Appendix B – BIOCHLOR Modeling Results for Key CVOCs for Perched Zone, USG, and LSG

Appendix B-1

Tables and Figures

TABLE B-1
BIOCHLOR Modeling Input Parameters and Sensitivity Analysis Summary
GE Aviation_Evendale, Ohio

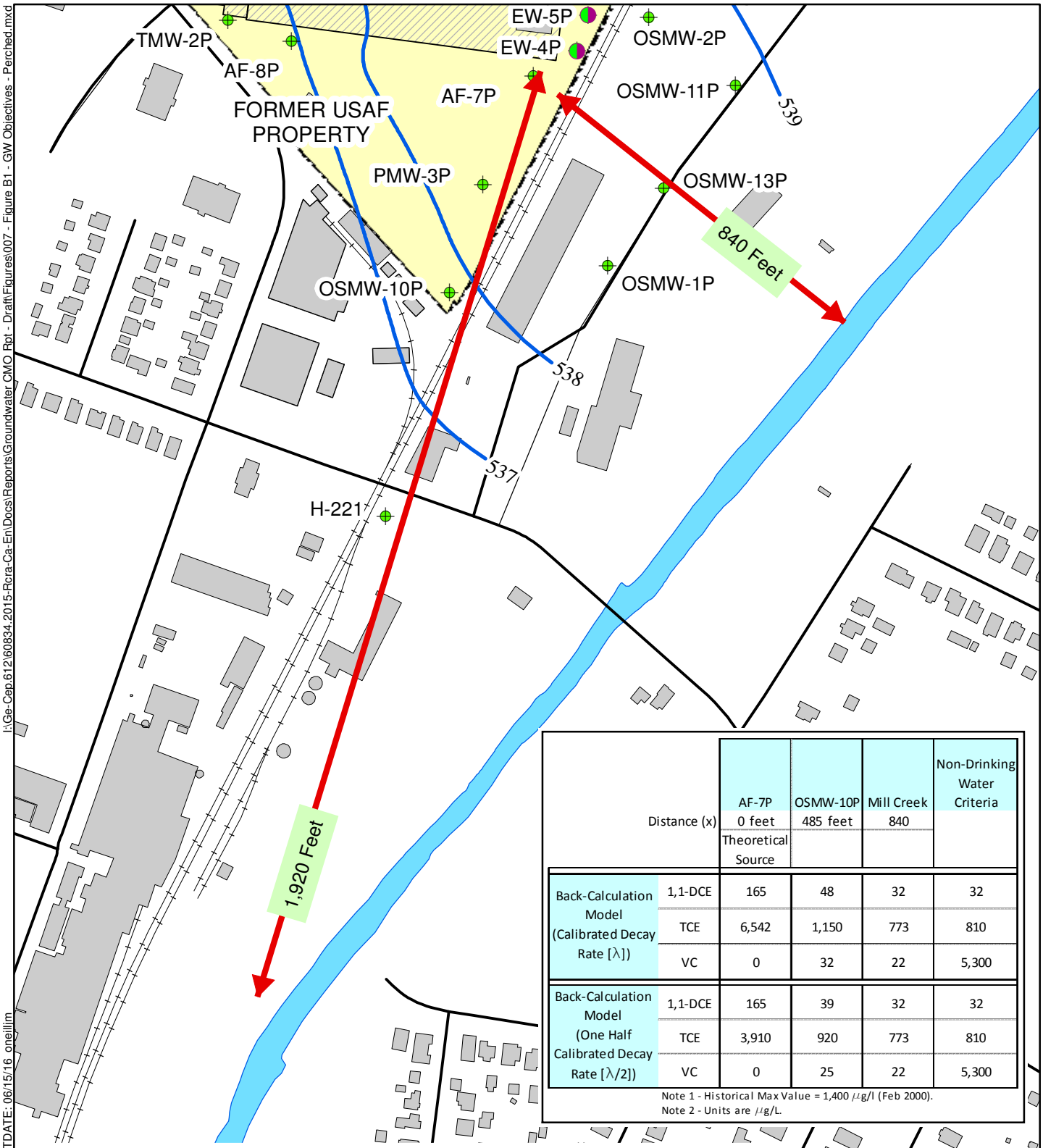
Data Type	Input Parameter	Range of Published/Site Values	Input Values Calibrated Model	Range of Sensitivity Test Values (±20%)	Maximum % Change in Model Concentration
Perched Zone					
Hydrogeology	**Hydraulic Conductivity (cm/sec)**	0.12 to 0.29	0.18	0.14 to 0.21	7
	Hydraulic Gradient (ft/ft)	5.3E-4 to 2.6E-3	2.60E-03	0.0021 to 0.0031	7
	Effective Porosity (unitless)	0.3	0.3	0.24 to 0.36	7
Dispersion	**Dispersion**				
	Alpha x (ft)	45	45	36 to 54	3
	Alpha y/Alpha x (unitless)	0.1	0.1	0.08 to 0.12	3
	Alpha z/Alpha x (unitless)	1E-10	1E-10	8.0E-11 to 1.2E-10	3
Adsorption	**Soil Bulk Density (kg/L)**	1.6 to 1.75	1.62	1.33 to 1.92	2
	Fraction Organic Carbon (unitless	0.0018 to 0.0020	0.0018	0.0015 to 0.0022	2
	Koc for constituents				2
	PCE	66 to 437	155	124 to 186	7
	TCE	18.5 to 166	166	133 to 199	
	1,1-DCE	4.1 to 64	59	47.2 to 70.8	
	VC	2.5 to 131	19	15.2 to 22.8	
	Eth	302	302	242 to 362	
Biotransformation	**Decay Coefficient (1/yr)**				
	PCE to TCE	0.0153 to 2.58	N/A	N/A	N/A
	TCE to DCE	0.0876 to 105.85	2.08	1.7 to 2.5	14
	1,1-DCE to VC	0.073 to 9.49	38.54	22.8 to 32.2	17
	VC to Eth	0.01095 to 23.0	39.48	31.5 to 47.4	3
General	**Simulation Time (yr)**	10 to 33	12	9.6 to 14.4	6
	Modeled Area Width (ft)	400 to 700	700	560 to 840	6
	Modeled Area Length (ft)	1920 to 2400	1680	1344 to 2016	8
Source Data	**Source Thickness Sat. Zone (ft)**	Average 20	20	16.0 to 24	6
	Source Width (ft)	400 to 700	700	560 to 840	6
	Source Concentrations (mg/L)				
	PCE	0	0	N/A	N/A
	TCE	1.0 to 1.48	1.14	0.91 to 1.4	19
	1,1-DCE	0 to 0.48	0.165	0.13 to 0.20	2
	VC	0 to 5500	0.0	0	N/A
	Source Area Decay Rate (1/yr)	0 to 0.2	TCE = 0.101, DCE & VC=0.11	0.09 to 0.13	6

TABLE B-1
BIOCHLOR Modeling Input Parameters and Sensitivity Analysis Summary
GE Aviation_Evendale, Ohio

Data Type	Input Parameter	Range of Published/Site Values	Input Values Calibrated Model	Range of Sensitivity Test Values (±20%)	Maximum % Change in Model Concentration
Lower Sand and Gravel					
Hydrogeology	**Hydraulic Conductivity (cm/sec)**	0.0173 to 0.28	0.18	0.14 to 0.21	7
	Hydraulic Gradient (ft/ft)	1.87E-3 to 4.19E-3	4.16E-03	0.0033 to 0.0050	7
	Effective Porosity (unitless)	0.3	0.3	0.24 to 0.36	6
Dispersion	**Dispersion:**				
	Alpha x (ft)	200	200	160 to 240	11
	Alpha y/Alpha x (unitless)	0.1	0.1	0.08 to 0.12	2
	Alpha z/Alpha x (unitless)	1.00E-99	1.00E-99	8.0E-100 to 1.2E-99	2
	Alpha z/Alpha x (unitless)	1.00E-99	1.00E-99	Value: 0.001, instead of 1E-99	6
Adsorption	**Soil Bulk Density (kg/L)**	1.6 to 1.75	1.6	1.28 to 1.92	6
	Soil Bulk Density (kg/L)	1.6 to 1.75	1.6	0.96 to 2.24	6
	Fraction Organic Carbon (unitless	0.0018 to 0.0020	0.0018	0.0014 to 0.0022	6
	Koc for constituents				
	PCE	66 to 437	155	124 to 186	6
	TCE	18.5 to 166	166	133 to 199	
	DCE	17.4 to 125	36	38.80 to 43.2	
	VC	2.5 to 131	19	15.2 to 22.8	
	Eth	302	302	242 to 362	
Biotransformation	**Decay Coefficient (1/yr)**				
	PCE to TCE	0.0153 to 2.58	N/A	N/A	N/A
	TCE to DCE	0.0876 to 105.85	25	20.0 to 30.0	6
	DCE to VC	0.073 to 9.49	16	12.8 to 19.2	11
	VC to Eth	0.01095 to 23.0	5	4.0 to 6.0	17
General	**Simulation Time (yr)**	10 to 72	60	48 to 72	78
	Modeled Area Width (ft)	400 to 1100	700	560 to 840	6
	Modeled Area Length (ft)	2076 to 5650	5650	4520 to 6780	28
Source Data	**Source Thickness in Sat. Zone (ft)**	Average 56	56	44.8 to 67.2	6
	Source Width (ft)	200 to 450	450	360 to 540	11
	Source Concentrations (mg/L)				
	PCE	0	0	N/A	N/A
	TCE	0.63 to 391.5	21	16.8 to 25.2	18
	DCE	0.48 to 158.5	8.5	6.8 to 10.2	17
	VC	0 to 1.0	0	N/A	N/A
	Source Area Decay Rate (1/yr)	0 to 0.6	0.055	0.044 to 0.066	78

Model Assumptions:	- Homogeneous, isotropic, constant decay (degradation) rate downgradient of source, and constant decay rate in source area.
	- 12 year time span for Perched Zone model based on utilization of AF-7P for source concentrations and calibration to 2001 and 2013 data.
	- 60 year time span for LSG model based on lack of information concerning time, location or magnitude of source release; established theoretical 1954 source release 220 ft upgradient of OSMW-3D based on reasonable match to 2004 and 2014 concentrations (*i.e.* , two time-point calibration) for OSMW-3D, OSMW6D, and OSMW-8D.
	- Predicted values for EW-8D performance monitoring wells based on LSG modeling in OSWM-3D area
	- Sensitivity testing using ±20% of calibrated model value

FIGURE B1



	Distance (x)	AF-7P 0 feet Theoretical Source	OSMW-10P 485 feet	Mill Creek 840	Non-Drinking Water Criteria
Back-Calculation Model (Calibrated Decay Rate [λ])	1,1-DCE	165	48	32	32
	TCE	6,542	1,150	773	810
	VC	0	32	22	5,300
Back-Calculation Model (One Half Calibrated Decay Rate [λ/2])	1,1-DCE	165	39	32	32
	TCE	3,910	920	773	810
	VC	0	25	22	5,300

Note 1 - Historical Max Value = 1,400 μg/l (Feb 2000).
Note 2 - Units are μg/L.

This document was developed in color. Reproduction in B/W may not represent the data as intended.

I:\Ge-Cep.612\60834.2015-Rcra-Ca-En\Docs\Reports\Groundwater CMO Rpt - Draft\Figures\007 - Figure B1 - GW Objectives - Perched.mxd

PLOTDATE: 06/15/16 oneillim

LEGEND

- PERCHED MONITORING WELL LOCATION
- PERCHED EXTRACTION WELL LOCATION
- GROUNDWATER CONTOUR (JULY 2015)

612/60834/005

DECEMBER 2015

GE AVIATION
EVENDALE, OHIO

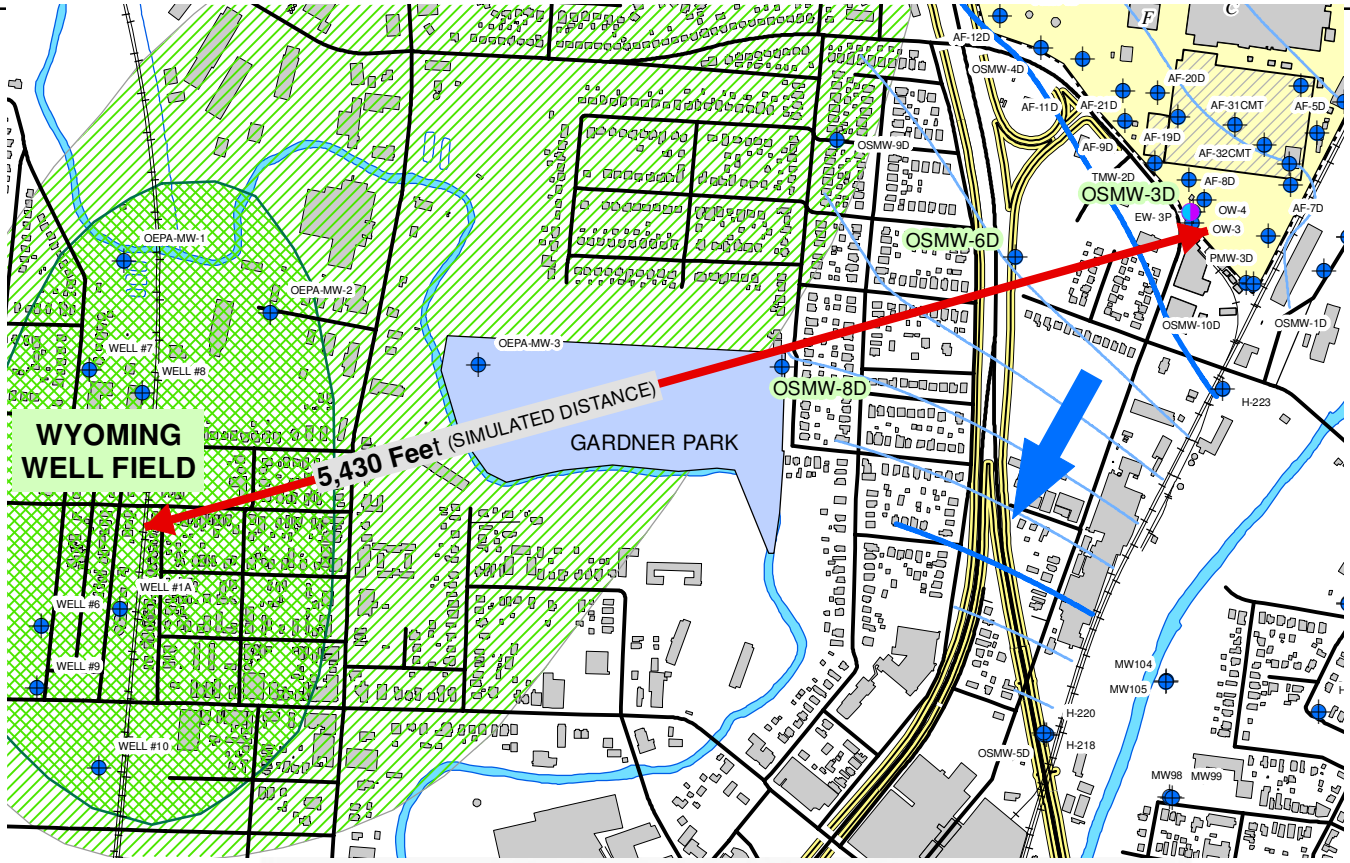
DEVELOPMENT OF GROUNDWATER CONCENTRATION OBJECTIVES MODEL RESULTS - PERCHED ZONE

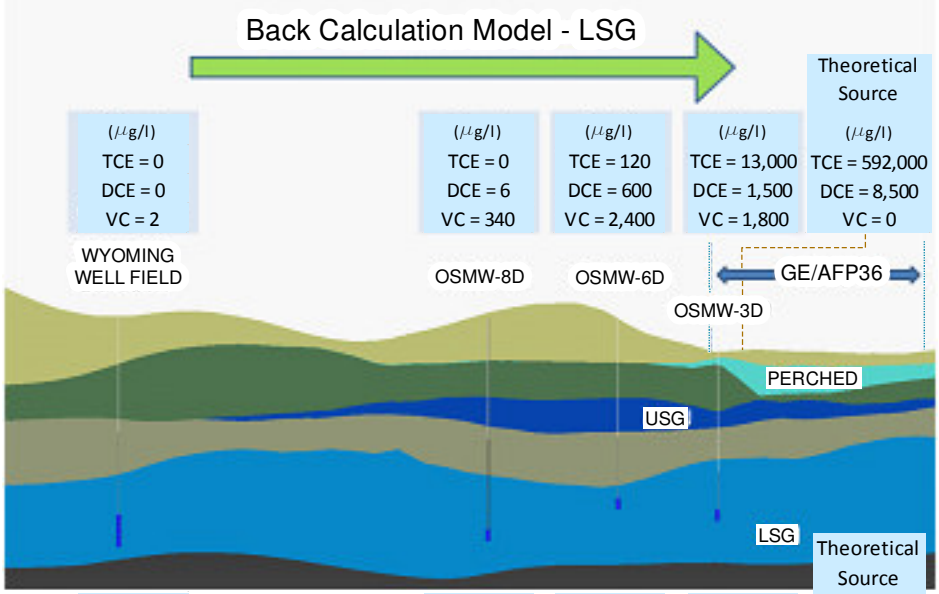
0 200 400 800
Feet

N

O'BRIEN & GERE ENGINEERS, INC.

FIGURE B2





	WYOMING WELL FIELD	OSMW-8D	OSMW-6D	OSMW-3D	Theoretical Source
Back Calculation Model (Calibrated Decay Rate λ)	(μg/l) TCE = 0 DCE = 0 VC = 2	(μg/l) TCE = 0 DCE = 6 VC = 340	(μg/l) TCE = 120 DCE = 600 VC = 2,400	(μg/l) TCE = 13,000 DCE = 1,500 VC = 1,800	(μg/l) TCE = 592,000 DCE = 8,500 VC = 0
Back Calculation Model (One Half Calibrated Decay Rate)	(μg/l) TCE = 0 DCE = 0 VC = 2	(μg/l) TCE = 0 DCE = 3 VC = 41	(μg/l) TCE = 12 DCE = 49 VC = 103	(μg/l) TCE = 260 DCE = 155 VC = 50	(μg/l) TCE = 11,000 DCE = 4,500 VC = 0

This document was developed in color. Reproduction in B/W may not represent the data as intended.

LEGEND

- LSG WELL LOCATION
- LSG EXTRACTION WELL LOCATION
- GROUND WATER CONTOUR (July 2015)
- WYOMING WELLFIELD 1 YR. TIME OF TRAVEL ZONE
- WYOMING WELLFIELD 5 YR. TIME OF TRAVEL ZONE
- INTERPRETED GROUNDWATER FLOW PATH

GE AVIATION
EVENDALE, OHIO

DEVELOPMENT OF GROUNDWATER CONCENTRATION OBJECTIVES MODEL RESULTS - LSG

N

0 600 1,200 2,400
Feet

612/60834/005
DECEMBER 2015

O'BRIEN & GERE ENGINEERS, INC.

I:\Ge-Cep.612\60834.2015-Rcra-Ca-En\Docs\Reports\Groundwater CMO Rpt - Draft\Figures\008 - Figure B2 - GW Objectives - LSG.mxd

PLOTDATE: 07/14/16 Oneilljm

Appendix B-2

Calibrated BIOCHLOR Model Input & Results – Perched Zone

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel '97

GE Evendale
AF7P, PMW3P, OSMW10P, H221
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ *or* 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ● Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	1581.8	(ft/yr)
or			
Hydraulic Conductivity	K	1.8E-01	(cm/sec)
Hydraulic Gradient	i	0.0026	(ft/ft)
Effective Porosity	n	0.3	(-)

2. DISPERSION

Alpha x*	45	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-10	(-)

Calc.

