DEPARTMENT OF THE AIR FORCE
AIR FORCE REAL PROPERTY AGENCY

02 JUN 2008

MEMORANDUM FOR - SEE DISTRIBUTION

FROM: AFRPA – Griffiss
Environmental Section
153 Brooks Road
Rome, NY 13441-4105

SUBJECT: On-Base Groundwater, Areas of Concern - Final Remedial Design Work Plan, Final Design Drawings

1. Enclosed are replacement/insert pages for the On-Base Groundwater Areas of Concern, Final Remedial Design Work Plan previously submitted in February 2008 and the Final Design Drawings. Responses to the regulatory comments received in April 2008 are included and the comments have been addressed in the documents. The remedial work is scheduled to begin during June 2008.

2. Should any questions arise, please feel free to contact Ms. Catherine Jerrard at (315) 356-0810, Ext. 204.

MICHAEL F. MCDERMOTT
BRAC Environmental Coordinator

Attachment
Final Design Documents -
On-Base Groundwater AOCs

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FINAL
Design Drawings
Former Griffiss Air Force Base
Rome, New York

Contract Number: W912DQ-06-D-0012

May 2008

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
KANSAS CITY DISTRICT
601 East 12th Street
Kansas City, Missouri 64106

Prepared by:

ECOLOGY AND ENVIRONMENT ENGINEERING, P.C.
368 Pleasant View Drive
Lancaster, New York 14086

Under Contract to:

PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP, INC.
290 Elwood Davis Road
Liverpool, New York 13088

Certificate of Compliance

Final Remedial Design Drawings
Former Griffiss Air Force Base, Rome, New York

May 2008

On behalf of Ecology and Environment Engineering, P.C. (EEEPC), the undersigned certify that the attached document was developed in conformance with EEEPC's Quality Control Plan.

Donald J. Miller, P.E.
Quality Control Manager

5/30/08
Date

Timothy J. Grady, P.E.
Program Manager

5/30/08
Date

David P. Albers, P.E.
Senior Manager

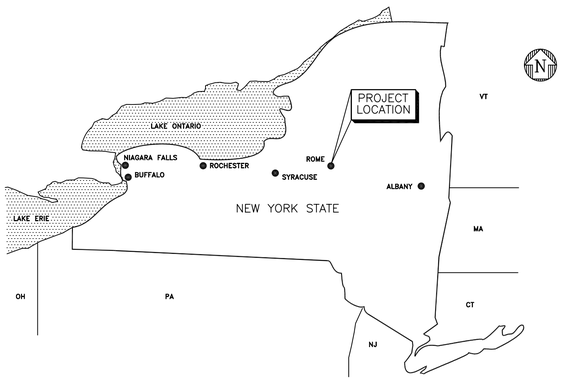
5/30/08
Date

Thomas R. Heins, P.E.
Project Manager

5/30/08
Date

ON-BASE GROUNDWATER REMEDIAL DESIGN
LANDFILL 6 SITE
FORMER GRIFFISS AIR FORCE BASE
ROME, NEW YORK

MAY 2008



VICINITY MAP
NTS

US Army Corps of Engineers

PARSONS *In Association with:* **FPM group**

ecology and environment engineering, p.c.

SOURCE: WOOLPERT CONSULTANTS

SITE LOCATION PLAN
1" = 1000'

LIST OF DRAWINGS

DWG. NO.	REV.	TITLE
1	C	COVER SHEET AND LIST OF DRAWINGS
2	C	NOTES, LEGEND AND ABBREVIATIONS
3	F	EXISTING SITE PLAN
4	C	PROPOSED SITE PLAN
5	C	SUBSTRATE SYSTEM SCHEMATIC

REFERENCE DRAWINGS			REVISIONS				
DWG NO.	DATE	DESCRIPTION	NO.	DATE	DWN	APP'D	DESCRIPTION
GR1216r-pn-17	9/1/98	SITE FEATURES SUPPLIED BY WOOLPERT CONSULTANTS	B	12/13/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR AFRPA/USACE REVIEW
TOPO.DWG	2/11/99	BASE TOPOGRAPHY SUPPLIED BY WOOLPERT CONSULTANTS	A	11/21/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR PARSONS REVIEW
			0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
			C	2/27/08	WAB	DJM	ISSUED FOR REGULATORY REVIEW

ecology and environment engineering p.c.

DESIGNED BY	CHECKED BY
KM POWELL	T HEINS P.E.
DRAWN BY	APPROVED BY
KM KRAJEWSKI/WA BAYLES	DJ MILLER P.E.

FORMER GRIFFISS AIR FORCE BASE
ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
LANDFILL 6
COVER SHEET AND LIST OF DRAWINGS

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
AS NOTED	11/21/07	Cover Sheet.dwg	Sheet 1 of 5	0

F:\Griffiss\2007 P&T\LF6\Construction Issue\Cover Sheet.dwg
BUFFplot: 4/1/08 KMK

NOTES:

GENERAL:

1. SUMMARY: THE LANDFILL 6 GROUNDWATER REMEDIATION WORK IS A SERIES OF VEGETABLE OIL INJECTIONS INTENDED TO ENHANCE BIODEGRADATION OF THE CONTAMINANTS OF CONCERN. THE PROJECT INCLUDES A VEGETABLE OIL INJECTION INTO A ROW OF SIX EXISTING INJECTION WELLS (LF6IW–01 THROUGH LF6IW–06) LOCATED IN THE AREA OF HIGHEST GROUNDWATER CONTAMINATION. AN ADDITIONAL VEGETABLE OIL INJECTION OR GROUNDWATER RECIRCULATION SYSTEM WILL BE USED IF DATA COLLECTED AFTER THE INJECTION INDICATES THEY ARE NEEDED. REFER TO THE "FINAL REMEDIAL DESIGN WORK PLAN" (EEEPC 2008) FOR ADDITIONAL INFORMATION.
2. LOCATION OF CENTERLINE OF THREE MILE CREEK HAS BEEN MODIFIED AS OF 2005.
3. TOPOGRAPHY AT LANDFILL 6 PERIMETER IS A COMBINATION OF SOURCES DATED 2–99 AND 7/06.
4. WETLANDS DELINEATION PROVIDED BY ECOLOGY AND ENVIRONMENT, INC. DATED 11/1/06.
5. UTILITY INFORMATION IS APPROXIMATE. VERIFY ALL UTILITIES, LOCATIONS, AND CONDITIONS WITH PROPERTY OWNERS PRIOR TO START OF FIELD ACTIVITIES.
6. PARCEL BOUNDARIES OBTAINED FROM AFRPA VIA FPM (MARCH 2007), AND WERE NOT VERIFIED IN THE FIELD.
7. VEHICULAR TRAFFIC AND CHEMICAL STORAGE IS PROHIBITED IN WETLANDS. SEE EXECUTION NOTE 1.

HEALTH AND SAFETY:

1. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE HEALTH AND SAFETY OF ALL ON–SITE PERSONNEL.
2. THE CONTRACTOR SHALL DEVELOP AND IMPLEMENT A HASP IN ACCORDANCE WITH USACE EM 385–1–1 TO PROTECT ALL SITE PERSONNEL INCLUDING THOSE OF SITE VISITORS, BUILDING OWNERS, AND THE OWNER'S TENANTS.
3. THE CONTRACTOR'S HEALTH AND SAFETY PLAN MUST COMPLY WITH ALL APPLICABLE FEDERAL AND STATE REGULATIONS PROTECTING HUMAN HEALTH AND THE ENVIRONMENT.
4. THE CONTRACTOR SHALL NOT INITIATE ONSITE WORK UNTIL A HASP HAS BEEN ISSUED.

PERMITS/AGREEMENTS:

1. THE CONTRACTOR IS RESPONSIBLE FOR SECURING ALL REQUIRED APPLICATIONS, PERMITS, EASEMENTS, PERMISSIONS, APPROVALS, LETTERS, AGREEMENTS, RIGHTS OF WAY AND CERTIFICATIONS NECESSARY FOR THE COMPLETION OF THE WORK.
2. MANAGE STORMWATER IN ACCORDANCE WITH NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM GENERAL PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITIES (GP–02–01) OR MOST RECENT VERSION.

PROJECT COORDINATION:

1. CONTACT "DIG SAFELY NEW YORK" TO LOCATE UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION ACTIVITIES. REGULATIONS PERTAINING TO THE PROTECTION OF UNDERGROUND FACILITIES IN NEW YORK STATE ARE GOVERNED BY NEW YORK CODES, RULES, AND REGULATIONS. HOWEVER, OTHER PRIVATELY OWNED UTILITIES AT THE SITE MAY EXIST THAT ARE NOT MEMBERS OF THE UTILITY LOCATOR SERVICE. COORDINATE ALL INTRUSIVE WORK WITH THE PROPERTY OWNER(S) TO IDENTIFY ANY OTHER POTENTIAL PRIVATELY OWNED UTILITIES PRESENT IN THE REMEDIAL CONSTRUCTION AREA.
2. CONTACT THE CITY OF ROME PUBLIC WORKS DEPARTMENT A MINIMUM OF 1 MONTH PRIOR TO INJECTION ACTIVITIES TO COORDINATE THE USE OF WATER FROM THE FIRE HYDRANT NEAR BUILDING 817 OR ON THE CORNER OF ELLSWORTH ROAD AND OTIS STREET.
3. CONTACT GRIFFISS AIR FORCE PERSONNEL A MINIMUM OF 1 MONTH PRIOR TO INJECTION ACTIVITIES TO COORDINATE THE USE OF BUILDING 817 FOR THE STORAGE OF CHEMICALS.
4. THE CONTRACTOR SHALL COORDINATE WITH GRIFFISS AIRPARK FLIGHT PERSONNEL (IF APPLICABLE) AND APPLICABLE PROPERTY OWNERS ON A DAILY BASIS TO OBTAIN ACCESS AND APPROVAL FOR WORK TO BE PERFORMED.
5. EEEPC SHALL NOT BE RESPONSIBLE FOR CONTRACTOR MEANS AND METHODS, INCLUDING DESIGN AND IMPLEMENTATION OF FUTURE CONTINGENCY MEASURES.

SURVEYS/AS–BUILT DRAWINGS/RECORD DOCUMENTS:

1. THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING RECORD AS–BUILT DRAWINGS AND MAINTAINING RECORDS OF FINAL INSPECTIONS, TREATMENT SYSTEM OPERATION, CHEMICAL DATA SHEETS, START–UP, MAINTENANCE, AND ENVIRONMENTAL MONITORING DURING TREATMENT SYSTEM START–UP. ALL RECORD DOCUMENTS, AS–BUILT DRAWINGS, AND SURVEYS SHALL BE CERTIFIED FOR ACCURACY BY PROJECT MANAGEMENT AND PROVIDED TO ECOLOGY AND ENVIRONMENT ENGINEERING P.C. OF LANCASTER, NEW YORK IN PREPARATION OF THE REMEDIAL ACTION REPORT.

TEMPORARY FACILITIES AND CONTROLS

1. THE CONTRACTOR SHALL SECURE AND PROVIDE ALL TEMPORARY UTILITIES REQUIRED TO PERFORM THE WORK INCLUDING BUT NOT LIMITED TO ELECTRICITY, LIGHTING, HEAT, VENTILATION, TELEPHONE SERVICE, WATER, SANITARY FACILITIES AND FIRE PROTECTION. THE CONTRACTOR SHALL COORDINATE THE LOCATION OF TEMPORARY FACILITIES WITH GRIFFISS AIR FORCE PERSONNEL PRIOR TO COMMENCEMENT OF WORK.
2. THE CONTRACTOR SHALL SECURE, PROVIDE AND MAINTAIN ALL TEMPORARY TRAFFIC CONTROLS, BARRIERS, ENCLOSURES, FENCING, TARPAULINS, CANOPIES AND WATER CONTROLS REQUIRED TO SATISFACTORILY PERFORM THE WORK.
3. TEMPORARY FACILITIES AND SERVICES PROVIDED BY THE CONTRACTOR INCLUDE, BUT ARE NOT NECESSARILY LIMITED TO, ACCESS ROADS, PARKING, AND DUST CONTROL.
4. THE CONTRACTOR IS RESPONSIBLE FOR CLEANUP AND REPAIR OF ALL DAMAGE CAUSED BY THE INSTALLATION OR USE OF TEMPORARY FACILITIES.
5. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE SECURITY OF THE CONTRACTOR'S WORK AREAS, EQUIPMENT, MATERIALS, AND SUPPLIES.
6. THE CONTRACTOR SHALL DEVELOP AND IMPLEMENT A SPCC PLAN FOR ALL CHEMICALS STORED ON SITE IF REQUIRED BY FEDERAL OR STATE REGULATIONS.
7. THE PRODUCTS SPECIFIED HEREIN SHALL BE LEASED OR OWNED BY THE CONTRACTOR AND WILL NOT BECOME PROPERTY OF THE FORMER GRIFFISS AIR FORCE BASE. ALL PRODUCTS SPECIFIED HEREIN SHALL BE REMOVED FROM THE WORK SITE WHEN NO LONGER NEEDED.

SITE RESTORATION:

1. ALL AREAS DISTURBED DURING PERFORMANCE OF THE WORK, INCLUDING BUT NOT LIMITED TO ASPHALT, SHALL BE RESTORED TO PRE–CONSTRUCTION CONDITIONS.
2. PROTECT ALL RESTORED AREAS FROM EROSION AND DAMAGE UNTIL SURFACE IS STABILIZED.
3. CONTRACTOR SHALL REPAIR OR REPLACE ANY RESTORED AREAS DAMAGED WITHIN 6 MONTHS OF PROJECT COMPLETION.
4. RESTORE ALL GRADES TO MAINTAIN EXISTING SURFACE WATER DRAINAGE PATTERNS.
5. IMPORTED TOPSOIL SHALL BE ORGANIC LOAM, WELL DRAINED, HOMOGENOUS AND MEET THE FOLLOWING MINIMUM REQUIREMENTS:
   a. PH BETWEEN 4.5 AND 7
   b. FREE OF ANY VEGETATION (ESPECIALLY INVASIVE SPECIES), DEBRIS OR OTHER OBJECTIONABLE MATERIALS.
   c. FREE OF ANY STONES OR PARTICLES GREATER THAN 1".
6. IN AREAS OF SOIL DISTURBANCE, PLACE 3" OF TOPSOIL ON EARTH FILL AND APPLY GRASS SEED AT A MINIMUM OF 3 POUNDS/1,000 SQUARE FEET. PROTECT NEWLY SEEDED AREAS FROM TRAFFIC AND EROSION. MAINTAIN ADEQUATE SOIL MOISTURE CONDITIONS UNTIL YOUNG PLANTS ARE WELL ESTABLISHED.
7. GRASS SEED SHALL BE A MIXTURE OF 30% ANNUAL RYEGRASS AND 70% PERENNIAL RYEGRASSES.
8. SOW GRASS SEED EVENLY BY HAND, HYDROSEED OR SEED SPREADER ON DRY OR MODERATELY DRY SOIL.
9. FERTILIZER SHALL BE A COMMERCIAL–GRADE 5–10–5 MIXTURE.
10. APPLY FERTILIZER IN ACCORDANCE WITH MANUFACTURER'S WRITTEN DIRECTIONS.

PRODUCTS AND EQUIPMENT:

1. THE INJECTION SYSTEM SHALL BE CAPABLE OF PUMPING A MINIMUM OF 40 GPM.
2. THE MIXING AND INJECTION SYSTEM PIPING SHALL BE HDPE. ALL EQUIPMENT, PIPING, VALVES, ETC., SHALL BE CHEMICALLY RESISTANT TO THE SUBSTRATE USED DURING INJECTION ACTIVITIES.
3. VALVES, CHECK VALVES, ETC. NOT SHOWN ON SHEET 5 FOR CLARITY (INSTALL AS REQUIRED).
4. INJECTION MIXTURE SHALL CONSIST OF 100% VEGETABLE OIL (CENTROMIX® WD, A SOY LECITHIN PRODUCT MANUFACTURED BY CENTRAL SOYA COMPANY, INC.), LACTATE (SODIUM LACTATE 60% SOLUTION MANUFACTURED BY JRW BIOREMEDIATION LLC), PH BUFFER PRODUCT (NEUTRAL ZONE ™ MANUFACTURED BY REMEDIATION AND NATURAL ATTENUATION SERVICES), AND MAKE–UP WATER. SEE TABLE 1 ON SHEET 5 FOR VOLUMES. OBTAIN CHEMICAL DATA SHEETS FROM THE MANUFACTURER AND SUBMIT AS SPECIFIED IN SURVEYS/AS–BUILT DRAWINGS/RECORD DOCUMENTS NOTE 1. MAKE–UP WATER SHALL BE OBTAINED FROM NEARBY FIRE HYDRANT VIA TANKER TRUCK. CONTRACTOR SHALL COORDINATE WATER DISTRIBUTION WITH UTILITY PERSONNEL PRIOR TO INJECTION ACTIVITIES.

QA/QC:

1. DURING THE INJECTION EVENT, PRESSURES, FLOWRATES, SUBSTRATE VOLUMES, INJECTION WELL SEALS, AND NEARBY MONITORING WELLS. INJECTION PRESSURES AND FLOWRATES SHALL NOT EXCEED VALUES LISTED IN TABLE 1 ON SHEET 5. SEE EXECUTION NOTE 12 FOR ADDITIONAL INSTRUCTIONS. INJECTION WELL SEALS SHALL BE VISUALLY INSPECTED TO ENSURE THAT THE SEAL HAS NOT BEEN COMPROMISED DURING OPERATION. MONITOR WATER LEVELS AT LF6MW–16, LF6MW–17, LF6MW–18, LF6MW–19, AND LF6MW–20 FOR MOUNDING. IF SIGNIFICANT MOUNDING OCCURS (NOT TO EXCEED THE TOP OF THE UNSATURATED ZONE RESULTING IN DAYLIGHTING OF THE SUBSTRATE), REDUCE FLOWRATES TO LIMIT THE MOUNDING. NEARBY DOWNGRADIENT WELLS SHALL BE VISUALLY MONITORED TO CHECK FOR SUBSTRATE BREAKTHROUGH USING DEDICATED CLEAR BAILERS. THE PRESENCE OF SUBSTRATE WILL BE EVIDENCED BY THE COLOR YELLOW.

EXECUTION:

1. IMPROVE ACCESS ROAD FROM PERIMETER ROAD TO THE LANDFILL 6 INJECTION SITE AS NEEDED. ROAD IMPROVEMENTS SHALL NOT EXTEND IN TO WETLAND AREAS (SEE SHEETS 3 AND 4 FOR WETLAND LOCATIONS). THE CONTRACTOR SHALL MARK THE LOCATION OF THE WETLANDS IN THE FIELD PRIOR TO INITIATING THIS REMEDIATION WORK. NO CONSTRUCTION ACTIVITIES SHALL OCCUR WITHIN 5 FEET OF THE EDGE OF THE WETLANDS.
2. INSTALL AND DEVELOP MONITORING WELL LF6MW–39 AT LEAST 1 MONTH PRIOR TO INJECTION ACTIVITIES. WELL TO BE CONSTRUCTED AS DESCRIBED IN THE "FINAL WORK PLAN PREDESIGN INVESTIGATIONS AT LANDFILL 6, BUILDING 817/WSA, BUILDING 775, AND AOC 9" (EEEPC 2006). SCREEN INTERVAL DEPTH TO BE 10–30 FEET BGS.
3. THE INJECTION SHALL BE PERFORMED IN EXISTING WELLS INCLUDED IN TABLE 1 ON SHEET 5. ADDITIONAL INJECTION EVENTS MAY BE PERFORMED BASED ON CRITERIA DESCRIBED IN THE "FINAL REMEDIAL DESIGN WORK PLAN" (EEEPC 2008). ADDITIONAL INJECTION DETAILS TBD PRIOR TO THE EVENTS.
4. PERFORM A FALLING–HEAD SLUG TEST AT WELLS LF6MW–30 AND LF6MW–28 WITHIN 1 MONTH PRIOR TO INJECTION ACTIVITIES AND DURING INJECTION ACTIVITIES. IF ADDITIONAL INJECTIONS ARE PERFORMED, SLUG TESTING WILL BE COMPLETED DURING THE NEXT REGULARLY SCHEDULED SAMPLING EVENT AFTER THE INJECTION ACTIVITY. THE FALLING–HEAD SLUG TEST INVOLVES DISPLACING THE WATER IN THE WELLS BY INSERTING A SOLID SLUG OF KNOWN VOLUME. DATA COLLECTION TO COMMENCE AT THE TIME OF SLUG INSERTION USING A PRESSURE TRANSDUCER/DATA LOGGER OR ELECTRONIC TAPE WATER LEVEL READER. COLLECT WATER LEVEL MEASUREMENTS AT PREDETERMINED TIME INTERVALS ON AN APPROXIMATE LOGARITHMIC SCALE AS THE WATER LEVEL RETURNS TO ITS INITIAL STATIC LEVEL. THE SLUG TEST WILL BE COMPLETE WHEN THE WATER LEVEL HAS RETURNED TO WITHIN AT LEAST 10% OF STATIC CONDITIONS OR A SUFFICIENT NUMBER OF READINGS HAVE BEEN MADE TO CLEARLY SHOW A TREND ON A SEMI–LOG PLOT OF TIME VERSUS DEPTH. DATA SHALL BE INTERPRETED BY THE BOWER AND RICE METHOD FOR UNCONFINED AQUIFERS, OR EQUIVALENT. THE SLUG WILL THEN BE REMOVED AND THE WATER LEVEL MONITORING PROCESS WILL BE REPEATED AS THE WATER LEVEL RISES.
5. CONTACT "DIG SAFELY NEW YORK" TO LOCATE UNDERGROUND UTILITIES PRIOR TO INJECTION ACTIVITIES. REGULATIONS PERTAINING TO THE PROTECTION OF UNDERGROUND FACILITIES IN NEW YORK STATE ARE GOVERNED BY NEW YORK CODES, RULES, AND REGULATIONS. HOWEVER, OTHER PRIVATELY OWNED UTILITIES AT THE SITE MAY EXIST THAT ARE NOT MEMBERS OF THE UTILITY LOCATOR SERVICE. COORDINATE ALL INTRUSIVE WORK WITH THE PROPERTY OWNER(S) TO IDENTIFY ANY OTHER POTENTIAL PRIVATELY OWNED UTILITIES PRESENT IN THE REMEDIAL CONSTRUCTION AREA.
6. STORE MATERIAL AND EQUIPMENT IN BUILDING 817, SEE PROJECT COORDINATION NOTE 3.
7. STORE BULK CHEMICALS UNDER COVER WHEN NOT IN USE AND IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS AND THE SITE'S SPCC PLAN (IF APPLICABLE).
8. CONTAINERIZE WASTE MATERIAL FROM THE SITE DAILY AND DISPOSE OF APPROPRIATELY.
9. PREPARE INJECTION MIXTURE (COMPRISED OF MAKE–UP WATER, VEGETABLE OIL, LACTATE, AND PH BUFFER) IN THE FIELD USING A STATIC–IN–LINE MIXER AS SHOWN ON SHEET 5. INJECT MIXTURE VOLUME CONTINUOUSLY UNTIL TOTAL VOLUME INJECTED.
10. THE NUMBER AND SEQUENCE OF WELLS TO BE INJECTED AT THE SAME TIME TBD IN THE FIELD.
11. INITIAL FLOW RATES OF THE SUBSTRATE INJECTION SHALL BE LESS THAN THE FLOW RATES PRESENTED IN TABLE 1 ON SHEET 5 FOR EACH INJECTION WELL TO ENSURE THAT ALL ASPECTS OF THE SYSTEM ARE IN PROPER WORKING ORDER. SYSTEM PRESSURES SHALL NOT EXCEED OVERBURDEN PRESSURES PRESENTED IN TABLE 1 ON SHEET 5. ADJUST FLOW RATES AS NEEDED TO REDUCE PRESSURES. AFTER SYSTEM INITIALIZED, FLOW RATES CAN BE INCREASED, HOWEVER THEY SHALL NOT EXCEED VALUES LISTED IN TABLE 1 ON SHEET 5.
12. AFTER THE SUBSTRATE VOLUME HAS BEEN INJECTED INTO THE SUBSURFACE, STOP THE SUBSTRATE FLOW AND REDUCE SYSTEM PRESSURE TO ZERO PRIOR TO DISCONNECTING ANY INJECTION LINE.
13. CONDUCT PERFORMANCE MONITORING ACCORDING TO "FINAL REMEDIAL DESIGN WORK PLAN" (EEEPC 2008).

LEGEND:

UE	UNDERGROUND ELECTRIC LINE		CENTERLINE OF THREE–MILE CREEK
OE	OVERHEAD ELECTRIC LINE		APPROXIMATE EXTENT OF HARDFILL C
X X	FENCE LINE		APPROXIMATE EXTENT OF LANDFILL 4
470	TOPOGRAPHIC CONTOUR LINE (5 FOOT INTERVAL)		APPROXIMATE EXTENT OF LANDFILL 6
2623	BUILDING LOCATION	50 50	MONITORING WELL TOTAL CHLORINATED VOC GROUNDWATER DATA IN ug/L FROM 2004 AND 2006
WL WL	DELINEATED WETLANDS	50 50	MONITORING WELL TOTAL CHLORINATED VOC GROUNDWATER DATA IN ug/L FROM 2007
LF6MW–18	EXISTING MONITORING WELL	PL	PARCEL BOUNDARY
LF6TW–37	EXISTING TEMPORARY MONITORING WELL		APPROXIMATE BOUNDARY OF B775 PLUME IN 2000
LF6MW–32	PERFORMANCE MONITORING WELL		APPROXIMATE BOUNDARY OF LF6 PLUME BASED ON AVAILABLE 2006 AND 2007 DATA
LF6MW–39	PROPOSED PERFORMANCE MONITORING WELL TO BE INSTALLED		BALL VALVE
LF6/TMCSW–1 / LF6SW–1PM	EXISTING SURFACE WATER SAMPLE LOCATION/SURFACE WATER SAMPLE LOCATION		DOSIMETER
LF6IW–03	EXISTING INJECTION WELL TO BE RE–USED		PRESSURE GAUGE

ABBREVIATIONS:

AFRPA	AIR FORCE REAL PROPERTY AGENCY	LF6	LANDFILL 6	QA/QC	QUALITY ASSURANCE/QUALITY CONTROL
BGS	BELOW GROUND SURFACE	ND	NON DETECT	SPCC	SPILL PREVENTION, CONTROL, AND COUNTERMEASURE
EEEPC	ECOLOGY AND ENVIRONMENT ENGINEERING, P.C.	NO.	NUMBER	TBD	TO BE DETERMINED
GPM	GALLONS PER MINUTE	NTS	NOT TO SCALE	USACE	UNITED STATES ARMY CORPS OF ENGINEERS
HASP	HEALTH AND SAFETY PLAN	PL	PROPERTY LINE	VOC	VOLATILE ORGANIC COMPOUND
HDPE	HIGH DENSITY POLYETHYLENE	PPB	PARTS PER BILLION	'	FEET
ID	IDENTIFICATION	PSI	POUNDS PER SQUARE INCH	"	INCHES
				µg/L	MICROGRAMS PER LITER

IT IS A VIOLATION OF NEW YORK STATE EDUCATION LAW TO ALTER THIS DOCUMENT BY MEANS INCONSISTENT WITH SECTION 7209 OF SAID LAW.

DWG NO.	DATE	DESCRIPTION
REFERENCE DRAWINGS		

NO.	DATE	DWN	APP'D	DESCRIPTION
0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
C	2/27/08	WAB	DJM	ISSUED FOR REGULATORY REVIEW
B	12/13/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR AFRPA/USACE REVIEW
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REVISIONS				

ecology and environment engineering p.c.

DESIGNED BY	CHECKED BY
KM POWELL	T HEINS PE
DRAWN BY	APPROVED BY
WA BAYLES	DJ MILLER PE

FORMER GRIFFISS AIR FORCE BASE

ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN LANDFILL 6 NOTES, LEGEND AND ABBREVIATIONS

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
NTS	11/21/07	2.dwg	Sheet 2 of 5	0

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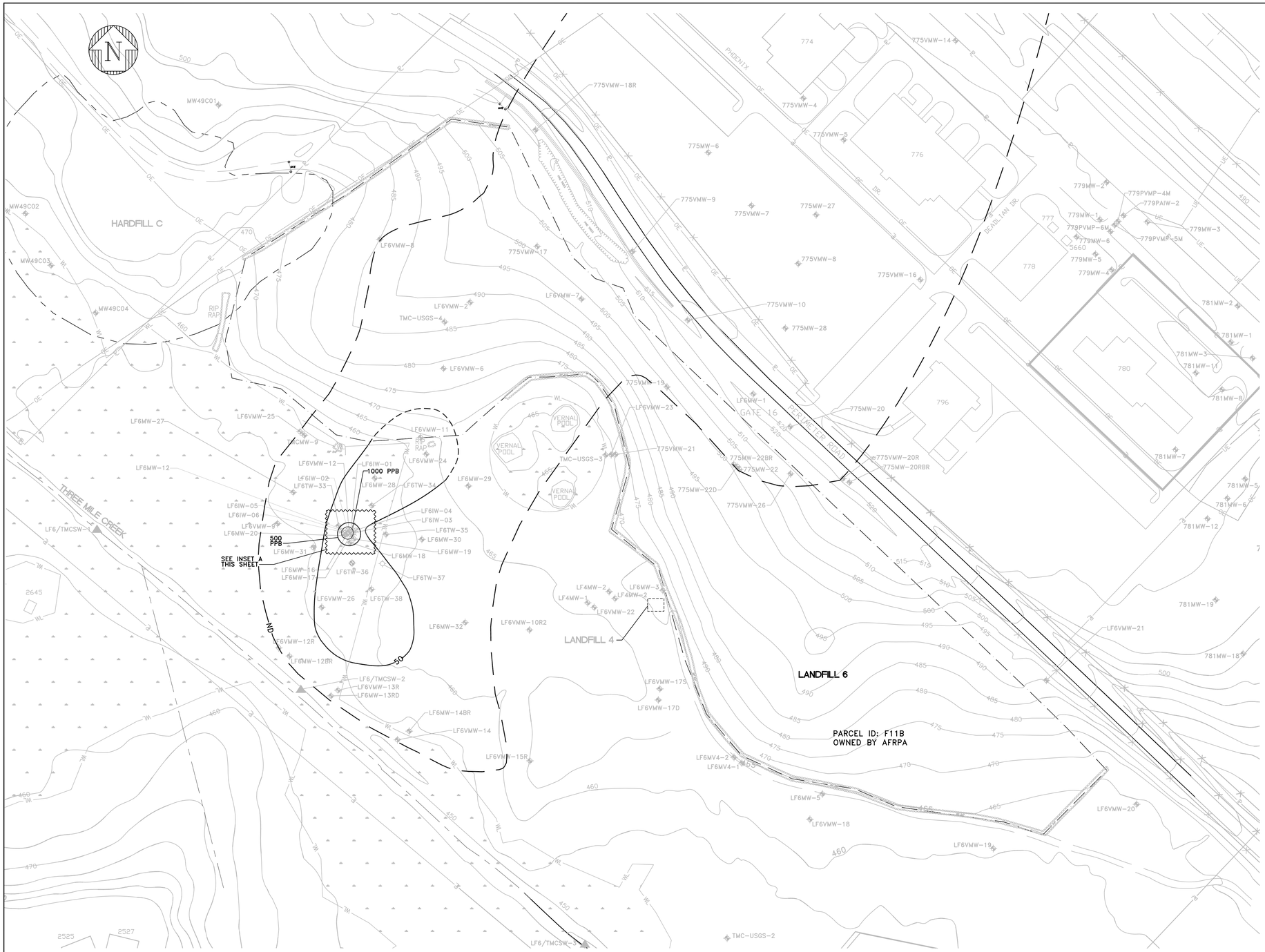
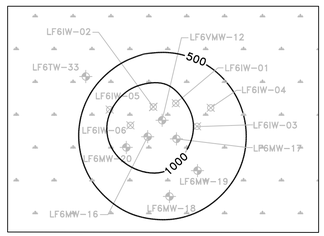
BUFfplot: 5/1/08 KMK





INSET A

SCALE: 1" = 20'-0"

SCALE IN FEET

0 20 40 60

SCALE IN FEET

0 100 200 300

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DWG NO.	DATE	DESCRIPTION
LF6_NEWMXD	3/14/07	PROPERTY OWNER INFO FROM AFRPA
LF6_Feb27.shp	2/27/07	PARCEL BOUNDARY PER FPM GROUP
ACAD-04C02R0-FINAL	7/12/06	LF 6 SURVEY SUPPLIED BY LAFAVE, WHITE & MCGIVERN L.S.,P.C.
GR1216r-pn-17	9/1/98	SITE FEATURES SUPPLIED BY WOOLPERT CONSULTANTS
TOPO.DWG	2/11/99	BASE TOPOGRAPHY SUPPLIED BY WOOLPERT CONSULTANTS

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D	11/21/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR PARSONS REVIEW
C	9/20/07	KMK	DJM	ISSUED FOR REGULATORY REVIEW
B	7/16/07	KMK	DJM	ISSUED FOR FOR AFRPA/USACE REVIEW
A	6/12/07	KMK	DJM	ISSUED FOR 30% DESIGN FOR PARSONS REVIEW

REVISIONS

ecology and environment engineering p.c.

DESIGNED BY	CHECKED BY
KM POWELL	T. HEINS P.E.
DRAWN BY	APPROVED BY
KM KRAJEWSKI/WA BAYLES	DJ MILLER P.E.

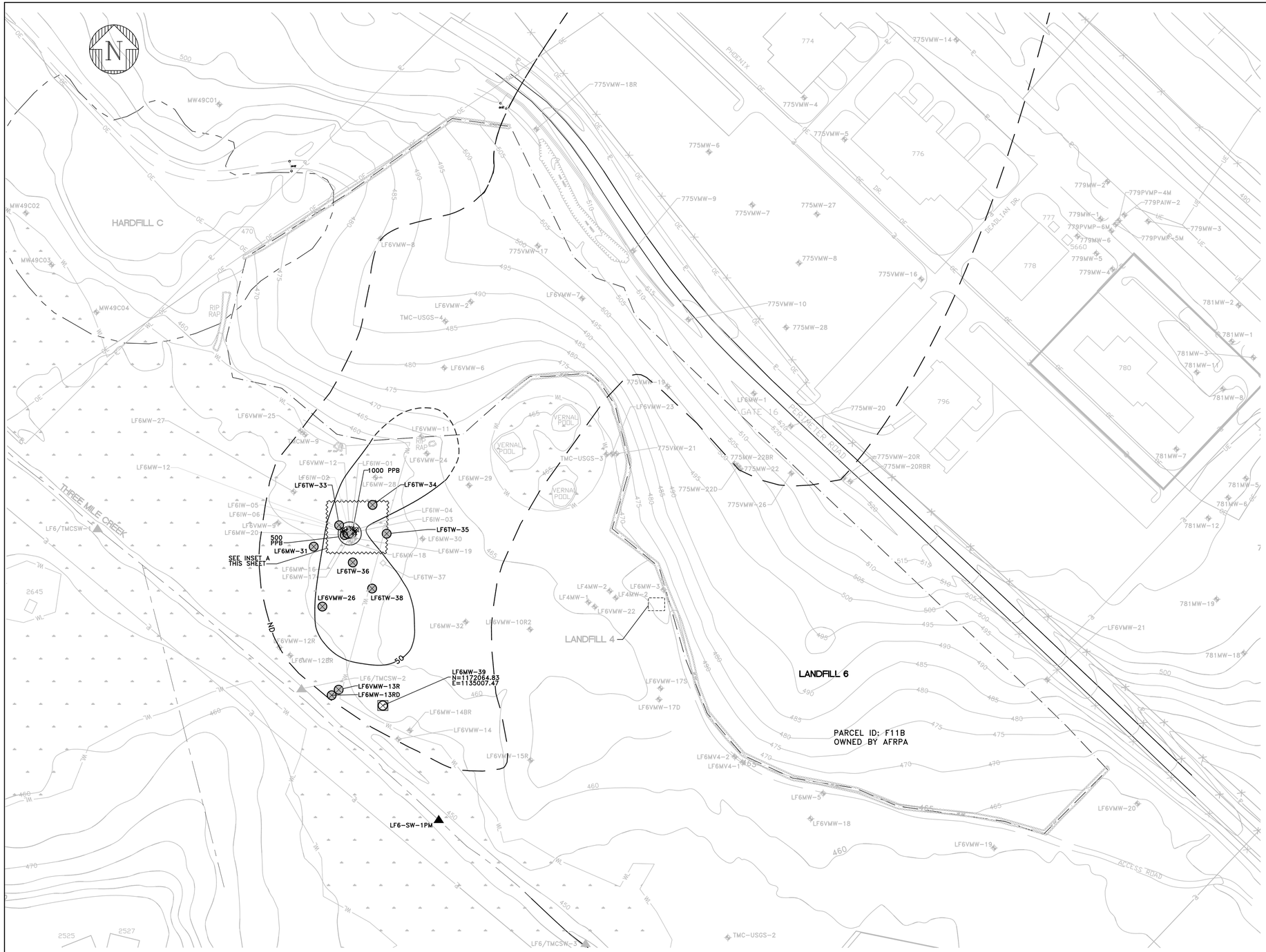
FORMER GRIFFISS AIR FORCE BASE

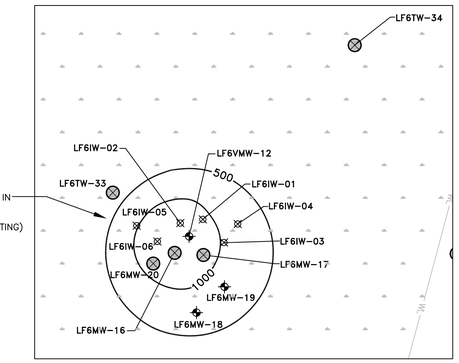
ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
LANDFILL 6
EXISTING SITE PLAN

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
1"=100'	6/12/07	3.dwg	Sheet 3 of 5	0

F:\Griffiss\2007 P&T\LF6\Construction Issue\1.dwg
BUFFplot: 5/1/08 KMK





INSET A

SCALE: 1" = 20'-0"

SCALE IN FEET

0 20 40 60

SCALE IN FEET

0 100 200 300

REFERENCE DRAWINGS

DWG NO.	DATE	DESCRIPTION
LF6_NEWMXD	3/14/07	PROPERTY OWNER INFO FROM AFRPA
LF6_Feb27.shp	2/27/07	PARCEL BOUNDARY PER FPM GROUP
ACAD-04C02R0-FINAL	7/12/06	LF 6 SURVEY SUPPLIED BY LAFAVE, WHITE & MCGIVERN L.S.,P.C.
GR1216r-pn-17	9/1/98	SITE FEATURES SUPPLIED BY WOOLPERT CONSULTANTS
TOPO.DWG	2/11/99	BASE TOPOGRAPHY SUPPLIED BY WOOLPERT CONSULTANTS

REVISIONS

NO.	DATE	DWN	APP'D	DESCRIPTION
0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
C	2/27/08	WAB	DJM	ISSUED FOR REGULATORY REVIEW
B	12/13/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR AFRPA/USACE REVIEW
A	11/21/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR PARSONS REVIEW

ecology and environment engineering p.c.

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FORMER GRIFFISS AIR FORCE BASE

ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
LANDFILL 6
PROPOSED SITE PLAN

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
1"=100'	11/21/07	4.dwg	Sheet 4 of 5	0

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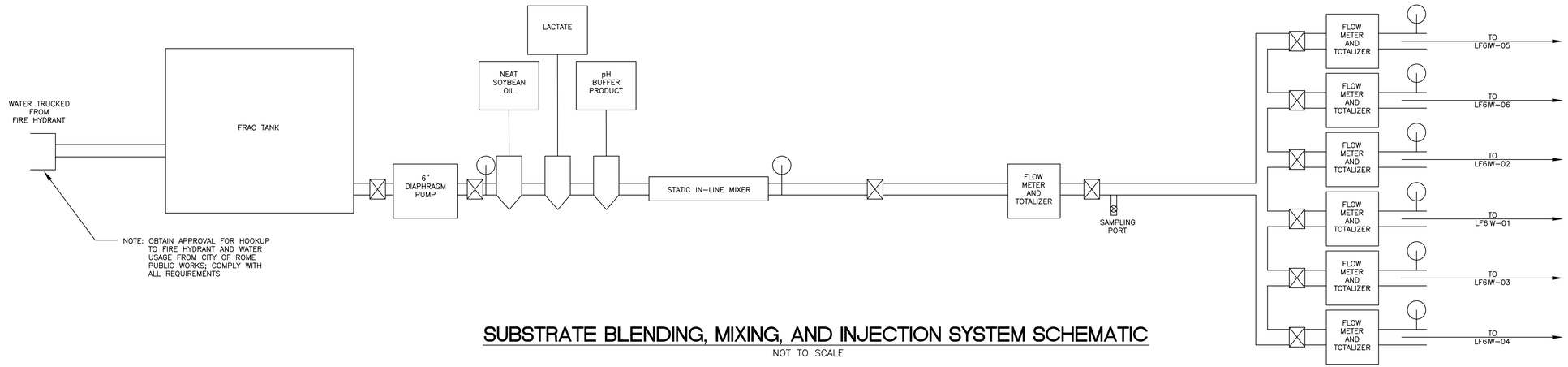
BUFFplot: 5/1/08 KMK



SUBSTRATE BLENDING, MIXING, AND INJECTION SYSTEM SCHEMATIC

NOT TO SCALE

NOTE: THE NUMBER AND SEQUENCE OF WELLS TO BE INJECTED AT THE SAME TIME TBD IN THE FIELD.

TABLE 1–SUBSTRATE MIXTURE AND INJECTION VOLUME

INJECTION WELL NO.	SCREEN INTERVAL (FEET BGS)	NEAT SOYBEAN OIL VOLUME (GALLONS)	LACTATE VOLUME (GALLONS)	pH BUFFER PRODUCT VOLUME (GALLONS)	MAKE-UP WATER VOLUME (GALLONS)	TOTAL SUBSTRATE VOLUME (GALLONS)	MAXIMUM OVERBURDEN PRESSURE (PSI)	MAXIMUM INJECTION FLOW RATE (GPM)
LF6IW-01	37-47	26	12	17	1150	1176	34	5
LF6IW-02	45-55	26	12	17	1150	1176	42	5
LF6IW-03	37-47	26	12	17	1150	1176	34	5
LF6IW-04	45-55	26	12	17	1150	1176	42	5
LF6IW-05	37-47	26	12	17	1150	1176	34	5
LF6IW-06	45-55	26	12	17	1150	1176	42	5

NOTE: THE TOTAL SUBSTRATE VOLUME DOES NOT INCLUDE LACTATE AND PH BUFFER VOLUMES AS THESE COMPONENTS ARE COMPLETELY SOLUBLE. THE COMBINED LACTATE AND PH BUFFER VOLUME IS MINOR COMPARED TO THE COMBINED VOLUME OF THE NEAT SOYBEAN OIL AND MAKE-UP WATER. THE INJECTED TOTAL SUBSTRATE VOLUME SHOULD BE +/- 5% OF THE TOTAL VOLUME PRESENTED IN TABLE 1.

DWG NO.	DATE	DESCRIPTION
FIGURE 3.4	9/10/07	PROCESS FLOW DIAGRAM FOR SUBSTRATE BLENDING AND MIXING SYSTEM BY PARSONS ENGINEERING SCIENCE, INC.
FIGURE 3.5	9/4/07	PROCESS FLOW DIAGRAM FOR SUBSTRATE INJECTION SYSTEM BY PARSONS ENGINEERING SCIENCE, INC.

REFERENCE DRAWINGS

NO.	DATE	DWN	APP'D	DESCRIPTION
0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
C	2/27/08	WAB	DJM	ISSUED FOR REGULATORY REVIEW
B	12/13/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR AFRPA/USACE REVIEW
A	11/21/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR PARSONS REVIEW

REVISIONS

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FORMER GRIFFISS AIR FORCE BASE

ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
LANDFILL 6
SUBSTRATE SYSTEM SCHEMATIC

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
NTS	11/21/07	5.dwg	Sheet 5 of 5	0

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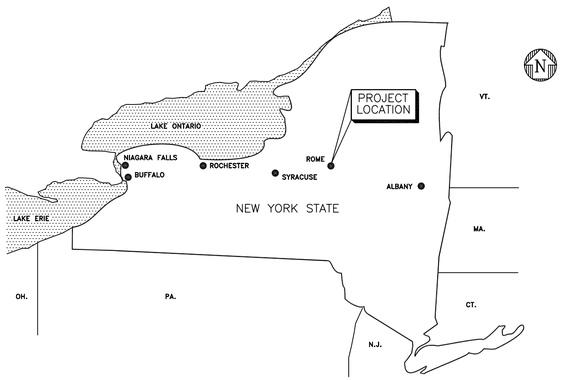
BUFFplot: 5/1/08 KMK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 775 SITE
FORMER GRIFFISS AIR FORCE BASE
ROME, NEW YORK

MAY 2008



VICINITY MAP
NTS

US Army Corps of Engineers

PARSONS *In Association with:* FPM group

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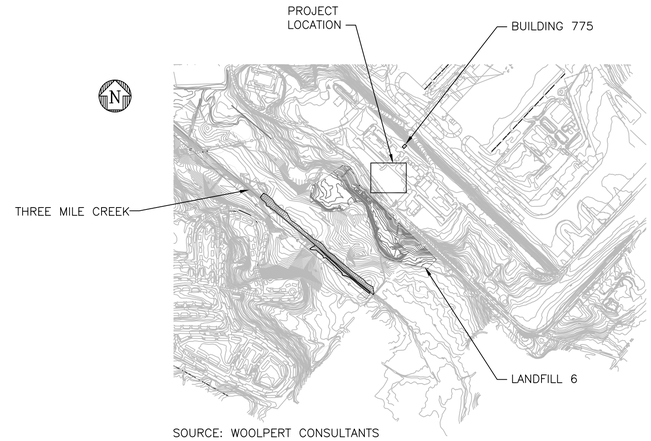

SOURCE: WOOLPERT CONSULTANTS

SITE LOCATION PLAN
1" = 1000'

LIST OF DRAWINGS		
DWG. NO.	REV.	TITLE
1	F	COVER SHEET AND LIST OF DRAWINGS
2	F	NOTES, LEGEND AND ABBREVIATIONS
3	F	EXTRACTION WELL PLAN
4	F	SECTIONS AND DETAILS
5	F	EROSION AND SEDIMENT CONTROL PLAN

REFERENCE DRAWINGS		
DWG NO.	DATE	DESCRIPTION
GR1216r-pn-17	9/1/98	SITE FEATURES SUPPLIED BY WOOLPERT CONSULTANTS
TOPO.DWG	2/11/99	BASE TOPOGRAPHY SUPPLIED BY WOOLPERT CONSULTANTS

REVISIONS				
NO.	DATE	DWN	APP'D	DESCRIPTION
0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
F	2/27/08	WAB	DJM	ISSUED FOR REGULATORY REVIEW
E	12/13/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR AFRPA/USACE REVIEW
D	11/21/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR PARSONS REVIEW
C	9/20/07	KMK	DJM	ISSUED FOR REGULATORY REVIEW
B	7/16/07	KMK	DJM	ISSUED FOR FOR AFRPA/USACE REVIEW
A	6/12/07	KMK	DJM	ISSUED FOR 30% DESIGN FOR PARSONS REVIEW

ecology and environment engineering p.c.

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FORMER GRIFFISS AIR FORCE BASE
ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 775
COVER SHEET AND LIST OF DRAWINGS

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
AS NOTED	6/12/07	Cover Sheet.dwg	Sheet 1 of 5	0

F:\Griffiss\2007 P&T\Building 775\Construction Issue\Cover Sheet.dwg
BUFFplot: 5/1/08 KMK

NOTES:

GENERAL:

1. THIS WORK GENERALLY CONSISTS OF THE FOLLOWING:
   - COORDINATION WITH UTILITIES AND PROPERTY OWNERS
   - WELL DRILLING
   - PUMP TESTING
   - TRENCHING AND DEWATERING
   - INSTALLATION OF FORCEMAIN PIPING, PUMPS, AND CONTROLS
   - PRESSURE TESTING PIPING
   - SITE RESTORATION
2. LOCATIONS OF EXISTING ACCESS PATHS, ROADWAYS AND STRUCTURES SHOWN ON THE DRAWINGS ARE APPROXIMATE. ACTUAL LOCATIONS TO BE DETERMINED IN FIELD.
3. BUILDING LOCATIONS AND UTILITIES PROVIDED BY LAFAVE, WHITE AND MCGIVERN, L.S., P.C. ON OCTOBER 9TH, 2007.
4. LOCATIONS OF EXISTING ABOVE AND BELOW GROUND UTILITIES, PIPELINES AND OTHER FEATURES SHOWN ON THE DRAWINGS ARE APPROXIMATE. ACTUAL LOCATIONS AND EXTENT OF THESE UTILITIES MUST BE VERIFIED BY THE CONTRACTOR IN THE FIELD.
5. CONTACT "DIG SAFELY NEW YORK" TO LOCATE UNDERGROUND UTILITIES PRIOR TO REMEDIAL WORK ACTIVITIES. REGULATIONS PERTAINING TO THE PROTECTION OF UNDERGROUND FACILITIES IN NEW YORK STATE ARE GOVERNED BY NEW YORK STATE CODES, RULES AND REGULATIONS. HOWEVER, THERE MAY EXIST OTHER PRIVATELY OWNED UTILITIES AT THIS SITE THAT ARE NOT MEMBERS OF THE UTILITY LOCATOR SERVICE. COORDINATE ALL INTRUSIVE WORK WITH THE PROPERTY OWNER TO IDENTIFY ANY OTHER POTENTIAL PRIVATELY OWNED UTILITIES PRESENT IN THE REMEDIAL CONSTRUCTION AREA.

5.1 NOTIFY PROJECT MANAGER NOT LESS THAN TWO DAYS IN ADVANCE OF PROPOSED UTILITY INTERRUPTIONS.
5.2 DO NOT PROCEED WITH UTILITY INTERRUPTIONS WITHOUT WRITTEN PERMISSION FROM THE PROJECT MANAGER.

6. PARCEL BOUNDARIES OBTAINED FROM AFRPA (MARCH 2007).
7. THE TERM "PROJECT MANAGER" USED IN THESE NOTES SHALL REFER TO THE DESIGNATED REPRESENTATIVE OF PARSONS INFRASTRUCTURE AND TECHNOLOGY GROUP, INC. IN ALL CASES.

HEALTH AND SAFETY:

1. THE CONTRACTOR IS SOLELY RESPONSIBLE AND LIABLE FOR THE HEALTH AND SAFETY OF ALL ON-SITE PERSONNEL.
2. THE CONTRACTOR SHALL DEVELOP AND IMPLEMENT A HEALTH AND SAFETY PLAN (HASP) IN ACCORDANCE WITH USACE EM 385-1-1 TO PROTECT ALL SITE PERSONNEL INCLUDING THOSE OF THE PROJECT MANAGER, SITE VISITORS, BUILDING OWNER AND THE OWNER'S TENANTS.
3. THE CONTRACTOR'S HEALTH AND SAFETY PLAN MUST COMPLY WITH ALL APPLICABLE FEDERAL AND STATE REGULATIONS PROTECTING HUMAN HEALTH AND THE ENVIRONMENT.
4. THE CONTRACTOR SHALL SUBMIT THE HASP TO THE PROJECT MANAGER FOR APPROVAL, AND SHALL NOT INITIATE ONSITE WORK UNTIL AN APPROVED HASP ADDRESSING ALL COMMENTS HAS BEEN ISSUED.

PERMITS/AGREEMENTS:

1. THE CONTRACTOR IS RESPONSIBLE FOR SECURING ALL REQUIRED APPLICATIONS, PERMITS, EASEMENTS, PERMISSIONS, APPROVALS, LETTERS, AGREEMENTS, RIGHTS OF WAY AND CERTIFICATIONS NECESSARY FOR THE COMPLETION OF THE WORK.
2. MANAGE STORMWATER IN ACCORDANCE WITH NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM GENERAL PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITIES (GP-02-01) OR MOST RECENT VERSION.

PROJECT COORDINATION:

1. THE CONTRACTOR SHALL COORDINATE WITH APPLICABLE PROPERTY OWNERS TO OBTAIN ACCESS AND APPROVAL FOR WORK TO BE PERFORMED.
2. THE PROJECT MANAGER SHALL BE RESPONSIBLE FOR OBTAINING AN INDUSTRIAL DISCHARGE PERMIT FROM THE CITY OF ROME WATER POLLUTION CONTROL FACILITY FOR FULL TIME SYSTEM OPERATION.
3. EEEPC SHALL NOT BE RESPONSIBLE FOR CONTRACTOR MEANS AND METHODS, INCLUDING DESIGN AND IMPLEMENTATION OF FUTURE CONTINGENCY MEASURES.

SURVEYS/SCHEDULE/AS-BUILT DRAWINGS/RECORD DOCUMENTS:

1. CONTRACTOR SHALL ENGAGE THE SERVICES OF A SURVEYOR, LICENSED TO PRACTICE IN THE STATE OF NEW YORK, TO IDENTIFY, PROVIDE, LOCATE, SET AND MAINTAIN LINES, LEVELS, CONTOURS AND DATUM REQUIRED TO PERFORM THE WORK. FINAL INVERT AND GRADE INFORMATION SHALL BE STAKED OUT AT INTERVALS AND LOCATIONS AS DIRECTED BY THE CONTRACTOR.
2. SUBMIT CATALOG CUTSHEETS AND PRODUCT INFORMATION FOR ALL MATERIALS AND EQUIPMENT TO BE FURNISHED AND INSTALLED AS DIRECTED BY THE PROJECT MANAGER AS SHOP DRAWINGS. THE PROJECT MANAGER SHALL REVIEW ALL SHOP DRAWINGS AND APPROVE OR DISAPPROVE THEM. PROVIDE A SHOP DRAWING FOR K-CRETE WHICH INCLUDES THE JOB MIX FORMULA AND DESTRUCTIVE TESTING DATA.
3. SUBMIT WELL DRILLER LICENSES AND PERMITS, OPERATIONS AND MAINTENANCE MANUALS, WARRANTIES, GUARANTEES FOR ALL EQUIPMENT TO BE FURNISHED AND INSTALLED. CONTRACTOR SHALL GUARANTEE ALL EQUIPMENT FURNISHED FOR A MINIMUM OF 1 YEAR. THE GUARANTEE PERIOD SHALL BEGIN UPON THE DATE OF ACCEPTANCE BY THE PROJECT MANAGER.
4. CONTRACTOR SHALL PROVIDE PHOTOGRAPHIC DOCUMENTATION OF SITE ACTIVITIES FOR EACH DAY ONSITE, AS DIRECTED BY THE PROJECT MANAGER. PHOTOGRAPHS SHALL BE SUBMITTED IN AN ELECTRONIC FORMAT ACCEPTABLE TO THE PROJECT MANAGER.
5. THE CONTRACTOR SHALL COMPILE AND PREPARE TWO BOUND COPIES OF ALL PROJECT DOCUMENTS AND CERTIFICATES, INCLUDING BUT NOT LIMITED TO:
   - SHOP DRAWINGS AND PRODUCT DATA
   - CERTIFICATES, I.E., MATERIAL AND EQUIPMENT
   - PHOTOCOPIES OF GUARANTEES, WARRANTIES AND SERVICE CONTRACTS
6. IN ADDITION TO THE ABOVE, THE CONTRACTOR SHALL PROVIDE 2 COMPLETE RED LINE COPIES OF THE CONTRACT DRAWINGS CLEARLY INDICATING THE ACTUAL LOCATIONS OF WELLS, TRENCHES, CONTROL PANELS, METER BOX AND ELECTRICAL ROUTING AS INSTALLED IN THE FIELD.
7. CONTRACTOR SHALL SUBMIT A BAR TYPE PROJECT SCHEDULE TO THE PROJECT MANAGER FOR APPROVAL PRIOR TO MOBILIZING ON-SITE.
8. CONTRACTOR IS RESPONSIBLE FOR COORDINATION OF HIS WORK WITH ALL SUBCONTRACTORS AS WELL AS OTHER BUSINESSES AND UTILITY SERVICES AT THE SITE. INTERRUPTIONS TO NORMAL TRAFFIC PATTERNS AND PARKING AREAS MUST BE CLEARLY MARKED WITH CONES, SIGNS, FLASHERS AND BARRICADES TO PROTECT THE PUBLIC.
9. ADEQUATE TRAFFIC CONTROLS MUST BE MAINTAINED DURING THE CONSTRUCTION PHASE OF THE PROJECT. PROVIDE MIN 1 WEEK ADVANCE NOTICE TO THE PROJECT MANAGER OF ALL WORK IN ROADWAYS AND PARKING AREAS.
10. THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING RECORD AS-BUILT DRAWINGS AND MAINTAINING RECORDS OF FINAL INSPECTIONS, TREATMENT SYSTEM OPERATION, START-UP, MAINTENANCE, AND ENVIRONMENTAL MONITORING DURING TREATMENT SYSTEM START-UP. ALL RECORD DOCUMENTS, AS-BUILT DRAWINGS, AND SURVEYS SHALL BE CERTIFIED FOR ACCURACY BY THE PROJECT MANAGER AND PROVIDED TO EEEPC IN PREPARATION OF THE REMEDIAL ACTION REPORT.

TEMPORARY FACILITIES AND CONTROLS:

1. THE CONTRACTOR SHALL SECURE AND PROVIDE ALL TEMPORARY UTILITIES REQUIRED TO PERFORM THE WORK INCLUDING BUT NOT LIMITED TO ELECTRICITY, LIGHTING, HEAT, VENTILATION, TELEPHONE SERVICE, WATER, SANITARY FACILITIES AND FIRE PROTECTION. CONTRACTOR SHALL COORDINATE THE LOCATION OF TEMPORARY FACILITIES WITH THE PROJECT MANAGER PRIOR TO THE COMMENCEMENT OF WORK.
2. THE CONTRACTOR SHALL SECURE, PROVIDE AND MAINTAIN ALL TEMPORARY TRAFFIC CONTROLS, BARRIERS, ENCLOSURES, FENCING, TARPAULINS, CANOPIES AND WATER CONTROLS REQUIRED TO SATISFACTORILY PERFORM THE WORK.
3. TEMPORARY FACILITIES AND SERVICES PROVIDED BY THE CONTRACTOR INCLUDE, BUT ARE NOT NECESSARILY LIMITED TO, ACCESS ROADS AND PARKING, DUST CONTROL AND SNOW REMOVAL.
4. ALL TEMPORARY UTILITIES AND CONTROLS SHALL BE SUBJECT TO THE PROJECT MANAGER'S ACCEPTANCE.
5. CONTRACTOR IS RESPONSIBLE FOR CLEANUP AND REPAIR OF ANY AND ALL DAMAGE CAUSED BY THE INSTALLATION OR USE OF TEMPORARY WORK.
6. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE SECURITY OF THE PROJECT MANAGER'S AND CONTRACTOR'S WORK AREAS, EQUIPMENT, MATERIALS, AND SUPPLIES.

SITE RESTORATION:

1. ALL AREAS DISTURBED DURING PERFORMANCE OF THE WORK SHALL BE RESTORED TO PRE-CONSTRUCTION CONDITIONS.
2. PROTECT ALL RESTORED AREAS FROM EROSION AND DAMAGE.
3. CONTRACTOR SHALL REPAIR OR REPLACE ANY RESTORED AREAS DAMAGED WITHIN 6 MONTHS OF PROJECT COMPLETION.
4. RESTORE ALL GRADES TO MAINTAIN EXISTING SURFACE WATER DRAINAGE PATTERNS.
5. RESTORE ASPHALT TO EXISTING THICKNESS WITH LIKE MATERIALS.
6. INSTALL ASPHALT IN ACCORDANCE WITH CURRENT NYSDOT STANDARD SPECIFICATIONS.
7. JOINTS BETWEEN EXISTING AND NEW ASPHALT SHALL BE SEALED WITH BITUMINOUS MATERIAL MEETING THE REQUIREMENTS OF NYSDOT SPECIFICATION SECTION 702-0700.
8. CAST-IN-PLACE CONCRETE SHALL BE NYSDOT CLASS E.
9. CONCRETE REINFORCING, IF NECESSARY, SHALL BE IN ACCORDANCE WITH ASTM A615 AND ASTM A185.
10. ALL CONCRETE SHALL BE PLACED IN ACCORDANCE WITH ACI 304.
11. PROTECT FRESHLY PLACED CONCRETE FROM TEMPERATURES BELOW 50 DEGREES FAHRENHEIT.
12. KEEP FRESHLY PLACED CONCRETE CONTINUOUSLY MOIST FOR NOT LESS THAN 72 HOURS OR CURE IN AN OTHERWISE APPROVED MANNER.
13. IMPORTED TOPSOIL SHALL BE ORGANIC LOAM, WELL DRAINED, HOMOGENOUS AND MEET THE FOLLOWING MINIMUM REQUIREMENTS:
    a. PH BETWEEN 4.5 AND 7
    b. FREE OF ANY VEGETATION, DEBRIS OR OTHER DELETERIOUS MATERIALS.
    c. FREE OF ANY STONES OR PARTICLES GREATER THAN 1-INCH.
14. PLACE 3" OF TOPSOIL ON EARTH FILL AND APPLY GRASS SEED AT A MINIMUM OF 3 POUNDS/1,000 SQUARE FEET. PROTECT NEWLY SEEDED AREAS FROM TRAFFIC AND EROSION. MAINTAIN ADEQUATE SOIL MOISTURE CONDITIONS UNTIL YOUNG PLANTS ARE WELL ESTABLISHED.
15. GRASS SEED SHALL BE A MIXTURE OF 30% ANNUAL RYEGRASS AND 70% PERENNIAL RYEGRASSES.
16. SOW GRASS SEED EVENLY BY HAND, HYDROSEED OR SEED SPREADER ON DRY OR MODERATELY DRY SOIL.
17. FERTILIZER SHALL BE A COMMERCIAL-GRADE 5-10-5 MIXTURE.
18. APPLY FERTILIZER IN ACCORDANCE WITH MANUFACTURER'S WRITTEN DIRECTIONS.
19. COVER THE SEEDED AREAS WITH A UNIFORM BLANKET OF STRAW MULCH AT THE RATE OF 100 POUNDS PER 1000 SQUARE FEET OF SEEDED AREA WITHIN ONE DAY AFTER SEEDING. IF CONTRACTOR CHOOSES TO PERFORM HYDROSEEDING, CONTRACTOR SHALL APPLY COLORED WOOD CELLULOSE FIBER PRODUCT SPECIFICALLY DESIGNED FOR USE AS A HYDRO-MECHANICAL APPLIED MULCH IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN INSTRUCTIONS AND RECOMMENDED RATES OF APPLICATION.

EXCAVATION:

1. CONTRACTOR SHALL PROVIDE ALL LABOR, EQUIPMENT, TOOLS, MATERIALS, AND SERVICES NEEDED TO EXCAVATE, HANDLE, TRANSPORT OR DISPOSE OF ANY AND ALL MATERIALS GENERATED DURING EXCAVATION OPERATIONS.
2. CONTRACTOR SHALL CONFINE EXCAVATION OPERATIONS TO THE IMMEDIATE WORK AREA. ALL WASTE MATERIALS SHALL BE PROMPTLY REMOVED FROM THE SITE.
3. PROVIDE WARNING SIGNS AND TRAFFIC CONTROL DEVICES TO PROTECT PEDESTRIANS AND MOTORISTS DURING DEWATERING OPERATIONS. DEWATERING PUMPS, POWER SUPPLY AND PIPING SHALL BE INSTALLED SO AS TO MINIMIZE DISRUPTION TO TRAFFIC.
4. EXCAVATION AND TRENCHING SHALL NOT BE PERFORMED UNTIL PUMP TEST RESULTS HAVE BEEN APPROVED BY THE PROJECT MANAGER.
5. ALL PAVED AREAS OUTSIDE THE IMMEDIATE WORK LIMITS MUST BE KEPT FREE OF MUD, SOIL OR OTHER DEBRIS CAUSED BY EXCAVATION OPERATIONS AT ALL TIMES.
6. CONTRACTOR SHALL STOCKPILE BORROWED MATERIALS AND SATISFACTORY EXCAVATED MATERIALS AT LOCATIONS DESIGNATED BY THE PROJECT MANAGER. MATERIALS SHALL BE STOCKPILED ON PLASTIC SHEETING WITHOUT INTERMIXING.
7. CONTRACTOR SHALL EMPLOY DUST CONTROL METHODS DURING EXCAVATION AND MATERIAL HANDLING OPERATIONS. STOCKPILES SHALL BE TARPED TO PREVENT WINDBLOWN DUST AND EROSION.
8. CONTRACTOR SHALL CLEARLY MARK ALL EXCAVATIONS PRIOR TO START OF WORK. CONTRACTOR SHALL CAREFULLY SAW CUT PAVED AREAS TO NEAT LINES. PERFORM EXCAVATIONS IN COMPLIANCE WITH OSHA GUIDELINES TO PROVIDE SAFE WORKING CONDITIONS. DO NOT UNDERMINE EXISTING PAVEMENT, WALKWAYS, LIGHT FIXTURES, UTILITIES OR OTHER STRUCTURES ADJACENT TO THE WORK AREA.
9. EXCAVATE TO REQUIRED SUB GRADE ELEVATIONS. PROTECT EXISTING DRAINAGE STRUCTURES, ELECTRICAL DISTRIBUTION CABLES AND OTHER UTILITIES WHICH MAY BE PRESENT IN THE WORK AREA.
10. NOTIFY PROJECT MANAGER WHEN EXCAVATIONS HAVE REACHED REQUIRED SUB GRADE. IF PROJECT MANAGER DETERMINES THAT UNSATISFACTORY BEARING CONDITIONS ARE PRESENT, CONTRACTOR SHALL CONTINUE EXCAVATION AND REPLACE WITH COMPACTED BACKFILL AS PER PROJECT MANAGER'S DIRECTIVE.

DEWATERING:

1. CONTRACTOR SHALL PROVIDE ALL LABOR, EQUIPMENT, TOOLS, MATERIALS, AND SERVICES NEEDED TO MAINTAIN A RELATIVELY DRY CONDITION IN ALL EXCAVATIONS AND TRENCHES.
2. WATER SHALL NOT BE DISCHARGED INTO OR THROUGH EXCAVATIONS.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL HANDLING AND DISPOSAL OF WATER REMOVED FROM EXCAVATIONS. EXCAVATION WATER DISPOSAL METHODS MUST BE APPROVED BY THE PROJECT MANAGER PRIOR TO DISPOSAL.
4. UPON COMPLETION OF DEWATERING OPERATIONS, CONTRACTOR SHALL POWER WASH OR OTHERWISE CLEAN ALL PAVED AREAS OF MUD, SOIL OR OTHER DEBRIS. ANY AND ALL PAVEMENT, MARKINGS, CURBS, PLANTINGS OR GRASSED AREAS DAMAGED OR OTHERWISE DISTURBED BY DEWATERING ACTIVITIES SHALL BE RESTORED TO PRE-EXISTING CONDITIONS AT THE CONTRACTOR'S EXPENSE.

BACKFILL:

1. ALL BACKFILL MATERIALS SHALL BE PROVIDED AND PLACED AS SPECIFIED ON THE DRAWINGS. NO STONE, PIPE BEDDING, EARTH, CONCRETE, TOPSOIL OR ASPHALT PAVING SHALL BE PLACED WITHOUT APPROVAL OF THE PROJECT MANAGER.
2. PROVIDE ADEQUATE ADVANCE NOTICE OF PLACEMENT OF BACKFILL MATERIALS TO THE ON-SITE PROJECT MANAGER TO ALLOW VISUAL OBSERVATION OF SUB GRADES, PIPING, CONDUITS, WELLS, EARTHEN FILL OR OTHER MATERIALS. DO NOT PLACE BACKFILL MATERIALS ON SURFACES THAT ARE MUDDY, FROZEN OR COVERED WITH ICE.
3. CONTRACTOR SHALL PLACE CLEAN EARTHEN FILL IN 6-INCH LIFTS AND COMPACT UNTIL CORRECT SUB GRADE ELEVATIONS ARE ACHIEVED IN NON-PAVED AREAS.
   CLEAN NATIVE SOIL REMOVED DURING EXCAVATION OR TRENCHING OPERATIONS MAY BE UTILIZED WITH PRIOR APPROVAL OF THE PROJECT MANAGER.
4. THE PROJECT MANAGER RESERVES THE RIGHT TO ORDER TESTING OF MATERIALS AT ANY TIME DURING THE WORK. SUCH TESTING WILL BE DONE BY A QUALIFIED, INDEPENDENT TESTING LAB. THE CONTRACTOR SHALL PAY FOR ALL COMPACTION TESTING PERFORMED BY THE TESTING LABORATORY.
5. CONTRACTOR SHALL FURNISH AND INSTALL "K-CRETE" BENEATH ALL PAVED AREAS. CONTRACTOR SHALL UTILIZE THE SERVICES OF A QUALIFIED INDEPENDENT TESTING LABORATORY TO COLLECT 4 CYLINDERS FOR EVERY DAY OF PLACEMENT. THE CONTRACTOR SHALL SUBMIT THE CYLINDERS FOR COMPRESSIVE STRENGTH TESTING AT 7, 14 AND 28-DAYS.
6. COMPACTION OF FILL MATERIALS BELOW PAVED AREAS MUST MEET THE REQUIREMENTS OF NYSDOT SPECIFICATION SECTION 203-3.12 MOST CURRENT REVISION. IMPROPERLY COMPACTED FILL MATERIALS SHALL BE REMOVED AND REPLACED AT THE CONTRACTOR'S EXPENSE.
7. IN NON-PAVED AREAS, PLACE CLEAN EARTHEN FILL IN 6 INCH LIFTS AND LIGHTLY COMPACT UNTIL CORRECT SUB GRADE ELEVATIONS ARE ACHIEVED. CLEAN NATIVE SOIL REMOVED DURING EXCAVATION OR TRENCHING OPERATIONS MAY BE UTILIZED WITH PRIOR APPROVAL OF THE PROJECT MANAGER.
8. WHERE SETTLING OF GRADED AREAS OCCURS PRIOR TO THE END OF THE PROJECT COMPLETION PERIOD, CONTRACTOR SHALL REMOVE FINISHED SURFACING, BACKFILL AND COMPACT AS REQUIRED WITH ADDITIONAL SOIL MATERIAL AND RECONSTRUCT SURFACING.
9. RESTORE APPEARANCE, QUALITY AND CONDITION OF ALL FINISHED SURFACES, PAVEMENT, AND WALKWAY AREAS TO MATCH EXISTING WORK. ELIMINATE EVIDENCE OF RESTORATION TO THE GREATEST EXTENT POSSIBLE. ALL UNSATISFACTORY OR DEFECTIVE WORK SHALL BE REMOVED AND REPLACED AT THE CONTRACTOR'S EXPENSE.

PLASTIC FORCE-MAIN PIPING:

1. PVC PIPING SHALL BE CUT, JOINED AND INSTALLED IN CONFORMANCE WITH THE MANUFACTURER'S WRITTEN DIRECTIONS. PVC PRESSURE PIPING SHALL BE SCHEDULE 80 CONFORMING TO ASTM D 1785.
2. ALL PVC PIPING SHALL BE HOMOGENOUS THROUGHOUT AND FREE OF VISIBLE CRACKS, HOLES, FOREIGN INCLUSIONS OR OTHER DELETERIOUS EFFECTS, AND SHALL BE UNIFORM IN COLOR, DENSITY, MELT INDEX AND OTHER PHYSICAL PROPERTIES.
3. PVC PRESSURE PIPING SHALL BE JOINED BY SOLVENT-WELD CONNECTIONS EXCEPT WHERE CONNECTING TO UNIONS, VALVES OR EQUIPMENT WITH THREADED CONNECTIONS THAT MAY REQUIRE FUTURE DISASSEMBLY.
4. SOCKET CONNECTIONS SHALL BE JOINED WITH PVC SOLVENT CEMENT CONFORMING TO ASTM D 2564. JOINTS SHALL BE PREPARED WITH PRIMERS CONFORMING TO ASTM F 656 PRIOR TO CEMENTING OR ASSEMBLY.
5. BURIED FLANGED OR THREADED CONNECTIONS SHALL NOT BE ALLOWED.
6. PVC FITTINGS SHALL BE SCHEDULE 80 CONFORMING TO ASTM D 2466 OR ASTM D 2467.
7. PIPING AND EQUIPMENT SHALL BE PROTECTED FROM DIRT, WATER AND DAMAGE PRIOR TO INSTALLATION.
8. ALL PIPE AND FITTINGS SHALL BE PRESSURE TESTED IN ACCORDANCE WITH ANSI/AWWA C605-05 PRIOR TO PLACING FILL OVER THE PIPE. ALL TESTING SHALL BE PERFORMED IN THE PRESENCE OF THE PROJECT MANAGER.
9. ALL PIPING SHALL BE OBSERVED IN PLACE BY THE PROJECT MANAGER PRIOR TO BACKFILLING. ANY PIPE BURIED WITHOUT APPROVAL OF THE PROJECT MANAGER SHALL BE UNCOVERED BY THE CONTRACTOR FOR OBSERVATION AT THE CONTRACTOR'S EXPENSE.

GROUNDWATER WELLS:

1. PUMPING WELLS SHALL BE INSTALLED IN CONFORMANCE WITH NYSDEC WATER WELL PROGRAM.
2. PERFORM PUMP TEST AT EW-1. EW-2 AND ASSOCIATED PIPING SHALL BE INSTALLED AS A CONTINGENCY BASED ON EW-1 PUMP TEST RESULTS.
3. CONTRACTOR SHALL PREPARE AND SUBMIT WELL CONSTRUCTION REPORTS AND WELL DEVELOPMENT REPORTS WITH FIELD MEASUREMENTS TO THE PROJECT MANAGER.
4. PUMPING WELL CASING SHALL BE SCHEDULE 40S STAINLESS STEEL CONFORMING TO ASTM A 312 / A312M WITH FLUSH THREADED JOINT FITTINGS.
5. PUMPING WELL SCREENS SHALL BE SCHEDULE 40S STAINLESS STEEL CONFORMING TO ASTM A 312 / A 312M. PROVIDE CONTINUOUS SLOT CONSTRUCTION, WIRE WOUND WITH FLUSH THREADED JOINT ENDS.
6. MONITORING WELL 775VMW-19 TO BE INSTALLED 1 MONTH PRIOR TO EXTRACTION WELL INSTALLATIONS. WELL TO BE CONSTRUCTED AS DESCRIBED IN THE "FINAL WORK PLAN PREDESIGN INVESTIGATIONS AT LANDFILL 6, BUILDING 817/WSA, BUILDING 775, AND AOC 9" (EEEPC 2006). SCREEN INTERVAL DEPTH TO BE 40 TO 60 FEET BGS.
7. CONTRACTOR SHALL PROVIDE 11B772-L-M LOCKS BY BEST ACCESS CO. FOR WELLS AND CONTROL PANEL ENCLOSURE. ALL LOCKS SHALL BE KEYED ALIKE WITH BX-1 CORE. CONTRACTOR SHALL PURCHASE LOCKS FROM THE GRIFFISS LOCAL DEVELOPMENT CORPORATION (CONTACT REGAN JOHNSON, 315-338-0393). CONTRACTOR SHALL PROVIDE PROJECT MANAGER WITH A COMPLETE SET OF KEYS.

SUBMERSIBLE PUMPS:

1. CONTRACTOR SHALL FURNISH AND INSTALL 4" DIAMETER 60 HZ STANDARD CAPACITY SUBMERSIBLE WELL PUMPS.
2. PUMPS SHALL BE CAPABLE OF CONTINUOUS OPERATION WITHIN THE WORKING LIMITS OF THE MOTOR AS RECOMMENDED BY THE MANUFACTURER.
3. PUMPS SHALL BE SUPPLIED WITH BUILT IN STAINLESS STEEL CHECK VALVE.
4. PUMP MOTOR SHALL BE NEMA RATED, CORROSION RESISTANT STAINLESS STEEL CONSTRUCTION WITH STAINLESS STEEL SPLINED SHAFT AND HERMETICALLY SEALED WINDINGS.
5. PROVIDE AND INSTALL PUMPS COMPLETE WITH ESSEX MODEL 2410 PUMP CONTROLLER AND SUBMERSIBLE PRESSURE TRANSDUCER TO TURN PUMPS ON AND OFF AT PROGRAMMABLE GROUNDWATER LEVELS.
6. PROVIDE AND INSTALL A STAINLESS STEEL PUMP RETRACTION CABLE. CABLE SHALL BE CAPABLE OF 3,600 LB WORKING LOAD. ATTACH THE CABLE TO THE PUMP. CABLE LENGTH SHALL BE A MINIMUM 10 FEET LONGER THAN FROM THE SUSPENDED PUMP TO THE WELL ENCLOSURE OR WELL HEAD. NEATLY COIL THE 10 FEET OF EXTRA CABLE INSIDE THE WELL ENCLOSURE OR WELL HEAD.

PUMP TESTING:

1. CONTRACTOR SHALL PERFORM PUMP TESTING AS DESCRIBED HEREIN TO VERIFY PUMP SELECTION AND DESIGN FLOW RATE.
2. AFTER PUMPING WELL COMPLETION, CONTRACTOR SHALL ALLOW 48 HOURS BEFORE DEVELOPING PUMPING WELLS. DEVELOP NEW WELLS UNTIL A TURBIDITY OF 50 NTU AND THE PH AND CONDUCTIVITY OF THE GROUNDWATER STABILIZE. A MINIMUM OF FIVE WELL VOLUMES SHALL BE REMOVED.
3. AFTER COMPLETION OF PUMPING WELL DEVELOPMENT, CONTRACTOR SHALL PERFORM PUMP TESTING TO DETERMINE THE WELL YIELD AND OPTIMUM PUMPING RATE AND VERIFY A RADIUS OF INFLUENCE TO CAPTURE GROUNDWATER WITHIN THE 50 UG/L CONTOUR PROVIDED ON SHEET 3. PUMP TESTING SHALL CONSIST OF A STEP TEST AND A CONSTANT-RATE TEST.

PUMP TESTING (CONTINUED):

4. GROUNDWATER LEVELS SHALL BE COLLECTED AT THE PUMPING WELL AND AT EXISTING MONITORING WELLS, INCLUDING 775VMW-4, 775VMW-28 AND 775VMW-10, AT A MINIMUM. THE USE OF PRESSURE TRANSDUCERS AND DATALOGGERS ARE ACCEPTABLE. THE FREQUENCY OF MEASUREMENT SHALL BE IN ACCORDANCE WITH TABLE 1 ON THIS SHEET. CONTRACTOR SHALL PERFORM WATER LEVEL MEASUREMENTS USING A PORTABLE WATER LEVEL INDICATOR AT A FREQUENCY OF AT LEAST ONCE PER HOUR TO CONFIRM DATA FROM TRANSDUCERS.
5. STEP TESTING SHALL BE PERFORMED BY PROGRESSIVELY INCREASING THE FLOW RATE AT 1-HOUR INTERVALS. STEP TESTING SHALL BE PERFORMED FOR FIVE STEPS, INCLUDING 5 GPM, 10 GPM, 15 GPM, 25 GPM AND 50 GPM. CONTRACTOR SHALL SUBMIT PLOTS OF DRAWDOWN-VERSUS-TIME ON A SEMILOGARITHMIC SCALE GRAPH FOR EACH STEP TO DETERMINE A FLOW RATE.
6. CONSTANT RATE PUMP TESTING SHALL BE PERFORMED AFTER THE PUMPING WELL HAS FULLY RECOVERED FROM THE STEP TEST. GROUNDWATER LEVEL MEASUREMENTS SHALL BE COLLECTED AT THE PUMPING WELL AND AT EXISTING MONITORING WELLS, INCLUDING 775VMW-4, 775VMW-28 AND 775VMW-10, AT A MINIMUM. THE FREQUENCY OF MEASUREMENT SHALL BE IN ACCORDANCE WITH TABLE 1 ON THIS SHEET. CONTRACTOR SHALL PERFORM WATER LEVEL MEASUREMENTS USING A PORTABLE WATER LEVEL INDICATOR AT A FREQUENCY OF AT LEAST ONCE PER HOUR TO CONFIRM DATA FROM TRANSDUCERS. THE FLOW RATE SHALL BE SELECTED BY THE PROJECT MANAGER.
7. CONSTANT RATE PUMP TESTING SHALL BE PERFORMED UNTIL A STRAIGHT-LINE TREND IS OBSERVED ON A PLOT OF DRAWDOWN-VERSUS- TIME ON A LOGARITHMIC SCALE. ASSUME A 72-HOUR PUMP TEST IS REQUIRED.
8. AFTER COMPLETION OF THE CONSTANT RATE PUMP TEST, RECORD RECOVERY DATA AT THE SAME TIME INTERVAL SPECIFIED ABOVE UNTIL APPROXIMATELY 90% RECOVERY.
9. IF A SUFFICIENT RADIUS OF INFLUENCE IS NOT ACHIEVED AT EW-1, CONTRACTOR SHALL INSTALL CONTINGENCY PUMPING WELL EW-2 AT THE LOCATION INDICATED AND PERFORM ADDITIONAL PUMP TESTING AS DESCRIBED IN NOTES 1-7 TO DETERMINE THE RADIUS OF INFLUENCE OF EW-2.
10. WATER GENERATED DURING PUMP TESTING SHALL BE HANDLED AS DIRECTED BY THE PROJECT MANAGER.
11. CONTRACTOR SHALL COORDINATE HANDLING AND DISCHARGE OF WATER GENERATED DURING PUMP TESTING WITH THE PROJECT MANAGER. CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING ANY TEMPORARY DISCHARGE PERMITS.

START-UP/BALANCING:

1. CONTRACTOR SHALL PERFORM START-UP TESTING AS RECOMMENDED BY EQUIPMENT MANUFACTURERS TO DEMONSTRATE THAT EQUIPMENT IS PROPERLY INSTALLED, READY FOR CONTINUOUS OPERATION AND IN COMPLIANCE WITH THE PROJECT REQUIREMENTS.

EFFLUENT METER:

1. CONTRACTOR SHALL PROVIDE AND INSTALL AN IN-LINE TURBINE TYPE EFFLUENT METER/TOTALIZER WITH ANALOG TYPE READOUT AT LOCATION INDICATED ON THE DRAWINGS.
2. CONTRACTOR SHALL PROVIDE AND INSTALL A NON-METALLIC LIGHTWEIGHT METER BOX WITH REMOVABLE LID AT THE LOCATION INDICATED ON THE DRAWINGS.

TABLE 1 – TIME INTERVALS FOR MEASURING DRAWDOWN

ELAPSED TIME SINCE START OR STOP OF TEST	INTERVALS BETWEEN MEASUREMENTS
0 – 5 SECONDS	0.5 SECONDS
5 – 20 SECONDS	1 SECOND
20 – 120 SECONDS	5 SECONDS
2 – 10 MINUTES	30 SECONDS
10 – 100 MINUTES	2 MINUTES
>100 MINUTES	5 MINUTES

MATERIALS – "K-CRETE" CONCRETE:

THE LIGHTWEIGHT CONCRETE AGGREGATE SHALL HAVE A SPECIFICATION CORRESPONDING TO THE FOLLOWING.

		PER CUBIC YARD	SSD WT	SOL. VOL		
CONCRETE CLASS:	PIPE BACKFILL	WATER	465	7.45	UNIT WT.:	129.27 PCF
W/C RATIO:	2.07	CEMENT	225	1.145	DESIGN STRENGTH	400 PSI
SUMP:	8-10"	AIR @ 6%		1.62		
PINE AGG NO.:	8-154F SP.GR. 2.65	PINE AGG (CORR SAND =85%	2359	14.226		
COARSE AGG No.:	8.9R.SP.GR:2.81	#1 STONE (SPLIT = 100%)	441	2.517		
		#2 STONE	0	0		
			3490	27.00 FT		

LEGEND:

SECTION LETTER OR DET NO.

B

SHT 5

DWG NO. ON WHICH SECTION OR DET APPEARS

SECTION DESIGNATION

Symbol	Description	Symbol	Description
OE	EXISTING OVERHEAD ELECTRIC LINE		EXISTING TREE LINE
X X	EXISTING FENCE LINE	470	TOPOGRAPHIC CONTOUR LINE (5 FOOT INTERVAL)
W	EXISTING WATER LINE		BUILDING LOCATION
S	EXISTING SANITARY DRAIN	775VMW-4	EXISTING MONITORING WELL
SS	EXISTING STORM DRAIN	EW-1	PROPOSED EXTRACTION WELL
	PROPOSED EXTRACTION WELL PIPING (FORCE MAIN)	775VMW-10	PERFORMANCE MONITORING WELL
	PROPOSED EXTRACTION WELL PIPING (FORCE MAIN) (CONTINGENCY)	775VMW-19R	PROPOSED PERFORMANCE MONITORING WELL TO BE INSTALLED
50 - - - - 50	MONITORING WELL TOTAL CHLORINATED VOC GROUNDWATER DATA IN μg/L FROM 2004 AND 2006		EXISTING POWER POLE
PL	PARCEL BOUNDARY	PERIMETER ROAD	EXISTING ROAD
			PROPOSED BOLLARD

ABBREVIATIONS:

A.C.	ASBESTOS CONCRETE	HZ	HERTZ	SOL. VOL	SOLID VOLUME
ACI	AMERICAN CONCRETE INSTITUTE	ID	INSIDE DIAMETER	SP. GR.	SPECIFIC GRAVITY
AFRPA	AIR FORCE REAL PROPERTY AGENCY	INV	INVERT	SSD	SATURATED SURFACE DRY
AGG	AGGREGATE	lb	POUND	SS	STAINLESS STEEL
ASME	AMERICAN SOCIETY OF MECHANICAL ENGINEERS	MAX	MAXIMUM	ST	STORM
		MH	MANHOLE	STM	STEAM
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	MIN	MINIMUM	TF	TOP OF FRAME
BGS	BELOW GROUND SURFACE	NEMA	NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION	TYP	TYPICAL
CB	CATCH BASIN			US	UNITED STATES
℄	CENTERLINE	NO	NUMBER	USACE	U.S. ARMY CORPS OF ENGINEERS
CONC.	CONCRETE	NTS	NOT TO SCALE		
EEEPC	ECOLOGY AND ENVIRONMENT ENGINEERING P.C.	NYCRR	NY CODES, RULES, AND REGULATIONS	W/	WITH
		NYSDOT	NYS DEPARTMENT OF TRANSPORTATION	W/C	WATER TO CEMENT
EL	ELEVATION	O.C.	ON CENTER	WT	WEIGHT
FT	FEET	OD	OUTSIDE DIAMETER	ø	DIAMETER
GAFB	GRIFFISS AIR FORCE BASE	OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	±	PLUS OR MINUS
GAL	GALLONS	PCF	POUNDS PER CUBIC FOOT	'	FEET
GLDC	GRIFFISS LOCAL DEVELOPMENT CORPORATION	PSI	POUNDS PER SQUARE INCH	"	INCHES
		PVC	POLYVINYL CHLORIDE	#	NUMBER
GPM	GALLONS PER MINUTE	PVMT	PAVEMENT	@	AT
HASP	HEALTH AND SAFETY PLAN	SCH	SCHEDULE	μg/L	MICROGRAMS PER LITER
		SHT	SHEET		

DWG NO.	DATE	DESCRIPTION

REFERENCE DRAWINGS

NO.	DATE	DWN	APP'D	DESCRIPTION
0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
F	2/27/08	WAB	DJM	ISSUED FOR REGULATORY REVIEW
E	12/13/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR AFRPA/USACE REVIEW
D	11/21/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR PARSONS REVIEW
C	9/20/07	KMK	DJM	ISSUED FOR REGULATORY REVIEW
B	7/16/07	KMK	DJM	ISSUED FOR FOR AFRPA/USACE REVIEW
A	6/12/07	KMK	DJM	ISSUED FOR 30% DESIGN FOR PARSONS REVIEW

REVISIONS

ecology and environment engineering p.c.

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JJ KOHLER	AM MURPHY P.E.
DRAWN BY	APPROVED BY
KM KRAJEWSKI/WA BAYLES	DJ MILLER P.E.

