2015	Treatment System; The cellular phone indicator status showed a red light indicating the phone was not in operation. Cycled power to the cellular phone and the phone re-activated normally. Down time: None.
1/19/2015	Treatment System; The valve seals in ECV 4 were worn and the valve would no longer close. Installed a new valve seal kit and cleaned the scale and sediment from the piston and the inside of the valve. Cycled the valve three times and observed normal operation. Down time: 2.5 hours at B9.
1/20/2015	Treatment System; Call from Time Communication-TGRS Fail. At the Site, ECV 4 failed to open on command. Exercised the control valves, flushed the control piping and reset the opening and closing speed control valves. Cycled the valve and observed normal operation. Down time: 2 hours at B9.
1/26/2015	Pumphouse SC2; The flow meter has stopped totaling water flow. Removed the flow meter and installed a re-built flow meter from inventory. Down time: 2 hours.

February 2015

2/5-9/2015	Pumphouse B8; There is a leak in the riser pipe. Thein Well removed the lift system and replaced three lengths of pipe. Re-installed the lift system and re-started the pump. Normal operation observed. Down time: 95 hours.

Appendix F-2

Maintenance Activities
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

2/6/2015	Pumphouses B5, B6 and B9; Increased the flow rates to maximum to offset the lost flow rate from B8. Down time: None.
2/10/2015	Pumphouse B3; Turned the pump off to replace portions of the ECV control piping. Re-started the pump and observed normal operation. Down time: 2 hours.
2/10/2015	Pumphouses B5, B6 and B9; Reset the flow rates to their target rates. Down time: None.
2/15-17/2015	Pumphouse B13; The motor starter was chattering loudly. Turned the pump off and contacted Laughlin Electric. Diagnosed as a bad output card. Replaced the output card with one from inventory and re-started the pump. Normal operation observed. Down time: 43 hours.
2/28/2015	Pumphouses B8 and SC1; No communication to the pumphouses. Turned the pumps to "Hand" and contacted Laughlin Electric. Troubleshooting indicates a bad communication cable between the hand hole behind B8 and the next hand hole in line to Building 116. Additional troubleshooting/repairs will be necessary. Down time: 3 hours at B8.

March 2015

3/1-13/2015	Pumphouses B8, B9 and SC1; No communication to the pumphouses. Turned the pumps to "Hand" and contacted Laughlin Electric. Troubleshooting indicates a bad communication cable between the hand hole behind B8 and the next hand hole in line to Building 116. Temporarily installed new communication cable on the ground between the hand holes. Switched the pumps to "Auto" and the pumps started. Normal operation observed. Down time: 2 hours at B3.
3/4-6/2015	Treatment System and Well Field; Laughlin electric performs the annual electrical inspection. Down time: None.
3/13/2015	Pumphouses B8, B9 and SC1; In addition to the information in note 1 above, Laughlin Electric on Site to install the communication wires and Bolander excavated two ditches across the two roads for the temporary connection of the new communication wires. Down time: 3.5 hours at B9.

Appendix F-2

Maintenance Activities
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

3/13/2015	Pumphouse B3 and B4; Following re-connection of the new communication wires, the lights for pumphouses B3 and B4 were flashing on the PLC. Replaced the sub IO scanner module and the pumps re-started and the lights relit normally. Down time: 1.5 hours at B3 and B4.
3/18/2015	Pumphouse B5, B6, B8 and B9; Performed cold water flow meter calibration work. Down time: None.
3/20/2015	Pumphouse B3 and B4; Performed cold water flow meter calibration work. Down time: None.
3/23/2015	Building 116; Bolander removed the chain link fence from around the building today. Down time: None.
3/23-24/2015	Pumphouse B4; No power to the pumphouse. Laughlin Electric inspects and finds the power line from the power pole to the pumphouse is worn and damaged. Contacted Xcel Energy and they pulled the fuses on the power pole near pumphouse B5. Laughlin replaced the wire and Xcel replaced the fuses. Re-started the pump and observed normal operation. Down time: 37 hours.
3/27/2015	Pumphouse B1, B13, SC2 and SC5; Performed cold water flow meter calibration work. Down time: None.
3/30/2015	Pumphouses B5, B13 and SC5; Removed the existing cold water flow meters and installed re-built cold water flow meters from inventory. Down time: None.

April 2015

4/2/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the light relit normally. At the pumphouse, normal operation was observed. Down time: 9.5 hours.
4/14-15/2015	Pumphouses B8, B9 and SC1; Bolander accidentally excavated and damaged the communication lines between the hand hole behind B8 and the next hand hole in line on the way to Building 116. Laughlin Electric installed a new hand hole where the lines were excavated and then installed new communication wires in the conduit between hand holes. Turned some of the extraction wells off during the work. Down time: 4 hours at B1 and B6; 2.5 hours at B9, B13, SC1 and SC2; 1.5 hours at B4 and SC5.

Appendix F-2

Maintenance Activities
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

4/15/2015	Pumphouse B9; Following installation of the new communication wire, the pumphouse was not communicating with the PLC in Building 116. Replaced the I/O adapter module in the pumphouse and the I/O scanner module in the PLC and re-started the pump. Normal operation was observed. Down time: 16 hours.
4/27/2015	Treatment System; Call from Time Communication - "TGRS Fail". Pump 4 would not start in "Auto" but would start in "Hand". Most likely a bad pump start float for Pump 4. Turned off the B5 and B9 pumps and left the TGRS in "Auto". Scheduled the replacement of the start float for Pump 4. Down time: 6.5 hours at B5 and 9 hours at B9.
4/28/2015	Treatment System; Turned the TGRS off and removed the old pump start float for Pump 4 and installed a new pump start float. Turned Pump 4 on in "Auto" and observed normal operation. Down time: None.
4/29/2015	Treatment System and Well Field; Call from Time Communication - "TGRS Fail". At the Site, there was no power to the treatment system or the well field. Contacted Xcel Energy and they found a blown fuse on a power pole near the entrance ramp from Highway 10 to I-35W North. They replaced the fuse and the TGRS re-started normally. Down time: 2 hours at B1, B13 and B3.
4/30/2015	Pumphouse B4; When Xcel Energy replaced the blown fuse on the power pole and the TGRS re-started, the sub-monitor at B4 tripped and the pump did not re-start. Reset the sub-monitor and the pump re-started normally. Down time: 13 hours.
May 2015	
5/5/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the light re-lit normally. At the pumphouse, normal pumping operation was observed. Down time: 3.5 hours.
5/20/2015	Pumphouse B12; While exercising the in-ground gate valve for the B10, B7, B12 forcemain line, a leak was observed coming from the B12 gate valve. Turned the majority of the TGRS wells off and replaced the gate valve. Re-opened the in-ground gate valve and verified there was no longer a leak at the B12 gate valve. Down time: 5 hours at B1, B13, B3 and B4. Three hours at B6 and B9 and 2 hours at SC5.
5/27/2015	Pumphouse SC2; Turned the pump off to work on the forcemain piping. Down time: 1 hour.

Appendix F-2

Maintenance Activities
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

June 2015

6/10/2015	Pumphouse B6; Turned the pump off to replace portions of the ECV control piping. Down time: 1 hour
6/22-23/2015	Pumphouse SC2; Mineral buildup in the flow meter stopped the flow meter from totaling. Turned the pump off and removed, cleaned and replaced the flow meter. Restarted the pump and observed normal flow meter operation. Down time: 18.5 hours.
6/28/2015	Pumphouse SC5; The light was flashing on the well field panel. Most likely the recent storm interrupted communication to the pumphouse. Reset the PLC and the light relit normally. At the pumphouse the pump was running normally. Down time: 8 hours.

July 2015

7/4/2015	TGRS; The daily inspection was not performed due to the Independence Day holiday. Down time: None.
7/6/2015	Pumphouse B8; The high water level light was lit on the pumphouse control panel. Reset the remote I/O adapter and restarted the pump. The pump turned on normally and normal operation was observed. Down time: 5 hours.
7/8/2015	Pumphouse SC1; The flow meter was not spinning. A piece of manganese was stuck in the impeller of the flow meter. Removed the debris and re-started the pump. Adjusted the daily flow rate to representative. Down time: None.
7/13/2015	Pumphouses B9 and SC5; Their lights were flashing on the well field panel. Reset the PLC and their lights relit normally. At the pumphouses normal operation was observed. Down time: 13 hours at B9 and 13 hours at SC5.
7/13-16/2015	Treatment System; Call from Time Communications - TGRS fail. Pump 4 fails to turn on in Auto or Hand. Preferred Electric diagnosed the motor as no longer operable. Turned pumps B3 and B9 off so Pump 3 in the treatment center can discharge treated water at a rate slightly greater than the influent flow rate to negate well field cycling. T. L. Stevens Well Company replaced the blown motor with the backup motor in inventory. Re-started Pump 4 and observed normal operation. Down time: 67 hours at B3 and B9.

Appendix F-2

Maintenance Activities
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

7/18/2015	Pumphouses B8, B9 and SC5; The lights were flashing on the well field panel. Reset the PLC and the lights relit normally. At the pumphouse, the pumps were running normally. Down time: 4 hours at B8, 4.5 hours at B9 and 3 hours at SC5.
7/21/2015	Pumphouses SC1 and SC2; Removed, cleaned and replaced the cold water flow meters. Down time: None.
7/28/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the light relit normally. At the pumphouse normal operation was observed. Down time: 5.5 hours.

August 2015

8/1/2015	Pumphouse SC5; The ECV opened overnight which increased the flow rate. Removed and replaced scaled portions of the control piping and reset the pilot. Normal operation observed. Down time: None.
8/7/2015	Pumphouse B4; The light was flashing on the well field panel. Reset the PLC and the light came on steady. At the pumphouse normal observation was observed. Down time: None.
8/11/2015	Pumphouse B4; The light was normal on the well field panel. At the pumphouse, the "Low Light" was on. Reset the controls and starter inside the panel and re-started the pump. A loud chatter came from the starter. Reset all components again and re-started the pump. The pump started normally. Monitored the pump for approximately five minutes. Normal operation continued. Down time: None, the pump went down during the daily inspection.
8/13/2015	Pumphouse B4; The light was off on the well field panel. Reset the PLC but the light remained off. At the pumphouse, the "Low light" was on. Phase monitor fault. Preferred Electric on Site. Replaced the phase monitor and re-started the pump. Normal operation was observed. Down time: 6 hours.
8/14/2015	Treatment System and Well Field; No power to the treatment system or well field. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired it incorrectly. Several voltage spikes surged through the electrical lines. They re-wired the transformer correctly and restored power to the TGRS. Preferred Electric on site to make repairs to damaged portions of the system. Down time: 38 hours at B3, B5 and B6. 40 hours at B1 and B13. 42 hours at SC1, SC2 and SC5.

Appendix F-2

Maintenance Activities
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

8/14-20/2015	Pumphouse B4; The voltage surge blew the submersible pump motor in B4. T. L. Stevens on site to pull the lift system and replace the motor and worn portions of the lift system. Following repair, the pump was turned on and normal operation was observed. Down time: 179 hours.
8/14-17/2015	Pumphouses B8 and B9; The voltage surge blew phase monitors in the control panels. Preferred Electric replaced the phase monitors. Re-started the pumps and normal operation was observed. Down time: 88 hours at B8 and 93 hours at B9.
8/23/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the light relit normally. At the pumphouse, normal operation was observed. Down time: 17 hours.
8/31/2015	Pumphouses SC1, SC2 and SC5; Power outage to the SC wells. Two fusible switches were open at Switch 40. Contacted Xcel Energy and they re-installed two new fuses. Power was restored. Turned the pumps back on for normal service. Down time: 8 hours at SC1 and SC5. 20 hours at SC2.

September 2015

9/5/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the SC5 light relit normally. At the pumphouse, the pump was on and pumping normally. Down time: 3.5 hours.
9/6/2015	Treatment System; Call from Time Communication "TGRS Fail". Pump 4 would not turn on. Reset the motor starter in the motor control center and attempted to restart Pump 4. A loud chatter noise came from the motor control center. Turned the pump to off and reset the starter again. Started Pump 4 again. This time the starter functioned properly and Pump 4 started normally. Cycled Pump 4 three times and observed normal operation. Down time: 1 hour at SC5.
9/7/2015	The daily inspection was not performed due to the Labor Day holiday. Meter readings were estimated. Down time: None.
9/8/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the SC5 light relit normally. At the pumphouse, the pump was on and pumping normally. Down time: None.
9/16/2015	Treatment System; Turned Pump 4 off to change the oil in the motor. Turned B6 and B8 off to minimize well field cycling. Down time: None.

Appendix F-2

Maintenance Activities
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

9/17/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the SC5 light relit normally. At the pumphouse, the pump was on and pumping normally. Down time: 8 hours.
9/29-30/2015	Pumphouse B6; The pump will not turn off when an emergency condition is created. Began troubleshooting with the PLC in an alarm condition which turned off the well field (except B6). Additional troubleshooting work will be necessary. Down time: 1.5 hours at B1; 2.5 hours at B3 and 3 hours at B13.
9/30/2015	Pumphouse SC2; The flow meter stopped totaling. Removed and cleaned the flow meter. Re-installed the flow meter and the meter began totaling normally. Down time: 10.5 hours at SC2.

F.3 Maintenance Activities by Location, Fiscal Year 2015, TGRS, OU2

Appendix F-3

Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

Pumphouse B1

12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
12/12/2014	Treatment System; Turned the TGRS off to change oil in the motor for pump 4. Down time: 1.5 hours at B1 and B3.
3/27/2015	Pumphouse B1, B13, SC2 and SC5; Performed cold water flow meter calibration work. Down time: None.
4/29/2015	Treatment System and Well Field; Call from Time Communication - "TGRS Fail". At the Site, there was no power to the treatment system or the well field. Contacted Xcel Energy and they found a blown fuse on a power pole near the entrance ramp from Highway 10 to I-35W North. They replaced the fuse and the TGRS re-started normally. Down time: 2 hours at B1, B13 and B3.
5/20/2015	Pumphouse B12; While exercising the in-ground gate valve for the B10, B7, B12 forcemain line, a leak was observed coming from the B12 gate valve. Turned the majority of the TGRS wells off and replaced the gate valve. Re-opened the in-ground gate valve and verified there was no longer a leak at the B12 gate valve. Down time: 5 hours at B1, B13, B3 and B4. Three hours at B6 and B9 and 2 hours at SC5.
8/14/2015	Treatment System and Well Field; No power to the treatment system or well field. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired it incorrectly. Several voltage spikes surged through the electrical lines. They re-wired the transformer correctly and restored power to the TGRS. Preferred Electric on site to make repairs to damaged portions of the system. Down time: 38 hours at B3, B5 and B6. 40 hours at B1 and B13. 42 hours at SC1, SC2 and SC5.
9/29-30/2015	Pumphouse B6; The pump will not turn off when an emergency condition is created. Began troubleshooting with the PLC in an alarm condition which turned off the well field (except B6). Additional troubleshooting work will be necessary. Down time: 1.5 hours at B1; 2.5 hours at B3 and 3 hours at B13.

Appendix F-3

Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

Pumphouse B3

10/31/2014	Pumphouses B3 and B8; Changed out portions of the pressure gauge and ECV piping that was leaking. Down time: None.
12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
12/12/2014	Treatment System; Turned the TGRS off to change oil in the motor for pump 4. Down time: 1.5 hours at B1 and B3.
2/10/2015	Pumphouse B3; Turned the pump off to replace portions of the ECV control piping. Re-started the pump and observed normal operation. Down time: 2 hours.
3/1-13/2015	Pumphouses B8, B9 and SC1; No communication to the pumphouses. Turned the pumps to "Hand" and contacted Laughlin Electric. Troubleshooting indicates a bad communication cable between the hand hole behind B8 and the next hand hole in line to Building 116. Temporarily installed new communication cable on the ground between the hand holes. Switched the pumps to "Auto" and the pumps started. Normal operation observed. Down time: 2 hours at B3.
3/13/2015	Pumphouse B3 and B4; Following re-connection of the new communication wires, the lights for pumphouses B3 and B4 were flashing on the PLC. Replaced the sub IO scanner module and the pumps re-started and the lights relit normally. Down time: 1.5 hours at B3 and B4.
3/20/2015	Pumphouse B3 and B4; Performed cold water flow meter calibration work. Down time: None.
4/29/2015	Treatment System and Well Field; Call from Time Communication - "TGRS Fail". At the Site, there was no power to the treatment system or the well field. Contacted Xcel Energy and they found a blown fuse on a power pole near the entrance ramp from Highway 10 to I-35W North. They replaced the fuse and the TGRS re-started normally. Down time: 2 hours at B1, B13 and B3.

Appendix F-3

Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

5/20/2015	Pumphouse B12; While exercising the in-ground gate valve for the B10, B7, B12 forcemain line, a leak was observed coming from the B12 gate valve. Turned the majority of the TGRS wells off and replaced the gate valve. Re-opened the in-ground gate valve and verified there was no longer a leak at the B12 gate valve. Down time: 5 hours at B1, B13, B3 and B4. Three hours at B6 and B9 and 2 hours at SC5.
7/13-16/2015	Treatment System; Call from Time Communications - TGRS fail. Pump 4 fails to turn on in Auto or Hand. Preferred Electric diagnosed the motor as no longer operable. Turned pumps B3 and B9 off so Pump 3 in the treatment center can discharge treated water at a rate slightly greater than the influent flow rate to negate well field cycling. T. L. Stevens Well Company replaced the blown motor with the backup motor in inventory. Re-started Pump 4 and observed normal operation. Down time: 67 hours at B3 and B9.
8/14/2015	Treatment System and Well Field; No power to the treatment system or well field. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired it incorrectly. Several voltage spikes surged through the electrical lines. They re-wired the transformer correctly and restored power to the TGRS. Preferred Electric on site to make repairs to damaged portions of the system. Down time: 38 hours at B3, B5 and B6. 40 hours at B1 and B13. 42 hours at SC1, SC2 and SC5.
9/29-30/2015	Pumphouse B6; The pump will not turn off when an emergency condition is created. Began troubleshooting with the PLC in an alarm condition which turned off the well field (except B6). Additional troubleshooting work will be necessary. Down time: 1.5 hours at B1; 2.5 hours at B3 and 3 hours at B13.

Pumphouse B4

12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
3/13/2015	Pumphouse B3 and B4; Following re-connection of the new communication wires, the lights for pumphouses B3 and B4 were flashing on the PLC. Replaced the sub IO scanner module and the pumps re-started and the lights relit normally. Down time: 1.5 hours at B3 and B4.

