Appendix H
Historical Chemistry Maps and Trend Charts

DATA SUMMARY AND CONCEPTUAL SITE MODEL
TAYLOR WAY AND ALEXANDER AVENUE FILL SITE
TACOMA, WASHINGTON

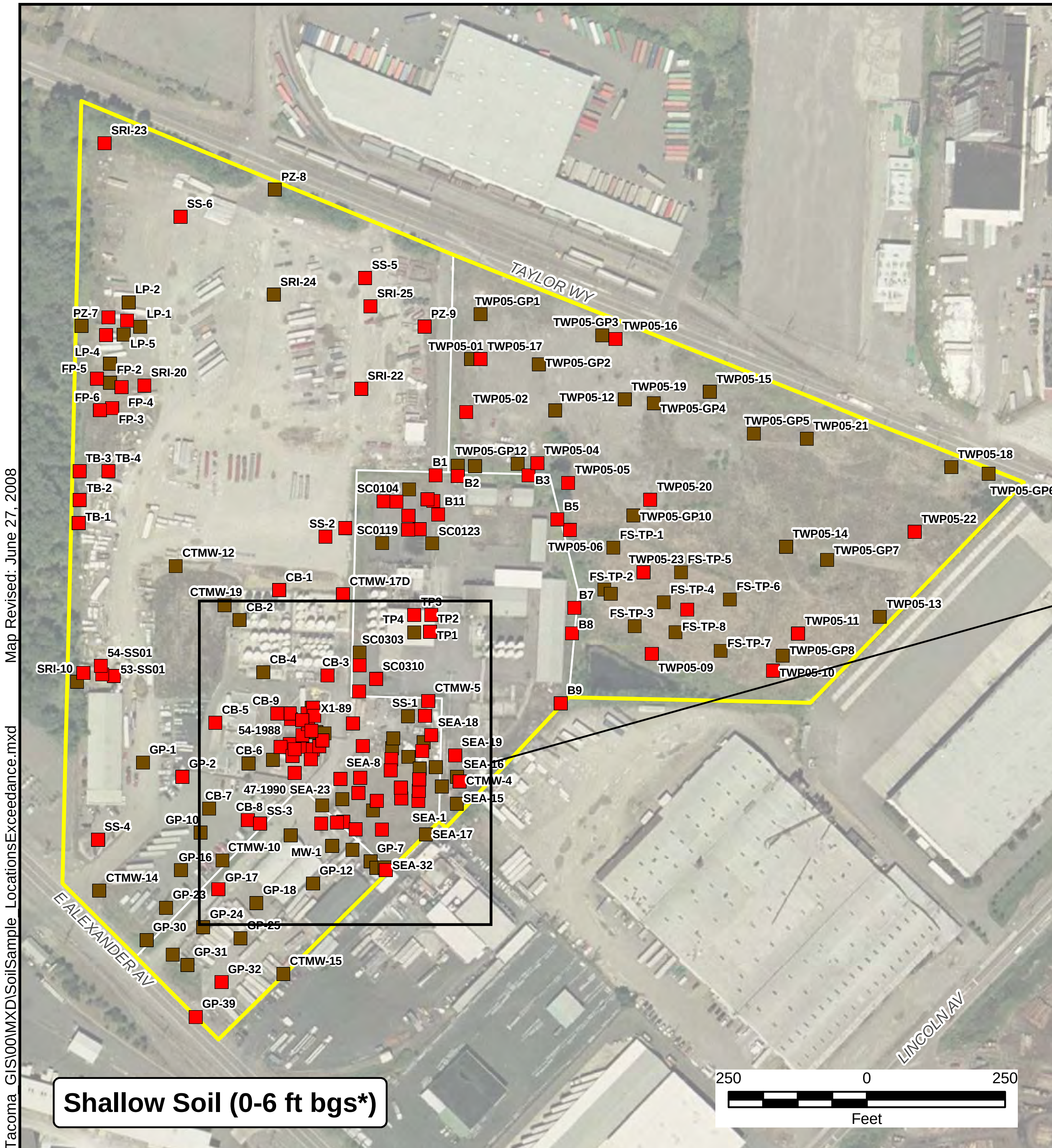
JULY 1, 2008

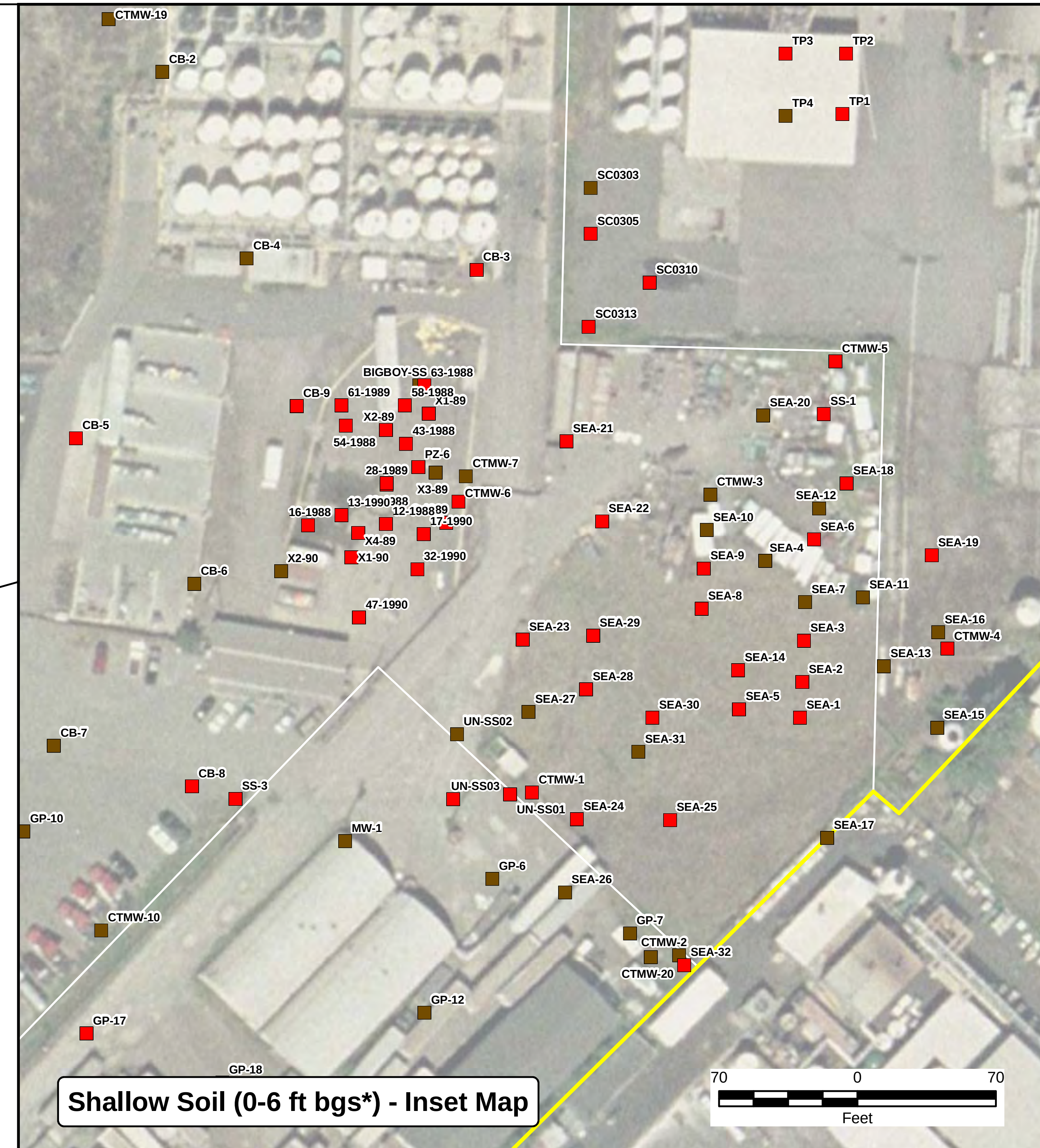
FOR
PORT OF TACOMA

GEOENGINEERS

File No. 0454-116-00

Office: TAC Path: P:\0\0454116 Tacoma GIS\00\MXD\SoilSample_LocationsExceedance.mxd Map Revised: June 27, 2008





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

Lambert Conformal Conic, Washington State Plane North, North American Datum 1983

Explanation

- Sample location exceeding PSC screening value
- Sample locations
- Approximate site boundary

*Below ground surface (bgs)

PROJECT NORTH

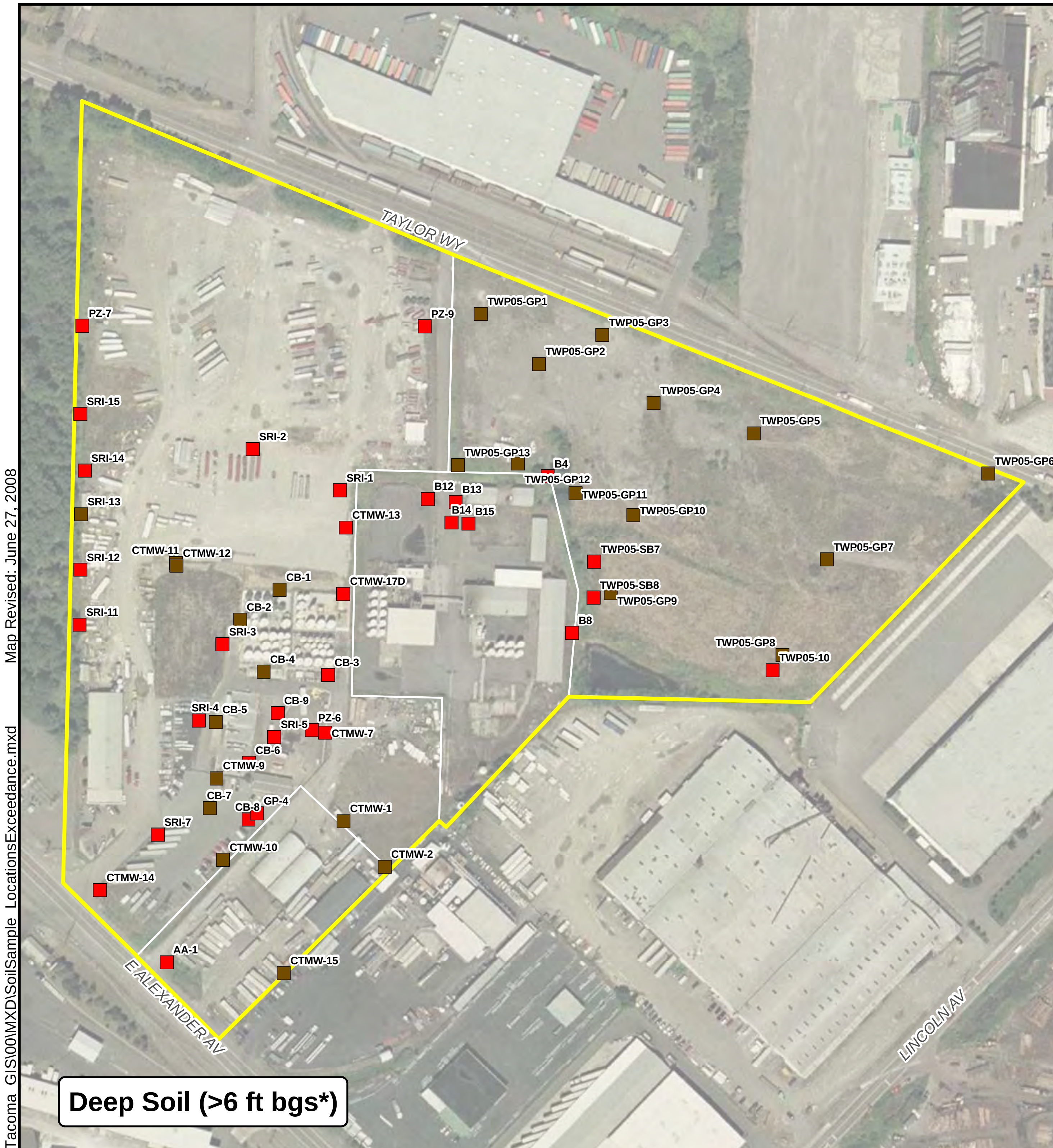
TRUE NORTH

Soil Sample and Exceedance Locations

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 6



Office: TAC Path: P:\0\0454116 Tacoma GIS\00\MXD\SoilSample_LocationsExceedance.mxd Map Revised: June 27, 2008

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

Lambert Conformal Conic, Washington State Plane North, North American Datum 1983

Explanation

- Sample location exceeding PSC screening value
- Sample locations
- Approximate site boundary

*Below ground surface (bgs)

PROJECT NORTH

TRUE NORTH

250 0 250

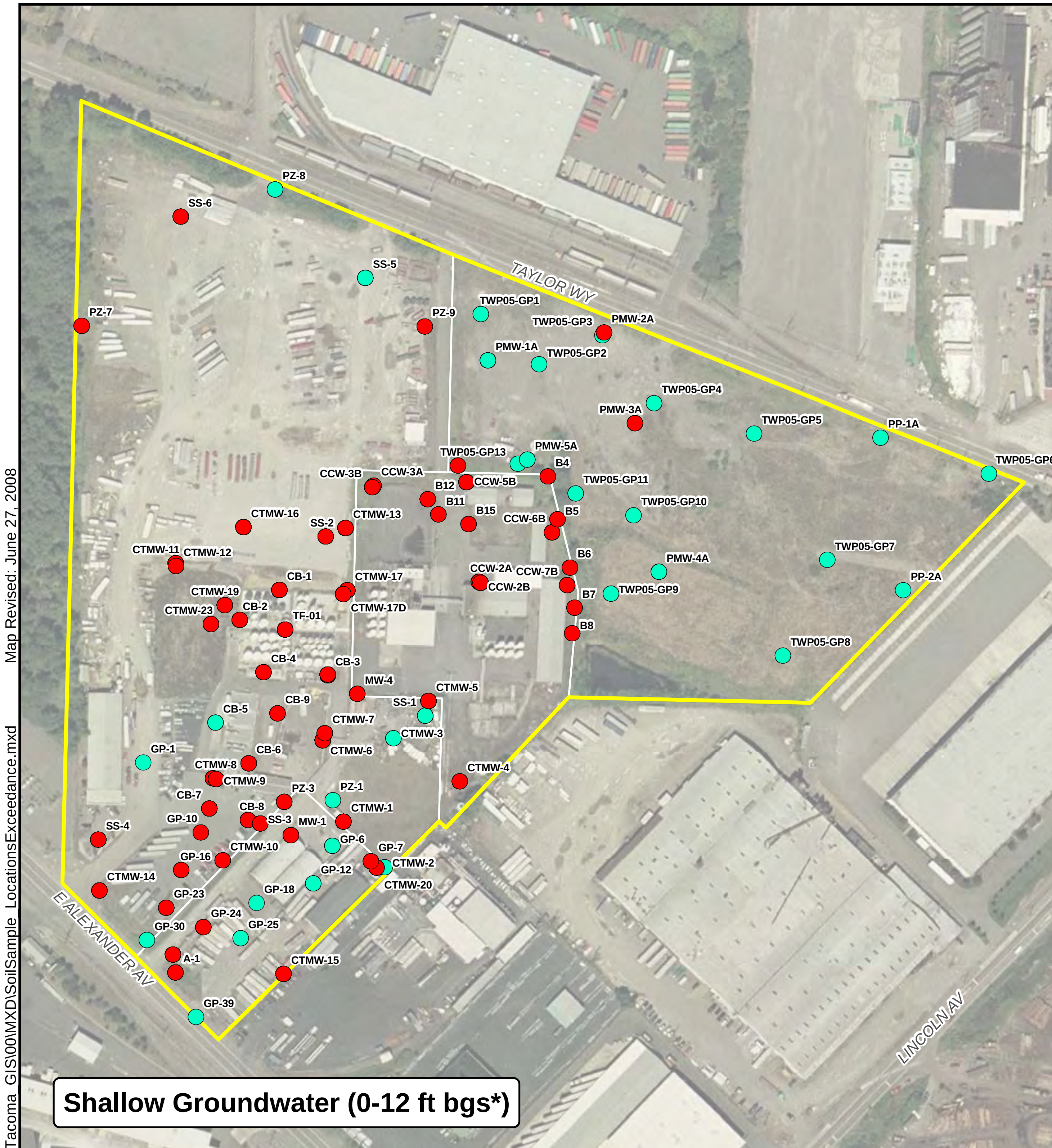
Feet

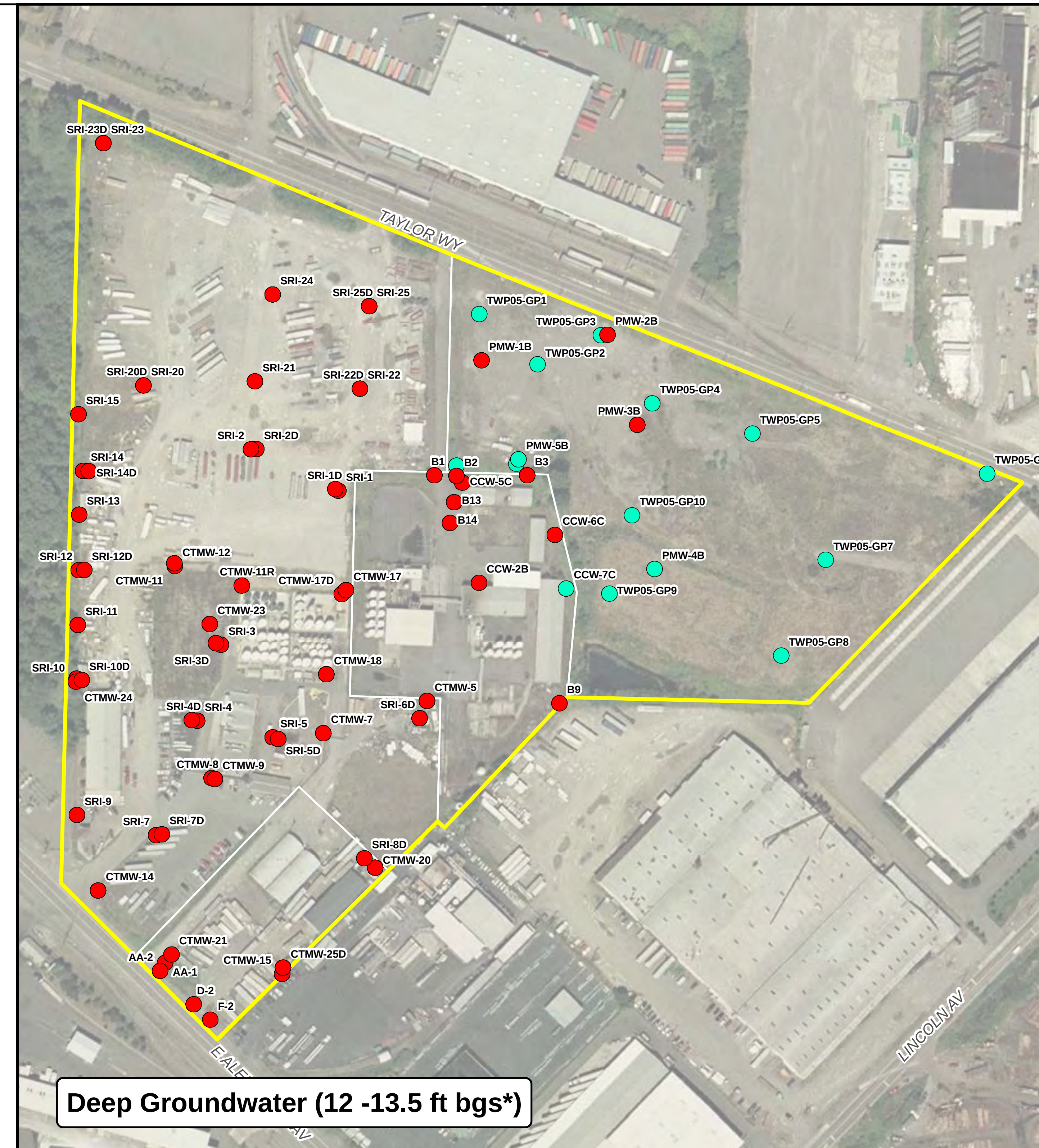
Soil Sample and Exceedance Locations

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 7





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

Lambert Conformal Conic, Washington State Plane North, North American Datum 1983

Explanation

- Sample location exceeding PSC screening value
- Sample locations
- Approximate site boundary

*Below ground surface (bgs)

PROJECT NORTH

TRUE NORTH

250 0 250

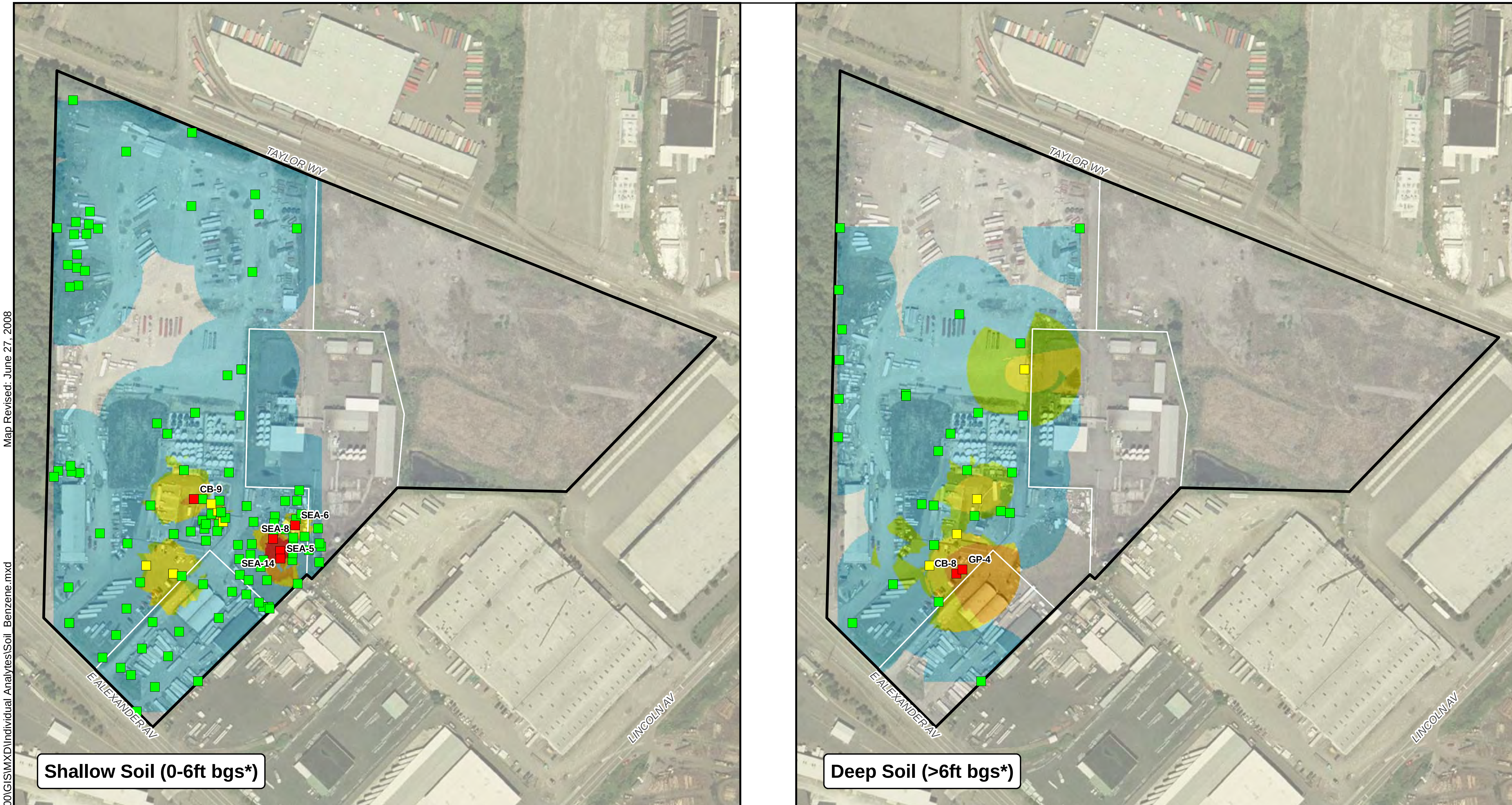
Feet

Groundwater Sample and Exceedance Locations

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 8



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: protection of groundwater

Benzene (mg/kg)

- <0.001
- 0.001 - 0.01
- 0.01 - 0.128
- 0.128** - 1
- >1

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

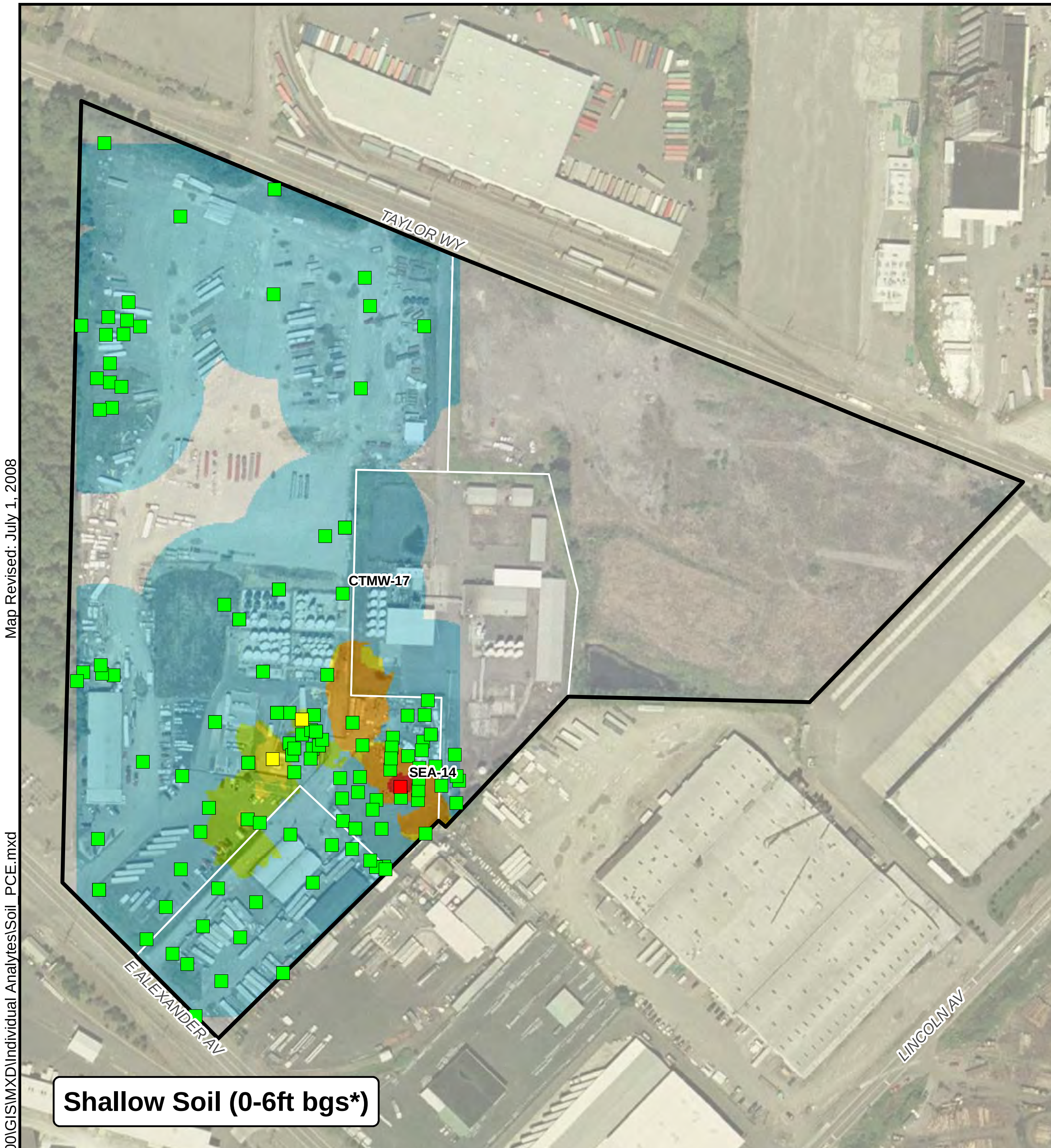
Benzene in Soil

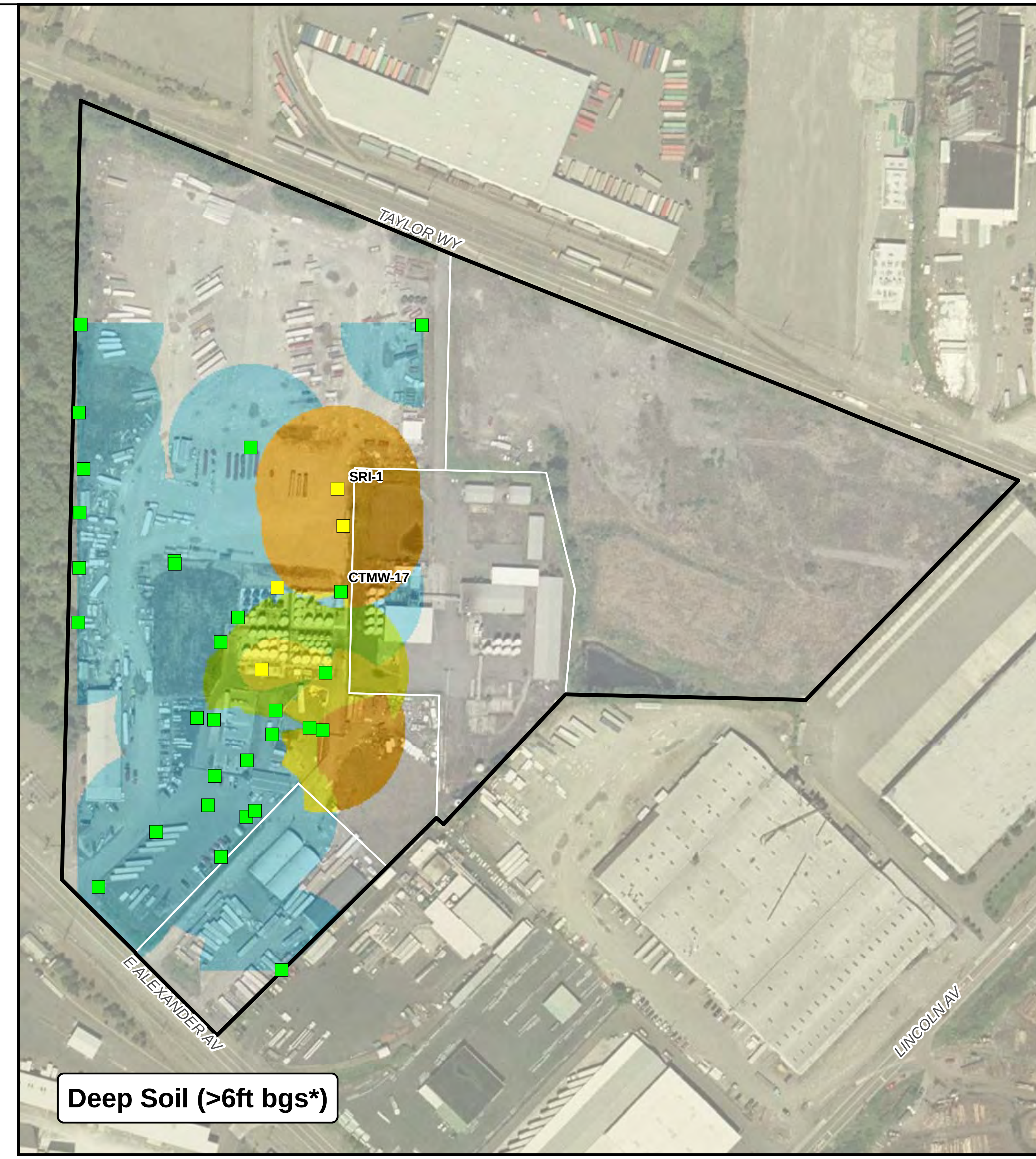
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 9

Office: TAC
Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Benzene.mxd
Map Revised: June 27, 2008





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: protection of groundwater

Tetrachloroethene (mg/kg)

- <0.0001
- 0.0001 - 0.001
- 0.001 - 0.053
- 0.053** - 25
- >25

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

Tetrachloroethene in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

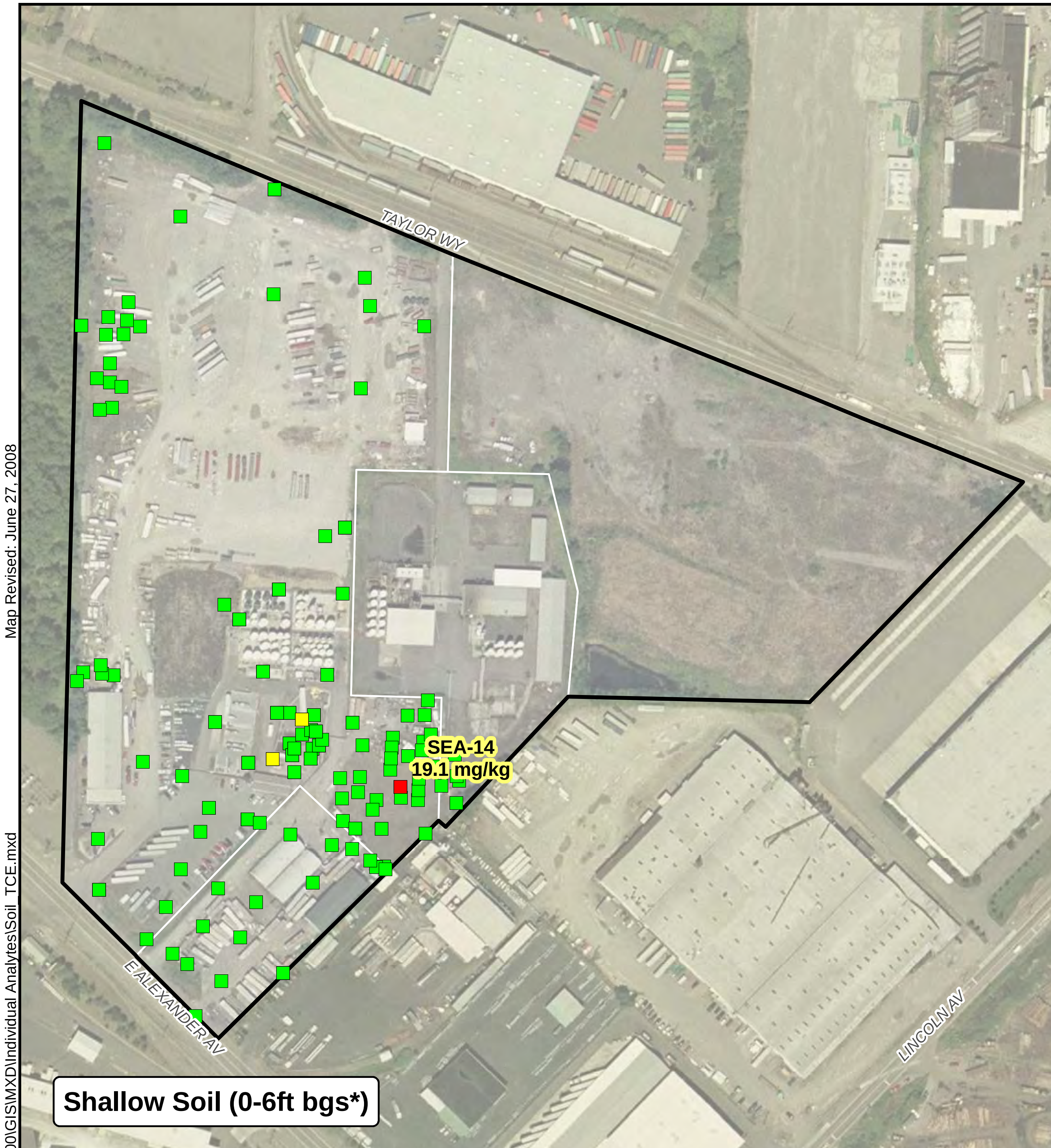
Figure 10

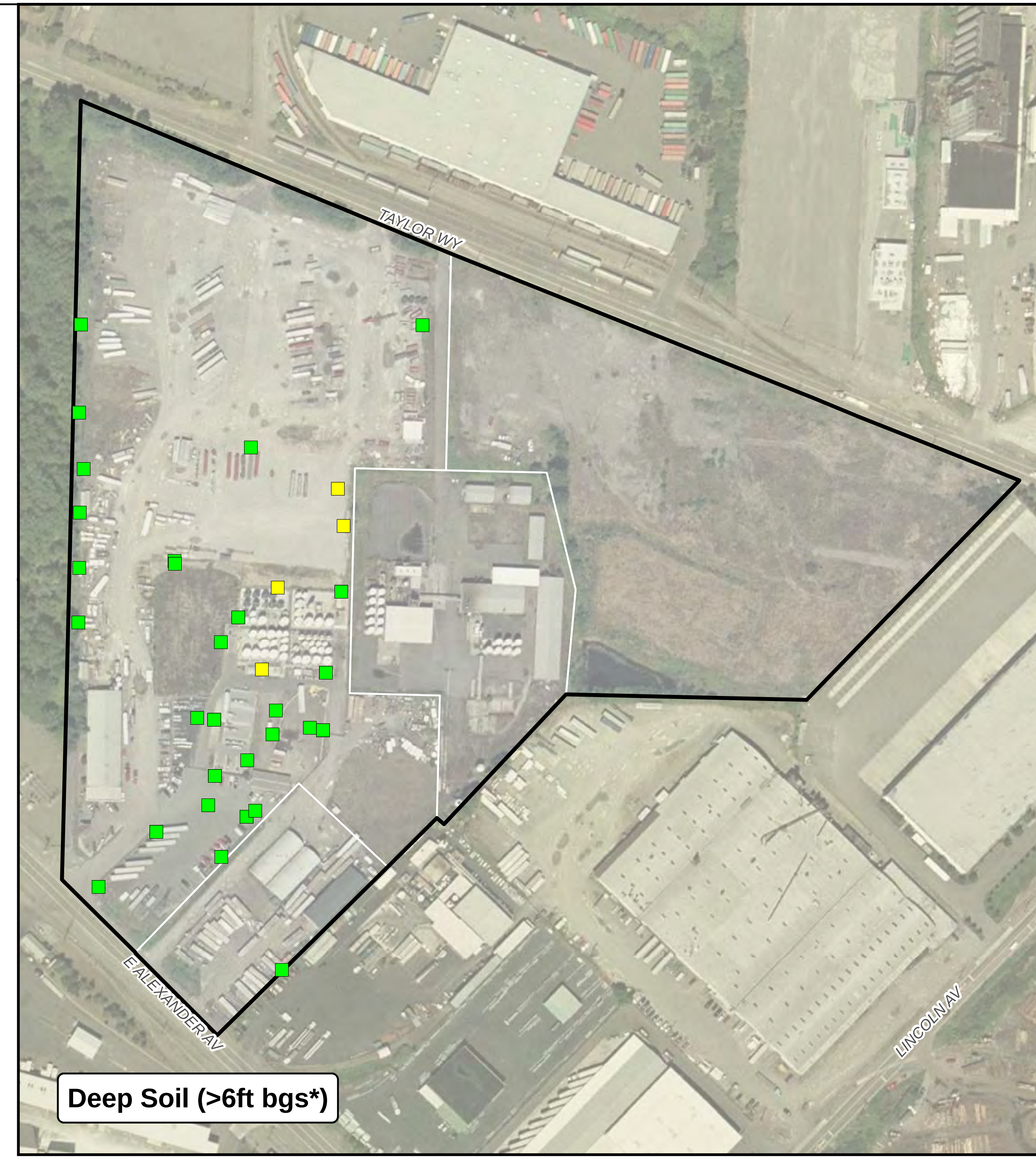
Map Revised: July 1, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_PCE.mxd

Office: TAC

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_TCE.mxd Map Revised: June 27, 2008





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level (red)
- Analyte detected (yellow)
- Analyte non-detect (green)

*Below ground surface (bgs)

PSC screening level = 0.368 mg/kg
Screening level basis: protection of water

PROJECT NORTH
TRUE NORTH

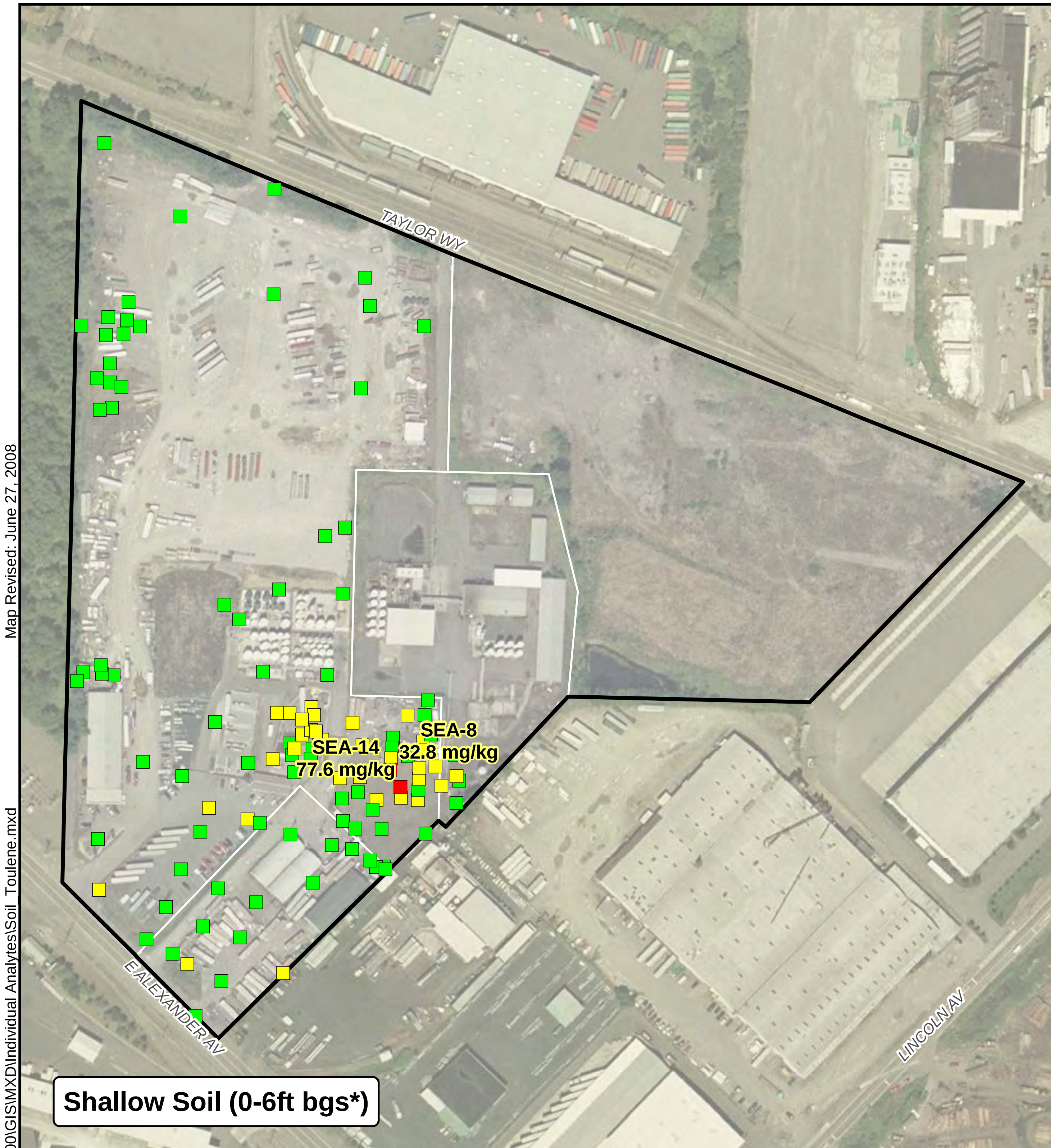
250 0 250
Feet

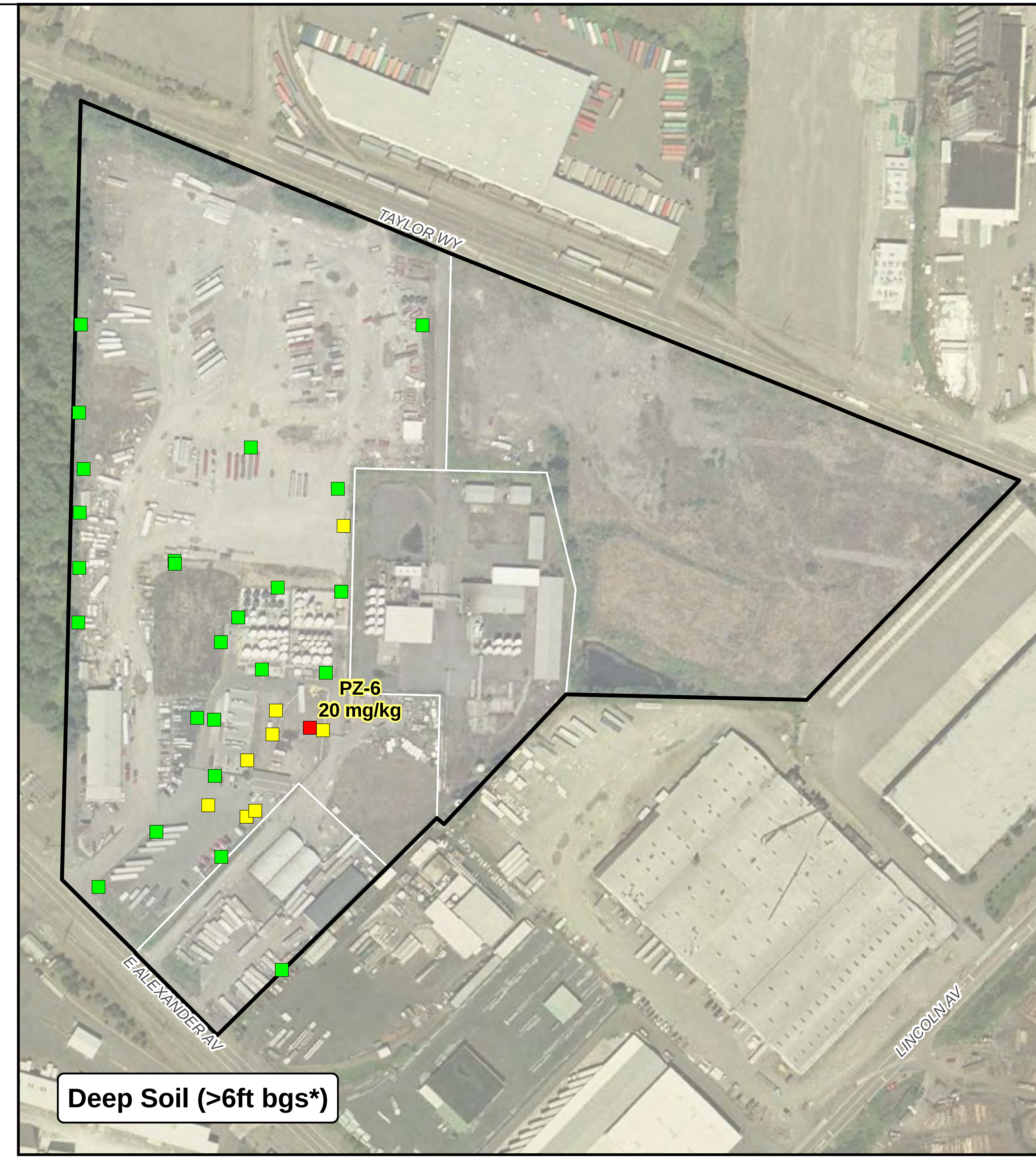
Trichloroethene in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 11





Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Toulene.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 15.5 mg/kg
Screening level basis: protection of groundwater

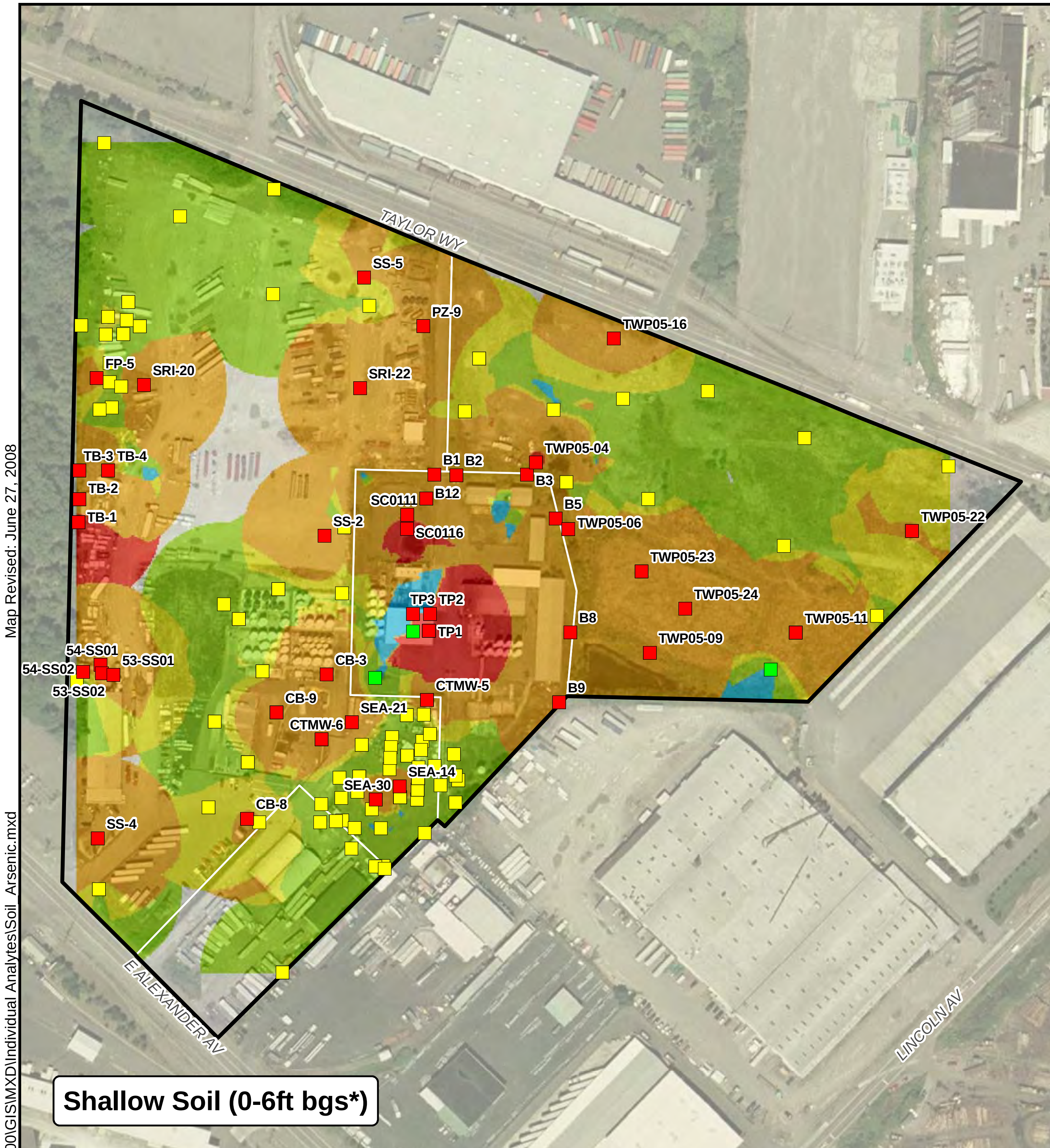
250 0 250
Feet

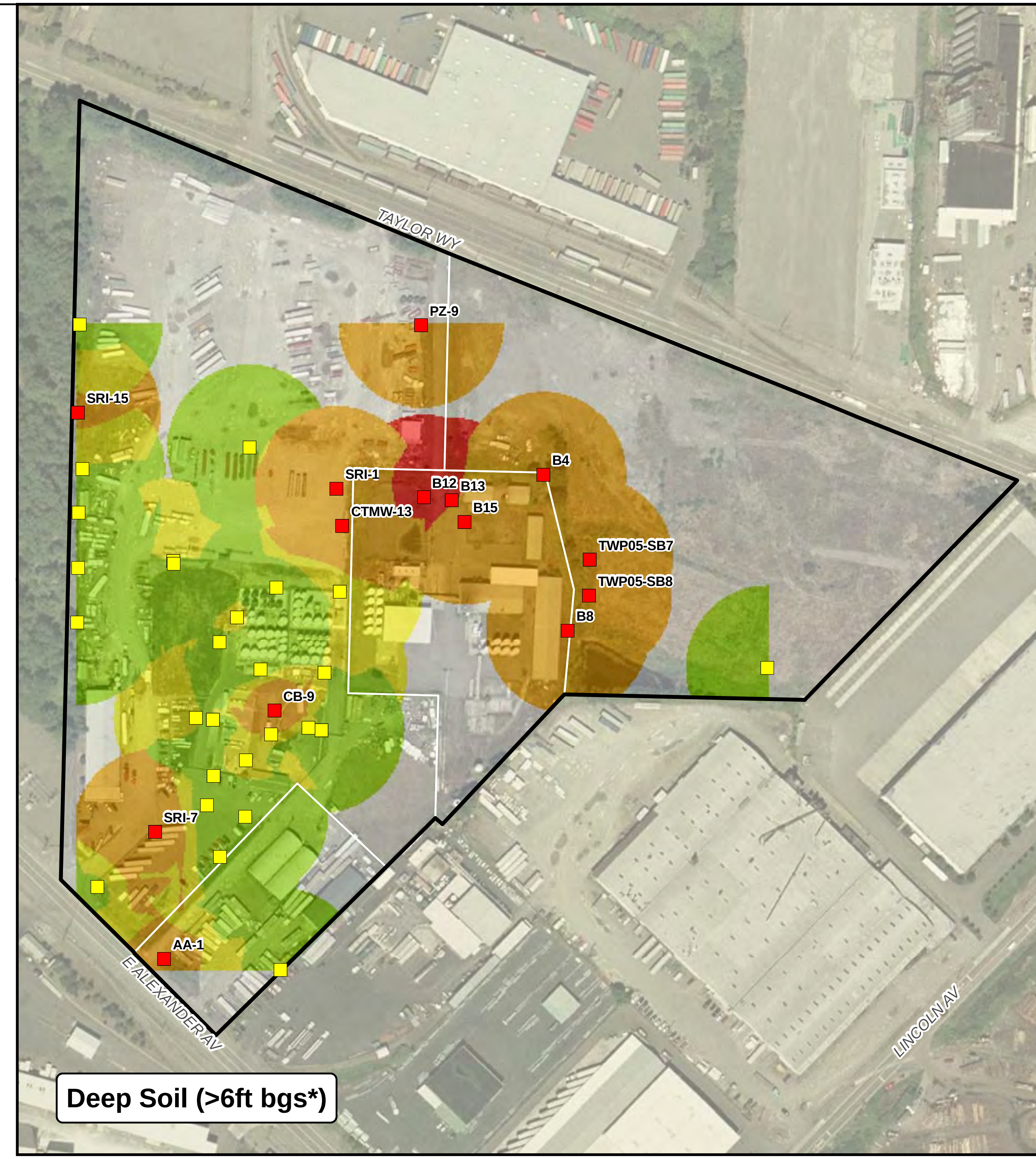
Toluene in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 12





Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Arsenic.mxd

Office: TAC

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

Arsenic (mg/kg)

- <1
- 1 - 5
- 5 - 7.3
- 7.3** - 100
- >100

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: natural background

PROJECT NORTH

TRUE NORTH

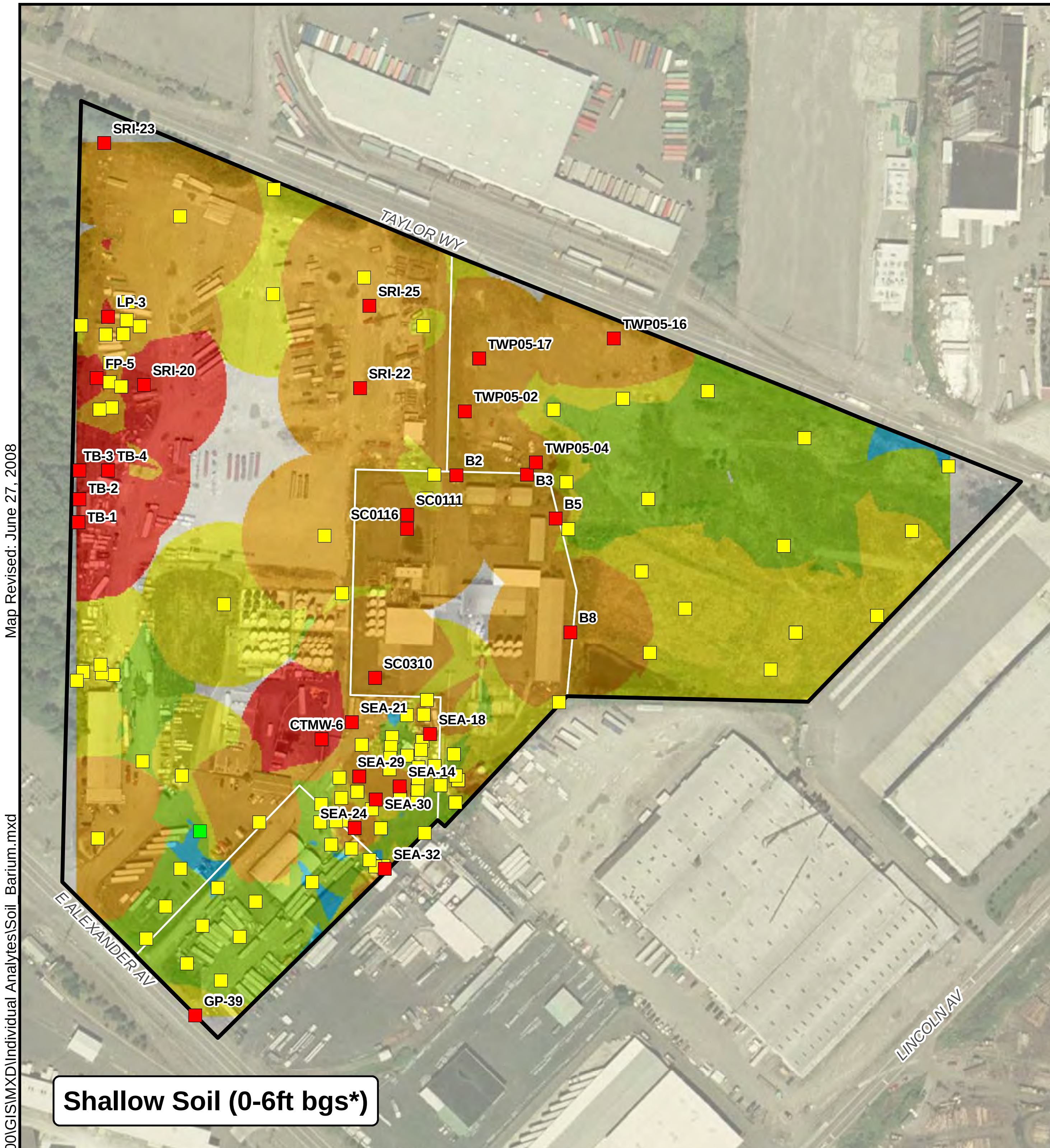
250 0 250
Feet

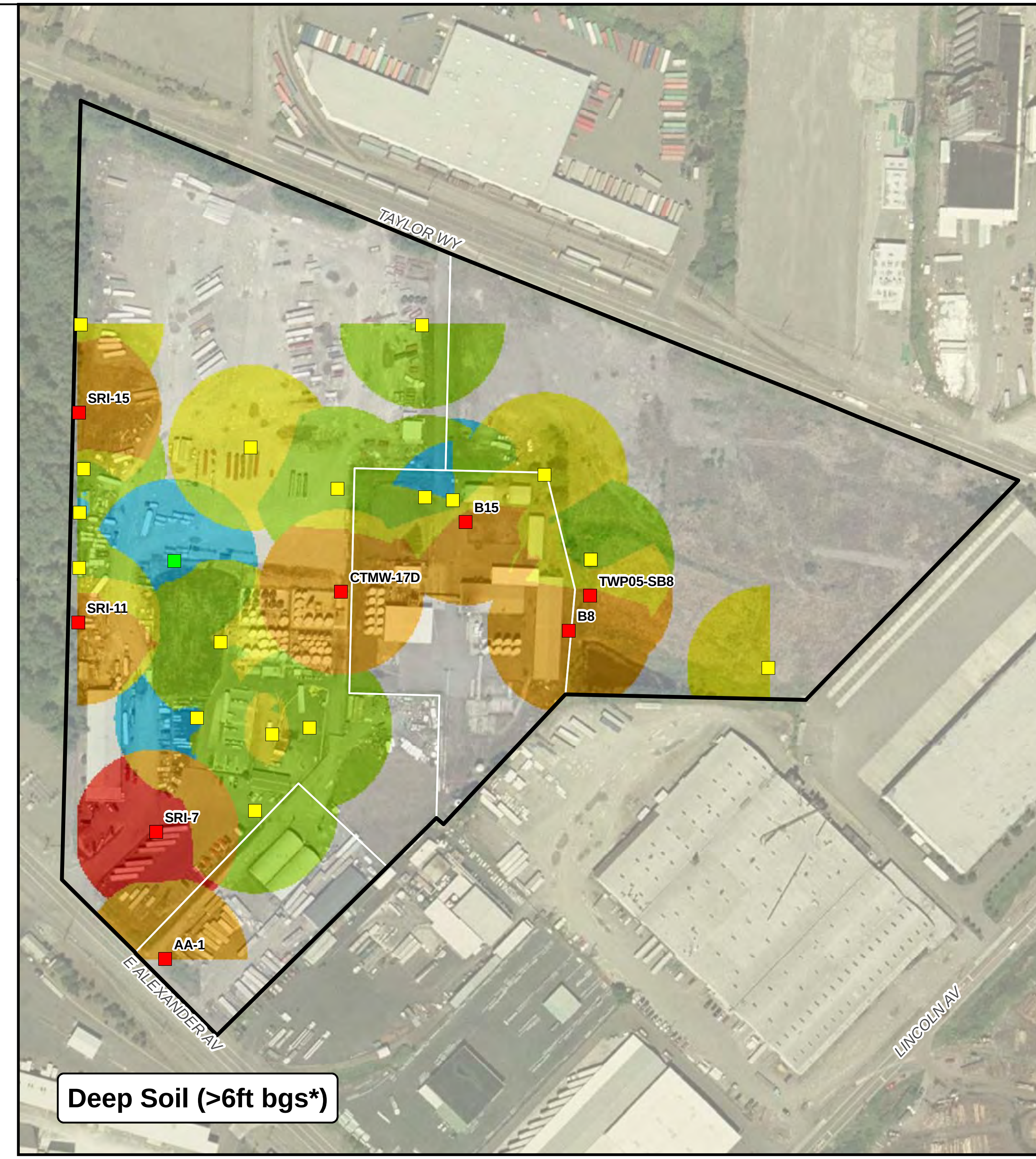
Arsenic in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GeoEngineers

Figure 13





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis:
protection of ecological receptors

Barium (mg/kg)

- <10
- 10 - 50
- 50 - 102
- 102** - 1,000
- >1,000

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

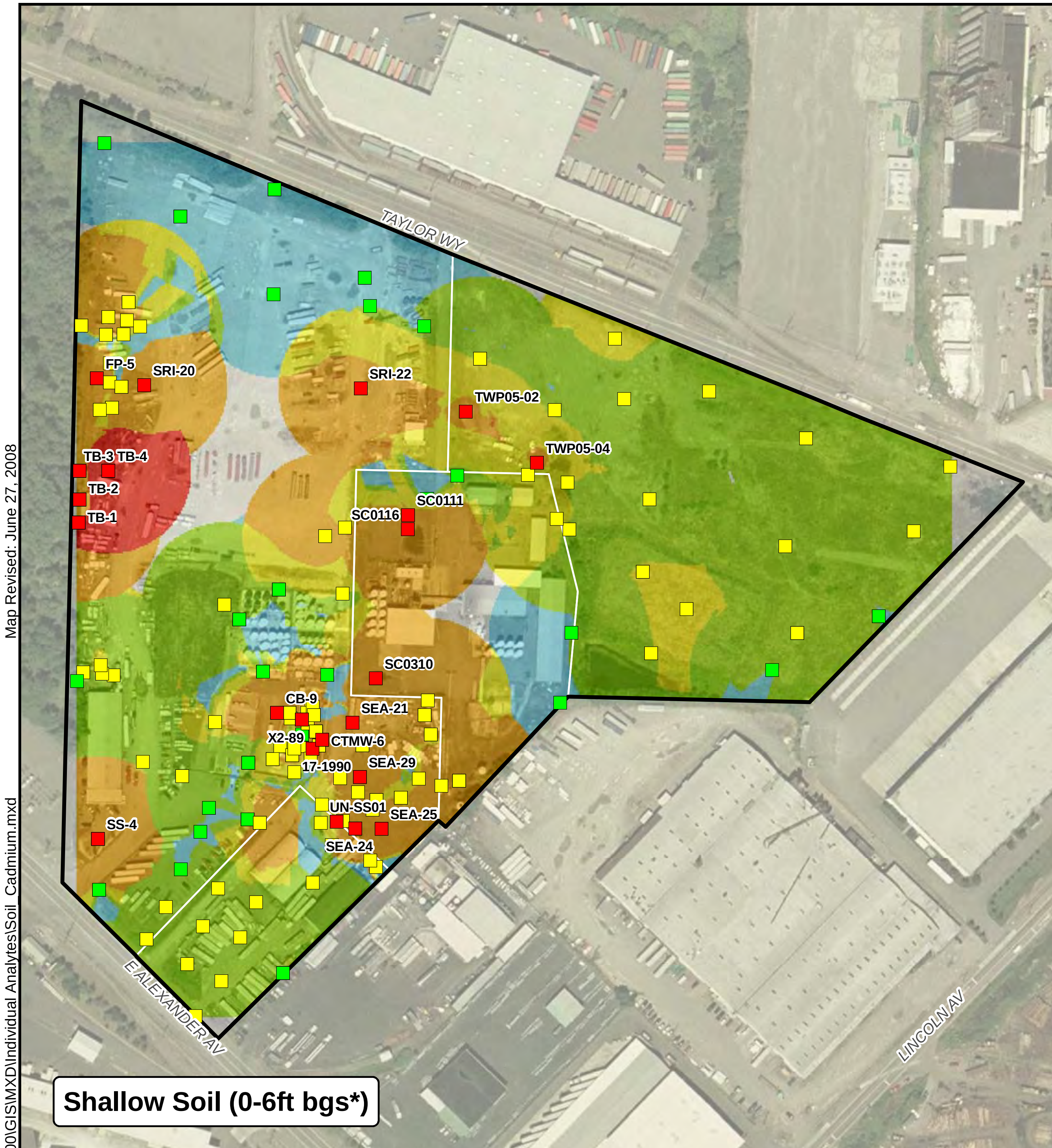
Barium in Soil

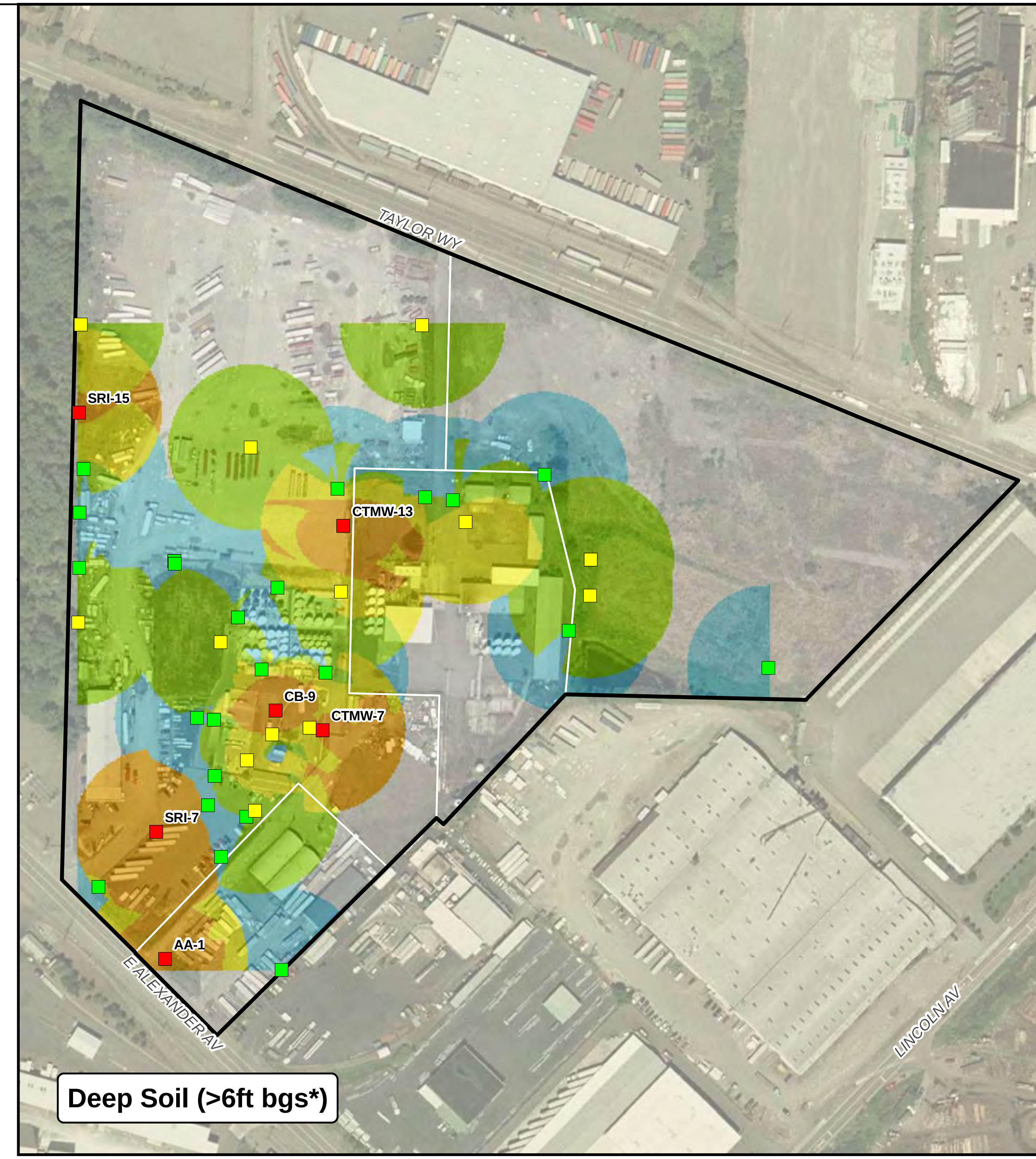
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 14

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Barium.mxd Map Revised: June 27, 2008





Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Cadmium.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: protection of groundwater

Cadmium (mg/kg)

- <0.01
- 0.01 - 1
- 1 - 5.52
- 5.52** - 1,000
- >1,000

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

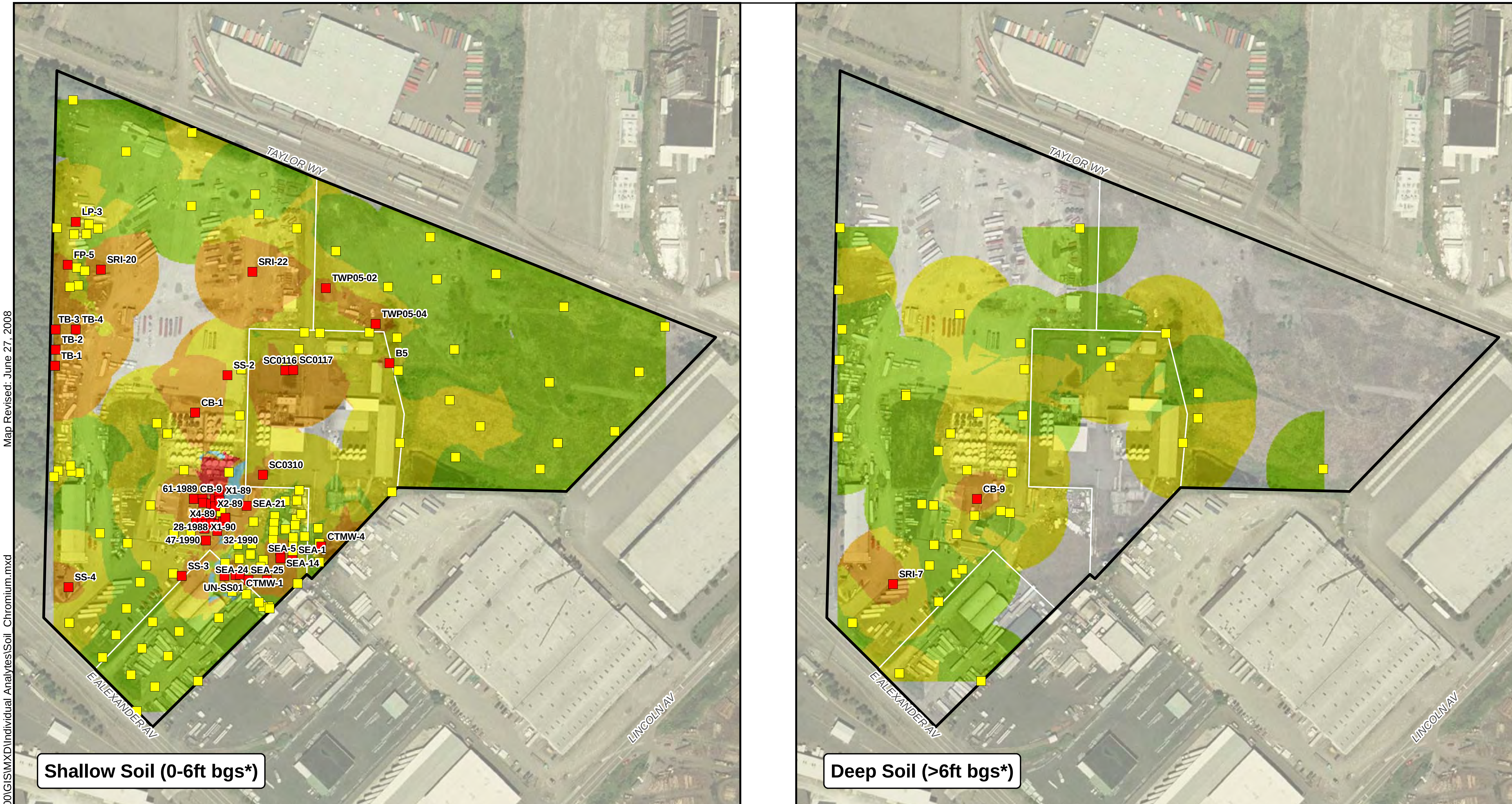
Cadmium in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 15

Map Revised: June 27, 2008



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: natural background

Chromium (mg/kg)

- <0.1
- 0.1 - 20
- 20 - 48.2
- 48.2** - 1,000
- >1,000

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

Chromium in Soil

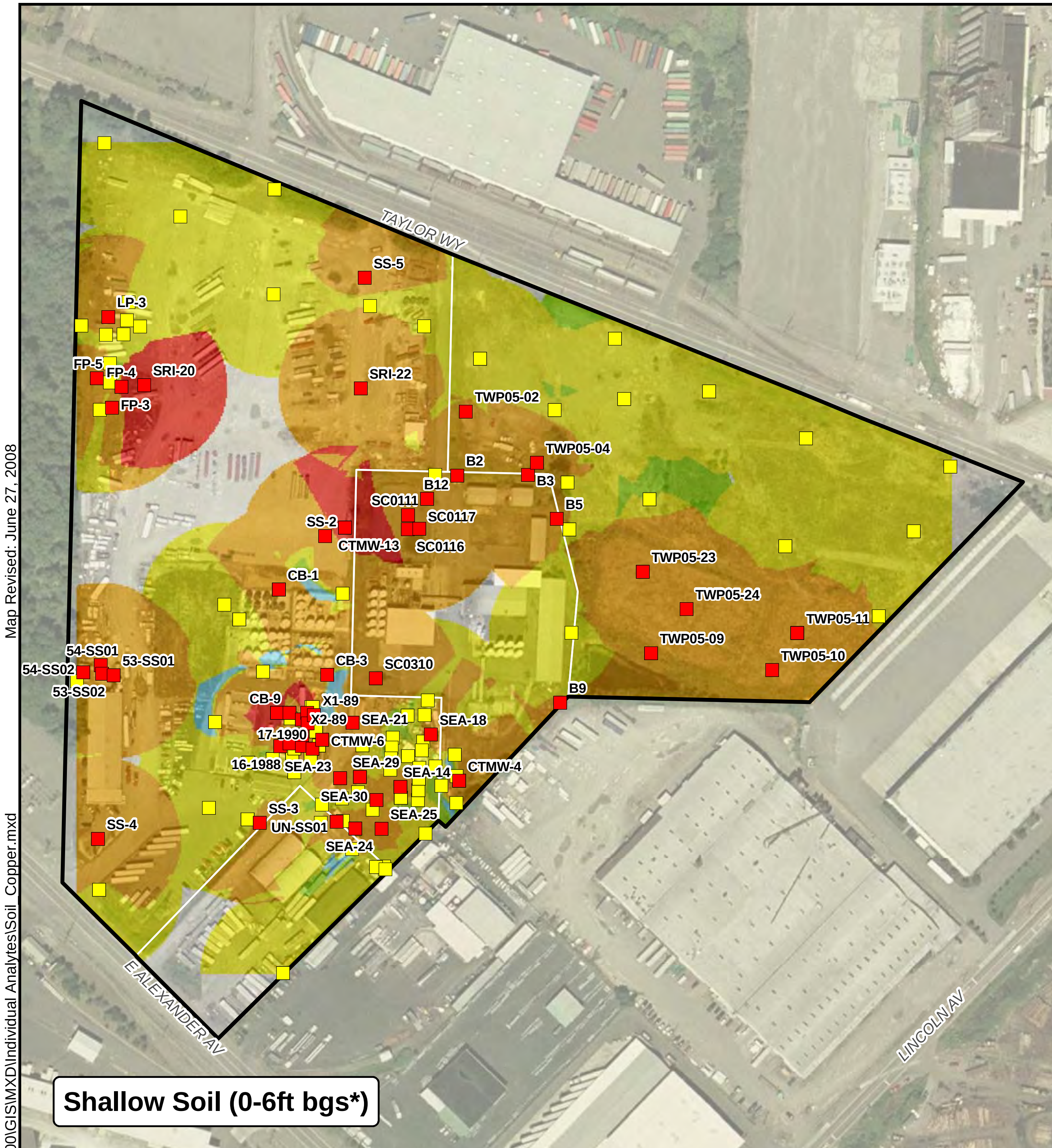
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

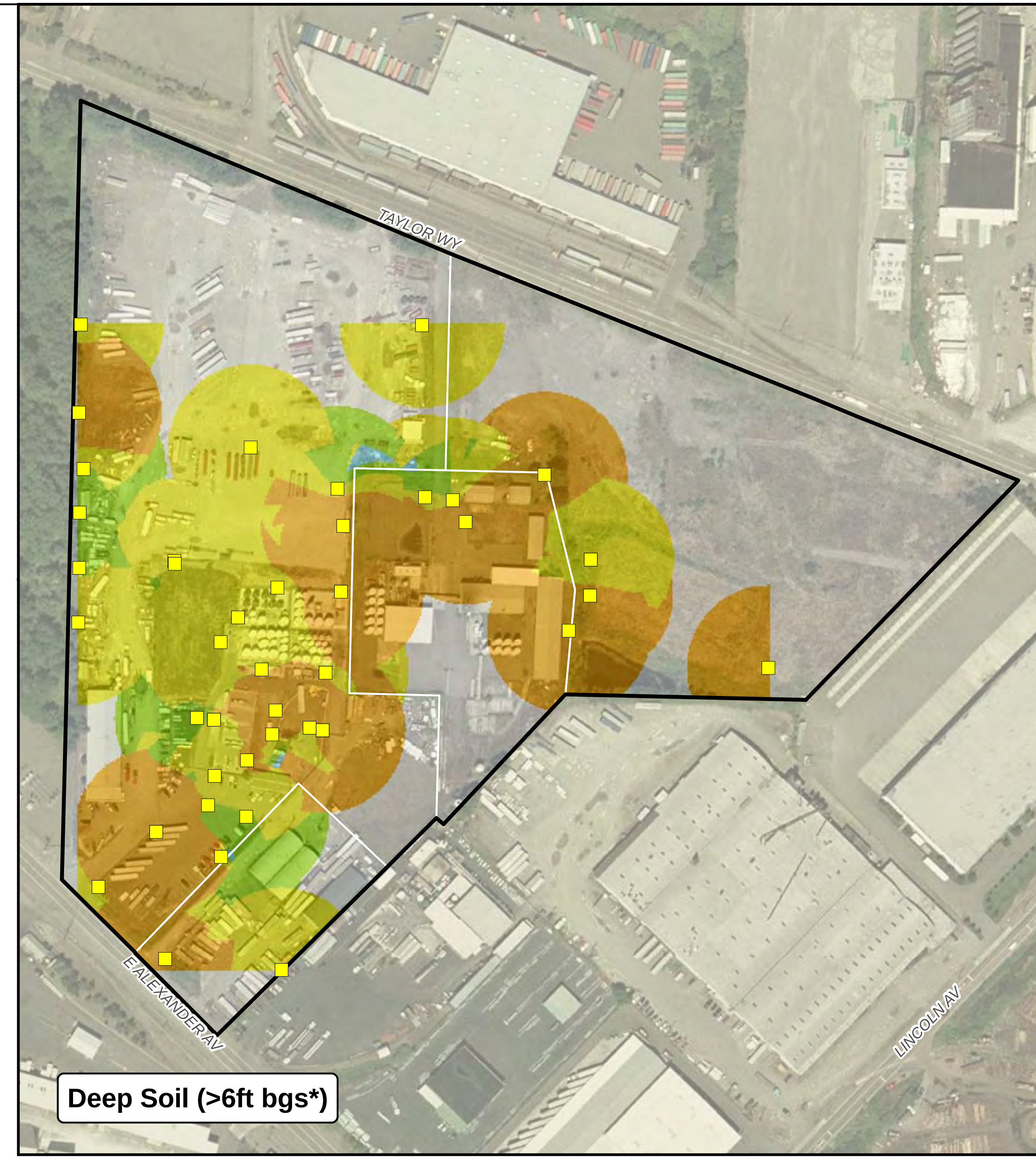
GEOENGINEERS

Figure 16

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Chromium.mxd

Office: TAC





Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Copper.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

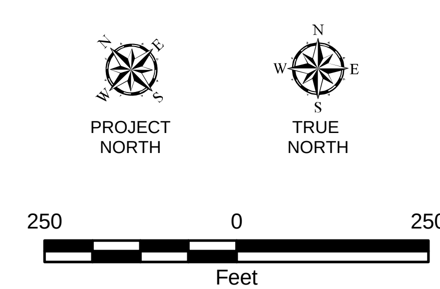
- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: natural background

Copper (mg/kg)

- <0.1
- 0.1 - 10
- 10 - 36.4
- 36.4** - 1,000
- >1,000

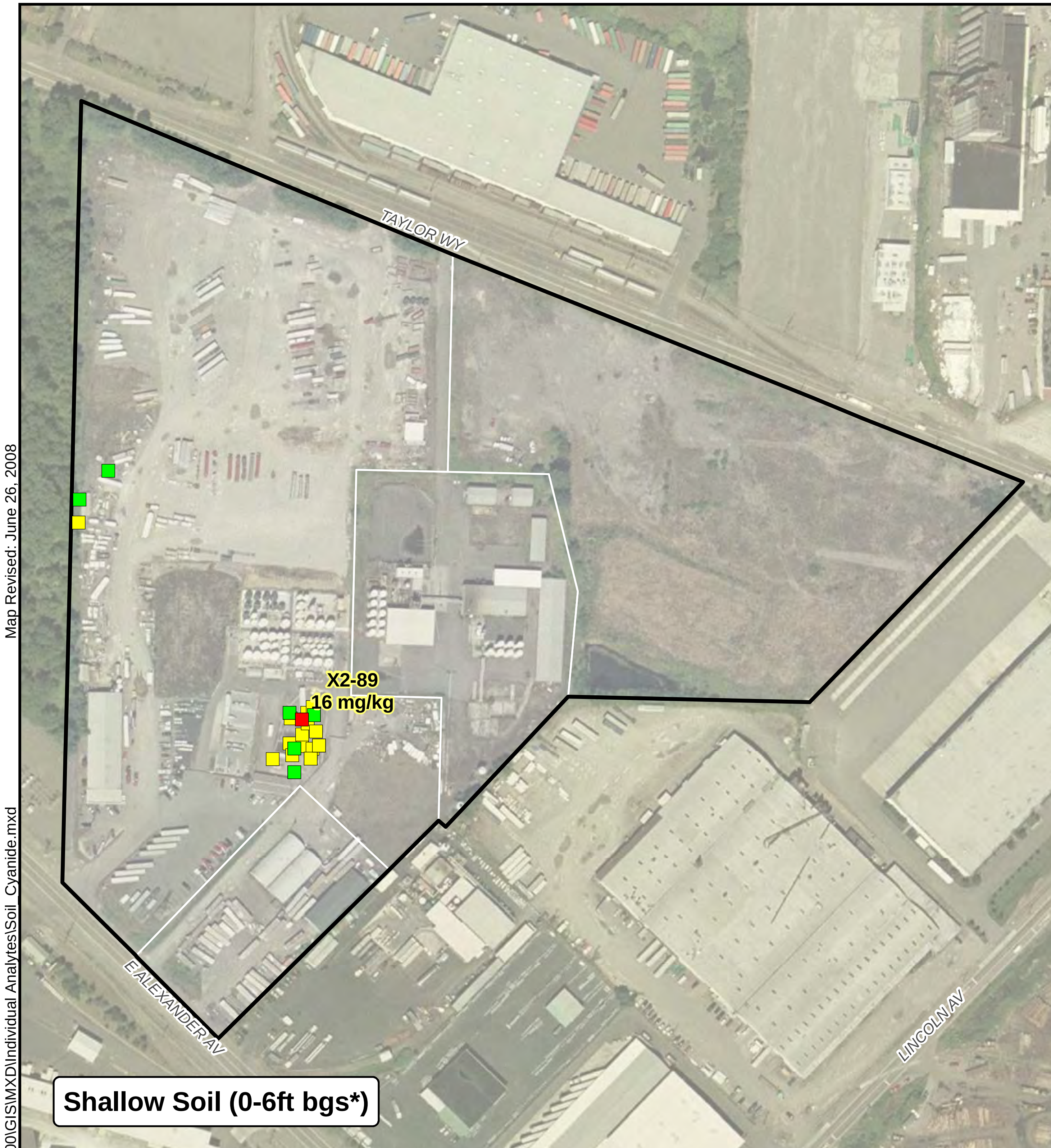


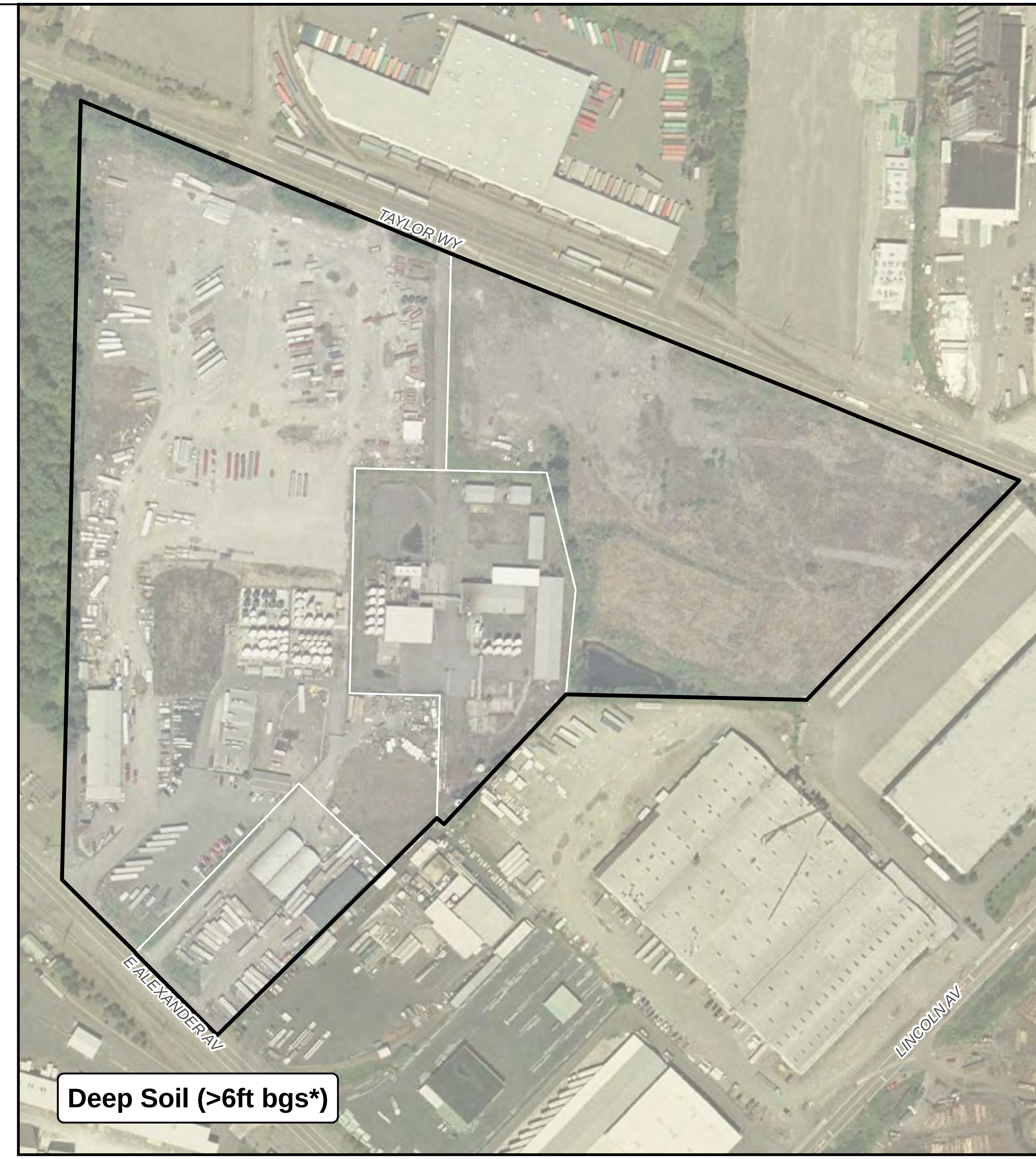
Copper in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 17





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 10.1 mg/kg
Screening level basis: protection of groundwater

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

Cyanide in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

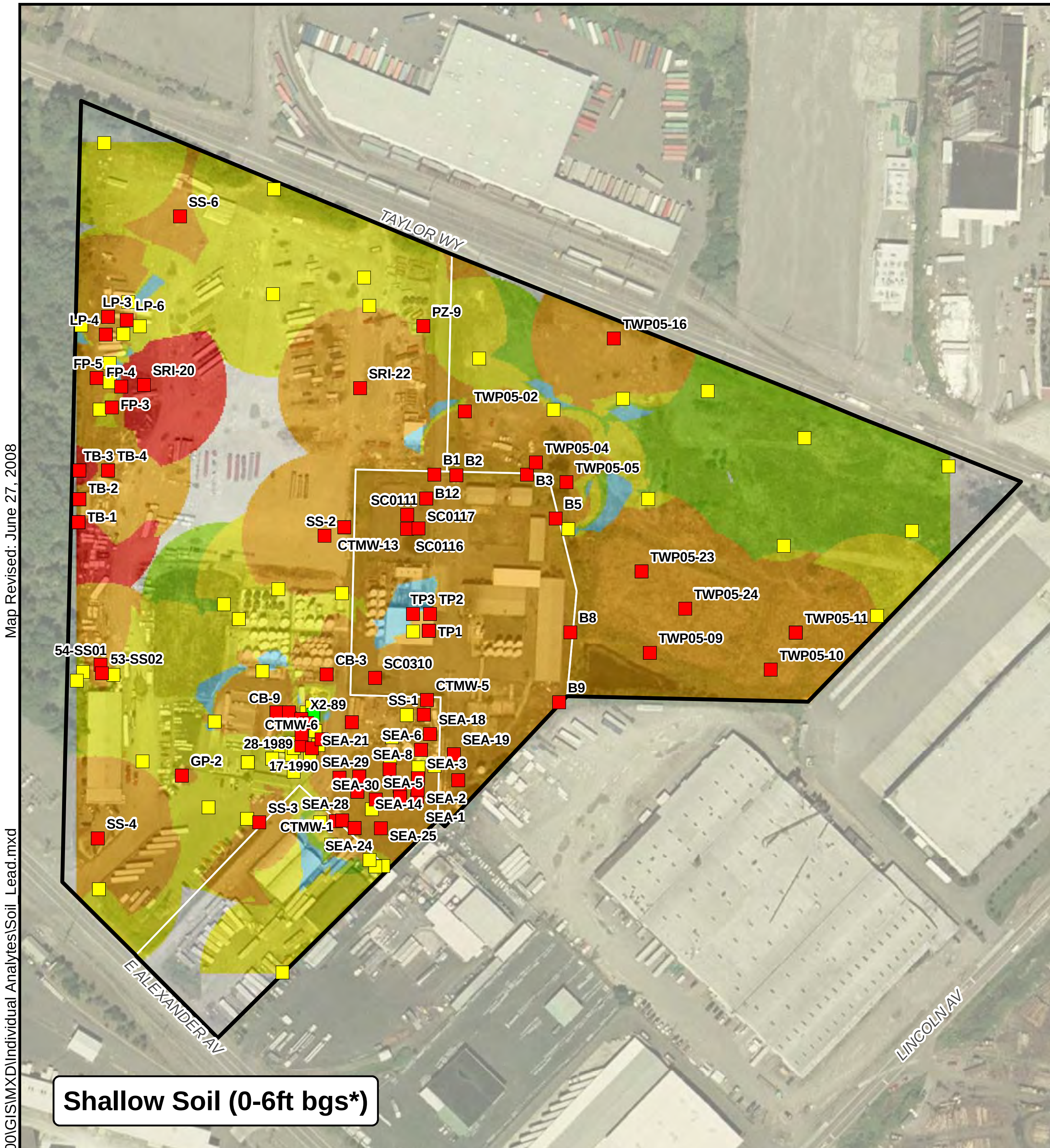
GEOENGINEERS

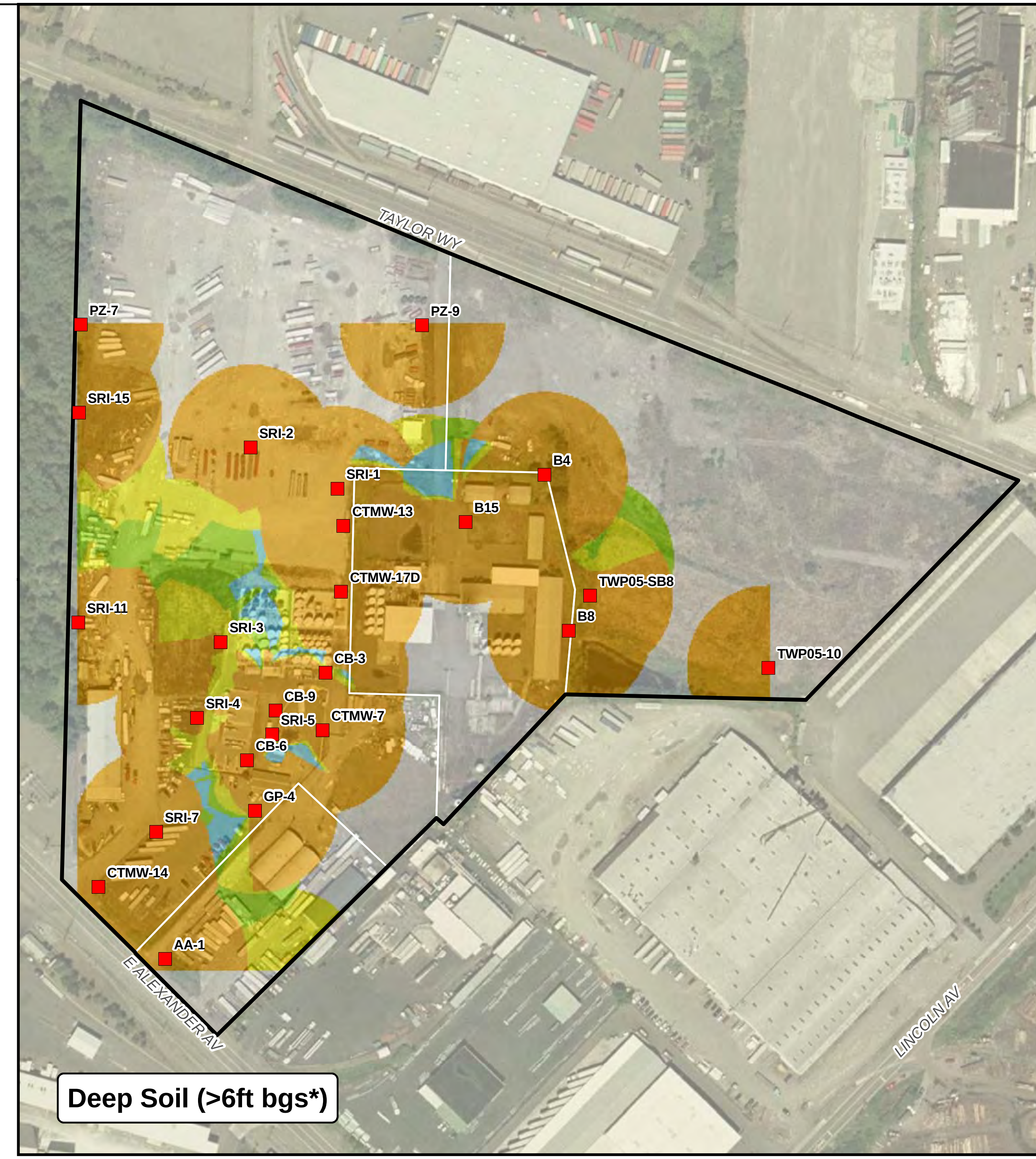
Figure 18

Map Revised: June 26, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Cyanide.mxd

Office: TAC





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: natural background

Lead (mg/kg)

- <0.1
- 0.1 - 5
- 5 - 24
- 24** - 5,000
- >5,000

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

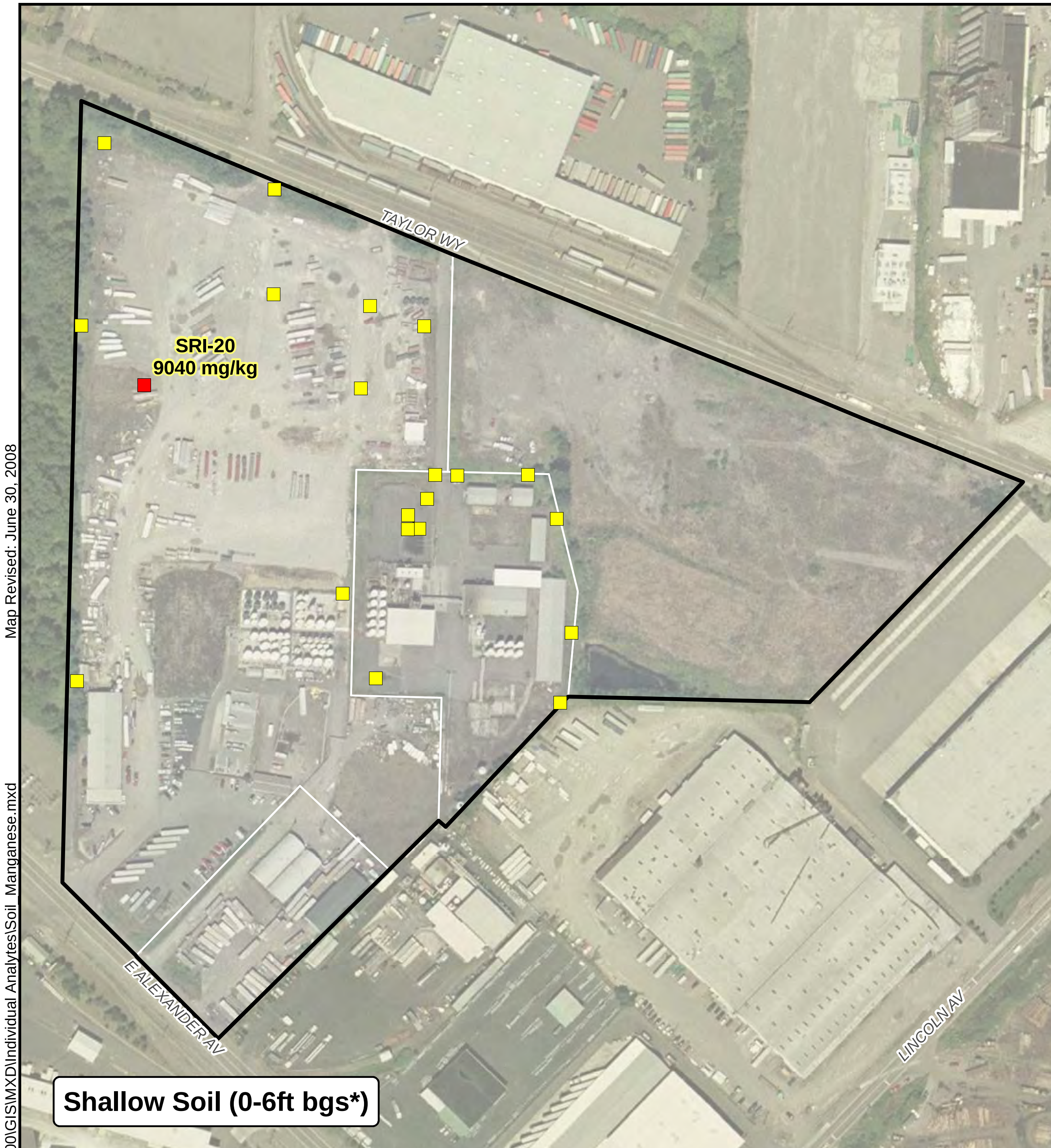
Lead in Soil

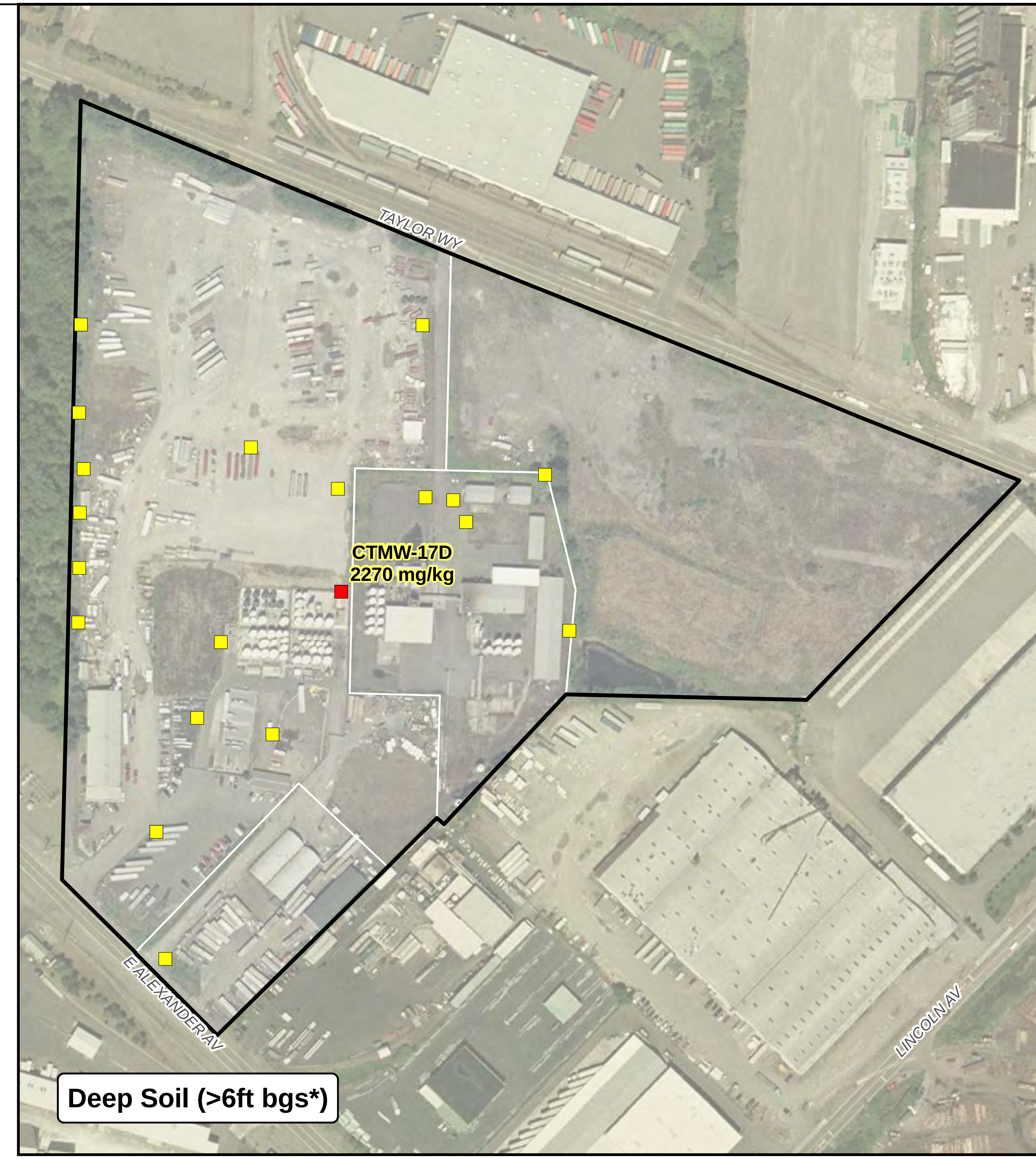
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 19

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Lead.mxd Map Revised: June 27, 2008





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 1,500 mg/kg
Screening level basis: protection of ecological receptors

N W E S

250 0 250
Feet

Manganese in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

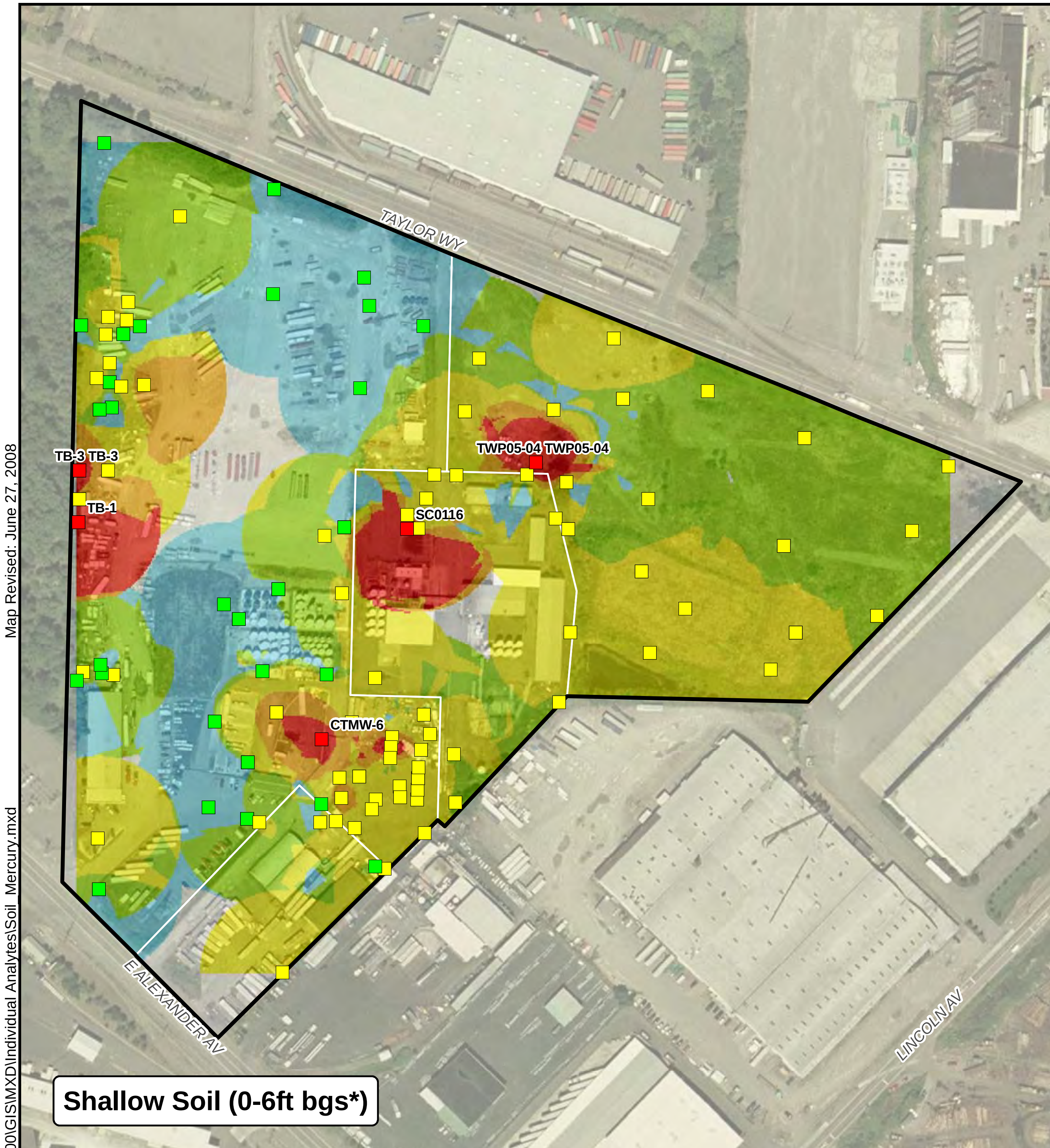
GeoEngineers

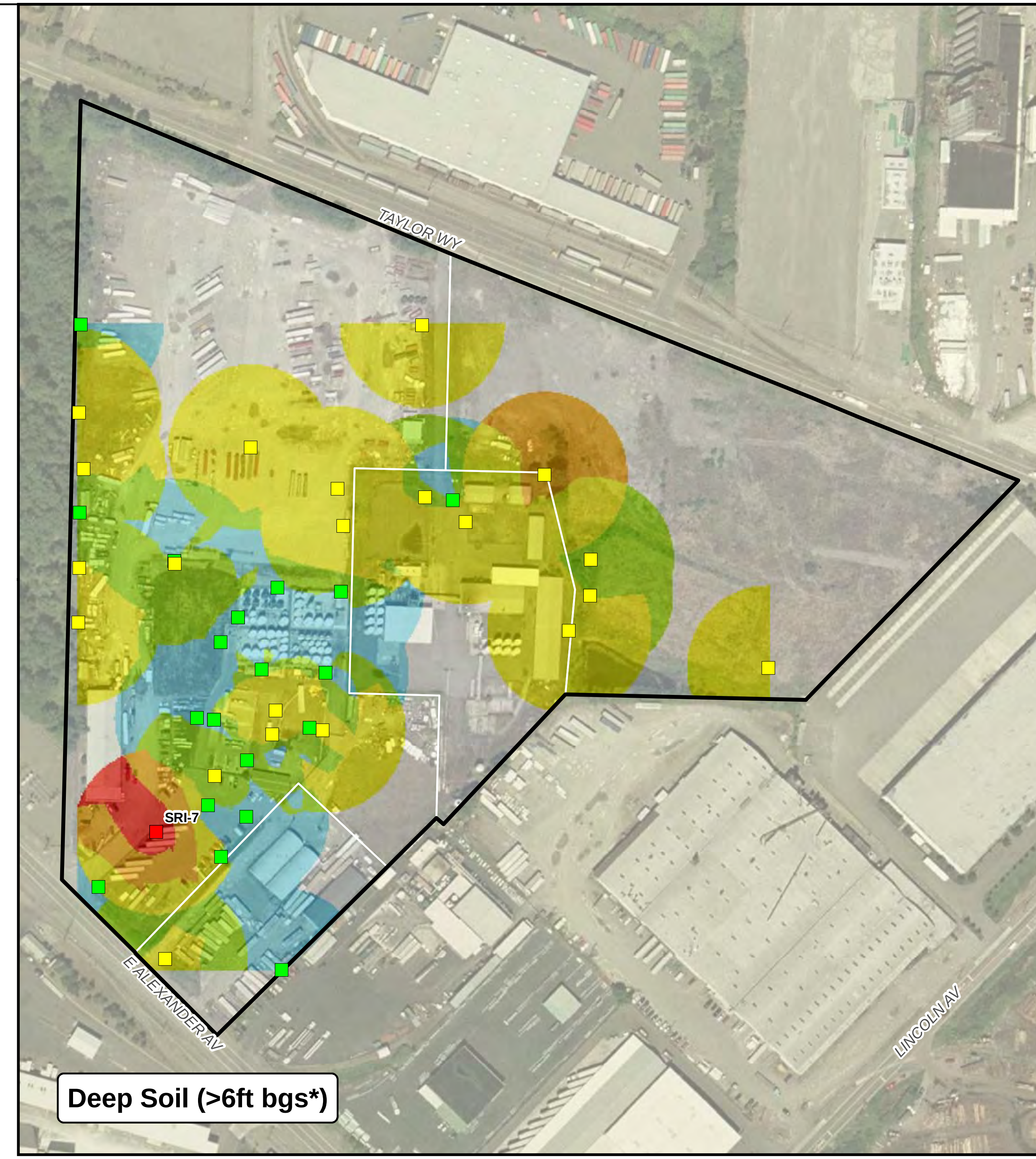
Figure 20

Map Revised: June 30, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Manganese.mxd

Office: TAC





Map Revised: June 27, 2008

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Mercury.mxd

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: protection of groundwater

Mercury (mg/kg)

- <0.01
- 0.01 - 0.1
- 0.1 - 1
- 1 - 2.09
- >2.09**

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

Mercury in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 21

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: natural background

Nickel (mg/kg)

- <5
- 5 - 20
- 20 - 48.2
- 48.2** - 500
- >500

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

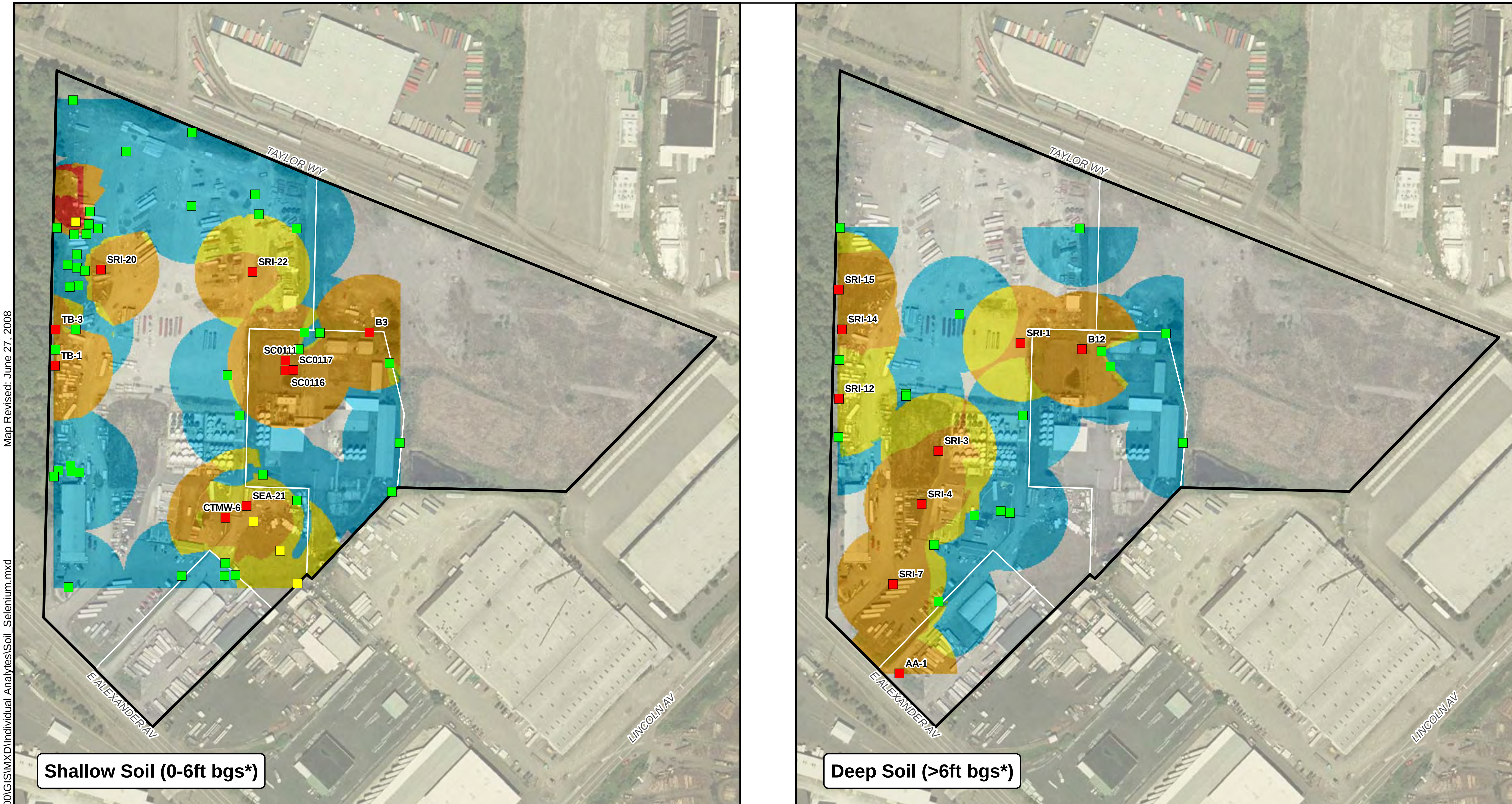
Nickel in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 22

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Nickel.mxd Map Revised: June 27, 2008



Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Selenium.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: practical quantitation limit

Selenium (mg/kg)

- <0.001
- 0.001 - 0.01
- 0.01 - 0.5
- 0.5** - 100
- >100

PROJECT NORTH

TRUE NORTH

250 0 250

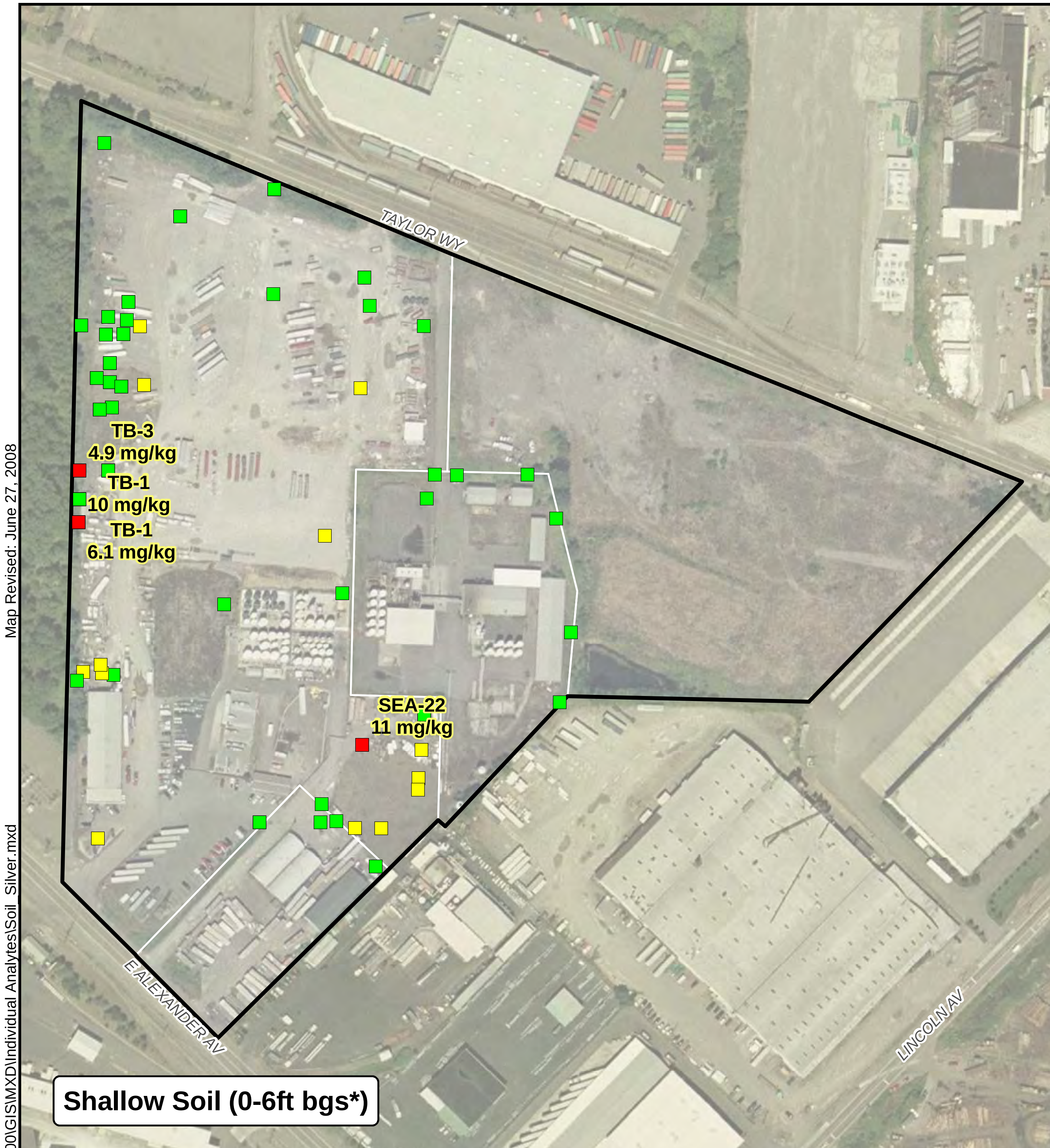
Feet

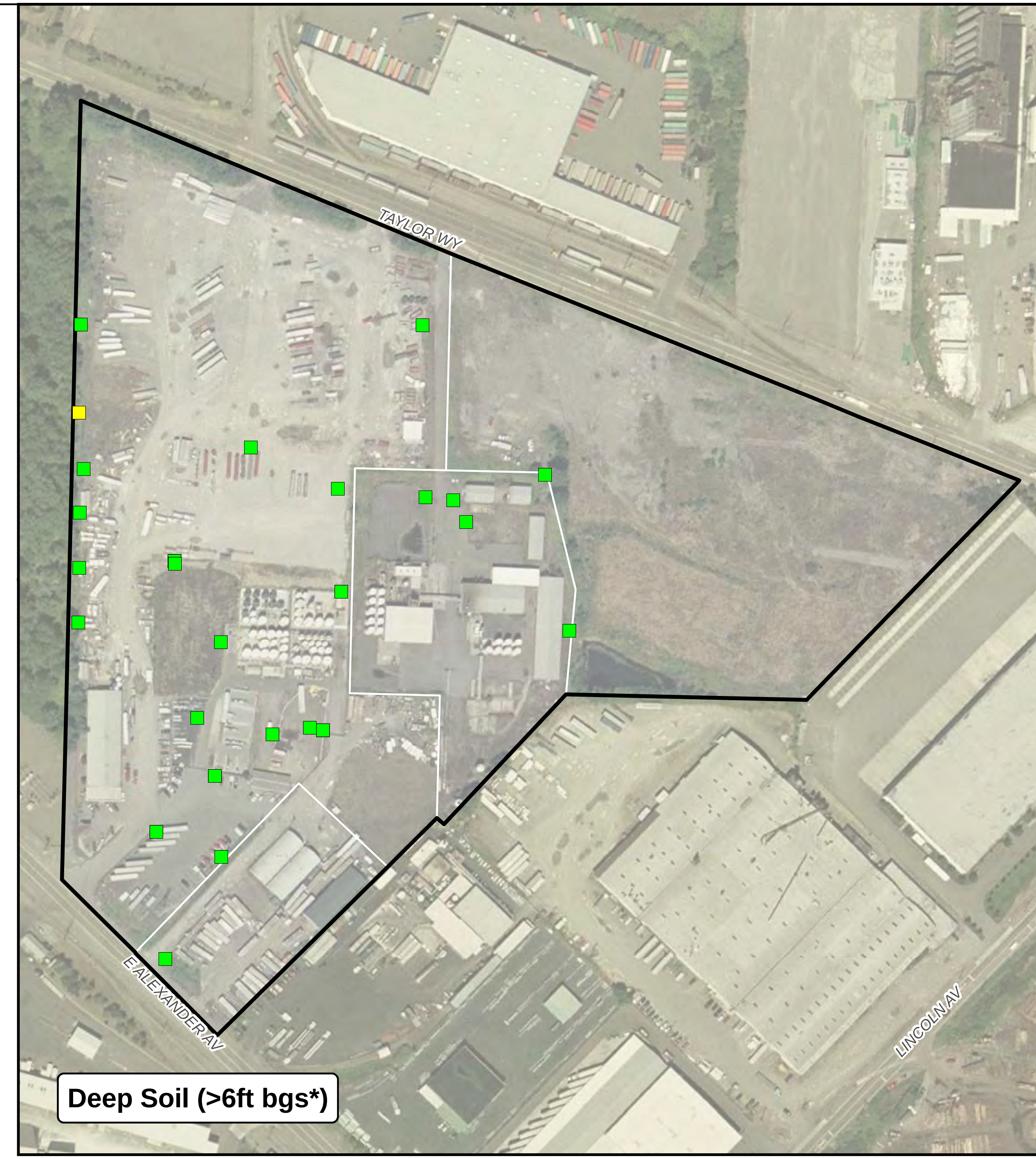
Selenium in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 23





Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Silver.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

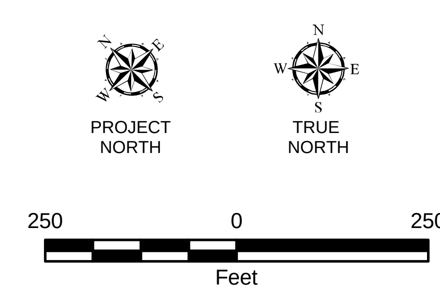
PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level (red)
- Analyte detected (yellow)
- Analyte non-detect (green)

*Below ground surface (bgs)

** PSC screening level = 4.41 mg/kg
Screening level basis: protection of groundwater

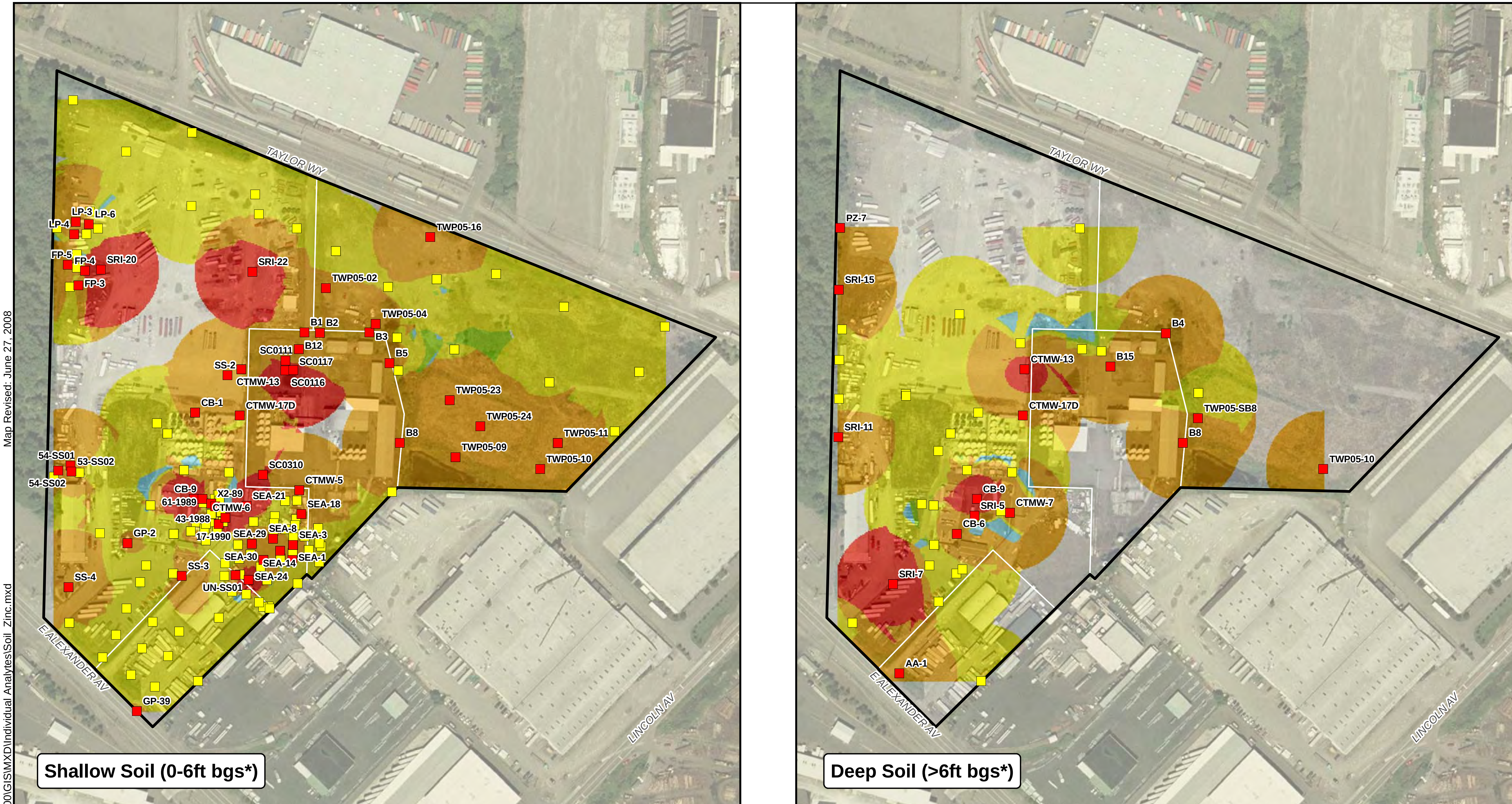


Silver in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 24



Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Zinc.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: protection of groundwater

Zinc (mg/kg)

- <0.1
- 0.1 - 10
- 10 - 101
- 101** - 1,000
- >1,000

PROJECT NORTH

TRUE NORTH

250 0 250

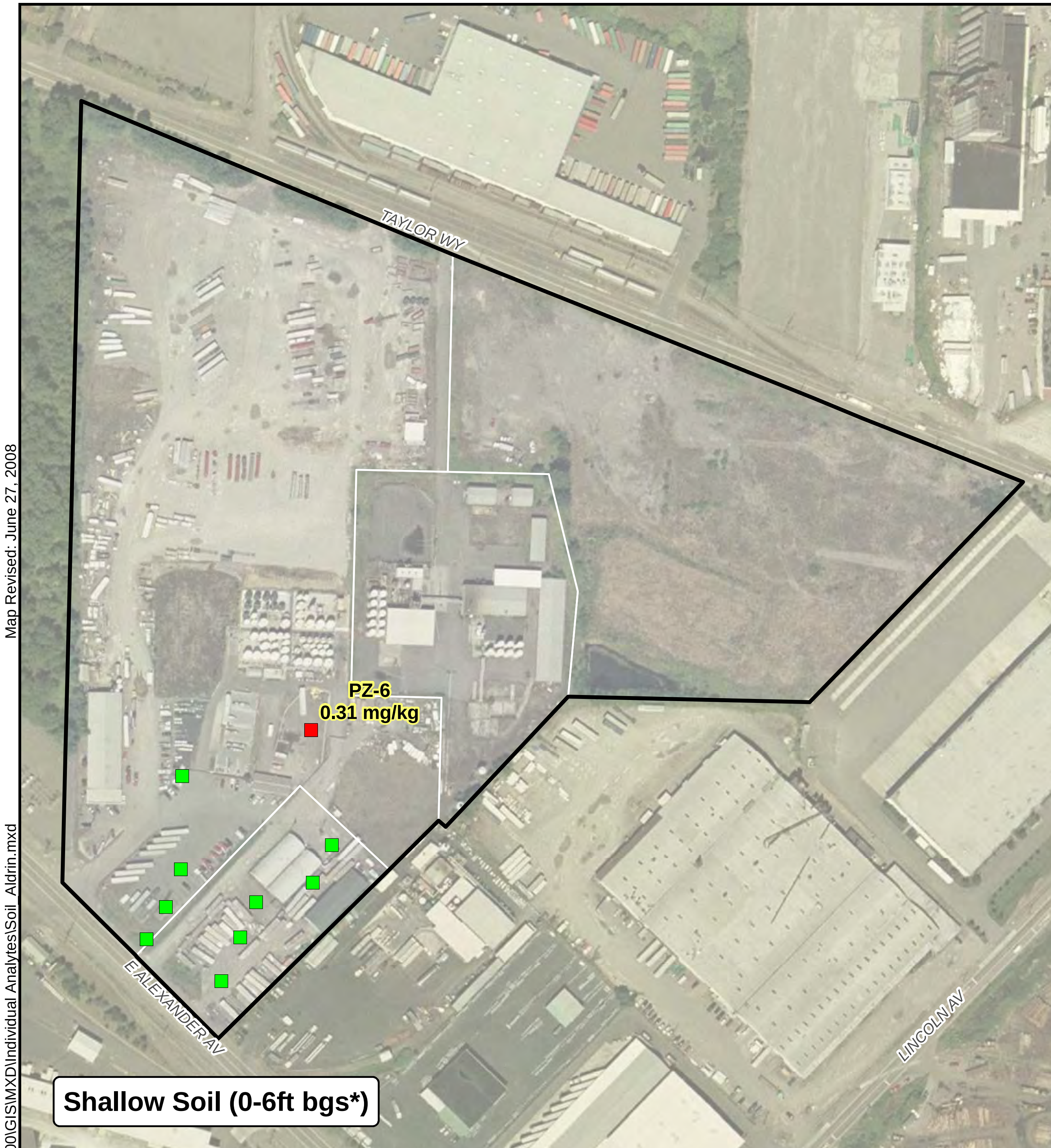
Feet

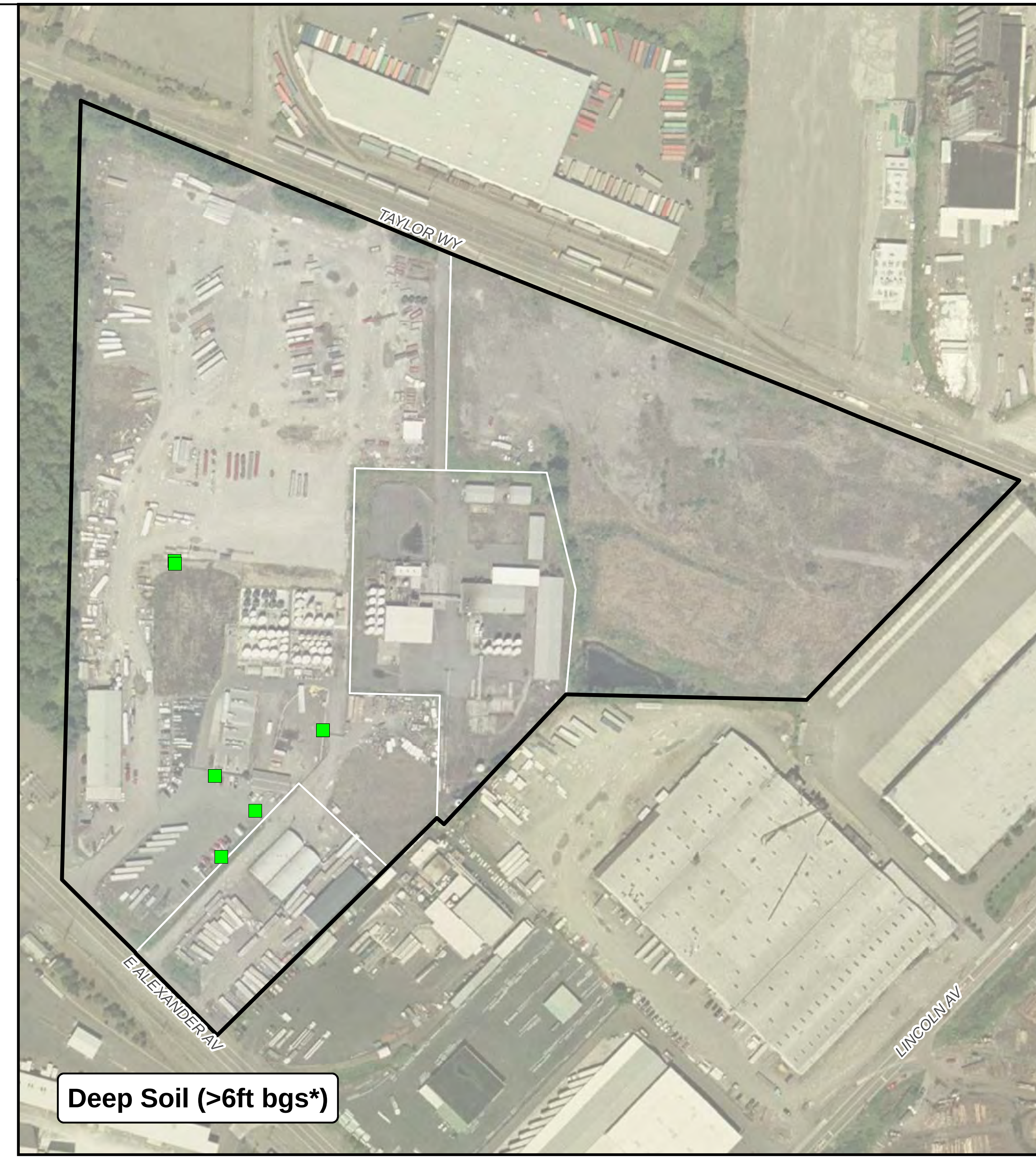
Zinc in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 25





Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Aldrin.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 0.0391 mg/kg
Screening level basis: protection of groundwater

PROJECT NORTH

TRUE NORTH

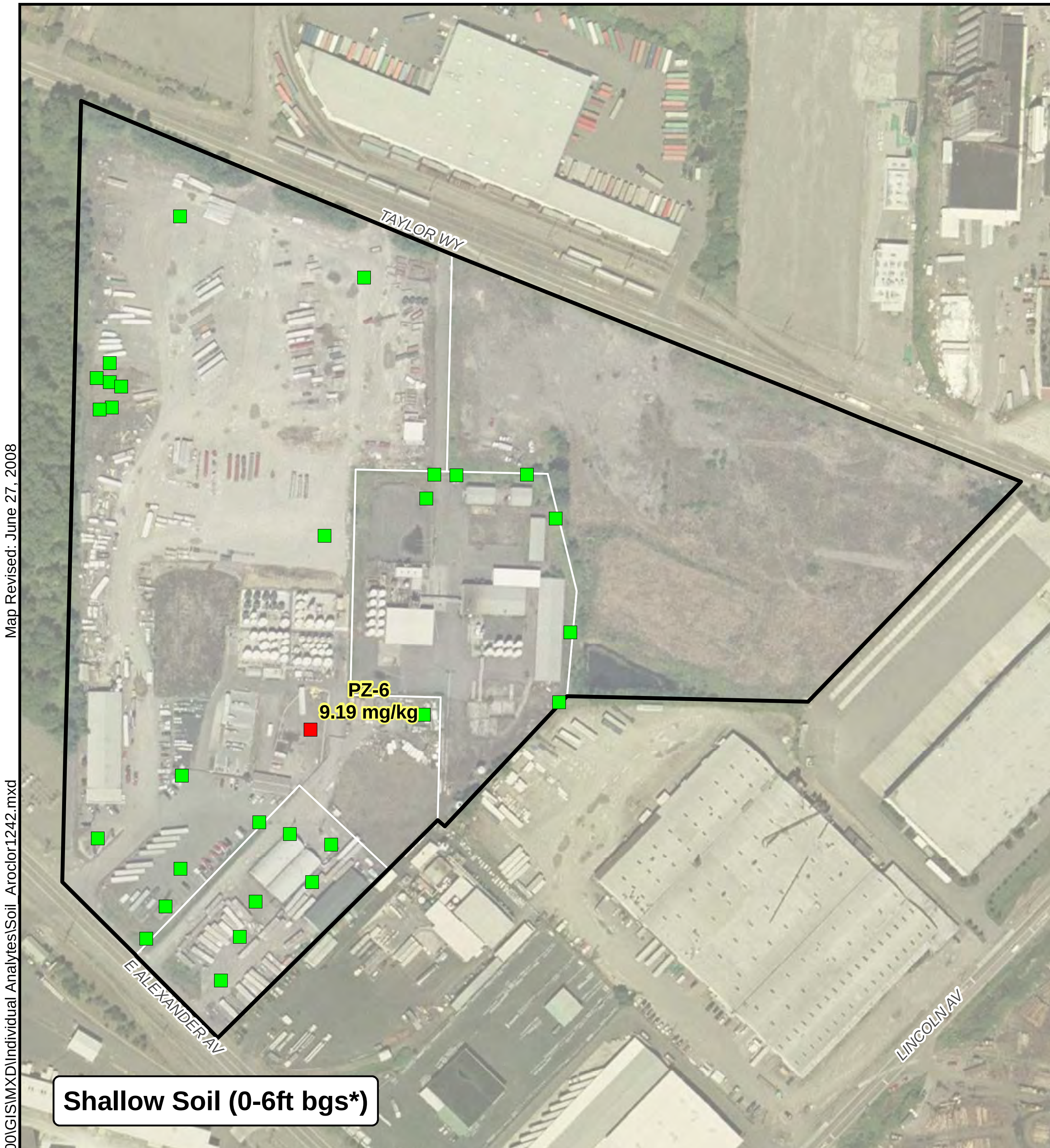
250 0 250
Feet

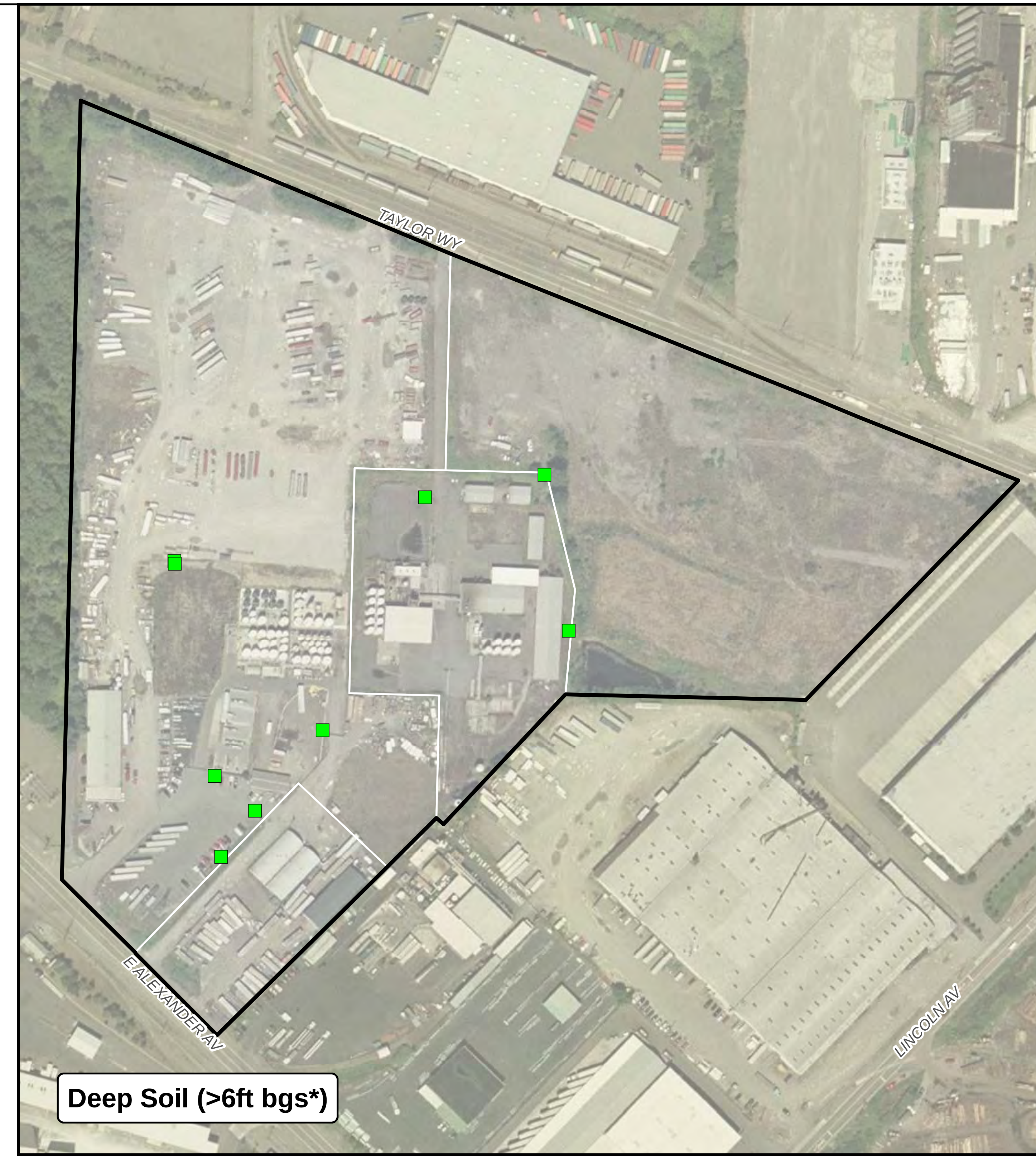
Aldrin in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 26





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

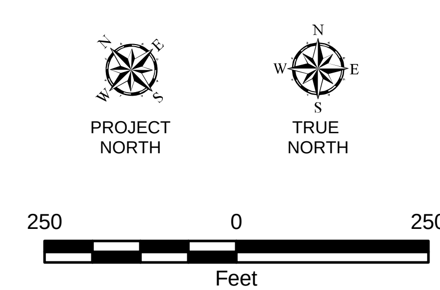
PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 0.025 mg/kg
Screening level basis: pratical quantitation limit



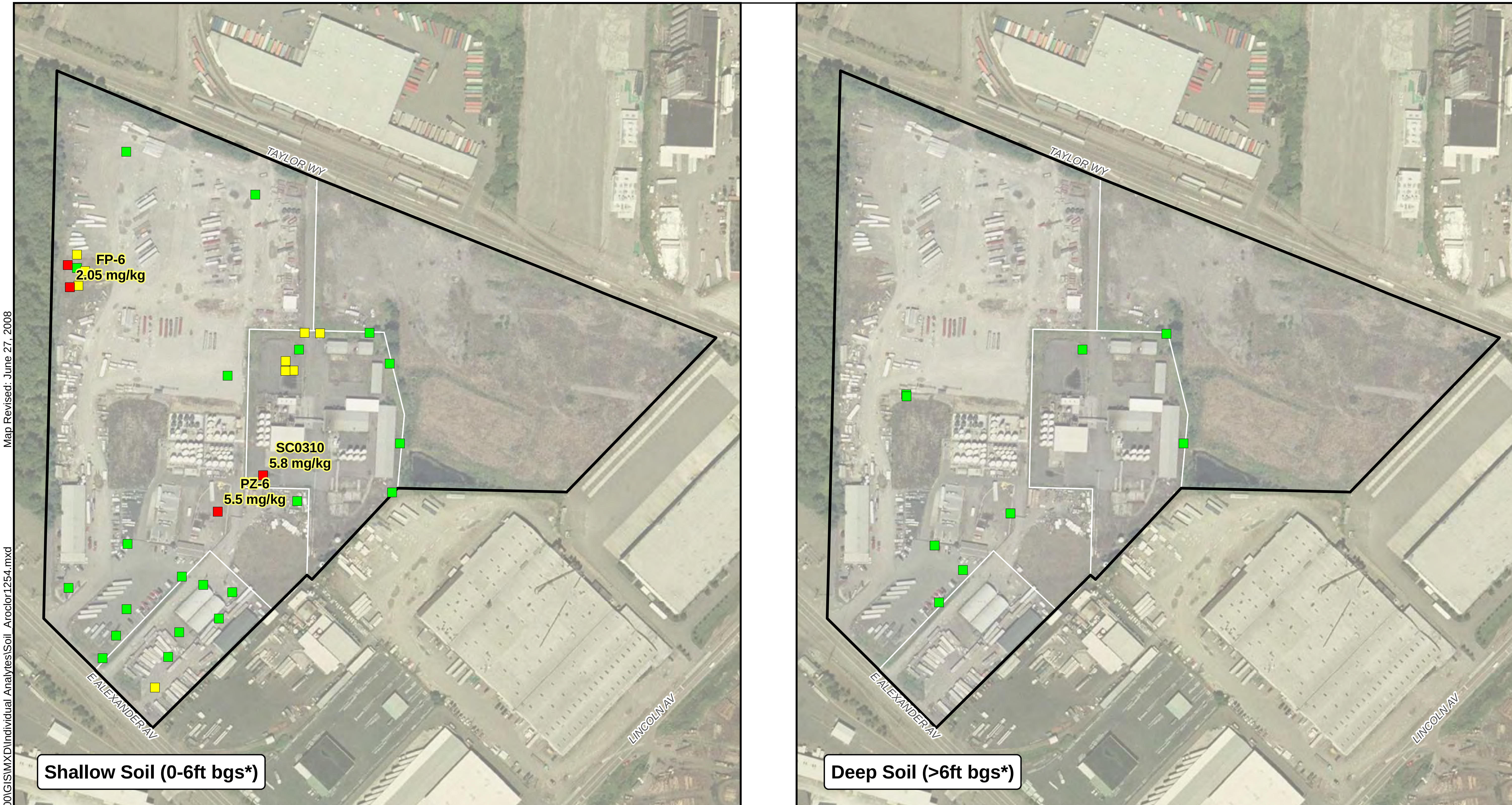
Aroclor 1242 in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 27

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Aroclor1242.mxd Map Revised: June 27, 2008



Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Aroclor1254.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level (red)
- Analyte detected (yellow)
- Analyte non-detect (green)

*Below ground surface (bgs)

** PSC screening level = 0.65 mg/kg
Screening level basis: protection of ecological receptors

PROJECT NORTH

TRUE NORTH

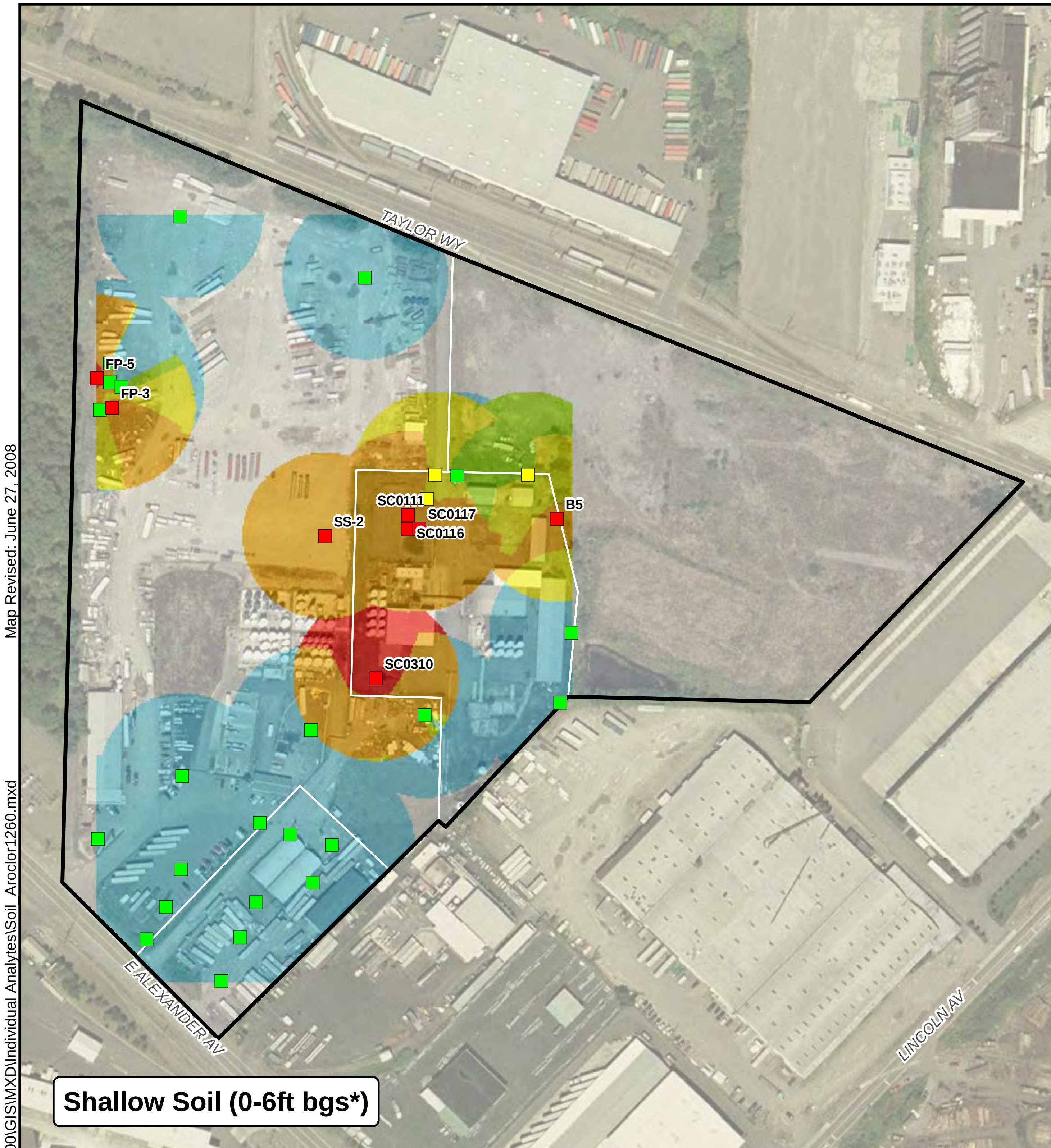
250 0 250
Feet

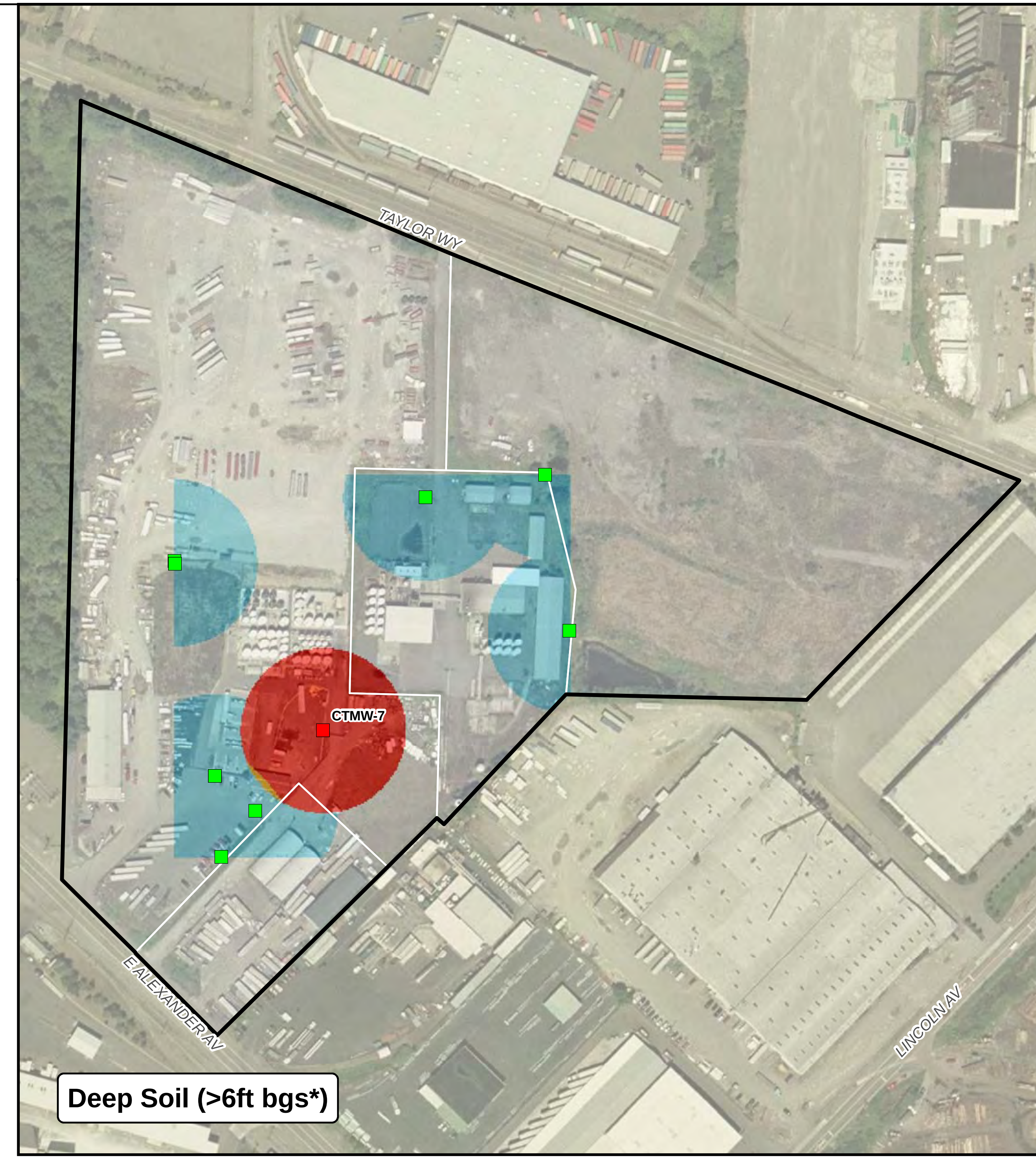
Aroclor 1254 in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 28





Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Aroclor1260.mxd Map Revised: June 27, 2008

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: protection of groundwater

Aroclor-1260 (mg/kg)

- <0.001
- 0.001 - 0.01
- 0.01 - 0.0375
- 0.0375** - 1
- >1

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

Aroclor-1260 in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

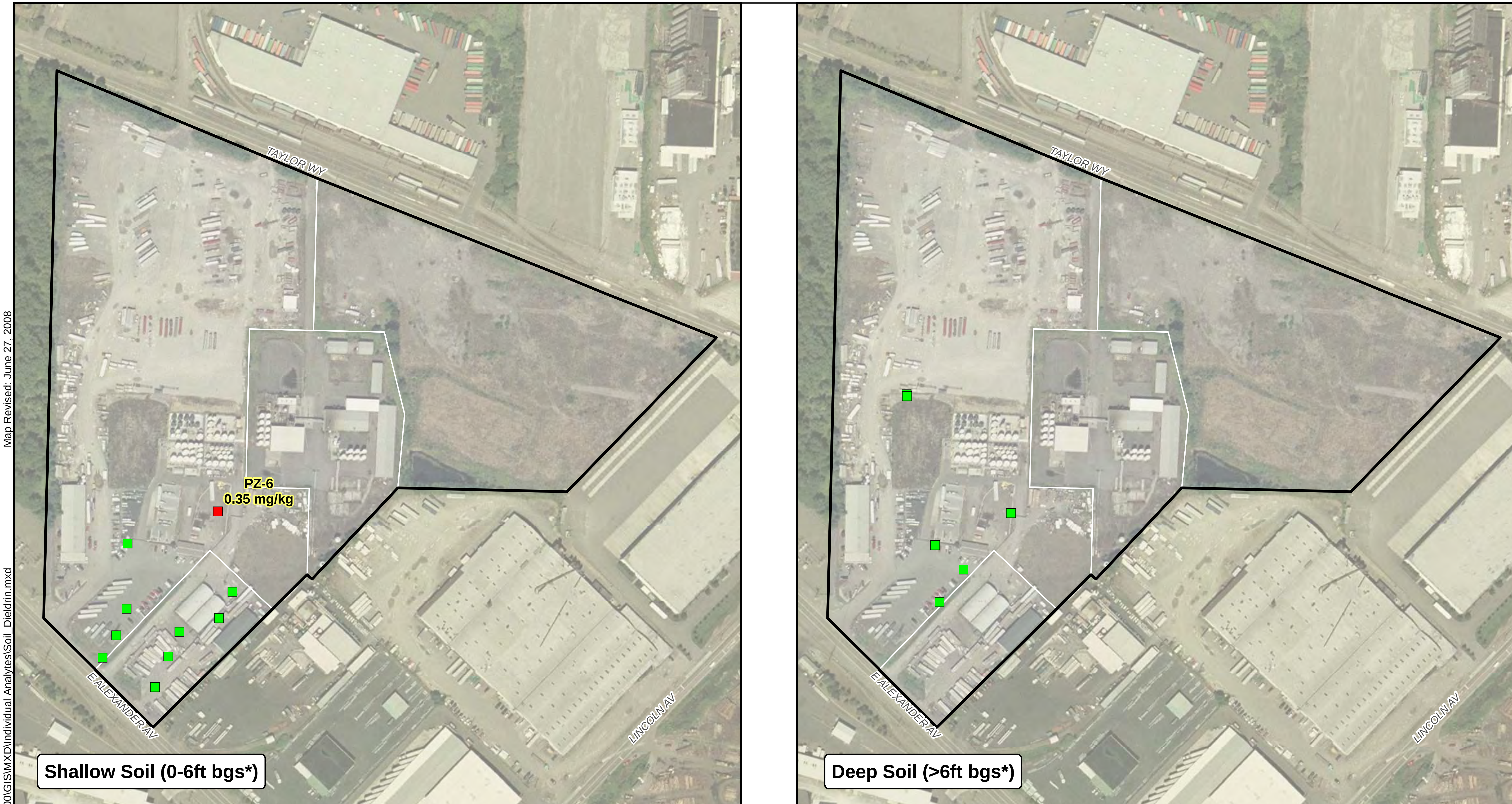
GEOENGINEERS

Figure 29

Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Dieldrin.mxd

Office: TAC



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources:
Sample data obtained from CC, Prologis and PSC. Aerial photo (dated September 2005) from Aerials Express (obtained from- http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.
PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

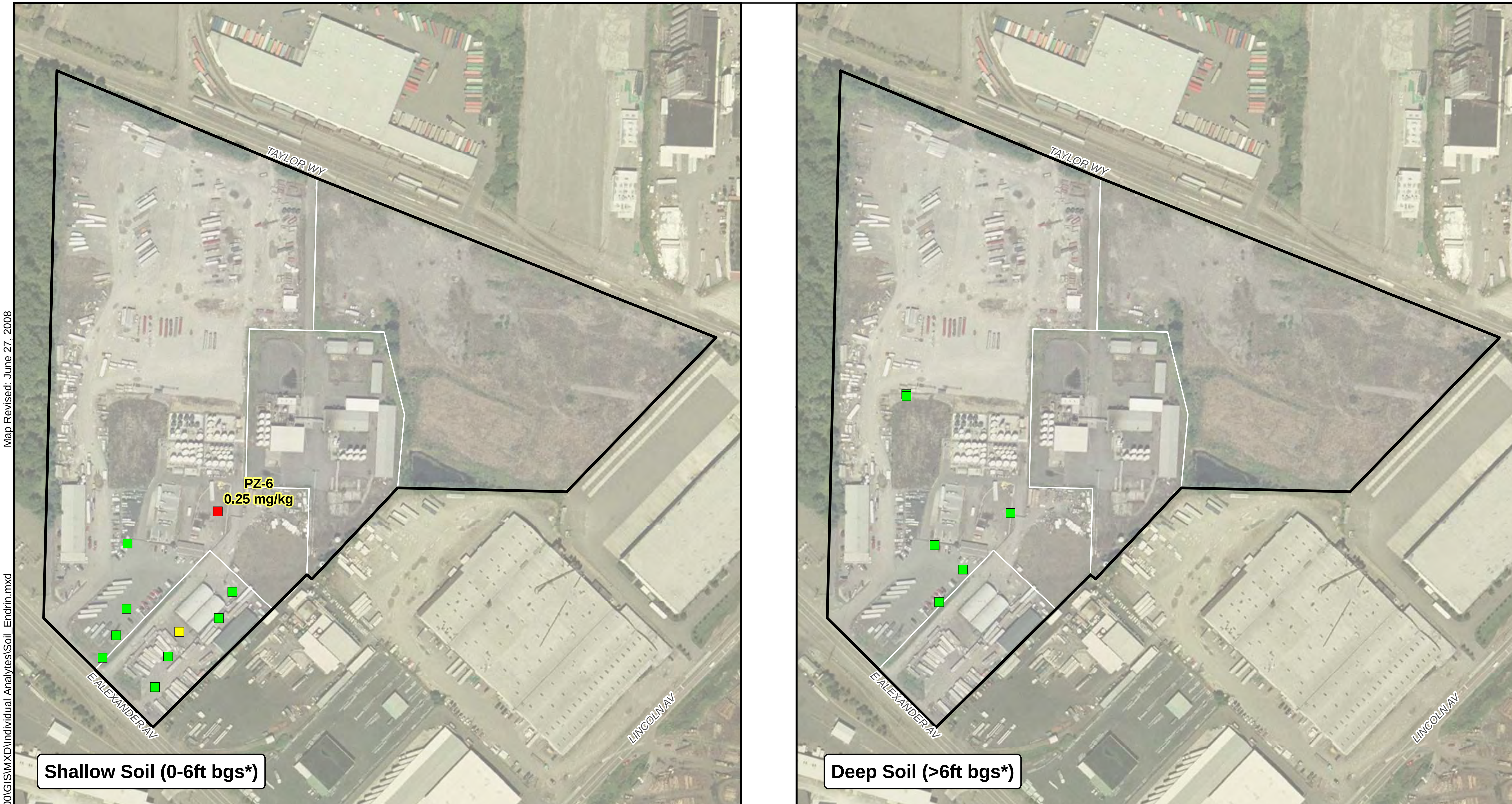
** PSC screening level = 0.0103 mg/kg
Screening level basis: protection of groundwater

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

Dieldrin in Soil	
Taylor Way and Alexander Avenue Fill Site Tacoma, Washington	
GEOENGINEERS	**Figure 30**



Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Endrin.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 0.0132 mg/kg
Screening level basis: protection of groundwater

PROJECT NORTH

TRUE NORTH

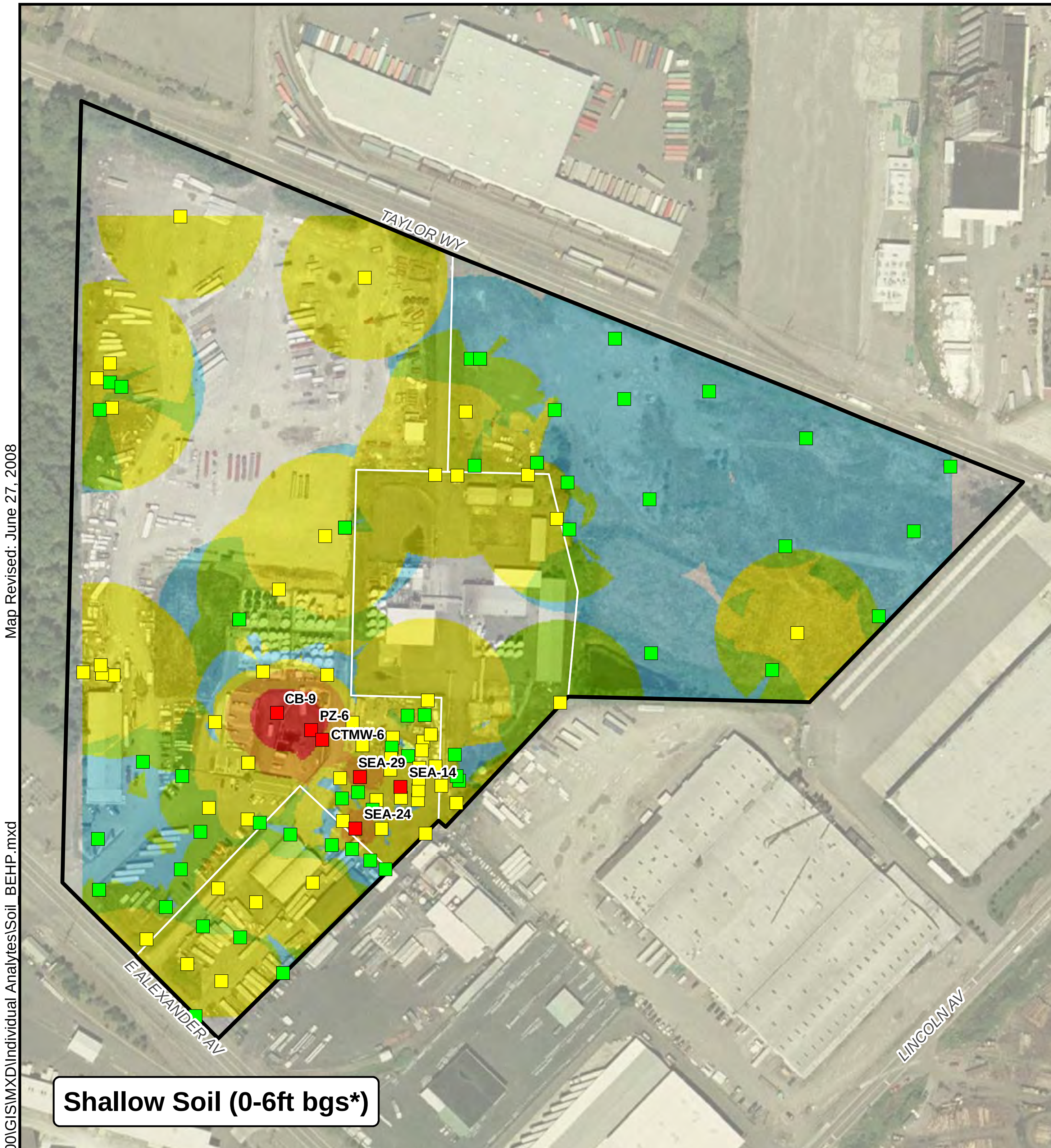
250 0 250
Feet

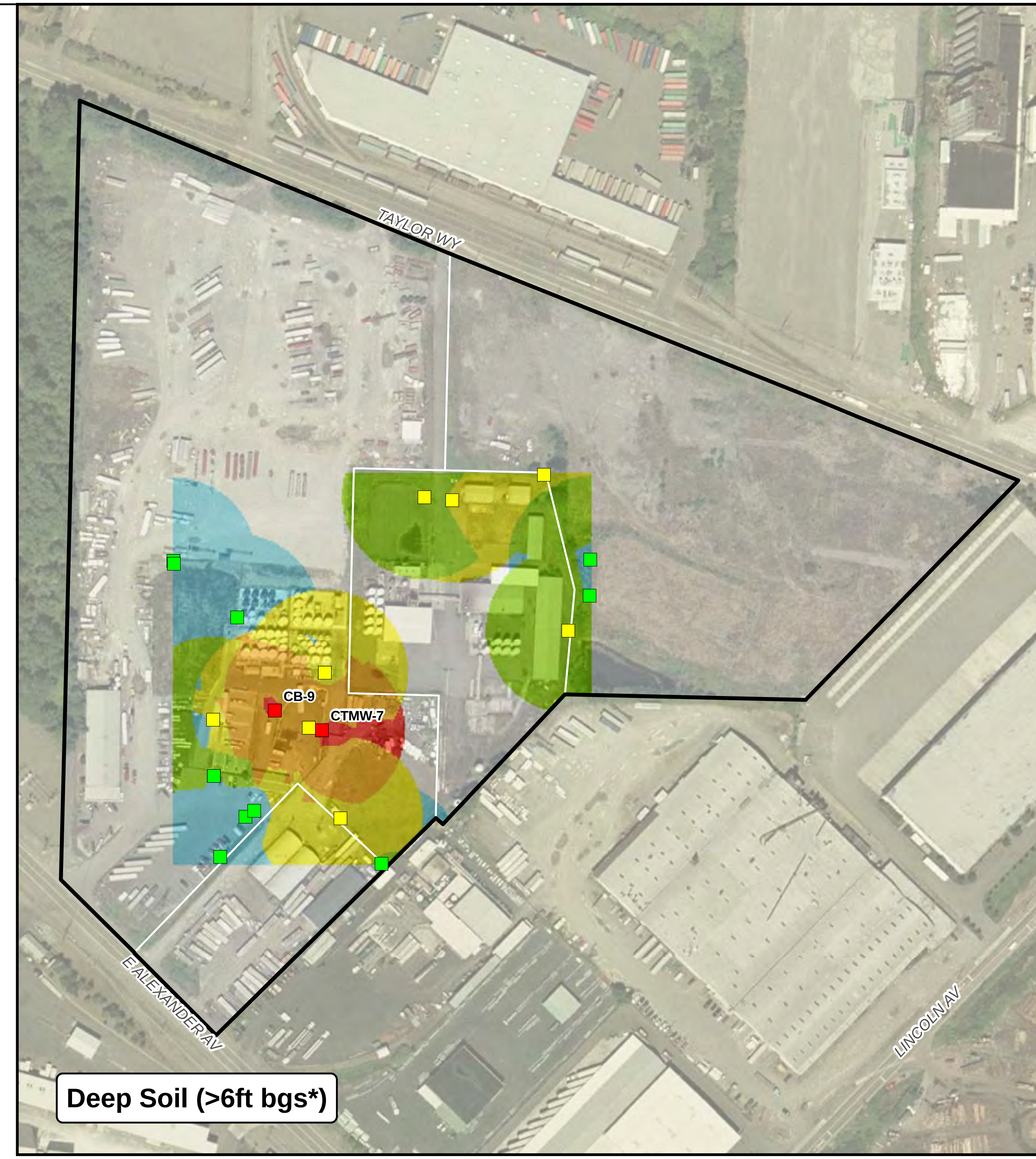
Endrin in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 31





Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_BEHP.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level (red)
- Analyte detected (yellow)
- Analyte non-detect (green)

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: protection of groundwater

Bis(2-ethylhexyl)phthalate (mg/kg)

- <0.001
- 0.001 - 0.1
- 0.1 - 22.3
- 22.3** - 100
- >100

PROJECT NORTH

TRUE NORTH

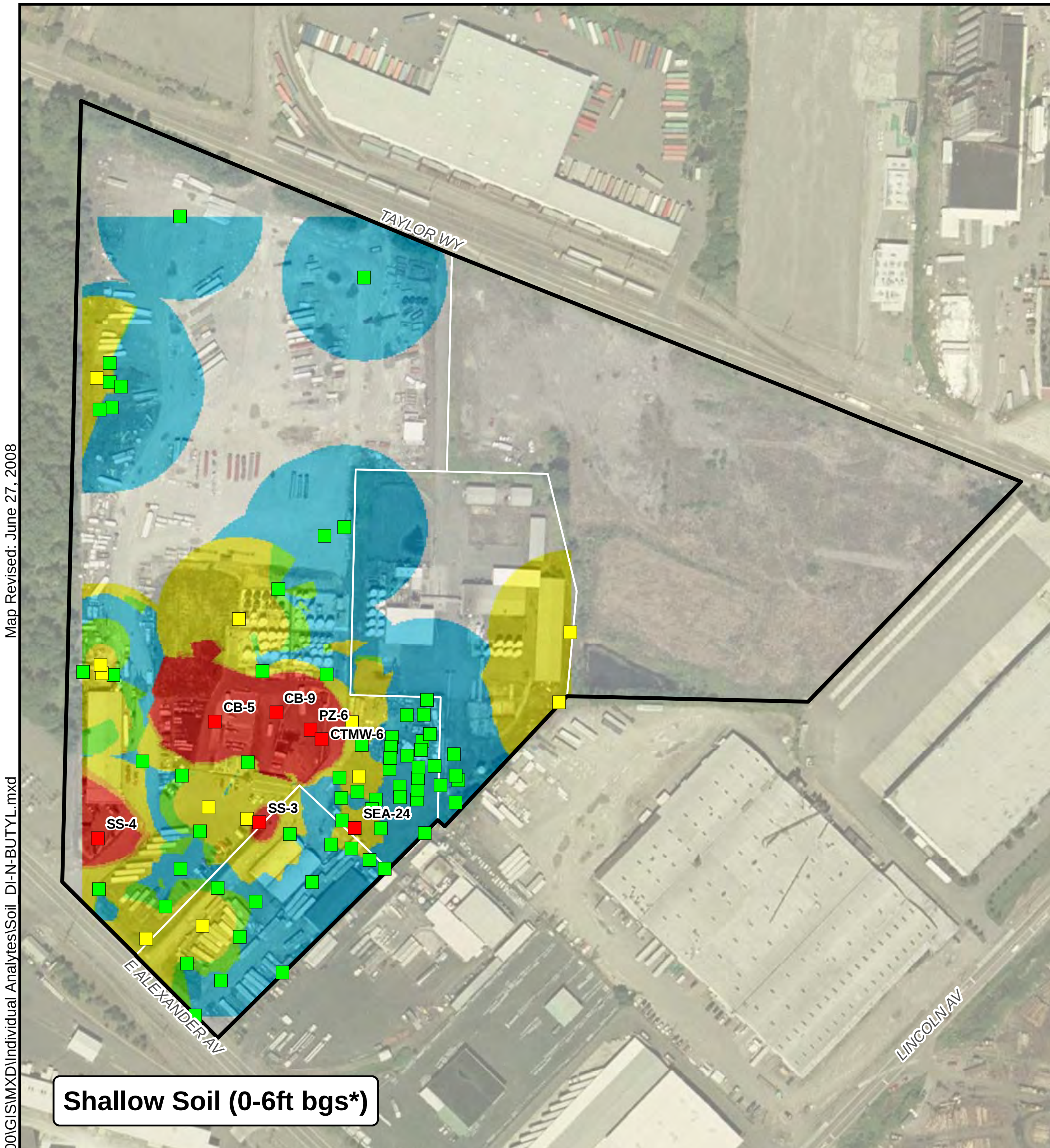
250 0 250
Feet

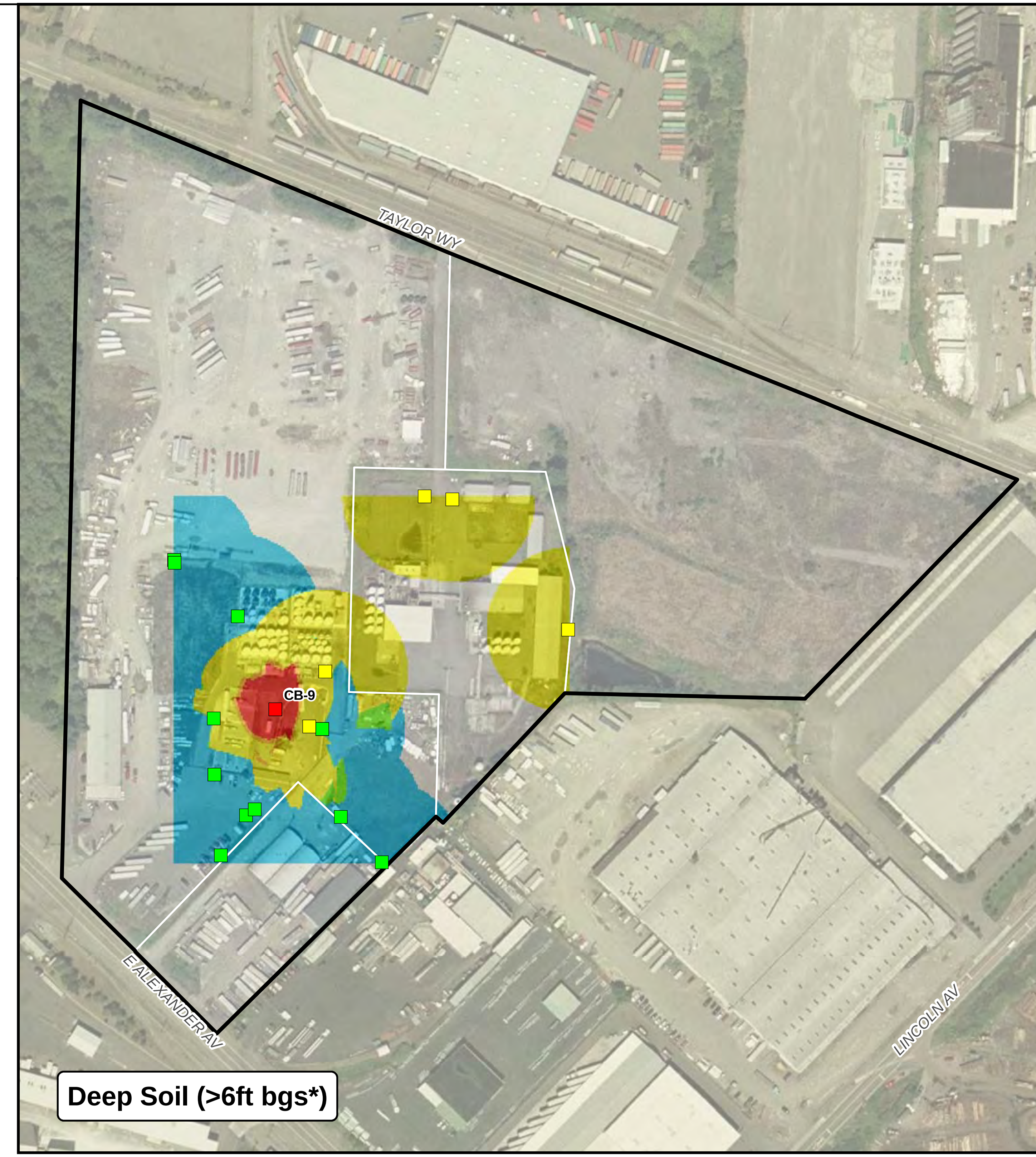
Bis(2-Ethylhexyl)phalate in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 32





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis:
protection of ecological receptors

Di-n-butylphthalate (mg/kg)

- <0.001
- 0.001 - 0.01
- 0.01 - 0.865
- 0.865** - 1
- >1

PROJECT NORTH   TRUE NORTH

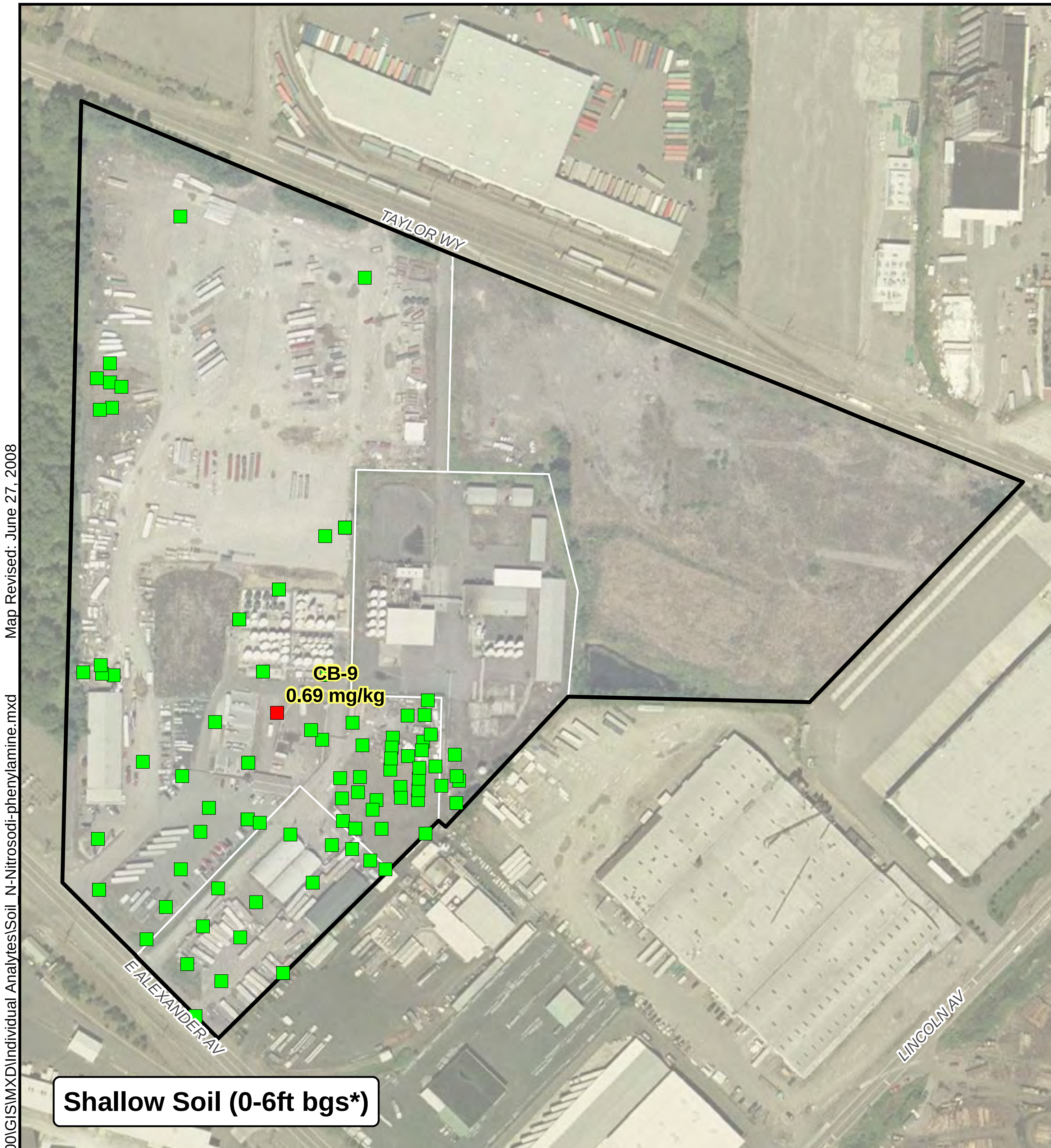
250   0   250
Feet

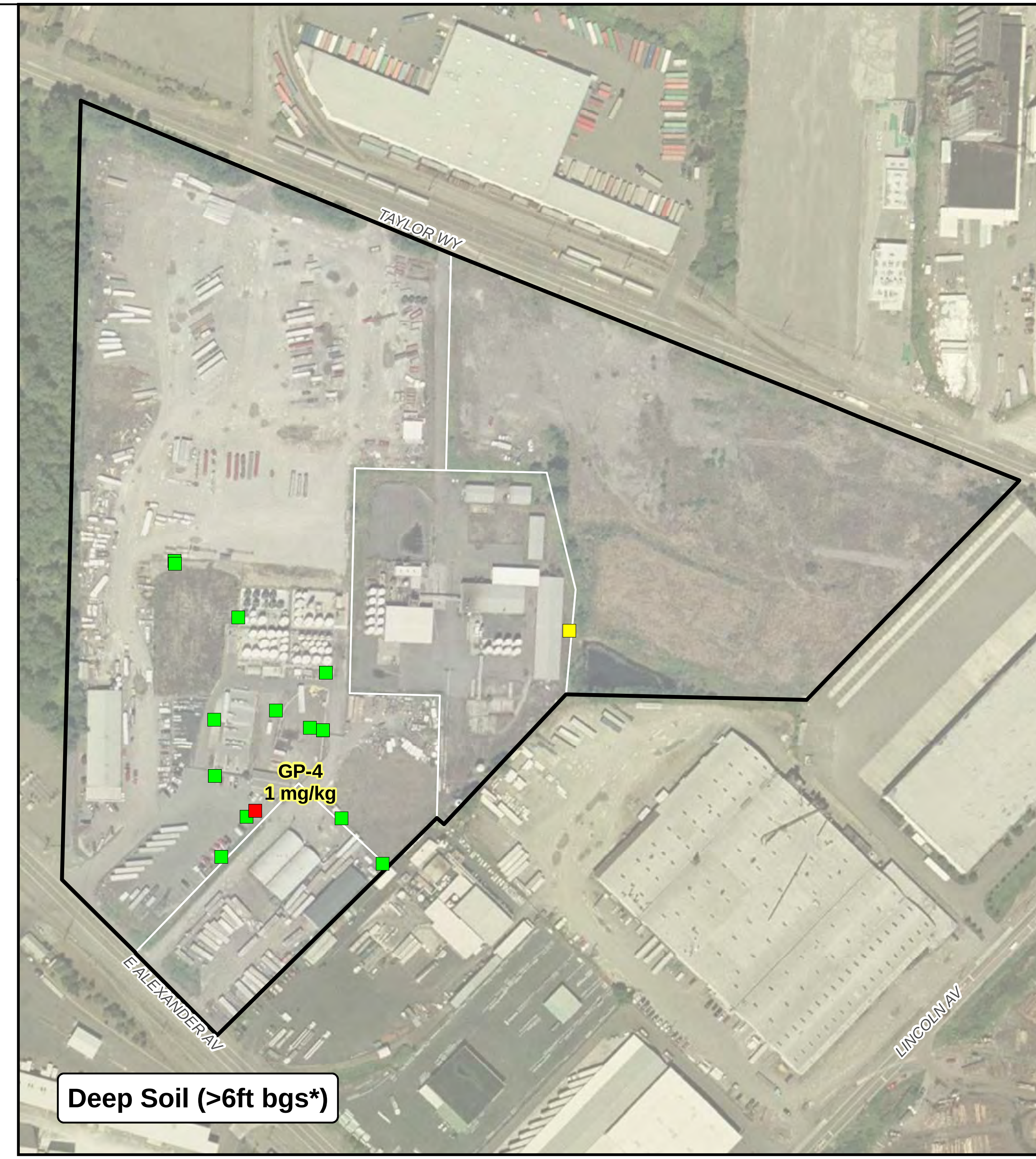
Di-n-butylphthalate in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 33





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Results exceeding PSC value
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 0.33 mg/kg
Screening level basis: practical quantitation limit

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

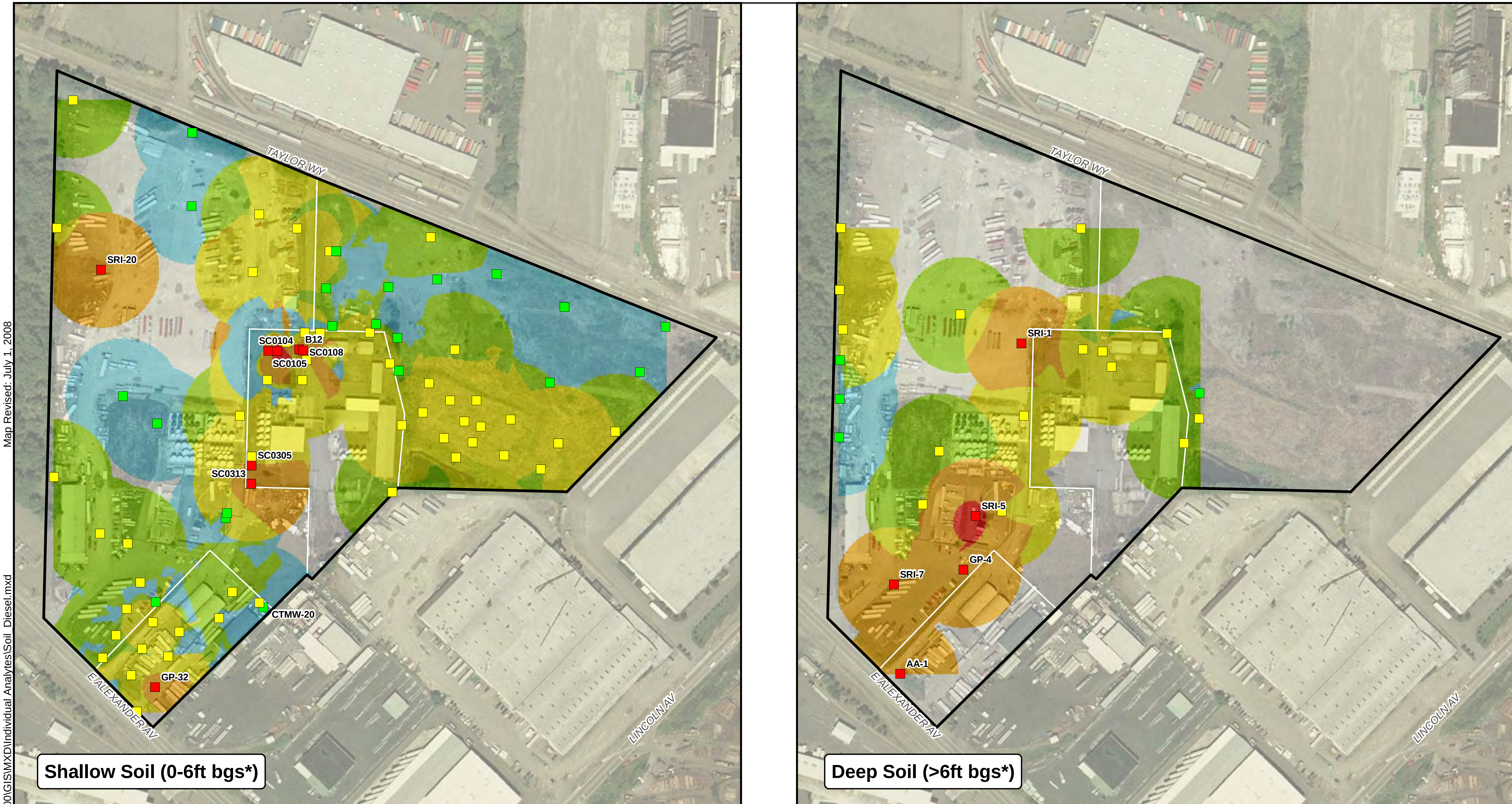
N-Nitrosodiphenylamine in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 34

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_N-Nitrosodi-phenylamine.mxd Map Revised: June 27, 2008



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: MTCA method A industrial

Diesel (mg/kg)

- <5
- 5 - 100
- 100 - 2,000
- 2,000** - 20,000
- >20,000

PROJECT NORTH

TRUE NORTH

250 0 250

Feet

Diesel in Soil

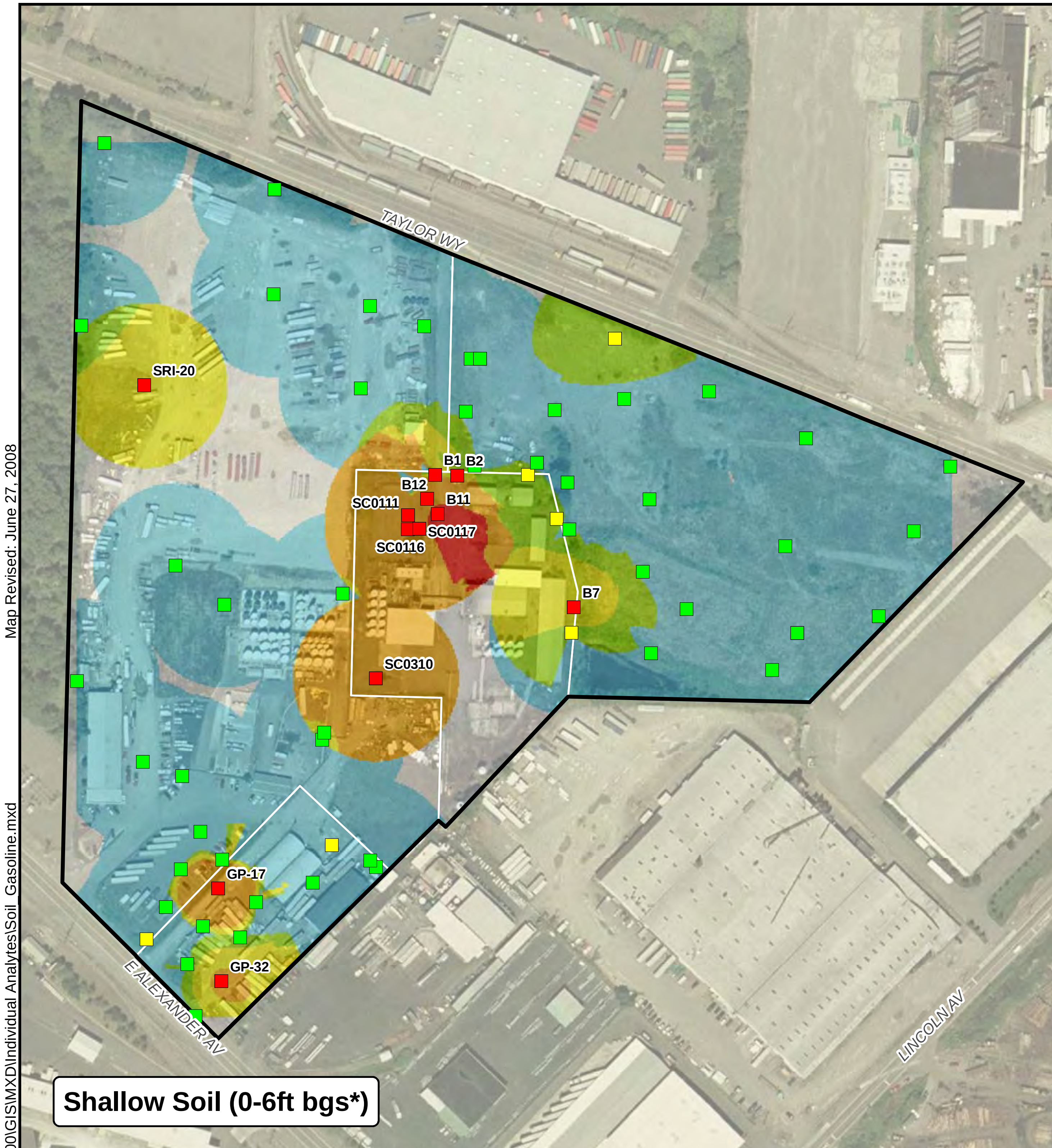
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

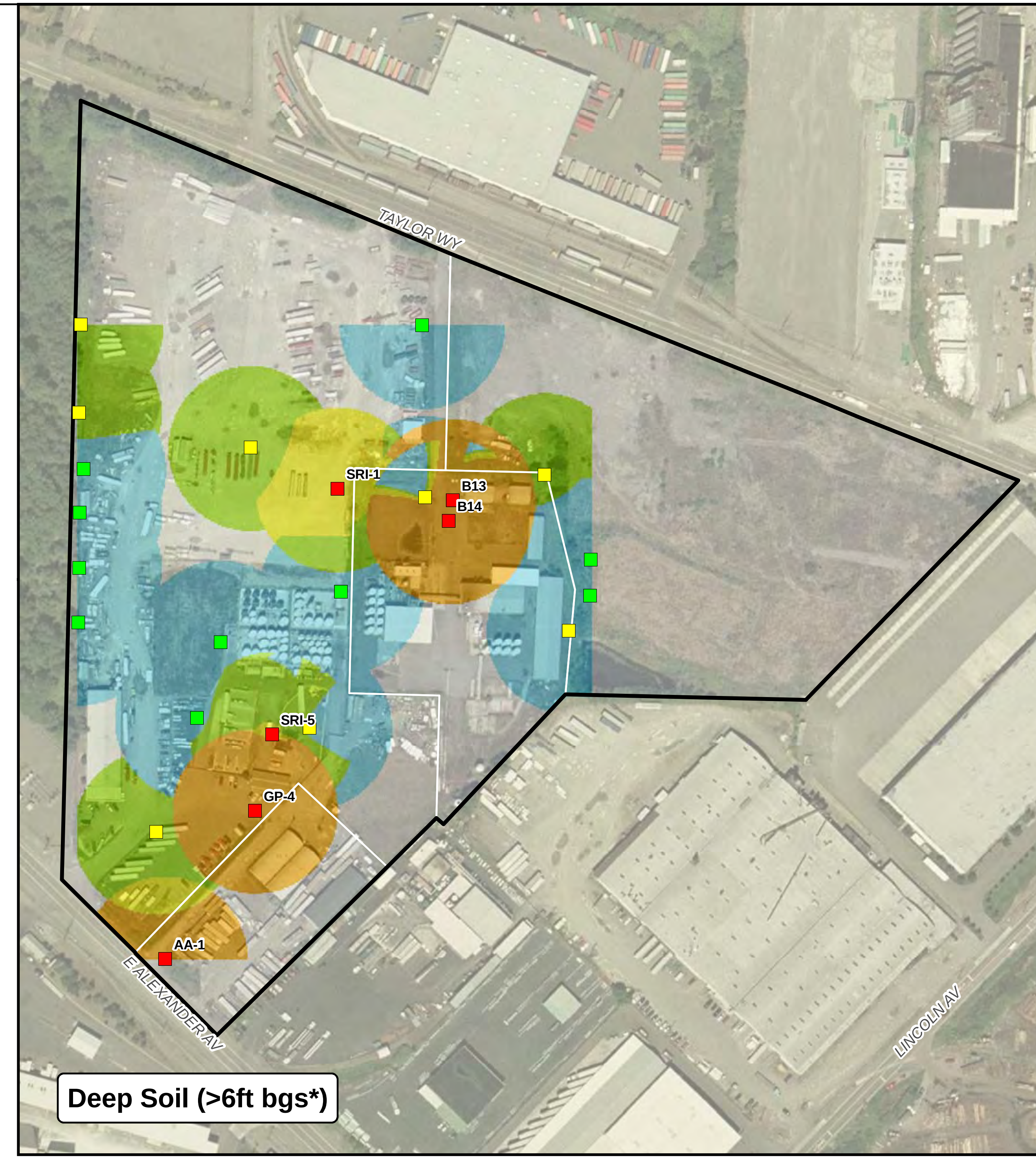
GEOENGINEERS

Figure 35

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Diesel.mxd Map Revised: July 1, 2008

Map Revised: June 27, 2008





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: MTCA method A industrial

Gasoline (mg/kg)

- <5
- 5 - 30
- 30** - 100
- 100 - 2,000
- >2,000

PROJECT NORTH

TRUE NORTH

250 0 250

Feet

Gasoline in Soil

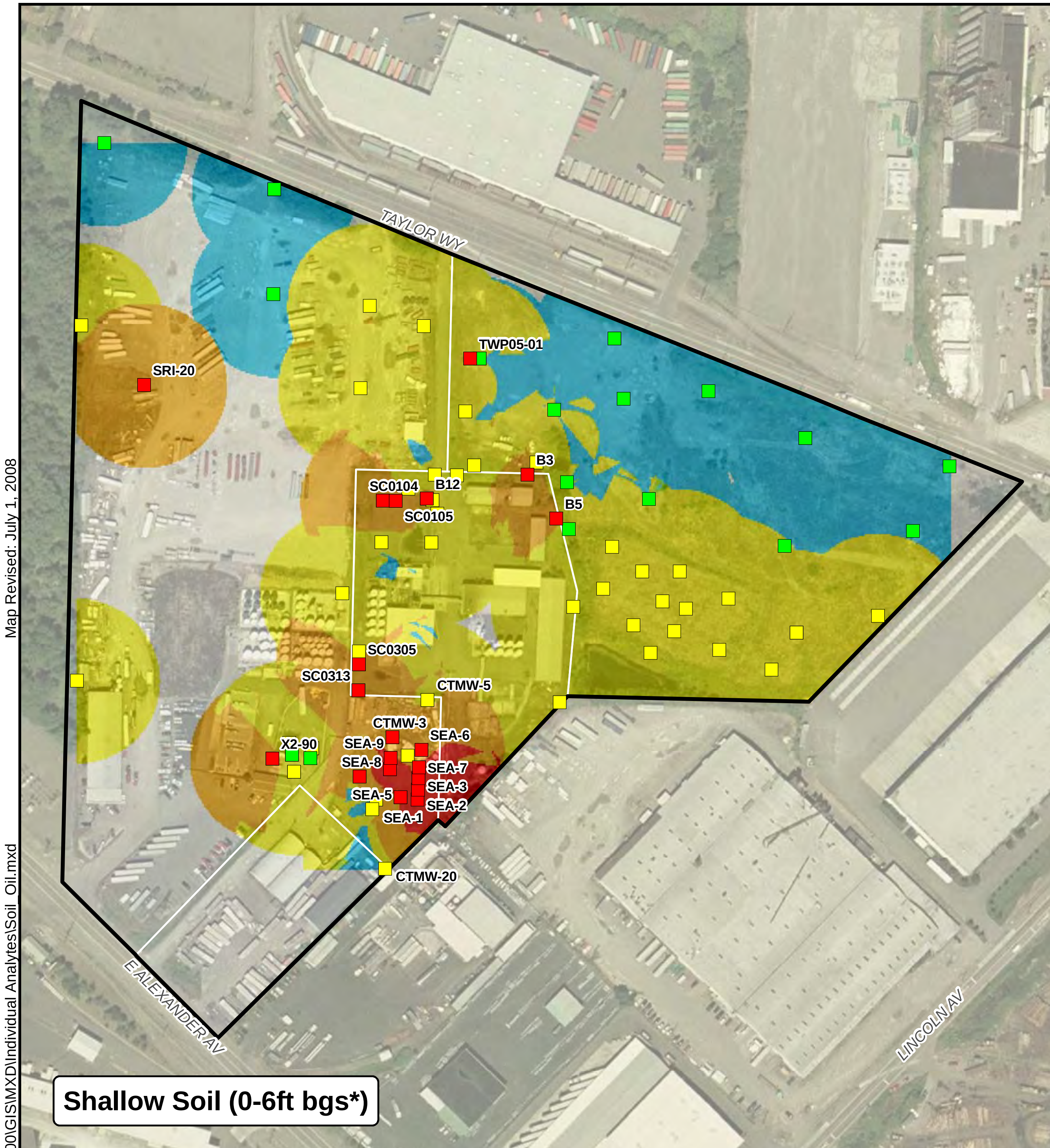
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

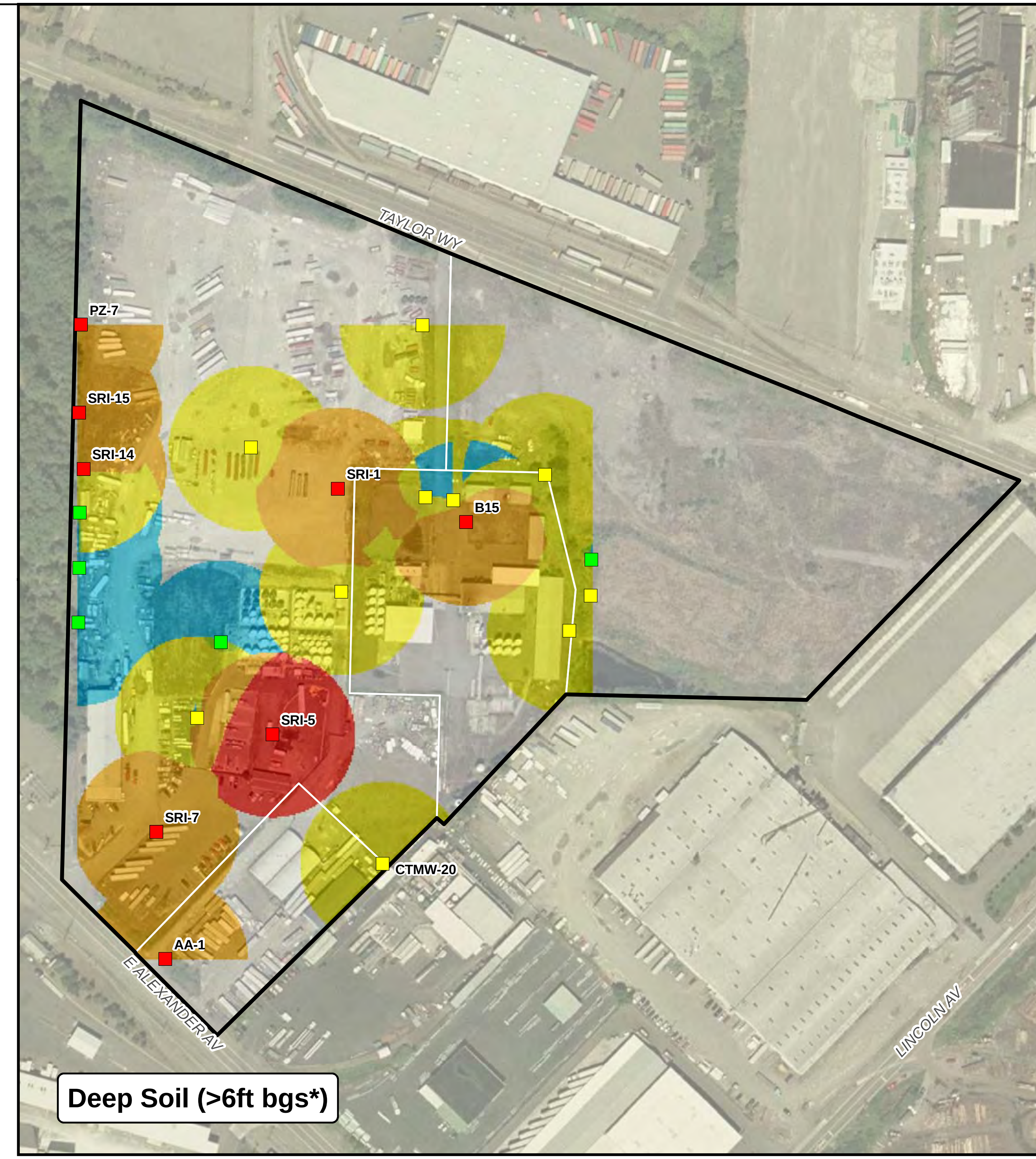
GEOENGINEERS

Figure 36

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Gasoline.mxd

Office: TAC





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-7 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC Screening Level
Screening level basis: MTCA method A industrial

Heavy Oil (mg/kg)

- <0.1
- 0.1 - 5
- 5 - 2,000
- 2,000** - 20,000
- >20,000

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

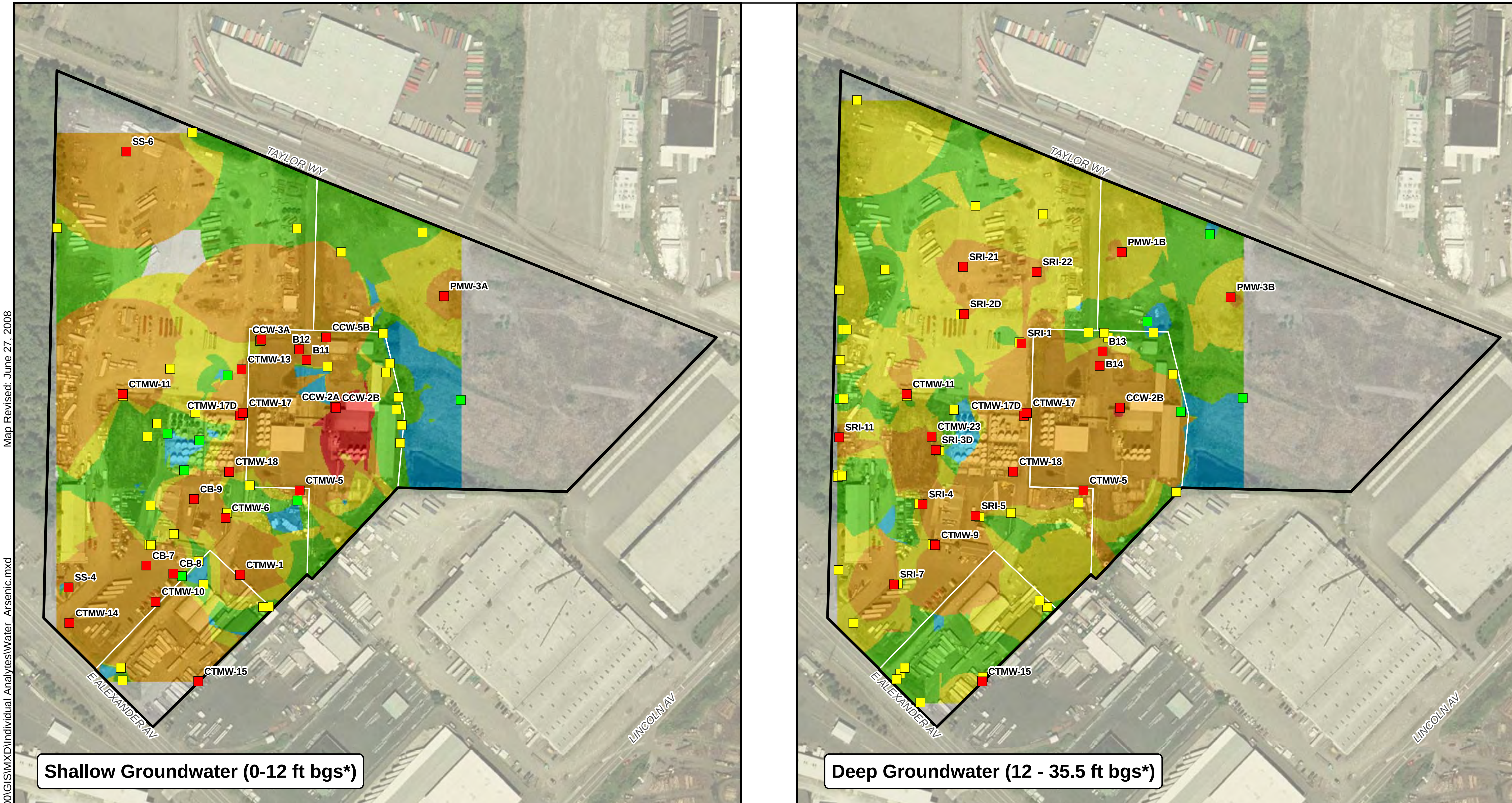
Heavy Oil in Soil

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GeoEngineers

Figure 37

Office: TAC
Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Soil_Oil.mxd
Map Revised: July 1, 2008



Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Water_Arsenic.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: practical quantitation limits

Arsenic (ug/L)

- <1
- 1 - 10
- 10 - 20
- 20** - 2,000
- >20,000

PROJECT NORTH

TRUE NORTH

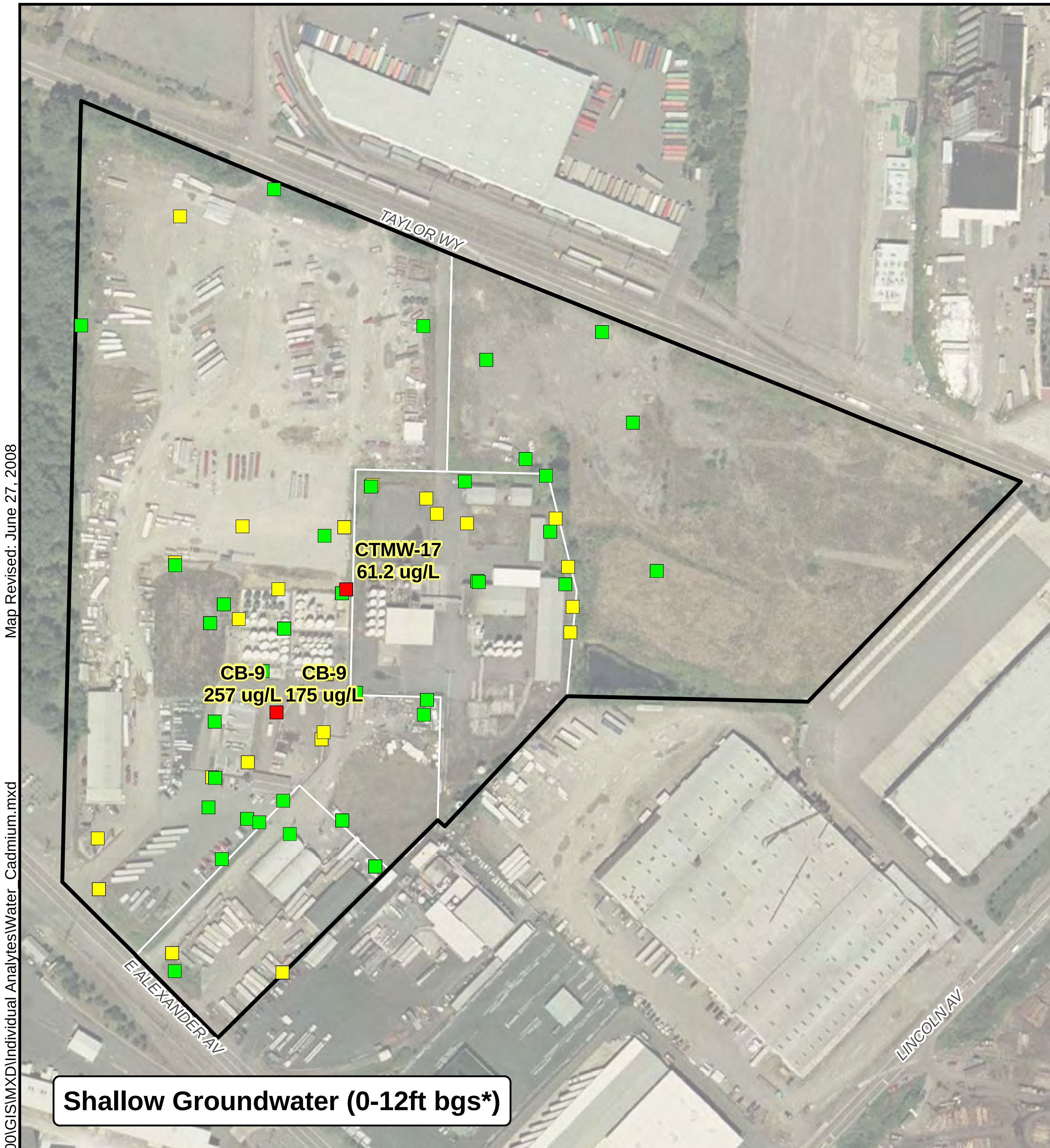
250 0 250
Feet

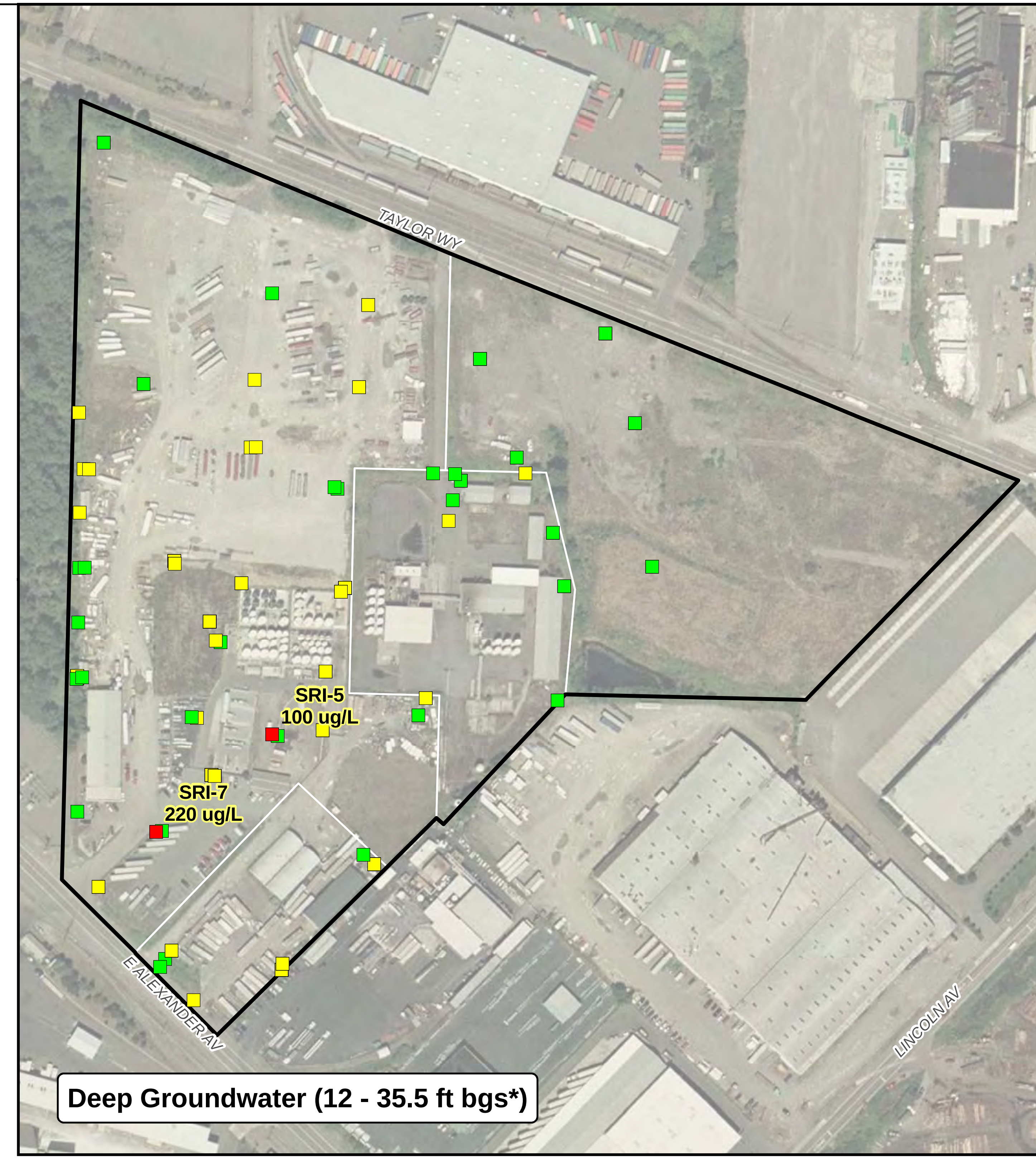
Arsenic in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 38





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 40 ug/L
Screening level basis: practical quantitation limits

PROJECT NORTH
TRUE NORTH

250 0 250
Feet

Cadmium in Groundwater

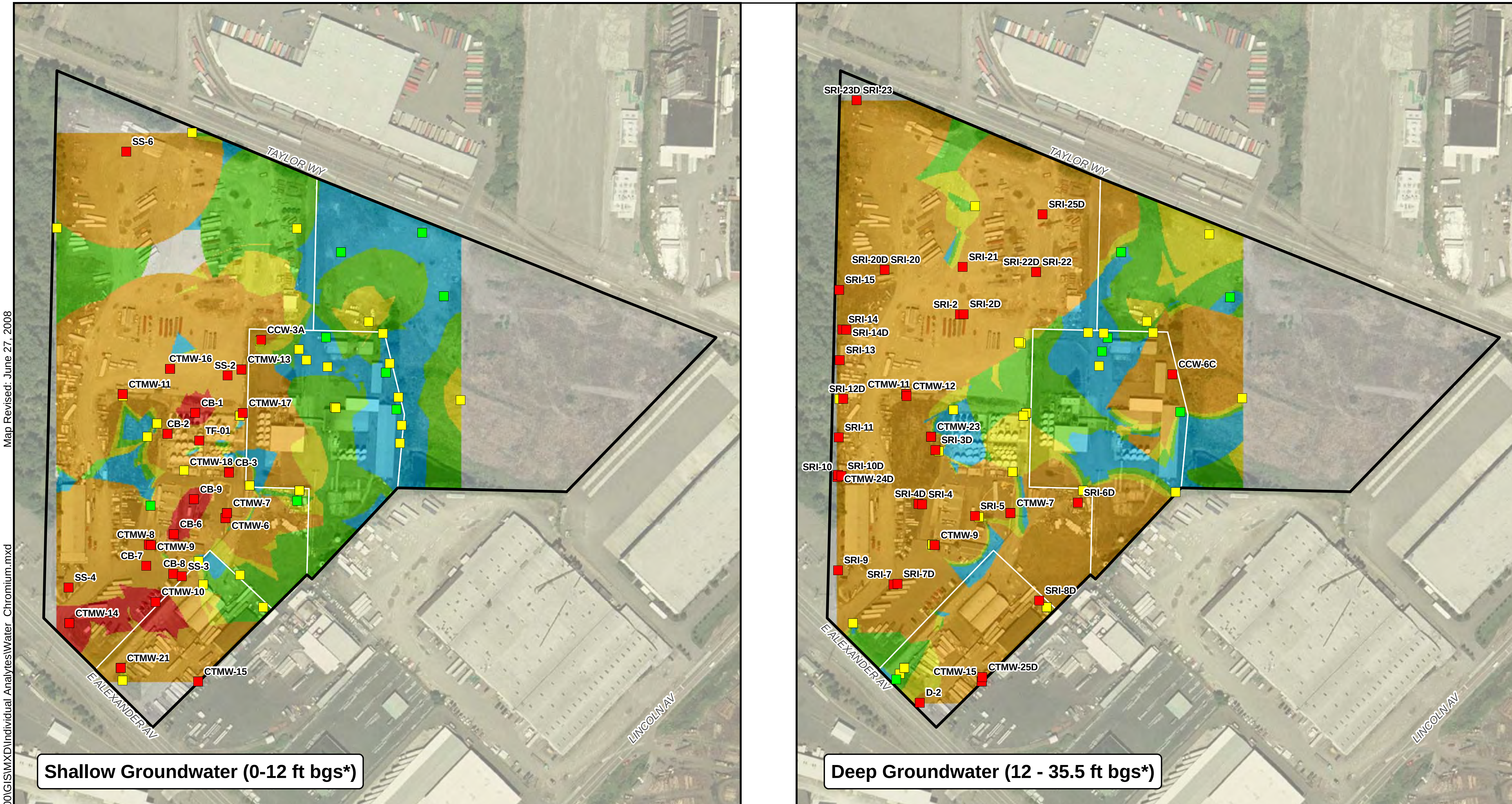
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 39

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Cadmium.mxd Map Revised: June 27, 2008

Map Revised: June 27, 2008



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: protection of surface water

Chromium (ug/L)

- <1
- 1 - 5
- 5 - 11
- 11** - 400
- >400

PROJECT NORTH

TRUE NORTH

250 0 250

Feet

Chromium in Groundwater

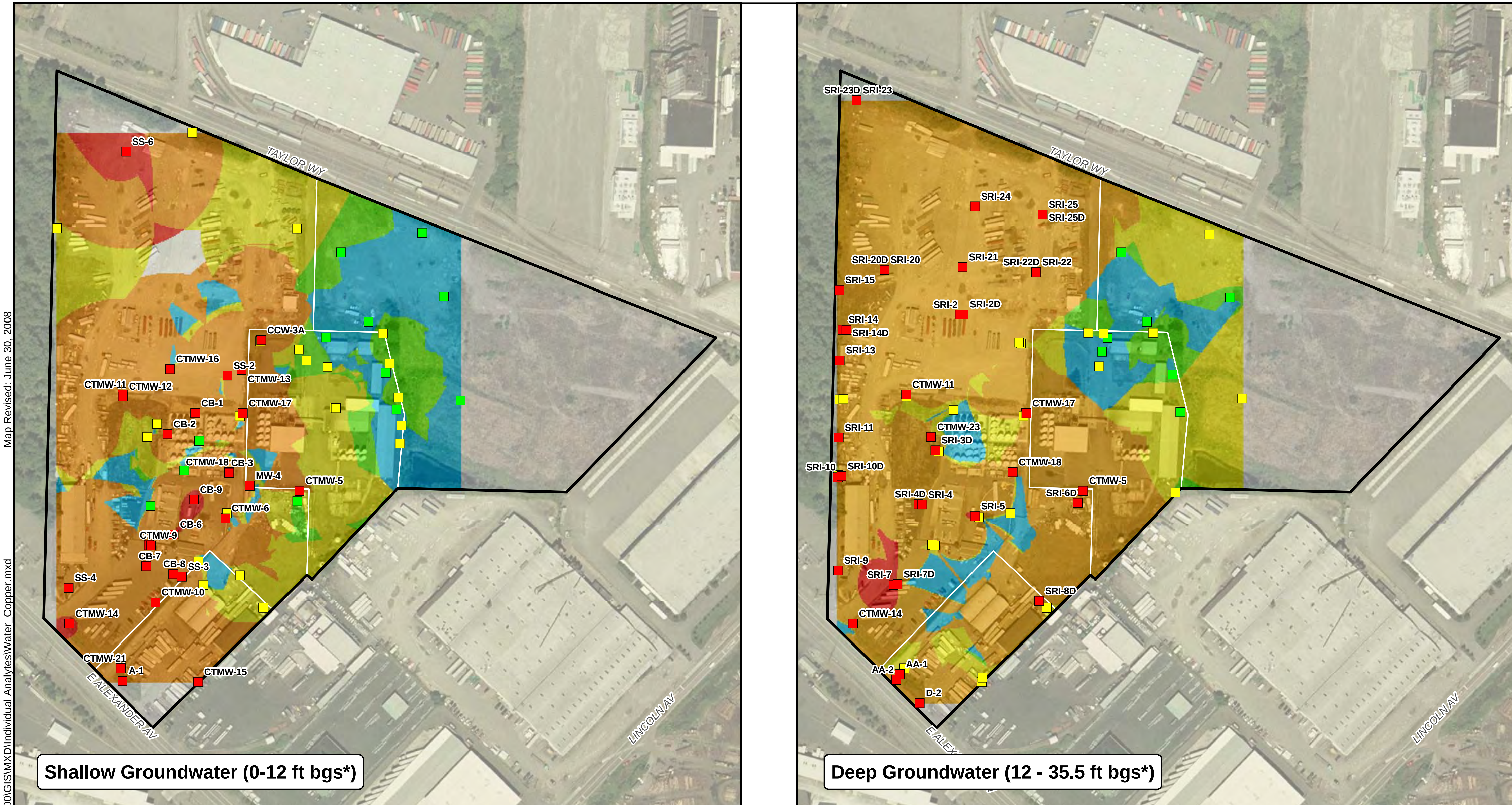
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 40

Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Chromium.mxd

Office: TAC



Map Revised: June 30, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Copper.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: practical quantitation limits

Copper (ug/L)
- < 0.1
- 0.1 - 1
- 1 - 10
- 10** - 1,000
- > 1,500

PROJECT NORTH

TRUE NORTH

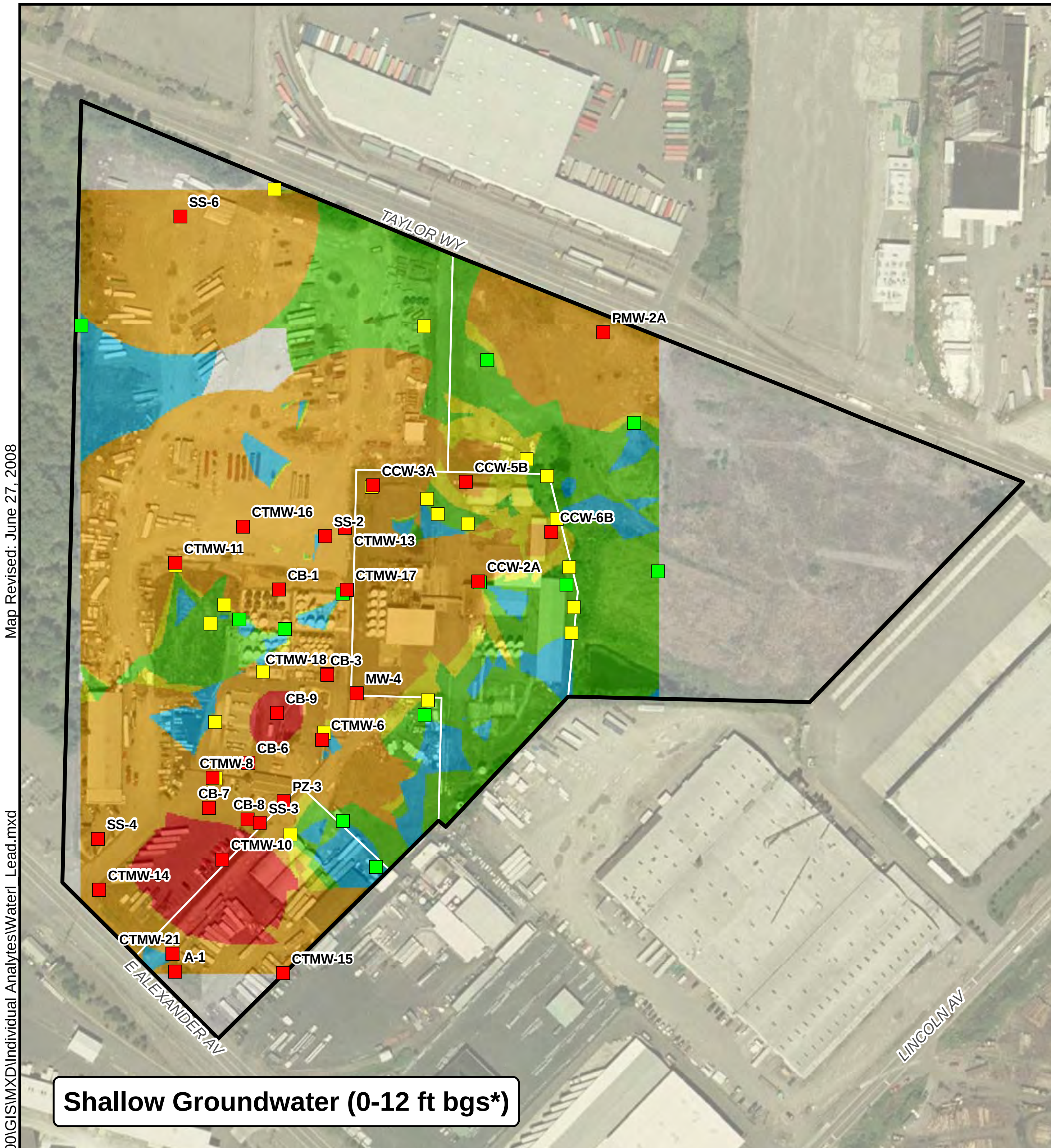
250 0 250
Feet

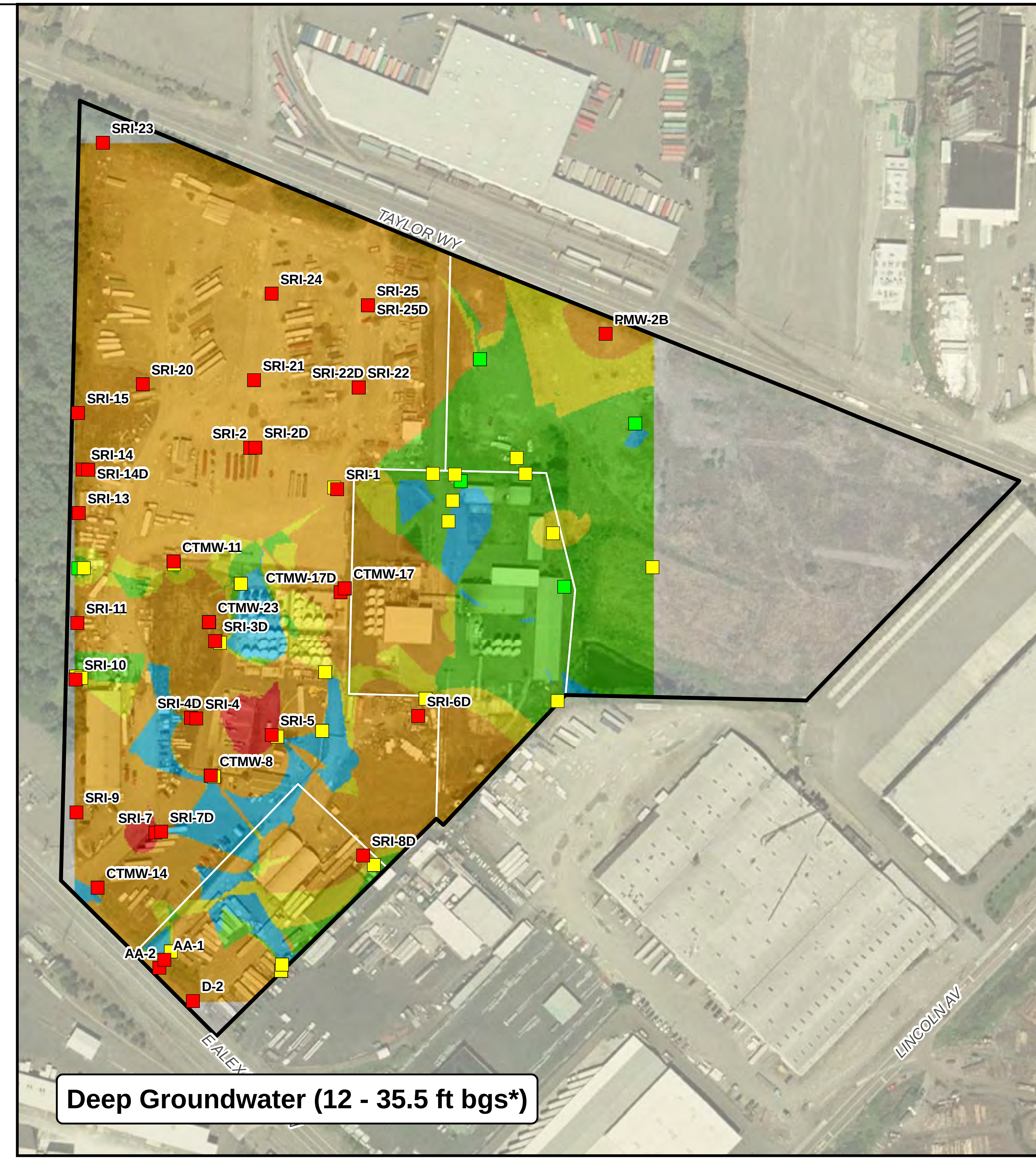
Copper in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GeoEngineers

Figure 41





Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Water\ Lead.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: practical quantitation limits

Lead (ug/L)

- <,0.01
- 0.01 - 5
- 5 - 10
- 10** - 5,000
- >5,000

PROJECT NORTH

TRUE NORTH

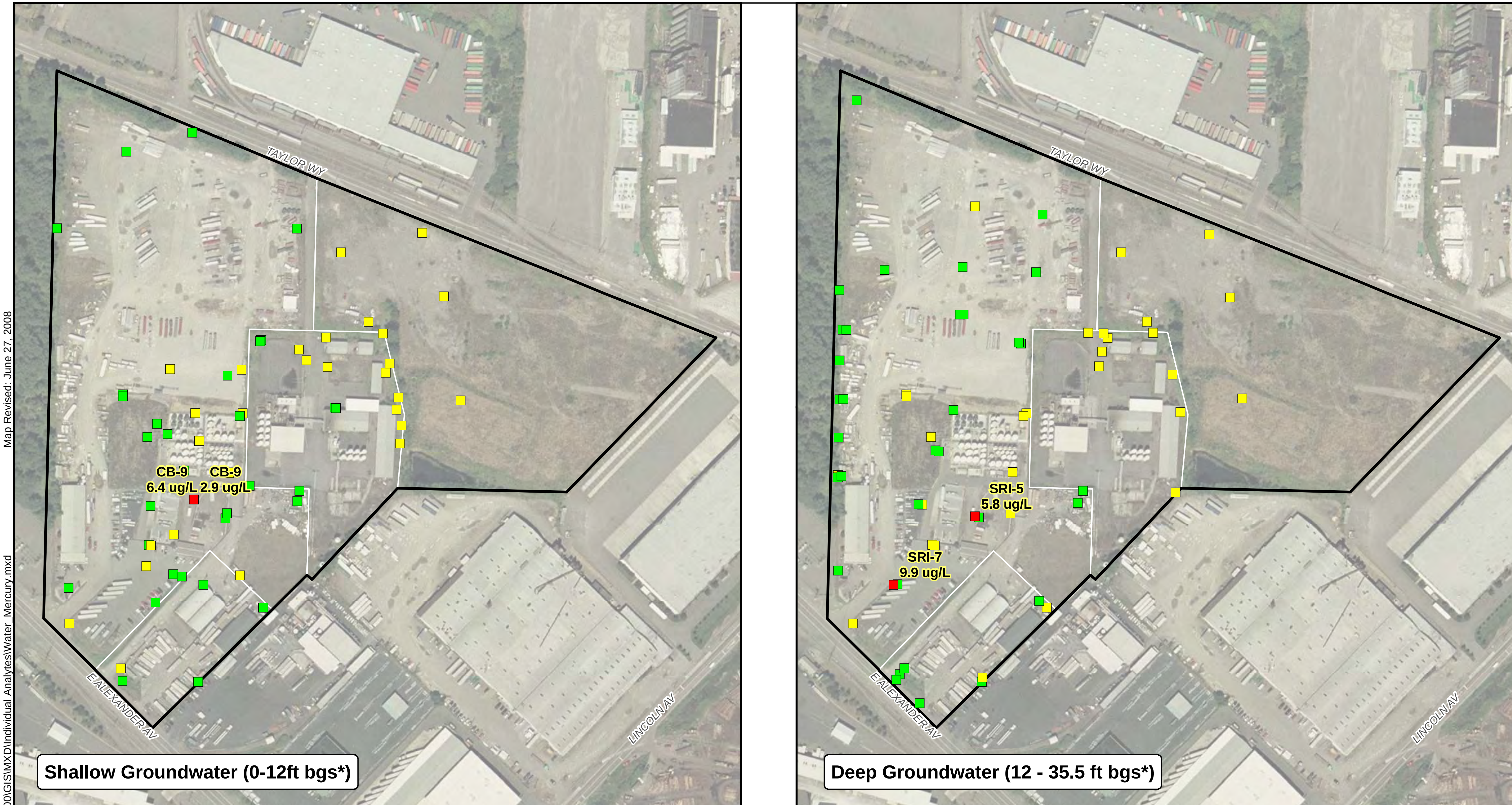
250 0 250
Feet

Lead in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 42



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources:
Sample data obtained from CC, Prologis and PSC. Aerial photo (dated September 2005) from Aerials Express (obtained from- http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.
PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 2 ug/L
Screening level basis: practical quantitation limits

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

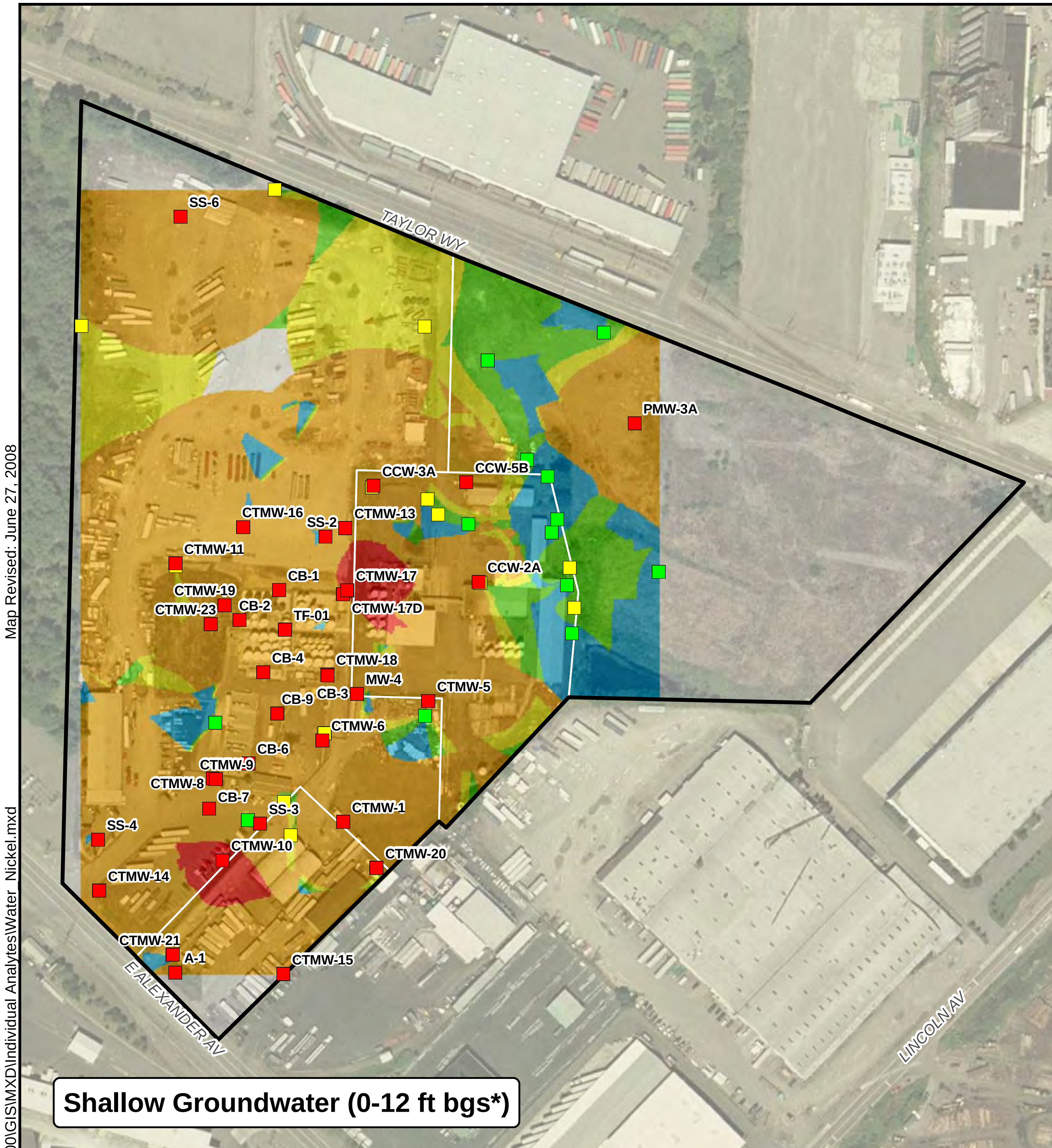
Mercury in Groundwater

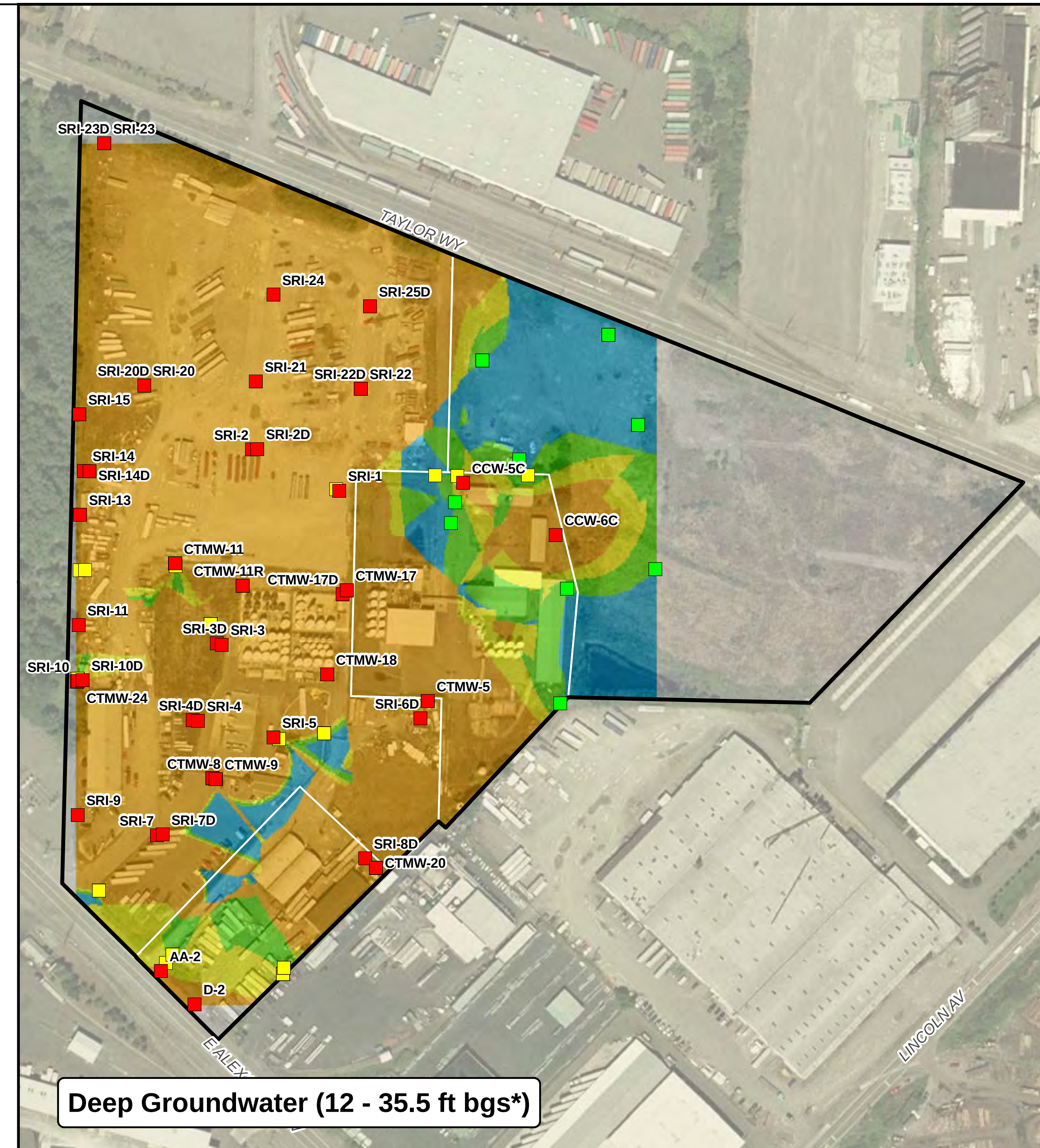
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 43

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Mercury.mxd Map Revised: June 27, 2008





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level (red)
- Analyte detected (yellow)
- Analyte non-detect (green)

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: practical quantitation limits

Nickel (ug/L)	
(blue)	<0.01
(green)	0.01 - 5
(yellow)	5 - 10
(orange)	10** - 3,000
(red)	>3,000

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

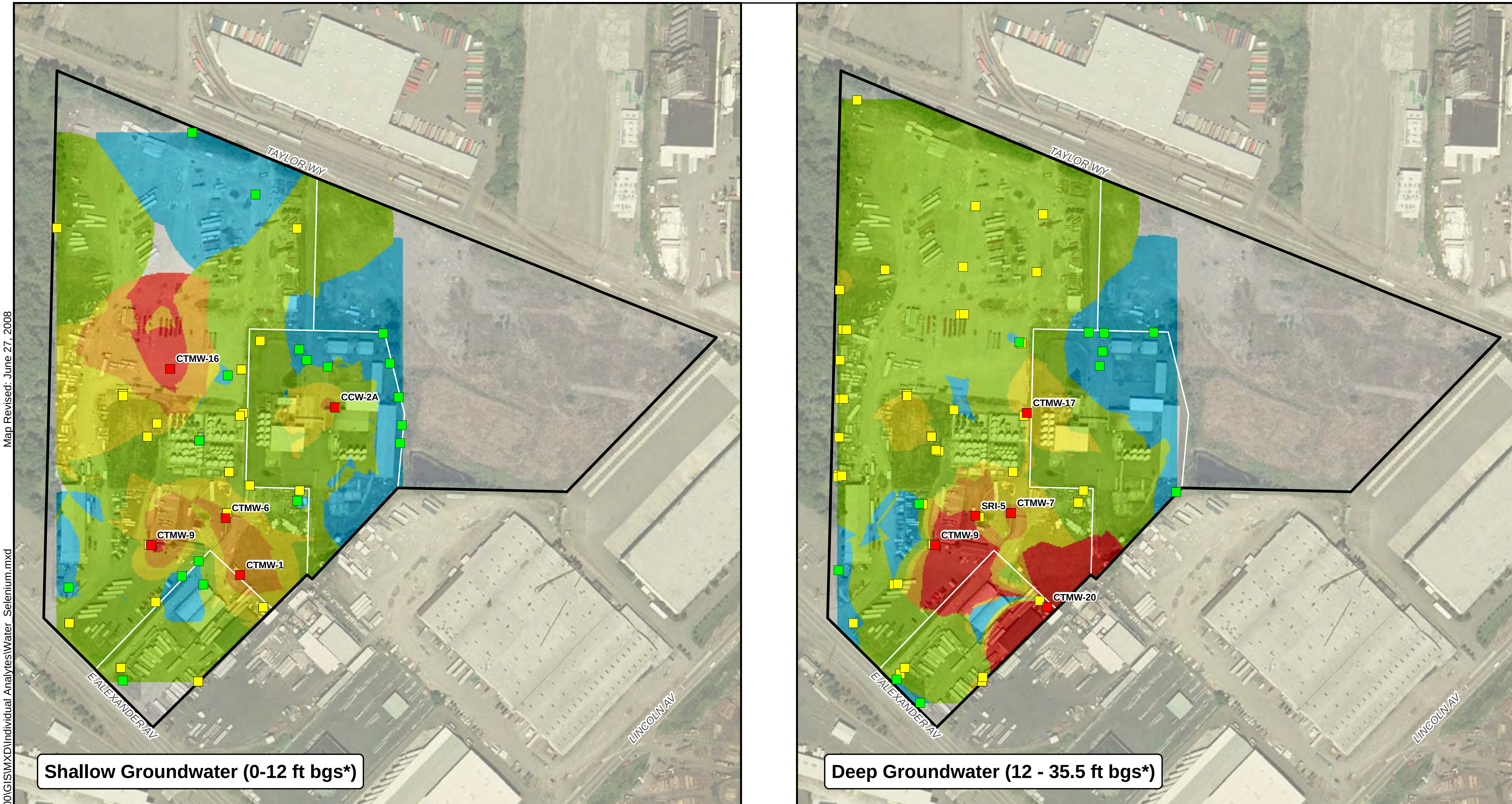
Nickel in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 44

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Nickel.mxd Map Revised: June 27, 2008



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: practical quantitation limits

Selenium (ug/L)

- <1
- 1 - 10
- 10 - 20
- 20** - 40
- >40

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

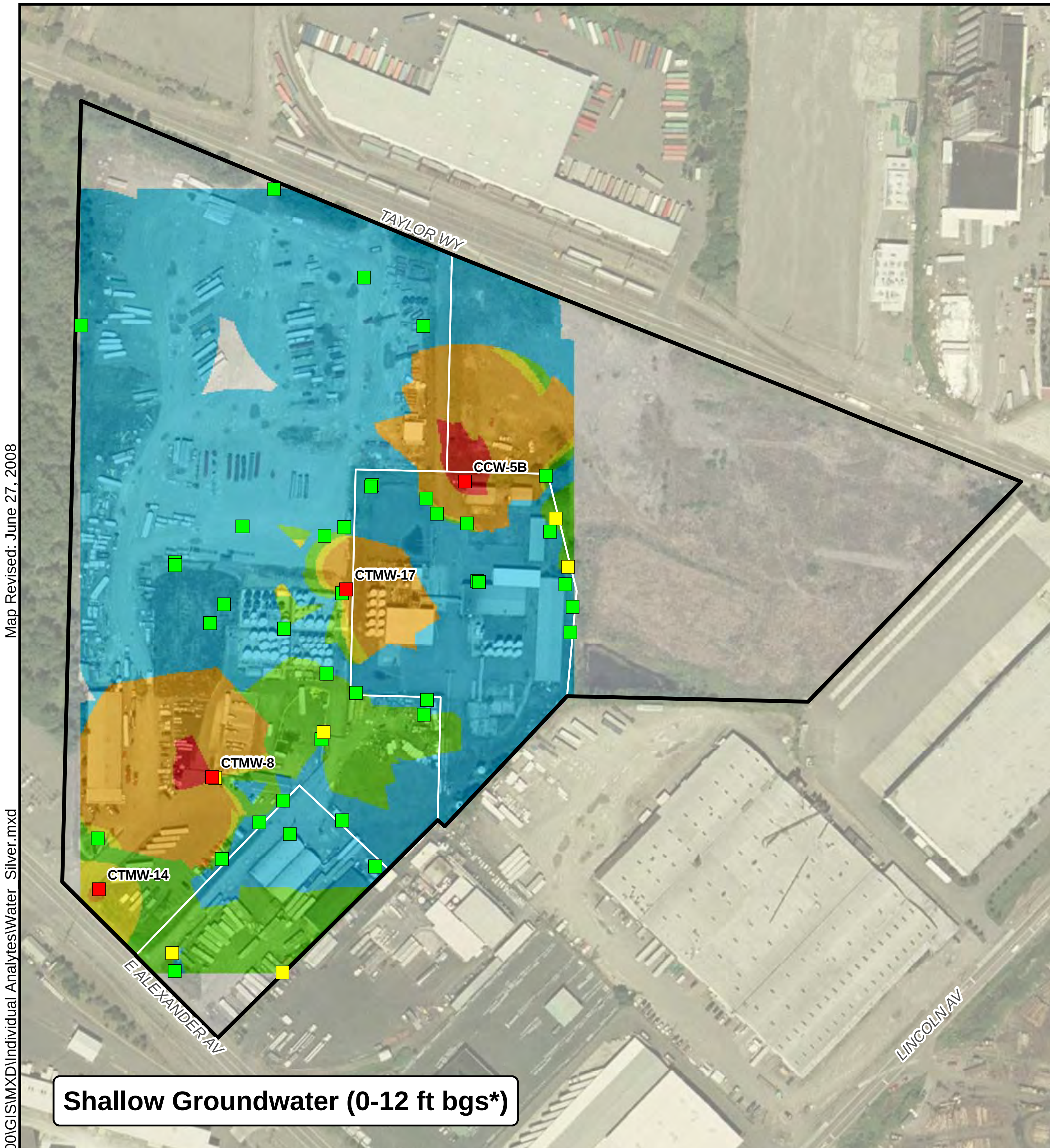
Selenium in Groundwater

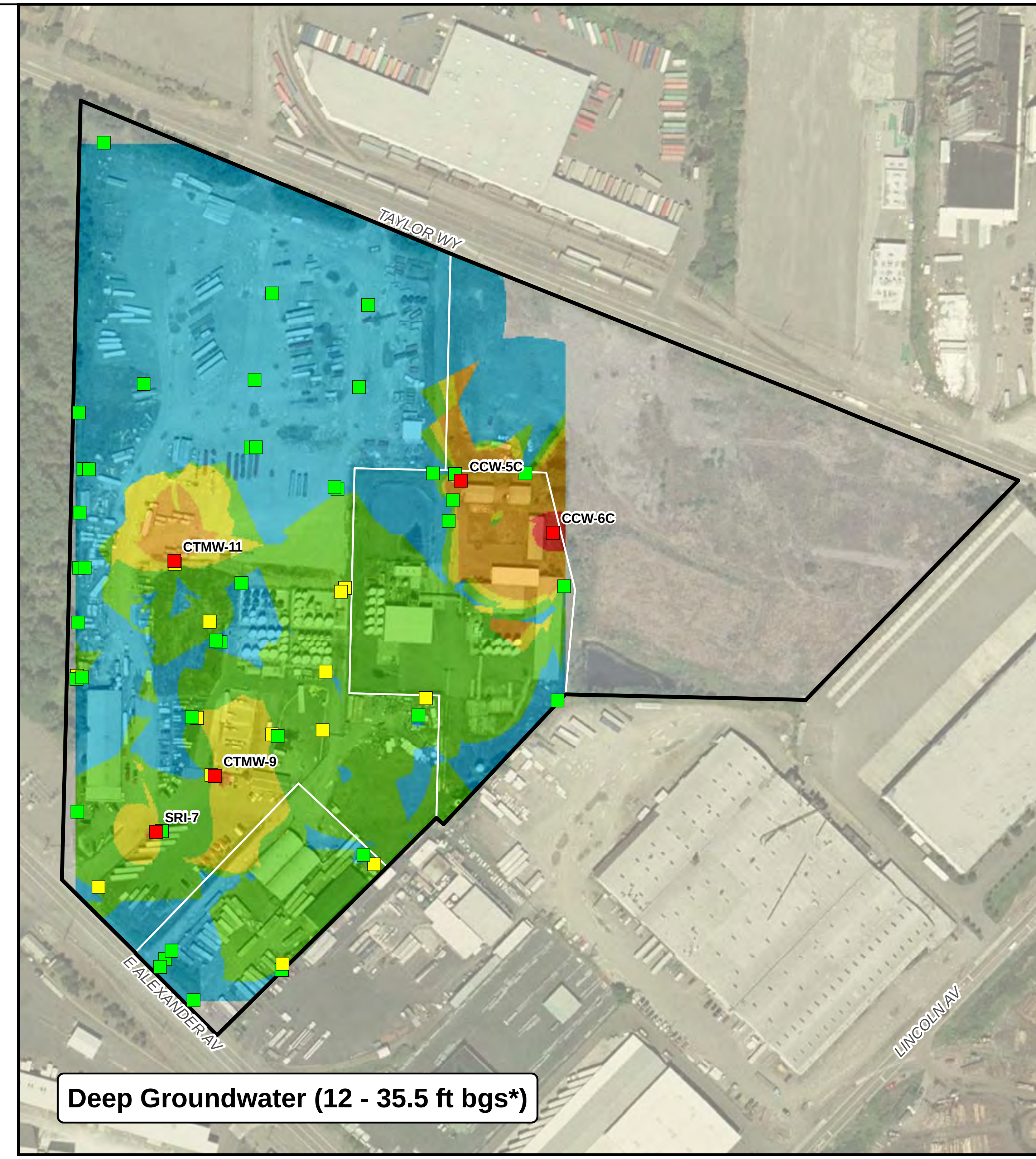
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 45

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Selenium.mxd Map Revised: June 27, 2008





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: practical quantitation limits

Silver (ug/L)

- <0.01
- 0.01 - 1
- 1 - 2
- 2** - 20
- >20

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

Silver in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

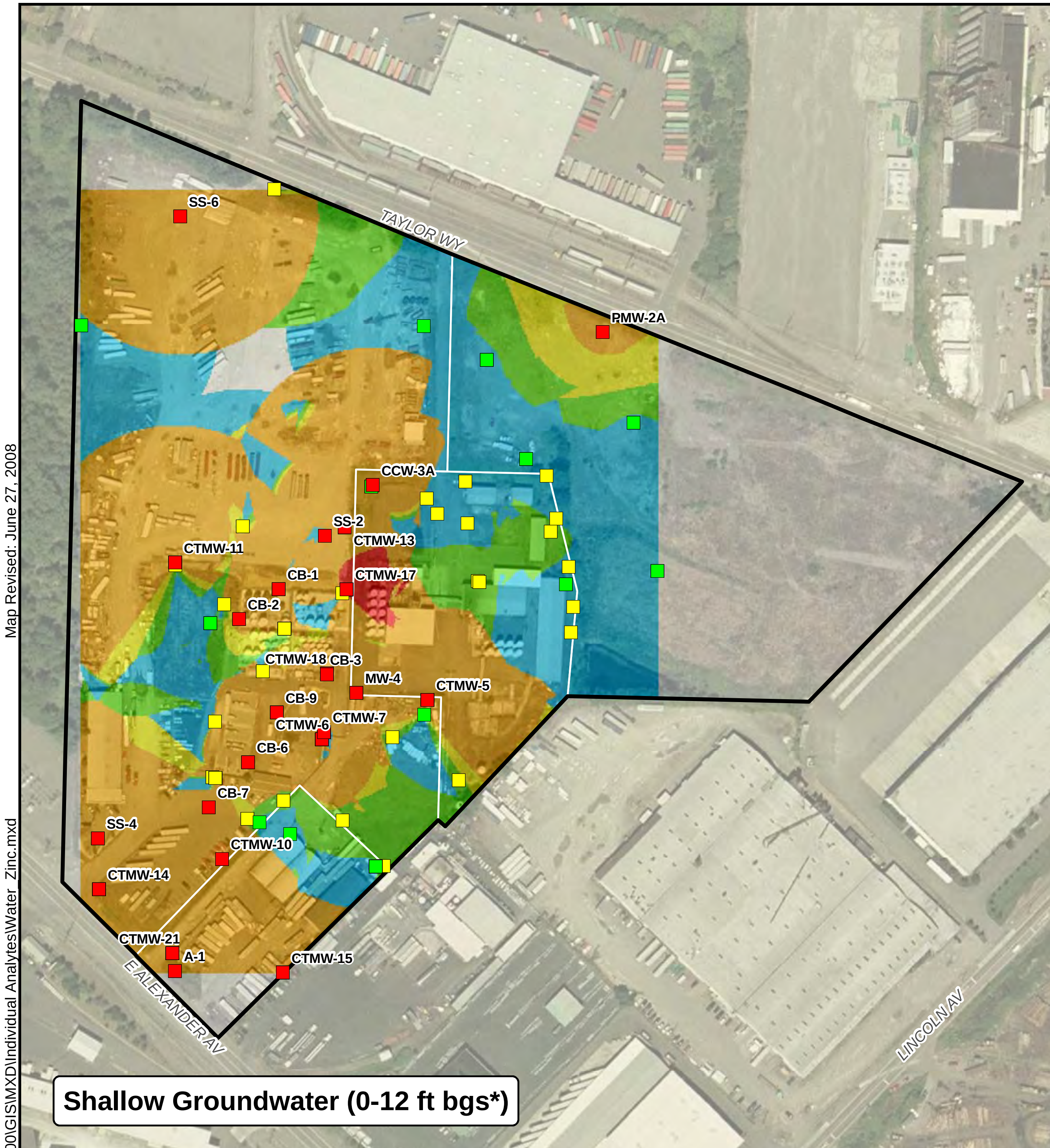
GEOENGINEERS

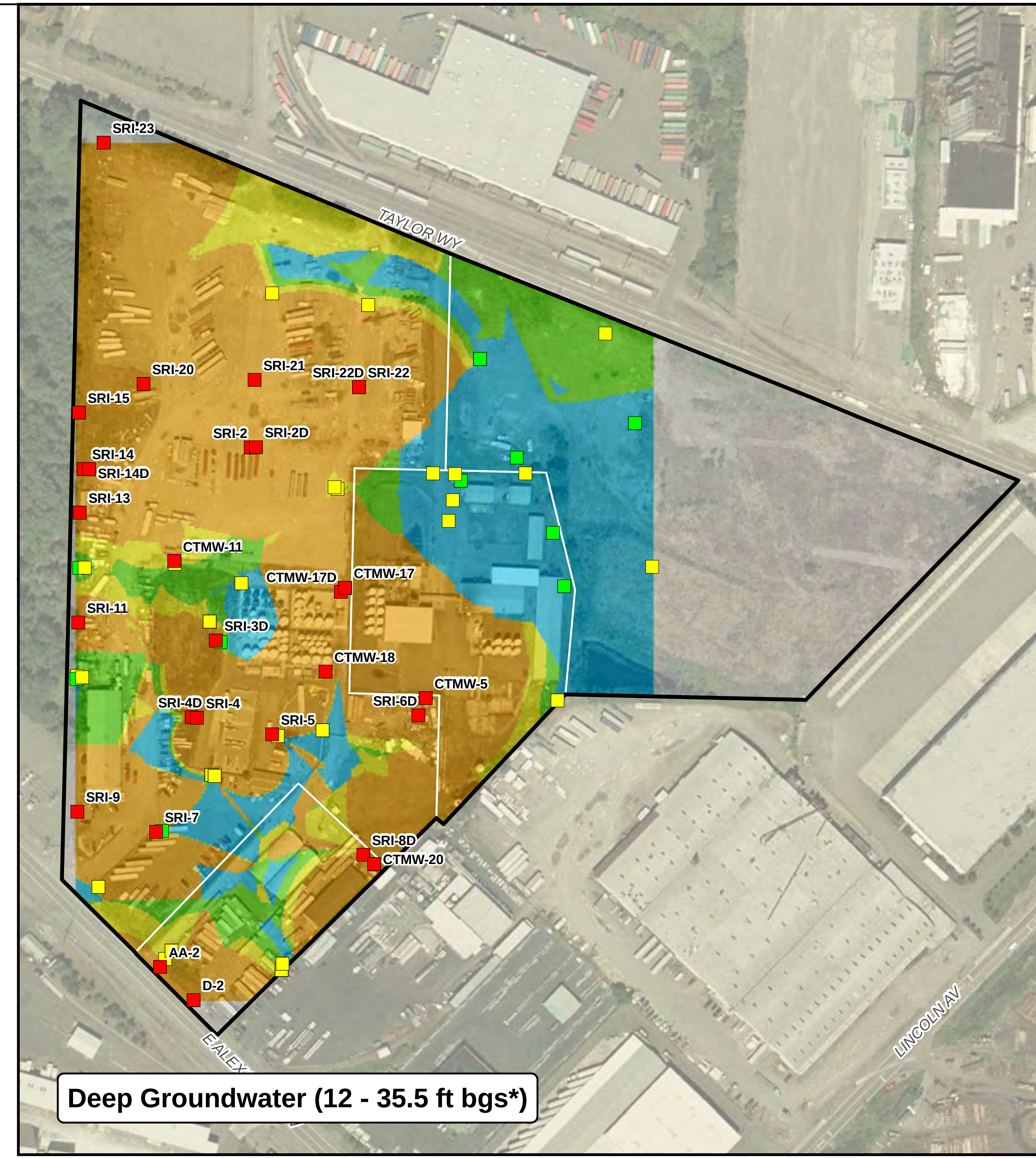
Figure 46

Office: TAC

Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Silver.mxd

Map Revised: June 27, 2008





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: protection of surface water

Zinc (ug/L)
- <10
- 10 - 40
- 40 - 81
- 81** - 100,000
- >100,000

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

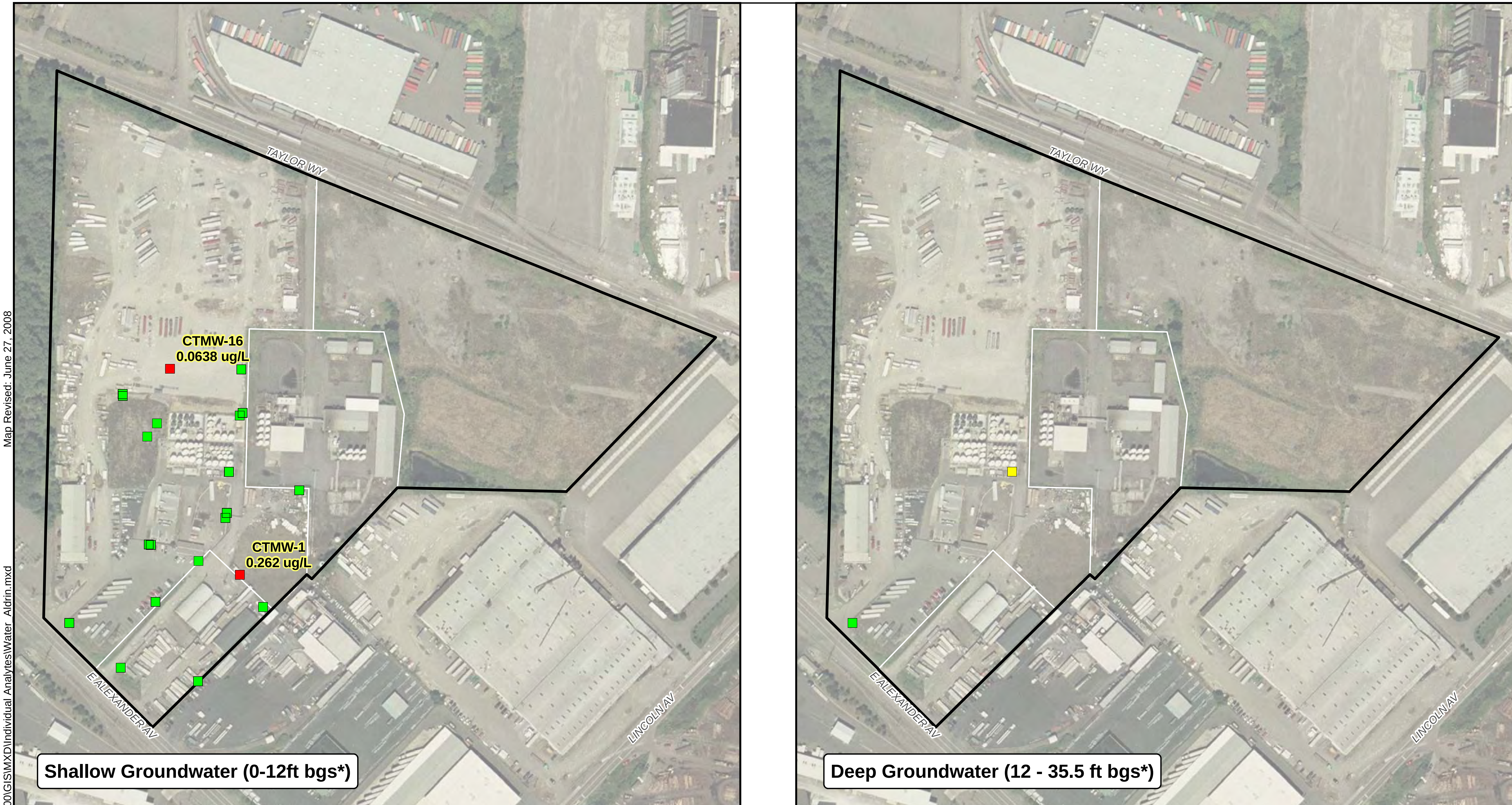
Zinc in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 47

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Zinc.mxd Map Revised: June 27, 2008



Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Aldrin.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 0.04 ug/L
Screening level basis: practical quantitation limits

PROJECT NORTH

TRUE NORTH

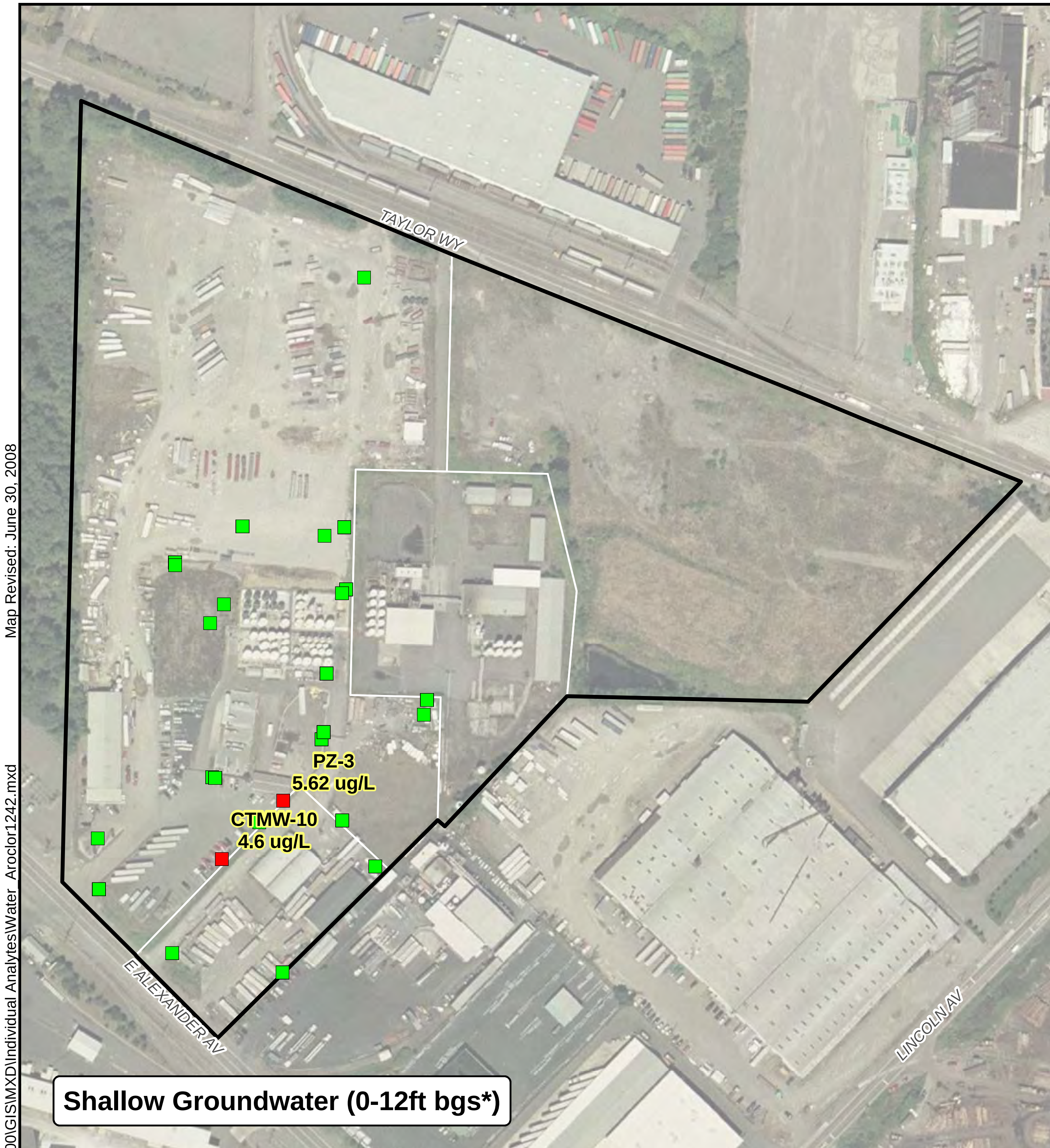
250 0 250
Feet

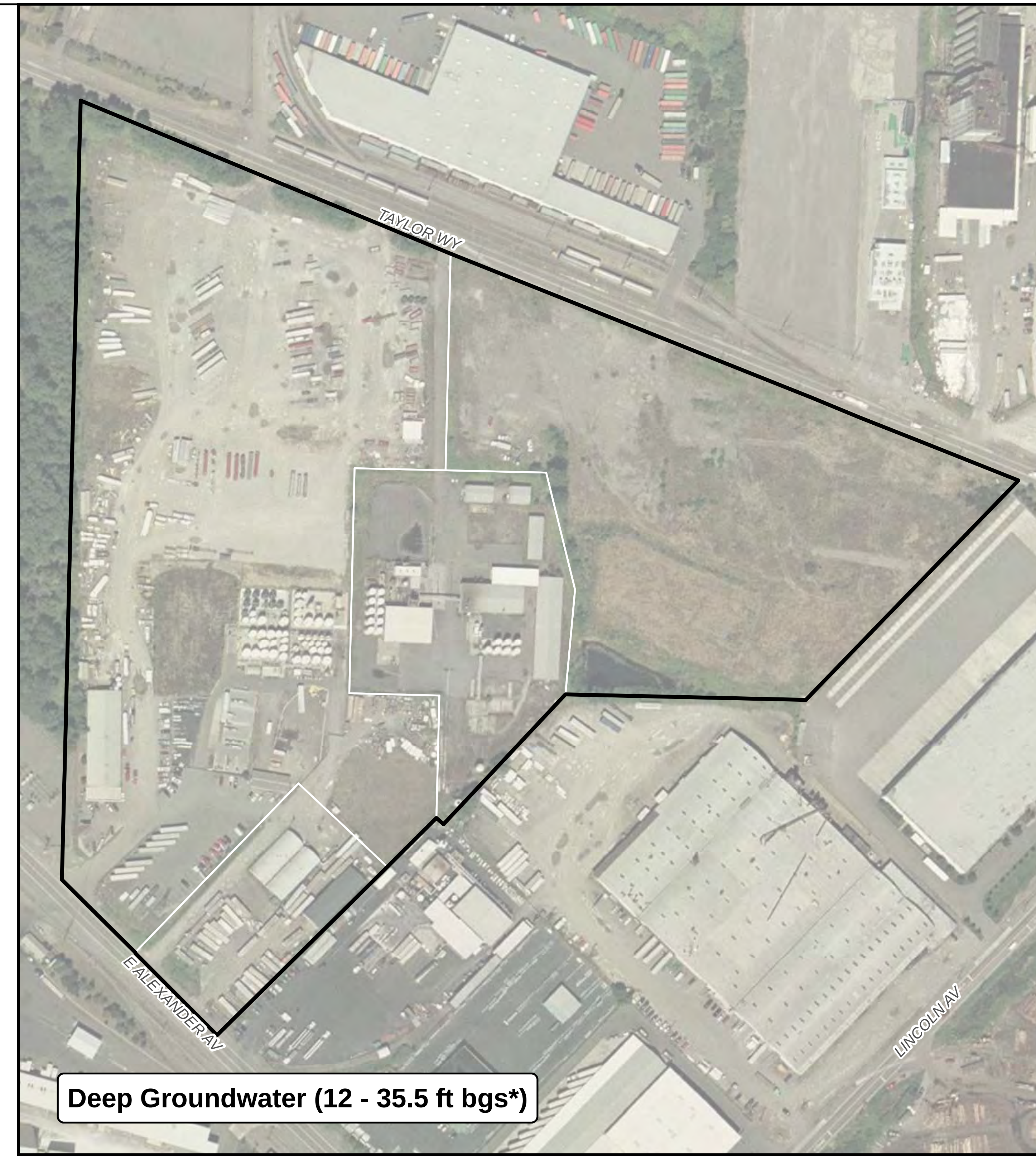
Aldrin in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 48