3. ADSORPTION

Retardation Factor*			R	
or				
Soil Bulk Density, rho	1.62	(kg/L)		
FractionOrganicCarbon, foc	1.8E-3	(-)		
Partition Coefficient	Koc			
PCE	155	(L/kg)	2.51	(-)
TCE	166	(L/kg)	2.61	(-)
DCE	59	(L/kg)	1.57	(-)
VC	19	(L/kg)	1.18	(-)
ETH	302	(L/kg)	3.94	(-)
Common R (used in model)* =			**2.51**	

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.679		0.79
TCE → DCE	2.078		0.74
DCE → VC	38.541		0.64
VC → ETH	39.478		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	12	(yr)
Modeled Area Width*	700	(ft)
Modeled Area Length*	1680	(ft)
Zone 1 Length*	1680	(ft)
Zone 2 Length*	0	(ft)

Zone 2=

6. SOURCE DATA

TYPE: Decaying
Single Planar

Source Options

Source Thickness in Sat. Zone* 20 (ft)

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations

	Y1	k_s* (1/yr)
Width* (ft)	700	
Conc. (mg/L)*	C1	
PCE	.0	0.11
TCE	1.14	0.101
DCE	.165	0.11
VC	0.0	0.11
ETH	0.0	0.11

View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)	.001										
TCE Conc. (mg/L)	.081	.15	.2	.11							
DCE Conc. (mg/L)	.001	.007	.006	.005							
VC Conc. (mg/L)	11-DCE		.006								
ETH Conc. (mg/L)											
Distance from Source (ft)	0	250	485	960	1920						
Date Data Collected	2013										

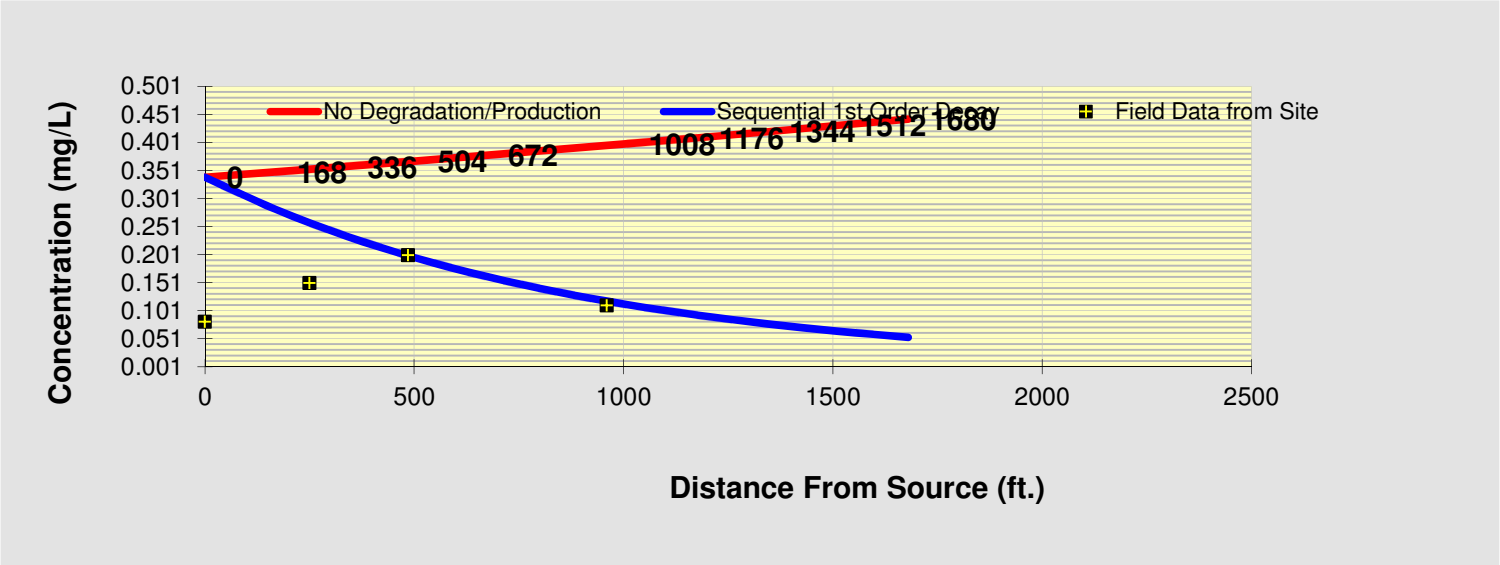
8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESET | SEE OUTPUT | Paste

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

TCE	Distance from Source (ft)										
	0	168	336	504	672	840	1008	1176	1344	1512	1680
No Degradation	0.339	0.348	0.358	0.368	0.378	0.388	0.399	0.410	0.421	0.432	0.443
Biotransformation	0.3391	0.282	0.234	0.195	0.162	0.135	0.112	0.093	0.077	0.064	0.053

	Monitoring Well Locations (ft)										
	0	250	485	960	1920						
Field Data from Site	0.081	0.150	0.200	0.110							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

12.0 Years

Log ⟺ Linear

Return to Input

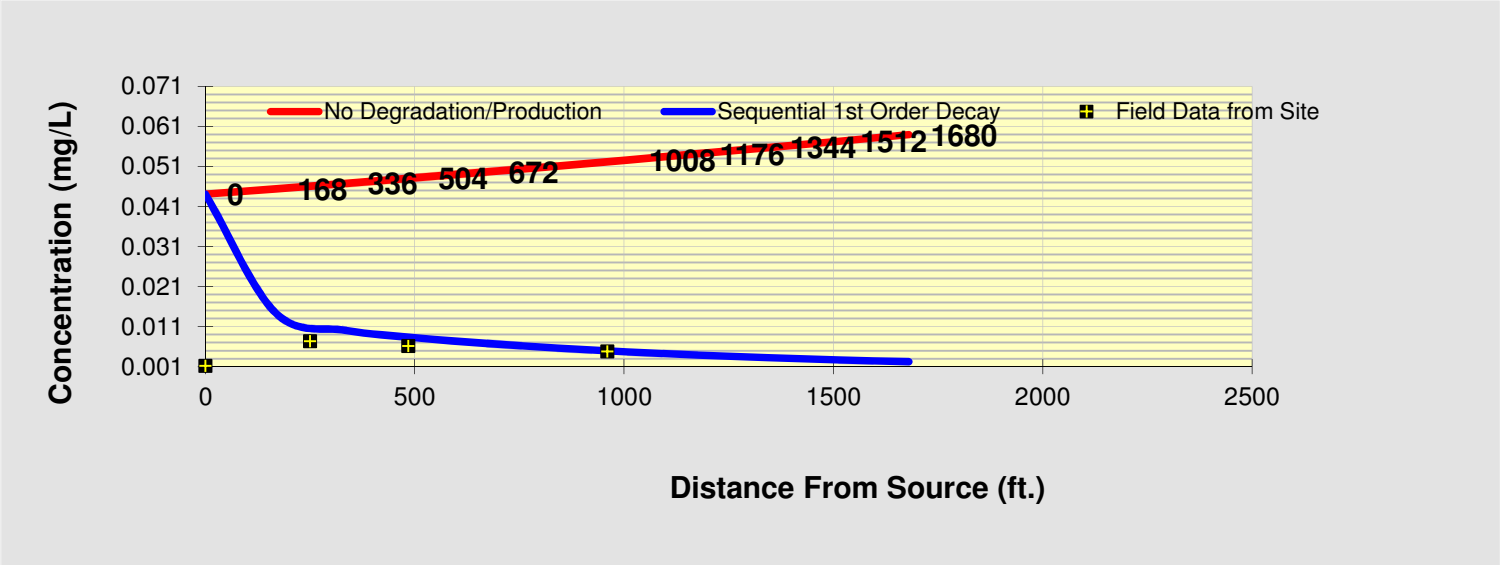
To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

DCE	Distance from Source (ft)										
	0	168	336	504	672	840	1008	1176	1344	1512	1680
No Degradation	0.044	0.045	0.047	0.048	0.050	0.051	0.053	0.054	0.056	0.057	0.059
Biotransformation	0.0441	0.014	0.010	0.008	0.007	0.006	0.005	0.004	0.003	0.003	0.002

	Monitoring Well Locations (ft)										
	0	250	485	960	1920						
Field Data from Site	0.001	0.007	0.006	0.005							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

12.0 Years

Log ⟺ Linear

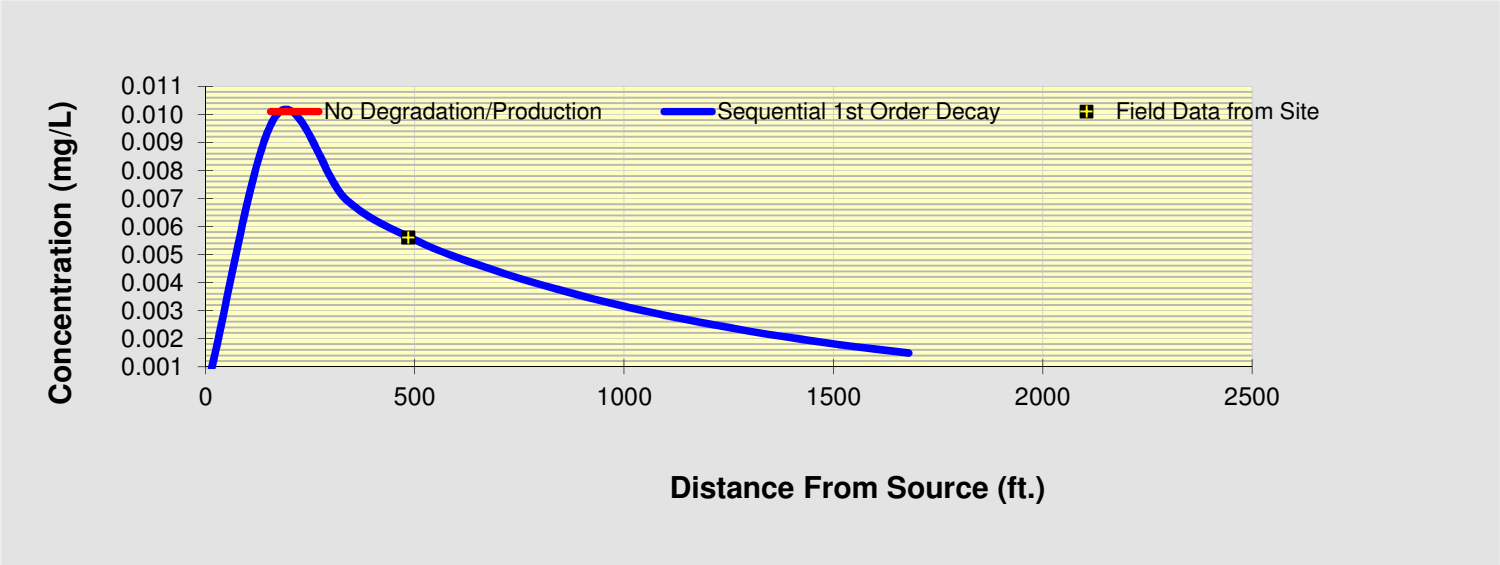
Return to Input

To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	168	336	504	672	840	1008	1176	1344	1512	1680
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.010	0.007	0.005	0.005	0.004	0.003	0.003	0.002	0.002	0.001
	Monitoring Well Locations (ft)										
	0	250	485	960	1920						
Field Data from Site			0.006								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

12.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Appendix B-3

Back-Calculated BIOCHLOR Model Input & Results – Perched Zone

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel '97

GE Evendale
AF7P, PMW3P, OSMW10P, H221
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
or
0.02 → 2. Calculate by filling in gray cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ● Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	1581.8	(ft/yr)
or			
Hydraulic Conductivity	K	1.8E-01	(cm/sec)
Hydraulic Gradient	i	0.0026	(ft/ft)
Effective Porosity	n	0.3	(-)

2. DISPERSION

Alpha x*	45	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-10	(-)

Calc.

3. ADSORPTION

Retardation Factor*			R	
or				
Soil Bulk Density, rho	1.62	(kg/L)		
FractionOrganicCarbon, foc	1.8E-3	(-)		
Partition Coefficient	Koc			
PCE	155	(L/kg)	2.51	(-)
TCE	166	(L/kg)	2.61	(-)
DCE	59	(L/kg)	1.57	(-)
VC	19	(L/kg)	1.18	(-)
ETH	302	(L/kg)	3.94	(-)
Common R (used in model)* =			**2.51**	

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.679		0.79
TCE → DCE	2.078		0.74
DCE → VC	38.541		0.64
VC → ETH	39.478		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	12	(yr)
Modeled Area Width*	700	(ft)
Modeled Area Length*	1680	(ft)
Zone 1 Length*	1680	(ft)
Zone 2 Length*	0	(ft)

Zone 2=

6. SOURCE DATA

TYPE: Decaying
Single Planar

Source Options

Source Thickness in Sat. Zone* 20 (ft)

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations

	Y1	k_s* (1/yr)
Width* (ft)	700	
Conc. (mg/L)*	C1	
PCE	.0	0.11
TCE	6.542	0.101
DCE	.165	0.11
VC	0.0	0.11
ETH	0.0	0.11

View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)	.001										
TCE Conc. (mg/L)	.081	.15	.2	.11							
DCE Conc. (mg/L)	.001	.007	.006	.005							
VC Conc. (mg/L)	11-DCE		.006								
ETH Conc. (mg/L)											
Distance from Source (ft)	0	250	485	960	1920						
Date Data Collected	2013										

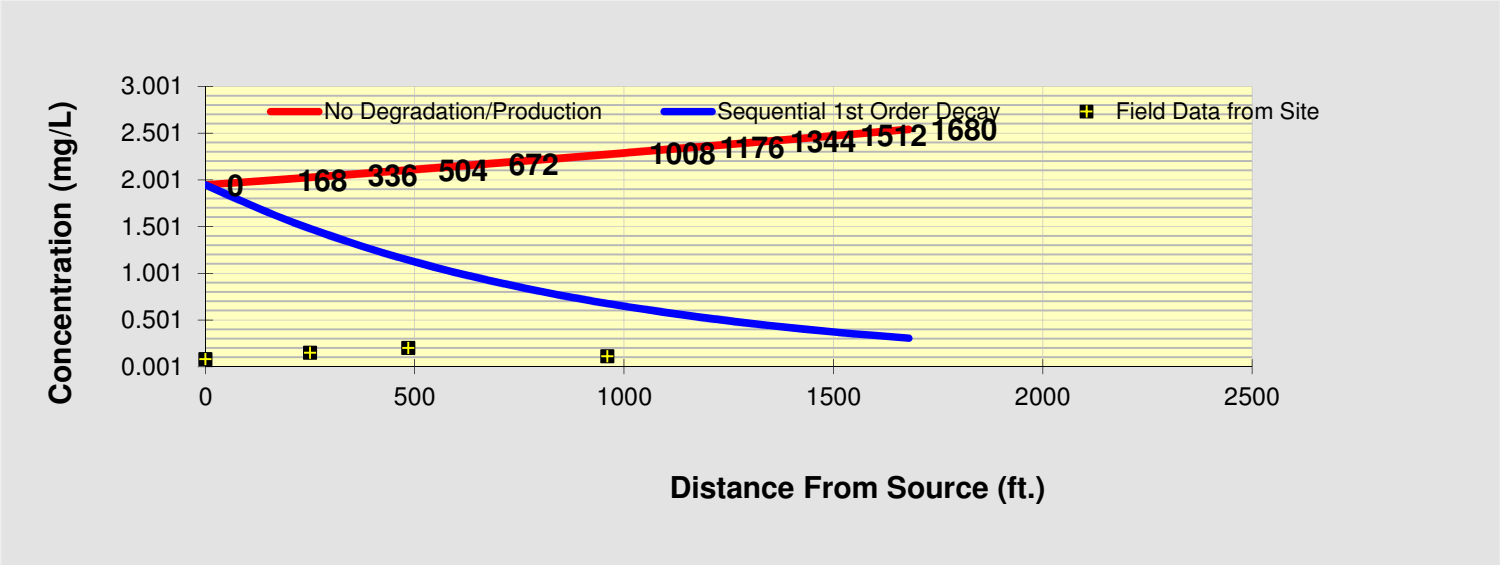
8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESET | SEE OUTPUT | Paste

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

TCE	Distance from Source (ft)										
	0	168	336	504	672	840	1008	1176	1344	1512	1680
No Degradation	1.947	2.000	2.055	2.112	2.170	2.229	2.290	2.352	2.414	2.478	2.541
Biotransformation	1.9468	1.619	1.346	1.119	0.930	0.773	0.643	0.534	0.444	0.369	0.306

	Monitoring Well Locations (ft)										
	0	250	485	960	1920						
Field Data from Site	0.081	0.150	0.200	0.110							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

12.0 Years

Log ⟺ Linear

Return to Input

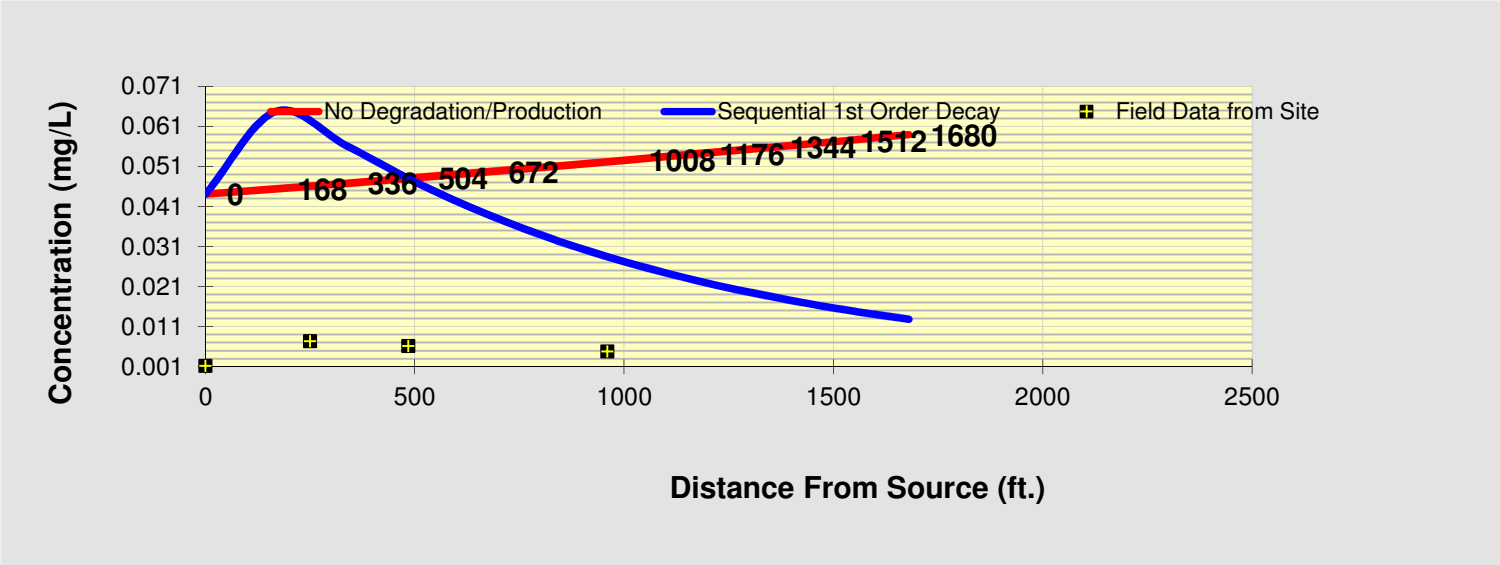
To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

DCE	Distance from Source (ft)										
	0	168	336	504	672	840	1008	1176	1344	1512	1680
No Degradation	0.044	0.045	0.047	0.048	0.050	0.051	0.053	0.054	0.056	0.057	0.059
Biotransformation	0.0441	0.065	0.056	0.047	0.039	0.032	0.027	0.022	0.019	0.015	0.013

	Monitoring Well Locations (ft)										
	0	250	485	960	1920						
Field Data from Site	0.001	0.007	0.006	0.005							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

12.0 Years

Log ⟺ Linear

Return to Input

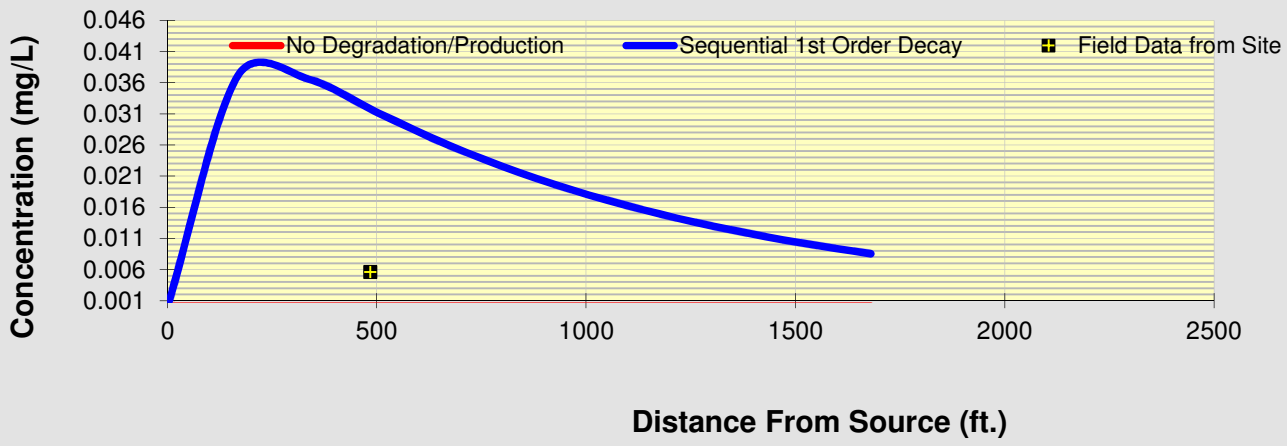
To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	168	336	504	672	840	1008	1176	1344	1512	1680
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.037	0.037	0.031	0.026	0.022	0.018	0.015	0.012	0.010	0.009

	Monitoring Well Locations (ft)										
	0	250	485	960	1920						
Field Data from Site			0.006								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

12.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Appendix B-4

Modified Back-Calculated BIOCHLOR Model (λ/2) Input & Results – Perched Zone

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel '97

GE Evendale
AF7P, PMW3P, OSMW10P, H221
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
or
0.02 → 2. Calculate by filling in gray cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation

TYPE OF CHLORINATED SOLVENT: Ethenes ● Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	1581.8	(ft/yr)
or			
Hydraulic Conductivity	K	1.8E-01	(cm/sec)
Hydraulic Gradient	i	0.0026	(ft/ft)
Effective Porosity	n	0.3	(-)

2. DISPERSION

Alpha x*	45	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-10	(-)

Calc.

3. ADSORPTION

Retardation Factor*			R	
or				
Soil Bulk Density, rho	1.62	(kg/L)		
FractionOrganicCarbon, foc	1.8E-3	(-)		
Partition Coefficient	Koc			
PCE	155	(L/kg)	2.51	(-)
TCE	166	(L/kg)	2.61	(-)
DCE	59	(L/kg)	1.57	(-)
VC	19	(L/kg)	1.18	(-)
ETH	302	(L/kg)	3.94	(-)
Common R (used in model)* =			**2.51**	

4. BIOTRANSFORMATION

-1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.679		0.79
TCE → DCE	1.039		0.74
DCE → VC	19.270		0.64
VC → ETH	19.739		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	12	(yr)
Modeled Area Width*	700	(ft)
Modeled Area Length*	1680	(ft)
Zone 1 Length*	1680	(ft)
Zone 2 Length*	0	(ft)

Zone 2=

6. SOURCE DATA

TYPE: Decaying
Single Planar

Source Options

Source Thickness in Sat. Zone* 20 (ft)

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations

	Y1	k_s* (1/yr)
Width* (ft)	700	
Conc. (mg/L)*	C1	
PCE	.0	0.11
TCE	3.91	0.101
DCE	.165	0.11
VC	0.0	0.11
ETH	0.0	0.11

View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)	.001										
TCE Conc. (mg/L)	.081	.15	.2	.11							
DCE Conc. (mg/L)	.001	.007	.006	.005							
VC Conc. (mg/L)	11-DCE		.006								
ETH Conc. (mg/L)											
Distance from Source (ft)	0	250	485	960	1920						
Date Data Collected	2013										

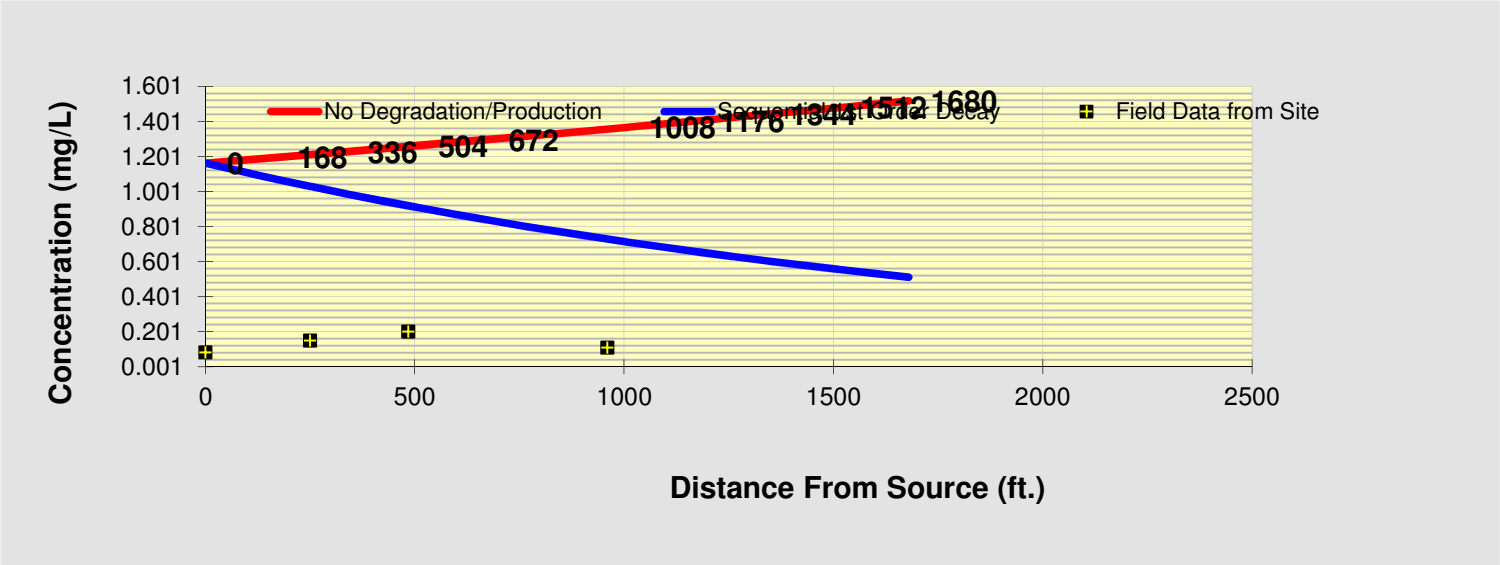
8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESET | SEE OUTPUT | Paste