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Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

3/20/2015	Pumphouse B3 and B4; Performed cold water flow meter calibration work. Down time: None.
3/23-24/2015	Pumphouse B4; No power to the pumphouse. Laughlin Electric inspects and finds the power line from the power pole to the pumphouse is worn and damaged. Contacted Xcel Energy and they pulled the fuses on the power pole near pumphouse B5. Laughlin replaced the wire and Xcel replaced the fuses. Re-started the pump and observed normal operation. Down time: 37 hours.
4/30/2015	Pumphouse B4; When Xcel Energy replaced the blown fuse on the power pole and the TGRS re-started, the sub-monitor at B4 tripped and the pump did not re-start. Reset the sub-monitor and the pump re-started normally. Down time: 13 hours.
5/20/2015	Pumphouse B12; While exercising the in-ground gate valve for the B10, B7, B12 forcemain line, a leak was observed coming from the B12 gate valve. Turned the majority of the TGRS wells off and replaced the gate valve. Re-opened the in-ground gate valve and verified there was no longer a leak at the B12 gate valve. Down time: 5 hours at B1, B13, B3 and B4. Three hours at B6 and B9 and 2 hours at SC5.
8/7/2015	Pumphouse B4; The light was flashing on the well field panel. Reset the PLC and the light came on steady. At the pumphouse normal observation was observed. Down time: None.
8/11/2015	Pumphouse B4; The light was normal on the well field panel. At the pumphouse, the "Low Light" was on. Reset the controls and starter inside the panel and re-started the pump. A loud chatter came from the starter. Reset all components again and re-started the pump. The pump started normally. Monitored the pump for approximately five minutes. Normal operation continued. Down time: None, the pump went down during the daily inspection.
8/13/2015	Pumphouse B4; The light was off on the well field panel. Reset the PLC but the light remained off. At the pumphouse, the "Low light" was on. Phase monitor fault. Preferred Electric on Site. Replaced the phase monitor and re-started the pump. Normal operation was observed. Down time: 6 hours.
8/14-20/2015	Pumphouse B4; The voltage surge blew the submersible pump motor in B4. T. L. Stevens on site to pull the lift system and replace the motor and worn portions of the lift system. Following repair, the pump was turned on and normal operation was observed. Down time: 179 hours.

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Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

Pumphouse B5

10/18-24/2014	Pumphouse B5; The pump is off and will not start after reset. Inspected the 50 amp fuses in breaker box and one appears blown. Replaced two of the three fuses and still no start up in "Auto" or "Hand". Thein Well pulled the lift system and the motor is good and the pump is worn but working. Laughlin Electric diagnosis bad wiring in the overhead conduit. Replaced the pump and the wiring and re-started the pump. Normal operation was observed. Down time: 159 hours.
10/27/2014	Pumphouse B5; Measured the new flow rates, pressures and pumping water levels since installing the new pump. Down time: None.
12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
2/6/2015	Pumphouses B5, B6 and B9; Increased the flow rates to maximum to offset the lost flow rate from B8. Down time: None.
2/10/2015	Pumphouses B5, B6 and B9; Reset the flow rates to their target rates. Down time: None.
3/18/2015	Pumphouse B5, B6, B8 and B9; Performed cold water flow meter calibration work. Down time: None.
3/30/2015	Pumphouses B5, B13 and SC5; Removed the existing cold water flow meters and installed re-built cold water flow meters from inventory. Down time: None.
4/27/2015	Treatment System; Call from Time Communication - "TGRS Fail". Pump 4 would not start in "Auto" but would start in "Hand". Most likely a bad pump start float for Pump 4. Turned off the B5 and B9 pumps and left the TGRS in "Auto". Scheduled the replacement of the start float for Pump 4. Down time: 6.5 hours at B5 and 9 hours at B9.

Appendix F-3

Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

8/14/2015	Treatment System and Well Field; No power to the treatment system or well field. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired it incorrectly. Several voltage spikes surged through the electrical lines. They re-wired the transformer correctly and restored power to the TGRS. Preferred Electric on site to make repairs to damaged portions of the system. Down time: 38 hours at B3, B5 and B6. 40 hours at B1 and B13. 42 hours at SC1, SC2 and SC5.

Pumphouse B6

12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
2/6/2015	Pumphouses B5, B6 and B9; Increased the flow rates to maximum to offset the lost flow rate from B8. Down time: None.
2/10/2015	Pumphouses B5, B6 and B9; Reset the flow rates to their target rates. Down time: None.
3/18/2015	Pumphouse B5, B6, B8 and B9; Performed cold water flow meter calibration work. Down time: None.
5/20/2015	Pumphouse B12; While exercising the in-ground gate valve for the B10, B7, B12 forcemain line, a leak was observed coming from the B12 gate valve. Turned the majority of the TGRS wells off and replaced the gate valve. Re-opened the in-ground gate valve and verified there was no longer a leak at the B12 gate valve. Down time: 5 hours at B1, B13, B3 and B4. Three hours at B6 and B9 and 2 hours at SC5.
6/10/2015	Pumphouse B6; Turned the pump off to replace portions of the ECV control piping. Down time: 1 hour

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Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

8/14/2015	Treatment System and Well Field; No power to the treatment system or well field. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired it incorrectly. Several voltage spikes surged through the electrical lines. They re-wired the transformer correctly and restored power to the TGRS. Preferred Electric on site to make repairs to damaged portions of the system. Down time: 38 hours at B3, B5 and B6. 40 hours at B1 and B13. 42 hours at SC1, SC2 and SC5.
9/16/2015	Treatment System; Turned Pump 4 off to change the oil in the motor. Turned B6 and B8 off to minimize well field cycling. Down time: None.
9/29-30/2015	Pumphouse B6; The pump will not turn off when an emergency condition is created. Began troubleshooting with the PLC in an alarm condition which turned off the well field (except B6). Additional troubleshooting work will be necessary. Down time: 1.5 hours at B1; 2.5 hours at B3 and 3 hours at B13.

Pumphouse B8

10/31/2014	Pumphouses B3 and B8; Changed out portions of the pressure gauge and ECV piping that was leaking. Down time: None.
12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
2/5-9/2015	Pumphouse B8; There is a leak in the riser pipe. Thein Well removed the lift system and replaced three lengths of pipe. Re-installed the lift system and re-started the pump. Normal operation observed. Down time: 95 hours.
2/28/2015	Pumphouses B8 and SC1; No communication to the pumphouses. Turned the pumps to "Hand" and contacted Laughlin Electric. Troubleshooting indicates a bad communication cable between the hand hole behind B8 and the next hand hole in line to Building 116. Additional troubleshooting/repairs will be necessary. Down time: 3 hours at B8.

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Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

3/1-13/2015	Pumphouses B8, B9 and SC1; No communication to the pumphouses. Turned the pumps to "Hand" and contacted Laughlin Electric. Troubleshooting indicates a bad communication cable between the hand hole behind B8 and the next hand hole in line to Building 116. Temporarily installed new communication cable on the ground between the hand holes. Switched the pumps to "Auto" and the pumps started. Normal operation observed. Down time: 2 hours at B3.
3/13/2015	Pumphouses B8, B9 and SC1; In addition to the information in note 1 above, Laughlin Electric on Site to install the communication wires and Bolander excavated two ditches across the two roads for the temporary connection of the new communication wires. Down time: 3.5 hours at B9.
3/18/2015	Pumphouse B5, B6, B8 and B9; Performed cold water flow meter calibration work. Down time: None.
4/14-15/2015	Pumphouses B8, B9 and SC1; Bolander accidentally excavated and damaged the communication lines between the hand hole behind B8 and the next hand hole in line on the way to Building 116. Laughlin Electric installed a new hand hole where the lines were excavated and then installed new communication wires in the conduit between hand holes. Turned some of the extraction wells off during the work. Down time: 4 hours at B1 and B6; 2.5 hours at B9, B13, SC1 and SC2; 1.5 hours at B4 and SC5.
7/6/2015	Pumphouse B8; The high water level light was lit on the pumphouse control panel. Reset the remote I/O adapter and restarted the pump. The pump turned on normally and normal operation was observed. Down time: 5 hours.
7/18/2015	Pumphouses B8, B9 and SC5; The lights were flashing on the well field panel. Reset the PLC and the lights relit normally. At the pumphouse, the pumps were running normally. Down time: 4 hours at B8, 4.5 hours at B9 and 3 hours at SC5.
8/14-17/2015	Pumphouses B8 and B9; The voltage surge blew phase monitors in the control panels. Preferred Electric replaced the phase monitors. Re-started the pumps and normal operation was observed. Down time: 88 hours at B8 and 93 hours at B9.
9/16/2015	Treatment System; Turned Pump 4 off to change the oil in the motor. Turned B6 and B8 off to minimize well field cycling. Down time: None.

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Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

Pumphouse B9

12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
1/19/2015	Treatment System; The valve seals in ECV 4 were worn and the valve would no longer close. Installed a new valve seal kit and cleaned the scale and sediment from the piston and the inside of the valve. Cycled the valve three times and observed normal operation. Down time: 2.5 hours at B9.
1/20/2015	Treatment System; Call from Time Communication-TGRS Fail. At the Site, ECV 4 failed to open on command. Exercised the control valves, flushed the control piping and reset the opening and closing speed control valves. Cycled the valve and observed normal operation. Down time: 2 hours at B9.
2/6/2015	Pumphouses B5, B6 and B9; Increased the flow rates to maximum to offset the lost flow rate from B8. Down time: None.
2/10/2015	Pumphouses B5, B6 and B9; Reset the flow rates to their target rates. Down time: None.
3/1-13/2015	Pumphouses B8, B9 and SC1; No communication to the pumphouses. Turned the pumps to "Hand" and contacted Laughlin Electric. Troubleshooting indicates a bad communication cable between the hand hole behind B8 and the next hand hole in line to Building 116. Temporarily installed new communication cable on the ground between the hand holes. Switched the pumps to "Auto" and the pumps started. Normal operation observed. Down time: 2 hours at B3.
3/13/2015	Pumphouses B8, B9 and SC1; In addition to the information in note 1 above, Laughlin Electric on Site to install the communication wires and Bolander excavated two ditches across the two roads for the temporary connection of the new communication wires. Down time: 3.5 hours at B9.
3/18/2015	Pumphouse B5, B6, B8 and B9; Performed cold water flow meter calibration work. Down time: None.

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Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

4/14-15/2015	Pumphouses B8, B9 and SC1; Bolander accidentally excavated and damaged the communication lines between the hand hole behind B8 and the next hand hole in line on the way to Building 116. Laughlin Electric installed a new hand hole where the lines were excavated and then installed new communication wires in the conduit between hand holes. Turned some of the extraction wells off during the work. Down time: 4 hours at B1 and B6; 2.5 hours at B9, B13, SC1 and SC2; 1.5 hours at B4 and SC5.
4/15/2015	Pumphouse B9; Following installation of the new communication wire, the pumphouse was not communicating with the PLC in Building 116. Replaced the I/O adapter module in the pumphouse and the I/O scanner module in the PLC and re-started the pump. Normal operation was observed. Down time: 16 hours.
4/27/2015	Treatment System; Call from Time Communication - "TGRS Fail". Pump 4 would not start in "Auto" but would start in "Hand". Most likely a bad pump start float for Pump 4. Turned off the B5 and B9 pumps and left the TGRS in "Auto". Scheduled the replacement of the start float for Pump 4. Down time: 6.5 hours at B5 and 9 hours at B9.
5/20/2015	Pumphouse B12; While exercising the in-ground gate valve for the B10, B7, B12 forcemain line, a leak was observed coming from the B12 gate valve. Turned the majority of the TGRS wells off and replaced the gate valve. Re-opened the in-ground gate valve and verified there was no longer a leak at the B12 gate valve. Down time: 5 hours at B1, B13, B3 and B4. Three hours at B6 and B9 and 2 hours at SC5.
7/13/2015	Pumphouses B9 and SC5; Their lights were flashing on the well field panel. Reset the PLC and their lights relit normally. At the pumphouses normal operation was observed. Down time: 13 hours at B9 and 13 hours at SC5.
7/13-16/2015	Treatment System; Call from Time Communications - TGRS fail. Pump 4 fails to turn on in Auto or Hand. Preferred Electric diagnosed the motor as no longer operable. Turned pumps B3 and B9 off so Pump 3 in the treatment center can discharge treated water at a rate slightly greater than the influent flow rate to negate well field cycling. T. L. Stevens Well Company replaced the blown motor with the backup motor in inventory. Re-started Pump 4 and observed normal operation. Down time: 67 hours at B3 and B9.
7/18/2015	Pumphouses B8, B9 and SC5; The lights were flashing on the well field panel. Reset the PLC and the lights relit normally. At the pumphouse, the pumps were running normally. Down time: 4 hours at B8, 4.5 hours at B9 and 3 hours at SC5.

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Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

8/14-17/2015 Pumphouses B8 and B9; The voltage surge blew phase monitors in the control panels. Preferred Electric replaced the phase monitors. Re-started the pumps and normal operation was observed.

Down time: 88 hours at B8 and 93 hours at B9.

Pumphouse B11

12/10/2014 Pumphouse B11; Closed the forcemain gate valve just west of pumphouse B1 to stop the flow of water to pumphouse B11 so the pumphouse will no longer need heat to keep the pipes from freezing.

Down time: None.

12/12/2014 Pumphouse B11; Removed portions of the piping to drain the piping and turned the heat off in the pumphouse.

Down time: None.

Pumphouse B12

5/20/2015 Pumphouse B12; While exercising the in-ground gate valve for the B10, B7, B12 forcemain line, a leak was observed coming from the B12 gate valve. Turned the majority of the TGRS wells off and replaced the gate valve. Re-opened the in-ground gate valve and verified there was no longer a leak at the B12 gate valve.

Down time: 5 hours at B1, B13, B3 and B4. Three hours at B6 and B9 and 2 hours at SC5.

Pumphouse B13

11/2/2014 Treatment System; Call from Time Communications that the TGRS had failed. At the site, the pump director unit showed that ECV 4 failed to open on command. Exercised the valves and flushed the control piping. Cycled the valve three times and the valve operated normally.

Down time: B13 for 1 hour.

11/12/2014 Pumphouse B13; Water was leaking from a union on the control piping. Replaced the union and stopped the leak.

Down time: None.

Appendix F-3

Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
2/15-17/2015	Pumphouse B13; The motor starter was chattering loudly. Turned the pump off and contacted Laughlin Electric. Diagnosed as a bad output card. Replaced the output card with one from inventory and re-started the pump. Normal operation observed. Down time: 43 hours.
3/27/2015	Pumphouse B1, B13, SC2 and SC5; Performed cold water flow meter calibration work. Down time: None.
3/30/2015	Pumphouses B5, B13 and SC5; Removed the existing cold water flow meters and installed re-built cold water flow meters from inventory. Down time: None.
4/29/2015	Treatment System and Well Field; Call from Time Communication - "TGRS Fail". At the Site, there was no power to the treatment system or the well field. Contacted Xcel Energy and they found a blown fuse on a power pole near the entrance ramp from Highway 10 to I-35W North. They replaced the fuse and the TGRS re-started normally. Down time: 2 hours at B1, B13 and B3.
5/20/2015	Pumphouse B12; While exercising the in-ground gate valve for the B10, B7, B12 forcemain line, a leak was observed coming from the B12 gate valve. Turned the majority of the TGRS wells off and replaced the gate valve. Re-opened the in-ground gate valve and verified there was no longer a leak at the B12 gate valve. Down time: 5 hours at B1, B13, B3 and B4. Three hours at B6 and B9 and 2 hours at SC5.
8/14/2015	Treatment System and Well Field; No power to the treatment system or well field. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired it incorrectly. Several voltage spikes surged through the electrical lines. They re-wired the transformer correctly and restored power to the TGRS. Preferred Electric on site to make repairs to damaged portions of the system. Down time: 38 hours at B3, B5 and B6. 40 hours at B1 and B13. 42 hours at SC1, SC2 and SC5.
9/29-30/2015	Pumphouse B6; The pump will not turn off when an emergency condition is created. Began troubleshooting with the PLC in an alarm condition which turned off the well field (except B6). Additional troubleshooting work will be necessary. Down time: 1.5 hours at B1; 2.5 hours at B3 and 3 hours at B13.

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Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

Pumphouse SC1

12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
2/28/2015	Pumphouses B8 and SC1; No communication to the pumphouses. Turned the pumps to "Hand" and contacted Laughlin Electric. Troubleshooting indicates a bad communication cable between the hand hole behind B8 and the next hand hole in line to Building 116. Additional troubleshooting/repairs will be necessary. Down time: 3 hours at B8.
3/1-13/2015	Pumphouses B8, B9 and SC1; No communication to the pumphouses. Turned the pumps to "Hand" and contacted Laughlin Electric. Troubleshooting indicates a bad communication cable between the hand hole behind B8 and the next hand hole in line to Building 116. Temporarily installed new communication cable on the ground between the hand holes. Switched the pumps to "Auto" and the pumps started. Normal operation observed. Down time: 2 hours at B3.
3/13/2015	Pumphouses B8, B9 and SC1; In addition to the information in note 1 above, Laughlin Electric on Site to install the communication wires and Bolander excavated two ditches across the two roads for the temporary connection of the new communication wires. Down time: 3.5 hours at B9.
4/14-15/2015	Pumphouses B8, B9 and SC1; Bolander accidentally excavated and damaged the communication lines between the hand hole behind B8 and the next hand hole in line on the way to Building 116. Laughlin Electric installed a new hand hole where the lines were excavated and then installed new communication wires in the conduit between hand holes. Turned some of the extraction wells off during the work. Down time: 4 hours at B1 and B6; 2.5 hours at B9, B13, SC1 and SC2; 1.5 hours at B4 and SC5.
7/8/2015	Pumphouse SC1; The flow meter was not spinning. A piece of manganese was stuck in the impeller of the flow meter. Removed the debris and re-started the pump. Adjusted the daily flow rate to representative. Down time: None.

Appendix F-3

Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

7/21/2015	Pumphouses SC1 and SC2; Removed, cleaned and replaced the cold water flow meters. Down time: None.
8/14/2015	Treatment System and Well Field; No power to the treatment system or well field. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired it incorrectly. Several voltage spikes surged through the electrical lines. They re-wired the transformer correctly and restored power to the TGRS. Preferred Electric on site to make repairs to damaged portions of the system. Down time: 38 hours at B3, B5 and B6. 40 hours at B1 and B13. 42 hours at SC1, SC2 and SC5.
8/31/2015	Pumphouses SC1, SC2 and SC5; Power outage to the SC wells. Two fusible switches were open at Switch 40. Contacted Xcel Energy and they re-installed two new fuses. Power was restored. Turned the pumps back on for normal service. Down time: 8 hours at SC1 and SC5. 20 hours at SC2.

Pumphouse SC2

12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
12/18/2014	Pumphouses SC2 and SC5; Power was off to the pumphouses. Called Xcel Energy. They found an electrical wire on the ground near the former location of Building 503. They re-strung the wire and repaired the problem. Down time: None.
1/26/2015	Pumphouse SC2; The flow meter has stopped totaling water flow. Removed the flow meter and installed a re-built flow meter from inventory. Down time: 2 hours.
3/27/2015	Pumphouse B1, B13, SC2 and SC5; Performed cold water flow meter calibration work. Down time: None.
5/27/2015	Pumphouse SC2; Turned the pump off to work on the forcemain piping. Down time: 1 hour.

