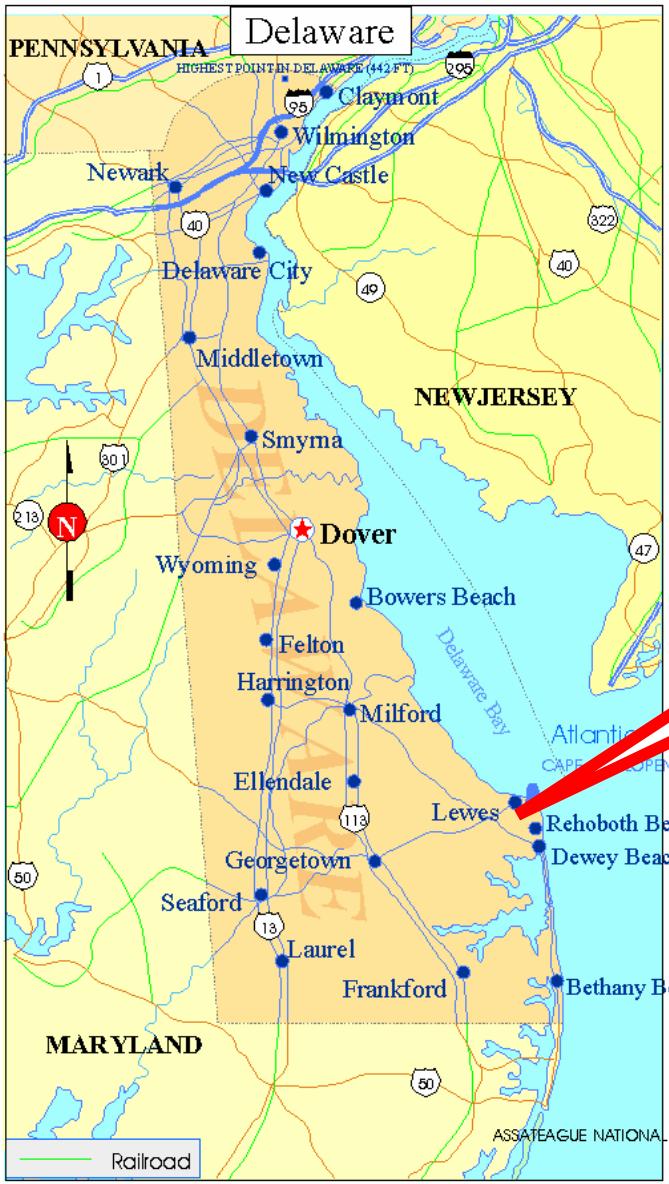
Case History: Domestic Well Impacts, Rehoboth Beach, Delaware

Patricia Ellis – Delaware DNREC

EPA Region 3 LUST Technical Conference

April 2006

Roanoke, Virginia



Tru-Vale Acres and Truitt's Midway Development, Rehoboth Beach

Former
UST Facility
Gas Station
#3
Gas Station
#2
Gas Station
#1
Impacted Wells
Area B
Impacted Wells
Area A

Initial Potable Well Impacts (November/December 2002)

- "My water tastes like gasoline"
- Initially, 7 of 32 total potable wells sampled showed MTBE and benzene impact, southwest corner of development
- Detected MTBE concentration range from 52.7 to 930 ppb
- Detected benzene concentration range from 25.5 to 480 ppb
- Carbon filters installed on impacted wells, monthly sampling
- Contamination was ultimately been detected in 16 wells

Spring 2003
Geoprobe Investigation Results

- Investigation to identify potential RPs
- No significant soil impact by MTBE and benzene
- Detected high benzene concentration in gw
  - 1,000 ppb at Site #1: GP-03 (20-24')
- Detected high MTBE concentration in gw
  - 13,000 ppb adjacent to Site #2: GP-06 (20-24')
- Existing wells on Site #3 were clean
- MTBE and benzene impact to groundwater not fully defined, but 2 potential sources identified
- Hydro letters sent to RPs

Site 1

- Former LUST (1995-1998)
- Prior to MTBE testing requirement
- Area reported to be served by public water
- Bioscreen modeling used for closure:
  - Highest total BTEX ever observed in gw should degrade within 300 feet, default values
- Residual soil contamination in old tank pit ~4816 ppm BTEX, 2100 ppm TPH following overexcavation

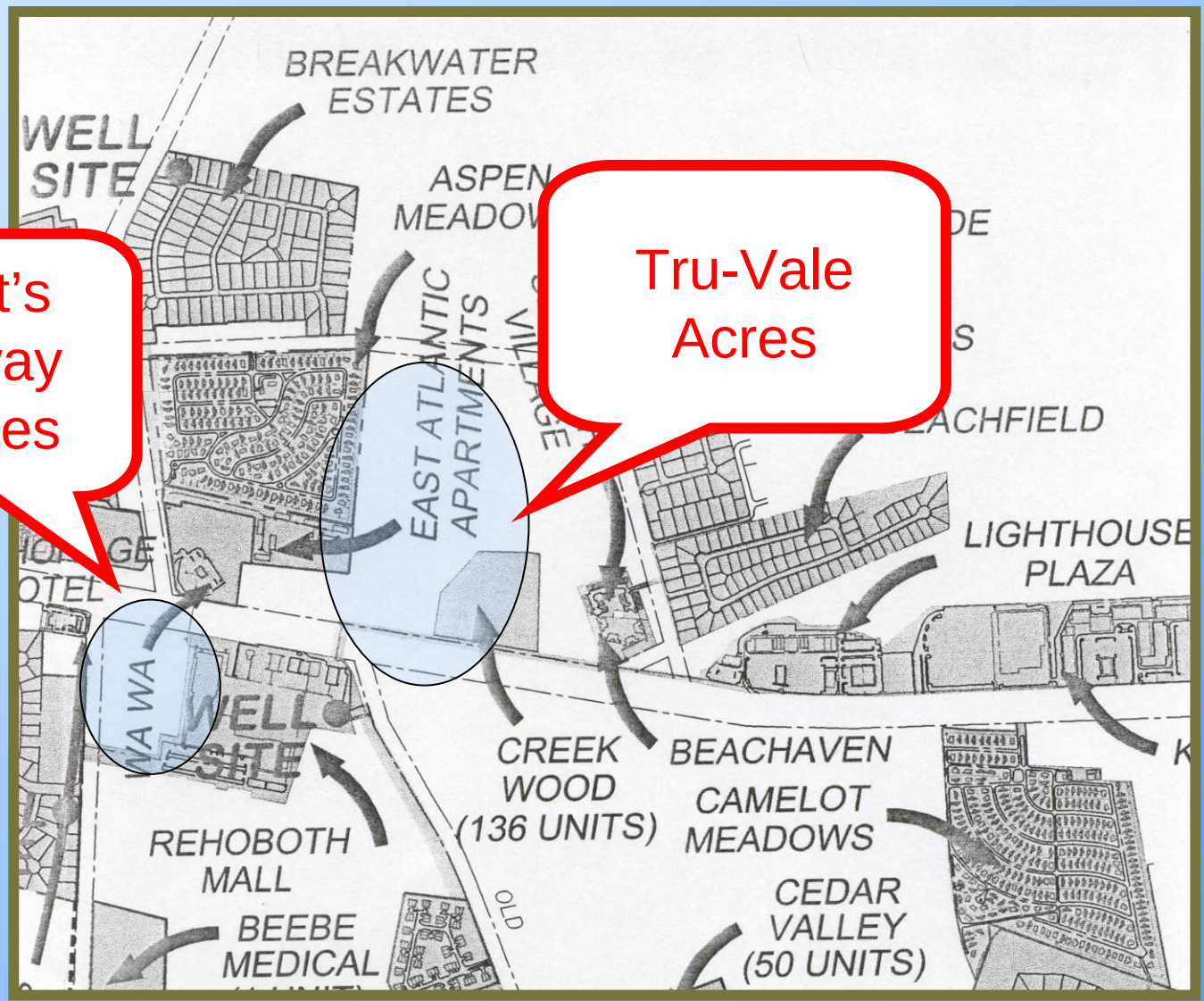
Site 2

- Former LUST (1984-1993)
- Tanks installed in 1981, removed in 1991
- Catastrophic release in 1984
- Free product removal and P&T, overexcavation when tanks removed
- MTBE included in analytes entire time – always ND
- New tanks in 1993 – double wall tanks and pipes
- Geoprobe sample on downgradient property boundary with 13 ppm MTBE (2003)

Site 3

- Virgin site until double wall system installed in 2001
- Monitoring wells on site are ND
- Geoprobe samples downgradient of site are ND
- Eliminated as potential RP

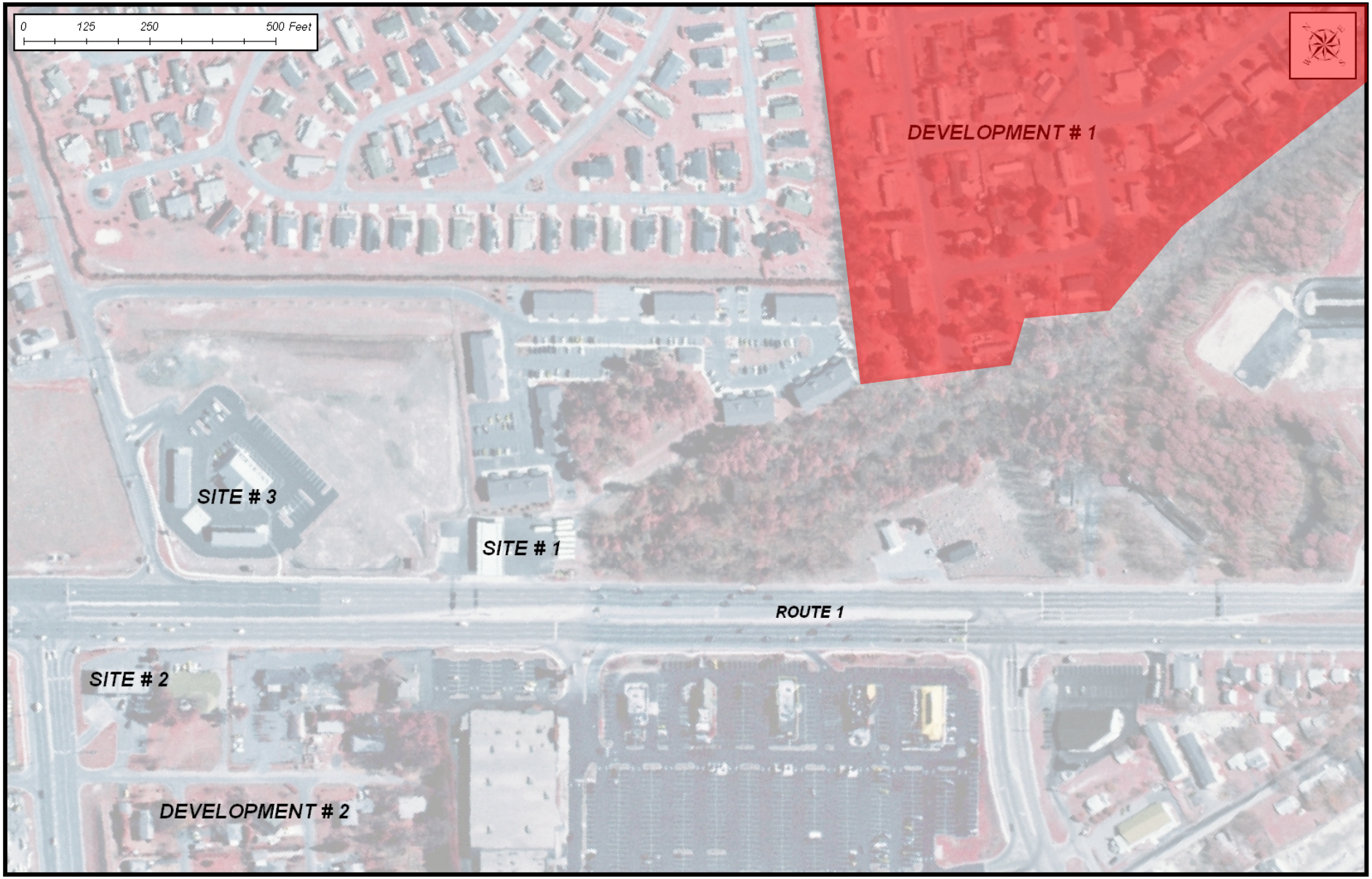
Service Area – Tidewater Utilities

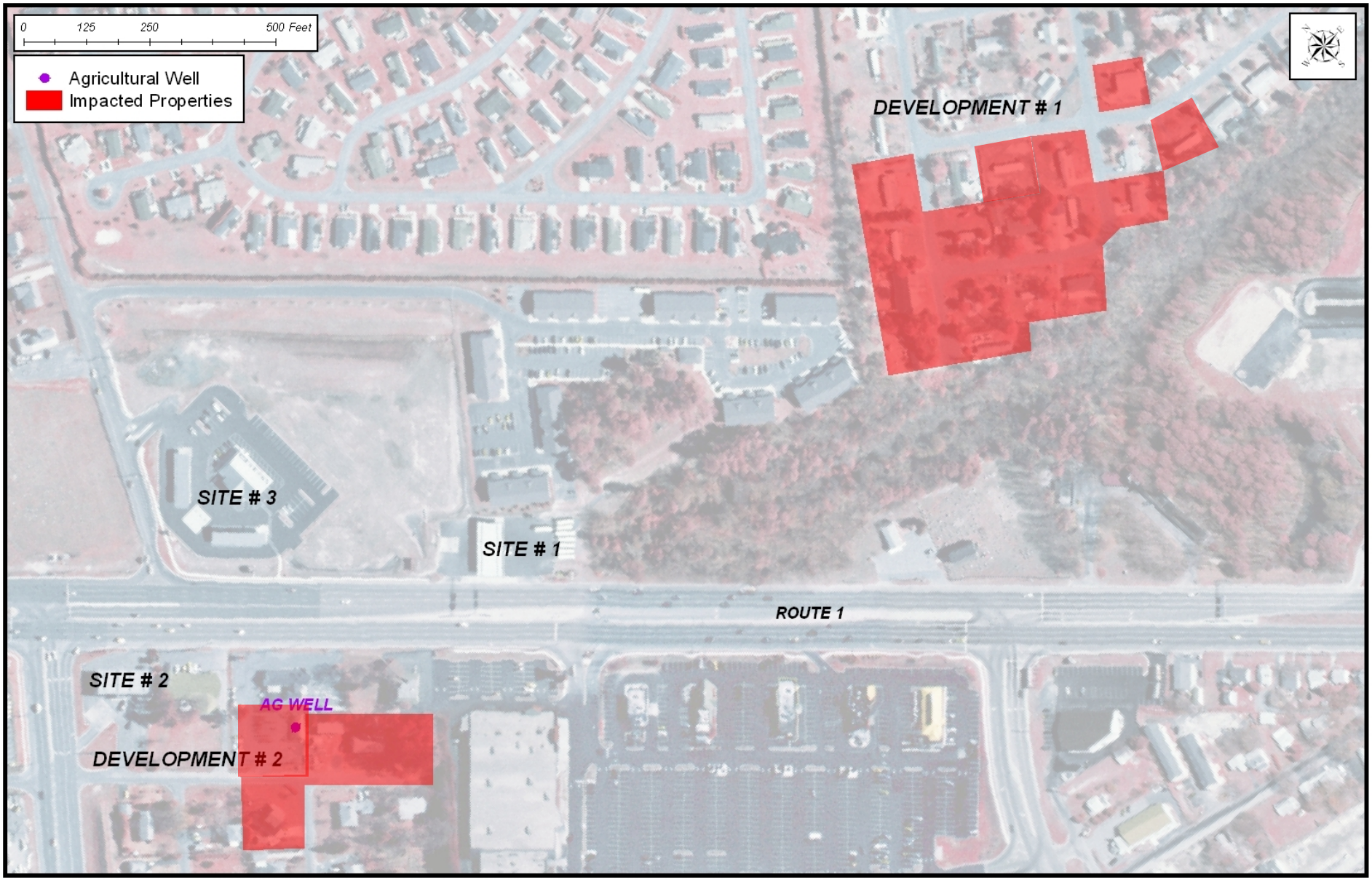


Tru-Vale Acres

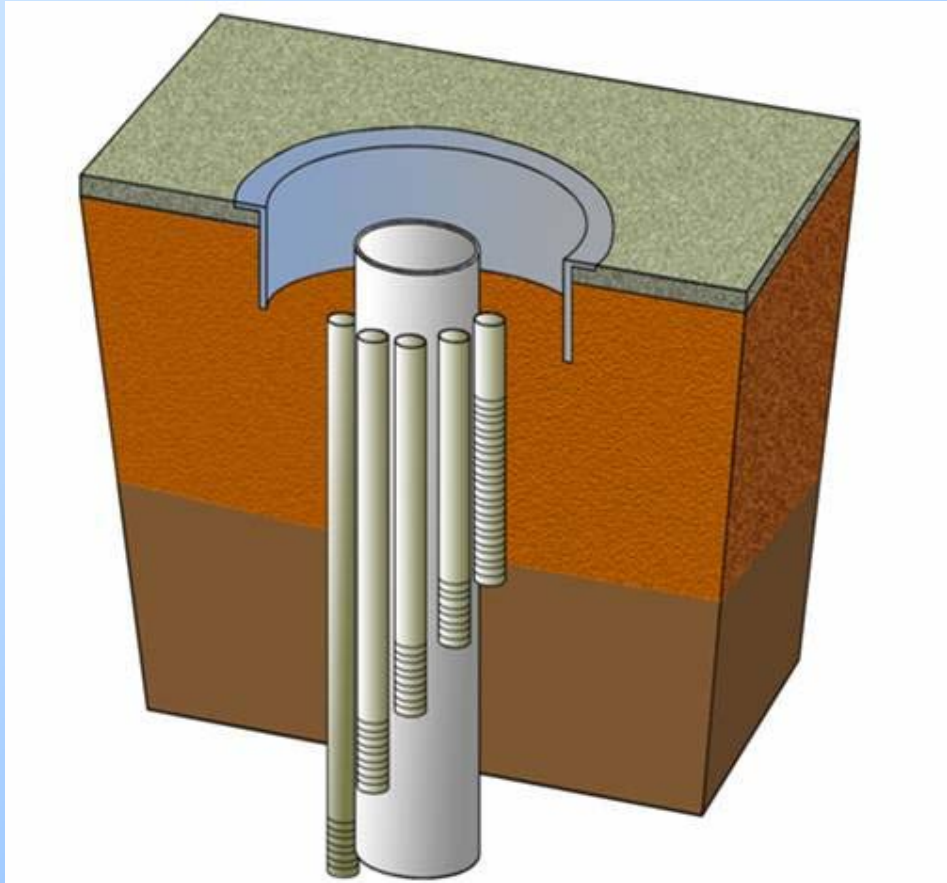
Tru-Vale Acres Neighborhood

Tru-Vale Acres Neighborhood


0
125
250
500 Feet
DEVELOPMENT # 1
SITE # 3
SITE # 1
ROUTE 1
SITE # 2
DEVELOPMENT # 2

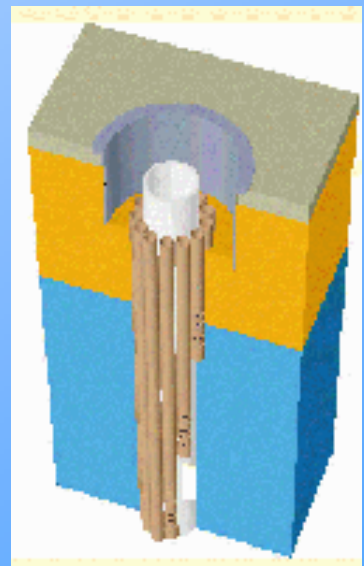

0
125
250
500 Feet
Agricultural Well
Impacted Properties
DEVELOPMENT # 1
SITE # 3
SITE # 1
ROUTE 1
SITE # 2
AG WELL
DEVELOPMENT # 2