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 0.65 ug/L
Screening level basis: practical quantitation limits

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

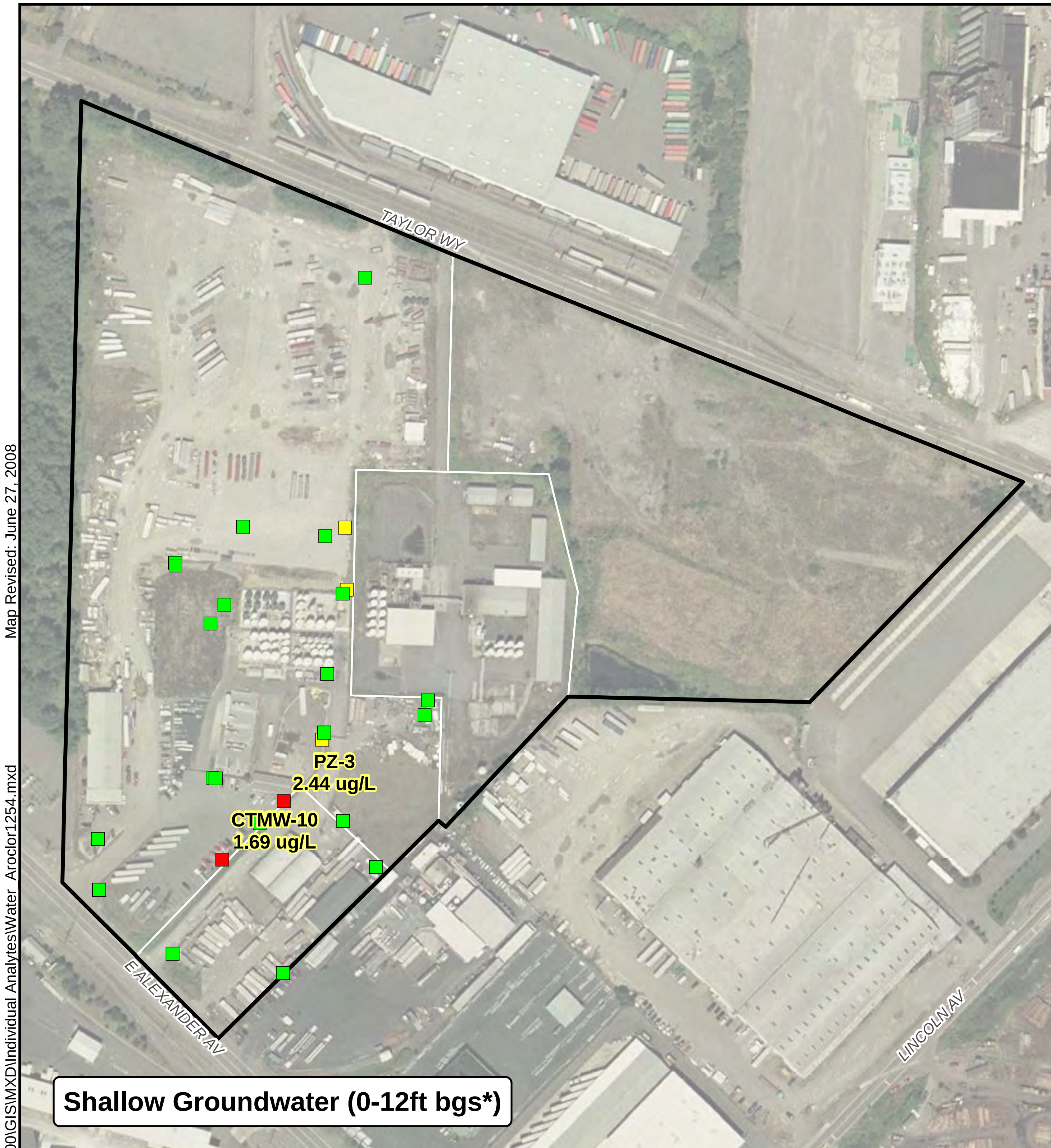
Aroclor 1242 in Groundwater

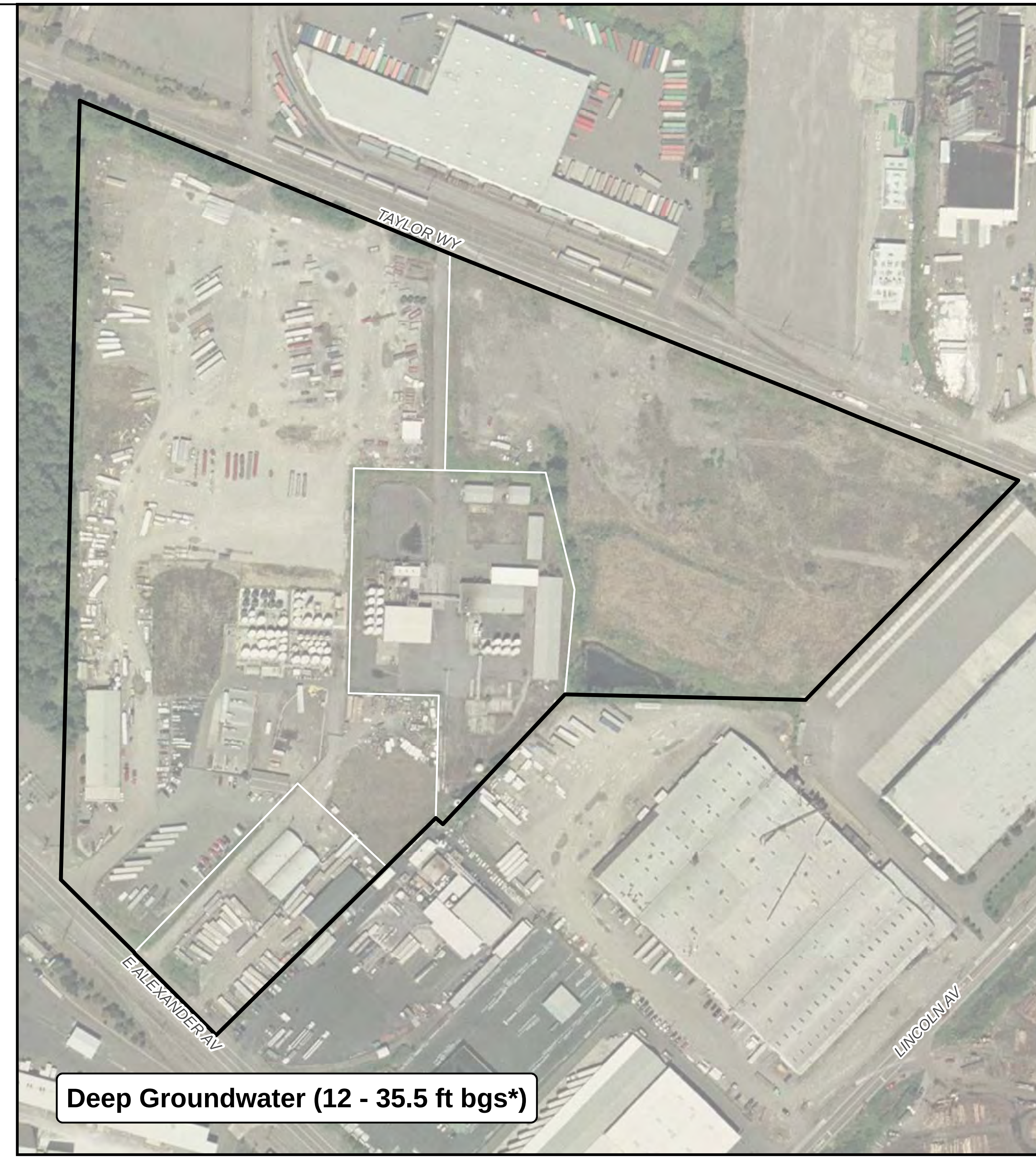
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 49

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater Aroclor1242.mxd Map Revised: June 30, 2008





Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Aroclor1254.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 1.3 ug/L
Screening level basis: practical quantitation limits

PROJECT NORTH

TRUE NORTH

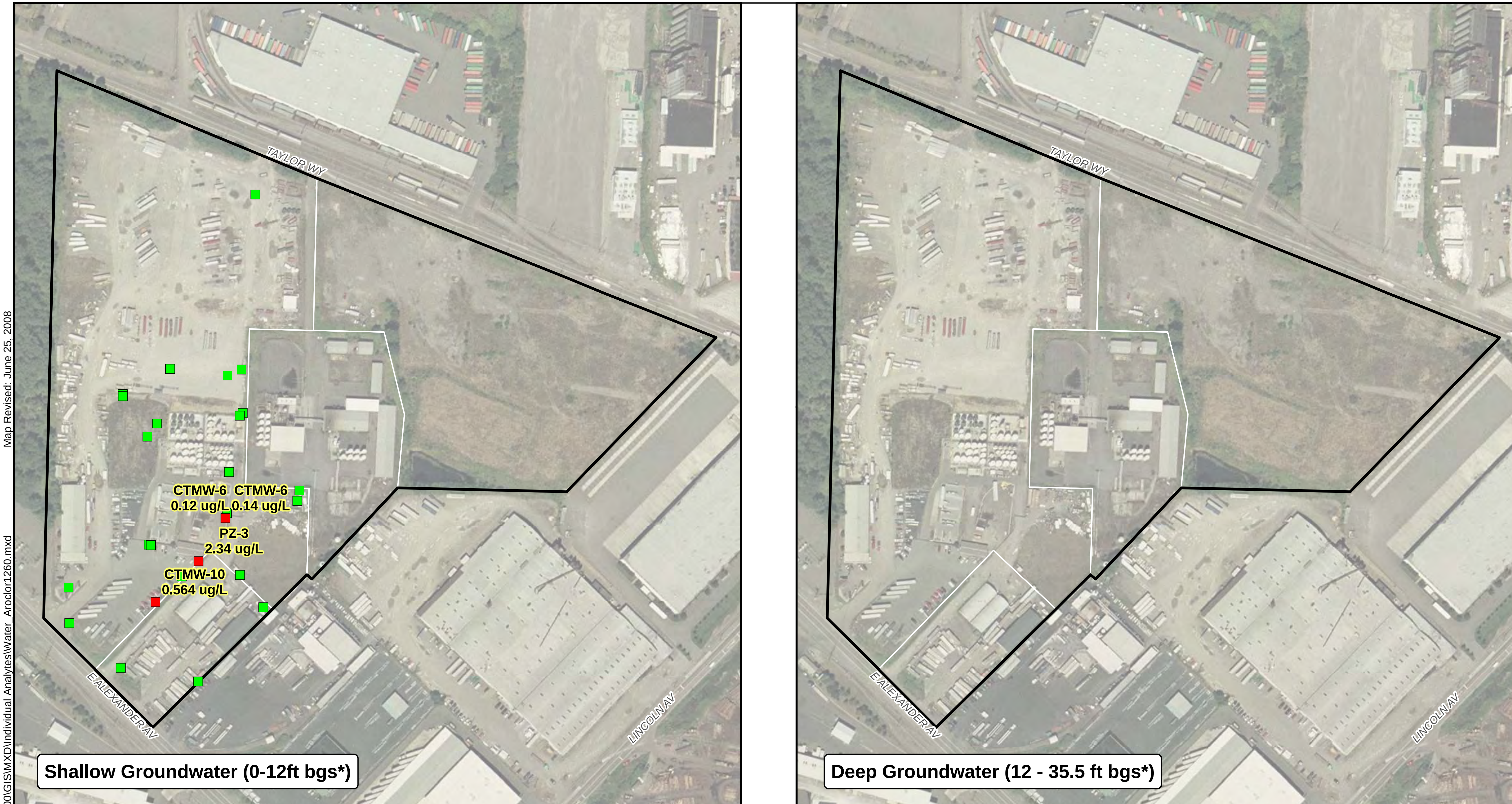
250 0 250
Feet

Aroclor 1254 in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 50



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 0.006 ug/L
Screening level basis: protection of surface water

PROJECT NORTH   TRUE NORTH

250   0   250
Feet

Aroclor 1260 in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

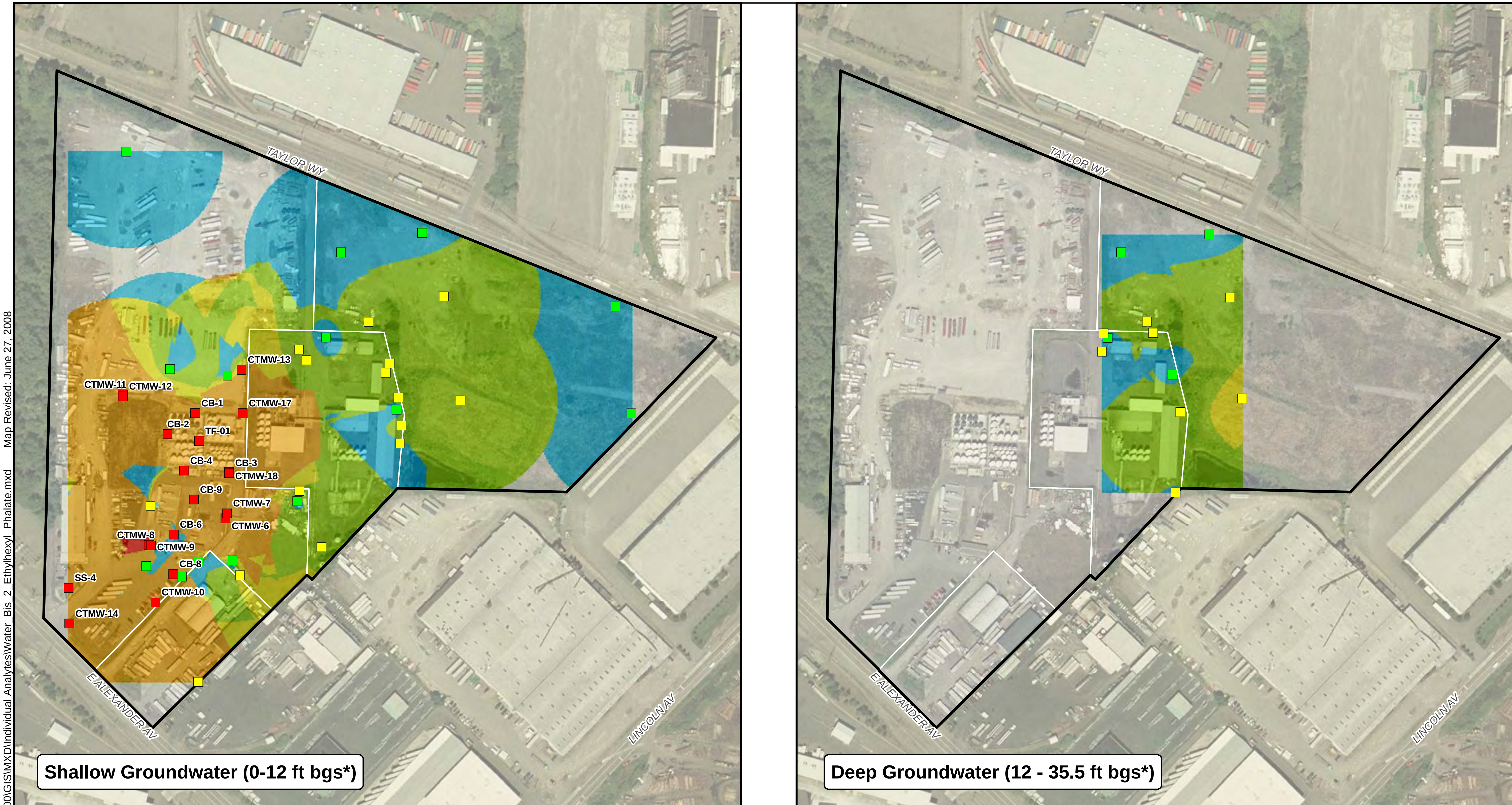
Figure 51

Map Revised: June 25, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater Aroclor1260.mxd

Office: TAC

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Bis_2_Ethylhexyl_Phalate.mxd Map Revised: June 27, 2008



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: practical quantitation limits

Bis(2-ethylhexyl)-phalate (ug/L)

- <1
- 1 - 5
- 5 - 10
- 10** - 6,000
- >6,000

PROJECT NORTH

TRUE NORTH

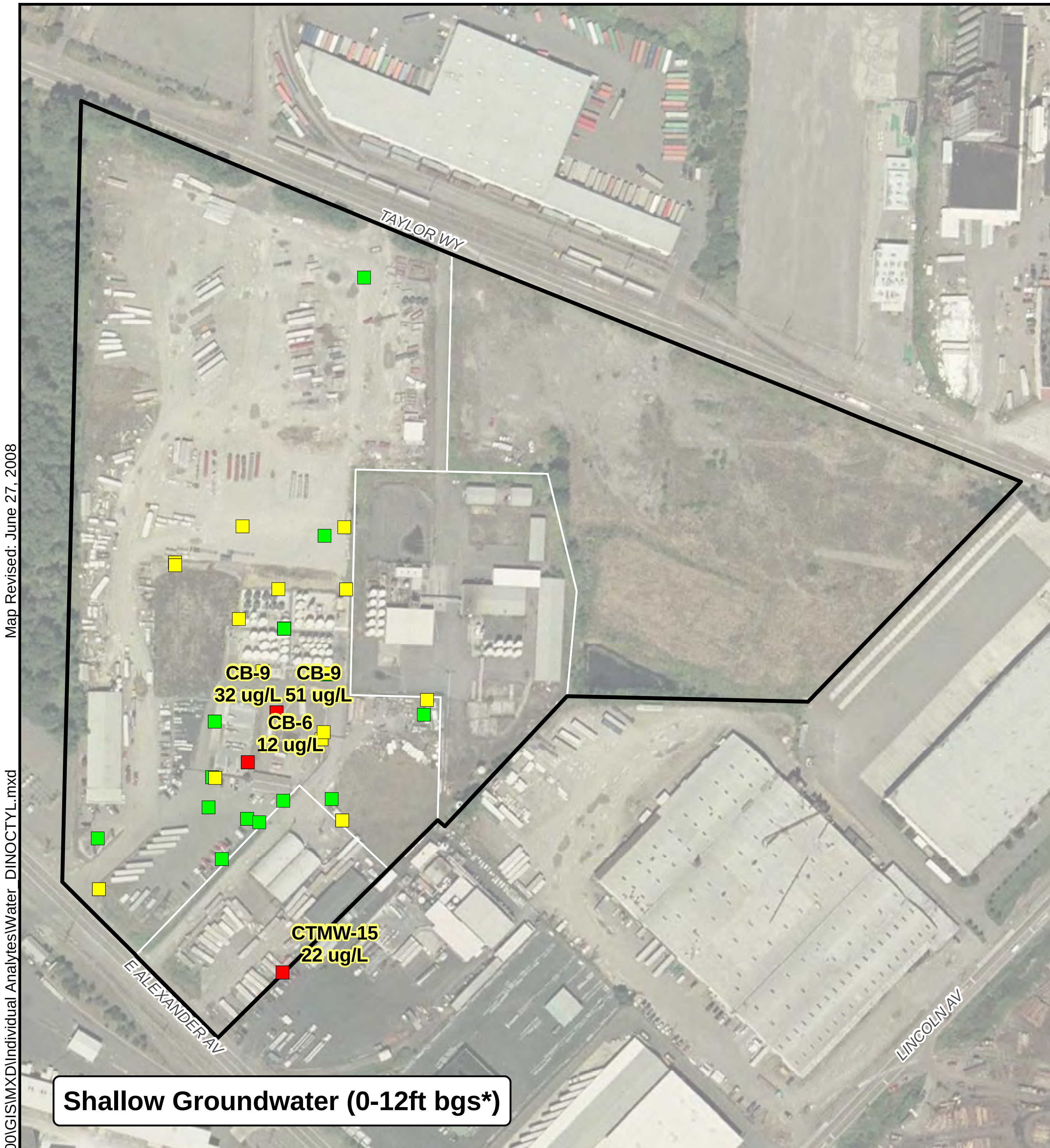
250 0 250
Feet

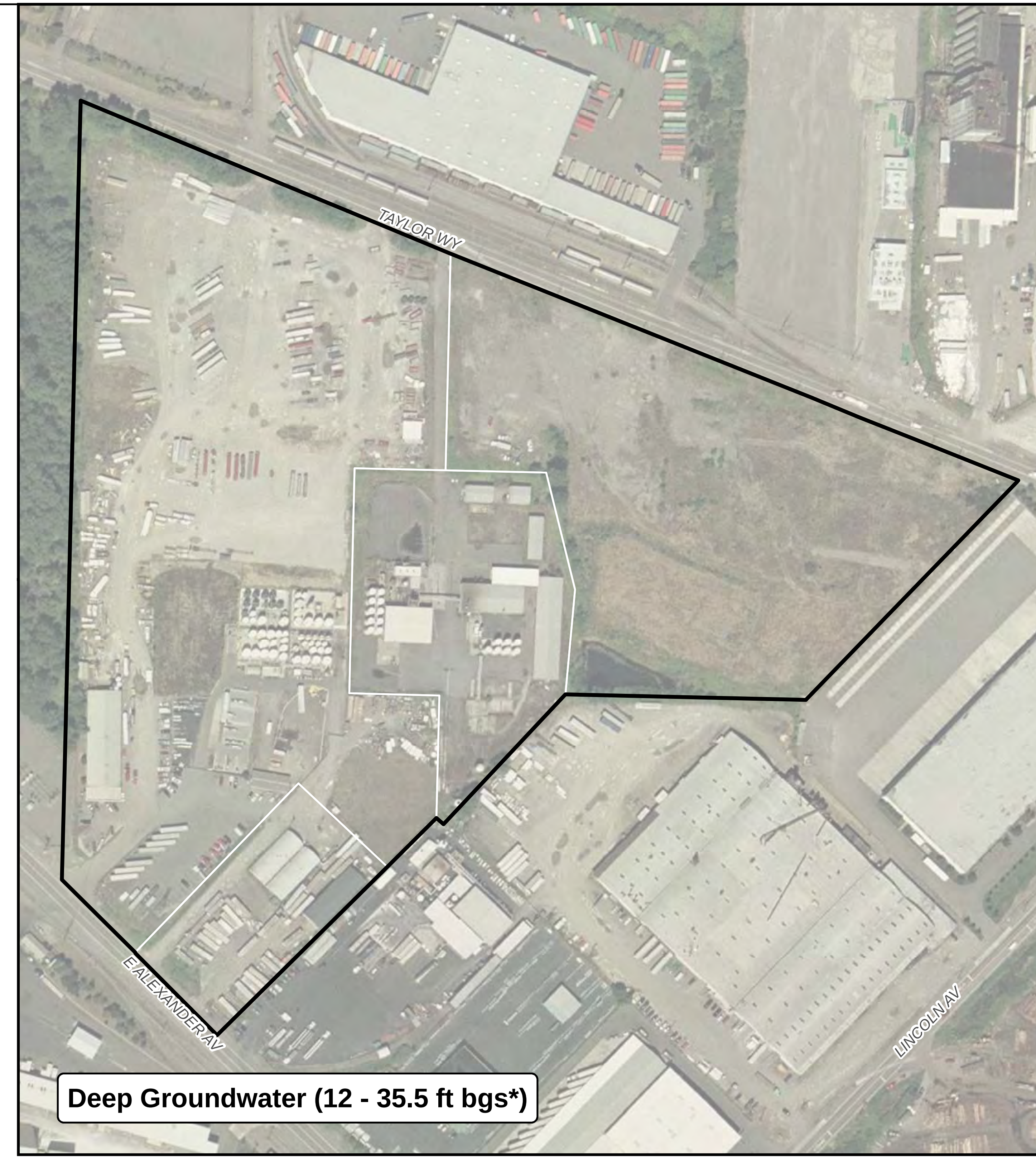
Bis(2-ethylhexyl)-phthalate in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 52





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 10 ug/L
Screening level basis: practical quantitation limits

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

Di-n-octylphthalate in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

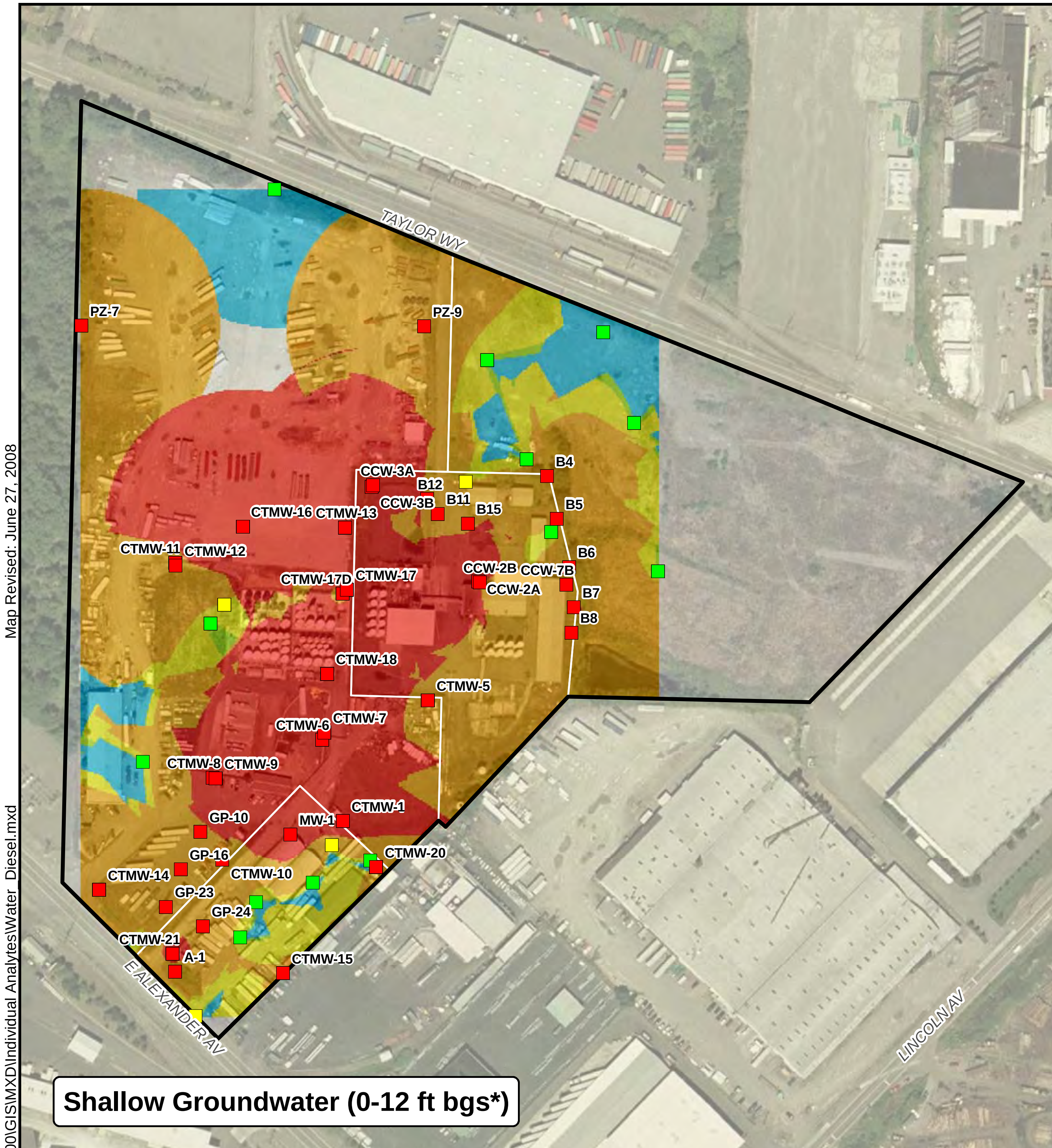
GEOENGINEERS

Figure 53

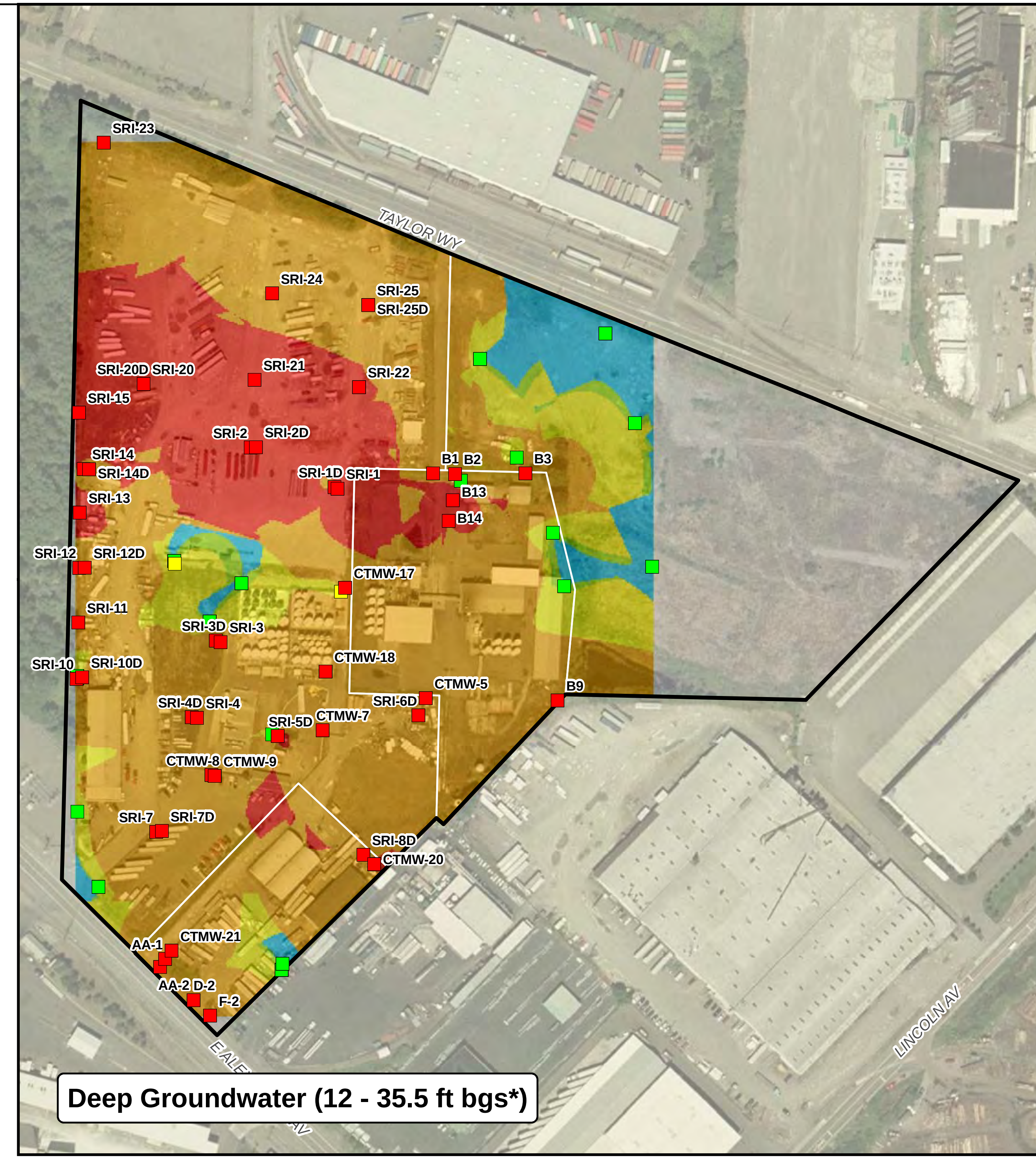
Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_DINOCTYL.mxd

Office: TAC



Shallow Groundwater (0-12 ft bgs*)



Deep Groundwater (12 - 35.5 ft bgs*)

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Water_Diesel.mxd Map Revised: June 27, 2008

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: protection of groundwater

Diesel (ug/L)

- <5
- 5 - 50
- 50 - 500
- 500** - 5,000
- >5000

PROJECT NORTH

TRUE NORTH

250 0 250

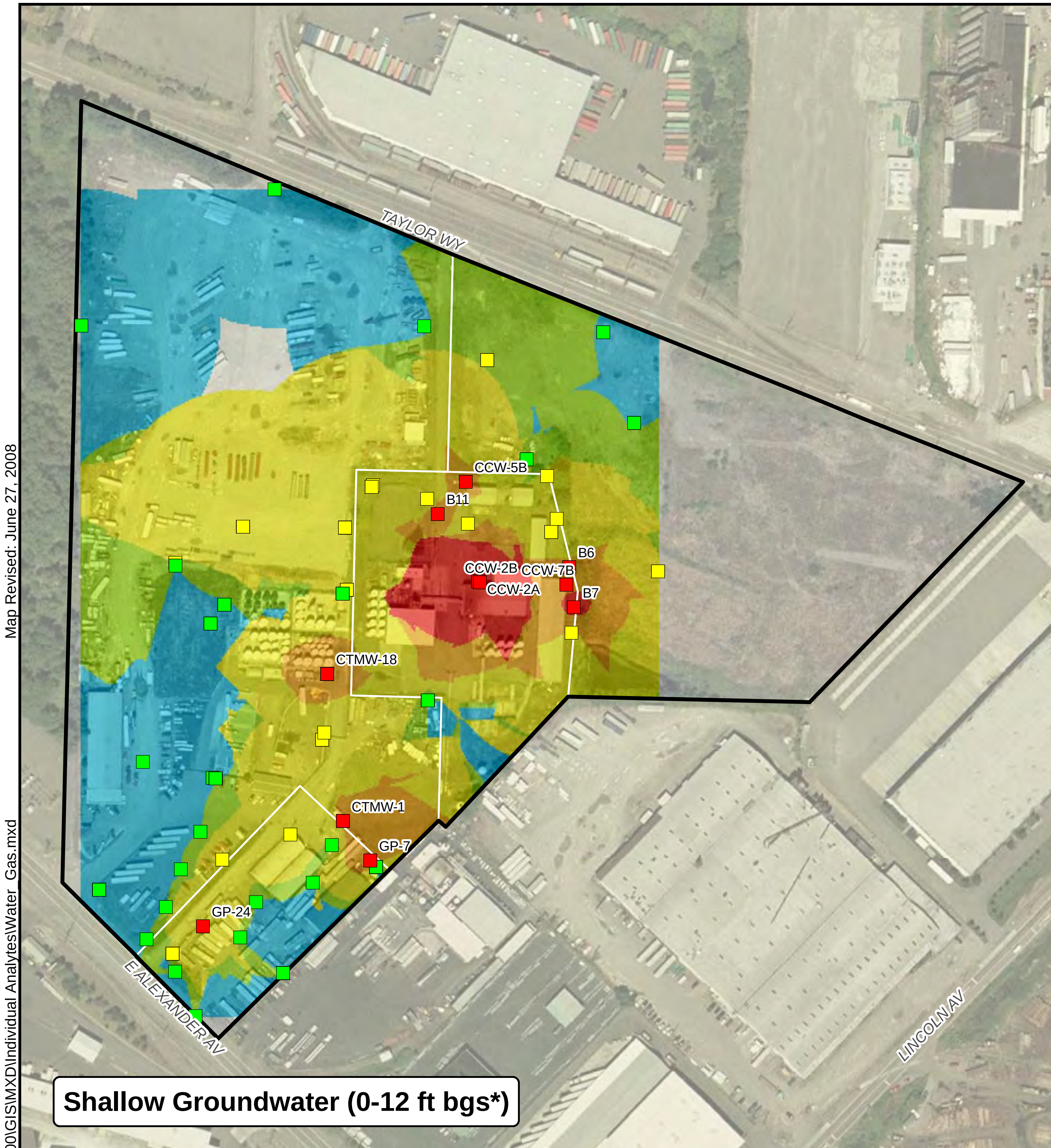
Feet

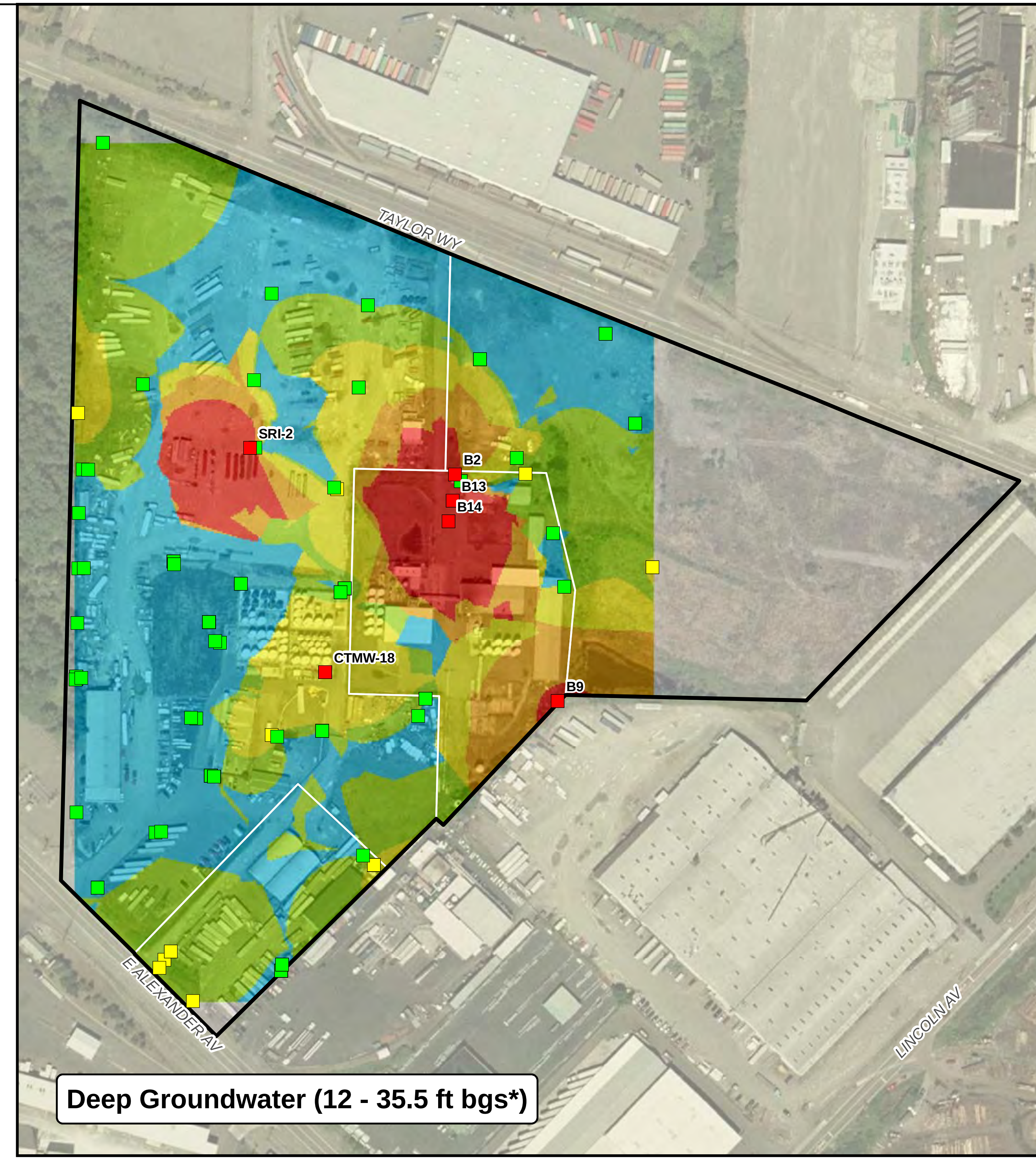
Diesel in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 54





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: protection of groundwater

Gasoline (ug/L)

- <5
- 5 - 100
- 100 - 800
- 800** - 2,000
- >2,000

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

Gasoline in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

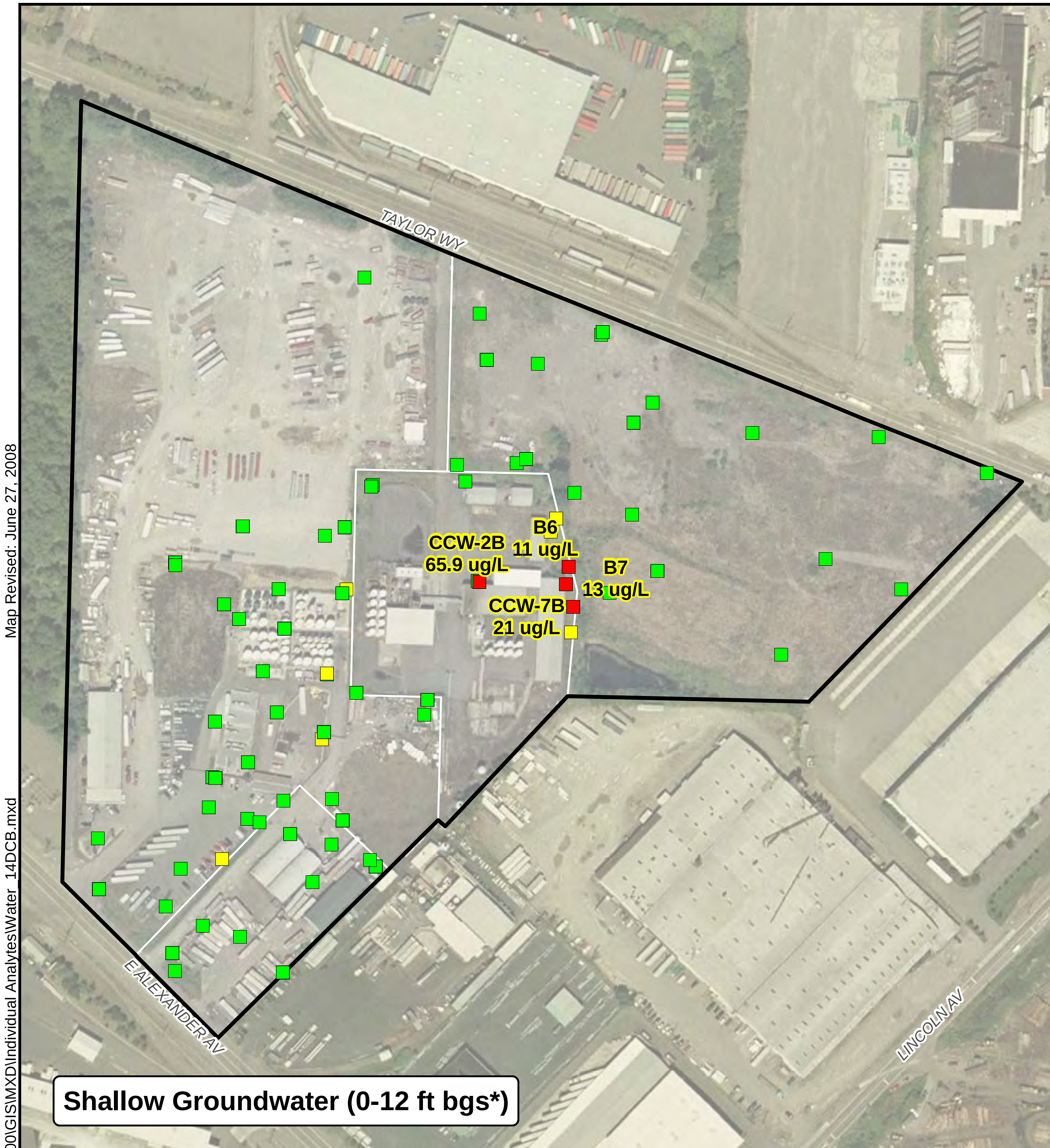
GEOENGINEERS

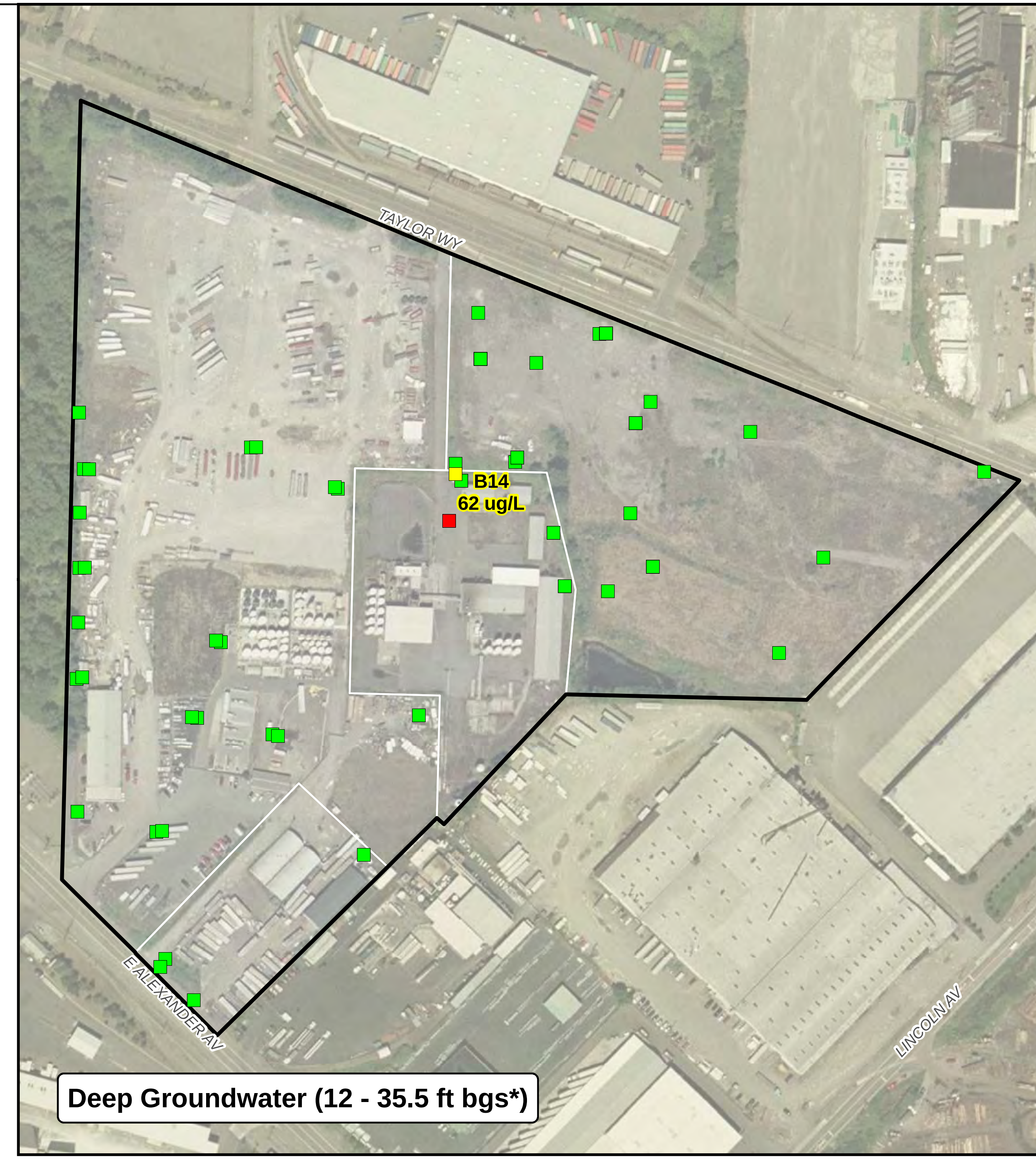
Figure 55

Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Gas.mxd

Office: TAC





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 10 ug/L
Screening level basis: practical quantitation limits

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

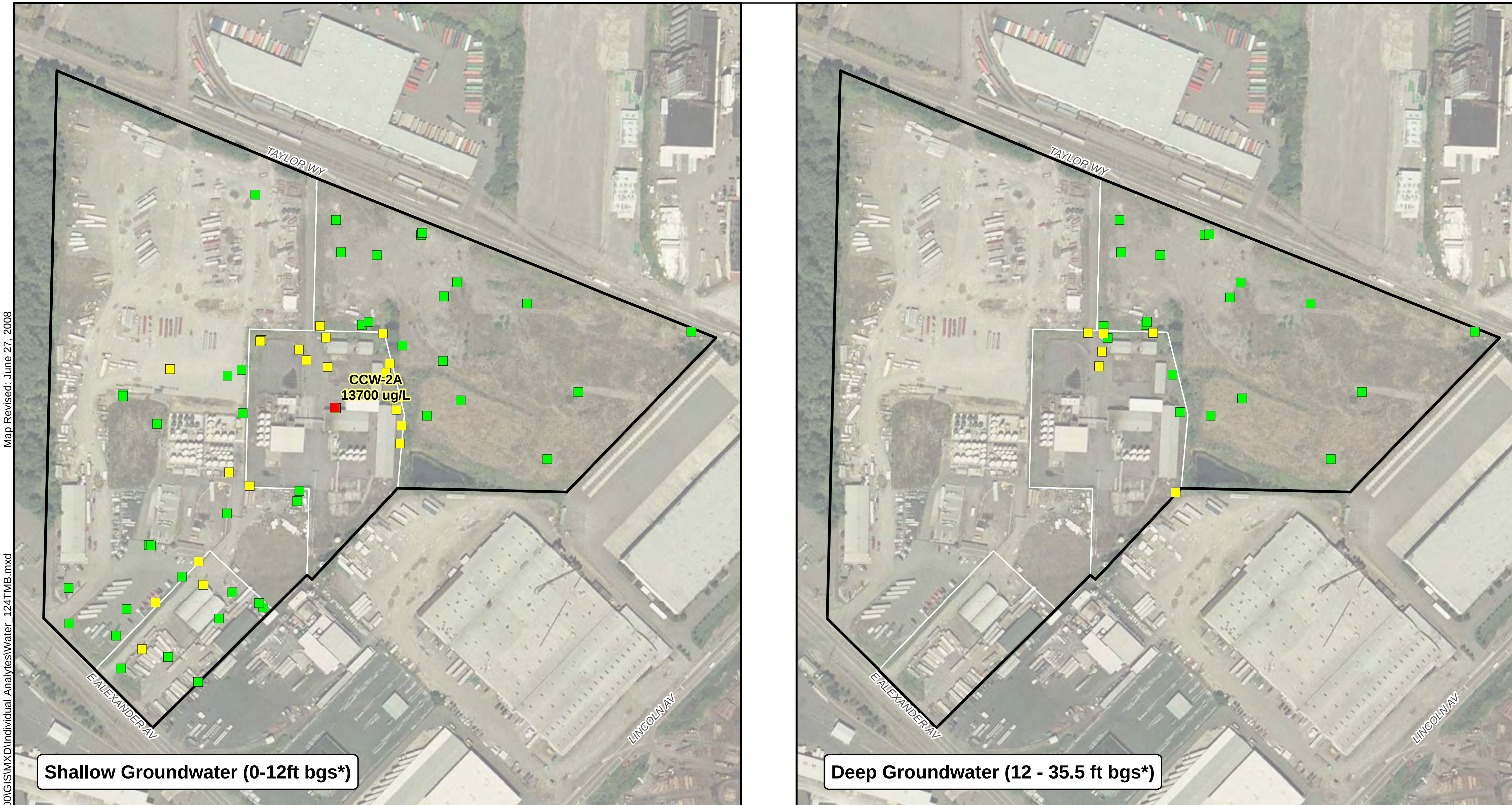
1,4-Dichlorobenzene in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 56

Office: TAC
Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater 14DCB.mxd
Map Revised: June 27, 2008



Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_124TMB.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 3870 ug/L
Screening level basis: protection of On-Site groundwater exposure

PROJECT NORTH

TRUE NORTH

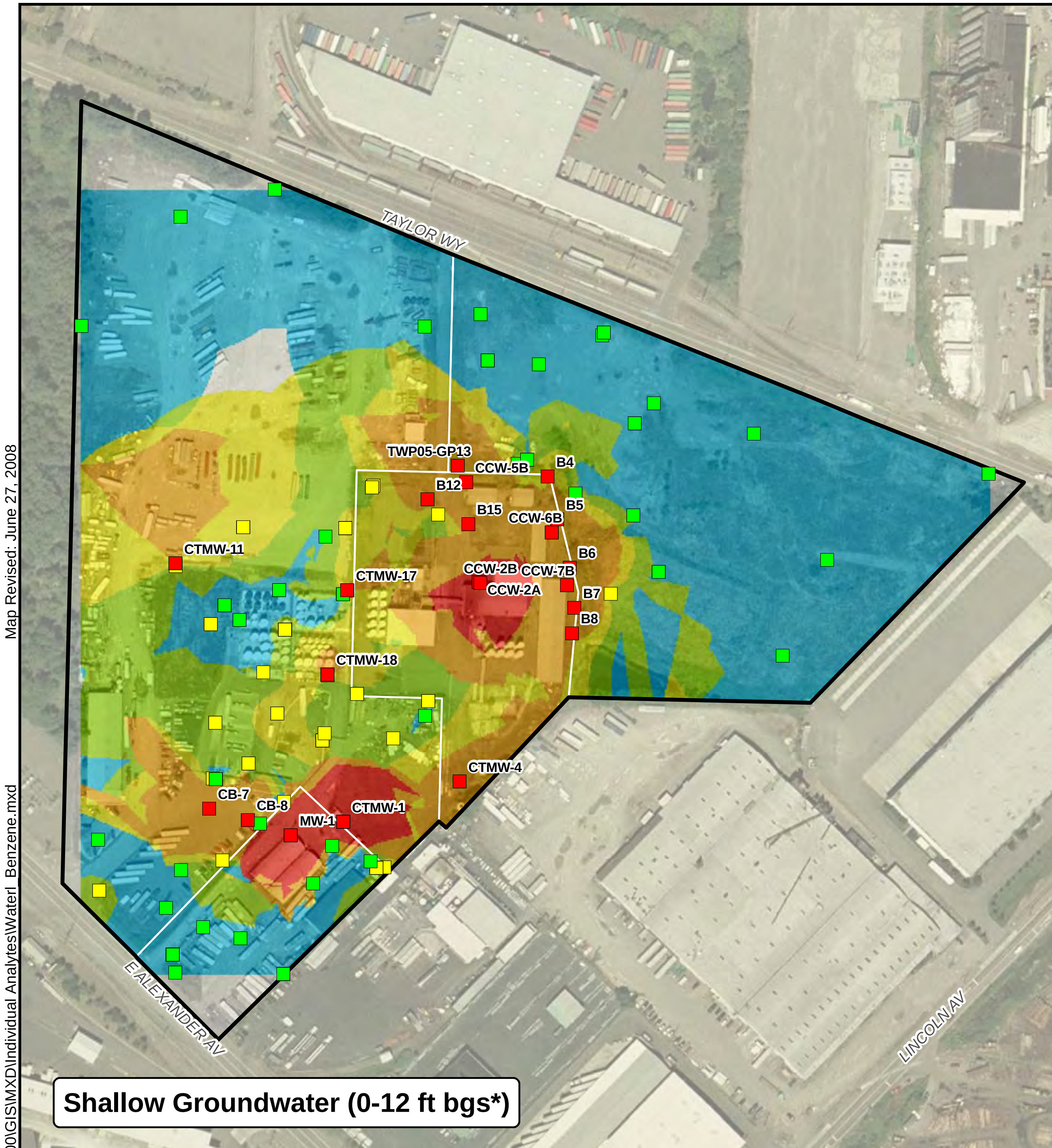
250 0 250
Feet

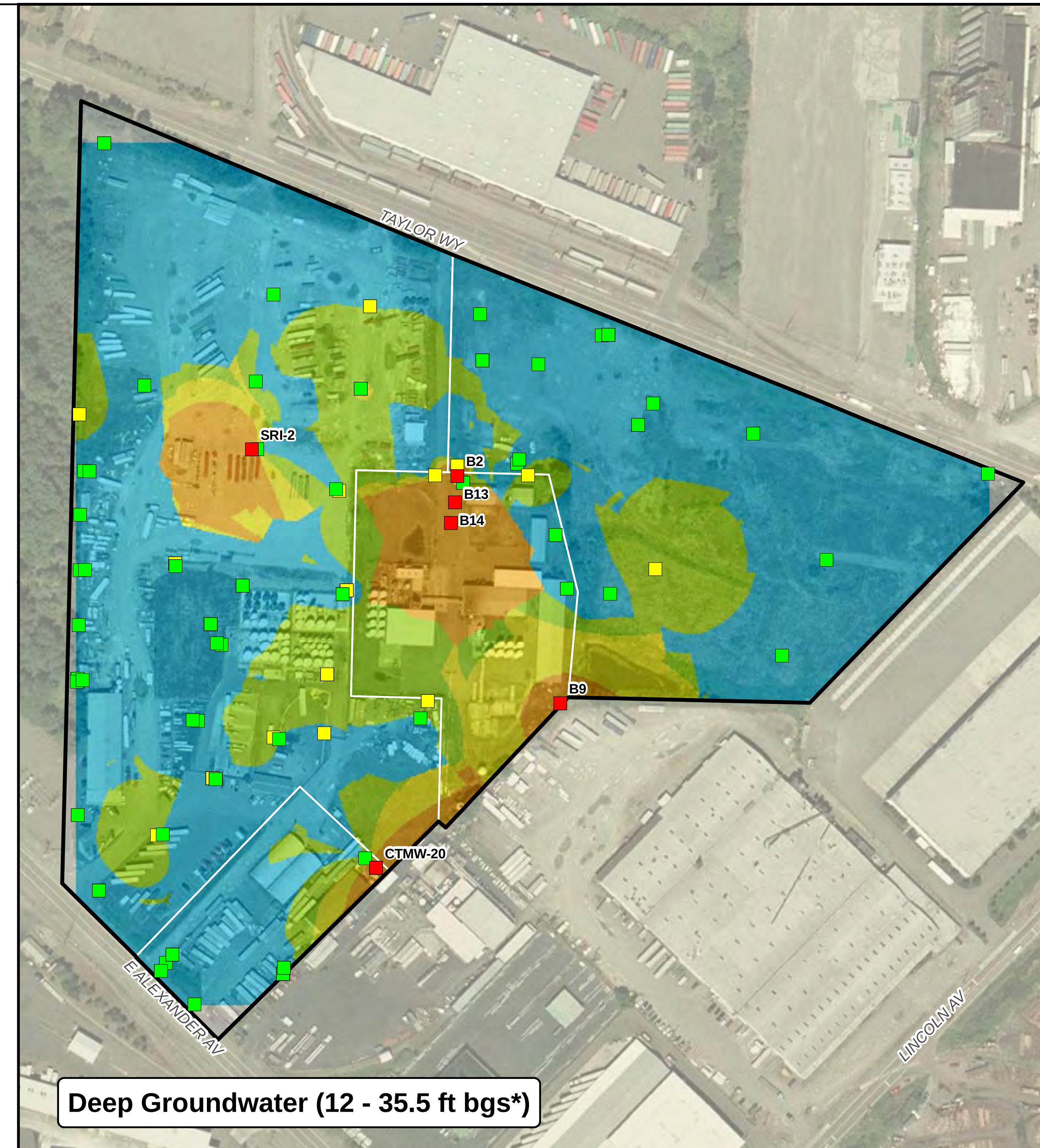
1,2,4-Trimethylbenzene in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 57





Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual Analytes\Water\ Benzene.mxd Map Revised: June 27, 2008

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: protection of surface water

Benzene (ug/L)

- <1
- 1 - 10
- 10 - 22.7
- 22.7** - 200
- >200

PROJECT NORTH

TRUE NORTH

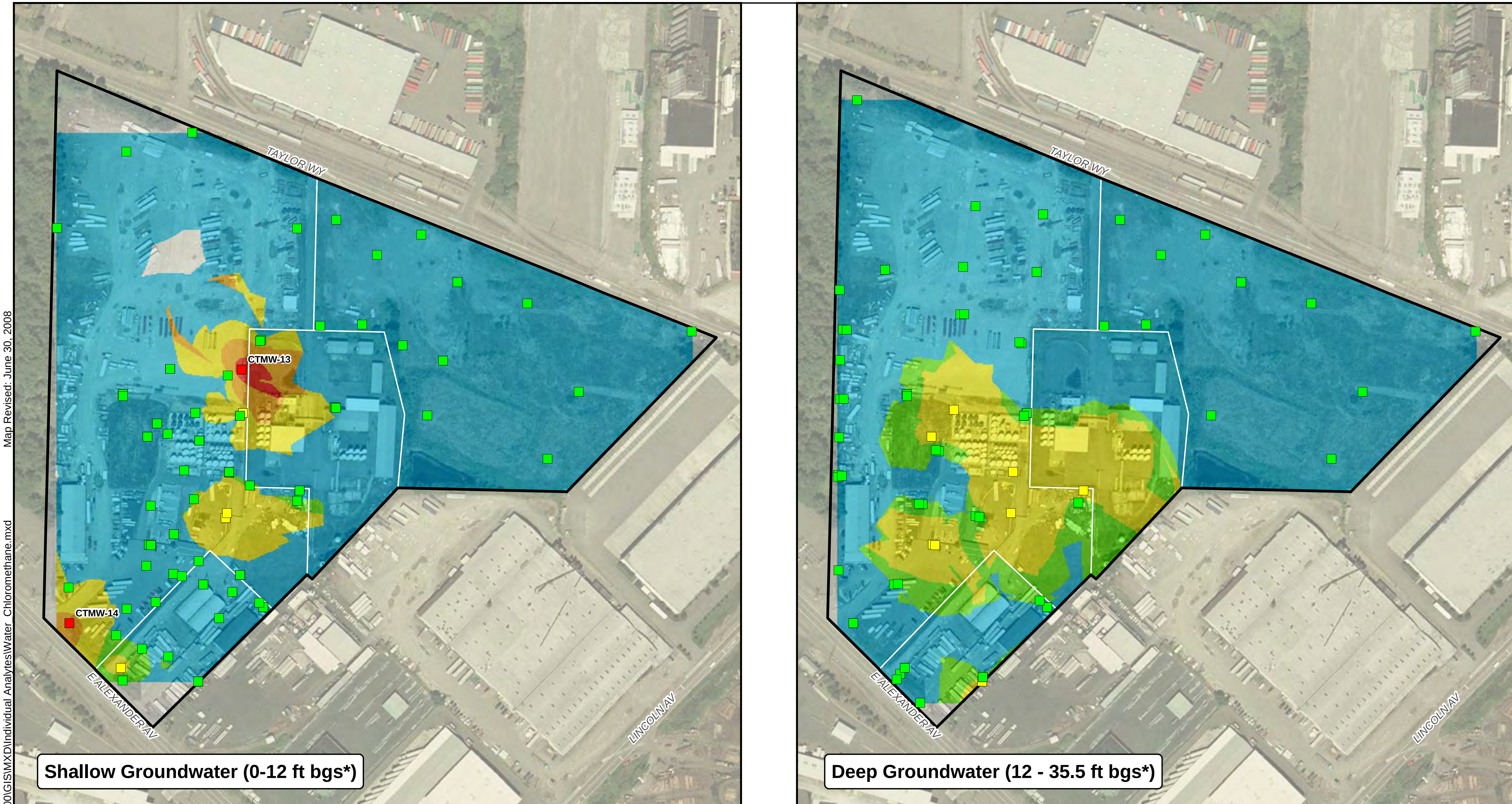
250 0 250
Feet

Benzene in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 58



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: protection of surface water

Chloromethane (ug/L)

- <0.01
- 0.01 - 0.1
- 0.1 - 133
- 133** - 500
- >500

PROJECT NORTH
TRUE NORTH

250 0 250
Feet

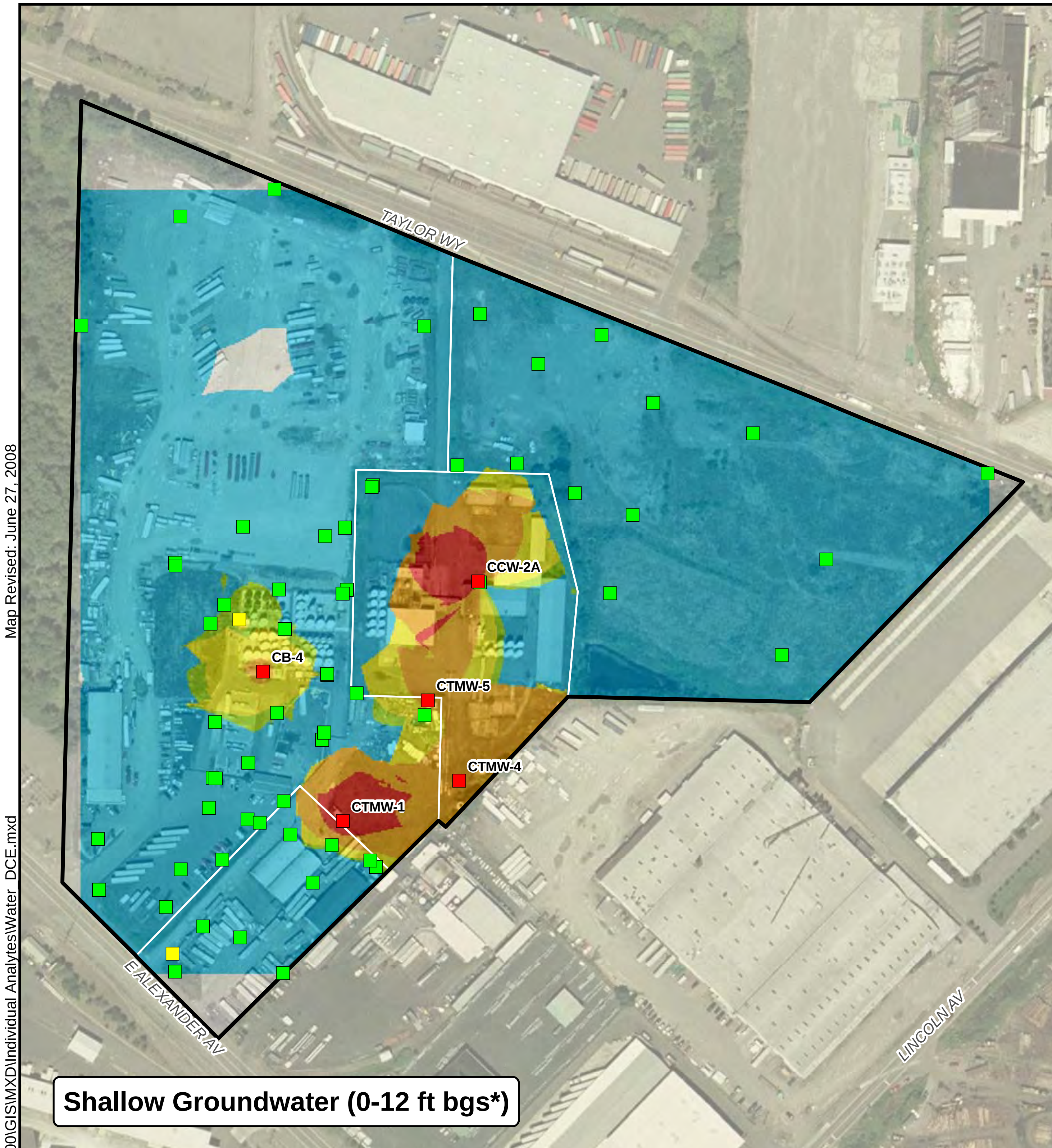
Chloromethane in Groundwater

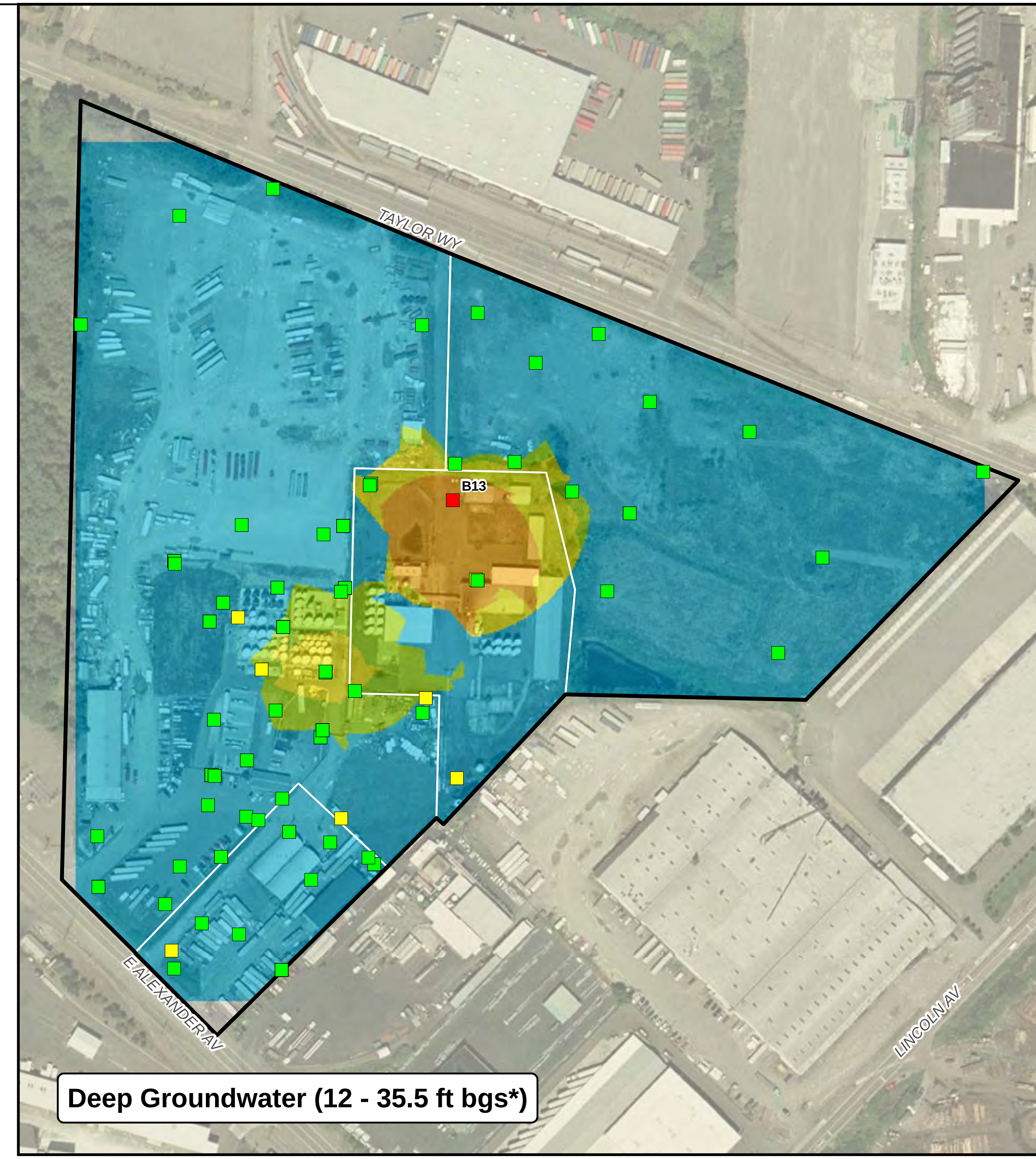
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 59

Office: TAC
Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Chloromethane.mxd
Map Revised: June 30, 2008





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

1,1-Dichloroethene (ug/L)

- <0.1
- 0.1 - 1
- 1 - 5
- 5** - 15
- >15

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: practical quantitation limits

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

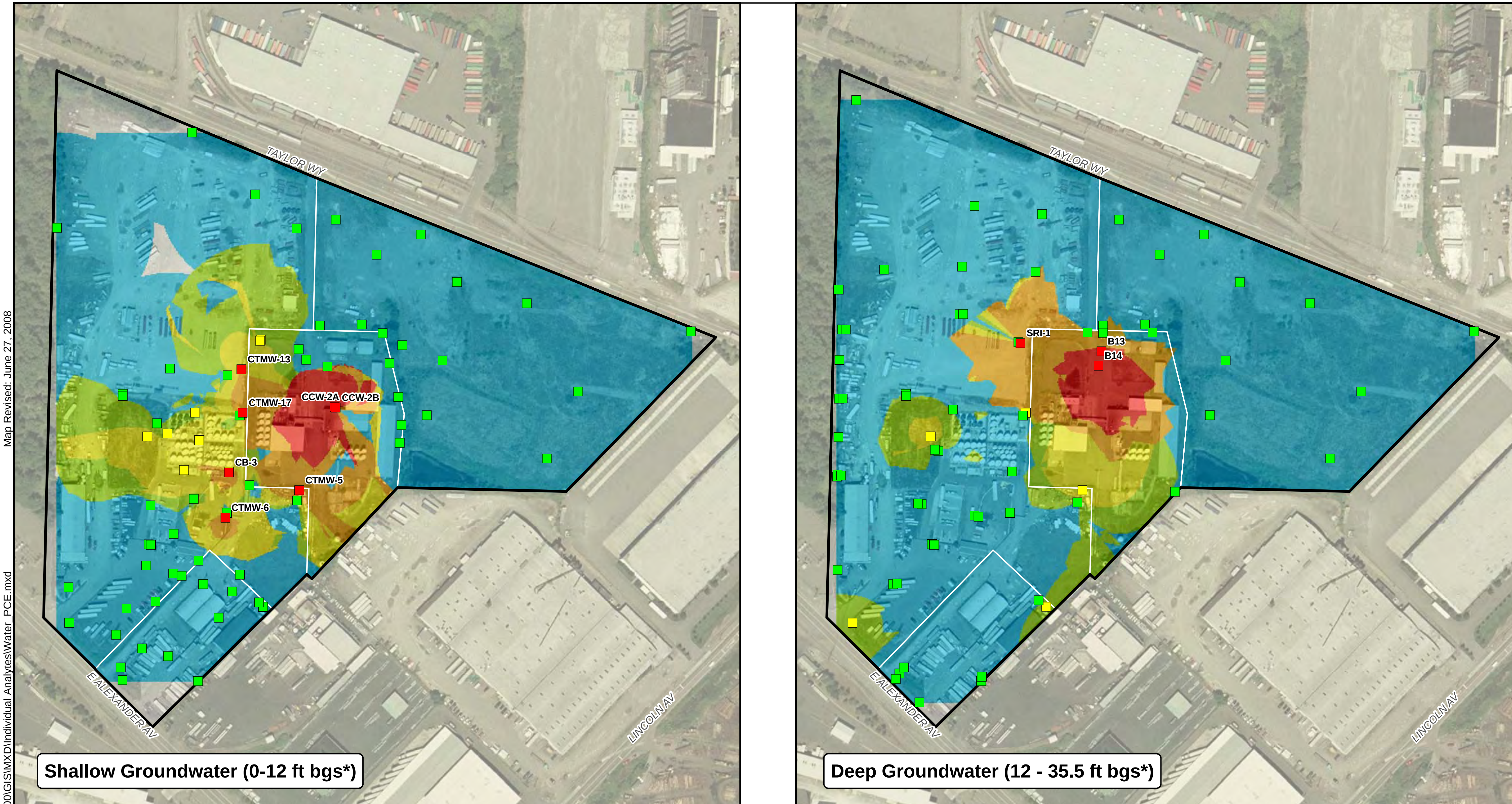
1,1-Dichloroethene in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 60

Office: TAC
Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_DCE.mxd
Map Revised: June 27, 2008



Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level (red)
- Analyte detected (yellow)
- Analyte non-detect (green)

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: practical quantitation limits

Tetrachloroethene (ug/L)

- <0.1
- 0.1 - 1
- 1 - 5
- 5** - 1,000
- >1,000

PROJECT NORTH   TRUE NORTH

250   0   250
Feet

Tetrachloroethene in Groundwater

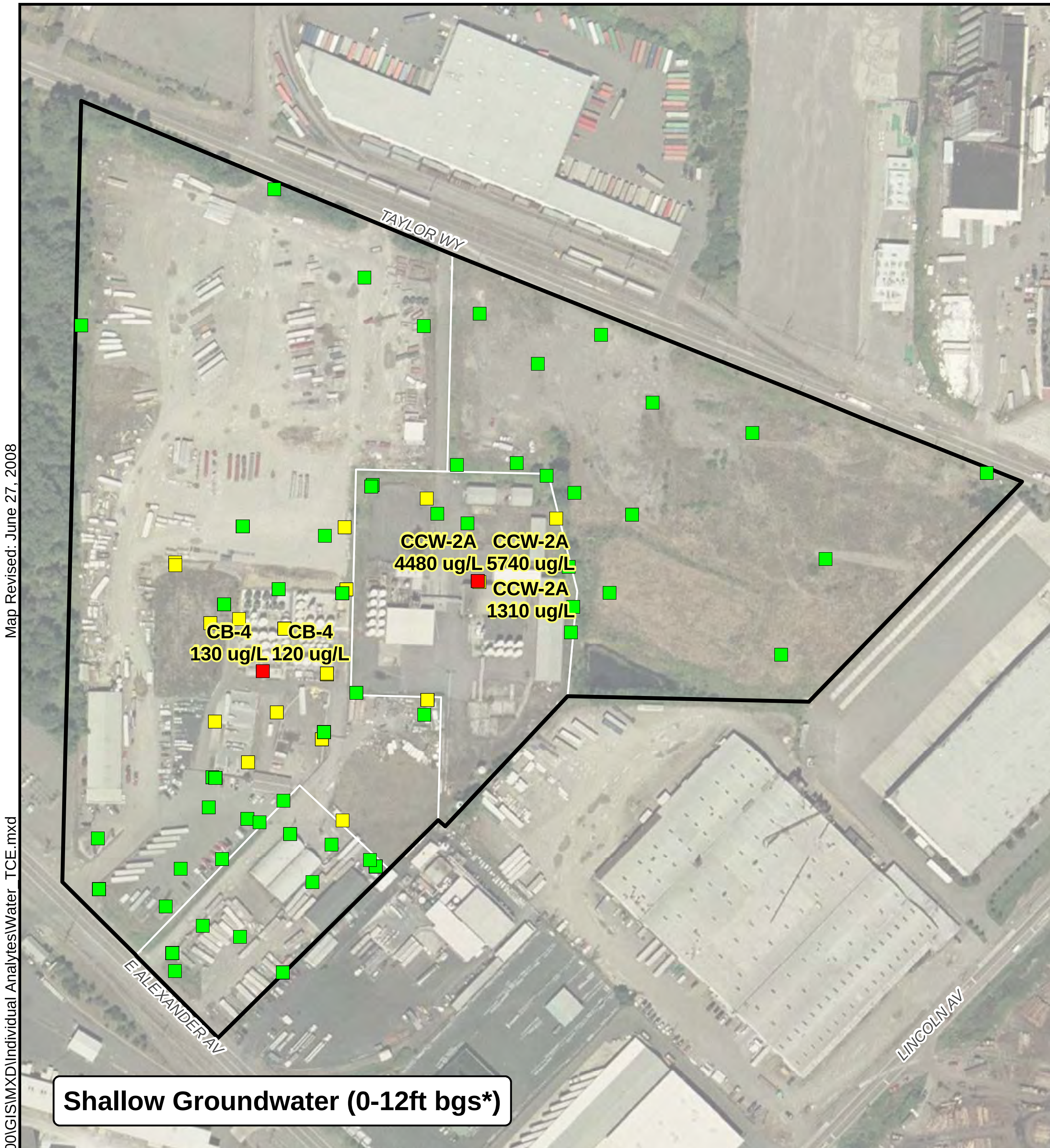
Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

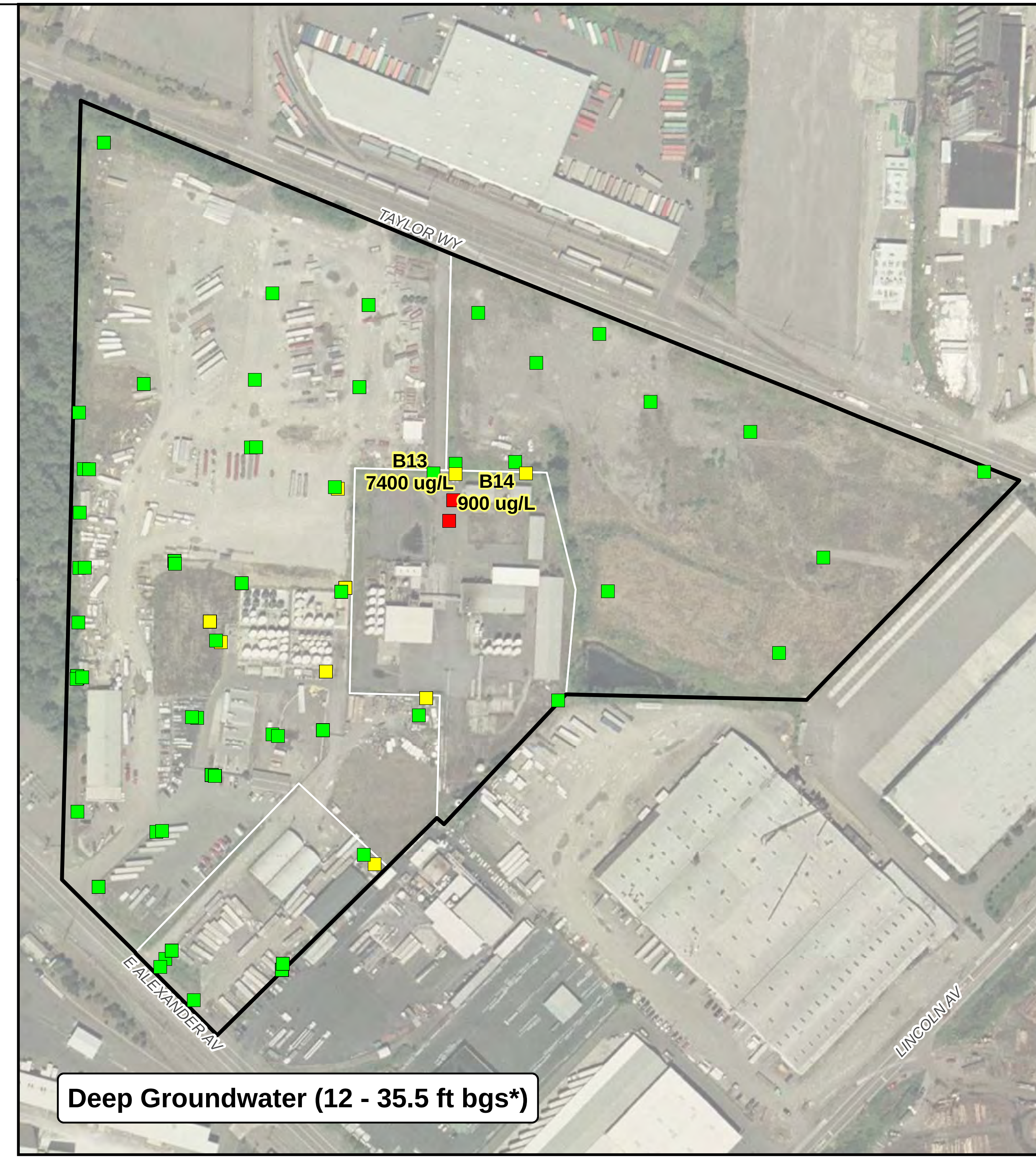
GEOENGINEERS

Figure 61

Office: TAC
Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_PCE.mxd
Map Revised: June 27, 2008

Map Revised: June 27, 2008





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** PSC screening level = 56 ug/L
Screening level basis: protection of surface water

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

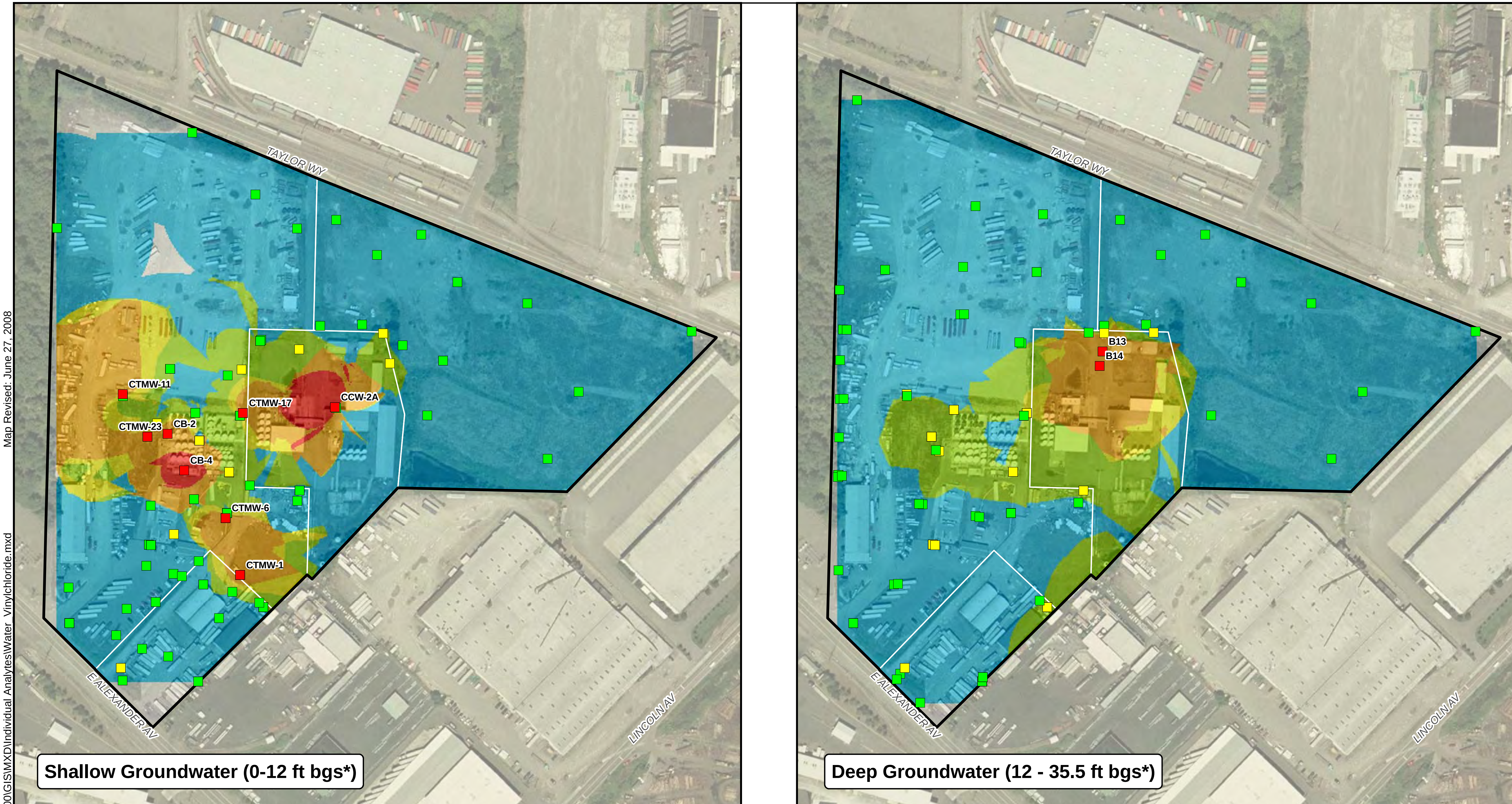
Trichloroethene in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

Figure 62

Office: TAC Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_TCE.mxd



Map Revised: June 27, 2008

Path: P:\0\0454116\00\GIS\MXD\Individual AnalytesWater_Vinylchloride.mxd

Office: TAC

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
3. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without permission.

Data Sources: Sample site data obtained from investigation reports for Clean Care, Prologis and Phillips Services Corporation. Aerial photo (dated September 2005) from Aerials Express (obtained from-http://services.arcgisonline.com/v92, April 2008). Street labels from Pierce County.

PSC Screening Levels obtained from Table 8-12 of Final Comprehensive Remedial Investigation Report, Philip Services Corporation, Tacoma Facility, Tacoma, Washington.

Explanation

- Analyte exceeding PSC screening level
- Analyte detected
- Analyte non-detect

*Below ground surface (bgs)

** Indicates PSC screening level
Screening level basis: practical quantitation limits

Vinyl Chloride (ug/L)

- <0.1
- 0.1 - 5
- 5 - 10
- 10** - 500
- >500

PROJECT NORTH

TRUE NORTH

250 0 250
Feet

Vinyl Chloride in Groundwater

Taylor Way and Alexander Avenue Fill Site
Tacoma, Washington

GEOENGINEERS

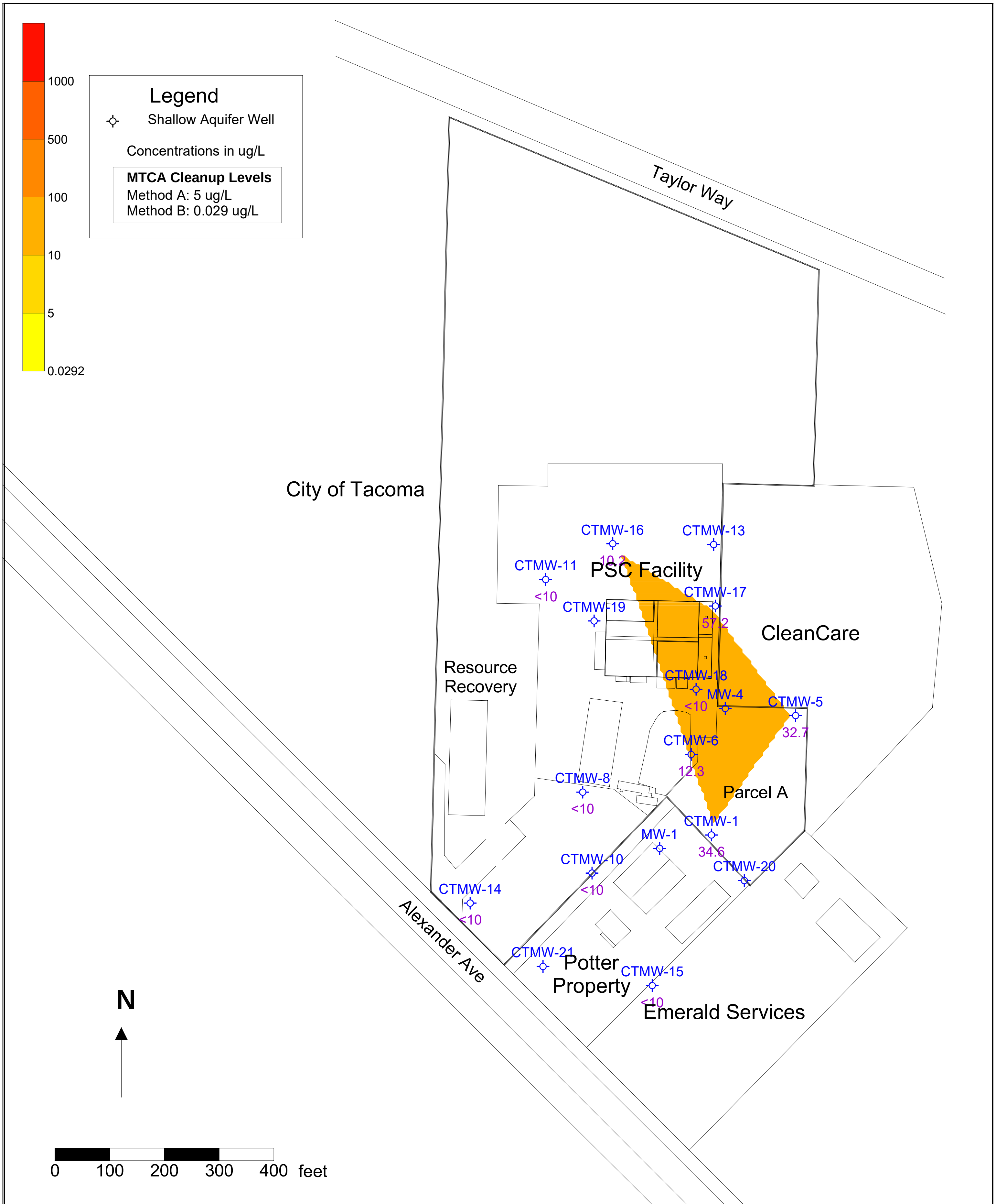
Figure 63

2005 PSC Remedial

Investigation

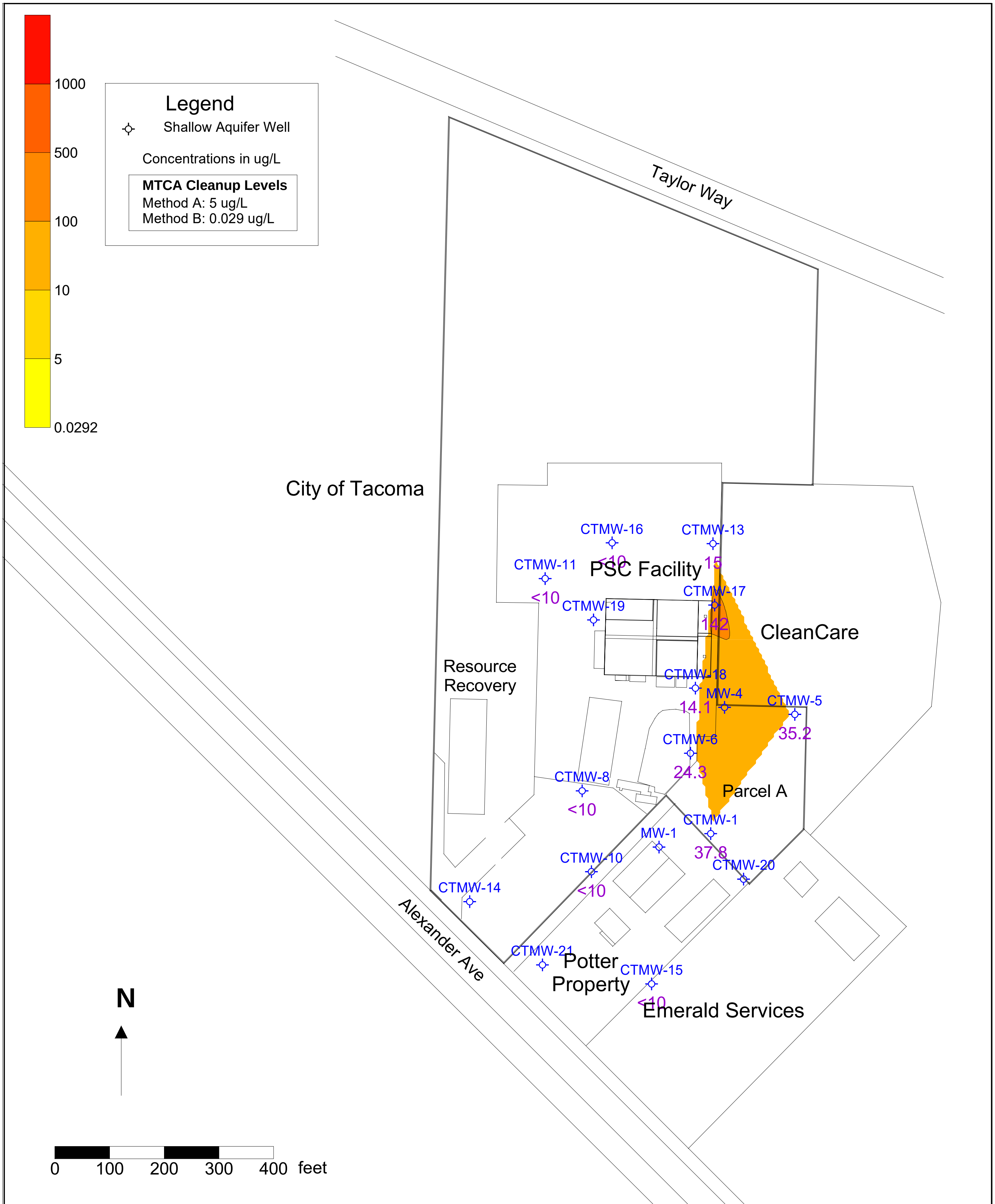
Appendix 10A

Groundwater Isopleth Maps



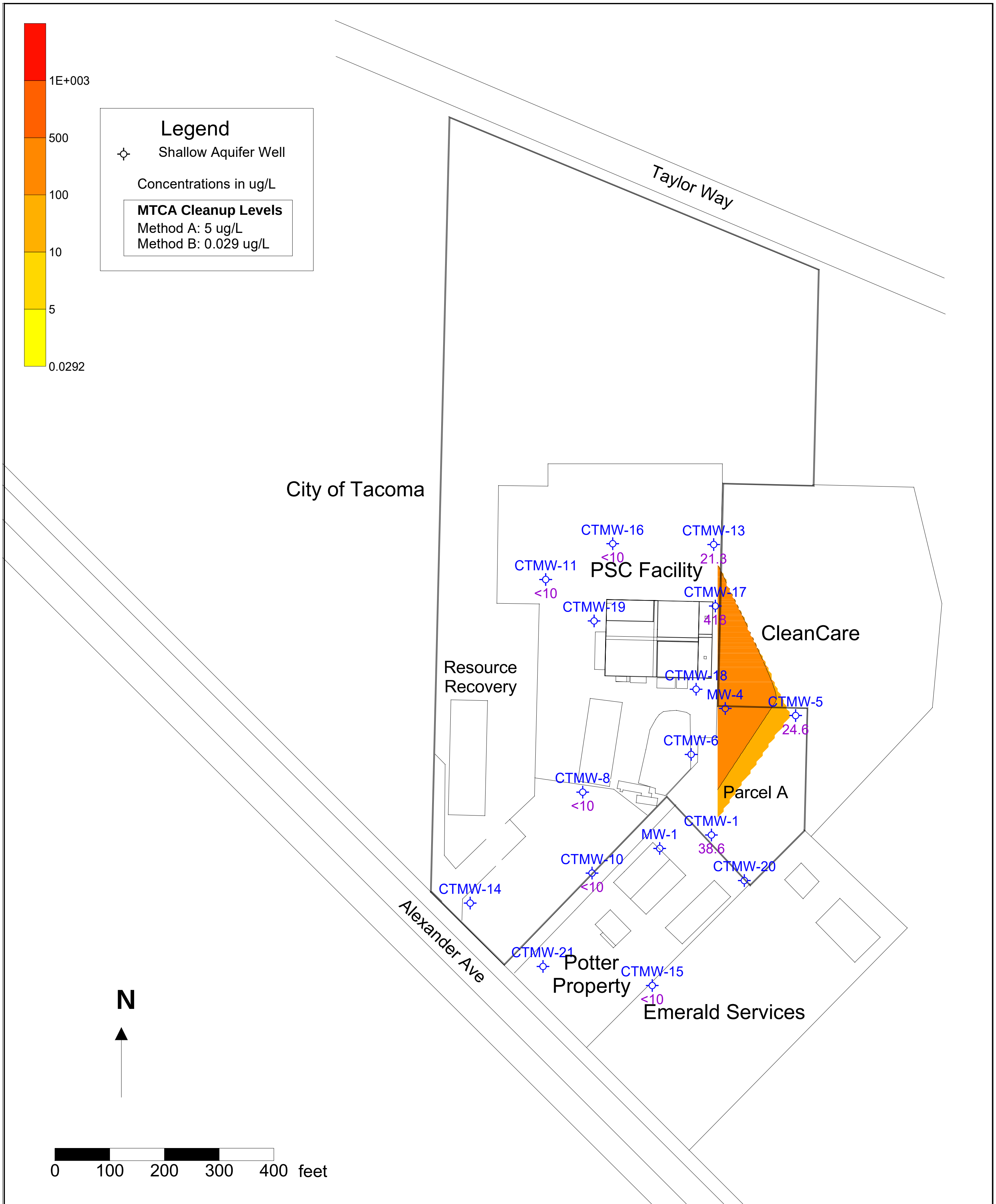
Arsenic Concentrations
1st Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



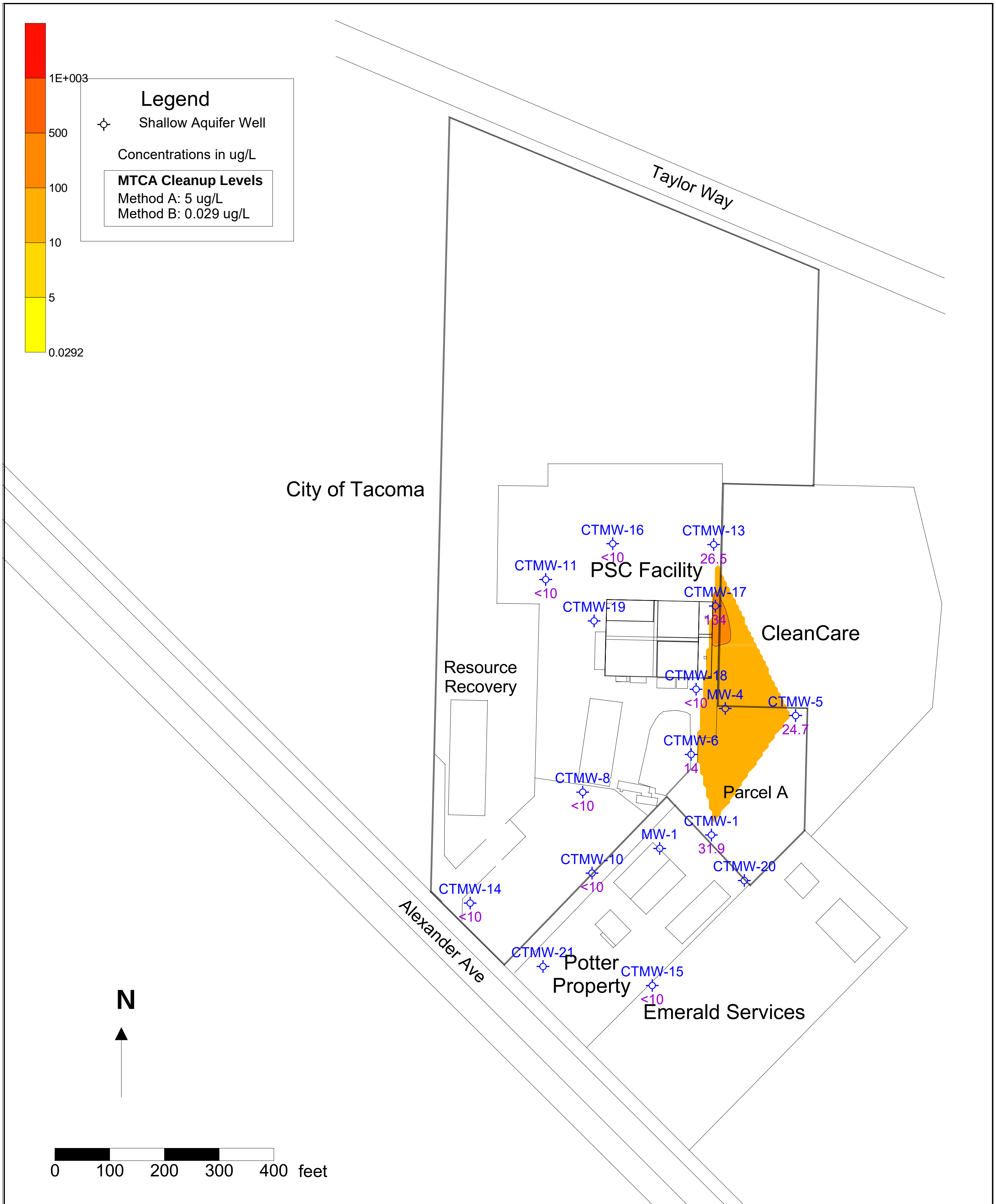
Arsenic Concentrations, 2nd Quarter 1998 Shallow Aquifer Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



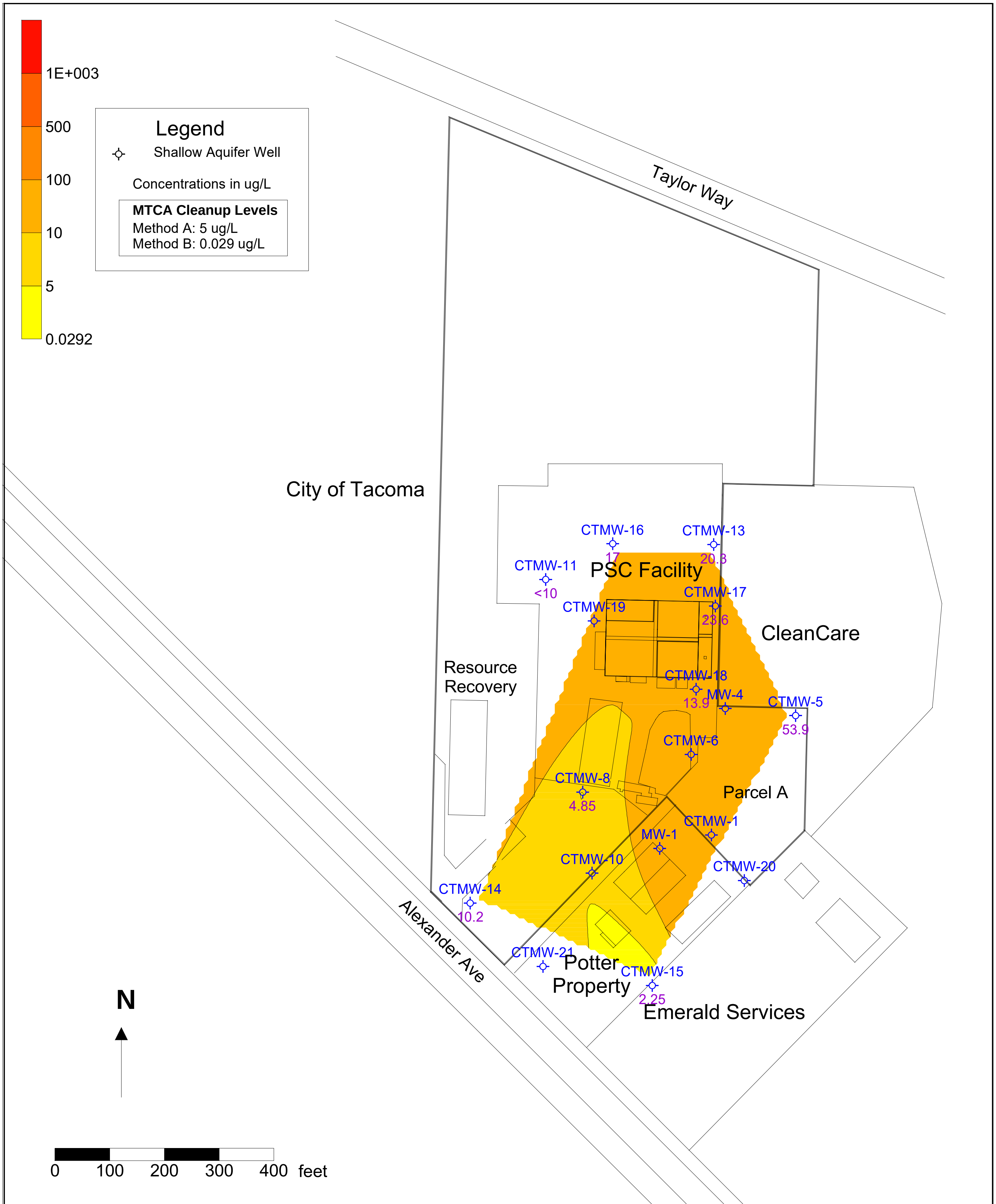
Arsenic Concentrations
3rd Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



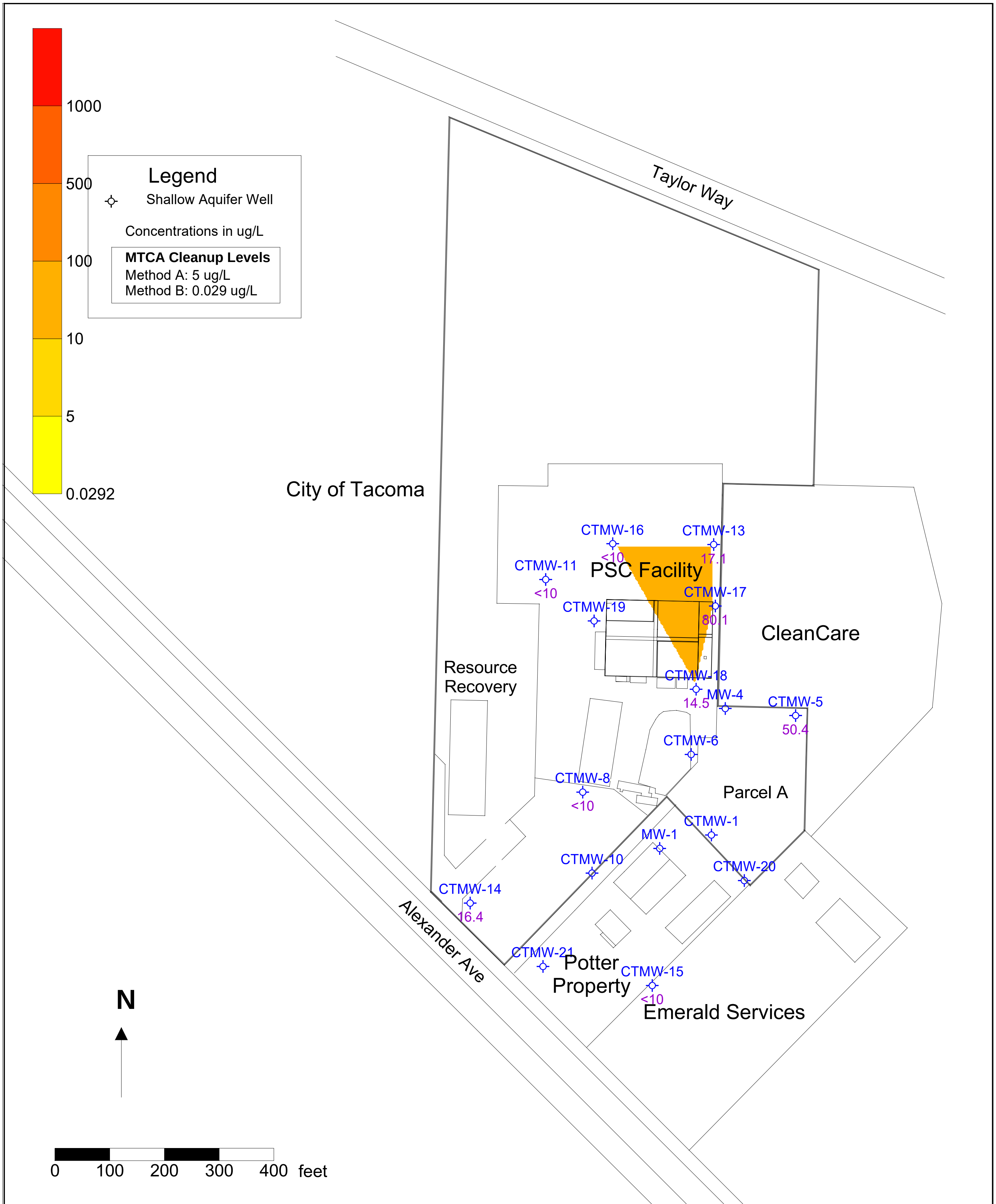
Arsenic Concentrations
4th Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



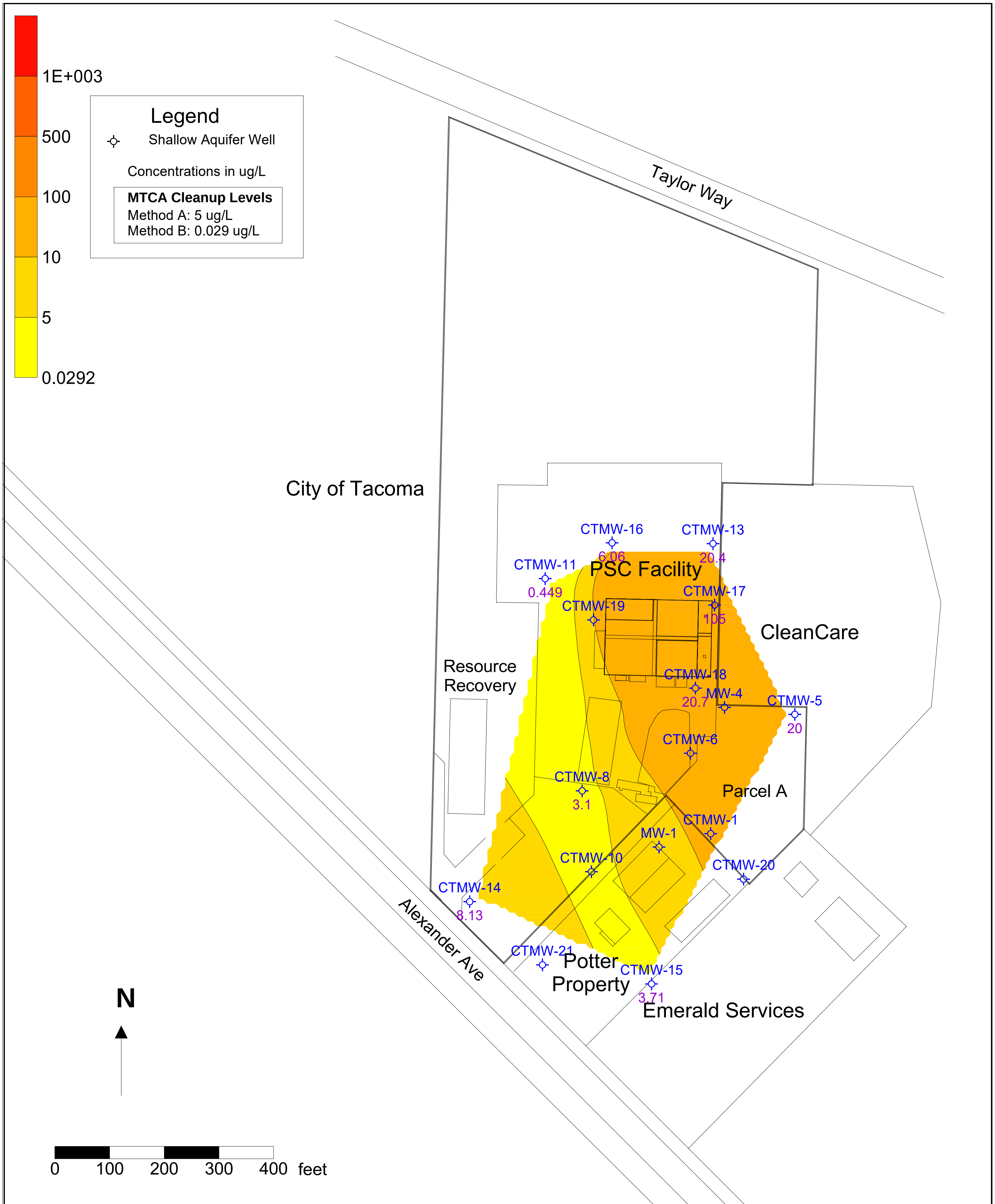
Arsenic Concentrations
1st Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



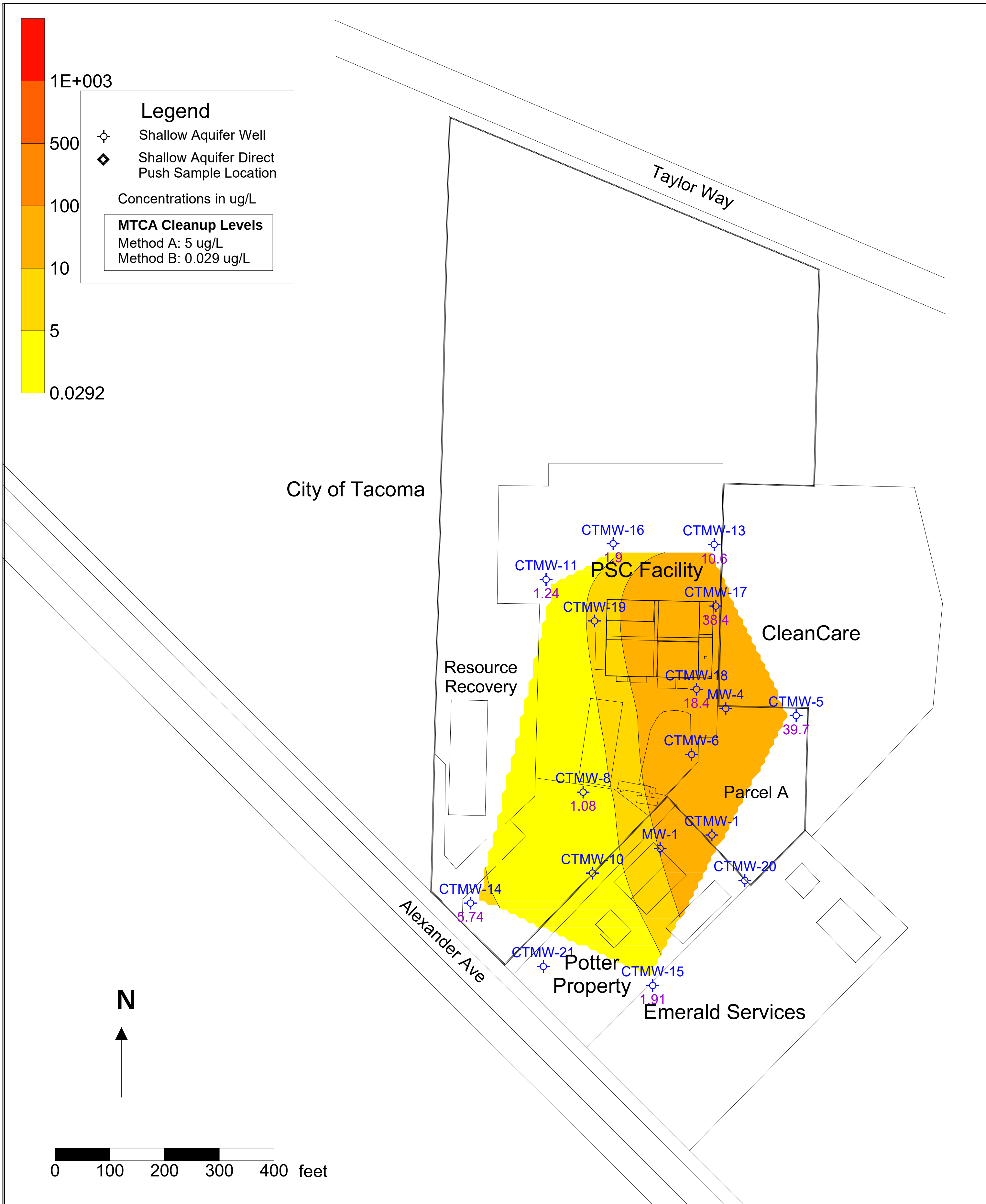
Arsenic Concentrations
2nd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:

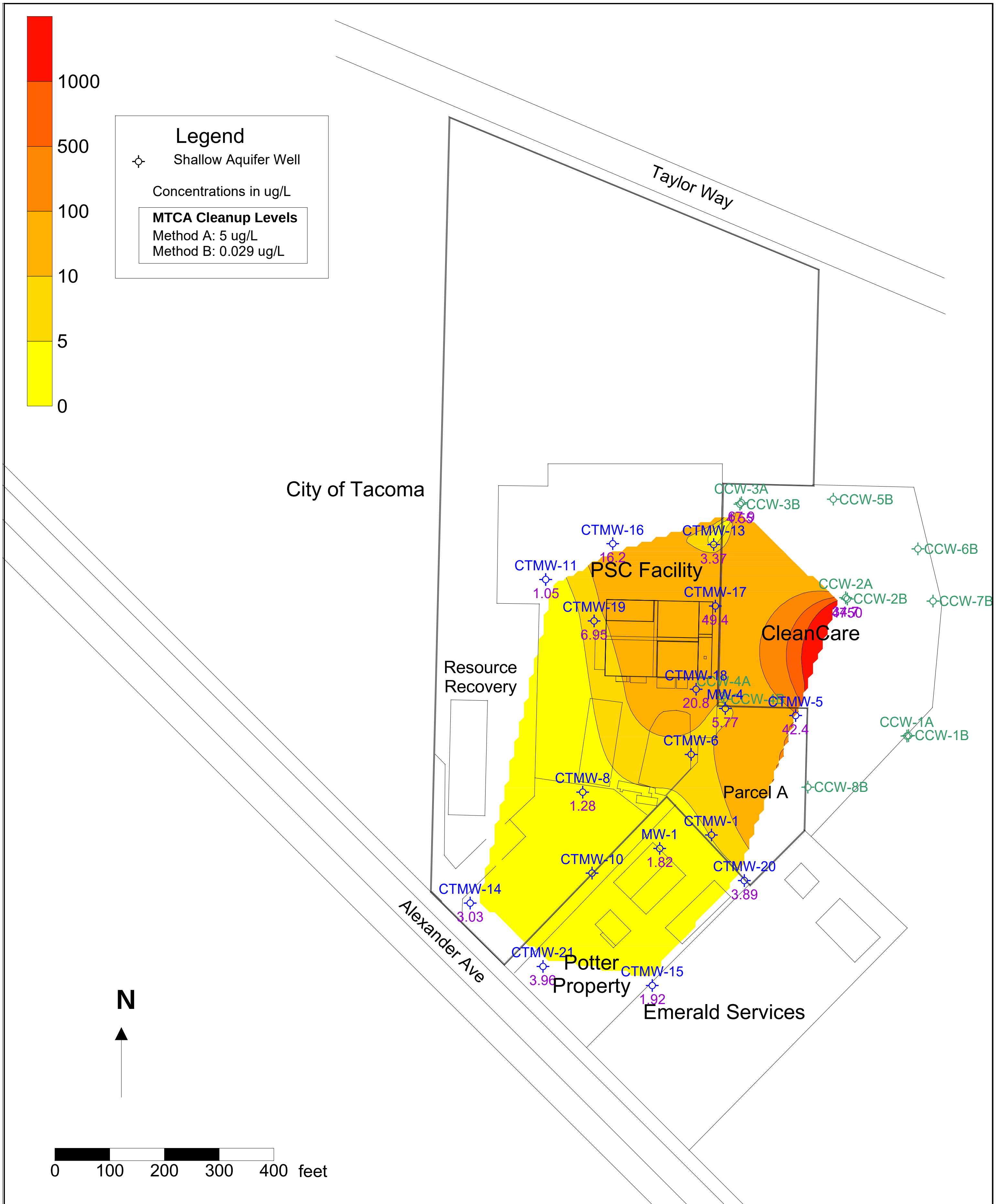


Arsenic Concentrations
3rd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:

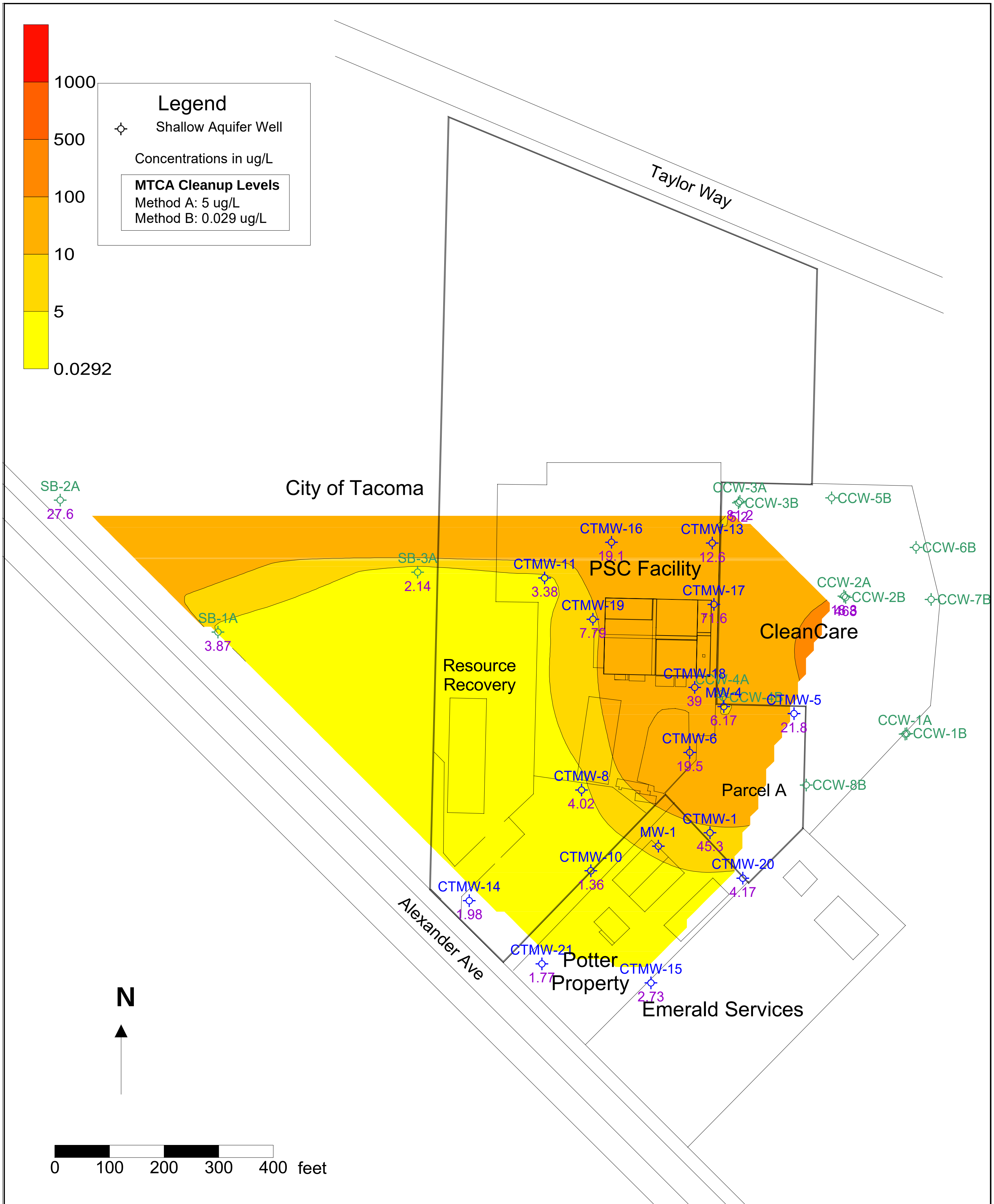


Arsenic Concentrations **4th Quarter 1999 and Step-Out Investigation** **Shallow Aquifer** **Tacoma Facility**	DWN:	DES:	PROJECT No:
	CHKD:	APPD:	FIGURE No:
	DATE:	REV:	



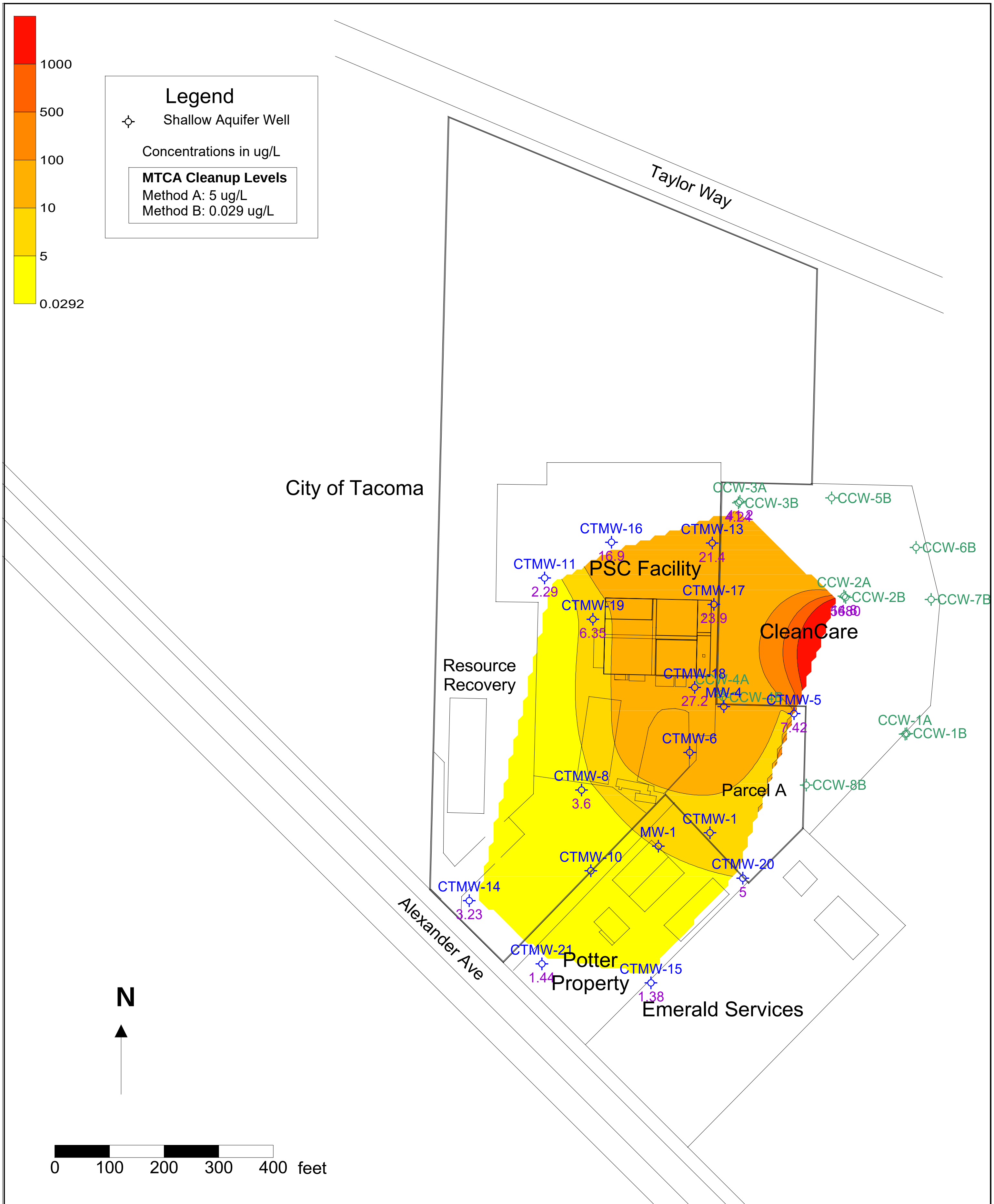
Arsenic Concentrations
2nd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



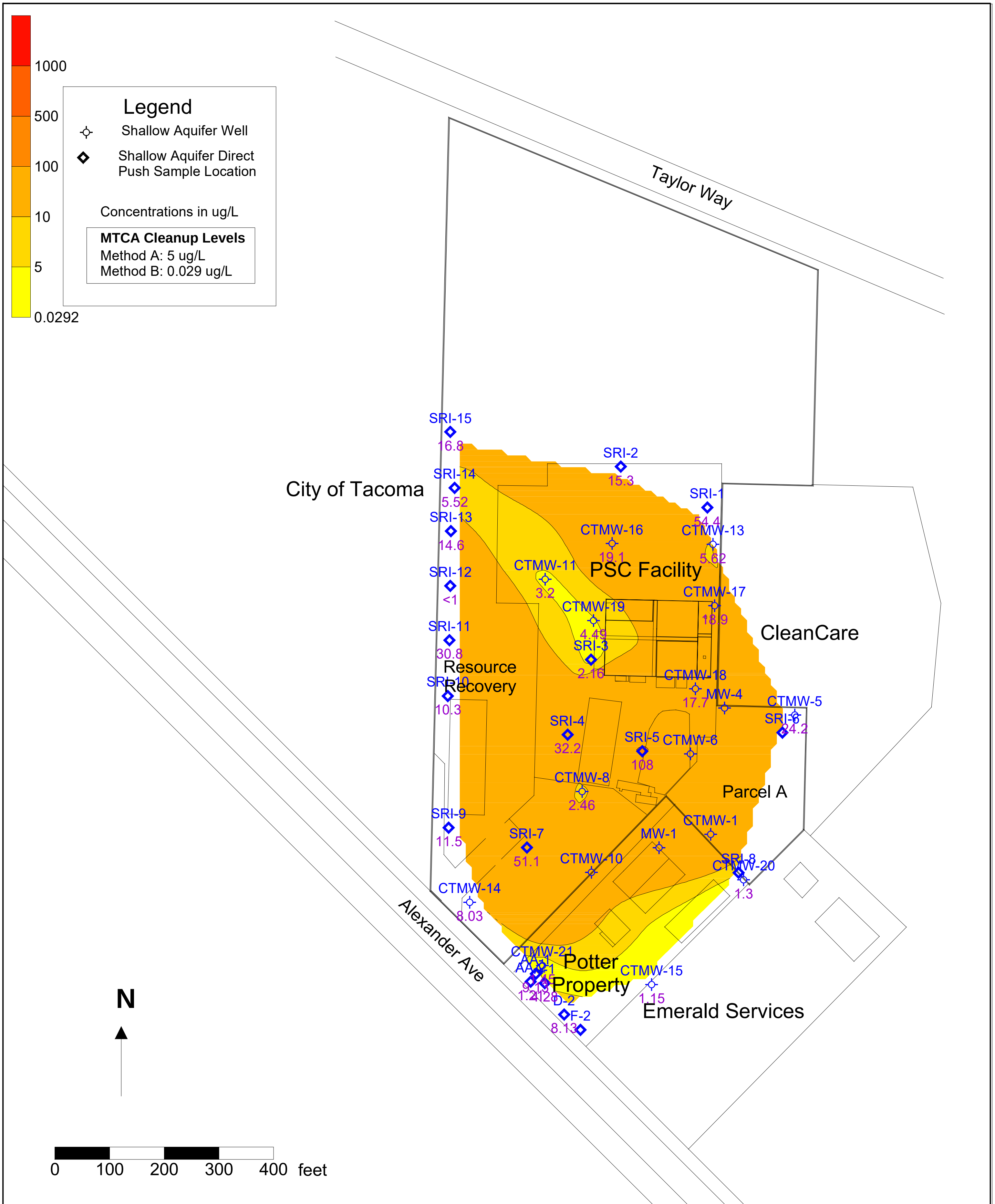
Arsenic Concentrations
3rd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



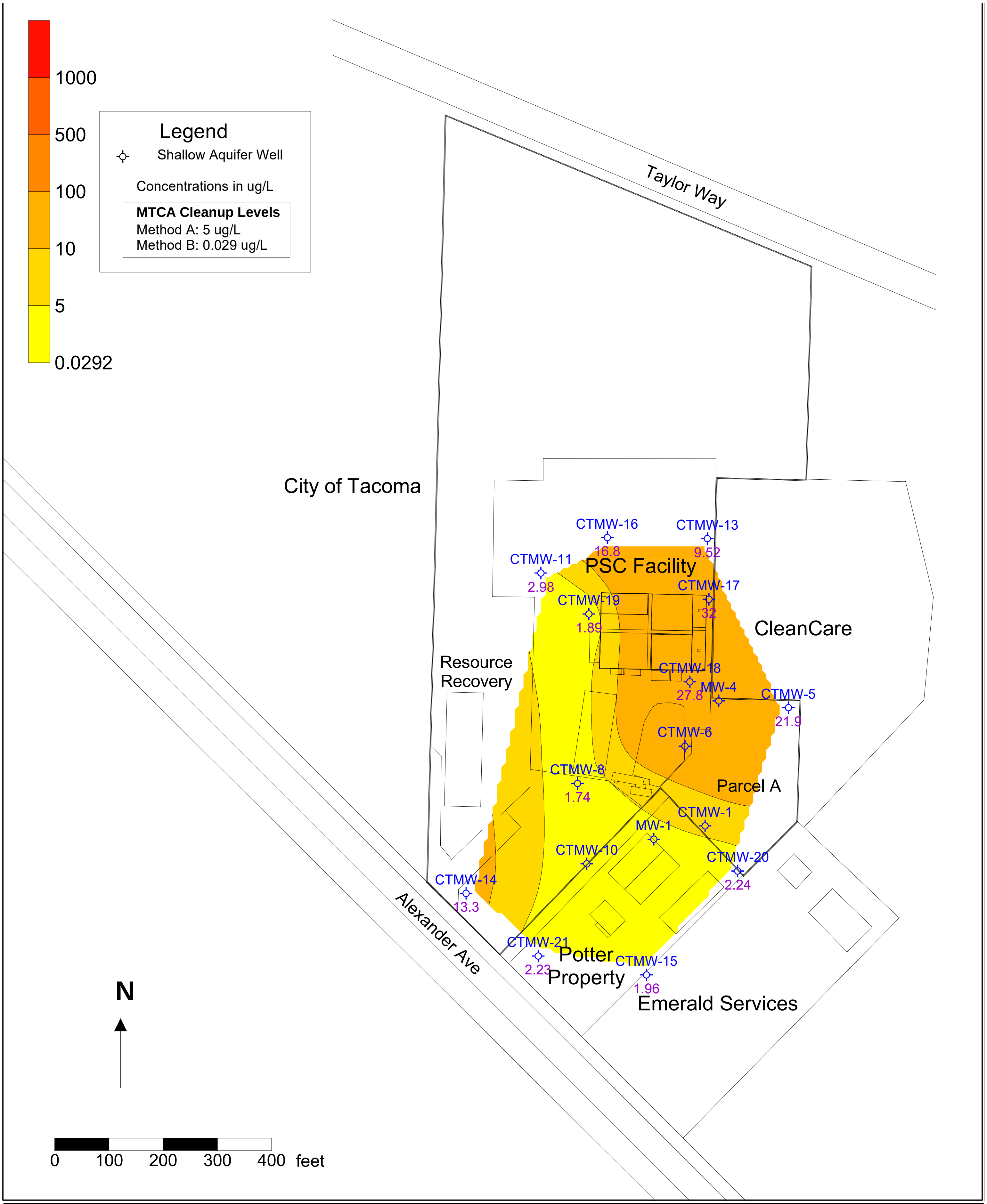
Arsenic.Concentrations
4th Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



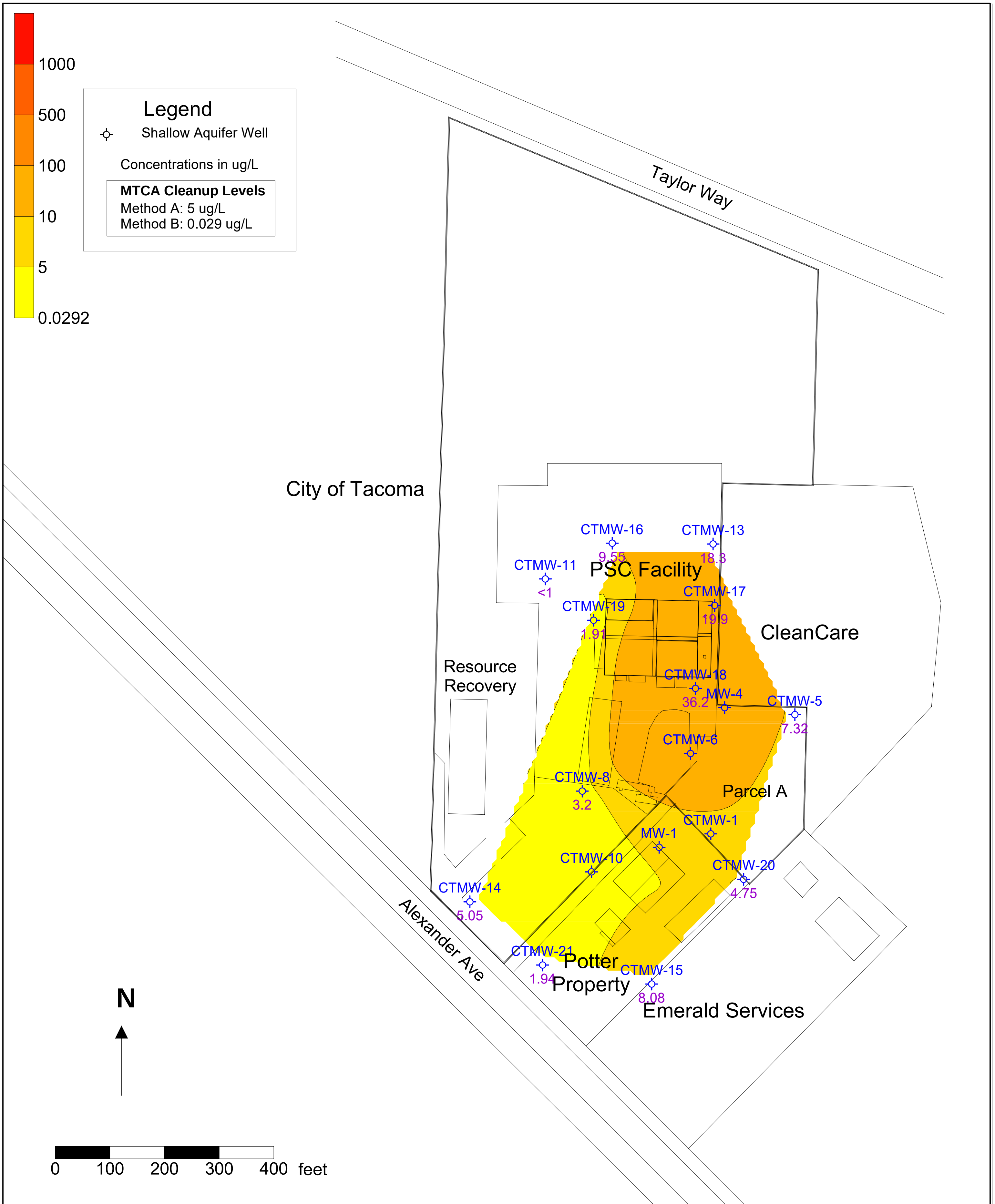
Arsenic Concentrations
1st Quarter 2001 and SRI
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



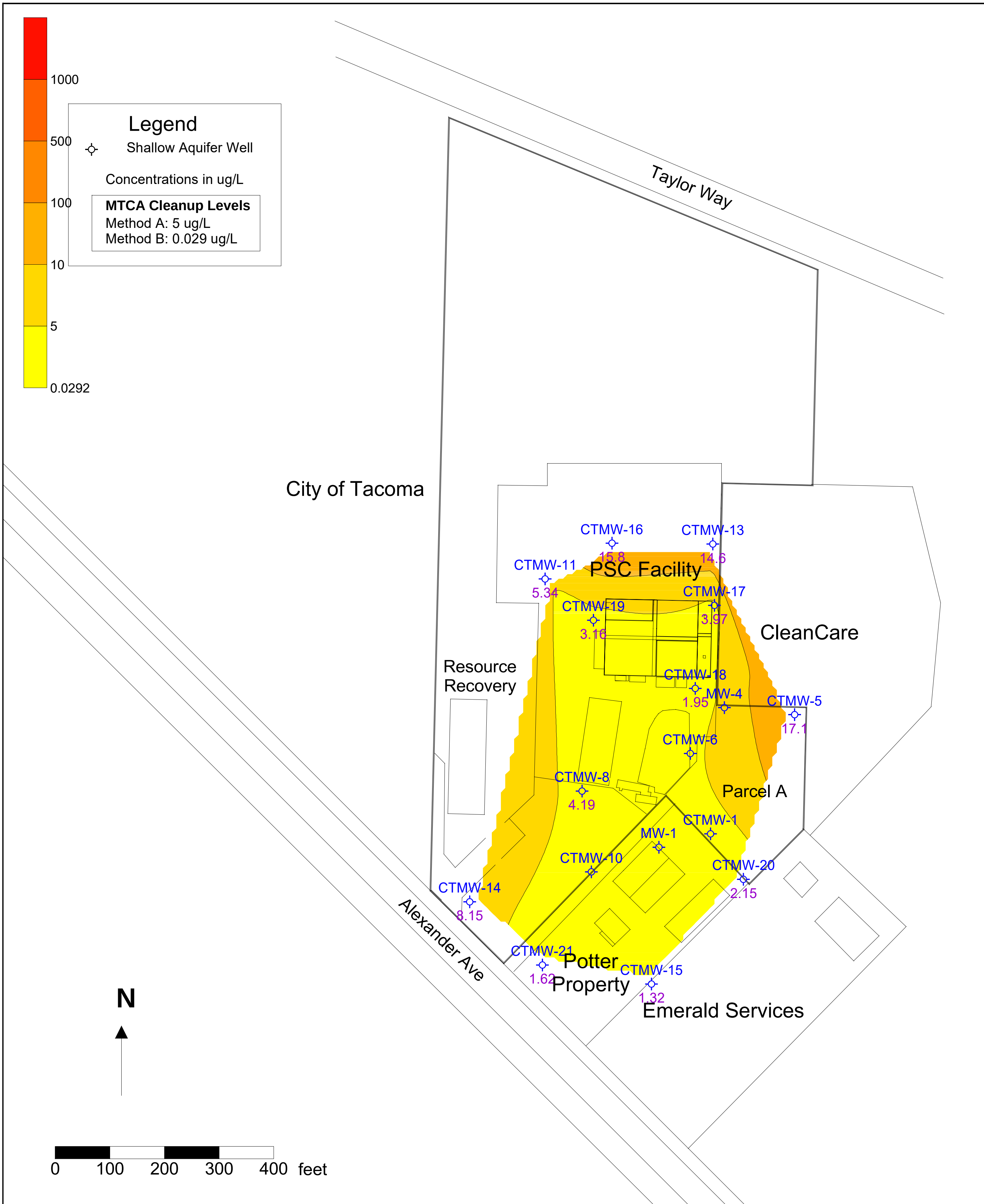
Arsenic Concentrations
2nd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



Arsenic Concentrations
3rd Quarter 2001
Shallow Aquifer
Tacoma Facility

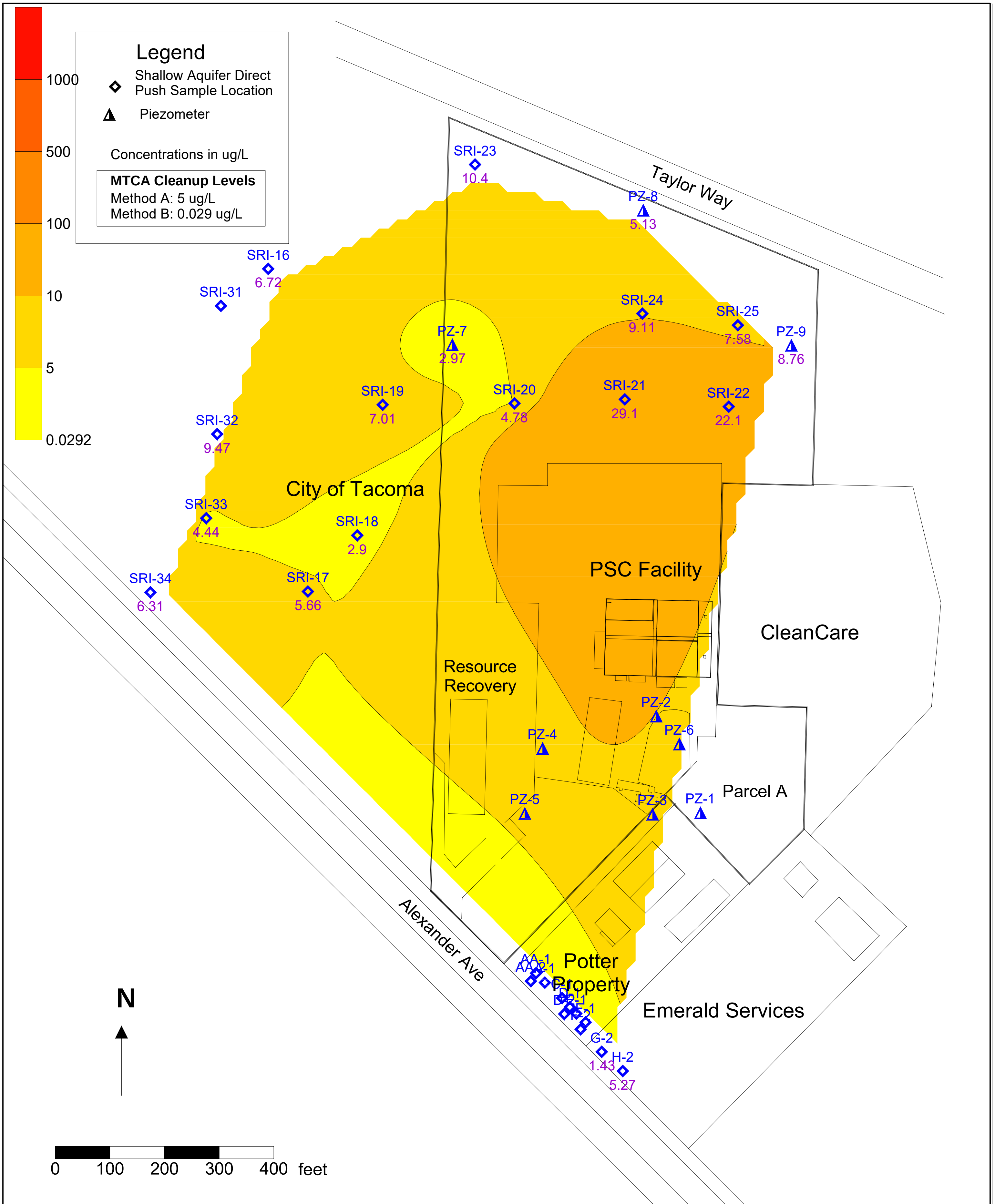
DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



PSC

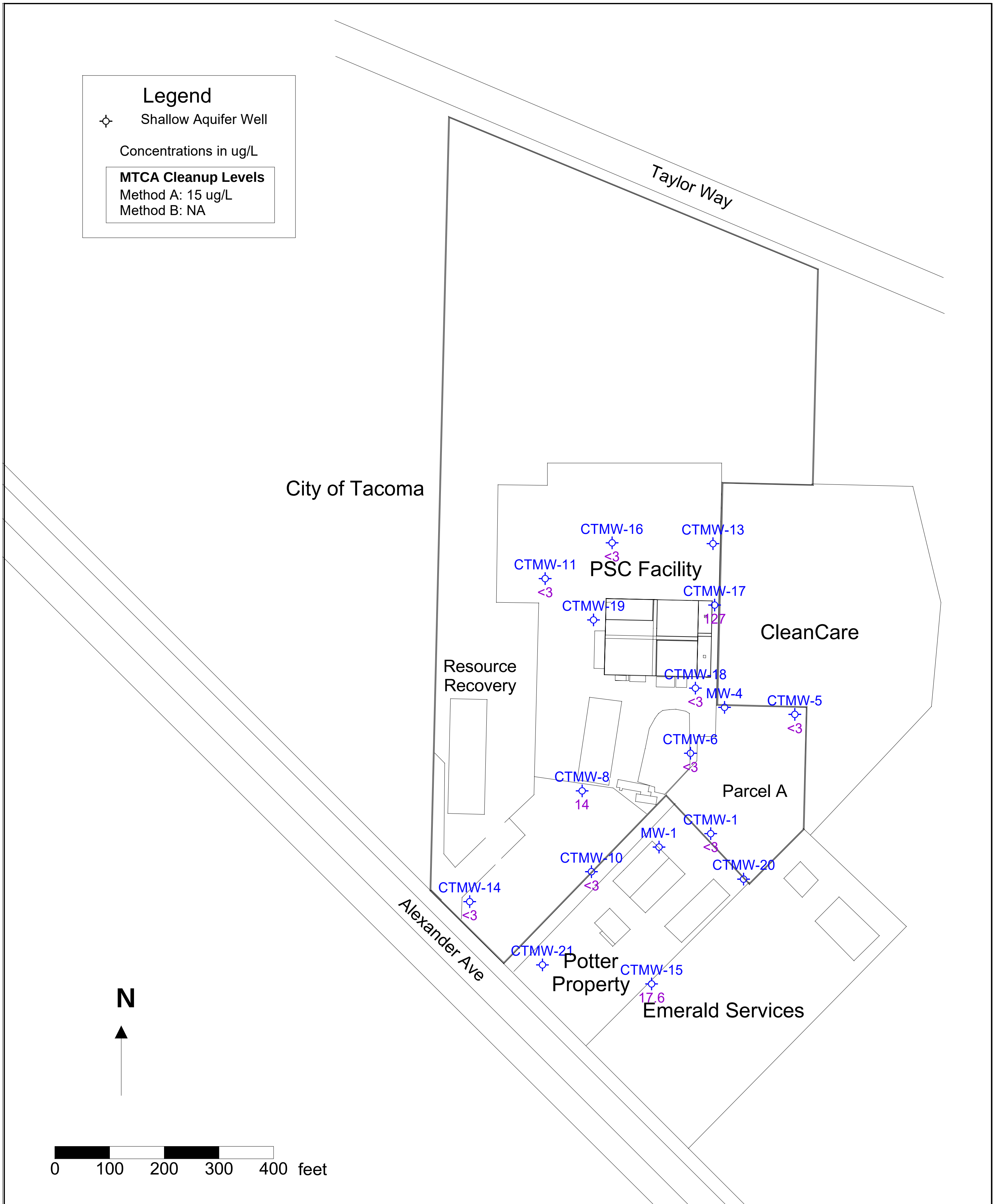
Arsenic Concentrations
4th Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



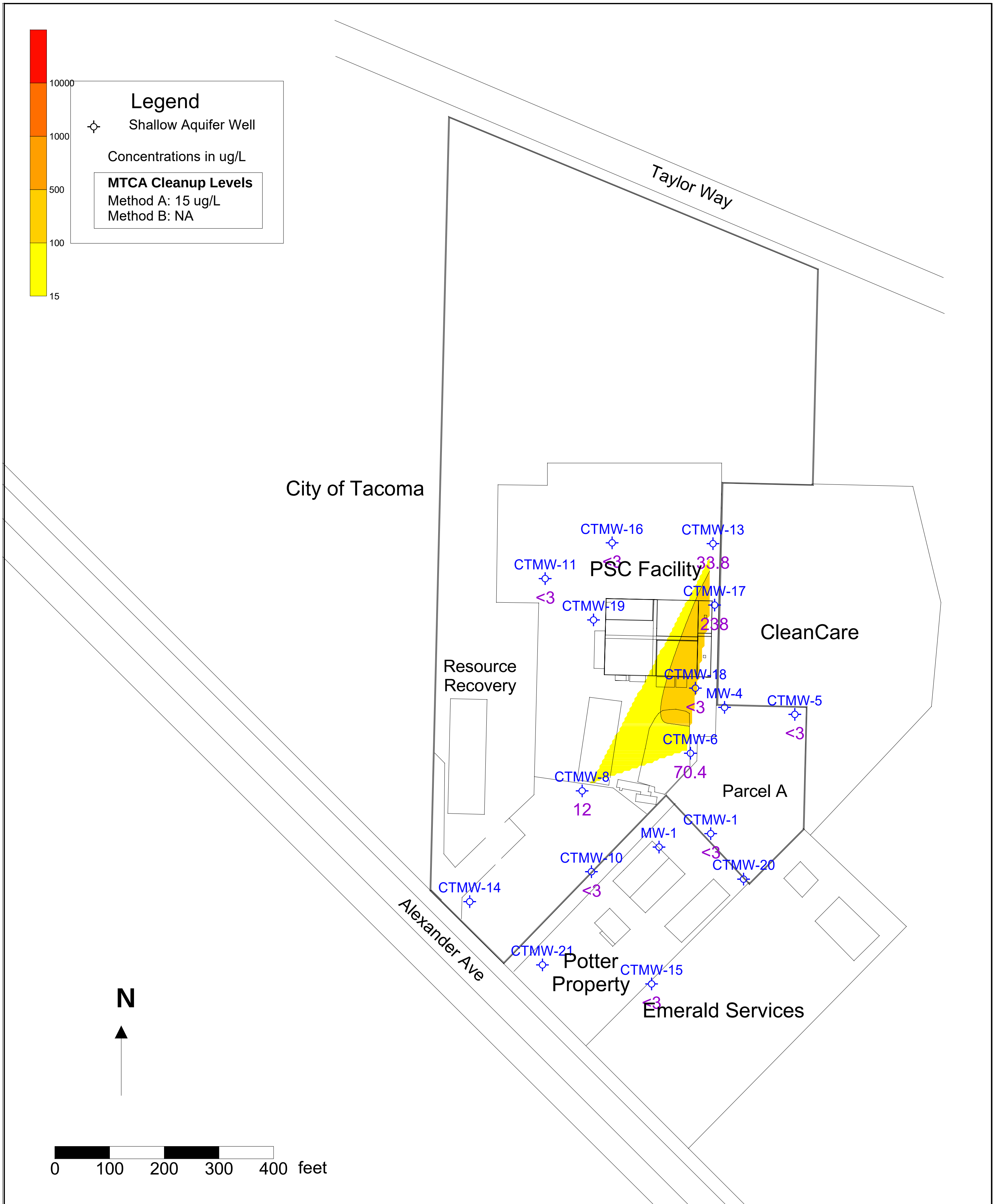
Arsenic Concentrations
SRI II 2002
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	

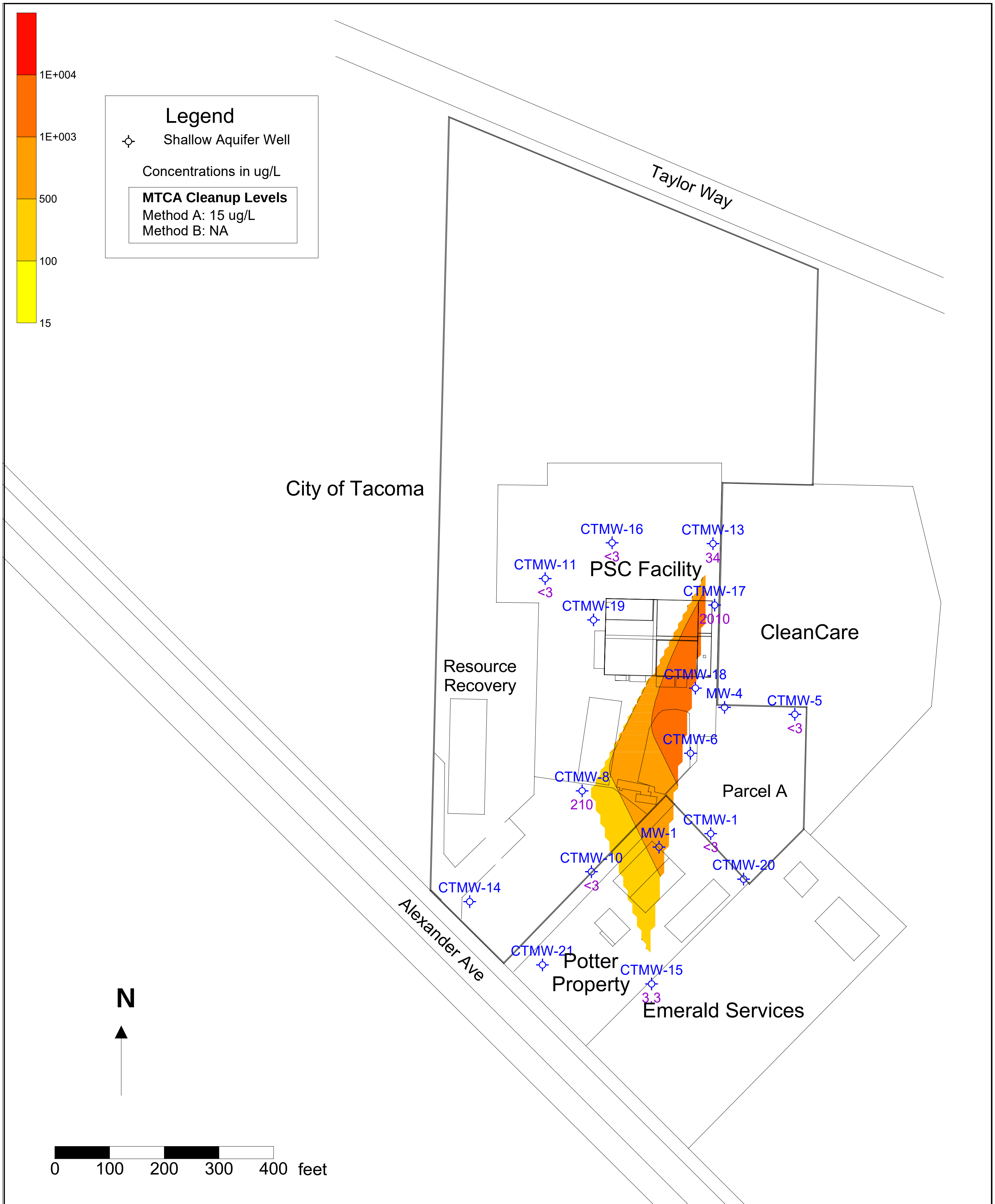


Lead Concentrations
1st Quarter 1998
Shallow Aquifer
Tacoma Facility

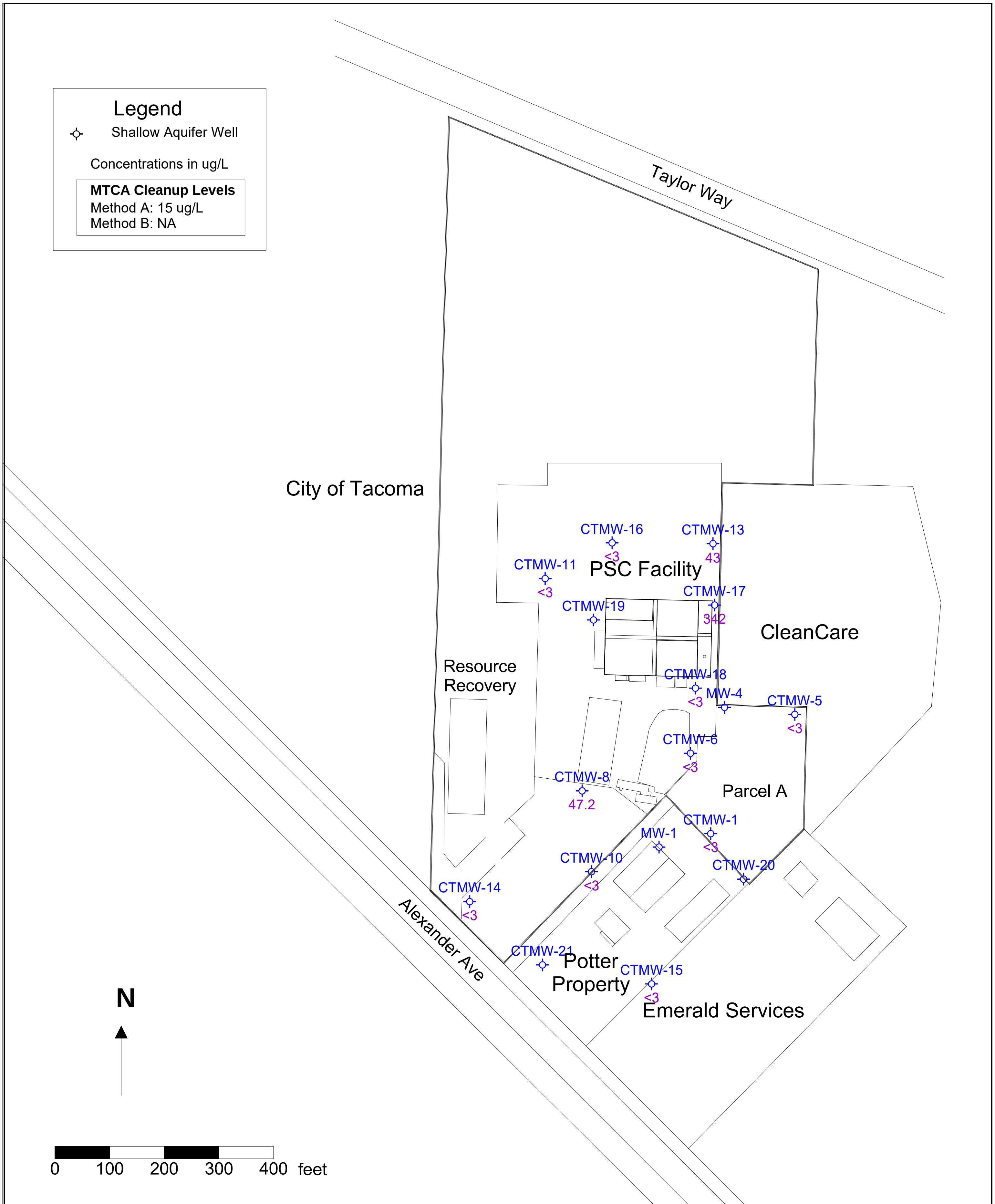
DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



PSC	**Lead Concentrations, 2nd Quarter 1998 Shallow Aquifer Tacoma Facility**	DWN:	DES:	PROJECT No:
		CHKD:	APPD:	FIGURE No:
		DATE:	REV:	

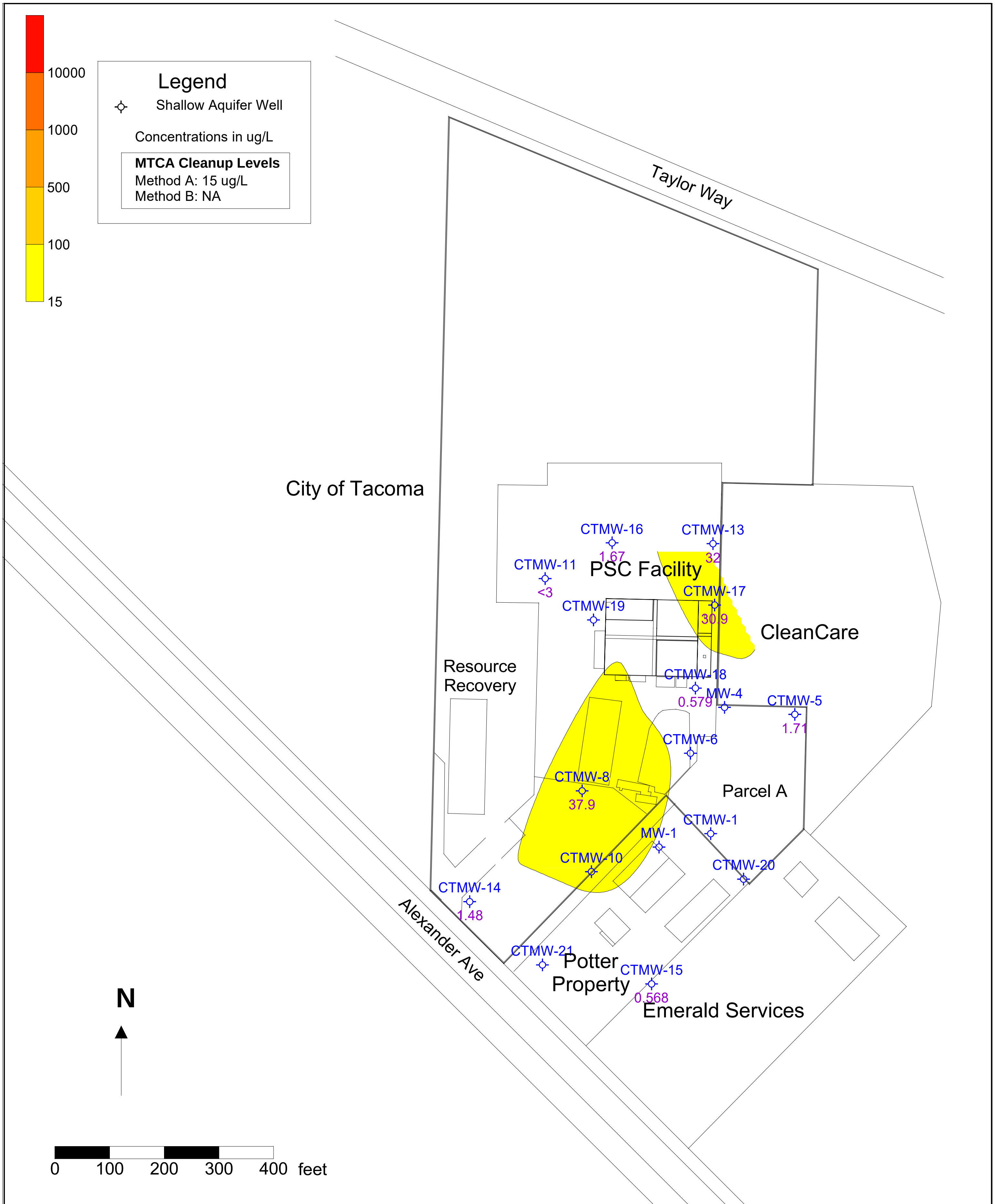


Lead Concentrations **3rd Quarter 1998** **Shallow Aquifer** **Tacoma Facility**	DWN:	DES:	PROJECT No:
	CHKD:	APPD:	FIGURE No:
	DATE:	REV:	



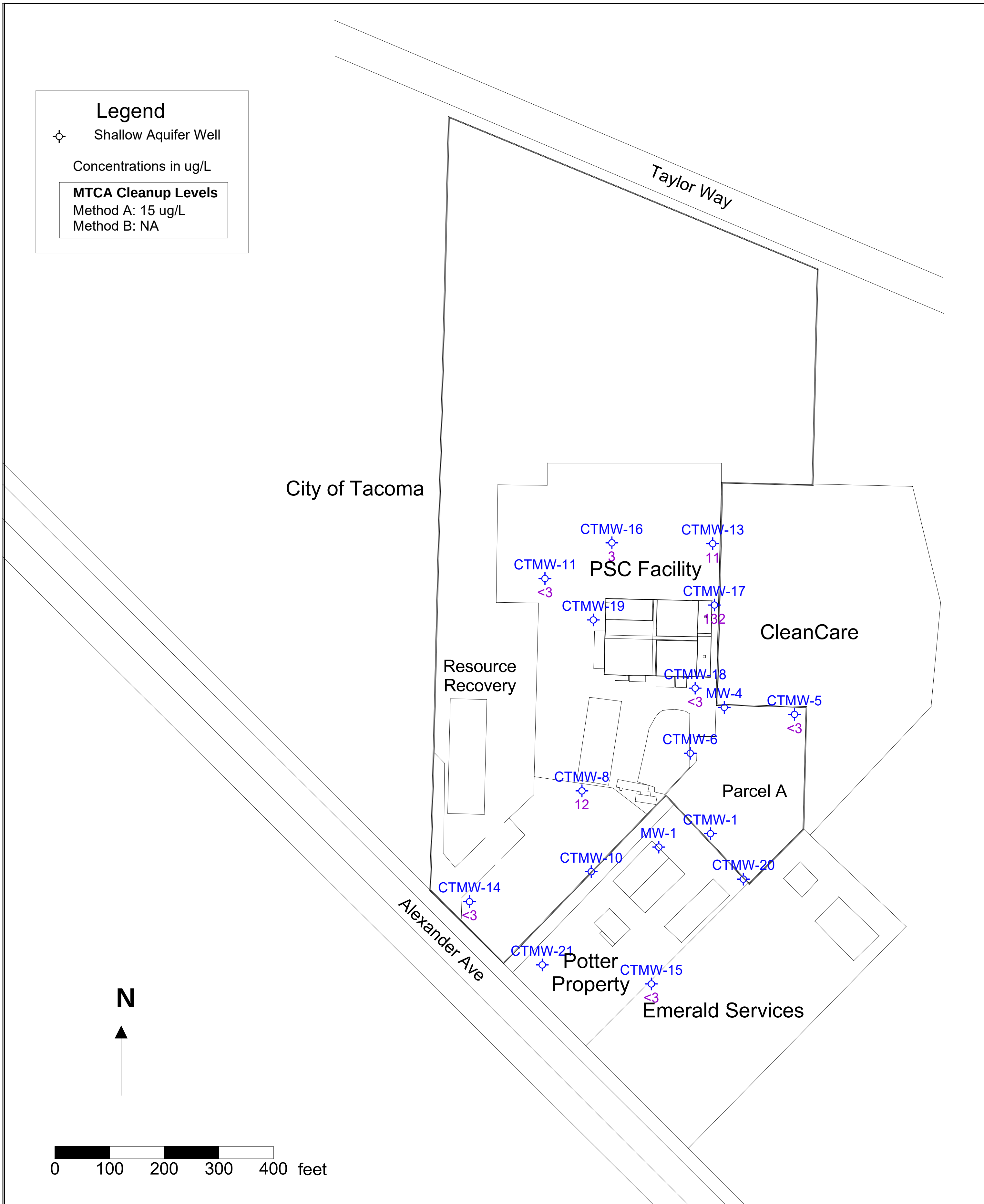
Lead Concentrations
4th Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



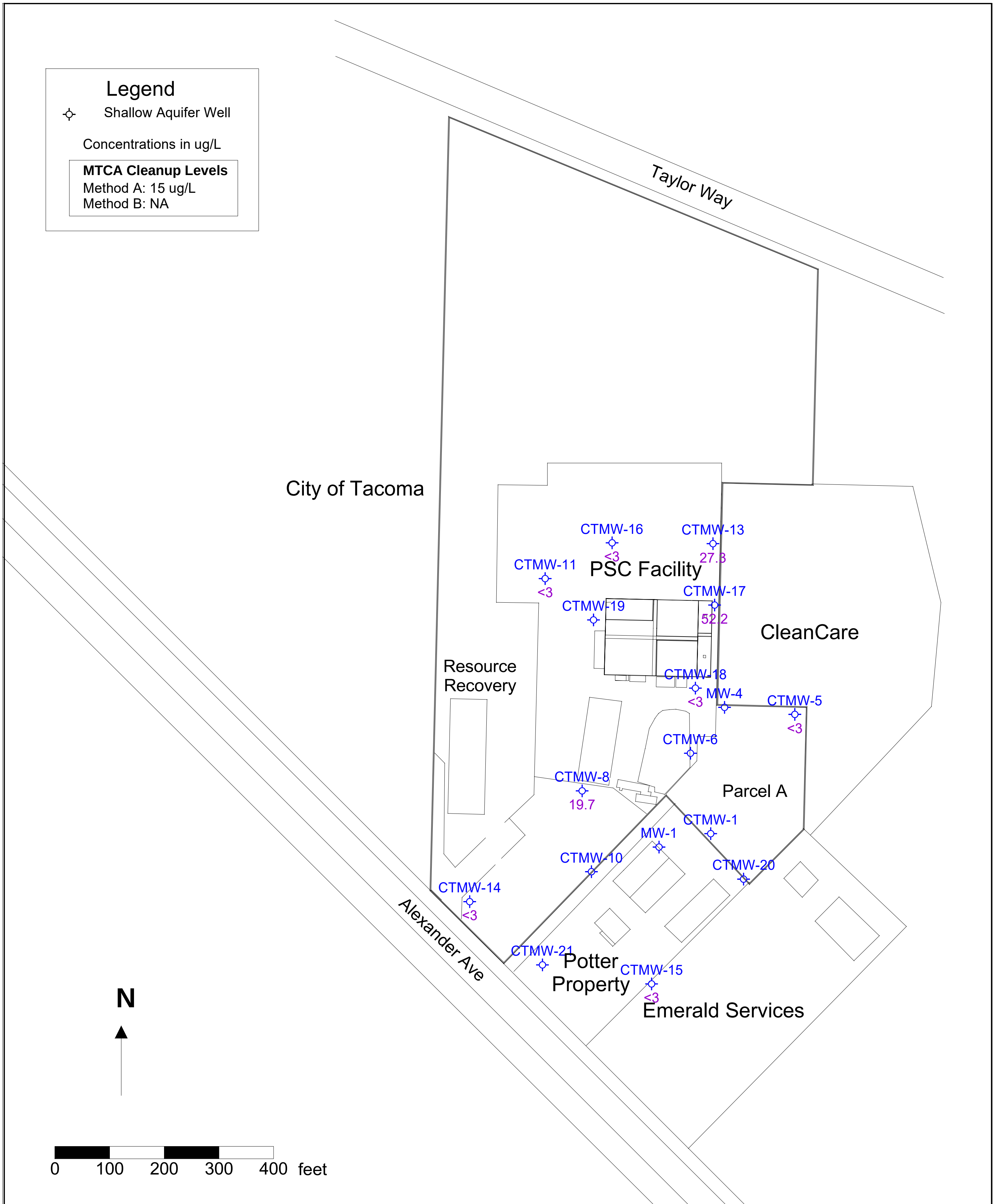
Lead Concentrations
1st Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



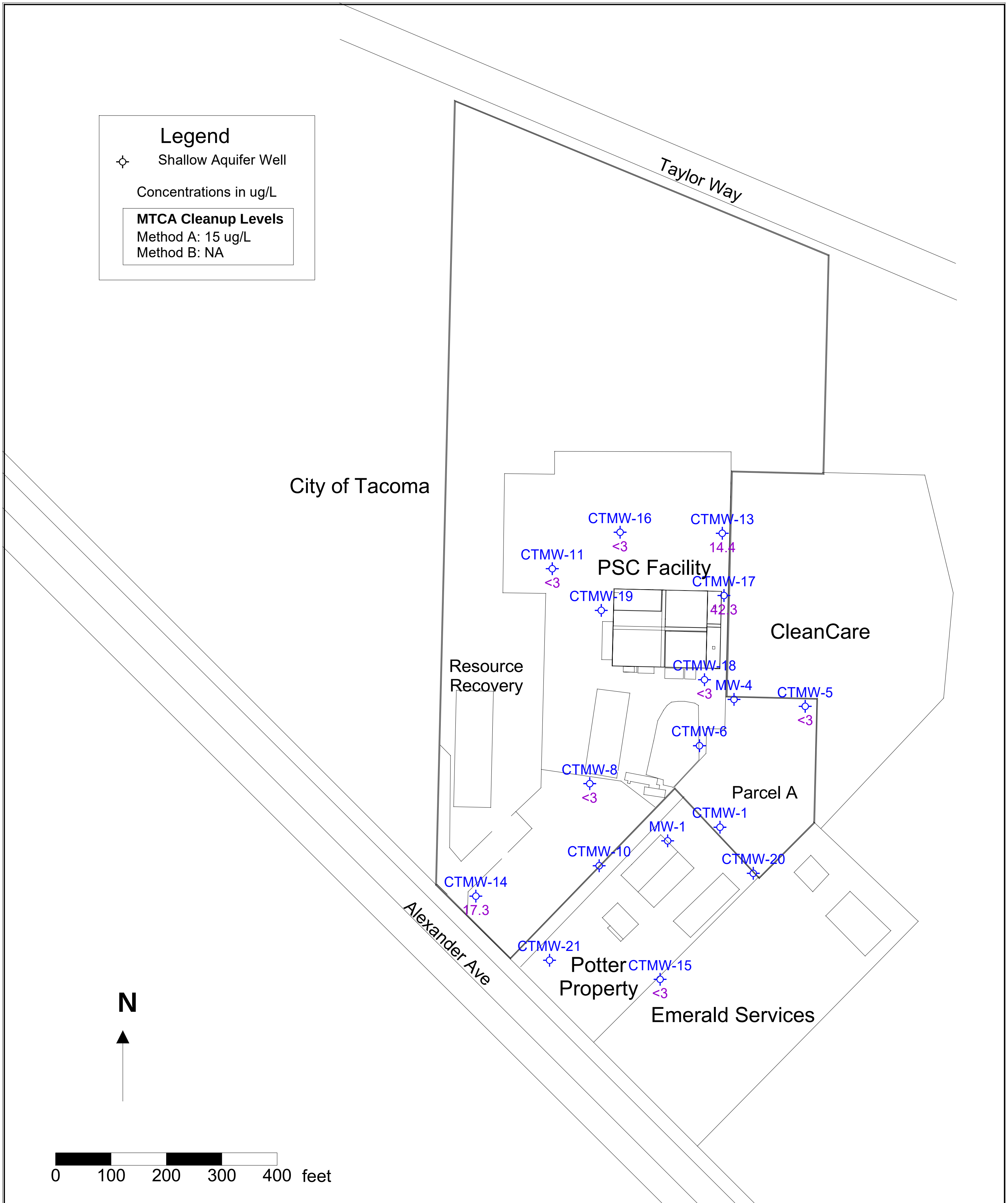
Lead Concentrations
2nd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



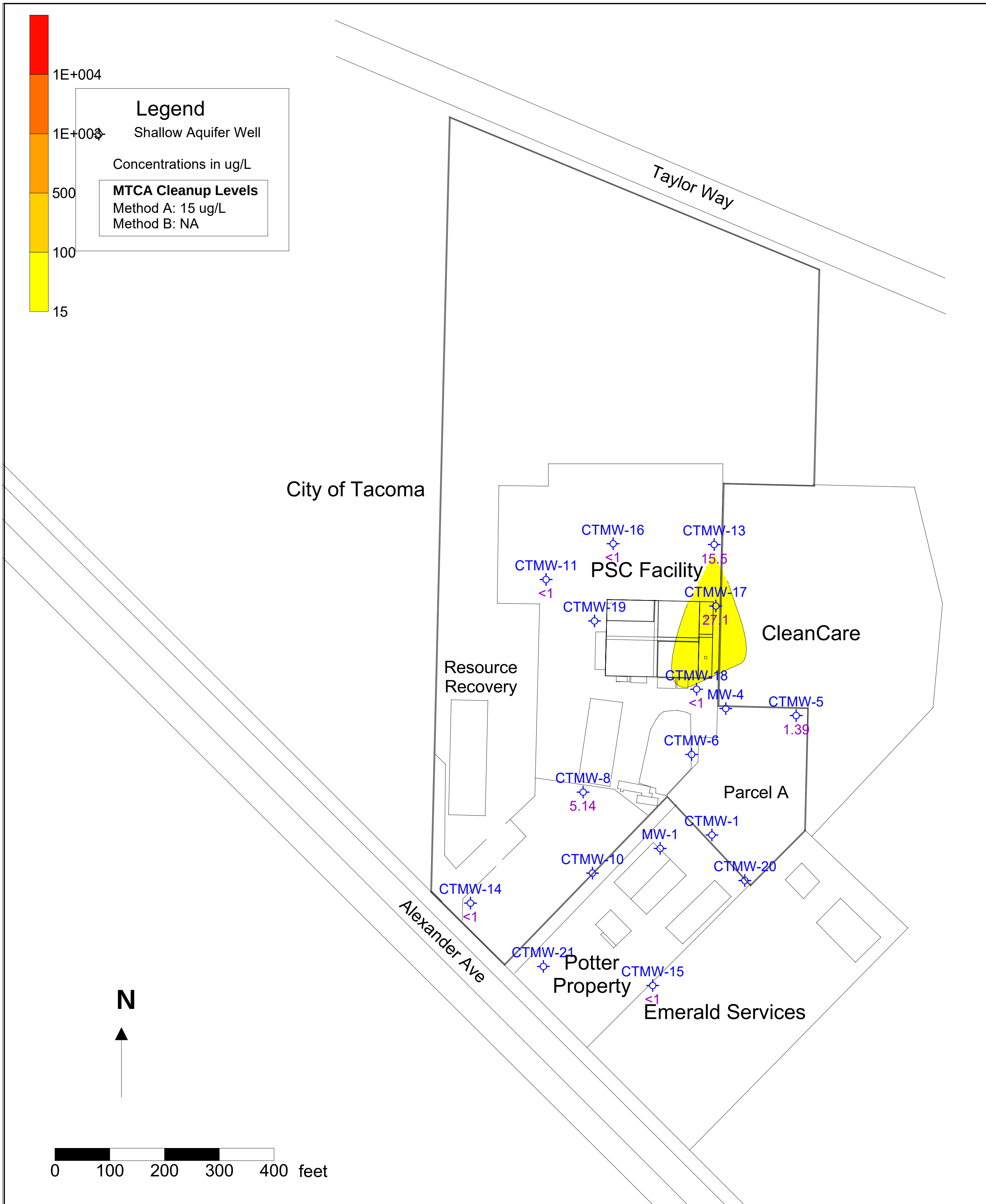
Lead Concentrations
3rd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



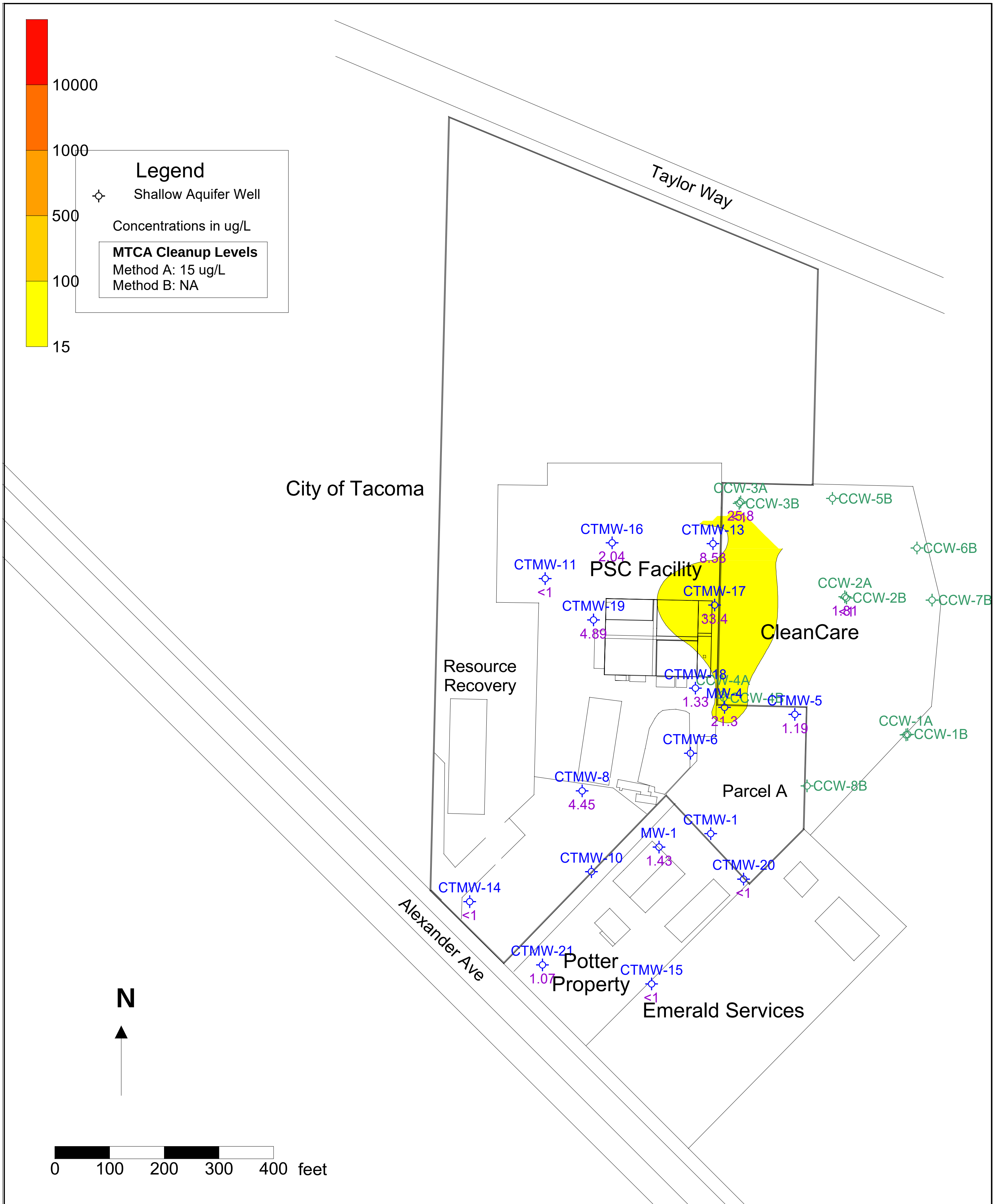
Lead Concentrations
4th Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



Lead Concentrations
1st Quarter 2000
Shallow Aquifer
Tacoma Facility

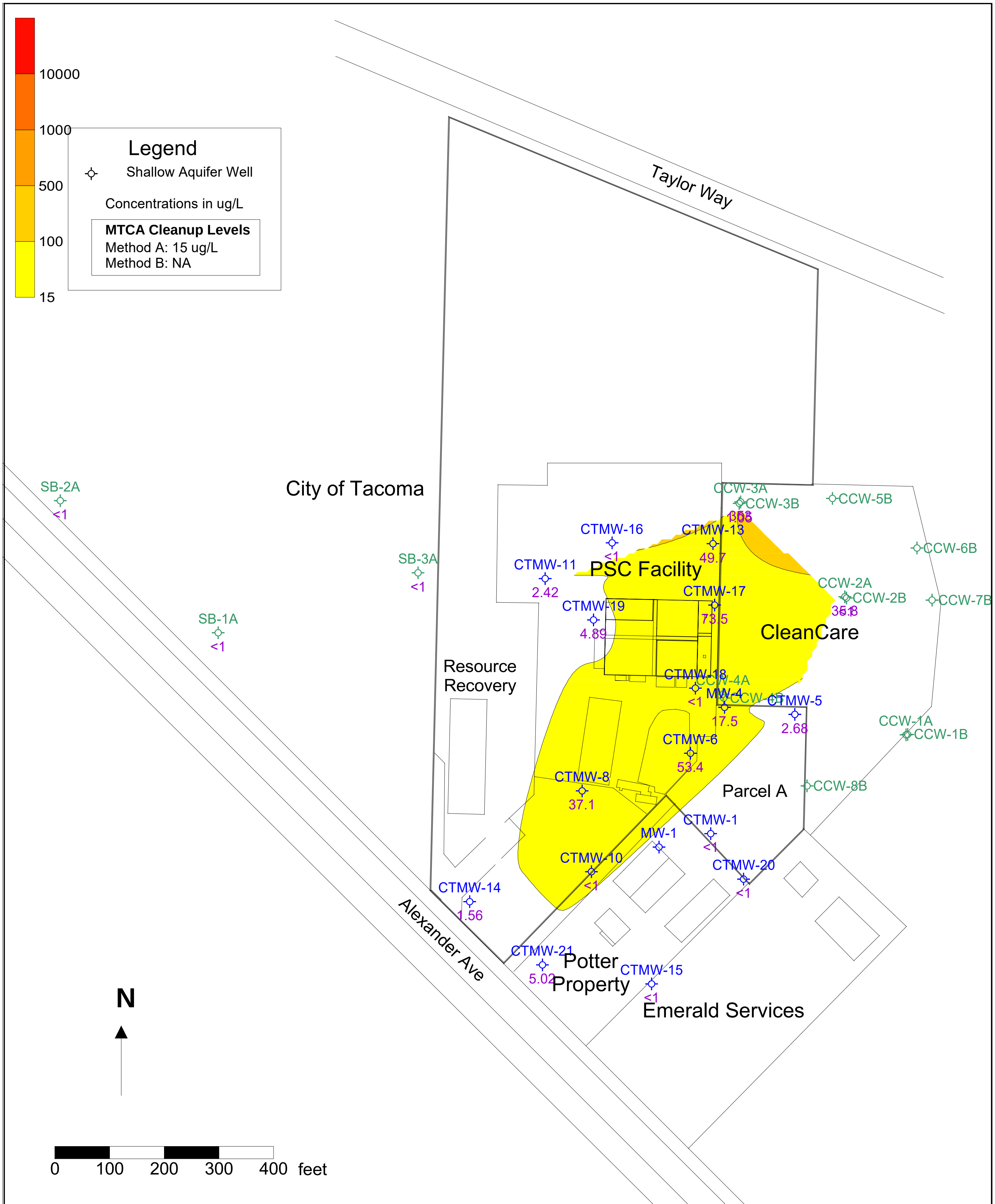
DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



PSC	**Lead Concentrations** **2nd Quarter 2000** **Shallow Aquifer** **Tacoma Facility**	DWN:	DES:
		CHKD:	APPD:
		DATE:	REV:

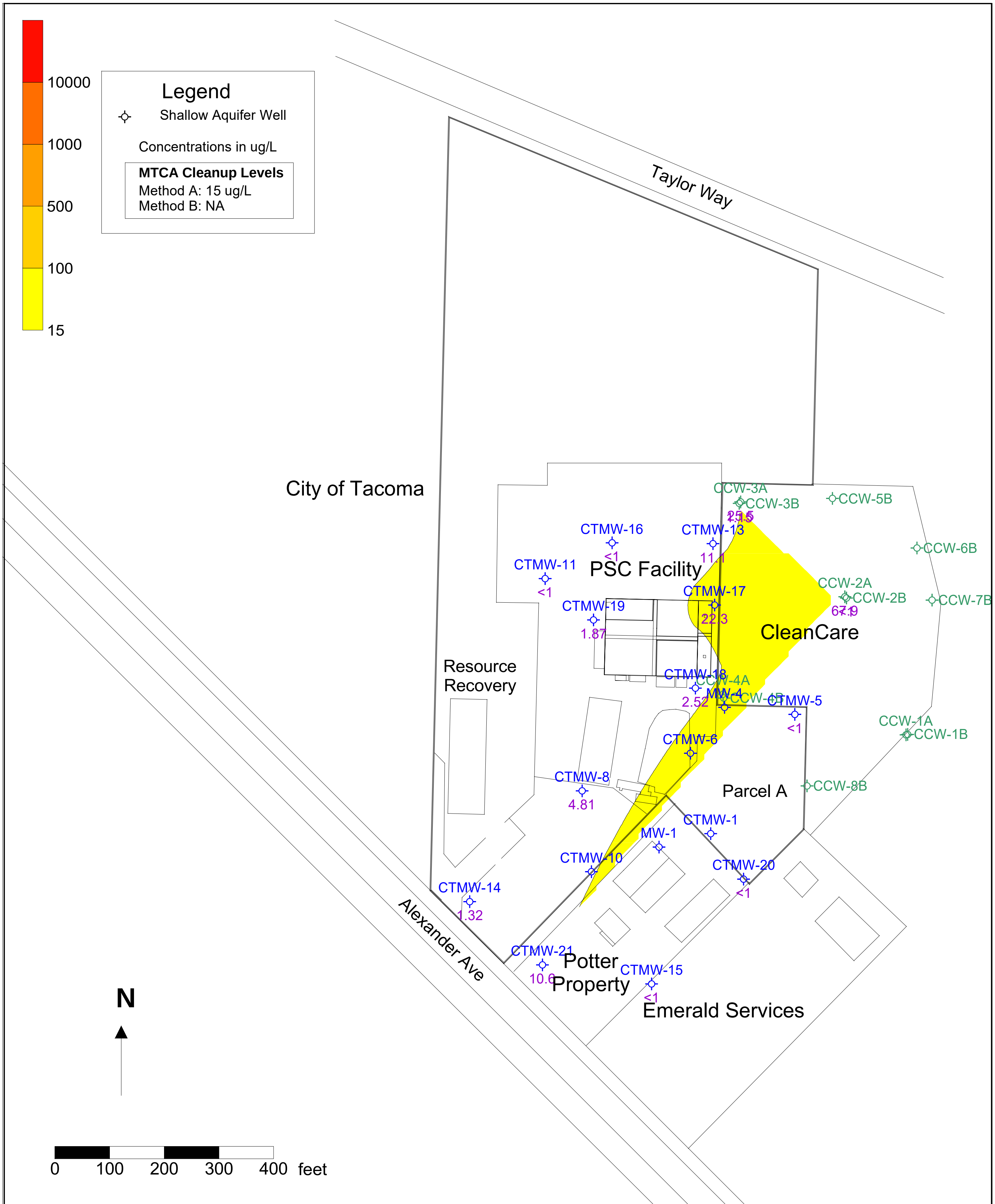
PROJECT No:

FIGURE No:



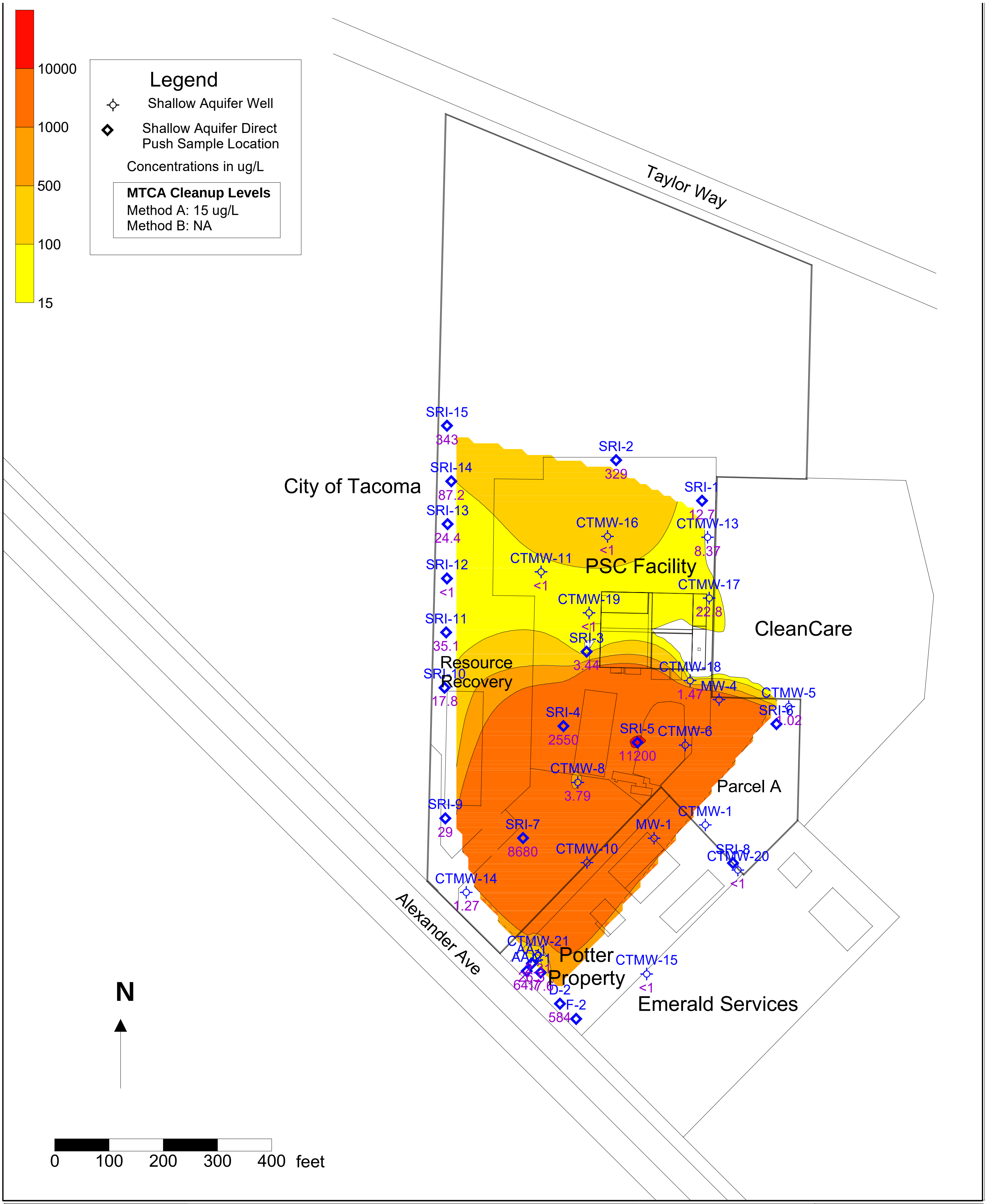
Lead Concentrations
3rd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



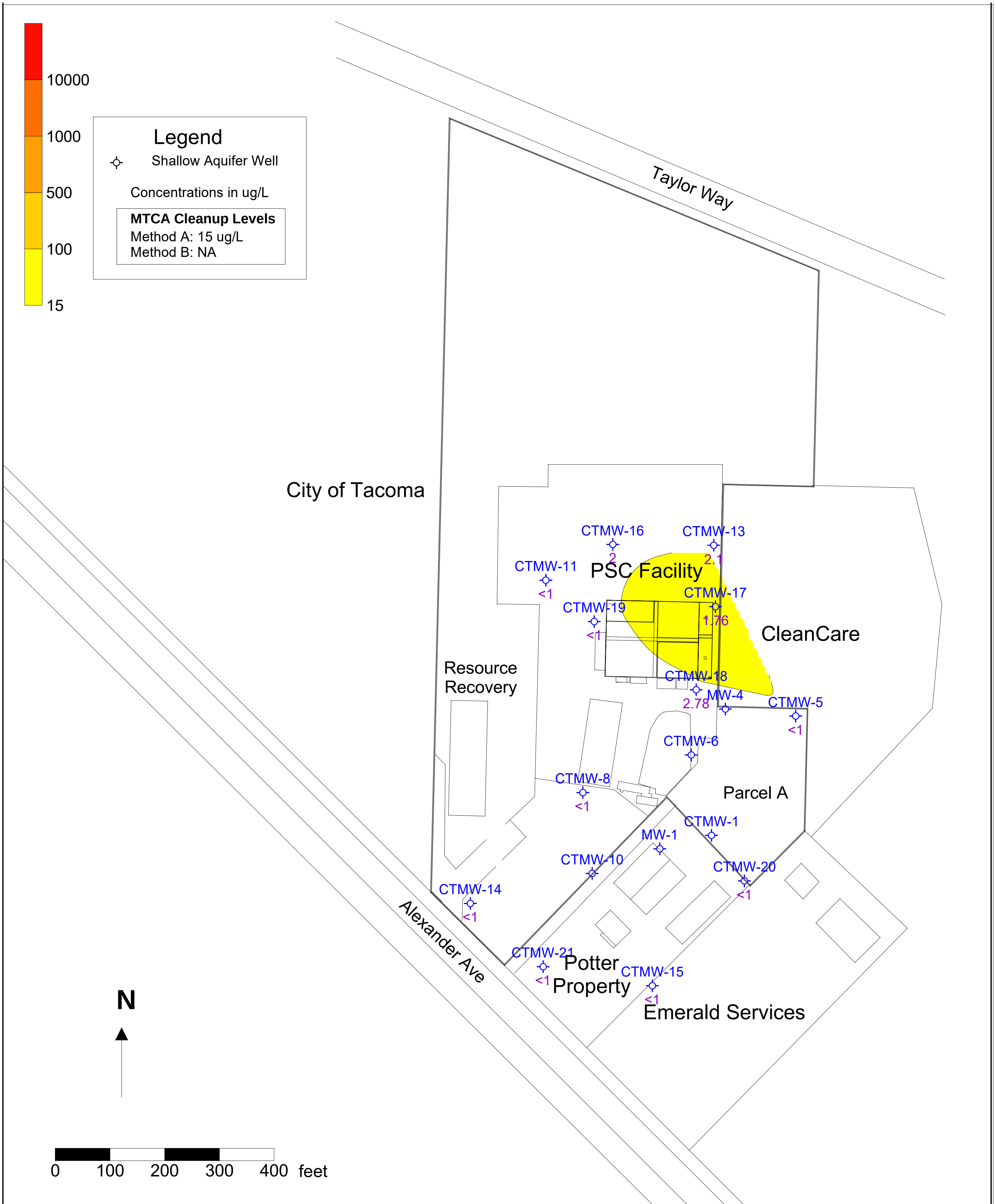
Lead Concentrations
4th Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:

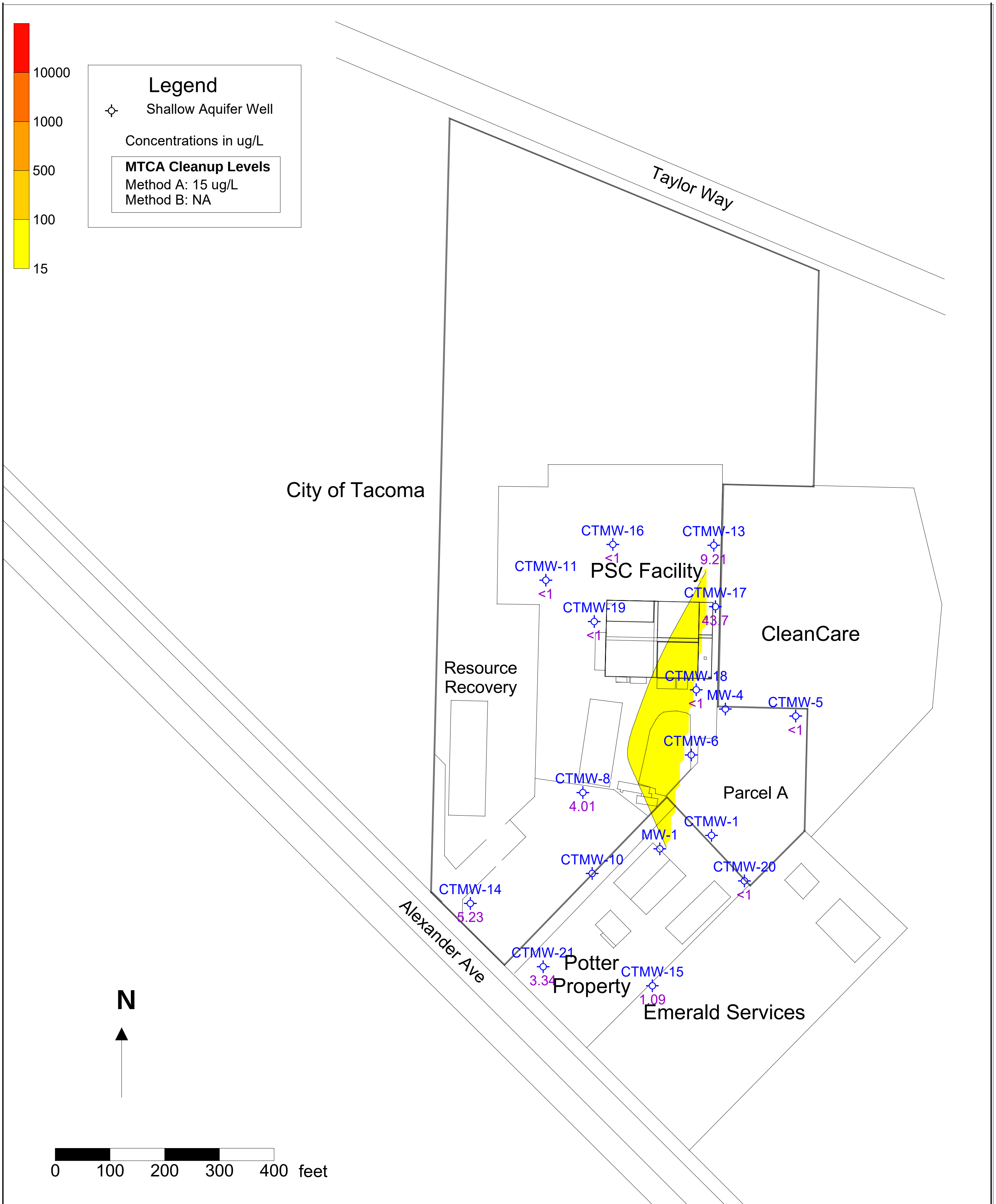


Lead Concentrations
1st Quarter 2001 and SRI
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:

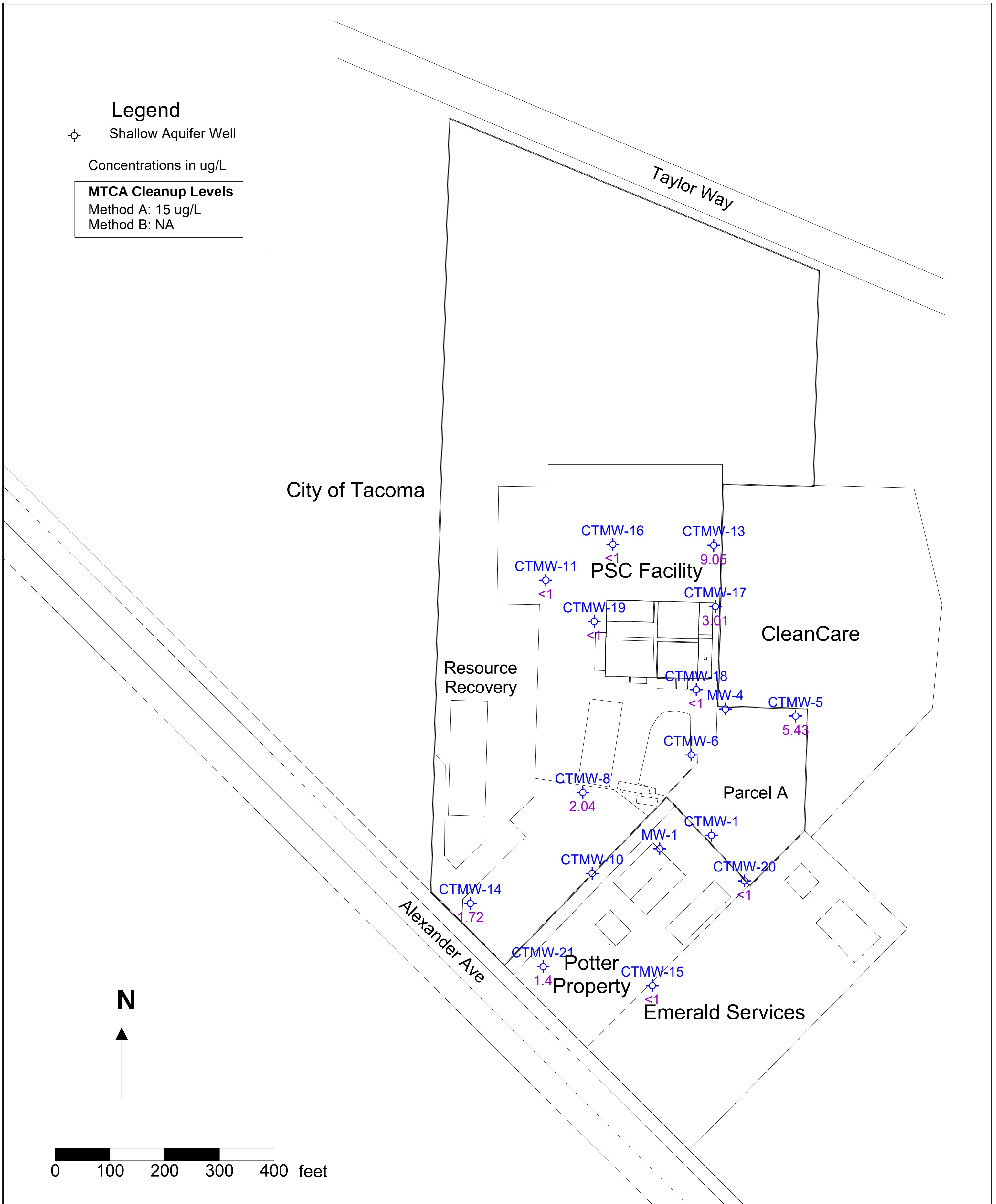


Lead Concentrations **2nd Quarter 2001** **Shallow Aquifer** **Tacoma Facility**	DWN:	DES:	PROJECT No:
	CHKD:	APPD:	FIGURE No:
	DATE:	REV:	



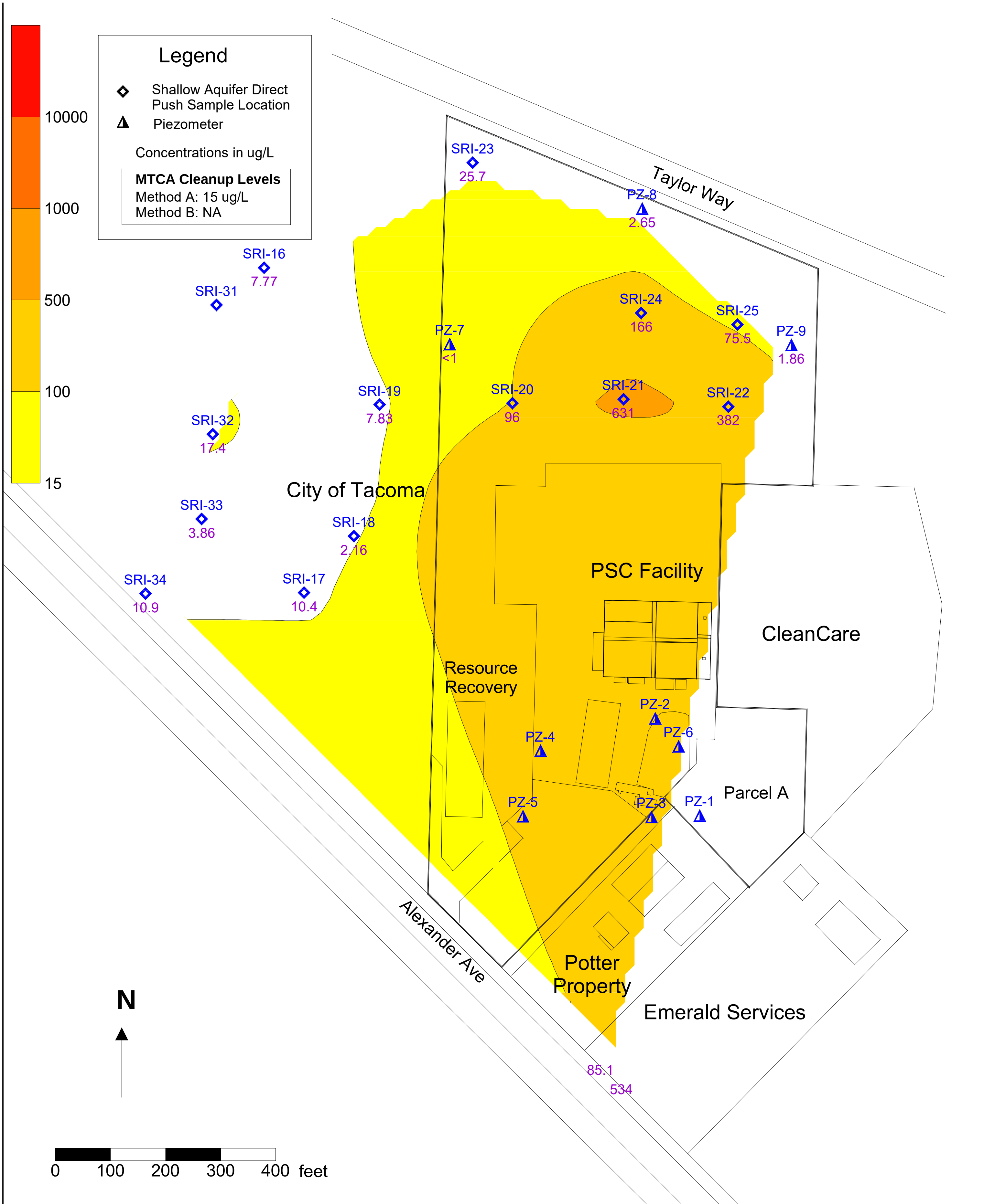
Lead Concentrations
3rd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



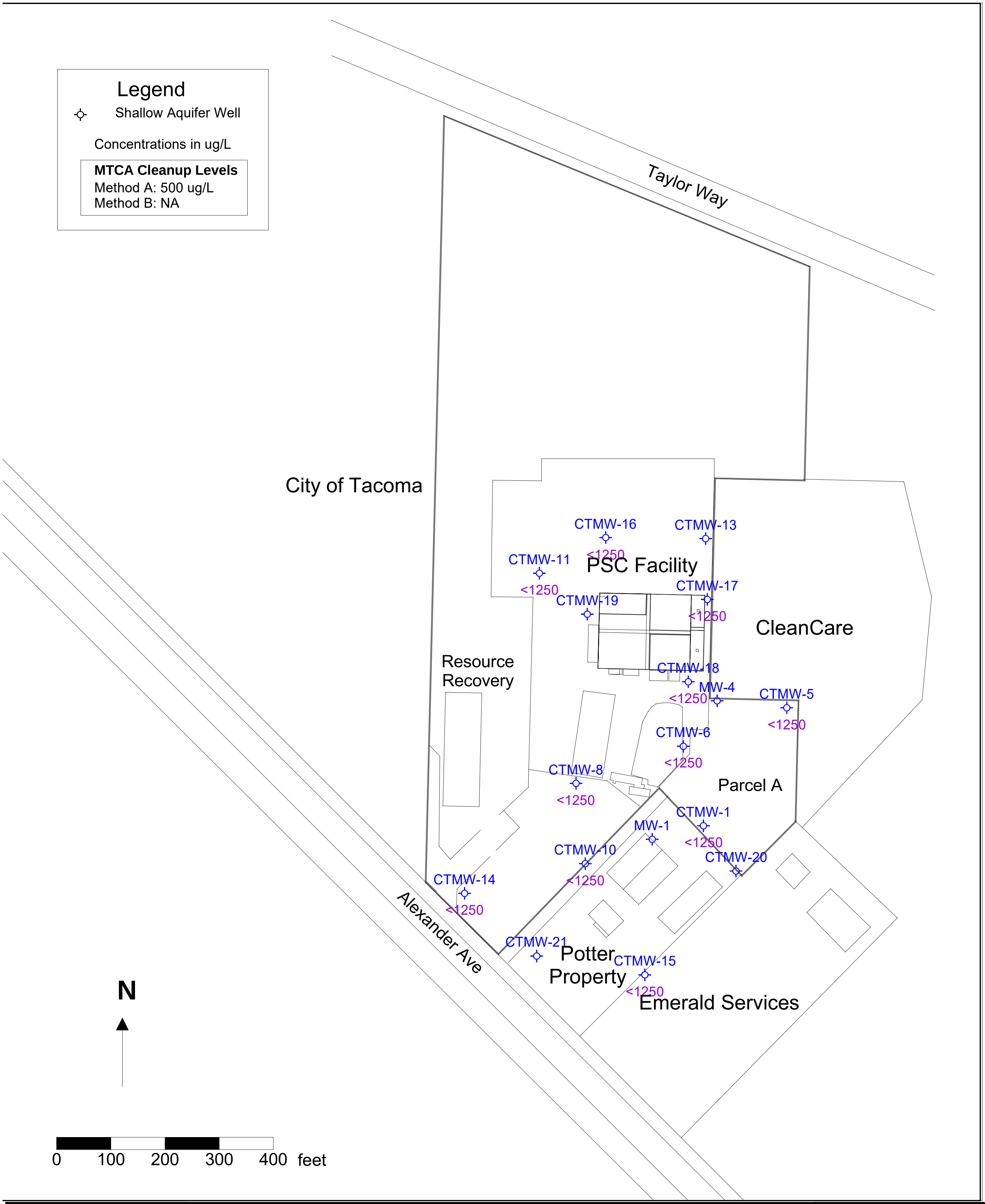
Lead Concentrations
4th Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



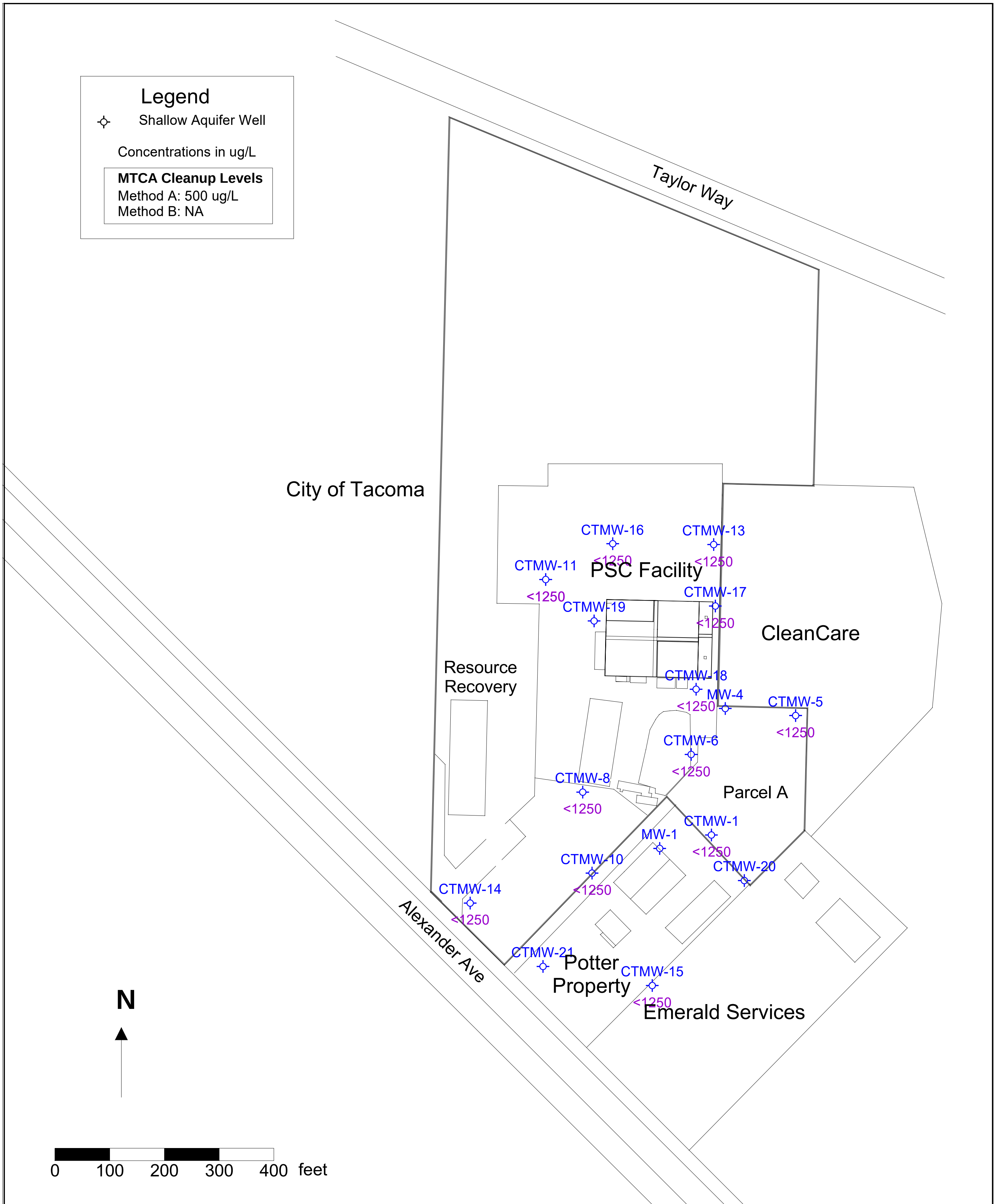
Lead Concentrations
SRI II 2002
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



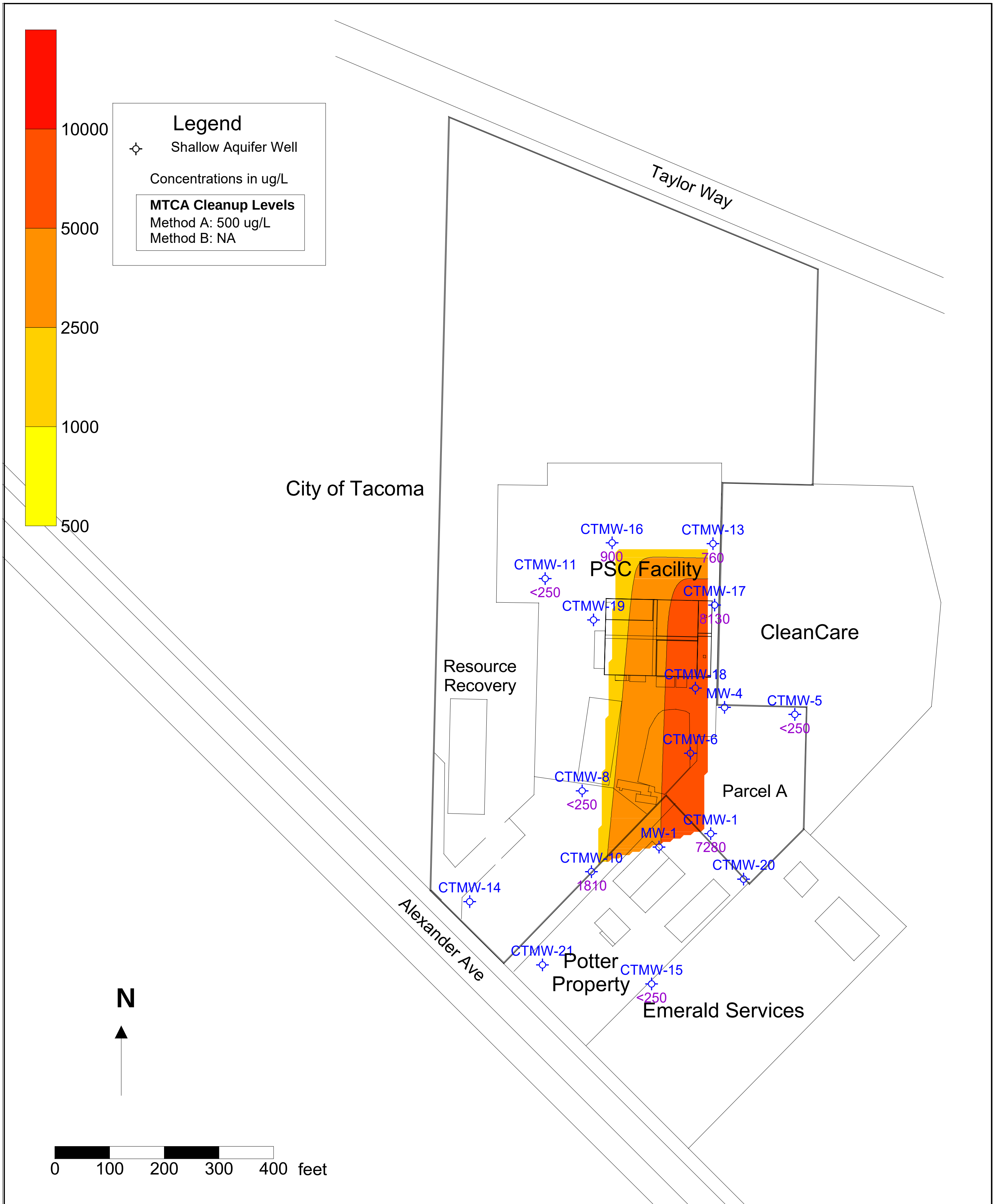
Diesel Concentrations
1st Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



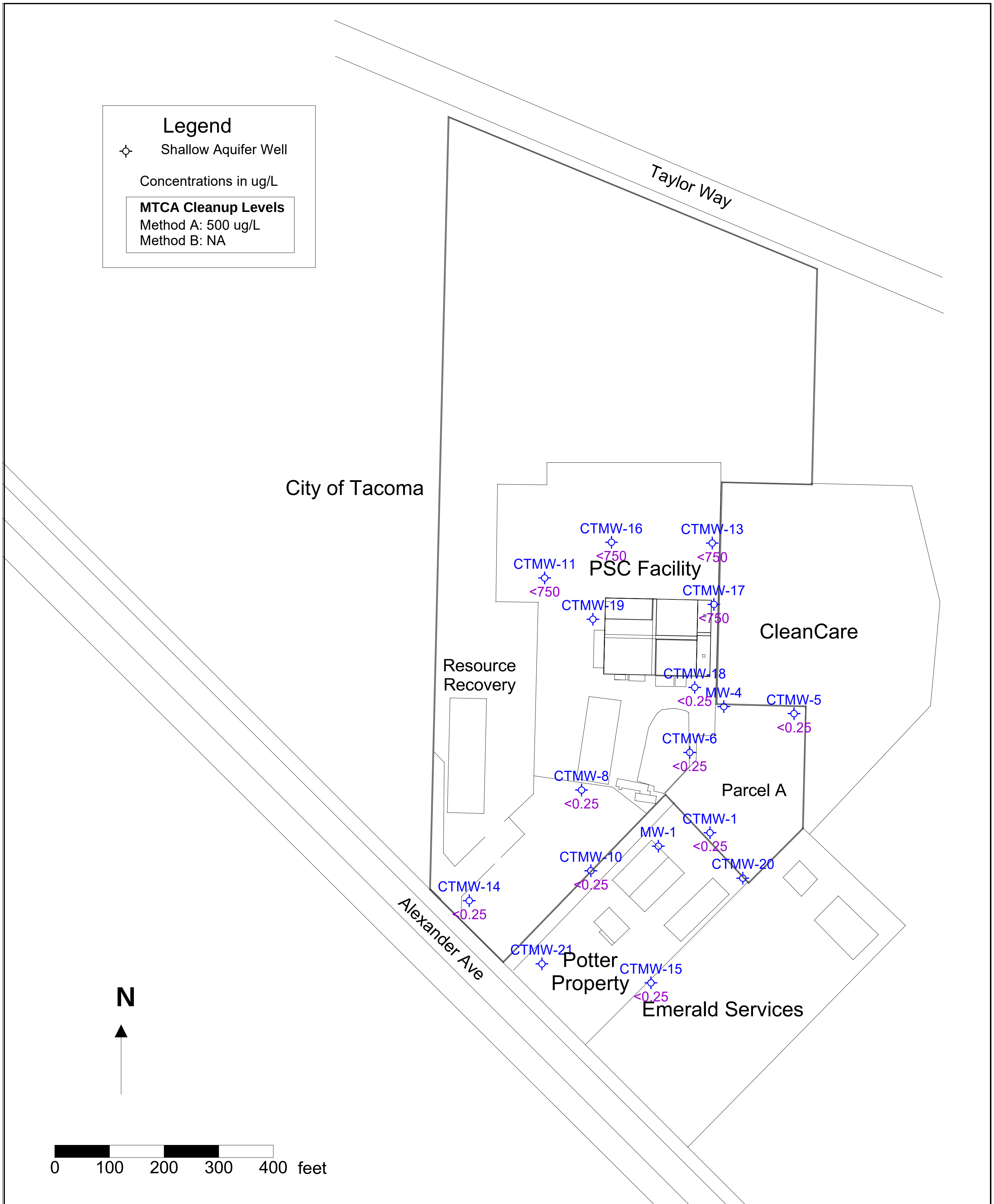
Diesel Concentrations, 2nd Quarter 1998 Shallow Aquifer Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



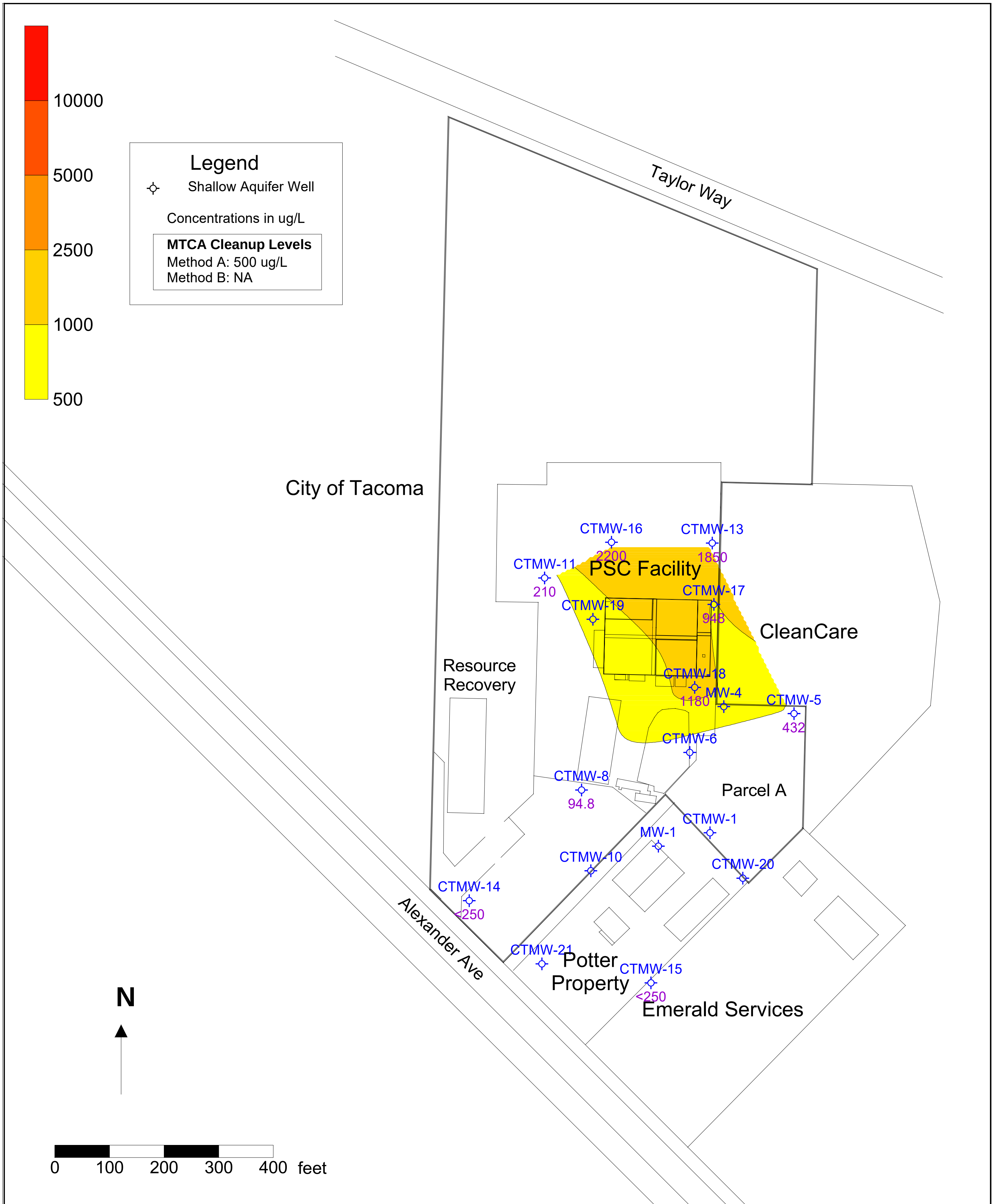
Diesel Concentrations
3rd Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



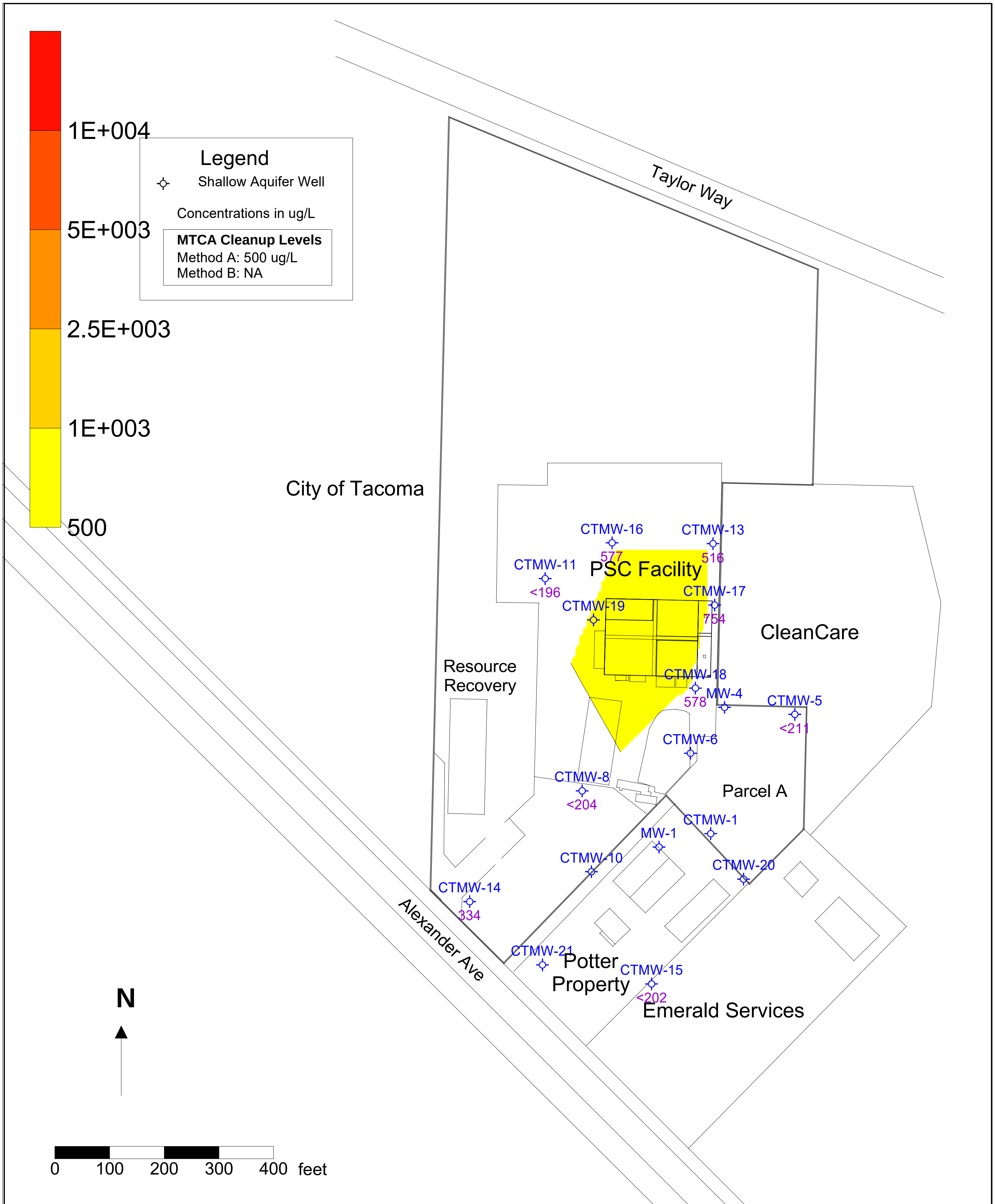
Diesel Concentrations
4th Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



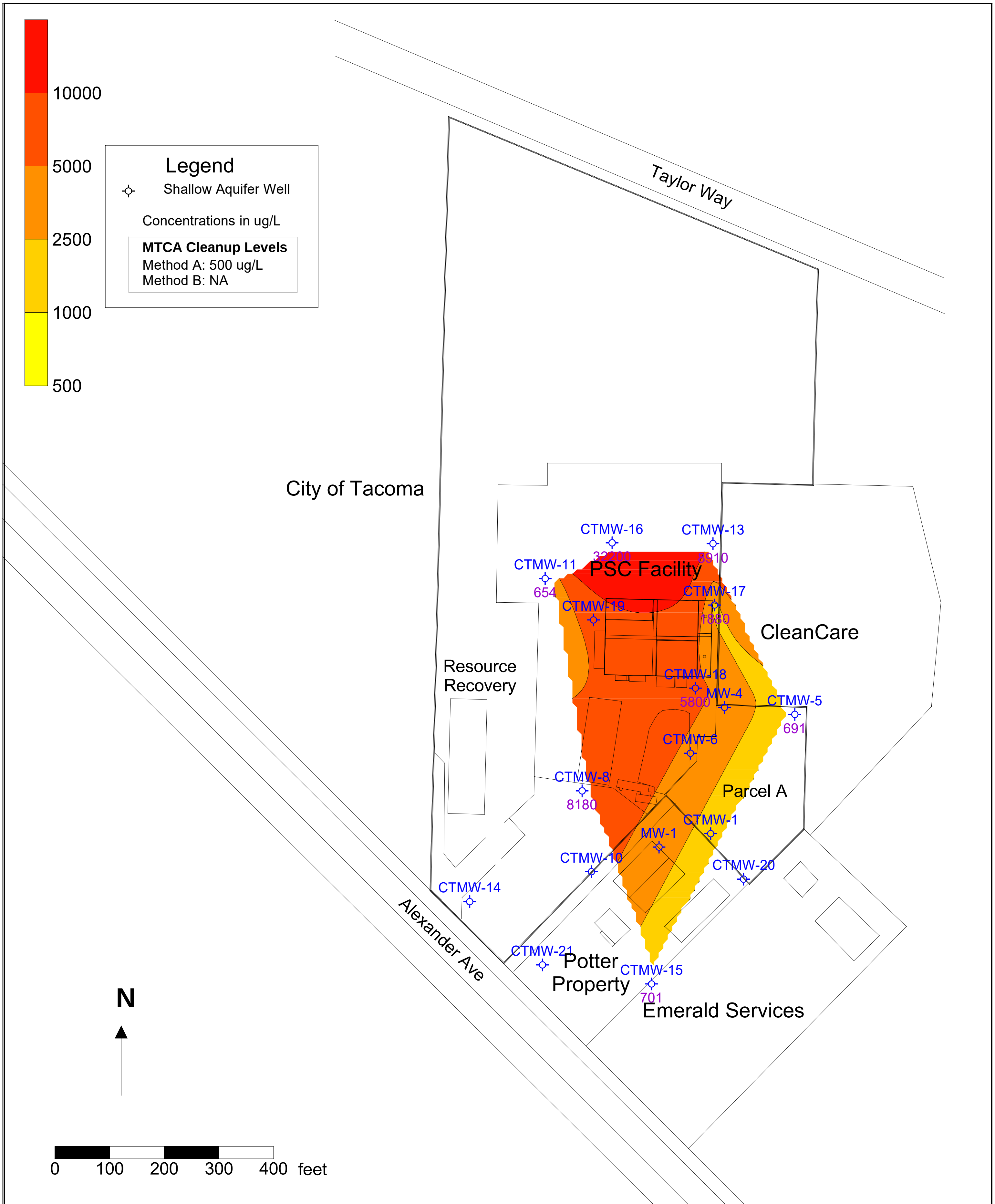
Diesel Concentrations
1st Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



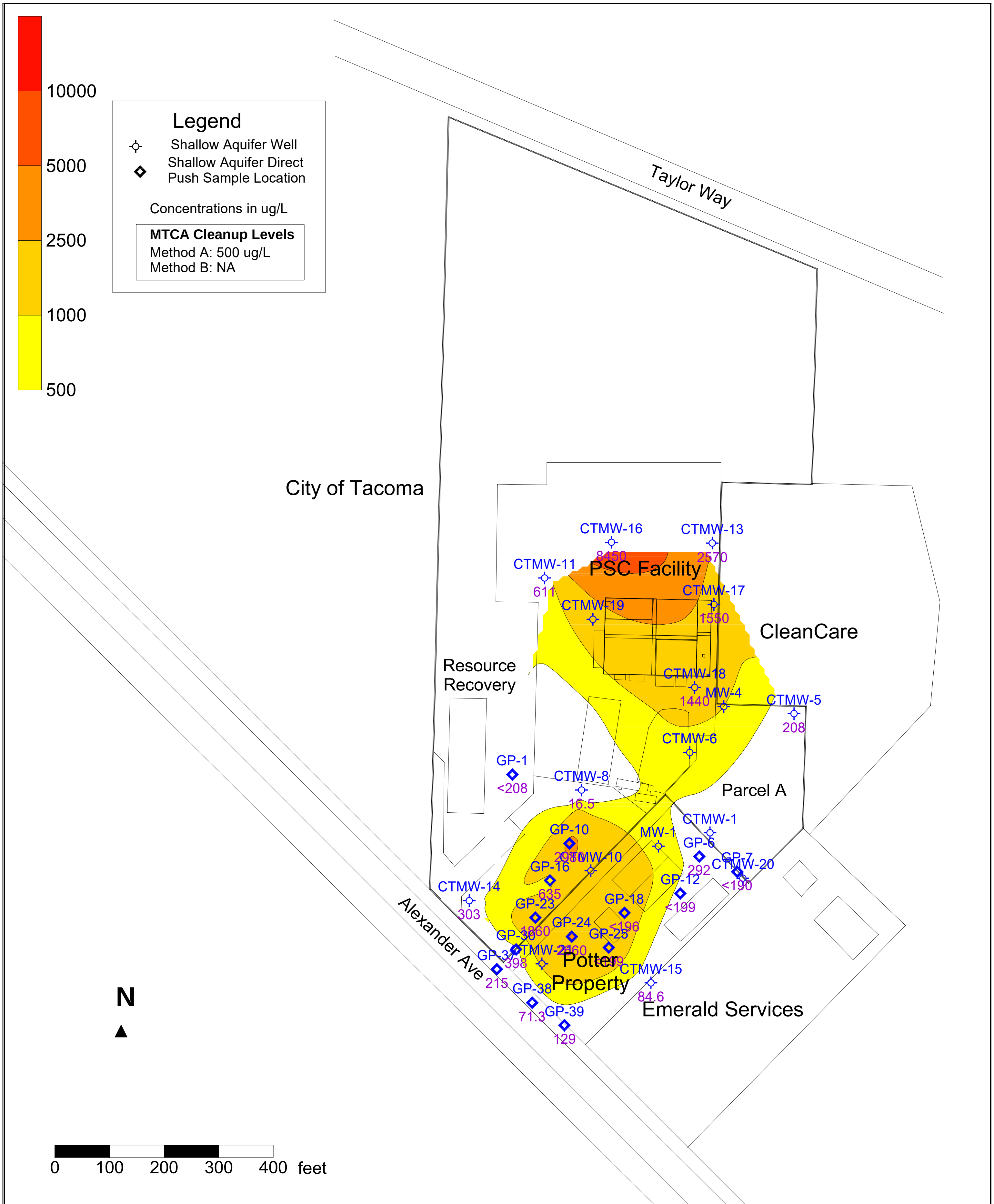
Diesel Concentrations
2nd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



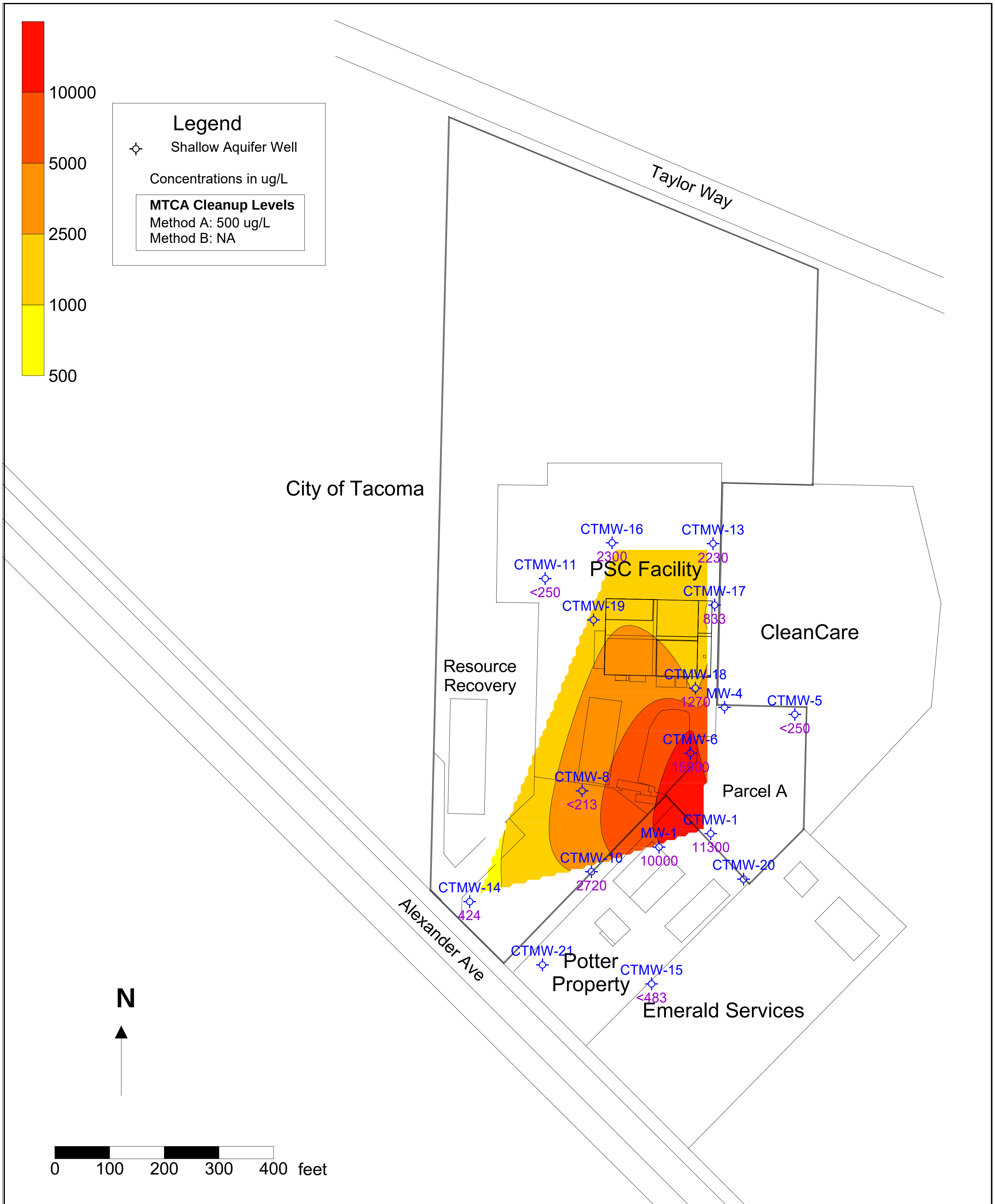
Diesel Concentrations
3rd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



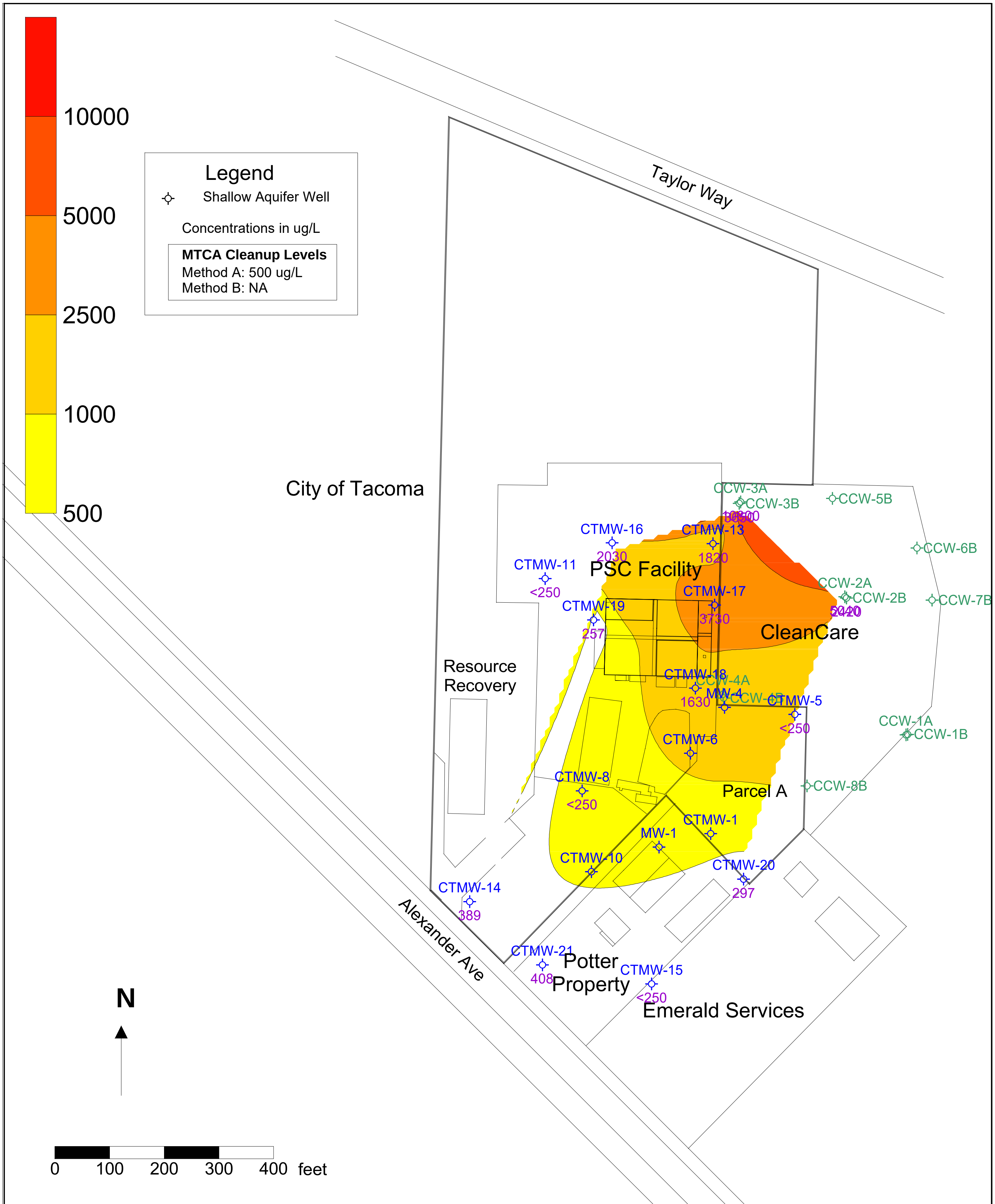
Diesel Concentrations
4th Quarter 1999 and Step-Out Investigation
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



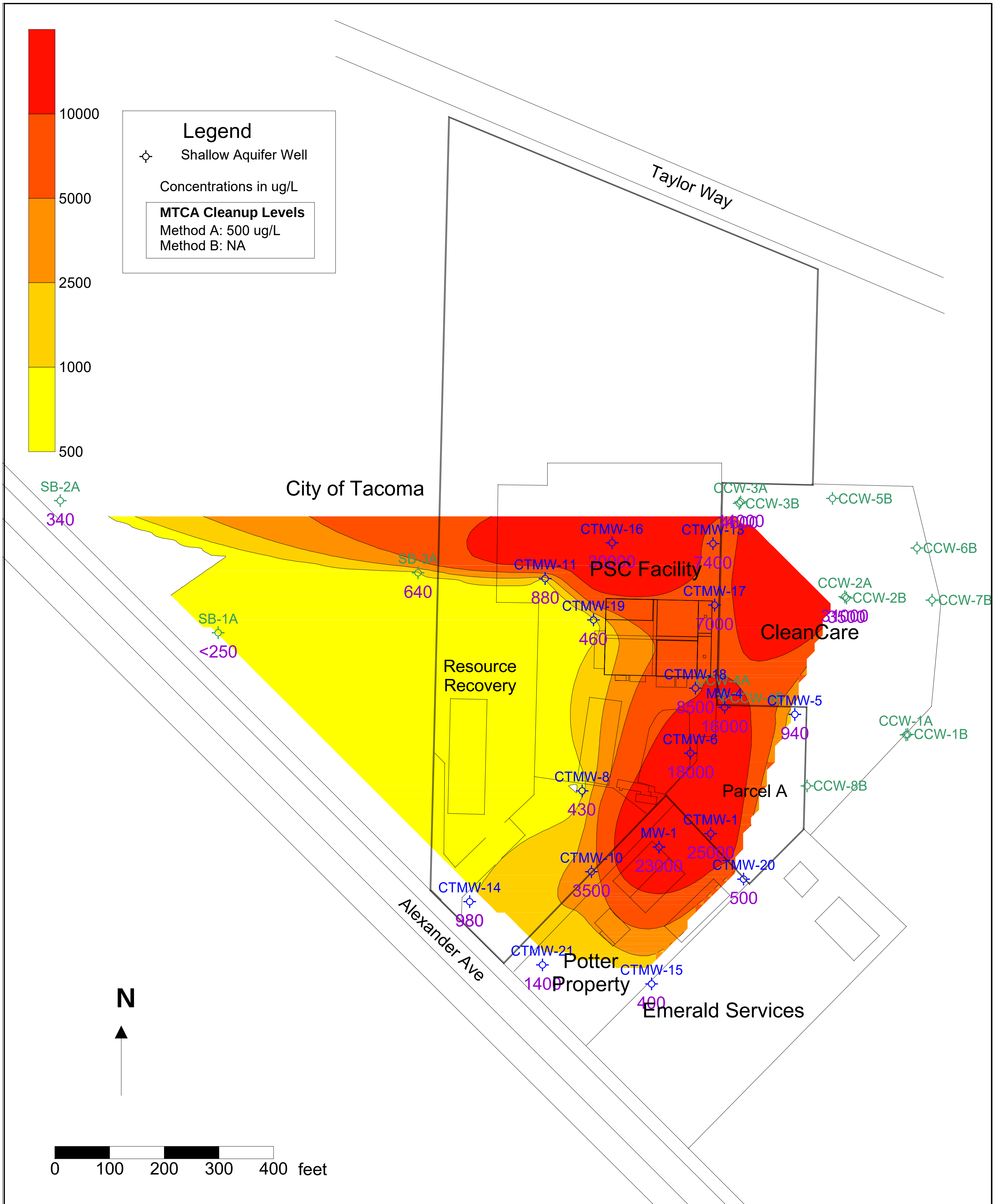
Diesel Concentrations
1st Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:

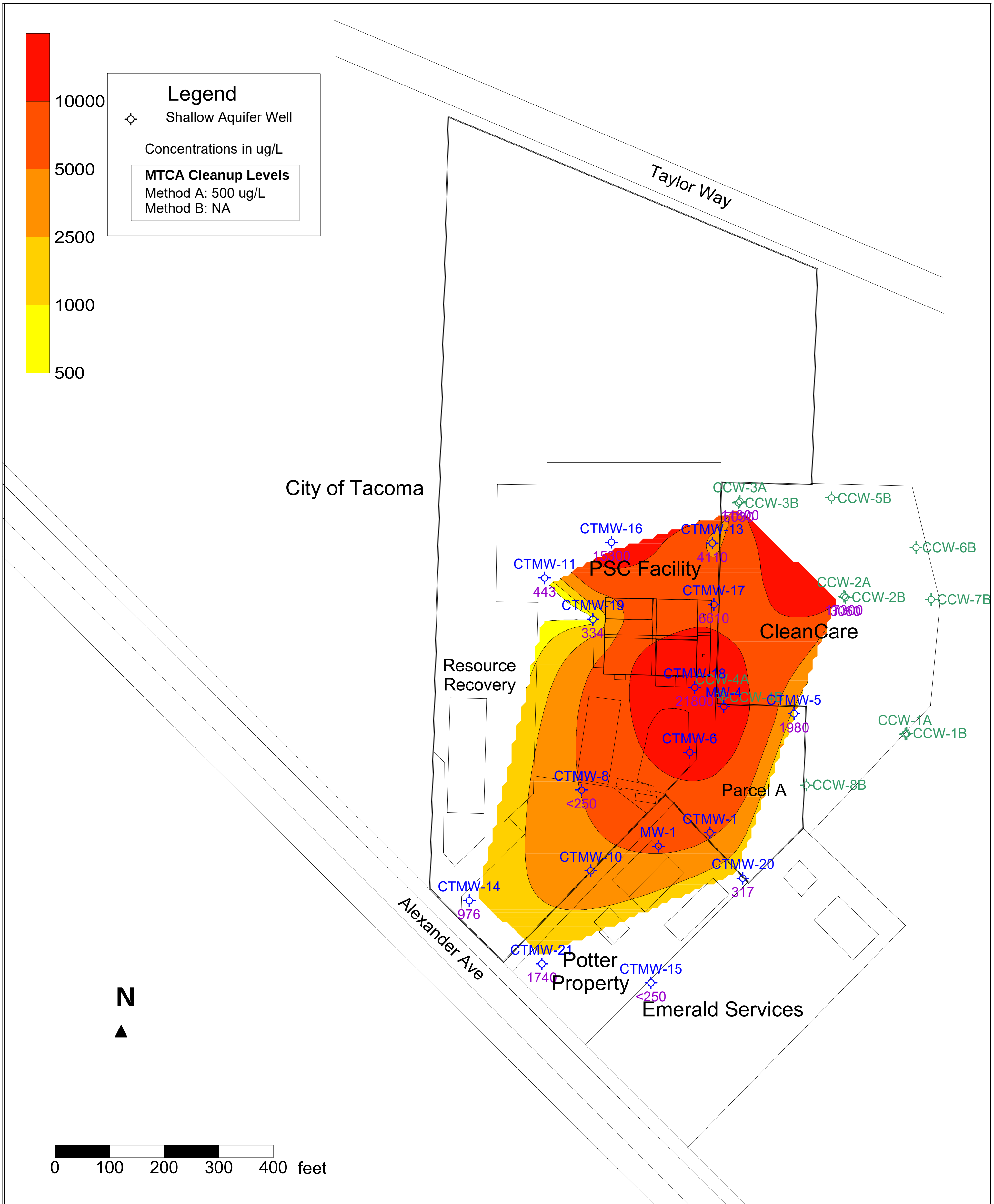


Diesel Concentrations
2nd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	

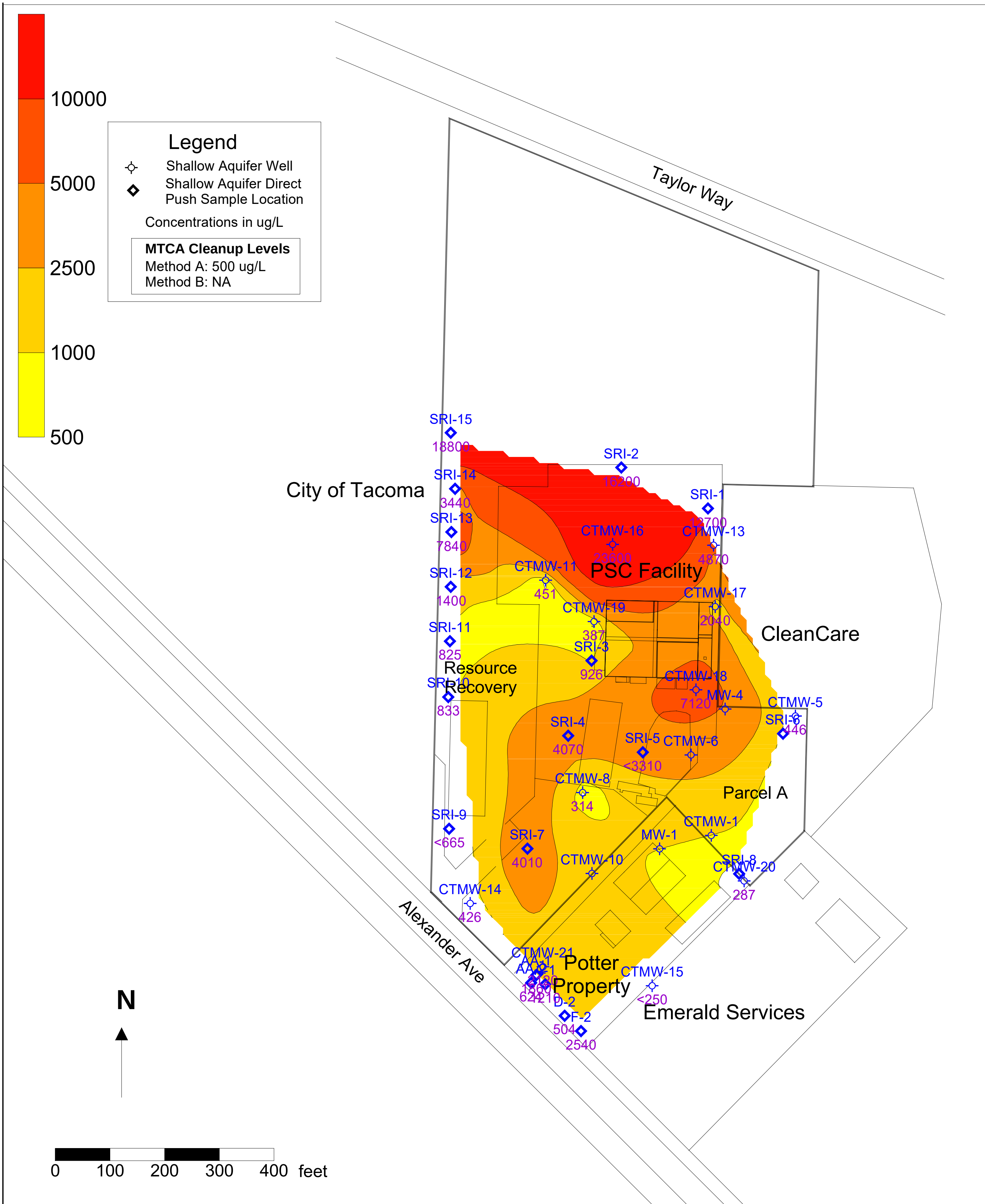


Diesel Concentrations 3rd Quarter 2000 Shallow Aquifer Tacoma Facility	DWN:	DES:	PROJECT No:
	CHKD:	APPD:	FIGURE No:
	DATE:	REV:	

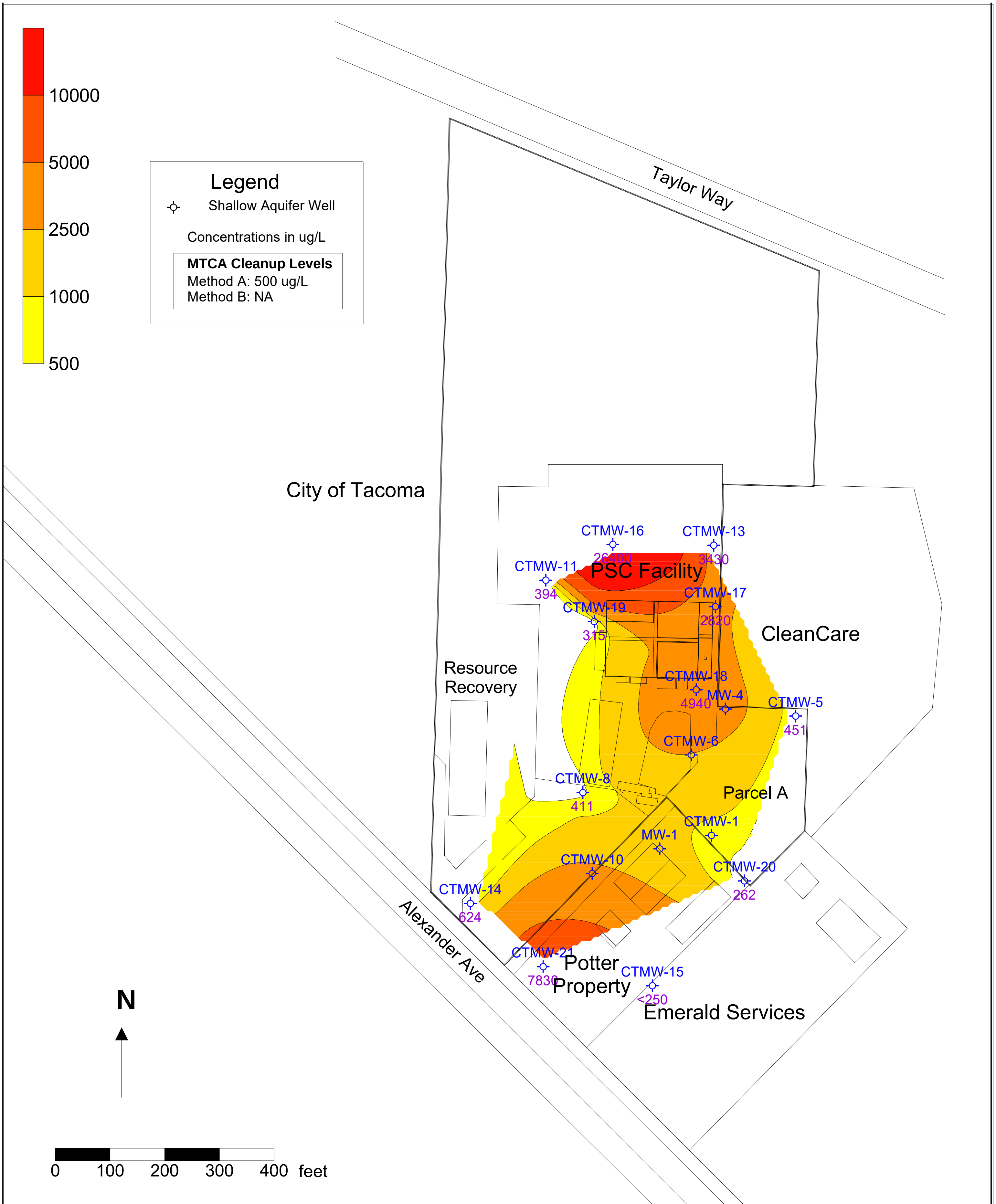


Diesel Concentrations
4th Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	

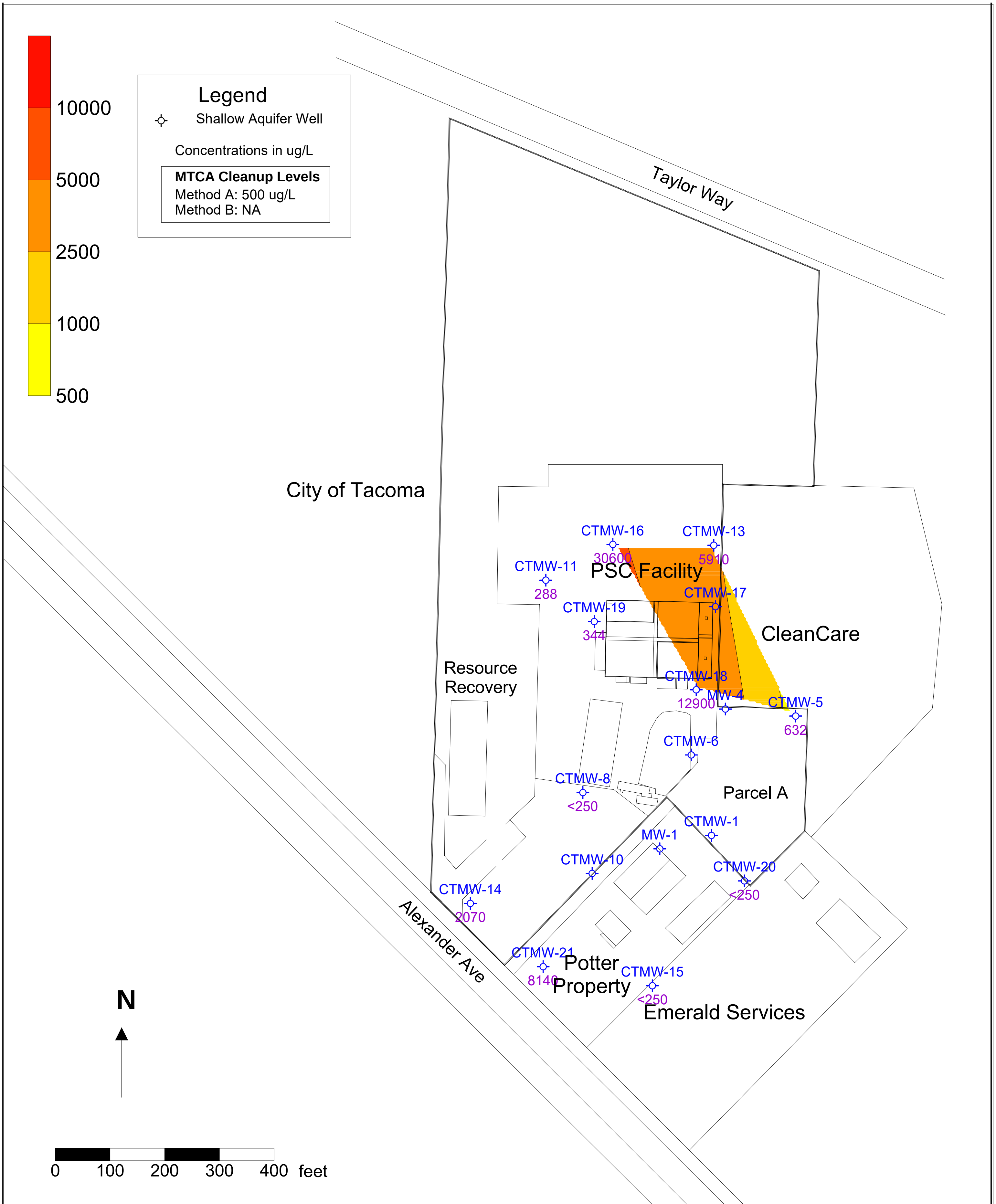


Diesel Concentrations 1st Quarter 2001 and SRI Shallow Aquifer Tacoma Facility	DWN:	DES:	PROJECT No:
	CHKD:	APPD:	FIGURE No:
	DATE:	REV:	



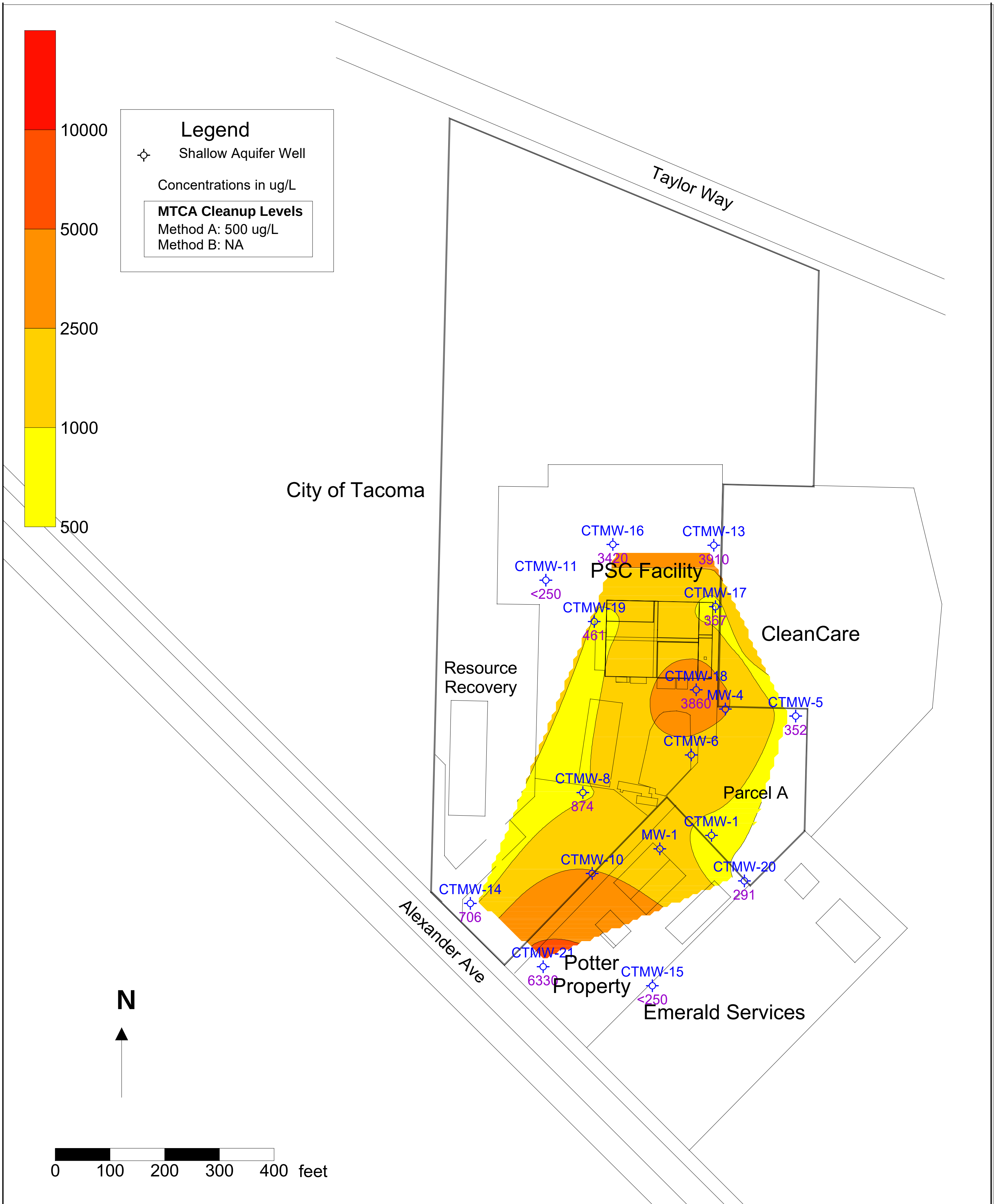
Diesel Concentrations
2nd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



Diesel Concentrations
3rd Quarter 2001
Shallow Aquifer
Tacoma Facility

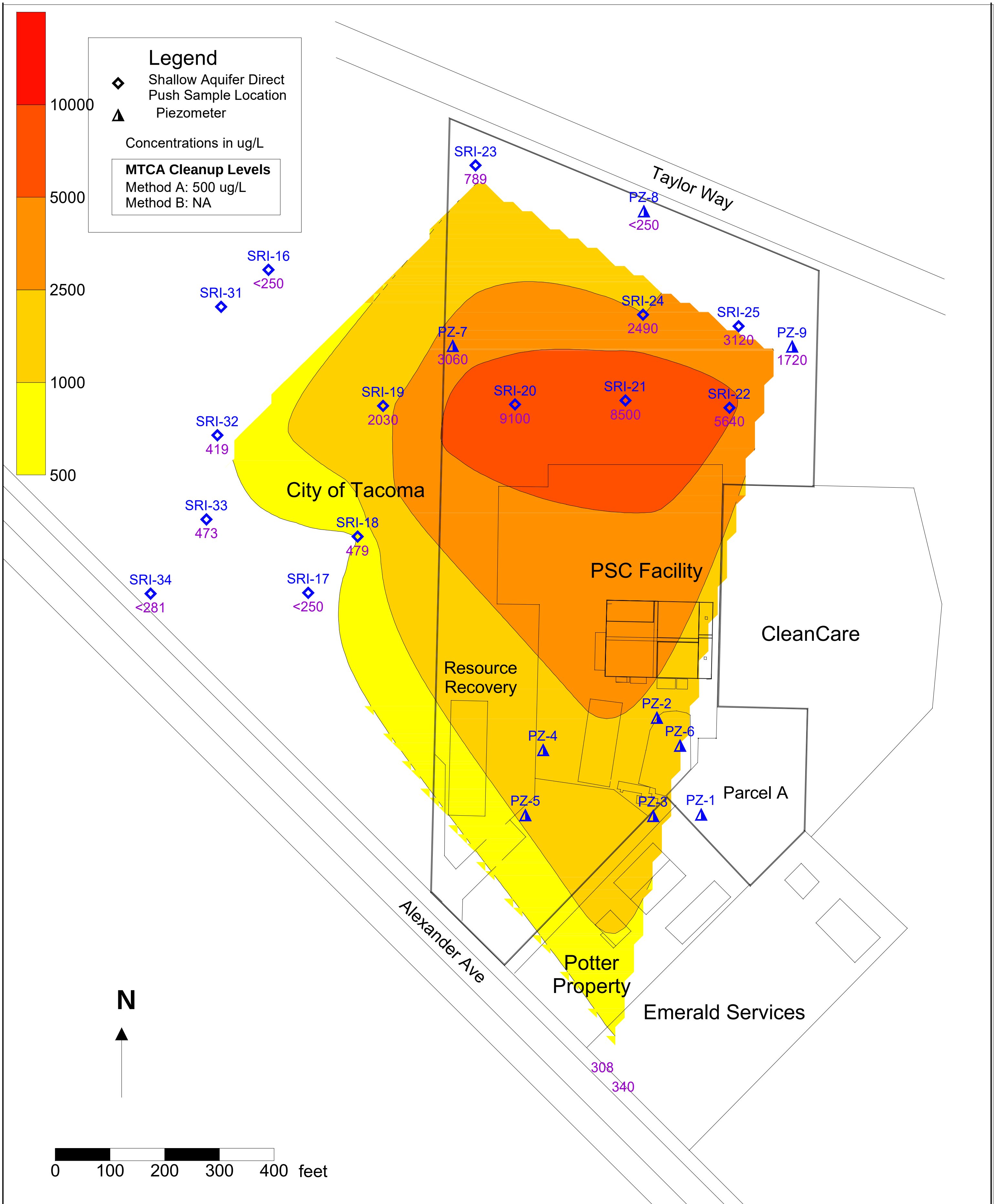
DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