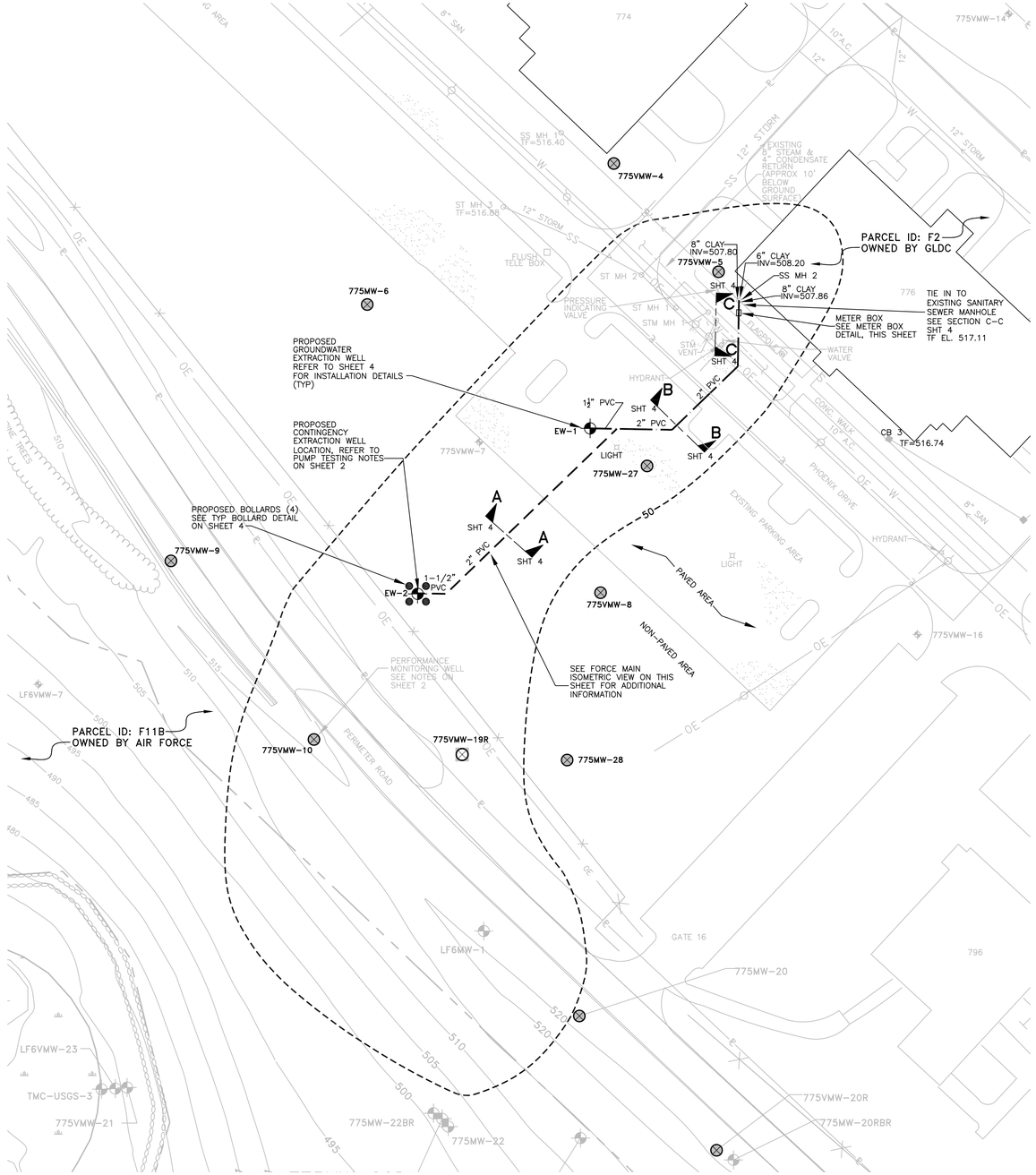
FORMER GRIFFISS AIR FORCE BASE

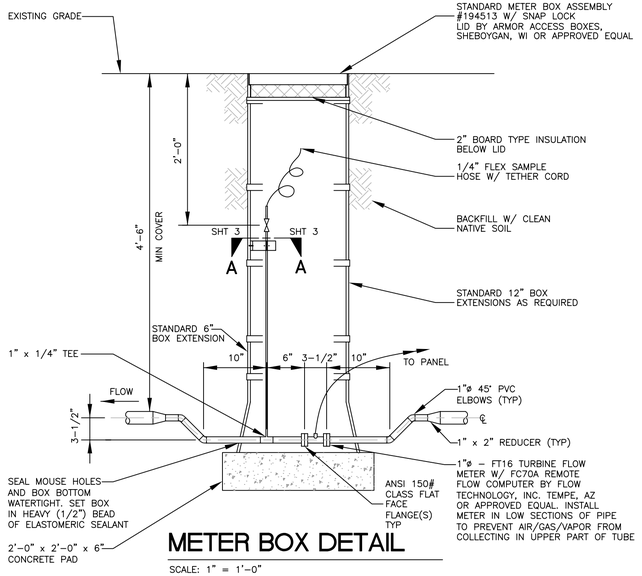
ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 775
GENERAL NOTES, LEGEND AND ABBREVIATIONS

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
NTS	6/12/07	Cover Sheet.dwg	Sheet 2 of 5	0

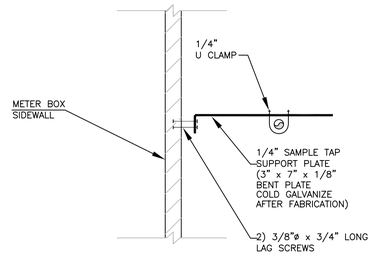
F:\Griffiss\2007 P&T\Building 775\Construction Issue\Cover Sheet.dwg
BUFFplot: 5/1/08 KMK





METER BOX DETAIL

SCALE: 1" = 1'-0"

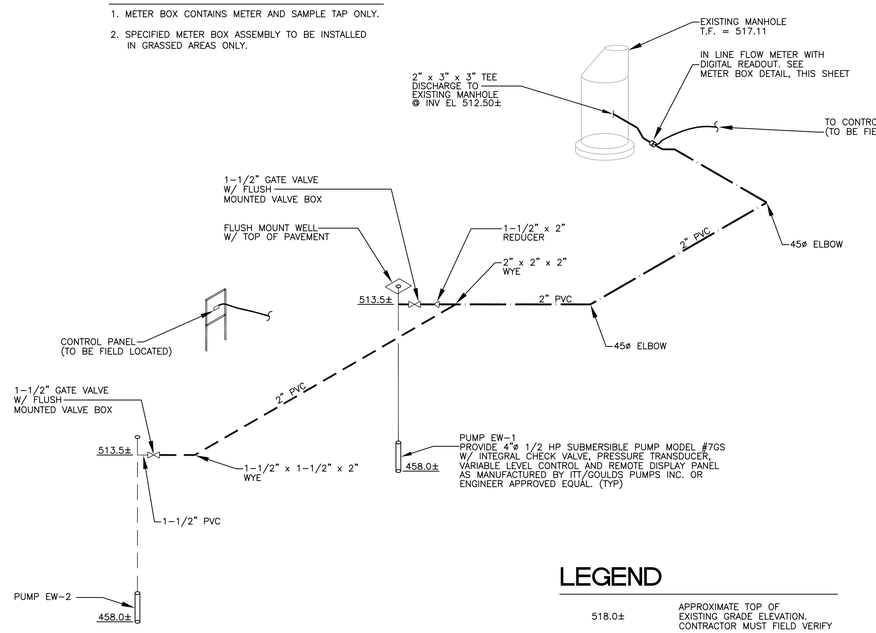


METER BOX SECTION A-A

SCALE: 6" = 1'-0"

NOTE:

1. METER BOX CONTAINS METER AND SAMPLE TAP ONLY.
2. SPECIFIED METER BOX ASSEMBLY TO BE INSTALLED IN GRASSED AREAS ONLY.



LEGEND

518.0±	APPROXIMATE TOP OF EXISTING GRADE ELEVATION. CONTRACTOR MUST FIELD VERIFY

FORCE MAIN ISOMETRIC VIEW

NOT TO SCALE

SCALE IN FEET

0 50 100 150

DWG NO.	DATE	DESCRIPTION
BL775_NEWMXD	3/14/07	PROPERTY OWNER INFO FROM CATHY JERRARD (AFRPA)
BL775_Feb27.shp	2/27/07	PARCEL BOUNDARY PER FPM GROUP
ACAD-04C02R0-FINAL	7/12/06	LF 6 SURVEY SUPPLIED BY LAFAVE, WHITE & MCGIVERN L.S.,P.C.
GR1216r-pn-17	9/1/98	SITE FEATURES SUPPLIED BY WOOLPERT CONSULTANTS
TOPO.DWG	2/11/99	BASE TOPOGRAPHY SUPPLIED BY WOOLPERT CONSULTANTS

REFERENCE DRAWINGS

NO.	DATE	DWN	APP'D	DESCRIPTION
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A	6/12/07	KMK	DJM	ISSUED FOR 30% DESIGN FOR PARSONS REVIEW

REVISIONS

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FORMER GRIFFISS AIR FORCE BASE

ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 775
EXTRACTION WELL PLAN

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
1"= 50'	6/12/07	3.dwg	Sheet 3 of 5	0

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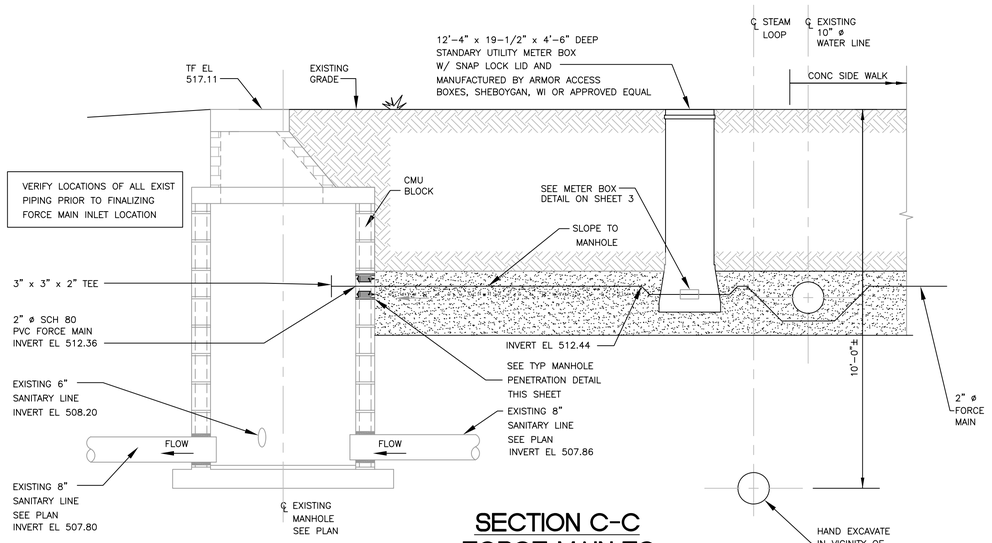
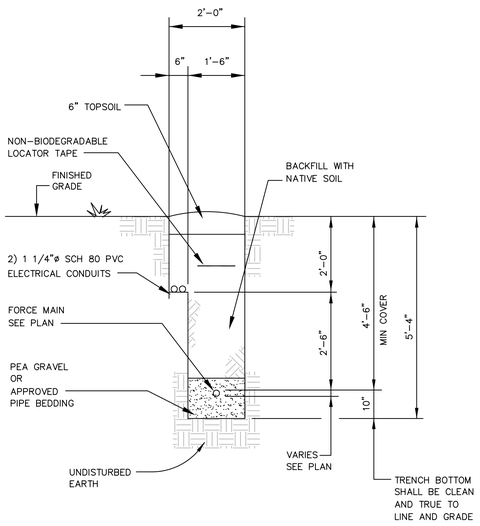
BUFFplot: 5/1/08 KMK



SECTION C-C FORCE MAIN TO EXISTING MANHOLE DETAIL

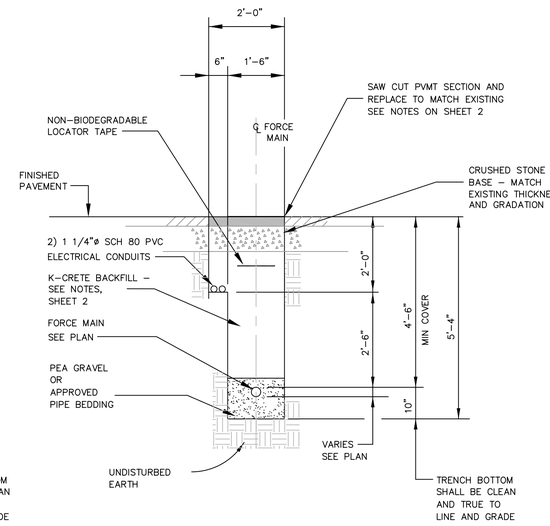
SCALE: 1/2" = 1'-0"

NOTE:
1. MANHOLE DIMENSIONS UNKNOWN. CONTRACTOR TO VERIFY ACTUAL DIMENSIONS.



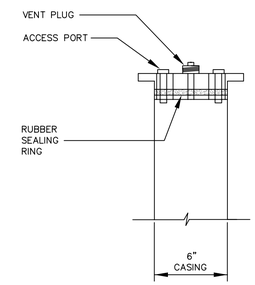
SECTION A-A

SCALE: 1/2" = 1'-0"



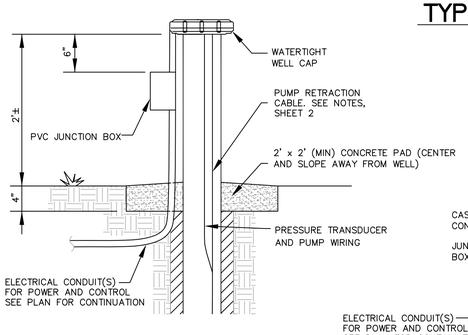
SECTION B-B

SCALE: 1/2" = 1'-0"



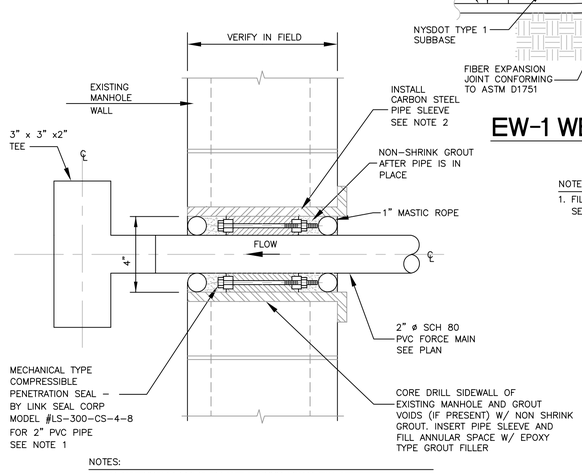
EW-1 WELL SEAL DETAIL

(WHEN SPECIFIED)



EW-2 WELL HEAD DETAIL

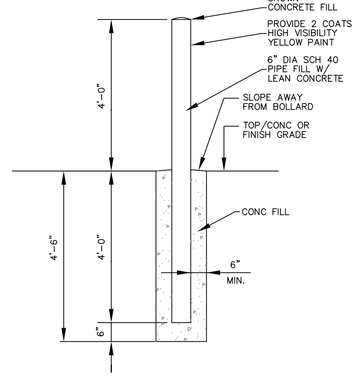
SCALE: 1" = 1'-0"



NOTES:
1. INSTALL COMPRESSIBLE SEAL IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS.
2. SLEEVE DIMENSIONS SHALL BE AS REQUIRED PER MFRS RECOMMENDATION FOR PIPE MATERIALS AND COMPRESSIBLE SEAL SPECIFIED.

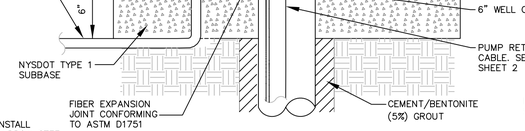
TYP MANHOLE PENETRATION DETAIL

SCALE: 3" = 1'-0"



TYP BOLLARD DETAIL

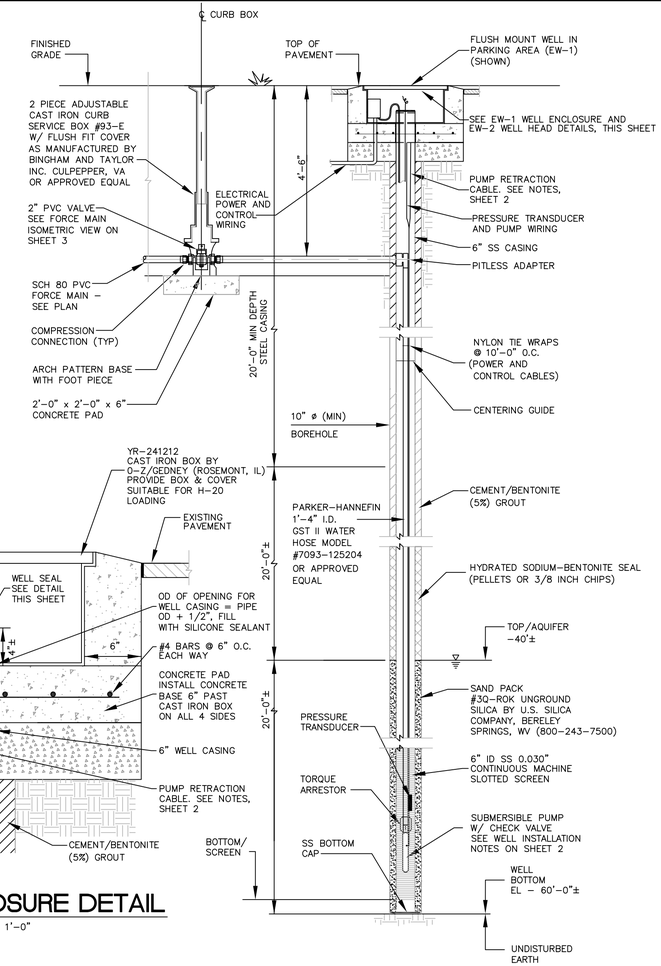
SCALE: 1/2" = 1'-0"



EW-1 WELL ENCLOSURE DETAIL

SCALE: 1-1/2" = 1'-0"

NOTE:
1. FILL VOIDS AT WELL ENCLOSURE WITH K-CRETE BACKFILL. SEE NOTES, SHEET 2.



TYP EXTRACTION WELL

SCALE: 1/2"= 1'-0"

APPROX WELL DEPTHS AND INTAKE INTERVALS

NORTHING	EASTING	WELL NUMBER AND LOCATION	APPROXIMATE DEPTH (ft bgs)	SCREEN LEVEL (ft bgs)	
				SCREEN TOP	SCREEN BOTTOM
1173031.89	1135795.07	EW-1	70	49	69
1172909.97	1135667.90	EW-2 (CONTINGENCY WORK)	60	34	59

DWG NO.	DATE	DESCRIPTION
07-E01-RO	10/9/07	SITE MAP OF BUILDING 775 AREA, LaFAVE, WHITE & McGIVERN, L.S., P.C.

REFERENCE DRAWINGS

NO.	DATE	DWN	APP'D	DESCRIPTION
0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
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REVISIONS

ecology and environment engineering p.c.

DESIGNED BY	CHECKED BY
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DRAWN BY	APPROVED BY
KM KRAJEWSKI/WA BAYLES	DJ MILLER P.E.

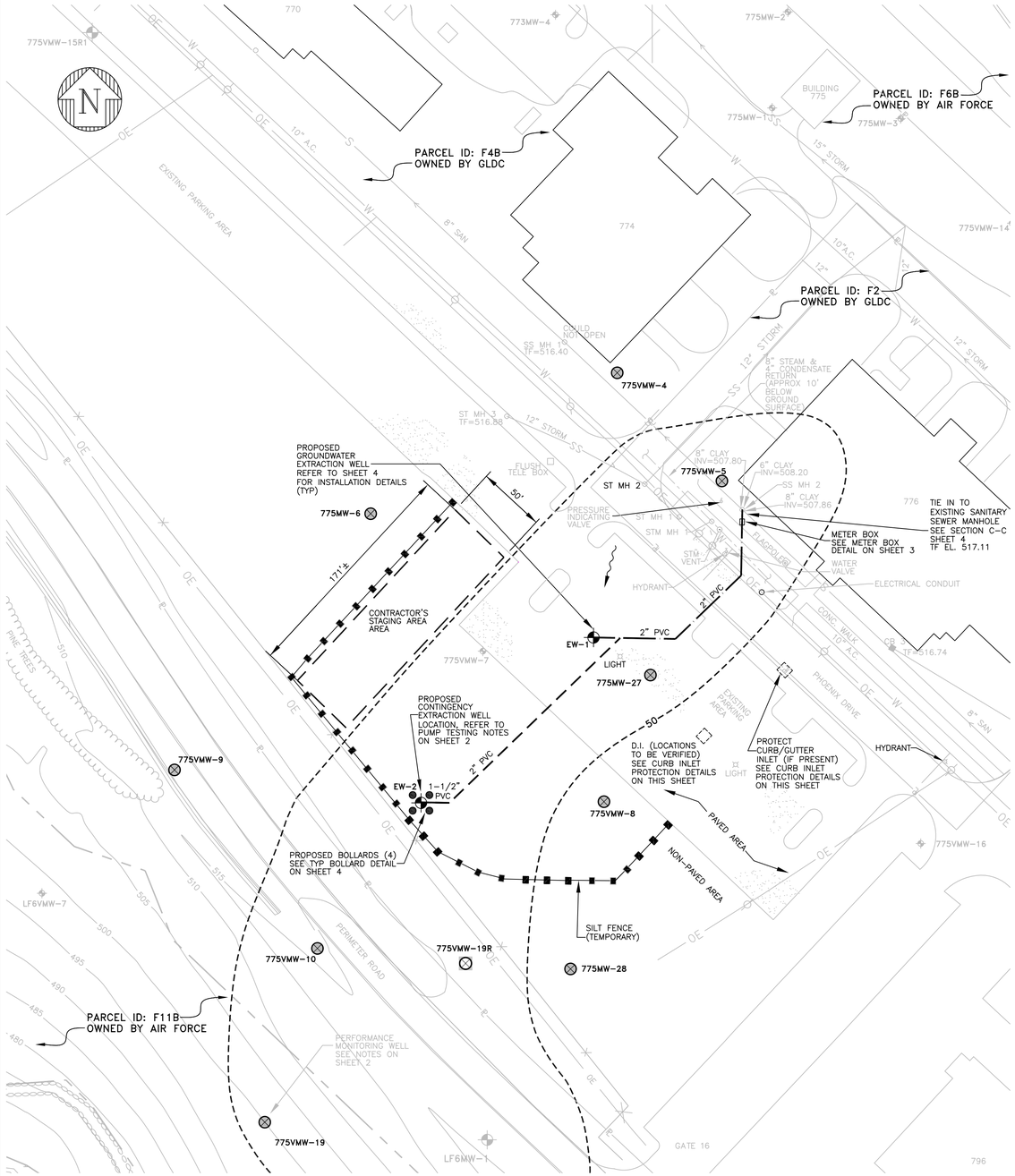
FORMER GRIFFISS AIR FORCE BASE

ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 775
SECTIONS AND DETAILS

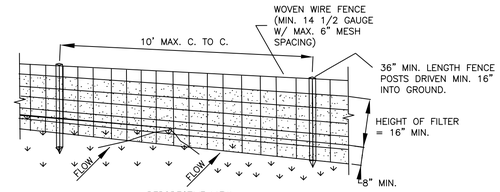
SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
NOTED	6/12/07	4.dwg	Sheet 4 of 5	0

F:\Griffiss\2007 P&T\Building 775\Construction Issue\4.dwg
BUFFplot: 5/1/08 KMK



LEGEND:

- FLOW DIRECTION
- SILT FENCE
- PROPOSED STAGING AREA
- LIMIT OF DISTURBED AREA

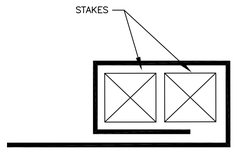


CONSTRUCTION SPECIFICATIONS

1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES. POSTS SHALL BE STEEL EITHER "T" OR "U" TYPE OR HARDWOOD.
2. FILTER CLOTH TO BE TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID SECTION. FENCE SHALL BE WOVEN WIRE, 12 1/2 GAUGE, 6" MAXIMUM MESH OPENING.
3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVER-LAPPED BY SIX INCHES AND FOLDED. FILTER CLOTH SHALL BE MIRAFI 100X OR APPROVED EQUIVALENT.
4. PREFABRICATED UNITS SHALL BE ENVIROFENCE OR APPROVED EQUIVALENT.
5. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

SILT FENCE

NOT TO SCALE



END STAKE

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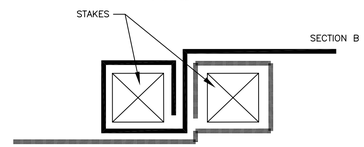
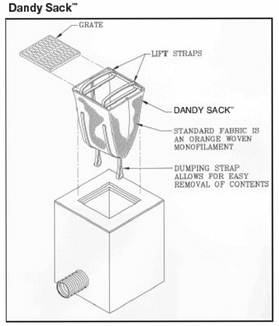


ADJOINING SECTIONS

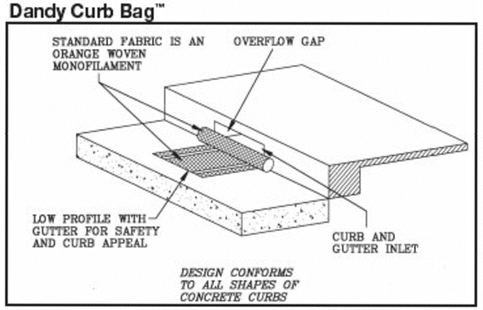
NOT TO SCALE

1. POSITION POSTS TO OVERLAP AS SHOWN ABOVE, MAKING CERTAIN THAT FABRIC FOLDS AROUND EACH POST AT LEAST ONE FULL TURN
2. DRIVE POSTS TIGHTLY TOGETHER AND SECURE TOPS OF POSTS BY TYING OFF WITH CORD OR WIRE TO PREVENT FLOW-THROUGH OF BUILT-UP SEDIMENT AT JOINT

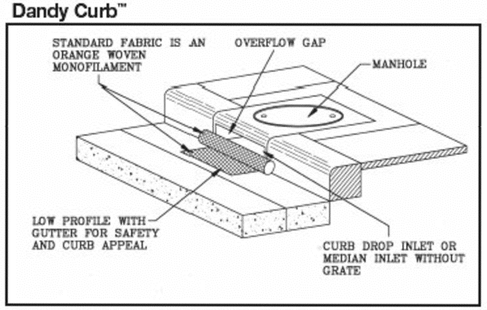
Dandy Sack™



Dandy Curb Bag™



Dandy Curb™



CONSTRUCTION SPECIFICATIONS

1. PRODUCT SHALL BE MIRAFI DANDY CURB BAG™, DANDY CURB™ OR DANDY SACK™ OR APPROVED EQUIVALENT TO FIT EXISTING SEWER INLET.
2. INSTALL PRODUCT PER MANUFACTURERS RECOMMENDATION IN INLETS THAT ACCEPT STORM WATER FROM DISTURBED PROJECT AREAS.
3. PERFORM OPERATION AND MAINTENANCE PER MANUFACTURERS RECOMMENDATION.

CURB INLET PROTECTION DETAILS

NOT TO SCALE

REFERENCE DRAWINGS

DWG NO.	DATE	DESCRIPTION
BL775_NEWMXD	3/14/07	PROPERTY OWNER INFO FROM CATHY JERRARD (AFRPA)
BL775_Feb27.shp	2/27/07	PARCEL BOUNDARY PER FPM GROUP
ACAD-04C02R0-FINAL	7/12/06	LF 6 SURVEY SUPPLIED BY LAFAVE, WHITE & MCGIVERN L.S.,P.C.
GR1216r-pn-17	9/1/98	SITE FEATURES SUPPLIED BY WOOLPERT CONSULTANTS
TOPO.DWG	2/11/99	BASE TOPOGRAPHY SUPPLIED BY WOOLPERT CONSULTANTS

REVISIONS

NO.	DATE	DWN	APP'D	DESCRIPTION
0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
F	2/27/08	WAB	DJM	ISSUED FOR REGULATORY REVIEW
E	12/13/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR AFRPA/USACE REVIEW
D	11/21/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR PARSONS REVIEW
C	9/20/07	KMK	DJM	ISSUED FOR REGULATORY REVIEW
B	7/16/07	KMK	DJM	ISSUED FOR FOR AFRPA/USACE REVIEW
A	6/12/07	KMK	DJM	ISSUED FOR 30% DESIGN FOR PARSONS REVIEW

ecology and environment engineering p.c.

DESIGNED BY	CHECKED BY
JJ KOHLER	AM MURPHY P.E.
DRAWN BY	APPROVED BY
KM KRAJEWSKI	DJ MILLER P.E.

FORMER GRIFFISS AIR FORCE BASE

ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 775
EROSION AND SEDIMENT CONTROL PLAN

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
NOTED	6/12/07	5.dwg	Sheet 5 of 5	0

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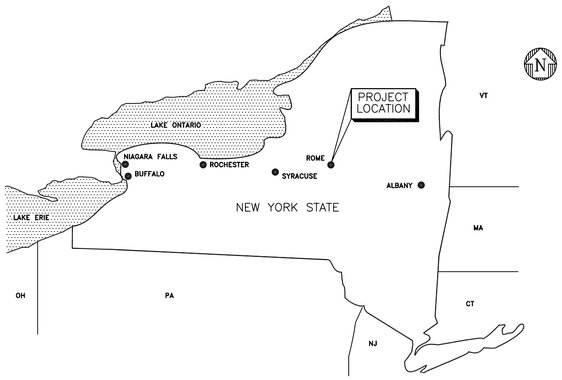
BUFFplot: 5/1/08 KMK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 817/WSA SITE
FORMER GRIFFISS AIR FORCE BASE
ROME, NEW YORK

MAY 2008



VICINITY MAP
NTS

US Army Corps
of Engineers

PARSONS *In Association with:*
FPM group

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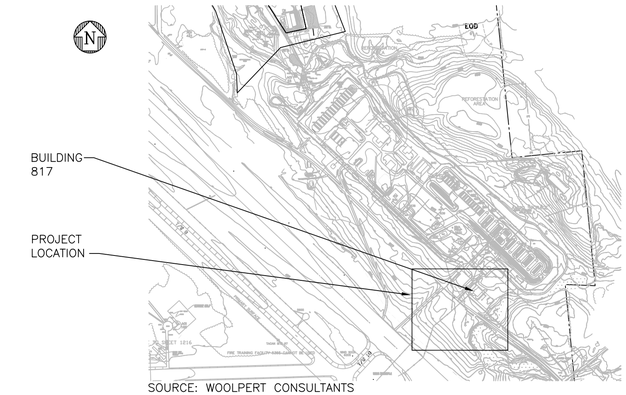

SITE LOCATION PLAN
1" = 1000'

LIST OF DRAWINGS

DWG. NO.	REV.	TITLE
1	F	COVER SHEET AND LIST OF DRAWINGS
2	C	NOTES, LEGEND AND ABBREVIATIONS
3	F	EXISTING SITE PLAN
4	F	PROPOSED SITE PLAN
5	C	SUBSTRATE SYSTEM SCHEMATIC

REFERENCE DRAWINGS

DWG NO.	DATE	DESCRIPTION
GR1216r-pn-17	9/1/98	SITE FEATURES SUPPLIED BY WOOLPERT CONSULTANTS
TOPO.DWG	2/11/99	BASE TOPOGRAPHY SUPPLIED BY WOOLPERT CONSULTANTS

REVISIONS

NO.	DATE	DWN	APP'D	DESCRIPTION
0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
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DESIGNED BY	CHECKED BY
KM POWELL	T HEINS P.E.
DRAWN BY	APPROVED BY
JJ KOHLER/KM KRAJEWSKI/WA BAYLES	DJ MILLER P.E.

FORMER GRIFFISS AIR FORCE BASE
ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 817/WSA
COVER SHEET AND LIST OF DRAWINGS

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
AS NOTED	6/12/07	Cover Sheet.dwg	Sheet 1 of 5	0

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BUFFplot: 5/1/08 KMK

NOTES:

GENERAL:

1. SUMMARY: THE BUILDING 817/WSA REMEDIATION WORK IS A SERIES OF VEGETABLE OIL INJECTIONS INTENDED TO ENHANCE BIODEGRADATION OF THE CONTAMINANTS OF CONCERN. THE PROJECT INCLUDES A PRIMARY VEGETABLE OIL INJECTION INTO A ROW OF EXISTING WELLS LOCATED NEAR THE UPGRADIENT PORTION OF THE PLUME. UP TO TWO SECONDARY VEGETABLE OIL INJECTION ROWS WILL BE USED IF DATA COLLECTED AFTER THE PRIMARY INJECTION INDICATES THEY ARE NEEDED. REFER TO THE "FINAL REMEDIAL DESIGN WORK PLAN" (EEEPC 2008) FOR ADDITIONAL INFORMATION.
2. UTILITY INFORMATION IS APPROXIMATE. VERIFY ALL UTILITIES, LOCATIONS, AND CONDITIONS WITH PROPERTY OWNERS PRIOR TO START OF FIELD ACTIVITIES.
3. PARCEL BOUNDARIES OBTAINED FROM AFRPA VIA FPM (MARCH 2007), AND WERE NOT VERIFIED IN THE FIELD.

HEALTH AND SAFETY:

1. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE HEALTH AND SAFETY OF ALL ON-SITE PERSONNEL.
2. THE CONTRACTOR SHALL DEVELOP AND IMPLEMENT A HASP IN ACCORDANCE WITH USACE EM 385-1-1 TO PROTECT ALL SITE PERSONNEL INCLUDING THOSE OF SITE VISITORS, BUILDING OWNERS, AND THE OWNER'S TENANTS.
3. THE CONTRACTOR'S HEALTH AND SAFETY PLAN MUST COMPLY WITH ALL APPLICABLE FEDERAL AND STATE REGULATIONS PROTECTING HUMAN HEALTH AND THE ENVIRONMENT.
4. THE CONTRACTOR SHALL NOT INITIATE ONSITE WORK UNTIL A HASP HAS BEEN ISSUED.

PERMITS/AGREEMENTS:

1. THE CONTRACTOR IS RESPONSIBLE FOR SECURING ALL REQUIRED APPLICATIONS, PERMITS, EASEMENTS, PERMISSIONS, APPROVALS, LETTERS, AGREEMENTS, RIGHTS OF WAY AND CERTIFICATIONS NECESSARY FOR THE COMPLETION OF THE WORK.
2. MANAGE STORMWATER IN ACCORDANCE WITH NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM GENERAL PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITIES (GP-02-01) OR MOST RECENT VERSION.

PROJECT COORDINATION:

1. CONTACT THE CITY OF ROME PUBLIC WORKS DEPARTMENT A MINIMUM OF 1 MONTH PRIOR TO INJECTION ACTIVITIES TO COORDINATE THE USE OF WATER FROM THE FIRE HYDRANT ON THE SOUTH SIDE OF PERIMETER ROAD (SEE SHEETS 3 AND 4 FOR APPROXIMATE LOCATION).
2. CONTACT GRIFFISS AIR FORCE PERSONNEL A MINIMUM OF 1 MONTH PRIOR TO INJECTION ACTIVITIES TO COORDINATE THE USE OF BUILDING 817 FOR THE STORAGE OF CHEMICALS.
3. CONTACT GRIFFISS AIRPARK FLIGHTLINE PERSONNEL A MINIMUM OF 1 MONTH PRIOR TO INJECTION ACTIVITIES TO COORDINATE ACCESS TO THE FLIGHTLINE FOR THE SECONDARY INJECTION EVENT.
4. THE CONTRACTOR SHALL COORDINATE WITH GRIFFISS AIRPARK FLIGHT PERSONNEL AND APPLICABLE PROPERTY OWNERS ON A DAILY BASIS TO OBTAIN ACCESS AND APPROVAL FOR WORK TO BE PERFORMED.
5. EEEPC SHALL NOT BE RESPONSIBLE FOR CONTRACTOR MEANS AND METHODS, INCLUDING DESIGN AND IMPLEMENTATION OF FUTURE CONTINGENCY MEASURES.

SURVEYS/AS-BUILT DRAWINGS/RECORD DOCUMENTS:

1. THE CONTRACTOR IS RESPONSIBLE FOR DEVELOPING RECORD AS-BUILT DRAWINGS AND MAINTAINING RECORDS OF FINAL INSPECTIONS, TREATMENT SYSTEM OPERATION, CHEMICAL DATA SHEETS, START-UP, MAINTENANCE, AND ENVIRONMENTAL MONITORING DURING TREATMENT SYSTEM START-UP. ALL RECORD DOCUMENTS, AS-BUILT DRAWINGS, AND SURVEYS SHALL BE CERTIFIED FOR ACCURACY BY PROJECT MANAGEMENT AND PROVIDED TO ECOLOGY AND ENVIRONMENT ENGINEERING P.C. OF LANCASTER, NEW YORK IN PREPARATION OF THE REMEDIAL ACTION REPORT.

TEMPORARY FACILITIES AND CONTROLS:

1. THE CONTRACTOR SHALL SECURE AND PROVIDE ALL TEMPORARY UTILITIES REQUIRED TO PERFORM THE WORK INCLUDING BUT NOT LIMITED TO ELECTRICITY, LIGHTING, HEAT, VENTILATION, TELEPHONE SERVICE, WATER, SANITARY FACILITIES AND FIRE PROTECTION. THE CONTRACTOR SHALL COORDINATE THE LOCATION OF TEMPORARY FACILITIES WITH GRIFFISS AIR FORCE PERSONNEL PRIOR TO COMMENCEMENT OF WORK.
2. THE CONTRACTOR SHALL SECURE, PROVIDE AND MAINTAIN ALL TEMPORARY TRAFFIC CONTROLS, BARRIERS, ENCLOSURES, FENCING, TARPAULINS, CANOPIES AND WATER CONTROLS REQUIRED TO SATISFACTORILY PERFORM THE WORK.
3. TEMPORARY FACILITIES AND SERVICES PROVIDED BY THE CONTRACTOR INCLUDE, BUT ARE NOT NECESSARILY LIMITED TO, ACCESS ROADS, PARKING, AND DUST CONTROL.
4. THE CONTRACTOR IS RESPONSIBLE FOR CLEANUP AND REPAIR OF ALL DAMAGE CAUSED BY THE INSTALLATION OR USE OF TEMPORARY FACILITIES.
5. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR THE SECURITY OF THE CONTRACTOR'S WORK AREAS, EQUIPMENT, MATERIALS, AND SUPPLIES.
6. THE CONTRACTOR SHALL DEVELOP AND IMPLEMENT A SPCC PLAN FOR ALL CHEMICALS STORED ON SITE IF REQUIRED BY FEDERAL OR STATE REGULATIONS.
7. THE PRODUCTS SPECIFIED HEREIN SHALL BE LEASED OR OWNED BY THE CONTRACTOR AND WILL NOT BECOME PROPERTY OF THE FORMER GRIFFISS AIR FORCE BASE. ALL PRODUCTS SPECIFIED HEREIN SHALL BE REMOVED FROM THE WORK SITE WHEN NO LONGER NEEDED.

SITE RESTORATION:

1. ALL AREAS DISTURBED DURING PERFORMANCE OF THE WORK, INCLUDING BUT NOT LIMITED TO ASPHALT, SHALL BE RESTORED TO PRE-CONSTRUCTION CONDITIONS.
2. PROTECT ALL RESTORED AREAS FROM EROSION AND DAMAGE UNTIL SURFACE IS STABILIZED.
3. CONTRACTOR SHALL REPAIR OR REPLACE ANY RESTORED AREAS DAMAGED WITHIN 6 MONTHS OF PROJECT COMPLETION.
4. RESTORE ALL GRADES TO MAINTAIN EXISTING SURFACE WATER DRAINAGE PATTERNS.
5. IMPORTED TOPSOIL SHALL BE ORGANIC LOAM, WELL DRAINED, HOMOGENOUS AND MEET THE FOLLOWING MINIMUM REQUIREMENTS:
   a. PH BETWEEN 4.5 AND 7
   b. FREE OF ANY VEGETATION (ESPECIALLY INVASIVE SPECIES), DEBRIS OR OTHER OBJECTIONABLE MATERIALS.
   c. FREE OF ANY STONES OR PARTICLES GREATER THAN 1".
6. IN AREAS OF SOIL DISTURBANCE, PLACE 3" OF TOPSOIL ON EARTH FILL AND APPLY GRASS SEED AT A MINIMUM OF 3 POUNDS/1,000 SQUARE FEET. PROTECT NEWLY SEEDED AREAS FROM TRAFFIC AND EROSION. MAINTAIN ADEQUATE SOIL MOISTURE CONDITIONS UNTIL YOUNG PLANTS ARE WELL ESTABLISHED.
7. GRASS SEED SHALL BE A MIXTURE OF 30% ANNUAL RYEGRASS AND 70% PERENNIAL RYEGRASSES.
8. SOW GRASS SEED EVENLY BY HAND, HYDROSEED OR SEED SPREADER ON DRY OR MODERATELY DRY SOIL.
9. FERTILIZER SHALL BE A COMMERCIAL-GRADE 5-10-5 MIXTURE.
10. APPLY FERTILIZER IN ACCORDANCE WITH MANUFACTURER'S WRITTEN DIRECTIONS.

PRODUCTS AND EQUIPMENT:

1. THE INJECTION SYSTEM SHALL BE CAPABLE OF PUMPING A MINIMUM OF 40 GPM.
2. THE MIXING AND INJECTION SYSTEM PIPING SHALL BE HDPE. ALL EQUIPMENT, PIPING, VALVES, ETC., SHALL BE CHEMICALLY RESISTANT TO THE SUBSTRATE USED DURING INJECTION ACTIVITIES.
3. VALVES, CHECK VALVES, ETC. NOT SHOWN ON SHEET 5 FOR CLARITY (INSTALL AS REQUIRED).
4. INJECTION MIXTURE SHALL CONSIST OF 100% VEGETABLE OIL (CENTROMIX® WD, A SOY LECITHIN PRODUCT MANUFACTURED BY CENTRAL SOYA COMPANY, INC.), PH BUFFER PRODUCT (NEUTRAL ZONE ™ MANUFACTURED BY REMEDIATION AND NATURAL ATTENUATION SERVICES), AND MAKE-UP WATER. SEE TABLE 1 ON SHEET 5 FOR VOLUMES. OBTAIN CHEMICAL DATA SHEETS FROM THE MANUFACTURER AND SUBMIT AS SPECIFIED IN SURVEYS/AS-BUILT DRAWINGS/RECORD DOCUMENTS NOTE 1. MAKE-UP WATER SHALL BE OBTAINED FROM FIRE HYDRANT ON SOUTH SIDE OF PERIMETER ROAD (SEE SHEETS 3 AND 4 FOR APPROXIMATE LOCATION). CONTRACTOR SHALL COORDINATE WATER DISTRIBUTION WITH UTILITY PERSONNEL PRIOR TO INJECTION ACTIVITIES.

QA/QC:

1. DURING THE INJECTION EVENT, PRESSURES, FLOWRATES, SUBSTRATE VOLUMES, INJECTION WELL SEALS, AND NEARBY MONITORING WELLS AND MANHOLES SHALL BE MONITORED. INJECTION PRESSURES AND FLOWRATES SHALL NOT EXCEED VALUES LISTED IN TABLE 1 ON SHEET 5. SEE EXECUTION NOTE 11 FOR ADDITIONAL INSTRUCTIONS. INJECTION WELL SEALS SHALL BE VISUALLY INSPECTED TO ENSURE THAT THE SEAL HAS NOT BEEN COMPROMISED DURING OPERATION. MONITOR WATER LEVELS AT B817-MW1, -MW2, AND -MW3 FOR MOUNDING. IF SIGNIFICANT MOUNDING OCCURS (NOT TO EXCEED THE TOP OF THE UNSATURATED ZONE RESULTING IN DAYLIGHTING OF THE SUBSTRATE), REDUCE FLOWRATES TO LIMIT THE MOUNDING. NEARBY DOWNGRADIENT WELLS SHALL BE VISUALLY MONITORED TO CHECK FOR SUBSTRATE BREAKTHROUGH USING DEDICATED CLEAR BAILERS. THE PRESENCE OF SUBSTRATE WILL BE EVIDENCED BY THE COLOR YELLOW. A POTENTIAL PREFERENTIAL PATHWAY (E.G., UNDERGROUND UTILITY CORRIDOR) EXTENDS FROM BUILDING 817 AND ACROSS PERIMETER ROAD. OBSERVE THE THREE MANHOLES IN THE AREA OF THE UNDERGROUND UTILITY CORRIDOR (MH-1, MH-2, AND MH-3) DURING THE INJECTION EVENT FOR THE PRESENCE OF SUBSTRATE. IF SUBSTRATE IS OBSERVED IN THE MANHOLES, DISCONTINUE INJECTION ACTIVITIES AND MONITOR DOC LEVELS. IF TARGET DOC CONCENTRATIONS ARE MET, CONTINUE INJECTION. IF TARGET DOC CONCENTRATIONS ARE NOT MET, DISCUSS FURTHER ACTION WITH PROJECT TEAM.

EXECUTION:

1. PRIMARY INJECTION SHALL BE PERFORMED IN EXISTING WELLS INCLUDED IN TABLE 1 ON SHEET 5. SECONDARY INJECTION EVENT SHALL BE PERFORMED AS NEEDED BASED ON CRITERIA DESCRIBED IN THE "FINAL REMEDIAL DESIGN WORK PLAN" (EEEPC 2008). DETAILS FOR SECONDARY INJECTION TBD.
2. PERFORM A FALLING-HEAD SLUG TEST AT WELLS WSA-MW8 AND WSA-MW18 FOR THE PRIMARY INJECTION WITHIN 1 MONTH PRIOR TO INJECTION ACTIVITIES AND DURING INJECTION ACTIVITIES. IF THE SECONDARY INJECTION IS REQUIRED, SLUG TESTING WILL BE COMPLETED DURING THE NEXT REGULARLY SCHEDULED SAMPLING EVENT AFTER THE INJECTION ACTIVITY. THE FALLING-HEAD SLUG TEST INVOLVES DISPLACING THE WATER IN THE WELLS BY INSERTING A SOLID SLUG OF KNOWN VOLUME. DATA COLLECTION TO COMMENCE AT THE TIME OF SLUG INSERTION USING A PRESSURE TRANSDUCER/DATA LOGGER OR ELECTRONIC TAPE WATER LEVEL READER. COLLECT WATER LEVEL MEASUREMENTS AT PREDETERMINED TIME INTERVALS ON AN APPROXIMATE LOGARITHMIC SCALE AS THE WATER LEVEL RETURNS TO ITS INITIAL STATIC LEVEL. THE SLUG TEST WILL BE COMPLETE WHEN THE WATER LEVEL HAS RETURNED TO WITHIN AT LEAST 10% OF STATIC CONDITIONS OR A SUFFICIENT NUMBER OF READINGS HAVE BEEN MADE TO CLEARLY SHOW A TREND ON A SEMI-LOG PLOT OF TIME VERSUS DEPTH. DATA SHALL BE INTERPRETED BY THE BOWER AND RICE METHOD FOR UNCONFINED AQUIFERS, OR EQUIVALENT. THE SLUG WILL THEN BE REMOVED AND THE WATER LEVEL MONITORING PROCESS WILL BE REPEATED AS THE WATER LEVEL RISES.
3. CONTACT "DIG SAFELY NEW YORK" TO LOCATE UNDERGROUND UTILITIES PRIOR TO INJECTION ACTIVITIES. REGULATIONS PERTAINING TO THE PROTECTION OF UNDERGROUND FACILITIES IN NEW YORK STATE ARE GOVERNED BY NEW YORK CODES, RULES, AND REGULATIONS. HOWEVER, OTHER PRIVATELY OWNED UTILITIES AT THE SITE MAY EXIST THAT ARE NOT MEMBERS OF THE UTILITY LOCATOR SERVICE. COORDINATE ALL INTRUSIVE WORK WITH THE PROPERTY OWNER(S) TO IDENTIFY ANY OTHER POTENTIAL PRIVATELY OWNED UTILITIES PRESENT IN THE REMEDIAL CONSTRUCTION AREA.
4. STORE MATERIAL AND EQUIPMENT IN BUILDING 817, SEE PROJECT COORDINATION NOTE 2.
5. STORE BULK CHEMICALS UNDER COVER WHEN NOT IN USE AND IN ACCORDANCE WITH MANUFACTURER'S DIRECTIONS AND THE SITE'S SPCC PLAN (IF APPLICABLE).
6. CONTAINERIZE WASTE MATERIAL FROM THE SITE DAILY AND DISPOSE OF APPROPRIATELY.
7. PROTECT THE HOSE THAT WILL DELIVER WATER FROM THE NEARBY FIRE HYDRANT FROM VEHICULAR TRAFFIC ON PERIMETER ROAD.
8. PREPARE INJECTION MIXTURE (COMPRISED OF MAKE-UP WATER, VEGETABLE OIL, AND PH BUFFER) IN THE FIELD USING A STATIC-IN-LINE MIXER AS SHOWN ON SHEET 5. INJECT MIXTURE VOLUME CONTINUOUSLY UNTIL TOTAL VOLUME INJECTED.
9. THE NUMBER AND SEQUENCE OF WELLS TO BE INJECTED AT THE SAME TIME TBD IN THE FIELD.
10. INITIAL FLOW RATES OF THE SUBSTRATE INJECTION SHALL BE LESS THAN THE FLOW RATES PRESENTED IN TABLE 1 ON SHEET 5 FOR EACH INJECTION WELL TO ENSURE THAT ALL ASPECTS OF THE SYSTEM ARE IN PROPER WORKING ORDER. SYSTEM PRESSURES SHALL NOT EXCEED OVERBURDEN PRESSURES PRESENTED IN TABLE 1 ON SHEET 5. ADJUST FLOW RATES AS NEEDED TO REDUCE PRESSURES. AFTER SYSTEM INITIALIZED, FLOW RATES CAN BE INCREASED, HOWEVER THEY SHALL NOT EXCEED VALUES LISTED IN TABLE 1 ON SHEET 5.
11. AFTER THE SUBSTRATE VOLUME HAS BEEN INJECTED INTO THE SUBSURFACE, STOP THE SUBSTRATE FLOW AND REDUCE SYSTEM PRESSURE TO ZERO PRIOR TO DISCONNECTING ANY INJECTION LINE.
12. CONDUCT PERFORMANCE MONITORING ACCORDING TO "FINAL REMEDIAL DESIGN WORK PLAN" (EEEPC 2008).

LEGEND:

- ABANDONED UNDERGROUND ELECTRIC
- 2623 — BUILDING LOCATION
- WL / WL — DELINEATED WETLANDS
- EXISTING RAILROAD TRACK
- X — X — FENCE LINE
- UE — UNDERGROUND ELECTRIC LINE
- OE — OVERHEAD ELECTRIC LINE
- S — SANITARY SEWER
- 480 — TOPOGRAPHIC CONTOUR LINE (5 FOOT INTERVAL)
- TREE OR TREE LINE
- W — WATER LINE
- LINE OF SUBSTRATE INJECTION POINT FOR SECONDARY INJECTION (NUMBER OF WELLS TBD)
- 600 — — — — — — — 600 — MONITORING WELL TOTAL CHLORINATED VOC GROUNDWATER DATA IN ug/L FROM 2004 AND 2006
- PL — / — PL — PARCEL BOUNDARY OUTSIDE AREA OF CONCERN/ PARCEL BOUNDARY INSIDE AREA OF CONCERN
- WSA-MW13Br — BEDROCK MONITORING WELL SAMPLED IN 2004
- WSA-MW11 — EXISTING MONITORING WELL
- WSATW-5 — SUPPLEMENTAL INVESTIGATION TEMPORARY WELL LOCATION
- MH — EXISTING MANHOLE
- B817IW-8 / B817IW-8 — EXISTING INJECTION WELL/EXISTING INJECTION WELL TO BE RE-USED
- WSA-MW21 — INJECTION AND PERFORMANCE MONITORING WELL
- WSA-SW1PW — SURFACE WATER SAMPLE LOCATION
- BALL VALVE
- DOSIMETER
- PRESSURE GAUGE

ABBREVIATIONS:

AFRPA	AIR FORCE REAL PROPERTY AGENCY	ID	IDENTIFICATION	SPCC	SPILL PREVENTION, CONTROL, AND COUNTERMEASURE
BGS	BELOW GROUND SURFACE	MH	MANHOLE	TBD	TO BE DETERMINED
EEEPC	ECOLOGY AND ENVIRONMENT ENGINEERING, P.C.	ND	NON DETECT	USACE	UNITED STATES ARMY CORPS OF ENGINEERS
DOC	DISSOLVED ORGANIC CARBON	NTS	NOT TO SCALE	'	FEET
GPM	GALLONS PER MINUTE	PL	PROPERTY LINE	"	INCHES
HDPE	HIGH DENSITY POLYETHYLENE	PSI	POUNDS PER SQUARE INCH	µg/L	MICROGRAMS PER LITER
HASP	HEALTH AND SAFETY PLAN	QA/QC	QUALITY ASSURANCE/QUALITY CONTROL	±	PLUS OR MINUS

DWG NO.	DATE	DESCRIPTION (REFERENCE DRAWINGS)	NO.	DATE	DWN	APP'D	DESCRIPTION (REVISIONS)
			0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
			C	2/27/08	WAB	DJM	ISSUED FOR REGULATORY REVIEW
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ecology and environment engineering p.c.

DESIGNED BY	CHECKED BY
KM POWELL	T HEINS PE
DRAWN BY	APPROVED BY
KM KRAJEWSKI/WA BAYLES	DJ MILLER PE

FORMER GRIFFISS AIR FORCE BASE

ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN BUILDING 817/WSA NOTES, LEGEND AND ABBREVIATIONS

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
NTS	11/21/07	1.dwg	Sheet 2 of 5	0

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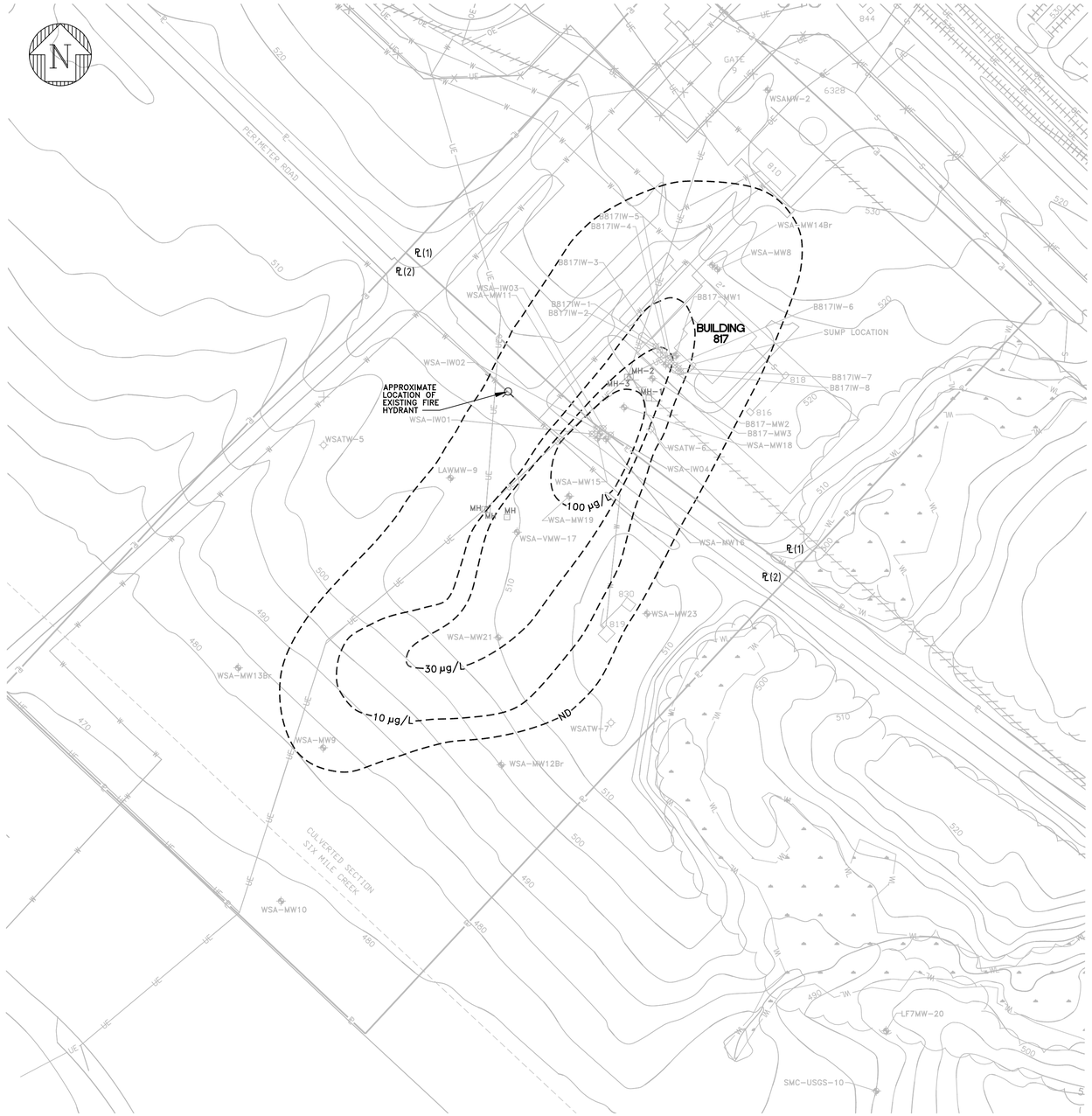
BUFFplot: 5/1/08 KMK



℄(1) PARCEL ID: F10C
OWNED BY AIR FORCE

℄(2) PARCEL ID: A5
OWNED BY AIR FORCE
LEASED TO ONEIDA COUNTY

SCALE IN FEET
0 100 200 300

DWG NO.	DATE	DESCRIPTION
B817_NEWMXD	3/14/07	PROPERTY OWNER INFO FROM AFRPA
B817_Feb27.shp	2/27/07	PARCEL BOUNDARY PER FPM GROUP
F06_VR_WT-ARS	11/1/06	WETLANDS DELINEATION PER ECOLOGY AND ENVIRONMENT, INC.
GR1216r-pn-17	9/1/98	SITE FEATURES SUPPLIED BY WOOLPERT CONSULTANTS
TOPO.DWG	2/11/99	BASE TOPOGRAPHY SUPPLIED BY WOOLPERT CONSULTANTS

REFERENCE DRAWINGS

NO.	DATE	DWN	APP'D	DESCRIPTION
0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
F	2/27/08	WAB	DJM	ISSUED FOR REGULATORY REVIEW
E	12/13/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR AFRPA/USACE REVIEW
D	11/21/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR PARSONS REVIEW
C	9/20/07	KMK	DJM	ISSUED FOR REGULATORY REVIEW
B	7/16/07	KMK	DJM	ISSUED FOR FOR AFRPA/USACE REVIEW
A	6/12/07	KMK	DJM	ISSUED FOR 30% DESIGN FOR PARSONS REVIEW

REVISIONS

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DRAWN BY	APPROVED BY
KM KRAJEWSKI/WA BAYLES	DJ MILLER PE

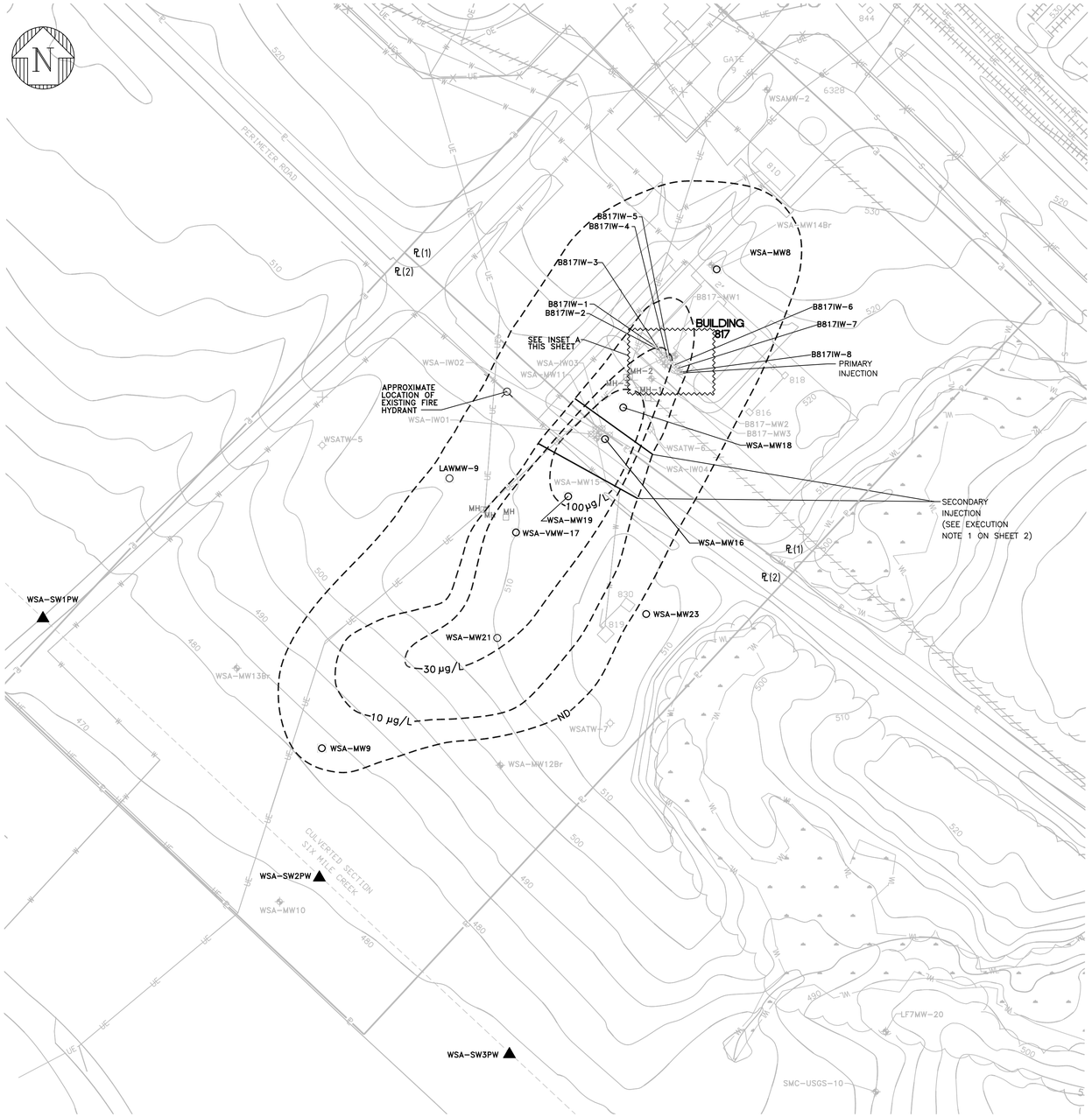
FORMER GRIFFISS AIR FORCE BASE

ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 817/WSA
EXISTING SITE PLAN

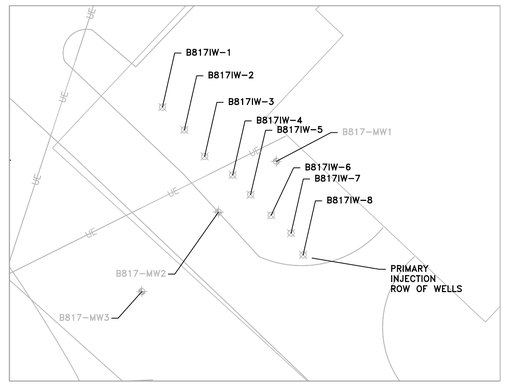
SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
1"=100'	6/12/07	2.dwg	Sheet 3 of 5	0

F:\Griffiss\2007 P&T\Building 817\Construction Issue\3.dwg
BUFFplot: 5/1/08 KMK



℄(1) PARCEL ID: F10C
OWNED BY AIR FORCE

℄(2) PARCEL ID: A5
OWNED BY AIR FORCE
LEASED TO ONEIDA COUNTY



INSET A

SCALE: 1" = 20'-0"

SCALE IN FEET

0 20 40 60

SCALE IN FEET

0 100 200 300

REFERENCE DRAWINGS

DWG NO.	DATE	DESCRIPTION
B817_NEWMXD	3/14/07	PROPERTY OWNER INFO FROM AFRPA
B817_Feb27.shp	2/27/07	PARCEL BOUNDARY PER FPM GROUP
F06_VR_WT-ARS	11/1/06	WETLANDS DELINEATION PER ECOLOGY AND ENVIRONMENT, INC.
GR1216r-pn-17	9/1/98	SITE FEATURES SUPPLIED BY WOOLPERT CONSULTANTS
TOPO.DWG	2/11/99	BASE TOPOGRAPHY SUPPLIED BY WOOLPERT CONSULTANTS

REVISIONS

NO.	DATE	DWN	APP'D	DESCRIPTION
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E	12/13/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR AFRPA/USACE REVIEW
D	11/21/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR PARSONS REVIEW
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B	7/16/07	KMK	DJM	ISSUED FOR FOR AFRPA/USACE REVIEW
A	6/12/07	KMK	DJM	ISSUED FOR 30% DESIGN FOR PARSONS REVIEW

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KM KRAJEWSKI/WA BAYLES	DJ MILLER PE

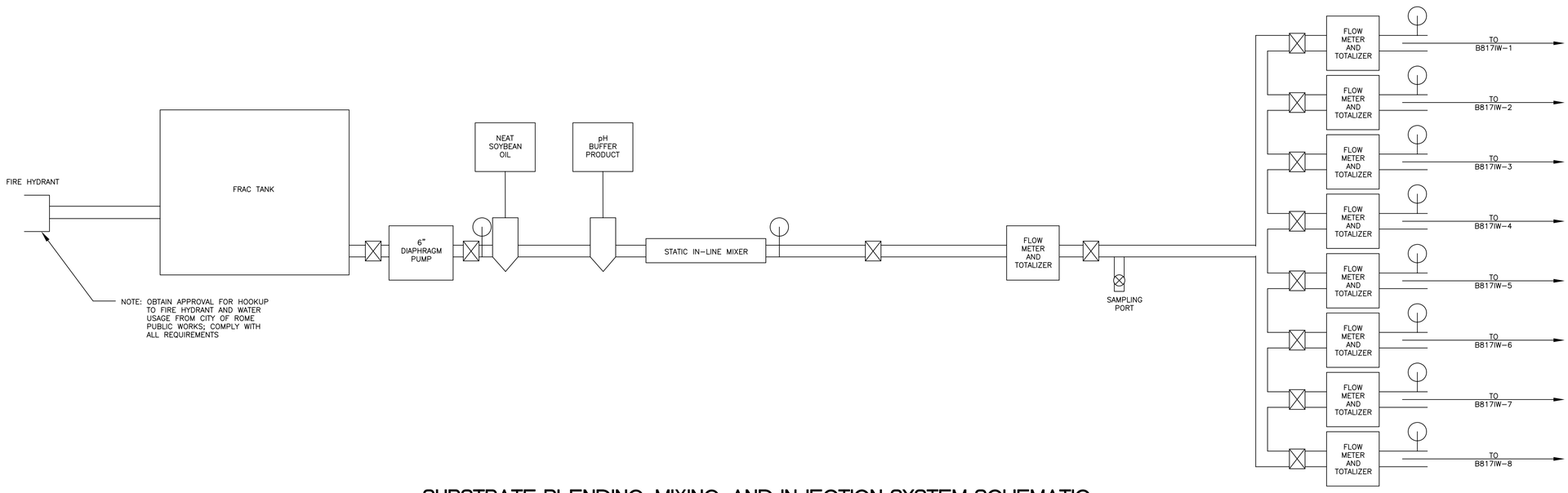
FORMER GRIFFISS AIR FORCE BASE

ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 817/WSA
PROPOSED SITE PLAN

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
1"=100'	6/12/07	3.dwg	Sheet 4 of 5	0

F:\Griffiss\2007 P&T\Building 817\Construction Issue\4.dwg
BUFFplot: 5/1/08 KMK



SUBSTRATE BLENDING, MIXING, AND INJECTION SYSTEM SCHEMATIC (PRIMARY INJECTION SHOWN)

NOT TO SCALE

NOTE: THE NUMBER AND SEQUENCE OF WELLS TO BE INJECTED AT THE SAME TIME TBD IN THE FIELD.

TABLE 1–SUBSTRATE MIXTURE AND INJECTION VOLUME

INJECTION WELL NO.	SCREEN INTERVAL (FEET BGS)	NEAT SOYBEAN OIL VOLUME (GALLONS)	pH BUFFER PRODUCT VOLUME (GALLONS)	MAKE-UP WATER VOLUME (GALLONS)	TOTAL SUBSTRATE VOLUME (GALLONS)	MAXIMUM OVERBURDEN PRESSURE (PSI)	MAXIMUM INJECTION FLOW RATE (GPM)
B817IW-1	14–19	90	45	3,000	3,090	12	7
B817IW-2	14–19	90	45	3,000	3,090	12	7
B817IW-3	14–19	90	45	3,000	3,090	12	7
B817IW-4	14–19	90	45	3,000	3,090	12	7
B817IW-5	14–19	90	45	3,000	3,090	12	7
B817IW-6	14–19	90	45	3,000	3,090	12	7
B817IW-7	14–19	90	45	3,000	3,090	12	7
B817IW-8	14–19	90	45	3,000	3,090	12	7

NOTE: THE TOTAL SUBSTRATE VOLUME DOES NOT INCLUDE THE pH BUFFER VOLUME IS MINOR COMPARED TO THE COMBINED VOLUME OF THE NEAT SOYBEAN OIL AND MAKE-UP WATER. THE INJECTED TOTAL SUBSTRATE VOLUME SHOULD BE ±5% OF THE TOTAL VOLUME PRESENTED IN TABLE 1.

REFERENCE DRAWINGS

DWG NO.	DATE	DESCRIPTION
FIGURE 3.4	9/10/07	PROCESS FLOW DIAGRAM FOR SUBSTRATE BLENDING AND MIXING SYSTEM BY PARSONS ENGINEERING SCIENCE, INC.
FIGURE 3.5	9/4/07	PROCESS FLOW DIAGRAM FOR SUBSTRATE INJECTION SYSTEM BY PARSONS ENGINEERING SCIENCE, INC.

REVISIONS

NO.	DATE	DWN	APP'D	DESCRIPTION
0	5/1/08	KMK	DJM	ISSUED FOR CONSTRUCTION
C	2/27/08	WAB	DJM	ISSUED FOR REGULATORY REVIEW
B	12/13/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR AFRPA/USACE REVIEW
A	11/21/07	WAB	DJM	ISSUED FOR 90% DESIGN FOR PARSONS REVIEW

ecology and environment engineering p.c.

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DRAWN BY	APPROVED BY
WA BAYLES	DJ MILLER PE

FORMER GRIFFISS AIR FORCE BASE
ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN
BUILDING 817/WSA
SUBSTRATE SYSTEM SCHEMATIC

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
NTS	11/21/07	4.dwg	Sheet 5 of 5	0

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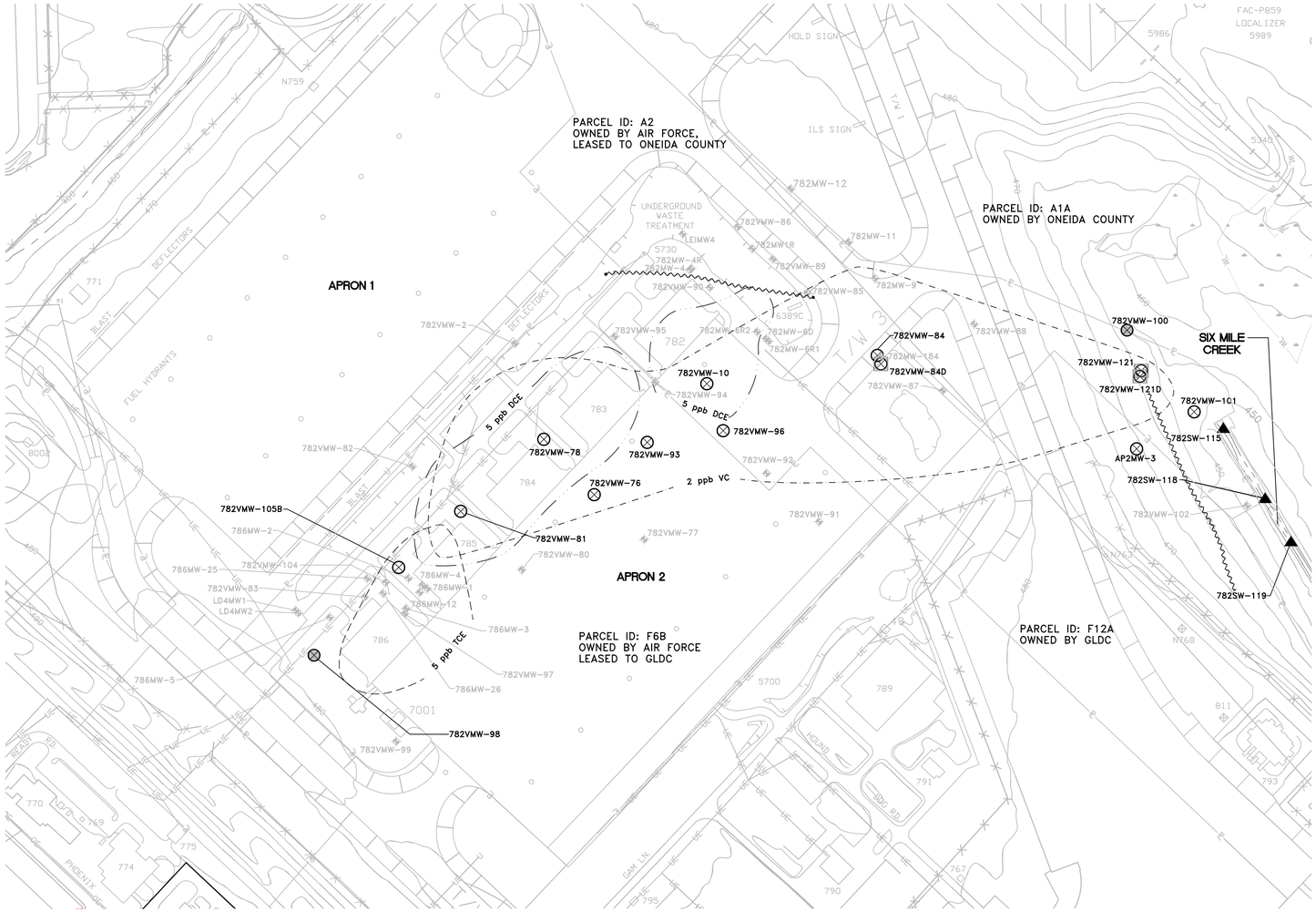
BUFFplot: 5/1/08 KMK



LEGEND:

2623	BUILDING LOCATION
WL WL	DELINEATED WETLAND
X X	FENCE LINE
OE	OVERHEAD ELECTRIC LINE
470	TOPOGRAPHIC CONTOUR LINE (5 FOOT INTERVAL)
UE	UNDERGROUND ELECTRIC LINE
782VMW-87	EXISTING MONITORING WELL
782SW-119	SURFACE WATER SAMPLE LOCATION
782VMW-93	PERFORMANCE MONITORING WELL
782VMW-98	PERFORMANCE AND LONG-TERM MONITORING WELL
782VMW-84D	PROPOSED PERFORMANCE AND LONG-TERM MONITORING WELL TO BE INSTALLED
	EDGE OF WATER OF SIX MILE CREEK
P	PARCEL BOUNDARY
	APPROXIMATE LOCATION OF EXISTING HORIZONTAL AIR SPARGE BARRIER
5 ppb TCE	TCE PLUME BASED ON MONITORING WELL DATA FROM 2004 AND 2006
5 ppb DCE	DCE PLUME BASED ON MONITORING WELL DATA FROM 2004 AND 2006
2 ppb VC	VC PLUME BASED ON MONITORING WELL DATA FROM 2004 AND 2006

PROPOSED MONITORING WELL INSTALLATION SUMMARY

DESIGNATION	NORTHING	EASTING	SCREEN INTERVAL (NOTE 2)
782VMW-84D	1174797.08	1138002.90	430-420 FEET AMSL
782VMW-121	1174777.45	1138757.64	440-430 FEET AMSL
782VMW-121D	1174761.05	1138753.62	430-420 FEET AMSL

NOTES:

GENERAL:

1. INSTALL AND DEVELOP MONITORING WELLS 782VMW-84D, 782VMW-121, AND 782VMW-121D AT LEAST 1 MONTH PRIOR TO FIRST SAMPLING ROUND. WELLS TO BE CONSTRUCTED AS DESCRIBED IN THE "FINAL WORK PLAN PREDESIGN INVESTIGATIONS AT LANDFILL 6, BUILDING 817/WSA, BUILDING 775, AND AOC 9" (EEEPC 2006). SCREEN INTERVAL DEPTH FOR 782VMW-84D IS 430-420 FEET AMSL, 782VMW-121 IS 440-430 FEET AMSL, AND 782VMW-121D IS 430-420 FEET AMSL.
2. MEASURE THE CURRENT GROUND SURFACE ELEVATIONS AT THE PROPOSED MONITORING WELL LOCATION PRIOR TO INSTALLATION. THE SCREEN INTERVAL SHALL BE ADJUSTED BASED ON CONDITIONS OBSERVED DURING DRILLING.
3. CONTACT GRIFFISS AIRPARK FLIGHT LINE PERSONNEL A MINIMUM OF 1 MONTH PRIOR TO DRILLING ACTIVITIES TO COORDINATE ACCESS TO THE FLIGHTLINE.
4. SAMPLING FREQUENCY AND ANALYSIS SHALL BE PERFORMED AS DESCRIBED IN THE "FINAL REMEDIAL DESIGN WORK PLAN" (EEEPC 2008).
5. UTILITY INFORMATION IS APPROXIMATE. VERIFY ALL UTILITIES, LOCATION, AND CONDITIONS WITH PROPERTY OWNERS PRIOR TO START OF FIELD ACTIVITIES.
6. PARCEL BOUNDARIES OBTAINED FROM AFRPA VIA FPM (MARCH 2007), AND WERE NOT VERIFIED IN THE FIELD.
7. CONTACT "DIG SAFELY NEW YORK" TO LOCATE UNDERGROUND UTILITIES PRIOR TO CONSTRUCTION ACTIVITIES. REGULATIONS PERTAINING TO THE PROTECTION OF UNDERGROUND FACILITIES IN NEW YORK STATE ARE GOVERNED BY NEW YORK CODES, RULES, AND REGULATIONS. HOWEVER, OTHER PRIVATELY OWNED UTILITIES AT THE SITE MAY EXIST THAT ARE NOT MEMBERS OF THE UTILITY LOCATOR SERVICE. COORDINATE ALL INTRUSIVE WORK WITH THE PROPERTY OWNER(S) TO IDENTIFY ANY OTHER POTENTIAL PRIVATELY OWNED UTILITIES PRESENT IN THE REMEDIAL CONSTRUCTION AREA.
8. EEEPC SHALL NOT BE RESPONSIBLE FOR CONTRACTOR MEANS AND METHODS, INCLUDING DESIGN AND IMPLEMENTATION OF FUTURE CONTINGENCY MEASURES.

ABBREVIATIONS:

AFRPA	AIR FORCE REAL PROPERTY AGENCY
AMSL	ABOVE MEAN SEA LEVEL
EEEPC	ECOLOGY AND ENVIRONMENT ENGINEERING P.C.
GLDC	GRIFFISS LOCAL DEVELOPMENT CORPORATION

SCALE IN FEET
0 200 400 600

DWG NO.	DATE	DESCRIPTION
APRON2_NEWMXD	3/14/07	PROPERTY OWNER INFO
Apron2_Feb27.shp	2/27/07	PARCEL BOUNDARY PER FPM GROUP
F06_VR_WT-ARS	11/1/06	WETLANDS DELINEATION PER ECOLOGY AND ENVIRONMENT, INC.
GR1216r-pn-17	9/1/98	SITE FEATURES SUPPLIED BY WOOLPERT CONSULTANTS
TOPO.DWG	2/11/99	BASE TOPOGRAPHY SUPPLIED BY WOOLPERT CONSULTANTS

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A	6/12/07	KMK	DJM	ISSUED FOR 30% DESIGN FOR PARSONS REVIEW

REVISIONS

ecology and environment engineering p.c.

DESIGNED BY	CHECKED BY
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DRAWN BY	APPROVED BY
KM KRAJEWSKI/WA BAYLES	DJ MILLER P.E.

FORMER GRIFFISS AIR FORCE BASE

ROME NEW YORK

ON-BASE GROUNDWATER REMEDIAL DESIGN NOSEDOCKS/APRON 2 PROPOSED MONITORING PLAN

SCALE	FIRST ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
1"=200'	6/12/07	1.dwg	Sheet 1 of 1	0

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BUFFplot: 5/1/08 KMK

Date:	ENGINEERING / DOCUMENT REVIEW		
May 20, 2008	Griffiss OBGW Project		Document: Remedial Design Work Plan (RDWP) and 90% design Drawings
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
Reviewer - USEPA - Douglas M. Pocze (212) 637-4432			
COMMENTS ON RESPONSE TO EPA 30% DESIGN COMMENTS			
1	General	The response to EPA Comment Number 9 is partially acceptable. It remains unclear, however, whether real time data will be accessible to anyone off site. For example, The RDWP needs to discuss if the pumps and meters will be connected to a programmable logic computer (PLC). If they are, indicate whether real time and historical operation data could be made available via the internet. Revise the RDWP to discuss whether the current design can accommodate a PLC to allow real time data to be accessible by offsite parties. [FOR CLARITY, EPA COMMENT NO. 9: "The Draft RDWP indicates that the control panels will be designed with hands-off-auto switches and a read-out screen. Typically under these circumstances, remote monitoring of the system over the internet is included in the design. Revise the Draft RDWP to either allow for remote monitoring of the system by others, or provide the rationale for why this process is not feasible." RESPONSE TO COMMENT NO. 9: "Remote monitoring might be appropriate on systems with sophisticated controls or where routine operations and maintenance (O&M) inspections cannot be performed. The Building 775 OBGW site does not fit either criterion. Controls on this system will consist of simple pressure transducers or similar located within pumping wells to turn pumps on and off. A local control panel for the system will be installed with lights that indicate to O&M personnel whether pumps are operating. O&M for the pump and treat system at the Building 775 OBGW site will be performed by the FPM Group (FPM). FPM is currently responsible for O&M of several other environmental sites at the base and maintains a fully staffed office on the base. Because of their on-base presence, FPM personnel will be able to inspect the system frequently, if necessary. The actual frequency of O&M inspections will be determined by FPM during preparation of the performance monitoring plan."]	A PLC is not included in the design. The design includes a pump controller (Essex model 2410) that will be used to cycle the pump on and off based on the water level in the well measured using a pressure transducer. The pump controller readout indicates pump on, pump off, and two alarm conditions for high and low water level. The system will also be equipped with a digital flow meter that outputs instantaneous flow rate and total flow. FPM is located on the base and will operate the pumping system by visiting the site regularly to check that it is operating.

Date:	ENGINEERING / DOCUMENT REVIEW		
May 20, 2008	Griffiss OBGW Project		Document: Remedial Design Work Plan (RDWP) and 90% design Drawings
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
2	General	The response to EPA Comment Number 16 requires additional clarification. The response states that Section 4.3.5 now describes how injection activities will proceed if substrate loss is attributed to a preferential pathway. Two issues require clarification: a. The text states that visual monitoring of existing manholes will be used to assess substrate loss. The RDWP does not specify what will constitute visual evidence under this standard. Unlike permanganate injections, which are clearly visible, purple color, edible oil emulsions are visibly pedestrian. Please clarify whether a tracer dye will be added to the substrate to aid in visual identification of the substrate in existing manholes. b. The text states "if target DOC levels are not met, discussions will be held with the project team to determine the next course of action." It is unclear from this statement where the responsibility for coordinating the discussion lies. Revise the RDWP to assign the responsibility and protocol for initiating this activity. [FOR CLARITY, EPA COMMENT NO. 16: "The Draft RDWP indicates that concern exists that the utility corridor is a preferential pathway and injected substrate may appear in manhole associated with the utility corridor. The Draft RDWP states that if injection conditions indicate the potential for substrate to enter the utility corridor, the manholes will be monitored. However, the Draft RDWP does not describe the manhole monitoring procedures which will be used. Revise the Draft RDWP to include information on the intended monitoring approach for the manholes. Furthermore, if this condition occurs, injection activities will be discontinued, and the need for additional injection wells will be evaluated. In the event injection activities need to be discontinued, an equivalent remedial approach will need to be presented. If an alternate injections is considered then it should be discussed and established. Revise the Draft RDWP to include an alternate configuration for substrate injection in the event that substrate is detected in the utility corridors."	a. The oil-in-water emulsion has a very distinct milky yellow color making it easy to visually differentiate from unimpacted water. It is Parson's experience that tracer dyes (i.e., fluorescene, chromatint) are ineffective unless present at high concentrations or samples are analyzed with laser induced flouresence. Tracer dye will not be added to the substrate during injections. b. Figure 4-1 Decision Process for Contingency Plan on page 4-13 describes the protocol for initiating discussions and has be updated to assign the responsibility of coordinating these activities to AFRPA. A revised Figure 4-1 is enclosed for replacement in your copy of the RDWP.

Date:	ENGINEERING / DOCUMENT REVIEW		
May 20, 2008	Griffiss OBGW Project		Document: Remedial Design Work Plan (RDWP) and 90% design Drawings
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
		RESPONSE TO COMMENT NO. 16: "Additional text to describe how the manholes will be monitored during injection activities will be added to Section 4.3.5 and Table 4-3 of the Final RDWP. Also, procedures will be added in Section 4.3.5 to describe how injection activities will proceed if substrate loss is attributable to the preferential pathway described in this section."]	
COMMENTS ON 90% DESIGN			
1	General	The Remedial Design/Remedial Action Handbook includes information on scoping a remedial design. Included in this guidance document is an outline for information to be included in an intermediate design. The guidance indicates that the intermediate design is to include an updated construction schedule. The schedule for implementation of the remedial action should identify the timing for initiation and completion of all critical path tasks. The schedule should also specifically identify the duration for completion of the project and major milestones. Revise the RDWP to provide a project schedule. This schedule should include, at a minimum: injection timeframes, performance monitoring, long term monitoring, additional injections, projected remediation timeframes, reporting, and permitting.	Implementation schedule to be provided by Parsons in RAWP. A general schedule of monitoring for each site is provided in the ROD. General remediation schedules with attainment of remedial goals are attached for each site.

Date:	ENGINEERING / DOCUMENT REVIEW		
May 20, 2008	Griffiss OBGW Project		Document: Remedial Design Work Plan (RDWP) and 90% design Drawings
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
2	Nosedocks/Apron 2	The RDWP in Section 1.4.4, Nosedocks/Apron 2, Current Conditions, Page 1-7, states that removing fuel mass (MTBE), which has commingled with the TCE plume may have adverse effects on the reductive dechlorination process. This is true. However, MTBE is not a good candidate for natural attenuation in an oxygenated environment as indicated in the RDWP. Natural Attenuation of Fuels and Chlorinated Solvents in the Subsurface, by Wiedemeier et all, states on page 164 that MTBE appears to be the most biologically recalcitrant of common contaminants. Because of its extremely high solubility, MTBE is also typically found in high concentrations, and tends to migrate well beyond the leading edge of the remainder of the hydrocarbon plume edge. Therefore, the proposed airsparging would have a limited effectiveness in remediating MTBE. Revise the RDWP to provide data on both the benzene and MTBE detections, plume size and location, and include benzene and MTBE in the list of contaminants of concern for the nosedock area. Ensure that the RDWP addresses MTBE's limited capacity to biodegrade and proposes an alternate remedial approach to air sparging.	Petroleum contaminants are not chemicals of concern (COCs) at the Nosedocks/Apron 2 OBGW Site (OBGW AOC SD-52). Petroleum contamination is addressed under NYSDEC's Petroleum Spills Program. Furthermore, groundwater monitoring at the site (OBGW Baseline Monitoring Report September, 2007) indicated that MTBE concentrations are below NYSDEC groundwater guidance values.

Date:	ENGINEERING / DOCUMENT REVIEW		
May 20, 2008	Griffiss OBGW Project		Document: Remedial Design Work Plan (RDWP) and 90% design Drawings
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
3	Nosedocks/ Apron 2 and Building 817/WSA	Figure 1-4 of the Design Drawings shows the locations of two existing horizontal air sparge barriers. The design documents and drawings do not include sufficient detail on these features which are proposed as a contingent alternative. The RDWP needs to be revised to clearly indicate whether these features already exist and what their design capabilities are. Furthermore, the RDWP needs to provide detailed information on their configuration. Ensure that any operation and maintenance criteria, clearly indicates what the performance indicator parameters are and their associated values which will trigger initiation of the contingent measures, which will apply to both remedies for Building 817/WSA and Nosedocks/Aprons 2.	Figure 1-4 presents existing horizontal sparge walls not associated with the remedial actions for the chlorinated solvents at the site. The design of the contingency air sparge barriers for the chlorinated plume at the site will be conducted only if and when deemed necessary. A conceptual (30%) design of the air sparge barrier was included in Section 4.6 of the RDWP. No further description or design is warranted at this time and no updates will be made to the RDWP. Typically, the barriers will consist of a row of wells placed across the plume width at 15 feet spacing. The sparge wells will have a 15 feet screened interval that extends to depths to be determined at a later time. The air sparging flow rate used for these systems will be 15 cfm. These design standards are based off of Parson's previous experience with similar sparging systems.
4	General	The OPS standard for the proposed remedies is based on total VOC concentrations. This approach appears to only contemplate chlorinated organics; however, benzene and MTBE are also site contaminants. Please revise the RDWP to clearly indicate if MTBE and benzene are included in this evaluation. If they are not included in the OPS standard, the RDWP needs to clearly justify why they are not.	BTEX and MTBE are not COCs. See response to 90% design general comment 2

Date:	ENGINEERING / DOCUMENT REVIEW		
May 20, 2008	Griffiss OBGW Project		Document: Remedial Design Work Plan (RDWP) and 90% design Drawings
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
5	Building 775	The RDWP does not discuss the Curb Inlet Protection Details included on Sheet 5 of 5 for Building 775. These features appear somewhat significant, and to have a unique function. Revise the RDWP text to include a discussion of the purpose for these features.	The curb inlet protection detail is intended for erosion control only. This general type of inlet protection is relatively common in the construction industry and its function is not unique or significant. Inlet protection is generally mentioned in section 3.9.2 of the RDWP. Further discussion within the RDWP is not deemed necessary at this time.
6	Landfill 6 and Building 817/WSA	Section 2.3.3 Injection Substrate and Volumes, Page 2-4: This section states that the injection will likely consist of a combination of vegetable oil, sodium lactate . . . ." In addition, the "amount of substrate to be injected per point will be calculated . . . . " And, "Calculations similar to these will be developed for the Landfill 6 site." It is unclear why, at the 90% design phase, these decisions and calculations have not been completed, yet injection volumes have been provided in tables in the Design Drawings for those areas undergoing substrate injection. Revise this section to state "what" and "how much" will be injected at Landfill 6, as well as, revising the text associated with Building 817/WSA. Revise Appendix F to include site-specific calculations, and revise the RDWP to identify how the substrate compositions were selected for each of these areas. Ensure that the discussion addresses the need to prevent biofouling of the aquifer as a result of the proposed injections, and how the proposed design mixtures and procedures sufficiently address this concern.	Specific injection volumes for each site have been calculated and are provided on the design drawings. The calculations performed for each site and included in the design drawings are enclosed. Please insert these at the end of Appendix F. Biofouling is possible but unlikely given the low substrate concentrations specified in the design. Substrate loading was intentionally minimized based on previous experience at other sites in order to reduce the potential for biofouling in the aquifer matrix. The potential for biofouling will be further reduced by ensuring that the substrate mixture remains consistent throughout the injection, thereby ensuring that the substrate is distributed throughout the injection area at a the designed concentration. Finally, a low concentration of substrate was specified for injection so the longevity of any biofouling that may form will be limited by the relatively short life expectancy of the application.

Date:	ENGINEERING / DOCUMENT REVIEW		
May 20, 2008	Griffiss OBGW Project		Document: Remedial Design Work Plan (RDWP) and 90% design Drawings
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
7	Landfill 6	Section 2.8 Regulatory Compliance, Page 2-13: The section describes all of the regulatory concurrence that may be necessary for this project to be completed. In total 5 permits must be acquired or plans must be written to satisfy applicable regulations. It is unclear exactly what steps remain to be completed to comply with the outlined requirements, and which of these tasks have been completed. Revise this section to state (1) which regulations definitively apply to this site, (2) discuss actions taken pursuant to these regulations, and (3) outline what still requires completion and who is responsible for completion each item.	This detailed discussion will be provided in the RAWP.
8	Building 775	Section 3.2, Extraction Wells, page 3-2: The second sentence in this section states that "it is anticipated that a single pumping well will provide sufficient capture of the plume to achieve remedial goals." It is unclear what this anticipation is based on. Revise the RDRWP to include calculations showing the anticipated radius of influence for the one well included in the current design, as well as the anticipated radius of influence with the second contingent pumping well. Significant cost savings may be realized if two wells are put in at the same time, rather than one, eventually followed by the second. Revise this section to also discuss design calculations and assumptions used in the planning of this remedy along with a flow net for both of the pumping well configurations proposed.	An analysis of the plume and aquifer properties conducted as part of the Feasibility Study demonstrated that an extraction rate of 1.5 gpm would capture the volumetric flow of the plume. This extraction rate was increased to 4.5 gpm for costing purposes. Data obtained from the pre-design investigation reduced the size of the plume. The reduction in plume size adds further conservatism to the 4.5 gpm extraction rate assumption. The recommended range for the selected pump is 1.5 to 10 gpm. However, the pumping rate and radius of influence will be confirmed during the pump testing performed by the remedial action contractor.