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

TCE	Distance from Source (ft)										
	0	168	336	504	672	840	1008	1176	1344	1512	1680
No Degradation	1.164	1.195	1.228	1.262	1.297	1.332	1.368	1.405	1.443	1.481	1.519
Biotransformation	1.1635	1.072	0.988	0.911	0.839	0.773	0.713	0.657	0.605	0.556	0.512

	Monitoring Well Locations (ft)										
	0	250	485	960	1920						
Field Data from Site	0.081	0.150	0.200	0.110							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

12.0 Years

Log ⟺ Linear

Return to Input

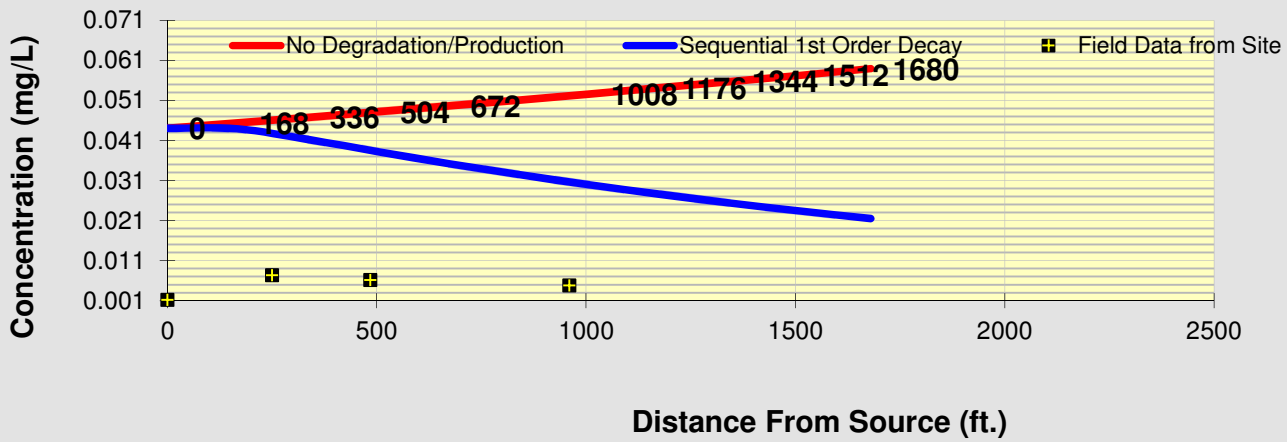
To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

DCE	Distance from Source (ft)										
	0	168	336	504	672	840	1008	1176	1344	1512	1680
No Degradation	0.044	0.045	0.047	0.048	0.050	0.051	0.053	0.054	0.056	0.057	0.059
Biotransformation	0.0441	0.044	0.041	0.038	0.035	0.032	0.030	0.028	0.025	0.023	0.022

	Monitoring Well Locations (ft)										
	0	250	485	960	1920						
Field Data from Site	0.001	0.007	0.006	0.005							



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

12.0 Years

Log ⟺ Linear

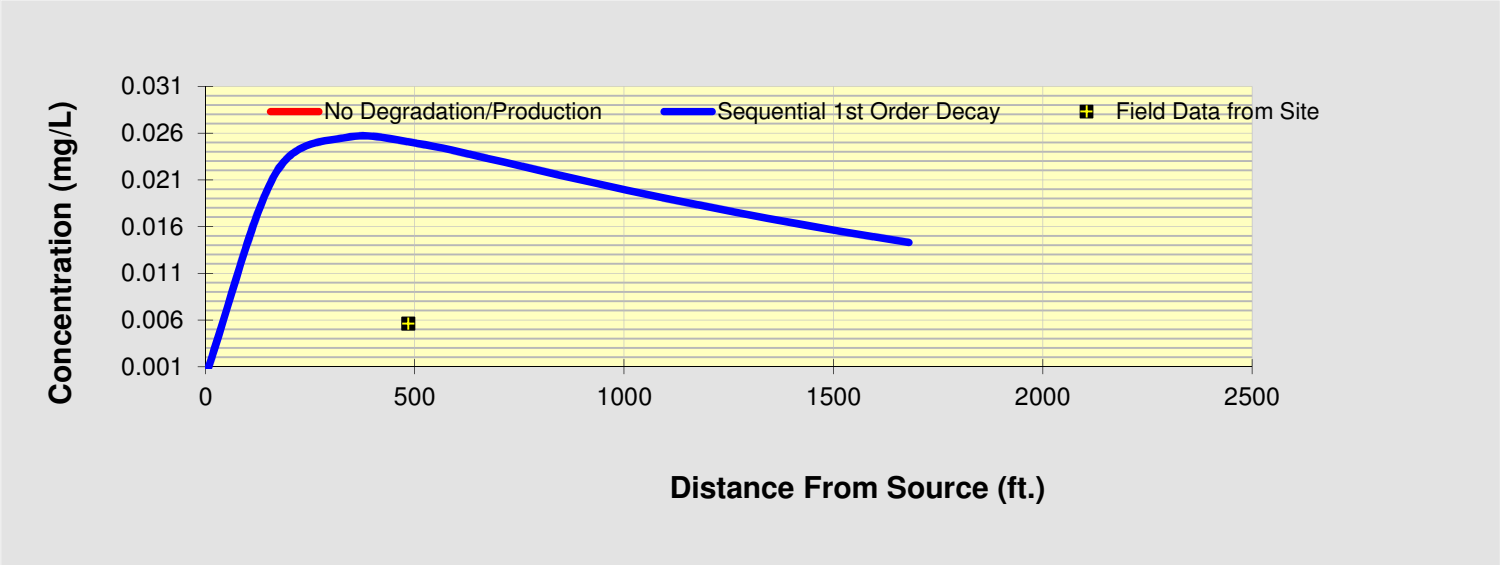
Return to Input

To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	168	336	504	672	840	1008	1176	1344	1512	1680
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.022	0.026	0.025	0.023	0.022	0.020	0.018	0.017	0.016	0.014
	Monitoring Well Locations (ft)										
	0	250	485	960	1920						
Field Data from Site			0.006								



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

12.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Appendix B-5

Calibrated BIOCHLOR Model Input & Results – LSG

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel '97

GE Evendale
OSMW3D-6D-8D
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ *or* 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation Screening Protocol

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	2525.1	(ft/yr)
or			
Hydraulic Conductivity	K	1.8E-01	(cm/sec)
Hydraulic Gradient	i	0.00416	(ft/ft)
Effective Porosity	n	0.3	(-)

2. DISPERSION

Alpha x*	200	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc. Alpha x

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.6	(kg/L)		
FractionOrganicCarbon, foc	1.8E-3	(-)		
Partition Coefficient	Koc			
PCE	155	(L/kg)	2.49	(-)
TCE	166	(L/kg)	2.59	(-)
DCE	36	(L/kg)	1.34	(-)
VC	19	(L/kg)	1.18	(-)
ETH	302	(L/kg)	3.90	(-)
Common R (used in model)* =			**2.49**	

4. BIOTRANSFORMATION **-1st Order Decay Coefficient***

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.000		0.79
TCE → DCE	25.000		0.74
DCE → VC	16.000		0.64
VC → ETH	5.000		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	60	(yr)
Modeled Area Width*	700	(ft)
Modeled Area Length*	5650	(ft)
Zone 1 Length*	5650	(ft)
Zone 2 Length*	0	(ft)

Zone 2= L - Zone 1

6. SOURCE DATA TYPE: Decaying Single Planar

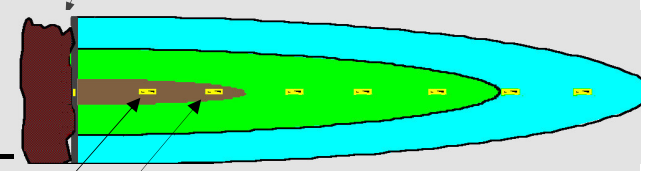
Source Options

Source Thickness in Sat. Zone* 56 (ft)

Width* (ft) Y1 450

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.0	0.055
TCE	21.0	0.055
DCE	8.5	0.055
VC	.0	0.055
ETH	0	0.055

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

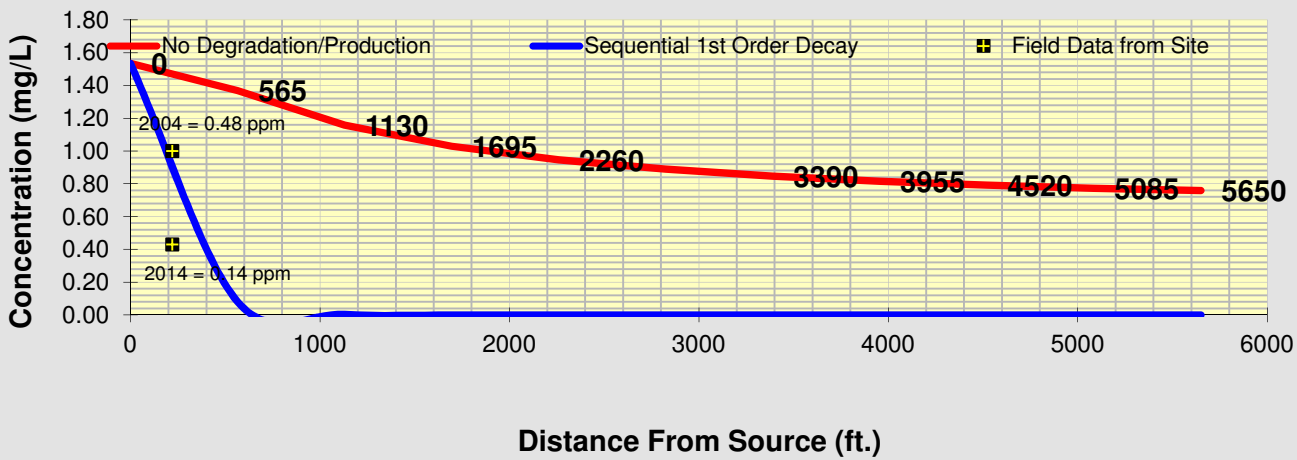
PCE Conc. (mg/L)	.0										
TCE Conc. (mg/L)	1.0	.0	.0	.0	.43	.0	.0	.0			
DCE Conc. (mg/L)	.48	.077	.002	.0	.14	.017	.001	.0			
VC Conc. (mg/L)	0.0	.021	.009	.002	.01	.15	.046	.002			
ETH Conc. (mg/L)	0.0										
Distance from Source (ft)	220	1077	2296	5650	220	1077	2296	5650			
Date Data Collected	2004										

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | *Help* | Restore | RESET | *SEE OUTPUT* | Paste

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

TCE	Distance from Source (ft)										
	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	1.535	1.370	1.159	1.031	0.947	0.889	0.847	0.815	0.791	0.773	0.759
Biotransformation	1.5350	0.081	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Monitoring Well Locations (ft)										
	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	1.000	0.000	0.000	0.000	0.430	0.000	0.000	0.000			



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:

48.0 Years

Log ⟺ Linear

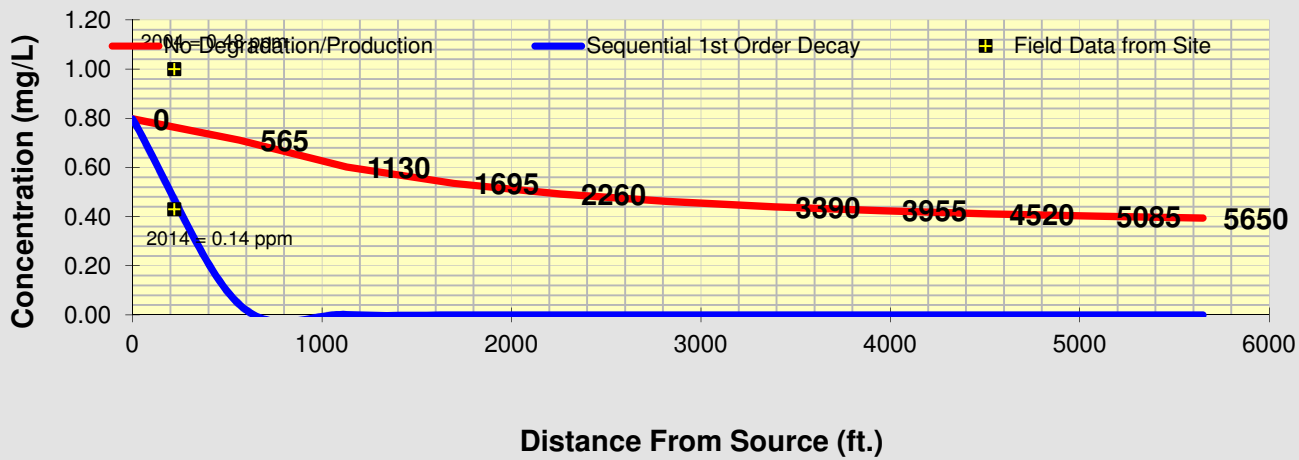
Return to Input

To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

TCE	Distance from Source (ft)										
	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	0.798	0.712	0.603	0.536	0.492	0.462	0.440	0.424	0.411	0.402	0.395
Biotransformation	0.7981	0.042	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Monitoring Well Locations (ft)										
	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	1.000	0.000	0.000	0.000	0.430	0.000	0.000	0.000			



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

60.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

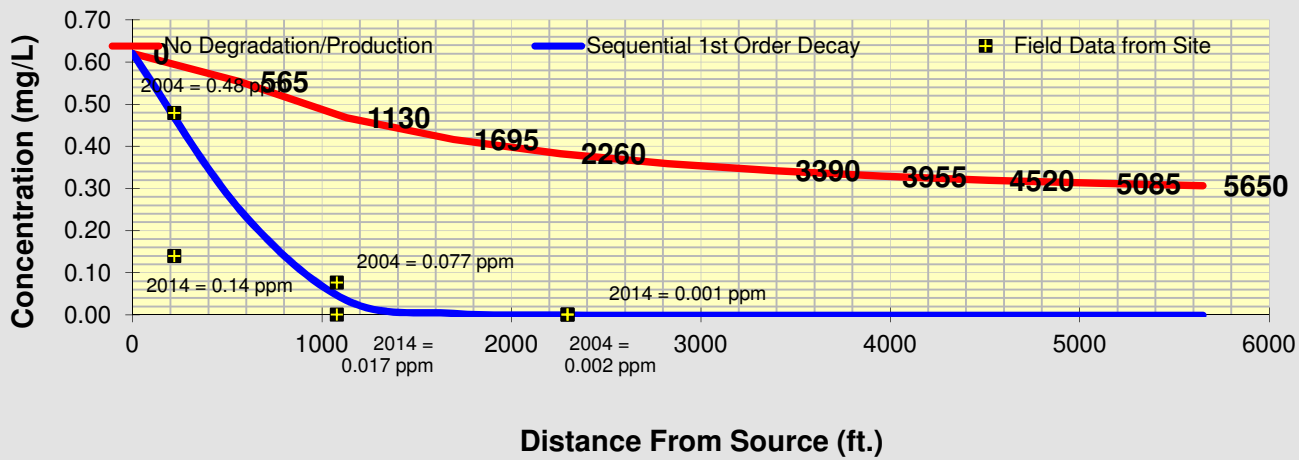
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	0.621	0.555	0.469	0.417	0.383	0.360	0.343	0.330	0.320	0.313	0.307
Biotransformation	0.6213	0.251	0.036	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	0.480	0.077	0.002	0.000	0.140	0.017	0.001	0.000			



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:

48.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

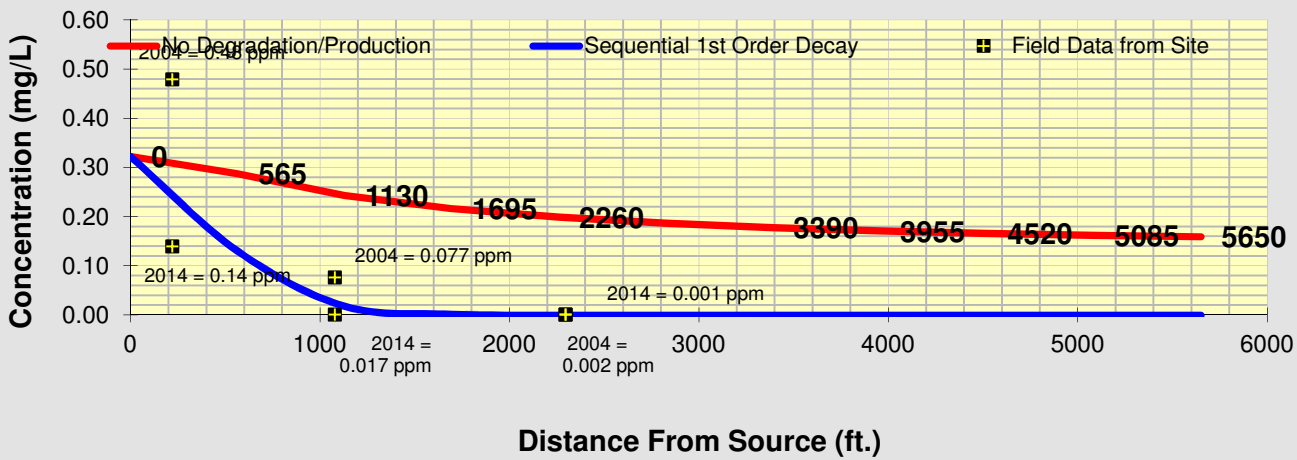
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	0.323	0.288	0.244	0.217	0.199	0.187	0.178	0.172	0.167	0.163	0.160
Biotransformation	0.3231	0.131	0.018	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	0.480	0.077	0.002	0.000	0.140	0.017	0.001	0.000			



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:

60.0 Years

Log ⟺ Linear

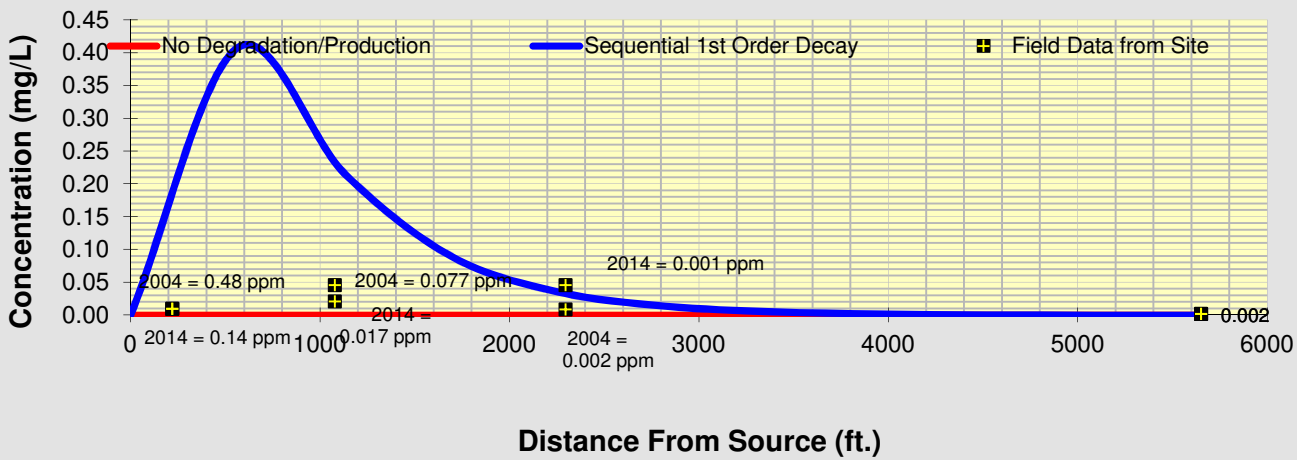
Return to Input

To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.408	0.216	0.090	0.036	0.014	0.006	0.002	0.001	0.000	0.000
	Monitoring Well Locations (ft)										
	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	0.010	0.021	0.009	0.002	0.010	0.150	0.046	0.002			



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:

48.0 Years

Log ⟺ Linear

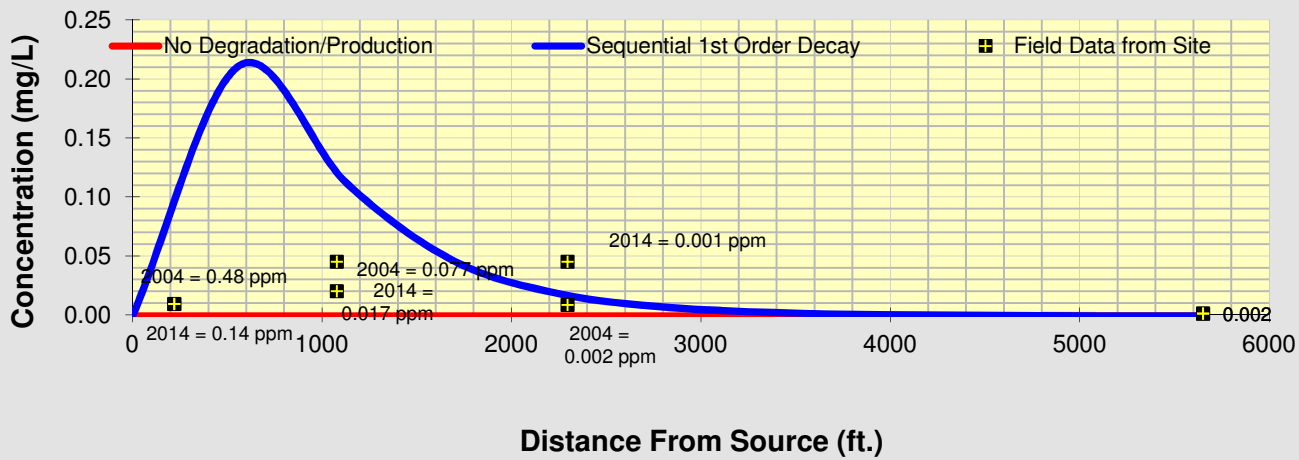
Return to Input

To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.212	0.113	0.047	0.019	0.007	0.003	0.001	0.000	0.000	0.000
	Monitoring Well Locations (ft)										
	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	0.010	0.021	0.009	0.002	0.010	0.150	0.046	0.002			



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:

60.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Appendix B-6

Back-Calculated BIOCHLOR Model Input & Results – LSG

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel '97

GE Evendale
OSMW3D-6D-8D
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ *or* 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation Screening Protocol

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	2525.1	(ft/yr)
or			
Hydraulic Conductivity	K	1.8E-01	(cm/sec)
Hydraulic Gradient	i	0.00416	(ft/ft)
Effective Porosity	n	0.3	(-)

