

*Migration of Inorganic Arsenic at a  
Former Pesticide Storage and  
Disposal Site*

*By W. A. Hohn*

- 1. History of inorganic arsenic as a grasshopper pesticide in the State of Wisconsin.**
- 2. Overview of the Town of Aniwa, Shawano County, WI. as a arsenic waste disposal site.**
- 3. Removal of arsenic at the Town of Aniwa Site.**
- 4. Arsenic and lead levels in soils after removal of buried arsenic pesticide.**



*The area of grasshopper infestation in Wisconsin for the year 1934*

*(WI. Dept. of Agriculture)*

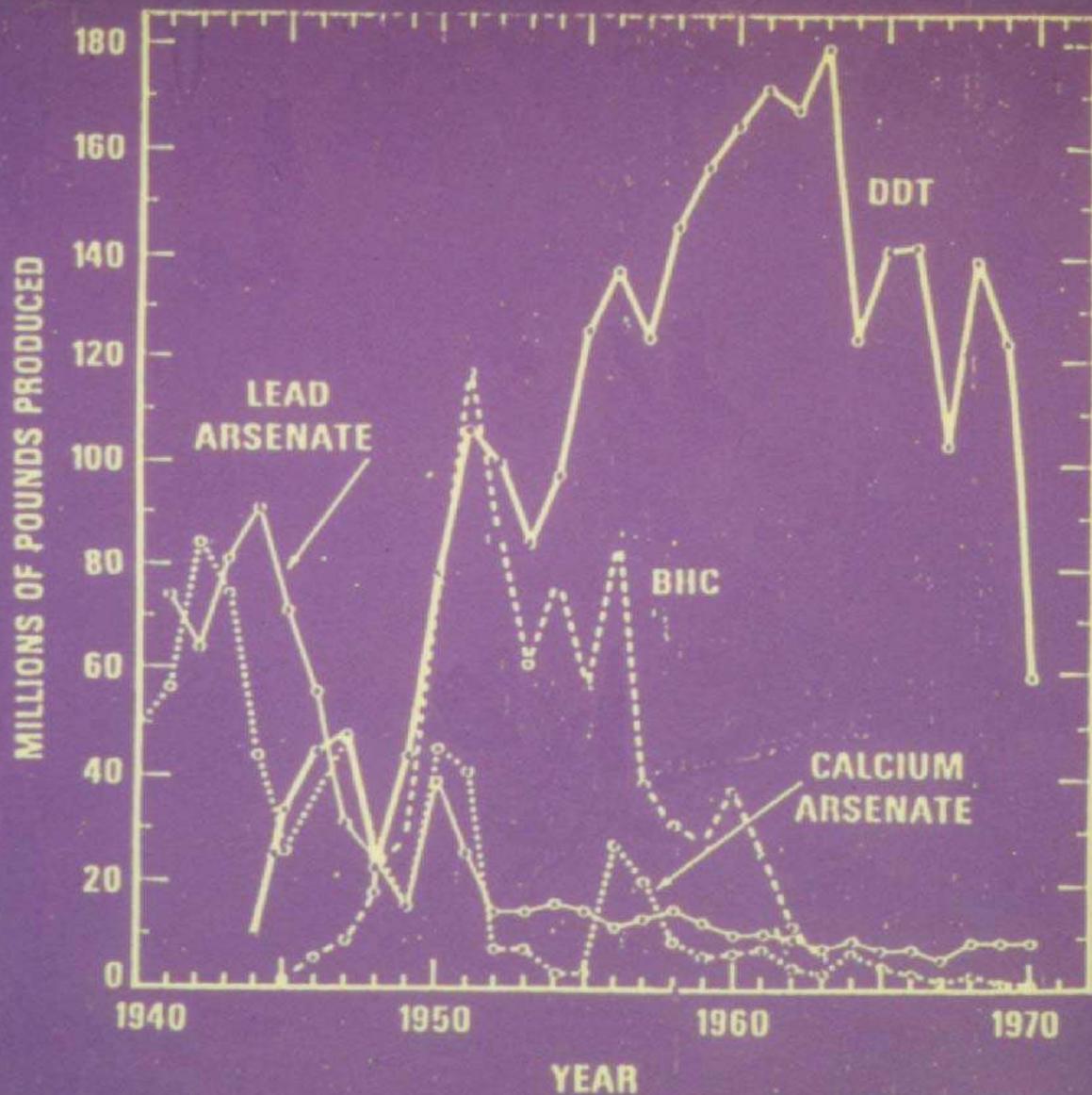
# Grasshoppers

AND THEIR  
**CONTROL**



**Farmers' Bulletin**  
**No. 1828**

U.S. DEPARTMENT *of* AGRICULTURE



*Production of various pesticides for the years 1940 - 1970 (USDA, 1973)*

DEPARTMENT OF AGRICULTURE OF  
STATE OF WISCONSIN  
U. S. DEPARTMENT OF AGRICULTURE  
COUNTY BOARD OF SUPERVISORS,  
CO-OPERATING

CO-OPERATIVE EXTENSION WORK  
- IN -  
AGRICULTURE AND HOME ECONOMICS  
STATE OF WISCONSIN

AGRICULTURAL EXTENSION  
SERVICE  
COUNTY AGRICULTURAL  
REPRESENTATIVE WORK

Shawano, Wisconsin  
May 10, 1943

E. L. Chambers  
Dept. of Entomology  
State Dept. of Agriculture  
Capitol Building  
Madison, Wisconsin

Dear Sir:

I am glad to know that our old stocks of Arsenite will be picked up. This should be done soon as we have barrels that are now in a leaky condition and others that are rusted so such an extent that a mere touching will spring a leak. We have a couple of places where stock has been poisoned from grazing close to the storage places. How soon do you think this will be picked up?

New barrels will have to be supplied in a lot of cases.

Very truly yours,

*E. J. Baumgardner*

County Agric. Agent

GFB:MT  
cc to Harold Volland  
Fred Christianson



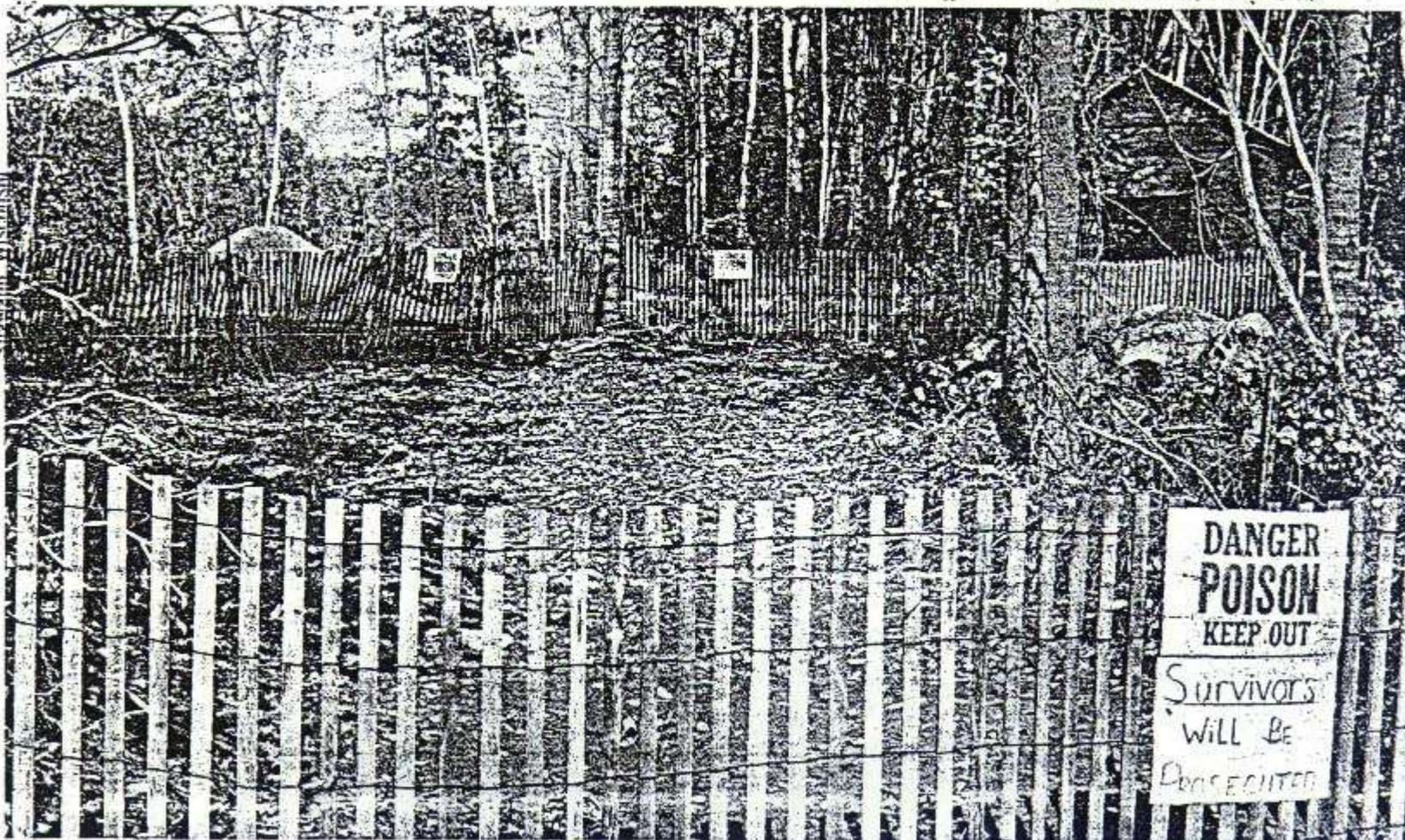
# Arsenic-contaminated soil in Aniwa to be hauled away

SEL/10/11/83

Shawano City-County Library

Shawano, Wisconsin

See other side



SHAWANO COUNTY

SEL photo

The warning at the arsenic burial site in the Town of Aniwa has gotten sterner. Original signs read

"No trespassing — Poison." Soil and water tests at the site have revealed serious contamination.

The shed was moved from its original site to allow a monitoring well to be dug.

For use only in Lib.

# Aniwa arsenic cleanup begins

By David Niles  
SEL Reporter

**TOWN OF ANIWA** — The clean-up of contaminated soil from an arsenic pesticide dump here began Tuesday as the U.S. Environmental Protection Agency started to dig up corroded barrels of the poison.

EPA officials from New Jersey and a contracted clean-up crew from Minneapolis donned protective "moonsuits" and masks to filter breathing air as they worked on the Marsh Road site between Aniwa and Birnamwood, just off Highway 45. The area was sealed off and guarded for safety reasons.

Six more wells are also being dug to expand monitoring of groundwater. While water samples from the burial site have showed contamination, samples from neighboring residential wells showed no contamination.

Four barrels were dug up Tuesday morning, and crews expected to find several more.

The arsenic was buried in 1975 after being stored at the site for several years. It was used in the 1930s as a grasshopper pesticide.

The state collected unused arsenic in the 1950s but some local governments, including the Town of Aniwa, kept their allotments. State officials fear other towns in this area also have arsenic stored or buried.

The work this week is the result of an EPA study initiated in December which concluded the problem was not serious

enough to warrant involvement of the EPA's Superfund. This week's digging is a further step in determination of EPA involvement.

Crews are expected to be at the site through the week. They will dig down to groundwater — about 12 feet down.

Because of the relatively small area of land involved, the digging this week will essentially equal the clean-up, said Dave Crehore, public information officer for the State Department of Natural Resources.

Soil samples and the corroded barrels of arsenic are being placed in new drums by the crews. Other soil that will be left at the site will be handled by the DNR.

There's another benefit in the EPA investigation. Because it is not a Superfund project, the agency does not have to be reimbursed for the work.

The state will pay for transportation of the soil and arsenic to a disposal site. Money will come out of the DNR's spill response fund. It still has not been determined whether the township will have to reimburse the state for that part of the clean-up.

Crehore said the "the really hot stuff" will be taken to a federally-approved land fill for permanent disposal, and less contaminated matter will be left in the area until a final disposal solution is agreed upon.

He said the matter will probably be taken to either Illinois or Alabama, depending on cost and other factors.

"The important thing is to get the hot stuff away from the ground water," he said.