Date:	ENGINEERING / DOCUMENT REVIEW		
May 20, 2008	Griffiss OBGW Project		Document: Remedial Design Work Plan (RDWP) and 90% design Drawings
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
9	Building 775	Section 3.2, Extraction Wells, page 3-2: This section states that pump testing will be performed at the proposed pumping well location. However, insufficient information about the pump test has been provided in the RDWP. Pump test procedures have been provided on the respective design drawings. Either revise this section to provide all of the operational and sampling procedures for the pump test outlined on the design drawings, or provide those details in an additional document specific to the pump testing, as the remedial action contractor will be implementing the pump test.	Although USEPA has been given the RDWP and the design drawings for review at the same time, it should be noted that the RDWP and the design drawings are related but separate in form and function. The RDWP is only intended to describe the process to be used during implementation of the design. The details of the design, such as implementation of the pump testing, are contained within the design drawings. The remedial action contractor will only be using the design drawings during implementation, as stated in the comment. Additional detail on the pump testing procedures as described in the design drawings have been added to the enclosed pages of the RDWP. Please replace these sheets in your copy. Additionally, the pump test procedures will be further detailed within the RAWP.
10	Landfill 6	Appendix B, LF6 Trend Analysis: The current trend analysis is of little benefit due to the scale selected. Please refit the y-axis on all graphs (except LF6VMWs – 12, 16, 17 and 20) to a maximum y value of 500 ug/L in order to more accurately assess the trends in the data.	The trend analyses for all wells at each of the sites were plotted on the same axis extents for comparison purposes. The y-axis extents for Landfill 6 were dictated by the data from LF6MW-16. The trend analyses for the Landfill 6 site have been replotted at the requested y-axis extents and are enclosed. These plots are to be added to Appendix B of the RDWP but are not intended to replace the plots previously submitted.
11	Building 817/WSA	Building 817/WSA, Figure 1-3: The most outward contour line appears to represent the non-detect limits, but the contour line is missing a label. Revise the figure to include a note for the most outward contour.	Figure 1-3 includes a label for the non-detect contour line located to the left of temporary monitoring well WSATW-7.
End of Comments			

Anticipated Project Schedule: Landfill 6
(to be finalized in the Remedial Action Work Plan, provided by others)

Action/Milestone	Frequency	Anticipated Completion
Complete injection	One-time milestone event	2008
Injection monitoring	Begin 1 month after injection. Continue quarterly for 1 year as indicated in Table 2-3 of this work plan	2009
Performance monitoring	Begin 6 months after last injection monitoring sample round. Continue semi-annually for 2 years as indicated in Table 2-3 of this work plan	2011
Implement additional injections, groundwater recirculation system, and/or contingency plan if necessary	Dependent on results of performance monitoring. One time milestone as indicated by Table 2-4 in this work plan	To be determined (based on performance monitoring)
Long term monitoring	As dictated by approved Long Term Monitoring Plan[1] until RAOs are achieved	2038[2]
Remedial action objectives achieved, discontinue long term monitoring	One-time milestone event	2038[2]

Notes:

1. Requirements and details of long term monitoring reporting and sampling frequency will be described in the Long Term Monitoring Plan, to be provided at later time by others.
2. Estimated date to for total VOC concentrations in groundwater to reach 5 ug/L based on projected trend analysis at Landfill 6 for monitoring well LF6-MW20 (located in the area of highest VOC concentrations). The end of long term monitoring will be based on achievement of the RAOs described in the Record of Decision.

Anticipated Project Schedule: Building 817/WSA
(to be finalized in the Remedial Action Work Plan, provided by others)

Action/Milestone	Frequency	Anticipated Completion
Complete injection	One-time milestone event	2008
Injection monitoring	Begin 1 month after injection. Continue quarterly for 1 year as indicated in Table 4-3 of this work plan	2009
Performance monitoring	Begin 6 months after last injection monitoring sample round. Continue semi-annually for 2 years as indicated in Table 4-3 of this work plan	2011
Implement additional injections and/or contingency plan if necessary	Dependent on results of injection and/or performance monitoring. One time milestone for additional injection as indicated by Section 4.5.1 in this work plan. One time milestone for contingency plan as indicated by Figure 4-1 of this work plan.	To be determined (based on performance monitoring)
Long term monitoring	As dictated by approved Long Term Monitoring Plan[1] to continue until RAOs are achieved	2020[2]
Remedial action objectives achieved, discontinue long term monitoring	One-time milestone event	2020[2]

Notes:

1. Requirements and details of long term monitoring reporting and sampling frequency are described in the Long Term Monitoring Plan, to be provided at later time by others.
2. Estimated date for total VOC concentrations in groundwater to reach 5 ug/L based on projected trend analysis at Building 817/WSA for monitoring well WSA-MW18 (located mid-way between Perimeter Road and Building 817). The end of long term monitoring will be based on achievement of the RAOs described in the Record of Decision.

Anticipated Project Schedule: Building 775
(to be finalized in the Remedial Action Work Plan, provided by others)

Action/Milestone	Frequency	Anticipated Completion
Perform pump test to confirm system parameters (potentially install additional extraction wells)	One-time milestone event	2008
Complete system installation	One-time milestone event	2008
System operations and maintenance (O&M)	Continuous, as needed, until plume reduced to below 50 ppb	2019
Discharge compliance sampling	As dictated by approved City of Rome discharge permit	2019
Performance monitoring	Quarterly for 1 year, semi-annually thereafter until total VOCs in monitoring well network below 50 ppb, as indicated in Table 3-1 of this work plan	2019
Plume reduced to below 50 ppb of TCE, discontinue O&M and site monitoring	One-time milestone event	2019
Long term monitoring	As dictated by approved Long Term Monitoring Plan[1] to continue until RAOs are achieved	2029
Remedial action objectives achieved, discontinue long term monitoring	One-time milestone event	2029

Notes:
1. Requirements and details of long term monitoring reporting and sampling frequency will be described in the Long Term Monitoring Plan, to be provided at later time by others.

Project Schedule: Nosedocks/Apron 2
(to be finalized in the Remedial Action Work Plan, provided by others)

Action/Milestone	Frequency	Anticipated Completion
Installation of two new monitoring wells	One-time milestone event	2008
Performance monitoring	Quarterly monitoring to continue for 1 year as indicated in this work plan in Table 5-1	2009
Implement contingency plan if necessary[2]	Dependent on results of long term monitoring as described in Figure 5-1 of this work plan	To be determined
Long term monitoring	Semi-annual monitoring[1] to continue until RAOs are achieved.	2030[3]
Remedial action objectives achieved, discontinue long term monitoring	One-time milestone event as indicated in 2006 FS	2030[3]

Notes:

1. Requirements and details of long term monitoring reporting and sampling frequency will be described in the Long Term Monitoring Plan, to be provided at later time by others.
2. Estimated date for vinyl chloride concentration in groundwater to reach 2 ug/L based on trend analysis performed by FPM in 2006.

FINAL
Remedial Design Work Plan and 90% Design Drawings Former Griffiss Air Force Base Rome, New York

Contract Number: W912DQ-06-D-0012

February 2008

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
KANSAS CITY DISTRICT
601 East 12th Street
Kansas City, Missouri 64106

Prepared by:

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Lancaster, New York 14086

Under Contract to:

PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP, INC.
290 Elwood Davis Road
Liverpool, New York 13088

DEPARTMENT OF THE AIR FORCE
AIR FORCE REAL PROPERTY AGENCY

MEMORANDUM FOR SEE DISTRIBUTION LIST

02/27/08

FROM: AFRPA-Griffiss
Environmental Section
153 Brooks Road
Rome NY 13441-4105

SUBJECT: On-Base Groundwater, Areas of Concern - Final Remedial Design Work Plan, 90% Design Drawings

1. Enclosed for your review are the On-Base Groundwater Areas of Concern, Final Remedial Design Work Plan and the 90% Design Drawings. The documents are provided in support of pending remediation work at the former Griffiss AFB. Please note that the associated Draft Record of Decision (ROD) was provided for NYSDEC and USEPA review on February 8, 2008.

2. Should any questions arise, please feel free to contact Ms. Catherine Jerrard at (315) 356-0810.

MICHAEL F. MCDERMOTT
BRAC Environmental Coordinator

Attachment
Final Design Documents -
On-Base Groundwater AOCs

DISTRIBUTION:

Ms. Heather L. Bishop
NYSDEC
Division of Hazardous Waste Remediation
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Herkimer NY 13350 (2 copies)
Gregory Rys, NYSDOH – 2 copies

Date:	**ENGINEERING / DOCUMENT REVIEW**		
12/10/2007	Griffiss OBGW Project		Document: *Draft Remedial Design Work Plan (RDWP) and 30% Design Drawings Former GAFB*
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
Reviewer – Doug Pocze, United States Environmental Protection Agency			
1	General	The remedial designs presented in the RDWP for LF6 and Bldgs 775 and 817/Weapons Storage Areas (WSA) discuss attainment of both Record of Decision (ROD) required treatment levels (i.e., New York State Department Environmental Conservation [NYSDEC] Groundwater Standards for a Class GA water source) and contractual monitoring limits (i.e., end of contract [EOC] values) defined as "operating properly and successfully" (OPS) limits of a total volatile organic compound (VOC) level of 50 parts per million (ppm). The Draft RDWP stresses the attainment of the OPS values, which may play a role in the remedy implementation process, but has no bearing on the success or failure of the remedy. Revise the Draft RDWP to more clearly differentiate between these two values, and please note the primary limit addressed by the ROD and of concern to EPA and NYSDEC is the attainment of the NYSDEC Groundwater Standards for a Class GA levels.	Additional text will be added to the Final RDWP to emphasize the attainment of NYSDEC groundwater standards as the ultimate remedial goals for the four OBGW sites.
2	General	The Draft RDWP does not include any cross-sections demonstrating groundwater conditions, or information on the screening levels of the wells versus the plume configuration with respect to depth. The design drawings include notations for the cross-sections, but no cross-sections could be located. Revise the Draft RDWP to include cross-section which show the plume configuration with depth and the monitoring intervals with respect to the vertical extent of the plume.	Cross-sections from previous site investigations will be included in an appendix in the Final RDWP as this was the last time a comprehensive round of groundwater sampling was performed. Text will be added to the report to reference these cross-sections.

Date:	ENGINEERING / DOCUMENT REVIEW		
12/10/2007	Griffiss OBGW Project		Document: *Draft Remedial Design Work Plan (RDWP) and 30% Design Drawings Former GAFB*
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
3	General	The monitoring well trend analysis plots in the appendices show trend lines for each well proposed for inclusion in the monitoring network. The trend analysis plots only provide the anticipated/projected degradation rates based on naturally occurring conditions and do not present degradation rates that are anticipated as a result of the amendments proposed for injection. Furthermore, the Draft RDWP does not discuss the anticipated benefit to be gained from the proposed amendments or pump and treat systems. Currently, the Draft RDWP only discusses the anticipated design life of the amendments; it does not discuss the change in degradation rates that can be expected. Revise the Draft RDWP to include information in the text and on the trend analysis plots of the anticipated benefits to be achieved from the injection of the proposed substrates.	Due to the nature of in situ injection activities, the performance of the injections (i.e. in a percent concentration reduction) cannot be accurately predicted. The injection activities at the Landfill 6 and Building 817/WSA sites are planned to achieve total VOC concentrations less than the calculated total VOC concentrations as presented in the trend analysis plots. To further evaluate the effectiveness of the injection activities at these sites, the following items will be added to the evaluation performed annually in Section 4.5.1, 2nd bullet (and similar section for the Landfill 6 site): - Graphs (contaminant concentration along a flowpath, and contaminant molar concentration plots with time [see *Principles and Practices of Enhanced Bioremediation of Chlorinated Solvents* (AFCEE 2004)]) - Evaluation of the following: o Reduction of parent compound concentrations o Production of dechlorination products o Production of ethane and/or ethene (even low concentrations may indicate reductive dechlorination)
4	General	Data Evaluation Reports are proposed for each remedial alternative. These documents will only be submitted to the Air Force Real Property Agency (AFRPA) and US Army Corps of Engineers (USACE), and will not be automatically forwarded to EPA and NYSDEC. Revise the Draft RDWP to allow for submission of these reports to the EPA and NYSDEC, or allow for an annual submission to be provided to EPA and NYSDEC that addresses all monitoring conducted annually for each area.	Data Evaluation Reports will be forwarded to EPA and NYSDEC in addition to USACE and AFRPA. The text in the Final RDWP will be updated to reflect this.

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12/10/2007	Griffiss OBGW Project		Document: *Draft Remedial Design Work Plan (RDWP) and 30% Design Drawings Former GAFB*
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
5	General	The monitoring well trend analyses plots in the appendices indicate that rebound of contaminants of concern (COC) has occurred in several instances. The Draft RDWP proposes that once individual VOC concentrations are below the NYSDEC groundwater standards for two consecutive routine sampling rounds, monitoring will be discontinued. This standard does not conservatively address the potential for COC rebound. Revise the Draft RDWP to allow for four consecutive sampling rounds to be below the NYSDEC groundwater standards prior to discontinuing groundwater monitoring, in order to adequately address the potential for rebound.	The text will be revised to indicate four consecutive, routine sampling rounds are below the NYSDEC groundwater standards prior to discontinuing groundwater monitoring for the four sites. Additionally, the USACE/AFRPA may request that USEPA/NYSDEC reduce the number of sample rounds used to demonstrate achievement of NYSDEC Groundwater Standards based on the long-term monitoring data.
6	General	The proposed substrate amendments are different for the two injection sites (LF6 and Bldg 817/WSA). It is unclear why different characteristics were selected for each injection substrate. Revise the Draft RDWP to indicate some of the key differences between the two sites which impacted the decision process such that two different substrate compositions were selected for these two sites.	Additional text will be included in the Final RDWP to describe the differences in substrate mixtures at the Landfill 6 and Building 817/WSA OBGW sites.
7	Section 2.7, Contingency Plan, Page 2-11	The second paragraph in this section discusses the collection of surface water samples from Three Mile Creek. The Draft RDWP figures do not show the proposed surface water sampling locations. Only the 30% Design drawings show the proposed surface water sampling locations. It is difficult to determine how the proposed surface water sample locations are situated to allow for the detection of groundwater discharges to surface water directly downgradient of LF6. Perhaps an additional sample should be included. The Draft RDWP could be revised to include and additional surface water sample location between locations LF6/TMCSW-2 and LF6/TMCSW-3, that would allow for the detection of groundwater discharges to surface water directly downgradient of the LF6 groundwater plume.	An additional surface water sample located between LF6/TMCSW-2 and -3 will be included in the performance and long-term monitoring program for the Landfill 6 OBGW site.
8	Figure 2-1, Decision Process for Contingency Plan Implementation, Landfill 6 Site, Pages 2-13 and 2-14	The flow path of the decision tree lists the decision criteria as "Total VOCs above the anticipated concentrations in the monitoring well network." These values are based on a sliding scale as described in Table 2-2, Attenuation Rates of COCs at the Landfill 6 Site. Ensure that in future design submittals this information is translated into a decreasing trend table for ease of reference.	The calculated total VOC concentrations presented in Appendix A will also be presented in either graphical or tabular format in future evaluation reports associated with this site for comparison purposes with recent data collected. Text will be added to Section 2.5.1 to ensure this information is included in future reports as requested.

Date:	ENGINEERING / DOCUMENT REVIEW		
12/10/2007	Griffiss OBGW Project		Document: *Draft Remedial Design Work Plan (RDWP) and 30% Design Drawings Former GAFB*
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
9	Draft RDWP Figure 1-1, Landfill 6, Total VOC Concentration Map	The second note on this drawing indicates that, "The non-detect contour is approximated based on 2000 groundwater data. The 50 ppb and higher total chlorinated VOC contours approximated based on 2006 and 2007 groundwater data." This approach seems problematic, as the plume conditions have most likely changed over the last 7 years and we should have a complete round of sampling results. If we do not have a complete round of sampling results, the Draft RDWP should include a discussion that includes a sensitivity analysis as to why the collect of a concurrent round of groundwater data is unnecessary.	The non-detect contaminant contour will be updated on both Figure 1-1 and the Landfill 6 design drawing to reflect the most current analytical groundwater data available (Landfill 6 post-closure monitoring since June 2006). In future evaluation reports, analytical data from the Landfill 6 OBGW and Landfill 6 post-closure long-term monitoring events will be reviewed to update the contaminant contours for this site.
10	Section 3.6, Instrumentation and Controls, page 3-4	The Draft RDWP indicates that the control panels will be designed with hands-off-auto switches and a read-out screen. Typically under these circumstances, remote monitoring of the system over the internet is included in the design. Revise the Draft RDWP to either allow for remote monitoring of the system by others, or provide the rationale for why this process is not feasible.	Remote monitoring might be appropriate on systems with sophisticated controls or where routine operations and maintenance (O&M) inspections cannot be performed. The Building 775 OBGW site does not fit either criterion. Controls on this system will consist of simple pressure transducers or similar located within pumping wells to turn pumps on and off. A local control panel for the system will be installed with lights that indicate to O&M personnel whether pumps are operating. O&M for the pump and treat system at the Building 775 OBGW site will be performed by the FPM Group (FPM). FPM is currently responsible for O&M of several other environmental sites at the base and maintains a fully staffed office on the base. Because of their on-base presence, FPM personnel will be able to inspect the system frequently, if necessary. The actual frequency of O&M inspections will be determined by FPM during preparation of the performance monitoring plan.
11	Detail 1 of Design Drawing 4 of 6, On-Base Groundwater Remedial Design, Building 775 Existing Manhole Tie in Details	There are no minimum dimensions provided for the linkseal and sanitary lines as they relate to the existing manhole. Ensure that future submittals include interior dimensions for these features, or a table or schedule for these values on the drawing.	The existing manhole detail will be revised with dimensions in the 90% design drawings.

Date:	ENGINEERING / DOCUMENT REVIEW		
12/10/2007	Griffiss OBGW Project		Document: *Draft Remedial Design Work Plan (RDWP) and 30% Design Drawings Former GAFB*
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
12	Typical Details of Pavement and Earth Cuts, Design Drawing 5 of 6, On-Base Groundwater Remedial Design, Building 775 Typical Details	The details show that both the surface material and pipe bedding materials are similar based on the shading used. According to the Earth Cut Detail, the bottom material is pea gravel and the top material is topsoil. In the Pavement Cut Detail, the bottom material is pea gravel and the top material is not specified. Revise this drawing to clearly differentiate the materials of constructions in future design submittals.	Construction materials will be clearly defined in the 90% design drawings.
13	Table 3-1, Monitoring Plan, Building 775 Site, Page 3-5	Not all of the proposed monitoring locations are shown on the design levels drawings. Revise the Bldg 775 Site Design DrawingS to be of sufficient scale to show all the proposed monitoring locations. In addition, the location of the "to be installed" monitoring location of 775VMW-19R could not be located on any of the figures or drawings provided for the Bldg 775 remedial design. Revise the Draft RDWP and associated design drawings to include a figure showing the location of proposed monitoring well 775VMW-19R.	Performance monitoring wells, including 775VMW-19R, will be indicated on the Final RDWP figure and design drawings. However, the scale of the design drawings will be maintained in order to clearly indicate the work to be performed during installation of the pumping system.
14	Section 4.2, Contaminant Source, Page 4-3	The Draft RDWP indicates that the results of the membrane interface probe (MIP) survey could not definitely identify a source area. The Draft RDWP does not address how this impacts the remedy. Revise the Draft RDWP to address how the lack of a clearly defined source area impacts the remedy, if any, and what additional contingencies need to be built into the remedy to address this issue.	Additional text will be added to the Final RDWP to describe how the lack of locating a source area impacts the remedial efforts at this site.
15	Section 4.3.2, Injection Program Configuration, Page 4-4	The Draft RDWP indicates that a secondary injection event will possibly occur, but does not provide decision criteria for determining whether one will be necessary. Revise the Draft RDWP to include decision criteria for determining if a secondary injection event will occur.	Criteria for a secondary injection at the Building 817/WSA OBGW site is described in Section 4.5; however, the description of this criteria will be included in Section 4.3.2 as well for clarity.

Date:	ENGINEERING / DOCUMENT REVIEW		
12/10/2007	Griffiss OBGW Project		Document: *Draft Remedial Design Work Plan (RDWP) and 30% Design Drawings Former GAFB*
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
16	Section 4.3.5, Special Considerations, Utility Corridor Bullet, Page 4-6	The Draft RDWP indicates that concern exists that the utility corridor is a preferential pathway and injected substrate may appear in manhole associated with the utility corridor. The Draft RDWP states that if injection conditions indicate the potential for substrate to enter the utility corridor, the manholes will be monitored. However, the Draft RDWP does not describe the manhole monitoring procedures which will be used. Revise the Draft RDWP to include information on the intended monitoring approach for the manholes. Furthermore, if this condition occurs, injection activities will be discontinued, and the need for additional injection wells will be evaluated. In the event injection activities need to be discontinued, an equivalent remedial approach will need to be presented. If an alternate injections is considered then it should be discussed and established. Revise the Draft RDWP to include an alternate configuration for substrate injection in the event that substrate is detected in the utility corridors.	Additional text to describe how the manholes will be monitored during injection activities will be added to Section 4.3.5 and Table 4-3 of the Final RDWP. Also, procedures will be added in Section 4.3.5 to describe how injection activities will proceed if substrate loss is attributable to the preferential pathway described in this section.

Date:	ENGINEERING / DOCUMENT REVIEW		
12/10/2007	Griffiss OBGW Project		Document: *Draft Remedial Design Work Plan (RDWP) and 30% Design Drawings Former GAFB*
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
17	Table 5-1, Monitoring Plan, Nosedocks/Apron 2 Site, Page 5-4	Table 5-1 presents the proposed surface water sampling locations. However, the most upgradient location proposed does not appear to be upgradient of the Nosedocks/Apron 2 groundwater plume. Revise the Draft RDWP to either propose a more upgradient location, or provide adequate justification why a more upgradient location cannot be sampled. Furthermore, the proposed monitoring wells do not indicate the sampling of side-gradient wells. Given the close proximity of the vinyl chloride plume to Six Mile Creek, the addition of side-gradient wells to ensure that plume stability is maintained, even if sampled only annually, would appear prudent. Revise the Draft RDWP to allow, at a minimum, annual sampling of side gradient monitoring wells 782-VMW-100 and AP2MW-3.	Currently, the most upgradient sampling location in Six Mile Creek (SMC) closest to the site is 782SW-115. This sampling location is right at the culvert opening. Due to the taxiways and runway at the former Griffiss AFB the next upgradient, accessible location is within the culverted section of SMC near the Building 817/WSA OBGW site. If contaminants of concern are detected in surface water samples associated with the Nosedocks/Apron 2 site, collection of a surface water sample at WSA-SW3PW as proposed in the Building 817/WSA OBGW remedial design will be considered. Potential collection of this surface water sample will be added to Figure 5-1, lower box, 5th bullet. Plume stability has been shown in the Final Remedial Investigation Report for the Nosedocks/Apron 2 OBGW site (FPM April 2004). Of the two monitoring wells proposed in this comment for cross-gradient sampling, 782VMW-100 has never shown more than one minor detection in the first sampling round and no detections in consecutive quarterly sampling rounds from 2002-2004. As such, 782VMW-100 will be included in the first annual sampling round to confirm past trends. If trends are confirmed, this well will not be resampled. Results for monitoring well AP2MW-3 showed exceedances for MTBE and benzene and the well is located within the petroleum plume located at Apron 2, which is currently undergoing long-term monitoring (LTM). No chlorinated solvents have ever been detected in the monitoring well. The data from the petroleum LTM sampling will be utilized during the LTM data evaluation for this site.

Date:	ENGINEERING / DOCUMENT REVIEW		
12/10/2007	Griffiss OBGW Project		Document: *Draft Remedial Design Work Plan (RDWP) and 30% Design Drawings Former GAFB*
Comment No	**Reference (Page and Para)**	**Comment**	**Response**
18	Table 5-1, Monitoring Plan, Nosedocks/Apron 2 Site, Page 5-4	Table 5-1 lists the target analytes proposed for evaluating monitored natural attenuation (MNA) in the Nosedocks/Apron 2 area. However, it is not clear why many of the geochemical indicators/electron acceptors/metabolic byproducts normally used in the evaluation of MNA are not included in the table. In particular, it is noted that total organic carbon (TOC), oxidation-reduction potential (ORP), dissolved oxygen (DO), pH, temperature, conductivity, ethane/ethane, methane, hydrogen, and carbon dioxide are not included in the proposed analytical list. Revise the Draft RDWP to include these analytical parameters or provide a discussion why these parameters are not justified at this site.	The MNA evaluation for the Nosedocks/Apron 2 OBGW plume has been completed as part of the RI/FS and comprehensive MNA indicators are not warranted at this time. Sampling is proposed for the contaminants of concern which are the site drivers of the MNA strategy. As part of the performance and long-term sampling plan, chloride, DOC, nitrate, sulfate, and total alkalinity will be analyzed. Furthermore, during sampling, stability readings to include ORP, temperature, DO, pH, conductivity and turbidity will be collected. These field parameters will be added to Table 5-1. If MNA trends vary in the future, then additional MNA indicators will be considered to explain the variation in observed trends.
End of Comments			

Certificate of Compliance

Final Remedial Design Work Plan
And 90% Design Drawings
Former Griffiss Air Force Base, Rome, New York

February 2008

On behalf of Ecology and Environment Engineering, P.C. (EEEPC), the undersigned certify that the attached document was developed in conformance with EEEPC's Quality Control Plan.

Donald J. Miller, P.E.
Quality Control Manager

2/26/08
Date

Timothy J. Grady, P.E.
Program Manager

2/26/08
Date

David P. Albers, P.E.
Senior Manager

2/26/08
Date

Thomas R. Heins, P.E.
Project Manager

2/26/08
Date

FINAL
Remedial Design Work Plan and 90% Design Drawings Former Griffiss Air Force Base Rome, New York

Contract Number: W912DQ-06-D-0012

February 2008

Prepared for:

U.S. ARMY CORPS OF ENGINEERS
KANSAS CITY DISTRICT
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Kansas City, Missouri 64106

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Appendix

List of Tables

List of Figures

List of Abbreviations and Acronyms

AFB	Air Force Base
AFCEE	Air Force Center for Engineering and the Environment
AFRPA	Air Force Real Property Agency
AOC	Area of Concern
bgs	below ground surface
BMP	Best Management Practice
BRAC	Base Realignment and Closure
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminants of concern
DCE	dichloroethene
DNAPL	dense nonaqueous-phase liquid
DO	dissolved oxygen
DOC	dissolved organic carbon
E & E	Ecology and Environment, Inc.
EEEPC	Ecology and Environment Engineering, P.C.
FAA	Federal Aviation Administration
FPM	FPM Group Ltd.
FSP	Field Sampling Plan
HOA	hand-off-auto
LF6	Landfill 6

List of Abbreviations and Acronyms (cont.)

MIP	membrane interface probe
MNA	Monitored natural attenuation
MSL	mean sea level
MS/MSD	matrix spike/matrix spike duplicate
MTBE	methyl tertiary butyl ether
ND	non-detect
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
O&M	operation and maintenance
OBGW	on-base groundwater
OPS	operating properly and successfully
ORP	oxidation reduction potential
OSHA	Occupational Safety and Health Administration
Parsons	Parsons Infrastructure and Technology Group, Inc.
PCE	perchloroethene
POTW	publicly owned treatment works
ppb	parts per billion
ppm	parts per million
PVC	polyvinyl chloride
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan
RC	response complete
RCRA	Resource Conservation and Recovery Act
RD	remedial design

List of Abbreviations and Acronyms (cont.)

RDWP	Remedial Design Work Plan
RI	remedial investigation
ROD	Record of Decision
SAC	Strategic Air Command
SDG	sample delivery group
SPCC	spill prevention, control, and countermeasure
SPDES	State Pollutant Discharge Elimination System
SVE	soil vapor extraction
TCA	trichloroethane
TCE	trichloroethene
TTO	total toxic organics
UIC	underground injection control
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VOC	volatile organic compound
WPCF	Water Pollution Control Facility
WSA	Weapons Storage Area

1 Introduction

Ecology and Environment Engineering, P.C. (EEEPC), in cooperation with Parsons Infrastructure and Technology Group, Inc. (Parsons) and the FPM Group, Ltd. (FPM), under contract to the United States Army Corps of Engineers (USACE), Kansas City District, Contract No. W912DQ-06-D-0012 has been tasked to develop remedial designs for the following on-base groundwater (OBGW) areas of concern (AOCs) at the former Griffiss Air Force Base (AFB) in Rome, New York: Landfill 6 (LF6), Building 775/Pumphouse 3, Building 817/Weapons Storage Area (WSA), and Nosedocks/Apron 2.

1.1 Scope

EEEPC has been tasked to develop the Remedial Design Work Plan (RDWP) for the project. This RDWP has been developed based on data accumulated to date for each of the OBGW AOCs and discussions with the Air Force Real Property Agency (AFRPA), Parsons, and FPM.

The remedial design is being developed in three phases: RDWP and 30% design drawings, 90% design drawings, and final design drawings. The design drawings developed for this 90% and final design packages include technical specifications. Each phase will proceed consecutively pending approval from the AFRPA, USACE, the New York State Department of Environmental Conservation (NYSDEC), and United States Environmental Protection Agency (USEPA).

A Remedial Action Work Plan (RAWP) will be developed after this RDWP has been approved. The RAWP will present discussions on how the remedial design (RD) will be implemented in the field and include such details as a spill management plan and permits as necessary. Subsequently, the approved remedial actions will be implemented. A long-term monitoring plan will be developed and implemented for each of the OBGW AOCs.

1.2 Remedial Design Objectives

The primary objective of this RD for the OBGW AOCs is to develop plans and specifications for implementing the selected remedy, which is based on the Record of Decision (ROD). The selected remedies for the OBGW AOCs are:

- Landfill 6 - Enhanced bioremediation,
- Building 775 - Groundwater pumping and treatment,
- Building 817/WSA - Enhanced bioremediation, and
- Nosedocks/Apron 2 - Monitored natural attenuation.

1.3 Document Organization

This RDWP is organized into the sections shown in Table 1-1 below.

Table 1-1 Remedial Design Work Plan Organization

Section	Description
1. Introduction	Presents background information and project objectives.
2. Landfill 6 Remedial Design	Describes design approach and technical discussions on the remedial action components specific to each site.
3. Building 775 Remedial Design	
4. Building 817/WSA Remedial Design	
5. Nosedocks/Apron 2 Remedial Design	
6. Access and Easement Requirements	Discusses access and easement requirements needed to implement remedial actions at each of the sites.
7. References	Presents a list of information sources used to develop this document.
90% Design Drawings	Oversize drawings include existing and proposed remedial actions for all OBGW AOCs. Specifications have been included on the 90% design drawings.

1.4 Site Conditions

1.4.1 Landfill 6

Geology and Hydrogeology

The contaminated aquifer associated with the Landfill 6 site consists of silty sands with a saturated thickness extending from 19 feet below ground surface (bgs) to 80 feet bgs, where till overlying the Utica shale bedrock of Permian Age is encountered. The till layer ranges from 10 to 15 feet thick beneath the site and consists of a mixture of large quartzite cobbles, coarse-to-fine sand, and silt grading to gravelly clay. The estimated effective groundwater velocity at this site is less than 4 feet per year. In general, the direction of groundwater flow at the site is to the southwest, toward Three Mile Creek (see Figure 1-1). Groundwater impacted by site contaminants was not found in the bedrock (E & E 2002).

Current Conditions

The Landfill 6 site plume is located downgradient and west of the former Landfill 6 and south of the Building 775 site. The most contaminated portion of the plume is located southwest of the landfill beneath a low-lying area adjacent to Three Mile Creek. Cross-sections illustrating the vertical extent of contamination at the Landfill 6 site are included in Appendix A. As part of a pilot study for this site, potassium permanganate injections were performed in November 2002 and 2003.

The time period shown on the Appendix B graphs was selected to illustrate groundwater conditions after the influence of the permanganate injection had dissipated. There is no evidence that volatile organic compounds (VOCs) have migrated to the creek.

The contaminants detected in groundwater samples exceeding NYSDEC Class GA groundwater standards are trichloroethene (TCE), cis-1,2-dichloroethene (DCE), and vinyl chloride (VC). In March 2004, the maximum observed TCE concentration was 2,140 parts per billion (ppb), the maximum cis-1,2-DCE concentration was 432 ppb, and the maximum VC concentration was 7.46 ppb. These maximum concentrations were detected in samples from wells located within an approximately 1,600-square-foot area centered around well LF6MW-12. In 2006, total VOC concentrations surrounding LF6MW-12 had decreased, with maximum TCE, cis-1,2-DCE, and VC levels dropping to 1,500 ppb, 470 ppb, and 2.7 ppb, respectively (FPM 2006b). Groundwater studies at the site found relatively aerobic conditions and low dissolved organic carbon within the TCE/ cis-1,2-DCE plume. Figure 1-1 identifies the portions of the site with total VOC concentrations exceeding 50, 500, and 1,000 ppb in the Landfill 6 plume and presents the 2004, 2006, and 2007 monitoring data.

Appendix B presents graphs illustrating contaminant concentrations versus time for Landfill 6 monitoring wells selected for performance monitoring (see Section 2.4) and wells for which several rounds of historical data are available. Based on groundwater sampling data collected in 2003 through April 2007, site contaminants of concern (COCs) have generally shown decreasing trends. This time period was selected to illustrate groundwater conditions after the influence of the permanganate injection had dissipated. For monitoring wells located within 50 feet downgradient of the permanganate injections (LF6MW-12, -16, -17, and -20), total VOC concentrations also have been consistently decreasing in the years following the injections. Monitoring well LF6VMW-26 is located outside of the influence of the permanganate injection events in 2002 and 2003 (E & E 2004b). Four sampling events conducted at this well in 2004 and 2006 indicate a consistent decrease in total VOCs of more than 40% over this time frame.

No buildings are currently associated with the Landfill 6 site. The groundwater plume at this site impacts one land parcel, which is owned by the Air Force (see the 90% design drawings (sheet 2 of 5). The future land use at this site is to remain the same as its current use, open space (non-residential).

Institutional controls for this site will be implemented as stated in the final ROD (to be published at a later date).

1.4.2 Building 775

Geology and Hydrogeology

The contaminated aquifer associated with the Building 775 site is comprised of silty sands, extending from 60 feet bgs to 120 feet bgs, where till overlying the Utica shale bedrock of Permian Age is encountered. The till layer ranges from 28 to 30 feet thick beneath the site and consists of a mixture of large quartzite cobbles, coarse-to-fine sand, and silt grading to gravelly clay. Average groundwater velocities at this site are slow and have been estimated to be approximately 10 feet per year. Higher velocities may occur in discontinuous seams of coarse sand and gravel. Groundwater impacted by site contaminants was not found in the bedrock (E & E 2002). Most of the Building 775 plume appears to have migrated south toward Landfill 6 (see Figure 1-2).

Current Conditions

The Building 775 plume is located downgradient and south of the former maintenance facilities in Buildings 774 and 776, as well as Building 775, the former fuel pump house immediately northeast of Building 774 (within the SAC Hill Area of the base). The degreasing room/vat in Building 774, located across from Building 775 to the west, was identified as the source of contamination at this site. Figure 1-2 indicates the extent of VOC contamination at this site and presents the 2004 and 2006 monitoring data.

The primary contaminant exceeding NYSDEC Class GA groundwater standards is TCE. 1,1,1-trichloroethane (TCA) and perchloroethene (PCE) also were detected, but at a lower frequency of occurrence. In November 2006, the maximum TCE concentration (82 ppb) was detected in a sample collected from monitoring well 775MW-27. TCE in monitoring wells at this site has been detected within the bottom half of the sandy aquifer in screened intervals from 88 to 120 feet bgs. Samples collected from nearby well LF6MW-1, which is screened in the upper 10 feet of the aquifer, did not have detectable concentrations of TCE. Cross-sections illustrating the vertical extent of contamination at the Building 775 site are included in Appendix A.

Based on groundwater analytical data collected from May 2000 through November 2006, site COCs have generally shown decreasing or relatively stable concentration trends over time. Appendix C presents graphs illustrating contaminant concentrations versus time at Building 775 monitoring wells selected for long-term monitoring (see Section 3) and wells for which several rounds of historical data are available. Monitoring well 775VMW-5 is typical of wells at this site exhibiting a decreasing trend: TCE concentrations were 160 ppb in May 2000, 99.2 ppb in September 2004, and 81.2 ppb in November 2006. Monitoring well 775MW-6 illustrates a fluctuating trend: TCE concentrations were 24.7 ppb in May 2000, 79.5 ppb in September 2004, and 43.9 ppb in November 2006.

Two buildings (Buildings 774 and 776) lie within the boundary of the elevated VOC plume associated with the Building 775 site, and the potential exists for future development within this area north of Perimeter Road.

Institutional controls for this site will be implemented as stated in the final ROD (to be published at a later date).

1.4.3 Building 817/WSA

Geology and Hydrogeology

The Building 817/WSA site is located south of the former WSA on the north side of the main runway, between Building 817 and a culverted section of Six Mile Creek. Site groundwater flows south under Perimeter Road and toward the culverted section of Six Mile Creek. The contaminated aquifer consists of relatively uniform fine sands that begin 5 feet bgs and extends approximately 20 to 25 feet bgs, where till overlying the Utica shale bedrock of Permian Age is encountered. The till layer ranges from 0.5 to 7 feet thick beneath the site and consists of a mixture of large quartzite cobbles, coarse-to-fine sand, and silt grading to gravelly clay. Groundwater velocities at this site have been estimated to be as high as 470 feet per year (1.3 feet per day) north of Perimeter Road. Groundwater impacted by site contaminants was not found in the bedrock (E & E 2002).

Current Conditions

The contaminants at this site exceeding NYSDEC Class GA groundwater standards are TCE and PCE. Building 817 was once used for electronics parts maintenance, and TCE and PCE were used as solvents at this location. As part of a pilot study for this site, a potassium permanganate injection was performed in November 2002. Cross-sections illustrating the vertical extent of contamination at the Building 817/WSA site are included in Appendix A. Figure 1-3 illustrates the horizontal extent of VOC contamination based on 2004 groundwater analytical data (FPM 2005b) and groundwater monitoring well data collected in 2006 (FPM 2007). In September 2004, the maximum TCE concentration was 94 ppb and the maximum PCE concentration was 72 ppb. In November 2006, the maximum TCE concentration was 68 ppb and the maximum PCE concentration was 53 ppb, illustrating a decrease in concentrations over a two-year period. The 2004 and 2006 maximum concentrations were detected at WSA-IW3/WSA-VMW17 and WSA-MW18, respectively. Both wells are located within 75 feet (north) of Perimeter Road.

Based on historical groundwater analytical data through November 2006, site COCs have generally shown relatively stable to decreasing trends over time. Appendix D presents graphs illustrating contaminant concentrations versus time at Building 817/WSA site monitoring wells selected for performance monitoring (see Section 4) and wells for which several rounds of historical data are available. WSA-MW8 is located upgradient of the plume, and LAWMW-9 is located outside (northwest) of the plume. The VOC concentrations detected in these moni-

toring wells have been at or below NYSDEC groundwater standards and show a relatively stable trend over time. WSA-MW9 is located downgradient of the plume and approximately 140 feet northeast of the culverted section of Six Mile Creek. No VOCs have been detected in samples collected from this well. WSA-MW16 is located within the plume, and samples collected from this well have exhibited an overall decrease in VOC concentrations after rebounding from the permanganate injection performed in late 2002.

The groundwater plume at the Building 817/WSA site extends from Building 817 in the north downgradient to slightly beyond the culverted section of Six Mile Creek to the south. The plume impacts two land parcels (see the 90% design drawings, sheets 3 of 5 and 4 of 5). The impacted parcels are currently owned by the Air Force; however, a parcel south of Perimeter Road is leased to Oneida County. There is potential for future industrial/commercial development of the areas above the contaminant plume.

Institutional controls for this site will be implemented as stated in the final ROD (to be published at a later date).

1.4.4 Nosedocks/Apron 2

Geology and Hydrogeology

The contaminated aquifer is located from 9 to 25 feet bgs, with the shallow depth occurring in the vicinity of Six Mile Creek. The aquifer consists of several well-defined layers, including a silty-sand layer in the uppermost 5 feet, a 5- to 15-foot-thick coarse sand and gravel layer in the middle of the aquifer, and a 15- to 20-foot-thick layer of till composed of fine sand, silt, and gravel resting on the shale bedrock. The thickness of the aquifer ranges from 45 feet in the source areas to less than 20 feet in the downgradient areas near Six Mile Creek. Site-related contaminants have not been detected in the bedrock.

In general, groundwater at this site flows to the east-northeast, toward Six Mile Creek. Based on site hydrology, there is a potential for groundwater from the site to discharge into Six Mile Creek. Although the site has a relatively flat gradient, the high hydraulic conductivity of gravel layers beneath the site results in an estimated average groundwater velocity of approximately 106 feet per year (FPM 2006c).

Current Conditions

Three principal contaminants at the site exceed NYSDEC Class GA groundwater standards and are considered the site COCs: TCE and its breakdown products cis-1,2-DCE and VC. These contaminants are present at the Apron 2 site in three plumes referred to as the TCE, DCE, and VC plumes (see Figure1-4). The contaminant concentration contours shown on Figure 1-4 are based on 2004 groundwater analytical data (as presented in the Final Feasibility Study [FPM 2006c]) and groundwater monitoring well data collected in 2006 (FPM 2007). Cross-

sections illustrating the vertical extent of contamination at the Nosedocks/Apron 2 site are included in Appendix A. Of the three plumes, the VC plume is the largest, spanning approximately 2,200 feet by 500 feet. The plume extends from Building 782 to just south of Six Mile Creek. The TCE plume is centrally located around Buildings 786 and 785 at the western edge of the site. The cis-1,2-DCE plume is located downgradient of the TCE plume and around Buildings 785, 784, 783, and 782.

The plumes are commingled with several petroleum plumes originating from the Apron 2 fueling system. At locations where TCE and fuel contaminants are commingled, significant reductive dechlorination is occurring and the TCE is almost totally degraded to cis-1,2 DCE and VC. In November 2006, the maximum detected TCE concentration was 8 ppb (in well 782VMW-105B), the maximum detected cis-1,2 DCE concentration was 43.9 ppb (in well 782MW-10, which is located south of Building 782 in an area with commingled fuel contamination), and the maximum detected VC concentration was 68.2 ppb (in well 782MW-96, which also is located in the center of fuel-contaminated groundwater). At many locations, methyl tertiary butyl ether (MTBE) and benzene also are present at levels exceeding NYSDEC Class GA groundwater standards (FPM 2006c). The MTBE and benzene plumes are being remediated under a separate contract, and both Apron 2 remediation efforts will be coordinated as discussed below.

An important consideration at this site is the positive impact of fuel contamination on reductive dechlorination processes. It is important that the fuel remediation strategy focuses on the leading edge of the fuel plume: Removing fuel mass from the TCE and cis-1,2-DCE plumes could upset the anaerobic conditions responsible for TCE and cis-1,2-DCE dechlorination. MTBE, the primary COC within the fuel plume, could potentially impact Six Mile Creek. The use of technology such as an air sparging barrier located just upgradient of Six Mile Creek is suggested as the best overall solution for treating the MTBE plume. It is important that oxygen not be introduced into the central area of the TCE and cis-1,2-DCE plumes because this would inhibit the reductive dechlorination process. However, the introduction of oxygen within the downgradient portion of the VC plume could aid in the aerobic degradation of VC as well as the removal of MTBE

Based on groundwater sampling data collected through November 2006, site COCs have generally shown decreasing concentration trends over time. Appendix E presents graphs illustrating contaminant concentrations versus time at Nosedocks/Apron 2 monitoring wells selected for long-term monitoring (see Section 5) and wells for which several rounds of data are available. A relatively stable trend in the concentration of total VOCs was identified at monitoring well 782VMW-101, while an increasing trend in the concentration of total VOCs (the sum of TCE, cis-1,2-DCE, and VC) was observed at monitoring well 782MW-10. The increasing trend for well 782MW-10 is likely attributable to the 1999 data which appears to be an outlier.

Five buildings (Buildings 782, 783, 784, 785, and 786) are currently present at Apron 2 above the areas with elevated levels of VOCs in groundwater. The groundwater plumes at this site impact several land parcels (see Figure 1-4). The impacted parcels are currently owned by either the Air Force or the Griffiss Local Development Corporation, two of which have been leased out (the land parcels on which the five buildings are situated). In addition, the potential exists for future industrial/commercial development of the areas above the contaminant plume.

Institutional controls for this site will be implemented as stated in the final ROD (to be published at a later date).

1.5 Proposed Plans

The following subsections present a brief description of the proposed remedial plans for each of the sites. At the Building 775 and Building 817/WSA sites, data collected during the pre-design investigations (EEEPC 2007a) indicated that it was appropriate to modify details of the remedy described in the proposed plan. These details are discussed below. A detailed description of the remedial designs for each site is presented in Sections 2 through 5.

1.5.1 Landfill 6

Enhanced bioremediation is being proposed because the pre-design investigation (EEEPC 2007a) indicated that the area exhibiting the highest concentrations was limited in size and that biodegradation of contaminants of concern is occurring at the site. The pre-design investigation data indicates that the 500 ppb total VOC contour is approximately 40 to 50 feet in diameter. Enhanced bioremediation will be implemented by increasing and sustaining a high level of dissolved organic carbon in the groundwater contaminated with greater than 500 ppb of total VOCs. The organic carbon will be added by injecting a vegetable oil emulsion into existing wells. The vegetable oil emulsion is intended to stimulate biodegradation of VOCs within the 500 ppb contour.

If elevated concentrations of cis-1,2-DCE and/or VC attributable to the Landfill 6 enhanced bioremediation application are detected in Three Mile Creek at concentrations that exceed performance indicators, a contingency plan may be implemented.

1.5.2 Building 775

At the Building 775 site, one or more pumping wells will be installed within the plume to collect and treat TCE-contaminated water in the lower portion of the aquifer. The Proposed Plan (AFRPA 2007) presents a figure from the Feasibility Study (EEEPC 2006b) that depicts five extraction wells placed to capture contaminated groundwater within the 50 ppb total chlorinated VOC contour based on data collected prior to 2004. The Proposed Plan also states that “the layout of the recovery wells will be based on field studies completed during the design stage.” Based on the pre-design investigation at this site (EEEPC 2007a), the VOC plume has reduced in size and total chlorinated VOC concentrations have decreased.

Due to this recent information, it is estimated that plume capture can be attained through installation of the proposed recovery well system (see Section 3.2 for more information). The proposed recovery well system is reflected in the ROD.

1.5.3 Building 817/WSA

Enhanced bioremediation will be implemented at this site by injecting a vegetable oil emulsion directly into the subsurface in the most contaminated portion of the plume. The initial vegetable oil emulsion/fructose injection made at the head of the plume, near Building 817, (EEEPC 2007a) indicates a general reduction in contaminant of concern concentrations in samples from downgradient monitoring wells. These injection points will be used to inject an oil-in-water emulsion to provide organic carbon so that contaminant concentrations continue to decline (see Section 4.3.1). Additional rows of injection points may be advanced, if necessary, to achieve decreasing VOC concentrations in the groundwater monitoring well network. The vegetable oil is intended to stimulate biodegradation of VOCs downgradient of the injection points.

If elevated concentrations of cis-1,2-DCE and/or VC attributable to the Building 817 enhanced bioremediation application are detected in Six Mile Creek at concentrations that exceed performance indicators, a contingency measure (e.g., installation of an air sparge wall or similar) will be implemented, if necessary.

The Proposed Plan (AFRPA 2007) states that remediation at Building 817/WSA will include "a combination of soil excavation source removal (if a source can be identified) and enhanced bioremediation". During the pre-design investigation at this site (EEEPC 2007a), the presence of a source was not conclusively found. Therefore, excavation of contaminated source soils will not be performed. These changes have been reflected in the ROD.

1.5.4 Nosedocks/Apron 2

Monitored natural attenuation (MNA) will be implemented based on the observed reductive dechlorination occurring at the site. A monitoring well network will be sampled semi-annually for VOCs and natural attenuation parameters. The actual monitoring period will depend on the observed contaminant levels and locations over time.

If elevated concentrations of cis-1,2-DCE and/or VC attributable to site groundwater are detected in Six Mile Creek at concentrations exceeding performance indicators, a contingency measure (e.g., installation of an air sparge wall or similar) will be implemented, if necessary.

2 Landfill 6

2.1 Design Approach

Enhanced bioremediation will be utilized at Landfill 6. Groundwater monitoring data obtained from this site indicate that enhanced bioremediation will provide treatment of site contaminants. The design approach at Landfill 6 will be based on our experience at similar contaminated groundwater sites, published guidance documents, and site-specific data, including:

- Groundwater analytical data and field measurements;
- Groundwater contamination contour interval and cross-section maps;
- Hydraulic conductivity test results; and
- Pilot study observations (potassium permanganate injections in 2002 and 2003).

Remediation of this site will be implemented in a phased approach. The first phase will consist of an initial injection of a vegetable oil emulsion in approximately six of the existing injection wells installed as part of the 2002/2003 pilot study. Subsequent phases will be implemented, if necessary, based on the groundwater contamination trends observed during performance monitoring. These subsequent phases may include additional injections and/or a bioreactor batching process involving the extraction of groundwater downgradient of the area within the 500-ppb contour and its re-injection upgradient of this area.

Although a vegetable oil emulsion injection pilot study has not been performed at this site, this technology has proven to be successful at sites with similar contaminant concentrations and subsurface conditions. In addition, according to screening guidance in the *Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents* (AFCEE 2004), site-specific parameters indicate the site is suitable for enhanced reductive dechlorination (see Table 2-1).

Table 2-1 Suitability of Enhanced Bioremediation at Landfill 6

Site Characteristics	Suitable for Enhanced Bioremediation	Suitability Uncertain	Enhanced Bioremediation Suitable for Landfill 6	
DNAPL presence	Residual DNAPL or sorbed sources	Poorly defined sources may require additional characterization.	Yes	VOCs detected as recently as April 2007
Plume size	Small, a few acres or less	Medium to large, a few acres plus. May require concurrent use of more than one technology.	Yes	Plume area is approximately 1.5 acres (within the 50-ppb total VOC contaminant contour)
On or near site infrastructure	The risk of vapor intrusion from contaminants or biogenic gases is deemed acceptable.	Target treatment zone is proximate to sensitive infrastructure.	Yes	No buildings or infrastructure are near the site.
Evidence of anaerobic dechlorination	Slow or stalled dechlorination	Limited evidence of anaerobic dechlorination	Yes	Historically, TCE daughter product concentrations have been detected and are decreasing over time.
Depth	< 50 feet to groundwater	> 100 feet to groundwater	Yes	Approximately 20 feet to groundwater
Hydraulic conductivity	> 1 foot/day	0.01 to 1 foot/day	Yes	Hydraulic conductivity estimated to be 2.8 feet/day.
Groundwater velocity	30 feet/year to 5 feet/day	10 feet/year to 30 feet/year, 5 feet/day to 10 feet/day	Uncertain	Velocities within proposed injection area estimated to be 0.01 foot/day
pH	6.0 - 8.0	5.0 to 6.0, 8.0 to 9.0	Yes	During 2006/2007 sampling, pH was measured at 5.7 to 8.0.
Sulfate concentration	< 500 ppm	500 to 5,000 ppm	Yes	During 2006 sampling, sulfate was detected at between 50 and 54 ppm (inside the plume) and 24 to 40 ppm (outside the plume).

Note:
1. Table is based on data provided in *Principles and Practices of Enhanced Bioremediation of Chlorinated Solvents* (AFCEE 2004).

The vegetable oil emulsion will be injected in the center of the plume, near LF6-MW12, which historically has been the area with the highest VOC concentrations. Injecting a vegetable oil substrate, which will provide electron donors, into the most contaminated portion of the aquifer is intended to stimulate reductive dechlorination of COCs. Equipment and materials typically used for injections are conventional, commercially available products, limiting the need for specialty construction.

Wastes generated during construction will be handled and disposed of in accordance with the appropriate regulations. After the vegetable oil substrate has been injected, monitoring will be performed to evaluate the effectiveness of the injection (see Section 2.4).

2.2 Contaminant Source

Identification and treatment of the plume source is critical to effectively remediating site contaminants using enhanced bioremediation. Previous site investigations concluded that a contaminant source appears to have originated from Landfill 6 or surficial dumping on or near the landfill (E & E 2000). In 2006, VOCs were either detected at low levels or were not detected (ND at LF6-MW25; 71 ppb TCE, 62 ppb DCE, 1 ppb VC at LF6-MW28; ND at LF6-MW24; 31 ppb TCE, 2.3 ppb DCE at LF6-MW29) in groundwater monitoring wells between the downgradient edge of the landfill and LF6-MW12 (EEEPC 2007a; FPM 2006b). In addition, VOC concentrations throughout the site appear to be decreasing over time, including wells with the highest VOC concentrations. These observations indicate there is a localized area of high VOC concentrations at the site but a continuous source of VOC contamination does not exist. The injections will target the area of the plume within the 500-ppb contour, as shown on the 90% design drawings. This 500-ppb contour was generated using pre-design investigation data obtained in 2006 and 2007 (EEEPC 2007a [2006 data]; FPM 2007 [2007 data]).

2.3 Substrate Injection

The 90% design drawings present existing conditions at the site and identify the locations of the proposed injection and monitoring wells. The contaminant concentrations presented on the drawings were developed as described in Section 1.4.1.

2.3.1 Pilot Study

A vegetable oil emulsion injection pilot study has not been performed at the Landfill 6 site. However, a potassium permanganate oxidation pilot study was conducted at the site by Ecology and Environment, Inc. (E & E 2004b). Two separate injections were performed at the site in November 2002, and a third was performed in November 2003. Observations and measurements made during the pilot study that were used to design the proposed vegetable oil emulsion injection program at this site include:

- Injection rates for individual injection wells ranged from approximately 592 gallons per day to approximately 703 gallons per day (over approximately 8 hours). Injection reagents were accepted at different rates in each well. Therefore, the flow to each injection well was modulated with valves to evenly distribute the potassium permanganate proportionately between the injection wells.

- Groundwater levels collected before and after each injection indicated no mounding in adjacent wells.

- The average radius of influence from the injection wells was approximately 10 feet. The spacing of the injection wells allowed for overlap among individual shallow and deep wells.

2.3.2 Injection Program Configuration

The injection program will be implemented using six pre-existing injection wells (LF6IW-01 through LF6IW-06) constructed in 2002 (E & E 2004b). The screened intervals of these injection wells extend through the full vertical thickness of the plume (approximately 37 to 55 feet bgs, as indicated on contaminant cross-sections developed in previous studies [E & E 2005]) and the full width (perpendicular to groundwater flow) of the 500-ppb contaminant contour, as shown on the 90% design drawings.

Due to the thickness of the contaminated aquifer zone and the screened intervals of the pre-existing injection wells, injections will be delivered at two different depth intervals. LF6IW-01, LF6IW-03, and LF6IW-05 are screened from approximately 37 to 47 feet bgs, while LF6IW-02, LF6IW-04, and LF6IW-06 are screened from approximately 45 to 55 feet bgs.

It is anticipated that substrate volumes will be adjusted during the injection to ensure an even distribution of substrate throughout the vertical extent of the contaminant plume and that an adequate radius of influence is achieved between the wells. The design will consider an overlap in radius of influence between points to provide treatment throughout the width of the injection area.

2.3.3 Injection Substrate and Volumes

The injection substrate will likely consist of a combination of vegetable oil, sodium lactate, a pH buffer and make-up water. Vegetable oil was selected as a suitable, long-lasting source of organic carbon for this site. The sodium lactate will be added to the substrate, if necessary, to condition the aquifer and establish reducing conditions more rapidly. A pH buffer such as sodium bicarbonate or similar will be added, if necessary, to ensure that subsurface pH conditions are favorable to a diverse microorganism population. It is anticipated that make-up water will be obtained from a nearby base fire hydrant.

The minimum amount of substrate to be injected per point will be calculated based on the geochemical electron demand of the soil and groundwater and the contaminant electron acceptor demand, then multiplied by a safety factor. This substrate calculation is based upon methods presented in AFCEE guidance (AFCEE 2004). This guidance document presents a methodology and associated calculations to estimate electron acceptor demand and, therefore, injection substrate (electron donor) volumes needed to meet that demand within the treatment zone. Inputs into the calculation include physical dimensions and hydrogeologic properties within the treatment zone. In addition, the amount of dissolved and solid-phase electron acceptors (both native and COCs) within the treatment zone must be known or estimated. Native electron acceptors include oxygen, ferric iron, sulfate, and carbon dioxide. This calculation yields an estimated quantity (in pounds) of specific common substrates (e.g., lactate, fructose, soybean oil) required to meet electron acceptor demand over a specific design period (e.g., 5 years) and includes a factor of safety. Empirical data will be employed to supplement this calculation in an effort to optimize substrate mixtures. This calculated value is then increased by the design life of the substrate (in years), which is estimated at 2 to 3 years based on previous experience. An example of substrate volume calculations (these were used to estimate substrate volumes during previous work at the Building 817/WSA site) are provided in Appendix F. Calculations similar to these will be developed for the Landfill 6 site.

2.3.4 Injection Delivery System

The vegetable oil emulsion will be prepared on site, as opposed to using a commercially available emulsified vegetable oil product, in order to produce an oil-in-water emulsion with a relatively large droplet size. The larger droplet size will result in increased substrate longevity in the subsurface and will minimize the potential for substrate migration with groundwater flow. A static in-line mixer or high-speed shear mixer will be used to prepare the oil-in-water emulsion in the field prior to injection into the subsurface. Typically, field preparation using static in-line or high-speed shear mixers is capable of obtaining average droplet sizes of 2 to 20 microns. Pumps, flow meters, a valve manifold, a mixer, and mixing tanks will be used to ensure that the emulsion is mixed to the desired composition and injected in appropriate quantities. The substrate mixture will be injected into each injection well at a rate of approximately 0.5 to 4 gallons per minute.

2.4 Monitoring Plan

VOC concentration trend plots were developed for monitoring wells within the performance monitoring network that exhibited total VOC concentrations greater than 50 ppb. These contaminant trends will be used as a basis for evaluating the effectiveness of the proposed remedy. These trend lines are presented in Appendix B. The VOC concentration trend lines are an indication of the “apparent” naturally occurring degradation occurring at the site and are the result of biodegradation and other processes, including abiotic degradation, dilution, dispersion, and sorption. Typically, attenuation trend lines follow a first order exponential decay pattern, with higher concentrations decreasing at a faster rate than lower

concentrations. Historical total VOC concentrations at monitoring wells from this site followed a similar trend. Using this historical data, total VOC concentration trend lines were calculated to illustrate what is likely to occur in the future through 2016, assuming the proposed remedy is not implemented. This trend line will be used for comparison purposes during periodic evaluations. Remedial actions are expected to result in more rapid total VOC concentration reduction rates.

For example, total VOC concentrations at LF6VMW-12, LF6MW-16, and LF6MW-20 have been detected at levels greater than 1,000 ppb as recently as March 2007. Concentrations at these wells have decreased over time at rates ranging from approximately 40 ppb per year to 900 ppb per year (analytical results potentially influenced by the historical pilot studies were excluded). In general, the observed annual rate of decrease was less than 200 ppb. Therefore, a total VOC concentration decrease rate of 150 ppb per year was selected. The total VOC concentration in the most recent (2006) sample collected from LF6VMW-26 was 85 ppb. Since 2004, total VOC concentrations at LF6VMW-26 have decreased at a rate of approximately 50 ppb per year. These observations indicate that the rate of concentration decline is dependant on the contaminant concentration present, with higher concentrations resulting in higher reduction rates, typical of first-order decay kinetics. Attenuation rate goals were developed based upon the first-order kinetics observed historically at Landfill 6 (see Table 2-2).

Table 2-2 Attenuation Rates of COCs at the Landfill 6 Site

Total VOC concentration (ppb)	Selected Rate of Concentration Decrease (ppb per year)
> 1,000	150
500 - 999	75
100 - 499	40
50 - 99	10

The rate of concentration decrease may be modified in the future based on new analytical data.

EEEPC prefers to use the observed trends in VOC contaminant reduction rather than calculated biodegradation rates based on published data. Biodegradation rates may be determined in controlled laboratory experiments. However, these biodegradation rates are dependant upon a limited quantity of soil and groundwater and may not accurately reflect conditions of the soil at the site. In addition, conditions at the site may vary from location to location. Biodegradation rates determined under laboratory conditions cannot be easily transferred to full-scale, field situations with any confidence (Bedient 1994). As such, the field data and analysis described above are believed to be better indicators of biodegradation rates.

2.4.1 Monitoring Well Network, Frequency, and Parameters

Monitoring plans were developed to identify wells to be sampled as part of the baseline, injection, and performance monitoring activities at this site. Thirteen proposed monitoring wells are located throughout the site, within and outside of the plume, to assess performance of the enhanced bioremediation application, determine the overall effectiveness of the remediation of the site groundwater, and to ensure that the plume geometry is not changing in an adverse way (e.g., migrating or expanding toward Three Mile Creek).

Baseline sampling was performed by FPM in November 2006 in accordance with the *Final Letter Work Plan, Baseline Sampling, On-Base Groundwater Areas of Concern* (FPM 2006a); analytical results from this sampling event are presented in the *Final Monitoring Report, Baseline and PDI2 Sampling, On-Base Groundwater Areas of Concern* (FPM 2007). Table 2-3 presents the proposed pre-/post-aquifer testing, injection and performance monitoring plan for this site.

The long-term monitoring plan for this specific site will be developed in a future document by FPM and will be based on available information from the baseline, injection, and performance monitoring. The long-term monitoring well network, sample frequency, and sample parameters will be established based on available performance monitoring data at the time long-term monitoring commences. Long-term monitoring will continue until remediation goals as presented in the ROD have been achieved. In accordance with 6 NYCRR Part 360, a post-closure monitoring plan for the landfill itself has been developed and is being implemented.

2.4.2 Modifications to the Performance and Long-term Monitoring Plan

Sampling data will be evaluated after each sampling event. (See Section 2.5 for evaluation and reporting details.) Based on this review, modifications to the monitoring plan will be made, as necessary, in order to better achieve the monitoring objectives. Modifications may include extension of the performance monitoring period to better understand seasonal variations, an increase or reduction in sampling parameters, and an increase or reduction in the number of monitoring wells in the plan. Primary approval of recommendations to the plan will be made by AFRPA and USACE. Subsequently, the recommendations will be discussed with the USEPA and NYSDEC prior to implementation.

2.5 Performance Evaluation

2.5.1 Data Evaluation and Reports

Sampling data will be reviewed after each sampling event. Data evaluation reports will be prepared by Parsons and FPM and submitted annually to NYSDEC, USEPA, AFRPA, and USACE during the current contract, as described below. Each evaluation will be used to optimize the monitoring well network so that only data of sufficient quantity and quality are being collected in support of the remedy performance.

Table 2-3 Monitoring Plan, Landfill 6 Site

Site/Sampling Locations[1]	Screen Interval Depth (feet above MSL)[2]	Basis for Sampling	Target Analytes (method)	Pre-/Post-Aquifer Testing[3]	Injection[4] (quarterly)	Performance[4] (semi-annual)
Groundwater						
LF6MW-16	408.41 - 418.41	Within 500-ppb contour	VOCs (SW8260B)	-	√	√
LF6MW-17	401.04 - 411.04	Within 500-ppb contour	DOC (E415.1)	-	√	√
LF6MW-20	404.35 - 414.35	Within 500-ppb contour	Sulfate (SW9056)	√[5]	√	-
LF6VMW-13R	416.12 - 436.12	Downgradient extent	Methane/ethane/ ethene (RSK-175)	√[5]	√	√
LF6VMW-13RD	411.51 - 431.51	Monitor potential vertical migration	Field Parameters: ORP, oxygen, pH, water levels	-	√	√
LF6MW-26	400.08 - 410.08	Within 50-ppb contour		-	√	√
LF6MW-31	398.20 - 418.20	Downgradient extent		-	√	√
LF6TW-33	417.17 - 437.17	Within 50-ppb contour		-	√	√
LF6TW-34	402.60 - 422.60	Within 50-ppb contour		-	√	√
LF6TW-35	402.39 - 422.39	Upgradient extent		-	√	√
LF6TW-36	400.08 - 420.08	Within 50-ppb contour		-	√	√
LF6TW-38	402.35 – 422.35	Within 50-ppb contour		-	√	√
LF6MW-39[6]	10-30 feet bgs	Downgradient extent		-	√	√
Surface Water						
LF6-SW1 PM	–	In line with plume, between existing surface water sample locations LF6/TMCSW-2 and -3	VOCs (SW8260B) Field Parameters: Water levels	-	-	√

Notes:

1 Groundwater and surface water data that are collected in association of the Part 360 monitoring at Landfill 6 or Three Mile Creek will be reviewed to augment this monitoring network.

2 Depth in feet above mean sea level (MSL) unless otherwise stated. Monitoring well LF6MW-39 has not been installed.

3 Aquifer testing to be performed within 1 month prior to injection activities. Post-injection aquifer testing to be performed concurrently with first round of injection sampling. Aquifer testing to be performed by falling-head slug test to determine impacts on the aquifer (e.g., bio-clogging) due to substrate addition.

4 Sampling will be in accordance with the USACE/USEPA/NYSDEC-approved Griffiss AFB Basewide Field Sampling Plan (FSP) (FPM 2005a). Samples to be collected include at least one matrix spike/matrix spike duplicate (MS/MSD) and two field duplicates per sample delivery group (SDG), one equipment blank per day, one ambient blank per day; and one trip blank per cooler containing VOCs. The first round of injection monitoring will be performed 1 month after the injection and will continue quarterly for 1 year. At this time, performance monitoring will commence 6 months after the last injection monitoring round. Performance monitoring will continue semi-annually for 2 years.

5 Additional monitoring wells and number of events may be included as a part of aquifer testing within the vicinity of the injection activities to monitor the hydraulic conductivity at the site.

6 New well to be established.

Recommended elements of the evaluation report for this site include:

- A summary of site activities.

- An evaluation of new data and comparisons with previous data and established performance criteria, which would consist of presentation of the following:
  - Data in tabular format (include comparison to Calculated Total VOCs found in Appendix B);
  - Graphs (e.g., contaminant concentration versus time for individual wells and contaminant molar concentration plots [see *Principles and Practices of Enhanced Bioremediation of Chlorinated Solvents* (AFCEE 2004)]);
  - Figures (contaminant contours); and
  - Evaluation of the following:
    - Reduction of parent compound concentrations,
    - Production of dechlorination products,
    - Production of ethane and/or ethene (even low concentrations may indicate reductive dechlorination),
    - Dissolved oxygen (DO) and oxidation-reduction potential (ORP) levels are conductive for enhanced bioremediation,
    - pH levels within a range of 5 to 9 are desirable for enhanced bioremediation, and
    - DOC concentrations greater than 20 to 50 mg/L are desired in the anaerobic treatment zone.

- An evaluation of need for implementation of additional remedial phases and/or contingency plan.

- Conclusions.

- Recommendations.

During the evaluation process, it will be determined whether there is a need to implement subsequent remediation phases or the contingency plan, as discussed in Sections 2.6 and 2.7.

2.5.2 Performance Criteria

As stated in the draft ROD (AFRPA 2008), remedial action objectives (RAOs) for this site are to:

1. Achieve the cleanup goals for COCs which are 5 ppb, 5 ppb, and 2 ppb for cis-1,2-DCE, TCE, and vinyl chloride, respectively;

2. Prevent human exposure to groundwater through groundwater-use restrictions until cleanup goals are achieved; and

3. Prevent contaminated groundwater from the site from adversely impacting surface water (in Three Mile Creek), which is defined as surface water concentrations above performance indicators (NYSDEC Class GA Groundwater Quality Standards of 5 ppb for DCE and 2 ppb for vinyl chloride).

These RAOs may change based on the final ROD which will subsequently be reflected in the RAWP.

Ultimately, attainment of NYSDEC Groundwater Standards for the contaminants of concern as presented in the draft ROD (AFRPA 2008) are the cleanup objectives for this site. According to the draft ROD, the contaminants of concern at this site are cis-1,2-DCE, TCE, and vinyl chloride with cleanup goals of 5 ppb, 5 ppb, and 2 ppb, respectively. The COCs may change based on the final ROD, which will subsequently be reflected in the RAWP.

OPS for this site will be demonstrated by total VOC concentrations detected in the performance or long-term monitoring well network indicating a projected downward trend toward 50 ppb or less. Total VOCs for this site are defined as the addition of cis-1,2-DCE, TCE, and vinyl chloride concentrations. Long-term monitoring will be performed by Parsons and/or FPM during the current contract and continue until the COCs, for four consecutive routine sampling rounds, are below NYSDEC groundwater standards in force at the time this report is issued (i.e., RC is achieved), as presented in Table 1 of 6 NYCRR 703.5. The USACE/AFRPA may request that the USEPA/NYSDEC reduce the number of sample rounds used to demonstrate achievement of NYSDEC groundwater standards based on long-term monitoring data. Long-term monitoring may be performed by others, if necessary, at the conclusion of the current contract.

2.6 Subsequent Remedial Phases

Several subsequent or additional remedial options may be implemented at the Landfill 6 site, if necessary. Examples are discussed in the following subsections. An example timeline for implementation of these potential additional remedial actions is provided in Table 2-4. Additional details regarding the implementation of these remedial actions will be provided in the RAWP.

Table 2-4 Example Time Line of Subsequent Remedial Phases at Landfill 6

Description	Potential Time Frame	Performance Criteria
Perform initial injection	June 2008	--
Perform additional injections	No sooner than 2010 and no sooner than 36 months after each injection	Groundwater monitoring results that are above the projected natural degradation trend lines for wells within the enhanced bioremediation treatment area. See Appendix B for trend lines.

Table 2-4 Example Time Line of Subsequent Remedial Phases at Landfill 6

Description	Potential Time Frame	Performance Criteria
Install groundwater extraction and recirculation system	No sooner than 2010	Total VOCs > 500 ppb in LF6TW-38 detected in two consecutive performance monitoring events performed a minimum of 12 months after the last injection.
Contingency air sparge system	No sooner than 2010	VOCs are detected above water quality standards in Three Mile Creek.

2.6.1 Additional Injections

Following the primary vegetable oil emulsion injection, a secondary injection may be implemented based on performance monitoring results. The proposed criterion for performing a second injection will be the presence of total VOC concentrations above the projected total VOC trend lines (see Section 2.4) for performance monitoring wells within the 500-ppb contour area 36 months after the initial injection. The three-year time period was selected because it corresponds to the life expectancy of the first injection. A shorter time period between injections might be used if the groundwater monitoring data indicate low concentrations of VOCs. Additional injections may be implemented after a second injection, based on similar criterion calculated from the date of the most recent injection.

The substrate mixture and injection volume may be modified in subsequent injections, based on experience with injections at similar contaminated groundwater sites, or if the groundwater quality data obtained during performance monitoring indicate that a different mixture or volume may provide better treatment.

2.6.2 Groundwater Extraction and Recirculation

Groundwater may be extracted from wells located downgradient of the 500-ppb contour and recirculated, depending on the results of the substrate injection(s). This "bioreactor" concept would create an artificial hydraulic gradient that is greater than that observed under normal conditions, allowing an increased flow of groundwater through the treatment zone. The proposed criterion for implementing this bioreactor process is the presence of total VOCs (i.e., the sum of TCE, DCE, and VC) in downgradient monitoring well LF6TW-38 at a concentration greater than 500 ppb in two consecutive performance monitoring events performed a minimum of 12 months after the last injection. The one-year time period was selected because it is the minimum time necessary to properly evaluate the performance of an injection.

If it is determined that the bioreactor process is required, the bioreactor design will begin. The substrate mixture may be modified, based on experience with injections at similar contaminated groundwater sites, if the groundwater quality data obtained during the performance monitoring indicate that a different mixture may

provide better results. The groundwater extraction rate will be sufficient to contain the groundwater flowing from the 500-ppb contour area.

2.7 Contingency Plan

A contingency plan is necessary to ensure that remedial actions at the Landfill 6 site do not negatively impact the water quality in Three Mile Creek, which is located downgradient of the plume. Therefore, the contingency plan for this site will be the design and installation of an air sparge system or other suitable measure, if necessary. Figure 2-1 presents the decision process that will be used to trigger the contingency plan. This contingency plan will be implemented if one of the following criteria is met:

- Total VOCs (i.e., the sum of TCE, DCE, and VC) are detected above 50 ppb in a monitoring well (e.g., LF6MW-39 [to be installed]) outside the current 50-ppb total VOC contour given in Figure 1-1, and there is an increase in the concentration of total VOCs in LF6MW-13R for two consecutive sampling events within a similar time period.

- VOC contamination detected within Three Mile Creek above performance indicators (NYSDEC groundwater standards of 5 ppb for DCE and 2 ppb for vinyl chloride) is positively attributable to the Landfill 6 site (i.e., DCE or VC contamination that is not attributable to an upstream source).

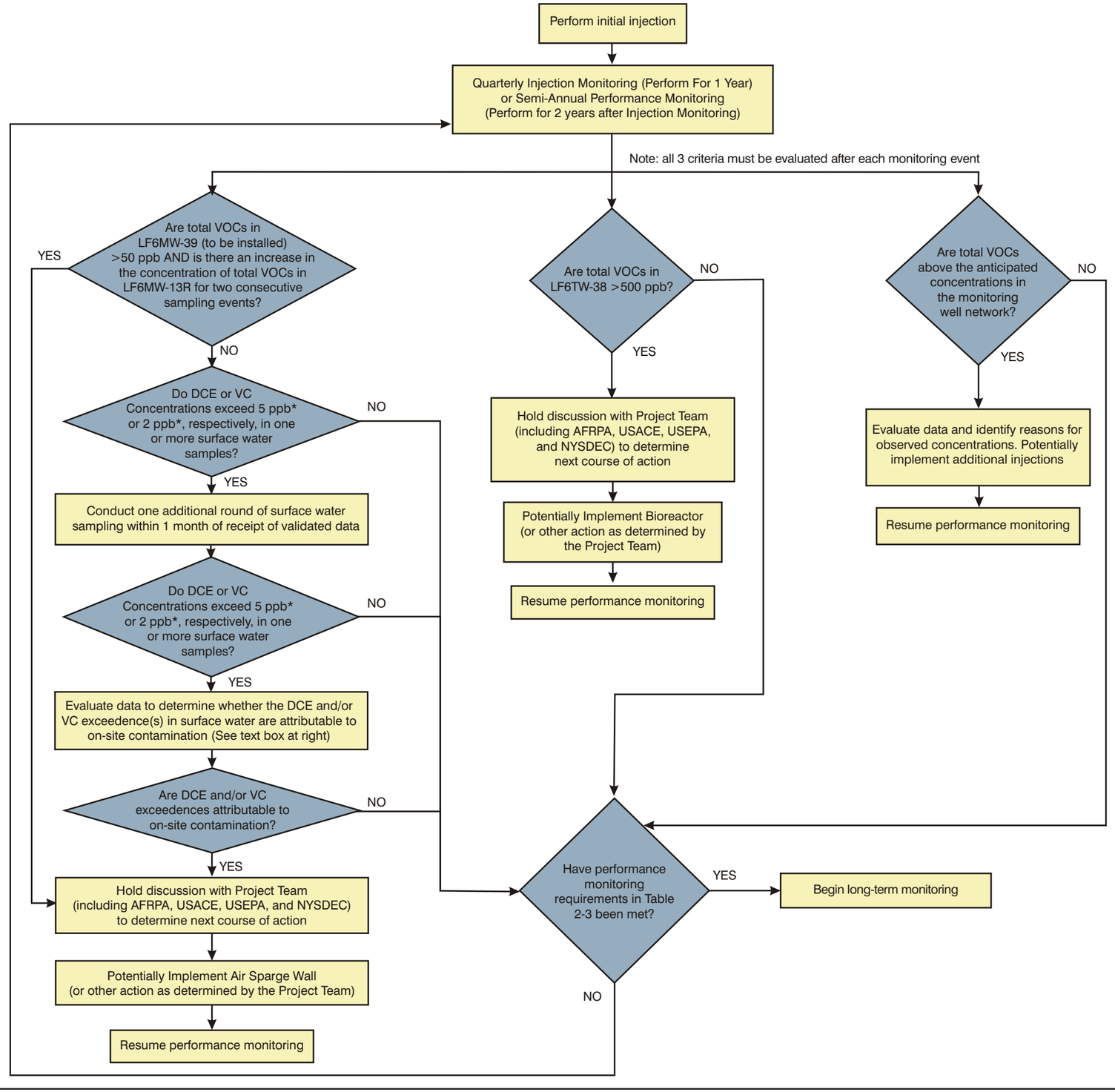
The landfill post-closure monitoring plan discussed in Section 2.4.1 includes collection of surface water samples from Three Mile Creek. The results of this surface water sampling and analysis will be used to evaluate the performance of the remedial action and as a basis for determining whether to implement the contingency plan.

In Figure 2-1, NYSDEC groundwater standards for Class GA waters are used as guidance values for surface water contaminants in the evaluation process. Groundwater standards were used because applicable surface water guidance or standard criteria for contaminants of concern in Three Mile Creek (a NYSDEC Class C stream) are not available.

2.8 Regulatory Compliance

2.8.1 Underground Injection Permitting

In New York, the USEPA is the regulatory authority that administers the Underground Injection Control (UIC) Program. Injection of the substrate at the site is considered subject to 40 CFR Part 144 because the injection points fall under the definition, “any dug hole or well that is deeper than its largest surface dimension, where the principal function of the hole is emplacement of fluids” (40 CFR 144.1(g)(1)(ii)). The injection wells are classified as Class V wells because they are not included in the descriptions of Class I, II, III, or IV wells. Class V wells are authorized by the rule contingent upon provision of basic operator information and notification of planned injection activities, as described in 40 CFR Part



Data Evaluation Procedure for Surface Water Concentration Exceedences

If DCE or VC concentrations are exceeded in one or more surface water samples, a technical memorandum should be developed. In the memorandum, the following, at a minimum, should be evaluated:

- Compare exceedence(s) concentration and location (i.e., upstream, in-line with plume, downstream) with other surface water samples collected. Is there a correlation?
- How do VC concentrations in groundwater from nearby upgradient wells compare to the exceedence in surface water?
- Do water levels indicate site groundwater is discharging into Three Mile Creek?
- Compare surface water and groundwater data with previous sampling round(s).
- Consider sampling for VOCs in sediment samples co-located with surface water sample locations (where applicable).
- Discuss sediment sample results, if applicable, and how the data correlates with exceedences detected in surface water.

* NYSDEC Groundwater Standard, Class GA

Figure 2-1 Decision Process for Contingency Plan Implementation, Landfill 6 Site

144.24. Although a permit will not be required, a notification to the USEPA will need to be filed prior to injection activities.

Extraction of contaminated groundwater followed by treatment and reinjection (as make-up water for enhanced bioremediation injection activities) within the plume's extent of contaminated groundwater appears to fall under the classification of a Class IV well. A Class IV well is defined in 40 CFR Part 144.6 as a well "used to dispose of hazardous waste." Class IV injection wells are allowable under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial actions as described by 40 CFR Part 144.13 and 23 as long as the groundwater has been treated and is being injected into the same formation from which is was drawn. Furthermore, a memorandum from Elizabeth Cotsworth (Director of USEPA's Office of Solid Waste) to Resource Conservation and Recovery Act (RCRA) Senior Policy Advisors, RCRA Enforcement Managers, and Superfund Regional Policy Managers in 2000 clarifies that treatment of the contaminated water can occur before or after reinjection (USEPA 2000). As the USEPA is the regulatory authority of the UIC program in New York, USEPA's approval for such an injection would be required. Class IV wells are authorized by rule for the life of the well.

2.8.2 Storm Water Pollution Prevention

It is not anticipated that more than an acre of soil will be disturbed as a result of the remedial construction. However, the equivalence of a temporary State Pollutant Discharge Elimination System (SPDES) permit may be required to address erosion and sediment control during remedial construction. Best Management Practices (BMPs) to control erosion and sediment, such as inlet protection and silt fencing, will be specified in the final design drawings.

2.8.3 Spill Prevention, Control, and Countermeasure Plan

Oils stored on-site are subject to 40 CFR 112, Oil Pollution Prevention. If the total volume of vegetable oil stored on site is greater than 1,320 gallons, Spill Prevention, Control, and Countermeasure (SPCC) regulations apply under 40 CFR 112 Subpart C. Under this subpart, an SPCC plan would need to be developed as well as considerations given to drainage of secondary containment systems. The fructose, lactate, and pH buffer also planned for injection activities do not fall under this regulation as these chemicals do not have similar physical properties as oil (e.g., solubility and density).

In addition, the vegetable oil and other anticipated substrate components (fructose, sodium lactate, sodium bicarbonate, etc.) do not meet the criteria of a "hazardous substance" as defined in New York State bulk chemical storage regulations (6 NYCRR Part 597) and, as such, these bulk chemical regulations do not apply.

2.8.4 Safety

Because this project is a CERCLA action involving hazardous chemicals, all remedial construction personnel shall be trained in accordance with 29 CFR

1910.120. All other applicable Federal Occupational Safety and Health Administration (OSHA) safety regulations must be followed during remedial construction and the O&M phases of the project, including the preparation of a health and safety plan.

2.8.5 Wetlands Disturbance and Mitigation

Field-delineated wetlands exist in the vicinity of Three Mile Creek, as shown on the 90% design drawings. Work limits will be defined in the final design drawings (sheet 4 of 5), if necessary, to limit disturbance of these wetlands. If wetlands are disturbed, a wetlands mitigation plan will be developed and submitted to NYSDEC for approval.

3 Building 775

3.1 Design Approach

The alternative recommended for this site in the Final Building 775 Feasibility Study Addendum (EEEPC 2006b) consists of groundwater extraction, treatment, and disposal. A pump-and-treat system will be designed based on the recommendations in the Final Feasibility Study (E & E 2005), the Feasibility Study Addendum (EEEPC 2006b), industry standards, and site-specific historical data, including:

- Groundwater analytical data and field measurements,
- Groundwater contamination contour maps,
- Soil boring logs, and
- Hydraulic conductivity test results.

The groundwater extraction well field will be designed to contain the contaminant plume within the 50-ppb total VOCs contour and extract groundwater for off-site treatment at a wastewater treatment facility to remove contaminants from the aquifer.

The pump-and-treat system will be designed for unmanned, automated operation with regular periodic inspections. Operation and maintenance (O&M) of the extraction wells and performance monitoring will be performed by Parsons and/or FPM under the current contract. AFRPA may contract others to perform this work, if necessary, once the current contract is finished. Products necessary for the system will be conventional, commercially available products, limiting the need for specialty construction.

As an alternative to an on-site pretreatment system, EEEPC has obtained preliminary approval for groundwater to be discharged directly to the existing sanitary sewer system for treatment at the publicly owned treatment works (POTW). The most recent groundwater analytical data indicate that VOCs are below the federal pretreatment standard of 2.13 parts per million (ppm) total toxic organics (TTO). (See further discussion in Section 3.4 below and correspondence in Appendix G.)

Wastes generated during construction will be handled and disposed of in accordance with the appropriate regulations.

3.2 Extraction Wells

Extraction wells will be located to capture groundwater within the 50-ppb VOC contour. It is anticipated that a single pumping well will provide sufficient capture of the plume to achieve remedial goals. However, pump testing will be conducted during implementation of the remedial action to further evaluate the flow rate necessary to meet remedial objectives. Additional wells will be installed, if necessary.

Pump testing will be performed at the proposed pumping well location to determine its capacity and capture zone. Detailed pump testing procedures are provided on the design drawings and are summarized here. Pump testing will begin with a step-drawdown test after the wells have been developed. Step testing is performed by progressively increasing the flow rate at 1-hour intervals in a serious of five steps that include 5 gallons per minute (gpm), 10 gpm, 15 gpm, 25 gpm and 50 gpm in order to evaluate its optimum pumping capacity. Following the step-drawdown test, a long-term, constant rate test will be performed over a suitable length of time (e.g., 24 hours, 72 hours, etc.) or until the cone of depression is stabilized as indicated by a straight-line trend analysis. Constant rate pump testing should be performed after the pumping well has fully recovered from the step test at a pumping rate determined in the field. During the pump test, water levels will be recorded at regular intervals at the pumping well and selected observation wells (e.g., monitoring wells 775VMW-4, 775VMW-28 and 775VMW-10 at a minimum) in the surrounding area to determine drawdown characteristics of the well. Water levels also will be collected after the pumping until groundwater has returned to approximately 90% of the pre-pumping elevation to evaluate recovery rates. Electronic dataloggers and transducers might be used to record water level measurements but water level measurements collected by a portable water level indicator should also be preformed to verify data from transducers. The data from the pump tests will be summarized and interpreted to determine whether additional pumping wells are required. Contingency pumping wells will be subject to additional pump tests as described above to determine their radius of influence. Groundwater extracted during the pumping tests will be managed in accordance with local regulations for discharge to the sanitary sewer.

The screened interval of the extraction wells will be designed so that the screen intercepts the most highly contamination levels, as determined by a review of historical data. Screen slot size will be selected based on particle size from the surrounding formation. Construction materials specified for extraction wells will be commercially available materials that meet industry standards. Extraction wells will be designed so that they can be installed using conventional rotary auger drill rigs. A proposed well detail is shown in the 90% design drawings.

Submersible well pumps will be sized and selected to transfer groundwater directly to the sanitary sewer system. An example of the type of submersible well pump that may be utilized for this project is provided in Appendix H. Instrumentation and control of the submersible pumps is discussed in Section 3.7.

3.3 Piping

As stated above, it is anticipated that one pumping well will be sufficient to contain the plume. However, system piping will be oversized, as necessary, to accommodate potential future flow from a contingency well. A proposed site plan that shows the piping is provided in the 90% design drawings. Using a common header for future flows will reduce the amount of trenching and piping necessary. Header piping will be located to limit trenching and site disruption and sized based on maximum anticipated flow rates. Specified piping will meet anticipated operational pressures and conditions. The depth of burial will be appropriate to protect piping from freezing.

3.4 Effluent Discharge

The sanitary sewer system at the former GAFB is operated by the City of Rome. Initial conversations with City of Rome Water Pollution Control Facility (WPCF) personnel indicate that discharge of effluent to the sewer is feasible (EEEPC 2007b). The City of Rome will impose limitations on water quantity and quality. For discharge to the sewer, federal pretreatment standards will apply, in addition to any others imposed by the City of Rome WPCF. Preliminary conversations with City of Rome WPCF personnel indicate that the federal pretreatment standard of 2.13 ppm TTO would be applicable as a criterion for discharge to the sanitary sewer for this project (EEEPC 2007b). Recent analytical data from the predesign investigation (EEEPC 2007a) and preliminary data from the most recent quarterly groundwater sampling indicates that the groundwater would comply with this requirement without pretreatment. Therefore, although on-site pretreatment is not anticipated, treatment of the contaminated groundwater will be performed off site at the WPCF.

A discharge point introduced/added onto the sanitary sewer system must be installed by a licensed plumber at a manhole, as required by the City of Rome WPCF. Existing sewer infrastructure along Phoenix Drive, north of the Building 775 plume, will be utilized, as directed by the City of Rome. Sewer usage fees will apply, and wet weather discharge restrictions may be imposed. If weather discharge restrictions are imposed, EEEPC and/or Parsons will evaluate the use of engineering controls to address these restrictions. Potential controls may include temporary diversion to a holding tank or temporary shut-down of the system. Temporary shutdowns, if any, due to wet weather conditions are assumed to be infrequent and short-term, based on preliminary conversations with the WPCF. Because the average groundwater velocity at this site is relatively low, at approximately 10 feet per year, any shutdown would likely have to occur for an extended period in order to prevent capture. Temporary shutdown due to equipment failure will be mitigated by maintaining replacement parts/products on site. An

example sewer discharge permit and discharge limitations provided by the City of Rome WPCF are presented in Appendix I. The sewer permit will be obtained during the RA phase.

Effluent discharge will require regular sampling and reporting to ensure that the effluent meets the discharge requirements of the sewer discharge permit.

3.5 Electrical Power

Electrical power will be required to operate pumps and controls at the extraction well. Overhead electrical power lines exist in the vicinity of the site, along Perimeter Road and adjacent to the Landfill 6 site. The electrical utility company will be identified and coordinated with to ensure that system electrical requirements can be met, determine where the power connection may be made, and whether transformers or other specialty infrastructure will be required. Electrical surge protection may be specified to mitigate system shutdowns due to voltage spikes within the electrical grid.

3.6 Instrumentation and Controls

Instrumentation and controls will be designed and selected to meet the requirements of the discharge permit and so that the system may operate with flexibility. Instrumentation is anticipated to include the ability to monitor system flow and groundwater levels at the pumping wells.

It is anticipated that a local control panel with a main power supply switch will be utilized at each pumping well. Control panels will contain hand-off-auto (HOA) switches and a read-out screen to display operational data such as flow totals, runtime, and water level information. Water level sensors and on/off controls will be specified so that pumps will operate between prescribed water levels. Remote control monitoring will not be included as part of the system as the system is relatively simplistic and O&M will be performed by FPM personnel who maintain a full staff at the former Griffiss AFB.

3.7 Monitoring Plan

Monitoring plans were developed to identify wells to be sampled as part of the baseline and performance monitoring for this site. Proposed wells are located throughout the site, within as well as outside of the plume, to assess performance of the pumping system, determine the overall effectiveness of the remediation of the site groundwater, and to ensure that the plume is not changing unexpectedly.

Baseline sampling was performed by FPM in November 2006 in accordance with the *Final Letter Work Plan, Baseline Sampling, On-Base Groundwater Areas of Concern, Former Griffiss Air Force Base, Rome New York* (FPM 2006a); analytical results from this sampling event are presented in the *Final Monitoring Report, Baseline and PDI2 Sampling, On-Base Groundwater Areas of Concern* (FPM 2007). Table 3-1 presents the proposed performance monitoring plan for this site. In addition to the sampling at these proposed locations, water levels should be

Table 3-1 Monitoring Plan, Building 775 Site

Site/Sampling Locations	Screen Interval Depth (feet above MSL)[1]	Basis for Sampling	Target Analyses (method)	Performance[2] (quarterly)	Performance[2] (semi-annual)	Evaluation Criteria
775VMW-4	447.64 - 457.64	Upgradient	VOCs (SW8260B)	√[3]	√[3]	Performance monitoring will be performed quarterly for 1 year and will continue semi-annually until remedy is complete (i.e., total VOC levels below 50 ppb in all wells).
775VMW-5	442.94 – 452.94	Within 50-ppb contour		√	√	
775MW-6	439.18 - 449.18	Within 50-ppb contour		√	√	
775VMW-8	439.29 - 449.29	Within 50-ppb contour	Field Parameters: Water levels	√	√	
775VMW-9	412.92 - 427.92	Outside 50-ppb contour, downgradient		√[3]	√[3]	
775VMW-10	412.14 - 427.14	Within 50-ppb contour		√	√	
775MW-20	398.33 - 408.33	Within 500-ppb contour		√	√	
775VMW-20R	403.85 - 413.85	Downgradient		√[3]	√[3]	
775VMW-19R[4]	80 - 120 feet bgs	Downgradient, replacement well for 775VMW-19		√	√	
775MW-27	435.79 - 455.79	Within 50-ppb contour		√	√	
775MW-28	424.72 - 444.72	Within 50-ppb contour		√	√	
Water levels will be collected from additional monitoring wells as necessary to verify the capture zone of the system.						

Notes:

1 Depth in feet above MSL unless otherwise stated.

2 Sampling will be in accordance with the USACE/USEPA/NYSDEC-approved Griffiss AFB Basewide FSP (FPM 2005a). Samples to be collected include at least one MS/MSD and two field duplicates per SDG, one equipment blank per day, one ambient blank per day, and one trip blank per cooler containing VOCs.

3 Annual sampling only.

4 New well to be installed.

5 Performance monitoring will also be completed on the five groundwater extraction wells. The samples from these samples will be collected at the same frequency as the monitoring well samples. These samples will be analyzed for VOCs (SW8260B) only. The baseline sample will be collected once the extraction system begins operation.

recorded at additional wells that are not sampled in order to verify the capture zone of the system.

The long-term monitoring plan for this specific site will be developed in a future document by FPM and will be based on available information from the baseline and performance monitoring. The long-term monitoring well network, sample frequency, and sample parameters will be established based on available performance monitoring data at the time long-term monitoring commences. Long-term monitoring will continue until remediation goals as presented in the ROD have been achieved.