PSC

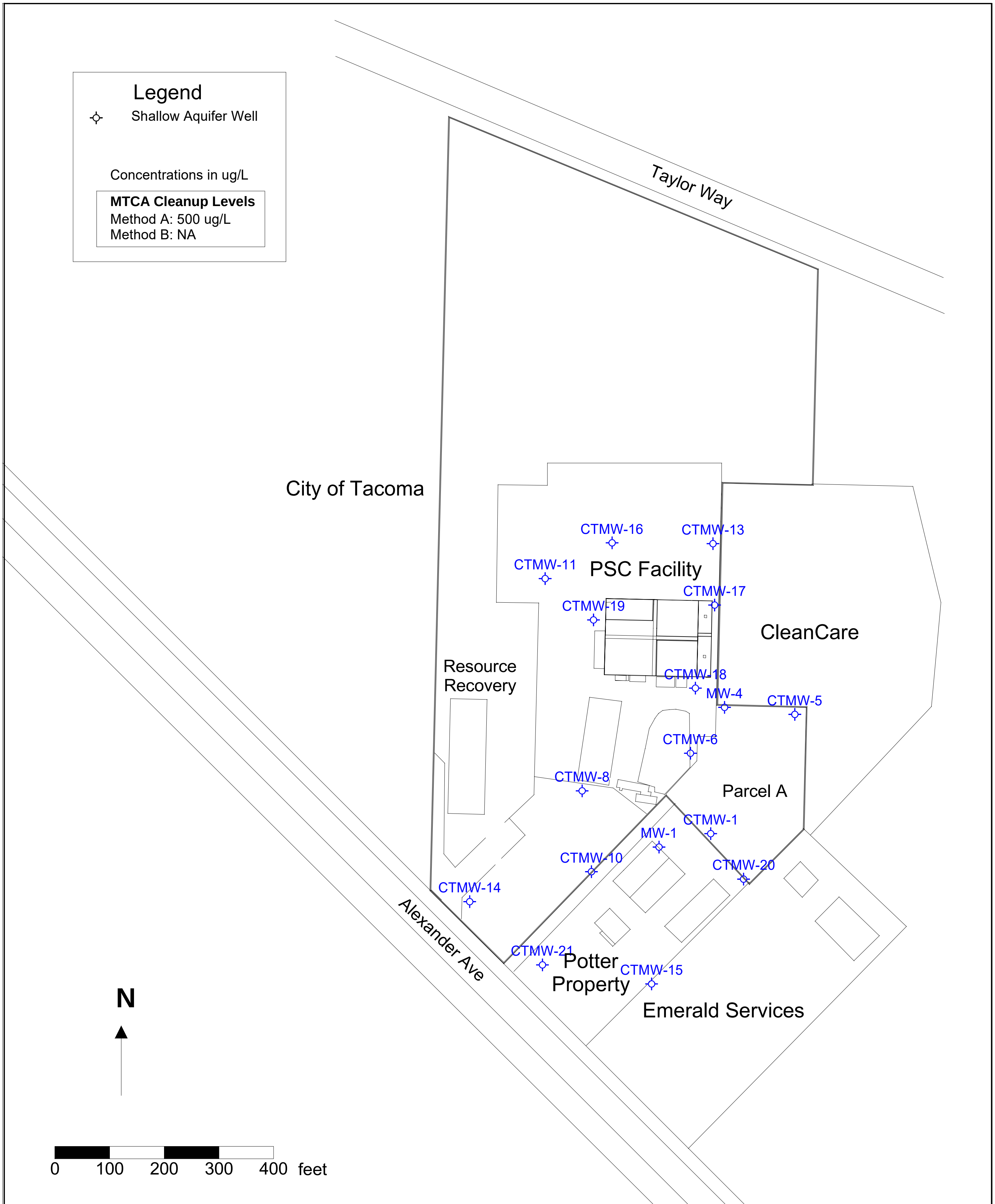
Diesel Concentrations
4th Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



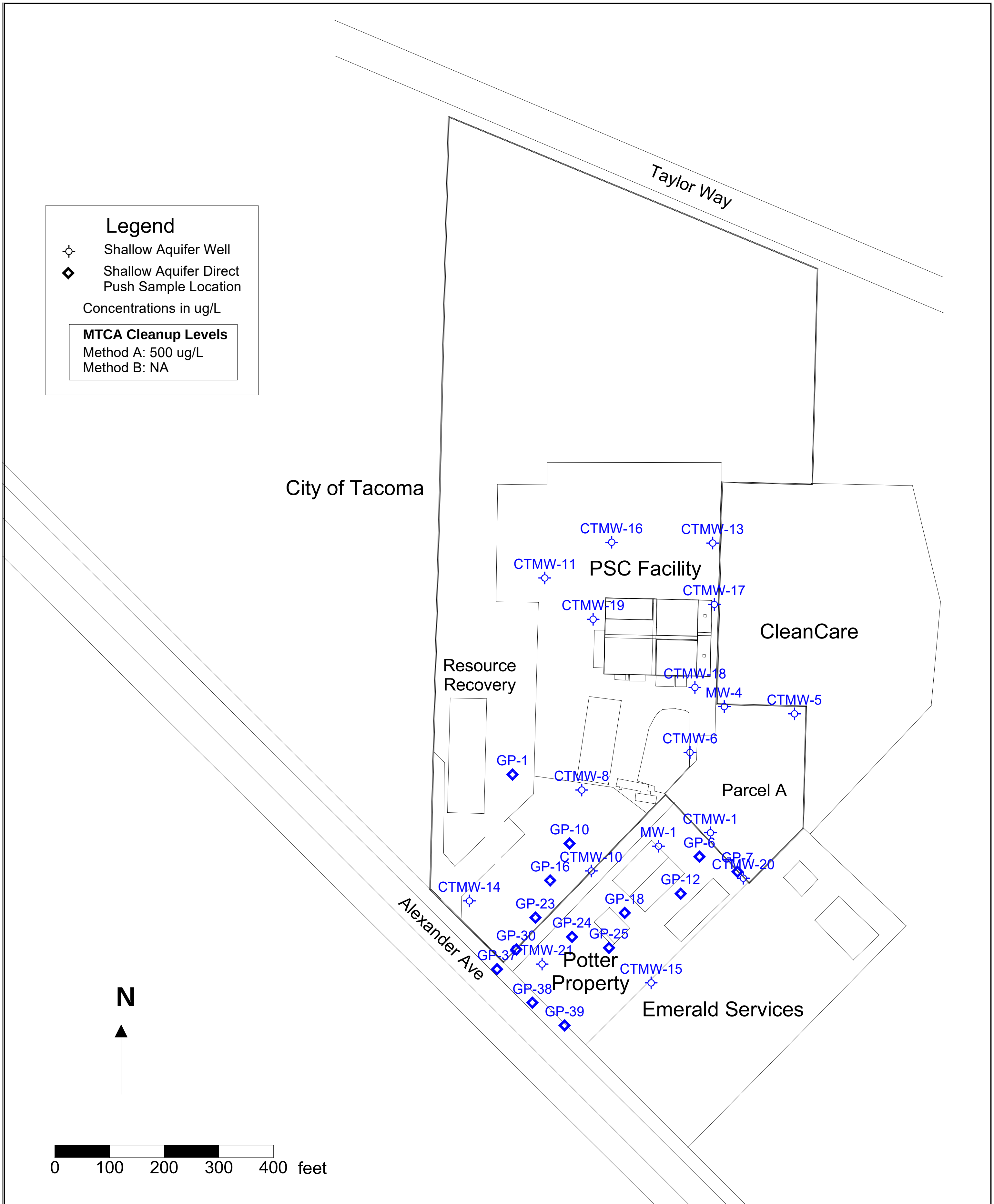
Diesel Concentrations
SRI II 2002
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



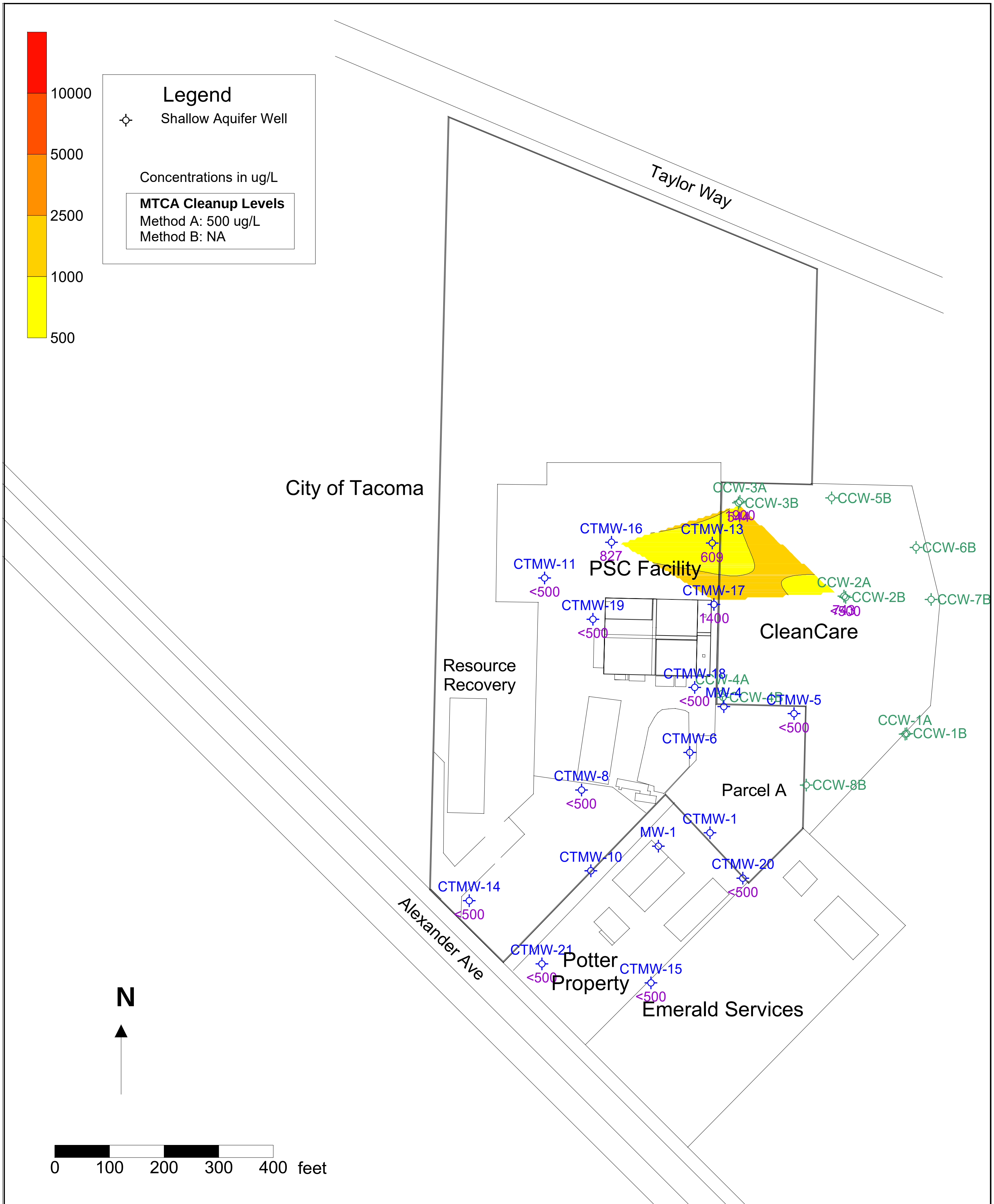
Lube Oil Concentrations
3rd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



Diesel Concentrations
4th Quarter 1999 and Step-Out Investigation
Shallow Aquifer
Tacoma Facility

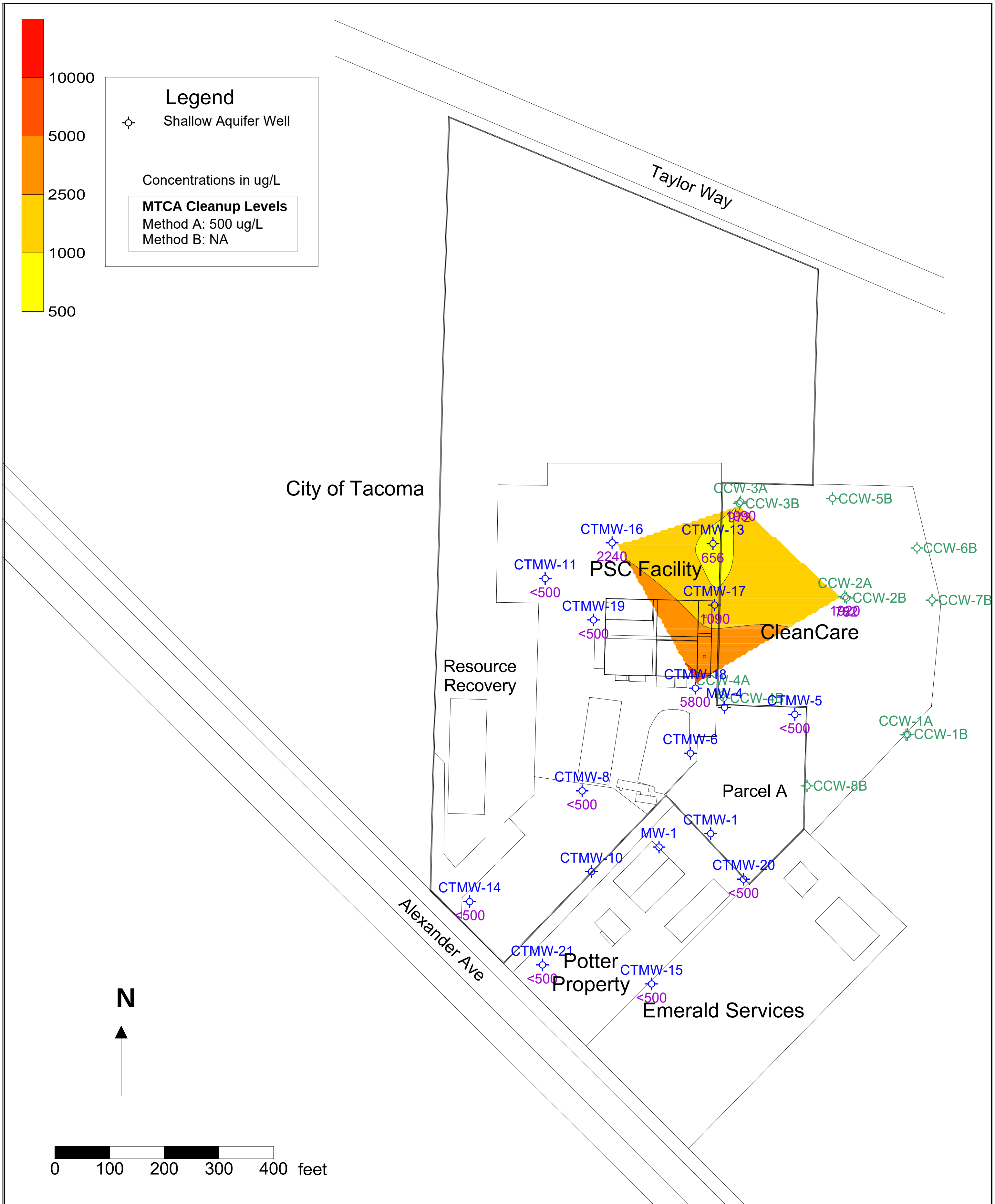
DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



PSC

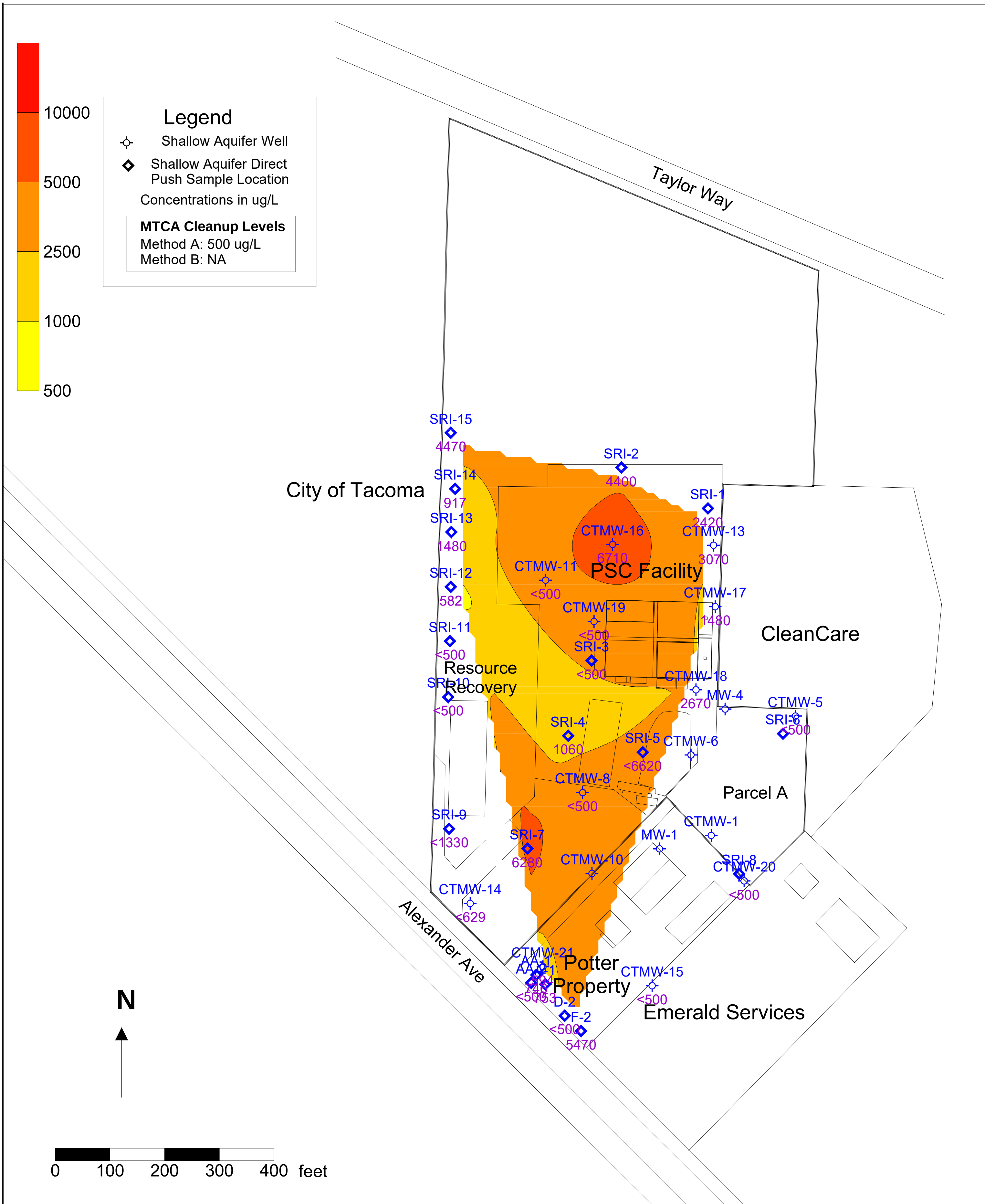
Lube Oil Concentrations
2nd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



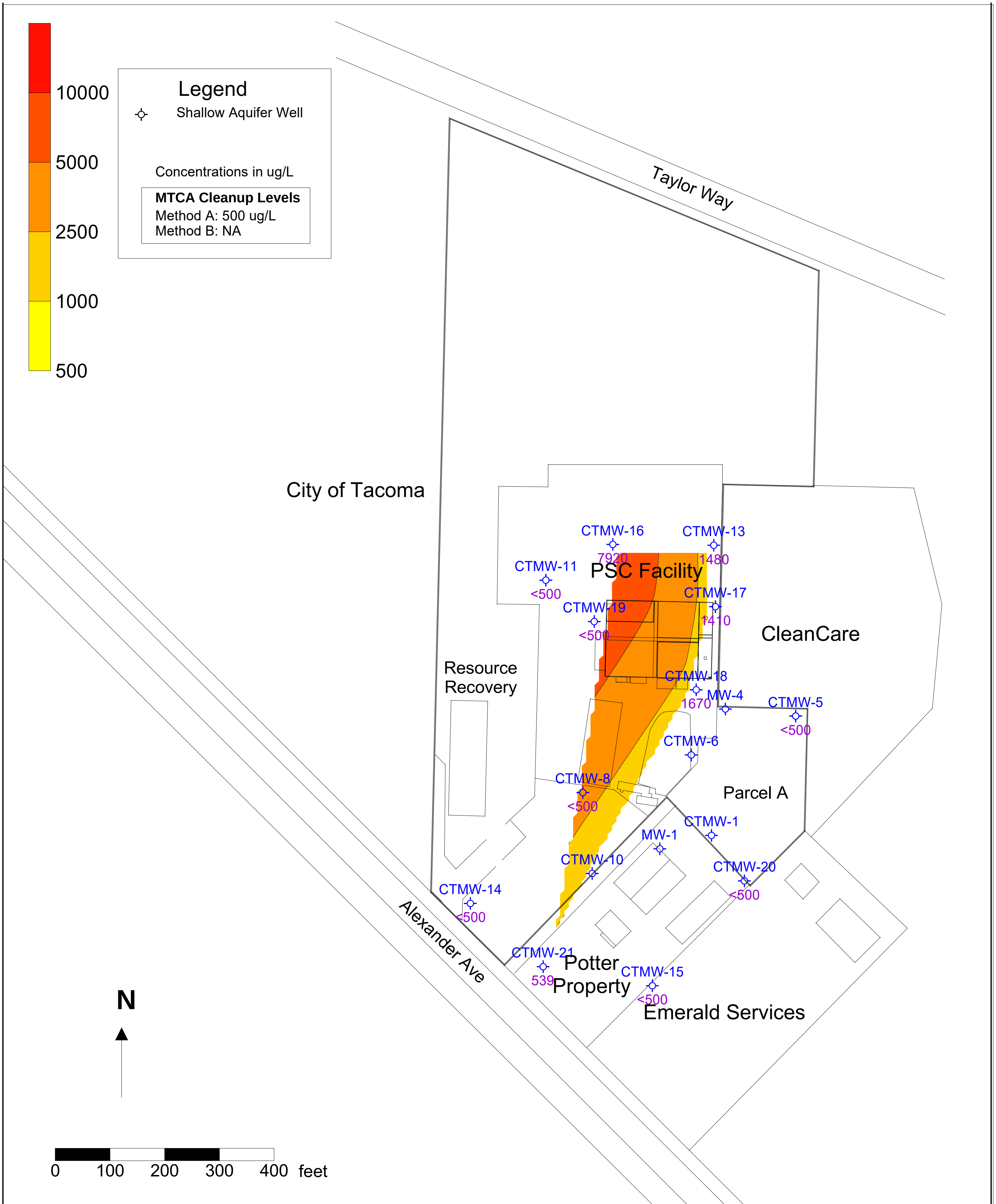
Lube Oil .Concentrations
4th Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



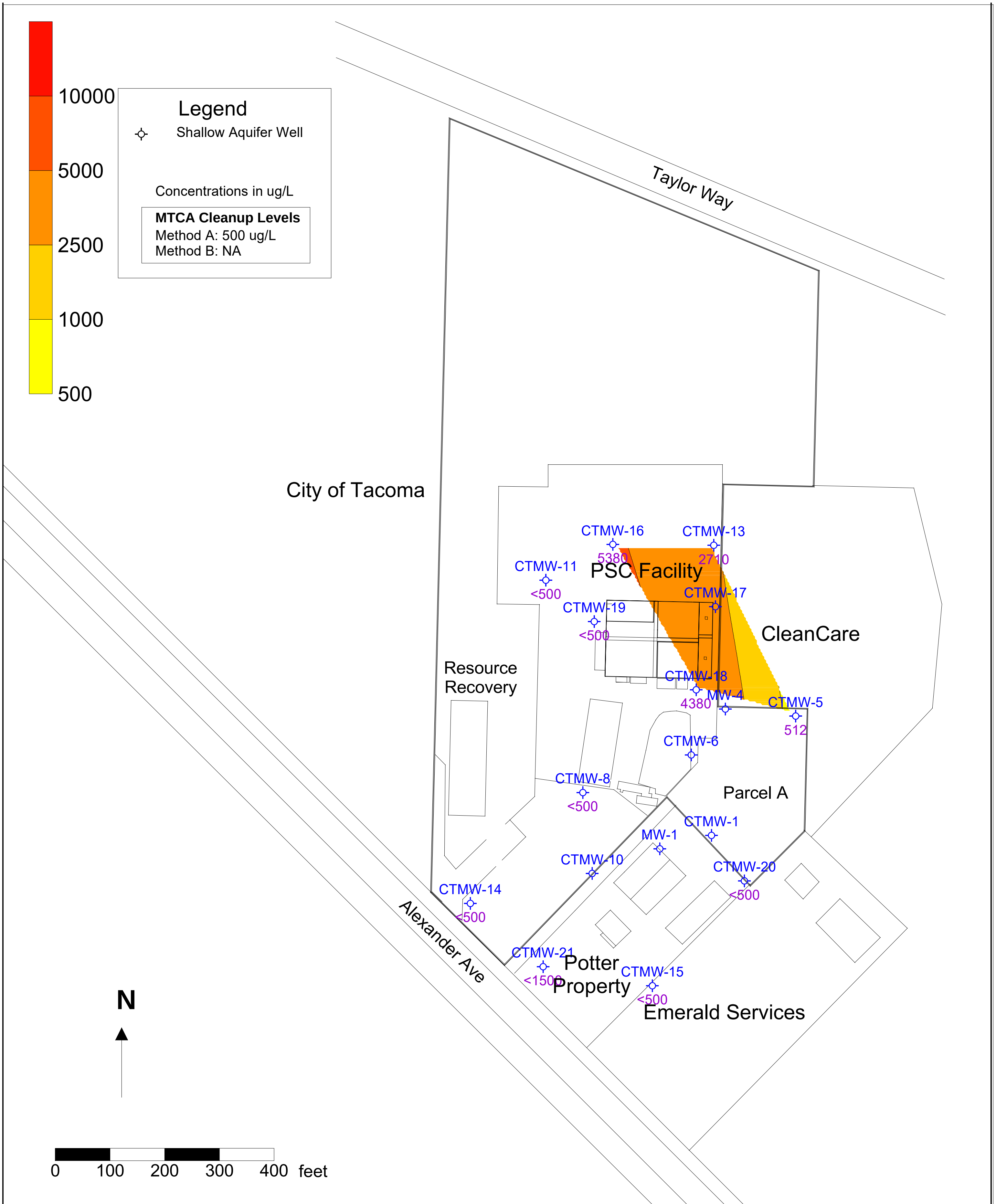
Lube Oil Concentrations
1st Quarter 2001 and SRI
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



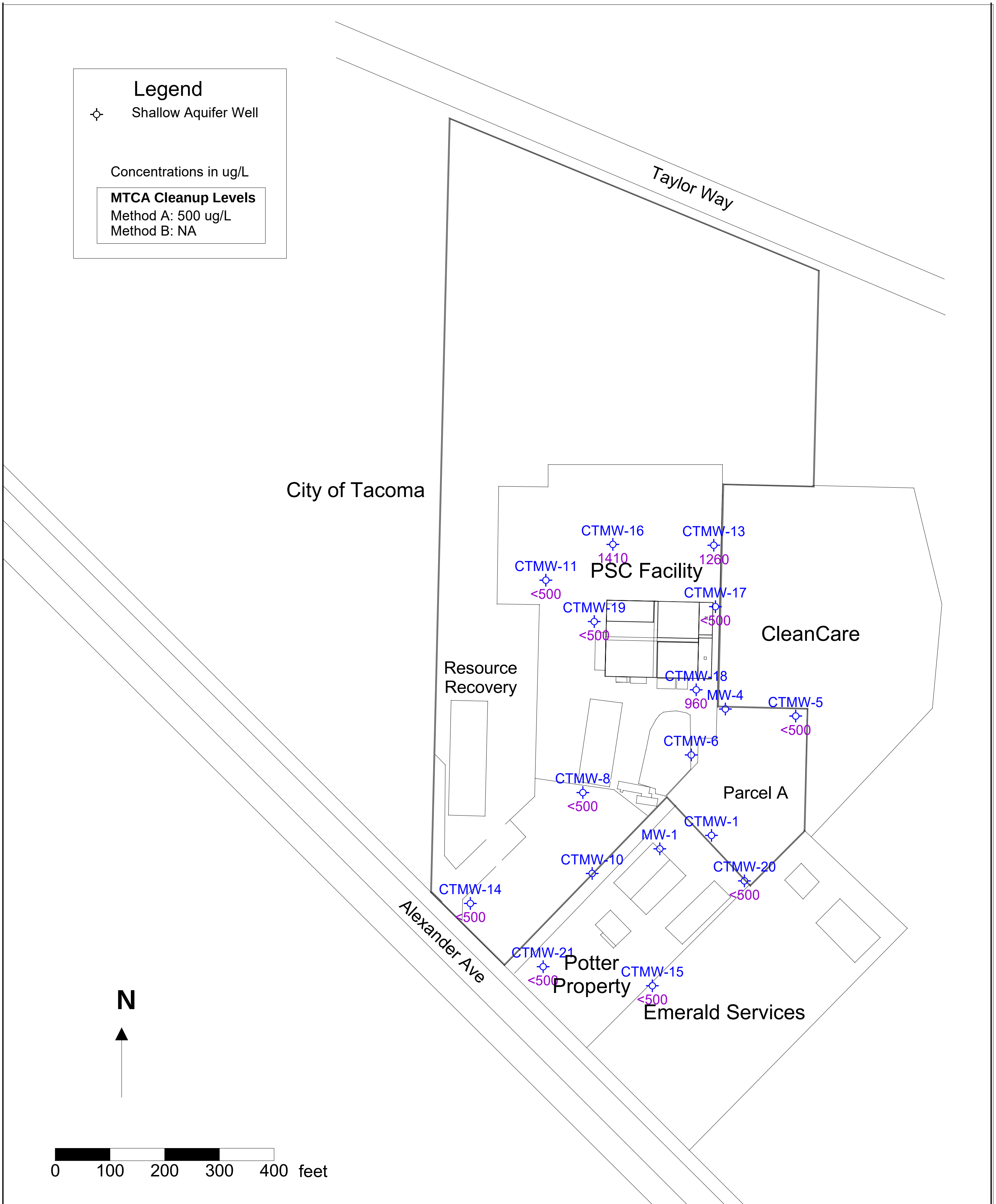
Lube Oil Concentrations
2nd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



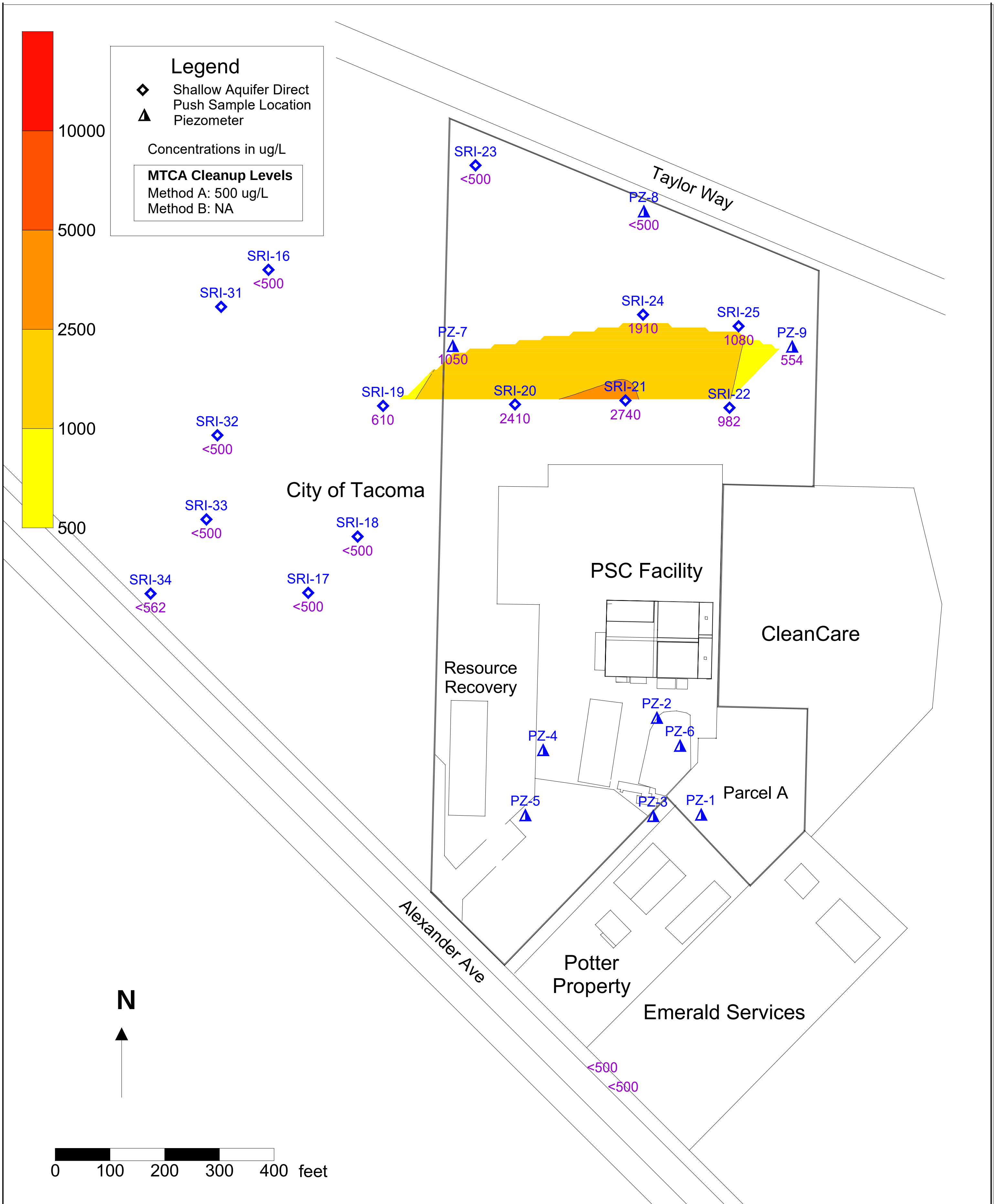
Lube Oil Concentrations
3rd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



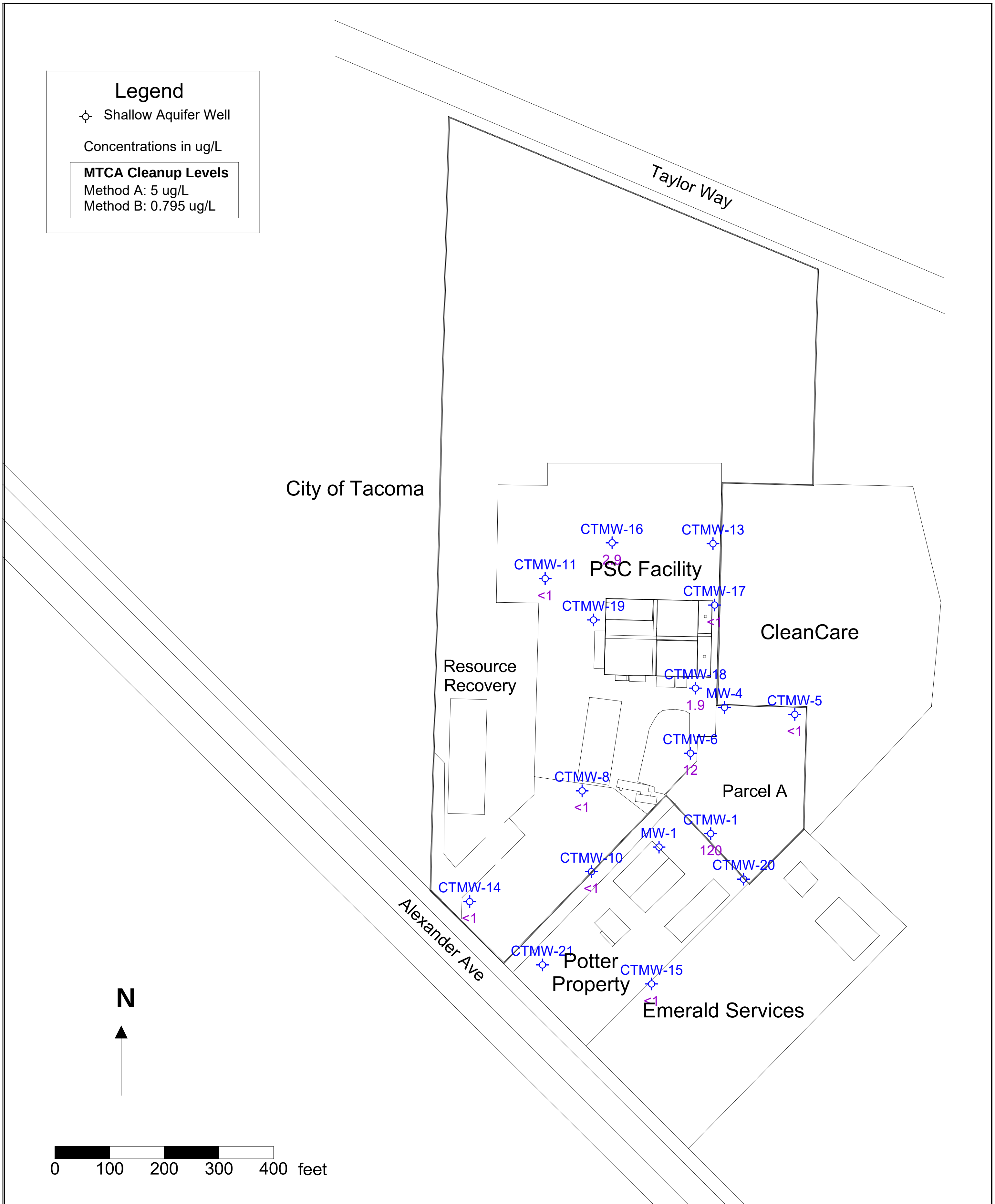
Lube Oil Concentrations
4th Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	

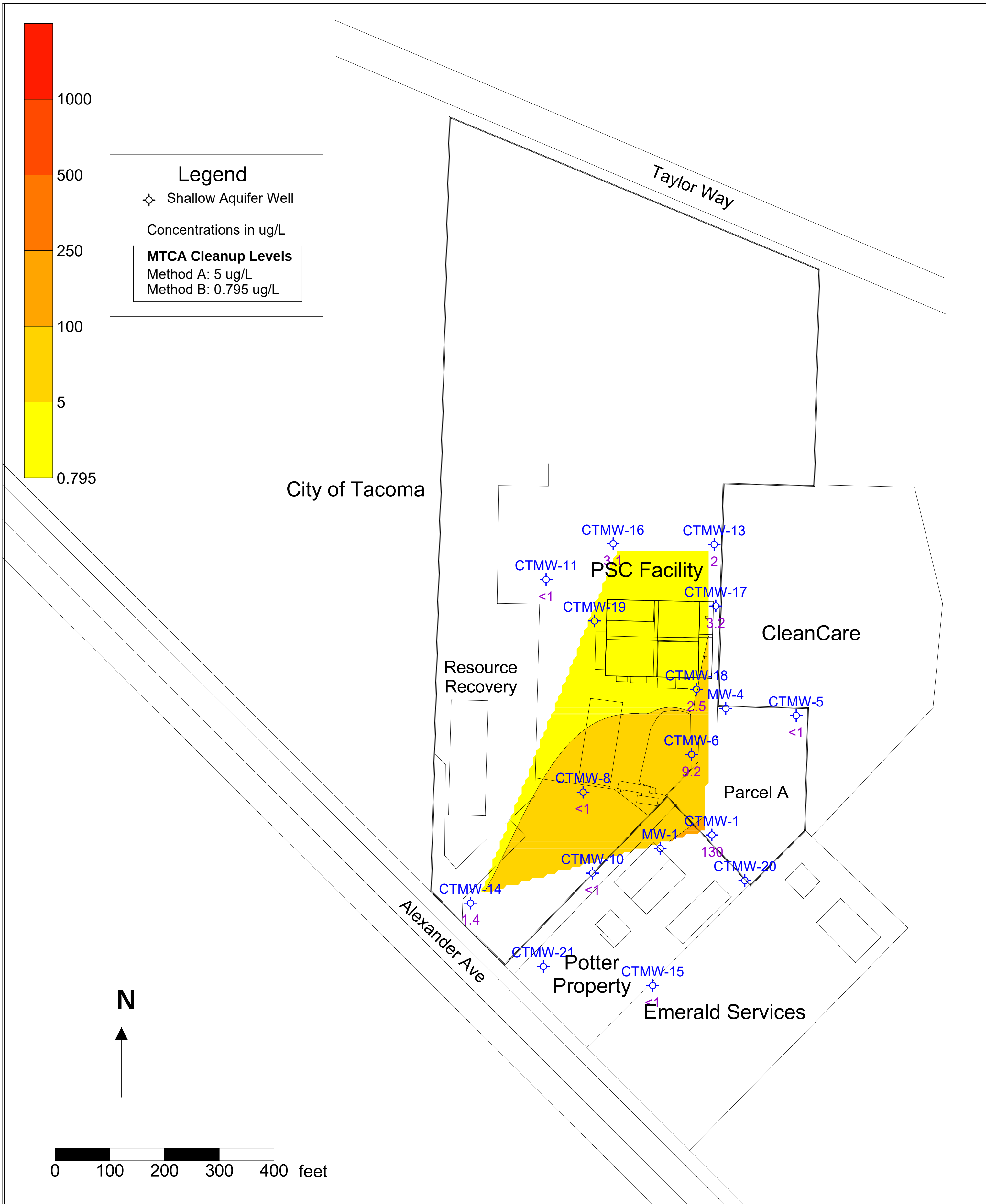


Lube Oil Concentrations
SRI II 2002
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:

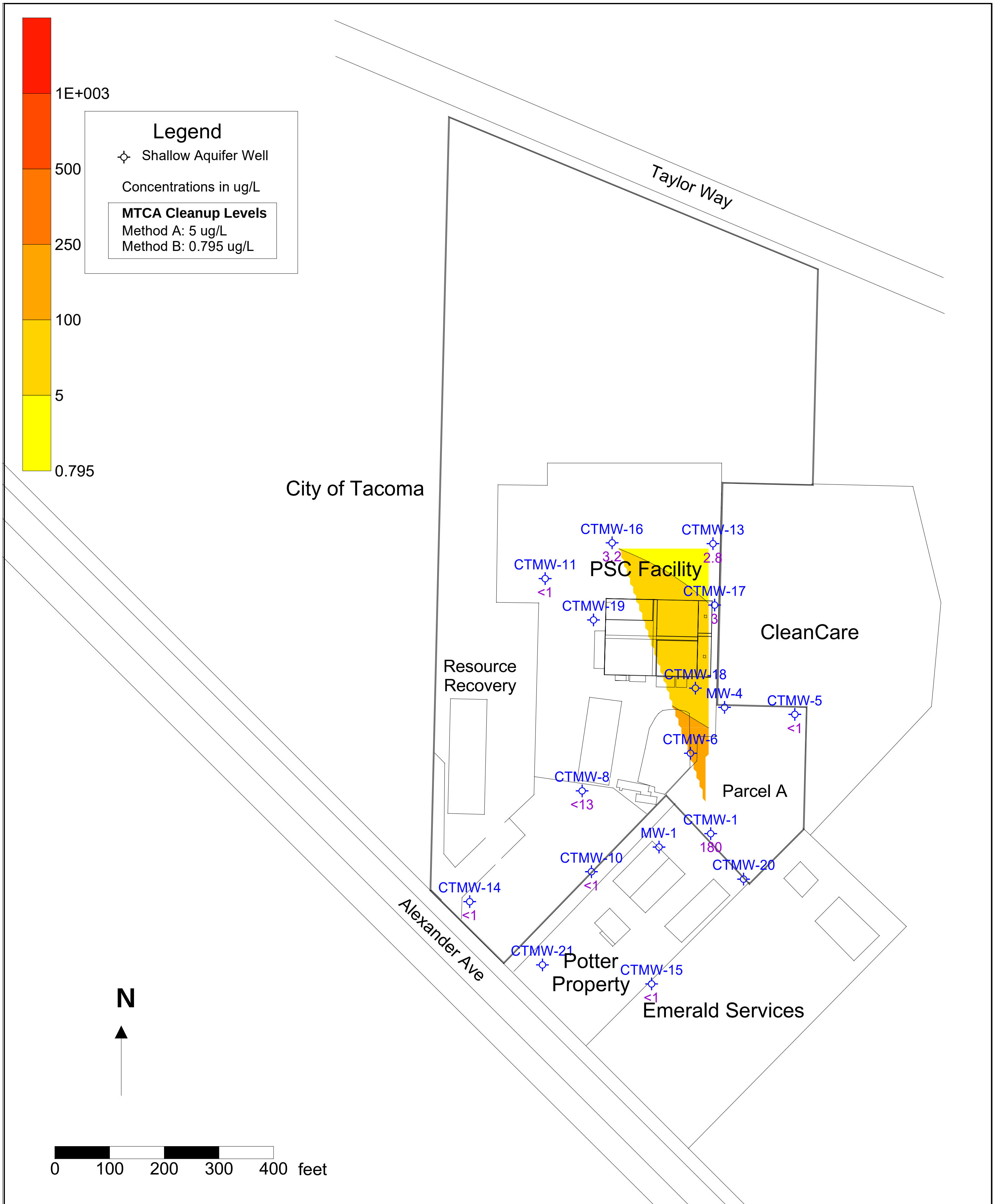


Benzene Concentrations, 1st Quarter 1998 **Shallow Aquifer** **Tacoma Facility**	DWN:	DES:	PROJECT No:
	CHKD:	APPD:	FIGURE No:
	DATE:	REV:	



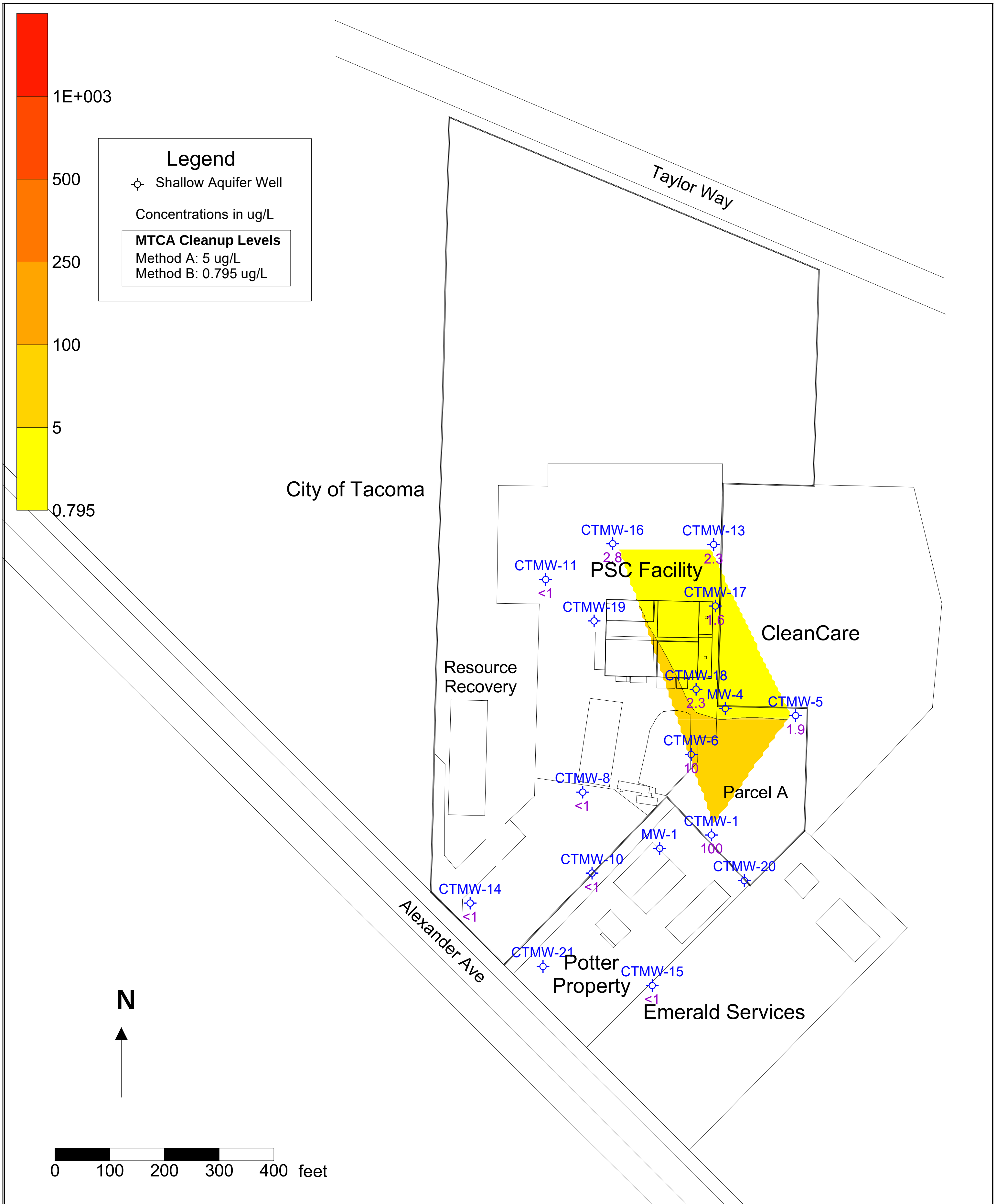
Benzene Concentrations
2nd Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



BenzeneConcentrations
3rd Quarter 1998
Shallow Aquifer
Tacoma Facility

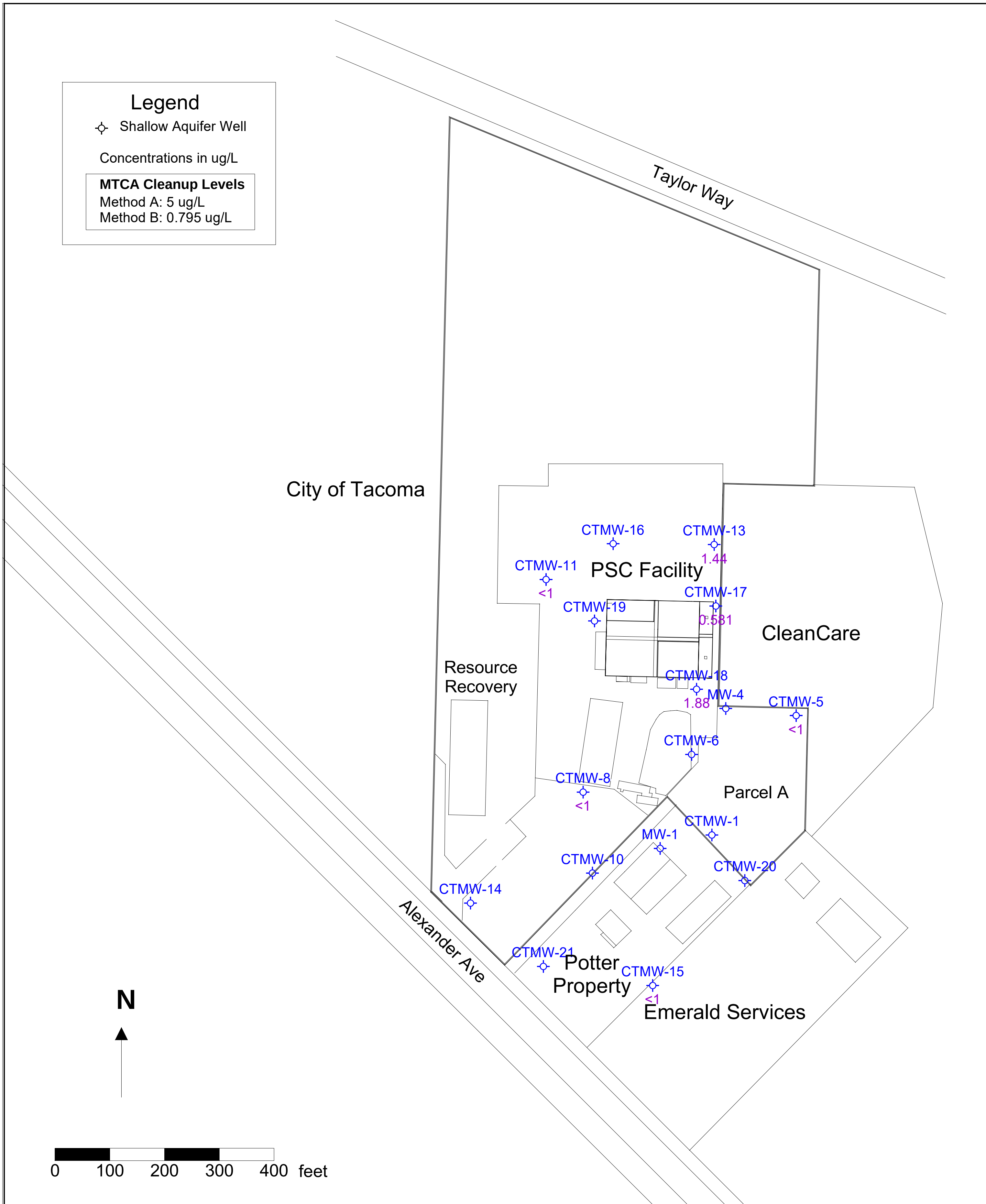
DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



PSC

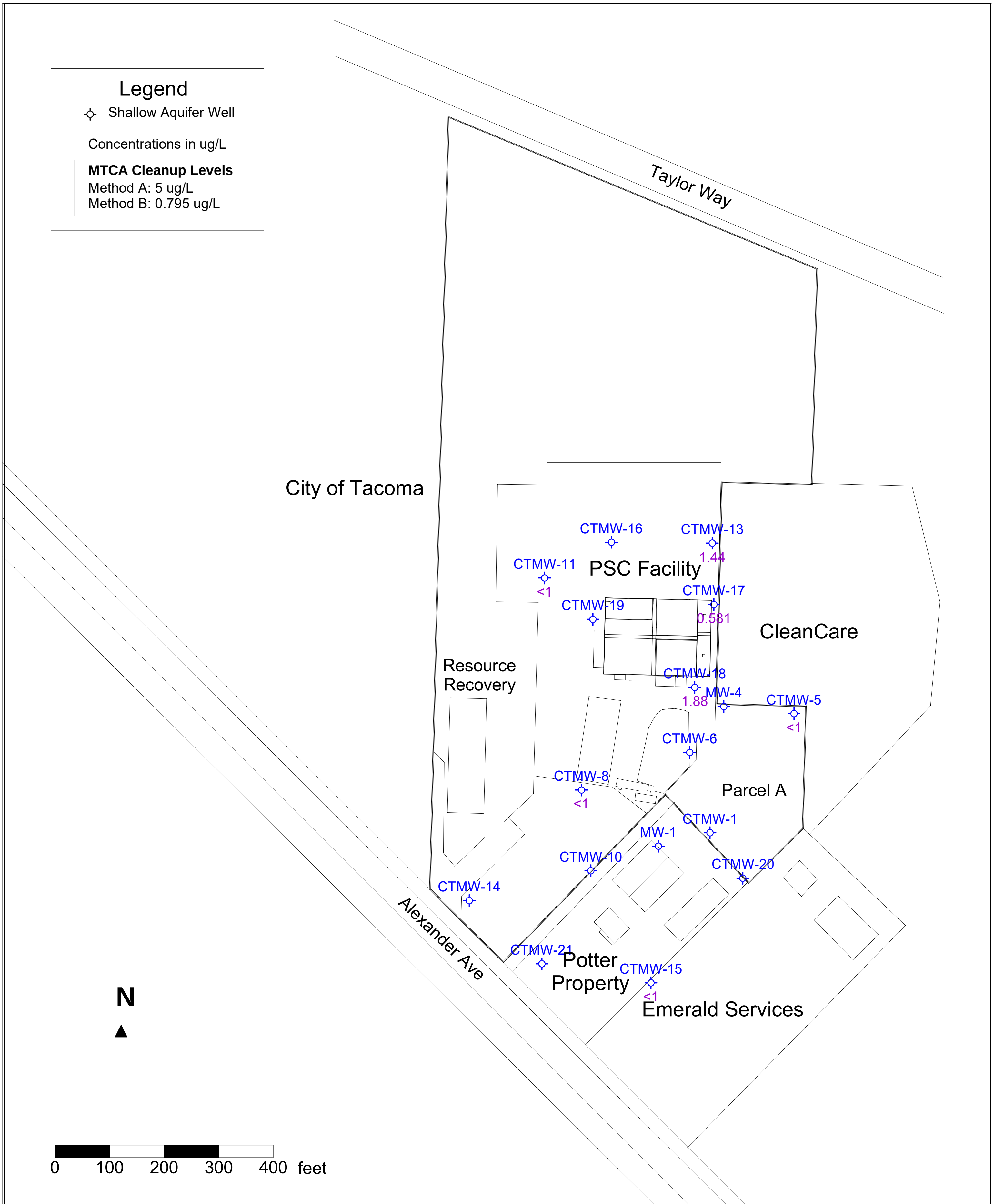
Benzene Concentrations
4th Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



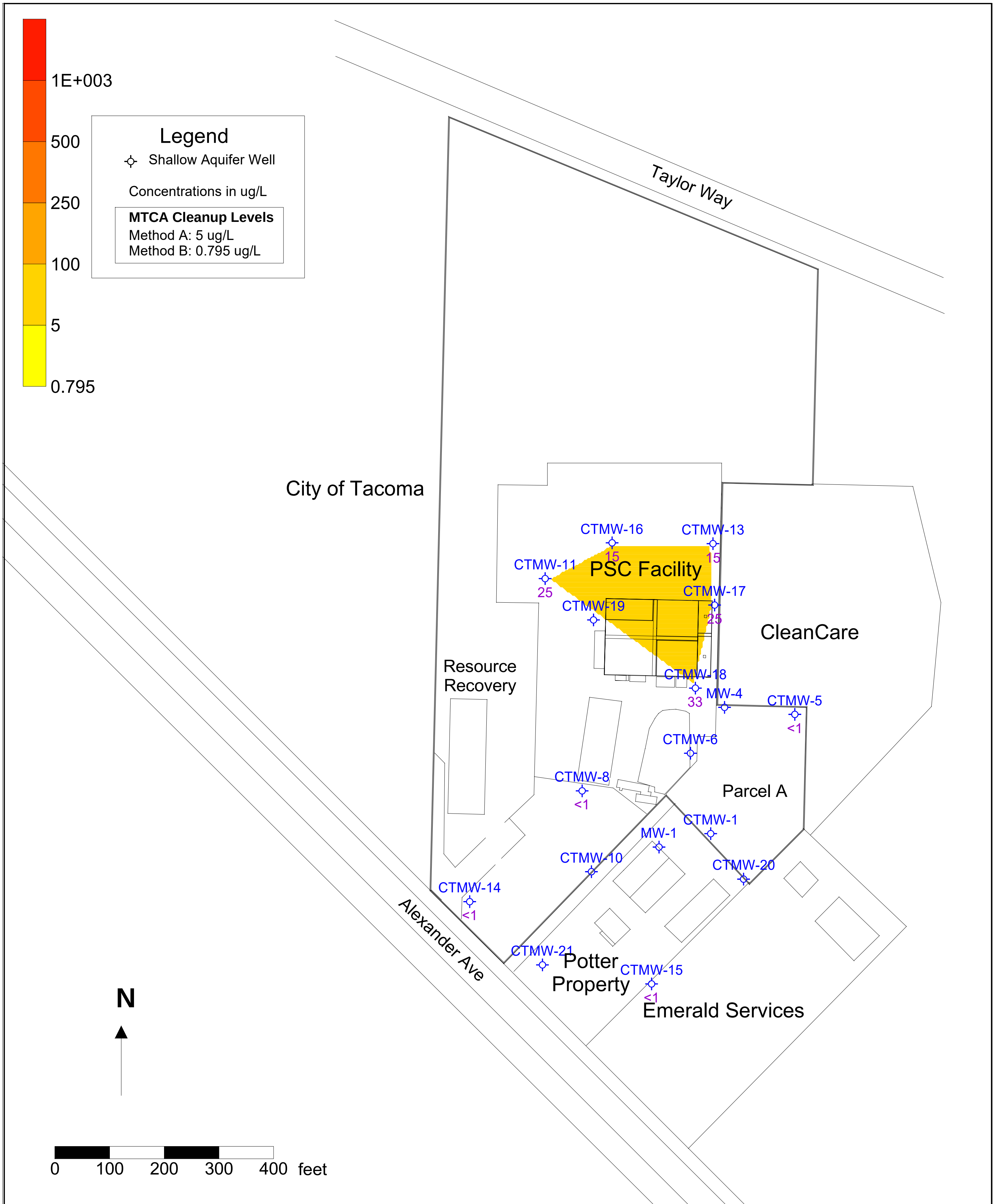
Benzene Concentrations
1st Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



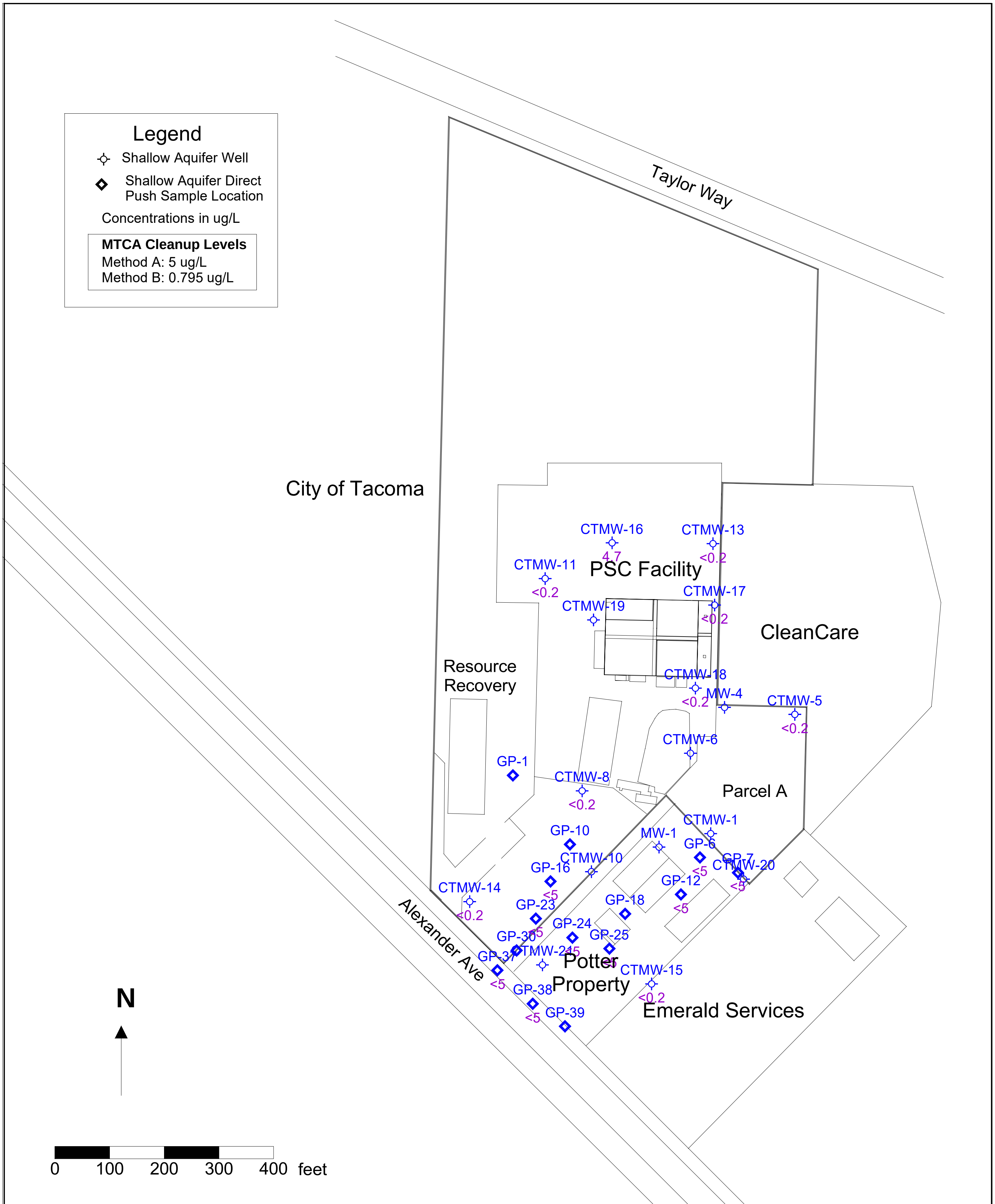
Benzene Concentrations
2nd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



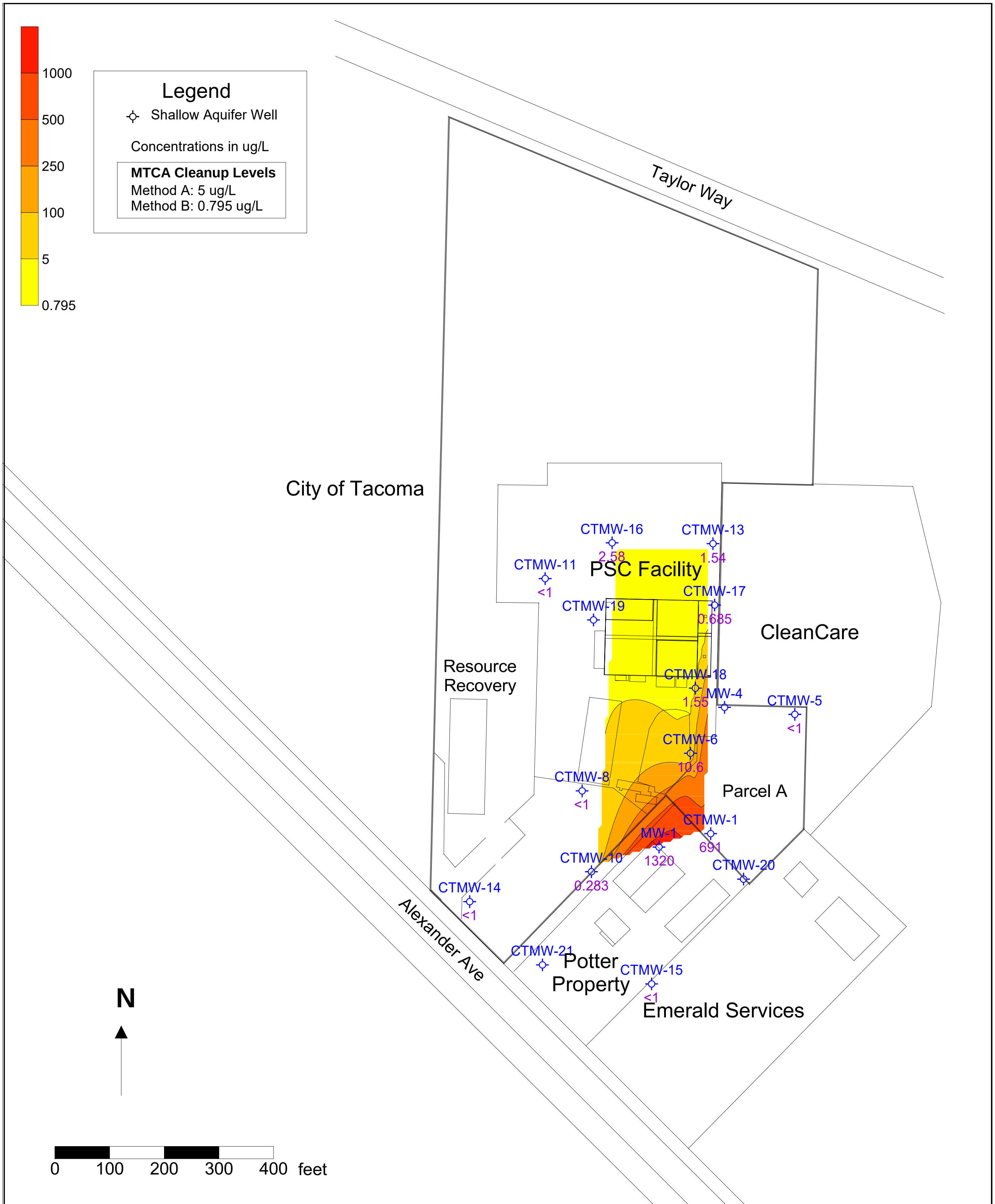
Benzene Concentrations
3rd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



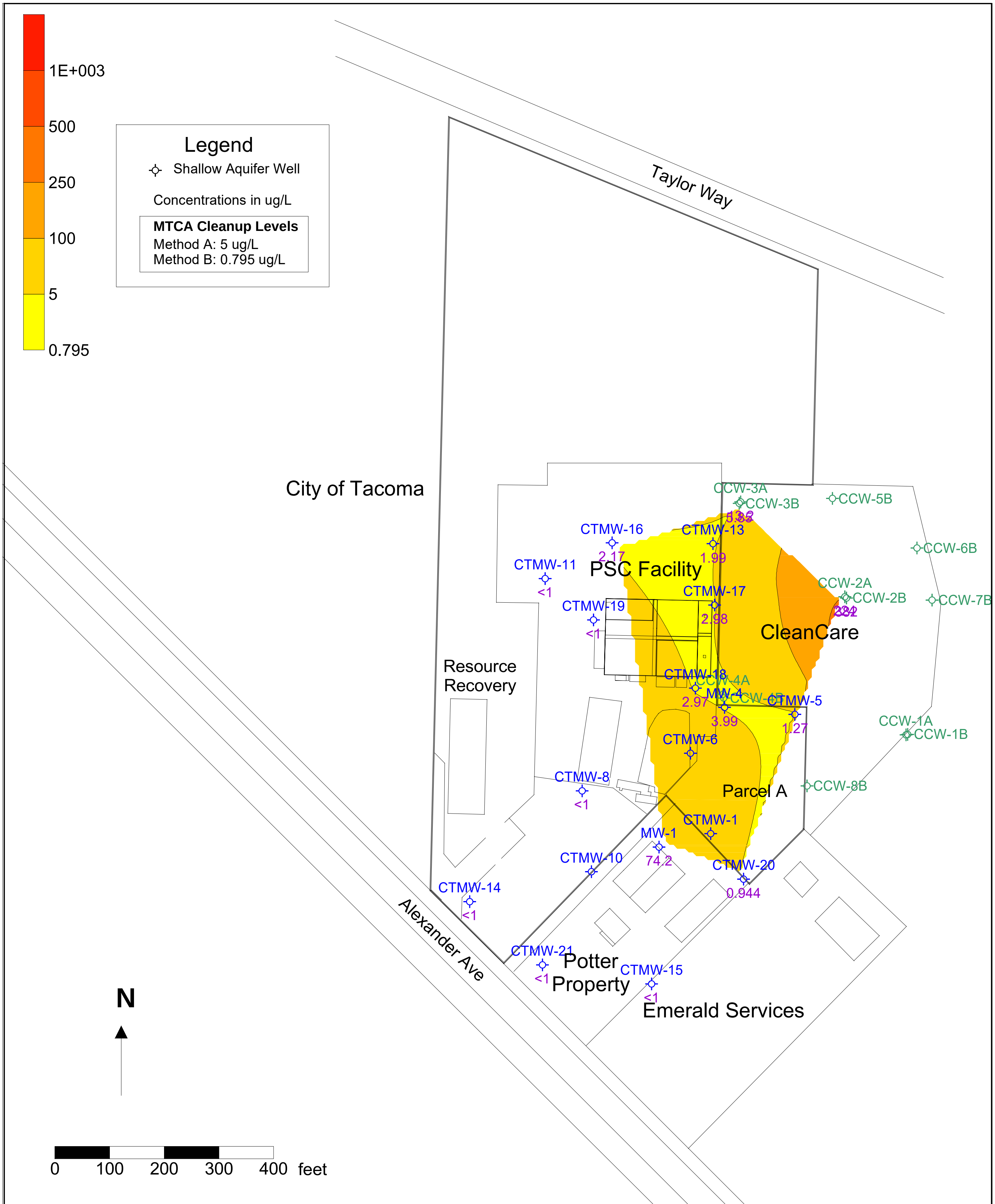
Benzene Concentrations
4th Quarter 1999 and Step-Out Investigation
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



Benene Concentrations
1st Quarter 2000
Shallow Aquifer
Tacoma Facility

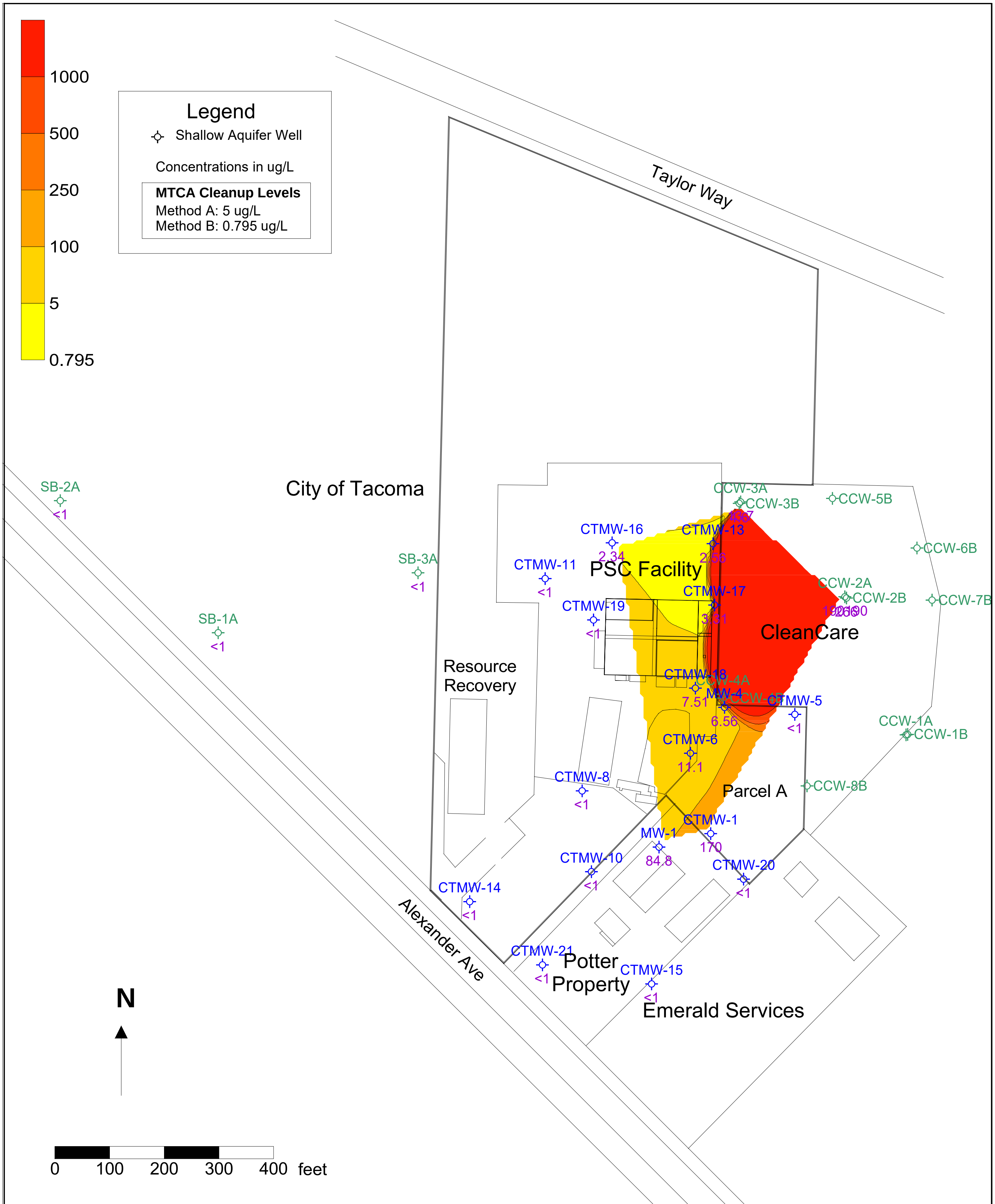
DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



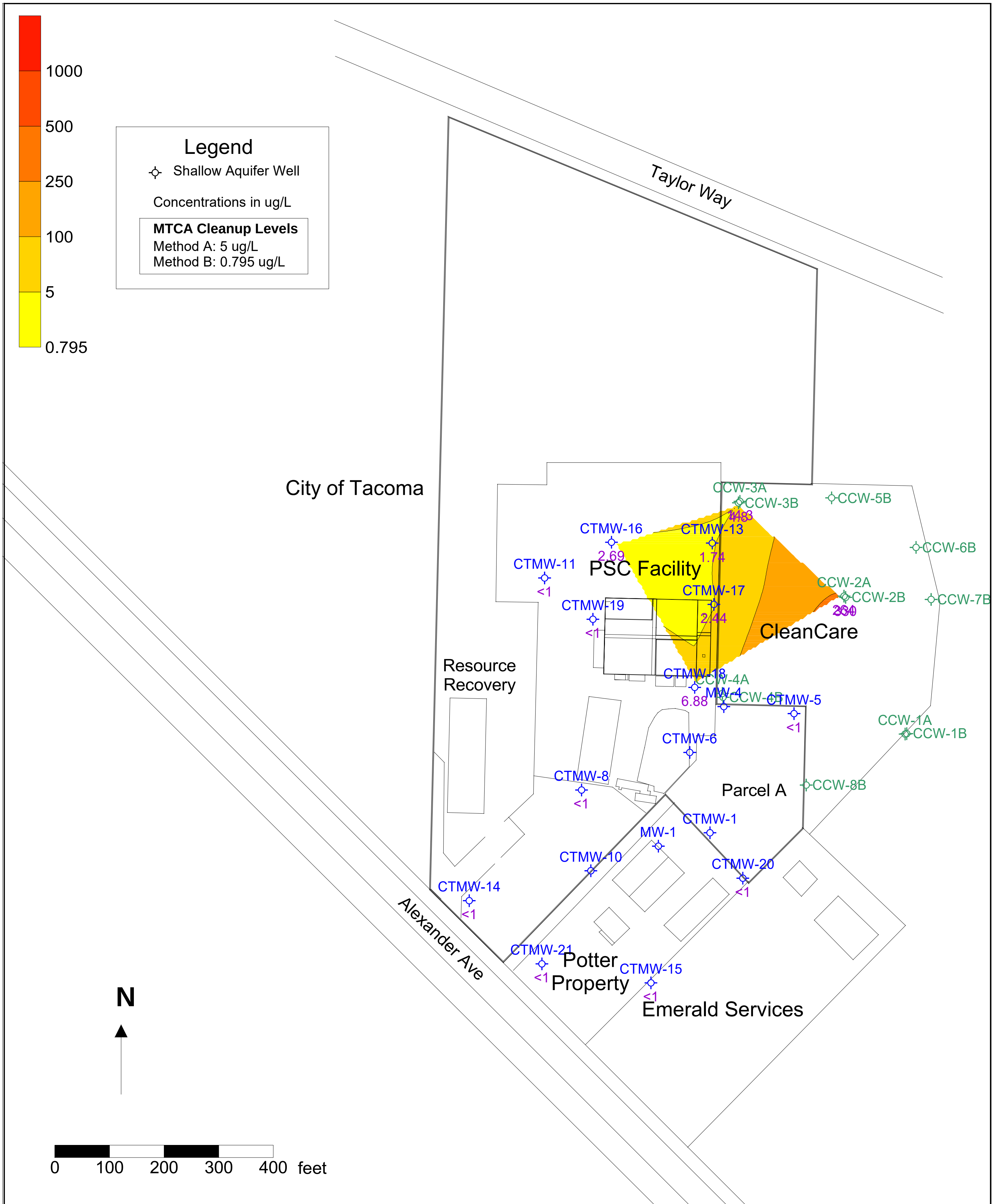
PSC

Benzene Concentrations
2nd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	

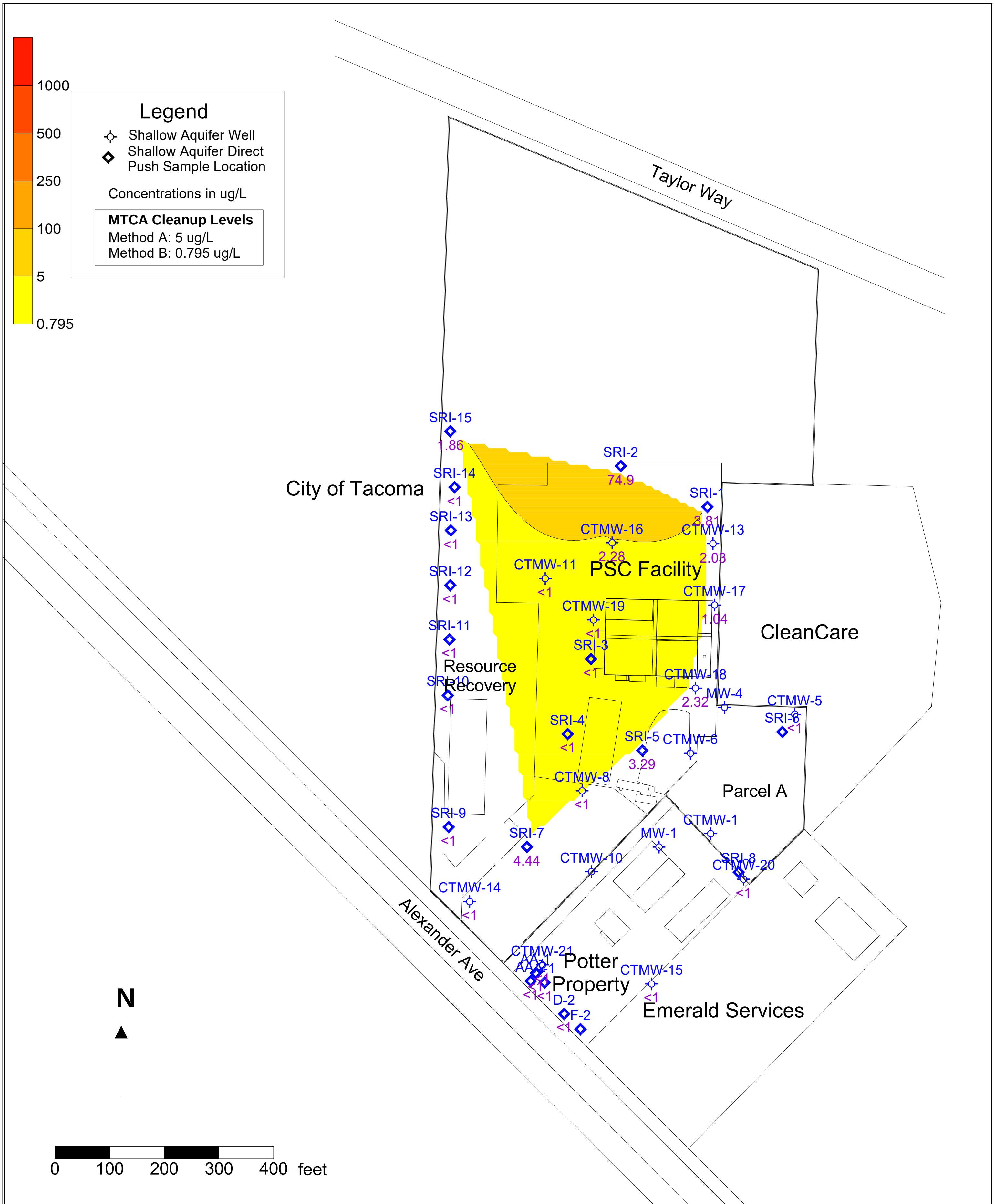


Benzene Concentrations **3rd Quarter 2000** **Shallow Aquifer** **Tacoma Facility**	DWN:	DES:	PROJECT No:
	CHKD:	APPD:	FIGURE No:
	DATE:	REV:	



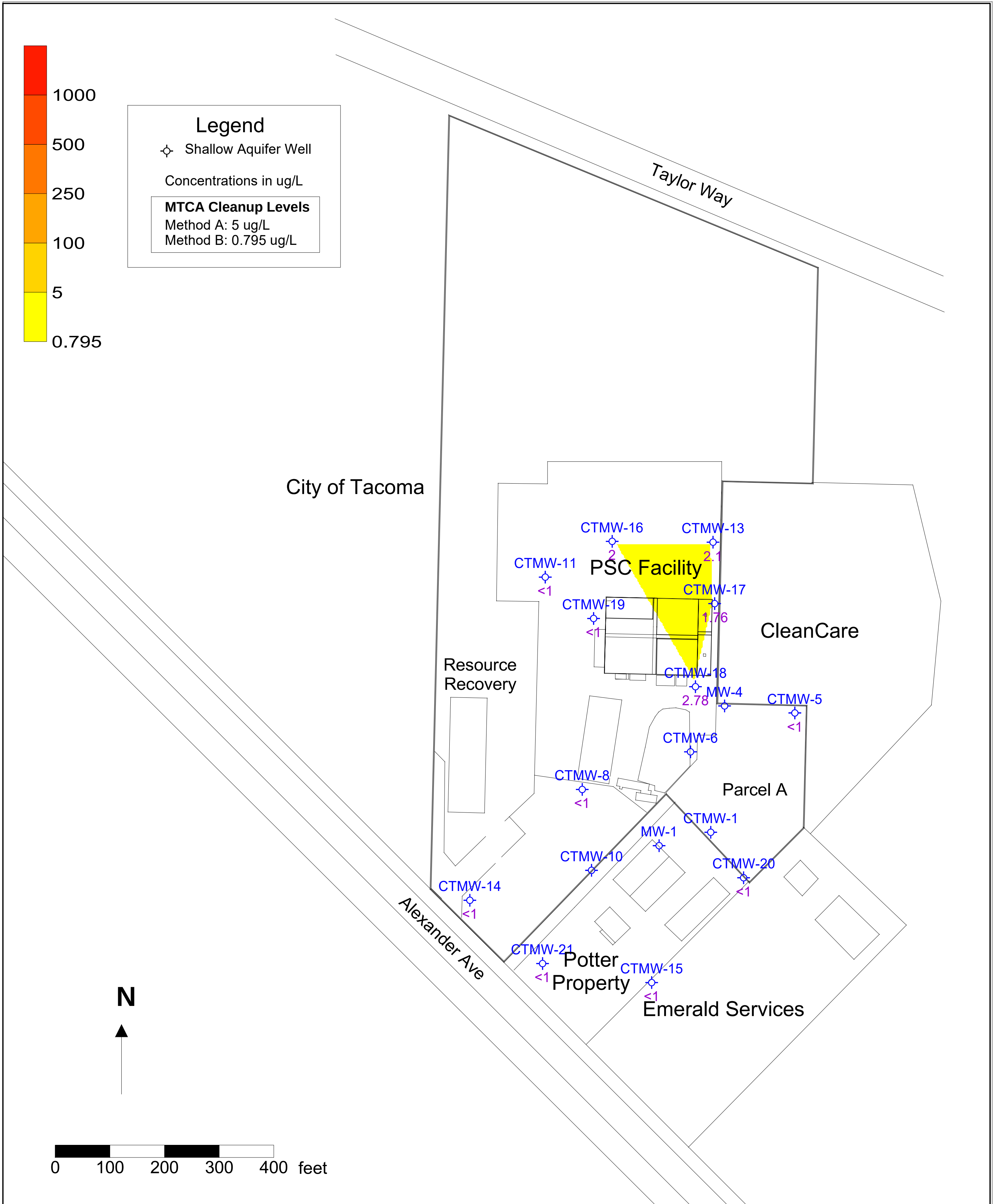
Benzene Concentrations
4th Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



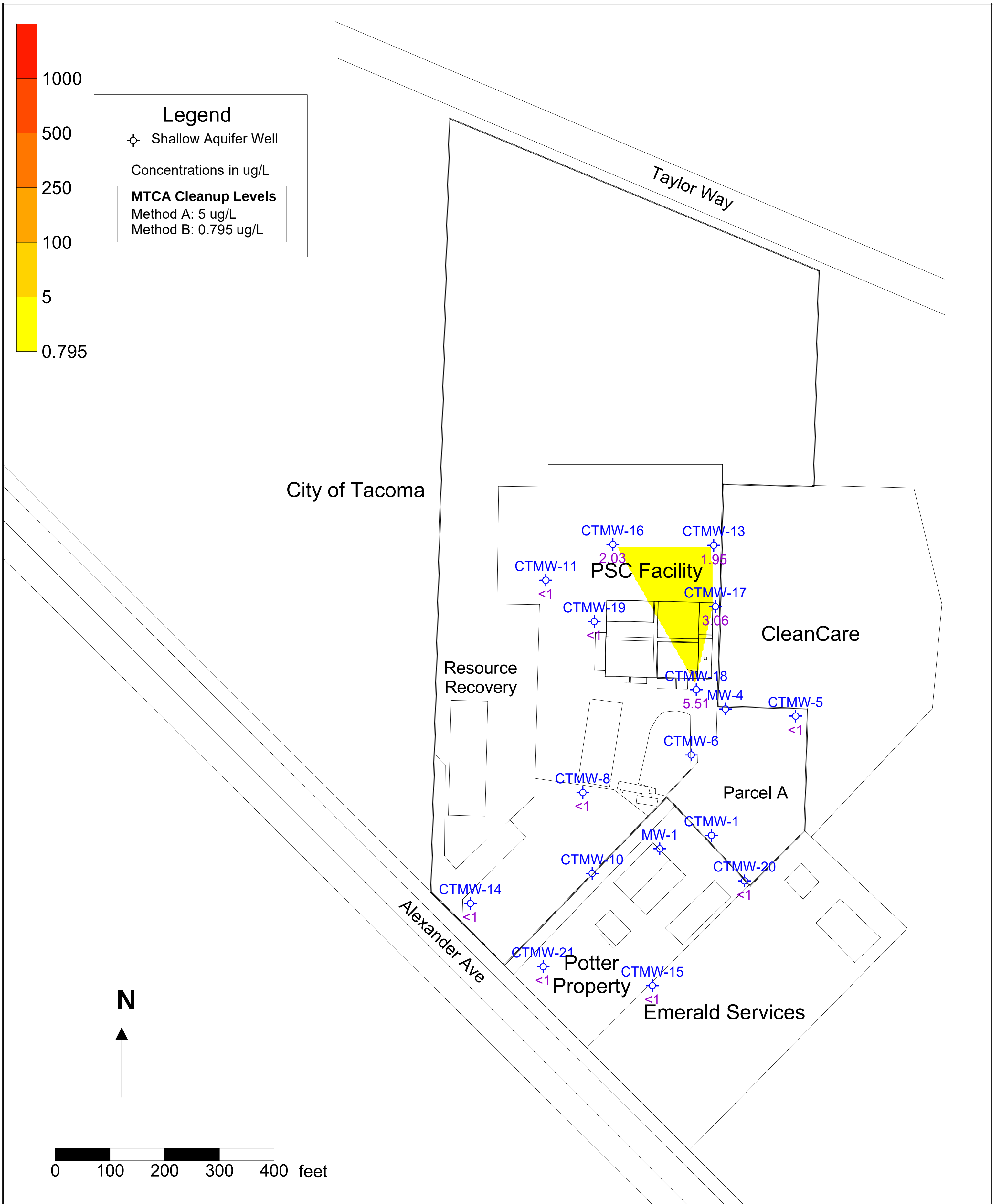
Lead Concentrations
1st Quarter 2001 and SRI
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



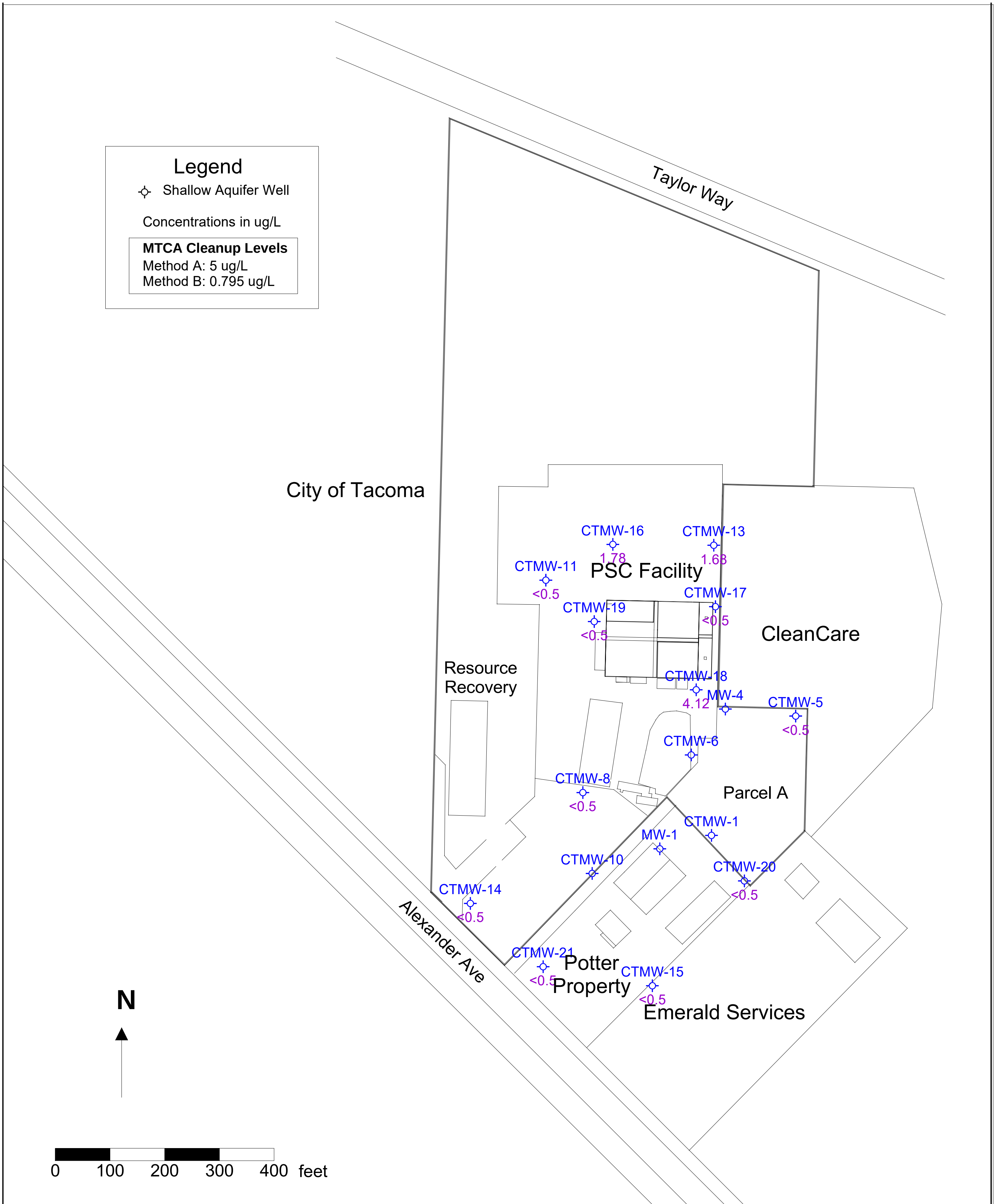
Benzene Concentrations
2nd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



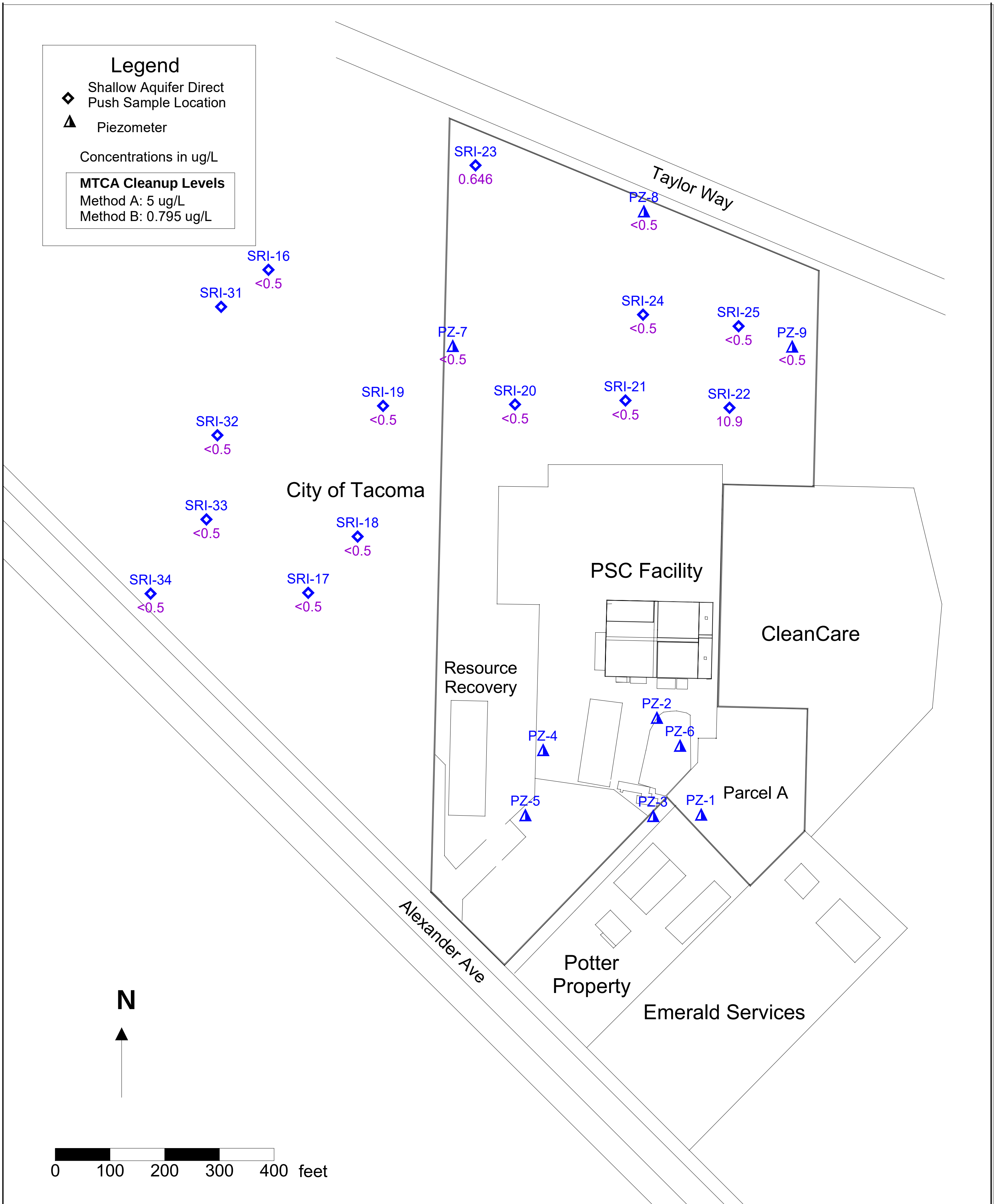
Benzene Concentrations
3rd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



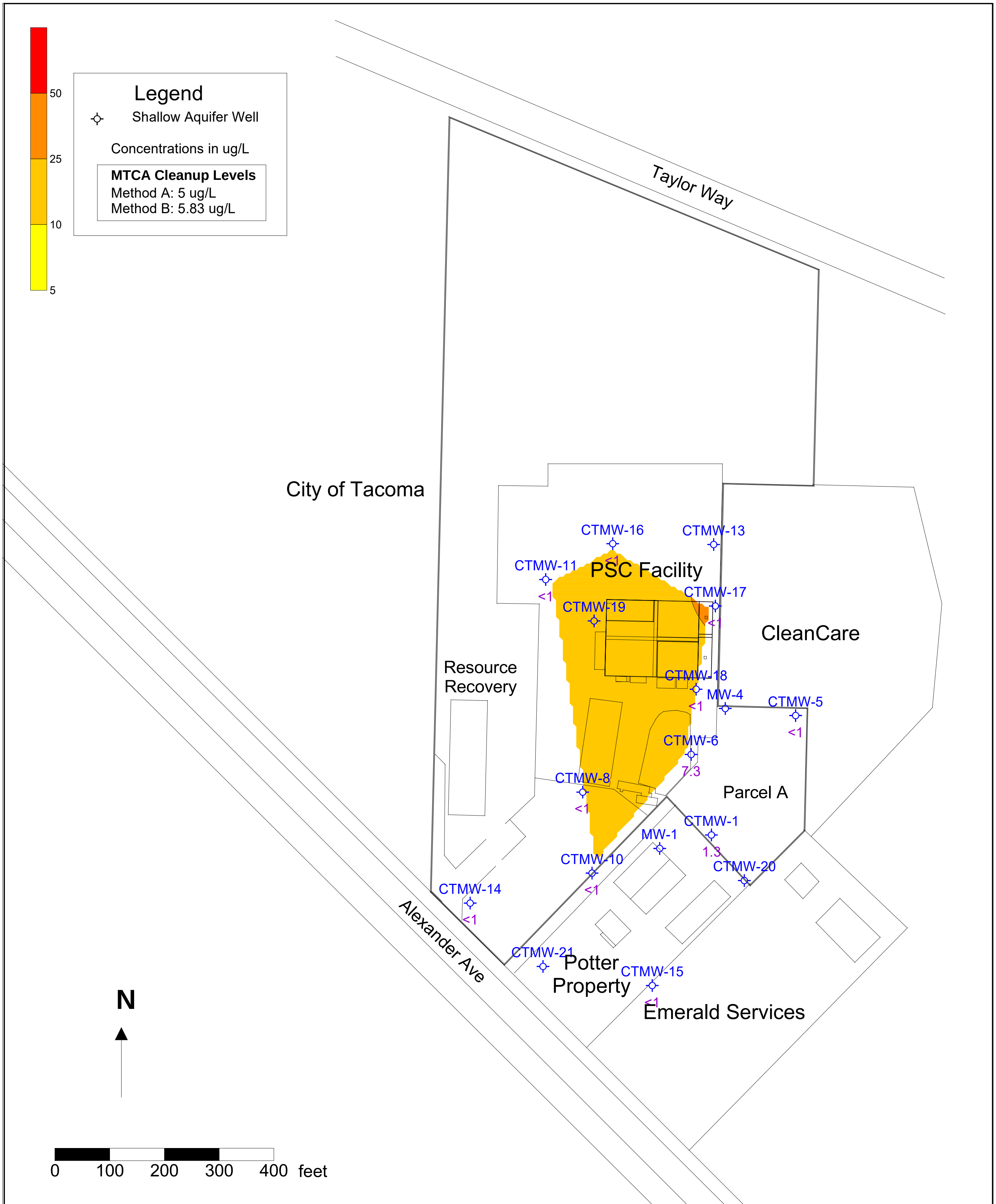
Benzene Concentrations
4th Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



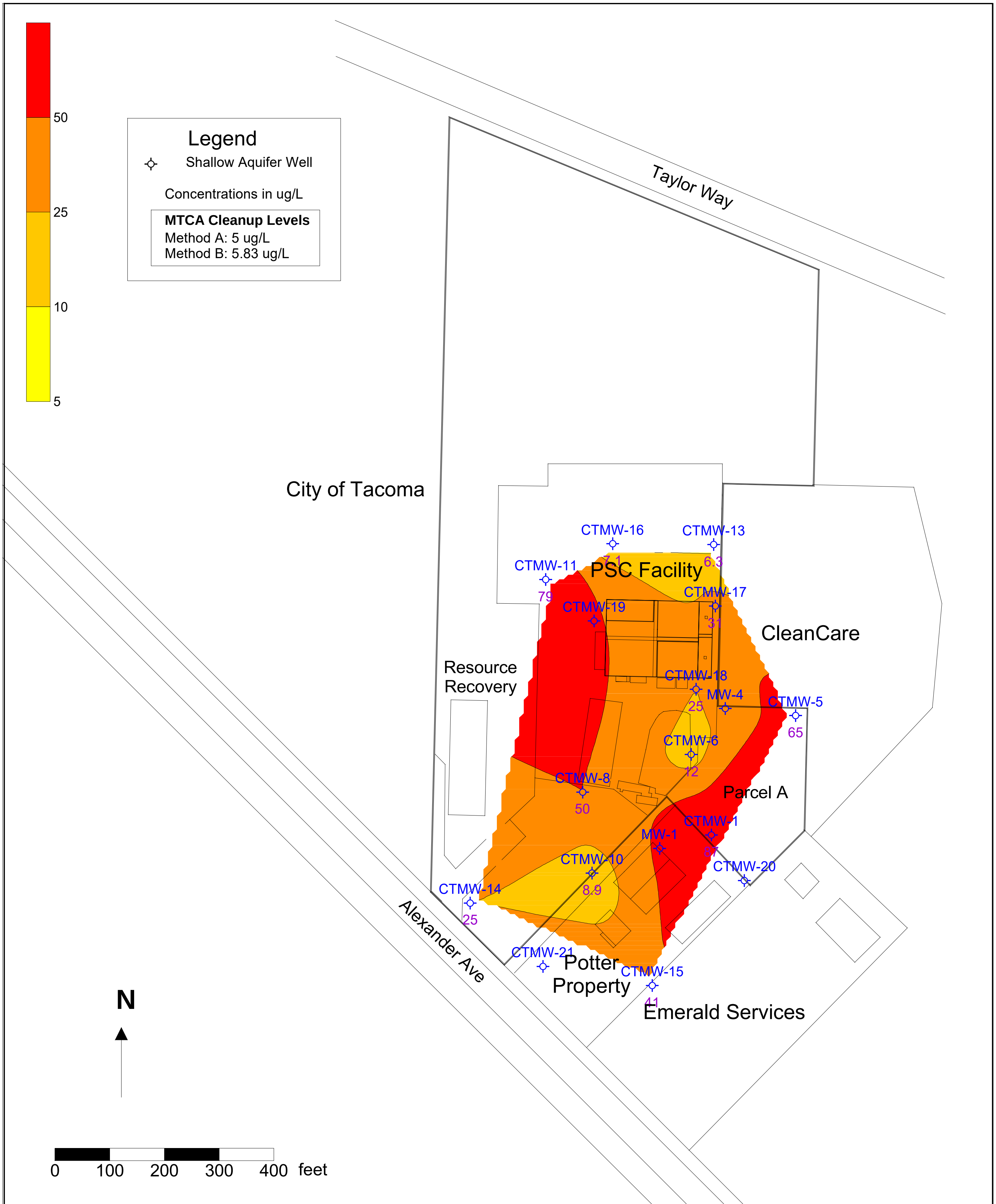
Benzene Concentrations
SRI II 2002
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



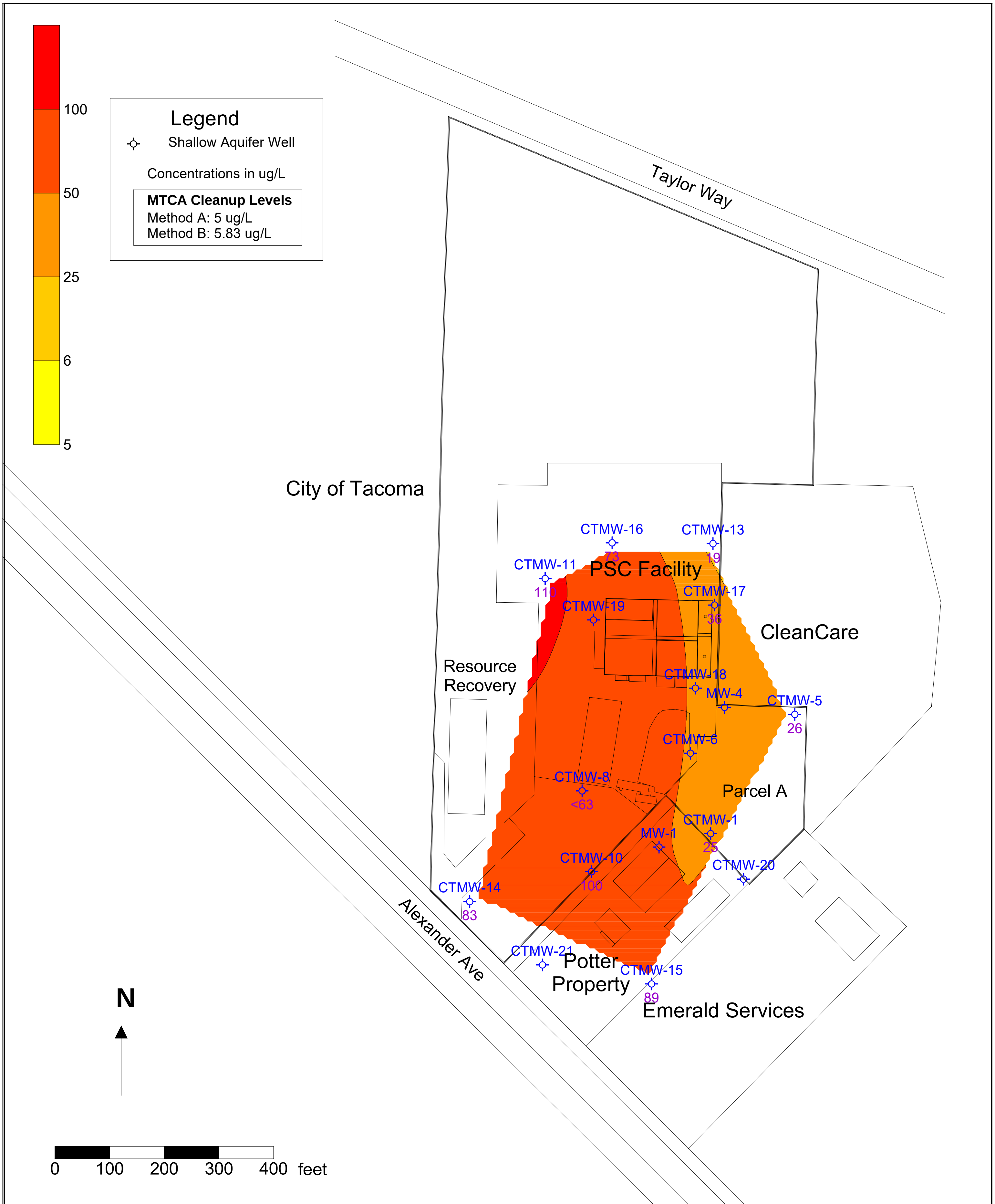
Mehylene Chloride Concentrations
1st Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



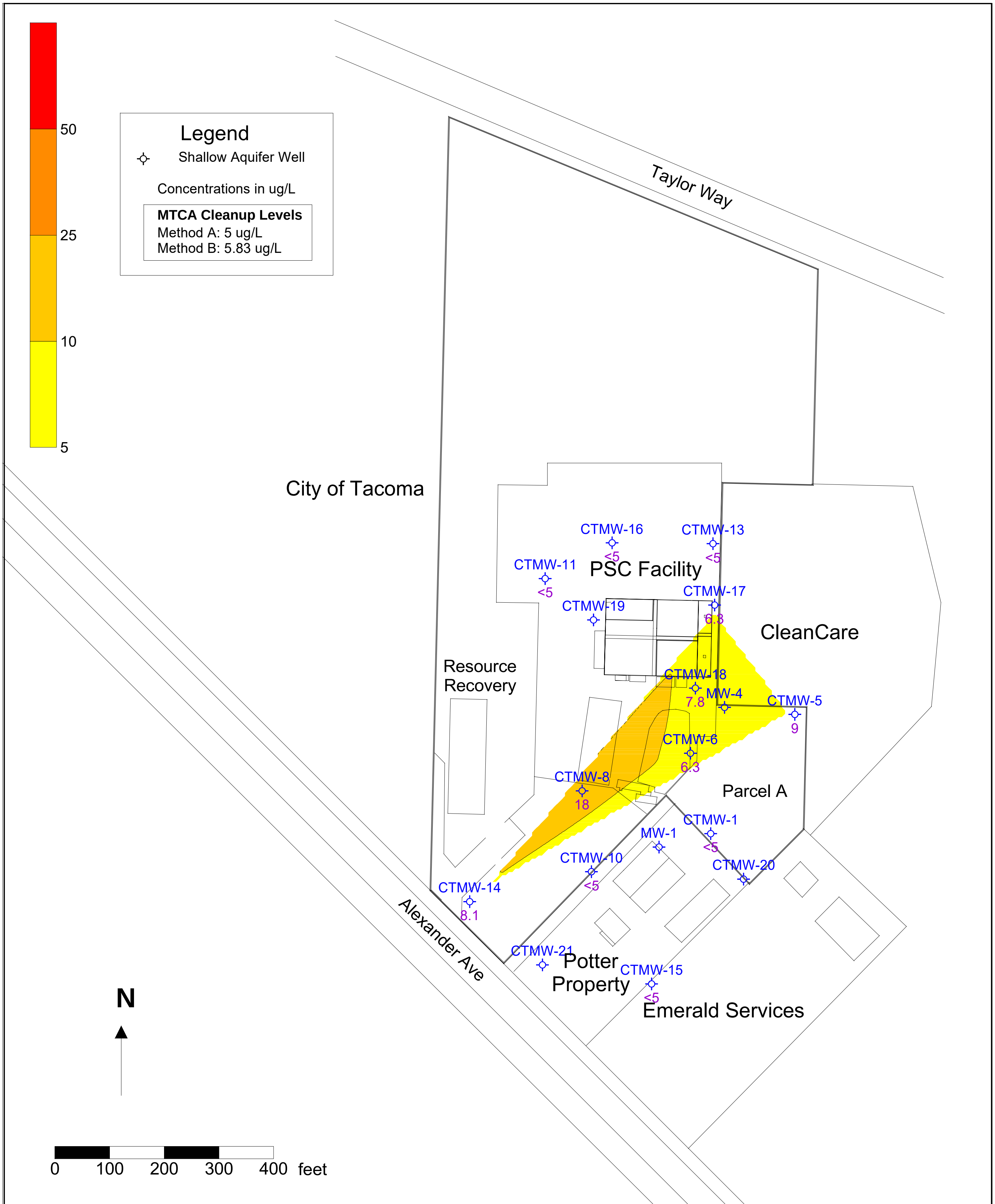
Methylene Chloride Concentrations, 2nd Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



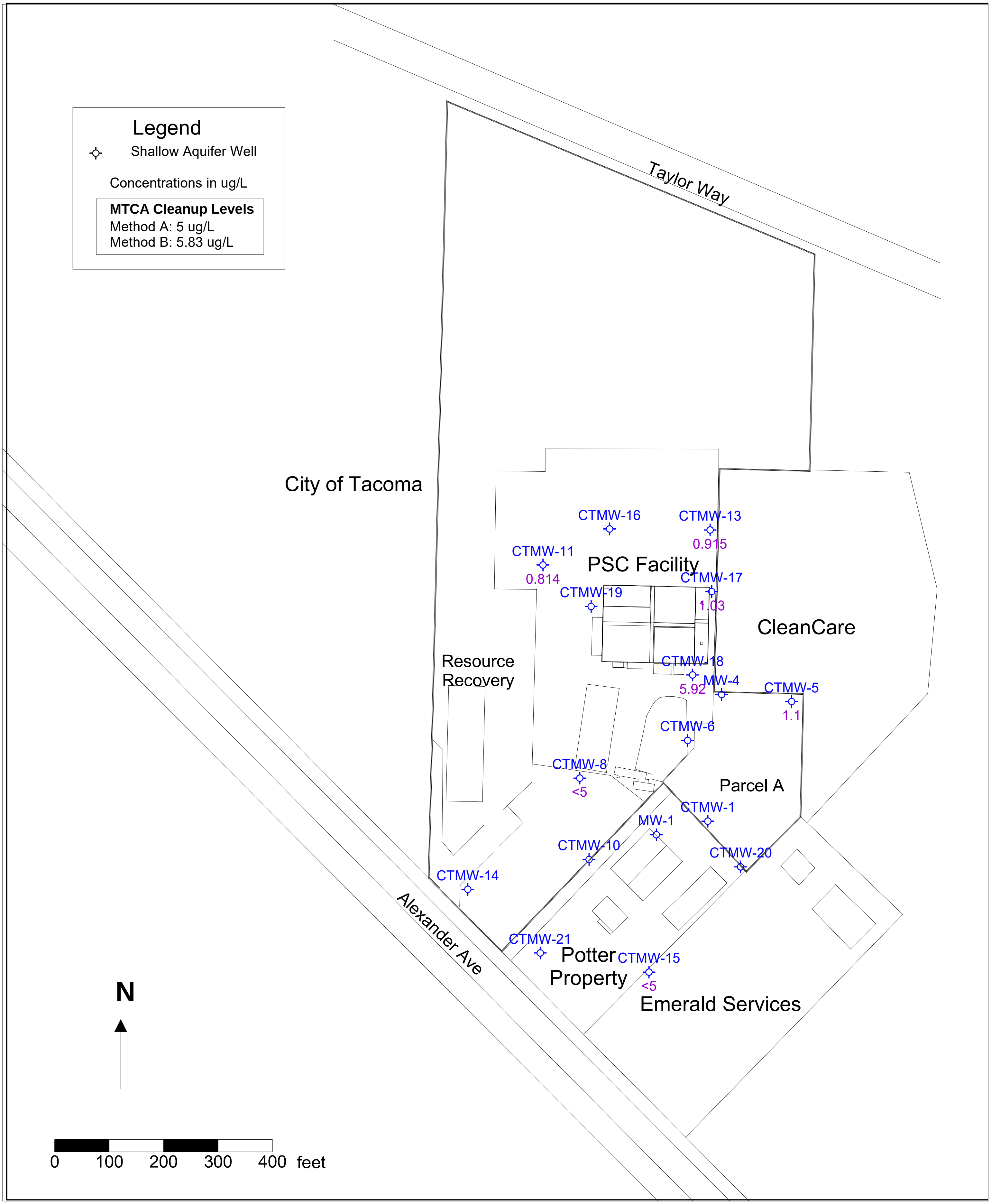
Methylene Chloride Concentrations
3rd Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



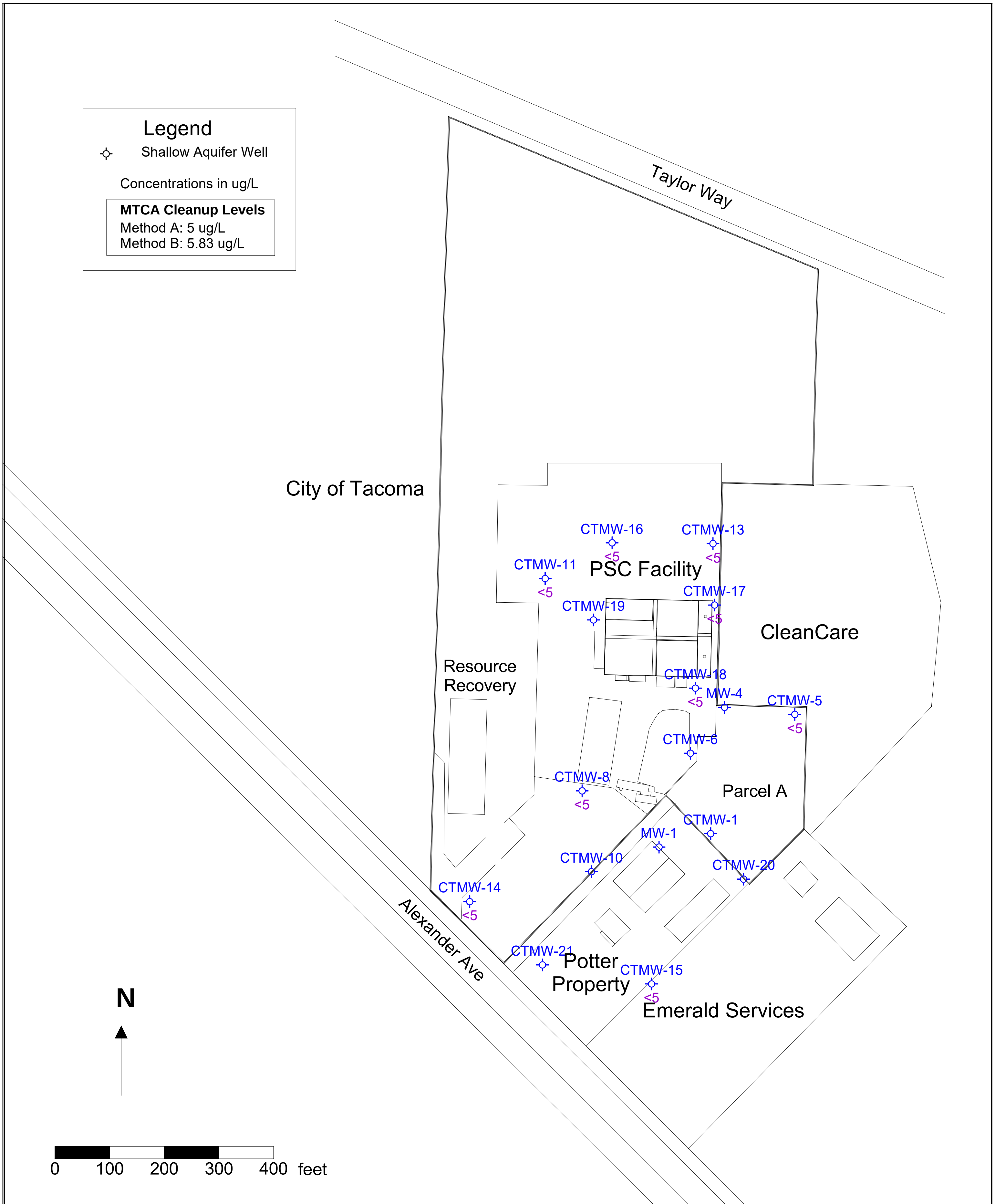
Methylene Chloride Concentrations
4th Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



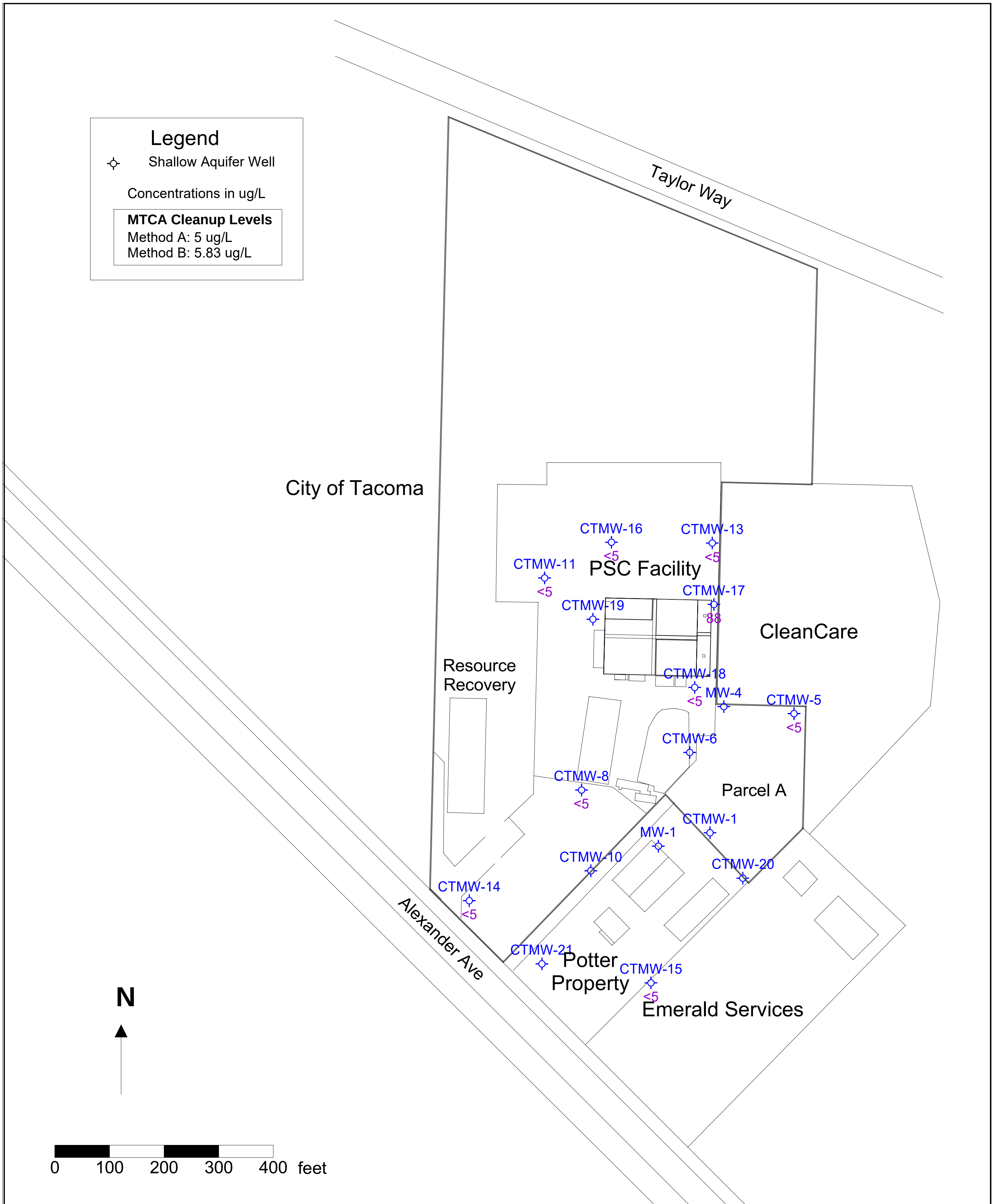
Methylene Chloride Concentrations
1st Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



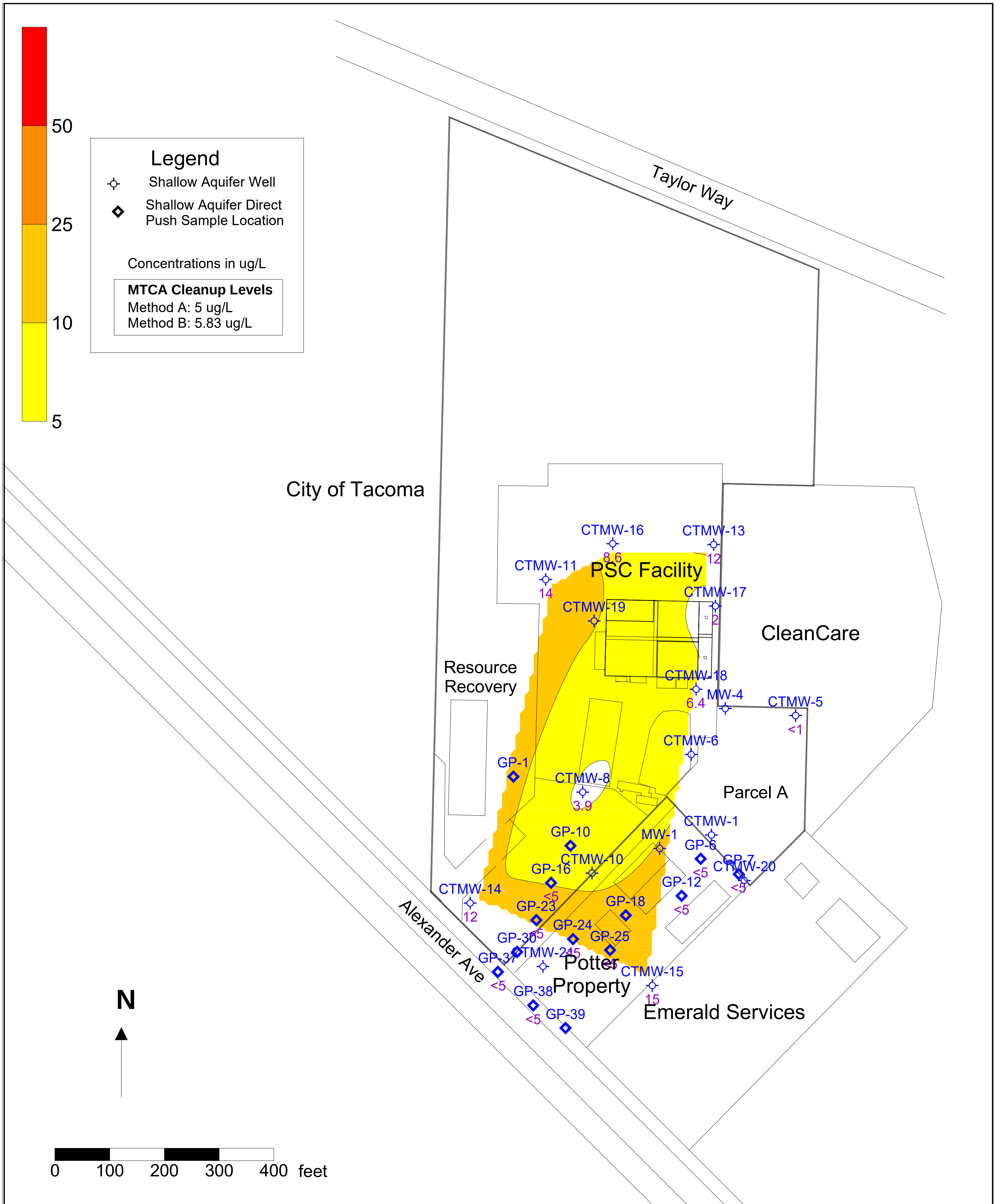
Methylene Chloride Concentrations
2nd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:

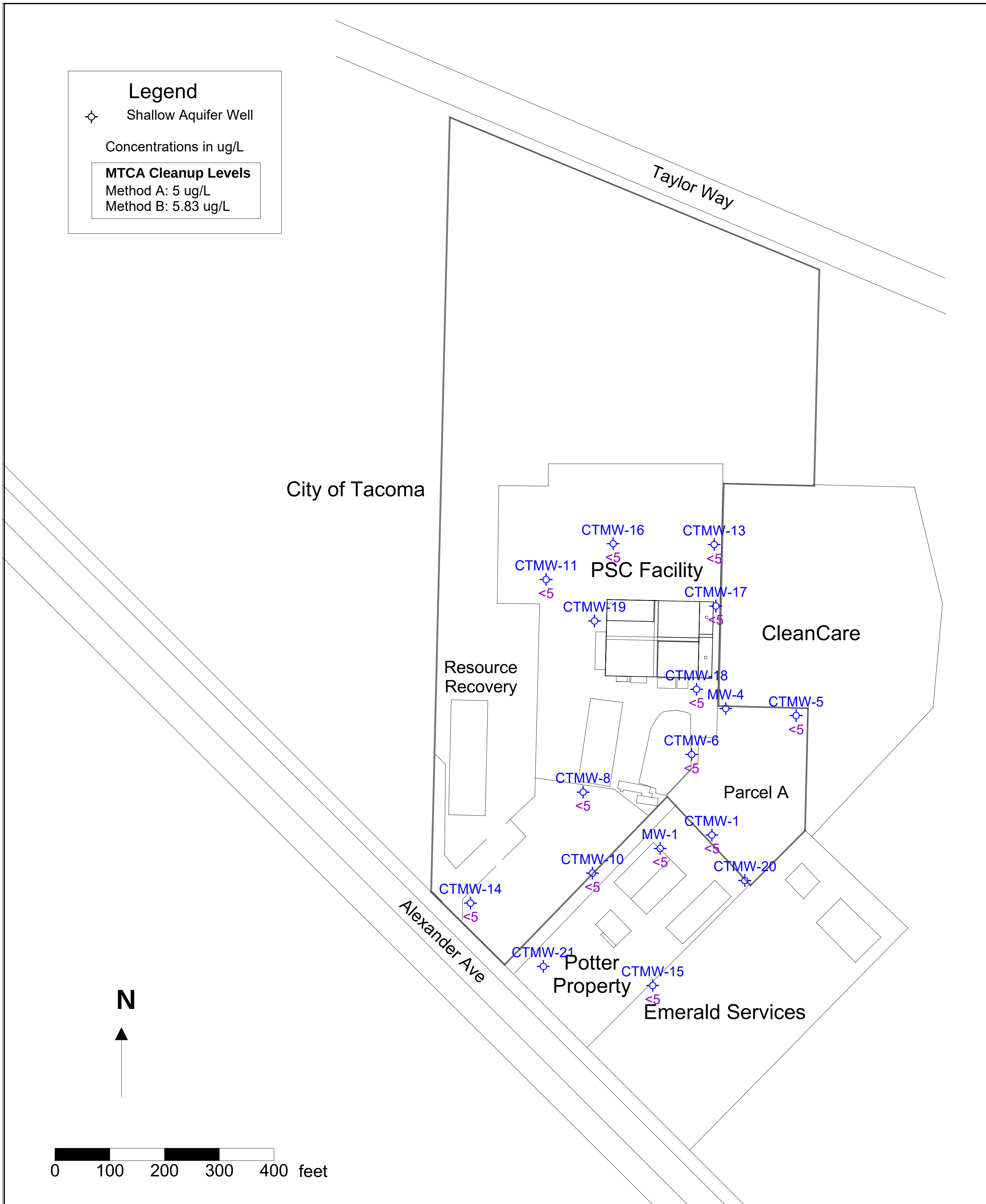


Methylene Chloride Concentrations
3rd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	

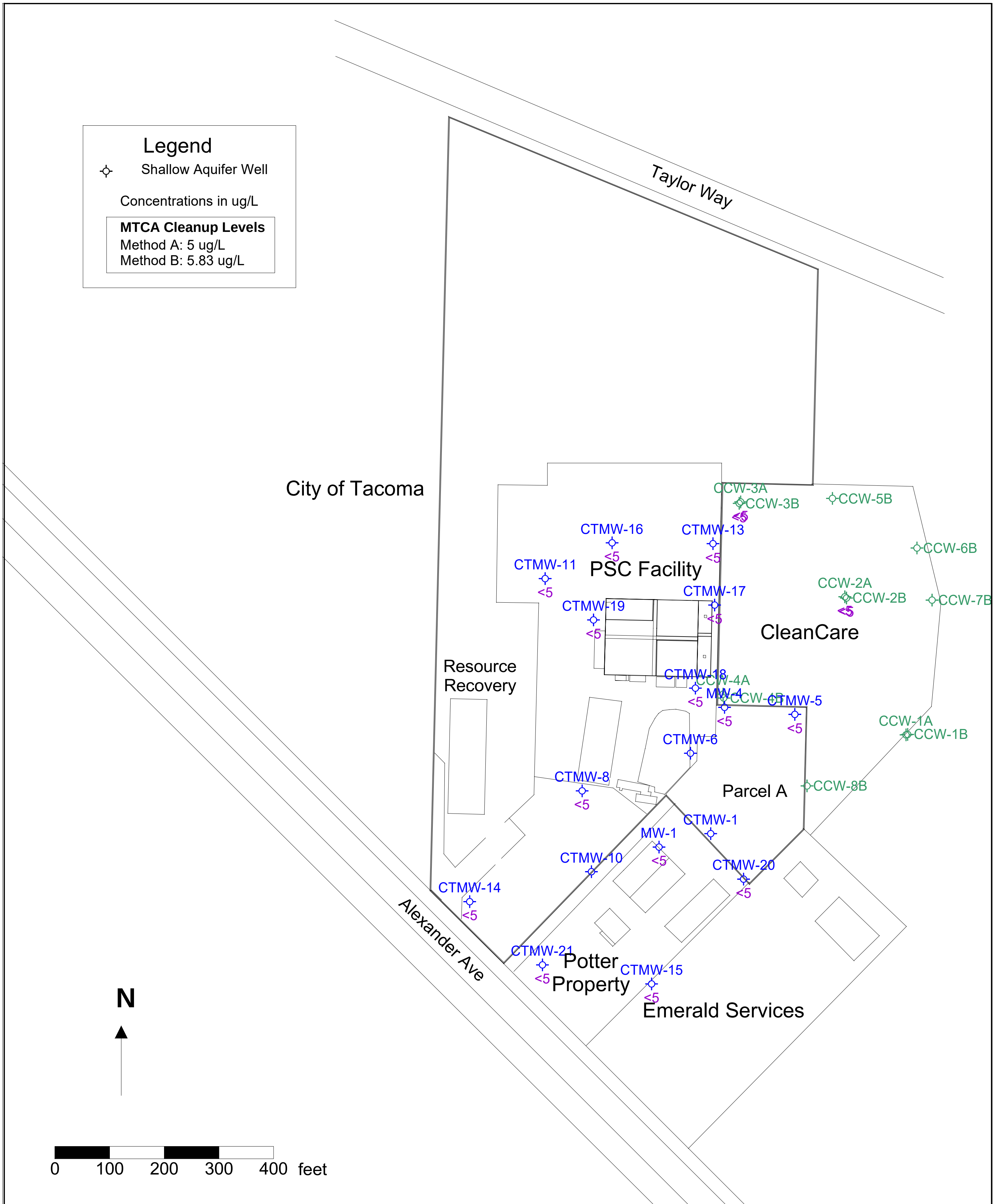


Methylene Chloride Concentrations **4th Quarter 1999 and Step-Out Investigation** **Shallow Aquifer** **Tacoma Facility**	DWN:	DES:	PROJECT No:
	CHKD:	APPD:	FIGURE No:
	DATE:	REV:	



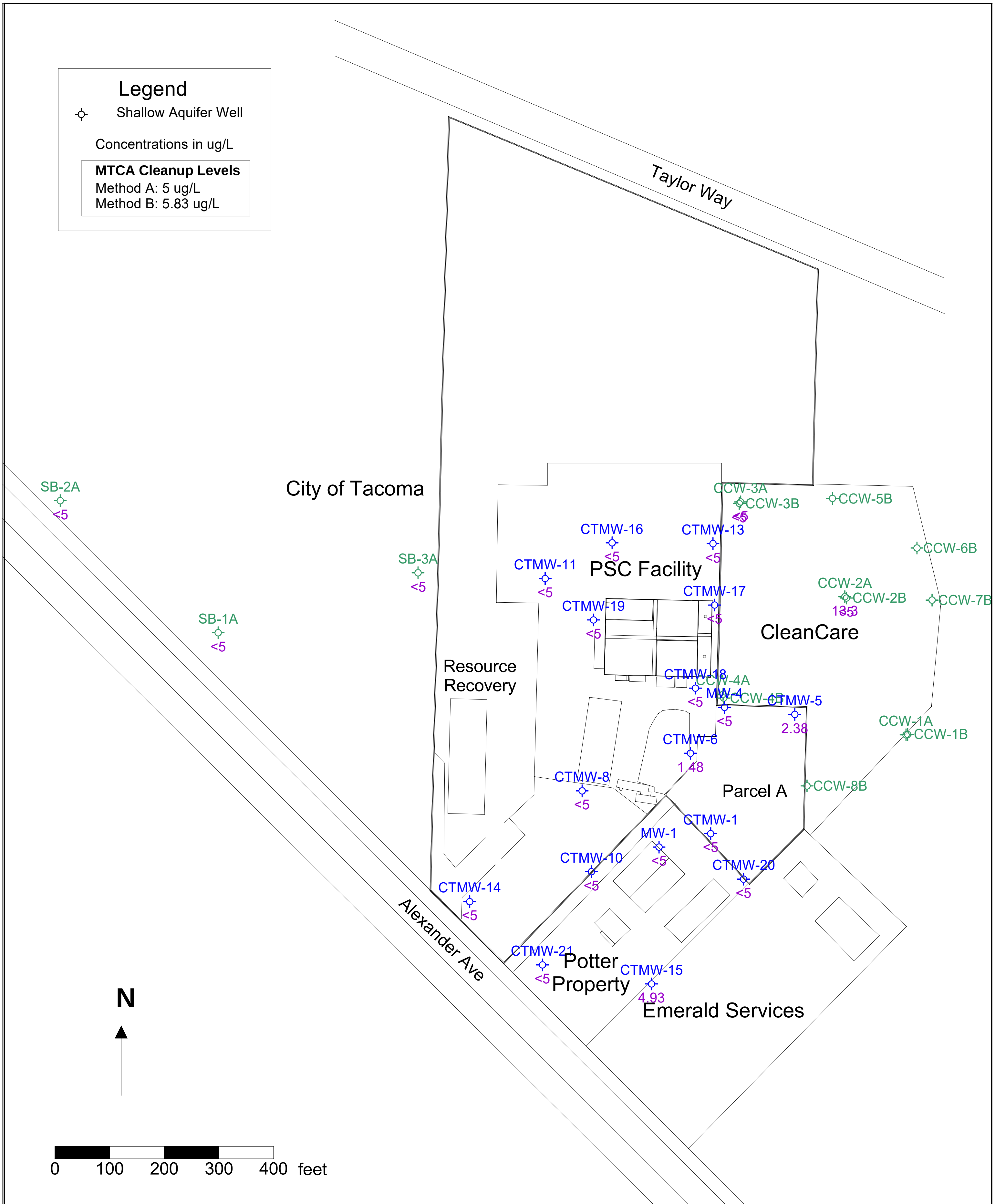
Methylene Chloride Concentrations
1st Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



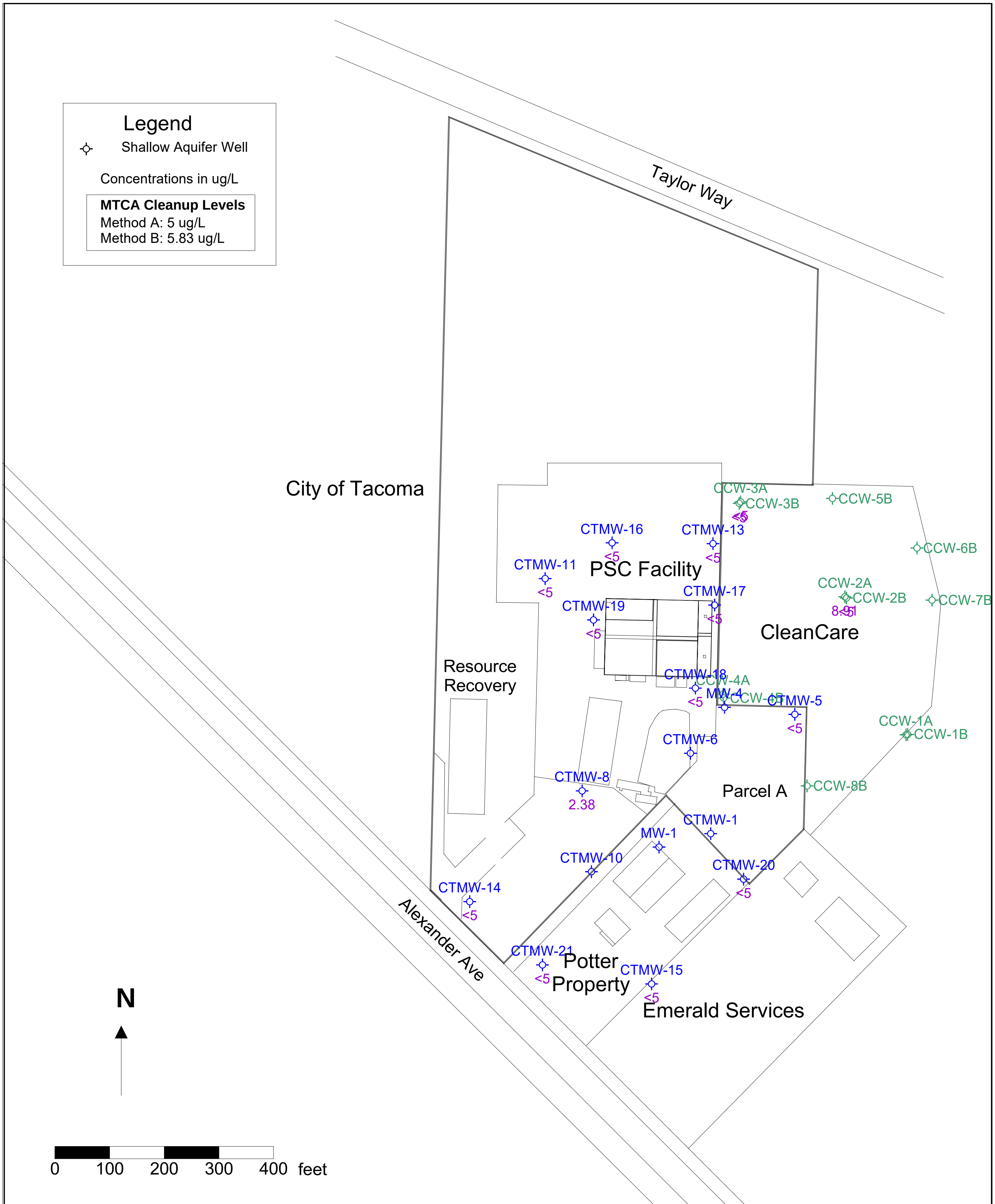
Methylene Chloride Concentrations
2nd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



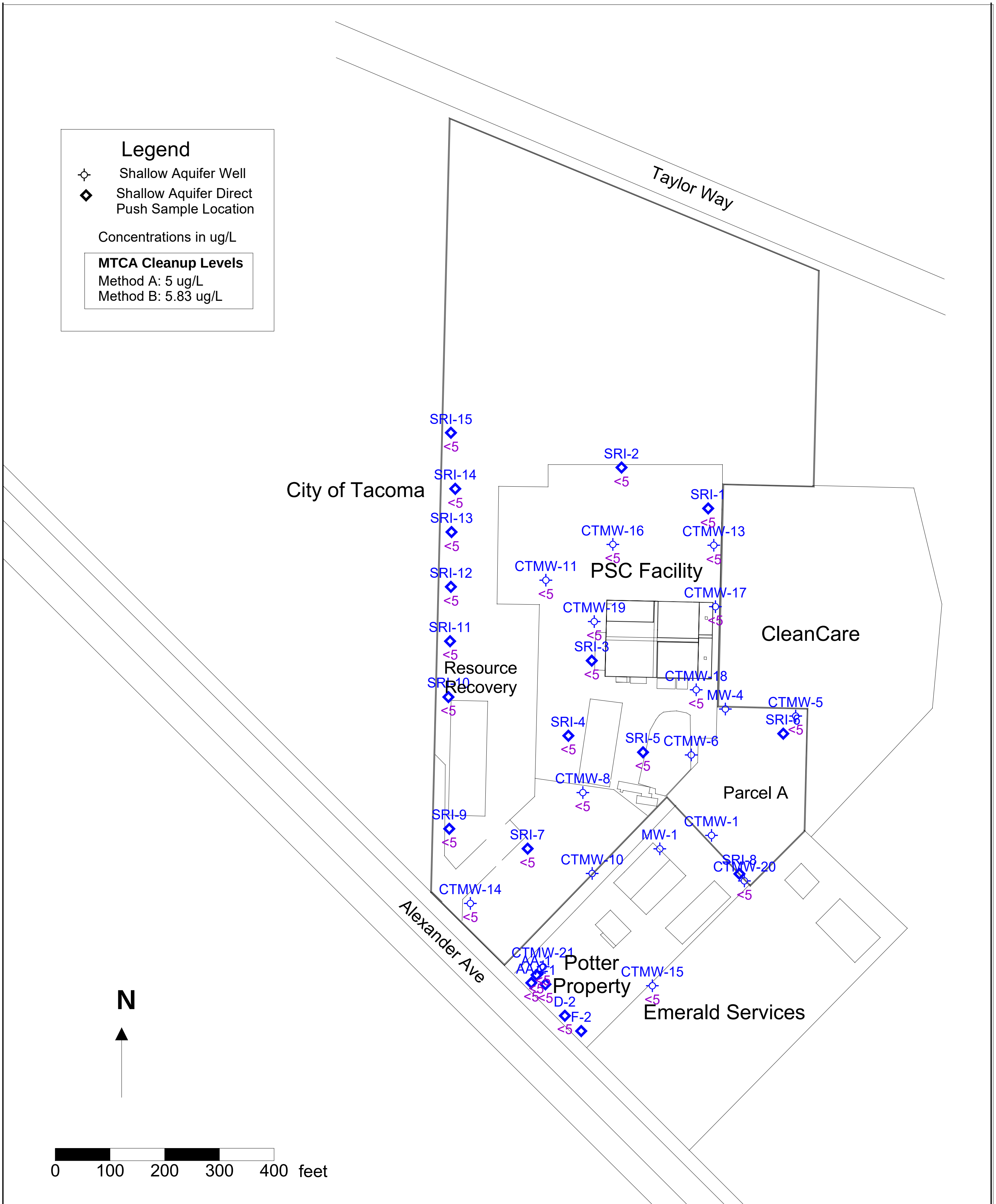
Methyl Chloride Concentrations
3rd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



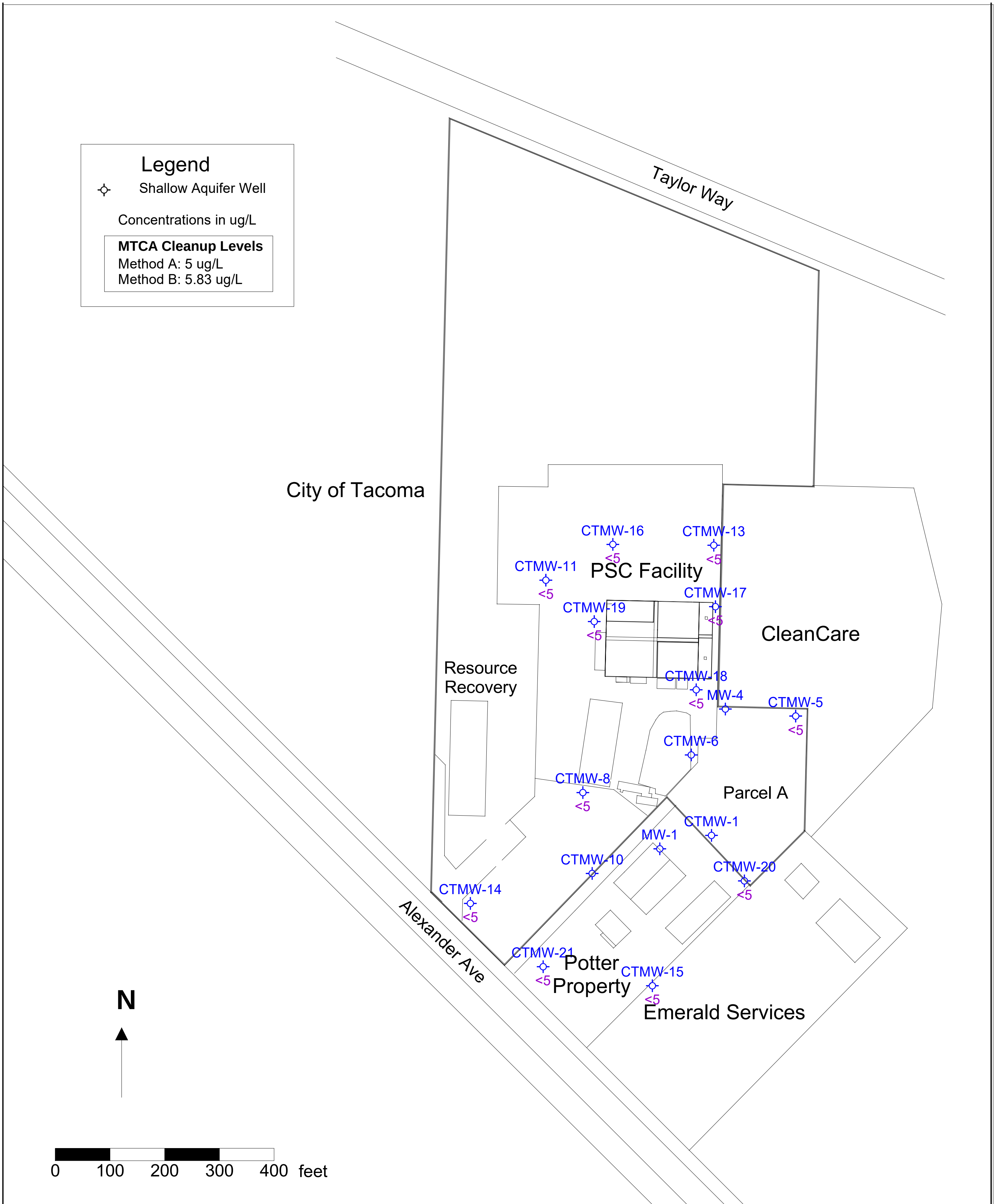
Methylene Chloride Concentrations
4th Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



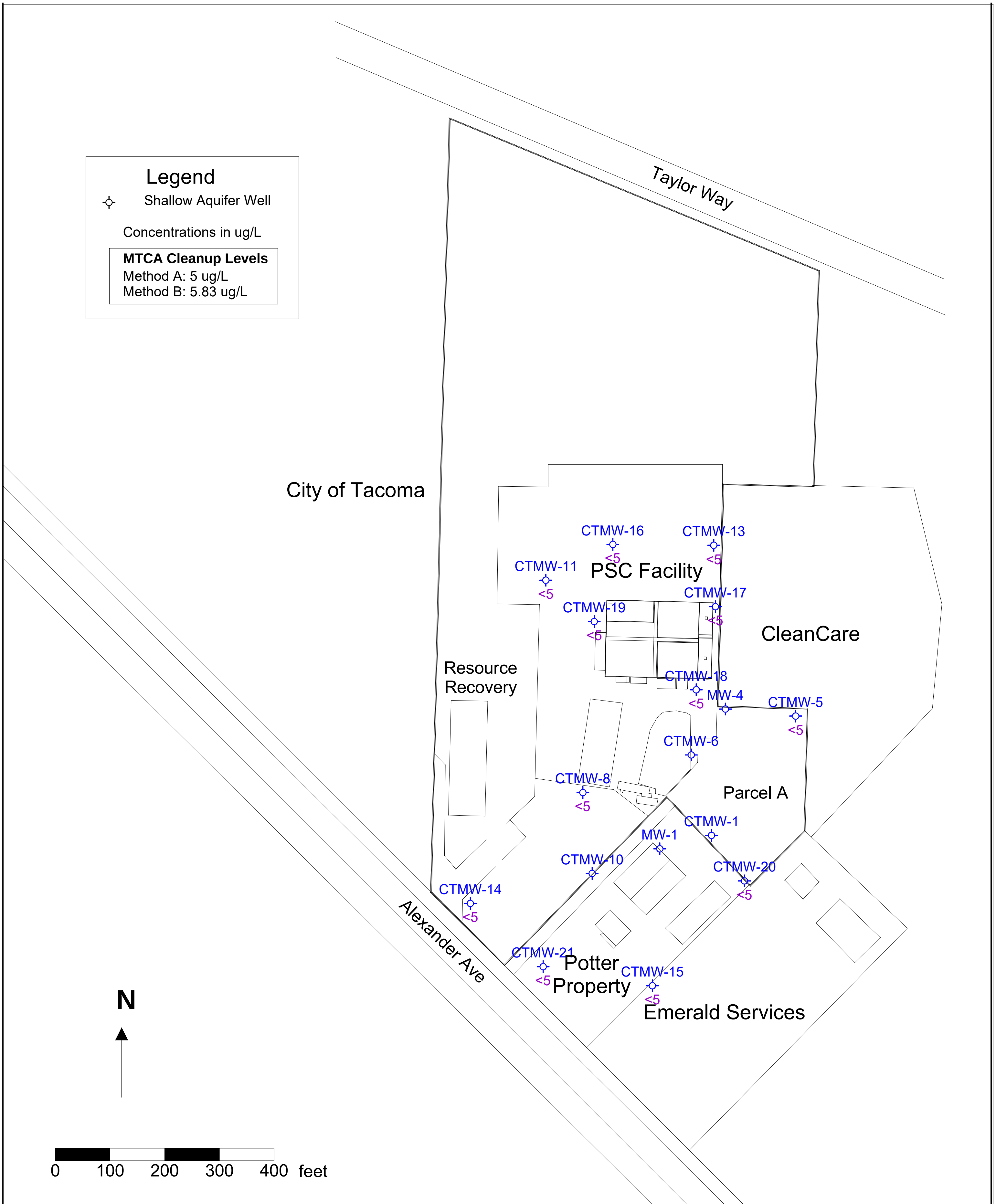
Methylene Chloride Concentrations
1st Quarter 2001 and SRI
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



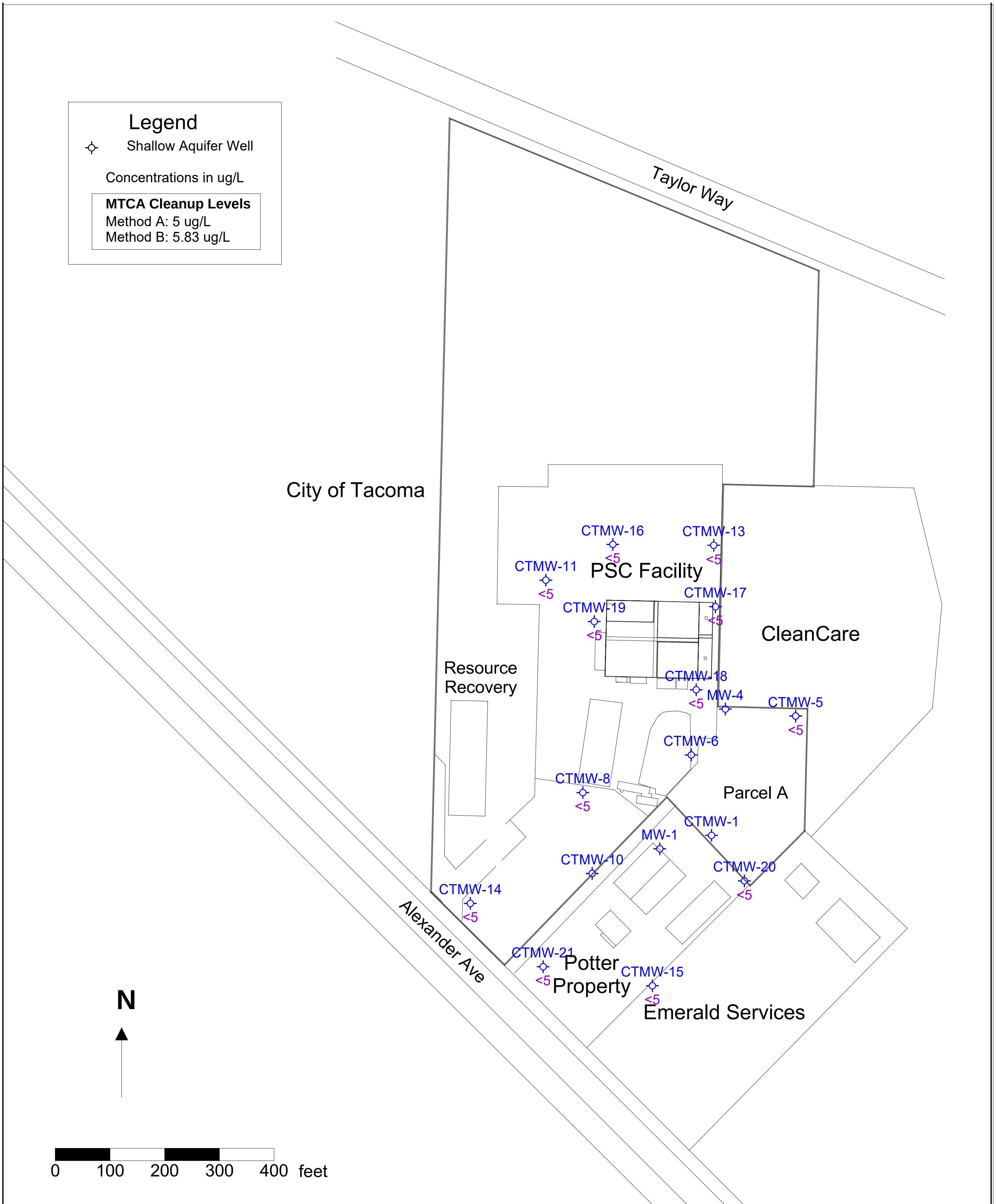
Methylene Chloride Concentrations
2nd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



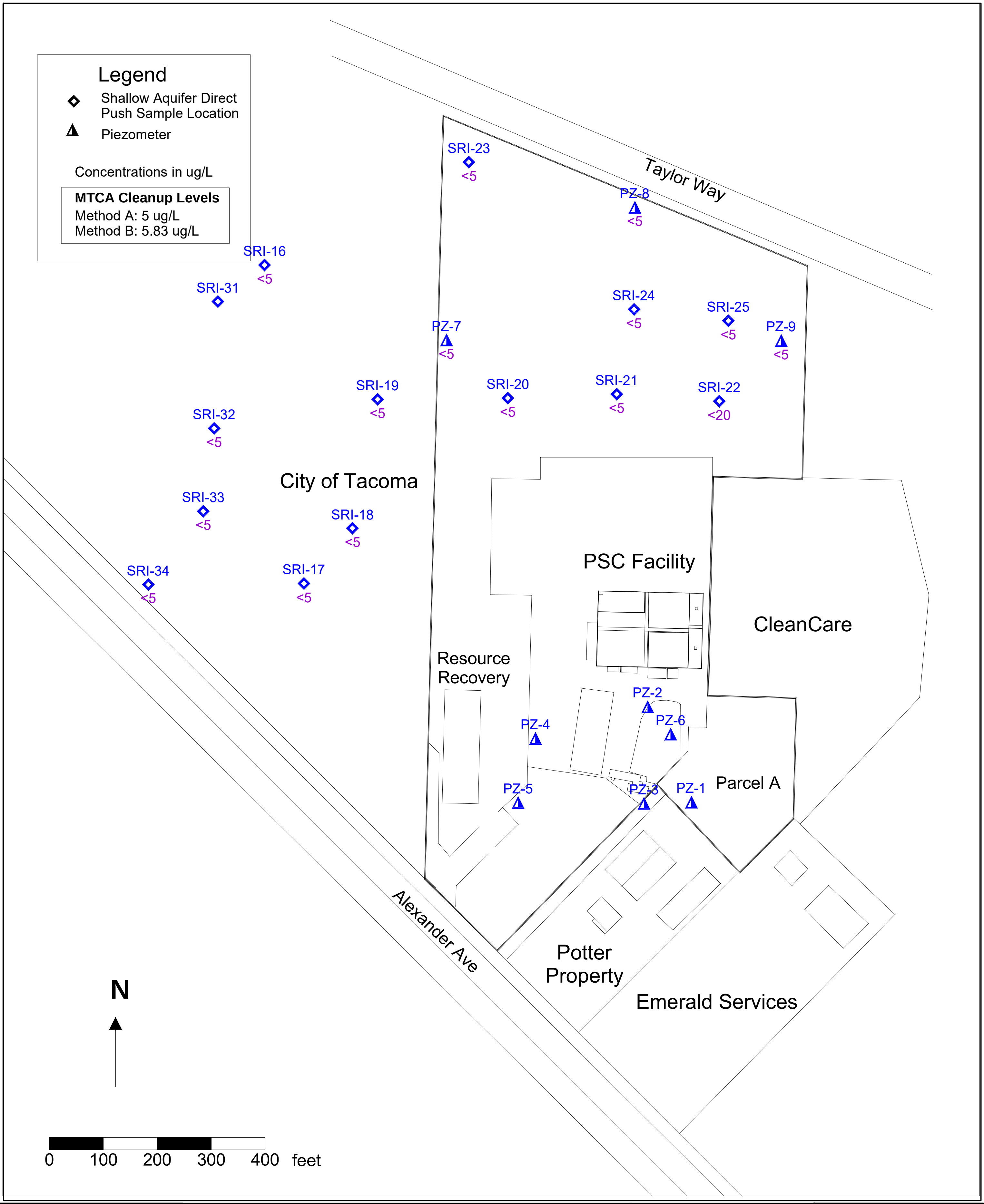
Methylene Chloride Concentrations
3rd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



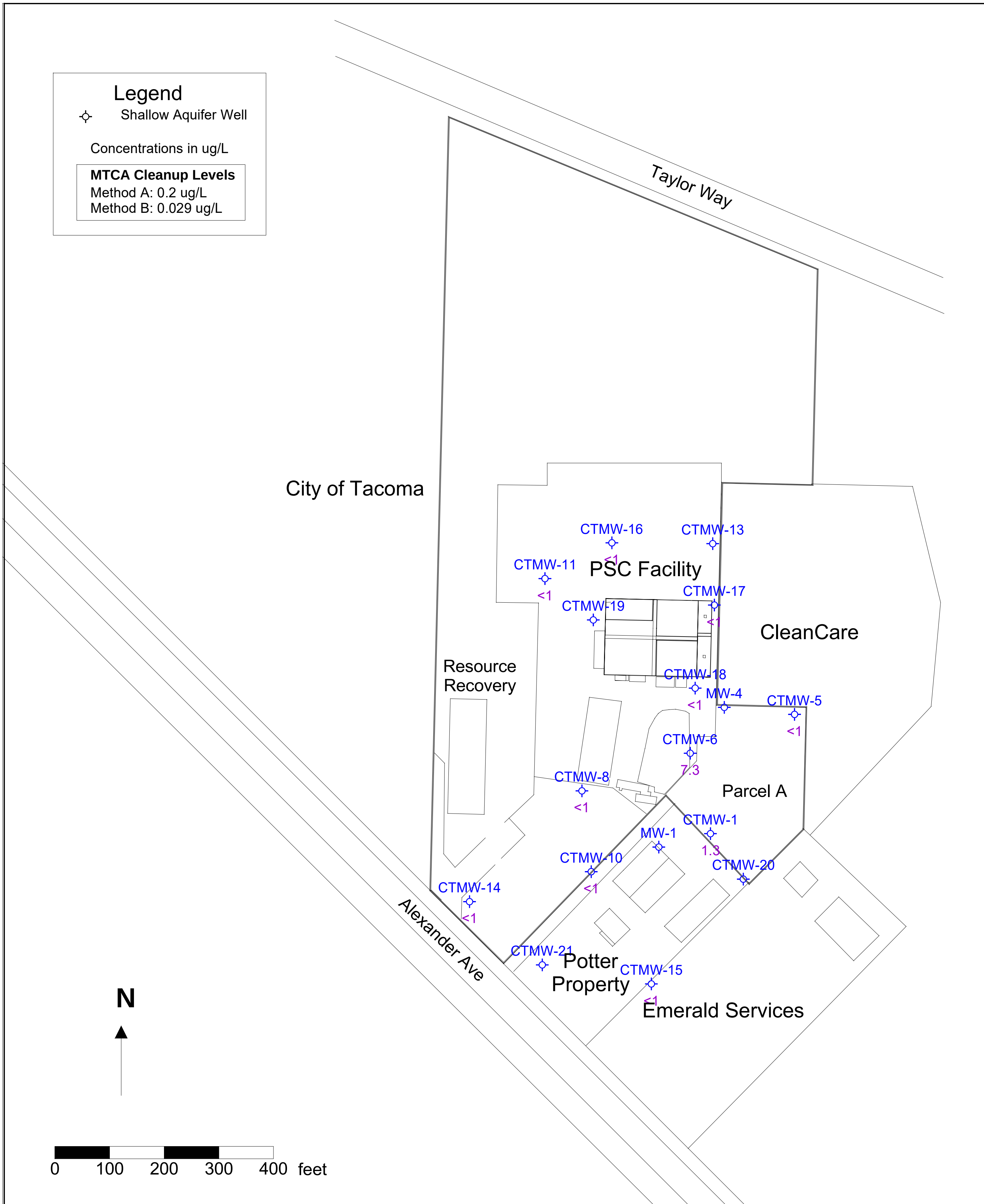
Methylene Chloride Concentrations
4th Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



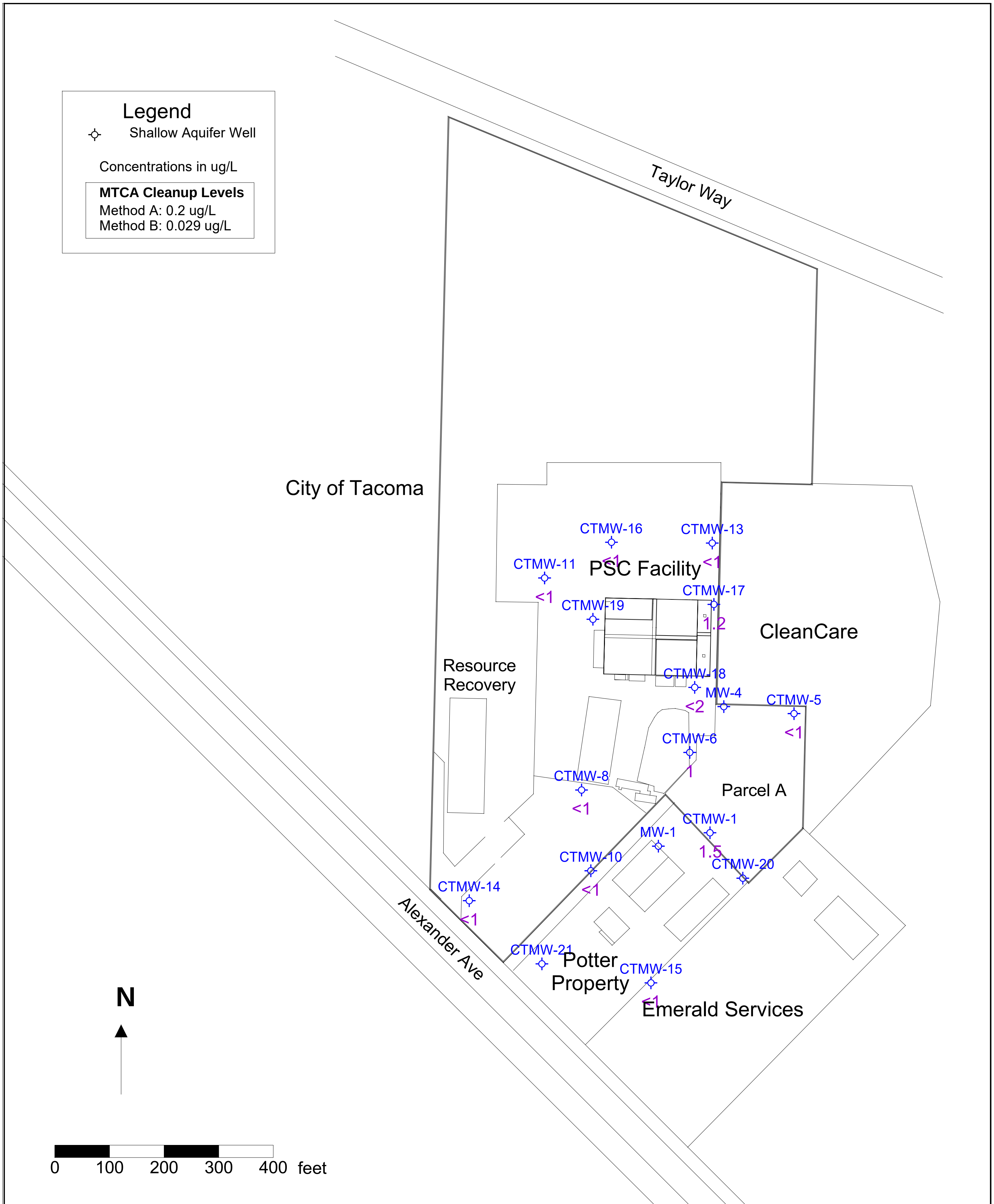
Methylene Chloride Concentrations
SRI II 2002
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



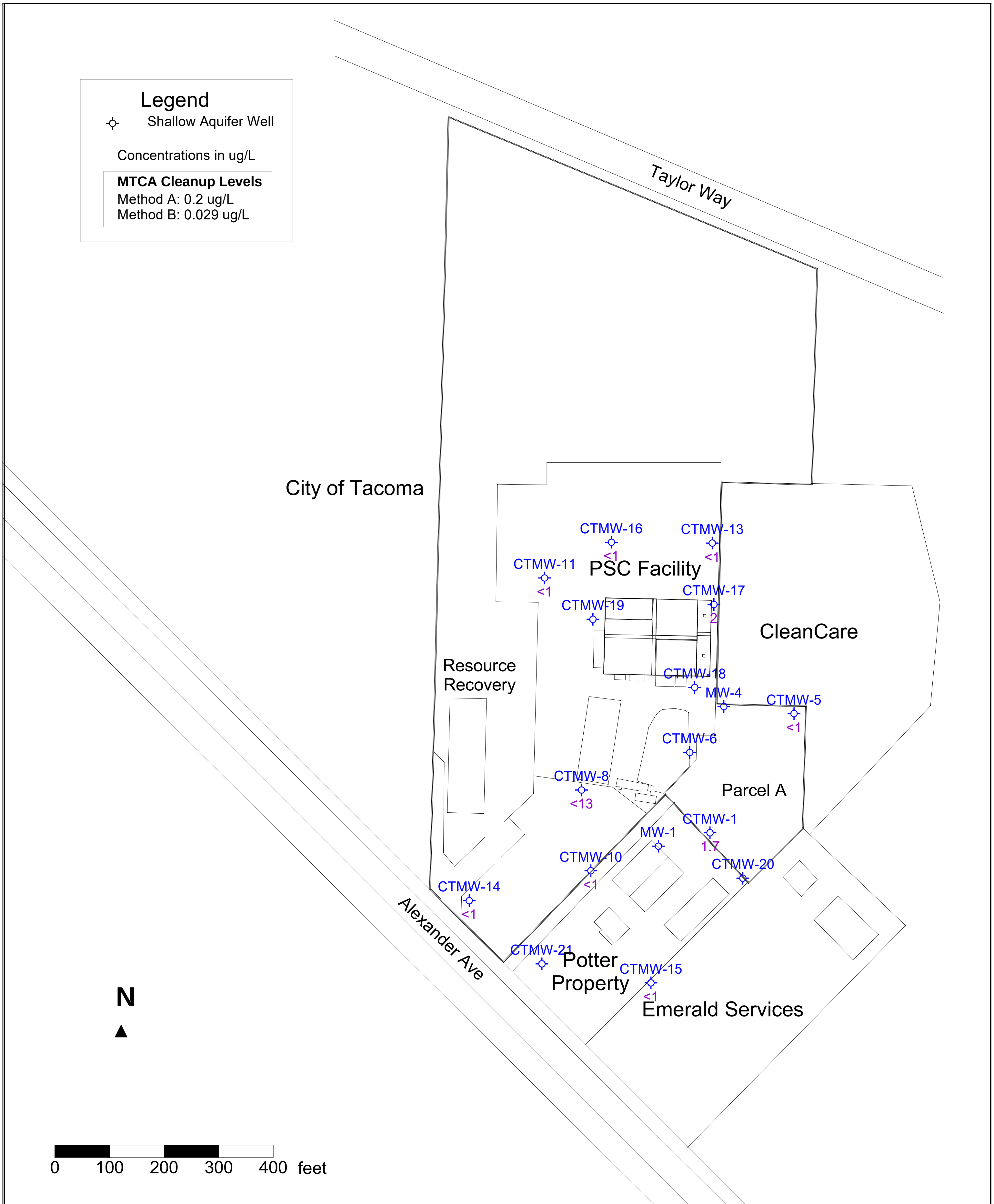
Vinyl Chloride Concentrations
1st Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



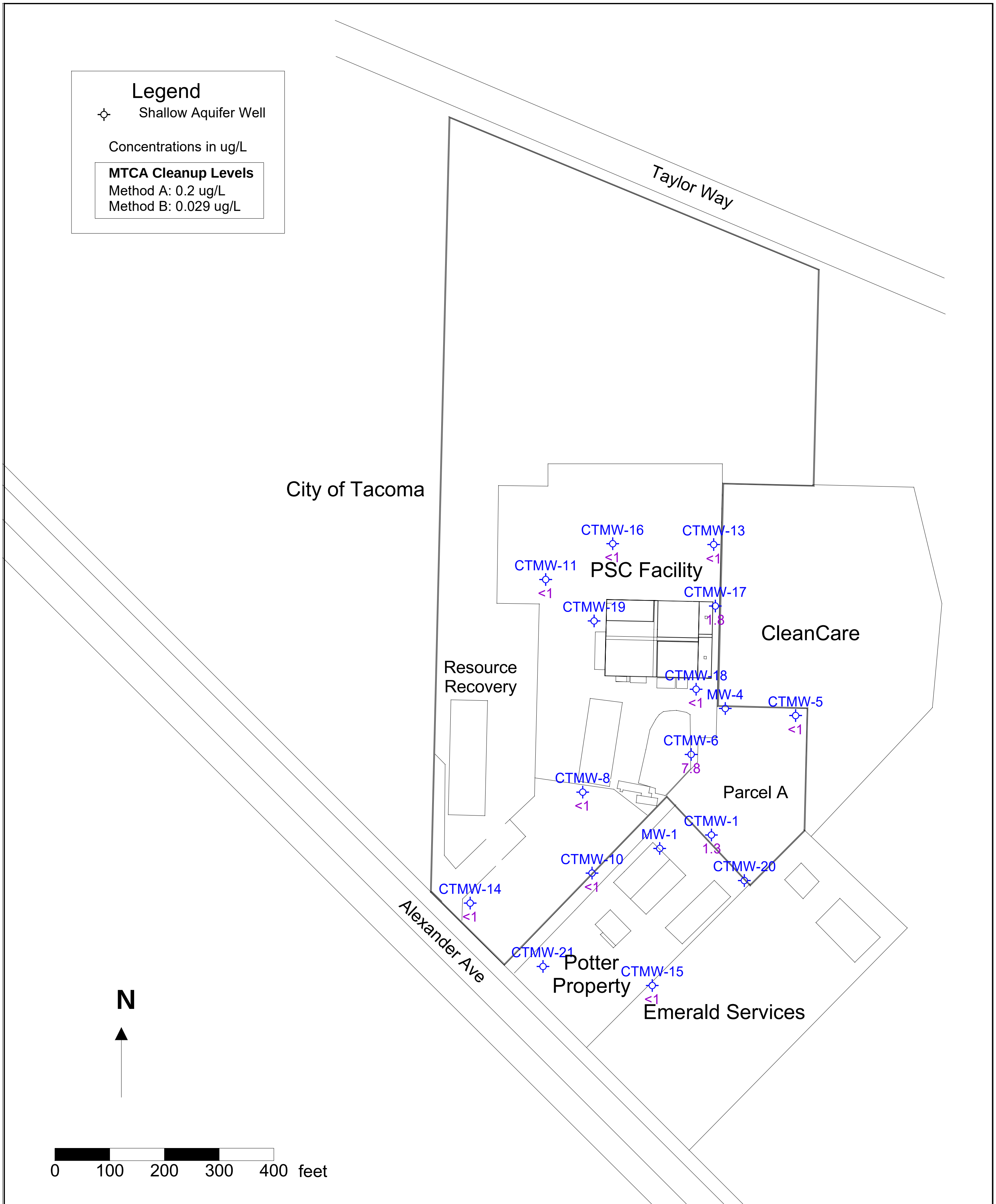
Vinyl Chloride Concentrations
2nd Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



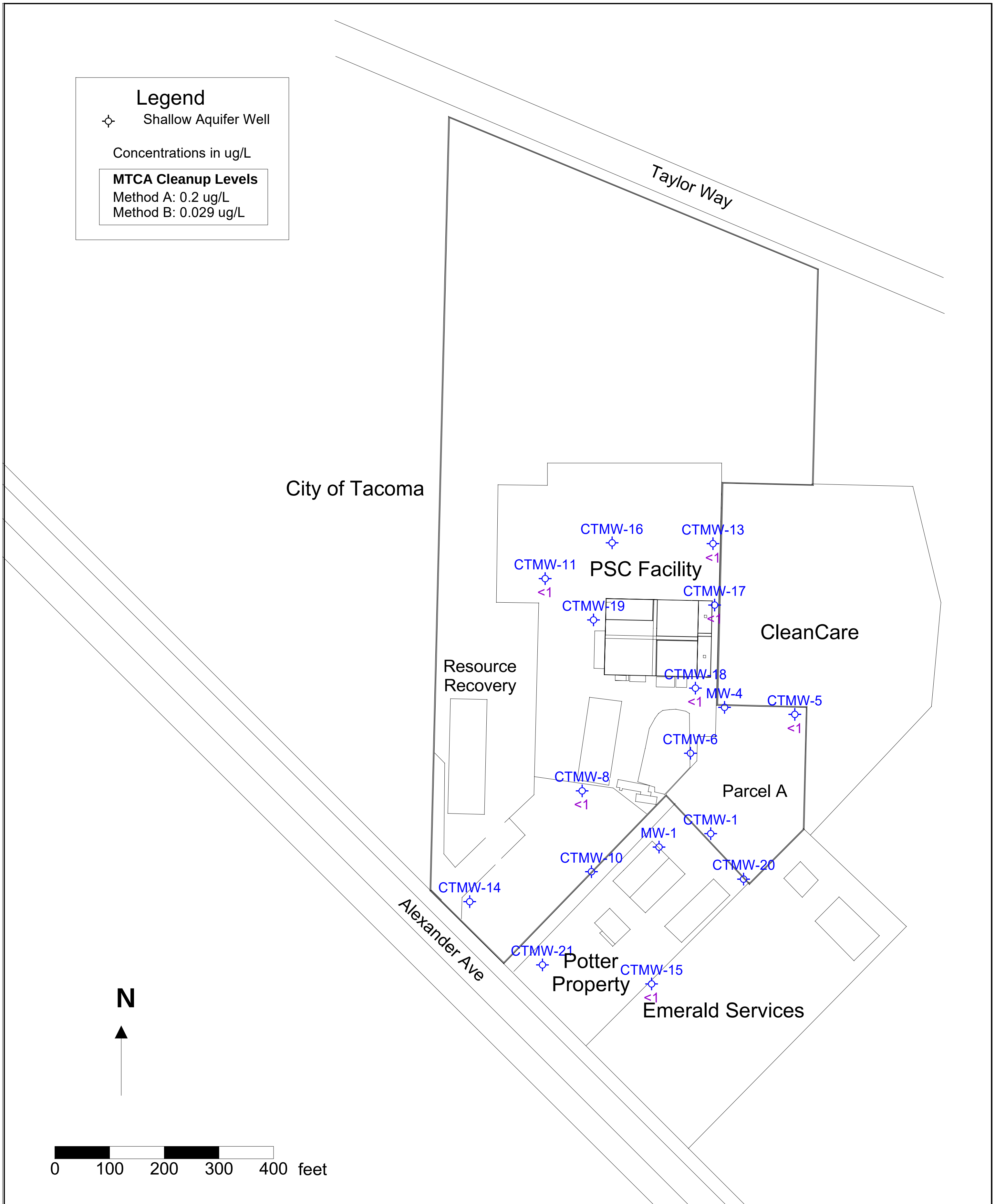
Vinyl Chloride Concentrations
3rd Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



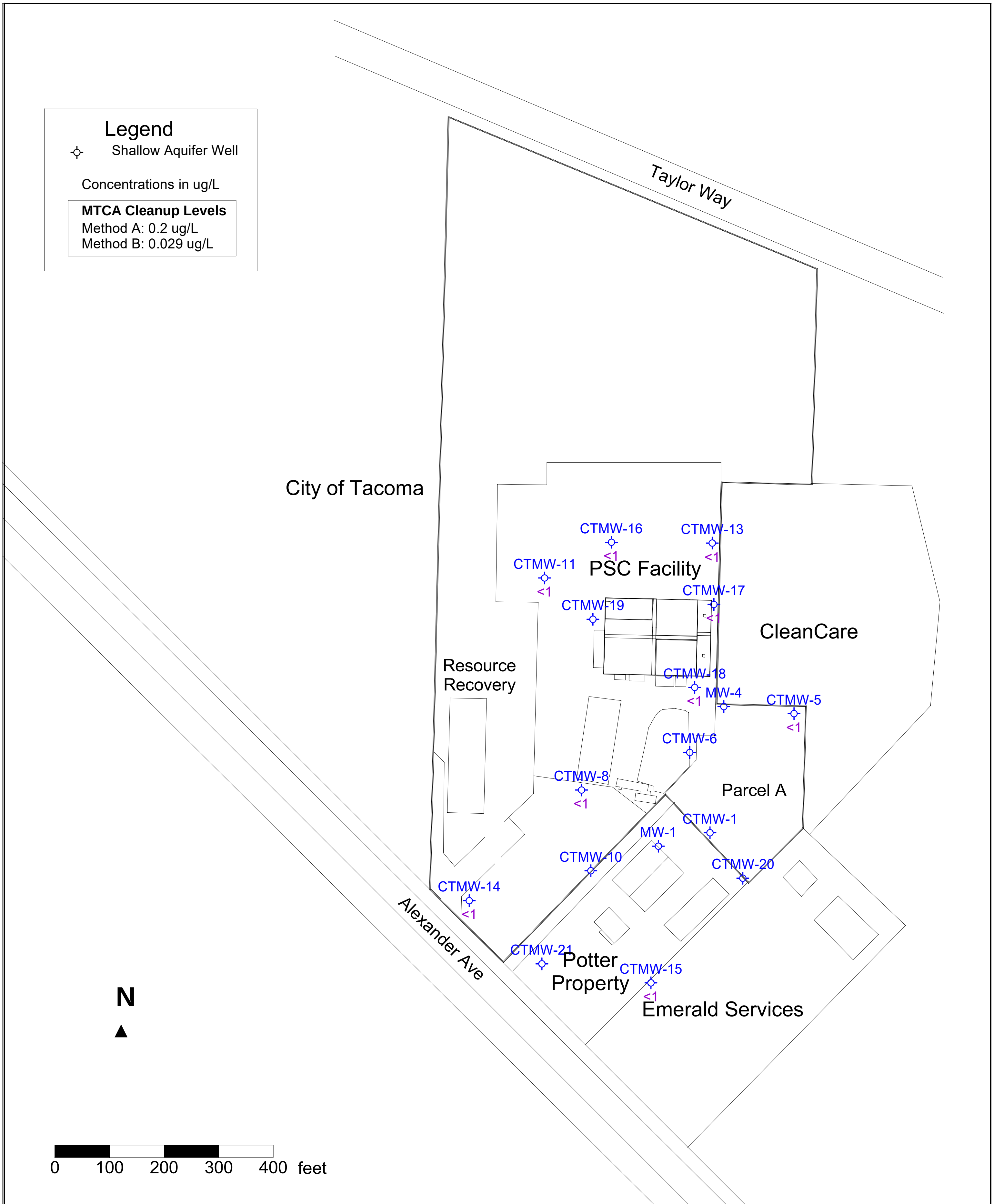
Vinyl Chloride Concentrations
4th Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



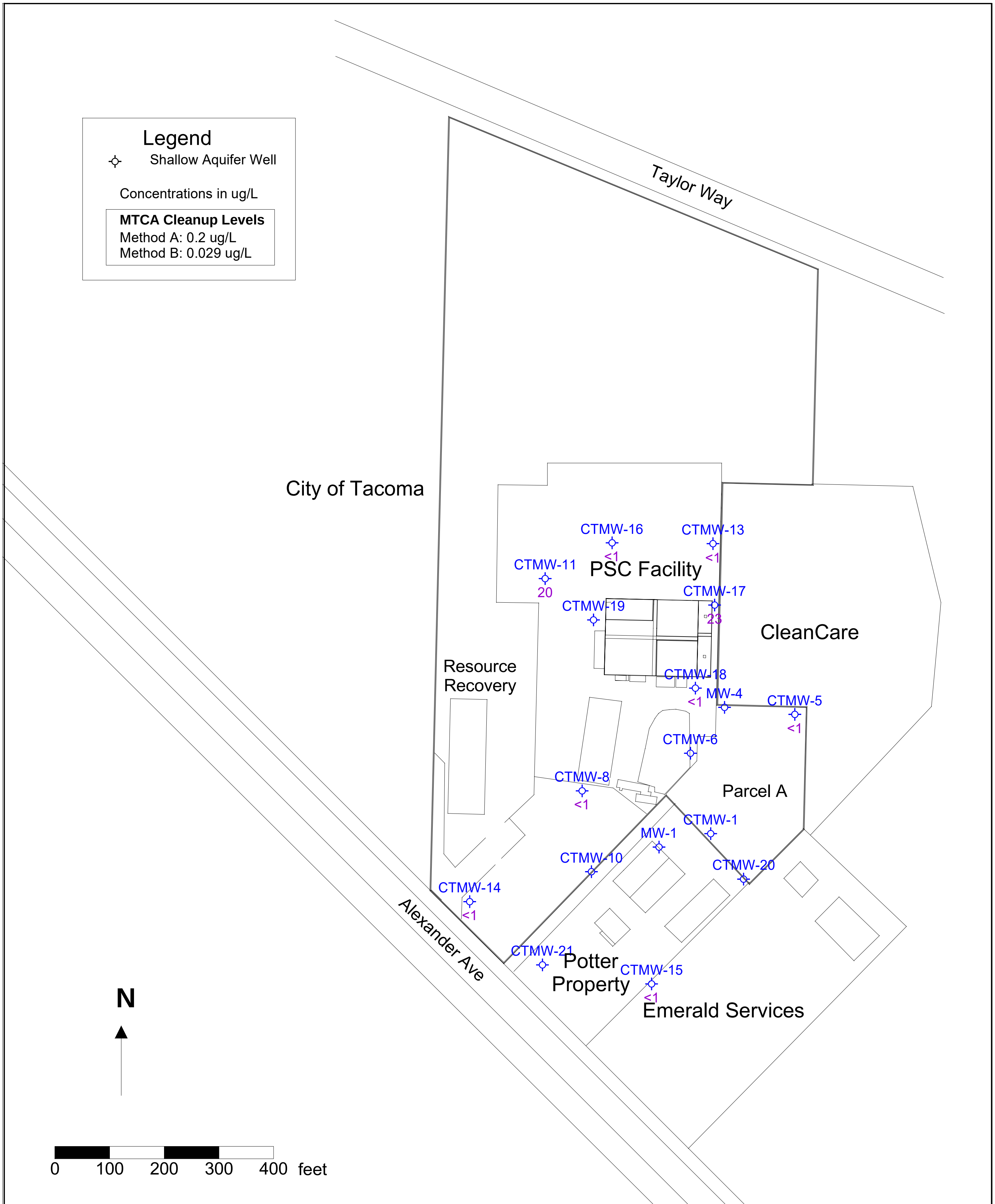
Vinyl Chloride Concentrations
1st Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



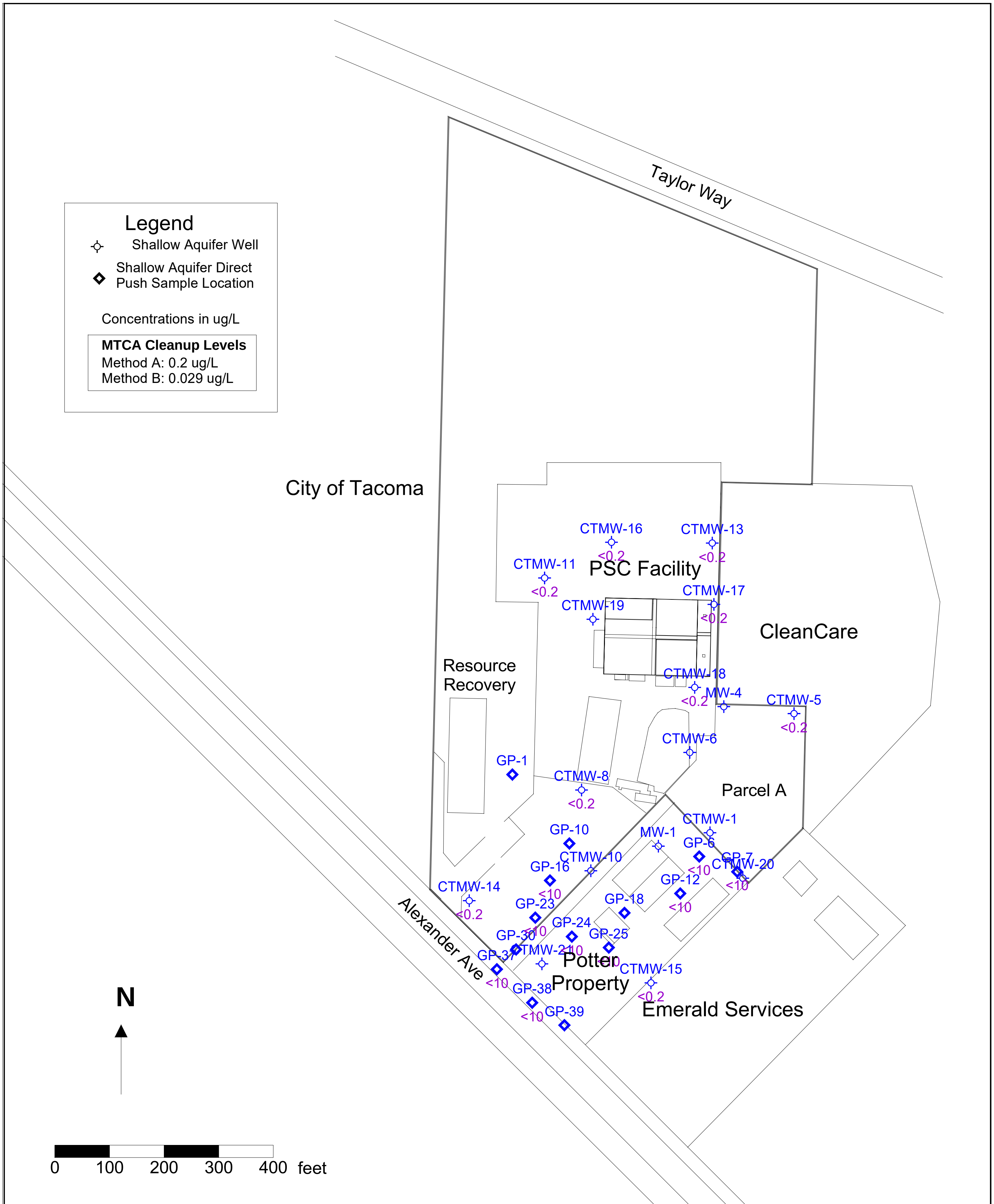
Vinyl Chloride Concentrations
2nd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



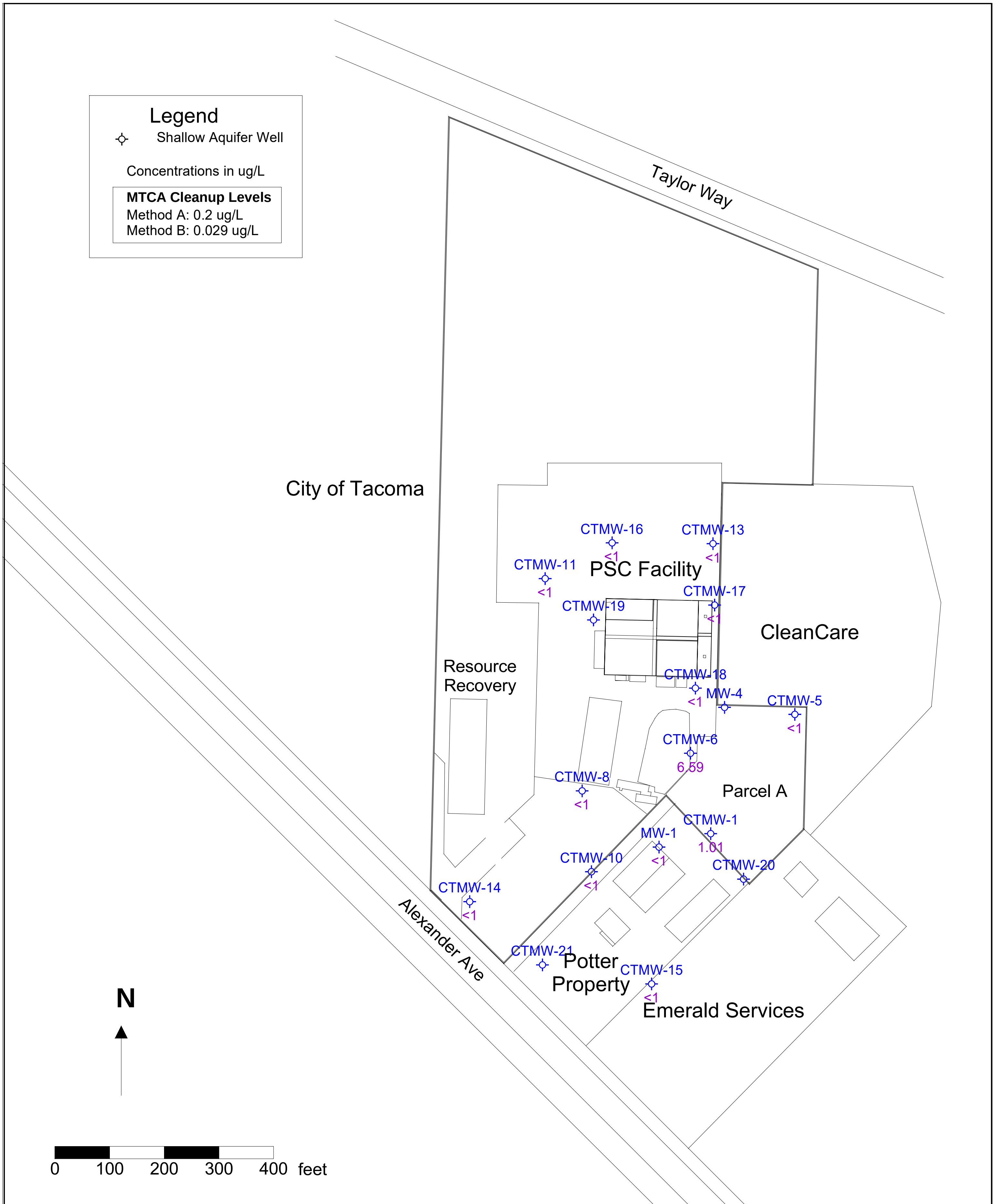
Vinyl Chloride Concentrations
3rd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



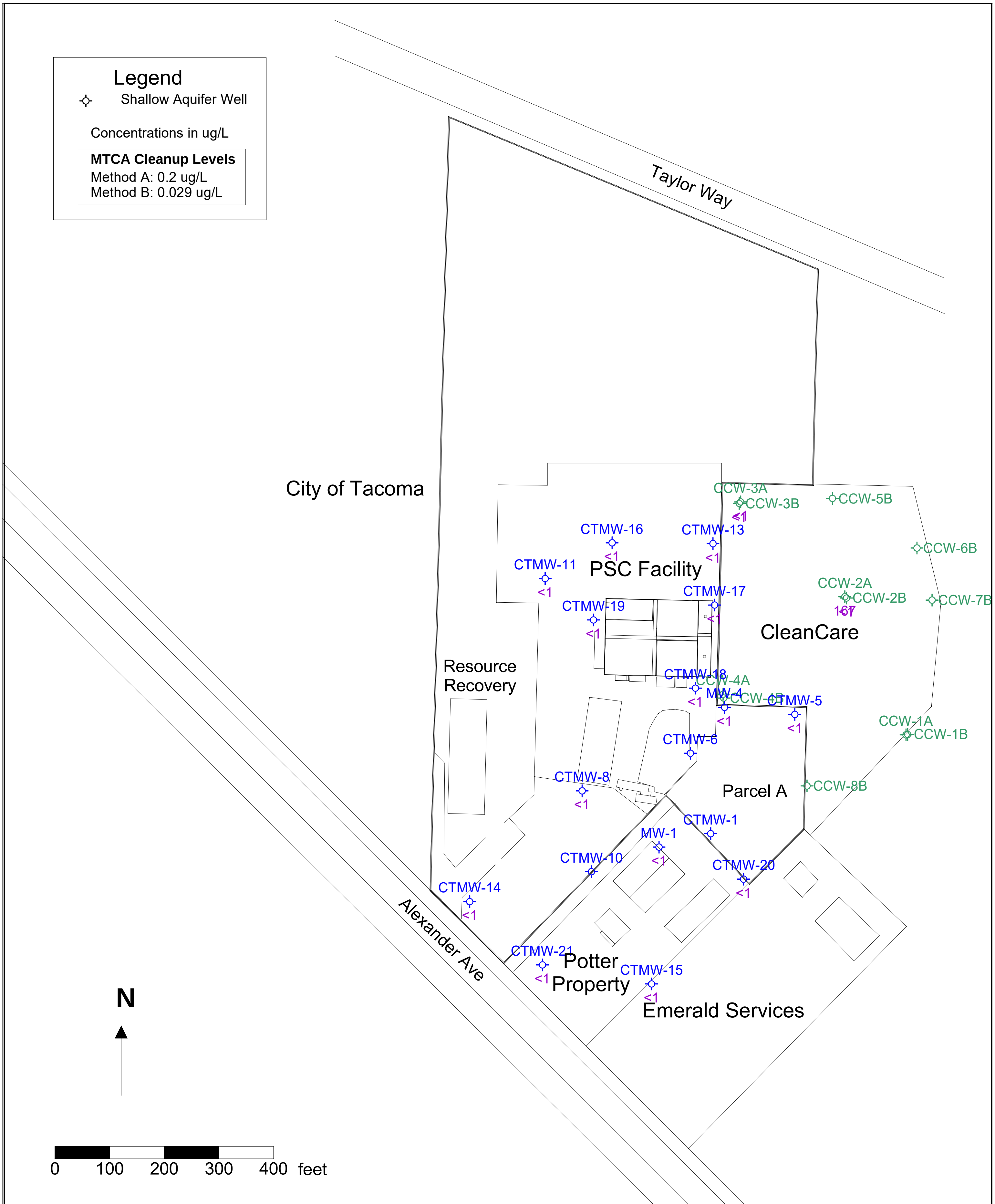
Vinyl Chloride Concentrations
4th Quarter 1999 and Step-Out Investigation
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



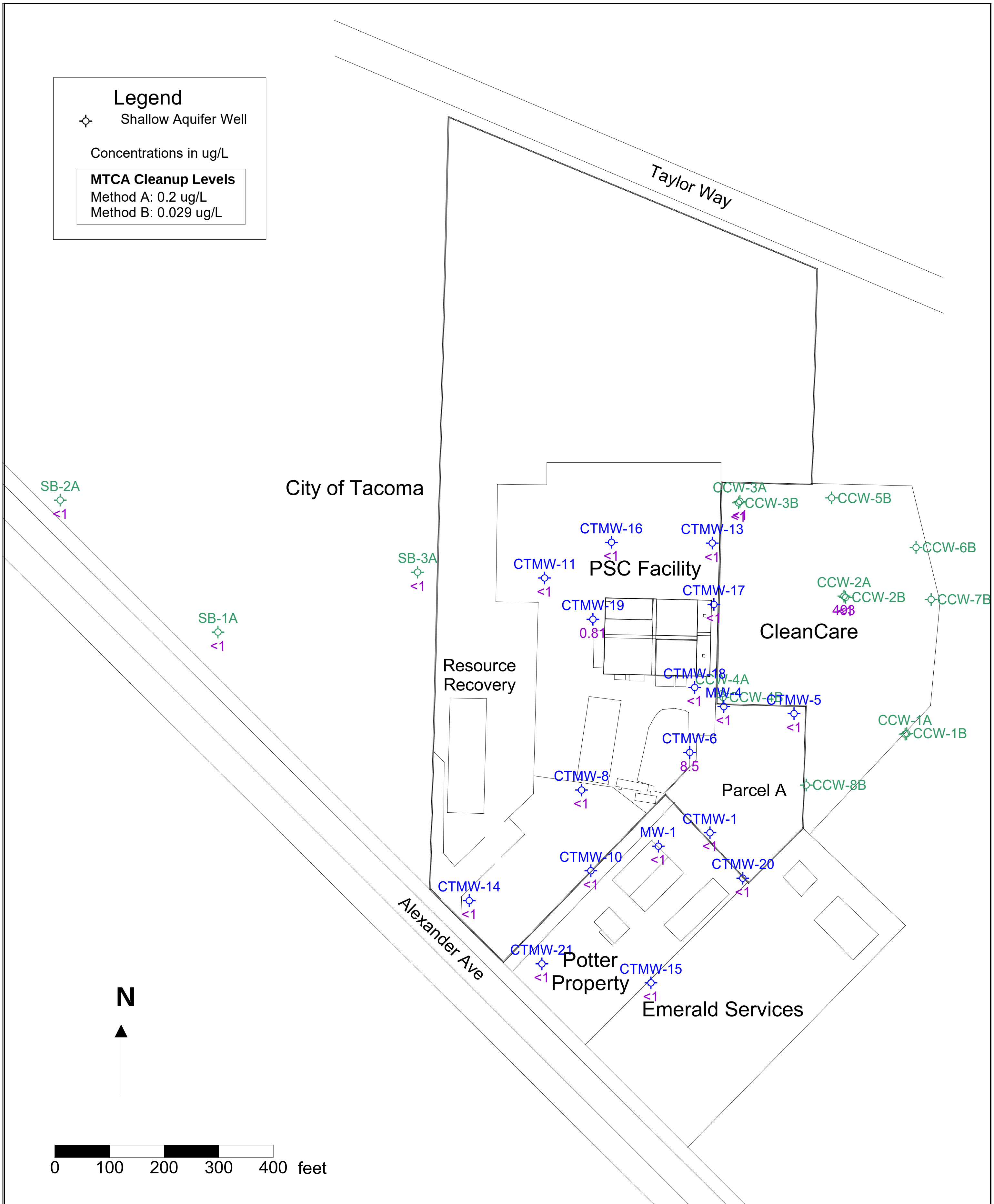
Vinyl Chloride Concentrations
1st Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



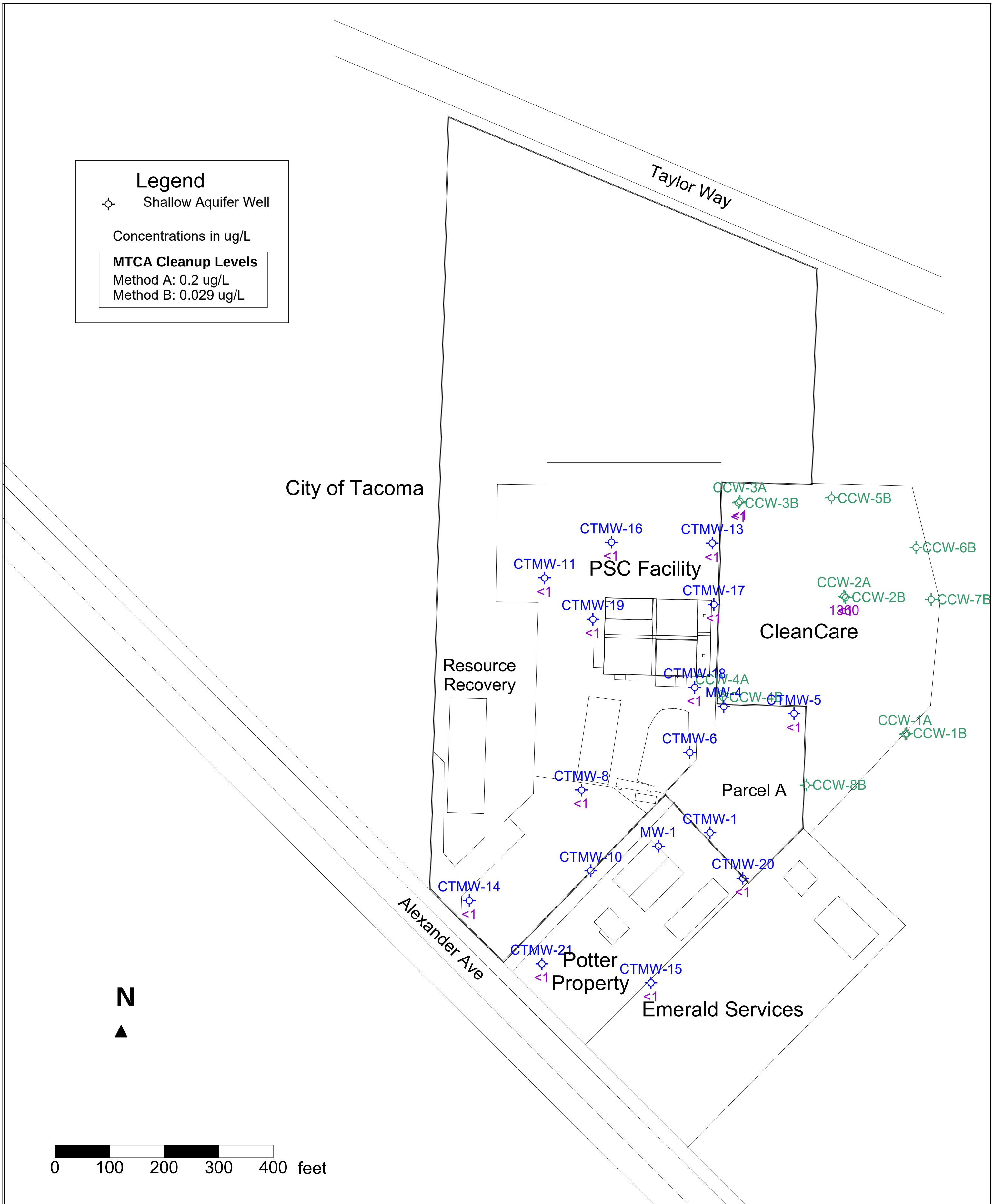
Vinyl Chloride Concentrations
2nd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



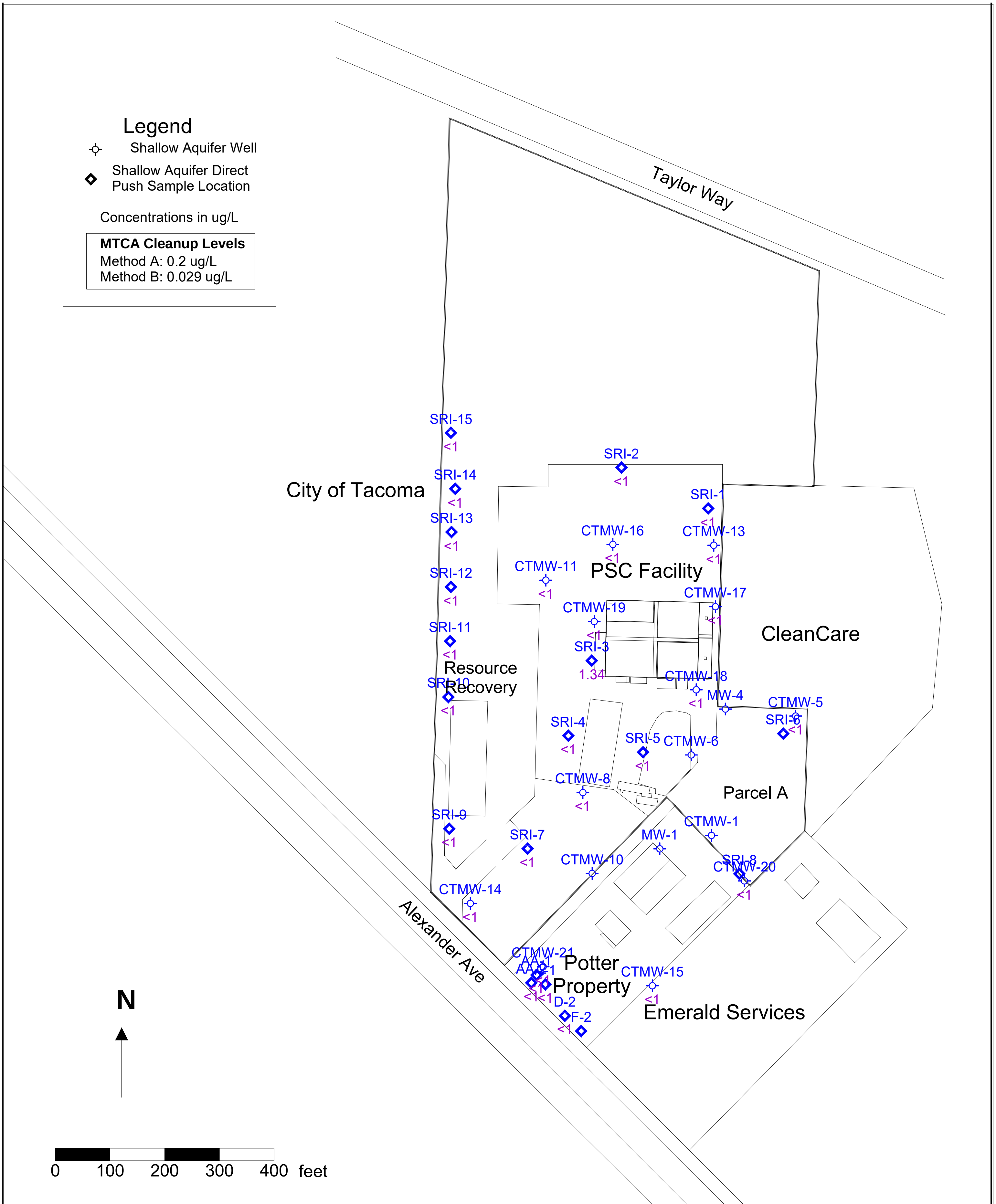
Vinyl Chloride Concentrations
3rd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



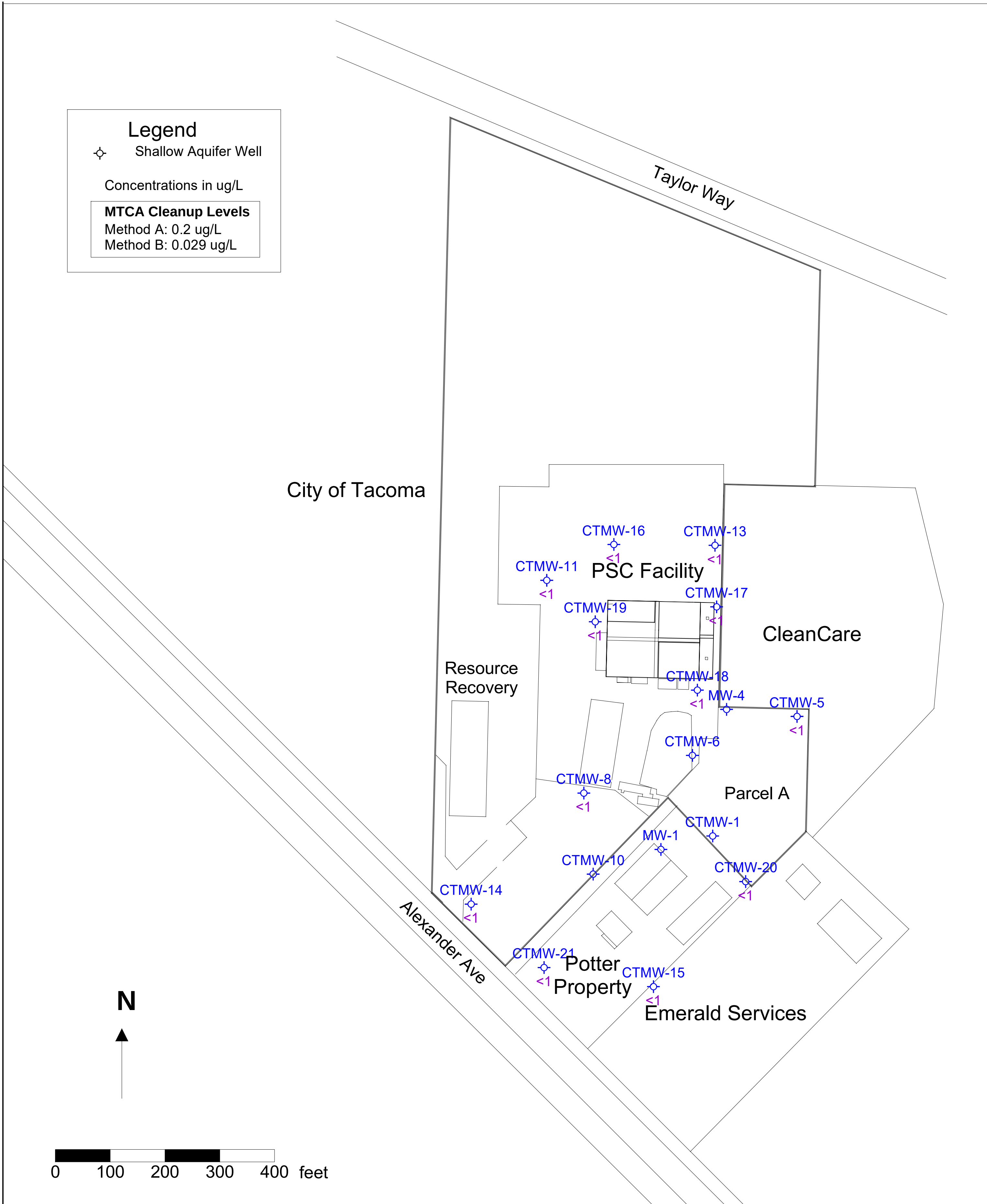
Vinyl Chloride Concentrations
4th Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



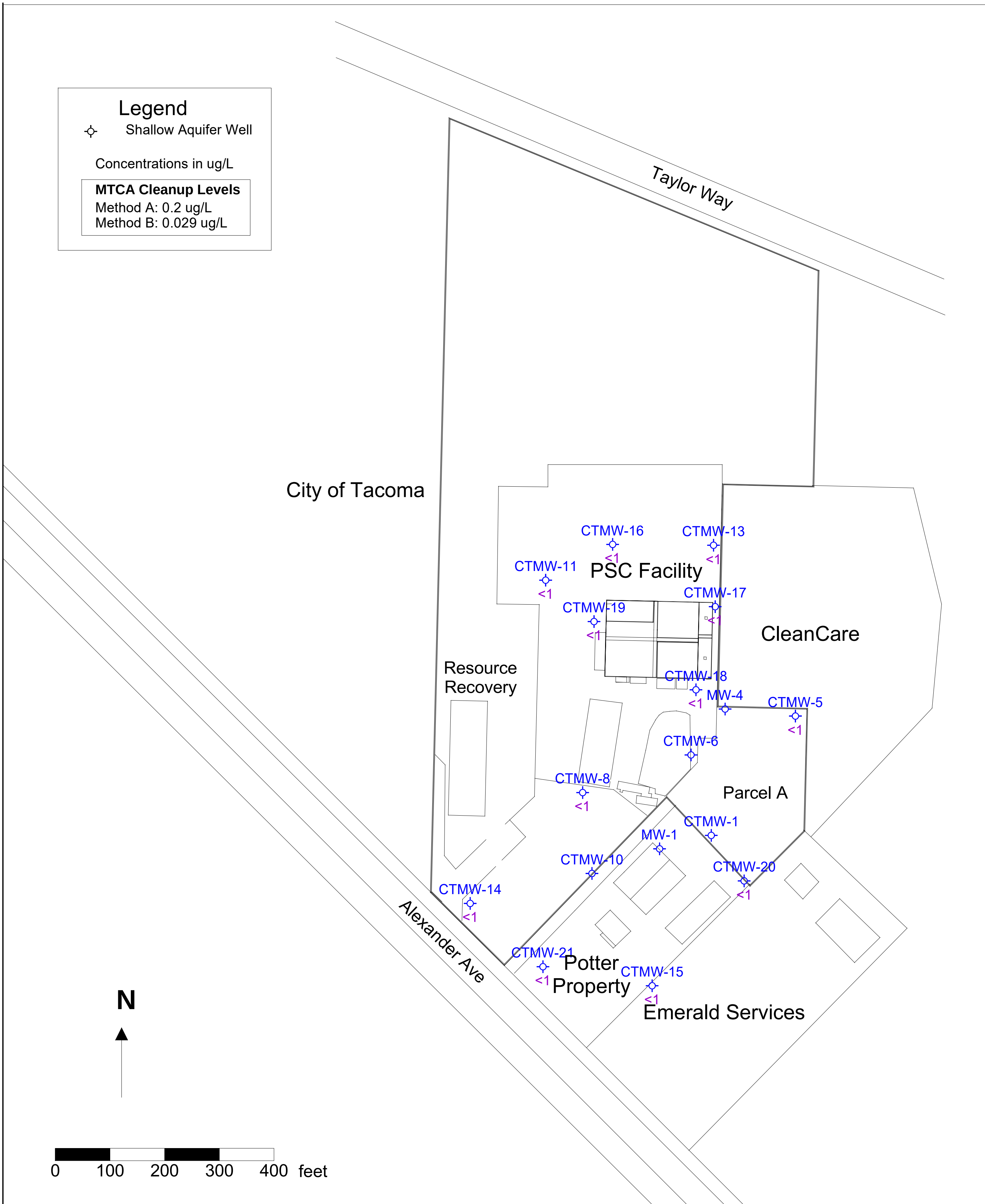
Vinyl Chloride Concentrations
1st Quarter 2001 and SRI
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



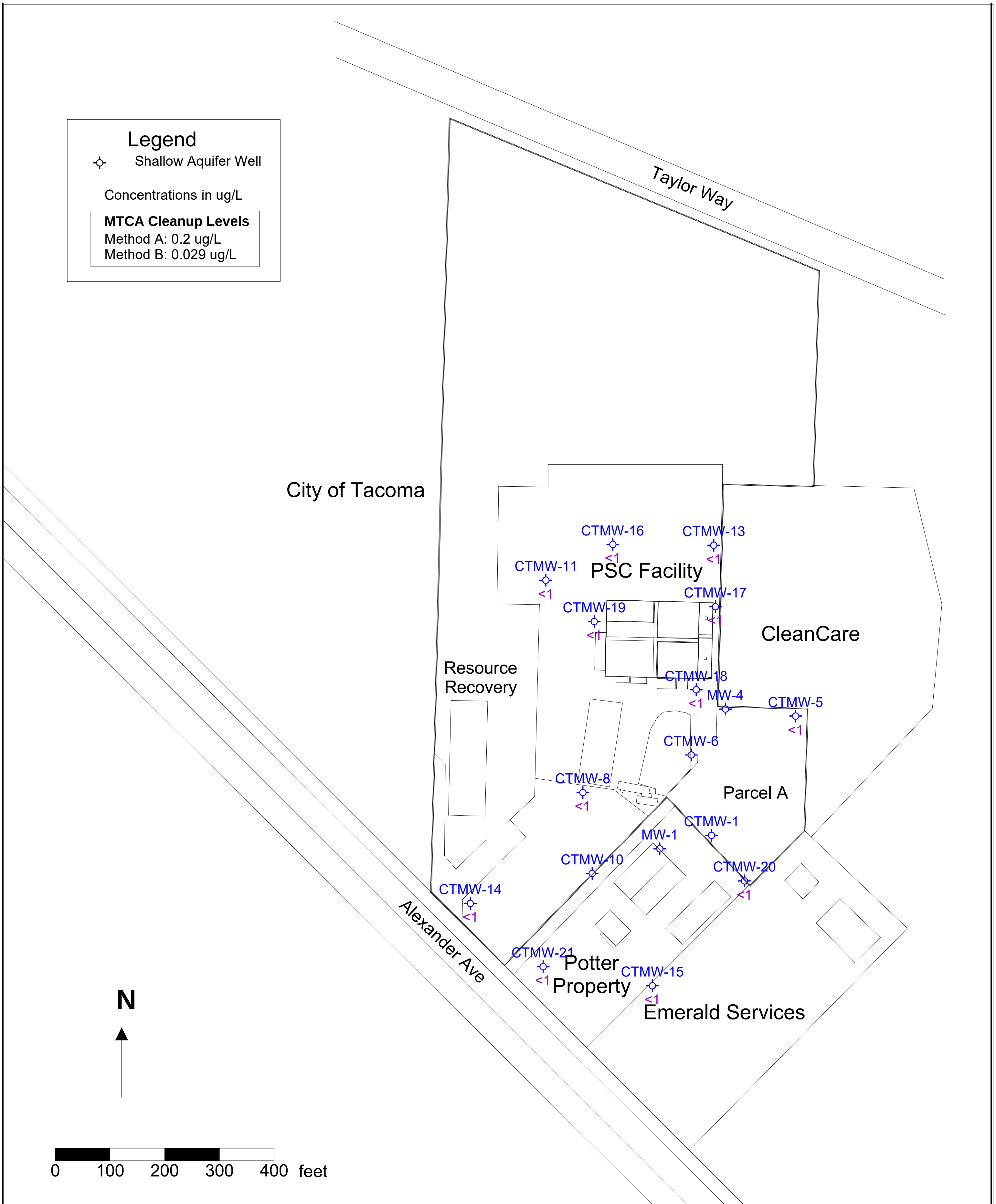
Vinyl Chloride Concentrations
2nd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



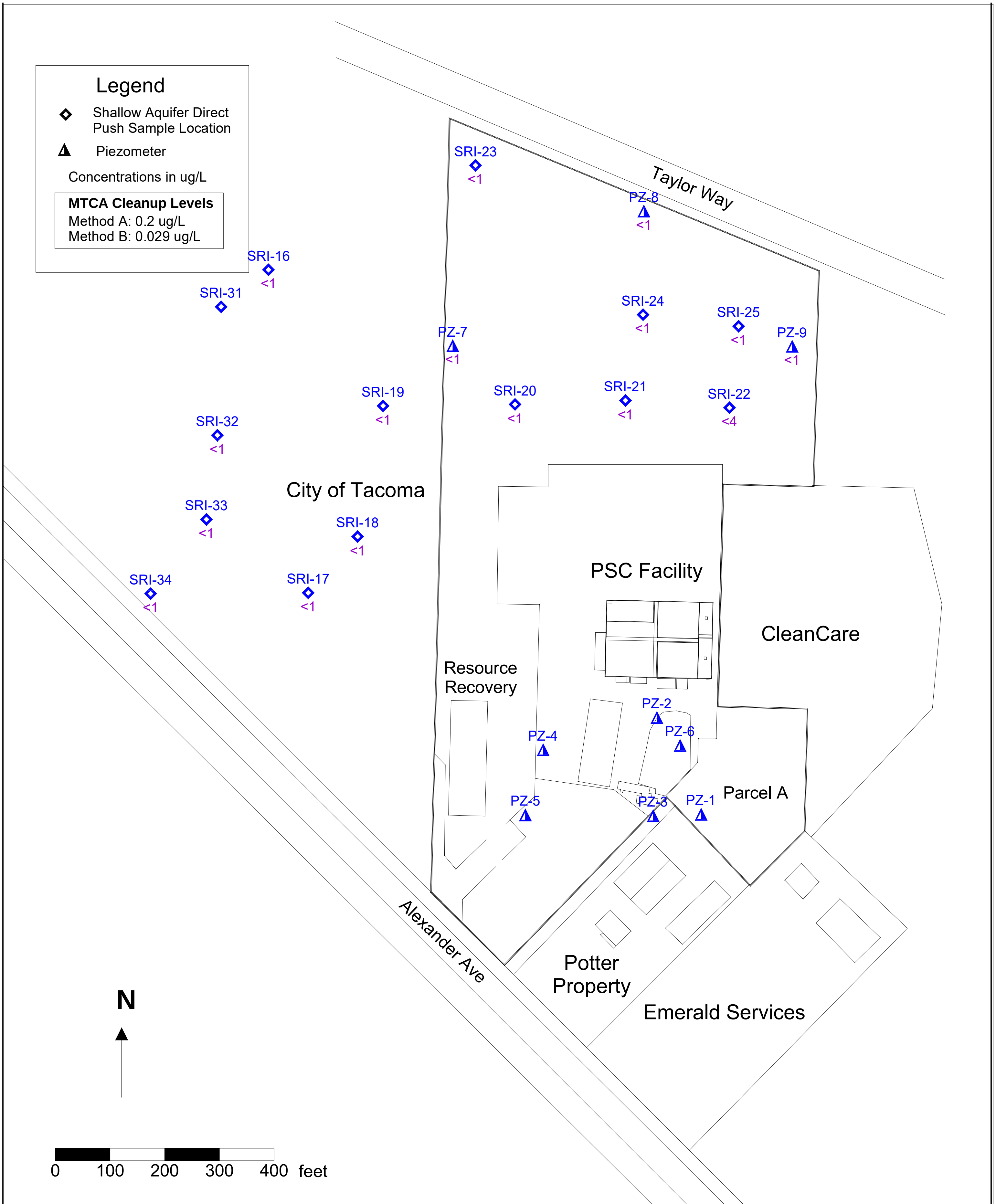
Vinyl Chloride Concentrations
3rd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



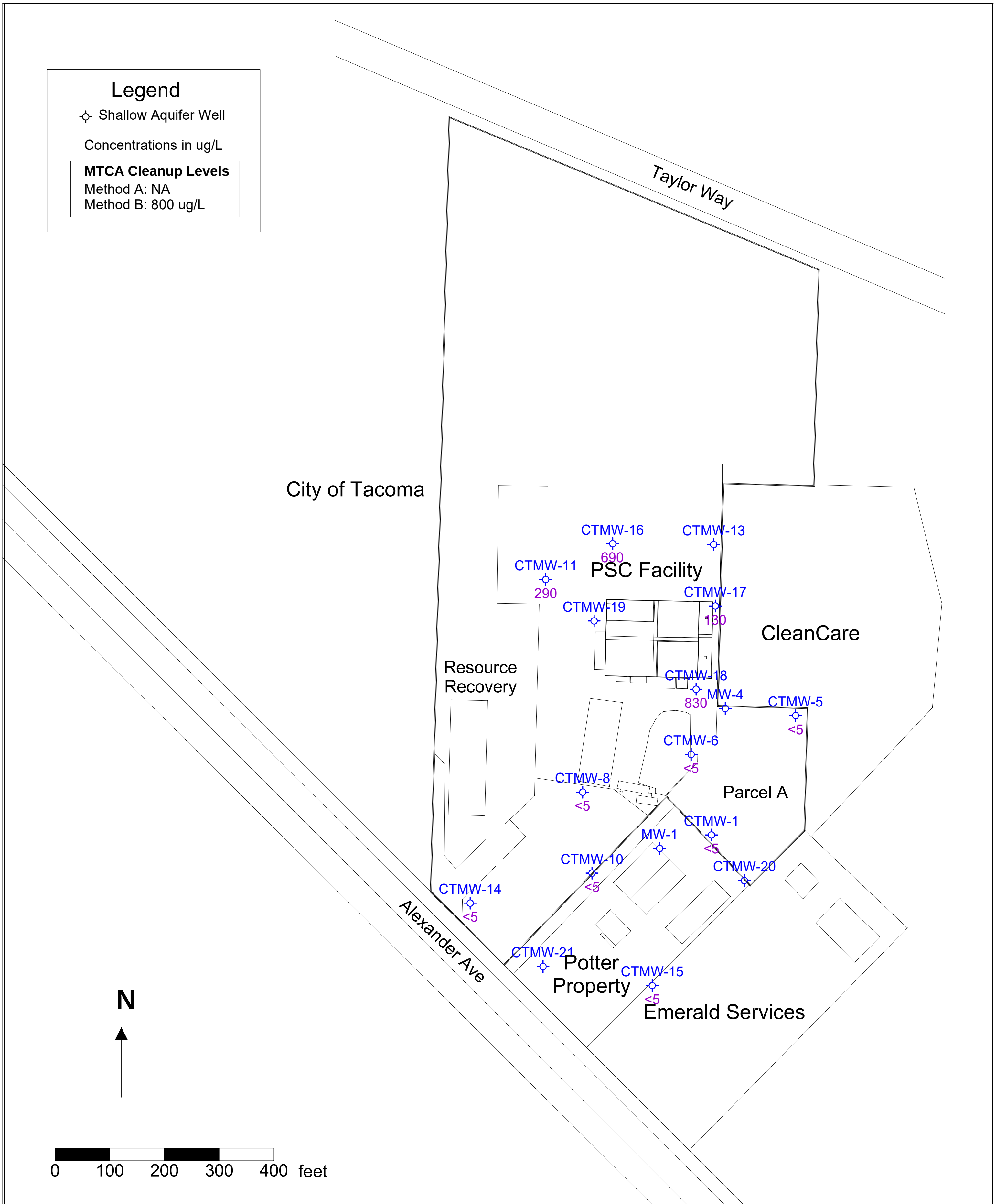
Vinyl Chloride Concentrations
4th Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



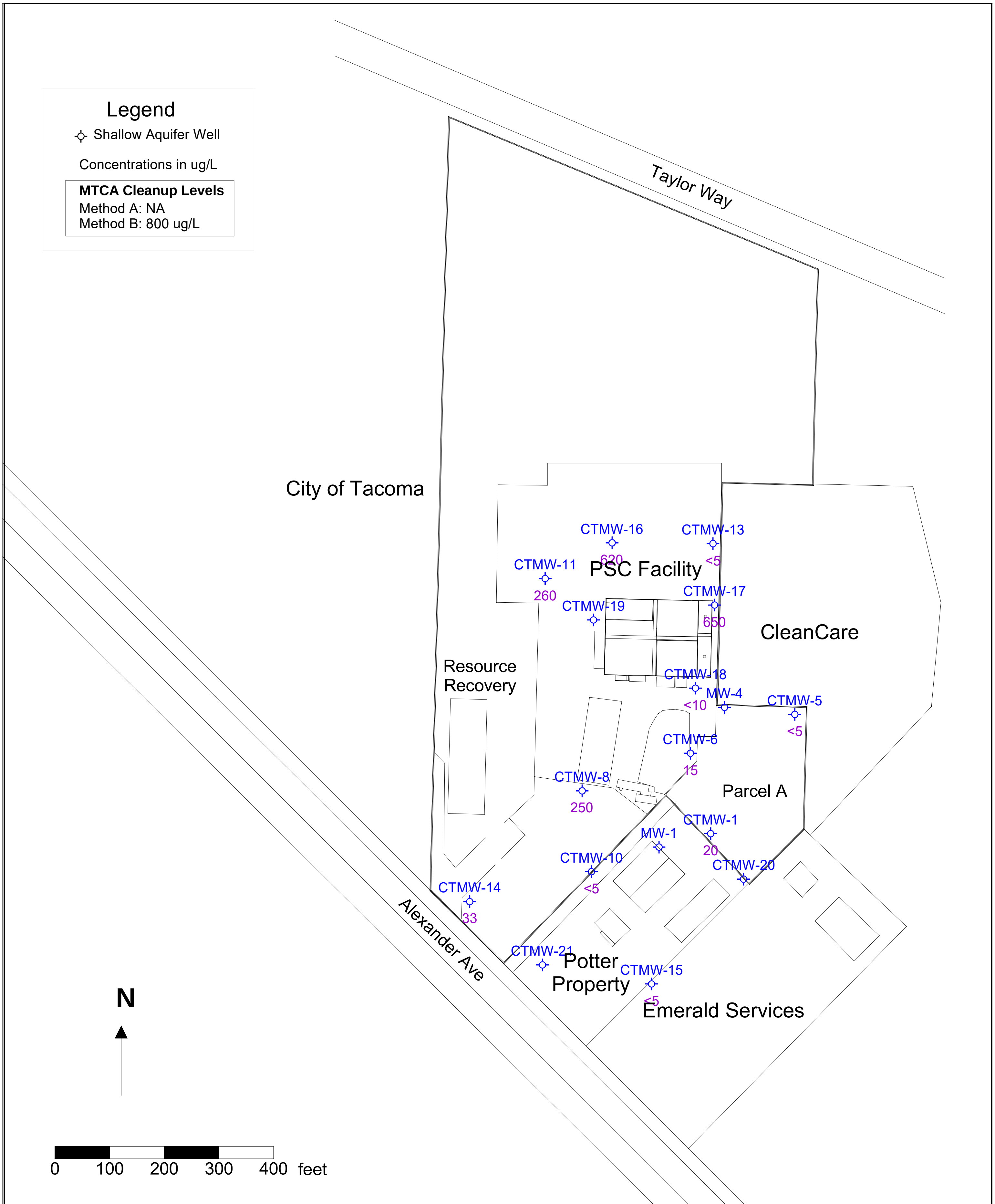
Vinyl Chloride Concentrations
SRI II 2002
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



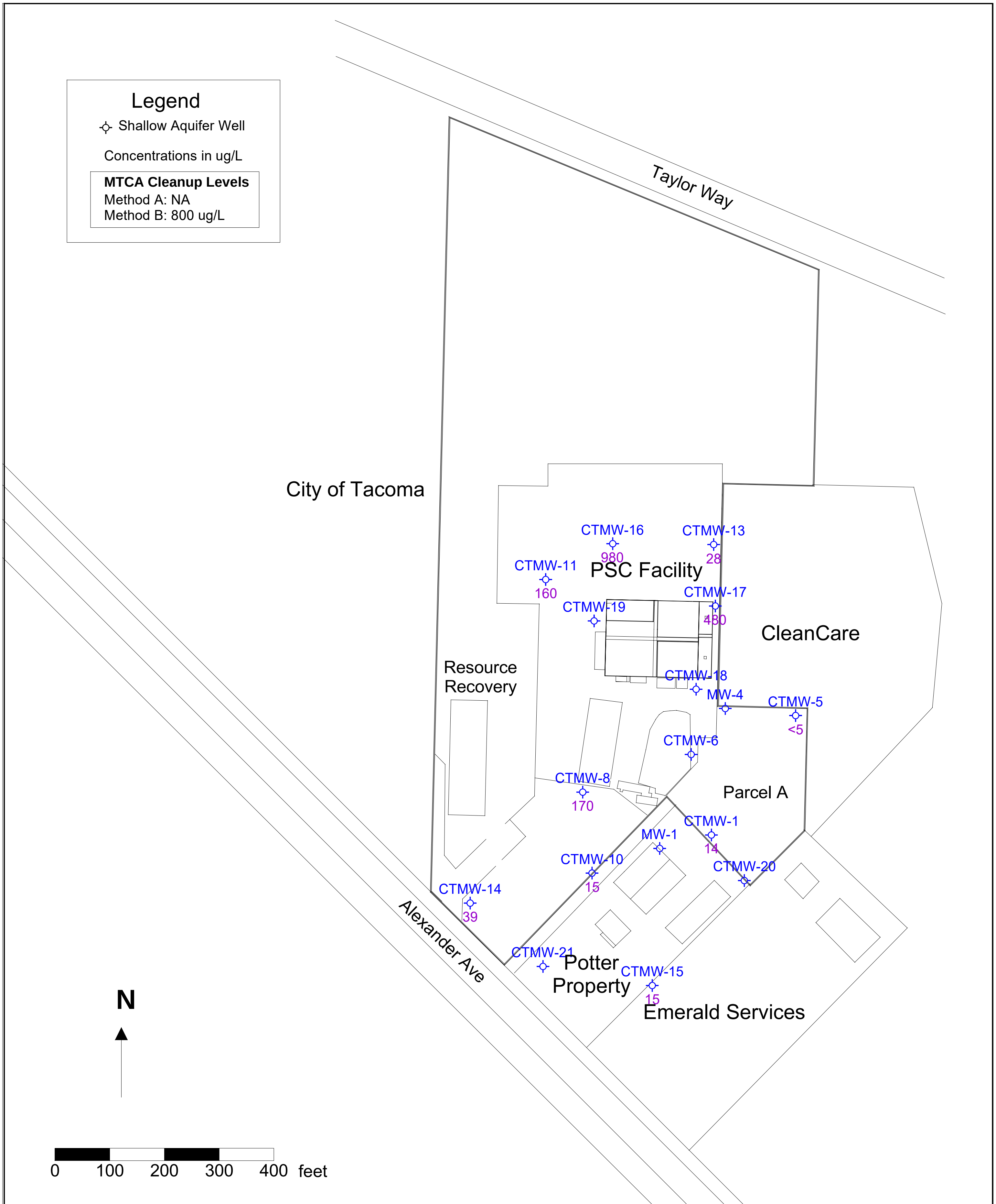
Acetone Concentrations
1st Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



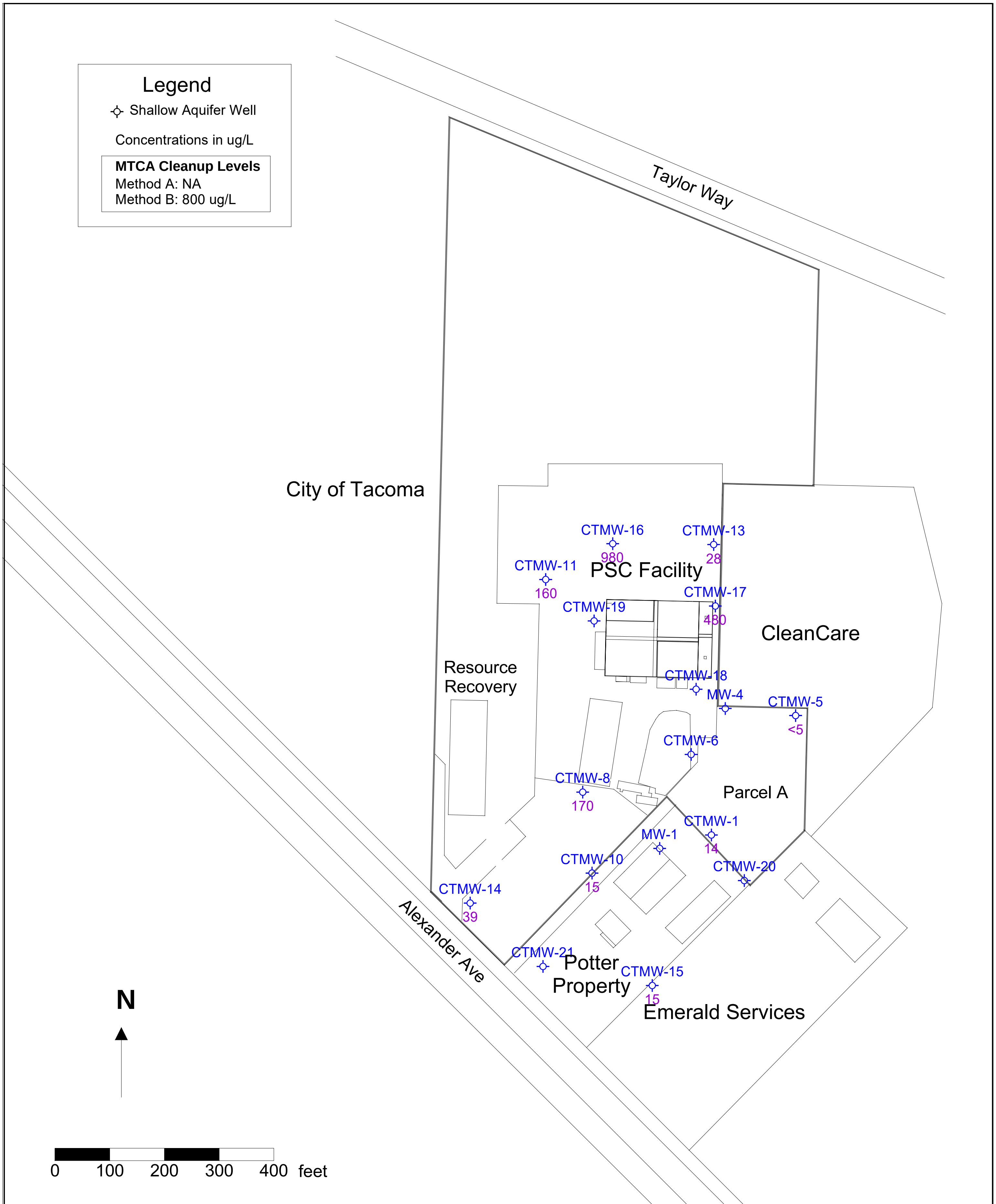
Acetone Concentrations
2nd Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



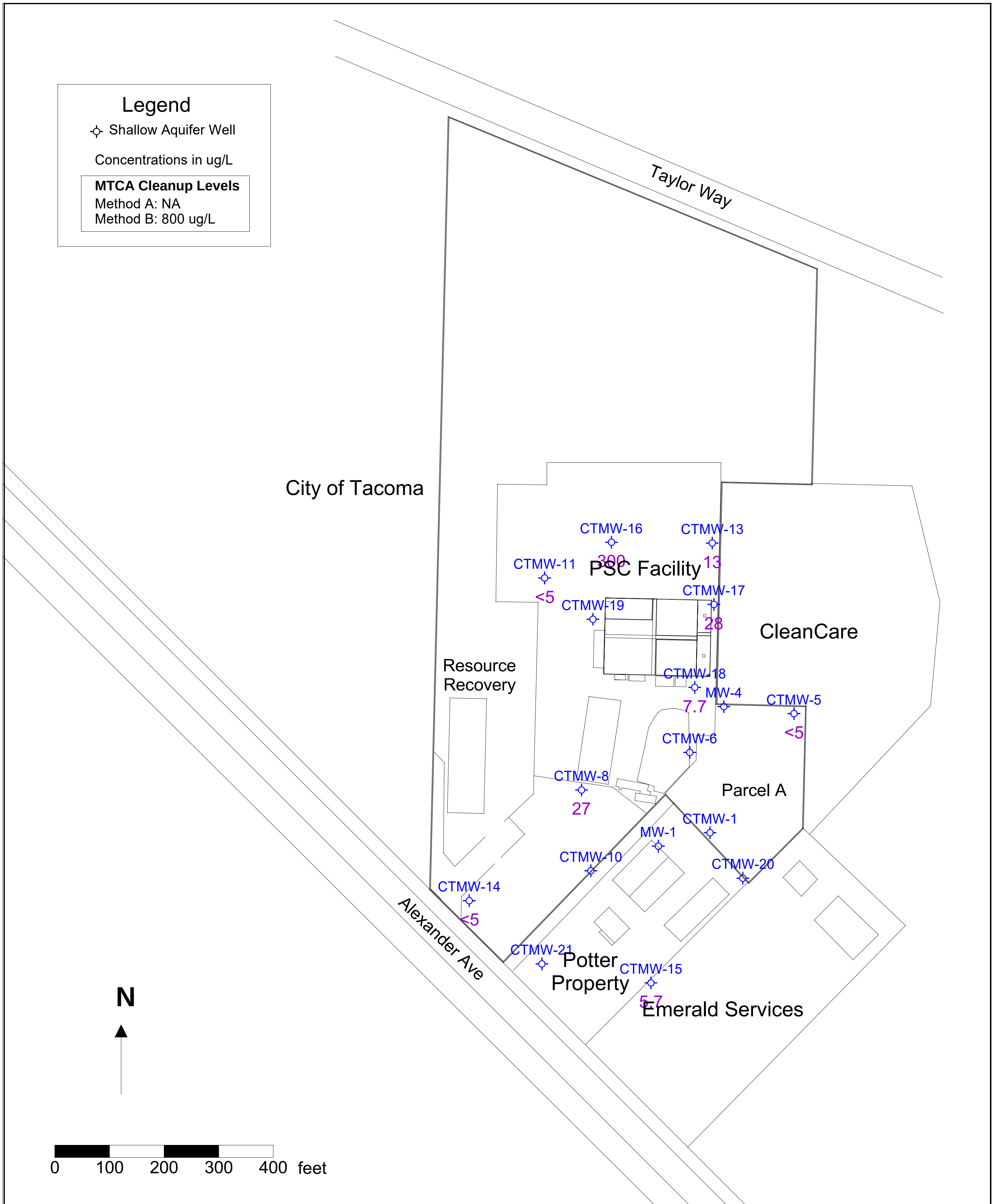
Acetone Concentrations
3rd Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



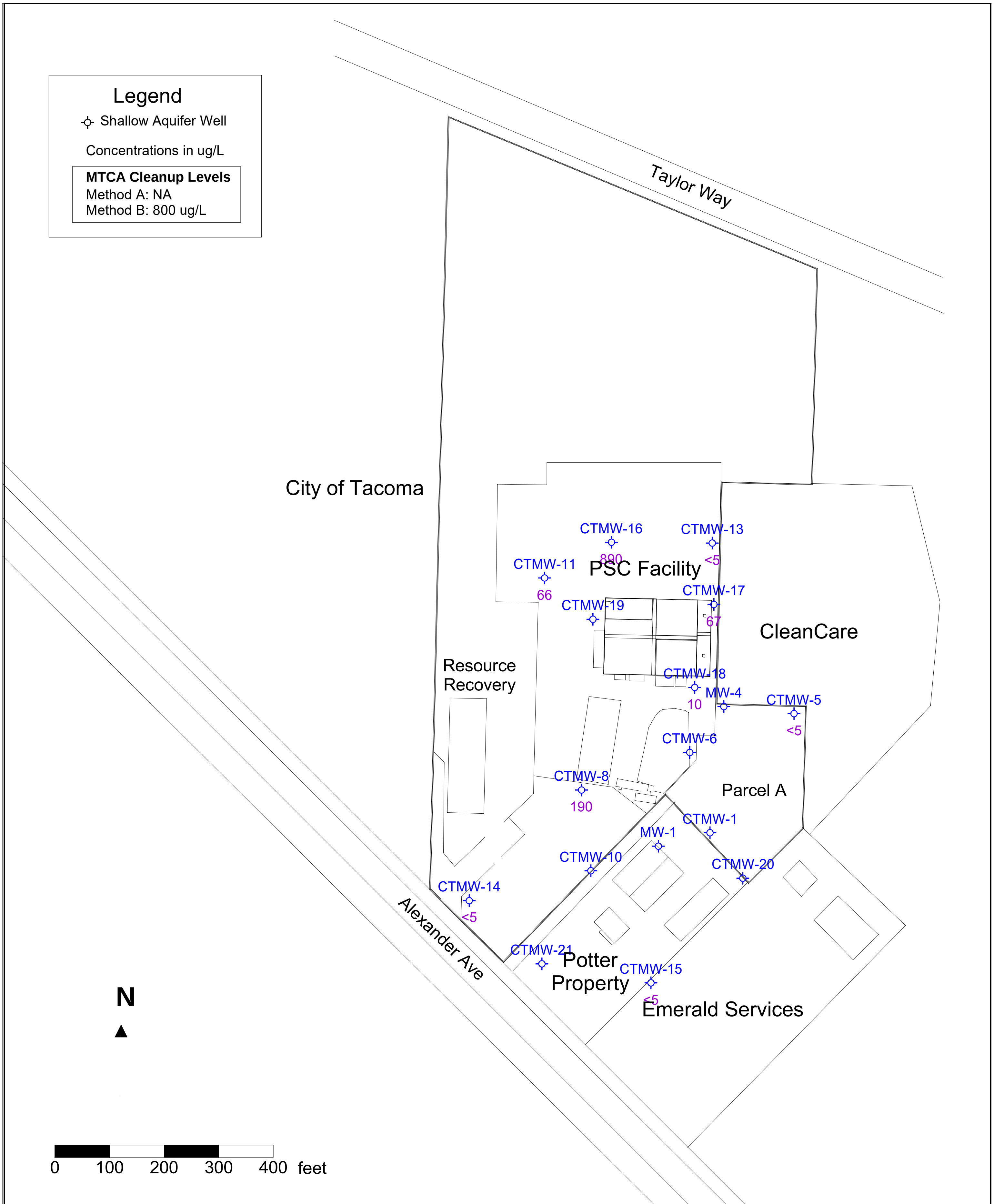
Acetone Concentrations
4th Quarter 1998
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



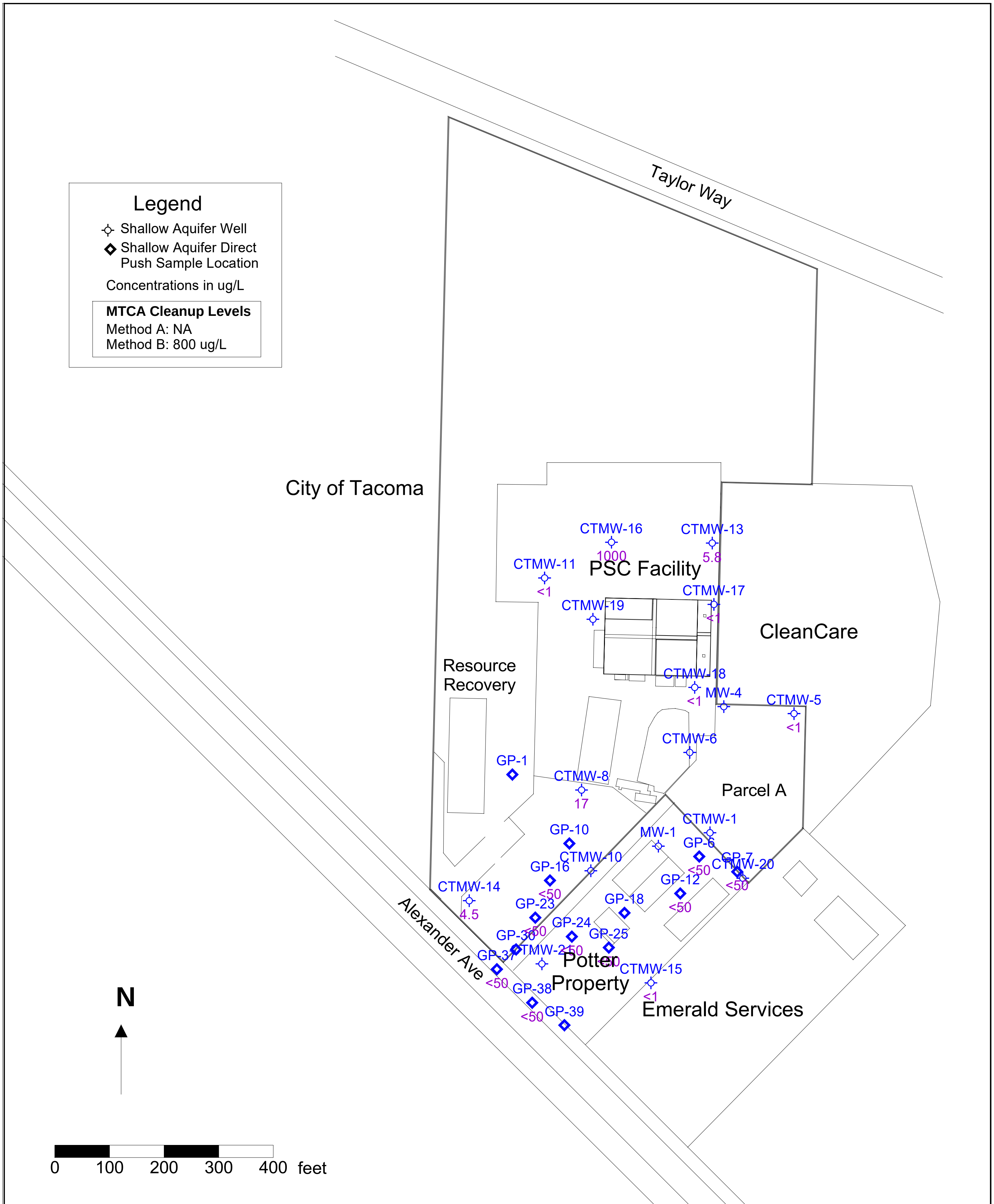
Acetone Concentrations
2nd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



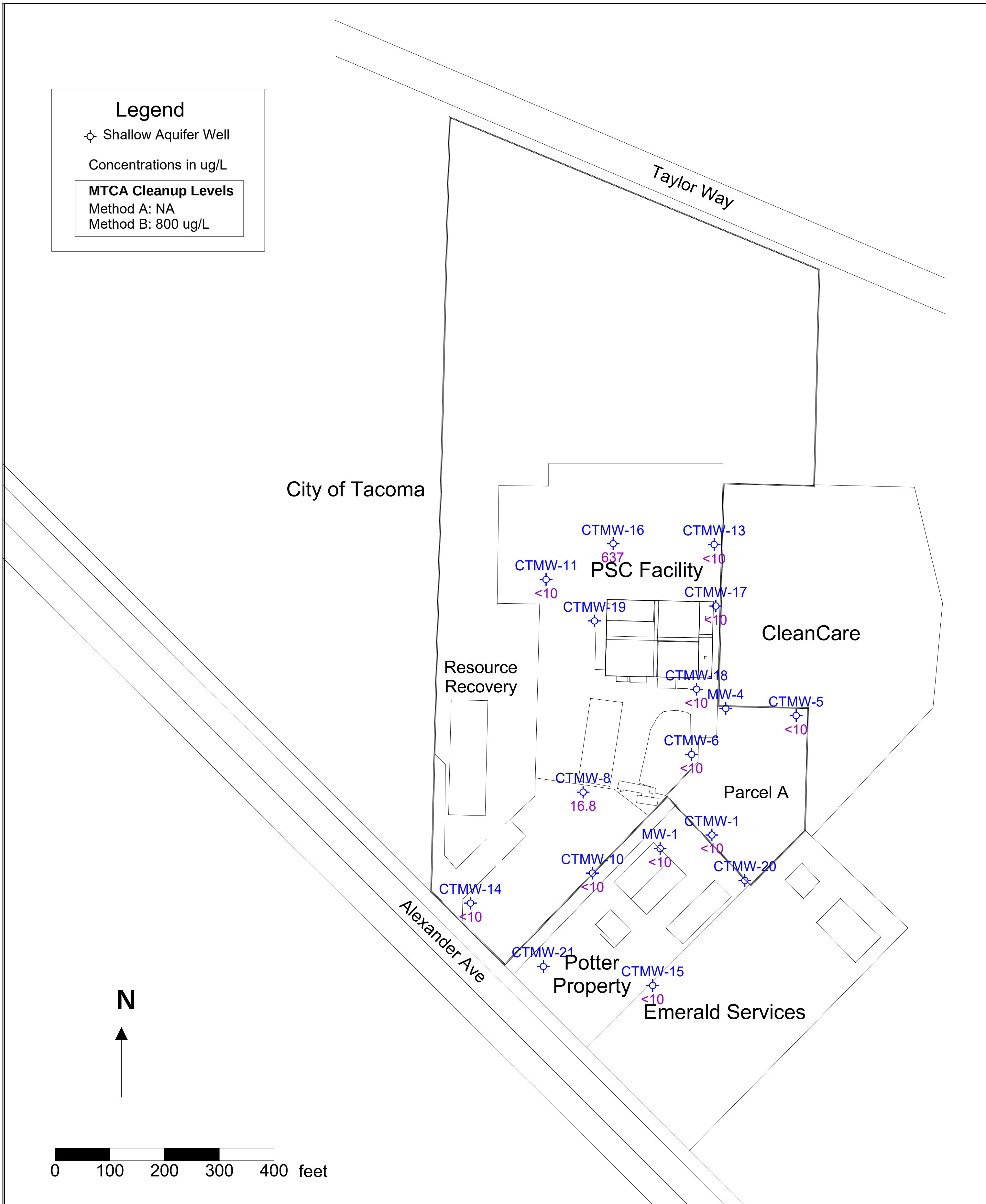
Benzene Concentrations
3rd Quarter 1999
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



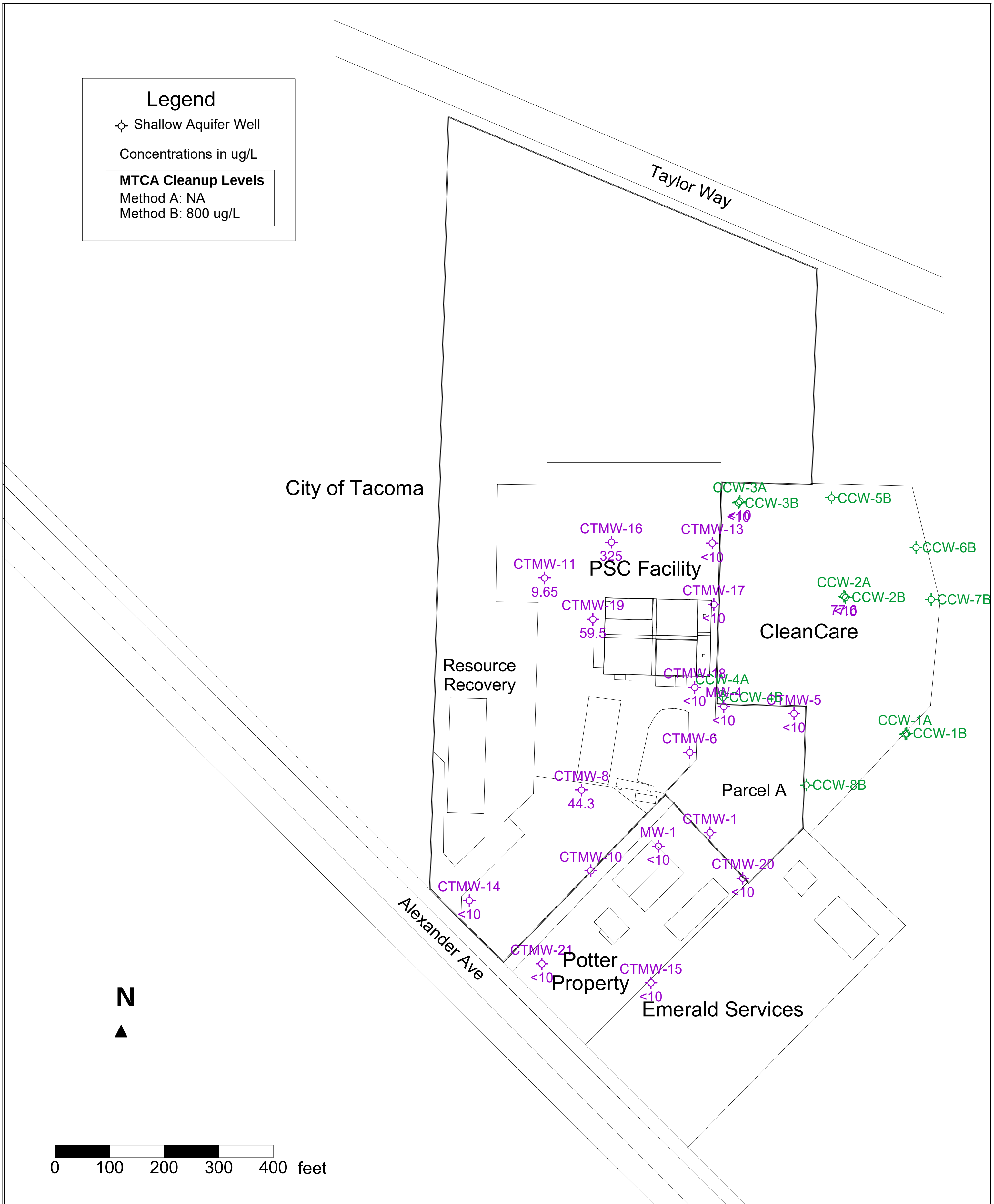
Acetone Concentrations
4th Quarter 1999 and Step-Out Investigation
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



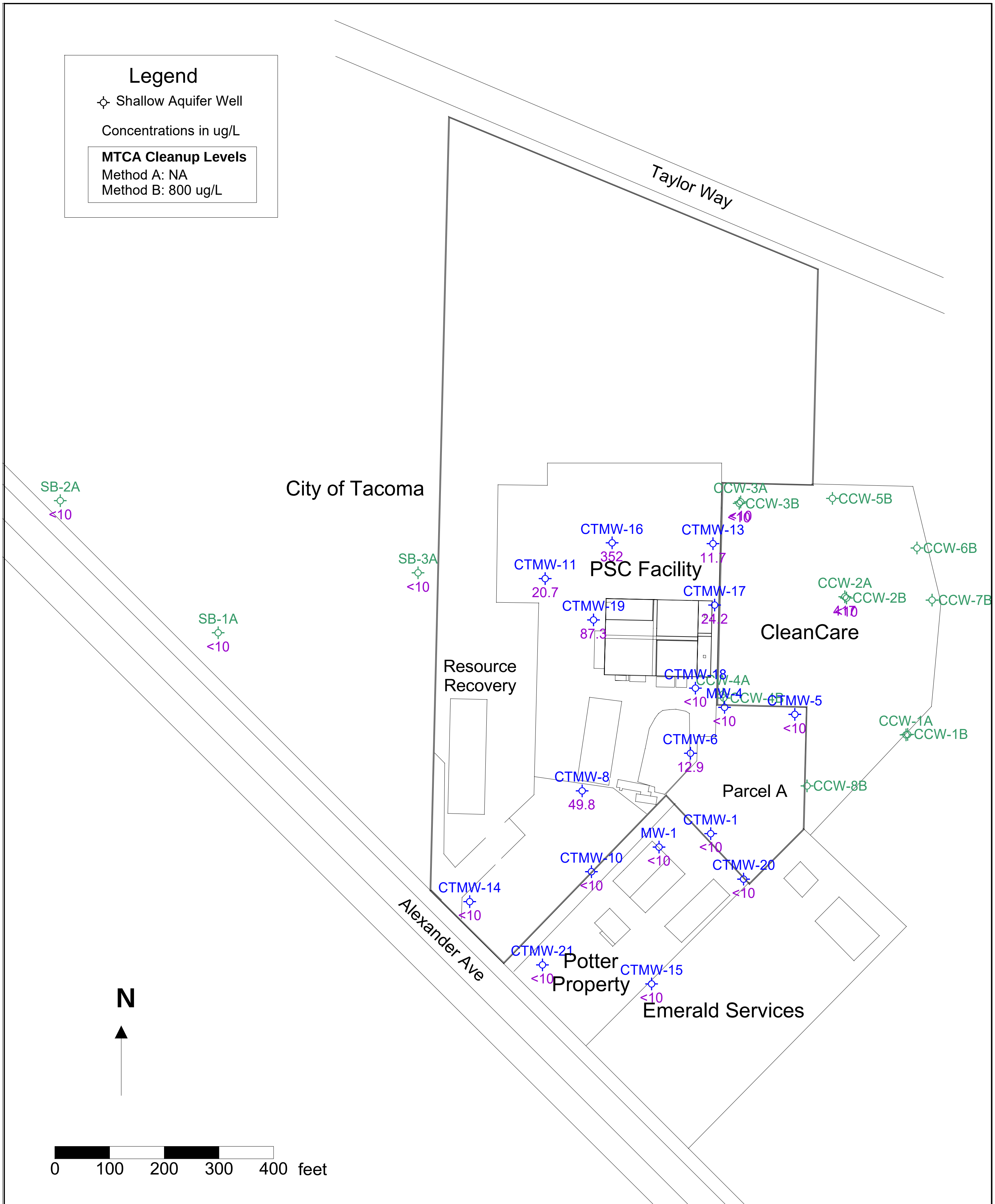
Acetone Concentrations
1st Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



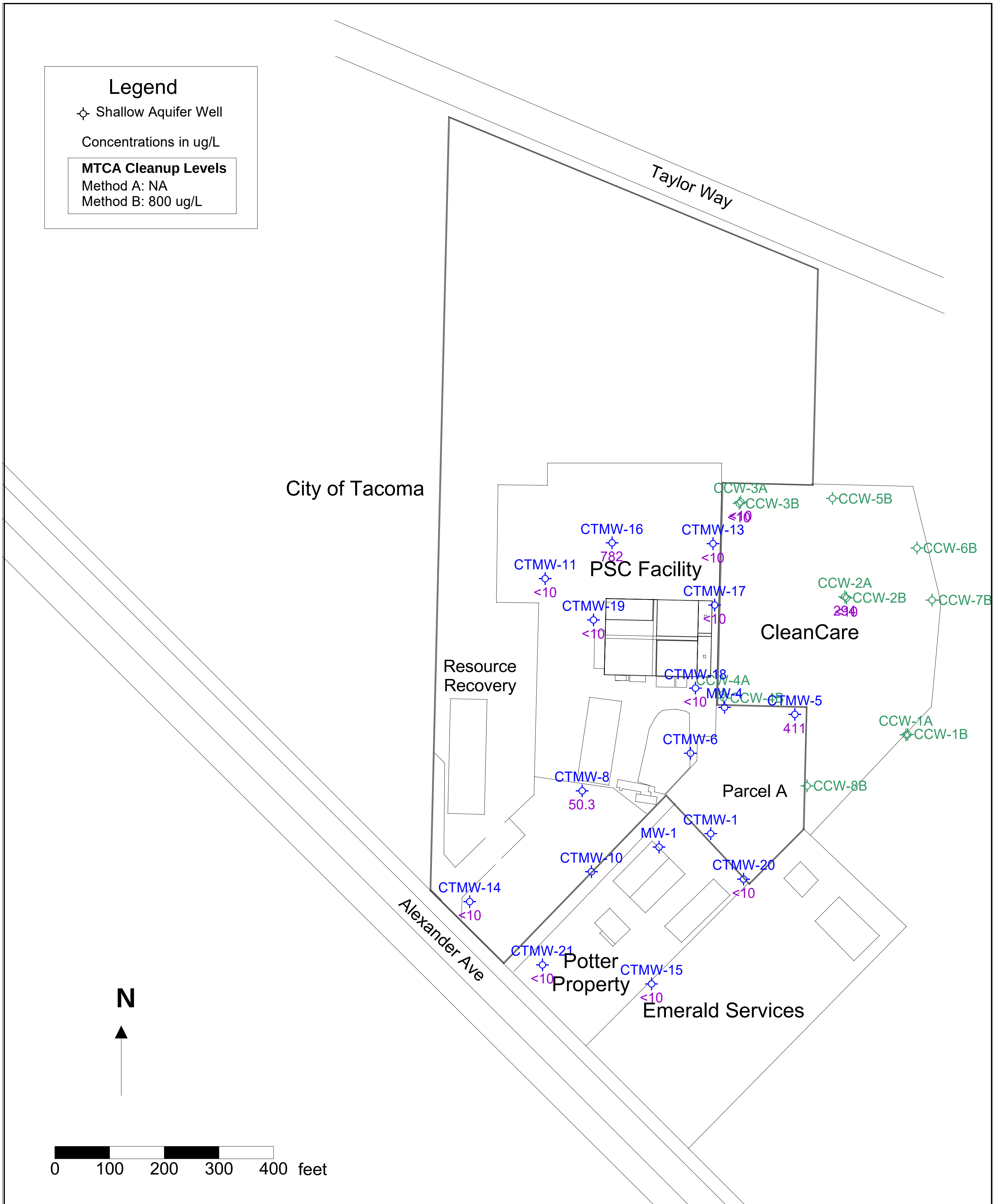
Acetone Concentrations
2nd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



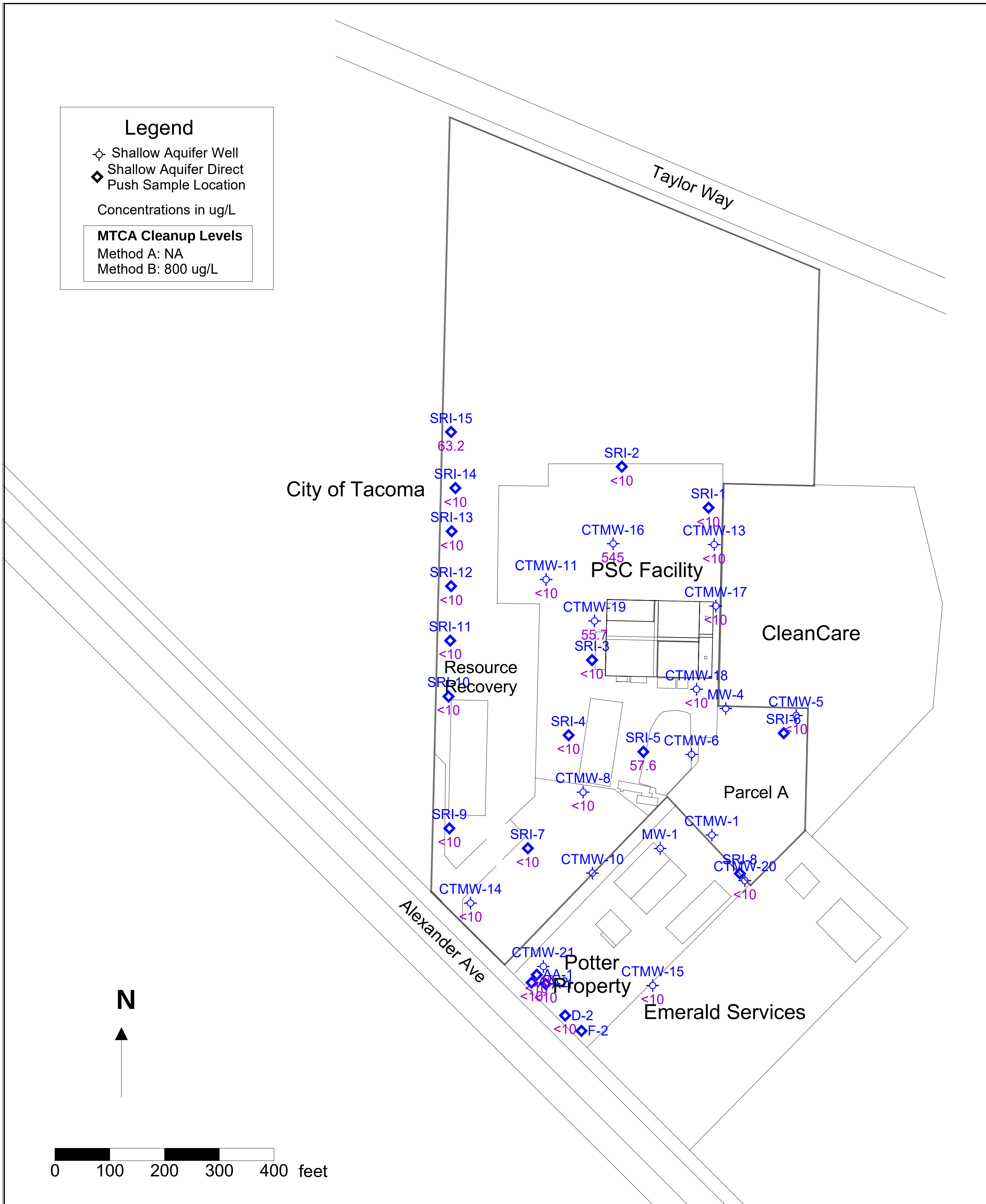
Acetone Concentrations
3rd Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



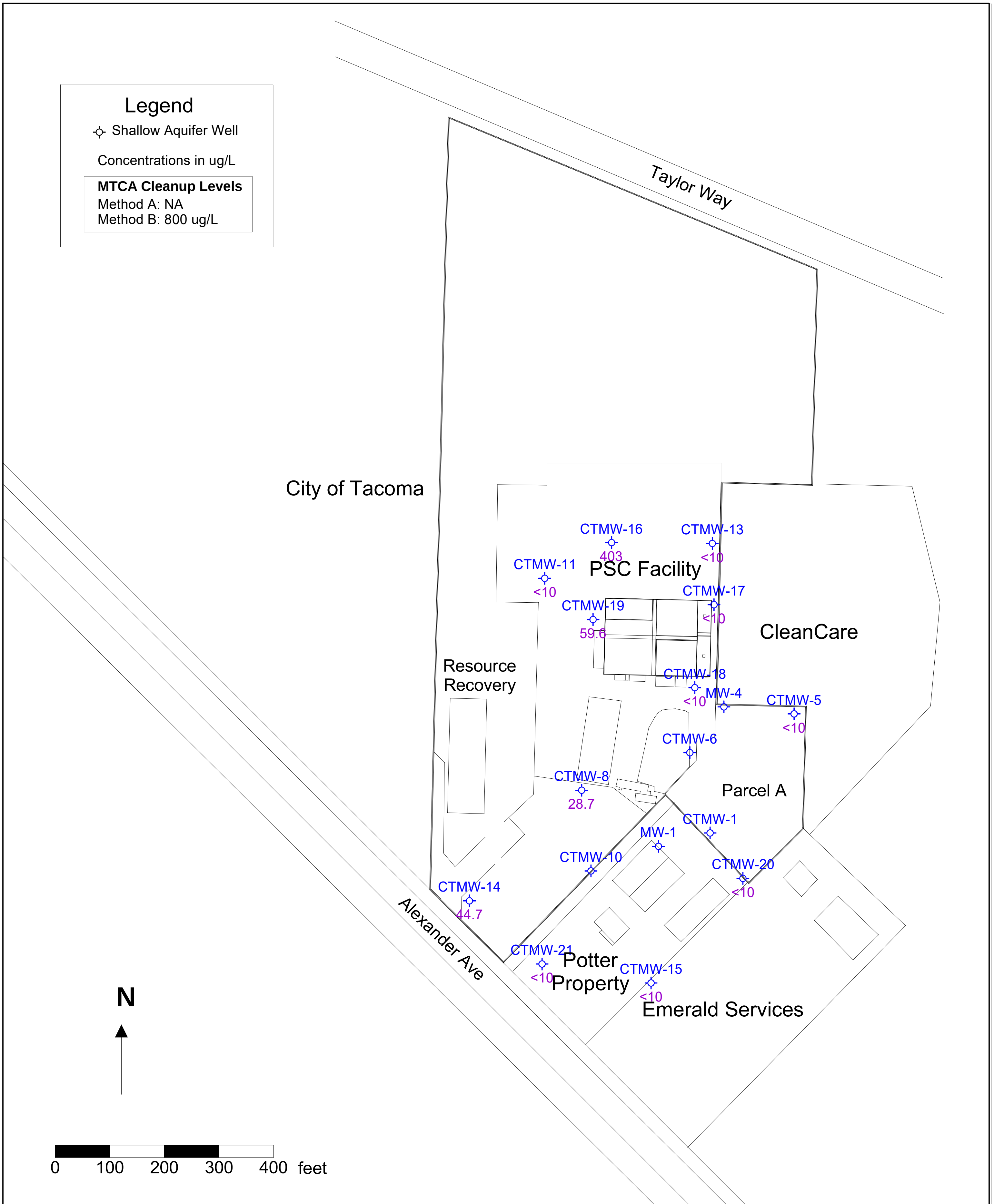
Acetone Concentrations
4th Quarter 2000
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



