



SOUTH CAROLINA  
PROSPECTIVE:


TREATMENT TRAINS FOR  
ENHANCED REMEDIATION  
EFFECTIVENESS

# SOUTH CAROLINA UST

- RBCA Program
- Free-product <0.01 feet
- No allowances for deed restrictions/restrictive covenant
- Conditional Closure of releases



# HISTORY OF REMEDIATION

- Pay-for-Performance
    - Site-Specific Target Levels Established
    - Environmental Contractor selected remedial strategy
    - Payment based on achieving reduction milestones
  - AS/SVE, Pump & Treat
  - Bioremediation (microbial or nutrient injections)
  - Often “stuck” in specific technology.
  - Sometimes used multiple technologies but not effective in long-term
- 



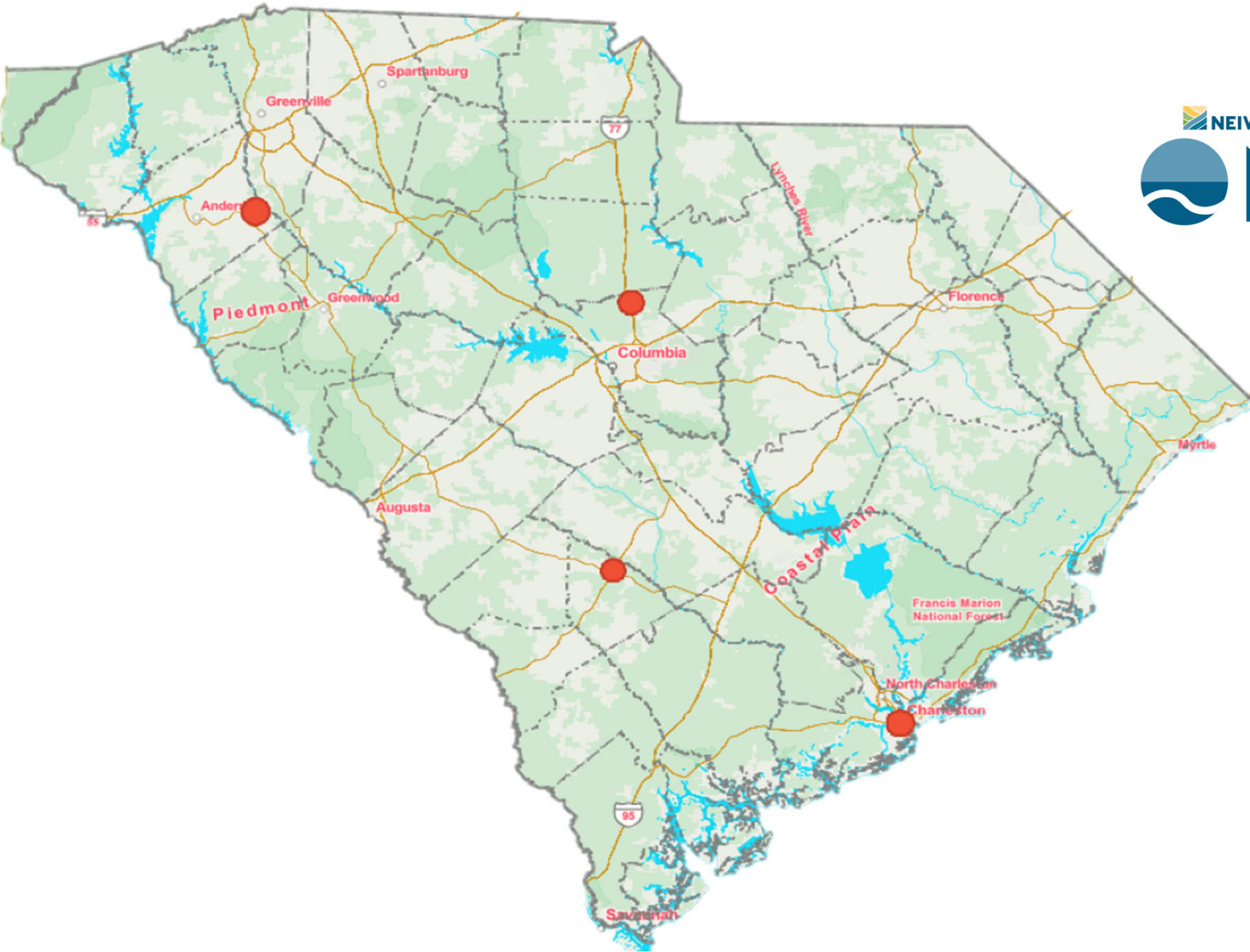
## **“RECENT CHANGES”**

Implementation of long duration Aggressive Fluid Vapor Recovery/Multi-Media Phase Extraction

Implementation of Targeted Remedial Efforts (e.g. Soil Excavation)







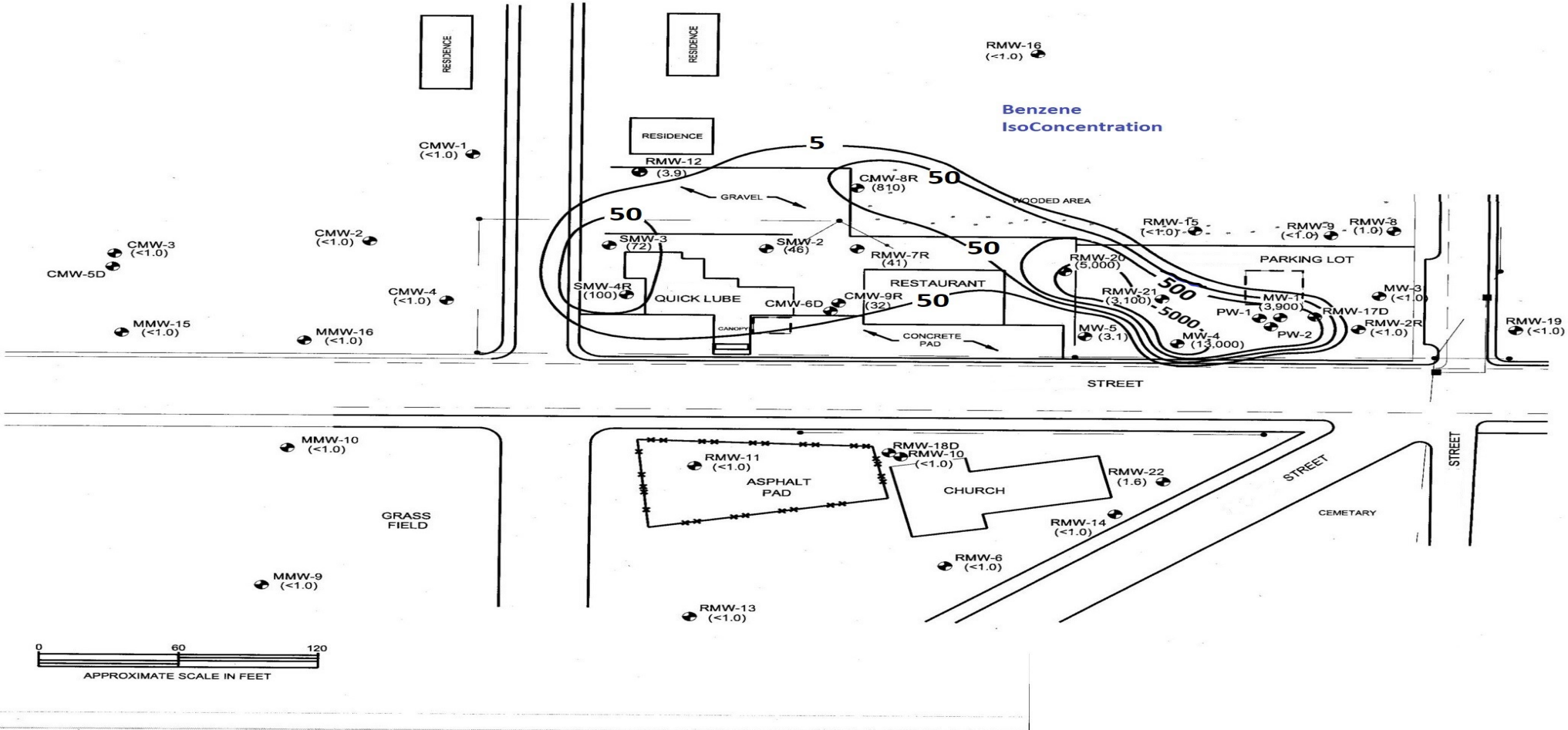
NEIWPCC EPA ASTSWMO pennsylvania  
DEPARTMENT OF ENVIRONMENTAL PROTECTION

