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Horizontal Remediation Wells

Remedial Construction and Design Services

Horizontal Wells: Avoiding Obstructions and Minimizing Disruptions

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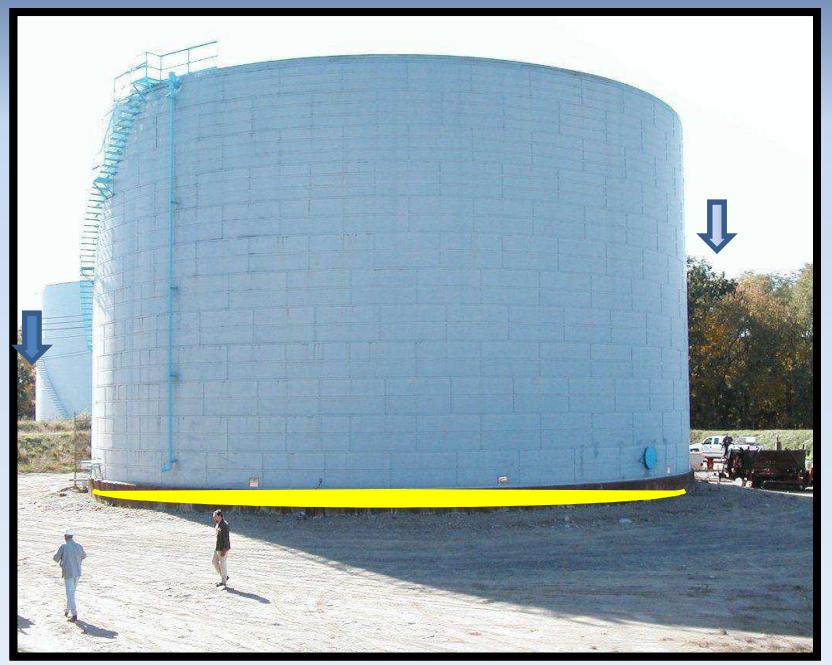
Presentation Outline

- Introduction
  - Applications of Horizontal Remediation Wells (HRWs)
  - Why Use HRWs
- Case Studies
  - Gas Station (NY)
  - Pipeline Terminal (FL)
  - Soil Sampling (FL)



How accurate is directional drilling? Extremely!

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Why Use Horizontal Remediation Wells

- Access
- Larger Areas
- Better for in situ because of contact with the well screen
- Business activities can continue during remedial construction
- Rapid Site Closure
- HRW makes any vertical technology more efficient

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Applications for Horizontal Remediation Wells

- Soil Sampling
- Air Sparge and SVE
- Bio Sparge
- Vapor Mitigation/SVE
- Injection
- Electrical Resistivity Heating
- And any other vertical technology