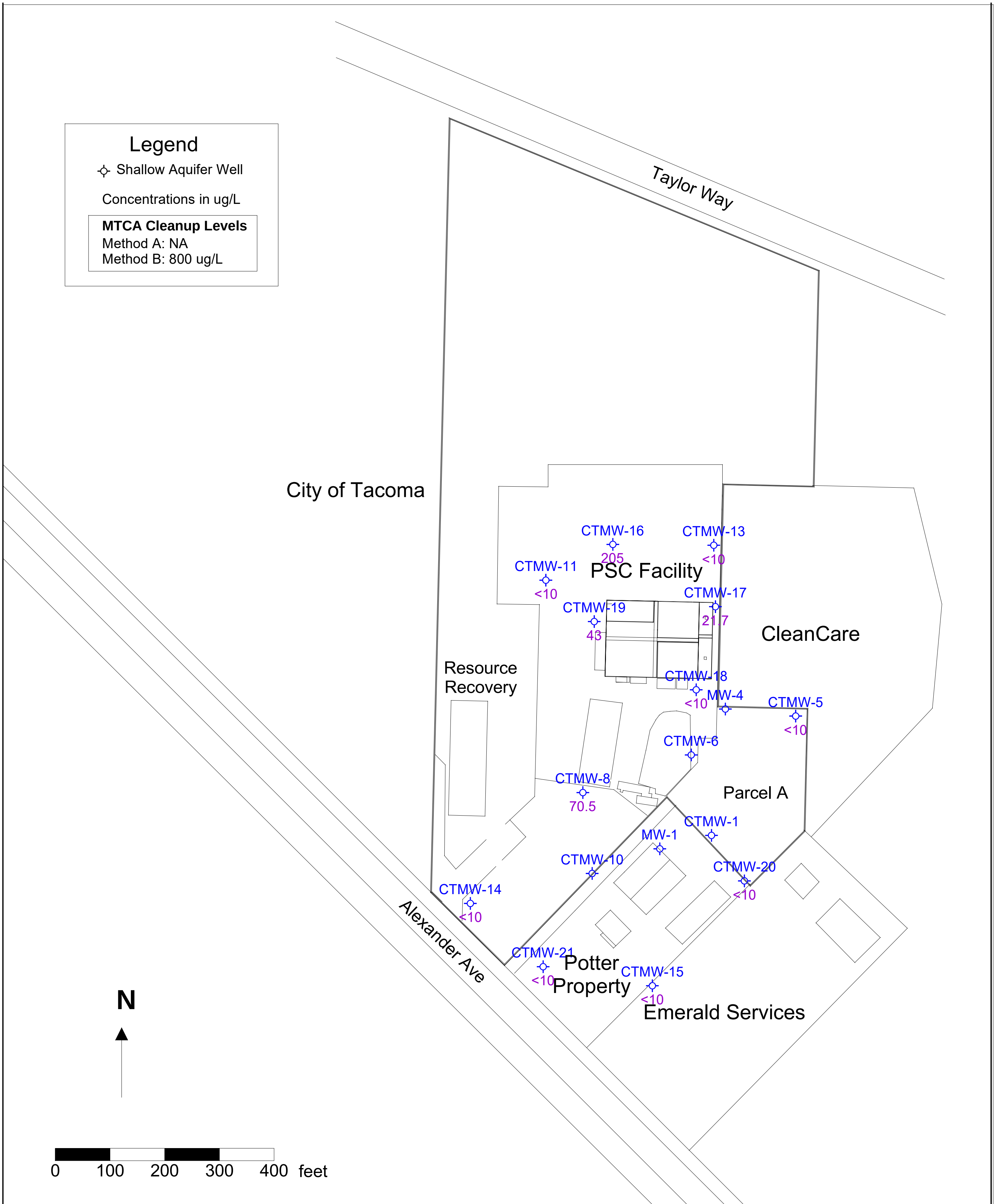
Acetone Concentrations
1st Quarter 2001 and SRI
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



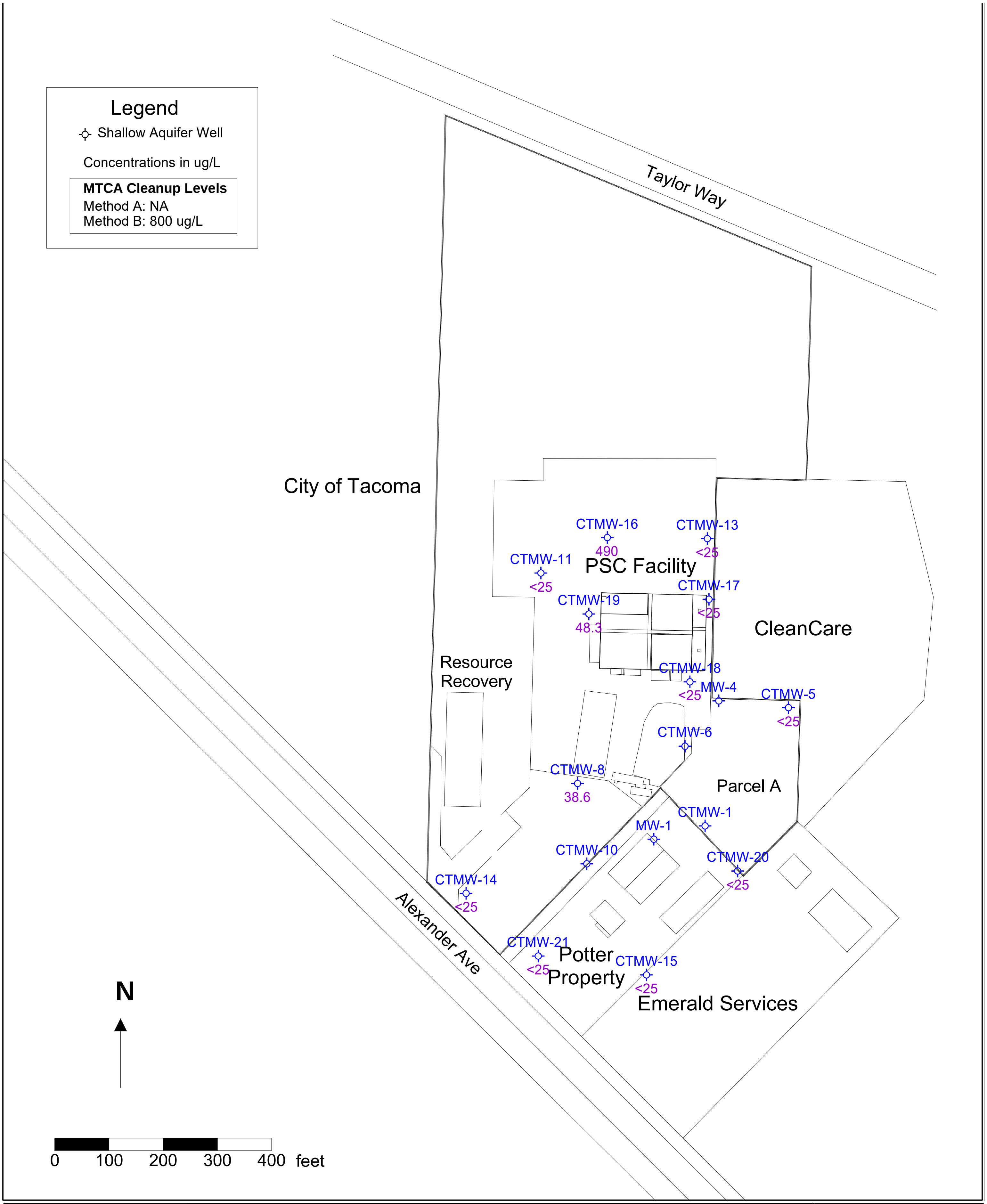
Acetone Concentrations
2nd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



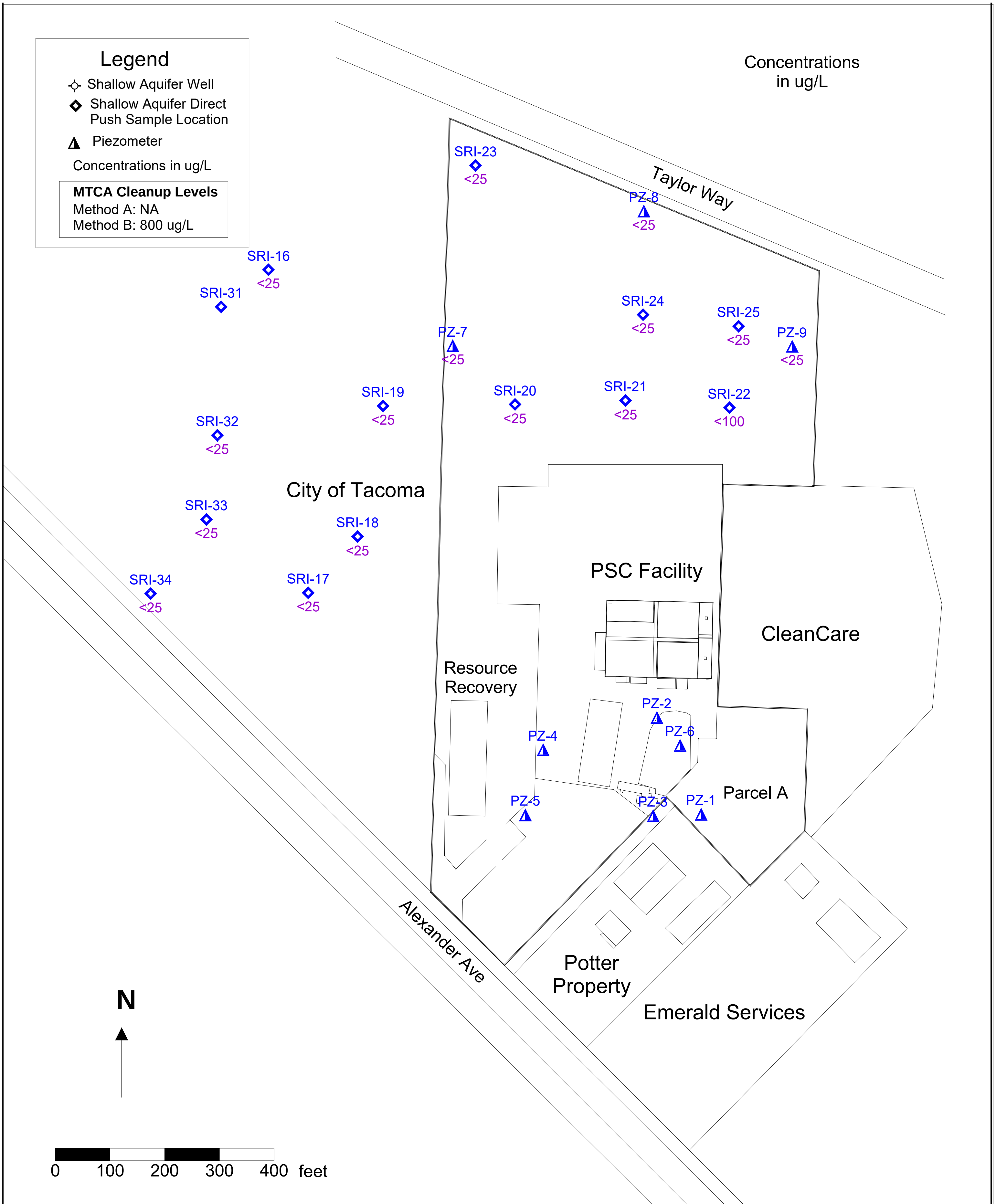
Acetone Concentrations
3rd Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



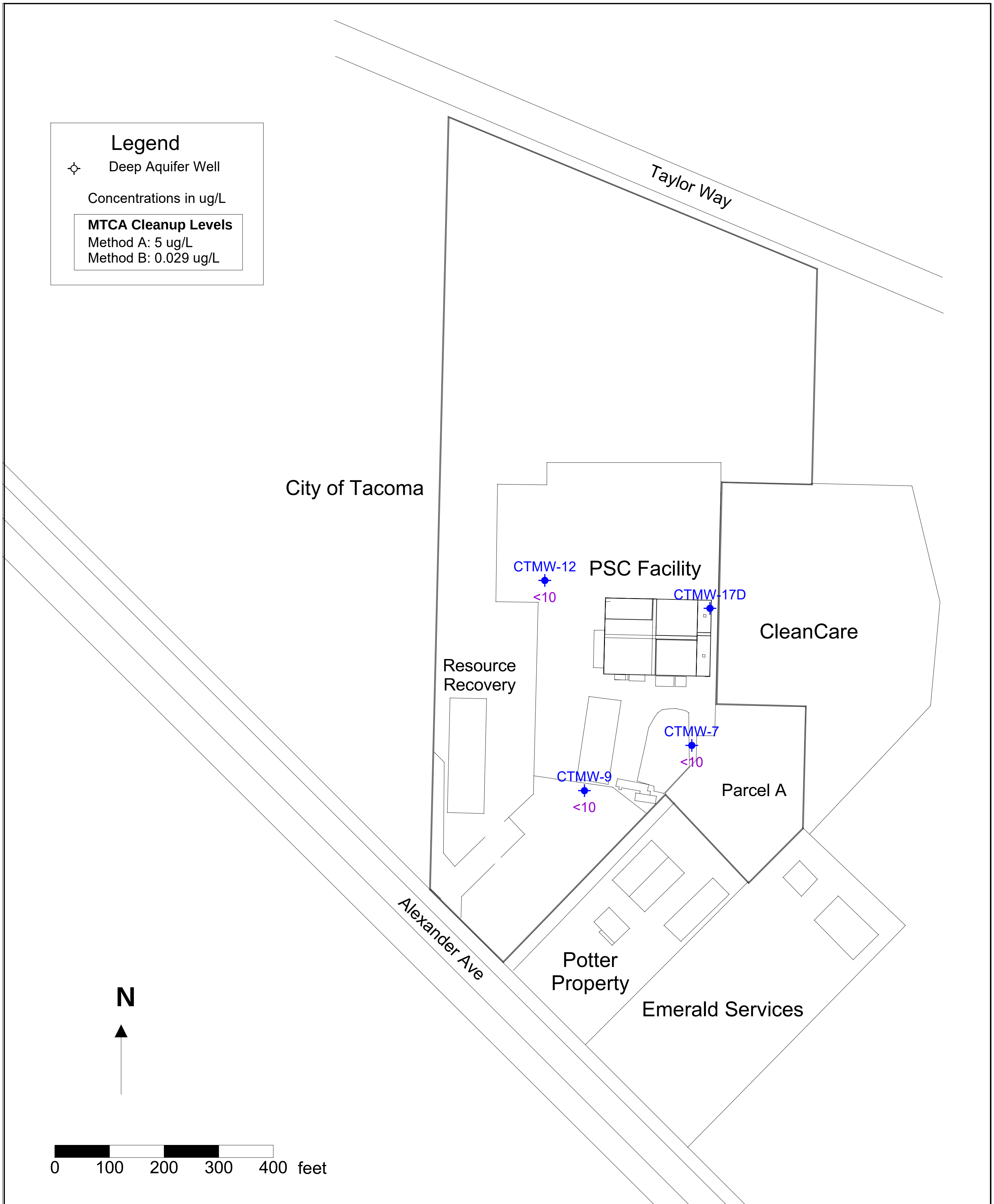
Acetone Concentrations
4th Quarter 2001
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



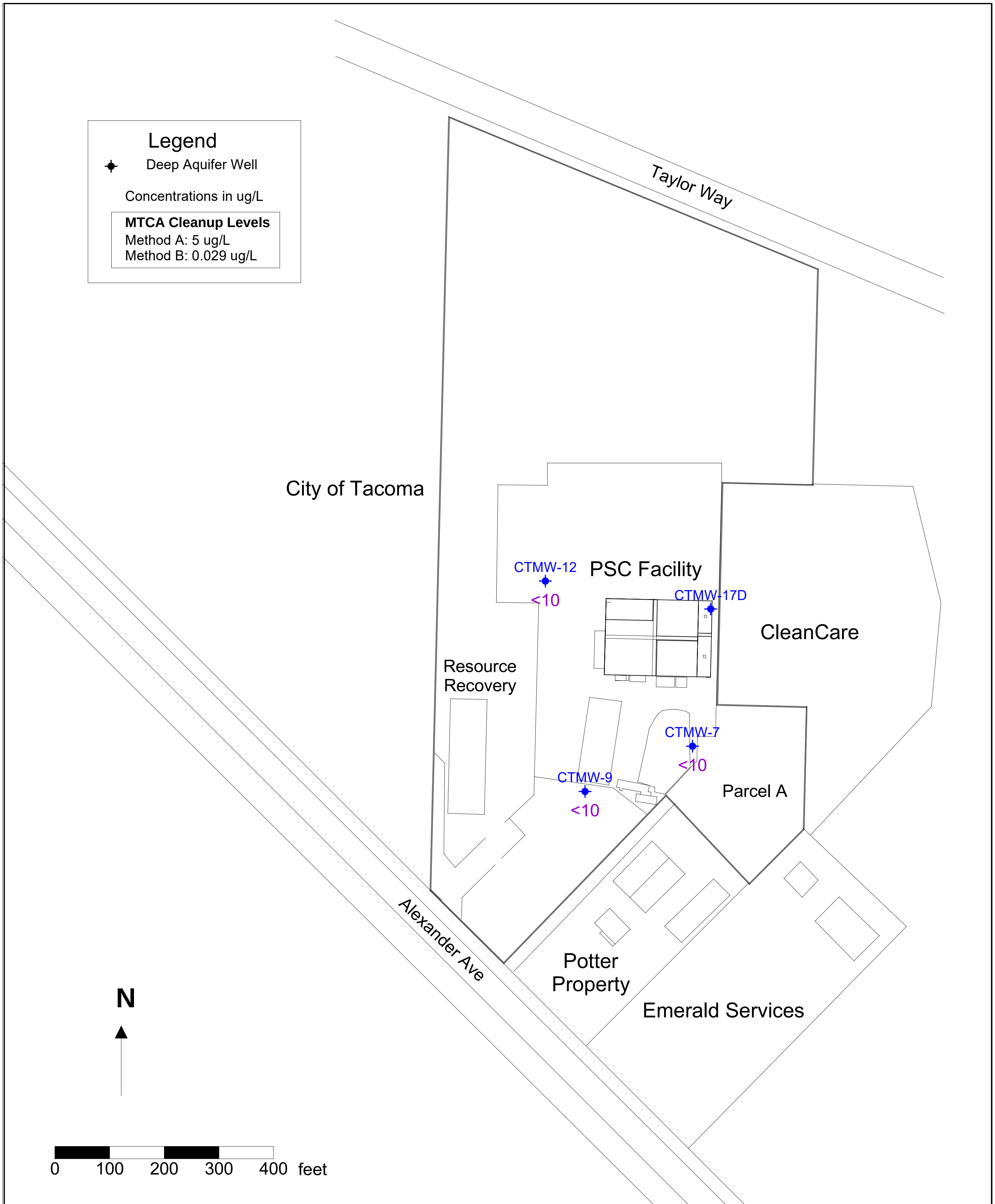
Acetone Concentrations
SRI II 2002
Shallow Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



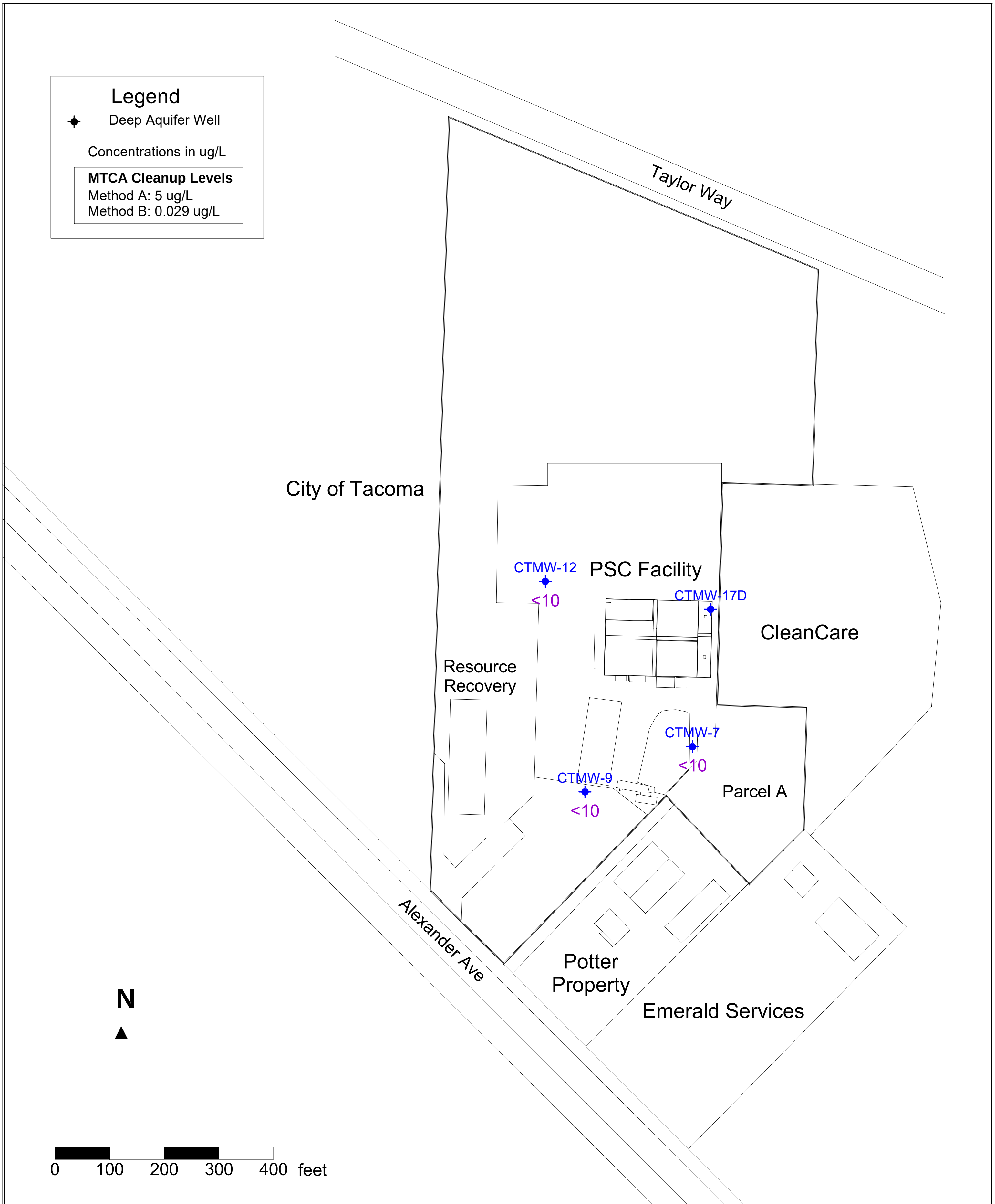
Arsenic Concentrations
1st Quarter 1998
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



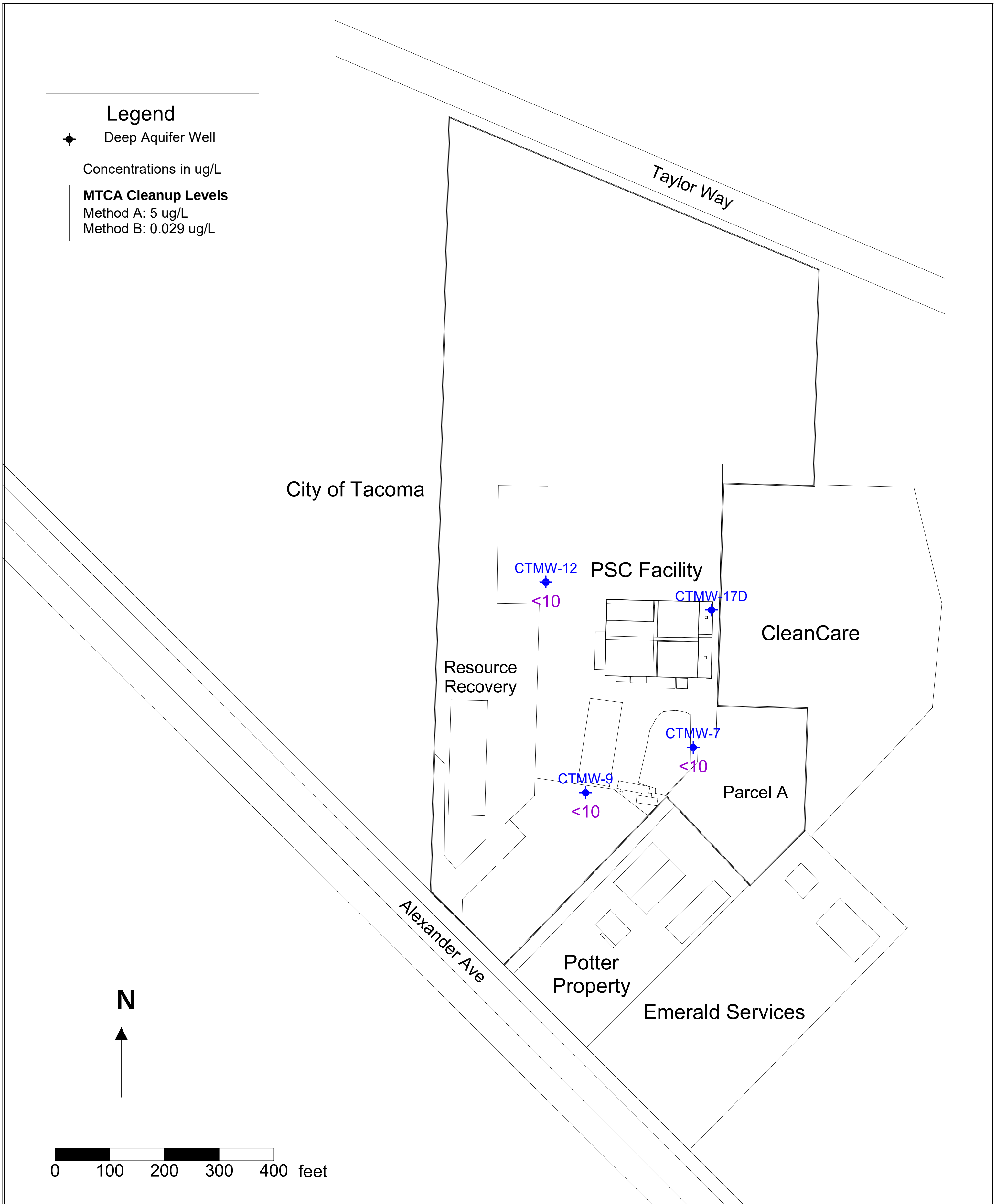
Arsenic Concentrations
2nd Quarter 1998
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



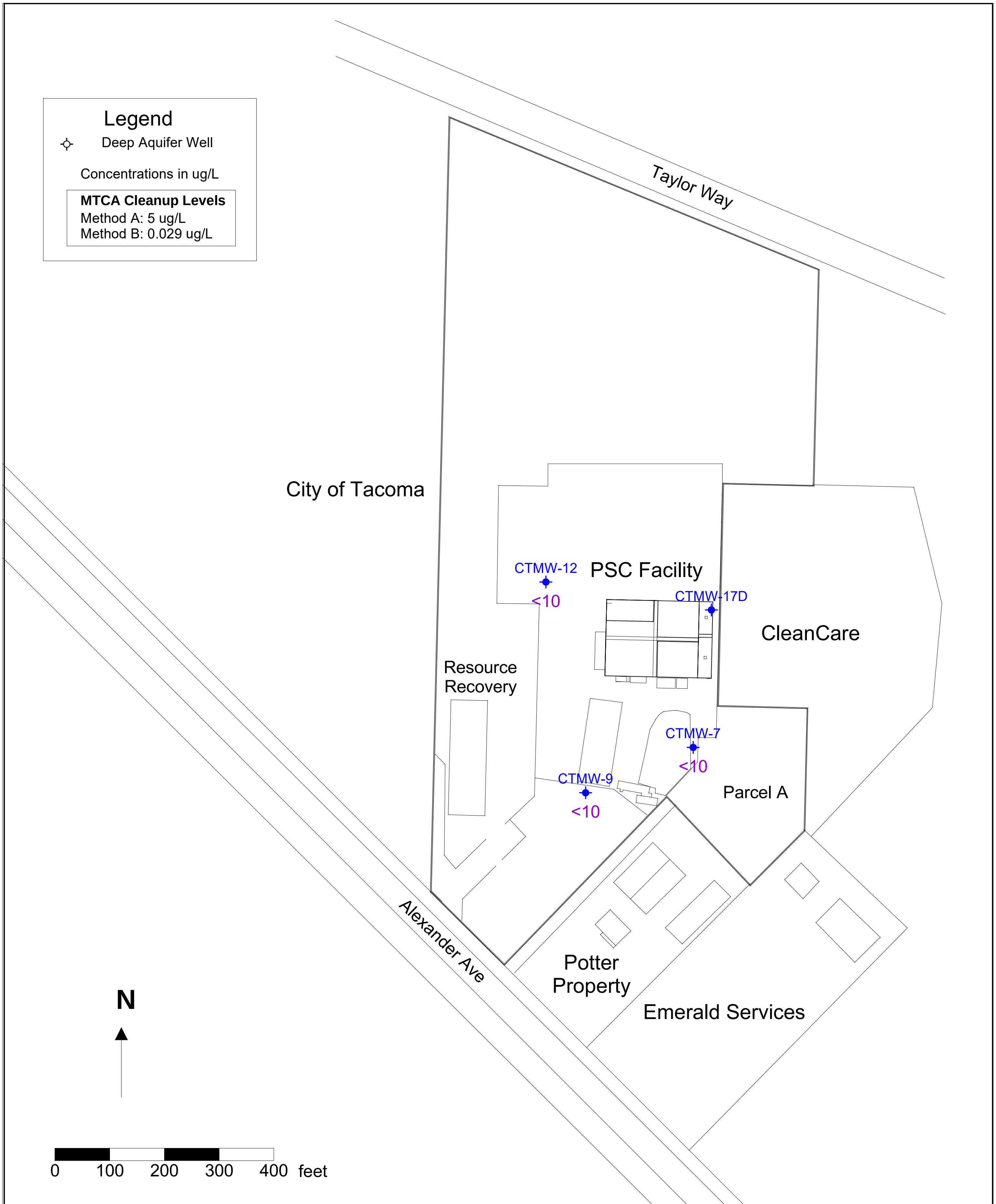
Arsenic Concentrations
3rd Quarter 1998
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



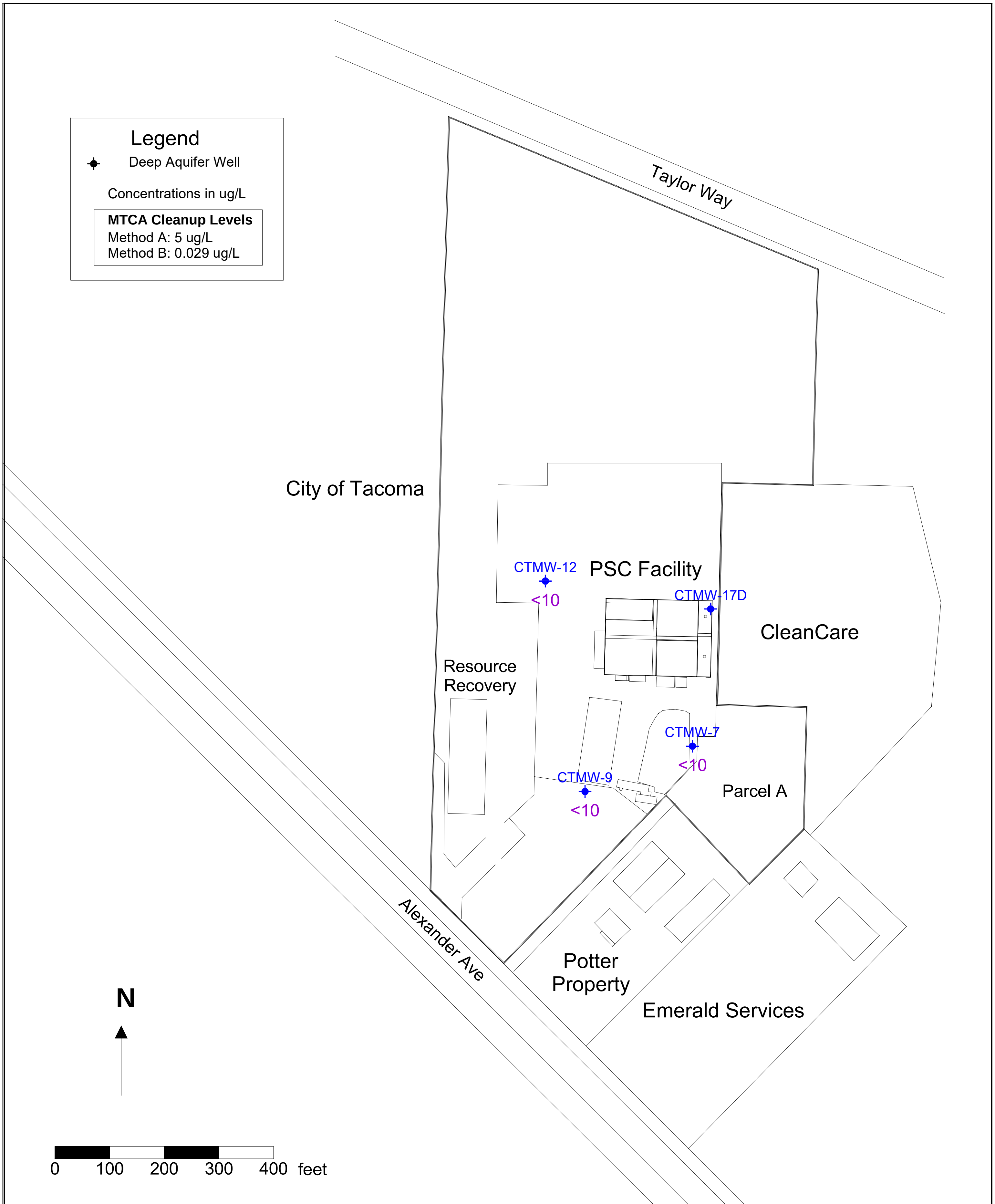
Arsenic Concentrations
4th Quarter 1998
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



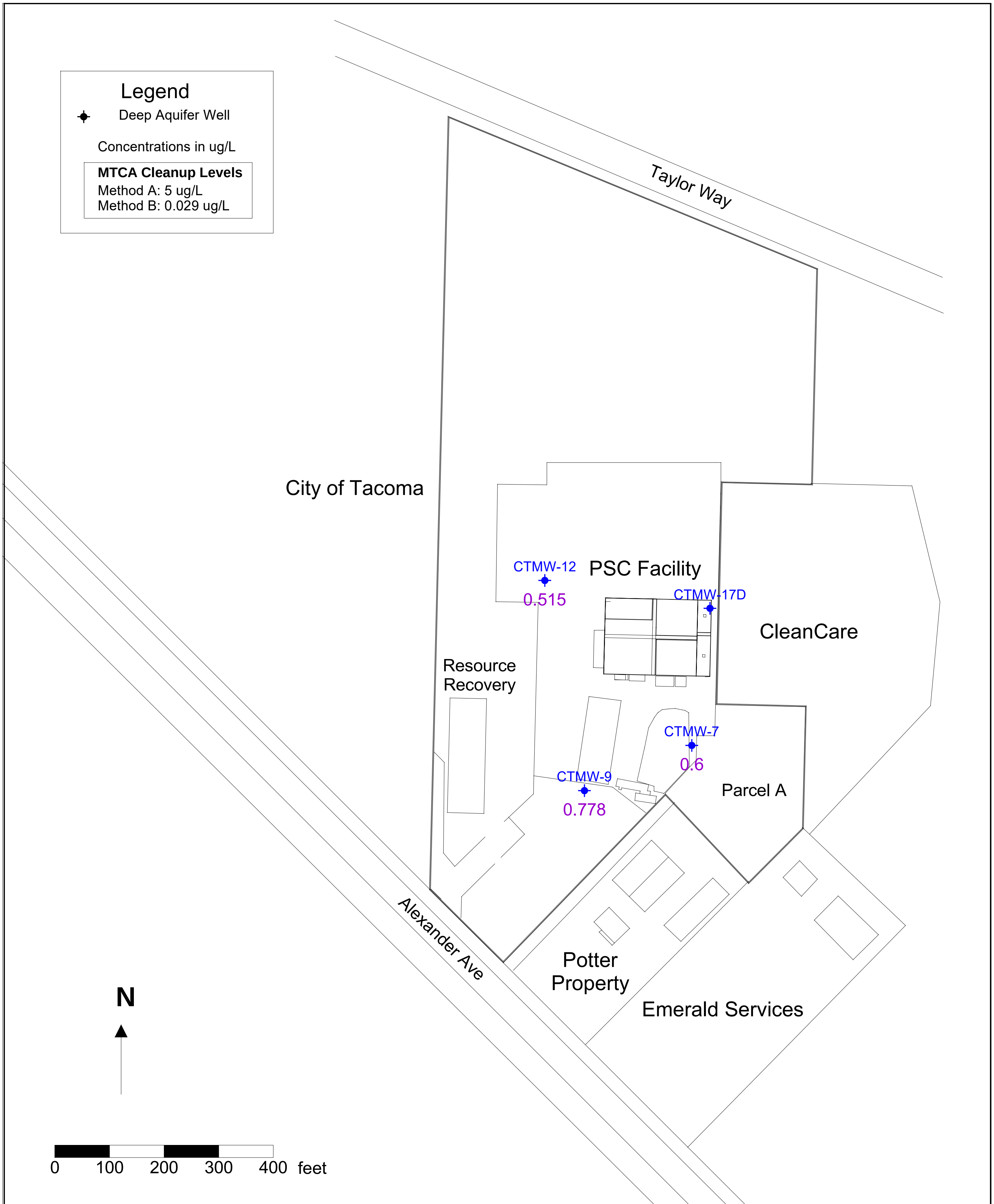
Arsenic Concentrations
1st Quarter 1999
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



Arsenic Concentrations
2nd Quarter 1999
Deep Aquifer
Tacoma Facility

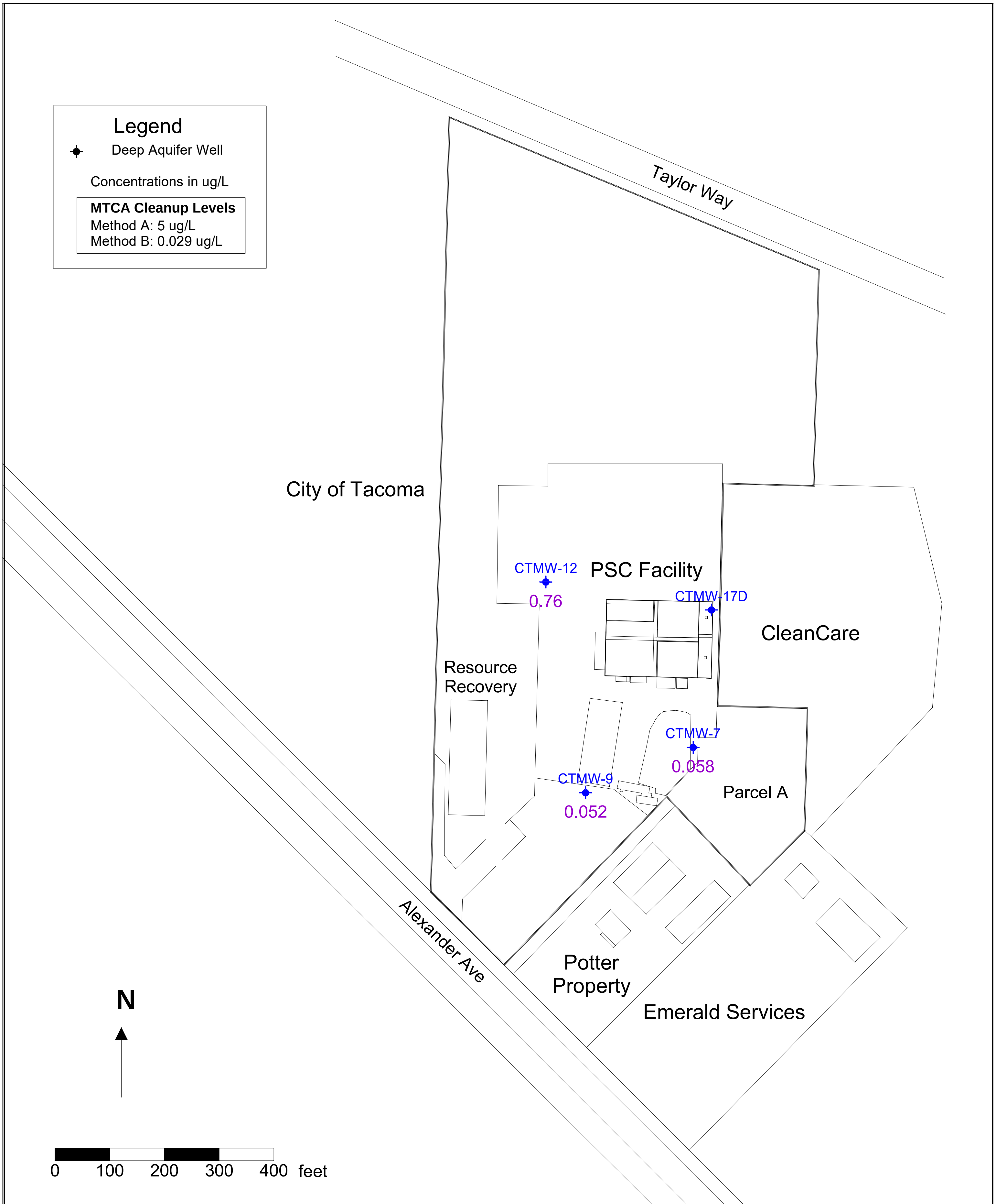
DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



PSC

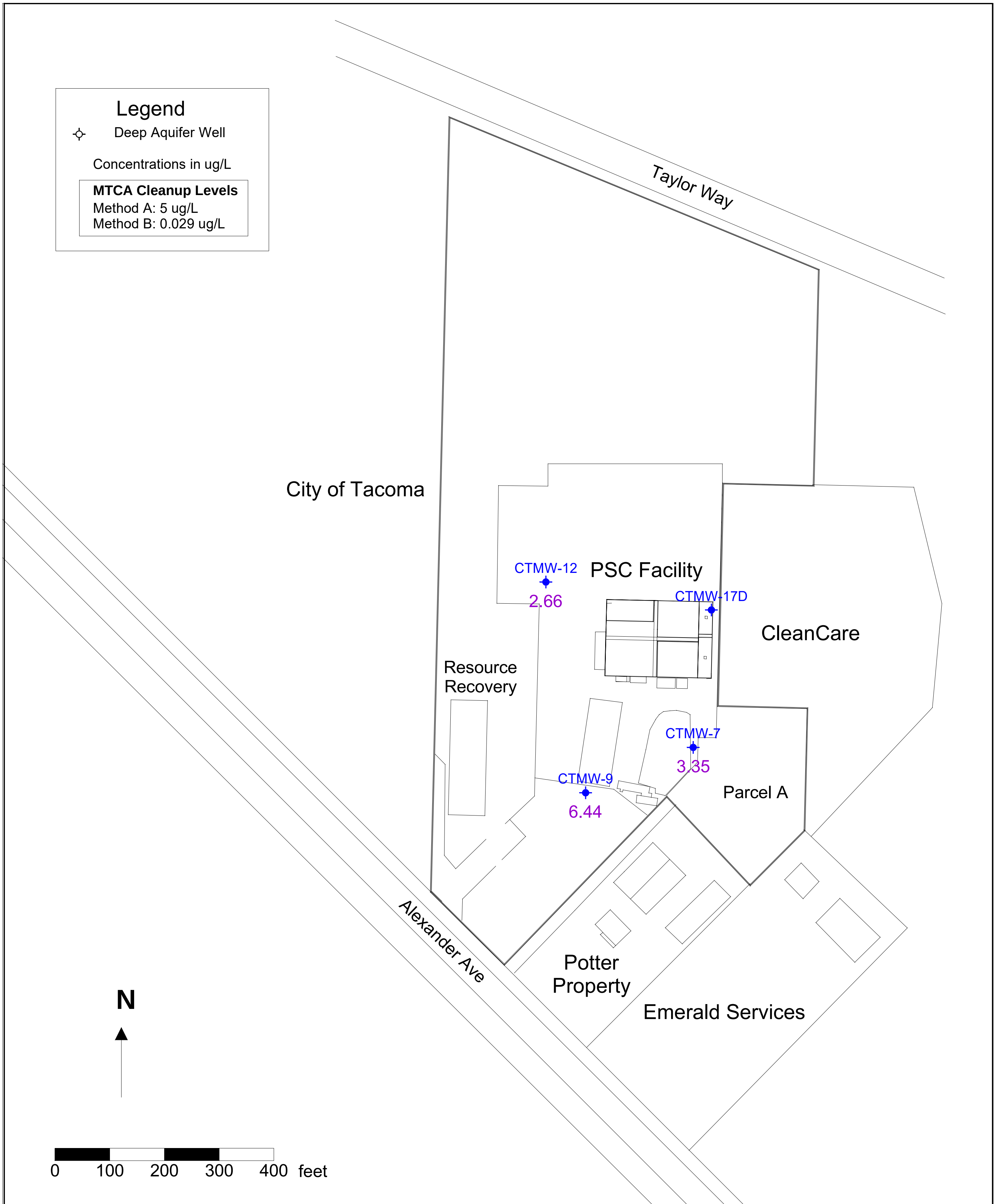
Arsenic Concentrations
3rd Quarter 1999
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



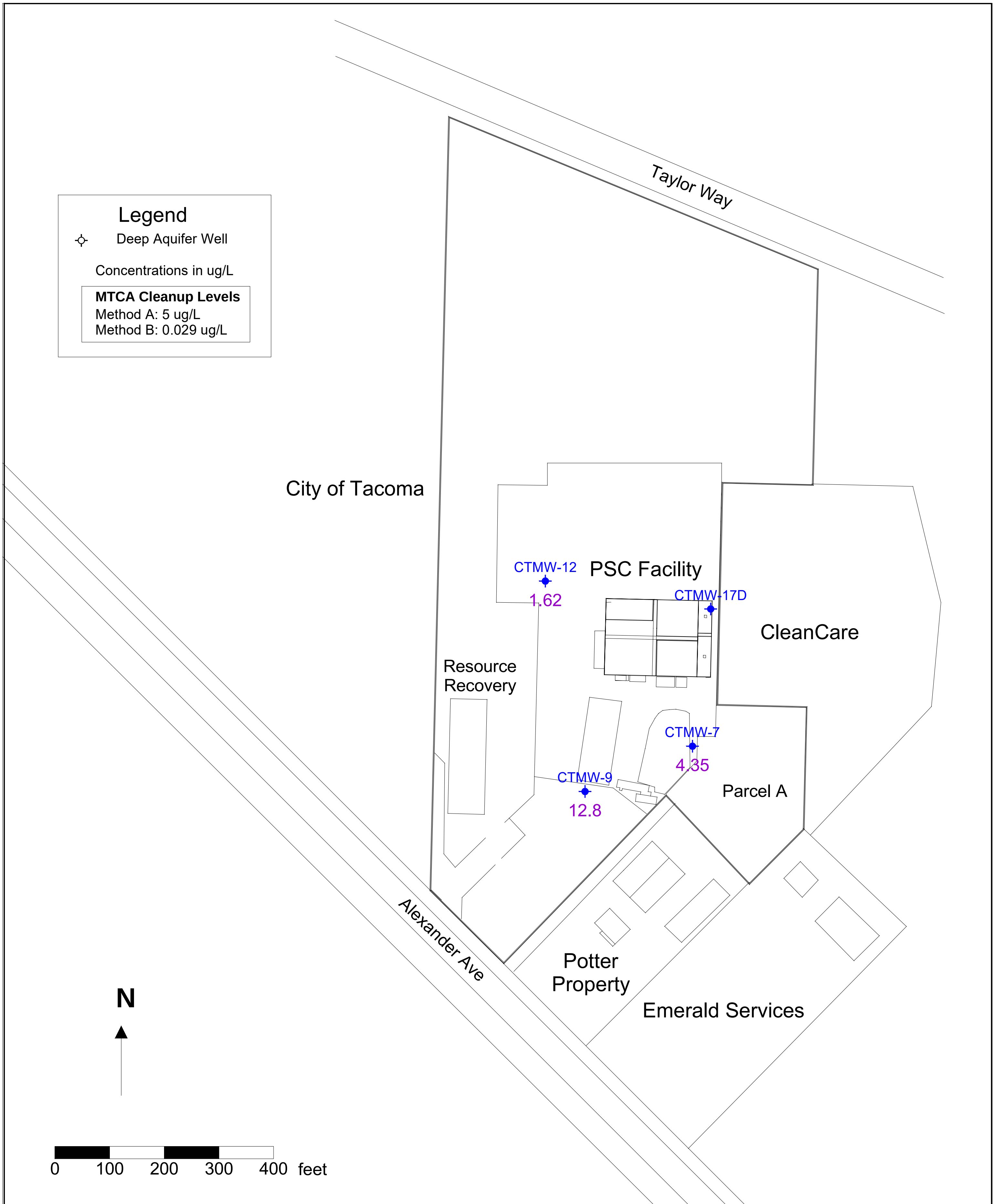
Arsenic Concentrations
4th Quarter 1999
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



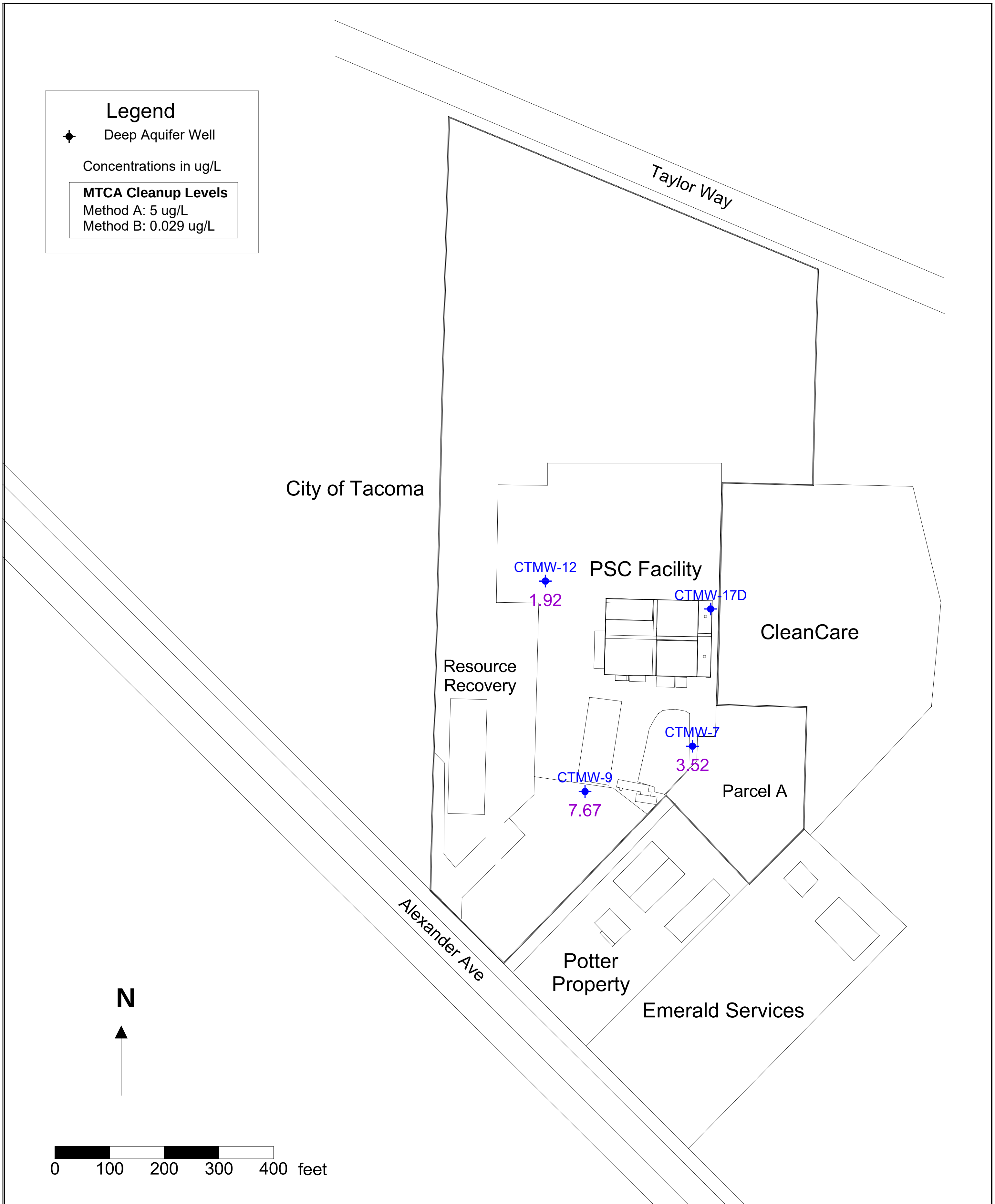
Arsenic Concentrations
1st Quarter 2000
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



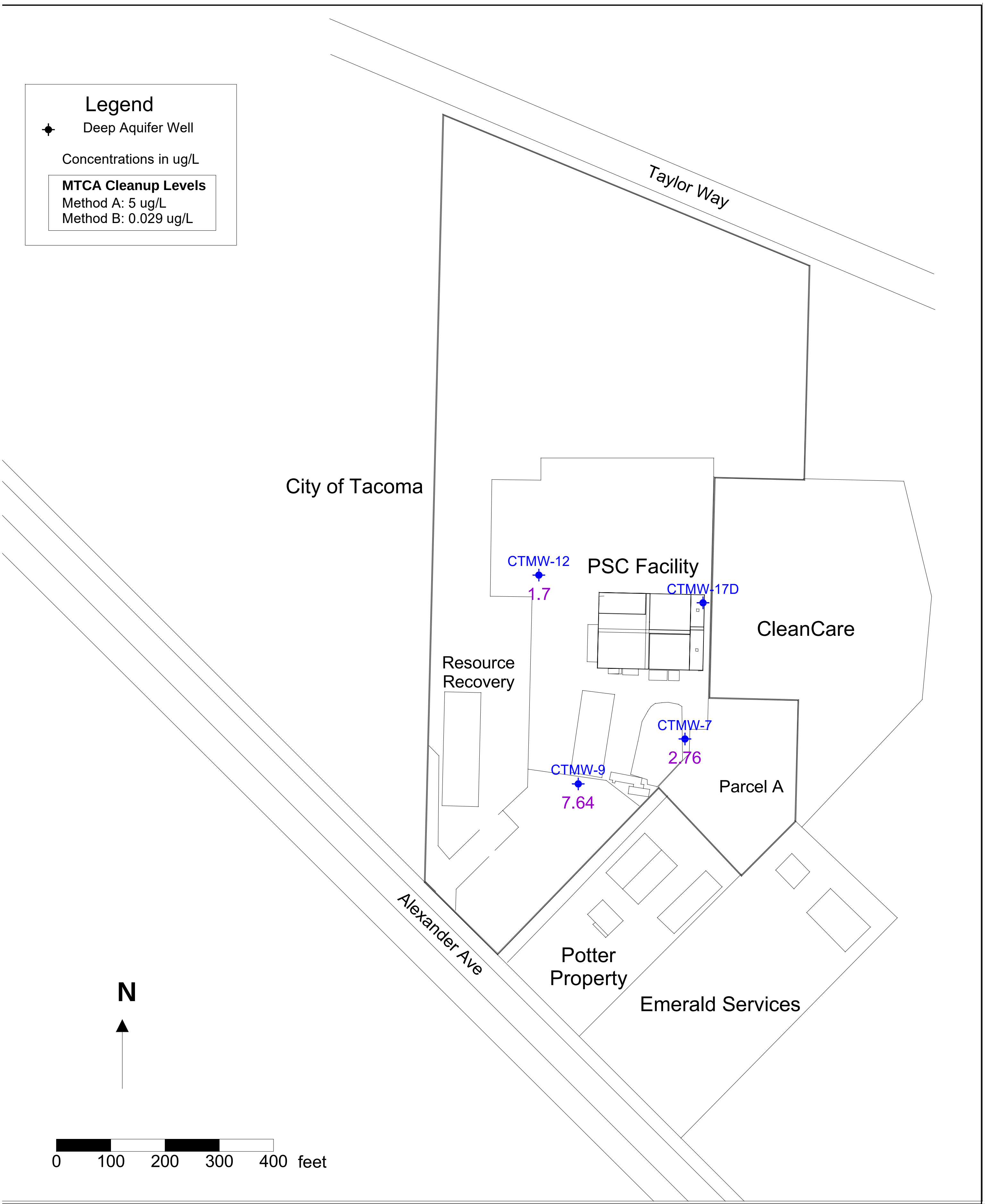
Arsenic Concentrations
2nd Quarter 2000
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:

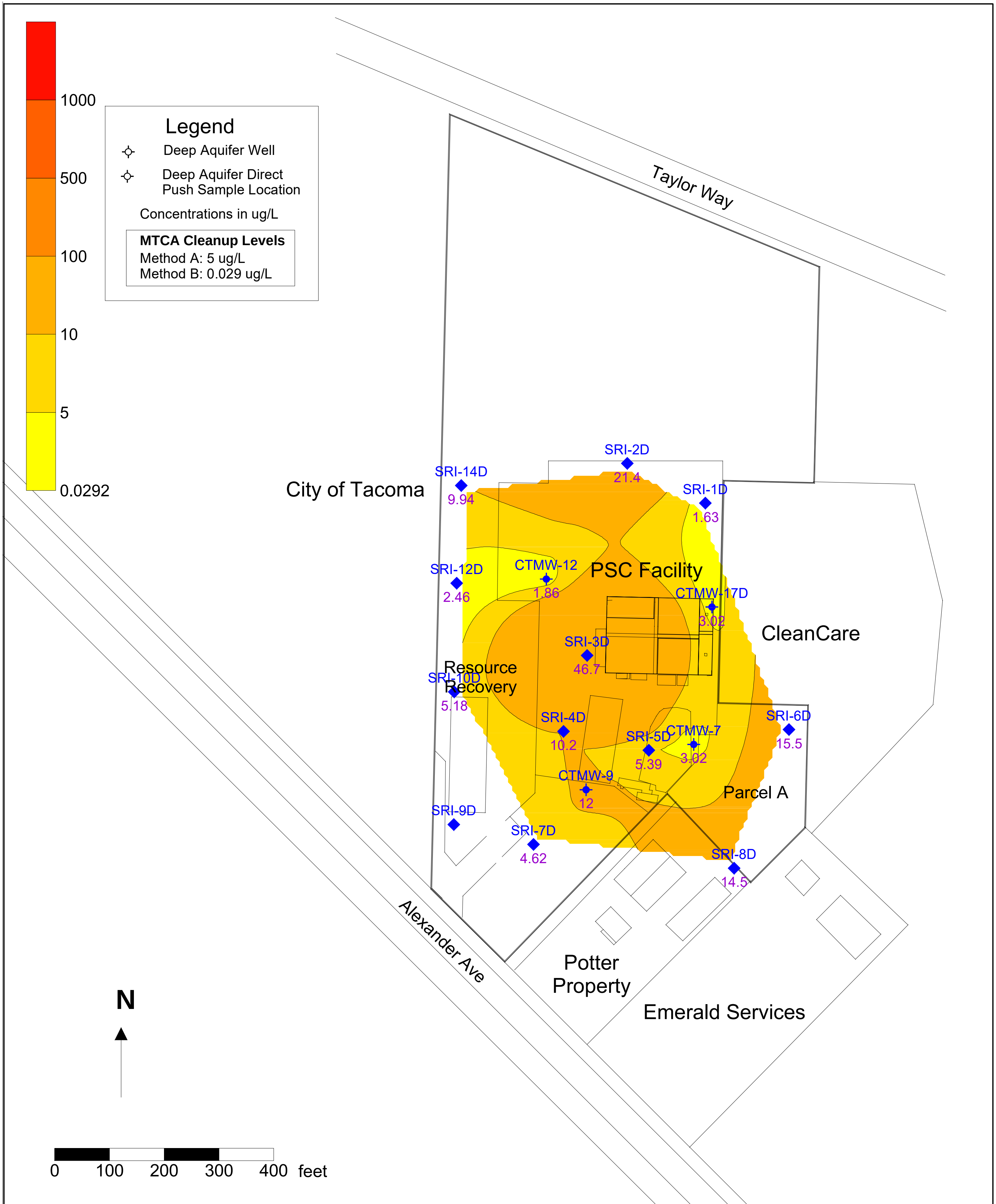


Arsenic Concentrations
3rd Quarter 2000
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	

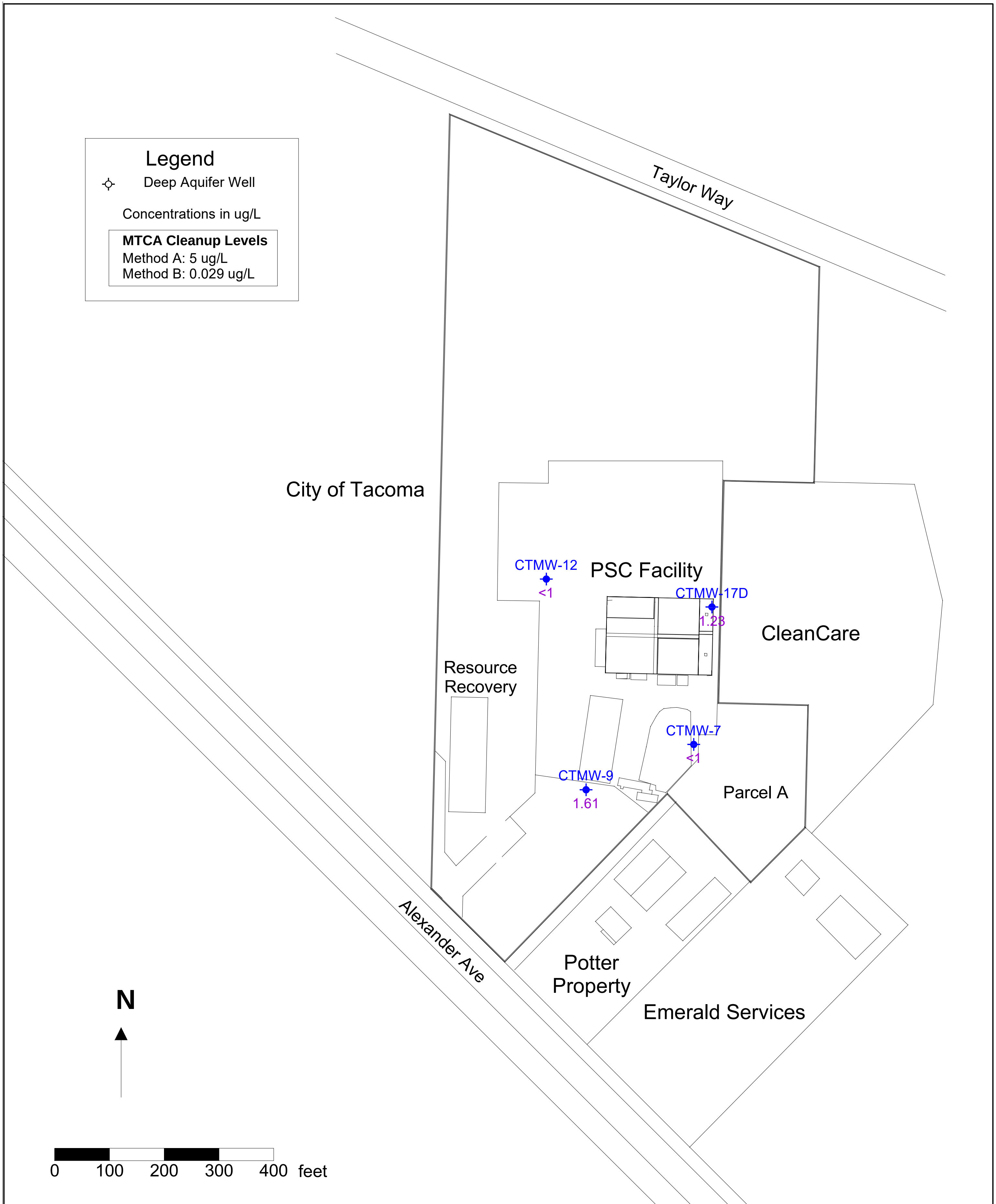


Arsenic Concentrations 4th Quarter 2000 Deep Aquifer Tacoma Facility	DWN:	DES:	PROJECT No:	
	CHKD:	APPD:	FIGURE No:	
	DATE:	REV:		



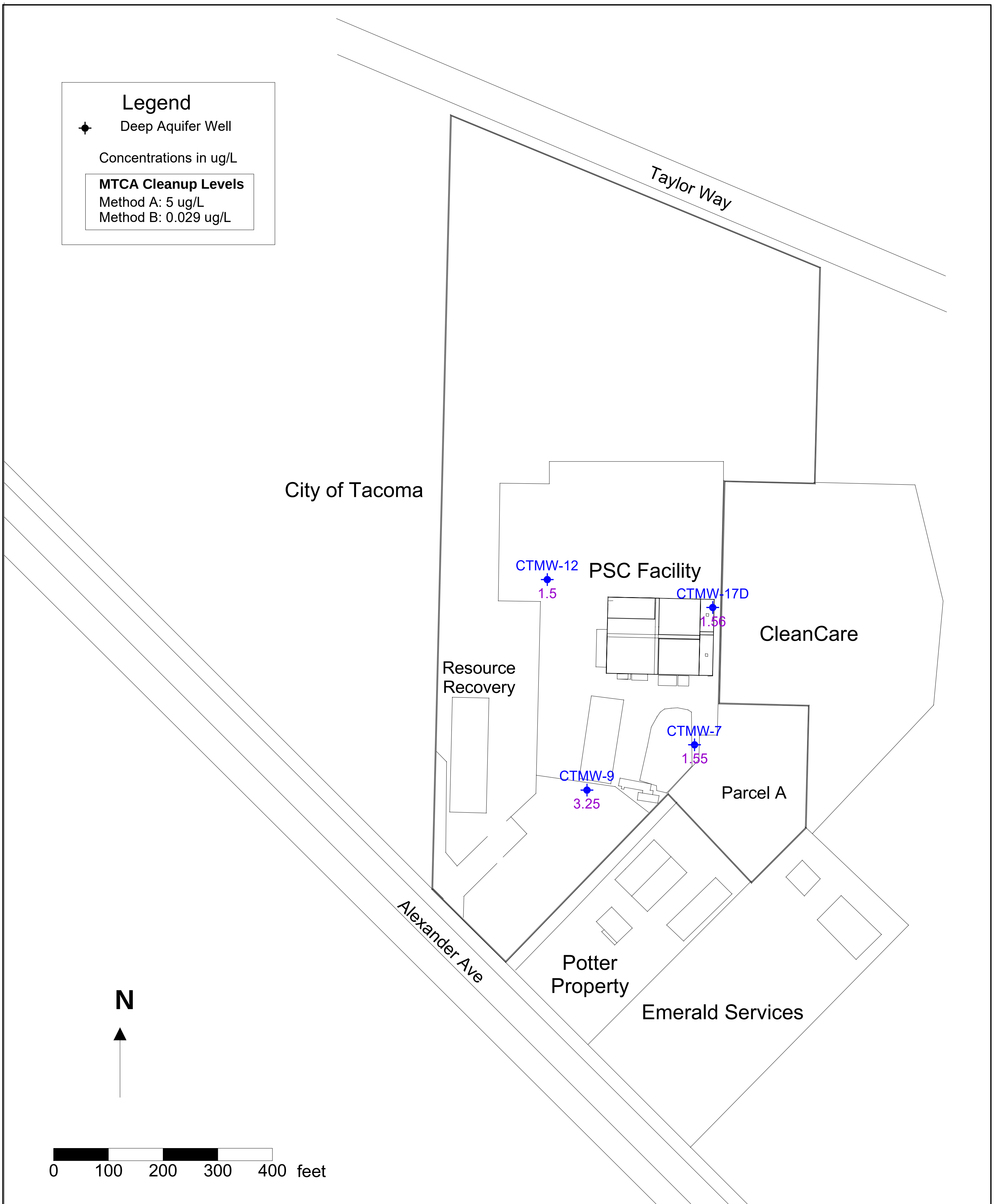
Arsenic Concentrations
1st Quarter 2001 and SRI
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



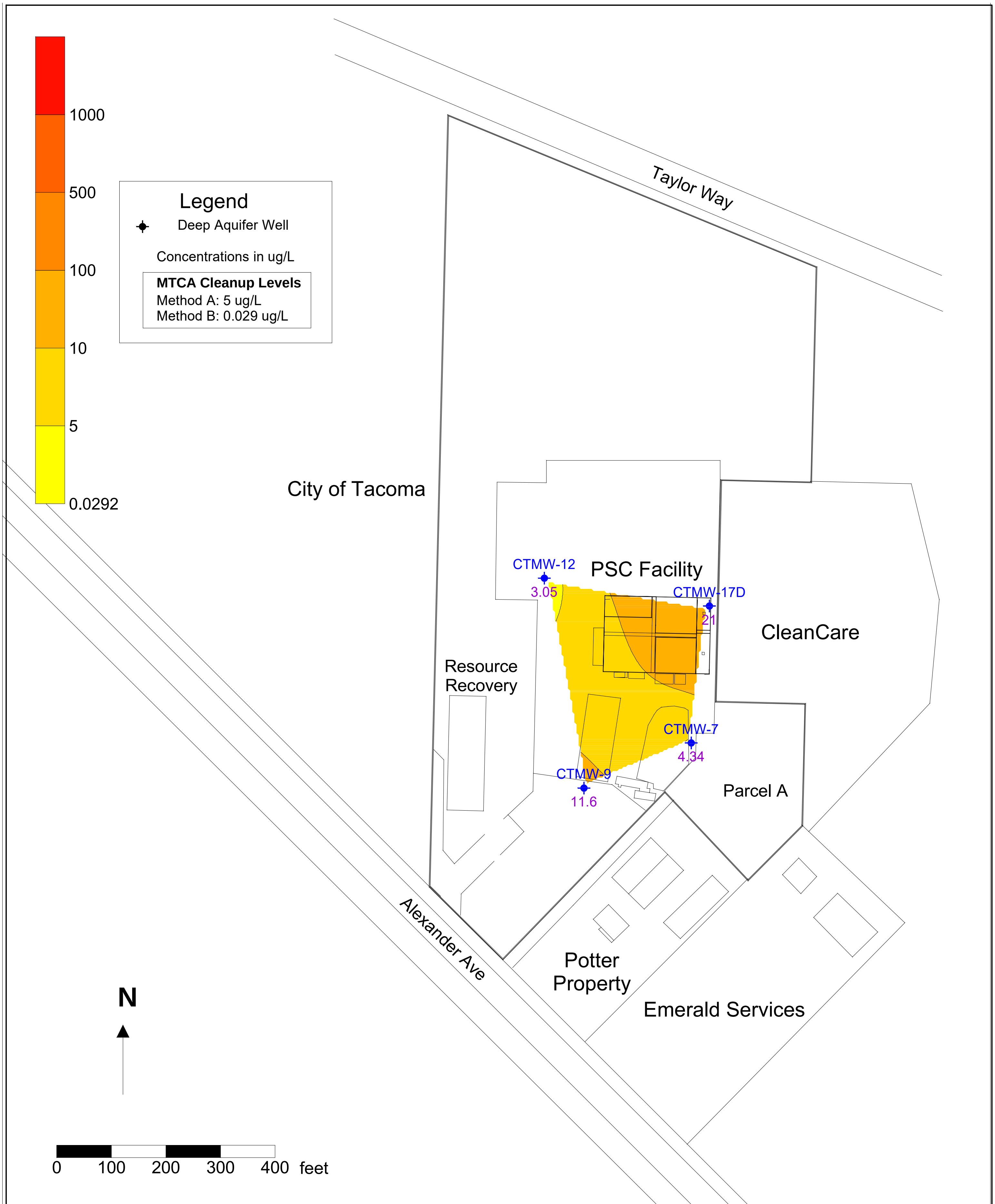
Arsenic Concentrations
2nd Quarter 2001
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



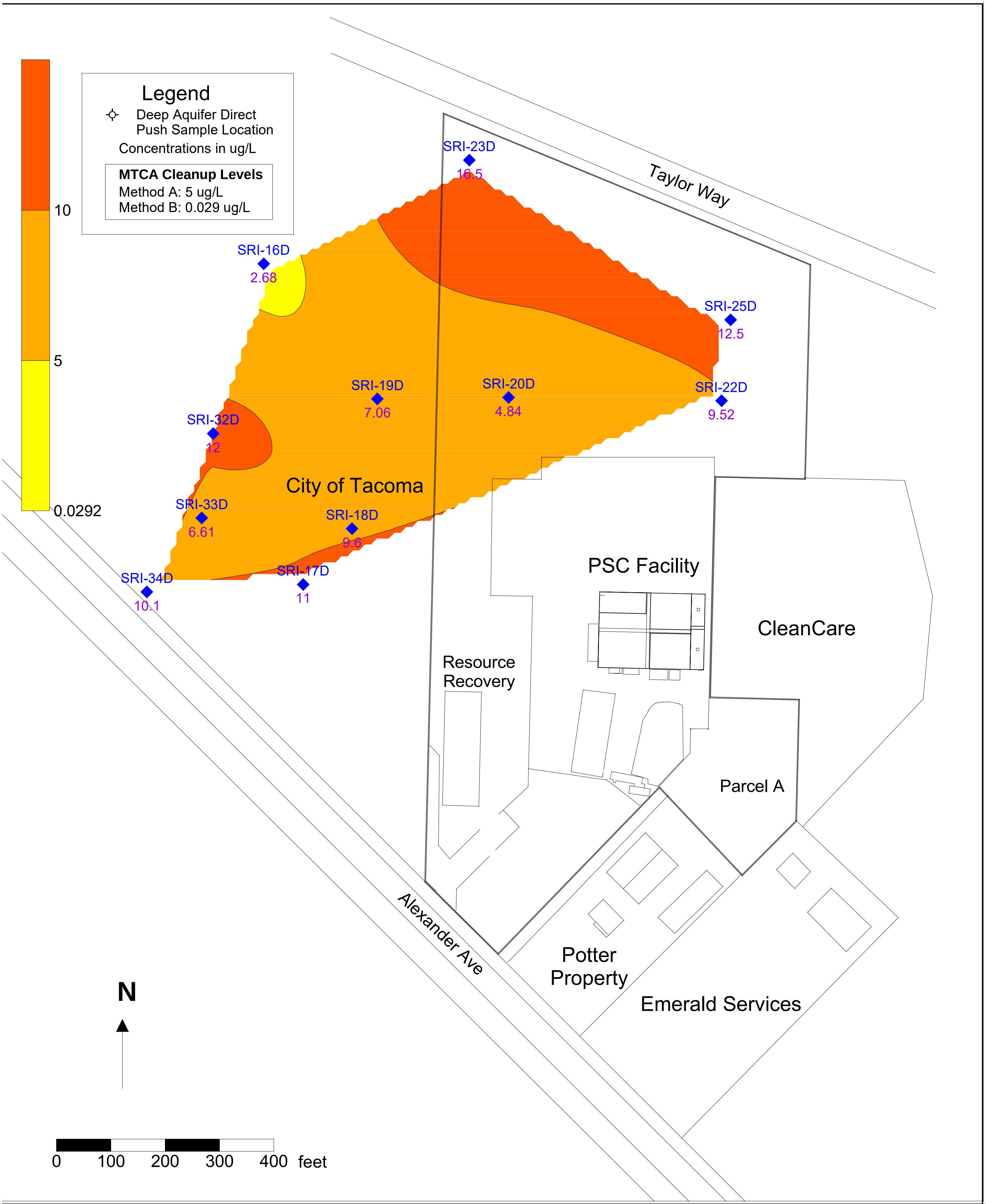
Arsenic Concentrations
3rd Quarter 2001
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



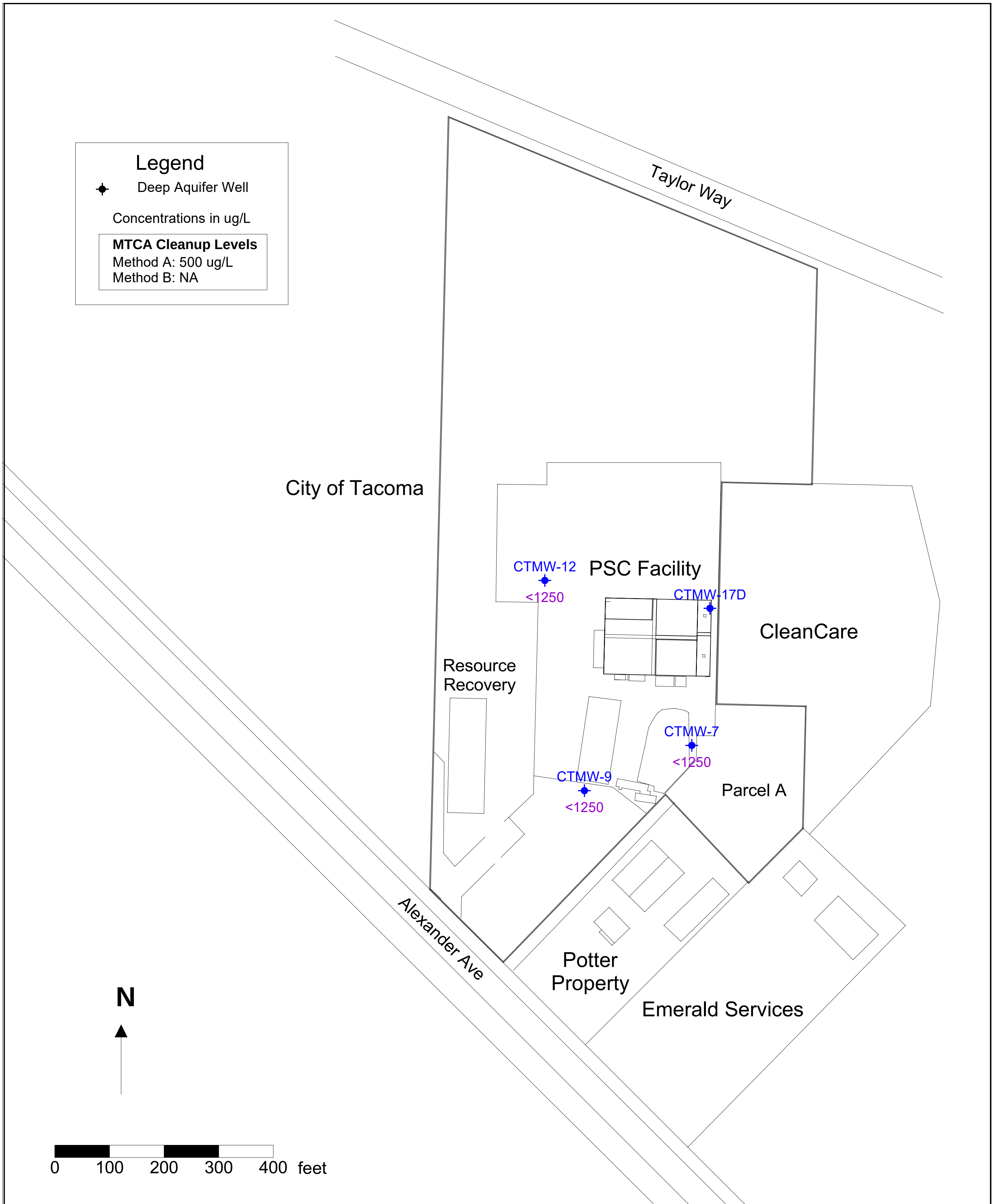
Arsenic Concentrations
4th Quarter 2001
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



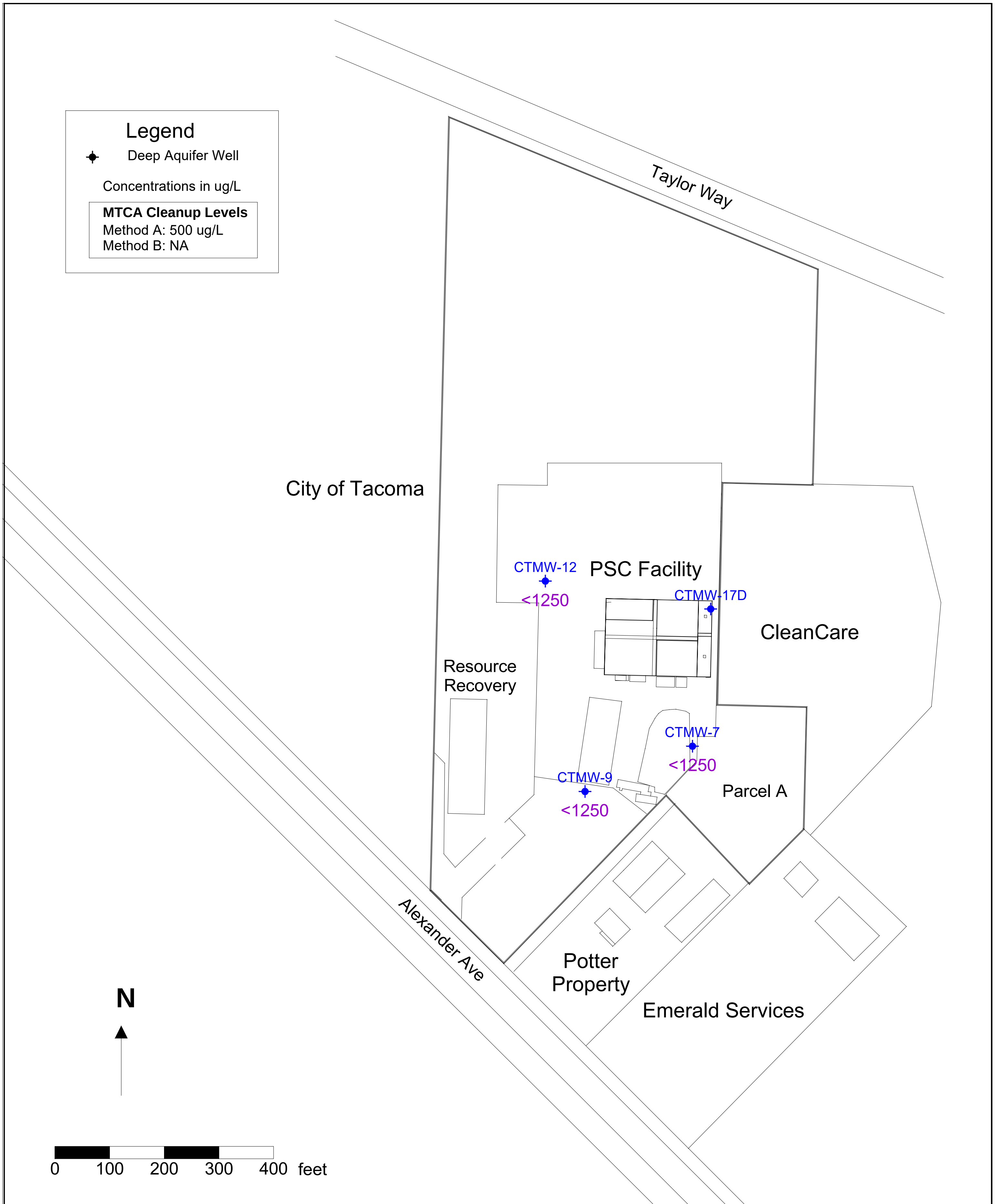
Arsenic Concentrations
SRI II 2002
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



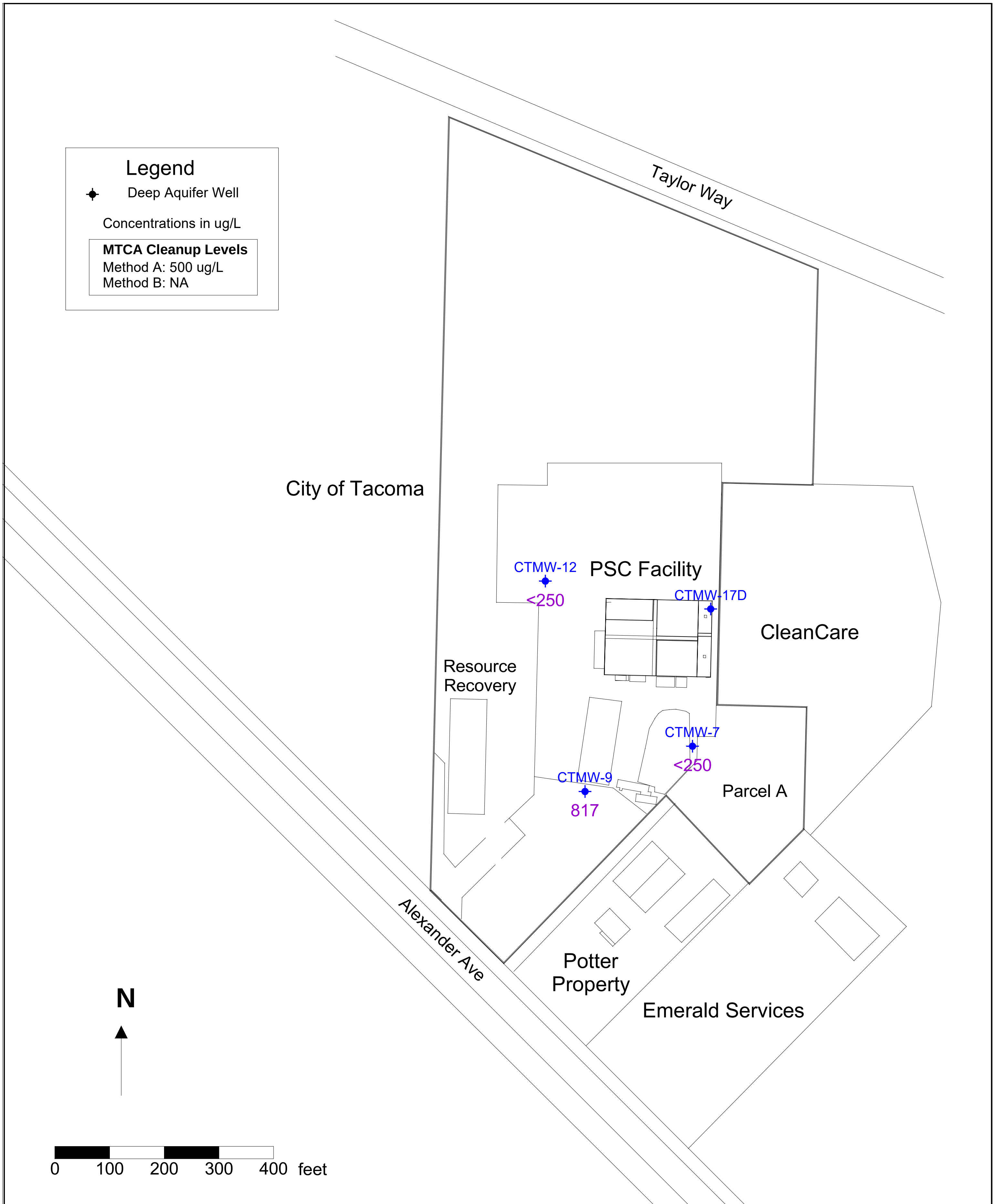
Diesel Concentrations
1st Quarter 1998
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



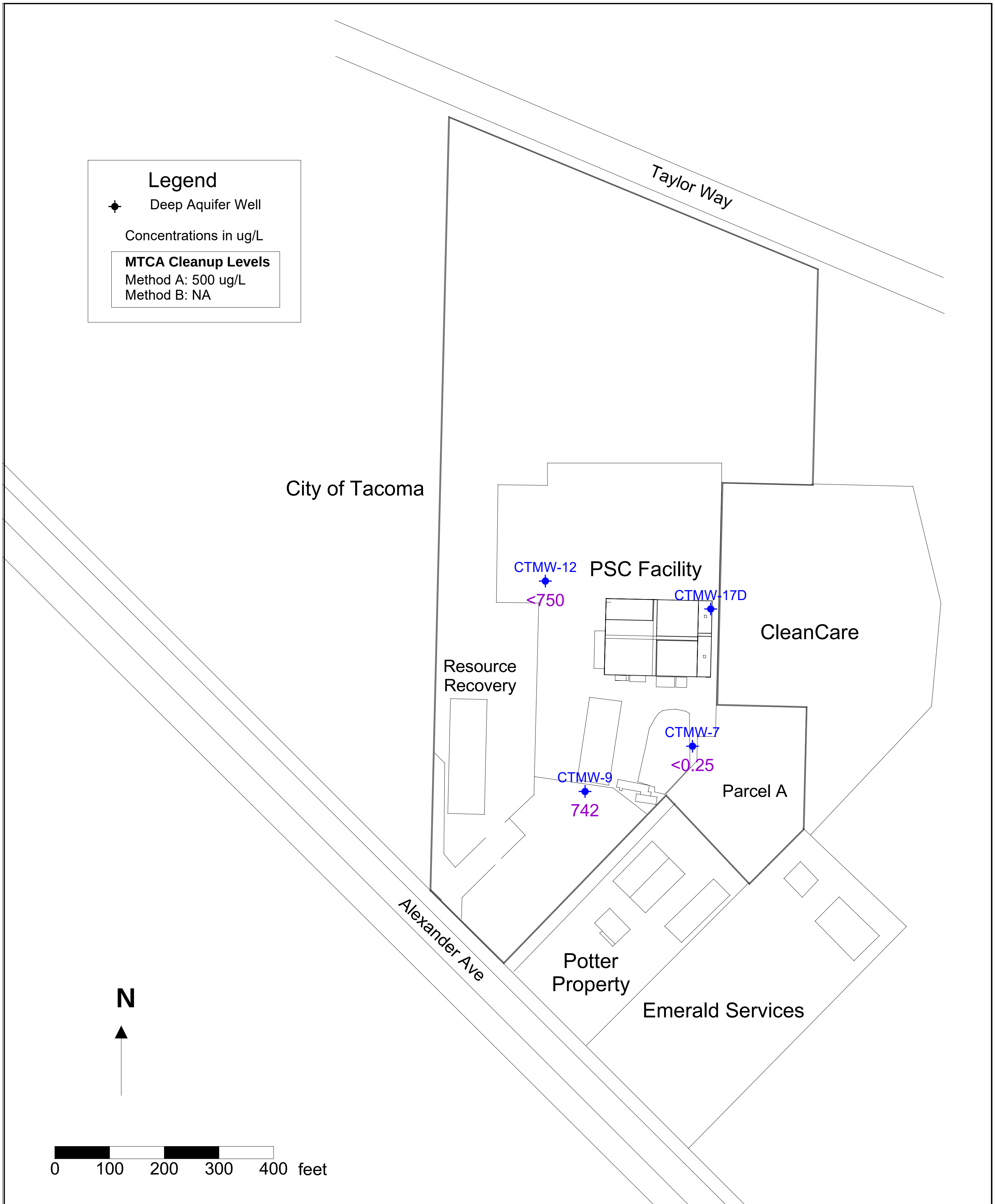
Diesel Concentrations
2nd Quarter 1998
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



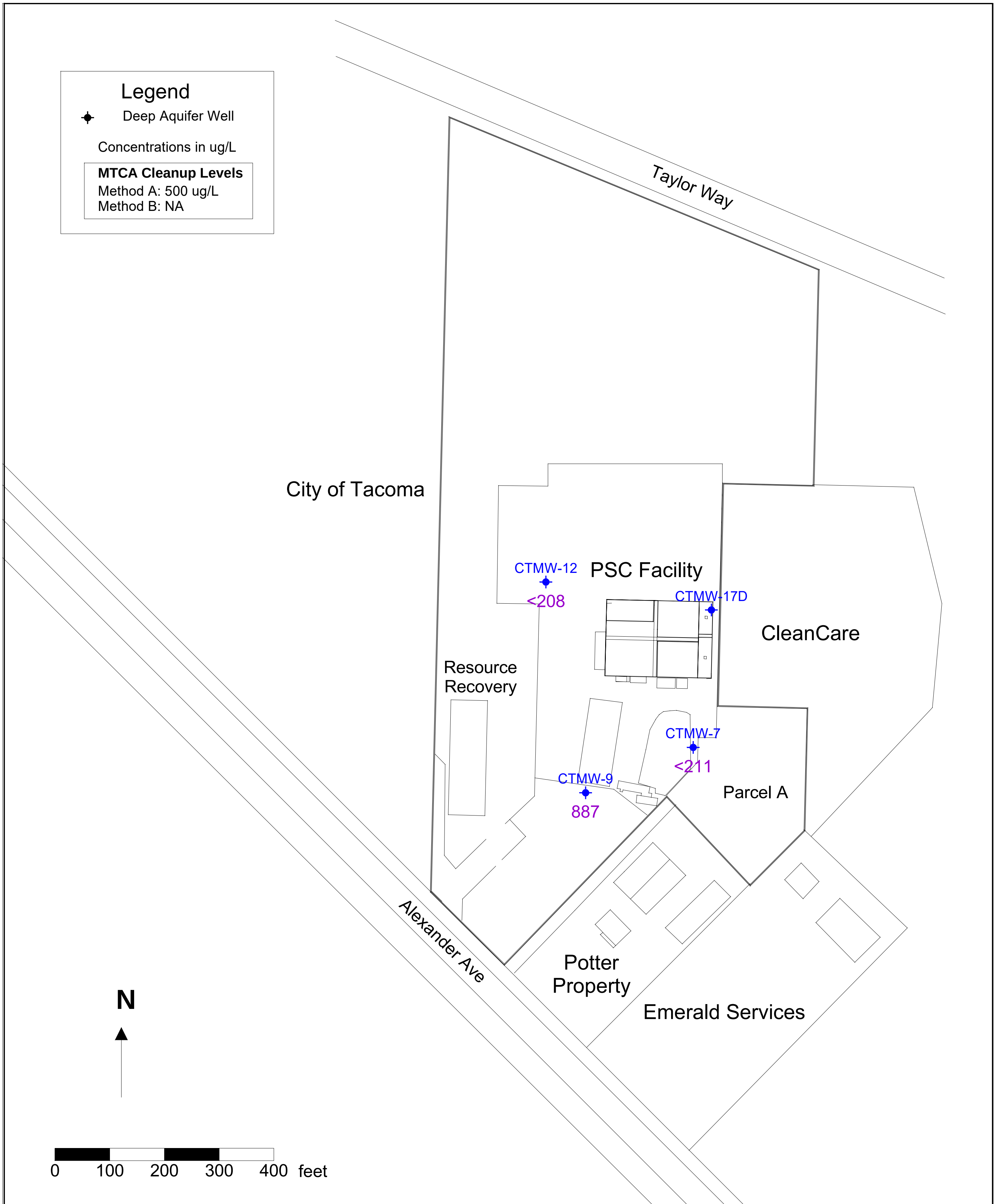
Diesel Concentrations
3rd Quarter 1998
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



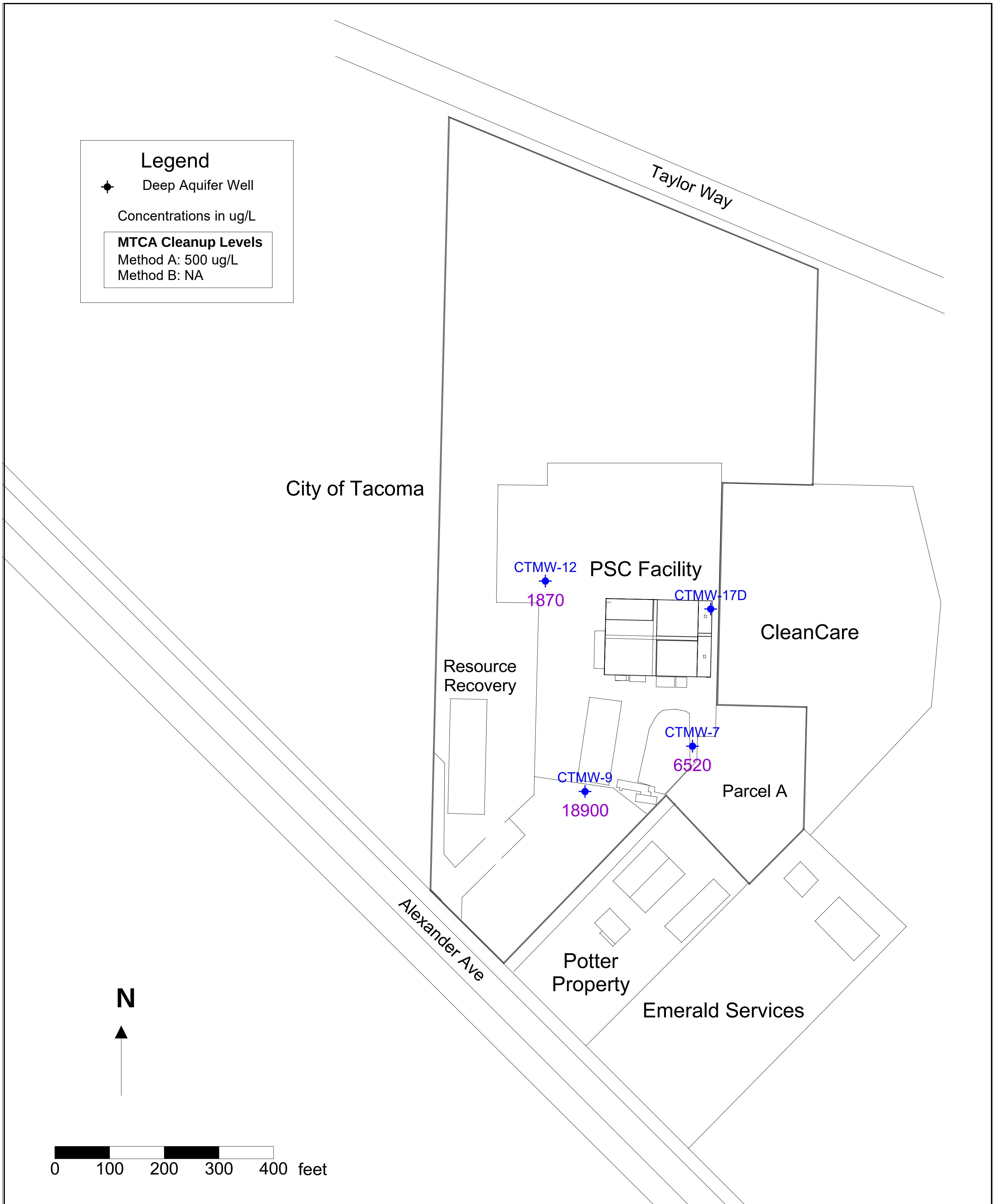
Diesel Concentrations
4th Quarter 1998
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



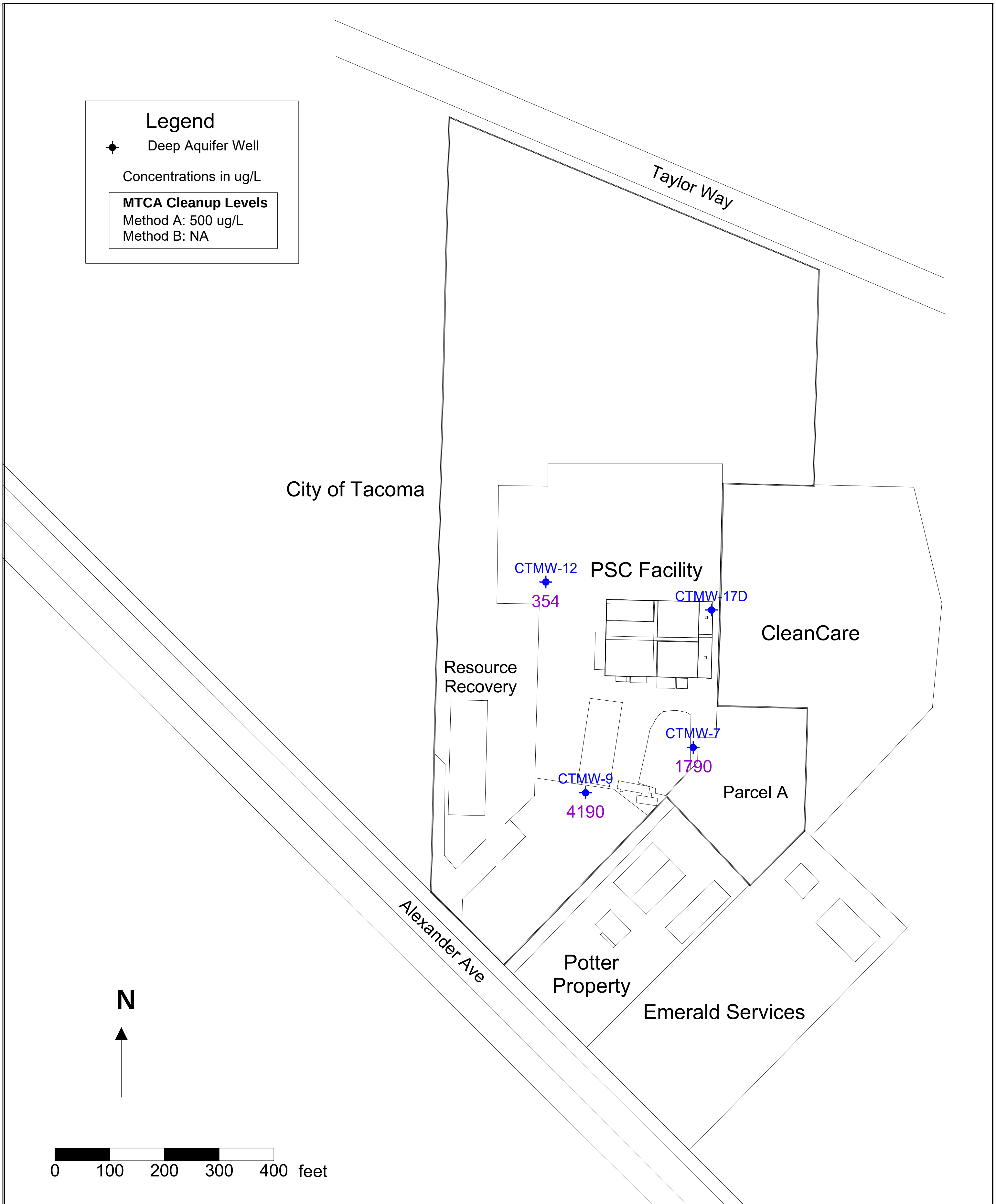
Diesel Concentrations
2nd Quarter 1999
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



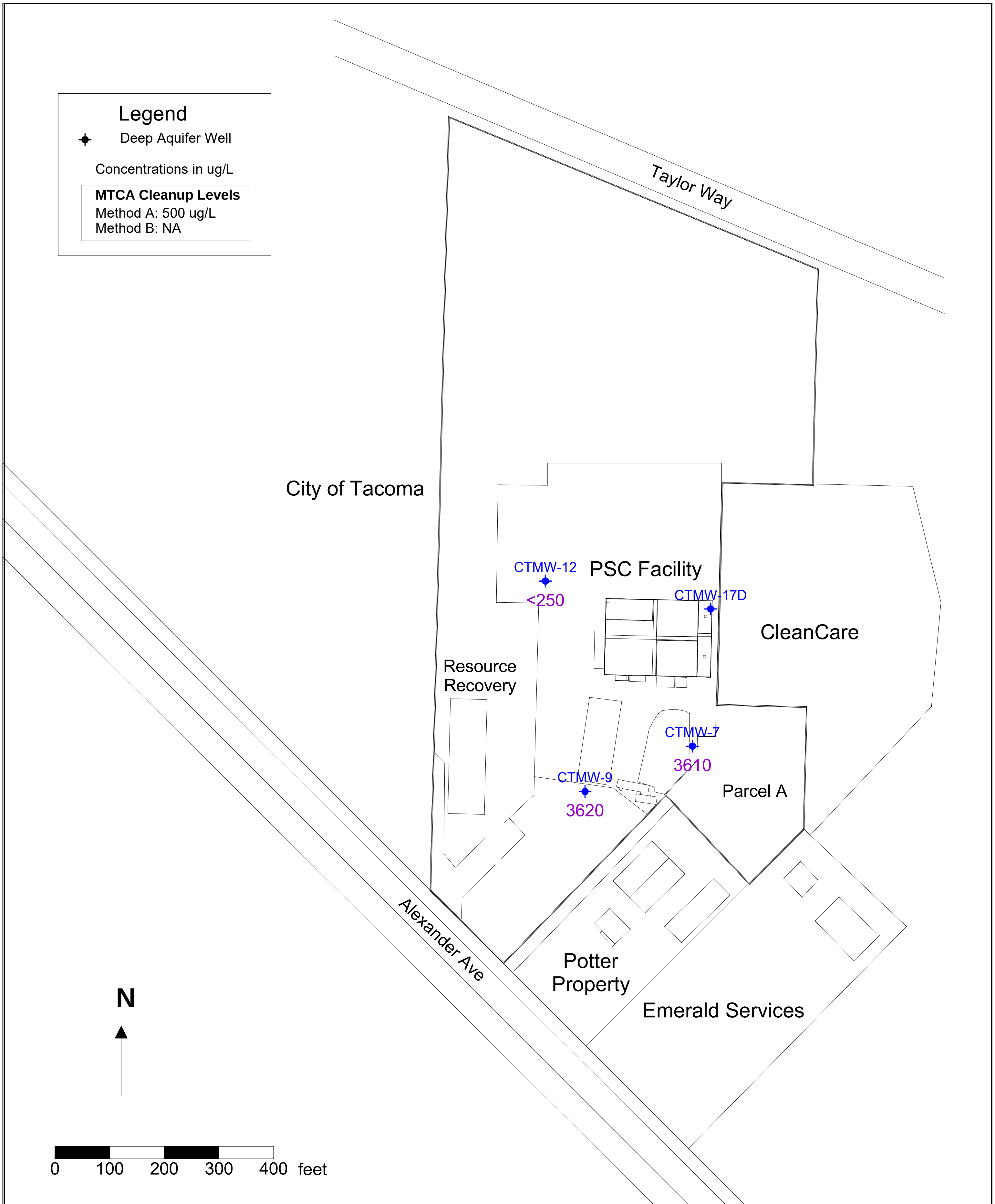
Diesel Concentrations
3rd Quarter 1999
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



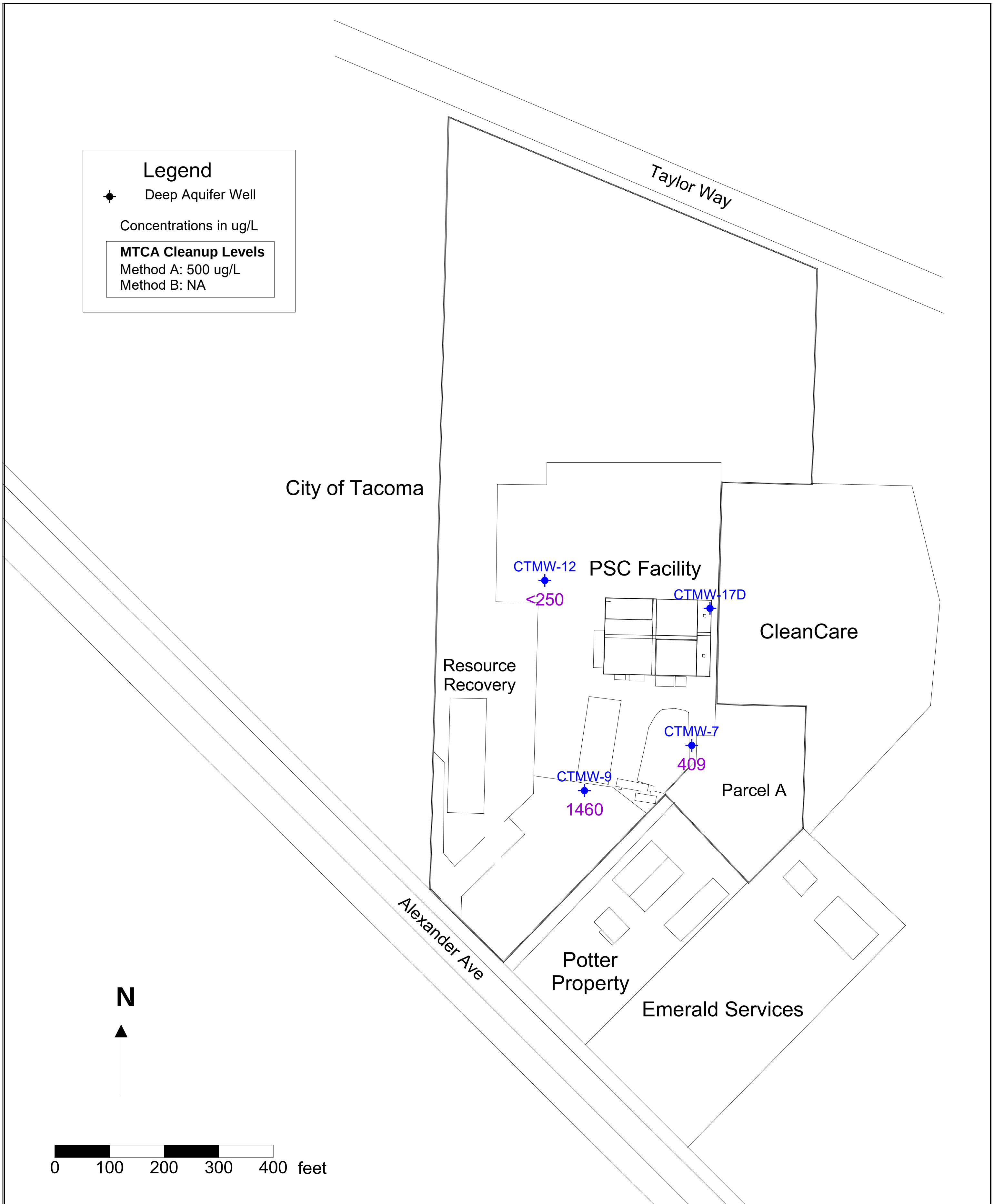
Diesel Concentrations
4th Quarter 1999
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



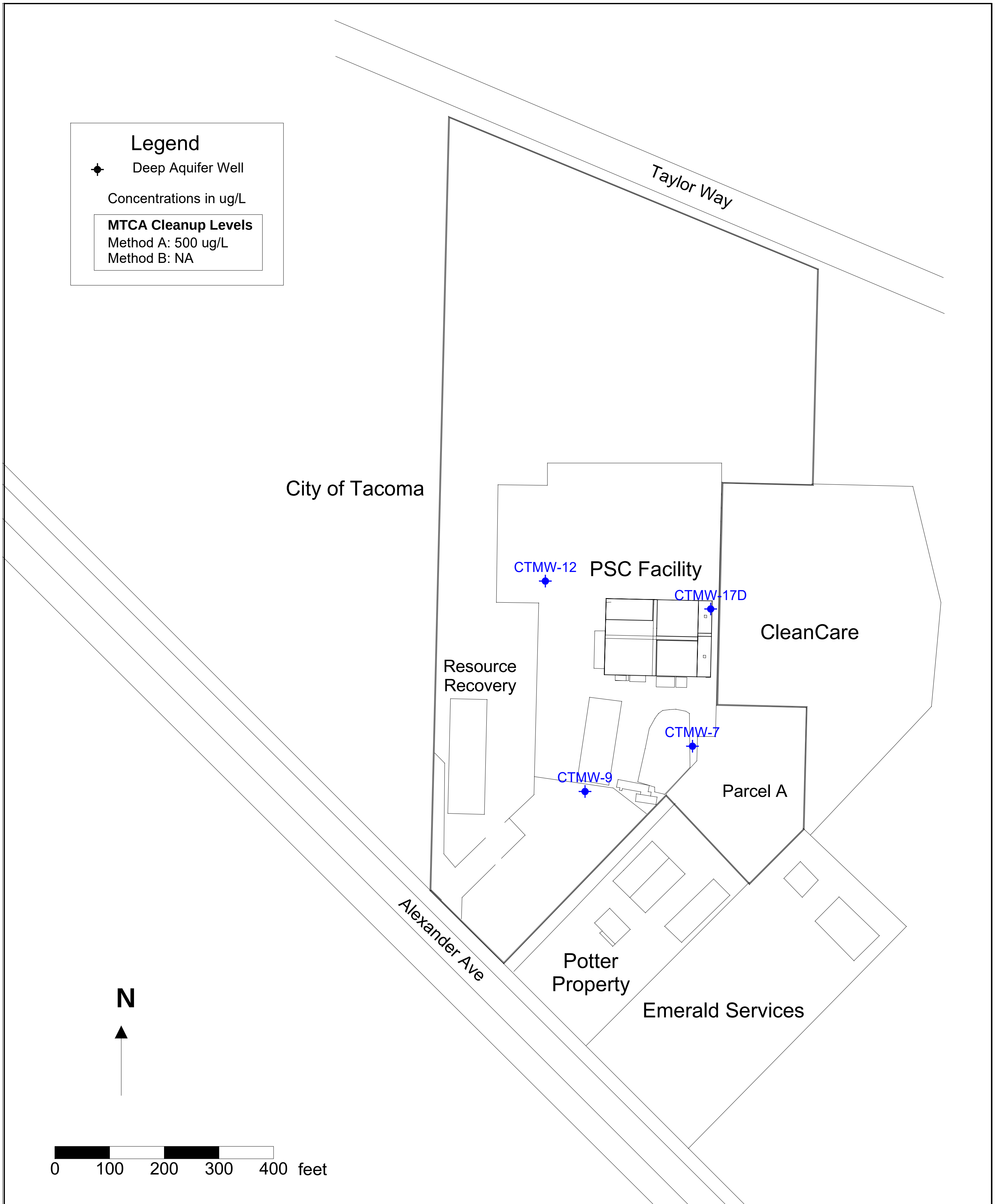
Diesel Concentrations
1st Quarter 2000
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



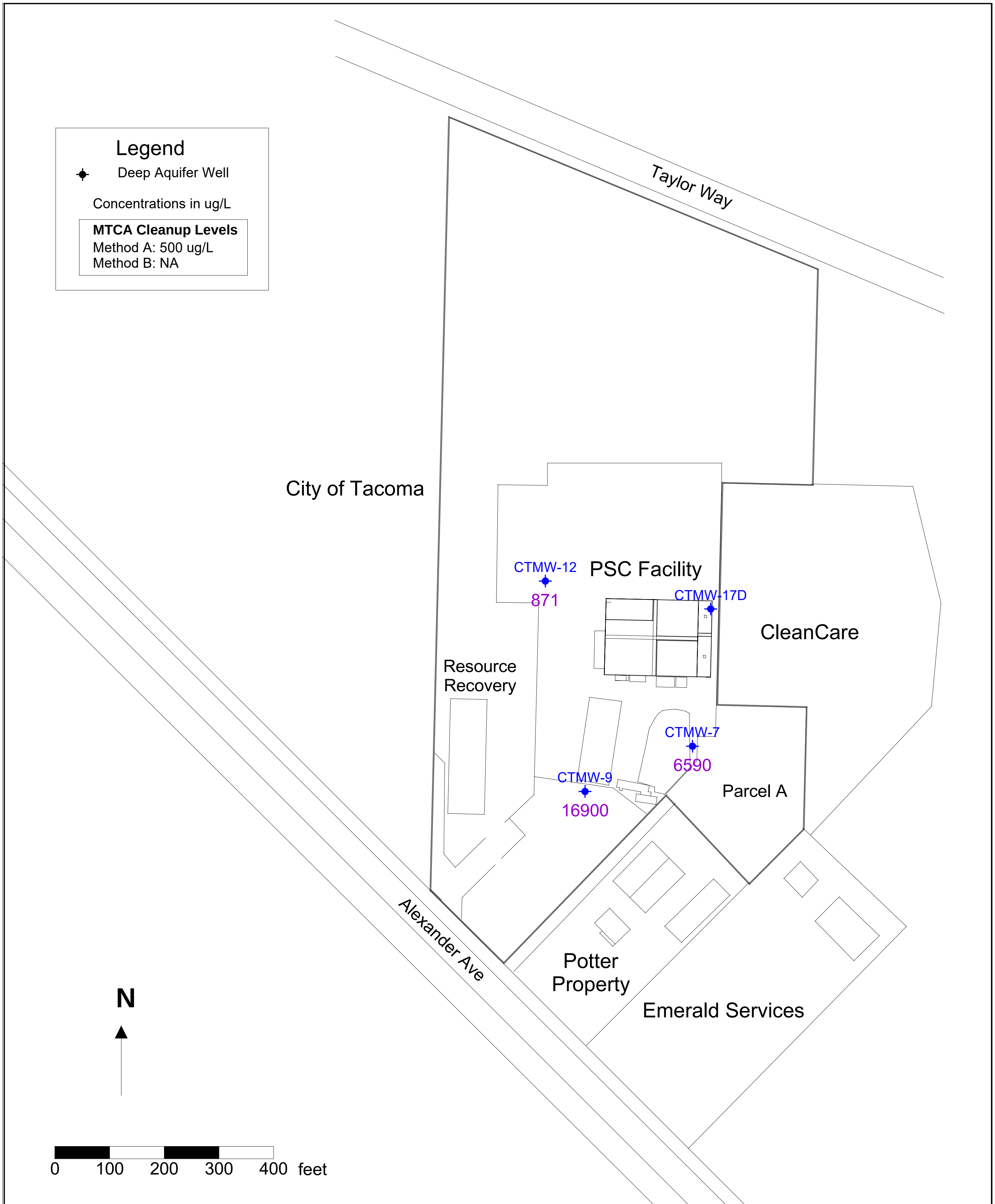
Diesel Concentrations
2nd Quarter 2000
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



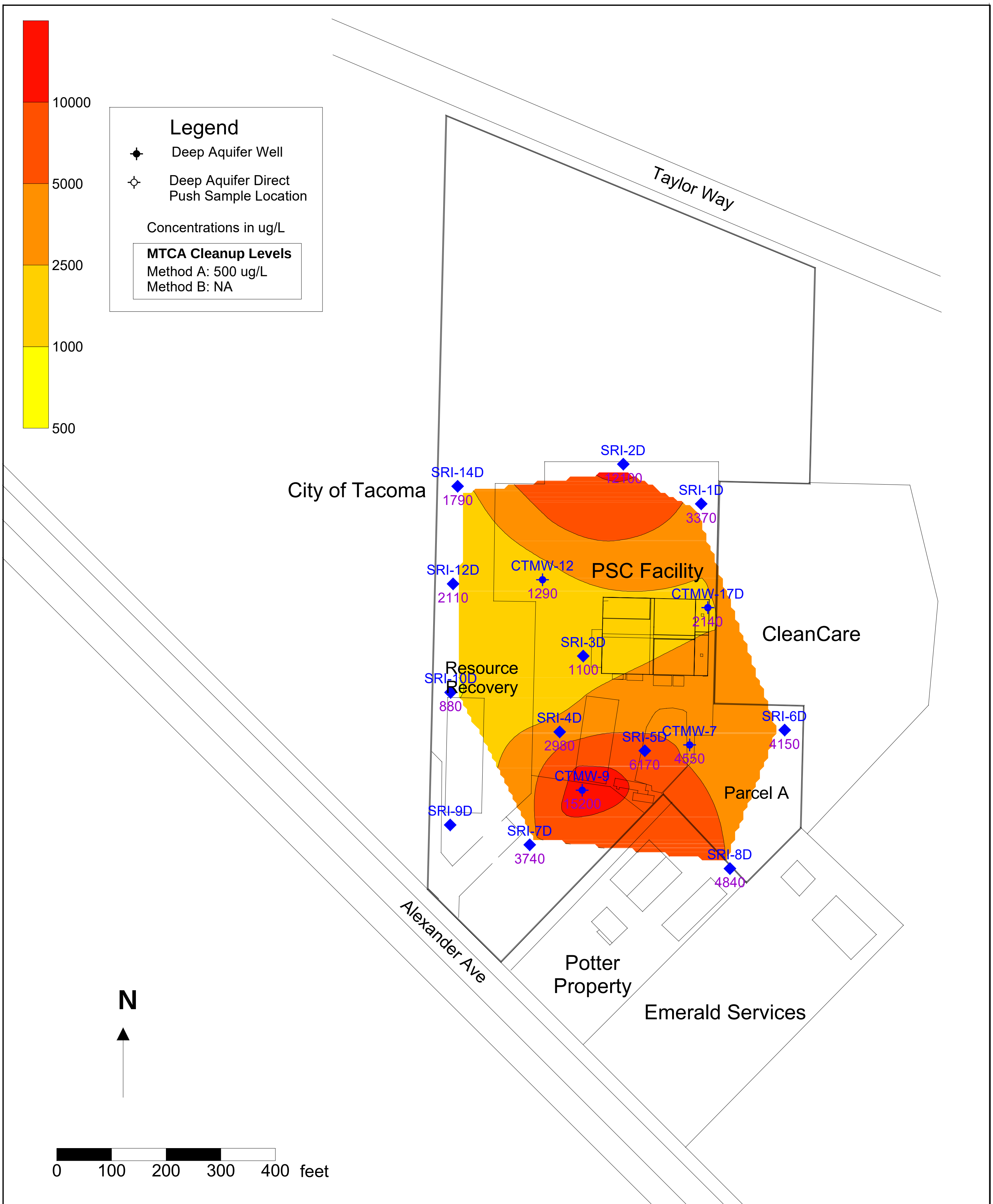
Methylene Chloride Concentrations
3rd Quarter 2000
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:

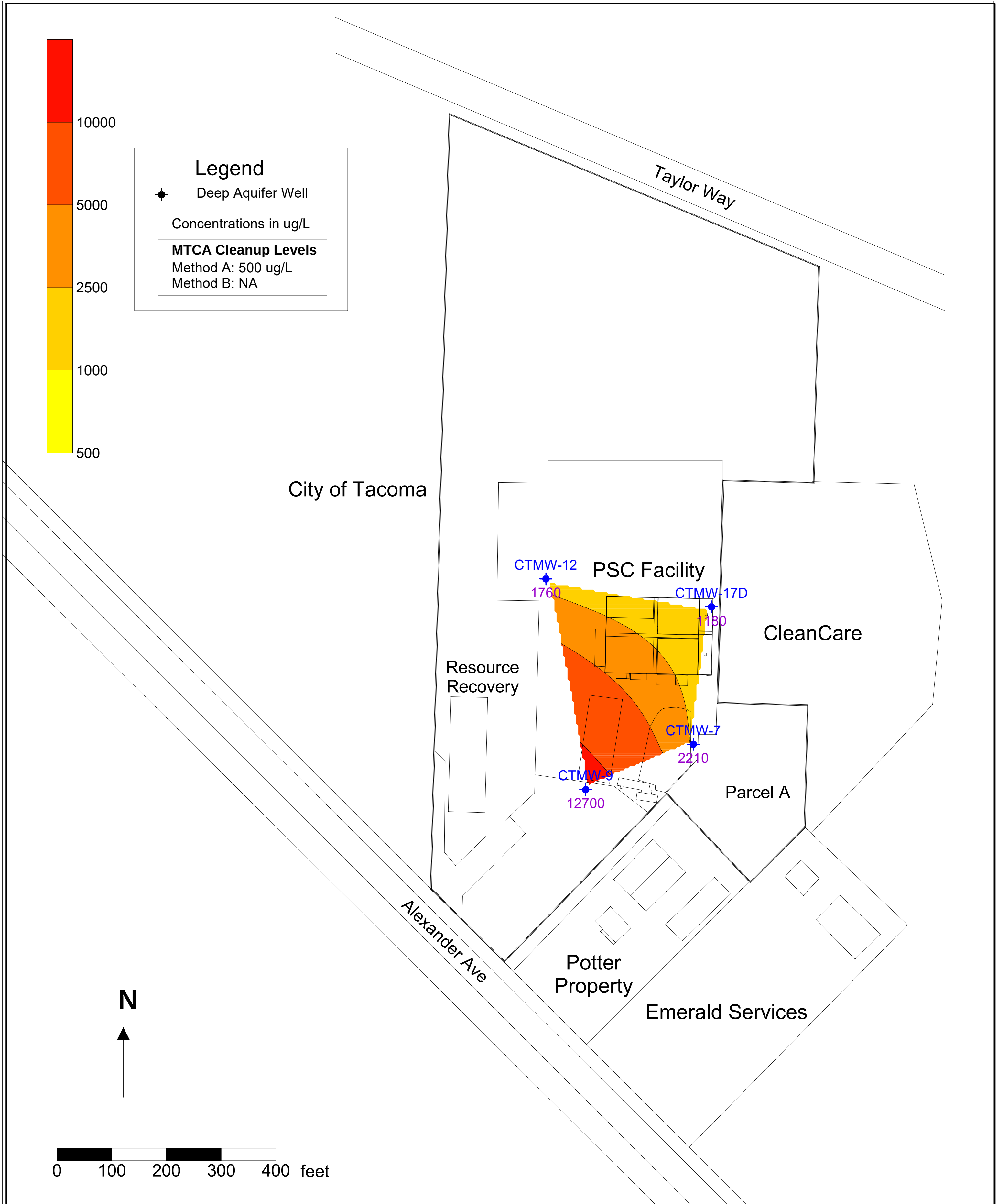


Diesel Concentrations
4th Quarter 2000
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	

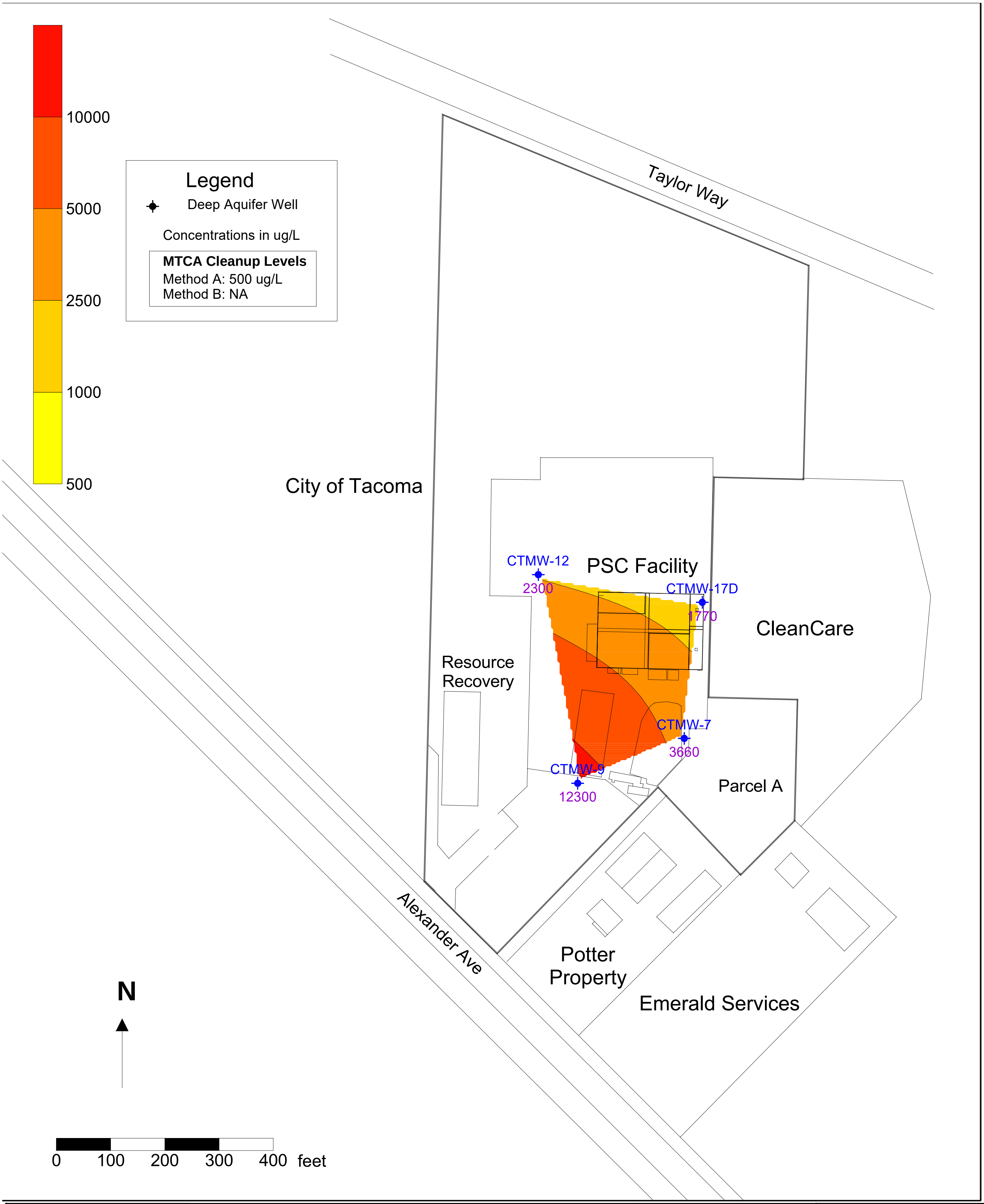


Diesel Concentrations **1st Quarter 2001 and SRI** **Deep Aquifer** **Tacoma Facility**	DWN:	DES:	PROJECT No:	
	CHKD:	APPD:	FIGURE No:	
	DATE:	REV:		

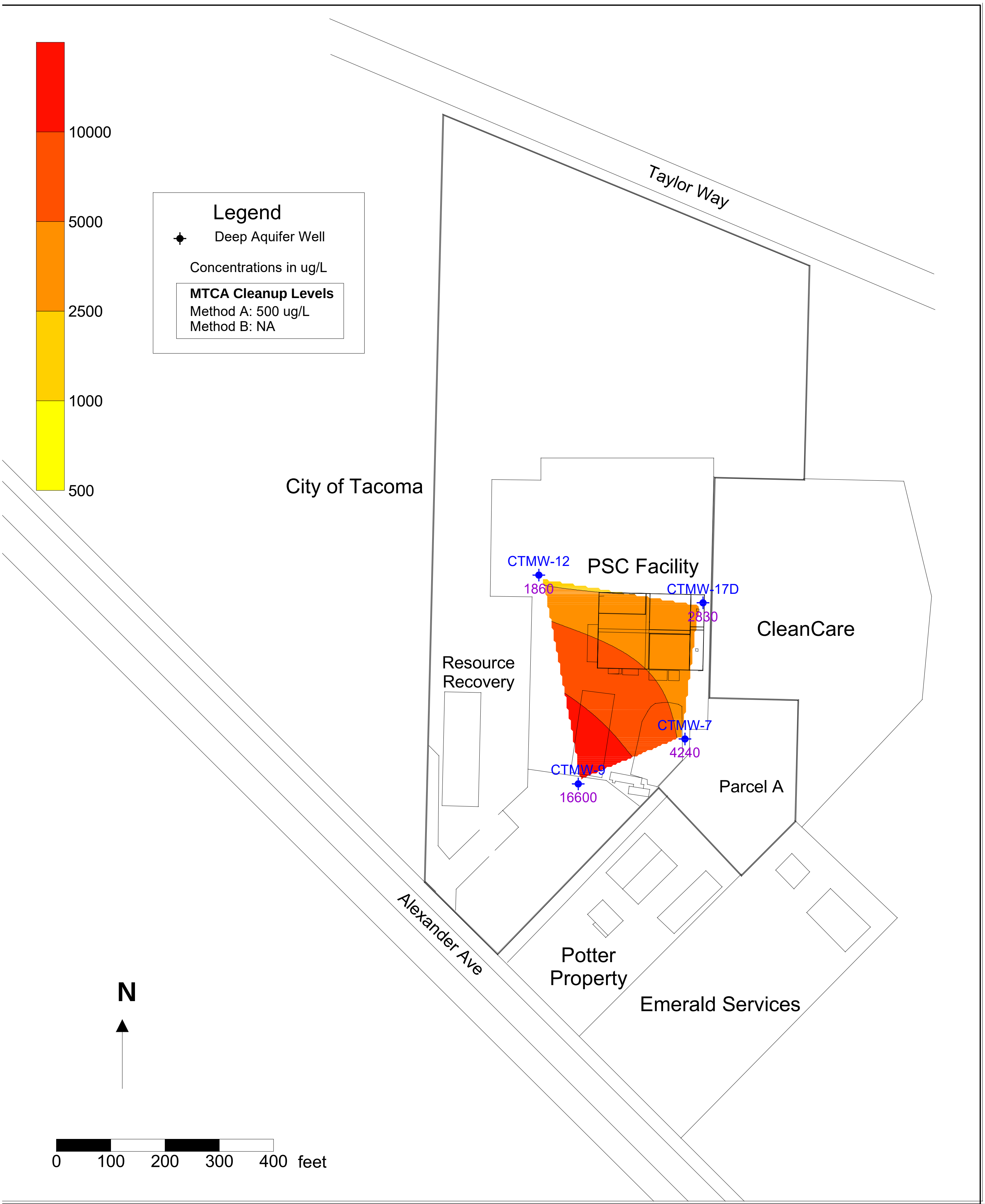


Diesel Concentrations
2nd Quarter 2001
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:

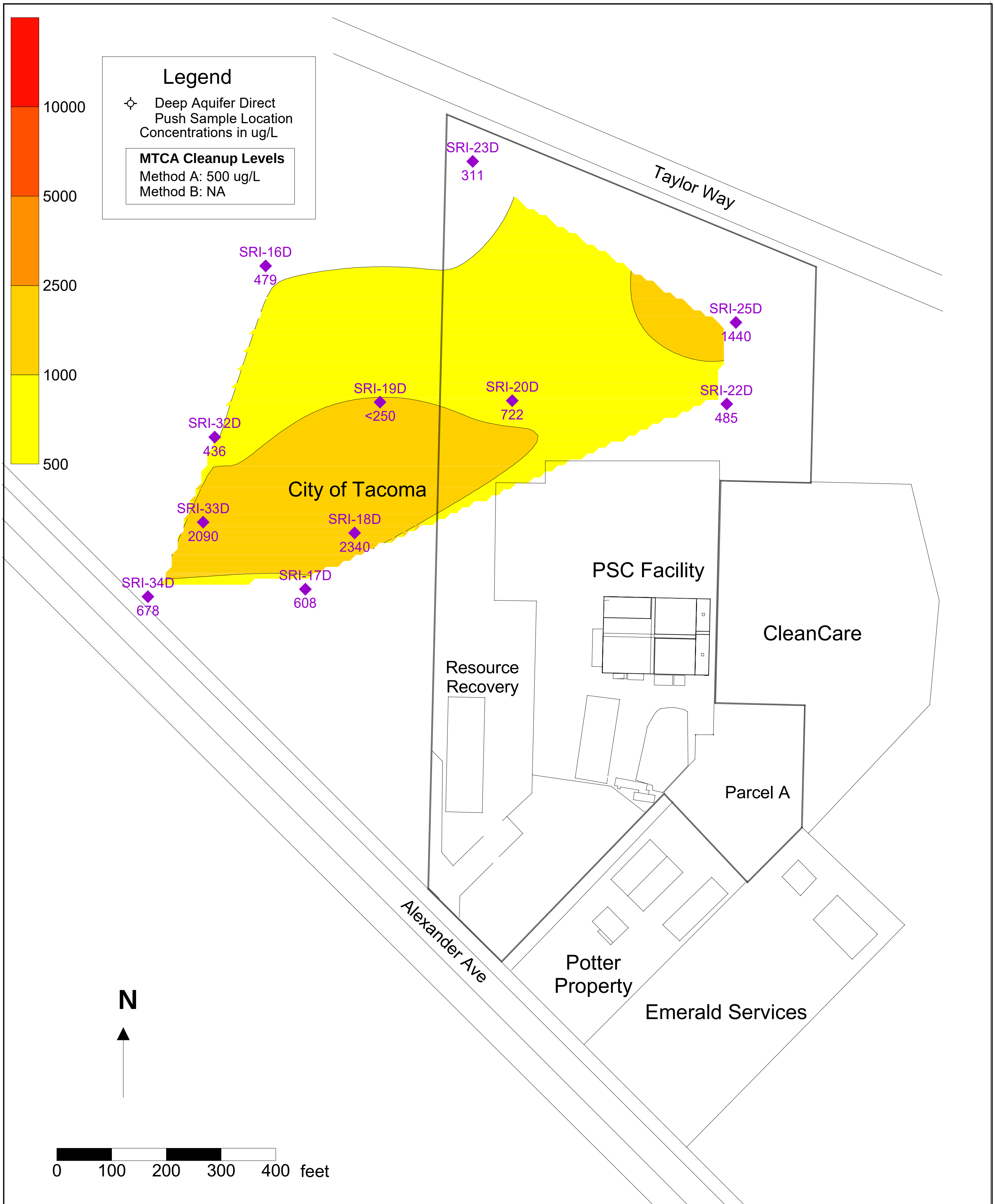


Diesel Concentrations **3rd Quarter 2001** **Deep Aquifer** **Tacoma Facility**	DWN:	DES:	PROJECT No:
	CHKD:	APPD:	FIGURE No:
	DATE:	REV:	



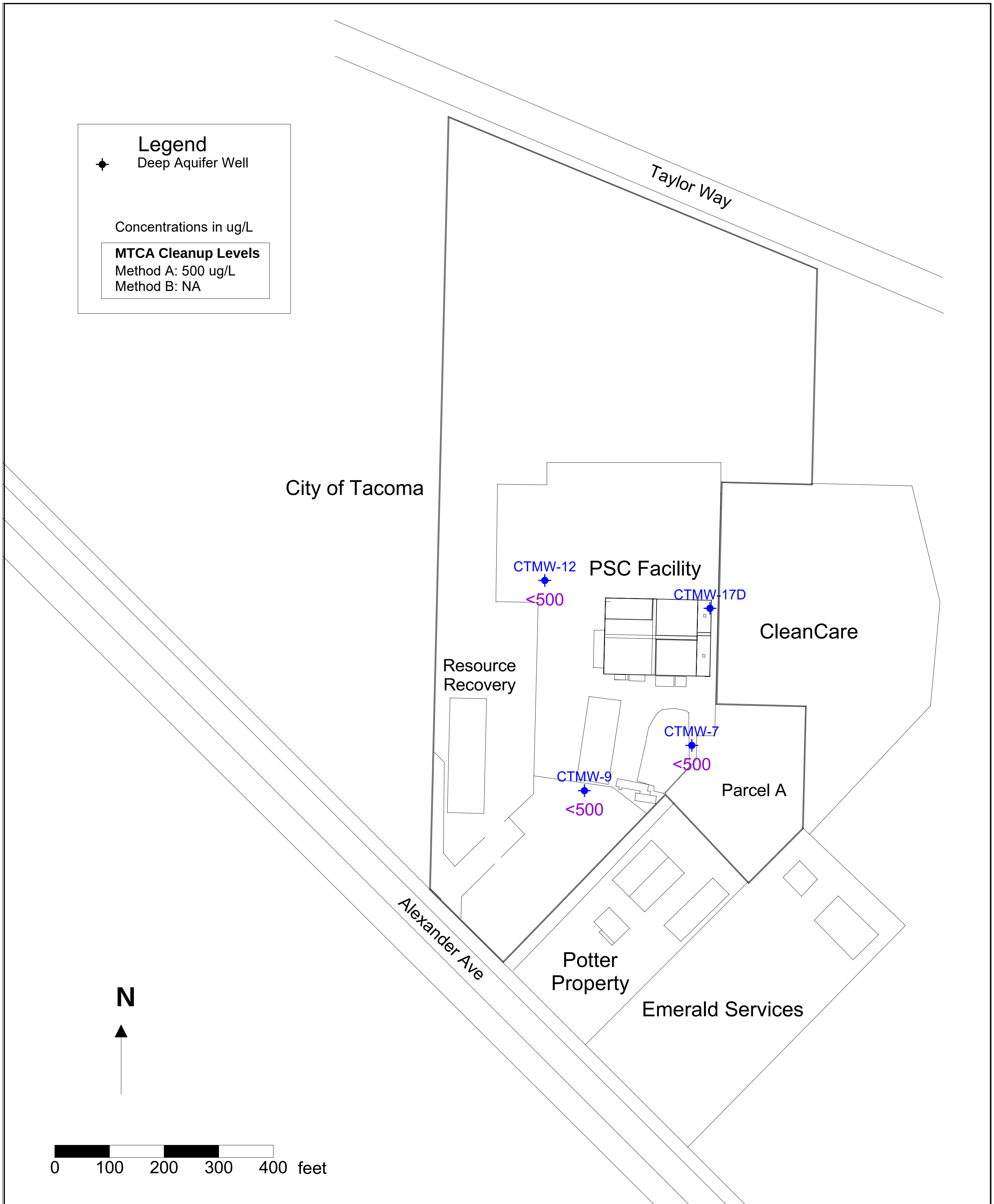
Diesel Concentrations
4th Quarter 2001
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



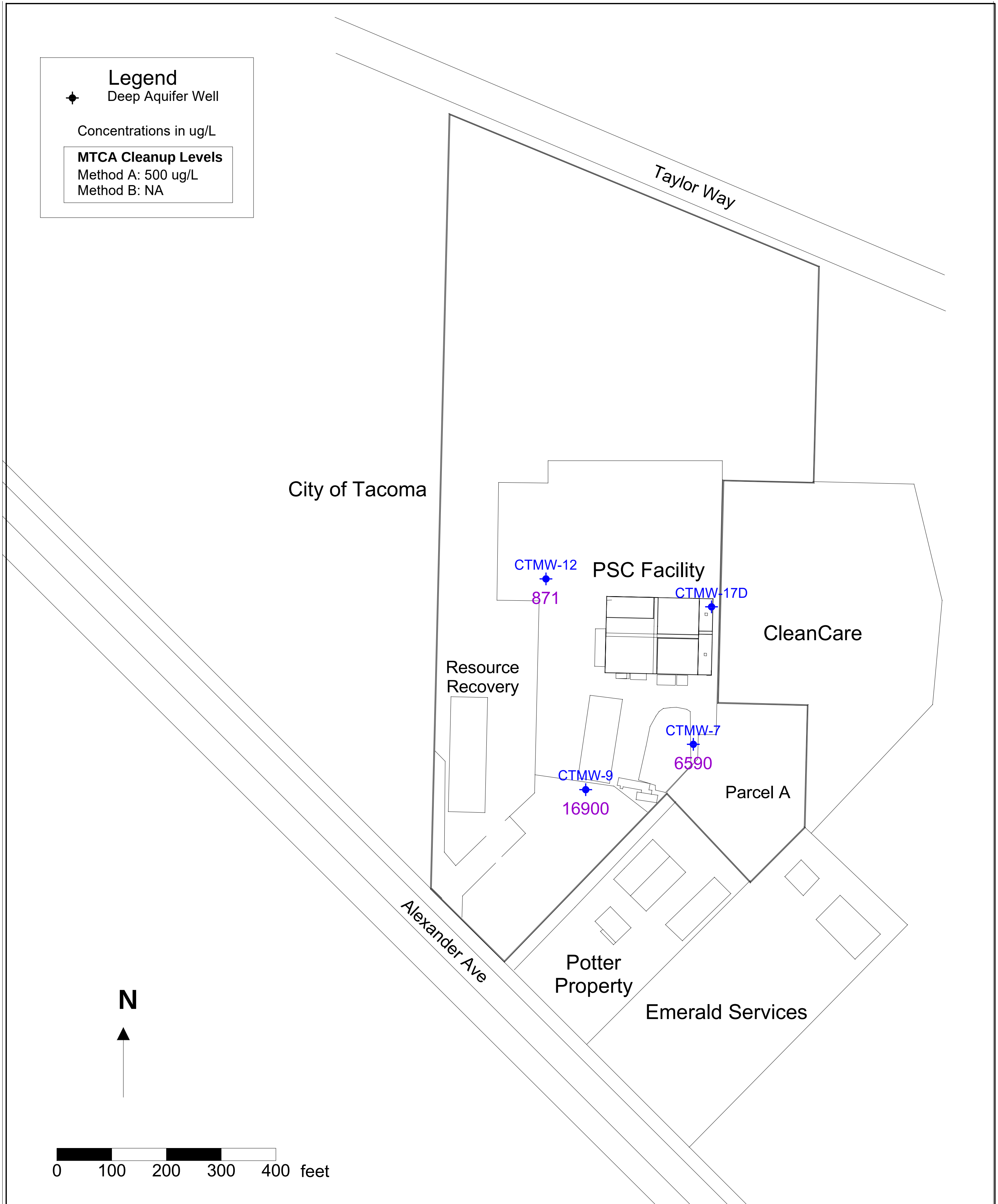
Diesel Concentrations
SRI II 2002
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



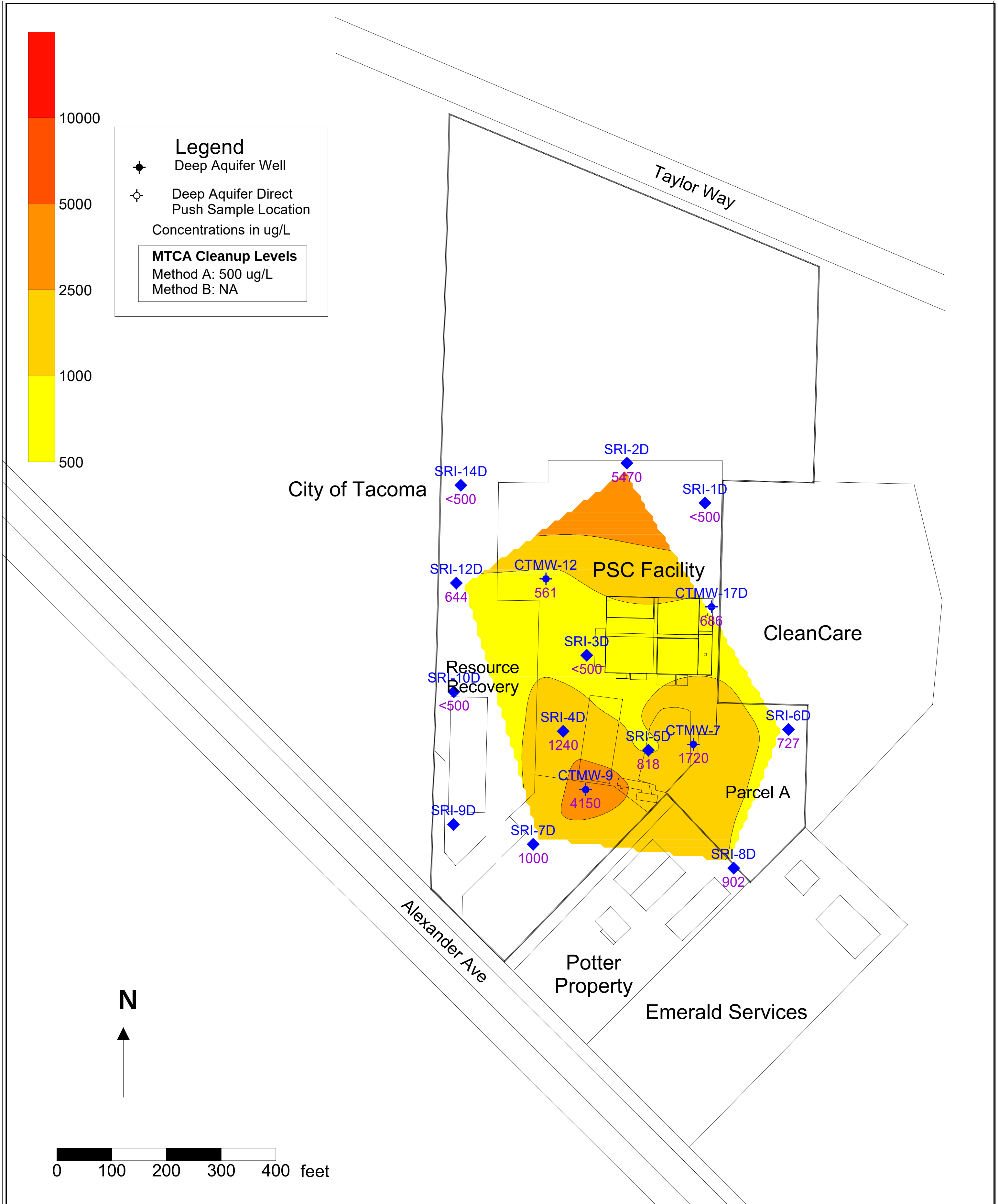
Lube Oil Concentrations
2nd Quarter 2000
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



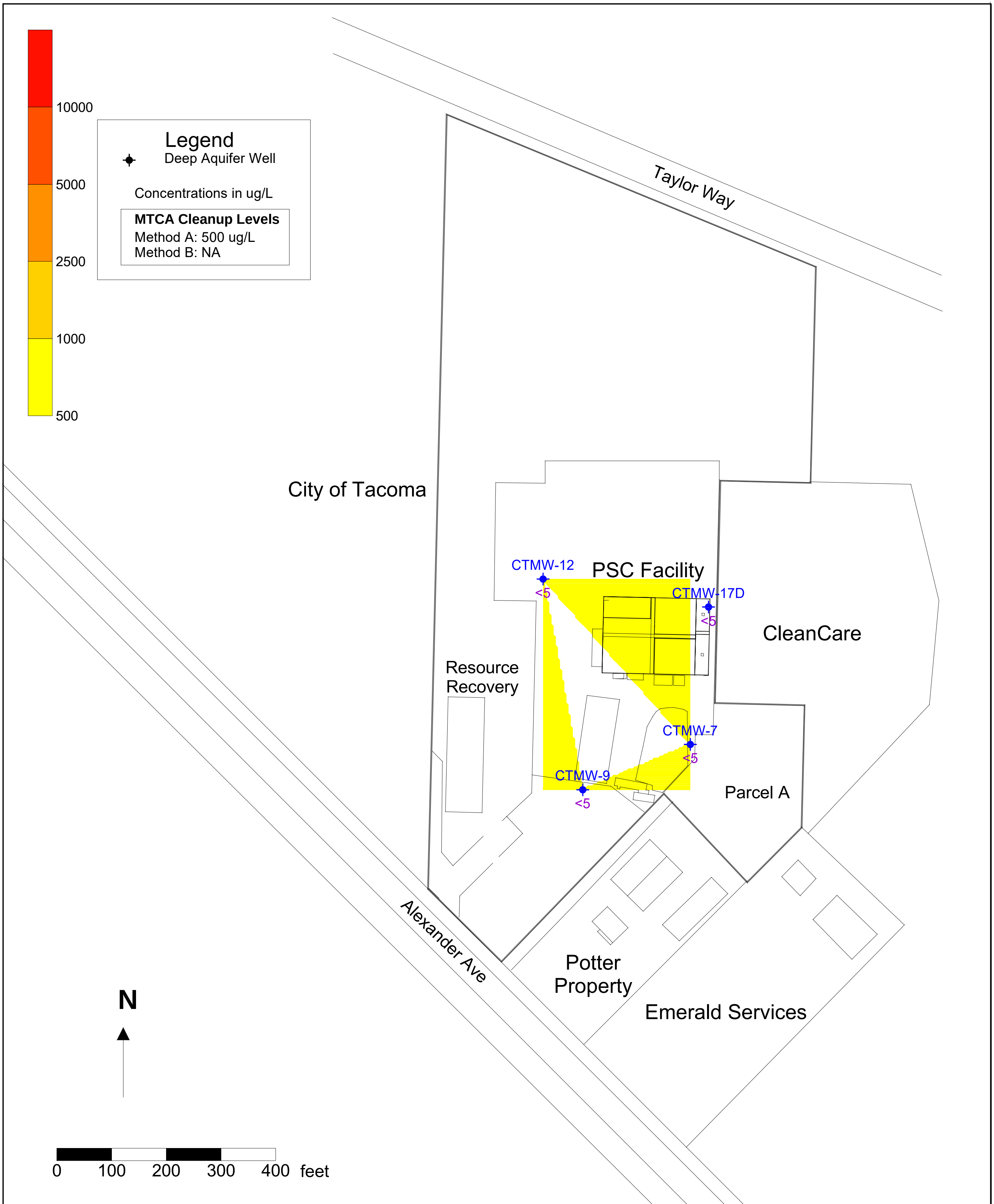
Lube Oil Concentrations
4th Quarter 2000
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



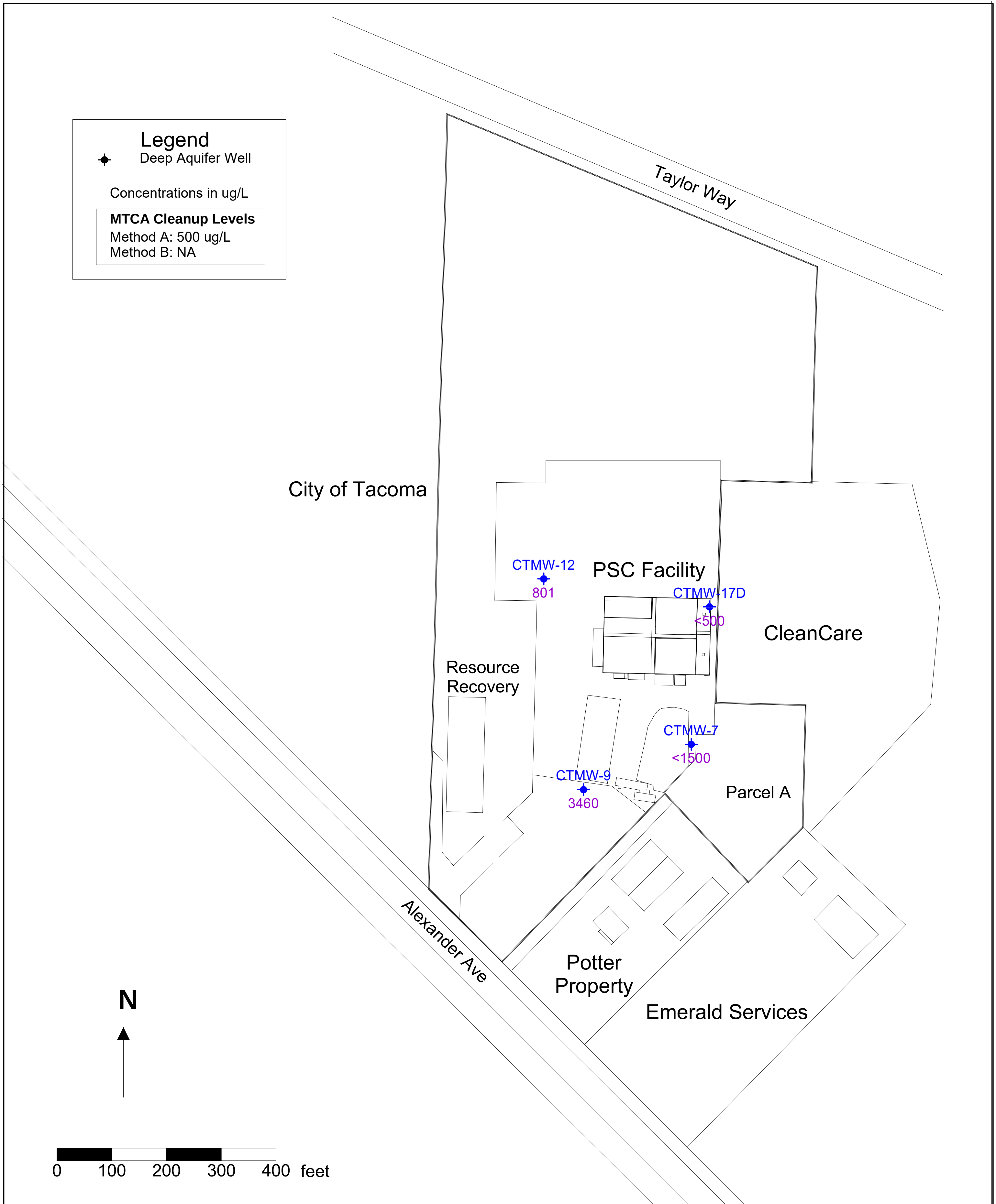
Lube Oil Concentrations
1st Quarter 2001 and SRI
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:



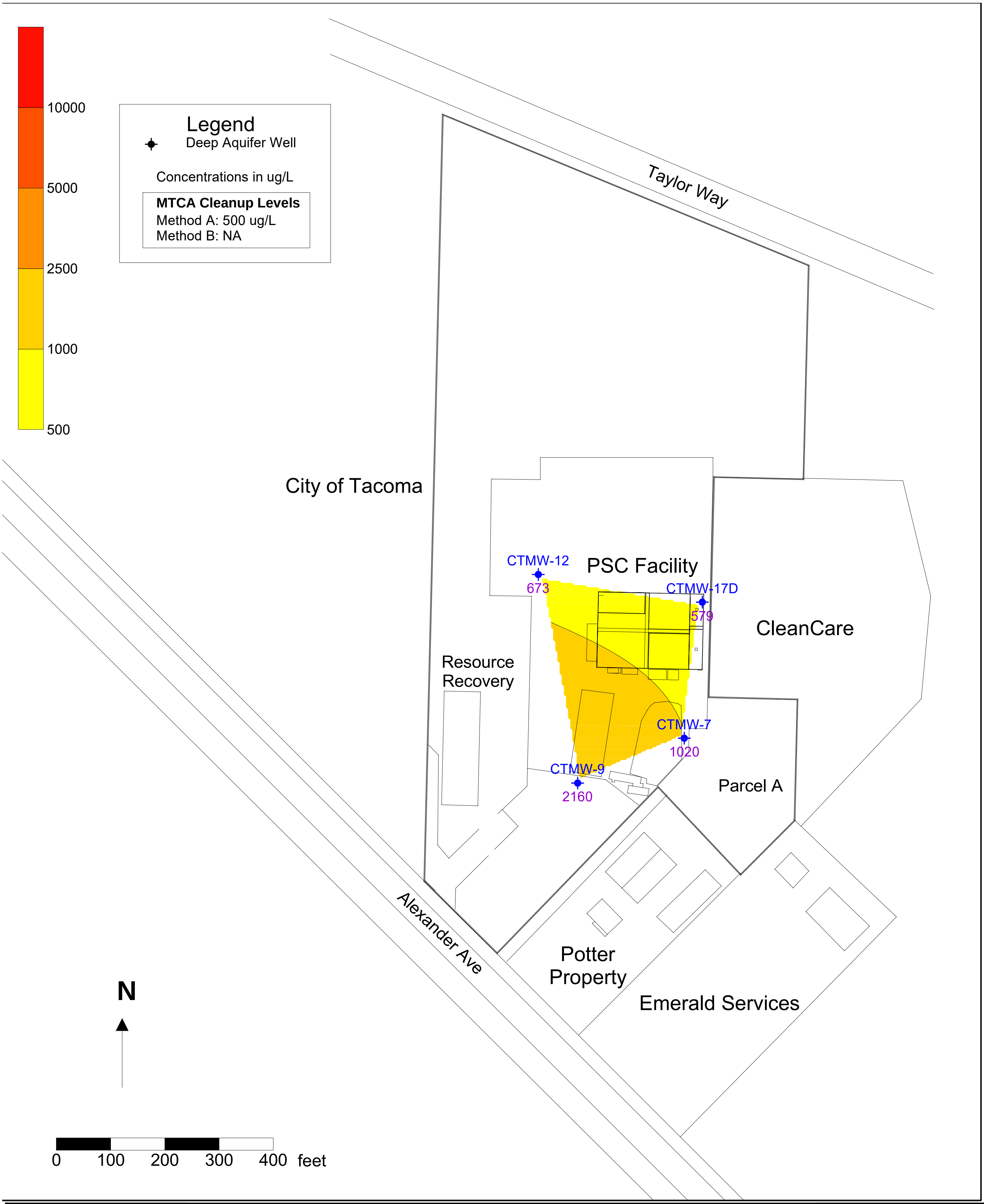
Lube Oil Concentrations
2nd Quarter 2001
Deep Aquifer
Tacoma Facility

DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	



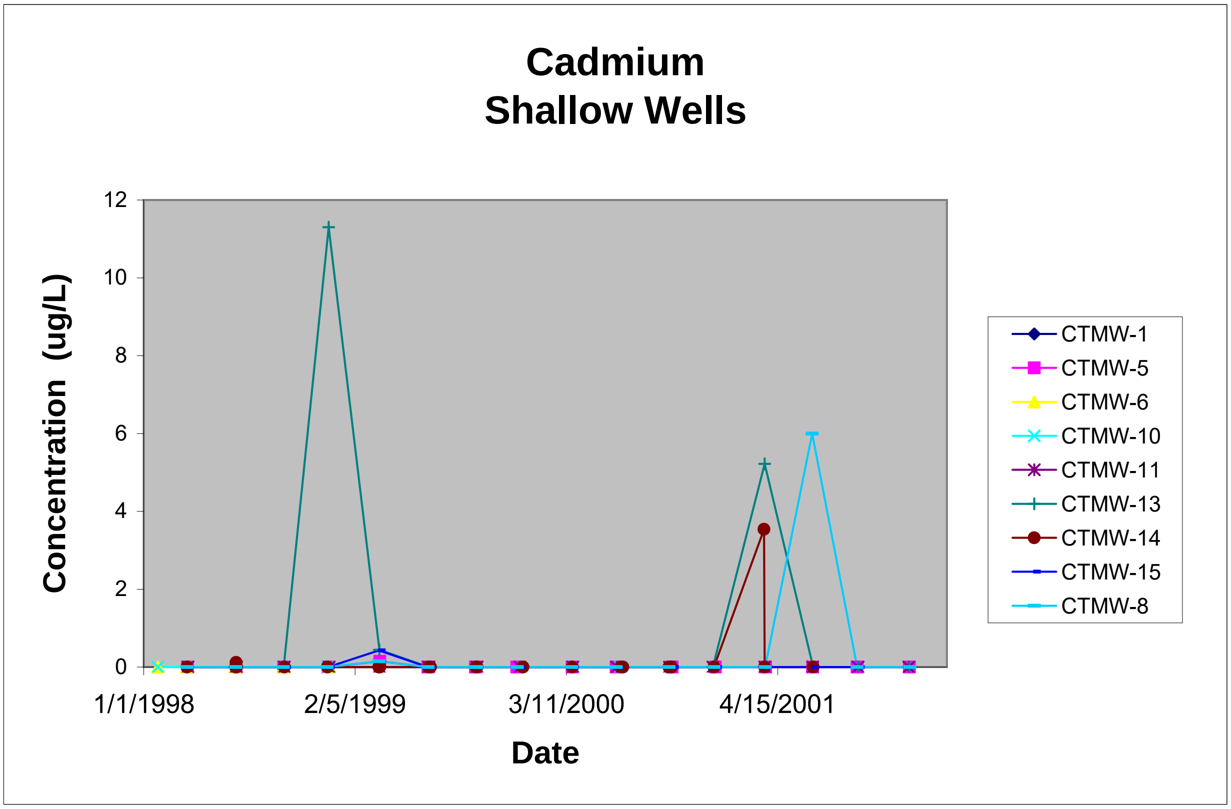
Lube Oil Concentrations
3rd Quarter 2001
Deep Aquifer
Tacoma Facility

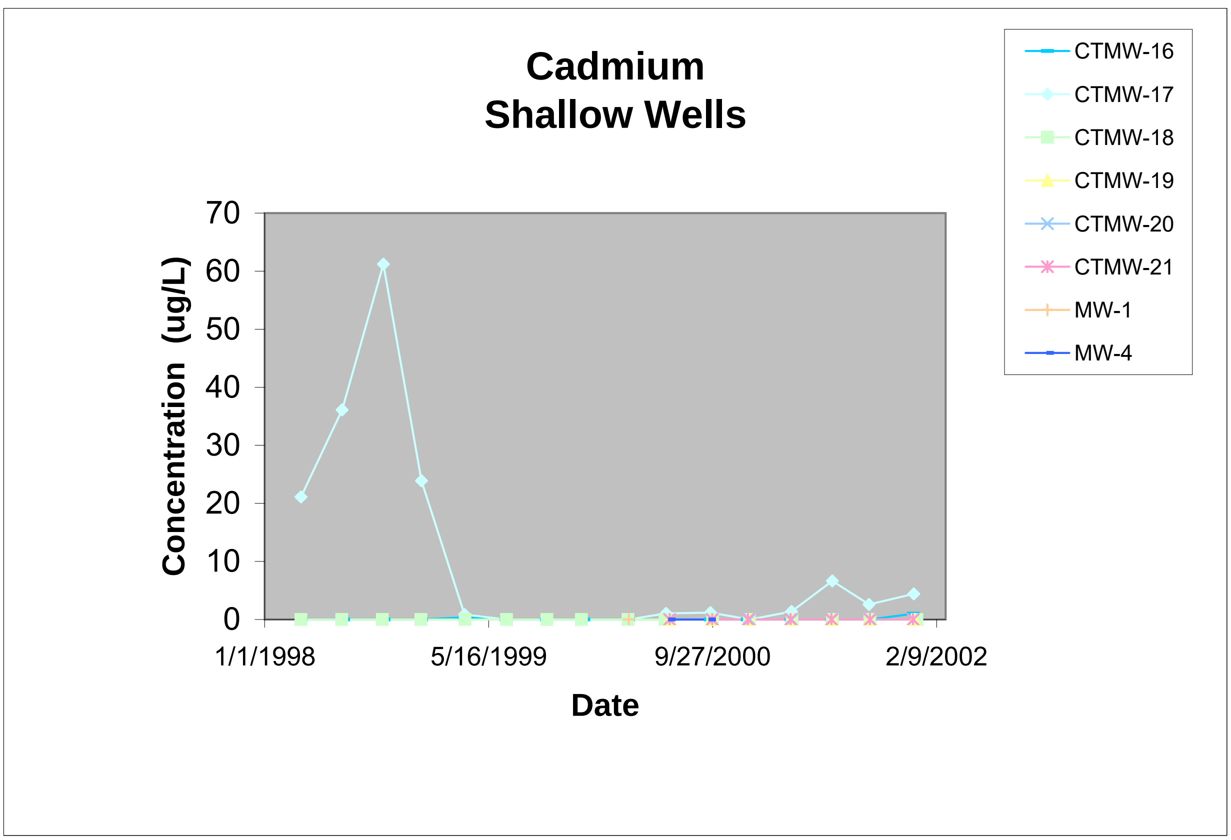
DWN:	DES:	PROJECT No:
CHKD:	APPD:	FIGURE No:
DATE:	REV:	

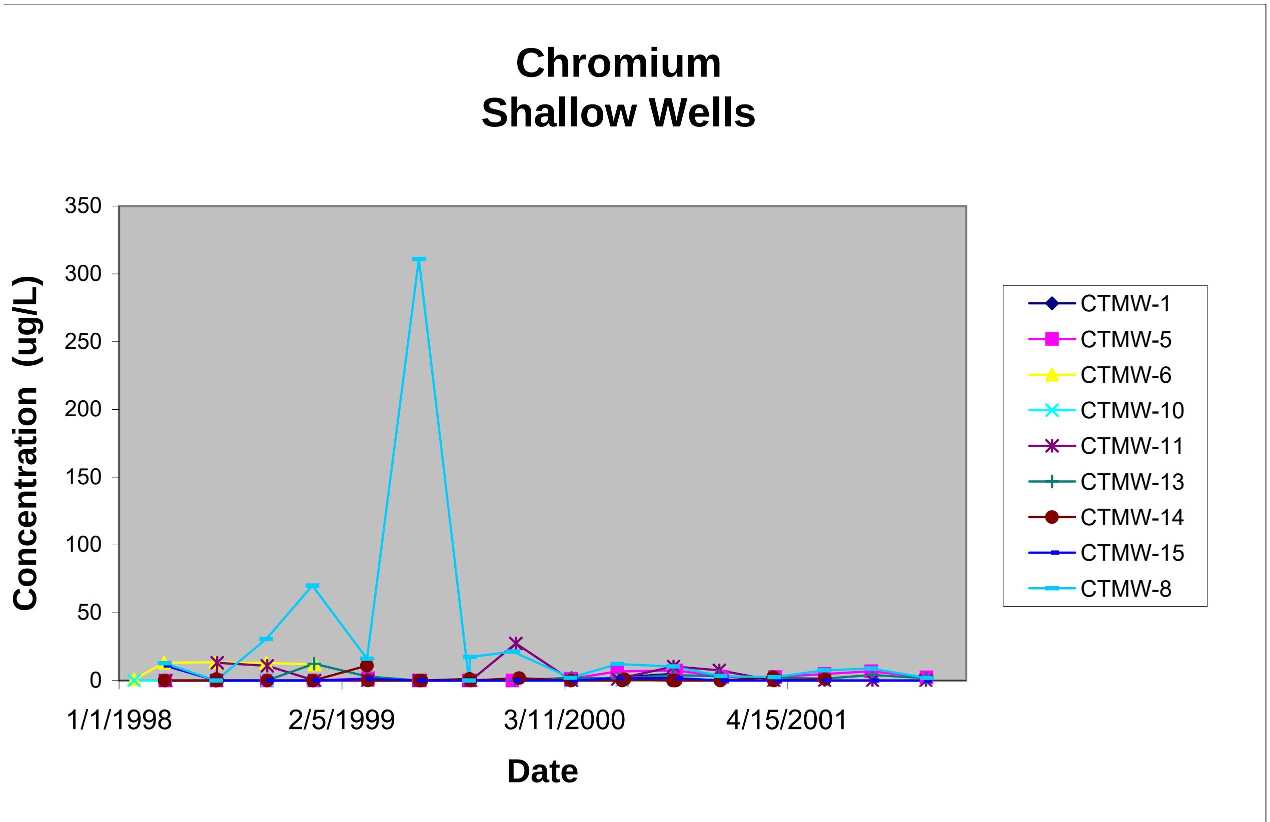


Lube Oil Concentrations
4th Quarter 2001
Deep Aquifer
Tacoma Facility

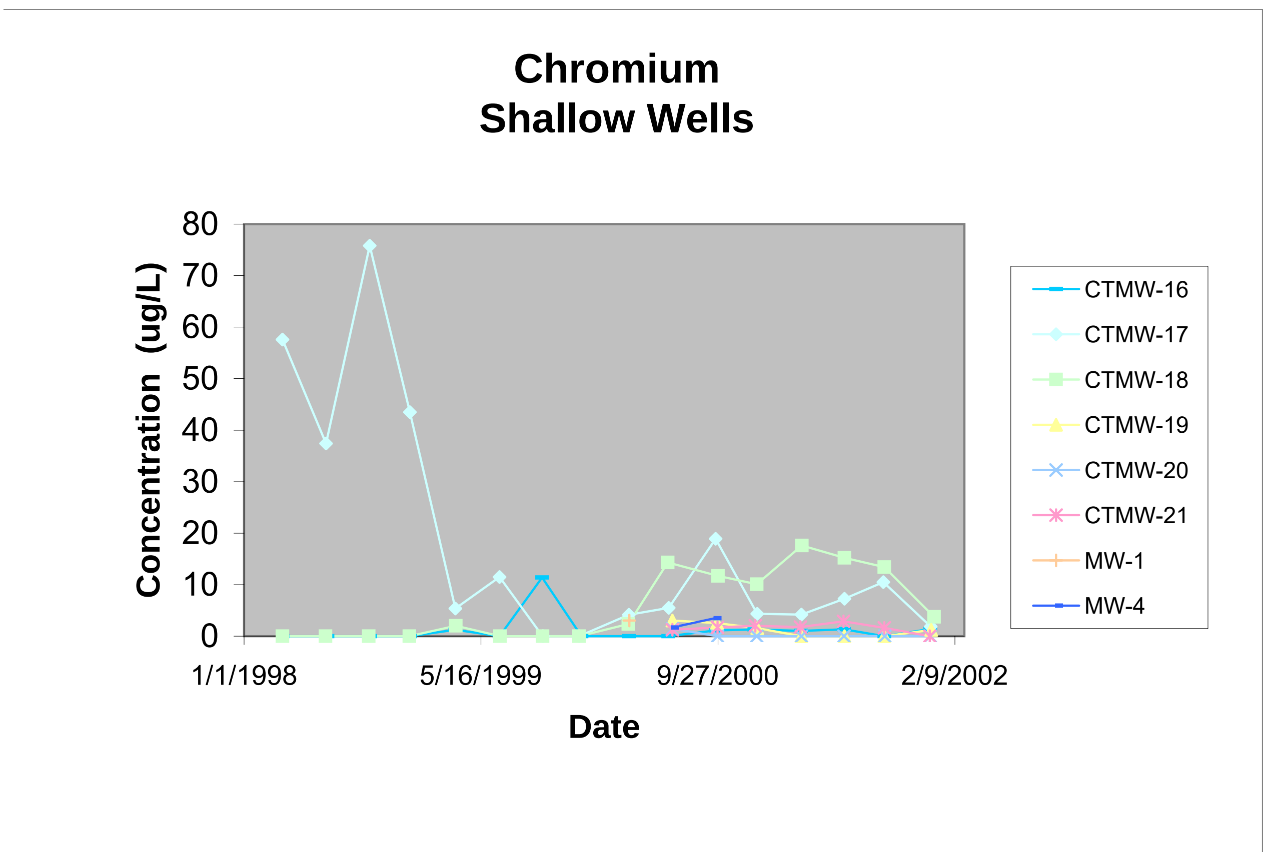
DWN:	DES:	PROJECT No:
CHKD:	APPD:	
DATE:	REV:	FIGURE No:


Cadmium
Shallow Wells
Concentration (ug/L)
12
10
8
6
4
2
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

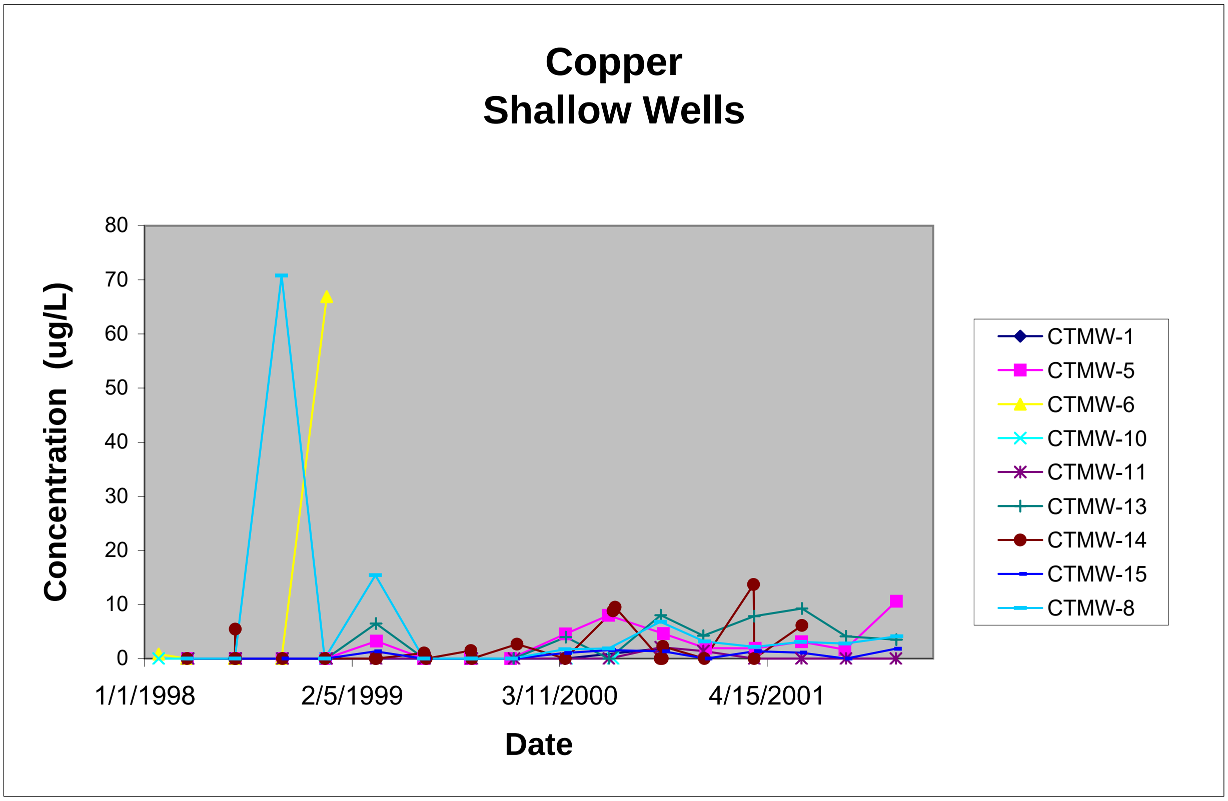

Cadmium
Shallow Wells
Concentration (ug/L)
70
60
50
40
30
20
10
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

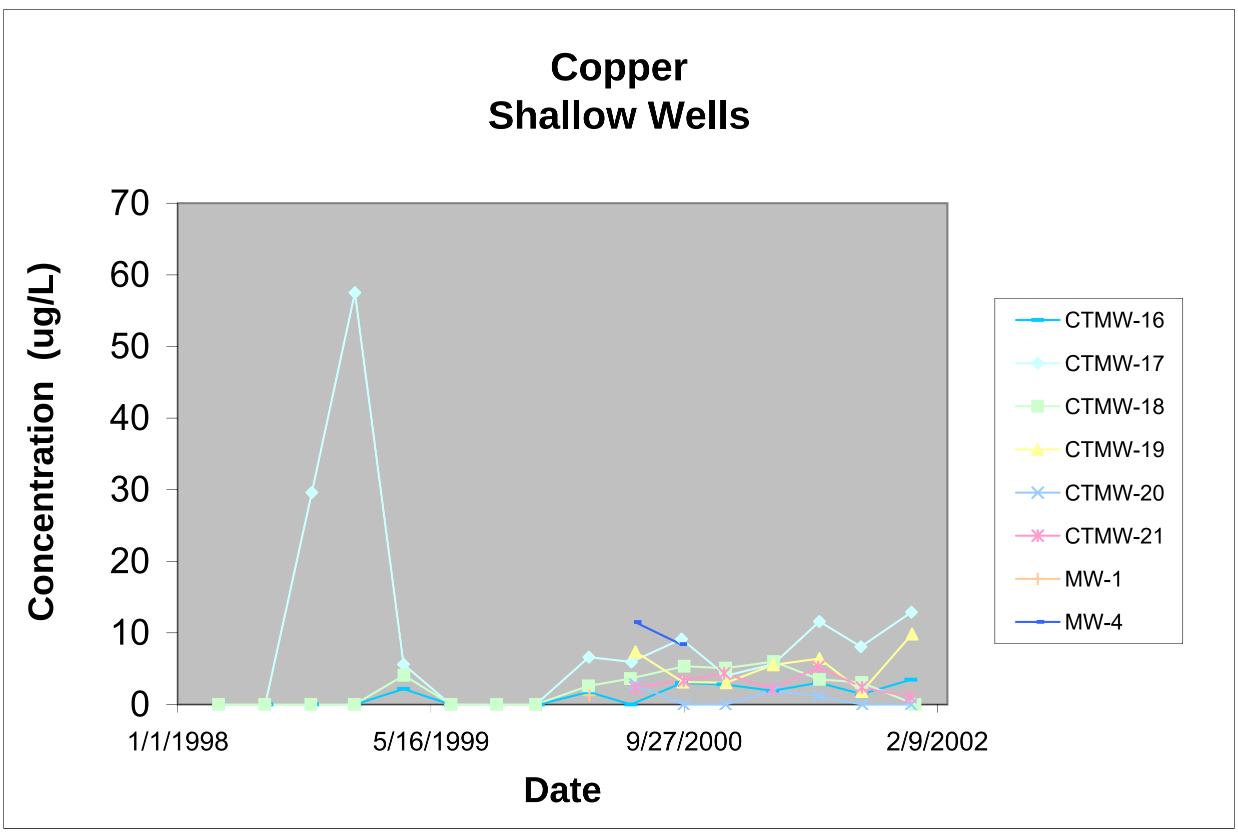


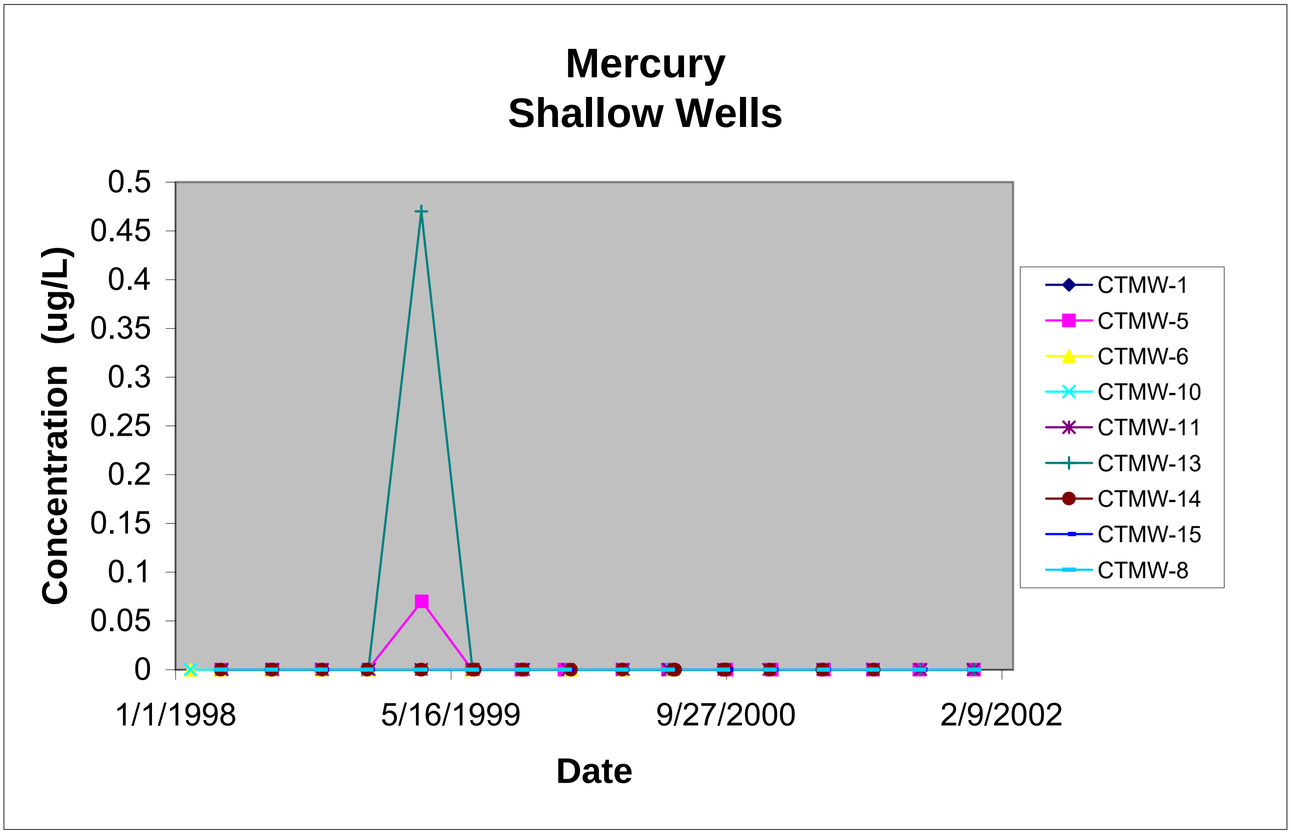
Chromium
Shallow Wells
Concentration (ug/L)
350
300
250
200
150
100
50
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8



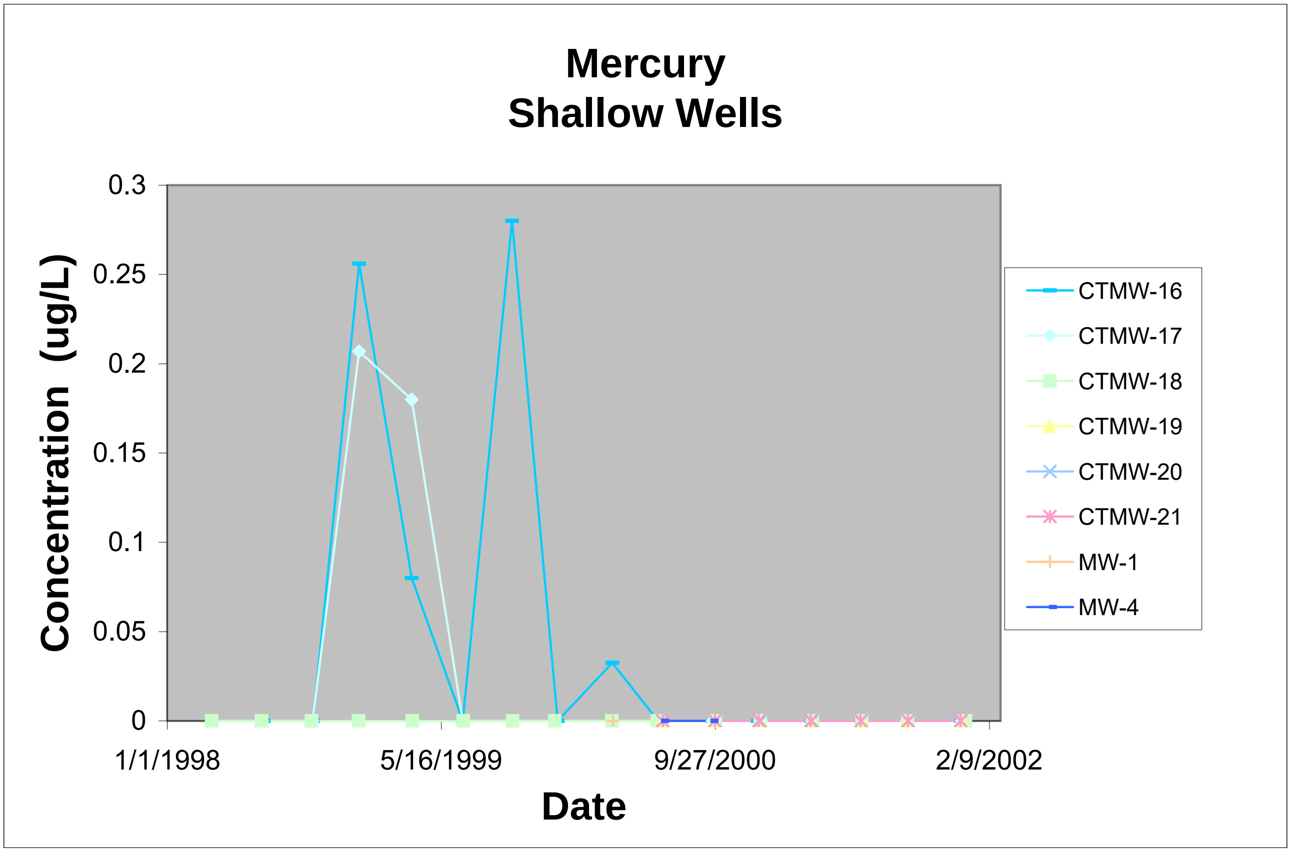
Chromium
Shallow Wells
Concentration (ug/L)
80
70
60
50
40
30
20
10
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


Copper
Shallow Wells
Concentration (ug/L)
80
70
60
50
40
30
20
10
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

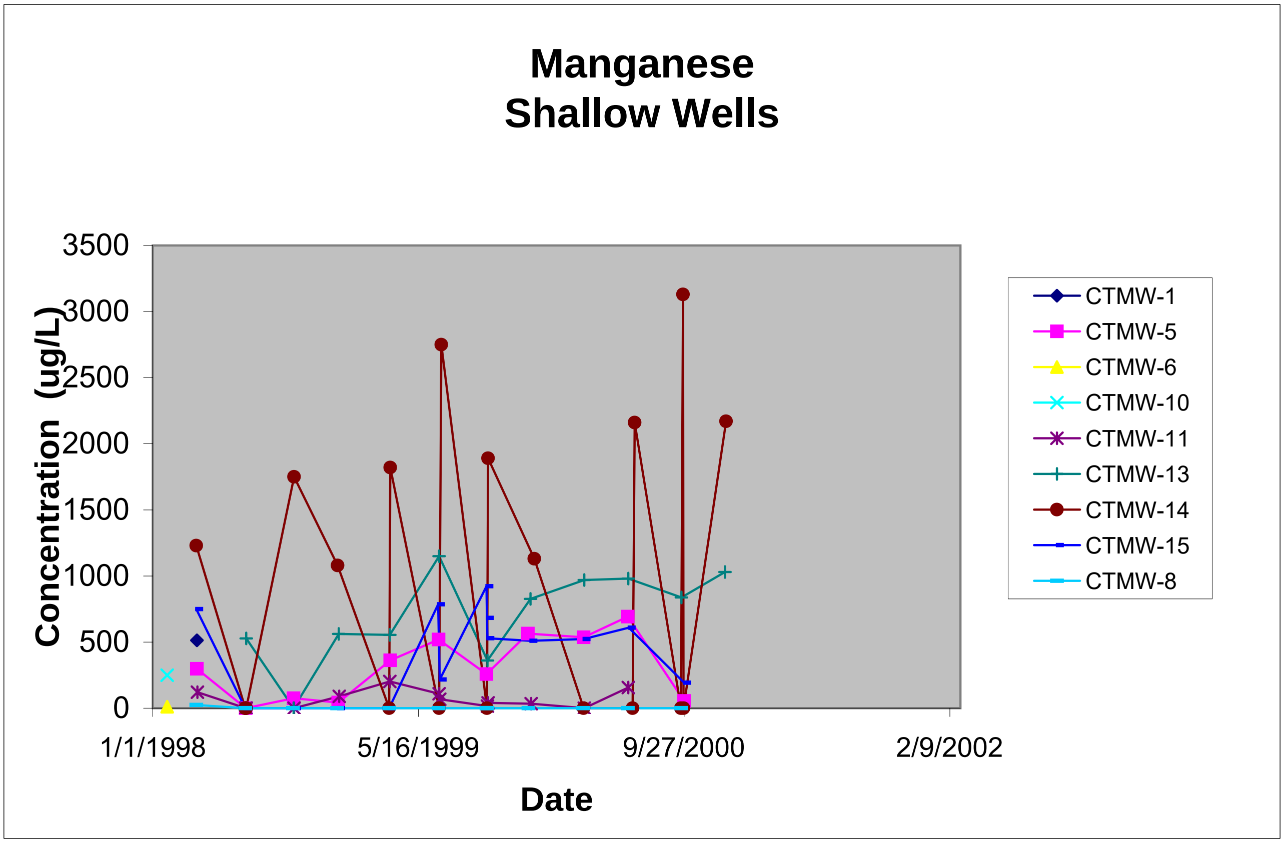

Copper
Shallow Wells
Concentration (ug/L)
70
60
50
40
30
20
10
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

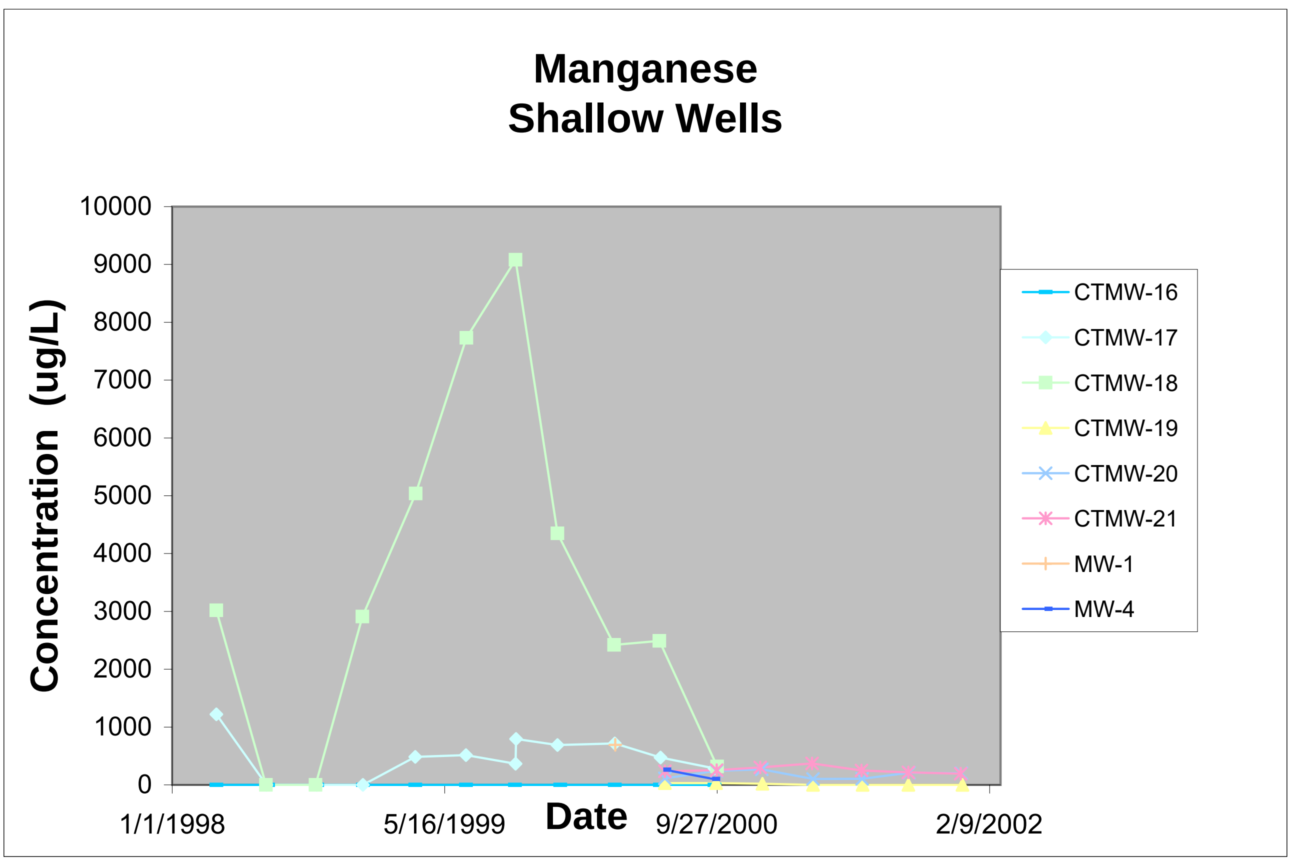


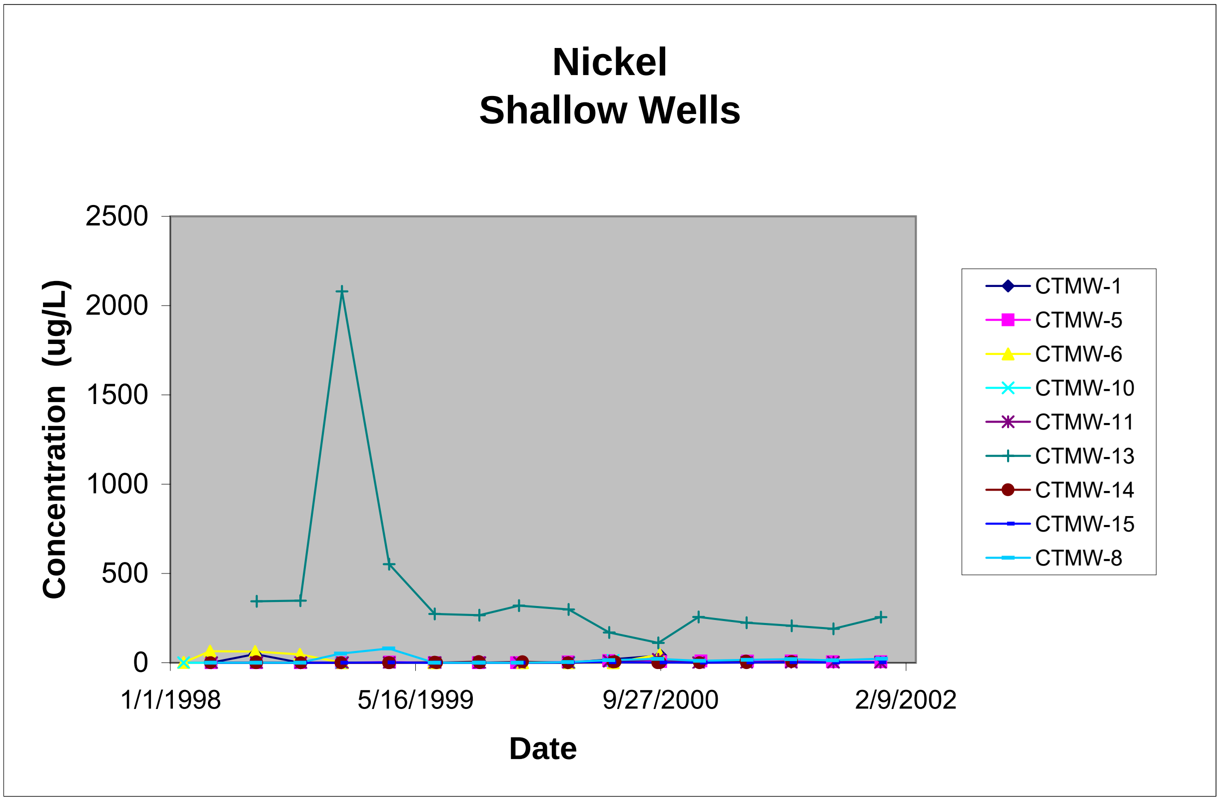
Mercury
Shallow Wells
Concentration (ug/L)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

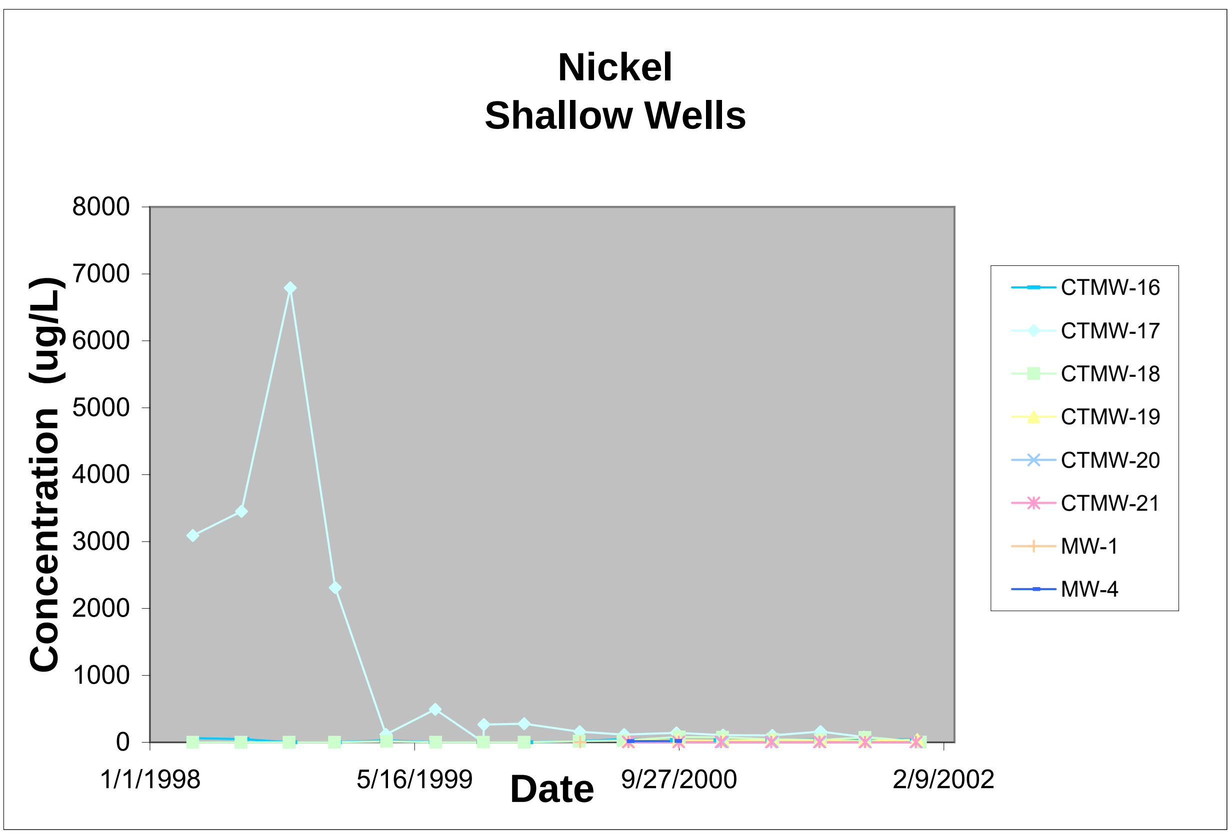


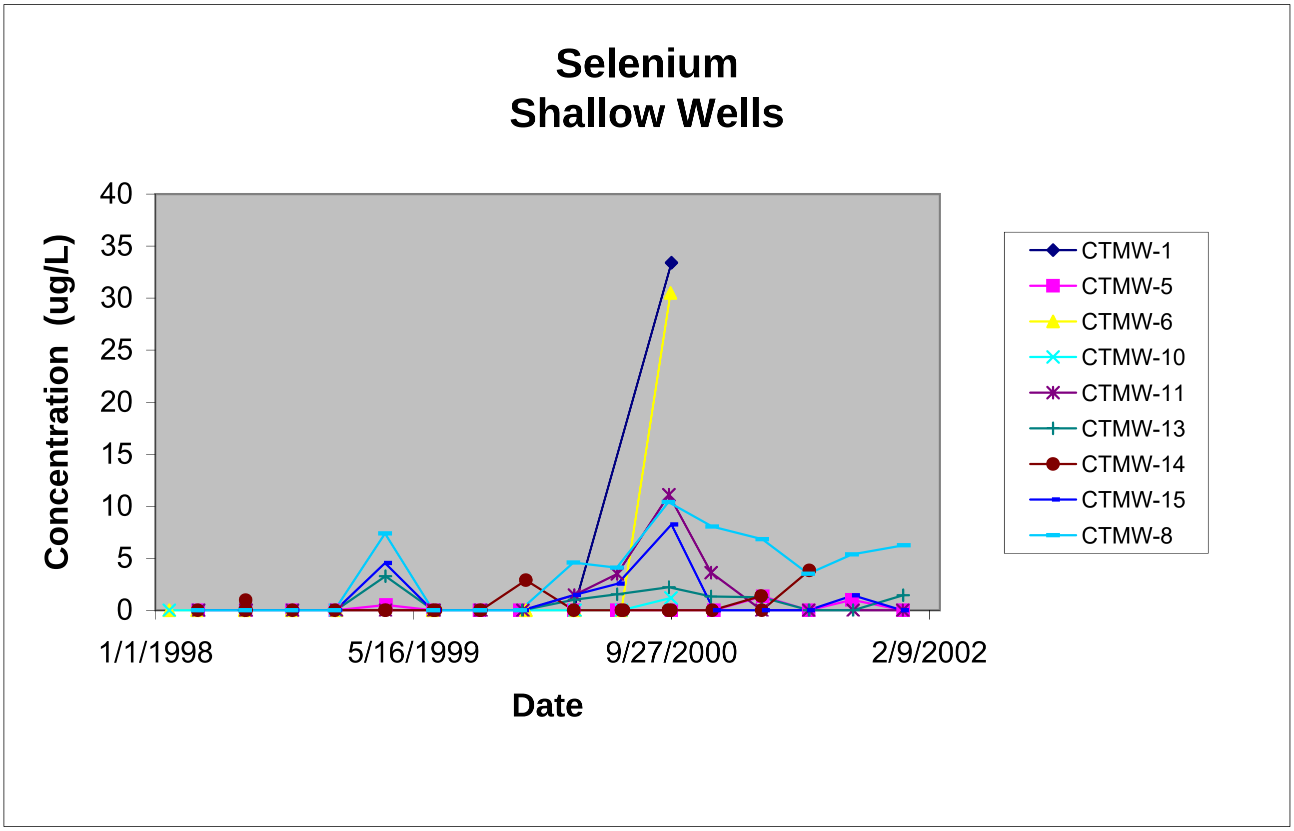
Mercury
Shallow Wells
Concentration (ug/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

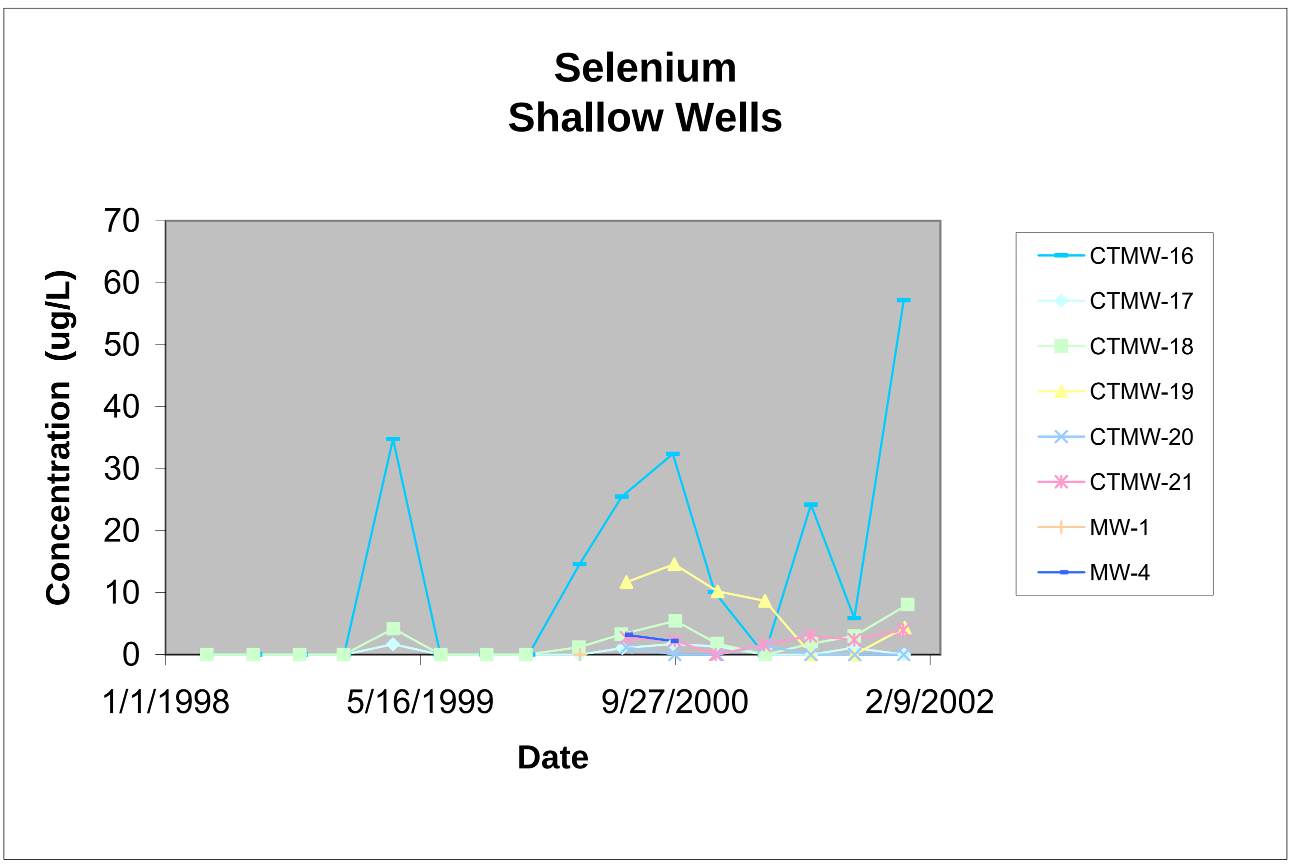

Manganese
Shallow Wells
Concentration (ug/L)
3500
3000
2500
2000
1500
1000
500
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

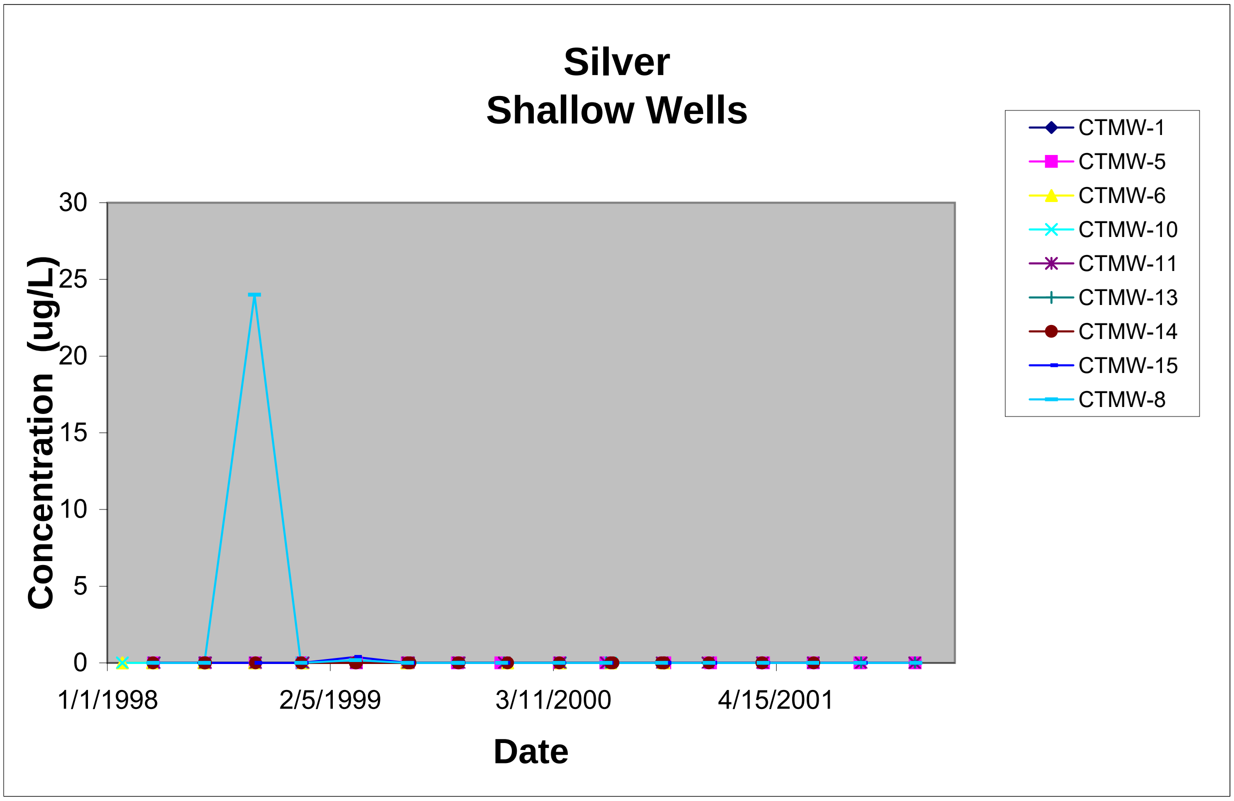

Manganese
Shallow Wells
Concentration (ug/L)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


Nickel
Shallow Wells
Concentration (ug/L)
2500
2000
1500
1000
500
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

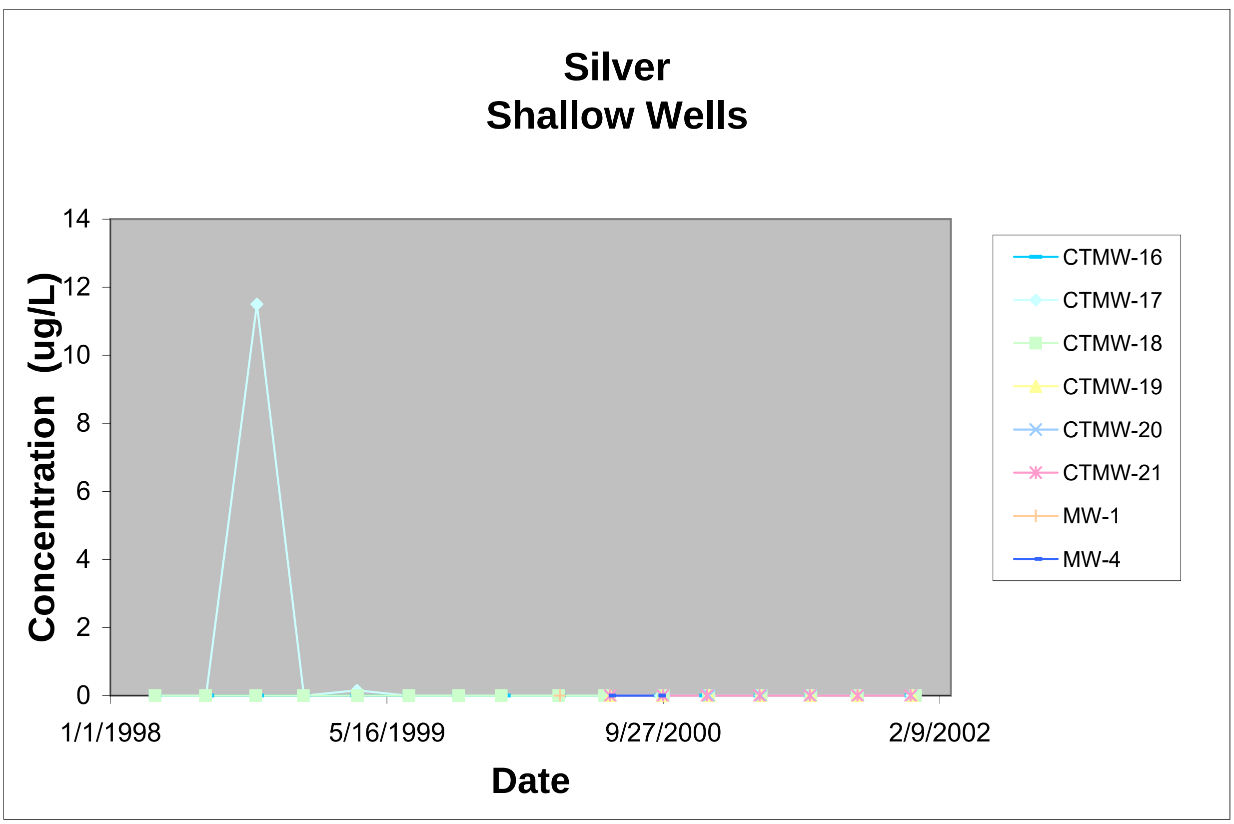

Nickel
Shallow Wells
Concentration (ug/L)
8000
7000
6000
5000
4000
3000
2000
1000
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


Selenium
Shallow Wells
Concentration (ug/L)
0
5
10
15
20
25
30
35
40
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

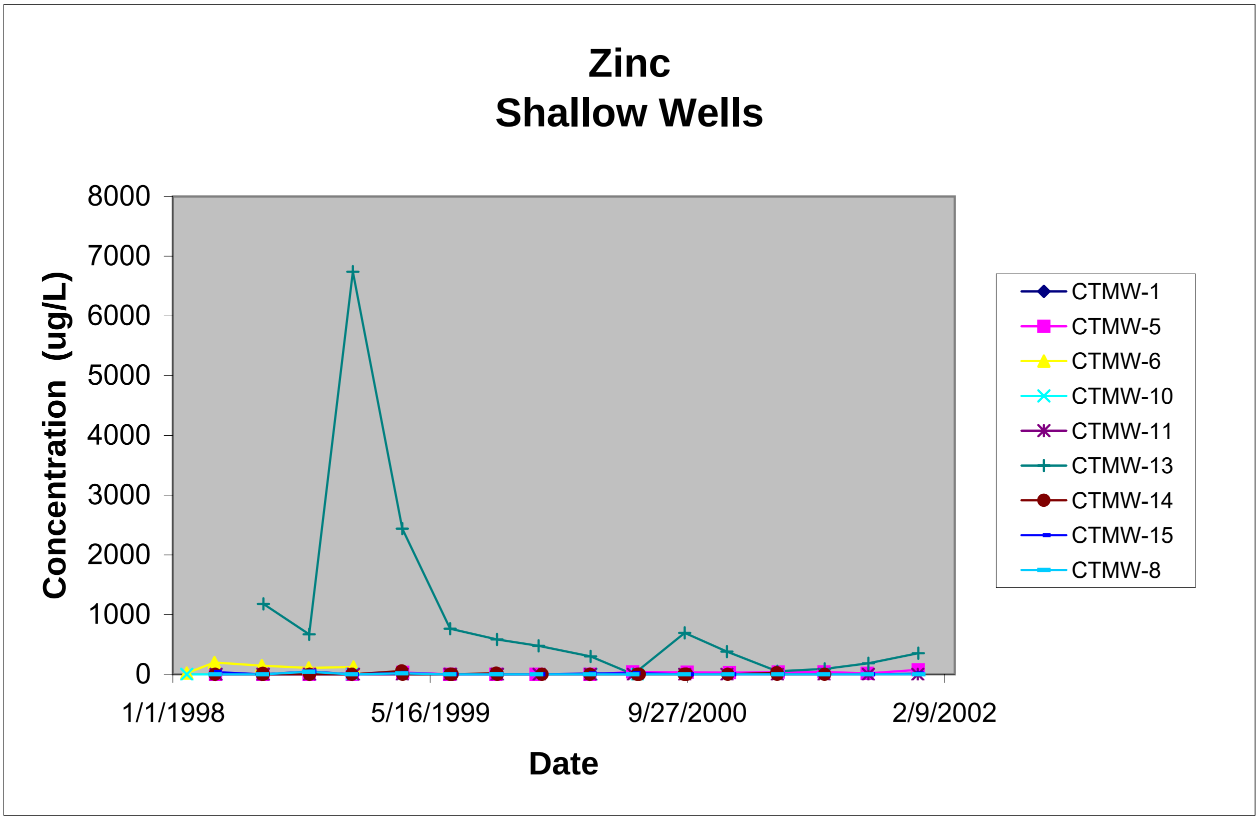

Selenium
Shallow Wells
Concentration (ug/L)
0
10
20
30
40
50
60
70
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

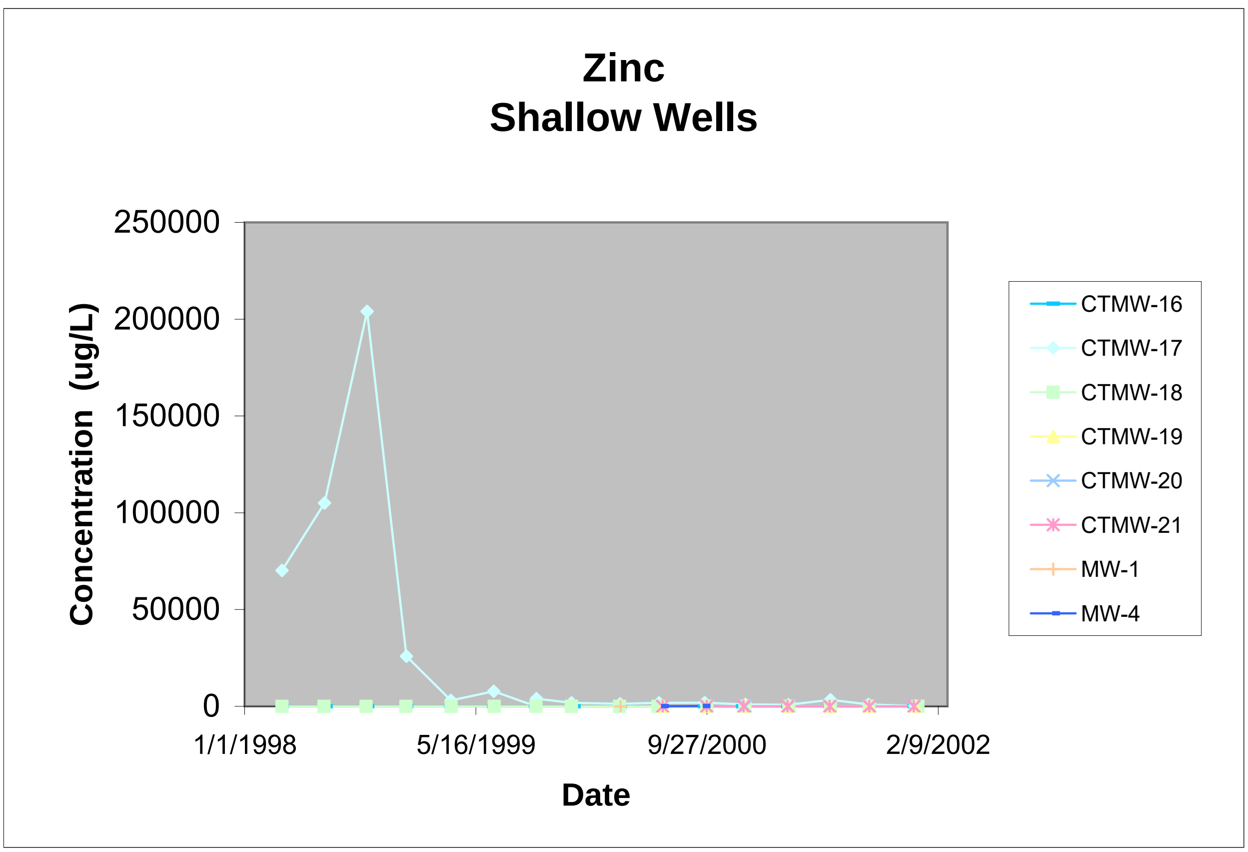


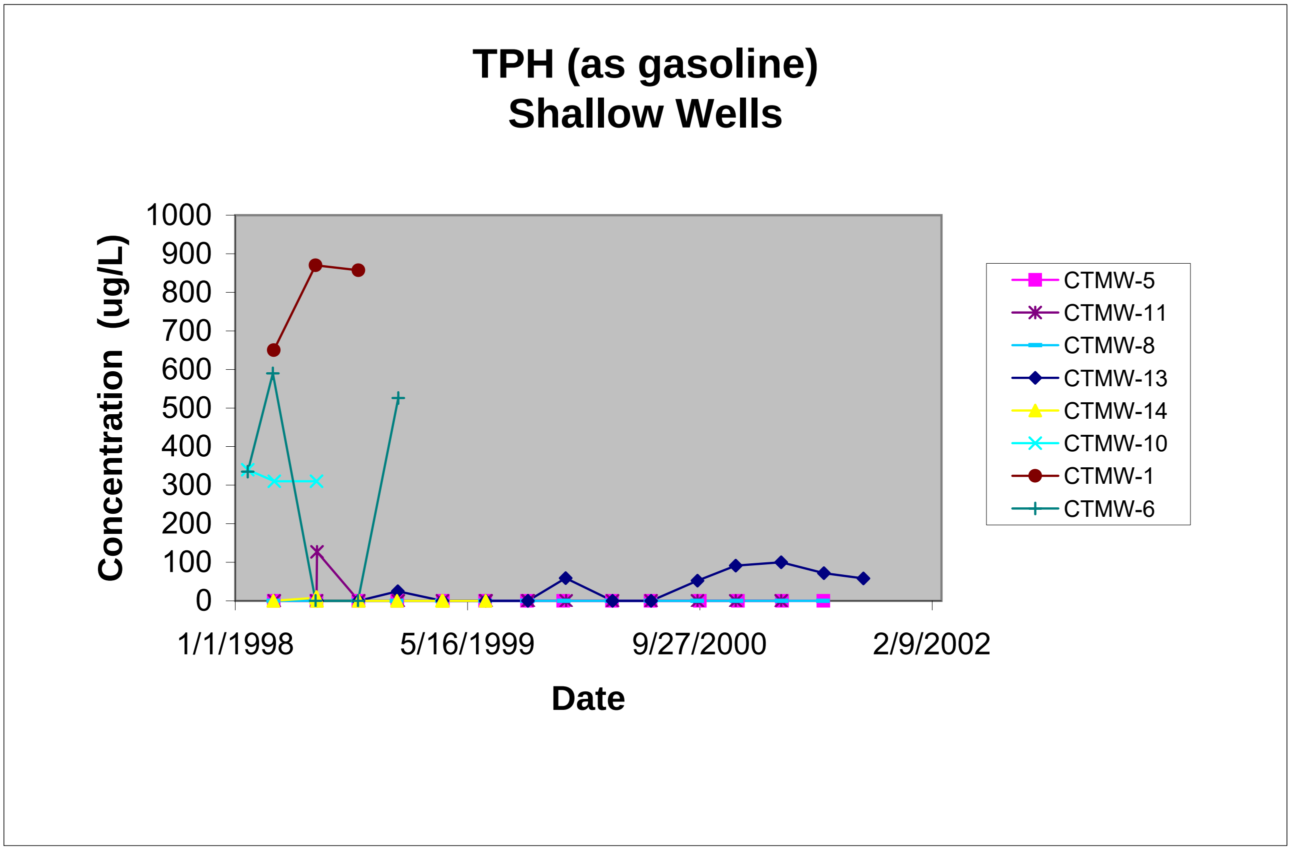
Silver
Shallow Wells
Concentration (ug/L)
30
25
20
15
10
5
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

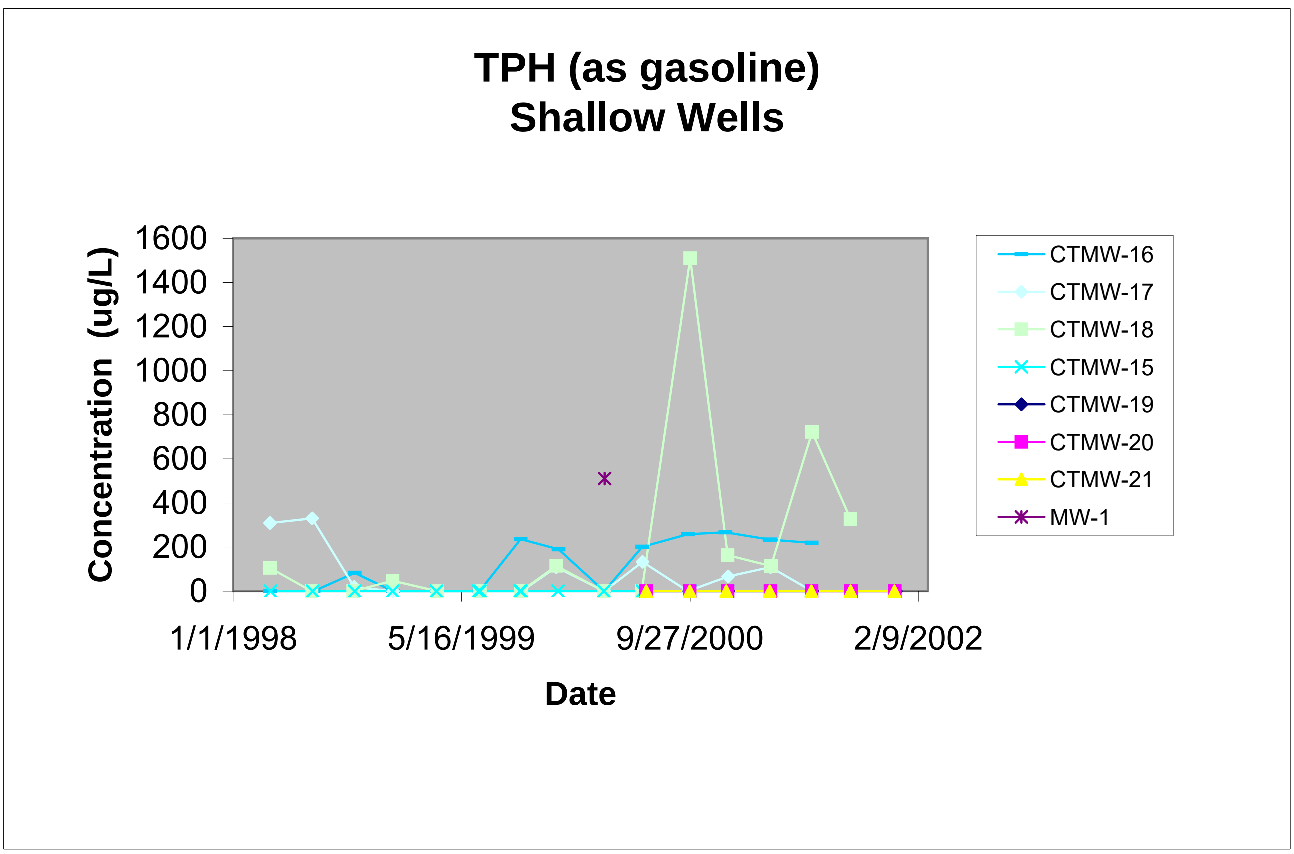


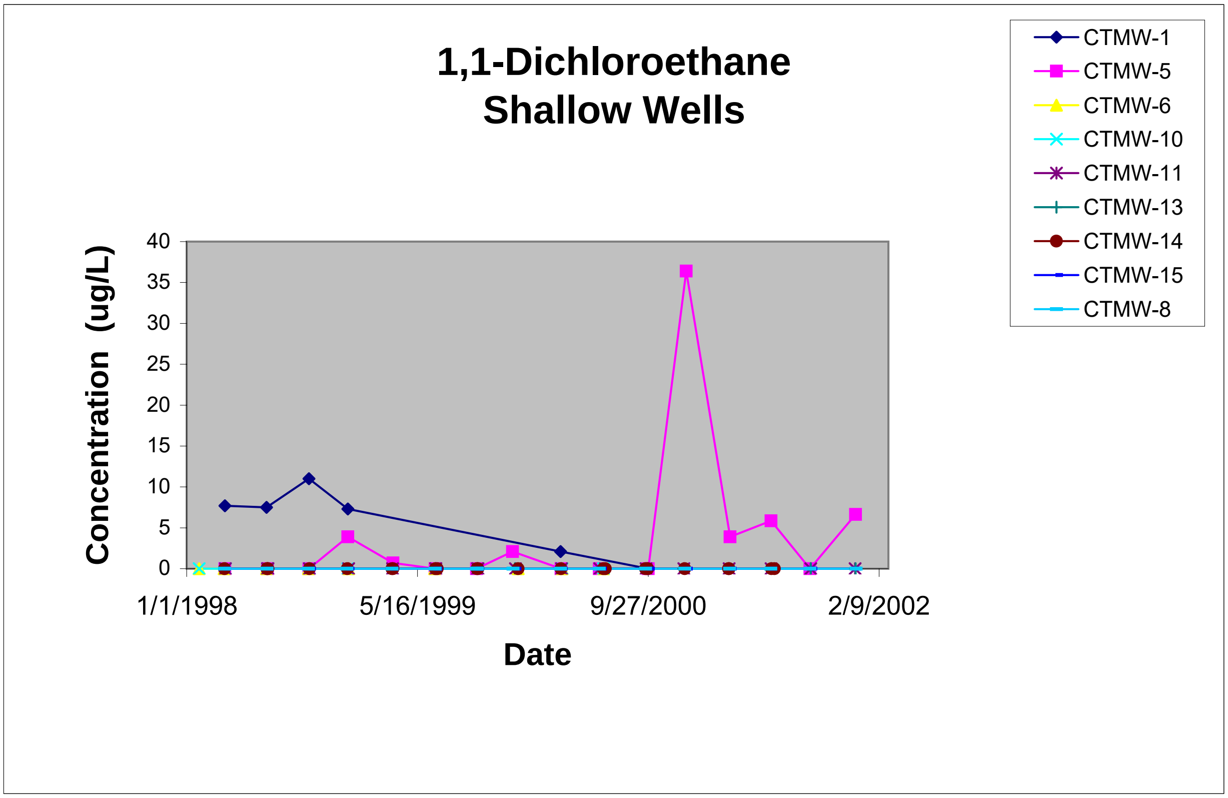
Silver
Shallow Wells
Concentration (ug/L)
14
12
10
8
6
4
2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

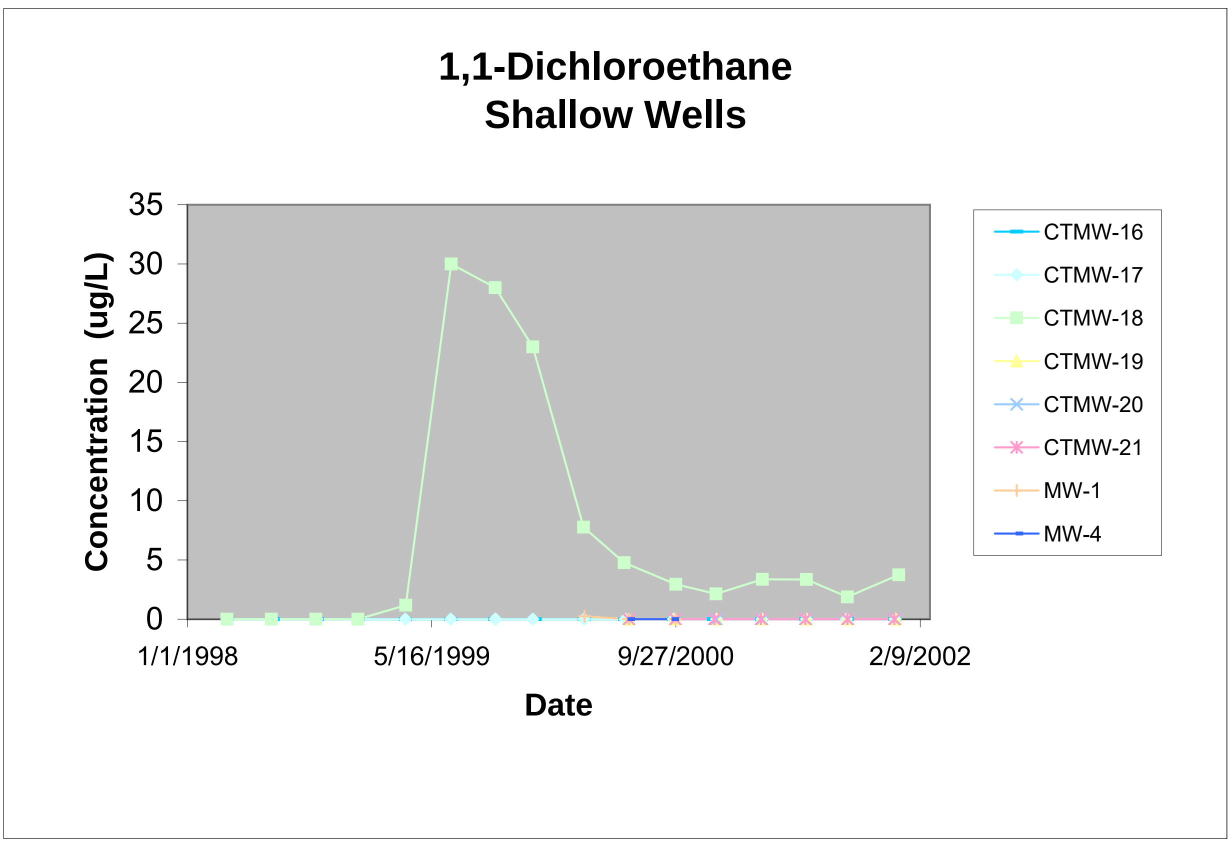

Zinc
Shallow Wells
Concentration (ug/L)
8000
7000
6000
5000
4000
3000
2000
1000
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

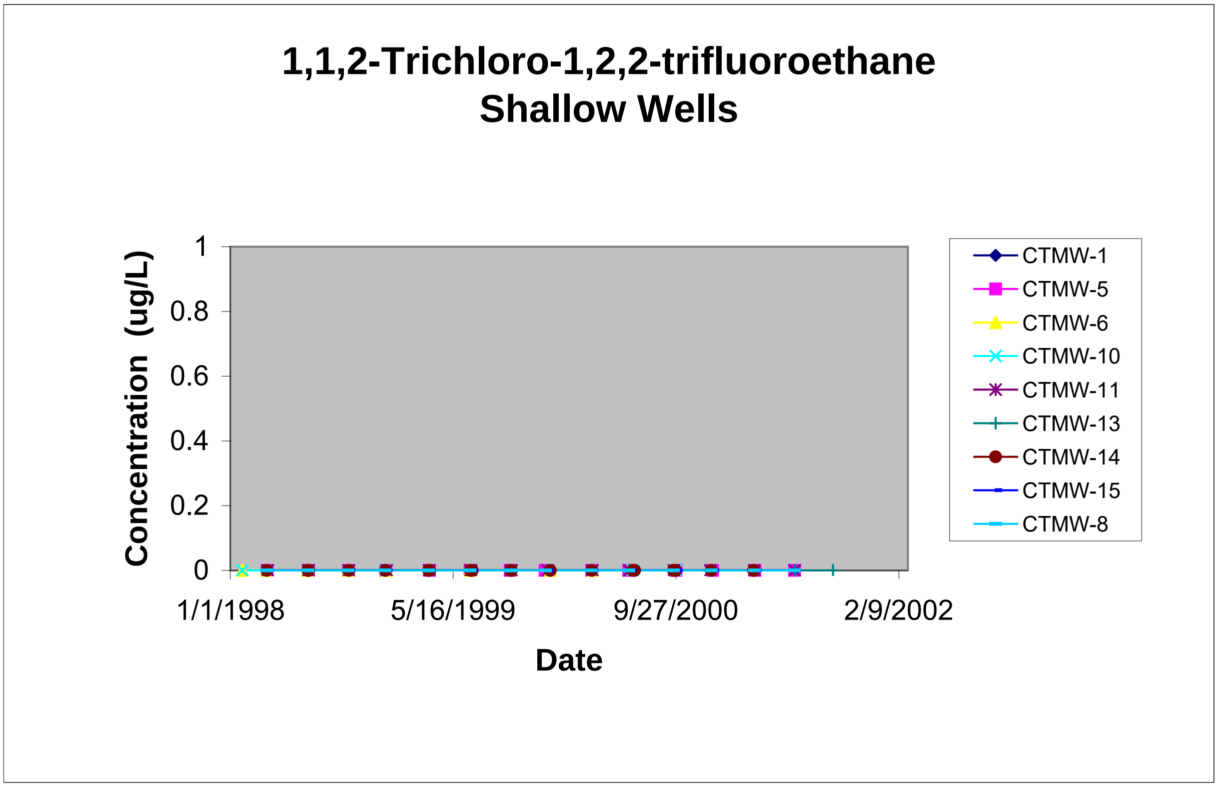

Zinc
Shallow Wells
Concentration (ug/L)
250000
200000
150000
100000
50000
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


TPH (as gasoline)
Shallow Wells
Concentration (ug/L)
1000
900
800
700
600
500
400
300
200
100
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-5
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-10
CTMW-1
CTMW-6

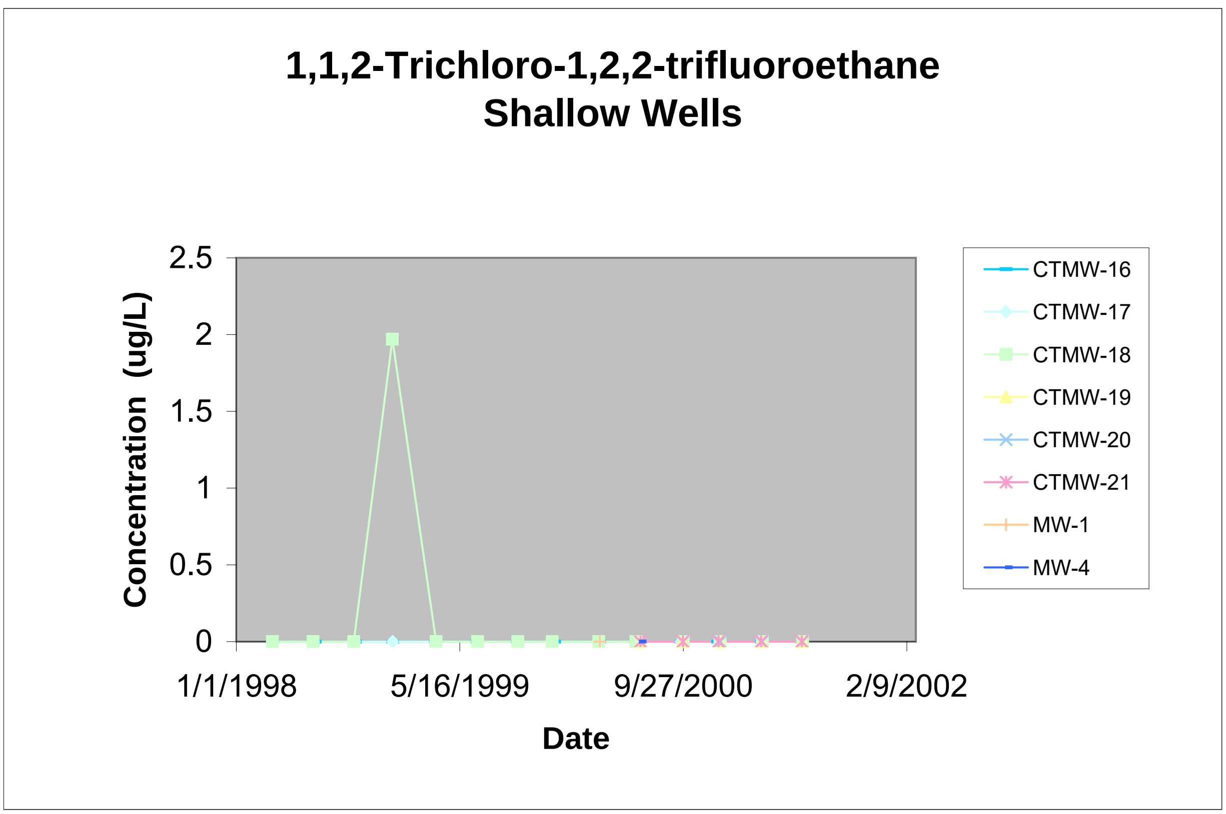

TPH (as gasoline)
Shallow Wells
Concentration (ug/L)
1600
1400
1200
1000
800
600
400
200
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15
CTMW-19
CTMW-20
CTMW-21
MW-1


1,1-Dichloroethane
Shallow Wells
Concentration (ug/L)
40
35
30
25
20
15
10
5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

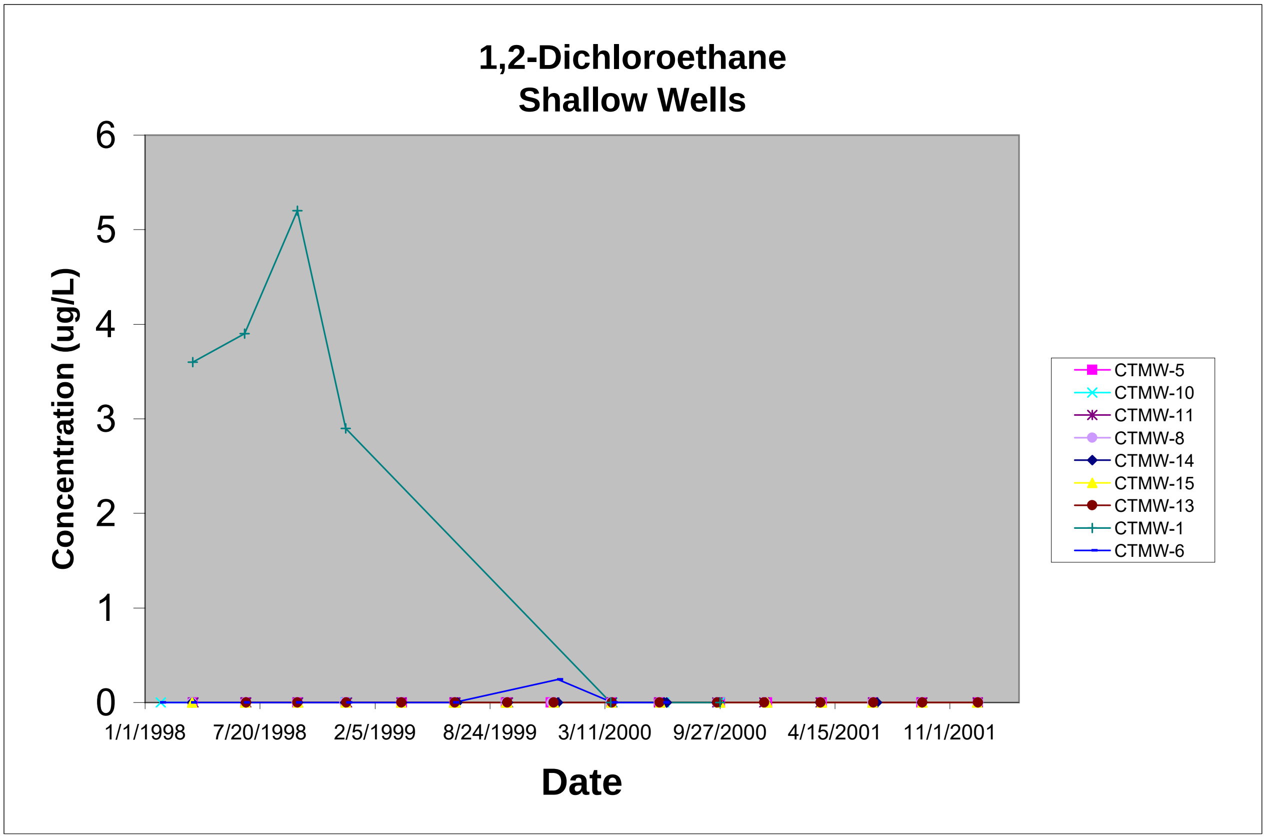

1,1-Dichloroethane
Shallow Wells
Concentration (ug/L)
35
30
25
20
15
10
5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

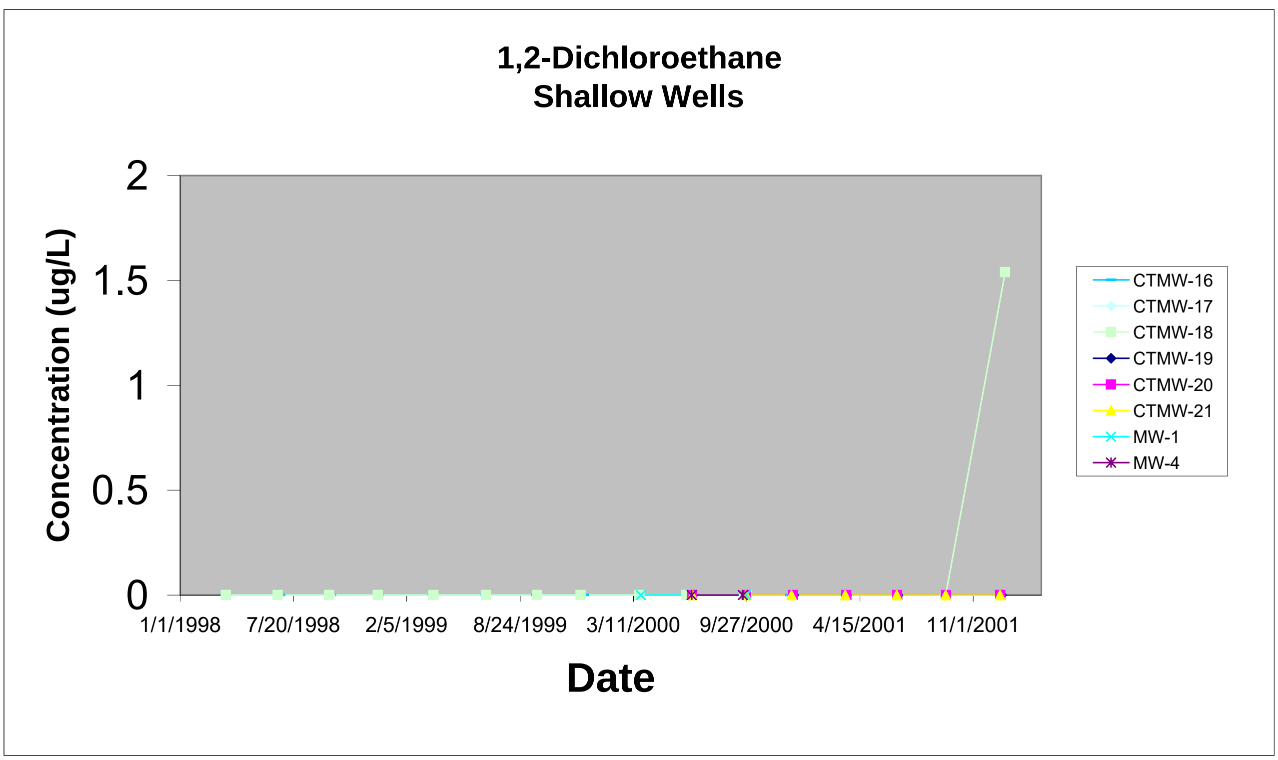


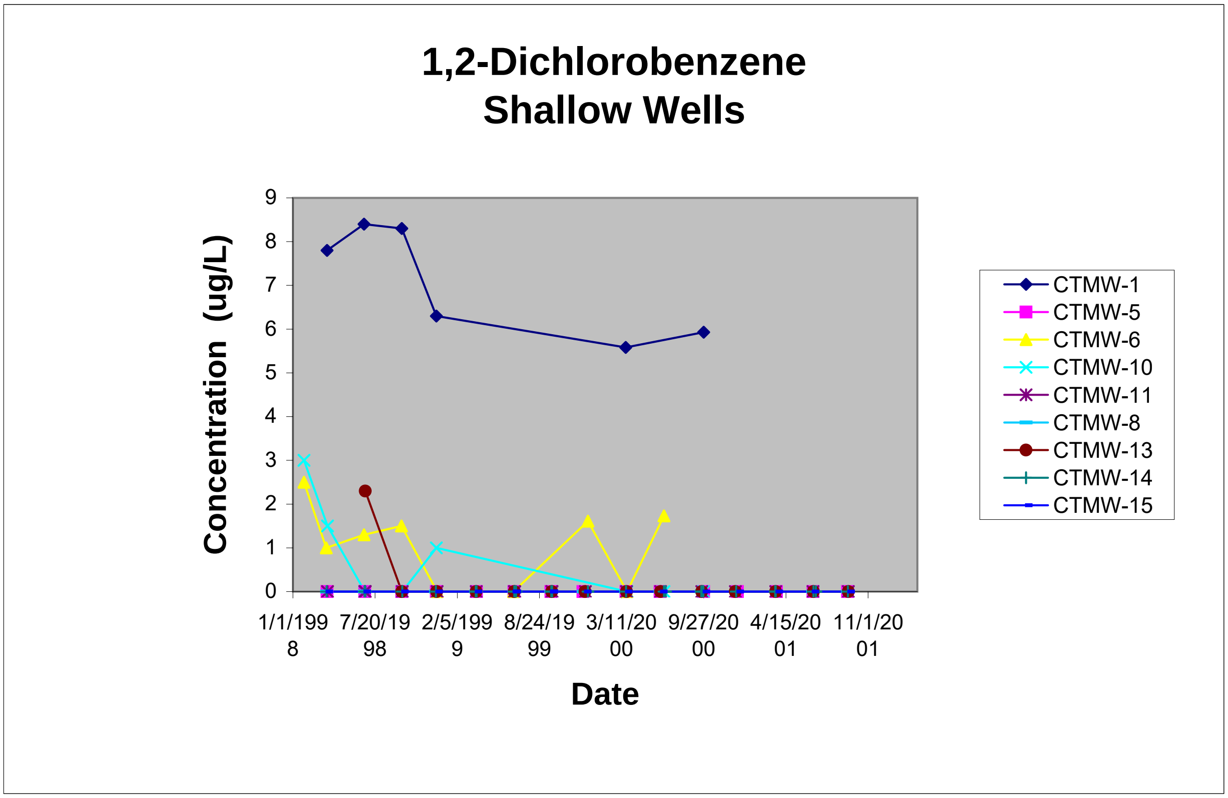
1,1,2-Trichloro-1,2,2-trifluoroethane
Shallow Wells
Concentration (ug/L)
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

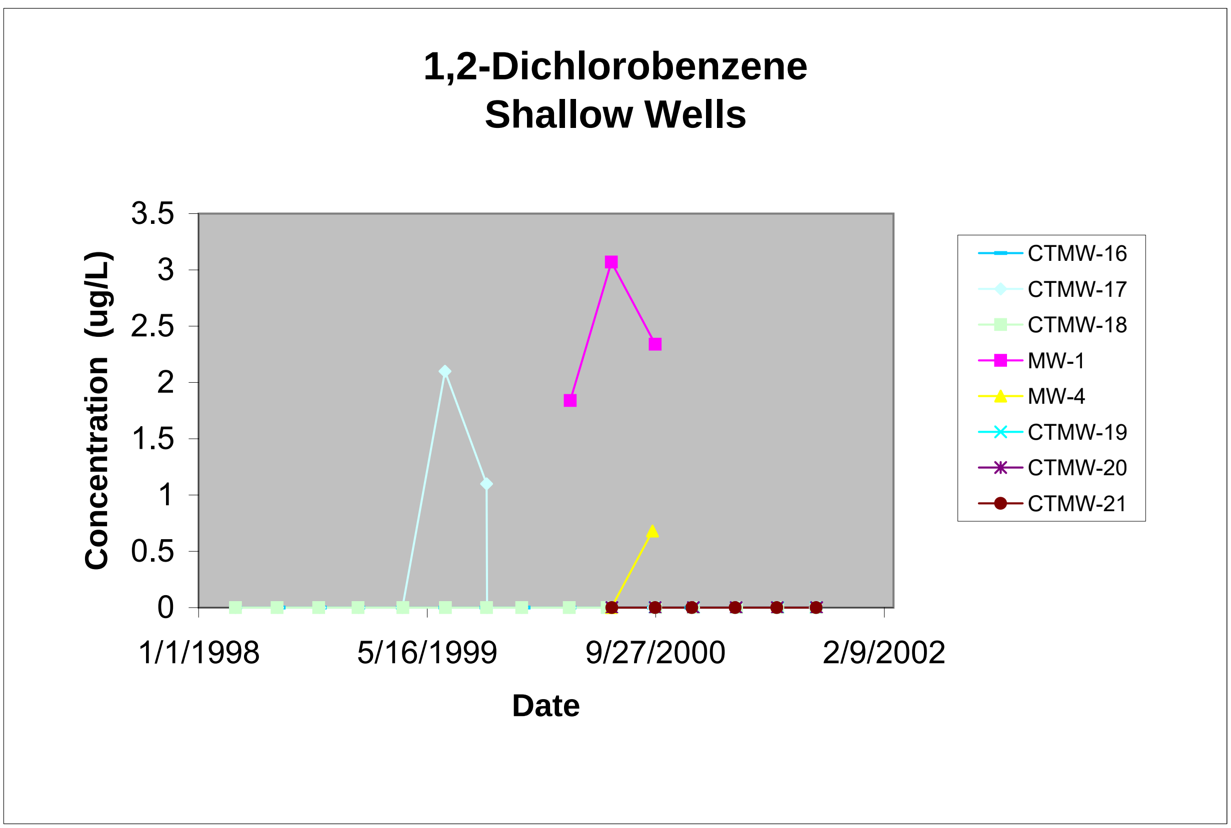


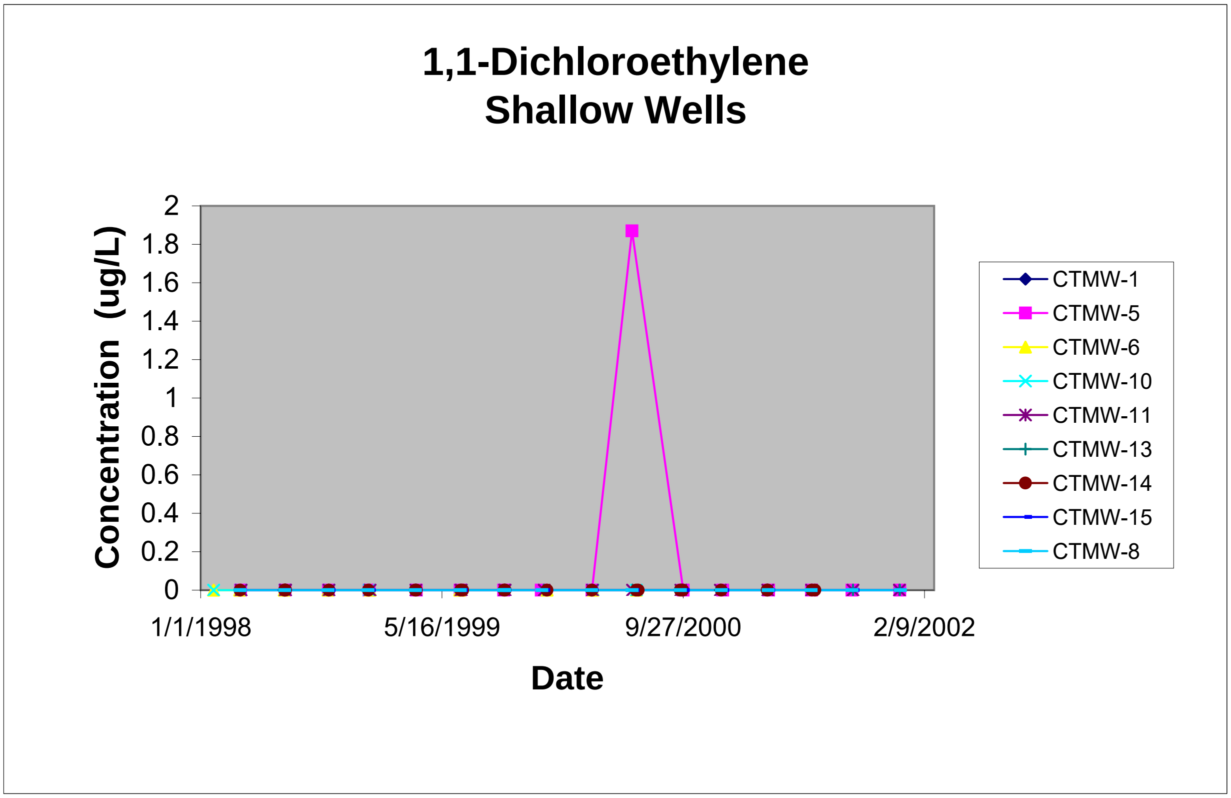
1,1,2-Trichloro-1,2,2-trifluoroethane
Shallow Wells
Concentration (ug/L)
2.5
2
1.5
1
0.5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

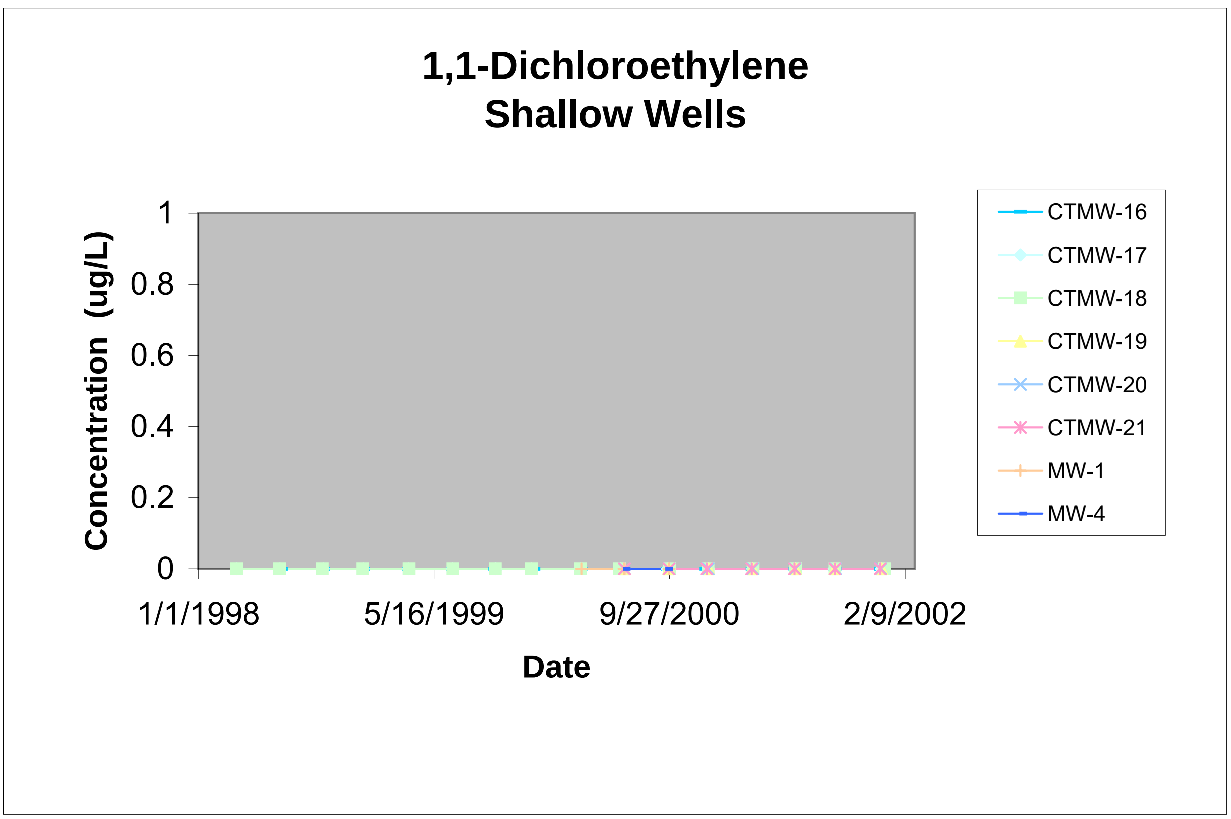

1,2-Dichloroethane
Shallow Wells
Concentration (ug/L)
6
5
4
3
2
1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-14
CTMW-15
CTMW-13
CTMW-1
CTMW-6

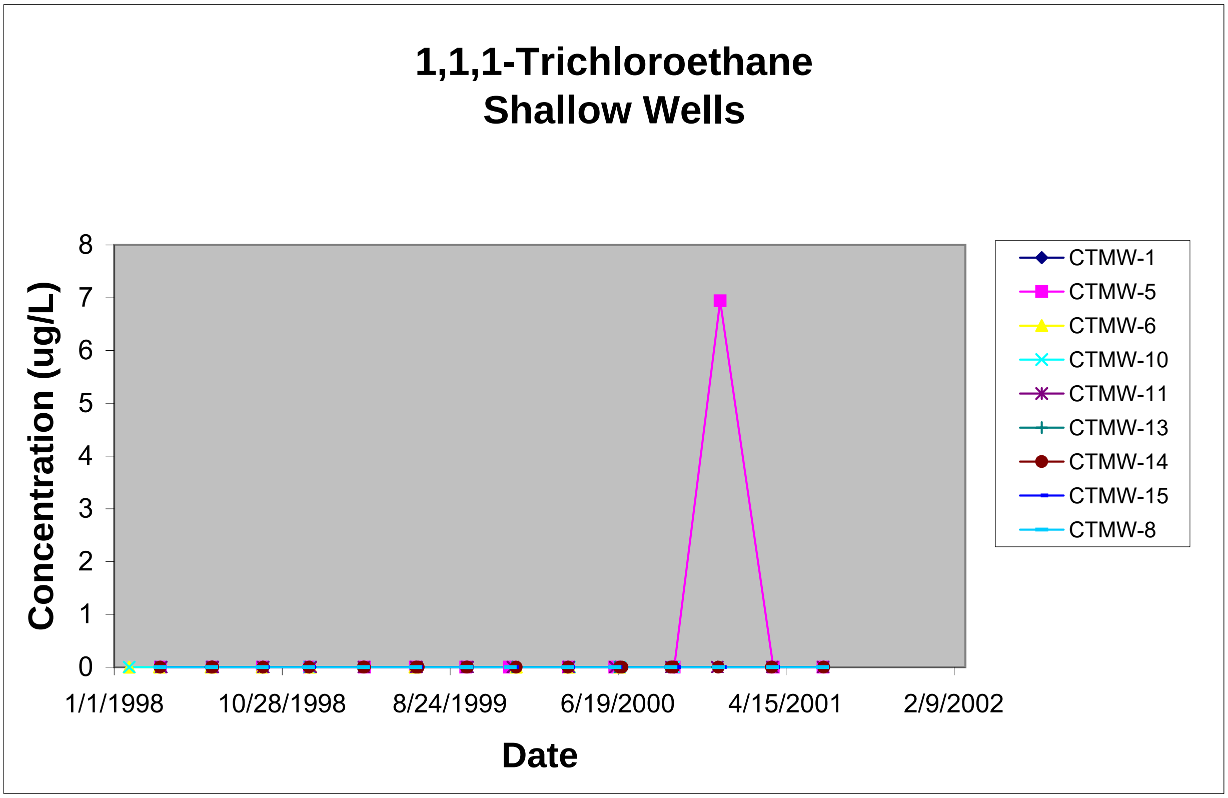

1,2-Dichloroethane
Shallow Wells
Concentration (ug/L)
2
1.5
1
0.5
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

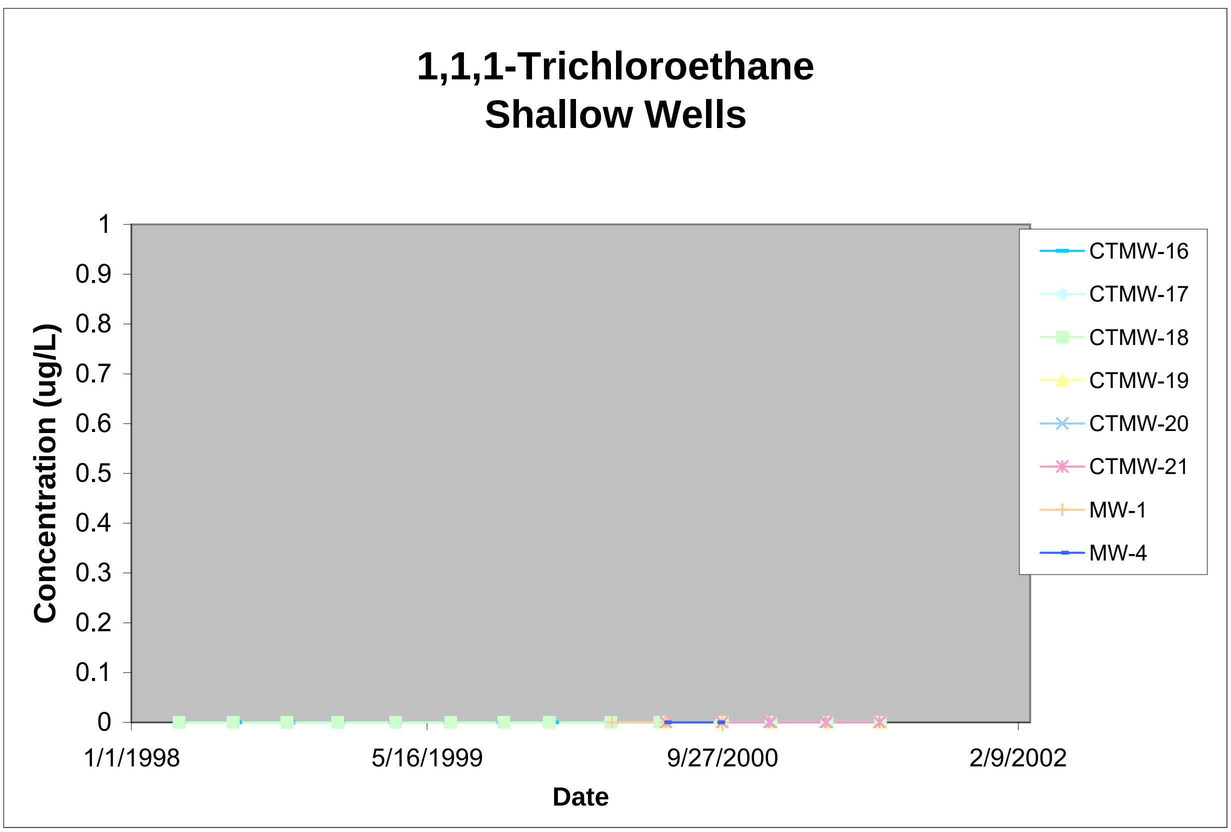

1,2-Dichlorobenzene
Shallow Wells
Concentration (ug/L)
9
8
7
6
5
4
3
2
1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-15

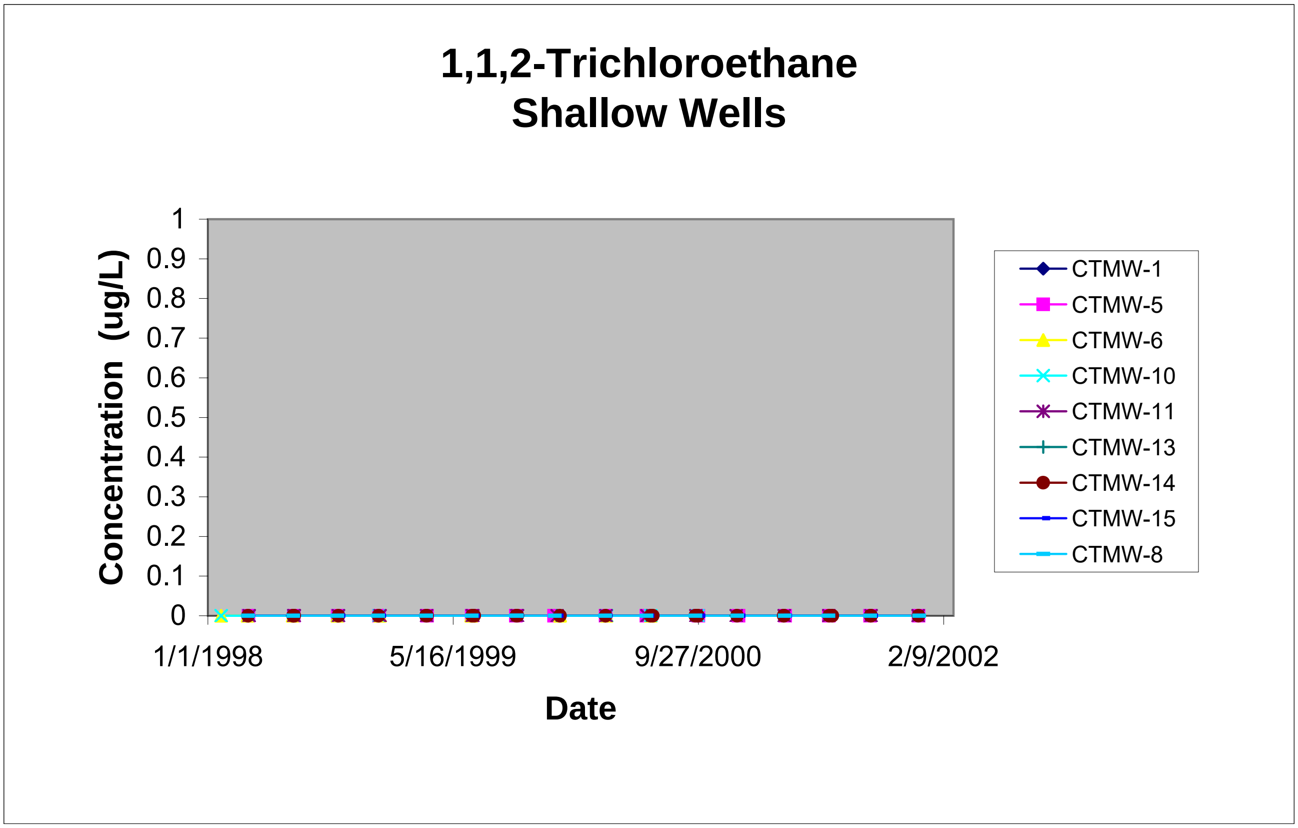

1,2-Dichlorobenzene
Shallow Wells
Concentration (ug/L)
3.5
3
2.5
2
1.5
1
0.5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
MW-1
MW-4
CTMW-19
CTMW-20
CTMW-21

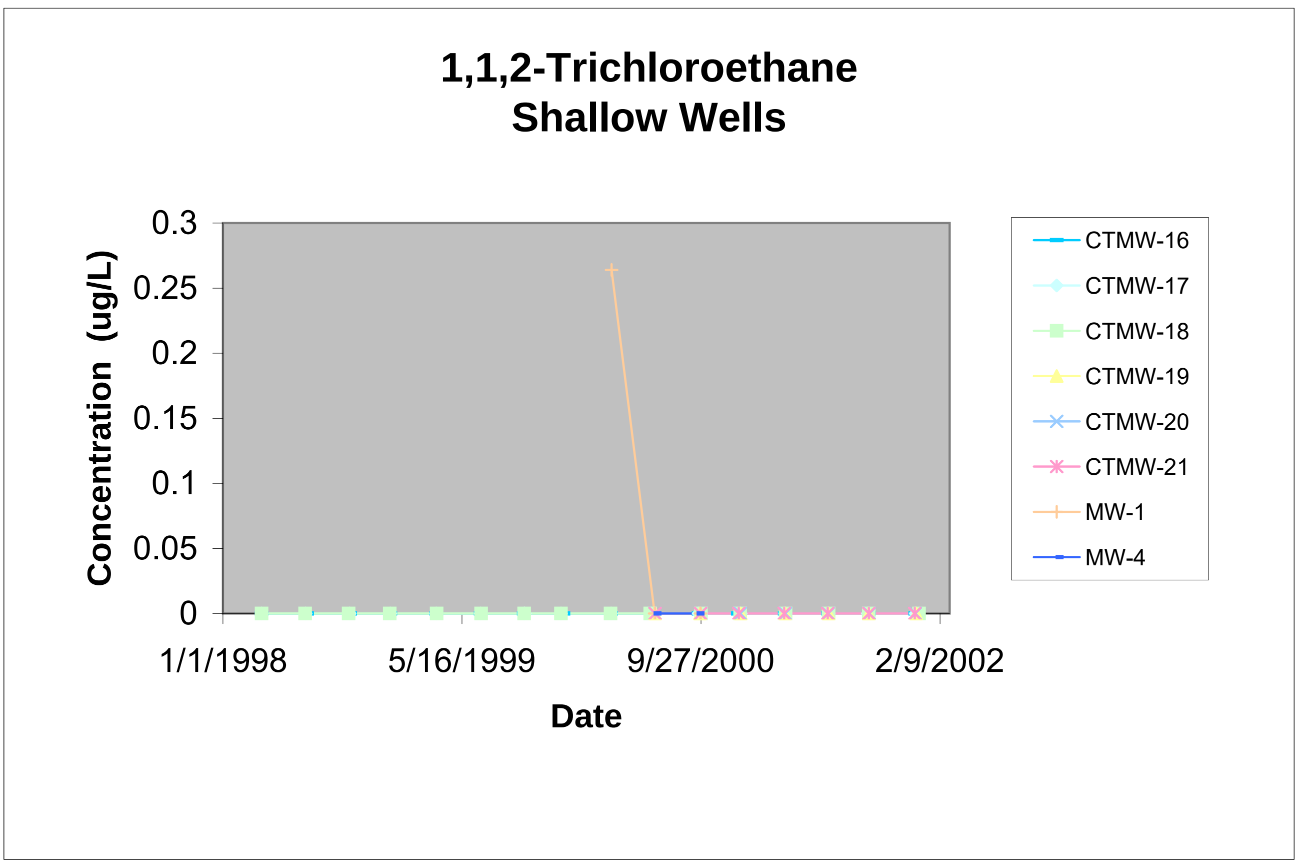

1,1-Dichloroethylene
Shallow Wells
Concentration (ug/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

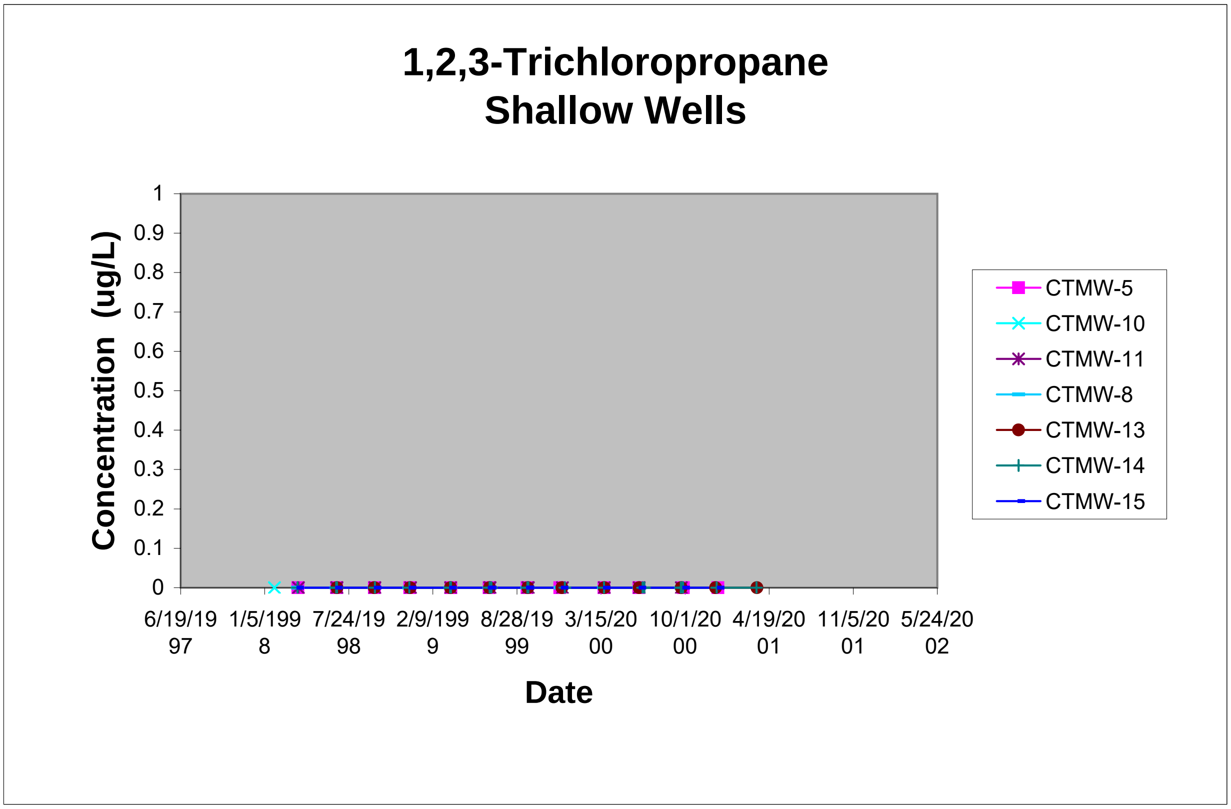

1,1-Dichloroethylene
Shallow Wells
Concentration (ug/L)
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

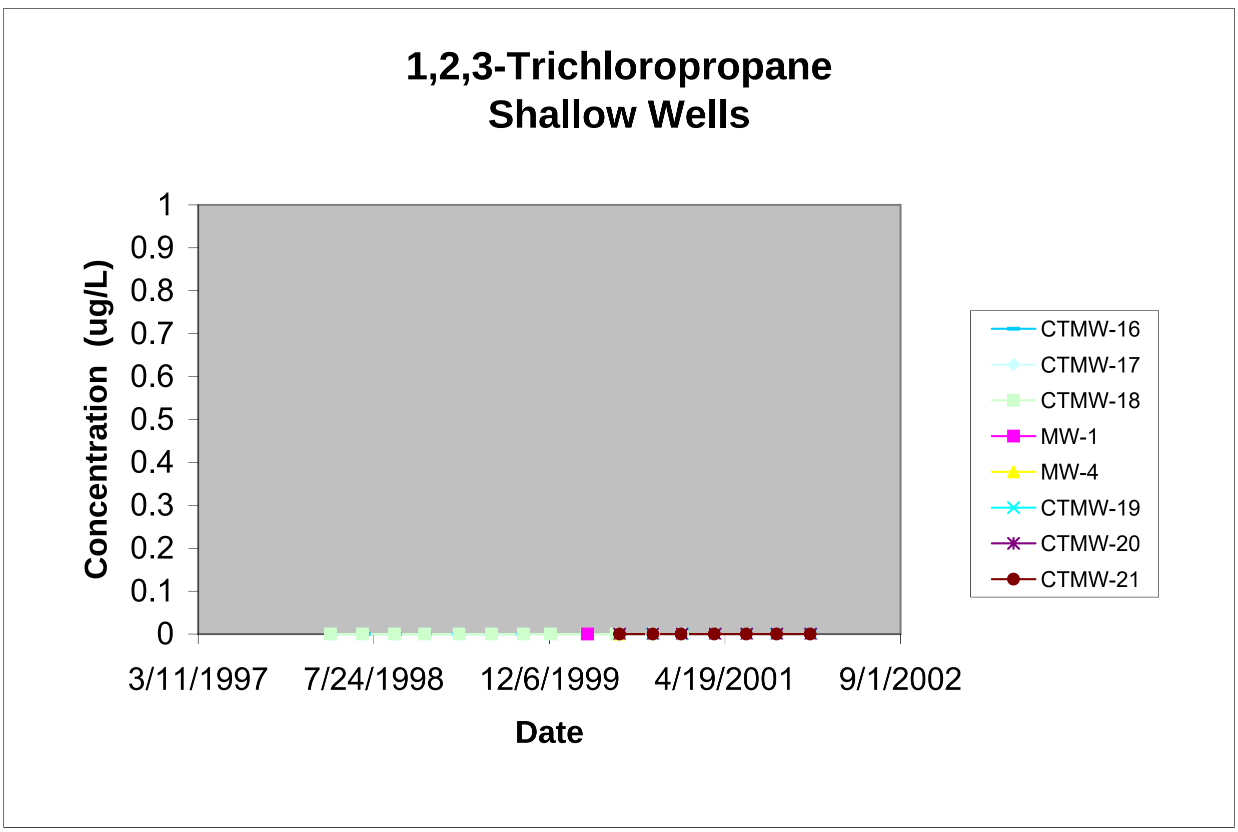

1,1,1-Trichloroethane
Shallow Wells
Concentration (ug/L)
8
7
6
5
4
3
2
1
0
1/1/1998
10/28/1998
8/24/1999
6/19/2000
4/15/2001
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