Multilevel Monitoring Wells



" Half-Haas Well"

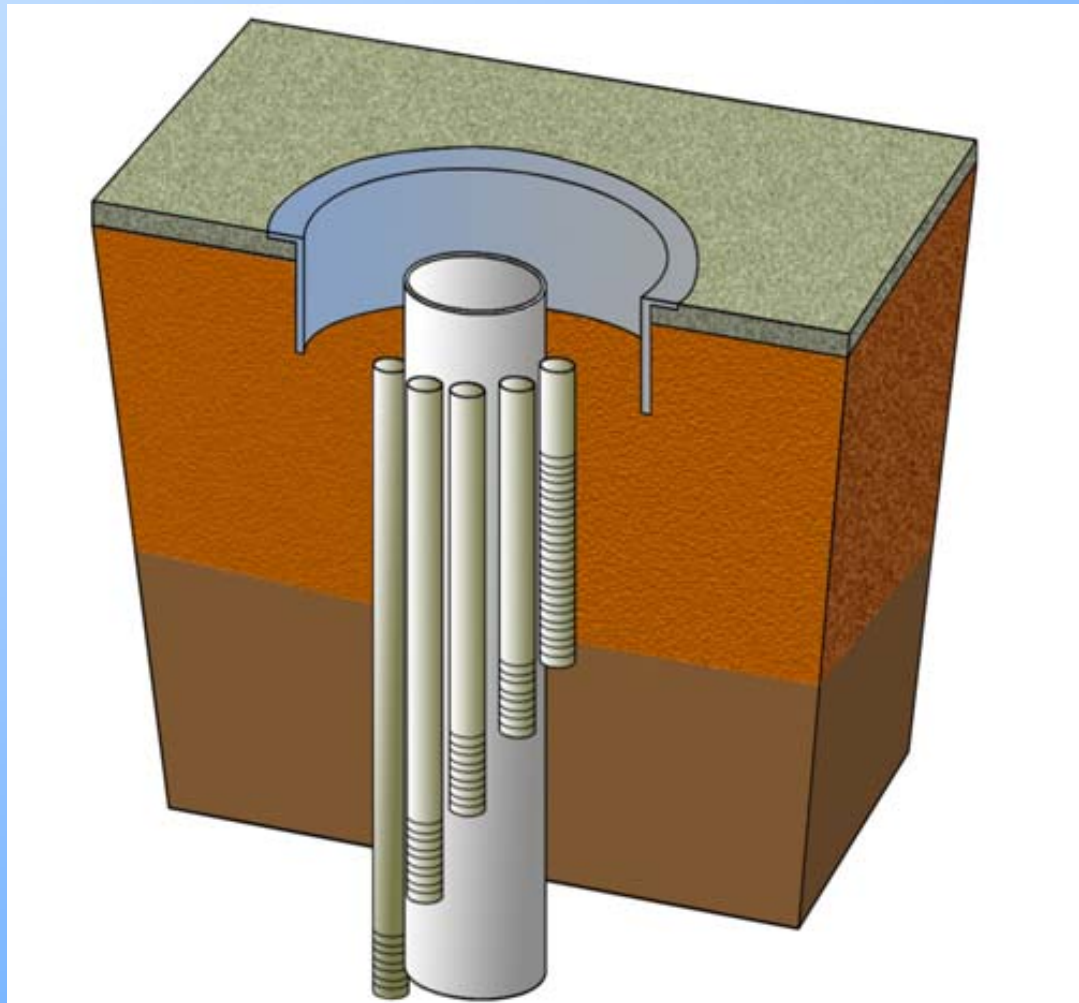
"Haas Well"



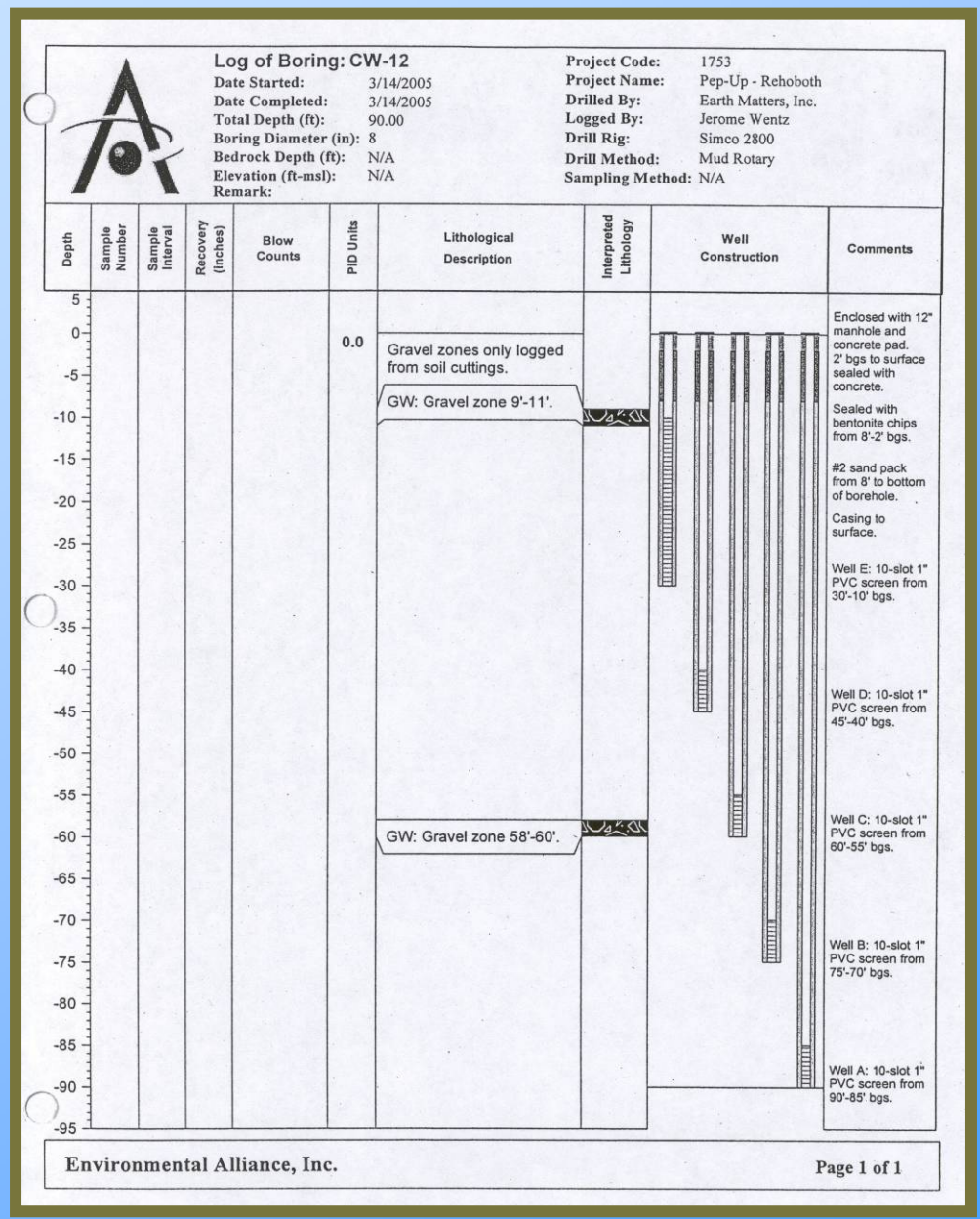
Multilevel Well Construction

Screen intervals

10-30
40-45
55-60
70-75
85-90
Feet bgs



Typical Cluster Well Construction



Log of Boring: CW-12

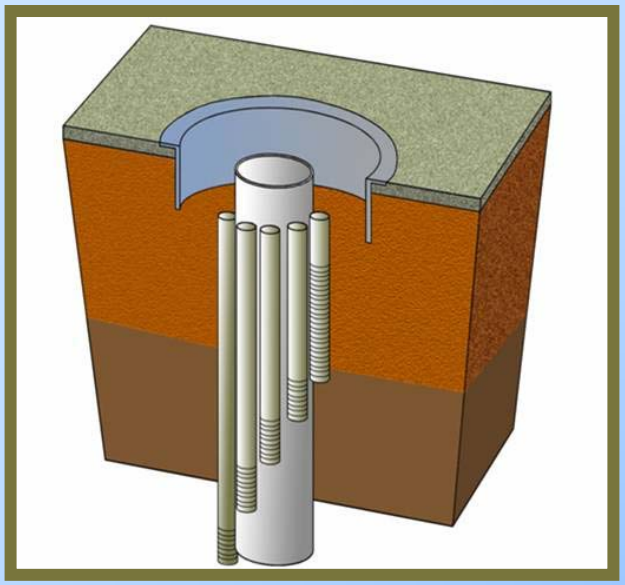
Date Started:	3/14/2005	Project Code:	1753
Date Completed:	3/14/2005	Project Name:	Pep-Up - Rehoboth
Total Depth (ft):	90.00	Drilled By:	Earth Matters, Inc.
Boring Diameter (in):	8	Logged By:	Jerome Wentz
Bedrock Depth (ft):	N/A	Drill Rig:	Simco 2800
Elevation (ft-msl):	N/A	Drill Method:	Mud Rotary
Remark:		Sampling Method:	N/A

Depth	Sample Number	Sample Interval	Recovery (Inches)	Blow Counts	PID Units	Lithological Description	Interpreted Lithology	Well Construction	Comments
5, 0, -5, -10, -15, -20, -25, -30, -35, -40, -45, -50, -55, -60, -65, -70, -75, -80, -85, -90, -95					0.0	Gravel zones only logged from soil cuttings. GW: Gravel zone 9'-11'. GW: Gravel zone 58'-60'.			Enclosed with 12" manhole and concrete pad. 2' bgs to surface sealed with concrete. Sealed with bentonite chips from 8'-2' bgs. #2 sand pack from 8' to bottom of borehole. Casing to surface. Well E: 10-slot 1" PVC screen from 30'-10' bgs. Well D: 10-slot 1" PVC screen from 45'-40' bgs. Well C: 10-slot 1" PVC screen from 60'-55' bgs. Well B: 10-slot 1" PVC screen from 75'-70' bgs. Well A: 10-slot 1" PVC screen from 90'-85' bgs.

Environmental Alliance, Inc.