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Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

6/22-23/2015	Pumphouse SC2; Mineral buildup in the flow meter stopped the flow meter from totaling. Turned the pump off and removed, cleaned and replaced the flow meter. Restarted the pump and observed normal flow meter operation. Down time: 18.5 hours.
7/21/2015	Pumphouses SC1 and SC2; Removed, cleaned and replaced the cold water flow meters. Down time: None.
8/14/2015	Treatment System and Well Field; No power to the treatment system or well field. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired it incorrectly. Several voltage spikes surged through the electrical lines. They re-wired the transformer correctly and restored power to the TGRS. Preferred Electric on site to make repairs to damaged portions of the system. Down time: 38 hours at B3, B5 and B6. 40 hours at B1 and B13. 42 hours at SC1, SC2 and SC5.
8/31/2015	Pumphouses SC1, SC2 and SC5; Power outage to the SC wells. Two fusible switches were open at Switch 40. Contacted Xcel Energy and they re-installed two new fuses. Power was restored. Turned the pumps back on for normal service. Down time: 8 hours at SC1 and SC5. 20 hours at SC2.
9/30/2015	Pumphouse SC2; The flow meter stopped totaling. Removed and cleaned the flow meter. Re-installed the flow meter and the meter began totaling normally. Down time: 10.5 hours at SC2.

Pumphouse SC5

10/5/2014	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the light came back on. At the pumphouse, normal pumping operation observed. Down time: 16 hours.
11/4/2014	Pumphouse SC5; The light was flashing on the well field panel. Reset the well field and the light came on steady. At the pumphouse, normal operation was observed. Down time: None.
11/6/2014	Pumphouse SC5; The light was flashing on the well field panel. Reset the well field and the light came on steady. At the pumphouse, normal operation was observed. Down time: 6 hours.

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Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
12/18/2014	Pumphouses SC2 and SC5; Power was off to the pumphouses. Called Xcel Energy. They found an electrical wire on the ground near the former location of Building 503. They re-strung the wire and repaired the problem. Down time: None.
3/27/2015	Pumphouse B1, B13, SC2 and SC5; Performed cold water flow meter calibration work. Down time: None.
3/30/2015	Pumphouses B5, B13 and SC5; Removed the existing cold water flow meters and installed re-built cold water flow meters from inventory. Down time: None.
4/2/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the light relit normally. At the pumphouse, normal operation was observed. Down time: 9.5 hours.
5/5/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the light re-lit normally. At the pumphouse, normal pumping operation was observed. Down time: 3.5 hours.
5/20/2015	Pumphouse B12; While exercising the in-ground gate valve for the B10, B7, B12 forcemain line, a leak was observed coming from the B12 gate valve. Turned the majority of the TGRS wells off and replaced the gate valve. Re-opened the in-ground gate valve and verified there was no longer a leak at the B12 gate valve. Down time: 5 hours at B1, B13, B3 and B4. Three hours at B6 and B9 and 2 hours at SC5.
6/28/2015	Pumphouse SC5; The light was flashing on the well field panel. Most likely the recent storm interrupted communication to the pumphouse. Reset the PLC and the light relit normally. At the pumphouse the pump was running normally. Down time: 8 hours.
7/13/2015	Pumphouses B9 and SC5; Their lights were flashing on the well field panel. Reset the PLC and their lights relit normally. At the pumphouses normal operation was observed. Down time: 13 hours at B9 and 13 hours at SC5.

Appendix F-3

Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

7/18/2015	Pumphouses B8, B9 and SC5; The lights were flashing on the well field panel. Reset the PLC and the lights relit normally. At the pumphouse, the pumps were running normally. Down time: 4 hours at B8, 4.5 hours at B9 and 3 hours at SC5.
7/28/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the light relit normally. At the pumphouse normal operation was observed. Down time: 5.5 hours.
8/1/2015	Pumphouse SC5; The ECV opened overnight which increased the flow rate. Removed and replaced scaled portions of the control piping and reset the pilot. Normal operation observed. Down time: None.
8/14/2015	Treatment System and Well Field; No power to the treatment system or well field. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired it incorrectly. Several voltage spikes surged through the electrical lines. They re-wired the transformer correctly and restored power to the TGRS. Preferred Electric on site to make repairs to damaged portions of the system. Down time: 38 hours at B3, B5 and B6. 40 hours at B1 and B13. 42 hours at SC1, SC2 and SC5.
8/23/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the light relit normally. At the pumphouse, normal operation was observed. Down time: 17 hours.
8/31/2015	Pumphouses SC1, SC2 and SC5; Power outage to the SC wells. Two fusible switches were open at Switch 40. Contacted Xcel Energy and they re-installed two new fuses. Power was restored. Turned the pumps back on for normal service. Down time: 8 hours at SC1 and SC5. 20 hours at SC2.
9/5/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the SC5 light relit normally. At the pumphouse, the pump was on and pumping normally. Down time: 3.5 hours.
9/6/2015	Treatment System; Call from Time Communication "TGRS Fail". Pump 4 would not turn on. Reset the motor starter in the motor control center and attempted to restart Pump 4. A loud chatter noise came from the motor control center. Turned the pump to off and reset the starter again. Started Pump 4 again. This time the starter functioned properly and Pump 4 started normally. Cycled Pump 4 three times and observed normal operation. Down time: 1 hour at SC5.
9/8/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the SC5 light relit normally. At the pumphouse, the pump was on and pumping normally. Down time: None.

Appendix F-3

Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

9/17/2015	Pumphouse SC5; The light was flashing on the well field panel. Reset the PLC and the SC5 light relit normally. At the pumphouse, the pump was on and pumping normally. Down time: 8 hours.

Treatment System

10/2/2014	Treatment System; Removed, cleaned and repaired the tower 4 airflow bank. Re-installed the airflow bank and normal operation was observed. Down time: None.
10/9/2014	Treatment System; Removed portions of ECV 4's control piping and cleaned/replaced as needed. Cycled ECV 4 and observed normal operation. Down time: None.
11/2/2014	Treatment System; Call from Time Communications that the TGRS had failed. At the site, the pump director unit showed that ECV 4 failed to open on command. Exercised the valves and flushed the control piping. Cycled the valve three times and the valve operated normally. Down time: B13 for 1 hour.
11/3/2014	Treatment System; Cycled ECV 3 and the valve would not close. Removed and cleaned portions of the control piping. Also exercised the control valves and flushed the control piping. Cycled the valve and observed normal operation. Down time: None.
12/8/2014	Treatment System and Well Field; Call from Time Communications "TGRS Fail". At the site, power was out to all of TCAAP. Contacted Xcel Energy. They found the top of the power pole located across Highway 10 from Scherer Brothers Lumber was burnt. They repaired the problem and restored power to TCAAP. Re-started the TGRS and observed normal operation. Down time: 11.5 hours at B1, B3 and B9; 10 hours at B4, B6, B8, B13, SC1; 7.5 hours at B5, SC5; 4 hours at SC2.
12/11/2014	Treatment System; Removed and replaced the effluent pressure gauge. Down time: None.
12/11/2014	Treatment System; Removed and cleaned the airflow meters for blowers 3 and 4. Down time: None.
12/12/2014	Treatment System; Turned the TGRS off to change oil in the motor for pump 4. Down time: 1.5 hours at B1 and B3.

Appendix F-3

Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

12/17/2014	Treatment System; ECV 3 would not open on command; Removed and cleaned portions of the control piping. Down time: None.
1/7-8/2015	Treatment System; There was a leak coming from the pilot on the ECV 4 control piping; Removed the pilot and installed a new seal kit then re-installed the pilot back on the ECV 4 control piping. Down time: None.
1/11/2015	Treatment System; The cellular phone indicator status showed a red light indicating the phone was not in operation. Cycled power to the cellular phone and the phone re-activated normally. Down time: None.
1/19/2015	Treatment System; The valve seals in ECV 4 were worn and the valve would no longer close. Installed a new valve seal kit and cleaned the scale and sediment from the piston and the inside of the valve. Cycled the valve three times and observed normal operation. Down time: 2.5 hours at B9.
1/20/2015	Treatment System; Call from Time Communication-TGRS Fail. At the Site, ECV 4 failed to open on command. Exercised the control valves, flushed the control piping and reset the opening and closing speed control valves. Cycled the valve and observed normal operation. Down time: 2 hours at B9.
3/4-6/2015	Treatment System and Well Field; Laughlin electric performs the annual electrical inspection. Down time: None.
4/27/2015	Treatment System; Call from Time Communication - "TGRS Fail". Pump 4 would not start in "Auto" but would start in "Hand". Most likely a bad pump start float for Pump 4. Turned off the B5 and B9 pumps and left the TGRS in "Auto". Scheduled the replacement of the start float for Pump 4. Down time: 6.5 hours at B5 and 9 hours at B9.
4/28/2015	Treatment System; Turned the TGRS off and removed the old pump start float for Pump 4 and installed a new pump start float. Turned Pump 4 on in "Auto" and observed normal operation. Down time: None.
4/29/2015	Treatment System and Well Field; Call from Time Communication - "TGRS Fail". At the Site, there was no power to the treatment system or the well field. Contacted Xcel Energy and they found a blown fuse on a power pole near the entrance ramp from Highway 10 to I-35W North. They replaced the fuse and the TGRS re-started normally. Down time: 2 hours at B1, B13 and B3.

Appendix F-3

Maintenance Activities By Location
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

7/13-16/2015	Treatment System; Call from Time Communications - TGRS fail. Pump 4 fails to turn on in Auto or Hand. Preferred Electric diagnosed the motor as no longer operable. Turned pumps B3 and B9 off so Pump 3 in the treatment center can discharge treated water at a rate slightly greater than the influent flow rate to negate well field cycling. T. L. Stevens Well Company replaced the blown motor with the backup motor in inventory. Re-started Pump 4 and observed normal operation. Down time: 67 hours at B3 and B9.
8/14/2015	Treatment System and Well Field; No power to the treatment system or well field. Xcel Energy found a blown transformer on a power pole across County Road 10 from Scherer Brothers Lumber. They replaced the transformer and then inadvertently wired it incorrectly. Several voltage spikes surged through the electrical lines. They re-wired the transformer correctly and restored power to the TGRS. Preferred Electric on site to make repairs to damaged portions of the system. Down time: 38 hours at B3, B5 and B6. 40 hours at B1 and B13. 42 hours at SC1, SC2 and SC5.
9/6/2015	Treatment System; Call from Time Communication "TGRS Fail". Pump 4 would not turn on. Reset the motor starter in the motor control center and attempted to restart Pump 4. A loud chatter noise came from the motor control center. Turned the pump to off and reset the starter again. Started Pump 4 again. This time the starter functioned properly and Pump 4 started normally. Cycled Pump 4 three times and observed normal operation. Down time: 1 hour at SC5.
9/16/2015	Treatment System; Turned Pump 4 off to change the oil in the motor. Turned B6 and B8 off to minimize well field cycling. Down time: None.

Forcemain

No maintenance activities

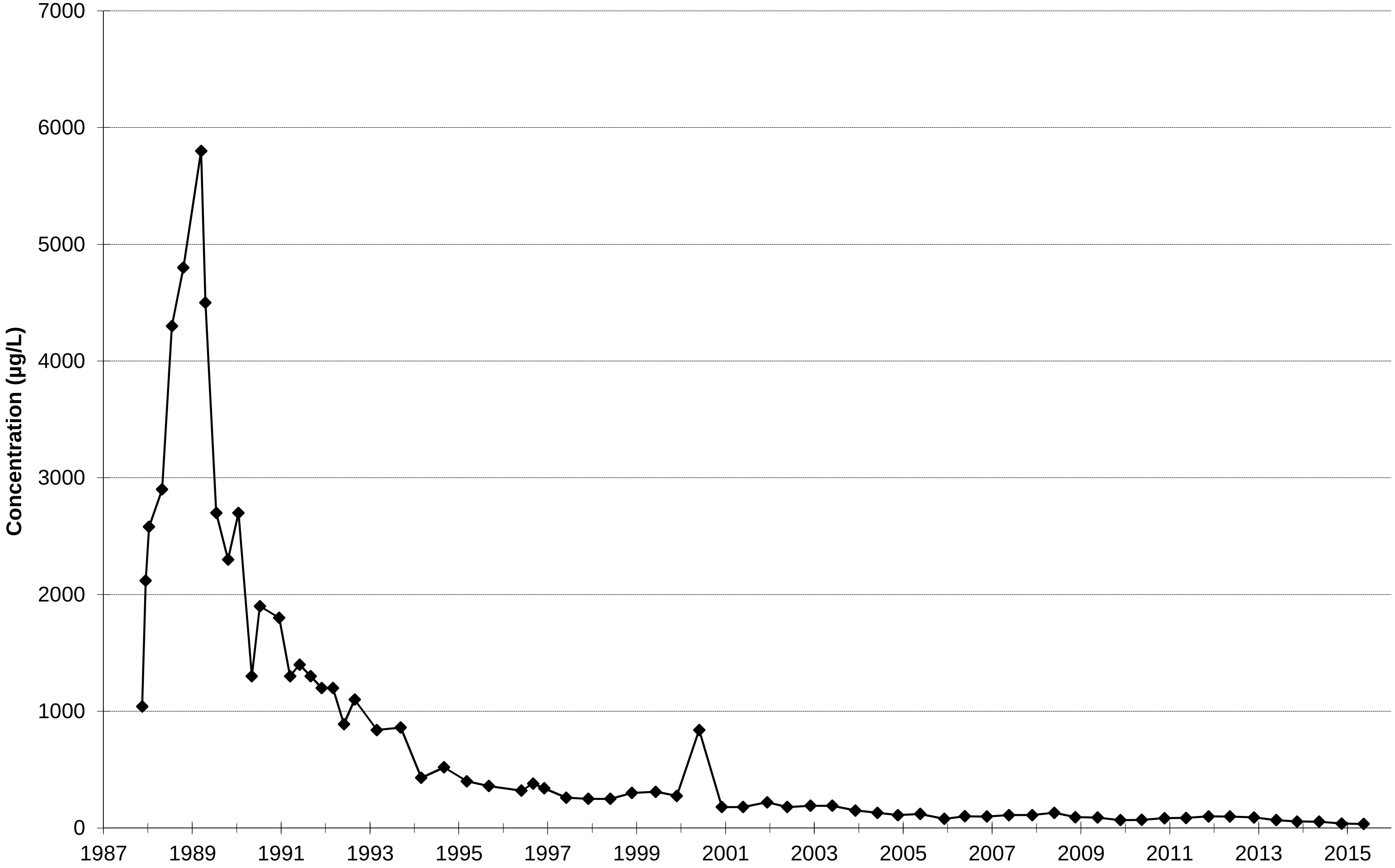
Appendix G

TGRS Chemical Data

G.1 TGRS Extraction Wells – TRCLE vs. Time

APPENDIX G-1

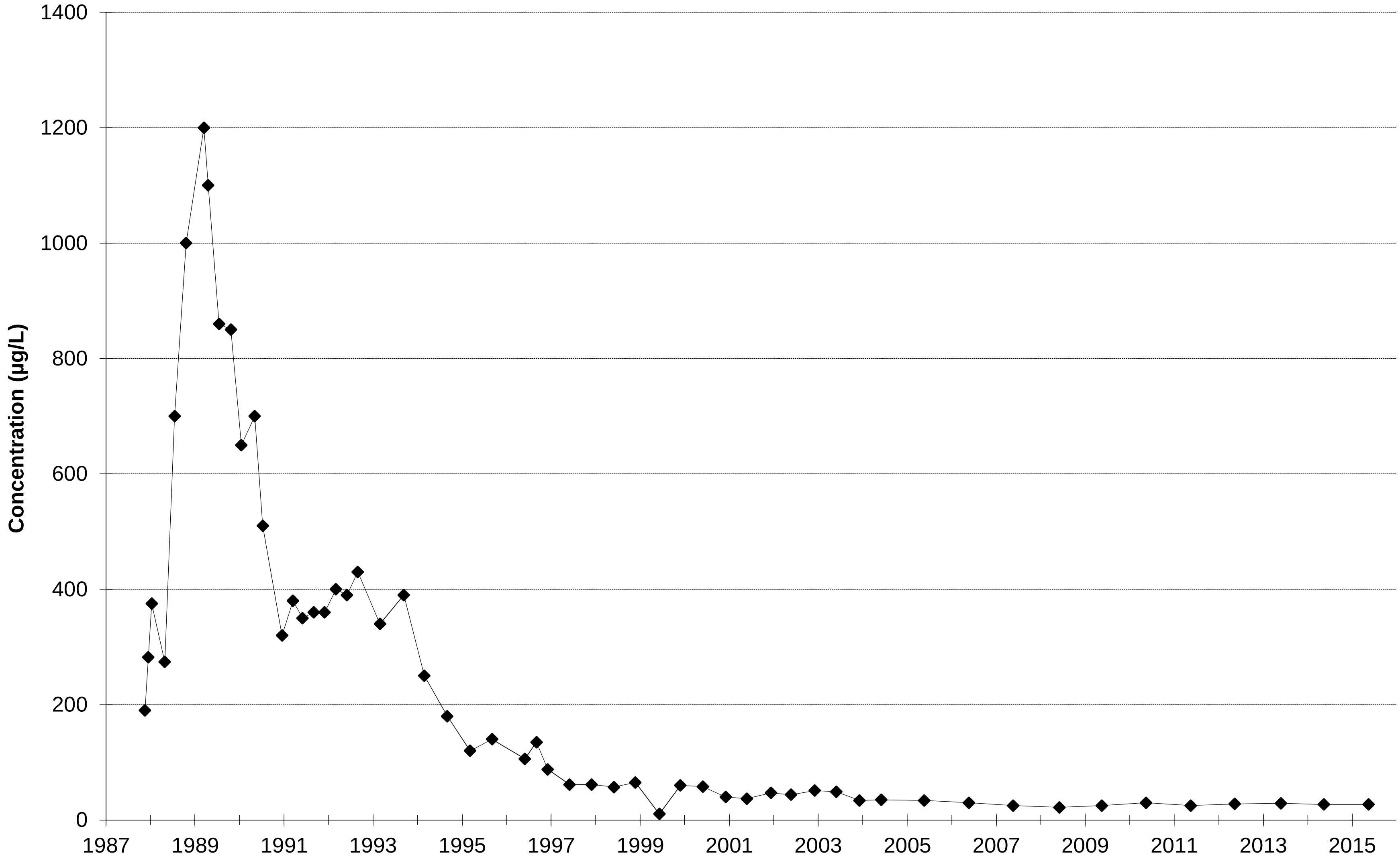
EXTRACTION WELL B1 - TRCLE VS.TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