# NTC 2022

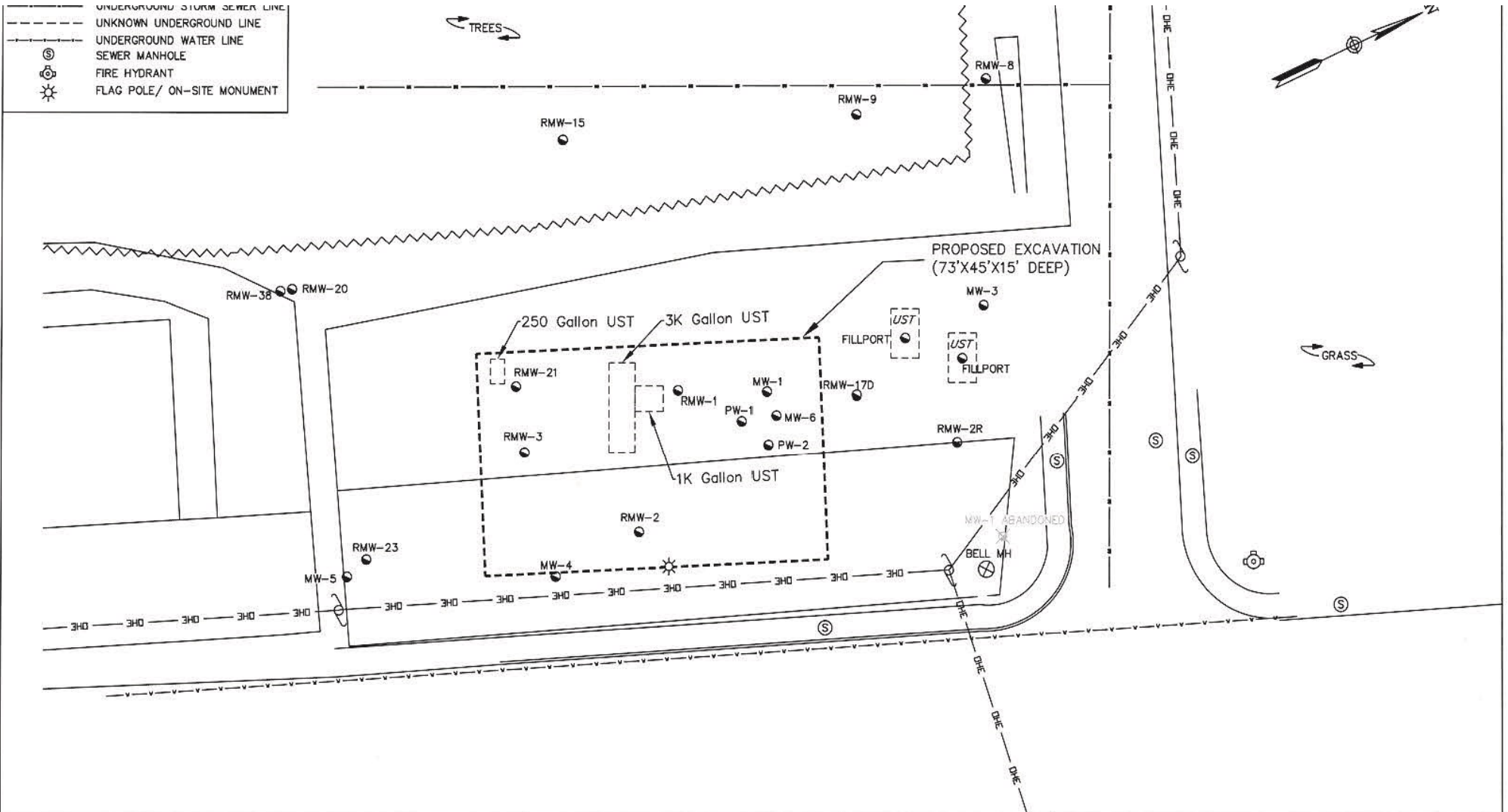


# Site #1 – Bamberg County

Source: Google.com



- UNDERGROUND STORM SEWER LINE
- - - UNKNOWN UNDERGROUND LINE
- - - UNDERGROUND WATER LINE
- ⊙ SEWER MANHOLE
- ⊙ FIRE HYDRANT
- ☀ FLAG POLE/ ON-SITE MONUMENT



0 10 20 40  
 ( IN FEET )  
 1 inch = 20 ft

PRE SOIL EXCAVATION SITE MAP  
 Rockland Industries  
 UST Permit No. 15475  
 Date: 05/08/19 Drawn by: DTH Figure: 2



## South End Excavation



## Excavation toward North End





Orphan 3,000 gallon tank



3,000 gallon & 1,000 gallon tank





## Removing USTs for transport



## Crushed stone placement





## Placement of ORC



## Crushed Stone mixed with ORC














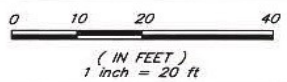
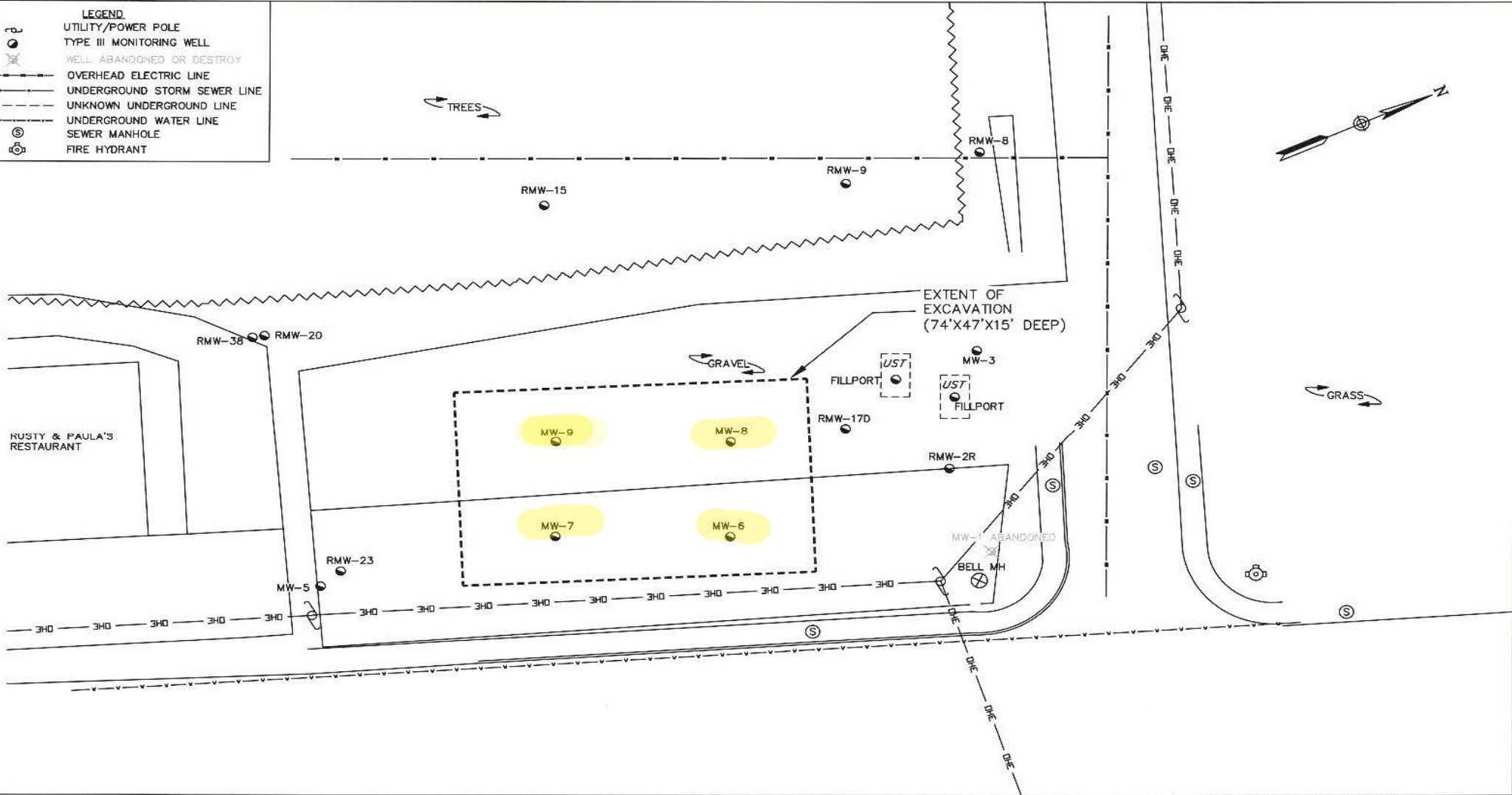
## Backfill & Compaction