2. DISPERSION

Alpha x*	200	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc. Alpha x

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.6	(kg/L)		
FractionOrganicCarbon, foc	1.8E-3	(-)		
Partition Coefficient	Koc			
PCE	155	(L/kg)	2.49	(-)
TCE	166	(L/kg)	2.59	(-)
DCE	36	(L/kg)	1.34	(-)
VC	19	(L/kg)	1.18	(-)
ETH	302	(L/kg)	3.90	(-)
Common R (used in model)* =			**2.49**	

4. BIOTRANSFORMATION -1st Order Decay Coefficient*

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.000		0.79
TCE → DCE	25.000		0.74
DCE → VC	16.000		0.64
VC → ETH	5.000		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	60	(yr)
Modeled Area Width*	700	(ft)
Modeled Area Length*	5650	(ft)
Zone 1 Length*	5650	(ft)
Zone 2 Length*	0	(ft)

L, W

Zone 2= L - Zone 1

6. SOURCE DATA TYPE: Decaying Single Planar

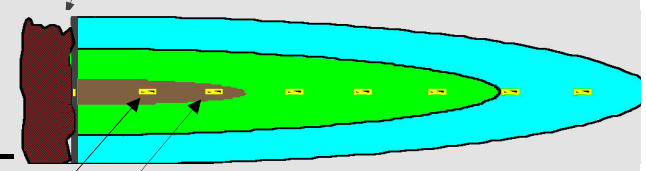
Source Options

Source Thickness in Sat. Zone* 56 (ft)

Width* (ft) Y1 450

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.0	0.055
TCE	591.5	0.055
DCE	8.5	0.055
VC	.0	0.055
ETH	0	0.055

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

PCE Conc. (mg/L)	.0										
TCE Conc. (mg/L)	1.0	.0	.0	.0	.43	.0	.0	.0			
DCE Conc. (mg/L)	.48	.077	.002	.0	.14	.017	.001	.0			
VC Conc. (mg/L)	0.0	.021	.009	.002	.01	.15	.046	.002			
ETH Conc. (mg/L)	0.0										
Distance from Source (ft)	220	1077	2296	5650	220	1077	2296	5650			
Date Data Collected	2004										

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | Help | Restore | RESET | SEE OUTPUT | Paste

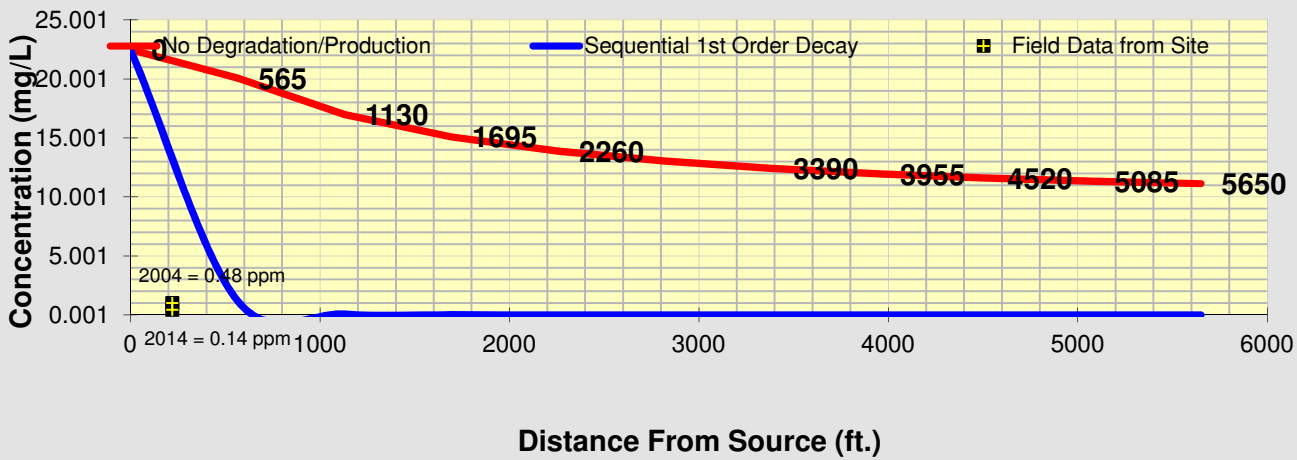
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

TCE	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	22.481	20.064	16.973	15.096	13.870	13.018	12.399	11.937	11.588	11.322	11.120
Biotransformation	22.4808	1.188	0.059	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	1.000	0.000	0.000	0.000	0.430	0.000	0.000	0.000			



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:

60.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

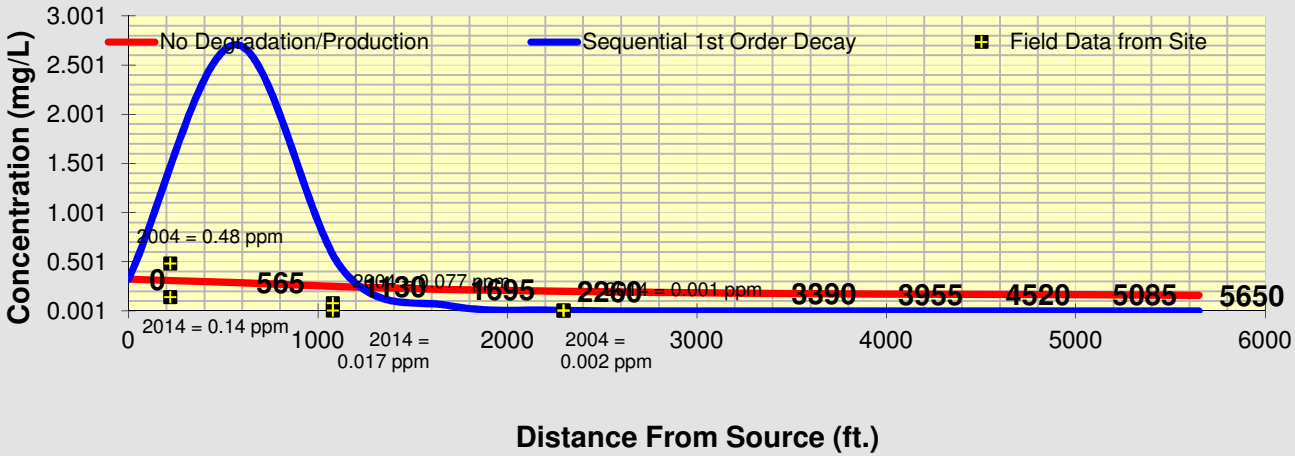
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	0.323	0.288	0.244	0.217	0.199	0.187	0.178	0.172	0.167	0.163	0.160
Biotransformation	0.3231	2.708	0.418	0.053	0.006	0.001	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	0.480	0.077	0.002	0.000	0.140	0.017	0.001	0.000			



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:

60.0 Years

Log ⟺ Linear

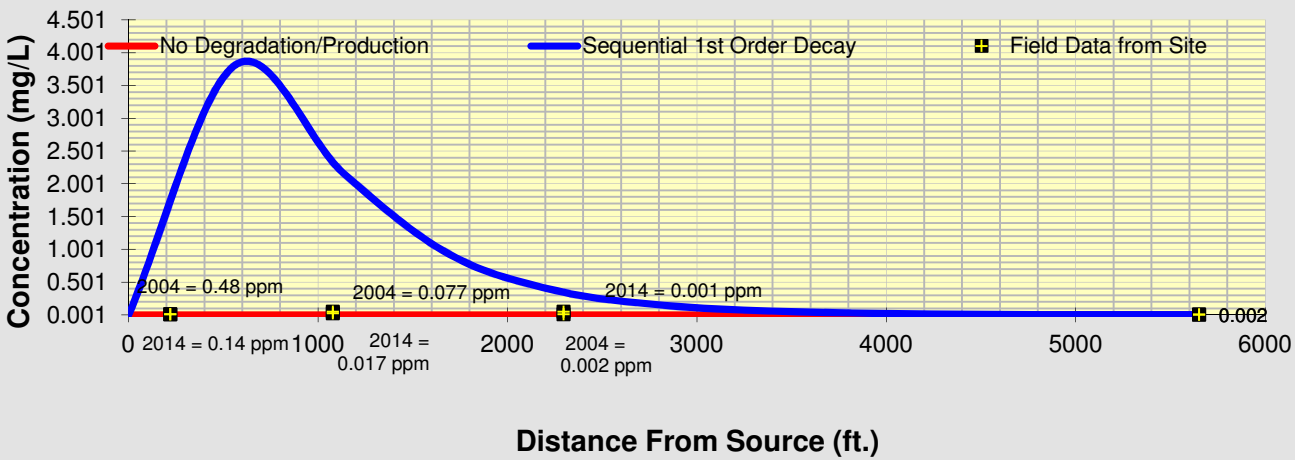
Return to Input

To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	3.816	2.173	0.923	0.369	0.147	0.059	0.024	0.010	0.004	0.002
	Monitoring Well Locations (ft)										
	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	0.010	0.021	0.009	0.002	0.010	0.150	0.046	0.002			



See PCE

See TCE

See DCE

See VC

See ETH

Replay

Time:

60.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Appendix B-7

Modified Back-Calculated BIOCHLOR Model ($\lambda/2$) Input & Results – LSG

BIOCHLOR Natural Attenuation Decision Support System

Version 2.2
Excel '97

GE Evendale
OSMW3D-6D-8D
Run Name

Data Input Instructions:

115 → 1. Enter value directly....or
↑ *or* 2. Calculate by filling in gray
0.02 cells. Press Enter, then C
(To restore formulas, hit "Restore Formulas" button)
Variable* → Data used directly in model.

Test if Biotransformation is Occurring → Natural Attenuation Screening Protocol

TYPE OF CHLORINATED SOLVENT: Ethenes ◉ Ethanes ○

1. ADVECTION

Seepage Velocity*	Vs	2525.1	(ft/yr)
or			
Hydraulic Conductivity	K	1.8E-01	(cm/sec)
Hydraulic Gradient	i	0.00416	(ft/ft)
Effective Porosity	n	0.3	(-)

2. DISPERSION

Alpha x*	200	(ft)
(Alpha y) / (Alpha x)*	0.1	(-)
(Alpha z) / (Alpha x)*	1.E-99	(-)

Calc. Alpha x

3. ADSORPTION

Retardation Factor* → R

or

Soil Bulk Density, rho	1.6	(kg/L)		
FractionOrganicCarbon, foc	1.8E-3	(-)		
Partition Coefficient	Koc			
PCE	155	(L/kg)	2.49	(-)
TCE	166	(L/kg)	2.59	(-)
DCE	36	(L/kg)	1.34	(-)
VC	19	(L/kg)	1.18	(-)
ETH	302	(L/kg)	3.90	(-)
Common R (used in model)* =			**2.49**	

4. BIOTRANSFORMATION **-1st Order Decay Coefficient***

Zone 1	λ (1/yr)	half-life (yrs)	Yield
PCE → TCE	0.000		0.79
TCE → DCE	12.500		0.74
DCE → VC	8.000		0.64
VC → ETH	2.500		0.45

Zone 2	λ (1/yr)	half-life (yrs)
PCE → TCE	0.000	
TCE → DCE	0.000	
DCE → VC	0.000	
VC → ETH	0.000	

λ HELP

5. GENERAL

Simulation Time*	60	(yr)
Modeled Area Width*	700	(ft)
Modeled Area Length*	5650	(ft)
Zone 1 Length*	5650	(ft)
Zone 2 Length*	0	(ft)

Zone 2= L - Zone 1

6. SOURCE DATA TYPE: Decaying Single Planar

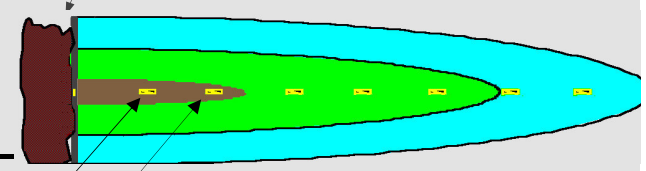
Source Options

Source Thickness in Sat. Zone* 56 (ft)

Width* (ft) Y1 450

Conc. (mg/L)*	C1	k_s* (1/yr)
PCE	.0	0.055
TCE	11.0	0.055
DCE	4.5	0.055
VC	.0	0.055
ETH	0	0.055

Vertical Plane Source: Determine Source Well Location and Input Solvent Concentrations



View of Plume Looking Down

Observed Centerline Conc. at Monitoring Wells

7. FIELD DATA FOR COMPARISON

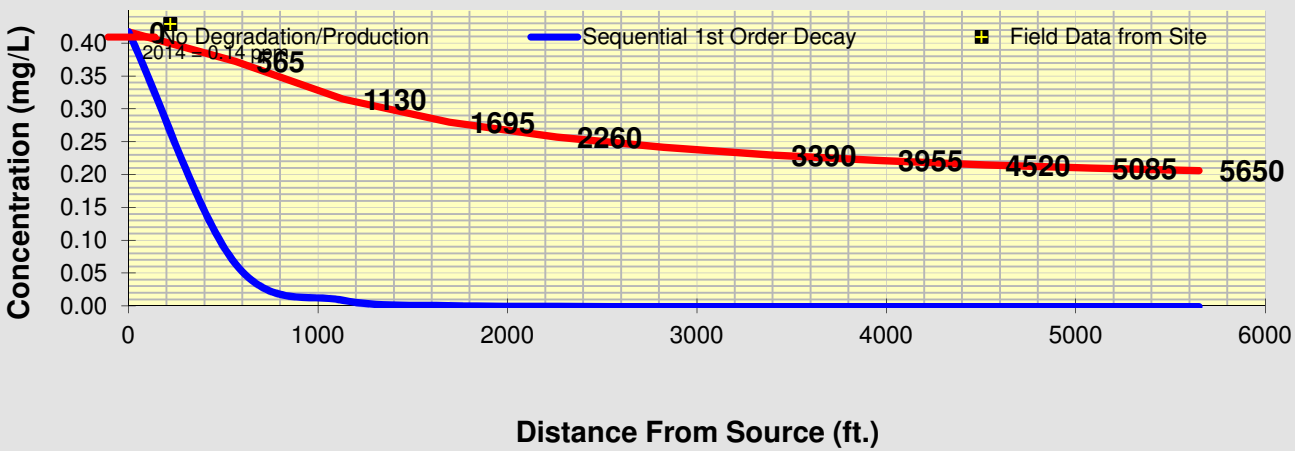
PCE Conc. (mg/L)	.0										
TCE Conc. (mg/L)	1.0	.0	.0	.0	.43	.0	.0	.0			
DCE Conc. (mg/L)	.48	.077	.002	.0	.14	.017	.001	.0			
VC Conc. (mg/L)	0.0	.021	.009	.002	.01	.15	.046	.002			
ETH Conc. (mg/L)	0.0										
Distance from Source (ft)	220	1077	2296	5650	220	1077	2296	5650			
Date Data Collected	2004										

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE | RUN ARRAY | *Help* | Restore | RESET | *SEE OUTPUT* | Paste

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

TCE	Distance from Source (ft)										
	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	0.418	0.373	0.316	0.281	0.258	0.242	0.231	0.222	0.216	0.211	0.207
Biotransformation	0.4181	0.065	0.010	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Monitoring Well Locations (ft)										
	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	1.000	0.000	0.000	0.000	0.430	0.000	0.000	0.000			



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

60.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

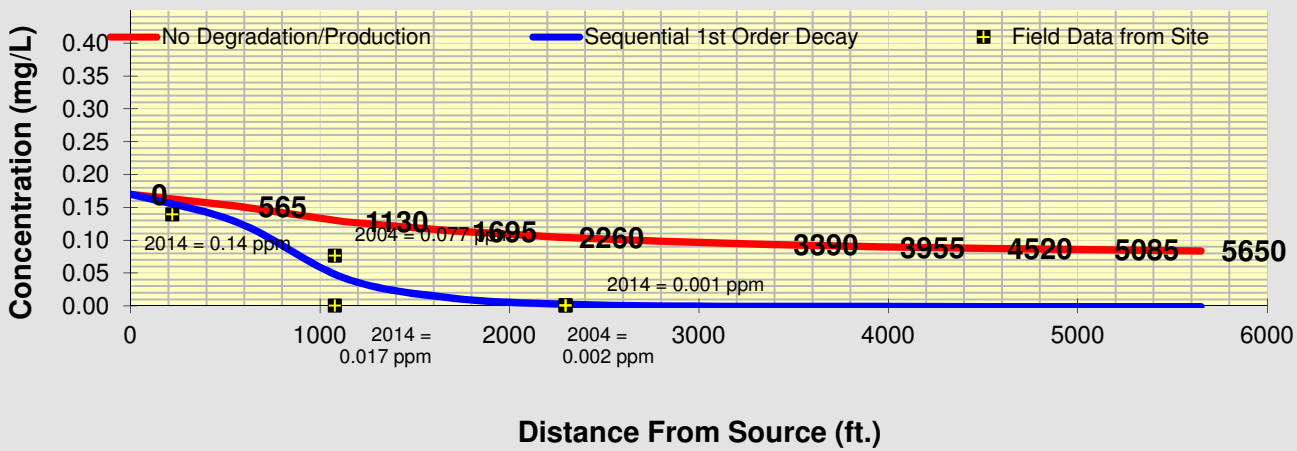
DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

Distance from Source (ft)

DCE	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	0.171	0.153	0.129	0.115	0.106	0.099	0.094	0.091	0.088	0.086	0.085
Biotransformation	0.1710	0.128	0.043	0.013	0.004	0.001	0.000	0.000	0.000	0.000	0.000

Monitoring Well Locations (ft)

	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	0.480	0.077	0.002	0.000	0.140	0.017	0.001	0.000			



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

60.0 Years

Log ⟺ Linear

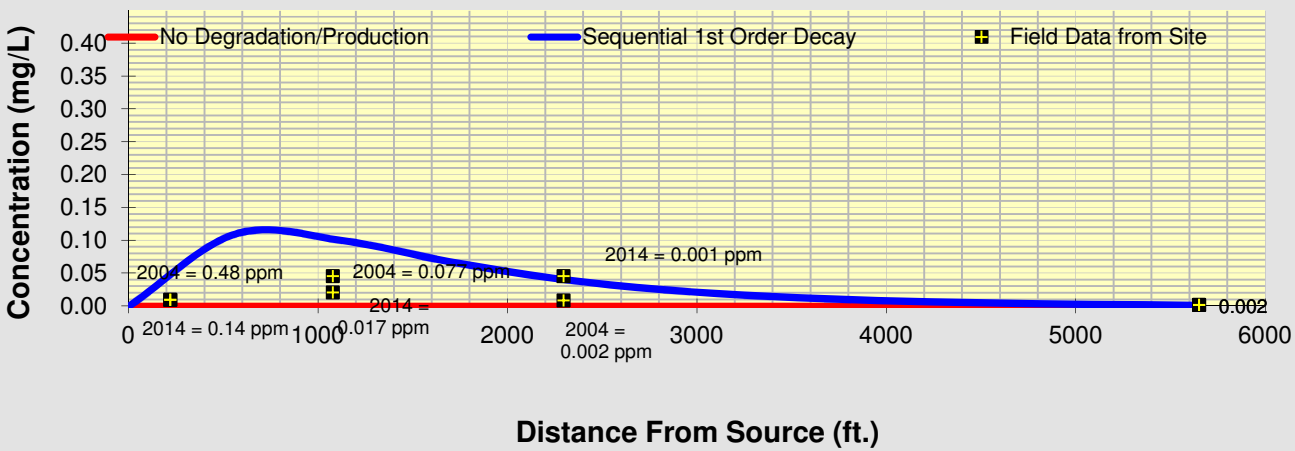
Return to Input

To All

To Array

DISSOLVED CHLORINATED SOLVENT CONCENTRATIONS ALONG PLUME CENTERLINE (mg/L) at Z=0

VC	Distance from Source (ft)										
	0	565	1130	1695	2260	2825	3390	3955	4520	5085	5650
No Degradation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biotransformation	0.0000	0.110	0.100	0.068	0.042	0.026	0.015	0.009	0.005	0.003	0.002
	Monitoring Well Locations (ft)										
	220	1077	2296	5650	220	1077	2296	5650			
Field Data from Site	0.010	0.021	0.009	0.002	0.010	0.150	0.046	0.002			



See PCE

See TCE

See DCE

See VC

See ETH

Prepare Animation

Time:

60.0 Years

Log ⟺ Linear

Return to Input

To All

To Array

Appendix C – Example of Closure Monitoring Procedures and Decision Guidelines

APPENDIX C
EXAMPLE OF CLOSURE MONITORING PROCEDURES AND DECISION GUIDELINES
GE AVIATION – EVENDALE, OH

Decision guidelines are developed based on target concentrations and performance monitoring locations for the groundwater IRM system using the following approach:

- Monitor CMO attainment using extraction well influent sampling results and the process outlined in Section 1.2 of the PMP. This process includes Four Problems[1] (Perched zone pumping, EW-7S pumping, EW-3D pumping, and EW-8D pumping). The Problems were defined to reflect different decision-making and data collection needs in each water-bearing unit.
- Use flow chart(s) (see example in Figure C-1) and tabulated study questions to outline the Yes-No decision guide, considering a number of key questions, including whether concentration objectives are met at the extraction well locations.
- Evaluate a transition to MNA once concentrations drop below these concentration objectives. The evaluation will include consideration of whether operation of P&T technology should be discontinued when continued operation would not be significantly more beneficial than MNA (*e.g.*, due to diffusion-limited conditions). The evaluation will also consider whether offsite exposure risks can be acceptably managed with a transition to MNA.
- Present the results of this evaluation to USEPA along with a plan for the transition of technologies.
- Monitor and evaluate COPC concentrations following shutdown of individual extraction wells to verify that conditions remain compatible with MNA. Attainment monitoring and rebound effects will be evaluated using intrawell statistical testing. The testing program will be described in an amended PMP.

As explained in the IRM PMP, the development of decision guidelines follows the principles of the USEPA Data Quality Objectives (DQO) guidance (USEPA, 2006). The terminology and sequence of planning are also modeled on the DQO guidance. Each Problem is further subdivided into a series of anticipated decisions. Each decision is composed of a Study Question (SQ) and two Alternative Actions corresponding with a Yes or No answer to the SQ. Each SQ is associated with a Decision Guide[2] (aka Decision Rule). The sequence of Problems, SQs, and Alternative Actions are shown in a flowchart(s) and table(s) of data collection requirements. For each SQ, the tables are used to summarize the type of information needed (e.g., water level or analytical data), sample locations, frequency, and methods.