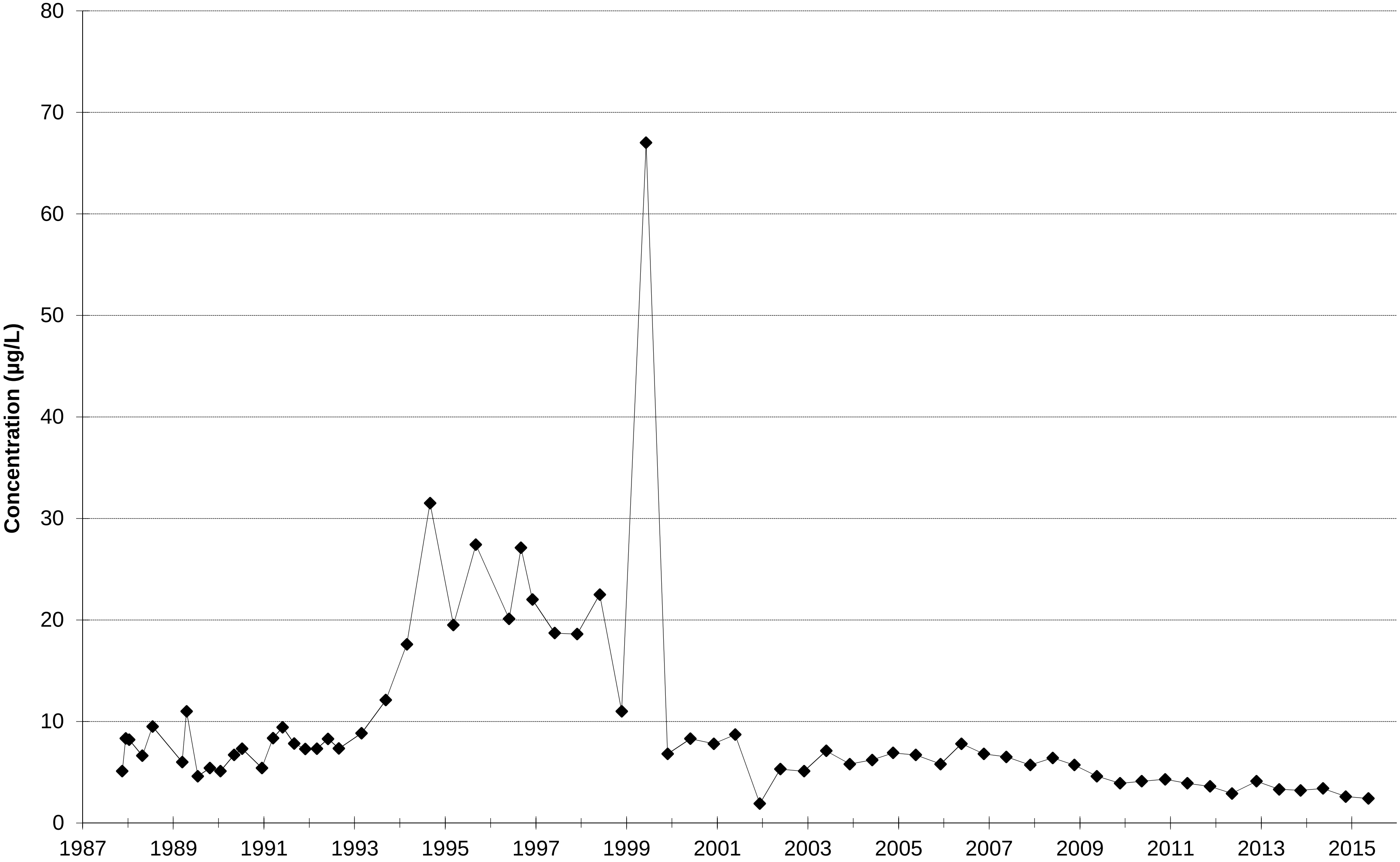
EXTRACTION WELL B2 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

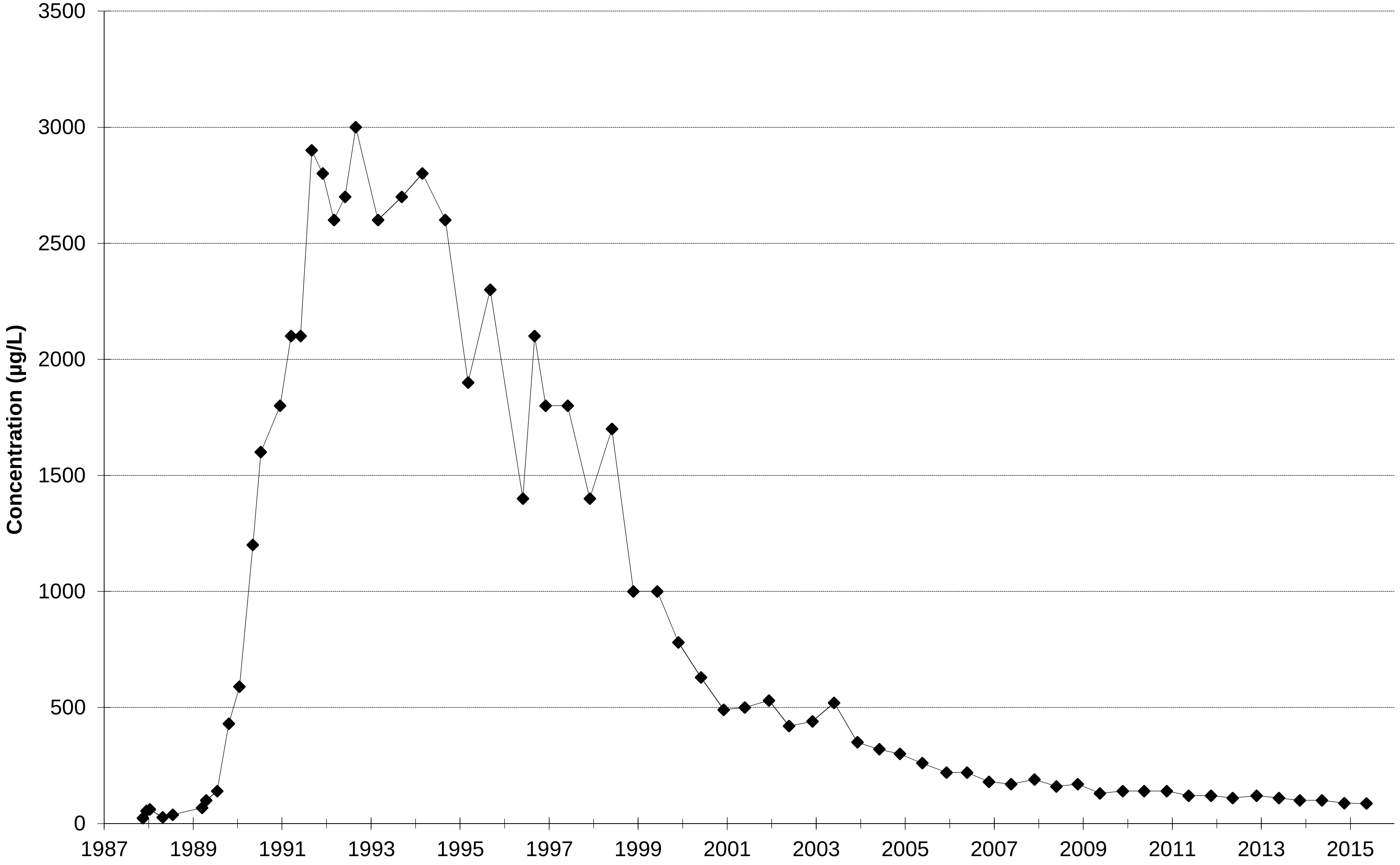
EXTRACTION WELL B3 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

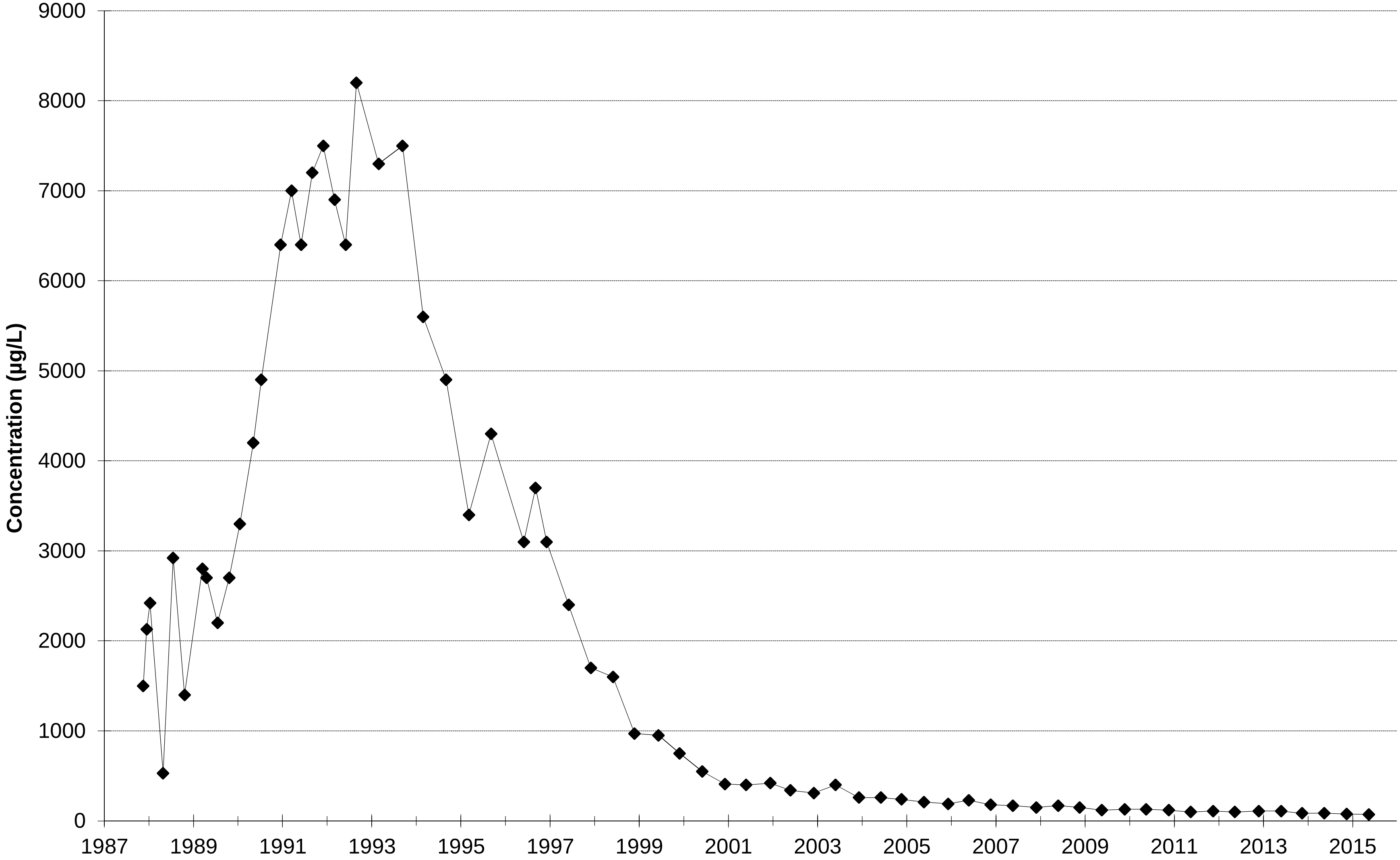
EXTRACTION WELL B4 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

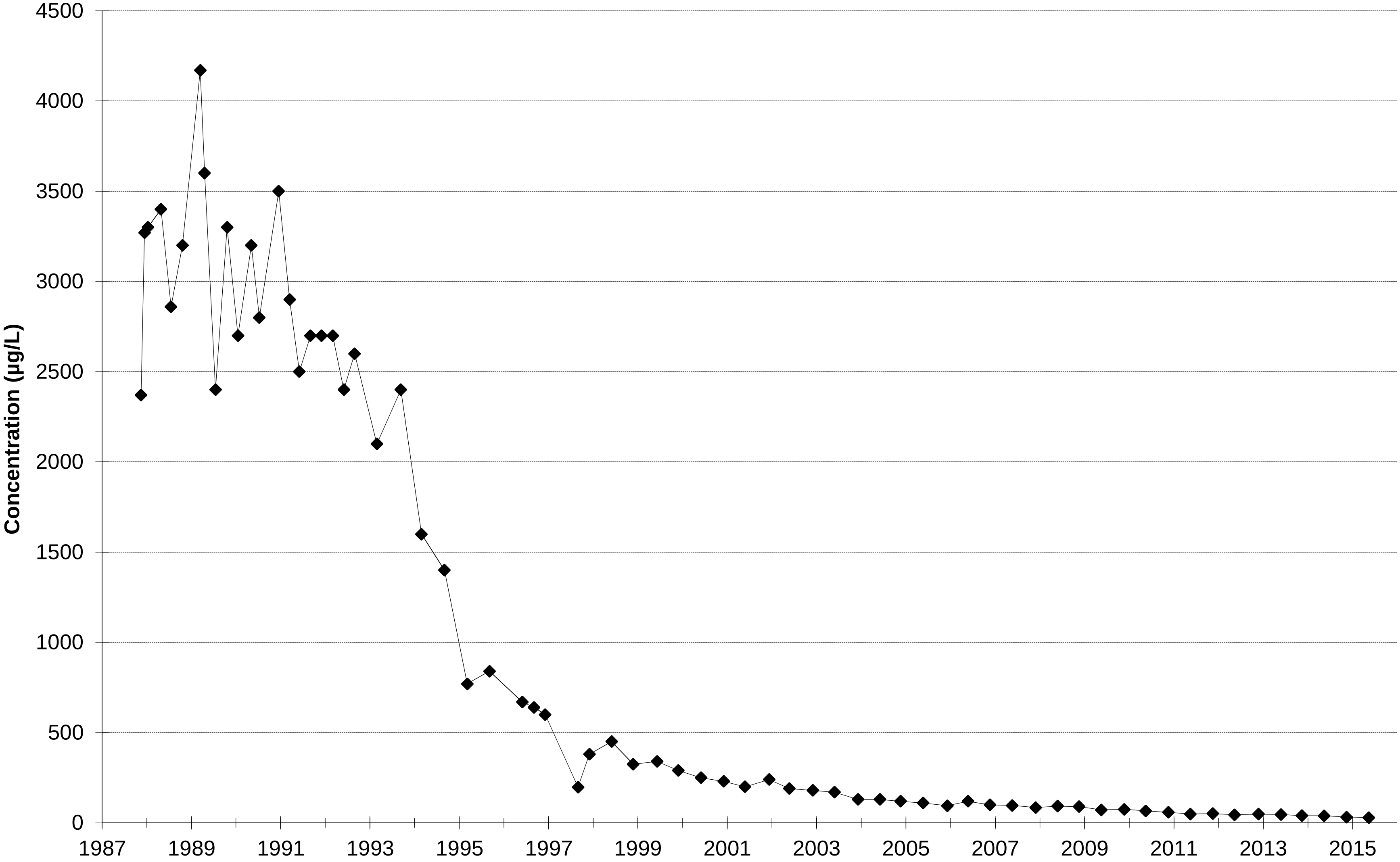
EXTRACTION WELL B5 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

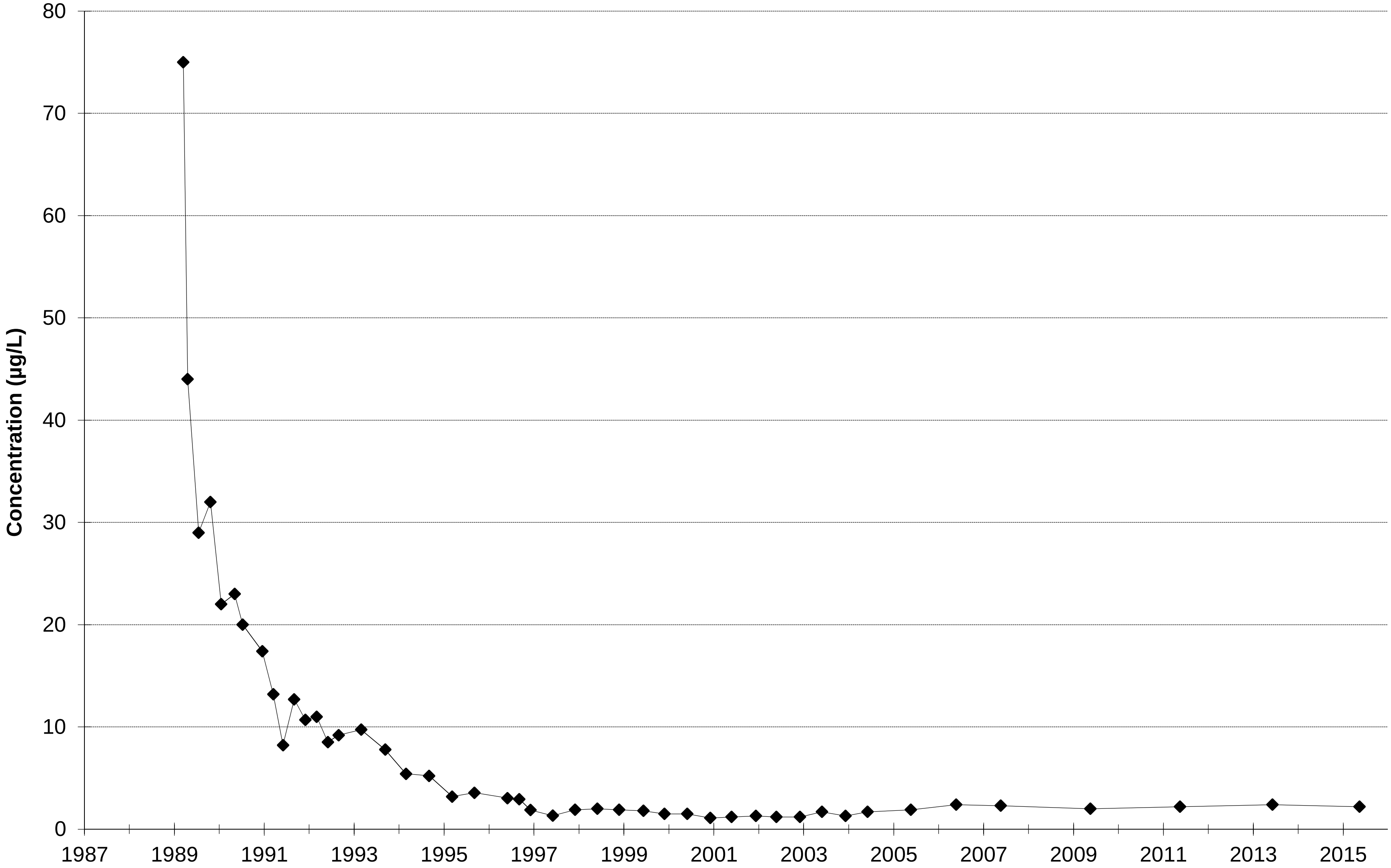
EXTRACTION WELL B6 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