## Leveled Surface before Asphalt



- LEGEND**
-  UTILITY/POWER POLE
  -  TYPE III MONITORING WELL
  -  WELL - ABANDONED OR DESTROY
  -  OVERHEAD ELECTRIC LINE
  -  UNDERGROUND STORM SEWER LINE
  -  UNKNOWN UNDERGROUND LINE
  -  UNDERGROUND WATER LINE
  -  SEWER MANHOLE
  -  FIRE HYDRANT



POST SOIL EXCAVATION SITE MAP

# COSTS



1993-2006: Assessment: \$70,451.03



2007-2014: AFVR Events & Sampling:  
\$79,195.94



2018-2021: Soil Excavation, Post  
Monitoring, & Closure: \$524,612.50



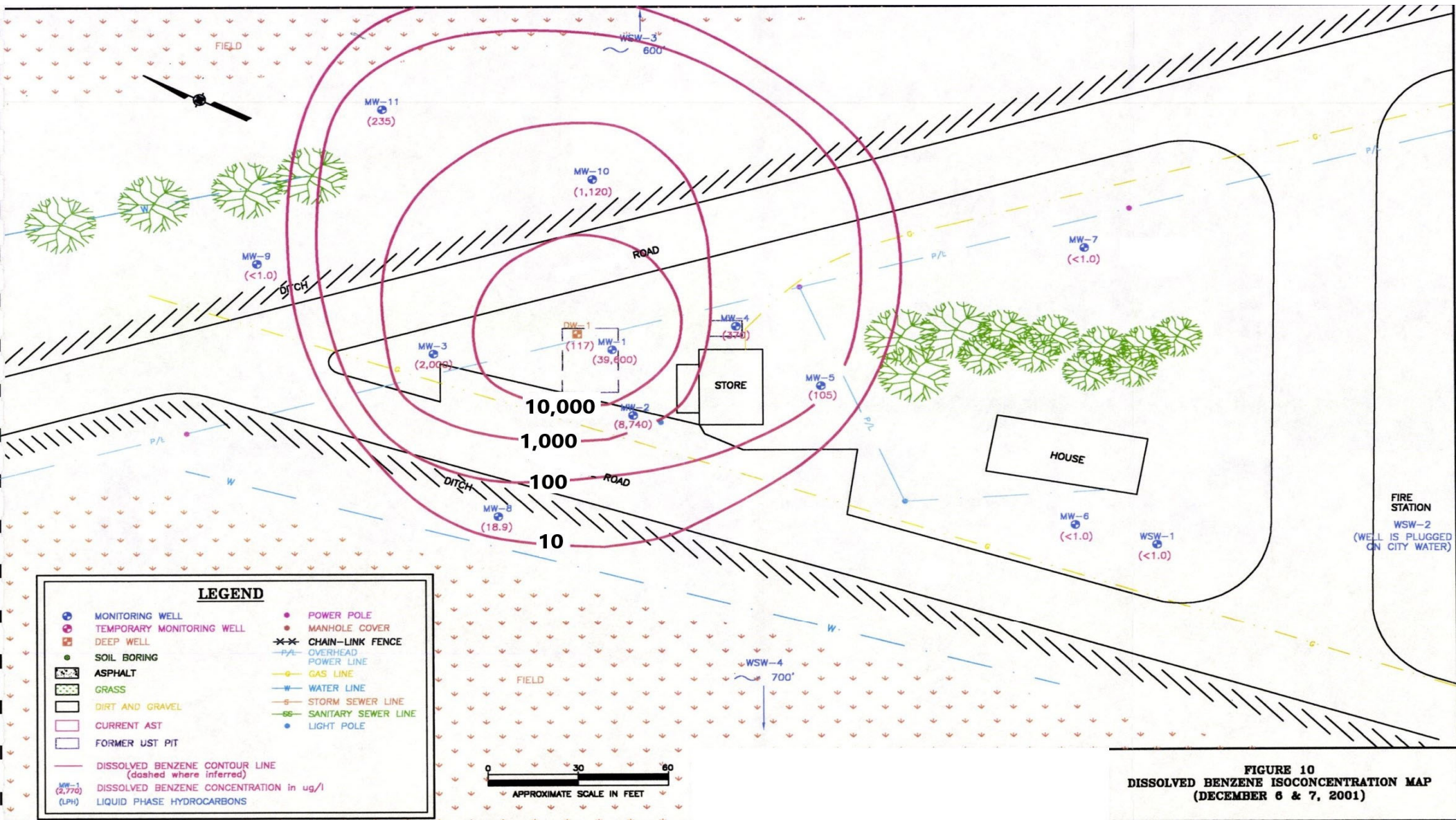
Total Cost: \$674,259.47



## Site #2 – Anderson County



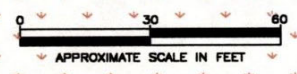




FIRE STATION  
WSW-2  
(WELL IS PLUGGED ON CITY WATER)

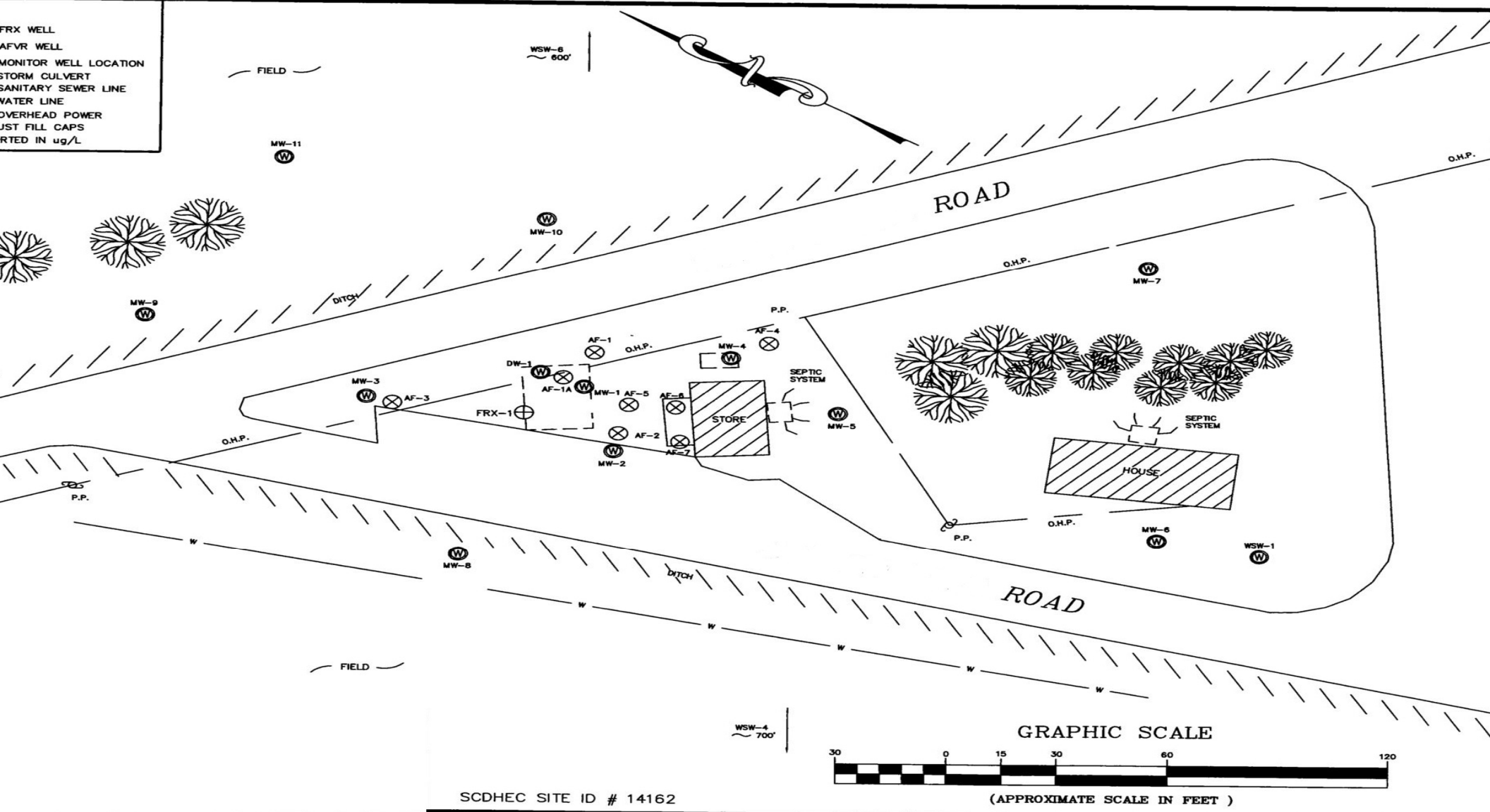
**LEGEND**

- MONITORING WELL
- TEMPORARY MONITORING WELL
- DEEP WELL
- SOIL BORING
- ASPHALT
- GRASS
- DIRT AND GRAVEL
- CURRENT AST
- FORMER UST PIT
- DISSOLVED BENZENE CONTOUR LINE (dashed where inferred)
- DISSOLVED BENZENE CONCENTRATION IN ug/l (LPH)
- POWER POLE
- MANHOLE COVER
- X-X- CHAIN-LINK FENCE
- P/- OVERHEAD POWER LINE
- G- GAS LINE
- W- WATER LINE
- S- STORM SEWER LINE
- SS- SANITARY SEWER LINE
- LIGHT POLE