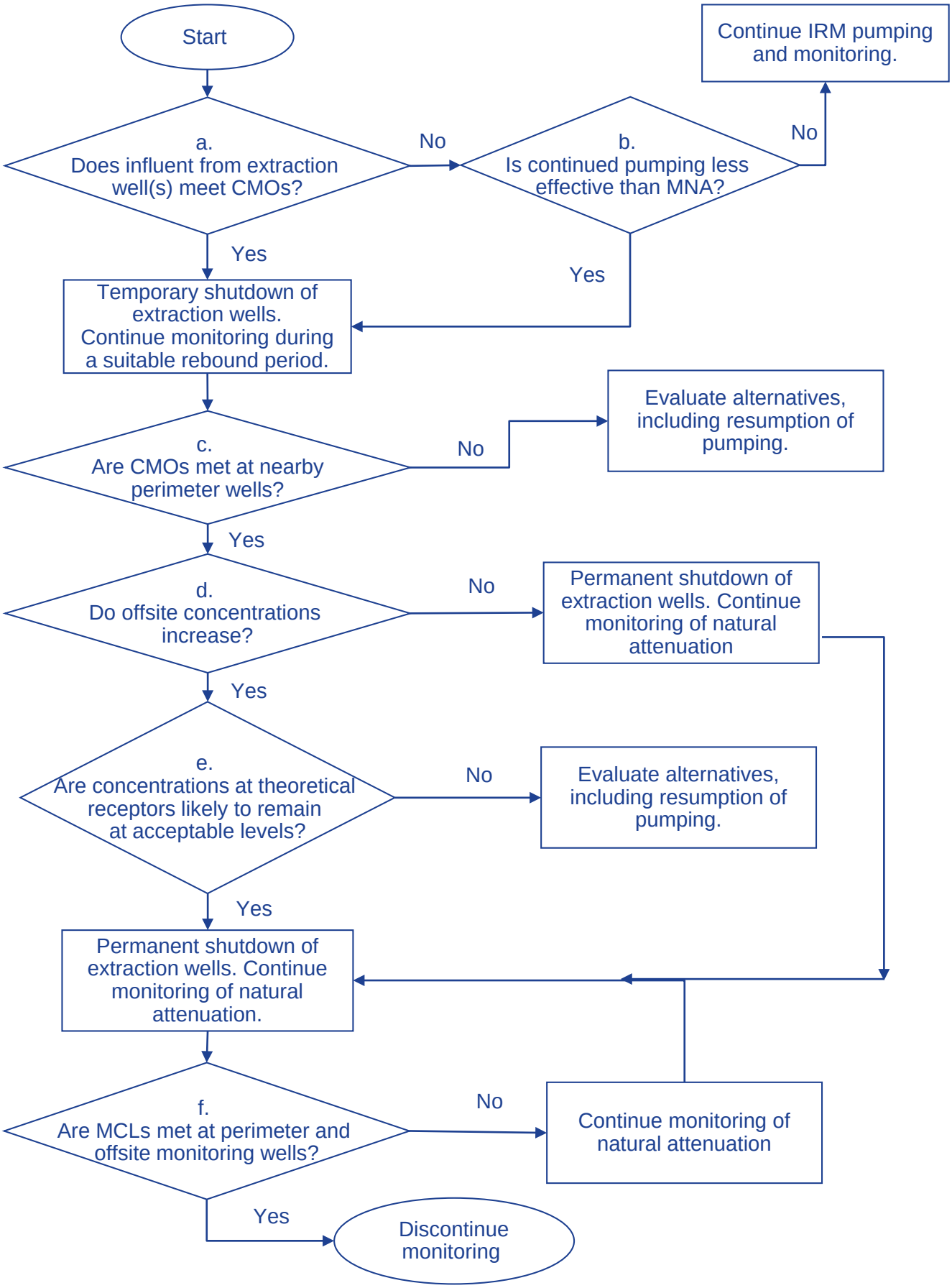
An example flowchart is provided in Figure C-1. The flowchart provides an example of how the CMOs will be used to guide the decisions regarding pump & treat at individual areas. The flowchart also illustrates the transition to MNA and long-term monitoring for attainment of aquifer restoration, by area. Details will be provided in a Revised PMP.

---

[1] As used here, "Problems" are a series of study questions, data collection, and decision-making guidelines related to a particular pumping location. Each Problem is conceptualized as a separate decision tree.

[2] The listing of Decision Guides in this interim report is intended to support the planning for future monitoring and not to constrain decision making. Depending upon actual conditions at the time of decision making, other considerations may be used to support decisions, and decision guides may be modified. GE has conferred with USEPA on past decisions and will continue to confer with USEPA on future monitoring results and decisions.

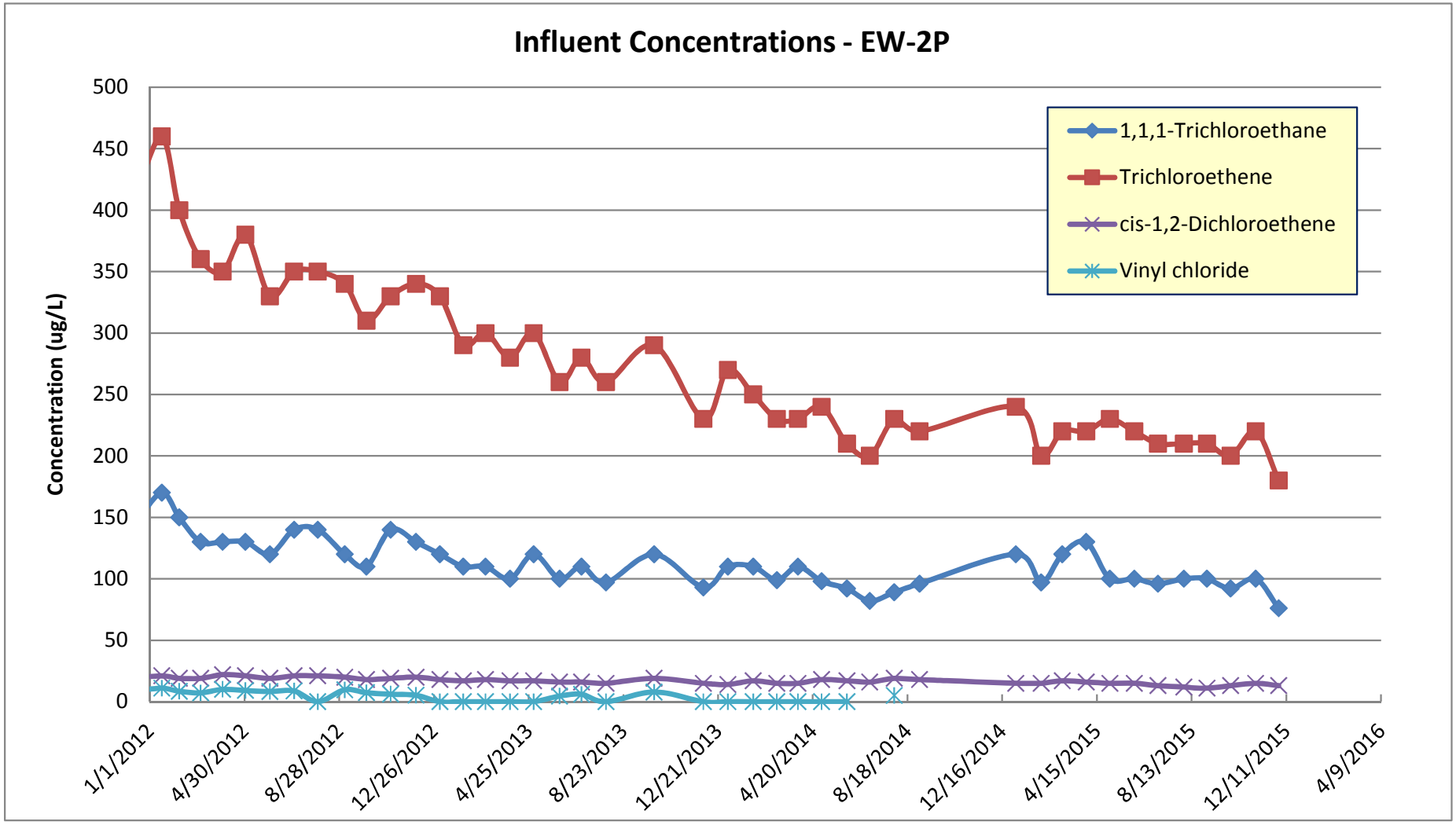
Figure C-1. Example Problem Flow Chart – Extraction Well EW-7S/EW-8D
Determine whether corrective measures have achieved objectives (CMOs)

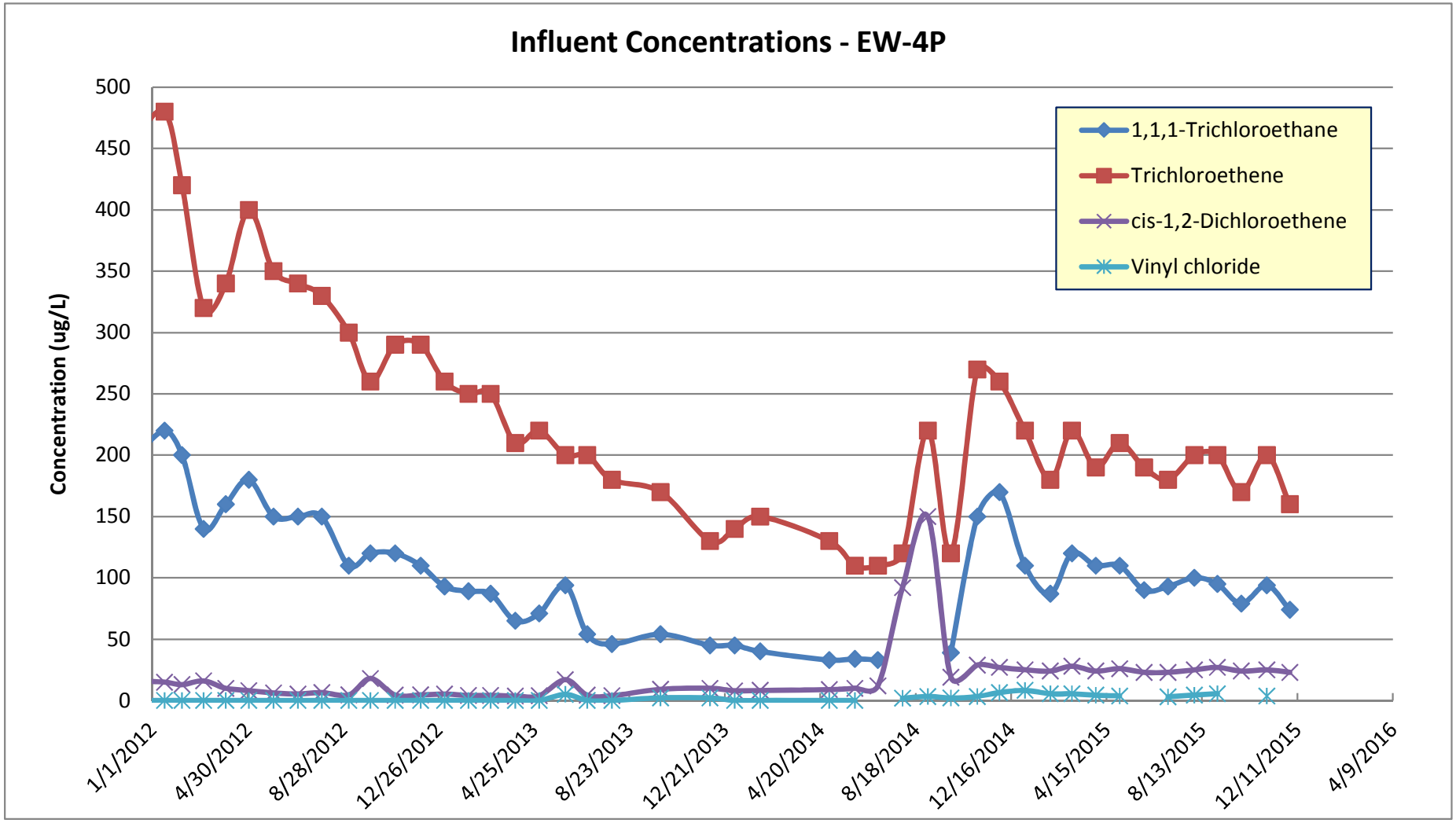


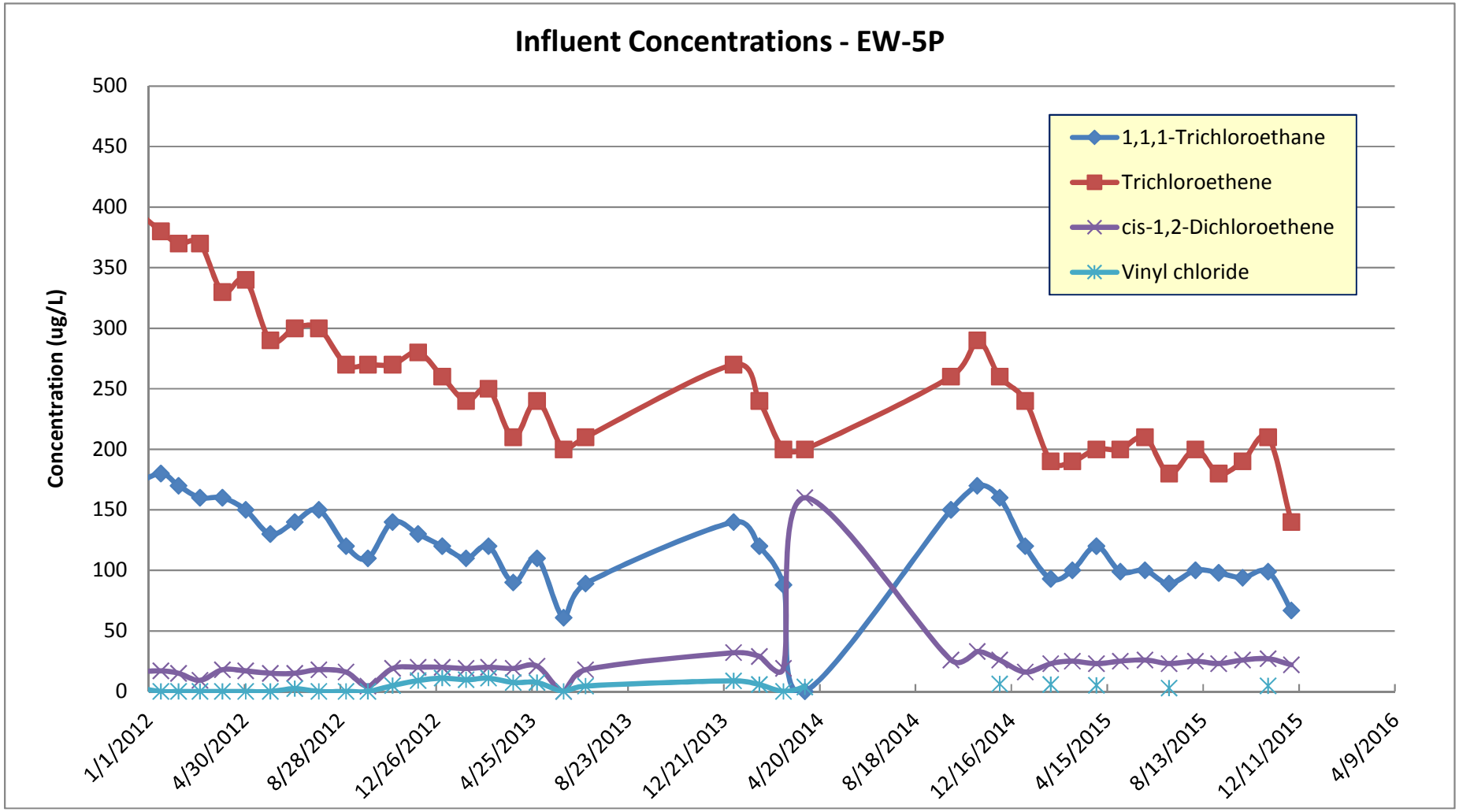
Appendix D - CVOC Concentrations

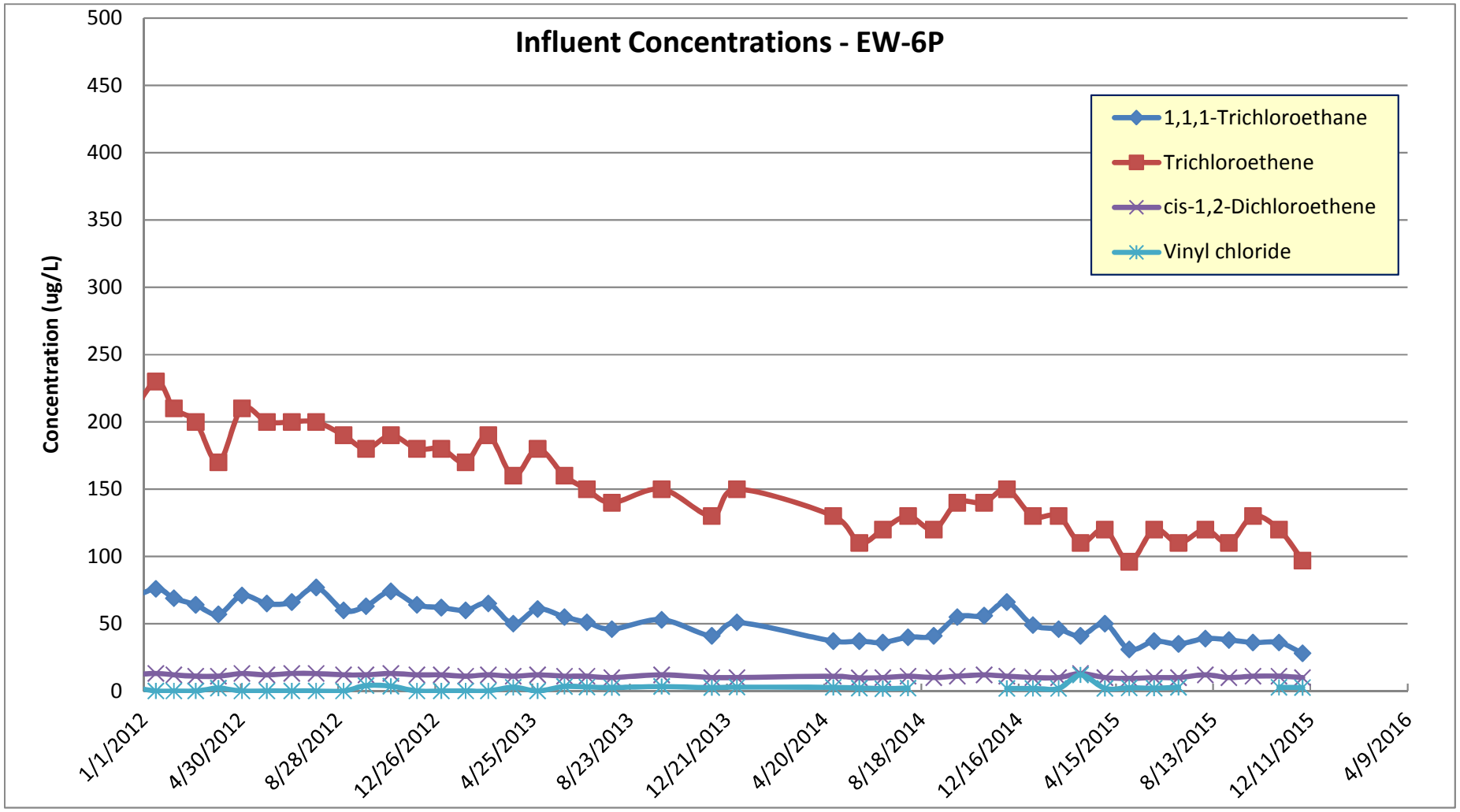
IRM Influent and Select Monitoring Wells