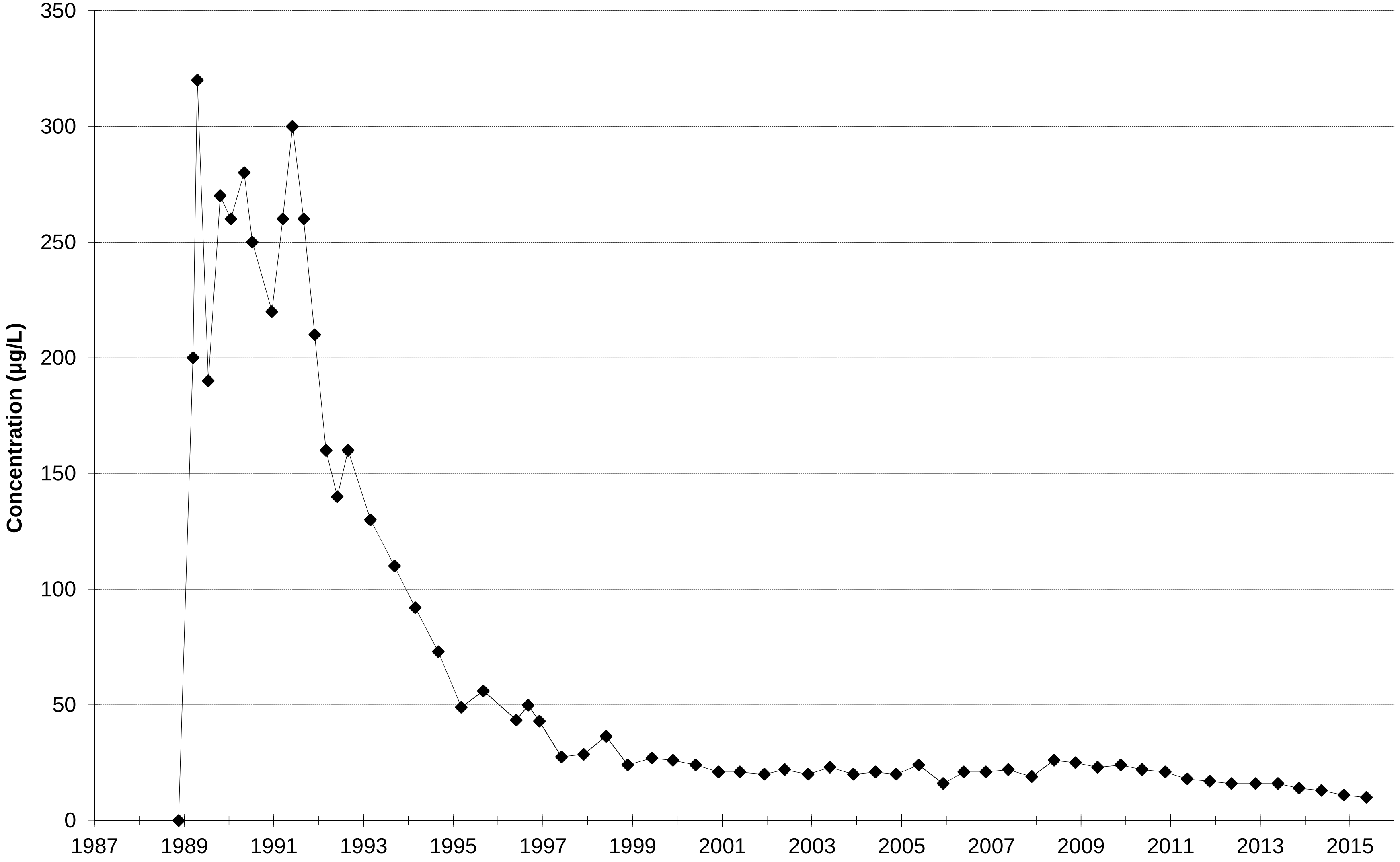
EXTRACTION WELL B7 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

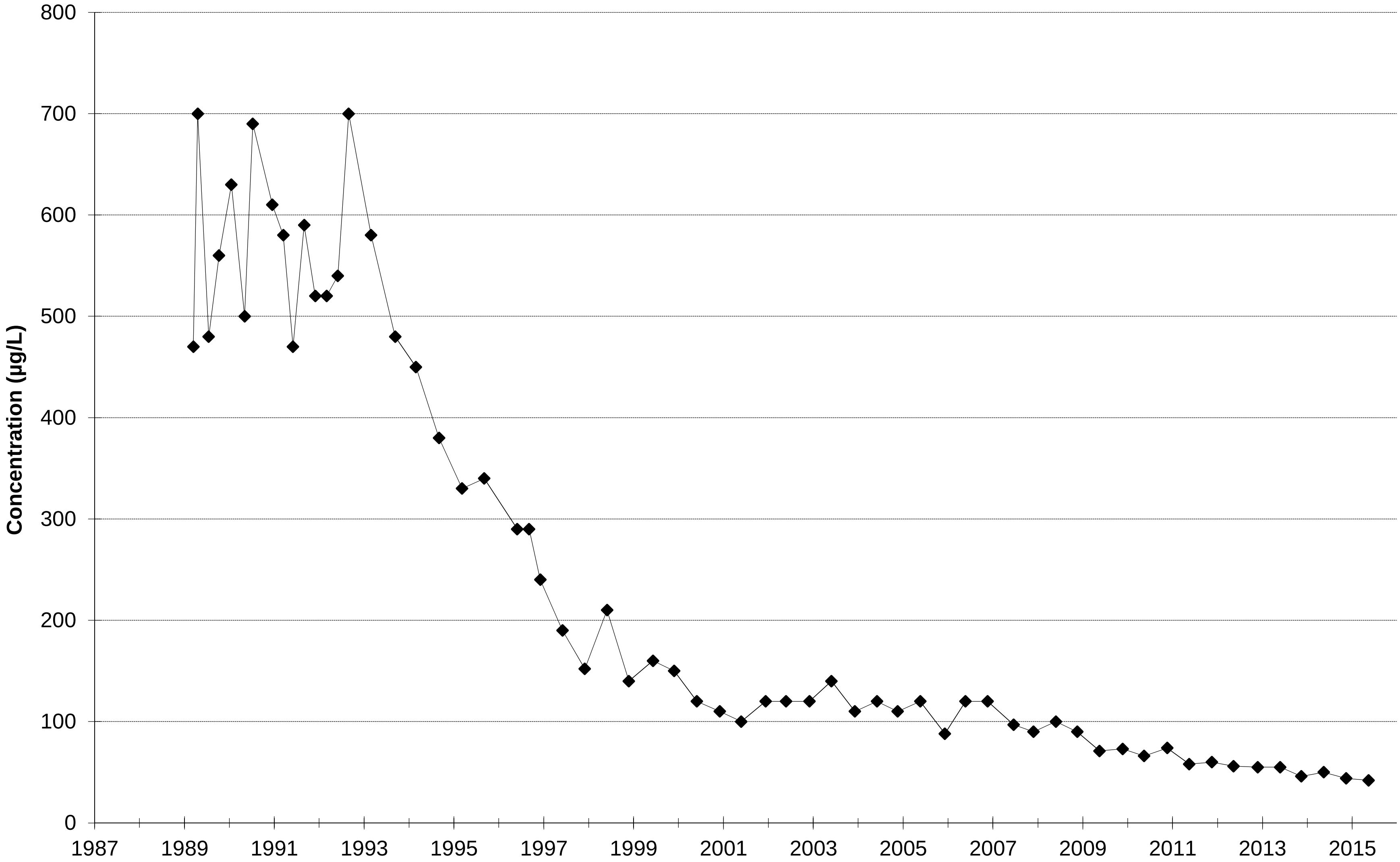
EXTRACTION WELL B8 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

EXTRACTION WELL B9 - TRCLE VS. TIME

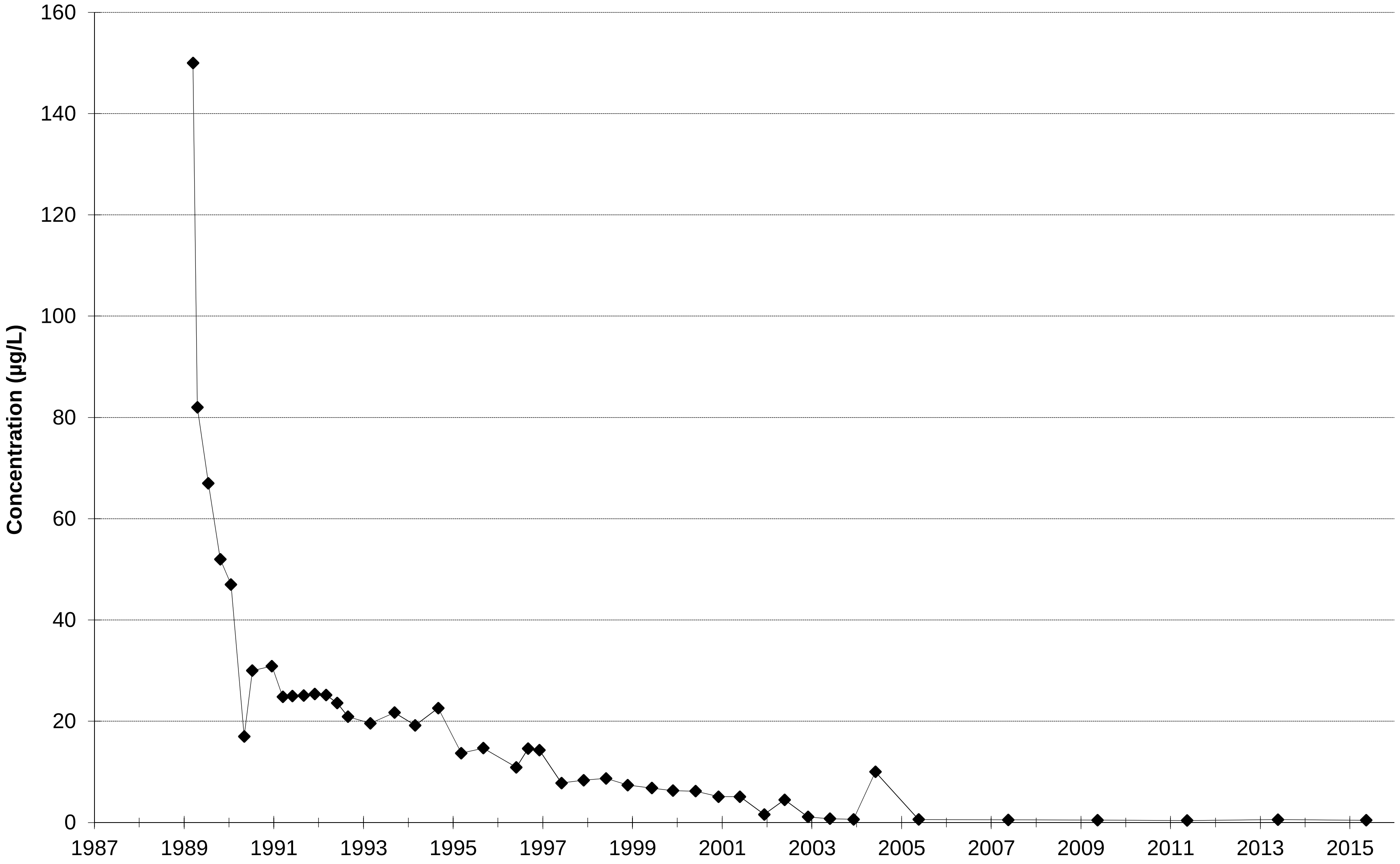


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11114607 (1)

APPENDIX G-1

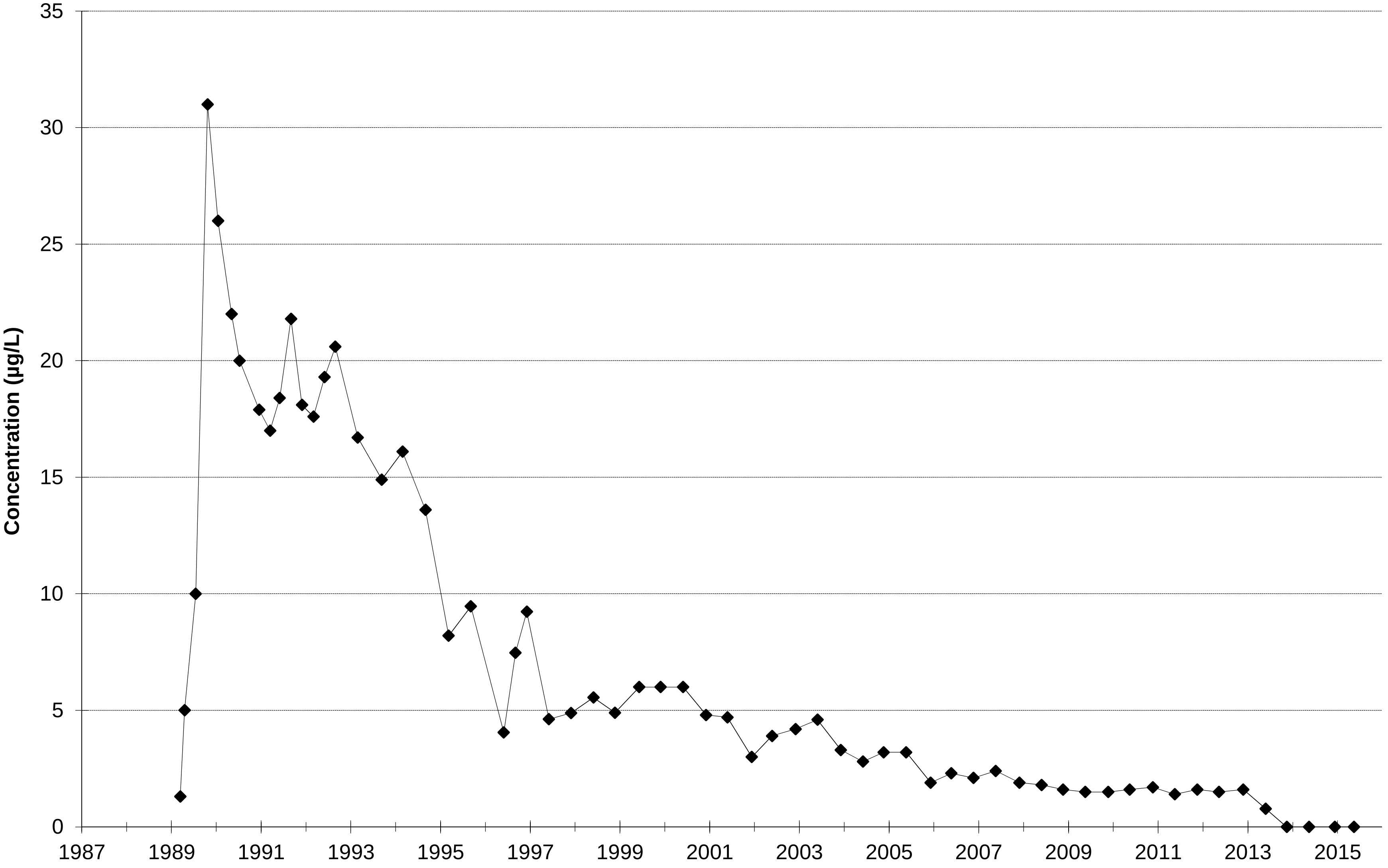
EXTRACTION WELL B10 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

EXTRACTION WELL B11 - TRCLE VS. TIME

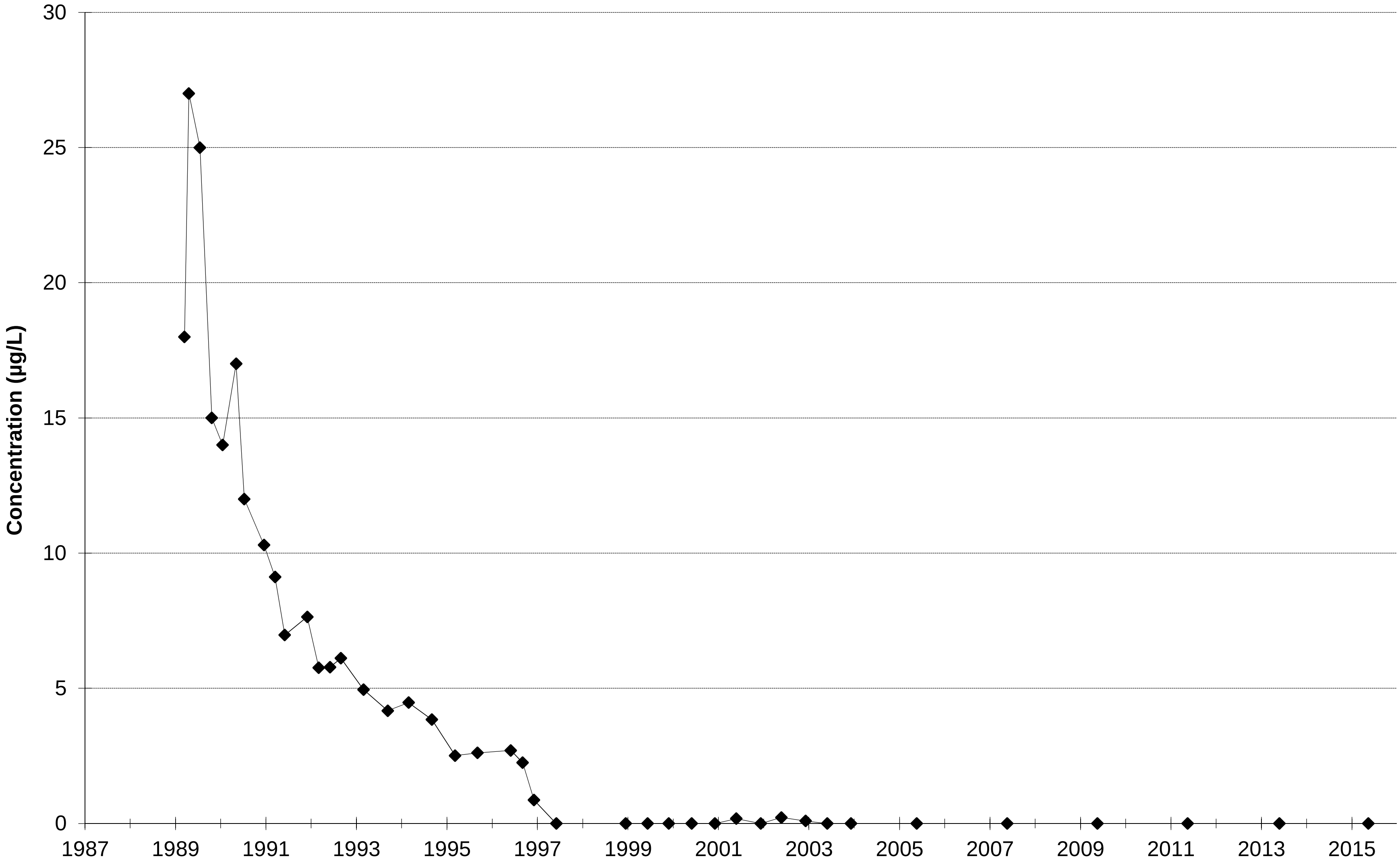


Note: Samples reporting concentrations less than the detection limit were plotted as zero.