**FIGURE 10**  
DISSOLVED BENZENE ISOCONCENTRATION MAP  
(DECEMBER 6 & 7, 2001)

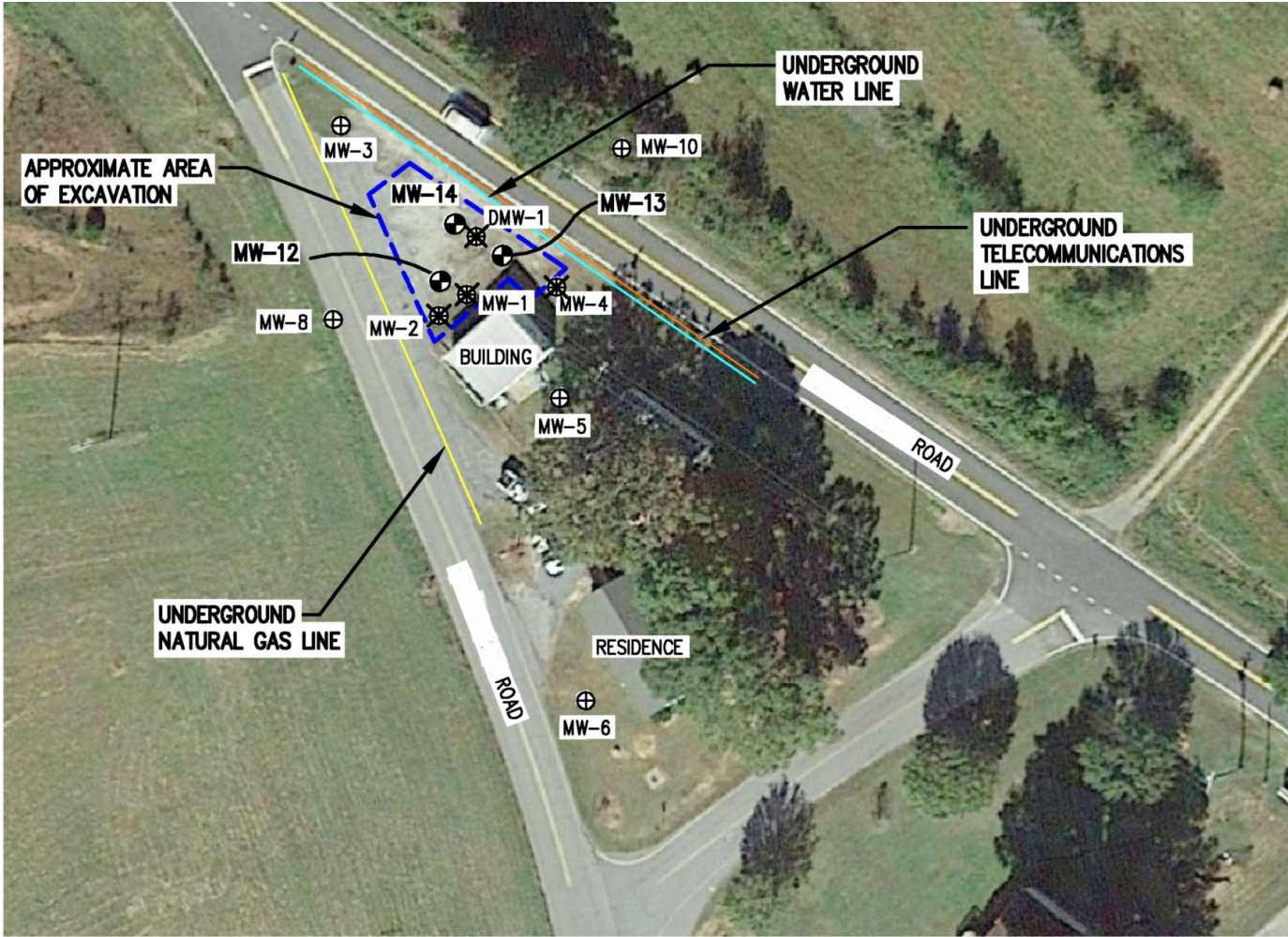
FRX WELL  
 AFVR WELL  
 MONITOR WELL LOCATION  
 STORM CULVERT  
 SANITARY SEWER LINE  
 WATER LINE  
 OVERHEAD POWER  
 JUST FILL CAPS  
 REPORTED IN ug/L



SCDHEC SITE ID # 14162

GRAPHIC SCALE  
 (APPROXIMATE SCALE IN FEET )





**LEGEND**

- ⊕ EXISTING GROUNDWATER MONITORING WELL
- ⊕/ ABANDONED OR DESTROYED EXISTING GROUNDWATER



# Excavation Area



Trench dug to install hydraulic abutment beams for sheet pilings



Excavation completed to 20 feet



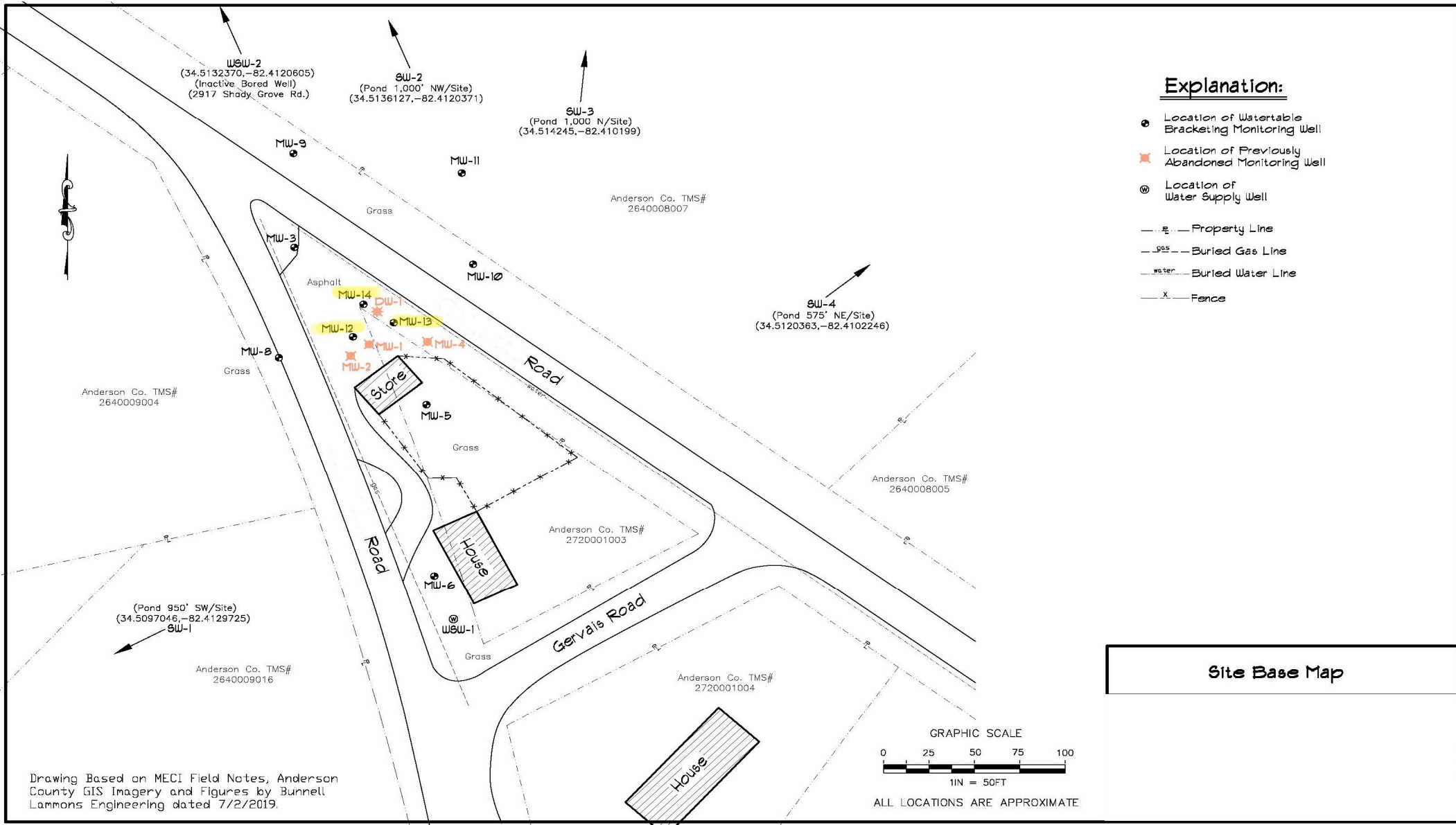


Provect-Oxs compound being distributed



Completion of backfill and compaction





**Site Base Map**

Drawing Based on MECI Field Notes, Anderson County GIS Imagery and Figures by Bunnell Lammons Engineering dated 7/2/2019.