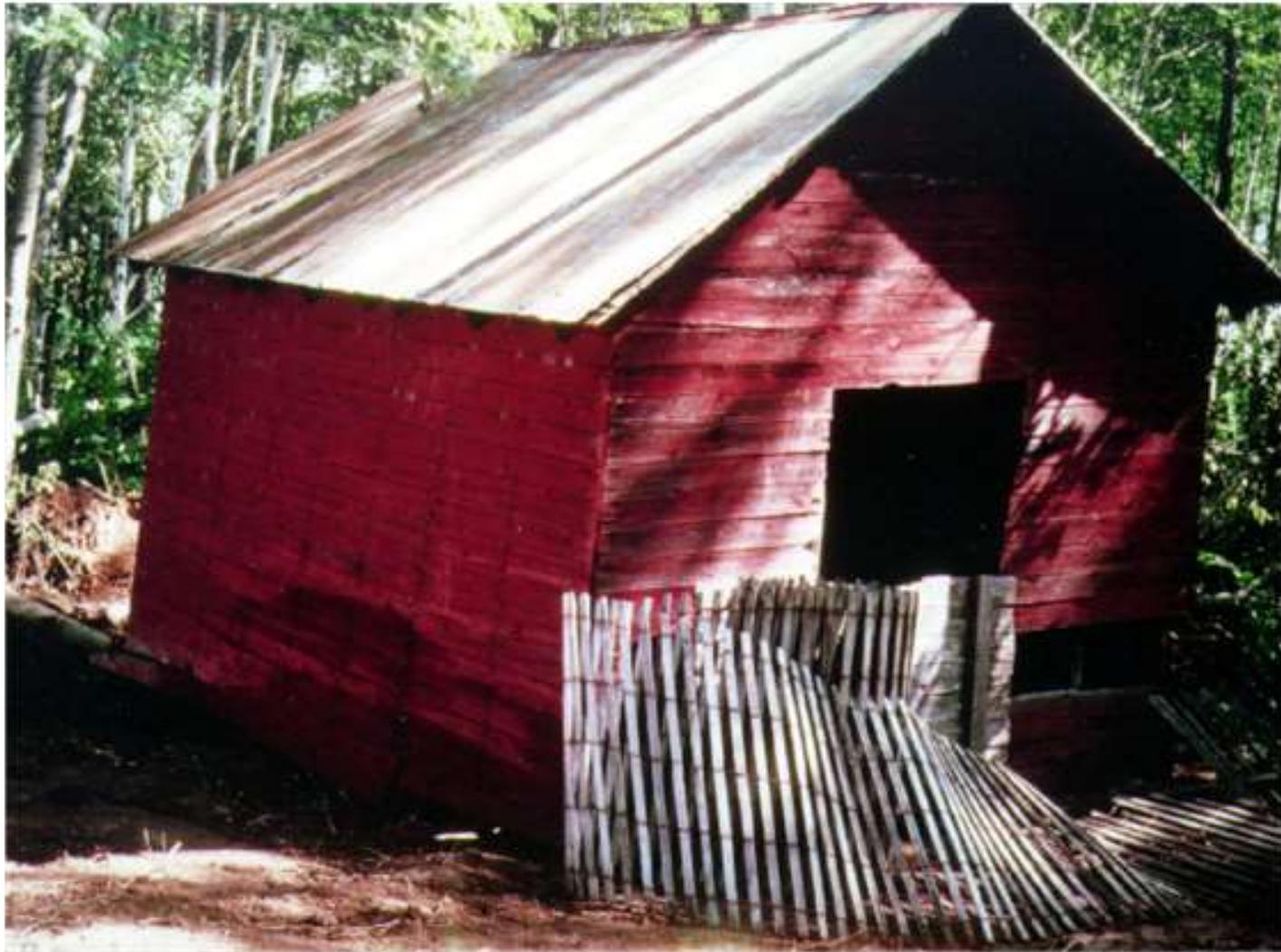












Client: W. Hohn Soil Testing

Project: Town of Aniwa Disposal Site

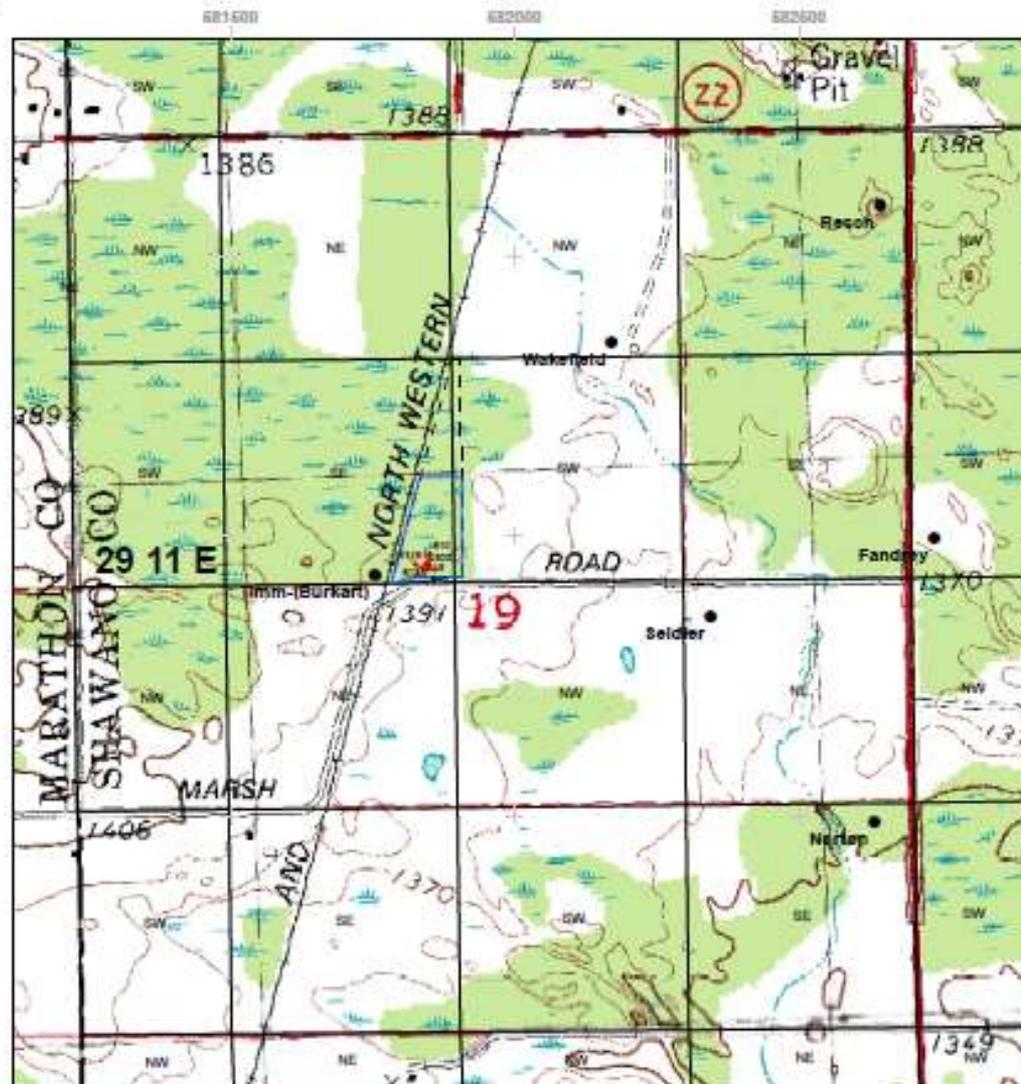
Location: Shawano Co. Wisconsin



Storage Shed

Figure

2



**Explanation**

- Private Well
- USGS Well Locations
- Property Outline
- Disposal Site
- QQSections

**Town Of Aniwa Disposal Site  
Shawano County, WI**

USGS Topographic Map  
Bismarwood Quadrangle  
1:24,000 Series

Coordinate System: NAD 1983 HARN Wisconsin TM  
Projection: Transverse Mercator  
Datum: North American 1983 HARN  
False Easting: 520,000.0000  
False Northing: -4,480,000.0000  
Central Meridian: -90.0000  
Scale Factor: 0.9998  
Latitude Of Origin: 0.0000  
Units: Meter



Feet

Reference Scale: 1:10,000

**Cartographic Services**

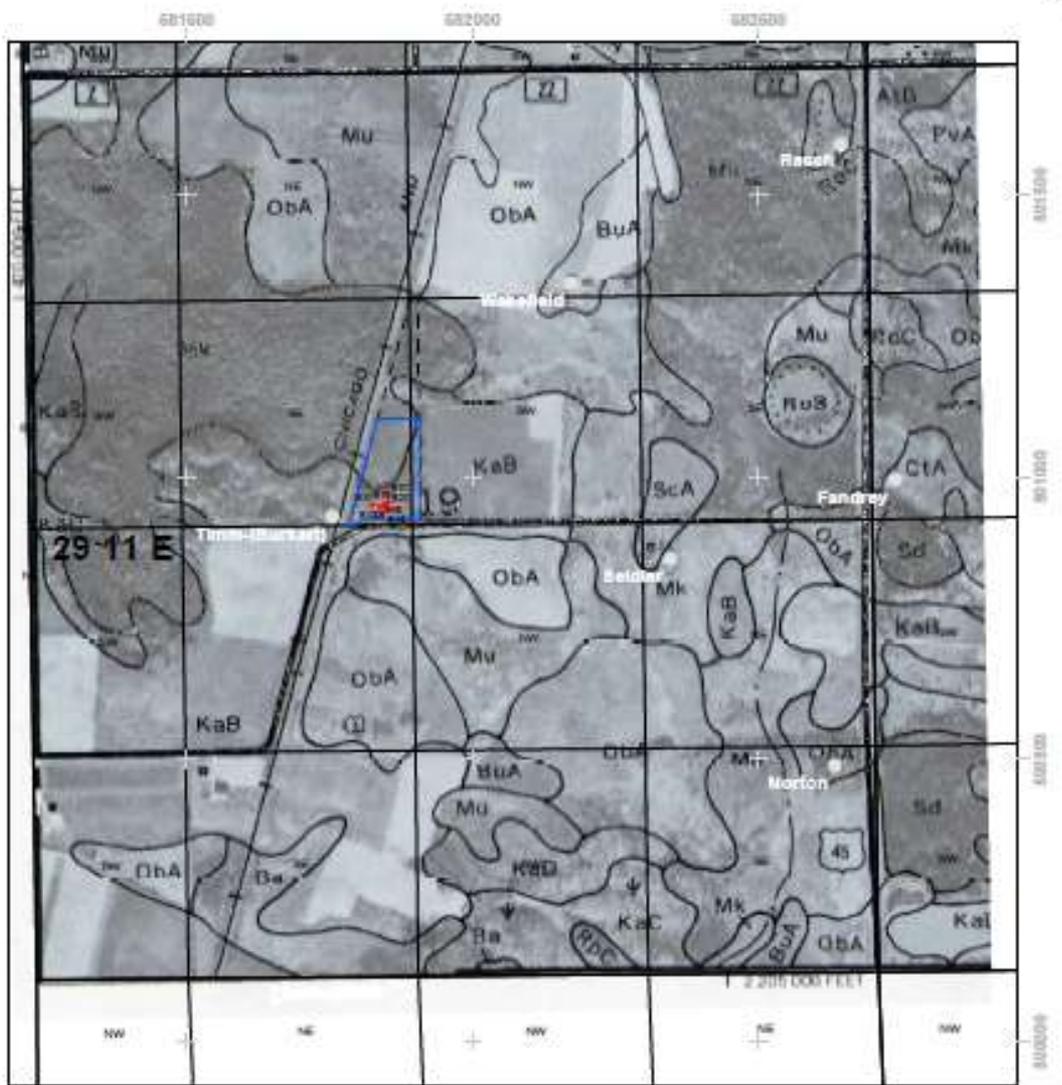
cartographic@cservices.com

Author: W. Hohn Soil Testing

Name: Aniwa\_Top

Date: 4/13/2014

Figure 3



**Explanation**

- Private Well
- ★ UGGS Well Locations
- Property Outline
- ▭ Disposal Site
- ▭ Sections
- ▭ QQSections

**Town of Aniwa Disposal Site  
Shawano County, WI**

USDA Soil Survey Map  
(Gundlach, et al., 1981)  
1:15,840 Series

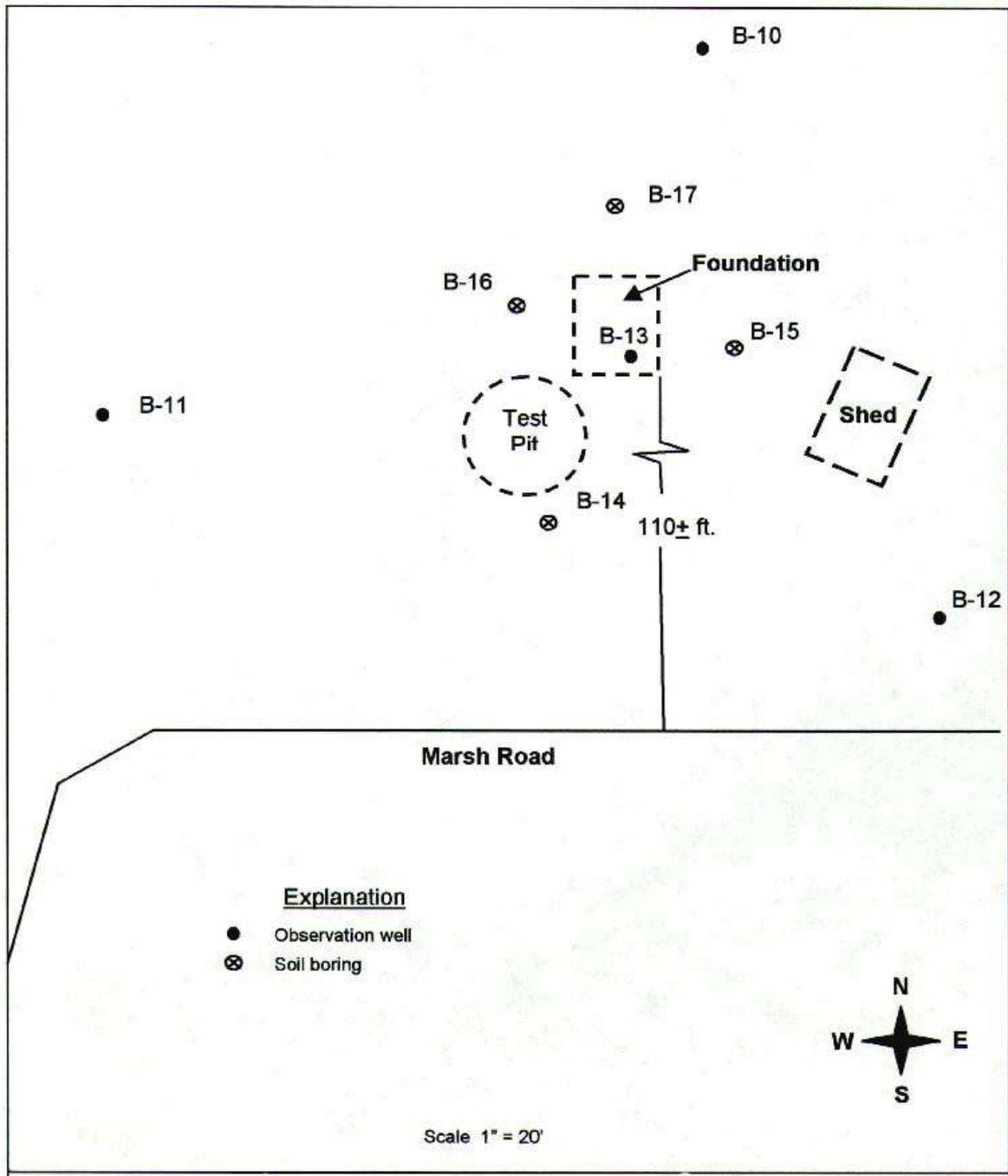
Coordinate System: NAD 1983 HARN Wisconsin TM  
Projection: Transverse Mercator  
Datum: North American 1983 HARN  
False Easting: 520,000.0000  
False Northing: -4,480,000.0000  
Central Meridian: -90.0000  
Scale Factor: 0.9998  
Latitude Of Origin: 0.0000  
Units: Meter



Reference Scale: 1:110,000



Author: W. Hohn Soil Testing  
Name: Aniwa\_Soil  
Date: 4/15/2014      Figure 4



Explanation

- Observation well
- ⊗ Soil boring



Scale 1" = 20'

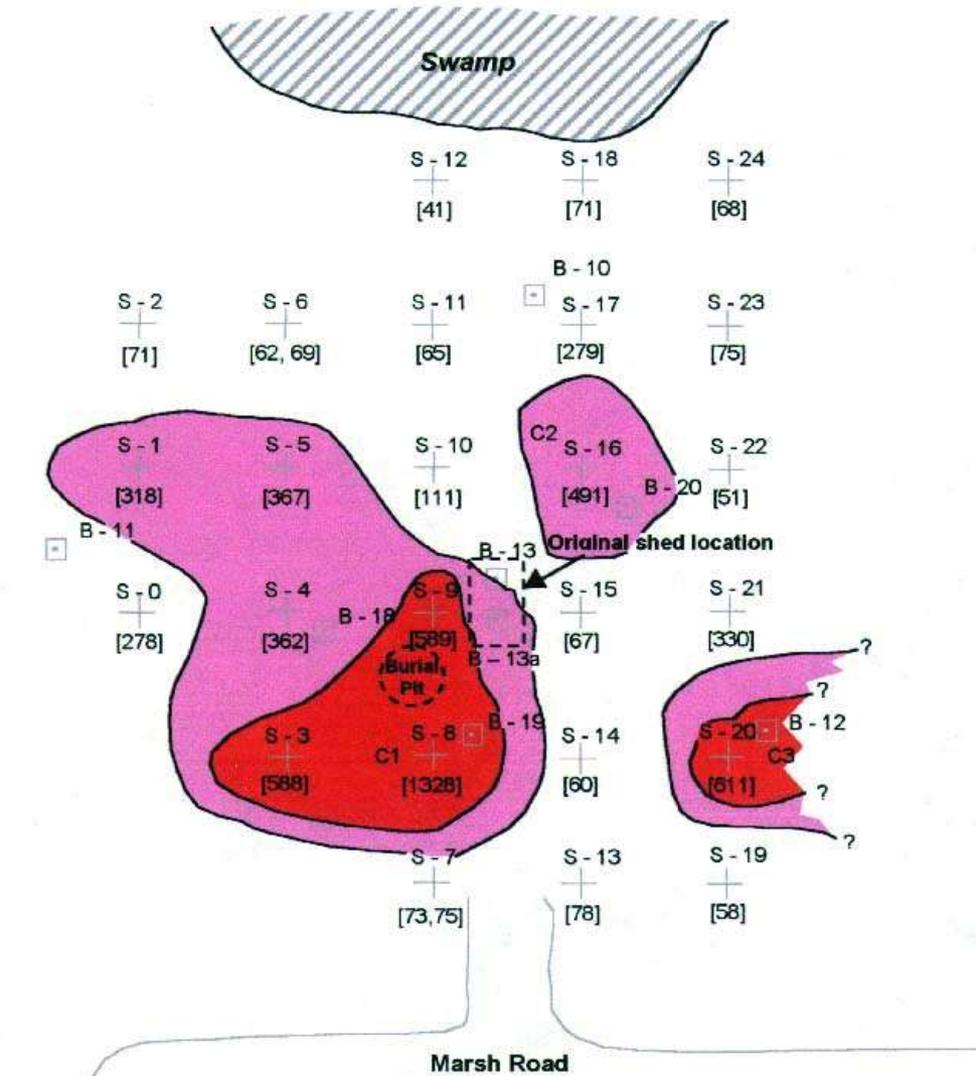
TABLE 1  
ARSENIC CONTENT OF SOIL SAMPLES  
Aniwa, Wisconsin