Page 1 of 1

Installation of Multilevel Wells



Sampling intervals

10-30′

40-45′

55-60′

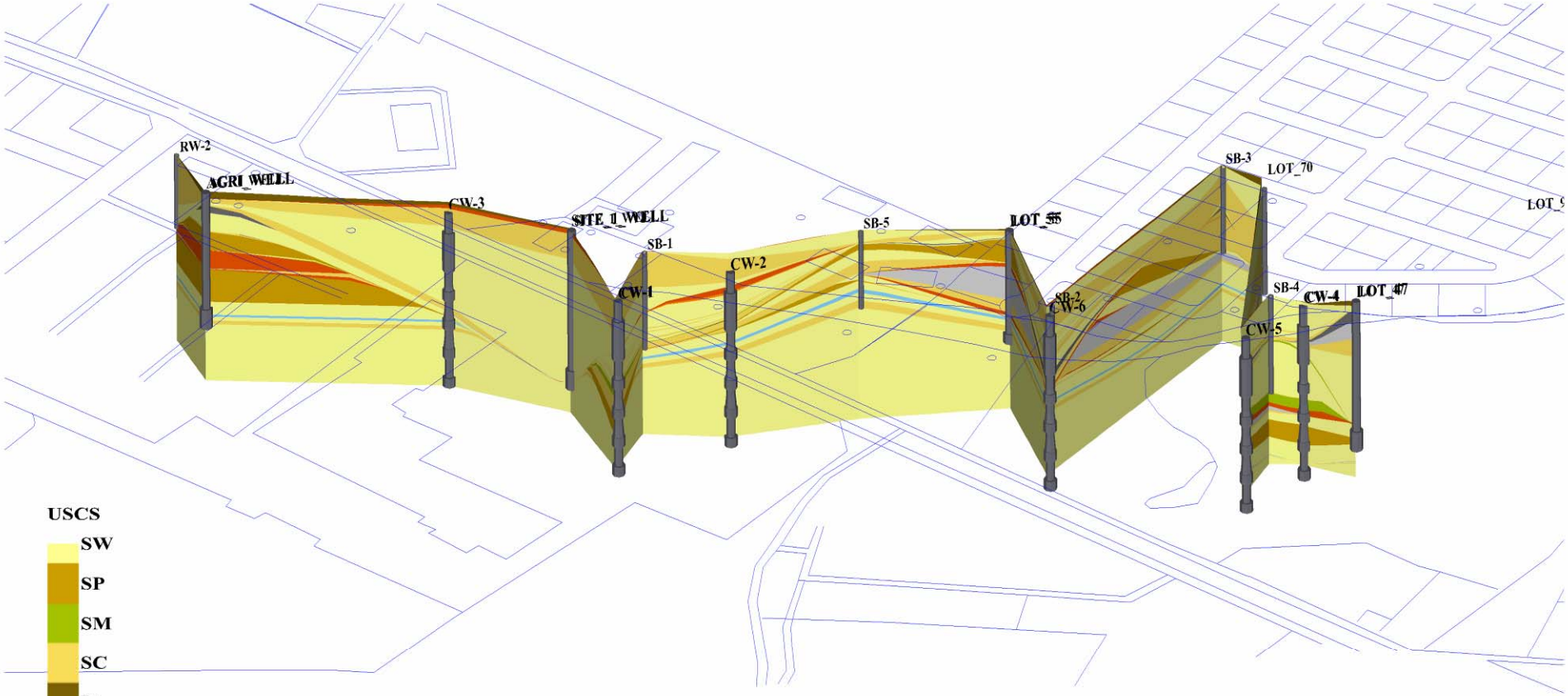
70-75′

85-90′

Wawa

Split Spoon Samples – Tru-Vale Drilling

Fenced Lithologic Cross-Section: Rehoboth, DE



USCS

- SW
- SP
- SM
- SC
- Pt
- ML
- MH
- GW
- GP
- CL
- CH

USCS

SW: Well graded sands or gravelly sands, little or no fines
SP: Poorly graded sands or gravelly sands, little or no fines
SM: Silty sands, sand-silt mixtuers
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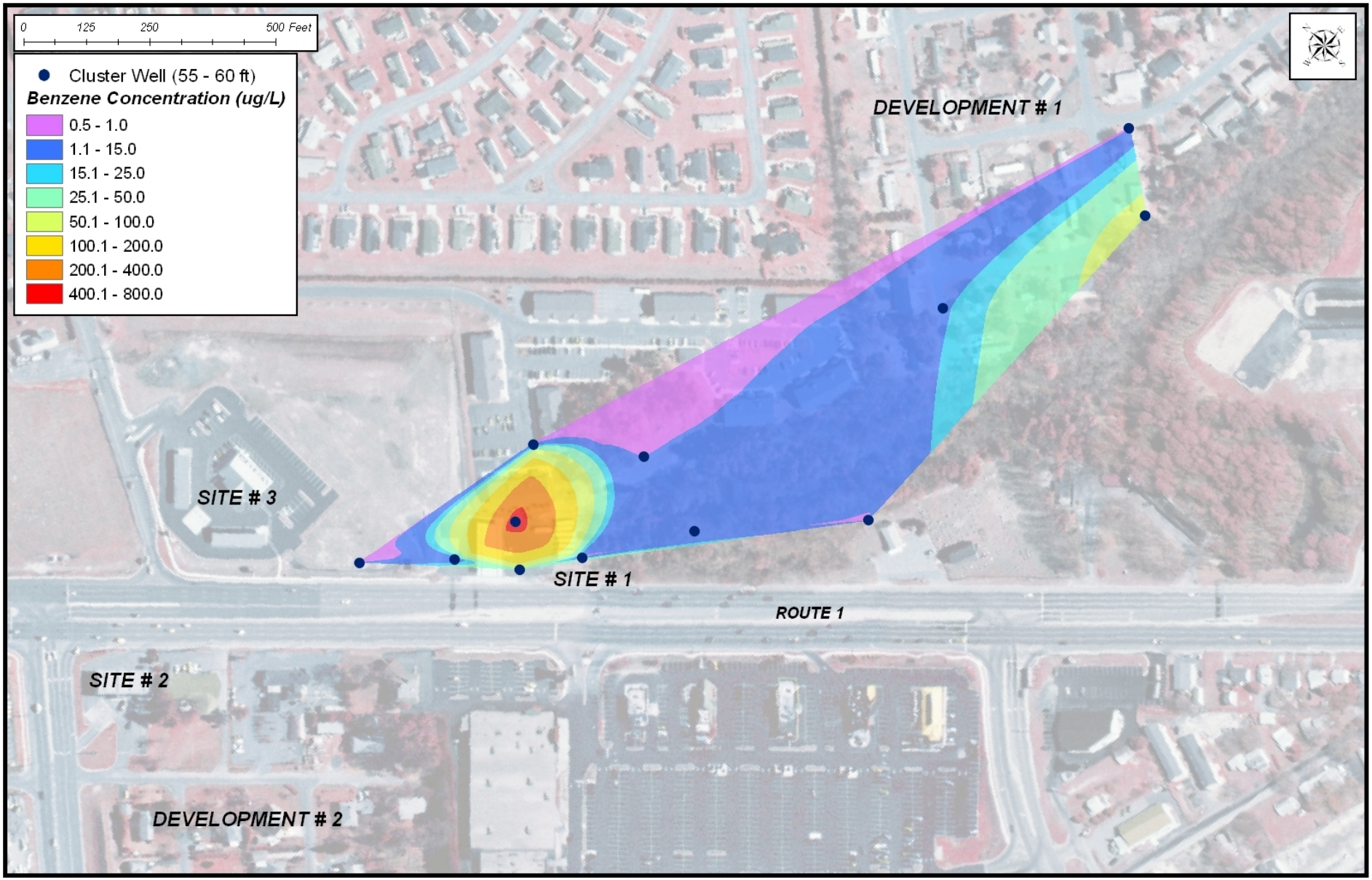
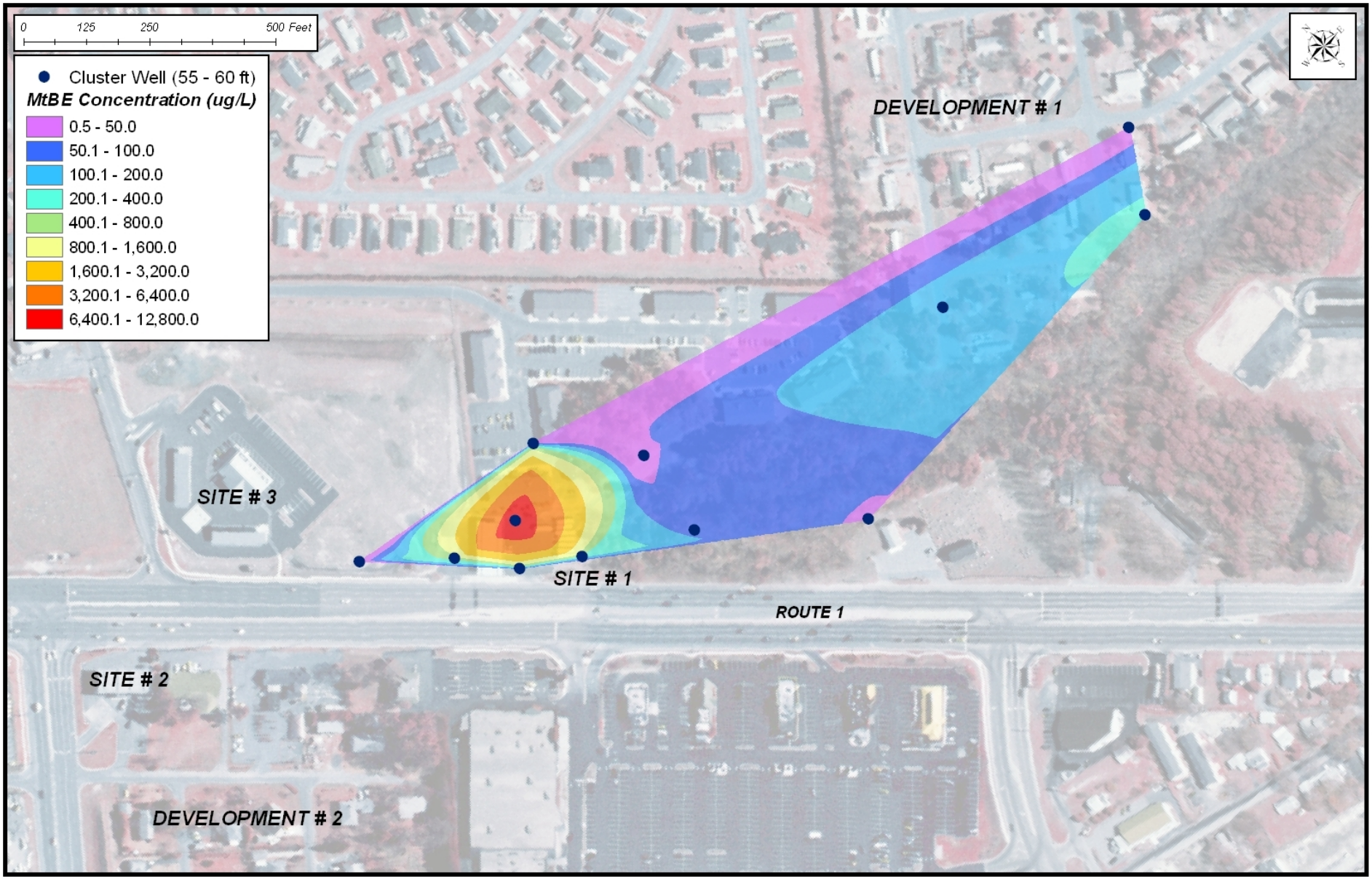
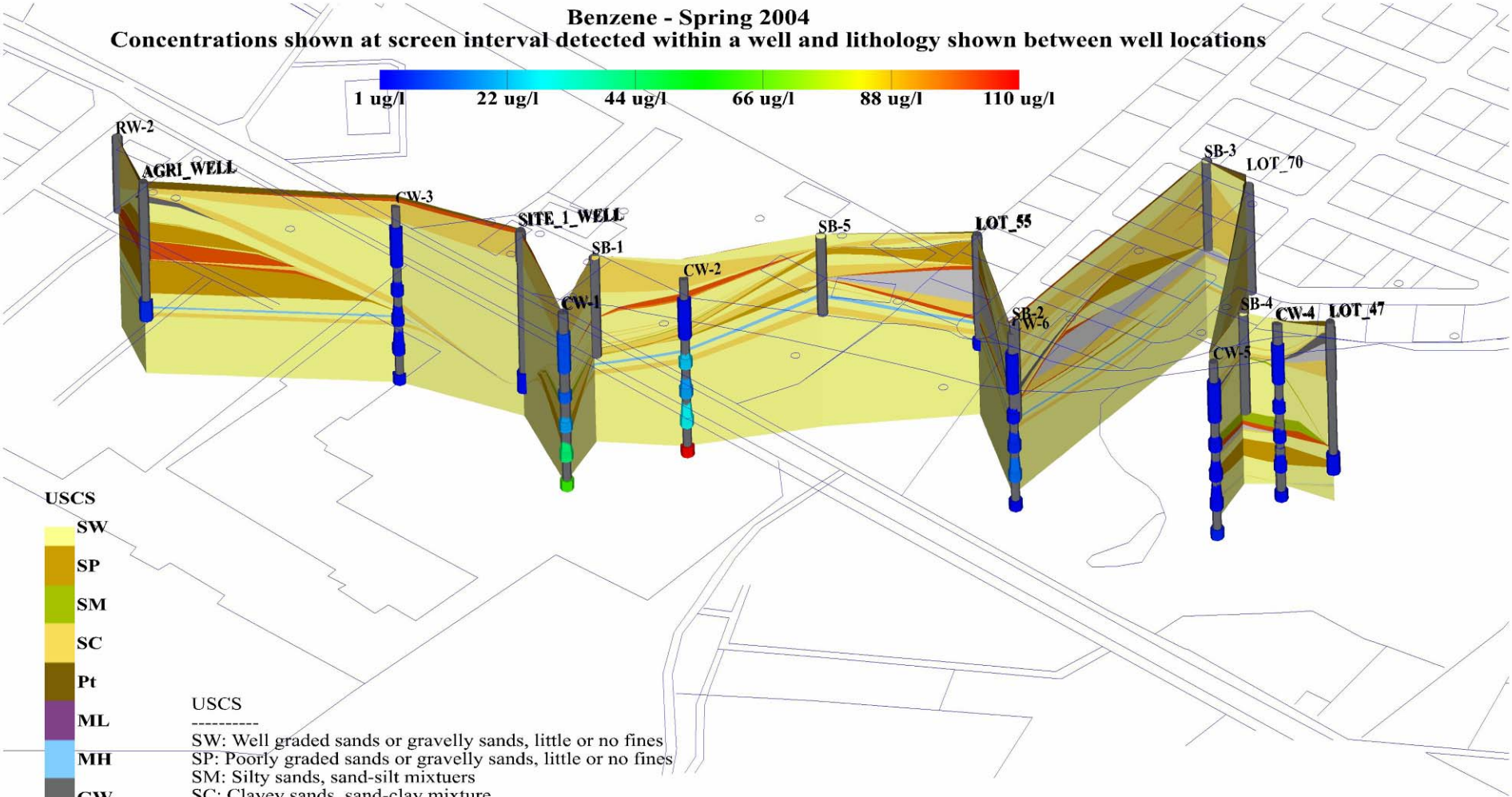
CH: Inorganic clays of high plasticity, fat clays


0
125
250
500 Feet
Cluster Well (55 - 60 ft)
Benzene Concentration (ug/L)
0.5 - 1.0
1.1 - 15.0
15.1 - 25.0
25.1 - 50.0
50.1 - 100.0
100.1 - 200.0
200.1 - 400.0
400.1 - 800.0
DEVELOPMENT # 1
SITE # 3
SITE # 1
ROUTE 1
SITE # 2
DEVELOPMENT # 2


0
125
250
500 Feet
Cluster Well (55 - 60 ft)
MtBE Concentration (ug/L)
0.5 - 50.0
50.1 - 100.0
100.1 - 200.0
200.1 - 400.0
400.1 - 800.0
800.1 - 1,600.0
1,600.1 - 3,200.0
3,200.1 - 6,400.0
6,400.1 - 12,800.0
DEVELOPMENT # 1
SITE # 3
SITE # 1
ROUTE 1
SITE # 2
DEVELOPMENT # 2

Screened Well Concentrations: Rehoboth, DE



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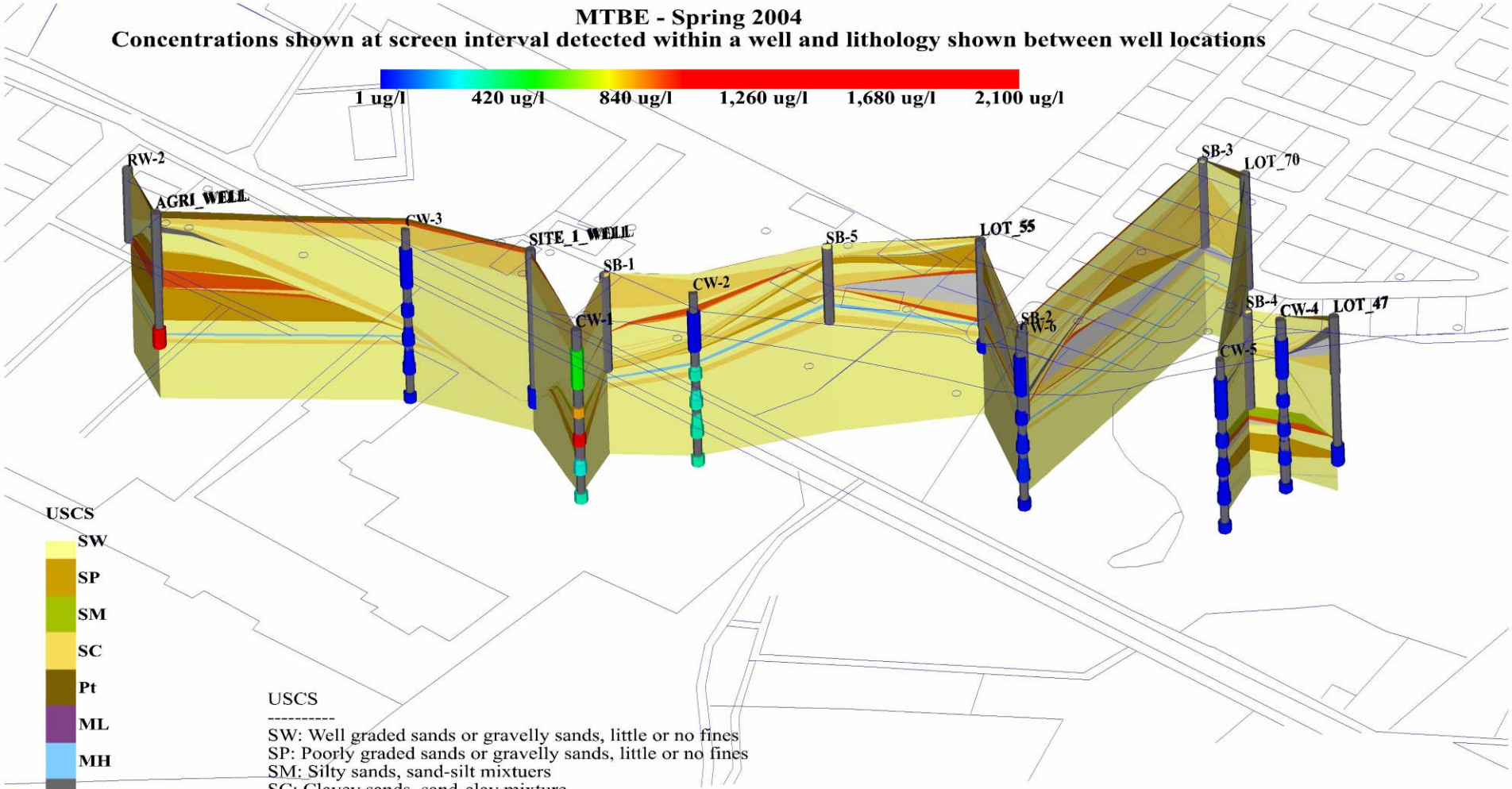

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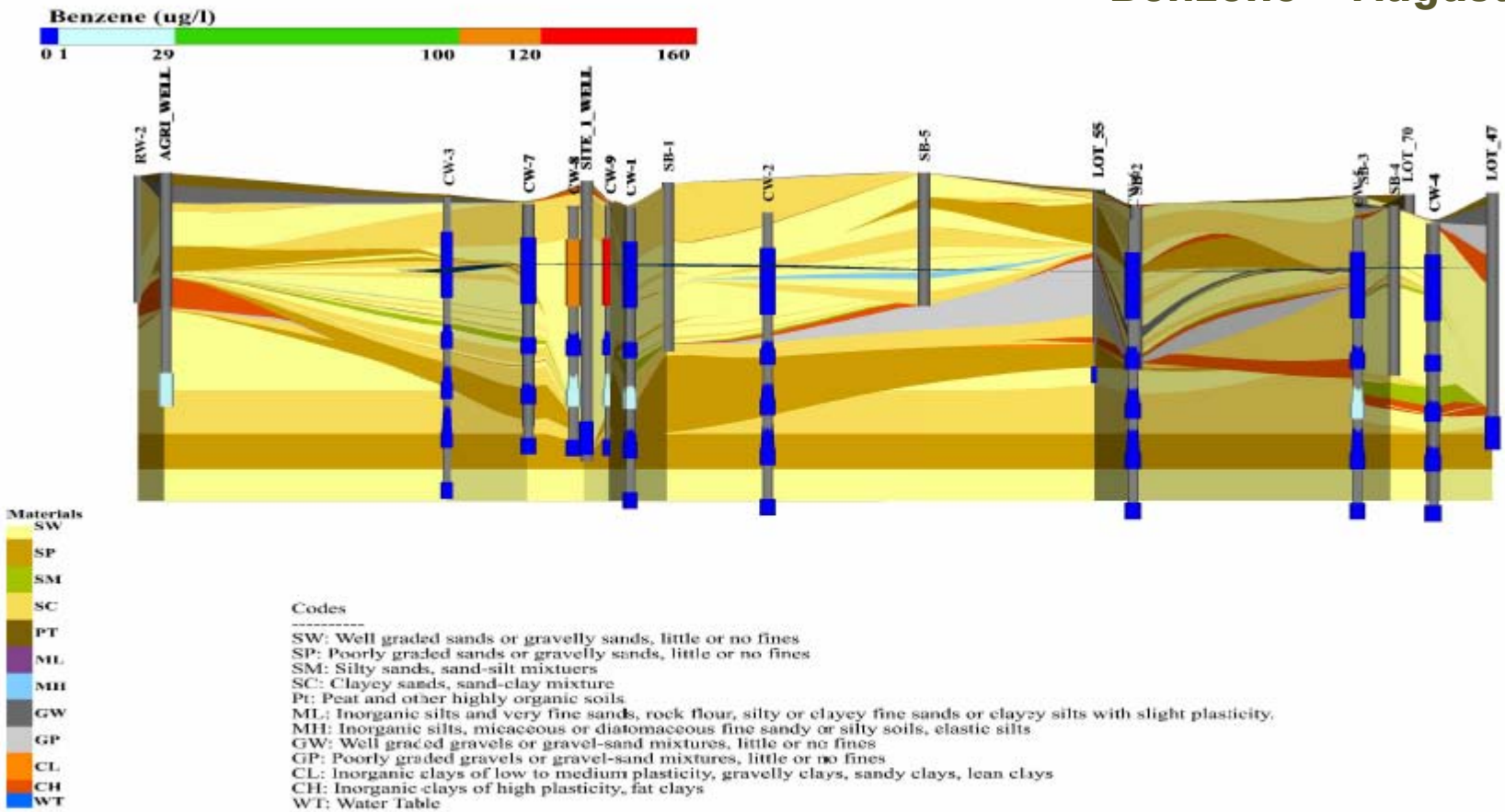
Benzene – August 2004



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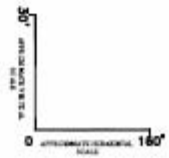
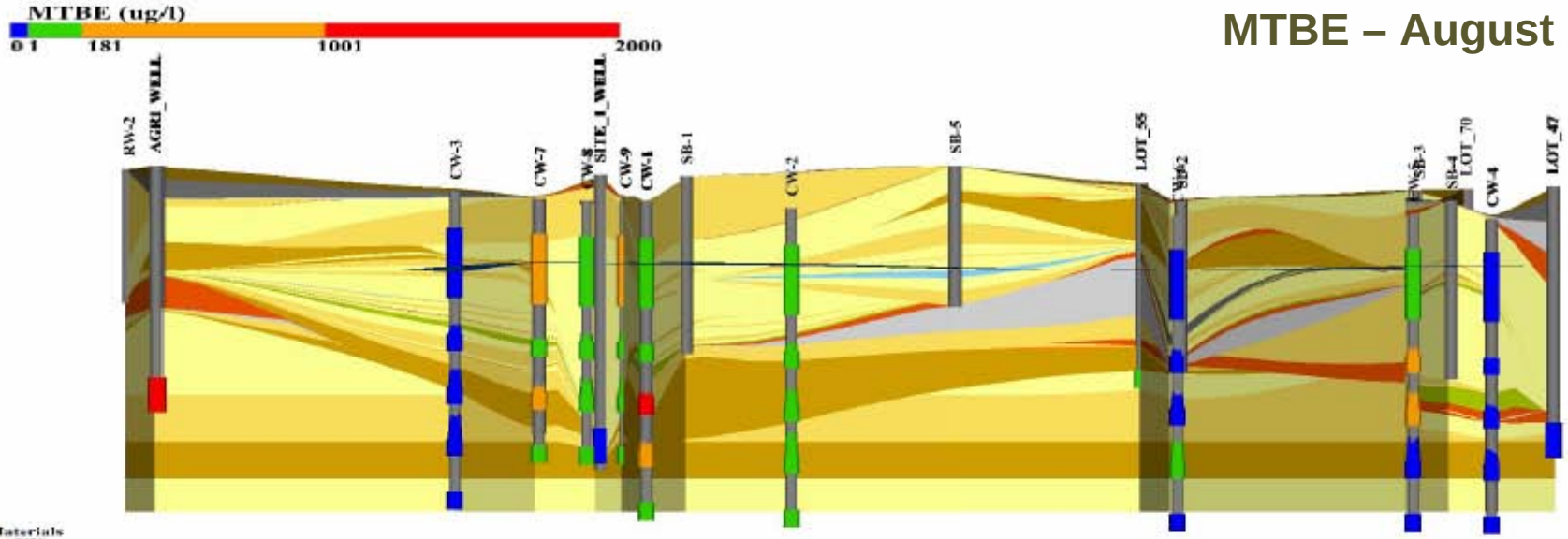
WT: Water Table