# COSTS



1987-2001: Assessment: \$22,170.14



2002-2008: Corrective Action & Verification Monitoring: \$83,443.64



2009-2018: Long Duration AFVR Events & Sampling: \$26,725.46



2018-2022: Soil Excavation, Post Monitoring, & Closure: \$335,868.10



Total Cost: \$468,207.34

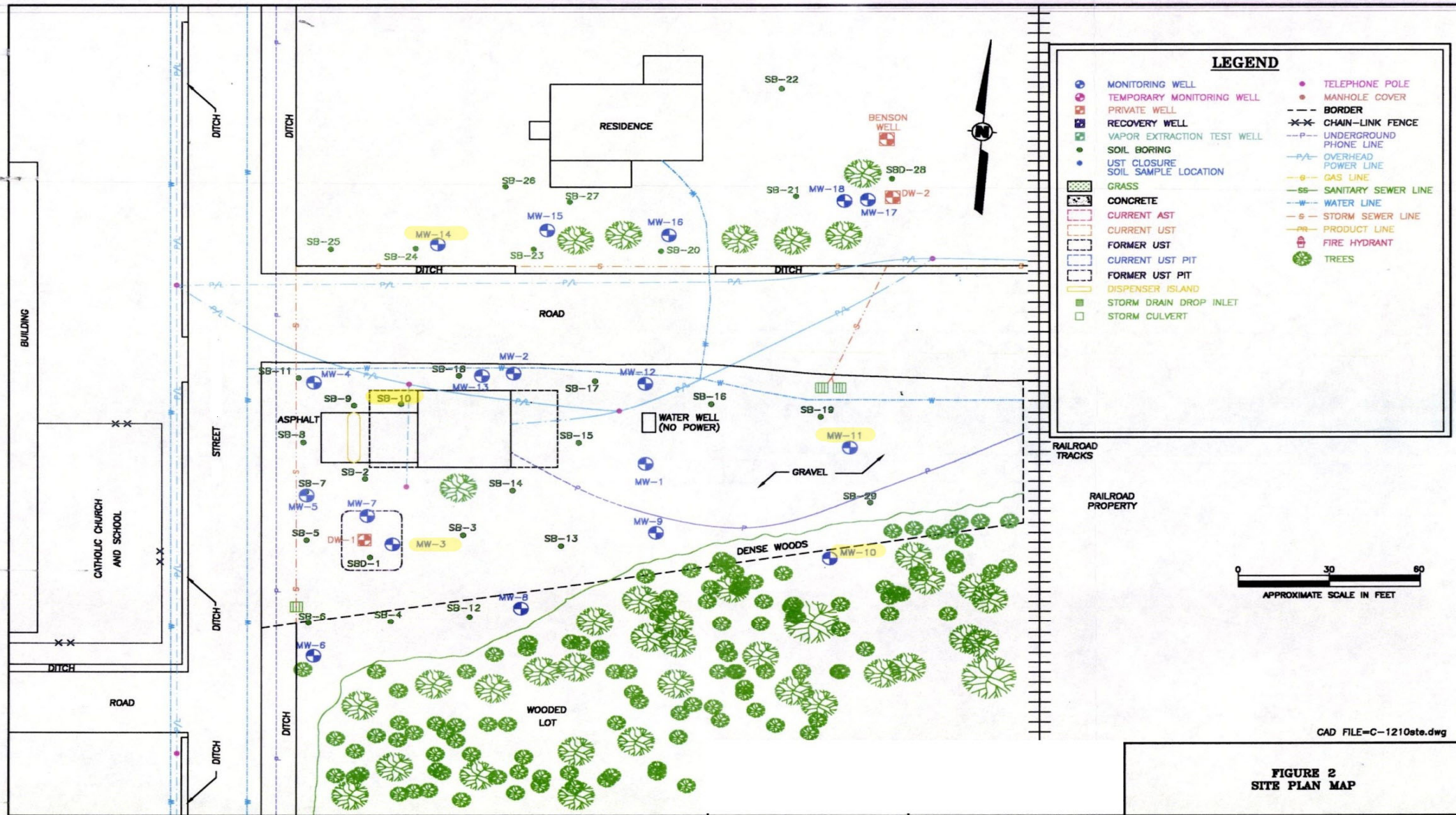







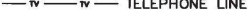


## Site #3 – Richland County

Source: Google.com

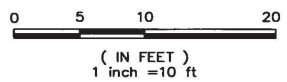
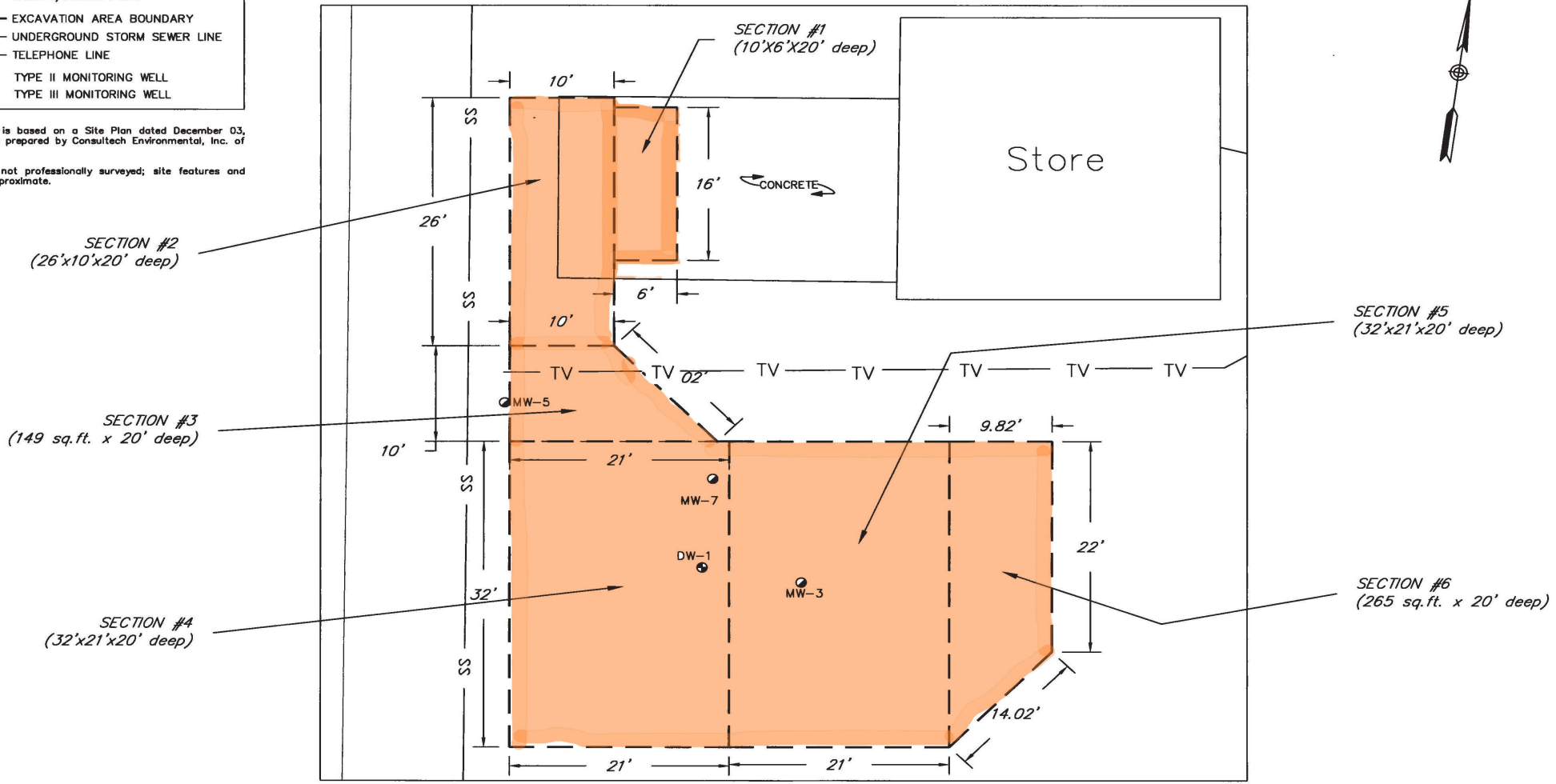




**LEGEND**

-  UTILITY/POWER POLE
-  EXCAVATION AREA BOUNDARY
-  UNDERGROUND STORM SEWER LINE
-  TELEPHONE LINE
-  TYPE II MONITORING WELL
-  TYPE III MONITORING WELL

**Note:**  
 1. This Site Map is based on a Site Plan dated December 03, 2002 that was prepared by Consultech Environmental, Inc. of Cary, NC.  
 2. This site was not professionally surveyed; site features and utilities are approximate.