Boring	Sample No.	Depth (ft)	As Results*	Groundwater (ft)
10 North Well	1	0	2.45	5.9***
	3	5	3.70	
	4	7.5	1.84	
	5	10	1.58	
11 West Well	1	0	4.06	12.4***
	3	5	3.33	
	5	10	1.73	
	6	12.5	1.26	
12 SE Well	1	0	2.63	11.0***
	3	5	2.92	
	5	10	2.70	
	6	12.5	2.72	
13 In Shed	1	0	39,800	11.9***
	3	5	4.14	
	4	7.5	731	
	5	10	52.5	
14 next to pit SW of shed	1	0	25.3	11**
	3	5	3.34	
	5	10	160	
15 E of shed	1	0	7.03	11.5**
	3	5	2.40	
	5	10	69.6	
	6	12.5	50.8	
16 W of shed	1	0	8.90	9**
	3	5	8.88	
	5	10	2.04	
17 N of shed	1	0	2.52	10.5-11.5**
	3	5	3.21	
	5	10	2.65	
	6	12.5	1.92	

\* Results are reported as micrograms arsenic per gram dry solids ( $\mu\text{g/g}$ ).  
Sample 1 from B-13 also had 41.7  $\mu\text{g/g}$  copper and 111  $\mu\text{g/g}$  lead.  
Samples collected September 1983.

\*\* Depth recorded while drilling.

\*\*\* Measured 4 October 1983  
Table revised 14 October 1983.



**Explanation**

- Monitoring well
- ⊕ Soil sample point
- C2 Soil core sample
- [10] Arsenic soil conc. (mg As / kg soil)
- ≥ 500 mg As/ kg soil
- ≥ 300 mg As/ kg soil



Scale 1" = 35'

## SOIL ARSENIC CORE RESULTS

C1 (1328.0 mg/kg)

0-6" 9127.0 mg/kg

6-12" 225.0 mg/kg

12-18" 207.0 mg/kg

18-24" 313.0 mg/kg

C2 (491.0 mg/kg)

0-6" 73.0 mg/kg

6-12" 73.0 mg/kg

12-18" 90.0 mg/kg

18-24" 64.0 mg/kg

C3 (611.0 mg/kg)

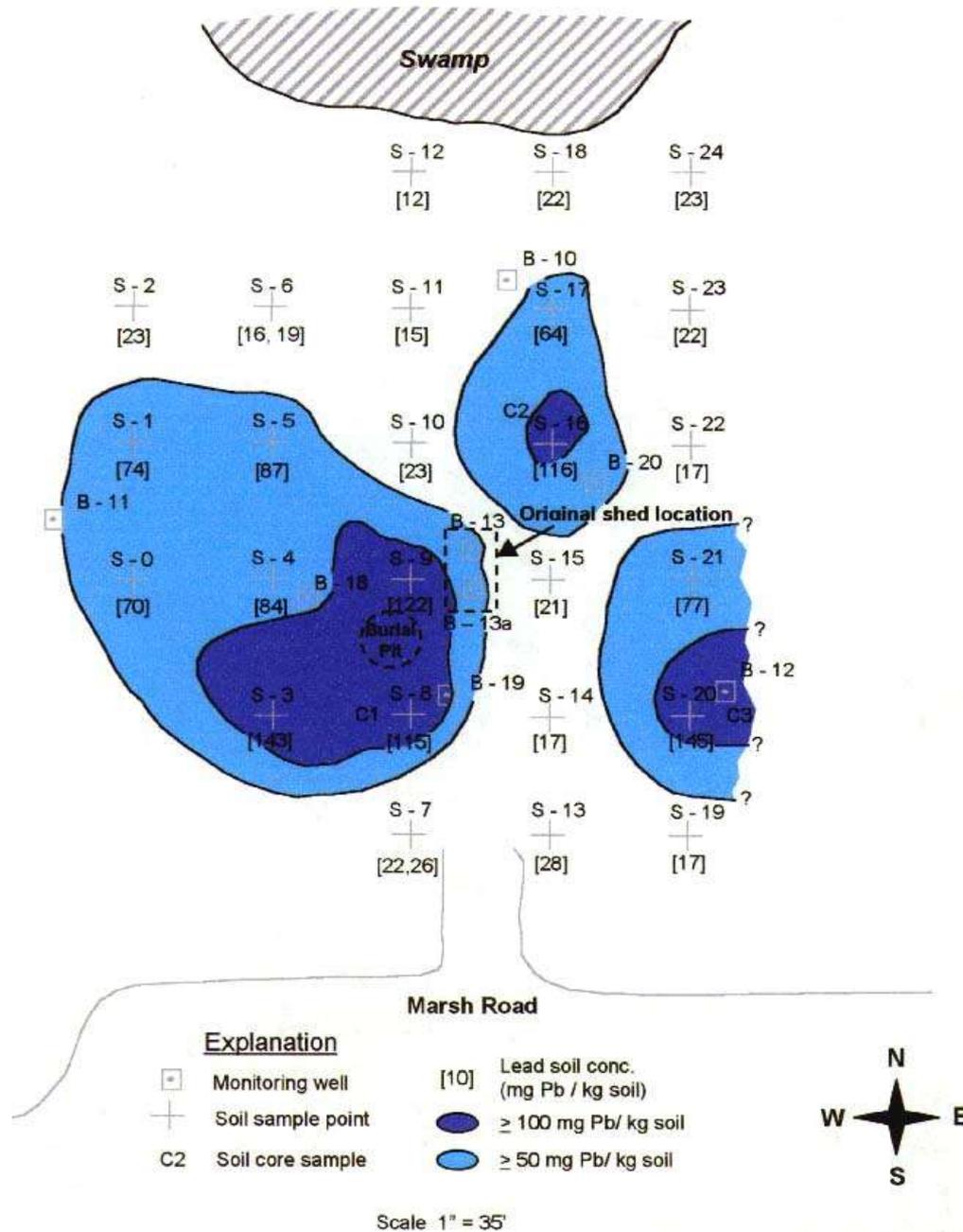
0-6" 65.0 mg/kg

6-12" 58.0 mg/kg

12-18" 57.0 mg/kg

18-24" 50.0 mg/kg

( ) = Closest composite sample result.





**Table 14.** Elevated arsenic soil borings done at the Town of Aniwa Disposal Site on 6 June 2007.

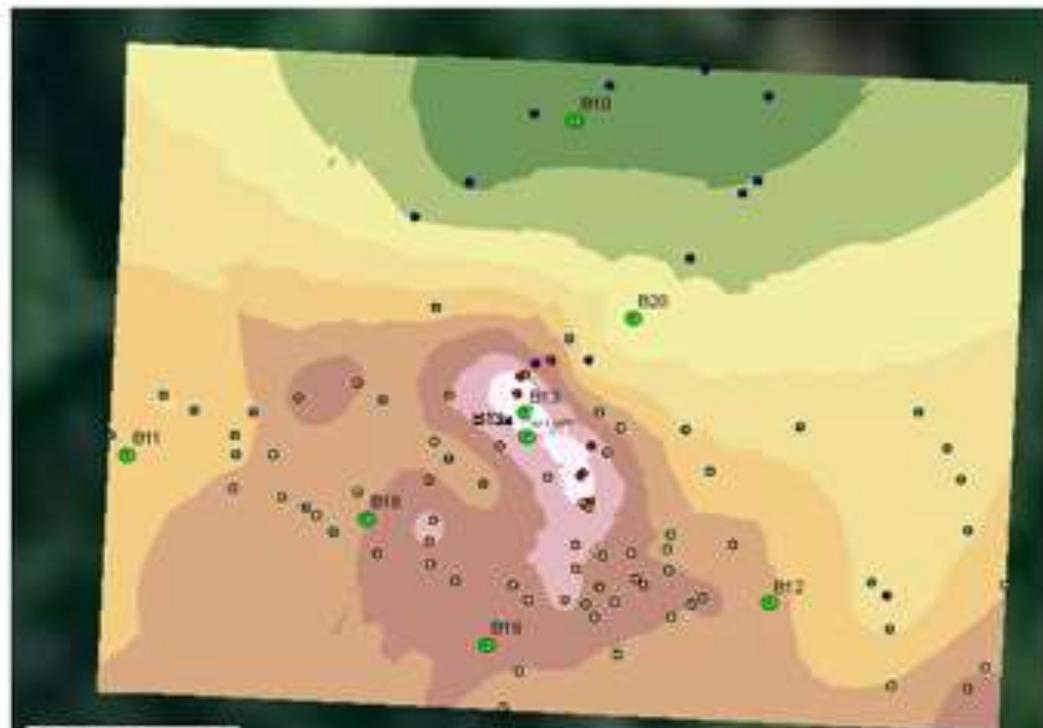
**B-2 Between B-13 and B-13a (Old Shed Site)**

<u>Sample No.</u>	<u>As(mg/Kg)</u>	<u>Pb(mg/Kg)</u>
S2A(1-2 ft)	1.18	1.42
S2B (3-4 ft.)	281.00	3.20
S2C (4-6 ft.)	232.00	4.75
S2D (7 ft.)	1.84	0.94
S2E (8 ft.)	2.06	2.29
S2F (8-10 ft.)	1.11	3.32
S2G (10-11 ft.)	0.91	2.07
S2H (12-14 ft.)	1.90	2.82
S2I (15 ft.)	N.D.	2.03
S2J (16 ft.)	1.08	1.13
S2K (17-18 ft.)	0.40	1.95
S2L (19-20 ft.)	N.D.	1.79
S2M (22 ft.)	N.D.	0.90

**B-3 In Front of Old shed site by test pit**

S3A (1-2 ft.)	10.30	6.80
S3B (3-4 ft.)	6.25	3.25
S3C (4-5 ft.)	4.03	5.72
S3D (8 ft.)	0.75	2.00
S3E (9 ft.)	9.32	2.06
S3F (12 ft.)	87.10	1.35
S3G (13-14 ft.)	117.10	1.05
S3H (16 ft.)	465.00	1.67
S3I (17-18 ft.)	296.00	N.D.
S3J (20 ft.)	32.00	1.53

**N.D. = No Detection**



**EM-31 Results  
(mS/m)**



Client: W. Hohn Soil Testing | Project: Town of Ashwa Disposal Site | Location: Shawano Co. Wisconsin



Geophysical Survey EM-31 Conductivity  
Contour Map  
compiled by D. Hart WGNH, 2011

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**Table 15.** Elevated arsenic soil borings done at the Town of Aniwa Disposal Site on 29 November 2012 and 08 December 2013.

**B-1 Northwest of Well B-13**

<u>Sample No.</u>	<u>As(mg/Kg)</u>	<u>TCLP(mg/L)</u>
SB1 (0-2 ft.)	3.70	
SB1 (2-4 ft.)	59.80	
SB1 (4-6 ft.)	36.20	
SB1 (6-8 ft.)	53.80	
SB1 (8-10 ft.)	54.50	
SB1 (10-12 ft.)	65.40	
SB1 (12-14 ft.)	36.00	
SB1 (14-16 ft.)	1.30	
SB1 (16-18 ft.)	17.40	
SB1 (18-20 ft.)	0.91	

**B-3 South of B-13 and B-13a (10 ft. off Old Shed Site)**

<u>Sample No.</u>	<u>As(mg/Kg)</u>	<u>TCLP(mg/L)</u>
SB3 (0-2 ft.)	3.90	
SB3 (2-4 ft.)	8,360.00	1.50
SB3 (4-6 ft.)	2.90	
SB3 (6-8 ft.)	1.60	
SB3 (8-10 ft.)	2.20	
SB3 (10-12 ft.)	10.70	
SB3 (12-14 ft.)	38.60	
SB3 (14-16 ft.)	7.60	
SB3 (16-18 ft.)	32.00	
SB3 (18-20 ft.)	12.80	
SB3A (0-6") (6 ft. South of SB3)	529.00	0.39

**B-6 West of B-13a and Old Shed Site**

<u>Sample No.</u>	<u>As(mg/Kg)</u>	<u>TCLP(mg/L)</u>
SB6 (0-2 ft.)	1,410.00	0.28
SB6 (2-4 ft.)	47.70	
SB6 (4-6 ft.)	110.00	0.46
SB6 (6-8 ft.)	7.20	
SB6 (8-10 ft.)	256.00	3.00
SB6 (10-12 ft.)	1.50	
SB6 (12-14 ft.)	74.30	
SB6 (14-16 ft.)	1.70	
SB6 (16-18 ft.)	68.10	
SB6 (18-20 ft.)	1.60	
(TCLP) (11-12 ft.)	1.30	