FORM DATE 11/11/04	Environmental Alliance, Inc. 1013 Newport Gap Pike Wilmington, DE 19808
DRAWN BY CR	FIGURE 5–1 BENZENE ANALYTICAL CROSS–SECTION AUGUST 2004 PEP–UP #11 REHOBOTH BEACH, DELAWARE
CHECKED BY JL	
REVISED BY AA	

MTBE – August 2004



Materials

- SW
- SP
- SM
- SC
- PT
- ML
- MH
- GW
- GP
- CL
- CH
- WT

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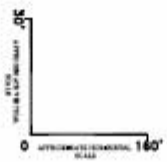
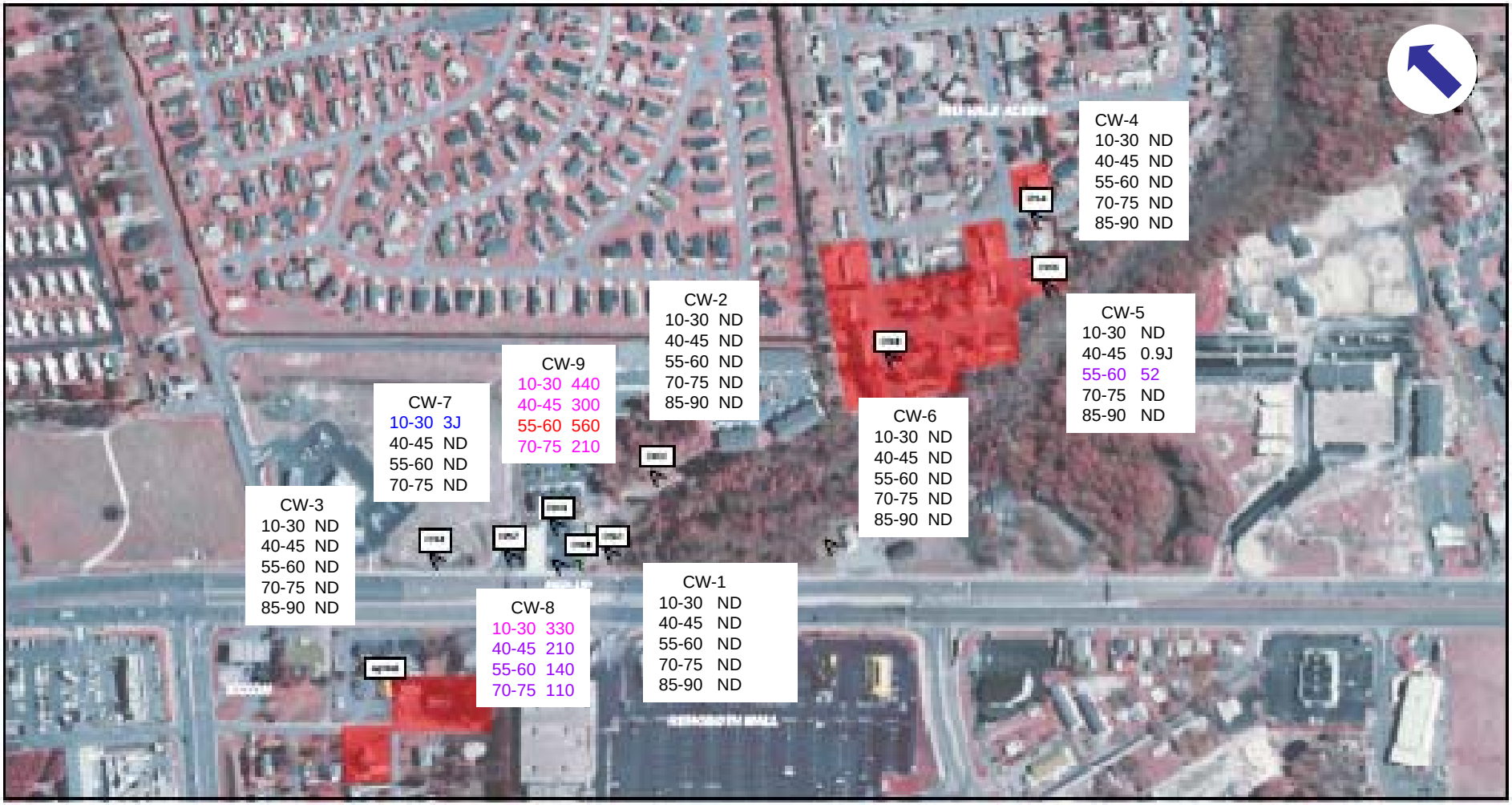


11/11/04	Environmental Alliance, Inc.
CR	FIGURE 5-2
JL	MTBE ANALYTICAL CROSS-SECTION
AA	AUGUST 2004
	PEP-UP #11
	REHOBOTH BEACH, DELAWARE

Benzene

Nov 2004



Legend

- Cluster Well
- Agricultural Well
- Impacted Properties

Proposed Locations

- Cluster Well
- Shallow Well

1 inch equals 200 feet

REHOBOTH BEACH, DELAWARE

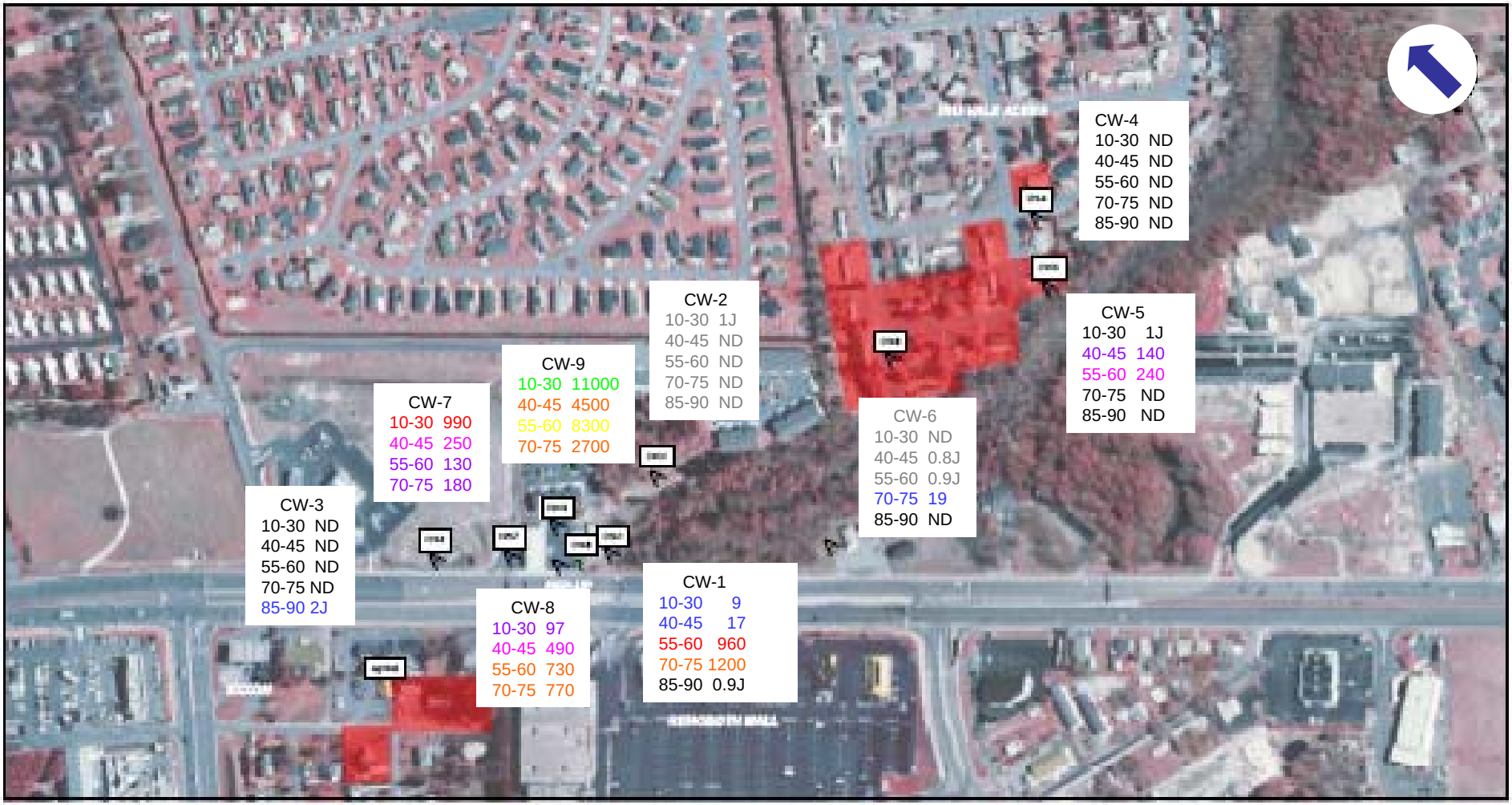
PROPOSED WELL LOCATION MAP

5-3

0 2 20 200 500 1000 5000 10000

MTBE

Nov 2004



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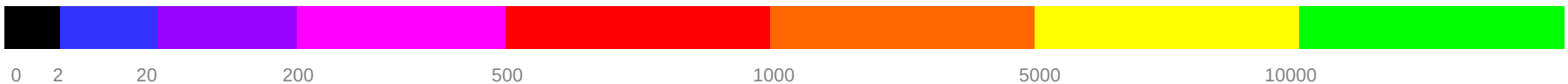
REHOBOTH BEACH, DELAWARE

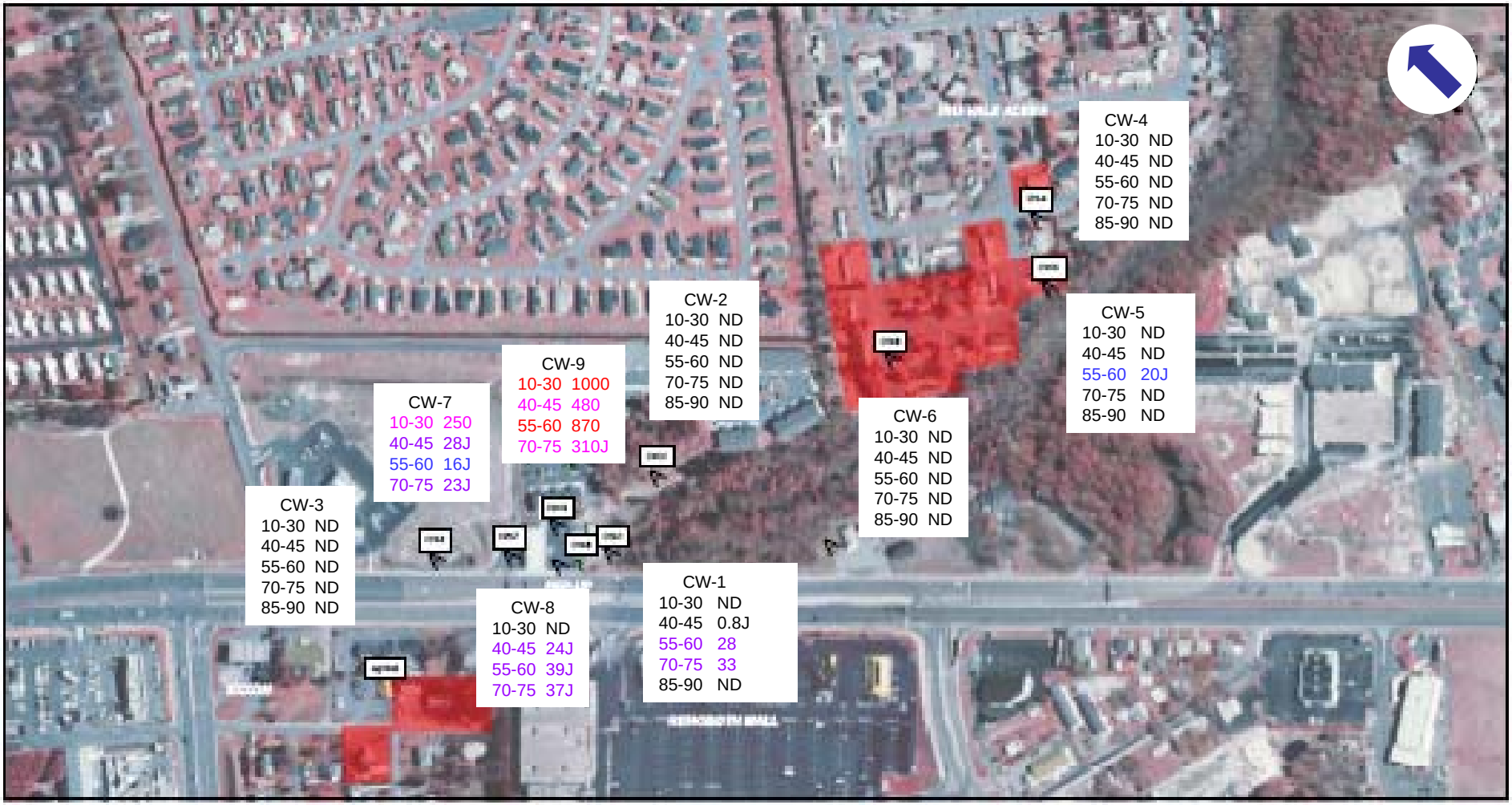
PROPOSED WELL LOCATION MAP

5-3



TAME

Nov 2004



Legend

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- Agricultural Well
- Impacted Properties