## Excavation Activities



## Abandoned Tanks





## Mixing Gravel with ORC & Carbon



## Mixing Gravel with ORC & Carbon



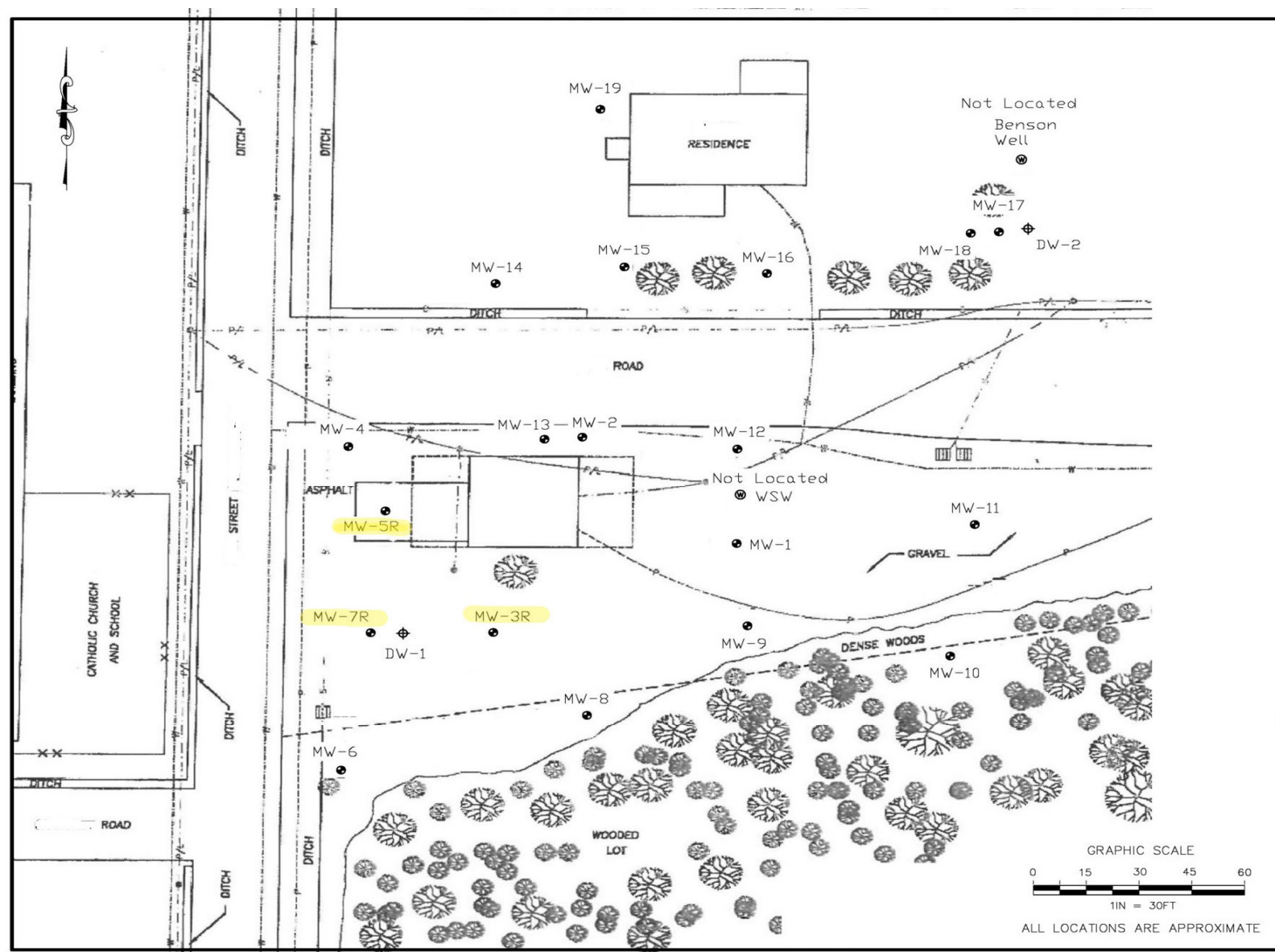


## Site Compaction



## Completed Site View



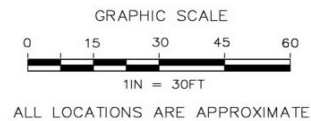


**Explanation:**

- Location of Watertable Bracketing Monitoring Well
- ⊕ Location of Double Cased "Deep" Monitoring Well
- ⊗ Location of Water Supply Well

Drawing Based on MECI Field Notes and Figures by Consultech Engineering, dated 12/3/2002.

**Site Base Map**



# COSTS



2002-2004: Assessment: \$29,313.64



2004-2018: Corrective Action & Verification Sampling: \$97,200.05



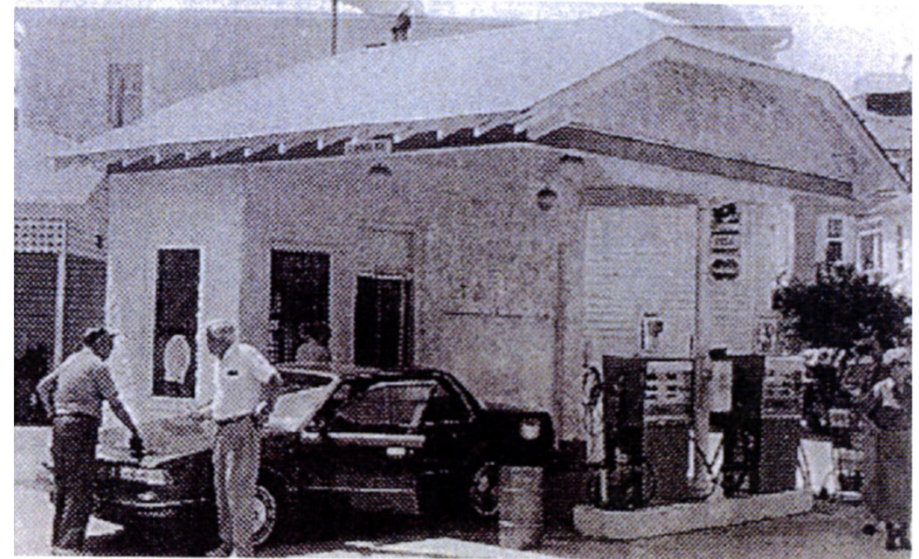
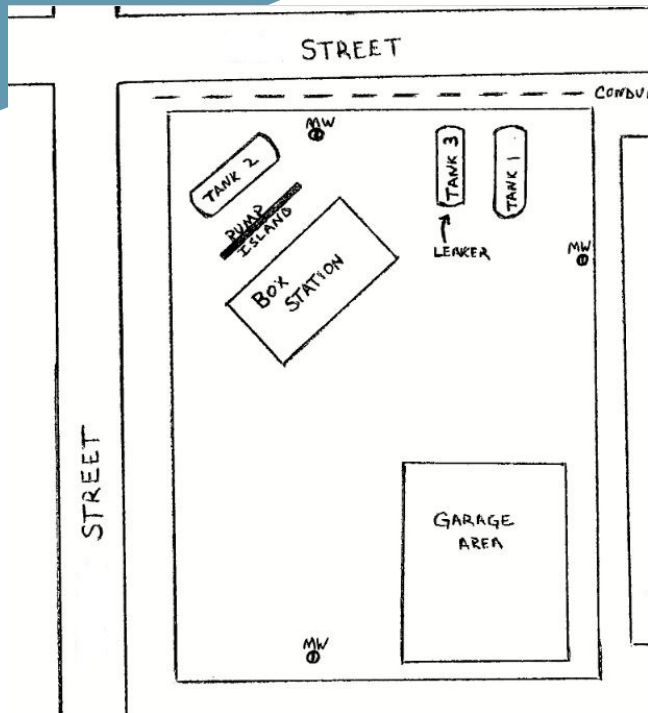
2019-2022: Soil Excavation, Post Monitoring, & Closure: \$325,910.17