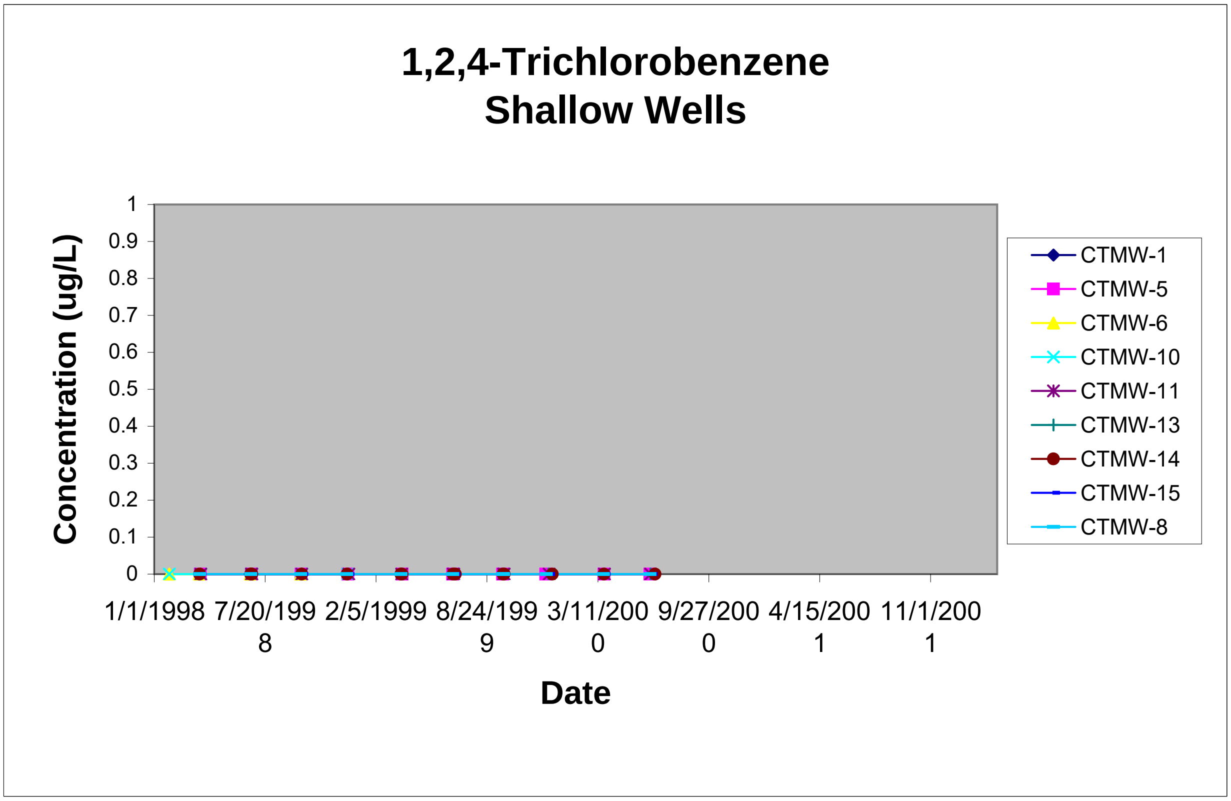

1,1,1-Trichloroethane
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

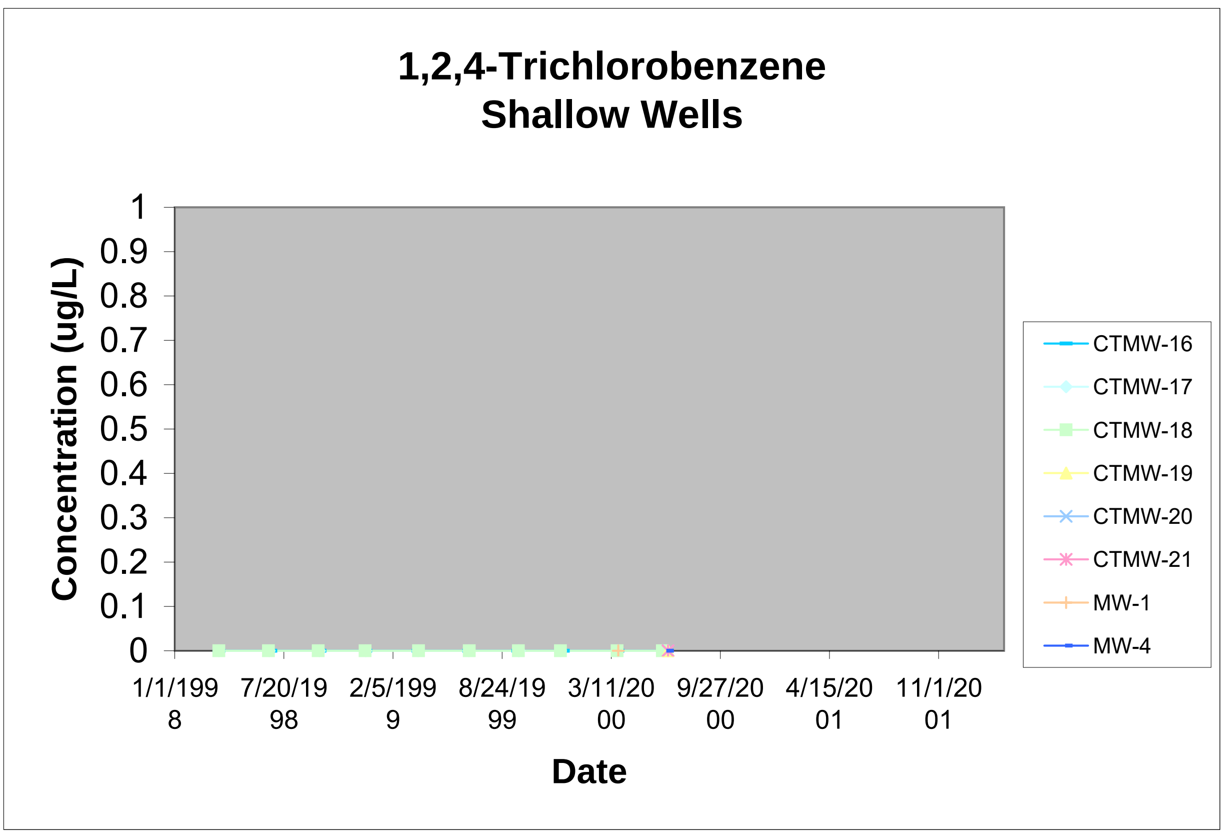

1,1,2-Trichloroethane
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

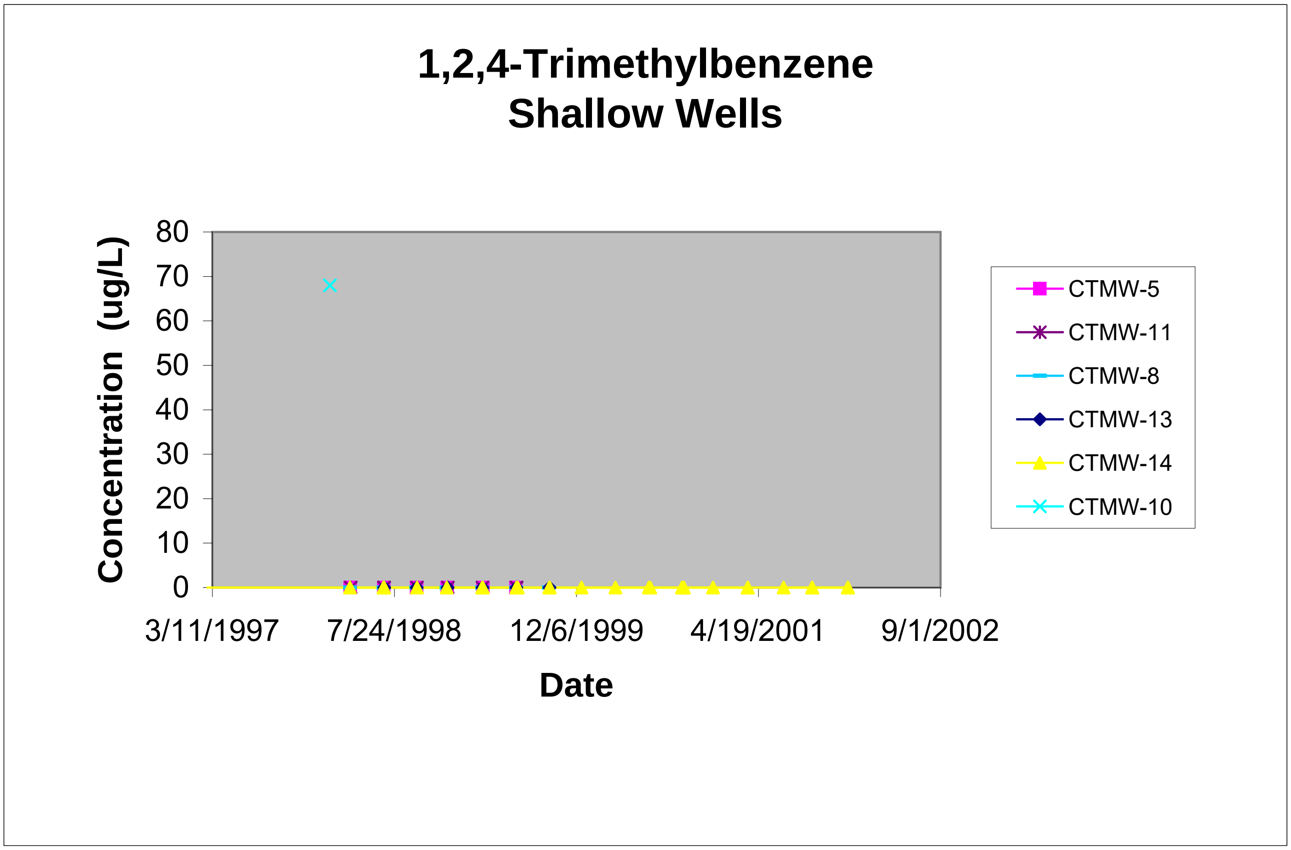

1,1,2-Trichloroethane
Shallow Wells
Concentration (ug/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

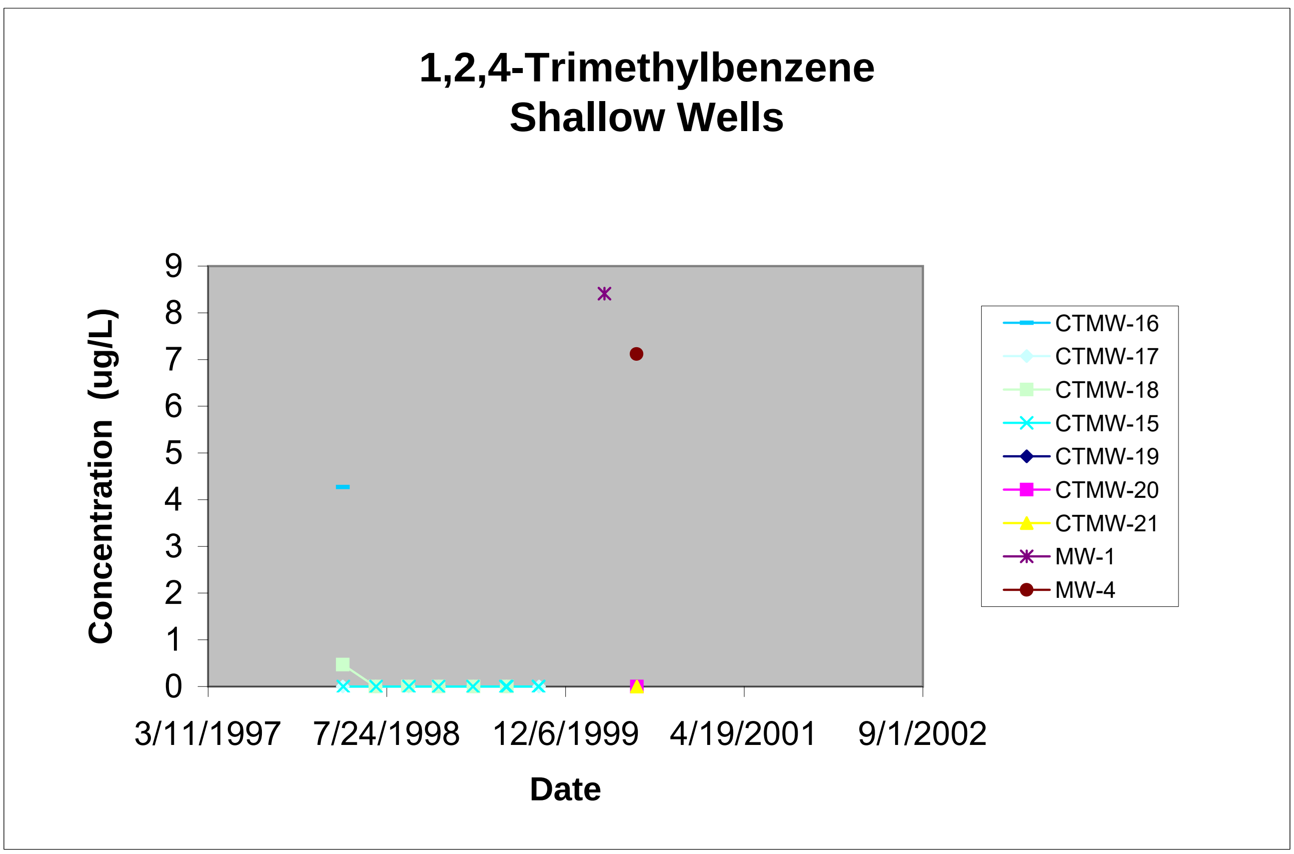

1,2,3-Trichloropropane
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/19/1997
1/5/1998
7/24/1998
2/9/1999
8/28/1999
3/15/2000
10/1/2000
4/19/2001
11/5/2001
5/24/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-15

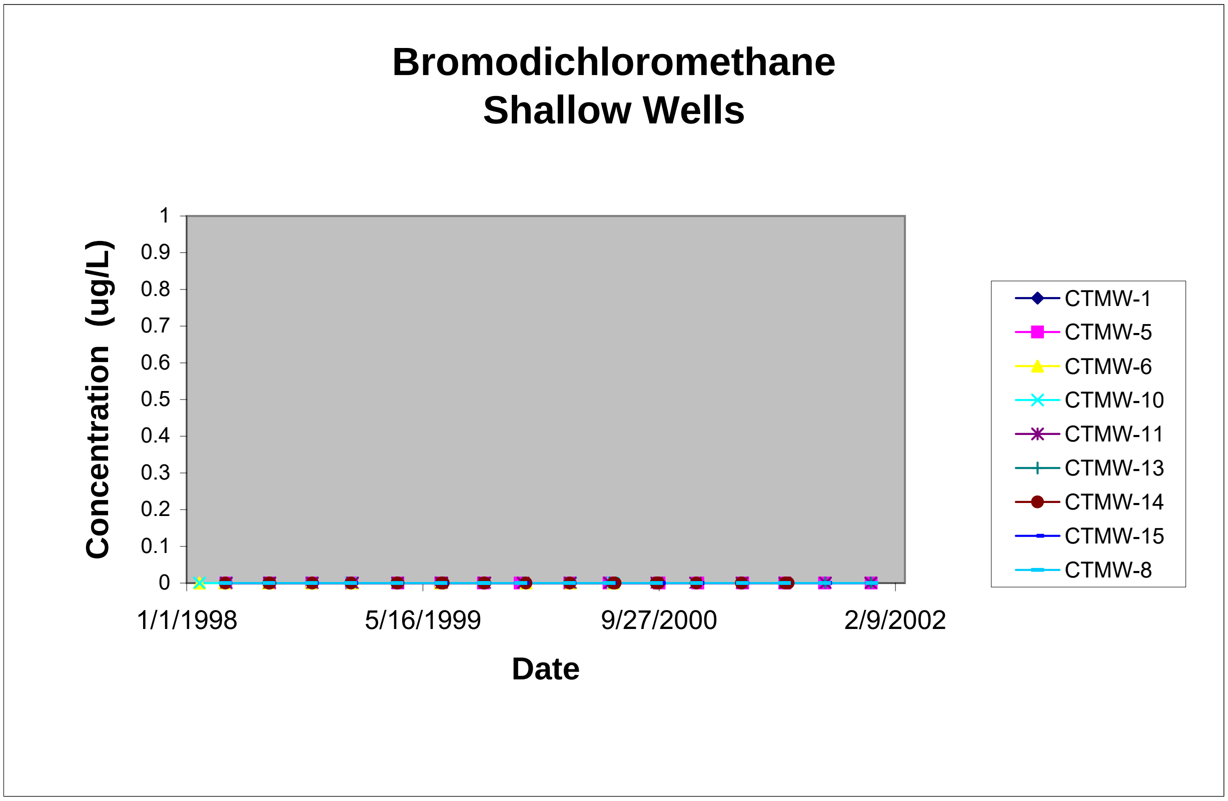

1,2,3-Trichloropropane
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
MW-1
MW-4
CTMW-19
CTMW-20
CTMW-21

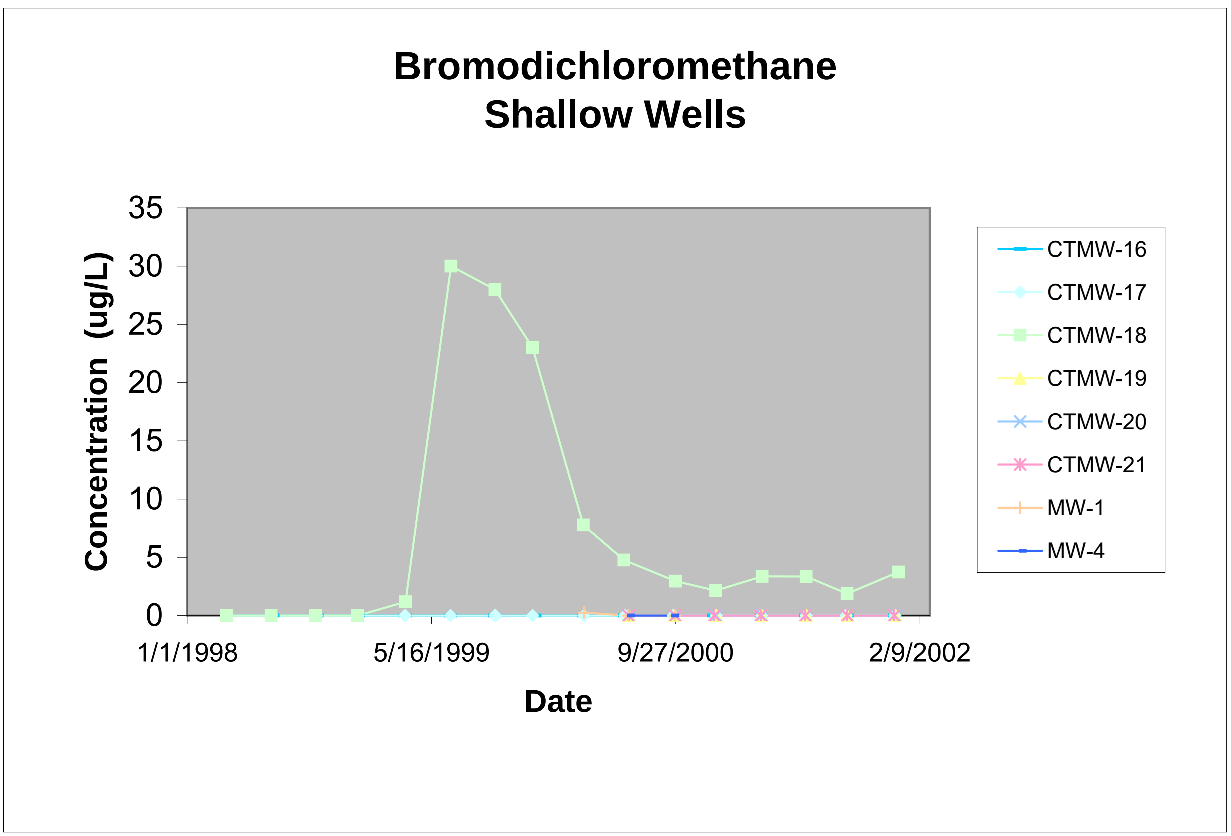

1,2,4-Trichlorobenzene
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

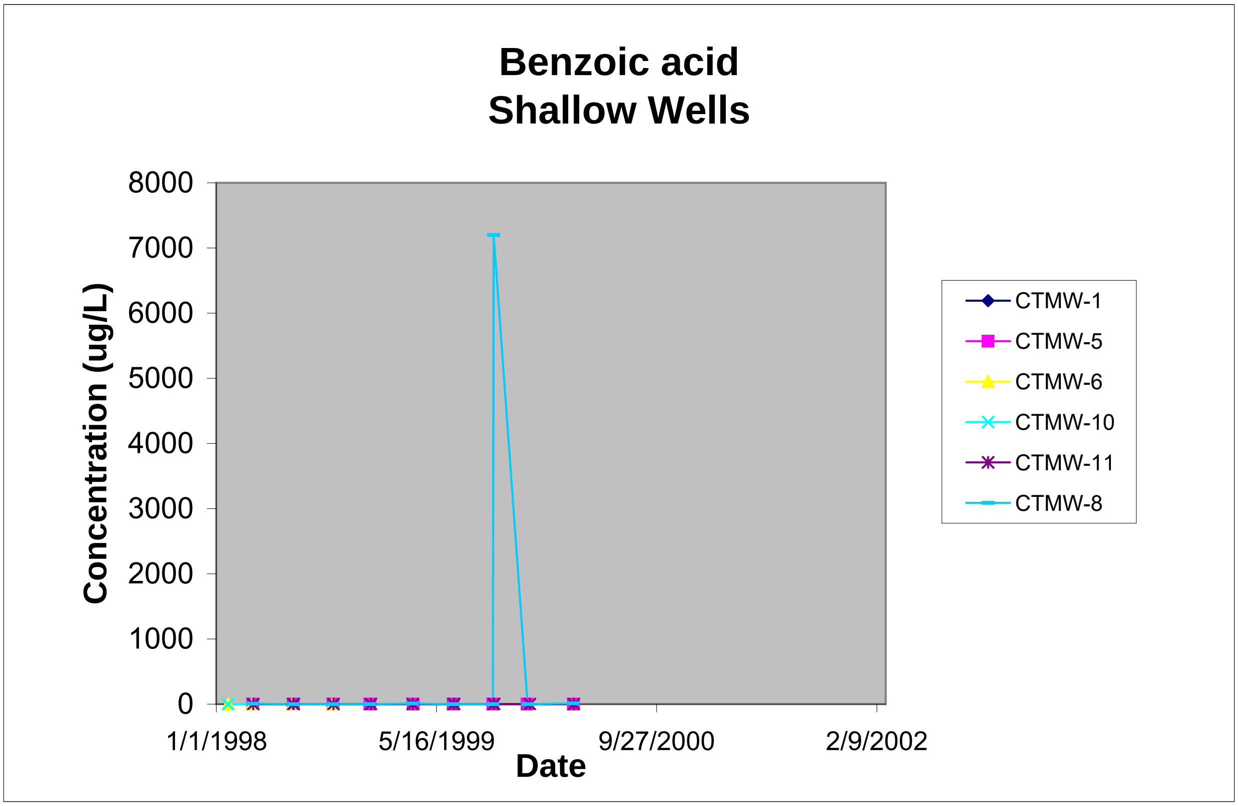

1,2,4-Trichlorobenzene
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

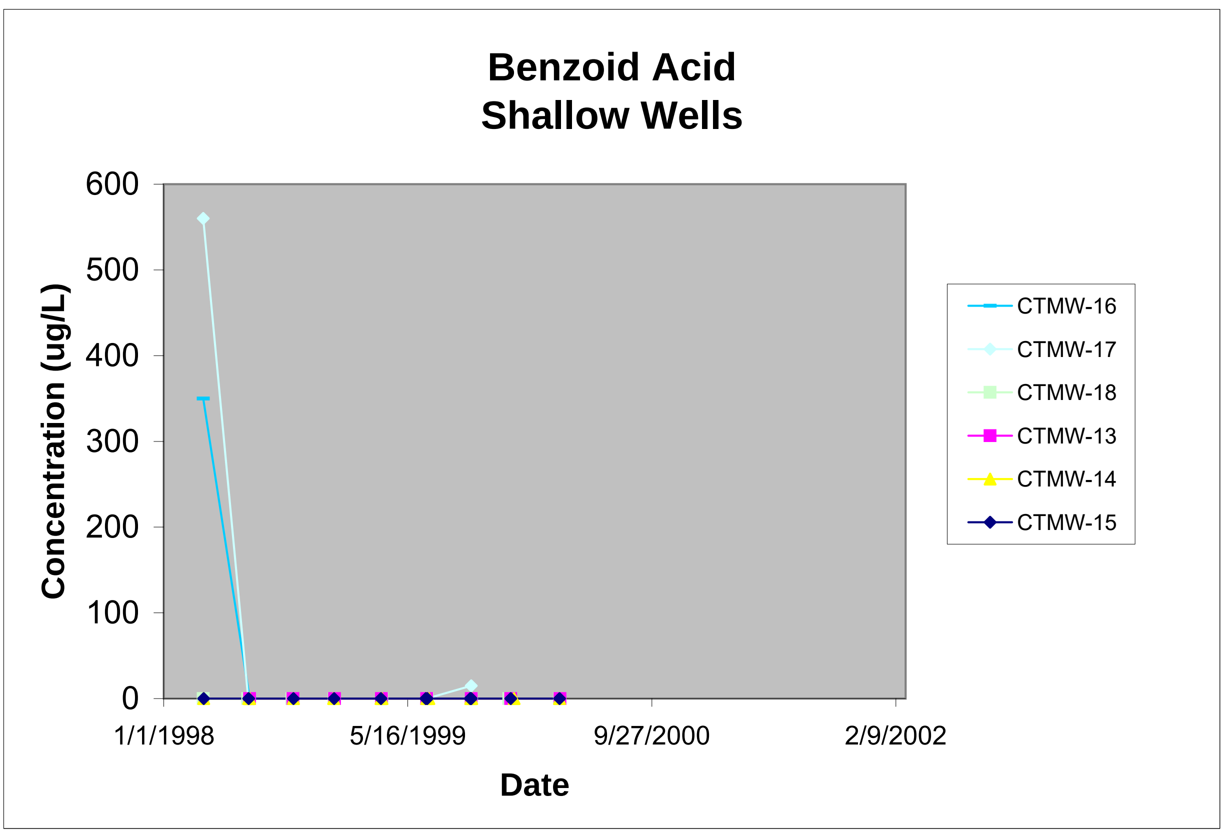

1,2,4-Trimethylbenzene
Shallow Wells
Concentration (ug/L)
80
70
60
50
40
30
20
10
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-5
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-10

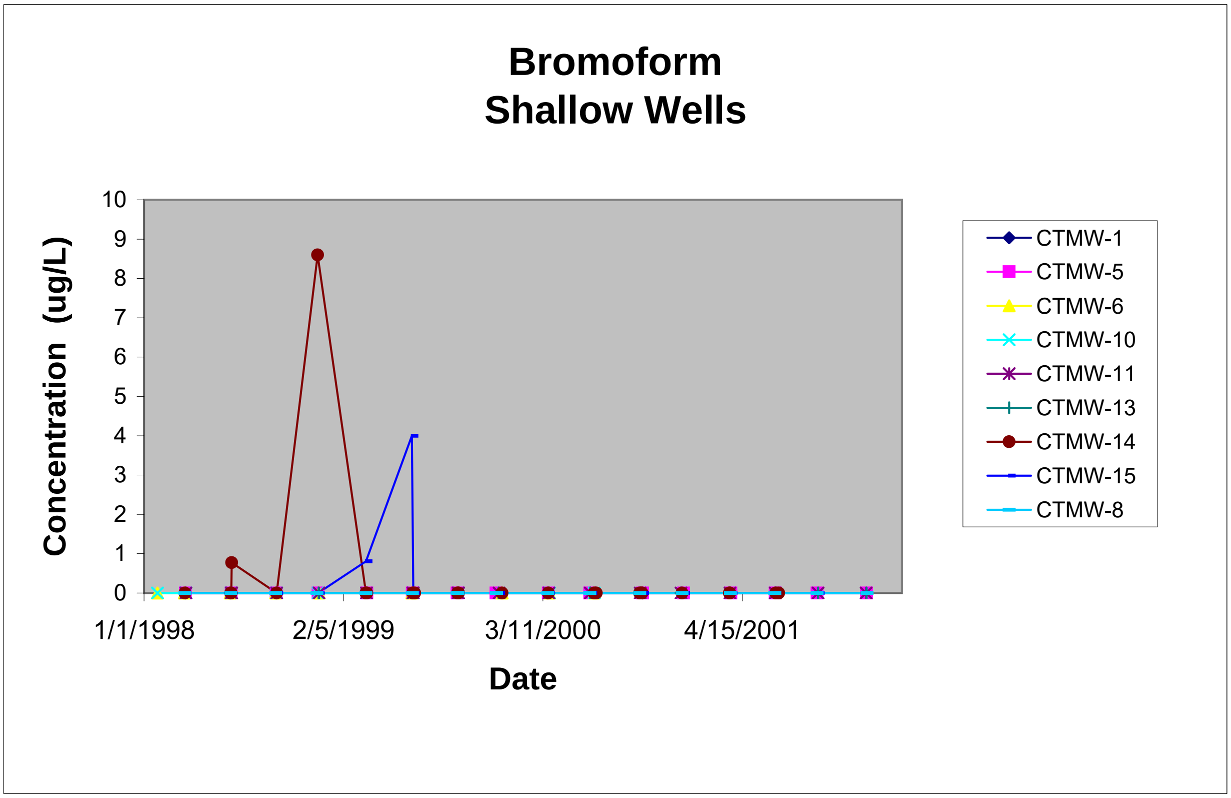

1,2,4-Trimethylbenzene
Shallow Wells
Concentration (ug/L)
9
8
7
6
5
4
3
2
1
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

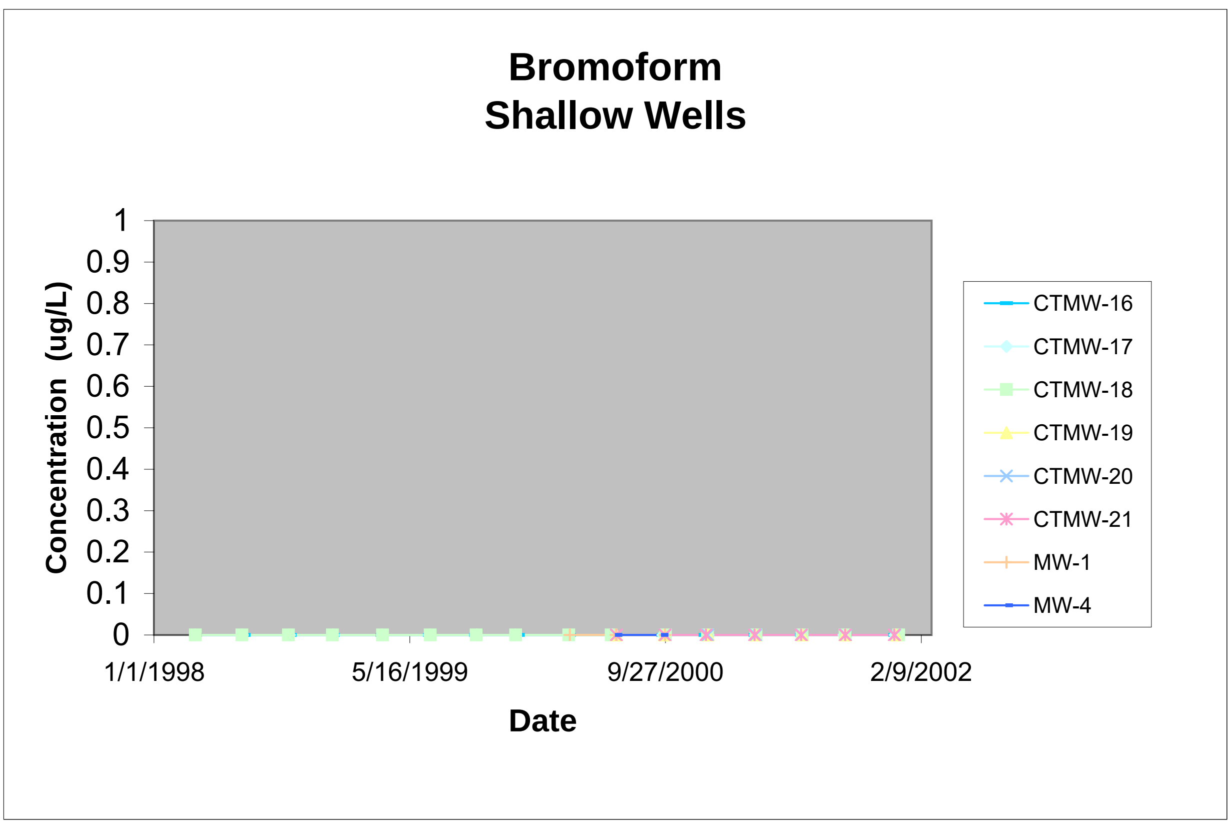

Bromodichloromethane
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

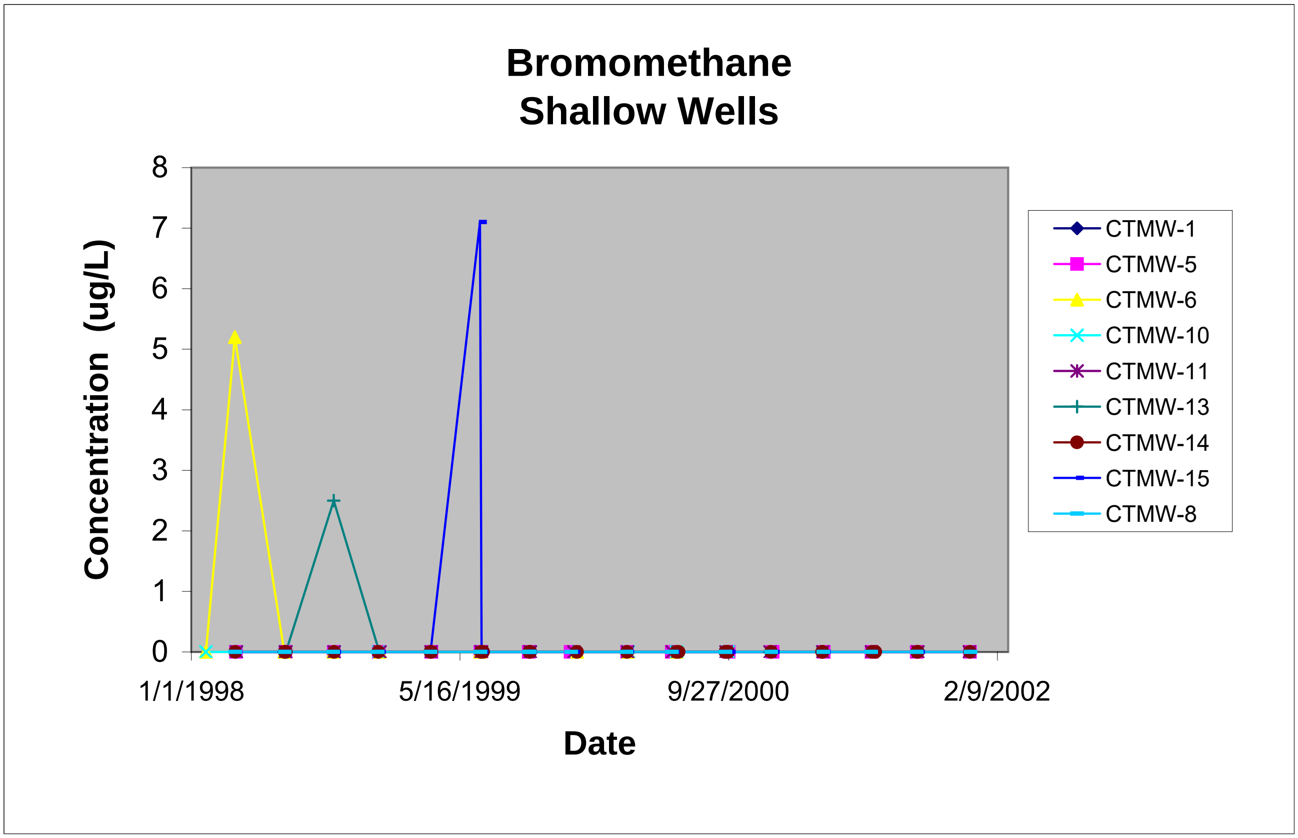

Bromodichloromethane
Shallow Wells
Concentration (ug/L)
35
30
25
20
15
10
5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

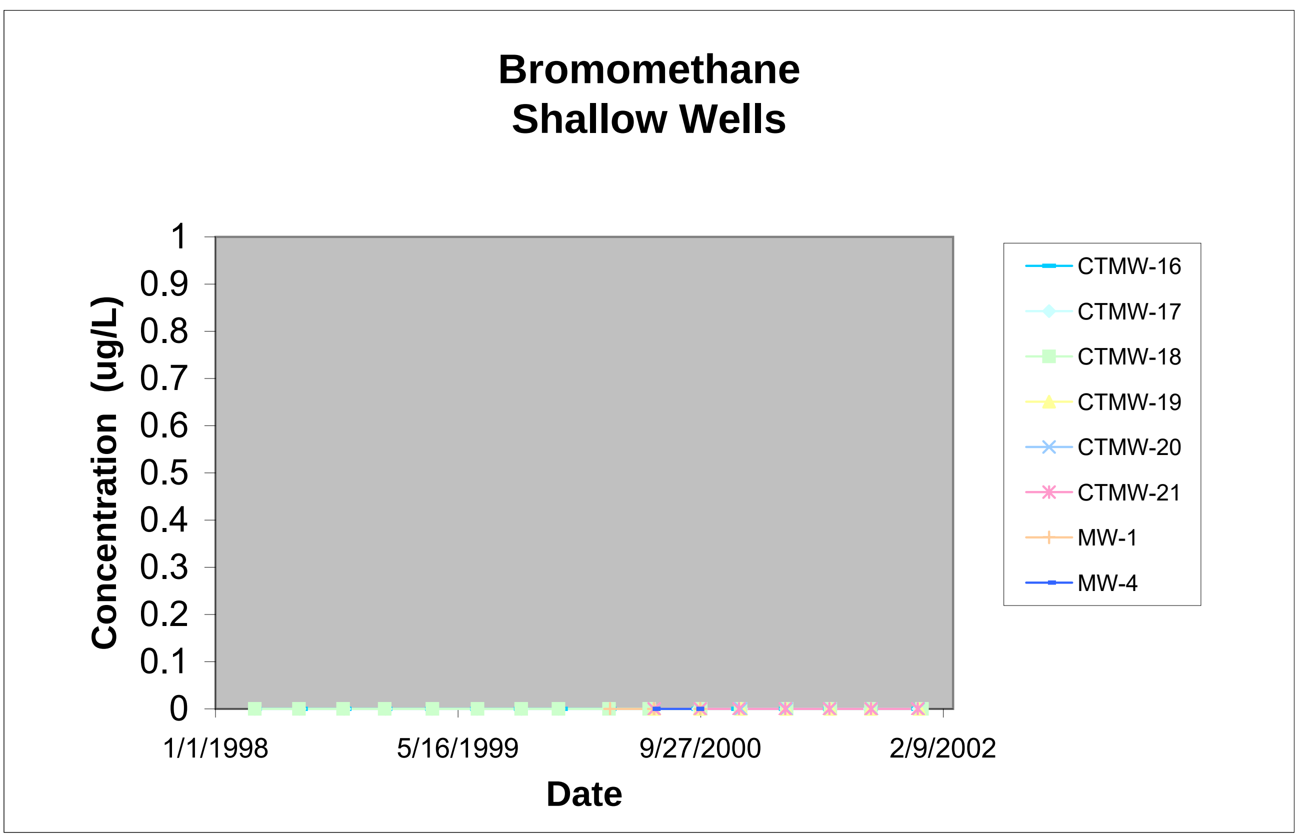

Benzoic acid
Shallow Wells
8000
7000
6000
5000
4000
3000
2000
1000
0
Concentration (ug/L)
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

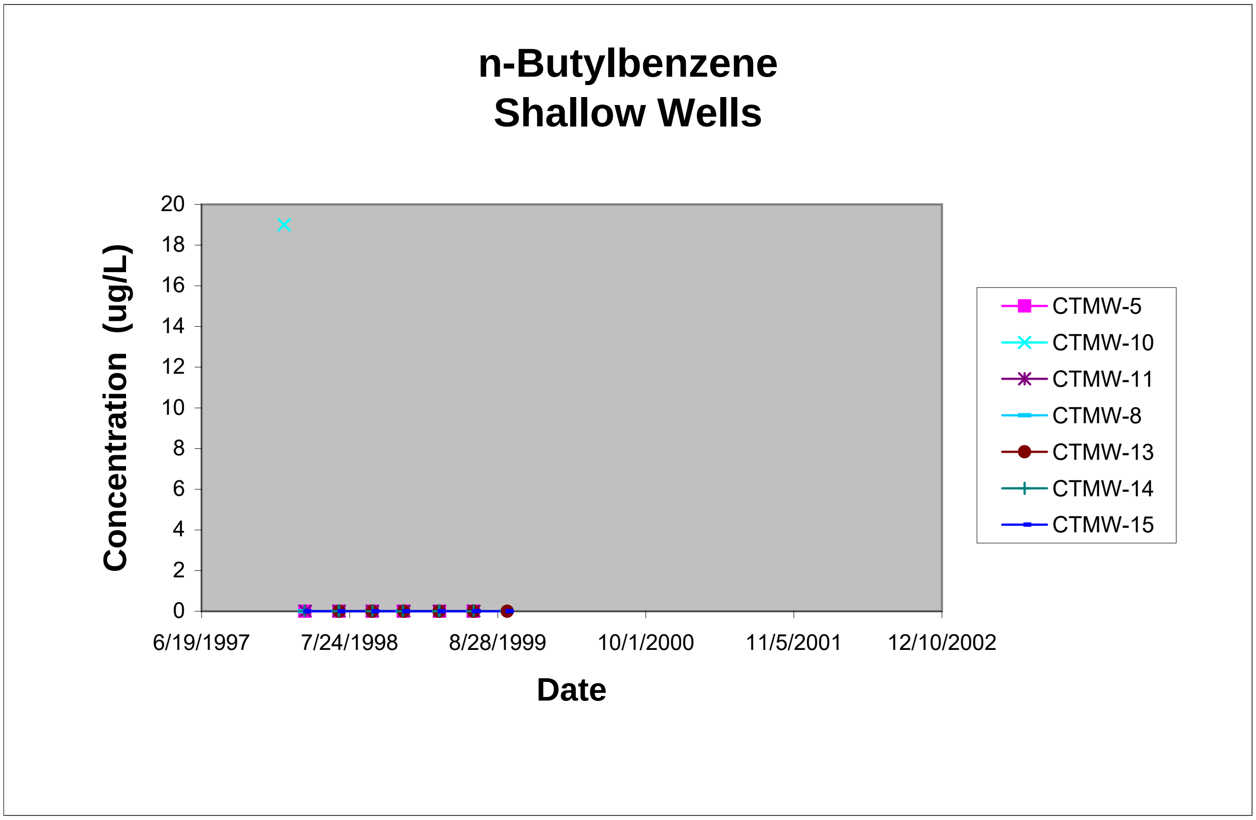

Benzoid Acid
Shallow Wells
600
500
400
300
200
100
0
Concentration (ug/L)
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

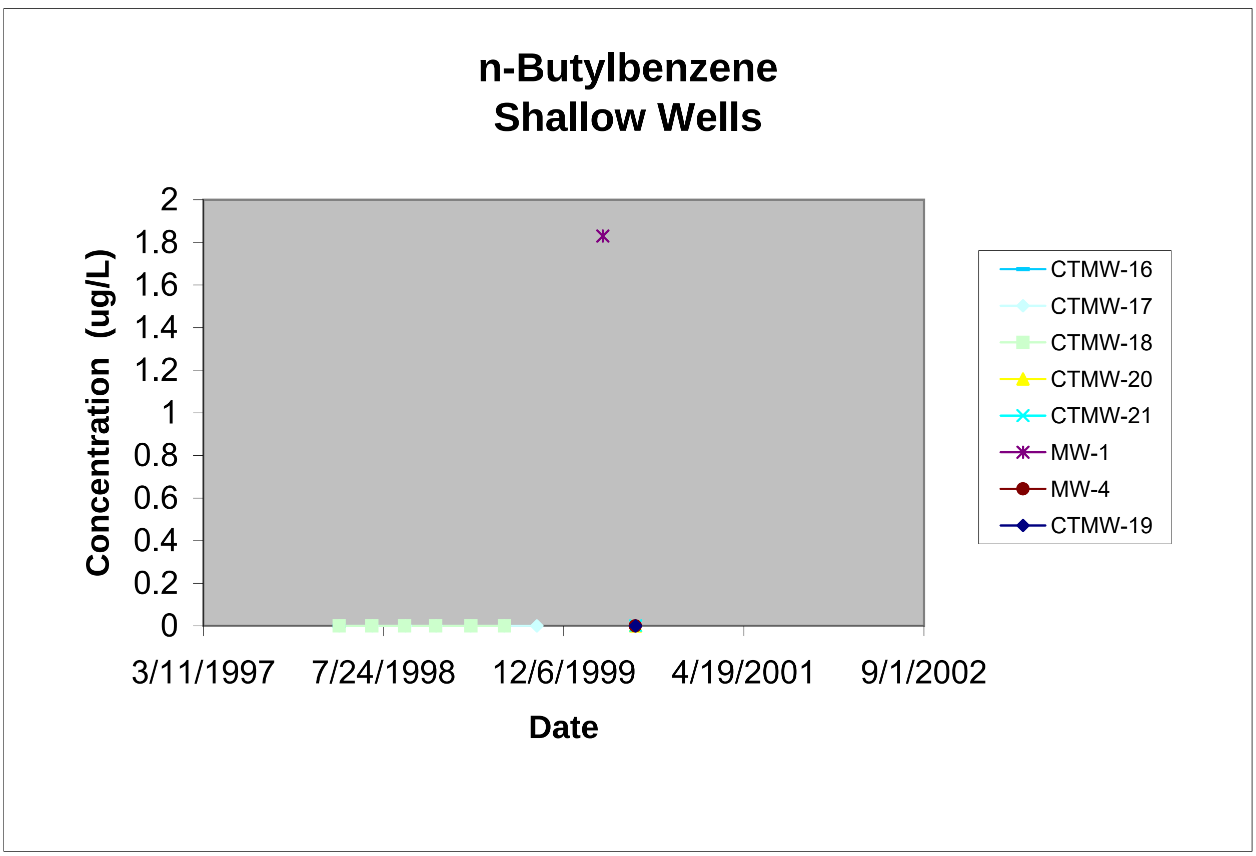

Bromoform
Shallow Wells
Concentration (ug/L)
10
9
8
7
6
5
4
3
2
1
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

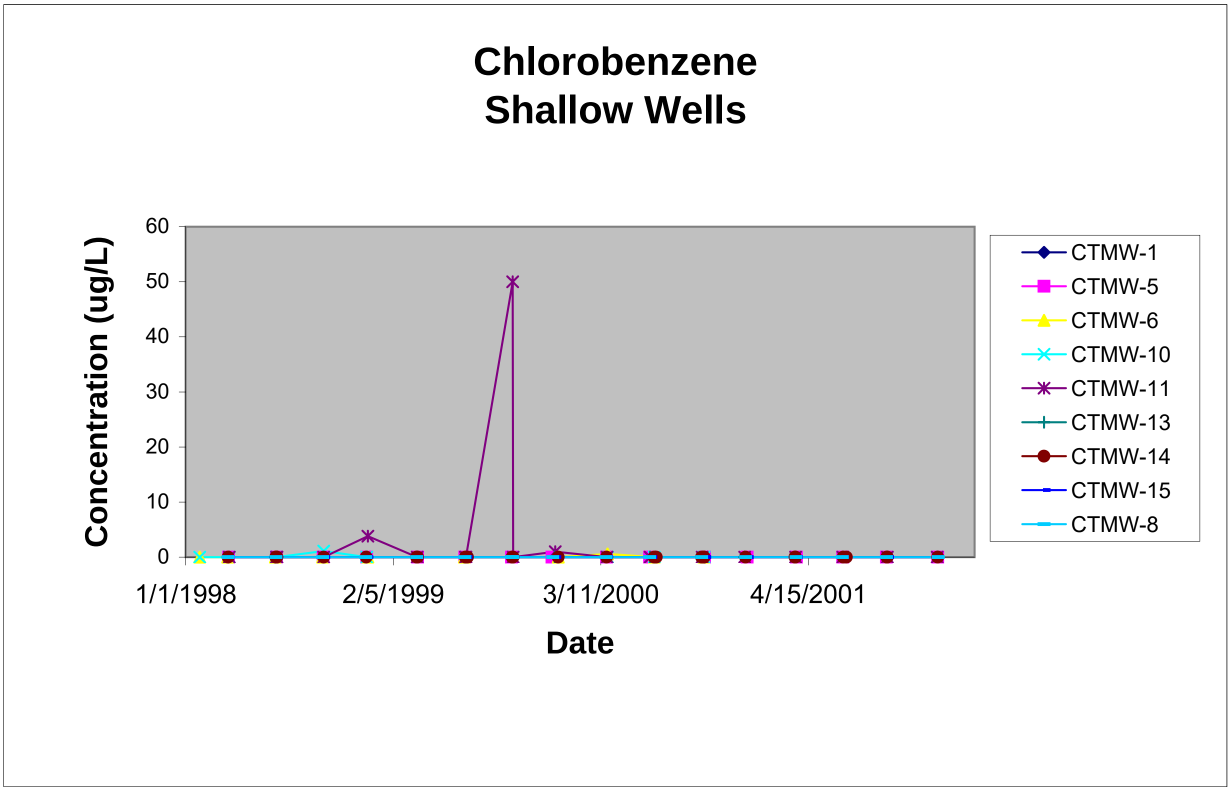

Bromoform
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


Bromomethane
Shallow Wells
Concentration (ug/L)
8
7
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

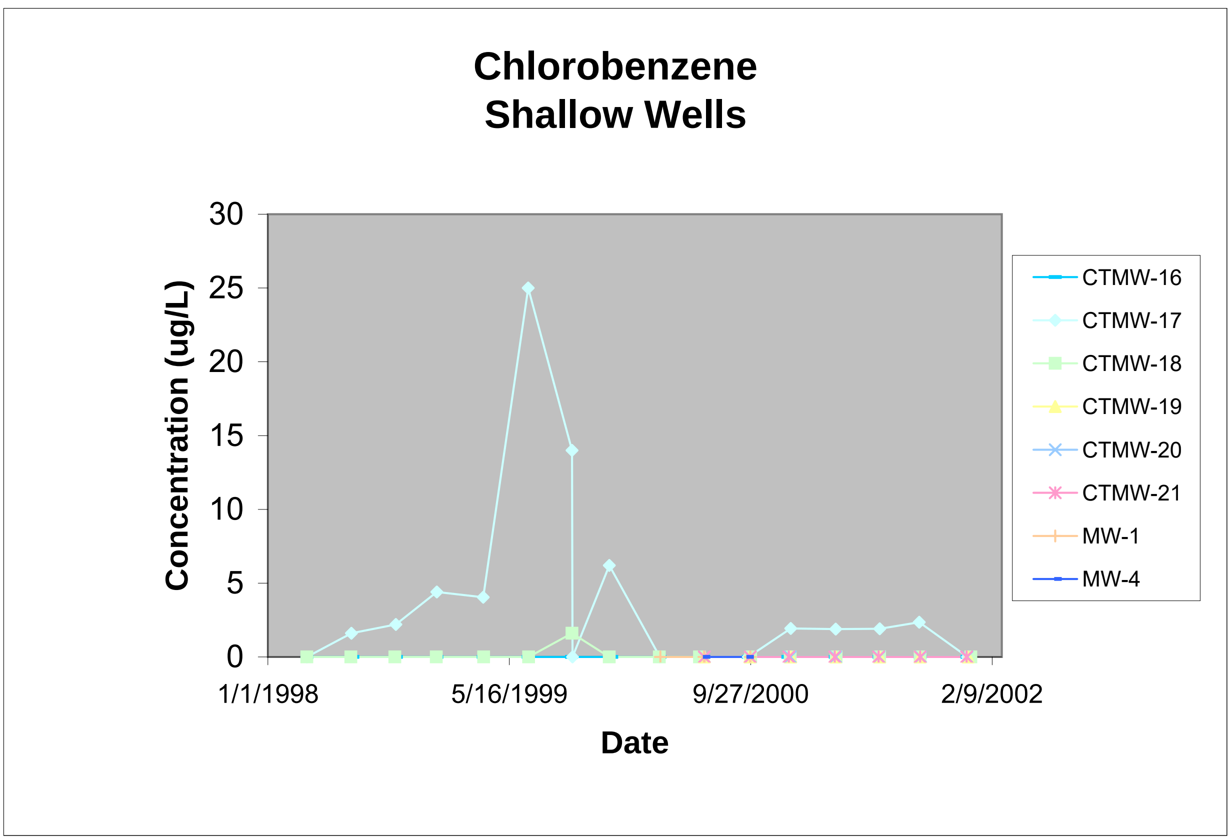

Bromomethane
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


n-Butylbenzene
Shallow Wells
Concentration (ug/L)
20
18
16
14
12
10
8
6
4
2
0
6/19/1997
7/24/1998
8/28/1999
10/1/2000
11/5/2001
12/10/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-15

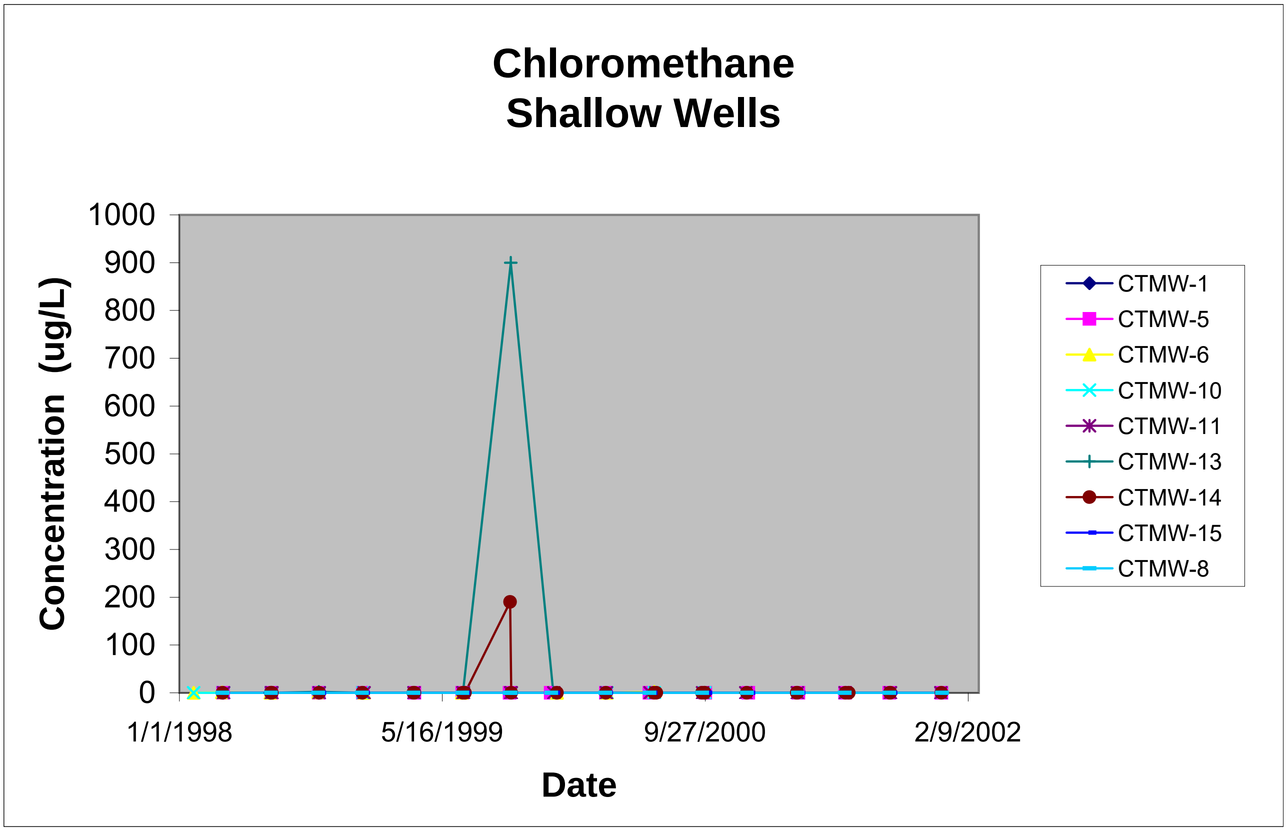

n-Butylbenzene
Shallow Wells
Concentration (ug/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-20
CTMW-21
MW-1
MW-4
CTMW-19

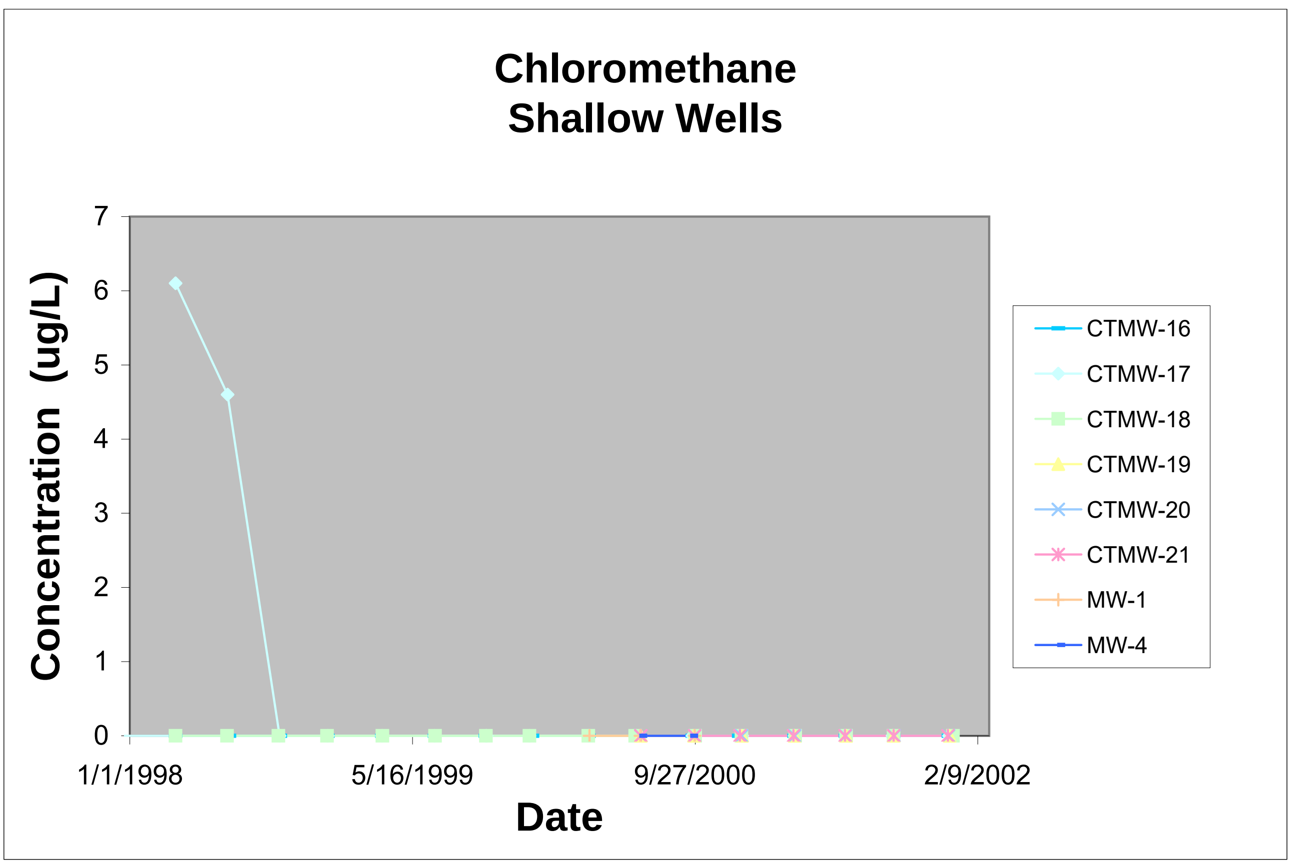


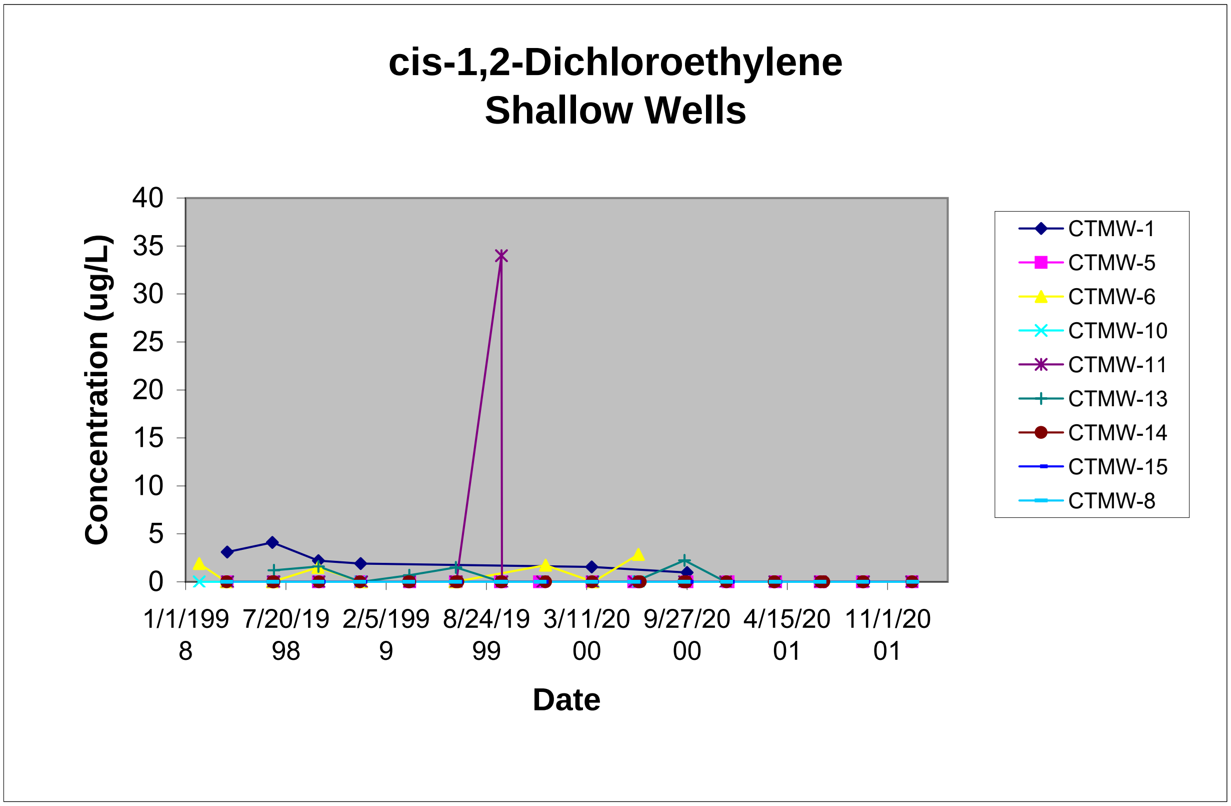
Chlorobenzene
Shallow Wells
Concentration (ug/L)
60
50
40
30
20
10
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

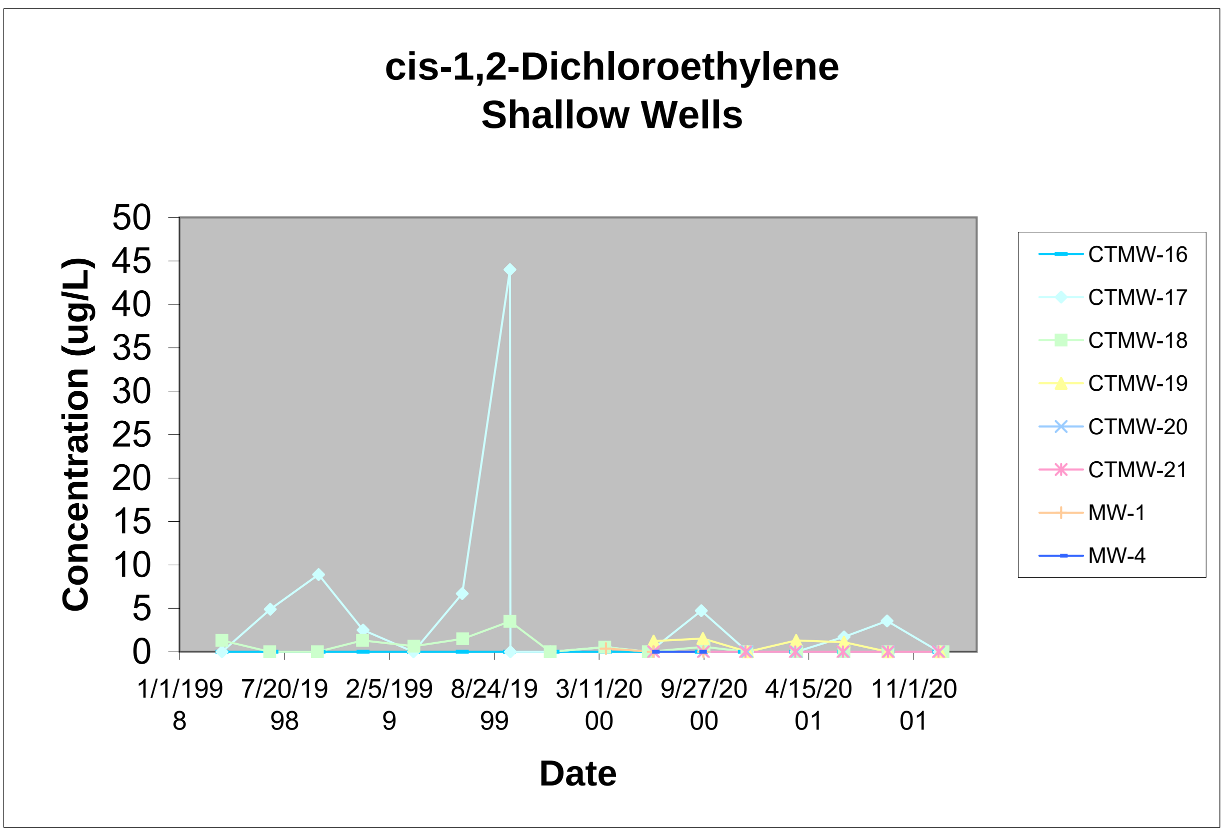


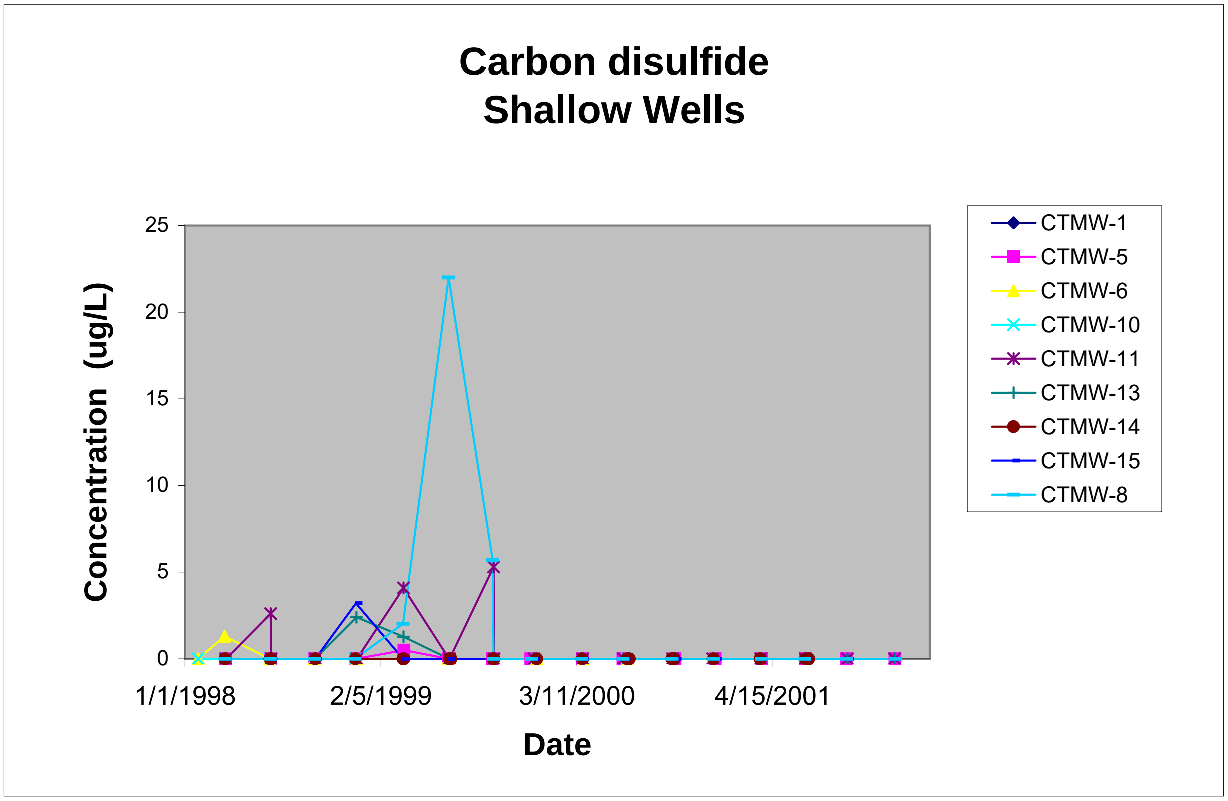
Chlorobenzene
Shallow Wells
Concentration (ug/L)
30
25
20
15
10
5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

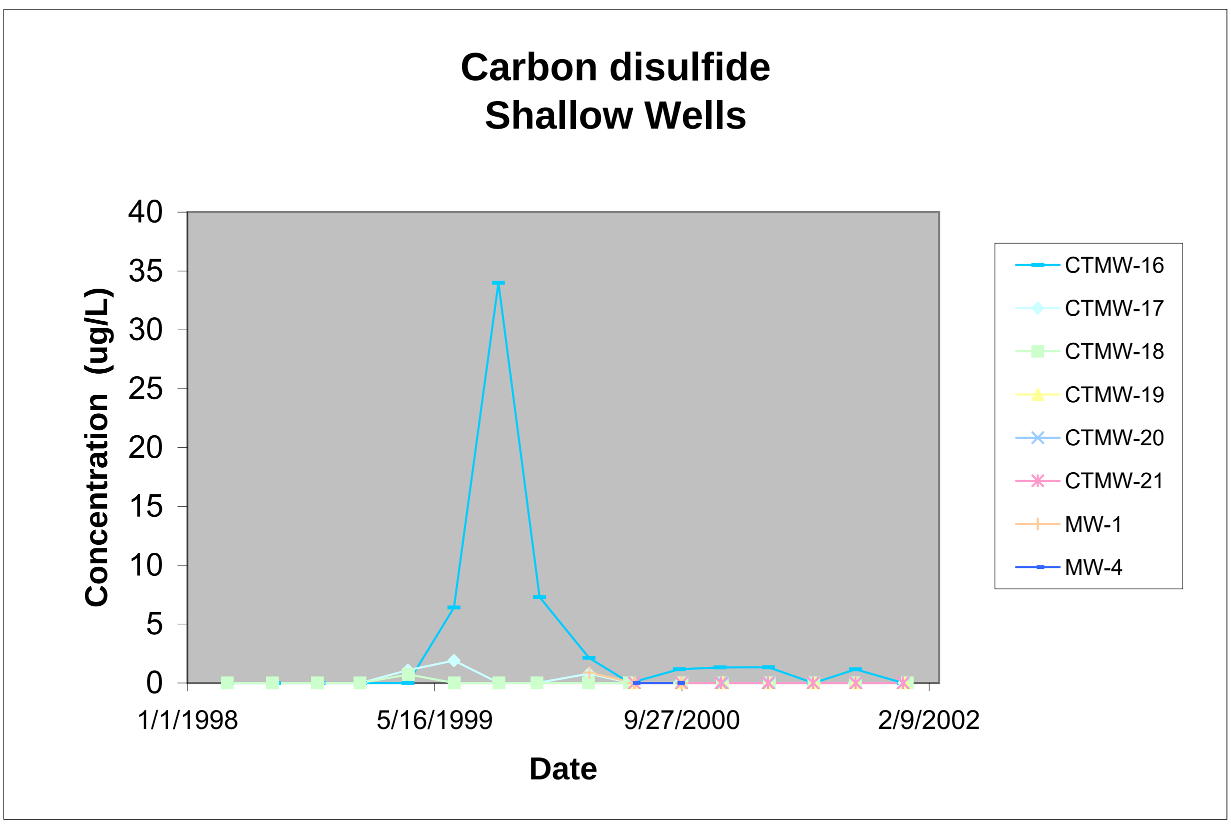

Chloromethane
Shallow Wells
1000
900
800
700
600
500
400
300
200
100
0
Concentration (ug/L)
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

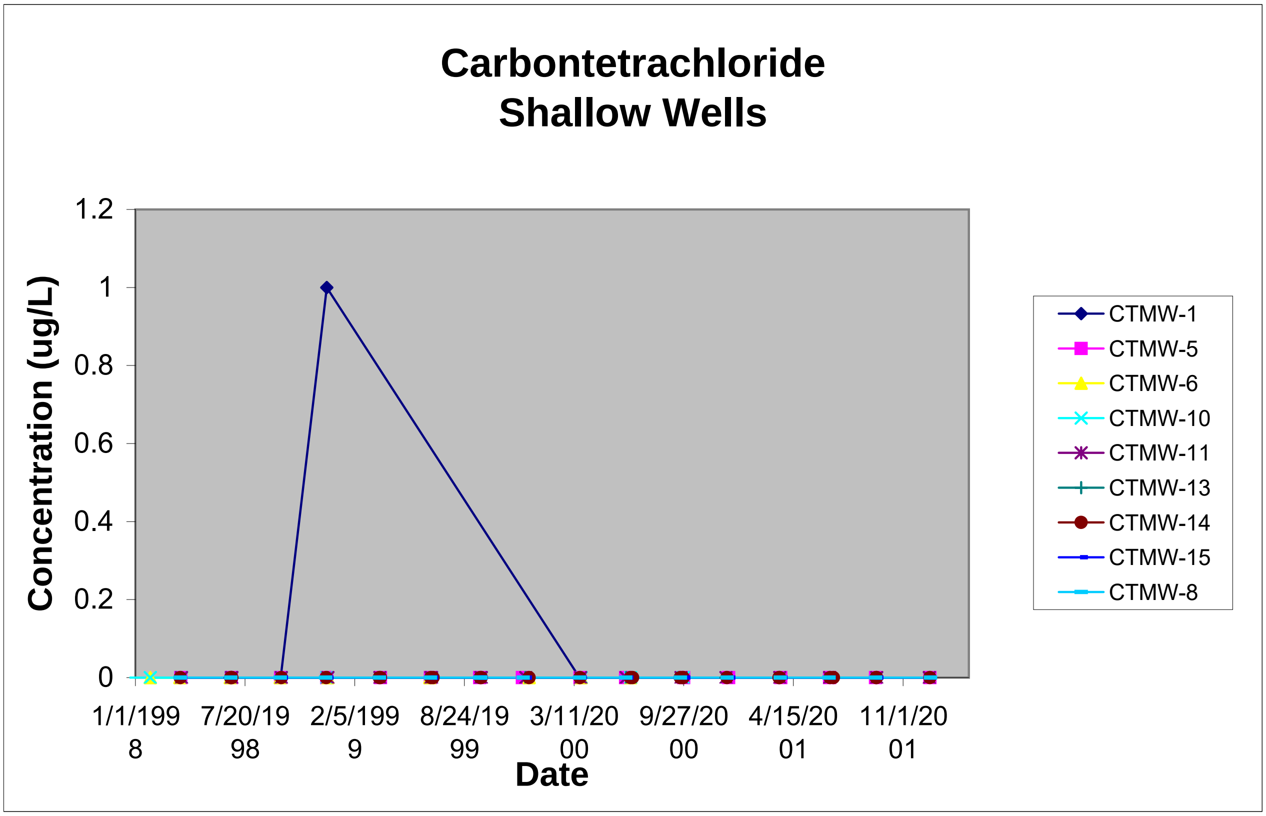

Chloromethane
Shallow Wells
7
6
5
4
3
2
1
0
Concentration (ug/L)
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

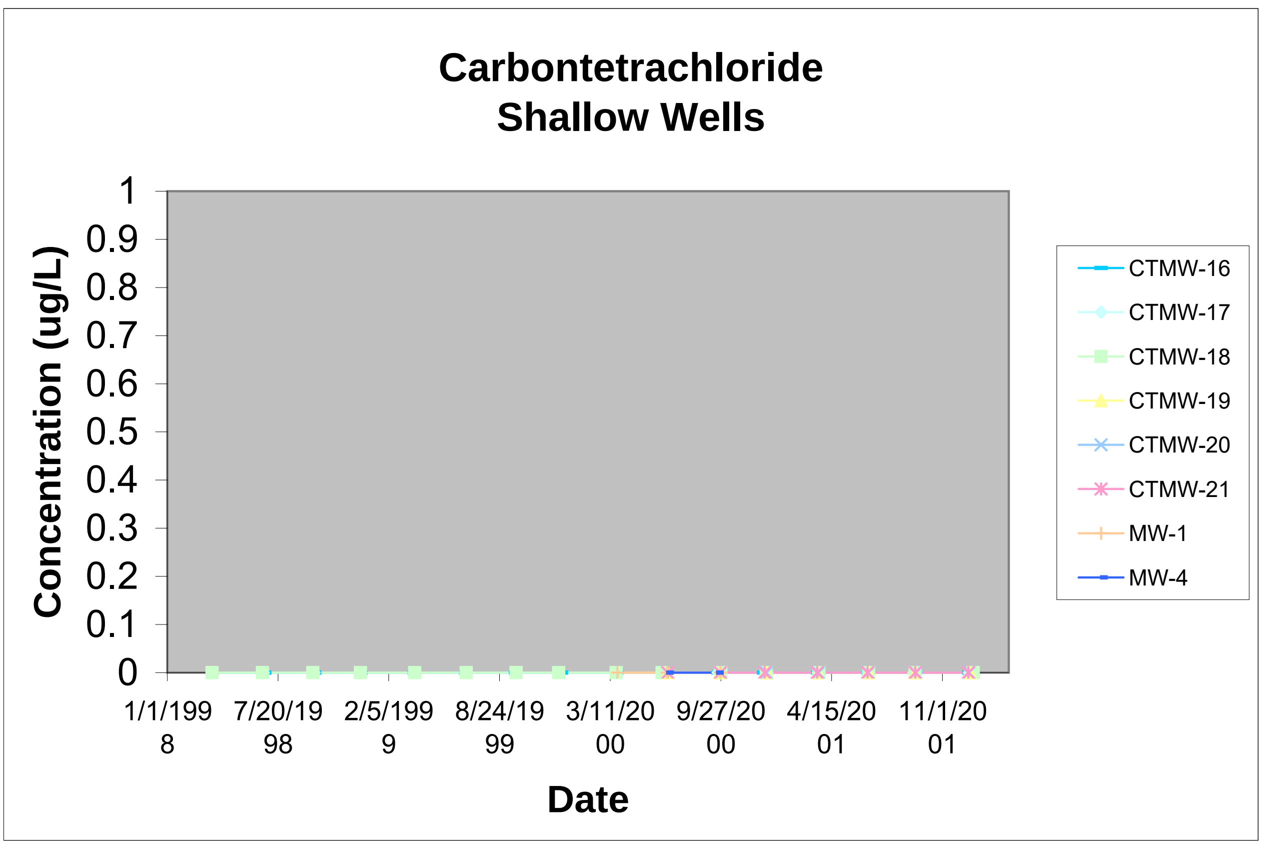

cis-1,2-Dichloroethylene
Shallow Wells
Concentration (ug/L)
40
35
30
25
20
15
10
5
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

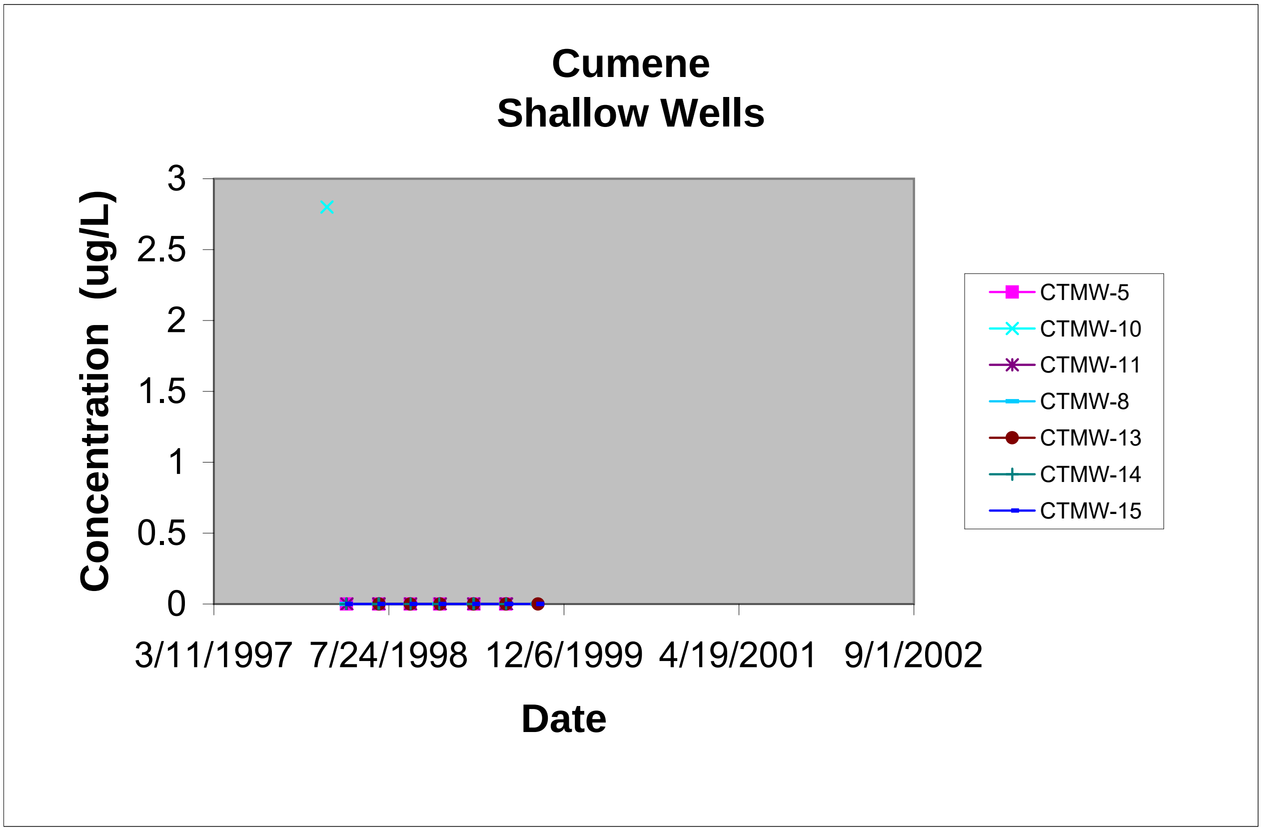

cis-1,2-Dichloroethylene
Shallow Wells
Concentration (ug/L)
50
45
40
35
30
25
20
15
10
5
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


Carbon disulfide
Shallow Wells
Concentration (ug/L)
25
20
15
10
5
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

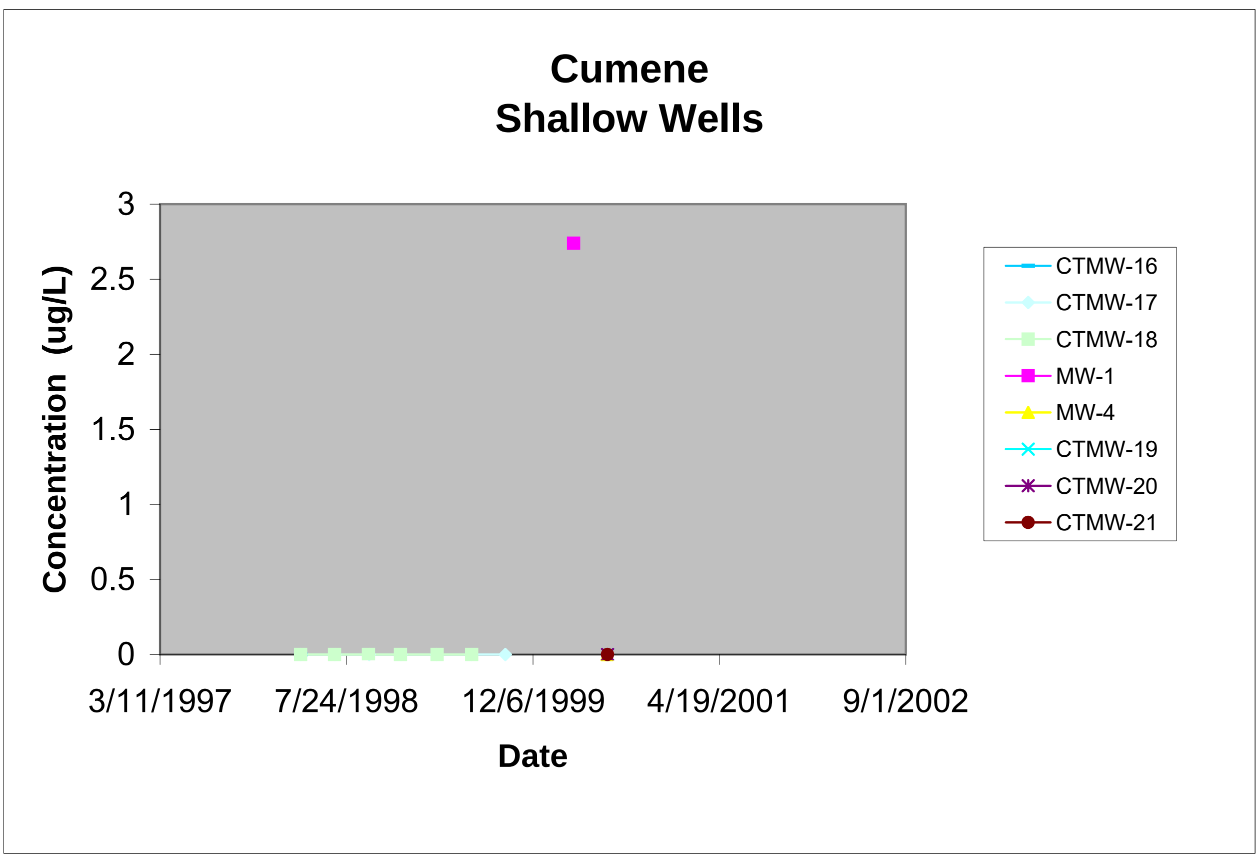

Carbon disulfide
Shallow Wells
Concentration (ug/L)
40
35
30
25
20
15
10
5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


Carbontetrachloride
Shallow Wells
Concentration (ug/L)
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

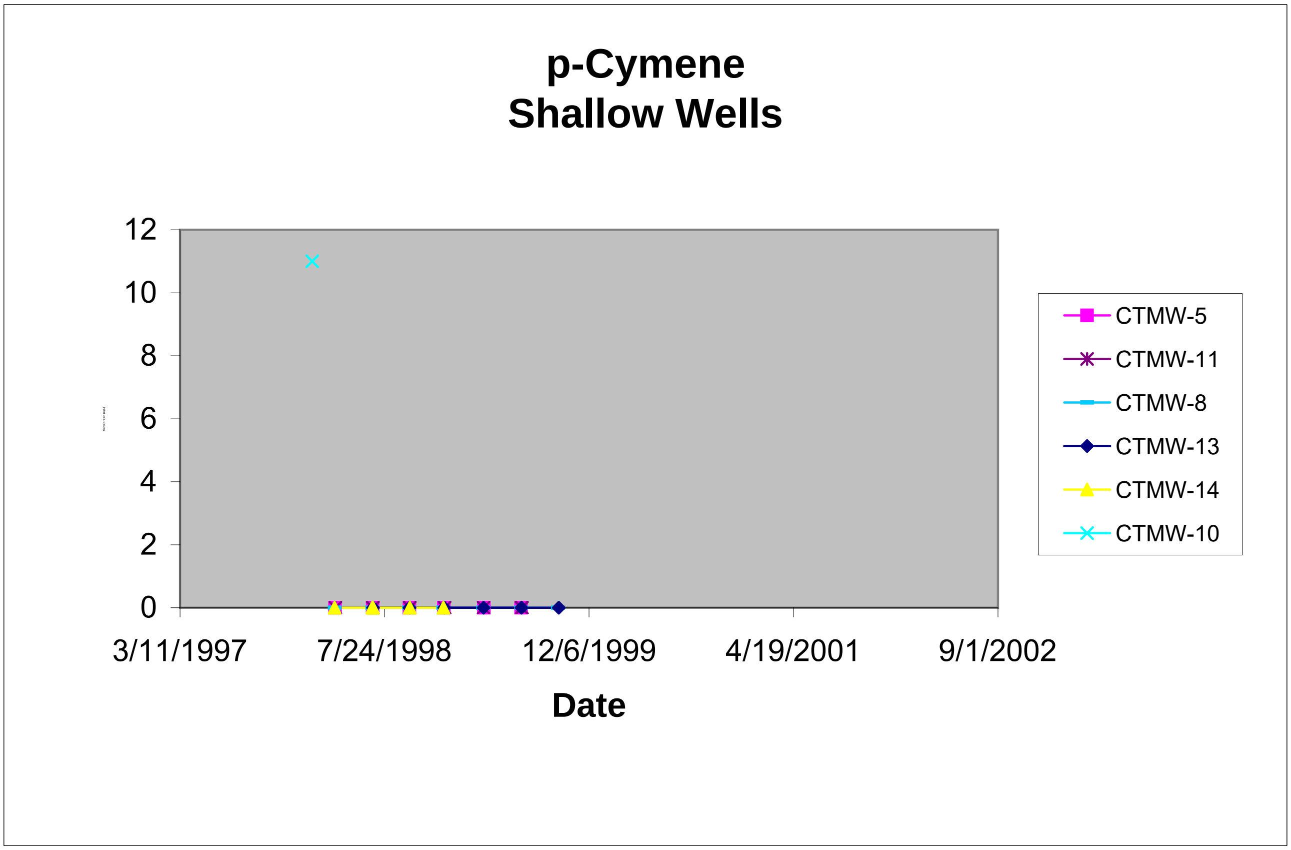

Carbontetrachloride
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

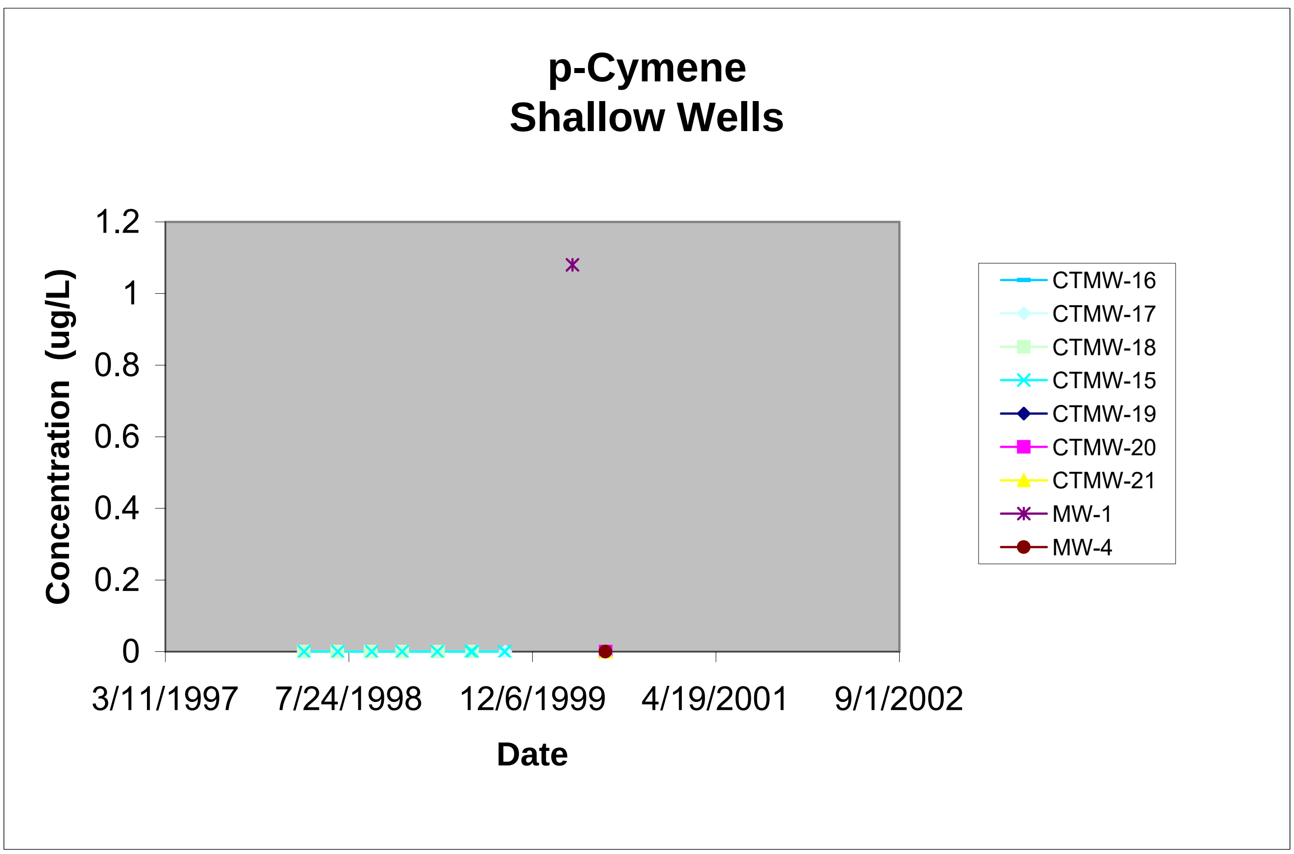


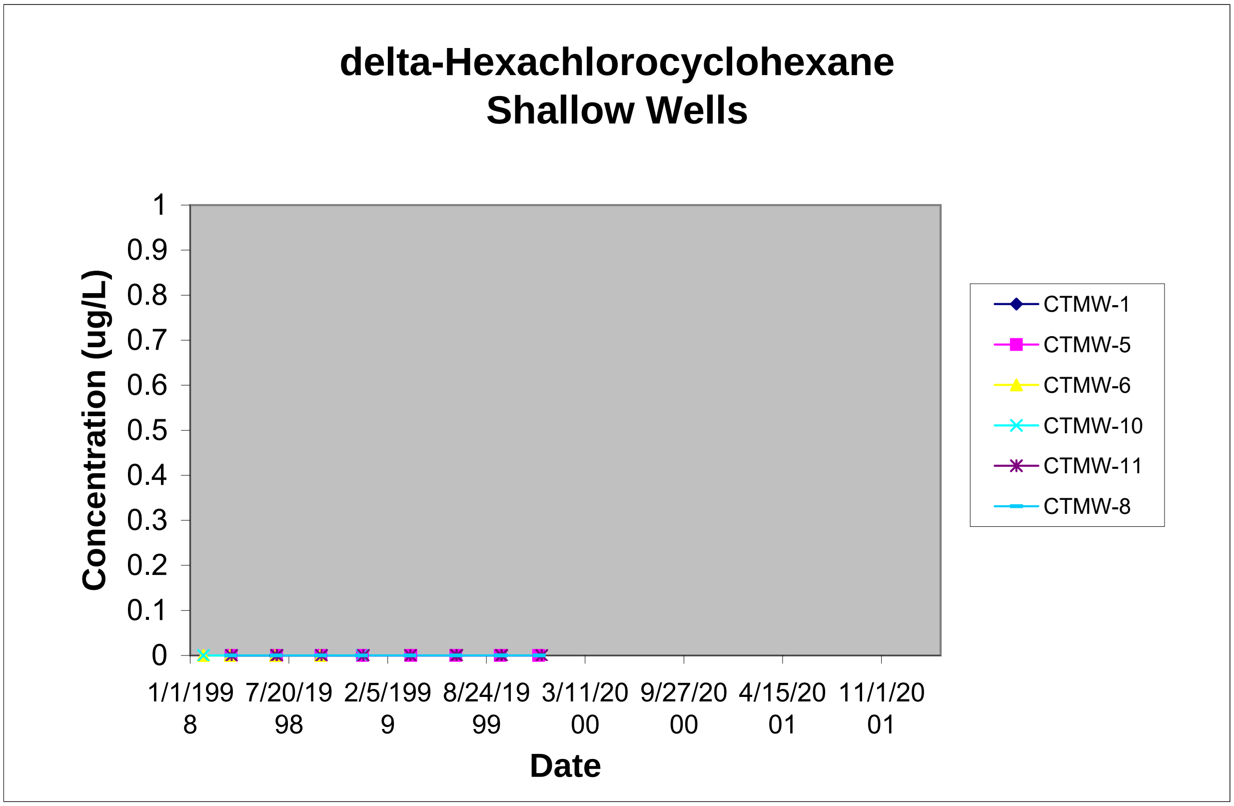
Cumene
Shallow Wells
Concentration (ug/L)
3
2.5
2
1.5
1
0.5
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-15

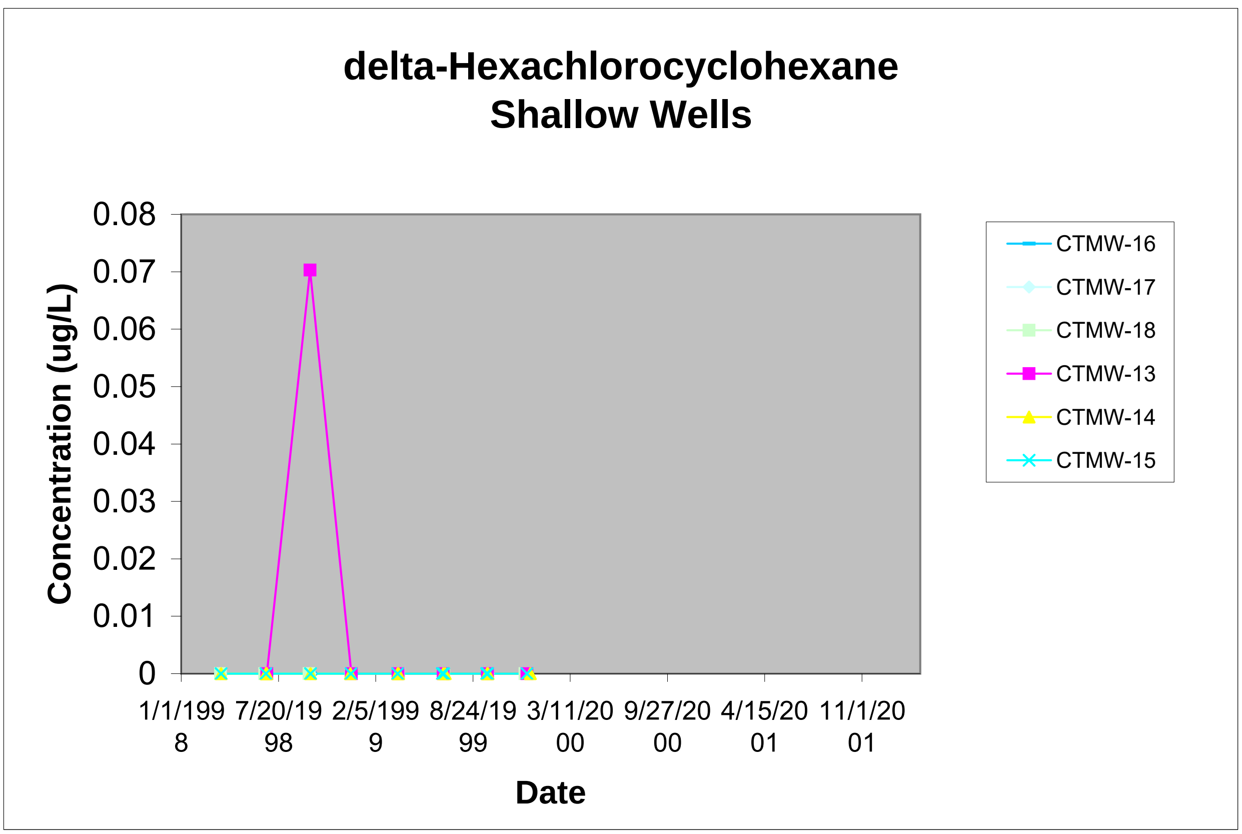


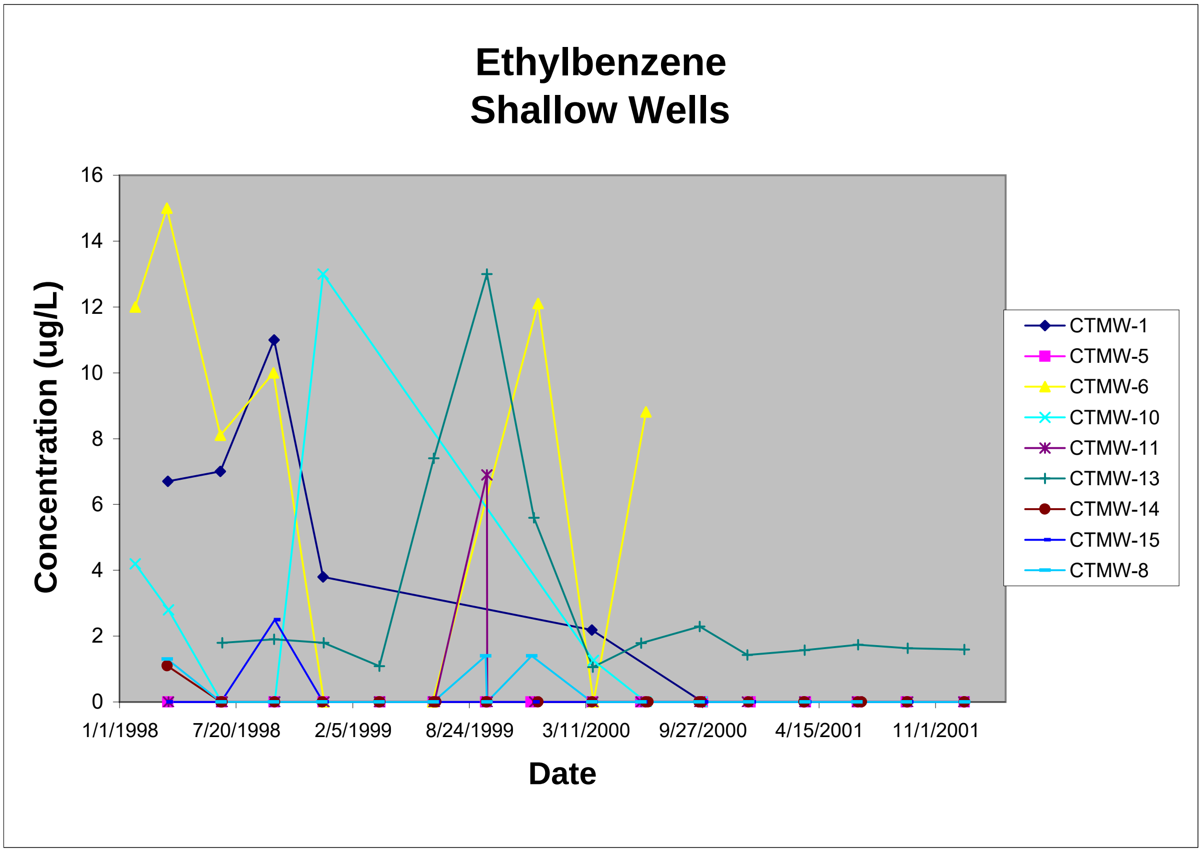
Cumene
Shallow Wells
Concentration (ug/L)
3
2.5
2
1.5
1
0.5
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
MW-1
MW-4
CTMW-19
CTMW-20
CTMW-21


p-Cymene
Shallow Wells
12
10
8
6
4
2
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-5
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-10

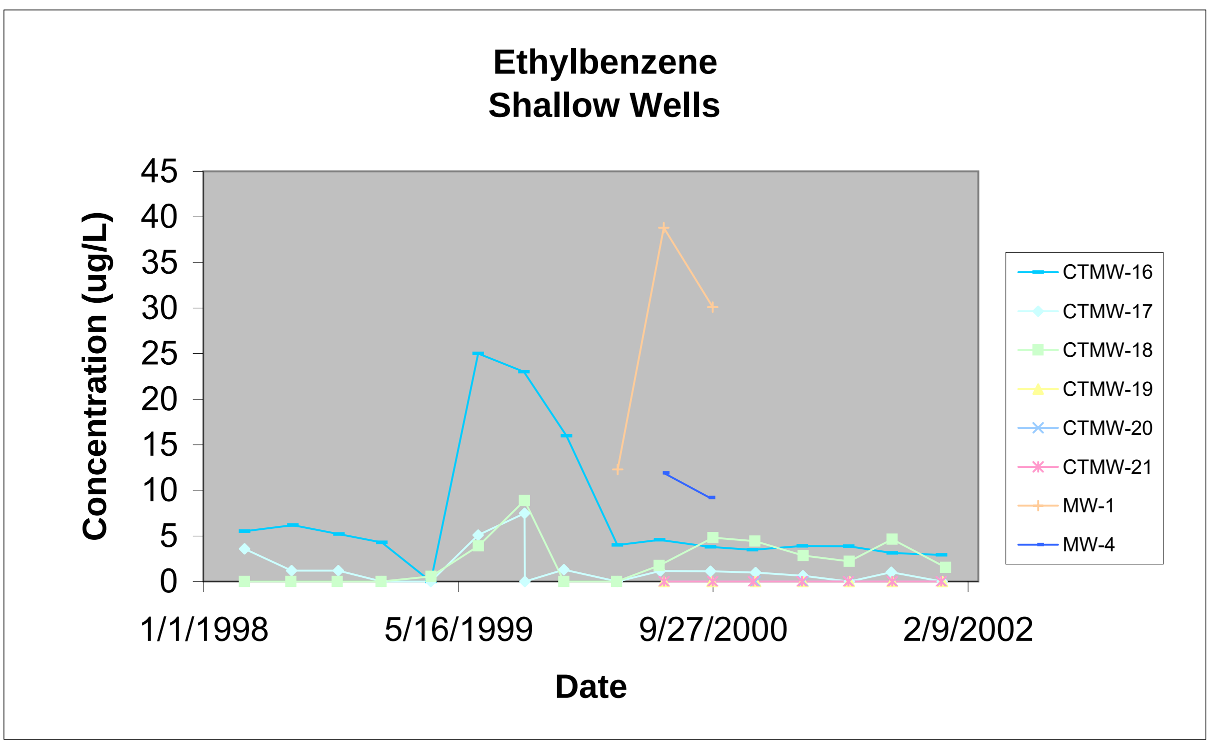

p-Cymene
Shallow Wells
Concentration (ug/L)
1.2
1
0.8
0.6
0.4
0.2
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


delta-Hexachlorocyclohexane
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

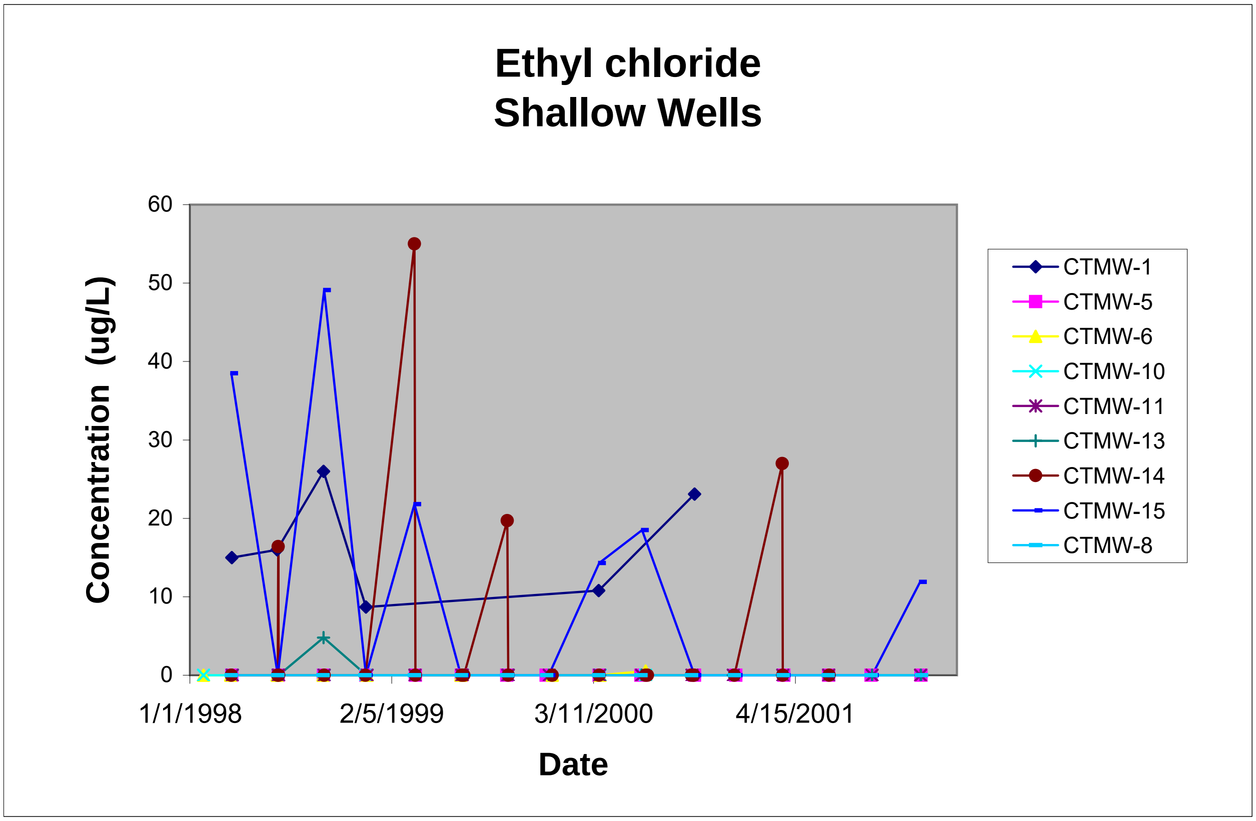

delta-Hexachlorocyclohexane
Shallow Wells
Concentration (ug/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

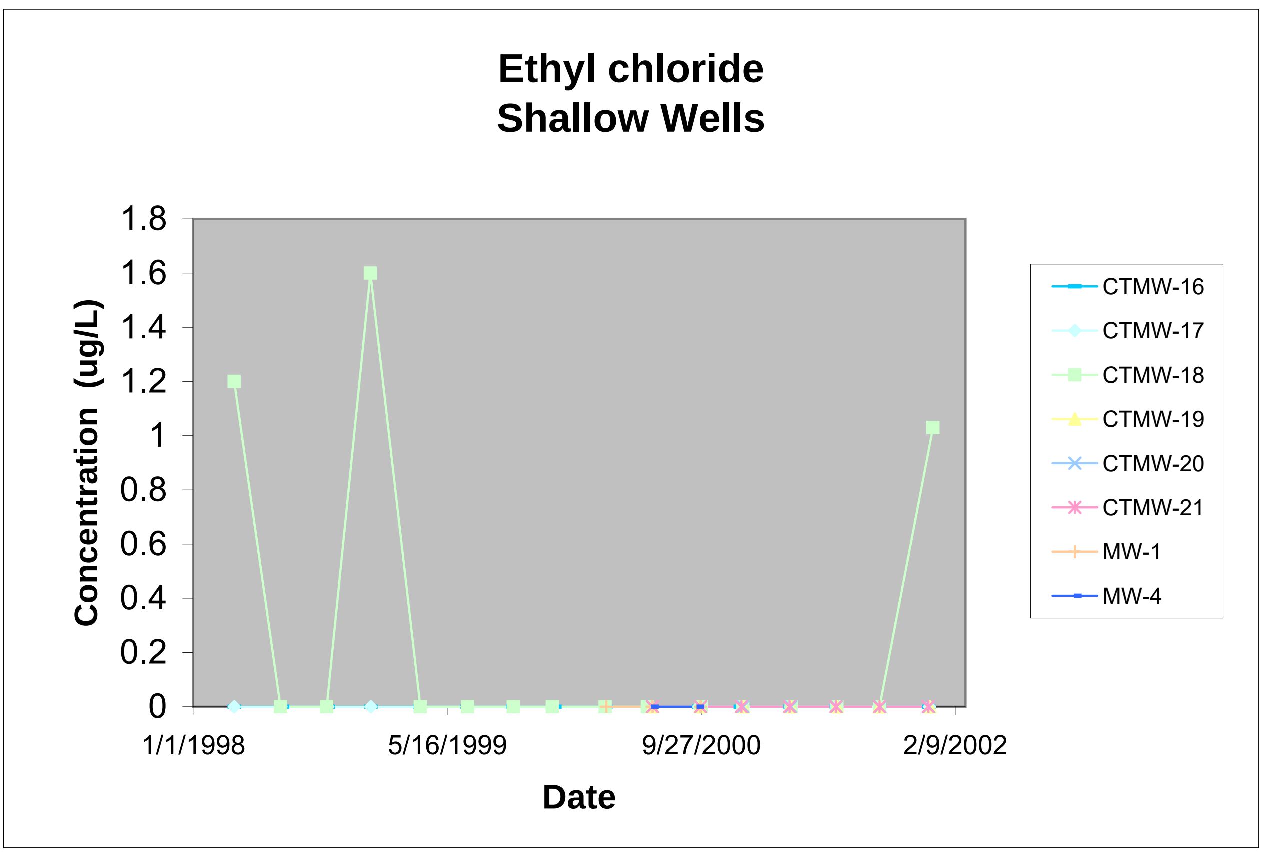


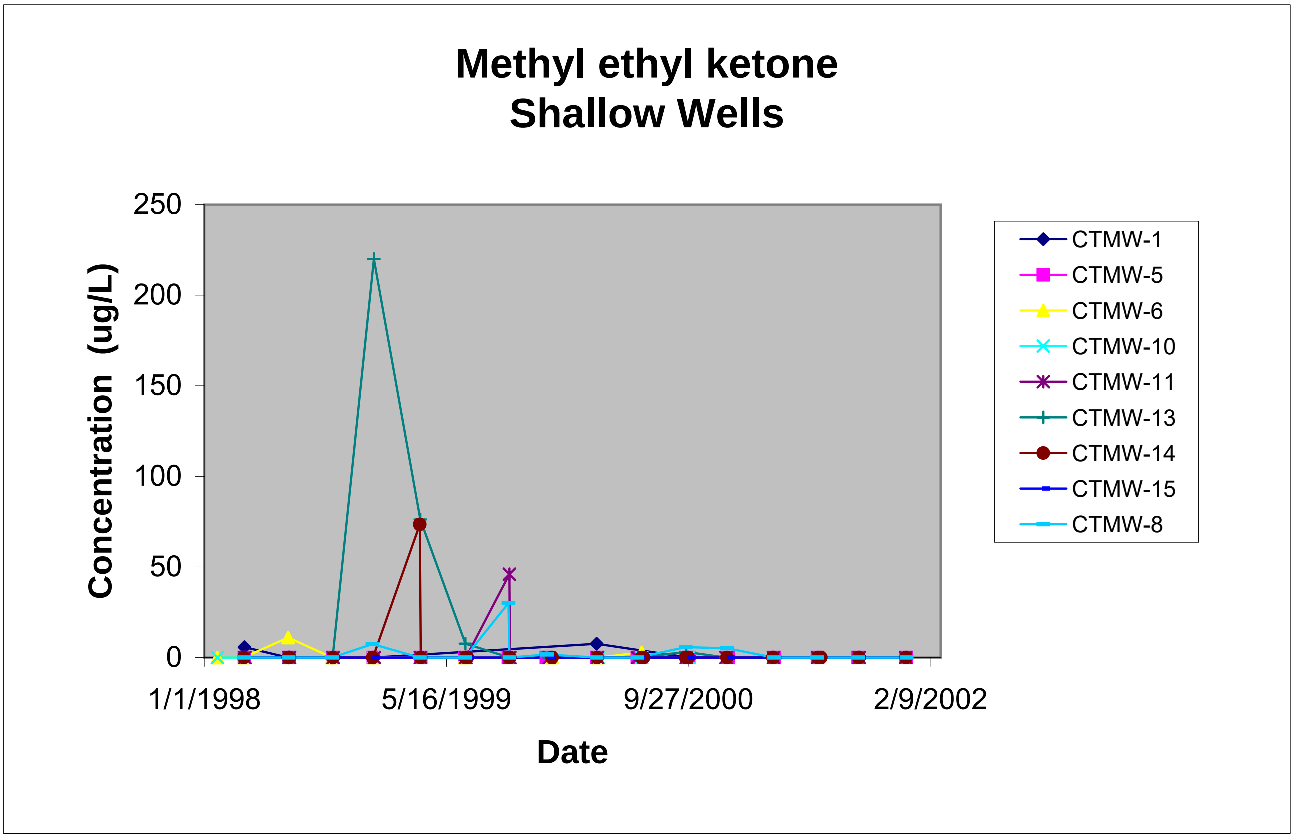
Ethylbenzene
Shallow Wells
Concentration (ug/L)
16
14
12
10
8
6
4
2
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8



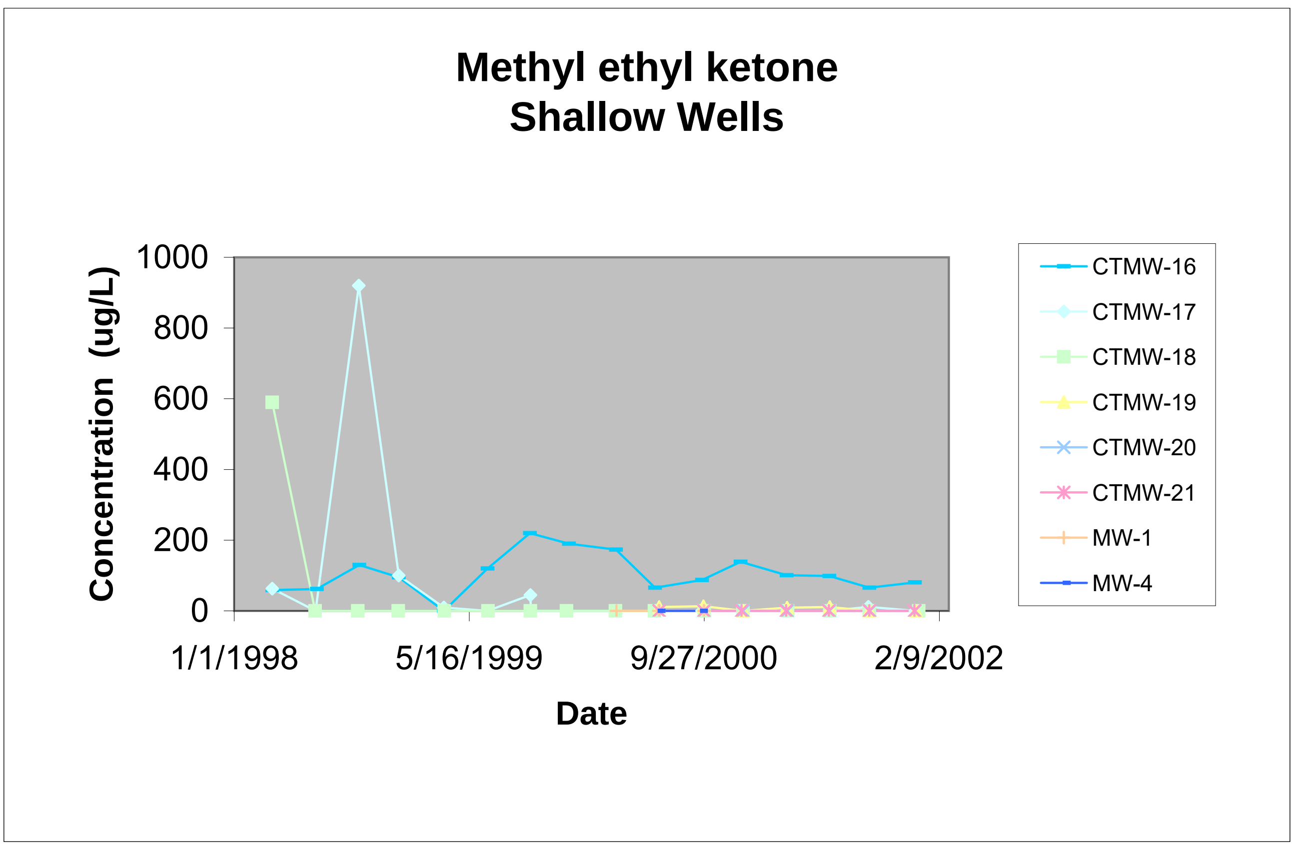
Ethylbenzene
Shallow Wells
Concentration (ug/L)
45
40
35
30
25
20
15
10
5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


Ethyl chloride
Shallow Wells
60
50
40
30
20
10
0
Concentration (ug/L)
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

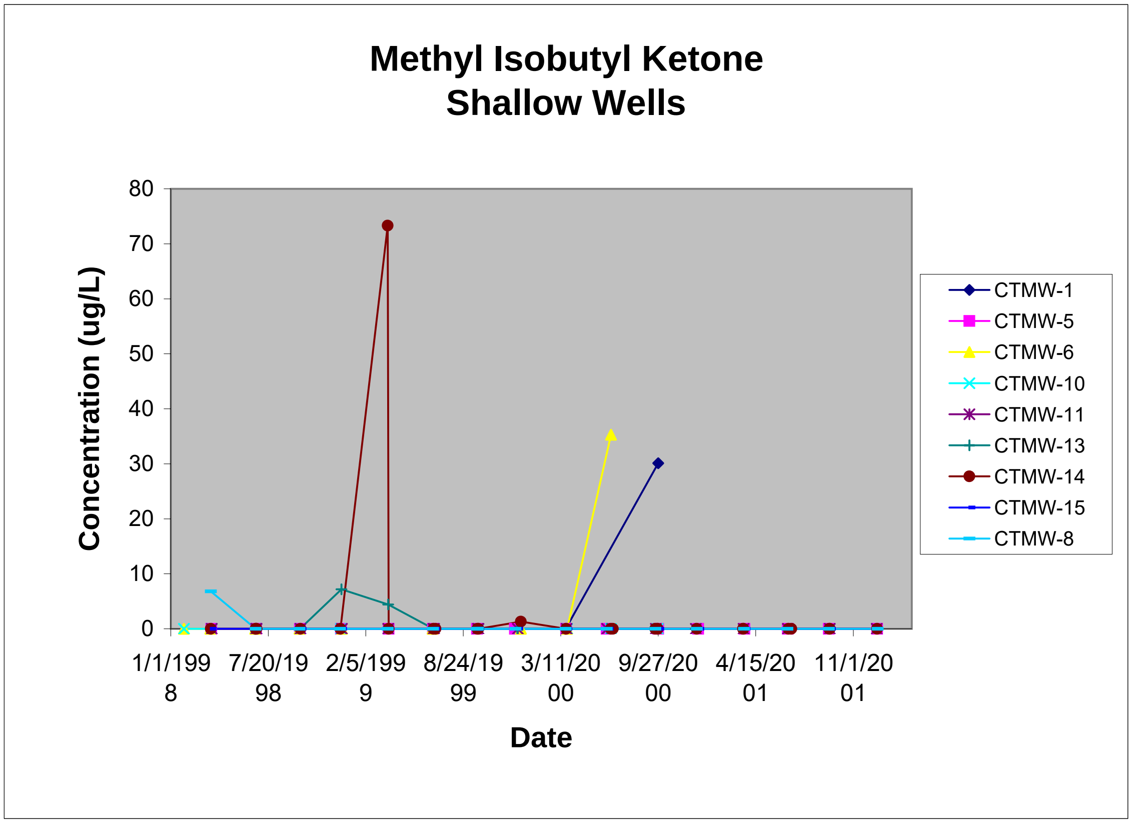

Ethyl chloride
Shallow Wells
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Concentration (ug/L)
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4



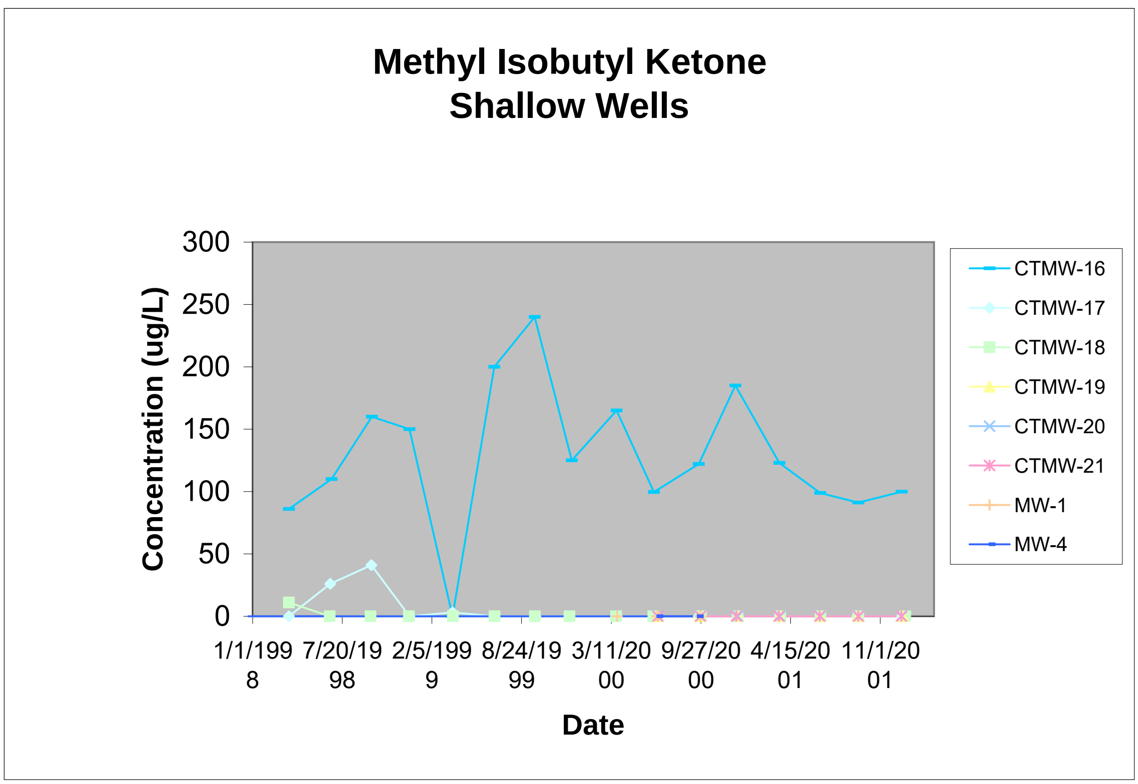
Methyl ethyl ketone
Shallow Wells
Concentration (ug/L)
250
200
150
100
50
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8



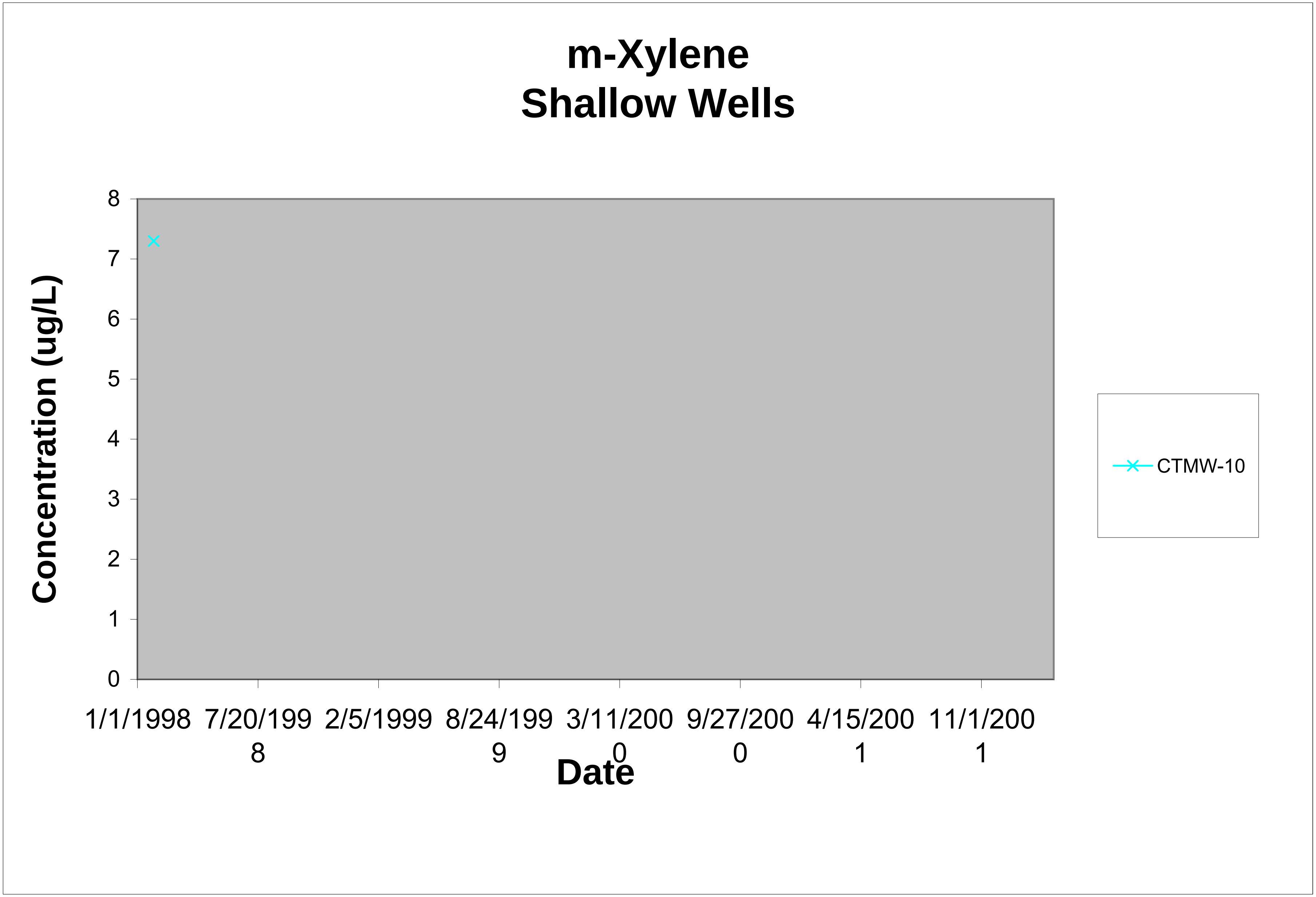
Methyl ethyl ketone
Shallow Wells
Concentration (ug/L)
1000
800
600
400
200
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4



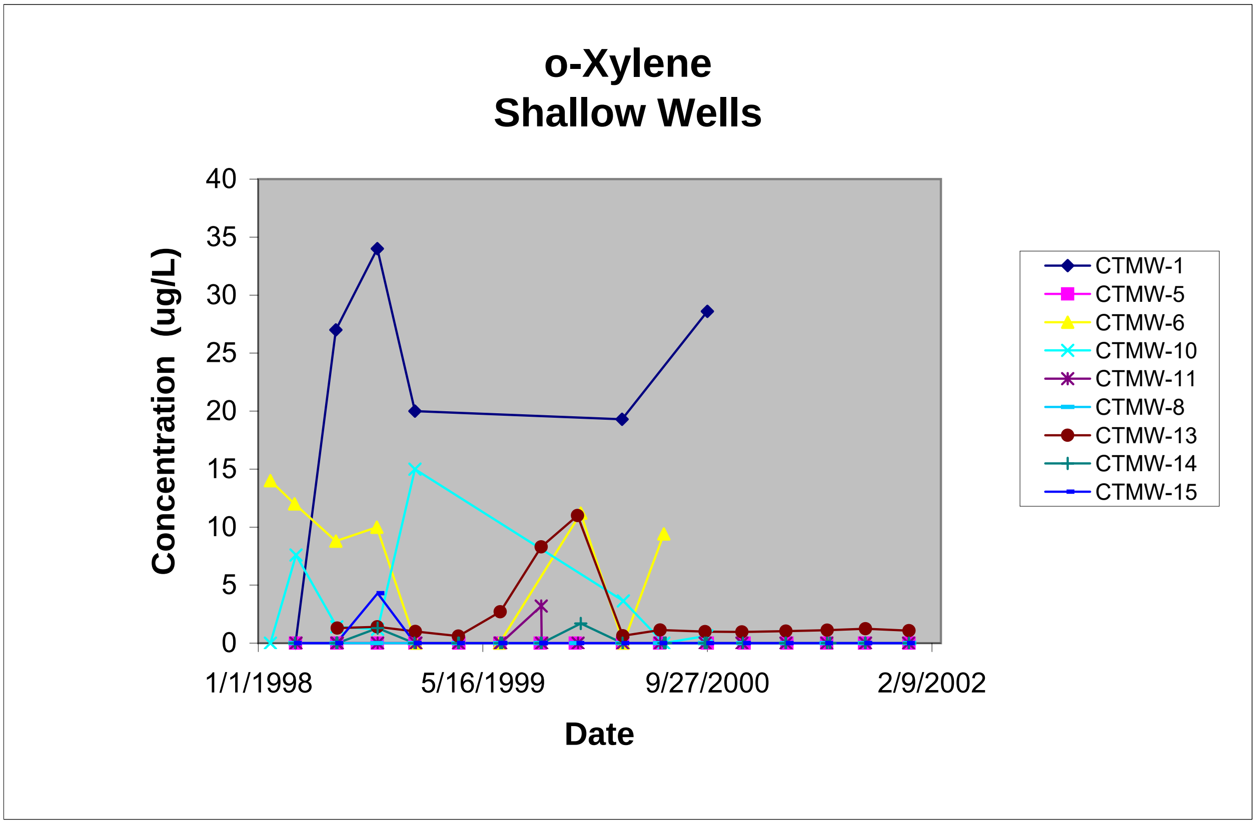
Methyl Isobutyl Ketone
Shallow Wells
Concentration (ug/L)
80
70
60
50
40
30
20
10
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8



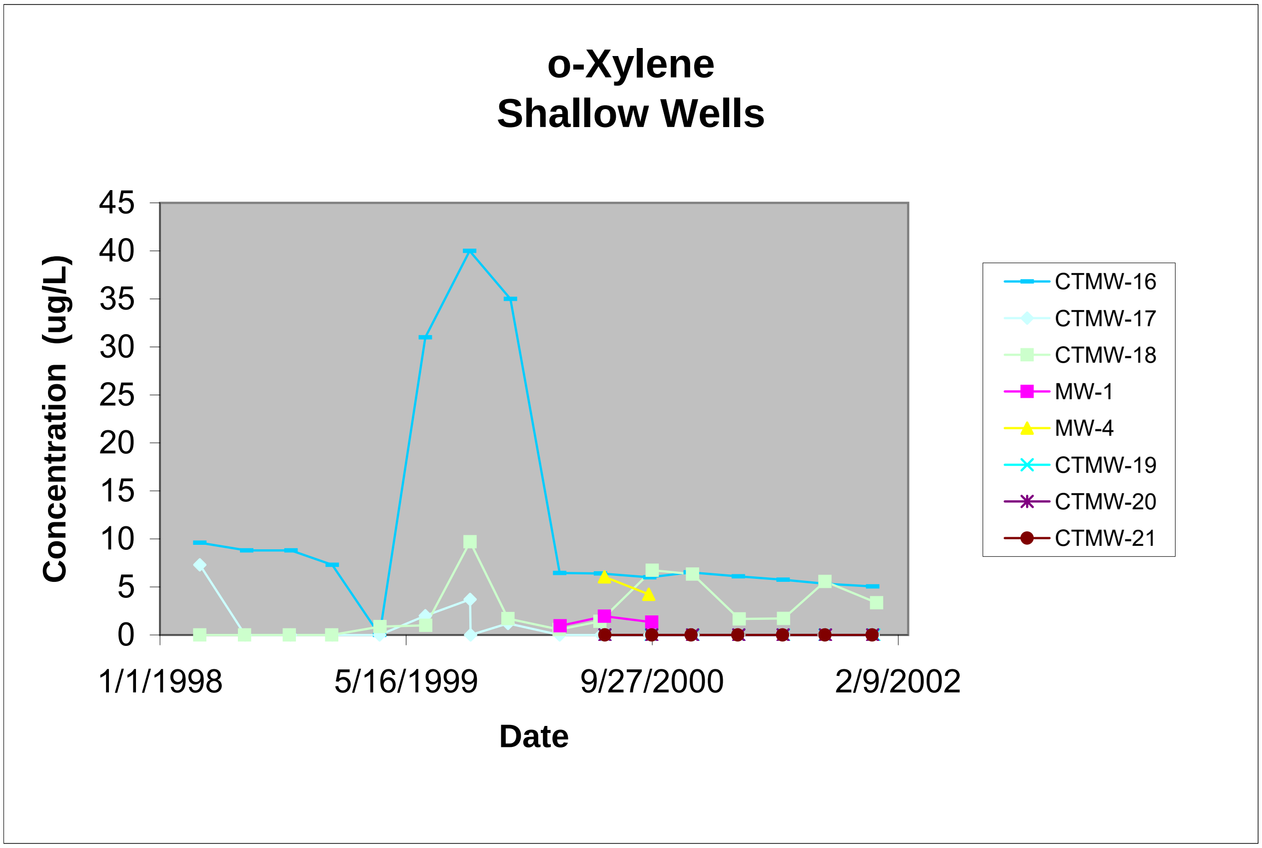
Methyl Isobutyl Ketone
Shallow Wells
Concentration (ug/L)
300
250
200
150
100
50
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4



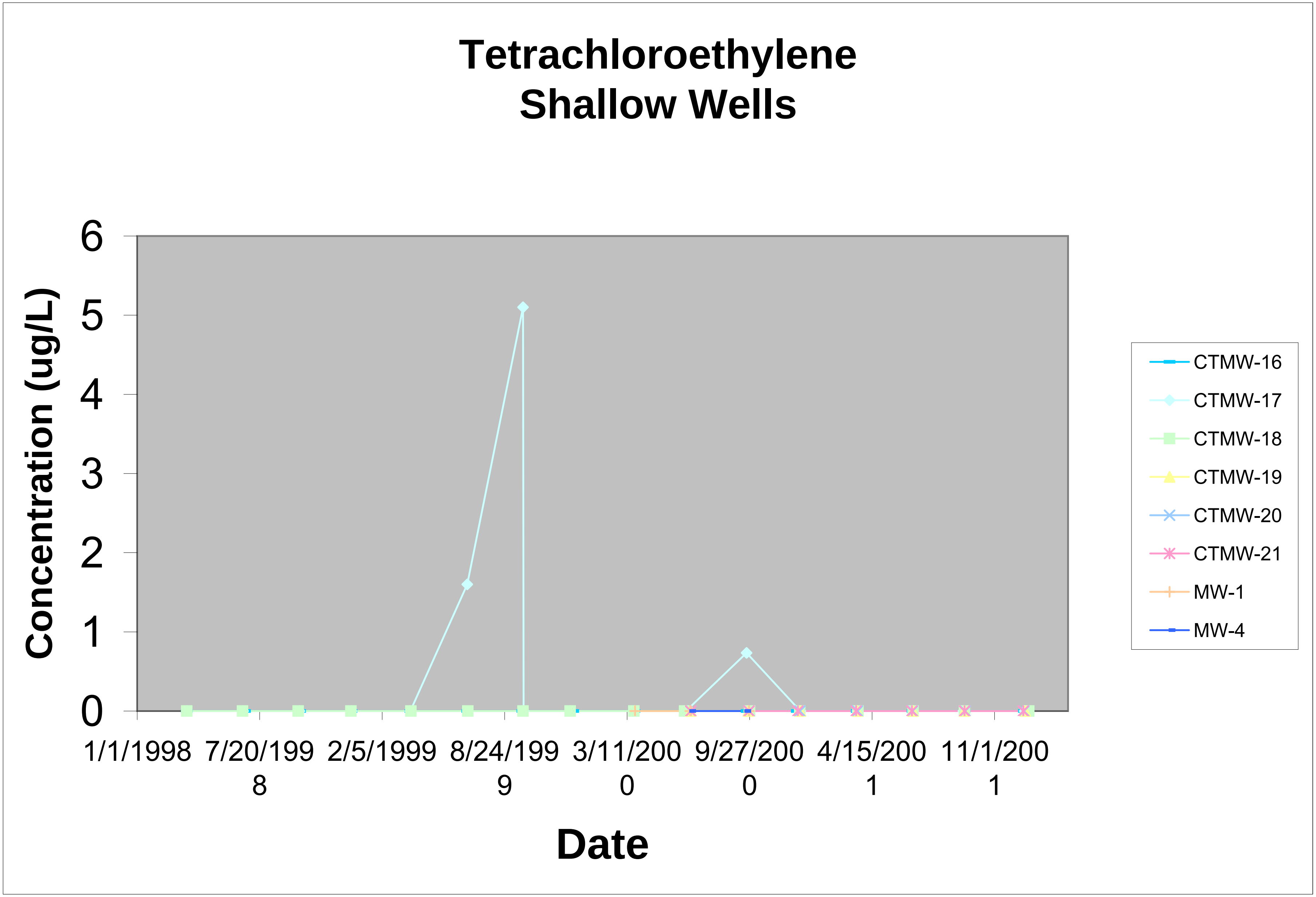
m-Xylene
Shallow Wells
Concentration (ug/L)
8
7
6
5
4
3
2
1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-10



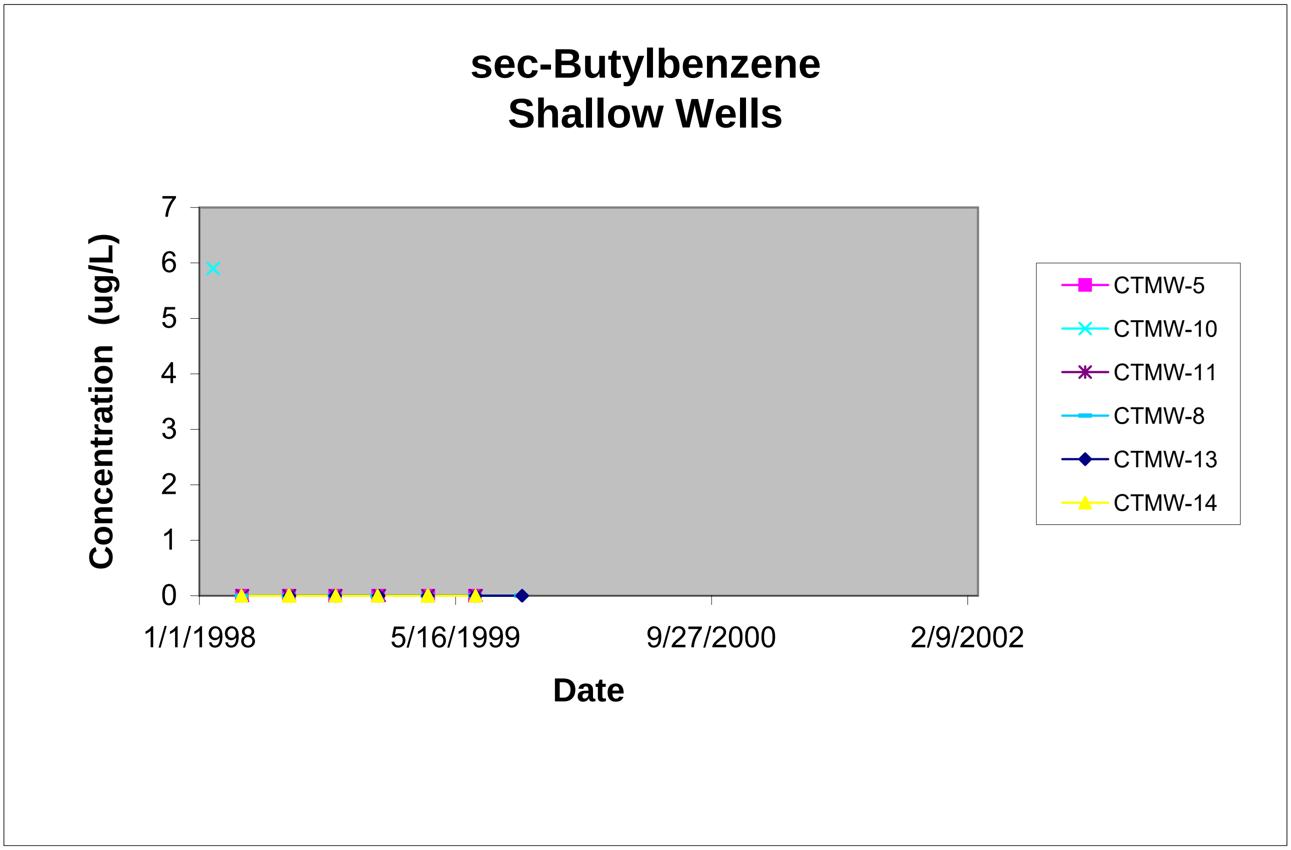
o-Xylene
Shallow Wells
Concentration (ug/L)
40
35
30
25
20
15
10
5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-15

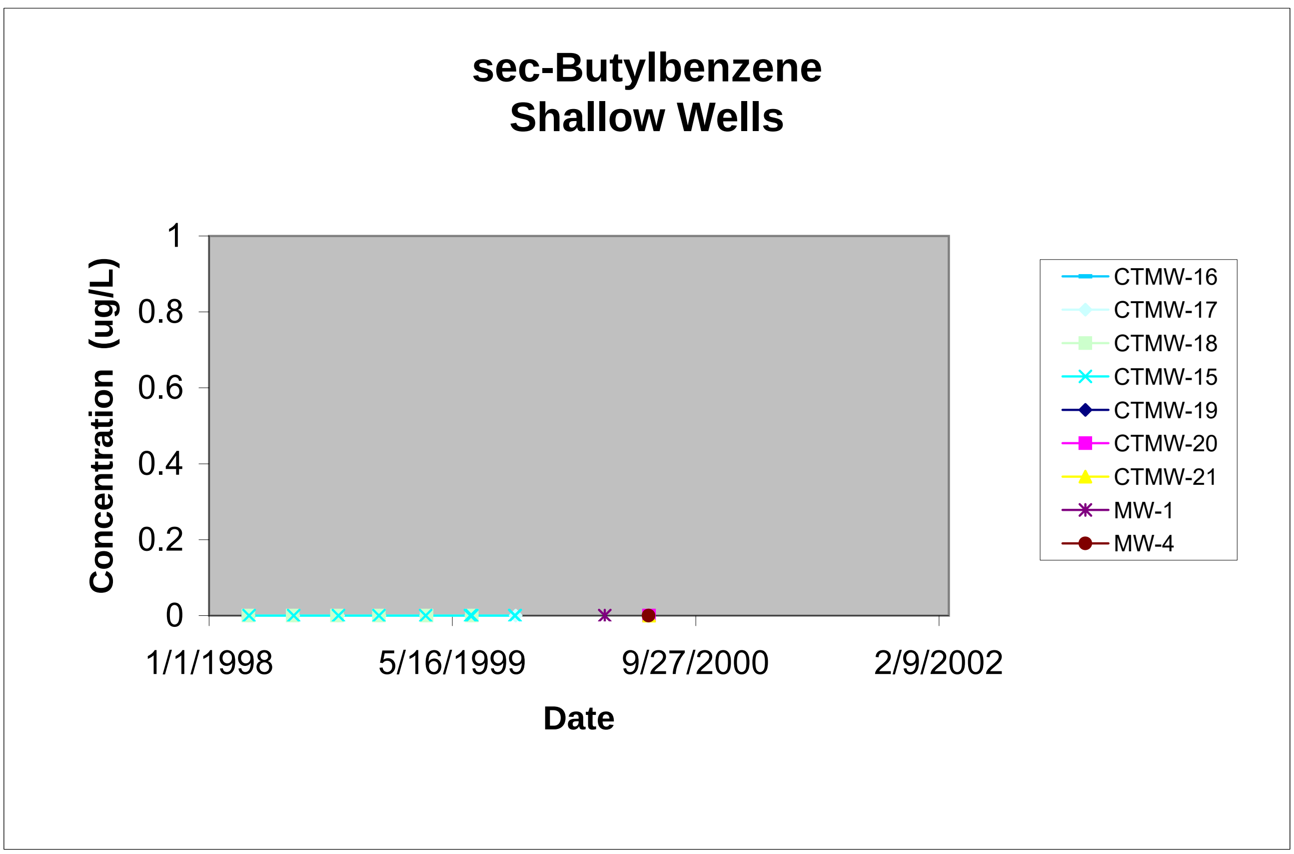


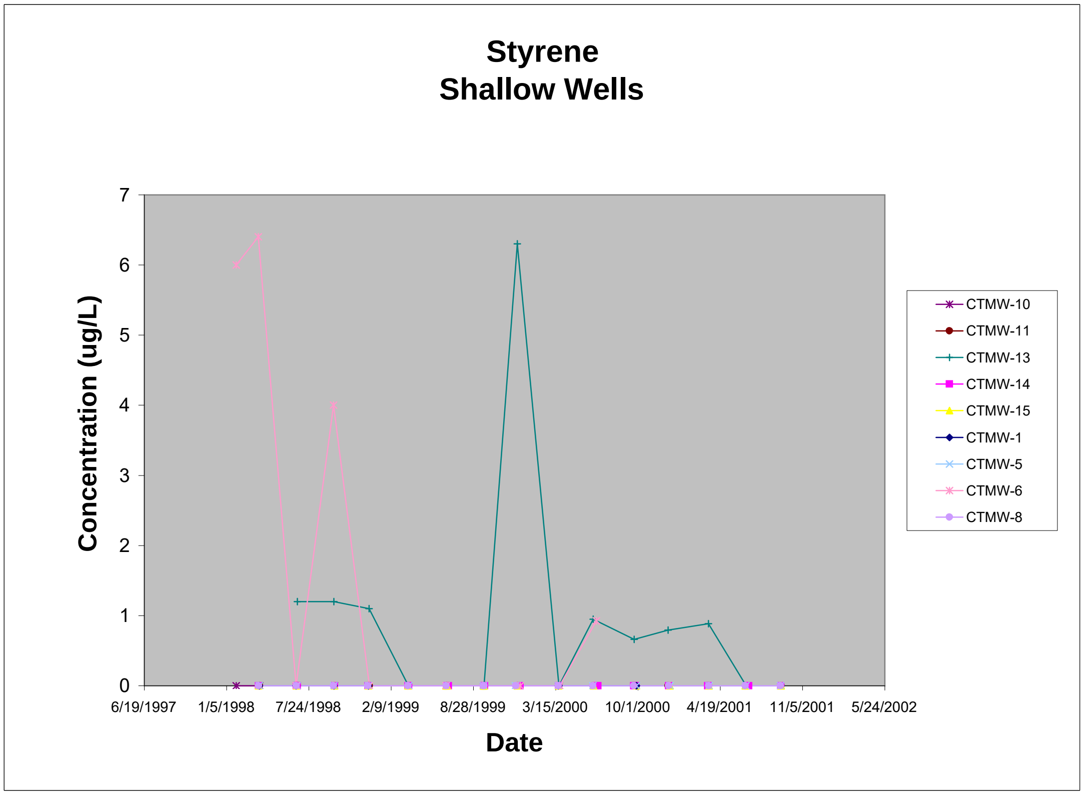
o-Xylene
Shallow Wells
Concentration (ug/L)
45
40
35
30
25
20
15
10
5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
MW-1
MW-4
CTMW-19
CTMW-20
CTMW-21



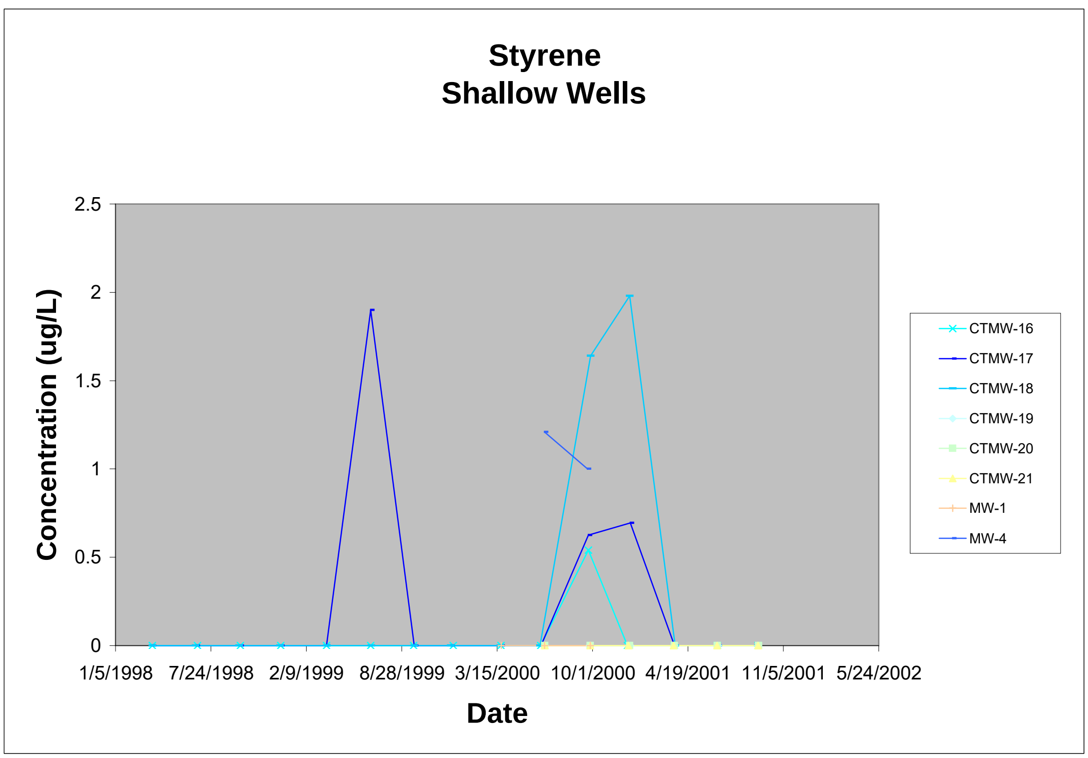
Tetrachloroethylene
Shallow Wells
Concentration (ug/L)
6
5
4
3
2
1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


sec-Butylbenzene
Shallow Wells
Concentration (ug/L)
7
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14

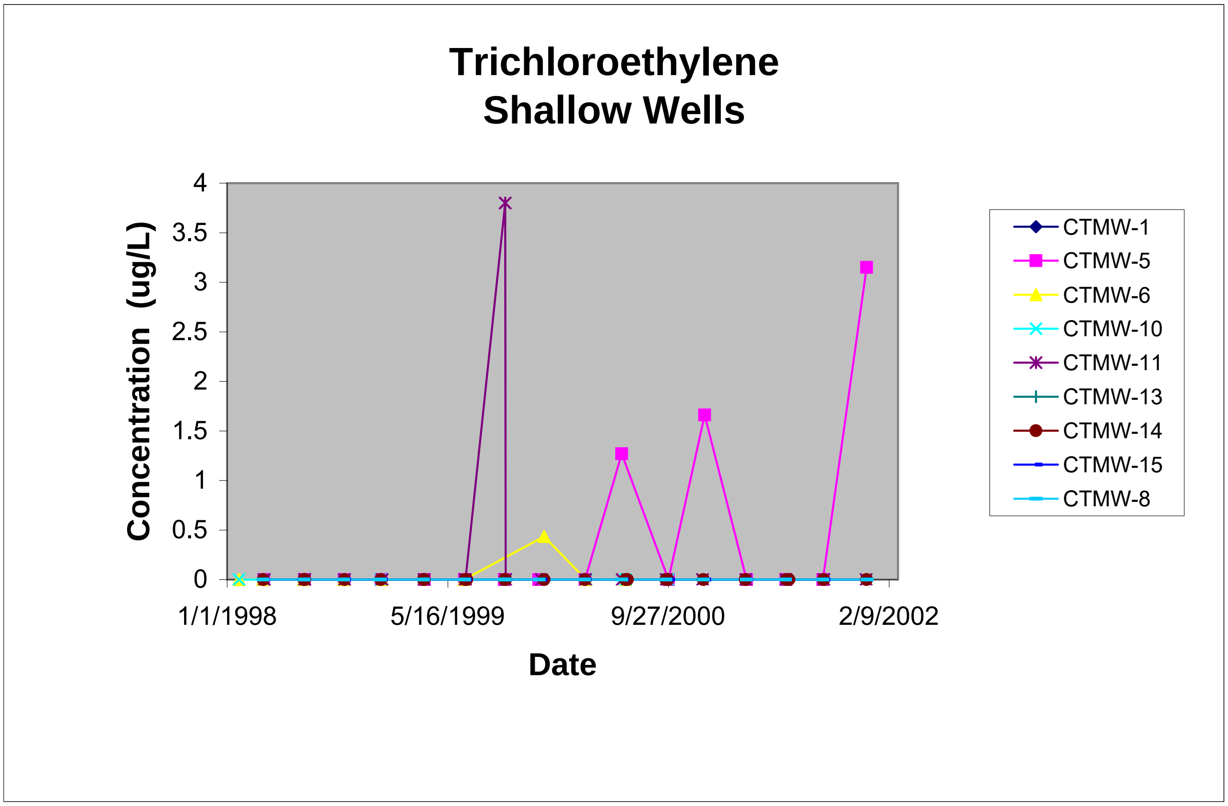

sec-Butylbenzene
Shallow Wells
Concentration (ug/L)
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4



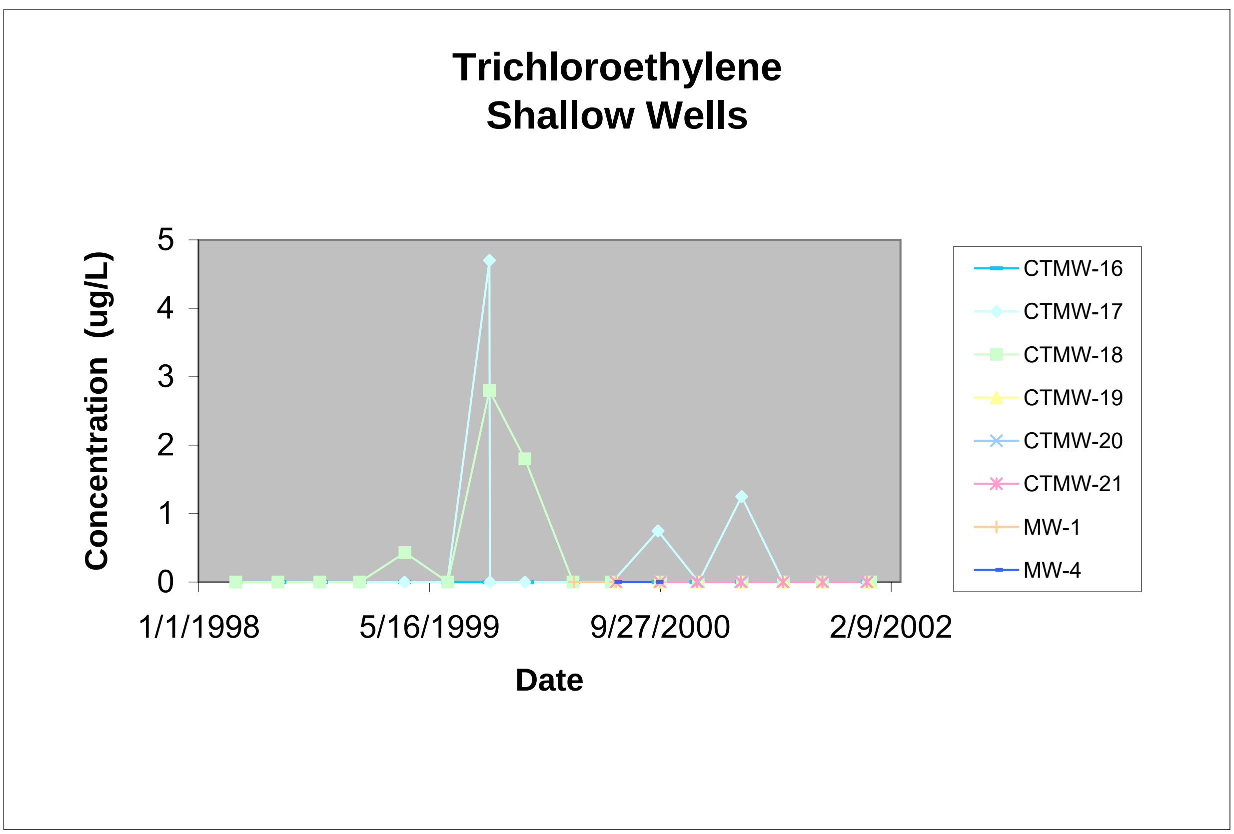
Styrene
Shallow Wells
Concentration (ug/L)
0
1
2
3
4
5
6
7
6/19/1997
1/5/1998
7/24/1998
2/9/1999
8/28/1999
3/15/2000
10/1/2000
4/19/2001
11/5/2001
5/24/2002
Date
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-1
CTMW-5
CTMW-6
CTMW-8



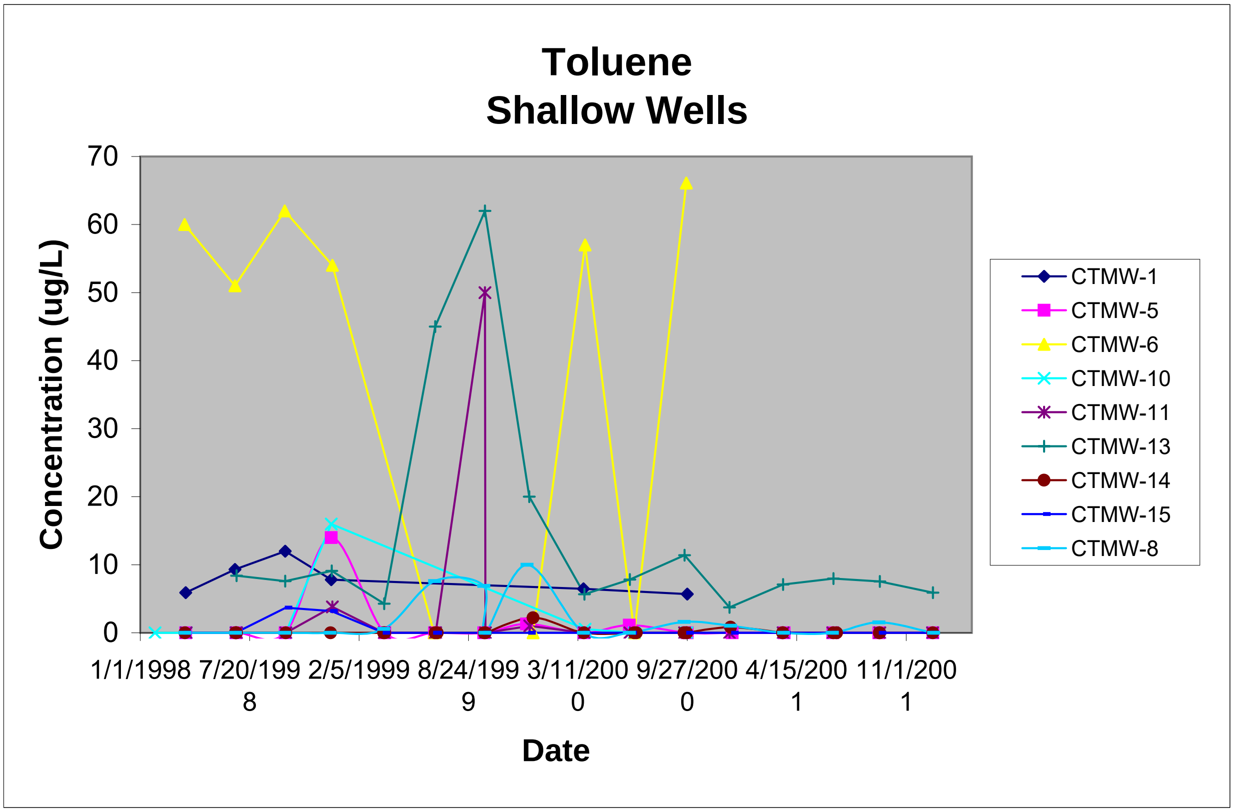
Styrene
Shallow Wells
Concentration (ug/L)
0
0.5
1
1.5
2
2.5
1/5/1998
7/24/1998
2/9/1999
8/28/1999
3/15/2000
10/1/2000
4/19/2001
11/5/2001
5/24/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

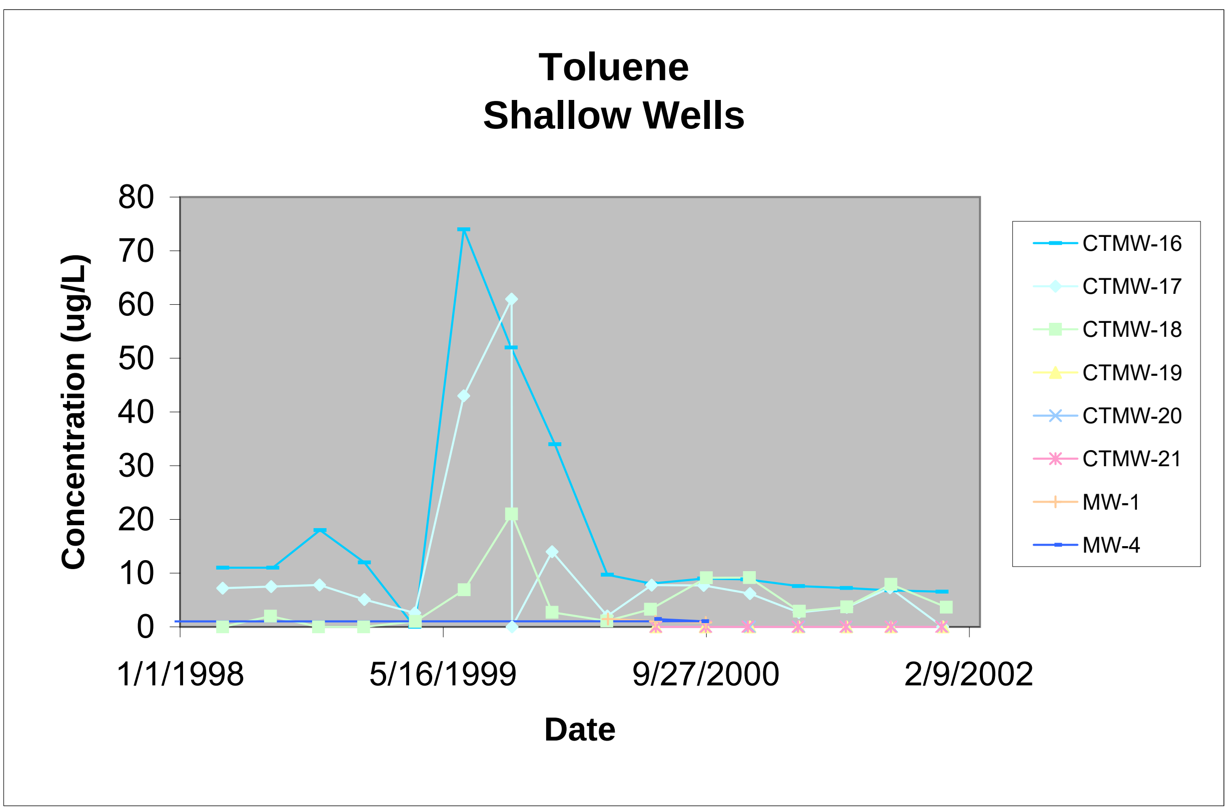


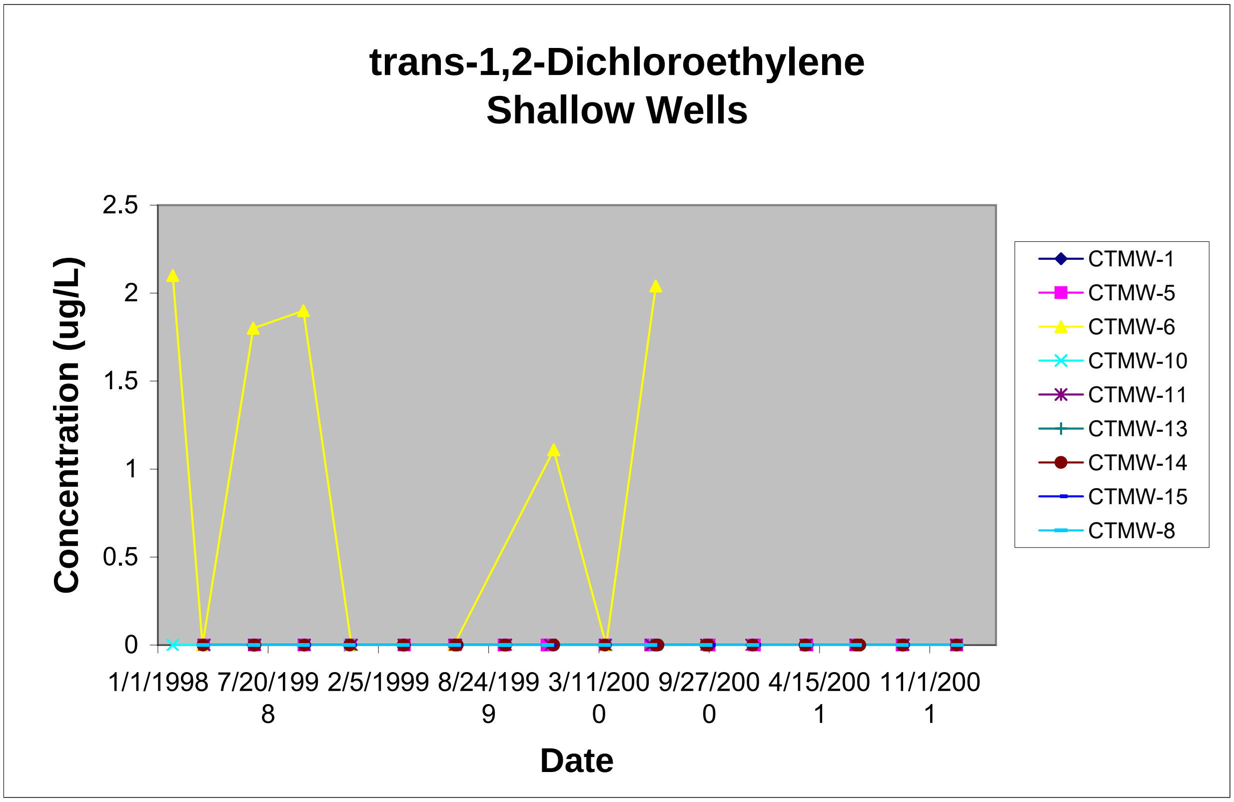
Trichloroethylene
Shallow Wells
Concentration (ug/L)
0
0.5
1
1.5
2
2.5
3
3.5
4
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8



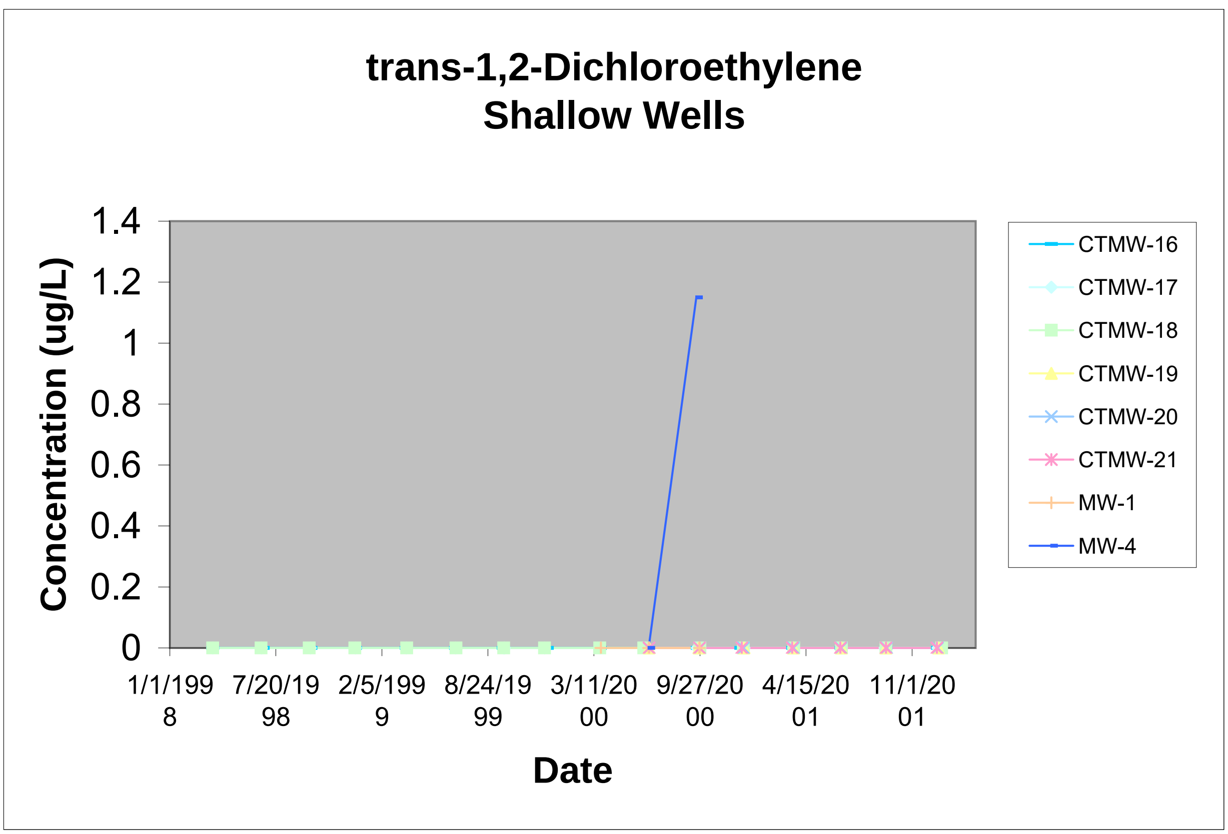
Trichloroethylene
Shallow Wells
Concentration (ug/L)
0
1
2
3
4
5
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


Toluene
Shallow Wells
Concentration (ug/L)
70
60
50
40
30
20
10
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

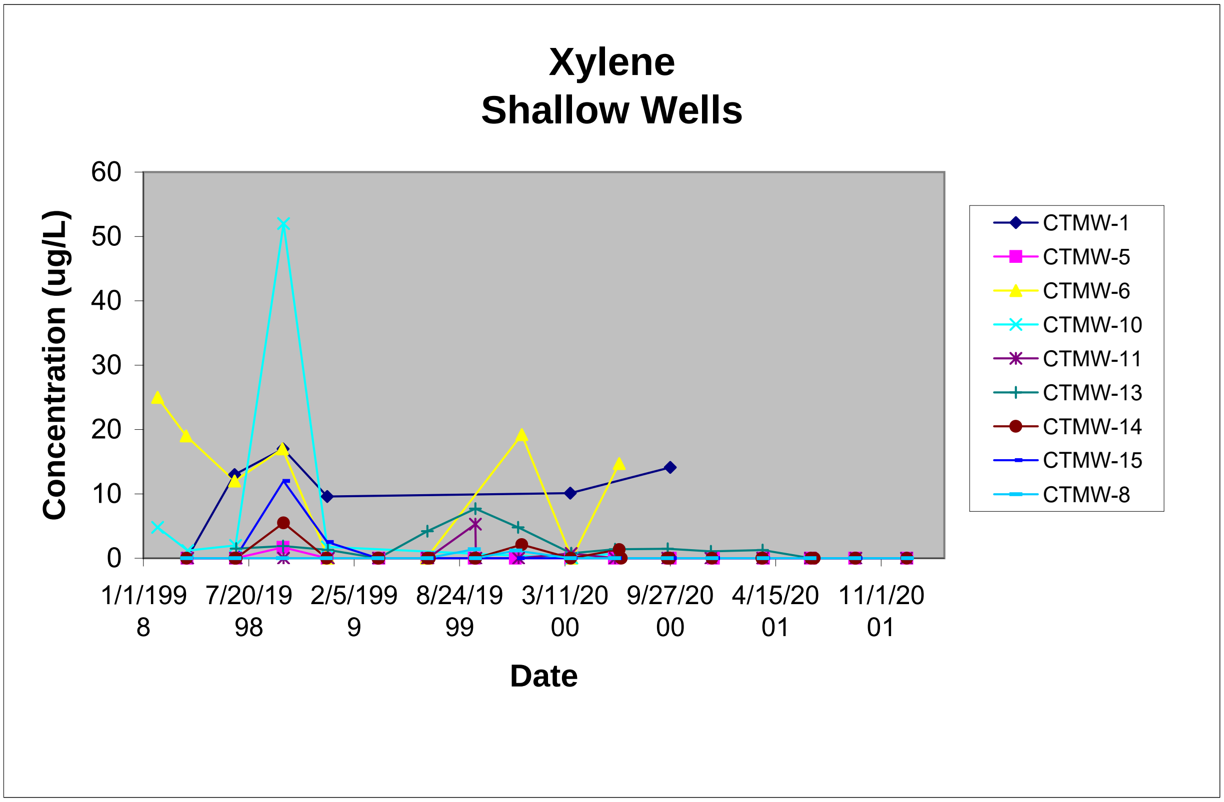

Toluene
Shallow Wells
Concentration (ug/L)
80
70
60
50
40
30
20
10
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

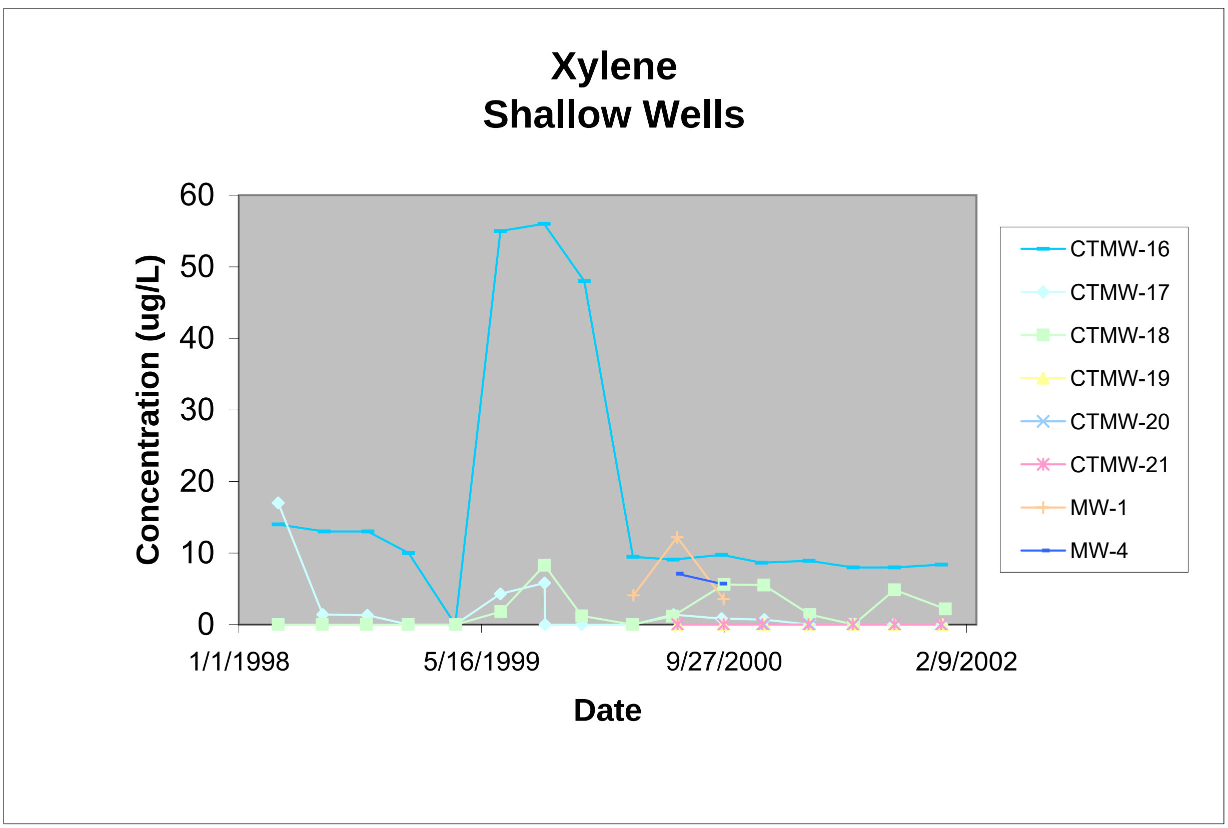


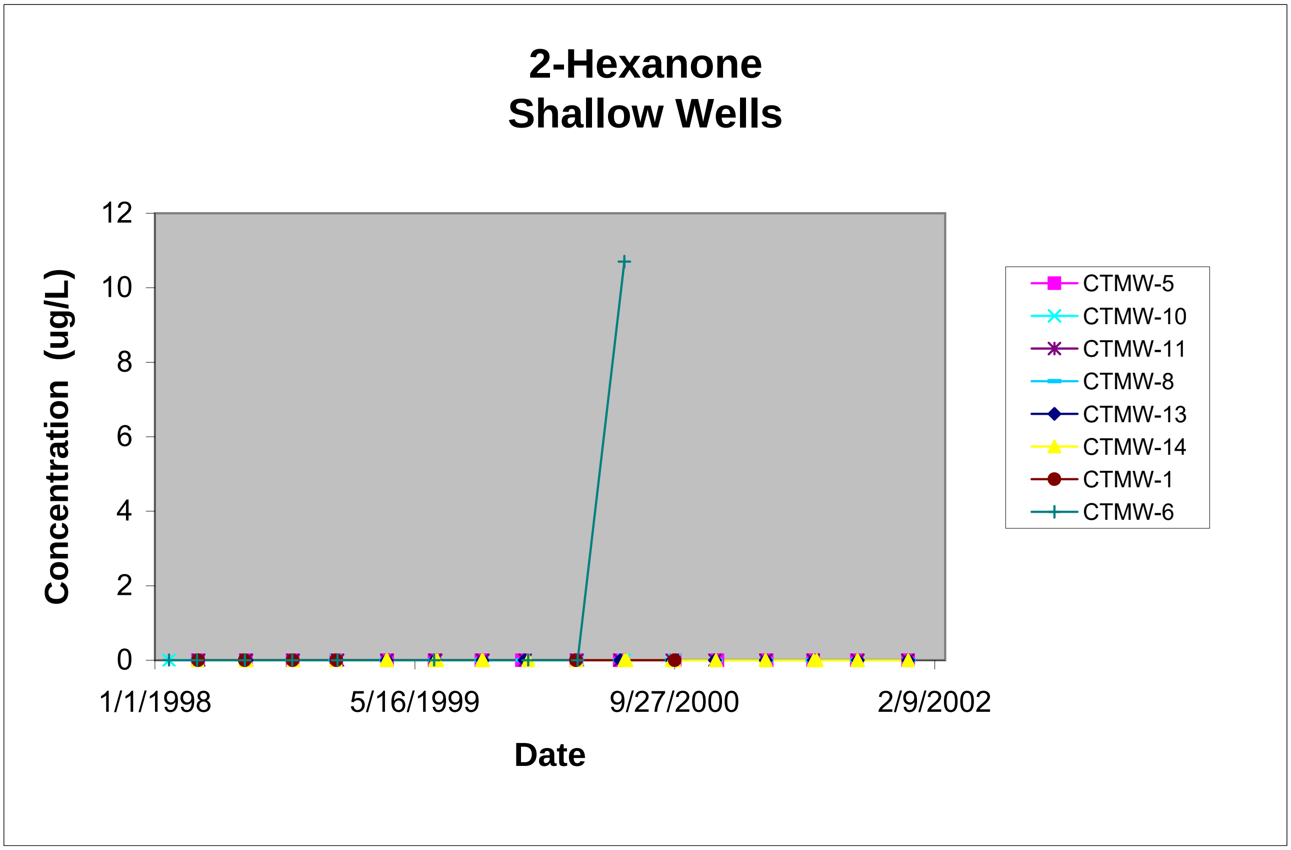
trans-1,2-Dichloroethylene
Shallow Wells
2.5
2
1.5
1
0.5
0
Concentration (ug/L)
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

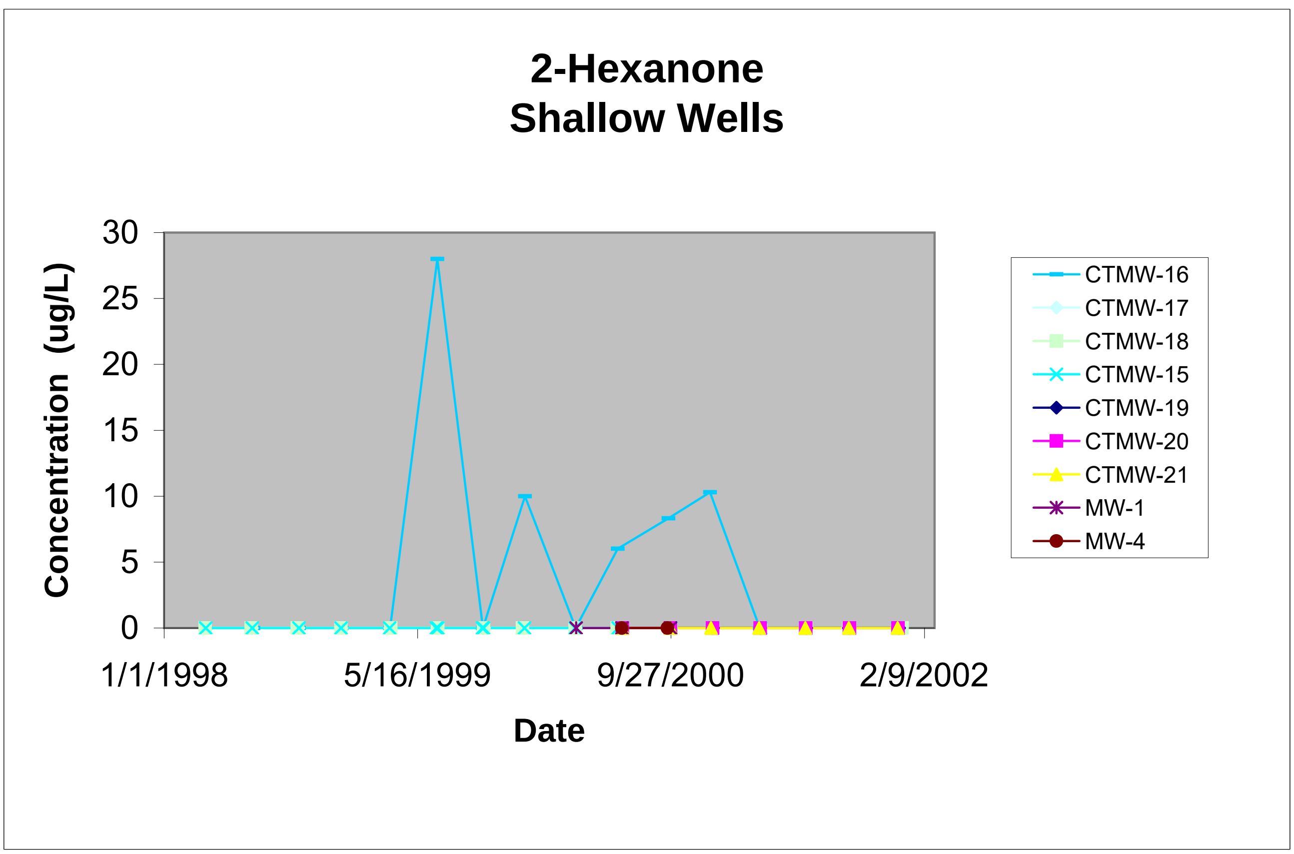


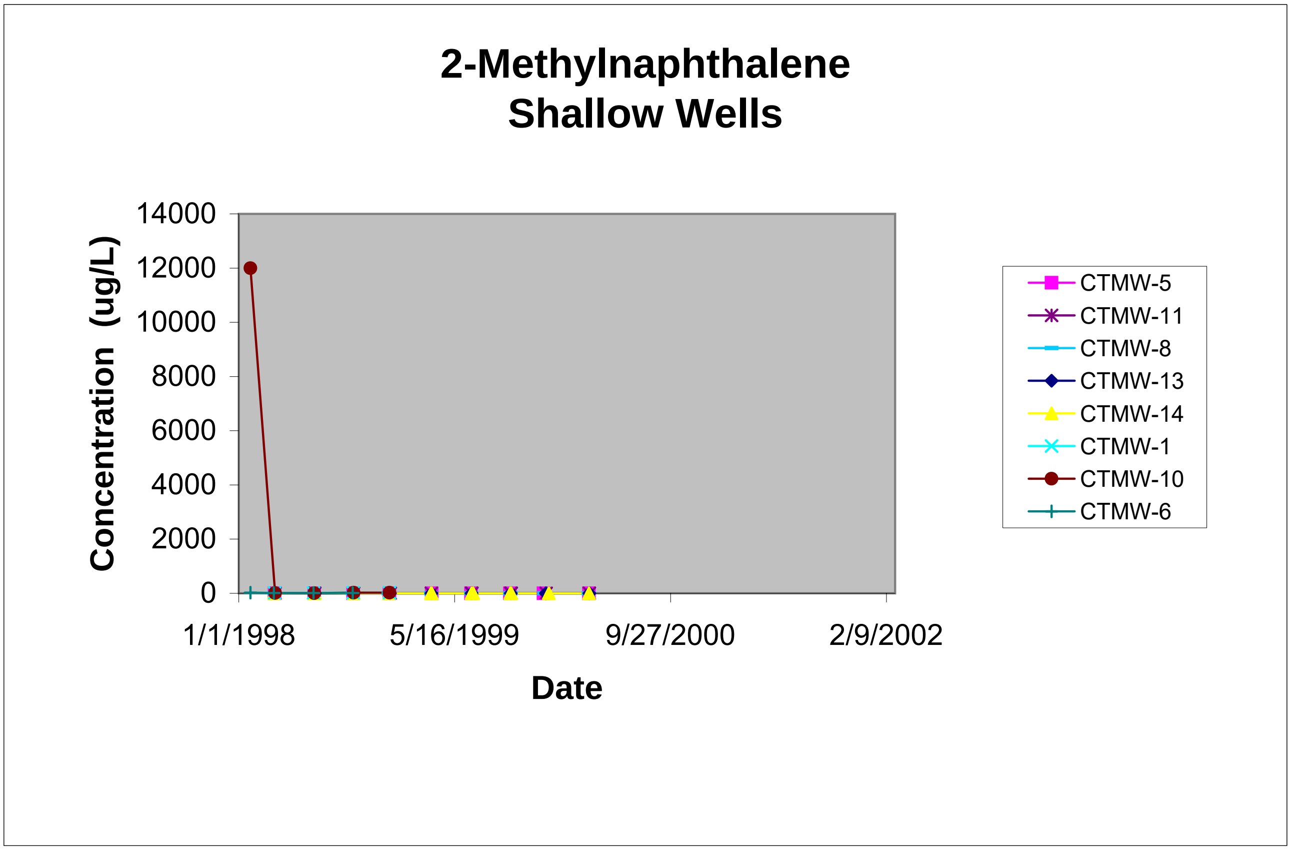
trans-1,2-Dichloroethylene
Shallow Wells
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Concentration (ug/L)
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

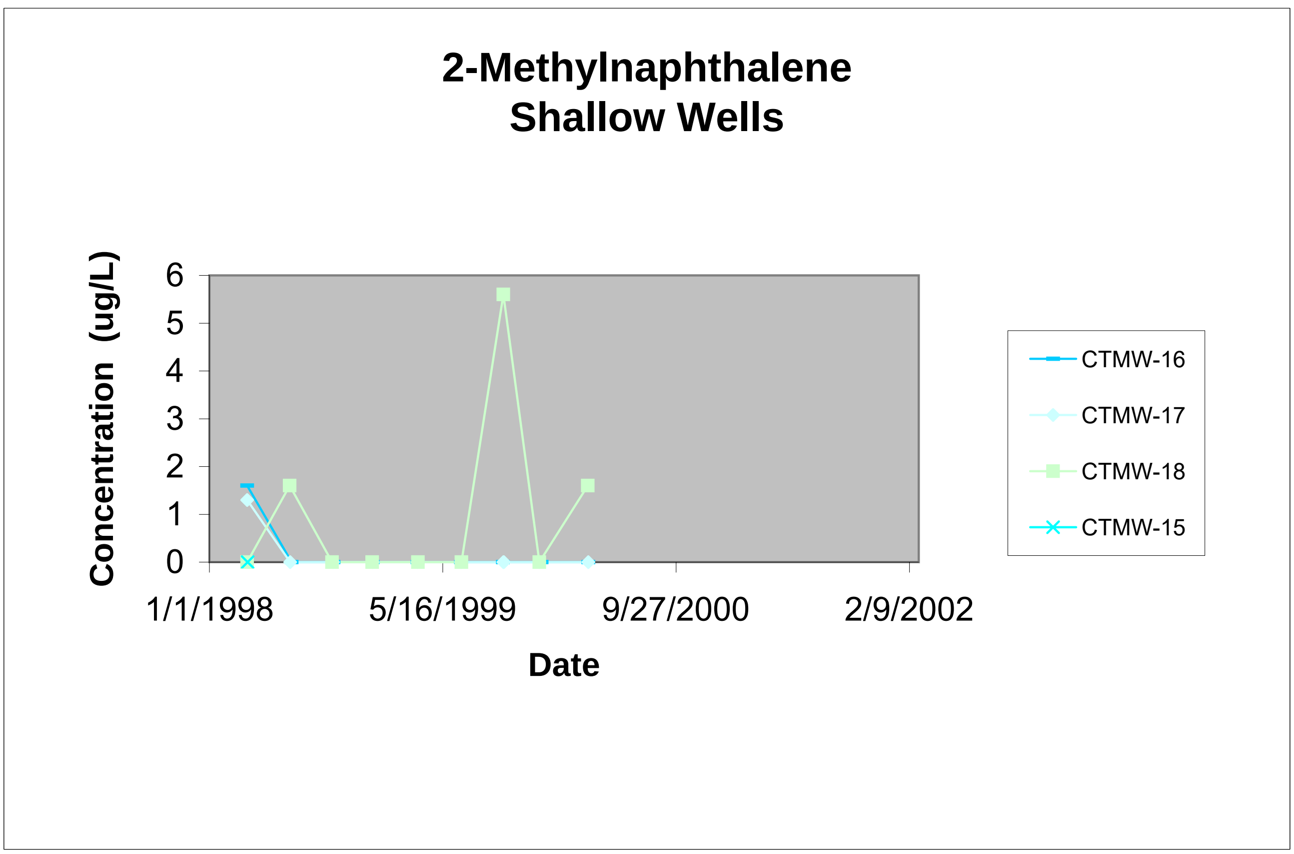

Xylene
Shallow Wells
Concentration (ug/L)
60
50
40
30
20
10
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

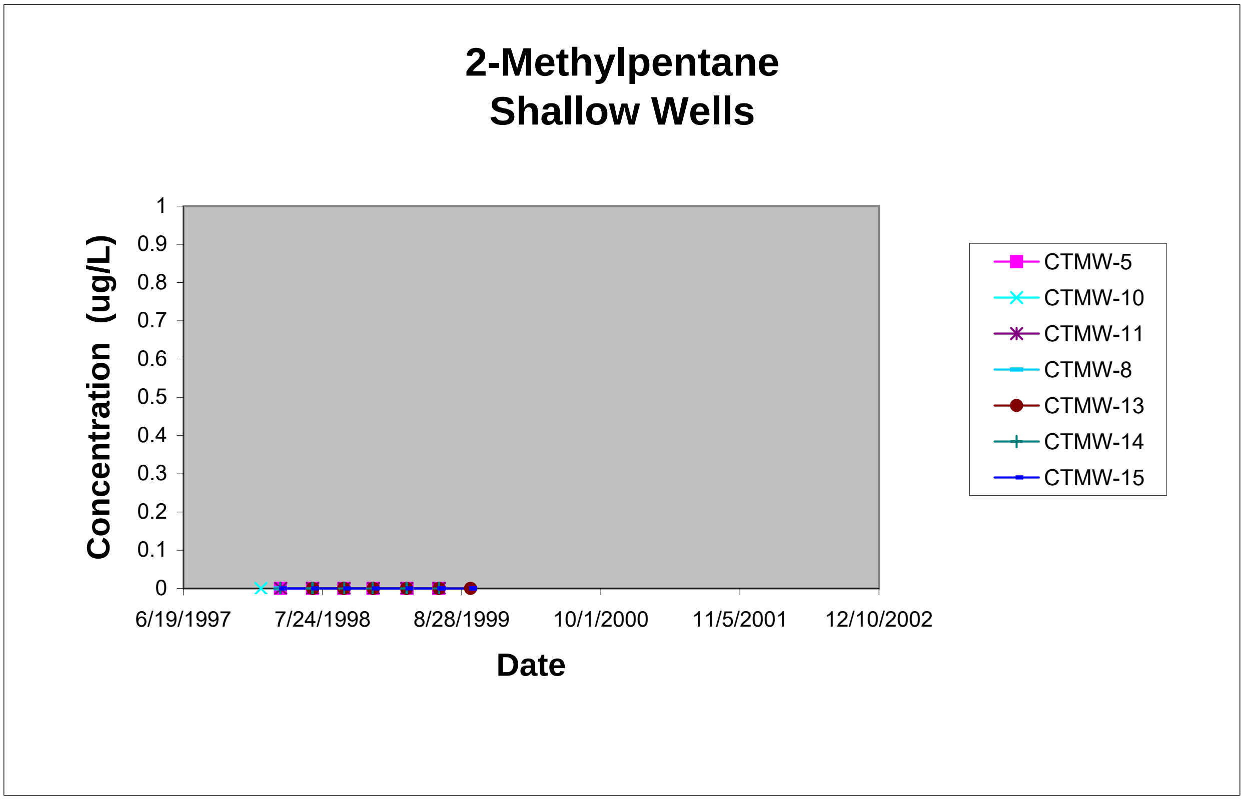

Xylene
Shallow Wells
Concentration (ug/L)
60
50
40
30
20
10
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


2-Hexanone
Shallow Wells
Concentration (ug/L)
12
10
8
6
4
2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-1
CTMW-6

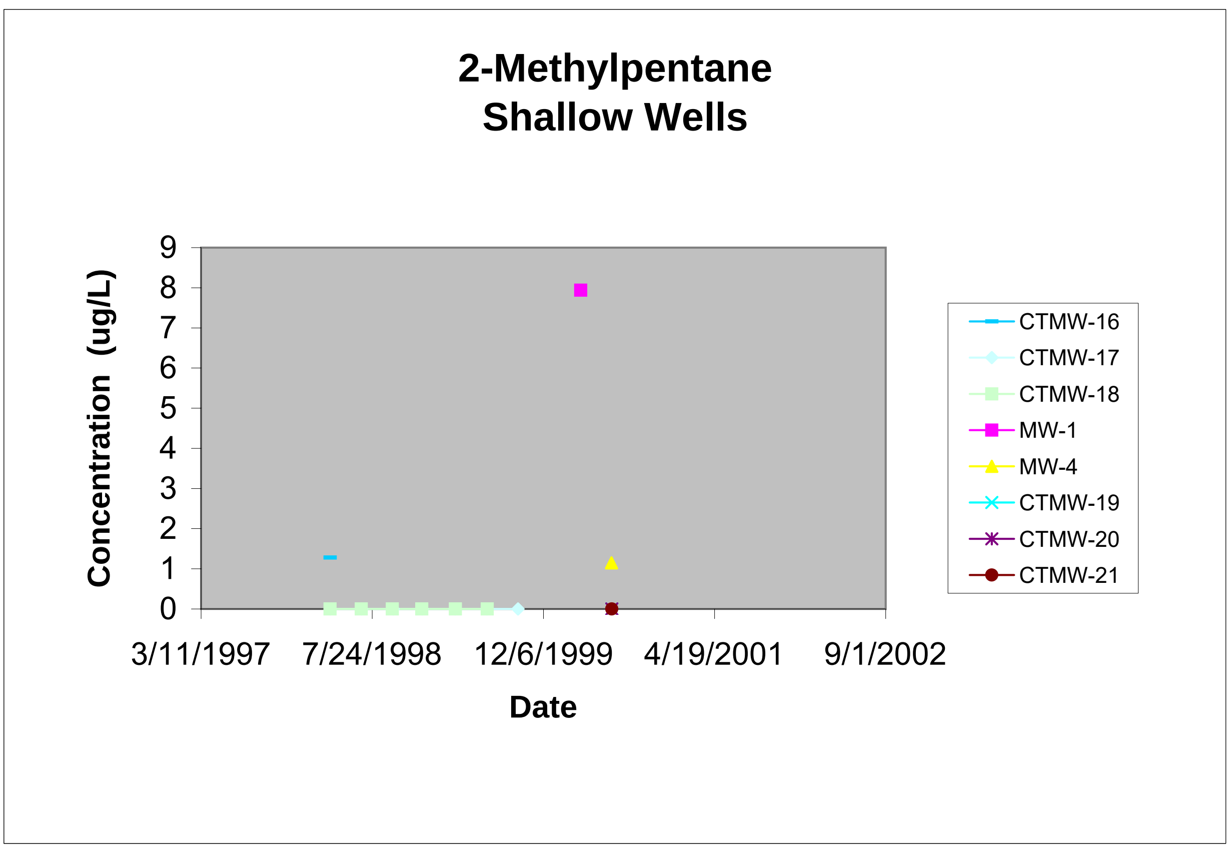

2-Hexanone
Shallow Wells
Concentration (ug/L)
30
25
20
15
10
5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


2-Methylnaphthalene
Shallow Wells
Concentration (ug/L)
14000
12000
10000
8000
6000
4000
2000
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-5
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-1
CTMW-10
CTMW-6

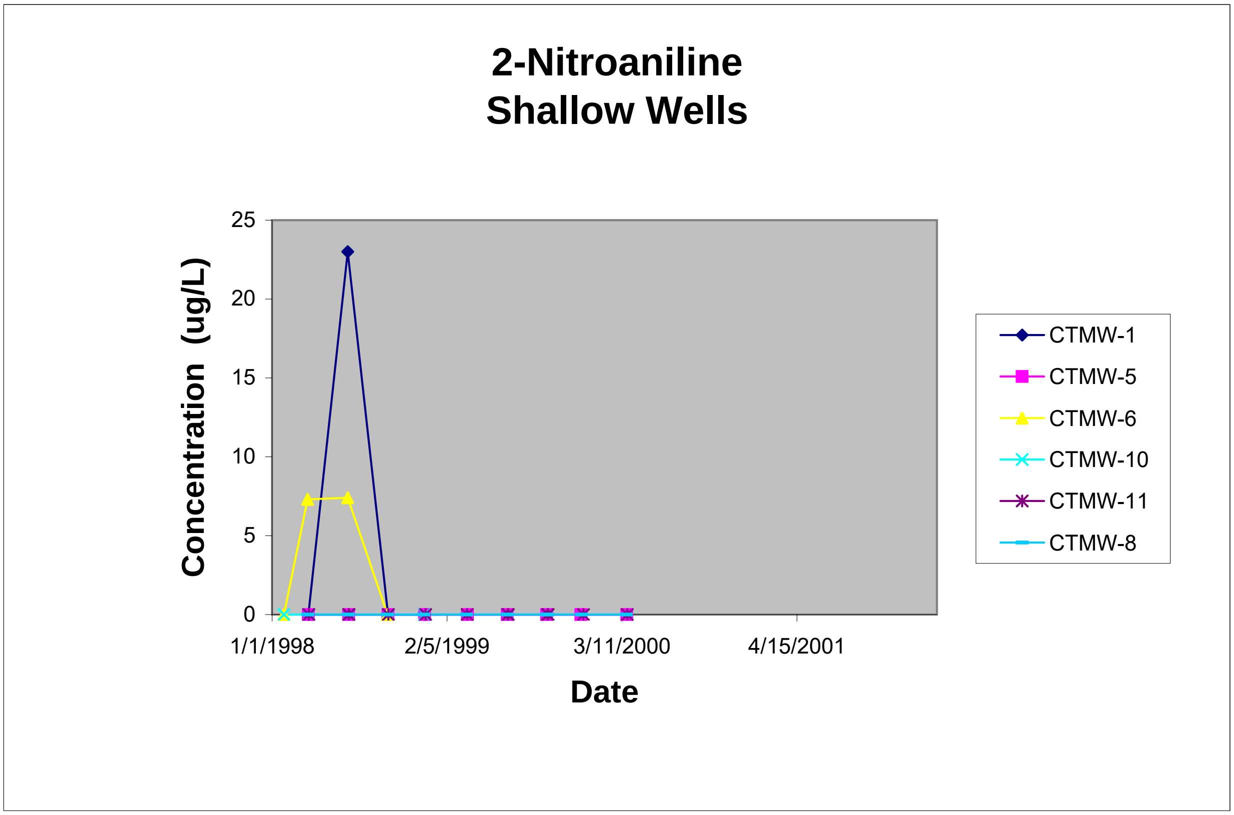

2-Methylnaphthalene
Shallow Wells
Concentration (ug/L)
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15

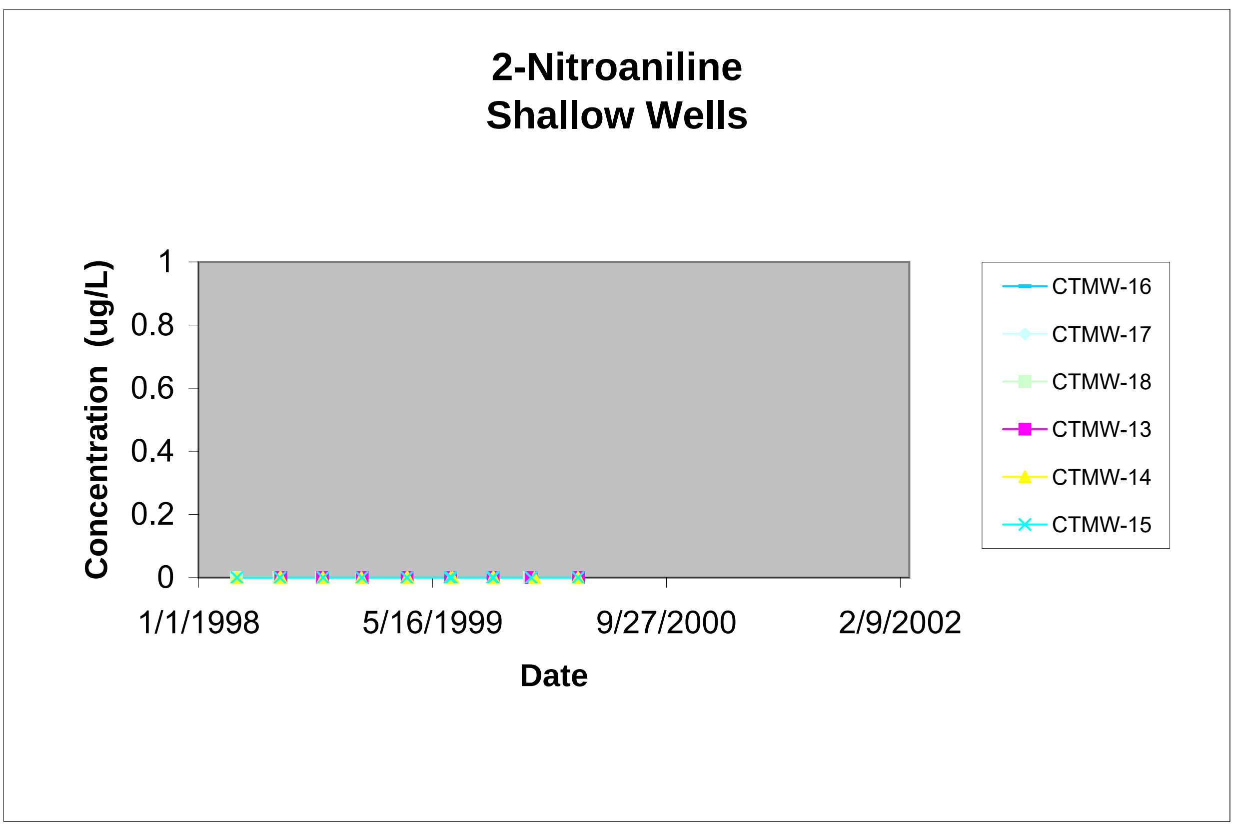


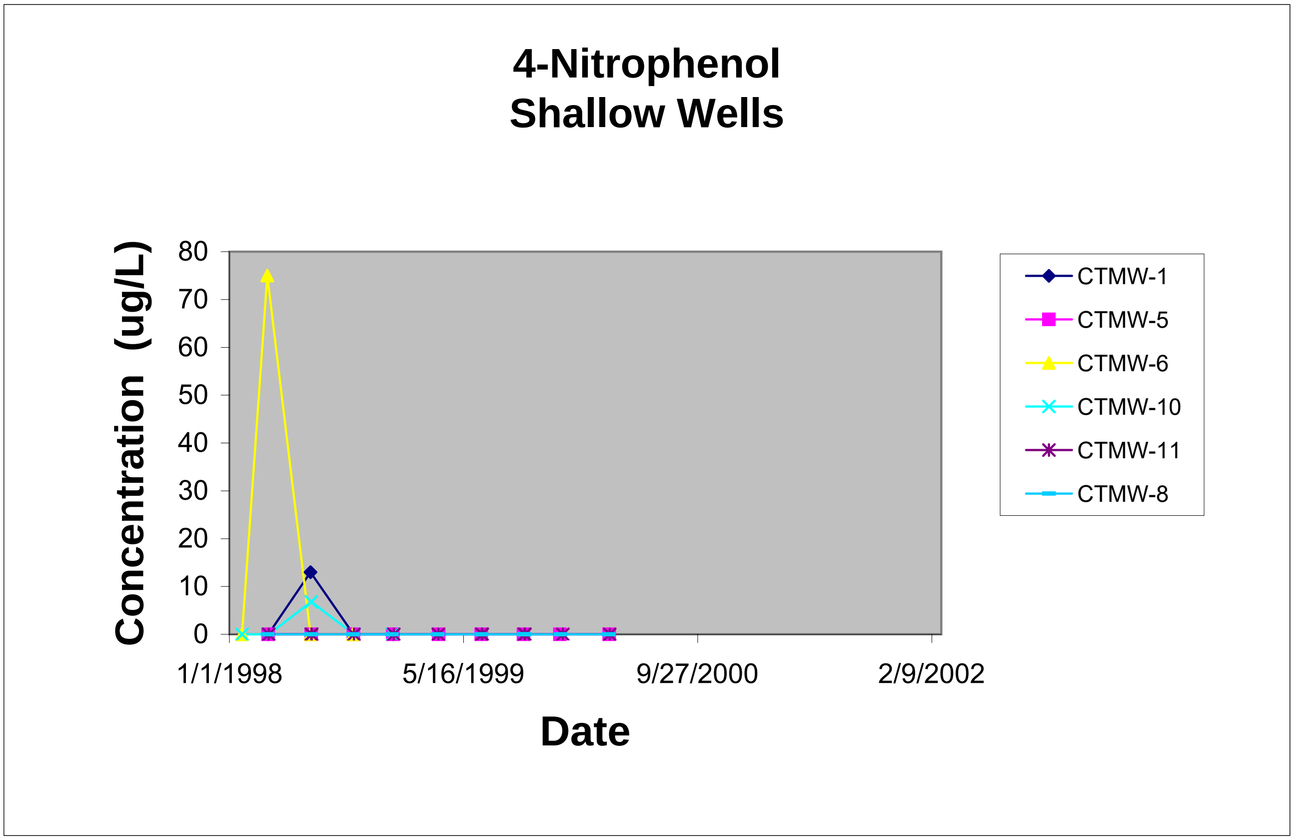
2-Methylpentane
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/19/1997
7/24/1998
8/28/1999
10/1/2000
11/5/2001
12/10/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-15

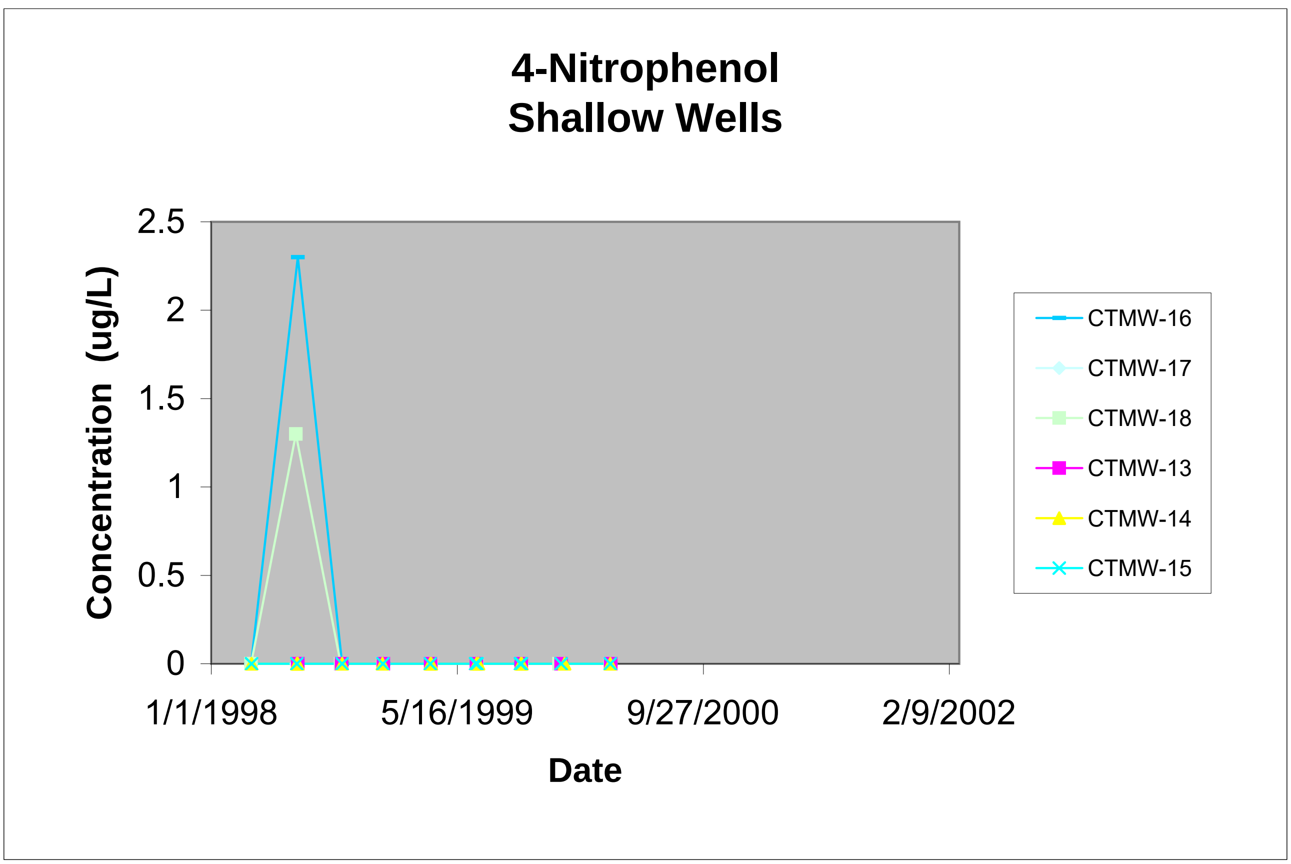


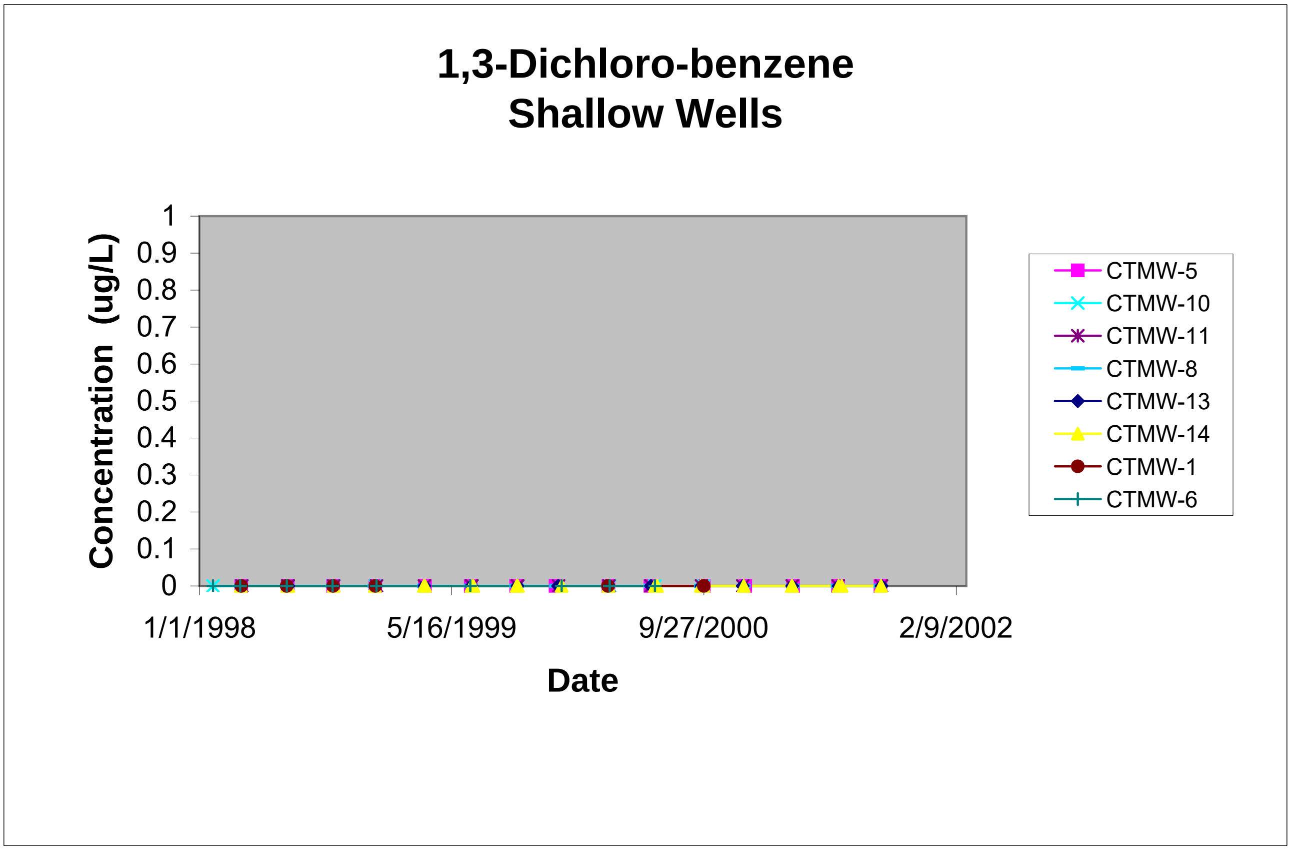
2-Methylpentane
Shallow Wells
Concentration (ug/L)
9
8
7
6
5
4
3
2
1
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
MW-1
MW-4
CTMW-19
CTMW-20
CTMW-21

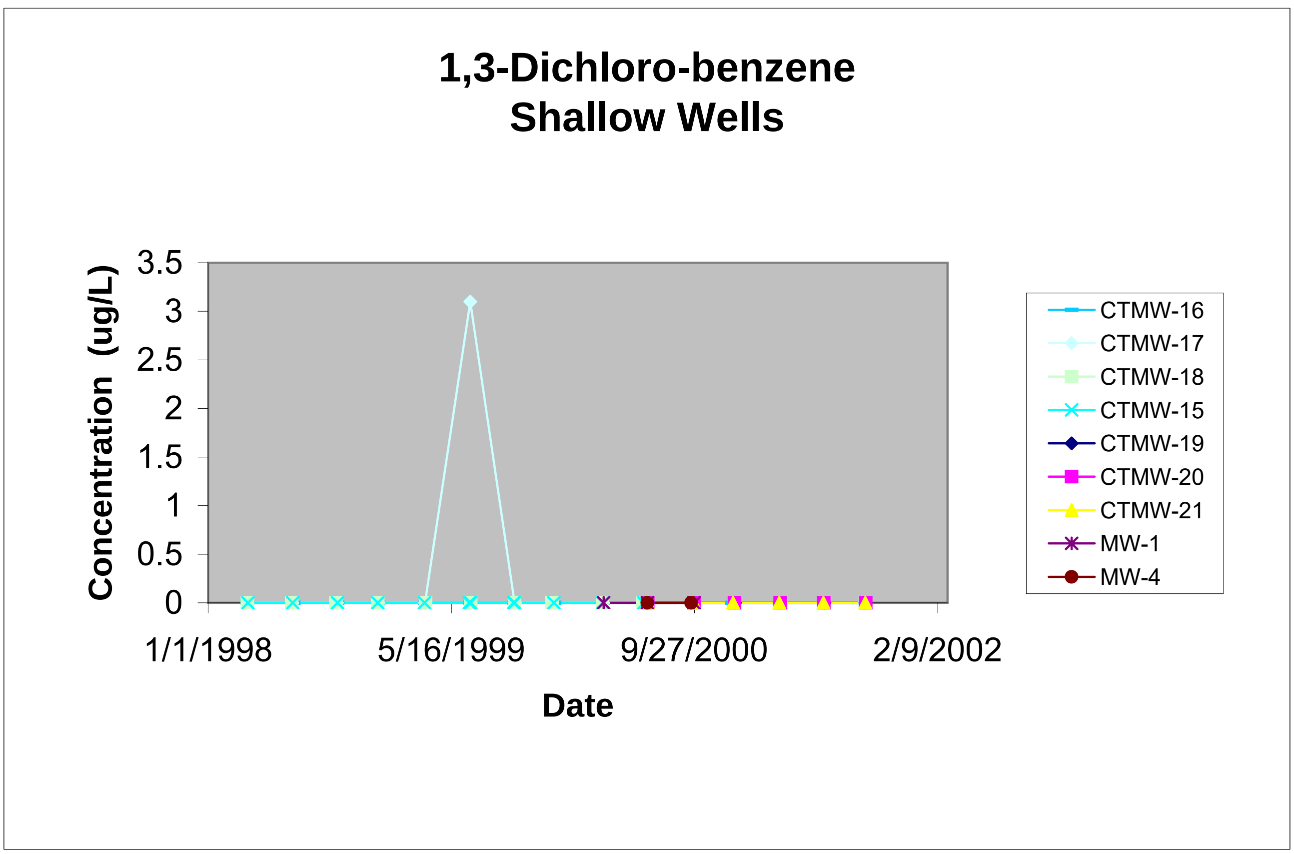

2-Nitroaniline
Shallow Wells
Concentration (ug/L)
25
20
15
10
5
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

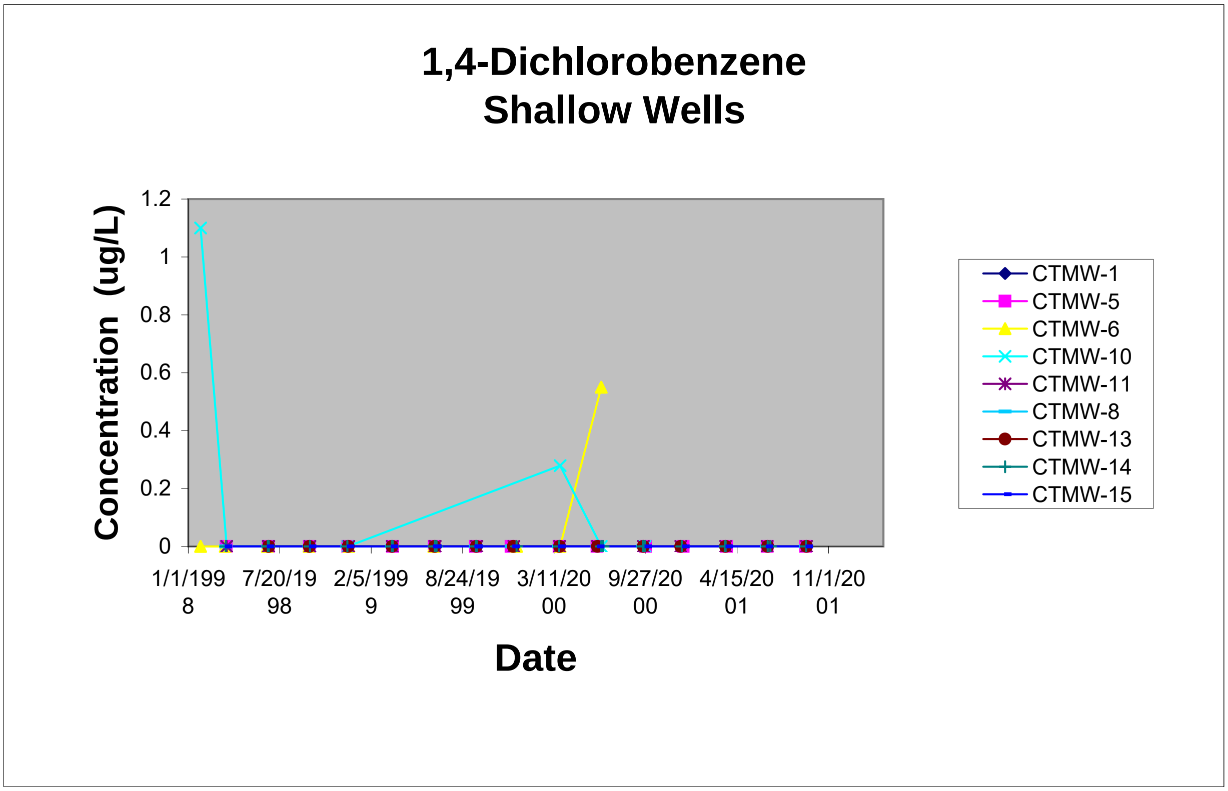

2-Nitroaniline
Shallow Wells
Concentration (ug/L)
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

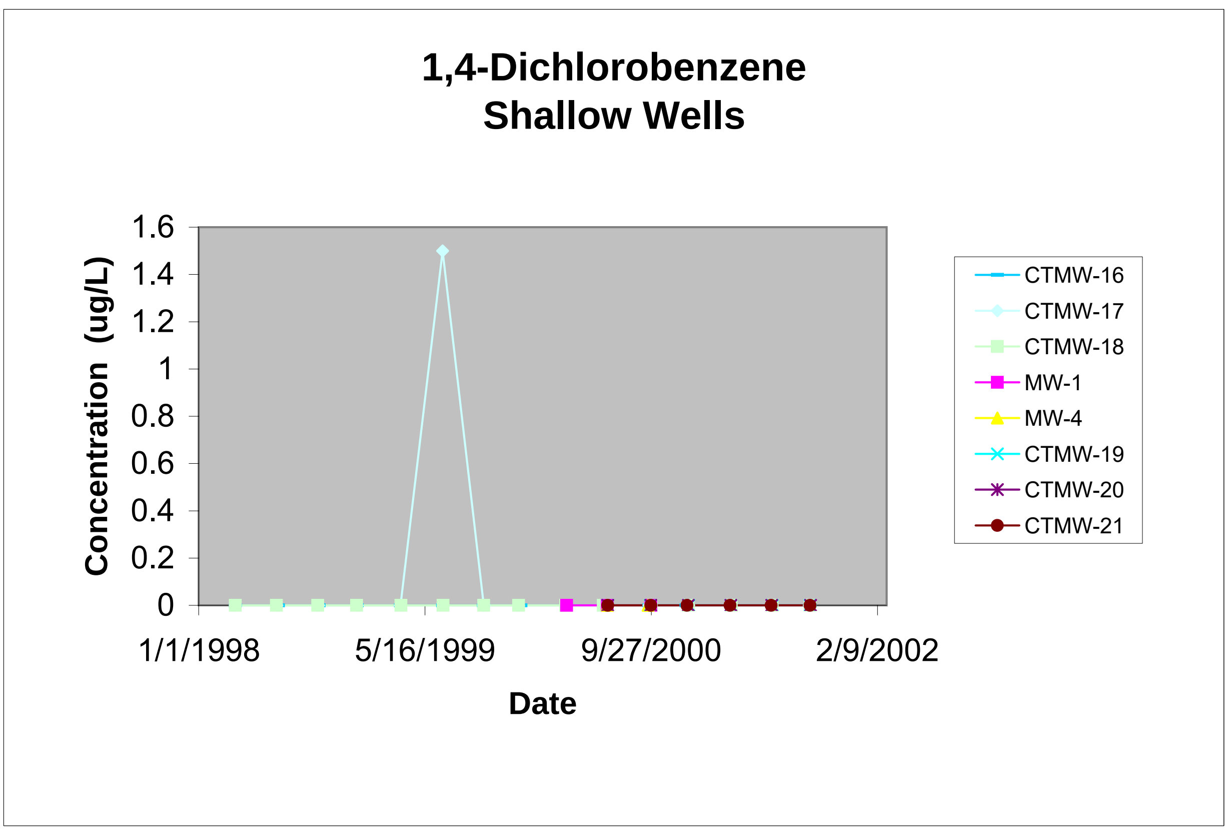

4-Nitrophenol
Shallow Wells
Concentration (ug/L)
80
70
60
50
40
30
20
10
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

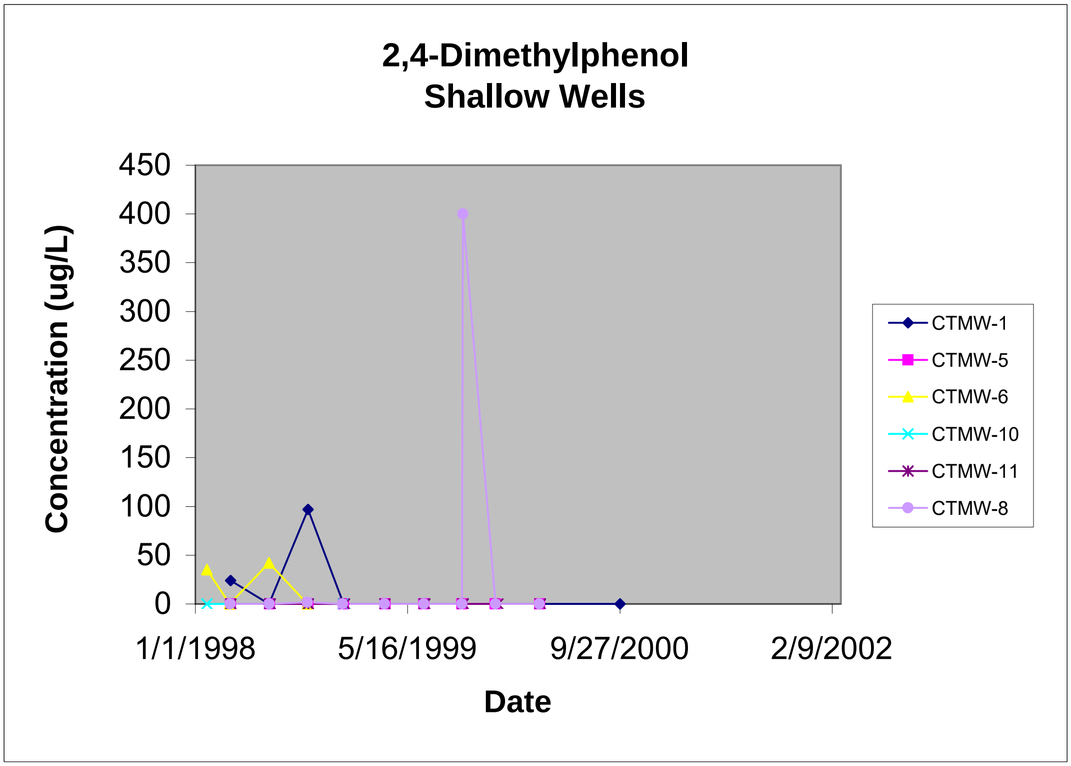

4-Nitrophenol
Shallow Wells
Concentration (ug/L)
2.5
2
1.5
1
0.5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


1,3-Dichloro-benzene
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-1
CTMW-6

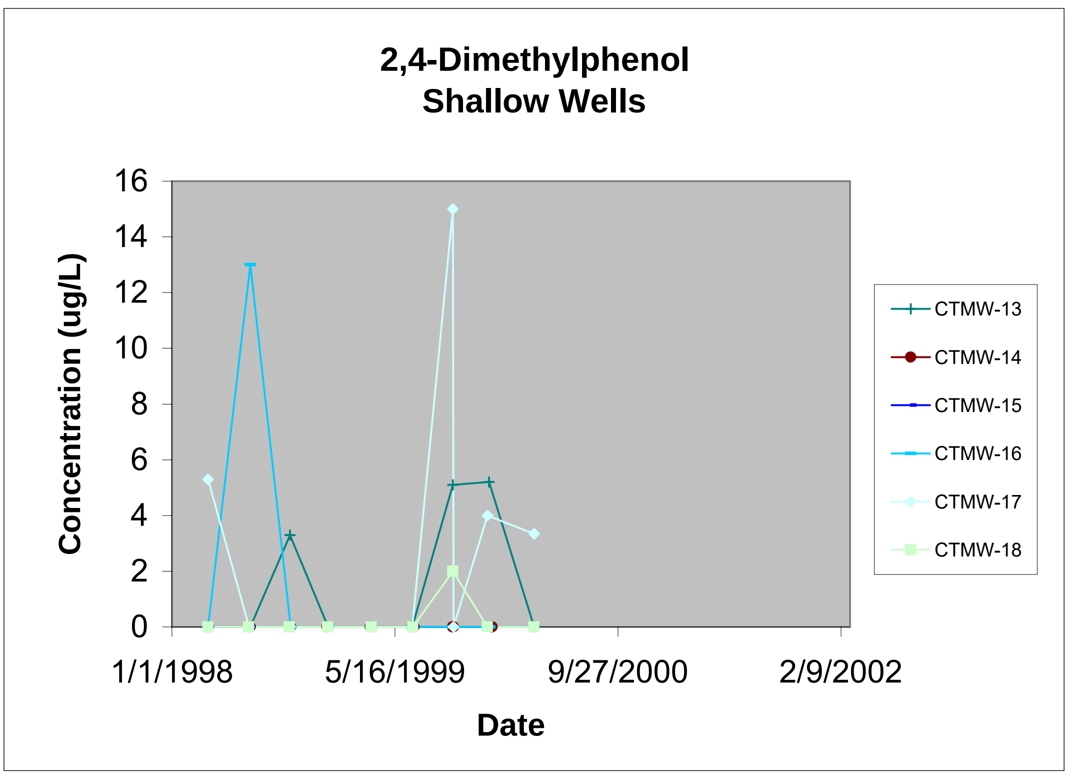

1,3-Dichloro-benzene
Shallow Wells
Concentration (ug/L)
3.5
3
2.5
2
1.5
1
0.5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


1,4-Dichlorobenzene
Shallow Wells
Concentration (ug/L)
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-15

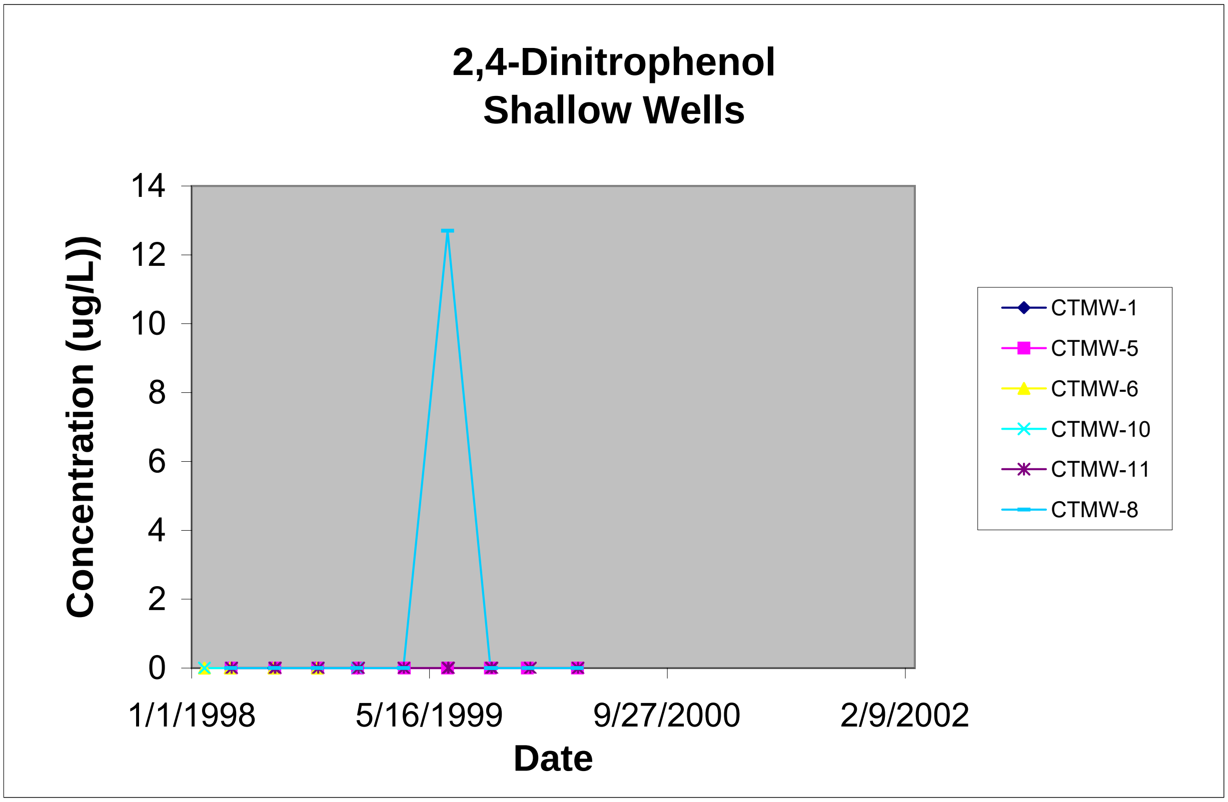

1,4-Dichlorobenzene
Shallow Wells
Concentration (ug/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
MW-1
MW-4
CTMW-19
CTMW-20
CTMW-21

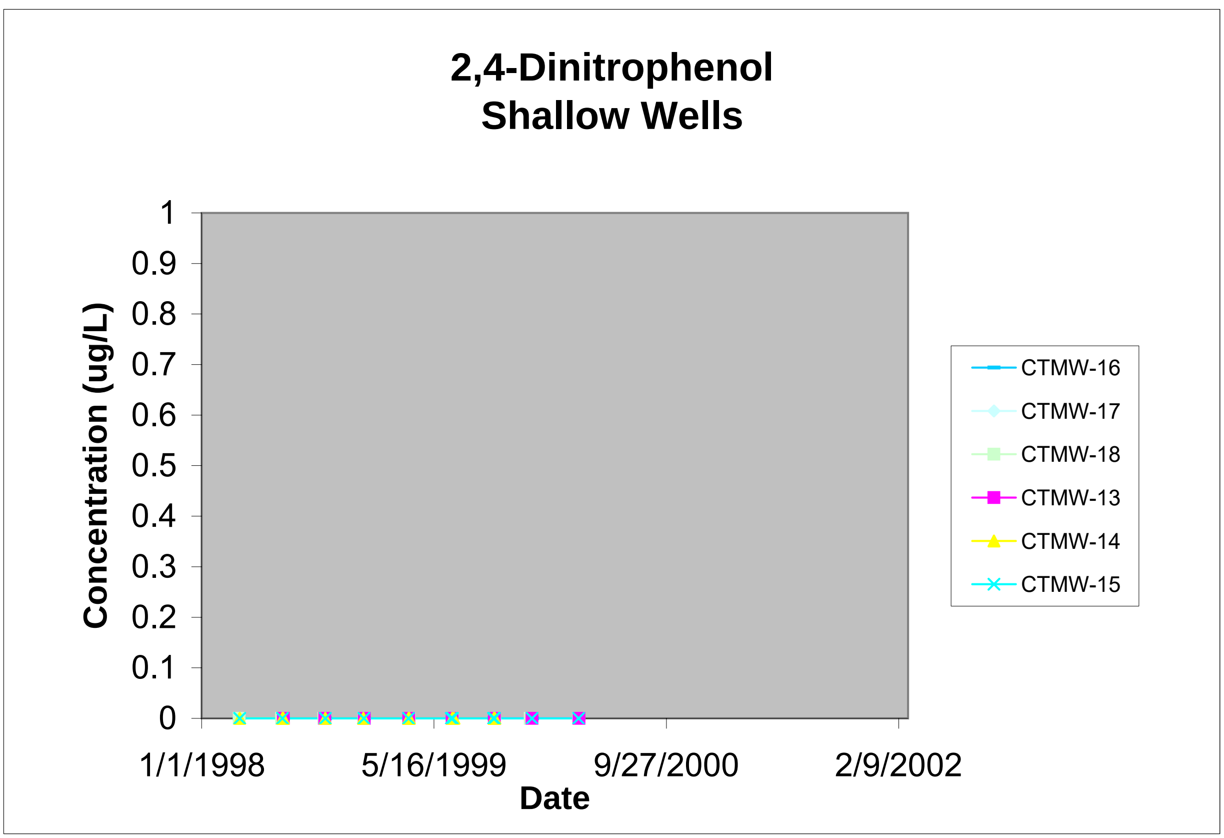


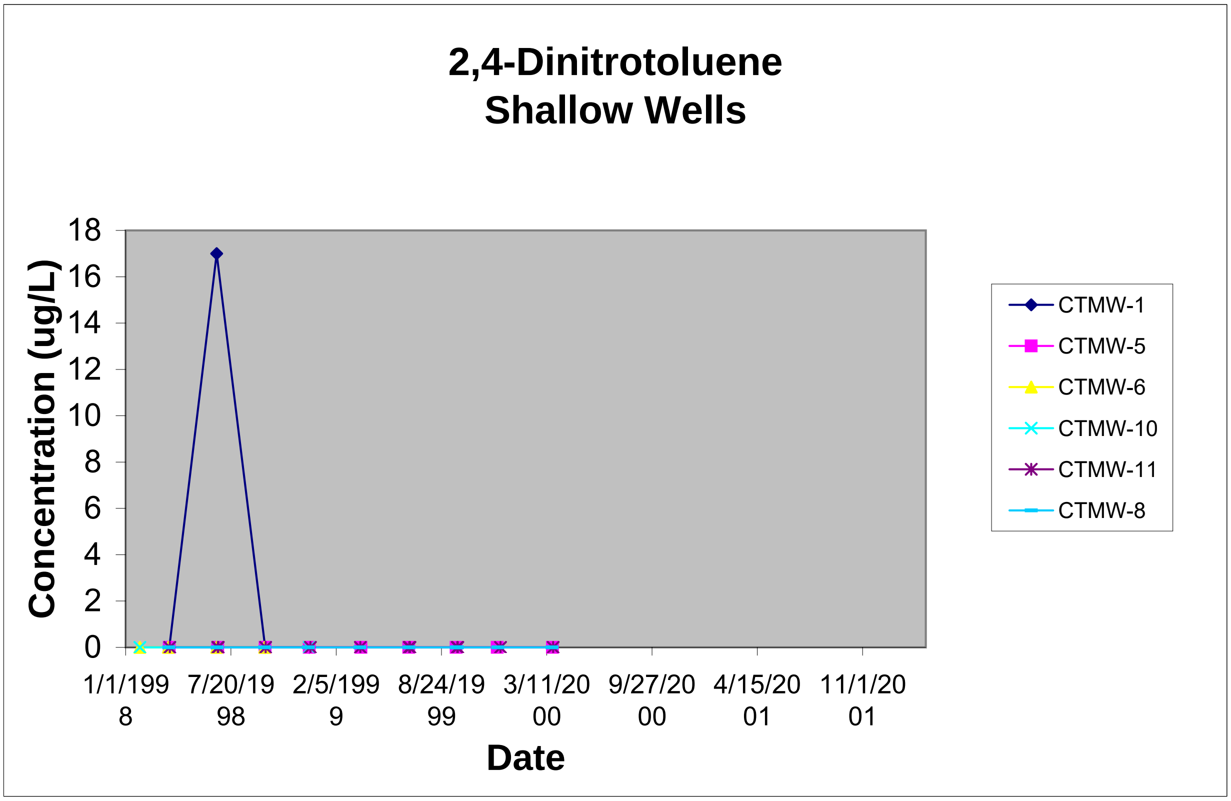
2,4-Dimethylphenol
Shallow Wells
Concentration (ug/L)
450
400
350
300
250
200
150
100
50
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

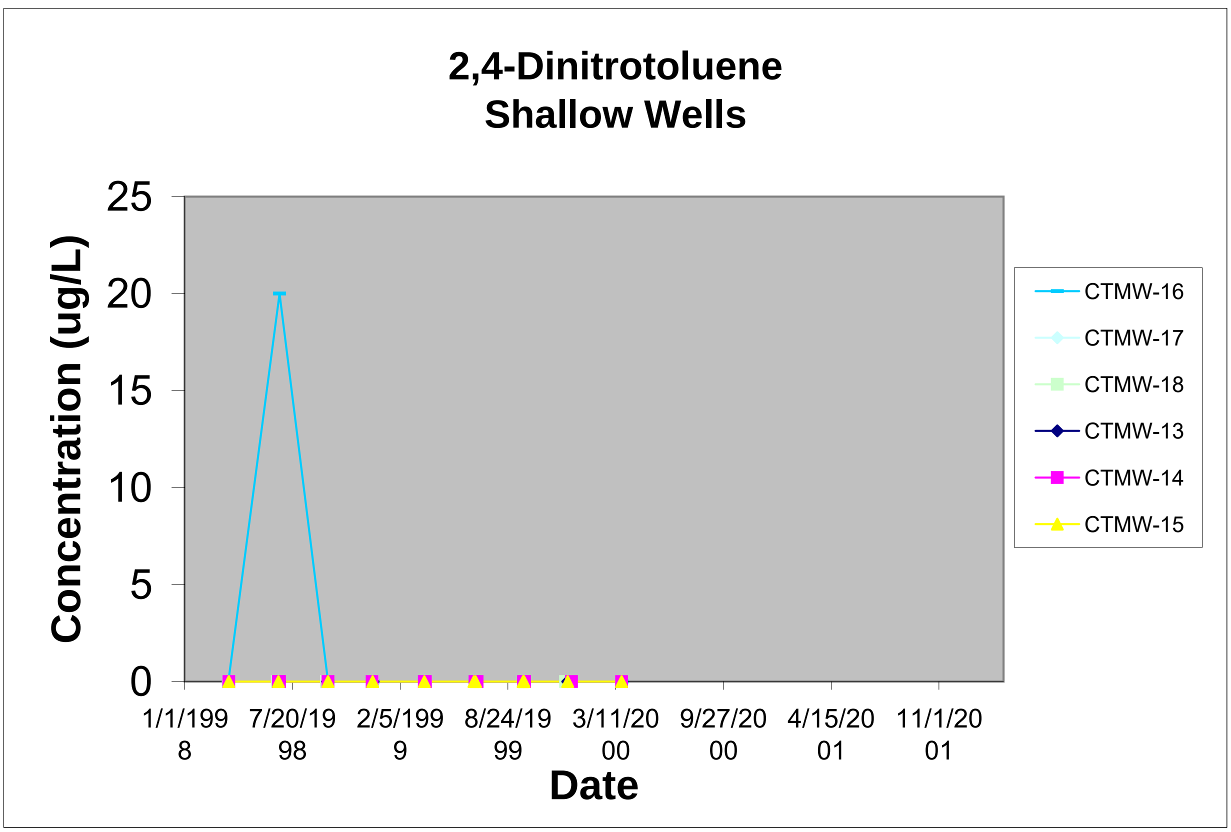


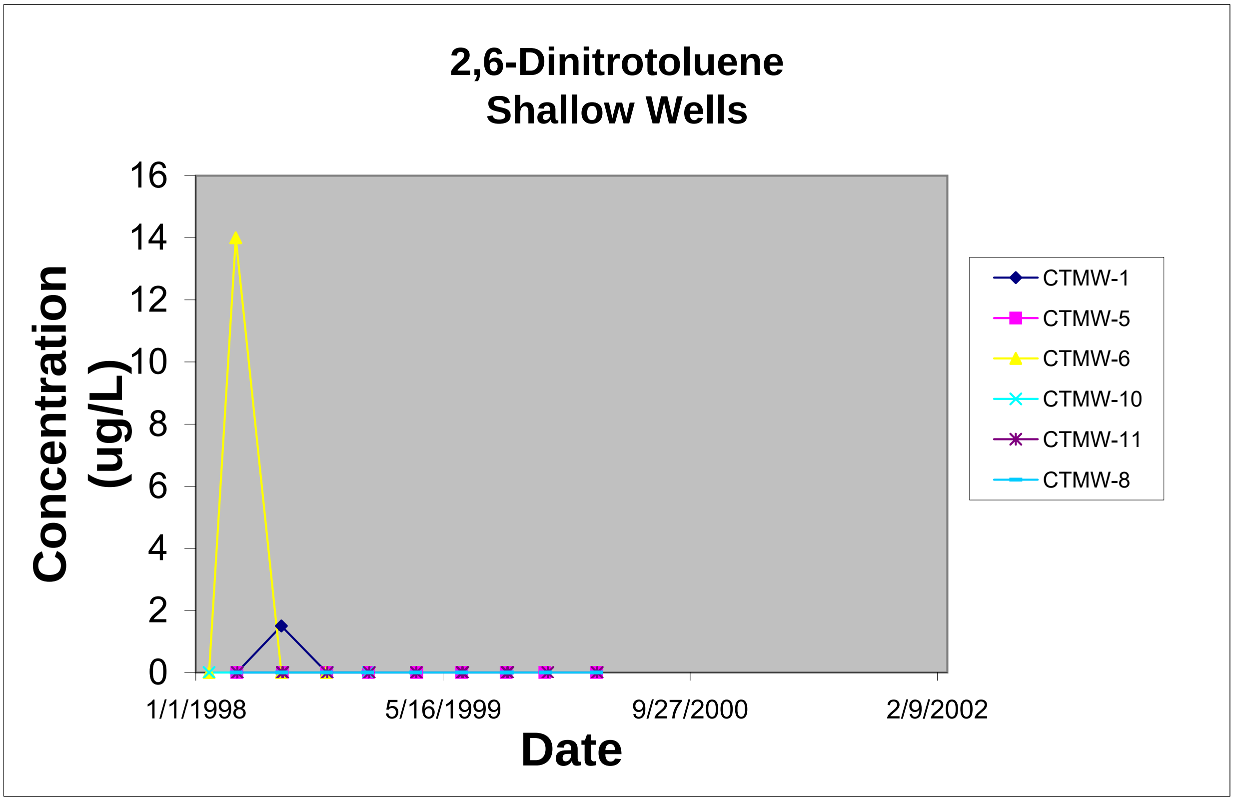
2,4-Dimethylphenol
Shallow Wells
Concentration (ug/L)
16
14
12
10
8
6
4
2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-13
CTMW-14
CTMW-15
CTMW-16
CTMW-17
CTMW-18


2,4-Dinitrophenol
Shallow Wells
Concentration (ug/L))
0
2
4
6
8
10
12
14
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

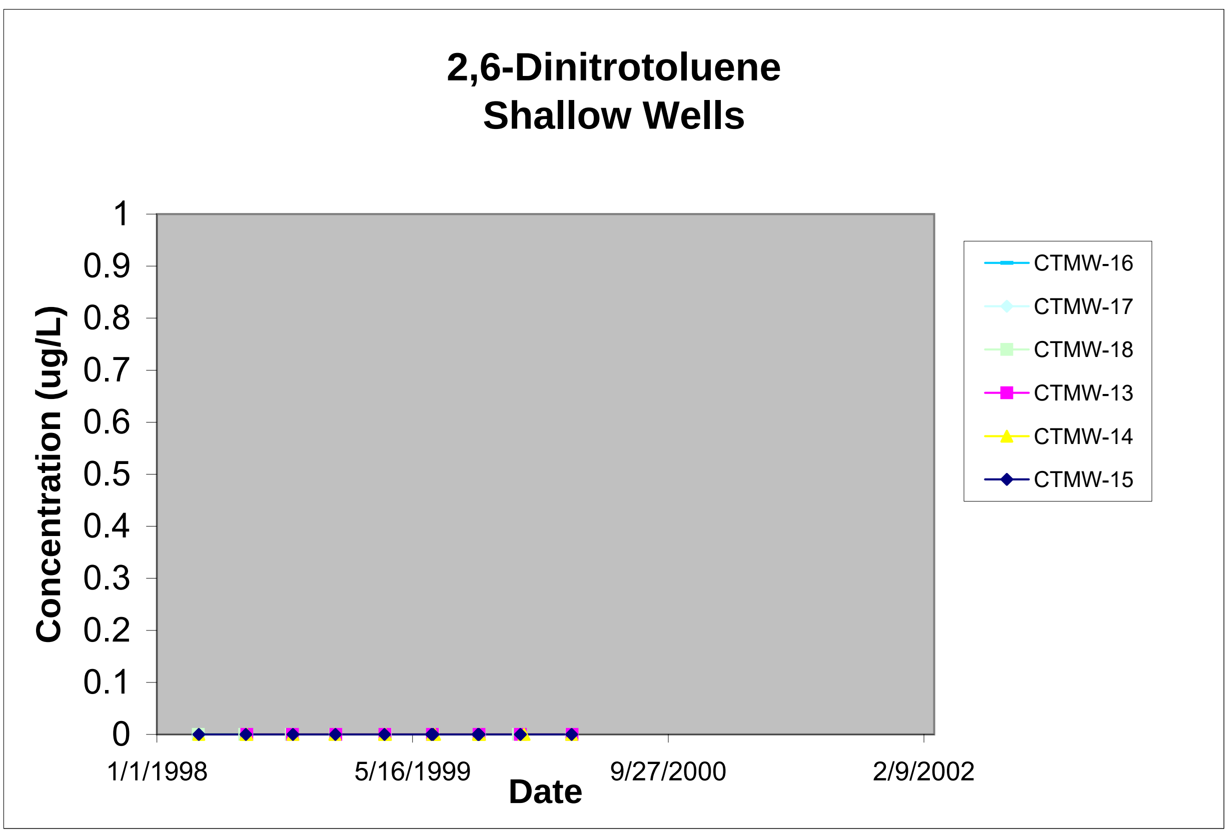

2,4-Dinitrophenol
Shallow Wells
Concentration (ug/L)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


2,4-Dinitrotoluene
Shallow Wells
Concentration (ug/L)
18
16
14
12
10
8
6
4
2
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

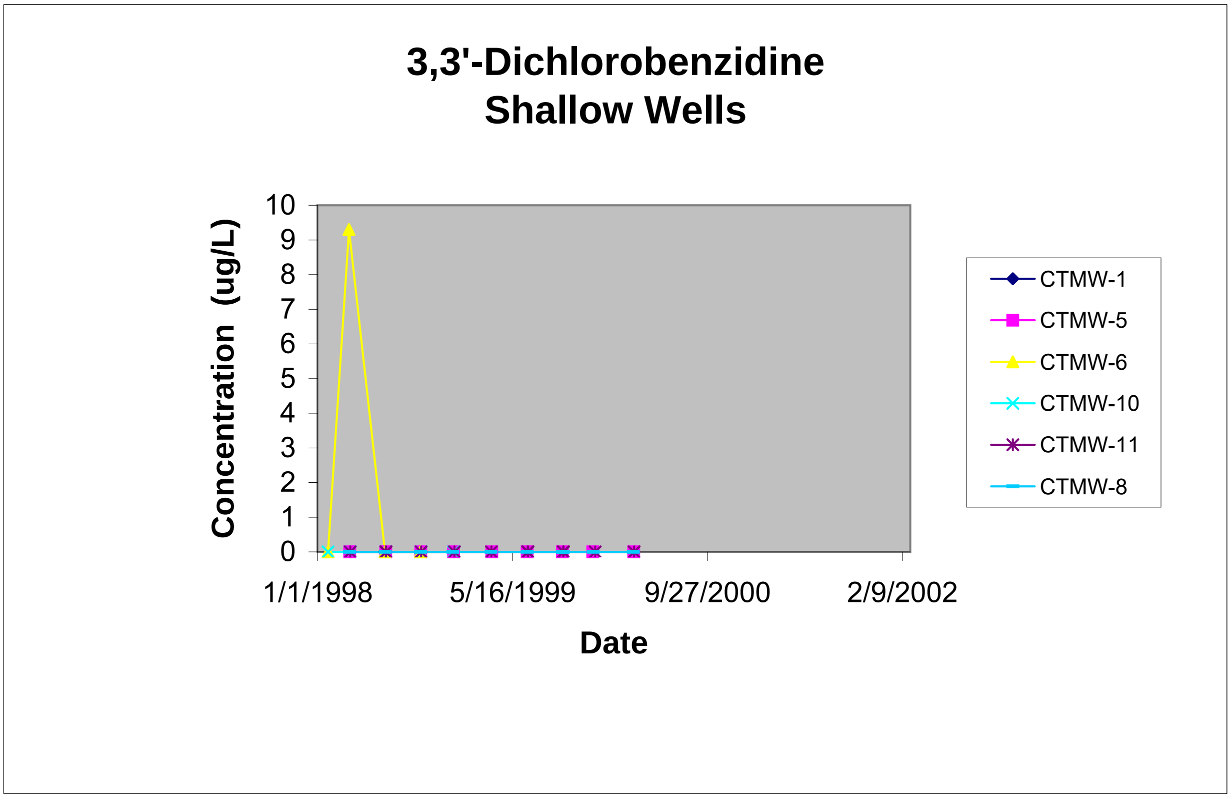

2,4-Dinitrotoluene
Shallow Wells
Concentration (ug/L)
25
20
15
10
5
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

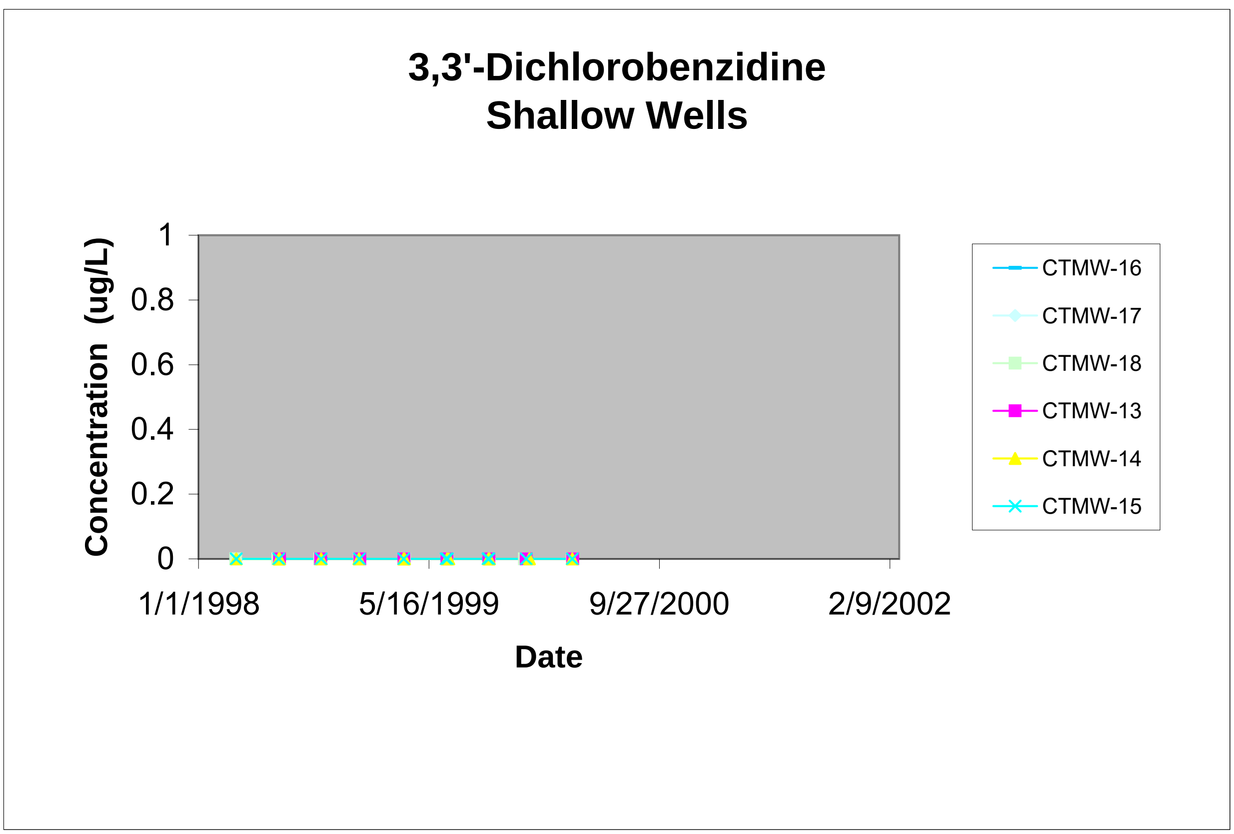


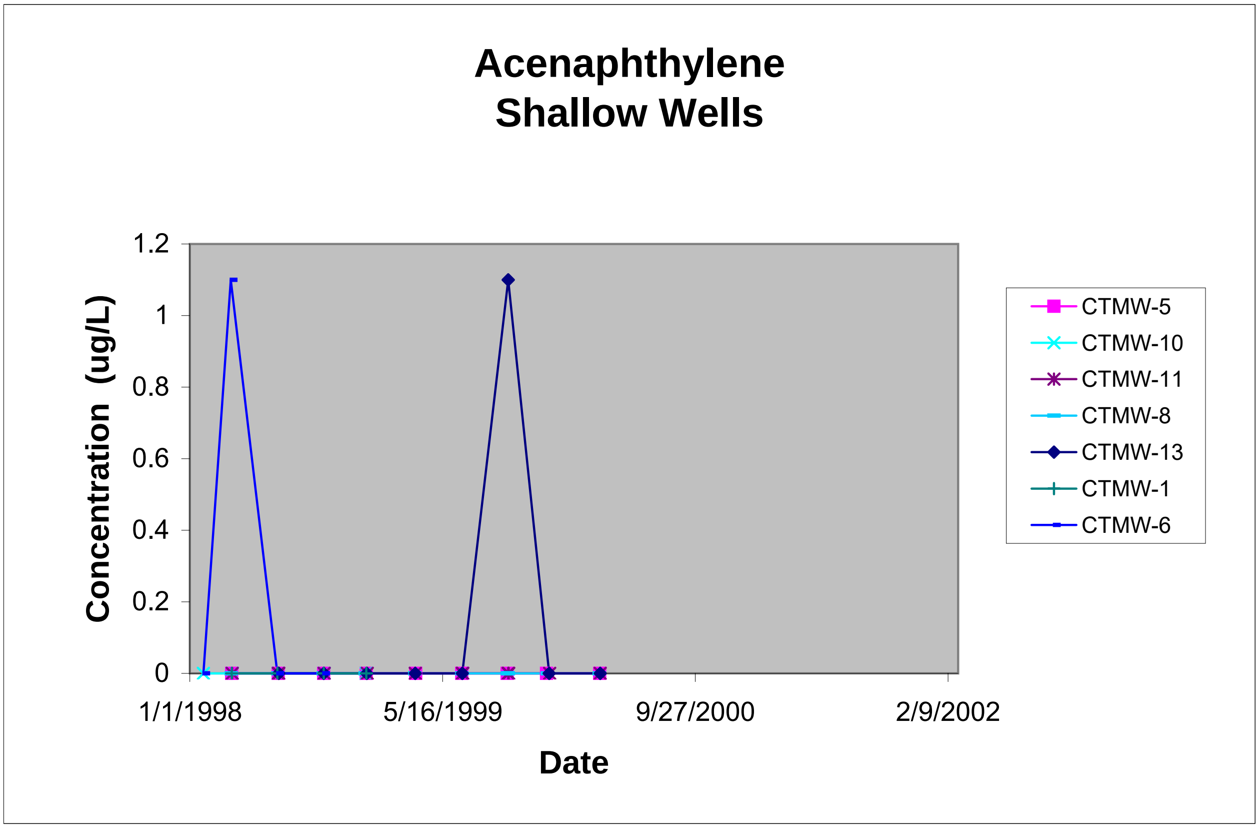
2,6-Dinitrotoluene
Shallow Wells
Concentration (ug/L)
16
14
12
10
8
6
4
2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8



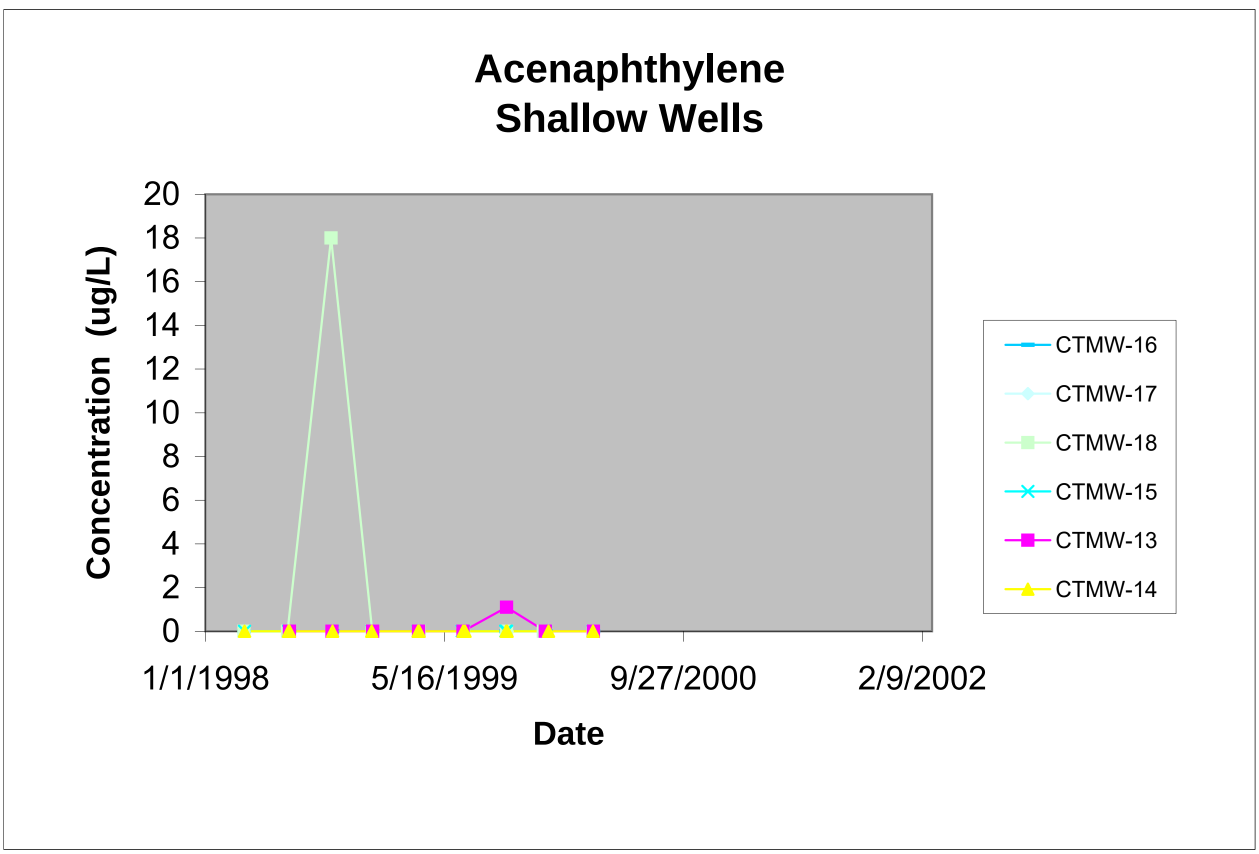
2,6-Dinitrotoluene
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


3,3'-Dichlorobenzidine
Shallow Wells
Concentration (ug/L)
10
9
8
7
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

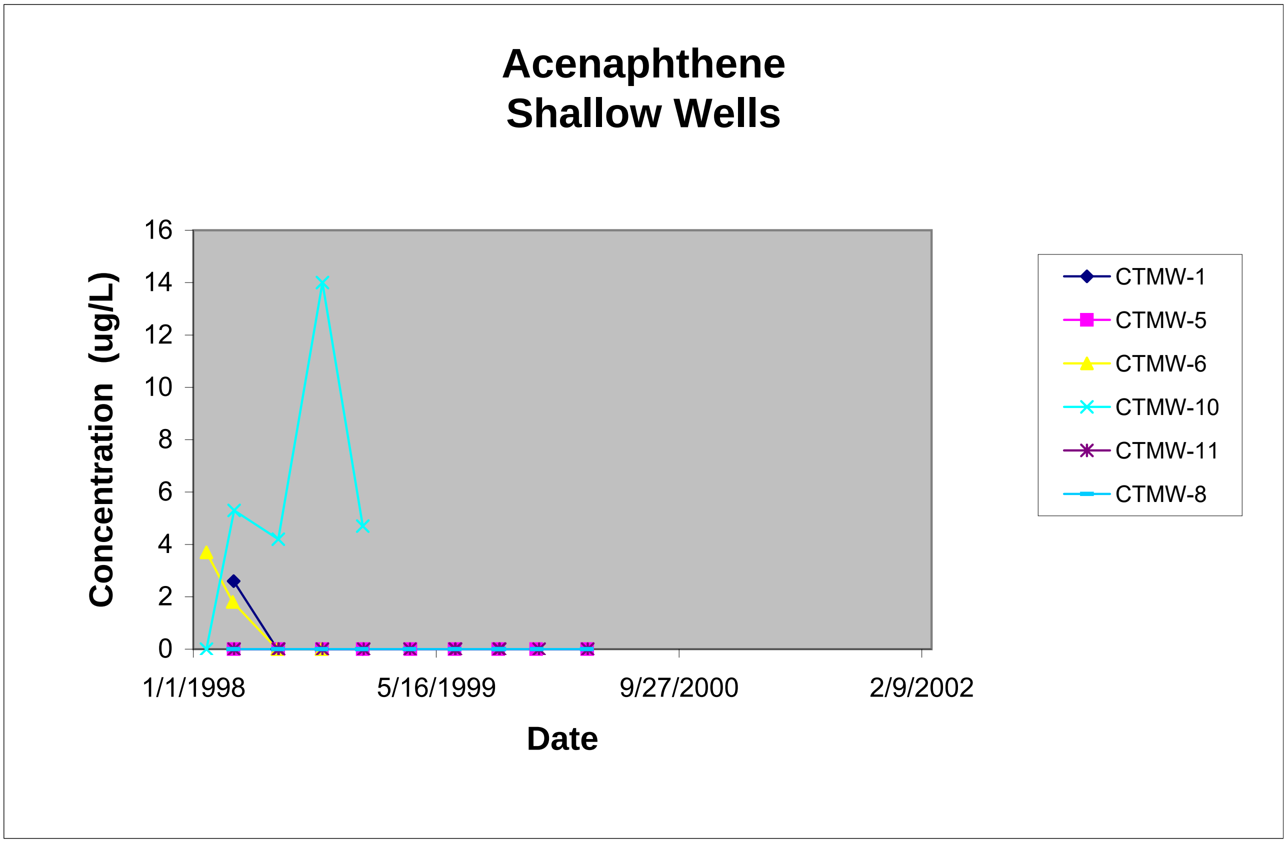

3,3'-Dichlorobenzidine
Shallow Wells
Concentration (ug/L)
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

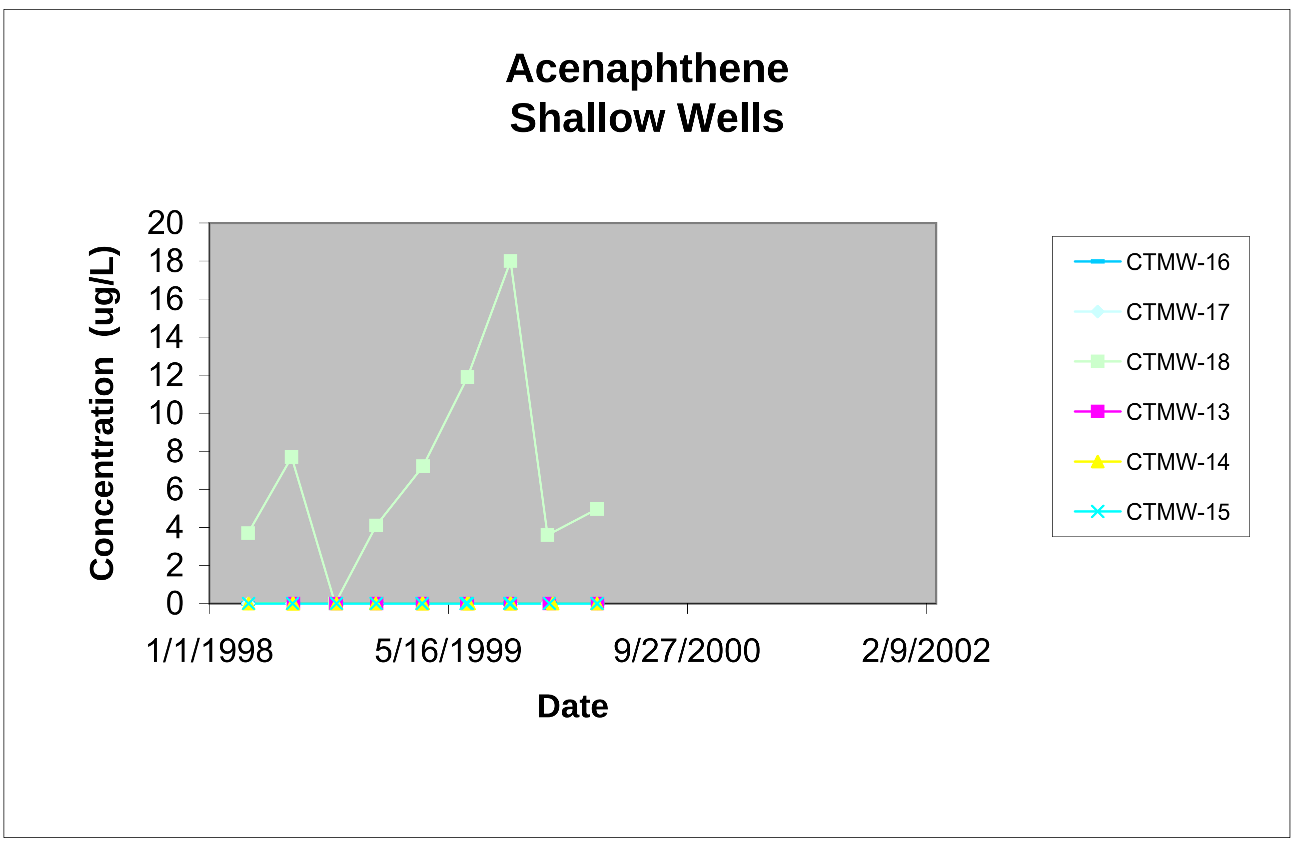


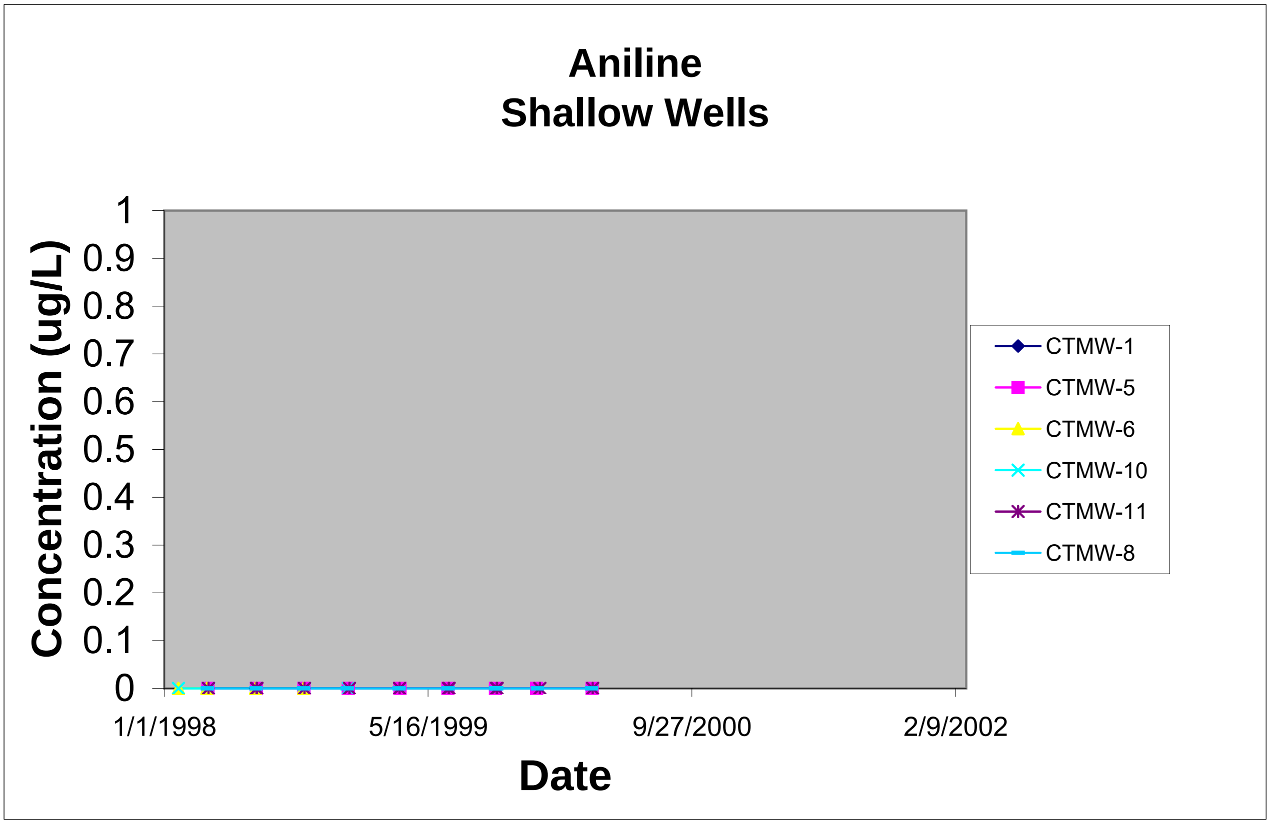
Acenaphthylene
Shallow Wells
Concentration (ug/L)
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-1
CTMW-6