Proposed Locations

- Cluster Well
- Shallow Well

1 inch equals 200 feet

REHOBOTH BEACH, DELAWARE

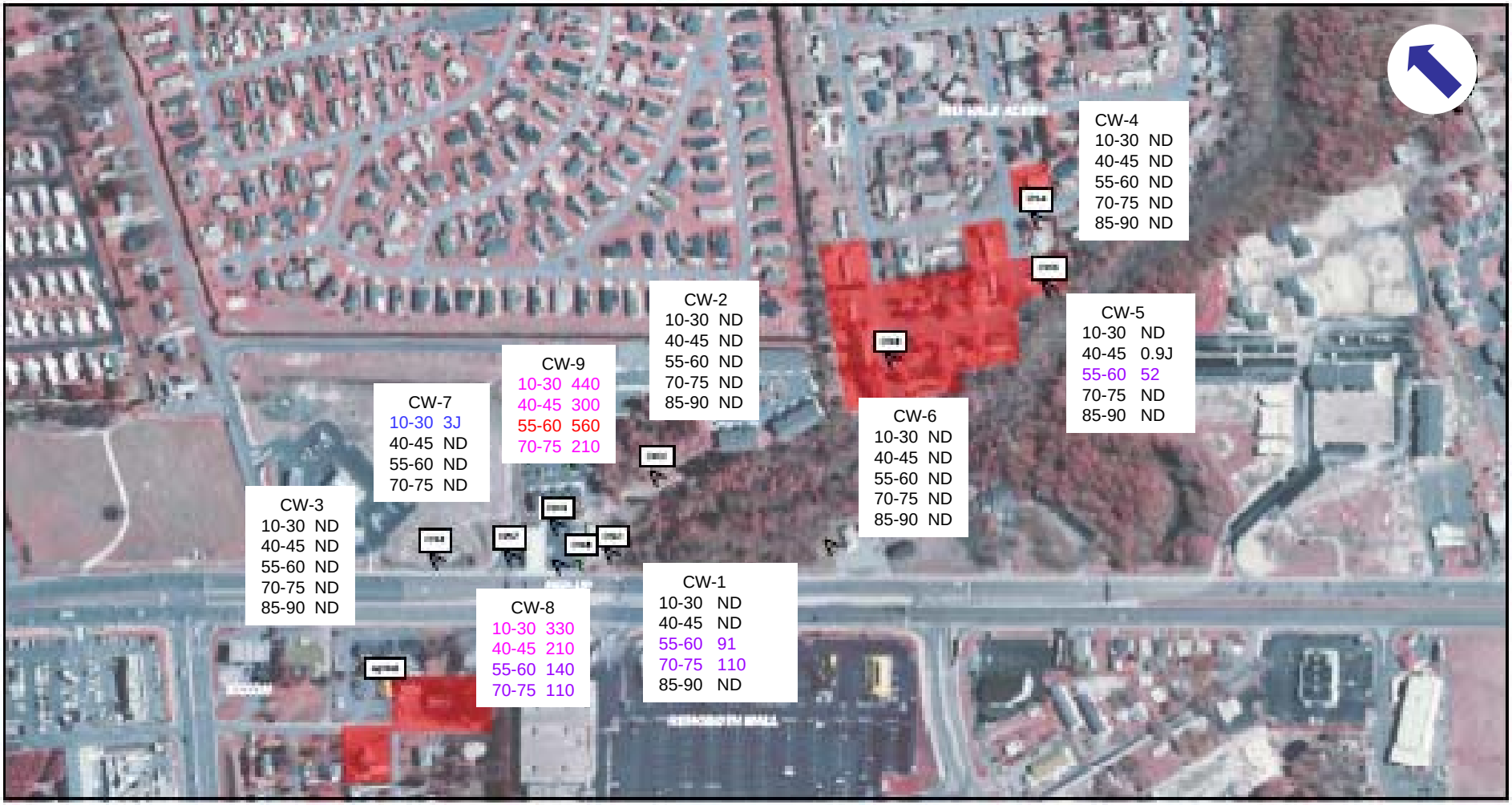
PROPOSED WELL LOCATION MAP

5-3

0	2	20	200	500	1000	5000	10000

TBA

Nov 2004



Legend

- Cluster Well
- Agricultural Well
- Impacted Properties

Proposed Locations

- Cluster Well
- Shallow Well

1 inch equals 200 feet

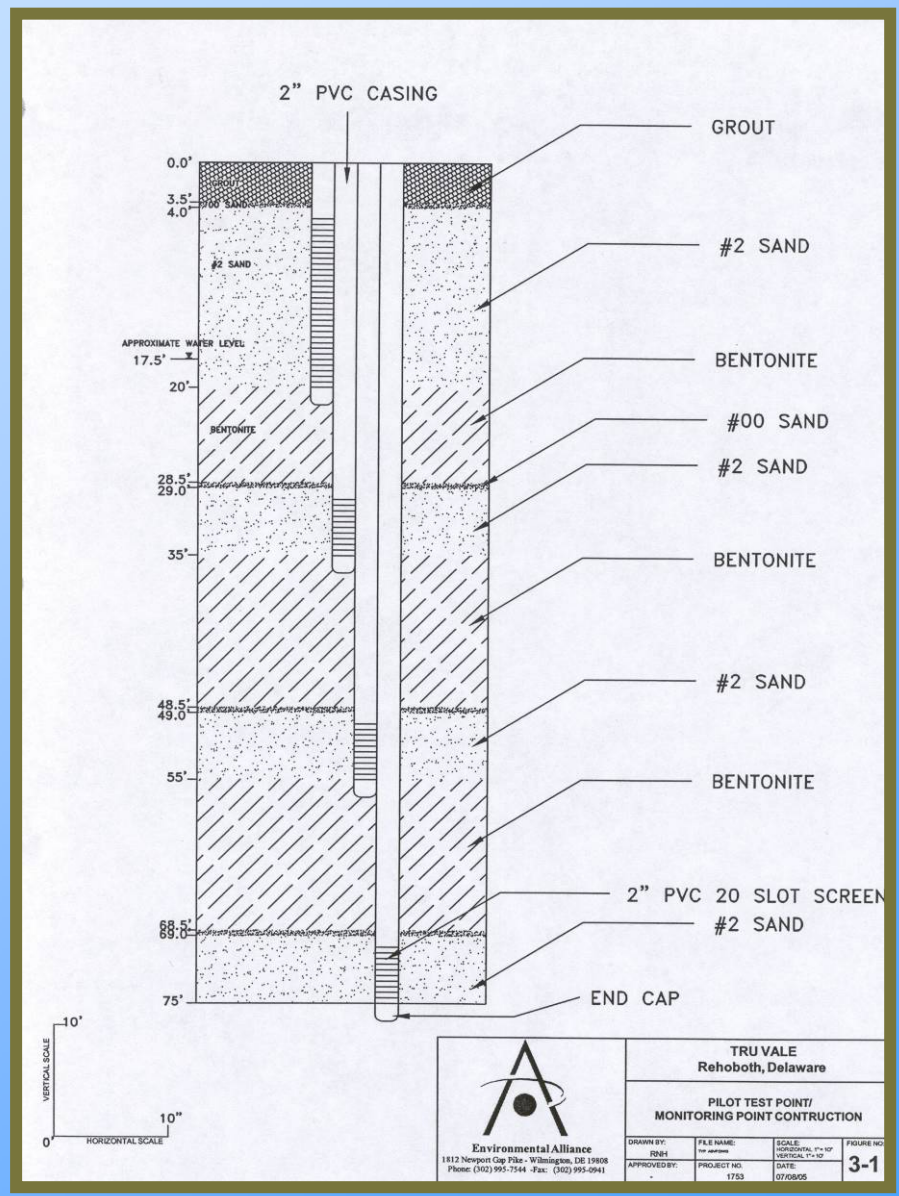
REHOBOTH BEACH, DELAWARE

PROPOSED WELL LOCATION MAP

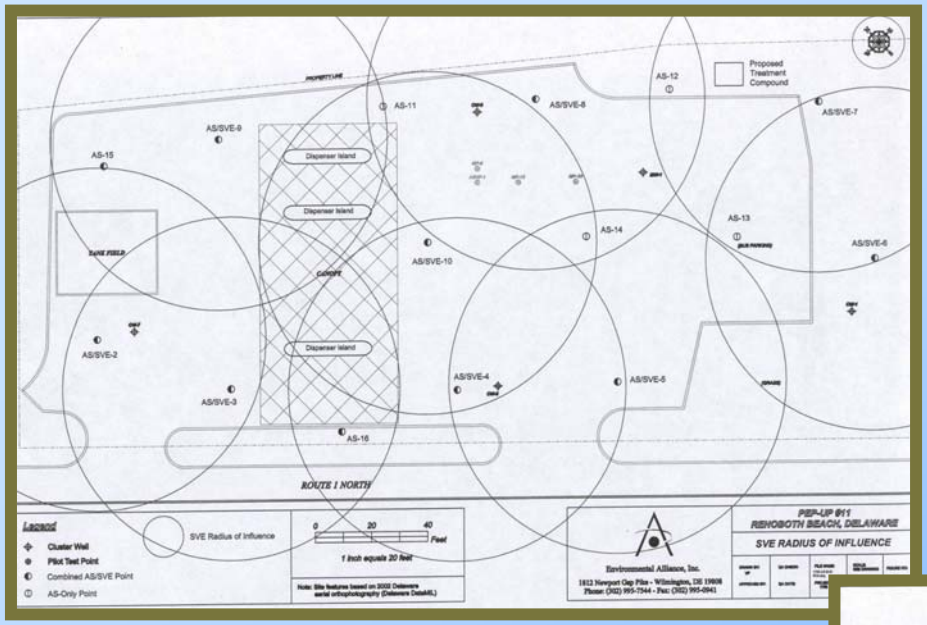
5-3

0 2 20 200 500 1000 5000 10000

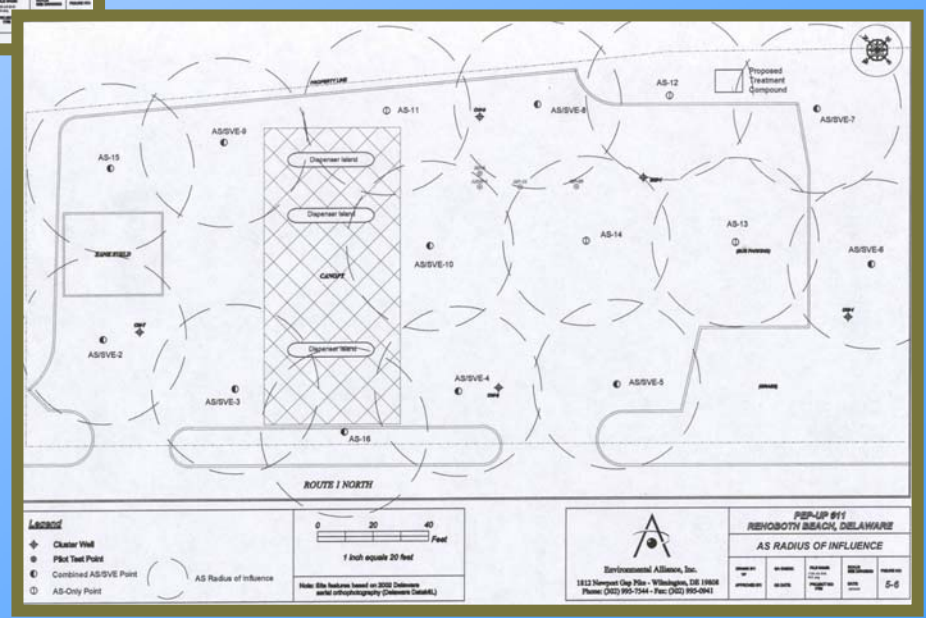
Pilot Test Point/Monitoring Point Construction



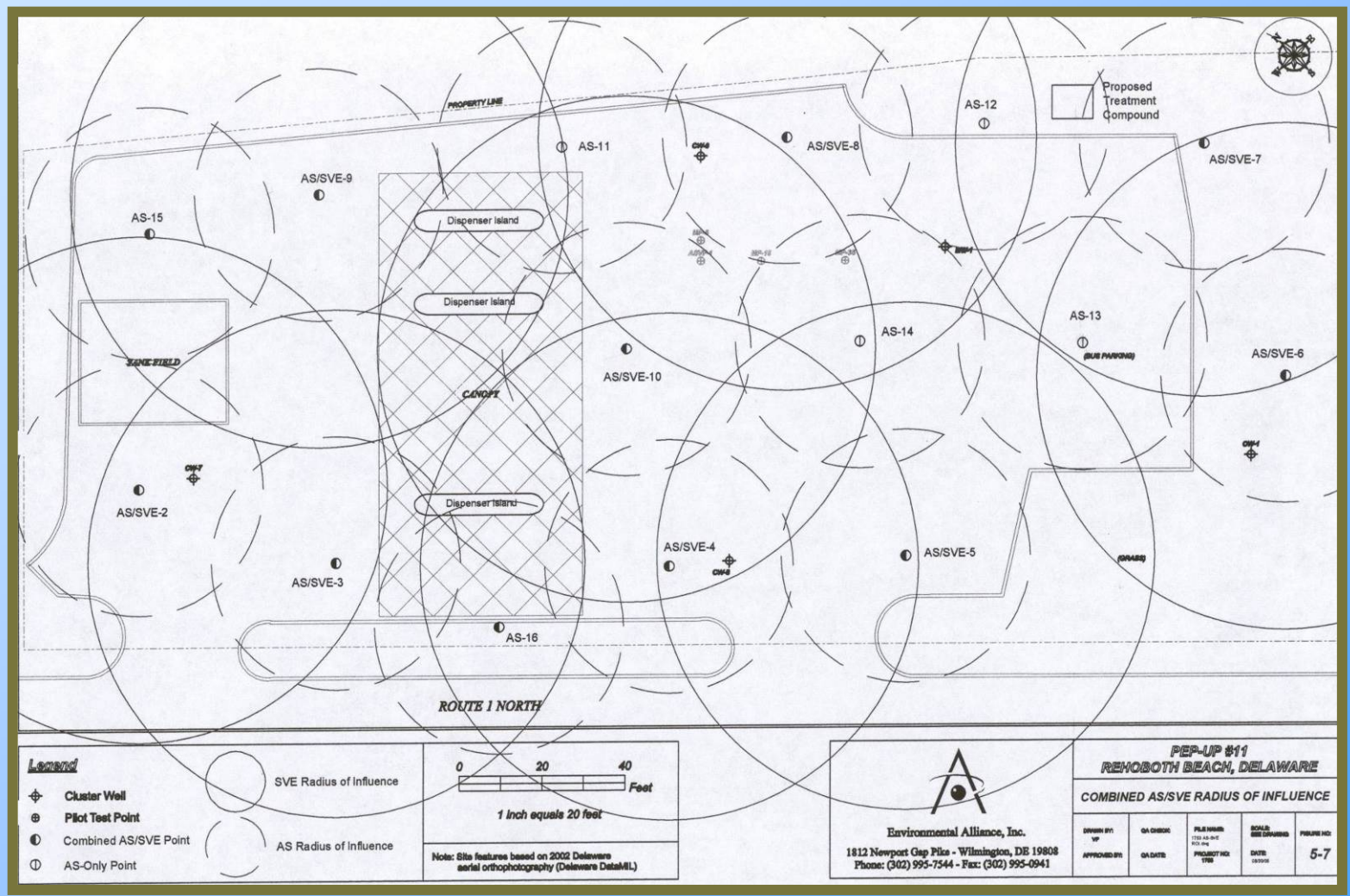
SVE Radius of Influence



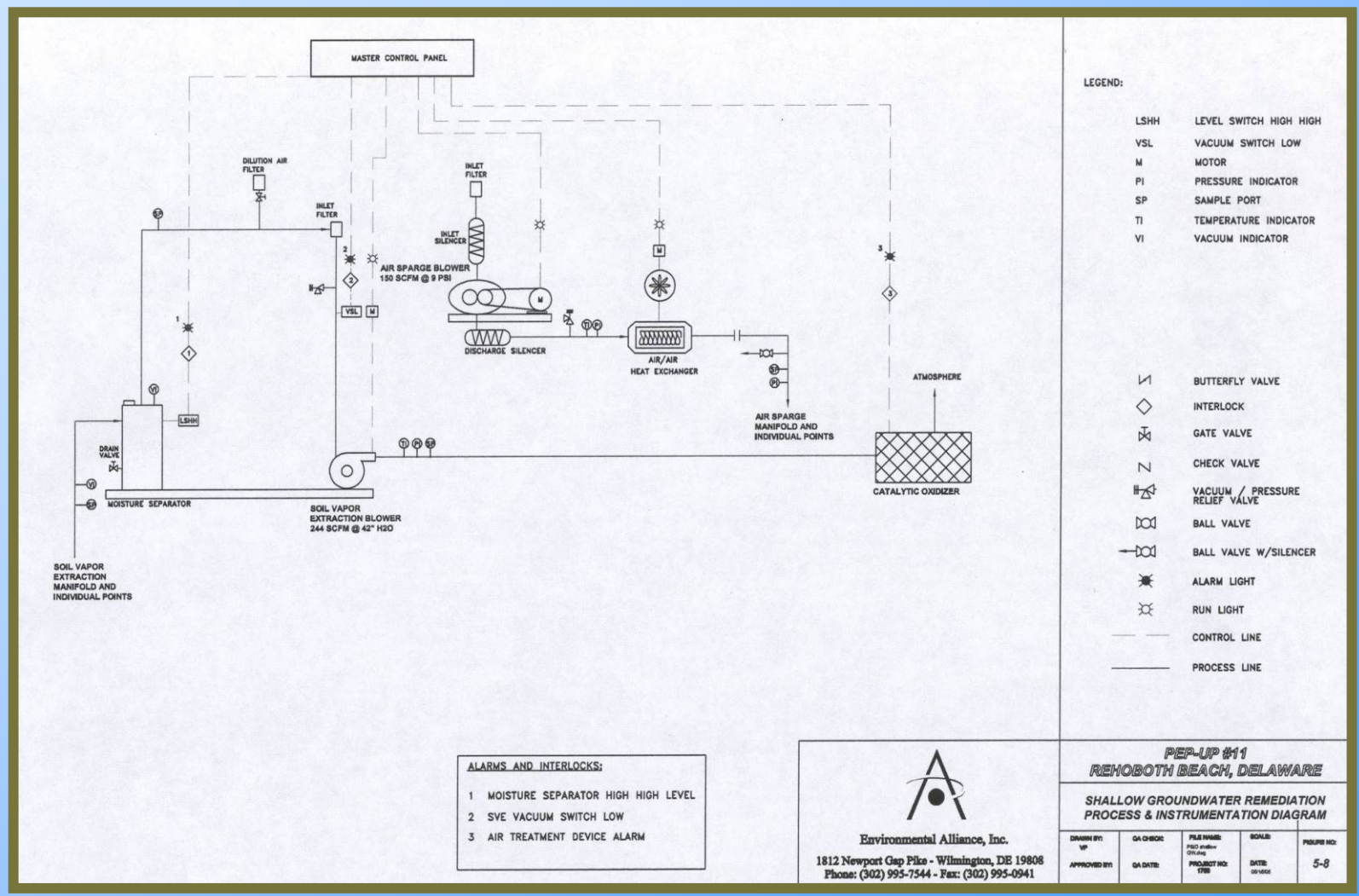
AS Radius of Influence



Combined AS/SVE Radius of Influence



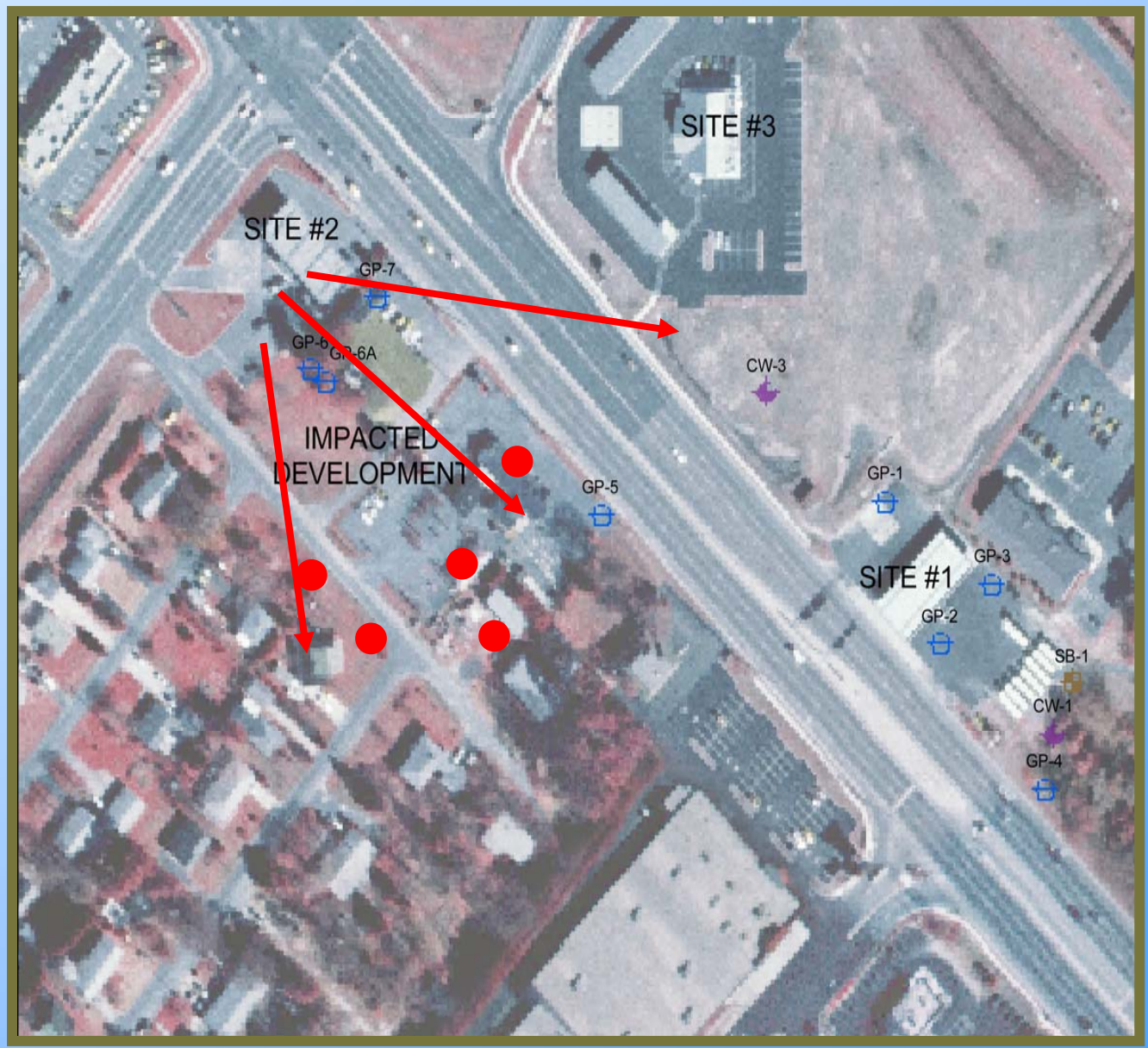
Shallow Groundwater Remediation Process and Instrumentation Diagram