3.7.1 Modifications to the Performance and Long-term Monitoring Plan

Sampling data will be evaluated after each sampling event for evaluation and reporting details. Based on this review, modifications to the monitoring plan will be made, as necessary, in order to better achieve the monitoring objectives. Modifications may include extending the performance monitoring period to better understand seasonal variations, increasing or reducing the number of sampling parameters, and increasing or reducing the number of monitoring wells in the plan. Primary approval of recommendations to the plan will be made by AFRPA and USACE. Subsequently, the recommendations will be discussed with the USEPA and NYSDEC prior to implementation.

3.8 Performance Evaluation

3.8.1 Data Evaluation and Reports

Sampling data will be reviewed after each sampling event. Data evaluation reports will be prepared by Parsons and FPM and submitted annually to NYSDEC, USEPA, AFRPA, and USACE during the current contract, as described below. Each evaluation will be used to optimize the monitoring well network so that only data of sufficient quantity and quality are being collected in support of remedy performance. Recommended elements of the evaluation report for this site include:

- A summary of site activities.

- An evaluation of new data and comparisons with previous data and established performance criteria, which would consist of presentation of the following:
  - Data in tabular format;
  - Graphs (e.g., contaminant concentration versus time for individual wells); and
  - Figures (contaminant contours).

- An evaluation of the capture zone of the system.

- Conclusions.
- Recommendations.

3.8.2 Performance Criteria

As stated in the draft ROD (AFRPA 2008), the RAOs for this site are to:

1. Achieve the cleanup goals for the site COC which is 5 ppb for TCE;
2. Prevent human exposure to groundwater through groundwater use restrictions until cleanup goals are achieved; and
3. Prevent contaminated groundwater from the site from adversely impacting surface water (in Three Mile Creek), which is defined as surface water concentrations above performance indicators (NYSDEC Class GA Groundwater Quality Standards of 5 ppb for DCE and 2 ppb for vinyl chloride).

These RAOs may change based on the final ROD which will subsequently be reflected in the RAWP.

Ultimately, attainment of NYSDEC Groundwater Standards for the COCs as presented in the draft ROD (AFRPA 2008) are the cleanup objectives for this site. According to the draft ROD, the COC at this site is TCE with a cleanup goal of 5 ppb. The COC may change based on the final ROD, which will subsequently be reflected in the RAWP.

OPS for this site will be demonstrated by total VOC concentrations detected in the performance or long-term monitoring well network indicating a projected downward trend toward 50 ppb or less. Total VOCs for this site are defined as the TCE concentration. Long-term monitoring will be performed by Parsons and/or FPM during the current contract and will continue until the COCs for four consecutive routine sampling rounds, are below the NYSDEC groundwater standards in force at the time this report is issued (i.e., RC is achieved), as presented in Table 1 of 6 NYCRR 703.5. The USACE/AFRPA may request that USEPA/NYSDEC reduce the number of sample rounds used to demonstrate achievement of NYSDEC groundwater standards based on the long-term monitoring data. Long-term monitoring may be performed by others, if necessary, at the conclusion of the current contract.

3.9 Regulatory Compliance

3.9.1 Discharge Permitting

Discharge to the sanitary sewer will require coordination and permitting with the City of Rome WPCF. The sewer discharge permit will have discharge limitations at least as stringent as the federal pretreatment standards of 2.13 ppm TTO.

3.9.2 Storm Water Pollution Prevention

It is not anticipated that more than an acre of soil will be disturbed as a result of the remedial construction. However, the equivalent of a temporary SPDES permit may be required to address erosion and sediment control during the remedial construction. BMPs to control erosion and sediment, such as inlet protection and silt fencing, are specified in the 90% design drawings.

3.9.3 Safety

Because this project is a remedial action involving toxic chemicals, all remedial construction personnel shall be trained in accordance with 29 CFR 1910.120. All other applicable federal OSHA safety regulations must be followed during remedial construction and the O&M phases of the project, including the preparation of a health and safety plan.

4 Building 817/WSA

4.1 Design Approach

The enhanced bioremediation (reductive dechlorination) program at Building 817/WSA will be based on concepts presented in the Feasibility Study Addendum (EEEPC 2006b), experience at similar contaminated groundwater sites, published guidance, and site-specific historical data, including:

- Groundwater analytical data and field measurements;
- Groundwater contamination contour interval and cross-section maps;
- Slug test results;
- Pilot study observations (potassium permanganate injection in 2002);
- Membrane Interface Probe (MIP) survey data (EEEPC 2007a); and
- Initial injection observations and results.

Enhanced bioremediation using vegetable oil has proven to be a successful technology for remediating sites with similar contaminant concentrations and subsurface conditions. In addition, according to screening guidance in the *Final Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents* (AFCEE 2004), site-specific parameters indicate the site is suitable for enhanced reductive dechlorination (see Table 4-1). Preliminary results from an initial injection performed at this site in late 2006 further indicate this site is amenable to enhanced bioremediation (see Section 4.3.1).

The injection activities will be performed in the upgradient portions of the plume, near Building 817. Injection of a vegetable oil substrate (electron donors) into the most contaminated portion of the aquifer is intended to stimulate reductive dechlorination of COCs over a period of approximately 2 to 3 years, based on the anticipated use and consumption of the substrate. Equipment and materials used for the injection are conventional, commercially available products, limiting the need for specialty construction.

Table 4-1 Suitability of Enhanced Bioremediation at Building 817/WSA

Site Characteristics	Suitable for Enhanced Bioremediation	Suitability Uncertain	Enhanced Bioremediation Suitable for Building 817/WSA	
DNAPL Presence	Residual DNAPL or sorbed sources	Poorly defined sources may require additional characterization.	Yes	VOCs detected as recently as February 2007.
Plume size	Small, less than a few acres	Medium to large, more than a few acres. May require concurrent use of more than one technology.	Yes	Plume area is approximately 2 acres (within the 30-ppb total VOC contaminant contour).
On or near site infrastructure	The risk of vapor intrusion from contaminants or biogenic gases is deemed acceptable.	Target treatment zone is proximate to sensitive infrastructure.	Yes	Building 817 is currently abandoned; no significant levels were detected in sub-slab samples inside Building 817 or in soil vapor samples along the centerline of the plume during the 2006 soil vapor study (EEEPC 2007c).
Evidence of Anaerobic Dechlorination	Slow or stalled dechlorination	Limited evidence of anaerobic dechlorination	Uncertain	Historically, PCE and TCE daughter product concentrations have been detected at low levels (i.e., below NYSDEC groundwater standards or non-detect).
Depth	< 50 feet to groundwater	> 100 feet to groundwater	Yes	Less than 10 feet to groundwater
Hydraulic conductivity	> 1 foot/day	0.01 to 1 foot/day	Yes	Hydraulic conductivity estimated to be 40.9 feet/day.
Groundwater velocity	30 feet/year to 5 feet/day	10 feet/year to 30 feet/year, 5 feet/day to 10 feet/day	Yes	Within proposed injection area, velocities were estimated to be 4 feet/day; downgradient velocities were estimated to be approximately 6 feet/day.
pH	6.0 - 8.0	5.0 to 6.0, 8.0 to 9.0	Yes	During 2006 sampling, pH was measured at 7.0 to 7.9.
Sulfate concentration	< 500 ppm	500 to 5,000 ppm	Yes	During 2006 sampling, sulfate was detected at 5.6 ppm to 11 ppm (inside the plume) and 22 ppm (outside the plume).

Notes:
1 Table is based on data provided in *Principles and Practices of Enhanced Bioremediation of Chlorinated Solvents* (AFCEE 2004).

Wastes generated during construction will be handled and disposed of in accordance with the appropriate regulations. After the substrate is injected, monitoring will be performed to evaluate the effectiveness of the injection (see Section 4.4).

4.2 Contaminant Source

Identification and treatment of the plume source is critical to effectively remediate site contaminants using enhanced bioremediation. Previous site investigations concluded that a PCE/TCE contaminant source appears to have originated near Building 817, near the upgradient edge of the contaminant plume (E & E 2001). Predesign activities were performed in late 2006 to locate a source area using MIP technology. Results of the MIP survey could not definitively identify a source area (EEEPC 2007a). Thus, the injection activities presented in this design will focus on remediation of the area of highest VOC contamination by injecting substrate at the head of the area of highest VOC concentrations immediately adjacent to Building 817. In the event the injection described above does not perform as anticipated as evidenced by analytical sampling, additional injections will be considered (see Section 4.3.2).

4.3 Substrate Injection

The 90% design drawings present existing conditions as well as the proposed design. Contaminant concentrations presented on the drawings were developed as described in Section 1.4.3.

4.3.1 Initial Injection

An initial vegetable oil injection was performed during the 2006 Predesign Investigation to evaluate critical design parameters for the full-scale application (EEEPC 2007a). On October 25 and 26, 2006, a total of approximately 8,000 gallons of the diluted vegetable oil/lactate substrate was injected in one row of eight temporary injection wells located just south of Building 817 (see 90% design drawings for well locations). These injection wells were screened over 5 feet between 14 and 19 feet bgs. The vegetable oil used was a 60% soybean oil emulsion (EOS 598) manufactured by EOS Remediation, Inc. High fructose corn syrup (80%) manufactured by Cargill Sweeteners also was a component of the injectant. The following observations made during this injection that are critical to this design include:

- Substrate was injected at a rate of 5 gallons per minute.
- Groundwater levels collected before and after each injection indicated no mounding in adjacent wells.
- Approximately six weeks after the injection (December 8, 2006), TOC and alkalinity data indicated that the substrate persistence within the influence area of the injections was not as high as expected. Several factors could have contributed to these preliminary results, including groundwater moving at a veloc-

ity greater than calculated, variability in subsurface geochemical conditions, or type of substrate material.

- After one round of analytical samples collected in February 2007, analytical results indicated decreasing total VOC concentrations. Based on a comparison of November 2006 and February 2007 results, total VOC concentrations decreased from 30.6 ppb to 9 ppb in B817-MW-002, 34 ppb to 20 ppb in B817-MW-003, and 121 ppb to 86.4 ppb in WSA-MW18 (FPM 2007). Additional rounds of sampling are planned to obtain a more thorough evaluation of the effect of the initial injection at the site.

4.3.2 Injection Program Configuration

The full-scale injection program will consist of one primary and possibly a secondary injection event involving injection points extending through the width of the plume (perpendicular to groundwater flow) to the 100-ppb contaminant contour, as shown on the 90% design drawings. The first injection event will involve one row of injection points located near the upgradient end of the plume. If total VOC concentrations in groundwater do not decrease as anticipated, up to two additional injection rows may be advanced throughout the plume during a secondary injection event (see Section 4.5). If observed total VOC concentrations exceed anticipated concentrations at levels greater than 30 ppb total VOCs for a minimum of two consecutive sampling events and DOC levels are less than 20 mg/L, the secondary injection will be considered. The secondary injection will be made at two additional rows of injection wells. The likely locations for these rows will be north of Perimeter Road and within 50 feet south of WSA-MW18, and just south of Perimeter Road and inside the fence line (refer to 90% design drawings for location). However, these locations may be modified as conditions change at the site.

For the primary injection event, vegetable oil will be injected in existing temporary wells spaced approximately 10 feet apart. These wells are screened at 14 to 19 feet bgs, which is where the highest VOC concentrations were detected (impacted groundwater has been detected at approximately 5 feet bgs and extends to approximately 20 to 25 feet bgs). Surrounding areas within the water column above, below, and side-gradient also will be impacted by the substrate injection by advection, diffusion, and dispersion. The screened intervals for points advanced in the secondary injection event will be determined at a later date.

Based on the target interval depth, substrate volumes will be modified to ensure that an adequate amount of substrate is injected and distributed between the wells. The design will include an overlap in radius of influence between points to provide treatment throughout the width of the plume.

4.3.3 Injection Substrate and Volumes

The substrate will consist of a combination of vegetable oil, a pH buffer, and make-up water. Based on observations made during the initial injection, 100%

neat soybean oil will be used as opposed to the 60% soybean oil emulsion used for the initial injection; this is expected to more effectively adhere to soil particles and provide for greater longevity within the aquifer. Additionally, a soluble substrate such as lactate (as proposed at the Landfill 6 site) will not be used at the Building 817/WSA site due to observations made during the initial injection. A soluble substrate was added during the initial injection however, did not appear to have a beneficial impact on the performance of the injection as groundwater flows are higher at this site than at Landfill 6. It is anticipated that the bulk material brought on site will be stored in Building 817. It also is anticipated that make-up water will be obtained from a nearby base fire hydrant. Confirmation for the use of Building 817 and hydrant water will need to be coordinated through the Air Force and applicable utility personnel.

The minimum amount of injection substrate to be injected per point will be calculated in a manner similar to that described in Section 2.3.3. Substrate volume calculations used for the initial injection will be updated to represent changes discussed in this section and other empirical data. These calculations are provided in Appendix F.

4.3.4 Injection Delivery System

For the primary injection event, existing 3/4-inch polyvinyl chloride (PVC) injection wells constructed for the initial injection event in 2006 will be used. The injection wells were installed to 19 feet bgs and constructed with a 5-foot (0.01-inch slot) PVC screen set from 14 to 19 feet bgs (EEEPC 2007a).

If secondary injection rows are needed, each injection point will be advanced using direct-push technology to a depth to be determined. It is assumed only one injection event will be necessary at these secondary injection rows. Therefore, temporary PVC injection wells will not be installed at each point. Direct-push injection points will be abandoned by filling them with bentonite.

The vegetable oil emulsion will be prepared on site in order to obtain an increased droplet size in the emulsion. The larger droplet size allows for greater longevity of the substrate in the subsurface. A static in-line mixer, high-speed shear mixer or similar may be used to emulsify the substrate mixture in the field prior to injecting it into the subsurface. Typically, field preparation using static in-line or high-speed shear mixers is capable of obtaining average droplet sizes of 2 to 20 microns. A diaphragm pump, flow meter, mixer, and mixing tank will be used, as necessary, to mix the emulsion to the desired composition. The substrate will be injected into each point at a rate of approximately 5 to 7 gallons per minute. The existing clean 1,000-gallon polyethylene tank available on-base (used during the initial injection) will be used to the extent practicable for mixing. Additional mixing tanks will be used as needed to fulfill injection requirements.

4.3.5 Special Considerations

Due to the nature of this technology (enhanced bioremediation) and the site location, special considerations have been identified.

- **Access (for work inside the fenceline).** Griffiss Airpark flightline personnel (Mr. Ed Arcuri at 315-736-4171 [cell], or other applicable personnel) will need to be informed a minimum of one month prior to injection activities of the number of personnel and type of equipment that will be needed to perform the remedial activities. Dates and hours of activities also must be conveyed to flightline personnel. Federal Aviation Administration (FAA) regulations and policies may apply to activities conducted within or near the existing air strip, which may involve coordination, notification, and special procedures. Applicable FAA regulations and policies also will be coordinated with Griffis Air Park.

- **Utility Corridor.** Previous investigations and studies identified a below-ground utility corridor extending perpendicular to Perimeter Road; this is shown on the existing site plan of the 90% design drawings as a potential preferential pathway (E & E 2004b). The suspected extent and configuration of the utility was discussed in the *Final Predesign Investigation Data Summary Report at Landfill 6, Building 817/WSA, Building 775/Pumphouse 3, and AOC 9* (EEEPC 2007a). There appears to be a hard-surface electrical conduit extending from a vault inside Building 817 to a manhole inside the fenceline south of Perimeter Road. The approximate location of this utility corridor is defined by Geoprobe refusals along a 7-foot-wide area perpendicular to Perimeter Road (see 90% design drawings). If this utility corridor appears to be a preferential pathway (e.g., a large quantity of substrate is accepted at low pressure), visual monitoring of existing manholes in this area will be performed. Injection activities will be discontinued if substrate appears in the manholes. DOC levels in existing monitoring wells will be monitored as part of injection sampling. If target DOC levels are met in the monitoring wells the injection will continue. If target DOC levels are not met, discussions will be held with the project team to determine the next course of action.

4.4 Monitoring Plan

VOC concentration trend lines were developed for monitoring wells within the performance monitoring network that exhibited total VOC concentrations greater than 30 ppb. These trend lines will be used as a basis for evaluating the effectiveness of the proposed remedy. These trend lines are presented in Appendix D. The VOC concentration trend lines are an indication of the "natural" degradation occurring at the site and are the result of other processes in addition to biodegradation, including abiotic degradation, dilution, dispersion, and sorption. Typically, attenuation trend lines follow an exponential decay pattern, with higher concentrations decreasing at a faster rate than lower concentrations. Historical total VOC concentrations at monitoring wells from this site followed a similar trend. Using

this historical data, total VOC concentration trend lines were calculated to illustrate what is likely to occur in the future through 2016, assuming the proposed remedy is not implemented. This trend line will be used for comparison purposes during periodic evaluations. Remedial actions are expected to result in total VOC concentrations below this curve.

For example, total VOC concentrations at WSA-MW16 were detected at levels greater than 100 ppb in 2004. Concentrations in this well have decreased over time at an approximate rate of 18 ppb per year. Considering this observed rate of concentration decrease at the site, attenuation rates were selected as indicated in Table 4-2.

Table 4-2 Attenuation Rates of COCs at the Building 817/WSA Site

Total VOC concentration (ppb)	Selected Rate of Concentration Decrease (ppb per year)
> 100	15
30 - 99	10
5 - 29	5

The rate of concentration decrease may be modified in the future based on new analytical data.

4.4.1 Monitoring Well Network, Frequency, and Parameters

Monitoring plans were developed to identify wells to be sampled as part of the baseline, injection, and performance monitoring for this site. Proposed wells are located throughout the site, within and outside of the plume, to assess performance of enhanced reductive dechlorination, determine the effectiveness of the remediation of the site groundwater, and to ensure that the plume is not changing in a negative way (e.g., expanding or migrating toward Six Mile Creek).

Baseline sampling was performed by FPM in November 2006 in accordance with the *Final Letter Work Plan, Baseline Sampling, On-Base Groundwater Areas of Concern* (FPM 2006a); analytical results from this sampling event are presented in the *Final Monitoring Report, Baseline and PDI2 Sampling, On-Base Groundwater Areas of Concern* (FPM 2007). Table 4-3 presents the pre-/post-aquifer testing, injection and performance monitoring plan for this site.

The long-term monitoring plan will be developed in a future document by FPM and will be based on available information from the baseline, injection, and performance monitoring. The long-term monitoring well network, sample frequency, and sample parameters will be established based on available performance monitoring data at the time long-term monitoring commences. Long-term monitoring will continue until remediation goals as presented in the ROD have been achieved.

Table 4-3 Monitoring Plan, Building 817/WSA Site

Site/Sampling Locations	Screen Interval Depth (feet above MSL)[1]	Basis of Sampling	Target Analytes (method)	Pre-/Post-Aquifer Testing[2]	Injection[3] (quarterly)	Performance[3] (semi-annual)
Groundwater						
WSA-MW8	506.37 - 516.37	Upgradient	VOCs (SW8260B)	–	√[4]	√[4]
WSA-MW9	474.6 - 479.6	Downgradient		–	√	√
LAWMW-9	490.84 - 500.84	Downgradient	DOC (E415.1)	–	√[4]	√[4]
WSA-MW16	491.86 - 501.86	Within 100-ppb contour		√[5]	√	√
WSA-VMW17	483.24 – 493.24	Within 30-ppb contour	Sulfate (SW9056)	–	√	√
WSA-MW18	499.23 - 504.23	Within 100-ppb contour		√[5]	√	√
WSA-MW19	493.79 - 498.79	Between MW-16 and VMW-17	Methane/ethane/ ethene (RSK-175)	√[5]	√	√
WSA-MW21	484.72 - 494.72	Downgradient, within 30 ppb contour		–	√[4]	√[4]
WSA-MW23	493.16 - 503.16	Cross-gradient, outside plume boundary	Field parameters: ORP, oxygen, pH, water levels	–	√[4]	√[4]
Surface Water						
WSA-SW1PM[6]	–	Upstream end of culverted section of Six Mile Creek	VOCs (SW8260B)	–	–	√
WSA-SW2PM[6]	–	Nearest downgradient manhole in culverted section of Six Mile Creek in projected pathway of plume; monitor potential discharge to Six Mile Creek	Field parameters: Water levels	–	–	√
WSA-SW3PM[6]	–	Culvert effluent; monitor potential discharge to Six Mile Creek		–	–	√

Table 4-3 Monitoring Plan, Building 817/WSA Site

Site/Sampling Locations	Screen Interval Depth (feet above MSL)[1]	Basis of Sampling	Target Analytes (method)	Pre-/Post-Aquifer Testing[2]	Injection[3] (quarterly)	Performance[3] (semi-annual)
Other						
MH-1	–	To identify potential preferential pathway	Visual Monitoring (look for presence of substrate)	–	√	–
MH-2	–	To identify potential preferential pathway		–	√	–
MH-3	–	To identify potential preferential pathway		–	√	–

Notes:

[1] Units in feet above MSL unless otherwise stated. WSA-VMW17 not yet surveyed.

[2] Aquifer testing to be performed within 1 month prior to injection activities. Post-injection aquifer testing to be performed concurrently with first round of injection sampling. Aquifer testing to be performed by falling-head slug test to determine impacts on the aquifer (e.g., bio-clogging) due to substrate addition.

[3] Sampling will be in accordance with the USACE/USEPA/NYSDEC-approved Griffiss Basewide FSP (FPM 2005a). Samples to be collected include at least one MS/MSD and two field duplicates per SDG, one equipment blank per day, one ambient blank per day, and one trip blank per cooler containing VOCs. The first round of injection monitoring will be performed 1 month after the injection has occurred and continue quarterly for 1 year. At this time, performance monitoring will commence 6 months after the last injection monitoring round. Performance monitoring will continue semi-annually for 2 years. Wells identified for annual sampling only will first be sampled during the first round of injection monitoring and annually thereafter.

[4] Annual sampling frequency only.

[5] Additional monitoring wells and number of events may be included as a part of aquifer testing within the vicinity of the injection activities to monitor the hydraulic conductivity at the site.

[6] Surface water samples will be collected only if results from WSA-MW9 are above the criteria identified on Figure 4-1.

4.4.2 Modifications to the Performance and Long-term Monitoring Plan

Sampling data will be evaluated after each sampling event for evaluation and reporting details. Based on this review, modifications to the monitoring plan will be made, as necessary, in order to better achieve the monitoring objectives. Modifications may include extending the performance monitoring period to better understand seasonal variations, increasing or reducing the number of sampling parameters, and increasing or reducing the number of monitoring wells in the plan. Primary approval of recommendations to the plan will be made by AFRPA and USACE. Subsequently, the recommendations will be discussed with the USEPA and NYSDEC prior to implementation.

4.5 Performance Evaluation

4.5.1 Data Evaluation and Reports

Sampling data will be reviewed after each sampling event. Data evaluation reports will be prepared by Parsons and FPM and submitted annually to NYSDEC, USEPA, AFRPA, and USACE, as described below. Each evaluation will be developed to optimize the monitoring well network so that only data of sufficient quantity and quality are being collected in support of remedy performance. Recommended elements of the evaluation report for this site will include:

- A summary of site activities;

- An evaluation of new data and comparisons with previous data and established performance criteria, which would consist of presentation of the following:
  - Data in tabular format,
  - Graphs (contaminant concentration versus time for individual wells, contaminant concentrations versus distance downgradient for several wells along the groundwater flowpath, and contaminant molar concentration plots [see *Principles and Practices of Enhanced Bioremediation of Chlorinated Solvents* (AFCEE 2004)]),
  - Figures (contaminant contours),
  - Evaluation of need to perform a secondary injection event,
  - Evaluation of need for implementation of contingency plan, and
  - Evaluation of the following:
    - Reduction of parent compound concentrations,
    - Production of dechlorination products,
    - Production of ethane and/or ethene (even at low concentrations may indicate reductive dechlorination);
    - DO and ORP levels are conductive for enhanced bioremediation,
    - pH levels within a range of 5 to 9 are desirable for enhanced bioremediation, and
    - DOC concentrations greater than 20 to 50 mg/L are desired in the anaerobic treatment zone.

- Conclusions;
- Recommendations.

During the evaluation process, it will be determined whether there is a need to perform a second injection event or implement the contingency plan. Anticipated total VOC concentration trend lines were developed for monitoring wells at the site with total VOC concentrations greater than 30 ppb (see Appendix D). These trend lines were estimated based on VOC concentration reductions observed to date at the site. If observed total VOC concentrations exceed anticipated concentrations at levels greater than 30 ppb total VOCs for a minimum of two consecutive sampling events and DOC levels are less than 20 mg/L, the secondary injection will be considered. The substrate mixture may be modified, based on experience at similar contaminated groundwater sites, if groundwater quality data obtained during the performance monitoring indicate that a different mixture may provide better results. Figure 4-1 presents the decision process that will be used to trigger the contingency plan described in Section 4.6.

The Building 817/WSA site has a greater groundwater velocity than the Landfill 6 site. Therefore, groundwater extraction and recirculation, as proposed at the Landfill 6 site in Section 2.6.2, is not anticipated.

4.5.2 Performance Criteria

As stated in the draft ROD (AFRPA 2008), the RAOs for this site are to:

1. Achieve the cleanup goals for COCs, which are 5 ppb and 5 ppb for PCE and TCE, respectively;

2. Prevent human exposure to groundwater through groundwater use restrictions until cleanup goals are achieved; and

3. Prevent contaminated groundwater from the site from adversely impacting surface water (in Six Mile Creek), which is defined as surface water concentrations above performance indicators (NYSDEC Class GA Groundwater Quality Standards of 5 ppb for DCE and 2 ppb for vinyl chloride).

These RAOs may change based on the final ROD which will subsequently be reflected in the RAWP.

Ultimately, attainment of NYSDEC Groundwater Standards for the COCs as presented in the draft ROD (AFRPA 2008) are the cleanup objectives for this site. According to the draft ROD, the COCs at this site are PCE and TCE with cleanup goals of 5 ppb and 5 ppb, respectively. The COCs may change based on the final ROD, which will subsequently be reflected in the RAWP.

OPS for this site will be demonstrated by total VOC concentrations detected in the performance or long-term monitoring well network indicating a projected downward trend toward 30 ppb or less. Total VOCs for this site are defined as the addition of PCE and TCE concentrations. Long-term monitoring will be performed by Parsons and/or FPM during the current contract and continue until the COCs, for four consecutive routine sampling rounds, are below NYSDEC groundwater standards in force at the time this report is issued (i.e., RC is achieved), as presented in Table 1 of 6 NYCRR 703.5. The USACE/AFRPA may request that the USEPA/NYSDEC reduce the number of sample rounds used to demonstrate achievement of NYSDEC groundwater standards based on the long-term monitoring data. Long-term monitoring may be performed by others, if necessary, at the conclusion of the current contract.

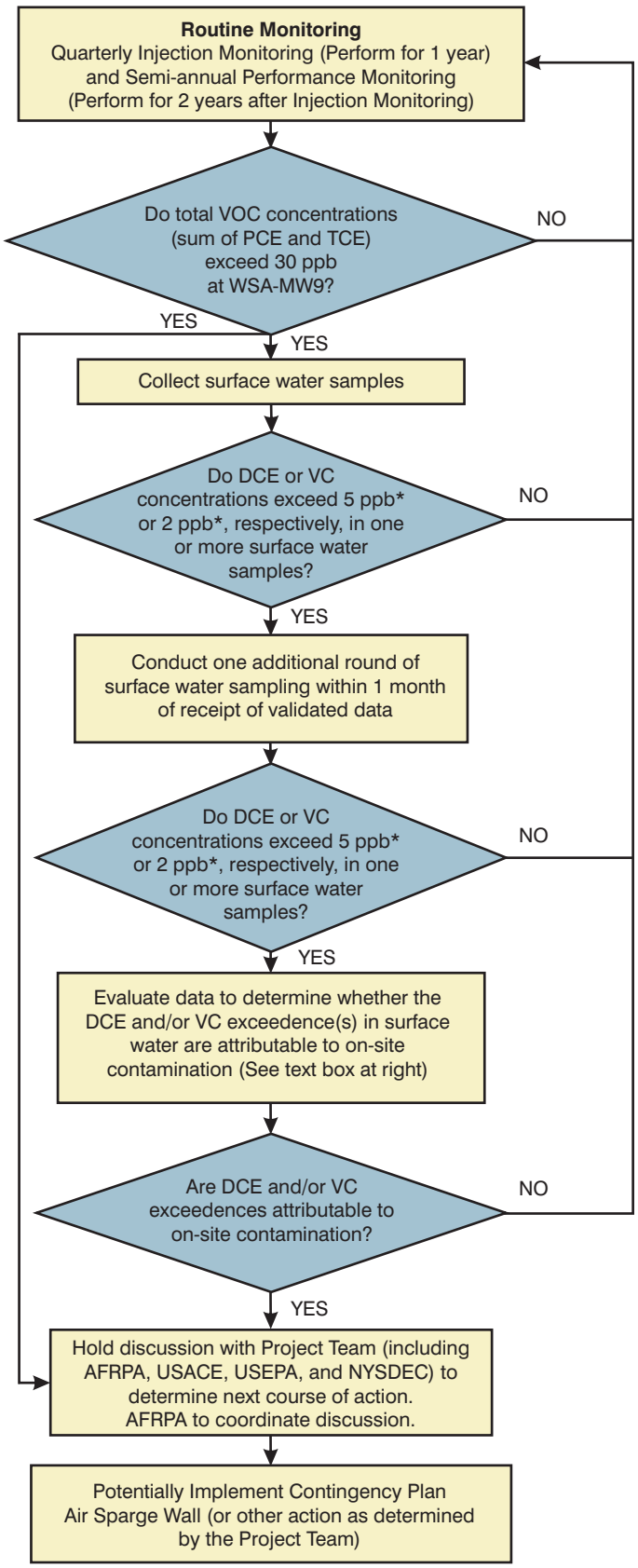
4.6 Contingency Plan

As PCE and TCE degrade under reductive dechlorination, a buildup of cis-1,2-DCE and VC in downgradient portions of the plume is not uncommon. Therefore, a contingency plan to address the entire areal extent of the plume will not be developed. Rather, a contingency plan will be described briefly to address the potential for cis-1,2-DCE and VC to reach Six Mile Creek, which could impact human health and environmental receptors. The contingency plan for this site will be implemented based on recommendations made during the evaluation process (see Section 4.5).

In Figure 4-1, NYSDEC groundwater standards for Class GA waters are used as guidance values for surface water contaminants in the evaluation process. Groundwater standards were used because applicable surface water guidance or standard criteria for contaminants of concern in Six Mile Creek (a NYSDEC Class C stream) are not available.

According to Figure 4-1, if surface water exceedances are attributable to site groundwater, AFRPA, USACE, USEPA, and NYSDEC will determine the next course of action at the site. An air sparge wall or similar measure that is protective of human health and the environment will be implemented. For the purposes of this report, the air sparge wall will be described briefly. Full-scale design of the wall or other measure will be performed at a later date if the need for installation is warranted.

At the Building 817/WSA site, an in situ air sparging wall system would be installed, if necessary, approximately 300 feet upgradient of the culverted section of Six Mile Creek to treat VOCs in site groundwater prior to potential discharge to the creek. Air sparging would be used to inject pressurized air into the groundwater across the width of the plume. As the injected air traverses up through the saturated zone, volatile organics that may be present will partition to the vapor phase and be transported toward the surface and eventually discharged to the ambient air through the unsaturated zone. The concentrations of contaminants in the emitted air are estimated to be negligibly low and, thus, no off-gas treatment



Data Evaluation Procedure for Surface Water Concentration Exceedences

If DCE or VC concentrations are exceeded in one or more surface water samples, a technical memorandum should be developed. In the memorandum, the following, at a minimum, should be evaluated:

- Compare exceedence(s) concentration and location (i.e., upstream, in-line with plume, downstream) with other surface water samples collected. Is there a correlation?
- How do VC concentrations in groundwater from nearby upgradient wells compare to the exceedence in surface water?
- Do water levels indicate site groundwater is discharging into Six Mile Creek?
- Compare surface water and groundwater data with previous sampling round(s).
- Consider sampling for VOCs in sediment samples co-located with surface water sample locations (where applicable).
- Discuss sediment sample results, if applicable, and how the data correlates with exceedences detected in surface water.

* NYSDEC Groundwater Standard, Class GA

Figure 4-1 Decision Process for Contingency Plan Implementation, Building 817/WSA Site

would be required. The need for a soil vapor extraction (SVE) system is not anticipated since the need to control and collect vapors would be unnecessary due to the absence of buildings or habitable structures in the vicinity of this portion of the creek.

4.7 Regulatory Compliance

4.7.1 Underground Injection Permitting

In New York, the USEPA is the regulatory authority that administers the Underground Injection Control Program. Injection of the substrate at the site is considered subject to 40 CFR Part 144 as the injection points fall under the definition, "any dug hole or well that is deeper than its largest surface dimension, where the principal function of the hole is emplacement of fluids" (40 CFR 144.1(g)(1)(ii)). The injection wells are classified as Class V wells because they are not included in the descriptions of Class I, II, III, or IV wells. Class V wells are authorized by the rule contingent upon provision of basic operator information and notification of planned injection activities as described in 40 CFR Part 144.24. Although a permit will not be required, a notification to the USEPA will need to be filed prior to injection activities.

4.7.2 Storm Water Pollution Prevention

Minor disturbance to the site is anticipated as a result of injection activities. Because soil disturbance is not anticipated to be greater than 1 acre, a NYSDEC SPDES permit for construction activities will not be required. Where applicable, BMPs will be used to control erosion and sediment transport for disturbed soils.

4.7.3 SPCC Plan

Oils stored on site are subject to 40 CFR 112, Oil Pollution Prevention. If the total volume of vegetable oil stored on site is greater than 1,320 gallons, SPCC regulations apply under 40 CFR 112 Subpart C. Under this subpart, an SPCC plan would need to be developed as well as considerations given to drainage of secondary containment systems.

In addition, the vegetable oil and other anticipated substrate component, sodium bicarbonate, do not meet the criteria of a "hazardous substance" as defined in New York State bulk chemical storage regulations (6 NYCRR Part 597) and, as such, these bulk chemical regulations do not apply.

4.7.4 Safety

Because this project is a CERCLA action involving hazardous chemicals, all remedial construction personnel shall have been trained in accordance with 29 CFR 1910.120. All other applicable Federal OSHA safety regulations must be followed during remedial construction and the O&M phases of the project, including the preparation of a health and safety plan.

5 Nosedocks/Apron 2

5.1 Design Approach

The MNA design will be based on recommendations presented in the Final Groundwater Feasibility Study (FPM 2006c) as well as site data, including:

- Groundwater analytical data and field measurements,
- Groundwater contamination contour interval maps, and
- Natural attenuation modeling.

The primary guidance documents used as a basis for this design include *Designing Monitoring Programs to Effectively Evaluate the Performance of Natural Attenuation* (AFCEE 2000) and *Performance Monitoring of MNA Remedies for VOCs in Groundwater* (USEPA 2004). The monitoring program at the Nosedocks/Apron 2 site will be designed to determine whether natural attenuation is occurring as expected and is capable of achieving program objectives. This evaluation process will be based on the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA 1998) and is described in detail in the following sections.

Wastes generated during construction will be handled and disposed of in accordance with the appropriate regulations.

5.2 MNA at Nosedocks/Apron 2

MNA uses the ongoing physical, chemical, and/or natural biological processes (i.e., volatilization, dispersion, sorption, and biodegradation) to reduce the concentration of contaminants within an aquifer. According to the *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (USEPA 1998), natural attenuation of chlorinated solvents in groundwater is demonstrated by the following evidence:

1. Historical groundwater and/or soil chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points.

2. Hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the site, and the rate at which such processes will reduce contaminant concentrations to required levels.

3. Data from field or microcosm studies that directly demonstrate the occurrence of a particular natural attenuation process at the site and its ability to degrade the contaminants of concern.

Section 5 of the Final Feasibility Study (FPM 2006c) provides detailed discussions in support of natural attenuation at the site based on the first two lines of evidence. Because the first two lines of evidence indicate natural biodegradation at the site, microcosm studies were not performed. USEPA guidance (USEPA 1998) supports this methodology, as microcosm studies are recommended for sites where the first two lines of evidence provide inadequate or inconclusive indication of natural biodegradation.

It is noted that an in situ horizontal air sparge barrier was installed in late 2006 near Six Mile Creek as part of the remediation efforts for the benzene plume. Air sparging is a common technology used to remediate VOC contaminated groundwater plumes (e.g., BTEX, chlorinated solvents). Because of the existing horizontal air sparge barrier's location, it should not impact the chlorinated solvent plume; however, the evaluation of groundwater concentrations monitored as part of this design should consider the potential impact of this adjacent remediation system.

5.3 Monitoring Objectives

In addition to the remedial design objectives presented in Section 1 of this report, the USEPA OSWER Directive 9200.4-17P (USEPA 1999) provides eight specific objectives for the performance monitoring program of an MNA remedy:

1. Demonstrate that natural attenuation is occurring according to expectations;

2. Detect changes in environmental conditions (e.g., hydrogeologic, geochemical, microbiological, or other changes) that may reduce the efficacy of any of the natural attenuation processes;

3. Identify any potentially toxic and/or mobile transformation products;

4. Verify that the plume(s) is not expanding downgradient, laterally or vertically;

5. Verify that there is no unacceptable impact on downgradient receptors;

6. Detect new releases of contaminants to the environment that could impact the effectiveness of the natural attenuation remedy;

7. Demonstrate the efficacy of institutional controls that were put in place to protect potential receptors; and

8. Verify attainment of remediation objectives.

The MNA performance monitoring plan discussed herein provides an evaluation process, including data collection and reporting, to achieve these objectives.

5.4 MNA Monitoring Plan

The MNA monitoring plan at this site includes collection of groundwater and surface water samples. Although groundwater is the media of concern at the site, surface water samples collected from Six Mile Creek will be included to monitor for site COCs potentially reaching the creek. This plan also addresses sample analysis and collection frequency.

5.4.1 Groundwater Monitoring Well Configuration

AFCEE and USEPA guidance (AFCEE 2000; USEPA 2004) recommend that the monitoring well network include wells upgradient from, within, and downgradient of the plume. Fifteen monitoring wells will be sampled, as shown on the 90% design drawings and Table 5-1, based on this guidance. Because there are three groundwater plumes at this site, monitoring well locations within the plumes were selected to be within an individual constituent plume, where reasonable, as well as where the plumes overlap. A "background" monitoring well (782VMW-98) is located upgradient from the TCE plume area to monitor background levels. Monitoring well 782VMW-101 is located downgradient of the leading edge of the plume and upgradient of Six Mile Creek. This well will be used to monitor the potential migration of COCs toward the creek. Two monitoring wells (782VMW-84D and 782VMW-121D) will be installed to monitor the vertical migration of site contaminants of concern.

Three new wells (782VMW-84D, 782VMW-121, and 782VMW-121D) will be installed as part of this design. Monitoring wells 782VMW-84D and 782VMW-121D will be installed to monitor potential vertical migration of the plume, while 782VMW-121 will be installed to monitor the leading edge of the plume nearest to Six Mile Creek. These wells will be installed and developed prior to the first round of sampling. The monitoring well locations are indicated on the 90% design drawing, and well construction details such as screened interval are presented on Table 5-1.

Table 5-1 Monitoring Plan, Nosedocks/Apron 2 Site

Site/Sampling Locations	Screen Interval Depth (feet above MSL)	Basis of Sampling	Target Analyses (method)	Performance[1] (quarterly)	Long-term[1] (semi-annual)
Groundwater					
782VMW-76	444.86 – 434.86	Within VC plume	VOCs (SW8260)	√	√
782VMW-78	446.26 – 436.26	Within DCE and VC plume		√	√
782VMW-81	437.71 – 427.71	Within DCE and VC plume	Natural Attenuation Parameters:	√	√
782VMW-84	441.9 – 431.9	Within VC plume	Chloride (SW9056)	√	√
782VMW-84D[2]	430 - 420	Monitor potential vertical migration of plume	DOC (E415.1)	√	√[3]
782VMW-93	447.79 – 437.79	Within VC plume	Nitrate (E353.2)	√	√
782VMW-96	444.13 – 434.13	Within VC plume	Sulfate (SW9056)	√	√
782VMW-98	452.06 – 442.06	Upgradient of plumes	Total Alkalinity (E310.1)	√	-
782VMW-100	447.1-432.1	Cross-gradient		√[4]	-
782VMW-101	444.11 – 429.11	Downgradient	Field Measurements:	√	√
782VMW-105B	450.37 – 435.37	Within TCE plume	ORP, temperature, DO,	√	√
782MW-10	458.79 – 443.79	Within DCE and VC plume	pH, conductivity, turbidity,	√	√
782VMW-121[2]	440 - 430	Within VC plume (near leading edge)	ferrous iron	√	√
782VMW-121D[2]	430 - 420	Monitor potential vertical migration of plume	Water levels	√	√[3]
AP2MW-3	446.97-432.41	Cross-gradient		√[5]	√[5]
Surface Water					
782SW-115	–	Potential contaminant receptor	VOCs (SW8260)	√	√
782SW-118	–	Potential contaminant receptor	Water levels	√	√
782SW-119	–	Potential contaminant receptor		√	√

Notes:

1 Sampling will be in accordance with the USACE/USEPA/NYSDEC-approved Griffiss AFB Basewide FSP (FPM 2005a). Samples to be collected include at least one MS/MSD and two field duplicates per SDG, one equipment blank per day, one ambient blank per day, and one trip blank per cooler containing VOCs.

2 New well to be installed; well screen interval is an approximation based on nearby wells (actual screen interval to be determined upon installation).

3 Annual sampling only.

4 To be sampled during first performance sampling round only.

5 Data collected from long-term monitoring of the Apron 2 petroleum plume will be utilized to augment this monitoring network.

5.4.2 Surface Water Sampling Locations

One sample location (782SW-115) of the three surface water sampling locations is located within Six Mile Creek downgradient of the approximate centerline of the plume. The remaining two sampling locations (782SW-118 and 782SW-119) are located within Six Mile Creek downgradient of 782SW-115, as shown on the 90% design drawing.

5.4.3 Sampling Parameters

Groundwater and surface water locations will be sampled in accordance with the Griffiss AFB Basewide FSP (FPM 2005a); and the samples will be analyzed for VOCs and select geochemical parameters. Table 5-1 presents the list of parameters to be sampled by media. Samples to be collected include at least one MS/MSD and two field duplicates per SDG, one equipment blank per day, one ambient blank per day, and one trip blank per cooler containing VOCs. See Section 5.4.5 for procedures on modification of the MNA monitoring plan.

5.4.4 Sampling Frequency

Sampling at this site will be performed at two frequencies: quarterly (performance monitoring) and semi-annually (long-term monitoring).

Performance Monitoring

Sampling for performance monitoring of groundwater and surface water will be performed quarterly for the first year to confirm the direction of plume migration and to better establish baseline conditions and seasonal variability. Table 5-1 identifies the monitoring locations that will be sampled.

Long-term Monitoring

After completion of performance monitoring, groundwater and surface water samples will be collected semi-annually as shown in Table 5-1. One of the two sampling events per year should occur in the quarter (from performance monitoring) showing the highest contaminant concentrations or the greatest extent of the plume (AFCEE 2000). Long-term monitoring will continue until remediation goals as presented in the ROD have been achieved. See Section 5.4.5 for procedures on modification of the long-term monitoring program.

5.4.5 Modifications to the MNA Monitoring Plan

Sampling data will be evaluated after each sampling event; see Section 5.6 for evaluation and reporting details. Based on this review, modifications to the monitoring plan will be made, as necessary, in order to better achieve the monitoring objectives. Modifications may include extending the performance monitoring period to better understand seasonal variations, increasing or reducing the number of sampling parameters, and increasing or reducing the frequency of long-term monitoring sampling. Primary approval of recommendations to the plan will be made by AFRPA and USACE. Subsequently, the recommendations will be discussed with the USEPA and NYSDEC prior to implementation.

5.5 Special Considerations

Due to the location of the new monitoring wells to be installed, special considerations have been identified. For any work inside the flightline, Griffiss Airpark flightline personnel (Mr. Ed Arcuri at 315-736-4171, or other applicable personnel) will need to be informed a minimum of one month prior to drilling activities of the number of personnel and type of equipment that will be needed to install the wells. Dates and hours of activities also must be conveyed to flightline personnel. Federal Aviation Administration (FAA) regulations and policies may apply to activities conducted within or near the existing air strip, which may involve coordination, notification, and special procedures. Applicable FAA regulations and policies also will be coordinated with Griffis Air Park.

5.6 Performance Evaluation

5.6.1 Data Evaluation and Reports

Sampling data will be reviewed after each sampling event, and evaluation reports will be submitted annually as described below. Each evaluation will assess the status and progress of MNA and achievement of monitoring objectives at the site. Elements of the MNA evaluation report for this site will include (USEPA 2004):

- A summary of data interpretation.
- Background and site description.
- Monitoring network and schedule description.
- An evaluation of new data and comparisons with previous data and established performance criteria, which would consist of presentation of the following:
  - Data in tabular format;
  - Graphs (contaminant concentration versus time for individual wells; contaminant concentrations versus distance downgradient for several wells along the groundwater flowpath);
  - Figures (contaminant contours);
  - Statistical analysis; and
  - An evaluation of the need for implementation of the contingency plan.
- Interpretation of new data with respect to the conceptual site model for natural attenuation, which would include a discussion on:
  - COCs and geochemical parameters,
  - Continuation of institutional controls, and
  - Progress towards achieving monitoring objectives.
- Conclusions.
- Recommendations.

USEPA guidance (USEPA 2004) provides details on the content that can be discussed in each of these sections. AFCEE guidance (AFCEE 2000) provides methods that can be used to develop/present graphs, figures, and statistical analyses tailored to demonstrate the effectiveness of MNA.

During the evaluation process, it will be determined whether there is a need to implement the contingency plan. Figure 5-1 presents the decision process that will be used to trigger the contingency plan described in Section 5.7.

5.6.2 Performance Criteria

As stated in the draft ROD (AFRPA 2008), the RAOs for this site are to

1. Achieve the cleanup goals for COCs which are 5 ppb, 5 ppb, and 2 ppb for cis-1,2-DCE, TCE, and vinyl chloride, respectively.

2. Prevent human exposure to groundwater through groundwater use restrictions until cleanup goals are achieved; and

3. Prevent contaminated groundwater from the site from adversely impacting surface water (in Six Mile Creek), which is defined as surface water concentrations above performance indicators (NYSDEC Class GA Groundwater Quality Standard of 2 ppb for vinyl chloride).

These RAOs may change based on the ROD, which will subsequently be reflected in the RAWP.

Ultimately, attainment of NYSDEC Groundwater Standards for the COCs as presented in the draft ROD (AFRPA 2008) are the cleanup objectives for this site. According to the draft ROD, the COCs at this site are cis-1,2-DCE, TCE, and vinyl chloride with cleanup goals of 5 ppb, 5 ppb, and 2 ppb, respectively. The COCs may change based on the final ROD, which will subsequently be reflected in the RAWP.

OPS for this site will be demonstrated by a consistent pattern of VOC reductions over a two- to three-year period in the long-term monitoring wells. Long-term monitoring will be performed by Parsons and/or FPM during the current contract and continue until the COCs, for four consecutive routine sampling rounds, are below NYSDEC groundwater standards in force at the time this report is issued (i.e., RC is achieved), as presented in Table 1 of 6 NYCRR 703.5. The USACE/AFRPA may request that the USEPA/NYSDEC reduce the number of sample rounds used to demonstrate achievement of NYSDEC groundwater standards based on the long-term monitoring data. Long-term monitoring may be performed by others, if necessary, at the conclusion of the current contract.

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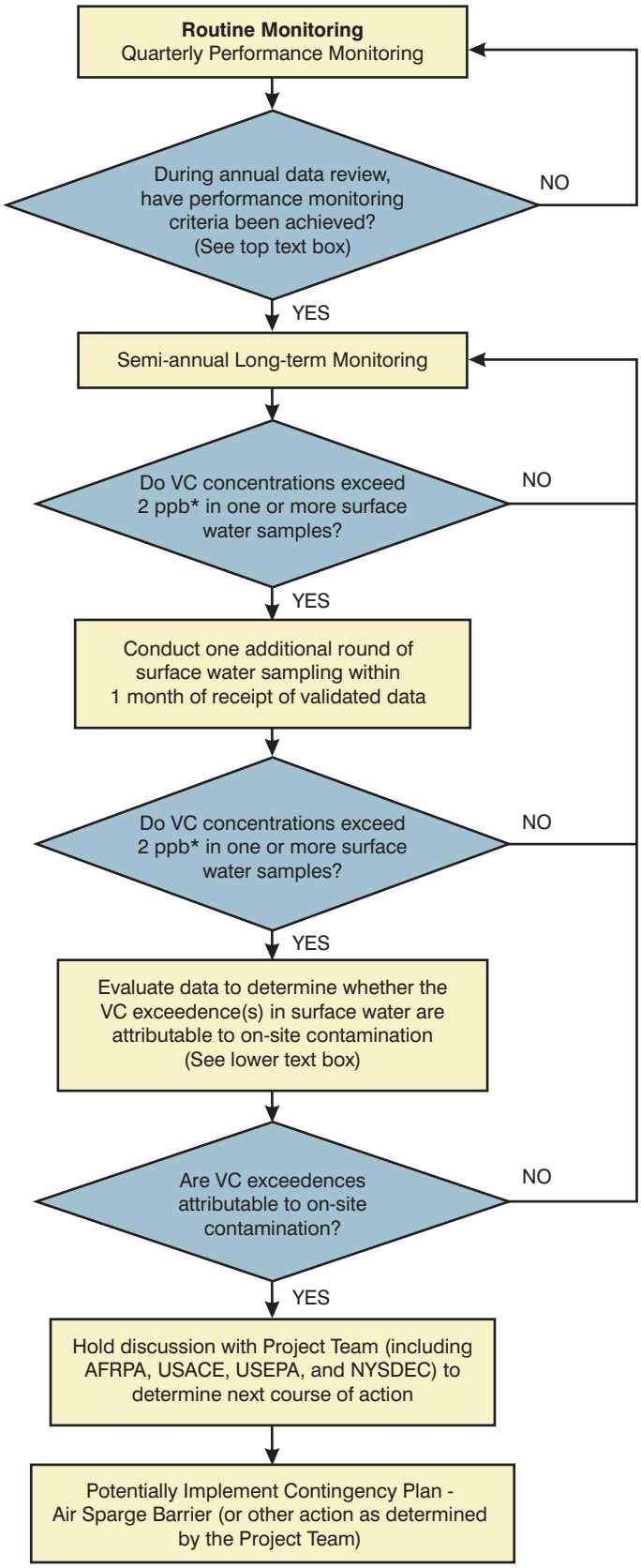

Performance Monitoring Criteria

- There is a general decrease in TCE, DCE, and VC concentrations from groundwater monitoring well samples collected.
- Geochemical data supports natural attenuation.
- There are no unexpected changes with site conditions that could impact implementation of natural attenuation at the site.

Data Evaluation Procedure for Surface Water Concentration Exceedences

If VC concentrations are exceeded in one or more surface water samples, a technical memorandum should be developed. In the memorandum, the following, at a minimum, should be evaluated:

- Compare exceedence(s) concentration and location (i.e., in-line with plume, downstream) with other surface water samples collected. Is there a correlation?
- How do VC concentrations in groundwater from nearby upgradient wells compare to the exceedence in surface water?
- Do water levels indicate site groundwater is discharging into Six Mile Creek?
- Compare surface water and groundwater data with previous sampling round(s).
- Consider sampling for VOCs from upgradient surface water locations (i.e., WSA-SW3PW as presented in the Building 817/WSA remedial efforts described in this plan).
- Consider sampling for VOCs in sediment samples co-located with surface water sample locations.
- Discuss sediment sample results, if applicable, and how the data correlates with exceedences detected in surface water.

* NYSDEC Groundwater Standard, Class GA

Figure 5-1 Decision Process for Contingency Plan Implementation, Nosedocks/Apron 2 Site

Based on estimates presented in the Final Feasibility Study (FPM 2006c), the plumes are expected to naturally attenuate to levels below NYSDEC groundwater standards in 26 to 30 years (or around 2030 to 2034).

5.7 Contingency Plan

Due to the evidence that natural attenuation is occurring at this site, MNA is expected to be successful at the site and a contingency plan to address remediation of the entire aerial extent of the plumes by an alternate technology will not be developed. Rather a contingency plan will be described briefly to address the potential for the VC plume to reach Six Mile Creek, which could impact human health and environmental receptors. The contingency plan for this site will be implemented based on recommendations made during the MNA evaluation process (see Section 5.6).

In Figure 5-1, NYSDEC groundwater standards for Class GA waters are used as guidance values for surface water contaminants in the evaluation process. Groundwater standards were used because applicable surface water guidance or standard criteria for contaminants of concern in Six Mile Creek (a NYSDEC Class C stream) are not available.

According to Figure 5-1, if surface water exceedences are attributable to site groundwater, a discussion with the Project Team (including AFRPA, USACE, USEPA, and NYSDEC) will occur to determine the next course of action at the site. As recommended in the Final Feasibility Study (FPM 2006c), an air sparge barrier is the selected contingency plan at this site for the protection of human health and the environment. For the purposes of this report, the barrier will be described briefly. Full-scale design of the barrier will be performed at a later date if the need for installation is warranted.

At the Nosedocks/Apron 2 site, an in situ air sparging barrier system will be installed immediately upgradient from Six Mile Creek to treat VOCs in site groundwater prior to discharging to the creek. Air sparging would be used to inject pressurized air into the groundwater across the plume width. As the injected air traverses up through the saturated zone, volatile organics that may be present will partition to the vapor phase and be transported toward the surface and eventually discharged to ambient air through the unsaturated zone. The concentrations of contaminants in the emitted air are estimated to be negligibly low and, thus, no off-gas treatment would be required. An SVE system would not be provided since the need to control and collect vapors would be unnecessary due to the absence of buildings or habitable structures in the vicinity of this portion of the creek (FPM 2006c).

6 Access and Easement Requirements

The OBGW AOCs exist on property owned or leased by the AFRPA or the Griffiss Local Development Corporation. In addition to coordination issues identified in previous sections, access to these sites shall be coordinated with AFRPA at a minimum. If access to properties owned or leased by others is required during the remedial action, temporary or permanent easements or a right-of-way may be required.

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A Previous Investigations Plume Maps and Cross-Sections

- LF6/B775 cross-sections taken from the *Landfill 6 and Building 775 Areas of Concern Groundwater Study, Technical Memorandum No. 1: Field Investigation Conducted in Spring 2000, Former Griffiss Air Force Base, Rome, New York*, Vol. 1 (E & E August 2000).

- B817/WSA cross-section taken from the *Final Addendum to the July 1998 Supplemental Investigations of Areas of Concern, Technical Memorandum No. 1: On-Base Groundwater, Former Griffiss Air Force Base, Rome, New York* (E & E August 2001).

- Apron 2 cross-section taken from the *Final Remedial Investigation Nosedocks/Apron 2 Chlorinated Plume, Former Griffiss Air Force Base Rome, New York* (FPM April 2004).

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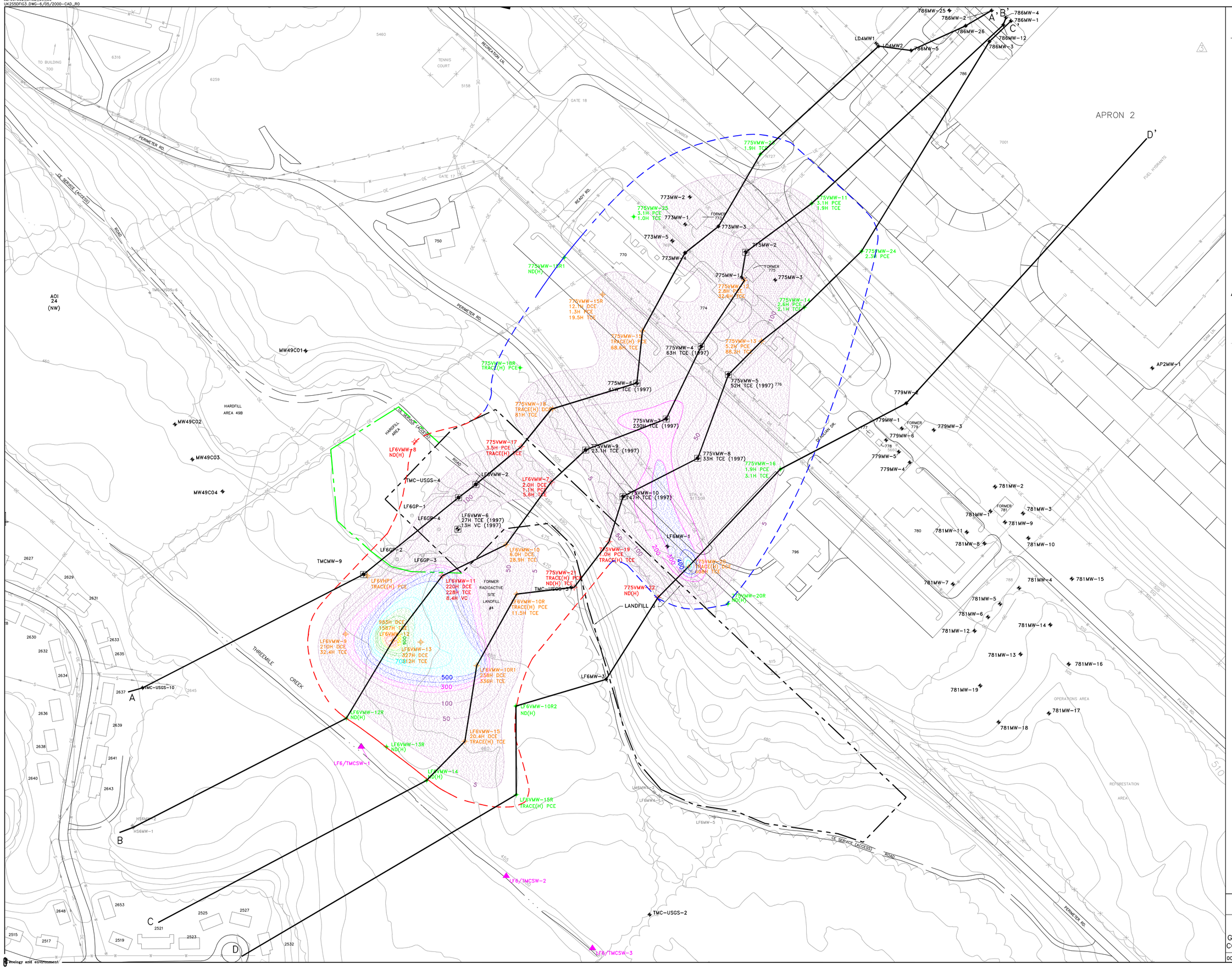

LEGEND

- LANDFILL 6/BUILDING 775 GROUNDWATER STUDY PERMANENT MONITORING WELL LOCATION
- LANDFILL 6/BUILDING 775 GROUNDWATER STUDY TEMPORARY MONITORING WELL LOCATION
- LANDFILL 6/BUILDING 775 VERTICAL PROFILE HYDROPUNCH SAMPLING LOCATION (WELL NOT INSTALLED)
- EXISTING MONITORING WELL
- MONITORING WELL RESAMPLED DURING ROUND 1 GROUNDWATER STUDY (MAY 2000)
- DECOMMISSIONED MONITORING WELL
- SUPPLEMENTAL INVESTIGATION GEOPROBE GROUNDWATER SCREENING SAMPLE LOCATION
- LANDFILL 6/BUILDING 775 GROUNDWATER STUDY SURFACE WATER SAMPLE LOCATION
- HARDFILL AREA
- LANDFILL BOUNDARY
- APPROXIMATE BOUNDARY OF B775 PLUME (DASHED WHERE INFERRED)
- APPROXIMATE BOUNDARY OF LF6 PLUME (DASHED WHERE INFERRED)
- A — A' CROSS SECTION LINE
- TOTAL CHLORINATED VOC CONCENTRATION CONTOUR LINE FROM HYDROPUNCH DATA (CONTOUR INTERVAL [in PPB] IS VARIABLE: 5,50, EVERY 100 TO 1000, THEN EVERY 500 TO 2500)
- 775MW-23 1.9H PCE — H= HIGHEST LEVEL OF HYDROPUNCH CONTAINMENTS OF CONCERN (i.e. CHLORINATED SOLVENTS) IN PARTS PER BILLION (PPB). SAMPLE RESULTS ARE FROM SPRING 2000, UNLESS INDICATED OTHERWISE.

DCE	cis-DICHLOROETHENE
ND	NOT DETECTED
PCE	TETRACHLOROETHENE
TCA	1,1,1 TRICHLOROETHANE
TCE	TRICHLOROETHENE
VC	VINYL CHLORIDE

0-5 PPB
5-200 PPB
200-400 PPB
400-600 PPB
600-800 PPB
800-1000 PPB
1000-1500 PPB
1500-2000 PPB
2000-2500 PPB
2500-3000 PPB

N

SCALE IN FEET
0 100 200 300

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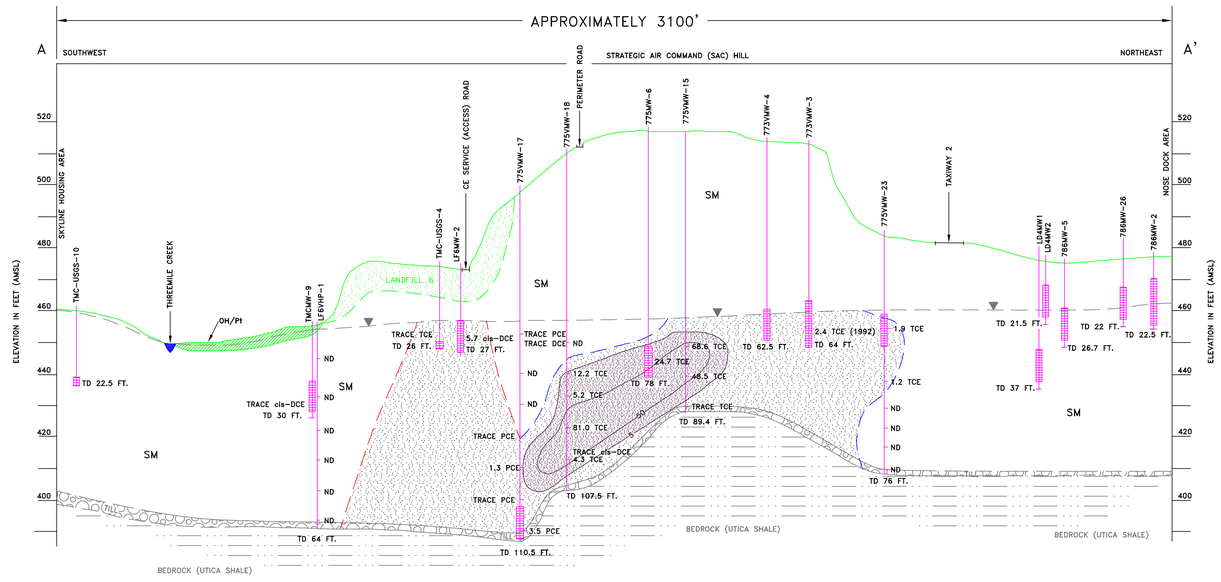
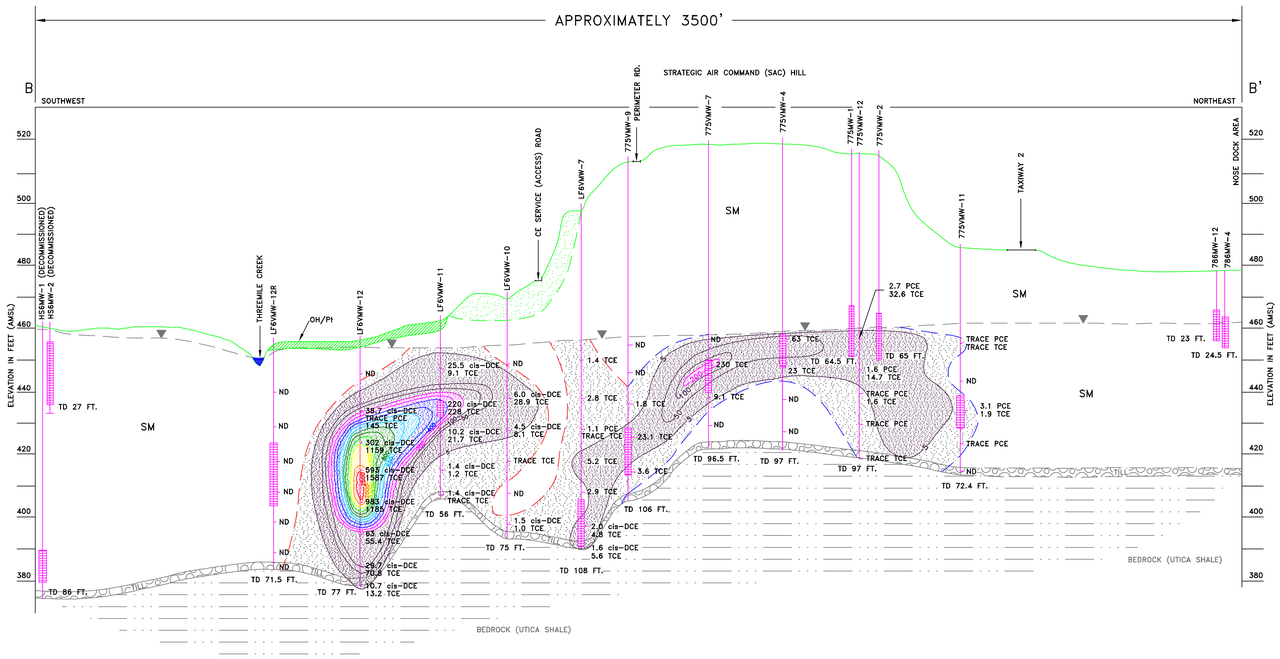
Figure 3-2
LANDFILL 6 AND BUILDING 775 GROUNDWATER STUDY HYDROPUNCH CONTAMINATION CONCENTRATION MAP

001002UK020900 JUNE 2000

BUFF plotted: 7/17/00 DDL

ecology and environment





LEGEND

- WATER TABLE
- TOP OF BEDROCK (DASHED WHEN INFERRED)
- WELL SCREEN INTERVAL
- LF6 AOC PLUME
- B775 AOC PLUME
- 0–5 PPB
- 5–200 PPB
- 200–400 PPB
- 400–600 PPB
- 600–800 PPB
- 800–1000 PPB
- 1000–1500 PPB
- 1500–2000 PPB
- 2000–2500 PPB
- 2500–>2500 PPB

AMSL	ABOVE MEAN SEA LEVEL
AOC	AREA OF CONCERN
DCE	DICHLOROETHENE (cis–, or trans–)
ND	NOT DETECTED
OH	ORGANIC CLAYS, ORGANIC SILTY CLAYS, ORGANIC SILTS
PCE	TETRACHLOROETHENE
PI	PEAT AND OTHER HIGHLY ORGANIC SOILS
SM	SILTY SANDS, SAND–SILT MIXTURES
TCE	TRICHLOROETHENE
VC	VINYL CHLORIDE

NOTE:

CONTAMINANT CONCENTRATIONS ARE IN PARTS PER BILLION (micrograms/Liter) FROM SPRING 2000 SAMPLING, UNLESS OTHERWISE INDICATED.

NO.	DATE	DWN	APP'D	DESCRIPTION
REVISIONS				

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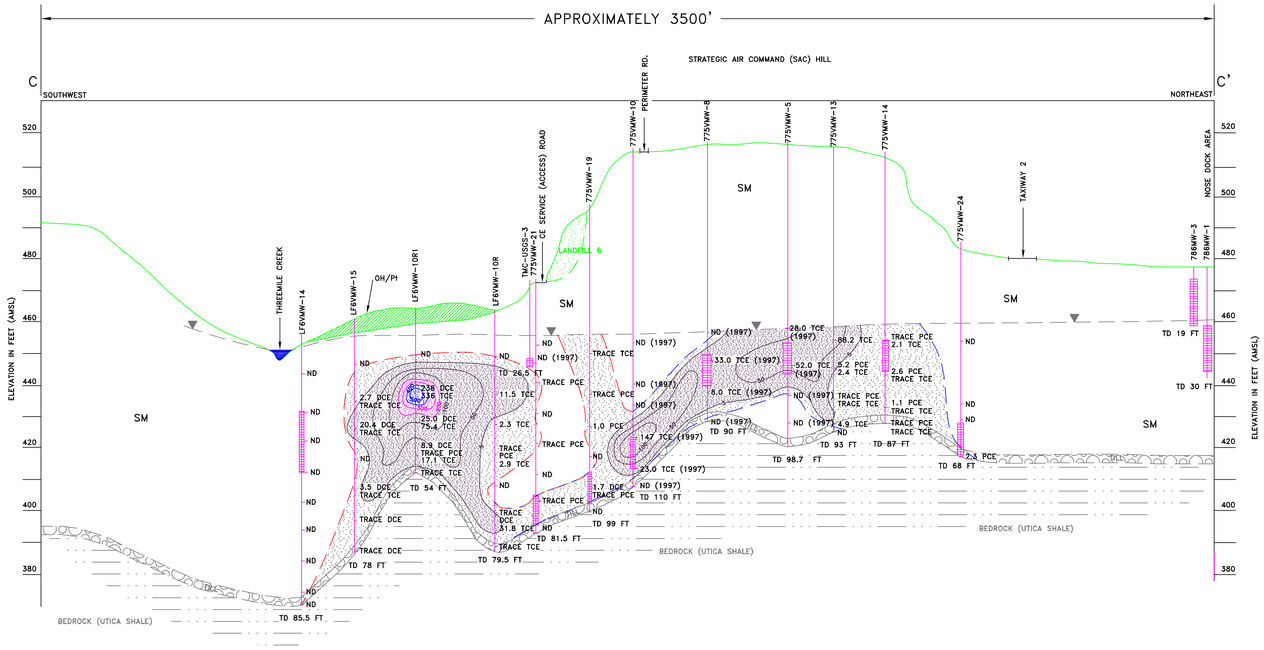
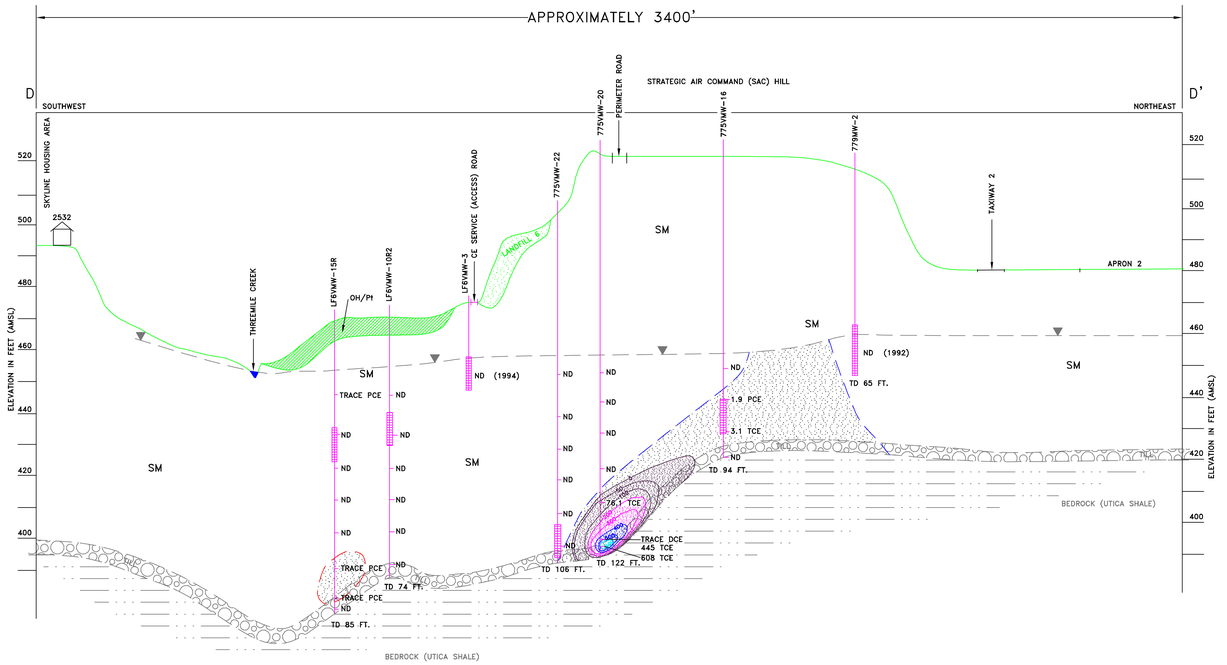
DRAWN BY	APPROVED BY
D. LUBACZ	D. MILLER

FIGURE 3–3a
LANDFILL 6 AND BUILDING 775 GROUNDWATER STUDY CROSS SECTIONS

SCALE	DATE ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
NTS	6/00	UK2S124D	X – X	

BUFF PLOTTED 6/10/02 mcn





LEGEND

- WATER TABLE
- TOP OF BEDROCK (DASHED WHEN INFERRED)
- WELL SCREEN INTERVAL
- LF6 AOC PLUME
- B775 AOC PLUME
- 0–5 PPB
- 5–200 PPB
- 200–400 PPB
- 400–600 PPB
- 600–800 PPB
- 800–1000 PPB
- 1000–1500 PPB
- 1500–2000 PPB
- 2000–2500 PPB
- 2500–>2500 PPB

AMSL	ABOVE MEAN SEA LEVEL
AOC	AREA OF CONCERN
DCE	DICHLOROETHENE (cis–, or trans–)
ND	NOT DETECTED
OH	ORGANIC CLAYS, ORGANIC SILTY CLAYS, ORGANIC SILTS
PCE	TETRACHLOROETHENE
PT	PEAT AND OTHER HIGHLY ORGANIC SOILS
SM	SILTY SANDS, SAND–SILT MIXTURES
TCE	TRICHLOROETHENE
VC	VINYL CHLORIDE

NOTE:

CONTAMINANT CONCENTRATIONS ARE IN PARTS PER BILLION (micrograms/Liter) FROM SPRING 2000 SAMPLING, UNLESS OTHERWISE INDICATED.

NO.	DATE	DWN	APP'D	DESCRIPTION
REVISIONS				

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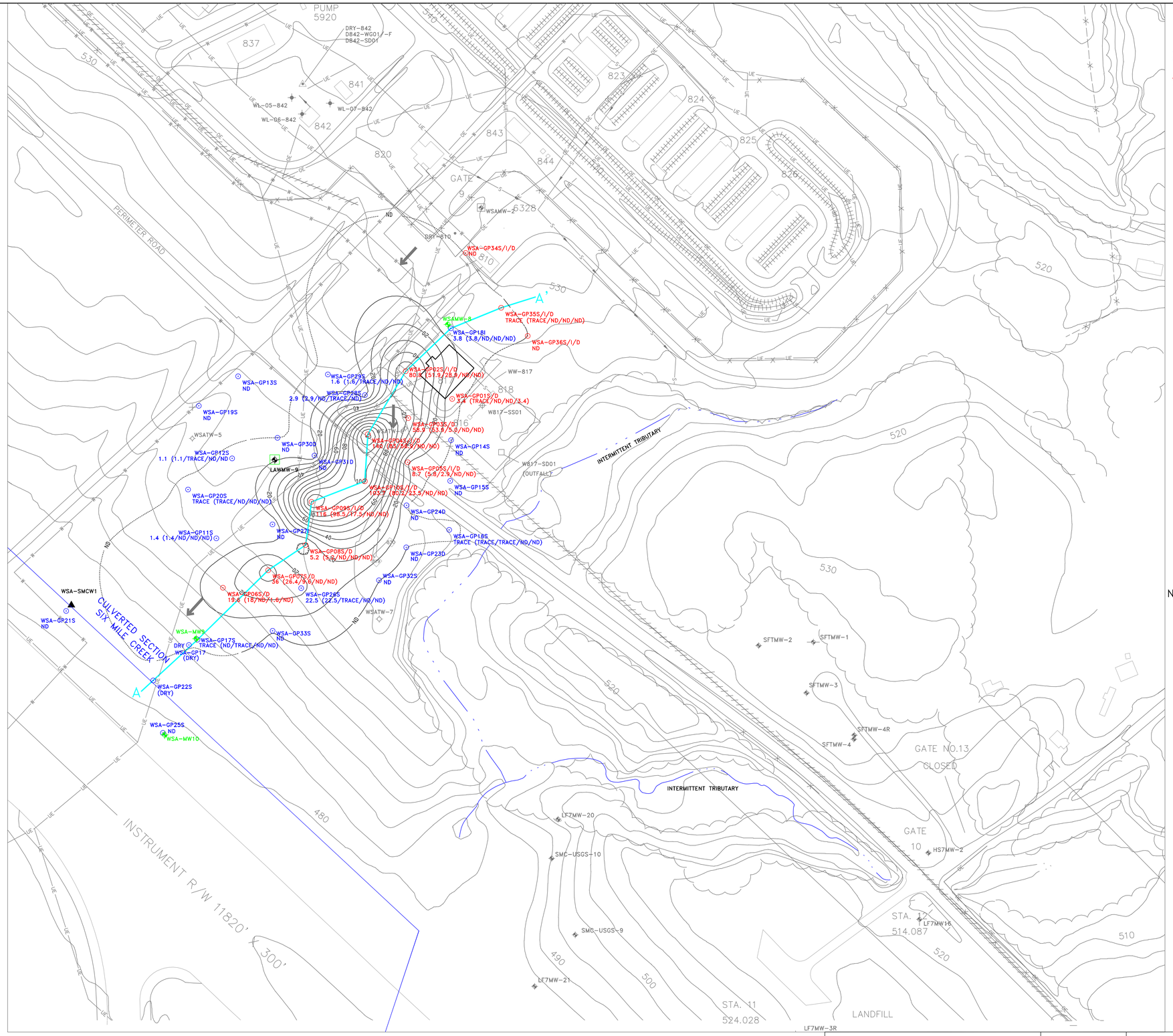
FIGURE 3–3b
LANDFILL 6 AND BUILDING 775 GROUNDWATER STUDY CROSS SECTIONS

SCALE	DATE ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
NTS	6/00	UK2S124D	X – X	

BUFF PLOTTED 6/10/02 mcn



LEGEND

- WSA-GP26.5 / 22.5 (22.5/TRACE/ND/ND) — YEAR 2000 SI GEOPROBE GROUNDWATER SAMPLING LOCATION WITH TOTAL CHLORINATED ETHENES CONCENTRATION IN µG/L. VALUES IN ( ) REPRESENT TCE/PCE/cis-1,2 DCE/VC, RESPECTIVELY.
- WSA-GP104S/I/D 140 (83/56.9/ND/ND) — YEAR 2000 SI VERTICAL PROFILE GEOPROBE GROUNDWATER SAMPLING LOCATIONS WITH TOTAL OF HIGHEST CHLORINATED ETHENES IN µG/L. VALUES IN ( ) REPRESENT HIGHEST CONCENTRATION OF TCE/PCE/cis-1,2 DCE/VC, RESPECTIVELY, FROM EITHER THE SHALLOW, INTERMEDIATE, OR DEEP SAMPLE AT THE LOCATION INDICATED.
- YEAR 2000 SI MONITORING WELL LOCATION
- RI MONITORING WELL RESAMPLED DURING YEAR 2000 SI
- YEAR 2000 SI SURFACE WATER SAMPLE LOCATION
- EXPANDED SITE INVESTIGATION TEMPORARY WELL
- SUPPLEMENTAL INVESTIGATION TEMPORARY WELL LOCATION
- LONG-TERM MONITORING PIEZOMETER
- RI MONITORING WELL RESAMPLED DURING INITIAL SUPPLEMENTAL INVESTIGATION
- DRYWELL LOCATION
- DRYWELL GRAB WATER AND SLUDGE SAMPLE LOCATION
- OUTFALL LOCATION
- DIRECTION OF GROUNDWATER FLOW
- FENCE
- 510 — TOPOGRAPHIC CONTOUR LINE
- UE — UNDERGROUND ELECTRIC
- W — WATER LINE
- S — SANITARY SEWER
- OE — OVERHEAD ELECTRIC
- ABANDONED UNDERGROUND ELECTRIC
- ND — NOT DETECTED
- TRACE — DETECTED BELOW PRACTICAL QUANTITATION LIMIT OF 1 µG/L
- 20 — TOTAL CHLORINATED ETHENES ISOCONCENTRATION CONTOUR IN µG/L (DASHED WHERE INFERRED)
- A—A' — CROSS-SECTION LINE

TCE TRICHLOROETHENE
PCE TETRACHLOROETHENE
DCE DICHLOROETHENE
VC VINYL CHLORIDE

NOTE: ISO CONCENTRATION CONTOURS REPRESENT TOTAL CHLORINATED ETHENES (TCE,PCE,cis-1,2 DCE, AND VC).
THE TOTAL CHLORINATED ETHENES AT VERTICALLY PROFILED LOCATIONS (S/I/D) REPRESENT THE HIGHEST CONCENTRATION OF EACH OF THE INDIVIDUAL CONTAMINANTS AT THAT LOCATION (FROM EITHER THE SHALLOW, INTERMEDIATE, OR DEEP INTERVALS), NOT THE TOTAL FROM ONE DEPTH INTERVAL.
(e.g. AT WSA-GP10, THE TOTAL CHLORINATED ETHENES ARE 104 g/L:
80.2 µg/L TCE FROM GP-10I;
23.5 µg/L PCE FROM GP-10S;
ND OF cis-1,2-DCE;
AND ND VC).

SCALE IN FEET
0 100 200 300
CONTOUR INTERVAL=10 µg/L

NO.	DATE	DWN	APP'D	DESCRIPTION
REVISIONS				

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R.MEYERS	R.WATT
DRAWN BY	APPROVED BY
D.LUBACZ	R.MEYERS

FIGURE 3-2
YEAR 2000 SUPPLEMENTAL INVESTIGATION ON-BASE GROUNDWATER AOC (AREA SOUTH OF THE WSA) GEOPROBE TOTAL CHLORINATED ETHENES CONCENTRATION MAP

SCALE	DATE ISSUED	C.A.D. FILE NO.	DRAWING NO.	REV.
1"=100'	7/00	CK1SO30D.DWG		

BUFFPLOT: 10/11/00 JJK

02:001002_UK03_06_04_90-B0491
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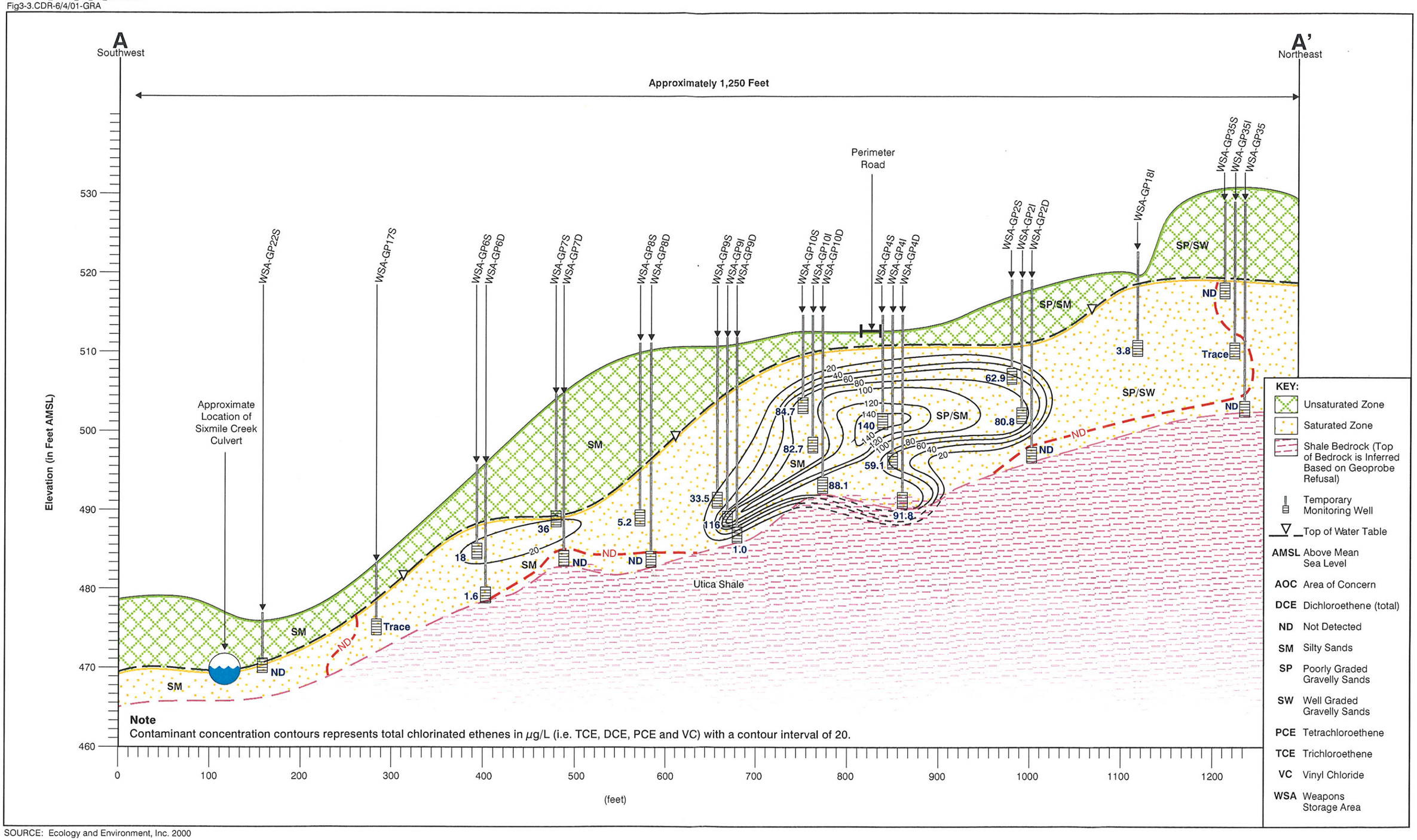
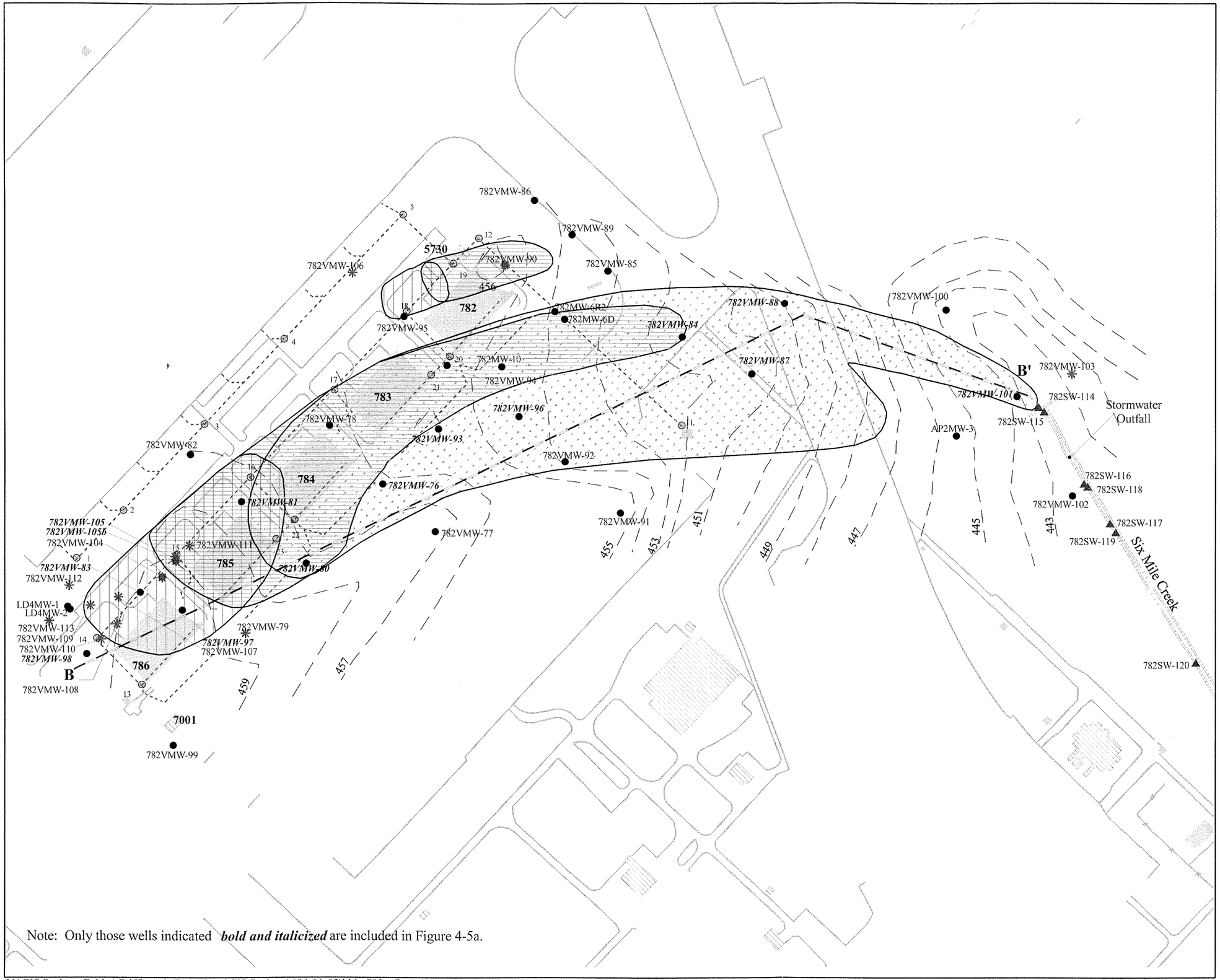
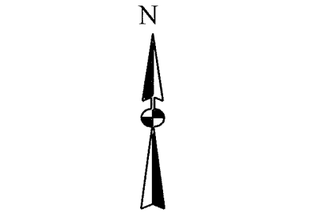


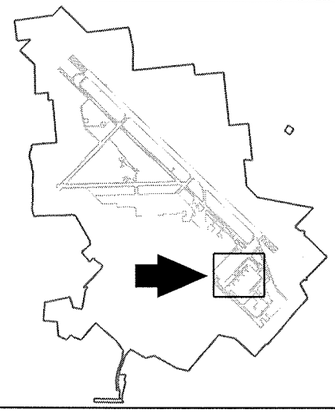
SOURCE: Ecology and Environment, Inc. 2000

Figure 3-3 YEAR 2000 SUPPLEMENTAL INVESTIGATION, ON-BASE GROUNDWATER AOC (AREA SOUTH OF THE WSA) CROSS SECTION A-A' (TOTAL CHLORINATED ETHENES)



Note: Only those wells indicated ***bold and italicized*** are included in Figure 4-5a.





- LTM Monitoring Well
- Temporary Vertical Profile Well Location
- Surface Water Sampling Location

PLUME
- TCE (Concentration > 5 µg/L)*
- cis-DCE (Concentration > 5 µg/L)*
- VC (Concentration > 2 µg/L)*
- Wash Waste Manhole
- Nosedocks Washwaste System
- Groundwater Contour, 2/02 ft. MSL
- Stream / Creek
- Road

FACILITY
- Existing
- Demolished

*Refers to the concentration in any one sample interval or monitoring well.