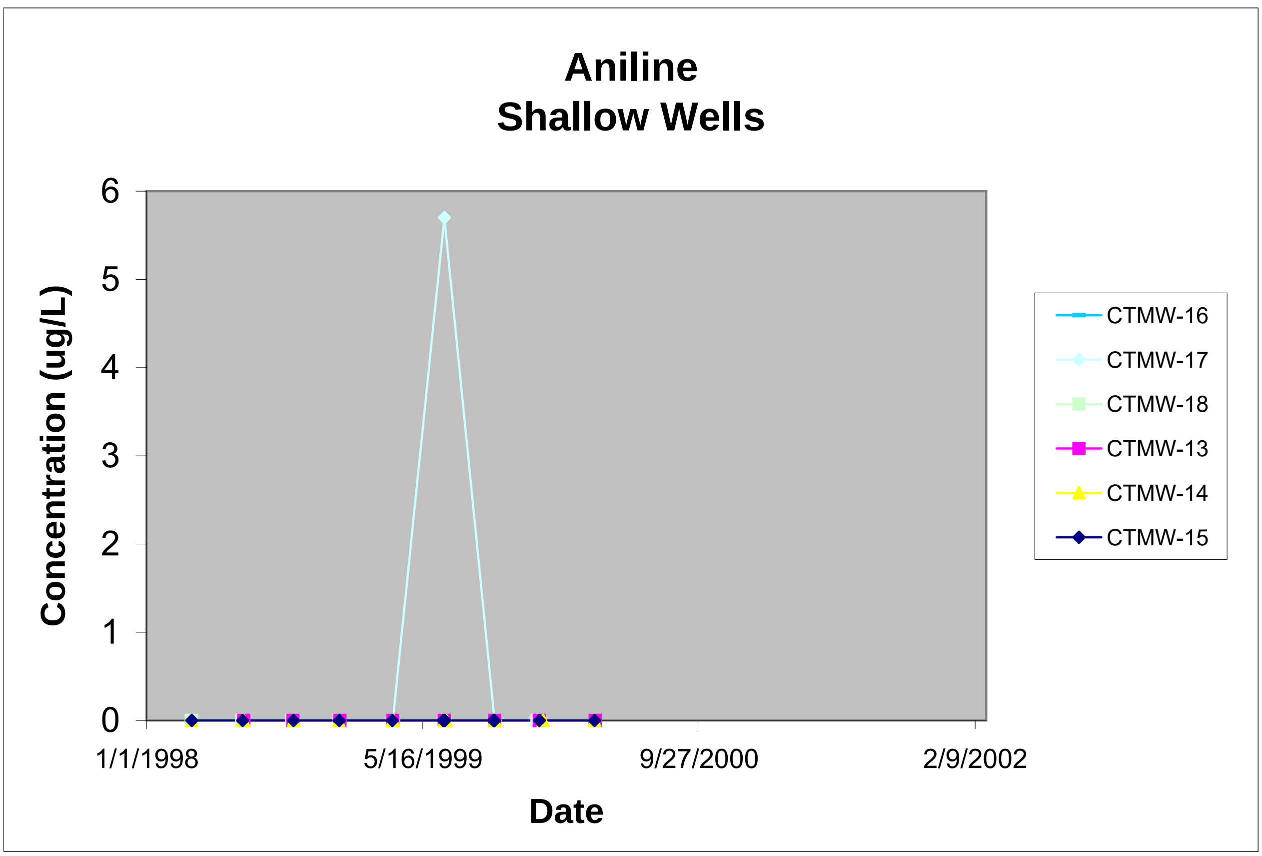


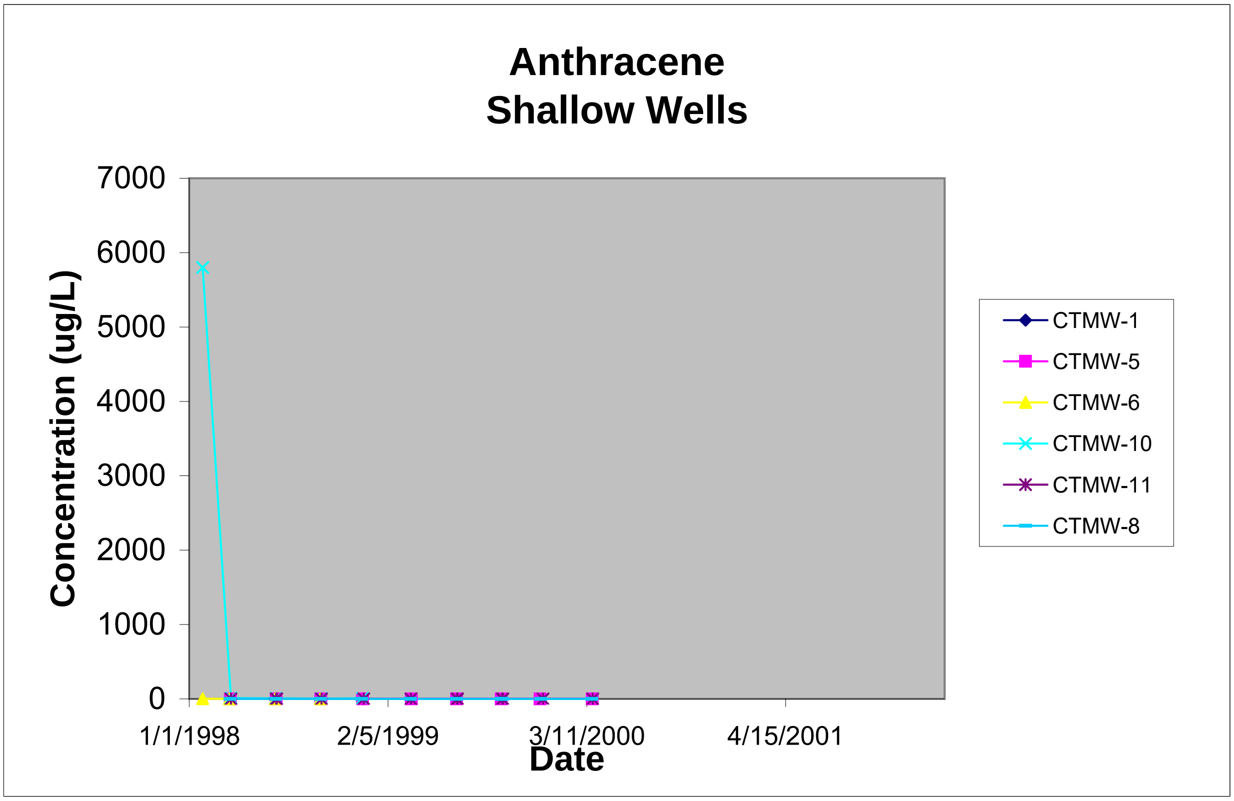
Acenaphthylene
Shallow Wells
Concentration (ug/L)
20
18
16
14
12
10
8
6
4
2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15
CTMW-13
CTMW-14

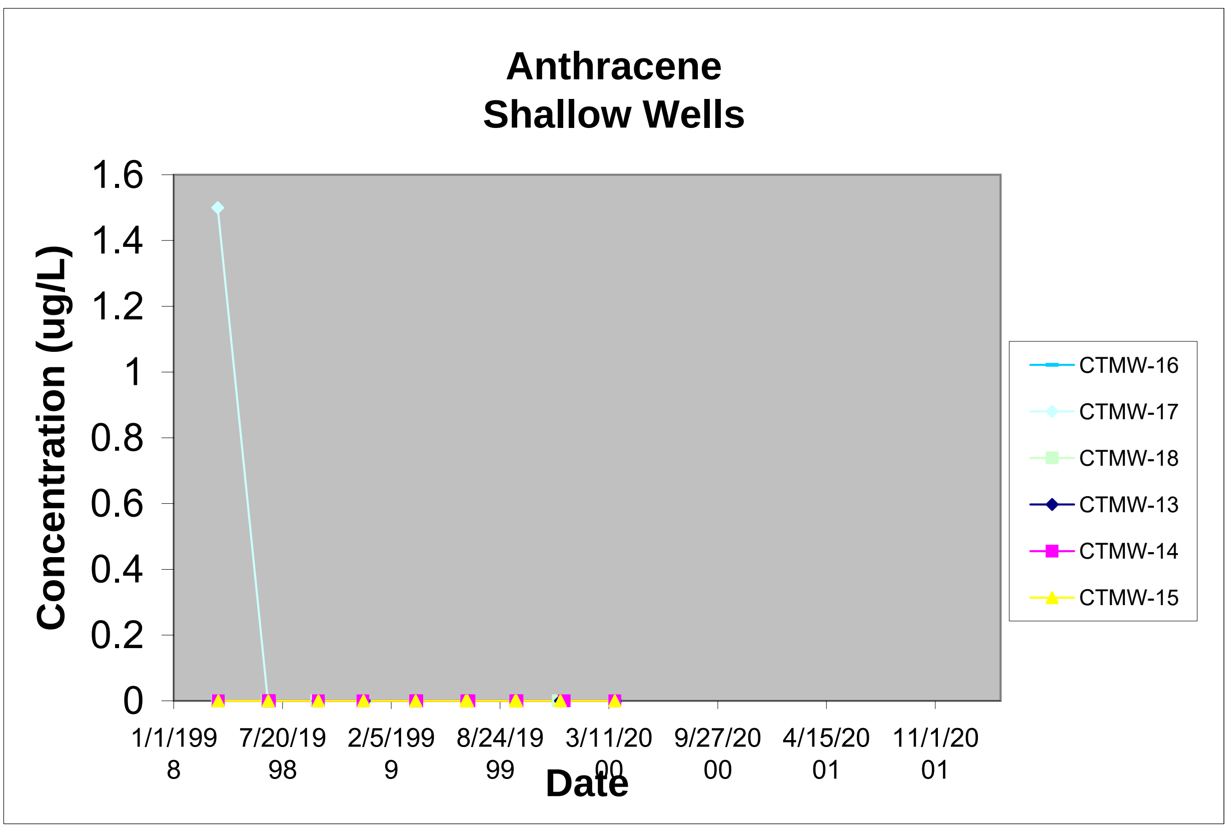

Acenaphthene
Shallow Wells
Concentration (ug/L)
16
14
12
10
8
6
4
2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

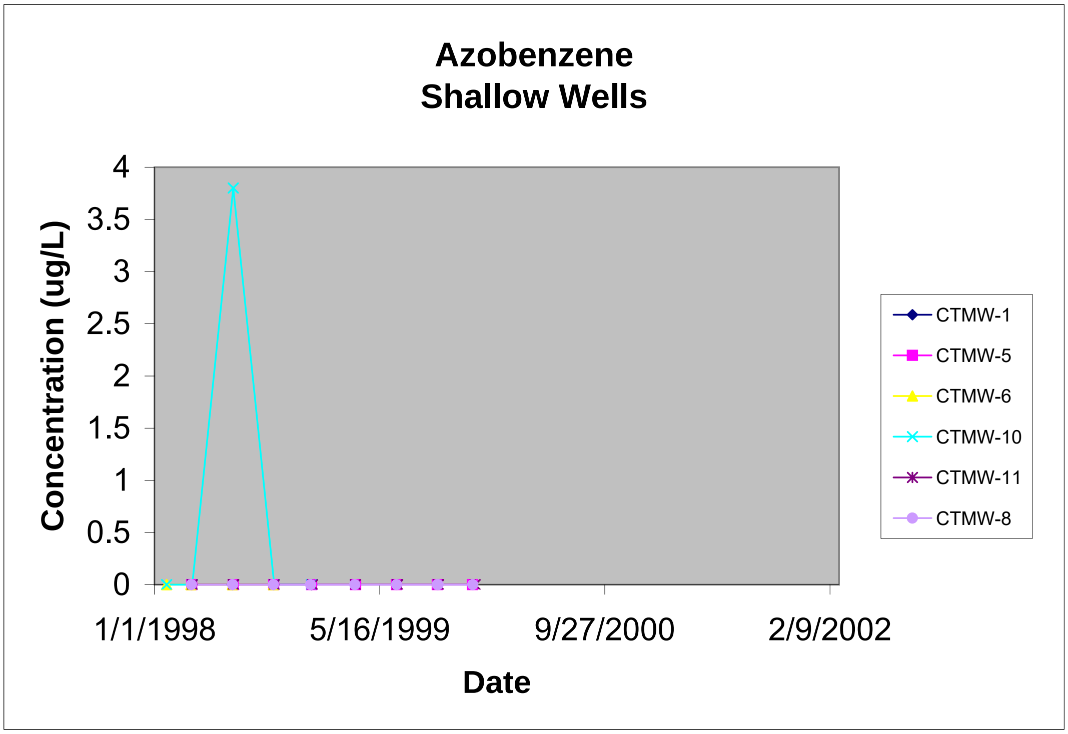

Acenaphthene
Shallow Wells
Concentration (ug/L)
20
18
16
14
12
10
8
6
4
2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

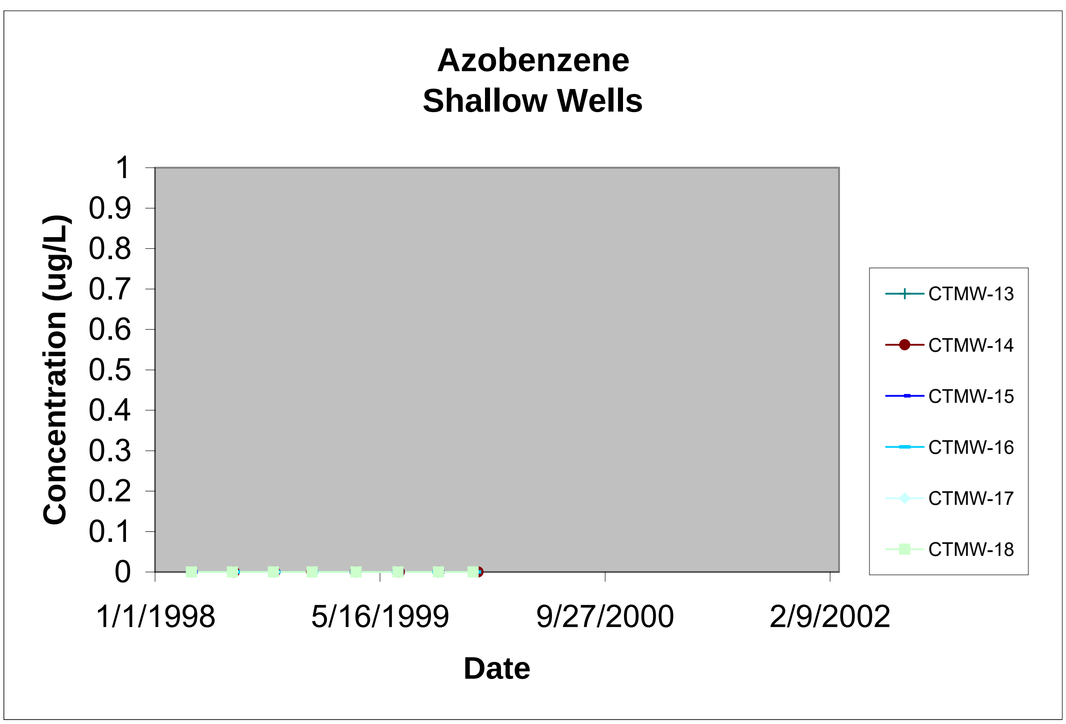

Aniline
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

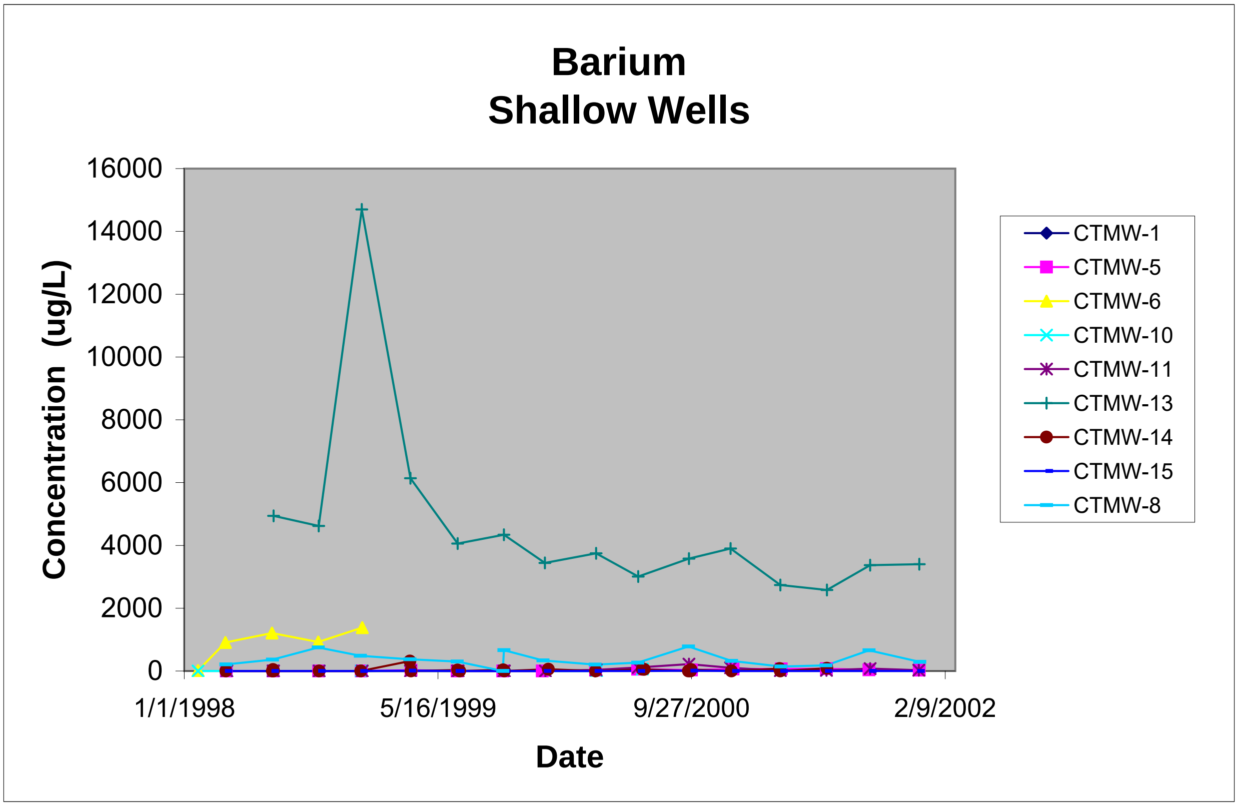

Aniline
Shallow Wells
Concentration (ug/L)
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

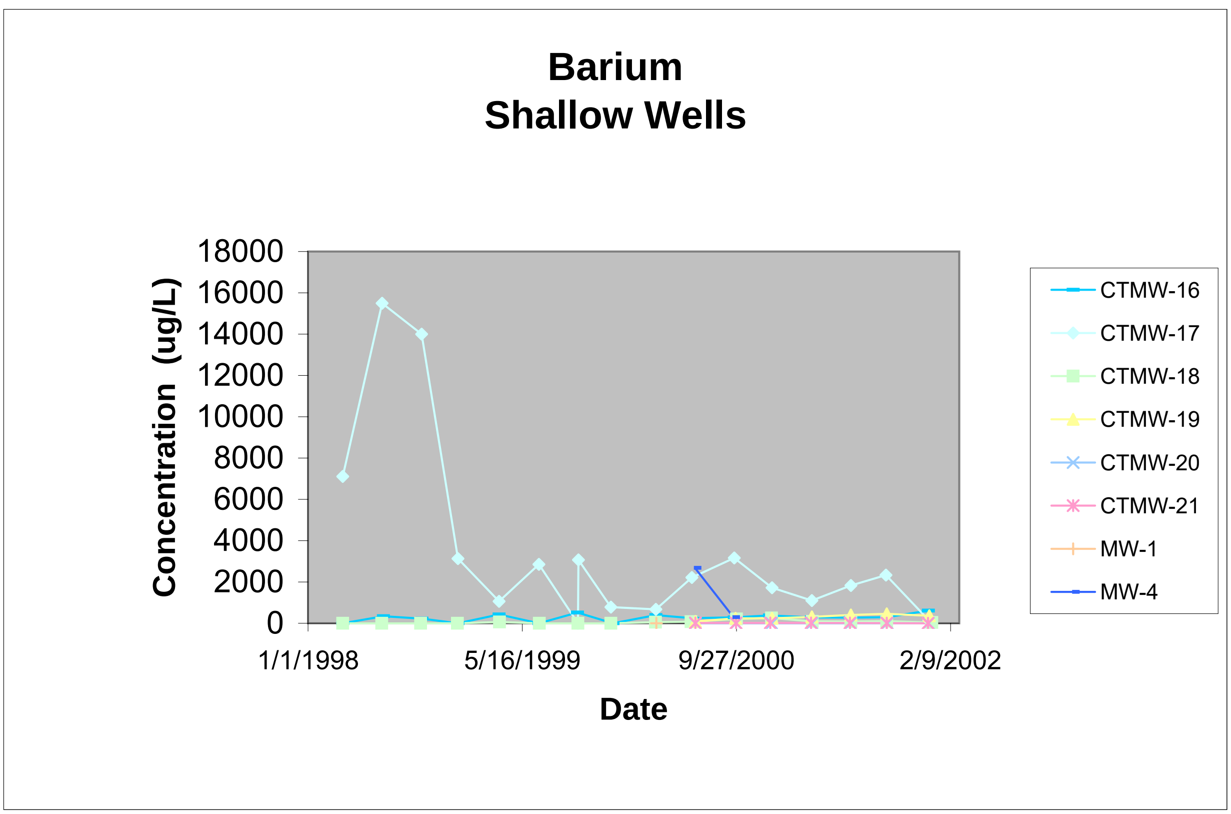

Anthracene
Shallow Wells
Concentration (ug/L)
7000
6000
5000
4000
3000
2000
1000
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

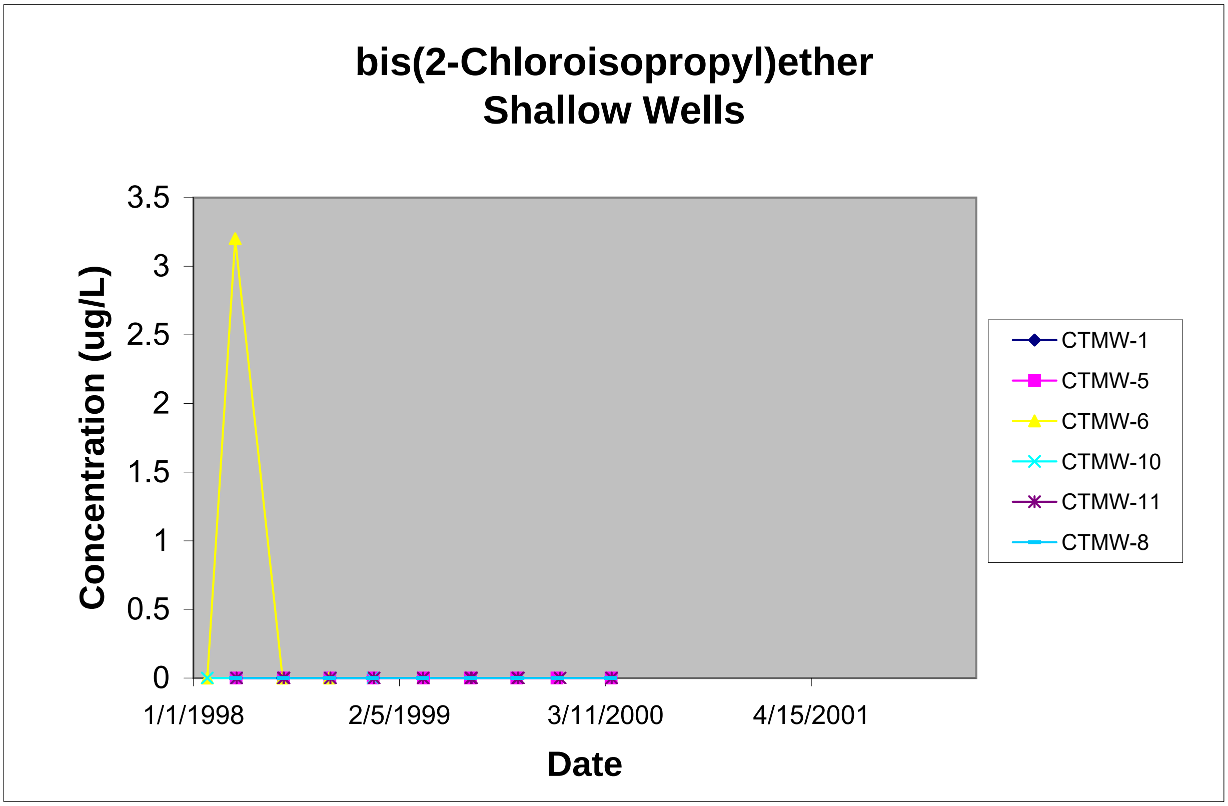

Anthracene
Shallow Wells
Concentration (ug/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

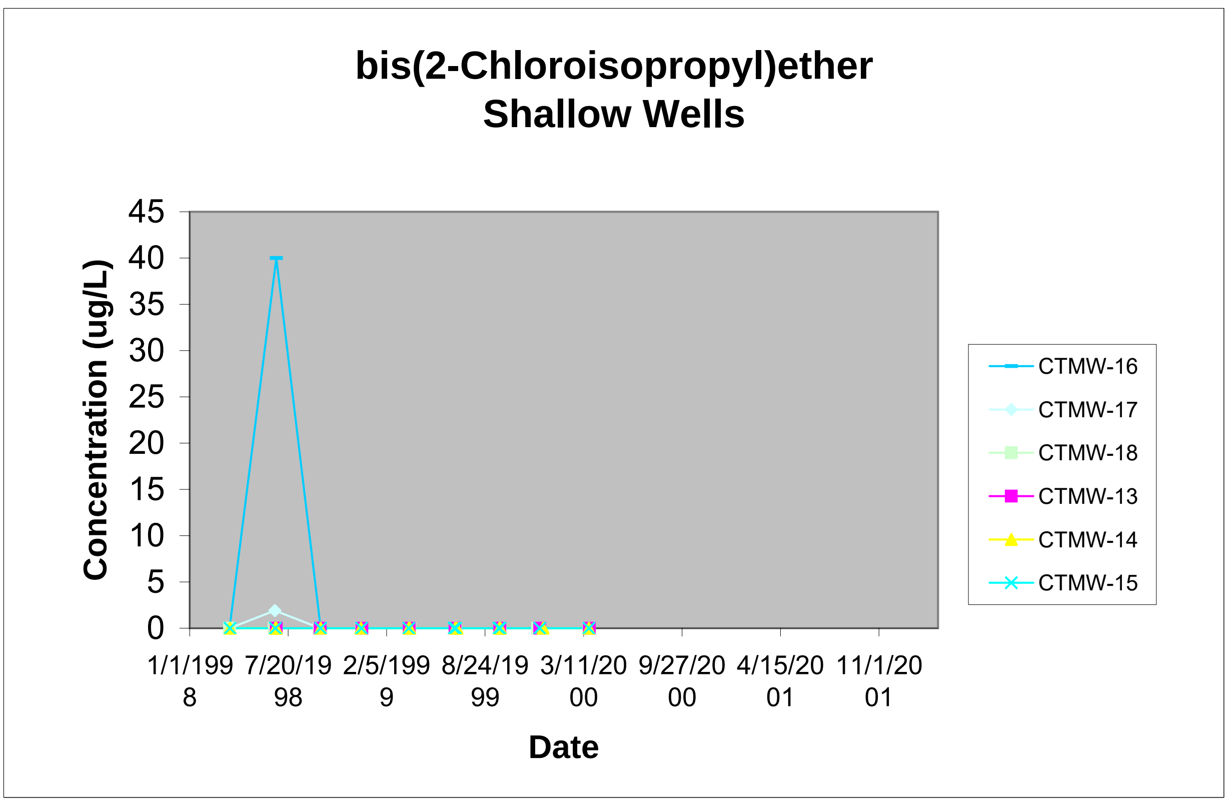

Azobenzene
Shallow Wells
Concentration (ug/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

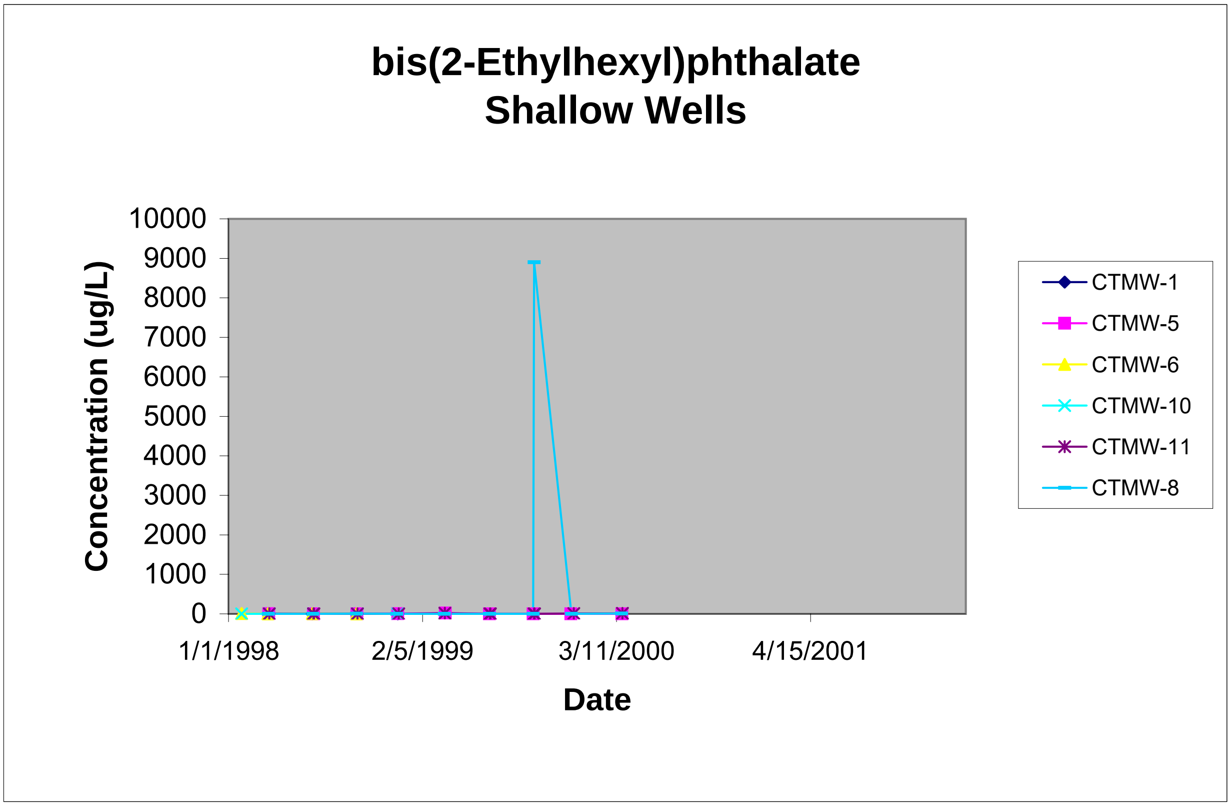

Azobenzene
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-13
CTMW-14
CTMW-15
CTMW-16
CTMW-17
CTMW-18

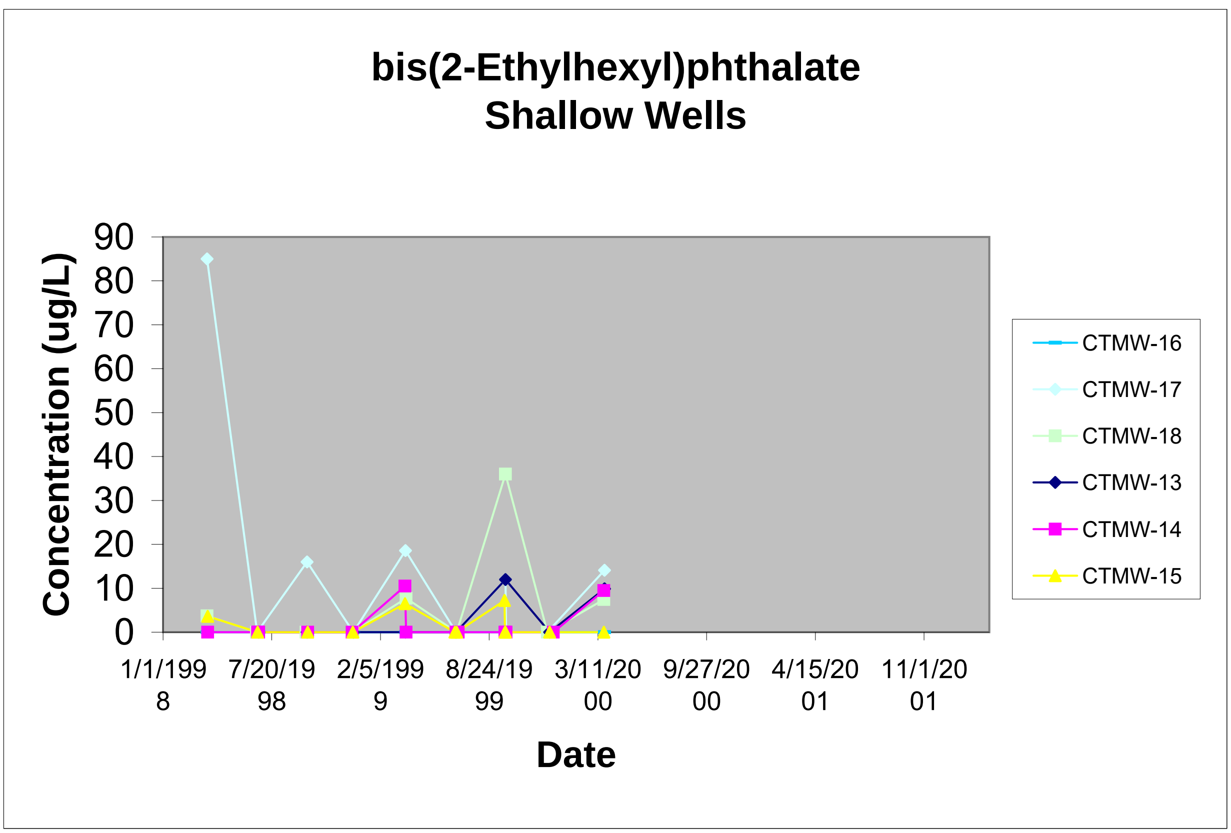

Barium
Shallow Wells
Concentration (ug/L)
16000
14000
12000
10000
8000
6000
4000
2000
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8

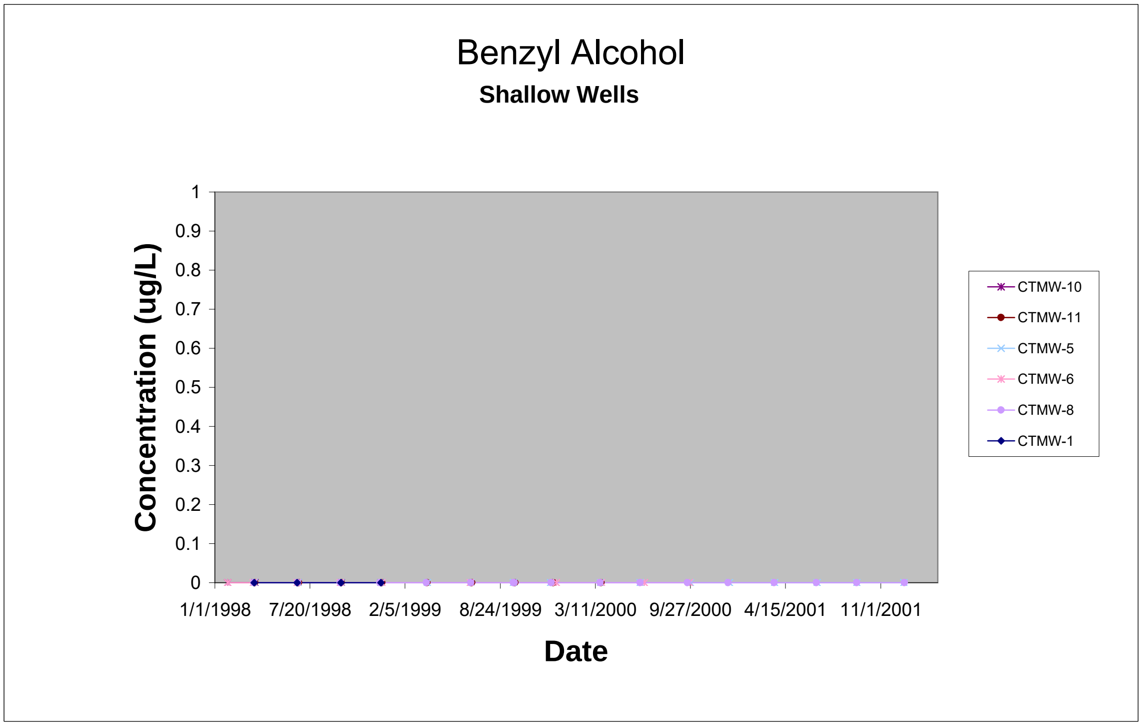

Barium
Shallow Wells
Concentration (ug/L)
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4


bis(2-Chloroisopropyl)ether
Shallow Wells
Concentration (ug/L)
3.5
3
2.5
2
1.5
1
0.5
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

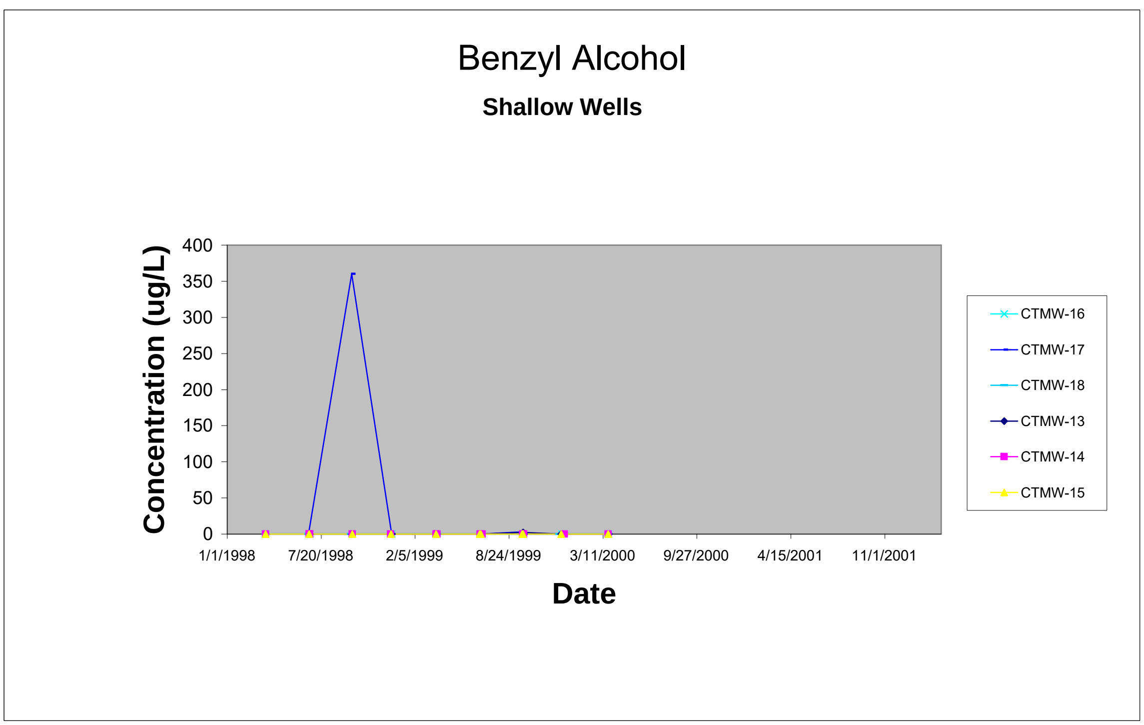

bis(2-Chloroisopropyl)ether
Shallow Wells
Concentration (ug/L)
45
40
35
30
25
20
15
10
5
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


bis(2-Ethylhexyl)phthalate
Shallow Wells
Concentration (ug/L)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

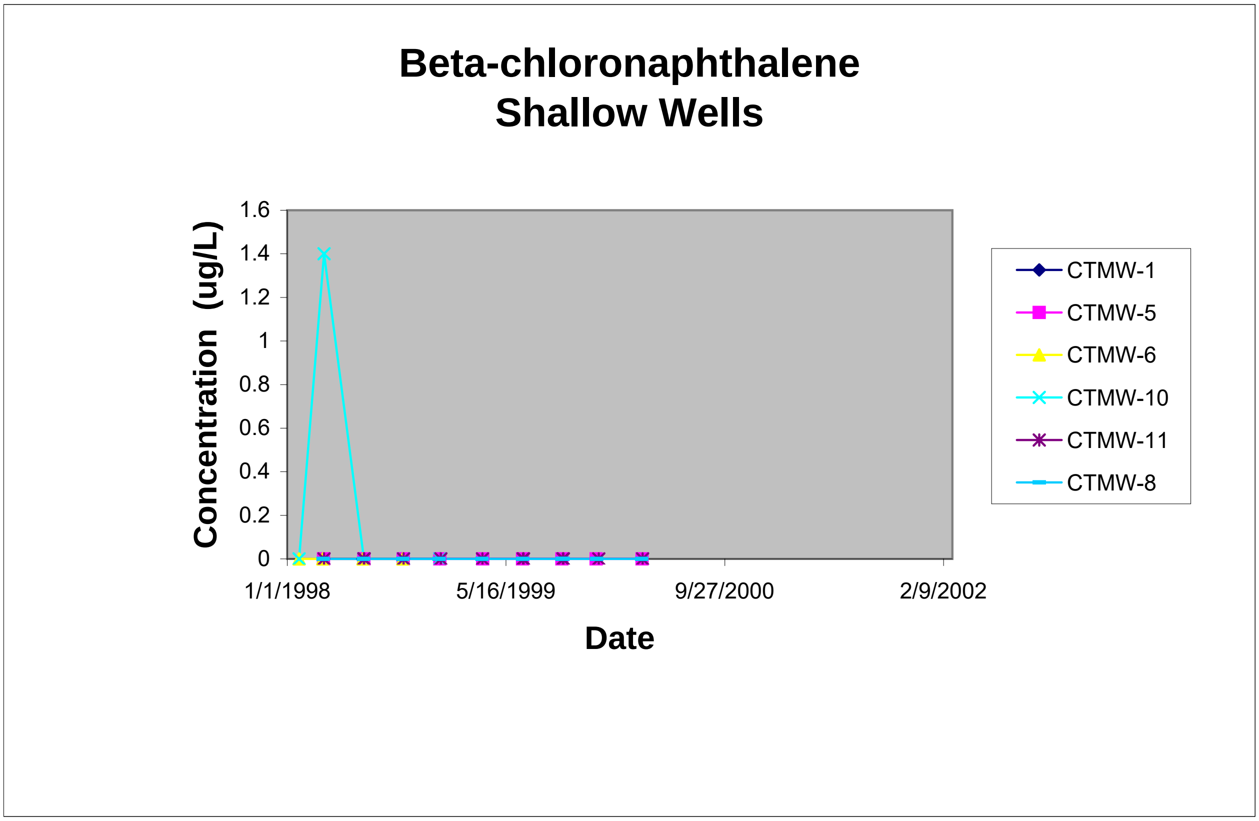

bis(2-Ethylhexyl)phthalate
Shallow Wells
Concentration (ug/L)
90
80
70
60
50
40
30
20
10
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

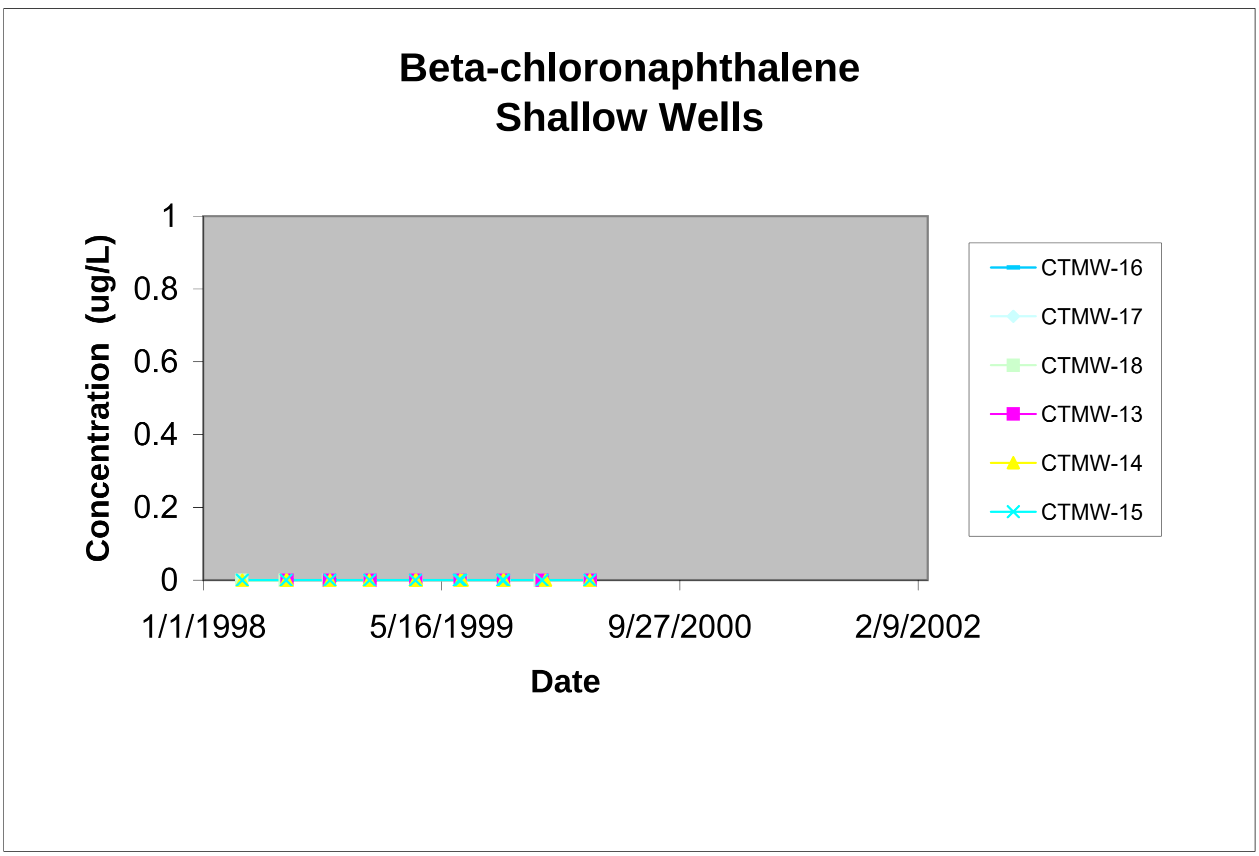


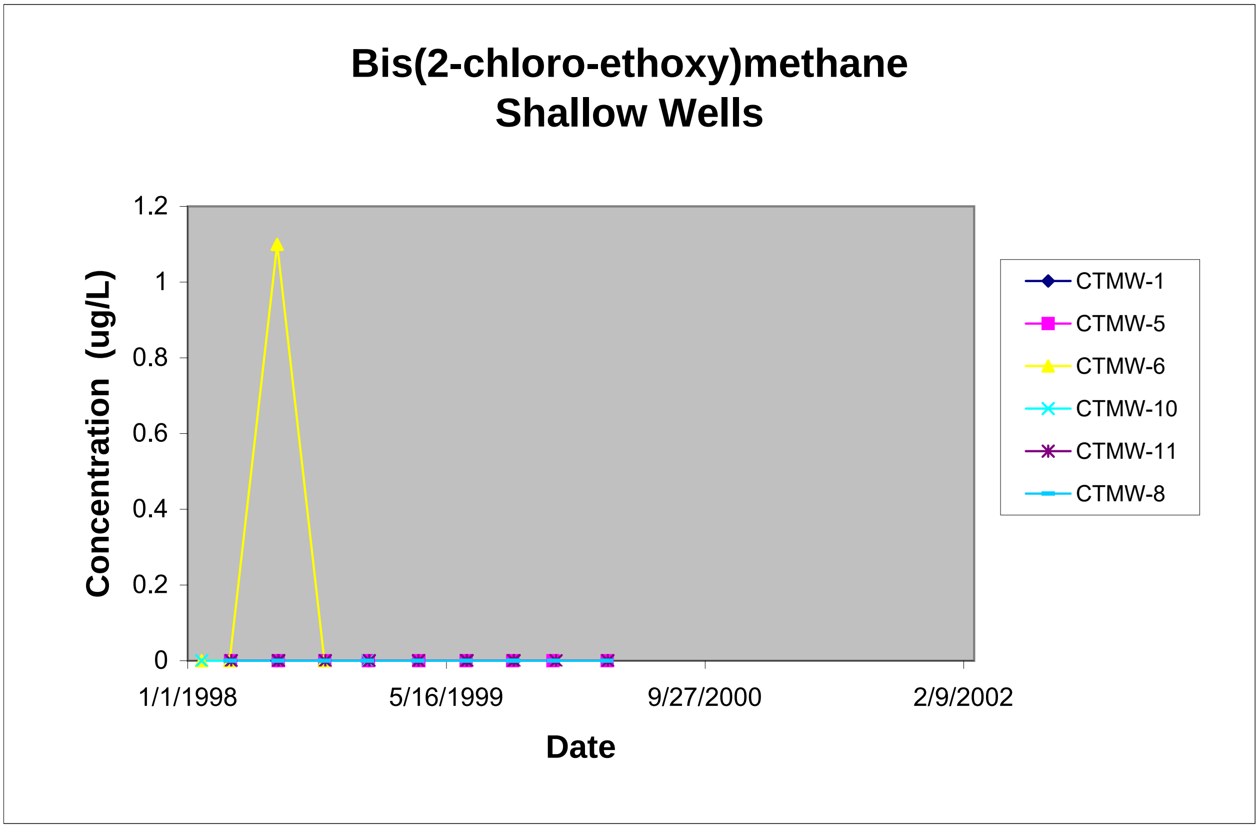
Benzyl Alcohol
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-10
CTMW-11
CTMW-5
CTMW-6
CTMW-8
CTMW-1



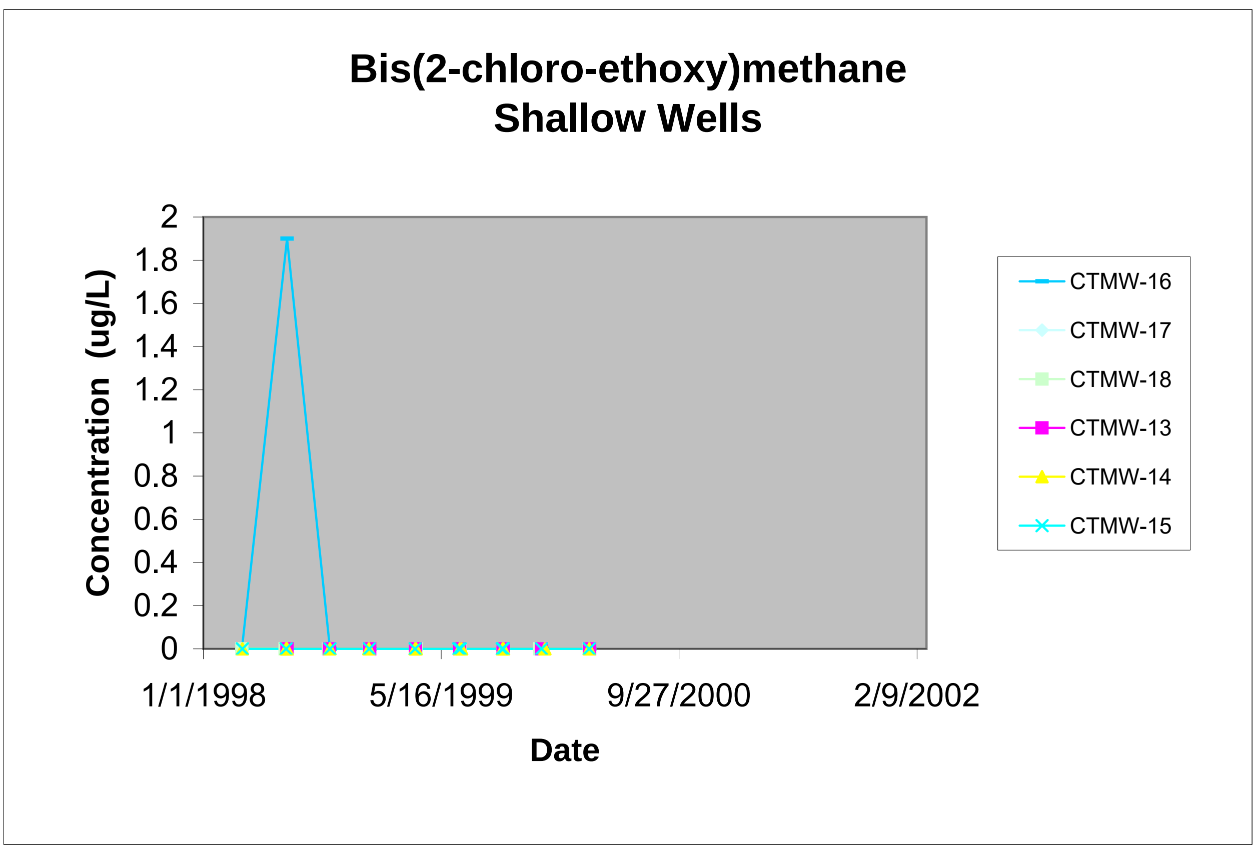
Benzyl Alcohol
Shallow Wells
Concentration (ug/L)
400
350
300
250
200
150
100
50
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


Beta-chloronaphthalene
Shallow Wells
Concentration (ug/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

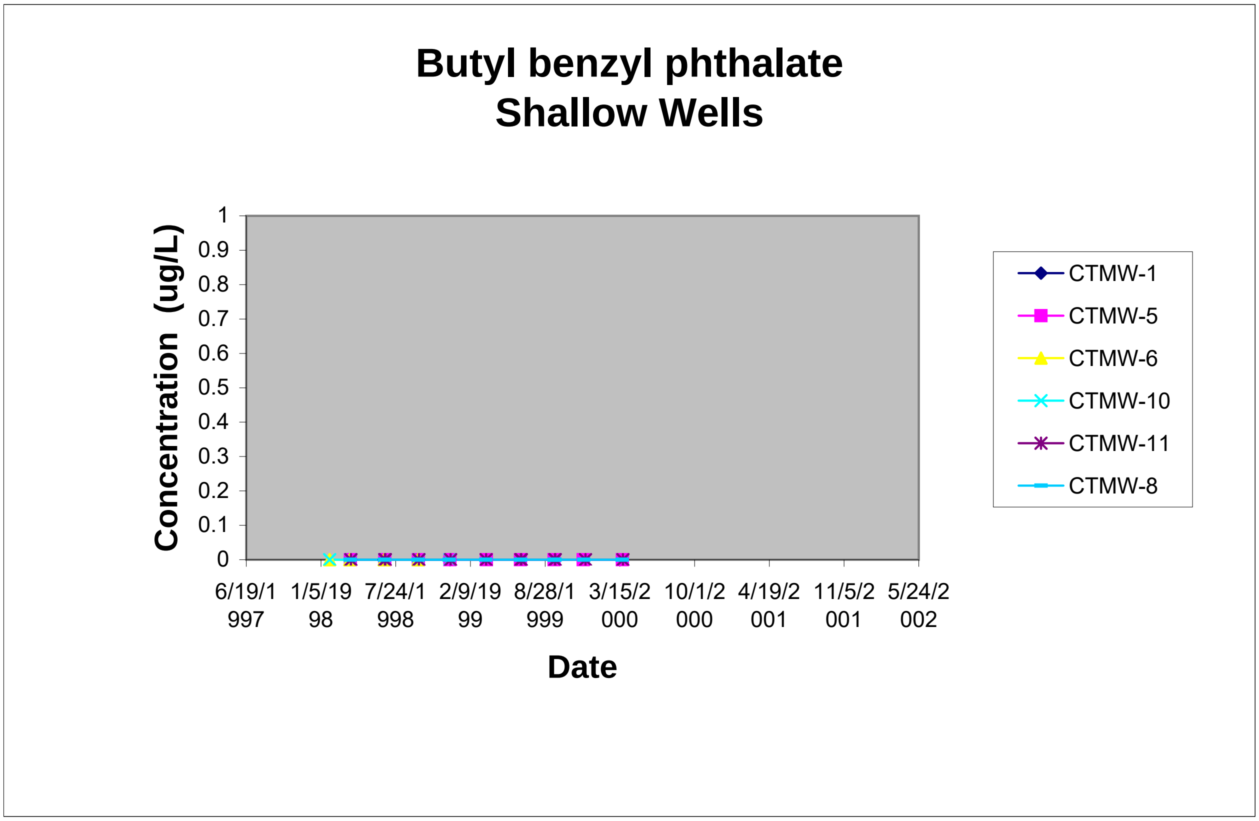

Beta-chloronaphthalene
Shallow Wells
Concentration (ug/L)
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15



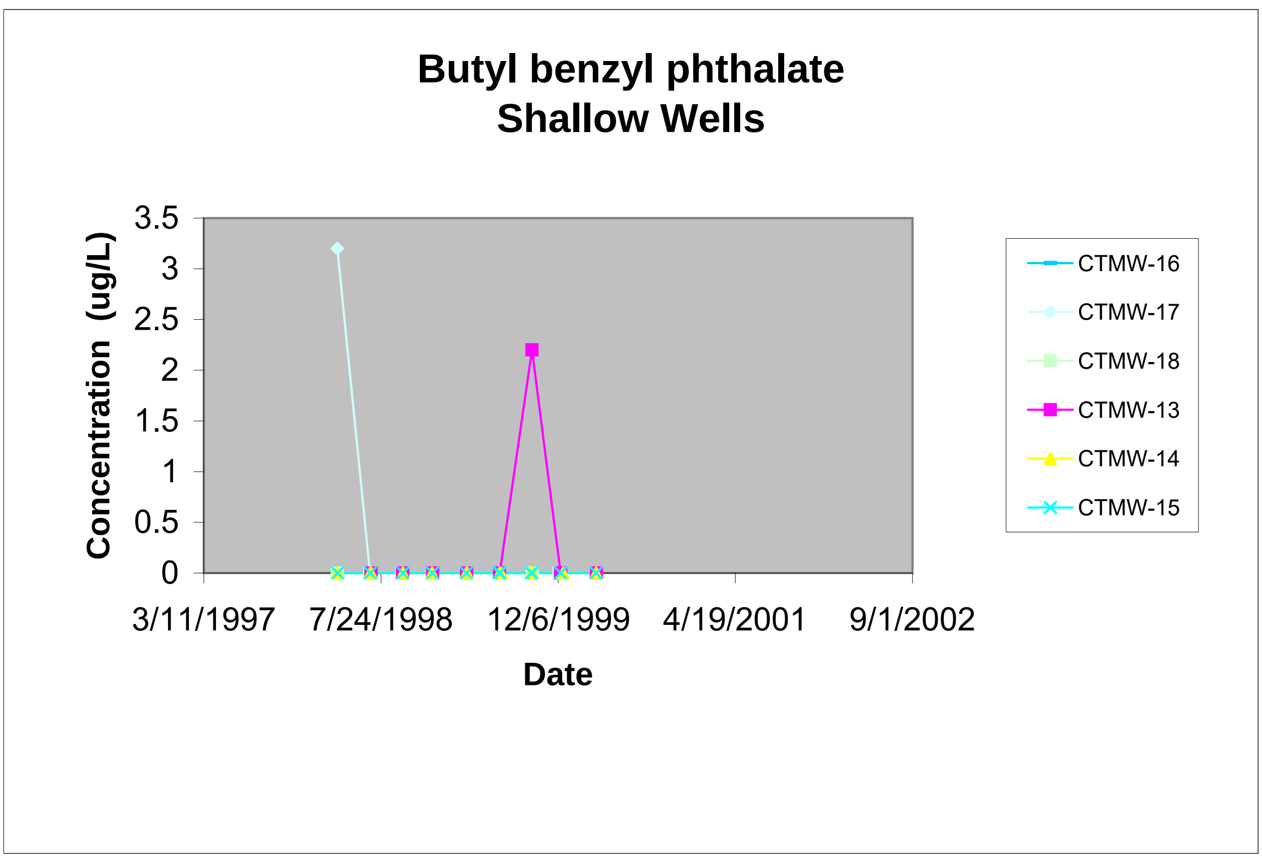
Bis(2-chloro-ethoxy)methane
Shallow Wells
1.2
1
0.8
0.6
0.4
0.2
0
Concentration (ug/L)
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8



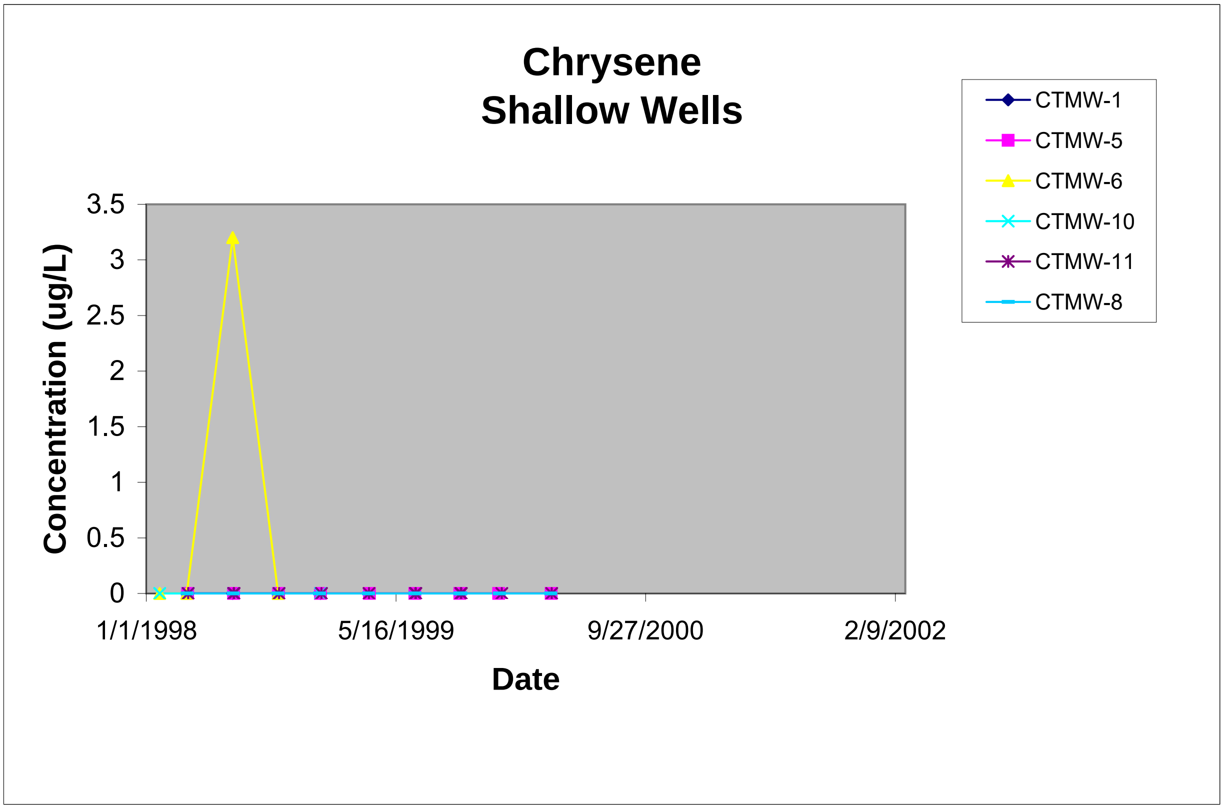
Bis(2-chloro-ethoxy)methane
Shallow Wells
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Concentration (ug/L)
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15



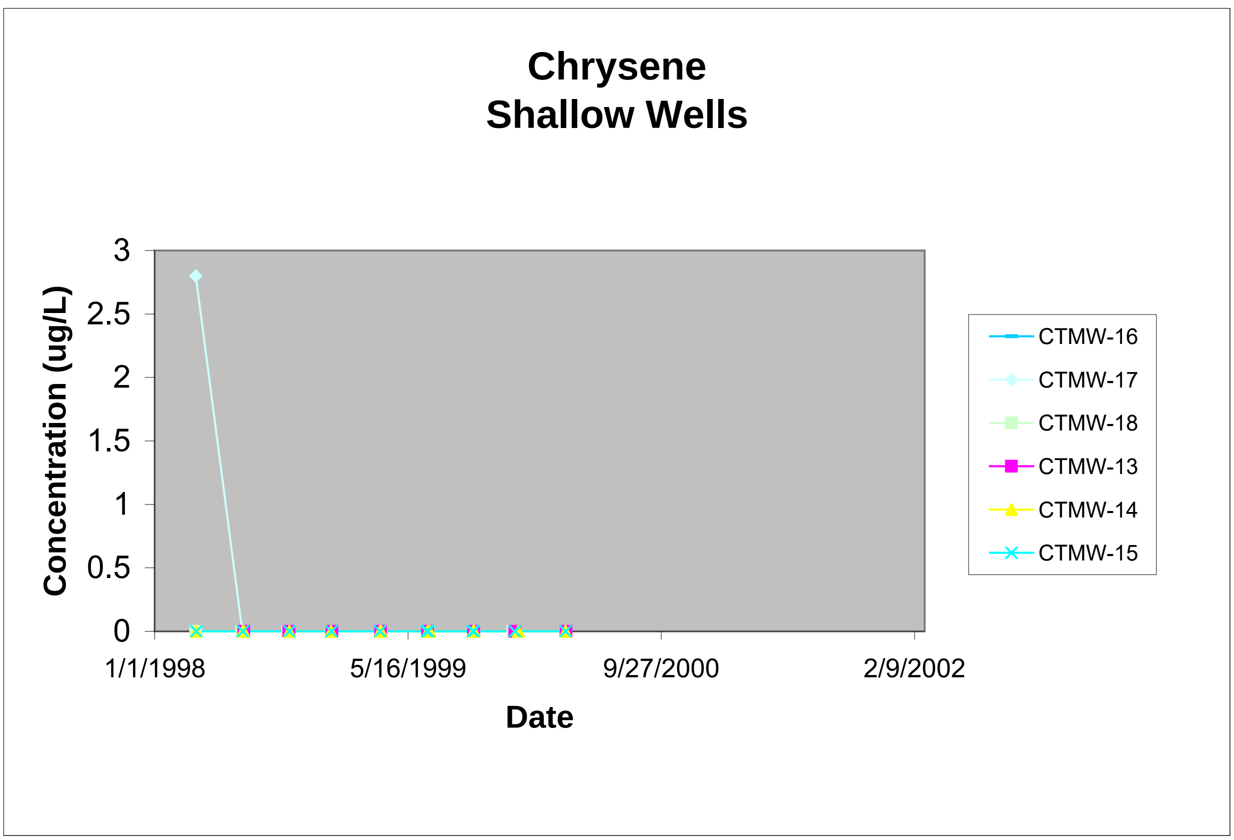
Butyl benzyl phthalate
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/19/1997
1/5/1998
7/24/1998
2/9/1999
8/28/1999
3/15/2000
10/1/2000
4/19/2001
11/5/2001
5/24/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8



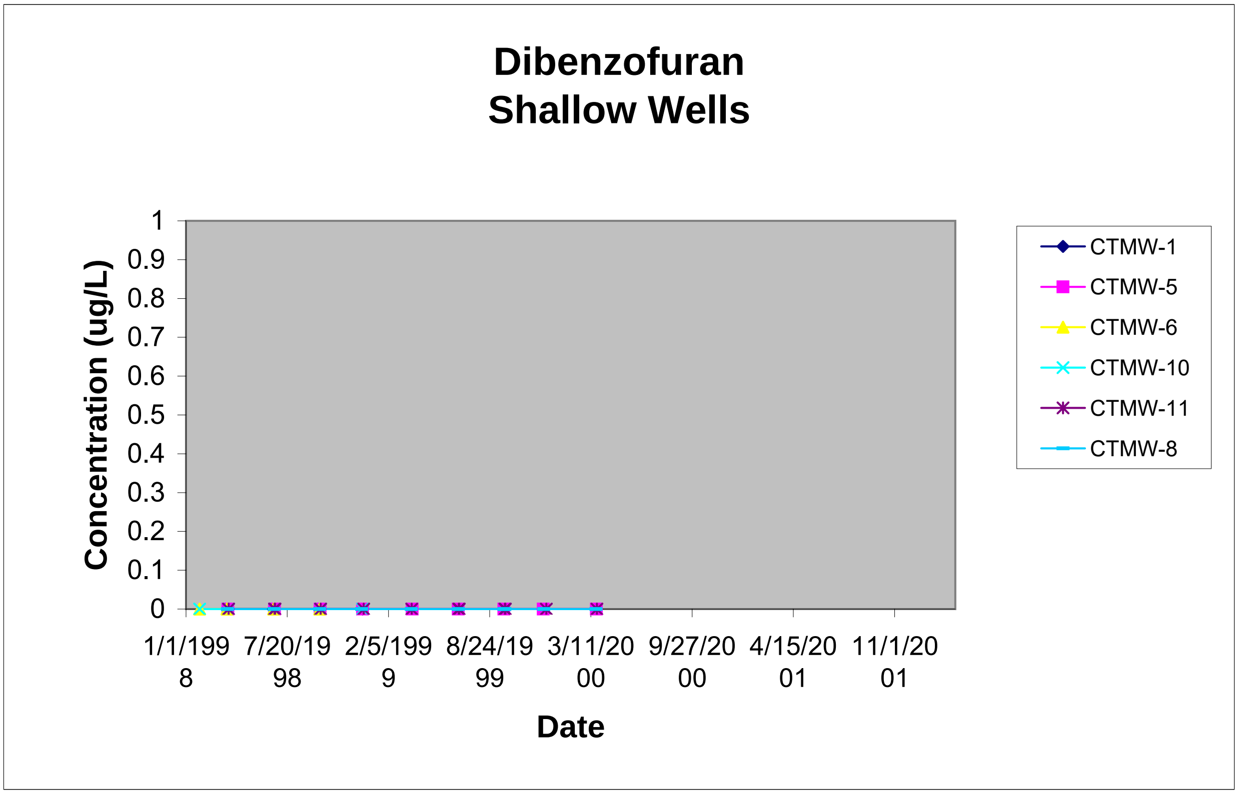
Butyl benzyl phthalate
Shallow Wells
Concentration (ug/L)
3.5
3
2.5
2
1.5
1
0.5
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

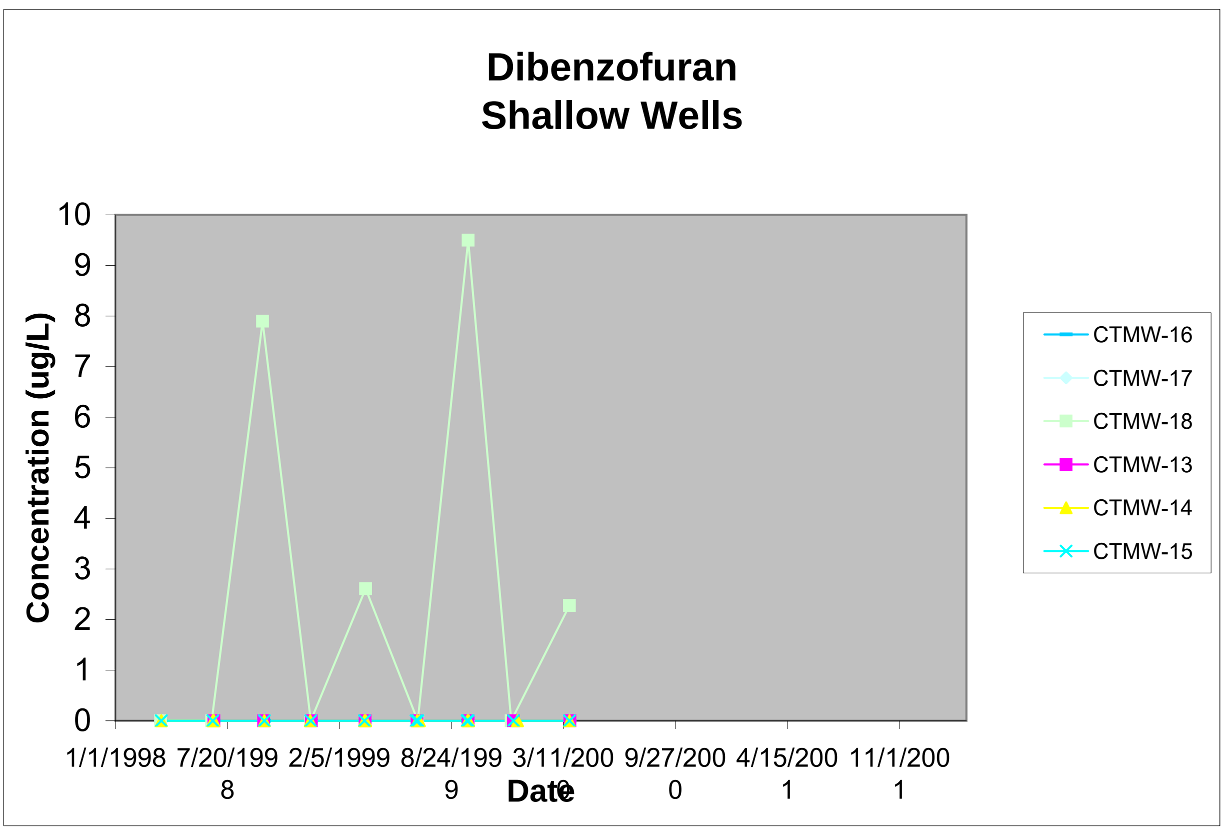


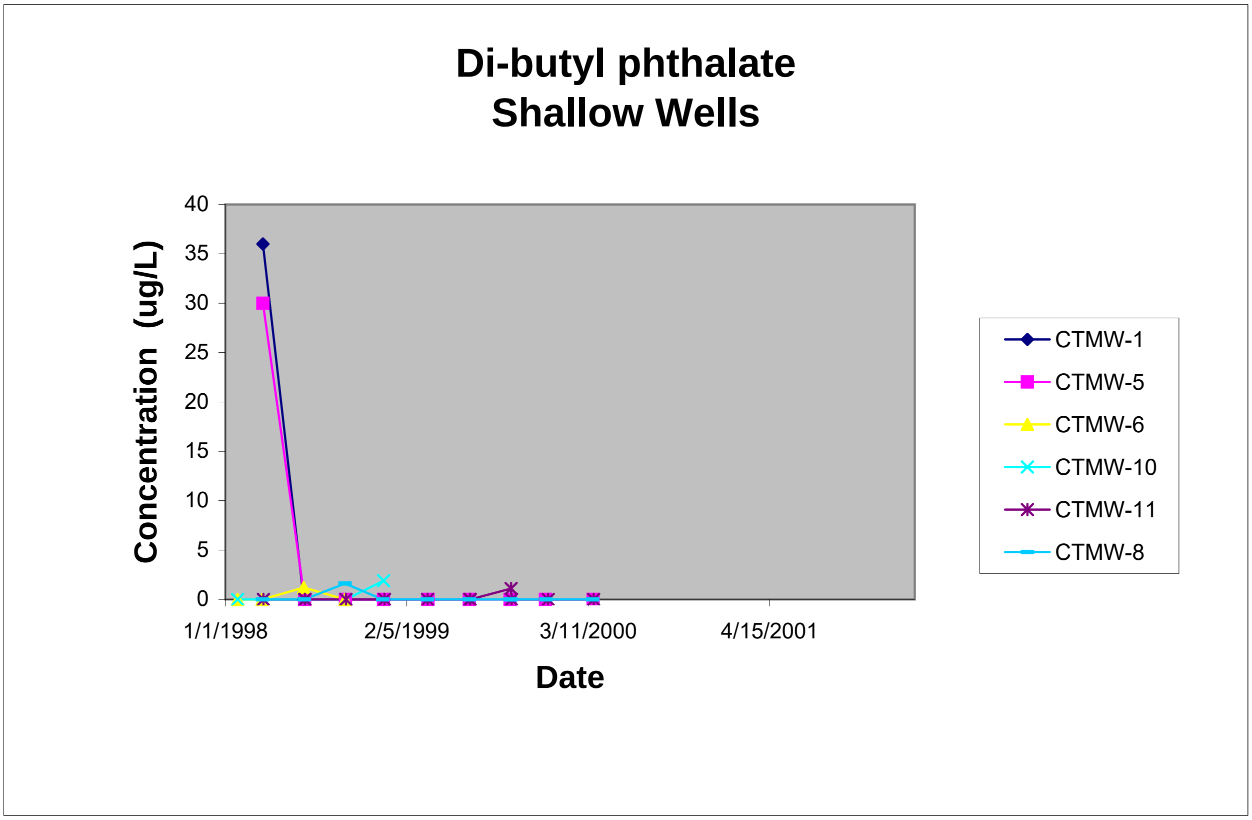
Chrysene
Shallow Wells
Concentration (ug/L)
3.5
3
2.5
2
1.5
1
0.5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8



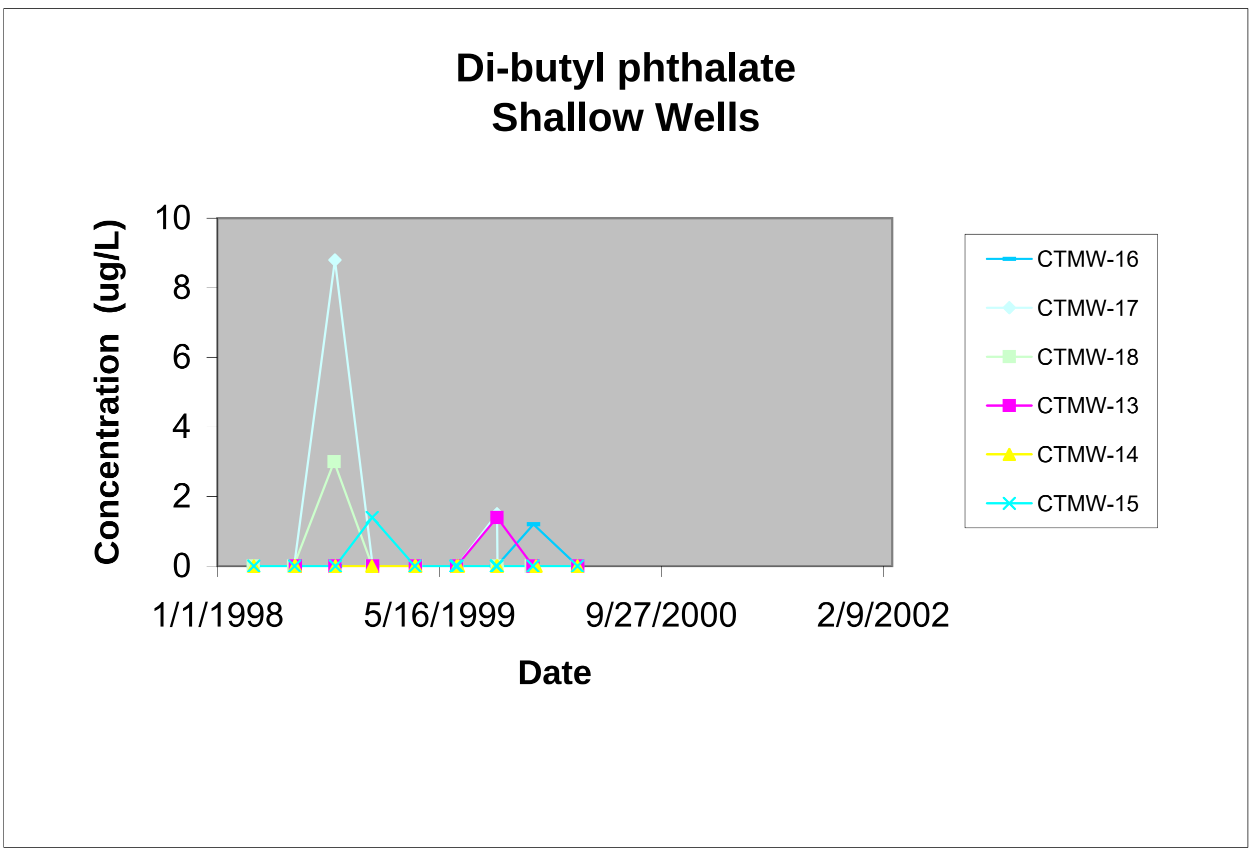
Chrysene
Shallow Wells
Concentration (ug/L)
3
2.5
2
1.5
1
0.5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


Dibenzofuran
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

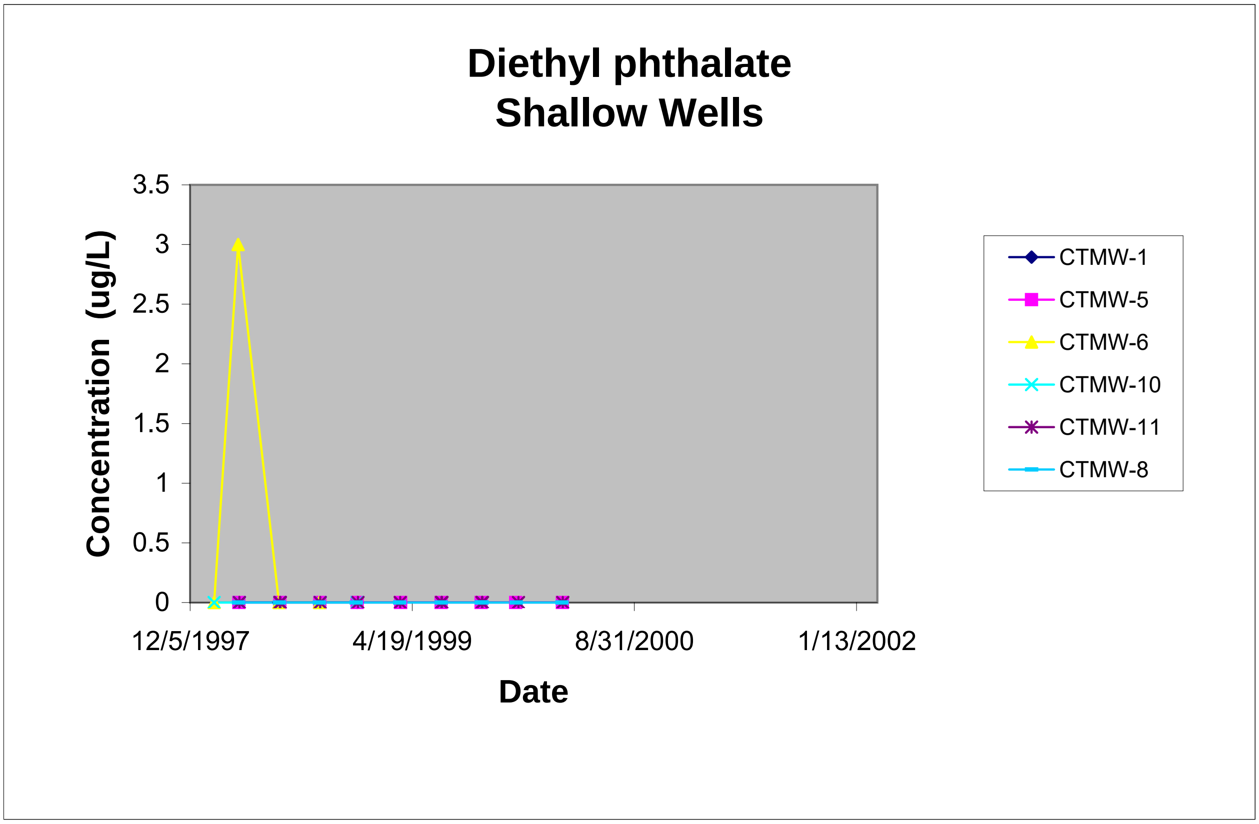

Dibenzofuran
Shallow Wells
Concentration (ug/L)
10
9
8
7
6
5
4
3
2
1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

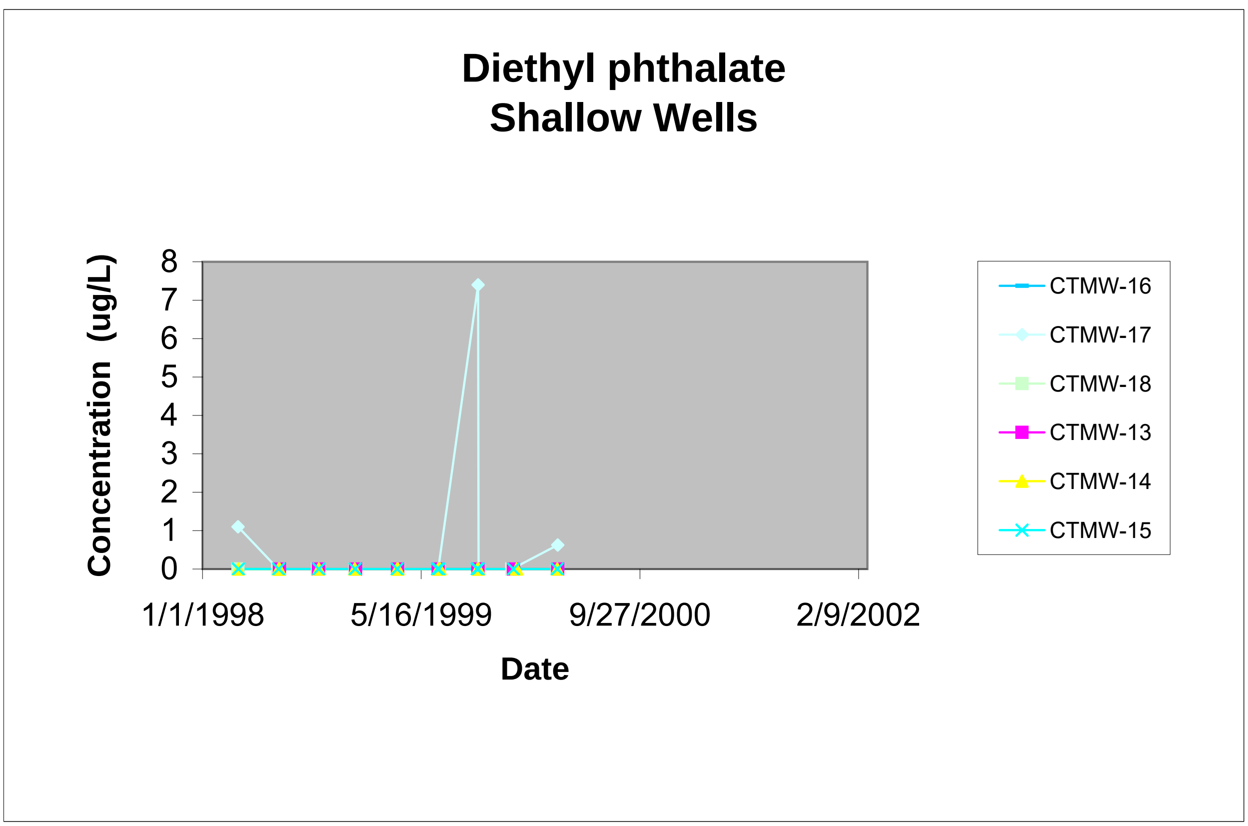


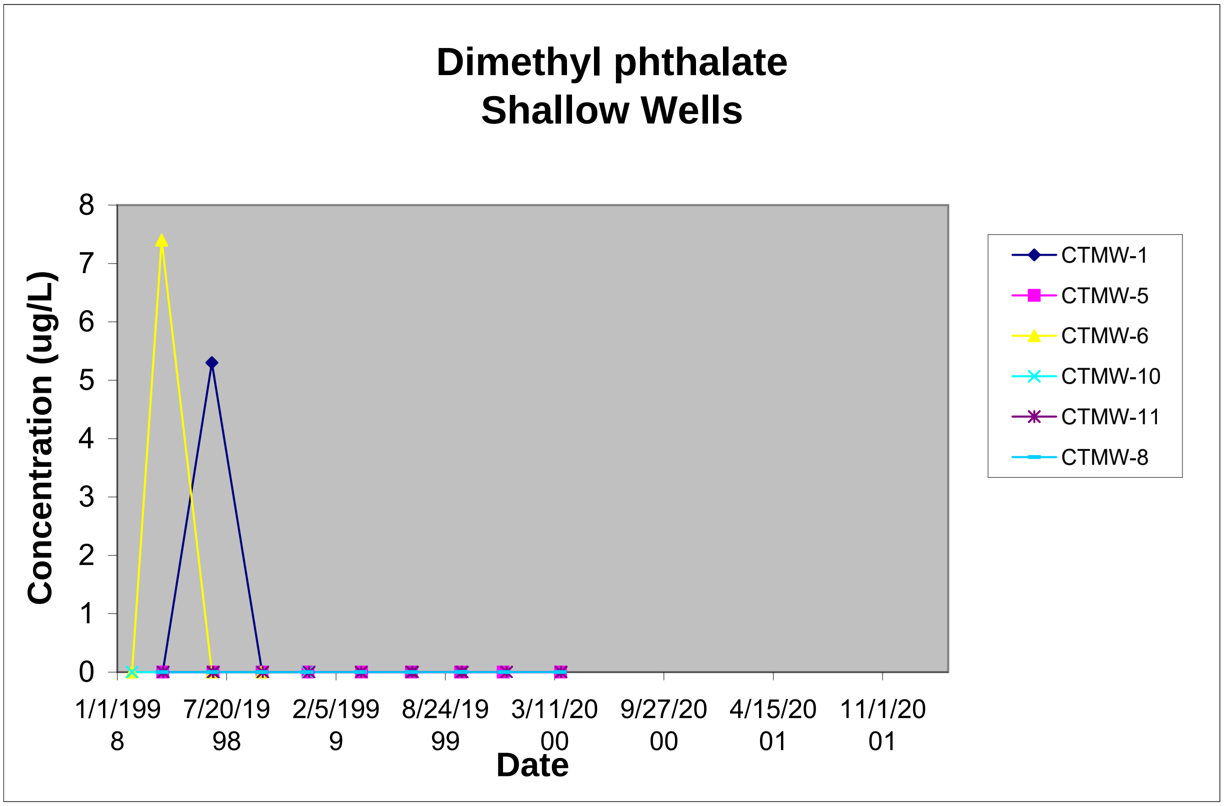
Di-butyl phthalate
Shallow Wells
Concentration (ug/L)
40
35
30
25
20
15
10
5
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8



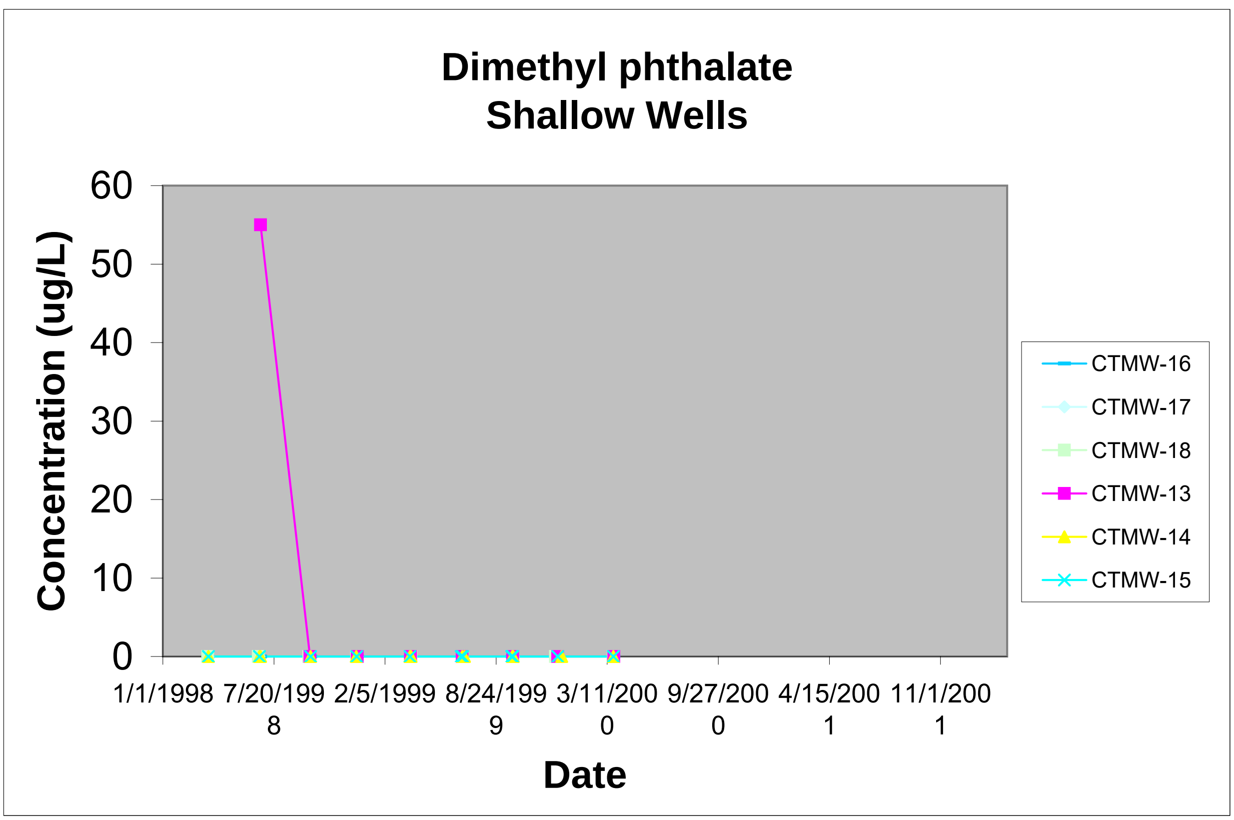
Di-butyl phthalate
Shallow Wells
Concentration (ug/L)
10
8
6
4
2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


Diethyl phthalate
Shallow Wells
Concentration (ug/L)
3.5
3
2.5
2
1.5
1
0.5
0
12/5/1997
4/19/1999
8/31/2000
1/13/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

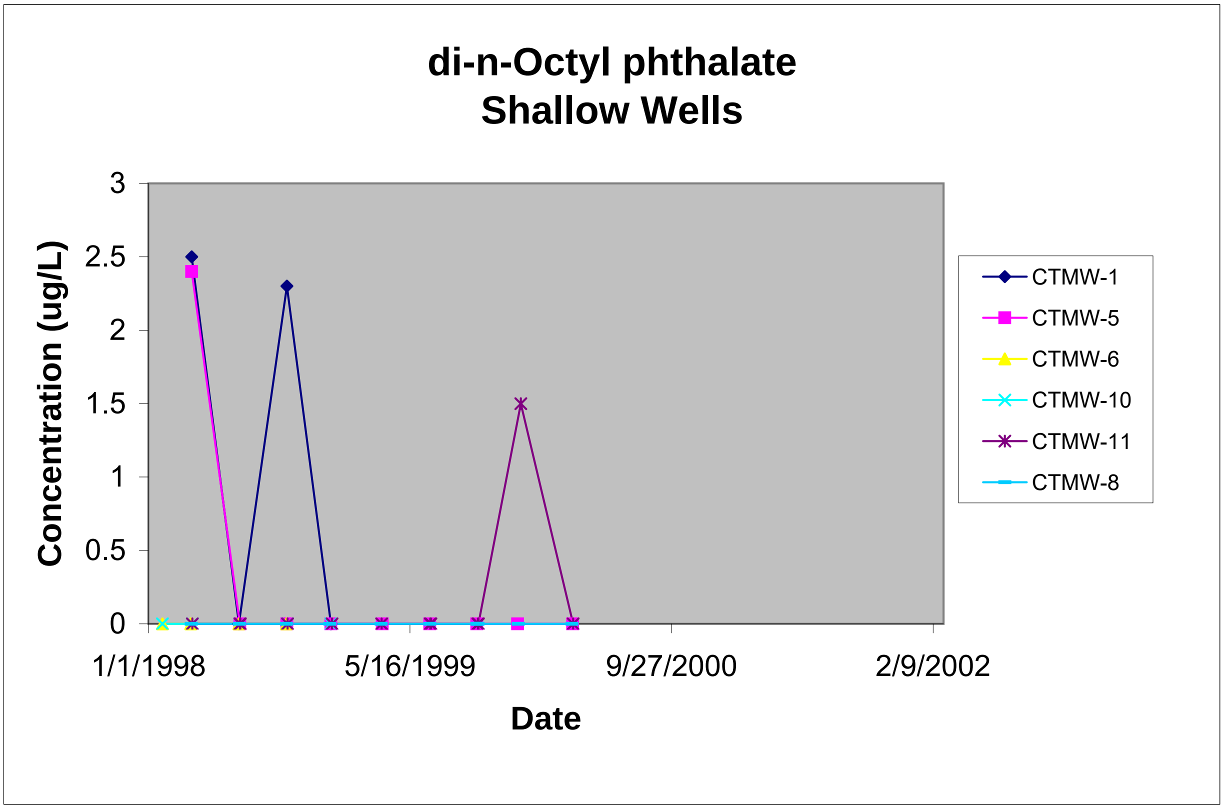

Diethyl phthalate
Shallow Wells
Concentration (ug/L)
8
7
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

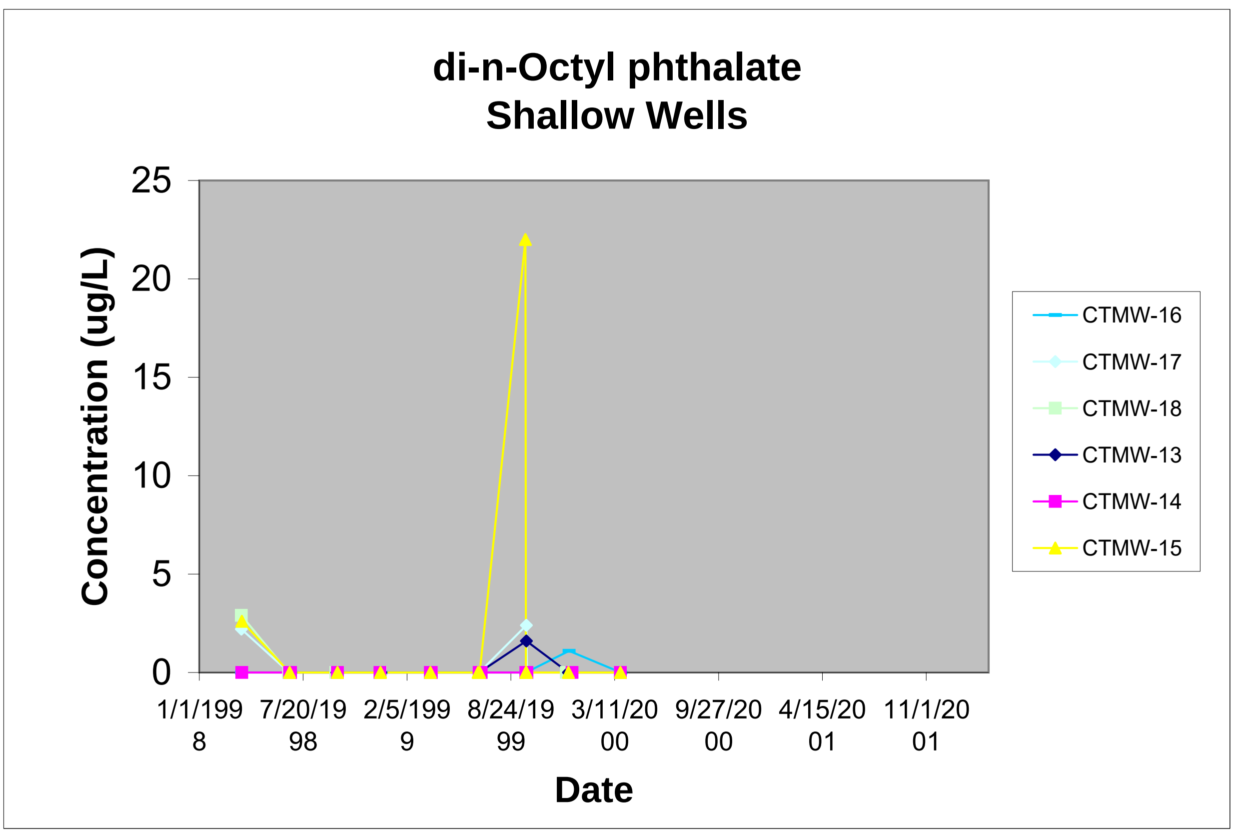


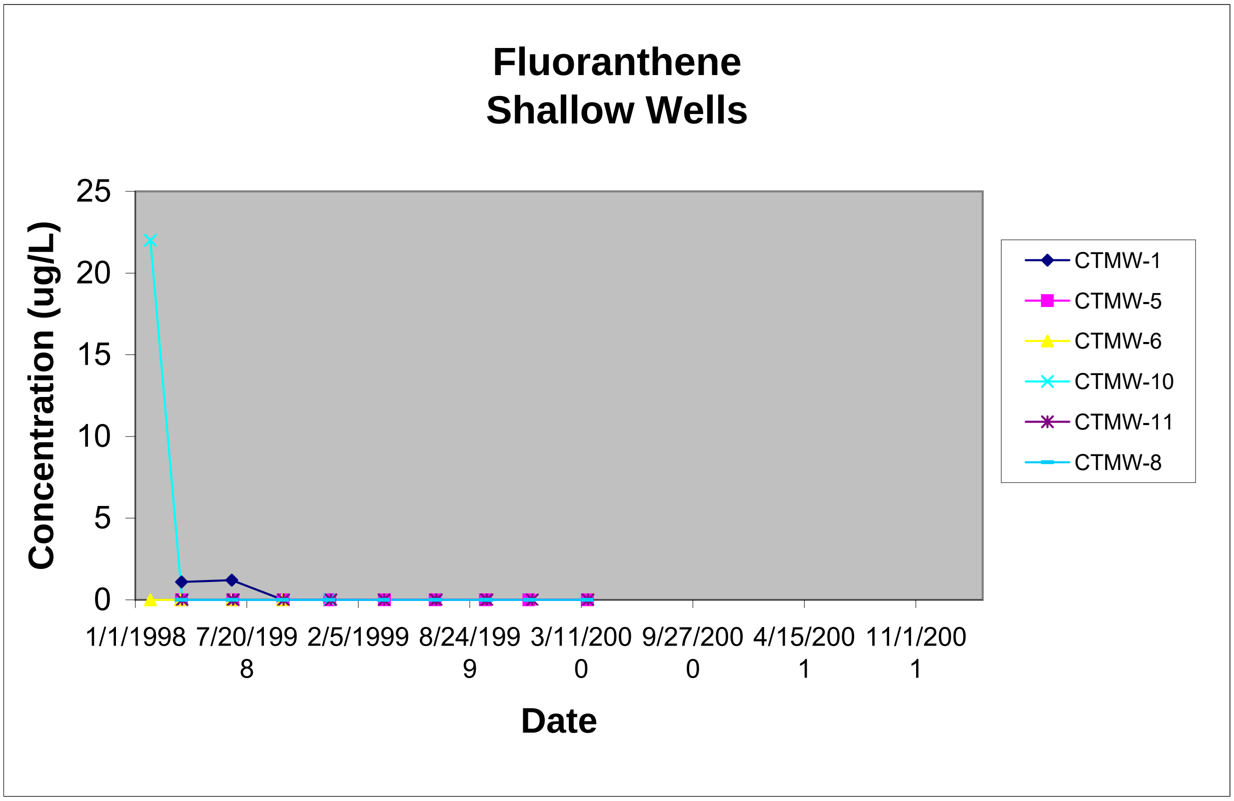
Dimethyl phthalate
Shallow Wells
Concentration (ug/L)
8
7
6
5
4
3
2
1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

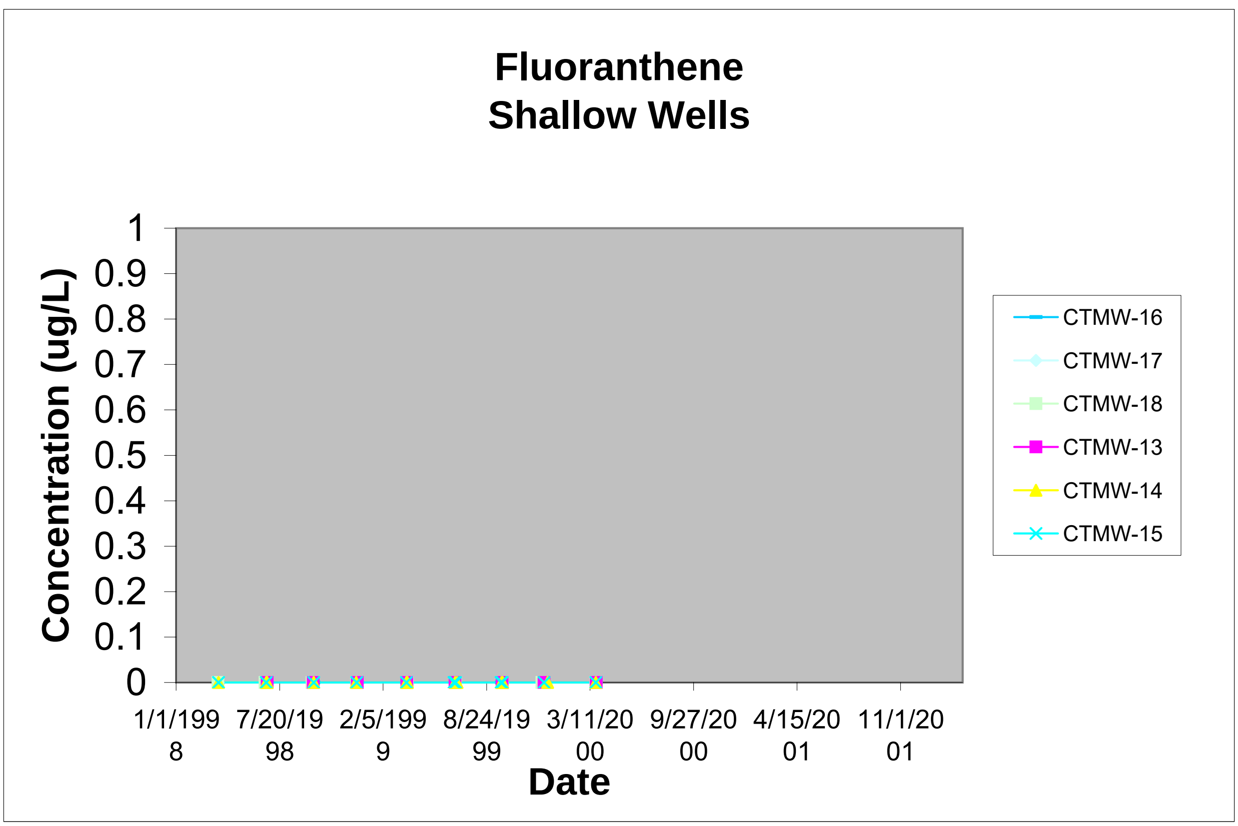


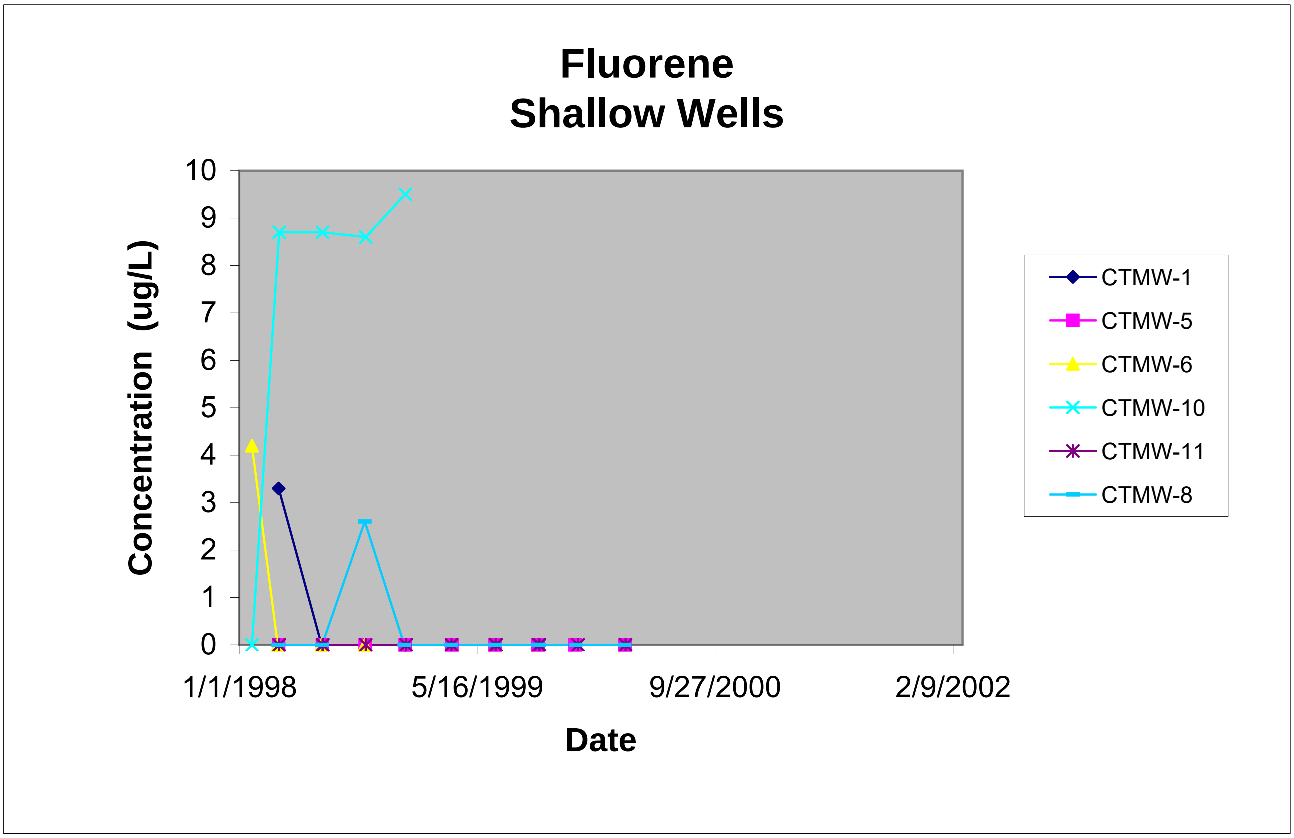
Dimethyl phthalate
Shallow Wells
Concentration (ug/L)
60
50
40
30
20
10
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

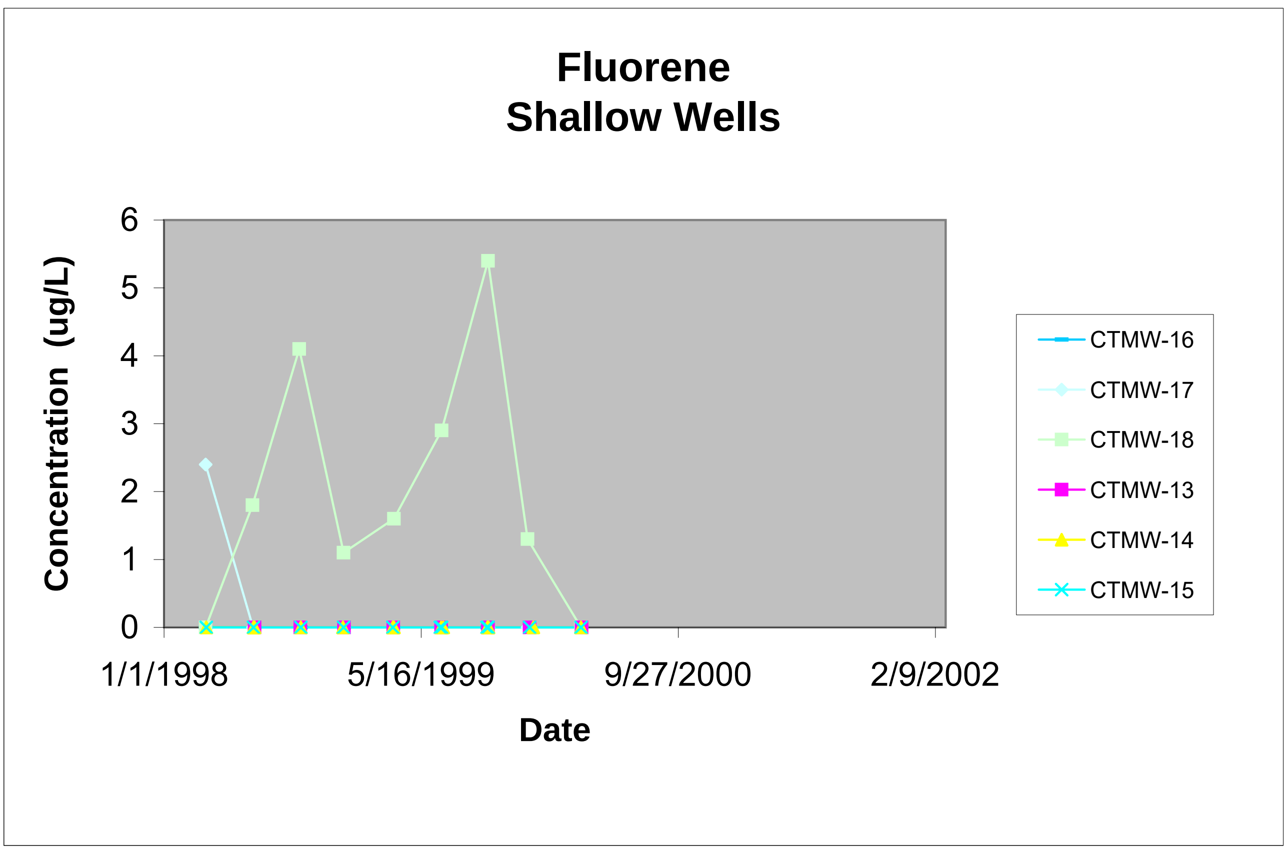

di-n-Octyl phthalate
Shallow Wells
Concentration (ug/L)
3
2.5
2
1.5
1
0.5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

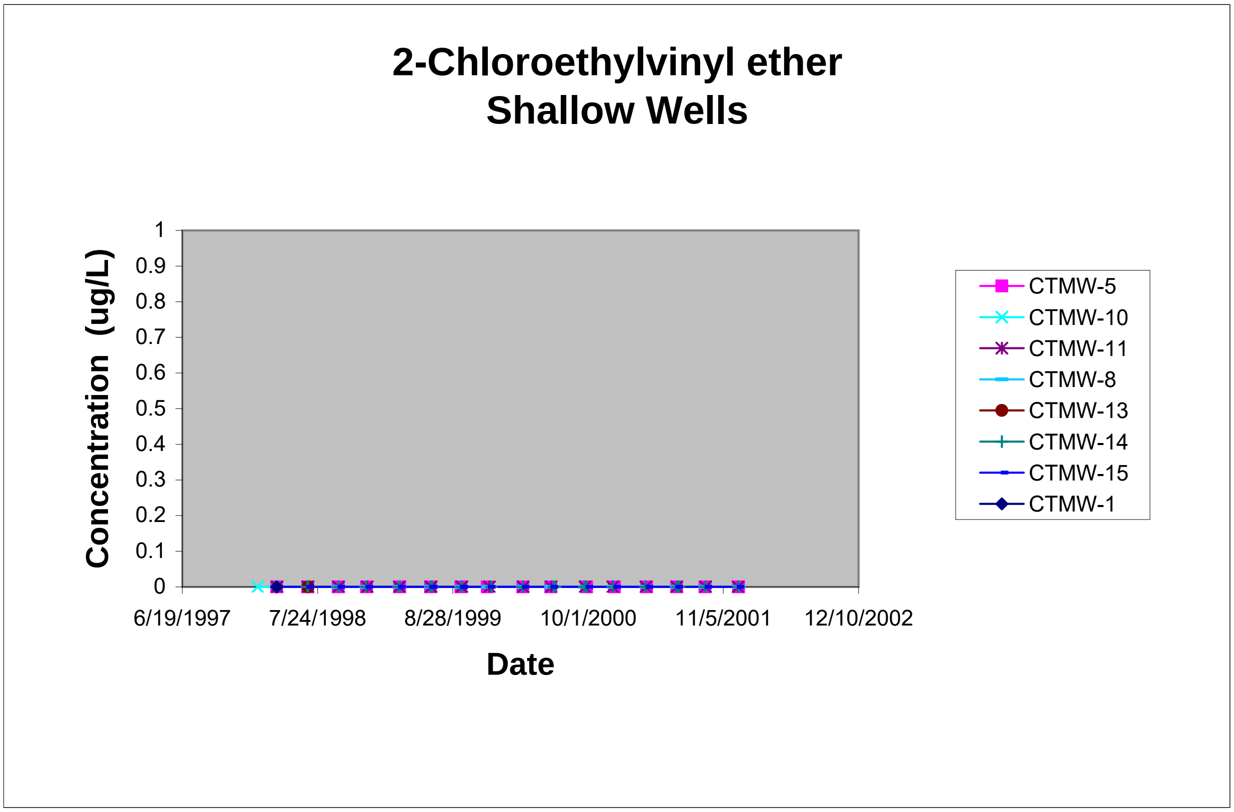

di-n-Octyl phthalate
Shallow Wells
Concentration (ug/L)
25
20
15
10
5
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

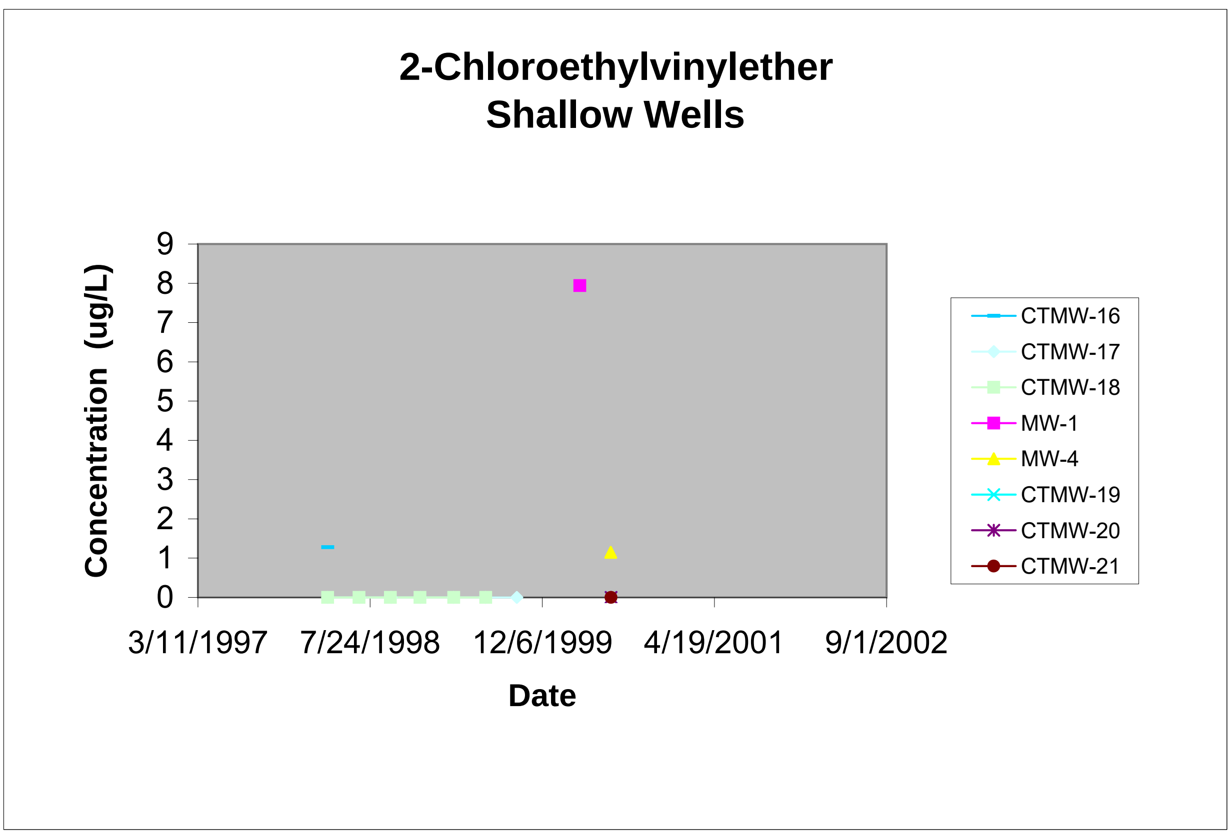

Fluoranthene
Shallow Wells
Concentration (ug/L)
25
20
15
10
5
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

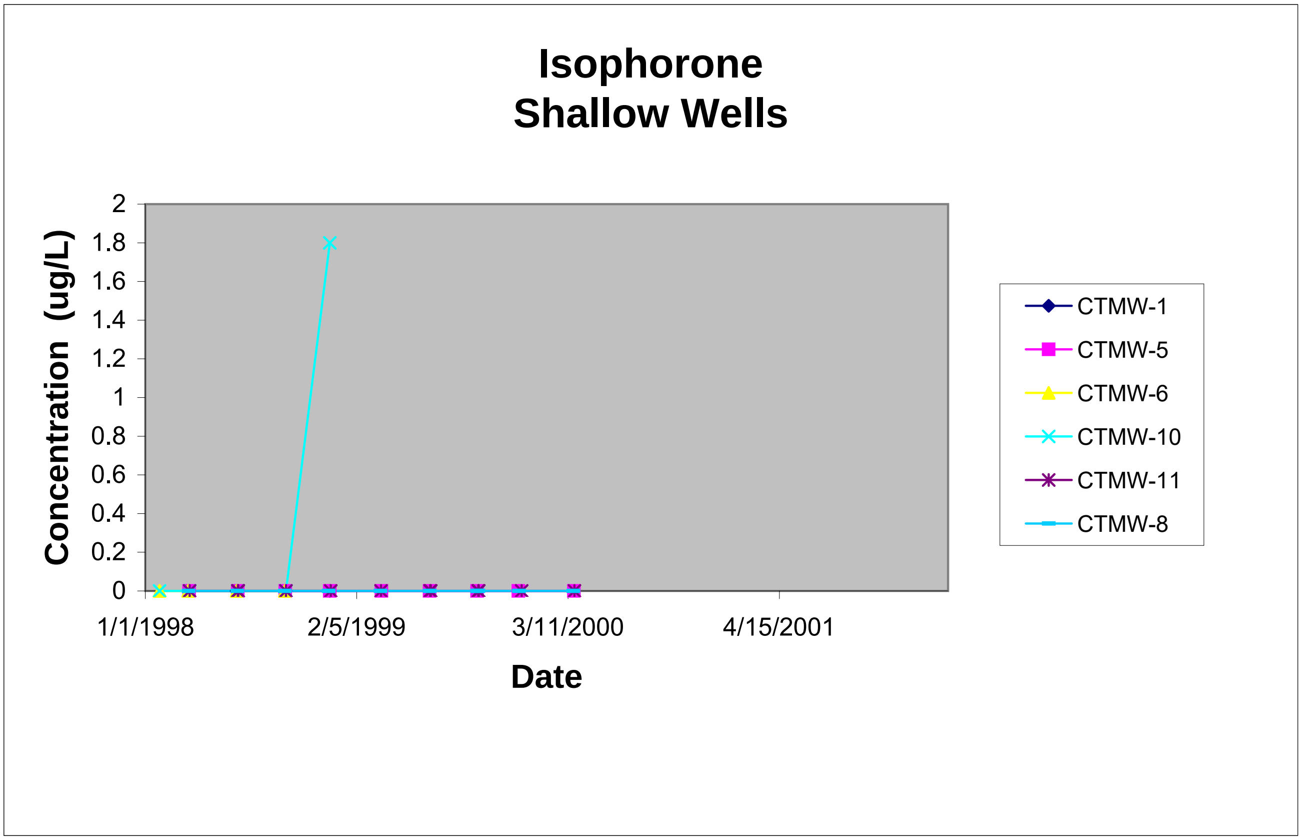

Fluoranthene
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

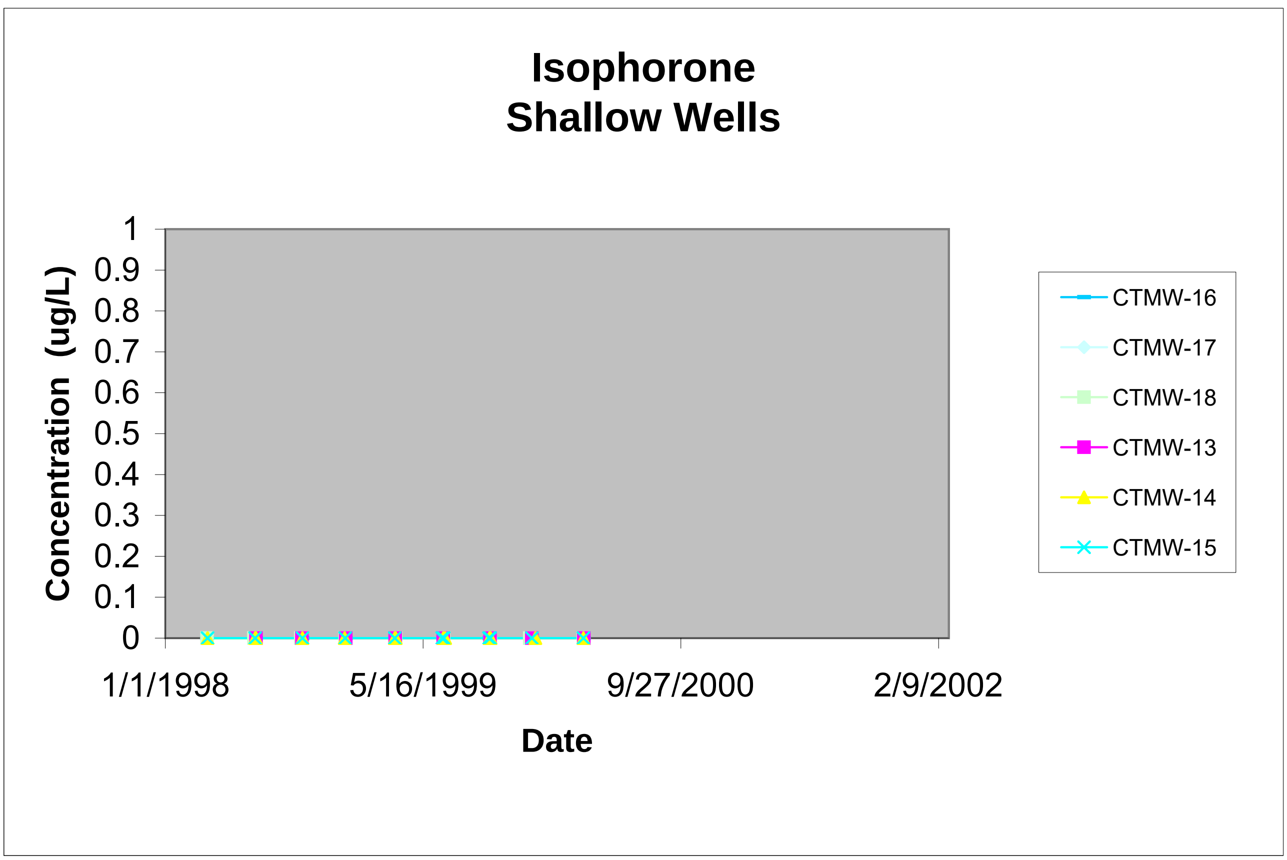

Fluorene
Shallow Wells
Concentration (ug/L)
10
9
8
7
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

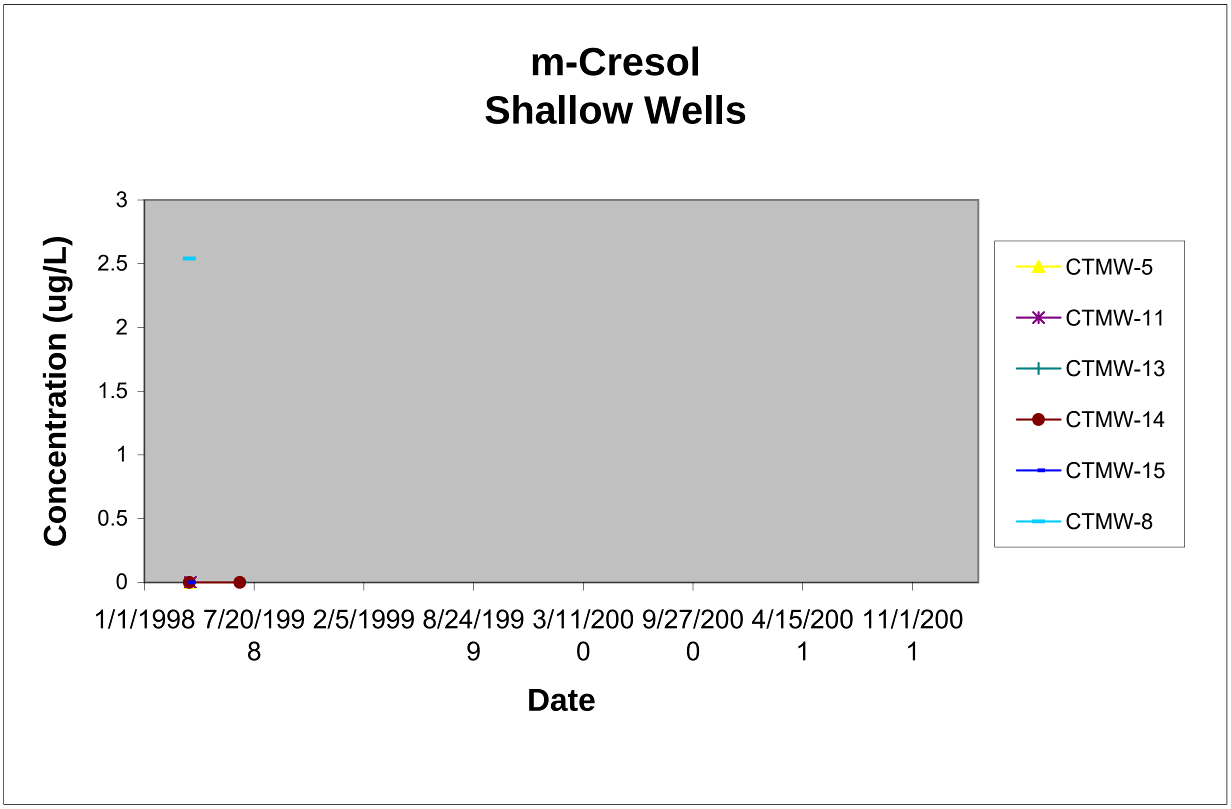

Fluorene
Shallow Wells
Concentration (ug/L)
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


2-Chloroethylvinyl ether
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/19/1997
7/24/1998
8/28/1999
10/1/2000
11/5/2001
12/10/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-15
CTMW-1

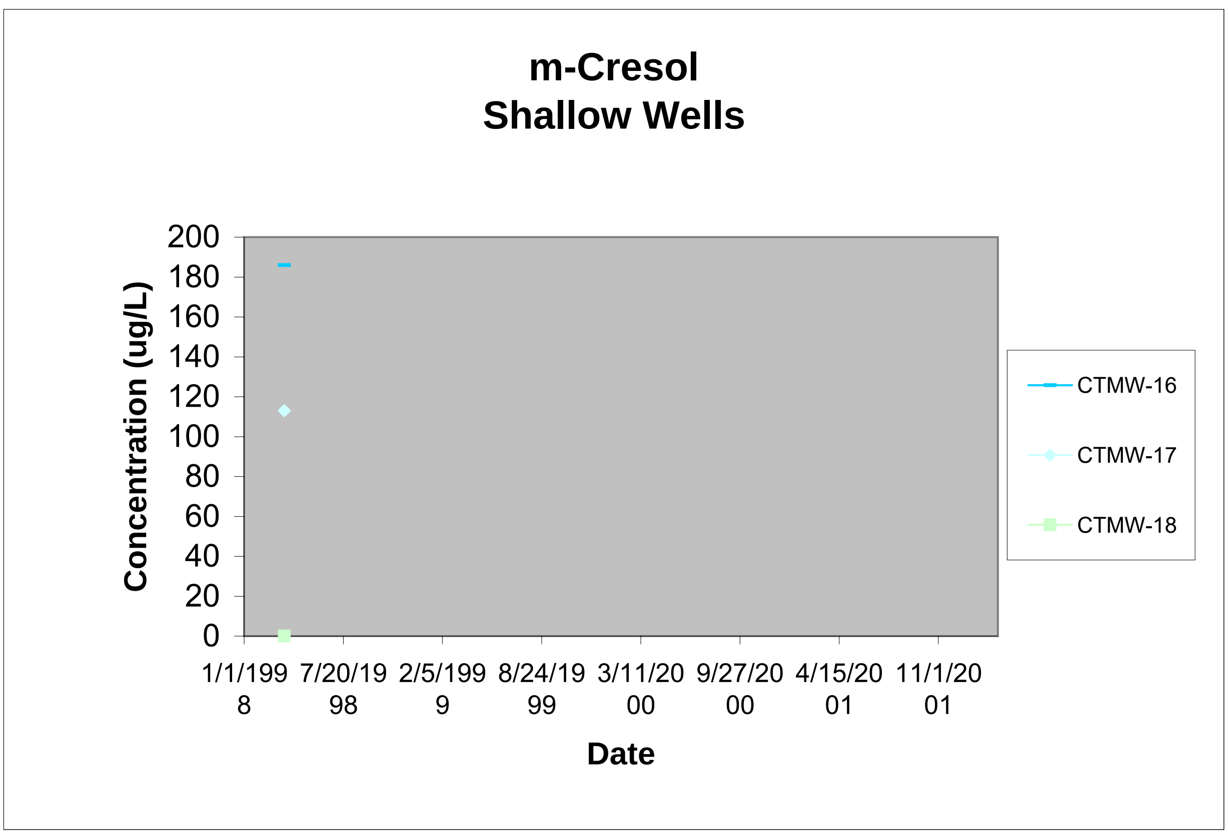

2-Chloroethylvinylether
Shallow Wells
Concentration (ug/L)
9
8
7
6
5
4
3
2
1
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
MW-1
MW-4
CTMW-19
CTMW-20
CTMW-21


Isophorone
Shallow Wells
Concentration (ug/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

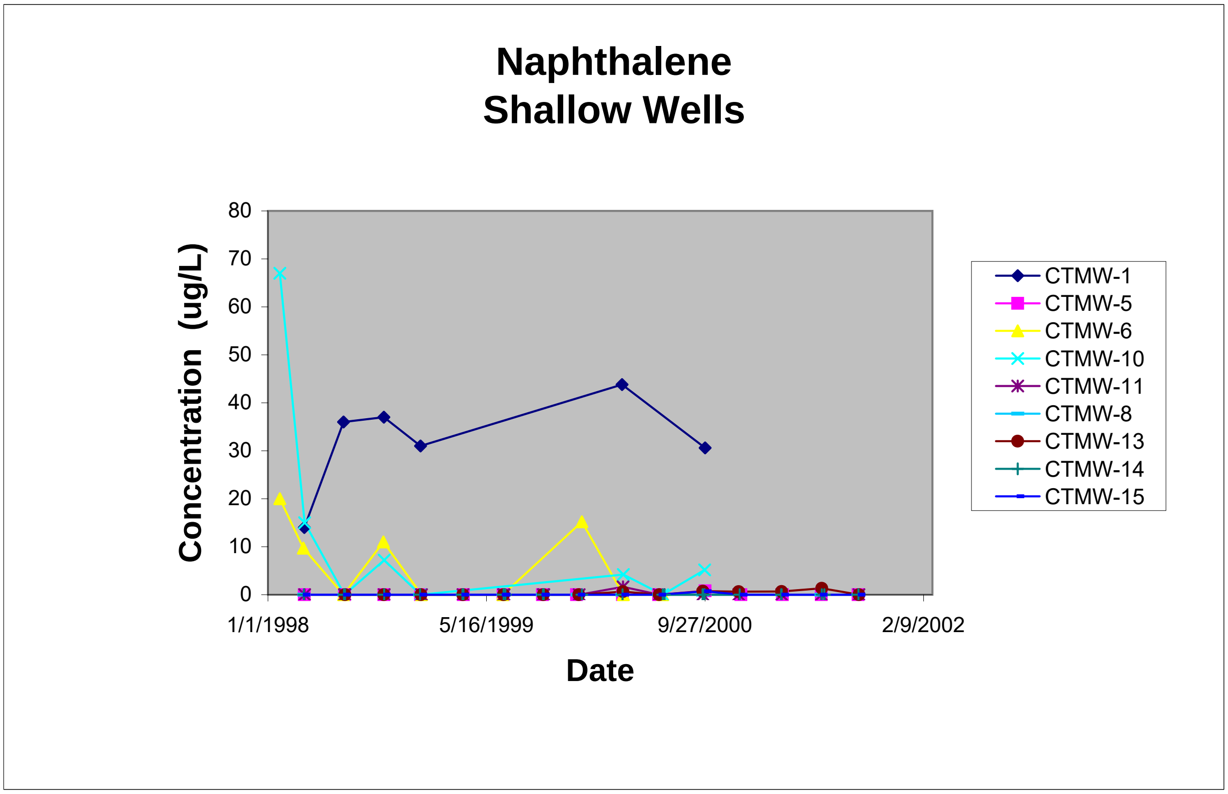

Isophorone
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15



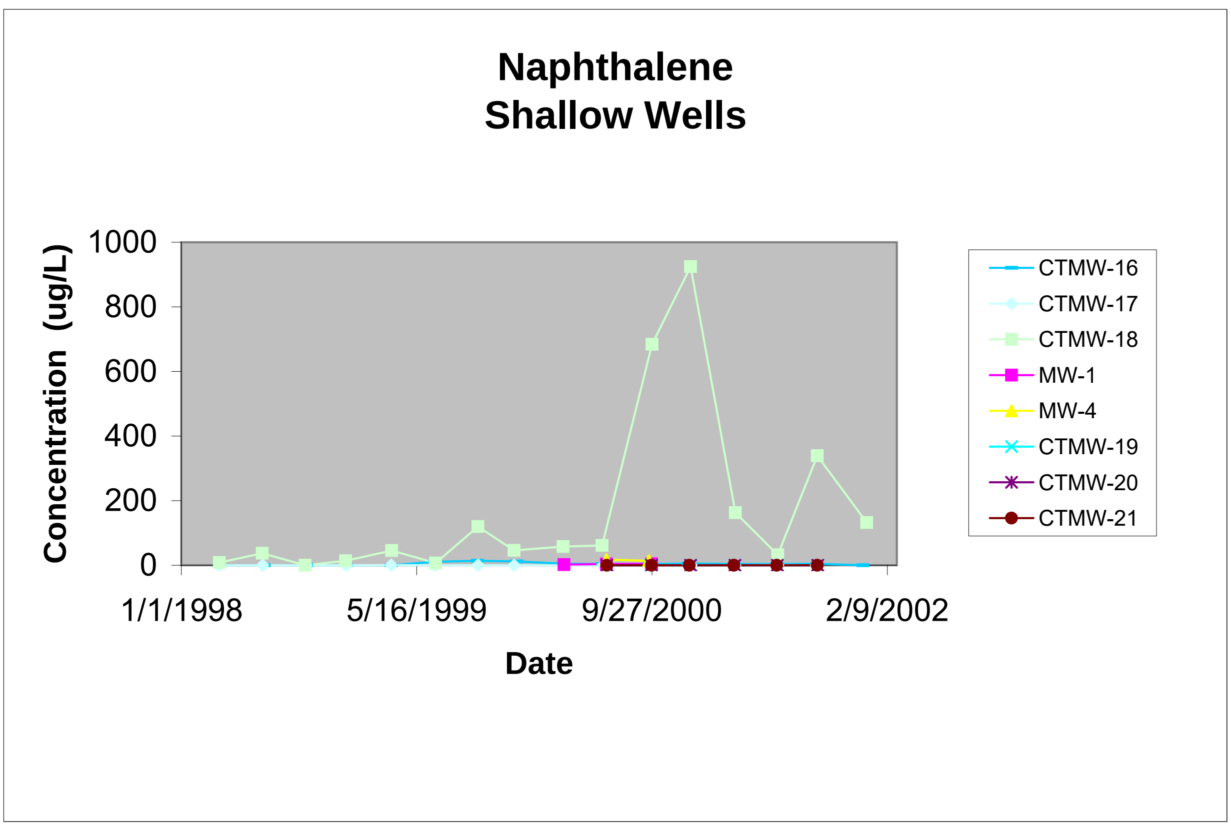
m-Cresol
Shallow Wells
Concentration (ug/L)
3
2.5
2
1.5
1
0.5
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-5
CTMW-11
CTMW-13
CTMW-14
CTMW-15
CTMW-8



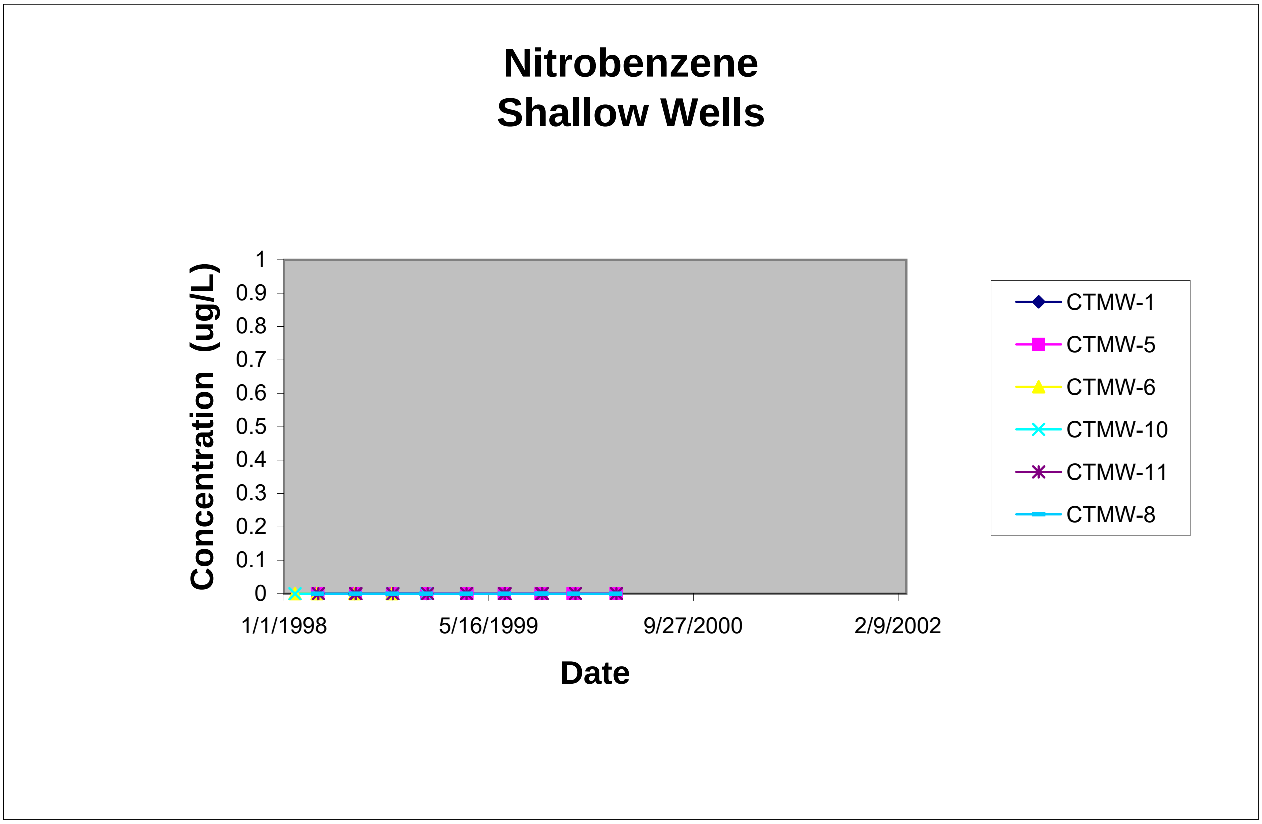
m-Cresol
Shallow Wells
Concentration (ug/L)
200
180
160
140
120
100
80
60
40
20
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18

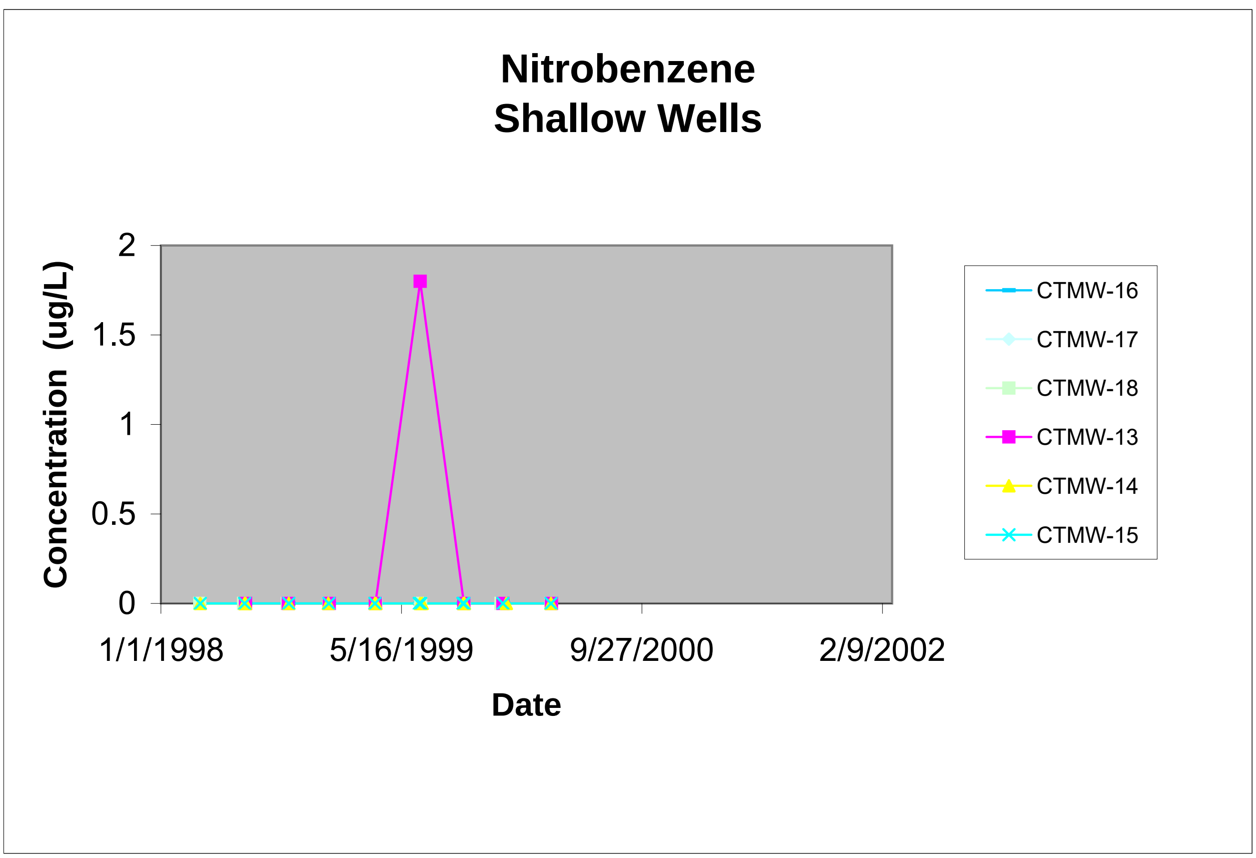


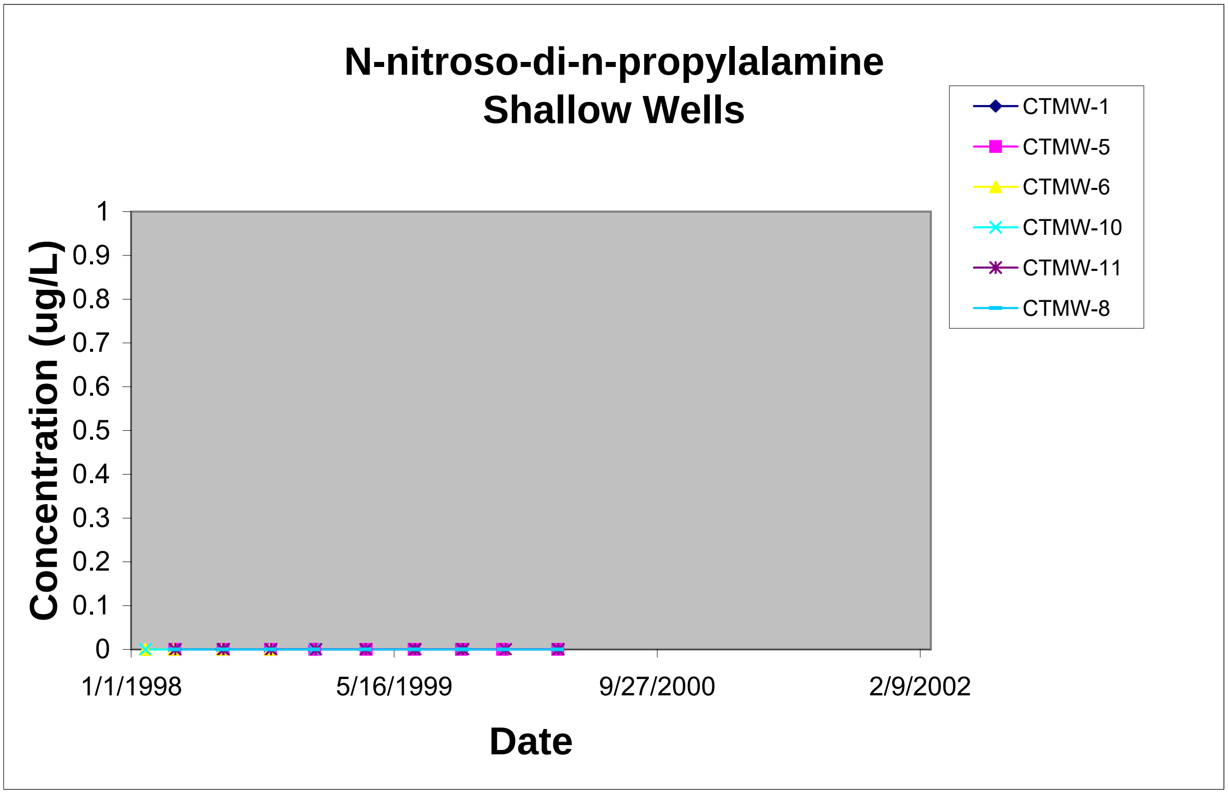
Naphthalene
Shallow Wells
Concentration (ug/L)
80
70
60
50
40
30
20
10
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-15

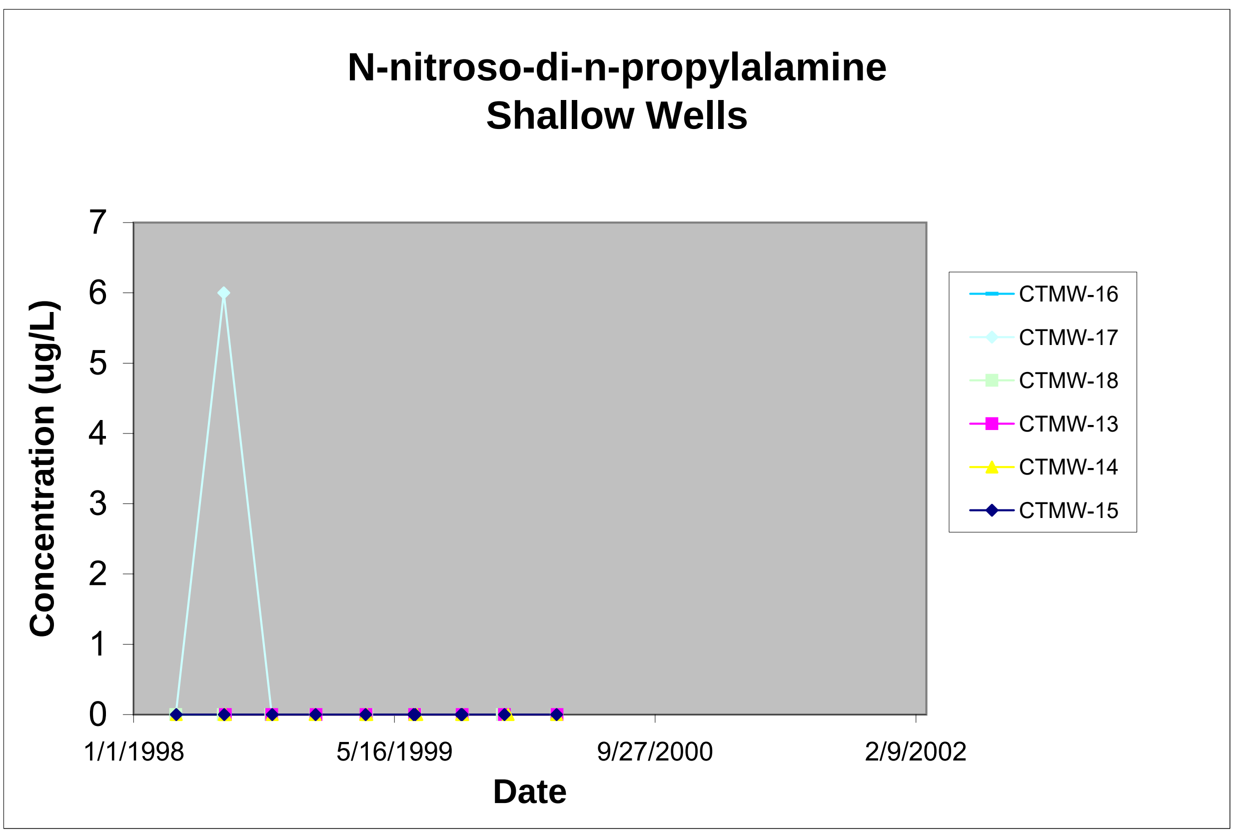


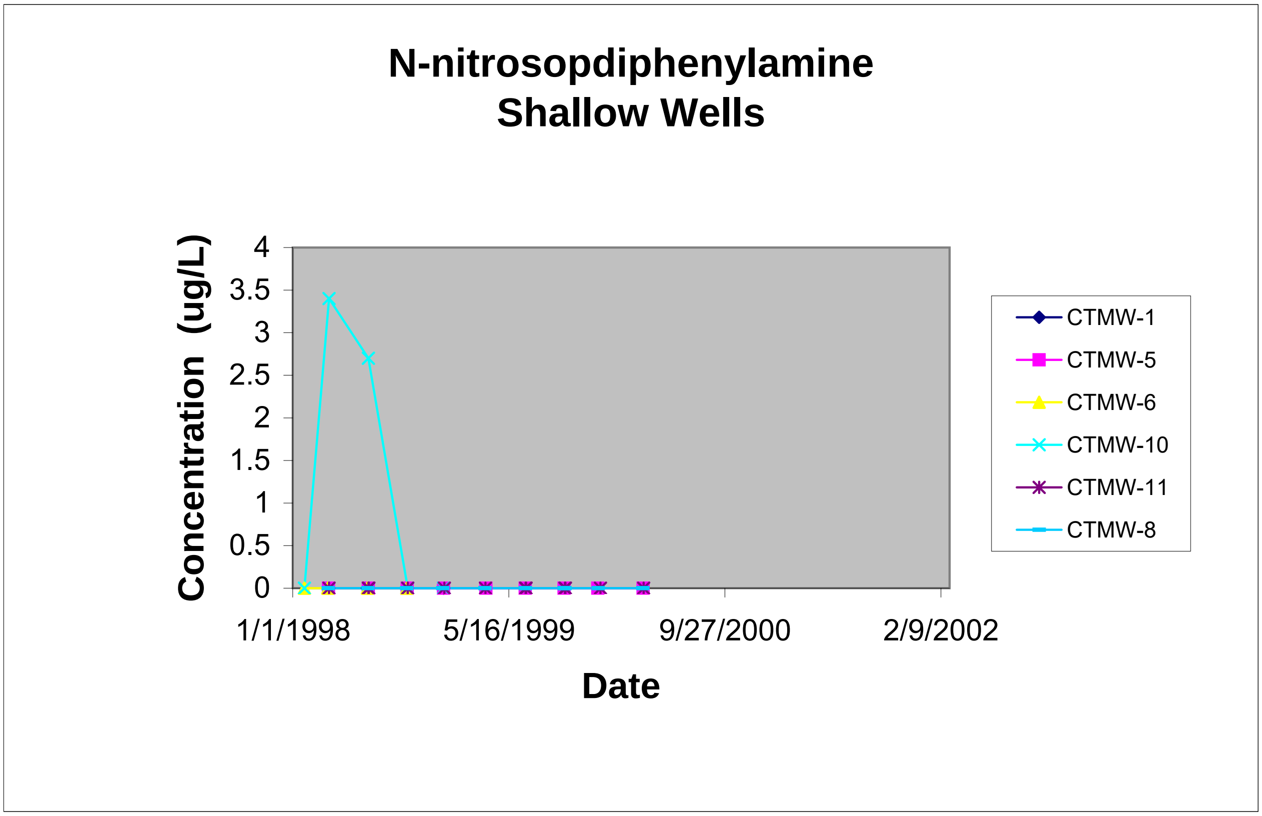
Naphthalene
Shallow Wells
Concentration (ug/L)
1000
800
600
400
200
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
MW-1
MW-4
CTMW-19
CTMW-20
CTMW-21


Nitrobenzene
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

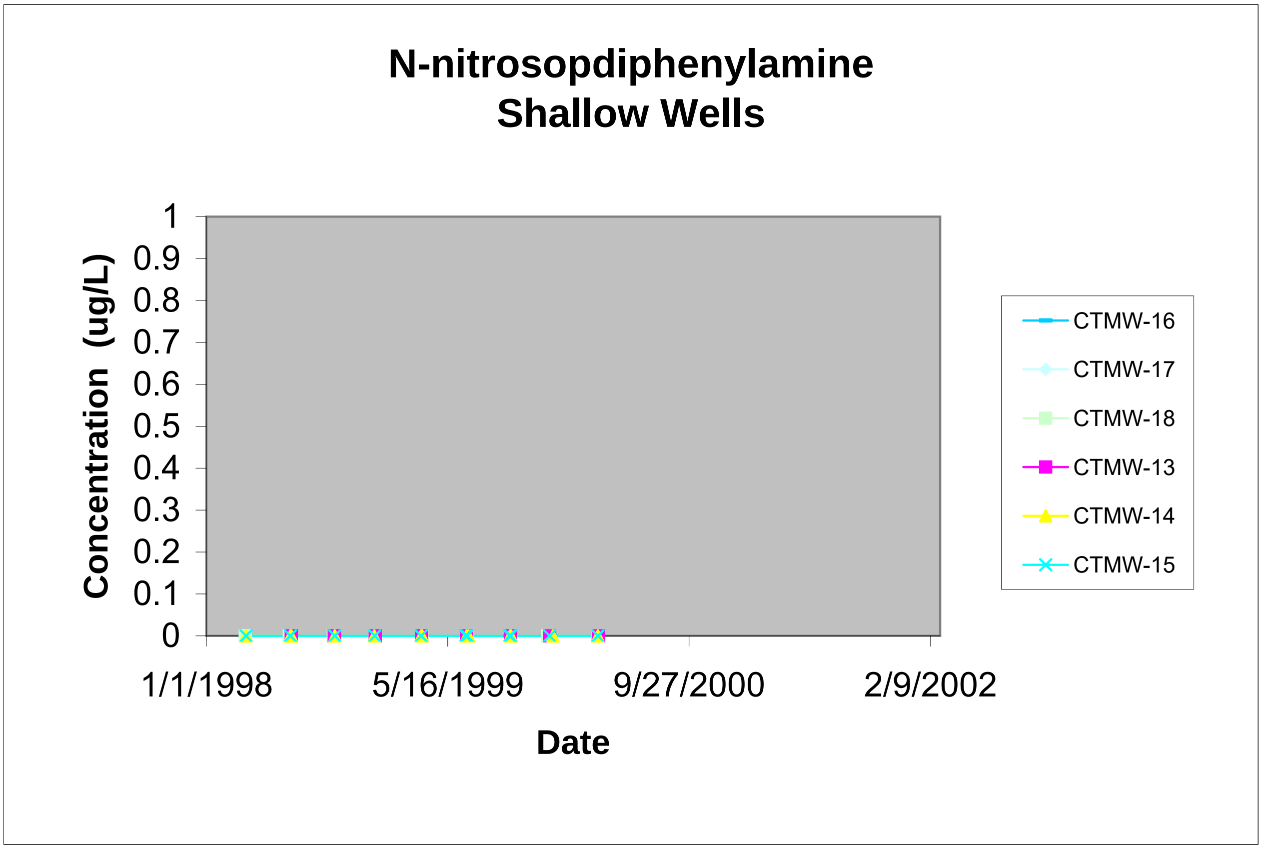

Nitrobenzene
Shallow Wells
Concentration (ug/L)
2
1.5
1
0.5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


N-nitroso-di-n-propylalamine
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

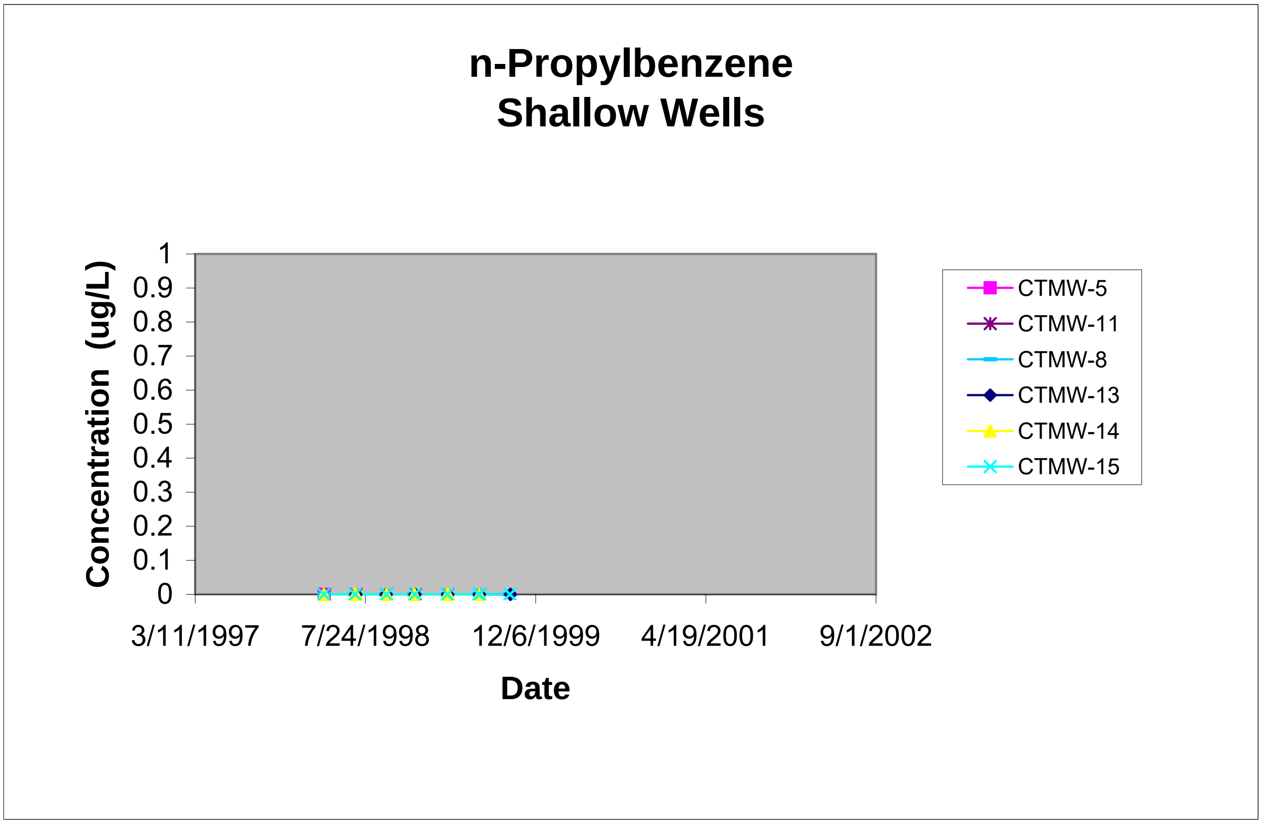

N-nitroso-di-n-propylalamine
Shallow Wells
Concentration (ug/L)
7
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

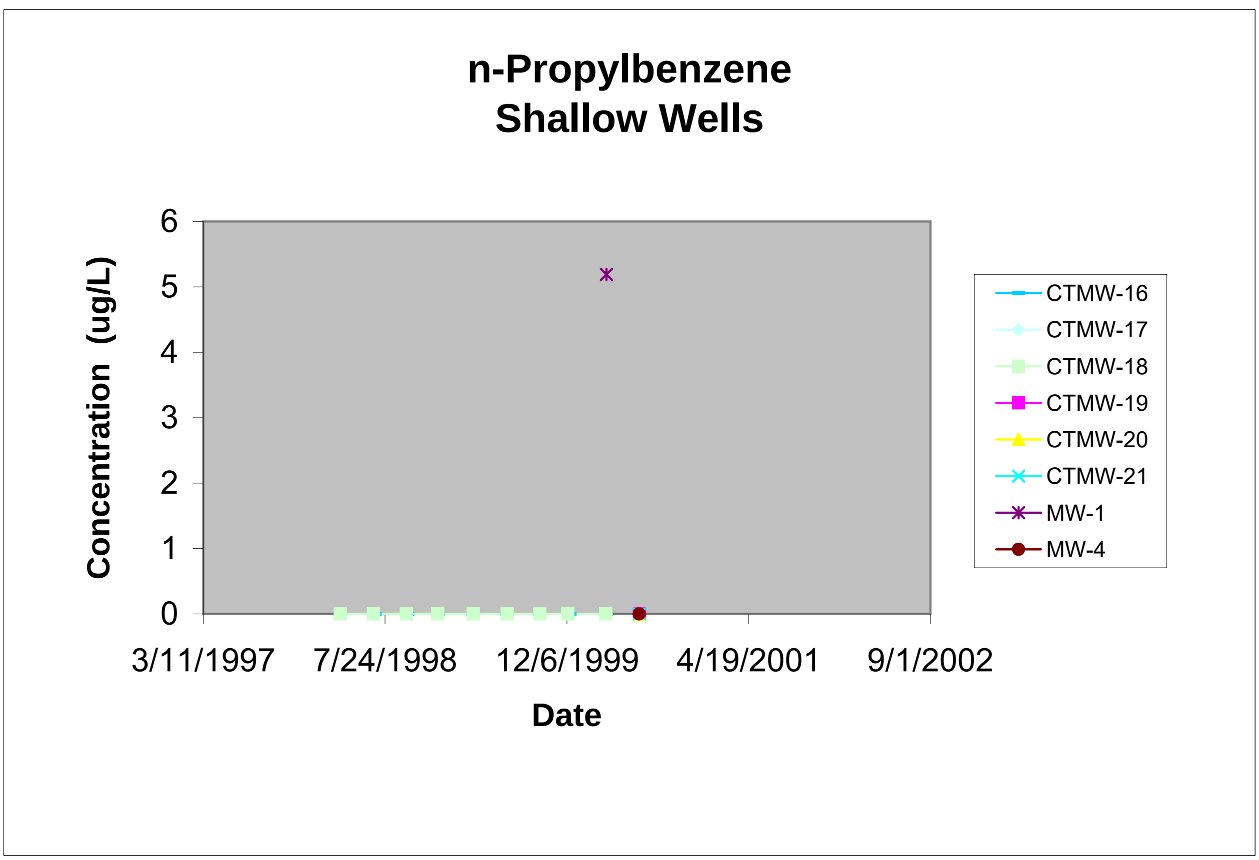


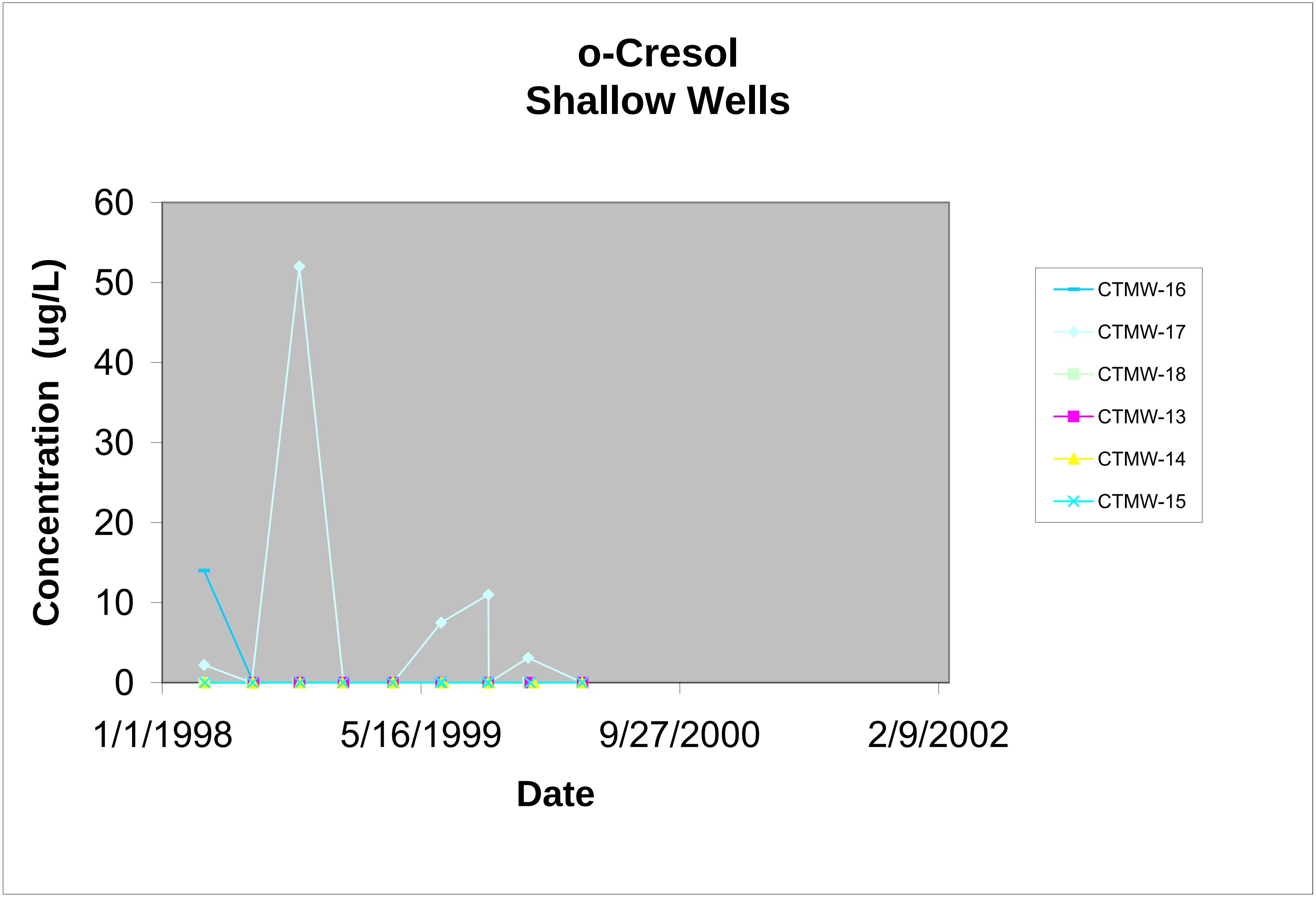
N-nitrosopdiphenylamine
Shallow Wells
Concentration (ug/L)
4
3.5
3
2.5
2
1.5
1
0.5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

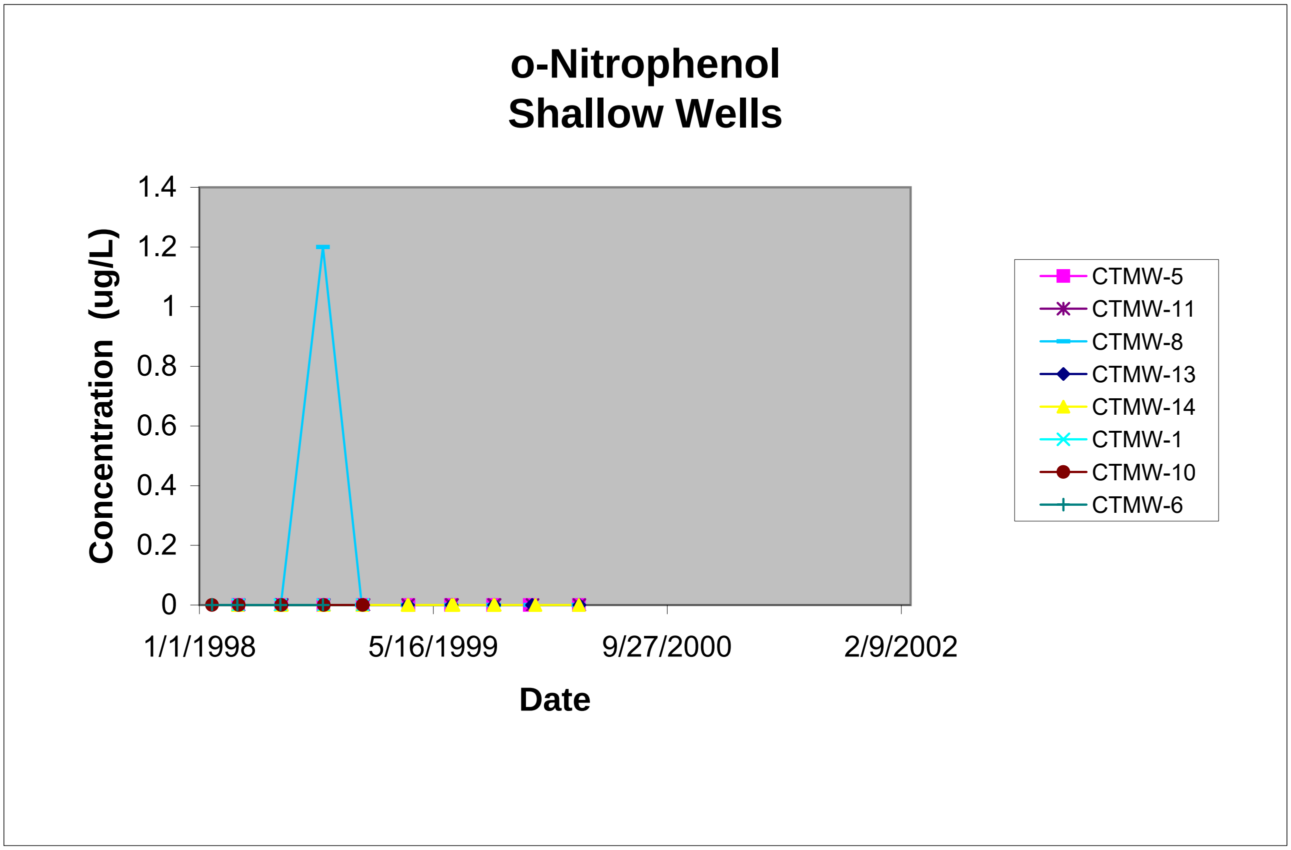


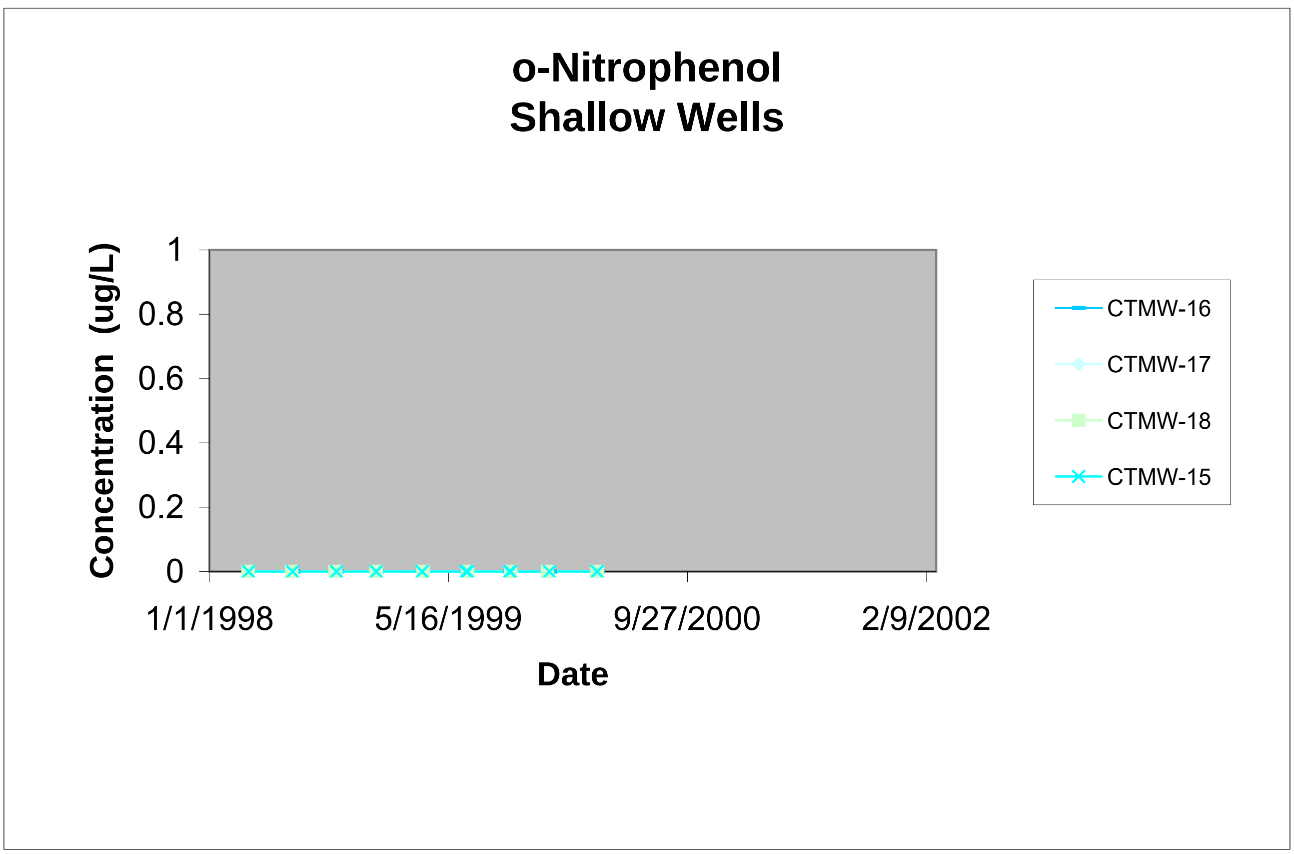
N-nitrosopdiphenylamine
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

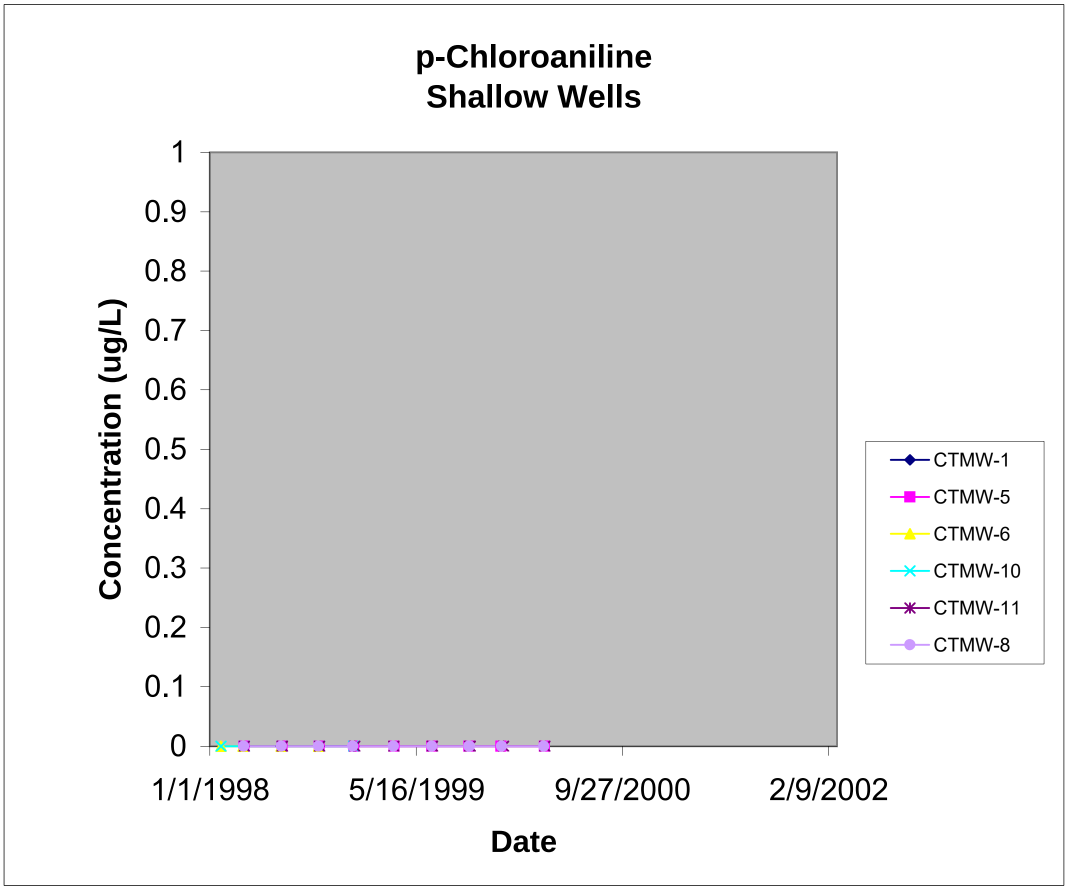

n-Propylbenzene
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-5
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-15


n-Propylbenzene
Shallow Wells
Concentration (ug/L)
6
5
4
3
2
1
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-19
CTMW-20
CTMW-21
MW-1
MW-4

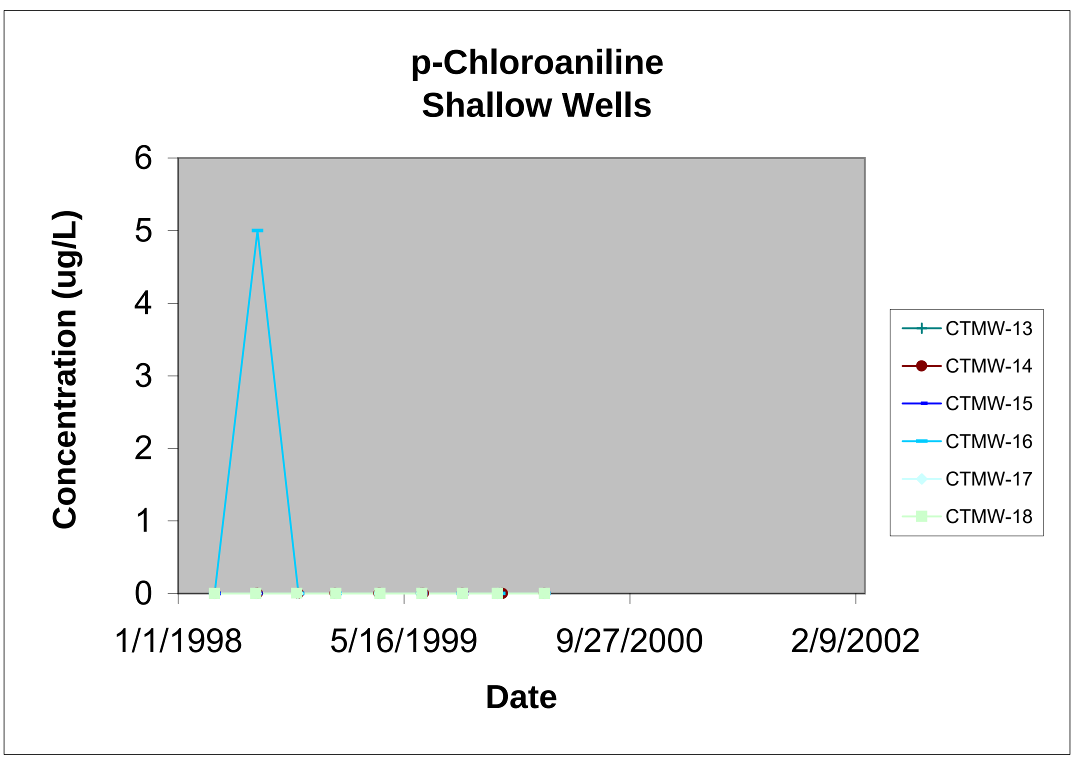

o-Cresol
Shallow Wells
60
50
40
30
20
10
0
Concentration (ug/L)
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


o-Nitrophenol
Shallow Wells
Concentration (ug/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-5
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-1
CTMW-10
CTMW-6

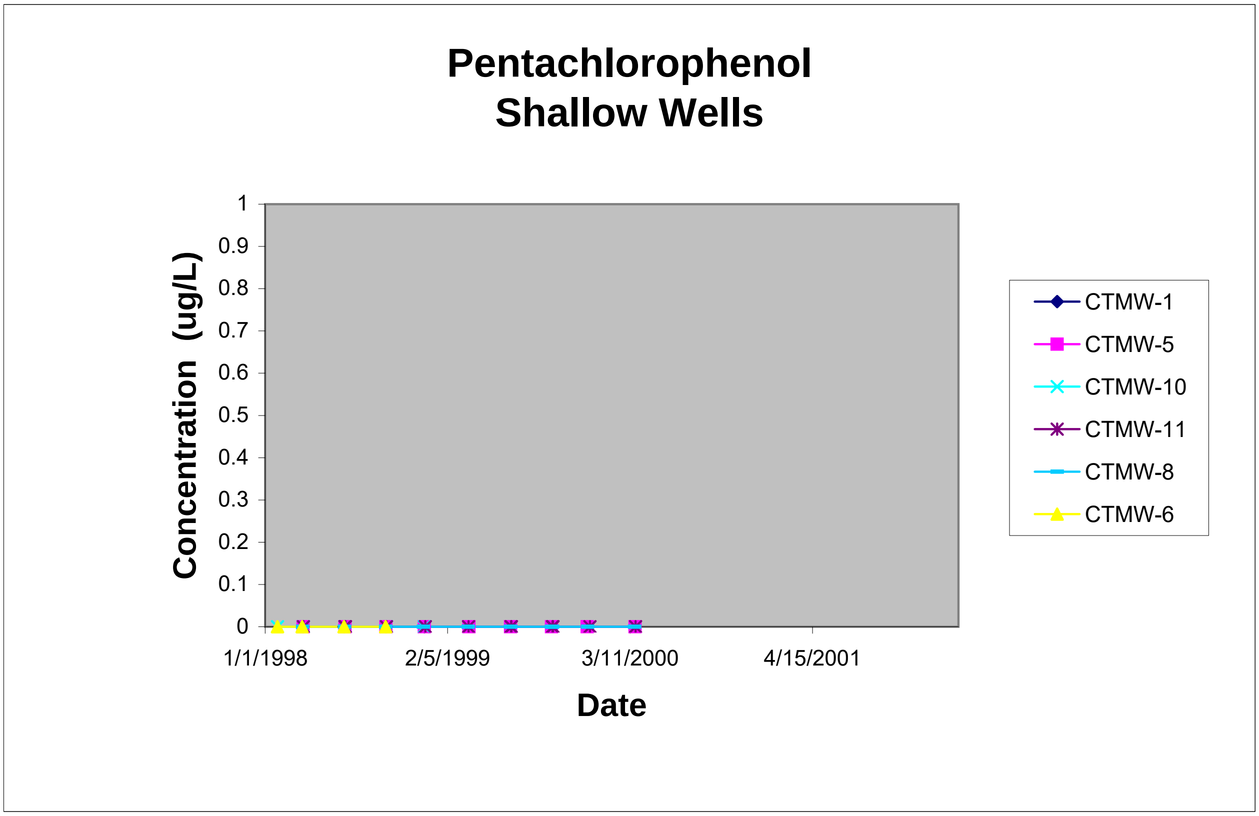

o-Nitrophenol
Shallow Wells
Concentration (ug/L)
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15

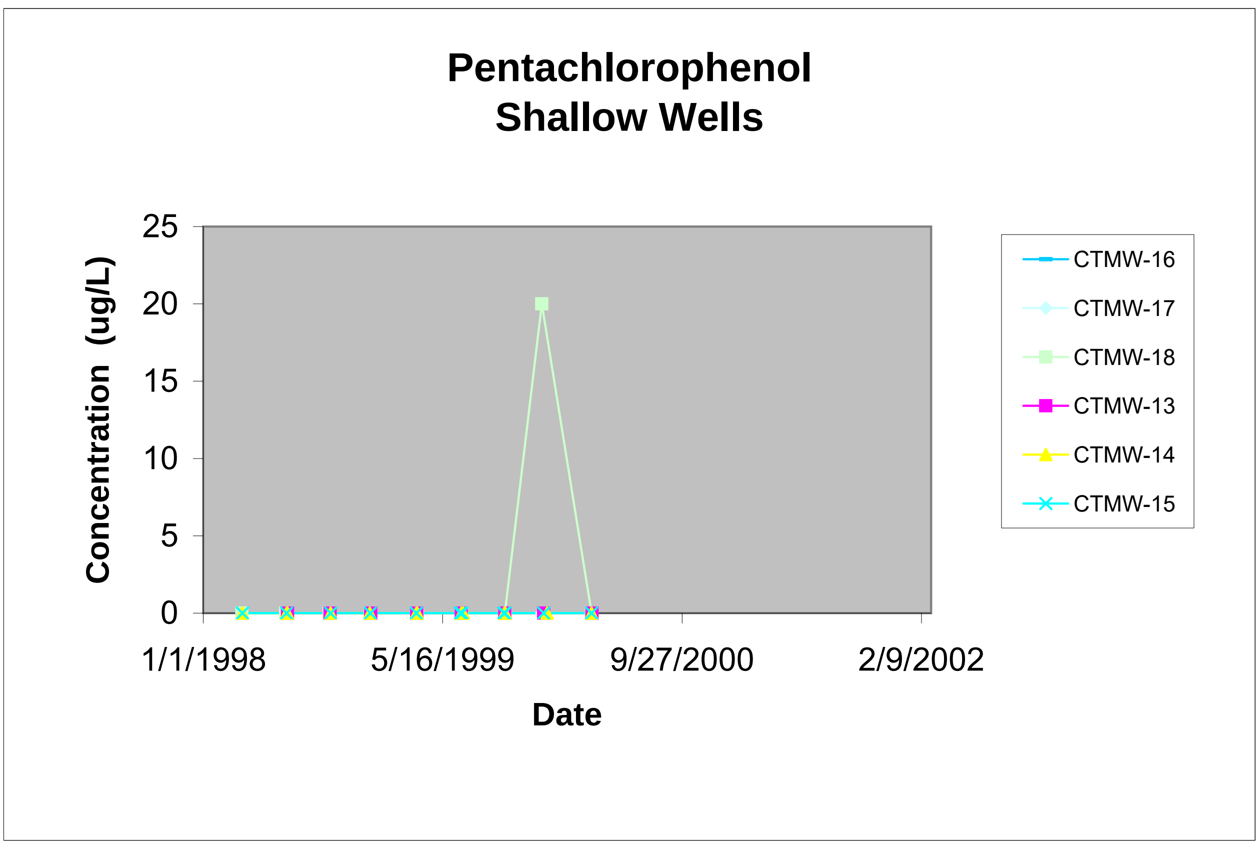


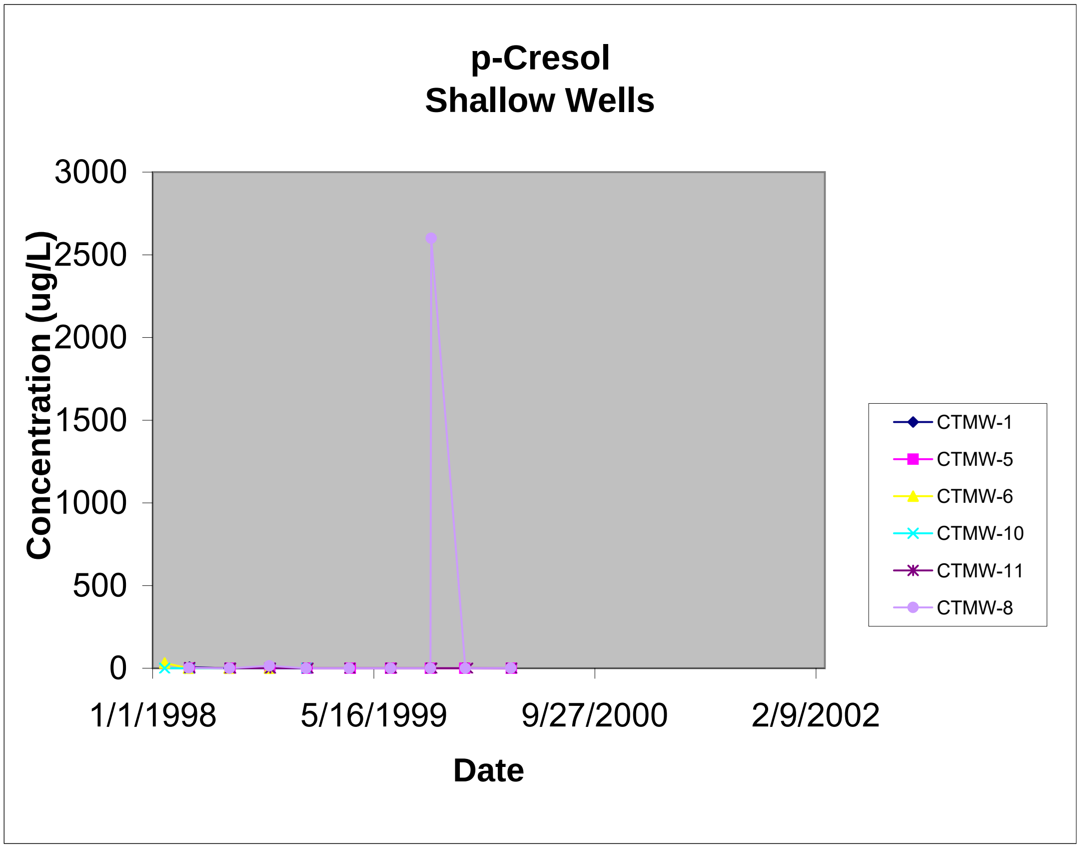
p-Chloroaniline
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

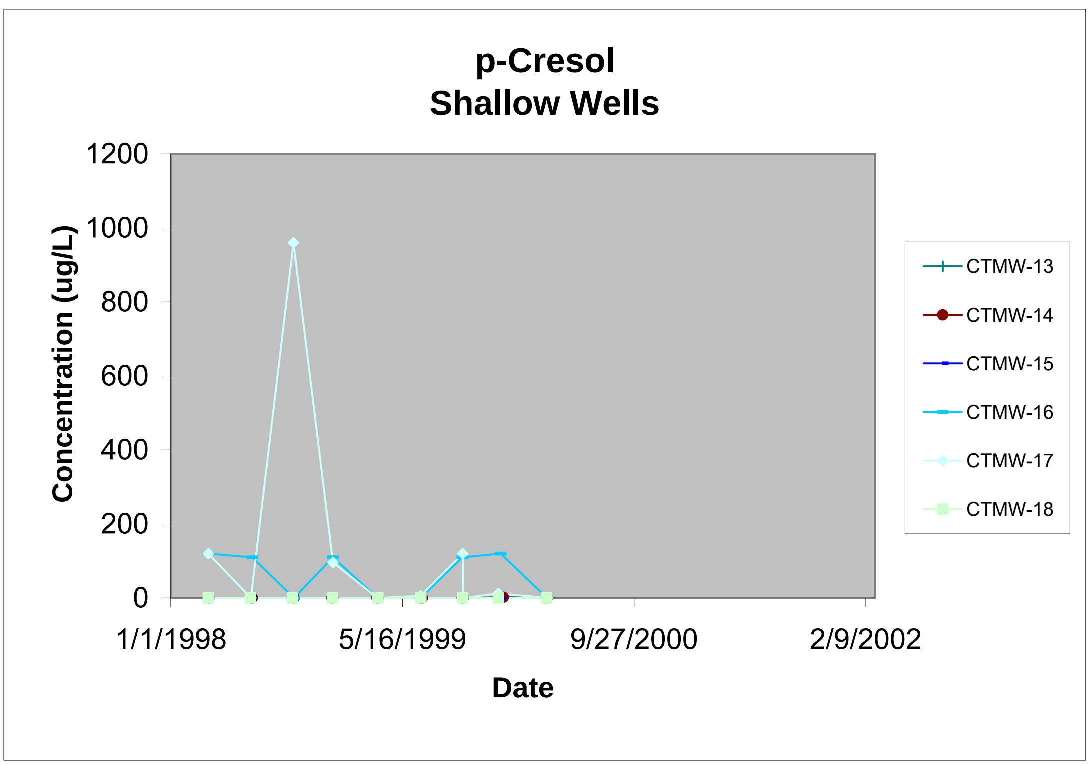


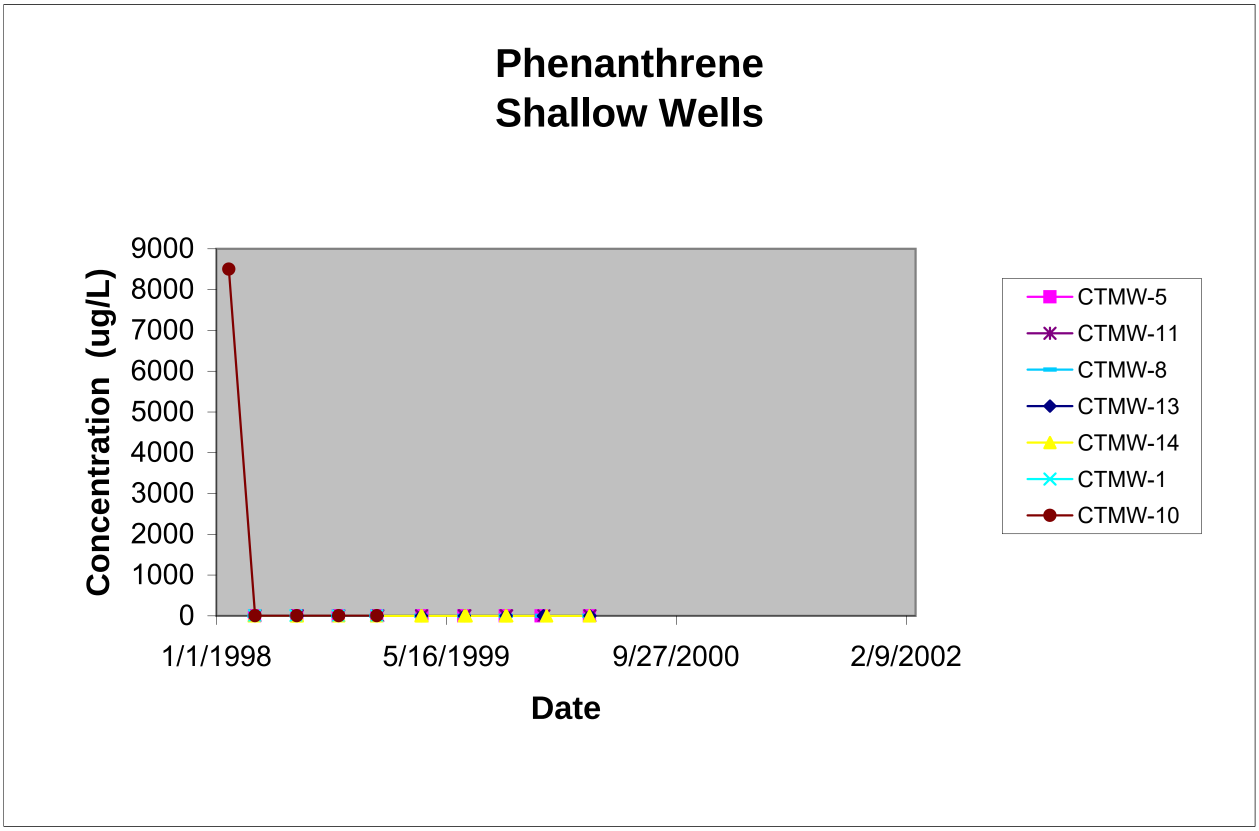
p-Chloroaniline
Shallow Wells
Concentration (ug/L)
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-13
CTMW-14
CTMW-15
CTMW-16
CTMW-17
CTMW-18

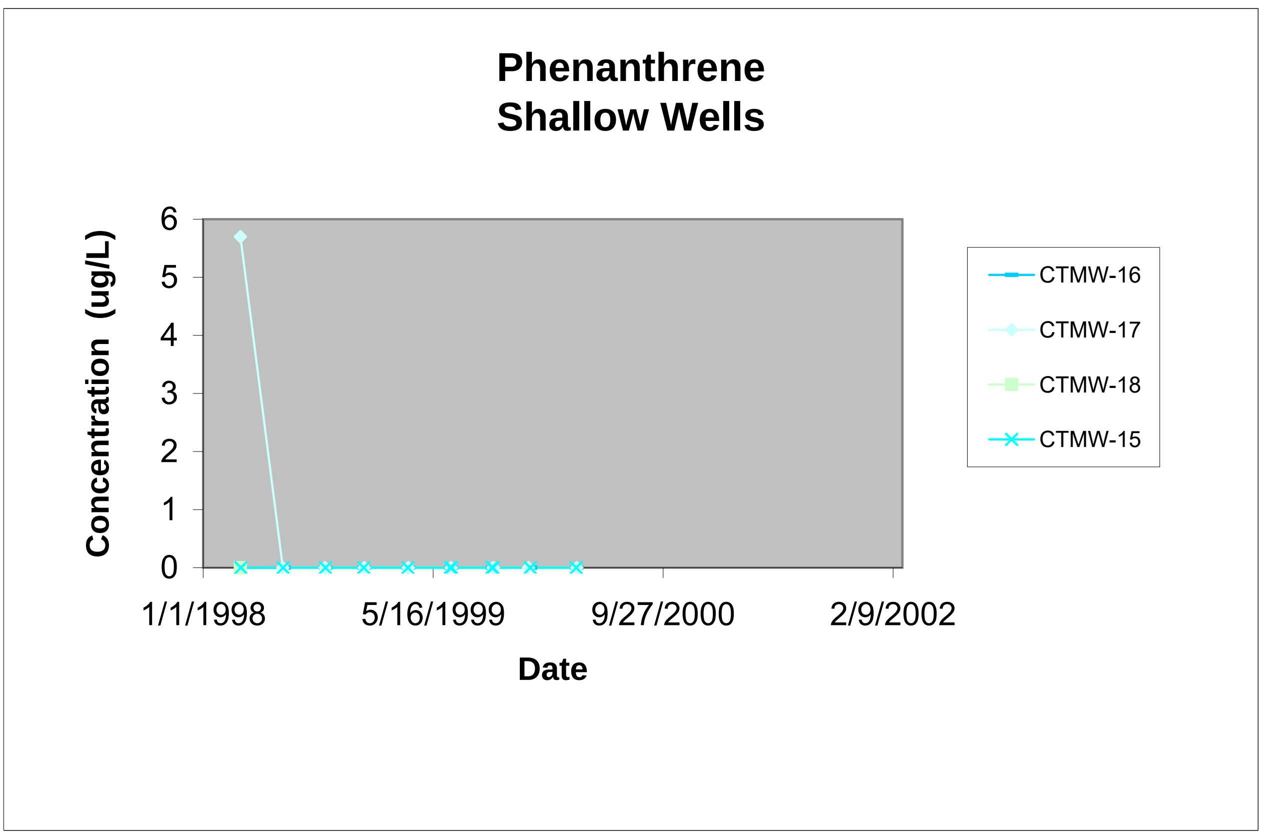

Pentachlorophenol
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
2/5/1999
3/11/2000
4/15/2001
Date
CTMW-1
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-6

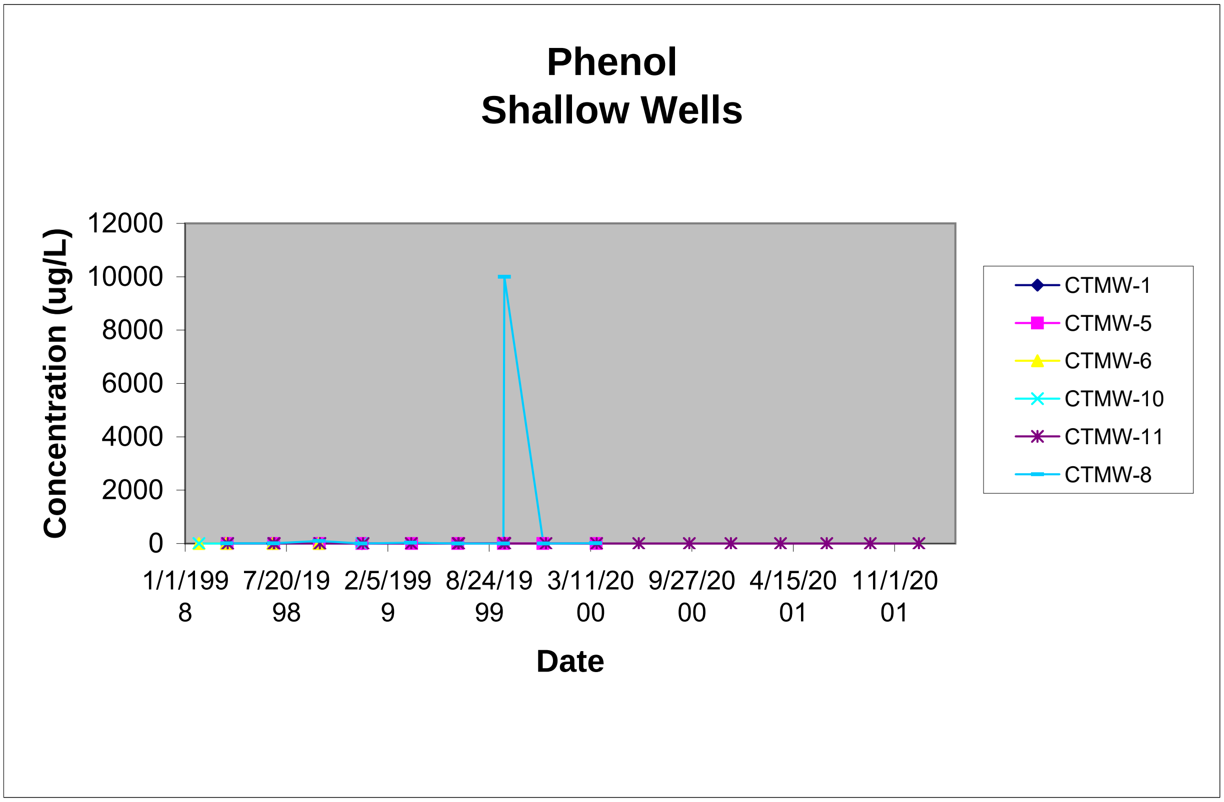

Pentachlorophenol
Shallow Wells
Concentration (ug/L)
25
20
15
10
5
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

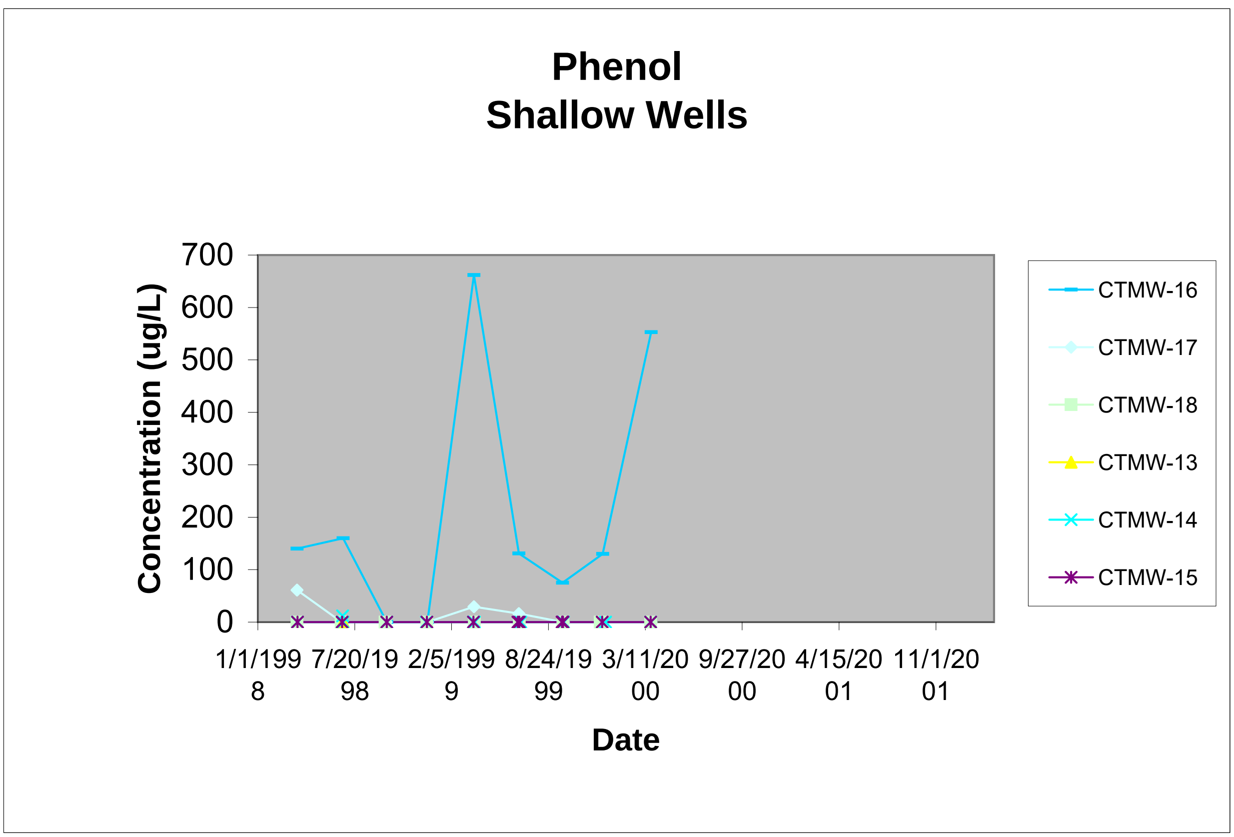

p-Cresol
Shallow Wells
Concentration (ug/L)
3000
2500
2000
1500
1000
500
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

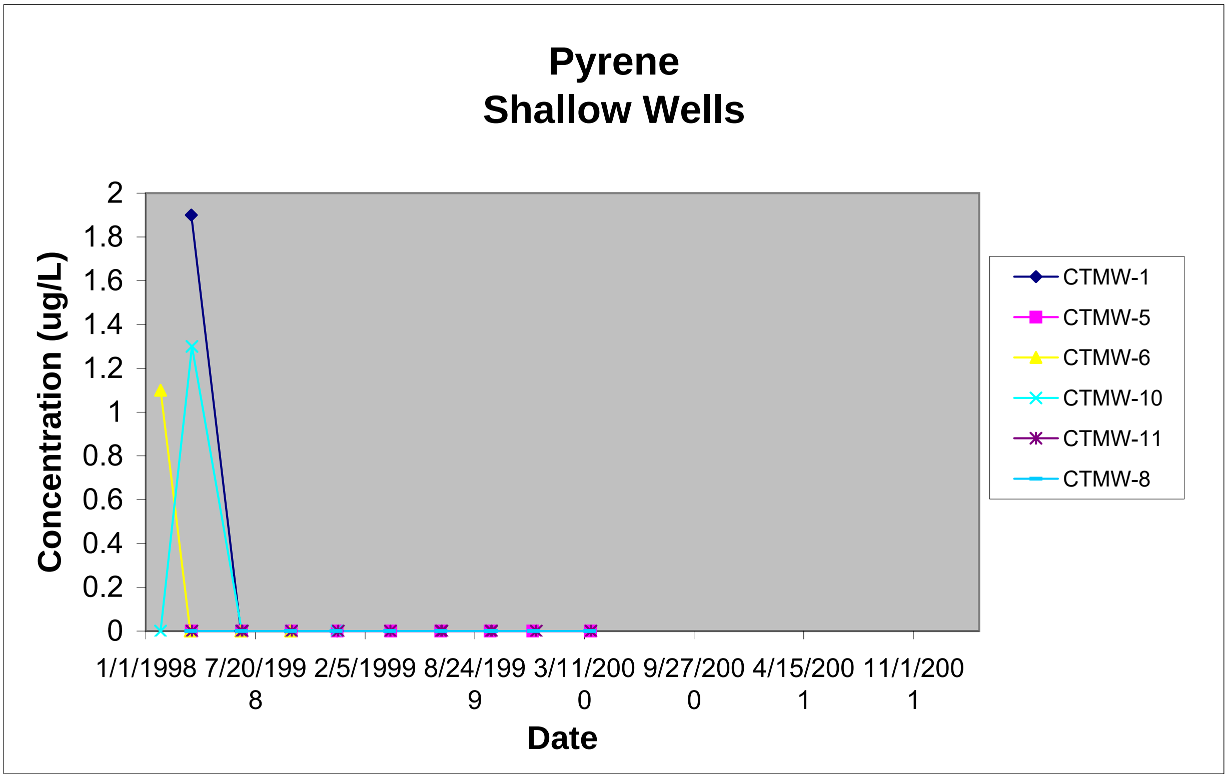

p-Cresol
Shallow Wells
Concentration (ug/L)
1200
1000
800
600
400
200
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-13
CTMW-14
CTMW-15
CTMW-16
CTMW-17
CTMW-18

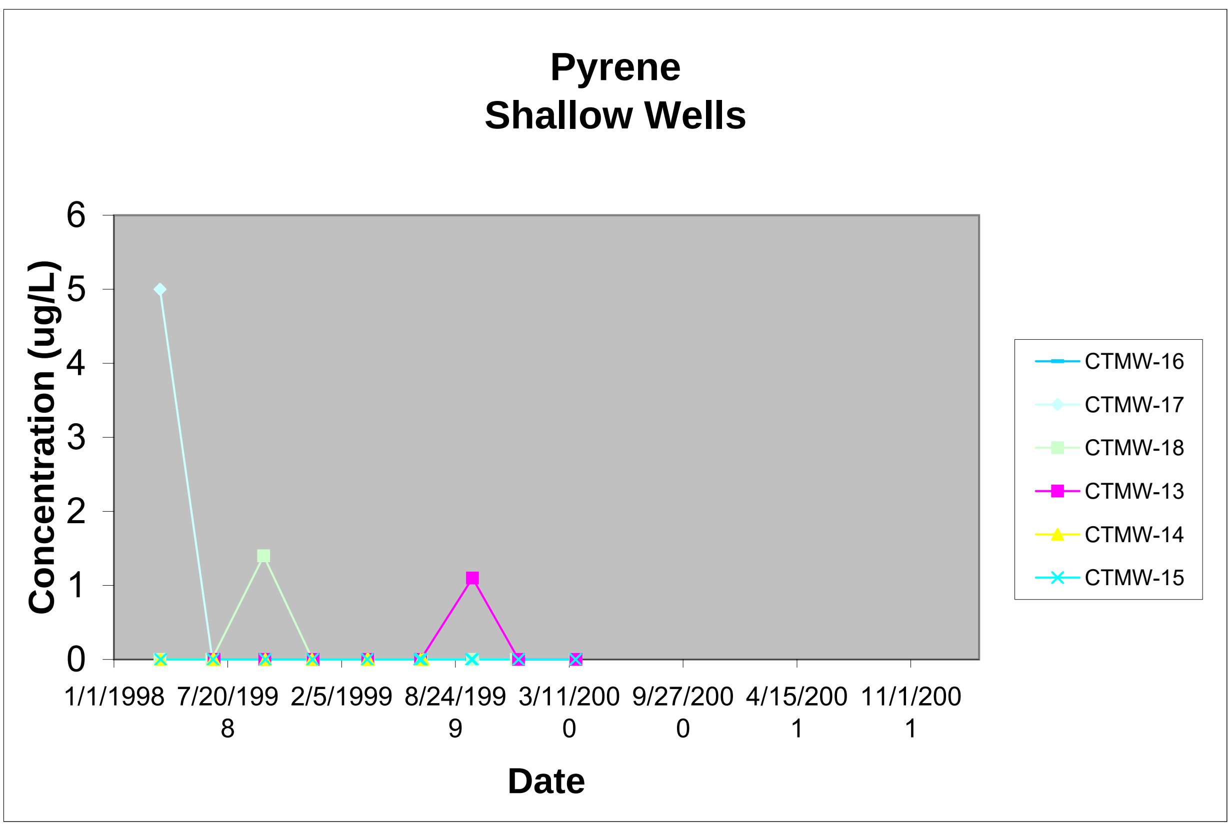

Phenanthrene
Shallow Wells
Concentration (ug/L)
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-5
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-1
CTMW-10

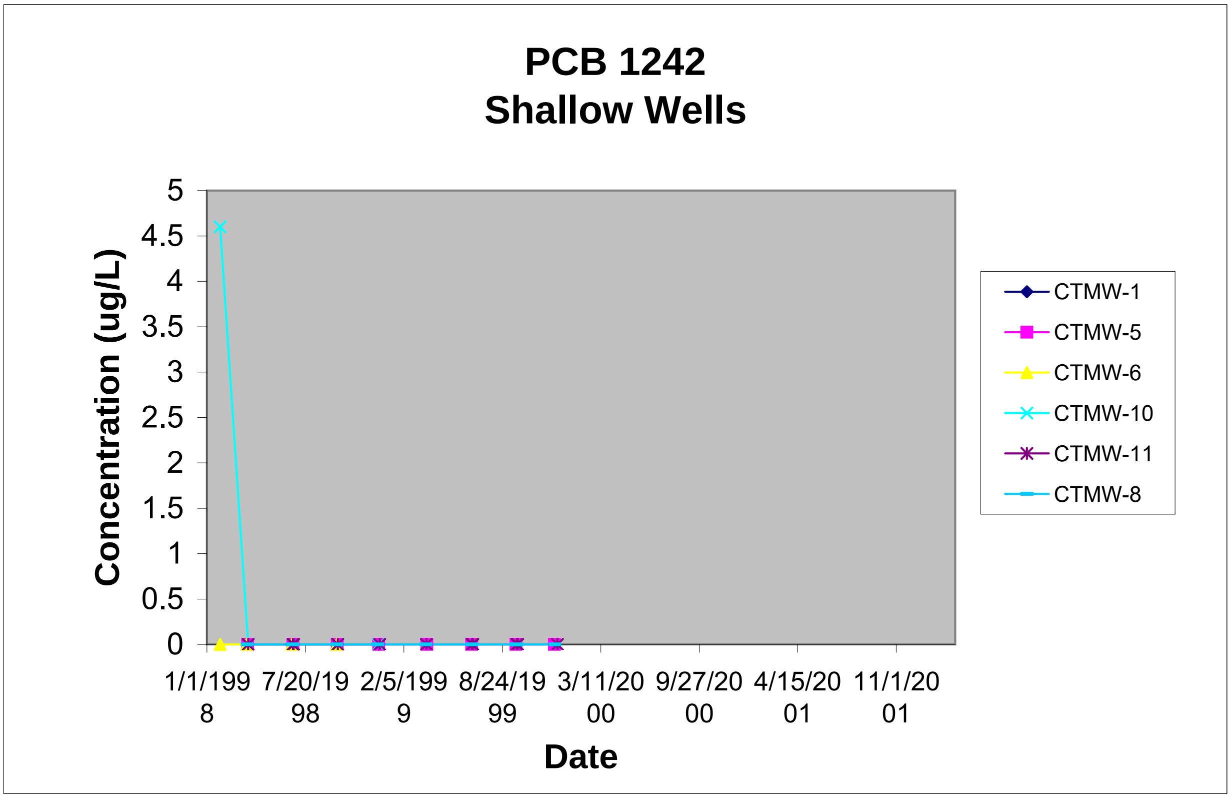

Phenanthrene
Shallow Wells
Concentration (ug/L)
6
5
4
3
2
1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15

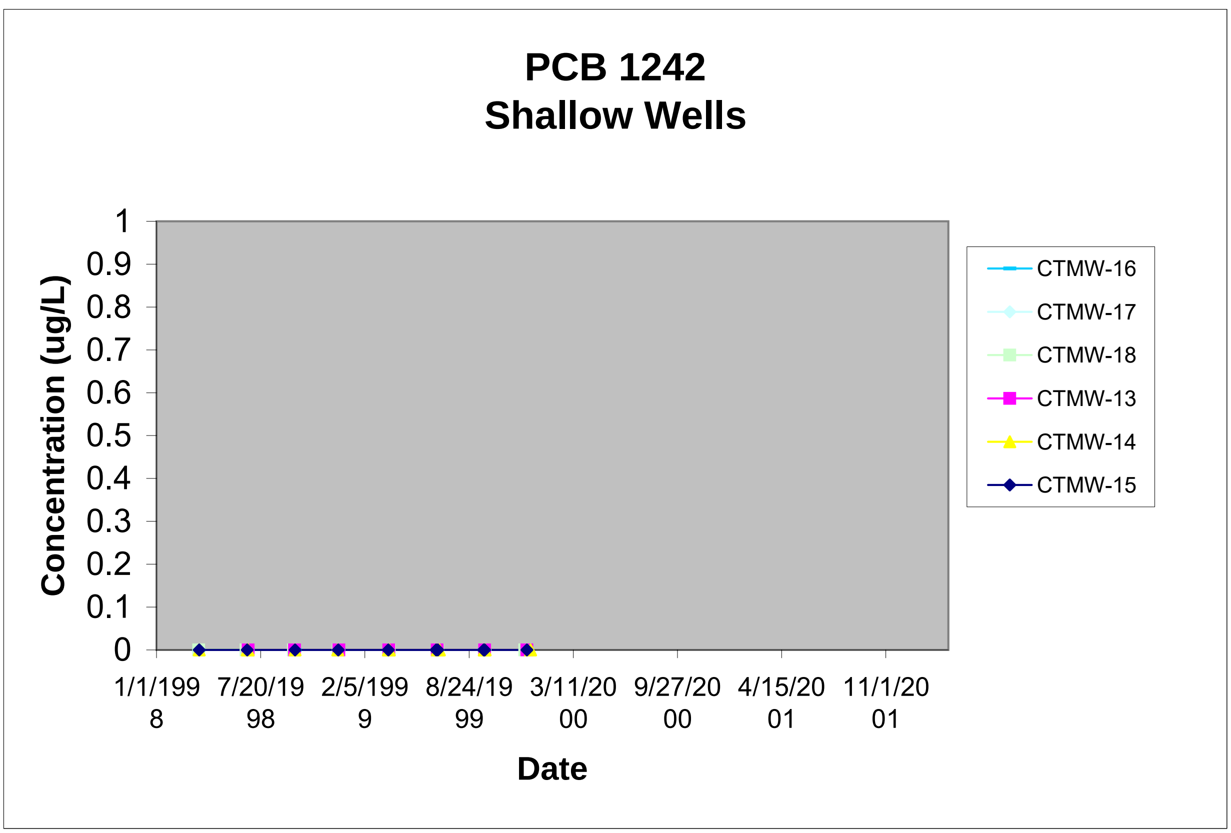

Phenol
Shallow Wells
Concentration (ug/L)
12000
10000
8000
6000
4000
2000
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

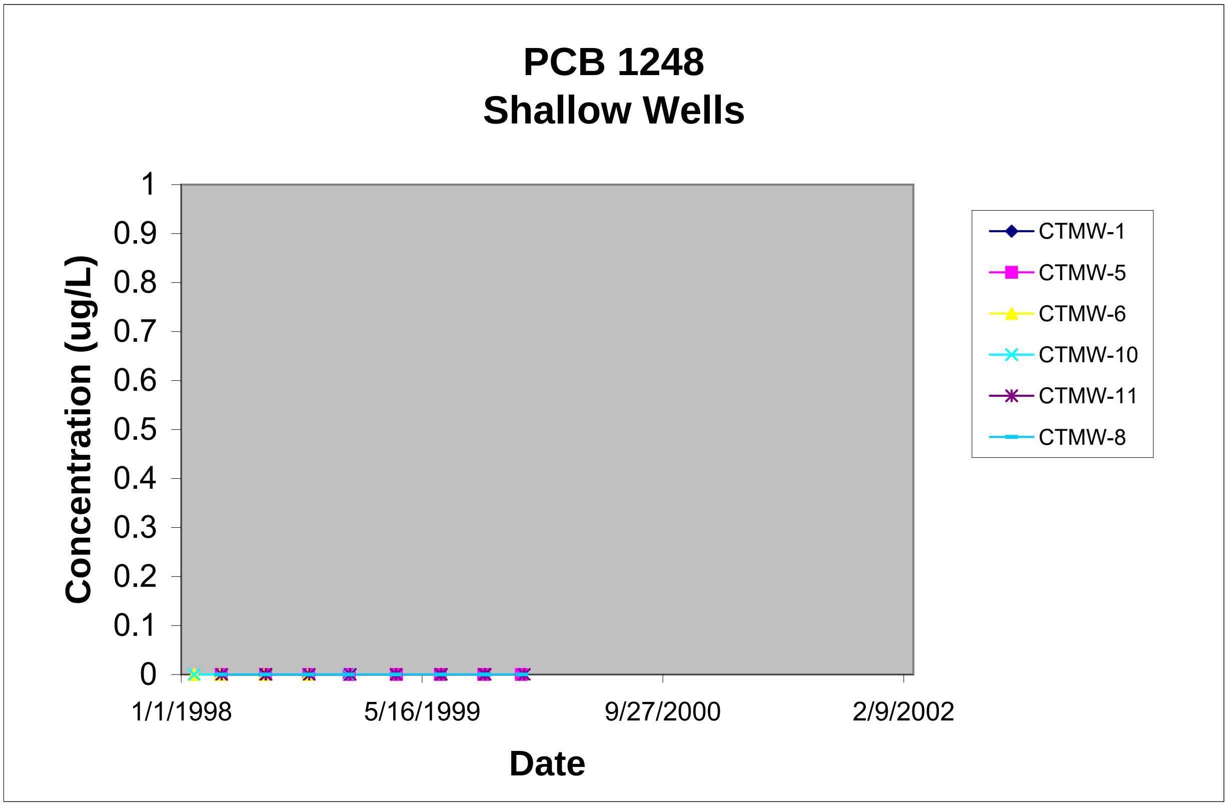

Phenol
Shallow Wells
Concentration (ug/L)
700
600
500
400
300
200
100
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

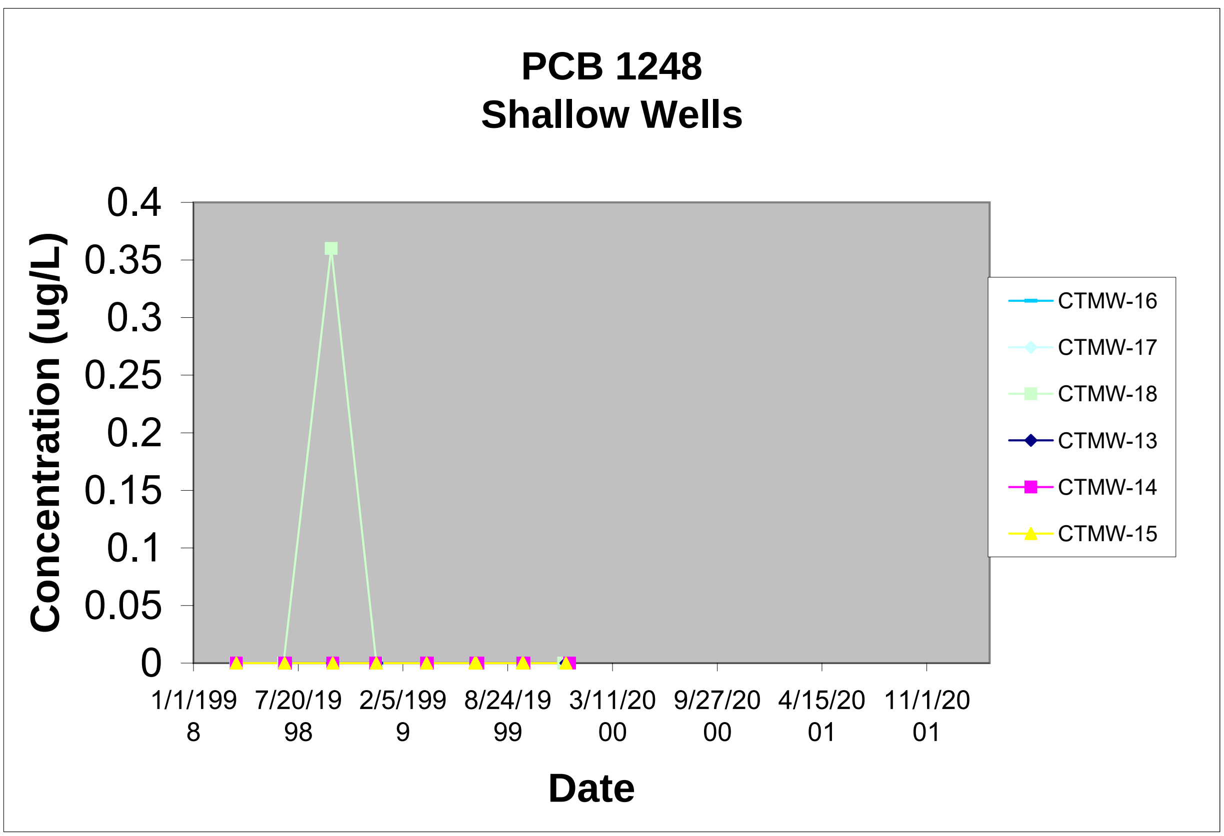

Pyrene
Shallow Wells
Concentration (ug/L)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

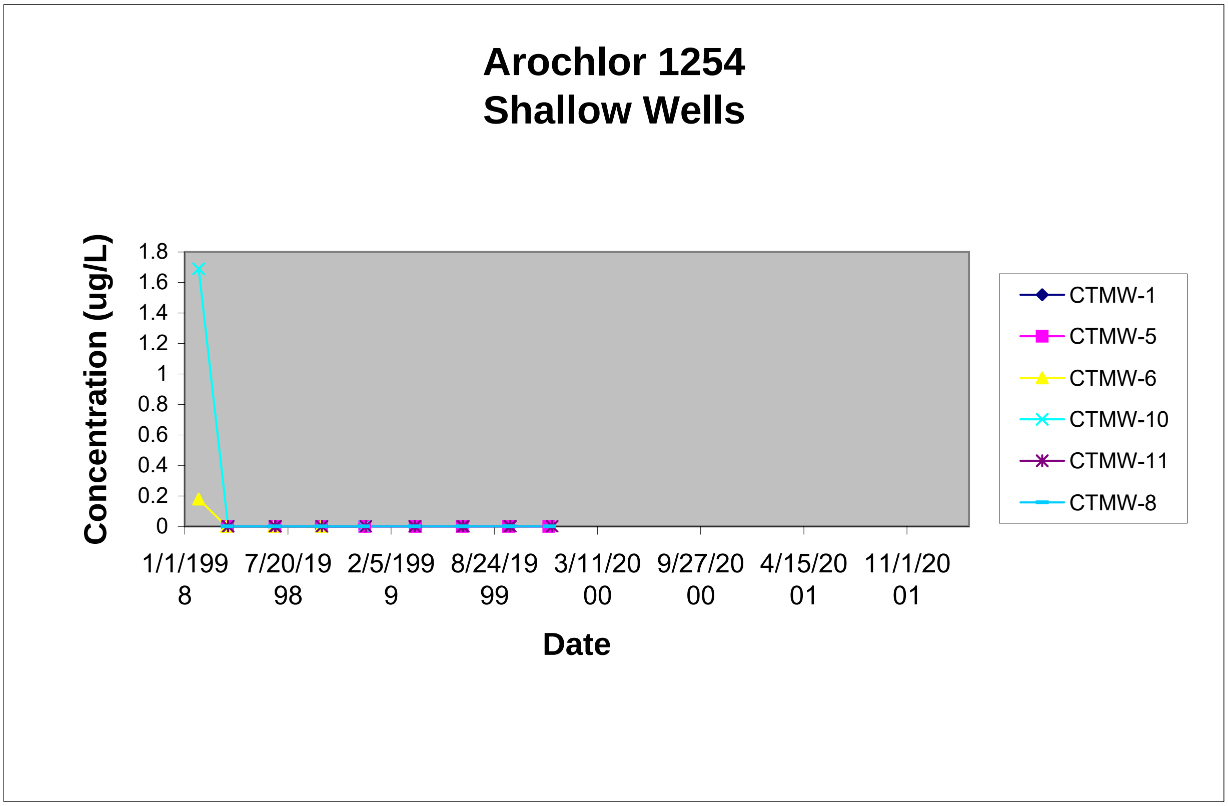

Pyrene
Shallow Wells
Concentration (ug/L)
6
5
4
3
2
1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

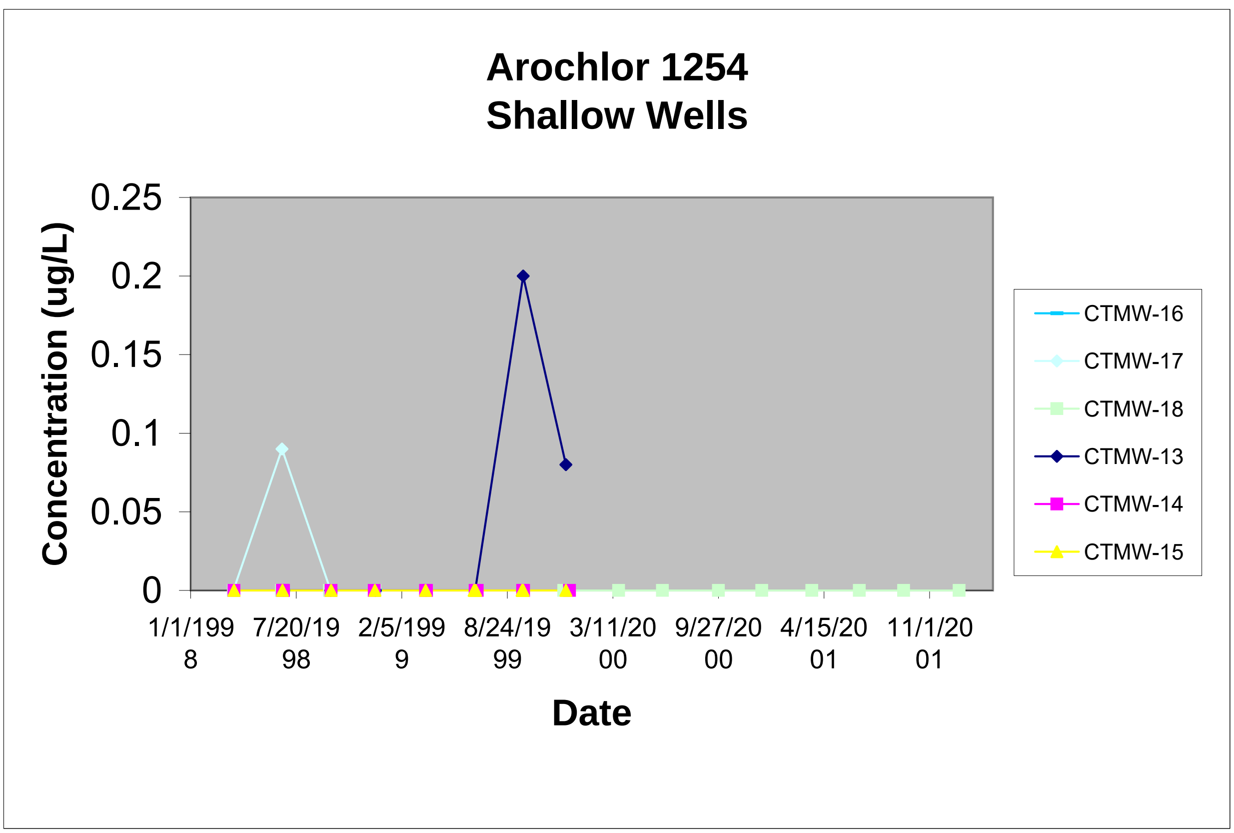

PCB 1242
Shallow Wells
Concentration (ug/L)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

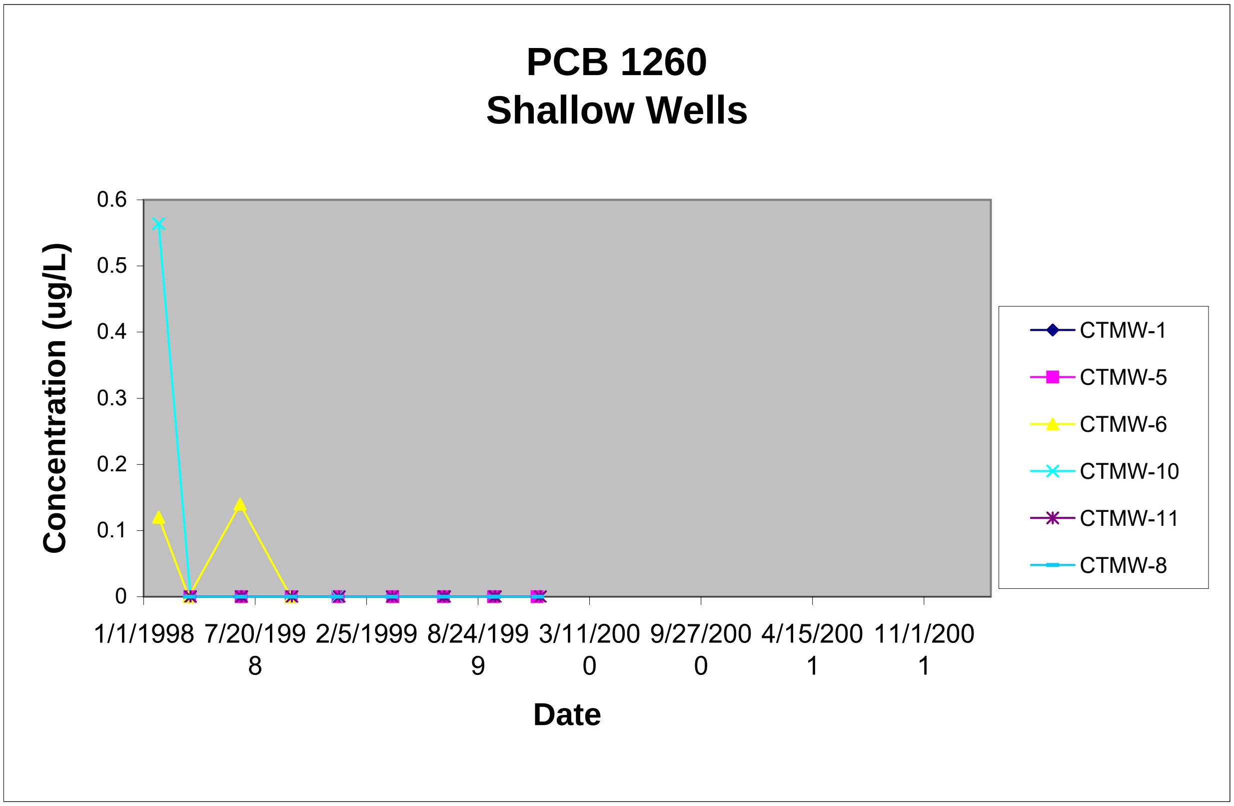

PCB 1242
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

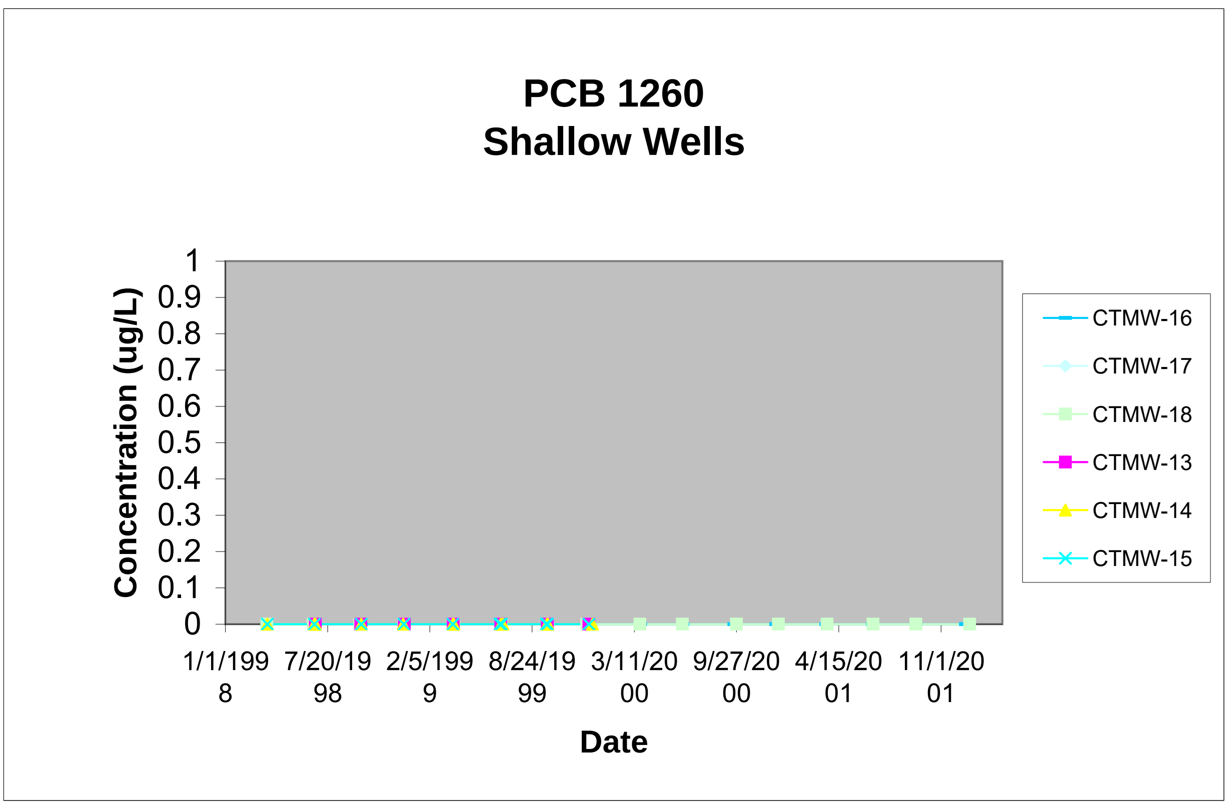

PCB 1248
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

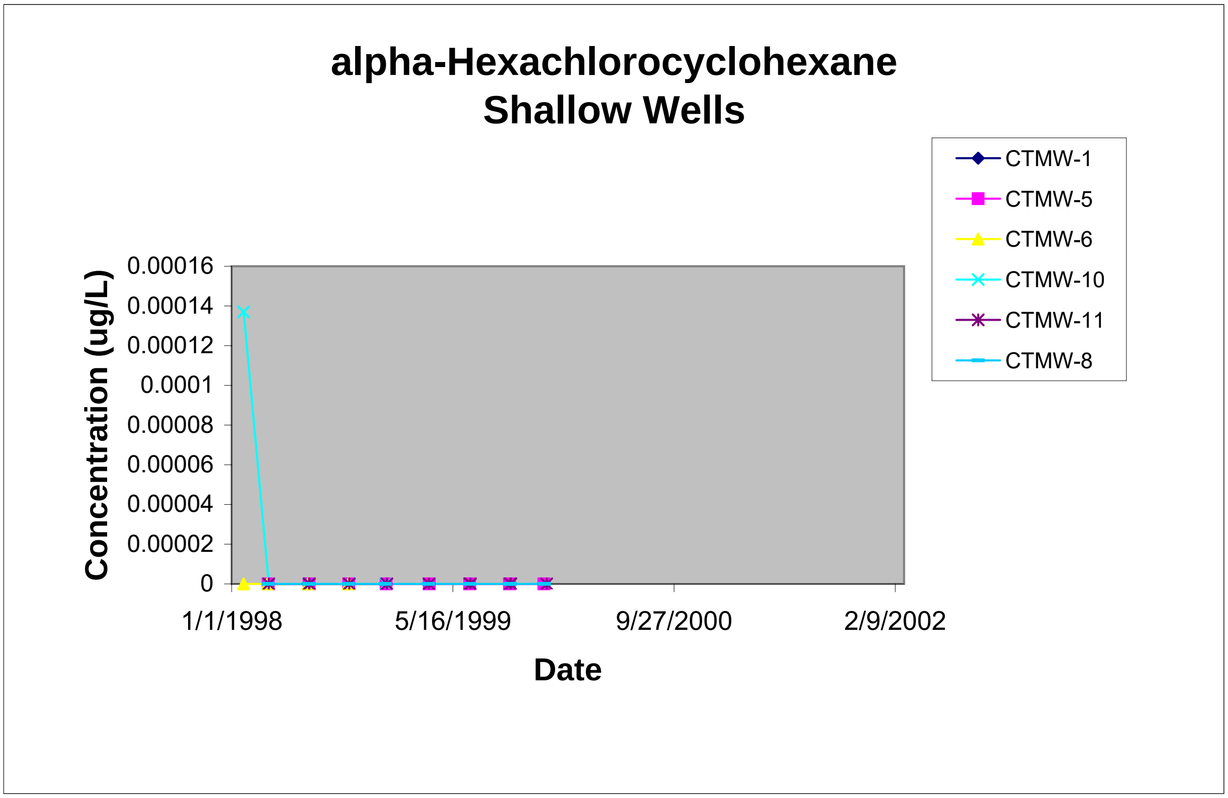

PCB 1248
Shallow Wells
Concentration (ug/L)
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

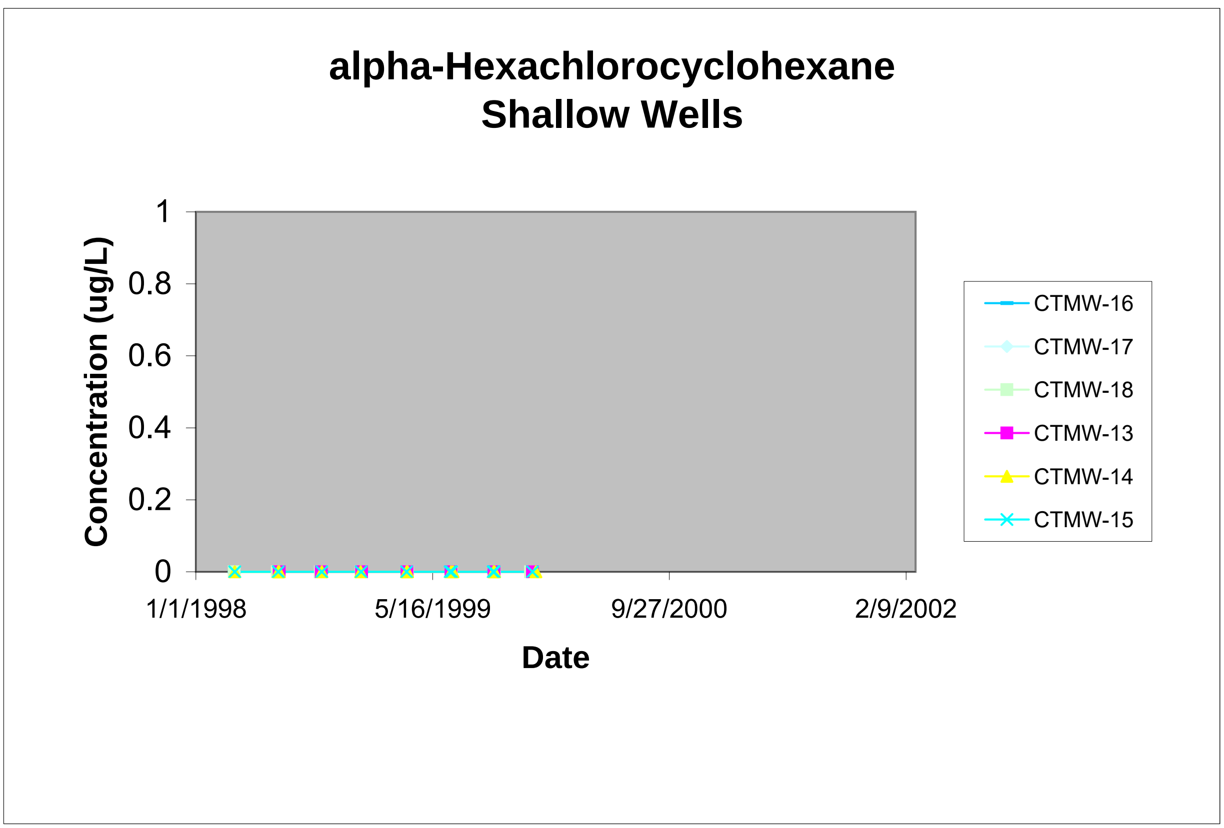

Arochlor 1254
Shallow Wells
Concentration (ug/L)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

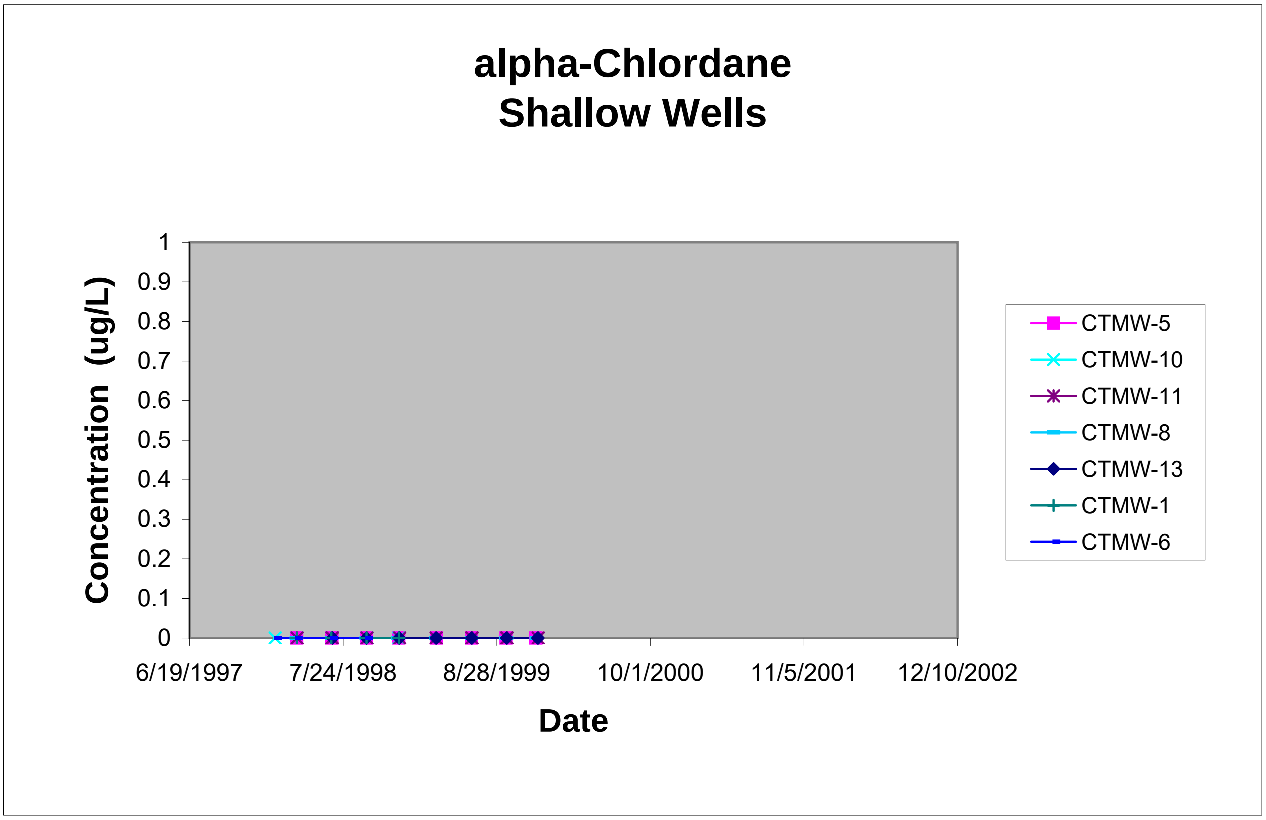

Arochlor 1254
Shallow Wells
Concentration (ug/L)
0.25
0.2
0.15
0.1
0.05
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

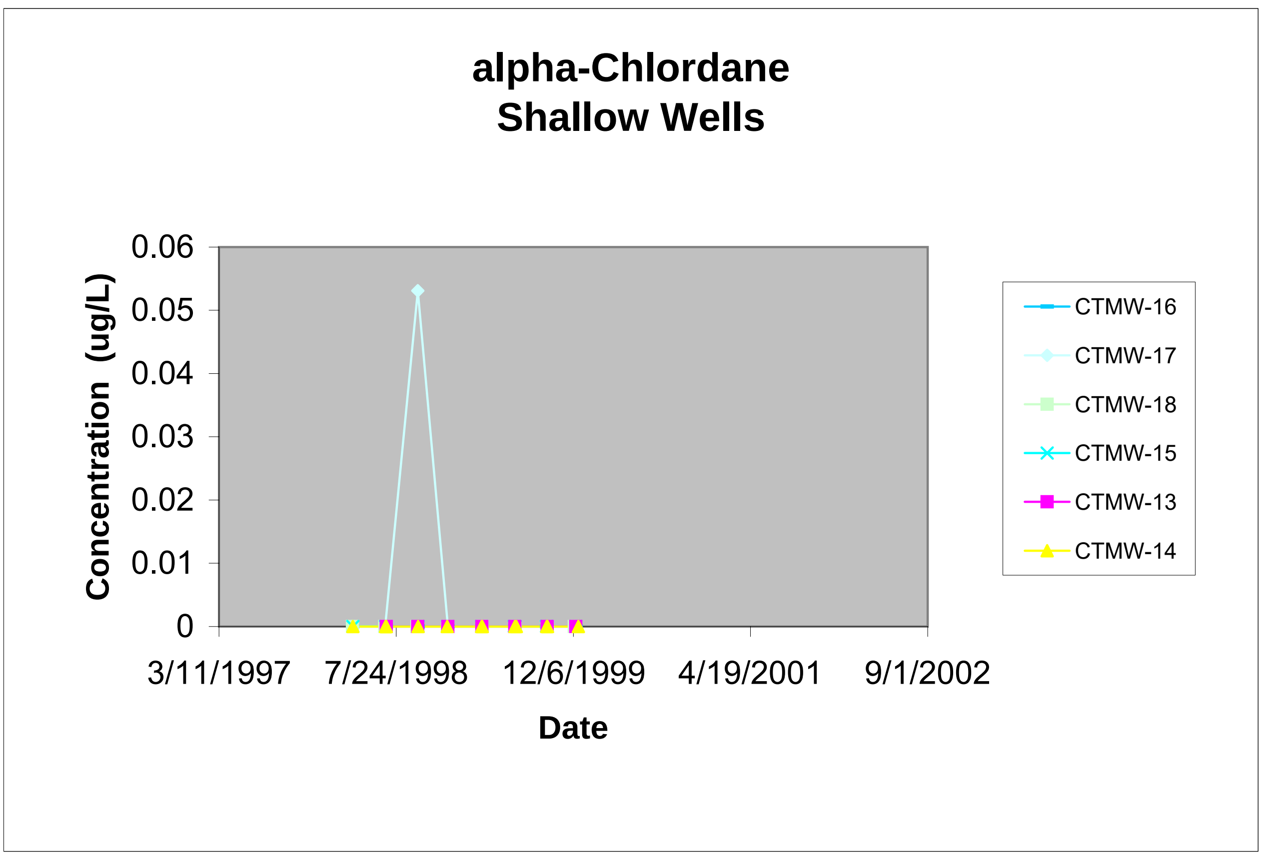

PCB 1260
Shallow Wells
Concentration (ug/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

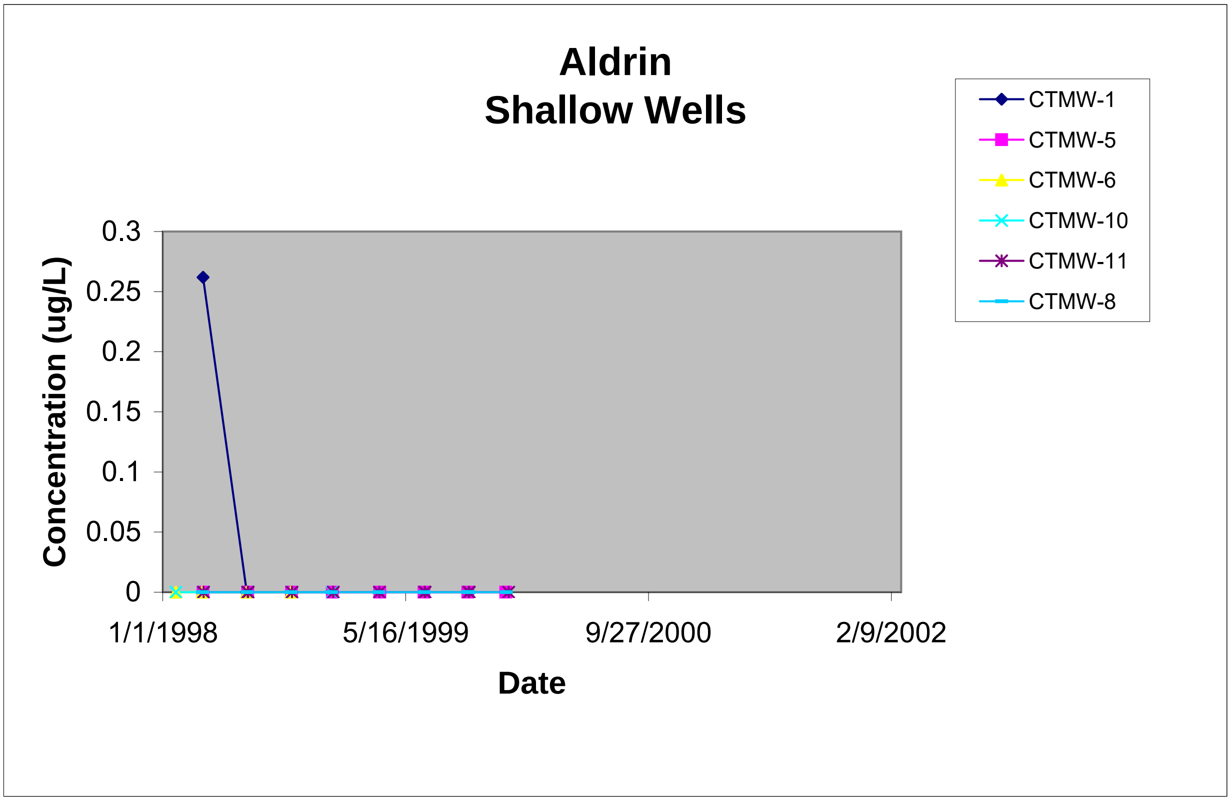

PCB 1260
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


alpha-Hexachlorocyclohexane
Shallow Wells
Concentration (ug/L)
0.00016
0.00014
0.00012
0.0001
0.00008
0.00006
0.00004
0.00002
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

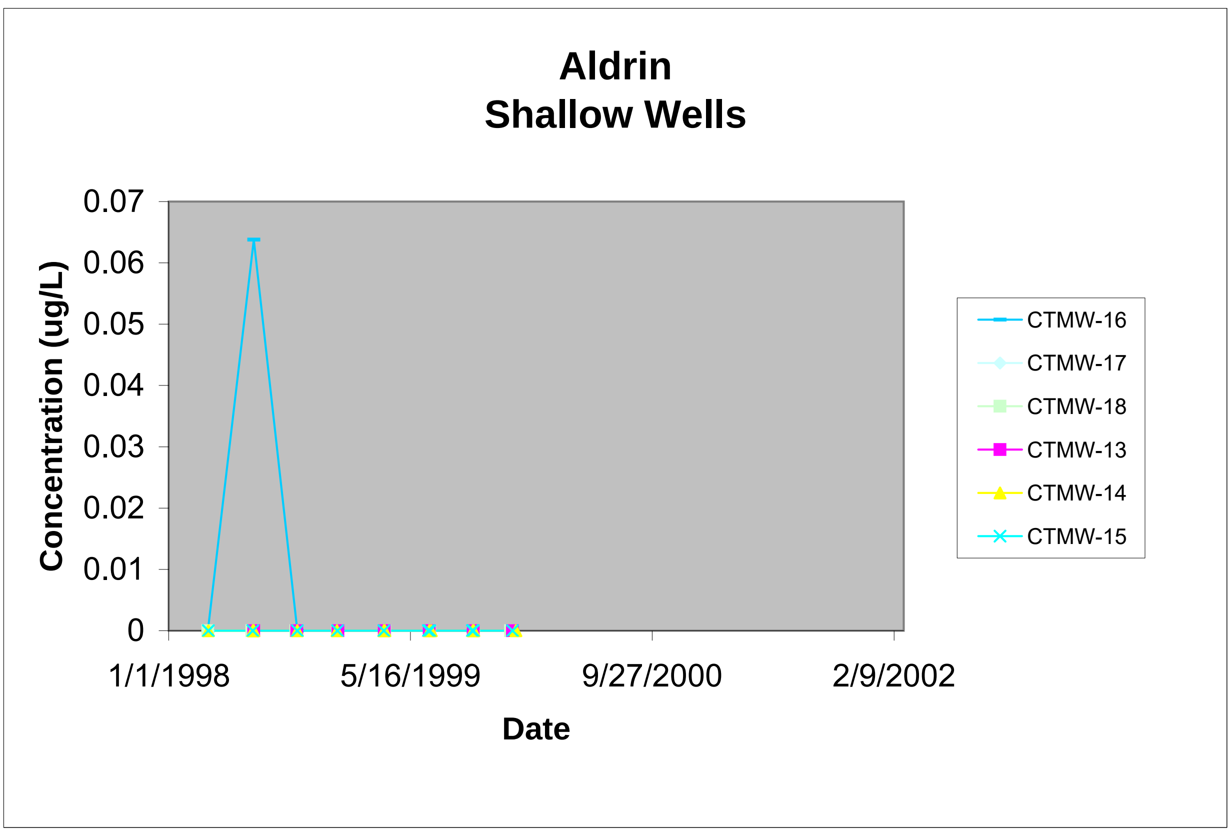

alpha-Hexachlorocyclohexane
Shallow Wells
Concentration (ug/L)
1
0.8
0.6
0.4
0.2
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


alpha-Chlordane
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/19/1997
7/24/1998
8/28/1999
10/1/2000
11/5/2001
12/10/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-1
CTMW-6

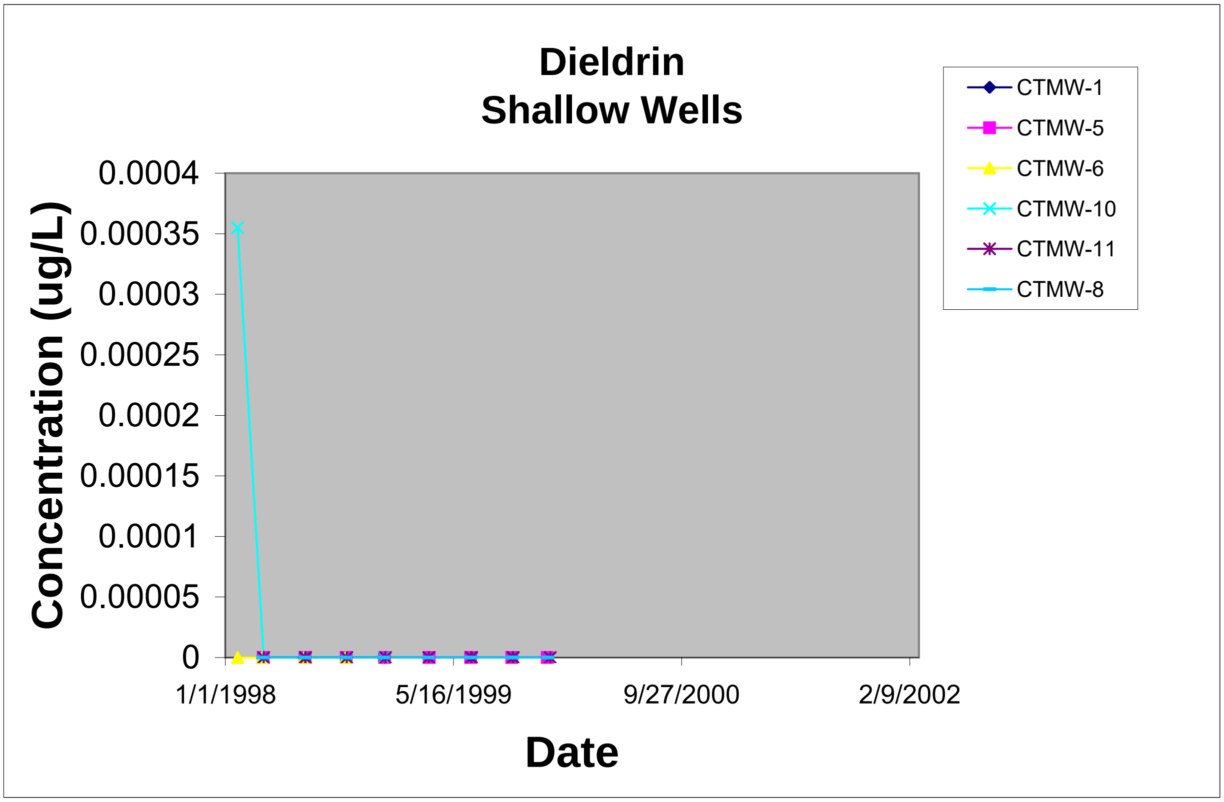

alpha-Chlordane
Shallow Wells
Concentration (ug/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15
CTMW-13
CTMW-14



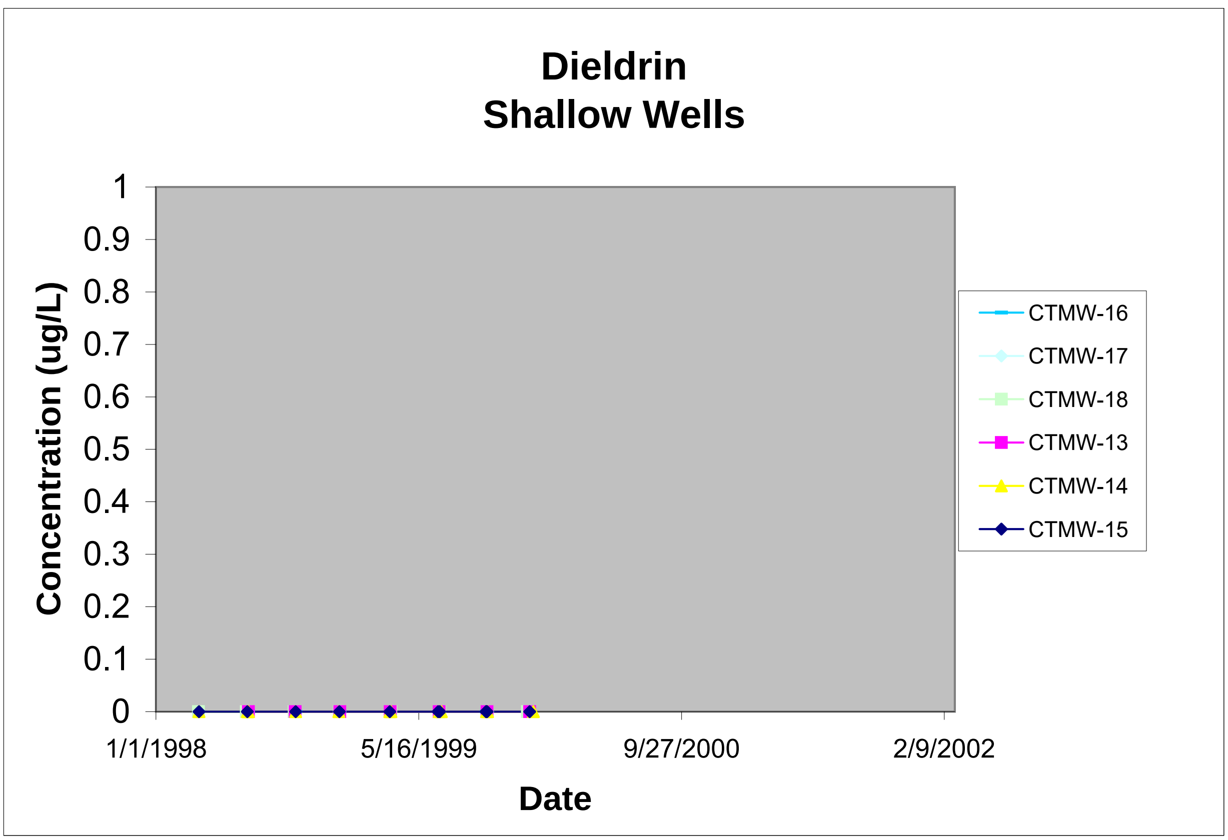
Aldrin
Shallow Wells
Concentration (ug/L)
0.3
0.25
0.2
0.15
0.1
0.05
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8



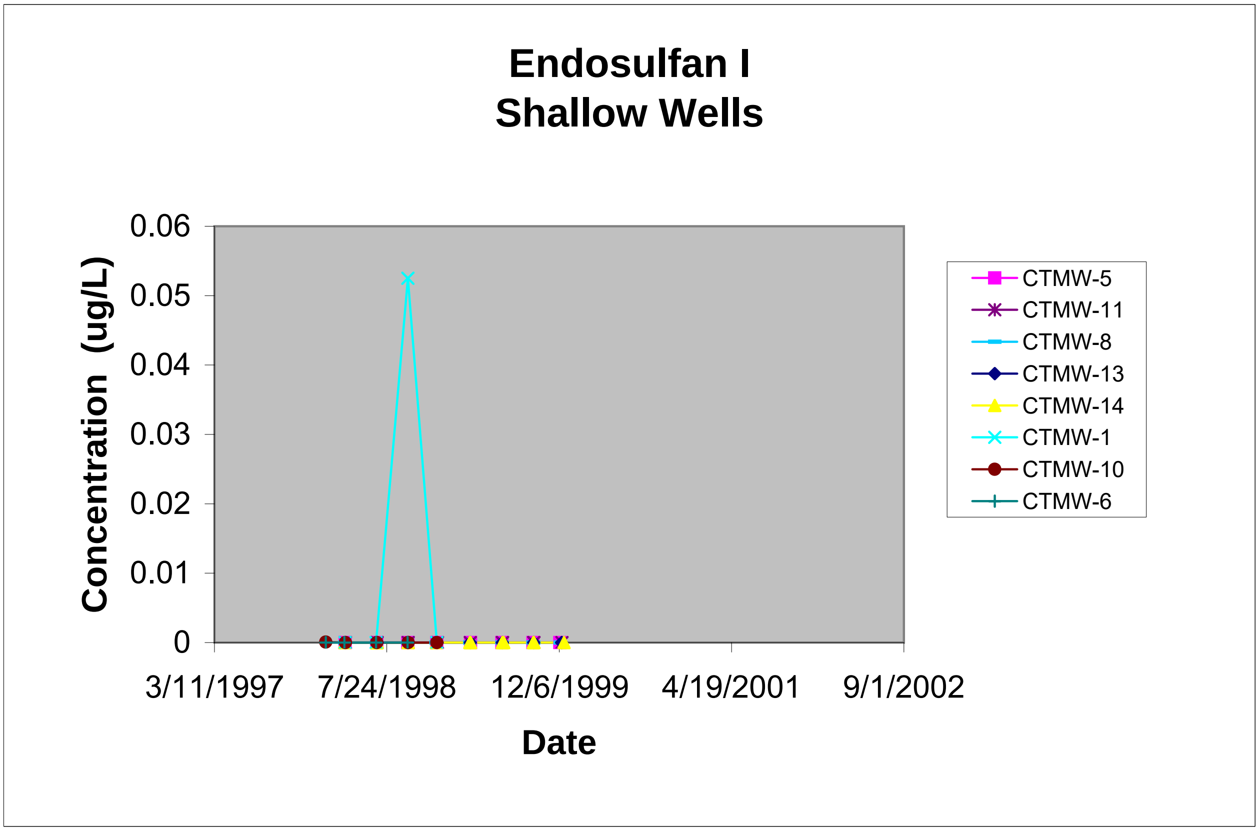
Aldrin
Shallow Wells
Concentration (ug/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

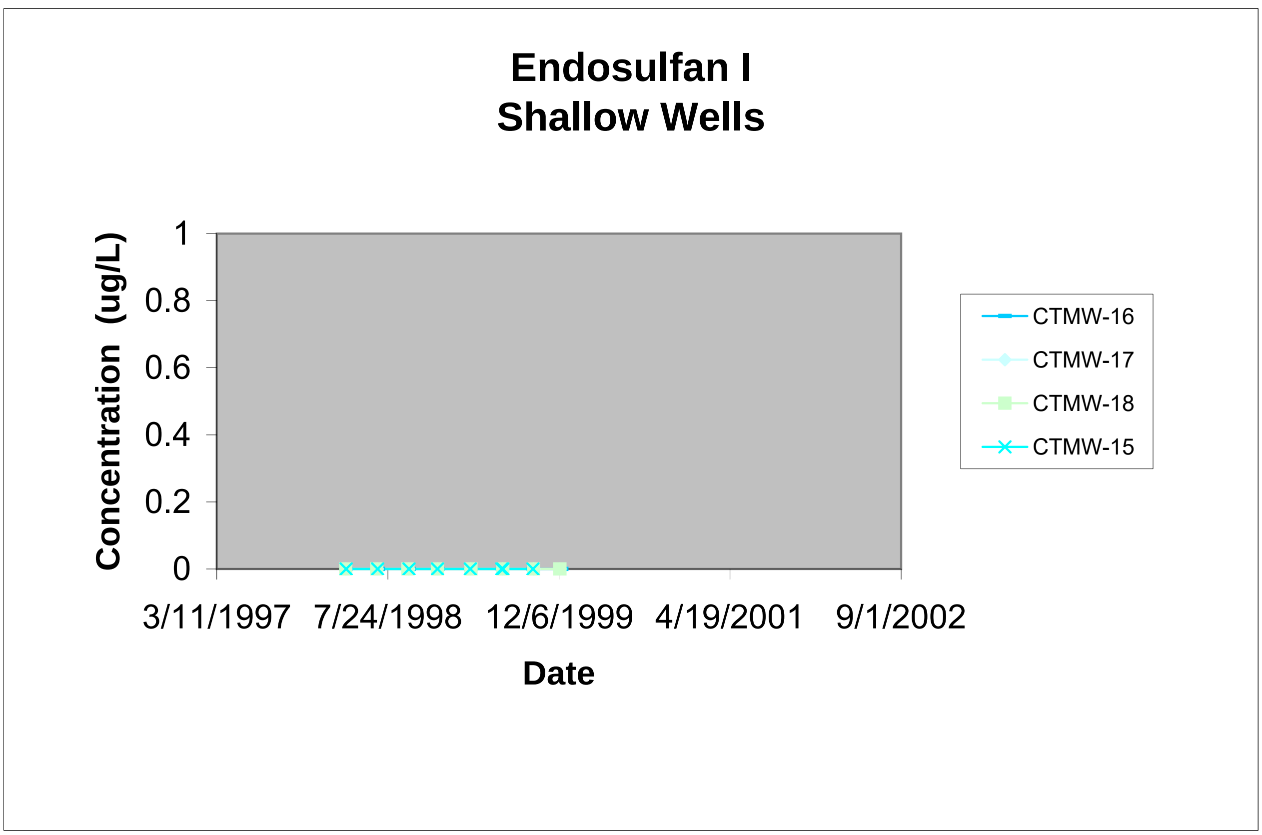


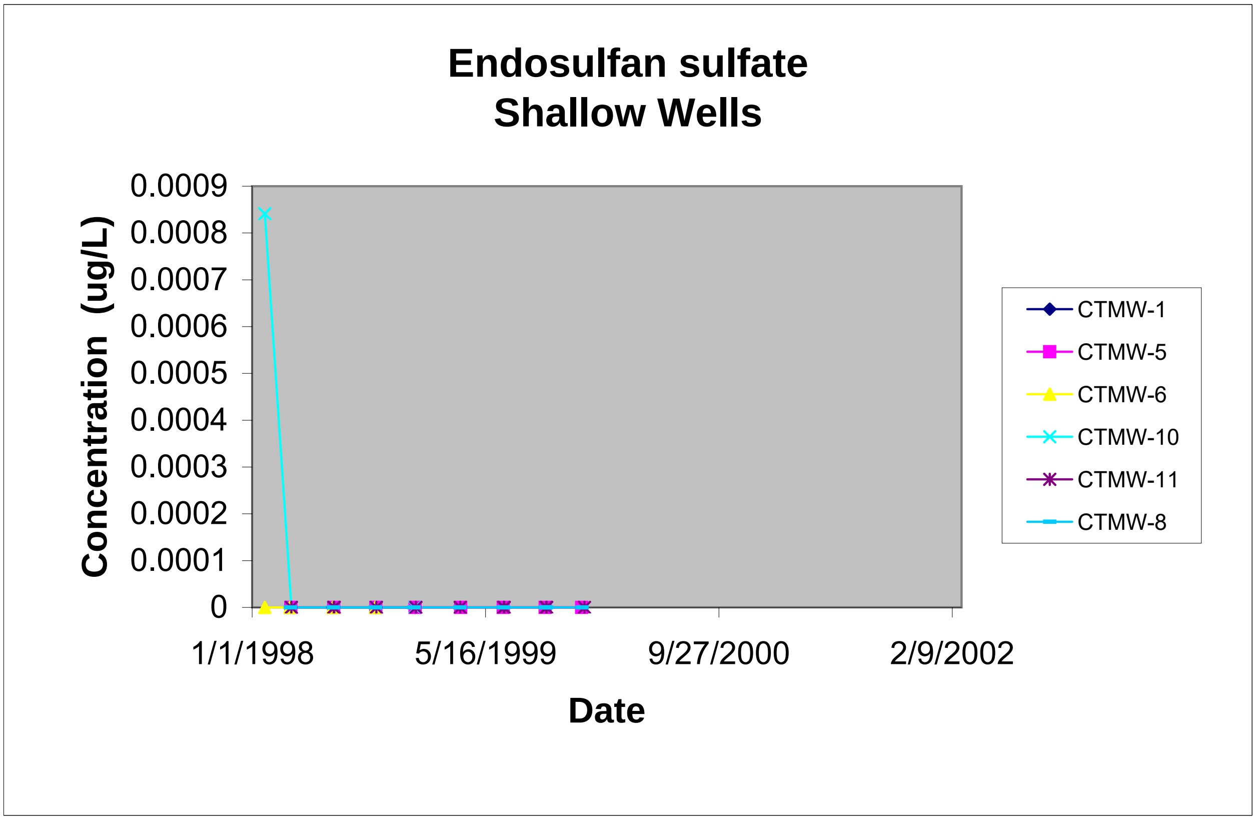
Dieldrin
Shallow Wells
Concentration (ug/L)
0.0004
0.00035
0.0003
0.00025
0.0002
0.00015
0.0001
0.00005
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