GHD 11114607 (1)

APPENDIX G-1

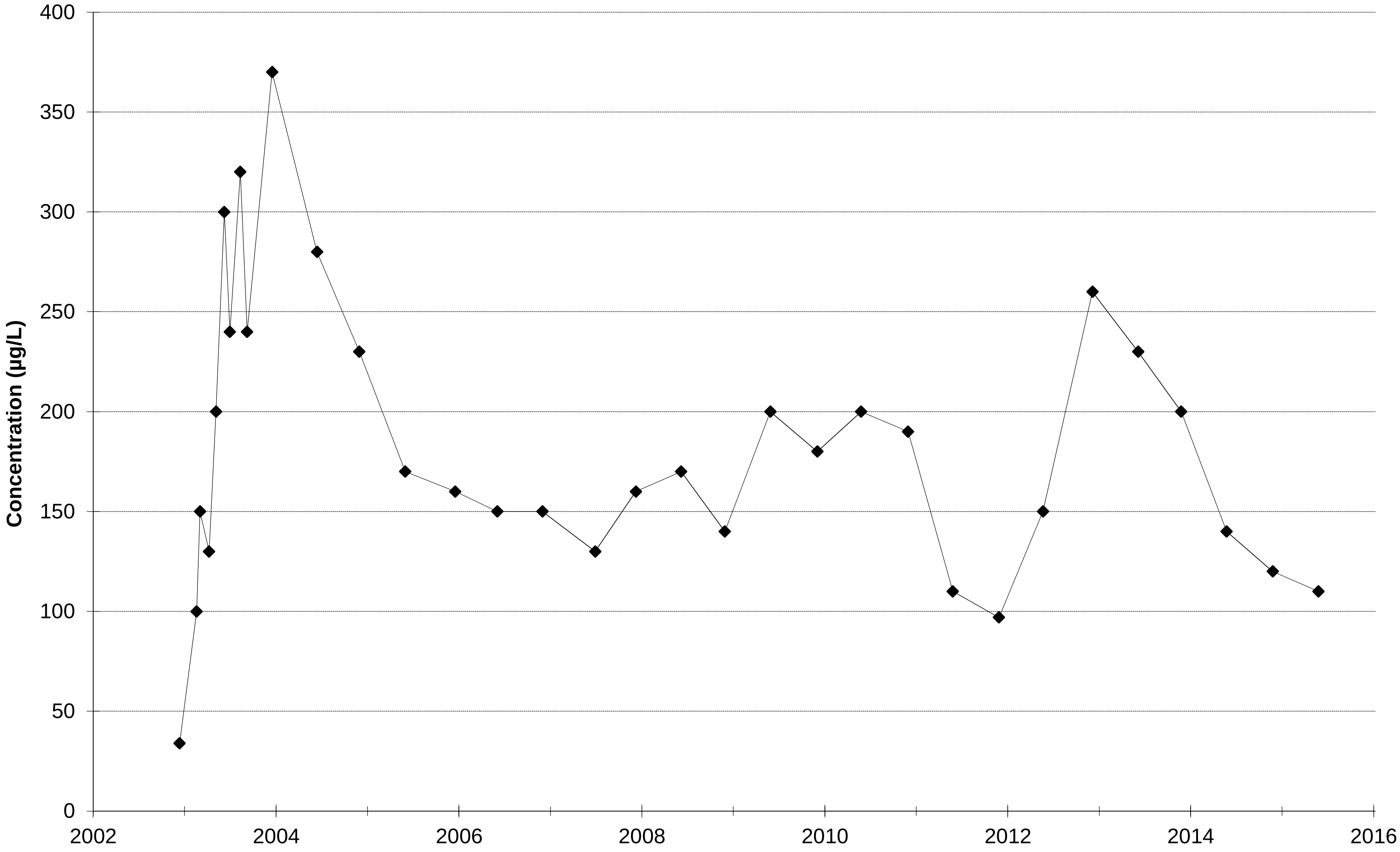
EXTRACTION WELL B12 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

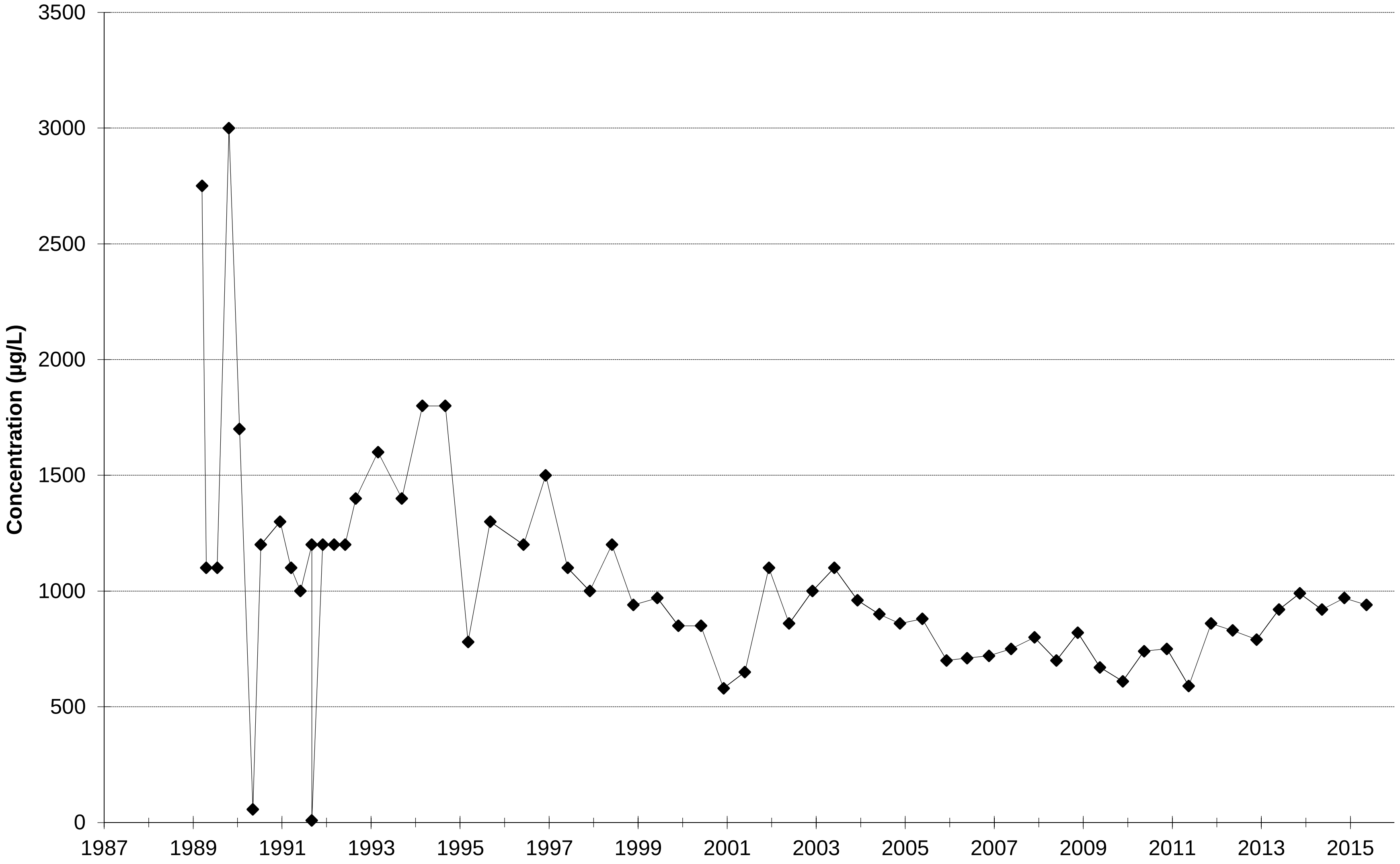
EXTRACTION WELL B13 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

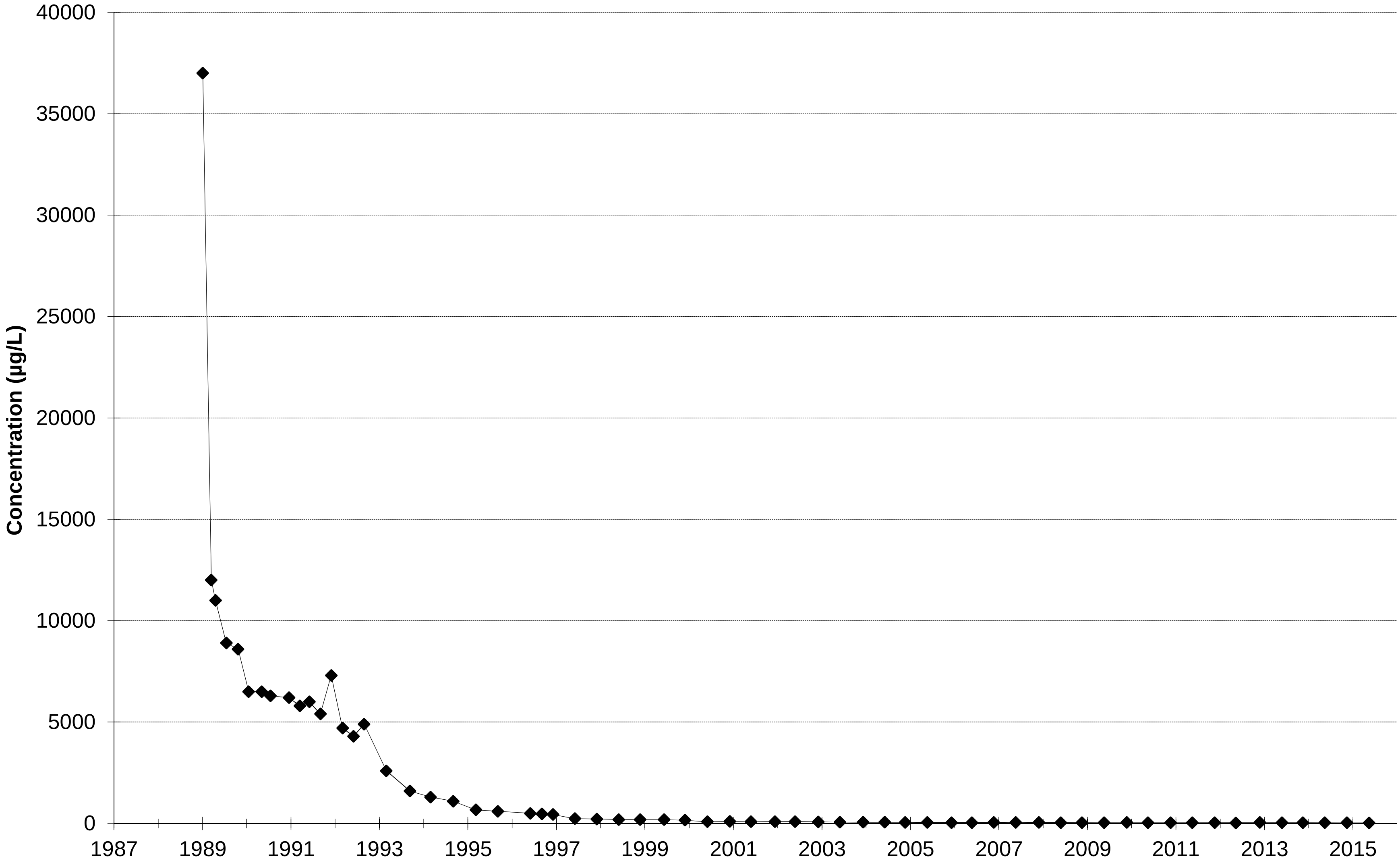
EXTRACTION WELL SC1 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

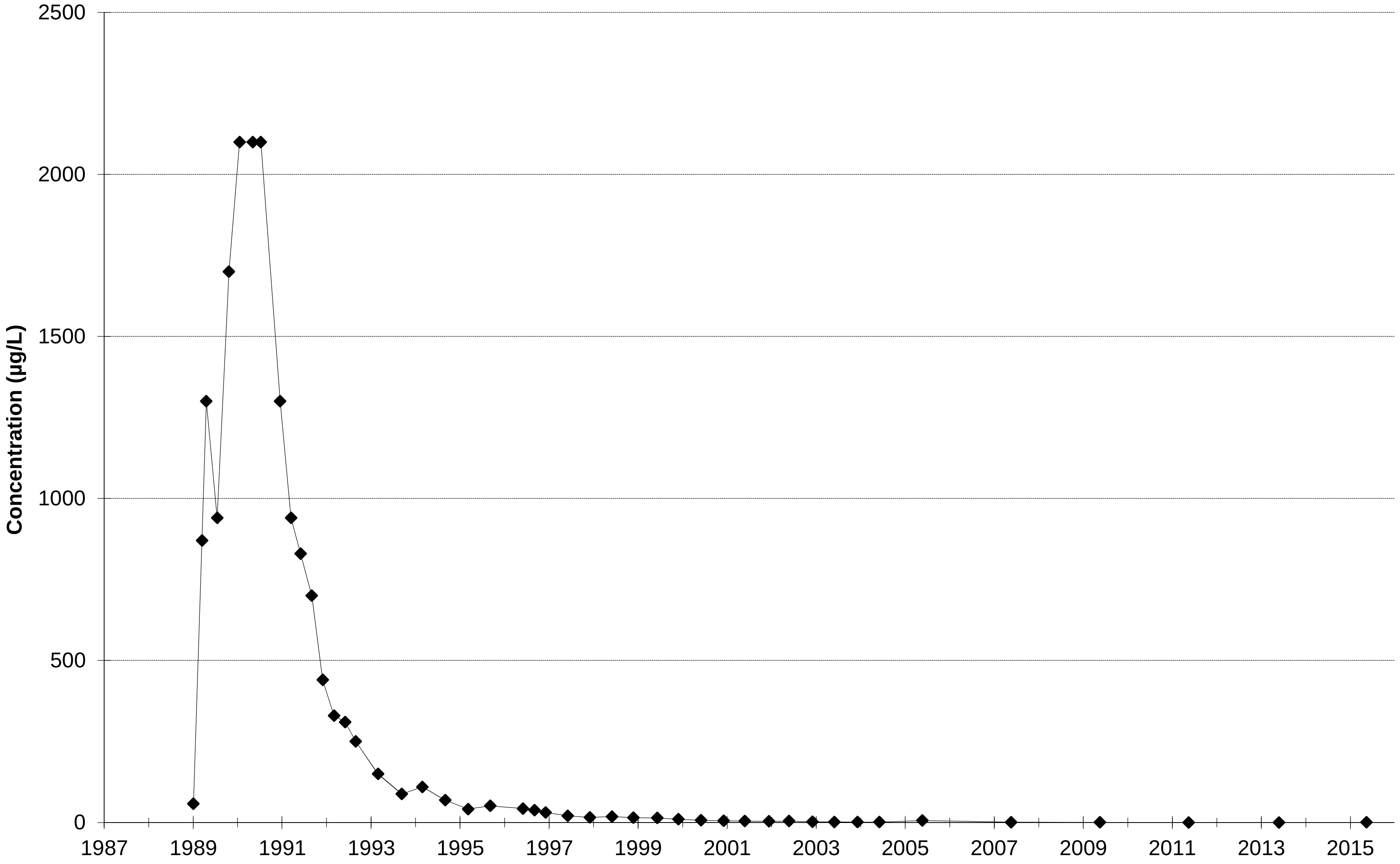
EXTRACTION WELL SC2 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

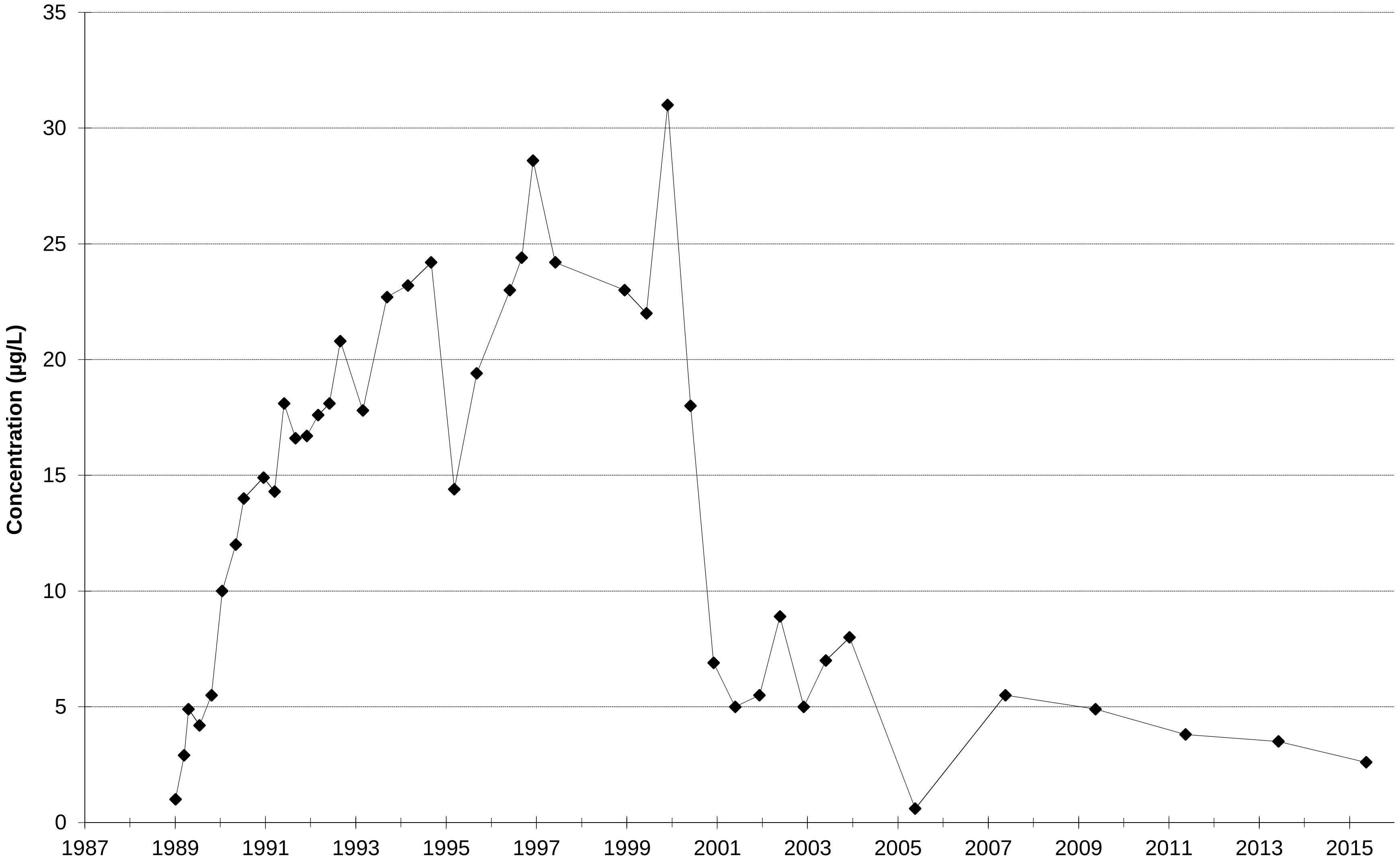
EXTRACTION WELL SC3 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