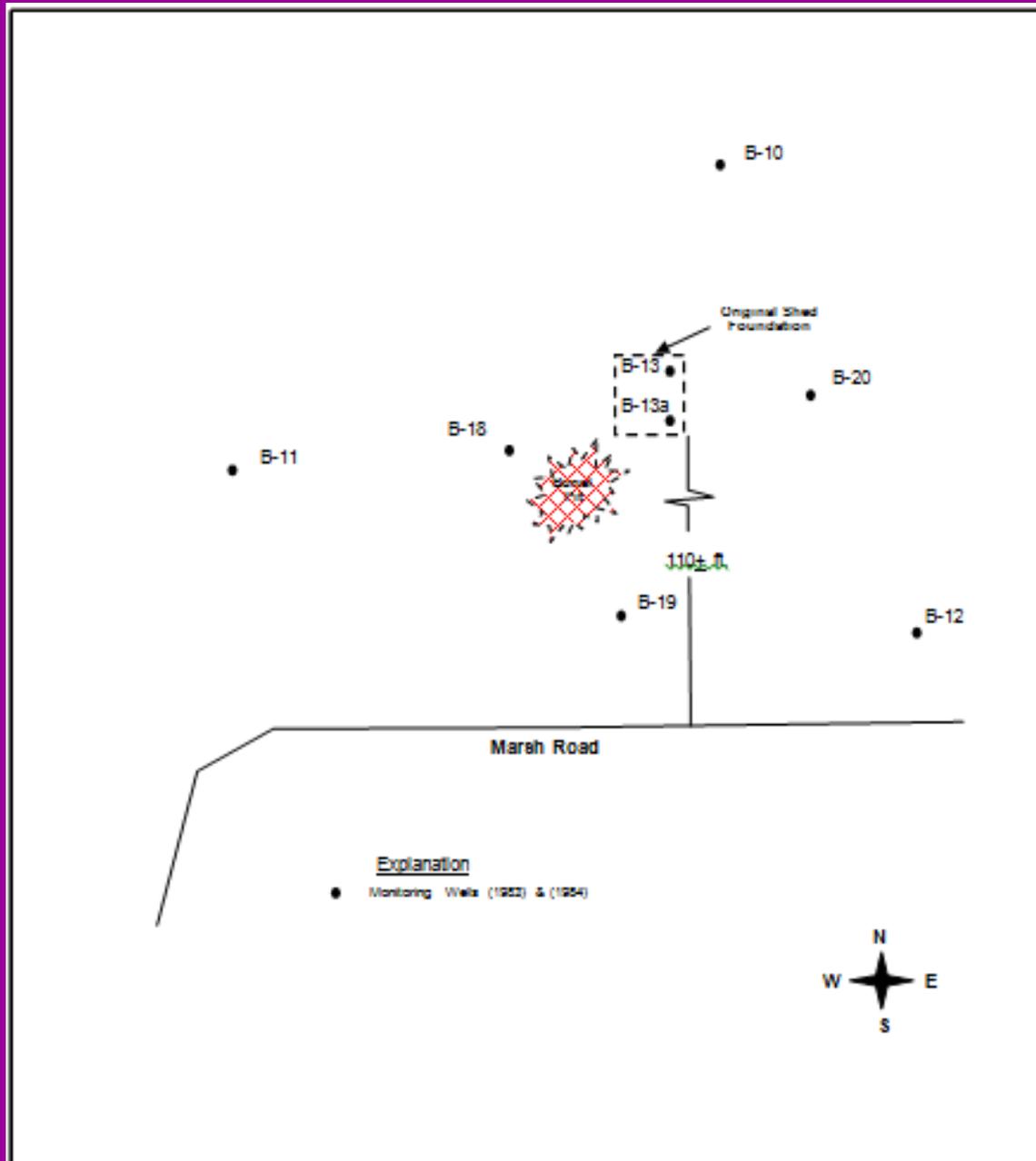
**1. Location of monitoring wells and direction of groundwater flow at the Township of Aniwa Site.**

**2. Levels of sodium, nitrates and arsenic found in the monitoring wells at the site.**

**3. Comparison of arsenic levels and groundwater height in wells B-12 & B-13 for the years 1990 - 1995.**

**4. Yearly arsenic levels in the wells B-12 & B-13 for the years 1990-2014.**

**5. Summary and Conclusions.**



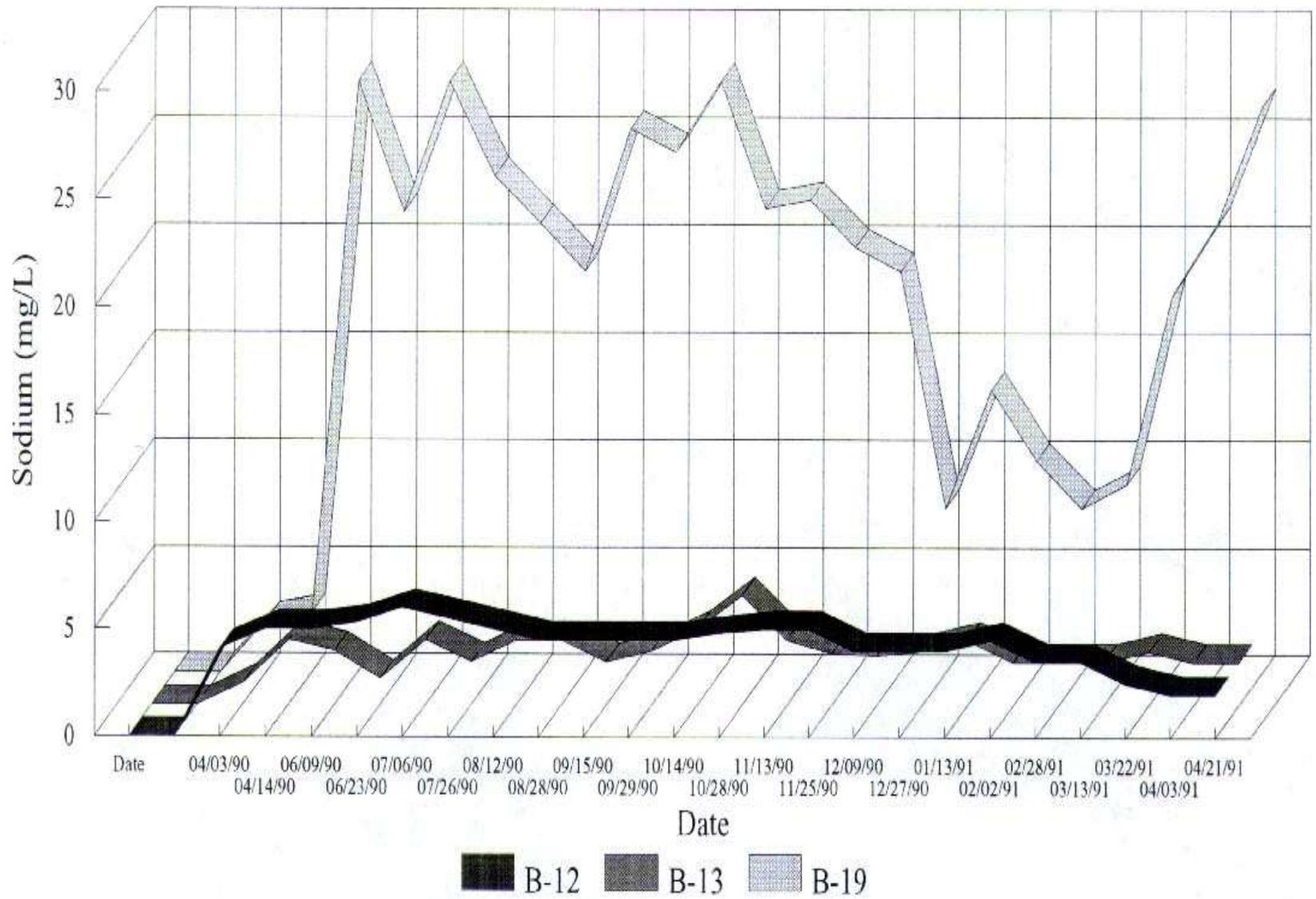
Explanation  
 ● Monitoring Wells (1983) & (1984)

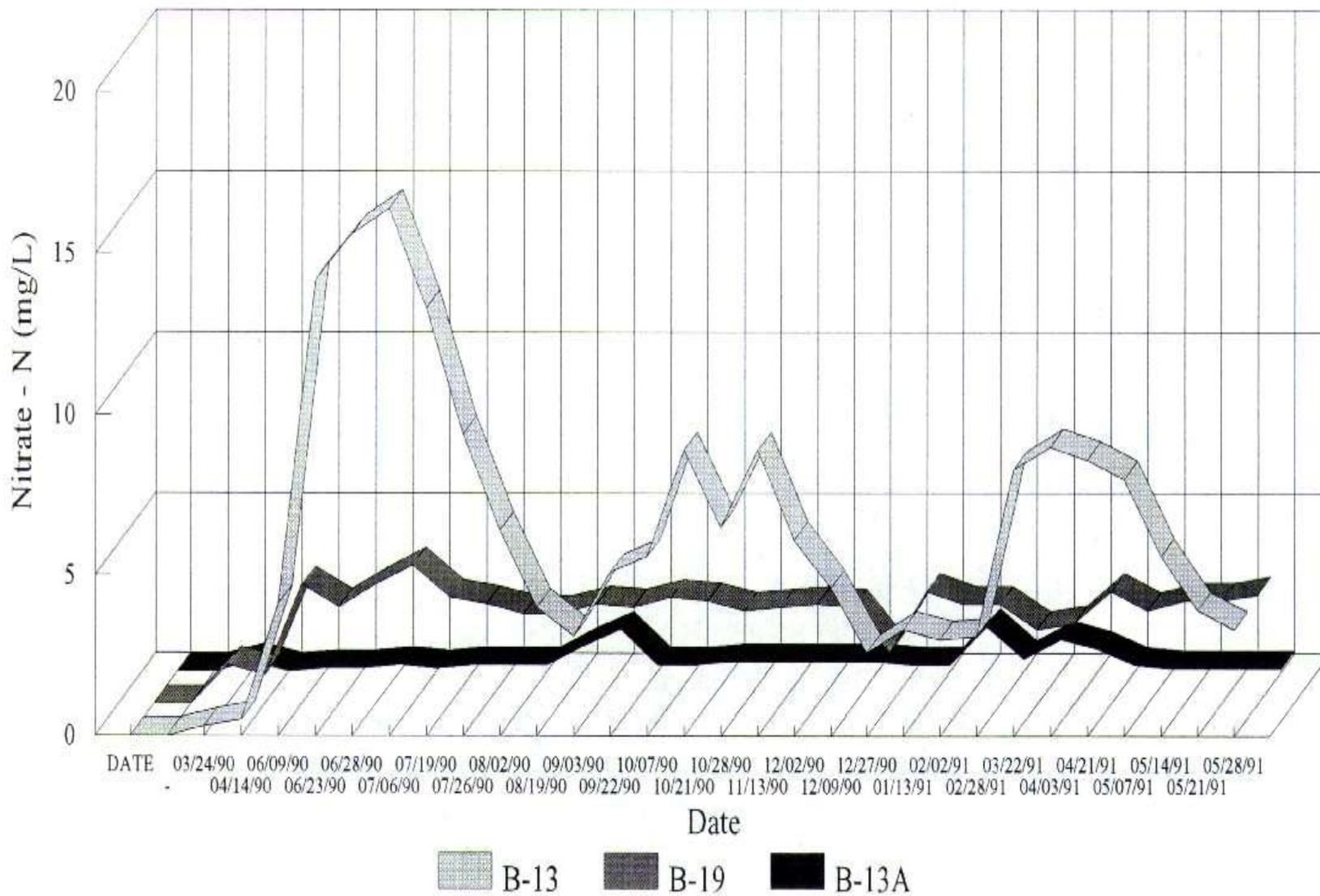
Client: W. Hahn Soil Testing    Project: Town of Antwa Disposal Site    Location: Shawano Co. Wisconsin