Installing first ever horizontal remediation wells (HRWs) in South Korea

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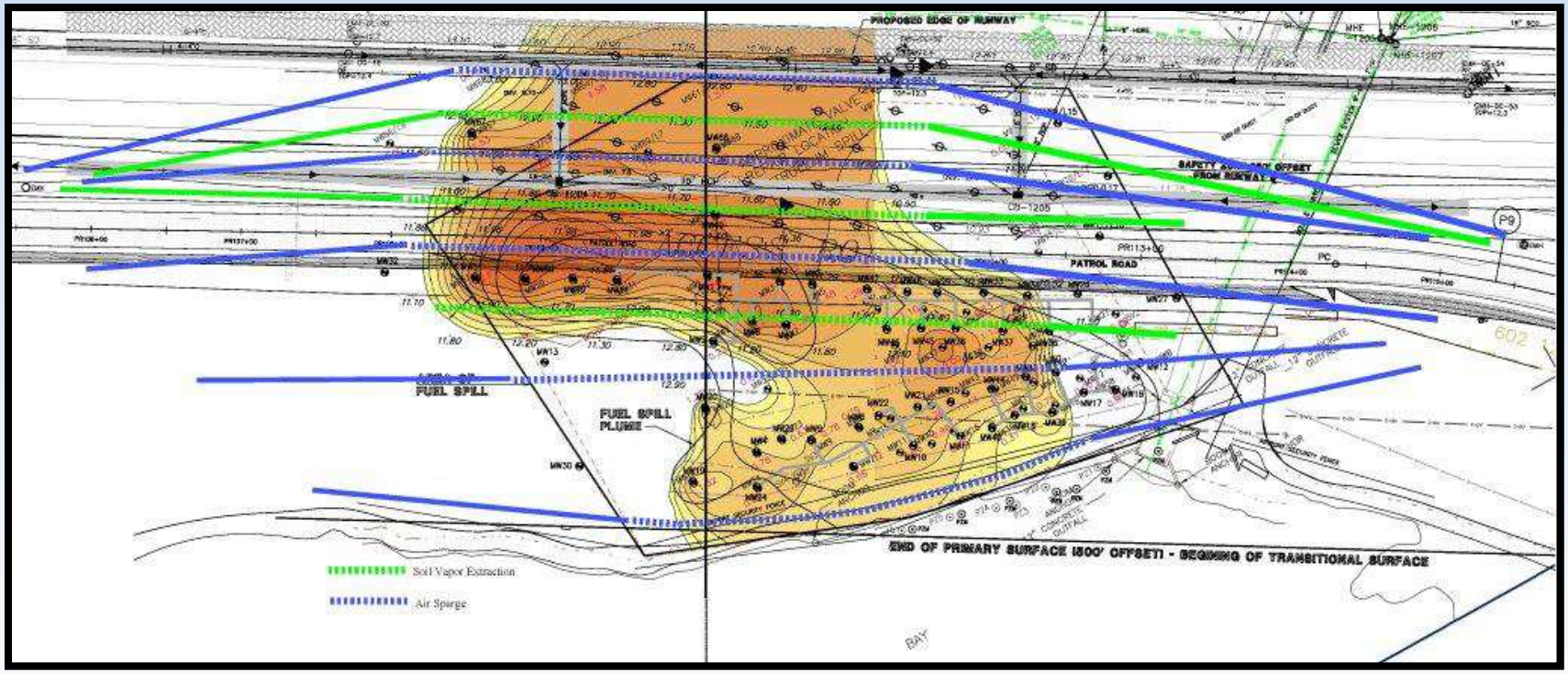
Air Sparge and SVE

- 3.5 Acres (>14,000 m^2) site remediated using 8 HRWs
- Access restricted areas



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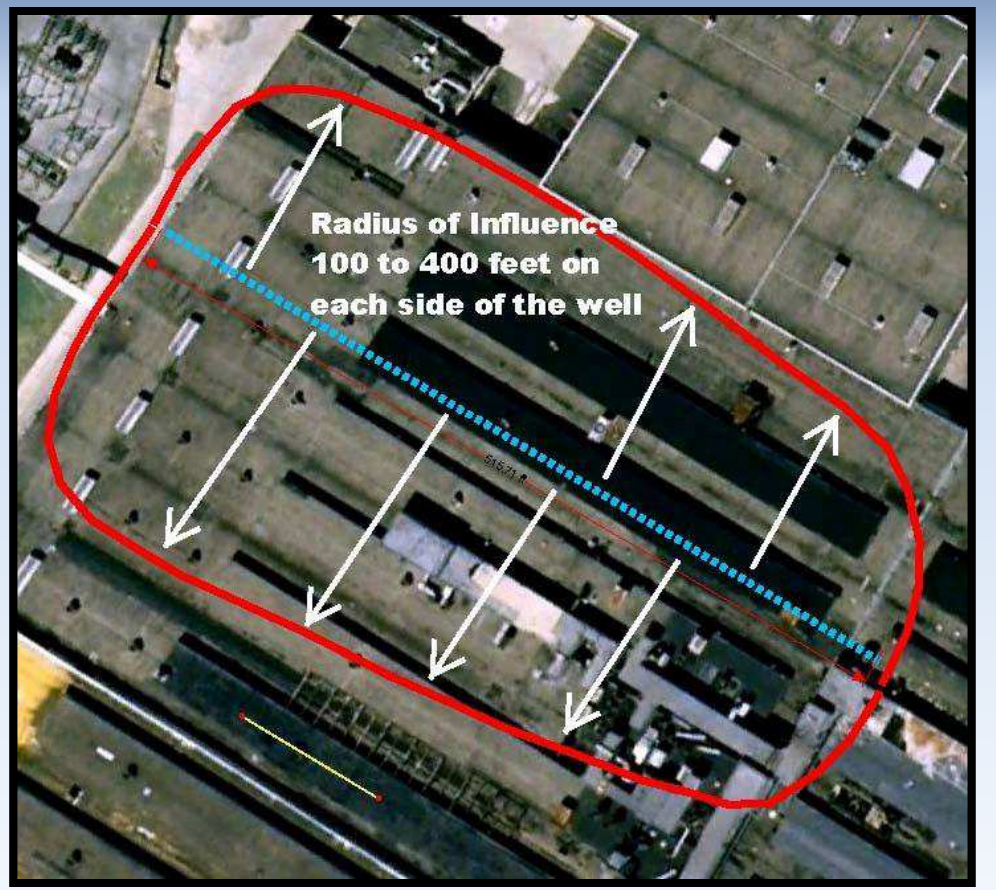
Vapor Mitigation and SVE