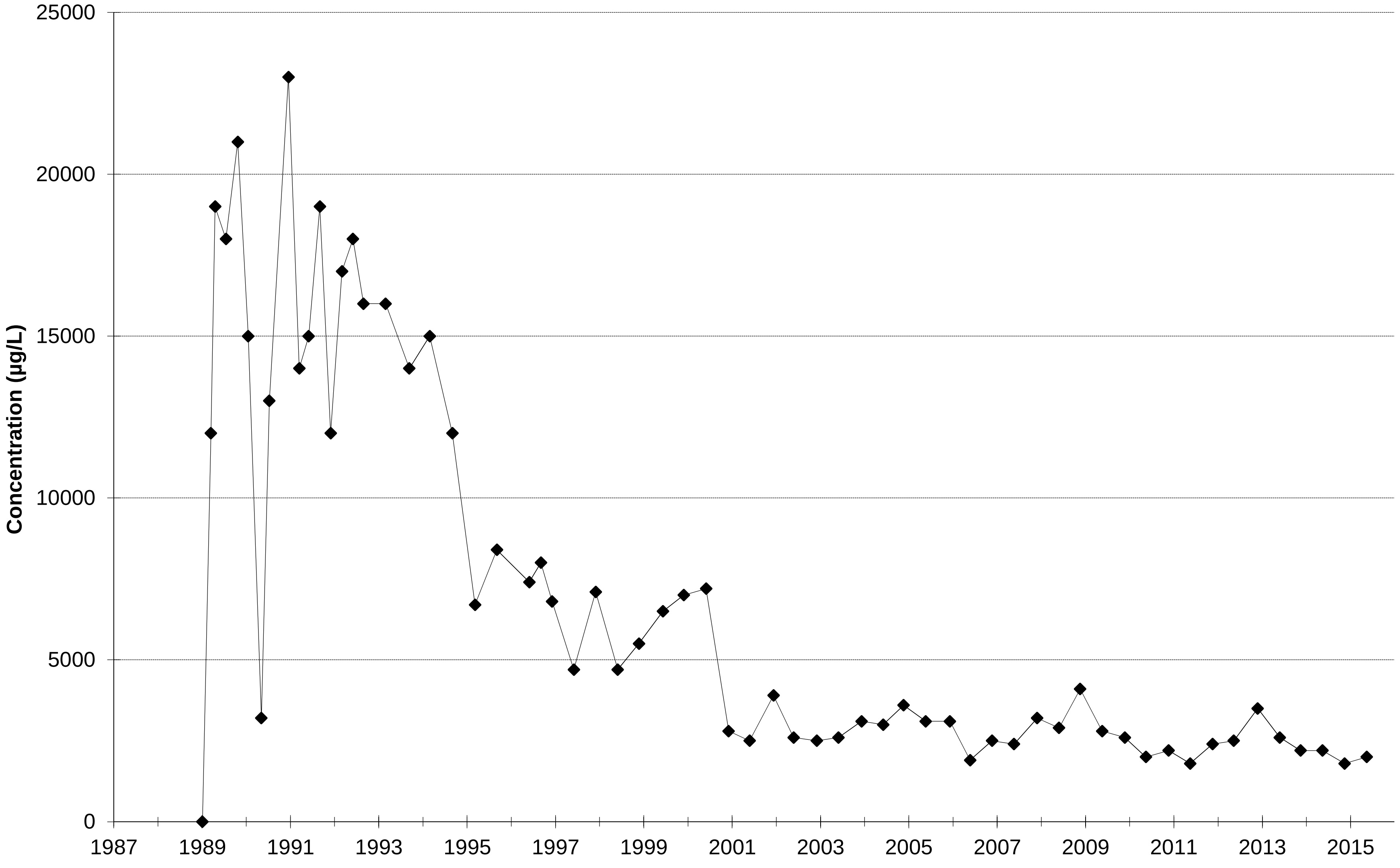
EXTRACTION WELL SC4 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

APPENDIX G-1

EXTRACTION WELL SC5 - TRCLE VS. TIME



Note: Samples reporting concentrations less than the detection limit were plotted as zero.

G.2 Influent/Effluent Database, Fiscal Year 2015, TGRS, OU2

Appendix G-2

Influent/Effluent Database
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

			1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
TGRS Cleanup Level(1)			200	70	6.0	4.0	70	5.0	5.0
Location	Date		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
TGRSE	10/1/2014		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1
TGRSE	10/1/2014	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.2
TGRSE	11/4/2014		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.3
TGRSE	11/4/2014	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.3
TGRSE	12/4/2014		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.3
TGRSE	1/5/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.5
TGRSE	1/5/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.5
TGRSE	2/9/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.6
TGRSE	2/9/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.5
TGRSE	3/5/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.6
TGRSE	3/5/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.7
TGRSE	4/7/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.7
TGRSE	5/8/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.6
TGRSE	5/8/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.7
TGRSE	6/4/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.6
TGRSE	6/4/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.5
TGRSE	7/6/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1
TGRSE	7/6/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.1
TGRSE	8/6/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.4
TGRSE	9/9/2015		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.3
TGRSE	9/9/2015	D	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	1.4

Appendix G-2

Influent/Effluent Database
Fiscal Year 2015
TGRS, OU2
Arden Hills, Minnesota

			1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	cis-1,2-Dichloroethene	Tetrachloroethene	Trichloroethene
TGRS Cleanup Level$^{(1)}$			**200**	**70**	**6.0**	**4.0**	**70**	**5.0**	**5.0**
Location	**Date**		**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
TGRSI	10/1/2014		27	1.9	2.1	< 1.0	2.0	0.78 JP	150
TGRSI	11/4/2014		30	2.0	2.6	< 1.0	2.2	1.1	170
TGRSI	12/4/2014		31	2.2	2.3	< 1.0	2.2	0.79 JP	160
TGRSI	12/4/2014	D	26	1.9	1.7	< 1.0	2.1	0.74 JP	140
TGRSI	1/5/2015		40	2.1	2.8	< 1.0	2.4	1.1	220
TGRSI	2/9/2015		42	2.3	3.2	< 1.0	2.6	1.3	180
TGRSI	3/5/2015		39	2.3	2.6	< 1.0	2.7	0.97 JP	250
TGRSI	4/7/2015		44	2.4	7.4	< 1.0	2.6	1.3	210
TGRSI	4/7/2015	D	46	2.5	6.1	< 1.0	2.6	1.3	220
TGRSI	5/8/2015		28	1.9	1.9	< 1.0	2.0	1.0	150
TGRSI	6/4/2015		42	2.3	4.7	< 1.0	2.5	1.3	180
TGRSI	7/6/2015		31	2.1	2.5	< 1.0	2.1	0.94 JP	160
TGRSI	8/6/2015		42	2.6	3.3	< 1.0	2.7	1.2	200
TGRSI	8/6/2015	D	43	2.6	3.4	< 1.0	2.7	1.2	190
TGRSI	9/9/2015		42	2.4	3.1	< 1.0	2.8	1.2	190

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.

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

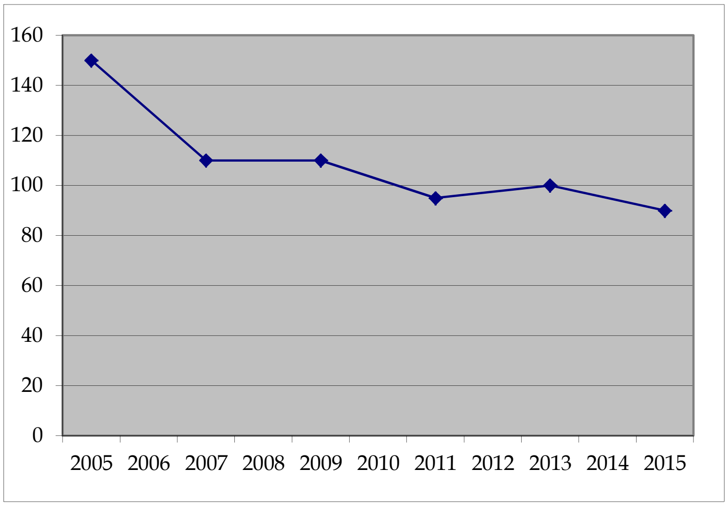
CONFIDENCE VALUES FOR SIX DATA PAIRS

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 03L673
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2015

Date	TCE (µg/l)	Mann-Kendall Calculation:								
6/22/2005	**150**	1								
6/21/2007	**110**	1	-1							
6/18/2009	**110**	1	-1	0						
6/24/2011	**95**	1	-1	-1	-1					
6/27/2013	**100**	1	-1	-1	-1	1				
6/12/2015	**90**	1	-1	-1	-1	-1	-1			
	N	6	5	4	3	2	1	0		15
	sum		-5	-3	-3	0	-1	0	Kendall S	-12
	Possibles	15								
									Kendall tau	-0.8

Mean	109.17
STNDEV	21.5445
COV	0.1974
Trend:	Negative
Confidence (lookup)	98.19%



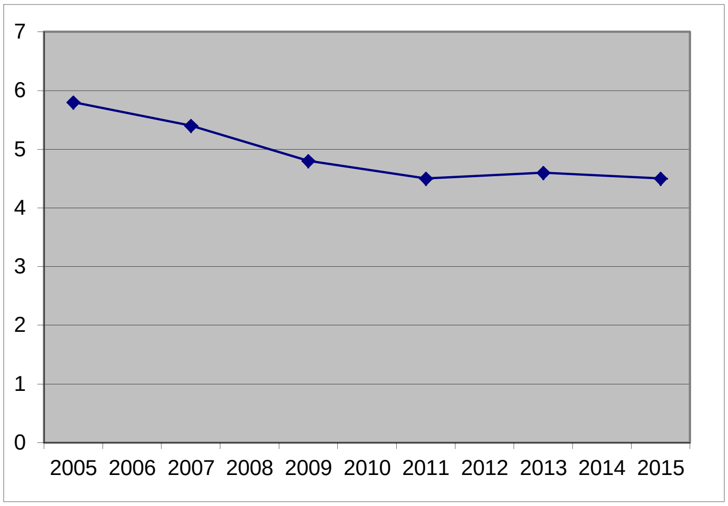
Raw Data

03L673	Date	TCE		Date	TCE	
	11/12/1987	1200		6/21/2007	110	
	5/2/1990	3200		6/18/2009	110	
	3/11/1991	2000		6/24/2011	95	
	3/11/1991	1900	D	6/27/2013	100	
	6/17/1991	5500		6/27/2013	100	D
	3/12/1992	3900		6/12/2015	90	
	3/3/1993	2100				
	3/4/1994	3300				
	6/6/1994	2000				
	6/6/1994	2000	D			
	9/14/1994	1600				
	12/8/1994	1400				
	3/15/1995	910				
	6/12/1996	650				
	6/12/1997	240				
	6/25/1998	270				
	6/4/1999	280				
	6/12/2001	24				
	6/1/2003	6.3				
	6/1/2004	180				
	6/22/2005	150				

WELL 03L848
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2015

Date	TCE (µg/l)	Mann-Kendall Calculation:								
6/21/2005	**5.8**	1								
6/21/2007	**5.4**	1	-1							
6/14/2009	**4.8**	1	-1	-1						
6/24/2011	**4.5**	1	-1	-1	-1					
6/27/2013	**4.6**	1	-1	-1	-1	1				
6/11/2015	**4.5**	1	-1	-1	-1	0	-1			
N		6	5	4	3	2	1	0		15
sum			-5	-4	-3	1	-1	0	Kendall S	-12
Possibles		15								
									Kendall tau	-0.8

Mean	4.93
STNDEV	0.5428
COV	0.1100
Trend:	Negative
Confidence (lookup)	98.19%



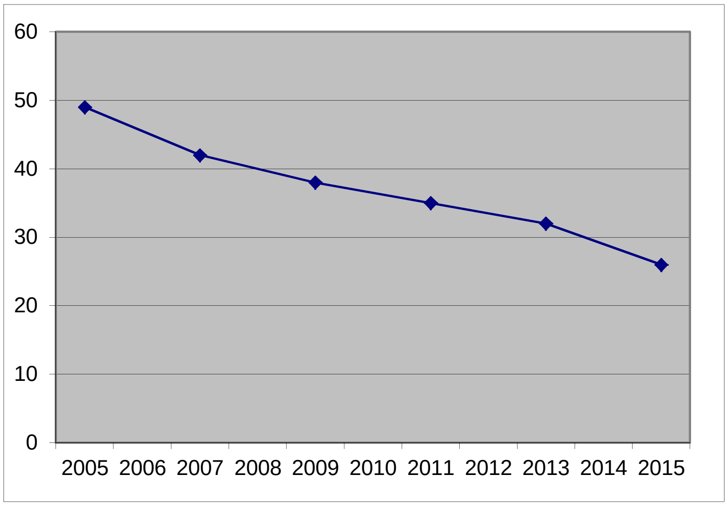
Raw Data

03L848	Date	TCE		Date	TCE	
	12/2/1987	570		6/21/2007	5.4	
	5/3/1989	270		6/21/2007	5.3	D
	7/20/1989	130		6/17/2009	4.8	
	10/19/1989	610		6/17/2009	2.6	D
	4/19/1990	460		6/24/2011	4.5	
	7/19/1990	260		6/27/2013	4.9	
	3/18/1991	250		6/11/2015	4.4	
	3/18/1992	92		6/11/2015	4.5	D
	3/9/1993	52.9				
	6/6/1994	27				
	9/15/1994	27.1				
	12/8/1994	22				
	3/10/1995	16.6				
	6/3/1996	11.3				
	6/5/1997	9.34				
	6/5/1997	8.57	D			
	6/29/1998	10.7				
	6/4/1999	7.3				
	6/12/2001	3.5				
	6/1/2003	3.8				
	6/21/2005	5.8				

WELL 04U673
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2015

Date	TCE (µg/l)		Mann-Kendall Calculation:							
6/22/2005	**49**	1								
6/21/2007	**42**	1	-1							
6/18/2009	**38**	1	-1	-1						
6/24/2011	**35**	1	-1	-1	-1					
6/24/2013	**32**	1	-1	-1	-1	-1				
6/12/2015	**26**	1	-1	-1	-1	-1	-1			
N		6	5	4	3	2	1	0		15
	sum		-5	-4	-3	-2	-1	0	Kendall S	-15
Possibles		15								
									Kendall tau	-1

Mean	37.00
STNDEV	8.0000
COV	0.2162
Trend:	Negative
Confidence (lookup)	99.86%



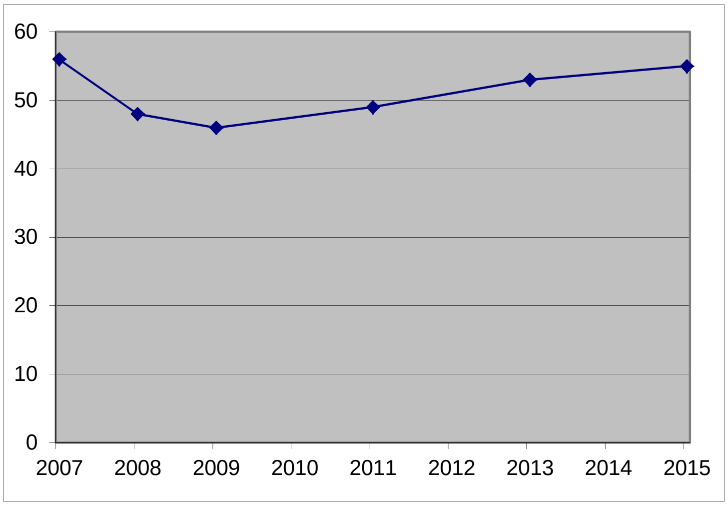
Raw Data

04U673	Date	TCE	Date	TCE
	11/24/1987	145	3/15/1995	160
	1/21/1988	580	3/15/1995	140
	5/16/1988	560	9/12/1995	260
	8/4/1988	253	6/12/1996	125
	11/1/1988	1700	6/12/1997	60.4
	5/3/1989	700	6/25/1998	81.9
	7/21/1989	1200	6/4/1999	74
	10/19/1989	1100	6/12/2001	2.9
	5/1/1990	3100	6/1/2003	15
	3/11/1991	990	6/1/2004	51
	3/11/1991	940	6/22/2005	49
	6/17/1991	410	6/21/2007	42
	3/12/1992	460	6/18/2009	38
	6/4/1992	430	6/24/2011	35
	9/8/1992	540	6/27/2013	32
	3/3/1993	280	6/12/2015	26
	9/13/1993	190		
	3/3/1994	270		
	6/6/1994	210		
	9/8/1994	170		
	12/8/1994	190		

WELL 04U832
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2015

Date	TCE (µg/l)		Mann-Kendall Calculation:							
6/22/2007	**56**	1								
6/17/2008	**48**	1	-1							
6/19/2009	**46**	1	-1	-1						
6/23/2011	**49**	1	-1	1	1					
6/27/2013	**53**	1	-1	1	1	1				
6/10/2015	**55**	1	-1	1	1	1	1			
N		6	5	4	3	2	1	0		15
	sum		-5	2	3	2	1	0	Kendall S	3
Possibles		15								
									Kendall tau	0.2

Mean	51.17
STNDEV	4.0702
COV	0.0795
Trend:	Positive
Confidence (lookup)	64.00%



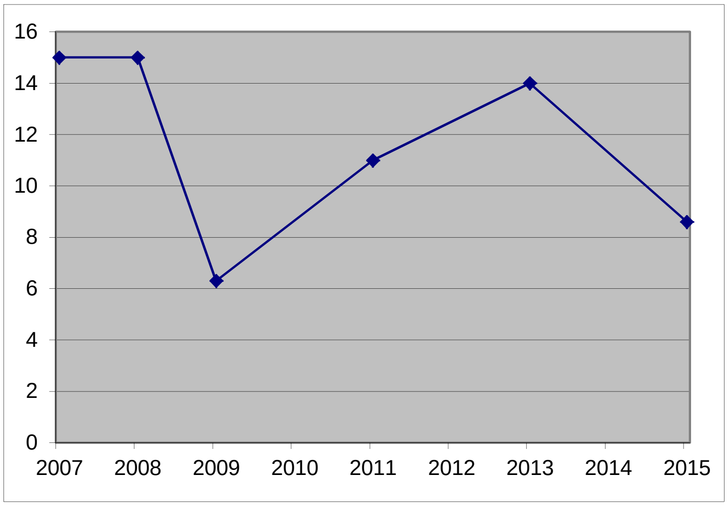
Raw Data

04U832	Date	TCE	Date	TCE
	11/24/1987	100	6/17/2008	48
	12/16/1988	65	6/19/2009	46
	4/25/1990	69.53	6/23/2011	49
	3/19/1991	47.6	6/27/2013	53
	3/25/1992	52.5	6/10/2015	55
	3/16/1993	42		
	3/16/1993	45.9		
	6/10/1994	49		
	9/13/1994	49.5		
	12/7/1994	43.3		
	12/7/1994	47.1		
	3/10/1995	56		
	6/3/1996	41		
	6/4/1997	35.2		
	6/25/1998	36.4		
	6/7/1999	29		
	6/14/2001	3.5		
	6/1/2003	4.1		
	6/23/2005	41		
	6/13/2006	54		
	6/22/2007	56		