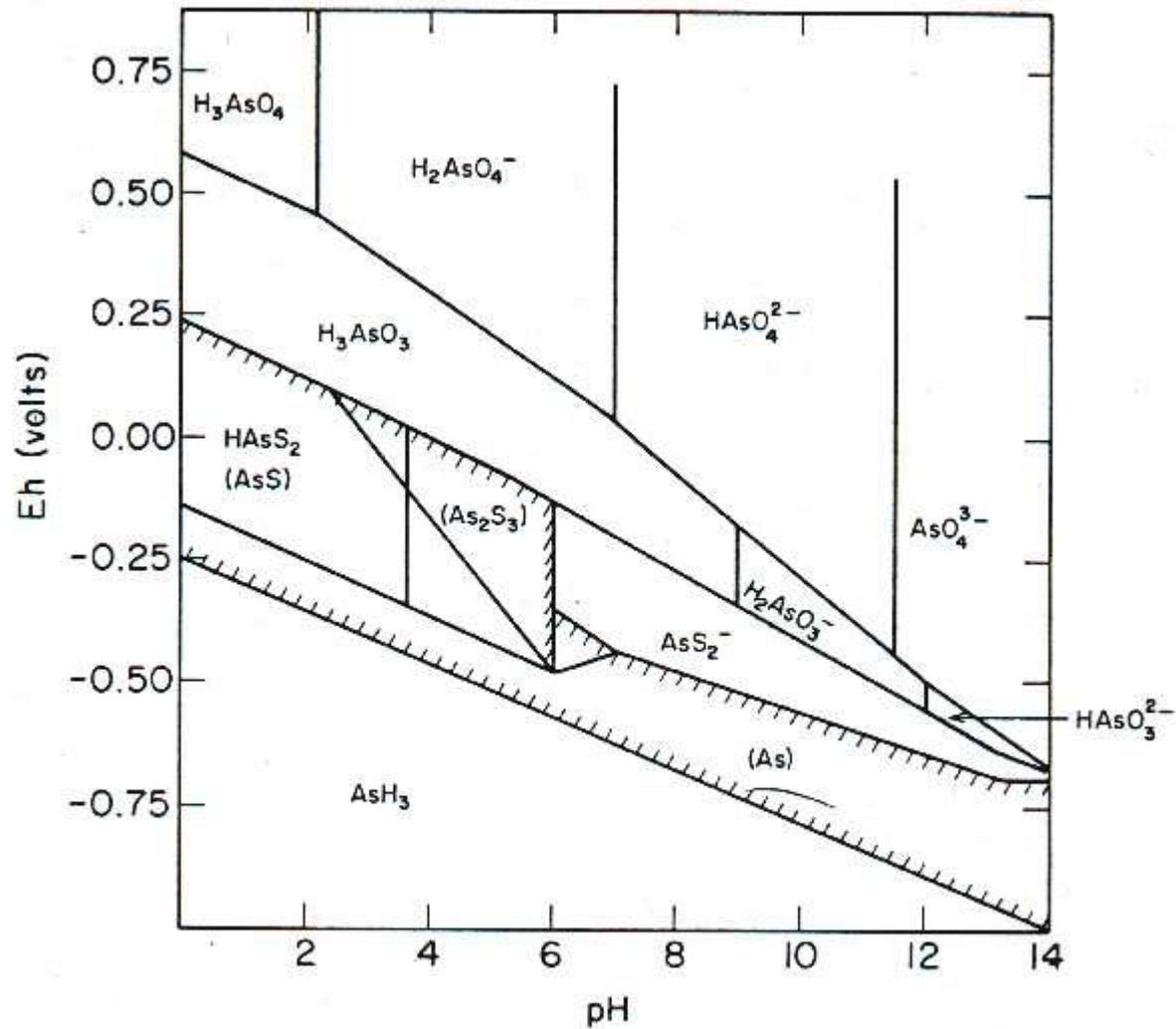


Monitoring well layout (Becher-Hoppe, 1983)  
 Not to scale





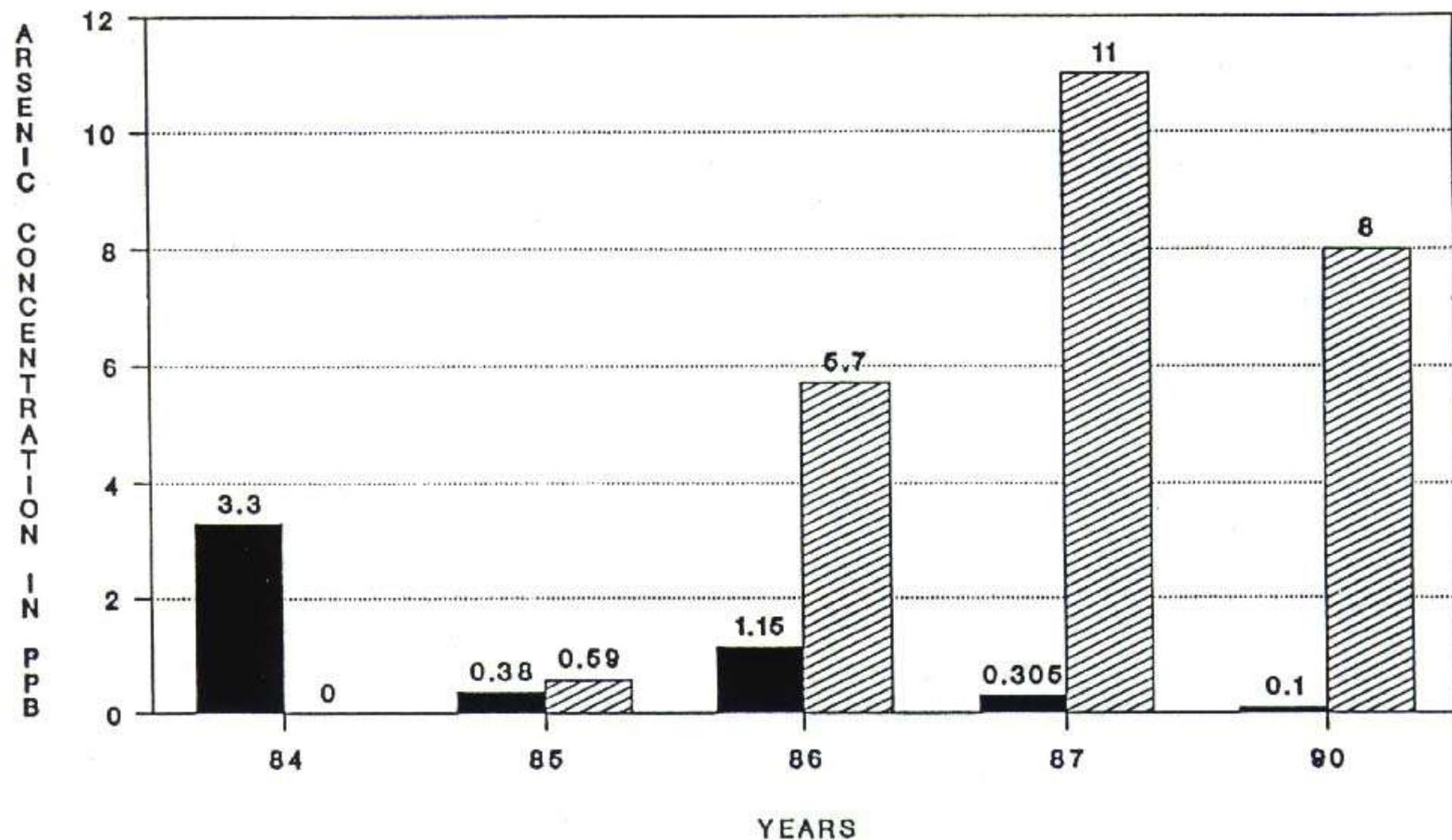




Eh-pH diagram for arsenic at 25°C and 1 atmosphere (Ferguson and Gavis, 1972)

# ARSENIC CONCENTRATIONS IN TEST WELLS B12 AND B13

■ B13    ▨ B12



**Table 12.** Summary of statistical results for arsenic levels (ug/L) for the monitoring wells found at the Town of Aniwa Disposal Site for the years 1990-2013.

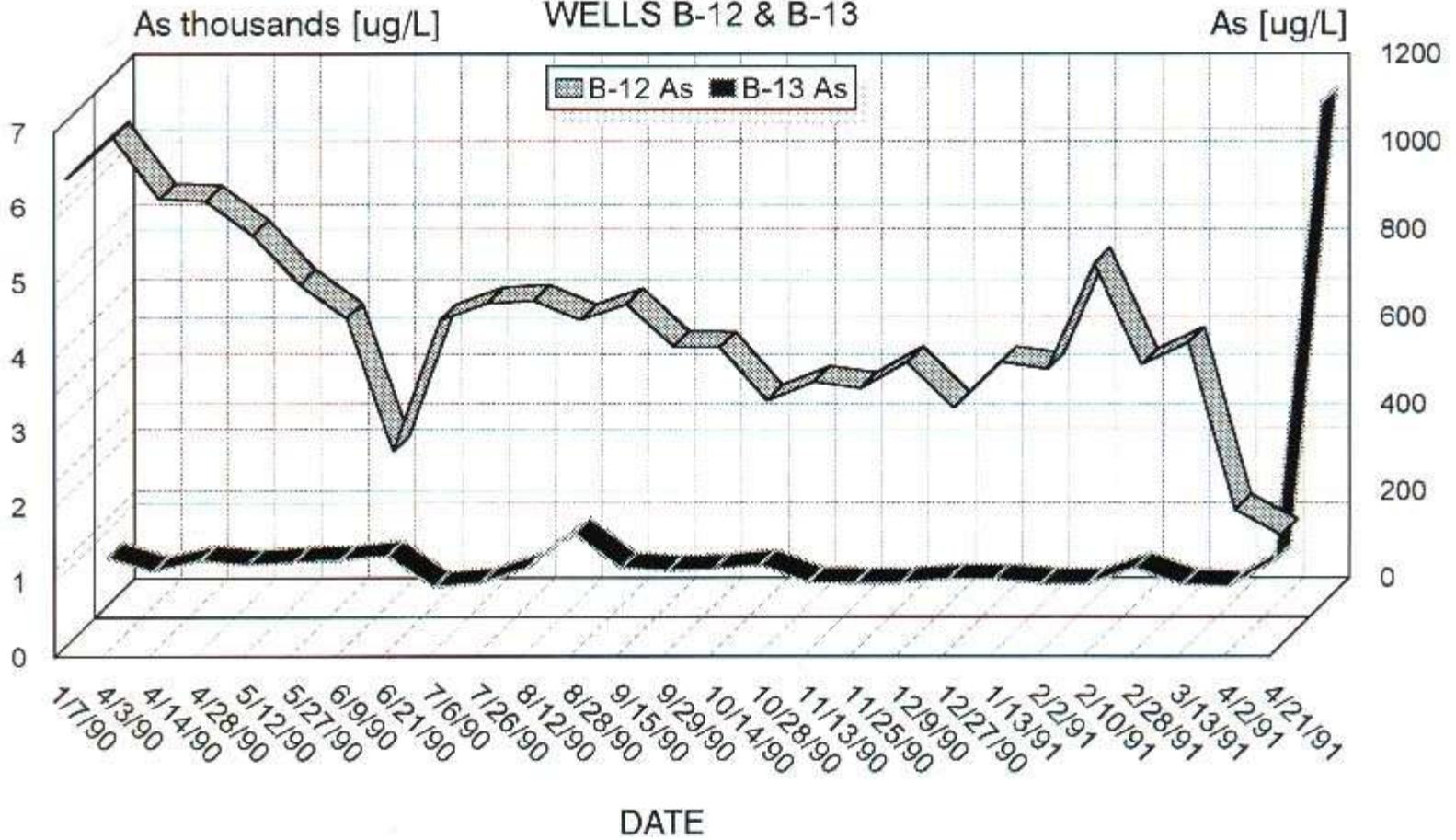
<u>Well #</u>	<u>N</u>	<u>Mean</u>	<u>St. Dev.</u>	<u>*Range</u>
B-10	41	2.6	5.7	0-33.0
B-11	39	2.1	4.5	0-21.2
B-12	151	1,790.0	1,459.3	200.0-10,300.0
B-13	156	5,843.1	10,397.6	41.0-72,000.0
B-13a	77	5.0	16.2	0-132.0
B-18	39	2.9	5.2	0-28.5
B-19	40	1.8	2.7	0-11.4
B-20	41	1.9	3.1	0-10.7
B-21	47	65.8	89.5	5.7-444.0

\* Below the detection limit of 1.0-5.0 ug/L As depending on date of analysis.

**Arsenic levels and groundwater  
heights for wells  
B-12, B13 and B13A**

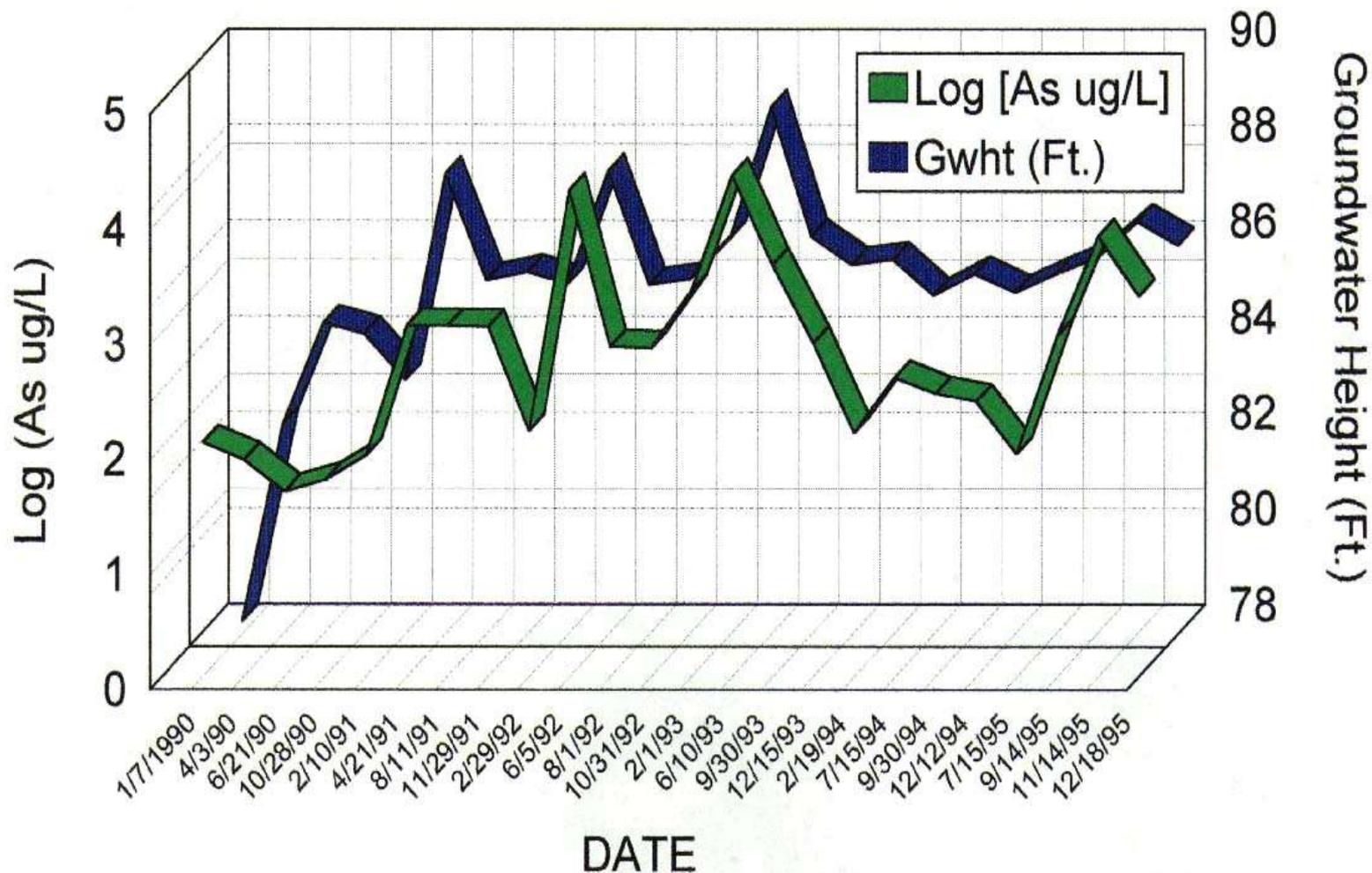
Date	B-12 As (ug/L)	B-12 Gwht (ft)	B-13 As (ug/L)	B-13 Gwht (ft)	B-13A As (ug/L)	B-13A Gwht (ft)
01/07/90	6230.00	80.65	109.00	78.28	4.00	80.98
04/03/90	6785.00	82.01	77.00	82.39	<1.0	82.24
04/14/90	5960.00	82.16	102.00	82.28	<5.0	82.26
04/28/90	5930.00	82.13	92.00	82.24	<5.0	82.31
05/12/90	5470.00	82.36	98.00	82.62	<5.0	82.52
05/27/90	4820.00	83.09	103.00	83.53	<5.0	83.37
06/09/90	4370.00	83.04	113.00	83.48	6.60	83.30
06/23/90	2855.00	84.03	41.00	84.50	<1.0	84.32
07/06/90	4350.00	83.98	51.00	84.47	<5.0	84.28
07/26/90	4570.00	83.39	85.00	83.86	<5.0	83.66
08/12/90	4610.00	83.03	164.00	83.46	5.00	83.31
08/28/90	4350.00	83.04	85.00	83.43	<5.0	83.29
09/15/90	4560.00	83.10	78.00	83.44	<5.0	83.34
09/29/90	3990.00	83.40	82.00	83.88	<5.0	83.67
10/14/90	3980.00	83.54	92.00	83.95	<5.0	83.81
10/28/90	3100.00	83.83	52.00	84.27	<1.0	84.11
11/13/90	3520.00	83.78	49.00	84.23	<5.0	84.11
11/25/90	3430.00	83.85	50.00	84.27		84.15
12/09/90	3780.00	83.81	58.00	84.19		84.01
12/27/90	3170.00	83.56	59.00	83.94		83.78
01/13/91	3780.00	83.21	49.00	83.68		83.46
02/02/91	3690.00	82.92	48.00	83.28		83.12
02/10/91	5100.00	82.94	85.00	83.31	<1.0	83.17
02/28/91	3750.00	82.72	46.00	83.04		82.87
03/13/91	4050.00	84.00	43.00	84.10		84.06
04/02/91	1800.00	85.97	101.00	86.40		86.22
04/21/91	1470.00	87.10	1150.00	87.61	<1.9	87.40
08/11/91	2440.00	85.00	1140.00	85.39	6.30	85.33
11/29/91	2670.00	85.19	1120.00	85.57	<1.4	85.46
02/29/92	3590.50	84.69	139.00	85.32	2.20	85.14
05/03/92	2191.50	87.87	15725.00	88.46	15.70	88.25
05/22/92			12125.00	88.09		
06/05/92	449.00	87.01	17272.00	87.67		
06/20/92	1027.00	86.14	4057.00	86.69		
07/06/92	310.00	85.47	12005.00	86.16		
07/18/92	1798.00	85.24	665.00	85.77	<1.0	85.60
08/01/92	2935.00	84.76	753.00	85.30		
10/31/92	2711.00	85.04	725.00	85.41	<1.0	85.34
02/01/93	1577.50	85.77	2310.00	86.28	3.30	86.04
03/28/93	1401.00	85.03	752.00	85.68		
06/10/93	1823.00	88.35	23095.50	88.99	3.40	88.75
07/07/93	2775.00	87.83	23578.00	88.49		