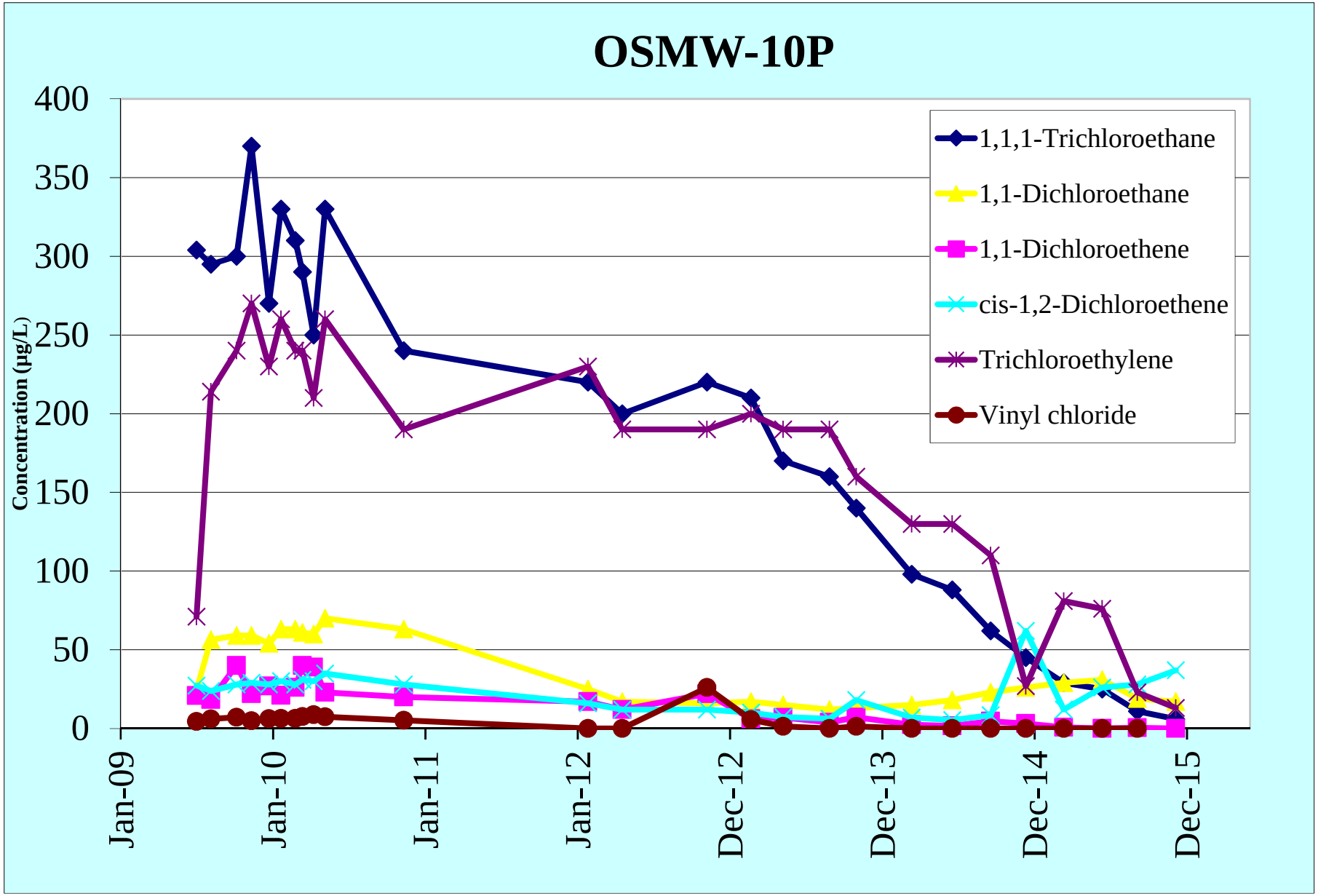
Appendix D-1 - *Perched Zone*

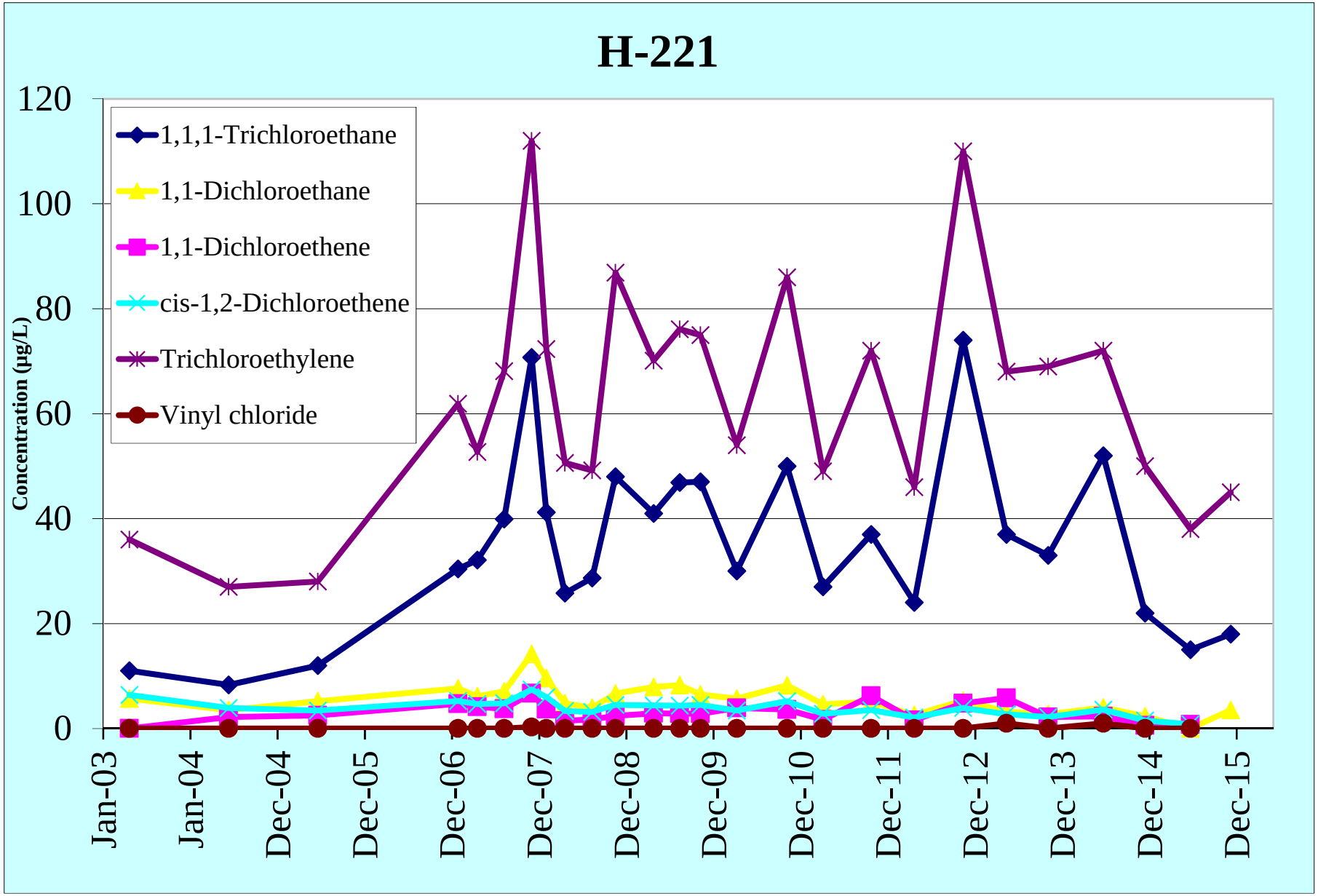

Influent Concentrations - EW-2P
Concentration (ug/L)
500
450
400
350
300
250
200
150
100
50
0
1/1/2012
4/30/2012
8/28/2012
12/26/2012
4/25/2013
8/23/2013
12/21/2013
4/20/2014
8/18/2014
12/16/2014
4/15/2015
8/13/2015
12/11/2015
4/9/2016
1,1,1-Trichloroethane
Trichloroethene
cis-1,2-Dichloroethene
Vinyl chloride

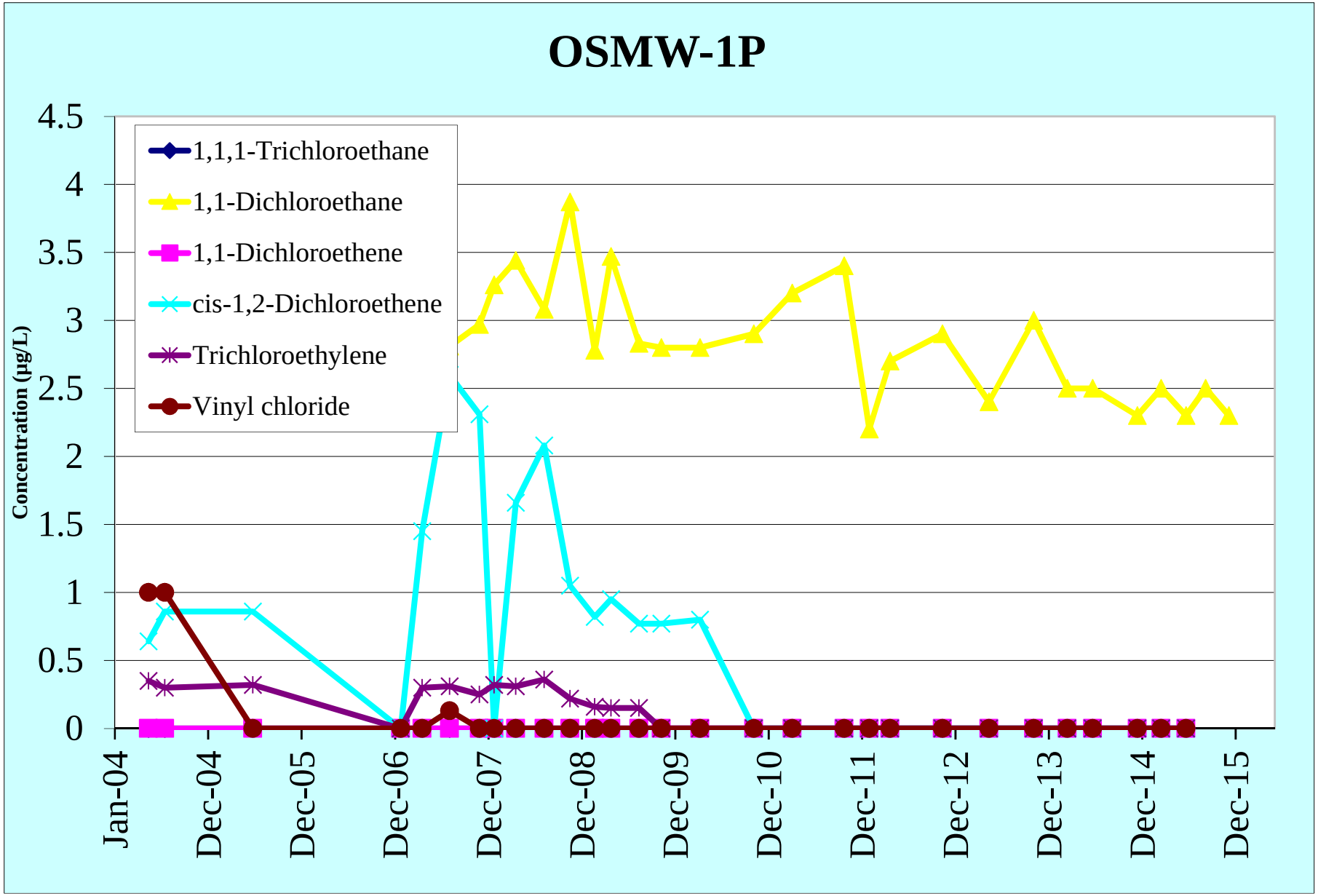

Influent Concentrations - EW-4P
Concentration (ug/L)
500
450
400
350
300
250
200
150
100
50
0
1/1/2012
4/30/2012
8/28/2012
12/26/2012
4/25/2013
8/23/2013
12/21/2013
4/20/2014
8/18/2014
12/16/2014
4/15/2015
8/13/2015
12/11/2015
4/9/2016
1,1,1-Trichloroethane
Trichloroethene
cis-1,2-Dichloroethene
Vinyl chloride

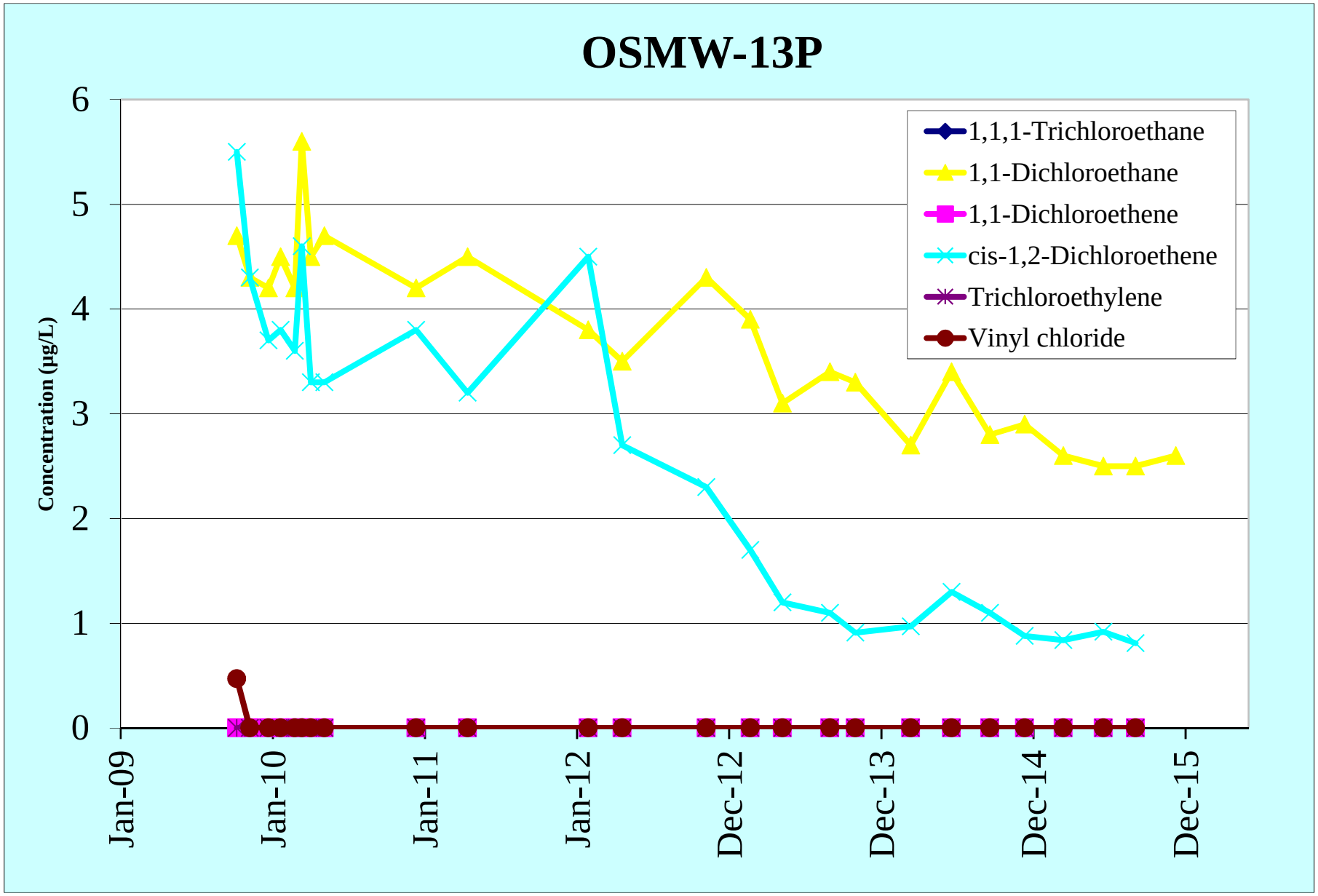

Influent Concentrations - EW-5P
Concentration (ug/L)
500
450
400
350
300
250
200
150
100
50
0
1/1/2012
4/30/2012
8/28/2012
12/26/2012
4/25/2013
8/23/2013
12/21/2013
4/20/2014
8/18/2014
12/16/2014
4/15/2015
8/13/2015
12/11/2015
4/9/2016
1,1,1-Trichloroethane
Trichloroethene
cis-1,2-Dichloroethene
Vinyl chloride


Influent Concentrations - EW-6P
Concentration (ug/L)
500
450
400
350
300
250
200
150
100
50
0
1/1/2012
4/30/2012
8/28/2012
12/26/2012
4/25/2013
8/23/2013
12/21/2013
4/20/2014
8/18/2014
12/16/2014
4/15/2015
8/13/2015
12/11/2015
4/9/2016
1,1,1-Trichloroethane
Trichloroethene
cis-1,2-Dichloroethene
Vinyl chloride

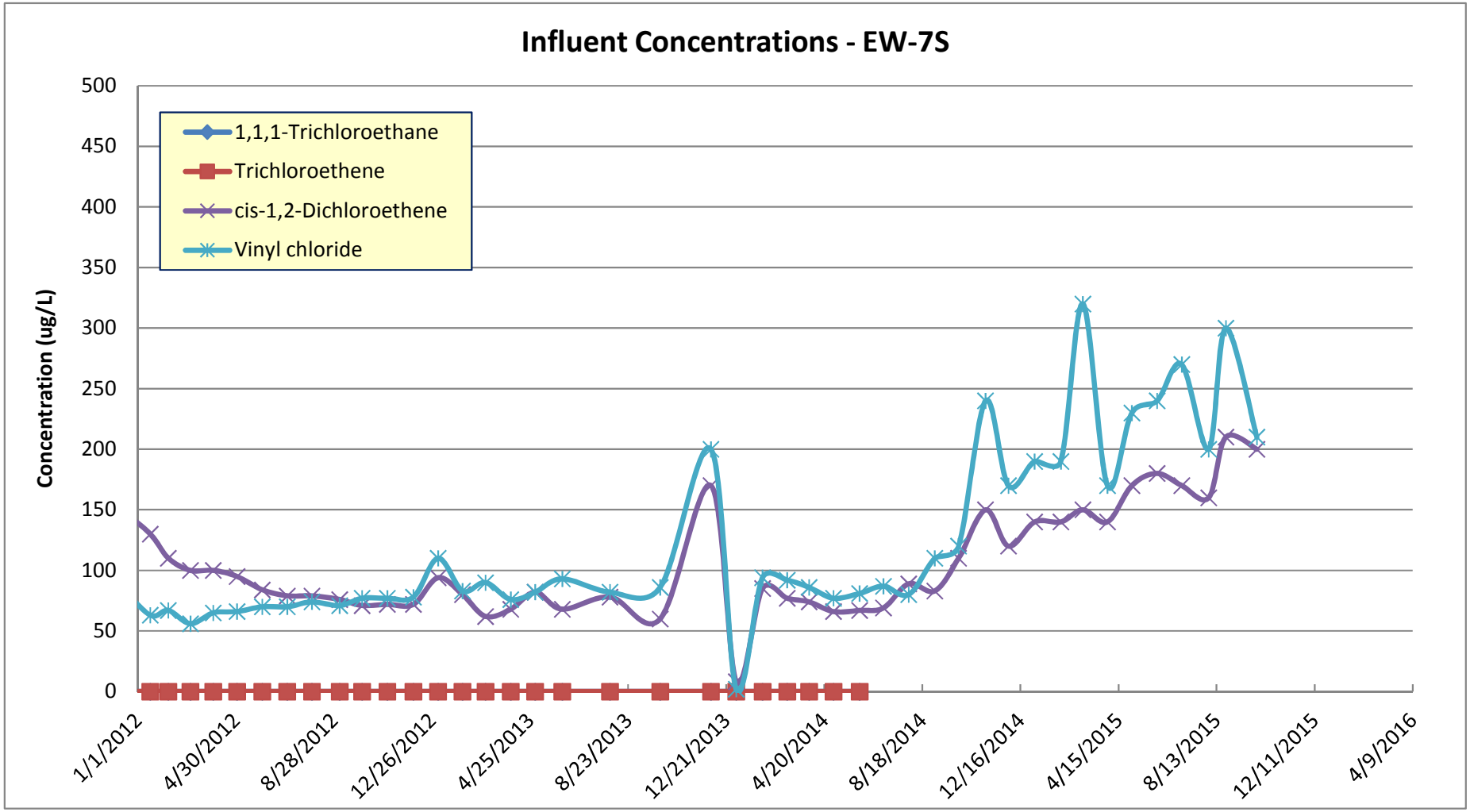

OSMW-10P
Concentration (µg/L)
400
350
300
250
200
150
100
50
0
Jan-09
Jan-10
Jan-11
Jan-12
Dec-12
Dec-13
Dec-14
Dec-15
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride

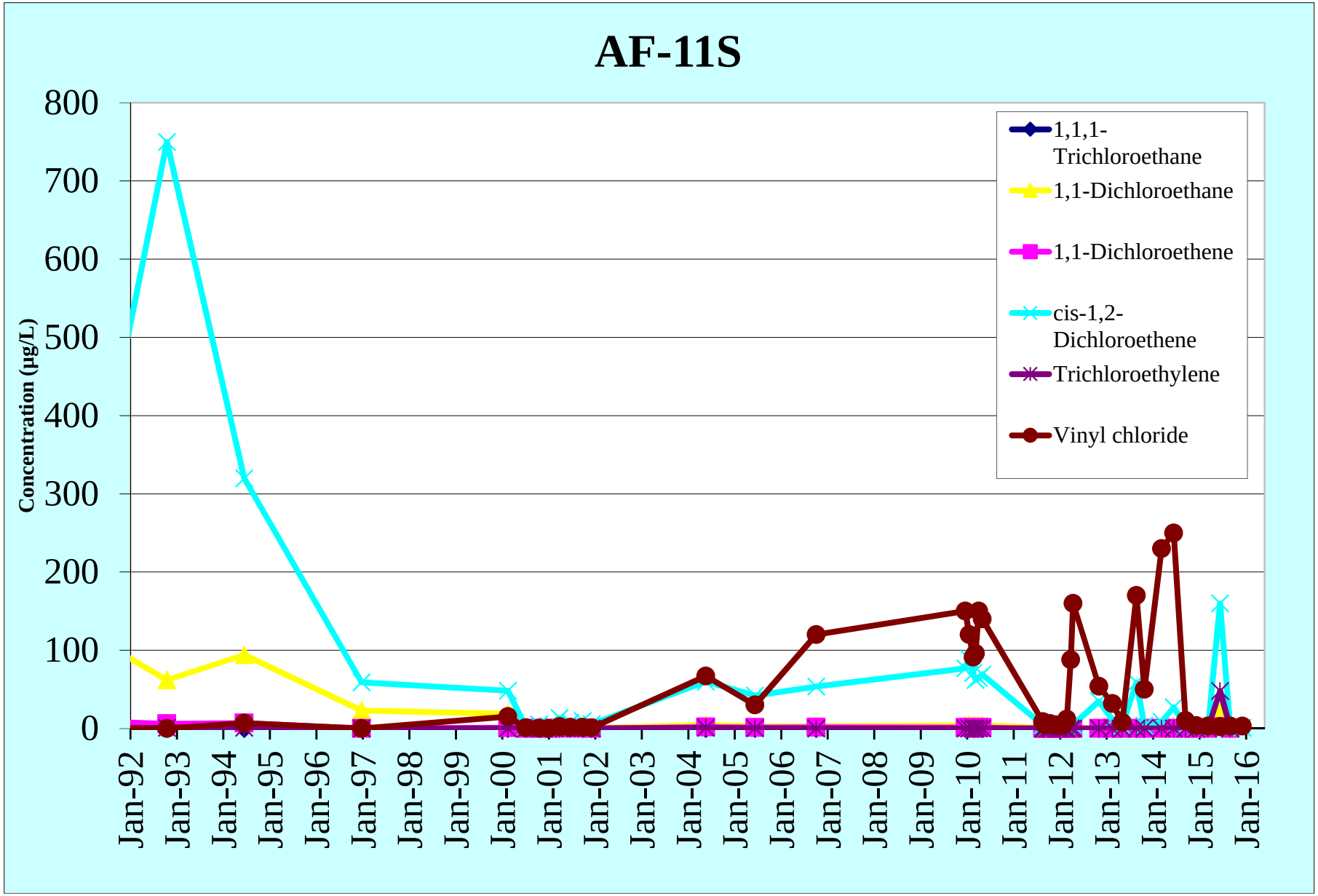

H-221
Concentration (µg/L)
120
100
80
60
40
20
0
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride
Jan-03
Jan-04
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15

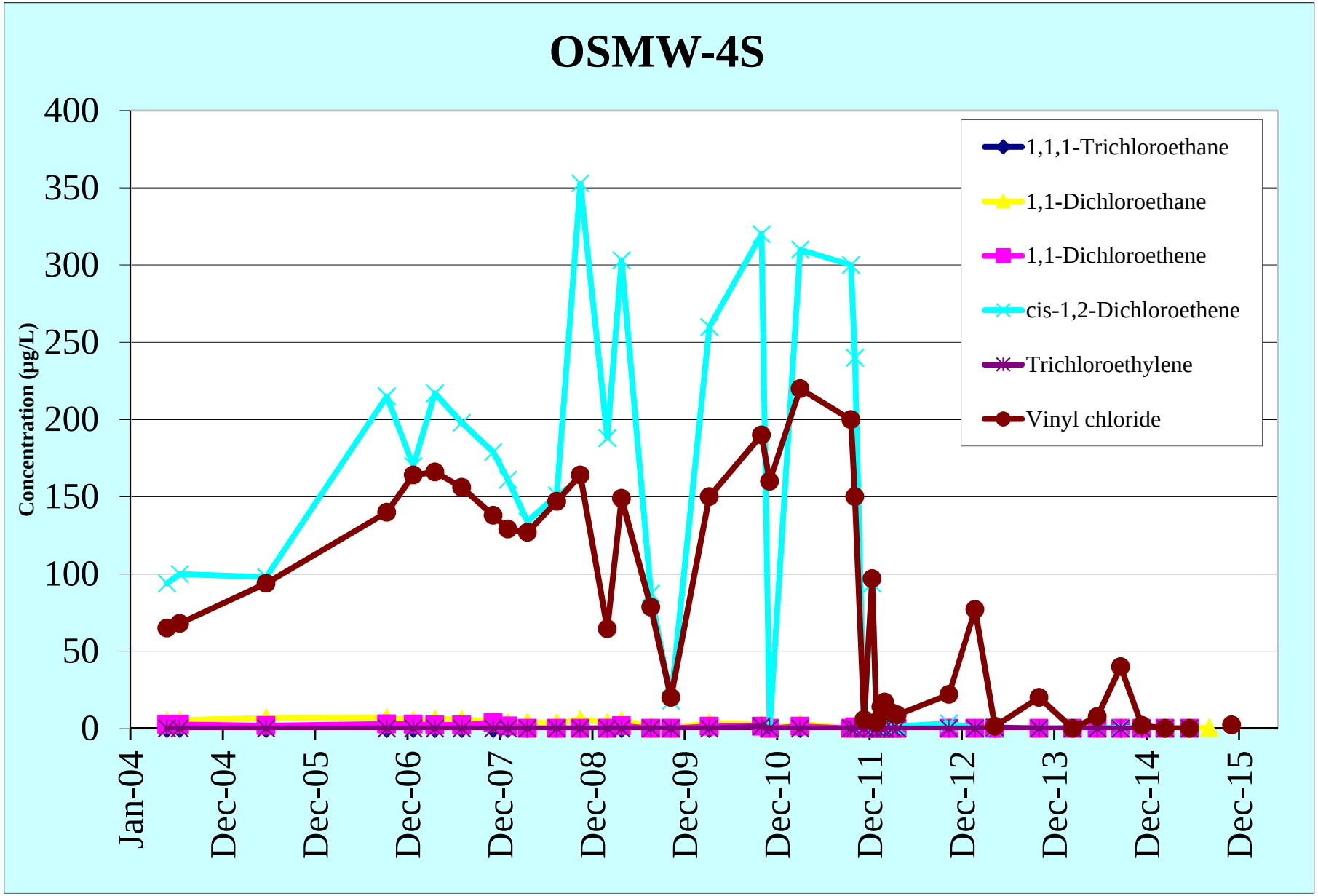

OSMW-1P
Concentration (µg/L)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride
Jan-04
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15