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ROME, NEW YORK

SCALE
100 0 100 200 300 400 Feet

Figure 4-5
Nosedocks / Apron 2
Cross-Section Location B-B'

FPM group

Figure 4-5a
Nosedocks/Apron 2 Chlorinated Plume Cross-Section Contours

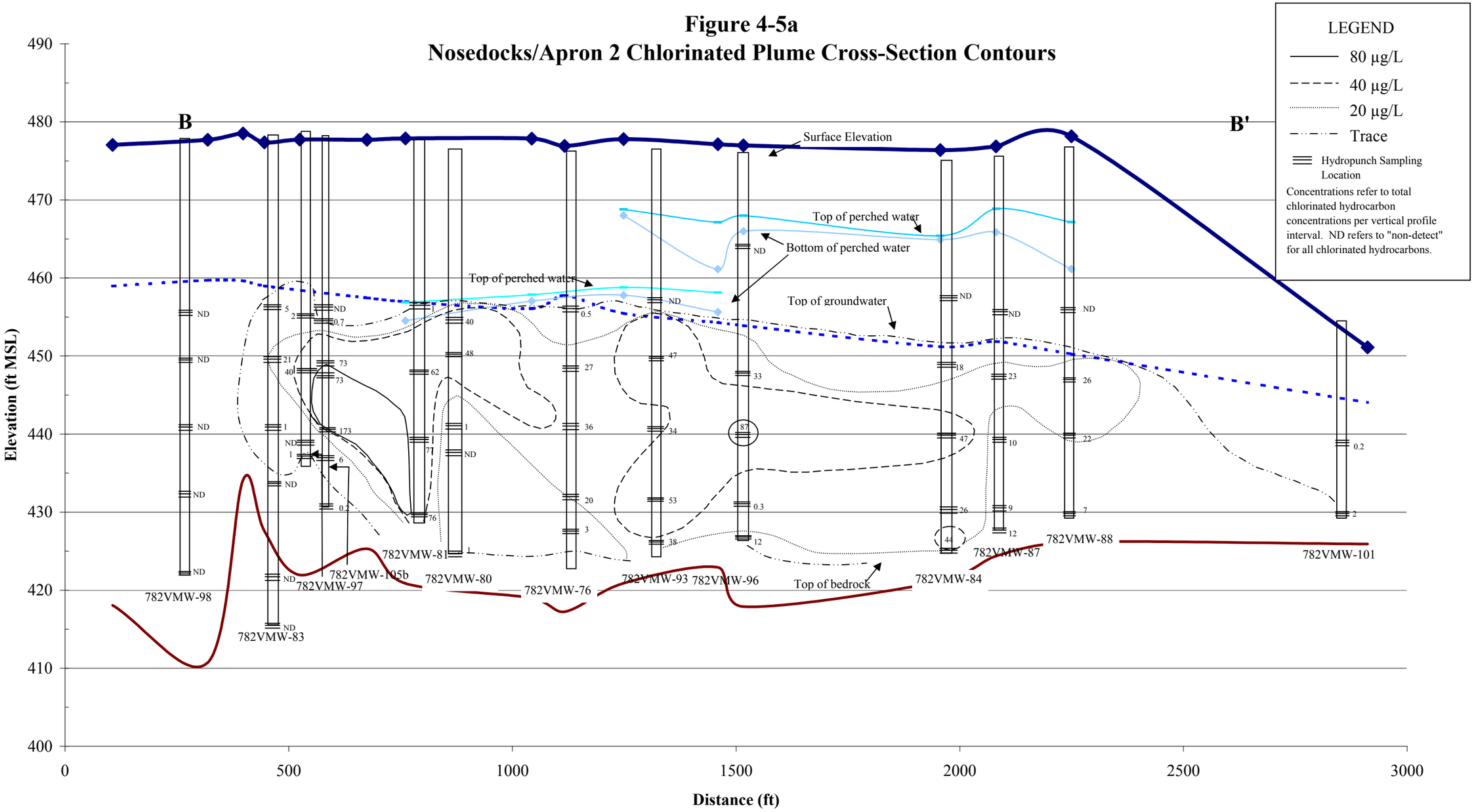
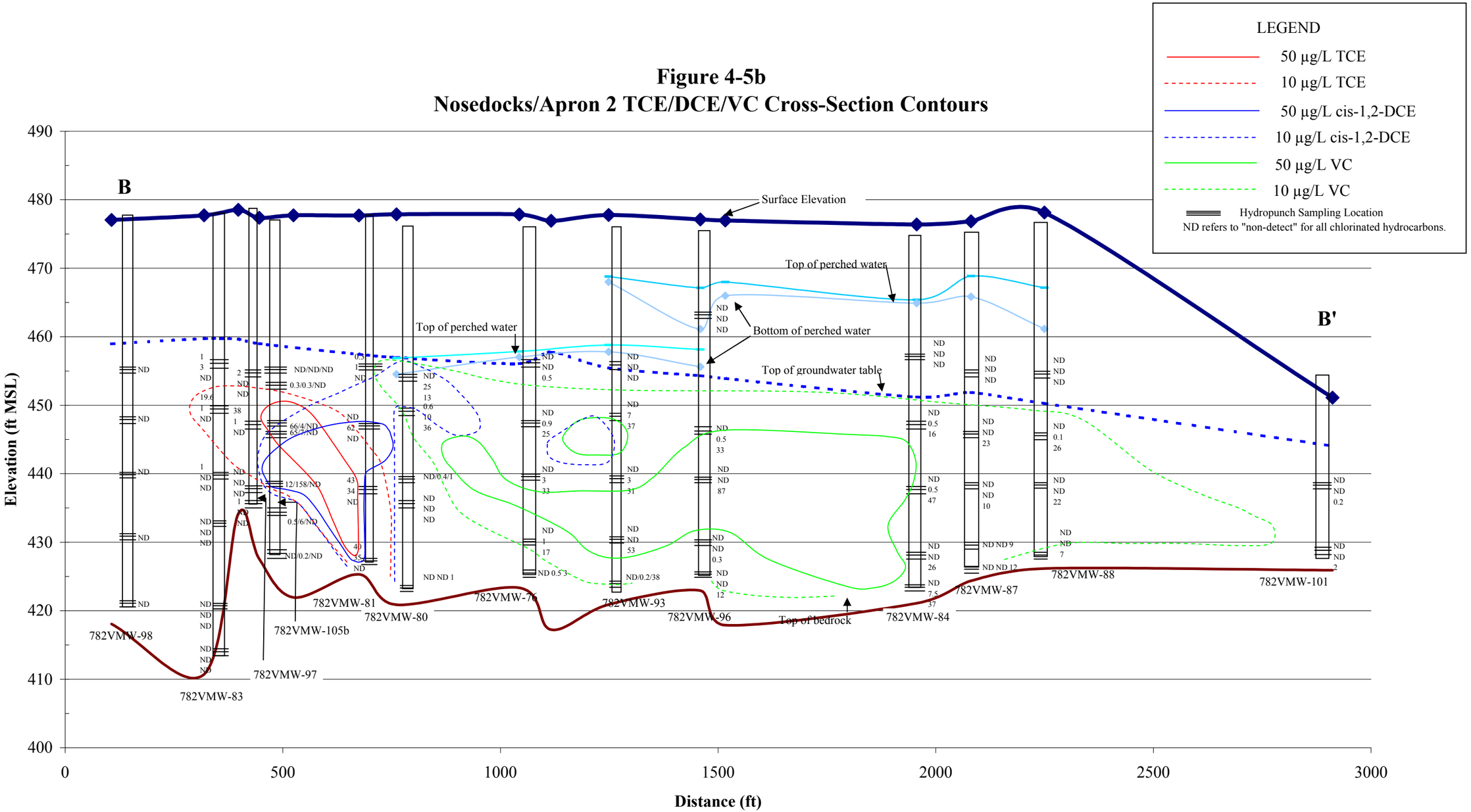
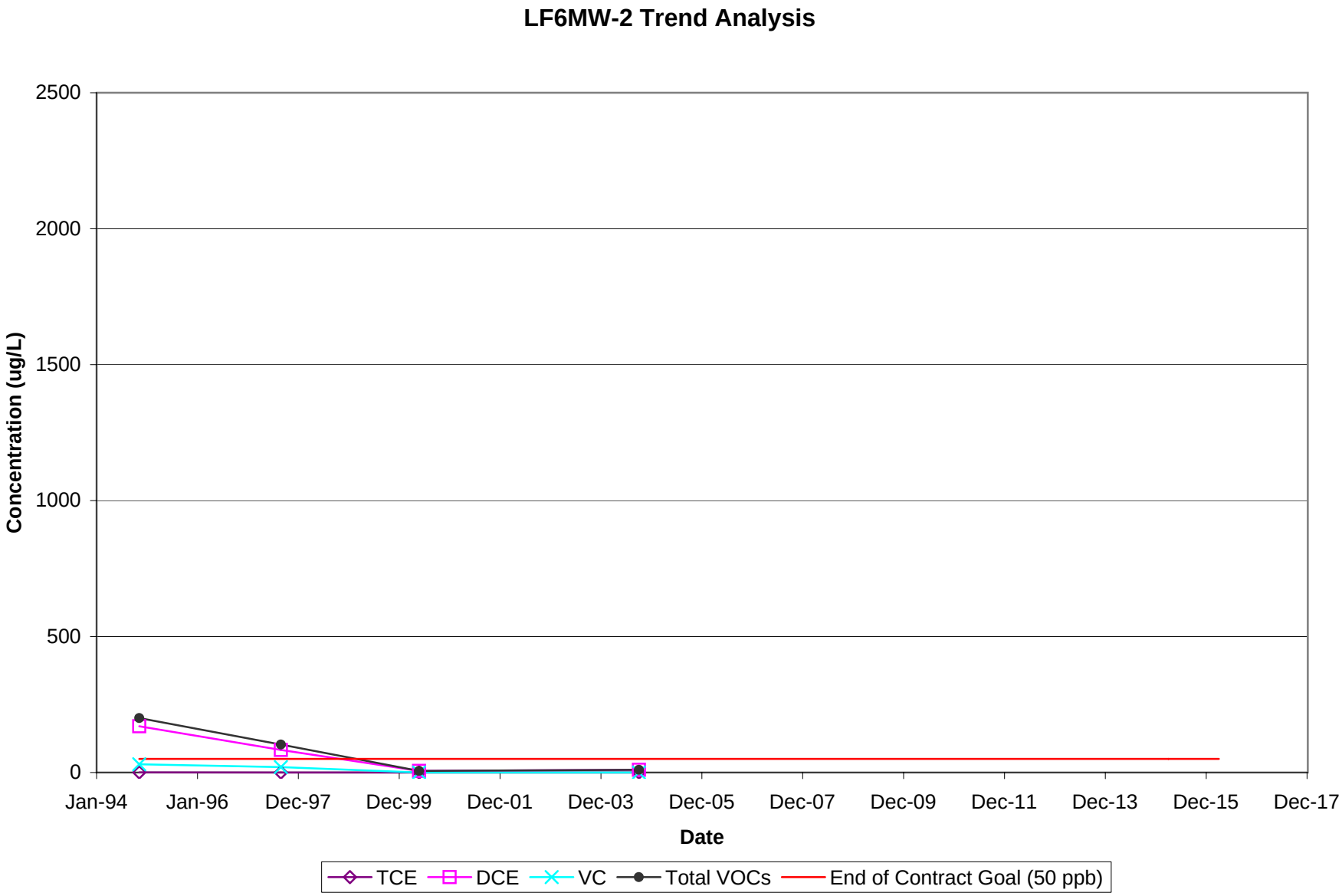
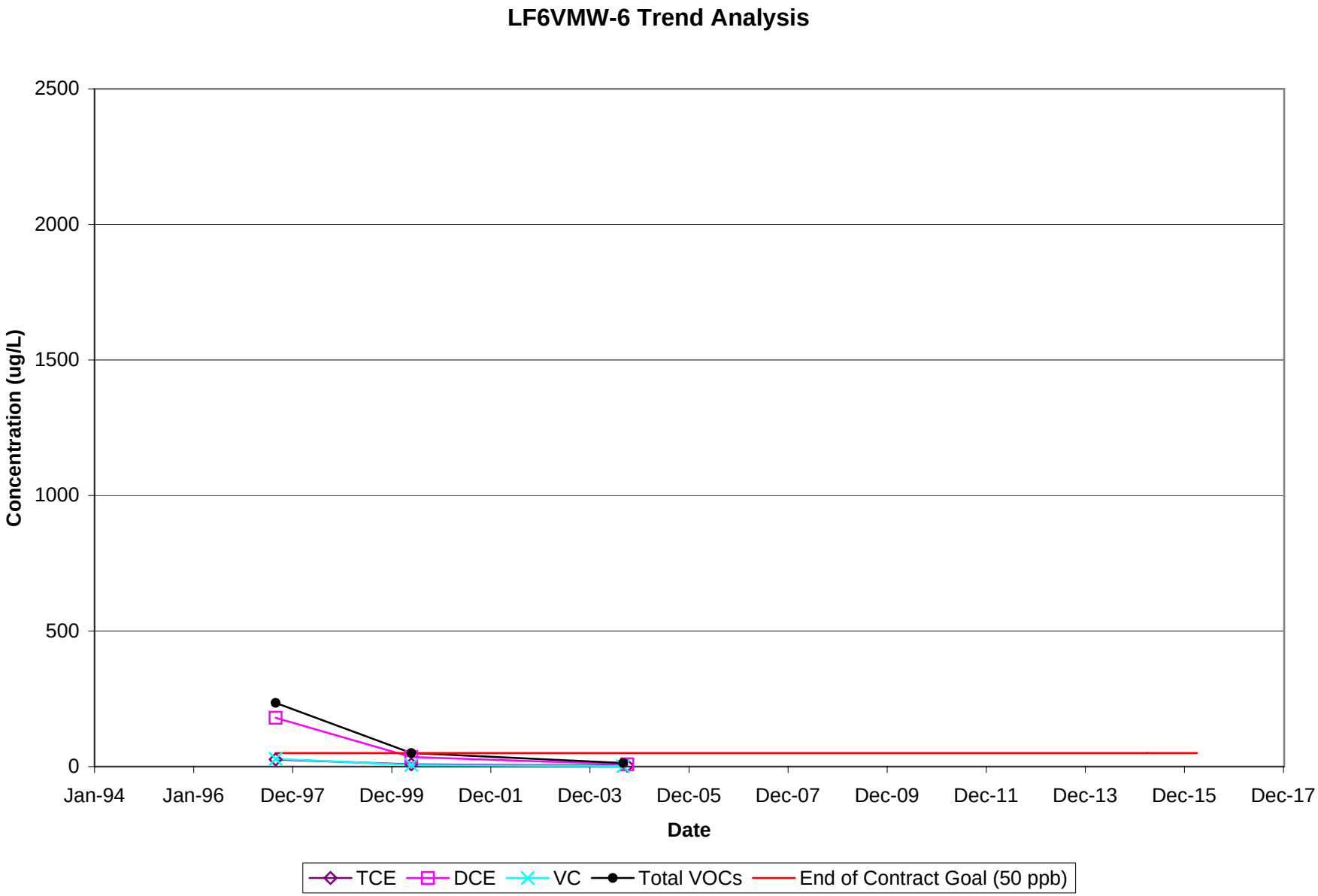


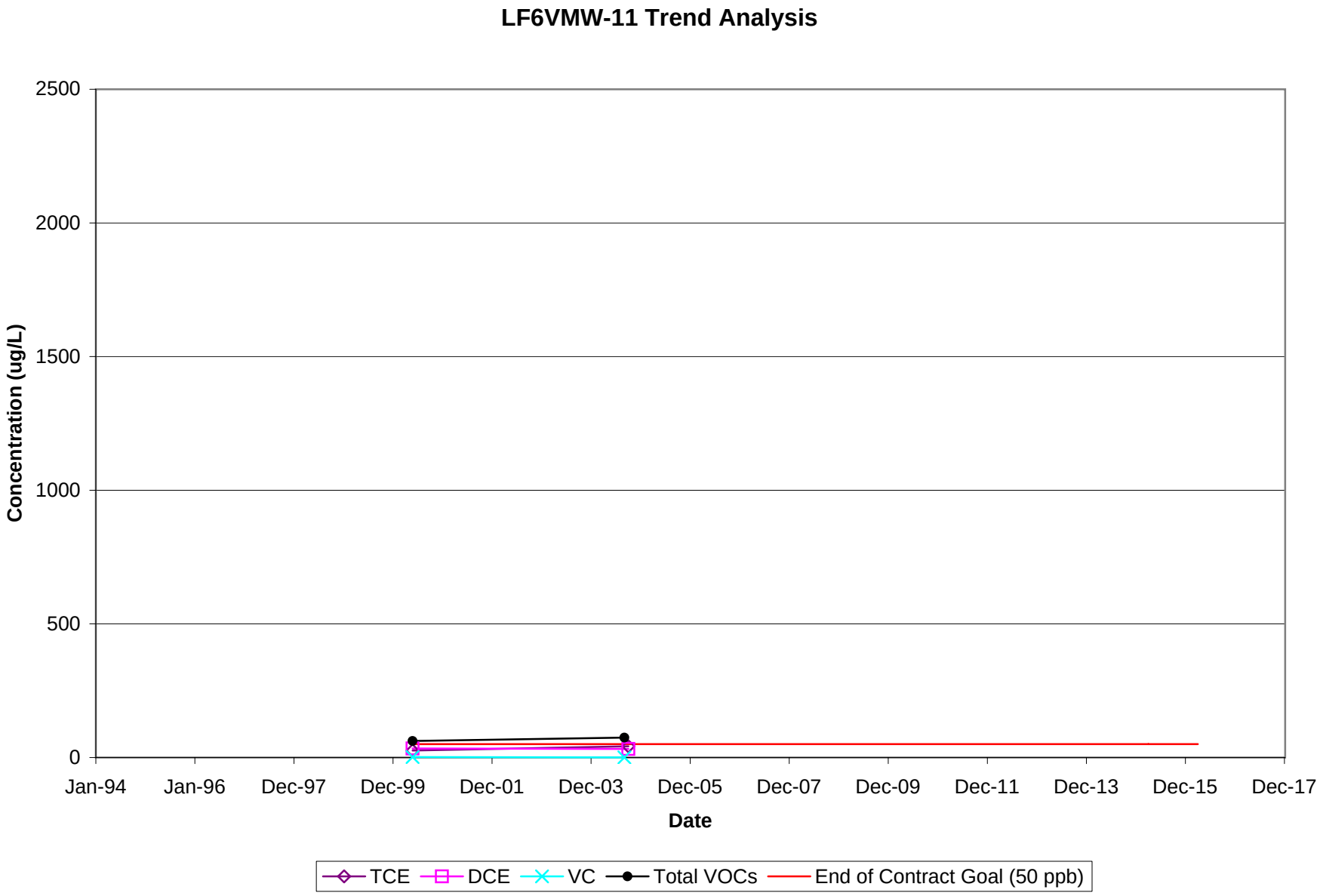
Figure 4-5b
Nosedocks/Apron 2 TCE/DCE/VC Cross-Section Contours

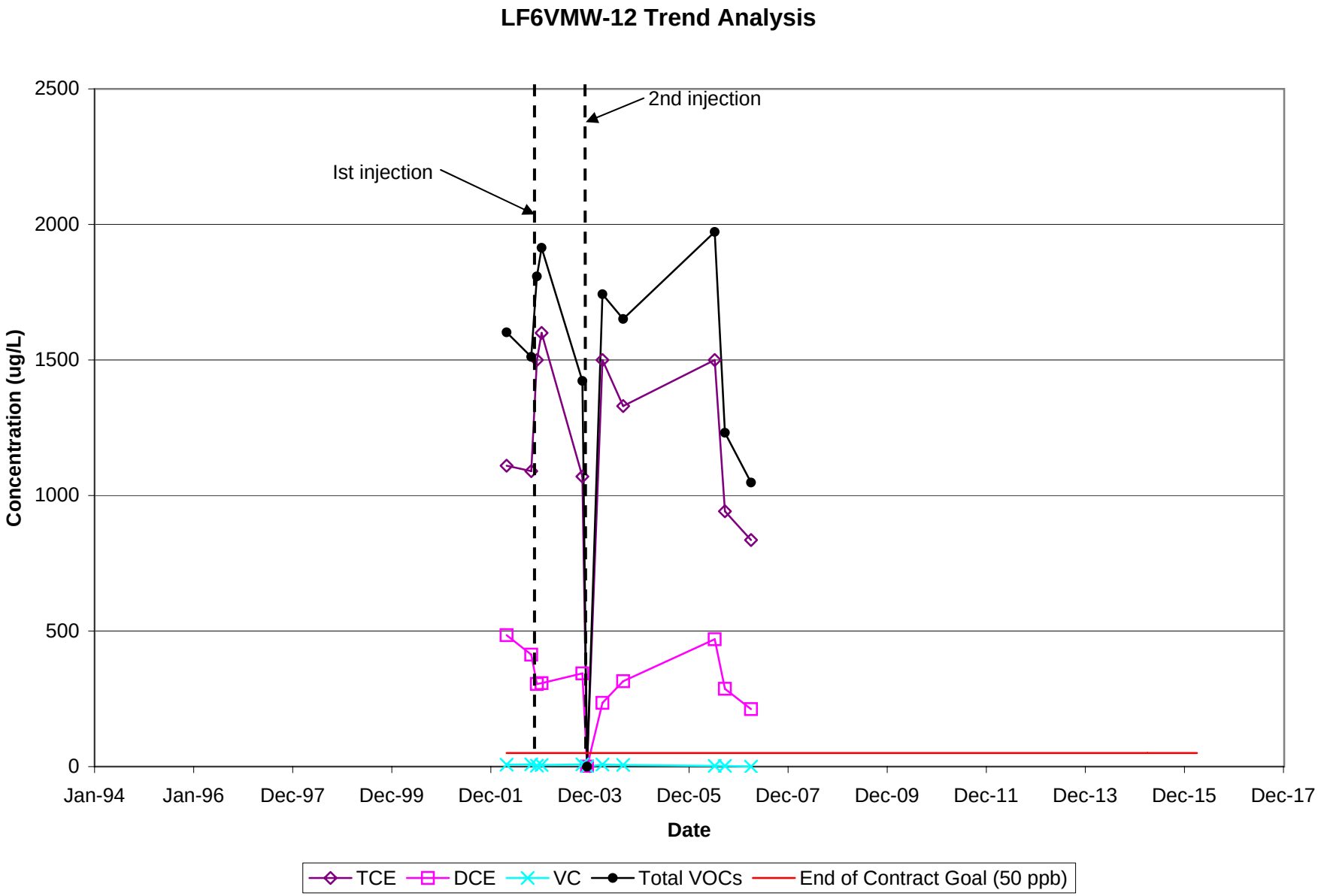


B LF6 Trend Analysis

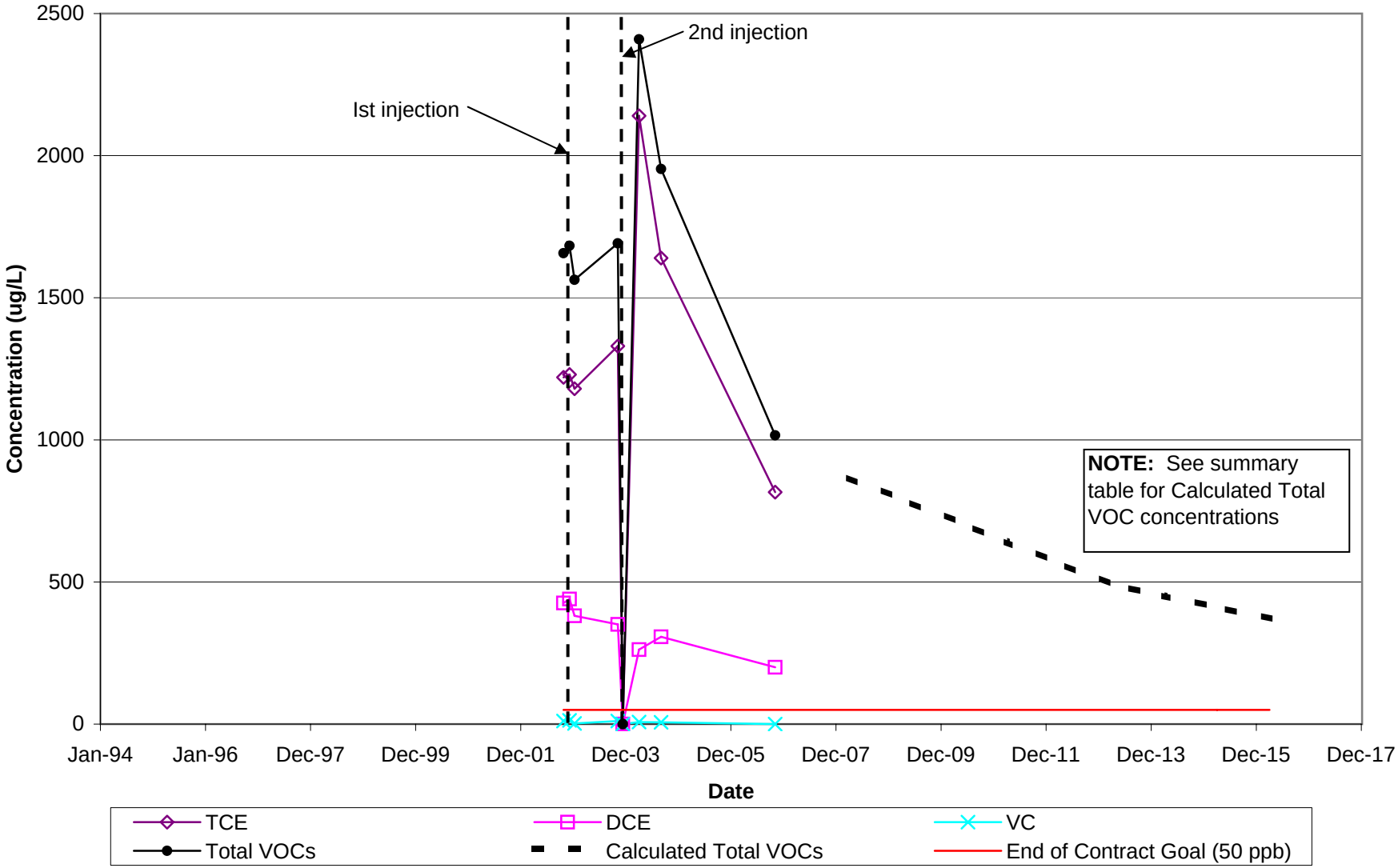

LF6MW-2 Trend Analysis
2500
2000
1500
1000
500
0
Concentration (ug/L)
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

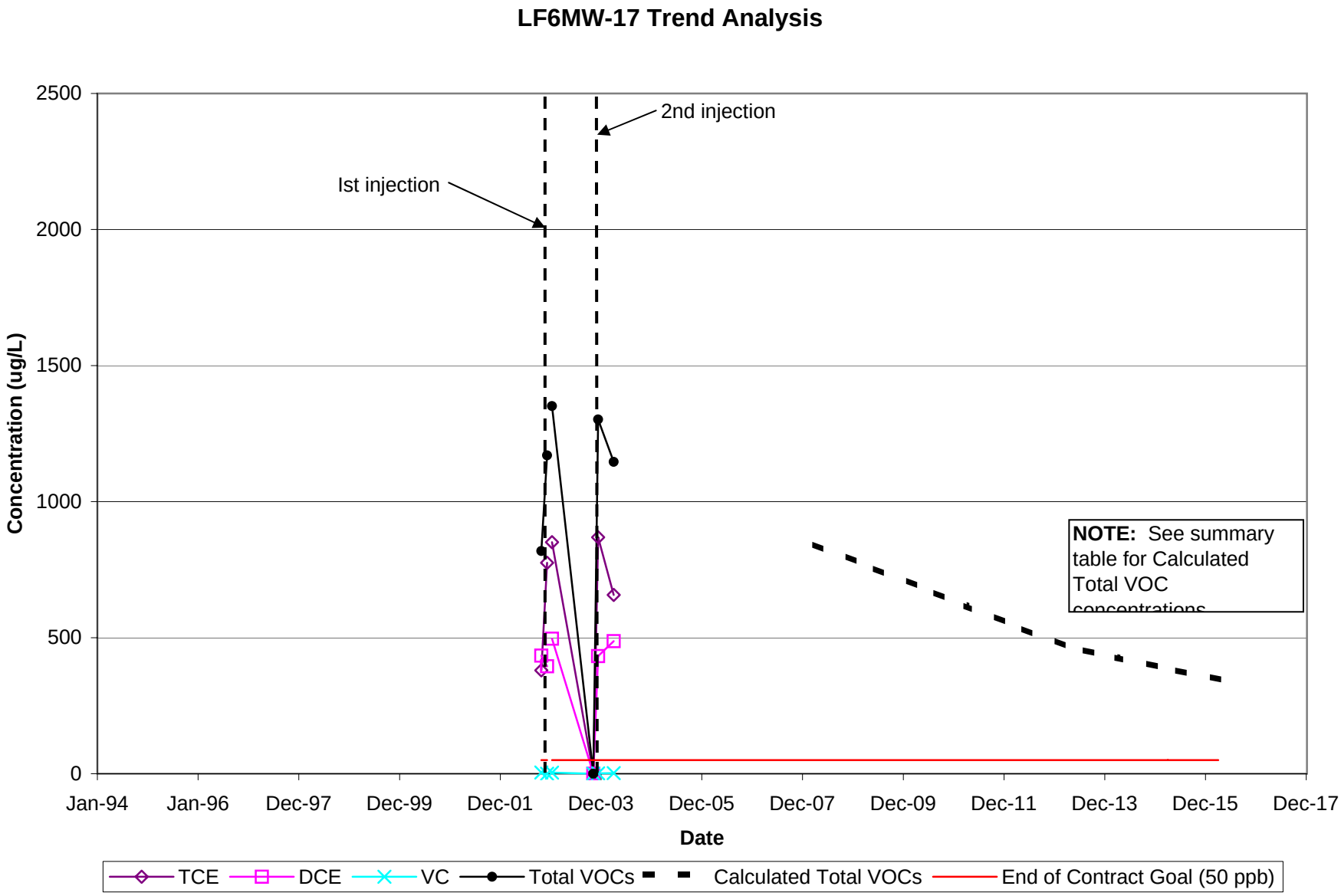

LF6VMW-6 Trend Analysis
2500
2000
1500
1000
500
0
Concentration (ug/L)
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

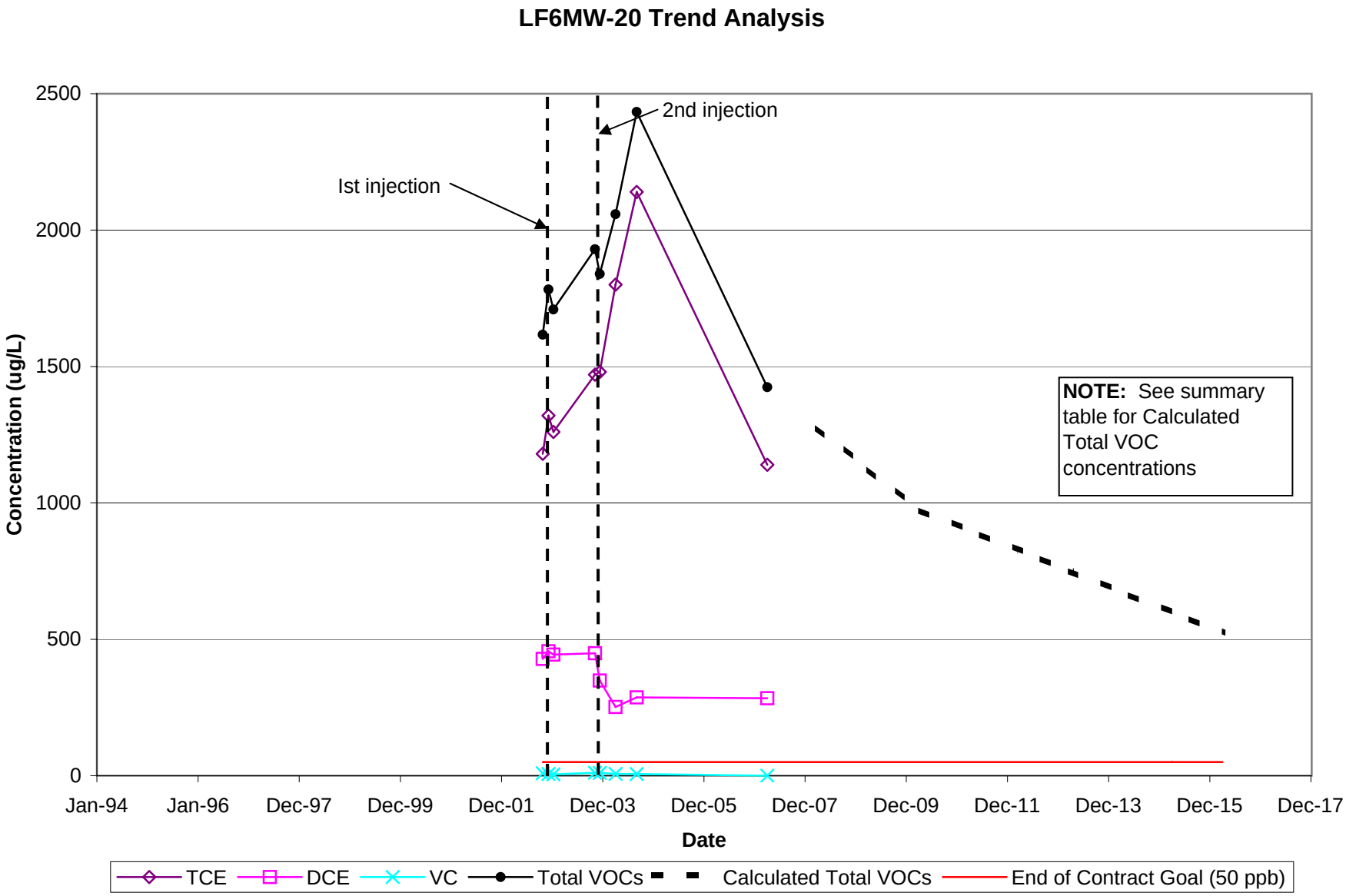

LF6VMW-11 Trend Analysis
2500
2000
1500
1000
500
0
Concentration (ug/L)
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)


LF6VMW-12 Trend Analysis
2500
2000
1500
1000
500
0
Concentration (ug/L)
Ist injection
2nd injection
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

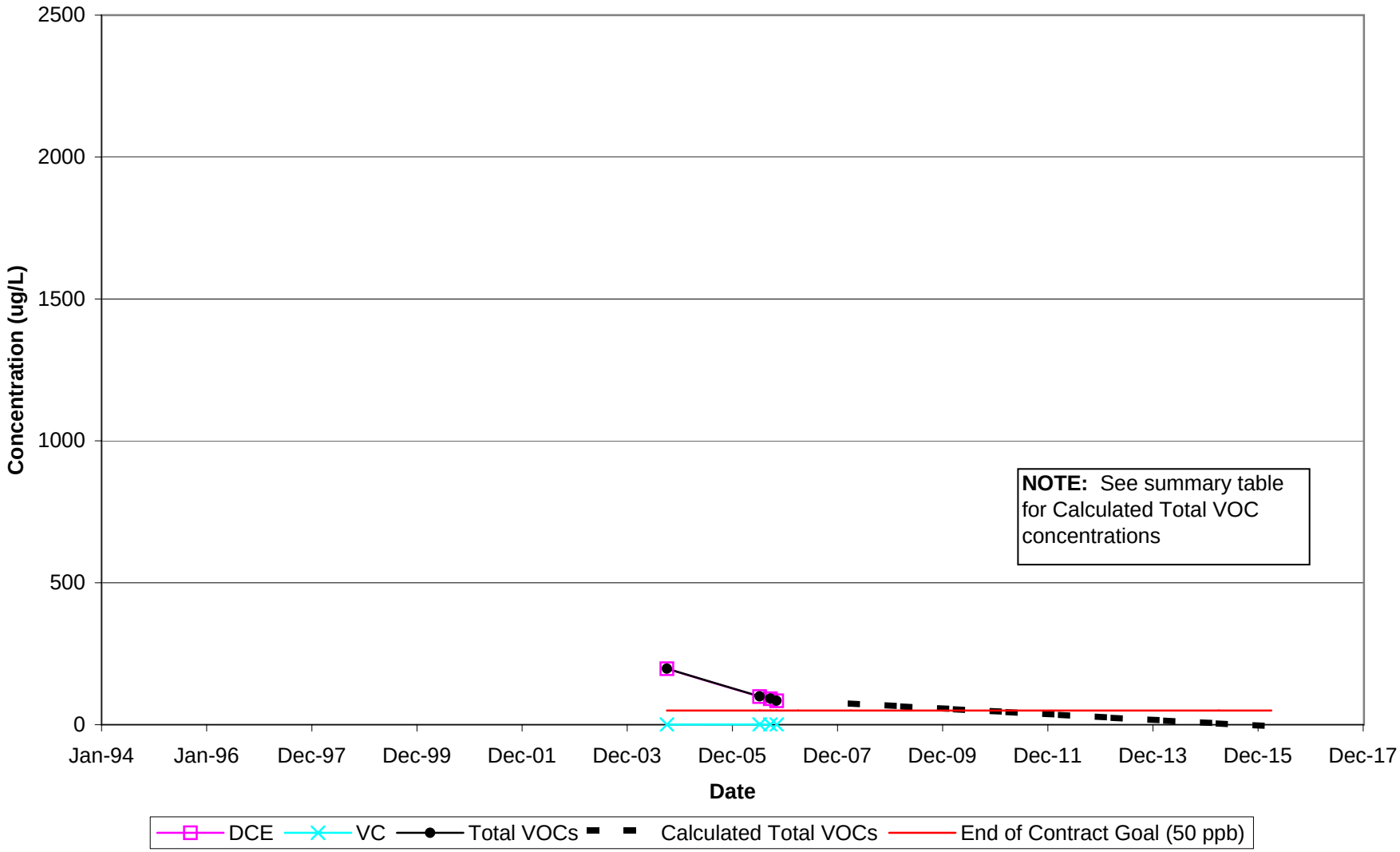
LF6MW-16 Trend Analysis

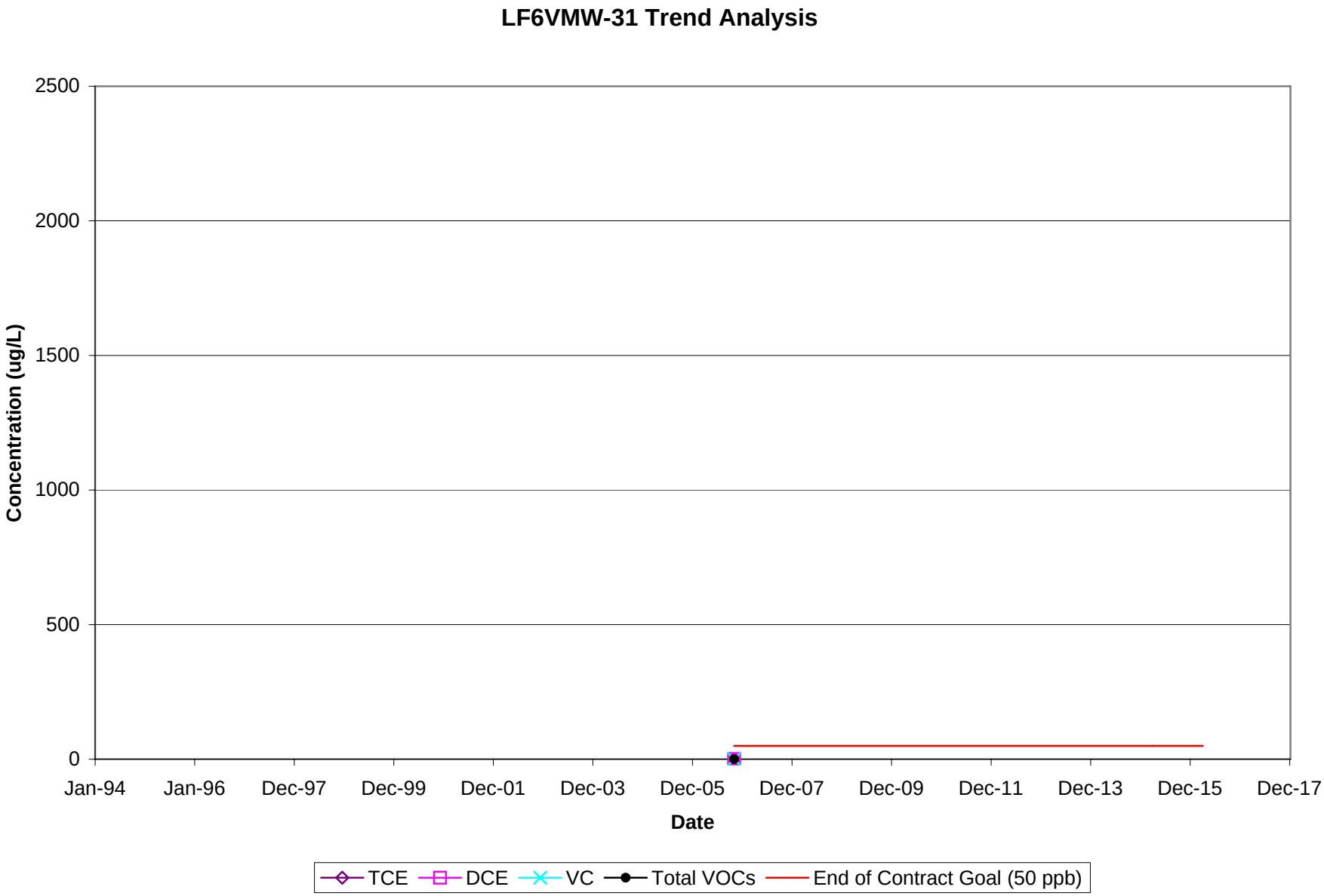


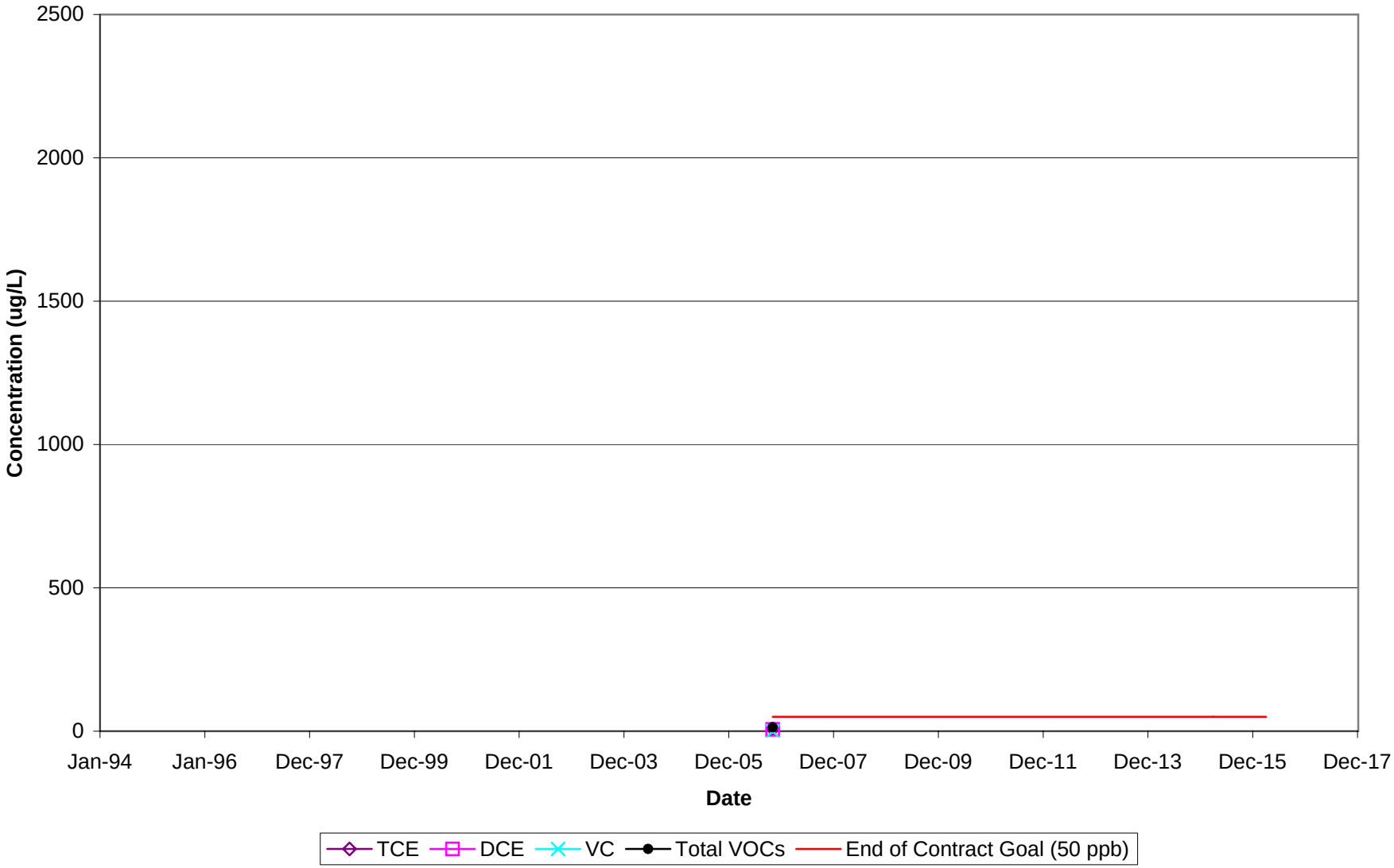

LF6MW-17 Trend Analysis
2500
2000
1500
1000
500
0
Concentration (ug/L)
2nd injection
Ist injection
NOTE: See summary table for Calculated Total VOC concentrations
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
Calculated Total VOCs
End of Contract Goal (50 ppb)


LF6MW-20 Trend Analysis
2500
2000
1500
1000
500
0
Concentration (ug/L)
Ist injection
2nd injection
NOTE: See summary table for Calculated Total VOC concentrations
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
Calculated Total VOCs
End of Contract Goal (50 ppb)

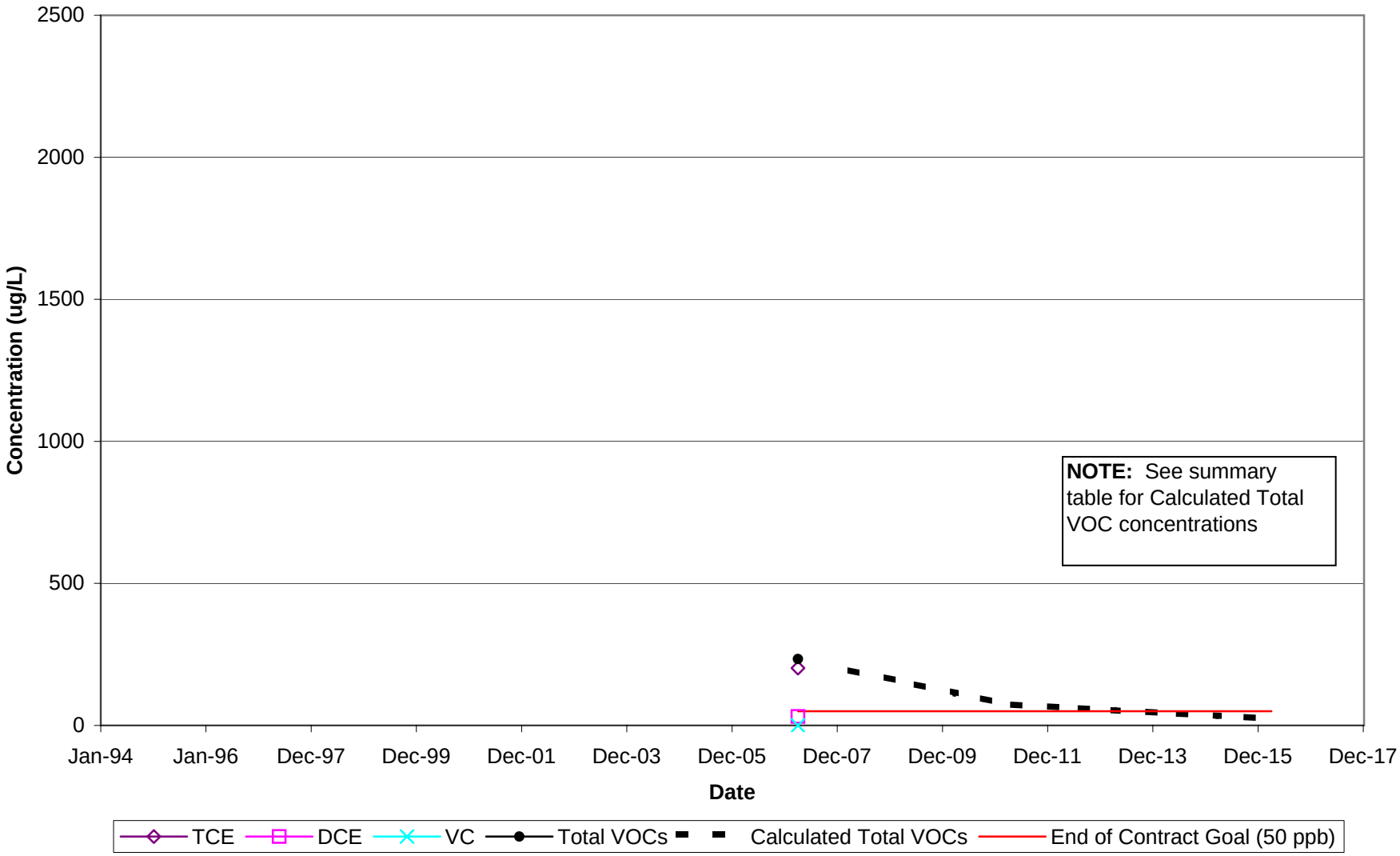
LF6VMW-26 Trend Analysis



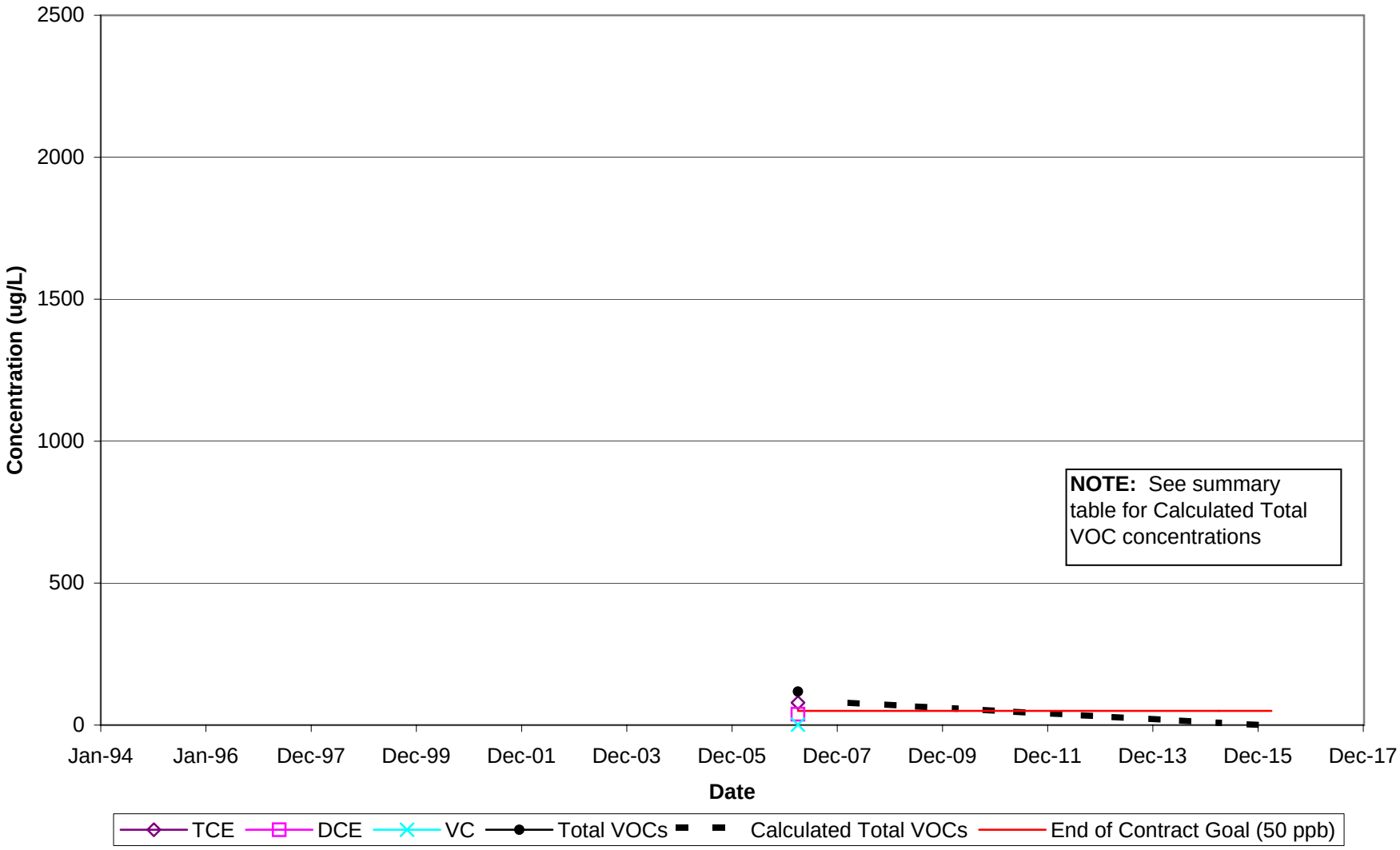

LF6VMW-31 Trend Analysis
2500
2000
1500
1000
500
0
Concentration (ug/L)
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

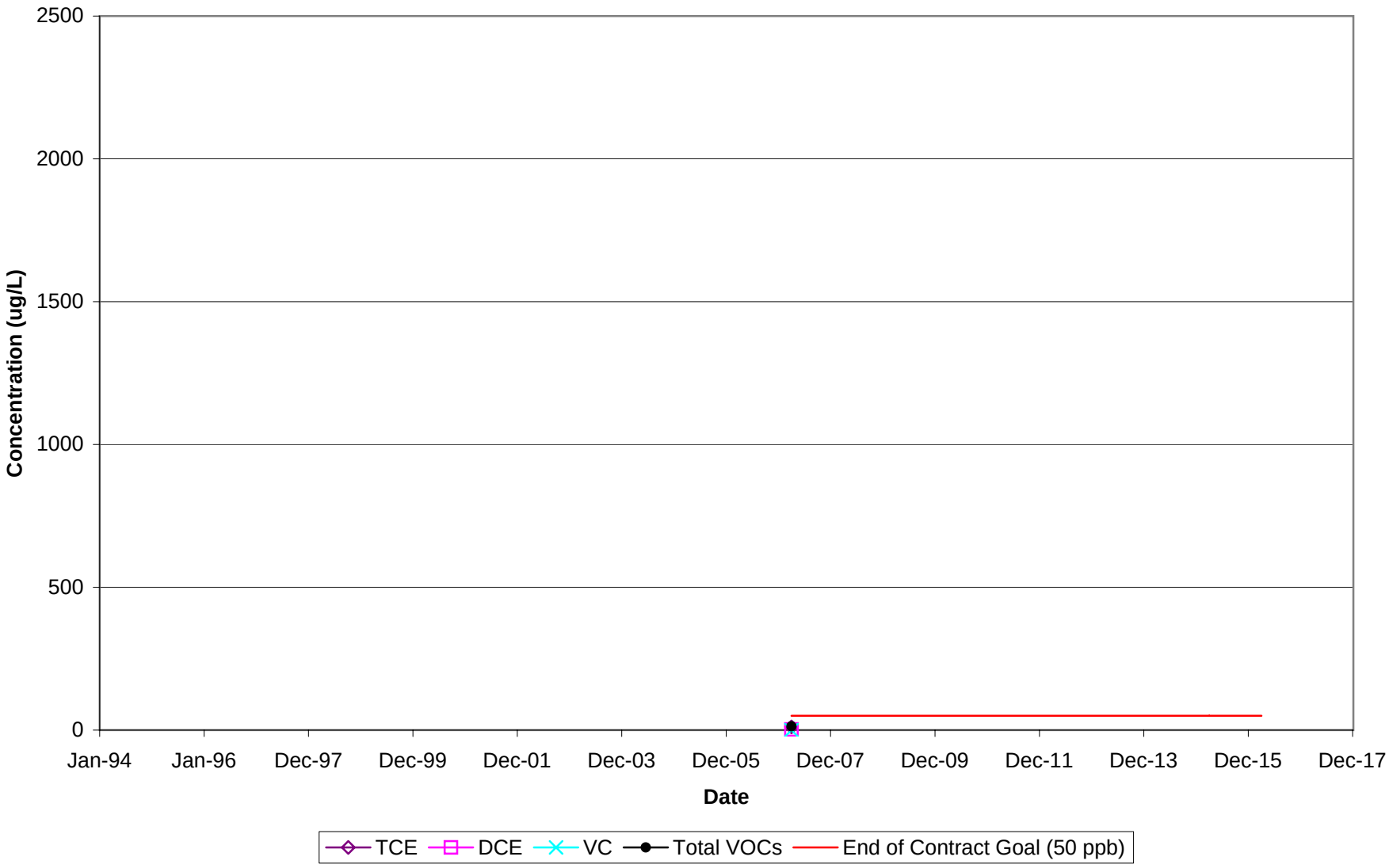

LF6VMW-32 Trend Analysis
2500
2000
1500
1000
500
0
Concentration (ug/L)
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

LF6VMW-33 Trend Analysis

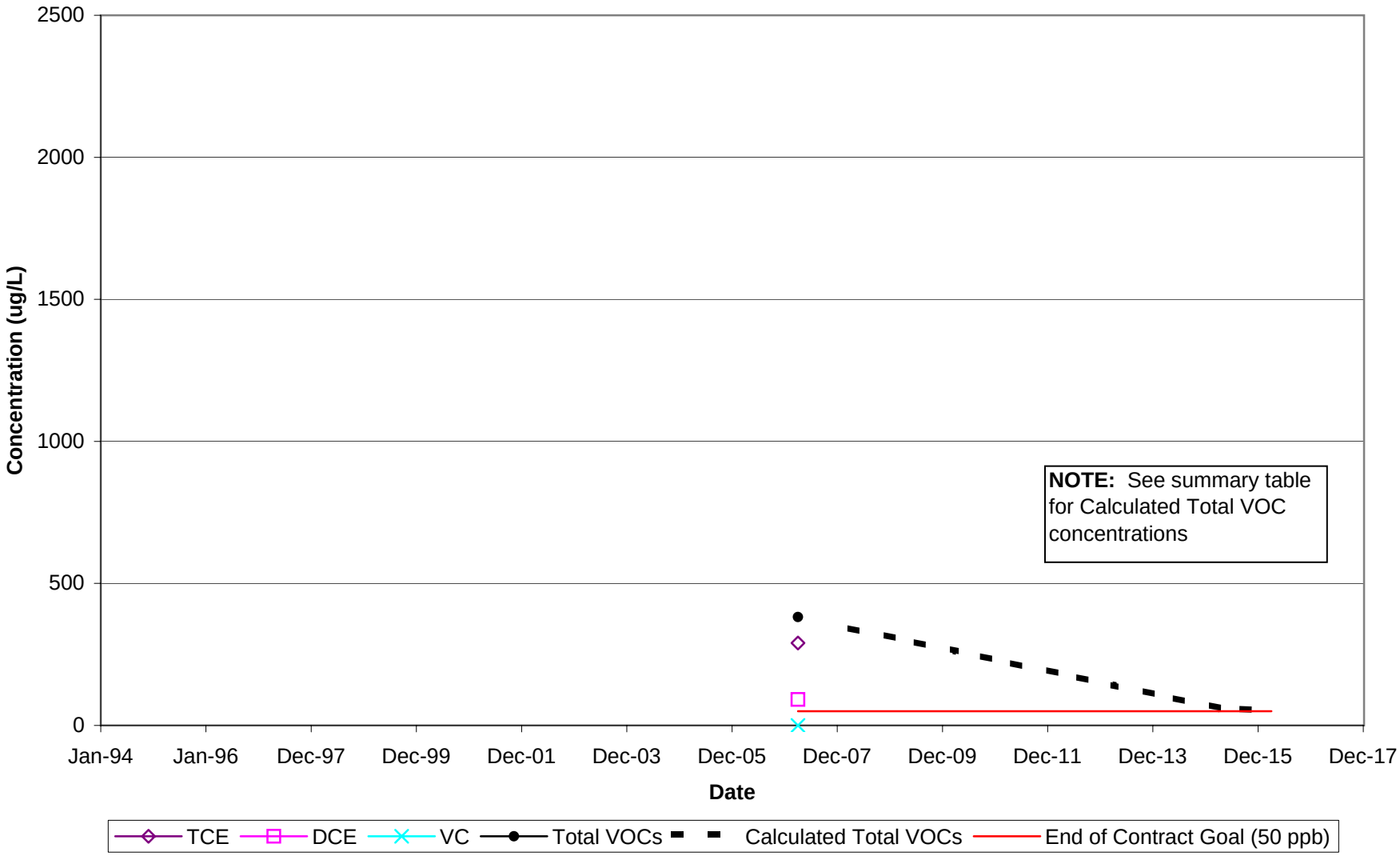


LF6VMW-34 Trend Analysis




LF6VMW-35 Trend Analysis
2500
2000
1500
1000
500
0
Concentration (ug/L)
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

LF6VMW-36 Trend Analysis



LF6VMW-38 Trend Analysis

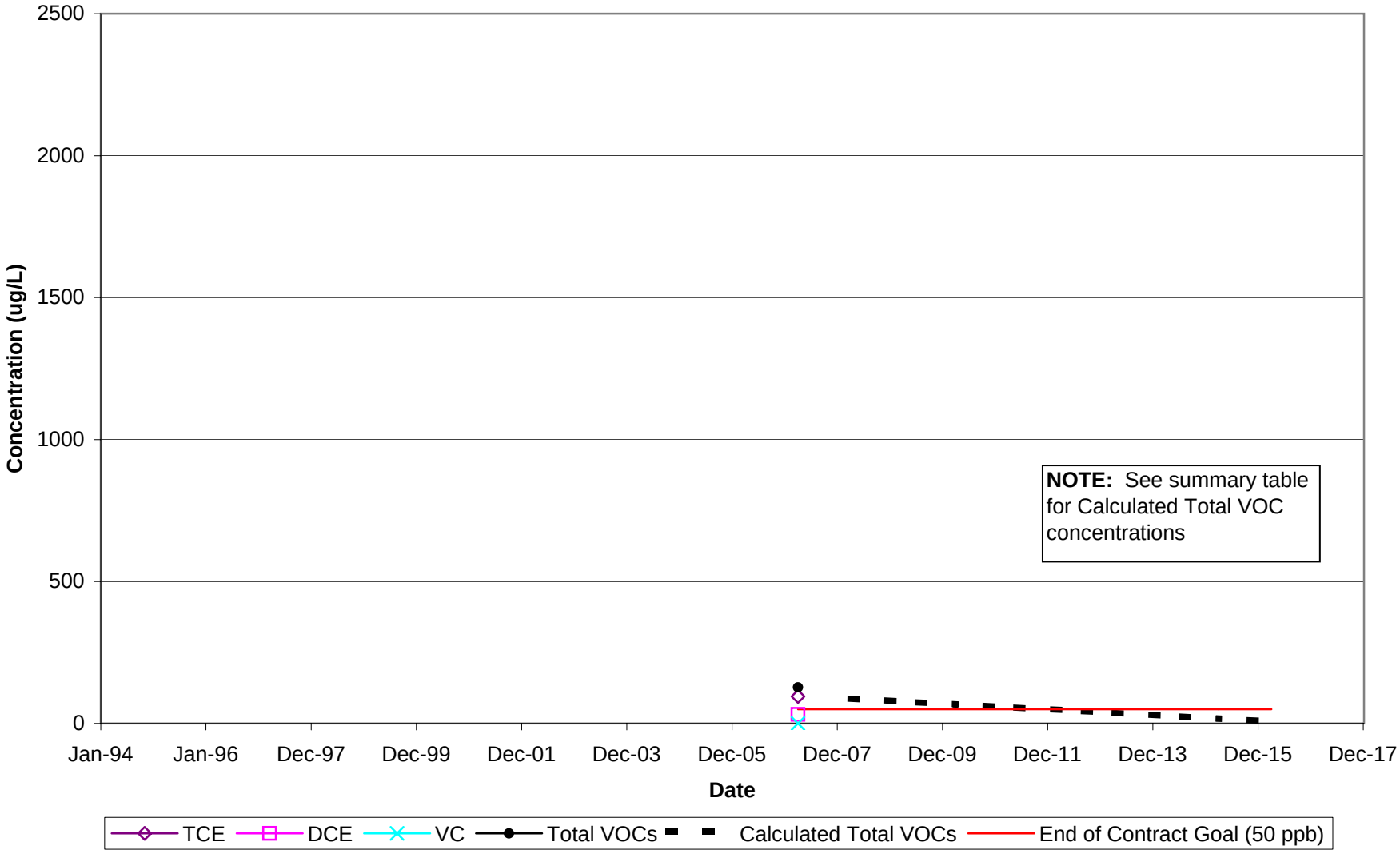


Table B-1 Summary of Groundwater Monitroing Well Data for Landfill 6

Well Number / Parameter	Screened Interval (ft BGS)	Analytical Results by Sample Date(s) (ug/L)																
		Nov-94 Ref 1	Aug-97 Ref 2	May-00 Ref 3	Apr-02 Ref 4	Oct-02 Ref 5	Dec-02 Ref 5[4]	Jan-03 Ref 5[4]	Nov-03 Ref 5[4]	Dec-03 Ref 5[5]	Mar-04 Ref 5[5]	Aug-04 Ref 6	Sep-04 Ref 7	Jul-06 Ref 8	Sep-06 Ref 9	Oct-06 Ref 10	Nov-06 Ref 11	Mar-07 Ref 11
LF6MW-2	16-26																	
TCE		0.39	U	U	-	-	-	-	-	-	-	-	U	-	-	-	-	-
cis-1,2-DCE		170	83	5.73	-	-	-	-	-	-	-	-	9.8	-	-	-	-	-
VC		30	20	U	-	-	-	-	-	-	-	-	0.123	-	-	-	-	-
Total VOCs		*200.39*	*103*	*5.73*	-	-	-	-	-	-	-	-	*9.923*	-	-	-	-	-
LF6VMW-6	35-45																	
TCE		-	26	8.45	-	-	-	-	-	-	-	-	3.6	-	-	-	-	-
cis-1,2-DCE		-	180	35.4	-	-	-	-	-	-	-	-	8.31	-	-	-	-	-
VC		-	29	6.21	-	-	-	-	-	-	-	-	1.33	-	-	-	-	-
Total VOCs		-	*235*	*50.06*	-	-	-	-	-	-	-	-	*13.24*	-	-	-	-	-
LF6VMW-11	25-30																	
TCE		-	-	26.3	-	-	-	-	-	-	-	-	42.2	-	-	-	-	-
cis-1,2-DCE		-	-	33.8	-	-	-	-	-	-	-	-	31.9	-	-	-	-	-
VC		-	-	1.96	-	-	-	-	-	-	-	-	0.648	-	-	-	-	-
Total VOCs		-	-	*62.06*	-	-	-	-	-	-	-	-	*74.748*	-	-	-	-	-
LF6VMW-12	41-51																	
TCE		-	-	-	1,110	1,090	1,500	1,600	1,070	U	1,500	1,330	-	1,500	942	-	-	836
cis-1,2-DCE		-	-	-	485	413	305	308	344	U	235	315	-	470	287	-	-	212
VC		-	-	-	6.9	8.6	3.49	5.88	8.64	U	7.46	6.24	-	2.7	2.64	-	-	U
Total VOCs		-	-	-	*1,601.9*	*1,511.6*	*1,808.49*	*1,913.88*	*1,422.64*	*0*	*1,742.46*	*1,651.24*	-	*1,972.70*	*1,231.64*	-	-	*1,048*
LF6MW-16	37-47																	
TCE		-	-	-	-	1,220	1,230	1,180	1,330	U	2,140	1,640	-	-	-	-	816	-
cis-1,2-DCE		-	-	-	-	426	440	381	351	U	262	307	-	-	-	-	200	-
VC		-	-	-	-	10.8	12.9	2.26	10.8	U	7.41	6.11	-	-	-	-	U	-
Total VOCs		-	-	-	-	*1,656.8*	*1,682.9*	*1,563.26*	*1,691.8*	*0*	*2,409.41*	*1,953.11*	-	-	-	-	*1,016*	-
LF6MW-17	45 - 55																	
TCE		-	-	-	-	380	775	762	851	U	869	657	-	-	-	-	-	-
cis-1,2-DCE		-	-	-	-	434	395	329	496	U	432	487	-	-	-	-	-	-
VC		-	-	-	-	4.4	U	1.88	4.17	U	1.28	2.12	-	-	-	-	-	-
Total VOCs		-	-	-	-	*818.4*	*1,170*	*1,092.9*	*1,351.2*	*0*	*1,302.3*	*1,146.1*	-	-	-	-	-	-
LF6MW-20	41 - 51																	
TCE		-	-	-	-	1,180	1,320	1,260	1,470	1,480	1,800	2,140	-	-	-	-	-	1,140
cis-1,2-DCE		-	-	-	-	428	456	444	449	349	252	287	-	-	-	-	-	284
VC		-	-	-	-	8.84	6.28	5.01	10.9	10.4	6.54	6.19	-	-	-	-	-	U
Total VOCs		-	-	-	-	*1,616.8*	*1,782*	*1,709.0*	*1,929.9*	*1,839*	*2,058.5*	*2,433.2*	-	-	-	-	-	*1,424.0*
LF6VMW-26	45-55																	
TCE		-	-	-	-	-	-	-	-	-	-	-	U	U	U	-	U	-
cis-1,2-DCE		-	-	-	-	-	-	-	-	-	-	-	197	99	91.6	-	84	-
VC		-	-	-	-	-	-	-	-	-	-	-	0.487	0.72	0.63	-	0.525	-
Total VOCs		-	-	-	-	-	-	-	-	-	-	-	*197.487*	*99.72*	*92.23*	-	*84.525*	-
LF6MW-31	19 - 39																	
TCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-	-
cis-1,2-DCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.52	-	-
VC		-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.29	-	-
Total VOCs		-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.81*	-	-
LF6MW-32	35 - 55																	
TCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-
cis-1,2-DCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.4	-	-
VC		-	-	-	-	-	-	-	-	-	-	-	-	-	-	U	-	-
Total VOCs		-	-	-	-	-	-	-	-	-	-	-	-	-	-	*13.8*	-	-

Table B-1 Summary of Groundwater Monitroing Well Data for Landfill 6

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LF6MW-33	35 - 55																	
TCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	202
cis-1,2-DCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31.7
VC		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U
Total VOCs		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*233.7*
LF6MW-34	35 - 55																	
TCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	79
cis-1,2-DCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38.3
VC		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.15
Total VOCs		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*118.3*
LF6MW-35	35 - 55																	
TCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
cis-1,2-DCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.43
VC		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U
Total VOCs		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*13.4*
LF6MW-36	35 - 55																	
TCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	290
cis-1,2-DCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	91.6
VC		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1
Total VOCs		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*381.7*
LF6MW-38	35 - 55																	
TCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95
cis-1,2-DCE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32.2
VC		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	U
Total VOCs		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*127.2*

Notes:

1. Data provided for detected concentrations only. Data qualifiers were omitted for purposes of graph development.
2. Hydropunch data collected at this site is not included in this analysis.
3. Shaded values denote an exceedence of the remediation goals presented in the ROD for the OBGW AOC. These values are as follows and are based on NYSDEC groundwater standards as of the approval date of the ROD.

TCE	=	5	ug/L
cis-1,2-DCE	=	5	ug/L
VC	=	2	ug/L

4. Sampling conducted after permanganate injection for pilot study in November 2002.
5. Sampling conducted after second injection in November 2003.
6. For monitoring wells with total VOCs greater than 50 ppb, anticipated total VOC concentrations were estimated through 2016. The following assumptions were made based on historical data:

If total VOC concentration is greater than	1000	ppb, assume degradation rate of	150	ppb per year
If total VOC concentration is greater than	500	ppb, assume degradation rate of	75	ppb per year
If total VOC concentration is greater than	100	ppb, assume degradation rate of	40	ppb per year
If total VOC concentration is less than	50	ppb, assume degradation rate of	10	ppb per year

References:

(1) Law Engineering and Environmental Services, Inc. December 1996. United States Air Force, Griffiss Air Force Base, N.Y., Remedial Investigation Landfill 6 Area of Concern, Volume 10.
(2) E & E. July 1998. Final Report for the Supplemental Investigations of Areas of Concern at the Former Griffiss Air Force Base.
(3) E & E. August 2000. Landfill 6 and Building 775 Areas of Concern Groundwater Study, Technical Memorandum No. 1: Field Investigation Conducted in Spring 2000.
(4) E & E. December 2002. Final Landfill 6, Building 775, AOC 9, and Building 817/WSA Technical Memorandum No. 1: Bedrock Groundwater Study.
(5) E & E. June 2004. Final Groundwater Treatability Pilot Study Report.
(6) E & E. December 2004. Landfill 6 Groundwater Treatability Pilot Study Supplemental Sampling Letter Report
(7) FPM Group. February 2005. Groundwater Monitoring Report
(8) FPM Group. September 2006. Long Term Monitoring Report
(9) FPM Group. September 2006 Groundwater Sampling associated with Landfill 6 Part 360 Monitoring
(10) EEEPC. February 2007. Predesign Investigation Report
(11) FPM Group. August 2007. Final Monitoring Report for Baseline and Predesign Investigation 2 Sampling

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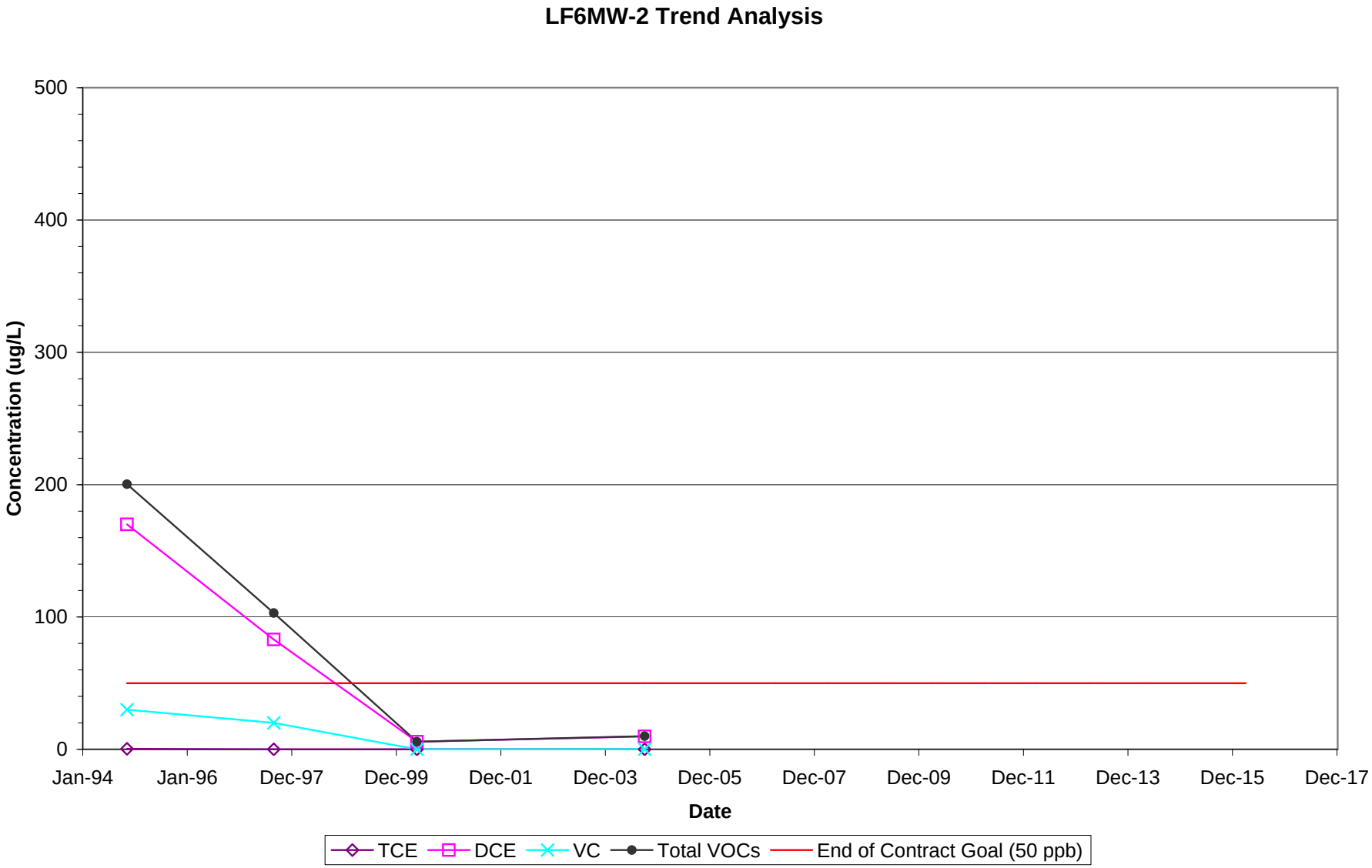
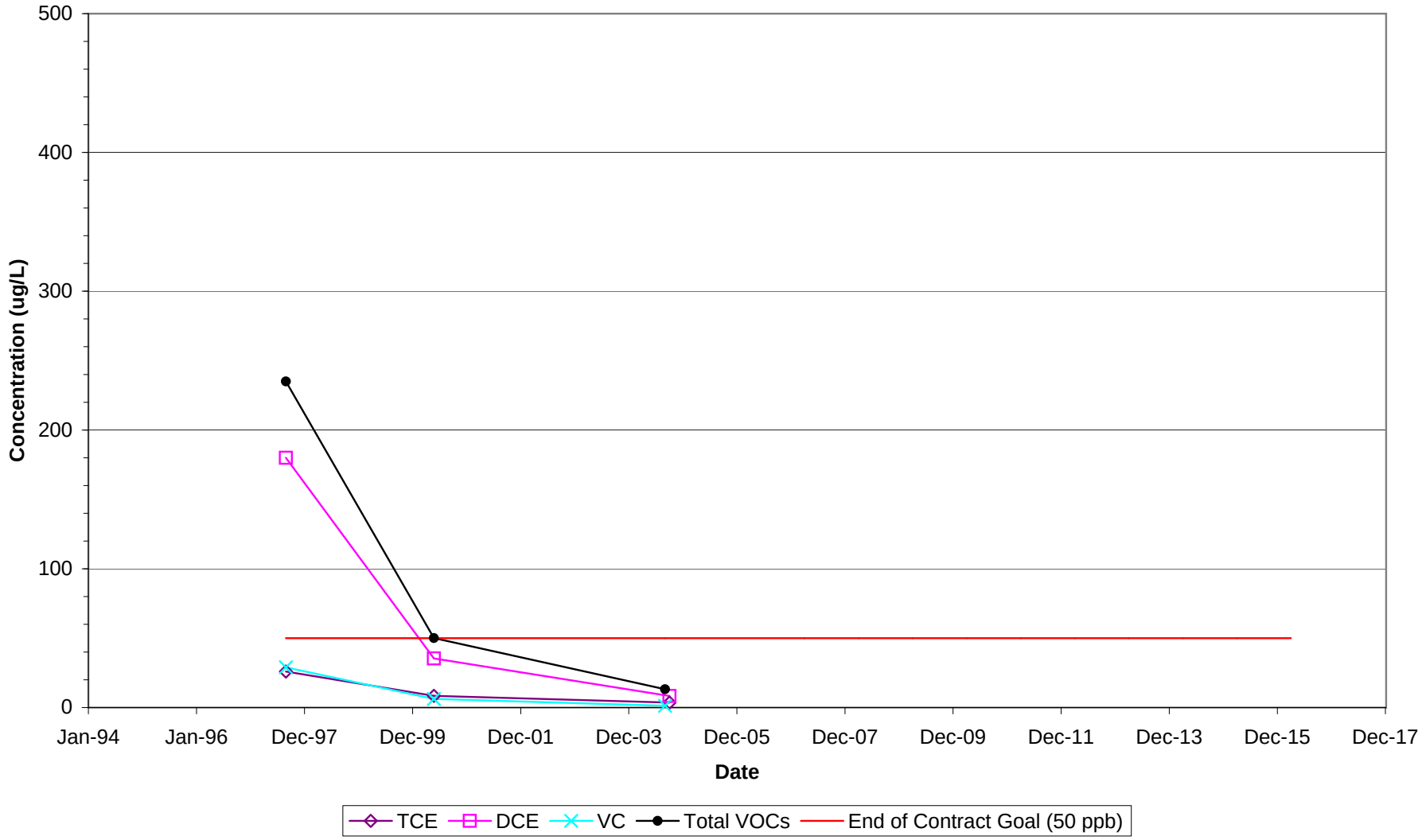
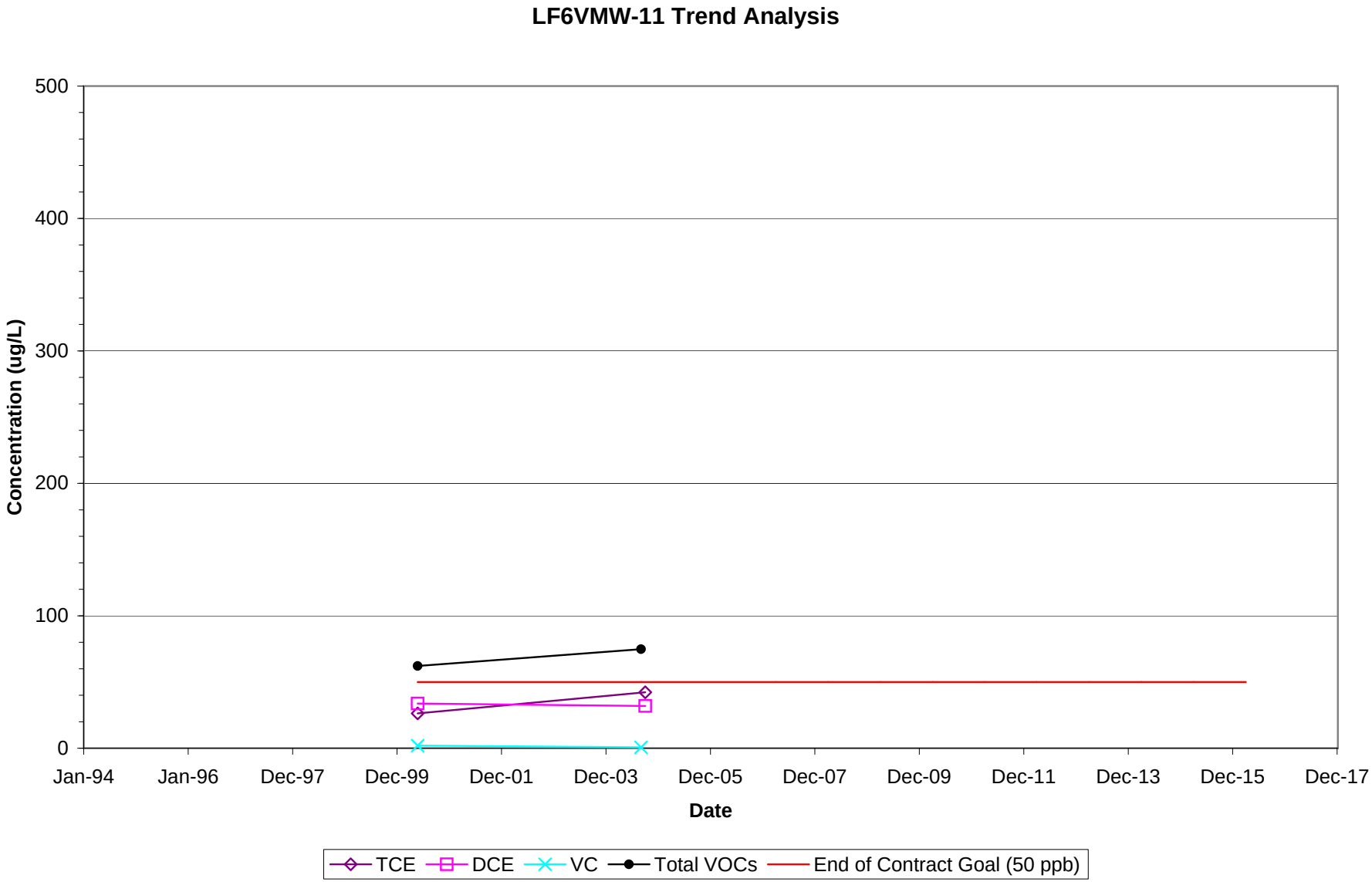
Key:
BGS = below ground surface
cis-1,2-DCE = cis-1,2-dichloroethene
ft = feet
TCE = trichloroethene
U = non-detect values
ug/L = micrograms per liter.
VC = vinyl chloride
VOCs = volatile organic compounds
7.6 Shaded values denote hits exceeding the NYSDEC standard.