- Creates large zones of influence
- Achieve both clean up and indoor air quality control via one system
- Wells can be used for future means of injection for final clean up



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Bio Sparge

In situ Remediation

versus

Excavation and Pump and Treat

and…

other costly remediation technologies

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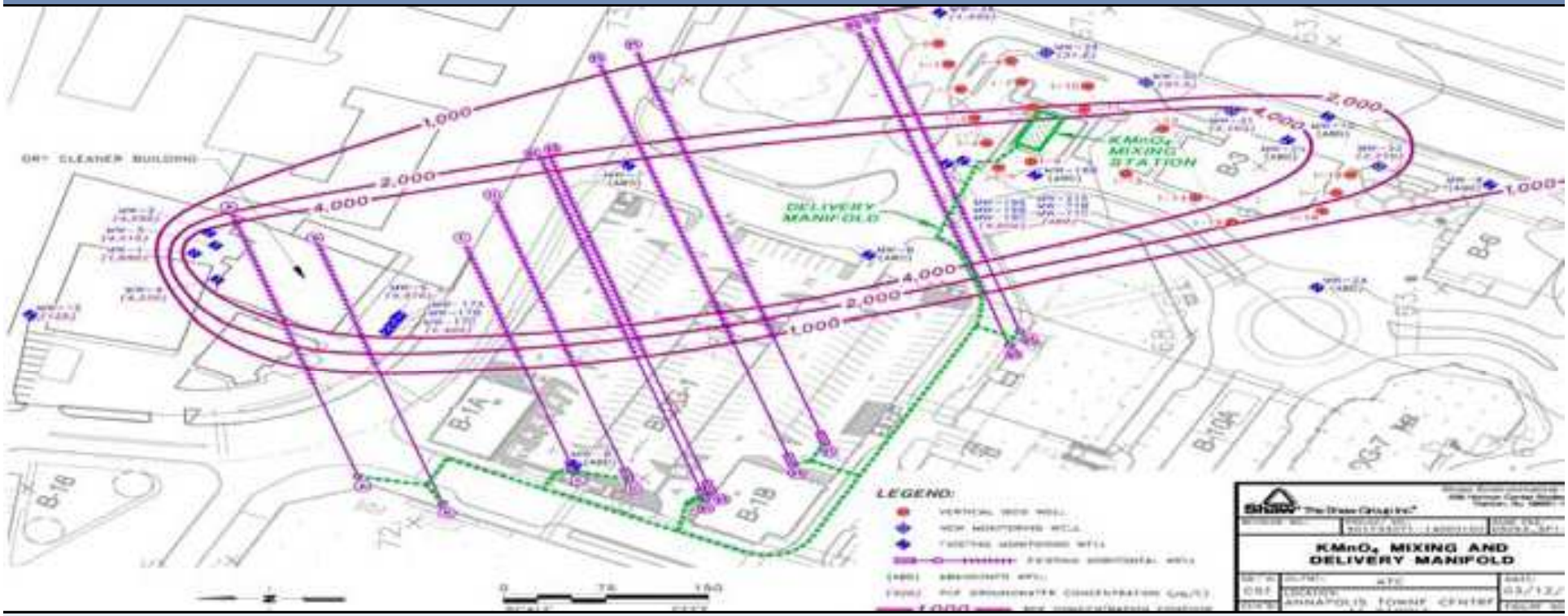
Injection