Total Cost: \$452,423.86



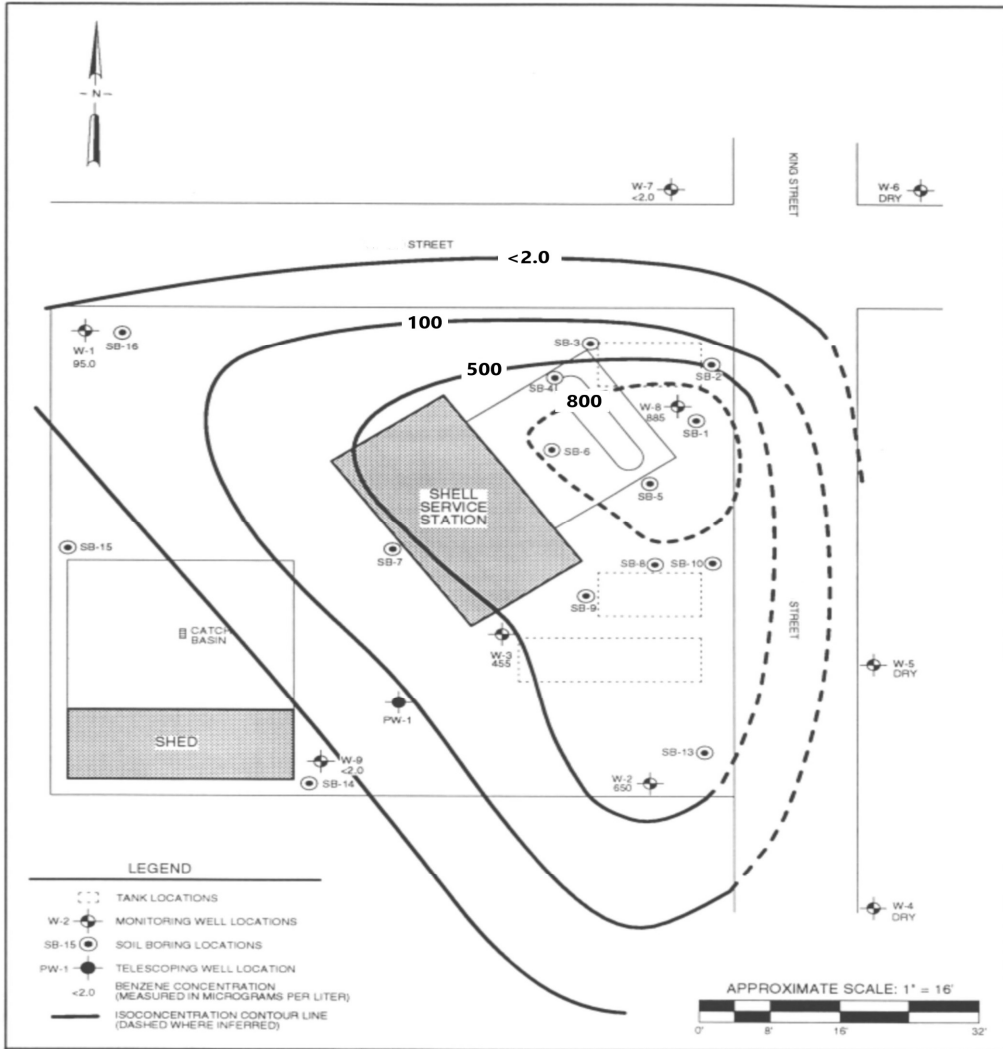
# SITE #4 – CHARLESTON COUNTY





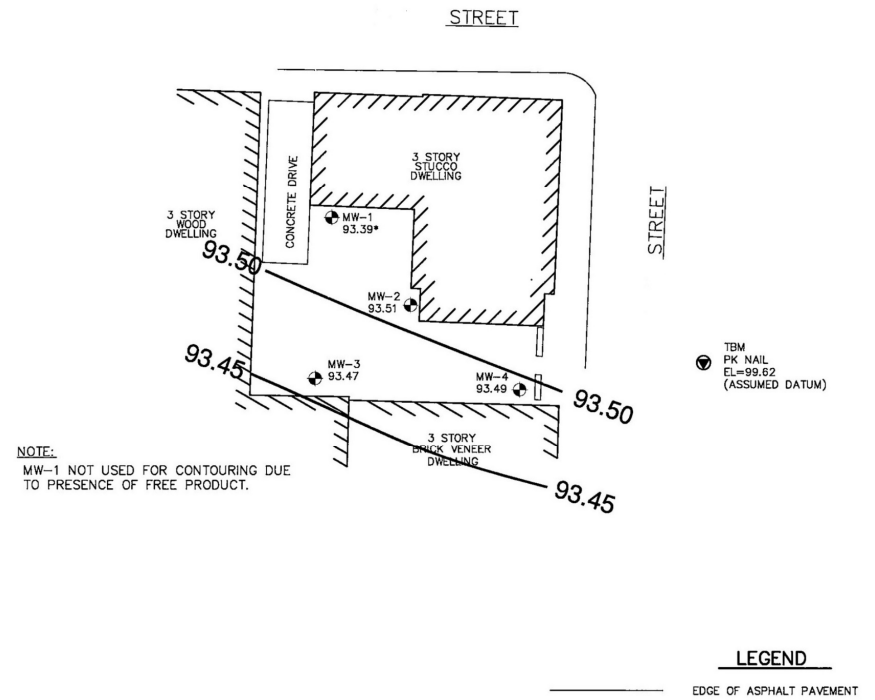
Source: Google.com





**WELL ELEVATION SCHEDULE**

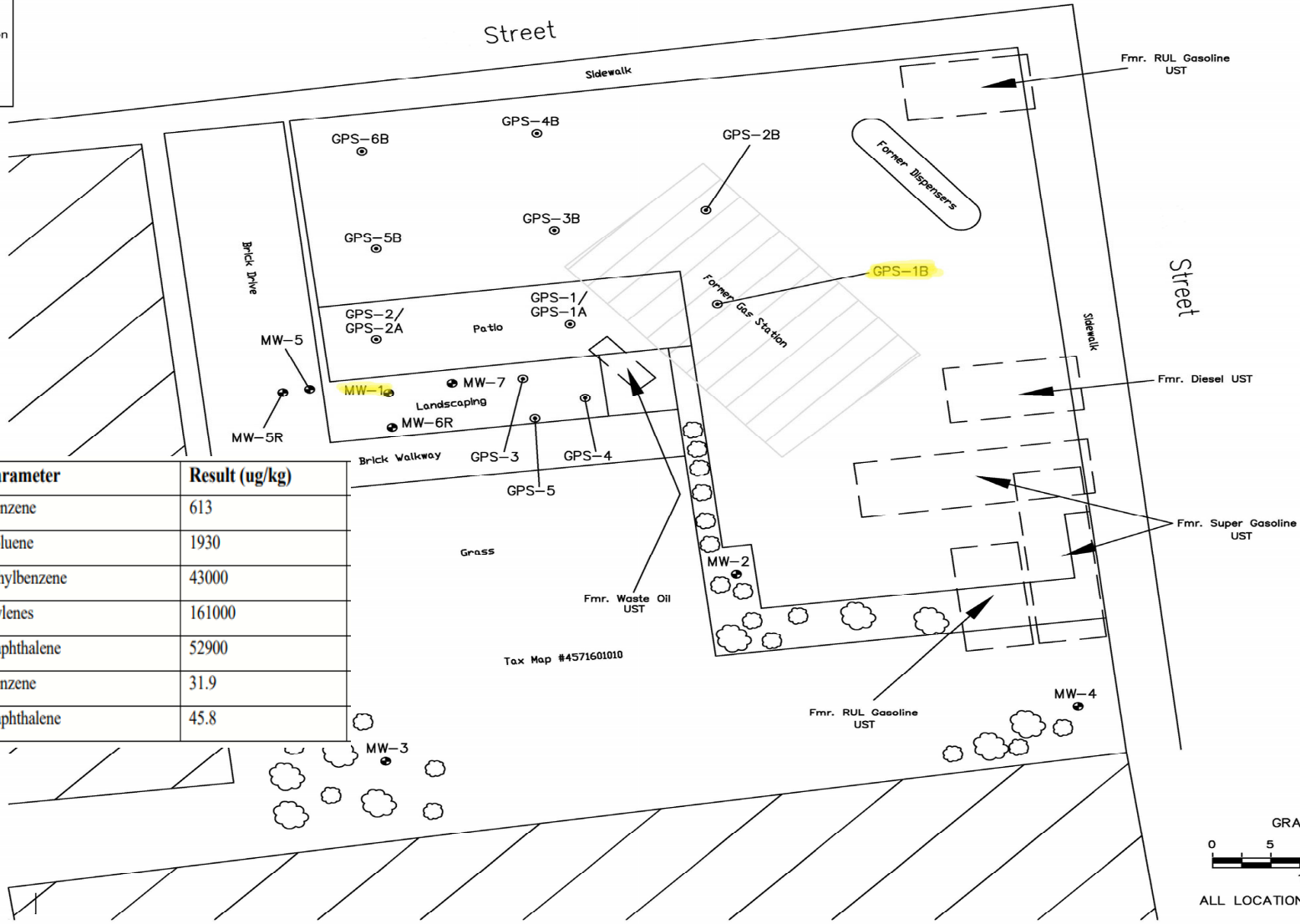
WELL ID	TOP OF CASING	GROUND SURFACE	CONCRETE PAD
MW-1	100.27	100.06	100.64
MW-2	99.79	99.92	100.22
MW-3	99.44	99.82	99.96
MW-4	99.30	99.44	99.73