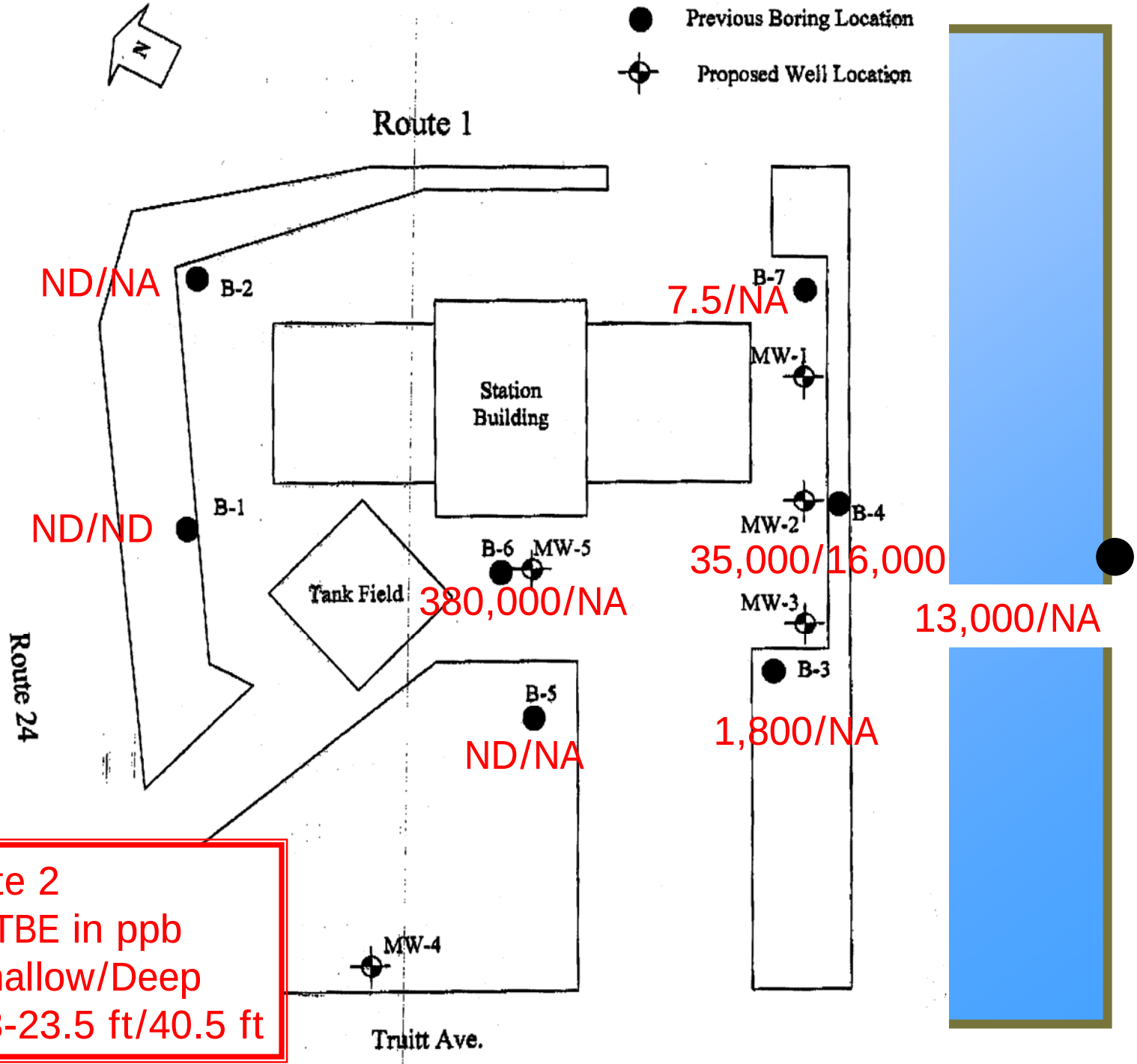


0
0.125
0.25
0.5 Miles
N
W
E
S
Site 3
SITE #3
Site 2
SITE #2
GP-7
GP-6
GP-6A
IMPACTED DEVELOPMENT
CW-3
Site 1
SITE #1
GP-1
GP-2
GP-3
GP-4
GP-5
GP-10
GP-8
SB-5
CW-2
GP-9
GP-18
GP-19
GP-20
Tru-Vale Acres
GP-11
GP-13
GP-12
IMPACTED DEVELOPMENT
CW-6
SB-2
GP-15
SB-4
CW-4
GP-14
CW-5
GP-16
GP-17
GP-21
Truitt's Midway Development
Tru-Vale Acres and Truitt's Midway Development
Environmental Alliance, Inc.
1812 Newport Gap Pike - Wilmington, DE 19808
Phone: (302) 995-7544 - Fax: (302) 995-0941
Rehoboth, Delaware
STUDY AREA MAP
DRAWN BY: AG
FILE NAME: SITE MAP
SCALE: SEE DRAWING
FIGURE NO:
APPROVED BY: RR
PROJECT NO: 1696
DATE: 04/20/04

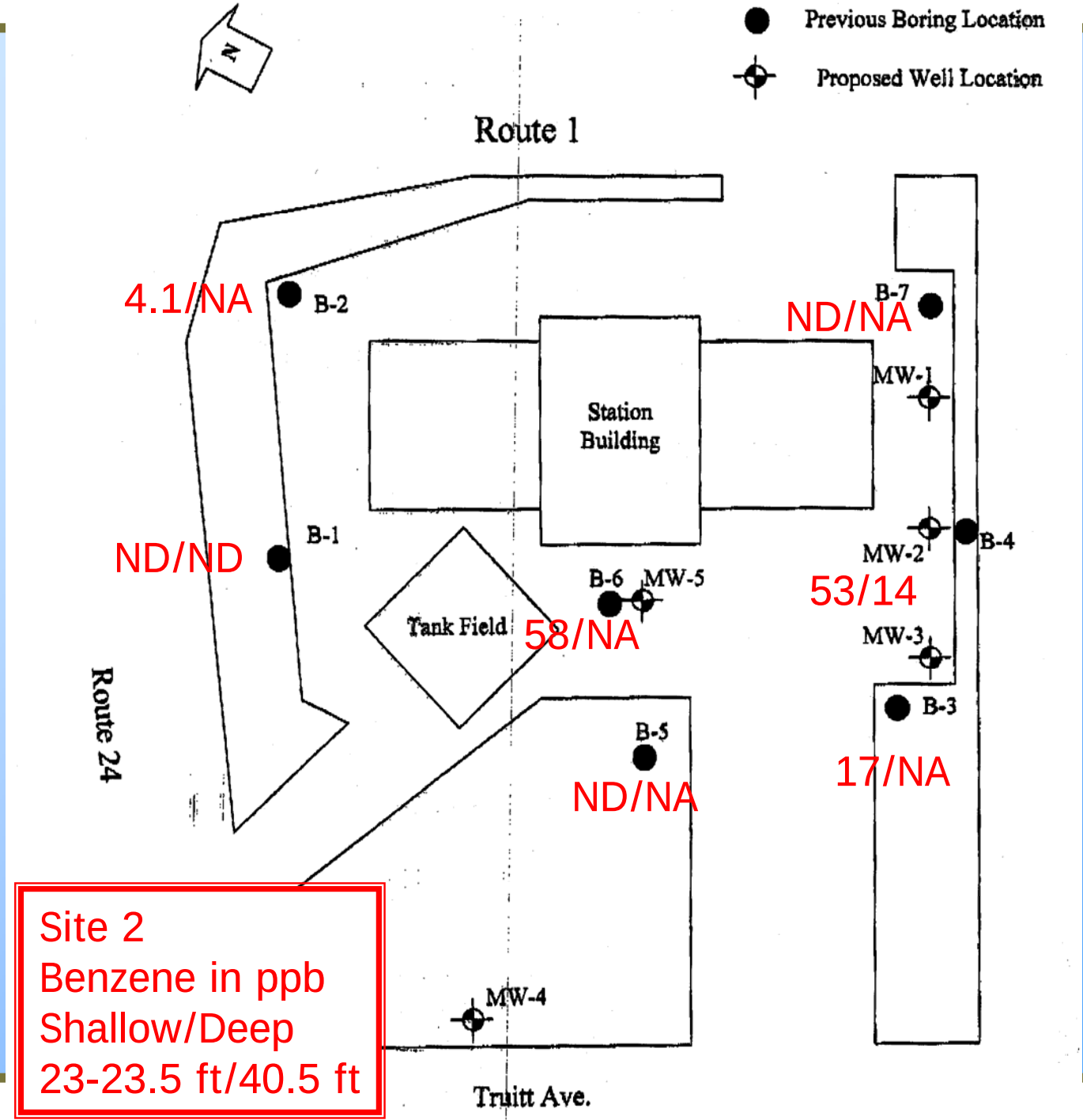
Additional Potable Well Impacts Adjacent to Site #2 – June 2004

- New well impacts in second residential development
- 4 domestic wells and one agricultural well impacted
- Maximum MTBE concentration 3000 ppb
- Maximum Benzene concentration 2.0J ppb


SITE #3
SITE #2
GP-7
GP-6
GP-6A
CW-3
IMPACTED
DEVELOPMENT
GP-5
GP-1
GP-3
SITE #1
GP-2
SB-1
CW-1
GP-4

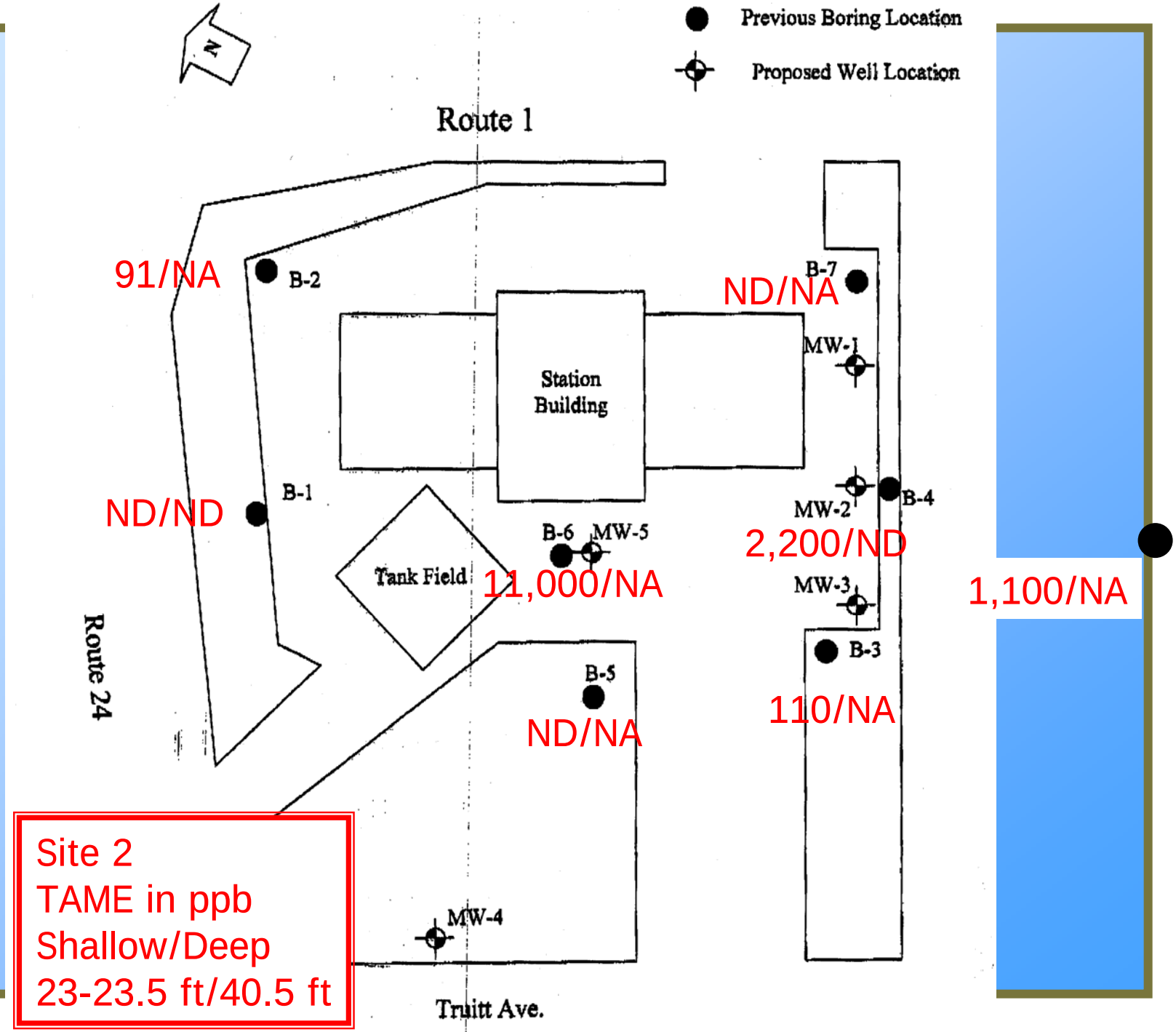


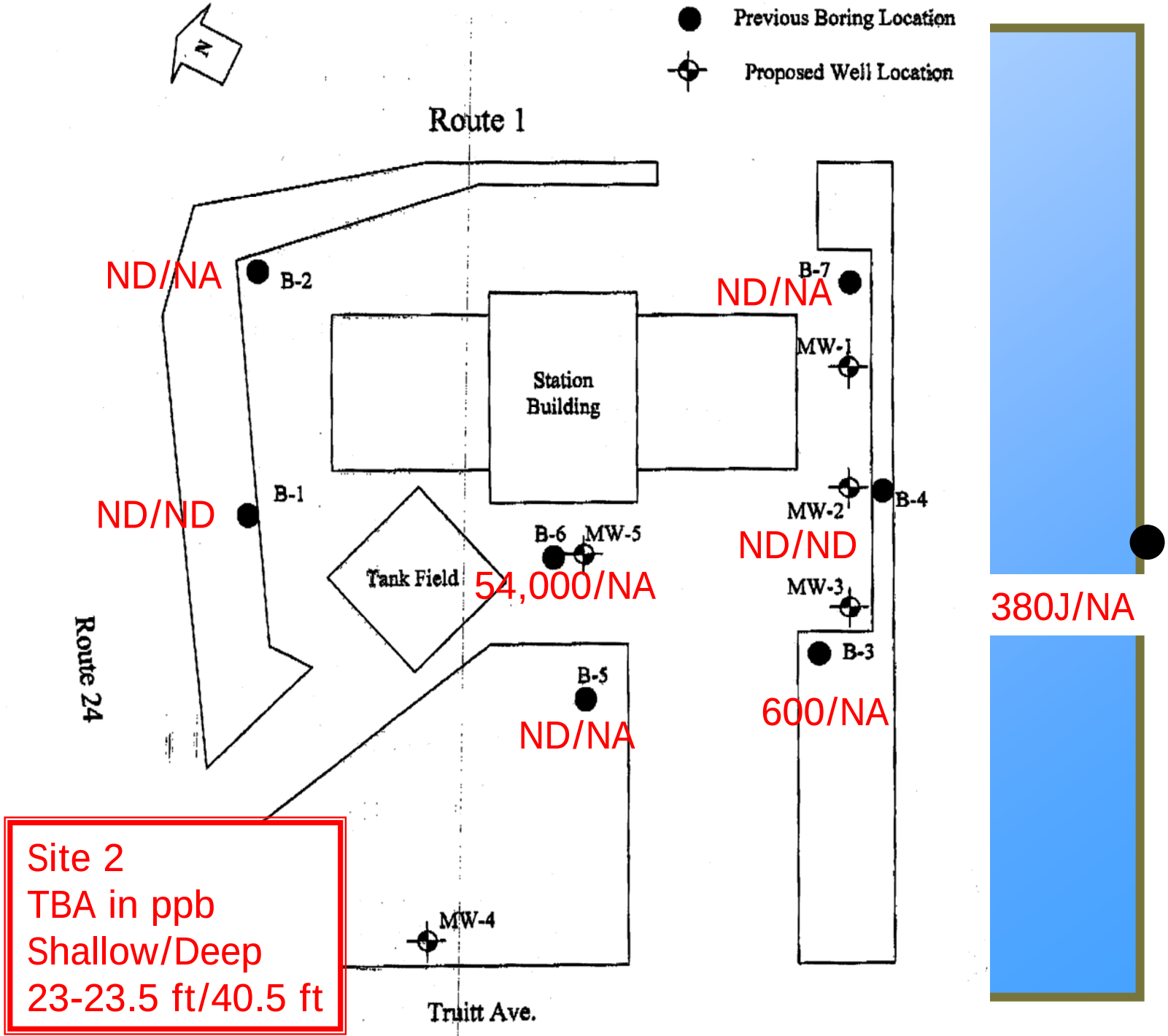
Site 2
MTBE in ppb
Shallow/Deep
23-23.5 ft/40.5 ft