- Large area covered by a single Horizontal Remediation Well
- Able to deliver large volumes of product
- Cover various depths along one alignment

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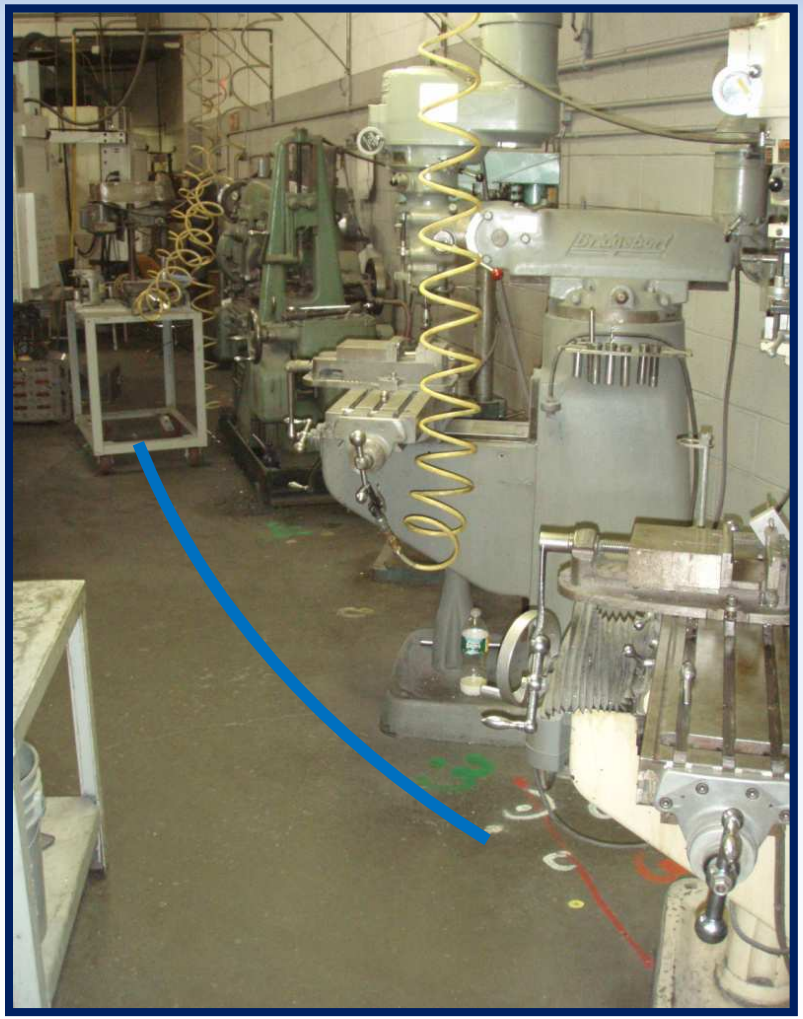
Electrical Resistivity Heating

- Place electrode into inaccessible sites
- Brings soil to required temperature in shorter period of time
- Project demonstrated versatility of HRWs