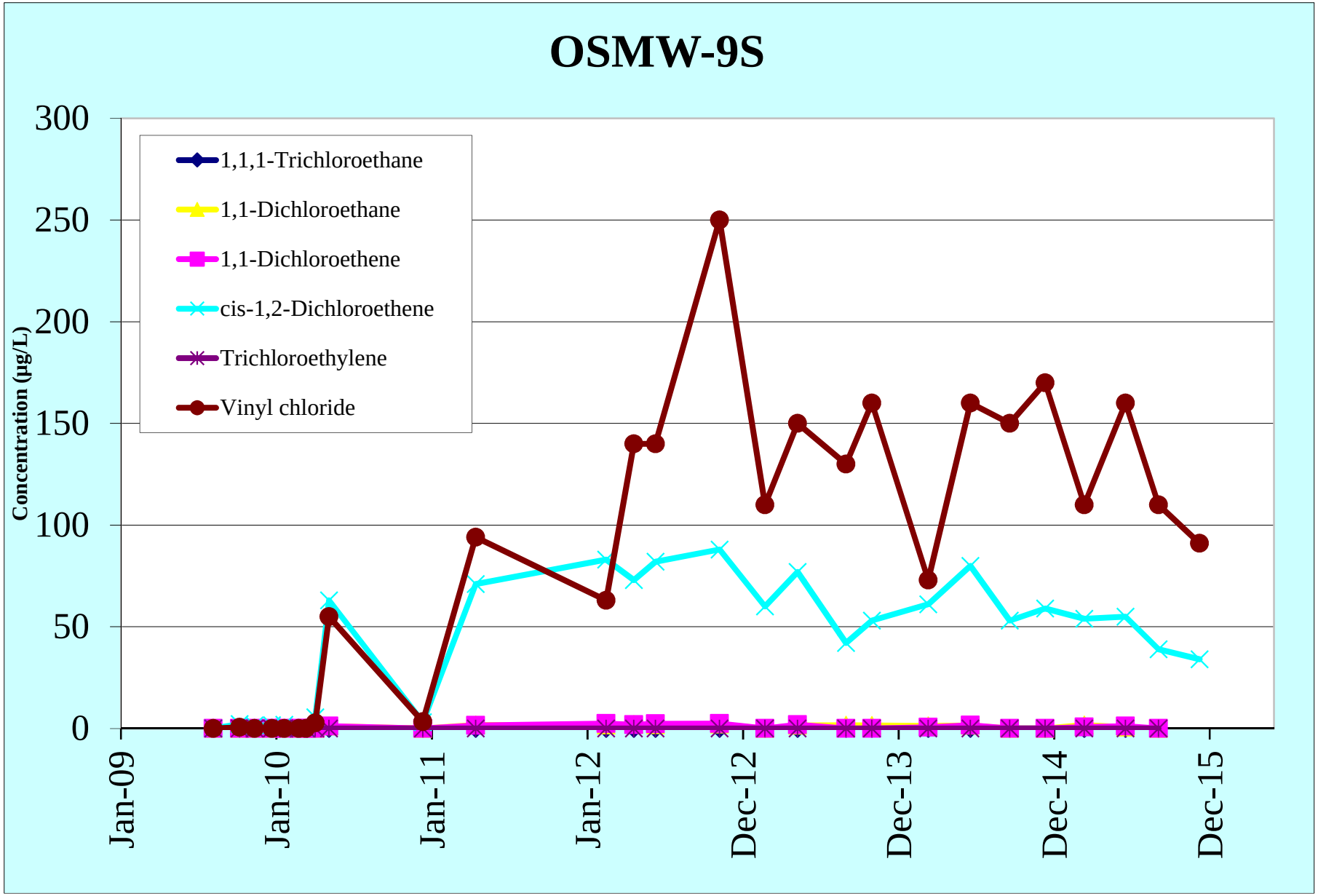

OSMW-13P
Concentration (µg/L)
6
5
4
3
2
1
0
Jan-09
Jan-10
Jan-11
Jan-12
Dec-12
Dec-13
Dec-14
Dec-15
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride

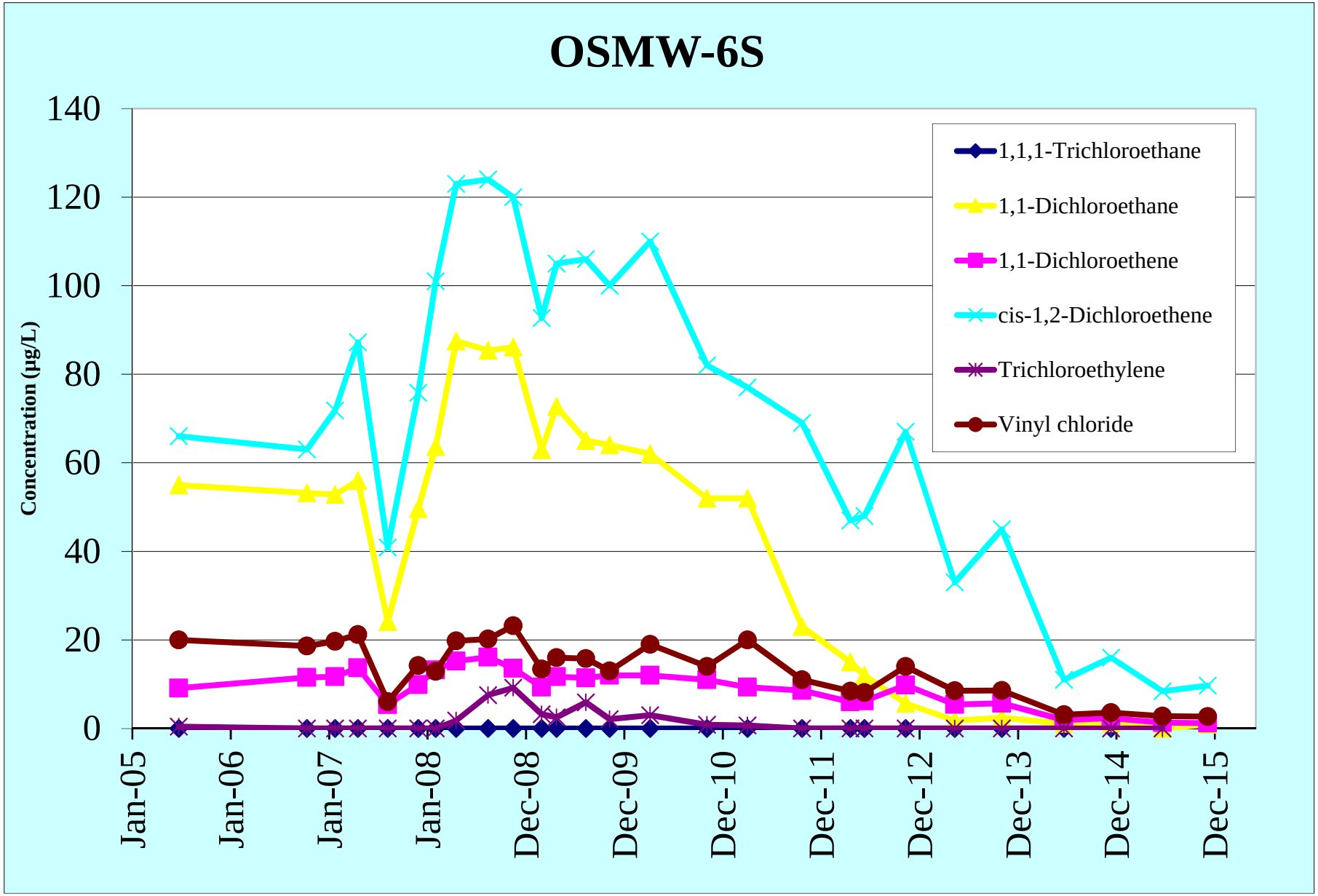
Appendix D-2 - *USG*

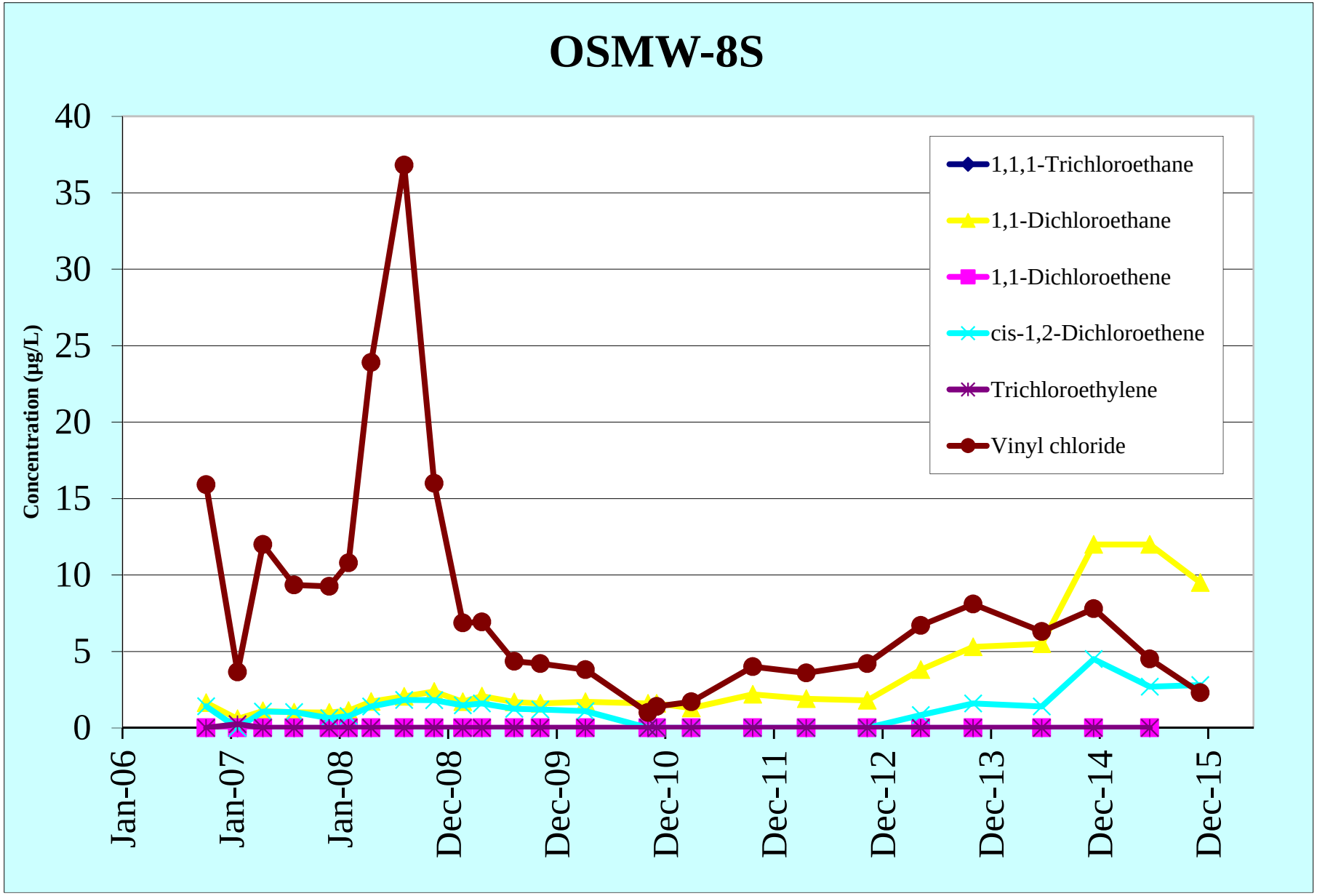

Influent Concentrations - EW-7S
Concentration (ug/L)
500
450
400
350
300
250
200
150
100
50
0
1,1,1-Trichloroethane
Trichloroethene
cis-1,2-Dichloroethene
Vinyl chloride
1/1/2012
4/30/2012
8/28/2012
12/26/2012
4/25/2013
8/23/2013
12/21/2013
4/20/2014
8/18/2014
12/16/2014
4/15/2015
8/13/2015
12/11/2015
4/9/2016


AF-11S
Concentration (µg/L)
800
700
600
500
400
300
200
100
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride

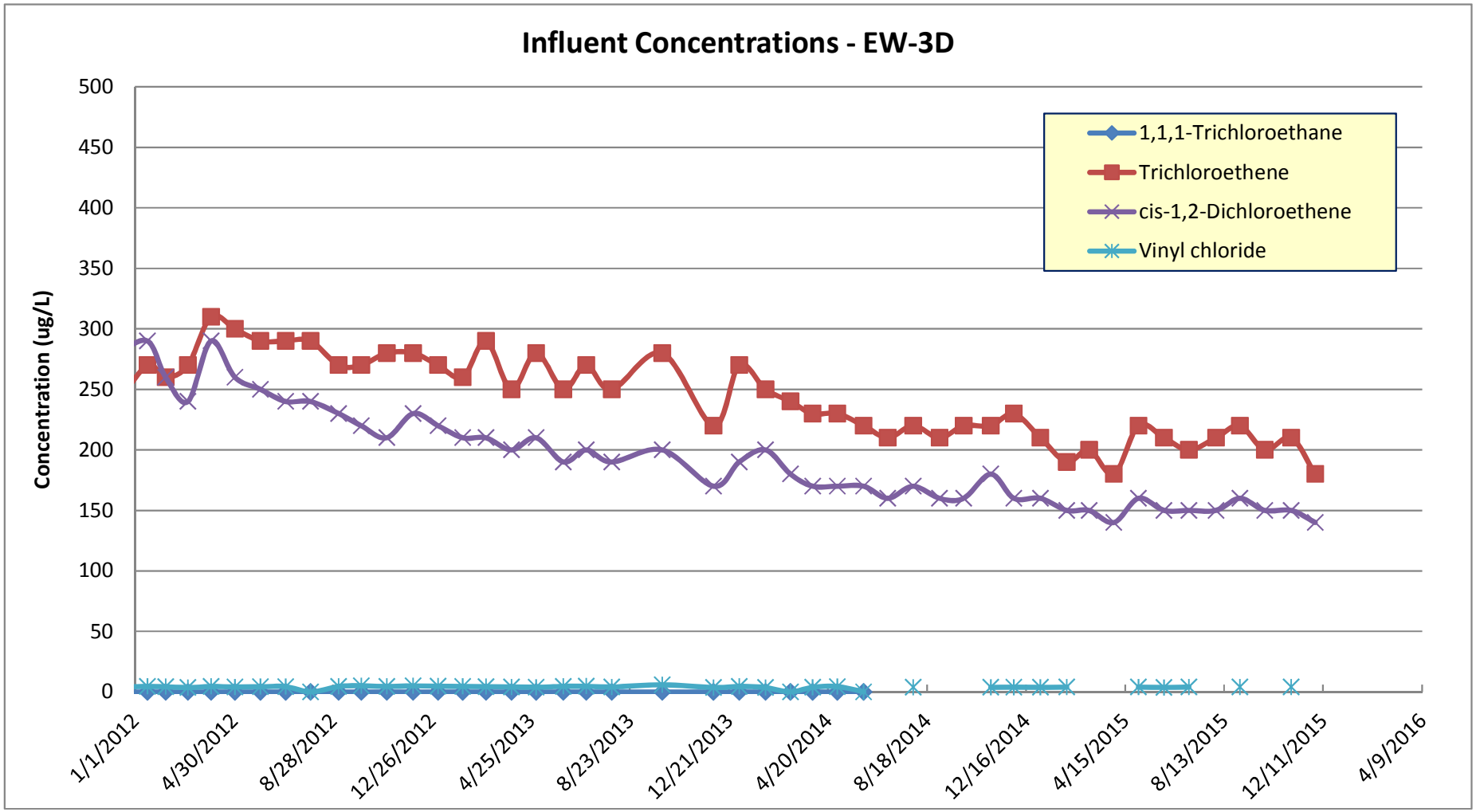

OSMW-4S
Concentration (µg/L)
400
350
300
250
200
150
100
50
0
Jan-04
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride

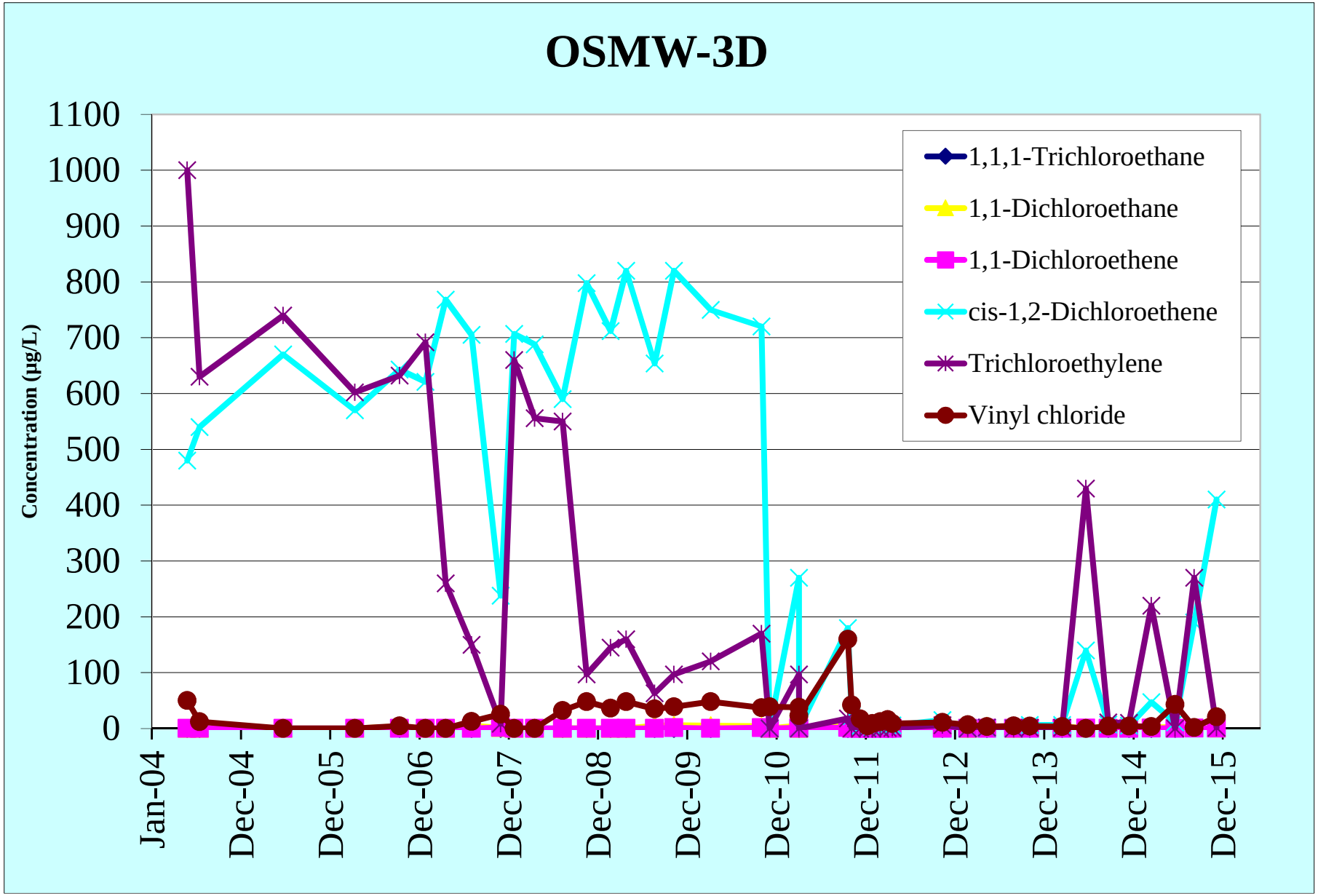

OSMW-9S
Concentration (µg/L)
300
250
200
150
100
50
0
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride
Jan-09
Jan-10
Jan-11
Jan-12
Dec-12
Dec-13
Dec-14
Dec-15