### As LEVELS WELLS B-12 & B-13



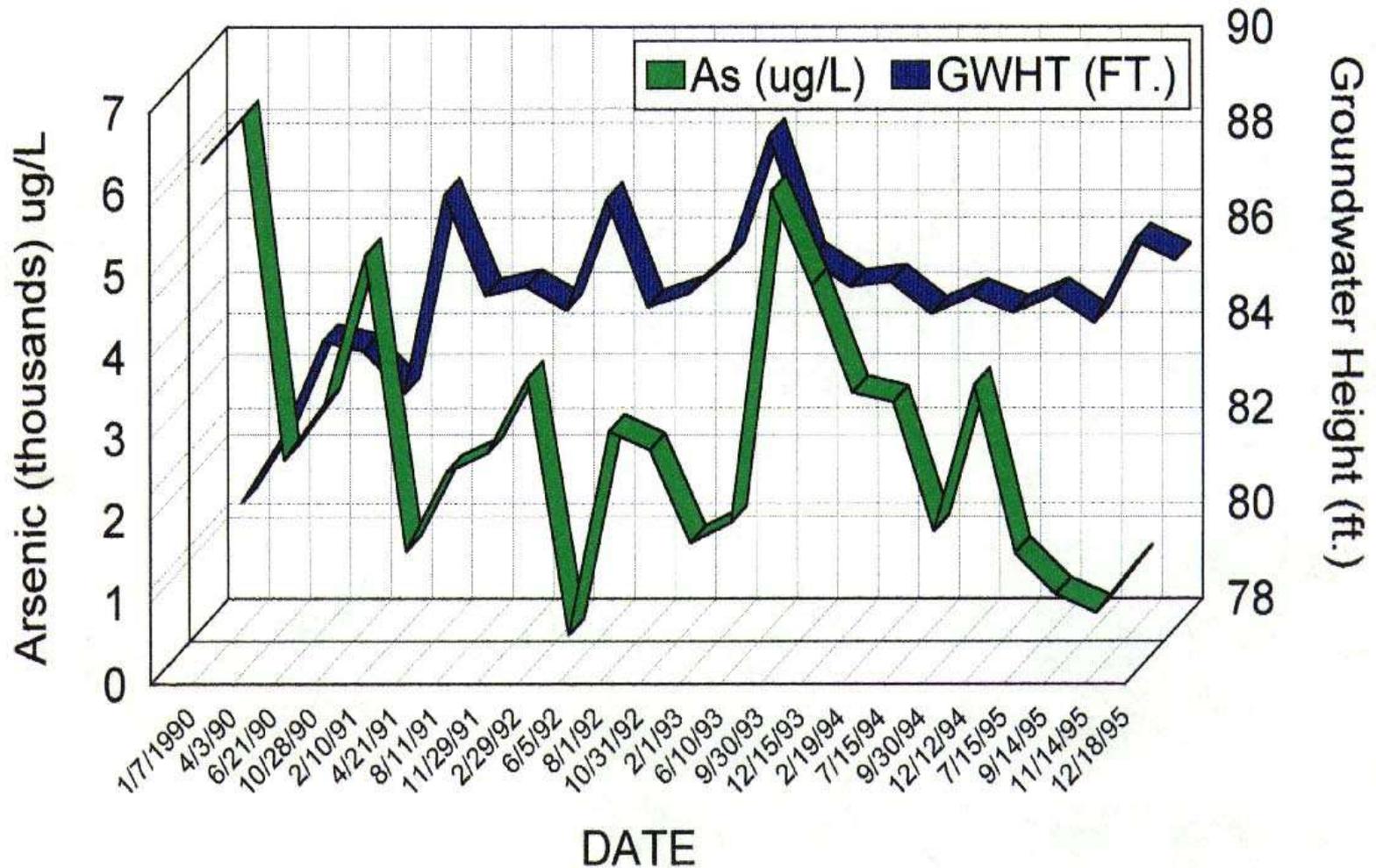
# ARSENIC AND GROUNDWATER LEVELS FOR WELL B-13

For the Years 1990-1995



# ARSENIC AND GROUNDWATER LEVELS FOR WELL B-12

For the Years 1990-1995

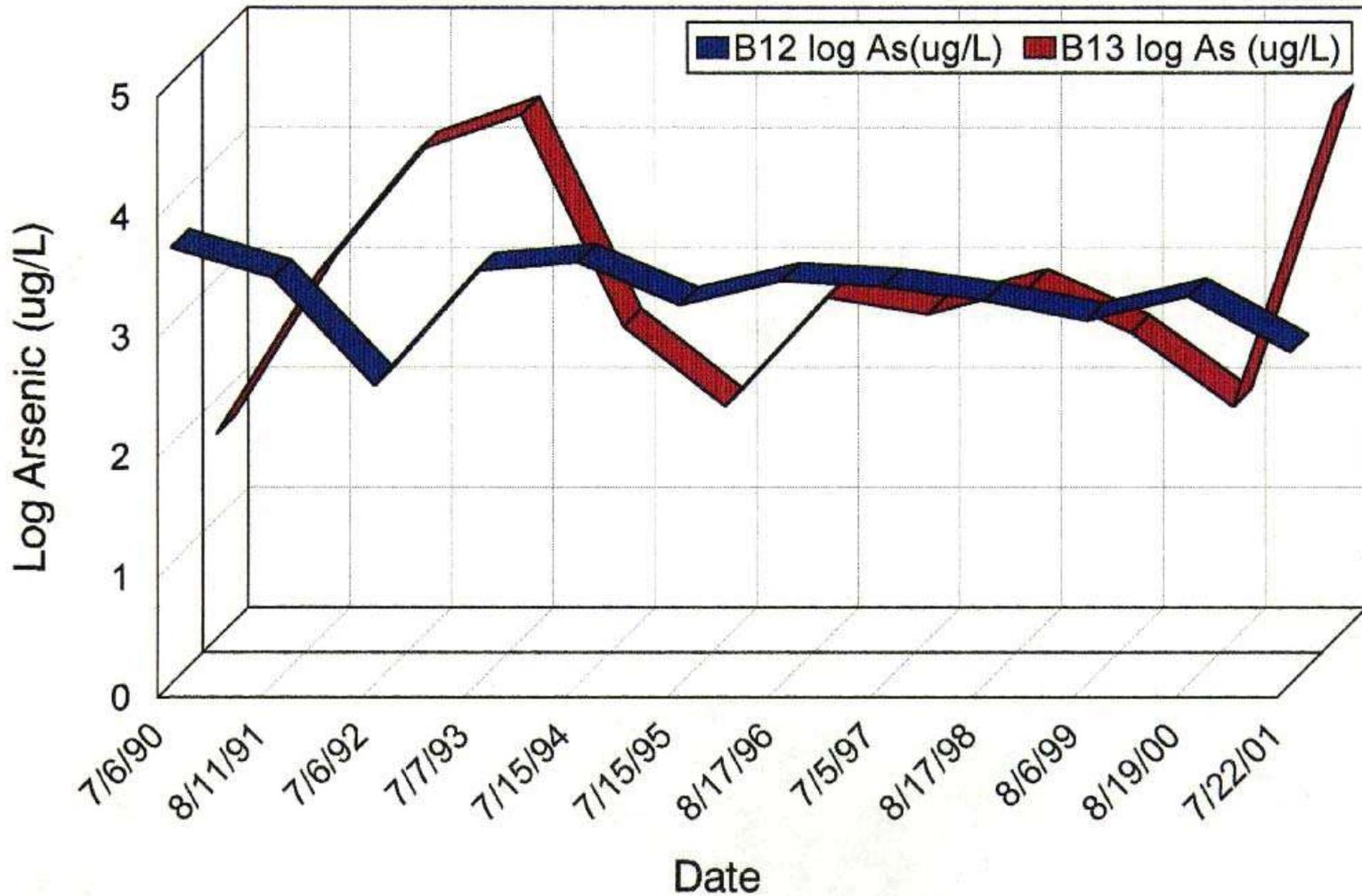


### Well B-12 & B-13 Arsenic Levels (1990-2004)

Date	Gwht. (B-12)	As B-12 (ug/L)	Gwht. (B-13)	As B-13 (ug/L)
7-06-90	83.98	4350.0	84.47	51.0
8-11-91	85.00	2440.0	85.39	1140.0
7-06-92	85.47	310.0	86.16	12005.0
7-07-93	87.83	2775.0	88.49	23578.0
7-15-94	84.62	3297.0	85.08	405.0
7-15-95	84.99	1440.0	85.53	87.5
8-17-96	83.04	2288.0	83.43	706.0
7-05-97	84.53	2058.0	84.09	510.0
8-17-98	85.24	1568.0	85.57	861.0
8-06-99	85.09	1073.0	85.42	359.0
8-19-00	84.69	1700.0	85.06	87.0
7-22-01	87.38	589.0	87.84	29047.0
7-14-02	86.18	1116.0	86.73	16273.0
6-29-03	86.56	952.7	87.09	11776.0
8-02-03	84.59	1363.1	85.15	928.0
6-27-04	87.89	801.0	88.49	31390.0
7-15-04	86.50	679.0	87.09	9560.0

# Arsenic Levels for Wells B-12 and B-13

For the Years 1990-2001



**Arsenic levels and groundwater  
heights for wells  
B-12, B13 and B13A**

Date	B-12	B-12	B-13	B-13	B-13A	B-13A
	As (ug/L)	Gwht (ft)	As (ug/L)	Gwht (ft)	As (ug/L)	Gwht (ft)
09/30/93	5872.00	85.75	3896.00	86.30	<1.0	85.99
12/15/93	4737.00	85.19	807.50	85.72	<1.0	85.52
02/19/94	3416.00	85.29	133.00	85.83	<1.0	85.64
07/15/94	3297.00	84.62	405.00	85.08	<1.0	84.88
09/30/94	1718.00	84.99	292.50	85.53	<1.0	85.29
12/12/94	3511.00	84.62	250.50	85.14	1.40	84.99
07/15/95	1444.00	84.99	87.50	85.53	1.70	85.33
09/14/95	946.00	84.43	49.30	84.93		
11/15/95	721.00	86.14	6901.00	86.61	4.30	86.34
12/18/95	1340.00	85.74	2086.00	86.13	1.30	85.95
08/17/96	2288.00	83.04	706.00	83.43	1.90	83.28
07/04/97	2058.00	84.53	510.00	84.89	<1.0	84.85
08/17/98	1568.00	85.24	861.00	85.57	1.00	85.27
08/06/99	1073.00	85.09	359.00	85.42	3.50	85.35
08/15/00	1700.00	84.69	86.90	85.26	<1.0	85.17
02/18/01	1872.00	83.49	244.00	83.97		
03/18/01	1802.00	84.67	277.00	85.00		
03/25/01	1472.00	84.60	252.00	84.95		
04/14/01	1034.00	87.53	1763.00	87.85		
04/22/01	771.00	87.19	7820.00	87.71		
05/04/01	998.00	86.93	11784.00	87.54		
05/19/01	914.00	87.20	38858.00	87.79		
06/17/01	1393.00	87.07	22098.00	87.48		
07/22/01	589.00	87.38	29047.00	87.84	6.70	87.61
08/25/01	575.00	87.23	22700.00	87.60		
09/25/01	1038.00	86.39	7605.00	86.71		
10/29/01	1222.00	85.06	905.00	85.42		
12/04/01	1062.00	84.66	632.00	85.00		

**Arsenic levels and groundwater  
heights for wells  
B-12, B13 and B13A**

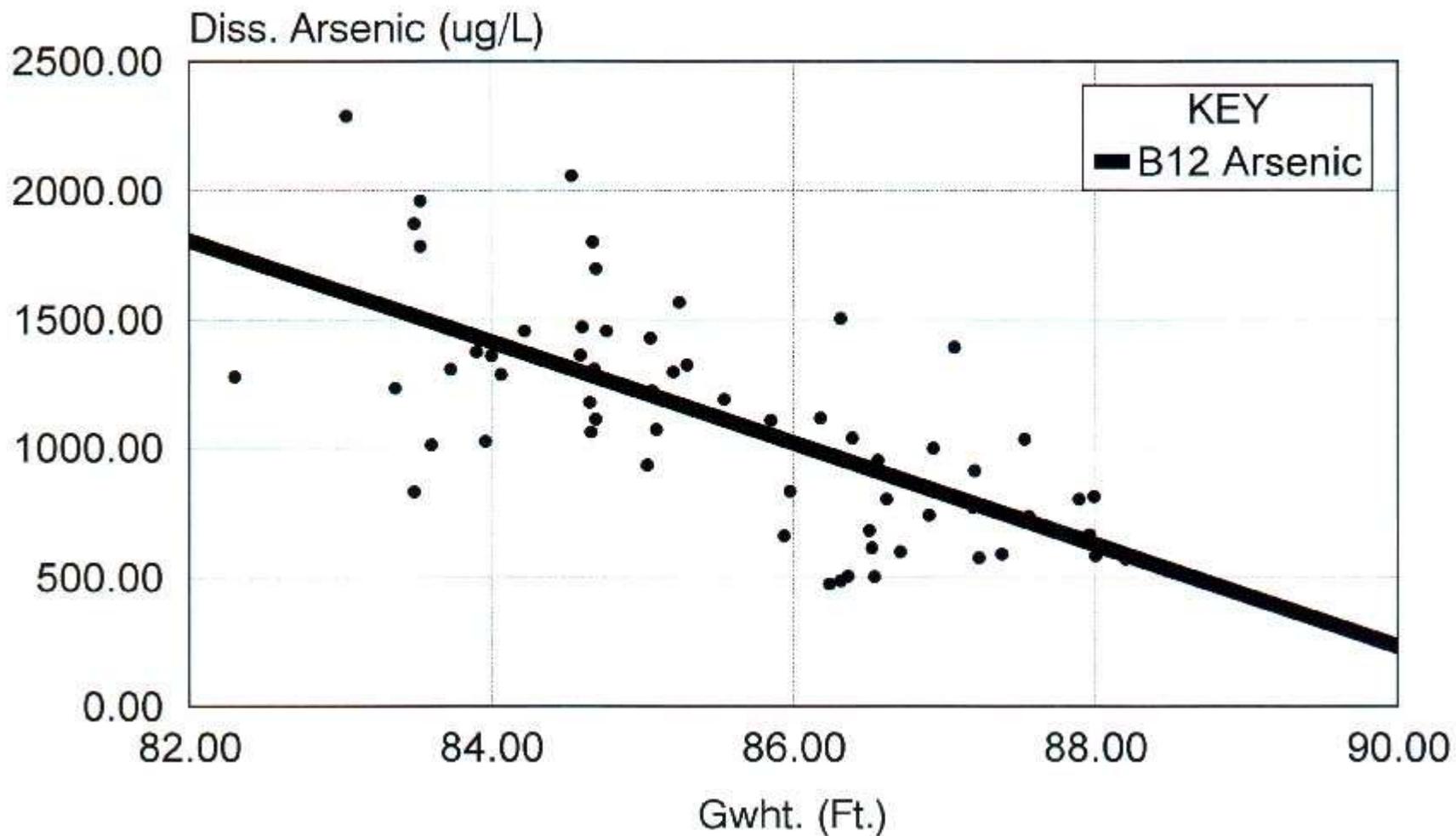
Date	B-12 As (ug/L)	B-12 Gwht (ft)	B-13 As (ug/L)	B-13 Gwht (ft)	B-13A As (ug/L)	B-13A Gwht (ft)
01/04/02	1027.00	83.96	374.00	84.28		
02/16/02	1785.00	83.53	1304.00	83.87		
03/17/02	1177.00	84.65	967.00	84.96		
04/01/02	1429.00	85.05	398.00	85.44		
04/21/02	834.00	85.98	4065.00	86.36		
05/12/02	598.00	86.71	14160.00	87.33		
05/27/02	801.00	86.62	22375.00	87.13		
06/16/02	811.00	87.99	36999.00	88.64		
07/14/02	1116.00	86.18	16273.00	86.73	52.60	86.53
09/14/02	1504.00	86.31	18990.00	86.92		
10/20/02	1107.00	85.85	5410.00	86.34		
12/02/02	1189.00	85.54	3468.00	86.02		
12/29/02	1325.00	85.29	911.00	85.76		
03/15/03	1960.00	83.53	1450.00	83.94		
03/30/03	1457.00	84.76	773.00	85.16		
04/13/03	1297.00	85.20	471.00	85.61		
04/20/03	612.00	86.52	1778.00	86.80		
04/27/03	738.00	86.90	4532.00	87.35		
05/12/03	571.00	88.20	4482.00	88.57		
05/20/03	583.00	88.00	20960.00	88.46		
06/02/03	760.30	87.35	17140.00	87.92		
06/29/03	952.70	86.56	11776.00	87.09		
08/02/03	1363.10	84.59	928.00	85.15	<1.0	84.81
09/01/03	1286.90	84.06	1807.00	84.42		
09/26/03	1306.60	83.73	1553.00	84.04		
11/15/03	1010.60	83.60	3446.00	84.20		
12/20/03	1233.40	83.36	2237.00	83.77		
02/27/04	1277.00	82.30	1272.00	82.82		