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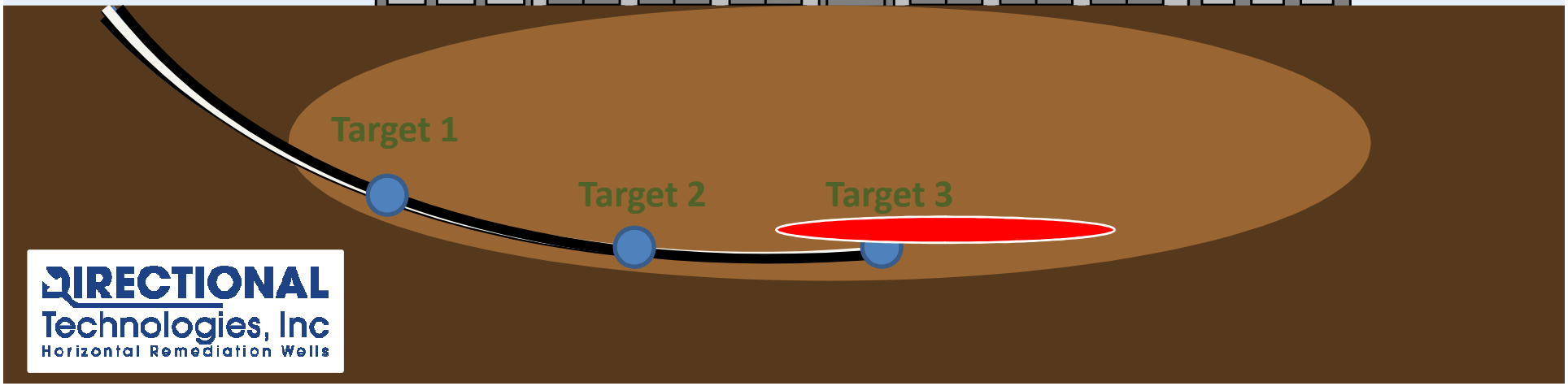
Horizontal Soil Sampling



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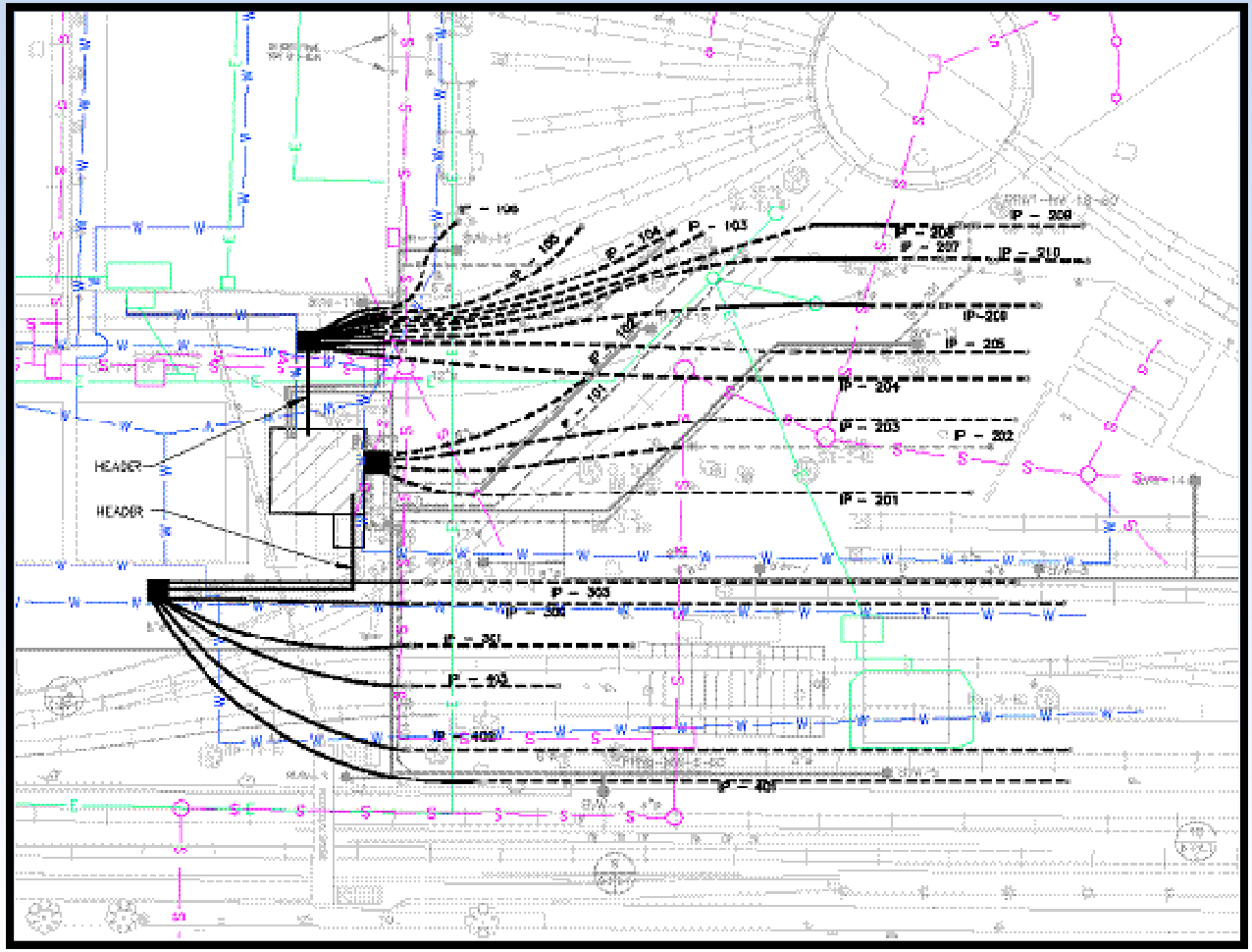
And any other Vertical Technology