WELL 04U845
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2015

Date	TCE (µg/l)		Mann-Kendall Calculation:							
6/22/2007	**15**	1								
6/17/2008	**15**	1	0							
6/17/2009	**6.3**	1	-1	-1						
6/23/2011	**11**	1	-1	-1	1					
6/25/2013	**14**	1	-1	-1	1	1				
6/11/2015	**8.6**	1	-1	-1	1	-1	-1			
	N	6	5	4	3	2	1	0		15
	sum		-4	-4	3	0	-1	0	Kendall S	-6
	Possibles	15								
									Kendall tau	-0.4

Mean	11.65
STNDEV	3.64
COV	0.31
Trend:	Negative
Confidence (lookup)	81.46%



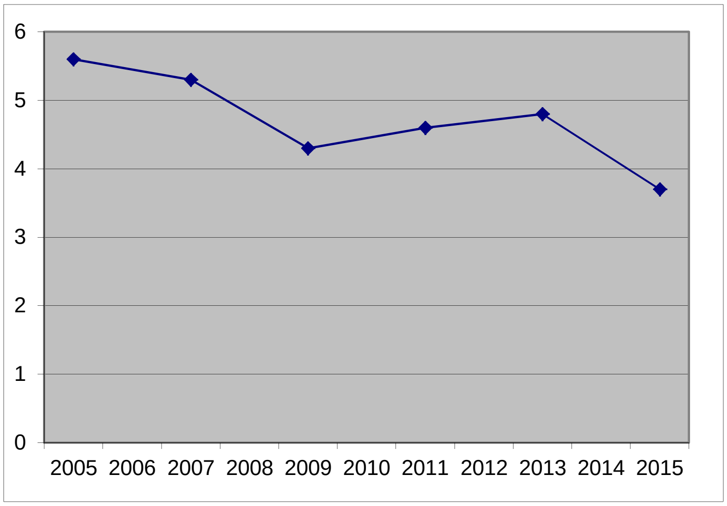
Raw Data

04U845	Date	TCE	Date	TCE
	12/1/1987	59	6/13/2006	14
	12/16/1988	155	6/13/2006	14
	5/4/1989	100	6/22/2007	15
	7/20/1989	160	6/17/2008	15
	10/20/1989	62	6/17/2009	6.3
	4/26/1990	38	6/23/2011	11
	3/20/1991	100	6/25/2013	14
	3/23/1992	>50.10	6/11/2015	8.6
	3/23/1992	100		
	3/15/1993	84		
	6/8/1994	64		
	9/13/1994	70		
	12/7/1994	54		
	3/10/1995	39.5		
	6/4/1996	51.2		
	6/5/1997	30.8		
	6/25/1998	32.9		
	6/7/1999	35		
	6/13/2001	4.3		
	6/1/2003	4		
	6/22/2005	20		

WELL 04U848
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2015

Date	TCE (µg/l)	Mann-Kendall Calculation:								
6/21/2005	**5.6**	1								
6/21/2007	**5.3**	1	-1							
6/17/2009	**4.3**	1	-1	-1						
6/24/2011	**4.6**	1	-1	-1	1					
6/27/2013	**4.8**	1	-1	-1	1	1				
6/11/2015	**3.7**	1	-1	-1	-1	-1	-1			
N		6	5	4	3	2	1	0		15
	sum		-5	-4	1	0	-1	0	Kendall S	-9
Possibles		15								
									Kendall tau	-0.6

Mean	4.72
STNDEV	0.6853
COV	0.1453
Trend:	Negative
Confidence (lookup)	93.20%



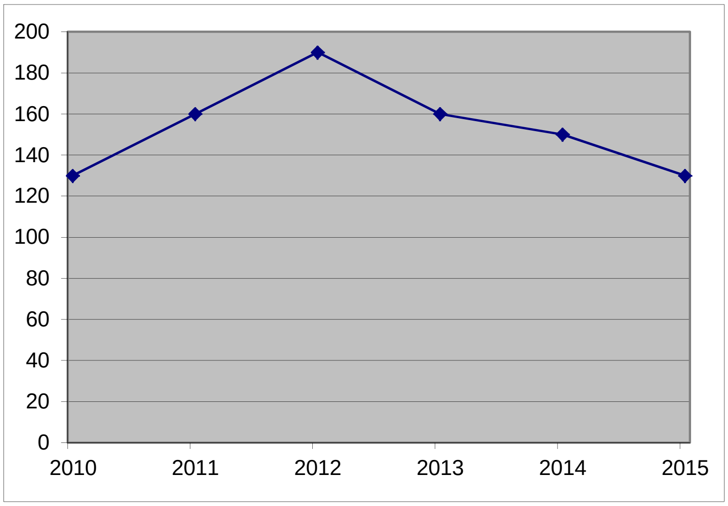
Raw Data

04U848	Date	TCE		Date	TCE	
	12/2/1987	700		6/1/2003	0.46	JP
	8/24/1988	470		6/21/2005	5.6	
	5/3/1989	150		6/21/2007	5.3	
	7/20/1989	700		6/17/2009	4.3	
	10/19/1989	280		6/24/2011	4.6	
	4/19/1990	240		6/27/2013	4.8	
	7/19/1990	140		6/11/2015	3.7	
	9/17/1990	150				
	3/18/1991	64				
	3/18/1992	22.5				
	3/18/1992	23.4				
	3/10/1993	26				
	6/6/1994	12.2				
	9/15/1994	16.8				
	12/8/1994	15.6				
	3/10/1995	9.94				
	6/3/1996	6.15				
	6/5/1997	3.3				
	6/29/1998	4.19				
	6/4/1999	3.6				
	6/12/2001	0.49	J			

WELL 03M848
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2015

Date	TCE (µg/l)		Mann-Kendall Calculation:							
6/8/2010	**130**	1								
6/24/2011	**160**	1	1							
6/1/2012	**190**	1	1	1						
6/27/2013	**160**	1	1	0	-1					
6/9/2014	**150**	1	1	-1	-1	-1				
6/11/2015	**130**	1	0	-1	-1	-1	-1			
	N	6	5	4	3	2	1	0		15
	sum		4	-1	-3	-2	-1	0	Kendall S	-3
	Possibles	15								
									Kendall tau	-0.2

Mean	153.33
STNDEV	22.5093
COV	0.1468
Trend:	Negative
Confidence (lookup)	64.00%



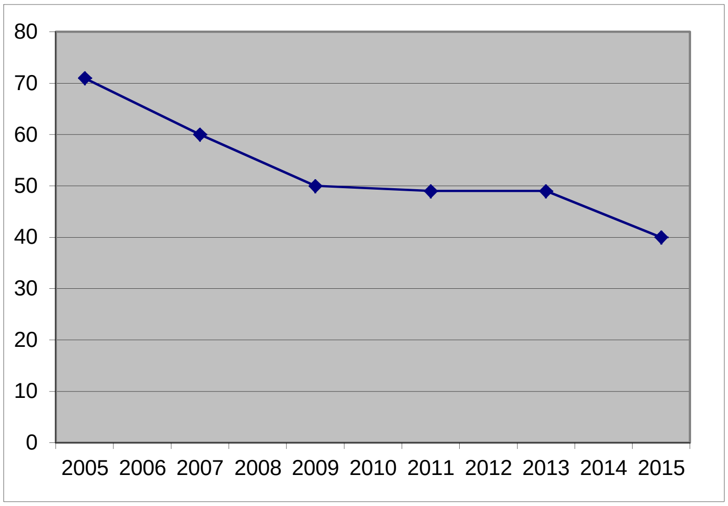
Raw Data
03M848

Date	TCE		Date	TCE	
12/2/1987	440		6/1/2003	450	
4/19/1990	190		6/21/2005	230	
7/19/1990	190		6/13/2006	190	
9/17/1990	330		6/21/2007	150	
3/18/1991	310		6/18/2008	130	
6/4/1991	730		6/17/2009	130	
9/3/1991	700		6/8/2010	130	
3/18/1992	640		6/24/2011	150	
6/3/1992	>50.10		6/24/2011	160	D
6/3/1992	570	D	6/1/2012	190	
9/3/1992	>50.10		6/1/2012	180	D
3/9/1993	1300		6/27/2013	160	
3/9/1993	970	D	6/9/2014	150	
3/17/1994	910		6/9/2014	150	D
3/16/1995	59		6/11/2015	130	
6/21/1996	1400				
6/26/1997	510				
6/29/1998	660				
6/4/1999	700				
6/4/1999	650	D			
6/12/2001	370				

WELL 04U859
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2015

Date	TCE (µg/l)		Mann-Kendall Calculation:							
6/22/2005	**71**	1								
6/21/2007	**60**	1	-1							
6/18/2009	**50**	1	-1	-1						
6/24/2011	**49**	1	-1	-1	-1					
6/27/2013	**49**	1	-1	-1	-1	0				
6/10/2015	**40**	1	-1	-1	-1	-1	-1			
N		6	5	4	3	2	1	0		15
	sum		-5	-4	-3	-1	-1	0	Kendall S	-14
Possibles		15								
									Kendall tau	-0.933

Mean	53.17
STNDEV	10.7966
COV	0.2031
Trend:	Negative
Confidence (lookup)	99.51%



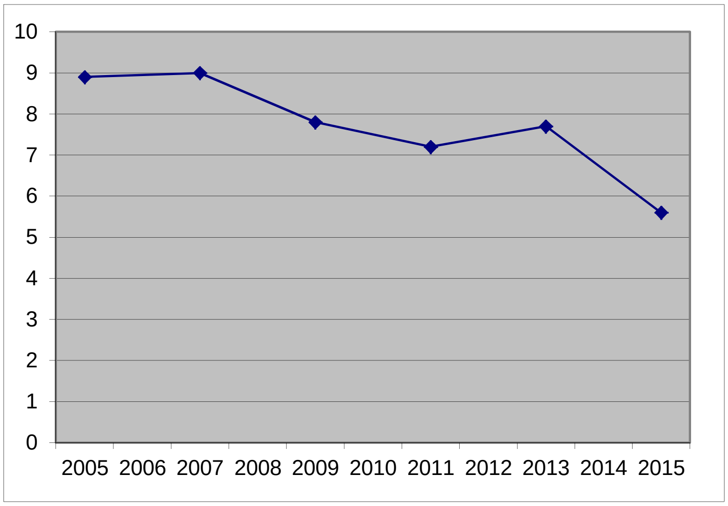
Raw Data

04U859	Date	TCE	Date	TCE
	11/13/1987	0.3	6/18/2009	50
	12/15/1988	8.5	6/24/2011	49
	4/30/1990	5.59	6/27/2013	49
	3/19/1991	5.24	6/10/2015	40
	3/20/1992	9.29		
	3/11/1993	40.5		
	3/18/1994	47		
	3/18/1994	49.5		
	6/9/1994	48.9		
	9/14/1994	64		
	12/7/1994	52.5		
	3/10/1995	43.8		
	6/3/1996	50.8		
	6/4/1997	31.9		
	6/25/1998	42		
	6/25/1998	46.8		
	6/7/1999	75		
	6/13/2001	8.4		
	6/1/2003	4.4		
	6/22/2005	71		
	6/21/2007	60		

WELL 03L859
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2015

Date	TCE (µg/l)		Mann-Kendall Calculation:							
6/22/2005	**8.9**	1								
6/21/2007	**9**	1	1							
6/18/2009	**7.8**	1	-1	-1						
6/24/2011	**7.2**	1	-1	-1	-1					
6/27/2013	**7.7**	1	-1	-1	-1	1				
6/10/2015	**5.6**	1	-1	-1	-1	-1	-1			
	N	6	5	4	3	2	1	0		15
	sum		-3	-4	-3	0	-1	0	Kendall S	-11
	Possibles	15								
									Kendall tau	-0.733

Mean	7.70
STNDEV	1.2490
COV	0.1622
Trend:	Negative
Confidence (lookup)	97.20%



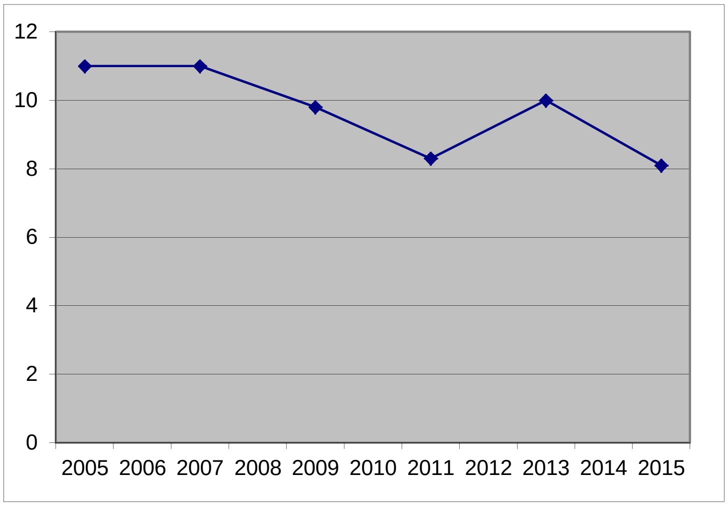
Raw Data

03L859	Date	TCE	
	11/13/1987	<0.2	
	12/15/1988	<1	
	4/30/1990	<0.5	
	3/19/1991	<0.5	
	3/20/1992	2.14	
	3/11/1993	3.5	
	3/18/1994	2.98	
	6/9/1994	6.27	
	9/14/1994	5.67	D
	9/14/1994	5.67	
	12/7/1994	4.75	
	3/10/1995	4.55	
	6/3/1996	5.96	
	6/4/1997	2.86	
	6/1/2004	10	
	6/22/2005	8.9	
	6/21/2007	9	
	6/18/2009	7.8	
	6/24/2011	7.2	
	6/27/2013	7.7	
	6/10/2015	5.6	

WELL 04U854
MANN-KENDALL STATISTICAL ANALYSIS
OU3 - 2015

Date	TCE (µg/l)	Mann-Kendall Calculation:								
6/23/2005	**11**	1								
6/21/2007	**11**	1	0							
6/18/2009	**9.8**	1	-1	-1						
6/23/2011	**8.3**	1	-1	-1	-1					
6/25/2013	**10**	1	-1	-1	1	1				
6/11/2015	**8.1**	1	-1	-1	-1	-1	-1			
N		6	5	4	3	2	1	0		15
	sum		-4	-4	-1	0	-1	0	Kendall S	-10
Possibles		15								
									Kendall tau	-0.667

Mean	9.70
STNDEV	1.2649
COV	0.1304
Trend:	Negative
Confidence (lookup)	95.20%



Raw Data

04U854	Date	TCE		Date	TCE
	10/20/1987	48.4		6/23/2011	8.3
	11/13/1987	50.7		6/25/2013	10
	12/16/1988	140		6/11/2015	8.1
	5/4/1989	27.3			
	7/20/1989	360			
	10/17/1989	89			
	4/30/1990	67			
	3/13/1992	83			
	3/15/1993	70			
	6/8/1994	35.3			
	9/14/1994	36.6			
	12/7/1994	32			
	3/9/1995	25			
	6/4/1996	26.7			
	6/5/1997	17.6	D		
	6/5/1997	16.5			
	6/1/2004	<1.0	D		
	6/1/2004	14			
	6/23/2005	11			
	6/21/2007	11			
	6/18/2009	9.8			

Appendix I

Annual Site Inspection Checklist for Land Use Controls

ANNUAL SITE INSPECTION CHECKLIST FOR LAND USE CONTROLS

Operable Unit 2, New Brighton/Arden Hills Superfund Site

Date: 7/23/15

Inspected by: MIKE FIX, JIM BARD, MARY LEE, MATT BOWERS

Period Covered: From prior annual inspection (7/12/12) to above date

	BLANKET LUCs				OTHER LUC AREAS	SITES WITH ADDITIONAL LUCs FOR SOIL COVERS							
					Area w/Restricted Commercial Use	C	D	E	G	H	I	129-15	Outdoor Firing Range
Property owner:	BRAC	N.G.	Reserve	R.C.	N.G.	BRAC	N.G.	N.G.	N.G.	N.G.	R.C.	N.G.	N.G.
Soil LUCs													
Are there any land uses that result in a non-compliant exposure versus the exposure assumptions described in the LUCRD?	NO	NO	NO	NO	NO	(Soil LUCs are covered under the Blanket LUCs)							
Soil Cover LUCs													
Has there been any excavation activity or any other man-made soil disturbance at the site?	N/A	N/A	N/A	N/A	N/A	NO	NO	NO	NO	NO	N/A	NO	NO
Are there any areas of the soil cover that have inadequate vegetative cover?	N/A	N/A	N/A	N/A	N/A	NO	NO	NO	NO	NO	N/A	NO	NO
Has there been any damage to run-on/runoff controls (swales, berms, riprap, etc.)?	N/A	N/A	N/A	N/A	N/A	NO	NO	NO	NO	NO	N/A	NO	NO
Has there been any damage to or removal of the signs marking the edge of the soil cover?	N/A	N/A	N/A	N/A	N/A	NO	NO	NO	NO	NO	N/A	NO	NO
If the soil cover has a permeability requirement, is there any woody vegetation present that exceeds 2-inch diameter?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NO	N/A	N/A	N/A	N/A
Has there been any damage to or removal of the concrete slab that serves as a protective cover?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(NOTE 1)	N/A	N/A
Groundwater LUCs													
Have any wells been installed that withdraw water from a contaminated aquifer, without MDH/MPCA/USEPA approval?	NO	NO	NO	NO	(Groundwater LUCs are covered under the Blanket LUCs)								
Has there been any damage to or interference with any groundwater remedy infrastructure (wells, piping, treatment systems, etc.)?	NO	NO	NO	NO									

Comments (Attach additional pages as necessary):

BRAC = Base Realignment and Closure Division N.G. = MN Army National Guard/National Guard Bureau Reserve = U.S. Army Reserve R.C. = Ramsey County

(1) THE SITE I BLDG 502 FLOOR SLAB HAS BEEN REMOVED IN THE PAST YEAR AS PART OF AN MPCA-APPROVED RESPONSE ACTION PLAN TO REMEDIATE THE CONTAMINATED SOILS BENEATH THIS FORMER SLAB (REMEDIATION IS CURRENTLY IN PROGRESS). HENCE, THIS LUC IS NO LONGER APPLICABLE.

Certification:

Based on the annual site inspection, the undersigned hereby certifies that the above-named property owners and above-described land use controls have been complied with for the period noted. Alternatively, any known deficiences and completed or planned actions to address such deficiencies are described in the attached Explanation of Deficiency(ies).

23 JUL 2015

Michael R. Fix (Commander's Representative)

Description of Deficiency(ies) attached? ☐ Yes ☒ No (none were identified)