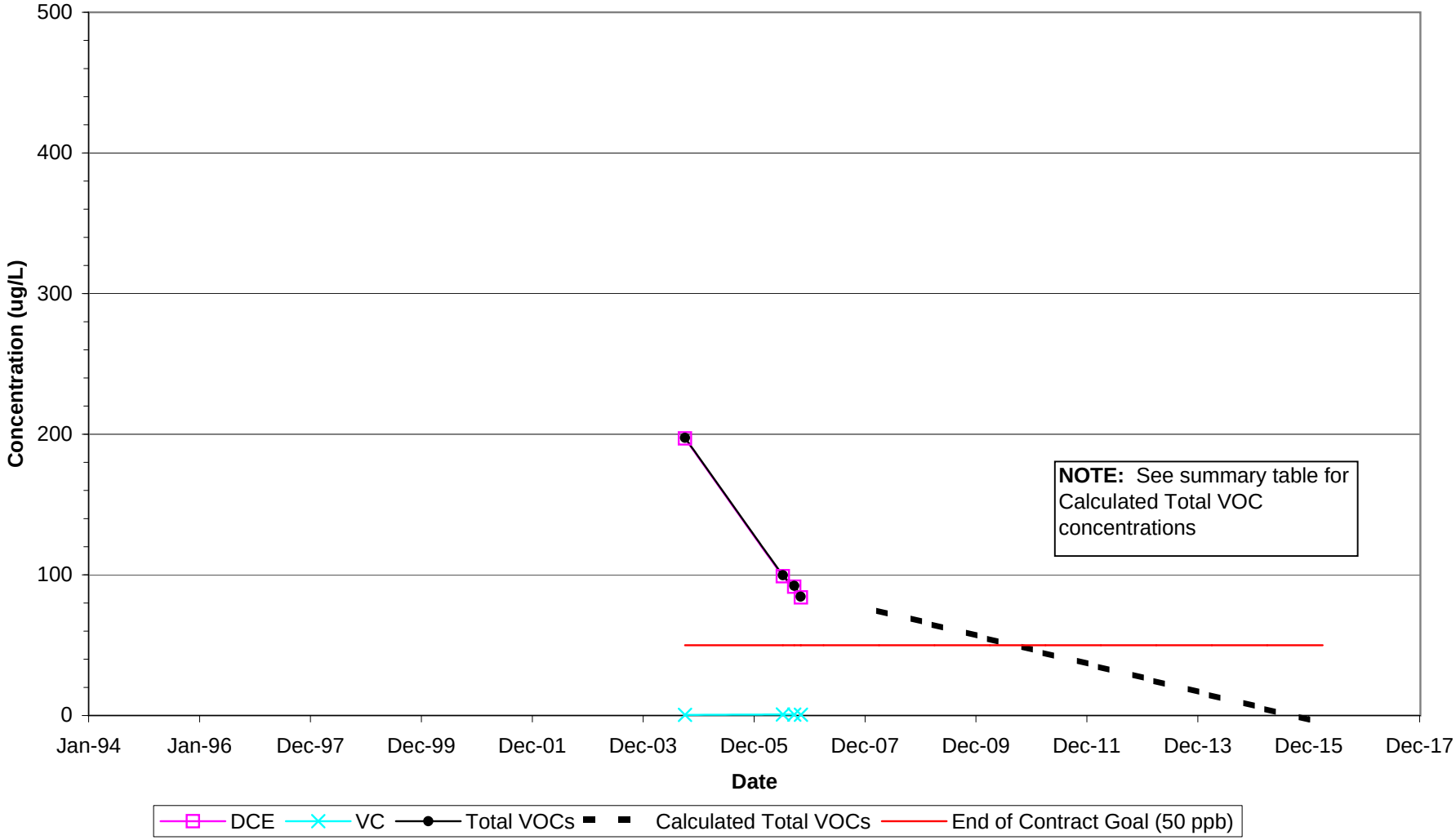

LF6MW-2 Trend Analysis
Concentration (ug/L)
500
400
300
200
100
0
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

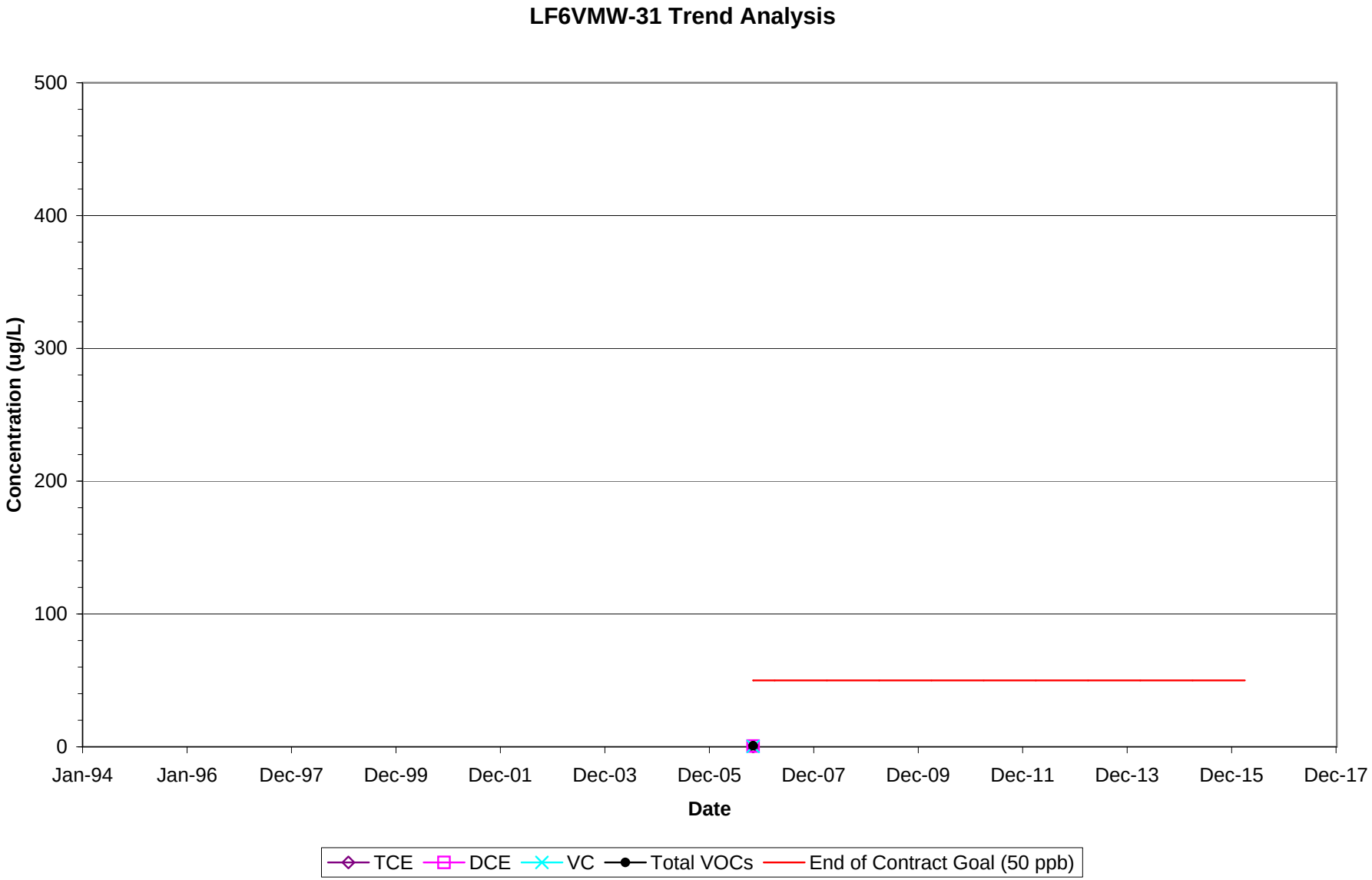
LF6VMW-6 Trend Analysis

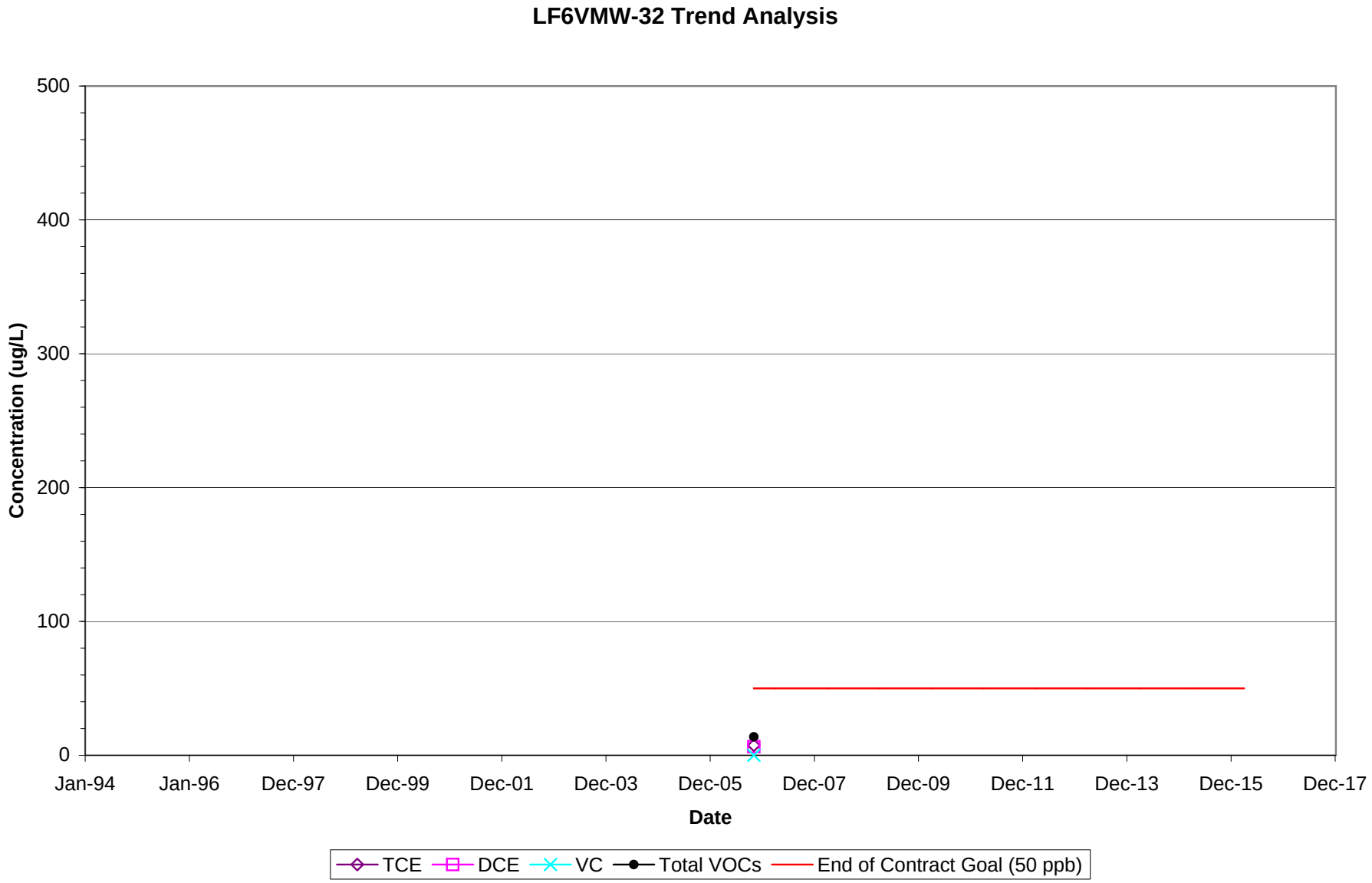



LF6VMW-11 Trend Analysis
500
400
300
200
100
0
Concentration (ug/L)
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

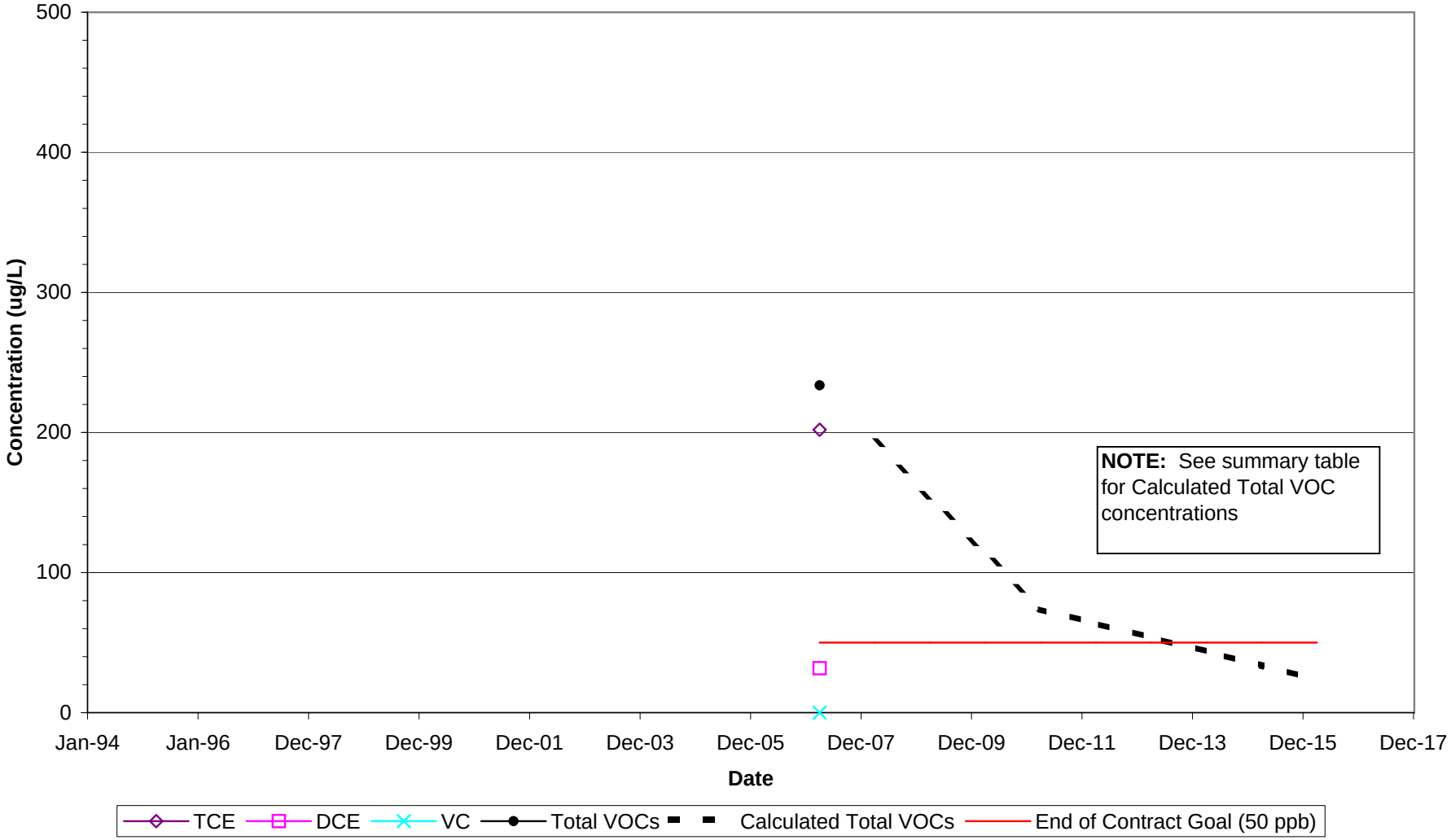
LF6VMW-26 Trend Analysis



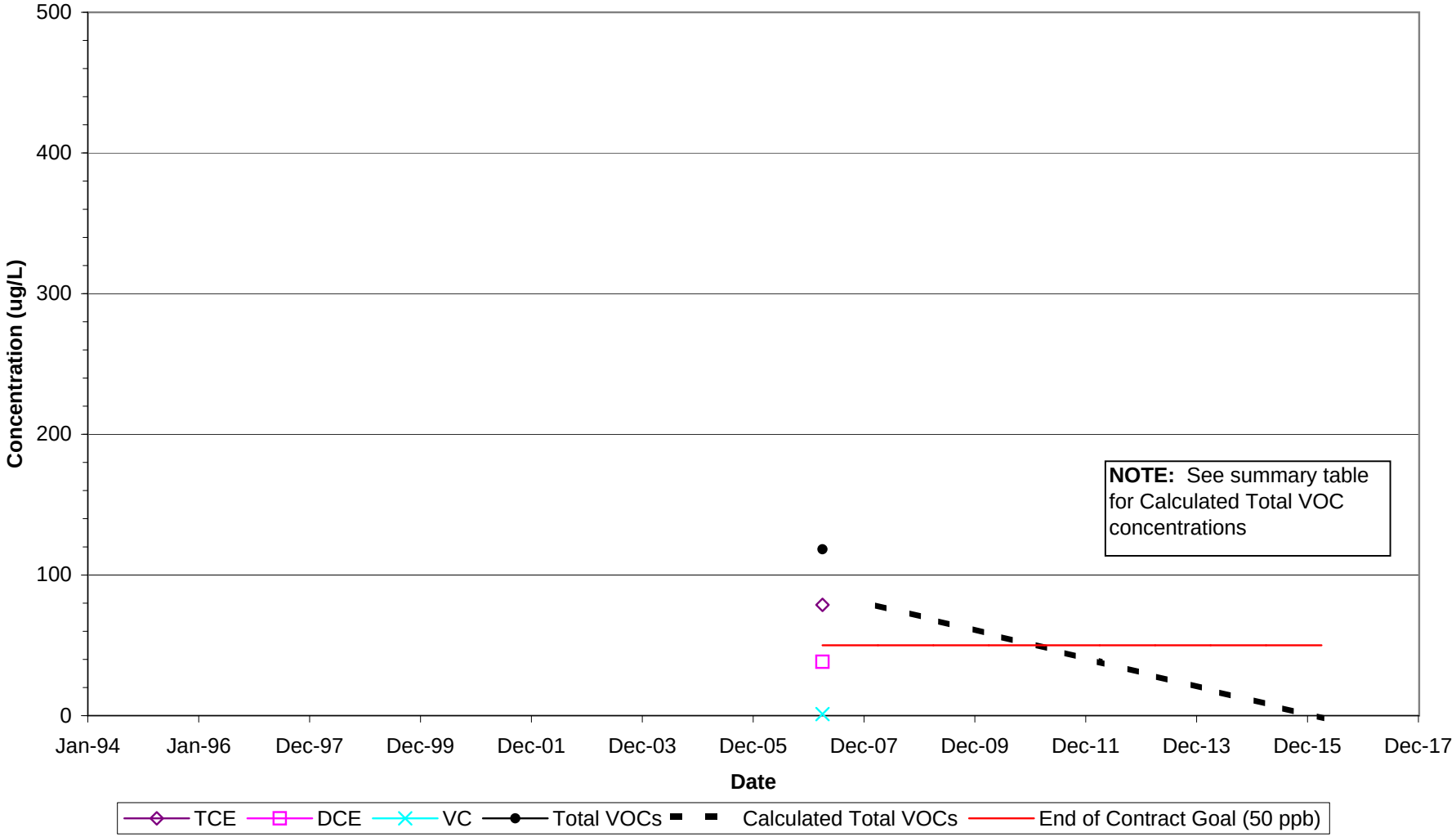

LF6VMW-31 Trend Analysis
500
400
300
200
100
0
Concentration (ug/L)
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

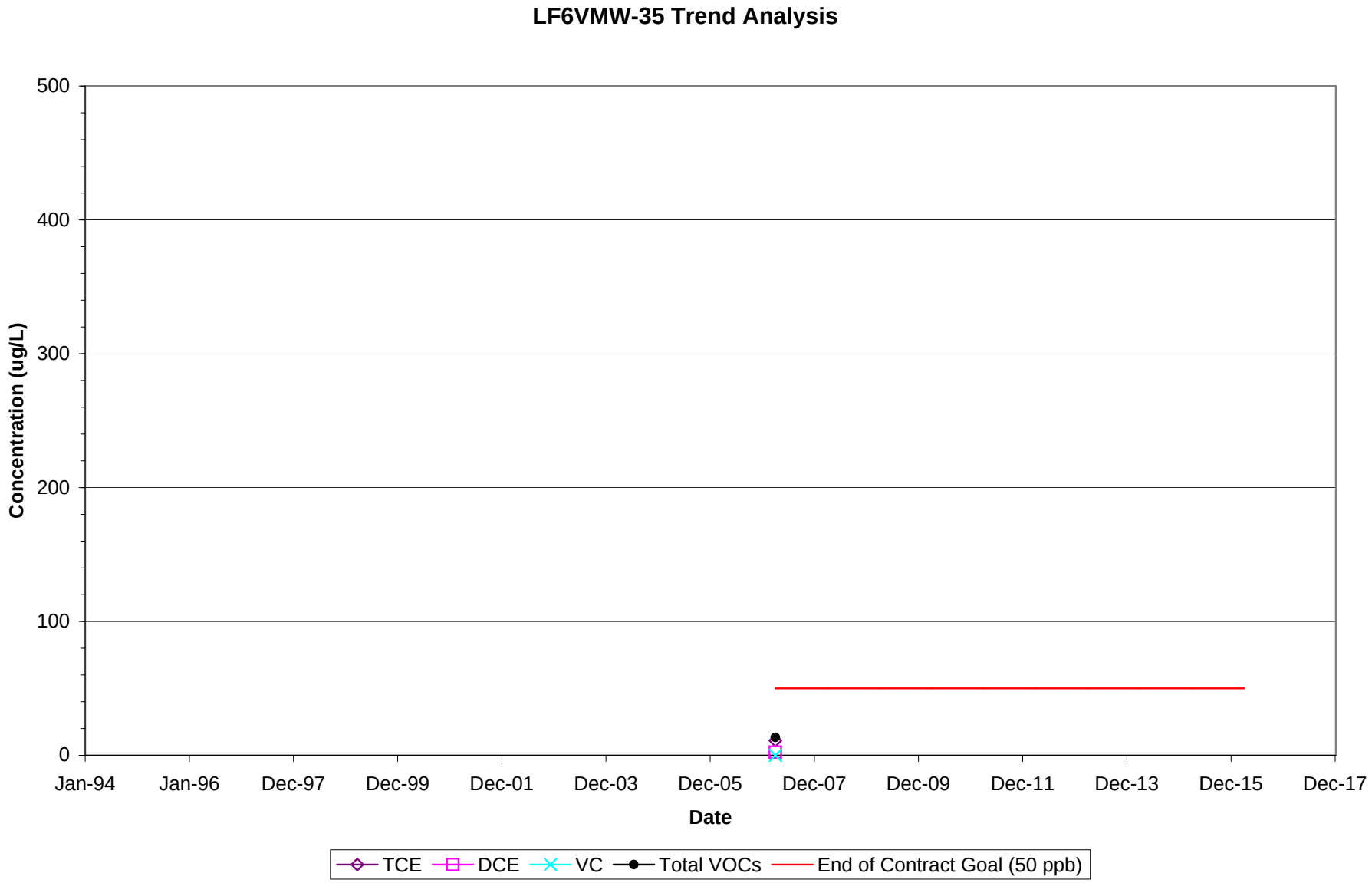

LF6VMW-32 Trend Analysis
500
400
300
200
100
0
Concentration (ug/L)
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

LF6VMW-33 Trend Analysis

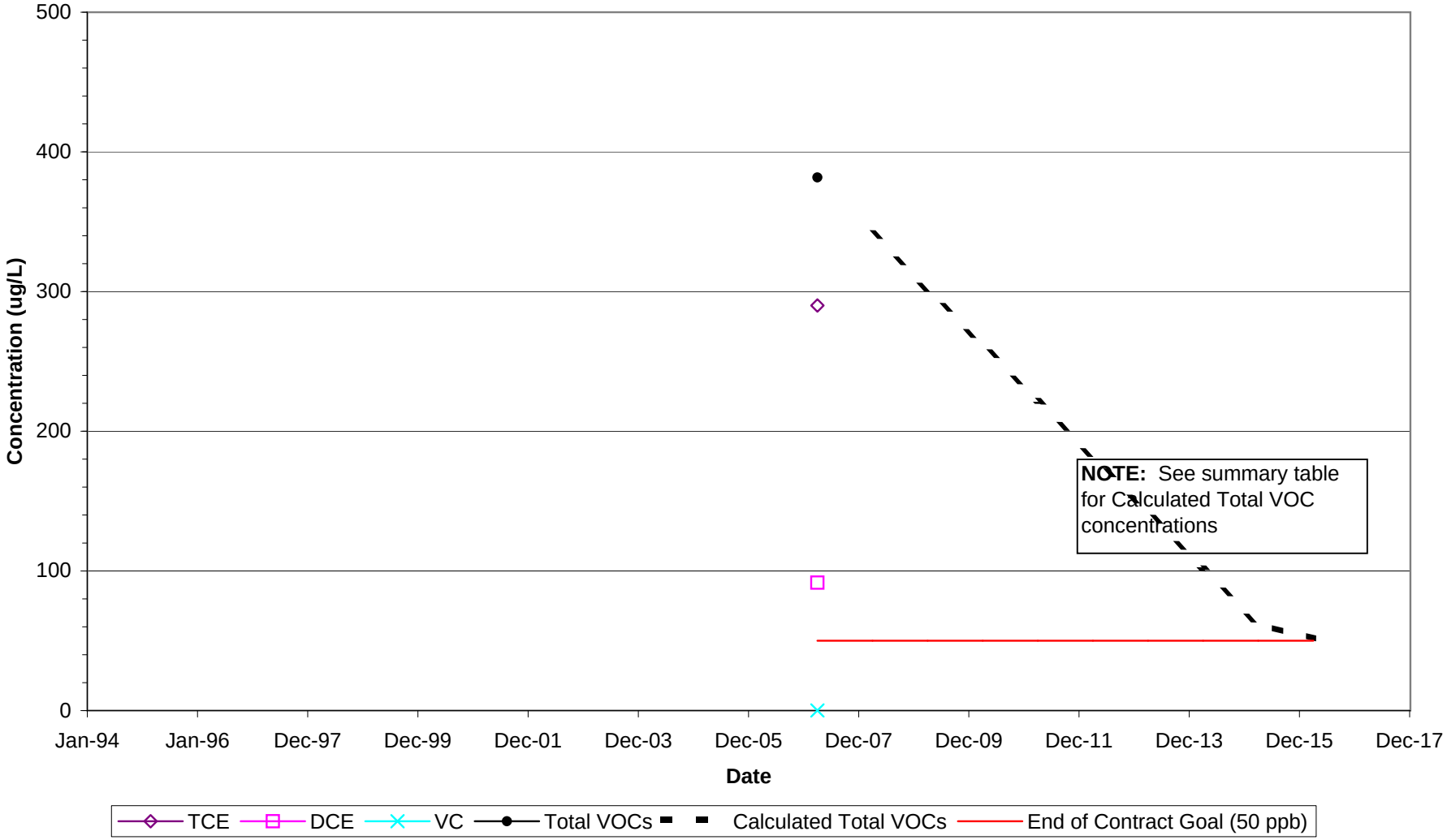


LF6VMW-34 Trend Analysis

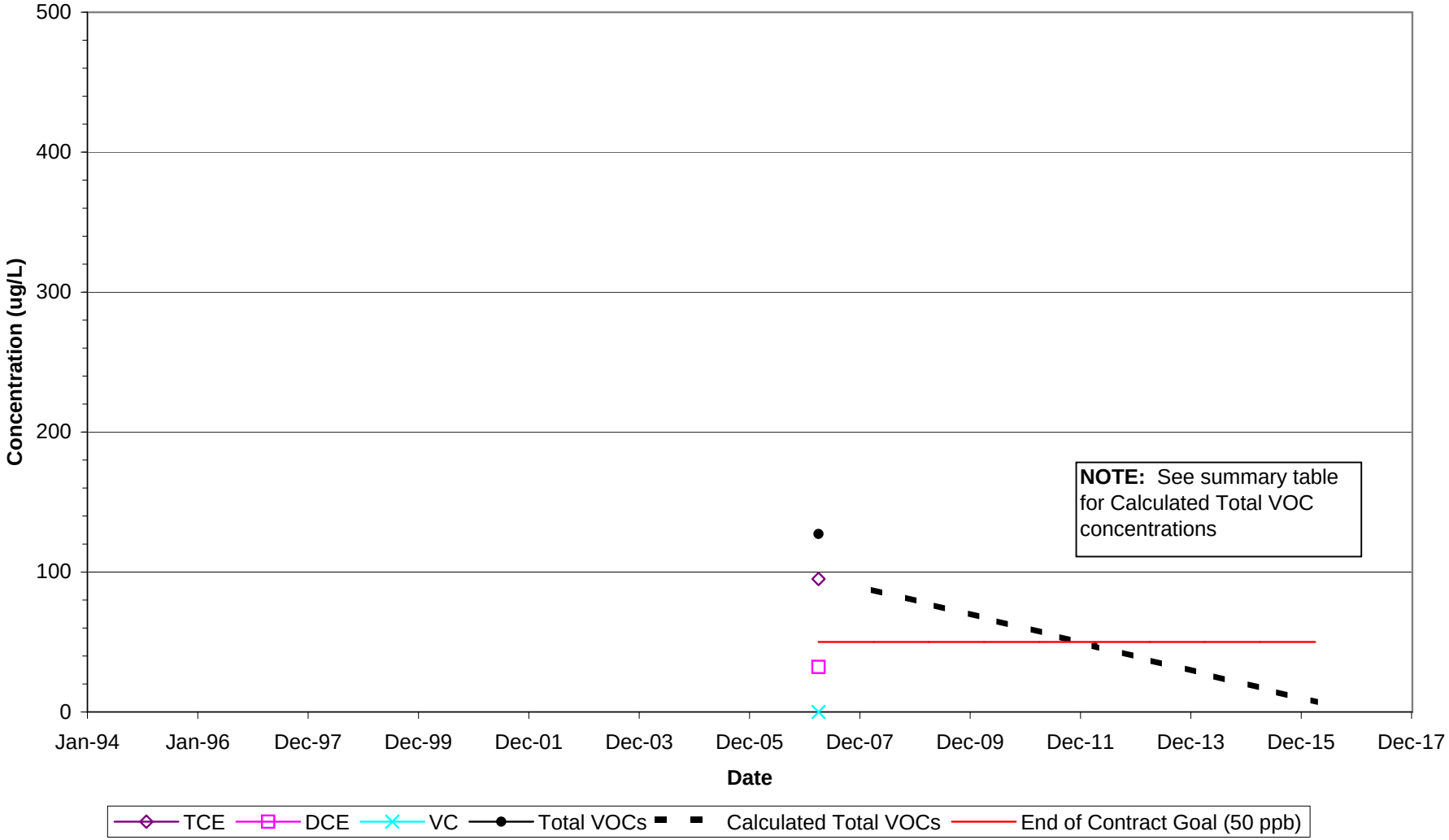



LF6VMW-35 Trend Analysis
500
400
300
200
100
0
Concentration (ug/L)
Jan-94
Jan-96
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Date
TCE
DCE
VC
Total VOCs
End of Contract Goal (50 ppb)

LF6VMW-36 Trend Analysis

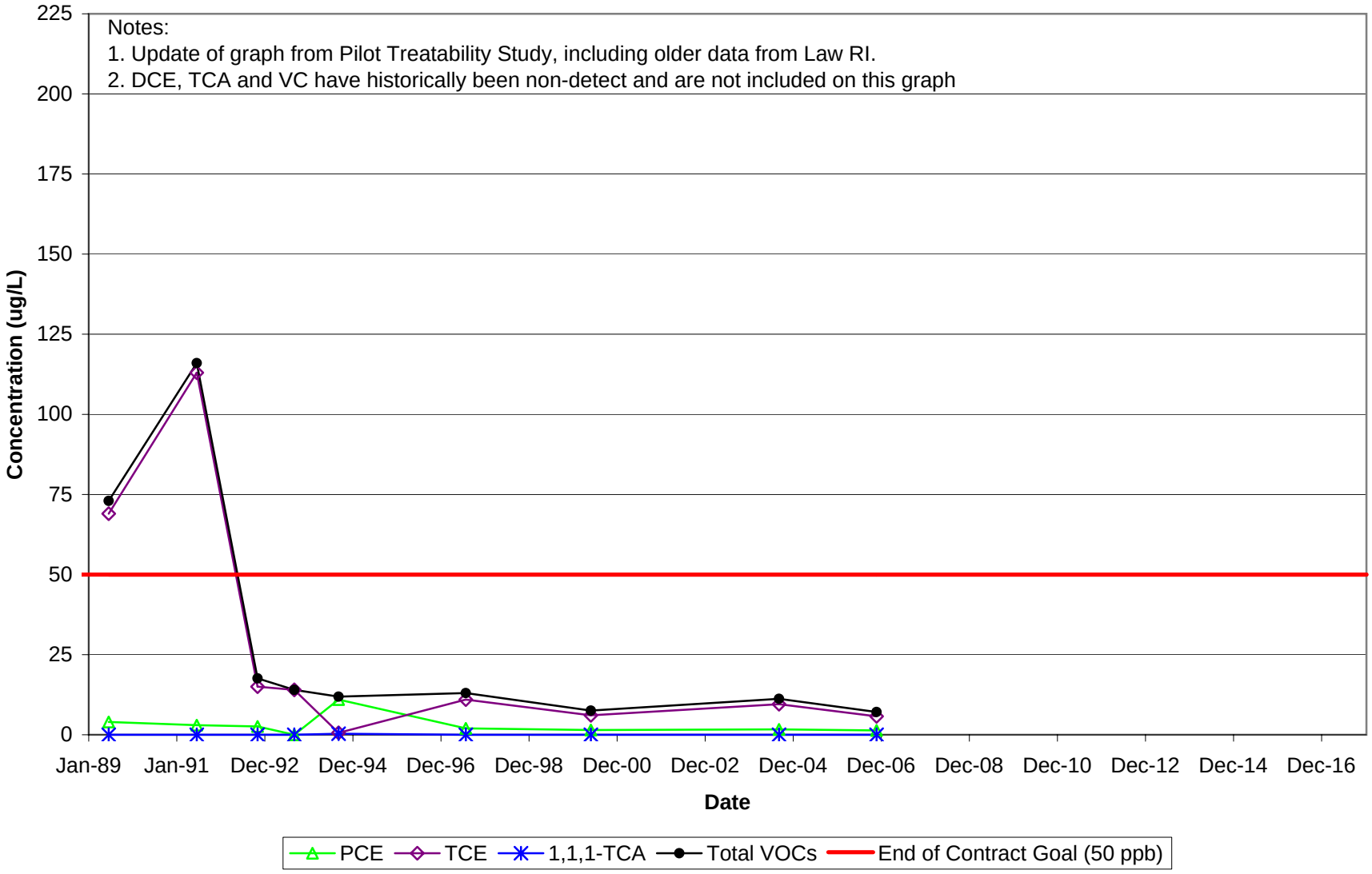


LF6VMW-38 Trend Analysis

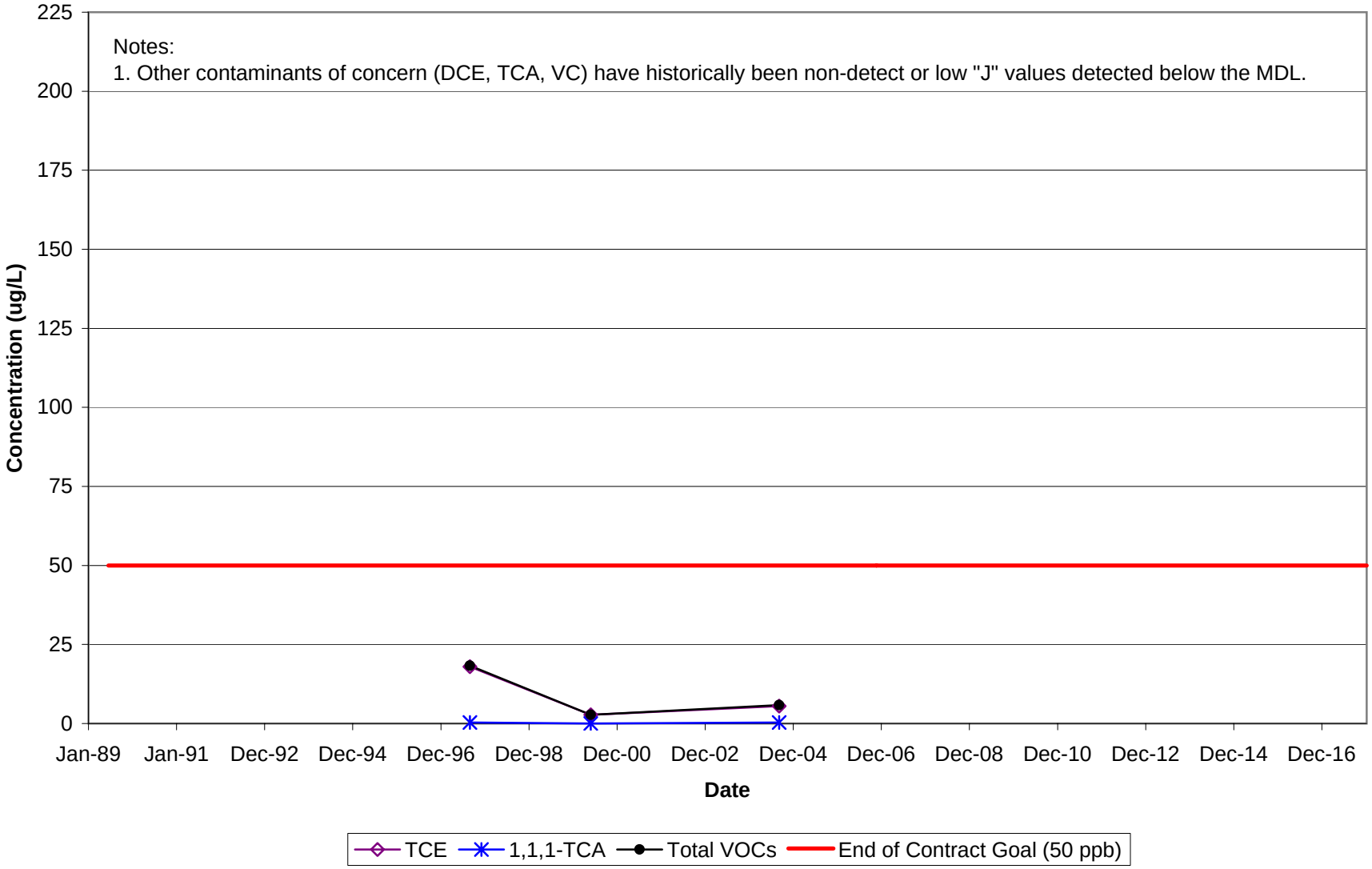


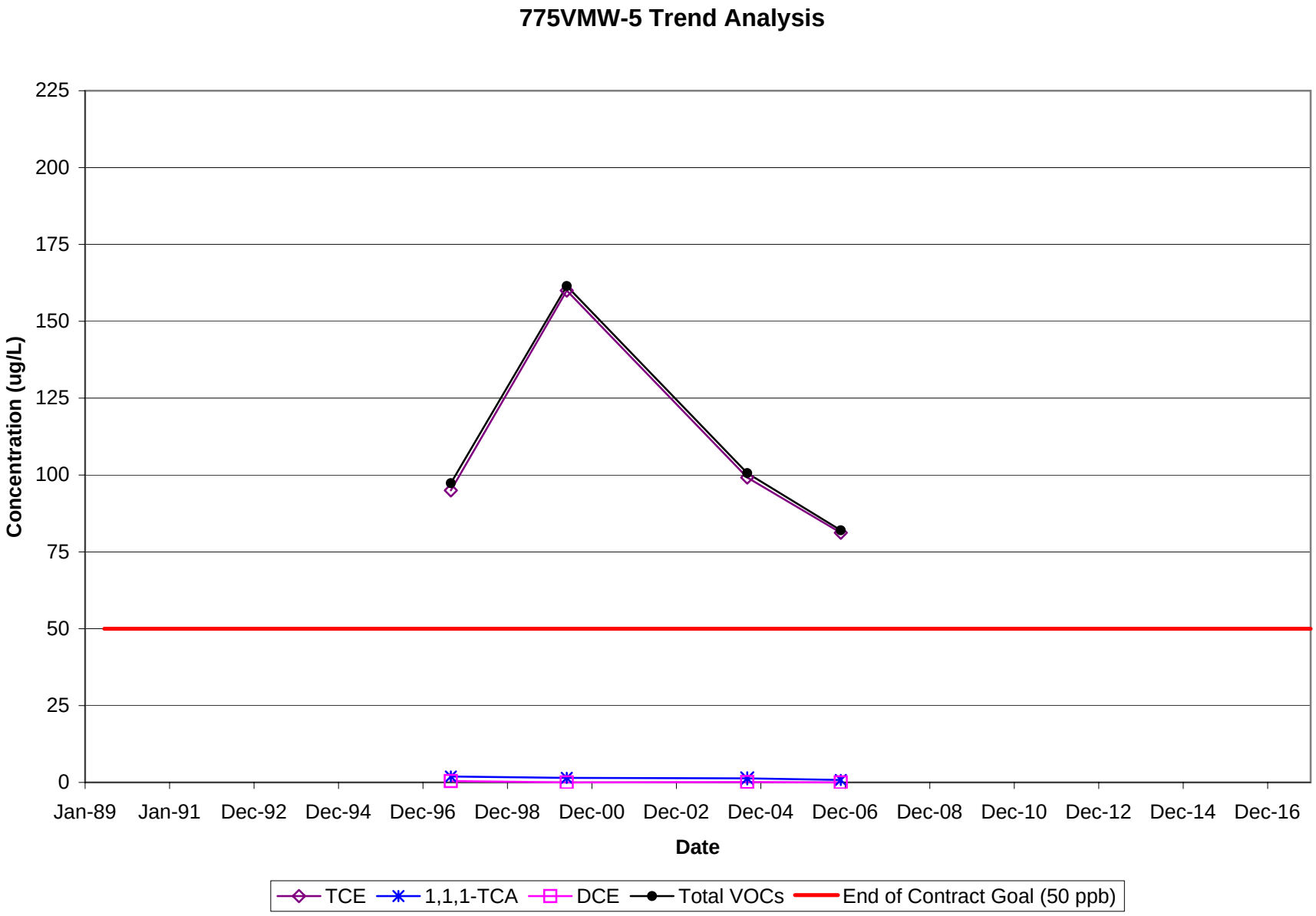
C B775 Trend Analysis

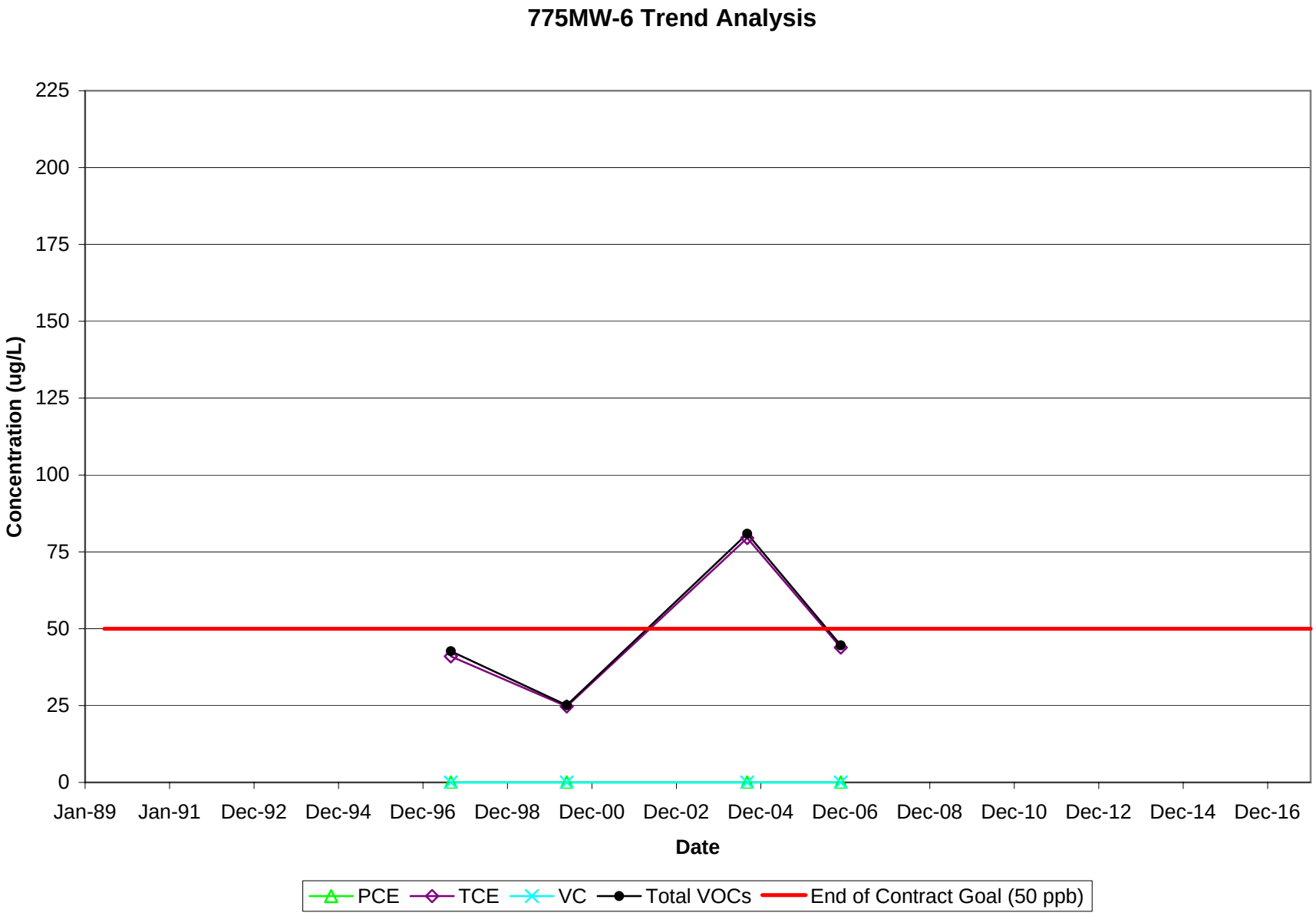
775MW-2 Trend Analysis



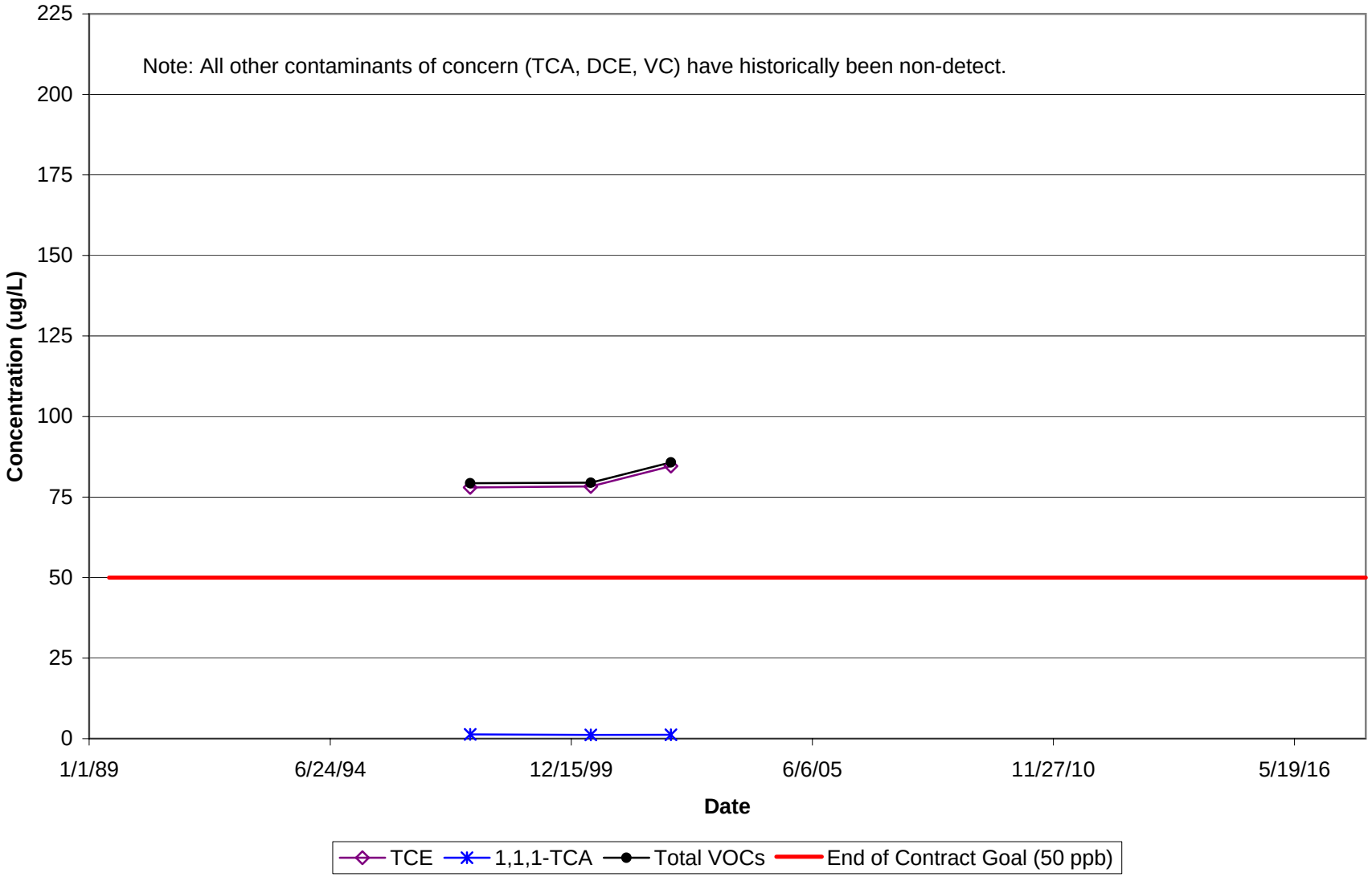
775VMW-4 Trend Analysis

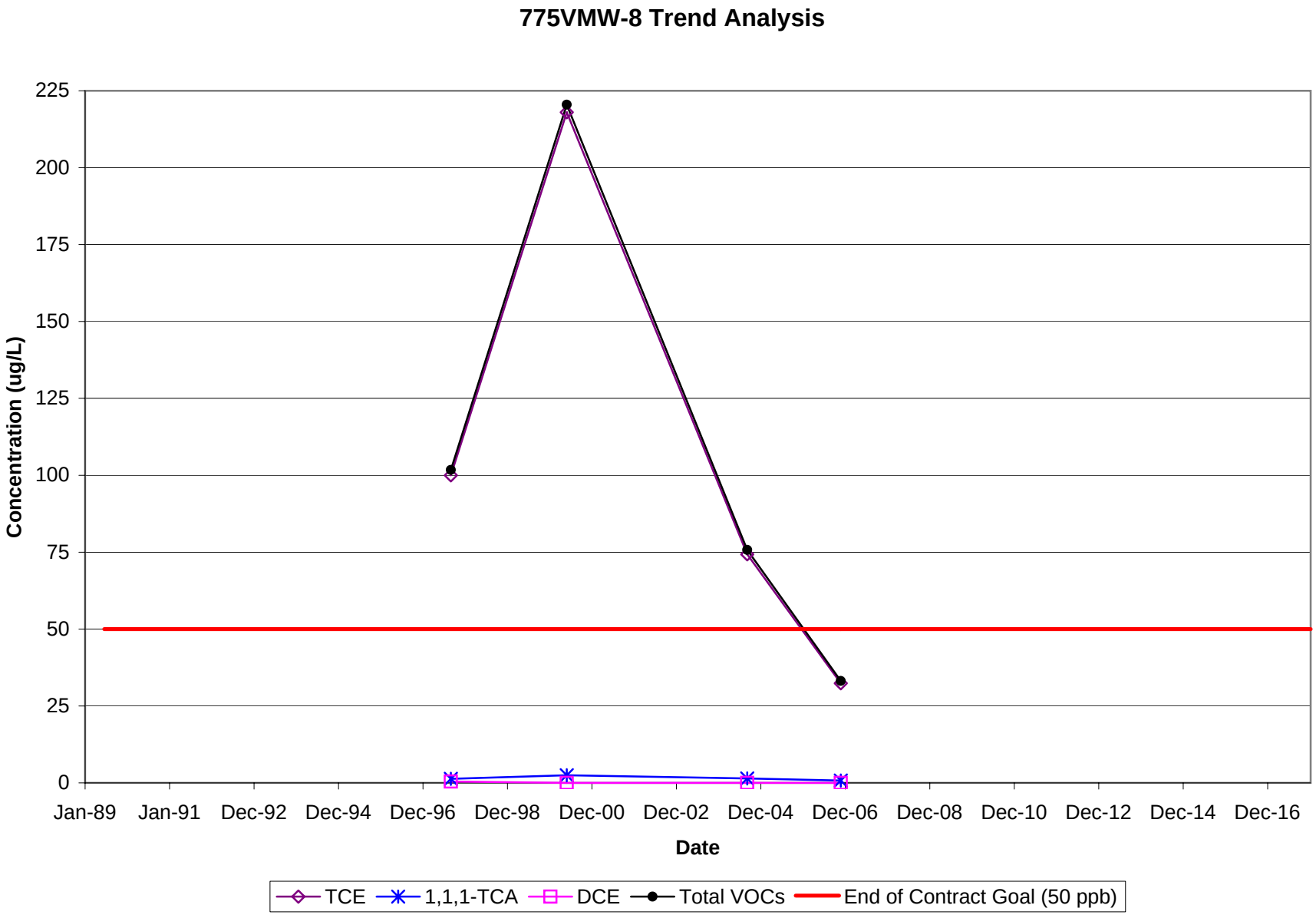



775VMW-5 Trend Analysis
225
200
175
150
125
100
75
50
25
0
Concentration (ug/L)
Jan-89
Jan-91
Dec-92
Dec-94
Dec-96
Dec-98
Dec-00
Dec-02
Dec-04
Dec-06
Dec-08
Dec-10
Dec-12
Dec-14
Dec-16
Date
TCE
1,1,1-TCA
DCE
Total VOCs
End of Contract Goal (50 ppb)

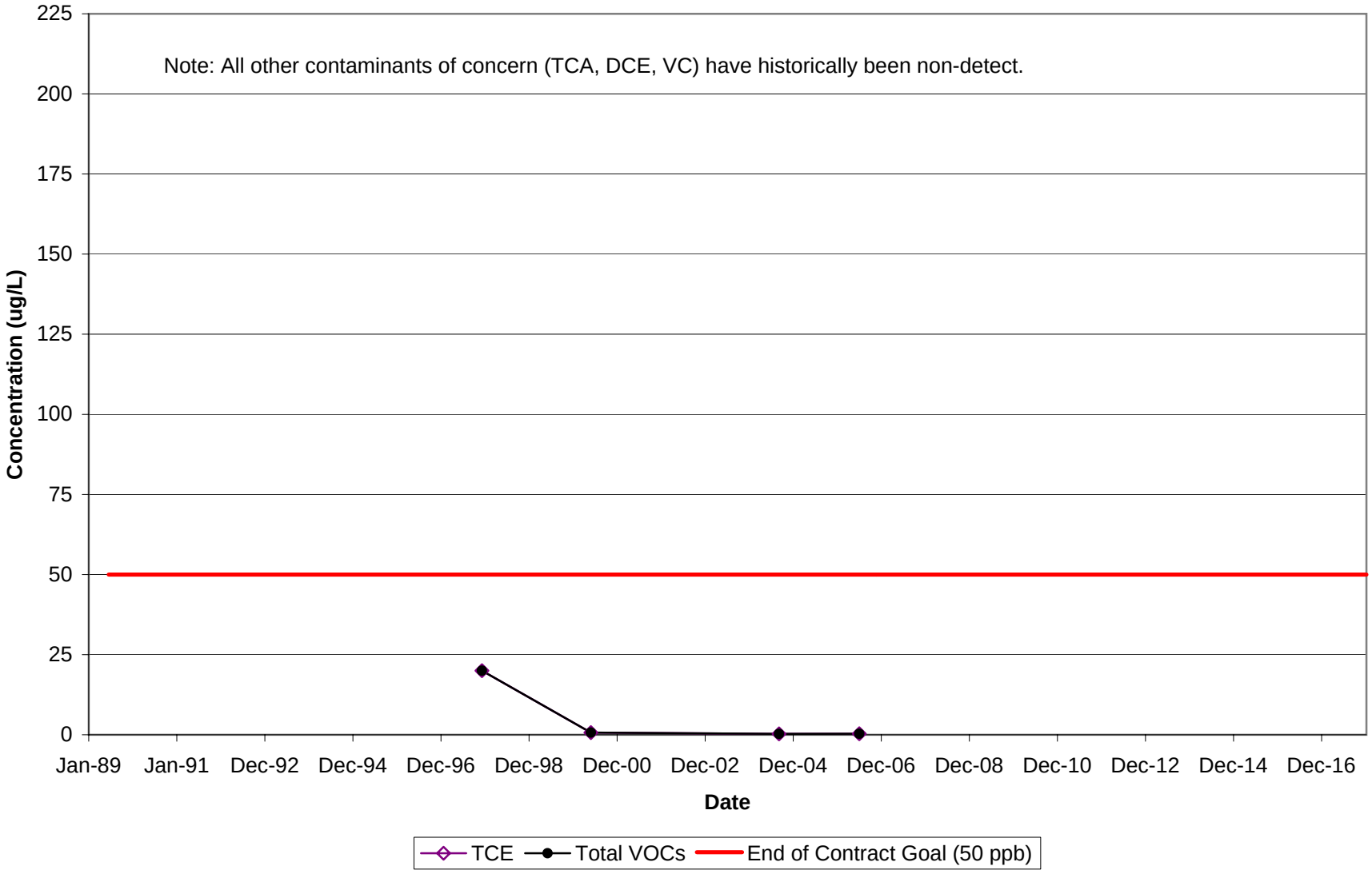

775MW-6 Trend Analysis
225
200
175
150
125
100
75
50
25
0
Concentration (ug/L)
Jan-89
Jan-91
Dec-92
Dec-94
Dec-96
Dec-98
Dec-00
Dec-02
Dec-04
Dec-06
Dec-08
Dec-10
Dec-12
Dec-14
Dec-16
Date
PCE
TCE
VC
Total VOCs
End of Contract Goal (50 ppb)

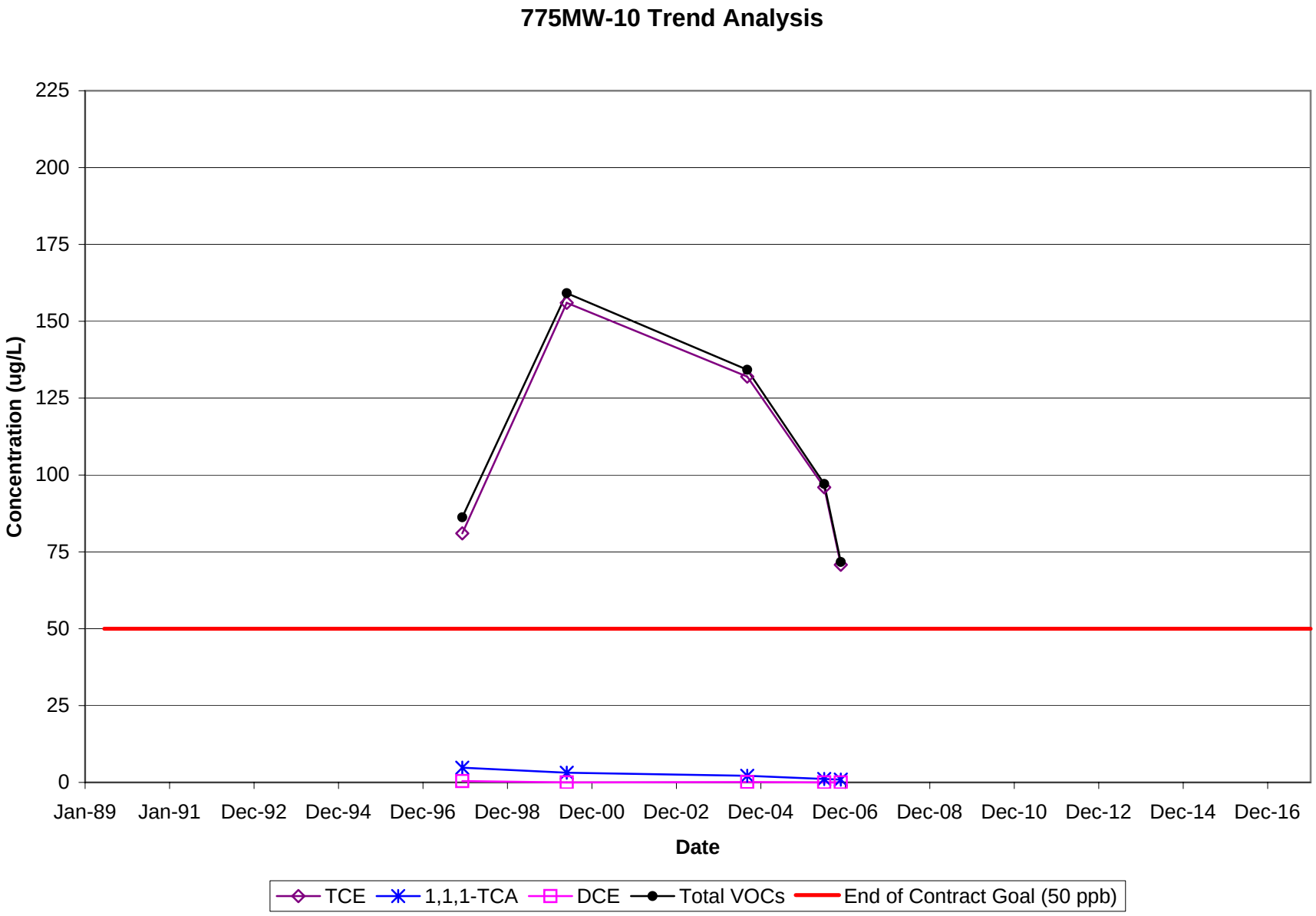
775VMW-7 Trend Analysis

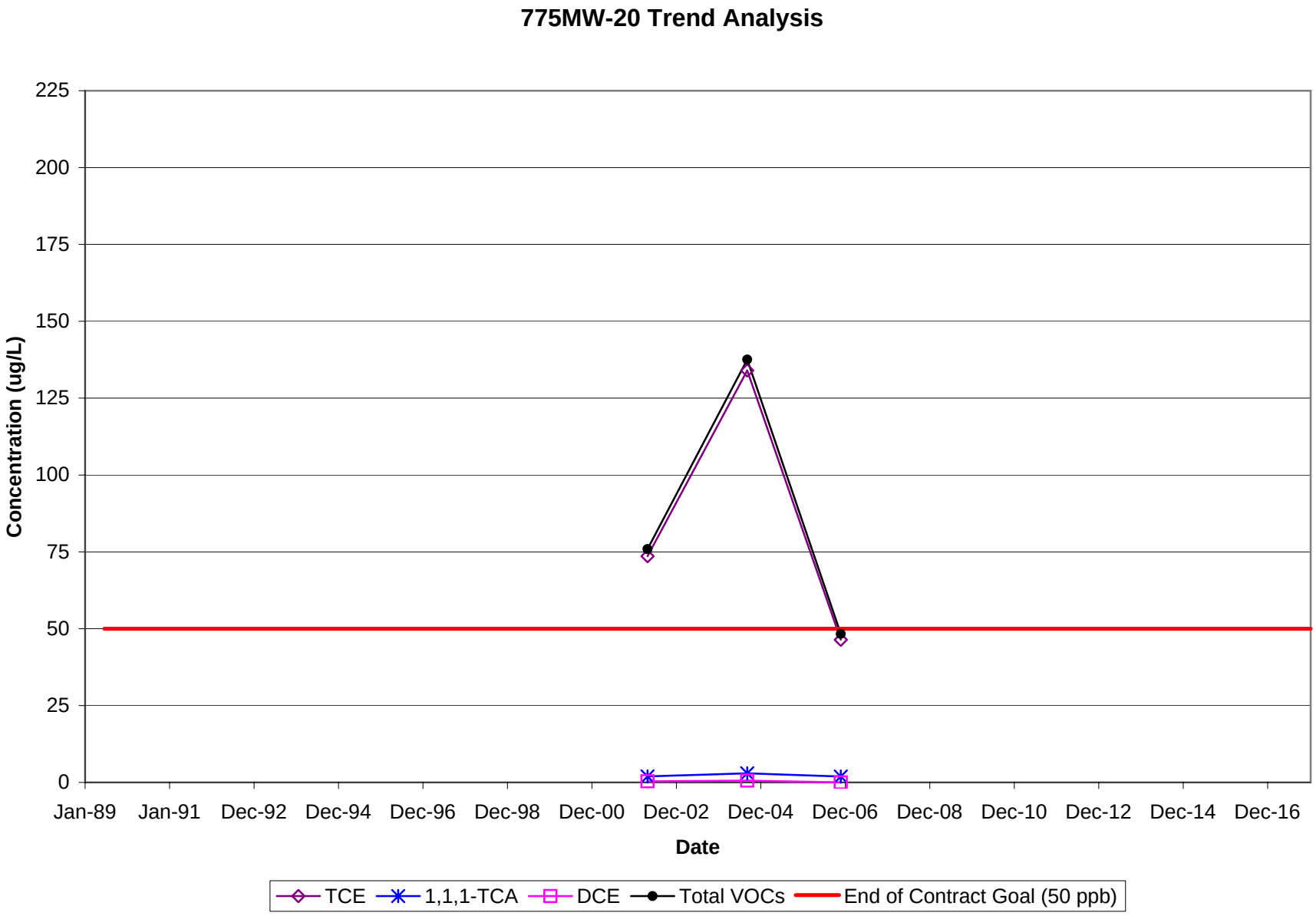


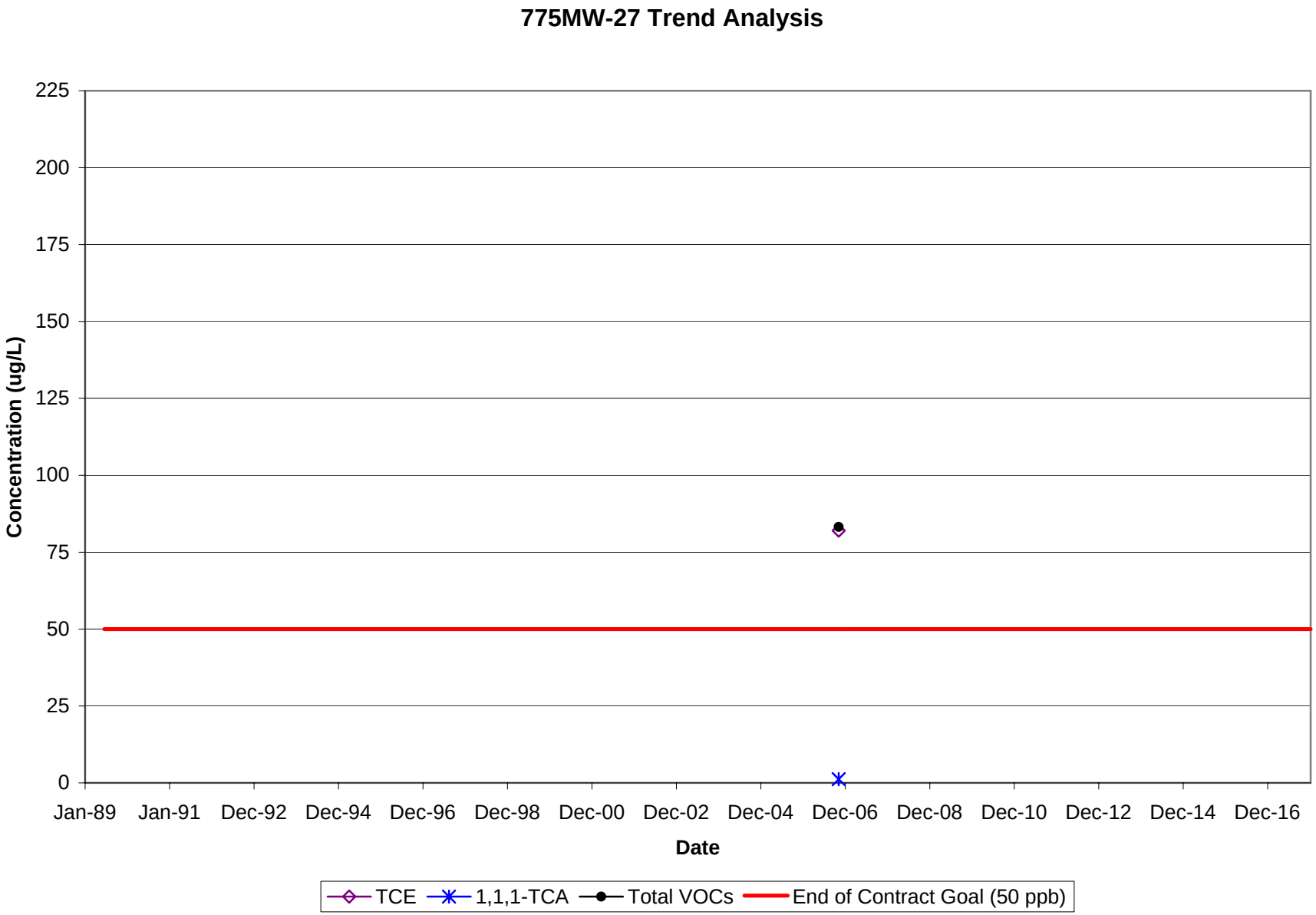

775VMW-8 Trend Analysis
225
200
175
150
125
100
75
50
25
0
Concentration (ug/L)
Jan-89
Jan-91
Dec-92
Dec-94
Dec-96
Dec-98
Dec-00
Dec-02
Dec-04
Dec-06
Dec-08
Dec-10
Dec-12
Dec-14
Dec-16
Date
TCE
1,1,1-TCA
DCE
Total VOCs
End of Contract Goal (50 ppb)

775VMW-9 Trend Analysis




775MW-10 Trend Analysis
225
200
175
150
125
100
75
50
25
0
Concentration (ug/L)
Jan-89
Jan-91
Dec-92
Dec-94
Dec-96
Dec-98
Dec-00
Dec-02
Dec-04
Dec-06
Dec-08
Dec-10
Dec-12
Dec-14
Dec-16
Date
TCE
1,1,1-TCA
DCE
Total VOCs
End of Contract Goal (50 ppb)


775MW-20 Trend Analysis
225
200
175
150
125
100
75
50
25
0
Concentration (ug/L)
Jan-89
Jan-91
Dec-92
Dec-94
Dec-96
Dec-98
Dec-00
Dec-02
Dec-04
Dec-06
Dec-08
Dec-10
Dec-12
Dec-14
Dec-16
Date
TCE
1,1,1-TCA
DCE
Total VOCs
End of Contract Goal (50 ppb)


775MW-27 Trend Analysis
225
200
175
150
125
100
75
50
25
0
Concentration (ug/L)
Jan-89
Jan-91
Dec-92
Dec-94
Dec-96
Dec-98
Dec-00
Dec-02
Dec-04
Dec-06
Dec-08
Dec-10
Dec-12
Dec-14
Dec-16
Date
TCE
1,1,1-TCA
Total VOCs
End of Contract Goal (50 ppb)

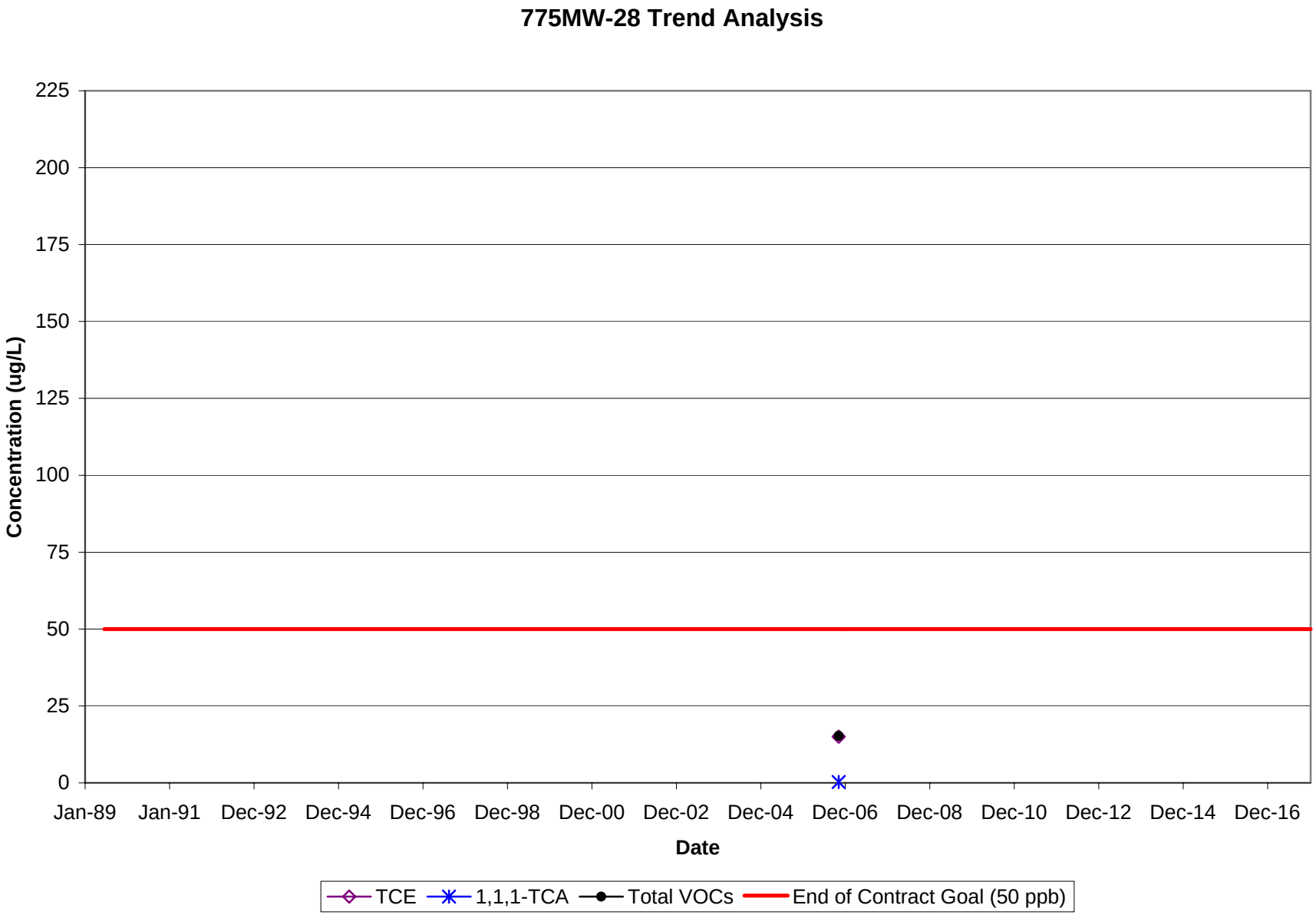

775MW-28 Trend Analysis
225
200
175
150
125
100
75
50
25
0
Concentration (ug/L)
Jan-89
Jan-91
Dec-92
Dec-94
Dec-96
Dec-98
Dec-00
Dec-02
Dec-04
Dec-06
Dec-08
Dec-10
Dec-12
Dec-14
Dec-16
Date
TCE
1,1,1-TCA
Total VOCs
End of Contract Goal (50 ppb)

Table C-1 Summary of Groundwater Monitroing Well Data for Building 775

Well Number / Parameter	Screened Interval (ft BGS)	Analytical Results by Sample Date(s) (ug/L)														
		Jun-89 Ref 1	Jun-91 Ref 1	Nov-92 Ref 1	Sep-93 Ref 1	Sep-94 Ref 2	Jul-97 Ref 3	Aug-97 Ref 3	Dec-97 Ref 3	May-00 Ref 4	Mar-02 Ref 5	Apr-02 Ref 5	Sep-04 Ref 6	Jun-06 Ref 7	Nov-06 Ref 8	Nov-06 Ref 9
775MW-2	50 - 65															
PCE		4	3	2.6	U	11	2	-	-	1.46	-	-	1.67	-	-	1.36
TCE		69	113	15	14	0.6	11	-	-	6.08	-	-	9.56	-	-	5.76
1,1,1-TCA		U	U	U	U	0.3	U	-	-	U	-	-	U	-	-	U
cis,1,2-DCE		U	U	U	U	U	U	-	-	U	-	-	U	-	-	U
VC		U	U	U	U	U	U	-	-	U	-	-	U	-	-	U
Total VOCs		*73*	*116*	*17.6*	*14*	*11.9*	*13*	-	-	*7.54*	-	-	*11.23*	-	-	*7.12*
775VMW-4	60 - 70															
PCE		-	-	-	-	-	-	U	-	U	-	-	U	-	-	-
TCE		-	-	-	-	-	-	18	-	2.77	-	-	5.52	-	-	-
1,1,1-TCA		-	-	-	-	-	-	0.32	-	U	-	-	0.318	-	-	-
cis,1,2-DCE		-	-	-	-	-	-	U	-	U	-	-	U	-	-	-
VC		-	-	-	-	-	-	U	-	U	-	-	U	-	-	-
Total VOCs		-	-	-	-	-	-	*18.32*	-	*2.77*	-	-	*5.8*	-	-	-
775VMW-5	65 - 70															
PCE		-	-	-	-	-	-	U	-	U	-	-	U	-	-	U
TCE		-	-	-	-	-	-	95	-	160	-	-	99.2	-	-	81.2
1,1,1-TCA		-	-	-	-	-	-	1.9	-	1.48	-	-	1.32	-	-	0.81
cis,1,2-DCE		-	-	-	-	-	-	0.43	-	U	-	-	0.104	-	-	U
VC		-	-	-	-	-	-	U	-	U	-	-	U	-	-	U
Total VOCs		-	-	-	-	-	-	*97.33*	-	*161.48*	-	-	*100.624*	-	-	*82.01*
775MW-6	68 - 78															
PCE		-	-	-	-	-	-	U	-	U	-	-	U	-	-	U
TCE		-	-	-	-	-	-	41	-	24.7	-	-	79.5	-	-	43.9
1,1,1-TCA		-	-	-	-	-	-	1.7	-	0.408	-	-	1.41	-	-	0.70
cis,1,2-DCE		-	-	-	-	-	-	U	-	U	-	-	U	-	-	U
VC		-	-	-	-	-	-	U	-	U	-	-	U	-	-	U
Total VOCs		-	-	-	-	-	-	*42.7*	-	*25.1*	-	-	*80.91*	-	-	*44.6*
775VMW-7	68 - 78															
PCE		-	-	-	-	-	-	U	-	U	U	-	-	-	-	-
TCE		-	-	-	-	-	-	78	-	78.3	84.6	-	-	-	-	-
1,1,1-TCA		-	-	-	-	-	-	1.3	-	1.14	1.18	-	-	-	-	-
cis,1,2-DCE		-	-	-	-	-	-	U	-	U	U	-	-	-	-	-
VC		-	-	-	-	-	-	U	-	U	U	-	-	-	-	-
Total VOCs		-	-	-	-	-	-	*79.3*	-	*79.44*	*85.78*	-	-	-	-	-
775VMW-8	68 - 78															
PCE		-	-	-	-	-	-	U	-	U	-	-	U	-	-	U
TCE		-	-	-	-	-	-	100	-	218	-	-	74.3	-	-	32.4
1,1,1-TCA		-	-	-	-	-	-	1.3	-	2.47	-	-	1.45	-	-	0.76
cis,1,2-DCE		-	-	-	-	-	-	0.43	-	U	-	-	U	-	-	U
VC		-	-	-	-	-	-	U	-	U	-	-	U	-	-	U
Total VOCs		-	-	-	-	-	-	*101.73*	-	*220.47*	-	-	*75.75*	-	-	*33.16*
775VMW-9	84 - 99															
PCE		-	-	-	-	-	-	-	U	U	-	-	U	-	-	U
TCE		-	-	-	-	-	-	-	20	0.676	-	-	0.29	-	-	0.33
1,1,1-TCA		-	-	-	-	-	-	-	U	U	-	-	U	-	-	U
cis,1,2-DCE		-	-	-	-	-	-	-	U	U	-	-	U	-	-	U
VC		-	-	-	-	-	-	-	U	U	-	-	U	-	-	U
Total VOCs		-	-	-	-	-	-	-	*20*	*0.676*	-	-	*0.29*	-	-	*0.33*
775VMW-10	88 - 103															
PCE		-	-	-	-	-	-	-	U	U	-	-	U	U	-	U
TCE		-	-	-	-	-	-	-	81	156	-	-	132	96	-	70.8
1,1,1-TCA		-	-	-	-	-	-	-	4.8	3.17	-	-	2.16	1.1	-	0.90
cis,1,2-DCE		-	-	-	-	-	-	-	0.44	U	-	-	0.1	U	-	U
VC		-	-	-	-	-	-	-	U	U	-	-	U	U	-	U
Total VOCs		-	-	-	-	-	-	-	*86.24*	*159.17*	-	-	*134.26*	*97.1*	-	*71.7*

Table C-1 Summary of Groundwater Monitroing Well Data for Building 775

Well Number / Parameter	Screened Interval (ft BGS)	Analytical Results by Sample Date(s) (ug/L)														
		Jun-89 Ref 1	Jun-91 Ref 1	Nov-92 Ref 1	Sep-93 Ref 1	Sep-94 Ref 2	Jul-97 Ref 3	Aug-97 Ref 3	Dec-97 Ref 3	May-00 Ref 4	Mar-02 Ref 5	Apr-02 Ref 5	Sep-04 Ref 6	Jun-06 Ref 7	Nov-06 Ref 8	Nov-06 Ref 9
775VMW-20	110.5 - 120.5															
PCE		-	-	-	-	-	-	-	-	-	-	U	U	-	-	U
TCE		-	-	-	-	-	-	-	-	-	-	73.6	134	-	-	46.4
1,1,1-TCA		-	-	-	-	-	-	-	-	-	-	1.95	2.94	-	-	1.9
cis,1,2-DCE		-	-	-	-	-	-	-	-	-	-	0.367	0.607	-	-	U
VC		-	-	-	-	-	-	-	-	-	-	U	U	-	-	U
Total VOCs		-	-	-	-	-	-	-	-	-	-	*75.9*	*137.5*	-	-	*48.3*
775MW-27	60.8 - 80.8															
PCE		-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
TCE		-	-	-	-	-	-	-	-	-	-	-	-	-	82	-
1,1,1-TCA		-	-	-	-	-	-	-	-	-	-	-	-	-	1.2	-
cis,1,2-DCE		-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
VC		-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
Total VOCs		-	-	-	-	-	-	-	-	-	-	-	-	-	*83.2*	-
775MW-28	71 - 91															
PCE		-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
TCE		-	-	-	-	-	-	-	-	-	-	-	-	-	15	-
1,1,1-TCA		-	-	-	-	-	-	-	-	-	-	-	-	-	0.29	-
cis,1,2-DCE		-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
VC		-	-	-	-	-	-	-	-	-	-	-	-	-	U	-
Total VOCs		-	-	-	-	-	-	-	-	-	-	-	-	-	*15.29*	-

Notes:

1. Sampling conducted after permanganate injection for pilot study in November 2002.
2. Data provided for detected concentrations only. Data qualifiers were omitted for purposes of graph development.
3. Geoprobe data collected at this site is not included in this analysis.
4. Shaded values denote an exceedence of the remediation goals presented in the ROD for the OBGW AOC. These values are as follows and are based on NYSDEC groundwater standards as of the approval date of the ROD.

PCE	=	5	ug/L
TCE	=	5	ug/L
1,1,1-TCA	=	5	ug/L
cis 1,2 - DCE	=	5	ug/L
VC	=	2	ug/L

References:

(1) Law EES. December 1996. Draft-Final Primary Report. Volume 27, Remedial Investigation, Building 775 (Pumphouse 3) Trichloroethylene Contamination Area of Concern.
(2) Law EES. December 1996. Draft-Final Primary Report. Volume 31, Remedial Investigation, On-Base Ground-Water Contamination Area of Concern.
(3) E & E. July 1998. Final Report for the Supplemental Investigations of Areas of Concern at the Former Griffiss Air Force Base.
(4) E & E. August 2000. Landfill 6 and Building 775 Areas of Concern Groundwater Study, Technical Memorandum No. 1: Field Investigation Conducted in Spring 2000.
(5) E & E. December 2002. Final Landfill 6, Building 775, AOC 9, and Building 817/WSA Technical Memorandum No. 1: Bedrock Groundwater Study.
(6) FPM Group. February 2005. Groundwater Monitoring Report.
(7) FPM Group. Long Term Monitoring Report September 2006
(8) EEEPC. EEEPC. February 2007. Predesign Investigation Report
(9) FPM Group. August 2007. Final Monitoring Report for Baseline and Predesign Investigation 2 Sampling

Key:

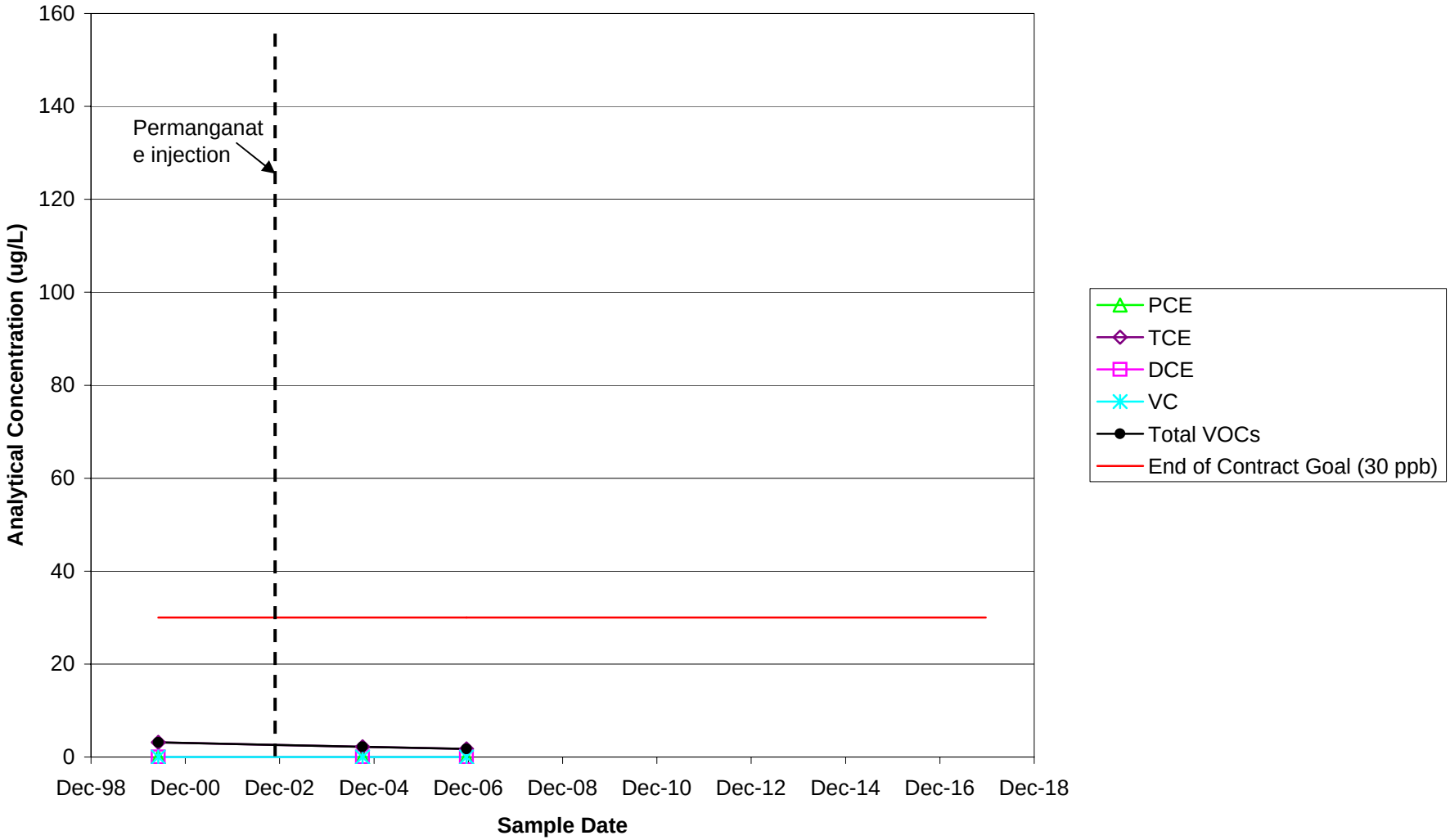
BGS = below ground surface.
cis-1,2-DCE = cis-1,2-dichloroethene
ft = feet
PCE = tetrachloroethene
1,1,1-TCA = 1,1,1-trichloroethane
TCE = trichloroethene
U = non-detect values
ug/L = micrograms per liter.
VC = vinyl chloride
VOCs = volatile organic compounds

7.6 Shaded values denote hits exceeding the NYSDEC standard.

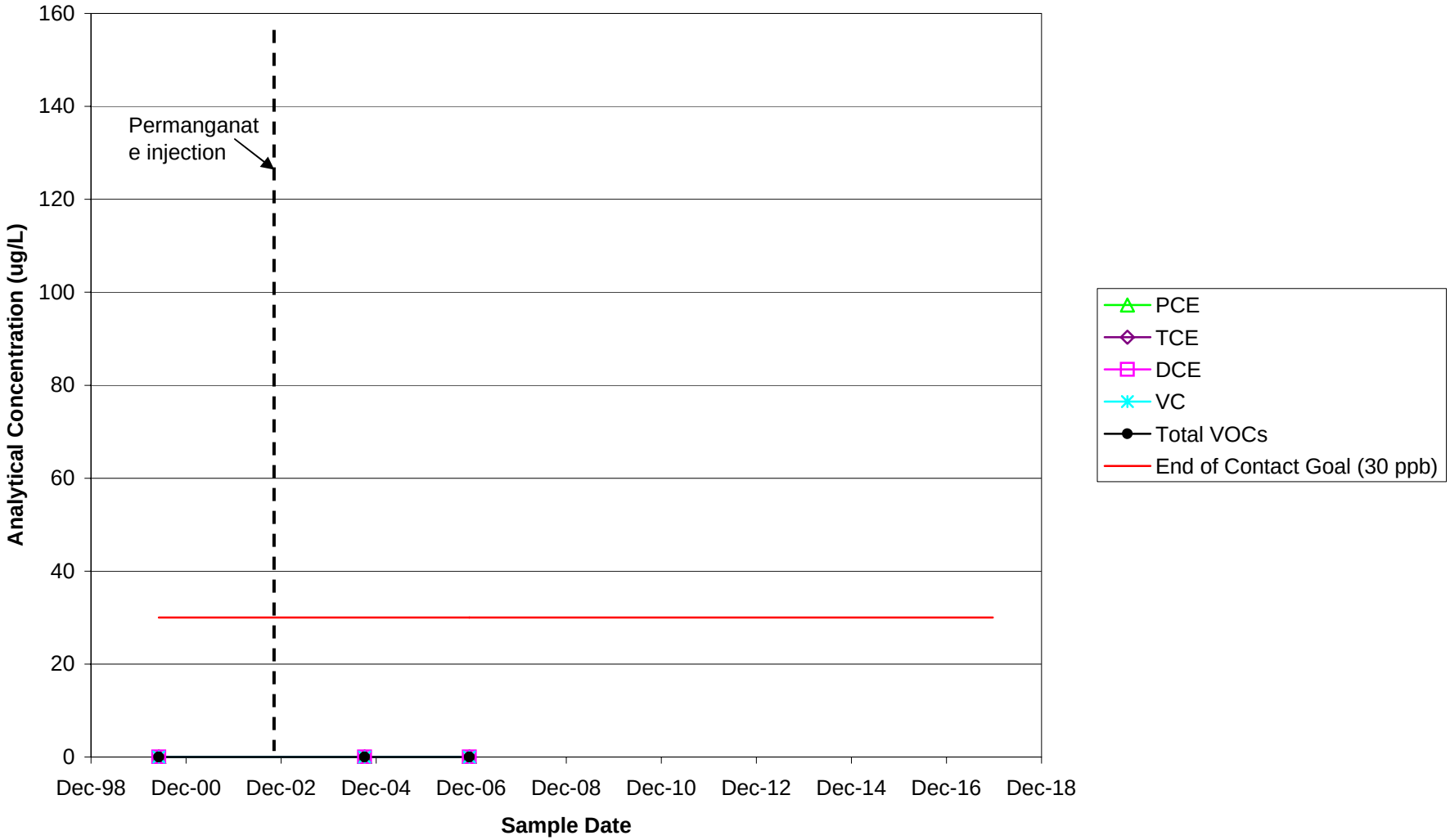
D

B817/WSA Trend Analysis

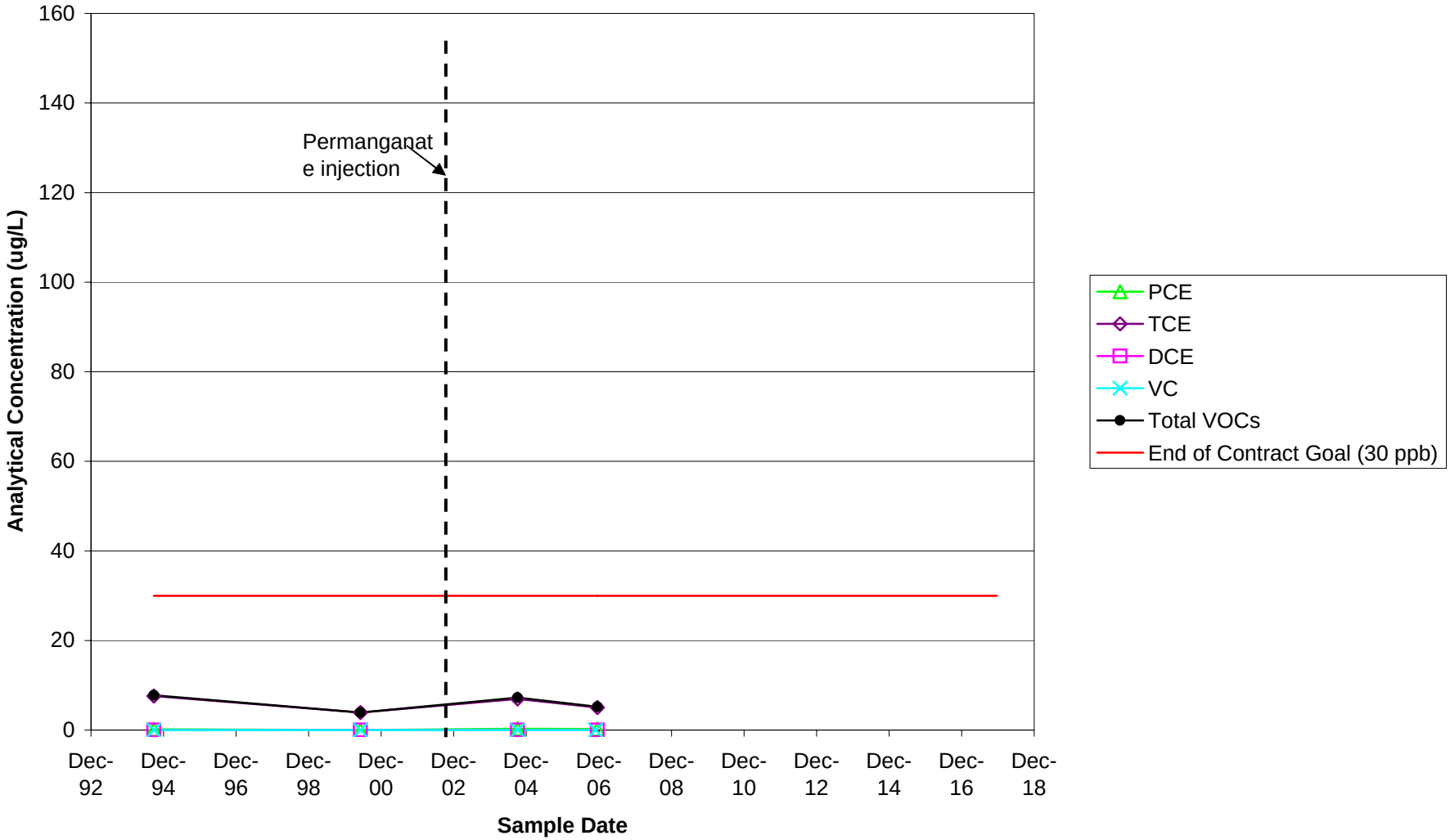
Trend Analysis
WSA-MW8 VOCs in groundwater



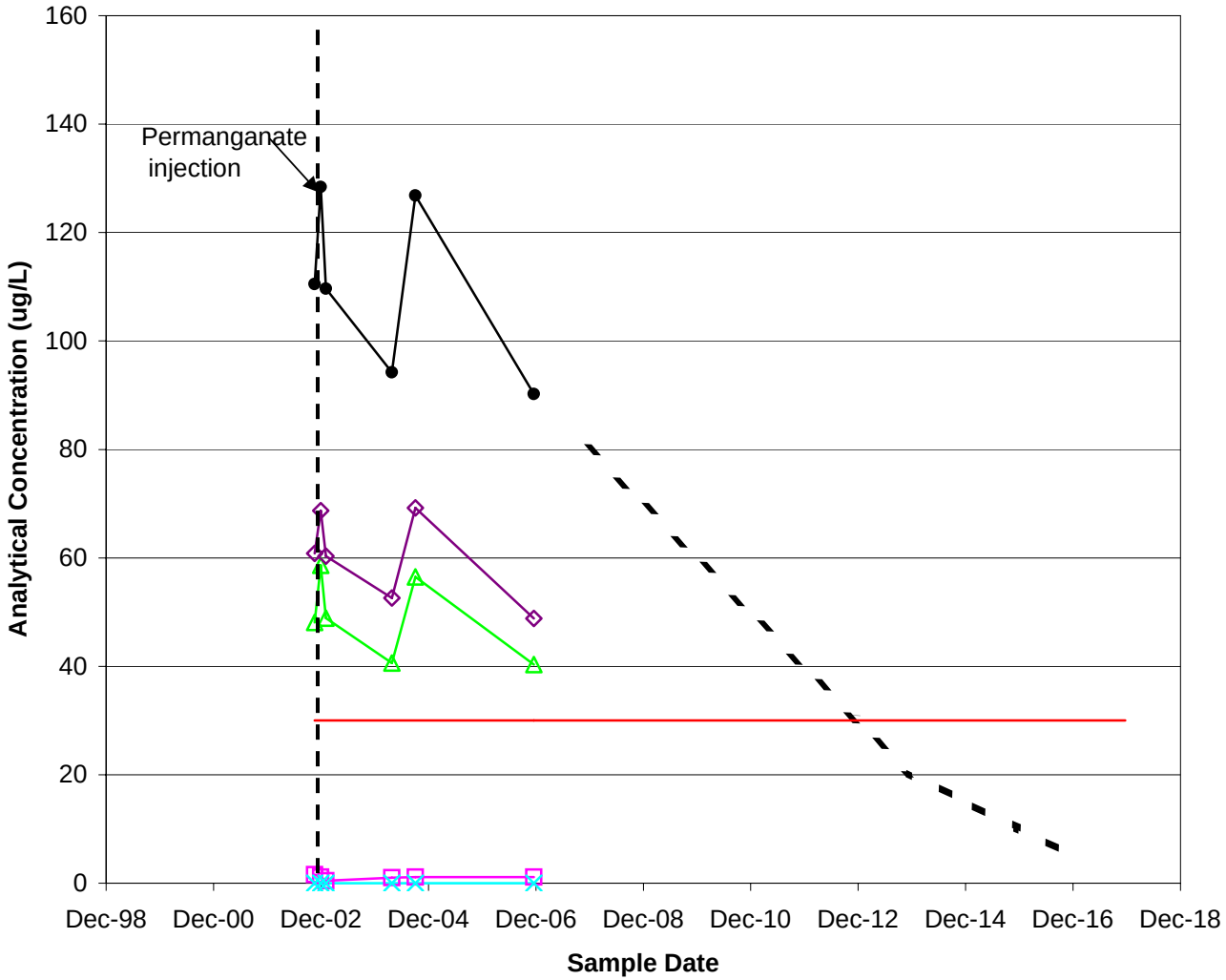
Trend Analysis
WSA-MW9 VOCs in groundwater

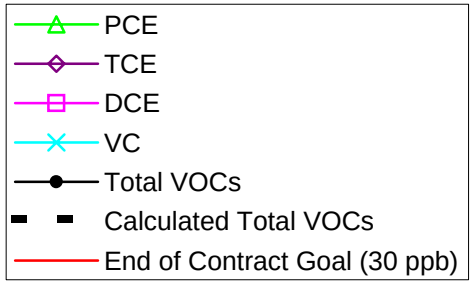


Trend Analysis
LAW-MW9 VOCs in groundwater



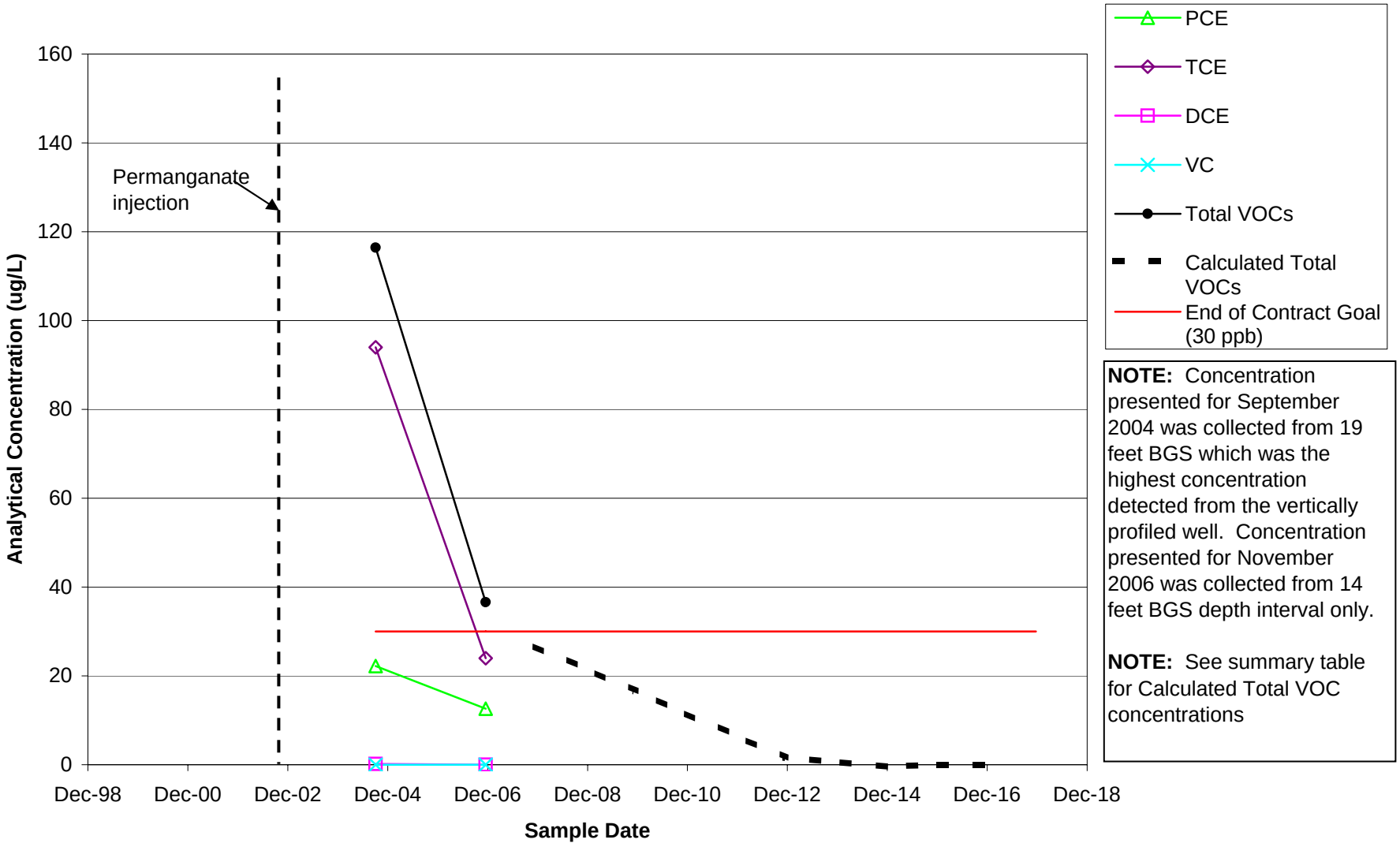
Trend Analysis
WSA-MW16 VOCs in groundwater





NOTE: See summary table for Calculated Total VOC concentrations

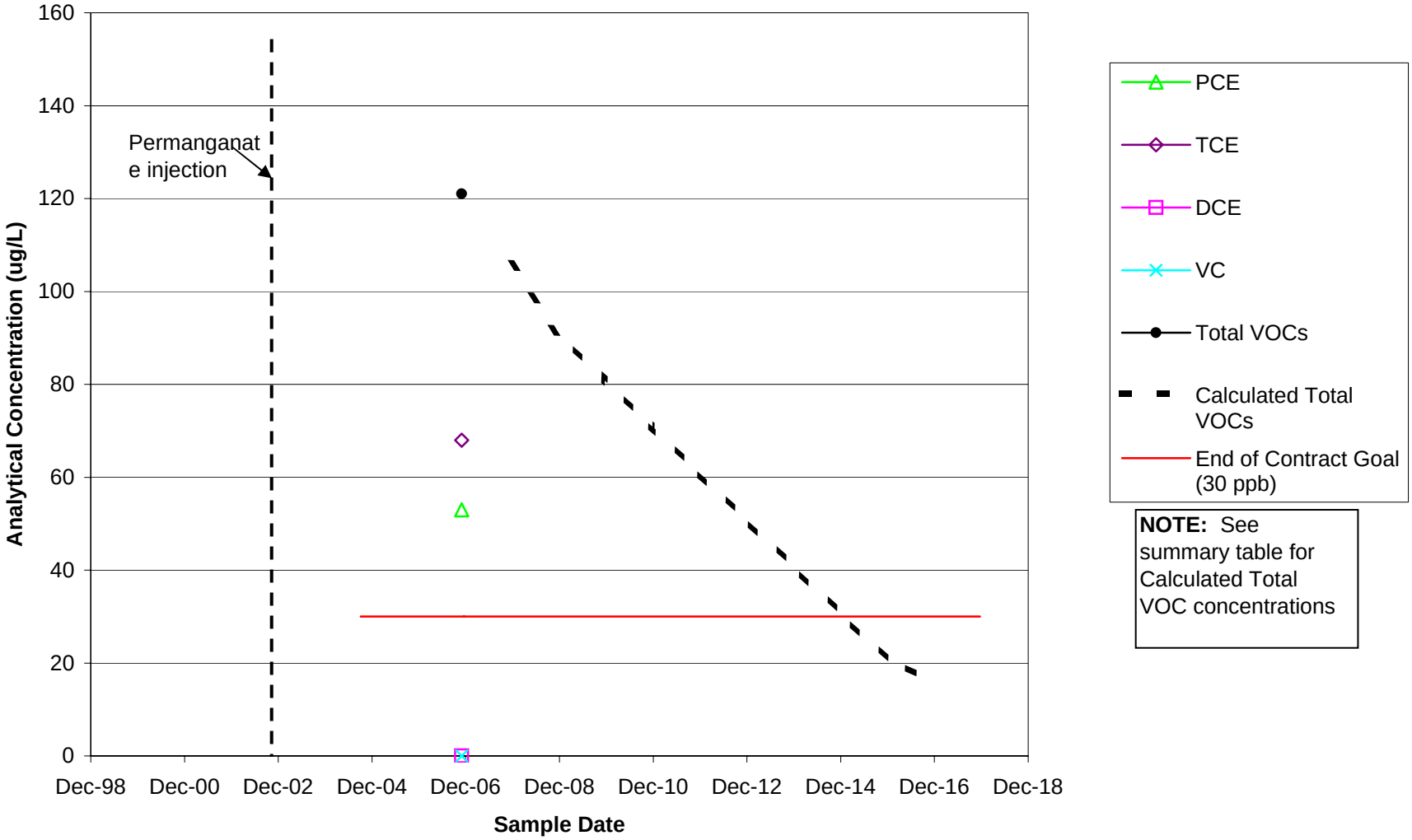
Trend Analysis
WSA-VMW17 VOCs in groundwater



NOTE: Concentration presented for September 2004 was collected from 19 feet BGS which was the highest concentration detected from the vertically profiled well. Concentration presented for November 2006 was collected from 14 feet BGS depth interval only.