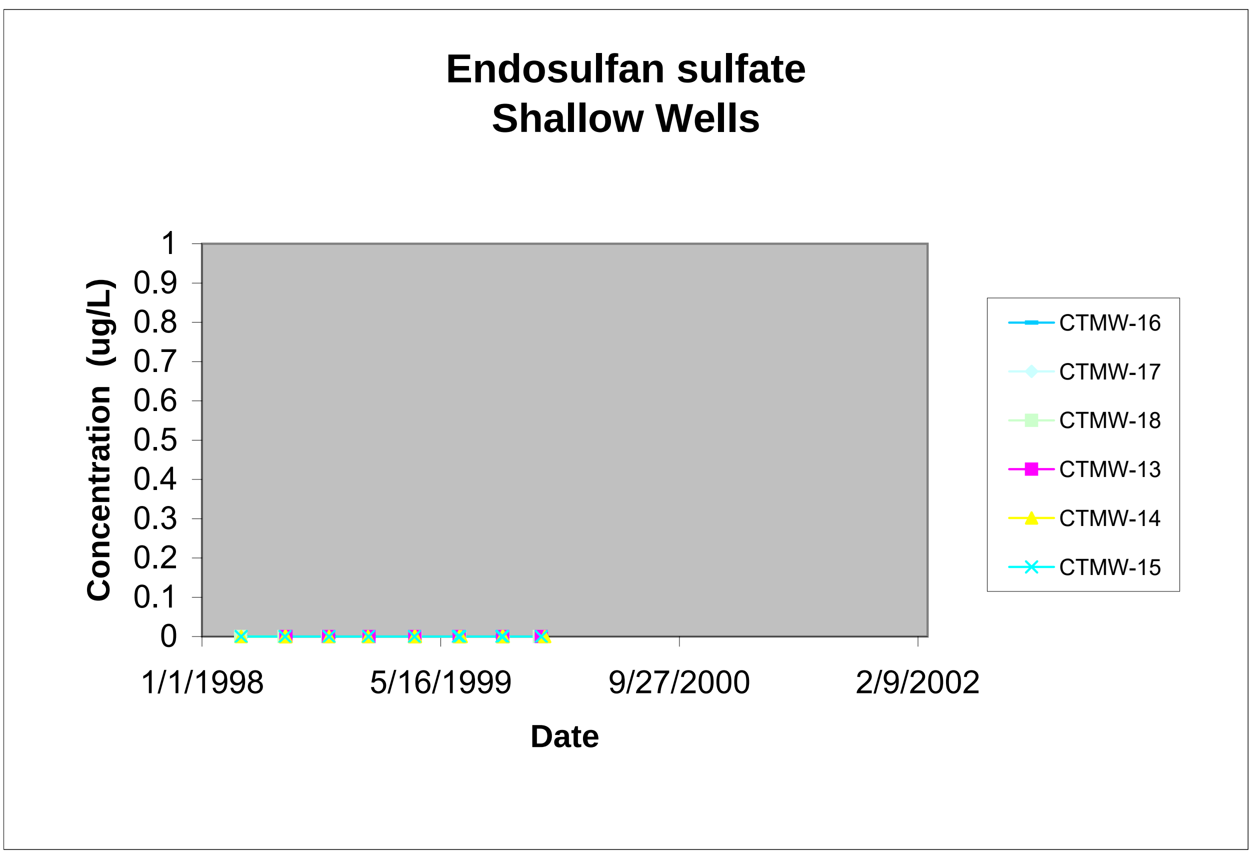


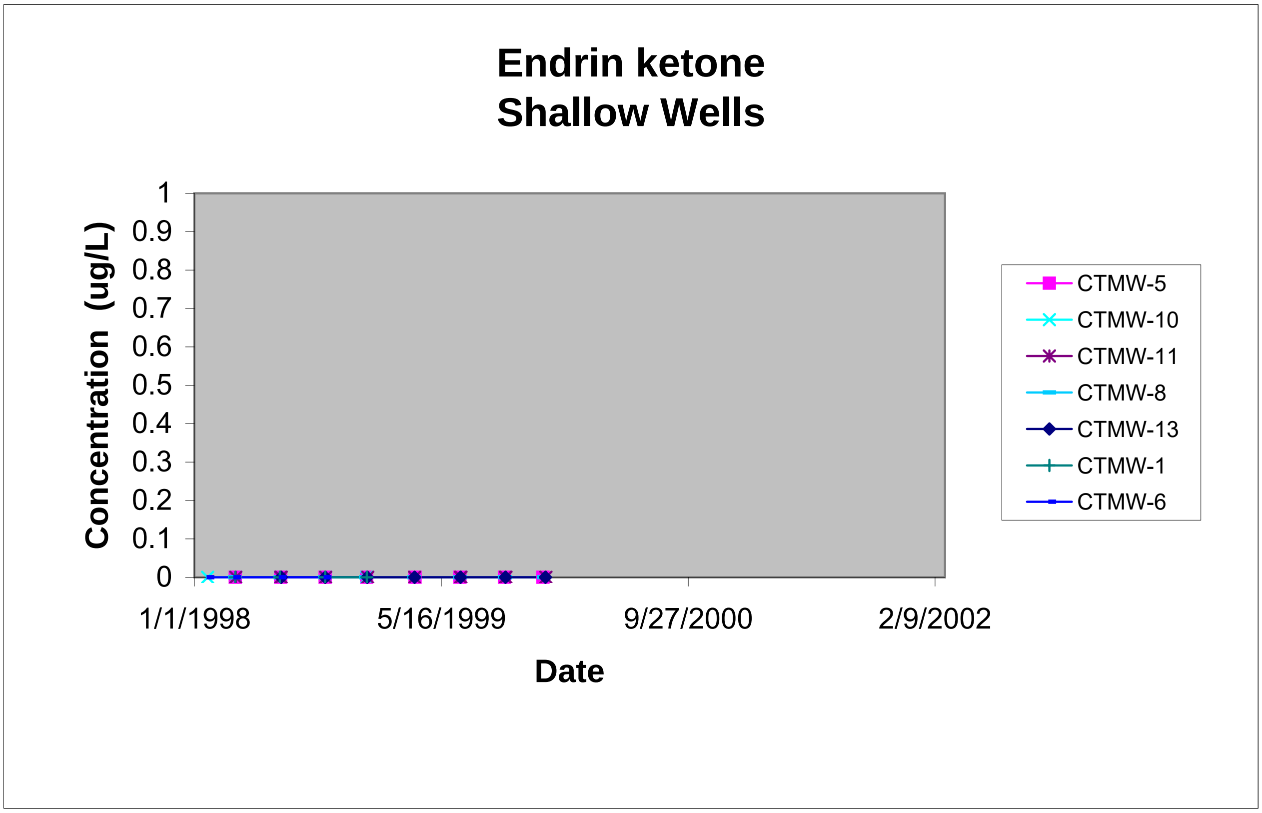
Dieldrin
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

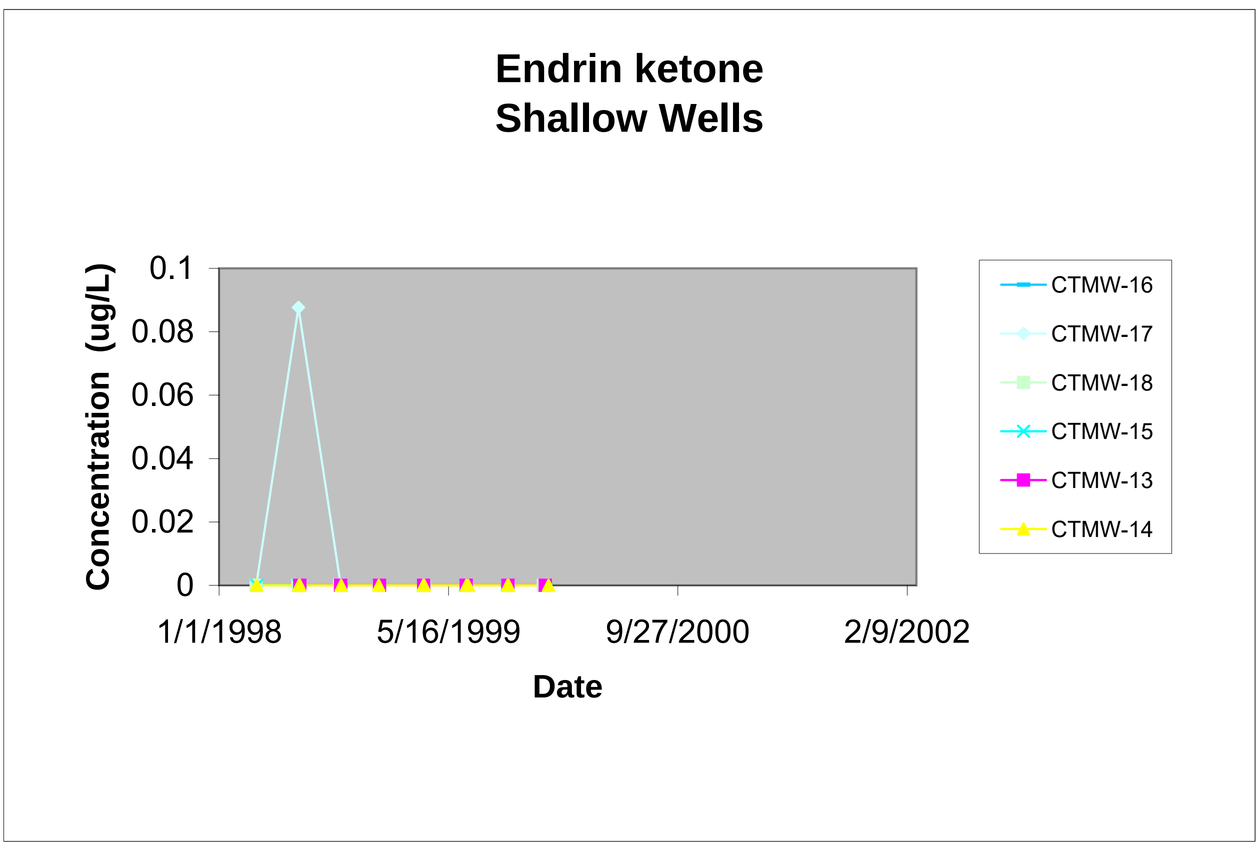

Endosulfan I
Shallow Wells
Concentration (ug/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-5
CTMW-11
CTMW-8
CTMW-13
CTMW-14
CTMW-1
CTMW-10
CTMW-6

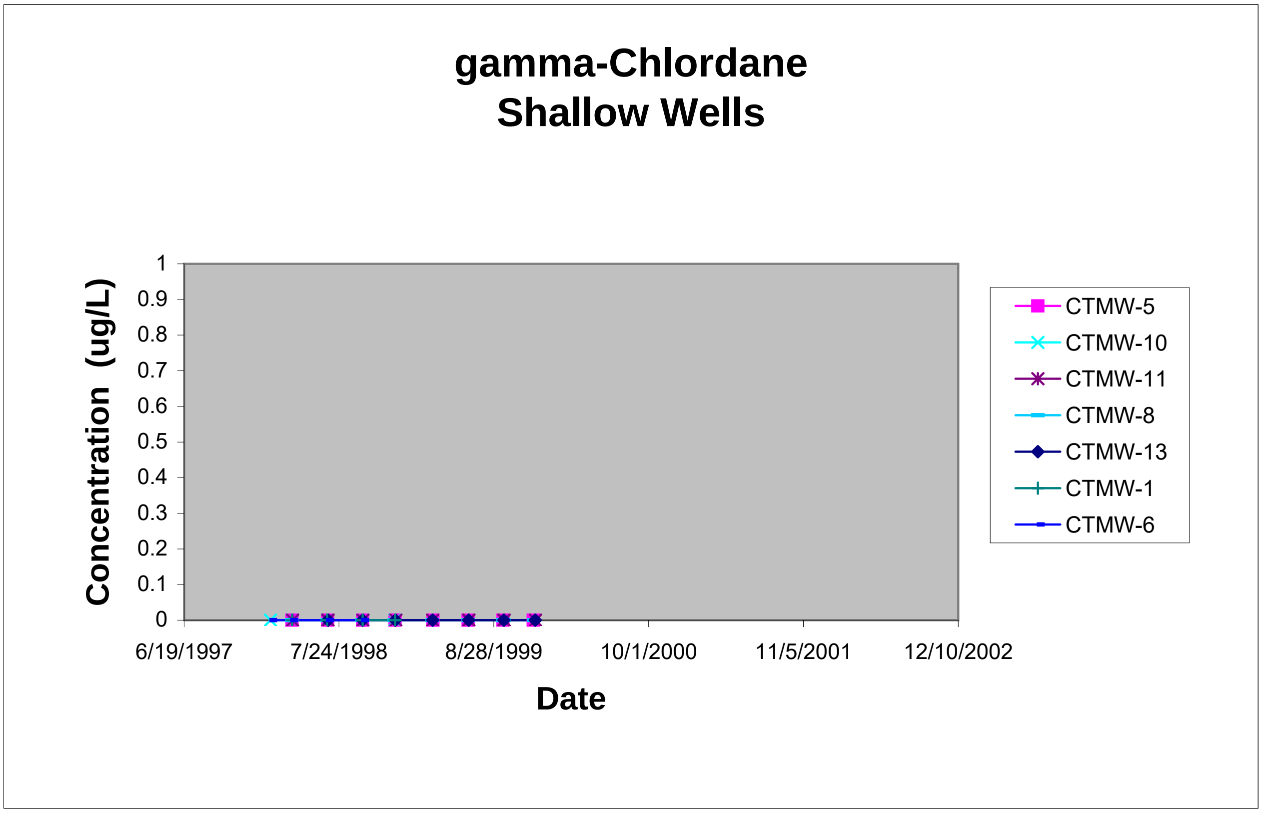

Endosulfan I
Shallow Wells
Concentration (ug/L)
1
0.8
0.6
0.4
0.2
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15

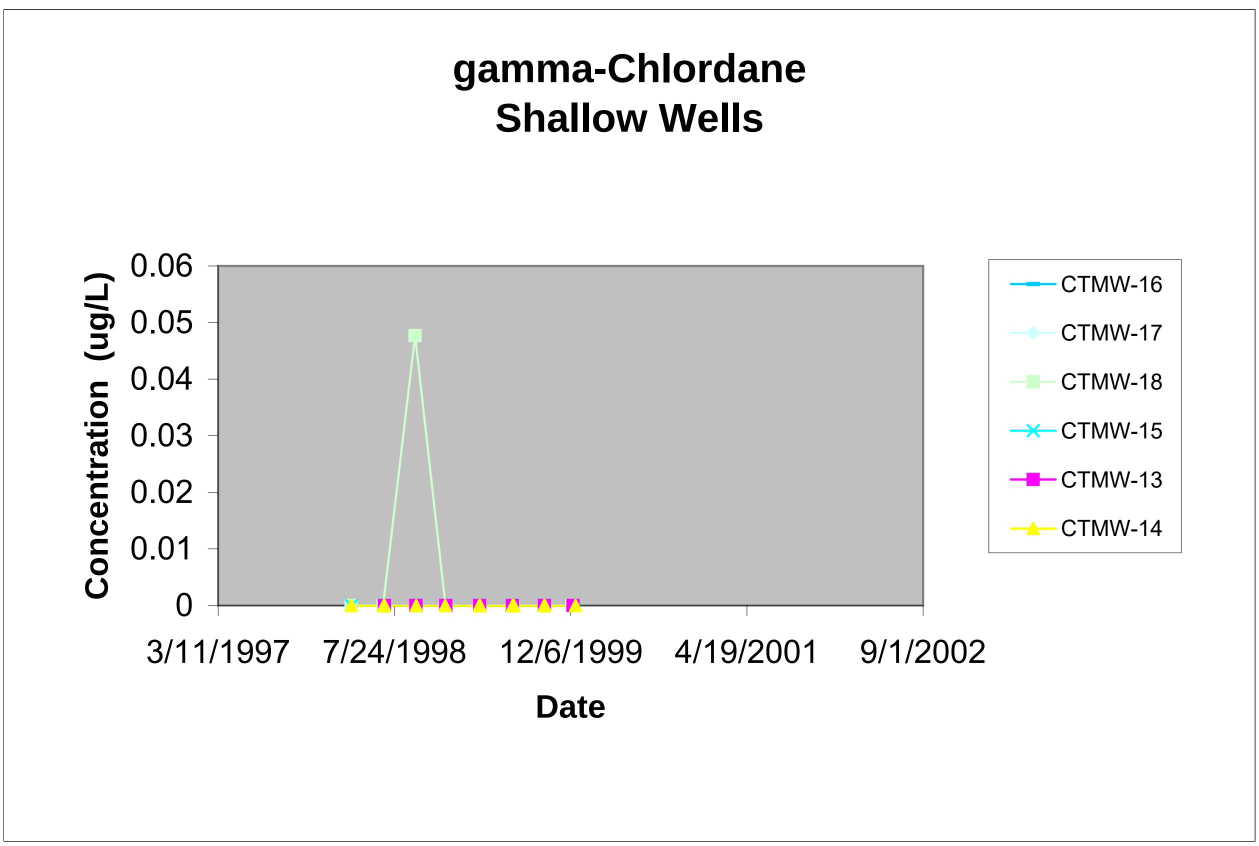

Endosulfan sulfate
Shallow Wells
Concentration (ug/L)
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

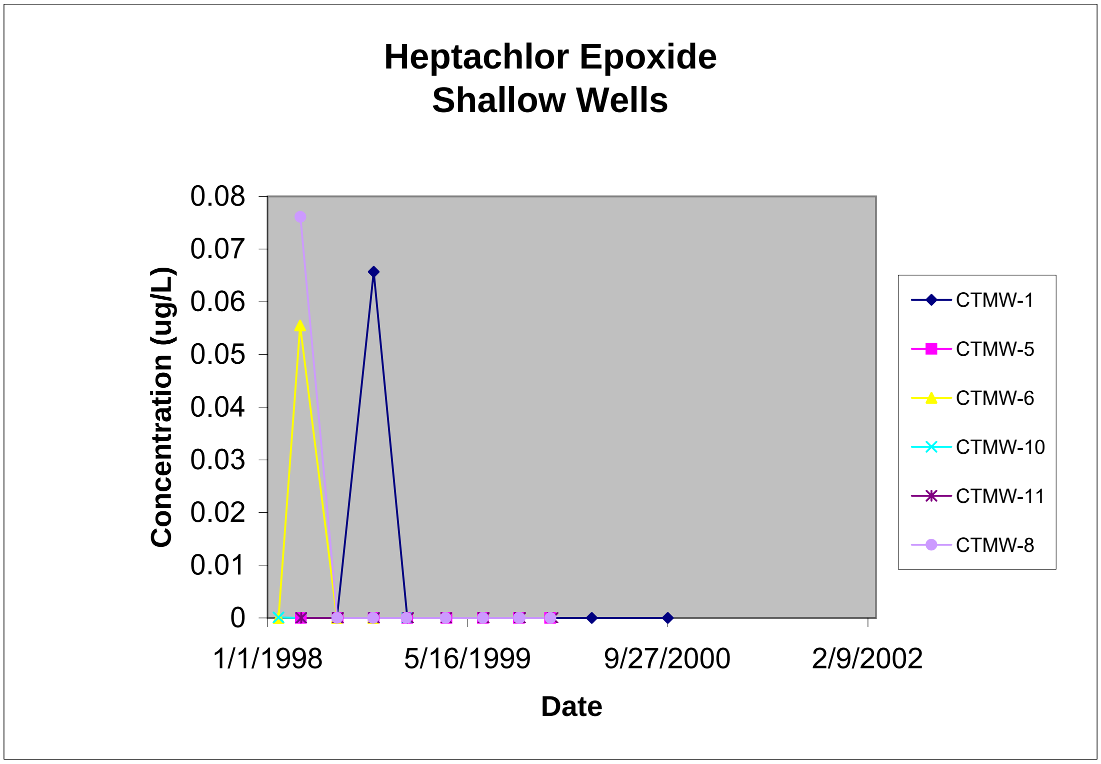

Endosulfan sulfate
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15

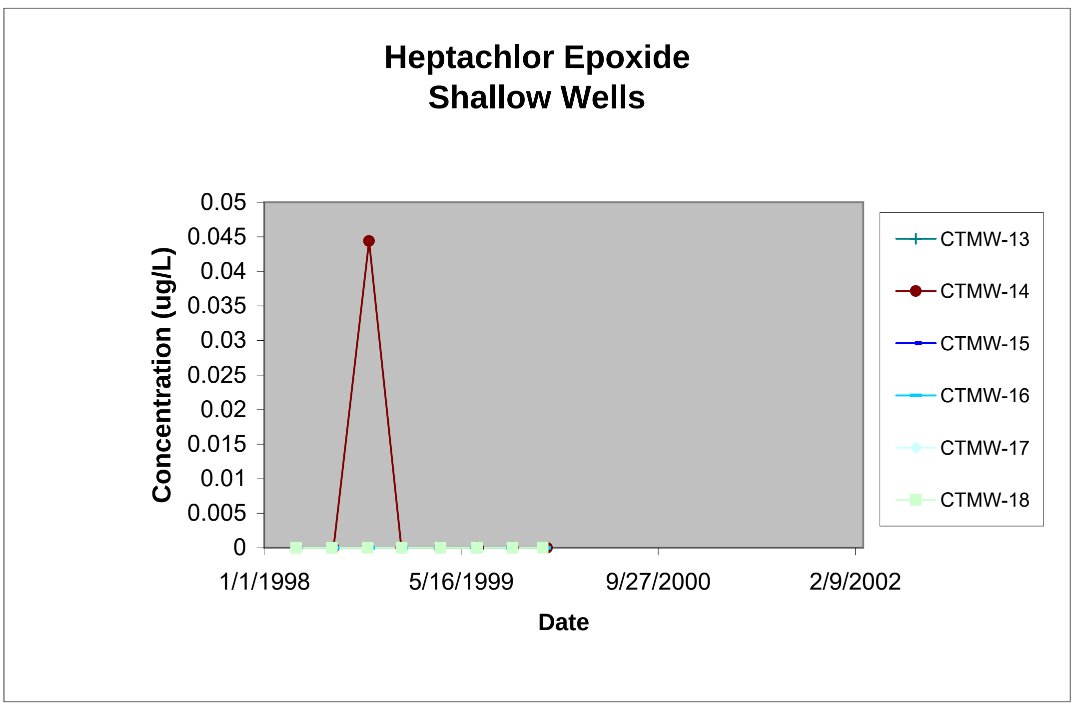

Endrin ketone
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-1
CTMW-6

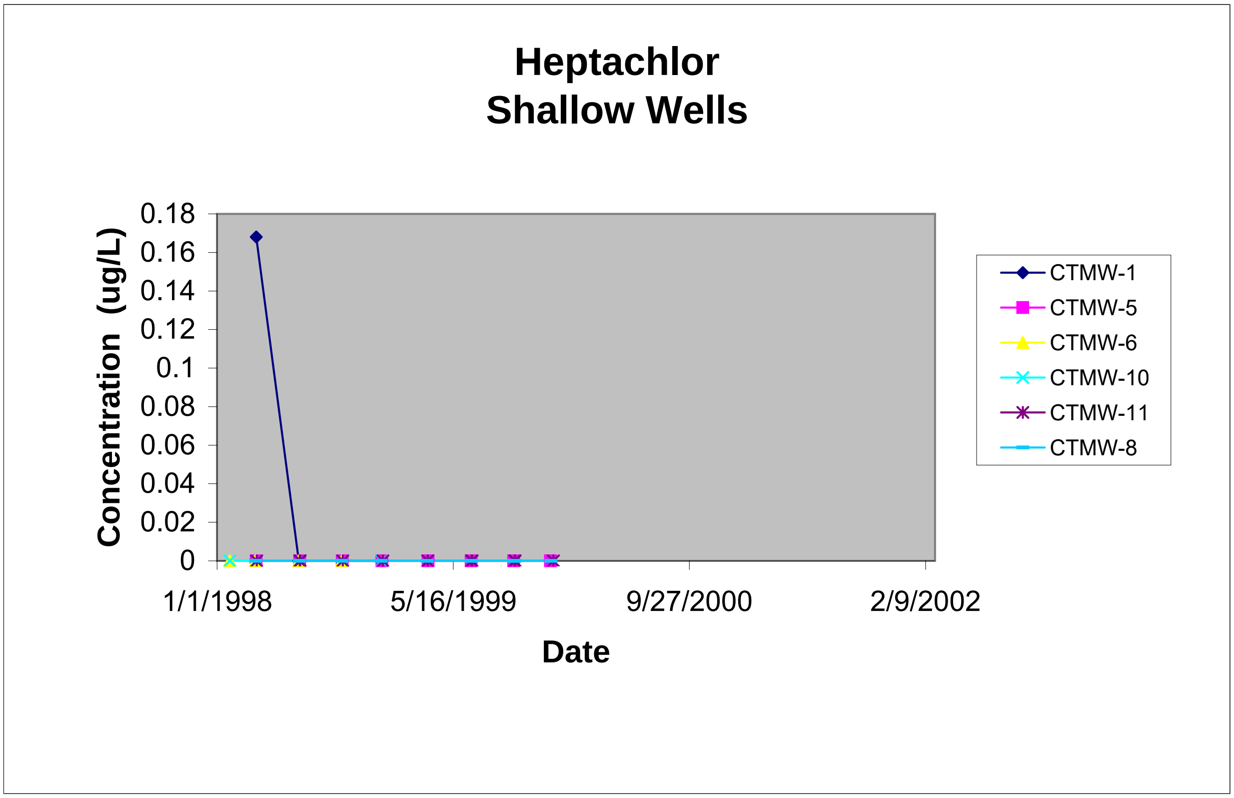

Endrin ketone
Shallow Wells
Concentration (ug/L)
0.1
0.08
0.06
0.04
0.02
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15
CTMW-13
CTMW-14

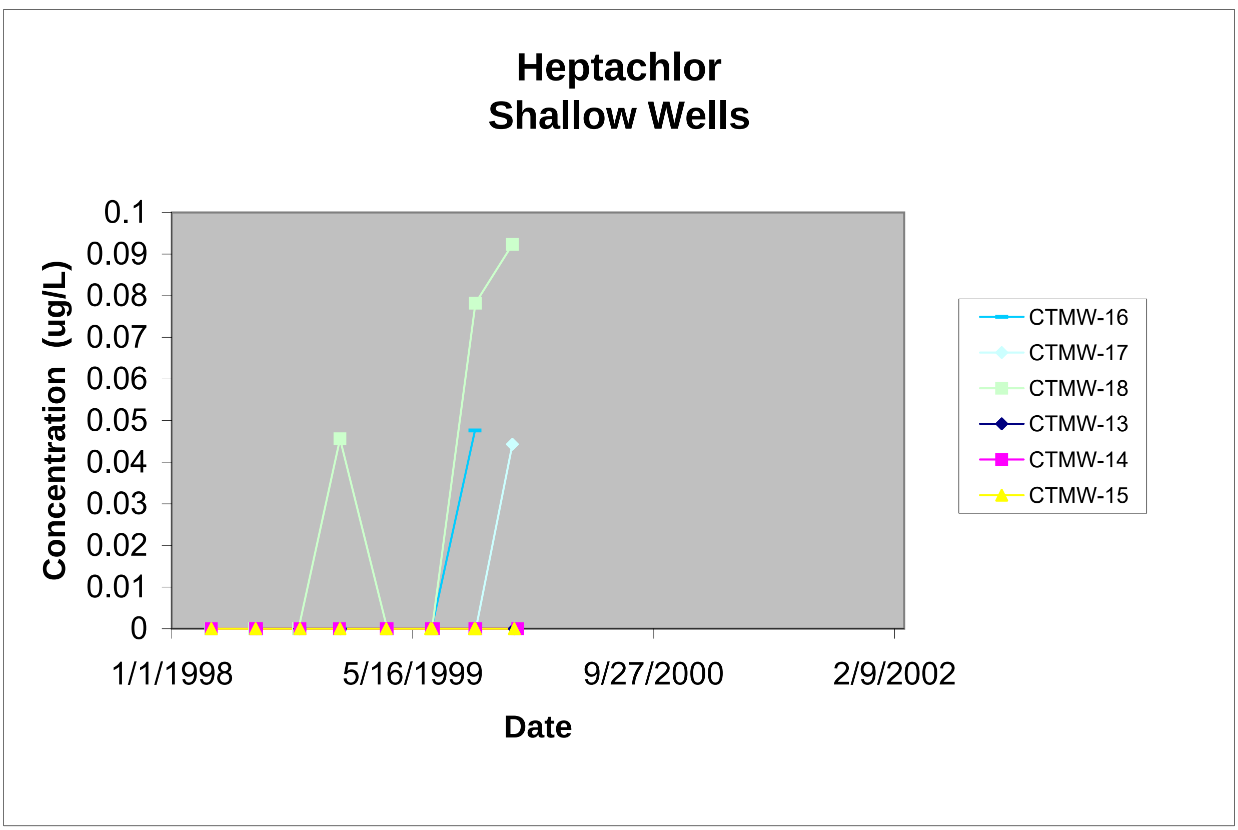

gamma-Chlordane
Shallow Wells
Concentration (ug/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/19/1997
7/24/1998
8/28/1999
10/1/2000
11/5/2001
12/10/2002
Date
CTMW-5
CTMW-10
CTMW-11
CTMW-8
CTMW-13
CTMW-1
CTMW-6

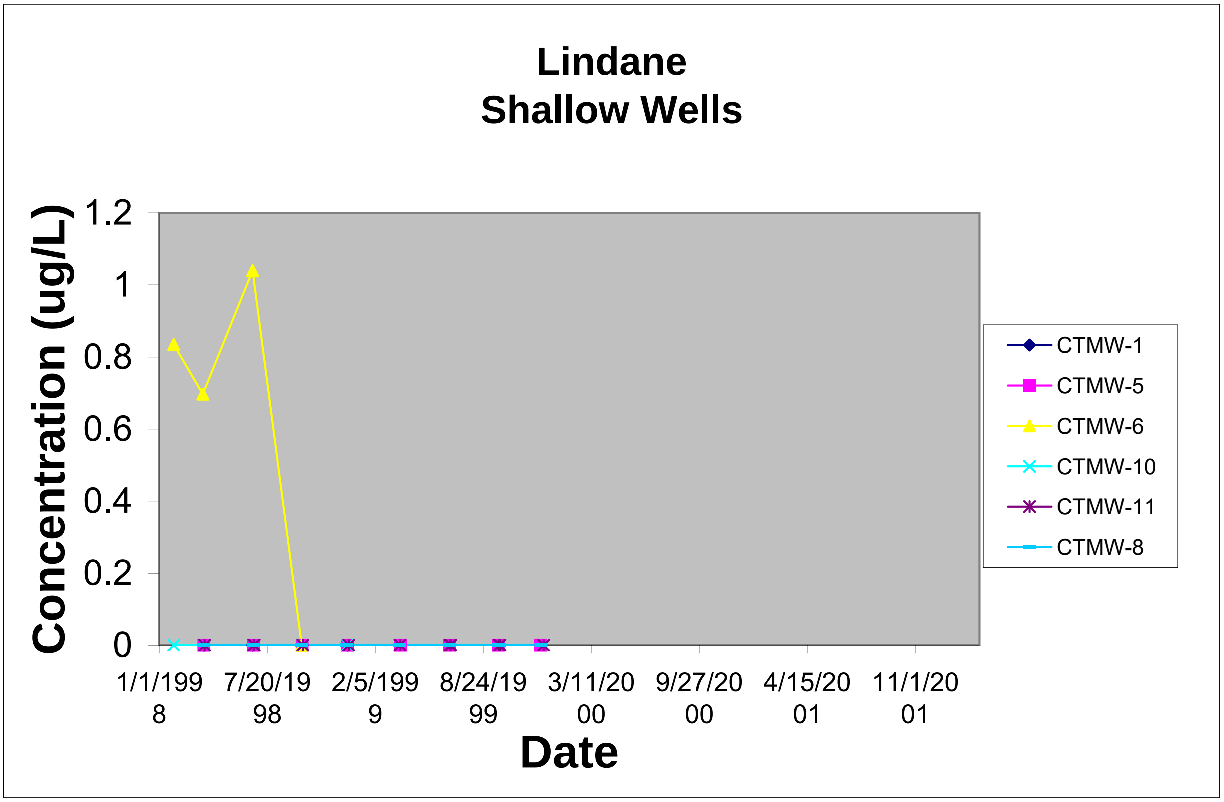

gamma-Chlordane
Shallow Wells
Concentration (ug/L)
0.06
0.05
0.04
0.03
0.02
0.01
0
3/11/1997
7/24/1998
12/6/1999
4/19/2001
9/1/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-15
CTMW-13
CTMW-14

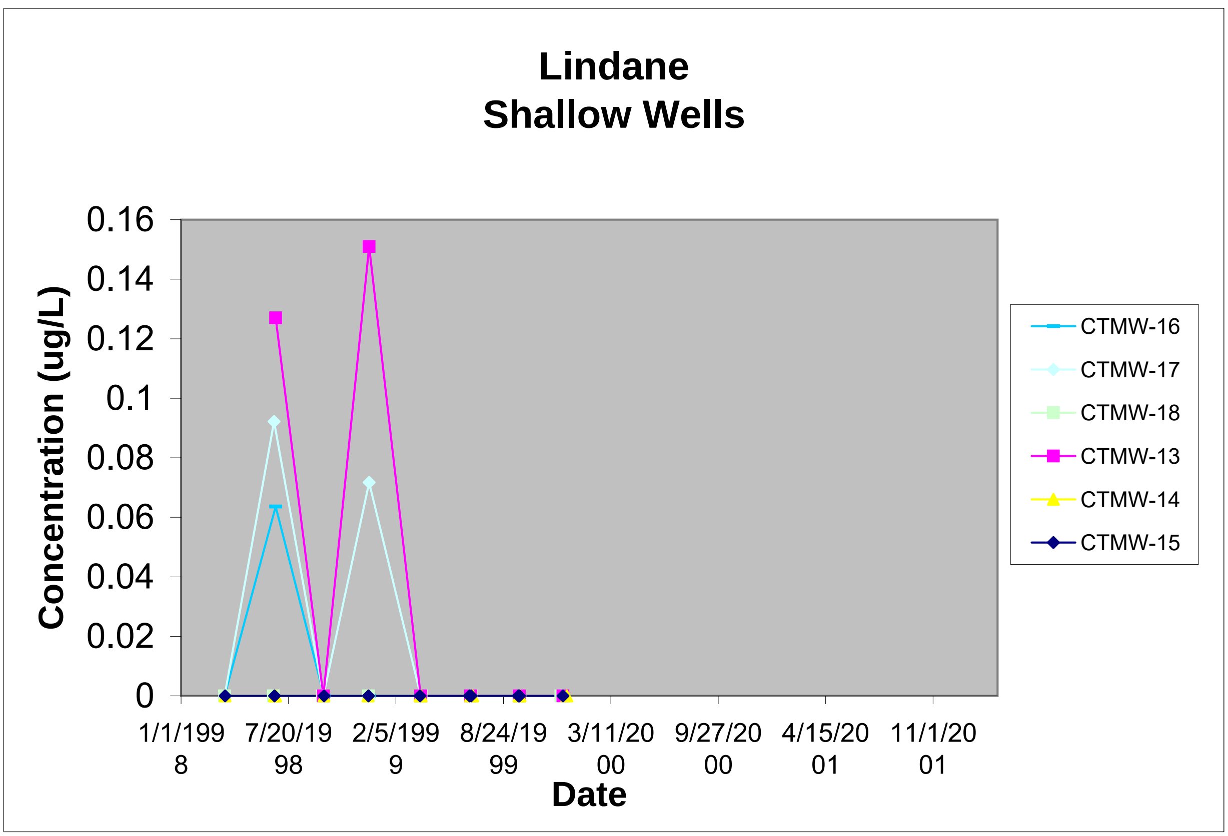

Heptachlor Epoxide
Shallow Wells
Concentration (ug/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

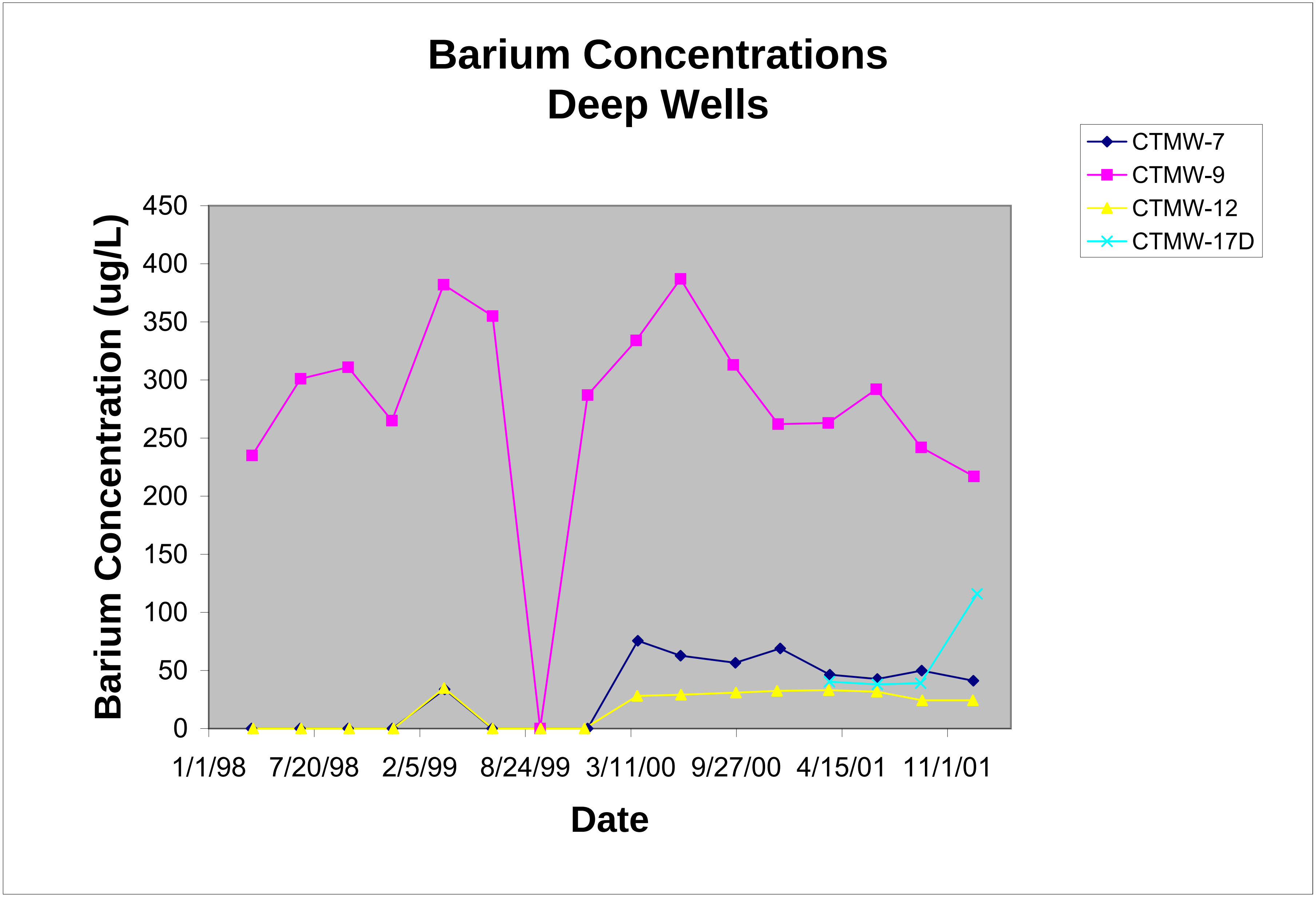

Heptachlor Epoxide
Shallow Wells
Concentration (ug/L)
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-13
CTMW-14
CTMW-15
CTMW-16
CTMW-17
CTMW-18

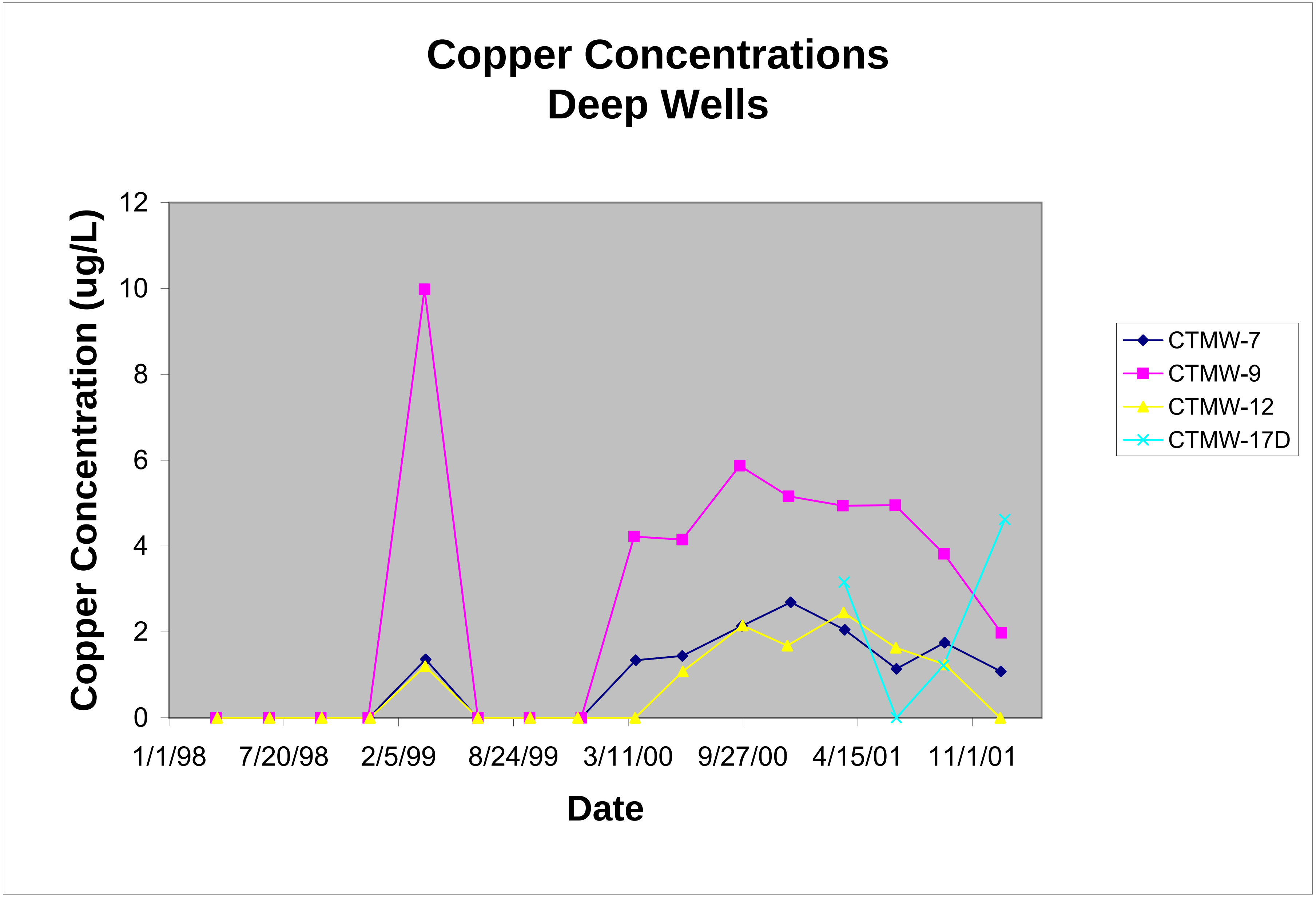

Heptachlor
Shallow Wells
Concentration (ug/L)
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

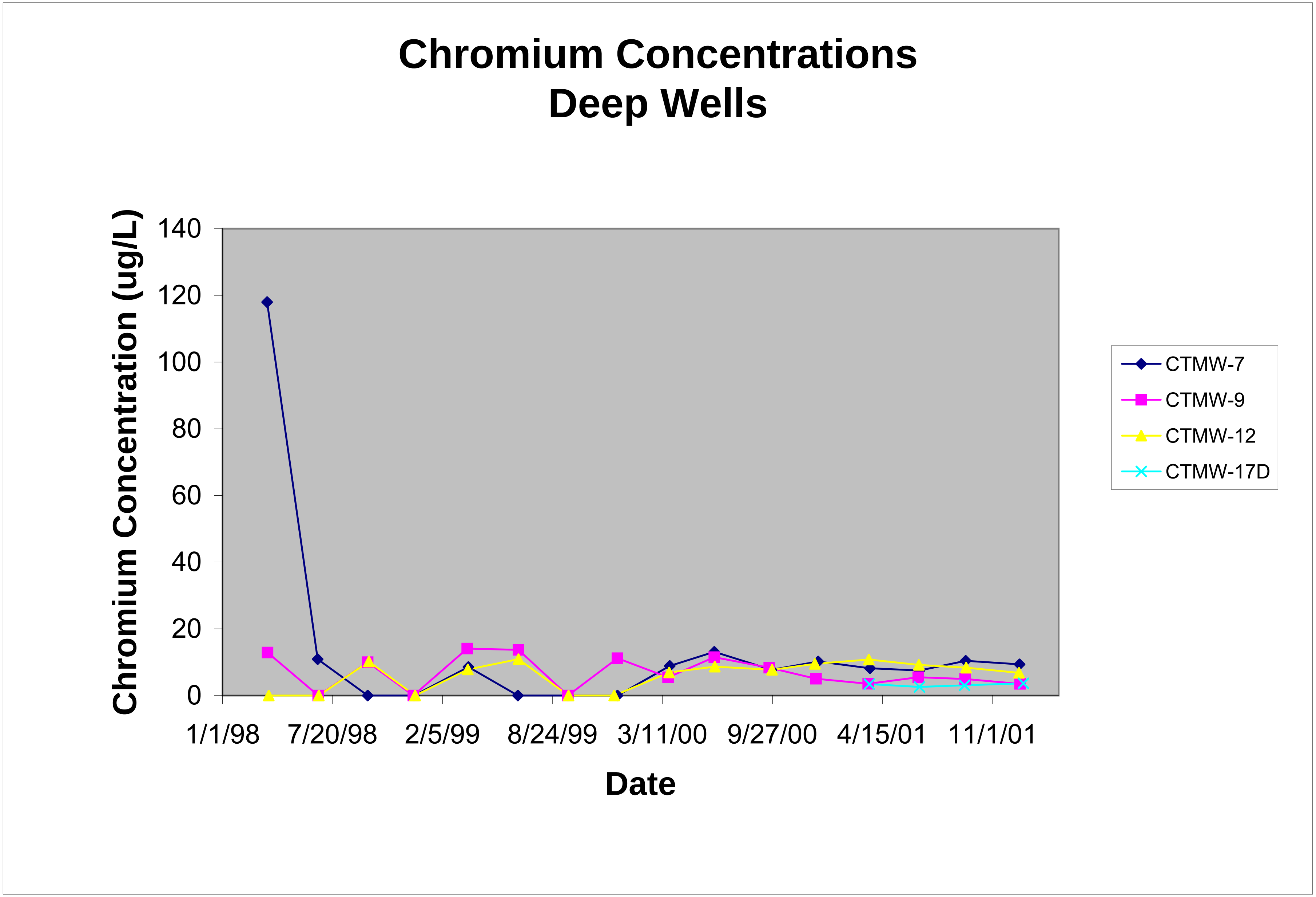

Heptachlor
Shallow Wells
Concentration (ug/L)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1/1/1998
5/16/1999
9/27/2000
2/9/2002
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


Lindane
Shallow Wells
Concentration (ug/L)
1.2
1
0.8
0.6
0.4
0.2
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-1
CTMW-5
CTMW-6
CTMW-10
CTMW-11
CTMW-8

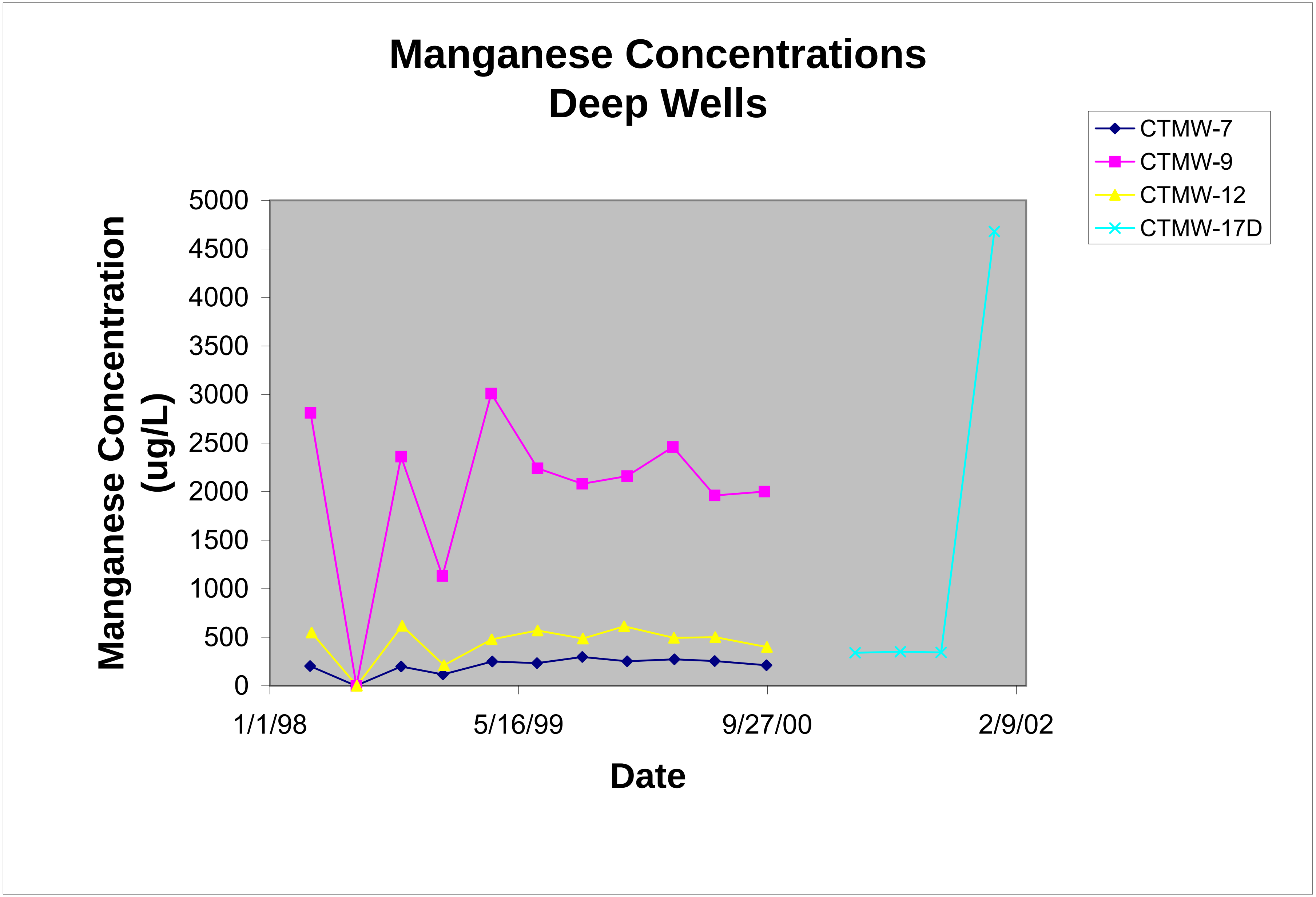

Lindane
Shallow Wells
Concentration (ug/L)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1/1/1998
7/20/1998
2/5/1999
8/24/1999
3/11/2000
9/27/2000
4/15/2001
11/1/2001
Date
CTMW-16
CTMW-17
CTMW-18
CTMW-13
CTMW-14
CTMW-15


Barium Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
CTMW-17D
Barium Concentration (ug/L)
450
400
350
300
250
200
150
100
50
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date

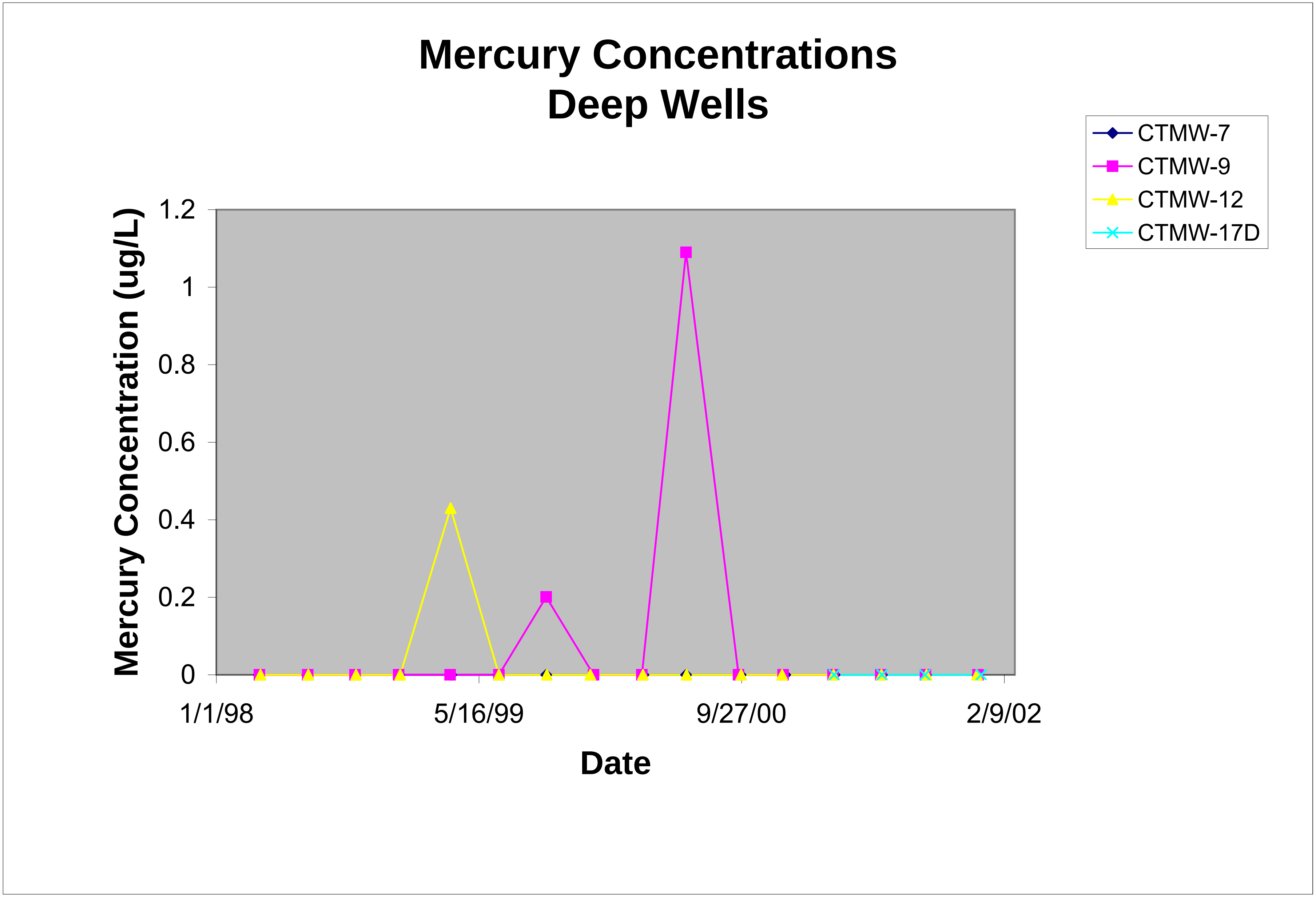

Copper Concentrations
Deep Wells
Copper Concentration (ug/L)
12
10
8
6
4
2
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D

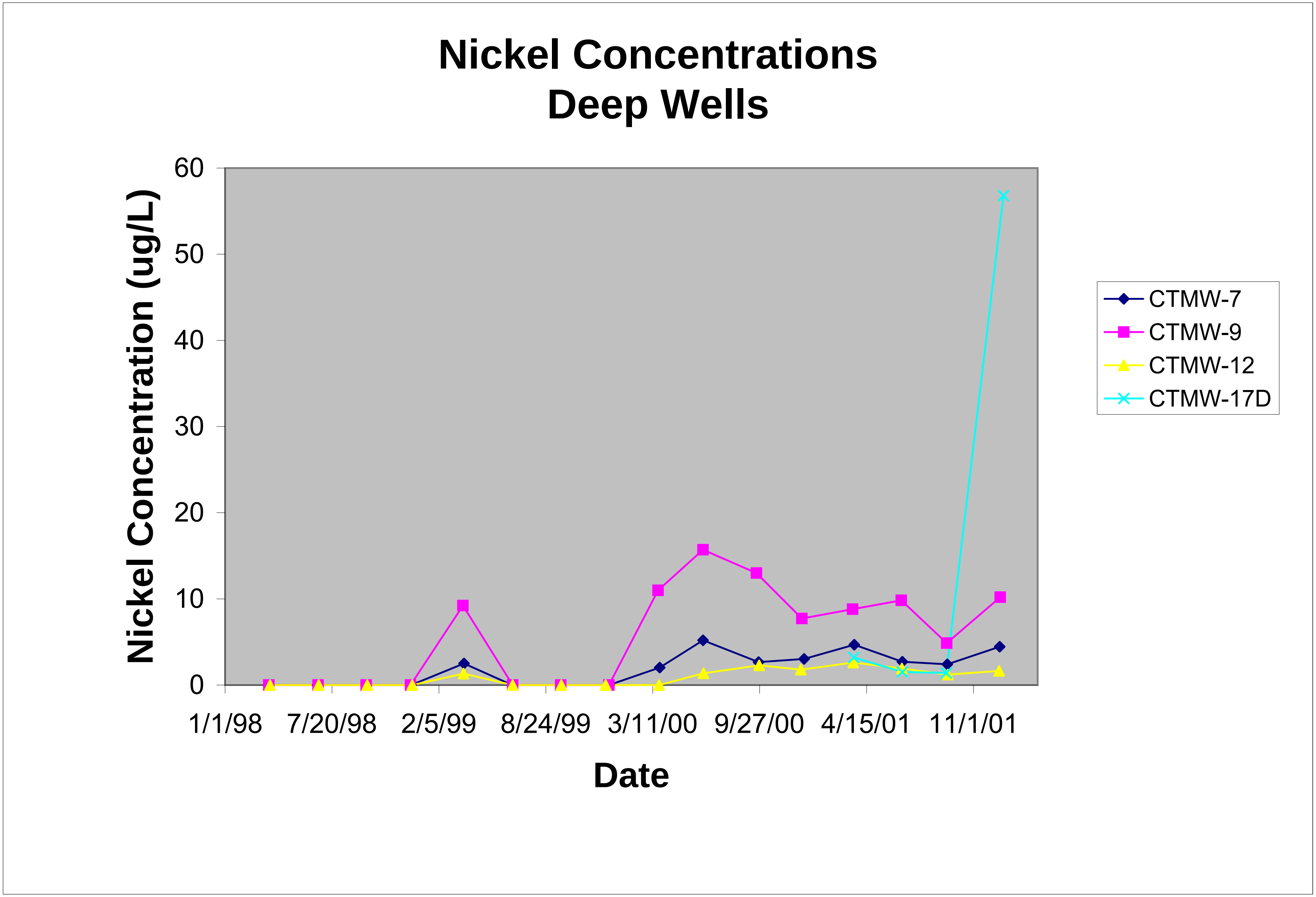


Chromium Concentrations
Deep Wells
Chromium Concentration (ug/L)
140
120
100
80
60
40
20
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D

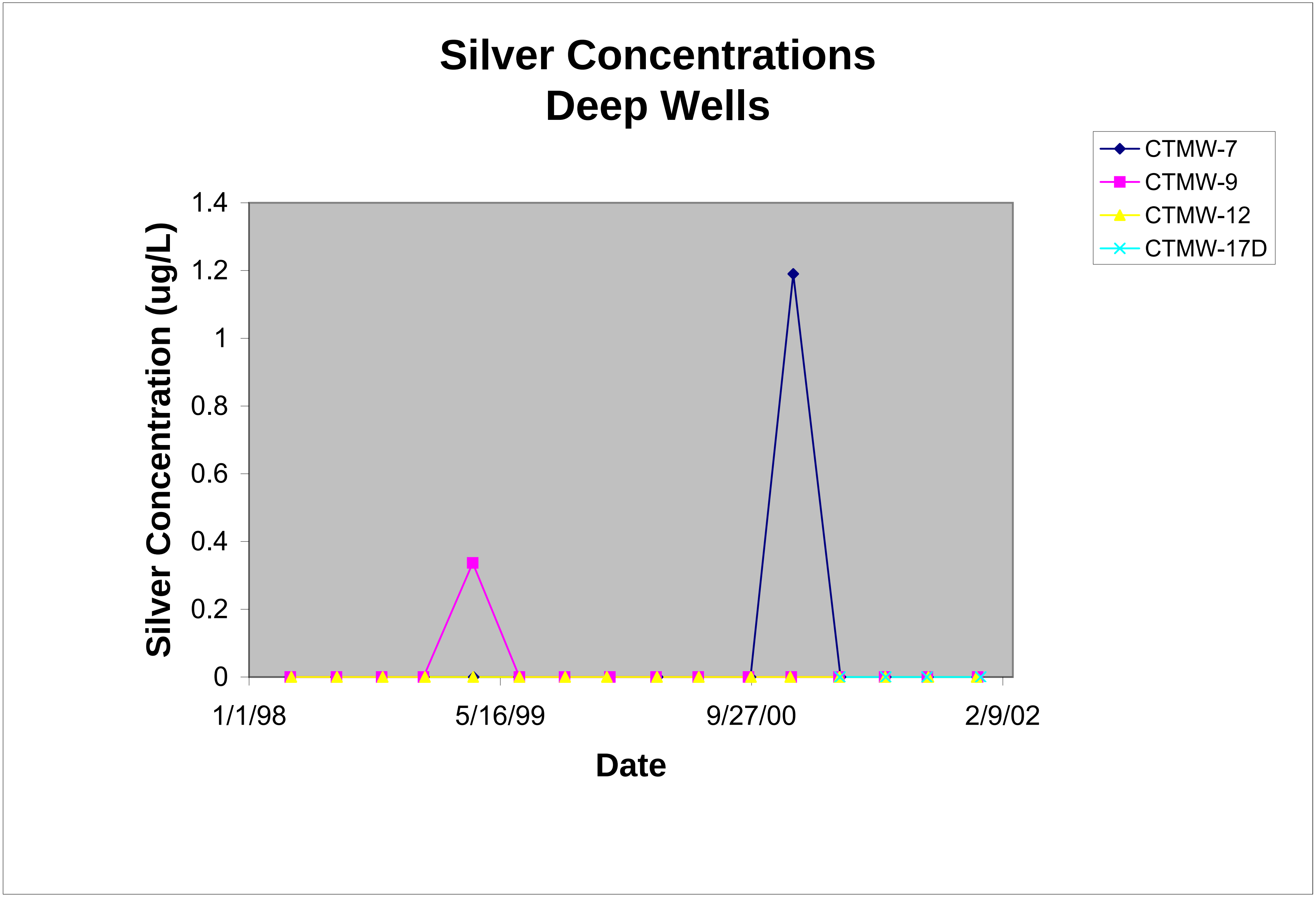


Manganese Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
CTMW-17D
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Manganese Concentration (ug/L)
1/1/98
5/16/99
9/27/00
2/9/02
Date

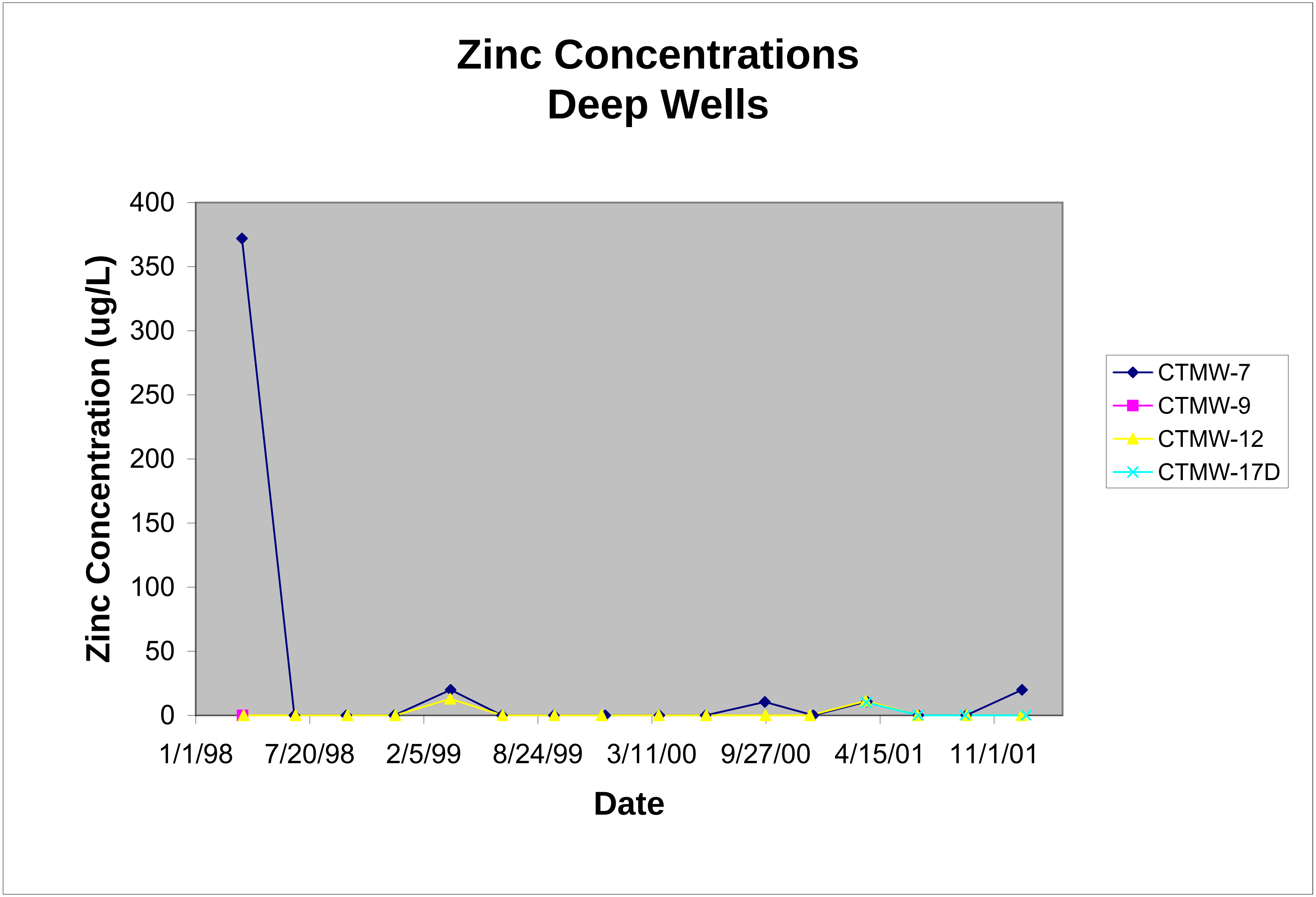

Mercury Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
CTMW-17D
Mercury Concentration (ug/L)
1.2
1
0.8
0.6
0.4
0.2
0
1/1/98
5/16/99
9/27/00
2/9/02
Date



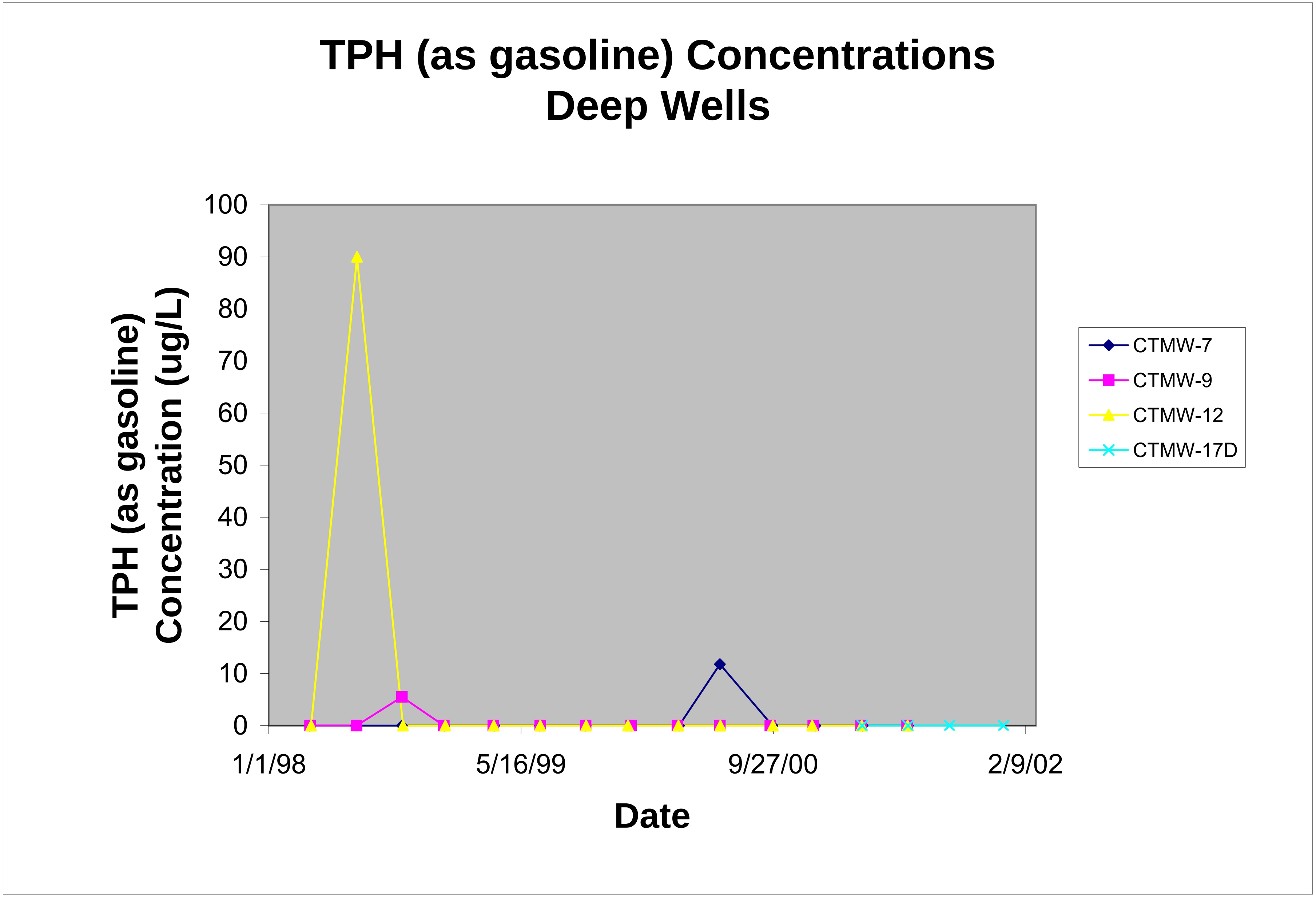
Nickel Concentrations
Deep Wells
Nickel Concentration (ug/L)
60
50
40
30
20
10
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D



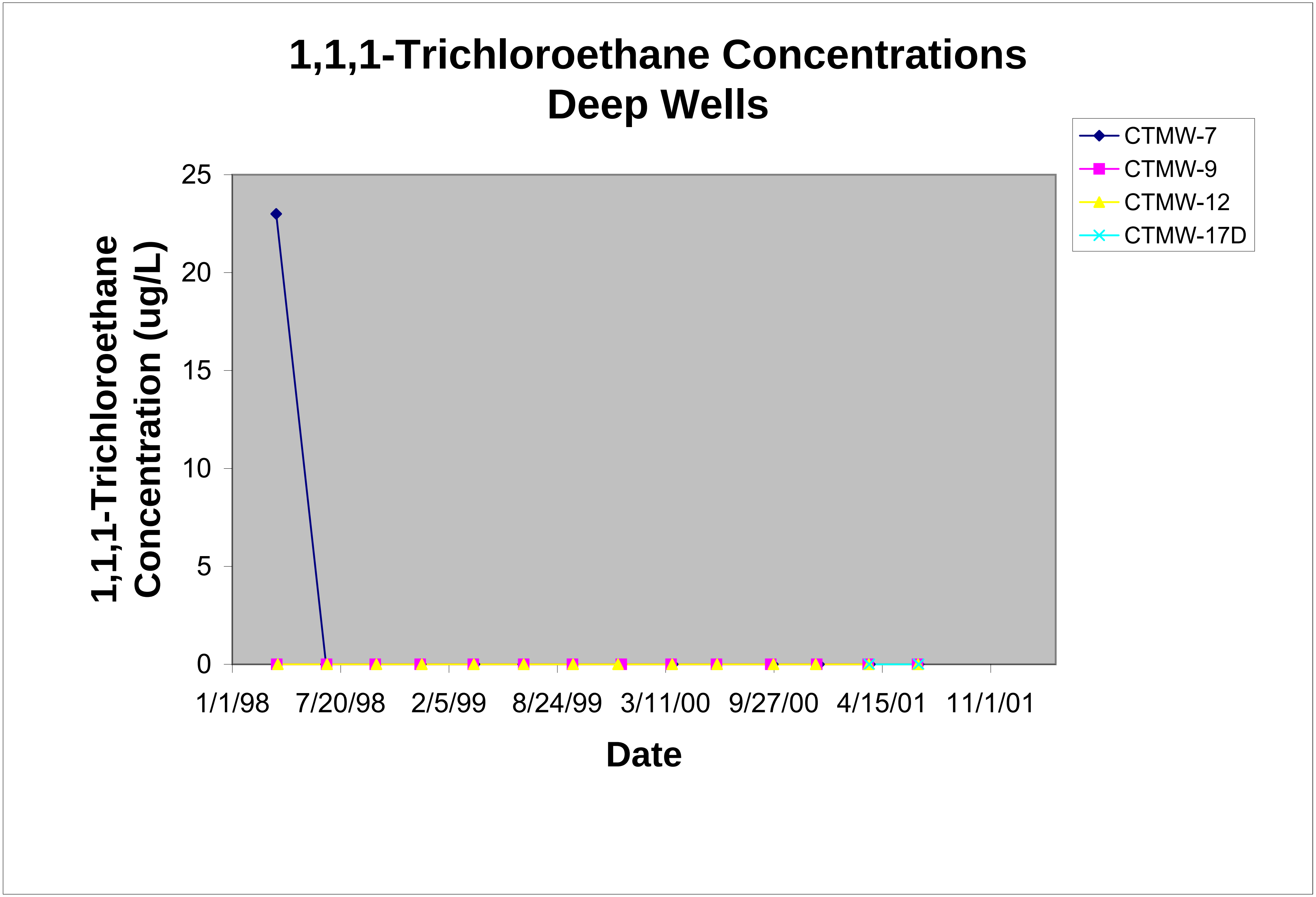
Silver Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
CTMW-17D
Silver Concentration (ug/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/98
5/16/99
9/27/00
2/9/02
Date

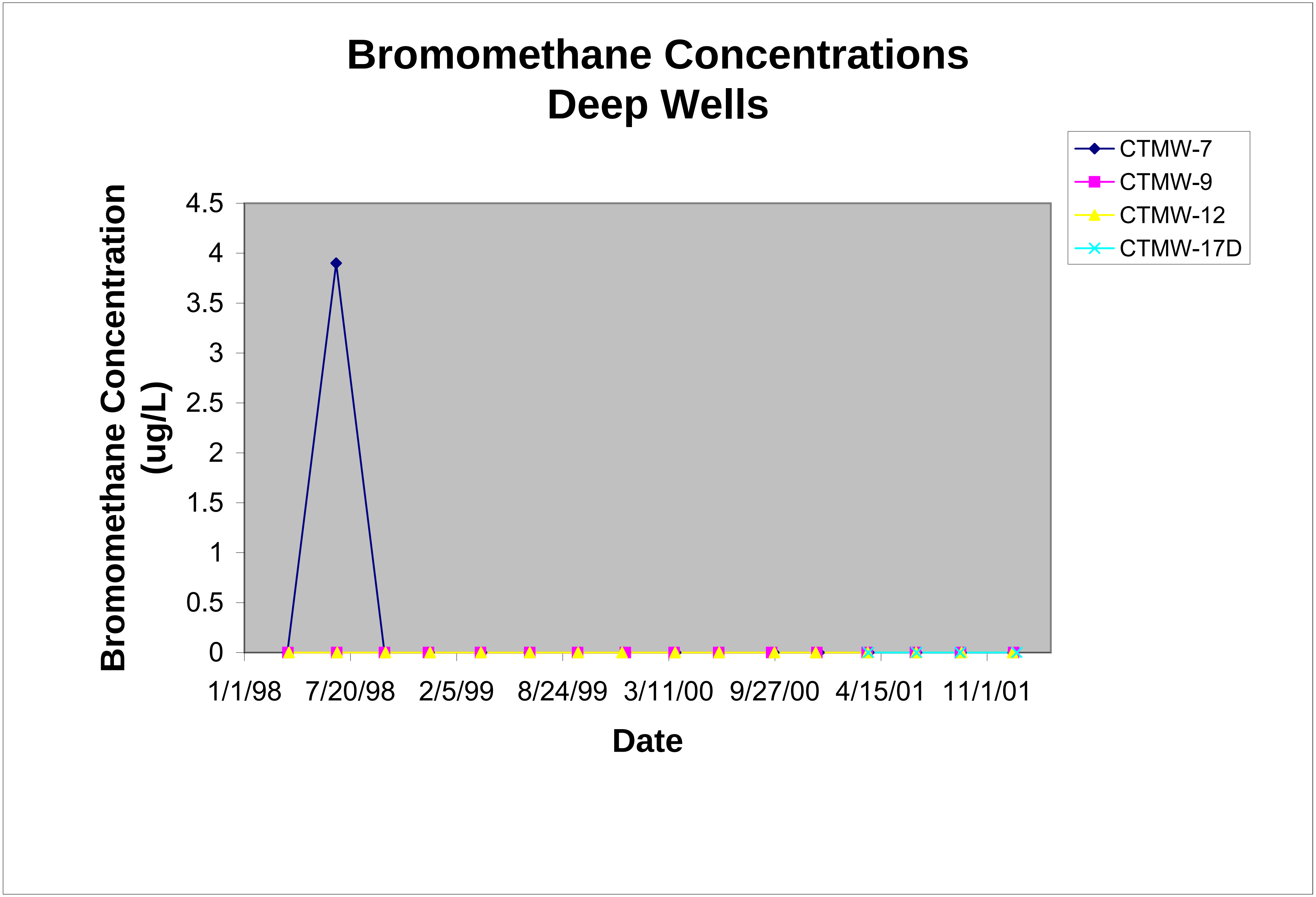


Zinc Concentrations
Deep Wells
Zinc Concentration (ug/L)
400
350
300
250
200
150
100
50
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D

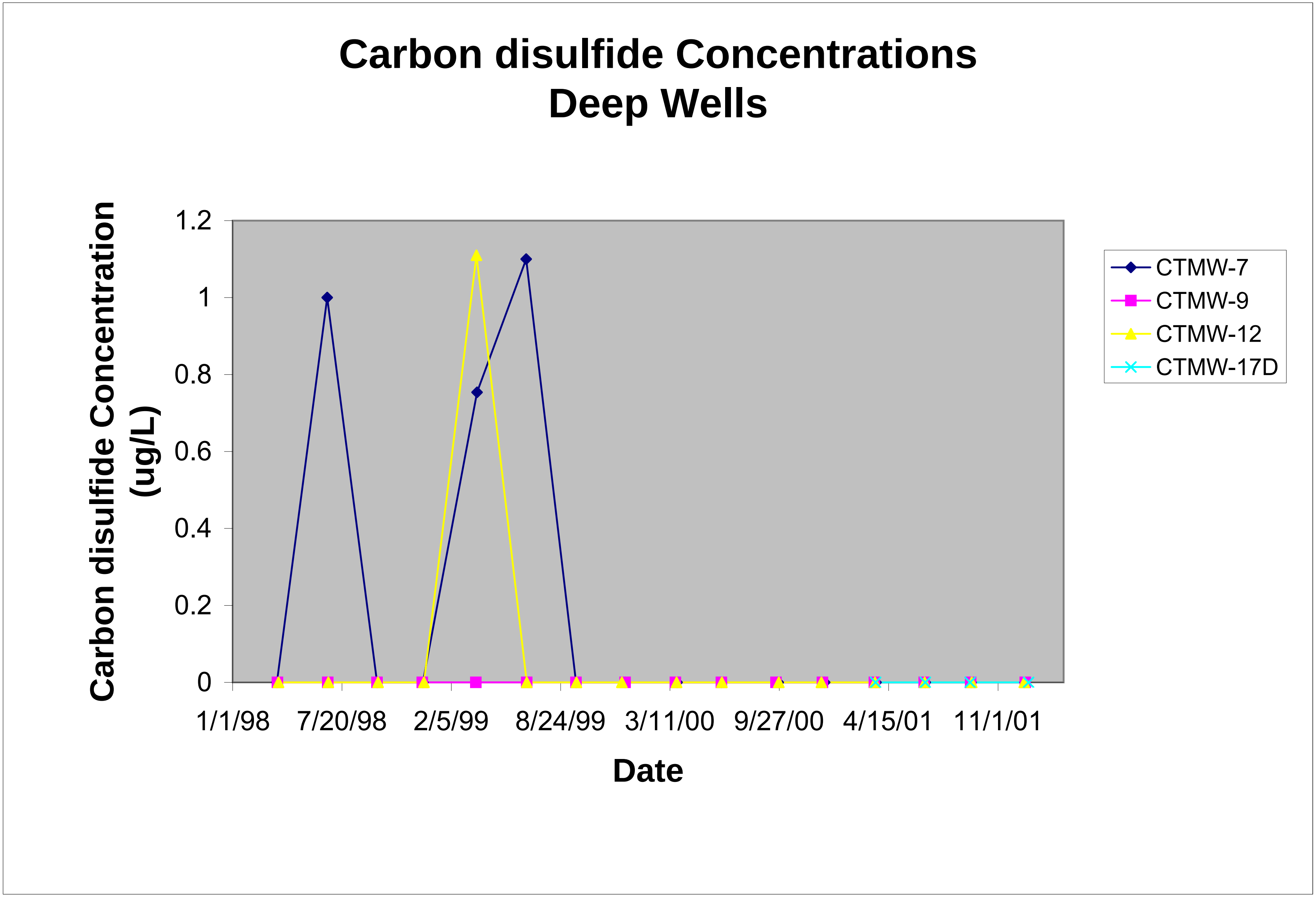


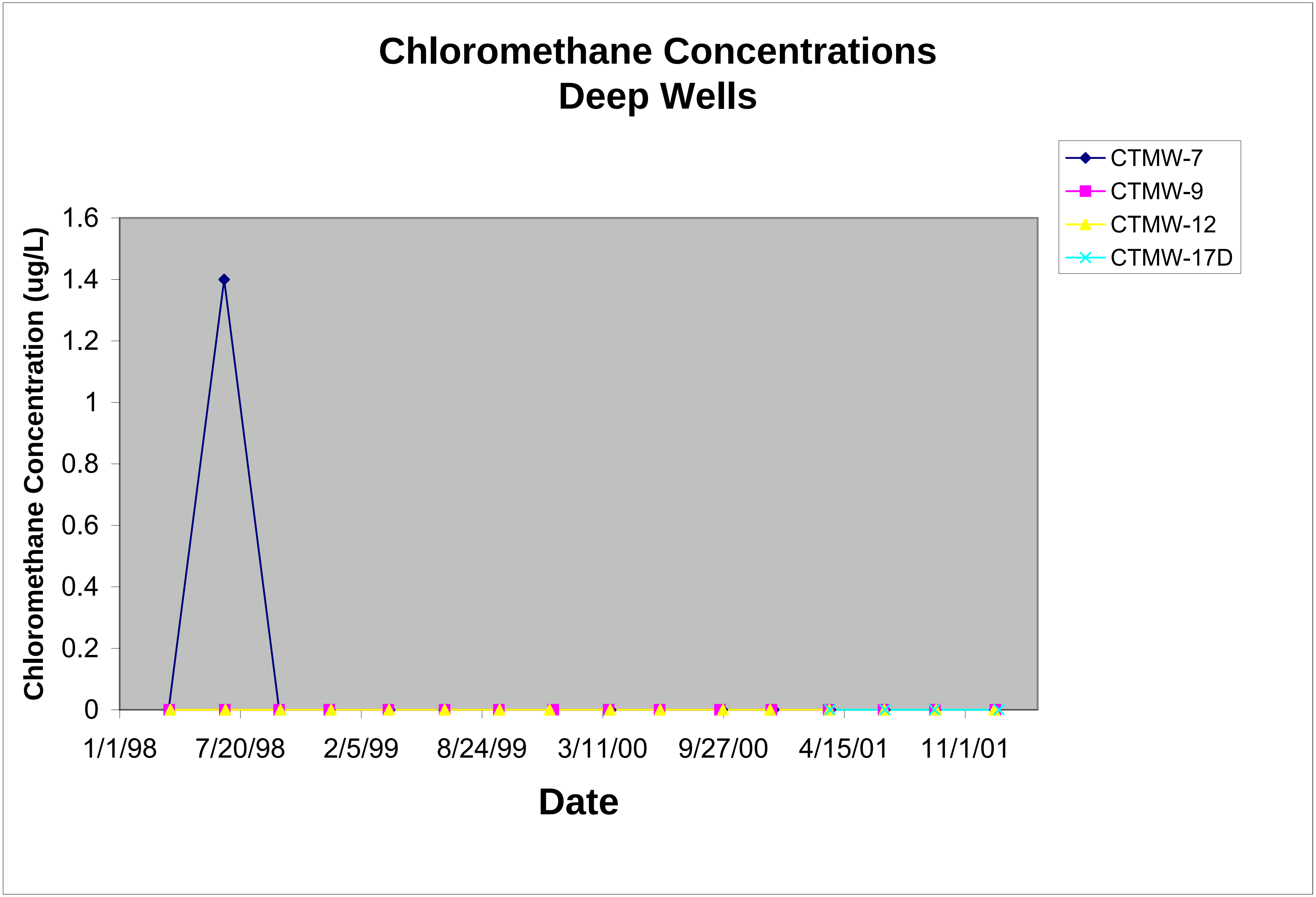
TPH (as gasoline) Concentrations
Deep Wells
TPH (as gasoline) Concentration (ug/L)
100
90
80
70
60
50
40
30
20
10
0
1/1/98
5/16/99
9/27/00
2/9/02
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D


1,1,1-Trichloroethane Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
CTMW-17D
1,1,1-Trichloroethane Concentration (ug/L)
25
20
15
10
5
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date

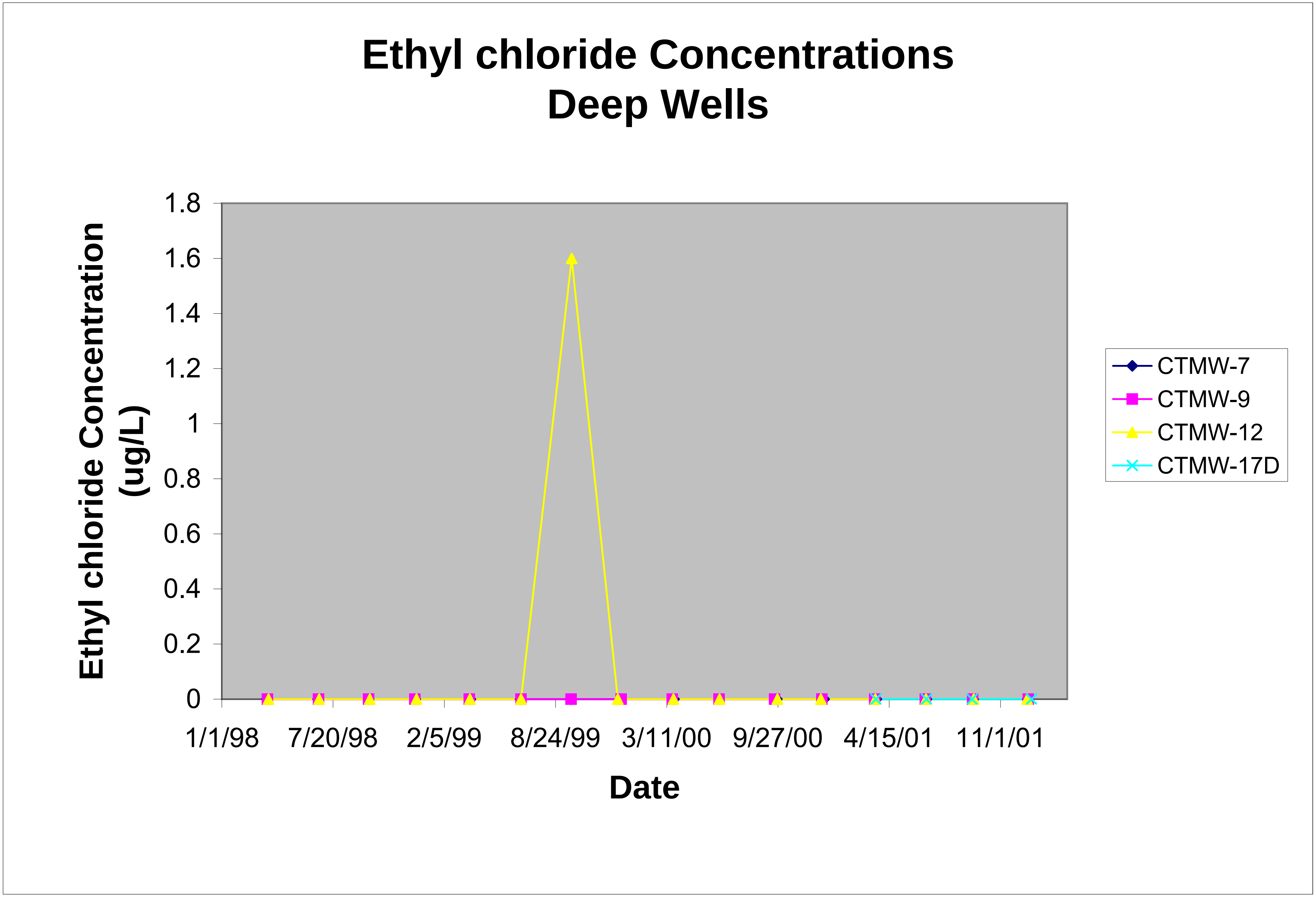


Bromomethane Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
CTMW-17D
Bromomethane Concentration (ug/L)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date

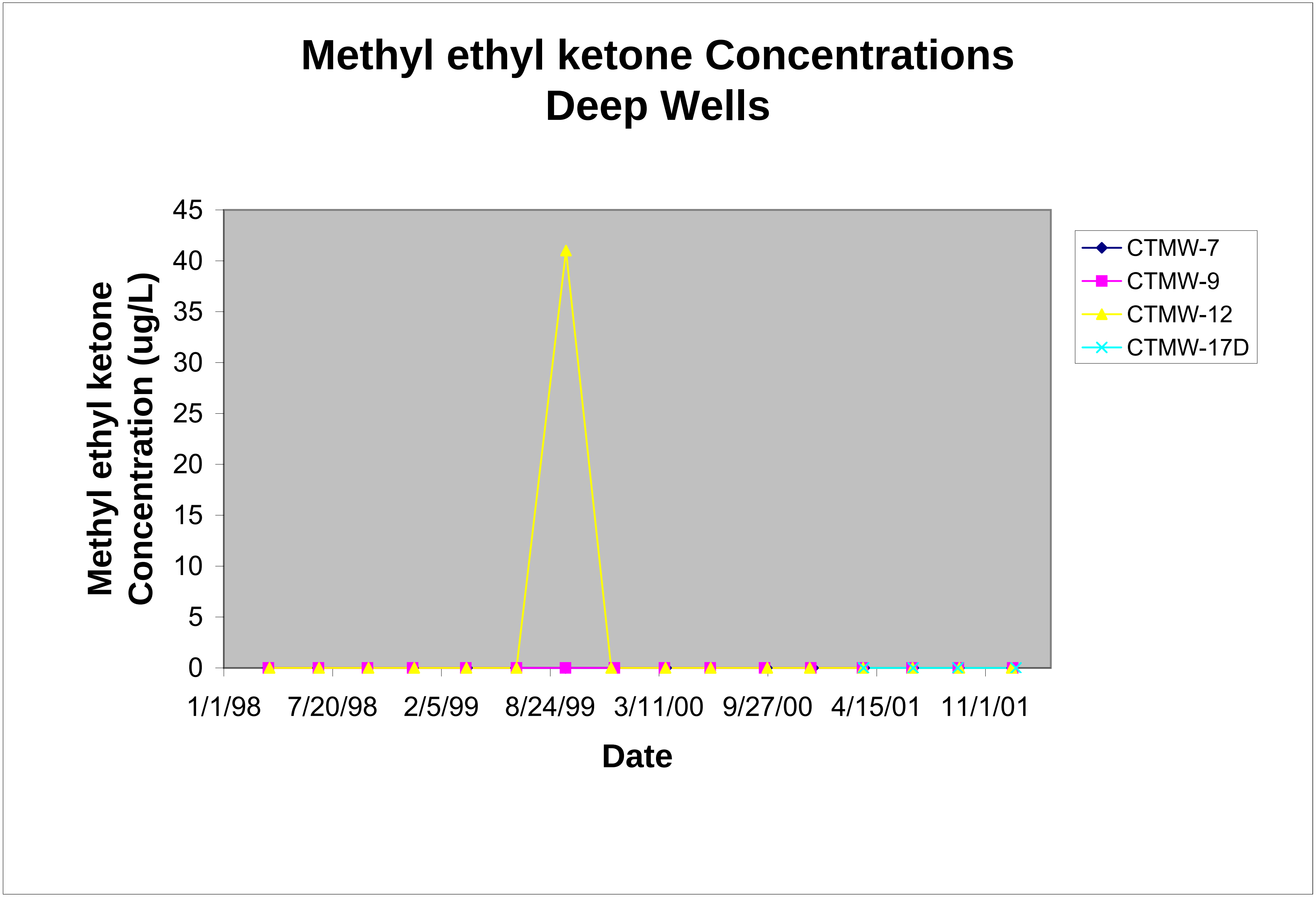

Carbon disulfide Concentrations
Deep Wells
Carbon disulfide Concentration (ug/L)
1.2
1
0.8
0.6
0.4
0.2
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D

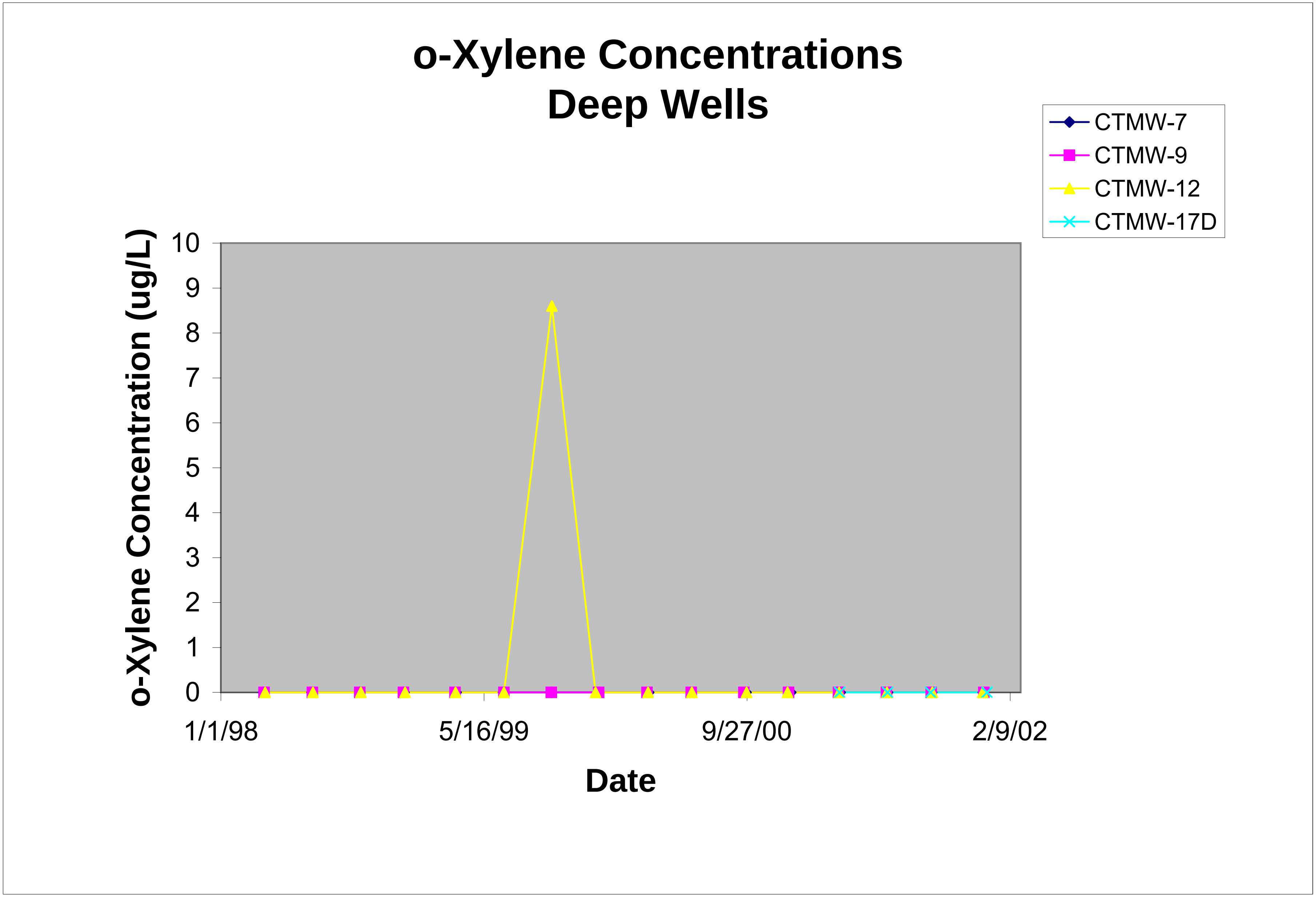


Chloromethane Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
CTMW-17D
Chloromethane Concentration (ug/L)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date

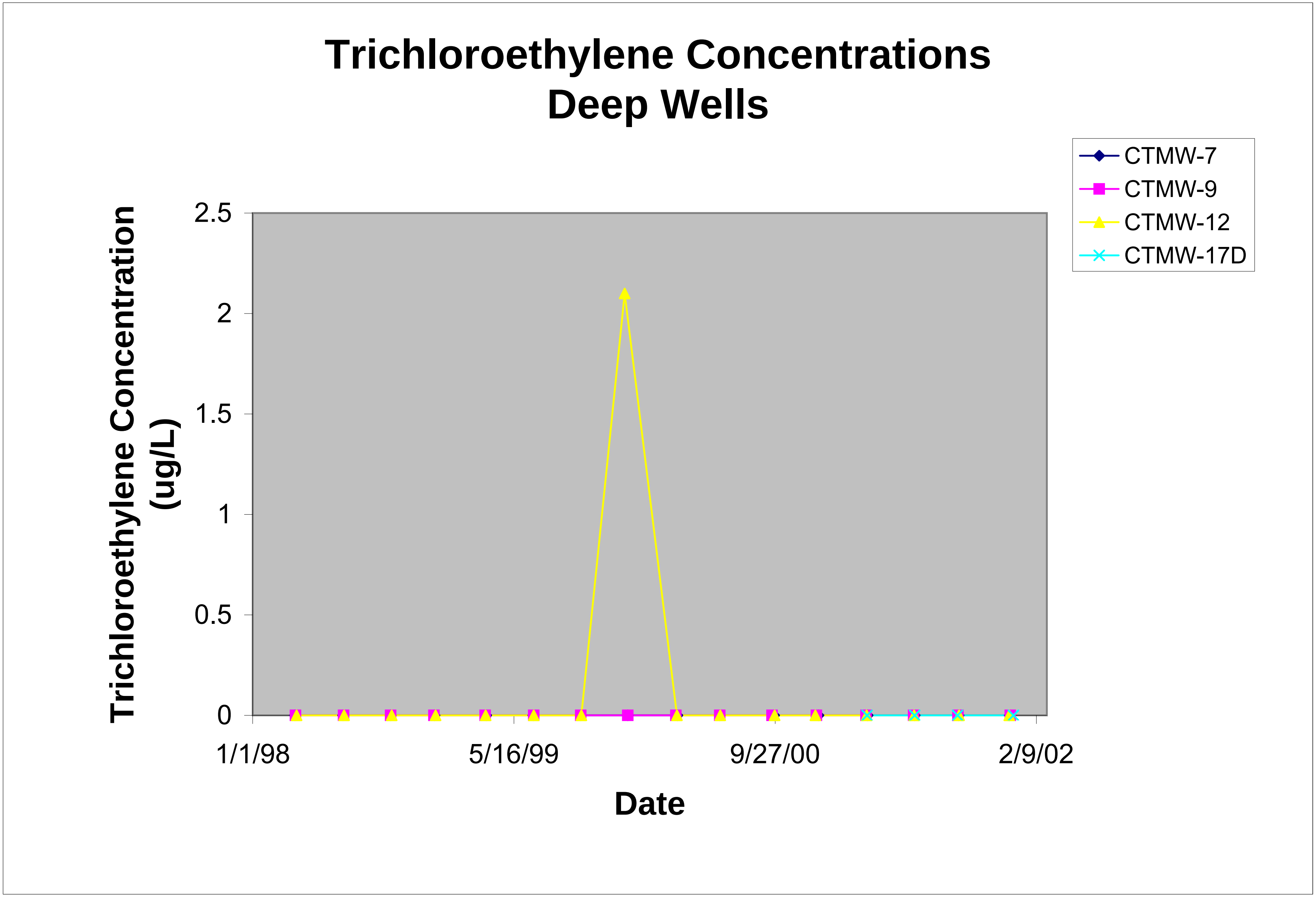


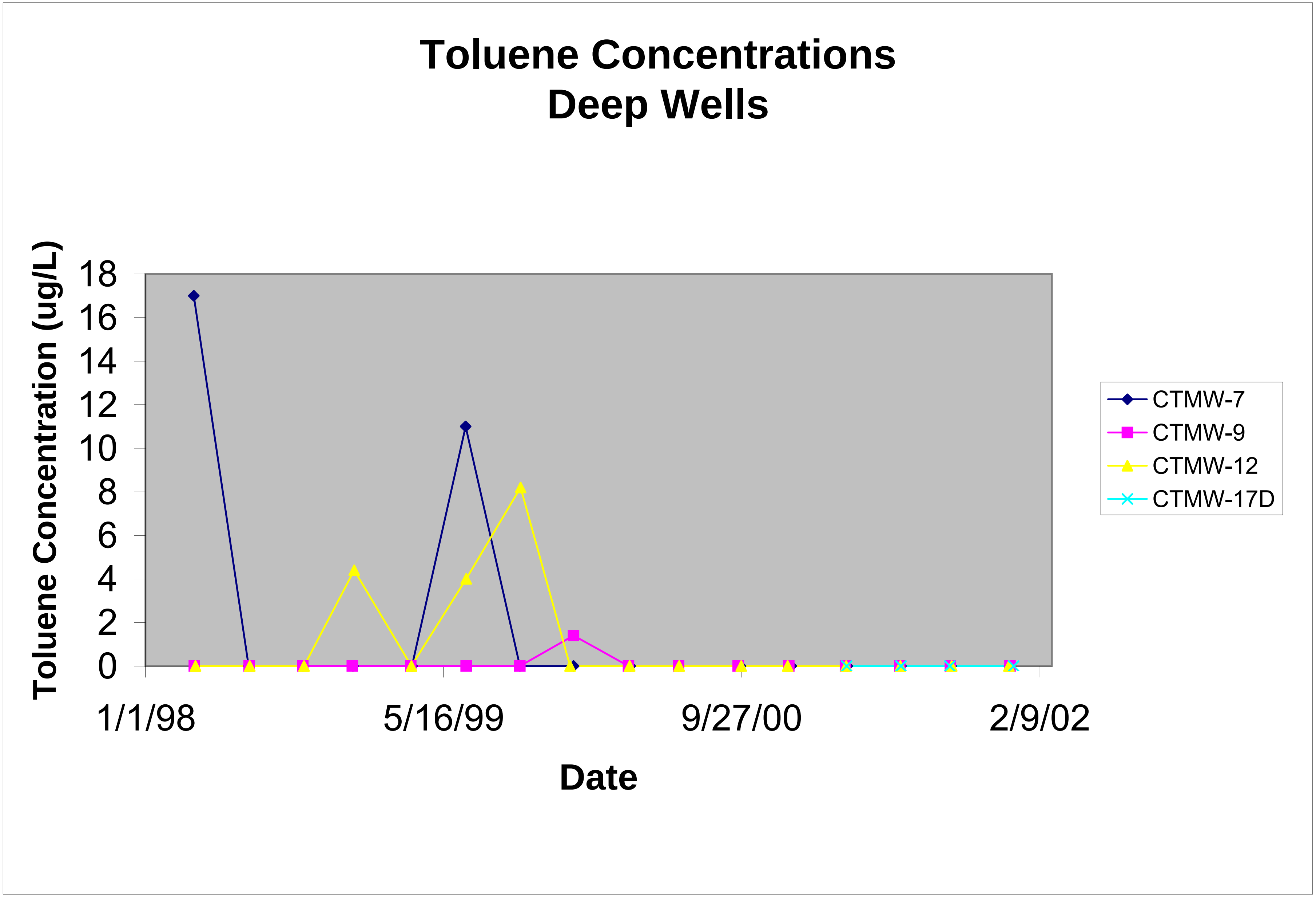
Ethyl chloride Concentrations
Deep Wells
Ethyl chloride Concentration (ug/L)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D

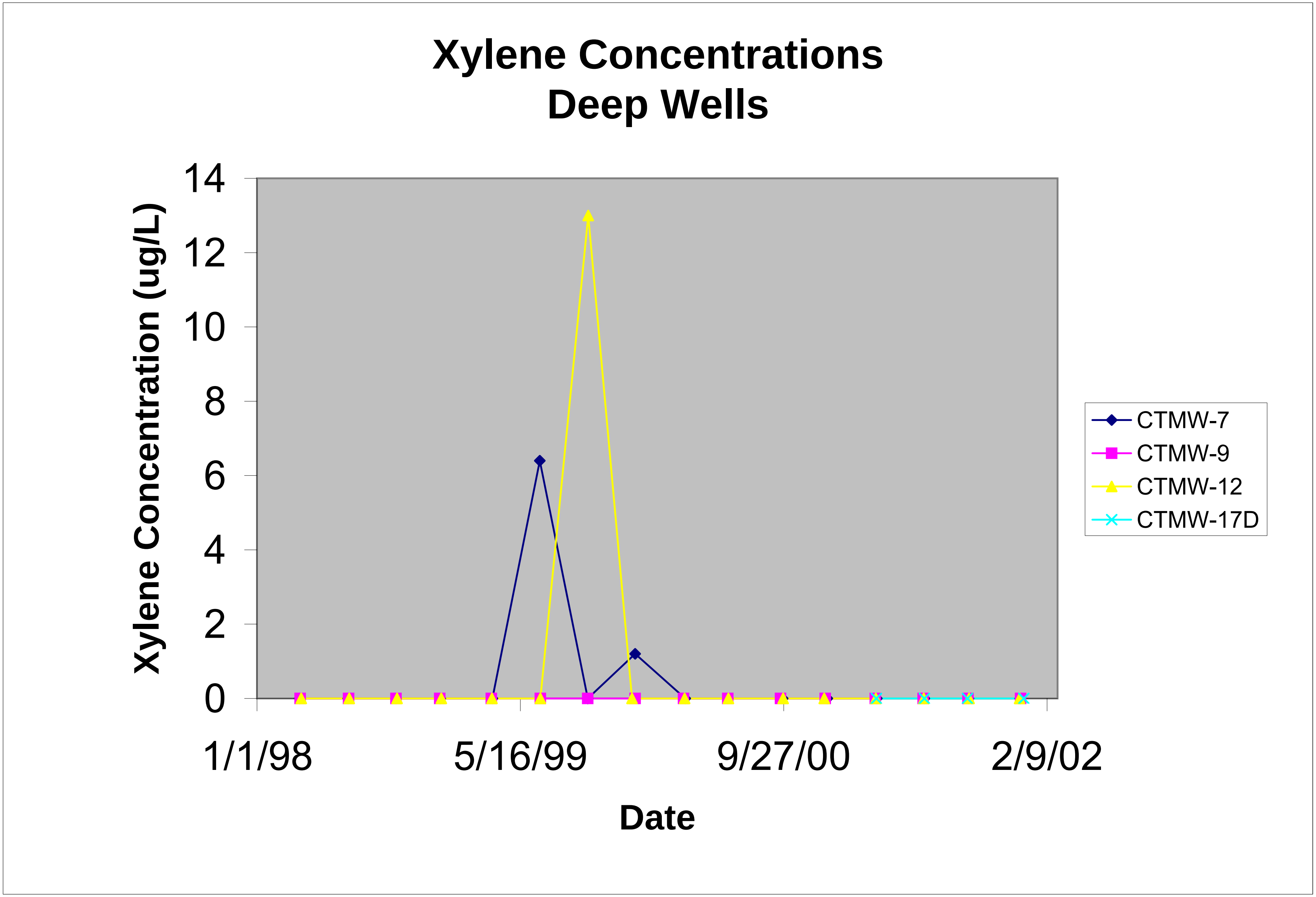

Methyl ethyl ketone Concentrations
Deep Wells
Methyl ethyl ketone Concentration (ug/L)
45
40
35
30
25
20
15
10
5
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D



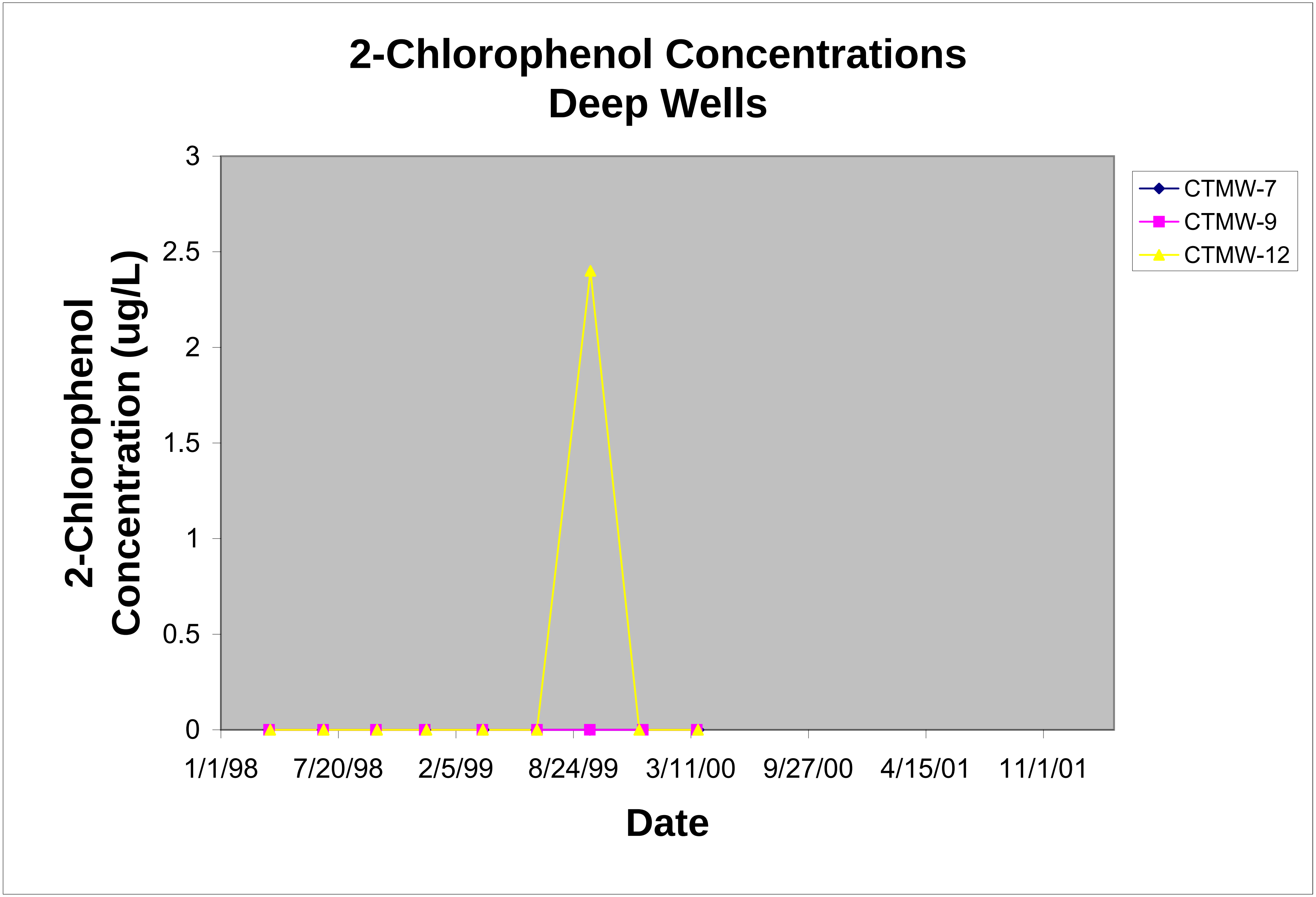
o-Xylene Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
CTMW-17D
o-Xylene Concentration (ug/L)
10
9
8
7
6
5
4
3
2
1
0
1/1/98
5/16/99
9/27/00
2/9/02
Date


Trichloroethylene Concentrations
Deep Wells
Trichloroethylene Concentration (ug/L)
2.5
2
1.5
1
0.5
0
1/1/98
5/16/99
9/27/00
2/9/02
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D

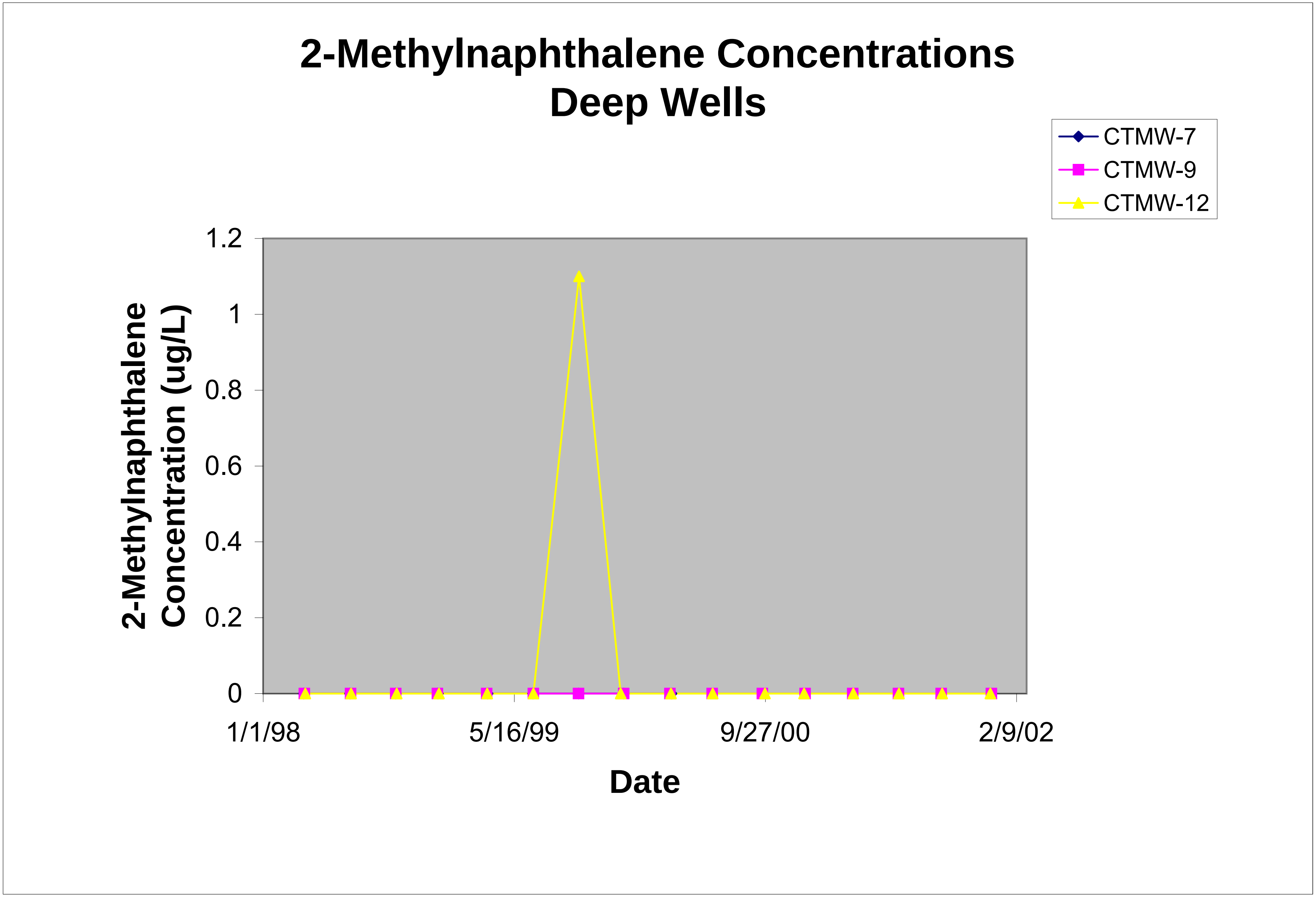

Toluene Concentrations
Deep Wells
Toluene Concentration (ug/L)
18
16
14
12
10
8
6
4
2
0
1/1/98
5/16/99
9/27/00
2/9/02
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D

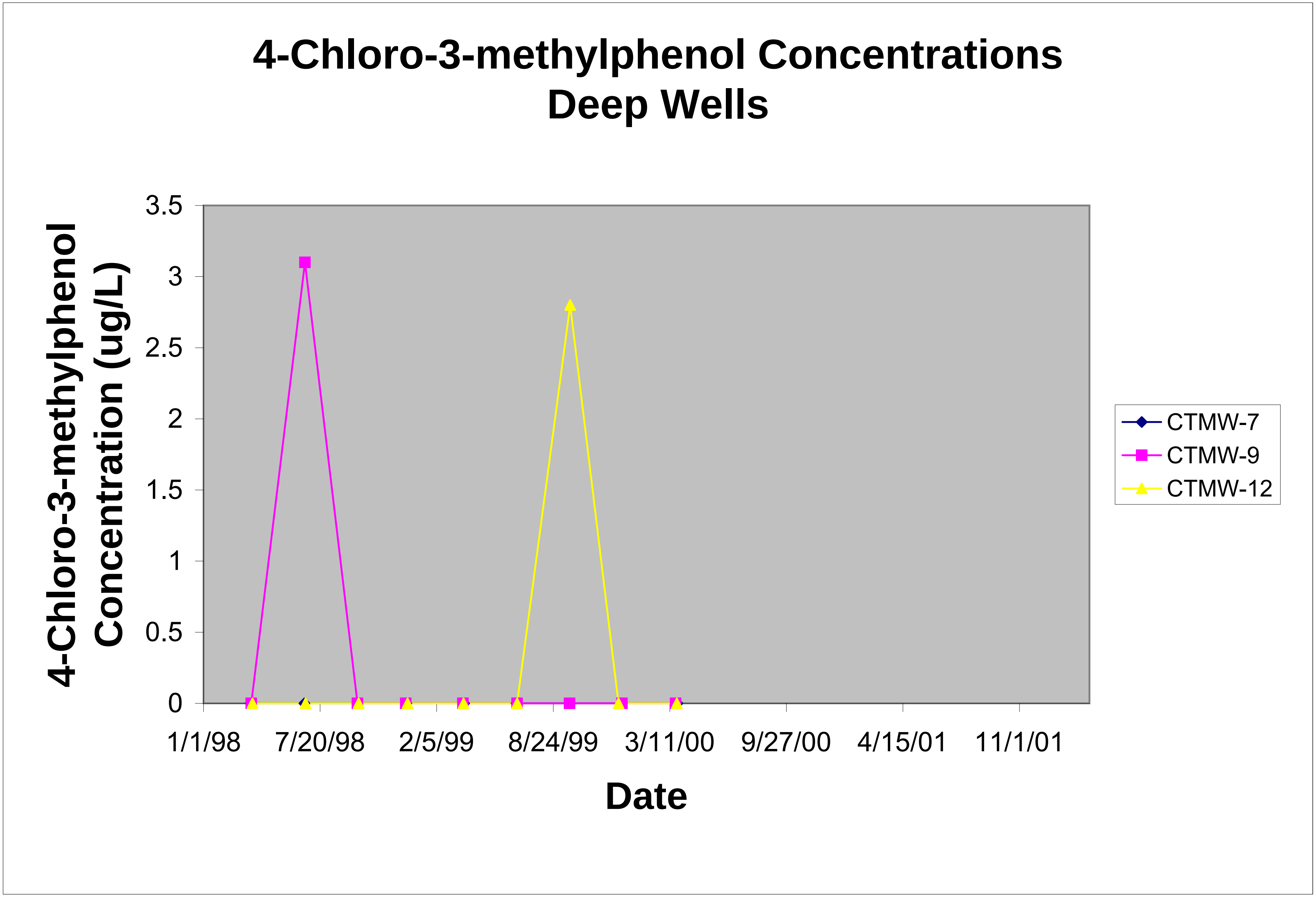


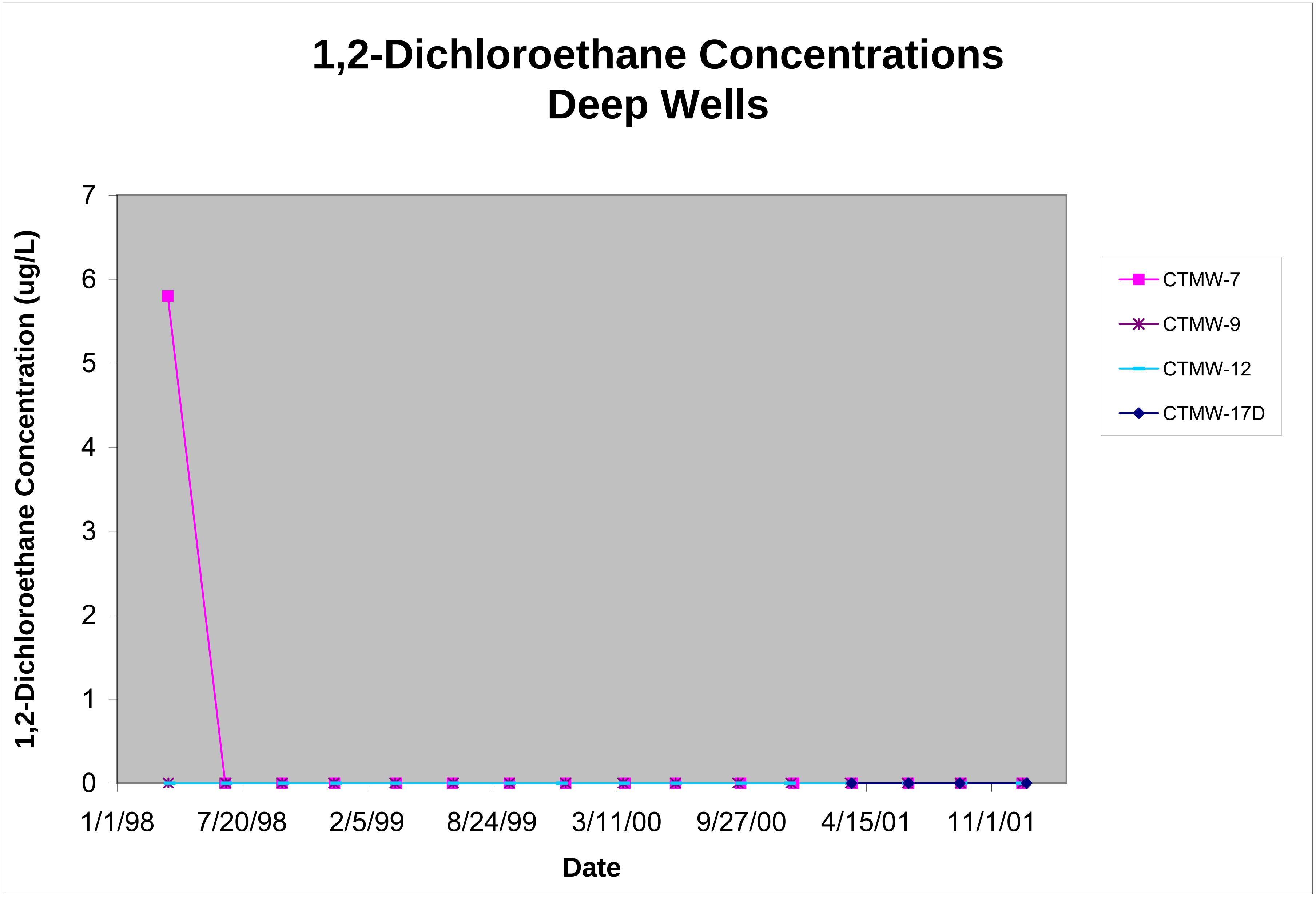
Xylene Concentrations
Deep Wells
Xylene Concentration (ug/L)
14
12
10
8
6
4
2
0
1/1/98
5/16/99
9/27/00
2/9/02
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D

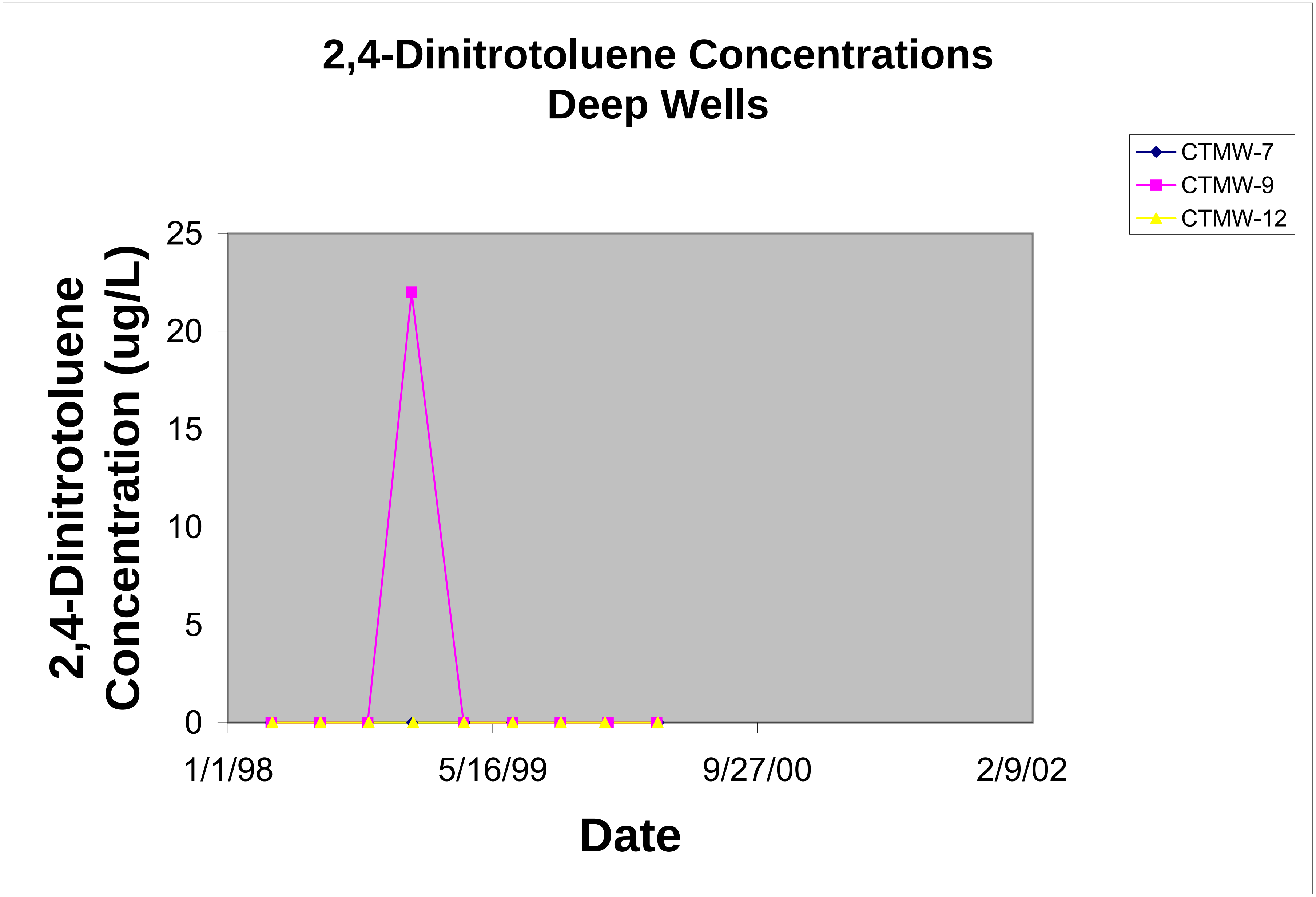


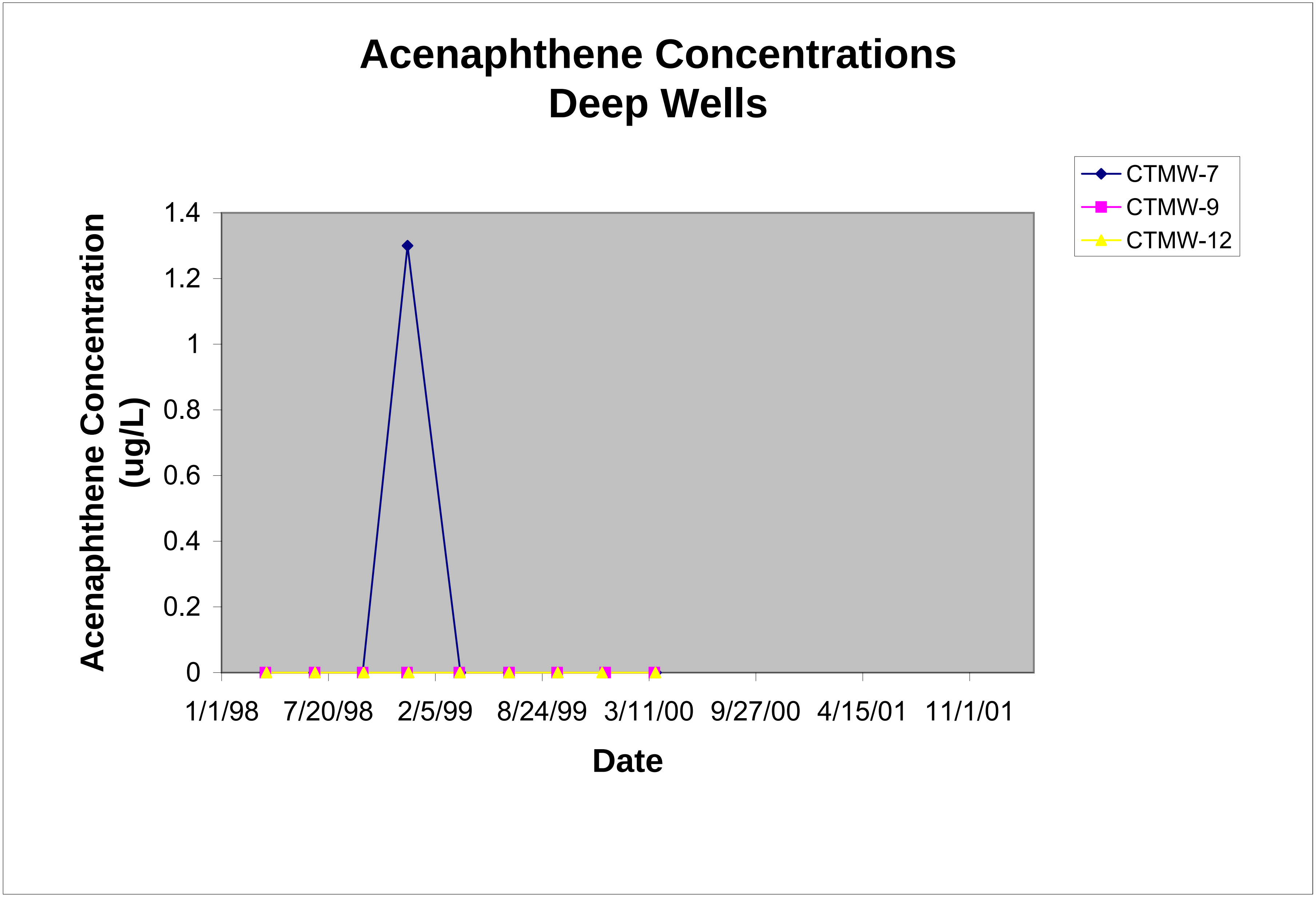
2-Chlorophenol Concentrations
Deep Wells
2-Chlorophenol Concentration (ug/L)
3
2.5
2
1.5
1
0.5
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12


2-Methylnaphthalene Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
2-Methylnaphthalene Concentration (ug/L)
1.2
1
0.8
0.6
0.4
0.2
0
1/1/98
5/16/99
9/27/00
2/9/02
Date

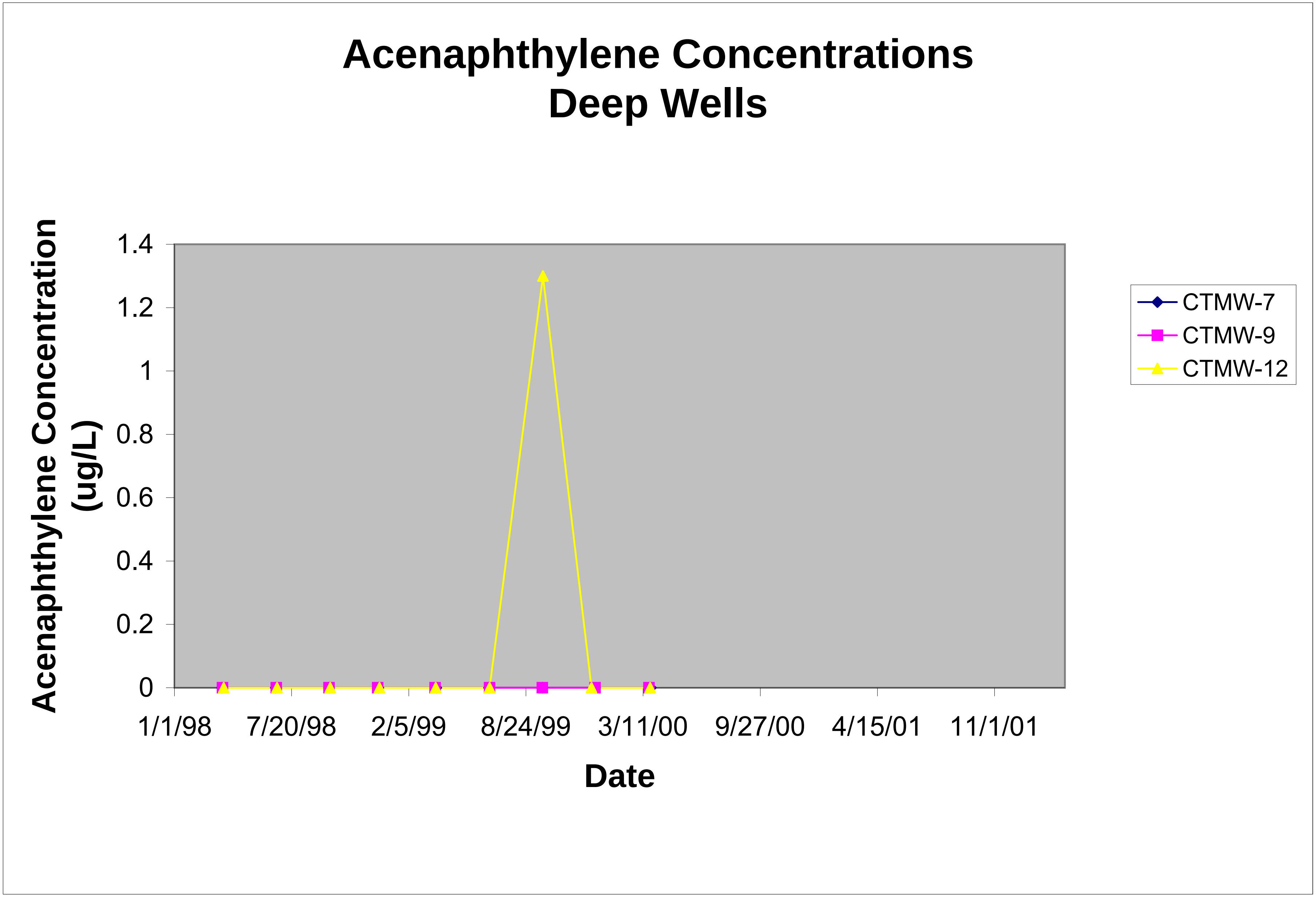

4-Chloro-3-methylphenol Concentrations
Deep Wells
4-Chloro-3-methylphenol Concentration (ug/L)
3.5
3
2.5
2
1.5
1
0.5
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12


1,2-Dichloroethane Concentrations
Deep Wells
1,2-Dichloroethane Concentration (ug/L)
7
6
5
4
3
2
1
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12
CTMW-17D

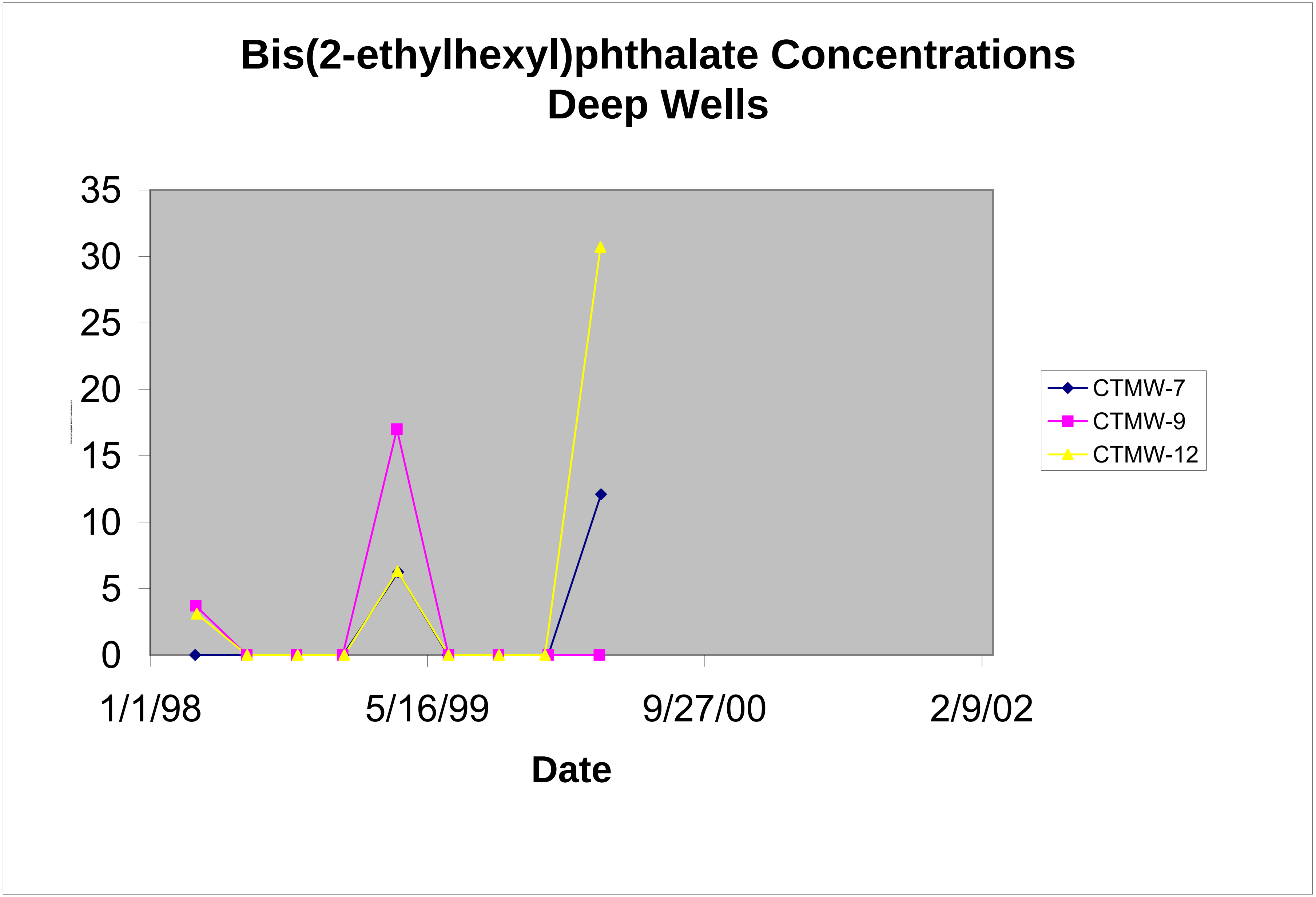

2,4-Dinitrotoluene Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
25
20
15
10
5
0
1/1/98
5/16/99
9/27/00
2/9/02
Date
2,4-Dinitrotoluene Concentration (ug/L)



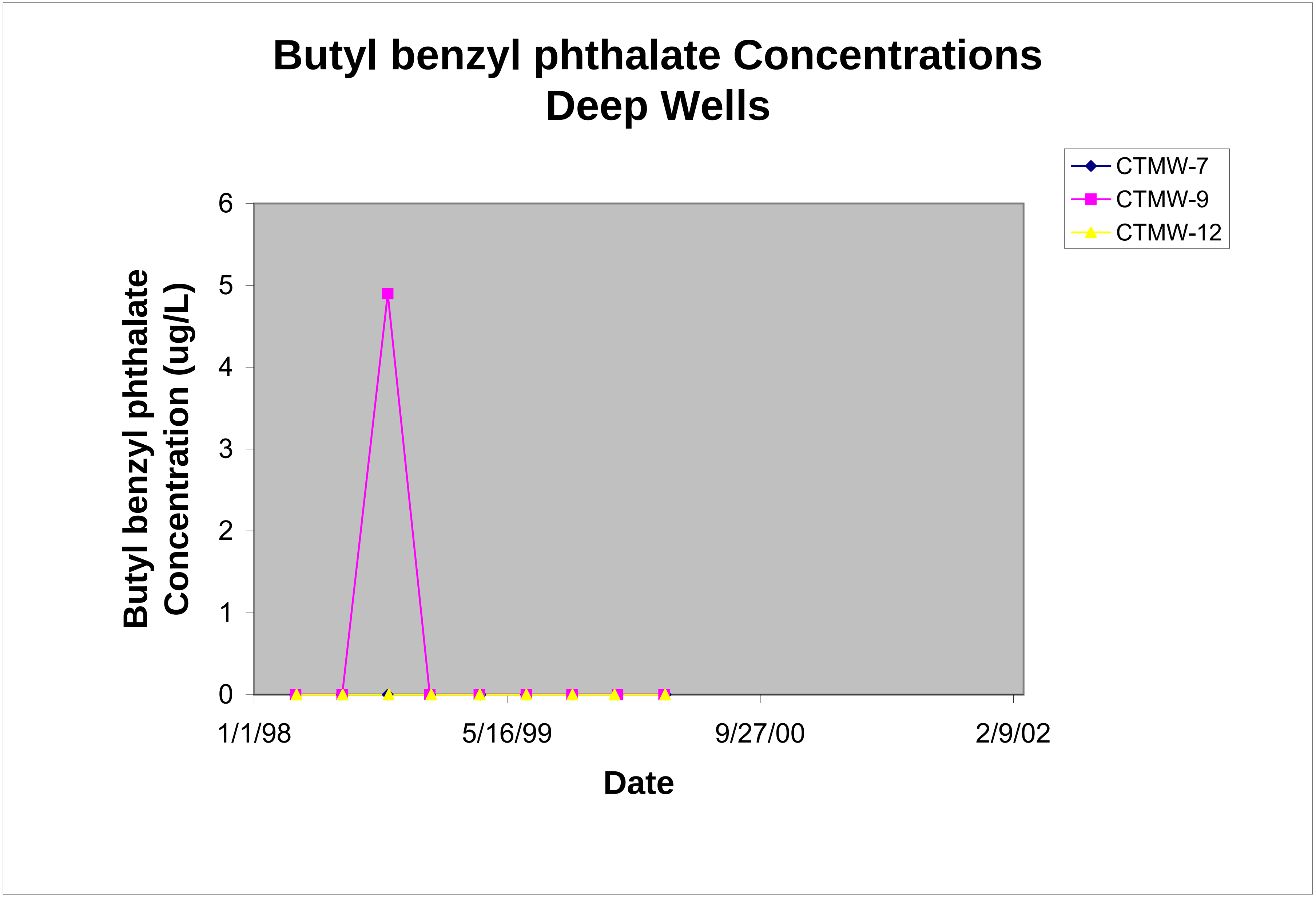
Acenaphthene Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
Acenaphthene Concentration (ug/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date

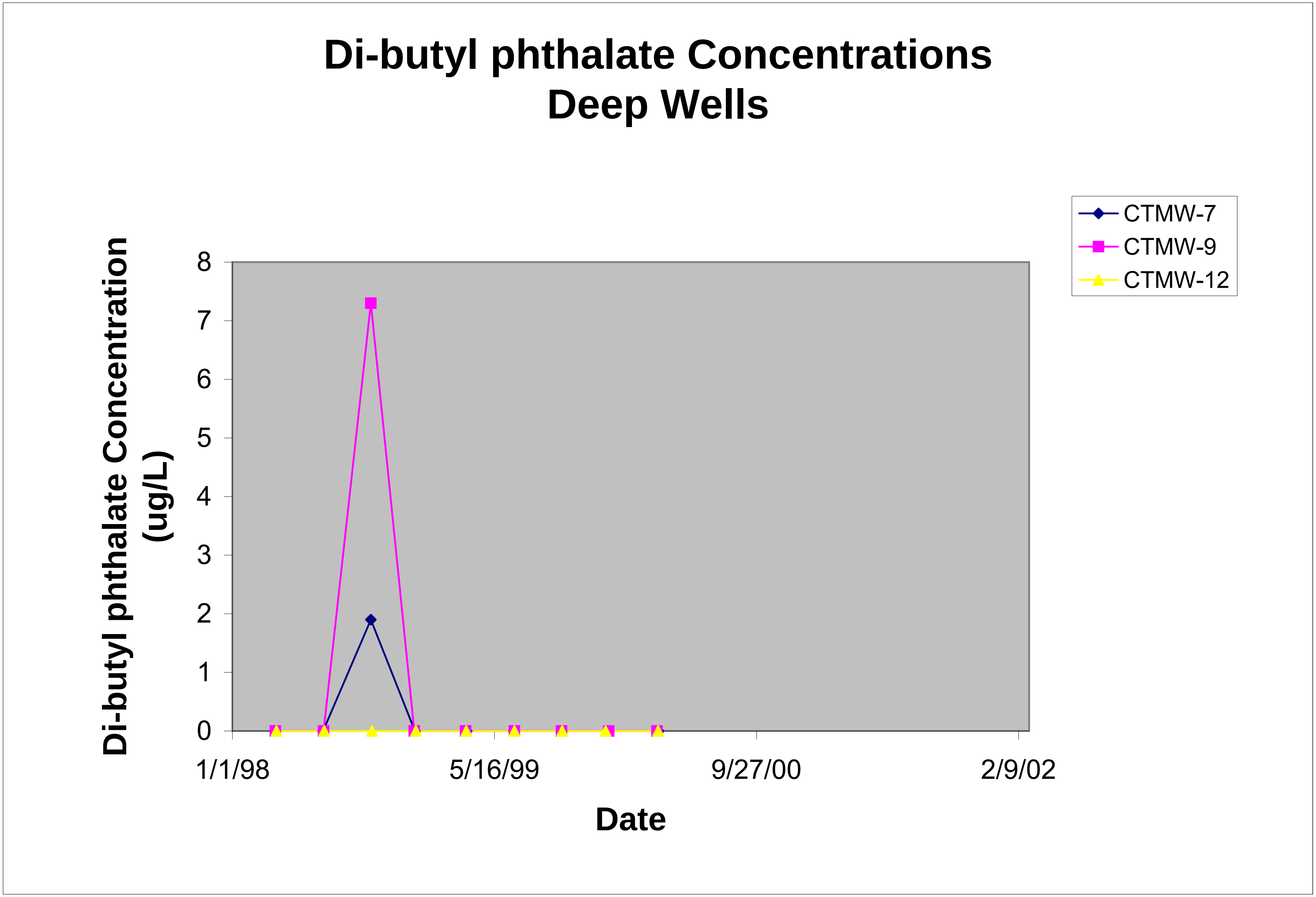


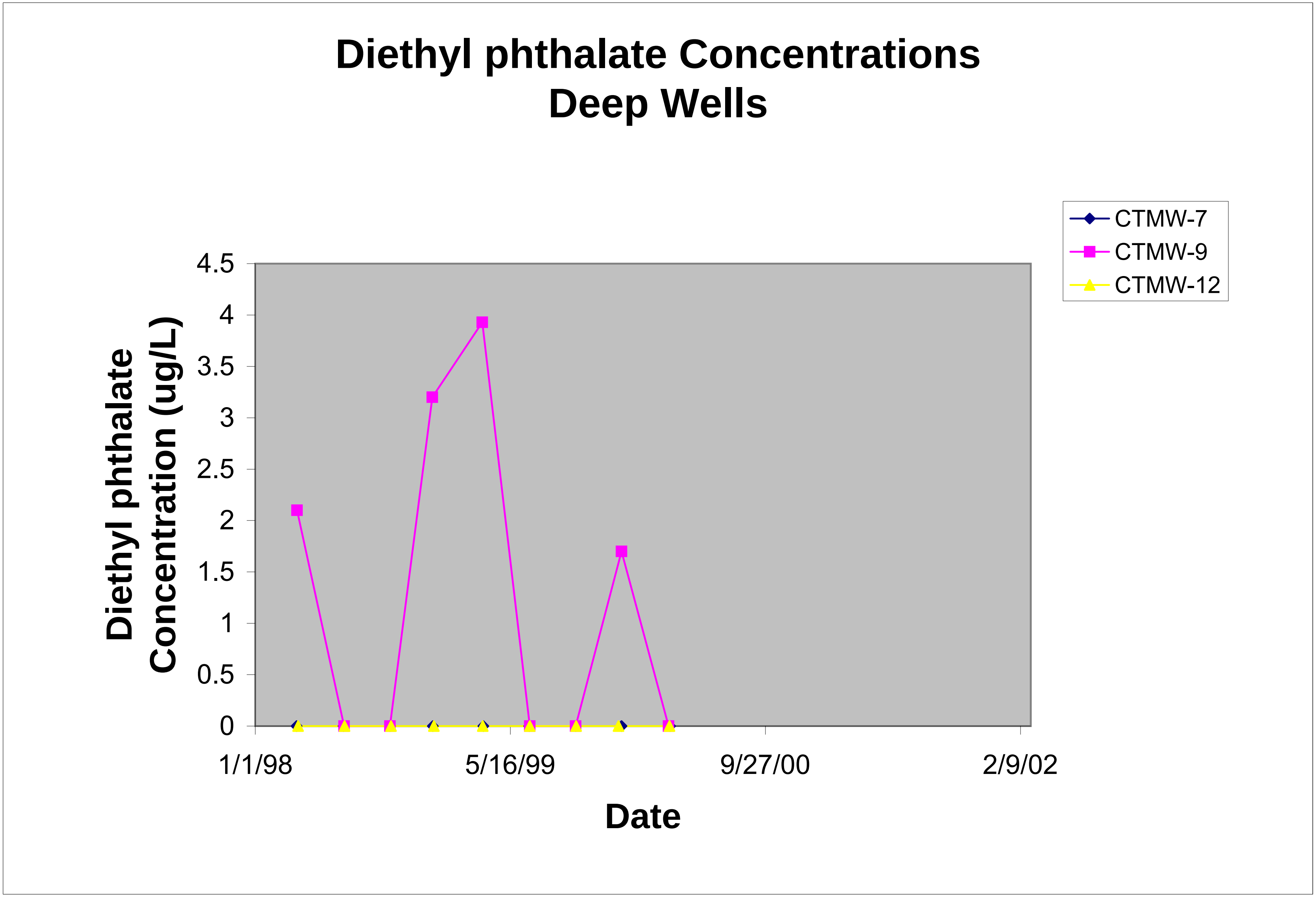
Acenaphthylene Concentrations
Deep Wells
Acenaphthylene Concentration (ug/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date
CTMW-7
CTMW-9
CTMW-12



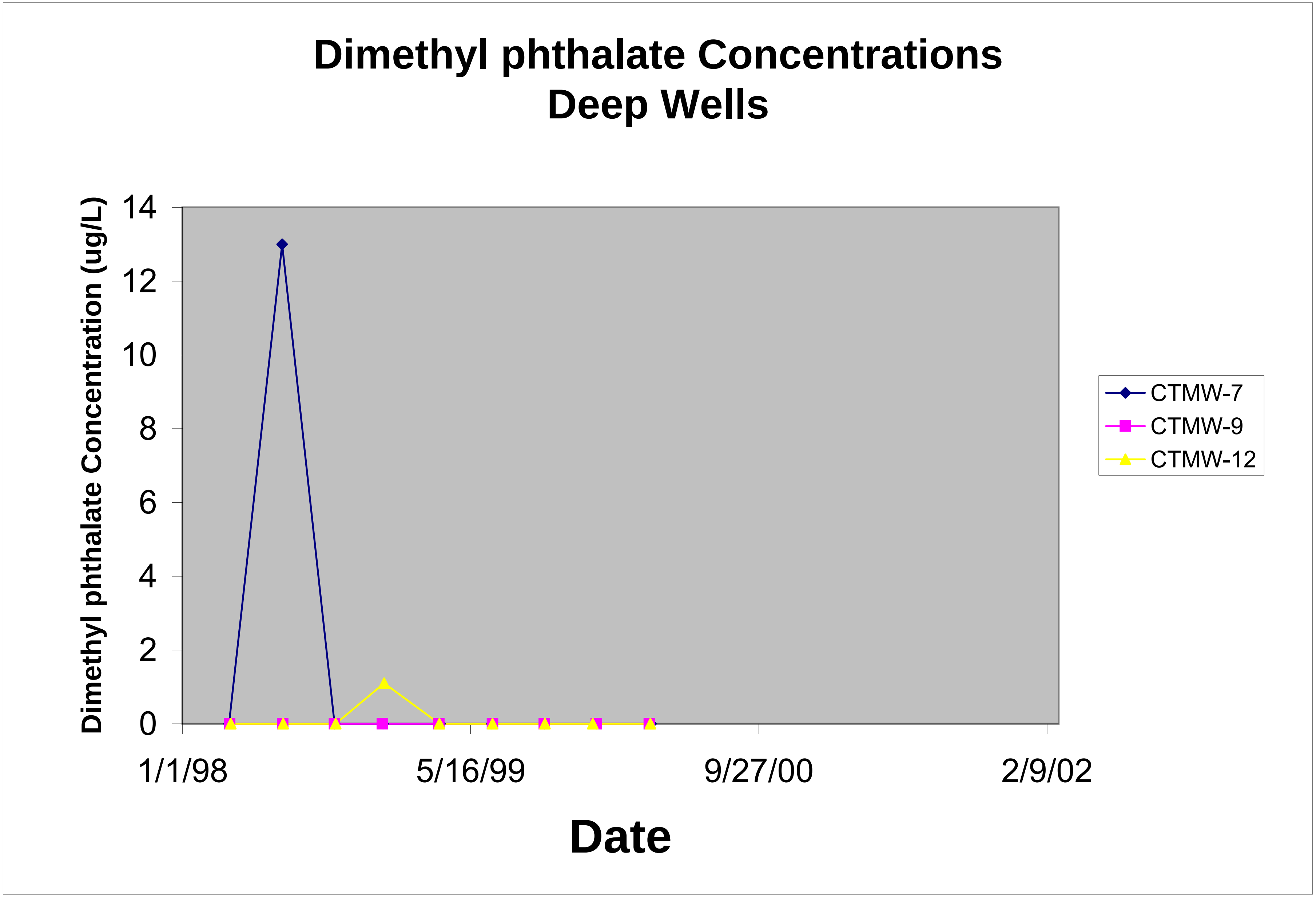
Bis(2-ethylhexyl)phthalate Concentrations
Deep Wells
35
30
25
20
15
10
5
0
1/1/98
5/16/99
9/27/00
2/9/02
Date
CTMW-7
CTMW-9
CTMW-12


Butyl benzyl phthalate Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
Butyl benzyl phthalate Concentration (ug/L)
6
5
4
3
2
1
0
1/1/98
5/16/99
9/27/00
2/9/02
Date

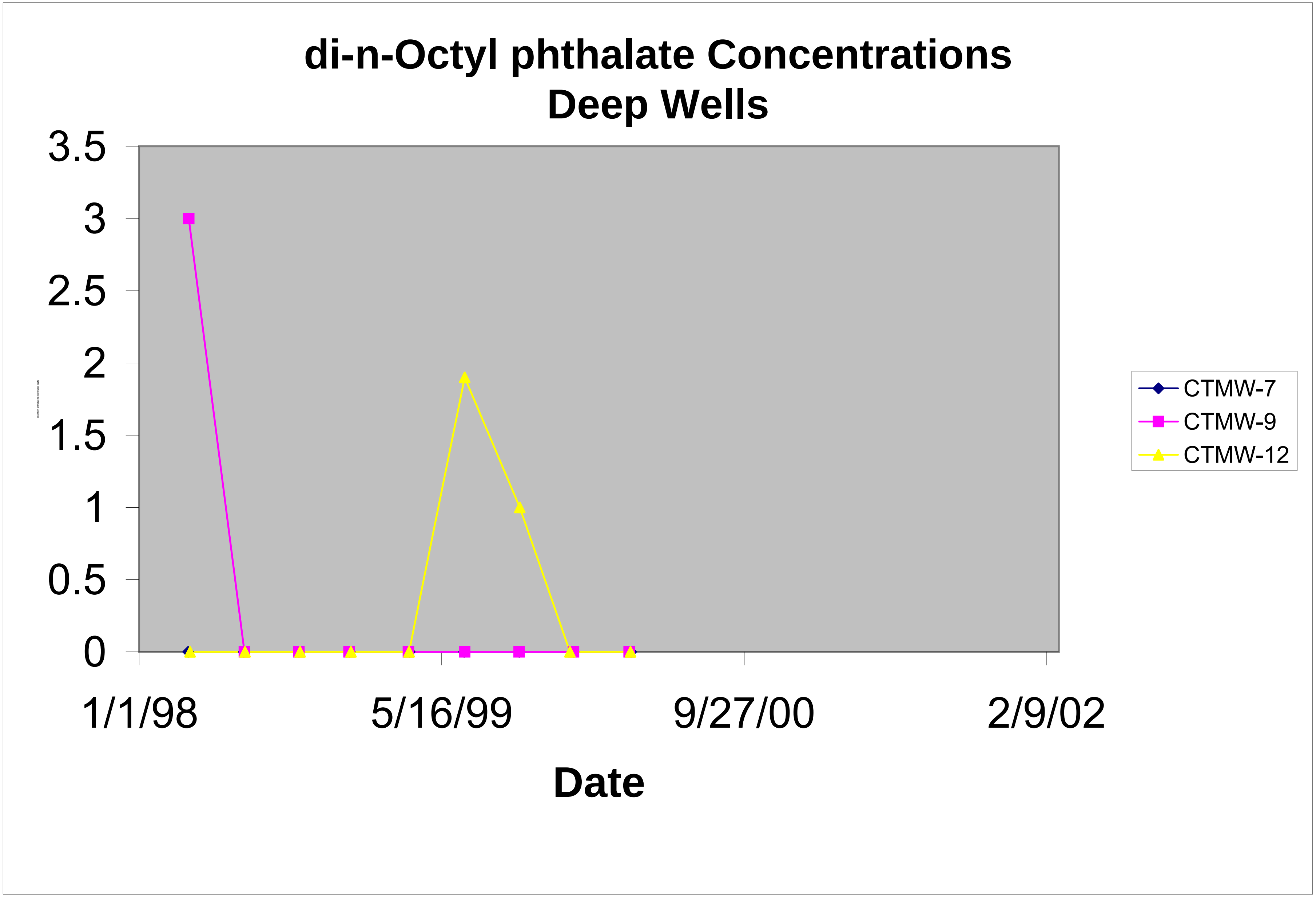

Di-butyl phthalate Concentrations
Deep Wells
Di-butyl phthalate Concentration (ug/L)
0
1
2
3
4
5
6
7
8
1/1/98
5/16/99
9/27/00
2/9/02
Date
CTMW-7
CTMW-9
CTMW-12

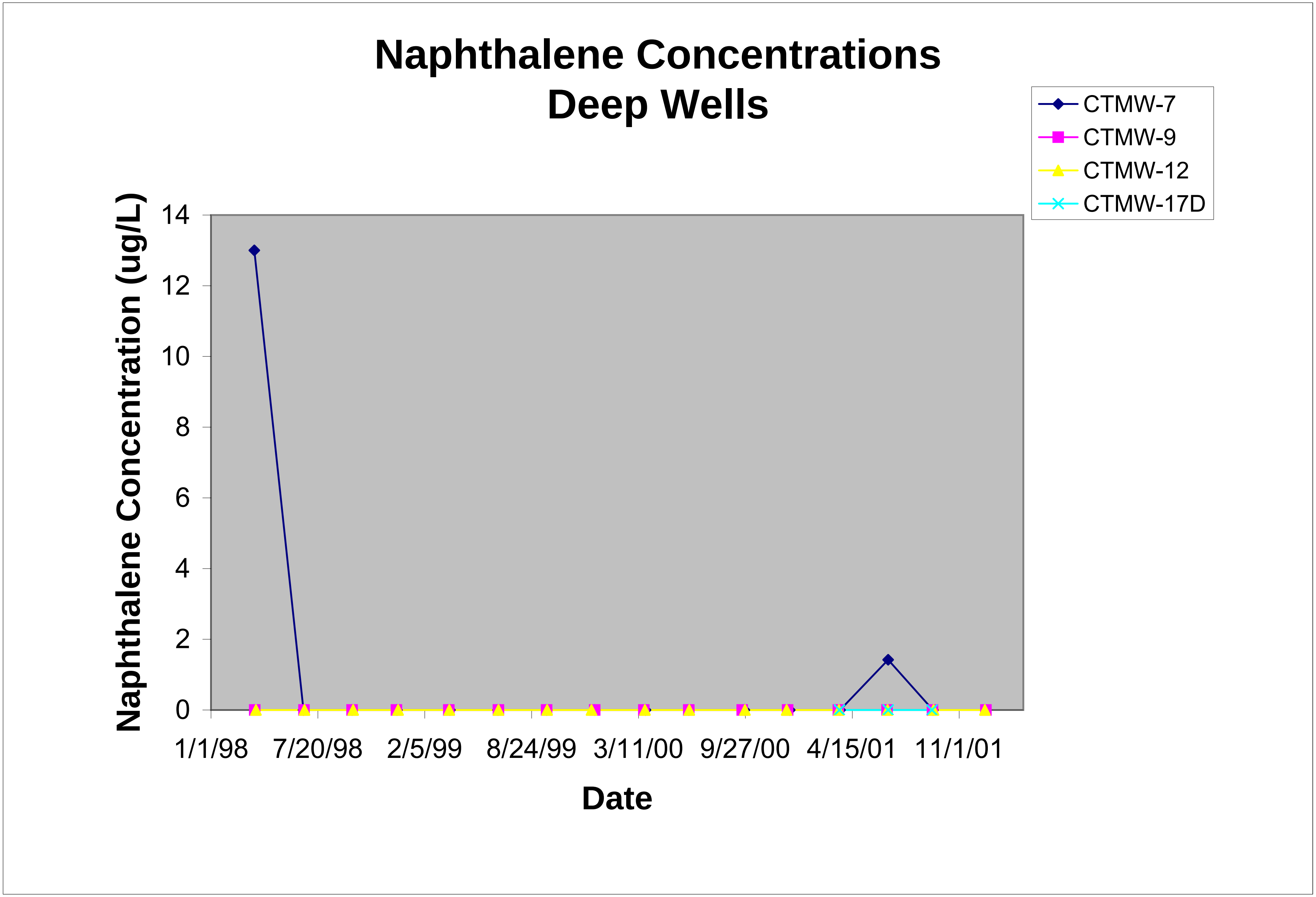


Diethyl phthalate Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
Diethyl phthalate Concentration (ug/L)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1/1/98
5/16/99
9/27/00
2/9/02
Date

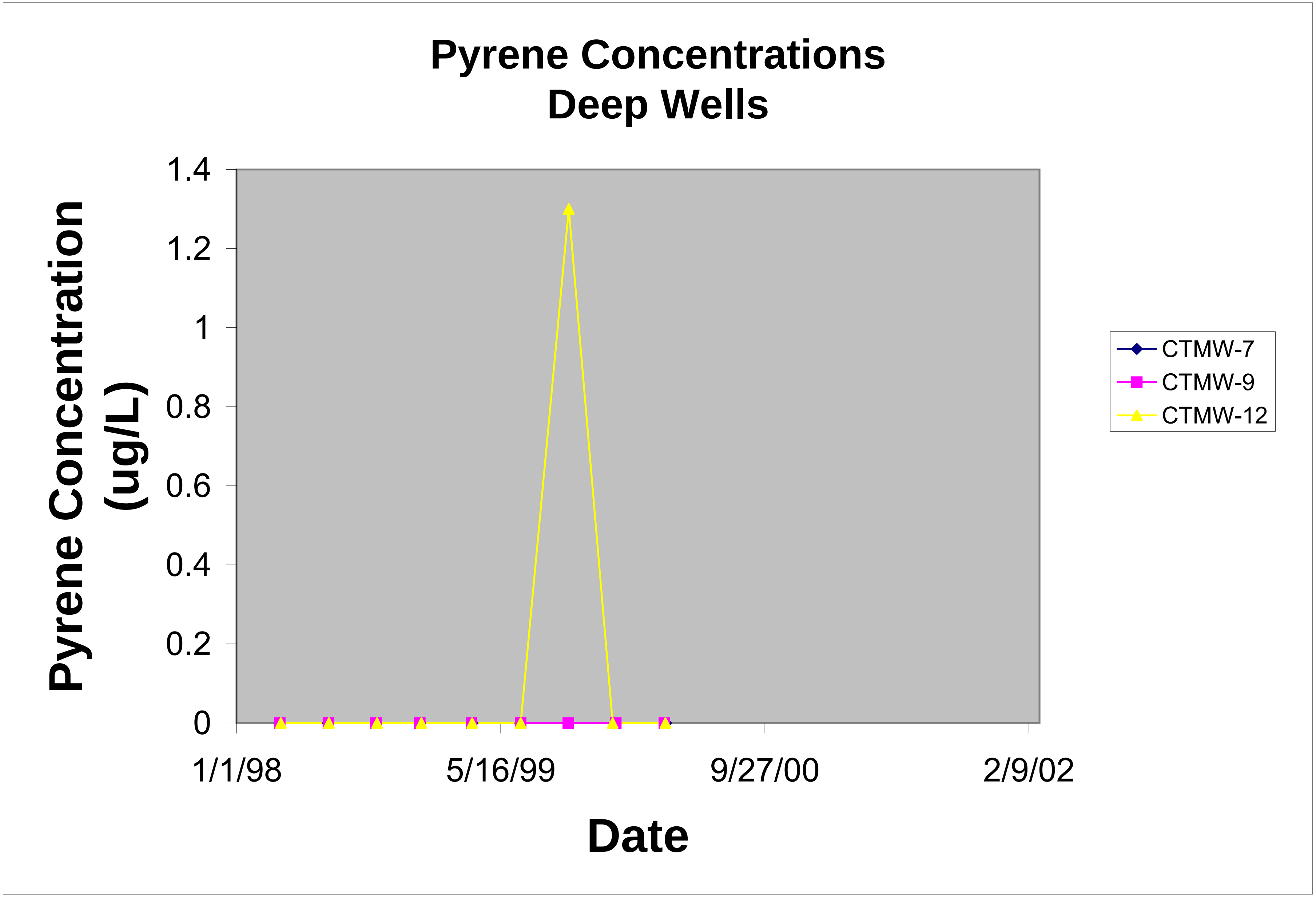


Dimethyl phthalate Concentrations
Deep Wells
Dimethyl phthalate Concentration (ug/L)
14
12
10
8
6
4
2
0
1/1/98
5/16/99
9/27/00
2/9/02
Date
CTMW-7
CTMW-9
CTMW-12


di-n-Octyl phthalate Concentrations
Deep Wells
3.5
3
2.5
2
1.5
1
0.5
0
1/1/98
5/16/99
9/27/00
2/9/02
Date
CTMW-7
CTMW-9
CTMW-12



Naphthalene Concentrations
Deep Wells
CTMW-7
CTMW-9
CTMW-12
CTMW-17D
Naphthalene Concentration (ug/L)
14
12
10
8
6
4
2
0
1/1/98
7/20/98
2/5/99
8/24/99
3/11/00
9/27/00
4/15/01
11/1/01
Date



Pyrene Concentrations
Deep Wells
Pyrene Concentration (ug/L)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1/1/98
5/16/99
9/27/00
2/9/02
Date
CTMW-7
CTMW-9
CTMW-12

Appendix I
Historical Petroleum Assessment
(2005 PSC Remedial Investigation)

Table 9-4
Petroleum Fingerprinting Results for Groundwater Samples

Location	Sample Collection Date	TPH Results	TPH Description (Friedman and Bruya, Inc.)	TPH Description (Manchester Environmental Laboratory)
CCW-2A (CleanCare)	06/21/00	NA	Not detected.	Large amount of weathered gasoline, small amount of #2 diesel oil and large amount of unknowns (PCE or DCE?)
MW-4 (Parcel A – NW corner at CleanCare boundary)	09/20/00	Gas: 500 U µg/L Diesel: 16,000 µg/L	Mixture of a middle distillate (e.g., diesel #2, heating oil, C12 to C24) and higher boiling product (e.g., lube oil, C20 to >C36).	Primarily lube oil with a heavily weathered #2 diesel oil (or #2 fuel oil).
CTMW-10 (Resource Recovery at Potter boundary)	06/22/00	Gas: 500 U µg/L Diesel: 6,900 µg/L	Mixture of a highly degraded middle distillate (e.g., diesel fuel, fuel oil, C10 to C24) and a higher boiling product (e.g., lube oil or biogenic material, C20 to C32).	Heavily weathered #2 diesel oil (or #2 fuel oil) and a lube oil.
	09/26/00	Gas: 500 U µg/L Diesel: 3,500 µg/L	Same as CTMW-10 (06/22/00).	NA
CTMW-1 (Parcel A at Potter boundary)	09/27/00	Gas: 870 µg/L Diesel: 25,000 µg/L	Same as CTMW-10 (06/22/00).	NA
MW-1 (Potter N)	06/22/00	Gas: 620 µg/L Diesel: 8,000 µg/L L	Same as CTMW-10 (06/22/00).	Same as CTMW-10 (06/22/00).
	09/26/00	Gas: 700 µg/L Diesel: 23,000 µg/L	Same as CTMW-10 (06/22/00).	NA
CTMW-6 (Parcels A and B boundary)	06/22/00	Gas: 500 U µg/L Diesel: 4,200 µg/L	Mixture of a degraded and non-degraded middle distillate (e.g., diesel fuel, fuel oil, C10 to C24) and a higher boiling product (e.g., lube oil or biogenic material, C20 to C32).	Heavily weathered #2 diesel oil (or #2 fuel oil) and a lube oil. Diesel weathering characterized by only the partial loss of the straight chain alkanes.
	09/25/00	Gas: 610 µg/L Diesel: 18,000 µg/L	Same as CTMW-6 (06/22/00).	NA
SRI-21 (Leased Area)	01/15/02	Diesel: 3,100 µg/L	Unidentifiable medium distillate (C8 to C32).	NA
SRI-22 (Leased Area)	01/7/02	Diesel: 4,100 µg/L	Unidentifiable medium distillate (C8 to C25).	NA

Notes:
DCA - dichloroethane
µg/L - microgram per liter
NA - not available
PCE - tetrachlorethene
TPH - total petroleum hydrocarbon

Table 10-7
Viscosity Results for Product Collected From MW-1 in January 2000

Temperature in Degrees Centigrade	Viscosity in Centipoises (cp)	Viscosity in Centistokes (cst)
10	81	90
15	60	67
20	52	58
25	40	44
30	35	39
40	35	39
50	16	18
60	13	14

Note: Viscosity in cp for other compounds: benzene: 0.652 (at 20 °C), light machine oil: 34.2 (at 37.8 °C), heavy machine oil: 127.4 (at 37.8 °C) (CRC Handbook of Chemistry and Physics, 61st Ed, 1981)

TABLE 10-8

LNAPL SAMPLE ANALYSES RESULTS

PSC Tacoma Facility
Tacoma, Washington

					NWEPH (mg/kg)										NWVPH (mg/kg)							
						Aliphatics					Aromatics					Aliphatics				Aromatics		
Sample ID	Sample Date	Specific Gravity	Density	Viscosity	Total	C8-C10	C10-C12	C12-C16	C16-C21	C21-C34	C10-C12	C12-C16	C16-C21	C21-C34	Total	C5-C6	C6-C8	C8-C10	C10-C12	C8-C10	C10-C12	C12-C13
W-1 NAPL	1/14/00	.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PZ-1-1298	12/15/98	.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PZ-3-0198	1/28/98	.91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PZ-3-1298	12/15/98	.94	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PZ-3-0399	3/25/99	.84	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
W-1 NAPL	1/14/00	.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P-4-CTMW6	4/23/92	.964	.912	59.80	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CTMW-10-0198	1/28/98	.93	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P-4-CTMW10	4/23/92	.94	.904	20.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CTMW-10-0399	3/25/99	.84	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-1-1201	12/21/01	NA	NA	NA	667000	<7500	19600	137000	137000	180000	7540	73100	71500	41500	1390	<50	66.2	<50	218	<50	289	817

1. NA = not applicable

Exponent®

EXTERNAL MEMORANDUM

TO: Tasya Gray, Geomatrix Consultants, Inc.

FROM: James J. Mc Ateer, Jr.

DATE: December 21, 2004

PROJECT: 8601793.001 0301

SUBJECT: Review of Diesel-Range Chromatograms for Wells CTMW-7, CTMW-8, and CTMW-9 at Philip Service Corporation's Tacoma Facility

Pursuant to your request and under the direction of Philip Services Corp. (PSC), this memorandum was prepared to provide interpretive comments on whether diesel-and oil-range petroleum hydrocarbons may be present in groundwater samples collected from the deep aquifer wells CTMW-7 and CTMW-9 located at PSC's Tacoma facility. Data from the shallow aquifer well CTMW-8, which is located next to the deep aquifer well CTMW-9, was also reviewed. Chromatograms for the diesel-and oil-range petroleum hydrocarbon analyses associated with the 2nd quarter 2002, 4th quarter 2002, 1st quarter 2003, 2nd quarter 2003, 3rd quarter 2003, 4th quarter 2003, 2nd quarter 2004, and the 3rd quarter 2004 sampling events were reviewed.

This memorandum presents the following:

- Summary of findings
- Background
  - Analytical procedures
  - Diesel- and oil-range petroleum hydrocarbons and biogenic interferences
- References

Summary of Findings

Based on my review of the applicable chromatographic profiles (e.g., chromatograms) for samples collected from Wells CTMW-7, CTMW-8, and CTMW-9, the following interpretation of the data is presented:

- There is no indication of unweathered diesel-range petroleum hydrocarbon in the samples.
- There is no indication of unweathered or weathered oil-range petroleum hydrocarbon in the samples.
- There is no definitive indication of weathered diesel-range petroleum hydrocarbon in the samples. However, a few chromatograms had peaks within the diesel-range. These peaks may be an unidentified and highly weathered petroleum hydrocarbon unrelated to diesel. Alternatively, the peaks may be due to the presence of particulate biogenic material.

  If a highly weathered petroleum product is present, it might be a type of kerosene or other similar product such as stoddard solvent. The specific data applicable to this issue include chromatograms for the following samples and quarters:

  - Sample CTMW-7 for analysis completed during the 1st quarter 2002, 1st quarter 2003, and 2nd quarter of 2003
  - Sample CTMW-8 for analysis completed during the 3rd quarter of 2003
  - Sample CTMW-9 for analyses completed during the 2nd quarter 2002, the 1st quarter 2003, the 2nd quarter 2003, the 3rd quarter 2003, and the 4th quarter 2003.

- The chromatographic profiles for the samples listed above do not provide definitive evidence to confirm that a highly weathered petroleum product such as kerosene or particulate biogenic material is either present or not present with any degree of certainty. More in-depth chemical analyses, such as gas chromatography/mass spectrometry (GC/MS), would be needed to more accurately characterize the chemical composition(s) in the affected samples.
- The chromatographic profiles for each of the samples vary from quarter to quarter with no apparent trend. This variability could result from changes in hydraulic gradient due to a fluctuating water table (e.g., seasonal variations or from tidal influences). This variation also could indicate multiple sources and varying influence on groundwater concentration due to fluctuating gradients.

Background

Analytical Procedures

The diesel-and oil-range petroleum hydrocarbon data were generated following the extraction and analysis by gas chromatography/flame ionization detection (GC/FID) using the NWTPH-Dx (extended) method developed by the Washington Department of Ecology (Ecology 1997). The analyses were completed by North Creek Analytical, Inc. (NCA) located in Bothell, Washington.

Ecology's NWTPH-Dx method (Ecology 1997) was developed exclusively for the extraction of diesel-range (and oil-range) hydrocarbons. This method requires extraction of samples using a solvent (methylene chloride) and analysis using GC/FID. All compounds present in a sample extract that will give a response (signal) to the FID are separated as the sample elutes through the chromatographic column. Components that may be present are separated based on boiling point, polarity, and affinity differences. As each compound elutes from the chromatographic column, it results in a specific chromatographic peak that has a specific retention time and response (e.g. peak area). The sum of all chromatographic peaks is represented by a chromatographic profile, chromatogram, or "fingerprint." Each "fingerprint" is then compared to the "fingerprints" of a known petroleum hydrocarbon mixture (e.g., diesel #2, jet fuels, motor oils, and hydraulic oils) to determine whether one, or more, petroleum hydrocarbons are or may be present in the sample. Prior to analysis, sample extracts are subjected to a sulfuric acid and silica gel cleanup starting in the 1st quarter 2002, as specified in Ecology's NWTPH-Dx method. This cleanup procedure is completed to remove (or minimize) interferences that can be caused by non-target analytes (e.g., biogenic materials) that could result in the reporting of false positives or concentrations of petroleum hydrocarbons that exhibit a high bias.

To evaluate the presence or absence of diesel-and oil-range petroleum hydrocarbons in the groundwater samples of concern, the chromatograms (e.g., instrument printouts) generated by the laboratory were compared to a chromatogram of a diesel #2 standard. Additional comparisons using chromatograms of other petroleum hydrocarbons (e.g., kerosene, diesel #1, jet fuels, motor oils, hydraulic oils, and lube oils) were also used to facilitate the data review.

Summary interpretation of the chromatographic profiles is presented in Table 1. Chromatograms of various petroleum products that are associated with diesel-and oil-range petroleum hydrocarbons (copied from the NWTPH-Dx method developed by the Washington Department of Ecology [Ecology 1997]) are presented in Attachment 1. Copies of the chromatographic profiles for each of the wells of concern for the applicable quarterly data reviewed are presented in Attachment 2 (Well CTMW-7), Attachment 3 (Well CTMW-8), and Attachment 4 (Well CTMW-9).

Diesel- and Oil-Range Petroleum Hydrocarbons and Biogenic Interferences

The actual composition of diesel- and oil-range petroleum hydrocarbons varies depending upon the source and age of the product. Generally, however, diesel-range petroleum hydrocarbons contain between 10 and 40+ carbons (referred to as the C10 to C40+ range). The types of petroleum products included in this carbon range include kerosene, jet fuels, diesel #1 and #2 fuel oils, Bunker-C, motor oils, mineral oils, hydraulic fluids, lubricating oils, transformer oils, and mixed fuel oils. The constituent compounds within this carbon range include non-polar hydrocarbons such as *n*-alkanes, straight-chain and branched alkanes, cycloalkanes, diaromatics (e.g., biphenyl), polycyclic aromatic hydrocarbons (PAHs), and a number of other compounds.

Hydrocarbons within the C10 to C40+ range are also present in naturally occurring organic matter (e.g., animal fats, vegetable oils, and humic compounds) and may be attributed to such sources as manure, peat, and plants and/or wood debris. If naturally occurring organic matter is present in a sample (usually as particulate matter in groundwater samples), a different chromatographic pattern is obtained than the chromatographic patterns that are indicative of specific petroleum hydrocarbon products; however, biogenic interferences will result in the reporting of false positive results and/or will bias high the concentration of a petroleum product that may be present in a sample.

An example of biogenic interferences quantified as gasoline and diesel is presented in Table 2. This table summarizes the reported petroleum hydrocarbon results for a number of biogenic materials (e.g., woody material from cedar and pine trees) illustrating how the presence of biogenic materials can result in the incorrect reporting of total petroleum hydrocarbons present in a sample. Table 3 shows how subsequent cleanup of the sample extracts using silica gel typically reduces the effect of the biogenic interferences. These results also show that biogenic interferences may remain in sample extracts after a single silica gel cleanup is conducted, and that samples may require several sequential cleanups to remove all potential biogenic interferences.

Should you have any questions regarding the information presented herein, please call me at (503) 534-3240.

References:

AFRL. 1998. Total petroleum hydrocarbon criteria working group series. Volume1. Analysis of petroleum hydrocarbons in environmental media. Edited by Wade Weisman, Air Force Research Laboratory, Operational Toxicology Branch. Amherst Scientific Publishers, Amherst MA.

Ecology. 1997. Analytical methods for petroleum hydrocarbons. June 1997. Washington Department of Ecology, Olympia, WA.

FBI 1992. Analytical techniques for determining petroleum products in soils and on groundwater. A workshop presented at the Third Annual West Coast Conference, Hydrocarbon Contaminated Soils and Groundwater. March 11, 1992. Presented by James E. Bruya, Ph.D, Friedman & Bruya, Inc., Seattle, WA. and Leslie Eng, Ph.D, Trillium, Inc., Street, MD.

U.S. EPA. 1983. Methods for chemical analysis of water and wastes. EPA 600/4-79-020. U.S. Environmental Protection Agency Environmental Monitoring and Support Laboratory, Cincinnati, OH.

Table 1. Summary of Chromatographic Review

Sample	Quarter	Diesel-range comments	Oil-range comments
CTMW-7	2nd02	*Peaks eluting within diesel range.* No indication of weathered or unweathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	4thQ02	*Few peaks eluting within diesel range.* **Chromatographically very different than 2ndQ02.** No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	1stQ03	*Peaks eluting within diesel range and more peaks present than previous two quarters.* **Chromatographically different than 2ndQ02 and 4thQ02.** No indication of unweathered diesel. No definitive indication of weathered diesel, but can not confirm with existing data.	Presence of oil (weathered or unweathered) not indicated.
	2nd03	*Peaks eluting within diesel range* . **Chromatographically similar to 2ndQ02.** No indication of unweathered diesel. No definitive indication of weathered diesel, but can not confirm with existing data.	Presence of oil (weathered or unweathered) not indicated.
	3rdQ03	*Few peaks eluting within diesel range.* No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	4thQ03	*Few peaks eluting within diesel range.* No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	2ndQ04	*Only one peak eluting within diesel range.* No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	3rdQ04	*Very few peaks eluting within diesel range.* No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.

Sample	Quarter	Diesel-range comments	Oil-range comments
CTMW-8	2nd02	*Very few peaks eluting within diesel range.* No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	4thQ02	*Very few peaks eluting within diesel range.* No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	1stQ03	*Very few peaks eluting within diesel range.* No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	2nd03	*Few peaks eluting within diesel range; less peaks than previous three quarters.* No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	3rdQ03	*Peaks eluting within diesel range and more peaks present than previous quarters.* No indication of unweathered diesel. No clear indication of weathered diesel, but can not state with absolute certainty.	Presence of oil (weathered or unweathered) not indicated.
	4thQ03	*Peaks eluting within diesel range.* **Chromatographically different than 3rdQ03.** No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	2ndQ04	*Very few peaks eluting within diesel range.* **Chromatographically different to 3rdQ03 and 4thQ03.** No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.
	3rdQ04	*Very few peaks eluting within diesel range.* **Chromatographically very different to 3rdQ03 and 4thQ03.** No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.

Sample	Quarter	Diesel-range comments	Oil-range comments
CTMW-9	2nd02	*Peaks eluting within diesel range and more peaks present than previous quarters.* No indication of unweathered diesel. <u>No definitive indication of weathered diesel, but can not state with absolute certainty.</u>	Presence of oil (weathered or unweathered) not indicated.
	4thQ02	*Very few peaks eluting within diesel range.* **Chromatographically very different than 2ndQ02.** <u>No indication of unweathered or weathered diesel.</u>	Presence of oil (weathered or unweathered) not indicated.
	1stQ03	*Peaks eluting within diesel range and more peaks present than previous quarters.* **Chromatographically different than 2ndQ02**. No indication of unweathered diesel. <u>No definitive indication of weathered diesel, but can not confirm with existing data.</u>	Presence of oil (weathered or unweathered) not indicated.
	2nd03	*Peaks eluting within diesel range and more peaks present than previous quarters*. **Chromatographically very similar to 1stQ03**. No indication of unweathered diesel. <u>No definitive indication of weathered diesel, but can not confirm with existing data.</u>	Presence of oil (weathered or unweathered) not indicated.
	3rdQ03	*Peaks eluting within diesel range and more peaks present than previous quarters.* **Chromatographically similar to 2ndQ02 and very different than 1stQ03 and 2ndQ03.** No indication of unweathered diesel. <u>No definitive indication of weathered diesel, but can not confirm with existing data.</u>	Presence of oil (weathered or unweathered) not indicated.
	4thQ03	*Peaks eluting within diesel range and more peaks present than previous quarters*. **Chromatographically similar to 2ndQ02, very similar to 3rdQ03, and very different than 1stQ03 and 2ndQ03.** No indication of unweathered diesel. <u>No definitive indication of weathered diesel, but can not</u> confirm with existing data.	Presence of oil (weathered or unweathered) not indicated.
	2ndQ04	*Very few peaks eluting within diesel range.* **Chromatographically very different than 2ndQ02.** <u>No indication of unweathered or weathered diesel.</u>	Presence of oil (weathered or unweathered) not indicated.

Sample	Quarter	Diesel-range comments	Oil-range comments
	3rdQ04	*Very few peaks eluting within diesel range.* **Chromatographically very different than 2ndQ02.** No indication of unweathered or weathered diesel.	Presence of oil (weathered or unweathered) not indicated.

Table 2. Concentrations of Gasoline and Diesel Quantified in Biogenic Material[a]

Biogenic Material	Concentration (mg/kg)	
	Gasoline	Diesel
Spinach	<10	60
Carrots	<10	10
Deadora tree	1,200	600
Moss	<10	<10
Cedar tree	1,400	2,200
Pine tree	450	400
Dandelion	<10	140
Daisy	40	40
Rhododendron	20	80

[a]Source Information:

FBI 1992. Analytical techniques for determining petroleum products in soils and on groundwater. A workshop presented at the Third Annual West Coast Conference, Hydrocarbon Contaminated Soils and Groundwater. March 11, 1992. Presented by James E. Bruya, Ph.D, Friedman & Bruya, Inc., Seattle, Washington and Leslie Eng, Ph.D, Trillium, Inc., Street, Maryland

Table 3. Effect of Silica Gel on Removing Biogenic Hydrocarbon Interferences[a]

	Concentration (mg/kg)			
Biogenic Material	Prior to Addition of Silica Gel	After 1st Addition of Silica Gel	After 2nd Addition of Silica Gel	After 3rd Addition of Silica Gel
Fresh pine needles	16,000	1,700	1,400	-
Pine bark	2,400	280	370	-
Pine needle Compost	1,200	70	67	-
Maple tree seeds	7,100	1,600	1,500	-
Oak leaves (dried)	18,000	4,800	4,600	-
Grass (dried)	14,000	4,500	2,700	2,600
Gall nuts	9,700	4,500	1,300	1,200

[a]Source Information:

AFRL. 1998. Total petroleum hydrocarbon criteria working group series. Volume1. Analysis of petroleum hydrocarbons in environmental media. Edited by Wade Weisman, Air Force Research Laboratory, Operational Toxicology Branch. Amherst Scientific Publishers, Amherst Massachusetts.

Data form "EPA Method 418.1, Total Petroleum Hydrocarbons by IR, Groundwater Analytical Bulletin, Buzzards Bay: Groundwater Analytical Inc. 1991

Attachment 1

Chromatograms of various petroleum products

Quantitation Report

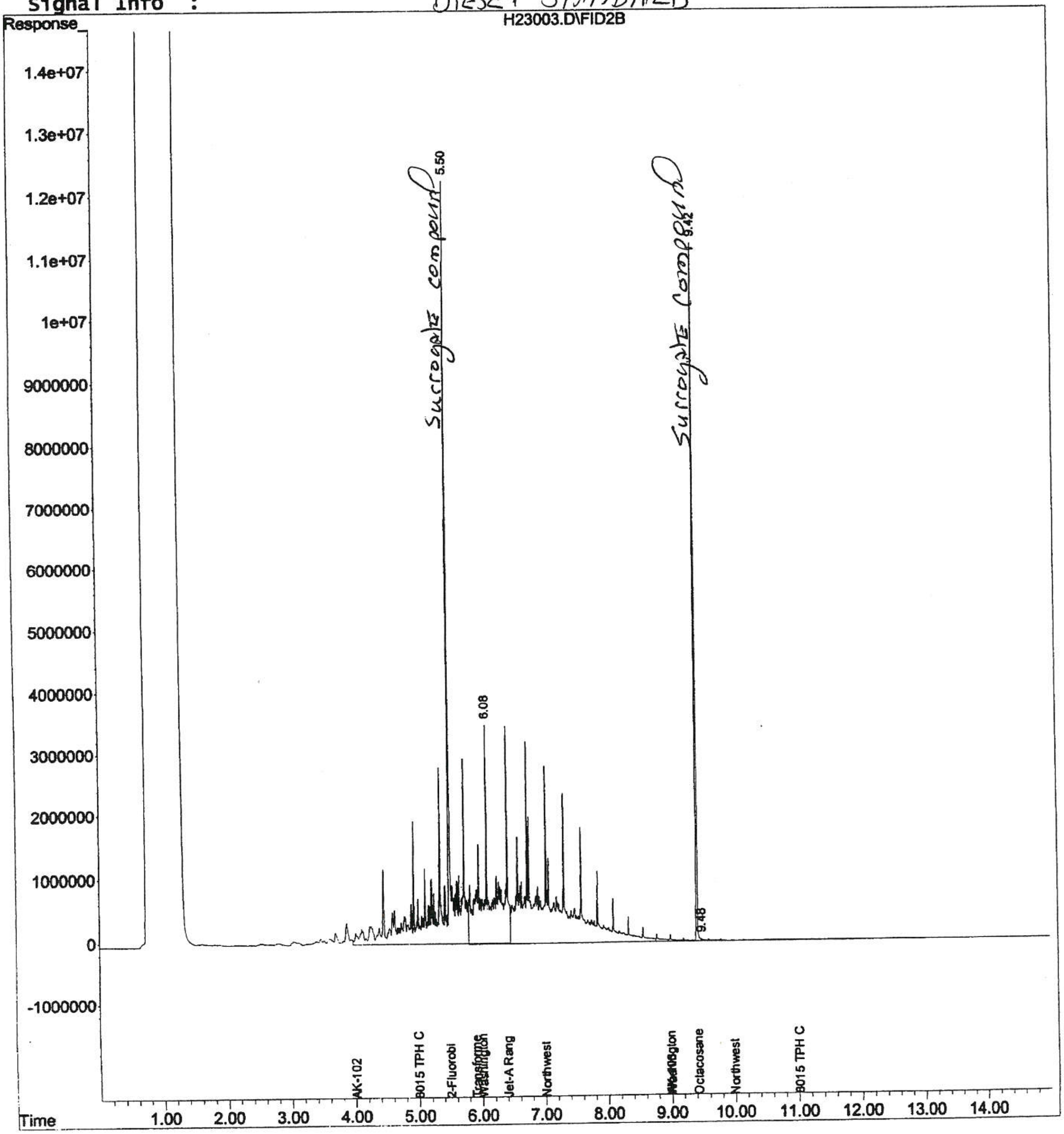
Data File : C:\HPCHEM\1\DATA.SEC\H23003.D
Acq On : 8-23-04 8:28:15
Sample : Diesel ccv
Misc : 100/1250 4070118
IntFile : SURR.E
Quant Time: Aug 23 8:43 2004 Quant Results File: H0904T9R.RES

Vial: 2
Operator:
Inst : GC #9
Multiplr: 1.00

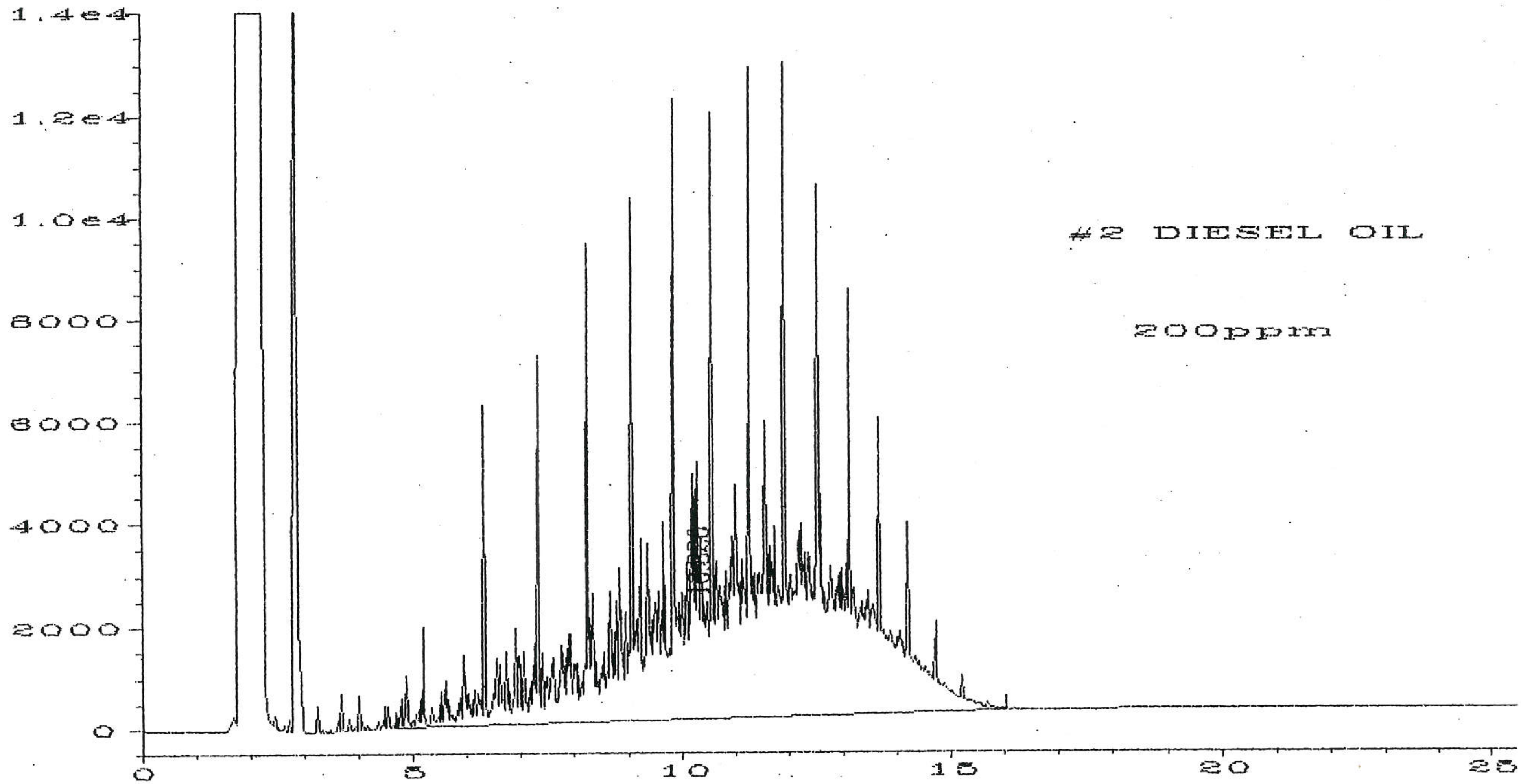
Quant Method : C:\HPCHEM\1\METHODS\H0904T9R.M (Chemstation Integrator)
Title : TPH-D Rear
Last Update : Tue Aug 10 11:43:42 2004
Response via : Multiple Level Calibration
DataAcq Meth : H0904T9F.M

Volume Inj. :
Signal Phase :
Signal Info :

DIESEL STANDARD

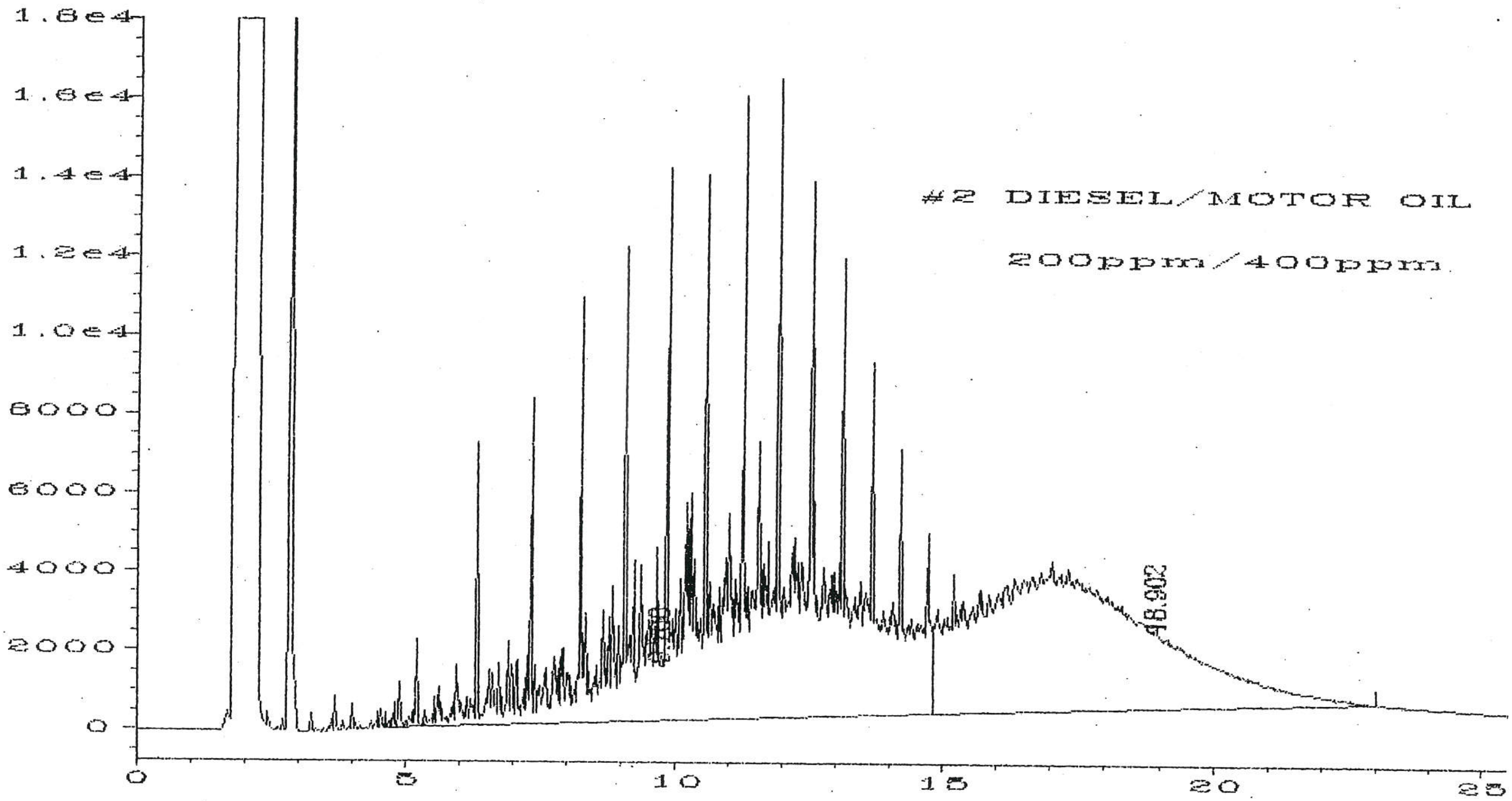


1-1



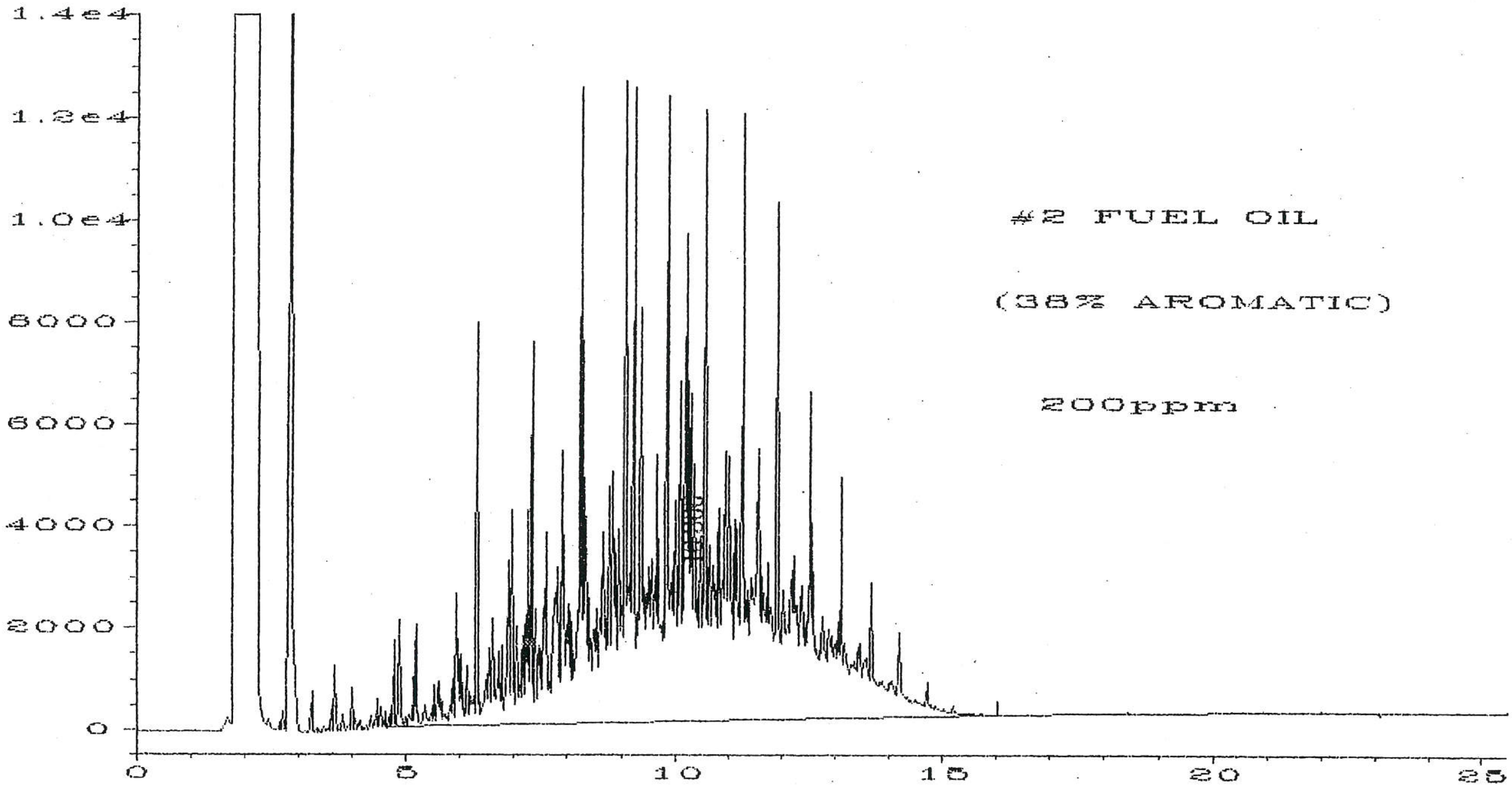
Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\008F0101.D

1-2



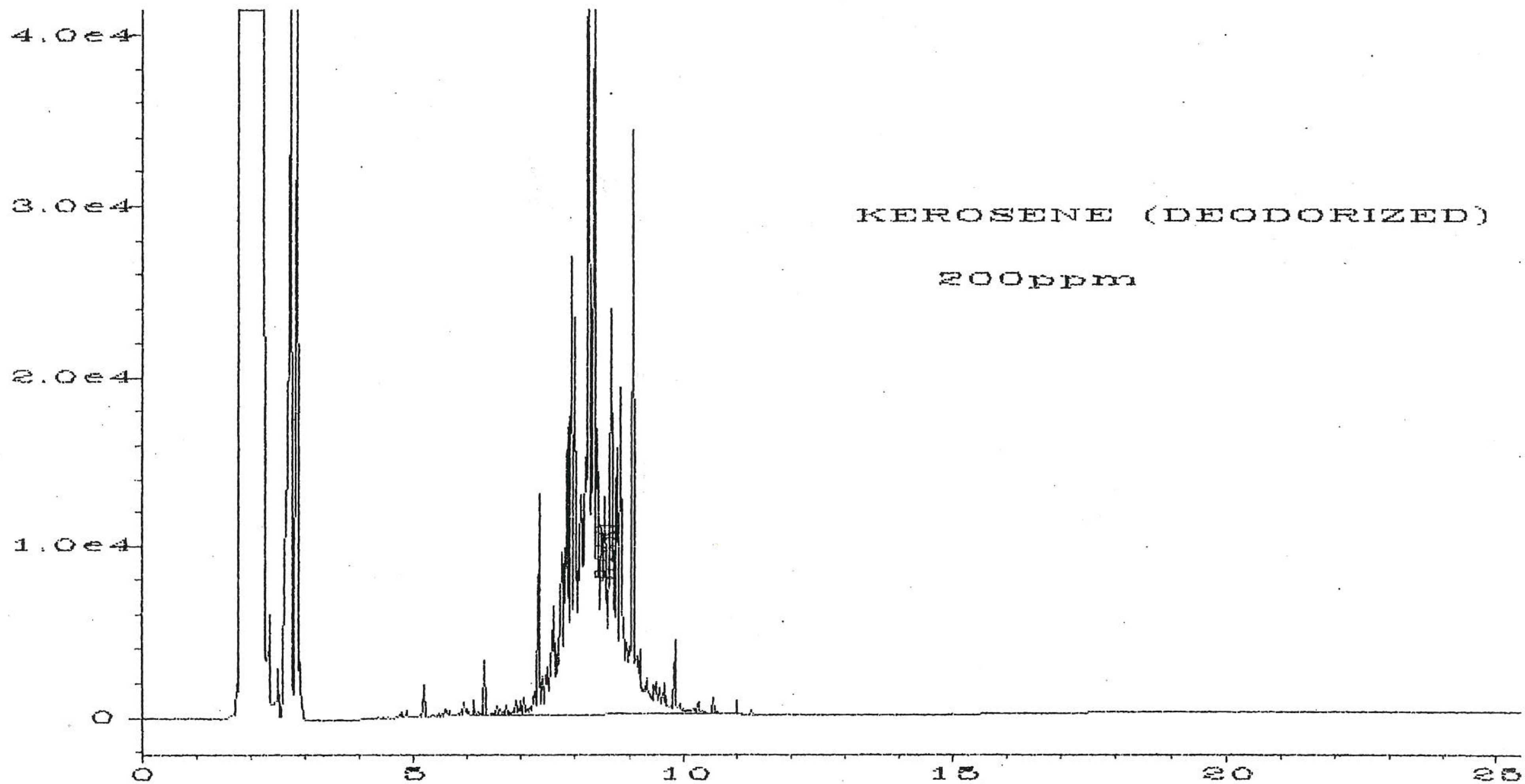
Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\007F0101.D

1-3

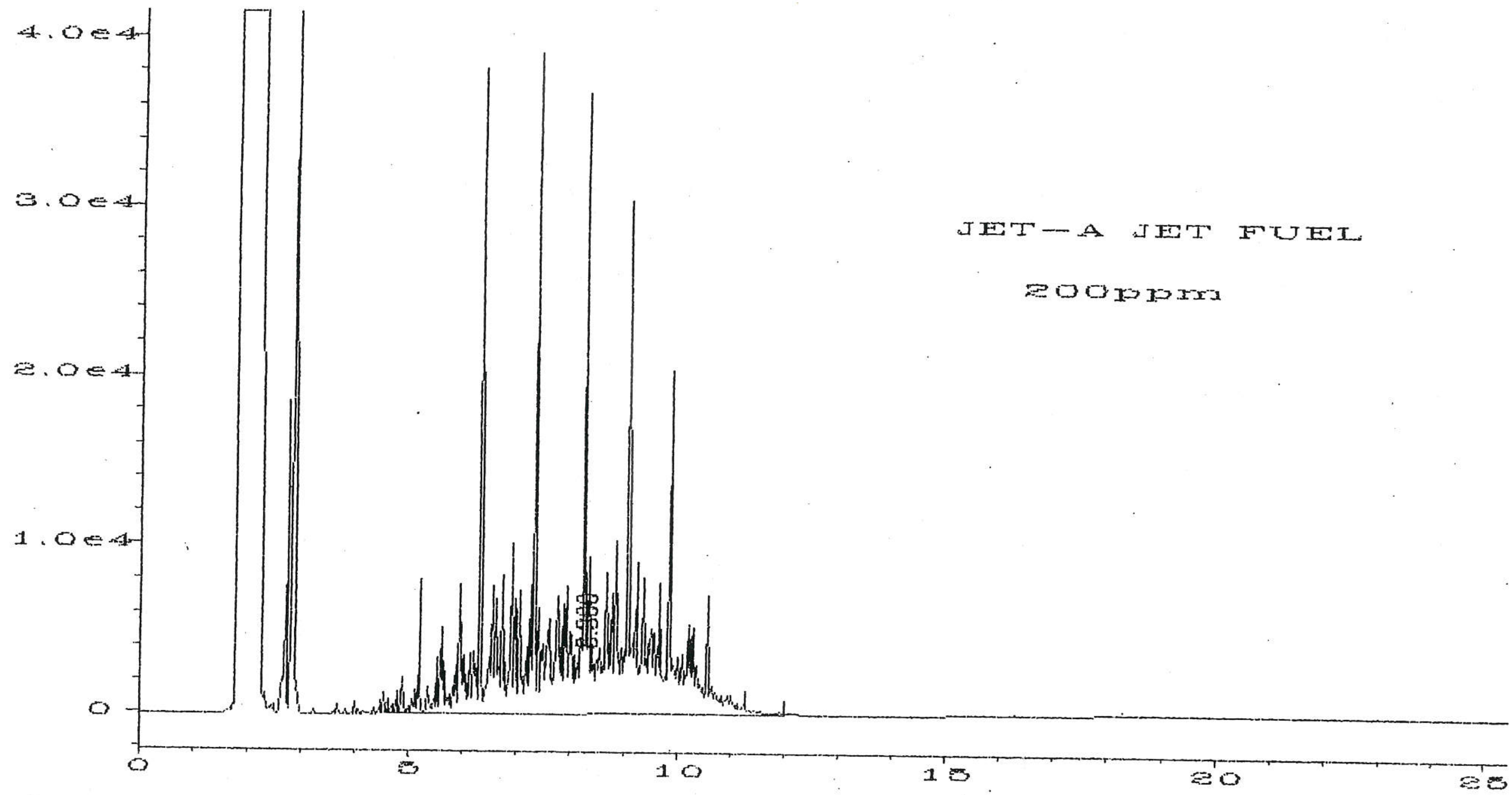


Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\005F0101.D

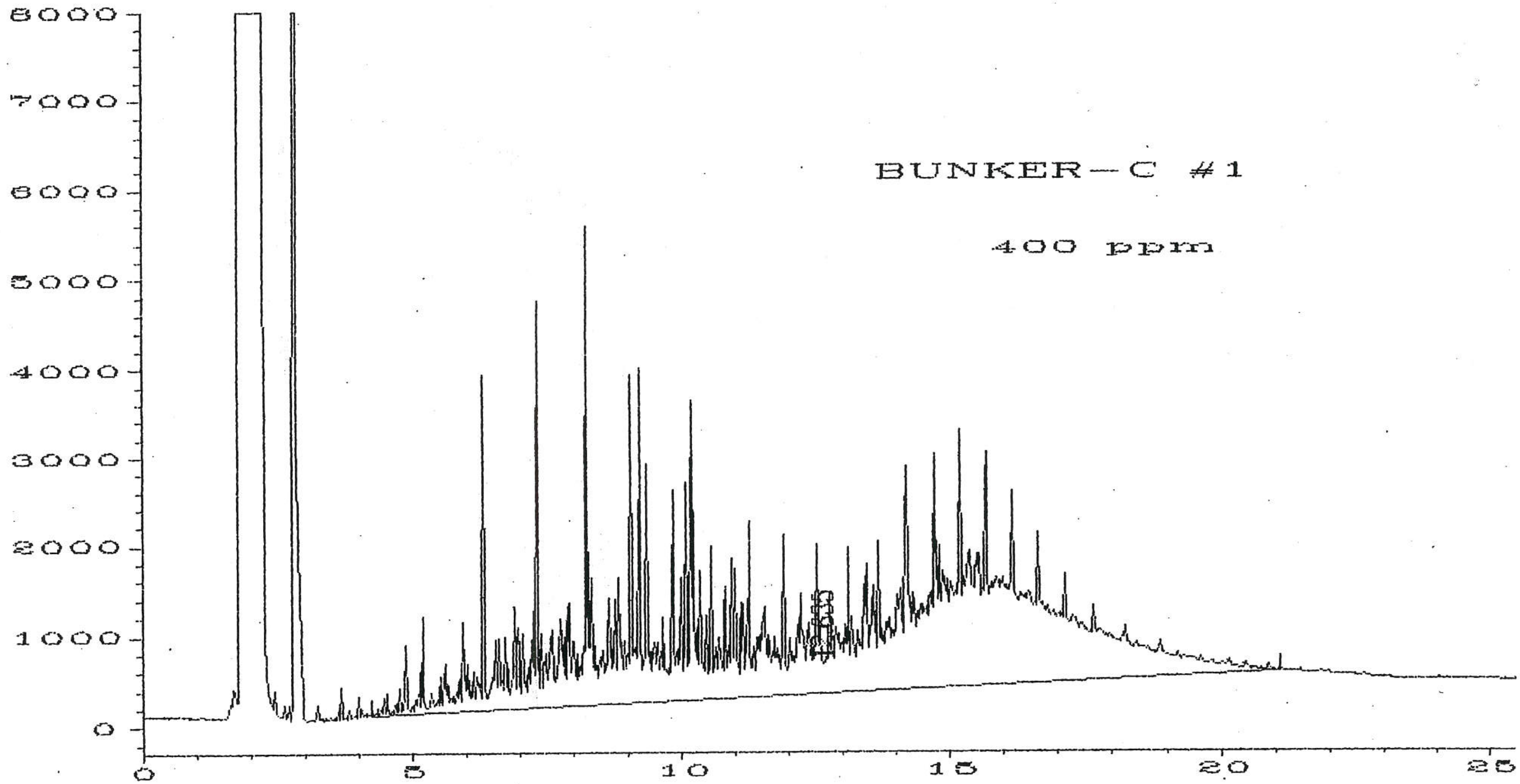
1-5



Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\004F0101.D

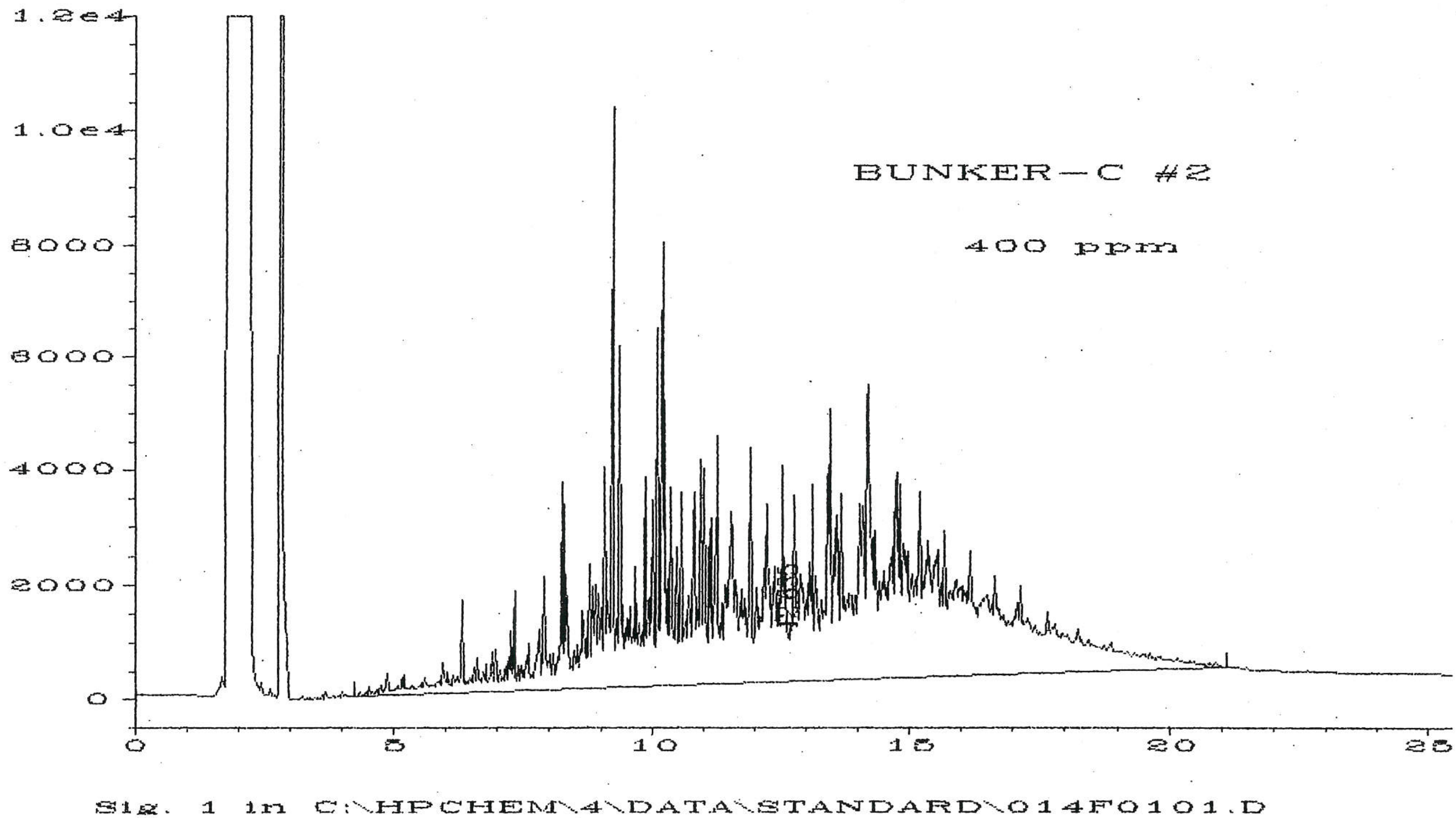


Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\003F0101.D

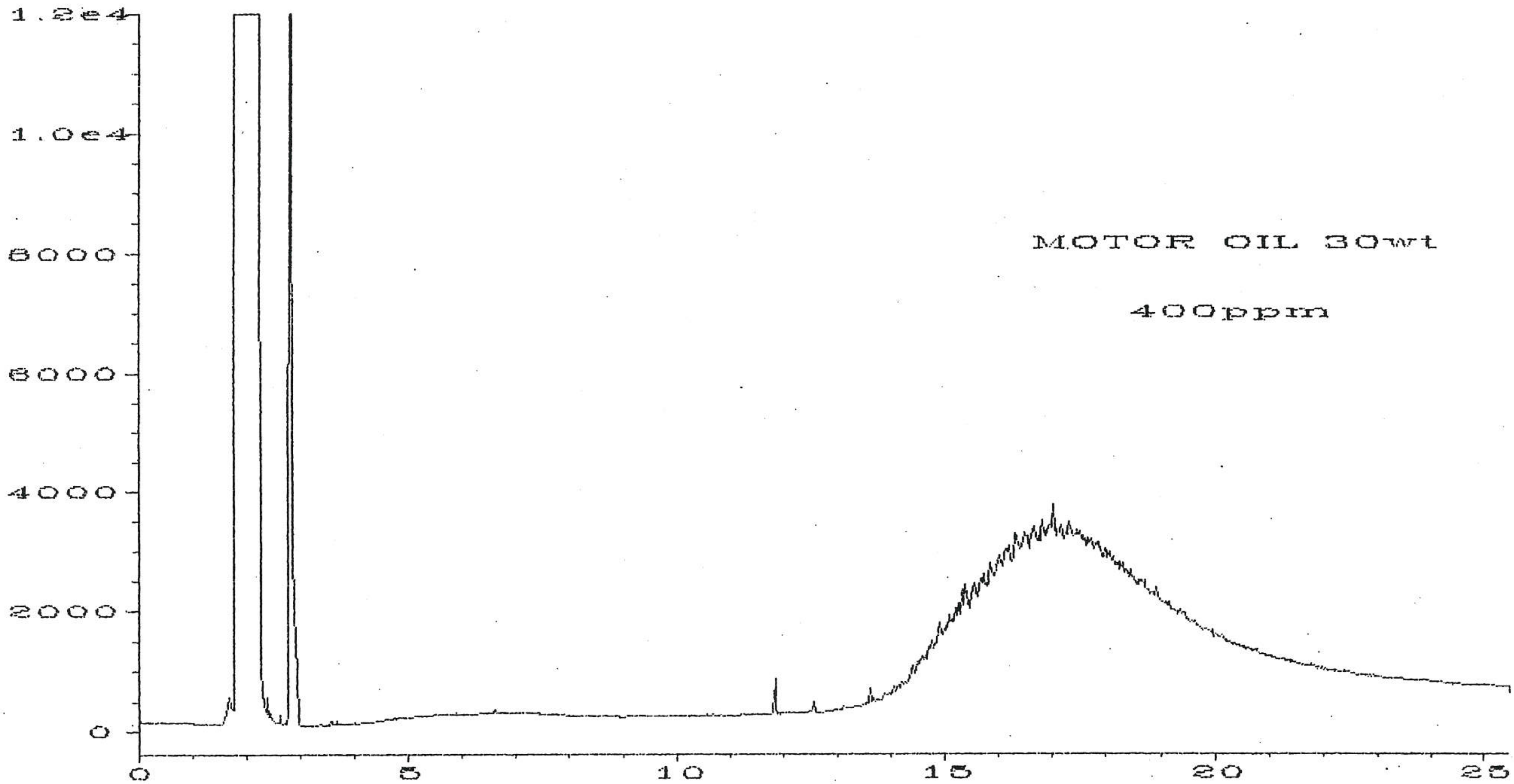


Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\013F0101.D

1-7

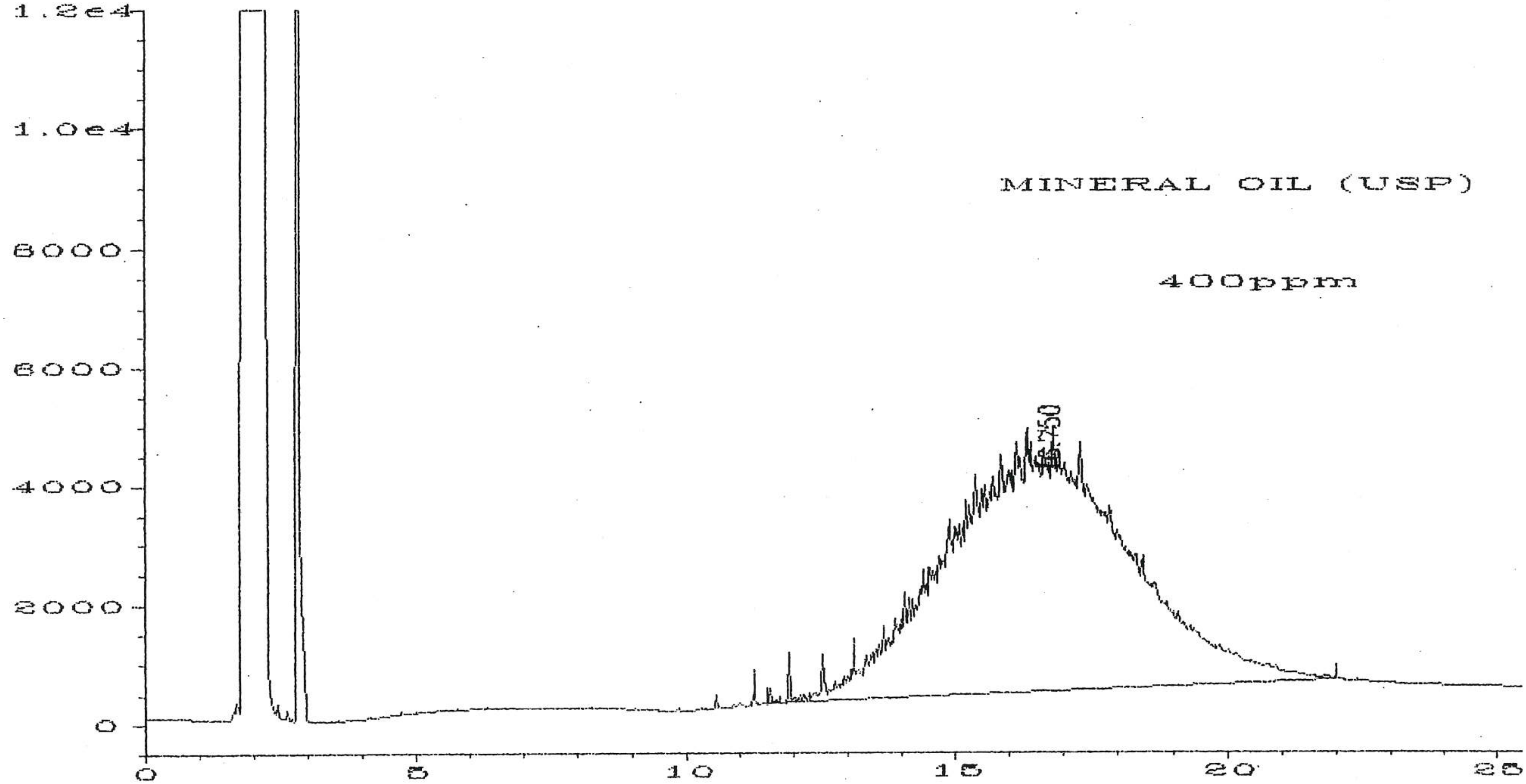

BUNKER—C #2
400 ppm
1.2e4
1.0e4
8000
6000
4000
2000
0
0
5
10
15
20
25
Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\014F0101.D

1-8



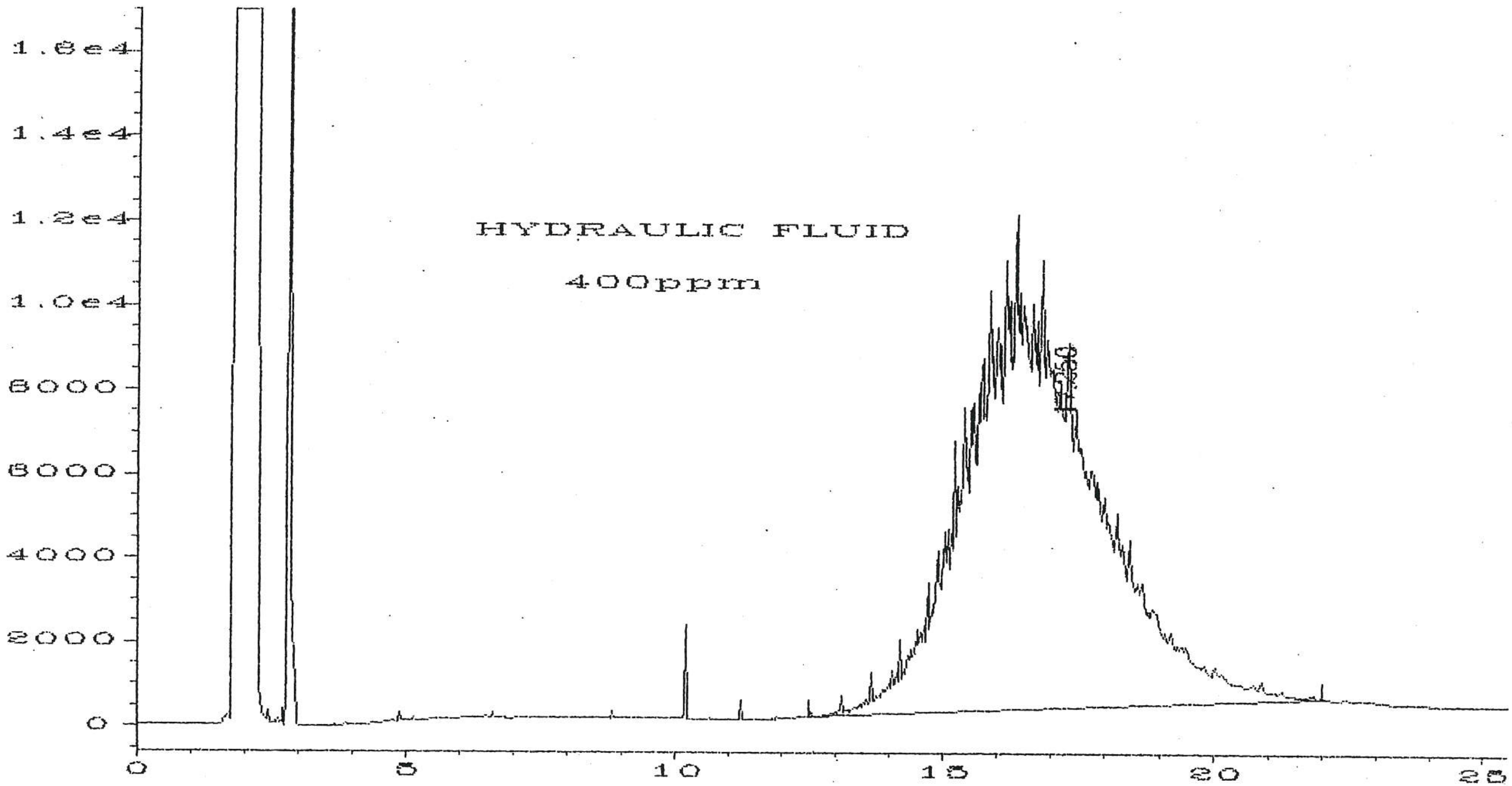
Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\011F0101.D

B-1



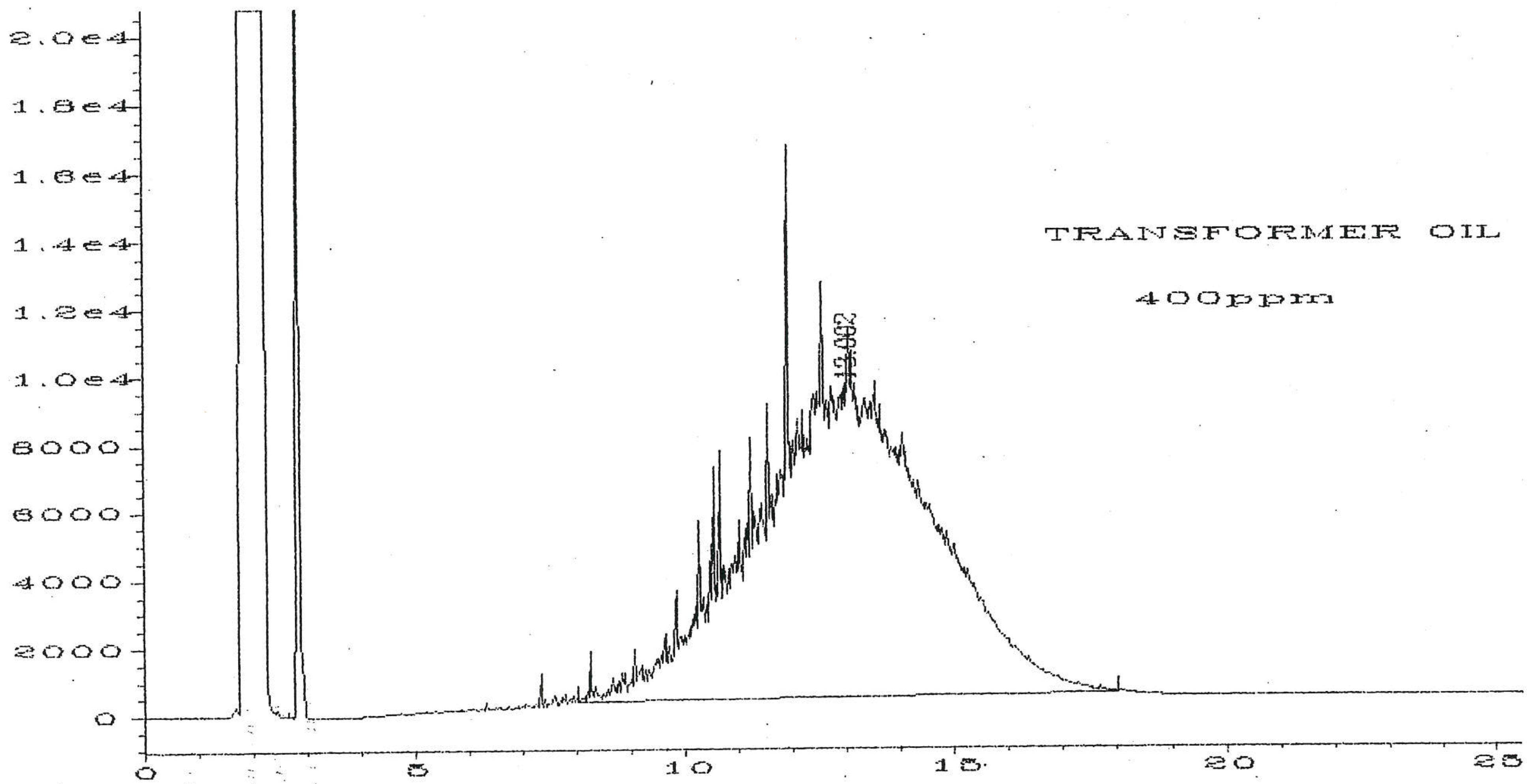
Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\010F0101.D

1-10



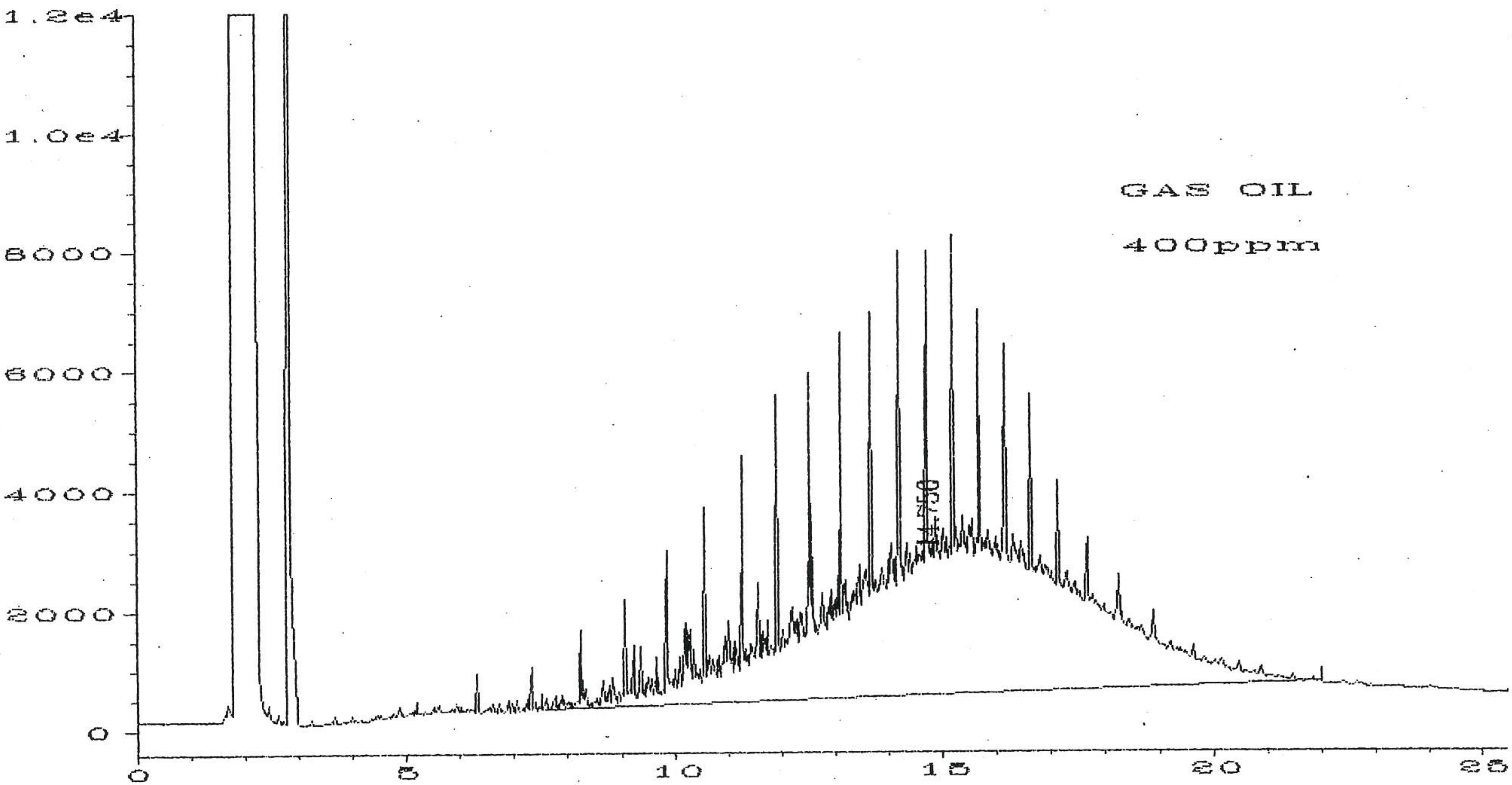
Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\009F0101.D

1-11



Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\006F0101.D

1-12



Sig. 1 in C:\HPCHEM\4\DATA\STANDARD\012F0101.D

Attachment 2

Chromatographic profiles for Well CTMW-7

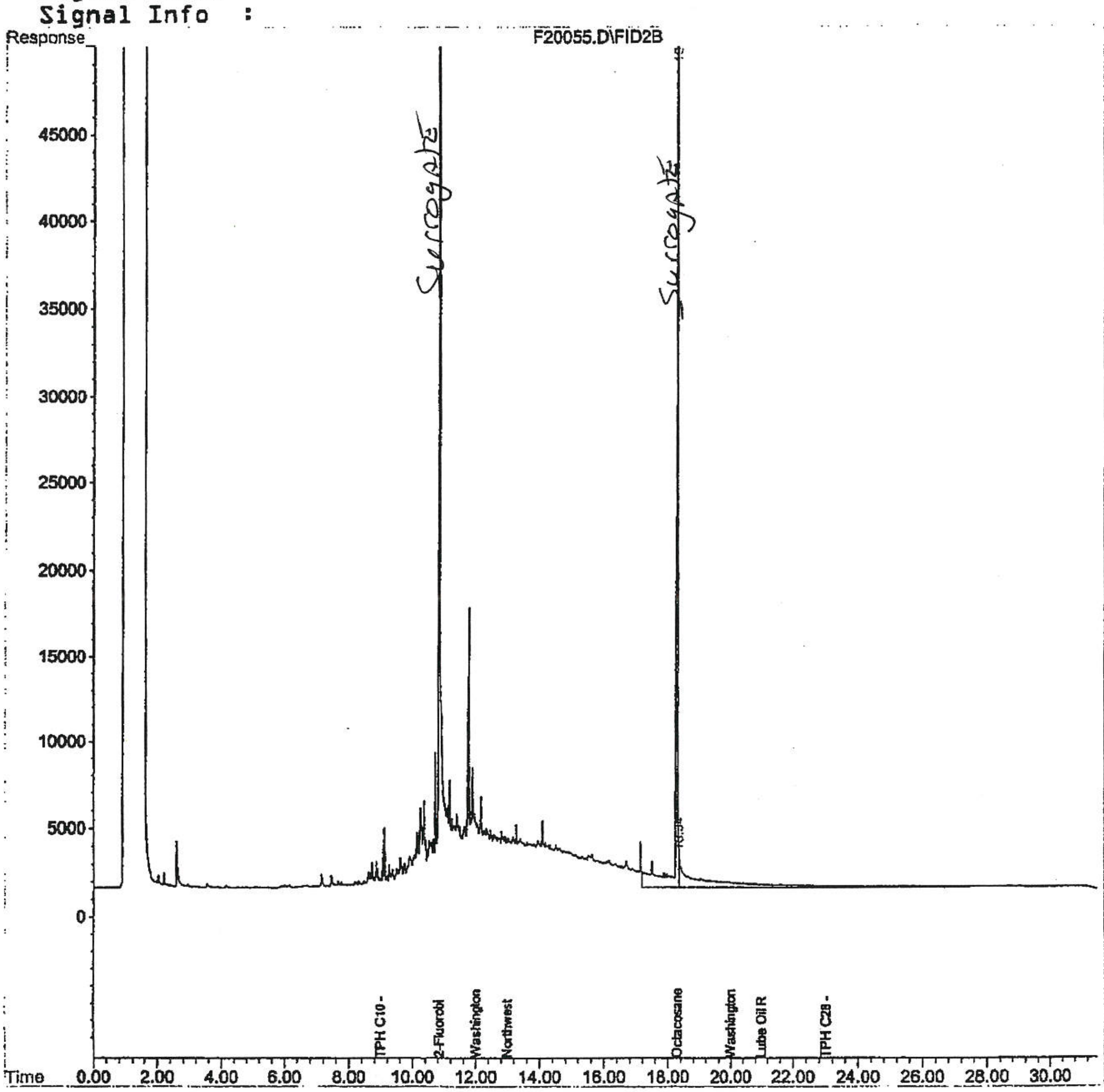
Quantitation Report

Data File : C:\HPCHEM\3\DATA.SEC\F20055.D
Acq On : 21 Jun 2002 3:35 am
Sample : B2F0431-02 = CTMW-7, 2nd Q02
Misc : 1x w nw sg
IntFile : SURR.E
Quant Time: Jun 21 4:07 2002 Quant Results File: 16502!5B.RES

Vial: 42
Operator: GAP
Inst : GC #5
Multiplr: 1.00

Quant Method : C:\HPCHEM\3\METHODS\16502!5B.M (Chemstation Integrator)
Title : TPH-D Rear Method
Last Update : Sun Jun 16 14:05:40 2002
Response via : Multiple Level Calibration
DataAcq Meth : 16502!5A.M

Volume Inj. :
Signal Phase :
Signal Info :



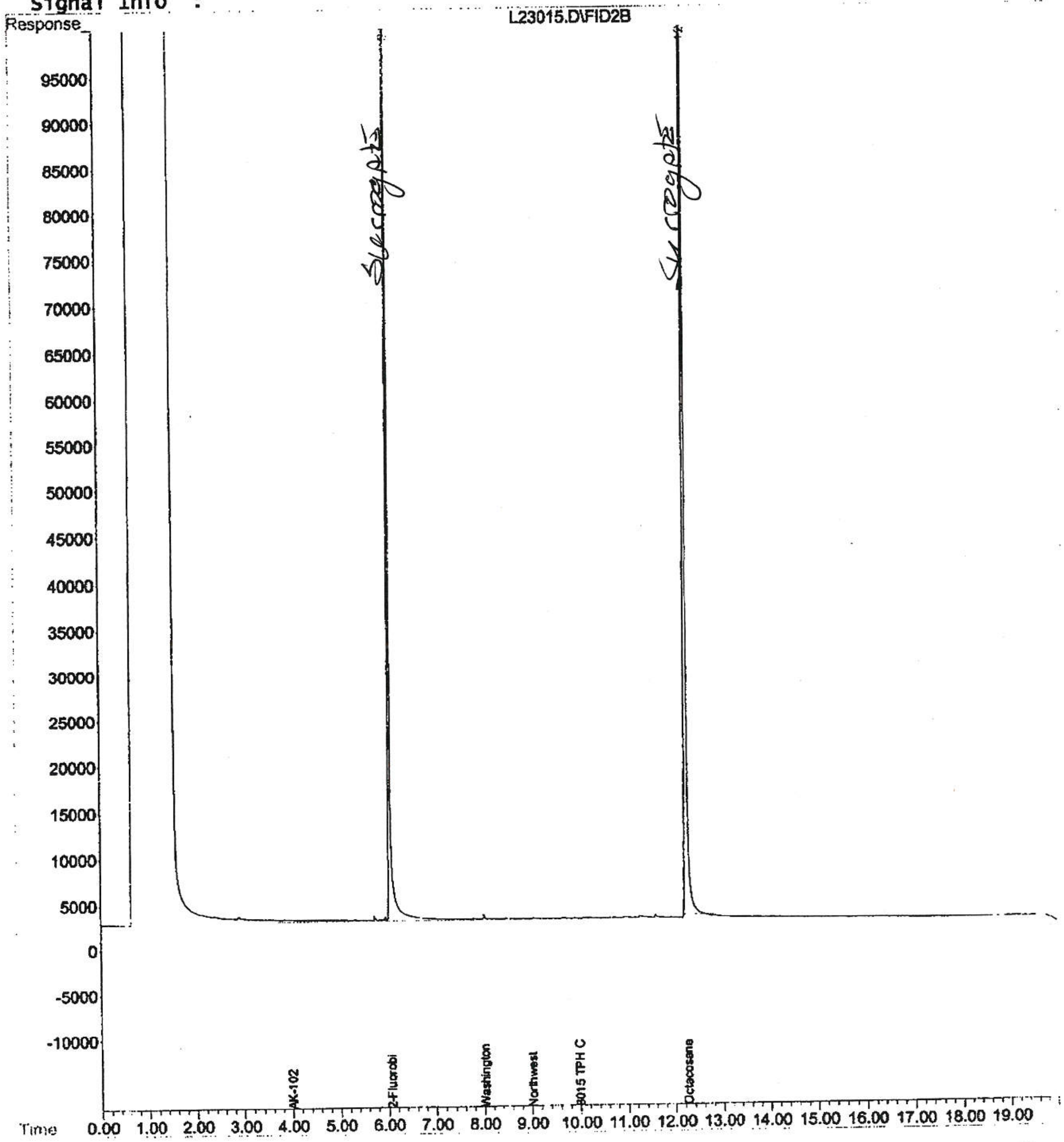
Quantitation Report

Data File : C:\HPCHEM\4\DATA.SEC\L23015.D
Acq On : 23 Dec 2002 10:31
Sample : b210394-05 = CTMW 7, 4thQ02
Misc : 1x nw-dx sg w
IntFile : SURR.E
Quant Time: Dec 23 10:51 2002 Quant Results File: L1602T1R.RES

Vial: 10
Operator: EDL
Inst : GC #1
Multiplr: 1.00

Quant Method : C:\HPCHEM\4\METHODS\L1602T1R.M (Chemstation Integrator)
Title : TPH-D Rear Method
Last Update : Tue Dec 17 11:38:00 2002
Response via : Multiple Level Calibration
DataAcq Meth : L1602T1F.M

Volume Inj. :
Signal Phase :
Signal Info :



2-2

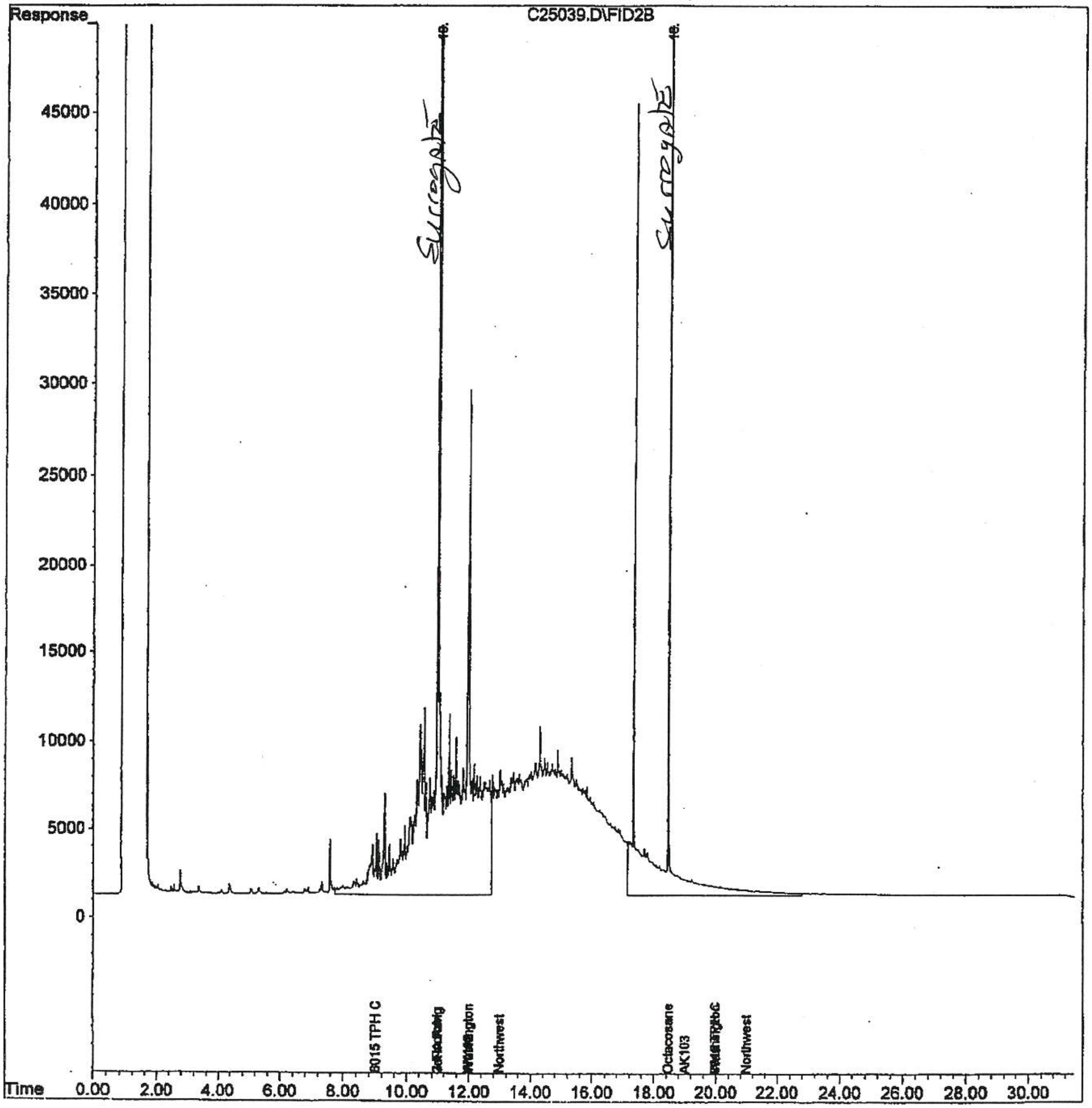
Quantitation Report

Data File : C:\HPCHEM\3\DATA.SEC\C25039.D
Acq On : 25 Mar 2003 8:08 pm
Sample : B3C0507-05 = CTMW-07, 1st Q 03
Misc : 1x w nw
IntFile : SURR.E
Quant Time: Mar 25 20:40 2003 Quant Results File: C0403T5R.RES

Vial: 26
Operator: GAP
Inst : GC #5
Multiplr: 1.00

Quant Method : C:\HPCHEM\3\METHODS\C0403T5R.M (Chemstation Integrator)
Title : TPH-D Rear Method
Last Update : Thu Mar 06 09:50:41 2003
Response via : Multiple Level Calibration
DataAcq Meth : C0403T5F.M

Volume Inj. :
Signal Phase :
Signal Info :



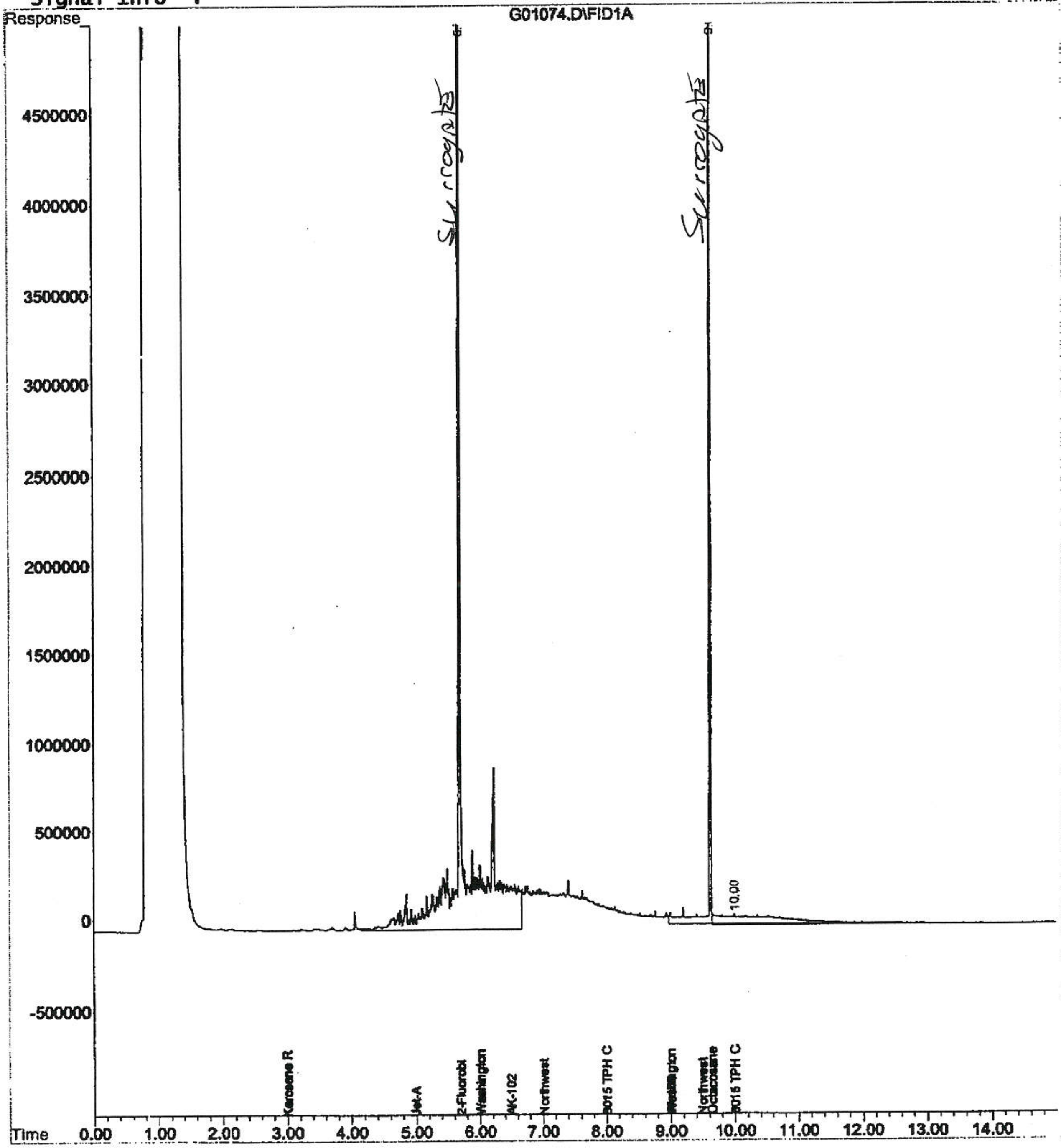
Quantitation Report

Data File : C:\HPCHEM\1\DATA\G01074.D
Acq On : 7-1-03 22:55:55
Sample : b3f0612-04 = CTMW-7, 2nd Q03
Misc : 1x nwdx sg w dup
IntFile : SURR.E
Quant Time: Jul 1 23:11 2003 Quant Results File: F1603T9F.RES

Vial: 48
Operator: EDL
Inst : GC #9
Multiplr: 1.00

Quant Method : C:\HPCHEM\1\METHODS\F1603T9F.M (Chemstation Integrator)
Title : TPH-D Front
Last Update : Fri Jun 20 11:10:29 2003
Response via : Multiple Level Calibration
DataAcq Meth : F1603T9F.M

Volume Inj. :
Signal Phase :
Signal Info :

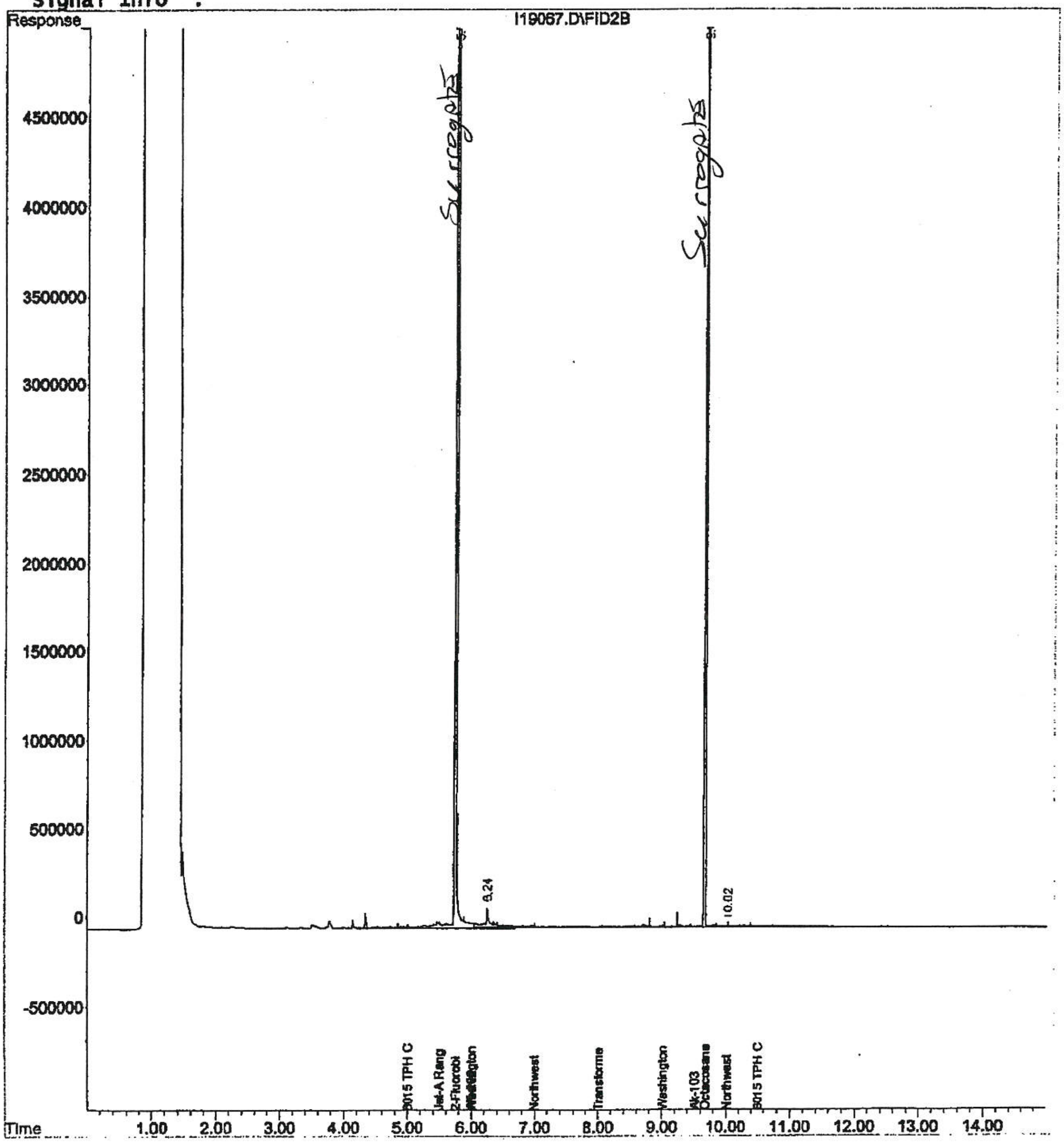


Quantitation Report

Data File : C:\HPCHEM\1\DATA.SEC\091903R\I19067.D   Vial: 11
Acq On   : 9-19-03 22:38:51   Operator: EJE
Sample   : b3i0450-02 CTMW-7, 3rd Q03   Inst   : GC #9
Misc   : W NWsg   Multiplr: 1.00
IntFile   : SURR.E
Quant Time: Sep 19 22:54 2003   Quant Results File: I1303T9R.RES

Quant Method : C:\HPCHEM\1\METHODS\I1303T9R.M (Chemstation Integrator)
Title   : TPH-D Rear
Last Update : Sun Sep 14 14:57:10 2003
Response via : Multiple Level Calibration
DataAcq Meth : I1303T9F.M

Volume Inj. :
Signal Phase :
Signal Info :

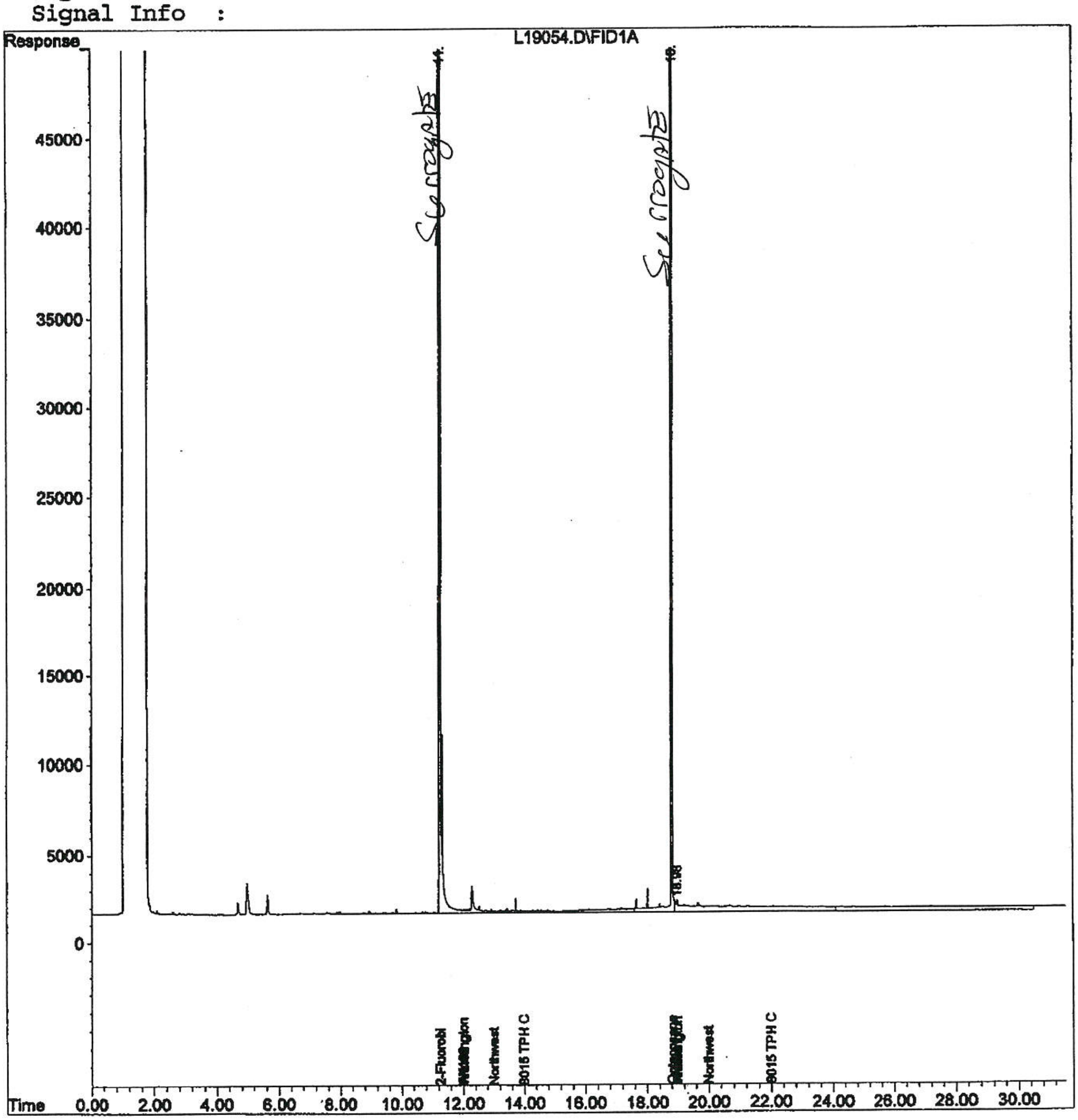


Quantitation Report

```
Data File : C:\HPCHEM\2\DATA\121903F\L19054.D          Vial: 35
Acq On    : 20 Dec 2003   1:38 am                  Operator: EJE
Sample    : B3L0493-02 =GTMW-7, 4thQ03             Inst    : GC#3
Misc      : 1x w nw sg                             Multiplr: 1.00
IntFile   : SURR.E
Quant Time: Dec 20  2:10 2003  Quant Results File: K2503T3F.RES

Quant Method : C:\HPCHEM\2\METHODS\K2503T3F.M (Chemstation Integrator)
Title        : TPH-D Rear Method
Last Update  : Wed Nov 26 09:34:26 2003
Response via : Multiple Level Calibration
DataAcq Meth : K2503T3F.M

Volume Inj.  :
Signal Phase :
Signal Info  :
```

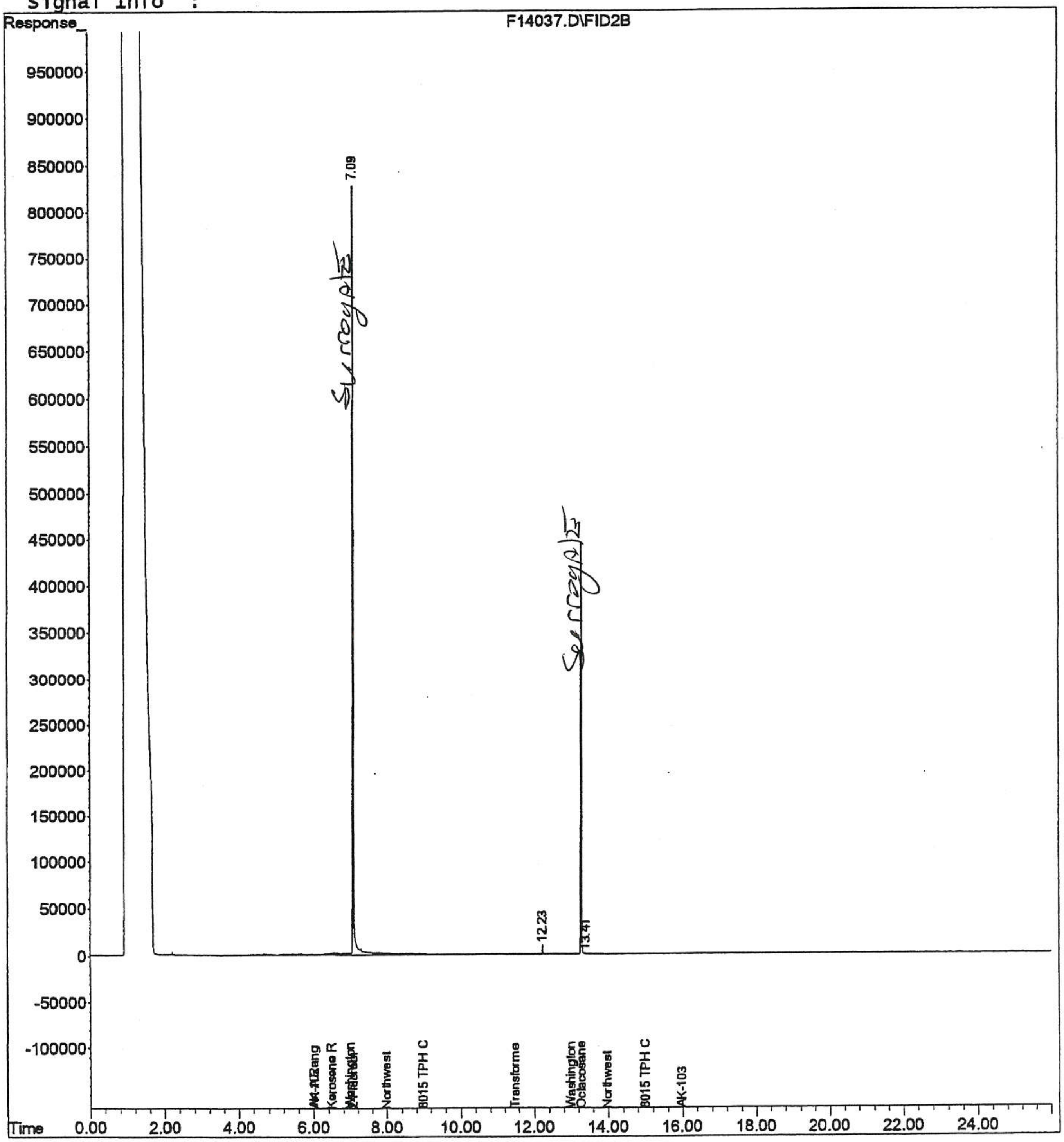


Quantitation Report

Data File : D:\HPCHEM\1\DATA\061404.SEC\F14037.D
Vial: 9
Acq On : 14 Jun 2004 7:33 pm
Operator: EDL
Sample : b4f0230-02 = ETMW3-7, 2nd Q04
Inst : GC#7
Misc : 1x nwdx sg w
Multiplr: 1.00
IntFile : SURR.E
Quant Time: Jun 14 20:00 2004 Quant Results File: E0604T7R.RES

Quant Method : D:\HPCHEM\1\METHODS\E0604T7R.M (Chemstation Integrator)
Title : GC#7 TPH-Dx Rear Column
Last Update : Mon May 10 08:52:48 2004
Response via : Multiple Level Calibration
DataAcq Meth : E0604T7F.M

Volume Inj. :
Signal Phase :
Signal Info :

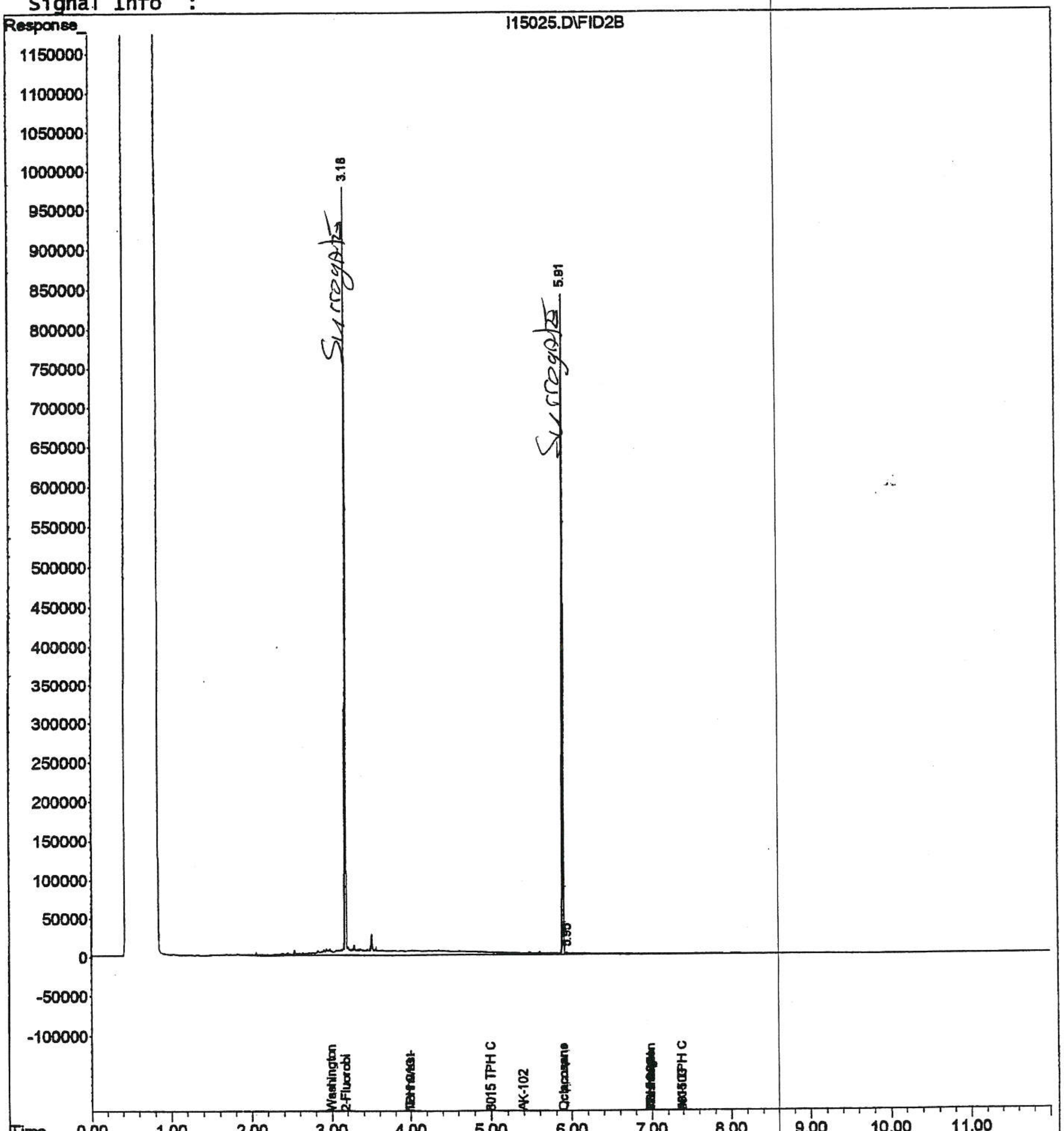


Quantitation Report

Data File : D:\HPCHEM\1\DATA\091504.SEC\I15025.D Vial: 20
Acq On : 15 Sep 2004 10:31 am Operator: GSM
Sample : B4I0246-02 = ~~CTMW-7~~, 3rd Q04 Inst : GC#7
Misc : 1X NWDX SG W Multiplr: 1.00
IntFile : SURR.E
Quant Time: Sep 15 11:51 2004 Quant Results File: I1404T7R.RES

Quant Method : D:\HPCHEM\1\METHODS\I1404T7R.M (Chemstation Integrator)
Title : GC#7 TPH-Dx Rear Column
Last Update : Wed Sep 15 10:34:59 2004
Response via : Multiple Level Calibration
DataAcq Meth : I1404T7F.M

Volume Inj. :
Signal Phase :
Signal Info :



Attachment 3

Chromatographic profiles for Well CTMW-8

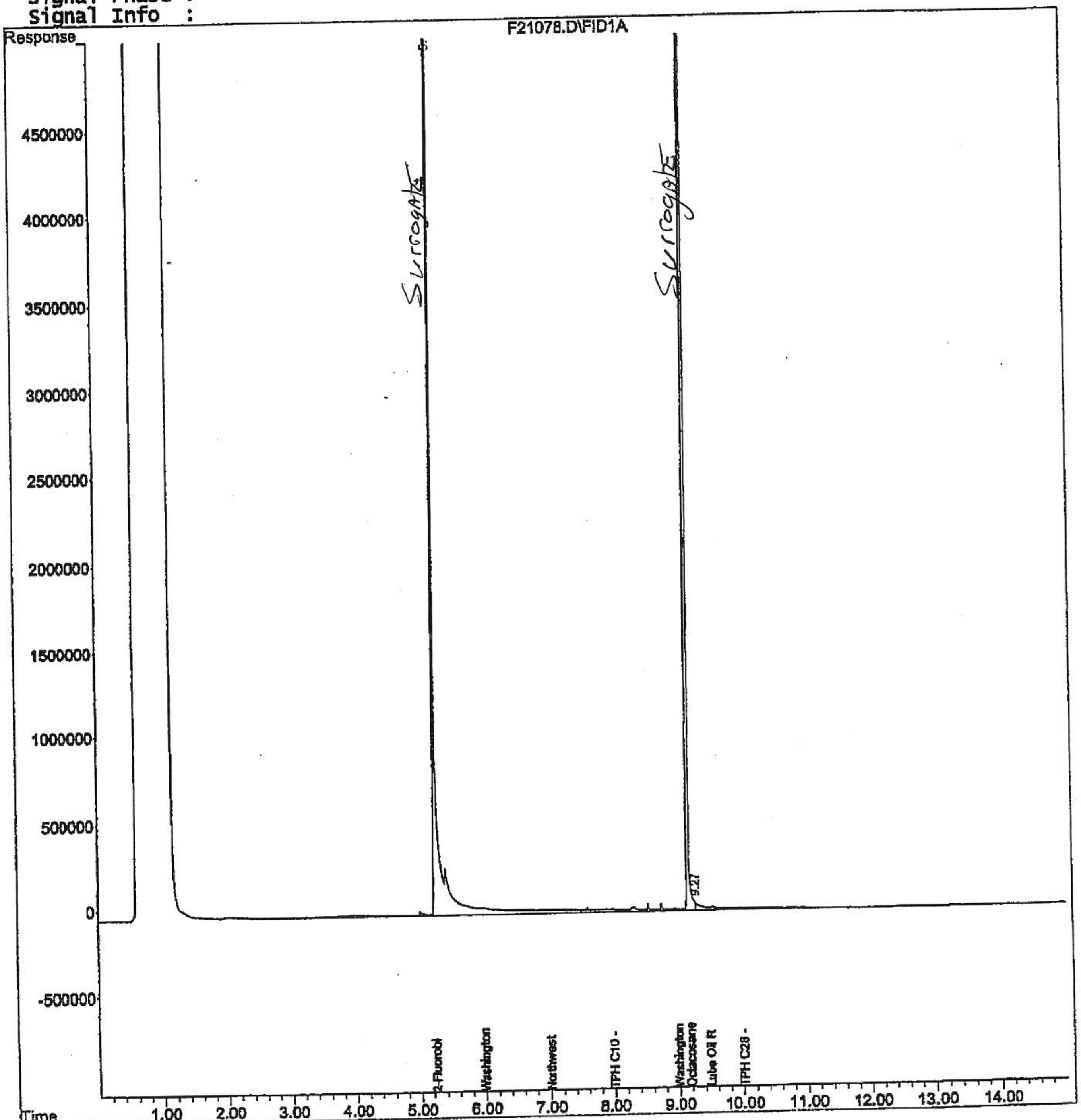
Quantitation Report

Data File : C:\HPCHEM\1\DATA\F21078.D
Acq On : 6-21-02 11:15:09 PM
Sample : b2f0460-03 = CTMW-8, 2nd QO2
Misc : W
IntFile : SURR.E
Quant Time: Jun 21 23:30 2002 Quant Results File: 155021 9A.RES