**Arsenic levels and groundwater  
heights for wells  
B-12, B13 and B13A**

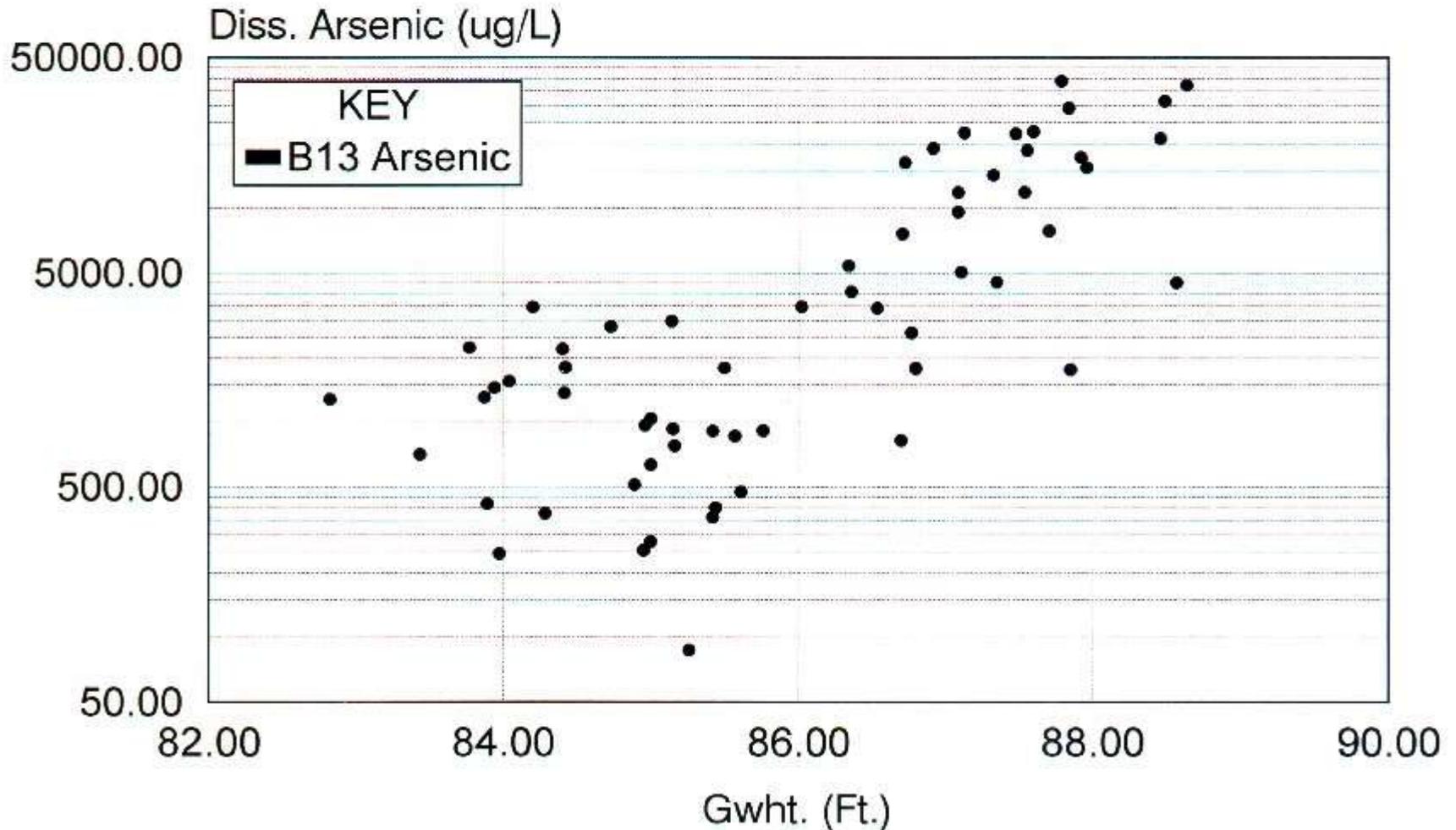
Date	B-12		B-13		B-13A	
	As (ug/L)	Gwht (ft)	As (ug/L)	Gwht (ft)	As (ug/L)	Gwht (ft)
03/27/04	1112.00	84.69	1035.00	85.00		
04/03/04	504.00	86.36	819.00	86.70		
04/25/04	487.00	86.31	1795.00	86.80		
05/11/04	660.00	85.94	3400.00	86.54		
05/17/04	475.00	86.24	2624.00	86.77		
05/31/04	503.00	86.54	5048.00	87.11		
06/10/04	734.00	87.56	18550.00	87.56		
06/14/04	663.00	87.96	15425.00	87.96		
06/27/04	801.00	87.89	31390.00	88.49		
07/15/04	679.00	86.50	9560.00	87.09		
08/17/04	933.00	85.03	1792.00	85.50		
09/04/04	1308.00	84.68	2968.00	85.14	<1.0	85.01
09/26/04	1359.00	84.00	2195.00	84.40		
10/09/04	830.00	83.49	416.00	83.89		
10/31/04	1375.00	83.90	1365.00	84.41		
12/31/04	1457.00	84.22	2799.00	84.73		

**Note:** Groundwater heights for wells are based on difference between a topographic benchmark of 100.0 ft. and the top of the PVC pipe in each monitoring wells. The relative elevations for the top of each well are: B12 (97.54'), B13 (98.98') and B13A (98.09'). Actual groundwater heights are calculated by subtracting the measured depth to water from the relative elevaton of the PVC pipe in each well.

# Dissolved Arsenic vs. Groundwater Height for Well B-12 For the Years 1996-2004



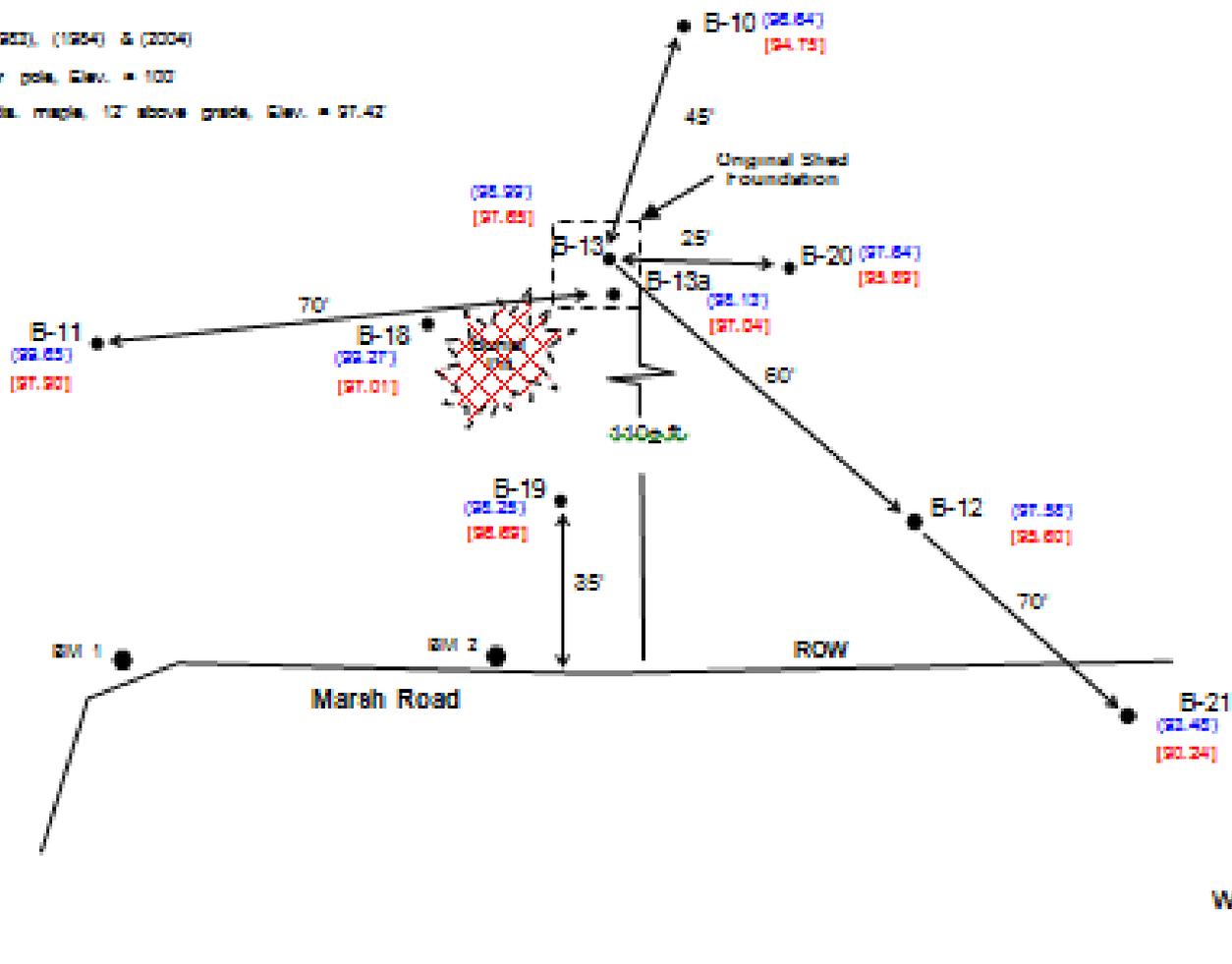
# Dissolved Arsenic vs. Groundwater Height for Well B-13 For the Years 1996-2004





**Explanation**

- Monitoring Well (1983), (1984) & (2004)
- BM 1 = Nail in power pole, Elev. = 100
- BM 2 = Nail in 10" dia. maple, 12" above grade, Elev. = 97.42
- ( ) = Elev. top of PVC pipe
- [ ] = Ground elevation



Client: W. Hohn Soil Testing      Project: Town of Antwa Disposal Site      Location: Shawano Co. Wisconsin



Monitoring well layout adapted from (Becher-Hoppe, 1983)  
 Not to scale

**DISSOLVED ARSENIC LEVELS AND  
GROUNDWATER ELEVATIONS FOR  
WELLS B12, B13 & B21**

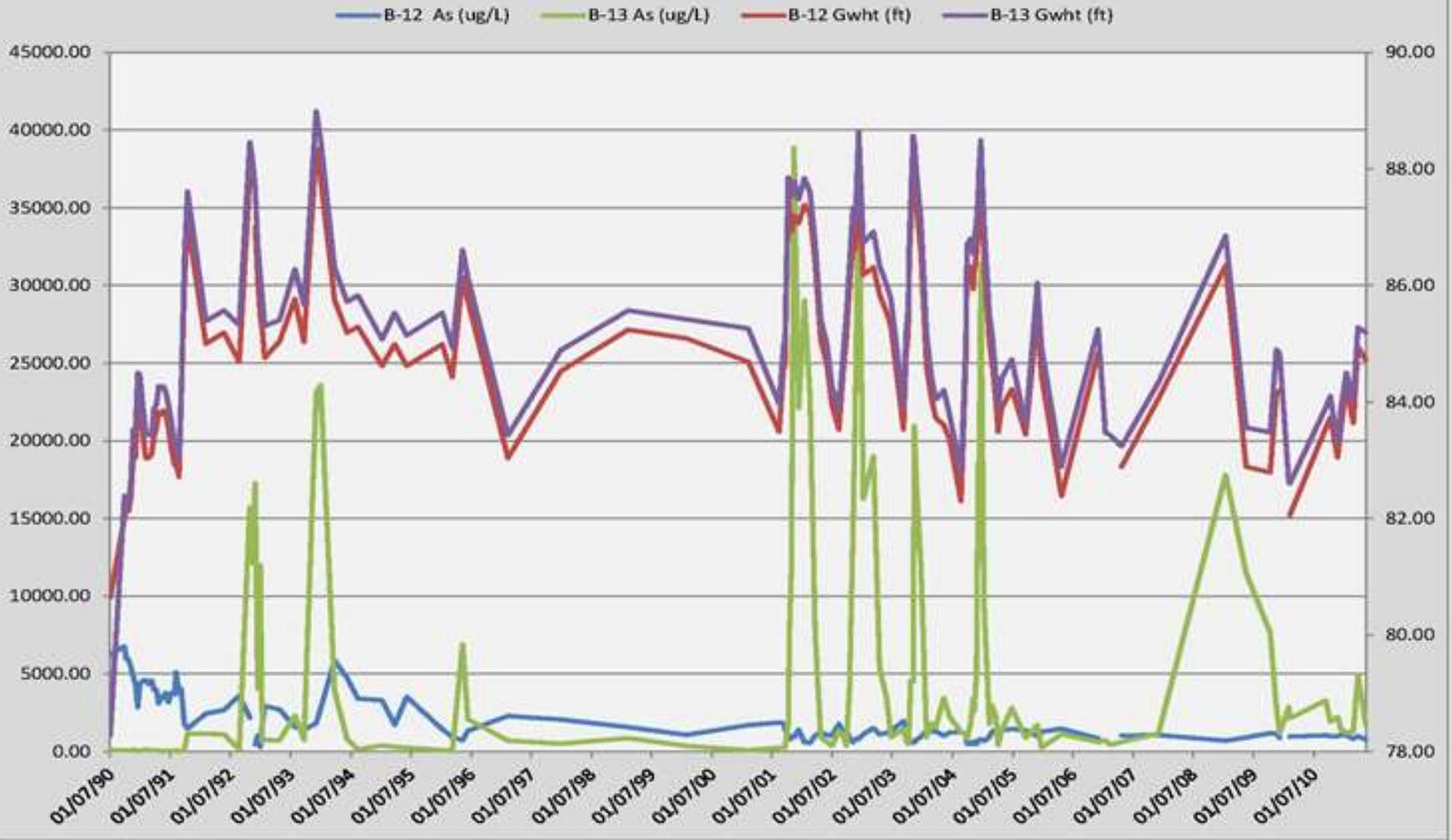
<u>Date</u>	<u>Well #</u>	<u>Diss. Arsenic (ug/L)</u>	<u>Gwht. (Ft.)*</u>	<u>Depth to Water(Ft.)</u>
7/15/04	B13	9560.0	87.09	11.89
7/15/04	B12	679.0	86.50	11.04
7/15/04	B21	444.0	85.90	7.58
8/17/04	B13	1792.0	85.50	13.48
8/17/04	B12	933.0	85.03	12.51
8/17/04	B21	279.0	84.56	8.92
9/04/04	B13	2967.0	85.14	13.84
9/04/04	B12	1308.0	84.68	12.86
9/04/04	B21	325.0	84.22	9.26
9/26/04	B13	2195.0	84.48	14.50
9/26/04	B12	1359.0	84.00	13.54
9/26/04	B21	242.0	83.53	9.95
10/09/04	B13	416.0	83.89	15.09
10/09/04	B12	830.0	83.49	14.05
10/09/04	B21	193.0	83.20	10.28
10/29/04	B13	1365.0	84.41	14.57
10/29/04	B12	1375.0	83.90	13.64
10/29/04	B21	281.0	83.63	9.85
12/30/04	B13	2799.0	84.73	14.25
12/30/04	B12	1457.0	84.22	13.32
12/30/04	B21	160.0	83.84	9.64

\*Based on the relative elevation on the top of PVC pipe in each monitoring well- (B12=97.54 ft., B13=98.98 ft., B21=93.48 ft.).