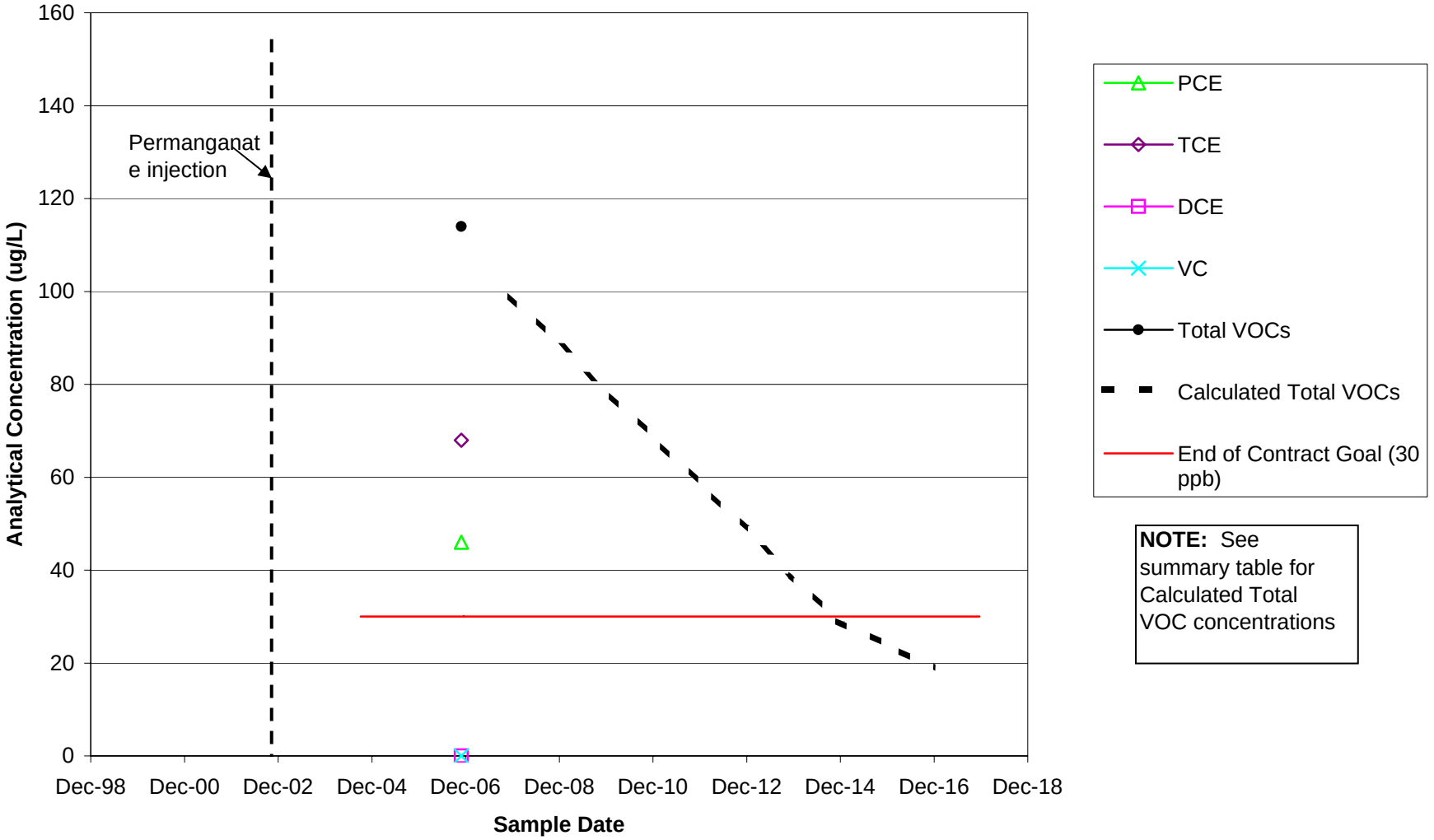
NOTE: See summary table for Calculated Total VOC concentrations

Trend Analysis
WSA-MW18 VOCs in groundwater



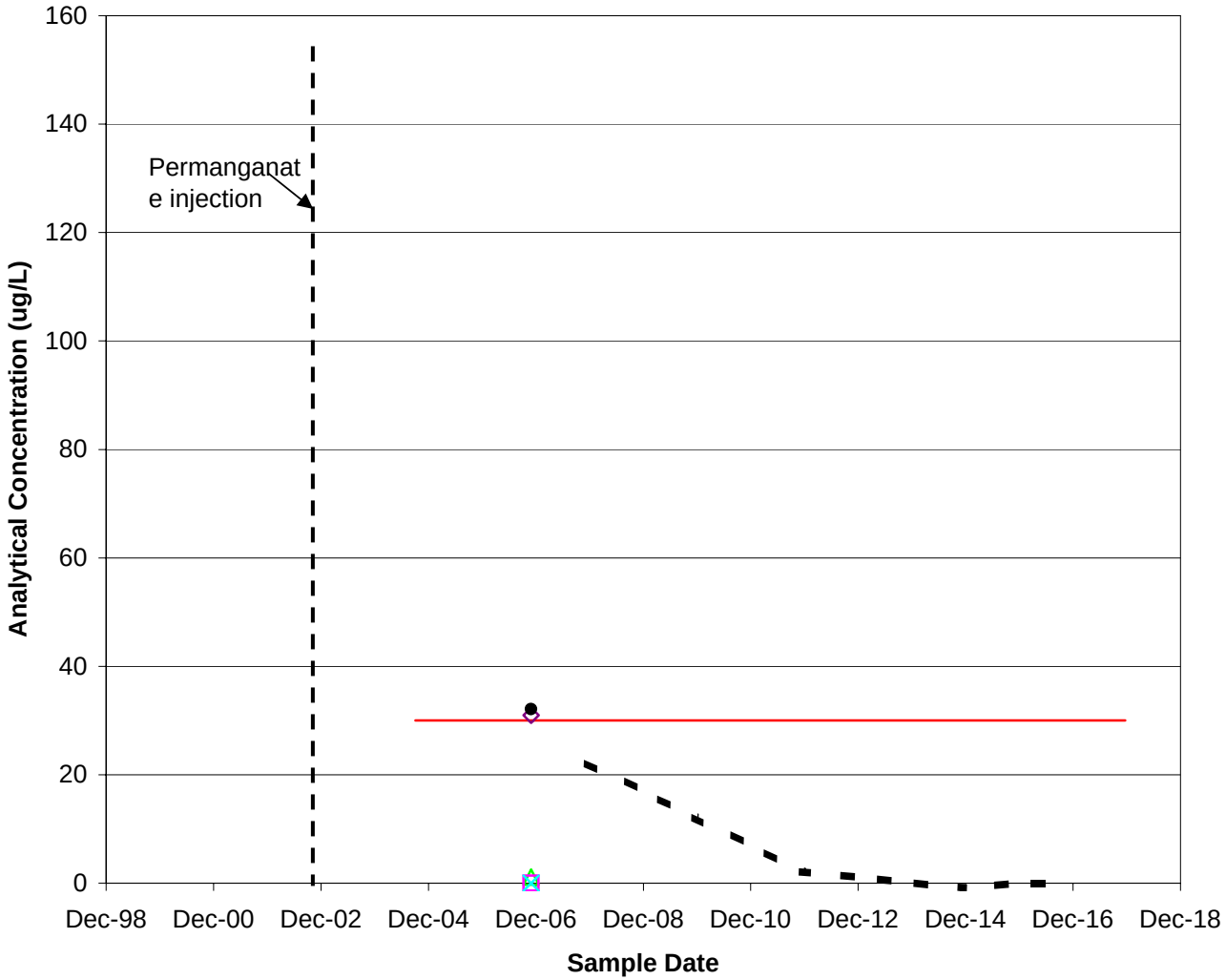
NOTE: See summary table for Calculated Total VOC concentrations

Trend Analysis
WSA-MW19 VOCs in groundwater



NOTE: See summary table for Calculated Total VOC concentrations

Trend Analysis
WSA-MW21 VOCs in groundwater



PCE
TCE
DCE
VC
Total VOCs
Calculated Total VOCs
End of Contract Goal (30 ppb)

NOTE: See summary table for Calculated Total VOC concentrations

Table D-1 Summary of Groundwater Monitroing Well Data for Building 817/WSA

Well Number / Parameter	Screened Interval (ft BGS)	Analytical Results by Sample Date(s) (µg/L)									
		Aug-94	May-00	Apr-02	Oct-02	Dec-02	Jan-03	Mar-04	Sep-04	Nov-06	Nov-06
		Ref 1	Ref 2	Ref 3,4	Ref 3	Ref 3[1]	Ref 3[1]	Ref 3[1]	Ref 5	Ref 6	Ref 7
WSA-MW8	4-14										
PCE		-	U	-	-	-	-	-	U	-	U
TCE		-	3.13	-	-	-	-	-	2.19	-	1.73
cis 1, 2 - DCE		-	U	-	-	-	-	-	U	-	U
VC		-	U	-	-	-	-	-	U	-	U
Total VOCs		-	*3.13*	-	-	-	-	-	*2.19*	-	*1.73*
WSA-MW9	3-8										
PCE		-	U	-	-	-	-	-	U	-	U
TCE		-	U	-	-	-	-	-	U	-	U
cis 1, 2 - DCE		-	U	-	-	-	-	-	U	-	U
VC		-	U	-	-	-	-	-	U	-	U
Total VOCs		-	*U*	-	-	-	-	-	*U*	-	*U*
LAW-MW9	7-17										
PCE		0.2	U	-	-	-	-	-	0.31	-	0.22
TCE		7.6	3.89	-	-	-	-	-	6.95	-	5.01
cis 1, 2 - DCE		U	U	-	-	-	-	-	U	-	U
VC		U	U	-	-	-	-	-	U	-	U
Total VOCs		*7.8*	*3.89*	-	-	-	-	-	*7.26*	-	*5.23*
WSA-MW16	10-20										
PCE		-	-	-	48.1	58.6	48.9	40.6	56.5	-	40.3
TCE		-	-	-	60.8	68.7	60.3	52.6	69.2	-	48.8
cis 1, 2 - DCE		-	-	-	1.57	1.11	0.47	1.02	1.11	-	1.1
VC		-	-	-	U	U	U	U	U	-	U
Total VOCs		-	-	-	*110.47*	*128.41*	*109.67*	*94.22*	*126.81*	-	*90.2*
WSA-VMW17[5]	14-23										
PCE	(14 ft depth)	-	-	-	-	-	-	-	1.82	-	12.6
TCE		-	-	-	-	-	-	-	3	-	24
cis 1, 2 - DCE		-	-	-	-	-	-	-	U	-	U
VC		-	-	-	-	-	-	-	U	-	U
Total VOCs		-	-	-	-	-	-	-	*4.82*	-	*36.6*
PCE	(19 ft depth)	-	-	-	-	-	-	-	22.2	-	-
TCE		-	-	-	-	-	-	-	94	-	-
cis 1, 2 - DCE		-	-	-	-	-	-	-	0.198	-	-
VC		-	-	-	-	-	-	-	U	-	-
Total VOCs		-	-	-	-	-	-	-	*116.398*	-	-
PCE	(21 ft depth)	-	-	-	-	-	-	-	11.6	-	-
TCE		-	-	-	-	-	-	-	28.9	-	-
cis 1, 2 - DCE		-	-	-	-	-	-	-	U	-	-
VC		-	-	-	-	-	-	-	U	-	-
Total VOCs		-	-	-	-	-	-	-	*40.5*	-	-

Table D-1 Summary of Groundwater Monitroing Well Data for Building 817/WSA

Well Number / Parameter	Screened Interval (ft BGS)	Analytical Results by Sample Date(s) (µg/L)									
		Aug-94	May-00	Apr-02	Oct-02	Dec-02	Jan-03	Mar-04	Sep-04	Nov-06	Nov-06
		Ref 1	Ref 2	Ref 3,4	Ref 3	Ref 3[1]	Ref 3[1]	Ref 3[1]	Ref 5	Ref 6	Ref 7
PCE	(23 ft depth)	-	-	-	-	-	-	-	U	-	-
TCE		-	-	-	-	-	-	-	0.453	-	-
cis 1, 2 - DCE		-	-	-	-	-	-	-	U	-	-
VC		-	-	-	-	-	-	-	U	-	-
Total VOCs		-	-	-	-	-	-	-	*0.453*	-	-
WSA-MW18	11 - 16										
PCE		-	-	-	-	-	-	-	-	53	-
TCE		-	-	-	-	-	-	-	-	68	-
cis 1, 2 - DCE		-	-	-	-	-	-	-	-	U	-
VC		-	-	-	-	-	-	-	-	U	-
Total VOCs		-	-	-	-	-	-	-	-	*121*	-
WSA-MW19	13 - 18										
PCE		-	-	-	-	-	-	-	-	46	-
TCE		-	-	-	-	-	-	-	-	68	-
cis 1, 2 - DCE		-	-	-	-	-	-	-	-	U	-
VC		-	-	-	-	-	-	-	-	U	-
Total VOCs		-	-	-	-	-	-	-	-	*114*	-
WSA-MW21	15 - 25										
PCE		-	-	-	-	-	-	-	-	1.1	-
TCE		-	-	-	-	-	-	-	-	31	-
cis 1, 2 - DCE		-	-	-	-	-	-	-	-	U	-
VC		-	-	-	-	-	-	-	-	U	-
Total VOCs		-	-	-	-	-	-	-	-	*32.1*	-

Notes:

1. Sampling conducted after permanganate injection for pilot study in November 2002.
2. Data provided for detected concentrations only. Data qualifiers were omitted for purposes of graph development.
3. Geoprobe data collected at this site is not included in this analysis.
4. Shaded values denote an exceedence of the remediation goals presented in the ROD for the OBGW AOC. These values are as follows and are based on NYSDEC groundwater standards as of the approval date of the ROD.

PCE	=	5	ug/L
TCE	=	5	ug/L
cis 1,2 - DCE	=	5	ug/L
VC	=	2	ug/L

5. For monitoring wells with total VOCs greater than 30 ppb, anticipated total VOC concentrations were estimated through 2016. The following assumptions were made based on historical data:

If total VOC concentration is greater than	100	ppb, assume degradation rate of	15	ppb per year
If total VOC concentration is greater than	30	ppb, assume degradation rate of	10	ppb per year
If total VOC concentration is greater than	5	ppb, assume degradation rate of	5	ppb per year
If total VOC concentration is less than	5	ppb, assume degradation rate of	1	ppb per year

Table D-1 Summary of Groundwater Monitroing Well Data for Building 817/WSA

Well Number / Parameter	Screened Interval (ft BGS)	Analytical Results by Sample Date(s) (µg/L)									
		Aug-94	May-00	Apr-02	Oct-02	Dec-02	Jan-03	Mar-04	Sep-04	Nov-06	Nov-06
		Ref 1	Ref 2	Ref 3,4	Ref 3	Ref 3[1]	Ref 3[1]	Ref 3[1]	Ref 5	Ref 6	Ref 7

References:

(1) Law EES. December 1996. Draft-Final Primary Report. Volume 31, Remedial Investigation, On-Base Ground-Water Contamination Area of Concern.
(2) E & E. August 2001. Addendum to the July 1998 Supplemental Investigations of Areas of Concern, Technical Memorandum No. 1: On-Base Groundwater (Area South of the WSA).
(3) E & E. June 2004. Final Groundwater Treatability Pilot Study Report.
(4) E & E. December 2002. Final Landfill 6, Building 775, AOC 9, and Building 817/WSA Technical Memorandum No. 1: Bedrock Groundwater Study.
(5) FPM Group. February 2005. Groundwater Monitoring Report.
(6) EEEPC. February 2007. Predesign Investigation Report
(7) FPM Group. August 2007. Final Monitoring Report for Baseline and Predesign Investigation 2 Sampling

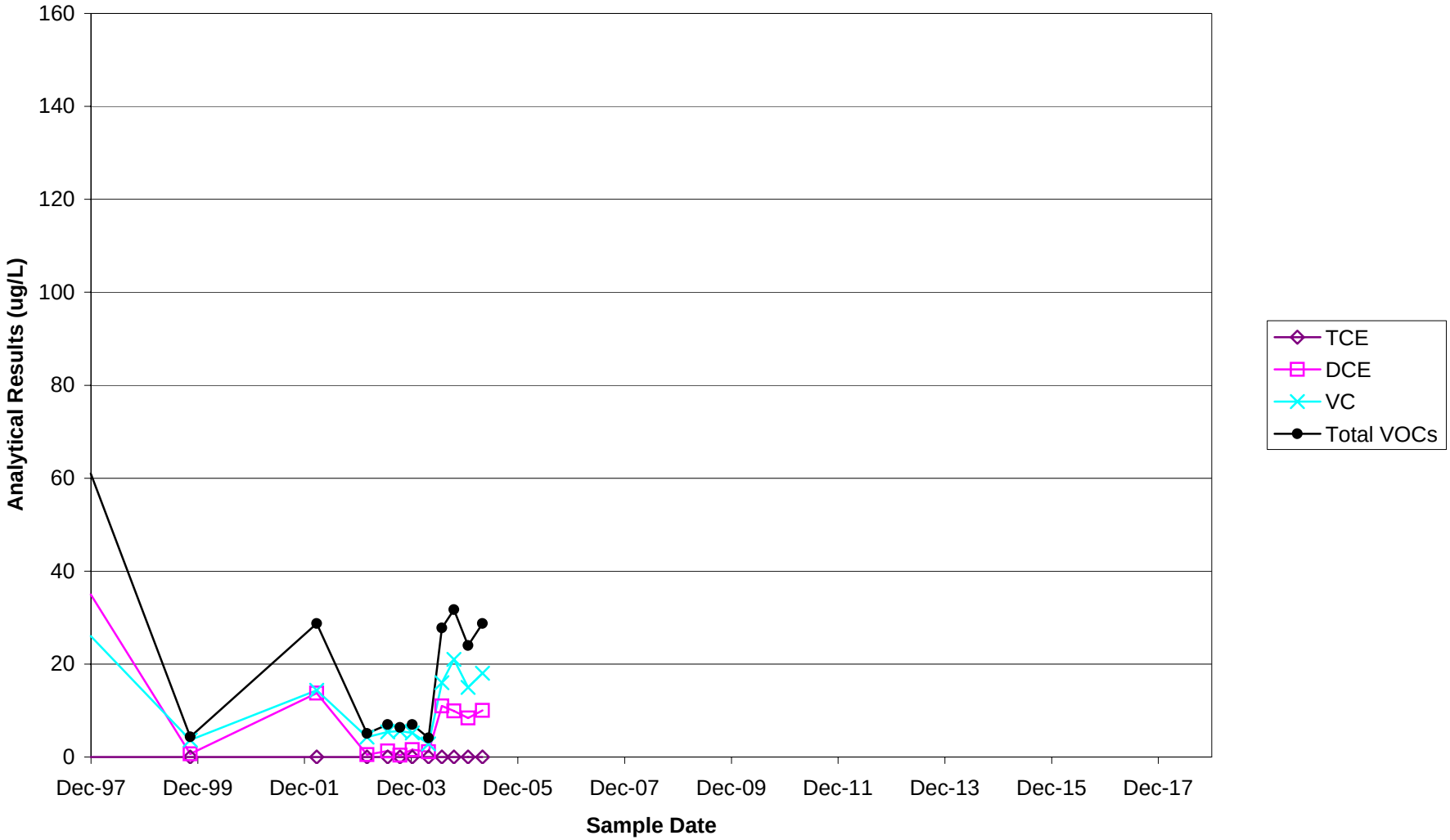
Key:

BGS = below ground surface.
cis-1,2-DCE = cis-1,2-dichloroethene
ft = feet
TCE = trichloroethene
U = non-detect values
ug/L = micrograms per liter.
VC = vinyl chloride
VOCs = volatile organic compounds
7.6 Shaded values denote hits exceeding the NYSDEC standard.

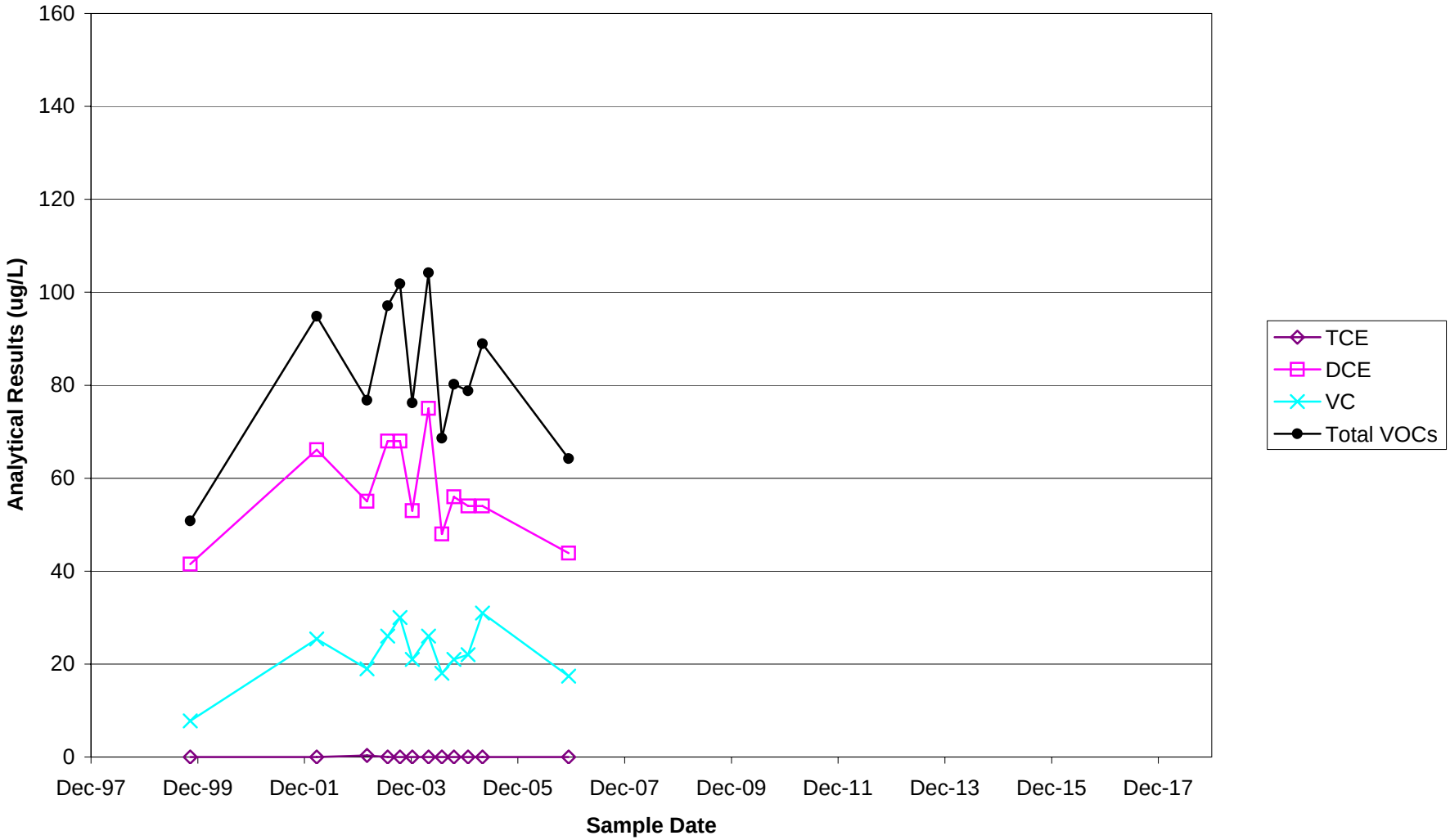
E

Apron 2 Trend Analysis

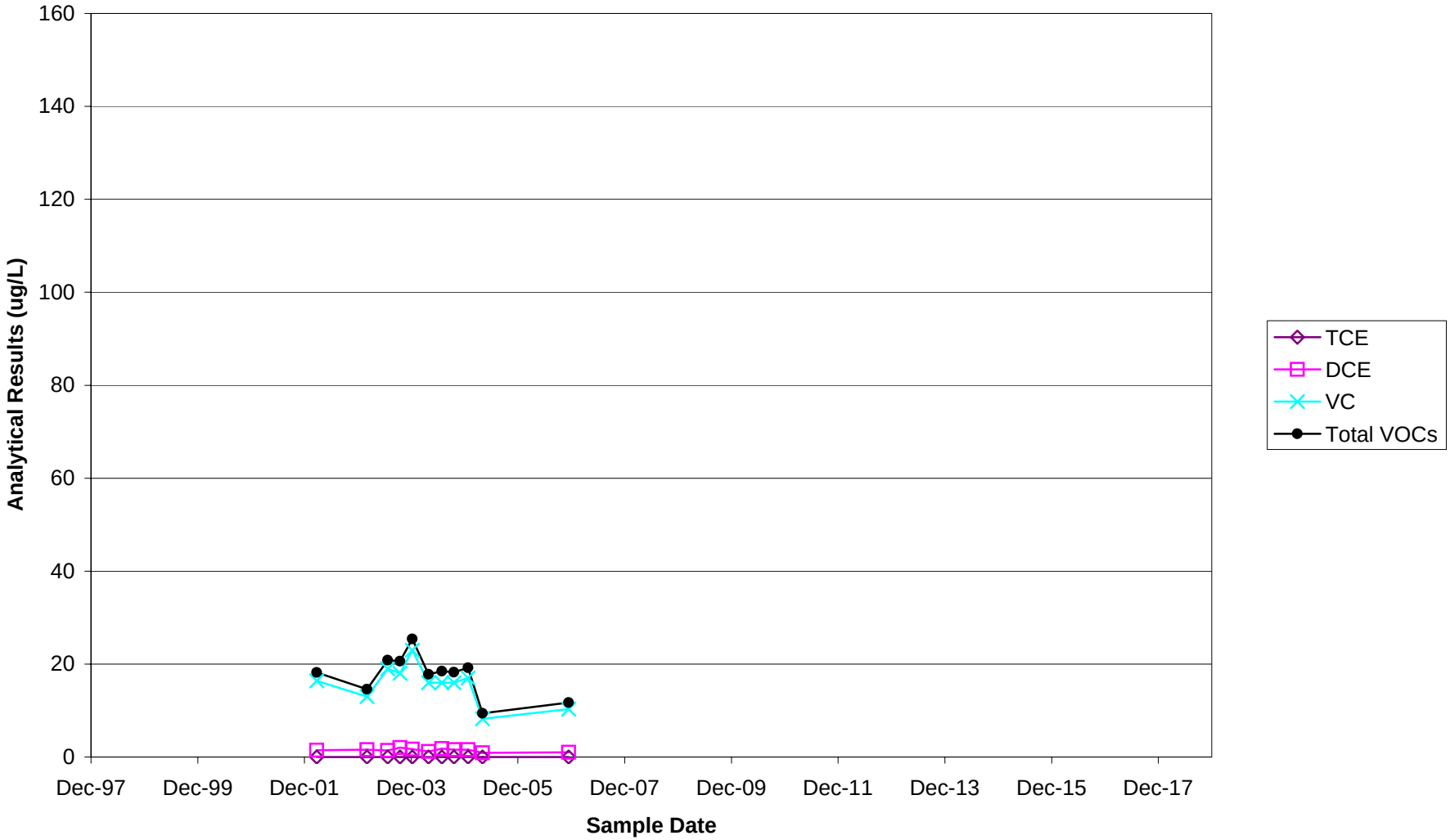
APRON 2
782MW-6R2, VOCs in groundwater



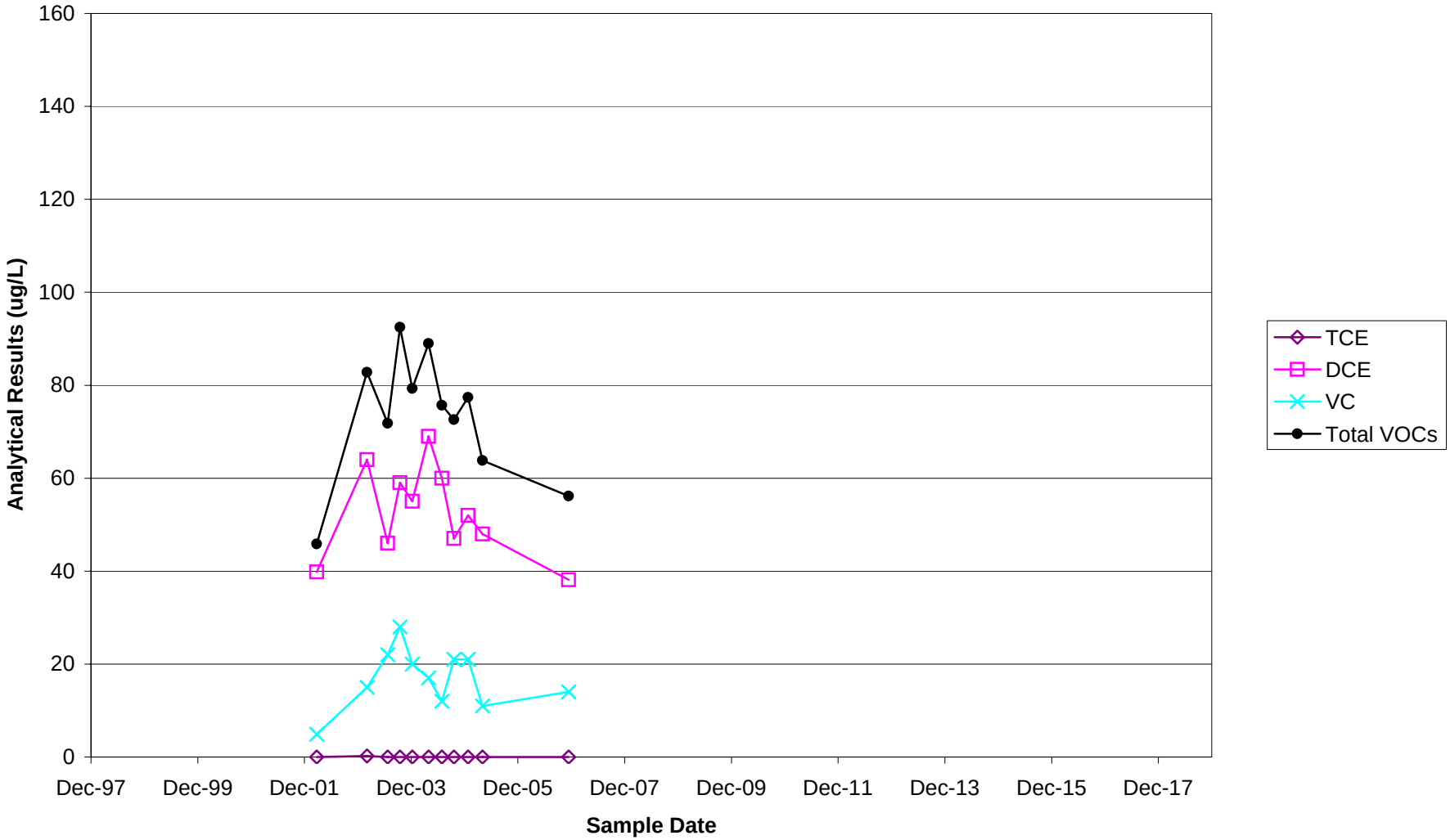
APRON 2
782MW-10, VOCs in groundwater



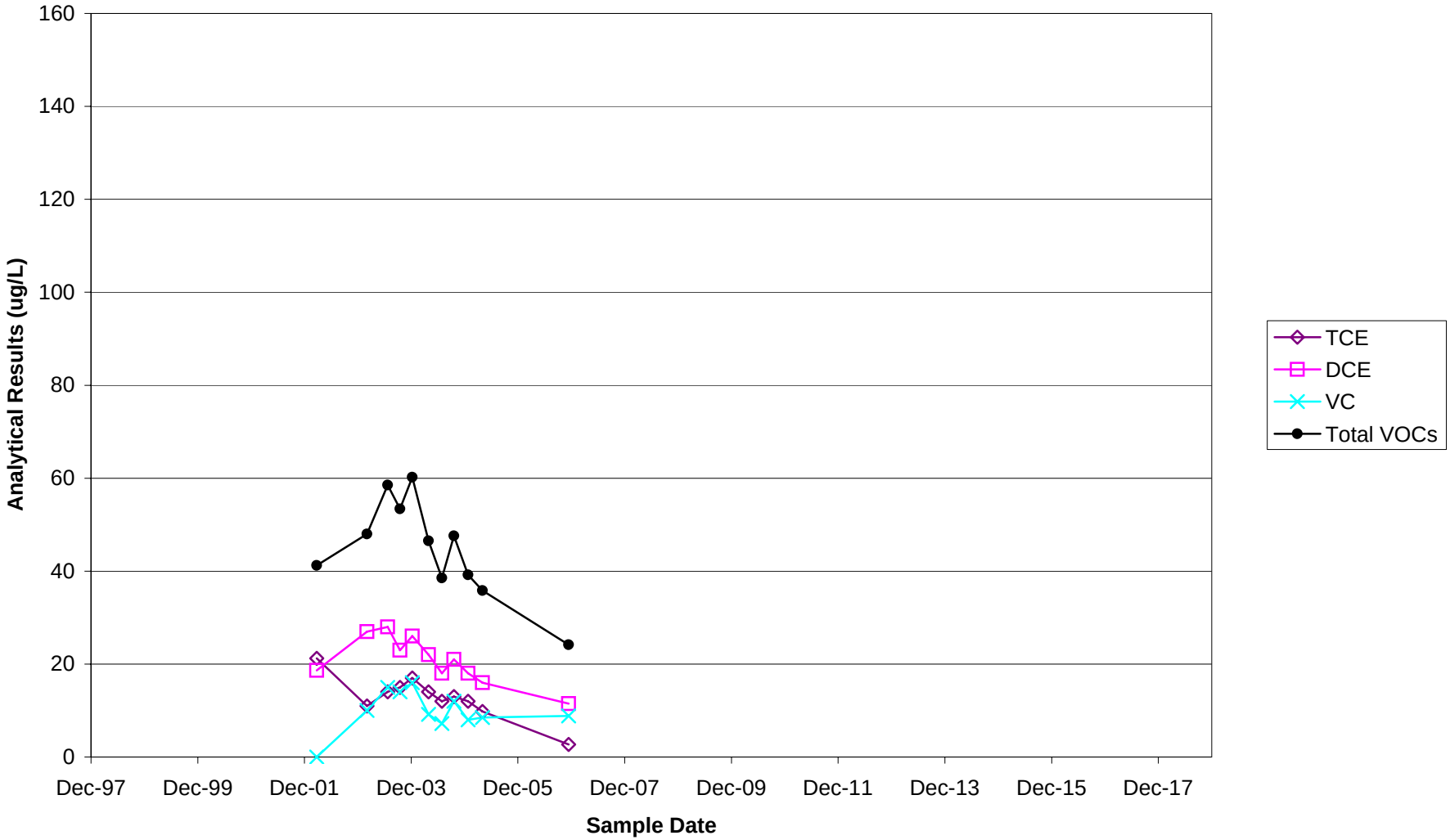
APRON 2
782VMW-76, VOCs in groundwater



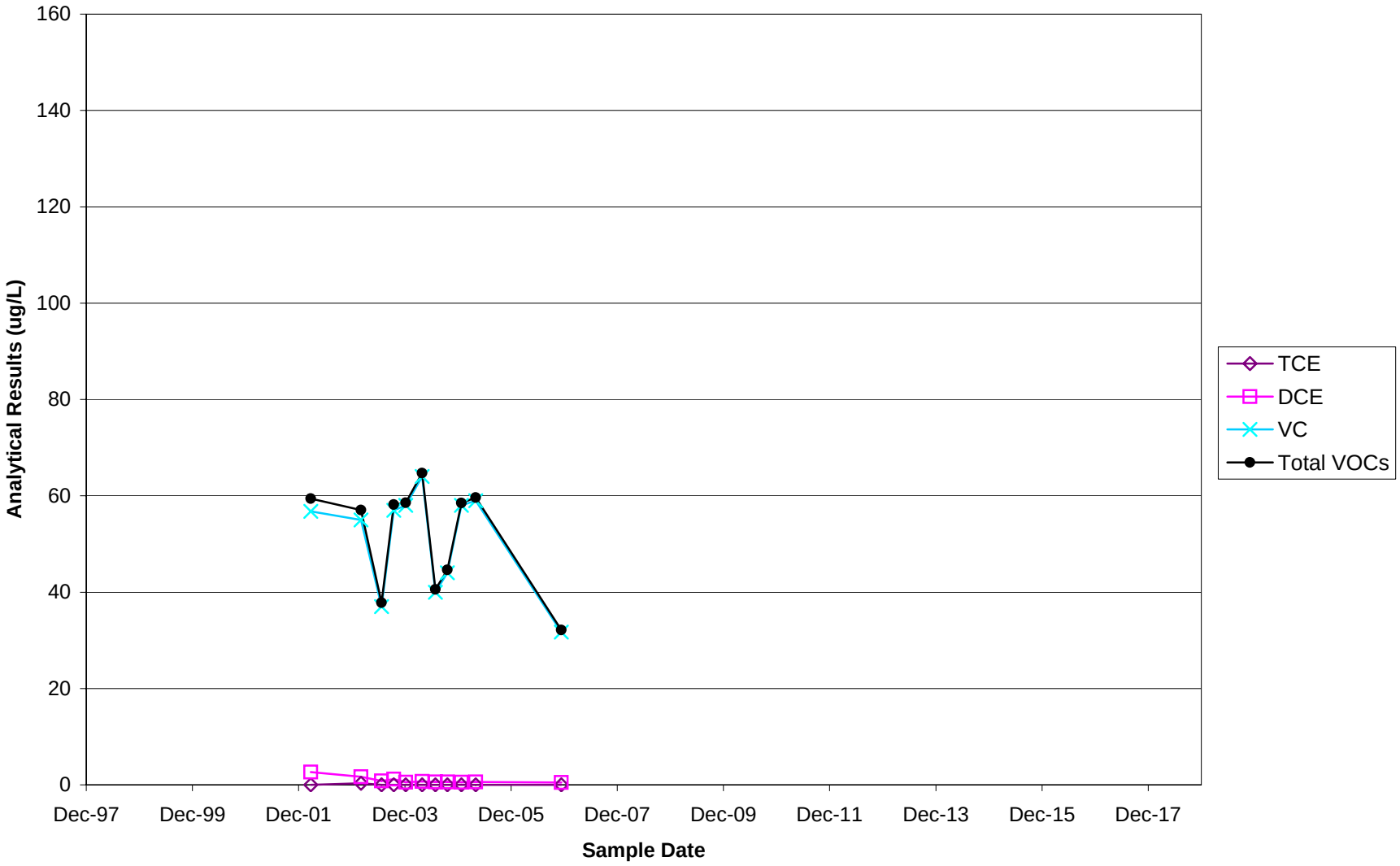
APRON 2
782VMW-78, VOCs in groundwater



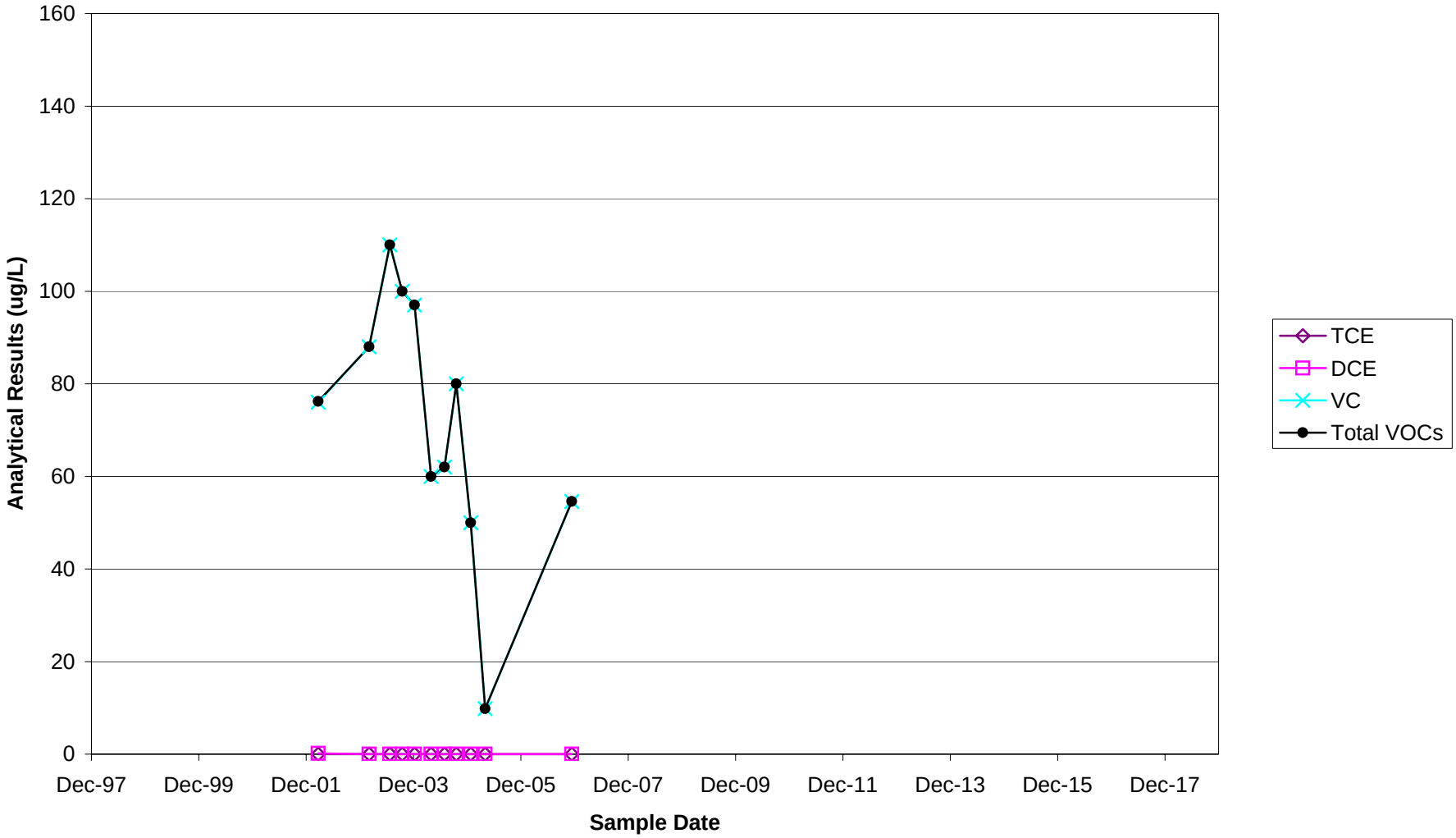
APRON 2
782VMW-81, VOCs in groundwater



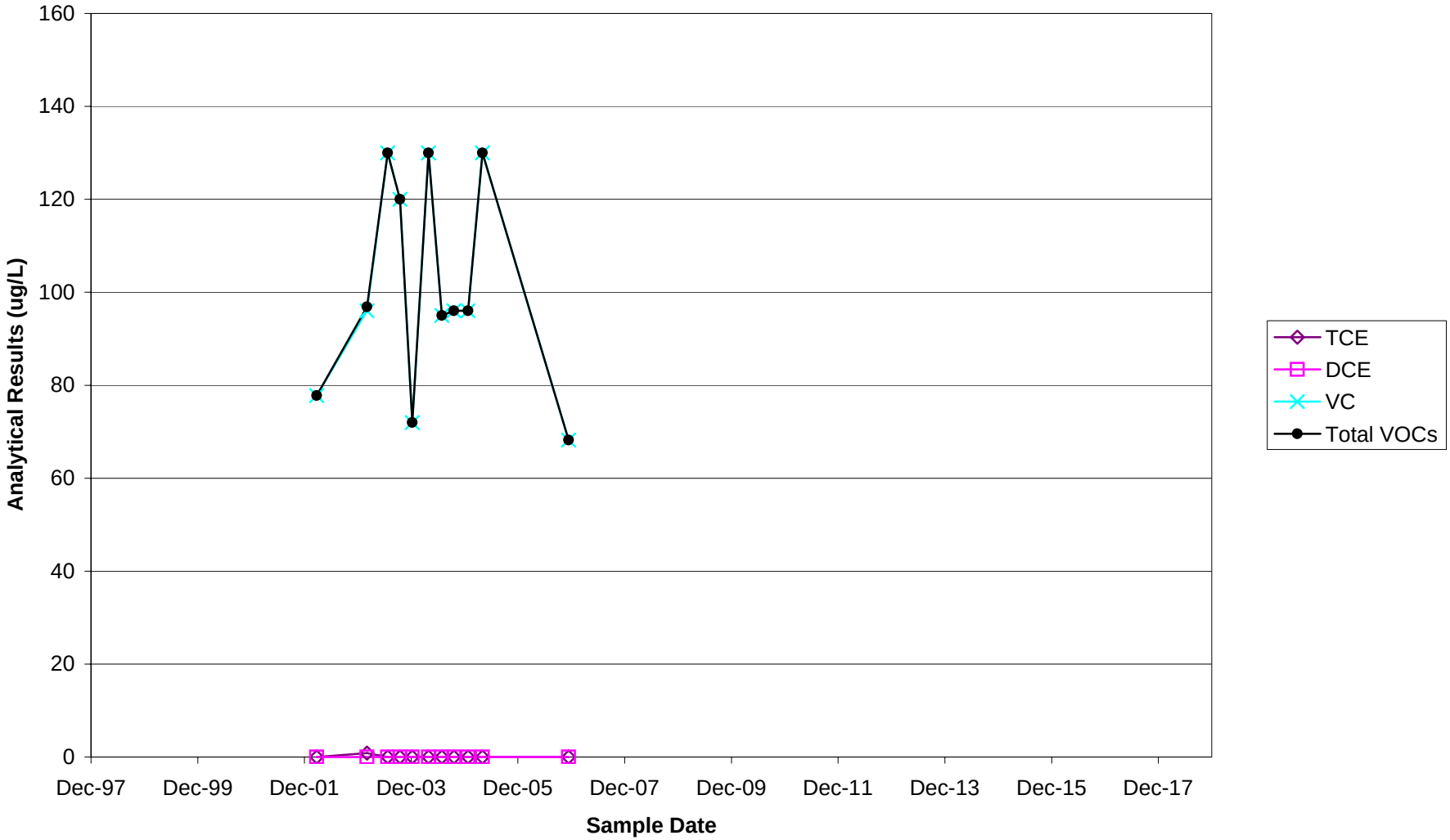
APRON 2
782VMW-84, VOCs in groundwater



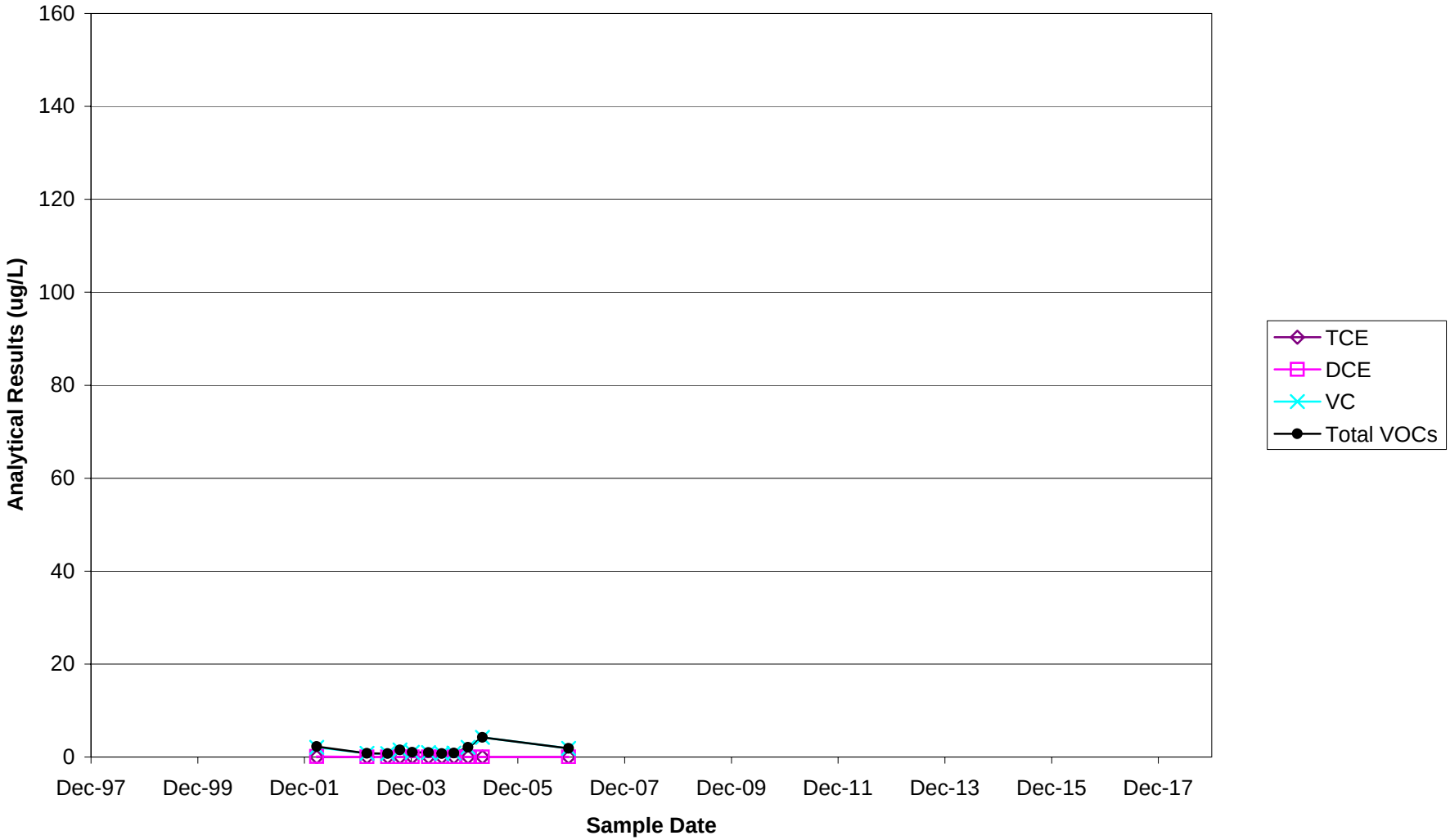
APRON 2
782VMW-93, VOCs in groundwater



APRON 2
782VMW-96, VOCs in groundwater



APRON 2
782VMW-101, VOCs in groundwater



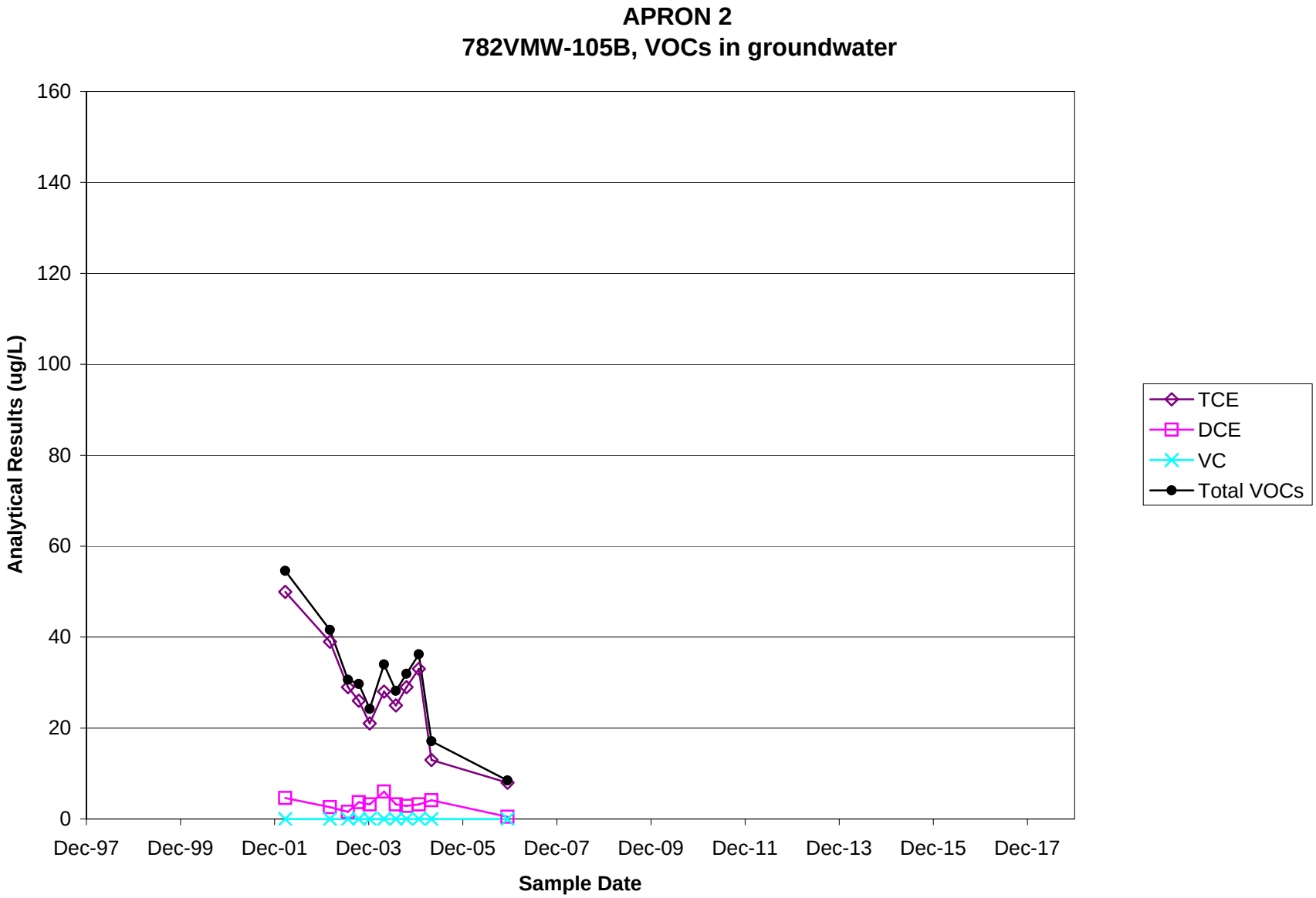

APRON 2
782VMW-105B, VOCs in groundwater
Analytical Results (ug/L)
160
140
120
100
80
60
40
20
0
Dec-97
Dec-99
Dec-01
Dec-03
Dec-05
Dec-07
Dec-09
Dec-11
Dec-13
Dec-15
Dec-17
Sample Date
TCE
DCE
VC
Total VOCs

Table E-1 Summary of Groundwater Monitroing Well Data for Nosedocks/Apron 2

Well Number / Parameter	Screen Interval (ft BGS)	Analytical Results by Sample Date (ug/L)												
		Dec-97 Ref 1	Oct-99 Ref 2	Feb-02 Ref 2	Feb-03 Ref 3	Jun-03 Ref 3	Sep-03 Ref 3	Dec-03 Ref 3	Apr-04 Ref 3	Jul-04 Ref 3	Sep-04 Ref 3	Dec-04 Ref 4	Apr-05 Ref 4	Nov-06 Ref 5
782MW-6R2	19.5 - 34.5													
TCE		U	U	U	U	U	U	U	U	U	U	U	U	-
cis 1,2 - DCE		35	0.7	13.8	0.48	1.3	0.4	1.6	1.1	11	9.9	8.4	10	-
VC		26	3.7	14.3	4.3	5.4	5.6	5.2	2.8	16	21	15	18	-
Total VOCs		*61*	*4.3*	*28.1*	*4.78*	*6.7*	*6.0*	*6.8*	*3.9*	*27*	*30.9*	*23.4*	*28*	-
782MW-10	19-34													
TCE		-	U	U	0.34	U	U	U	U	U	U	U	U	U
cis 1,2 - DCE		-	41.5	66.1	55	68	68	53	75	48	56	54	54	43.9
VC		-	7.8	25.4	19	26	30	21	26	18	21	22	31	17.4
Total VOCs		-	*49.3*	*91.5*	*74.34*	*94*	*98*	*74*	*101*	*66*	*77*	*76*	*85*	*61.3*
782VMW-76	33 - 43													
TCE		-	-	U	U	U	U	U	U	U	U	U	U	U
cis 1,2 - DCE		-	-	1.5	1.6	1.4	2	1.7	1.2	1.8	1.6	1.6	0.89	1.0
VC		-	-	16.4	13	19	18	23	16	16	16	17	8.2	10.3
Total VOCs		-	-	*17.9*	*14.6*	*20.4*	*20*	*24.7*	*17.2*	*17.8*	*17.6*	*18.6*	*9.09*	*11.3*
782VMW-78	32 - 42													
TCE		-	-	U	0.21	U	U	U	U	U	U	U	U	U
cis 1,2 - DCE		-	-	39.8	64	46	59	55	69	60	47	52	48	38.1
VC		-	-	4.9	15	22	28	20	17	12	21	21	11	14
Total VOCs		-	-	*44.8*	*79.2*	*68*	*87*	*75*	*86*	*72*	*68*	*73*	*59*	*52.1*
782VMW-81	40 - 50													
TCE		-	-	21.2	11	14	15	17	14	12	13	12	9.8	2.7
cis 1,2 - DCE		-	-	18.7	27	28	23	26	22	18	21	18	16	11.5
VC		-	-	U	10	15	14	16	9.2	7.2	12	8	8.5	8.9
Total VOCs		-	-	*39.9*	*48*	*57*	*52*	*59*	*45.2*	*37.2*	*46*	*38*	*34.3*	*23.1*
782VMW-84	35 - 45													
TCE		-	-	U	0.3	U	U	U	U	U	U	U	U	U
cis 1,2 - DCE		-	-	2.7	1.7	0.8	1.2	0.6	0.7	0.6	0.6	0.5	0.6	0.5
VC		-	-	56.8	55	37	57	58	64	40	44	58	59	31.7
Total VOCs		-	-	*59.4*	*57.0*	*37.8*	*58.2*	*58.6*	*64.7*	*40.6*	*44.6*	*58.5*	*59.6*	*32.2*
782VMW-93	30 - 40													
TCE		-	-	U	U	U	U	U	U	U	U	U	U	U
cis 1,2 - DCE		-	-	0.2	U	U	U	U	U	U	U	U	U	U
VC		-	-	76.0	88	110	100	97	60	62	80	50	9.8	54.6
Total VOCs		-	-	*76.2*	*88*	*110*	*100*	*97*	*60*	*62*	*80*	*50*	*9.8*	*54.6*

Table E-1 Summary of Groundwater Monitroing Well Data for Nosedocks/Apron 2

Well Number / Parameter	Screen Interval (ft BGS)	Analytical Results by Sample Date (ug/L)												
		Dec-97 Ref 1	Oct-99 Ref 2	Feb-02 Ref 2	Feb-03 Ref 3	Jun-03 Ref 3	Sep-03 Ref 3	Dec-03 Ref 3	Apr-04 Ref 3	Jul-04 Ref 3	Sep-04 Ref 3	Dec-04 Ref 4	Apr-05 Ref 4	Nov-06 Ref 5
782VMW-96	33 - 43													
TCE		-	-	U	0.9	U	U	U	U	U	U	U	U	U
cis 1,2 - DCE		-	-	U	U	U	U	U	U	U	U	U	U	U
VC		-	-	77.8	96.0	130	120	72	130	95	96	96	130	68.2
Total VOCs		-	-	*77.8*	*96.9*	*130*	*120*	*72*	*130*	*95*	*96*	*96*	*130*	*68.2*
782VMW-101	7 - 22													
TCE		-	-	U	U	U	U	U	U	U	U	U	U	U
cis 1,2 - DCE		-	-	0.14	U	U	U	U	U	U	U	U	U	U
VC		-	-	2.1	0.8	0.7	1.5	1.0	1.0	0.8	0.9	2.1	4.2	1.9
Total VOCs		-	-	*2.3*	*0.8*	*0.7*	*1.5*	*1.0*	*1.0*	*0.8*	*0.9*	*2.1*	*4.2*	*1.9*
782VMW-105B	27 - 42													
TCE		-	-	50.0	39	29	26	21	28	25	29	33	13	8.0
cis 1,2 - DCE		-	-	4.6	2.6	1.6	3.7	3.2	6	3.2	2.9	3.2	4.1	0.51
VC		-	-	U	U	U	U	U	U	U	U	U	U	U
Total VOCs		-	-	*54.6*	*41.6*	*30.6*	*29.7*	*24.2*	*34*	*28.2*	*31.9*	*36.2*	*17.1*	*8.48*

Notes:

1. Data provided for detected concentrations only. Data qualifiers were omitted for purposes of graph development.
2. Hydropunch data collected at this site is not included in this analysis.
3. Shaded values denote an exceedence of the remediation goals presented in the ROD for the OBGW AOC. These values are as follows and are based on NYSDEC groundwater standards as of the approval date of the ROD.

TCE	=	5	ug/L
cis 1,2 - DCE	=	5	ug/L
VC	=	2	ug/L

References:

(1) E & E. July 1998. Final Report for the Supplemental Investigations of Areas of Concern at the Former Griffiss Air Force Base.
(2) FPM Group. April 2004. Final Remedial Investigation Report, Nosedocks/Apron 2 Chlorinated Plume, Griffiiss Air Force Base, Rome, New York
(3) FPM Group . August 2006. Final Groundwater Feasibility Study, NoseDocks/Apron 2 Chlorinated Plume, Former Griffiss Air Force Base, Rome, New York
(4) FPM Group. Preliminary data.
(5) FPM Group. August 2007. Final Monitoring Report for Baseline and Predesign Investigation 2 Sampling

Key:

BGS = below ground surface
cis-1,2-DCE = cis-1,2-dichloroethene
ft = feet
TCE = trichloroethene
U = non-detect values
ug/L = micrograms per liter.
VC = vinyl chloride
VOCs = volatile organic compounds
7.6 Shaded values denote hits exceeding the NYSDEC standard.

F Typical Vegetable Oil Injection Calculations

Table 1 Substrate Calculations in Hydrogen Equivalents
Source Area Treatment System

NOTE: Unshaded boxes are user input.

1. Treatment Zone Physical Dimensions	Values	Range	Units
Width (Perpendicular to predominant groundwater flow direction)	80	1-10,000	feet
Length (Parallel to predominant groundwater flow)	10	1-1,000	feet
Saturated Thickness	5	1-100	feet
Treatment Zone Cross Sectional Area	400	--	ft^2
Treatment Zone Volume	4,000	--	ft^3
Treatment Zone Total Pore Volume (total volume x total porosity)	10,475	--	gallons
Treatment Zone Effective Groundwater Volume (total volume x effective porosity)	8,978	--	gallons
Design Period of Performance	2	.5 to 5	year

2. Treatment Zone Hydrogeologic Properties			
Total Porosity	35%	.05-50	
Effective Porosity	30%	.05-50	
Average Aquifer Hydraulic Conductivity	54	.01-1000	ft/day
Average Hydraulic Gradient	0.0016	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through the Treatment Zone	0.29	--	ft/day
Average Groundwater Seepage Velocity through the Treatment Zone	105.1	--	ft/yr
Average Groundwater Flux through the Treatment Zone	94,381	--	gallons/year
Soil Bulk Density	1.65	1.4-2.0	gm/cm^3
Soil Fraction Organic Carbon (foc)	0.0021	0.0001-0.1	

3. Initial Treatment Cell Electron-Acceptor Demand (one total pore volume)

A. Aqueous-Phase Native Electron Acceptors		Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Oxygen	avg of 4 readings	3.0	0.26	7.9	0.03	4
Nitrate		2.0	0.17	10.2	0.02	5
Sulfate		288	25.17	10.6	2.38	8
Carbon Dioxide (estimated as the amount of Methane produced)		10.0	0.87	5.5	0.16	8
				Soluble Competing Electron Acceptor Demand (lb.)	**2.6**	

B. Solid-Phase Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Manganese (IV) (estimated as the amount of Mn (II) produced)	0.3	0.03	27.5	0.00	1
Iron (III) (estimated as the amount of Fe (II) produced)	10	0.87	55.9	0.02	1
			Solid-Phase Competing Electron Acceptor Demand (lb.)	**0.02**	

C. Soluble Contaminant Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	0.000	0.00	20.6	0.00	8
Trichloroethene (TCE)	0.100	0.01	21.7	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.000	0.00	24.0	0.00	4
Vinyl Chloride (VC)	0.000	0.00	31.0	0.00	2
Carbon Tetrachloride (CT)	0.000	0.00	19.1	0.00	8
Trichloromethane (or chloroform) (CF)	0.000	0.00	19.8	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.000	0.00	21.1	0.00	4
Chloromethane	0.000	0.00	25.0	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.8	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	0.000	0.00	22.1	0.00	6
Dichloroethane (1,1-DCA and 1,2-DCA)	0.000	0.00	24.5	0.00	4
Chloroethane	0.000	0.00	32.0	0.00	2
			Total Soluble Contaminant Electron Acceptor Demand (lb.)	**0.00**	

D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	Soil Conc. (mg/kg)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	263	0.00	0.00	20.6	0.00	8
Trichloroethene (TCE)	107	0.02	0.01	21.7	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	45	0.00	0.00	24.0	0.00	4
Vinyl Chloride (VC)	3.0	0.00	0.00	31.0	0.00	2
Carbon Tetrachloride (CT)	224	0.00	0.00	25.4	0.00	8
Trichloromethane (or chloroform) (CF)	63	0.00	0.00	12.3	0.00	6
Dichloromethane (or methylene chloride) (MC)	28	0.00	0.00	21.1	0.00	4
Chloromethane	25	0.00	0.00	25.0	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	117	0.00	0.00	20.8	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	105	0.00	0.00	22.0	0.00	6
Dichloroethane (1,1-DCA and 1,2-DCA)	30	0.00	0.00	25.0	0.00	4
Chloroethane	3	0.00	0.00	32.0	0.00	2
				Total Sorbed Contaminant Electron Acceptor Demand (lb.)	**0.00**	

(continued)

Table 1 Substrate Calculations in Hydrogen Equivalents

4. Treatment Cell Electron-Acceptor Flux (per year)

A. Soluble Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Oxygen	3.0	2.36	7.9	0.30	4
Nitrate	2.0	1.58	10.2	0.15	5
Sulfate	18	14.18	10.6	1.34	8
Carbon Dioxide (estimated as the amount of Methane produced)	15	11.81	5.5	2.16	8
Total Competing Electron Acceptor Demand Flux (lb/yr)				**4.0**	

B. Soluble Contaminant Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	0.000	0.00	20.6	0.00	8
Trichloroethene (TCE)	0.100	0.08	21.7	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.000	0.00	24.0	0.00	4
Vinyl Chloride (VC)	0.000	0.00	31.0	0.00	2
Carbon Tetrachloride (CT)	0.000	0.00	19.1	0.00	8
Trichloromethane (or chloroform) (CF)	0.000	0.00	19.8	0.00	6
Dichloromethane (or methylene chloride) (MC)	0.000	0.00	21.1	0.00	4
Chloromethane	0.000	0.00	25.0	0.00	2
Tetrachloroethane (1,1,1,2-PCA and 1,1,2,2-PCA)	0.000	0.00	20.8	0.00	8
Trichloroethane (1,1,1-TCA and 1,1,2-TCA)	0.000	0.00	22.1	0.00	6
Dichloroethane (1,1-DCA and 1,2-DCA)	0.000	0.00	24.5	0.00	4
Chloroethane	0.000	0.00	32.0	0.00	2
Total Soluble Contaminant Electron Acceptor Demand Flux (lb/yr)				**0.00**	

Initial Hydrogen Demand First Year (lb)	**6.57**
Total Life-Cycle Hydrogen Demand (lb)	**10.54**

5. Design Factors and Total Hydrogen Demand

Microbial Efficiency Uncertainty Factor	2X - 5X
Methane and Solid-Phase Electron Acceptor Uncertainty	2X - 5X
Remedial Design Safety Factor (e.g., Substrate Leaving Reaction Zone)	1X - 2X
SOLUBLE SUBSTRATE DESIGN FACTOR:	**5.0**
HRC DESIGN FACTOR:	**3.0**
SLOW RELEASE EDIBLE OIL DESIGN FACTOR:	**3.0**

Table 2 Substrate Calculations in Hydrogen Equivalents
Hydrogen Produced by Fermentation Reactions of Common Substrates

Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate	Ratio of Hydrogen Produced to Substrate (gm/gm)	P&P Manual Appendix C
Lactic Acid (assuming 100%)	$C_3H_6O_3$	90.1	15	0.3357	**2**
Molasses (assuming 100% sucrose)	$C_{12}H_{22}O_{11}$	342	15	0.0883	**8**
Fructose (assuming 100%)	$C_6H_{12}O_6$	180	8	0.0895	**4**
Ethanol (assuming 100%)	C_2H_6O	46.1	2	0.0875	**2**
HRC®	$C_{39}H_{56}O_{39}$	956	24	0.0506	**26**
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	$C_{18}H_{32}O_2$	281	12	0.0862	**16**

Table 3
Estimated Substrate Requirements for
Hydrogen Demand in Table 1

Design Life (years): 2

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand (pounds)	Substrate Product Required to Fulfill Hydrogen Demand (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand (milligrams)	Effective Substrate Concentration (mg/L)
Lactic Acid	5.0	157	157	7.12E+07	94
Sodium Lactate Product (60 percent solution)	**5.0**	**157**	**326**	**7.12E+07**	**94**
Molasses (assuming 60% sucrose by weight)	5.0	596	994	2.71E+08	359
Fructose Product (assuming 80% fructose by weight)	5.0	589	736	2.67E+08	354
Ethanol Product (assuming 80% ethanol by weight)	5.0	602	753	2.73E+08	362
HRC® (assumes 40% lactic acid and 40% glycerol by weight)	3.0	625	625	2.83E+08	301
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	3.0	367	367	1.66E+08	220
Commercial Vegetable Oil Emulsion Product (60% oil by weight)	**3.0**	**367**	**611**	**1.66E+08**	**220**

NOTES: Sodium Lactate Product

1. Assumes sodium lactate product is 60 percent sodium lactate by weight.
2. Molecular weight of sodium lactate (CH_3-CHOH-COONa) = 112.06.
3. Molecular weight of lactic Acid ($C_6H_6O_3$) = 90.08.
4. Therefore, sodium lactate product yields 48.4 (0.60 x (90.08/112.06)) percent by weight lactic acid.

Table 4 Substrate Calculations in Hydrogen Equivalents for Griffiss AFB Building 817 Pilot

Well ID	Injection Points: Injection Interval (feet)	Injection Points: Injection Spacing (feet)	Substrate Injection Mixture: Emulsion Product (60% oil by weight): Volume (gallons)	Oil Component (gallons)	Oil Component (pounds)	Lactate (pounds)	Fructose (pounds)	Makeup Water (gallons)	Total Volume: Substrate (pounds)	Water + Substrate (gallons)	Injection Interval (feet)	Estimated Effective Porosity (percent)	Radius of Influence (feet)	Injection Time at 5 gpm (hours)
Permeable Biobarrier 1 (east to West)														
SA-INJ-01	15-20	10	31	18.4	143.3	8.0	150	1000	301	1,031	5	25%	5.9	3.4
SA-INJ-02	15-20	10	31	18.4	143.3	8.0	150	1000	301	1,031	5	25%	5.9	3.4
SA-INJ-03	15-20	10	31	18.4	143.3	8.0	150	1000	301	1,031	5	25%	5.9	3.4
SA-INJ-04	15-20	10	31	18.4	143.3	8.0	150	1000	301	1,031	5	25%	5.9	3.4
SA-INJ-05	15-20	10	31	18.4	143.3	8.0	150	1000	301	1,031	5	25%	5.9	3.4
SA-INJ-06	15-20	10	31	18.4	143.3	8.0	150	1000	301	1,031	5	25%	5.9	3.4
SA-INJ-07	15-20	10	31	18.4	143.3	8.0	150	1000	301	1,031	5	25%	5.9	3.4
SA-INJ-08	15-20	10	31	18.4	143.3	8.0	150	1000	301	1,031	5	25%	5.9	3.4
TOTAL:			**248**	**147**	**1147**	**64**	**1200**	**8000**	**2410**	**8248**			**Days:**	**2**

SUBSTRATE CONCENTRATIONS

Final Percent Substrate by Weight:	**3.6%**	**Final Fructose Concentration:**	**18.4**	**grams/liter**	**Percent Oil by Volume in Emulsion: 1.8%**
Final Percent Water by Weight:	**96.4%**	**Final Oil Concentration:**	**16.7**	**grams/liter**	

EFFECTIVE TREATMENT ZONE CONCENTRATIONS

Design Life (years):	**2.0**	**Final Fructose Treatment Zone Concentration:**	**21**	**mg/L**	**Final Vegetable Oil Concentration (mg/L): 19**
		Treatment Zone Volume + Groundwater Flux Volume	**104,856**	**gallons**	
		Percentage of Treatment Zone Volume relative to Volume of Injected Fluid	**7.9%**		

NOTES: Sodium Lactate Product

1. Assumes WillClear sodium lactate product is 60 percent sodium lactate by weight.
2. Molecular weight of sodium lactate (CH_3-CHOH-COONa) = 112.06.
3. Molecular weight of lactic Acid ($C_6H_6O_3$) = 90.08 .
4. Specific gravity of WillClear Product = 1.323 @ 20 degrees Celsius.
5. Weight of WillClear Product = 11.0 pounds per gallon.
6. Pounds per gallon of lactic acid in product = 1.323 x 8.33 lb/gal H_2O x 0.60 x (90.08/112.06) = 5.31 lb/gal.

Drums	Gallons	Per Well
1	55	7.9
1.5	**82.5**	**11.8**
2	110	15.7

NOTES: Fructose Product

1. Assumes fructose product is 80 percent fructose sugar by weight.

Note: fructose wieghs 11 lb/gallon so 150 pounds = about 13.5 gallons.

NOTES: Vegetable Oil Emulsion Product

1. Assumes emulsion product is 60 percent soybean oil by weight.
2. Soybean oil is 7.8 pounds per gallon.
3. Assumes sepcific gravity of emulion product is 0.96 and that emulsion product is 4 percent sodium lactate by weight.

Table 1 Substrate Calculations in Hydrogen Equivalents

Source Area Treatment System

Landfill 6, Former Griffiss AFB

NOTE: Shaded boxes are user input.

1. Treatment Zone Physical Dimensions

	Values	Range	Units
Width (Perpendicular to predominant groundwater flow direction)	30	1-10,000	feet
Length (Parallel to predominant groundwater flow)	30	1-1,000	feet
Saturated Thickness	10	1-100	feet
Treatment Zone Cross Sectional Area	300	--	ft^2
Treatment Zone Volume	9,000	--	ft^3
Treatment Zone Total Pore Volume (total volume x total porosity)	23,568	--	gallons
Treatment Zone Effective Groundwater Volume (total volume x effective porosity)	20,201	--	gallons
Design Period of Performance	1	.5 to 5	year

2. Treatment Zone Hydrogeologic Properties

Total Porosity	35%	.05-50	
Effective Porosity	30%	.05-50	
Average Aquifer Hydraulic Conductivity	2.8	.01-1000	ft/day
Average Hydraulic Gradient	0.013	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through the Treatment Zone	0.1	--	ft/day
Average Groundwater Seepage Velocity through the Treatment Zone	45	--	ft/yr
Average Groundwater Flux through the Treatment Zone	30,191	--	gallons/year
Soil Bulk Density	1.5	1.4-2.0	gm/cm^3
Soil Fraction Organic Carbon (foc)	0.01	0.0001-0.1	

3. Initial Treatment Cell Electron-Acceptor Demand (one total pore volume)

A. Aqueous-Phase Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Oxygen	1.2	0.24	7.9	0.03	4
Nitrate	0.05	0.01	10.2	0.00	5
Sulfate	56.9	11.19	10.6	1.06	8
Carbon Dioxide (estimated as the amount of Methane produced)	15	2.95	5.5	0.54	8
Soluble Competing Electron Acceptor Demand (lb.)				**1.6**	

B. Solid-Phase Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Manganese (IV) (estimated as the amount of Mn (II) produced)	4.45	0.88	27.5	0.03	1
Iron (III) (estimated as the amount of Fe (II) produced)	0.019	0.00	55.9	0.00	1
Solid-Phase Competing Electron Acceptor Demand (lb.)				**0.03**	

C. Soluble Contaminant Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	0.000	0.00	20.6	0.00	8
Trichloroethene (TCE)	1.500	0.29	21.7	0.01	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.486	0.10	24.0	0.00	4
Vinyl Chloride (VC)	0.0027	0.00	31.0	0.00	2
Total Soluble Contaminant Electron Acceptor Demand (lb.)				**0.02**	

D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	Soil Conc. (mg/kg)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	263	0.00	0.00	20.6	0.00	8
Trichloroethene (TCE)	107	1.61	1.35	21.7	0.06	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	45	0.22	0.18	24.0	0.01	4
Vinyl Chloride (VC)	3.0	0.00	0.00	31.0	0.00	2
Total Sorbed Contaminant Electron Acceptor Demand (lb.)					**0.07**	

4. Treatment Cell Electron-Acceptor Flux (per year)

A. Soluble Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Oxygen	1.2	0.30	7.9	0.04	4
Nitrate	0.1	0.01	10.2	0.00	5
Sulfate	57	14.33	10.6	1.36	8
Carbon Dioxide (estimated as the amount of Methane produced)	15	3.78	5.5	0.69	8
Total Competing Electron Acceptor Demand Flux (lb/yr)				**2.1**	

Table 1 Substrate Calculations in Hydrogen Equivalents

B. Soluble Contaminant Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	0.000	0.00	20.6	0.00	8
Trichloroethene (TCE)	0.000	0.00	21.7	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.000	0.00	24.0	0.00	4
Vinyl Chloride (VC)	0.000	0.00	31.0	0.00	2
Total Soluble Contaminant Electron Acceptor Demand Flux (lb/yr)				**0.00**	
Initial Hydrogen Demand First Year (lb)				**4**	
Total Life-Cycle Hydrogen Demand (lb)				**4**	

5. Design Factors and Total Hydrogen Demand

SOLUBLE SUBSTRATE DESIGN FACTOR:	**6.0**
SLOW RELEASE EDIBLE OIL DESIGN FACTOR:	**27.0**

Table 2 Substrate Calculations in Hydrogen Equivalents
Hydrogen Produced by Fermentation Reactions of Common Substrates
Landfill 6, Former Griffiss AFB

Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate[1]	Ratio of Hydrogen Produced to Substrate[2] (gm/gm)
Lactic Acid (assuming 100%)	$C_3H_6O_3$	90.1	1.5	0.0336
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	$C_{18}H_{32}O_2$	281	12	0.0862

Notes:

1. Listed values based on Appendix C of Final Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents (AFCEE 2004) and experience at similar sites.
2. Ratio of hydrogen produced to substrate = (moles of hydrogen produced per mole of substrate x 2.016) / substrate molecular weight, where 2.016 is the molecular weight of hydrogen (gm/mole)

Table 3
Estimated Substrate Requirements for Hydrogen Demand in Table 2
Landfill 6, Former Griffiss AFB

Design Life (years): 1

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand[1] (pounds)	Substrate Product Required to Fulfill Hydrogen Demand[2] (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand[3] (milligrams)	Effective Substrate Concentration[4] (mg/L)
Lactic Acid	6.0	686	686	3.11E+08	1,530
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	27.0	1,202	1,202	5.45E+08	2,679

Notes:

1. Pure Substrate Mass Required to Fulfill Hydrogen Demand = (Total Life-cycle Hydrogen Demand [Table 1] x Design Factor) / Ratio of Hydrogen Produced to Substrate [Table 2]
2. Substrate Product Required to Fulfill Hydrogen Demand = Pure Substrate Mass Required to Fulfill Hydrogen Demand * percent substrate by weight
3. Substrate Mass Required to Fulfill Hydrogen Demand = Pure Substrate Mass Required to Fulfill Hydrogen Demand x 453.6 x 1000, where [453.6 x 1000] is the conversion from pounds to milligrams.
4. Effective Substrate Concentration = Substrate Mass Required to Fulfill Hydrogen Demand / (Treatment Zone Total Pore Volume + (Average Groundwater Flux through the Treatment Zone x Design Period of Performance)) x 3.7853, where 3.7853 is the conversion from gallons to liters.