Vial: 52
Operator: EDL
Inst : GC #9
Multiplr: 1.00

Quant Method : C:\HPCHEM\1\METHODS\155021 9A.M (Chemstation Integrator)
Title : TPH-D Front
Last Update : Tue Jun 04 12:37:24 2002
Response via : Multiple Level Calibration
DataAcq Meth : 155021 9A.M

Volume Inj. :
Signal Phase :
Signal Info :



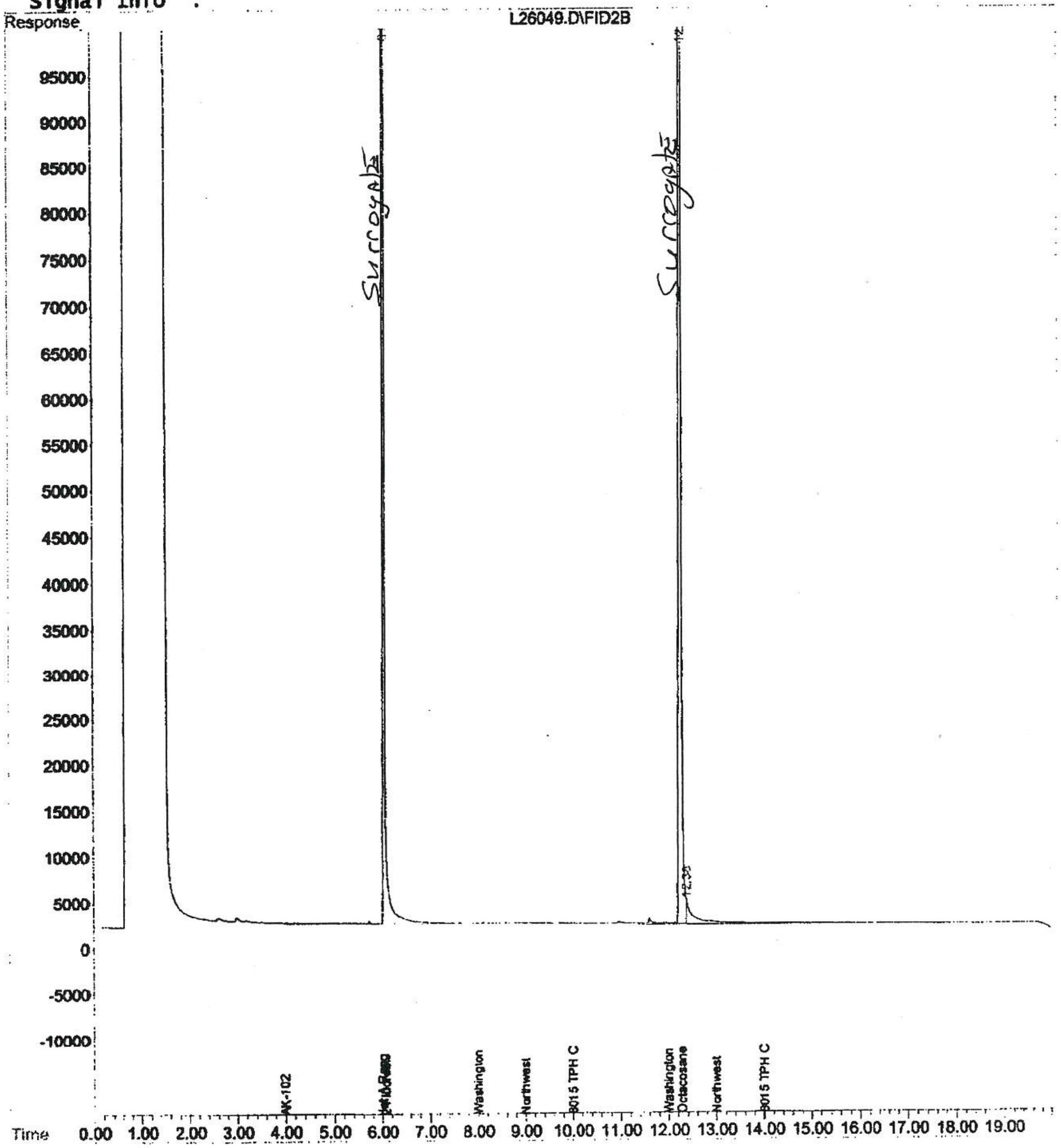
Quantitation Report

Data File : C:\HPCHEM\4\DATA.SEC\L26049.D
Acq On : 26 Dec 2002 20:26
Sample : B2L0442-07 = CTMW-8, 4thQ02
Misc : 1x w nw sg
IntFile : SURR.E
Quant Time: Dec 26 20:46 2002 Quant Results File: L1602T1R.RES

Vial: 35
Operator: GAP
Inst : GC #1
Multiplr: 1.00

Quant Method : C:\HPCHEM\4\METHODS\L1602T1R.M (Chemstation Integrator)
Title : TPH-D Rear Method
Last Update : Thu Dec 26 08:28:38 2002
Response via : Multiple Level Calibration
DataAcq Meth : L1602T1F.M

Volume Inj. :
Signal Phase :
Signal Info :

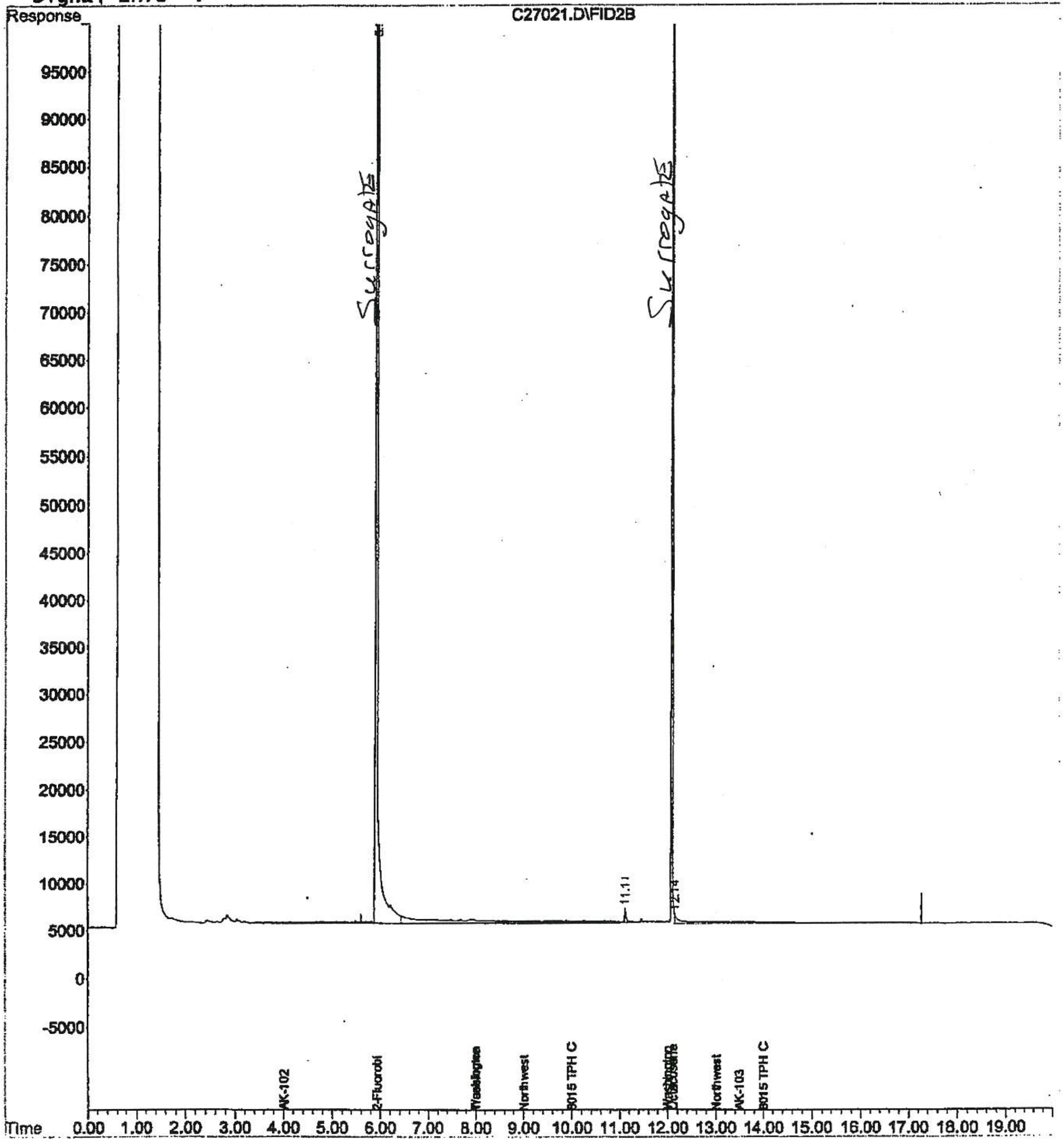


Quantitation Report

Data File : C:\HPCHEM\4\DATA.SEC\C27021.D   Vial: 14
Acq On : 27 Mar 2003 12:38   Operator: EJE
Sample : b3c0552-02 = CTMW-8, 1st Q03   Inst : GC #1
Misc : w NWsg R1   Multiplr: 1.00
IntFile : SURR.E
Quant Time: Mar 27 12:59 2003 Quant Results File: C2303T1R.RES

Quant Method : C:\HPCHEM\4\METHODS\C2303T1R.M (Chemstation Integrator)
Title : TPH-D Rear Method
Last Update : Mon Mar 24 10:59:02 2003
Response via : Multiple Level Calibration
DataAcq Meth : C2303T1F.M

Volume Inj. :
Signal Phase :
Signal Info :

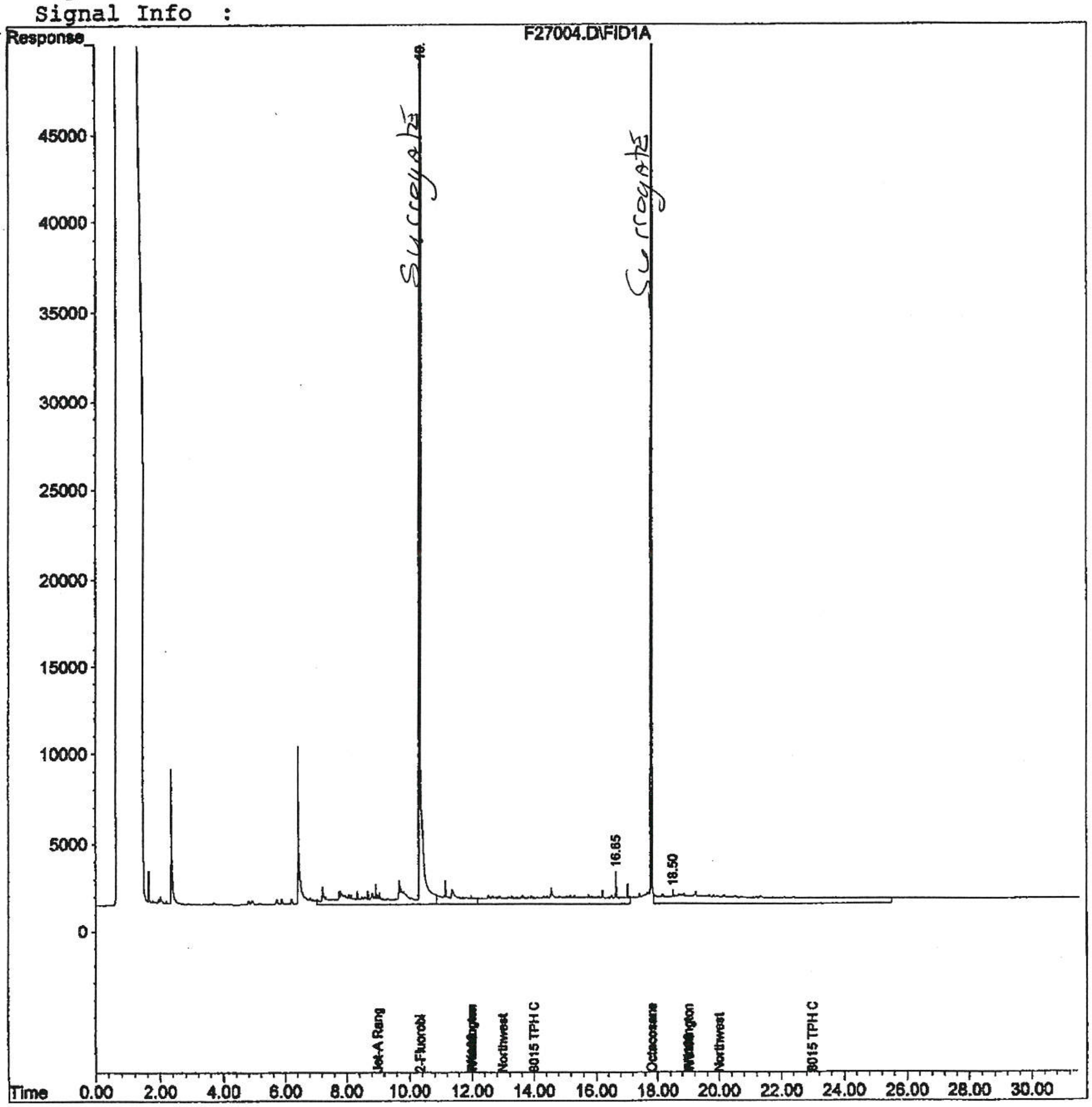


Quantitation Report

Data File : C:\HPCHEM\2\DATA\F27004.D Vial: 5
Acq On : 27 Jun 2003 1:54 pm Operator: EJE
Sample : B3F0576-02 = CJMW-8, 2nd Q03 Inst : GC#3
Misc : 1x w nw sg Multiplr: 1.00
IntFile : SURR.E
Quant Time: Jun 27 14:26 2003 Quant Results File: F1903T3F.RES

Quant Method : C:\HPCHEM\2\METHODS\F1903T3F.M (Chemstation Integrator)
Title : TPH-D Rear Method
Last Update : Fri Jun 20 17:35:48 2003
Response via : Multiple Level Calibration
DataAcq Meth : F1903T3F.M

Volume Inj. :
Signal Phase :
Signal Info :



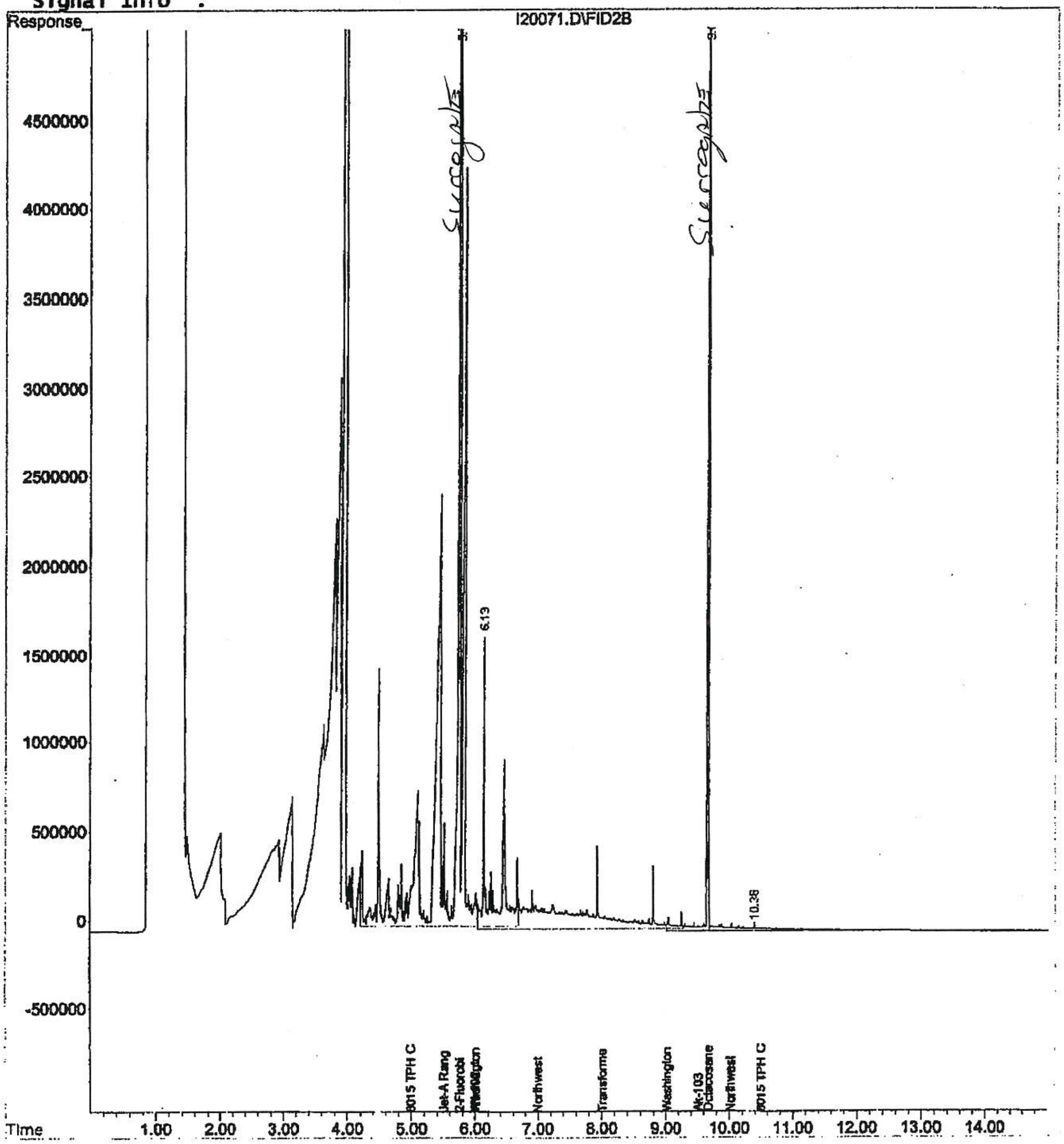
Quantitation Report

Data File : C:\HPCHEM\1\DATA.SEC\I20071.D
Acq On : 9-21-03 8:16:37
Sample : b3i0494-02 = CTMW-8, 3rd Q03
Misc : W NWSg
IntFile : SURR.E
Quant Time: Sep 21 8:32 2003 Quant Results File: I1303T9R.RES

Vial: 41
Operator: EJE
Inst : GC #9
Multiplr: 1.00

Quant Method : C:\HPCHEM\1\METHODS\I1303T9R.M (Chemstation Integrator)
Title : TPH-D Rear
Last Update : Sun Sep 14 14:57:10 2003
Response via : Multiple Level Calibration
DataAcq Meth : I1303T9F.M

Volume Inj. :
Signal Phase :
Signal Info :



3-5

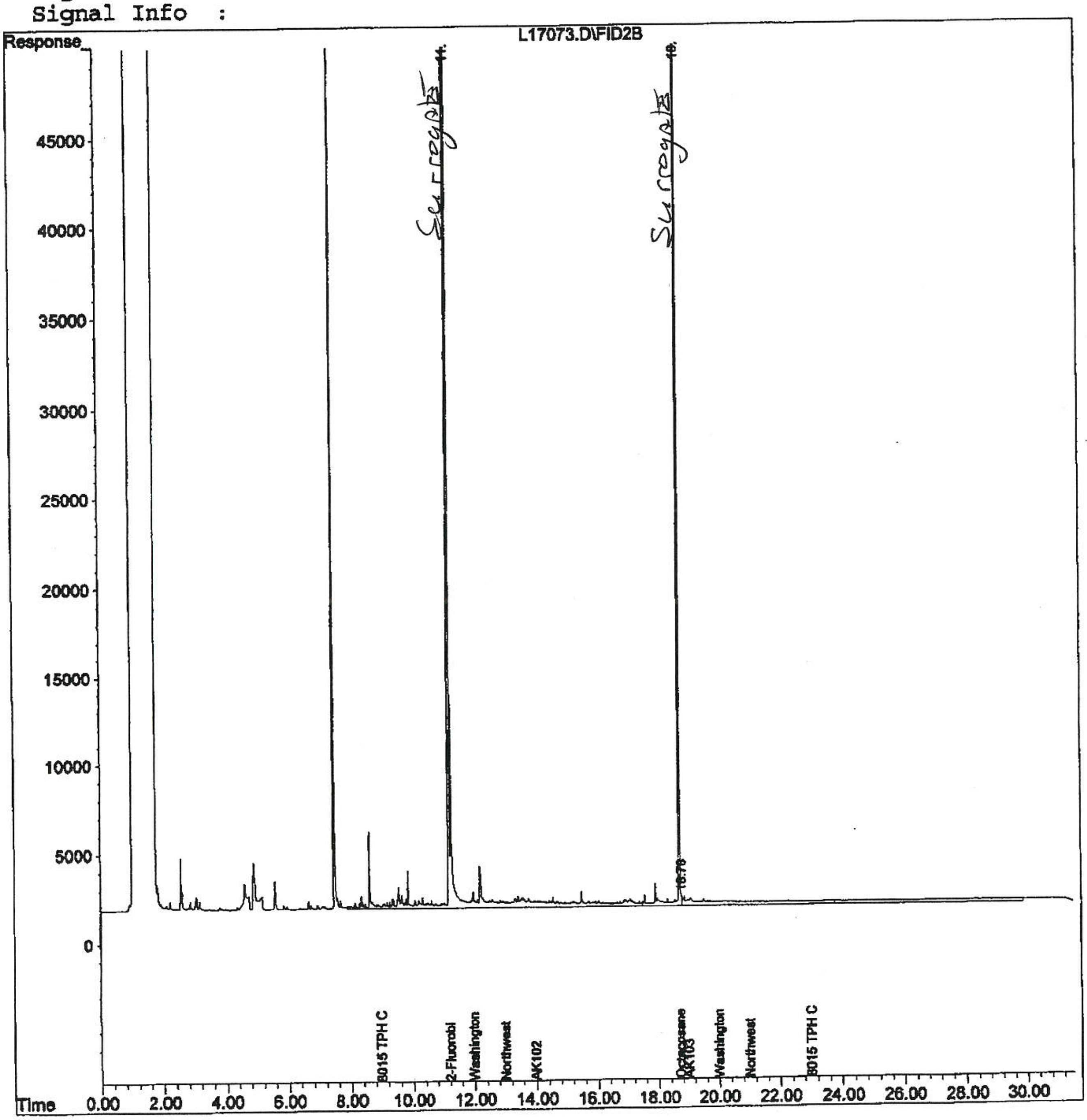
Quantitation Report

Data File : C:\HPCHEM\2\DATA.SEC\L17073.D
Acq On : 18 Dec 2003 7:23 am
Sample : b310484-03 = CTMW-8, 4thQ03
Misc : w NWsg
IntFile : SURR.E
Quant Time: Dec 18 7:56 2003 Quant Results File: K2503T3R.RES

Vial: 46
Operator: EJE
Inst : GC#3
Multiplr: 1.00

Quant Method : C:\HPCHEM\2\METHODS\K2503T3R.M (Chemstation Integrator)
Title : TPH-D Rear Method
Last Update : Wed Nov 26 10:01:15 2003
Response via : Multiple Level Calibration
DataAcq Meth : K2503T3F.M

Volume Inj. :
Signal Phase :
Signal Info :



3-6

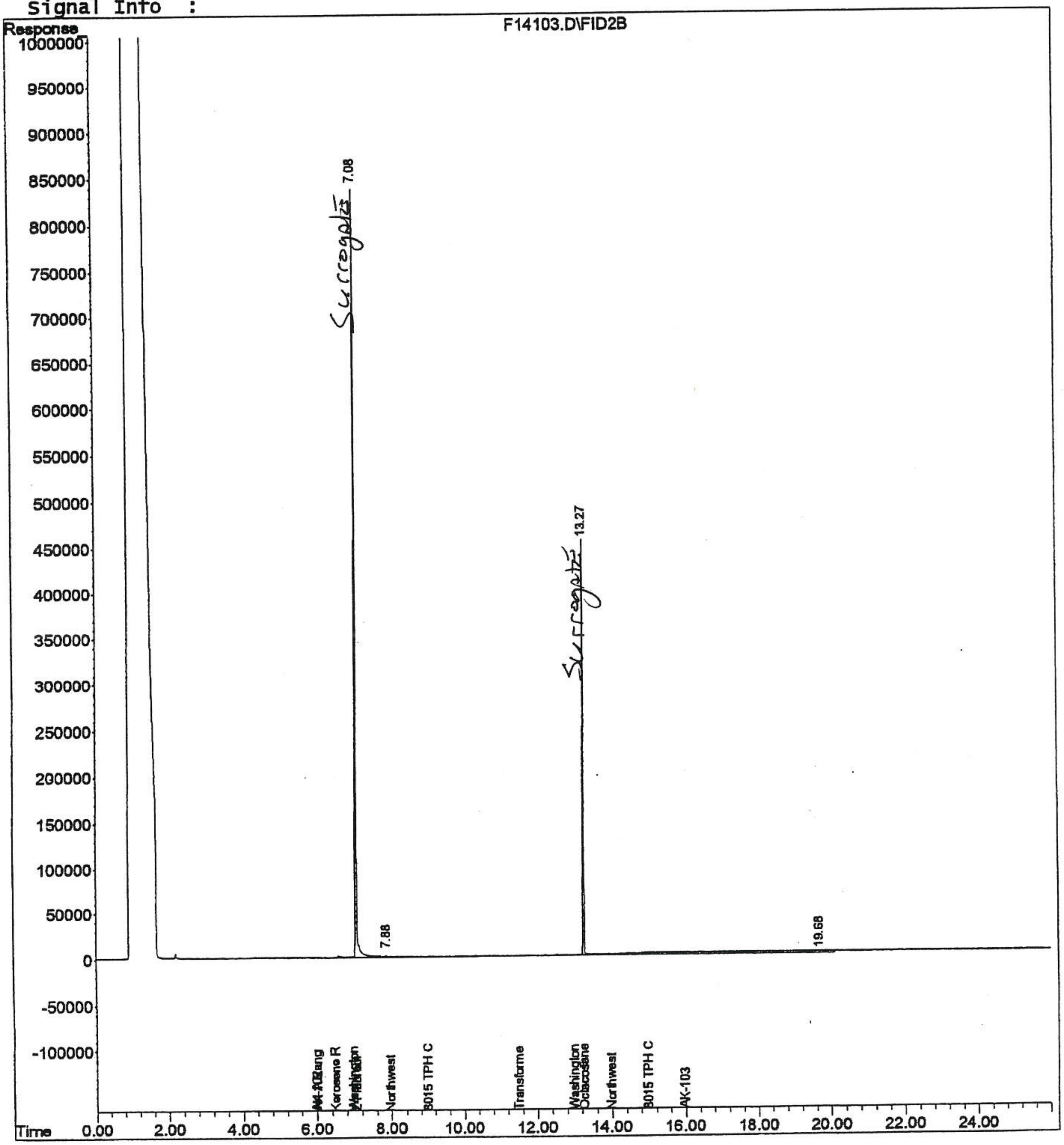
Quantitation Report

Data File : D:\HPCHEM\1\DATA\061404.SEC\F14103.D
Acq On : 15 Jun 2004 2:28 pm
Sample : b4f0230-05 = CTMW-8, 2nd Q04
Misc : 1x nwdx sg rs1
IntFile : SURR.E
Quant Time: Jun 15 14:55 2004 Quant Results File: E0604T7R.RES

Vial: 12
Operator: EDL
Inst : GC#7
Multiplr: 1.00

Quant Method : D:\HPCHEM\1\METHODS\E0604T7R.M (Chemstation Integrator)
Title : GC#7 TPH-Dx Rear Column
Last Update : Mon May 10 08:52:48 2004
Response via : Multiple Level Calibration
DataAcq Meth : E0604T7F.M

Volume Inj. :
Signal Phase :
Signal Info :

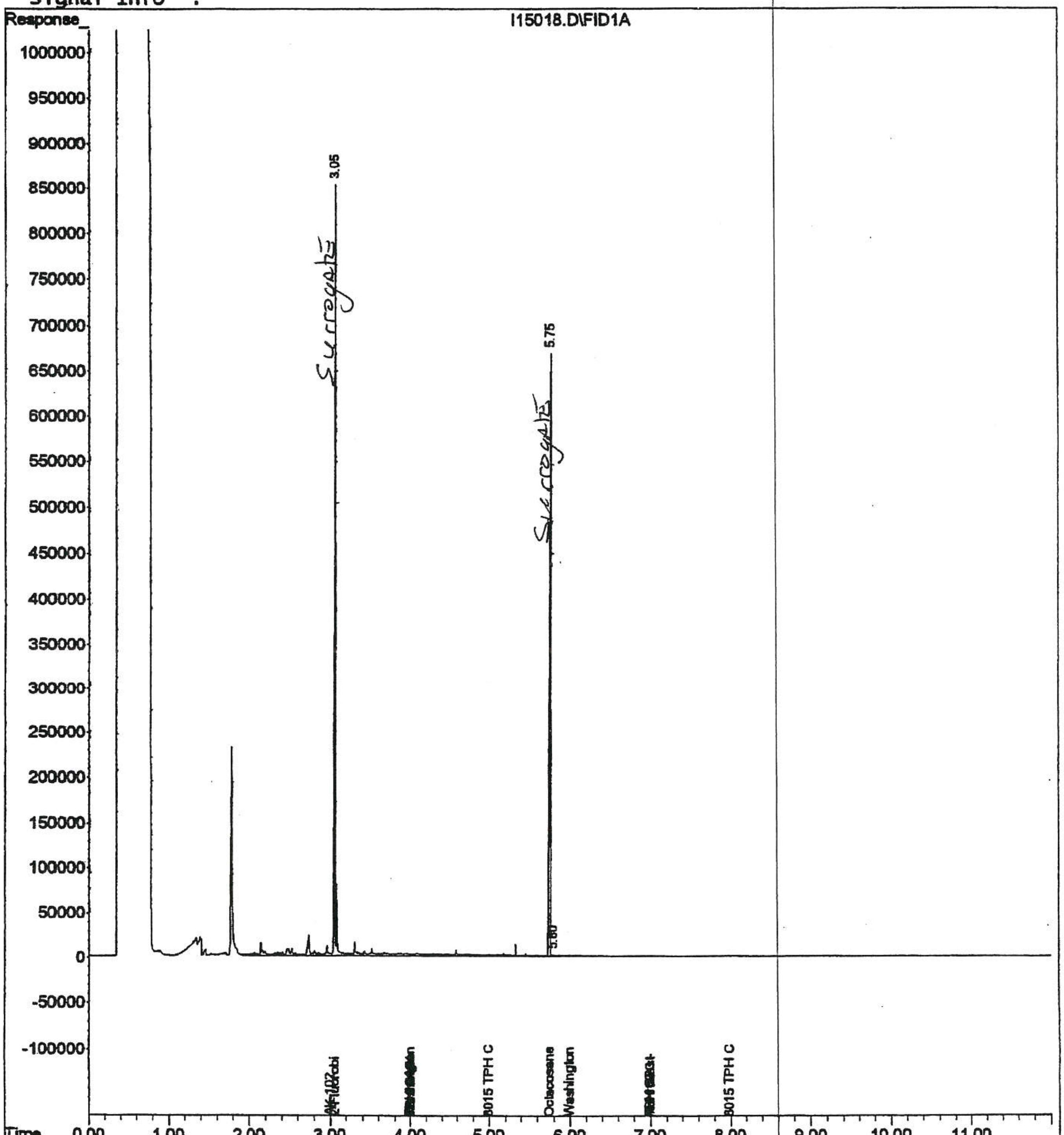


Quantitation Report

Data File : D:\HPCHEM\1\DATA\091504\I15018.D Vial: 13
Acq On : 15 Sep 2004 9:16 am Operator: GSM
Sample : B4I0180-02 = CTMW-8, 3rd QO4 Inst : GC#7
Misc : 1X NWDX SG W Multiplr: 1.00
IntFile : SURR.E
Quant Time: Sep 15 11:56 2004 Quant Results File: I1404T7F.RES

Quant Method : D:\HPCHEM\1\METHODS\I1404T7F.M (Chemstation Integrator)
Title : GC#7 TPH-Dx Rear Column
Last Update : Wed Sep 15 10:53:38 2004
Response via : Multiple Level Calibration
DataAcq Meth : I1404T7F.M

Volume Inj. :
Signal Phase :
Signal Info :



Attachment 4

Chromatographic profiles for Well CTMW-9

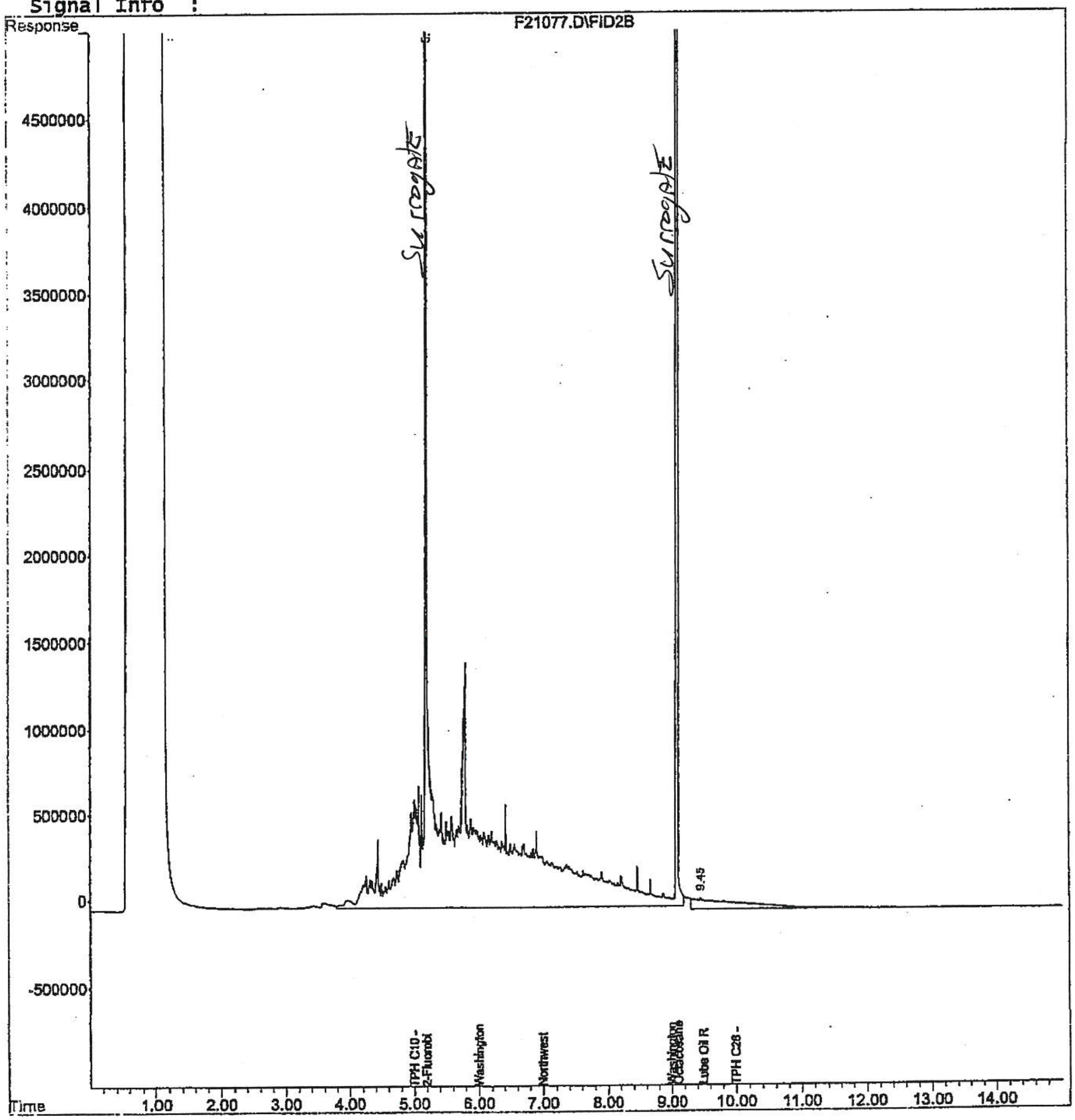
Quantitation Report

Data File : C:\HPCHEM\1\DATA.SEC\F21077.D
Acq On : 6-21-02 11:15:09 PM
Sample : b2f0460-02 = CTMW-9, 2nd QO2
Misc : W
IntFile : SURR.E
Quant Time: Jun 21 23:30 2002 Quant Results File: 1550219B.RES

Vial: 51
Operator: EDL
Inst : GC #9
Multiplr: 1.00

Quant Method : C:\HPCHEM\1\METHODS\1550219B.M (Chemstation Integrator)
Title : TPH-D Rear
Last Update : Tue Jun 04 13:02:38 2002
Response via : Multiple Level Calibration
DataAcq Meth : 1550219A.M

Volume Inj. :
Signal Phase :
Signal Info :



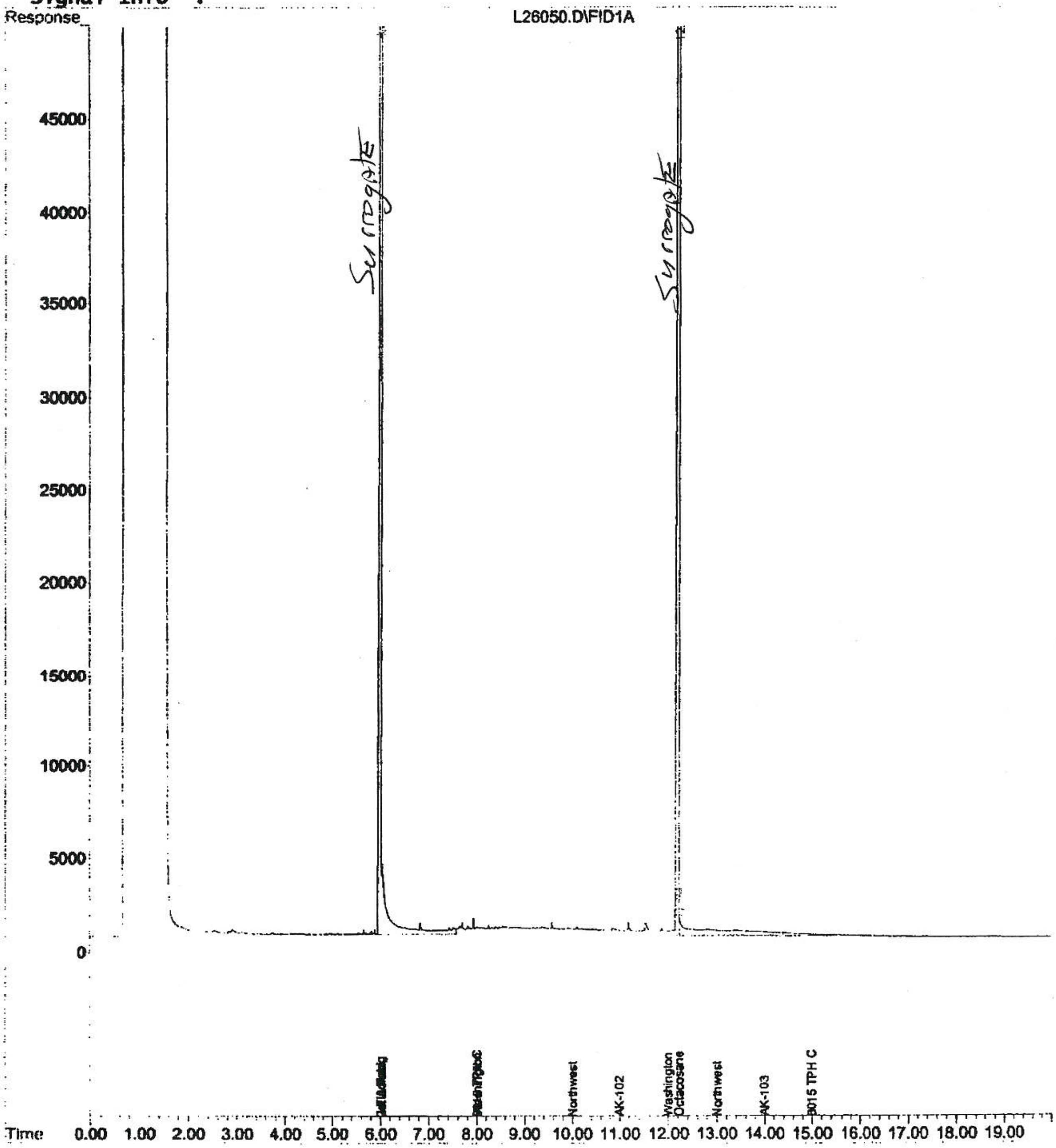
4-1

Quantitation Report

Data File : C:\HPCHEM\4\DATA\L26050.D Vial: 36
Acq On : 26 Dec 2002 20:26 Operator: GAP
Sample : B2L0442-08 = CTMW-9, 4th QO2 Inst : GC #1
Misc : 1x w nw sg Multiplr: 1.00
IntFile : SURR.E
Quant Time: Dec 26 20:46 2002 Quant Results File: L1602T1F.RES

Quant Method : C:\HPCHEM\4\METHODS\L1602T1F.M (Chemstation Integrator)
Title : TPH-D Rear Method
Last Update : Thu Dec 26 09:04:25 2002
Response via : Multiple Level Calibration
DataAcq Meth : L1602T1F.M

Volume Inj. :
Signal Phase :
Signal Info :

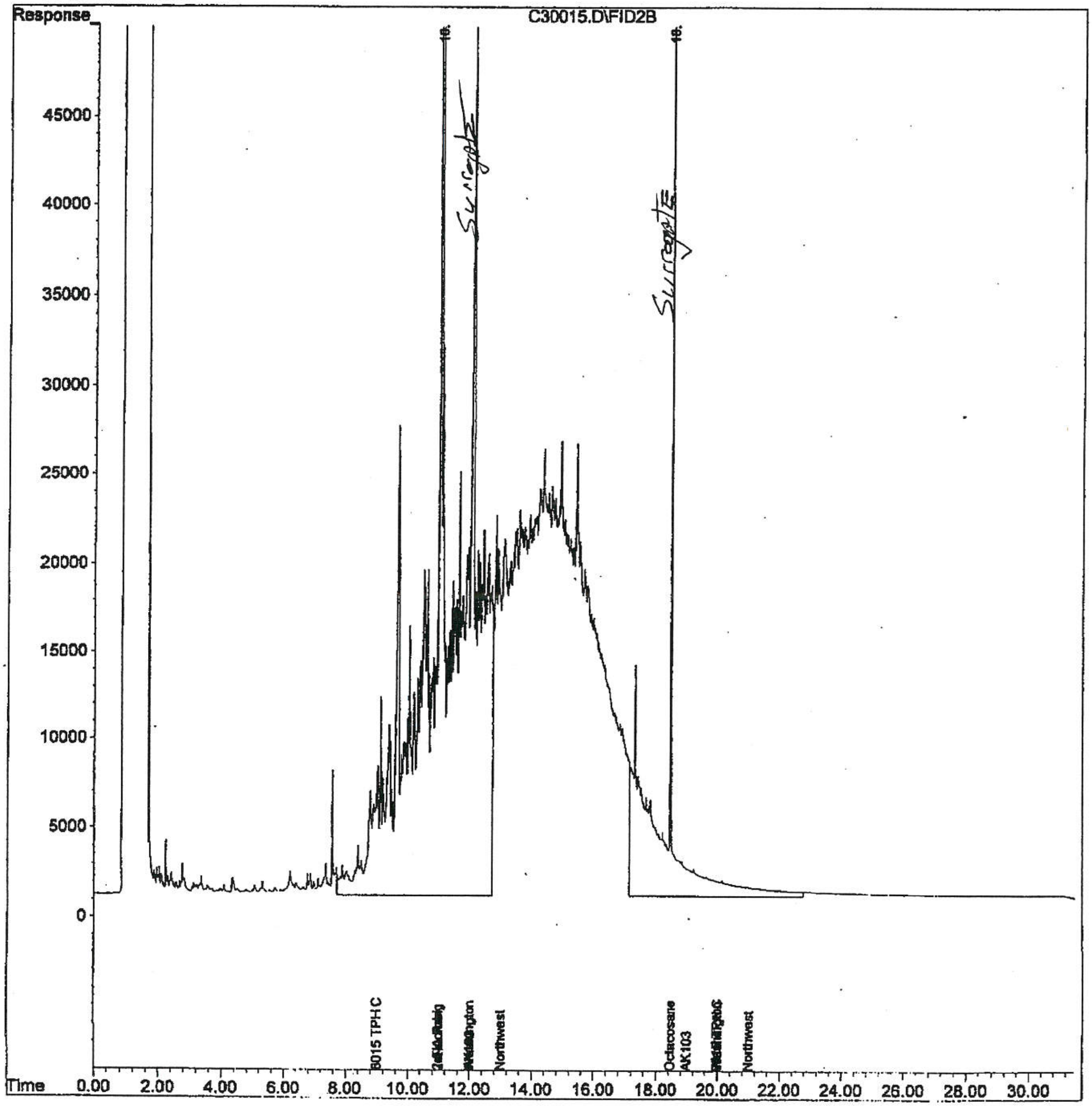


Quantitation Report

Data File : C:\HPCHEM\3\DATA.SEC\033003R\C30015.D Vial: 7
Acq On : 30 Mar 2003 7:01 pm Operator: EDL
Sample : b3c0552-03re1 = CTMW9, 1st Q03 Inst : GC #5
Misc : 1x nwdx sg w Multiplr: 1.00
IntFile : SURR.E
Quant Time: Mar 30 19:33 2003 Quant Results File: C0403T5R.RES

Quant Method : C:\HPCHEM\3\METHODS\C0403T5R.M (Chemstation Integrator)
Title : TPH-D Rear Method
Last Update : Thu Mar 06 09:50:41 2003
Response via : Multiple Level Calibration
DataAcq Meth : C0403T5F.M

Volume Inj. :
Signal Phase :
Signal Info :

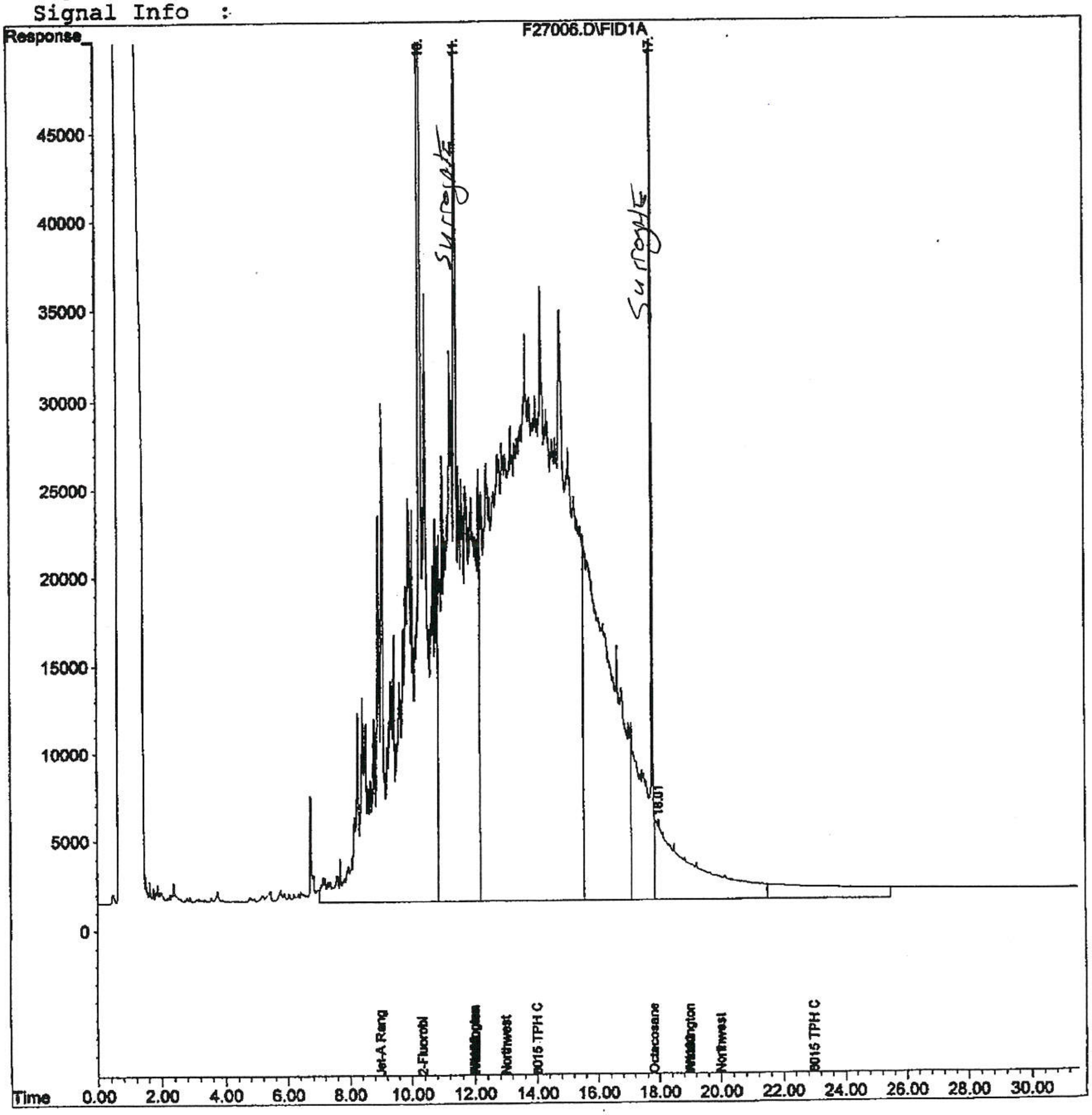


Quantitation Report

```
Data File : C:\HPCHEM\2\DATA\F27006.D                    Vial: 7
Acq On    : 27 Jun 2003   2:35 pm                     Operator: EJE
Sample    : B3F0576-03 = GMW-9, 2nd QO3               Inst    : GC#3
Misc      : 1x w nw sg                                Multiplr: 1.00
IntFile   : SURR.E
Quant Time: Jun 27 15:07 2003  Quant Results File: F1903T3F.RES

Quant Method : C:\HPCHEM\2\METHODS\F1903T3F.M (Chemstation Integrator)
Title        : TPH-D Rear Method
Last Update  : Fri Jun 20 17:35:48 2003
Response via : Multiple Level Calibration
DataAcq Meth : F1903T3F.M

Volume Inj.  :
Signal Phase :
Signal Info  :
```

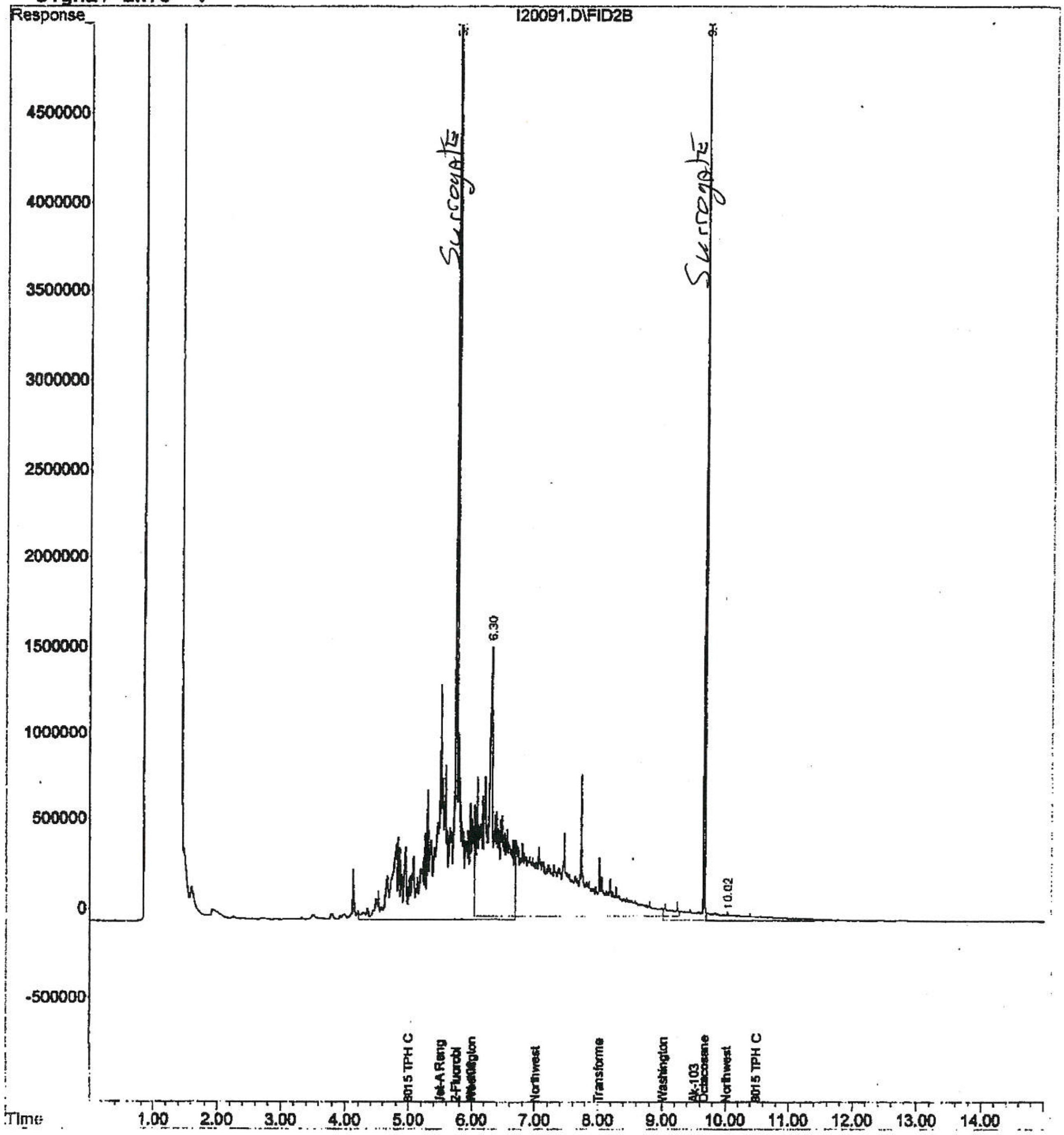


Quantitation Report

Data File : C:\HPCHEM\1\DATA.SEC\I20091.D Vial: 42
Acq On : 9-21-03 13:32:19 Operator: EDL
Sample : b3i0494-03 = CTMW-9, 3@Q03 Inst : GC #9
Misc : w NWsg r1 Multiplr: 1.00
IntFile : SURR.E
Quant Time: Sep 21 13:47 2003 Quant Results File: I1303T9R.RES

Quant Method : C:\HPCHEM\1\METHODS\I1303T9R.M (Chemstation Integrator)
Title : TPH-D Rear
Last Update : Sun Sep 14 14:57:10 2003
Response via : Multiple Level Calibration
DataAcq Meth : I1303T9F.M

Volume Inj. :
Signal Phase :
Signal Info :

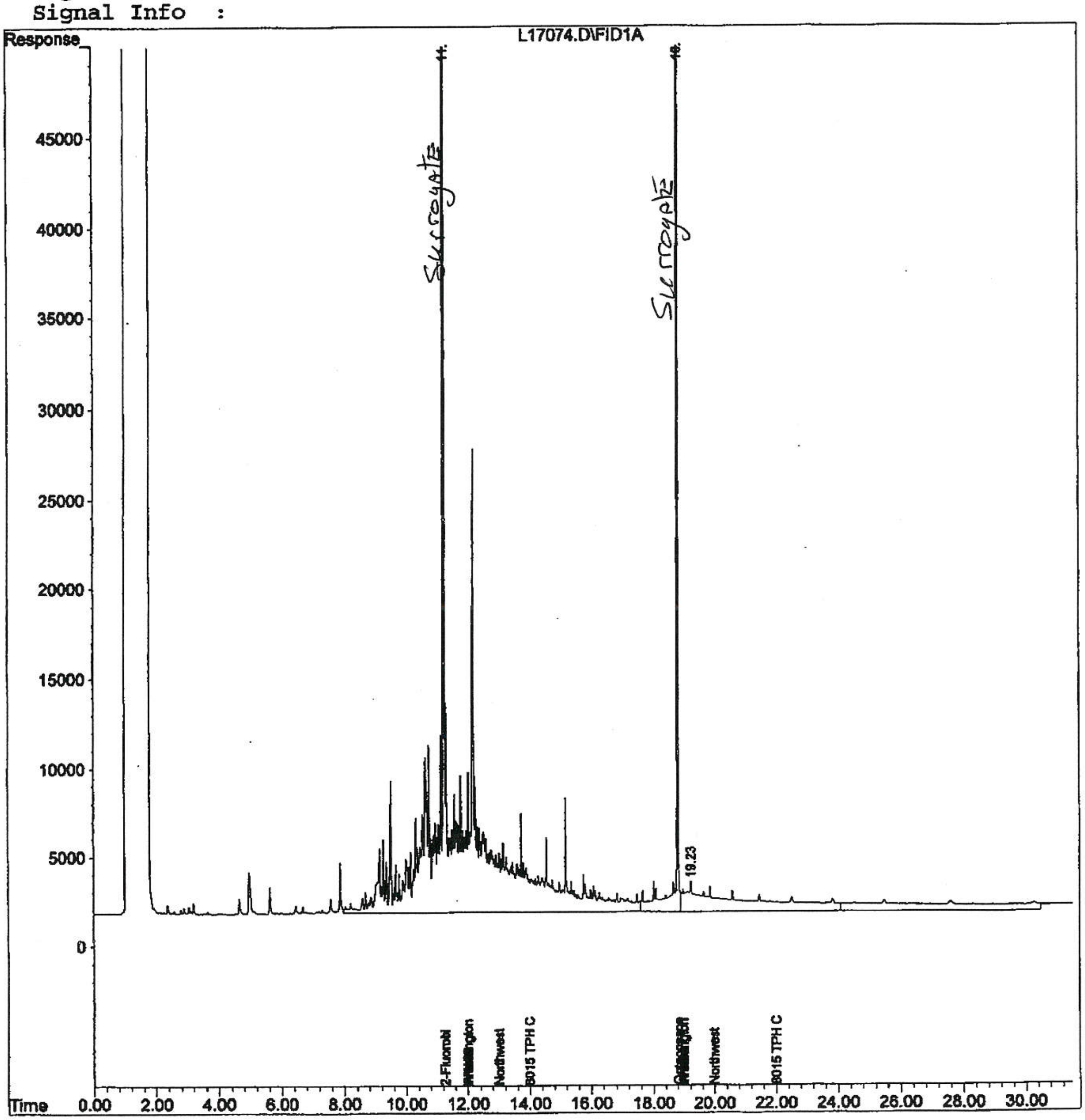


Quantitation Report

Data File : C:\HPCHEM\2\DATA\L17074.D Vial: 47
Acq On : 18 Dec 2003 7:23 am Operator: EJE
Sample : b310484-04 CTMW-9, 4th Q03 Inst : GC#3
Misc : w NWsg Multiplr: 1.00
IntFile : SURR.E
Quant Time: Dec 18 7:55 2003 Quant Results File: K2503T3F.RES

Quant Method : C:\HPCHEM\2\METHODS\K2503T3F.M (Chemstation Integrator)
Title : TPH-D Rear Method
Last Update : Wed Nov 26 09:34:26 2003
Response via : Multiple Level Calibration
DataAcq Meth : K2503T3F.M

Volume Inj. :
Signal Phase :
Signal Info :

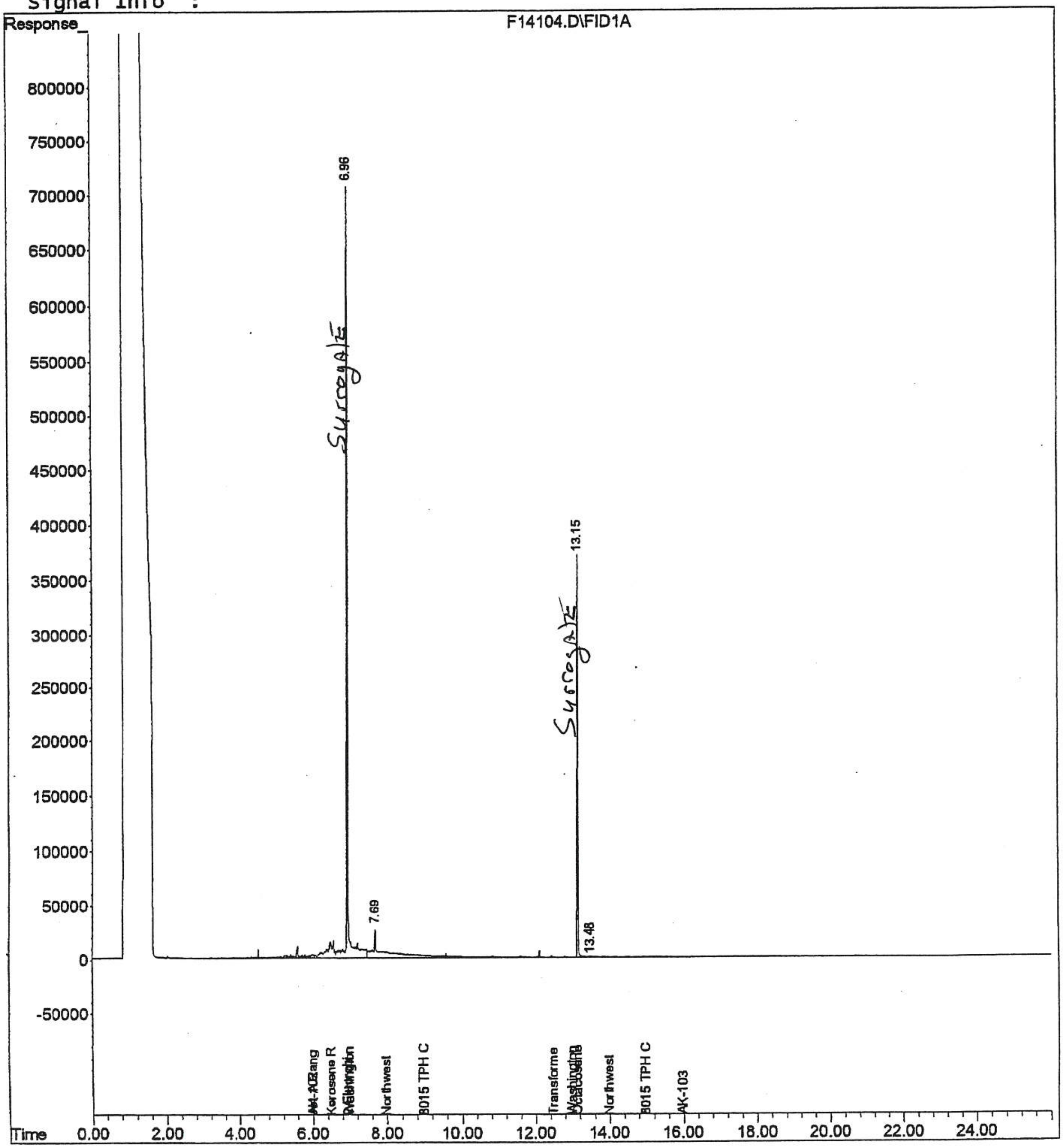


Quantitation Report

Data File : D:\HPCHEM\1\DATA\061404\F14104.D   Vial: 13
Acq On : 15 Jun 2004 2:28 pm   Operator: EDL
Sample : b4f0230-06 = CTMW-9, 2ndQ04   Inst : GC#7
Misc : 1x nwdx sg s rs1   Multiplr: 1.00
IntFile : SURR.E
Quant Time: Jun 15 14:55 2004 Quant Results File: E0604T7F.RES

Quant Method : D:\HPCHEM\1\METHODS\E0604T7F.M (Chemstation Integrator)
Title : GC#7 TPH-Dx Rear Column
Last Update : Mon May 10 10:43:04 2004
Response via : Multiple Level Calibration
DataAcq Meth : E0604T7F.M

Volume Inj. :
Signal Phase :
Signal Info :

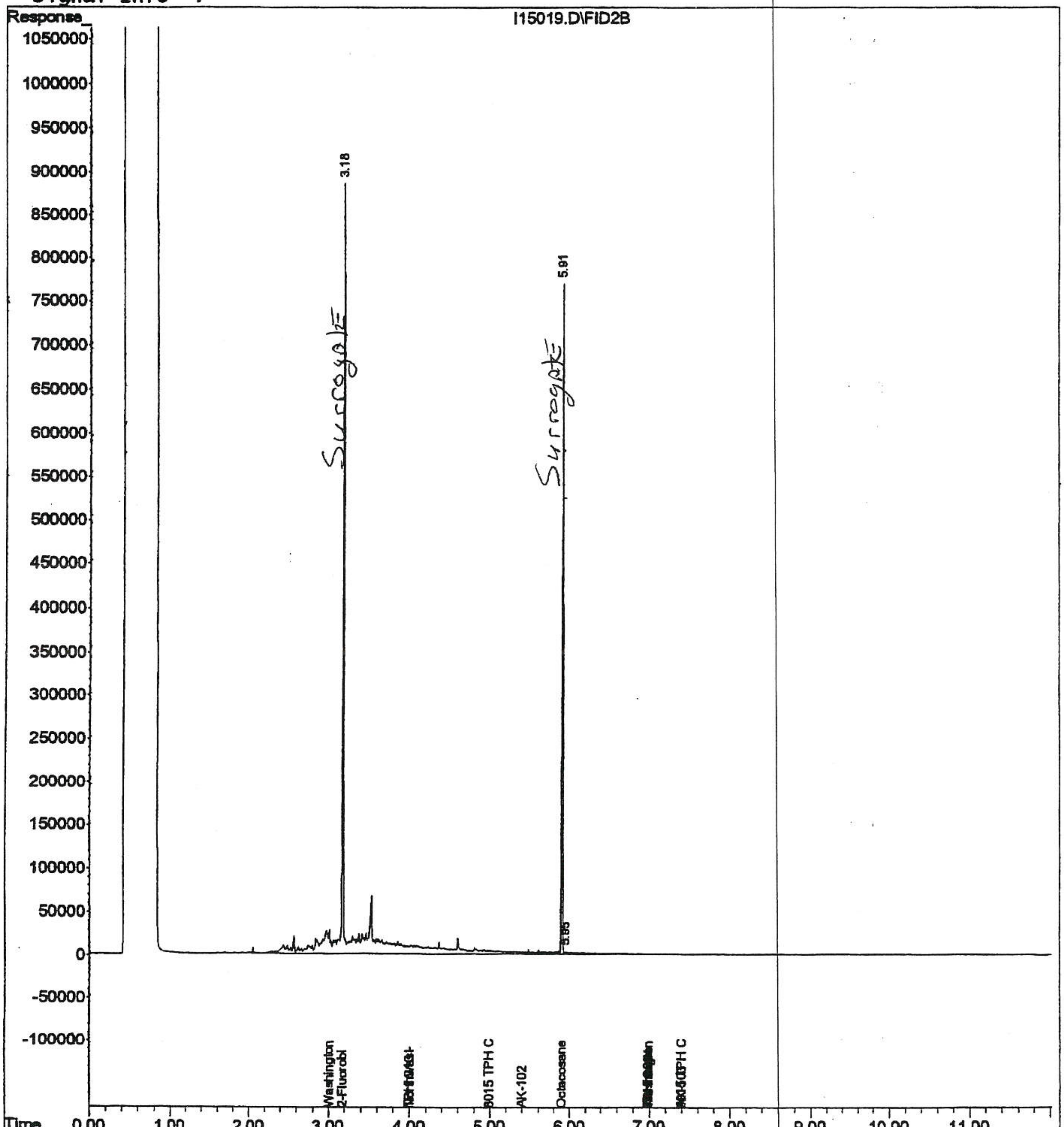


Quantitation Report

Data File : D:\HPCHEM\1\DATA\091504.SEC\I15019.D Vial: 14
Acq On : 15 Sep 2004 9:35 am Operator: GSM
Sample : B4I0180-03 = CTMW-9, 3rd Q04 Inst : GC#7
Misc : 1X NWDX SG W Multiplr: 1.00
IntFile : SURR.E
Quant Time: Sep 15 11:42 2004 Quant Results File: I1404T7R.RES

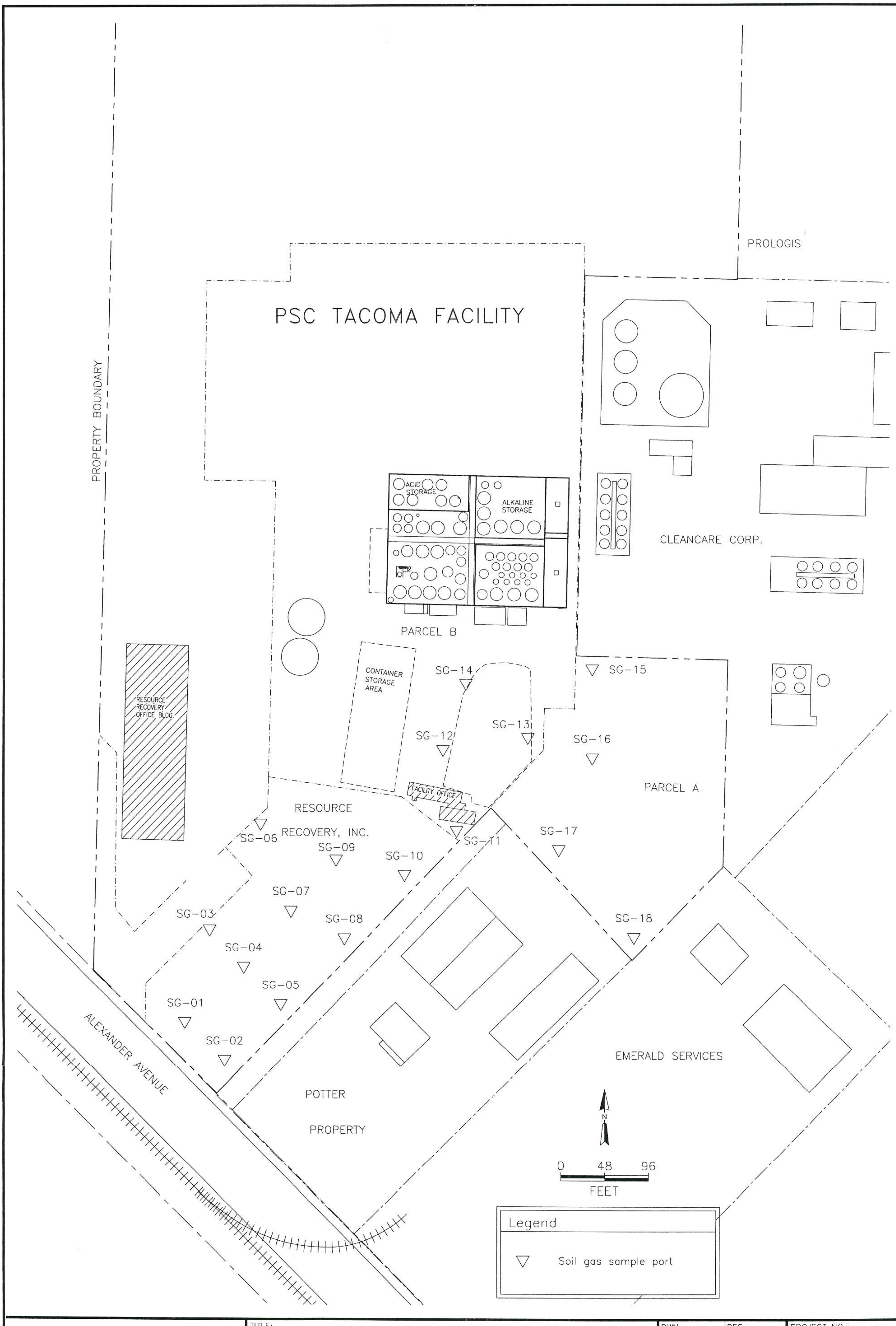
Quant Method : D:\HPCHEM\1\METHODS\I1404T7R.M (Chemstation Integrator)
Title : GC#7 TPH-Dx Rear Column
Last Update : Wed Sep 15 10:34:59 2004
Response via : Multiple Level Calibration
DataAcq Meth : I1404T7F.M

Volume Inj. :
Signal Phase :
Signal Info :



4-8

Appendix J
1993 Soil Vapor Study Results
(2005 PSC Remedial Investigation)



PSC	TITLE: Soil Gas Sample Locations Tacoma Facility	DWN: dtb CHKD: DATE: 5/31/02	DES.: APPD: REV.:	PROJECT NO.: RI 2002 FIGURE NO.: 4-5

Appendix 4F - Data Summary Table
Matrix Type: Soil-Gas
Method Grouping: Volatile Organics - Part 1

Site ID		SG-02				SG-03				SG-04				SG-05				SG-06				SG-07				SG-08			
Sample ID		SG-02				SG-03				SG-04				SG-05				SG-06				SG-07				SG-08			
Sample Date		10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993			
Depth Range in Ft.		-				-				-				-				-				-				-			
Lab		Burli				Burli				Burli				Burli				Burli				Burli				Burli			
Sample Type		☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC			
Parameter	**A<-MTCA CUL->B**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**
1,1,1,2-Tetrachloroethan																													
1,1,1-Trichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1,2,2-Tetrachloroethan		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1,2-Trichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1,2-Trichlorotrifluoroet		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1-Dichloro-1,2,2-triflu																													
1,1-Dichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1-Dichloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1-Dichloropropene																													
1,2,3-Trichlorobenzene																													
1,2,3-Trichloropropane																													
1,2,4-Trichlorobenzene																													
1,2-dibromo-ethane																													
1,2-Dichlorobenzene		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
1,2-Dichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,2-Dichloroethene																													
1,2-Dichloropropane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,3,5-trimethylbenzene																													
1,3-Dichlorobenzene		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
1,3-Dichloropropane																													
1,4-Dichlorobenzene		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
1,4-Dioxane																													
1-methylethylbenzene																													
2,2-Dichloropropane																													
2-Butanone		10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l
2-Chloroethylvinyl ether		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
2-Chlorotoluene																													
2-Hexanone		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
3-Methylpentane																													
4-Chlorotoluene																													
4-Methyl-2-pentanone		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l

Notes: CUL = Cleanup Level Ql = Lab Qualifier Qv = Validation Qualifer U = Unit of Measure

Note - Results reported in ug/L equate ug/m3 utilizing a 1:1000 conversion (i.e. 1 ug/L = 1000 ug/m3) - *note added 1/29/19*

Appendix 4F - Data Summary Table
Matrix Type: Soil-Gas
Method Grouping: Volatile Organics - Part 1

		SG-10				SG-11				SG-12				SG-13				SG-14				SG-15				SG-16			
Site ID		SG-10				SG-11				SG-12				SG-13				SG-14				SG-15				SG-16			
Sample ID		SG-10				SG-11				SG-12				SG-13				SG-14				SG-15				SG-16			
Sample Date		10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993			
Depth Range in Ft.		-				-				-				-				-				-				-			
Lab		Burli				Burli				Burli				Burli				Burli				Burli				Burli			
Sample Type		☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC			
Parameter	**A<-MTCA CUL->B**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**
1,1,1,2-Tetrachloroethan																													
1,1,1-Trichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1,2,2-Tetrachloroethan		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1,2-Trichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1,2-Trichlorotrifluoroet		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1-Dichloro-1,2,2-triflu																													
1,1-Dichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	3			ug/l	2	U		ug/l	2	U		ug/l
1,1-Dichloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1-Dichloropropene																													
1,2,3-Trichlorobenzene																													
1,2,3-Trichloropropane																													
1,2,4-Trichlorobenzene																													
1,2-dibromo-ethane																													
1,2-Dichlorobenzene		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
1,2-Dichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,2-Dichloroethene																													
1,2-Dichloropropane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,3,5-trimethylbenzene																													
1,3-Dichlorobenzene		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
1,3-Dichloropropane																													
1,4-Dichlorobenzene		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
1,4-Dioxane																													
1-methylethylbenzene																													
2,2-Dichloropropane																													
2-Butanone		10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l
2-Chloroethylvinyl ether		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
2-Chlorotoluene																													
2-Hexanone		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
3-Methylpentane																													
4-Chlorotoluene																													
4-Methyl-2-pentanone		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l

Notes: CUL = Cleanup Level Ql = Lab Qualifier Qv = Validation Qualifer U = Unit of Measure

Appendix 4F - Data Summary Table
Matrix Type: Soil-Gas
Method Grouping: Volatile Organics - Part 1

Site ID	SG-18	SG-19	SG-20	SG-21	SG-22	SG-23
Sample ID	SG-18	SG-19	SG-20	SG-21	SG-22	SG-23
Sample Date	10/21/1993	10/21/1993	10/21/1993	10/21/1993	10/21/1993	10/21/1993
Depth Range in Ft.	-	-	-	-	-	-
Lab	Burli	Burli	Burli	Burli	Burli	Burli
Sample Type	☑ RI Sample ☐ QC	☑ RI Sample ☑ QC	☑ RI Sample ☑ QC	☑ RI Sample ☑ QC	☑ RI Sample ☑ QC	☑ RI Sample ☑ QC

Parameter	**A<-MTCA CUL->B**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**
1,1,1,2-Tetrachloroethan																									
1,1,1-Trichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1,2,2-Tetrachloroethan		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1,2-Trichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1,2-Trichlorotrifluoroet		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1-Dichloro-1,2,2-triflu																									
1,1-Dichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1-Dichloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,1-Dichloropropene																									
1,2,3-Trichlorobenzene																									
1,2,3-Trichloropropane																									
1,2,4-Trichlorobenzene																									
1,2-dibromo-ethane																									
1,2-Dichlorobenzene		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
1,2-Dichloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,2-Dichloroethene																									
1,2-Dichloropropane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
1,3,5-trimethylbenzene																									
1,3-Dichlorobenzene		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
1,3-Dichloropropane																									
1,4-Dichlorobenzene		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
1,4-Dioxane																									
1-methylethylbenzene																									
2,2-Dichloropropane																									
2-Butanone		10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l
2-Chloroethylvinyl ether		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
2-Chlorotoluene																									
2-Hexanone		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
3-Methylpentane																									
4-Chlorotoluene																									
4-Methyl-2-pentanone		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l

Notes: CUL = Cleanup Level Ql = Lab Qualifier Qv = Validation Qualifer U = Unit of Measure

Appendix 4F - Data Summary Table
Matrix Type: Soil-Gas
Method Grouping: Volatile Organics - Part 2

Site ID	SG-02	SG-03	SG-04	SG-05	SG-06	SG-07	SG-08
Sample ID	SG-02	SG-03	SG-04	SG-05	SG-06	SG-07	SG-08
Sample Date	10/21/1993	10/21/1993	10/21/1993	10/21/1993	10/21/1993	10/21/1993	10/21/1993
Depth Range in Ft.	-	-	-	-	-	-	-
Lab	Burli	Burli	Burli	Burli	Burli	Burli	Burli
Sample Type	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC

Parameter	A<-MTCA CUL->B	SG-02 Result	Ql	Qv	U	SG-03 Result	Ql	Qv	U	SG-04 Result	Ql	Qv	U	SG-05 Result	Ql	Qv	U	SG-06 Result	Ql	Qv	U	SG-07 Result	Ql	Qv	U	SG-08 Result	Ql	Qv	U
Acetamidofluorene																													
Acetone		10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l
Acetonitrile																													
Acrolein																													
Acrylonitrile																													
Allyl chloride																													
Benzene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Benzene, 1,2,4-trimethyl																													
Bromobenzene																													
Bromodichloromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Bromoform		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Bromomethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Carbon disulfide		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Carbon tetrachloride		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chlorobenzene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chlorobromomethane																													
Chloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chloroform		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chloromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
cis-1,3-Dichloropropene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
cis12Dichloroethylene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
cresylic acid																													
cyclohexanone																													
Dibromochloromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Dibromochloropropane																													
Dichlorodifluoromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Diethyl ether																													
Ethane																													
ethyl acetate																													
Ethyl methacrylate																													
Ethyl t-butyl ether																													
Ethylbenzene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Ethylene																													
Heptan-2-one																													
Hexachlorobutadiene																													
Iodomethane																													
Isobutyl alcohol																													

Notes: CUL = Cleanup Level Ql = Lab Qualifier Qv = Validation Qualifer U = Unit of Measure

Appendix 4F - Data Summary Table
Matrix Type: Soil-Gas
Method Grouping: Volatile Organics - Part 2

Site ID		SG-10				SG-11				SG-12				SG-13				SG-14				SG-15				SG-16			
Sample ID		SG-10				SG-11				SG-12				SG-13				SG-14				SG-15				SG-16			
Sample Date		10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993			
Depth Range in Ft.		-				-				-				-				-				-				-			
Lab		Burli				Burli				Burli				Burli				Burli				Burli				Burli			
Sample Type		☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC			
Parameter	**A<-MTCA CUL->B**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**
Acetamidofluorene																													
Acetone		10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l
Acetonitrile																													
Acrolein																													
Acrylonitrile																													
Allyl chloride																													
Benzene		2	U		ug/l	21			ug/l	2	U		ug/l	2	U		ug/l	11			ug/l	3			ug/l	2	U		ug/l
Benzene, 1,2,4-trimethyl																													
Bromobenzene																													
Bromodichloromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Bromoform		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Bromomethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Carbon disulfide		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Carbon tetrachloride		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chlorobenzene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chlorobromomethane																													
Chloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chloroform		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chloromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
cis-1,3-Dichloropropene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
cis12Dichloroethylene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
cresylic acid																													
cyclohexanone																													
Dibromochloromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Dibromochloropropane																													
Dichlorodifluoromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	6			ug/l	2	U		ug/l	2	U		ug/l
Diethyl ether																													
Ethane																													
ethyl acetate																													
Ethyl methacrylate																													
Ethyl t-butyl ether																													
Ethylbenzene		3			ug/l	8			ug/l	2	U		ug/l	2	U		ug/l	11			ug/l	3			ug/l	2	U		ug/l
Ethylene																													
Heptan-2-one																													
Hexachlorobutadiene																													
Iodomethane																													
Isobutyl alcohol																													

Notes: CUL = Cleanup Level Ql = Lab Qualifier Qv = Validation Qualifer U = Unit of Measure

Appendix 4F - Data Summary Table
Matrix Type: Soil-Gas
Method Grouping: Volatile Organics - Part 2

Site ID	SG-18	SG-19	SG-20	SG-21	SG-22	SG-23
Sample ID	SG-18	SG-19	SG-20	SG-21	SG-22	SG-23
Sample Date	10/21/1993	10/21/1993	10/21/1993	10/21/1993	10/21/1993	10/21/1993
Depth Range in Ft.	-	-	-	-	-	-
Lab	Burli	Burli	Burli	Burli	Burli	Burli
Sample Type	☑ RI Sample ☐ QC	☑ RI Sample ☑ QC	☑ RI Sample ☑ QC	☑ RI Sample ☑ QC	☑ RI Sample ☑ QC	☑ RI Sample ☑ QC

Parameter	**A<-MTCA CUL->B**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**
Acetamidofluorene																									
Acetone		10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l	10	U		ug/l
Acetonitrile																									
Acrolein																									
Acrylonitrile																									
Allyl chloride																									
Benzene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Benzene, 1,2,4-trimethyl																									
Bromobenzene																									
Bromodichloromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Bromoform		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Bromomethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Carbon disulfide		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Carbon tetrachloride		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chlorobenzene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chlorobromomethane																									
Chloroethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chloroform		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Chloromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
cis-1,3-Dichloropropene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
cis12Dichloroethylene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
cresylic acid																									
cyclohexanone																									
Dibromochloromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Dibromochloropropane																									
Dichlorodifluoromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Diethyl ether																									
Ethane																									
ethyl acetate																									
Ethyl methacrylate																									
Ethyl t-butyl ether																									
Ethylbenzene		2	U		ug/l	2	U		ug/l	4			ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Ethylene																									
Heptan-2-one																									
Hexachlorobutadiene																									
Iodomethane																									
Isobutyl alcohol																									

Notes: CUL = Cleanup Level Ql = Lab Qualifier Qv = Validation Qualifer U = Unit of Measure

Appendix 4F - Data Summary Table
Matrix Type: Soil-Gas
Method Grouping: Volatile Organics - Part 3

Site ID		SG-02				SG-03				SG-04				SG-05				SG-06				SG-07				SG-08			
Sample ID		SG-02				SG-03				SG-04				SG-05				SG-06				SG-07				SG-08			
Sample Date		10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993			
Depth Range in Ft.		-				-				-				-				-				-				-			
Lab		Burli				Burli				Burli				Burli				Burli				Burli				Burli			
Sample Type		☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC				☑ RI Sample ☐ QC			
Parameter	**A<-MTCA CUL->B**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**
Isopropyl Ether																													
m,p-Xylene																													
m-Xylene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Methacrylonitrile																													
Methane																													
Methanol																													
Methyl tert-amyl ether																													
Methyl-tert-butyl-ether																													
methylcyclopentane																													
Methylene bromide																													
Methylene chloride		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
n-Butyl Alcohol																													
n-Butylbenzene																													
n-Propylbenzene																													
Naphthalene		12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l
o-Xylene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
p-Isopropyltoluene																													
p-Xylene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Pyridine																													
sec-Butylbenzene																													
sec-Dichloropropane																													
Styrene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
tert-Butylbenzene																													
Tetrachloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Toluene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Total Dichlorobenzenes																													
trans-1,3-Dichloroprope		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
trans-1,4-Dichloro-2-but																													
trans12Dichloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Trichloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Trichlorofluoromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Vinyl acetate		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Vinyl chloride		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l

Notes: CUL = Cleanup Level Ql = Lab Qualifier Qv = Validation Qualifer U = Unit of Measure

Appendix 4F - Data Summary Table
Matrix Type: Soil-Gas
Method Grouping: Volatile Organics - Part 3

Site ID	SG-10	SG-11	SG-12	SG-13	SG-14	SG-15	SG-16
Sample ID	SG-10	SG-11	SG-12	SG-13	SG-14	SG-15	SG-16
Sample Date	10/21/1993	10/21/1993	10/21/1993	10/21/1993	10/21/1993	10/21/1993	10/21/1993
Depth Range in Ft.	-	-	-	-	-	-	-
Lab	Burli	Burli	Burli	Burli	Burli	Burli	Burli
Sample Type	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC	☑ RI Sample ☐ QC

Parameter	A<-MTCA CUL->B	SG-10 Result	Ql	Qv	U	SG-11 Result	Ql	Qv	U	SG-12 Result	Ql	Qv	U	SG-13 Result	Ql	Qv	U	SG-14 Result	Ql	Qv	U	SG-15 Result	Ql	Qv	U	SG-16 Result	Ql	Qv	U
Isopropyl Ether																													
m,p-Xylene																													
m-Xylene		3			ug/l	10			ug/l	2	U		ug/l	2	U		ug/l	20			ug/l	2	U		ug/l	2	U		ug/l
Methacrylonitrile																													
Methane																													
Methanol																													
Methyl tert-amyl ether																													
Methyl-tert-butyl-ether																													
methylcyclopentane																													
Methylene bromide																													
Methylene chloride		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
n-Butyl Alcohol																													
n-Butylbenzene																													
n-Propylbenzene																													
Naphthalene		12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l
o-Xylene		2	U		ug/l	5			ug/l	2	U		ug/l	2	U		ug/l	21			ug/l	2	U		ug/l	2	U		ug/l
p-Isopropyltoluene																													
p-Xylene		3			ug/l	10			ug/l	2	U		ug/l	2	U		ug/l	20			ug/l	2	U		ug/l	2	U		ug/l
Pyridine																													
sec-Butylbenzene																													
sec-Dichloropropane																													
Styrene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
tert-Butylbenzene																													
Tetrachloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Toluene		2	U		ug/l	14			ug/l	5			ug/l	2	U		ug/l	110			ug/l	3			ug/l	2	U		ug/l
Total Dichlorobenzenes																													
trans-1,3-Dichloroprope		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
trans-1,4-Dichloro-2-but																													
trans12Dichloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Trichloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Trichlorofluoromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Vinyl acetate		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Vinyl chloride		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l

Notes: CUL = Cleanup Level Ql = Lab Qualifier Qv = Validation Qualifer U = Unit of Measure

Appendix 4F - Data Summary Table
Matrix Type: Soil-Gas
Method Grouping: Volatile Organics - Part 3

Site ID		SG-18				SG-19				SG-20				SG-21				SG-22				SG-23			
Sample ID		SG-18				SG-19				SG-20				SG-21				SG-22				SG-23			
Sample Date		10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993				10/21/1993			
Depth Range in Ft.		-				-				-				-				-				-			
Lab		Burli				Burli				Burli				Burli				Burli				Burli			
Sample Type		☑ RI Sample ☐ QC				☑ RI Sample ☑ QC				☑ RI Sample ☑ QC				☑ RI Sample ☑ QC				☑ RI Sample ☑ QC				☑ RI Sample ☑ QC			
Parameter	**A<-MTCA CUL->B**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**	**Result**	**Ql**	**Qv**	**U**
Isopropyl Ether																									
m,p-Xylene																									
m-Xylene		2	U		ug/l	2	U		ug/l	4			ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Methacrylonitrile																									
Methane																									
Methanol																									
Methyl tert-amyl ether																									
Methyl-tert-butyl-ether																									
methylcyclopentane																									
Methylene bromide																									
Methylene chloride		5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l	5	U		ug/l
n-Butyl Alcohol																									
n-Butylbenzene																									
n-Propylbenzene																									
Naphthalene		12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l	12	U		ug/l
o-Xylene		2	U		ug/l	2	U		ug/l	2			ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
p-Isopropyltoluene																									
p-Xylene		2	U		ug/l	2	U		ug/l	4			ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Pyridine																									
sec-Butylbenzene																									
sec-Dichloropropane																									
Styrene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
tert-Butylbenzene																									
Tetrachloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Toluene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Total Dichlorobenzenes																									
trans-1,3-Dichloroprope		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
trans-1,4-Dichloro-2-but																									
trans12Dichloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Trichloroethene		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Trichlorofluoromethane		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Vinyl acetate		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l
Vinyl chloride		2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l	2	U		ug/l

Notes: CUL = Cleanup Level Ql = Lab Qualifier Qv = Validation Qualifer U = Unit of Measure

Appendix J
Sampling and Analysis Plan

Revised Data Gaps Sampling and Analysis Plan

TAYLOR WAY AND ALEXANDER AVENUE FILL AREA SITE

TACOMA, WASHINGTON

January 29, 2019

Prepared by:

DALTON, OLMSTED, & FUGLEVAND
10827 NE 68th St., Suite B
Kirkland, Washington 98033

Prepared for:

GENERAL METALS
GLENN SPRINGS HOLDINGS
PORT OF TACOMA
STERICYCLE ENVIRONMENTAL SOLUTIONS

Table of Contents

FIGURES

TABLES

1.0 INTRODUCTION

Dalton, Olmsted, and Fuglevand, Inc. (DOF), has prepared this Revised Sampling and Analysis Plan (SAP) for the Taylor Way and Alexander Avenue Fill Area (TWAAFA) Site in support of the 2019 Revised Data Gaps Work Plan (Figure 1).

This SAP describes the data gaps activities to be performed and the methods for data collection.

1.1 Investigation Overview

There are several data gaps related to completing a comprehensive Remedial Investigation for the TWAAFA site since the site involves several properties investigated by different parties at different periods of time. This data gaps identified are:

- **Aboveground Site Conditions Documentation** – Mapping of above ground structures, paved areas (and their condition), potentially pervious areas, stormwater flow patterns and control features, and general topography.
- **Well Usability Survey** – Field evaluation of existing wells on the site to determine which wells remain in good condition, which remain but require rehabilitation, and which should be recommended for abandonment (or have already been abandoned). Ponded stormwater may require management in order to assess some wells on the CleanCare property. The field team will coordinate with Ecology prior to performing the inspection in order to develop an approach to draining stormwater to facilitate the inspection and future sampling. Survey information will also be reviewed for wells slated to be used for future monitoring to evaluate any changes due to construction or use of different datum.
- **Hylebos Marsh Characterization**
  - Completion of 4 direct push borings to investigate presence and type of fill materials in this area (Figure 2). Borings would be visually logged continuously and completed to the top of the silt layer, with field screening via a photoionization detector for VOCs. Soil and groundwater samples will be collected for laboratory analyses.
  - Completion of 2 deep aquifer borings for groundwater sampling and subsequent well installation near locations SB-1 and SB-4 (Figure 3) to improve the coverage of deep aquifer groundwater elevation data.
  - Abandonment of wells that may be screened in the silt layer – SB-1, SB-3, and SB-4.
- **Parcel A Assessment** – Completion of 1 direct push or hand auger sample in the area of the former sample SEA-14 at a similar depth (approximately 4.7 feet bgs) to investigate presence and type of fill materials in this area and current residual VOC soil concentrations (Figure 2).
- **Monitoring Well Network** – Installation of 3 new shallow and up to 5 new deep wells for water level and groundwater monitoring, in addition to the well replacements to be completed on the Western Port of Tacoma (Hylebos Marsh) property.
  - Installation of 3 new shallow wells along the northern edge of the 1514 Taylor Way property (Figure 2).

- Completion of 5 deep aquifer borings on 1514 Taylor Way, Stericycle and CleanCare properties for groundwater collection at multiple depths with possible deep wells to be installed at each location pending receipt of results and discussion with Ecology (Figure 3).
- Replacement of several wells on the western Port of Tacoma property as described in the Hylebos Marsh section above.

- **Deep Aquifer Characterization** - Existing wells at the TWAAFA site are only screened as deep as the shallowest portion of the deep aquifer; additional characterization of the deep aquifer at greater depths will be performed to determine screen depths for new deep aquifer wells. Depth-discrete groundwater samples will be collected in higher transmissive water-bearing units at approximately 10-foot intervals and/or at major lithology changes to a depth of 60 feet. It is estimated that a minimum of three-to-four depth-discrete groundwater samples will be collected at each location. Soil samples will be collected from fine-grained units for possible VOCs analysis.
- **Groundwater Monitoring –** Quarterly monitoring of wells on the TWAAFA site, for an initial period of one year.
- **Indoor Air Assessment** – Perform a vapor intrusion assessment for the full site, consistent with Ecology's 2018 updated Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action. The above ground conditions information will be used in the first Tier 1 stage of vapor intrusion assessment to identify specific areas of the site for Tier 2 assessment. Tier 2 assessments are anticipated to include sampling in select portions of the site (as has been conducted on portions of the site already) and would include collection of sub-slab, indoor air, ambient air, and/or methane samples from selected Site buildings not previously evaluated for vapor intrusion risk. Differential pressure measurements would be collected as part of methane investigation. Sampling will also include the assessment of short-term TCE exposure concentrations per recent revisions to Ecology guidance regarding this exposure concern. The initial assessment will include proposed sampling locations and methods to be used. Separately, a TWAAFA site indoor air assessment protocol to be used at the site in the future will also be produced. The protocol will provide predictability in approach for site owners and enable remedial designers to consistently investigate and address the vapor pathway issue as development changes at the site.

2.0 WELL SURVEY & SITE CONDITIONS MAPPING

A field evaluation will be performed to document existing conditions of aboveground structures at the TWAAFA site. GPS and hand measurements will be used to verify existing mapped structures and update maps with previously unmapped and/or new structures. The results of the field evaluation will be used to identify features that may require formal survey for northing, easting, and elevation, such as previously unverified wells or piezometers.

The following details will be documented during field observation and recorded on maps as well as with supporting descriptions of the individual features.

- Existing buildings (location, size, general condition, structure type and use)
- Catch basins and manholes
- Impervious areas (type of paving and condition)
- Potentially Pervious Areas (stormwater infiltration areas -natural or engineered)
- Outfalls
- Paved areas (concrete versus asphalt)
- Utility vaults
- Other aboveground structures such as tanks, containment areas, floor/roof drains, and fences
- Obviously filled or elevated piles of soil/gravel
- Monitoring wells and piezometers – A full inspection of all wells found will be conducted, consistent with the methodology for well inspection outlined in the Groundwater Monitoring Plan and including measurement of total well depth if records for measure in the last five years old are not found.

The following equipment is necessary for the survey.

- Hand-held GPS
- Measuring wheel and hand held tape
- Base maps showing known features
- Camera
- Well keys (if available)
- Wrench set for opening flush well monuments
- Catch basin grate hook
- Well inspection tools including tools to bail surface water in well monuments, weighted tapes for measuring total well depth, and decontamination equipment consistent with the Groundwater Monitoring Plan

Field personnel will contact each property owner prior to conducting the field survey and arrange agreeable dates and times for safe inspection. Individual health and safety concerns for each property will be evaluated and site-specific health and safety plans developed prior to implementation. Ponded stormwater may require management in order to assess some wells on the CleanCare property. The field team will coordinate with Ecology prior to performing the inspection in order to develop an approach to draining stormwater to facilitate the inspection and future sampling.

3.0 DRILLING AND WELL INSTALLATION

Procedures for soil borings and monitoring well installation are described below. Samples to be collected are listed in Table 1.

Subsurface utilities will be identified prior to the start of any subsurface drilling. Field personnel will mark the proposed drilling locations on the ground. The utilities underground location center (One Call) will be contacted, and a private utility locate will be conducted within the work areas to at least 20 feet beyond the limits of subsurface work, where possible. The intended drilling locations might be modified in the field if they interfere or appear to interfere with subsurface utilities.

Once mobilized to the site a tailgate health and safety meeting will be conducted, outlining all of the anticipated hazards and hazard mitigation with all workers. Work zone, traffic control components, and spill prevention measures will be set up.

3.1 Shallow Soil Borings and Groundwater Samples

Five soil borings are proposed for the TWAAFA site to investigate the presence and type of fill material and possible shallow soil and/or groundwater contamination. Borings TWA-SB1 through TWA-SB4 will be drilled using direct push drilling equipment. Boring TWA-SB5 will be drilled using direct push or hand auger sampling methods. Each boring will be continuously logged to record lithology and screen soil cores for volatile compounds using a photoionization detector. Field personnel will photograph soil cores for additional documentation, noting location and depths. Borings TWA-SB1 through TWA-SB4 will be advanced to the top of the silt layer and will not penetrate the silt (approximately 15 feet or shallower). Borings will be conducted by a licensed drilling contractor in the state of Washington. Boring TWA-SB5 will be advanced to approximately 5 feet bgs. Oversight of drilling activities will be conducted by an environmental professional familiar with environmental sampling.

Soil samples will be collected at the depths noted in Table 1. Additional samples will be collected if one of the waste fill materials is encountered or there are field indications of volatile contaminants or sheens.

Shallow groundwater samples will be collected at borings TWA-SB1 through TWA-SB4. Groundwater samples will be collected from temporary wells constructed using 4 to 5 feet long, 0.010-inch slot size screen made of new disposable PVC or decontaminated stainless-steel screen with retractable protective sheath driven via direct push methods. Low-flow purging and sampling methods using a peristaltic pump and disposable polyethylene tubing will be conducted. Sampling methods will otherwise follow the methods described in the Standard Operating Procedure included in the TWAAFA Groundwater Monitoring Plan.

Borings will be backfilled with bentonite and the surface repaired to match existing conditions.

3.2 Deep Soil Borings and Groundwater Samples

Seven locations are proposed for groundwater sampling beneath the silt unit to characterize the deep aquifer at multiple depths. The approach to deep aquifer sampling locations will be:

- Use conductor cased drilling methods to seal off and sample below the silt layer at each planned deep aquifer boring to a depth of approximately 60 feet bgs.
- Collect depth-discrete groundwater samples in higher transmissive water-bearing units at approximately 10-foot intervals and/or at major lithology changes. It is estimated that a minimum of three-to-four depth-discrete groundwater samples will be collected at each location. Samples will be collected via a temporary screen, using low flow purging and sampling methods as is done for the shallow groundwater samples.
- Soil samples will be collected from fine-grained units encountered beneath the silt unit for possible VOCs analysis. Samples will be analyzed if VOCs are detected in groundwater samples collected from the same boring at concentrations exceeding screening levels.

Results of deep aquifer sampling will be shared with Ecology and used to determine final proposed new deep well completion location, depths, and screen intervals.

3.3 Well Installation

Three new shallow wells and up to seven new deep are proposed for installation at the TWAAFA site. Boreholes for the groundwater monitoring wells will be drilled using hollow-stem auger or sonic drilling equipment.

Each shallow boring will be continuously logged to record lithology and determine appropriate screen depth. Deep well boring locations will be logged during the characterization step described in Section 3.2; screened depths will be pre-determined prior to well drilling at these locations.

Monitoring wells will be constructed by a licensed drilling contractor in the state of Washington, in accordance with the Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC). Oversight of drilling and well installation activities will be conducted by an environmental professional familiar with environmental sampling and construction of resource protection wells.

The monitoring wells will be constructed with 2-inch-diameter, flush-threaded, Schedule 40 PVC pipe. The shallow wells will be constructed with 5-ft screens set at a depth to intersect the groundwater table (anticipated between 5 to 9 ft bgs) and be screened above the silt layer. The deep wells will be constructed using a conductor cased method to reduce the chance for cross-contamination above and below the silt layer. Deep wells will be screened below the silt layer at depths established based on the results of the deep aquifer characterization samples and approved by Ecology.

Well screens will be constructed of a 0.010-inch machine-slotted casing. A filter pack material consisting of pre-washed, pre-sized number 2/12 silica sand (or similar) will be placed from the bottom of the well to approximately one to two feet above the top of the screen. Filter pack material will be placed slowly and carefully to avoid bridging of material. A bentonite seal will be placed above the filter sand pack material to within about 3 feet of ground surface. Bentonite will be used to backfill the boring to the subgrade for placement of the protective cover. The wells will be completed with flush-mounted or above-ground protective casings (with bollards), depending on the surrounding structures and grade.

The well names and the identification numbers assigned by Ecology will be marked on the well identification tags supplied by Ecology and will be attached to each well casing following well installation.

3.3 Well Development

The monitoring wells will be developed after construction to remove formation material from the well borehole and the filter pack prior to groundwater level measurement and sampling. Development will be conducted consistent with Stericycle's previously approved SOP 121, included in the Groundwater Monitoring Plan.

3.4 Equipment Decontamination

Drilling equipment such as augers and split spoons will be cleaned prior to use and in between drilling locations to prevent cross-contamination. All non-dedicated equipment will be decontaminated consistent with Stericycle's previously approved SOP 200, included in the Groundwater Monitoring Plan.

3.5 Waste Management

Investigation-derived waste (IDW), including soil cuttings and water generated during drilling, and waste/wastewater generated during decontamination of equipment, will be collected and managed in appropriate waste containers such as 55-gallon poly or steel drums.

DOF will coordinate with property owners and the TWAAFA group to appropriately characterize all waste in accordance with applicable regulations based on the laboratory analytical results and historical knowledge. All IDW will be disposed of at facilities approved by the TWAAFA group in accordance with applicable regulations.

4.0 GROUNDWATER NETWORK MONITORING

Groundwater monitoring methods and schedule for the revised well network will follow the Groundwater Monitoring Plan included in the Data Gaps Work Plan.

5.0 INDOOR AIR

A vapor intrusion assessment will be performed for the full site, consistent with Ecology's 2018 updated Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action and ASTM E2993-16, Standard Guide for Evaluating Potential Hazard as a Result of Methane in the Vadose Zone. The above ground conditions information will be used in the first Tier 1 stage of vapor intrusion assessment to identify specific areas of the site for Tier 2 assessment. Where Tier 2 assessments recommends sampling, the methods will be included for sub-slab, indoor air, ambient air, and/or methane samples. Differential pressure measurements would be collected as part of methane investigation. Sampling will also include the assessment of short-term TCE exposure concentrations per recent revisions to Ecology guidance regarding this exposure concern.

In addition to the above ground conditions assessment, methane will be analyzed where shallow groundwater samples are collected on the Western Port of Tacoma property (TWA-SB1 through TWA-SB2).

6.0 SCHEDULE

The schedule for implementing this Revised Data Gaps Work Plan will be based on the approval of the plan and timing of finalization of the Agreed Order. Work will commence within 30 days of signing the Agreed Order, to allow for the parties represented to collectively determine the approach to implementation and project management for the next stage of work.

The tentative schedule for implementation and reporting is included in Section 6 of the Revised Data Gaps Work Plan.

7.0 CLOSING

The services described in this plan were performed consistent with generally accepted professional consulting principles and practices. No other warranty, expressed or implied, is made. This plan is solely for the use and information of our client unless otherwise noted. Any reliance on this report by a third party is at such party's sole risk.

PLOT TIME: 8/31/2017 12:05 PM MOD TIME: 8/25/2017 6:53 AM USER: John Bliss DWG: D:\Projects\Stericycle\Tacoma\TWAAFA\CAD\Figures\2017-08\TWAAFA Fig 01.dwg

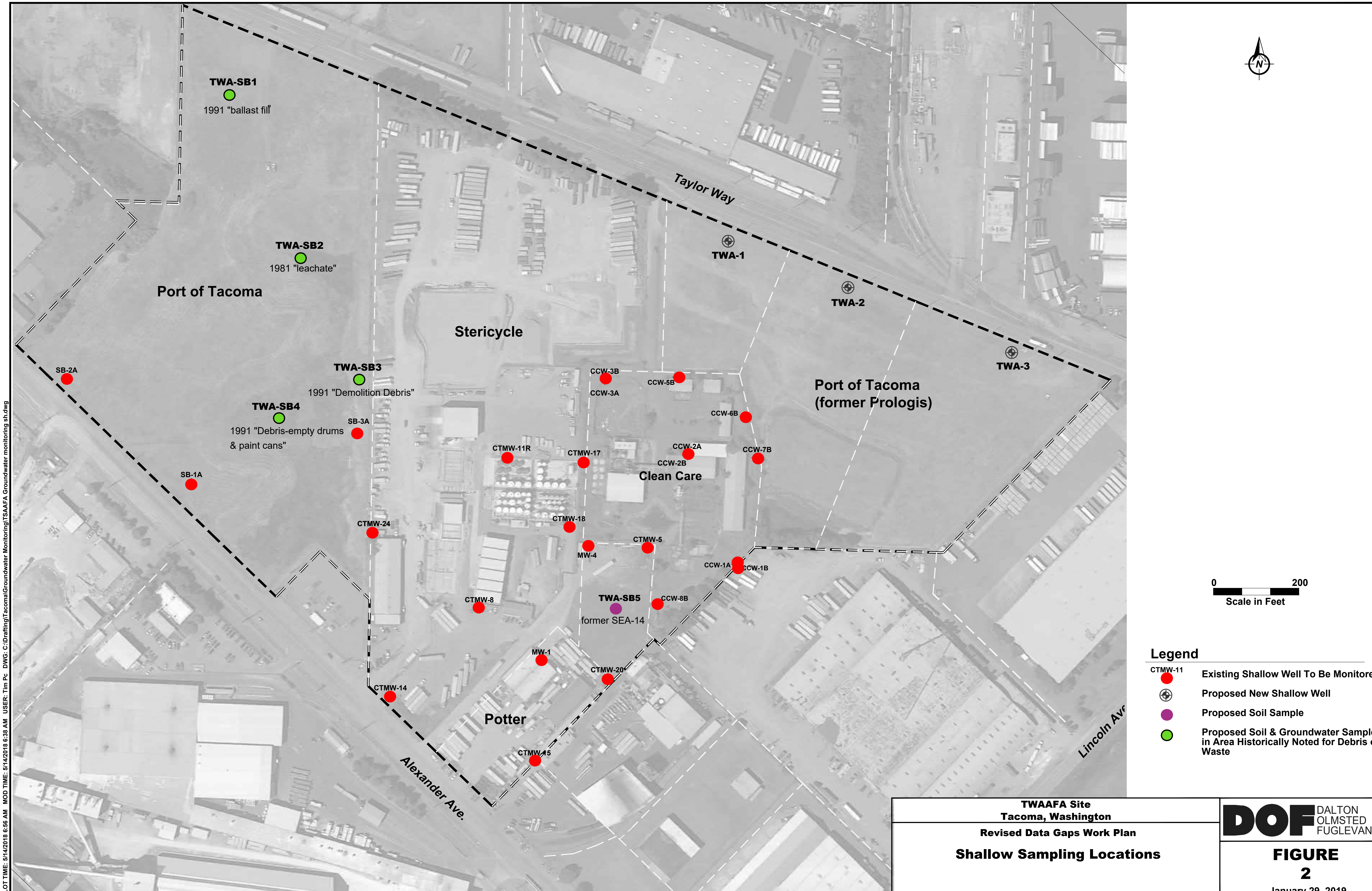
TWAAFA Site
Tacoma, Washington
Data Gaps Work Plan

Site Location Map

DOF DALTON OLMSTED FUGLEVAND

FIGURE 1

August 25, 2017



TWAAFA Site
Tacoma, Washington

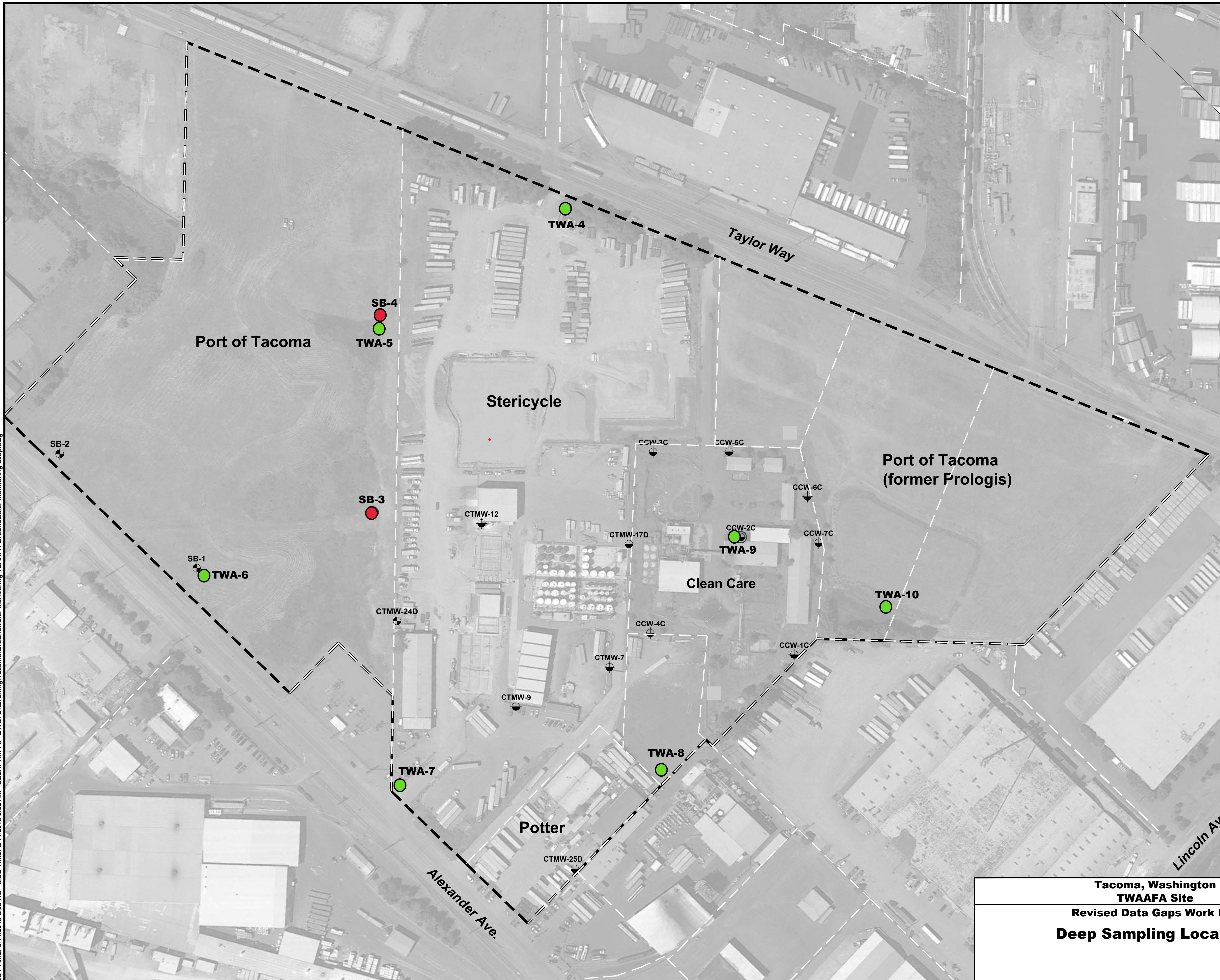
Revised Data Gaps Work Plan

Shallow Sampling Locations

DOF DALTON OLMSTED FUGLEVAND

FIGURE 2

January 29, 2019



0 200
Scale in Feet

Legend

CTMW-9	Existing Deep Well To Be Monitored
(green circle)	Proposed Deep Groundwater Boring & Possible Well
(red circle)	Existing Well to be Decommissioned

Tacoma, Washington
TWAAFA Site
Revised Data Gaps Work Plan

Deep Sampling Locations

DOF DALTON OLMSTED FUGLEVAND

FIGURE 3

January 29, 2019

PLOT TIME: 5/14/2018 6:53 AM MOD TIME: 5/14/2018 6:52 AM USER: Tim Pc DWG: C:\Drafting\Tacoma\Groundwater Monitoring\TSAAFA Groundwater monitoring deep.dwg

TABLE 1
DATA GAPS INVESTIGATION TASKS
Taylor Way and Alexander Avenue Fill Area Site
Tacoma, Washington

Data Gaps Task	Location	Boring Depth	Sample Depth	Soil Samples						Groundwater Samples						
			(feet bgs)	VOCs	TPH-D	TPH-G	SVOCs	PCBs	Metals[5]	VOCs	TPH-D	TPH-G	SVOCs[4]	PCBs	Metals[5]	Methane
Shallow soil and groundwater sampling[1]	TWA-SB1	top of silt, approximately 15 feet	1-2 ft and above water table	X	X	X	X	X	X	--	--	--	--	--	--	--
			water table	--	--	--	--	--	--	X	X	X	X	X	X	X
	TWA-SB2		1-2 ft and above water table	X	X	X	X	X	X	--	--	--	--	--	--	--
			water table	--	--	--	--	--	--	X	X	X	X	X	X	X
	TWA-SB3		1-2 ft and above water table	X	X	X	X	X	X	--	--	--	--	--	--	--
			water table	--	--	--	--	--	--	X	X	X	X	X	X	X
	TWA-SB4		1-2 ft and above water table	X	X	X	X	X	X	--	--	--	--	--	--	--
			water table	--	--	--	--	--	--	X	X	X	X	X	X	X
	TWA-SB5	5 feet	4.5-5	X	X	X	X	X	X	--	--	--	--	--	--	--
Discrete depth deep groundwater sampling[2]	TWA-4	approximately 60 feet	20, 30, 40, 50	X[6]	--	--	--	--	--	X	X	X	X	X	X	--
	TWA-5		20, 30, 40, 50	X[6]	--	--	--	--	--	X	X	X	X	X	X	--
	TWA-6		20, 30, 40, 50	X[6]	--	--	--	--	--	X	X	X	X	X	X	--
	TWA-7		20, 30, 40, 50	X[6]	--	--	--	--	--	X	X	X	X	X	X	--
	TWA-8		20, 30, 40, 50	X[6]	--	--	--	--	--	X	X	X	X	X	X	--
	TWA-9		20, 30, 40, 50	X[6]	--	--	--	--	--	X	X	X	X	X	X	--
	TWA-10		20, 30, 40, 50	X[6]	--	--	--	--	--	X	X	X	X	X	X	--
Shallow well installation	TWA-1	approximately 15 to 20 feet, based on field observations	water table	--	--	--	--	--	--	--	--	--	--	--	--	--
	TWA-2		water table	--	--	--	--	--	--	--	--	--	--	--	--	--
	TWA-3		water table	--	--	--	--	--	--	--	--	--	--	--	--	--
Deep Aquifer well installation[3]	TWA-4	TBD	TBD													
	TWA-5	TBD	TBD	--	--	--	--	--	--	--	--	--	--	--	--	--
	TWA-6	TBD	TBD	--	--	--	--	--	--	--	--	--	--	--	--	--
	TWA-7	TBD	TBD	--	--	--	--	--	--	--	--	--	--	--	--	--
	TWA-8	TBD	TBD	--	--	--	--	--	--	--	--	--	--	--	--	--
	TWA-9	TBD	TBD	--	--	--	--	--	--	--	--	--	--	--	--	--
	TWA-10	TBD	TBD	--	--	--	--	--	--	--	--	--	--	--	--	--
Groundwater sampling and elevation measurement and mapping	Sitewide	--	--	--	--	--	--	--	--	see Groundwater Monitoring Plan						

Notes:

1. Additional soil samples will be collected in the following circumstances: one of the waste fill materials is encountered, there are field indications of volatile contaminants or sheens
   Shallow groundwater samples will be collected at the water table.
2. Depth discrete samples will be collected from 3 to 4 different intervals below the silt unit.
   Anticipated depths are approxiately 10 ft intervals with the intent of sampling transmissive zones of this interbedded aquifer.
   Conductor cased sampling methods will be used to seal the upper fill from the deep aquifer.
3. Well screen depths will be based on results of discrete depth sampling evaluation.
4. To achieve more representative samples for SVOC analyses, it is acceptable for the laboratory to filter these samples through a 0.70 um (micron) glass fiber filter prior to analyses.
5. Metals include: arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, manganese
6. To be collected from fine-grained units encountered below the silt unit.

Appendix L
Groundwater Monitoring Plan

Revised Ground Water Monitoring Plan

TAYLOR WAY AND ALEXANDER AVENUE FILL AREA SITE

TACOMA, WASHINGTON

January 29, 2019

Prepared by:

DALTON, OLMSTED, & FUGLEVAND
1001 SW Klickitat Way, Suite 200B
Seattle, Washington 98134

Prepared for:

GENERAL METALS
GLENN SPRINGS HOLDINGS
PORT OF TACOMA
STERICYCLE ENVIRONMENTAL SOLUTIONS

Table of Contents

TABLES

FIGURES

ATTACHMENTS

Attachment A- Quality Assurance Project Plan

Attachment B- Standard Operating Procedures

SOP 105- Groundwater Monitoring Well Installation

SOP Groundwater Monitoring Well Abandonment

SOP 120- Measuring Water and NAPL Elevations, and Total Depths

SOP 121- Monitoring Well Development

SOP 124- Low-Flow Groundwater Sampling Procedure

SOP 200- Equipment Decontamination Procedure

SOP 400- Documentation Procedures

1.0 INTRODUCTION

Dalton, Olmsted, and Fuglevand, Inc. (DOF), has prepared this Groundwater Monitoring Plan for the Taylor Way and Alexander Avenue Fill Area (TWAAFA) Site on behalf of Glenn Springs Holdings, Inc. (Occidental Chemical), the Port of Tacoma, General Metals of Tacoma (GMT), and Stericycle Environmental Solutions, Inc. (Stericycle). These parties are among those identified in the draft Agreed Order Number 14260 proposed by the Washington State Department of Ecology (Ecology) as potentially liable parties at the TWAAFA (each a" PLP"", collectively, the "PLPs") and have agreed to prepare this Groundwater Monitoring Plan requested by Ecology to be incorporated into the proposed Agreed Order. Stericycle separately performs routine groundwater monitoring on the Stericycle property under a Stericycle Groundwater Monitoring Plan (AMEC, 2011). This TWAAFA plan includes similar methods used in the Stericycle plan.

1.1 Background and Objective

The Groundwater Monitoring Plan is designed to monitor the groundwater at the TWAAFA site. It utilizes existing groundwater monitoring wells installed at the site and additional wells planned for installation as part of the Revised Data Gaps Work Plan. The monitoring wells, the analyses conducted, and the frequency of sampling are included in Table 1. The monitoring wells are located to provide adequate information on (1) groundwater flow at the site, (2) groundwater units underlying the site; and (3) groundwater leaving the site and flowing to off-site, downgradient and cross-gradient locations.

Groundwater samples will be analyzed for the chemicals of potential concern (COPCs) evaluated during past groundwater investigations on the site, including volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) including 1,4-dioxane, total petroleum hydrocarbons (TPH), PCBs, and metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, and manganese) as shown in Table 1.

The groundwater monitoring program outlined in this plan is designed to address Remedial Investigation data gaps identified in the TWAAFA site Revised Data Gaps Work Plan (DOF, 2019).

1.2 Scope of Plan

This plan addresses the following major elements:

- Description of the existing groundwater monitoring network;
- Procedures for completing water-level surveys, groundwater sampling, well evacuation, field decontamination, sample storage and transportation, sample analysis, and quality assurance/quality control;
- Procedures and requirements for new well construction, maintenance, and decommissioning;
- Requirements for reporting and notification;
- Personnel functions and responsibilities;
- Worker health and safety planning
- How the plan objective will be met; and

- Field and laboratory quality assurance.

2.0 MONITORING NETWORK

The groundwater monitoring well network and maintenance program for the TWAAFA site are described in this section.

2.1 Monitoring Well Locations

The locations of the full groundwater monitoring network are shown on Figure 1. Figure 1 shows the monitoring wells that will be monitored for both water levels and chemical constituents during sampling events.

2.2 Monitoring Well Numbering System

A variety of well numbering designation approaches have been used at the TWAAFA site since the site includes properties owned and historically monitored by different parties. Any new wells will follow general historical formats and avoid duplication of previously used well names. Wells installed for the TWAAFA site evaluation purposes will be named with the prefix "TWA", followed by a number designation, as shown on Figures 1 and 2. Wells installed below the silt unit will be assigned a "D" to designate they are not screened in the Fill Unit, similar to the approach used at many of the existing wells at the TWAAFA site.

2.3 Monitoring Well Construction

For all wells in the groundwater monitoring network, well construction details are summarized in Table 2. This table will be updated after completion of the TWAAFA above ground structures evaluation, one of the first Data Gaps Work Plan tasks, so that it includes an accurate summary of existing wells at the TWAAFA site.

2.4 Monitoring Well Survey

In the Public Land Survey System, the facility is located in the SW1/4 of Section 26, and in the NW1/4 of Section 35, Township 21N, Range 3E, Willamette Meridian. All survey data are recorded relative to this section, township, and range. All vertical survey data was based on the National Geodetic Vertical Datum (NGVD) of 1929 and converted to the North American Vertical Datum (1988). All horizontal data are provided relative to the Washington State Plane Coordinate System, South Zone (North American Datum, 1983/91). The survey coordinates for each well in the monitoring network specified in this groundwater monitoring plan were obtained from the Final RI (PSC, 2005) and are provided in Table 3. This table will be updated after completion of the TWAAFA above ground structures evaluation, and when new wells are added to the network.

2.5 Monitoring Well Network Inspection, Maintenance, and Replacement

This section describes a program to provide regular inspection, and if necessary, maintenance of the monitoring wells and associated equipment. In addition, well construction and decommissioning procedures are presented in this section.

2.5.1 Well Inspection

The integrity of monitoring wells at the site will be inspected by the sampling team during each monitoring event. The inspection involves an all-inclusive visual inspection of each well to determine if it has been damaged or tampered with, and verifies the physical condition of the well at the ground surface as well as the internal well casing. Problems discovered during the inspection will be recorded in a field inspection logbook, as well as a well inspection checklist, and a copy will be provided to the TWAAFA Site Coordinator. Problems that require immediate attention will be reported to the TWAAFA Site Coordinator and applicable property owner so as to remedy the condition prior to the next sampling event. If a significant problem such as a broken well head, bent casing, or other damage that compromises well access is discovered, it may be necessary to remedy the problem before sampling. A problem with the well integrity may require a modification of the sampling schedule or some other change in the sampling program. All decisions regarding such modifications will be addressed by the TWAAFA Site Coordinator, who will notify and request approval from the regulatory agencies regarding such issues. The TWAAFA Site Coordinator will notify Ecology by telephone or in writing within 15 days of any visible damage to or deterioration of wells.

2.5.2 Maintenance

Borehole integrity will be maintained at each well. Borehole integrity is assessed by pulling the dedicated pumps and measuring the total well depths. This procedure will be initially performed as part of the Data Gaps Work Plan tasks and subsequently on a 5 year basis. If more than 1 foot of sediment has built up in the bottom of the well, the well will be redeveloped and the sediment removed, per Stericycle's previously approved Standard Operating Procedure (SOP)-121 (Attachment B). The 5-year period is based on experiences from annually checking wells at the Stericycle site.

All pumps and other sampling equipment used for groundwater monitoring will be maintained regularly by the sampling team member(s) according to the equipment manuals and manufacturers' recommendations.

2.5.3 Monitoring Well Replacement

If any monitoring well in the network must be replaced, efforts will be made to replace the well prior to the next sampling event. The TWAAFA Site Coordinator will submit to Ecology a written explanation of the rationale for the well's replacement and the time frame and location for the replacement, at least 15 days prior to decommissioning. The replacement will be completed within 45 days of Ecology approval unless otherwise approved by Ecology.

If it is agreed that the well should be replaced, the replacement well will be installed as close as possible to the well being replaced. A monitoring well construction form will be completed for the new well and a copy will be submitted to the agency. When necessary, wells will be decommissioned following the procedures specified in Section 2.5.5.

2.5.4 Monitoring Well Construction

A qualified geologist will inspect the drilling and construction of all new or replacement monitoring wells consistent with SOP 105 and the procedures below. A detailed log of each well will be prepared. The logs and descriptions will include the following information:

- Date and time of construction;
- Drilling method and any drilling fluid used;
- Well location (surveyed to within 0.5 foot);

- Borehole diameter and well casing diameter;
- Well depth (to within 0.1 foot);
- Initial depth to water (to within 0.1 foot);
- Drilling logs and lithologic logs from the field, including a description of soil or rock types, depth to water, color, weathering, texture, structure, and fractures;
- Casing materials;
- Screen material and design, including screen length and slot size;
- Casing and screen joint type;
- Filter pack material, including size, placement method, and approximate volume;
- Composition and approximate volume of sealant material and method of placement;
- Surface seal design and construction;
- Well development procedures;
- Ground surface elevation (to within 0.01 foot);
- Top-of-casing elevation (to within 0.01 foot); and
- Detailed drawing of well, including dimensions.

The logs and descriptions, as-built drawings, and location of the new well will be submitted to Ecology within 30 calendar days of well completion or according to the schedule approved by Ecology in specific work plans.

2.5.5 Monitoring Well Decommissioning

Requests for decommissioning wells will be submitted to Ecology for review and approval. Wells will be decommissioned in accordance with the appended SOP for well decomissioning, the WAC 173-160-460 (Abandonment of Resource Protection Wells), and applicable updates. The selected drilling contractor will file the appropriate notification of well abandonment with Ecology. In addition, the TWAAFA Site Coordinator will provide written rationale for the decision to decommission the well at least 30 days prior to the decommissioning. If the well being decommissioned is being replaced, it should be decommissioned no later than 90 days after installation of the replacement well.

Wells not needed for groundwater or water level monitoring will be decommissioned upon request to and approval by Ecology. Such wells will be decommissioned within 45 days of receipt of Ecology's approval, or a request from Ecology to decommission.

Minor deviations from the decommissioning procedures that are deemed necessary due to unforeseen events in the field at the time of well abandonment will be noted in the operating record and reported to Ecology, along with an explanation of the need for the deviation. Significant deviations will require prior approval from Ecology.

3.0 GROUNDWATER MONITORING PROCEDURES

The subsections below describe each of the principal components of the groundwater monitoring program. All of the work will be conducted in accordance with the Quality Assurance Project Plan (QAPP) included as Attachment A.

3.1 Water Level Monitoring

Water level measurements will be collected quarterly in March, June, September, and December on the TWAAFA site for at least 4 quarters. Wells monitored include 52 monitoring wells and piezometers across the TWAAFA site. The wells included in the water level monitoring events are presented in Table 1 and shown on Figure 1.

Using an oil/water interface probe, all of the wells will be measured for water level, as well as nonaqueous-phase liquids (NAPL) that may have accumulated. Light, free-phase NAPL (e.g., LNAPL) in the subsurface tends to accumulate on top of the water table. The wells indicated in Table 1 routinely contain LNAPL, and the thickness of the LNAPL can be measured at the same time the water level is measured.

Water-level and LNAPL measurements will be performed by the sampling team. The procedures for these measurements are provided below.

3.1.1 Schedule

A water-level measurement event will be conducted in accordance with the schedule presented in Table 1. Water level measurements will be conducted prior to the corresponding groundwater sampling event (if applicable), and measurements will be obtained within as short a time as possible prior to sampling, not to exceed one working day.

3.1.2 Procedures

The procedure for measuring water levels is described in Ecology-approved SOP 120, presented in Attachment B.[1] Wells will be vented prior to measurement to allow water levels to stabilize before measurement. Water level measurements and well venting times will be recorded in the field on a water level measurement form.

3.1.3 Equipment

Equipment used for the water-level survey is listed in the Ecology-approved SOP-120, as provided in Attachment B. Depth-to-water measurements will be made using an electronic water-level meter. The meter consists of a coaxial cable or plastic-coated flat wire permanently marked with increments of 0.01 foot, a detection probe, and electronic controls contained in a spool or reel. The water-level meter/sounder registers a response when the probe attached to the cable contacts an electrically conductive medium such as water, thereby completing the electrical circuit. The response is visible (e.g., red light), audible (e.g., alarm), or a combination of the two.

---

[1] The SOPs identified in this section were developed by Stericycle and approved for use on the Tacoma Facility site by Ecology. Their use in this Groundwater Monitoring Plan is expected to eliminate need for obtaining Ecology approval of new SOPs for this project.

An oil/water interface probe is used to measure LNAPL thickness. The same type of equipment used to measure water levels is used; however, the oil/water interface detector emits one type of response to indicate that the probe has contacted NAPL and one type of response to indicate that the probe has contacted water. The probe is lowered until the depth of the air/LNAPL interface is detected, and the depth is recorded. The probe is then continuously lowered until the LNAPL/water interface is detected, and that depth is recorded. LNAPL depths that are less than 0.01 foot will be recorded as “sheen.”

3.1.4 Reporting

All water-level data will be recorded in the field on water-level data forms. The water-level data forms facilitate transmission of data from the field to the office. The field form will be provided to the TWAAFA Site Coordinator to file with the site field forms. The water level data will be used to create potentiometric contour maps and a summary table of the water-level measurements, which will be included with an annual report.

3.2 Water Quality Monitoring

This section describes the equipment used and the procedures for groundwater sampling, field decontamination, field records preparation, sample identification, and sample storage and transport for water quality testing.

3.2.1 Schedule

Groundwater samples will be collected in accordance with the schedule presented in Table 1 and includes 34 wells (19 screened in the shallow zone and 15 screened in the deep groundwater zone). Figure 1 shows the locations of wells used for groundwater sampling.

3.2.2 Groundwater Sampling Procedure

Groundwater samples will be collected following the procedures outlined in Ecology- approved SOP-124, presented in Attachment B. This is a low-flow groundwater sampling methodology based on groundwater sampling guidance and comments from Ecology and the U.S. Environmental Protection Agency under RCRA. The groundwater sampling procedure involves purging groundwater from the monitoring well prior to sampling at a flow rate less than 500 milliliters per minute (mL/min.). During the purging, groundwater quality parameters, including temperature, pH, turbidity, dissolved oxygen, oxidation/reduction potential (ORP), and specific conductivity, will be monitored approximately every 3 minutes, and purging will be conducted until these parameters stabilize within criteria outlined in SOP-124. Once the water quality parameters have stabilized, groundwater samples will be collected using a flow rate of less than 500 mL/min.

3.2.3 Equipment

The monitoring wells included in this plan will be sampled with a nondedicated peristaltic pump using dedicated polyethylene tubing. The tubing intake will be set at mid-screen for sampling or mid-water column if the top of the screen is above the water table. Other equipment to be used for well evacuation is listed in SOP 124 (Attachment B). This equipment includes a flow-through water quality meter, turbidity meter, water level meter, and/or oil/water interface detector. All meters will be calibrated according to instrument instructions. The calibration results for each parameter will be recorded in the field logbook.

3.2.4 Field Decontamination Procedures

The decontamination procedures for all nondedicated field sampling equipment are outlined in Ecology-approved SOP 200 (provided in Attachment B). This equipment includes any instrument that is placed in a well or comes in contact with the groundwater sample, including the water-level indicator and any non-dedicated pump.

The flow-through water quality meter requires decontamination with deionized water, but not with soaps or solvents, which may adversely affect the probes in the meter. The flow-through cell will be disconnected prior to sample collection; therefore, groundwater collected for laboratory analysis at the laboratory will not contact the flow-through cell.

3.2.5 Field Records

Ecology-approved SOP 400, presented in Attachment B, contains a description of field logbook documentation procedures required for field sampling events. Field observations for well evacuation and groundwater sampling will be recorded in the field in the logbook and on monitoring well water sampling sheets. The monitoring well water sampling sheet will be designed to help the sampling team determine when the water quality parameters are stable enough to collect a sample and also facilitates transmission of data from the field to the office. The following information will be recorded on the sampling sheet during well evacuation: well identification, date, sampling personnel, beginning and ending water levels, sampling method, equipment used, and samples collected. Readings of water quality parameters (pH, specific conductivity, temperature, turbidity, dissolved oxygen, and ORP) will be recorded on the sheet approximately every 3 minutes, along with flow rate and pump speed.

3.2.6 Sample Label and Identification System

A sample label will be affixed to each sample bottle before sample collection. Each label will include the following information:

- Sample number (see below),
- Sampling event location,
- Date and time of sample collection,
- Preservatives added to the sample, and
- Analytes for which the sample is to be analyzed.

Water samples will be labeled with a unique sample number. The sample number consists of the appropriate monitoring well designation followed by, and separated by a hyphen from, a date identification code. The date identification code consists of a four-digit number that represents the month and year that the sample was collected. For instance, the sample number CTMW-24-0617 denotes a sample collected in June 2017 from monitoring well CTMW-24.

Quality control samples will follow a similar nomenclature. Field duplicate samples will be labeled the same as regular samples, except a “9” will be added to the sample number preceding the well number and separated by hyphens on either side (e.g., CTMW 9 24-0617). Matrix spike and matrix spike duplicate (MS/MSD) samples will be labeled the same as regular samples, but it should be noted on the chain-of-custody form that extra volume was collected for MS/MSD. Field blank samples will be labeled

"Field Blank#1-0617" and trip blank samples will be labeled "Trip Blank#1-0617", with each consecutive blank having a different numeral after "#" sign. The location at which field blanks are collected should be noted in the field logbook and/or field form. Equipment blanks will not normally collected, but might be necessary if non-dedicated tubing or bailers are used during groundwater sampling. If they are collected, equipment blanks will be labeled "Equipment Blank#1-0617" and, if collected, the location should be noted in the field logbook and/or field form.

3.2.7 Sample Storage and Transportation

After sampling is completed for the day, all samples will be packed for shipping and placed in ice cooled transport containers. The transport containers will consist of sturdy, insulated, commercially produced coolers. All bottle caps will be secured tightly, and all glass containers will be secured into position within the shipping container to avoid breakage. Trip blanks will be included in any transport container that carries water samples being analyzed for VOCs or TPH as gasoline. A custody seal will be affixed to the container prior to laboratory pickup or delivery. The chain-of-custody form should be taped to the top of the cooler or shipping container in most circumstances.

During sample collection or at the end of each day and prior to shipping or storage, chain-of-custody forms will be completed for all samples by a designated field team member. The information on the sample labels will be rechecked and verified against field logbook entries and the chain-of-custody forms. The chain-of-custody form should include information such as sample name, sample time, sample date, type of medium, and analyses requested. Any necessary changes to chain of custody forms, sample container labels, or the field logbook will be made by striking out the error with one line and entering the correct information. The new entries will be initialed and dated. Samples with extra volume for laboratory quality control protocols (MS/MSD and laboratory duplicates) will be designated as such on the chain-of-custody form. The field team should ensure that analyte method numbers and analyte lists required for the project are either listed on the chain-of-custody form, attached to the chain-of-custody form, or referred to on the chain of custody form. Every person who takes possession of the samples while transporting the samples from the field to the laboratory must sign the chain-of-custody form.

For most samples, the field team will either transport the samples to the laboratory or have a laboratory courier come to the site at the end of each sampling day to pick up samples for delivery to the laboratory. Upon receipt of the sample transport containers by the analytical laboratory, laboratory personnel will open the containers and examine the contents for problems, such as damaged transport containers, broken custody seals, missing or broken sample bottles, chain-of-custody discrepancies, and documentation errors. Problems will be reported to the TWAAFA Site Coordinator.

3.2.8 Analytical Procedures

The sampling and analysis schedule for this plan is included in Table 1. Typical detection limits and more detailed information about the analytical methods are provided in the QAPP (Attachment A). Groundwater monitoring analytical data will be analyzed and validated in accordance with the requirements in the QAPP.

The analytical laboratory purchases new and certified clean sample bottles for each sampling event. The recommended specifications for bottle types, volume of sample required for analysis, and types of sample preservative required for analyses are provided in Table 1. However, these recommendations may be modified by the laboratory as analytical methods are modified and improved.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

All work associated with the Groundwater Monitoring Plan will be conducted in accordance with the QAPP (Attachment A).

5.0 PERSONNEL FUNCTIONS AND RESPONSIBILITIES

All fieldwork will be completed in accordance with a project-specific Health and Safety Plan (HASP). The specific tasks of key personnel involved in the groundwater monitoring program are summarized below.

5.1 TWAAFA Site Coordinator

The function of the TWAAFA Site Coordinator will be to:

- Maintain correspondence between regulatory agencies, the parties included in the TWAAFA Agreed Order, and property owners of parcels included in the TWAAFA site.
- Verify parameter requirements and modify the groundwater monitoring program if necessary.
- Maintain the groundwater monitoring network in good working condition.

5.2 Sampling Team Members

The functions of the sampling team members will be to:

- Learn and follow all of the procedures in this Groundwater Monitoring Plan.
- Notify the TWAAFA Site Coordinator of any unresolved problems or deviations from approved procedures.
- Obtain, maintain, and inspect all equipment used to fulfill their responsibilities.
- Oversee field sampling activities and equipment repair.
- Work to prevent sample and/or well contamination.
- Schedule sample analysis services with the analytical laboratory and the field sampling team.
- Verify or arrange for the shipment of sample bottles and sample transport containers, both from the analytical laboratory to the field and from the field to the laboratory.
- Calibrate equipment.
- Examine sample bottles, preservatives, and sample transport containers.
- Assume responsibility for storage and provide security of sample transport containers and sample equipment.
- Conduct health and safety meetings, and implement safety requirements.
- Provide field technical guidance for sampling and maintenance procedures.

- Perform or supervise the water-level survey and well inspection.
- Maintain lines of communication between those personnel involved in the field sampling activities, the TWAAFA Site Coordinator, and the analytical laboratory.
- Maintain or service all dedicated sampling equipment.
- Take all field measurements.
- Purge monitoring wells.
- Collect and preserve samples.
- Check that samples are correctly identified and packed securely with ice in the sample transport container(s).
- Take neat and complete field notes.
- Update the TWAAFA site monitoring well information tables.
- Trend Analyses of the significant COCs for the four quarters of sampling.

6.0 SCHEDULE

Ecology should be notified at least seven days in advance of any monitoring events.

Annual monitoring events conducted on the Stericycle site occur every calendar year in the second quarter (typically in June), and quarterly TWAAFA site-specific water level and monitoring events, as identified in this plan, will occur in the March, June, September, and December). Monitoring well inspections will occur quarterly in March, June, September, and December.

One initial year of groundwater monitoring is proposed for the TWAAFA site to satisfy data gap requirements outlined in the Data Gaps Work Plan (DOF, 2017). Additional sampling may be conducted under this plan and would be coordinated with Ecology pending results of the Data Gaps investigation work.

Ecology may request additional wells based on review of results from sampling. The TWAAFA group will install new wells within 45 days of receipt of such request from Ecology unless otherwise approved by Ecology.

7.0 REPORTING

A groundwater data analysis report will be submitted to Ecology after each quarterly monitoring event is complete and within 30 days of receiving validated groundwater data. The report shall summarize the data collected and activities performed with respect to the groundwater monitoring program over the previous quarter. The report shall include the following information:

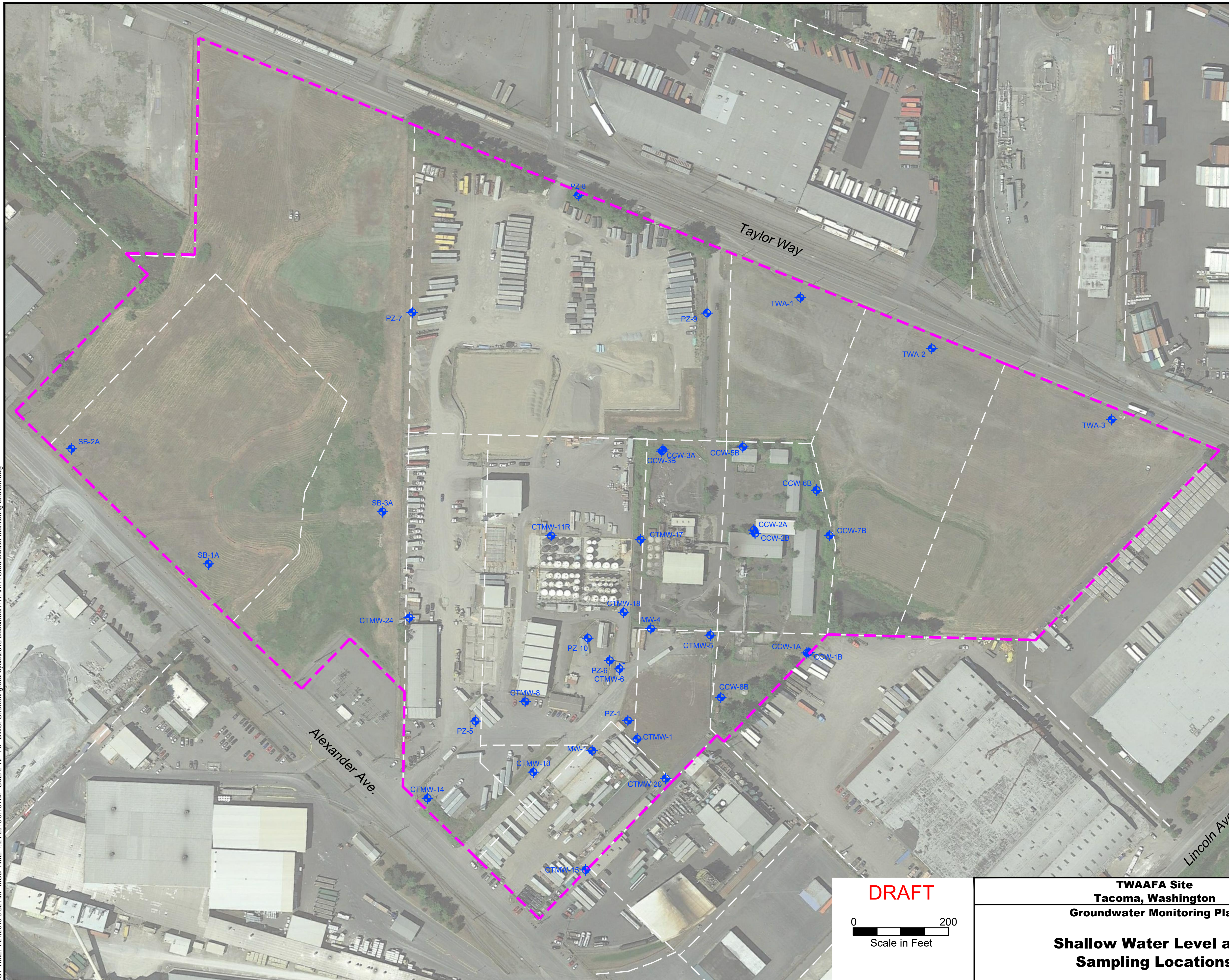
- A description of groundwater monitoring activities completed during the year;
- A description of any groundwater monitoring activities planned for the next year;
- A summary of any problems, how problems were resolved, deviations from this plan, and a justification for all deviations;

- A summary of significant findings, changes in personnel, and significant contacts with all federal, state, and local governments and community and public interest groups;
- All laboratory analyses in tabulated data format for which quality assurance procedures were completed during the current time period and for upload to Ecology's Environmental Information Management database;
- A summary of constituent concentrations which exceed MTCA cleanup levels;
- All field measurements; and
- A table with measured groundwater elevations for each well as well as groundwater level contour maps.

8.0 REFERENCES

AMEC, 2011. Groundwater Monitoring Plan, PSC Tacoma Facility, Tacoma, Washington, November.

Dalton Olmsted, and Fuglevand (DOF), 2019. Revised Data Gaps Work Plan, TWAAFA Site, Tacoma Washington, January.



Legend

CTMW-17	Groundwater Sampling & Water Level Well (Shallow)
	TWAAFA Site Boundary
	Parcel Boundary

Note:
Well Locations to be verified as part of Data Gaps Investigation.

DRAFT

0 200
Scale in Feet

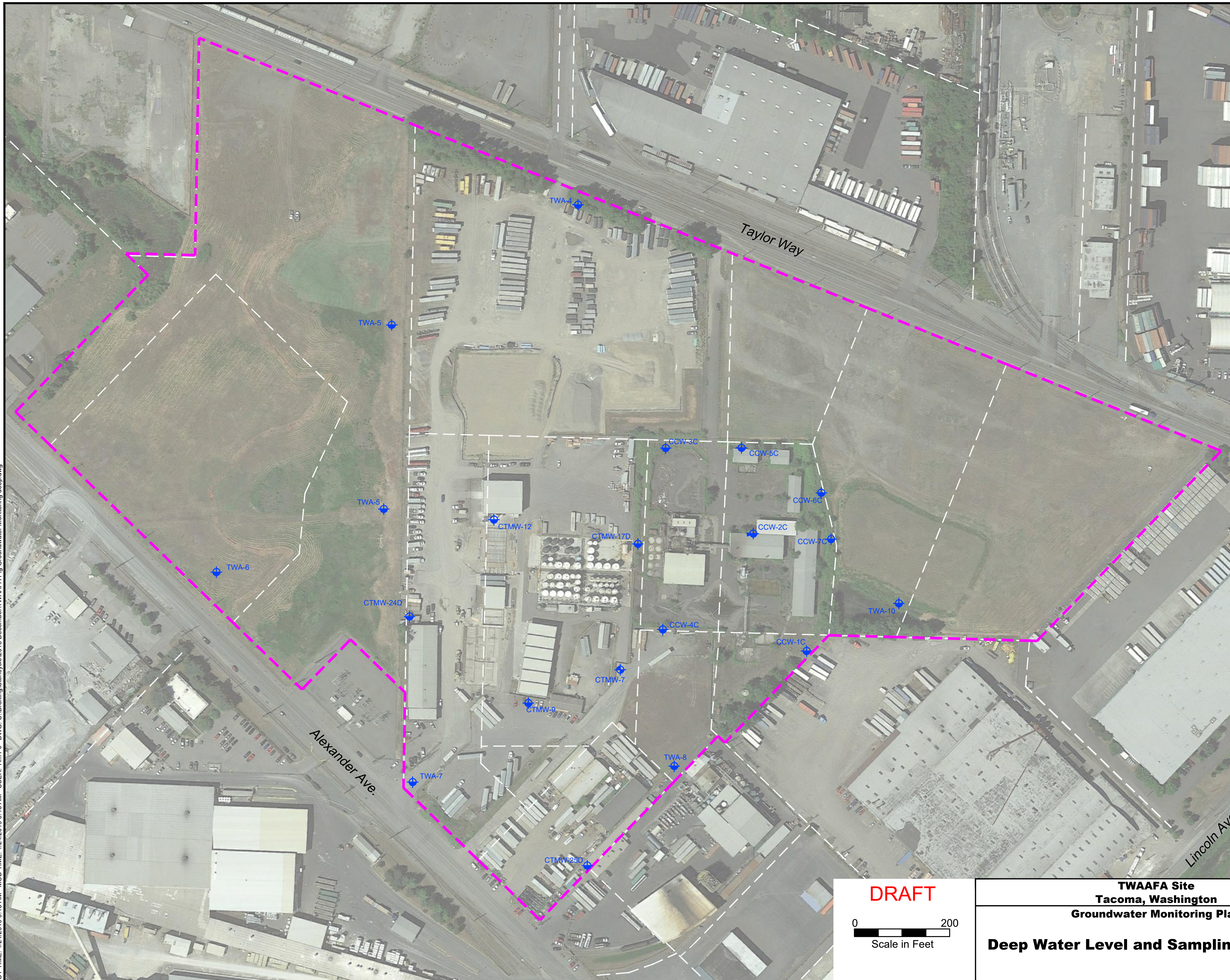
TWAAFA Site
Tacoma, Washington
Groundwater Monitoring Plan

Shallow Water Level and Sampling Locations

DOF DALTON OLMSTED FUGLEVAND

FIGURE 1

January 24, 2019



Legend

CTMW-17D — Groundwater Sampling & Water Level Well (Deep)

TWAAFA Site Boundary

Parcel Boundary

Note:
Well Locations to be verified as part of Data Gaps Investigation.

DRAFT

0 200
Scale in Feet

TWAAFA Site
Tacoma, Washington
Groundwater Monitoring Plan

Deep Water Level and Sampling Locations

DOF DALTON OLMSTED FUGLEVAND

FIGURE
2

January 24, 2019

PLOT TIME: 1/24/2019 9:15 AM MOD TIME: 1/24/2019 9:13 AM USER: Tim Pc DWG: C:\Drafting\Stericycle\2018 December\TWAAFA Fig Groundwater Monitoring deep.dwg

TABLE 1
GROUNDWATER MONITORING SCHEDULE
TWAAFA Site
Tacoma, Washington

Analytical Method	Water Levels	VOC by 8260B	VOC by 8260B w/SIM	TPH-Diesel by NWTPH-Dx[2]	TPH-Gasoline by NWTPH-Gx	Total Metals[1] by 6020 & Mercury by 7470A	SVOCs by 8270	cPAHS only by 8270	1,4-Dioxane	PCBs by 8082
		Analyses								
CCW-1A	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-1B	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-1C	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-2A	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-2B	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-2C	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-3A	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-3B	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-3C	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-4C	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-5B	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-5C	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-6B	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-6C	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-7B	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-7C	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CCW-8B	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
MW-1 (Potter) [3]	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
MW-4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
SB-1A	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
SB-2A	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
SB-3A	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
CTMW-1 [6]	1,2,3,4						--			--
CTMW-5	1,2,3,4	2	2	2		2	--			--
CTMW-6 [3]	1,2,3,4						--			--
CTMW-7	1,2,3,4	2	2	2		2	--	2	2	--
CTMW-8	1,2,3,4	2	2	2		2	--			--
CTMW-9	1,2,3,4	2	2	2		2	--		2	--
CTMW-10 [3]	1,2,3,4						--			--
CTMW-11R	1,2,3,4	2	2	2		2	--			--
CTMW-12	1,2,3,4	2	2	2		2	--	2		--
CTMW-14	1,2,3,4	2	2	2		2	--	2		--
CTMW-15	1,2,3,4	2	2	2		2	--	2	2	--
CTMW-17	1,2,3,4	2	2	2		2	--		2	--
CTMW-17D	1,2,3,4	2	2	2		2	--			--
CTMW-18	1,2,3,4	2	2	2	2	2	--			--
CTMW-20	1,2,3,4	2	2	2	2	2	--			--
CTMW-24	1,2,3,4	2	2	2		2	--	2		--
CTMW-24D	1,2,3,4	2	2	2		2	--			--
CTMW-25D	1,2,3,4	2	2	2		2	--	2	2	--
PZ-1 [3]	1,2,3,4	--	--	--	--	--	--	--	--	--
PZ-5	1,2,3,4	--	--	--	--	--	--	--	--	--
PZ-6 [3]	1,2,3,4	--	--	--	--	--	--	--	--	--
PZ-7	1,2,3,4	--	--	--	--	--	--	--	--	--
PZ-8	1,2,3,4	--	--	--	--	--	--	--	--	--
PZ-9	1,2,3,4	--	--	--	--	--	--	--	--	--
PZ-10	1,2,3,4	--	--	--	--	--	--	--	--	--
TWA-1	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
TWA-2	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
TWA-3	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
TWA-10D	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
TWA-8D	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
TWA-7D	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	--	2	2	--
TWA-4D	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	--	2	2	--
TWA-5D	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4
TWA-6D	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	--	1,2,3,4	1,2,3,4

Notes
1. Metals: As, Cd, Cr, Cu, Pb, Ni, Zn, and Mn
2. Will be analyzed with and without silica gel cleanup during the first sampling event and sample prep methods assesed in cooperation with Ecology for future events.
3. Wells that historically had LNAPL.
4. -- = not measured/ not applicable.
Blue shading indicates well is screened in deep zone

Abbreviations
As = arsenic
Cd = cadmium
Ni = nickel
Cr = chromium
Cu = copper
Pb = lead
Zn = zinc

DOF

Table 2
Well Construction Information
TWAAFA Site
Tacoma, Washington

Well ID	Installation Date	Contractor	Drilling Method	Total Borehole Depth	Initial Total Well	Casing: Depth Upper	Casing: Depth Lower	Casing: Material	Casing: Nominal Diameter	Casing: Flush or Aboveground	Screen: Depth Interval Upper	Screen: Depth Interval Lower	Screen: Screened Hydro-	Screen: Material	Screen: Nominal Diameter	Screen: Slot Size	Filter Pack: Depth Interval Upper	Filter Pack: Depth Interval Lower	Filter Pack: Material	Seals: Depth Interval Upper	Seals: Depth Interval Lower	Seals: Material	Seals: Surface Seal
CCW-1A	1-2 Feb 1994	Holt Drilling	Hollow stem auger	6.0	5.8	0.0	4.0	Sch. 40 PVC	2	Flush Mount	4	5.8	Shallow aq.	Sch. 40 PVC	2	0.02	3	6	# 10-20 silica sand	0 1.5	1.5 3	Concrete Bentonite	Flush mount
CCW-1B	1-2 Feb 1994	Holt Drilling	Hollow stem auger	12.0	9.6	0.0	7.8	Sch. 40 PVC	2	Flush Mount	7.8	9.6	Shallow aq.	Sch. 40 PVC	2	0.01	5.6	9.8	# 20-40 silica sand	0 1.5 9.8	1.5 5.6 12	Concrete Bentonite chips Bentonite chips	Flush Mount
CCW-1C	3-5 Jul 2001	Cascade Drilling, Inc.	Hollow stem auger	23.0	23.0	0.0	18.0	Sch. 40 PVC	2	Flush Mount	18	23	Deep aq.	Sch. 40 PVC	2	0.01	17	23	# 2 / 12 sand	0 0.5	0.5 17	Asphalt Bentonite	Flush mount
CCW-2A	1-2 Feb 1994	Holt Drilling	Hollow stem auger	6	5.8	0.0	4.0	Sch. 40 PVC	2	Flush mount	4.0	5.8	Shallow aq.	Sch. 40 PVC	2	0.02	3.0	6.0	# 10-20 silica sand	0.0 1.5	1.5 3.0	Concrete Bentonite chips	Concrete, flush mount
CCW-2B	1-2 Feb 1994	Holt Drilling	Hollow stem auger	15	12.8	0.0	11.0	Sch. 40 PVC	2	Flush mount	11.0	12.8	Shallow aq.	Sch. 40 PVC	2	0.01	9.0	13.0	# 20-40 silica sand	0.0 1.5 13.0	1.5 9.0 15.0	Concrete Bentonite chips Bentonite chips	Concrete, flush mount
CCW-2C	2-3 Jul 2001	Cascade Drilling, Inc.	Hollow stem auger	24	24	0.0	19.0	Sch. 40 PVC	2	Flush mount	19	24	Deep aq.	Sch. 40 PVC	2	0.01	18.0	24.0	# 2 / 12 sand	0.0 0.5	0.5 18.0	Asphalt Bentonite	Flush mount
CCW-3A	1-2 Feb 1994	Holt Drilling	Hollow stem auger	6	5.8	0.0	4.0	Sch. 40 PVC	2	Flush mount	4.0	5.8	Shallow aq.	Sch. 40 PVC	2	0.02	3.0	6.0	# 10-20 silica sand	0.0 1.5	1.5 3.0	Concrete Bentonite chips	Concrete, flush mount
CCW-3B	1-2 Feb 1994	Holt Drilling	Hollow stem auger	12	10.8	0.0	9.0	Sch. 40 PVC	2	Flush mount	9.0	10.8	Shallow aq.	Sch. 40 PVC	2	0.01	6.0	11.5	# 20-40 silica sand	0.0 1.5 11.5	1.5 6.0 12.0	Concrete Bentonite chips Bentonite chips	Concrete, flush mount
CCW-3C	29 Jun - 02 Jul 2001	Cascade Drilling, Inc.	Hollow stem auger	28	23	0.0	23.0	Sch. 40 PVC	2	Flush mount	23	28	Deep aq.	Sch. 40 PVC	2	0.01	22.0	28.0	# 2 / 12 sand	0.0 0.5	0.5 22.0	Asphalt Bentonite	Flush mount
CCW-4C	05 Jul 2000	Cascade Drilling, Inc.	Hollow stem auger	24	24	0.0	19.0	Sch. 40 PVC	2	Flush mount	19	24	Deep aq.	Sch. 40 PVC	2	0.01	18.0	24.0	# 2 / 12 sand	0.0 0.5	0.5 18.0	Asphalt Bentonite	Flush mount
CCW-5B	27 Jun 2001	Cascade Drilling, Inc.	Hollow stem auger	11	10	0.0	5.0	Sch. 40 PVC	2	Flush mount	5	10	Shallow aq.	Sch. 40 PVC	2	0.01	4.0	11.0	# 2 / 12 sand	0.0 0.5	0.5 4.0	Concrete Bentonite	Concrete, flush mount
CCW-5C	27 Jun 2001	Cascade Drilling, Inc.	Hollow stem auger	24	24	0.0	19.0	Sch. 40 PVC	2	Flush mount	19	24	Deep aq.	Sch. 40 PVC	2	0.01	18.0	24.0	# 2 / 12 sand	0.0 0.5	0.5 18.0	Asphalt Bentonite	Flush mount
CCW-6B	27 Jun 2001	Cascade Drilling, Inc.	Hollow stem auger	9.0	8.5	0.0	3.5	Sch. 40 PVC	2	Flush Mount	3.5	8.5	Shallow aq.	Sch. 40 PVC	2	0.01	3	9	# 2-12 sand	0 0.5	0.5 3	Concrete Bentonite	Flush mount
CCW-6C	28 Jun 2001	Cascade Drilling, Inc.	Hollow stem auger	23.0	23.0	0.0	18.0	Sch. 40 PVC	2	Flush Mount	18	23	Deep aq.	Sch. 40 PVC	2	0.01	17	23	# 2-12 sand	0 0.5	0.5 17	Concrete Bentonite	Flush Mount
CCW-7B	28 Jun 2001	Cascade Drilling, Inc.	Hollow stem auger	11.0	9.0	0.0	4.0	Sch. 40 PVC	2	Flush Mount	4	9	Shallow aq.	Sch. 40 PVC	2	0.01	3	11	# 2-12 sand	0 0.5	0.5 3	Concrete Bentonite	Flush mount
CCW-7C	28 Jun 2001	Cascade Drilling, Inc.	Hollow stem auger	26.0	26.0	0.0	21.0	Sch. 40 PVC	2	Flush Mount	21	26	Deep aq.	Sch. 40 PVC	2	0.01	20	26	# 2-12 sand	0 0.5	0.5 20	Asphalt Bentonite	Flush Mount
CCW-8B	03 Jul 2001	Cascade Drilling, Inc.	Hollow stem auger	12.0	11.0	0.0	6.0	Sch. 40 PVC	2	Flush Mount	6	11	Shallow aq.	Sch. 40 PVC	2	0.01	5	11	# 2-12 sand	0 0.5	0.5 5	Concrete Bentonite	Flush mount
MW-1 (Potter)	18 Feb 1986	--	--	9	8	0.0	3.0	--	--	Flush mount	3.0	8.0	Shallow aq.	--	--	--	--	--	--	--	--	--	--
SB-1A	28 Mar 2001	--	--	--	--	0.0	5.0	PVC	2	Above grade monument	5.0	10.0	Shallow aq.	PVC	2	0.01	3.0	11.0	# 10 / 20 Select Silica Sand	0.0 1.0	1.0 3.0	Concrete Bentonite chips (Enviroplug)	Concrete, above grade monument

Table 2
Well Construction Information
TWAAFA Site
Tacoma, Washington

Well ID	Installation Date	Contractor	Drilling Method	Total Borehole Depth	Initial Total Well	Casing Depth Upper	Casing Depth Lower	Casing Material	Casing Nominal Diameter	Casing Flush or Aboveground	Screen Depth Interval Upper	Screen Depth Interval Lower	Screened Hydro-	Screen Material	Screen Nominal Diameter	Slot Size	Filter Pack Depth Interval Upper	Filter Pack Depth Interval Lower	Filter Pack Material	Seals Depth Interval Upper	Seals Depth Interval Lower	Seals Material	Surface Seal
SB-2A	29 Mar 1991	--	--	--	--	1.0	6.0	PVC	2	Above grade monument	6.0	11.0	Shallow aq.	PVC	2	0.01	4.0	11.5	# 10 / 20 Select Silica Sand	0.0 1.0	1.0 4.0	Concrete Med. bentonite chips (Enviroplug)	Concrete, above grade monument
SB-3A	01 Jan 2001	--	--	--	--	0.0	6.0	PVC	2	Above grade monument	6.0	11.0	Shallow aq.	PVC	2	0.01	4.0	11.5	# 10 / 20 Select Silica Sand	0.0 1.0	1.0 4.0	Concrete Med. bentonite chips (Enviroplug)	Concrete, above grade monument
CTMW-1	03 Jun 1987	Tacoma Pump & Drill	Hollow stem auger	11.2	10	0.0	10.0	Sch. 40 PVC	2	Above grade monument	3.0	10.0	Shallow aq.	Sch. 40 PVC	2	0.01	2.5	10.2	Silica sand, 8x12 (Colorado)	0.0 1.0	1.0 10.5	Concrete Bentonite pellets	Concrete, standpipe w/ locking cap
CTMW-5	29 May 1987	Tacoma Pump & Drill	Hollow stem auger	13	9.48	0.0	3.0	Sch. 40 PVC	2	Flush mount	3.0	9.5	Shallow aq.	Sch. 40 PVC	2	0.01	2.5	10.0	Silica sand, 8x12 (Colorado)	0.0 0.5 10.0	0.5 2.5 11.5	Concrete Bentonite pellets Bentonite pellets	Concrete, flush mount
CTMW-6	01 Jun 1987	Tacoma Pump & Drill	Hollow stem auger	13	10.3	0.0	3.5	Sch. 40 PVC	3	Above grade monument	3.5	10.5	Shallow aq.	Sch. 40 PVC	2	0.01	3.0	11.0	Silica sand, 8x12 (Colorado)	0.0 1.0 11.0	1.0 3.0 13.0	Concrete Bentonite pellets Bentonite pellets	Concrete, standpipe w/ locking cap
CTMW-7	25 Nov 1987	Tacoma Pump & Drill	Cable tool	32.5	28.5	0.0	18.5	Sch. 40 PVC	2	Above grade monument	18.5	28.5	Deep aq.	Sch. 40 PVC	2	0.01	16.3	31.0	Silica sand, 8x12 (Colorado)	0.0 1.0	1.0 16.3	Concrete Bentonite chips	Concrete, standpipe w/ locking cap
CTMW-8	27 Nov 1987	Tacoma Pump & Drill	Hollow stem auger	13	11.54	0.0	3.0	Sch. 40 PVC	2	Above grade monument	3.0	9.8	Shallow aq.	Sch. 40 PVC	2	0.01	2.5	10.0	Silica sand, 8x12 (Colorado)	0.0 0.5	0.5 2.5	Concrete Bentonite pellets	Concrete, standpipe w/ locking cap
CTMW-9	27 Nov 1987	Tacoma Pump & Drill	Hollow stem auger	33	30.14	0.0	18.0	Sch. 40 PVC	2	Above grade monument	18.0	28.5	Deep aq.	Sch. 40 PVC	2	0.01	15.0	29.5	Silica sand, 8x12 (Colorado)	0.0 1.0 4.0	1.0 4.0 15.0	Concrete Bentonite slurry Bentonite pellets	Concrete, standpipe w/ locking cap
CTMW-10	27 Nov 1987	Tacoma Pump & Drill	Hollow stem auger	10	9.8	0.0	2.8	Sch. 40 PVC	2	Above grade monument	2.8	9.8	Shallow aq.	Sch. 40 PVC	2	0.01	2.5	10.0	Silica sand, 8x12 (Colorado)	0.0 0.5	0.5 2.5	Concrete Bentonite pellets	Concrete, standpipe w/ locking cap
CTMW-11R	07 Jun 2007	Cascade Drilling, Inc.	Hollow stem auger	14	13	0.0	3.0	Sch. 40 PVC	2	Above grade monument	3.0	13.0	Shallow aq.	Sch. 40 PVC	2	0.01	2.5	14.0	# 2 / 12 Sand	0.0 1.0	1.0 2.5	Concrete Bentonite chips	Concrete, stand-up with bollards
CTMW-12	27 Nov 1987	Tacoma Pump & Drill	Cable tool	37.5	37.03	0.0	21.0	Sch. 40 PVC	2	Above grade monument	21.0	31.5	Deep aq.	Sch. 40 PVC	2	0.01	20.0	33.0	Silica sand, 8x12 (Colorado)	0.0 1.0 4.0	1.0 4.0 20.0	Concrete Bentonite pellets Bentonite chips	Conrete, standpipe w/ locking cap
CTMW-14	12 May 1989	Hokkaido Drilling	Hollow stem auger	12	11.17	0.0	5.0	Sch. 80 PVC	2	Above grade monument	4.9	9.4	Shallow aq.	Sch. 80 PVC	2	0.01	3.5	9.5	Silica sand, 8x12 (Colorado)	0.0 0.5	0.5 3.5	Concrete Med. Bentonite chips	Concrete, standpipe w/ locking cap
CTMW-15	16 May 1989	Hokkaido Drilling	Hollow stem auger	12	10.46	0.0	5.8	Sch. 80 PVC	2	Above grade monument	5.8	8.2	Shallow aq.	Sch. 80 PVC	2	0.01	4.1	8.2	Silica sand, 8x12 (Colorado)	0.0 1.1	1.1 4.1	Concrete Med. Bentonite chips	Conrete, standpipe w/ locking cap
CTMW-17	08 Apr 1991	Tacoma Pump & Drill	Hollow stem auger	15.5	~15.5	0.0	4.0	PVC	2	Flush mount	4.0	14.5	Shallow aq.	PVC	2	0.01	3.5	15.5	# 10-20 silica sand	0.0 2.0	2.0 3.5	Concrete Bentonite chips	Concrete, flush mount
																			# 2 / 20	0.0	2.0	Concrete	

Table 2
Well Construction Information
TWAAFA Site
Tacoma, Washington

				Total	Initial	Casing					Screen						Filter Pack			Seals			
	Installation		Drilling	Borehol	Total	Depth			Nominal	Flush or	Depth Interval		Screened		Nominal	Slot	Depth Interval			Depth Interval			
Well ID	Date	Contractor	Method	e Depth	Well	Upper	Lower	Material	Diameter	Aboveground	Upper	Lower	Hydro-	Material	Diameter	Size	Upper	Lower	Material	Upper	Lower	Material	Surface Seal
CTMW-17D	11 Jan 2001	Cascade Drilling, Inc.	Hollow stem auger	31.5	30.75	0.0	25.7	Sch. 40 PVC	2	Flush mount	25.7	30.8	Deep aq.	Sch. 40 PVC	2	0.01	25.0	31.5	Pacific Materials Lapis	2.0	25.0	Med. bentonite chips	Concrete, traffic box
CTMW-18	09 Apr 1991	Tacoma Pump & Drill	Hollow stem auger	14.5	13	0.0	4.8	PVC	2	Above grade monument	4.8	13.0	Shallow aq.	PVC	2	0.01	4.0	14.5	# 10-20 silica sand	0.0	1.5	Concrete	Concrete, standpipe w/ locking cap
																				1.5	4.0	Bentonite chips	
CTMW-20	20 Jun 2000	Cascade Drilling, Inc.	Hollow stem auger	11.5	10.5	0.0	3.5	Sch. 40 PVC	2	Flush mount	3.5	10.5	Shallow aq.	Sch. 40 PVC	2	0.01	3.0	11.5	# 2 / 12 Monterey sand	0.0	1.0	Concrete	Concrete, flush mount
																				1.0	3.0	Med. bentonite chips	
CTMW-23	28 May 2002	Cascade Drilling, Inc.	Hollow stem auger	12.5	~12.5	0.0	3.5	Sch. 40 PVC	2	Flush mount	3.5	10.2	Shallow aq.	Sch. 40 PVC	2	0.01	3.0	11.0	# 2 / 12 Monterey	0.0	2.0	Concrete	Concrete, flush mount
																				2.0	3.0	Bentonite	
CTMW-24	16 Aug 2005	Cascade Drilling, Inc.	Hollow stem auger	11	~11	0.0	5.5	Sch. 40 PVC	2	Above grade monument	5.5	10.3	Shallow aq.	Sch. 40 PVC	2	0.01	3.5	11.0	# 2 / 12 Monterey sand	0.0	2.5	Concrete	Concrete, above grade monument with bollards
																				2.5	3.5	Med. Bentonite chips	
CTMW-24D	16 Aug 2005	Cascade Drilling, Inc.	Hollow stem auger	24.5	~24.5	0.0	19.0	Sch. 40 PVC	2	Above grade monument	19.0	23.8	Deep aq.	Sch. 40 PVC	2	0.01	17.0	24.5	# 2 / 12 Monterey sand	0.0	2.0	Concrete	Concrete, above grade monument with bollards
																				2.0	4.0	Med. Bentonite chips	
																				4.0	16.0	Baroid Quickgrout	
																				16.0	17.0	Med. Bentonite chips	
CTMW-25D	19 Aug 2005	Cascade Drilling, Inc.	Hollow stem auger	21	~21	0.0	15.5	Sch. 40 PVC	2	Above grade monument	15.5	20.3	Shallow aq.	Sch. 40 PVC	2	0.01	13.5	21.0	# 2 / 12 Monterey sand	0.0	1.0	Concrete	Concrete, above grade monument with bollards
																				1.0	2.0	Med. Bentonite chips	
																				2.0	12.5	Med. Bentonite chips	
PZ-1	17 Mar 1994	Burlington	RECON	7.5	7	0.0	1.0	PVC	1.5	Flush mount	1.0	7.0	Shallow aq.	PVC	1.5	0.02	--	--	None	0.0	0.5	Bentonite	Flush mount
PZ-4	17 Mar 1994	Burlington	RECON	8	7.2	0.0	1.2	PVC	1.5	Flush mount	1.2	7.0	Shallow aq.	PVC	1.5	0.01	--	--	None	0.0	0.5	Bentonite	Flush mount
PZ-5	17 Mar 1994	Burlington	RECON	8.5	7.2	0.0	1.2	PVC	1.5	Flush mount	1.2	7.2	Shallow aq.	PVC	1.5	0.01	--	--	None	0.0	0.5	Bentonite	Flush mount
PZ-6	15 Jun 1999	Cascade Drilling, Inc.	Hollow stem auger	14.5	11.5	0.0	1.5	PVC	1.5	Flush mount	1.5	11.5	Shallow aq.	Sch. 40 PVC	1.5	0.02	1.2	14.5	# 2 / 12 Lonestar Sand	0.0	0.9	Concrete	Concrete, flush mount
																				0.9	1.2	Med. Bentonite chips	
PZ-7	10 Jan 2001	Cascade Drilling, Inc.	Hollow stem auger	18	17	0.0	3.5	PVC	2	Flush mount	3.5	17.0	Shallow aq.	Sch. 40 PVC	2	0.01	2.5	18	# 2 / 20 Pacific Materials Lapis	0.0	0.5	Concrete	Concrete, flush mount
																				0.5	2.5	Med. Bentonite chips	
PZ-8	09 Jan 2001	Cascade Drilling, Inc.	Hollow stem auger	12	10.2	0.0	5.0	PVC	2	Flush mount	5.0	10.2	Shallow aq.	Sch. 40 PVC	2	0.01	2.5	12.0	# 2 / 20 Pacific Materials Lapis	0.0	0.8	Concrete	Concrete, flush mount
																				0.8	2.5	Med. Bentonite chips	
PZ-9	09 Jan 2001	Cascade Drilling, Inc.	Hollow stem auger	11.5	10.2	0.0	3.0	PVC	2	Flush mount	3.0	10.2	Shallow aq.	Sch. 40 PVC	2	0.01	2.5	11.5	# 2 / 20 Pacific Materials Lapis	0.0	1.5	Concrete	Concrete, flush mount
																				1.5	2.5	Med. Bentonite chips	

DOF

Table 2
Well Construction Information
TWAAFA Site
Tacoma, Washington

Well ID	Installation Date	Contractor	Drilling Method	Total Borehole Depth	Initial Total Well	Casing: Depth Upper	Casing: Depth Lower	Casing: Material	Casing: Nominal Diameter	Casing: Flush or Aboveground	Screen: Depth Interval Upper	Screen: Depth Interval Lower	Screen: Screened Hydro-	Screen: Material	Screen: Nominal Diameter	Screen: Slot Size	Filter Pack: Depth Interval Upper	Filter Pack: Depth Interval Lower	Filter Pack: Material	Seals: Depth Interval Upper	Seals: Depth Interval Lower	Seals: Material	Seals: Surface Seal
PZ-10	17 Mar 1994	Cascade Drilling, Inc.	Hollow stem auger	8	7.5	0.0	7.5	PVC	1.5	Flush mount	2.5	7.0	Shallow aq.	Sch. 40 PVC	1.5	0.02	2.5	7.5	# 2 / 20 Pacific	0.0 0.5	0.5 2.5	Concrete Bentonite	Concrete, flush mount
TWA-1	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Shallow aq.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
TWA-2	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Shallow aq.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
TWA-3	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Shallow aq.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
TWA-4D	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Deep aq.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
TWA-5D	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Deep aq.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
TWA-6D	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Deep aq.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
TWA-7D	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Deep aq.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
TWA-8D	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Deep aq.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
TWA-10D	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	Deep aq.	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Notes & Abbreviations
NA/-- = not available
TBD = to be determined
aq. = aquifer
bgs = below ground surface
Med. = medium
PVC = polyvinyl chloride
Sch = Schedule

TABLE 3
WELL SURVEY DATA
TWAAFA Groundwater Monitoring Plan
Tacoma, Washington

Well ID	Northing	Easting	Top of Casing (feet)[1]
CTMW-1	712038.30	1170995.20	17.01
CTMW-5	712256.70	1171148.90	17.68
CTMW-6	712185.60	1170957.90	18.38
CTMW-7	712198.50	1170961.70	18.33
CTMW-8	712116.90	1170759.60	18.35
CTMW-9	712115.6	1170765.1	17.96
CTMW-10	711968.40	1170777.00	16.38
CTMW-11R	712465.50	1170814.20	23.18
CTMW-12	712500.90	1170692.60	21.87
CTMW-14	711913.7	1170554.1	16.71
CTMW-15	711762.9	1170886.9	16.86
CTMW-17	712457.20	1171002.20	22.90
CTMW-17D	712449.90	1170995.00	20.22
CTMW-18	712304.80	1170966.90	22.94
CTMW-20	711954.90	1171055.30	14.61
CTMW-23	712395.7	1170755.9	28.01
CTMW-24	712293.10	1170515.80	19.93
CTMW-24D	712297.20	1170515.40	19.97
CTMW-25D	711774.10	1170888.60	16.64
PZ-1	712076.80	1170976.40	17.37
PZ-4	712194.50	1170687.50	17.41
PZ-5	712076.20	1170656.00	16.44
PZ-6	712203.10	1170937.60	15.68
PZ-7	712935.20	1170522.10	24.55
PZ-8	713181.90	1170871.40	18.42
PZ-9	712934.00	1171142.30	19.13
PZ-10	712250.10	1170892.00	16.19
CCW-1A	712219.30	1171352.20	12.77
CCW-1B	712220.20	1171355.10	12.12
CCW-1C	712224.80	1171349.40	13.06
CCW-2A	NA	NA	15.80
CCW-2B	NA	NA	15.70
CCW-2C	712471.70	1171237.40	15.64
CCW-3A	712646.20	1171049.70	17.33
CCW-3B	712643.40	1171047.30	17.69
CCW-3C	712651.10	1171053.40	19.26
CCW-4C	712270.10	1171047.40	13.72
CCW-5B	712652.40	117127.60	16.20
CCW-5C	712651.60	1171212.70	15.98
CCW-6B	712561.70	1171372.40	12.31
CCW-6C	712557.10	1171380.10	12.13
CCW-7B	712466.10	1171399.60	11.91
CCW-7C	712125.70	1171400.80	12.06
CCW-8B	712125.70	1171171.20	13.32
MW-1	712013.70	1170900.50	14.42
SB-1A	NA	NA	15.92
SB-2A	NA	NA	15.49
SB-3A	NA	NA	17.16

Notes
1. North American Vertical Datum 1988.
2. Survey data obtained from Table 4-5 in Final RI (PSC, 2005)

Abbreviations
NA = not available

Quality Assurance Project Plan

TAYLOR WAY AND ALEXANDER AVENUE FILL AREA SITE

TACOMA, WASHINGTON

January 29, 2019

Prepared by:

DALTON, OLMSTED, & FUGLEVAND
1001 SW Klickitat Way, Suite 200B
Seattle, Washington 98134

Prepared for:

GENERAL METALS
GLENN SPRINGS HOLDINGS
PORT OF TACOMA
STERICYCLE ENVIRONMENTAL SOLUTIONS

DOF DALTON OLMSTED FUGLEVAND

Table of Contents

Distribution List

This list identifies all individual to receive a copy of the approved Quality Assurance Project Plan, either in hard copy or electronic format, as well as any subsequent revisions.

Washington State Department of Ecology Project Manager:	Andrew Smith Washington State Department of Ecology Toxics Cleanup Program Southwest Regional Office PO Box 47775 Olympia, WA 98504-7775 (360) 407-6316 ansm461@ECY.WA.GOV
TWAAFA Project Coordinator:	TBD
Quality Assurance Leader:	TBD
Field Coordinator:	TBD

1.0 Background

Dalton, Olmsted, and Fuglevand, Inc. (DOF), has prepared this Quality Assurance Project Plan (QAPP) for the Taylor Way and Alexander Avenue Fill Area (TWAAFA) Site on behalf of Glenn Springs Holdings, Inc. (Occidental Chemical), the Port of Tacoma, Schnitzer Steel Industries, Inc., and Stericycle Environmental Solutions, Inc. (Stericycle). These parties are among those identified in the Washington State Department of Ecology's (Ecology) draft Agreed Order Number 14260 and have agreed to prepare a Groundwater Monitoring Plan requested by Ecology as part of finalizing the Agreed Order.

The project description, regulatory background, site history, site characterization, and site conditions are described in the Revised Data Gaps Work Plan (DOF, 2019).

This QAPP outlines quality assurance (QA) and quality control (QC) protocols to be followed in implementing the Groundwater Monitoring Plan.

2.0 Project Description

The Groundwater Monitoring Plan outlines a program to monitor the groundwater emanating from the TWAAFA site. The objective of the GWMP is to track the concentrations of known contaminants at the facility as well as provide monitoring for any potential new releases. The monitoring wells are located to provide adequate information on (1) groundwater flow at the site, (2) groundwater underlying the site; and (3) groundwater leaving the site and flowing to off-site, downgradient locations.

3.0 Organization

The individuals responsible for planning and implementing field and laboratory operations and QA/QC procedures for this project are identified in Table 1, along with contact information and a summary of each individual's responsibilities for project management and QA procedures.

3.1 Management Responsibilities

Project management responsibilities are shown in Table 1. Detailed descriptions of the management and QA responsibilities of laboratory personnel are described in the laboratory QA Manual (available upon request or on the laboratory's website).

3.2 Quality Assurance

The personnel responsible for review and approval of the QAPP and for data verification, validation, and data quality assessment are described in Table 1.

3.3 Field Responsibilities

Field Responsibilities for collection of the samples are provided in the Groundwater Monitoring Plan and in Sections 9 through 8 of this QAPP.

3.4 Laboratory Responsibilities

ALS Global laboratory in Kelso, Washington will provide analytical services for the groundwater monitoring program. The laboratory QA officer, as described in Table 1, will ensure that appropriate procedures are followed during sample analysis and preparation of the data packages and electronic deliverables. ALS' QA Manual will be provided to the QA/QC coordinator. The QA Manual includes descriptions of the laboratory organization, personnel, and responsibilities; facilities and equipment, analytical methods and QA/QC protocols; and routine procedures for sample custody and data handling.

4.0 QUALITY OBJECTIVES

The sampling design, field procedures, laboratory procedures, and QC procedures are set up to provide high-quality data for use in the groundwater monitoring program. Specific data quality factors that may affect data usability include quantitative factors (precision, bias, accuracy, completeness, and reporting limits) and qualitative factors (representativeness and comparability). The measurement quality objectives (MQOs) associated with these data quality factors are summarized in Table 2 and discussed below.

4.1 PRECISION

Precision is the agreement among a set of replicate measurements without assuming knowledge of the true value. Precision is measured for this project by calculating the relative percentage difference (RPD) for analytical results from field duplicate and lab duplicate samples. Precision is optimized by collecting data at multiple locations and adhering to strict procedural guidelines that minimize possible sample contamination. RPD results that are outside the control limits listed in Table 2 for laboratory split samples will be qualified appropriately during data validation.

Field precision will be assessed through the collection and analytical testing of field duplicates at a rate of one duplicate per 20 field samples, or a minimum of 1 per day. These analyses measure both field and laboratory precision. The results, therefore, may have more variability than laboratory- generated duplicates.

Laboratory precision is assessed through analysis of duplicate spiked and/or unspiked samples, as specified by the analytical method. Specific discussion of the different types of laboratory duplicate samples is found in Section 8.1.

The RPD value will be calculated according to the following formula:

$$RPD(\%) = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} * 100$$

Where:

D1 = Concentration of analyte in sample.

D2 = Concentration of analyte in duplicate sample.

The calculation applies to split samples, replicate analyses, duplicate spiked environmental samples (matrix spike duplicates), and laboratory control duplicates. The RPD will be calculated for samples and compared to the applicable criteria. Precision may also be expressed as the percent difference (%D) between replicate analyses. During data validation, the data validator will evaluate all RPD values and take action as described in U.S. Environmental Protection Agency (EPA) guidance (EPA, 2008, 2010).

4.2 BIAS

Bias is systematic deviation of a measured value from the true value. Bias can be assessed by comparing a measured value to an accepted reference value in a sample of known concentration or by determining the recovery of a known amount of contaminant spiked into a sample. Bias is minimized for this project by standardizing field activity methodologies, including methods for equipment decontamination, sample collection, field observation and documentation, sample transport, and chain-of-custody control. Descriptions of these methodologies are included in the Groundwater Monitoring Plan.

4.3 ACCURACY

Accuracy is the degree of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy will depend on a combination of random error and of common systematic error (or bias). Accuracy will be evaluated for this project by evaluating laboratory spike sample recoveries that represent the difference between an observed value and an accepted reference value. Control limits for spike recoveries have been documented by the project laboratory and are found in Table 2. Results showing noncompliant recoveries will be qualified appropriately during data validation. In general, if percent recoveries are consistently low, nondetect results may indicate that compounds of interest are not present when in fact these compounds are present. Detected compounds may be biased low or reported at a value less than actual environmental conditions. The reverse is true when recoveries are consistently high. In such case, results for detected analytes may be higher than the true value. Accuracy will be optimized for this project by using procedures designed to reduce potential error that might impact the accuracy of results. Proper decontamination methods and equipment will be used during field activities to ensure accurate results. The laboratory QC procedures, described in Section 8.1, also reduce error to improve accuracy.

Accuracy will be assessed by the percent recovery (%R) of a surrogate compound (also known as "system monitoring compound"), a matrix spike result, and/or results from a laboratory control sample (also known as standard reference material or blank spikes) where:

$$Recovery(\%) = \frac{Sample\ Result}{Spike\ Amount} * 100$$

The data validator will evaluate all %R values and take action as described in EPA guidance (EPA, 2008, 2010).

4.4 REPRESENTATIVENESS

Representativeness is the measure of how well data reflect the actual environment and the conditions under which the data are collected. Representativeness will be optimized for this project by using general historical and investigative information to determine proper locations of new sampling points that represent the areas of concern. The methodologies used to collect samples and measurements, as detailed in the Groundwater Monitoring Plan, are also designed to collect representative data with minimal disturbance of the environment from which they are collected.

To be considered representative, a data set should accurately and precisely represent the actual field conditions. Determination of the representativeness of the data will be performed by:

- Comparing actual sampling procedures to those prescribed in the Groundwater Monitoring Plan and this QAPP;
- Comparing analytical results from field duplicates to determine variation in the analytical results; and

- Flagging nonrepresentative data as invalid or identifying data that are noncompliant with project specifications.

Only representative data will be used in subsequent data reduction, validation, and reporting activities.

4.5 COMPARABILITY

Comparability is how well multiple data sets can be used for a common interpretation. Comparability will be optimized for this project by using the same standards for data collection at each location, and the same analytical procedures and QA procedures during each sampling event.

Comparability expresses the confidence with which one set of data can be compared to another. Since numeric goals do not exist for comparability, a statement of comparability will be prepared to determine overall usefulness of data sets, following the determination of both precision and accuracy. This statement will be included in the Data Review Reports (see Section 10.2.3).

4.6 COMPLETENESS

Completeness is a measure of the amount of data collected that are found to be valid in relation to the total amount of data intended to be collected according to the sampling design. Completeness will be optimized for this project by having all analytical results validated or reviewed by a data validator to assess the validity of the data.

The number of samples and results expected establishes the comparative basis for completeness and is defined as a ratio of acceptable measurements (including estimated data) obtained to the total number of planned measurements for an activity. Completeness (C) can be calculated as follows:

$$\%C = \frac{(number\ of\ acceptable\ data\ points)}{(total\ number\ of\ data\ points)} * 100$$

The data quality objective (DQO) for completeness for this project is 100 percent useable data for samples/analyses planned. If the completeness goal is not achieved, an evaluation will be made to determine if the data are adequate to meet study objectives. Completeness below 100 percent will require review of the sampling objectives to determine whether further sampling and analyses may be required.

4.7 REPORTING LIMITS

Analytical methods have quantitative limitations at a given statistical level of confidence that are often expressed as the method detection limit (MDL). Although results reported near the MDL provide insight to actual field conditions, quality assurance requires that analytical methods achieve a consistently reliable level of quantitation known as the practical quantitation limit (PQL). The laboratory will provide numerical results for all analytes and report them as detected above the PQL or undetected at the PQL.

Ideally, the laboratory's reporting limits (PQLs) should be low enough to compare to the applicable Model Toxics Control Act (MTCA) Method A or Method B screening levels. A reasonable level of effort will be exercised to achieve these goals.

Several factors may influence laboratory PQLs and individual sample quantitation limits. Changes in laboratory protocols may change the applicable PQL that the laboratory can achieve. The most recent laboratory QA Manual will provide the current applicable PQL. Analytical procedures may also require dilution and/or cleanup of samples and subsequent reanalysis to accurately quantify a particular analyte at concentrations above the range of the instrument. The effect is that other analytes may be reported as undetected at a PQL much higher than a specified screening level. Data users must be aware that nondetected analytes with a high stated reporting limit, although correctly reported, can bias statistical summaries, and careful interpretation is required to correctly characterize site conditions. During data validation, evaluation will be made and the most appropriate result for each analyte will be reported.

5.0 SAMPLING PROCESS DESIGN

The sampling design, including figures showing field work locations, tables of samples to be collected, and the sample collection schedule, are included in the Groundwater Monitoring Plan.

6.0 SAMPLING PROCEDURES

Procedures for all field activities are described in the Groundwater Monitoring Plan. All field personnel will have completed 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Site Operations (HAZWOPER) training.

All instruments used in the collection of samples will be properly calibrated according to the manufacturer's recommendations and decontaminated between samples if the instrument is reusable and comes in contact with samples. All samples will be placed in iced coolers immediately following sample collection, and strict chain-of-custody control will be maintained at all times. Samples will be delivered or shipped to the project laboratory.

6.1 SAMPLE IDENTIFICATION

Each sample will be assigned a unique alphanumeric identification code (identifier) that contains sufficient information to identify the sample location and date. The sample labeling procedure is described in the Groundwater Monitoring Plan.

6.2 SAMPLE LABELING

A label will be securely attached to every sample container. Each label will include the following information:

- sample identifier;
- project name;
- date and time of collection (using 24-hour time clock to minimize potential confusion about a.m. and p.m.; e.g., "1300" vs. "1:00 p.m."); and
- analyses to be performed.

6.3 FIELD LOG MAINTENANCE

All sample location descriptions, sample identifiers, and analyte lists will be recorded in the field log. The field log will include, but not be limited to, the following information:

- all incidents observed during each sampling event;
- the names of all personnel present involved in the sampling event;
- the major events that occurred during the day;
- details about field procedures conducted; and
- details about samples collected or problems that occurred.

Procedures for maintaining the field log are described in the Groundwater Monitoring Plan.

6.4 SAMPLE CONTAINERS AND PRESERVATIVES

Table 1 in the Groundwater Monitoring Plan specifies the sample containers required for each analytical method. Table 3 also specifies the required containers as well as the sample size, preservation protocol, and holding times for the list of analyses to be performed. All sample containers will be provided by the laboratory and will include the appropriate preservatives.

Sample containers will be placed in opaque, insulated coolers packed with ice to minimize their exposure to light and to cool them approximately to the recommended temperature. The coolers will be packed with sufficient packing material to prevent sample container breakage and/or leakage during transport.

The project manager and field personnel will plan sampling activities and coordinate sample delivery with laboratory personnel so that the sample holding time limits and temperatures specified in Table 3 are not exceeded.

6.5 SAMPLE STORAGE AND TRANSPORTATION

The exteriors of all sample containers will be wiped clean after they have been closed. Blank (QC) samples will be packaged with the primary samples that they control. Any vacant space in the cooler will be filled with ice or packing material. If the cooler has a drain, it will be taped shut. Then each cooler will be secured.

6.6 SAMPLE CHAIN-OF-CUSTODY

Chain-of-custody procedures will be followed by all project personnel to document sample transfer, sample possession, and sample integrity, from the time of sample collection through the completion of sample analysis. A chain-of-custody form will be initiated at the time of sampling, and will accompany the samples at all times including upon receipt at the project laboratory. The project laboratory maintains an internal custody protocol. The chain-of-custody form has blank fields for entering the sample identifier, the date and time of sample collection, the name of the person who collected the sample, and the requested laboratory analyses. Each chain-of-custody form will be signed by every person who handles the sample containers. Sample transfers will be noted on the chain-of-custody form for each sample.

The chain-of-custody form documents sample identifications, locations, sample times, and the analyses required for each sample. This is the principal document shared by the sample generator and the project laboratory. Therefore accuracy and completeness are extremely important.

Personnel initiating the chain-of-custody form will refer to the field forms and the field log (described below) to access the required information. This continuity will help make the various forms of documentation consistent and reduce the risk of error. The chain-of-custody form will accompany all samples during transport. The field sampler also will keep a copy of the chain-of-custody form for the project file.

All samples will be delivered directly to laboratory personnel authorized to receive samples (sample custodians). When the laboratory receives the samples, the sample custodian will inspect the exterior condition of the shipping container. Then the sample custodian will open and examine the interior of the shipping container. Next the sample custodian will examine the sample containers and check the contents of the shipping container against the chain-of-custody form. The sample custodian will record any inconsistencies or problems with the sample shipment (breakage or signs of leakage, and missing or extra samples) on the chain-of-custody record and notify the TWAAFA project coordinator or the QA Leader for immediate resolution. Official acceptance of sample custody will be documented by the sample custodian's signature on the chain-of-custody form. The samples will then be tracked through the laboratory by the laboratory's internal custody procedures.

7.0 MEASUREMENT PROCEDURES

The analytical and QA/QC procedures used by the laboratory are described in the laboratory QA Manual and SOPs.

7.1 LABORATORY MEASUREMENT PROCEDURES

Groundwater samples will be analyzed for the list of analytes as identified in the Groundwater Monitoring Plan. Chemical laboratory analyses will be performed using the following sets of standard laboratory methods:

- Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition (EPA, 2007);
- Ecology method NWTPH (for total petroleum hydrocarbons).

7.2 FIELD MEASUREMENT PROCEDURES

Field equipment will be used in general accordance with the manufacturer's recommendations. More details on field procedures are provided in the Groundwater Monitoring Plan.

8.0 QUALITY CONTROL

This section outlines QC procedures to be followed by both the field personnel and the analytical laboratory. Following these QC procedures will support the development of a complete and accurate data set following laboratory analysis and data validation. In this section, a sampling event is defined as consecutive days of sampling not separated by more than 2 days of inactivity.

8.1 ANALYTICAL LABORATORY QUALITY CONTROL

The project laboratories are required to adhere to specified criteria in the following areas to verify the validity of data being produced:

- Holding times;
- Instrument tuning;
- Initial calibrations and continuing calibration verification;
- Method blanks;
- Surrogate spike compounds;
- Matrix spike samples and matrix spike duplicates (MS/MSD);
- Laboratory control samples (LCS);
- Laboratory duplicates; and
- Internal standards.

8.1.1 Holding Times

Holding time constraints for each method will be met to ensure the validity of the results report. Holding times are outlined in Table 3.

8.1.2 Instrument Tuning

Instrument tuning for analyses by gas chromatography/mass spectrometry (GC/MS) will be completed to ensure that mass resolution, identification, and, to some degree, sensitivity of the analyses are acceptable. Instrument tuning will be completed each 12-hour period during which samples or standards are analyzed. In the event that an instrument tuning does not meet control limits, analyses of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any project samples analyzed while the instrument is out of calibration will be reanalyzed.

8.1.3 Laboratory Instrument Calibration

Initial calibration of instruments, as applicable, will be performed at the start of the project and when any ongoing calibration does not meet control criteria. The number of points used in the initial calibration is defined in each analytical method. Continuing calibration verification will be performed as specified in the analytical methods to track instrument performance. In the event that continuing calibration verification does not meet control limits (as specified by the method requirements), analysis of project samples will be suspended until the source of the control failure is either eliminated or reduced to within control specifications. Any project samples analyzed while the instrument was out of calibration will be reanalyzed. Calibration documentation will be retained at the laboratory and readily available for review.

8.1.4 Laboratory Method Blanks

According to the EPA (2008, 2010), “the purpose of laboratory (or field) blank analyses is to determine the existence and magnitude of contamination resulting from laboratory (or field) activities. The criteria for evaluation of blanks apply to any blank associated with the samples (e.g., method blanks, instrument blanks, trip blanks, and equipment blanks).”

Method blanks are laboratory QC samples that consist of either a contaminant-free, soil-like material or deionized water. Method blanks are created in the laboratory during sample preparation and follow samples throughout the analysis process. The frequency of method blanks will be at least one per analytical batch for each matrix. No more than 20 non-QC field samples can be contained in one batch.

If a substance is found in the method blank then one (or more) of the following events occurred.

- The measurement apparatus or containers were not properly cleaned and contained contaminants.
- Reagents used in the process were contaminated with a substance(s) of interest.
- Contaminated analytical equipment was not properly cleaned.
- Volatile substances in the air contaminated the samples during preparation or analysis.

Given method blank results, validation guidelines aid in determining which substances in samples are considered “real” and which ones are inadvertent contaminants of the analytical process. During data validation, the data validator will evaluate all method and field blank sample results and take action as described in EPA reference documents (EPA, 2008, 2010); professional judgment will be applied as necessary.

8.1.5 Surrogate Spikes

Surrogate spike compounds are used during analysis for organic analytes to verify the accuracy of the instrument being used and assess extraction efficiency. Surrogates are substances similar to, but not one of, the target analytes. A known concentration of surrogate compound is added to the sample and passed through the instrument, and the surrogate compound recovery is recorded. Each surrogate compound used has an established range of acceptable percent recoveries, as summarized in Table 2. If a surrogate recovery is low, sample results may be biased low, and, depending on the recovery value, a possibility of false negatives may exist. Conversely, when recoveries are above the specified range of acceptance a possibility of false positives exists, although nondetected results are considered accurate.

8.1.6 Matrix Spike/Matrix Spike Duplicates

Laboratory precision will be determined by splitting spiked or unspiked samples. MS/MSD sample analyses are used to determine accuracy and precision and to assess interferences caused by the physical or chemical properties of the sample itself. The analyst uses this information to determine the precision of the preparation and analytical techniques used to analyze the duplicate sample.

MS samples are preselected by field personnel and labeled accordingly on the chain-of-custody. The laboratory divides the sample into equal aliquots, and then spikes each of the aliquots with a known concentration of target analytes. Matrix spike samples are prepared by spiking a known amount of one or more of the target analytes at a concentration of 5 to 10 times higher than the expected sample result. Matrix spikes will be prepared and analyzed at a minimum frequency of 5 percent or one for each batch of 20 or fewer samples for each matrix. Some analyses (such as total petroleum hydrocarbons) do not require MS/MSDs, as shown on Table 4. In addition, some analyses only require an MS sample and not an MSD.

MS/MSD data are reviewed in combination with other data quality indicators (e.g., LCS/LCS duplicate [LCSD]) to determine matrix effects. In some cases, matrix effects cannot be determined due to dilution and/or high levels of related substances in the sample.

8.1.7 Laboratory Control Spikes/Laboratory Control Spike Duplicates

The purpose of the laboratory control spike samples (also known as blank spikes) is to aid in assessment of overall accuracy and precision of the entire analytical process (e.g., sample preparation, instrument performance, and analyst performance). An LCS will be prepared and analyzed at a minimum of one LCS with each batch of 20 samples or fewer for each matrix. LCS are similar to matrix spikes; however, the LCS spike medium is “clean” or contaminant free.

8.1.8 Laboratory Replicates/Duplicates

Precision for inorganic analytes is monitored by analysis of [nonspiked] sample replicates/duplicates. Laboratory duplicate sample analysis, for inorganic analytes, will be prepared and analyzed at a minimum frequency of 5 percent or one laboratory duplicate with each batch of 20 samples or fewer for each matrix.

8.1.9 Internal Standards

Internal standards are added to all field and QC samples immediately prior to analysis for analyses completed by GC/MS. The internal standards are used to quantify target compounds and to ensure that the instrument is stable and functioning as calibrated.

No special QC procedures will be required for this project. Ranges of laboratory-established control limits for surrogates, MS/MSD recoveries, LCS recoveries, and laboratory duplicate RPDs, as applicable, are provided in Table 2. The most current laboratory control limits will be used to evaluate results during data review and may be obtained directly from the laboratory Project Managers.

8.2 FIELD QUALITY CONTROL

Field QC samples are collected and analyzed to assess sample collection techniques, possible sources of contamination, interferences that may be attributed to the sample matrix, and, to some degree, the bias and precision of the reported results. Field QC will be evaluated, along with laboratory QC, by the data validator during data review and validation. Affected data will be qualified in accordance with EPA (2008 and 2010) guidelines. A description of each type of QC sample is described below. For the purpose of this discussion, the term “primary sample” is defined to be a field sample of environmental medium (e.g., soil) other than a field QC sample.

8.2.1 Field Equipment Calibration Procedures

Field equipment requiring calibration will be calibrated to known standards in accordance with manufacturer’s recommended schedules and procedures for each instrument. Calibration (or drift) checks of the vapor measurement equipment will be conducted daily, and the instruments will be recalibrated as required. Calibration measurements will be recorded in the daily field logs. If field equipment becomes inoperable, it will be replaced with a properly calibrated instrument.

8.2.2 Equipment (Rinsate) Blanks

Equipment rinsate blanks will be collected whenever nondedicated or nondisposable sampling equipment will be used. Equipment rinsate blanks will be used to identify possible contamination from the sampling environment or from sampling equipment. These blanks will be collected by pouring deionized and distilled water over (or through) the decontaminated sampling equipment and into a sample jar. One equipment rinsate blank will be collected for each type of sampling equipment used during the sampling event and will be analyzed for all analytes except conventional analytes. The frequency of collection will be 1 per 20 samples collected. These are typically not required during routine sampling since PSC uses dedicated or disposable equipment for sampling all wells, but would be required if that were ever not the case.

8.2.3 Field Blanks

Sampling personnel will collect field blanks and submit the blanks to the laboratory as natural samples. Field blanks will be used to identify possible contamination occurring from the sampling environment. These blanks will consist of deionized and distilled water from the analytical laboratory in clean and preserved sampling containers. In the field, this water will be transferred to an empty sampling container at a specified sampling location. The sample will be preserved for the applicable analysis to be completed. The frequency of collection will be 1 per 20 samples collected. Field blanks will be analyzed for all analytes.

8.2.4 Trip Blanks

Trip blank samples, consisting of organic-free water poured into 40-milliliter (ml) sample vials at the laboratory under contaminant-free conditions, will be provided by the laboratory for each sampling event that includes analysis of volatile organic compounds (VOCs). Trip blanks remain sealed during sampling and are kept in the sample transport container at all times. Trip blank samples are analyzed for VOCs and gasoline-range organics and will provide a measure of potential cross-contamination with VOCs during shipment and handling.

Trip blanks will be included at a rate of one per cooler for analyses of all volatile constituents (e.g., VOCs, and gasoline-range organics). Results of trip blank samples are used to assess potential contamination that may impact groundwater samples during transport.

8.2.5 Field Duplicates

Field duplicates are used to assess the homogeneity of samples collected in the field and the precision of sampling methods. Field duplicates are prepared by collecting two aliquots (i.e., splits) of sample from the same sampling location using the same sampling equipment and technique, then submitting them for analysis as separate samples. Results from the analysis of field duplicates are used to evaluate the precision and consistency of laboratory analytical procedures and methods, and the consistency of the sampling techniques used by field personnel. Groundwater field duplicates will be collected at a rate of 1 per 20 samples per sampling event. Field duplicates will be collected at locations with suspected contamination. Any well with detections the previous sampling round would be eligible to be a field duplicate location the following round. The field duplicate RPD should be less than 30 percent for groundwater samples.

8.2.6 Matrix Spike/Matrix Spike Duplicate

Extra sample volume must be collected by field staff to enable the lab to run MS/MSD analyses for the designated analyses listed in Table 4. MS/MSD sample volume should be submitted at a rate of 1 per 20 samples collected, or one per field mobilization (lab batch) at a minimum. All MS/MSD samples should be noted on the chain-of-custody form. MS samples should be collected at relatively “clean” locations and are analyzed to assess the effects of the sample matrix on the accuracy of analytical measurements. Any well without COC detections the previous sampling round would be eligible to be a field duplicate location the following round. MSD samples are used to assess both accuracy and precision.

8.3 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or QC performance outside established criteria. Corrective action can occur during field activities, laboratory analyses, data validation, or data assessment.

Corrective actions should be designed to correct the problem and to minimize the possibility of recurrence. Examples of corrective actions include modifying nonconforming procedures, forms, or worksheets; instituting a quality check; and the like. Proposed corrective actions should be reviewed and approved by the QA Leader prior to implementation. Significant noncompliance and corrective actions will be discussed in QA reports to the TWAAFA Site Coordinator and Washington State Department of Ecology (Ecology), as appropriate.

8.3.1 Field Corrective Action

Project personnel will be responsible for reporting technical or QA nonconformances or deficiencies of any activity or issued document to the Field Coordinator. The Field Coordinator will consult with the QA Leader to determine whether the situation warrants a reportable nonconformance and subsequent corrective action. If so, a Corrective Action Report (CAR) will be initiated by the QA Leader.

Corrective actions will be implemented and documented in the field record log. No staff member will initiate corrective action without prior communication of findings using the process described above.

8.3.2 Laboratory Corrective Action

Corrective action by the laboratory may occur prior to or during initial analyses. Conditions such as broken sample containers, multiple phases, low/high pH readings, and potentially high-concentration samples may be identified during sample log-in or prior to analysis.

Laboratory corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, and who checks potential sources of error, such as instrument calibration, spike and calibration mixes, and instrument sensitivity. If the problem persists, or cannot be identified, the problem should be referred to the supervisor, manager, and/or Laboratory Project Manager for further investigation and possible formal corrective action.

The contracted laboratory's QA Manual includes specific procedures for identification and documentation of nonconformance and implementation and reporting of corrective actions.

8.3.3 Corrective Actions Resulting From Data Validation

If necessary, the data validator will contact the laboratory for further information, clarification, or needed resubmissions and/or corrective actions. All communications will be documented and included with the data validation report as an appendix.

In cases where a deficiency or problem is a recurring nonconformance requiring more extensive corrective action, it should be documented on a formal CAR. The CAR will be sent to the organization responsible for the corrective action, and a copy routed to the QA Leader. When the corrective action is complete, the data validator will complete the CAR.

9 DATA MANAGEMENT PROCEDURES

Computerized systems will be used to record, store, and sort the technical data that will support the site investigation. The data record will include a unique sample code, station ID, sample type (matrix), analyte, analyte concentration, and concentration units. Automated data handling increases the data integrity by reducing errors, omissions, and ambiguities that can be introduced by manual procedures. In addition, automated procedures will generally be used by the laboratories to capture and summarize analytical results. Sampling location coordinates will be entered into the database to enable the generation of maps and figures and upload to Ecology's Environmental Information Management System.

Field logbooks, station/sample forms, and chain-of-custody/sample analysis request forms are prepared by the field team while sample collection activities are in progress. Sample information from the field, such as water elevation data, is entered manually. Data from the laboratories are entered directly from the electronic data deliverables (EDDs). A small portion of the laboratory data may be entered manually if electronic data cannot be supplied. Data qualifiers are entered into the database when data validation is completed and verified, and the data set is approved as final. All manual and electronic entries are verified by the data manager or validation personnel.

9.1 LABORATORY DATA REPORTS

The project laboratory will complete all analyses as described in the Groundwater Monitoring Plan and present the following, at a minimum, in a report to the QA Leader within approximately 30 days of the receipt of samples, unless a shorter turnaround time is requested.

- Case narrative: The case narrative will describe the analytical methods used and discuss any irregularities encountered during sample analyses and any resulting data qualification.
- Analyte concentrations: A summary of analytical results will be presented for each sample.
- Method reporting limits: Method reporting limits achieved by the laboratory will be presented with the analyte concentrations.
- Laboratory data qualifier codes and a summary of code definition: Data qualifiers will appear next to analyte concentrations, and associated definitions will be summarized in the report.
- Lab QC results: Results for method blanks, MS/MSD, LCS/LCSD, lab duplicates, and surrogate recoveries will be provided with final results.
- Chromatographs for all samples run for petroleum analyses.
- EDD version of results: A full set of results will be provided in database format.

9.2 PROJECT DATABASE

Data validation will be performed on specified analytical data for this project, and the data validator will enter validation qualifiers and comments into the data set as necessary.

The QA Leader will then transmit the validated EDD along with the validation report to the database uploader, who will upload it into Ecology's Environmental Information Management System. Tables from the EDD/database will then be backchecked against hard copy results. Any corrections will be made to the database based on backcheck findings. The data will then be considered final, and EDDs or tables will be created from the EDD/database as necessary for use in data analysis and reporting.

9.3 RECORDS MANAGEMENT

The QA Leader will inventory and store all analytical data, including all resubmissions collected during data validation efforts, worksheets, and original data validation reports.

10 AUDITS AND REPORTS

10.1 AUDITS

Any deviations from the Groundwater Monitoring Plan that occur during the reporting period will be included in the annual reports provided to Ecology.

10.2 REPORTS

Procedures, observations, and test results will be documented for all sample collection, laboratory analysis and reporting, and data validation activities. In addition to data reports provided by the laboratories, reports will be prepared that address data quality and usability and that provide tabulated laboratory and field data. Internal and external reporting procedures for this project are described in this section.

Upon receipt of the chemical data from the laboratories, the data will be subjected to a QA review (i.e., data validation). The QA reviews are anticipated to be completed within 30 days of receipt of the last data package from the laboratory. The results of the validated data will then be reported according to the schedule in the Groundwater Monitoring Plan. Details regarding the validation of data are presented in Section 11.0 of this QAPP. In the event of unscheduled delays in the project schedule, the TWAAFA Site Coordinator will inform the Ecology project manager.

10.2.1 Field Records

Field records will be maintained during all stages of sample collection and preparation for shipment to the laboratories. Field records will include the following items:

- Field notebook to record daily sampling activities, conditions, and field measurements;
- Combined station/sample log to document station locations and date and time of collection;
- Sample labels and tags;
- Combined chain-of-custody/sample analysis request (COC/SAR) forms;
- Custody seals to monitor cooler security during shipment; and
- Photographic documentation (if taken).

Descriptions of the information that will be reported on each field record form are provided in SOP-400, contained in the Groundwater Monitoring Plan.

In addition to the routine field records, the following reports will be completed if a deviation from the Groundwater Monitoring Plan or QAPP is encountered:

- Corrective action reports documenting any problems encountered during field activities and corrective actions taken,
- A summary of any changes made to documented procedures and the rationale for the changes.

10.2.2 Laboratory Data Reports

The laboratories will perform data reduction as described in each test method for this project and submit complete data packages, as appropriate, with full documentation for all analyses or other determinations. The laboratory QA managers or their designees are responsible for reviewing their respective laboratory data packages, verifying all method-specific QA/QC protocols were completed and are acceptable, and checking data reduction so that a QA review has been completed for all data reported prior to submittal to the TWAAFA group. Any transcription or computation errors identified during this review will be corrected by the laboratory.

The analytical laboratories will provide all information required to complete an abbreviated QA review (i.e., summary review) on 100 percent of the data.

To complete an abbreviated QA review, the information to be reported (as applicable to the analytical method) will include, at a minimum, the following:

- A cover letter discussing analytical procedures and any difficulties that were encountered;

- A summary of analyte concentrations and method reporting limits;
- Laboratory data qualifier codes appended to analyte concentrations, as appropriate, and a summary of code definitions;
- Results for method and calibration blanks;
- Results for all QA/QC checks, including SMCs, surrogate compounds, MS samples, LCSs, MSD samples, and laboratory duplicate or triplicate samples.

10.2.3 Data Review Report

A data review report will be prepared upon completion of the data review. The data review reports will summarize the results of the data validation and data quality review and will describe any significant QA problems that were encountered. The data review reports for the chemical analyses may include all or a portion (depending on the type of data validation that may be completed) of the following items:

- Executive summary of overall data quality and recommendations for data use and limitations;
- Description of sample collection and shipping, including chain-of-custody and holding time documentation;
- Description of analytical methods and detection limits;
- Description of data reporting;
- Description of completeness relative to QAPP objectives;
- Description of instrument tuning and initial and continuing calibration results;
- Description of any contamination in field and laboratory blanks and implications for bias of the data;
- Description of accuracy relative to QAPP objectives, including results of SMC, surrogate, MS, and LCS recoveries;
- Description of precision relative to QAPP objectives, including results for field and laboratory replicate analyses;
- Identification of cases where control limits or measurement performance criteria were not met and summary of the significance of these deviations; and
- Description of analyte identification and quantification.

All data and any qualifiers applied to the data as a result of the QA review will be reported in the final data report.

10.2.4 Location of Records and Reports

The records generated during sample collection and analysis document the validity and authenticity of the project data. These records will become part of the final project file. The project file will be retained by the TWAAFA Site Coordinator. Project reports will be kept with the project files for reference purposes. Records that are more than 3 years old may be archived at a data archiving subcontractor's site, but all data will be retrievable in a quick time frame (normally 1-2 days).

11 DATA REVIEW, VERIFICATION, AND VALIDATION

Data review, verification, and validation are conducted to establish the data quality and usability for the project. These procedures are described below. Data verification is the process of determining whether data have been collected or generated according to the Groundwater Monitoring Plan, QAPP, and the respective SOPs or method descriptions. Data validation is the process of evaluating the technical usability of the verified data with respect to the planned objectives of the project.

11.1 SAMPLE DESIGN AND SAMPLE COLLECTION PROCEDURES

The conformance of the field activities to requirements in the Groundwater Monitoring Plan will be evaluated by the Field Coordinator and/or QA Leader on an ongoing basis while field activities are in progress. The review process will include immediate evaluation of any change to the sampling plan so that an alternate field procedure may be established.

Additional verification procedures may be completed for information generated in the field. A final verification review of field activities will be made when the field effort is complete. The verification results will be included in the data quality and usability report. Specifically, field forms will be reviewed for:

- correct documentation of sample location;
- complete and accurate procedures for sample collection or measurement and proper documentation;
- proper chain-of-custody methodology, including sample shipment and preservation during transport; and
- evaluation of field QC results; field QC sample contamination could result in data qualification.

The analytical laboratories will complete a data review and verification prior to producing results. This verification will include checking that QC procedures were included at the required frequencies and that the QC results meet the control limits specified by the laboratory at the time of analysis. Any QA issues identified by the laboratory will be described in the case narrative and may result in qualification of some of the results by the laboratory.

11.2 VERIFICATION AND VALIDATION OF CHEMICAL DATA

Verification of chemical data will be completed at the laboratories and by the QA Manager. The laboratory will be responsible for the review and verification of all bench sheets; manual entry or transcriptions of data; review of any professional judgments made by a chemist during sample preparation, analysis, and calculation; and reporting of the final concentrations. The laboratory will also be responsible for the review of QC results to determine whether data are of usable quality or reanalyses are required. Any nonconformance issues identified during the laboratory's QA checks will be corrected and noted by the laboratory. Any data quality deviations will be discussed in the laboratory case narrative, including the direction and magnitude of any bias to the data, if possible.

Data validation and verification will be completed by the QA Manager prior to finalizing the data and release of the data set for interpretation. All data will be verified and validated in accordance with

U.S. EPA National Functional Guidelines (EPA, 2008, 2010), method-specific QC requirements, and laboratory-established control limits. Data will be qualified when QC procedures are not completed as required, when measurement performance criteria established in the applicable method are not met, or when specific data quality objectives established for this project are not achieved.

External data verification and validation will include an abbreviated QA review (summary data review) on 100 percent of the data. The laboratory information that will be reviewed, as applicable to the analyses completed, for each of these validation efforts is described below.

11.2.1 Abbreviated QA Review

Completion of an abbreviated QA review (i.e., a summary review data validation effort) assumes that all field results reported by the laboratory are correct. For this level of effort, summaries of applicable calibration and QC measurements are reviewed. Calculations and transcriptions are not verified or confirmed, and original instrument printouts are not reviewed. The following laboratory information will be reviewed, as applicable to each analysis:

- Chain-of-custody documentation to verify completeness of the data set;
- Case narratives discussing analytical problems (if any) and procedures;
- Sample preparation logs or laboratory summary result forms to verify analytical holding time constraints were met;
- Instrument tuning, initial calibration, and continuing calibration results to assess instrument performance;
- Method blank, trip blank, equipment rinsate blank, and other field blank results;
- Surrogate or system monitoring compound recoveries to assess preparation and analyses;
- MS and LCS recoveries; and
- Laboratory duplicate, field duplicate, and MSD results.

12 DATA QUALITY ASSESSMENT

The goal of data verification and validation is to determine the quality of each data point and to identify data points that do not meet measurement performance criteria and other project DQOs.

Nonconforming data may be qualified as estimated (J) or rejected (R) as unusable during data validation if criteria for data quality are not met. Rejected data (R) will be flagged as unreportable in the project database and will be excluded from all data retrievals. These data will not be used for any purpose. An explanation of the rejected data will be included in a data validation report. If the rejected data are needed to make a decision, then it may be necessary to resample. Any decision to resample would be based on discussions among the project management team.

Data qualified as estimated (J) will be appropriately qualified in the final project database. Although estimated data are less precise or less accurate than unqualified data, estimated results may still be used to evaluate and interpret site conditions provided that consideration of these data does not compromise the project objectives. The data review report will include all available pertinent information regarding the direction or magnitude of bias or the degree of imprecision for qualified data to facilitate the assessment of data usability.

The effect of estimated sample results in interpretation of site conditions depends on several factors.

- The nature and magnitude of the data quality problem: for example, a small positive bias in sample(s) concentration near a screening level may result in a conservative conclusion but a large negative bias may render the screening-level comparison meaningless.

- The nature and location of the affected sample(s): for example, a data deficiency in a result for a reference area may have a much greater impact on data interpretation than a similar deficiency in one of many results for a study site.
- The context of the sample results within the data set: for example, a questionable result for an analyte that is detected at high concentrations and important for site interpretation is likely to have a much greater impact on data interpretation than a questionable result for an analyte that is present at only low concentrations.
- The assessment of any data deficiencies on interpretive activities will be completed on a case-by-case basis. The data users are responsible for assessing the effect of the inaccuracy or imprecision of the qualified data on comparisons to screening criteria, statistical procedures, risk assessments, and other data uses. The effect of any data deficiencies on risk assessment and other interpretive activities and conclusions will be described in the final report.

13 REFERENCES

EPA (U.S. Environmental Protection Agency), 2007, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition, February.

EPA, 2008, USEPA Contract Laboratory Program, National Functional Guidelines for Superfund Organic Methods Review, EPA-540-R-0801, June.

EPA, 2010, USEPA Contract Laboratory Program, National Functional Guidelines for Inorganic Superfund Data Review, EPA-540-R-10-011, January.

TABLE 1
PROJECT PERSONNEL AND RESPONSIBILITIES
TWAAFA Site, Tacoma, Washington

Personnel	Responsibilities	Contact Information
Andrew Smith+A5 Washington State Department of Ecology Project Manager	Oversee all program activities to ensure compliance; perform technical oversight and consultation on major quality assurance problems; provide final approval of all necessary actions and adjustments for activities to accomplish project objectives. Provide final approval of the Groundwater Monitoring Plan and QAPP.	Washington State Department of Ecology, SWRO PO Box 47775 Olympia, WA 98504-7775 (360) 407-6247
TBD, TWAAFA Site Coordinator	Overall responsibility for sample collection activities. Oversee all program activities to ensure compliance; provide technical oversight and consultation on major quality assurance problems; implement final approval of all necessary actions and adjustments for activities to accomplish project objectives.	TBD
TBD, Sampling Team Leader	Coordinate with TWAAFA Site Coordinator, Field Team Leaders, and project laboratories for bottle and equipment shipments to the site and sample shipments to the laboratories; track submittal and receipt of samples to the laboratory, and initiate COC/SAR forms. Ensure field procedures are completed in accordance with Plans and QAPP; authorize and document minor adjustments to the sampling plan in response to field conditions, as necessary, notify TWAAFA Site Coordinator and QA/QC Coordinator.	TBD
TBD, Database Administrator	Organize and maintain project database. Ensure that the data are stored in accordance with the Groundwater Monitoring Plan and QAPP; supervise data management personnel.	TBD
TBD, QA/QC Coordinator	Provide technical quality assurance assistance; develop and review QAPP; oversee quality assurance activities to ensure compliance with QAPP; coordinate and supervise data validation and data quality report preparation; review and submit quality assurance reports.	TBD
Kurt Clarkson, ALS Global Laboratory Project Manager	Ensure that sample receipt and custody records are properly handled and data are reported within specified turnaround times: calibrate and maintain instruments as specified; perform internal quality control measures and analytical methods as required; take appropriate corrective action as necessary; notify the QA/QC Coordinator when problems occur; report data and supporting quality assurance information as specified in this QAPP.	ALS Global, 1317 S. 13th Avenue Kelso, WA 98626 (360) 577-7222

Abbreviations
COC = chain-of-custody
GWMP = groundwater monitoring plan
QAPP = quality assurance project plan
QA/QC = quality assurance and quality control
SAR = sampling analysis and request

TABLE 2
MEASUREMENT QUALITY OBJECTIVES
TWAAFA Site, Tacoma, Washington

Analyte	Analytical Method[1]	LCS %Recovery Limits[2]	MS %Recovery Limits[2]	Sample Surrogate %Recovery Limits[2, 3]	MS/MSD, or Laboratory Duplicate RPD Limits[4] (%)	Field Duplicate RPD Limits[4] (%)
Total Metals	EPA 6020	80-120	75-125	NA	≤20	≤30
Total Mercury	EPA 7470A	83-117	75-125	NA	<20	<30
TPH-Diesel	NWTPH-Dx	45-159	45-140	50-150	<30	<30
TPH-Gasoline	NWTPH-Gx	77-122	71-128	50-150	<30	<30
1,4-Dioxane	EPA 8270C-SIM	52-105	40-114	42-112	≤30	≤30
PCBs	EPA 8082	50-115	50-115	39-94	≤30	≤30
SVOCs	EPA 8270C	10-149	10-197	32-149	≤30	≤30
SVOCs	EPA 8270C-SIM	10-176	33-174	10-140	≤30	≤30
VOCs	EPA 8260B	10-171	10-182	59-129	≤30	≤30
VOCs-SIM	EPA 8260B SIM	46-148	70-130	46-123	≤30	≤30

Notes:
Recovery limits are those previously provided by the project laboratory; data will be evaluated during data review using the most current control limits provided by the laboratory.

TABLE 3
SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES
TWAAFA Site, Tacoma, Washington

Analyte	Analytical Method[1]	Sample Container	Preservation / Temperature	Holding Time[2]
Total Metals	EPA 6020	500 mL HDPE	2.5 mL 1:1 HNO_3; ≤6°C	6 months
Total Mercury	EPA 7470A	500 mL HDPE	5 mL 1:1 HNO_3; ≤6°C	28 days
TPH-Diesel	Ecology NWTPH-Dx	2 x 500 mL amber glass	≤6°C	7 days
TPH-Gasoline	Ecology NWTPH-Gx	2 x 40 mL VOA	HCl to pH<2.0; ≤6°C	14 days
1,4-Dioxane	EPA 8270C-SIM	1 x 250 mL amber glass	≤6°C	7 days
SVOCs	EPA 8270C	2 x 1 L amber glass	≤6°C	7 days to extraction; 40 days to analysis
SVOCs - SIM	EPA 8270C-SIM	2 x 1 L amber glass	≤6°C	7 days to extraction; 40 days to analysis
PCBs	EPA 8082	2 x 1 L amber glass	≤6°C	7 days
VOCs	EPA 8260B	3 x 40-mL vial	HCl to pH<2.0; ≤6°C	14 days
VOCs - SIM	EPA 8260B SIM	3 x 40-mL vial	HCl to pH<2.0; ≤6°C	14 days

Notes
1. Method numbers refer to SW-846 EPA Analytical Methods (EPA,1986), or Washington State Department of Ecology analytical methods, or Standard Methods (SM) for the Examination of Water and Wastewater.
2. Holding times are based on elapsed time from date and time of collection.

Abbreviations
°C = degree Celsius
EPA = U.S. Environmental Protection Agency HCl = hydrochloric acid
HDPE = high density polypropylene HNO_3 = nitric acid
L = liter
mL = milliliter
SIM = selective ion monitoring
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis VOCs = volatile organic compounds

TABLE 4
QUALITY CONTROL SAMPLE TYPES AND FREQUENCY
TWAAFA Site, Tacoma, Washington

Parameter	Field QC			Laboratory QC			
	Field Duplicates[3]	Field Blank	Trip Blanks	Method Blanks	LCS	MS/MSD	Lab Duplicates
Total Metals	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	1 set/batch	NR
Total Mercury	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	1 set/batch	NR
TPH-Diesel	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	NR	1/batch
TPH-Gasoline	1/20 samples per sampling event	1/20 samples per sampling event	1/cooler	1/batch	1/batch	NR	1/batch
SVOCs	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	1 set/batch	NR
PCBs	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	1 set/batch	NR
VOCs	1/20 samples per sampling event	1/20 samples per sampling event	1/cooler	1/batch	1/batch	1 set/batch	NR
1,4-Dioxane	1/20 samples per sampling event	1/20 samples per sampling event	NR	1/batch	1/batch	1 set/batch	NR

Notes
1. A sampling event is defined as consecutive days of sampling not separated by more than two days of inactivity.
2. A batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS, and MS/MSD (or MS and lab duplicate). No more than 20 field samples can be contained in one batch.
3. Field duplicates will be collected only for events with more than five samples.

Abbreviations
LCS = laboratory control sample
QC = quality control
MS = matrix spike sample
VOCs = volatile organic compounds
MSD = matrix spike duplicate sample
NR = not required

Standard Operating Procedures

Measuring Water and NAPL Elevations, and Total Depths

Written By:	Approved By:	Date:	QA Concurrence:	Date:
Joe Depner	Carolyn Mayer		Tasya Gray Lou La Rosa	

This standard operating procedure (SOP) contains the following sections:

1 Purpose

The purpose of this SOP is to provide personnel with the specific information needed to collect and document consistent and representative data on liquid levels at, and total depths of, monitoring wells and piezometers.

2 Application

This SOP shall be followed by all personnel who measure liquid levels at, and total depths of, monitoring wells and piezometers at the following PSC facilities in Washington state: Seattle (Georgetown), Kent, Tacoma, Washougal.

3 References

Yeskis, D. and B. Zavala. May 2002. Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers. EPA Office of Solid Waste and Emergency Response. EPA 542-S-02-001.

U.S. EPA. Nov 1992. RCRA Groundwater Monitoring: Draft Technical Guidance. Office of Solid Waste. EPA/530-R-93-001.

4 Associated SOPs

PSC-124 – Low-Flow Groundwater Sampling Procedure
PSC-200 – Equipment Decontamination Procedure
PSC-300 – Photoionization Detector Calibration and Operation
PSC-400 – Documentation Procedures

5 Terminology

The following terminology is used in this SOP:

> "NAPL" means nonaqueous-phase liquid. "DNAPL" and "LNAPL" mean dense and light NAPL (described below), respectively.
>
> "Wells" means groundwater-monitoring wells and piezometers.
>
> "Liquid levels" means the elevations of fluid interfaces in wells. These include the following:
>
>> The "LNAPL level" is the elevation of the air/LNAPL interface, if floating LNAPL is present.
>>
>> The "water level" is either (1) the elevation of the air/water interface if LNAPL is absent, or (2) the elevation of the LNAPL/water interface if LNAPL is present.
>>
>> The "DNAPL level" is the elevation of the water/DNAPL interface, if DNAPL is present.
>
> The level is measured as the depth of the interface, from the well's measuring point (MP).

6 Equipment and Supplies

The following equipment and supplies are necessary to properly measure liquid levels and total depths:

- Equipment required to open the well monuments (e.g., padlock keys, well keys, hand drill, socket set, Allen wrenches or other tools).
- A photoionization detector (PID) or similar instrument to monitor the well headspace.
- An electric water-level indicator and/or an electric oil/water interface detector. Each such instrument must have a chemically inert suspension line that is graduated in 0.01-foot increments and sufficiently long to reach the bottom of the well.
- Fully charged batteries for each battery-powered instrument.
- An accurate and reliable watch that has been properly set.
- Documentation materials as described in SOP PSC-400.
- Health-and-safety equipment and supplies (e.g., personal protective equipment [PPE]) as described in the relevant site health-and-safety plan (HSP).
- Decontamination equipment and supplies as specified in SOP PSC-200.

Although not essential, the following items are useful for verifying the correctness of field measurements:

- A construction (as-built) diagram for each well, showing the well's total depth and its screened interval.
- A table or graph (e.g., a well hydrograph) of field measurement results (liquid levels, total depth) from previous monitoring events, for each well.

7 Procedures

7.1 Simultaneity of Measurements

If liquid-level measurements are to be completed at a group of wells at a site, then complete the entire set of measurements for the group within a single business day. In addition, if any of the wells at a site are screened in tide-influenced hydrogeologic units, then complete the set of measurements corresponding to those wells within a single one-hour period. To facilitate compliance with this requirement, the water-level field form for each site shall identify those wells screened in tide-influenced units.

7.2 Order of Completion

At each well, complete the liquid-level and total-depth measurements in the following order:

1. LNAPL level
2. water level
3. DNAPL level
4. total depth

7.2.1 Special Instructions for Wells with Dedicated Pumps

The instrument access ports on some dedicated pumps will not accommodate some probes (e.g., most oil/water interface probes). If so, the pump must be removed from the well to measure the DNAPL level and the total depth. At wells with dedicated pumps, complete the measurements in the following order:

1. Measure the water level.
2. Remove the pump from the well and place it in a clean plastic bag.
3. Allow the liquid levels to stabilize.
4. Measure the DNAPL level.
5. Measure the total depth.

7.3 Pre-Measurement Procedures

On arrival at each well, complete the following steps in the order listed:

1. Don appropriate PPE as described in the site HSP.
2. Remove any debris (e.g., soil, vegetation, or refuse) and any standing water from the well opening, to prevent foreign matter from entering the well.
3. Open the well monument.
4. Vent the well by carefully removing the well cap. Record the time at which the well is initially vented to the atmosphere (i.e., the time at which the well cap is removed). If the gas in the well casing appears to have been over-pressurized or under-pressurized relative to the atmosphere, then note this in the field book.

Caution (1): Never put your face, head, or any other body part over the well when venting it. If possible, vent the well gradually, so the cap does not become airborne.

Caution (2): Handle monitoring wells with care at all times. If it is necessary to apply lift or torque to a well cap to remove it (e.g., if the casing is airtight and under a vacuum), then be extremely careful to prevent the well casing from being raised or rotated.

5. Immediately after removing the well cap, monitor the headspace within the well using the PID (see SOP PSC-300 for PID operation). Do this by placing the instrument probe at the opening of the well, and recording the reading in the field book and on the appropriate field forms.

6. Wait at least 20 minutes from the time the well is vented, to allow the liquid levels in the well to equilibrate to the current atmospheric pressure, before measuring liquid levels. At some wells it may be necessary to vent for longer periods.

7.4 General Measurement Procedures

Each liquid level measurement involves lowering an instrument probe into the well, until the instrument emits the appropriate response, indicating the probe has reached the desired fluid interface in the well. Depending on the type (manufacturer and model) of instrument, the response may be audible (e.g., a tone is steadily or intermittently emitted), visible (e.g., an indicator light is steadily or intermittently illuminated), or both. Consult the instrument's operating manual for details. The probe is attached to the body of the instrument by a flexible suspension line consisting of a graduated "tape" or coaxial cable that sheathes an electric conductor. After lowering the probe to the appropriate level in the well (see below), hold the upper end of the graduated tape against the well's MP and read the numeric value off the tape. Record all of the measurements to the nearest 0.01 foot below the well's MP. If the MP is not clearly marked (typically by a notch cut into the top of the well riser), then measure all levels from the top of the north side of the riser or dedicated pump.

Duplicate each liquid-level and total-depth measurement in the field to ensure that the reading is accurate. Record all results (times, measured values, etc.) both in the field book and on the water-level field form.

7.5 Measuring LNAPL Levels

LNAPLs are NAPLs that are less dense than water. In the subsurface, free-phase LNAPL tends to accumulate on the water table. Free-phase LNAPL that enters a well tends to accumulate on the air/water interface. Some wells routinely contain LNAPL. Typically, the thicknesses of the LNAPL layers in such wells are measured at the same time the water levels are measured.

Use an oil/water interface detector for the measurement. Turn the detector on. Then slowly lower the probe into the well. In some cases a very thin (~ 0.01 foot) layer of LNAPL may accumulate on the air/water interface in the well, so the probe must be lowered very slowly if the

LNAPL layer is to be detected and accurately measured. The oil/water interface detector emits one type of response to indicate that the probe has contacted NAPL, and a different type of response to indicate that the probe has contacted water. First, lower the probe until the air/LNAPL interface is detected. Measure the depth to the interface. Record the result. Record "sheen" if the instrument detects an LNAPL layer whose thickness is less than 0.01 foot.

7.6 Measuring Water Levels

Measure water levels using either an oil/water interface detector or, if no LNAPL is present, using an electric water-level indicator.

7.6.1 Measuring Water Levels Using the Oil/Water Interface Detector

After measuring the depth to LNAPL in the well, and before retrieving the probe from the well, slowly lower the probe further into the well. When the LNAPL/water (or air/water) interface is detected, measure the depth to the interface. Record the result.

7.6.2 Measuring Water Levels Using the Electric Water-Level Indicator

Turn the water-level indicator on. Manually adjust the sensitivity to a medium level. Slowly lower the indicator probe into the well until the indicator emits a short audible tone, indicating the probe has contacted the air-water interface. Measure the depth to the interface. Record the result.

7.7 Measuring DNAPL Levels

DNAPLs are NAPLs that are denser than water. In the subsurface, free-phase DNAPL tends to sink below the water table. Free-phase DNAPL that enters a well tends to sink to the bottom of the well. DNAPL levels are measured at some wells at the same time that the water levels are measured. Use an oil/water interface detector to measure the DNAPL level as described below.

If the well does *not* have a dedicated pump, then after measuring the water level in the well, and before retrieving the probe from the well, slowly lower the probe further into the well. If the well *does* have a dedicated pump, then after the pump has been removed from the well and the liquid levels in the well have been allowed to stabilize, slowly lower the probe into the well.

When (if) the water/DNAPL interface is detected, measure the depth to the interface. Record the result.

7.8 Measuring Well Total Depths

For measuring well total depths, complete the following steps in the order listed:

1. Lower the instrument (water-level indicator or oil/water interface detector) probe to the bottom of the well to measure the well's total depth.

2. Gently bounce the probe on the well bottom to determine when the probe is at the bottom of the well, and take up the slack on the suspension line.

3. Measure the total depth. Record the result.

7.9 Post-Measurement Procedures

After all of the measurements have been made at a well, and the results have been recorded, complete the following steps in the order listed:

1. Retrieve the instrument (water-level indicator and/or the oil/water interface detector) suspension line and probe from the well, and simultaneously decontaminate the instrument suspension line and probe (see below).

2. If the well has a dedicated pump that was removed to complete the measurements, replace the pump.

3. Close (seal) and secure the well.

4. Record any well integrity concerns in the field book and on the well maintenance form.

8 Decontamination

Decontaminate all equipment that may come in contact with the well water or NAPL, at the following times:

- prior to, or on, arrival at the site
- on moving from one well to another, on site
- immediately prior to exit from the site.

Follow the decontamination procedures given in SOP PSC-200.

9 Documentation

Record all measurement results (liquid levels, total depth, and time of measurement) on the appropriate field forms and field notebook. Follow the documentation procedures given in SOP PSC-400.

10 Measure of Proficiency

Field staff shall demonstrate proficiency on this SOP by successfully completing sections 7, 8, and 9 at least twice under the direct supervision of the Corrective Actions Manager or her/his designee.

Monitoring Well Development

Written By:	Edited by:	Approved By:	QA Concurrence:
Carolyn Mayer	Tasya Gray	Carolyn Mayer	Kevin McNeil
11/23/97	**1/22/02**	7/24/01	7/24/01

This SOP contains nine sections:

1.0 Purpose

The purpose of this SOP is to provide field personnel with a set of guidelines to assure proper monitoring well development. According to EPA all monitoring wells should be developed to create an effective filter pack around the well screen, to rectify damage to the formation caused by drilling, to remove fine particulates from the formation near the borehole, and to assist in restoring the natural water quality of the aquifer in the vicinity of the well.

2.0 Application

This SOP provides a step-by-step guideline to be followed by the field sampling crew for performing or overseeing monitoring well development.

3.0 References

RCRA Groundwater Monitoring Draft Technical Guidance (Nov. 1992) EPA/530-R-93-001

4.0 Associated SOPs

PSC-200 – Equipment Decontamination Procedure
PSC-300 – Photo-ionization Detector Calibration and Operation
PSC-400 – Documentation Procedures

5.0 Equipment

The following equipment is necessary to properly develop a ground water monitoring well:

- A well key, hand drill, socket set, pad lock key, or other well access equipment.
- A calibrated photo-ionization detector (PID) to monitor and record the well headspace.
- An electric water meter and oil/water interface probe calibrated to a hundredth of a foot, and sufficiently long to reach the bottom of the well.
- Well purging equipment (e.g. bailer, silicone line, PVC pipe, plug, pump, tubing, power supply, and extension cord), as needed.
- A solid PVC surge block.
- A sufficient number of 55-gallon drums (including lids, gaskets, and fasteners) to contain all purge water, unless other water handling arrangements have been made.
- A calibrated water quality meter that measures temperature, pH, specific conductivity, dissolved oxygen, redox potential, and turbidity.
- All required documentation including sample labels, field books, sampling forms, and chains-of-custody.
- Personal protective equipment as described in the Site Health and Safety Plan.

- Decontamination equipment as specified in the Work Plan.

6.0 Decontamination

All equipment that will come in contact with the well water will be decontaminated prior to arrival on site, relocation on site, and site exit. Standard Operating Procedure PSC-200 shall be followed.

7.0 Well Development Procedures

Upon arrival at each well, the following procedures shall be followed:

- Suit up in appropriate personal protective equipment as described in the Site Health and Safety Plan.

- Brush any soil or vegetation and pump any standing water away from the well opening.

- Lay plastic sheeting around well to place equipment on and keep cords, tubing and pumps from touching the ground.

- Open the well cap.

- Monitor the headspace within the well using the PID (PSC-300 for PID operation). This is done by placing the instrument probe at the opening of the well, and recording the reading in the field book and on the appropriate field forms.

- Measure and record the depth to LNAPL, water, DNAPL, and total depth of the well using a decontaminated oil/water interface probe or water level indicator (depending on the historical presence of NAPLs in the well). All LNAPL and DNAPL measurements are to be made in accordance with PSC-120. Measurements are to be made to the nearest one hundredth of a foot and recorded in the field book and on the appropriate field form.

- Compute the unit purge volume using the following formula and the input values on the attached Well Volumes Sheet.

  1 well volume (including annular space) = [x(total well depth – water level)] + [(y **x 0.40)**(total well depth – bottom of seal)]

where "x" is the Casing/Riser Volume per Unit Length, Internal (gal/ft), "y" is the Annular Volume per Unit Length (gal/ft), **and 0.40 is a conservative estimate of the porosity of the sand pack.**

7.1 New Well Development Procedure

- If a submersible pump is to be used for well development, gently lower the pump to the well bottom. If a non-submersible pump is used, lower the tubing to the bottom of the well.

- Begin to purge the well at a rate sufficient to remove fines, slowly run the pump up and down the well over the length of the screen, and initiate physical water quality testing at least every 20% water removed for temperature, pH, conductivity, dissolved oxygen, and turbidity.

- A minimum of three and maximum of five well volumes (including annular space) will be removed. If this is the first time the well has been developed and water was used in the drilling process, the volume of water introduced into the formation during well formation must also be removed during development. *Purging is completed once the following has occurred:*
  - *the minimum purge volume has been removed and the water quality parameters have stabilized by the following screening requirements for three consecutive readings: Turbidity <5 NTU, specific conductivity within 10% of each other, and pH within 0.5 units; OR*
  - *the well runs dry; OR*
  - *five purge volumes and drilling process water volumes have been removed.*

- Measure total depth of well after development.

- Containerize all purge water in 55-gallon drums, unless other handling arrangements have been made.

- Record additional information such as unique odors or water color, and a description of the suspended particle content in the field notes and on appropriate field forms.

- Upon completion of development, both the well and the purge drums are to be properly sealed and secured.

- All drums are to be permanently labeled as follows:
  Well ID
  Facility Name
  Drum Contents
  Date
  Drum Number

- Close the well appropriately and record any well integrity concerns in the field book and on the sampling form.

7.2 Existing Well Development Procedure

- Remove pump from well.

- Attach one length of twine to the surge block or use a drill rig or tripod and lower it to the bottom of the well.

- Vigorously begin moving the surge block up and down in the well creating a surging action across the screened interval. This action will bring the finer grained materials into suspension.

- Remove the surge block.

- Begin to purge the well at a sufficient rate to remove fines and initiate physical water quality testing at a minimum of every 20% water removed for turbidity.

- Repeat surging and purging to reduce silt presence in water and keep checking total depth measurements.

- A minimum of three and maximum of five well volumes (including annual space) will be removed. *Purging is completed once the following has occurred:*
  - *the minimum purge volume has been removed and the water quality parameters have stabilized by the following screening requirements for three consecutive readings: Turbidity <5 NTU, specific conductivity within 10% of each other, and pH within 0.5 units;* <u>*OR*</u>
  - *the well runs dry;* <u>*OR*</u>
  - *five purge volumes and drilling process water volumes have been removed.*

- Measure total depth of well after development.

- Containerize all purge water in 55-gallon drums, unless other handling arrangements have been made.

- Record additional information such as unique odors or water color, and a description of the suspended particle content in the field notes and on appropriate field forms.

- Upon completion of development, both the well and the purge drums are to be properly sealed and secured.

- All drums are to be permanently labeled as follows:
  Well ID
  Facility Name
  Drum Contents
  Date
  Drum Number

- Close the well appropriately and record any well integrity concerns in the field book and on the sampling form.

8.0 Documentation

Documentation of all monitoring well development activities including all field forms and the maintenance of a detailed field notebook are described in PSC-400.

9.0 Measure of Proficiency

Field staff will demonstrate proficiency on this SOP by successfully completing sections 6.0, 7.0, and 8.0 a minimum of twice under the direct supervision of the Corrective Actions Manager or her/his designee.

Written By:	Edited by:	Approved By:	QA Concurrence:	Date:
Carolyn Mayer	Jimmy McKechnie	Lou La Rosa	Lou La Rosa	12-1-09

This SOP contains nine sections:

1 Purpose

The purpose of this SOP is to provide personnel with the specific information needed to consistently collect and document representative groundwater samples for laboratory analyses from monitoring wells using a low-flow groundwater sampling technique.

The purpose of low-flow groundwater sampling is to collect a groundwater sample that is representative of actual site conditions. Therefore, the purge rate is designed to be low enough to simulate actual groundwater flow and to pull water from a discrete zone near the pump intake into the pump rather than pulling groundwater from a large area around the well or outside of the screened area of the well. A low purge rate is also intended to reduce the possibility of stripping volatile organic compounds from groundwater and to reduce the likelihood of mobilizing colloids in the subsurface that are immobile under natural flow conditions.

2 Application

This SOP applies to groundwater sampling of permanent monitoring wells at PSC facilities that are undergoing RCRA Corrective Action in Washington State.

The basis for choosing low-flow sampling methodology for these sites is that all of the sites have defined groundwater plumes and wells that are accurately screened in the known plume areas.

3 References

U.S. EPA. 1992. RCRA Groundwater Draft Technical Guidance.

U.S. EPA, Region I. 30 July 1996. SOP GW-0001, Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.

Puls, R. and M. Barcelona. April 1996. Ground Water Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures. U.S. EPA. EPA/540/S-95/504.

Wilde, F.D., D.B. Radtke, J.Gibs and R.T. Iwatsubo, eds. 1998. *National Field Manual for the Collection of Water-Quality Data*; U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Handbooks for Water-Resources Investigations, variously paginated.

Wilkin, R.T., M.S. McNeil, C.J. Adair and J.T. Wilson. 2001. Field Measurement of Dissolved Oxygen: A Comparison of Methods. *Ground Water Monitoring and Remediation*, Vol. 21, No. 4, pp. 124-132.

Phoenix Health and Safety, Inc. January 2001. Site Health and Safety Plan – Corrective Actions Group.

PSC, 2002. Groundwater Sampling Field Manual. (Updated Annually)

4 Associated SOPs

PSC-120 – Measuring Water, LNAPL, and DNAPL Elevations
PSC-200 – Equipment Decontamination Procedure

PSC-300 – Photoionization Detector Calibration and Operation
PSC-302 - Hach Digital Titrator and Colorimeter Procedures
PSC-303 – LaMotte Turbidimeter Calibration and Operation
PSC-305 – Hydrolab Surveyor 4 Water Quality Data Logger, FC 5000 Data Sonde Flow-Through Cell Calibration and Operation
PSC-400 – Documentation Procedures

5 Equipment

The following equipment is recommended for properly sampling a groundwater monitoring well:

- A Groundwater Sampling Field Manual that includes a map of well locations, sampling plan, appropriate SOPs and well construction information.
- A well key, hand drill, socket set, padlock key, or other well access equipment.
- A calibrated photoionization detector (PID) or similar device (and calibration gases), to monitor volatile constituents in the well headspace and breathing zone.
- An electric water-level indicator and/or oil/water interface detector calibrated to 0.01 foot, and sufficiently long to reach the bottom of the well.
- A weighted tape measure (Oil/Water Interface Indicator) for determining total depths of wells, when this is required.
- Well purging equipment (e.g.; pump, converter, tubing, power supply and extension cord).
- A sufficient number of containers (e.g., 55-gallon drums with lids, labels, gaskets, and fasteners) to store all purge water, unless other water handling arrangements have been made.
- A calibrated flow-through water-quality meter(s) and calibration solutions to measure, pH, specific conductivity, and oxidation-reduction potential (ORP).
- An instrument and calibration solutions to measure turbidity.
- In-line disposable 0.45 micron filters, if necessary, for metals analyses when

Turbidity is > 5 NTU's.

- A sufficient number of sampling containers, including containers for regular samples and quality control samples (e.g., field blanks, equipment blanks, duplicates, trip blanks, and matrix spike/matrix spike duplicates).

- All required documentation including weather proof sample labels, weather proof field books, sampling forms, chain-of-custody (COC) forms, weatherproof pens and paper for sampling forms, and COC seals.

- Personal protective equipment (PPE) described in the site health and safety plan.

- Decontamination equipment as specified in SOP PSC-200.

- Water flow-rate measurement equipment (e.g., flow meter, or graduated container and stopwatch).

- Sampling support equipment and supplies (e.g., sample coolers, clean bagged ice, bubble wrap and VOC bottle holders, clear tape, plastic locking bags, razor knives, garbage bags, paper towels, deionized water, nitrile gloves, disposable 0.45 micron in-line filter, five-gallon buckets, clean fold out table for sample bottles and equipment, fabricated foam spill berm equivalent to 5 gallon bucket) as needed.

6 Decontamination

All reusable equipment that will contact the well and/or water samples will be decontaminated prior to its use, according to the procedures described in SOP PSC-200.

7 Well Sampling Procedures

7.1 Set Up

On arrival at each well, the following procedures shall be followed:

- Don appropriate PPE & safety vests as described in the site health and safety plan.

- Remove any soil or vegetation, and standing water from the well monument casing. Check the well condition, making sure the flexible gasket seals are clean and intact. If applicable, also check the condition of the dedicated pump cap. Record any problems in the field book and the appropriate field forms.

- Place fabricated foam spill berm on the ground next to the well, and place the sampling equipment and bottles on a clean fold out table to keep them from touching the ground.

- Remove the well cap.

- Monitor the headspace within the well using a PID or similar instrument (see SOP PSC-300 for PID operation). Record the reading in the field book and on the appropriate field form(s).

- Set up the pump, converter, and flow-through cell and turbidity meter in preparation for purging. Connect the discharge line from the pump to a flow-through cell. A "T" connection is needed in the tubing between the pump discharge line and the influent flow-through cell to allow for the collection of water for the turbidity measurements, using a turbidimeter or similar instrument. The discharge line from the flow-through cell must be directed to a container to contain the purge water during the purging and sampling of the well.

- Record the depth of the pump intake on the sampling form and/or in the sampling field book. The Groundwater Sampling Field Manual should specify the pre-determined depths for the pump intakes. The dedicated pump intake is set at the interval within the screen where the contamination is known to exist. Check with the project manager if there is uncertainty regarding this issue. If the well doesn't have a dedicated pump, (e.g.; well with dedicated tubing for use with a Parastaltic Pump) the tubing should be lowered into the well alongside of a weighted measuring tape or water-level indicator to ensure that the intake of the pump is set at the appropriate depth.

- Measure and record the depth to water using a decontaminated water-level indicator or oil/water interface detector to the nearest 0.01 foot, in accordance with SOP PSC-120. Record the reading in the field book and on the appropriate field form(s). Calculate the volume of water in the casing and the screened interval. The following equation is used to calculate the well volume:

$$V = V_{casing} \text{ (well depth - static water depth)}$$

where:
V_{casing} = casing volume per unit length
(e.g., ~ 0.17 gal/ft for two-inch casing)

(The Groundwater Sampling Field Manual includes all well specifications necessary for this calculation.)

- Before purging, adjust the pumping rate to its lowest setting, and set the data logger in the flow-through cell to record readings every three minutes.

7.2 Purging Monitoring Wells

7.2.1 Purging Procedure

Measure the initial (static) water level in the well and record the reading on the field form(s). All wells have dedicated tubing that will be used for both purging and sampling.

Start the pump at a flow rate of 200 to 500 mL/min. Maintain a steady flow rate while maintaining a drawdown of less than 0.33 foot. The flow rate can be measured using a graduated cup and a stop watch.

To determine water-level stability, subtract the second water-level reading (not the static water-level reading) from the current water-level reading to determine the current drawdown.

After the flow rate is stable, record the water level and the flow rate every three minutes. Record water levels more frequently if the rate is being adjusted. A drawdown less than 0.33 foot is preferred but may not always be possible. If the drawdown exceeds 0.33 foot at low flow rates (≤ 500 mL/min), lower the flow rate as practical (not to drop below 100 mL/min) to reduce the drawdown.[*]

Begin recording water-quality parameters after all water has been purged from the sample

[1] *The 0.33-foot drawdown goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. The water levels in water-table wells should not be allowed to drop below the pump intake. In all other cases, the water level should not be allowed to drop below the top of the well screen. If the water table drops below one of these minimum values, the pump should be turned off and the water level should be allowed to recover. See section 7.2.2, fifth bullet for more information.*

tubing, pump, and flow-through cell. Initiate water-quality testing for temperature, pH, specific conductivity, DO, ORP and turbidity. Record water-quality parameters every three minutes.

7.2.2 Purging Requirements

Sampling cannot begin until the drawdown is no greater than 0.33 foot, and all water-quality parameters are stable. Each water-quality parameter is considered stable when it satisfies the corresponding stability criterion specified in the table below.

Water-Quality Parameter	Stability Criterion
Turbidity	{X} < 5 NTU or RPD < 10 % for values {X} > 5 NTU
Dissolved Oxygen	Δ ≤ 0.3 mg/L
Specific Conductivity	RPD ≤ 3 %
ORP	Δ < 10 mV
Temperature	Δ < 3%
pH	Δ < 0.1 unit

Where: {X} = the last three water-quality readings

$$m = \text{mean} = \frac{\text{Max}\ \{X\} + \text{Min}\{X\}}{2}$$

$$\Delta = \text{Max}\ \{X\} - \text{Min}\ \{X\}$$

$$\text{RPD} = \frac{\Delta}{m} \times 100\%$$

In some circumstances, the well may not stabilize according to the above criteria, but the well can be sampled if one of the following conditions occurs:

- Wells are unable to meet stability criteria due to equipment accuracy. The accuracy of the instruments will often limit the ability to achieve stabilization on a percentage basis. For example, if the ORP is consistently fluctuating between 1 and 15 mV, then Δ = 14 mV, which is not within the requirements for stability. However, the accuracy of the instrument currently used is +/- 20 mV. Therefore, in this case the stability criterion would be considered satisfied within the range of accuracy of the equipment. This is particularly important when the water-quality parameter values are low. Examples of accuracy limits for the equipment that is currently used (e.g.; Hydrolab Surveyor 4 Water-Quality Data Logger and Hydrolab FC 5000 Data Sonde flow-through cell, and the LaMotte 2020e Turbidimeter) are provided here for reference. However, if another instrument is used, field personnel must consult the instrument's manual to determine its accuracy.

Water-Quality Parameter	Equipment Accuracy
Turbidity	+/- 0.02 NTU
Dissolved Oxygen[2]	+/- 0.2 mg/L
Specific Conductivity	+/- 0.001 mS/cm
ORP[2]	+/- 20 mV
pH	+/- 0.2 unit

- Wells for which all water-quality parameters have stabilized may be sampled if it is clear that the drawdown will not stabilize before the water level drops below the minimum allowable value (i.e., pump intake, or top of screen if aquifer is confined).

- If collecting metals samples and all water-quality parameters except turbidity stabilize, it is acceptable to collect filtered and unfiltered metals samples without waiting for turbidity to stabilize or for one well volume to be purged. A filtered sample should be collected using a disposable 0.45 micron in-line filter. If there are no directions on the filter for rinsing, then a minimum of 0.5 liter of groundwater from the well should be run through the filter prior to collecting the sample.

- Water-quality parameters are not stable, but at least one well volume of water has been removed from the well. See the equation in Section 7.1.

- The water level drops below the minimum value (i.e., the pump intake, or the top of the screen if the aquifer is confined) during purging. In this case, the pump

[2] If the final dissolved oxygen measurement is less than 1 mg/L, a sample should be collected and analyzed by the spectrometric, colorimetric or Winkler titration methods.
[3] ORP may not always be an appropriate stabilization parameter, depending on site conditions. The project manager may designate wells in the Groundwater Sampling Field Manual that will not require ORP measurements.

should be turned off and the well should be allowed to recover. As long as a minimum of two tubing volumes (including the tubing and pump) has been removed from the well, then the well should be sampled as soon as the water level has recovered sufficiently to collect volume of groundwater necessary for all samples. Use the following equations to determine the minimum volume of groundwater to be removed prior to sampling when this problem occurs:

Minimum purge volume = 2 [500 mL + M (length of tubing in feet)]
where M is the volume (in mL) contained in a one-foot length of tubing

For tubing of various inner diameters, M is equal to:

Inner Diameter	M
1/8"	2.4
¼"	9.7
½"	39

This is acceptable even though the water-quality parameters have not stabilized and one well volume has not been removed.

Record in the field book and field form if any monitoring wells did not meet the stabilization and drawdown criteria and describe the rationale for sampling the well at the time it was sampled.

7.3 Sampling Procedure

Do not stop pumping after the purging requirements have been met. Don clean nitrile gloves. Disconnect the sampling tube from the influent flow-through cell. All wells have dedicated tubing that will be used for both purging and sampling. Collect each sample directly from the dedicated tubing. Minimize the turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container.

The sampling flow rate may remain at the established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 500 mL/min are appropriate.

When collecting the dissolved gas samples (e.g. volatile organic compounds, total petroleum hydrocarbons – gasoline range, or methane/ethane/ethane) the following procedures should be followed:

- The tubing should be completely filled with water to prevent the groundwater from being aerated as it flows through the tubing.
- A meniscus must be formed over the mouth of the vial to eliminate the formation of air bubbles and headspace prior to capping.

Samples do not have to be collected in a particular order unless unfiltered metals samples are collected, in which case they should be collected last.

7.4 Post-Sampling Procedures

After all of the samples have been collected in containers that are labeled and appropriately treated with preservatives, the following tasks should be completed:

- Measure and record the depth to water to determine total drawdown. Record the estimated total volume of water purged from the well.
- If dedicated equipment is in place at the well, disconnect aboveground tubing and properly seal the well.
- If non-dedicated equipment is used, then remove the equipment. Discard disposable items and decontaminate reusable items according to PSC SOP-200.
- Close and secure the well, and record any well integrity concerns (bolt tightness, etc) in the field book and on the sampling form.
- Rinse the water-quality meters with deionized water between wells.
- Report if any monitoring wells did not meet the stabilization and drawdown criteria with recommendation on how to conduct the sampling for the next sampling event.

8 Documentation

SOP PSC-400 describes the documentation of all monitoring well sampling activities, including all field forms, and the maintenance of a detailed field notebook.

9 Measure of Proficiency

Field staff will demonstrate proficiency on this SOP by properly completing sections 6, 7 and 8 at least twice under the direct supervision of the project manager or her/his designee.

Written By:	Edited by:	Approved By:	Date:	QA Concurrence:	Date:
Tasya Gray	Tasya Gray	Carolyn Mayer	7/6/01	Kevin McNeil	7/6/01

This SOP contains eight sections:

1.0 Purpose

The purpose of this SOP is to provide field personnel with an outline of the procedure and frequency of decontaminating equipment that has come into contact with monitoring well water.

2.0 Application

This SOP provides a step-by-step guideline to be followed by the field sampling crew to prevent cross-contamination between monitoring wells and preserve well integrity.

3.0 References

RCRA Groundwater Draft Technical Guidance (EPA, 1992)

4.0 Associated SOPs

PSC-120 - Measuring Water, LNAPL, and DNAPL Elevations
PSC-121 - Monitoring Well Development
PSC-124 – Micropurge Groundwater Sampling Procedure
PSC-400 – Documentation Procedures

5.0 Equipment

The following equipment is necessary to properly decontaminate equipment used with monitoring wells:

- Di-ionized water and spray bottle.
- Alconox and spray bottle, hexane and spray bottle, and 10% Nitric acid and spray bottle, paper towels/rags.
- PVC pipe, capped on one end, 5 feet long.
- A clean hose and tap water source.
- A labeled 55-gallon drum for wastewater and a bucket to use for smaller volume prior to containing in drum.
- Personal protective equipment as described in the Site Health and Safety Plan.

6.0 General Decontamination Procedures

All reusable equipment that will come in contact with the well and/or be used to acquire samples will be decontaminated prior to arrival on site, relocation on site, and site exit.

6.1 Decontamination When Organic Constituents Are of Interest

- Wash the equipment with a solution of nonphosphate detergent (Alconox or equivalent) and water.
- Rinse the equipment with tap water.
- Rinse the equipment with Hexane.
- Rinse the equipment with DI water.

6.2 Decontamination When Inorganic Constituents Are of Interest

- Wash the equipment with a solution of nonphosphate detergent (Alconox or equivalent) and water.
- Rinse the equipment with tap water.
- Rinse the equipment with 10% Nitric Acid solution.
- Rinse the equipment with DI water.

6.3 Decontamination When Inorganic and Organic Constituents Are of Interest

- Wash the equipment with a solution of nonphosphate detergent (Alconox or equivalent) and water.
- Rinse the equipment with tap water.
- Rinse the equipment with Hexane.
- Rinse the equipment with DI water.
- Rinse the equipment with 10% Nitric Acid solution.
- Rinse the equipment with DI water.

7.0 Specific Decontamination Procedures

7.1 Non-Dedicated Submersible Pump Decontamination Procedure

After sampling or developing a well using a non-dedicated submersible pump, decontaminate the pump as follows:

- Use hose to spray off pump with tap water.
- Place pump into a capped approximately 5' long, 3" diameter PVC pipe.
- Fill the PVC pipe with tap water and detergent.

- Run the pump until the pipe is empty, refilling it with tap water 3 times. The discharge decontamination water will be pumped into a 55-gallon drum.
- Remove the pump and wash out the pipe using tap water from the hose.
- Place the pump in the pipe again and fill with tap water.
- Repeat the process, running the pump until the pipe empties 3 times, when there is half a pipe of water left, add 2L of Hexane and continue pumping until pipe is empty.
- Remove the pump and rinse out the pipe with tap water.
- Place the pump back in the pipe and fill with tap water.
- Run the pump until the pipe empties 3 times, when there is half a pipe of water left add 2L of 10% Nitric Acid.
- Run the pump until it empties, then rinse it with water and refill the pipe with di-ionized water.
- Run the pump until the pipe empties three times with the deionized water.

8.0 Documentation

Documentation of all decontamination procedures associated with monitoring well activities including all field forms and the maintenance of a detailed field notebook as described in PSC-400.

9.0 Measure of Proficiency

Field staff will demonstrate proficiency on this SOP by successfully completing sections 6.0, 7.0, and 8.0 a minimum of twice under the direct supervision of the Corrective Actions Manager or her/his designee.

Documentation Procedure

Written By:	Approved By:	Date:	QA Concurrence:	Date:
Carolyn Mayer	Carolyn Mayer	7/6/01	Tasya Gray	7/6/01

This SOP contains seven sections:

1.0 Purpose

The purpose of this SOP is to outline, in detail, the required documentation needed to maintain accurate logs and files of all field procedures conducted by Philip Services Corporation (PSC).

2.0 Application

This SOP provides documentation guidelines, including examples, required for all geotechnical exploratory and sampling procedures conducted or overseen by PSC personnel (see Table 1).

3.0 References

None

4.0 Associated SOPs

PSC-100 – Surface Water Sampling Procedures
PSC-101 – Collection and Handling of Sediment Samples
PSC-102 – Collection and Handling of Surface Soil Samples
PSC-103 – Standard Penetration Tests and Split Spoon Sampling

PSC-120 – Measuring Water, LNAPL, and DNAPL Elevations
PSC-121 – Monitoring Well Development
PSC-124 – Micropurge Groundwater Sampling Procedure
PSC-126 – Soil Gas Monitoring Port Sampling
PSC-200 – Equipment Decontamination Procedure
PSC-300 – Photoionization Detector Calibration and Operation
PSC-301 – YSI Calibration and Operation

5.0 Field Books

All field books should be pocket size “Rite in the Rain” or equivalent and should have non-removable pages. These field books are to be dedicated to a project, and the corrective actions’ project manager is responsible for maintaining a field book inventory. This inventory should include a numbering and tracking mechanism for each field book assigned to a particular case.

Each field book is to be maintained as follows:

- Label the outside front cover with the following information: Burlington Environmental dba Philip Services Corporation, Facility Name, Dates Included, and Book Number. The inside cover should include: Burlington Environmental dba Philip Services Corporation, Project Manager’s Name, 955 Powell Avenue, Renton, WA 98155. (206) 227-XXXX, Dates Included, and Book Number.

- Inside the cover, list the full names and initials of each person working on the project that will be referred to in the field book.

- Maintain all field notes directly in the field books (i.e. notes are not to be taken then transferred to the field books at a later time).

- Record all field notes in permanent ink (sharpie markers).

- Initial, date, and number each page upon completion.

- Correction of mistakes are made with a single line and initialing the correction.

- Avoid blank spaces within the notes. Unavoidable blank spaces are to be struck with a single line.

Examples of information required in the field book include:

- The date of entry.
- Time of entry for specific events (in military time).
- A meteorological description of daily changes.
- Personnel present including arrival and departure times and affiliations.
- Make, model and condition of equipment used.
- The time interval and reasons for delays including a detailed description of corrective actions taken by the field crew.
- A detailed description and rationale for any deviations from the Work Plan, Sampling Plan, or Health and Safety Plan.

6.0 Field Forms

The field forms have been designed to detail all steps, actions, and readings associated with specific field procedures. These forms are to be completed in full. No sections are to be left blank, if a section is "not applicable", it is to be indicated as such. All forms, including location diagrams, are to be completed in the field with permanent ink. Refer to Table 1 to see which forms are required for specific field procedures. Examples of each form are also attached.

7.0 Measure of Proficiency

Proficiency assessment for documentation is associated with specific procedural proficiency, therefore, no separate proficiency measures for documentation are needed.

Groundwater Monitoring Well Installation

Written By:	Approved By:	Date:	QA Concurrence:	Date:
Carolyn Mayer	Carolyn Mayer	7/1/98	Laurel Muselwhite	7/1/98

This SOP contains nine sections:

1.0 Purpose

The purpose of this SOP is to provide geotechnical field personnel with an outline of the specific information needed to install and construct monitoring wells in both unconsolidated and bedrock media. The required equipment and documentation are also outlined for each of these procedures. The recommended monitoring well design, as presented in this SOP, is based on the assumption that the objective of the program is to obtain representative ground water information and water quality samples from aquifers.

1.0 Application

Ground water monitoring wells are generally used as collection points for ground water samples and as measuring points for aquifer hydraulic properties.

This SOP provides a step-by-step guideline to be followed by the site geologist to design and install monitoring wells suited to these purposes.

1.0 References

ASTM Proposed Recommended Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (February 19, 1990).

U.S. EPA, Office of Solid Waste. 1992. RCRA Ground-Water Monitoring Draft Technical Guidance. November.

Driscoll, Fletcher G. 1986. Groundwater and Wells. Second Edition. Published by Johnson Filtration Systems, Inc., St. Paul Minnesota.

1.0 Associated SOPs

PSC-103
PSC-121
PSC-400

1.0 Installation Equipment and Materials

The following equipment should be provided and maintained by the site geologist:

- a calibrated photoionization detector; isobutylene span gas, regulator, and tedlar bag;
- a weighted fiberglass tape calibrated to .001 foot and of sufficient length to reach the bottom of the deepest bore hole;
- a wooden folding ruler calibrated to a .001 foot;
- an electric water level indicator, immiscible phase probe or chalked steel tape for obtaining water level measurement to an accuracy of .001 foot;
- a field notebook and calculator.
- a camera;

- a small file or saw to permanently mark a double notch at the top of the well casing/riser;
- permanent marker or paint pen to mark the identification of the well on the steel pipe finish;
- a sufficient supply of blank daily drilling reports and monitoring well construction field forms;
- a copy of the Field Operations Plan including, at a minimum, the Field Sampling Plan, the Health and Safety Plan and the Quality Assurance Project Plan
- all required personnel protective equipment as defined in the Health and Safety Plan;
- a sufficient amount of deionized water to hydrate the bentonite.
- A brass or hardened-steel security lock.

The drilling contractor is responsible for providing the following:

- well screen and riser components with flush joints with square profile threads to obtain water tight seals;
- machine slotted well screens (0.010 size);
- bentonite pellets or chips;
- "quick-set" additive (if necessary when cold weather conditions);
- filter sand;
- a steam cleaner;
- cement grout, mixer, tremie pipe;
- the project specific required surface finishing materials; and
- all required personnel protective equipment as defined in the Health and Safety Plan.

6.0 Monitoring Well Installation Procedure

Once a stable bore hole has been advanced to the desired depth in accordance with Standard Operating Procedure PSC-103, the installation of a well screen and riser will proceed as follows:

Materials Inspection and Cleaning

- decontaminate both inside and outside of the well screen, bottom plug and riser immediately prior to assembly and installation, using a water source of known chemistry and a mild non-phosphate detergent then rinse with deionized water; store decontaminated riser and screen in an area free of contaminants and cover with plastic sheeting;

- inspect all materials prior to assembly to insure material integrity.

Bore Hole Preparation

- if viscous drilling fluids were introduced to the borehole, then the borehole should be flushed with clean water of known chemistry. This is done to remove all viscous drill fluids from the bore hole which could prevent proper setting of well construction materials;

- record the volume of water introduce into the bore hole and recovered from the bore hole during flushing. The difference in there two volumes requires recovery during well development in addition to the calculated well volume to be removed PSC-121.

- check the total depth of the bore hole using a weighted fiberglass tape and a constant datum such as the ground surface. Bore holes that are partially obstructed by caved or blow-in sediments should be cleared in accordance with Standard Operating Procedure PSC-103 prior to initiating well installation;

- a 1.0 foot thick base layer of filter san should be placed at the base of the bore hole using a decontaminated, flush threaded, one inch internal diameter (minimum) tremie pipe. Alternatively, the filter sand may be added directly between the rise pipe and the auger or casing. Verify the depth of the top of the sand base;

Monitoring Well Pre-assembly

- pre-cut the uppermost section of the well riser so that when the well is in place, the top of the well riser will be approximately 4 to 6 inches below the ground surface for flush finished wells, or 3.0 feet above the ground surface for wells designed with a standpipe finish;

- permanently identify the survey and measuring point on the upper rim of the well riser by cutting a double notch into the rim (Figure 1);

Monitoring Well Installation

- quickly assemble the well within the bore hole by adding sections to the top of the column until the screened section is set at the desired depth. Care should be taken to prevent any materials from entering the well during down hole assembly;

- use of a geosock to prevent fines from entering the well should be discussed on an individual basis per project. If used, slip it on over the screened interval as the well is being assembled.

- cap the well riser to prevent materials from entering the well during construction;

- begin placing the chemically inert filter pack within the annular space surrounding the well screen while simultaneously removing the augers or casing;

- the filter pack should be added slowly in order to prevent bridging of the sand between the riser and the borehole or auger; when adding filter pack below the water table or to a deep well, a tremie pipe should be used;

- add the filter sand until it extends no more than 2.0 feet inside the auger or casing, then pull the casing upward allowing the filter sand to flow from the bottom, filling the resultant annular space. Frequent depth measurements should be taken using a weighted tape to verify the effectiveness of this procedure. The augers or casings should not be extracted in greater than 2.0 foot increments to minimize the potential for native sediments to cave or slump into the annular space;

- continue placing the filter pack until it extends above the screen for a distance equal to approximately 20% of the total screened interval, but not less than 2.0 feet above the top of the screen. Where there is a hydraulic connection between the zone to be monitored and the overlying strata, this upward extension of the filter pack should be minimized, subject to the construction described above, to prevent seepage from upper zones which may result in less than representative sampling;

- it is optional to place a secondary, finer filter pack directly above the first to prevent intrusion of the bentonite seal into the primary filter pack. This filter pack should be designed with a vertical thickness ranging between 0.5 and 2.0 feet. As with the primary filter pack, the secondary filter must not extend into an overlying hydrologic unit. The need for this filter pack should consider the gradation of the primary filter pack, the hydraulic heads between adjacent units, and the potential for grout intrusion into the primary filter pack;

- place an annular sealant seal directly above the filter pack(s) while continuing to remove the augers or casing in 2.0 foot increments. This seal consisting of bentonite pellets or chips, should extend a minimum of 3.0 feet above the top of the filter pack. Frequent depth measurements should be taken using a weighted tape to verify the efficiency of this procedure.

- pour water of a known chemistry over the bentonite pellets or ships if the seal is located in the vadose (unsaturated) zone (i.e., above the water table) to hydrate the bentonite. Record the amount of water added during this procedure for corrected well water removal during well development (PSC-121).

- fill the remaining annular space with a bentonite grount slurry continuing to remove the augers or casing in two foot increments. The slurry should extend to approximately 5.0 to 6.0 feet below ground surface and all augers or casing should be withdrawn. Allow 24 hours to settle and set;

- top-off the grouted column to 5.0 to 6.0 feet below the ground surface and allow to set overnight.

6.0 Standard Surface Finishing Designs

The following defined our standard "flush mount" and "stand pipe" monitoring well finishing procedures:

7.1 Standard Flush Mount Finish

This finishing design (Figure 2) is used when monitoring wells are installed in high traffic areas or other areas where a low profile design is needed. Flush mount wells are less preferable than stand pipe wells because there is a greater chance of surface water entering a flush mount well. The standard flush mount finish is constructed as follows:

- add filter sand to the annular space above the grouted column to a depth of approximately 3.5 feet below ground surface;

- center a 4.0 foot length of 4 or 5 inch diameter steel casing, with locking steel cap into the bore hole. This casing should be placed so that the locking lid rests approximately 2 inches above the top of the capped well riser, and is seated a minimum of 6 inches into the filter sand;

- place a bentonite seal using water of known chemistry;

- place filter sand in the annular space between the well riser and the steel casing to a depth of 1.0 foot below ground surface;

- center a 13 inch diameter, aluminum cast, manhole-type cover equipped with a water tight gasket and a 1.0 foot aluminum vertical extension, over the locking steel casing. The top of the aluminum cover should be approximately a ¼ inch above the ground surface;

- add grout to the excavated area, allowing the grout to flow into the annular spacing surrounding the steel casing. Fill the excavation evenly to a depth of approximately 8 inches below the ground surface and allow to settle and set (to shorten the setting time, the use of adding "quick-set" to the grout is acceptable). The bottom few inches of the aluminum cover should be seated in the cement;

- add cement to the excavated area surrounding the aluminum cover until the cement is flush with the ground surface. Gently grade and smooth the cement from the edge to the cover, so that runoff is away from the well and allow to set;

- permanently identify the well by labeling the cement pad, aluminum cover and lid to the locking steel casing; and

- secure well with an approved brass or hardened-steel lock.

7.2 Standard Stand Pipe Finish

This finishing design (Figure 3) is used when the flush finish design is not needed. The standard stand pipe finish is constructed as follows:

- add filter sand to the annular space above the grouted column to a depth of approximately 1.5 feet below ground surface;

- center a 5.0 foot length of 4 or 5 inch inside diameter steel casing, with locking steel cap into the bore hole. This casing should be placed so that the locking lid rests approximately 2 inches above the top of the capped well riser, and is seated a minimum of 6 inches into filter sand;

- place filter sand in the annular space between the well riser and the steel casing to ground surface;

- excavate a 2.5 foot square which measures approximately 6 inches deep around the edges and grades deeper with depth at a slope of approximately 45° toward the bore hole. Take care to minimize the deposition of soil into the annular space outside the steel casing;

- using 2' x 6' lumber, construct a 3.0 foot square wooden frame and insert the frame into the excavation. Situate the frame so that all edges are flush with the ground surface;

- place three 3.0 foot long steel bumper guards in the excavation to protect the stand pipe from damage resultant from vehicular traffic on the line;

- add cement to the excavated area, allowing the cement to flow into the annular spacing surrounding the steel casing, until the cement is flush with the ground surface. Gently grade and smooth the cement from the edge to the casing, so the runoff is away from the well, and allow to set (to shorten the setting tiem, the sue of adding "quick-set" to the cement is acceptable under cold weather conditions);

- permanently identify the well by labeling the cement pad, stand pipe and lid to the locking steel casing; and,

- secure well with an approved brass or hardened-steel lock and record key number in field log book.

8.0 Documentation

Documentation of all monitoring well installation activities including all geotechnical forms and the maintenance of a detailed field notebook will be recorded in accordance with Standard Operating Procedure PSC-400.

9.0 Measure of Proficiency

Field staff will demonstrate proficiency on this SOP by successfully completing Sections 6.0, 7.0 and 8.0 a minimum of twice under the direct supervision of the Corrective Actions Manager or a designee.

JSA Title:	Well Abandonment – Chip in Place						
Step No: order	**Sequence of Job Steps** Break down Job into steps.	**Potential Hazards & Impacts** Identify hazards faced at each step of the task. Identify what may happen if the hazard is not effectively controlled.	**Risk Rating** pre action	**Procedure or action required** Determine the actions necessary to reduce risk to an acceptable level. Record responsibility for the action as applies	**Risk Rating** post action	**Responsible Person(s) - Initials**	**Mitigation on Steps Verified**
1	Unload tooling	Exertion - strain and sprains	8	• Wear all required PPE • Buddy system for awkward or heavy objects over 50 lbs. • *Use "Safety In Motion" Training*	3		
		Contact with pinch points		• Watch hand placement			
2	Remove well box	OE, SB – jackhammer use, flying debris	8	• Set up exclusion zone and ensure adequate protection from traffic and pedestrian interference. • Refer to JSA Jackhammer Use. • Refer to JSA Well Box Removal	3		
3	Back fill with bentonite chips	Exertion - back strain	5	• Use proper lifting techniques lifting 50 lbs. bags.	3		
		Fall - Create tripping hazard		• Fill hole with bentonite chips to 2 ft. below surface. Do not overfill. • Hydrate chips completely to prevent future swelling of chips. • Use an adequate amount of concrete on top of chips. • Overfilling with bentonite chips, failing to properly hydrate chips, and using an inadequate amount of concrete, can all cause future "eruption" of surface layer resulting in a trip hazard.			

JSA Title:	Well Destruction – Pressure Grout with Drill Rig						
Step No: order	**Sequence of Job Steps** Break down Job into steps.	**Potential Hazards & Impacts** Identify hazards faced at each step of the task. Identify what may happen if the hazard is not effectively controlled.	**Risk Rating** pre action	**Procedure or action required** Determine the actions necessary to reduce risk to an acceptable level. Record responsibility for the action as applies	**Risk Rating** post action	**Responsible Person(s) - Initials**	**Mitigation on Steps Verified**
1	Remove well box	Contact - Flying debris Exertion - Back strain	12	• See JSA Jackhammer Use if appropriate • Communicate with co-workers and make sure nobody is in the way • Stretch before lifting, get assistance with heavy (>50 lbs.) or awkward objects • Use appropriate tools such as hand trucks, booms, lift trucks, etc. • Use “Safety In Motion” Training	6		
2	Mix Grout	Exposure - Dust inhalation Exertion - Back Strain from removing Whirlybird mixer	8	• Avoid breathing dust, stand upwind. • Do not lift and twist at the same time. Lift the mixer all the way out. Point your toes in the direction you are turning. • If you are not tall enough to lift it all the way out before twisting, use the buddy system. • Use “Safety In Motion” Training	3		
3	Hook up pressure grout system	Contact - smashed fingers due to system binding up	5	• Make sure coupler is properly seated all the way down on casing • Secure manifold with auger bolt to spindle • Never pressure grout any well unless you can get your drill head on it • Use “Show Your Hands” procedure	3		
4	Pressure up grout system	Contact - Injury due to casing blowout Contact - Flying dirt/mud	12	• Whip checks must be used on all pressurized hose connections • Inspect casing for cracks and breaks • Use and watch pressure gauge, Do not exceed 50 psi • Back away from system while pressuring up • Safety Glasses required	6		
5	Disconnect air hose/ remove manifold	Contact Struck by air hose	8	• Check gauge to make sure pressure is reduced to below 5 psi • Be aware of pressure still in casing when removing manifold	3		
6	Remove the top 5 ft. of well	Contact with flying debris due to breaking casing	8	• Make sure everybody but the Driller is at least 10 ft. away • Driller should be aware of possible flying debris	3		
7	Cap hole with concrete	Exposure- Cement dust	8	• Avoid breathing dust • Wash hands before you eat or drink	3		