Date	Well #	Diss. As (ug/L)	GwEl. (Ft.)*	Depth to Water (Ft.)
08/05/05	B-21	71.00	85.24	8.24
08/30/06	B-21	37.80	84.02	9.46
08/13/05	B-21	73.70	82.45	11.03
10/29/05	B-21	305.00	82.14	11.34
02/28/06	B-21	129.00	82.52	10.96
04/02/06	B-21	37.00	84.48	9.00
05/07/06	B-21	38.00	84.83	8.65
06/18/06	B-21	24.00	84.27	9.21
07/22/06	B-21	70.00	82.87	10.61
08/20/06	B-21	42.00	83.07	10.41
10/29/06	B-21	85.00	82.47	11.01
06/09/07	B-21	49.30	83.65	9.85
07/21/08	B-21	21.00	86.00	7.48
11/22/08	B-21	44.20	82.85	10.83
04/18/09	B-21	25.20	82.60	10.88
05/25/09	B-21	28.30	83.88	9.80
06/14/09	B-21	29.70	83.92	9.56
08/15/09	B-21	58.40	81.55	11.85
03/21/10	B-21	25.40	83.44	10.04
04/18/10	B-21	48.80	83.30	10.18
08/10/10	B-21	45.90	82.68	10.80
06/20/10	B-21	51.40	83.24	10.24
07/24/10	B-21	13.90	83.61	9.87
09/04/10	B-21	54.70	83.33	10.15
10/20/10	B-21	19.00	83.91	9.57
11/20/10	B-21	37.20	84.40	9.08
05/07/11	B-21	16.60	87.47	6.01
08/26/11	B-21	31.50	84.75	8.73
08/07/11	B-21	32.20	83.52	9.96
09/24/11	B-21	35.00	83.60	9.88
10/16/11	B-21	29.50	84.28	9.20
11/20/11	B-21	39.30	84.08	9.40
01/08/12	B-21	24.90	83.77	9.71
03/24/12	B-21	10.50	85.40	8.08
05/04/12	B-21	5.70	85.92	7.56
07/07/12	B-21	15.00	84.48	9.00
08/11/12	B-21	23.00	83.40	10.08
10/20/12	B-21	44.00	81.88	11.80
08/02/13	B-21	14.00	86.48	7.00
08/22/13	B-21	17.00	86.32	7.16
09/07/13	B-21	30.00	83.76	9.72
11/02/13	B-21	28.00	83.44	10.04
11/18/13	B-21		82.84	10.64

\* Based on the relative elevation on the top of PVC in each monitoring well (B-12=97.54 ft., B-13=98.98 ft., B-21=93.48 ft.)

## B-12 & B-13 Monitoring Wells



Client: **W. Hohn Soil Testing**

Project: **Town of Aniwa Disposal Site**

Location: **Shawano Co. Wisconsin**

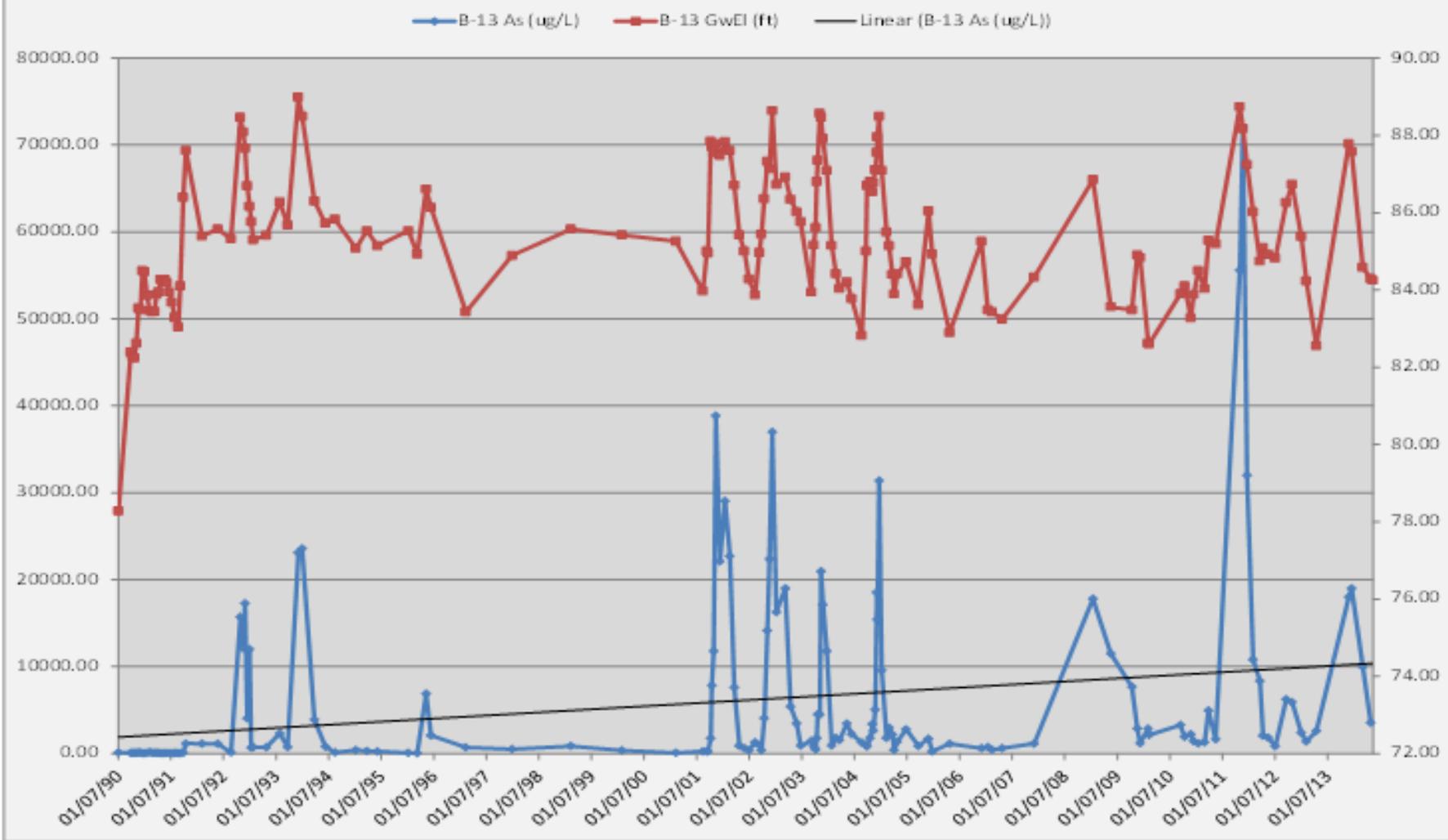


**Wells B-12 & B-13**  
**dissolved arsenic levels and groundwater elevations**  
**for years 1990-2010**

Figure

15

## B-13 Monitoring Well



Client: **W. Hohn Soil Testing**

Project: **Town of Aniwa Disposal Site**

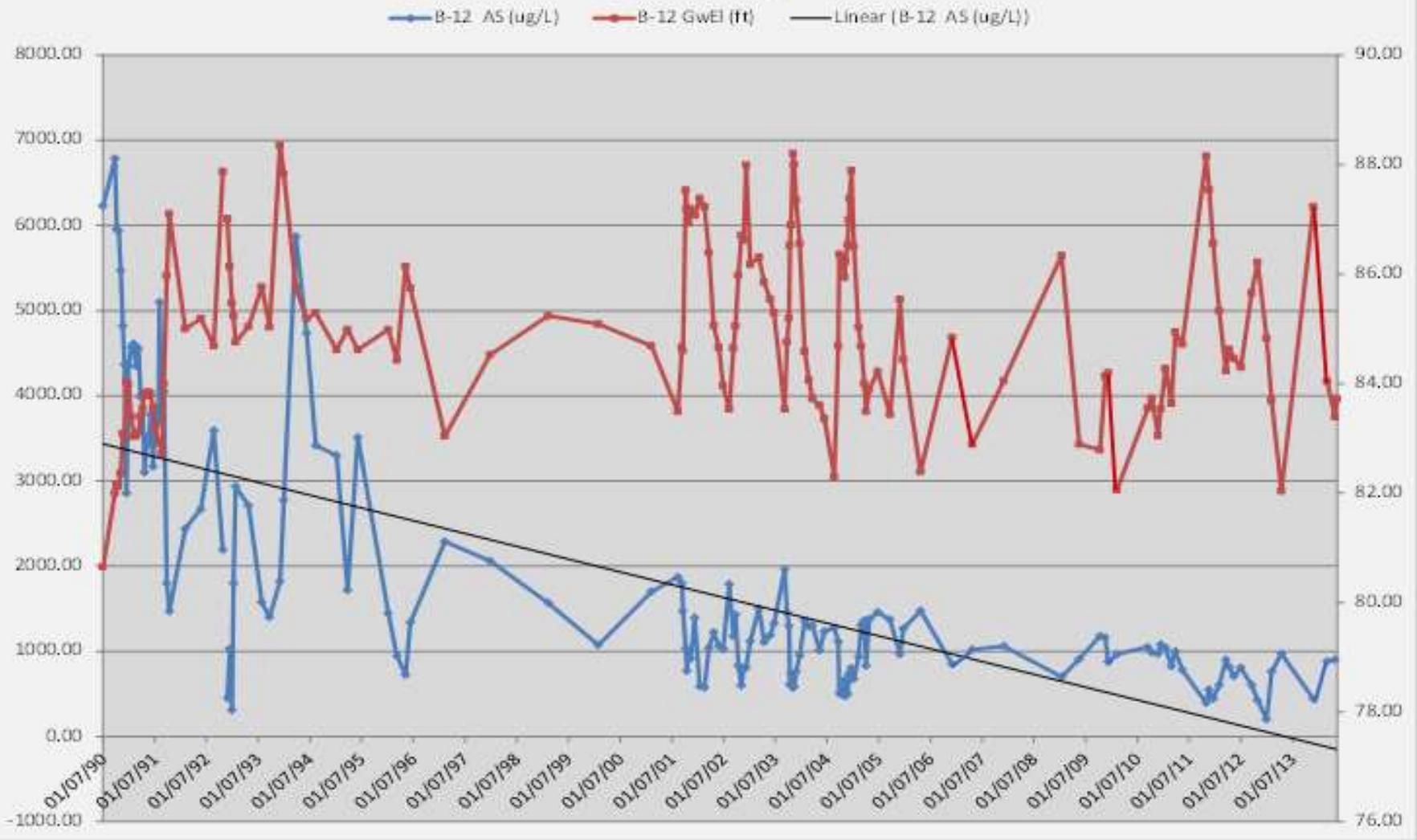
Location: **Shawano Co. Wisconsin**



**Well B-13**  
**Dissolved arsenic levels and groundwater elevations**  
**for the years 1990-2013**

Figure  
18

# B-12 Monitoring Well



Client: **W. Hohn Soil Testing**

Project: **Town of Aniwa Disposal Site**

Location: **Shawano Co. Wisconsin**



**Well B-12**  
 Dissolved arsenic levels and groundwater elevations  
 for the years 1990-2013

Figure  
 19

# Conclusions

**Arsenic soil levels exceed background levels for arsenic but are primarily confined to the upper 6 feet of the soil profile.**

**Dissolved arsenic concentrations present in monitoring Well B-13 become extremely high during high water table events such as spring runoff or excessive precipitation. During these high water table events the arsenic levels in Well B-12 become reduced.**

**Well B-13 arsenic levels of 20,000 - 72,000 ppb (ug/L) are found when the groundwater height approaches 86.00 ft. (based on an established benchmark), approx. 8-10 ft. below the surface indicating arsenic soil contamination at that level.**

**B-21 arsenic levels of 5.7-444.0 ppb(ug/L) indicate the arsenic plume has traveled off the property to the south.**

**None of the surrounding residential drinking water wells have shown arsenic concentrations above 10.0 (ug/L) arsenic.**

**However, the private drinking water well 450 ft. to the west has shown a level of 9.2 ug/L approaching the WDNR enforcement standard of 10.0 ug/L.**

## **RECOMENDATIONS**

**(1) Continue monitoring the site twice a year to determine groundwater levels and dissolved arsenic levels in Wells B-12, B-13, B-13A and B-21 for a period of two years to determine if the dissolved arsenic levels are decreasing or increasing. Sampling times should be around June 1st and later in the fall when the ground freezes. The early sampling time should be based on Well B-13 groundwater heights above 86.0 ft. Also, the wetland to the north of Well B-10 and the manmade pond approx. a quarter mile southeast of the site on the neighbor's property should be sampled. Neighboring private drinking water wells should also be sampled, especially the well directly to the west.**

**(2) Install some sort of in situ treatment such as a permeable barrier wall which would run in a northeasterly direction between Wells B-13 and B-12 using zero valent iron to retard arsenic flow. The wall would need to be approximately 14 feet deep and additional monitoring would be required. Quarterly sampling of monitoring Wells B-12, B-13, B-13A and B-21 is recommended to determine effectiveness. Funding would be required to finance this project as the Town of Aniwa has limited resources, possibly a research institution could take the project on to test a new technology.**

**(3) The final alternative would be removal of the arsenic source. This would be the most costly of the three alternatives and may not even find the source. Soil borings done in 2007 showed elevated arsenic levels near the original shed site of 281.0-232.0 mg/Kg at a depth of 3-6 ft. and just south of the shed site of 87.1-465.0 mg/Kg at 12-18 ft. Additional soil borings in 2012 indicated excessive arsenic levels south and west of the original shed location at a depth of 0-10 ft. of 110-8360.0 mg/Kg to try to pinpoint the arsenic source. Originally the DNR used a magnetometer at the site and no metal barrels were found. The Dave Hart (WGNHS) research team used a EM-31 conductivity meter and no barrels could be located, the arsenic plume appeared to be moving northwest of Well B-13 to the southeast. Cleanup including off site removal of the elevated arsenic soils (an area 35 ft. X 50 ft.) (1300 cu. yds.) down to the water table to a municipal and/or hazardous waste landfill could cost in excess of a \$250,000 and would require additional funding.**