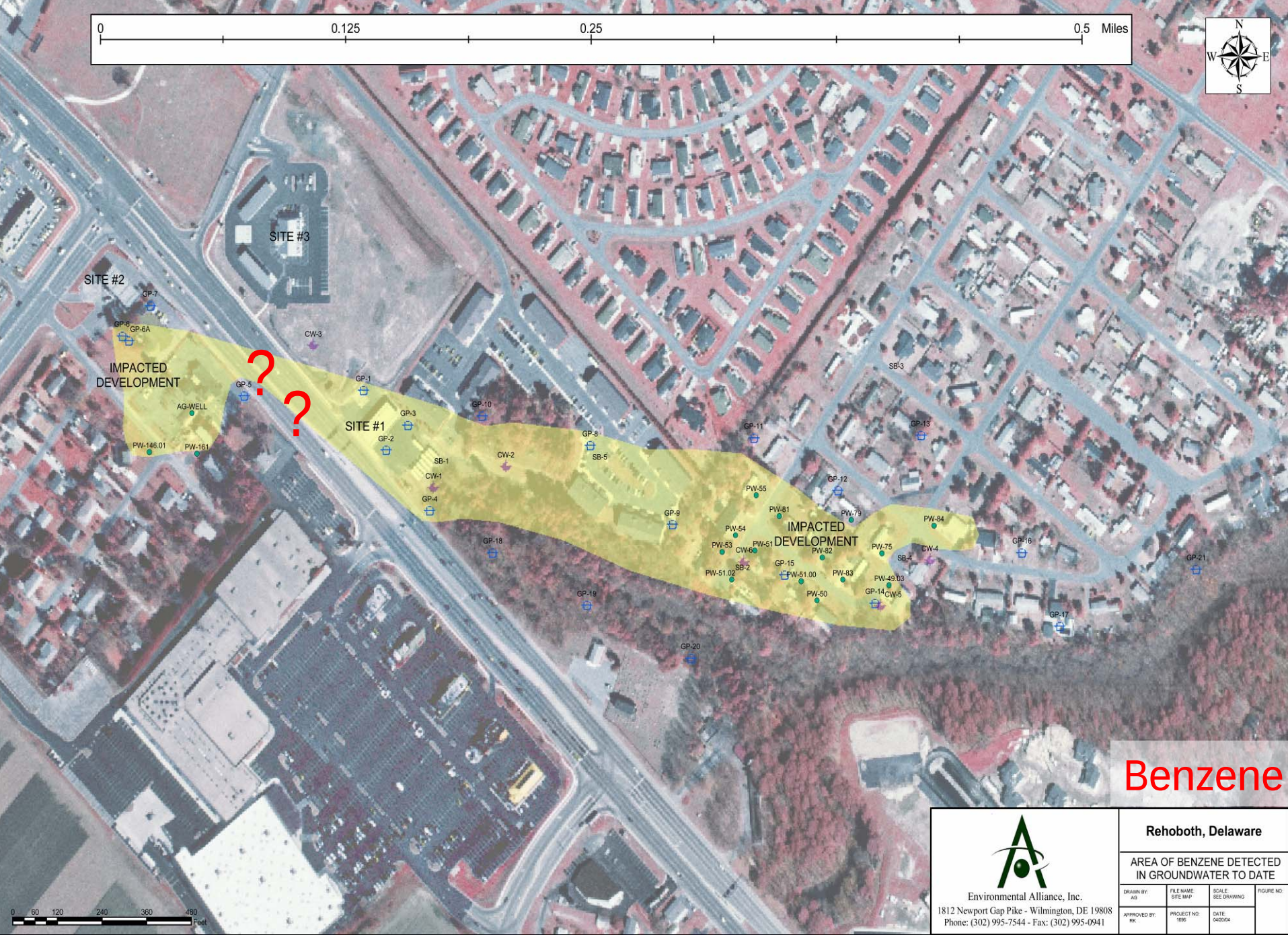


Site 2
Benzene in ppb
Shallow/Deep
23-23.5 ft/40.5 ft

5J/NA


Previous Boring Location
Proposed Well Location
N
Route 1
Station Building
Tank Field
Route 24
Truitt Ave.
B-1
B-2
B-3
B-4
B-5
B-6
B-7
MW-1
MW-2
MW-3
MW-4
MW-5
91/NA
ND/NA
ND/ND
11,000/NA
2,200/ND
110/NA
ND/NA
1,100/NA
Site 2
TAME in ppb
Shallow/Deep
23-23.5 ft/40.5 ft


Previous Boring Location
Proposed Well Location
N
Route 1
Station Building
Tank Field
Route 24
Truitt Ave.
B-1
B-2
B-3
B-4
B-5
B-6
B-7
MW-1
MW-2
MW-3
MW-4
MW-5
ND/NA
ND/NA
ND/ND
54,000/NA
ND/ND
380J/NA
600/NA
ND/NA
Site 2
TBA in ppb
Shallow/Deep
23-23.5 ft/40.5 ft


0
0.125
0.25
0.5 Miles
N
W
E
S
SITE #3
SITE #2
GP-7
GP-8
GP-6A
CW-3
IMPACTED DEVELOPMENT
GP-5
?
?
GP-1
AG-WELL
GP-3
GP-10
SITE #1
GP-2
PW-146.01
PW-161
SB-1
CW-2
GP-8
SB-5
CW-1
GP-4
GP-11
SB-3
GP-13
GP-12
PW-55
PW-81
PW-79
PW-84
GP-9
PW-54
IMPACTED DEVELOPMENT
PW-53
CW-6
PW-51
PW-82
PW-75
CW-4
GP-16
GP-18
SB-4
GP-21
SB-2
GP-15
PW-51.02
PW-51.00
PW-83
PW-49.03
GP-19
PW-50
GP-14
CW-5
GP-17
GP-20
0 60 120 240 360 480 Feet
Benzene
Environmental Alliance, Inc.
1812 Newport Gap Pike - Wilmington, DE 19808
Phone: (302) 995-7544 - Fax: (302) 995-0941
Rehoboth, Delaware
AREA OF BENZENE DETECTED IN GROUNDWATER TO DATE
DRAWN BY: AG
FILE NAME: SITE MAP
SCALE: SEE DRAWING
FIGURE NO:
APPROVED BY: RK
PROJECT NO: 1696
DATE: 04/20/04

0
0.125
0.25
0.5 Miles
N
W
E
S
SITE #3
SITE #2
SITE #1
IMPACTED DEVELOPMENT
IMPACTED DEVELOPMENT
?
?
?
GP-7
GP-6
GP-6A
CW-3
GP-5
GP-1
AG-WELL
GP-3
GP-10
GP-2
PW-146.01
PW-161
SB-1
CW-1
CW-2
GP-8
SB-5
GP-4
GP-18
GP-19
GP-20
GP-9
GP-11
GP-13
SB-3
GP-12
PW-55
PW-81
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PW-84
PW-54
PW-53
CW-6
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PW-52
PW-75
CW-4
SB-4
GP-16
GP-21
SB-2
PW-51.02
GP-15
PW-51.00
PW-83
PW-49.03
PW-50
GP-14
CW-5
GP-17
MTBE
0 60 120 240 360 480
Feet
Environmental Alliance, Inc.
1812 Newport Gap Pike - Wilmington, DE 19808
Phone: (302) 995-7544 - Fax: (302) 995-0941
Rehoboth, Delaware
AREA OF MTBE DIRECTED IN GROUNDWATER TO DATE
DRAWN BY: AG
FILE NAME: SITE MAP
SCALE: SEE DRAWING
FIGURE NO:
APPROVED BY: RK
PROJECT NO: 1696
DATE: 04/20/04

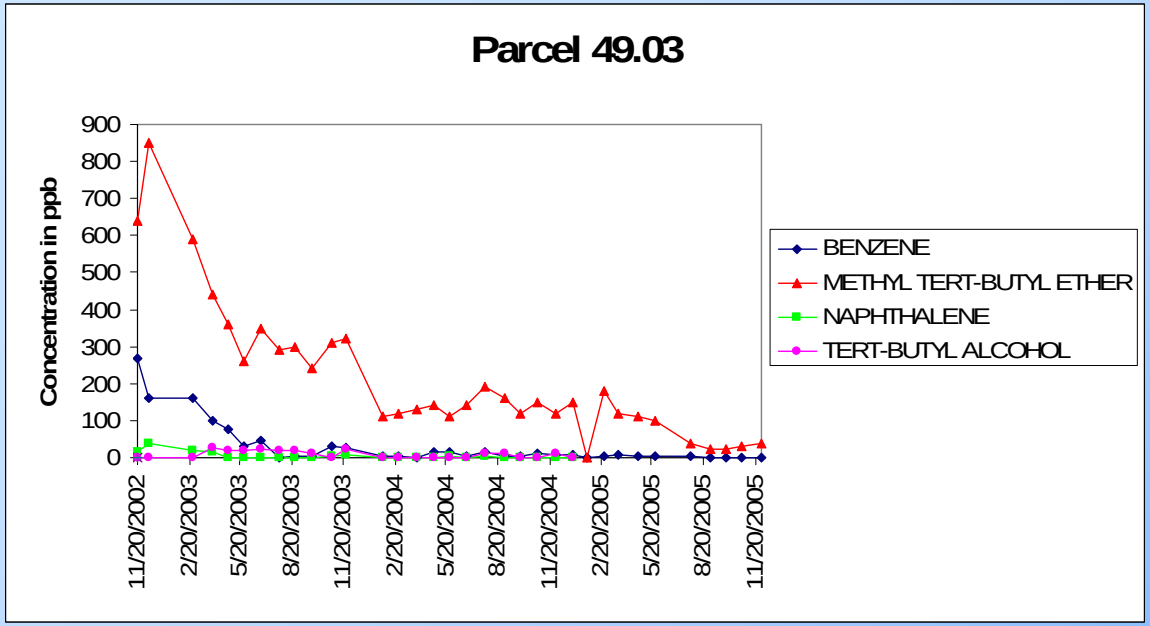
Status of Site 1

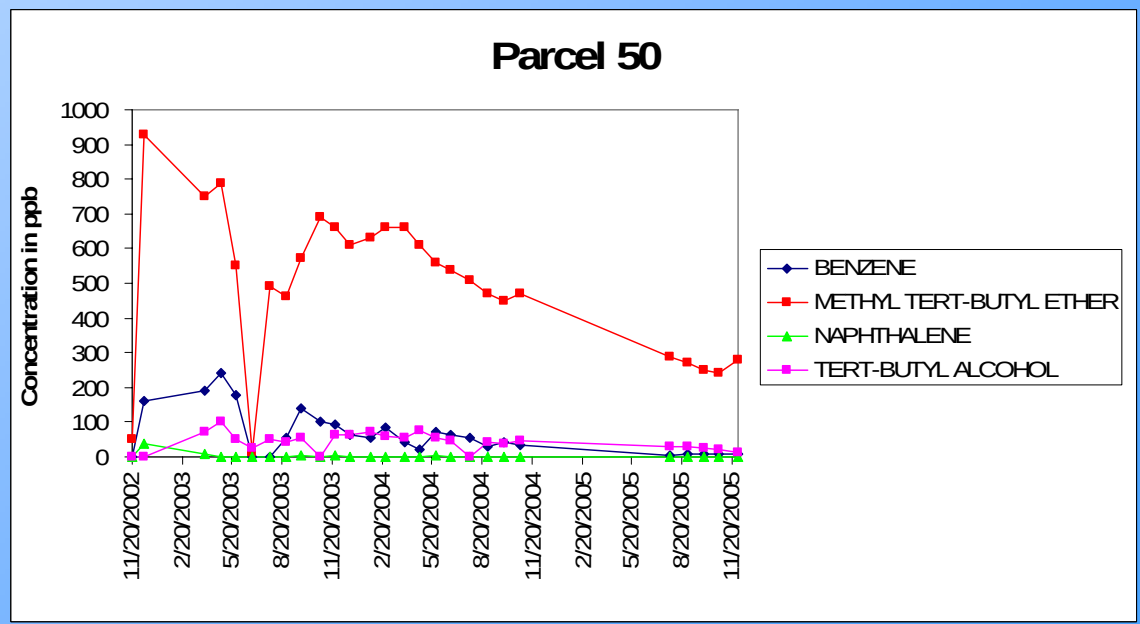
- Onsite and offsite delineation of 1500 foot long plume, using multilevel sampling with cluster wells. Some domestic wells will be converted to monitoring wells.
- Pilot test for onsite remediation completed. AS/SVE system installed and ready to start.
- Public water line has been extended into Tru-Vale Acres. Connected 16 impacted wells and 13 threatened wells. 20 additional wells could be connected.
- Evaluating options for containment or remediation of offsite plume

Status of Site 2

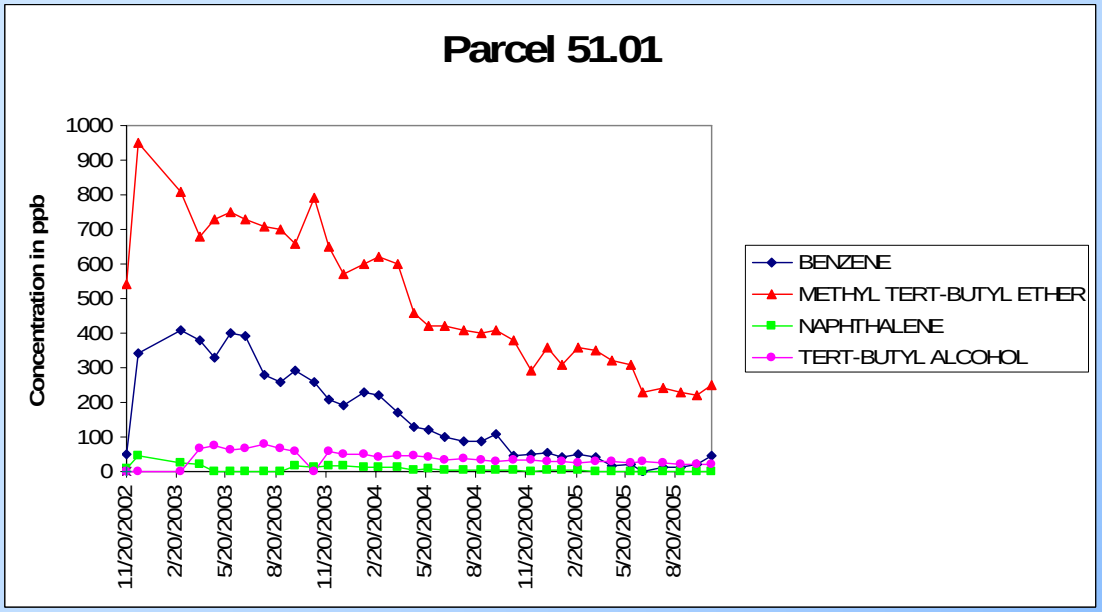
- Notice of Violation when RP refused to investigate.
- Notice of Intent to take over and cost recover when RP still refused
- Temporary wells onsite to confirm release
- Paired monitoring wells installed onsite
- Periodic vacuum truck extraction events on hottest well
- Reluctantly took over sampling of residential wells, maintenance of carbon filters
- Some offsite wells are proposed, to be installed soon. More will be needed – access issues