Table 4 Substrate Calculations in Hydrogen Equivalents
Landfill 6, Former Griffiss AFB

Well ID	Injection Points: Injection Interval (feet BGS)	Injection Points: Injection Spacing (feet)	Substrate Injection Mixture: 100% Vegetable Oil: Volume (gallons)	Oil Component (gallons)	Oil Component (pounds)	Lactic Acid (pounds)	pH Buffer (gallons)	Makeup Water (gallons)	Total Volume: Substrate (pounds)	Water + Substrate (gallons)	Injection Interval (feet)	Estimated Effective Porosity (percent)	Radius of Influence (feet)	Injection Time at 5 gpm (hours)
Injection Points (east to west)														
LF6IW-01	37 to 47	5	26	26	206	125	17	1150	1,598	1,176	10	30%	4.1	3.9
LF6IW-02	45 to 55	5	26	26	206	125	17	1150	1,598	1,176	10	30%	4.1	3.9
LF6IW-03	37 to 47	5	26	26	206	125	17	1150	1,598	1,176	10	30%	4.1	3.9
LF6IW-04	45 to 55	5	26	26	206	125	17	1150	1,598	1,176	10	30%	4.1	3.9
LF6IW-05	37 to 47	5	26	26	206	125	17	1150	1,598	1,176	10	30%	4.1	3.9
LF6IW-06	45 to 55	5	26	26	206	125	17	1150	1,598	1,176	10	30%	4.1	3.9
TOTAL:			**159**	**159**	**1,238**	**750**	**102**	**6,900**	**9,590**	**7,059**			**Days[7]:**	**3**

SUBSTRATE CONCENTRATIONS

Final Percent Substrate by Weight:	**3.6%**	**Final Lactate Concentration:**	**12.8**	**grams/liter**	**Percent Oil by Volume in Emulsion:** **2.3%**
Final Percent Water by Weight:	**96.4%**	**Final Oil Concentration:**	**21.1**	**grams/liter**	

EFFECTIVE TREATMENT ZONE CONCENTRATIONS

Design Life (years):	**1**	**Final Lactate Treatment Zone Concentration:**	**1,675**	**mg/L**	**Final Vegetable Oil Concentration (mg/L):** **2,765**
		Treatment Zone Volume + Groundwater Flux Volume	**53,759**	**gallons**	
		Percentage of Treatment Zone Volume relative to Volume of Injected Fluid	**13.1%**		

NOTES:

1. Soybean oil weighs approximately 7.8 lb/gal
2. Pounds per gallon of lactic acid = volume of makeup water x % lactic acid in solution (assumed) x weight of water
3. Weight of water = 8.3 lb/gal
4. % of lactic acid in solution = 1.3%
5. pH buffer to be injected at 2% of weight of water
6. pH buffer weighs approximately 11 lb/gal
7. Injection time in days assumes 8 hours/day.

Table 1 Substrate Calculations in Hydrogen Equivalents

Source Area Treatment System

Building 817, Former Griffiss AFB (Primary Injection, Row Immediately Adjacent to Building 817)

NOTE: Shaded boxes are user input.

1. Treatment Zone Physical Dimensions	**Values**	**Range**	**Units**
Width (Perpendicular to predominant groundwater flow direction)	90	1-10,000	feet
Length (Parallel to predominant groundwater flow)	19	1-1,000	feet
Saturated Thickness	5	1-100	feet
Treatment Zone Cross Sectional Area	450	--	ft^2
Treatment Zone Volume	8,550	--	ft^3
Treatment Zone Total Pore Volume (total volume x total porosity)	22,390	--	gallons
Treatment Zone Effective Groundwater Volume (total volume x effective porosity)	19,191	--	gallons
Design Period of Performance	3	.5 to 5	year

2. Treatment Zone Hydrogeologic Properties			
Total Porosity	35%	.05-50	
Effective Porosity	30%	.05-50	
Average Aquifer Hydraulic Conductivity	40.9	.01-1000	ft/day
Average Hydraulic Gradient	0.032	0.1-0.0001	ft/ft
Average Groundwater Seepage Velocity through the Treatment Zone	4.4	--	ft/day
Average Groundwater Seepage Velocity through the Treatment Zone	1,592	--	ft/yr
Average Groundwater Flux through the Treatment Zone	1,608,409	--	gallons/year
Soil Bulk Density	1.5	1.4-2.0	gm/cm^3
Soil Fraction Organic Carbon (foc)	0.009	0.0001-0.1	

3. Initial Treatment Cell Electron-Acceptor Demand (one total pore volume)

A. Aqueous-Phase Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Oxygen	8.2	1.53	7.9	0.19	4
Nitrate	1.2	0.22	10.2	0.02	5
Sulfate	11	2.06	10.6	0.19	8
Carbon Dioxide (estimated as the amount of Methane produced)	15	2.80	5.5	0.51	8
Soluble Competing Electron Acceptor Demand (lb.)				**0.9**	

B. Solid-Phase Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Manganese (IV) (estimated as the amount of Mn (II) produced)	0.048	0.01	27.5	0.00	1
Iron (III) (estimated as the amount of Fe (II) produced)	0.92	0.17	55.9	0.00	1
Solid-Phase Competing Electron Acceptor Demand (lb.)				**0.00**	

C. Soluble Contaminant Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	0.053	0.01	20.6	0.00	8
Trichloroethene (TCE)	0.068	0.01	21.7	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.000	0.00	24.0	0.00	4
Vinyl Chloride (VC)	0.000	0.00	31.0	0.00	2
Total Soluble Contaminant Electron Acceptor Demand (lb.)				**0.00**	

D. Sorbed Contaminant Electron Acceptors (Soil Concentration = Koc x foc x Cgw)	Koc (mL/g)	Soil Conc. (mg/kg)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	263	0.13	0.10	20.6	0.00	8
Trichloroethene (TCE)	107	0.07	0.05	21.7	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	45	0.00	0.00	24.0	0.00	4
Vinyl Chloride (VC)	3.0	0.00	0.00	31.0	0.00	2
Total Sorbed Contaminant Electron Acceptor Demand (lb.)					**0.01**	

Table 1 Substrate Calculations in Hydrogen Equivalents

4. Treatment Cell Electron-Acceptor Flux (per year)

A. Soluble Native Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Oxygen	8.2	110.06	7.9	13.93	4
Nitrate	1.2	15.70	10.2	1.54	5
Sulfate	11	147.64	10.6	13.98	8
Carbon Dioxide (estimated as the amount of Methane produced)	15	201.32	5.5	36.87	8
Total Competing Electron Acceptor Demand Flux (lb/yr)				**66.3**	

B. Soluble Contaminant Electron Acceptors	Concentration (mg/L)	Mass (lb)	Stoichiometric demand (wt/wt h_2)	Hydrogen Demand (lb)	Electron Equivalents per Mole
Tetrachloroethene (PCE)	0.000	0.00	20.6	0.00	8
Trichloroethene (TCE)	0.000	0.00	21.7	0.00	6
Dichloroethene (cis-DCE, trans-DCE, and 1,1-DCE)	0.000	0.00	24.0	0.00	4
Vinyl Chloride (VC)	0.000	0.00	31.0	0.00	2
Total Soluble Contaminant Electron Acceptor Demand Flux (lb/yr)				**0.00**	

Initial Hydrogen Demand First Year (lb)	**67**
Total Life-Cycle Hydrogen Demand (lb)	**200**

5. Design Factors and Total Hydrogen Demand

SOLUBLE SUBSTRATE DESIGN FACTOR:	**0.0**
SLOW RELEASE EDIBLE OIL DESIGN FACTOR:	**34.0**

Table 2 Substrate Calculations in Hydrogen Equivalents
Hydrogen Produced by Fermentation Reactions of Common Substrates
Building 817, Former Griffiss AFB (Primary Injection, Row Immediately Adjacent to Building 817)

Substrate	Molecular Formula	Substrate Molecular Weight (gm/mole)	Moles of Hydrogen Produced per Mole of Substrate[1]	Ratio of Hydrogen Produced to Substrate[2] (gm/gm)
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	$C_{18}H_{32}O_2$	281	12	0.0862

Notes:
1. Listed values based on Appendix C of Final Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents (AFCEE 2004) and experience at similar sites.
2. Ratio of hydrogen produced to substrate = (moles of hydrogen produced per mole of substrate x 2.016) / substrate molecular weight, where 2.016 is the molecular weight of hydrogen (gm/mole)

Table 3 Estimated Substrate Requirements for Hydrogen Demand in Table 2
Building 817, Former Griffiss AFB (Primary Injection, Row Immediately Adjacent to Building 817)

Design Life (years): 3

Substrate	Design Factor	Pure Substrate Mass Required to Fulfill Hydrogen Demand[1] (pounds)	Substrate Product Required to Fulfill Hydrogen Demand[2] (pounds)	Substrate Mass Required to Fulfill Hydrogen Demand[3] (milligrams)	Effective Substrate Concentration[4] (mg/L)
Linoleic Acid (Soybean Oil, Corn Oil, Cotton Oil)	34.0	78,807	78,807	3.57E+10	1,948

Notes:
1. Pure Substrate Mass Required to Fulfill Hydrogen Demand = (Total Life-cycle Hydrogen Demand [Table 1] x Design Factor) / Ratio of Hydrogen Produced to Substrate [Table 2]
2. Substrate Product Required to Fulfill Hydrogen Demand = Pure Substrate Mass Required to Fulfill Hydrogen Demand * percent substrate by weight
3. Substrate Mass Required to Fulfill Hydrogen Demand = Pure Substrate Mass Required to Fulfill Hydrogen Demand x 453.6 x 1000, where [453.6 x 1000] is the conversion from pounds to milligrams.
4. Effective Substrate Concentration = Substrate Mass Required to Fulfill Hydrogen Demand / (Treatment Zone Total Pore Volume + (Average Groundwater Flux through the Treatment Zone x Design Period of Performance)) x 3.7853, where 3.7853 is the conversion from gallons to liters.

Table 4 Substrate Calculations in Hydrogen Equivalents
Building 817, Former Griffiss AFB (Primary Injection, Row Immediately Adjacent to Building 817)

	Injection Points		Substrate Injection Mixture						Total Volume					
	Injection	Injection	100% Vegetable Oil											
Well ID	Interval (feet)	Spacing (feet)	Volume (gallons)	Oil Component (gallons)	Oil Component (pounds)[1]	Lactic Acid (pounds)	pH Buffer (gallons)	Makeup Water (gallons)	Substrate (pounds)	Water + Substrate (gallons)	Injection Interval (feet)	Estimated Effective Porosity (percent)	Radius of Influence (feet)	Injection Time at 7 gpm (hours)
Injection Points (east to west)														
B817-IW1	14 to 19	10	90	90	702	0	45	3,000	747	3,090	5	30%	9.4	7.4
B817-IW2	14 to 19	10	90	90	702	0	45	3,000	747	3,090	5	30%	9.4	7.4
B817-IW3	14 to 19	10	90	90	702	0	45	3,000	747	3,090	5	30%	9.4	7.4
B817-IW4	14 to 19	10	90	90	702	0	45	3,000	747	3,090	5	30%	9.4	7.4
B817-IW5	14 to 19	10	90	90	702	0	45	3,000	747	3,090	5	30%	9.4	7.4
B817-IW6	14 to 19	10	90	90	702	0	45	3,000	747	3,090	5	30%	9.4	7.4
B817-IW7	14 to 19	10	90	90	702	0	45	3,000	747	3,090	5	30%	9.4	7.4
B817-IW8	14 to 19	10	90	90	702	0	45	3,000	747	3,090	5	30%	9.4	7.4
TOTAL:		**80**	**720**	**720**	**5,616**	**0**	**360**	**24,000**	**5,976**	**24,720**			**Days[2]:**	**7**

SUBSTRATE CONCENTRATIONS

Final Percent Substrate by Weight:	**3.0%**	**Final Fructose Concentration:**	**0.0**	**grams/liter**	**Percent Oil by Volume in Emulsion:** **3.0%**
Final Percent Water by Weight:	**97.0%**	**Final Oil Concentration:**	**27.3**	**grams/liter**	

EFFECTIVE TREATMENT ZONE CONCENTRATIONS

Design Life (years):	**3**	**Final Fructose Treatment Zone Concentration:**	**0**	**mg/L**	**Final Vegetable Oil Concentration (mg/L):** **1,993**
		Treatment Zone Volume + Groundwater Flux Volume	**4,847,615**	**gallons**	
		Percentage of Treatment Zone Volume relative to Volume of Injected Fluid	**0.5%**		

NOTES:

1. Soybean oil weighs approximately 7.8 lb/gal
2. Injection time in days assumes 8 hours/day.
3. Weight of water = 8.3 lb/gal
4. pH buffer to be injected at 2% of weight of water
5. pH buffer weighs approximately 11 lb/gal

G

B775 Sanitary Sewer Correspondence

From: Clifford, Bruce [bclifford@romecitygov.com]
Sent: Tuesday, April 24, 2007 1:03 PM
To: Murphy, Andrew (Buffalo)
Subject: RE: Potential Discharge-former Griffiss AFB

Dear Mr. Murphy,

A review of analysis data submitted in letter dated 2/23.07 indicates pollutant level from this site may be acceptable for discharge to the

City of Rome sanitary sewer without pretreatment. Any increased changes in pollutant levels may require pretreatment prior to discharge. A permit from this office would be required, included in this permit would be flow restriction and a fee to discharge. A plumbing permit would also be required to connect to the sanitary sewer.

Please keep this office informed. Thank You,

Bruce Clifford

IPP Coordinator

From: Murphy, Andrew (Buffalo) [mailto:AMurphy@ene.com]
Sent: Tuesday, April 24, 2007 9:15 AM
To: Clifford, Bruce
Subject:

H

Example Submersible Pump

ITT

Residential Water Systems

Goulds Pumps

5GS, 7GS, 10GS, 13GS, 18GS, 25GS

60 Hz Standard Capacity
4" Submersible Pumps

GOULDS PUMPS

Goulds Pumps is a brand of ITT Water Technology, Inc. - a subsidiary of ITT Industries, Inc.

www.goulds.com

Engineered for life

FEATURES

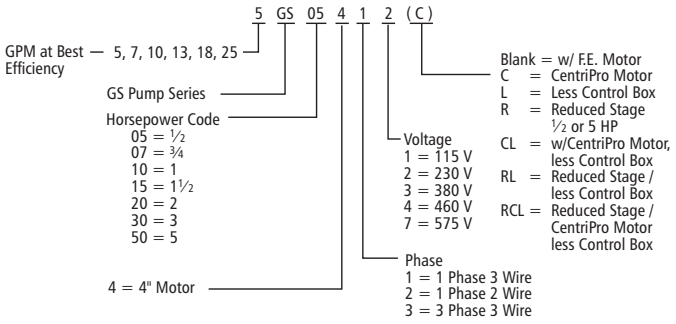
- **Powered for Continuous Operation:** All ratings are within the working limits of the motor as recommended by the motor manufacturer. Pump can be operated continuously without damage to the motor.
- **Field Serviceable:** Units have left hand threads and are field serviceable with common tools and readily available repair parts.
- **Sand Handling Design:** Our face clearance, floating impeller stack has proven itself for over 40 years as a superior sand handling, durable pump design.
- **FDA Compliant Non-Metallic Parts:** Impellers, diffusers and bearing spiders are constructed of glass filled engineered composites. They are corrosion resistant and non-toxic.
- **Discharge Head/Check Valve:** Cast 303 stainless steel for strength and durability. Two cast-in safety line loops for installer convenience. The built-in check valve is constructed of stainless steel and FDA compliant BUNA rubber for abrasion resistance and quiet operation.
- **Motor Adapter:** Cast 303 stainless steel for rigid, accurate alignment of pump and motor. Easy access to motor mounting nuts using standard open end wrench.
- **Stainless Steel Casing:** Polished stainless steel is strong and corrosion resistant.
- **Hex Shaft Design:** Six sided shafts for positive impeller drive.
- **Engineered Polymer Bearings:** The proprietary, engineered polymer bearing material is strong and resistant to abrasion and wear. The enclosed upper bearing is mounted in a durable Noryl® bearing spider for excellent abrasion resistance.

WATER END DATA

Series	Model	Required H.P.	Stages	Water End	
				Length (in)	Wt (lbs)
5GS	5GS05R	.5	9	12.9	8
	5GS05R	.5	12	15.0	9
	5GS07	.75	15	17.0	11
	5GS10	1	20	21.7	13
	5GS15	1.5	26	25.8	15
	5GS20	2	33	31.6	19
7GS	7GS05R	.5	7	11.7	6
	7GS05R	.5	10	13.8	7
	7GS07	.75	13	16.0	8
	7GS10	1	17	18.8	9
	7GS15	1.5	22	23.6	12
	7GS20	2	27	27.2	13
	7GS30	3	34	33.2	18
10GS	10GS05R	.5	5	10.1	6
	10GS05	.5	7	11.5	7
	10GS07	.75	10	13.6	8
	10GS10	1	12	15.0	9
	10GS15	1.5	17	18.4	12
	10GS20	2	20	21.7	13
	10GS30	3	27	27.5	18
	10GS50R	5	35	33.0	21
	10GS50	5	42	40.2	24
13GS	13GS05	.5	5	10.1	6
	13GS07	.75	7	11.5	7
	13GS10	1	10	13.6	8
	13GS15	1.5	12	15.0	9
	13GS20	2	17	18.4	12
	13GS30	3	21	22.3	15
18GS	18GS75	.75	6	11.8	7
	18GS10	1	8	13.5	8
	18GS15	1.5	11	16.1	10
	18GS20	2	14	18.6	11
	18GS30	3	19	24.1	15
	18GS50R	5	24	28.3	17
	18GS50	5	30	34.4	21
25GS	25GS10	1	7	13.4	8
	25GS15	1.5	9	15.3	9
	25GS20	2	11	17.2	10
	25GS30	3	15	20.9	14
	25GS50R	5	22	28.7	17
	25GS50	5	26	33.4	21

NOMENCLATURE

See price book for complete order numbers.



SPECIFICATIONS

Model	Flow Range GPM	Horse-power Range	Best Efficiency GPM	Discharge Connection	Minimum Well Size	Rotation①
5GS	1.2 – 7.5	½ – 2	5	1¼	4"	CCW
7GS	1.5 – 10	½ – 3	7	1¼	4"	CCW
10GS	3 – 16	½ – 5	10	1¼	4"	CCW
13GS	4 – 20	½ – 3	13	1¼	4"	CCW
18GS	6 – 28	½ – 5	18	1¼	4"	CCW
25GS	8 – 33	1 – 5	25	1¼	4"	CCW

① Rotation is counterclockwise when observed from pump discharge end.

"GS" SERIES MATERIALS OF CONSTRUCTION

Part Name	Material
Discharge Head	AISI 303 SS
Check Valve Poppet	AISI 304 SS
Check Valve Seal	BUNA, FDA compliant
Check Valve Seat	AISI 304 SS
Check Valve Retaining Ring	AISI 302 SS
Bearing Spider – Upper	Noryl® GFN2
Bearing	Proprietary Engineered Polymer
Klipring	AISI 301 SS
Diffuser	Lexan®
Impeller	Noryl®
Bowl	AISI 304 SS
Intermediate Sleeve*	AISI 304 SS, Powder Metal
Intermediate Shaft Coupling*	AISI 304 SS, Powder Metal
Intermediate Bearing Spider*	Glass Filled Engineered Composite
Intermediate Bearing Spider*	AISI 303 SS
Shim	AISI 304 SS
Screws – Cable Guard	AISI 304 SS
Motor Adapter	AISI 303 SS
Casing	AISI 304 SS
Shaft	
Coupling	AISI 304 SS, Powder Metal
Cable Guard	AISI 304 SS
Suction Screen	AISI 304 SS

*See repair parts for where used.

AGENCY LISTINGS

All factory assembled, complete pump/motor assemblies are UL778 and CSA listed. All pumps and motors comply with ANSI/NSF 61-1992. Motors are UL778 recognized.

Canadian Standards Association

Underwriters Laboratories

ANSI/NSF 61 - Drinking Water System Components 4P49

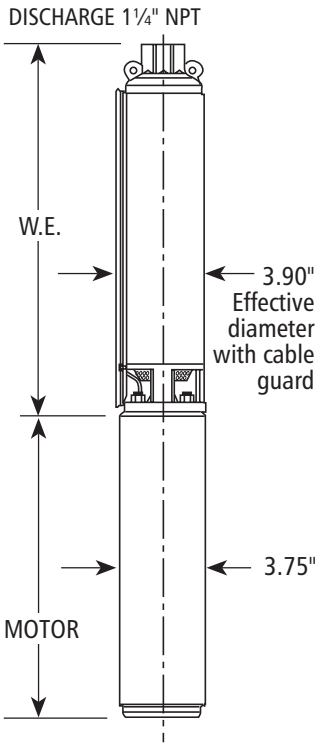
Goulds Pumps is ISO 9001 Registered.

CENTRIPRO 4" SINGLE-PHASE MOTORS

Order No.	Type	HP	Volts	Length (in)	Weight (lb)
M05421	2-wire PSC	.5	115	11.0	19.2
M05422		.5	230	11.0	19.2
M07422		.75	230	12.4	22.7
M10422		1	230	13.3	24.5
M15422		1.5	230	14.9	28.9
M05411	3-wire	.5	115	10.0	18.9
M05412		.5	230	9.7	18.1
M07412		.75	230	10.8	21.4
M10412		1	230	11.7	23.1
M15412		1.5	230	13.6	27.4

FRANKLIN ELECTRIC 4" SINGLE-PHASE MOTORS

Order No.	Type	HP	Volts	Length (in)	Weight (lb)
S04932	2-wire Split-Phase	.5	115	9.5	18
S04942		.5	230	9.5	18
S05942		.75	230	10.7	21
S06942		1	230	11.8	24
S07942		1.5	230	15.1	31
S04930	3-wire	.5	115	9.5	19
S04940		.5	230	9.5	19
S05940		.75	230	10.7	21
S06940		1	230	11.8	24
S07940		1.5	230	13.6	28
S08940		2	230	15.1	33
S09940		3	230	19.1	41
S09940HT		3	230	22.2	55
S10940		5	230	28.2	70



FRANKLIN ELECTRIC 4" THREE-PHASE MOTORS

Order No.	HP	Volts	Length (in)	Weight (lb)
S04978	.5	200	9.5	18
S04970		230		
S04975		460		
S05978	.75	200	10.7	21
S05970		230		
S05978		460		
S06978	1	200	11.8	24
S06970		230		
S06975		460		
S07978	1.5	200	11.8	24
S07970		230		
S07975		460		
S07979		575		
S08978	2	200	13.6	28
S08970		230		
S08975		460		
S08979		575		
S09978	3	200	16.1	35
S09970		230		
S09975		460		
S09979		575		
S09978HT	3 High Thrust	200	19.2	42
S09970HT		230		
S09975HT		460		
S09979HT		575		
S10978	5	200	22.2	55
S10970		230		
S10975		460		
S10979		575		
S119784	7.5	200	28.2	70
S119704		230		
S119754		460		
S129724	10	460	30.5	75

NEMA MOTOR

- Corrosion resistant stainless steel construction.
- Built-in surge arrestor is provided on single phase motors through 5 HP.
- Stainless steel splined shaft.
- Hermetically sealed windings.
- Replaceable motor lead assembly.
- UL 778 recognized.
- NEMA mounting dimensions.
- Control box is required with 3 wire single phase units.
- Three phase units require a magnetic starter with three leg protection. Magnetic starter and heaters must be ordered separately.

Model 5GS

SELECTION CHART

Horsepower Range ½ – 2, Recommended Range 1.2 – 7.5 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																																						
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	380	420	460	500	540	580	620	660	700	740	780	820	860	900	940	980	1020
5GS05R	½	0					7.5	7.2	6.8	6.3	5.8	5.2	4.7	3.8	2.9																						
		20			7.4	7.1	6.7	6.2	5.7	5.1	4.4	3.7	2.6																						
		30		7.3	6.9	6.6	6.0	5.6	5.0	4.3	3.4	2.3																						
		40	7.3	6.9	6.5	6.0	5.5	4.9	4.2	3.4	2.2																						
		50	6.9	6.5	5.9	5.4	4.9	4.1	3.2	2.0																						
		60	6.2	5.6	5.2	4.6	3.8	2.7	1.2																								
Shut-off PSI			120	112	103	94	86	77	68	60	51	42	34	25	16																		
5GS05	½	0							7.4	7.2	6.9	6.6	6.3	5.9	5.4	5.0	4.5	3.4															
		20					7.4	7.2	6.9	6.5	6.1	5.7	5.3	4.9	4.4	3.8	3.2	1.3															
		30			7.7	7.4	7.1	6.8	6.4	6.0	5.6	5.2	4.8	4.3	3.7	3.1	2.2																
		40			7.4	7.1	6.7	6.4	6.0	5.6	5.2	4.7	4.2	3.6	3.0	2.2																	
		50	7.6	7.3	7.0	6.7	6.3	6.0	5.5	5.1	4.6	4.1	3.5	2.9	2.0																		
		60	7.0	6.7	6.5	6.2	5.8	5.4	5.0	4.6	4.0	3.4	2.6	1.2																			
Shut-off PSI			166	156	147	139	130	121	113	104	95	87	78	69	61	52	43	26															
5GS07	¾	0									7.5	7.3	7.1	6.9	6.7	6.4	6.1	5.6	5.0	4.2	3.3	2.0											
		20							7.5	7.3	7.1	6.8	6.6	6.4	6.1	5.8	5.5	4.8	4.1	3.1	1.8												
		30					7.6	7.4	7.2	7.0	6.8	6.5	6.3	6.0	5.7	5.4	5.1	4.4	3.5	2.2													
		40				7.6	7.4	7.2	7.0	6.8	6.5	6.3	6.0	5.7	5.4	5.1	4.7	3.9	2.9	1.6													
		50			7.6	7.4	7.2	6.9	6.7	6.5	6.2	6.0	5.7	5.3	5.0	4.7	4.3	3.4	2.2														
		60	7.5	7.3	7.1	6.9	6.8	6.5	6.3	6.1	5.8	5.5	5.2	4.9	4.5	4.1	3.7	2.6	1.2														
Shut-off PSI			225	216	208	199	190	182	173	166	156	147	139	130	121	113	104	87	69	52	35	17											
5GS10	1	0											7.6	7.5	7.3	7.1	6.9	6.6	6.1	5.7	5.2	4.6	3.9	3.1	2.1								
		20										7.4	7.3	7.1	6.9	6.7	6.5	6.0	5.6	5.1	4.5	3.8	3.0	2.0									
		30									7.4	7.2	7.1	6.9	6.6	6.4	6.2	5.8	5.3	4.7	4.1	3.3	2.4										
		40								7.4	7.2	7.0	6.8	6.6	6.4	6.2	6.0	5.5	5.0	4.4	3.7	2.9	1.8										
		50						7.5	7.4	7.2	7.0	6.8	6.6	6.4	6.2	6.0	5.7	5.2	4.6	4.0	3.2	2.2											
		60				7.5	7.4	7.2	7.0	6.9	6.7	6.5	6.4	6.2	6.0	5.7	5.5	5.0	4.4	3.6	2.7	1.2											
Shut-off PSI						253	245	234	227	219	210	201	193	184	175	167	158	141	123	106	89	71	54	37	19								
5GS15	1½	0													7.5	7.3	7.2	6.9	6.7	6.5	6.2	5.9	5.5	5.1	4.7	4.3	3.8	3.3	2.6	1.7				
		20											7.4	7.3	7.1	7.0	6.9	6.7	6.4	6.1	5.8	5.4	5.1	4.7	4.2	3.7	3.2	2.5						
		30										7.4	7.2	7.1	7.0	6.9	6.8	6.5	6.3	6.0	5.6	5.2	4.8	4.4	4.0	3.4	2.8	2.0						
		40								7.5	7.4	7.2	7.1	7.0	6.9	6.8	6.7	6.4	6.1	5.8	5.4	5.0	4.6	4.2	3.7	3.1	2.4	1.4						
		50							7.5	7.3	7.2	7.1	7.0	6.9	6.8	6.6	6.5	6.2	5.9	5.5	5.2	4.8	4.3	3.9	3.4	2.7	1.8						
		60						7.5	7.3	7.2	7.1	7.0	6.8	6.7	6.6	6.5	6.3	6.0	5.7	5.3	4.9	4.5	4.1	3.6	3.0	2.2	1.2						
Shut-off PSI								325	317	308	299	291	282	273	265	256	247	230	213	195	178	161	143	126	109	91	74	57	39	22				
5GS20	2	0																			7.6	7.3	7.0	6.7	6.4	6.1	5.7	5.4	4.9	4.6	4.1	3.6	3.1	2.5	1.9
		20																		7.5	7.2	7.0	6.7	6.3	6.0	5.7	5.3	4.9	4.5	4.0	3.6	3.0	2.4	1.7	
		30																	7.6	7.4	7.1	6.8	6.5	6.1	5.8	5.5	5.1	4.7	4.2	3.8	3.3	2.7	2.1	1.2	
		40																	7.5	7.2	6.9	6.6	6.3	6.0	5.6	5.2	4.8	4.5	4.0	3.5	3.0	2.3	1.6		
		50																7.6	7.3	7.0	6.7	6.4	6.1	5.8	5.4	5.0	4.6	4.2	3.7	3.2	2.6	1.9			
		60																7.4	7.2	6.9	6.6	6.2	5.9	5.5	5.2	4.8	4.4	3.9	3.4	2.9	2.2	1.5			
Shut-off PSI																		322	305	288	270	253	236	219	201	184	167	149	132	115	97	80	63	45	28

Model 7GS

SELECTION CHART

Horsepower Range ½ – 1, Recommended Range 1.5 – 10 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																												
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	540	580	620
7GS05R	½R	0						10.2	8.9	7.5	5.9	3.6																		
		20				9.8	8.5	7.0	5.3	2.5																				
		30			9.6	8.3	6.8	4.9	1.9																					
		40		9.4	8.1	6.5	4.6	1.2																						
		50	9.2	7.8	6.3	4.2	0.5																							
		60	7.6	6.0	3.8																									
Shut-off PSI			85	77	68	59	51	42	33	25	16	7																		
7GS05	½	0								10.1	9.2	8.3	7.4	6.3	5.0	3.4														
		20						9.8	9.0	8.1	7.1	6.0	4.6	2.7																
		30					9.7	8.8	7.9	6.9	5.8	4.3	2.4																	
		40			10.4	9.6	8.7	7.8	6.7	5.6	4.1	2.0																		
		50		10.3	9.4	8.5	7.6	6.6	5.4	3.8	1.7																			
		60	10.2	9.3	8.4	7.5	6.4	5.1	3.5																					
Shut-off PSI			125	116	107	99	90	81	73	64	55	47	38	29	21	12														
7GS07	¾	0											10.0	9.3	8.6	7.9	7.1	6.2	5.2	4.0	2.4									
		20								10.4	9.8	9.1	8.4	7.7	6.9	6.0	4.9	3.5	1.8											
		30							10.3	9.7	9.0	8.3	7.5	6.7	5.8	4.7	3.3	1.5												
		40						10.2	9.5	8.9	8.2	7.4	6.6	5.6	4.5	3.1														
		50					10.1	9.4	8.8	8.1	7.3	6.5	5.5	4.3	2.8															
		60				10.0	9.3	8.7	7.9	7.2	6.3	5.3	4.1	2.5																
Shut-off PSI						140	131	122	114	105	96	88	79	70	62	53	44	36	27	18	10									
7GS10	1	0														10.1	9.6	9.0	8.5	7.9	7.3	6.7	6.0	5.3	4.4	3.4	2.1			
		20											10.4	9.9	9.4	8.9	8.3	7.7	7.1	6.5	5.8	5.0	4.1	3.0	1.6					
		30										10.3	9.9	9.3	8.8	8.2	7.6	7.0	6.4	5.7	4.9	4.0	2.8							
		40									10.3	9.8	9.2	8.7	8.1	7.5	6.9	6.3	5.6	4.8	3.8	2.6								
		50								10.2	9.7	9.2	8.6	8.0	7.4	6.8	6.2	5.4	4.6	3.7	2.4									
		60							10.1	9.6	9.1	8.5	7.9	7.3	6.7	6.0	5.3	4.5	3.5	2.2										
Shut-off PSI									166	158	149	140	132	123	114	106	97	88	80	71	62	54	45	36	28	19	10			

Horsepower Range 1½ – 3, Recommended Range 1.5 – 10 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																											
			200	220	240	260	280	300	340	380	420	460	500	540	580	620	660	700	740	780	820	860	900	940	980	1020	1060	1100	1140
7GS15	1½	0								10.2	9.3	8.5	7.6	6.8	5.9	4.7	2.6												
		20							10.1	9.2	8.3	7.5	6.7	5.8	4.5	2.1													
		30						10.4	9.6	8.7	7.8	7.0	6.2	5.1	3.3														
		40					10.3	9.9	9.1	8.2	7.4	6.6	5.6	4.2	1.6														
		50				10.3	9.9	9.4	8.6	7.7	6.9	6.0	4.9	2.9															
		60			10.2	9.8	9.4	8.9	8.1	7.2	6.4	5.4	3.9																
Shut-off PSI					194	186	177	168	151	134	116	99	82	64	47	30	12												
7GS20	2	0											9.8	9.3	8.7	8.4	7.8	7.1	6.3	5.4	4.5	3.5	2.2						
		20										9.8	9.3	8.7	8.4	7.7	6.9	6.2	5.3	4.3	3.2	2.8							
		30									9.9	9.5	9.0	8.5	7.9	7.2	6.4	5.7	4.4	3.7									
		40								10.0	9.7	9.2	8.7	8.3	7.5	6.7	6.0	5.2	4.1	3.0									
		50								9.9	9.4	8.9	8.5	7.8	7.2	6.3	5.5	4.7	3.5										
		60							10.0	9.6	9.1	8.7	8.2	7.4	6.6	5.8	5.0	4.0											
Shut-off PSI									268	251	234	216	199	182	165	147	130	113	95	80	61								
7GS30	3	0														9.8	9.5	9.2	8.7	8.3	7.9	7.4	6.8	6.2	5.4	4.7	3.9	3.0	2.0
		20														9.8	9.4	9.2	8.7	8.3	7.8	7.2	6.7	6.2	5.3	4.5	3.7	3.3	1.7	
		30												10.0	9.6	9.2	8.8	8.5	8.0	7.5	6.9	6.3	5.7	4.8	4.1	3.2	2.3			
		40											10.0	9.7	9.4	9.0	8.6	8.2	7.7	7.2	6.6	5.9	5.2	4.4	3.6	2.7	1.7			
		50											9.9	9.5	9.2	8.7	8.4	7.9	7.4	6.8	6.3	5.5	4.8	3.9	3.1	2.2				
		60										10.0	9.7	9.3	9.0	8.6	8.1	7.6	7.0	6.5	5.8	5.1	4.2	3.4	2.5	1.5				
Shut-off PSI												320	303	286	268	251	234	216	199	182	165	147	130	113	95	78	61	43	27	

Model 10GS

SELECTION CHART

Horsepower Range ½ – 3, Recommended Range 3 – 16 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																												
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	380	420	460	500	540	580	620	660	700	740	780	820
10GS05R	½	0			15.6	14.0	12.4	10.4	6.5																					
		20	15.4	13.5	11.5	9.2	6.0																							
		30	13.0	11.1	8.0	4.0																								
		40	11.0	7.9	3.0																									
		50	7.0																											
		60																												
Shut-off PSI			61	53	44	34	26	18	10																					
10GS05	½	0				16.0	15.3	14.3	12.8	11.3	9.0	6.4																		
		20		15.9	14.9	13.8	12.5	10.8	8.3	4.8																				
		30	15.7	14.6	13.5	12.3	10.5	7.8	4.0																					
		40	14.5	13.4	12.0	10.3	7.5	3.0																						
		50	13.0	11.5	9.8	7.2																								
		60	11.3	9.0	6.4																									
Shut-off PSI			89	81	72	63	55	46	37	29	20	11																		
10GS07	¾	0						16.0	15.2	14.3	13.4	12.5	11.5	10.3	9.0	7.0	4.0													
		20				15.8	15.0	14.0	13.0	12.3	11.2	10.2	8.5	6.0																
		30			15.7	14.8	13.9	12.8	12.0	11.0	9.8	8.2	5.5																	
		40		15.6	14.7	13.8	12.7	11.9	10.8	9.7	8.1	5.2																		
		50	15.3	14.4	13.5	12.6	11.6	10.5	9.4	7.5	4.8																			
		60	14.3	13.4	12.5	11.5	10.3	9.0	7.0	4.0																				
Shut-off PSI			130	121	113	104	95	87	78	69	61	52	43	35	26	17	9													
10GS10	1	0								15.8	15.2	14.5	13.7	12.8	12.0	11.0	10.0	6.7												
		20						15.7	14.9	14.3	13.5	12.7	11.7	10.6	9.6	8.1	6.5													
		30				16.0	15.6	14.8	14.2	13.3	12.5	11.6	10.4	9.4	7.8	5.5	3.0													
		40			16.0	15.5	14.7	14.1	13.2	12.4	11.5	10.3	9.1	7.4	5.0	3.0														
		50			15.3	14.6	13.9	13.0	12.3	11.3	10.1	8.9	7.0	4.3																
		60	15.8	15.2	14.5	13.7	12.8	12.0	11.0	10.0	8.6	6.7	4.0																	
Shut-off PSI			158	150	141	132	124	115	106	98	89	81	72	63	55	46	37	20												
10GS15	1½	0												15.7	15.3	14.8	14.4	13.3	12.2	10.9	9.3	7.1	3.0							
		20									16.0	15.6	15.2	14.7	14.3	13.7	13.2	11.9	10.6	9.0	6.5									
		30								15.9	15.5	15.2	14.6	14.2	13.5	13.1	12.6	11.3	9.7	7.6	4.0									
		40							15.8	15.5	15.1	14.6	14.2	13.5	13.0	12.5	11.8	10.3	8.8	6.0										
		50						15.7	15.4	14.9	14.5	14.0	13.4	12.8	12.3	11.7	11.0	9.4	7.4	3.4										
		60					15.7	15.3	14.8	14.4	13.9	13.3	12.8	12.2	11.6	10.9	10.1	8.1	5.6											
Shut-off PSI							197	188	180	171	162	154	144	136	128	119	110	93	76	58	41	24	6							
10GS20	2	0														16.0	15.7	14.9	14.2	13.4	12.4	11.4	10.0	8.2	5.8					
		20												15.9	15.5	15.3	14.8	14.1	13.2	12.2	11.0	9.9	8.0	5.2						
		30											15.8	15.4	15.1	14.7	14.4	13.5	12.7	11.7	10.3	8.8	6.5							
		40										15.8	15.4	15.1	14.7	14.4	14.0	12.9	12.2	10.9	9.5	7.8	3.9							
		50								16.1	15.7	15.3	15.0	14.6	14.2	14.0	13.4	12.5	11.5	10.1	8.5	6.0								
		60							16.0	15.7	15.3	14.9	14.5	14.2	13.8	13.4	12.8	11.8	10.7	9.1	7.2	3.4								
Shut-off PSI									225	216	208	199	190	182	173	164	156	139	121	104	87	69	52	35	17					
10GS30	3	0																	15.8	15.2	14.6	14.0	13.3	12.6	11.9	11.0	10.0	9.0	7.5	5.8
		20																15.7	15.1	14.5	13.9	13.2	12.5	11.8	10.9	9.9	8.8	7.2	5.4	
		30															15.9	15.4	14.8	14.2	13.4	12.8	12.0	11.3	10.3	9.3	8.1	6.2	3.8	
		40														15.9	15.6	15.0	14.4	13.8	13.1	12.4	11.5	10.8	9.7	8.6	7.1	4.7		
		50												16.0	15.8	15.6	15.3	14.7	14.1	13.3	12.7	11.9	11.0	10.2	9.1	7.8	6.0	3.0		
		60											16.0	15.8	15.5	15.2	14.8	14.3	13.7	12.9	12.3	11.4	10.6	9.6	8.3	6.8	4.5			
Shut-off PSI													284	275	267	258	249	232	215	197	180	163	145	128	111	94	76	59	42	24

Horsepower Range 5, Recommended Range 3 – 16 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																	
			340	380	420	460	500	540	580	620	660	700	740	780	820	860	900	940	980	1020	1060
10GS50R	5	0					15.6	15.1	14.6	14.2	13.7	13.3	12.8	12.3	11.7	11.0	10.2	9.2	7.9	6.3	4.3
		20			16.0	15.5	15.0	14.6	14.1	13.6	13.2	12.7	12.2	11.6	10.9	10.1	9.0	7.6	6.0	3.9	
		30			15.7	15.3	14.8	14.3	13.8	13.4	12.9	12.4	11.9	11.2	10.4	9.5	8.2	6.7	4.9		
		40		16.0	15.5	15.0	14.5	14.0	13.6	13.1	12.6	12.1	11.5	10.8	9.9	8.8	7.4	5.7	3.6		
		50		15.7	15.2	14.7	14.2	13.8	13.3	12.9	12.4	11.8	11.1	10.3	9.3	8.0	6.5	4.5			
		60	15.9	15.4	14.9	14.4	14.0	13.5	13.0	12.6	12.0	11.4	10.7	9.7	8.6	7.2	5.4	3.2			
Shut-off PSI			341	324	306	289	272	255	237	220	203	185	168	151	133	116	99	81	64	47	29

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																						
			440	480	520	560	600	640	680	720	760	800	840	880	920	960	1000	1040	1080	1120	1160	1200	1240	1280	1320
10GS50	5	0						16	15.5	15.2	14.9	14.5	14	13.5	13	12.5	12	11.5	10.8	10.2	9.5	8.5	7	5.2	
		20					15.9	15.4	15.1	14.8	14.5	13.9	13.4	12.9	12.4	11.9	11.3	10.7	10.1	9.4	8.2	6.8	4.3		
		30					15.6	15.2	14.9	14.6	14.2	13.7	13.1	12.6	12.1	11.6	11.0	10.4	9.8	8.8	7.5	6.0	3.0		
		40				15.8	15.3	15.1	14.7	14.4	13.8	13.3	12.8	12.3	11.8	11.2	10.6	10.0	9.2	7.9	6.6	4.1			
		50				15.5	15.2	14.9	14.6	14.1	13.6	13.0	12.5	12.1	11.5	10.9	10.3	9.7	8.6	7.3	5.6				
		60			15.7	15.3	15.0	14.7	14.3	13.7	13.2	12.7	12.2	11.7	11.1	10.5	9.9	9.0	7.7	6.5	3.2				
Shut-off PSI					346	329	312	294	277	260	242	225	208	191	173	156	139	121	104	87	69	52	35	17	

Model 13GS

SELECTION CHART

Horsepower Range ½ – 3, Recommended Range 4 – 20 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																													
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	380	420	460	500	540	580	620	660	700	740	780	820		
13GS05	½	0			19.0	17.5	15.3	12.5	8.2																							
		20	18.8	16.5	14.5	12.0	8.0																									
		30	16.0	13.4	11.0	4.1																										
		40	13.3	10.6	4.0																											
		50	9.8																													
		60																														
Shut-off PSI			60	52	43	35	26	17	9																							
13GS07	¾	0				19.7	18.5	17.0	15.0	13.2	11.5	8.5																				
		20		19.4	18.0	16.4	14.8	12.9	10.5	6.0																						
		30	18.9	17.5	16.0	14.6	12.5	10.0	5.0																							
		40	17.4	15.9	14.4	12.4	9.7	4.0																								
		50	15.4	13.8	12.0	9.5																										
		60	13.2	11.5	8.5																											
Shut-off PSI			86	78	69	61	52	43	35	26	17	8																				
13GS10	1	0						19.6	18.4	17.6	16.6	15.4	14.1	12.8	11.4	9.5	6.0															
		20			20.0	19.4	18.5	17.2	16.3	15.0	13.8	12.5	11.0	8.5	4.0																	
		30		20.0	19.2	18.2	17.1	15.8	14.7	13.6	12.2	10.5	7.5																			
		40	19.9	19.0	18.0	17.0	15.7	14.6	13.5	12.0	10.1	7.3																				
		50	18.8	17.8	16.8	15.5	14.5	13.0	11.6	9.9	7.0																					
		60	17.6	16.6	15.4	14.1	12.8	11.4	9.5	6.0																						
Shut-off PSI			128	119	110	102	93	84	76	67	58	50	41	32	24	15	6															
13GS15	1½	0							19.7	18.9	18.2	17.3	16.3	15.2	14.2	13.2	12.1	8.7													
		20					19.5	18.4	17.9	17.0	16.0	15.1	14.1	12.9	11.8	10.2	8.8															
		30			20.2	19.4	18.6	17.6	16.8	15.8	14.9	14.0	12.6	11.5	9.9	7.9	4.0															
		40		20.0	19.3	18.5	17.5	16.6	15.7	14.8	13.9	12.5	11.4	9.5	7.3	4.0																
		50	20.0	19.1	18.3	17.4	16.4	15.5	14.5	13.6	12.3	11.0	9.2	6.3																		
		60	18.9	18.2	17.3	16.3	15.2	14.2	13.3	12.1	11.0	8.7	5.6																			
Shut-off PSI			156	147	139	130	121	113	104	95	87	78	69	61	52	43	35	17														
13GS20	2	0										20.0	19.5	19.0	18.3	17.9	17.2	15.8	14.4	12.6	10.5	7.7									
		20								19.8	19.4	18.8	18.2	17.6	17.0	16.3	15.6	14.1	12.4	10.2	6.8										
		30							19.7	19.3	18.7	18.2	17.4	16.8	16.2	15.5	14.8	13.1	11.1	8.8											
		40						19.6	19.2	18.6	18.1	17.3	16.7	16.1	15.4	14.7	13.8	12.0	9.8	6.0											
		50				20.1	19.5	19.1	18.4	18.0	17.2	16.6	16.0	15.2	14.6	13.7	12.9	10.8	8.5												
		60			20.0	19.5	19.0	18.3	17.9	17.2	16.5	15.8	15.1	14.4	13.6	12.6	11.5	9.2	5.0												
Shut-off PSI					206	198	189	180	172	163	155	146	137	129	120	111	103	85	68	51	33	16										
13GS30	3	0													19.8	19.4	18.9	18.0	17.1	16.0	14.6	13.5	11.9	10.0	7.3						
		20											19.6	19.2	18.9	18.3	17.9	17.0	15.9	14.7	13.3	11.8	9.7	6.9							
		30									20.0	19.5	19.1	18.8	18.2	17.8	17.4	16.4	15.2	13.9	12.3	10.5	8.3	4.0							
		40								20.0	19.4	19.1	18.7	18.2	17.8	17.3	16.8	15.6	14.5	13.0	11.4	9.5	6.0								
		50							19.9	19.5	19.0	18.6	18.1	17.7	17.2	16.7	16.1	14.9	13.7	12.0	10.1	7.9									
		60						19.8	19.4	18.9	18.5	18.0	17.5	17.1	16.6	16.0	15.4	14.2	12.9	11.0	9.0	5.0									
Shut-off PSI								235	226	217	209	200	191	183	174	165	157	139	122	104	87	70	53	35	18						

Model 18GS

SELECTION CHART

Horsepower Range ¾ – 5, Recommended Range 6 – 28 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																													
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	380	420	460	500	540	580	620	660	700	740	780	820	860
18GS07	¾	0			28.2	26.5	24.0	21.0	17.9	13.5																					
		20	27.7	25.9	23.0	20.0	16.5	10.8																							
		30	25.0	22.0	18.8	15.7	9.5																								
		40	22.2	18.9	15.1	9.0																									
		50	18.4	15.0	7.5																										
		60	13.5	5.0																											
Shut-off PSI			74	66	58	49	40	32	23	14																					
18GS10	1	0					27.0	25.5	23.6	21.2	18.8	15.9	12.0																		
		20		28.0	26.6	25.1	22.7	20.0	17.6	14.0	10.0																				
		30	27.9	26.1	24.3	22.2	19.8	17.1	13.8	8.3																					
		40	26.0	24.1	22.0	19.7	17.0	13.1	8.0																						
		50	24.0	22.0	19.1	16.5	13.0	7.1																							
		60	21.0	18.6	15.8	12.0																									
Shut-off PSI			103	94	86	77	68	60	51	42	34	25	16																		
18GS15	1½	0						28.4	27.2	26.0	24.8	23.0	21.4	19.6	17.5	15.0	12.1														
		20				27.8	26.8	25.4	24.0	22.2	20.6	18.8	16.7	14.0	10.0																
		30			27.7	26.5	25.3	23.8	22.0	20.2	18.5	16.1	13.5	10.0																	
		40		27.5	26.3	25.0	23.6	22.0	20.1	18.1	16.0	13.1	9.5																		
		50	27.6	26.4	25.0	23.4	21.8	20.0	18.0	15.5	13.0	9.2																			
		60	26.0	24.6	23.0	21.2	19.5	17.5	15.0	12.0	7.9																				
Shut-off PSI			143	134	126	117	108	100	91	82	74	65	56	48	39	30	22														
18GS20	2	0								28.0	27.1	26.2	25.1	24.0	22.9	21.4	20.0	16.8	12.8												
		20						27.8	26.8	25.8	24.6	23.7	22.6	21.0	19.5	18.0	16.0	11.6														
		30					27.5	26.5	25.5	24.5	23.3	22.1	20.6	19.0	17.5	15.8	13.6	6.5													
		40			28.5	27.4	26.4	25.4	24.4	23.2	22.0	20.5	18.9	17.4	15.7	13.5	11.0														
		50		28.0	27.2	26.2	25.3	24.3	23.0	21.8	20.3	18.7	17.0	15.3	13.1	10.5	6.0														
		60	28.0	27.1	26.2	25.1	24.0	22.9	21.4	20.0	18.3	16.8	14.8	12.8	9.5																
Shut-off PSI			183	174	165	157	148	139	131	122	113	105	96	87	79	70	61	44	27												
18GS30	3	0											28.0	27.4	26.7	26.0	25.0	23.5	21.5	19.2	16.9	14.2	10.5								
		20									27.7	27.0	26.3	25.8	24.9	24.0	23.0	21.0	18.9	16.5	13.5	9.0									
		30								27.6	26.9	26.2	25.5	24.8	23.9	22.9	21.9	19.8	17.5	14.9	11.2										
		40							27.5	26.9	26.2	25.4	24.6	23.8	22.8	21.8	20.9	18.5	16.0	13.3	8.0										
		50						27.4	26.8	26.0	25.2	24.5	23.6	22.6	21.7	20.6	19.5	17.3	14.5	11.0											
		60				28.0	27.4	26.7	26.0	25.0	24.3	23.5	22.5	21.5	20.5	19.2	18.0	15.7	12.8	7.0											
Shut-off PSI						225	216	208	199	190	182	173	164	156	147	139	130	113	95	78	61	43	26								
18GS50R	5	0															27.7	26.6	25.4	24.0	22.5	20.8	19.0	16.9	14.5	11.7	8.1				
		20													27.6	27.0	26.4	25.2	23.8	22.2	20.5	18.7	16.6	14.1	11.2	7.4					
		30											28.0	27.5	26.9	26.3	25.7	24.4	22.9	21.3	19.5	17.5	15.2	12.5	9.1						
		40										27.9	27.4	26.8	26.2	25.6	25.0	23.5	22.0	20.3	18.4	16.2	13.7	10.6	6.7						
		50									27.9	27.3	26.7	26.1	25.5	24.8	24.1	22.7	21.0	19.2	17.2	14.8	12.0	8.5							
		60								27.8	27.2	26.7	26.1	25.4	24.7	24.0	23.3	21.7	20.0	18.1	15.9	13.3	10.1	6.0							
Shut-off PSI										261	252	244	235	226	218	209	200	183	166	148	131	114	96	79	62	44	27				
18GS50	5	0																	27.9	26.8	25.8	24.8	23.7	22.6	21.2	19.9	18.4	16.8	14.8	12.4	9.7
		20																27.5	26.6	25.6	24.5	23.3	22.2	21.0	19.8	18.0	16.2	14.3	12.0	8.8	
		30															28.0	26.9	26.0	25.0	23.9	22.9	21.6	20.3	18.6	17.0	15.0	13.0	10.2	6.2	
		40														28.0	27.4	26.3	25.3	24.4	23.2	22.1	20.1	19.4	17.9	16.0	14.0	11.6	8.0		
		50													27.9	27.3	26.8	25.9	24.9	23.8	22.7	21.3	20.1	18.5	16.9	14.9	12.8	10.0	6.0		
		60												27.9	27.2	26.8	26.2	25.2	24.1	23.0	21.9	20.7	19.2	17.5	15.8	13.6	11.0	7.8			
Shut-off PSI														307	298	290	281	264	246	229	212	195	177	160	143	125	108	91	73	56	39

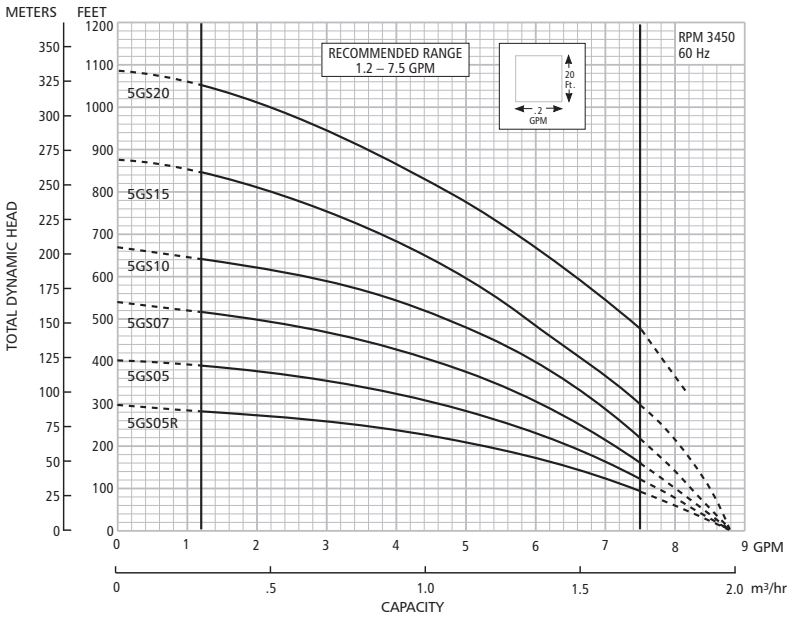
Model 25GS

SELECTION CHART

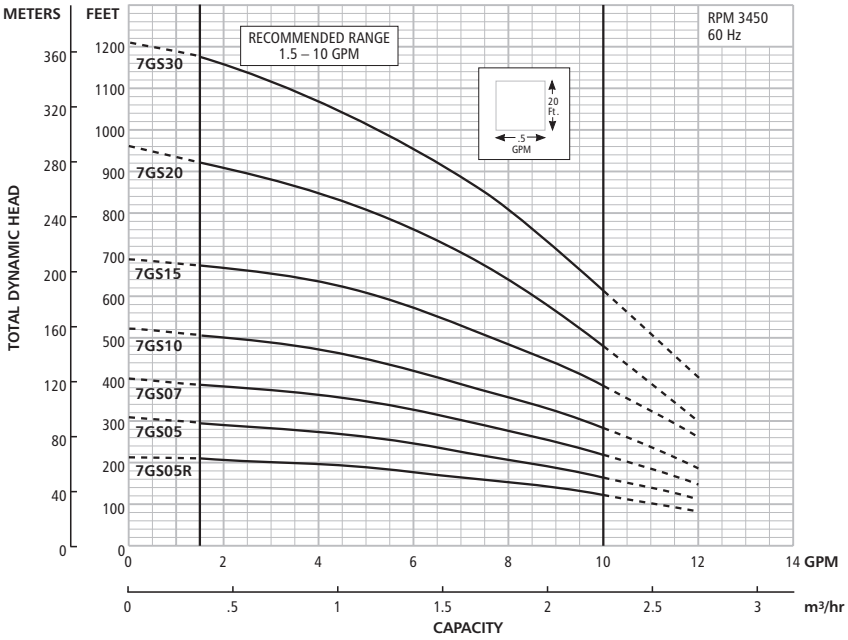
Horsepower Range 1 – 5, Recommended Range 8 – 33 GPM, 60 Hz, 3450 RPM

Pump Model	HP	PSI	Depth to Water in Feet/Ratings in GPM (Gallons per Minute)																											
			20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	340	380	420	460	500	540	580	620	660	700	740
25GS10	1	0			32.8	30.8	28.6	26.2	23.5	20.0	16.2	11.0																		
		20	31.8	30.0	27.5	25.2	22.0	19.0	15.0	8.0																				
		30	29.6	27.2	25.0	21.6	18.0	14.0																						
		40	27.1	24.9	21.5	17.9	13.9																							
		50	24.3	21.0	17.5	13.0																								
		60	20.0	16.2	11.0																									
Shut-off PSI			82	74	65	56	48	39	30	22	13	4																		
25GS15	1½	0				33.0	31.8	30.3	28.8	26.9	24.8	22.0	19.8	16.5	11.0															
		20		32.6	31.2	29.6	28.0	26.0	23.8	21.0	18.1	14.8	8.0																	
		30	32.5	31.0	29.5	27.6	25.6	23.2	20.9	17.9	14.0																			
		40	30.9	29.4	27.5	25.5	23.1	20.8	17.7	13.6																				
		50	29.0	27.2	25.1	22.9	20.4	17.2	13.0																					
		60	26.9	24.8	22.0	19.8	16.5	11.0																						
Shut-off PSI			111	103	94	85	77	68	59	51	42	33	25	16	7															
25GS20	2	0						33.0	31.8	30.4	29.0	27.4	25.7	22.6	21.5	19.3	15.4													
		20				32.7	31.3	30.0	28.6	26.8	25.0	22.9	20.9	18.3	14.3	9.0														
		30			32.3	31.0	29.6	28.5	26.4	24.5	22.6	20.5	18.0	14.0	8.0															
		40			30.9	29.5	28.2	26.3	24.3	22.4	20.4	17.8	13.6	8.0																
		50		30.5	29.4	28.0	26.0	24.1	22.1	20.0	17.2	13.2																		
		60	30.4	29.0	27.4	25.7	22.6	21.5	19.3	15.4	12.2																			
Shut-off PSI			139	130	121	113	104	95	87	78	69	61	52	43	35	26	17													
25GS30	3	0								33.0	32.2	31.5	30.5	29.6	28.3	27.1	25.8	22.6	19.0	14.0										
		20						32.8	32.0	31.0	30.0	29.0	27.9	26.6	25.0	23.8	21.9	20.0	12.6											
		30					32.6	31.8	30.9	30.0	28.8	27.6	26.5	24.9	23.4	21.6	19.9	15.2	8.0											
		40				32.5	31.7	30.9	29.9	28.8	27.5	26.2	24.7	23.3	21.5	19.9	17.8	11.9												
		50			32.3	31.6	30.8	29.8	28.5	27.3	26.0	24.5	23.0	21.2	19.5	17.4	11.5													
		60	33.0	32.2	31.5	30.5	29.6	28.3	27.1	25.8	24.1	22.6	20.9	19.0	16.9	14.0	10.0													
Shut-off PSI			191	183	174	165	157	148	139	131	122	113	105	96	87	79	70	53	35	18										
25GS50R	5	0											32.7	32.2	31.7	31.2	30.5	29.1	27.3	25.3	23.3	21.4	19.3	16.5	11.7					
		20								33.0	32.5	32.1	31.5	31.0	30.3	29.6	28.8	27.0	25.0	23.0	21.1	18.9	15.9	10.6						
		30							32.9	32.5	32.0	31.5	30.9	30.2	29.5	28.7	27.8	25.9	23.9	21.9	19.9	17.4	13.3							
		40						32.9	32.4	31.9	31.4	30.8	30.1	29.4	28.5	27.6	26.7	24.7	22.7	20.8	18.6	15.3								
		50					32.8	32.3	31.8	31.3	30.7	30.0	29.2	28.4	27.5	26.5	25.6	23.6	21.6	19.6	16.9									
		60				32.7	32.2	31.7	31.2	30.6	29.9	29.1	28.3	27.4	26.4	25.4	24.4	22.4	20.4	18.2	14.6									
Shut-off PSI						252	243	234	226	217	208	200	191	182	174	165	156	139	122	104	87	70	52	35	18					
25GS50	5	0														33.0	32.5	31.5	30.2	29.0	27.6	26.0	24.2	22.4	20.5	18.3	15.8	12.0
		20												32.9	32.3	31.8	31.3	30.0	28.8	27.2	25.8	23.9	22.0	20.0	17.8	15.0	11.0	
		30											32.8	32.2	31.8	31.2	30.5	29.3	27.9	26.4	24.8	22.9	21.0	18.9	16.2	13.0	8.0	
		40										32.7	32.1	31.7	31.1	30.4	29.9	28.5	27.1	25.4	23.7	21.9	19.9	17.5	14.5	10.5		
		50									32.6	32.1	31.6	31.0	30.3	29.9	29.2	27.8	26.3	24.5	22.6	21.8	18.7	16.0	12.7			
		60							33.0	32.5	32.0	31.5	30.8	30.2	29.8	29.0	28.3	26.9	25.1	23.3	21.5	19.5	17.0	14.0	9.5			
Shut-off PSI									286	277	268	260	251	242	234	225	216	199	182	165	147	130	113	95	78	61	43	26

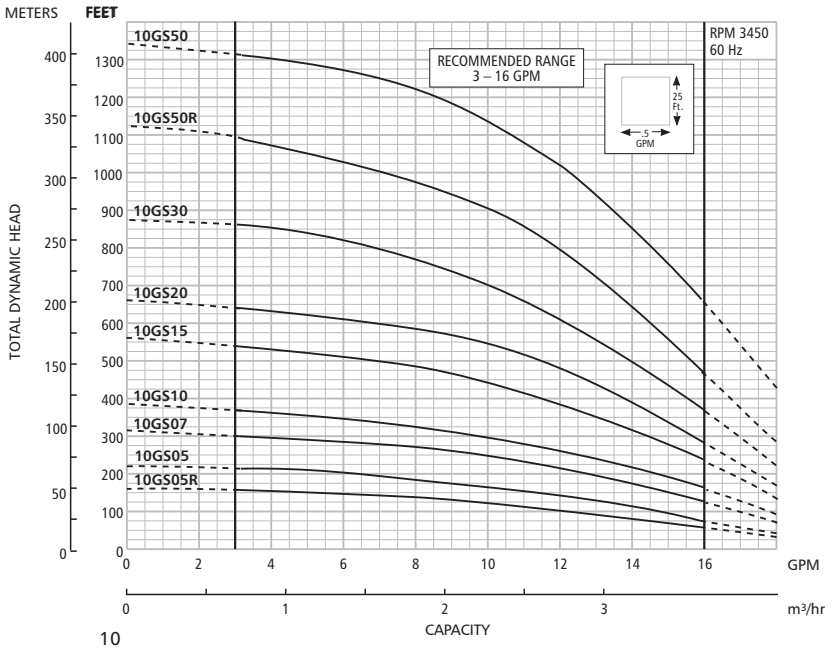
Model 5GS



Model 7GS



Model 10GS



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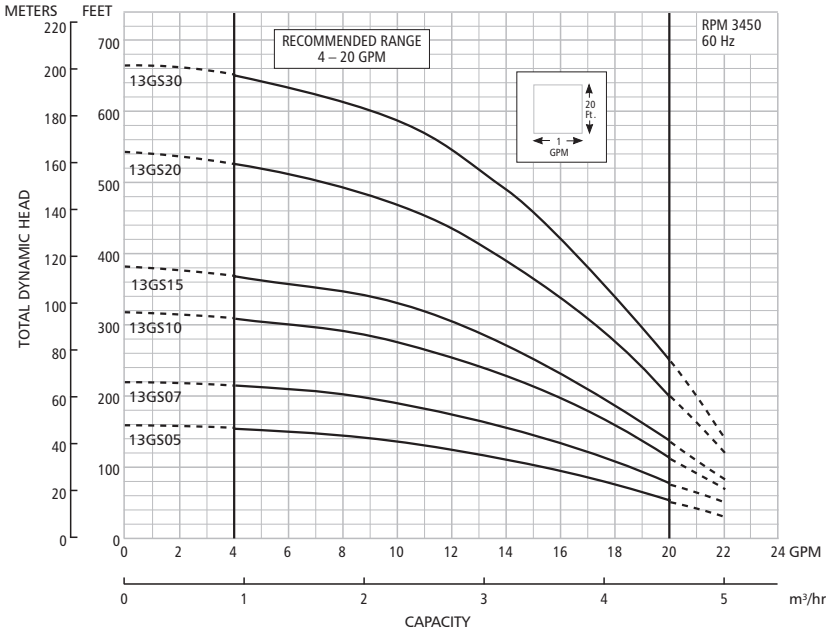
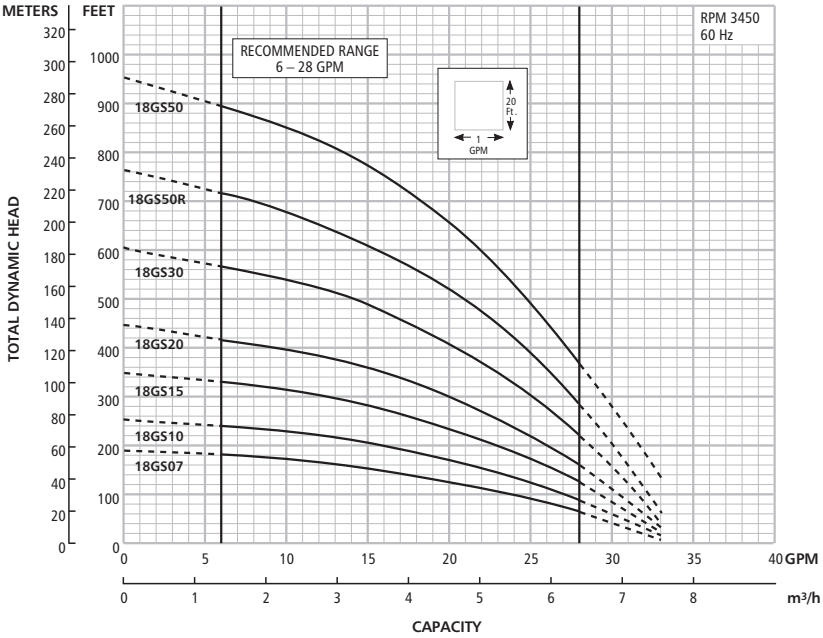
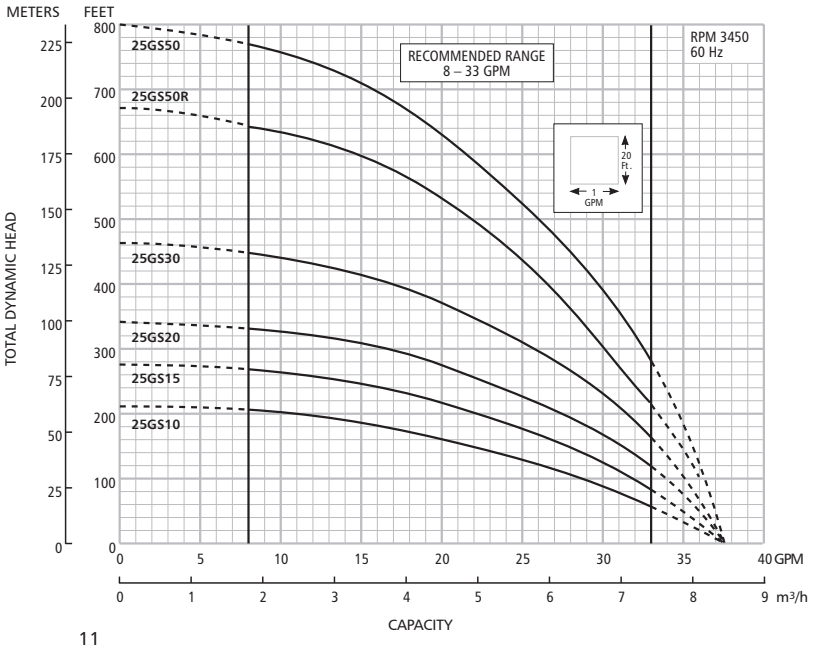


Model 18GS



Model 25GS



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Residential Water Systems

GOULDS PUMPS

B5-25GS May, 2006

Engineered for life

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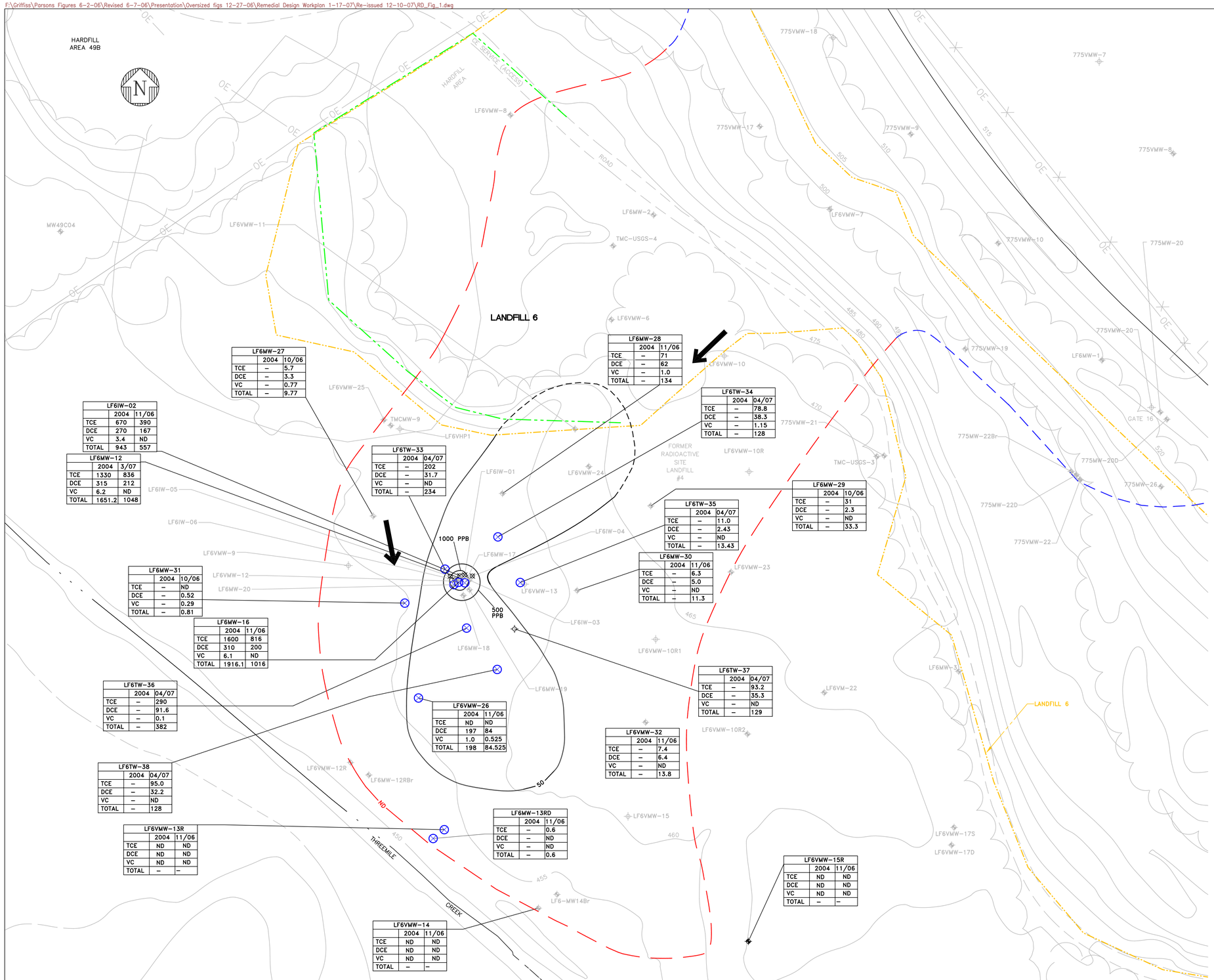

LEGEND:

- DIRECTION OF GROUNDWATER FLOW
- FENCE
- OE — OVERHEAD ELECTRIC
- 505 — TOPOGRAPHIC CONTOUR LINE (CONTOUR INTERVAL = 5 FT)
- LF6VMW-24 — EXISTING MONITORING WELL ("BR" INDICATES A BEDROCK MONITORING WELL)
- 775MW-23 — HYDROPUNCH SAMPLING LOCATION
- LF6TW-33 — TEMPORARY MONITORING WELL INSTALLED AND SAMPLED IN MARCH/APRIL 2007
- LF6IW-02 — EXISTING INJECTION WELL TO BE RE-USED
- PERFORMANCE MONITORING WELL
- HARDFILL AREA
- LANDFILL BOUNDARY
- APPROXIMATE BOUNDARY OF B775 PLUME IN 2000 (DASHED WHERE INFERRED)
- APPROXIMATE BOUNDARY OF LF6 PLUME BASED ON AVAILABLE 2006 AND 2007 DATA (DASHED WHERE INFERRED)
- MONITORING WELL TOTAL CHLORINATED VOC GROUNDWATER DATA IN ug/L FROM 2004 AND 2006
- MONITORING WELL TOTAL CHLORINATED VOC GROUNDWATER DATA IN ug/L FROM 2007

DCE — cis-1,2 DICHLOROETHENE
ND — NOT DETECTED
TCE — TRICHLOROETHENE
VC — VINYL CHLORIDE

NOTES:

1. ALL CONCENTRATIONS PRESENTED IN ug/L.
2. THE NON-DETECT CONTOUR IS APPROXIMATED BASED ON 2000 GROUNDWATER DATA. THE 50 PPB AND HIGHER TOTAL CHLORINATED VOC CONTOURS APPROXIMATED BASED ON 2006 AND 2007 GROUNDWATER DATA.

SCALE IN FEET
0 60 120 180
SCALE: 1"=60'

GRIFFISS AFB OBGW SITES
LANDFILL 6 SITE
ROME, NEW YORK

Prepared by: parsons
In Association with: FPM group; ecology and environment engineering p.c.

DRAWING TITLE:
LANDFILL 6
TOTAL VOC CONCENTRATION MAP

FIGURE 1-1

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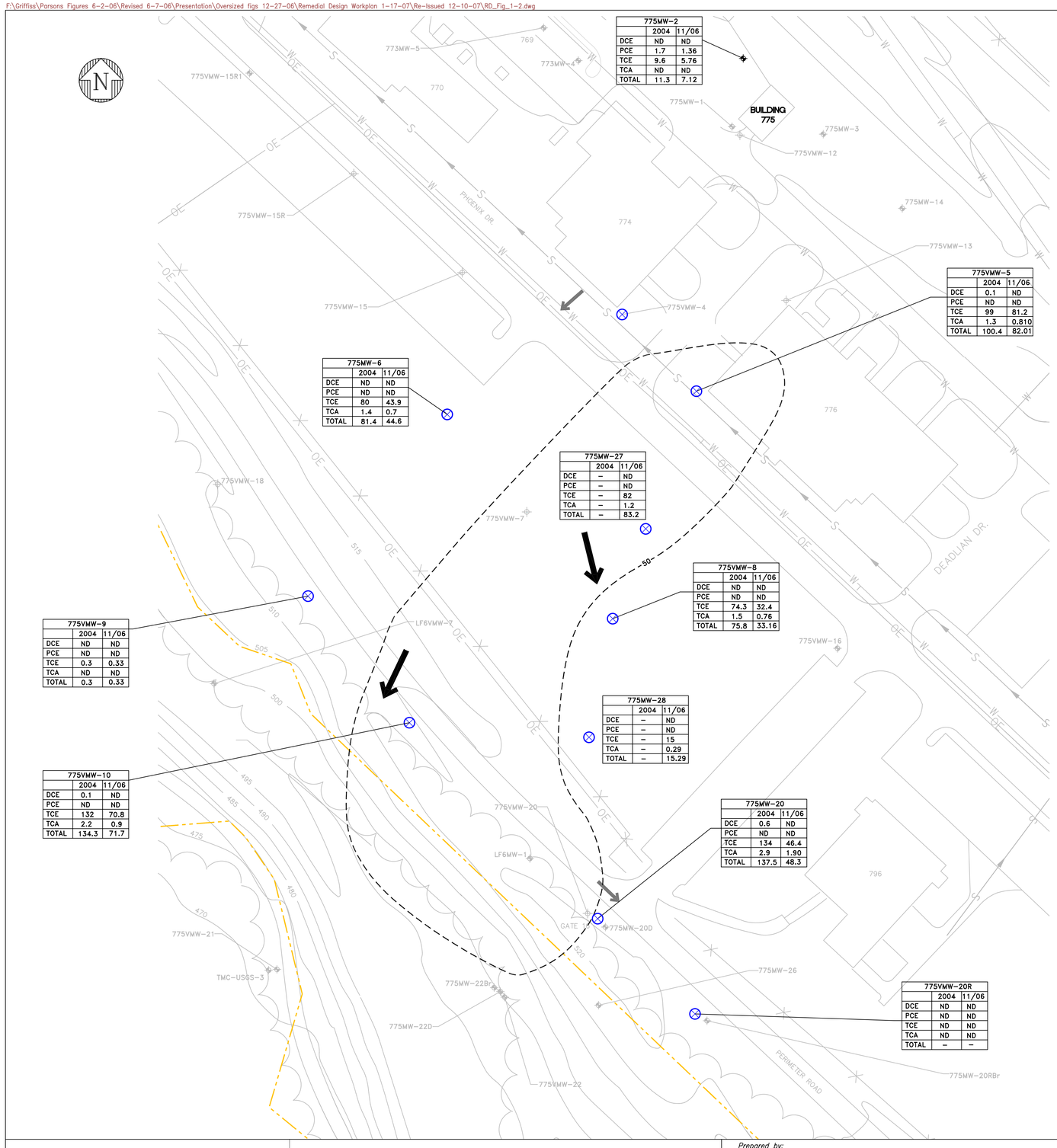

775MW-2	2004	11/06
DCE	ND	ND
PCE	1.7	1.36
TCE	9.6	5.76
TCA	ND	ND
TOTAL	11.3	7.12

775VMW-5	2004	11/06
DCE	0.1	ND
PCE	ND	ND
TCE	99	81.2
TCA	1.3	0.810
TOTAL	100.4	82.01

775MW-6	2004	11/06
DCE	ND	ND
PCE	ND	ND
TCE	80	43.9
TCA	1.4	0.7
TOTAL	81.4	44.6

775MW-27	2004	11/06
DCE	–	ND
PCE	–	ND
TCE	–	82
TCA	–	1.2
TOTAL	–	83.2

775VMW-8	2004	11/06
DCE	ND	ND
PCE	ND	ND
TCE	74.3	32.4
TCA	1.5	0.76
TOTAL	75.8	33.16

775VMW-9	2004	11/06
DCE	ND	ND
PCE	ND	ND
TCE	0.3	0.33
TCA	ND	ND
TOTAL	0.3	0.33

775MW-28	2004	11/06
DCE	–	ND
PCE	–	ND
TCE	–	15
TCA	–	0.29
TOTAL	–	15.29

775VMW-10	2004	11/06
DCE	0.1	ND
PCE	ND	ND
TCE	132	70.8
TCA	2.2	0.9
TOTAL	134.3	71.7

775MW-20	2004	11/06
DCE	0.6	ND
PCE	ND	ND
TCE	134	46.4
TCA	2.9	1.90
TOTAL	137.5	48.3

775VMW-20R	2004	11/06
DCE	ND	ND
PCE	ND	ND
TCE	ND	ND
TCA	ND	ND
TOTAL	–	–

LEGEND:

- DIRECTION OF GROUNDWATER FLOW
- OE — OVERHEAD ELECTRIC
- S — SANITARY SEWER
- 505 — TOPOGRAPHIC CONTOUR LINE (CONTOUR INTERVAL = 5 FT)
- UE — UNDERGROUND ELECTRIC
- W — WATER LINE
- LF6VMW-24 — EXISTING MONITORING WELL ("BR" INDICATES A BEDROCK MONITORING WELL)
- 775MW-23 — HYDROPUNCH SAMPLING LOCATION
- PERFORMANCE MONITORING WELL
- LANDFILL BOUNDARY
- MONITORING WELL TOTAL CHLORINATED VOC GROUNDWATER DATA IN ug/L FROM 2004 AND 2006

DCE cis-1,2 DICHLOROETHENE

ND NOT DETECTED

PCE TETRACHLOROETHENE

TCA 1,1,1 TRICHLOROETHANE

TCE TRICHLOROETHENE

NOTES:

1. ALL CONCENTRATIONS PRESENTED IN ug/L.

SCALE IN FEET

0 60 120 180

SCALE: 1"=60'

GRIFFISS AFB OBGW SITES
BUILDING 775 SITE
ROME, NEW YORK

Prepared by: parsons

In Association with: FPM group; ecology and environment engineering p.c.

DRAWING TITLE:

BUILDING 775
TOTAL VOC CONCENTRATION MAP

FIGURE 1-2

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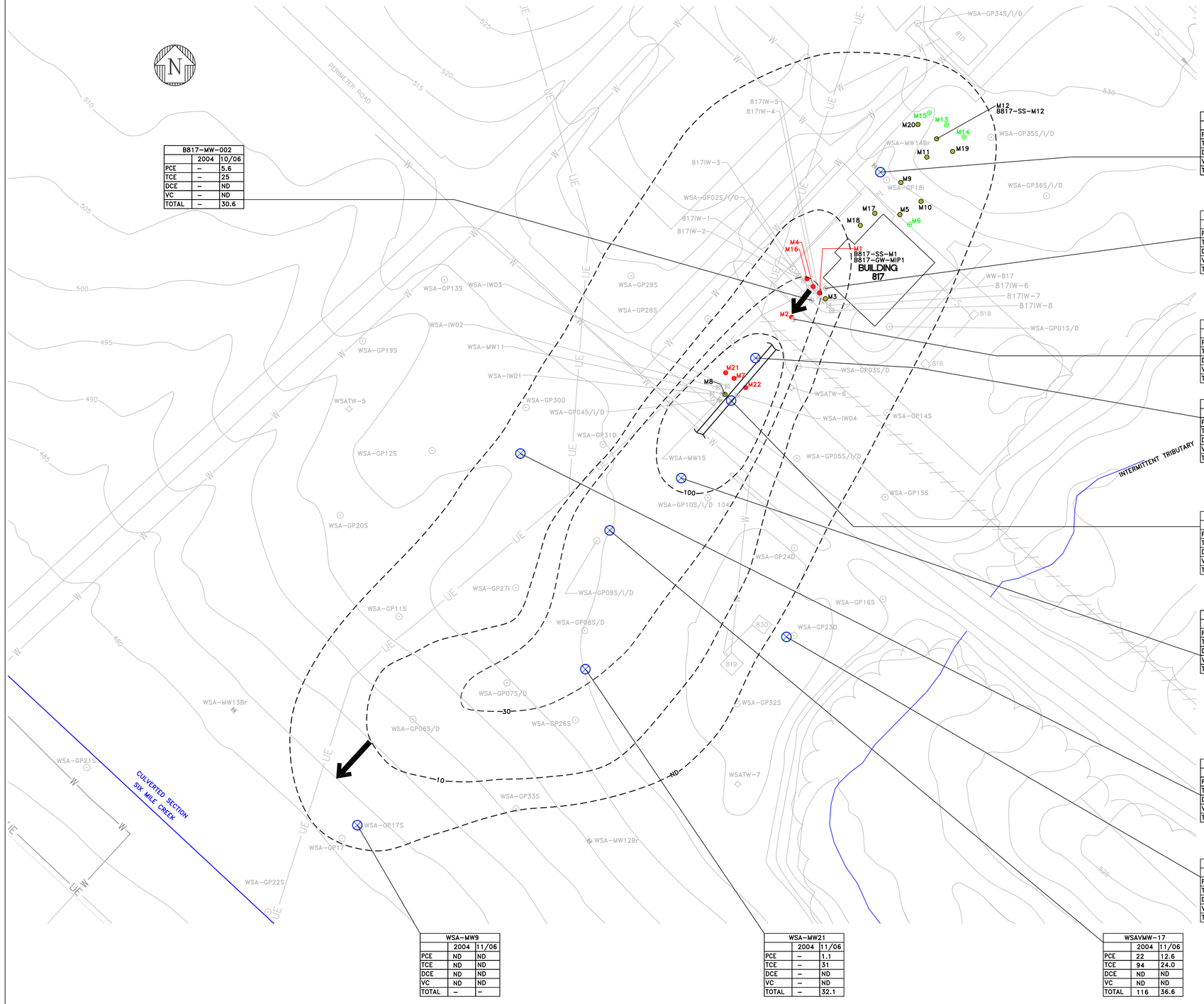

LEGEND:

	DIRECTION OF GROUNDWATER FLOW
UE	ABANDONED UNDERGROUND ELECTRIC
×	FENCE
OE	OVERHEAD ELECTRIC
S	SANITARY SEWER
480	TOPOGRAPHIC CONTOUR LINE (CONTOUR INTERVAL = 5 FT)
UE	UNDERGROUND ELECTRIC
W	WATER LINE
817IW-8	EXISTING INJECTION WELL
WSA-MW11	EXISTING MONITORING WELL ("BR" INDICATES A BEDROCK MONITORING WELL)
WSATW-5	SUPPLEMENTAL INVESTIGATION TEMPORARY WELL LOCATION
WSA-GP104S/I/D	GEOPROBE GROUNDWATER SAMPLING LOCATION IN SHALLOW, INTERMEDIATE, OR DEEP SAMPLE
M10	MIP LOCATION, ELEVATED ECD DETECTION
M11	MIP LOCATION, MODERATE ECD DETECTION
M23	MIP LOCATION, LOW ECD DETECTION
	PERFORMANCE MONITORING WELL
	MONITORING WELL TOTAL CHLORINATED VOC GROUNDWATER DATA IN ug/L FROM 2004 AND 2006
	APPROXIMATE LOCATION OF UTILITY CORRIDOR (APPROXIMATELY 7' WIDE)
ND	NOT DETECTED
TRACE	DETECTED BELOW PRACTICAL QUANTITATION LIMIT OF 1 ug/L
TCE	TRICHLOROETHENE
PCE	TETRACHLOROETHENE
DCE	CIS-1,2 DICHLOROETHENE
VC	VINYL CHLORIDE
ECD	ELECTRON CAPTURE DETECTOR
MIP	MEMBRANE INTERFACE PROBE

NOTES:

1. GROUNDWATER (GW) AND SUBSURFACE SOIL (SS) SAMPLES COLLECTED DURING MIP SURVEY IN OCTOBER 2006. SAMPLES CO-LOCATED WITH MIP POINTS SHOWN ON DRAWING.
2. ALL CONCENTRATIONS PRESENTED IN ug/L.

SCALE IN FEET
0 60 120 180
SCALE: 1"=60'

GRIFFISS AFB OBGW SITES
BUILDING 817/WSA SITE
ROME, NEW YORK

Prepared by: parsons *In Association with:* FPM group, ecology and environment engineering p.c.

DRAWING TITLE:
BUILDING 817/WSA
TOTAL VOC CONCENTRATION MAP

FIGURE 1-3

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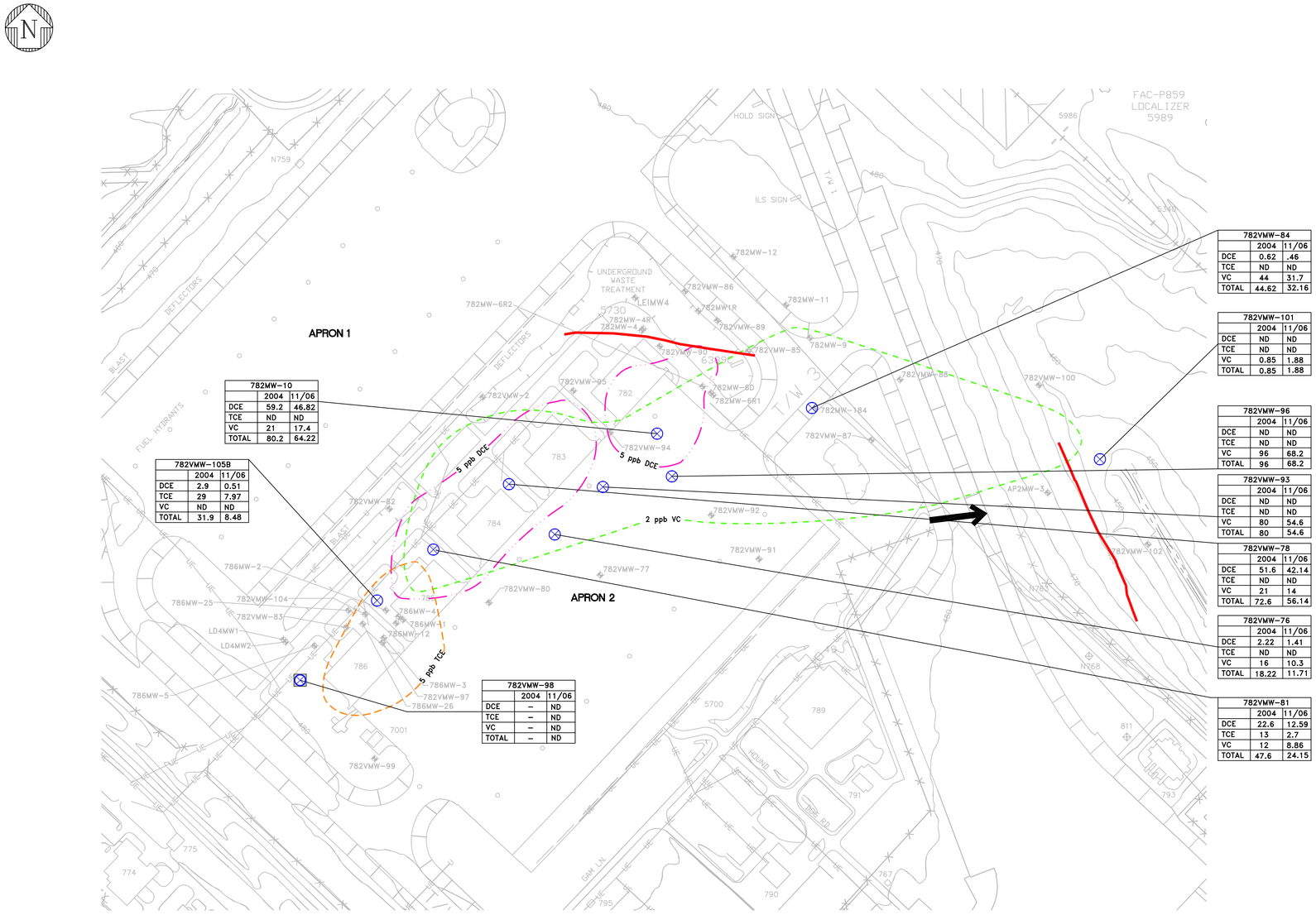

LEGEND:

- DIRECTION OF GROUNDWATER FLOW
- FENCE
- UE — OVERHEAD ELECTRIC
- 505 — TOPOGRAPHIC CONTOUR LINE (CONTOUR INTERVAL = 5 FT)
- 782VMW-87 — EXISTING MONITORING WELL
- 782VMW-98 — PERFORMANCE AND LONG-TERM MONITORING WELL
- 782VMW-93 — PERFORMANCE MONITORING WELL
- APPROXIMATE LOCATION OF EXISTING HORIZONTAL AIR SPARGE BARRIER
- 5 ppb TCE — TCE PLUME BASED ON MONITORING WELL DATA FROM 2004 AND 2006
- 5 ppb DCE — DCE PLUME BASED ON MONITORING WELL DATA FROM 2004 AND 2006
- 2 ppb VC — VC PLUME BASED ON MONITORING WELL DATA FROM 2004 AND 2006
- DCE — SUM OF cis-1,2 DICHLOROETHENE AND TRANS-1,2 DICHLOROETHENE
- ND — NOT DETECTED
- TCE — TRICHLOROETHENE
- VC — VINYL CHLORIDE

NOTES:

1. GROUNDWATER PLUME CONCENTRATION CONTOURS BASED ON 2004 GROUNDWATER DATA AND UPDATED USING 2006 GROUNDWATER DATA COLLECTED FROM PERFORMANCE AND LONG-TERM MONITORING WELLS.
2. ALL CONCENTRATIONS PRESENTED IN ug/L.

SCALE IN FEET

0 200 400 600

SCALE: 1"=200'

GRIFFISS AFB OBGW SITES
NOSEDOCKS APRON 2
ROME, NEW YORK

Prepared by: parsons

In Association with: FPM group; ecology and environment engineering p.c.

DRAWING TITLE:
NOSEDOCKS APRON 2
TOTAL VOC CONCENTRATION MAP

FIGURE 1-4