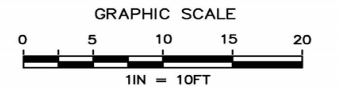
**LEGEND**

- Monitoring Well Location
- 2020 Soil Sampling Location

**Notes:**  
Well locations are approximate.  
Base Map is taken from Oct 2020 report by Midlands.

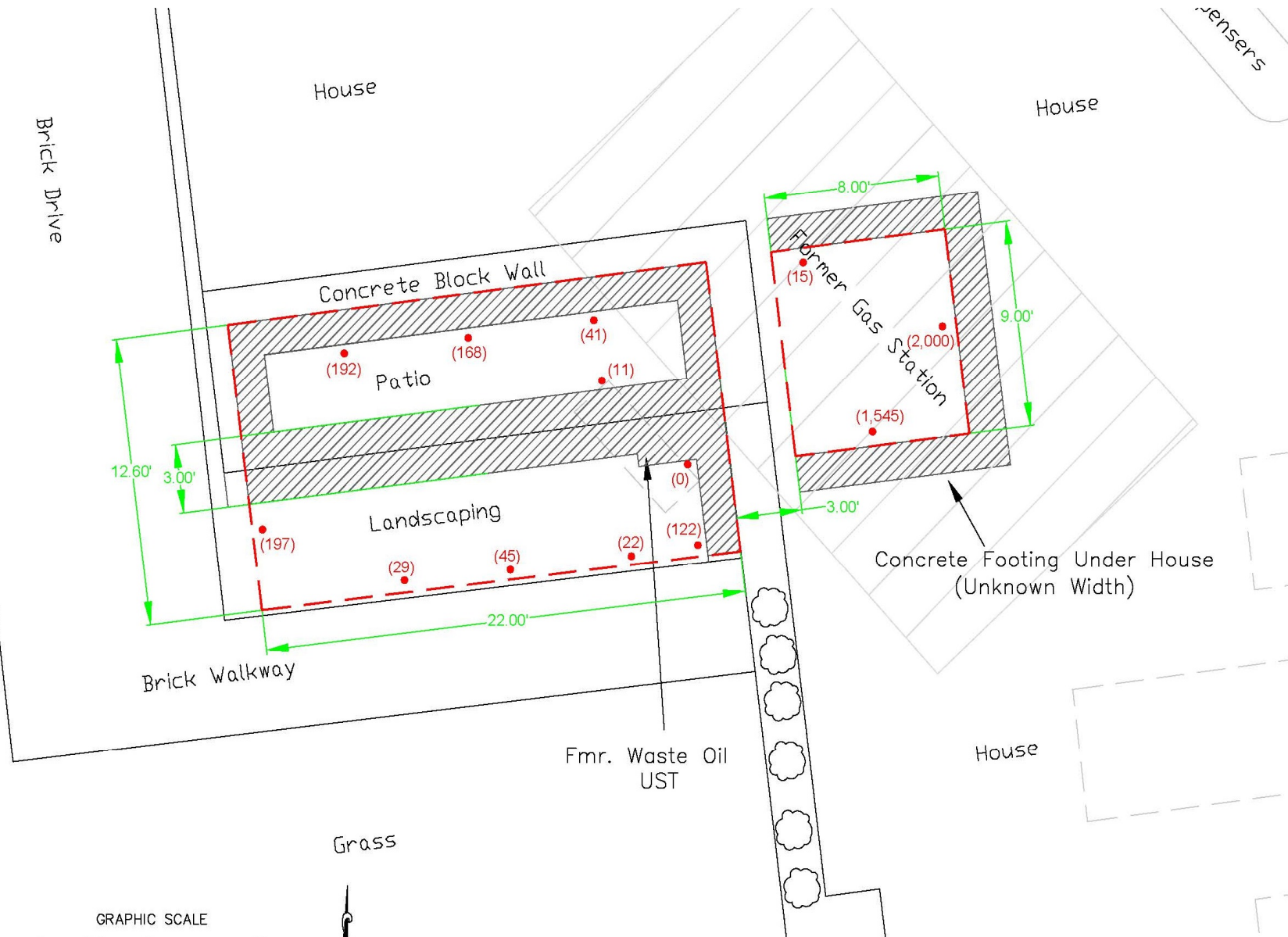


Soil Boring	Parameter	Result (ug/kg)
GPS-1B (6'-8')	Benzene	613
GPS-1B (6'-8')	Toluene	1930
GPS-1B (6'-8')	Ethylbenzene	43000
GPS-1B (6'-8')	Xylenes	161000
GPS-1B (6'-8')	Naphthalene	52900
GPS-2B (8'-10')	Benzene	31.9
GPS-2B (8'-10')	Naphthalene	45.8



ALL LOCATIONS ARE APPROXIMATE

Notes:  
Locations are approximate.  
Dimensions are in feet.  
Base Map is taken from Oct 2020  
report by Midlands.







Helical anchors were installed below the concrete footings to support the residence foundation.



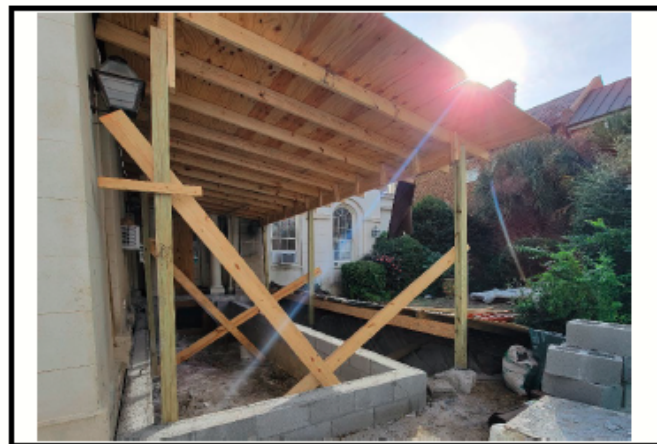
An access point to the crawlspace was installed beneath the rear entrance of the residence.



Sodium persulfate mixed with gravel was added to the excavation.



Excavation was backfilled with subsoil type S-1 (structural fill). Compaction of the backfill material occurred in approximate one-foot lifts using a vibrating compactor. Old cinderblock patio support is visible.



A temporary rain cover was installed during reconstruction of the cinderblock wall/patio supports.



# COSTS



1992-2004: Assessment: \$47,492.42



2004-2019: AFVR Events & Sampling:  
\$200,554.48




2020-2022: Soil Excavation,  
Monitoring, & Closure: \$642,370



Total Cost: \$890,377.90



# CONCLUSIONS

- Average time to closure: 28.5 years
  - Average Cost: \$621,317.14
  - When technology reaches its effective limit, transition to another technology is necessary.
  - Excavation is an effective source removal and long-term treatment solution.
  - Utilized when other remedial methods no longer effective.
- 



**DEBRA THOMA  
UST MANAGEMENT DIVISION  
SC DEPARTMENT OF HEALTH &  
ENVIRONMENTAL CONTROL**

**P: 803-898-0643**

**Email: [thomadl@dhec.sc.gov](mailto:thomadl@dhec.sc.gov)**