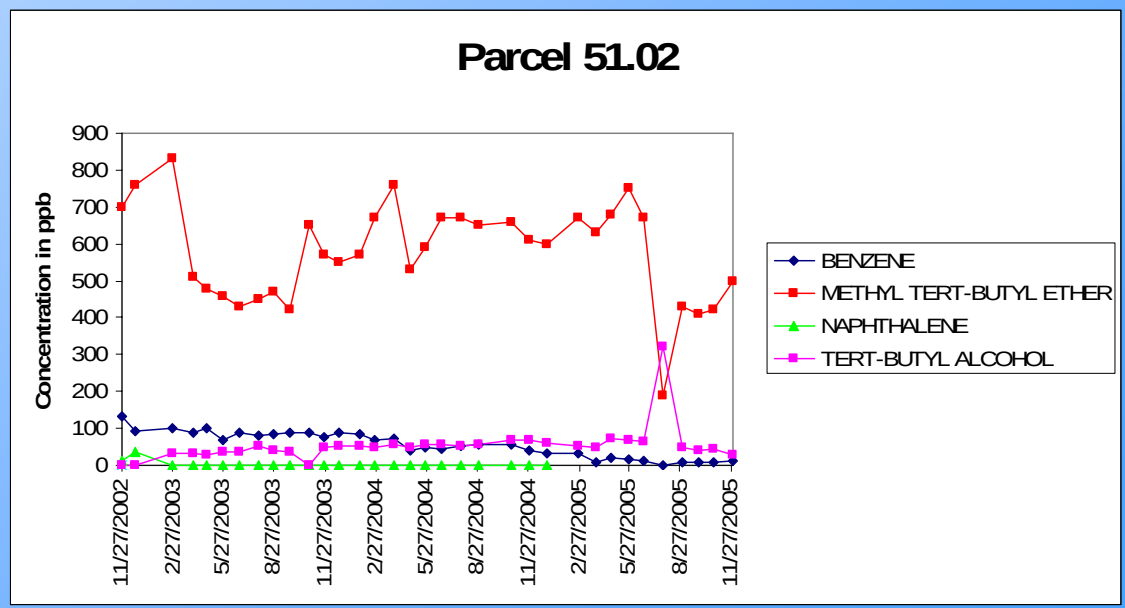
Tru-Vale Acres Domestic Wells



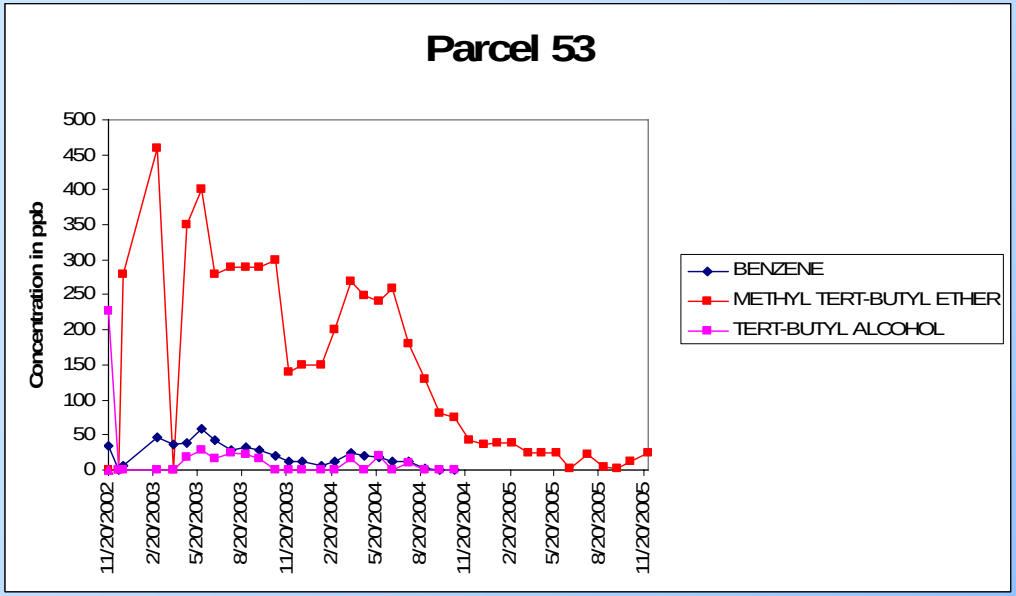


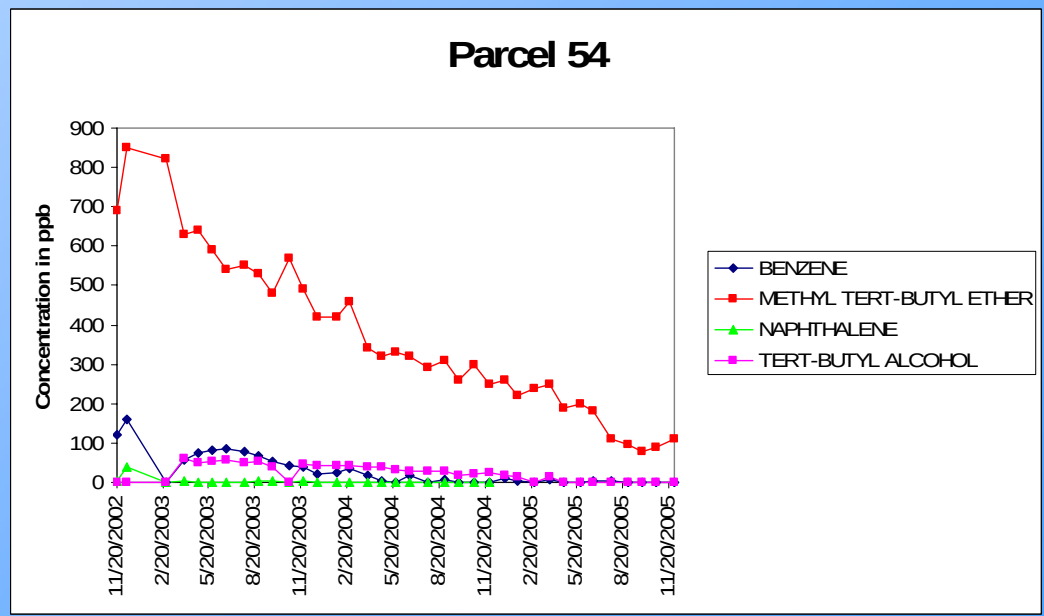
Tru-Vale Acres Domestic Wells



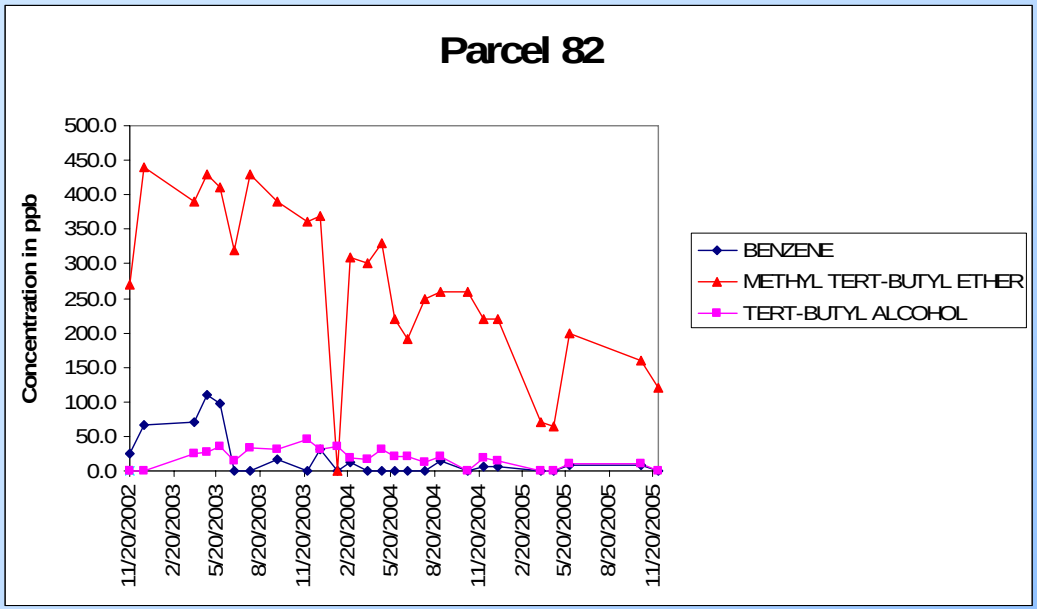


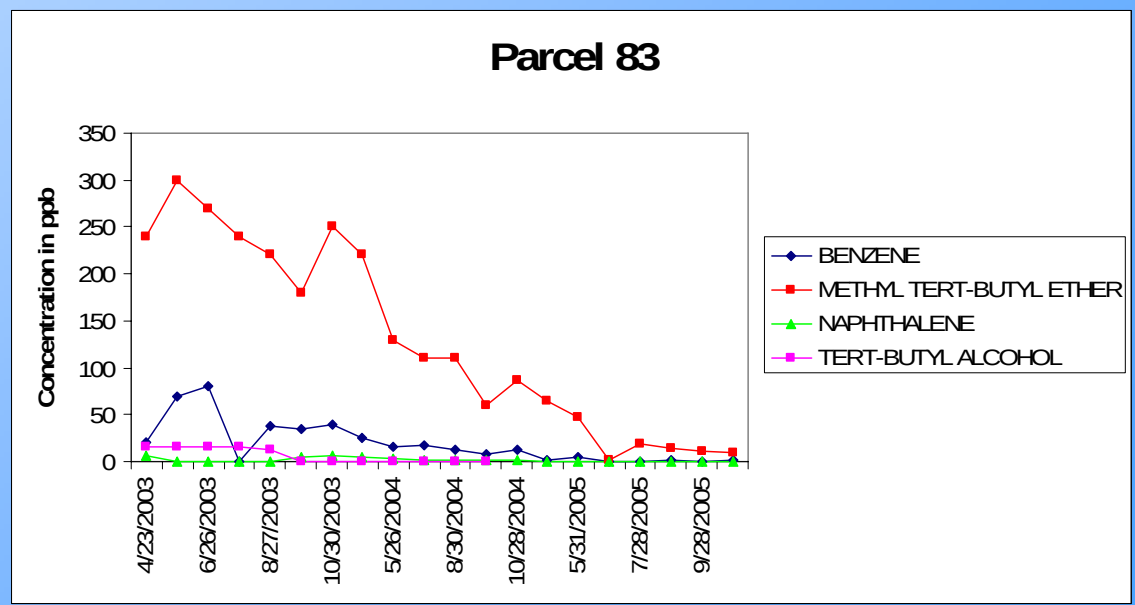
Tru-Vale Acres Domestic Wells



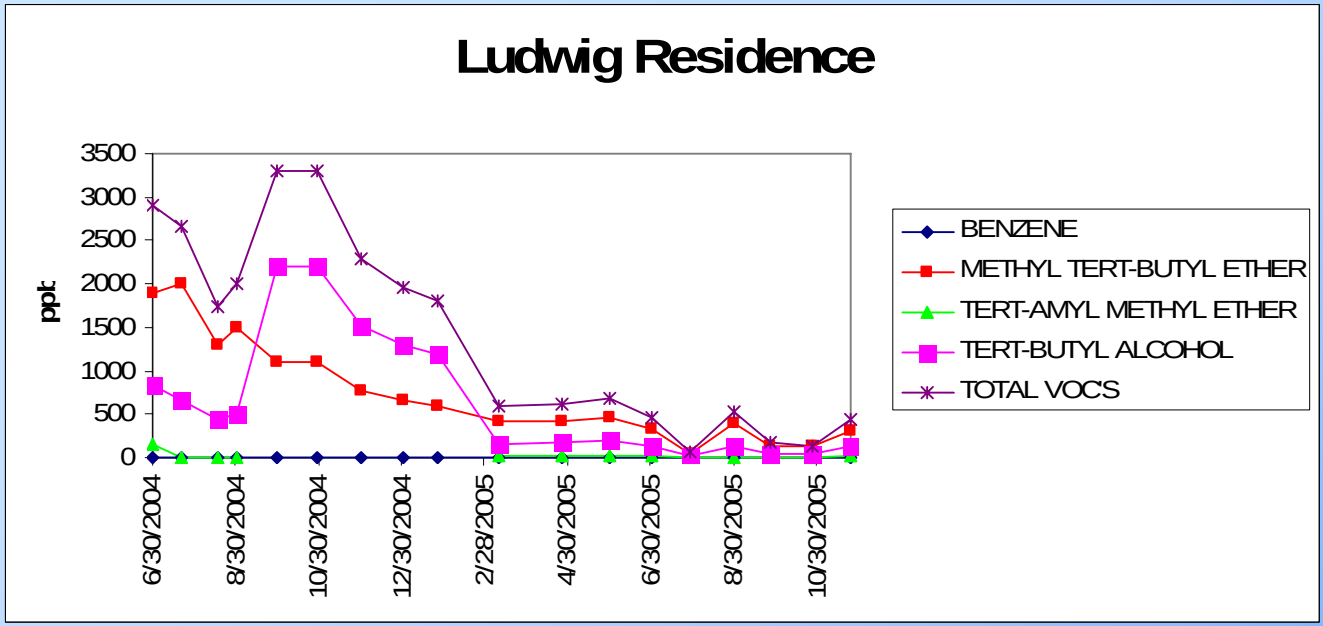


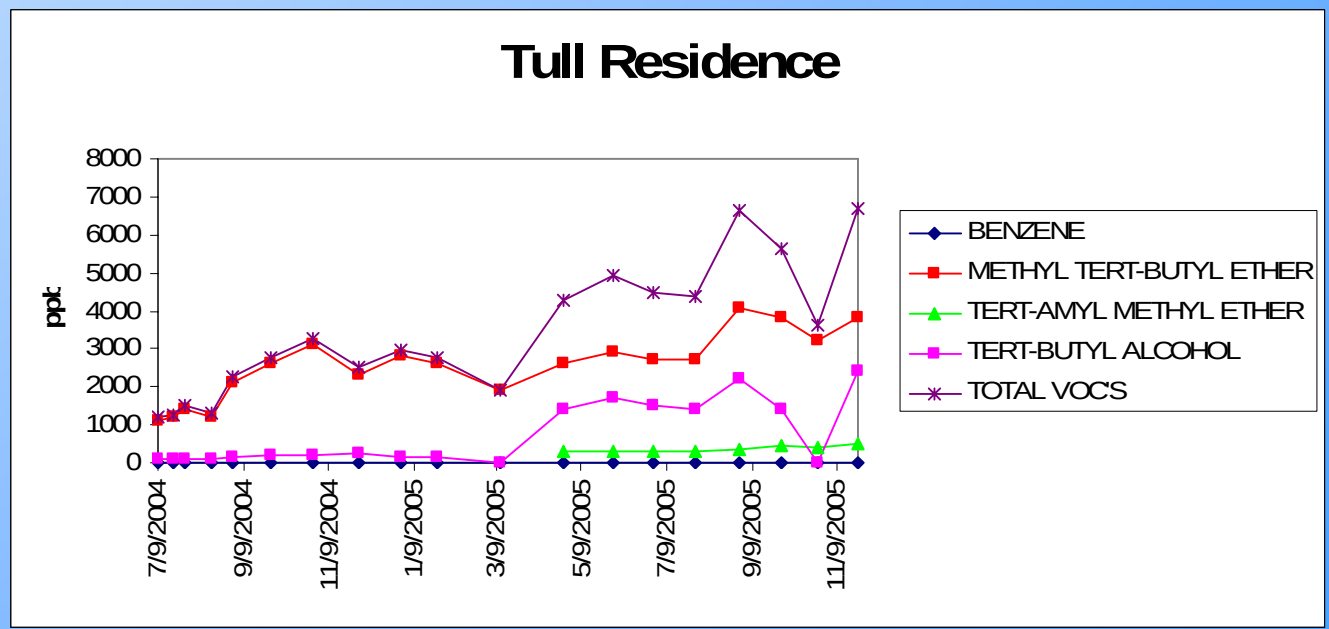
Tru-Vale Acres Domestic Wells



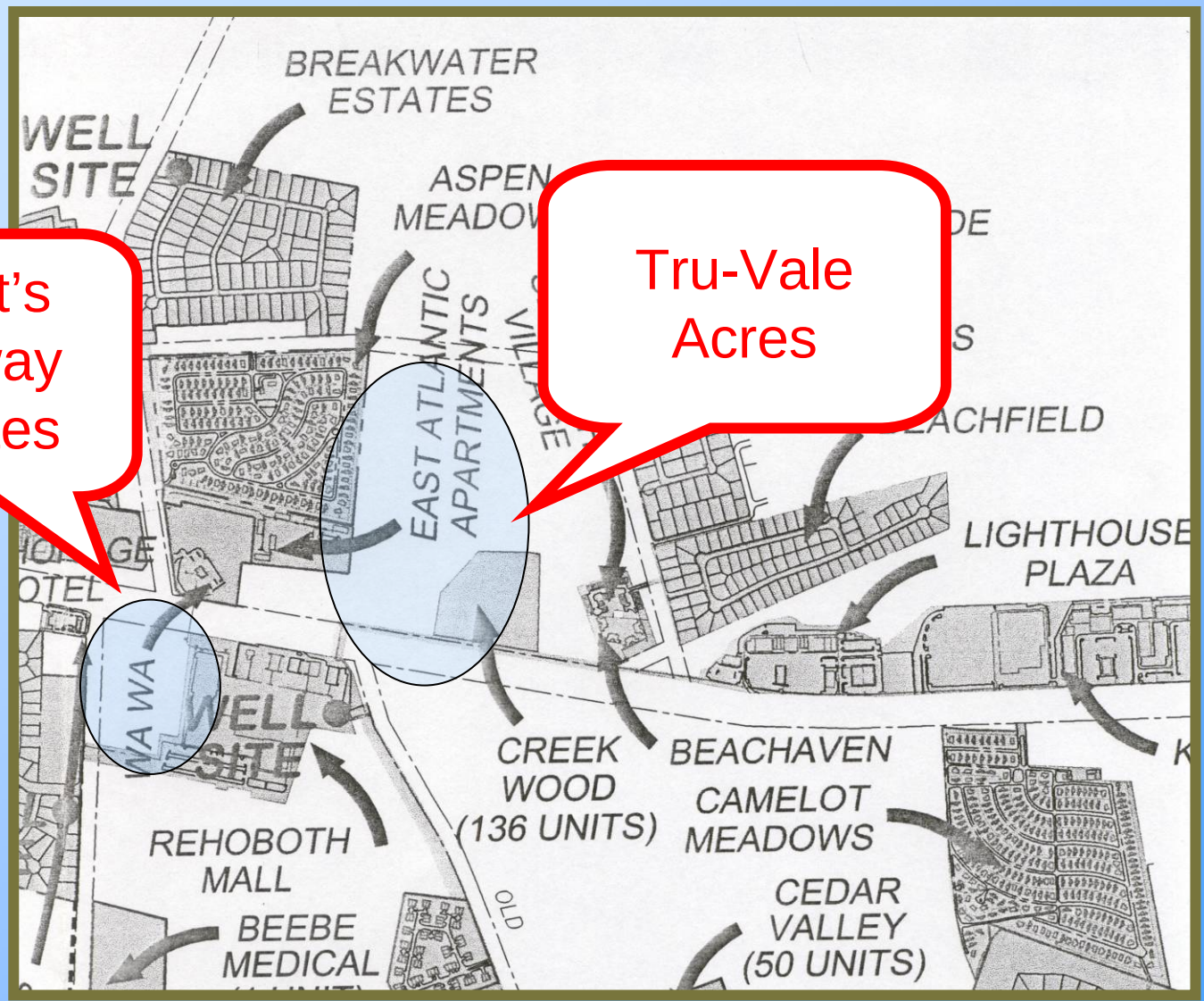


Truitt's Midway Development Domestic Wells



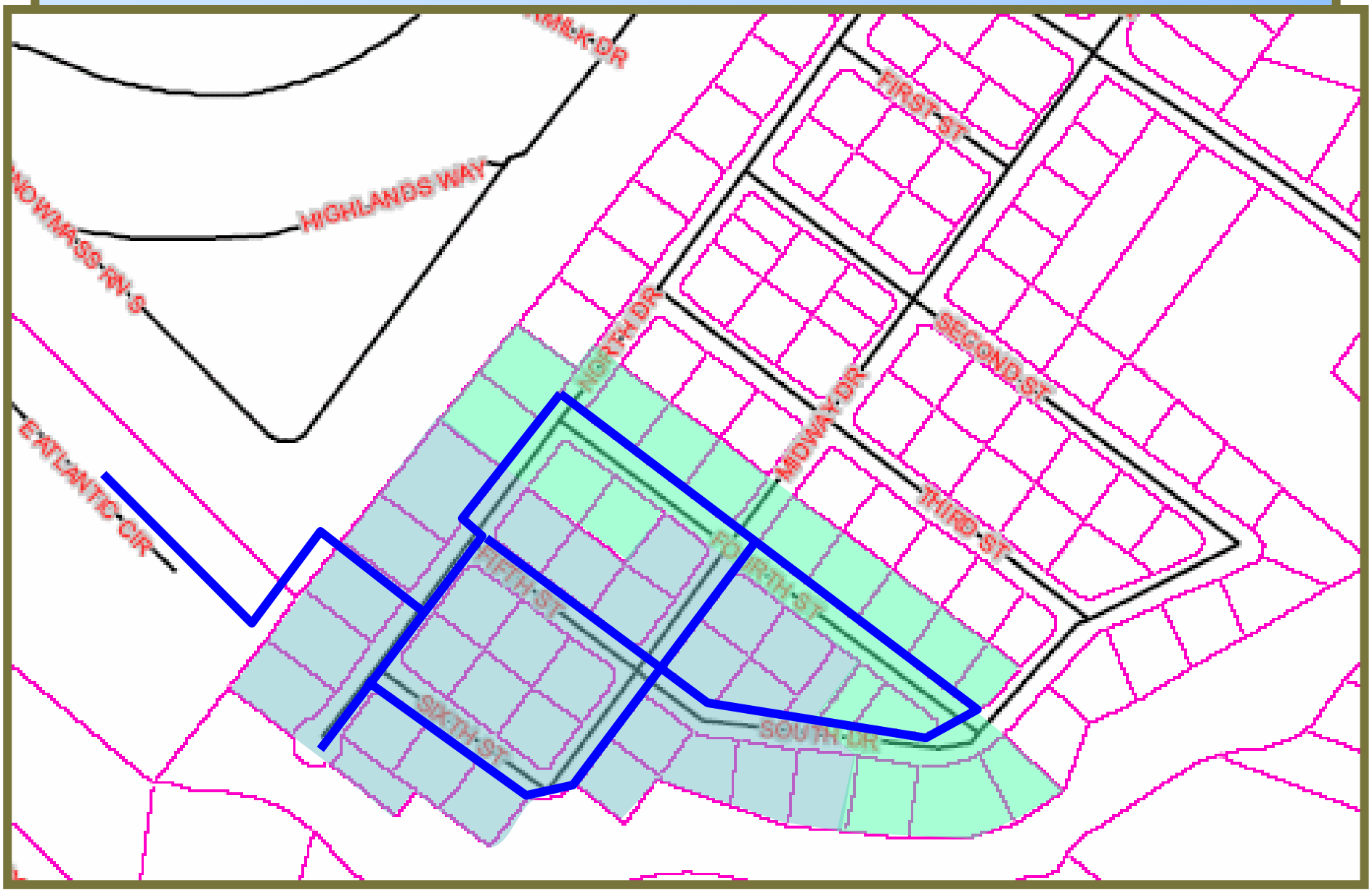


Service Area – Tidewater Utilities



Wellhead Protection Areas

Extension of Water Main



Site 1 – Costs to Date

- Costs for investigation - $300,000-400,000
- Costs for carbon filters and domestic well sampling - $250,000
- Costs for installation and operation of AS/SVE system onsite
- Cost for extension of water line - $650,000
- Costs for offsite remedial activities

FIVE GALLONS OF HIGH TEST
DELAWARE WELL WATER