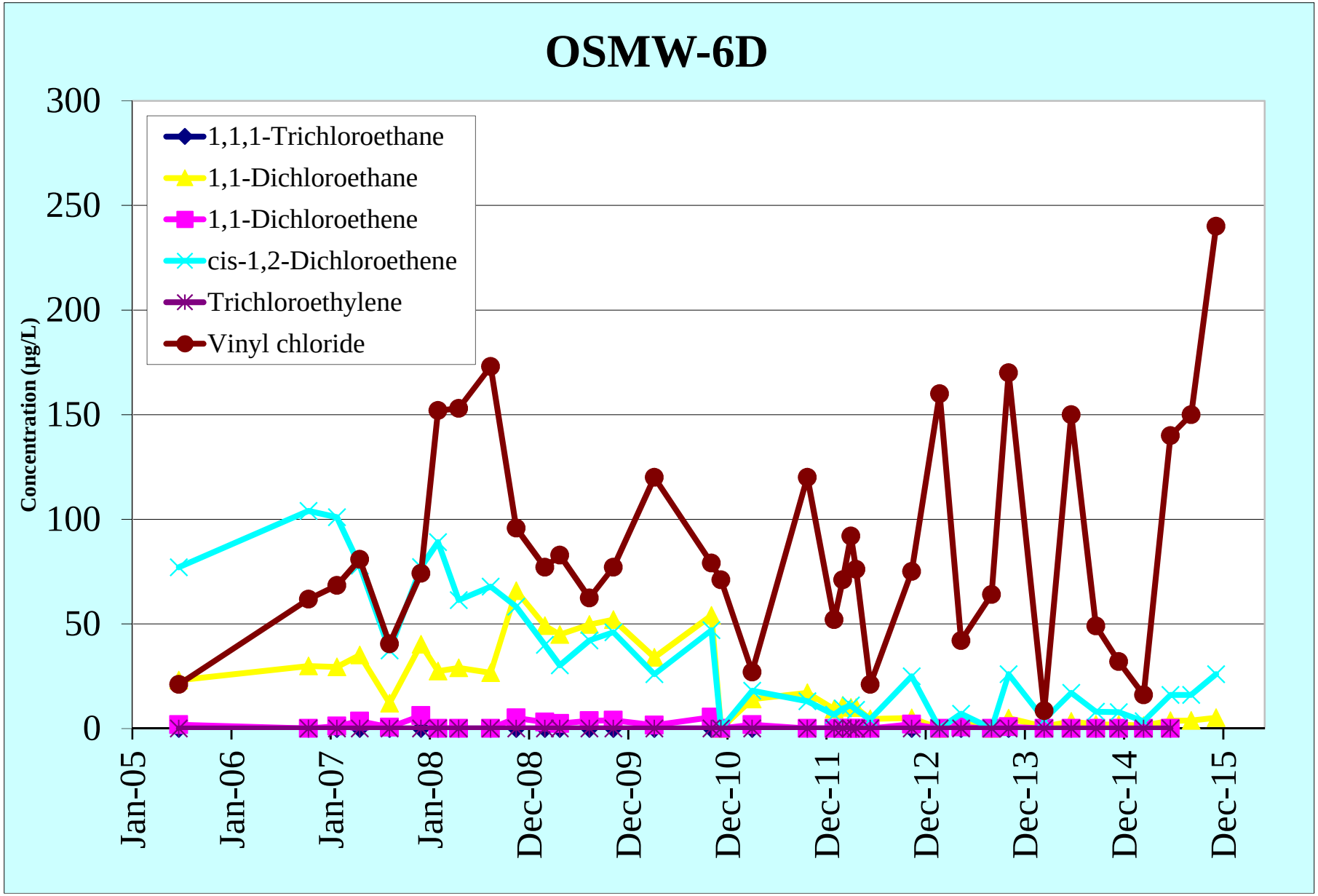

OSMW-6S
Concentration (µg/L)
140
120
100
80
60
40
20
0
Jan-05
Jan-06
Jan-07
Jan-08
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride

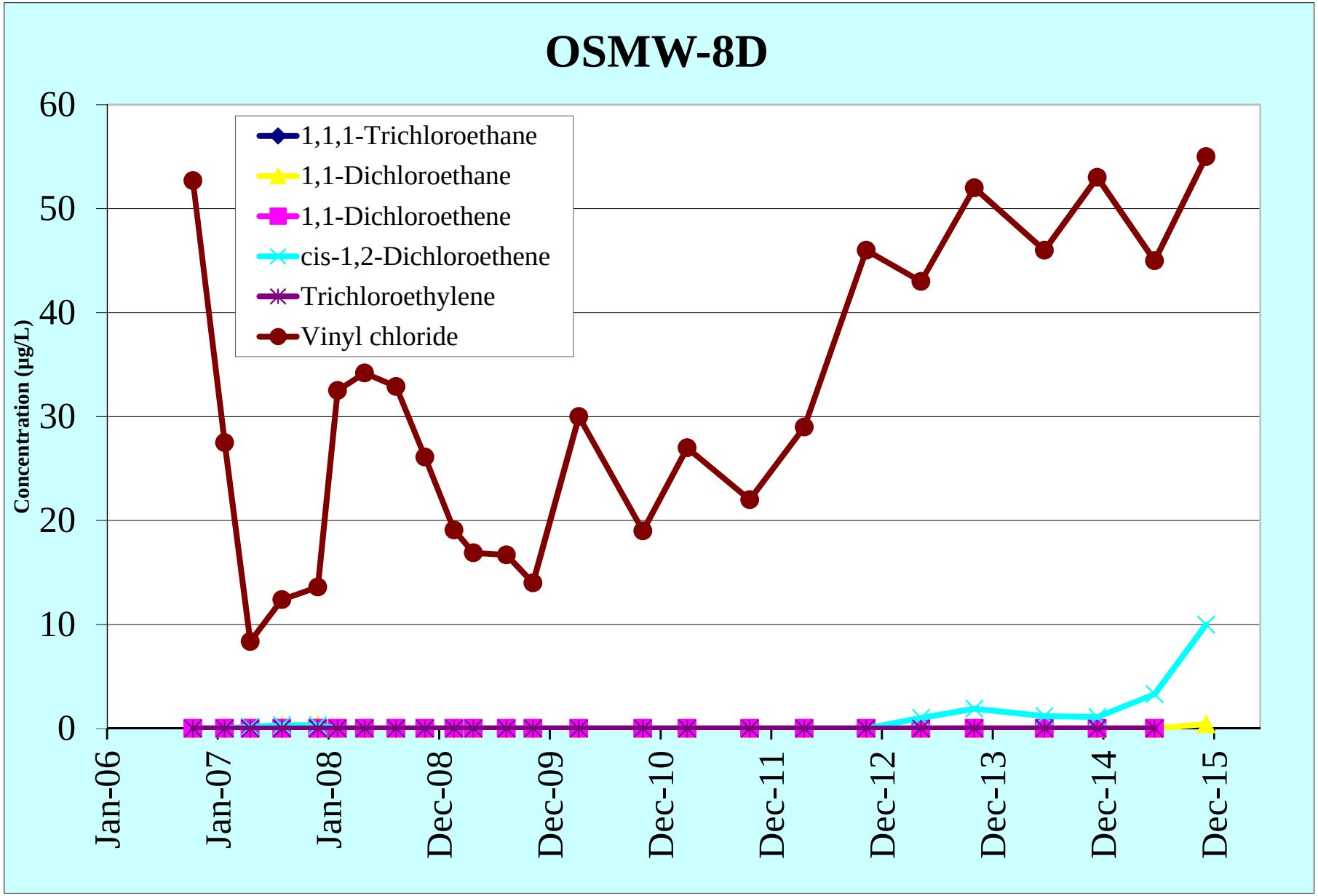

OSMW-8S
Concentration (µg/L)
40
35
30
25
20
15
10
5
0
Jan-06
Jan-07
Jan-08
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride

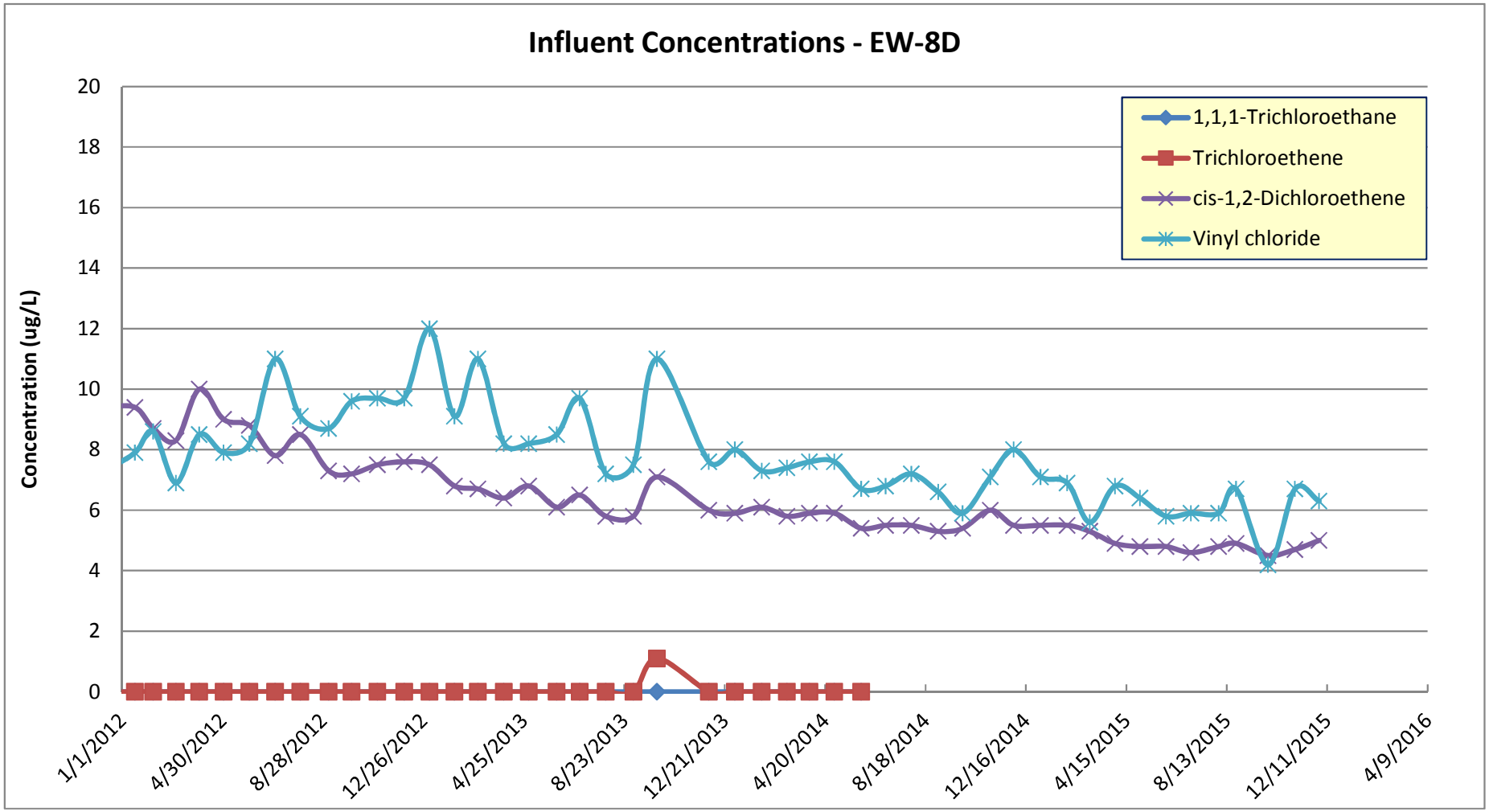
Appendix D-3 - *LSG*

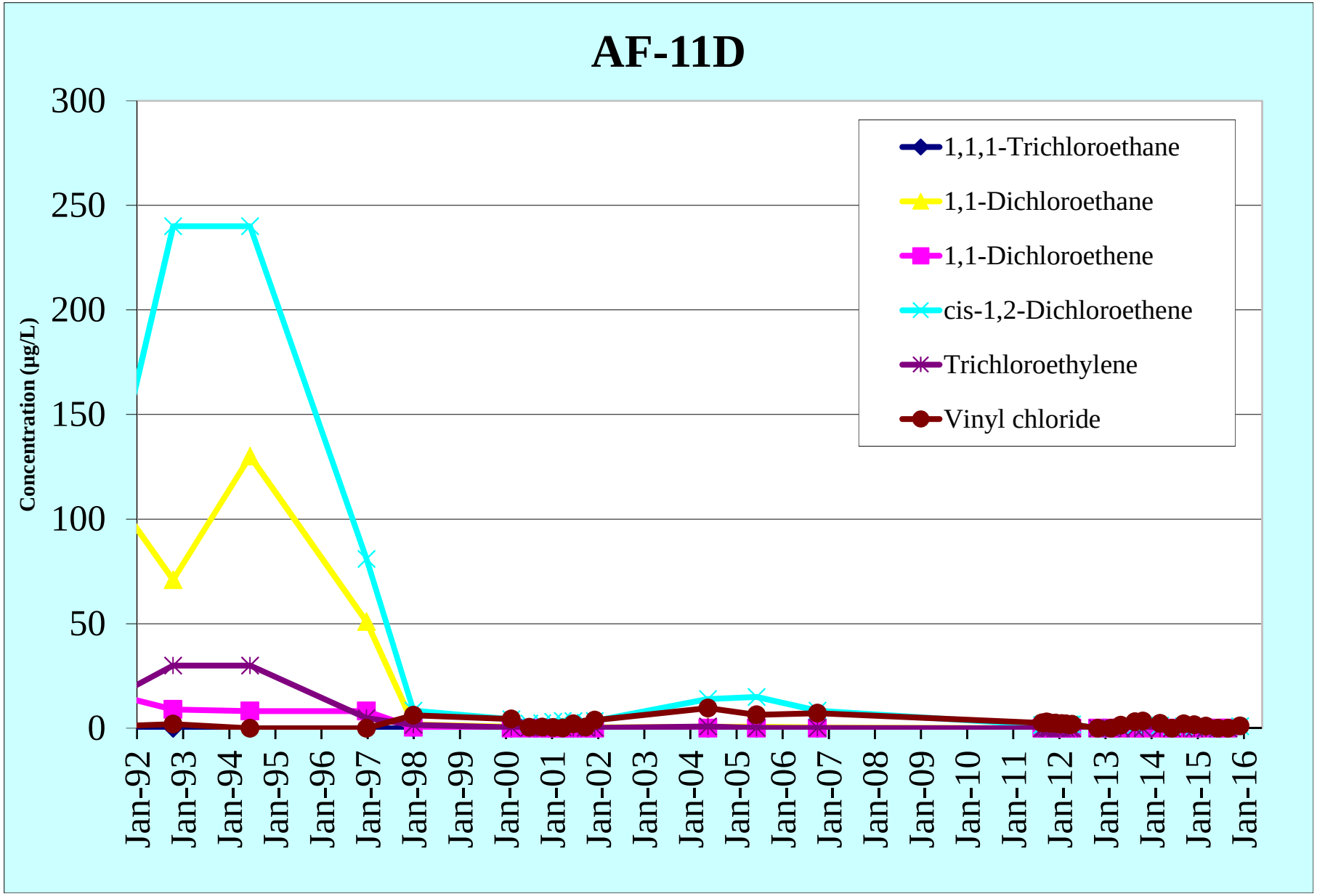

Influent Concentrations - EW-3D
Concentration (ug/L)
500
450
400
350
300
250
200
150
100
50
0
1/1/2012
4/30/2012
8/28/2012
12/26/2012
4/25/2013
8/23/2013
12/21/2013
4/20/2014
8/18/2014
12/16/2014
4/15/2015
8/13/2015
12/11/2015
4/9/2016
1,1,1-Trichloroethane
Trichloroethene
cis-1,2-Dichloroethene
Vinyl chloride

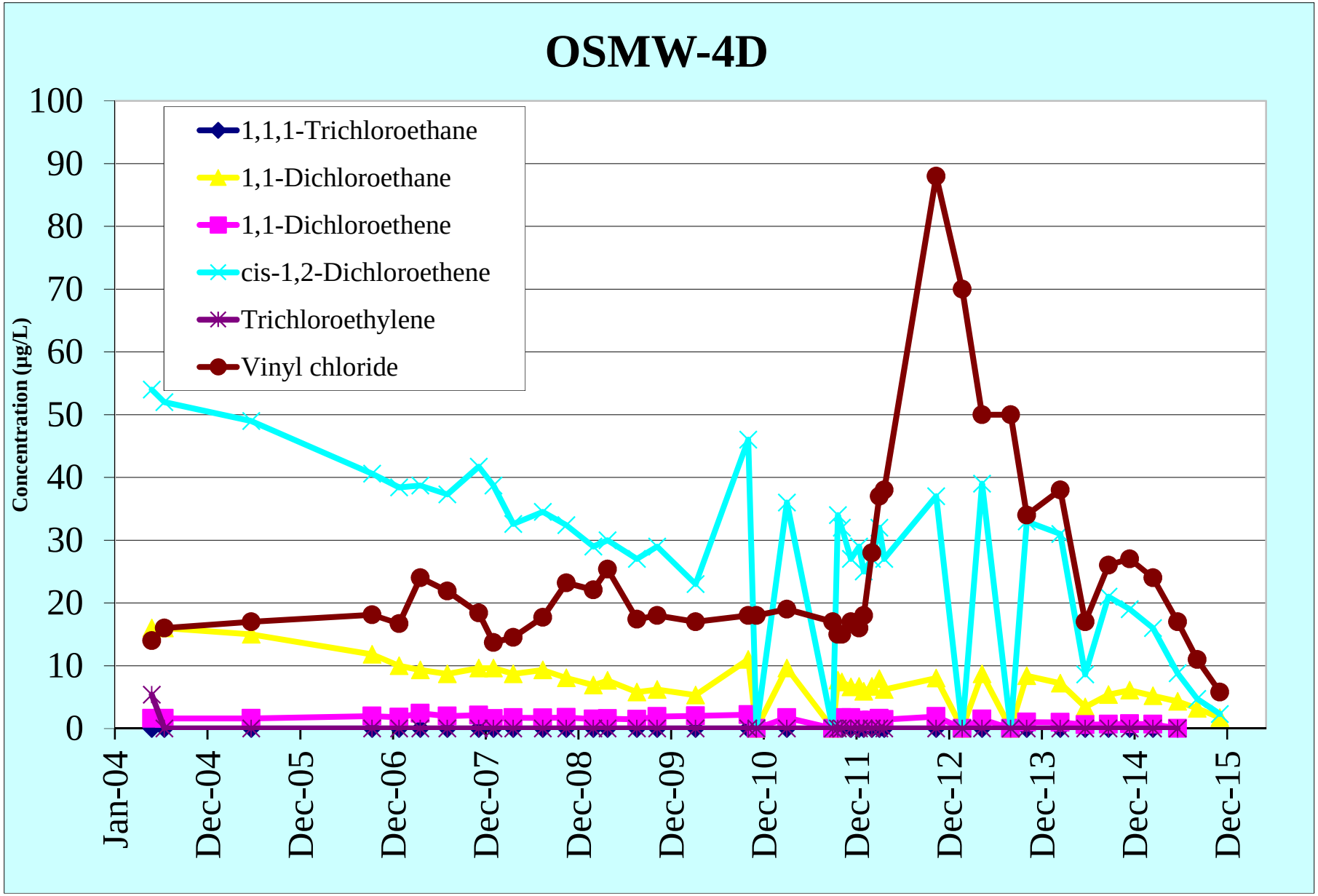

OSMW-3D
Concentration (µg/L)
1100
1000
900
800
700
600
500
400
300
200
100
0
Jan-04
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride

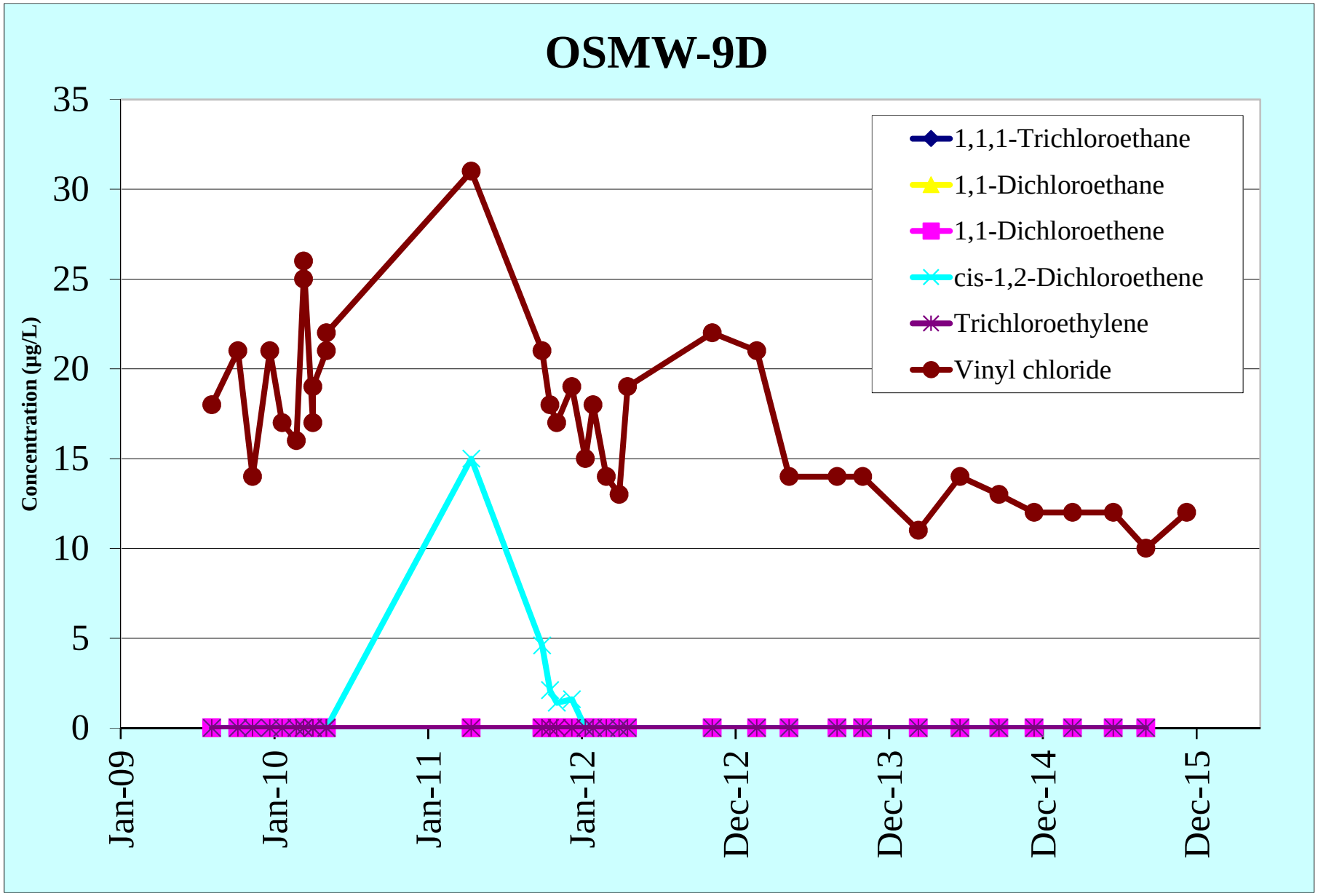

OSMW-6D
Concentration (µg/L)
300
250
200
150
100
50
0
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride
Jan-05
Jan-06
Jan-07
Jan-08
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15


OSMW-8D
Concentration (µg/L)
60
50
40
30
20
10
0
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride
Jan-06
Jan-07
Jan-08
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15


Influent Concentrations - EW-8D
Concentration (ug/L)
20
18
16
14
12
10
8
6
4
2
0
1/1/2012
4/30/2012
8/28/2012
12/26/2012
4/25/2013
8/23/2013
12/21/2013
4/20/2014
8/18/2014
12/16/2014
4/15/2015
8/13/2015
12/11/2015
4/9/2016
1,1,1-Trichloroethane
Trichloroethene
cis-1,2-Dichloroethene
Vinyl chloride


AF-11D
Concentration (µg/L)
300
250
200
150
100
50
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Jan-09
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride


OSMW-4D
Concentration (µg/L)
100
90
80
70
60
50
40
30
20
10
0
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride
Jan-04
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09
Dec-10
Dec-11
Dec-12
Dec-13
Dec-14
Dec-15


OSMW-9D
Concentration (µg/L)
35
30
25
20
15
10
5
0
Jan-09
Jan-10
Jan-11
Jan-12
Dec-12
Dec-13
Dec-14
Dec-15
1,1,1-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
cis-1,2-Dichloroethene
Trichloroethylene
Vinyl chloride