- HRWs provide solutions for many projects that were previously not feasible



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Why Use Horizontal Remediation Wells

- Limited or No Access
- Larger Areas to Remediate
- Better for *in situ* due to contact with well screen
- Business activities can continue during remedial construction
- Rapid Site Closure
- HRWs increase efficiency when comparing to vertical technology or vertical application

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Access

- Under buildings and other surface obstructions, highways, parks, wetlands….
- Inside buildings

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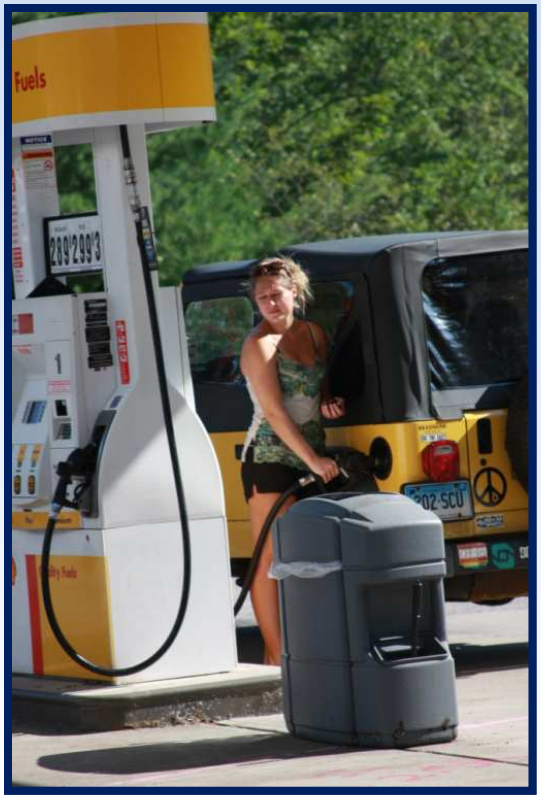
Normal Business Activities Continue During Remedial Construction

- Directional drilling equipment is set up out of way… and discreetly installs engineered wells… from a distance



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Rapid Site Closure

- HRW achieve rapid site closure due to ability of well screen to have maximum contact

Monitoring Well ID	Designation	Baseline BTEX (µg/l) Nov 2008	Year 2, 1st Qtrly BTEX (µg/l) July 2010	% Reduction from Baseline
MW-16	Down gradient	2,114	0.99	99.99
MW-20R2	Source area	11,720	107	99.08
MW-22	Source area	11,000	0.32	99.99
MW-28	Source area	583	BDL	99.99
Totals		**25,417**	**108.31**	**99.57**
Monitoring Well ID	**Designation**	**Baseline MTBE (µg/l) Nov 2008**	**Year 2, 1st Qtrly MTBE (µg/l) July 2010**	**% Reduction from Baseline**
MW-16	Down gradient	37	4.2	92.7
MW-20R2	Source area	590	87	76.27
MW-22	Source area	260	13	81.53
MW-28	Source area	140	2	98.71
Totals		**1,027**	**106.2**	**89.65**

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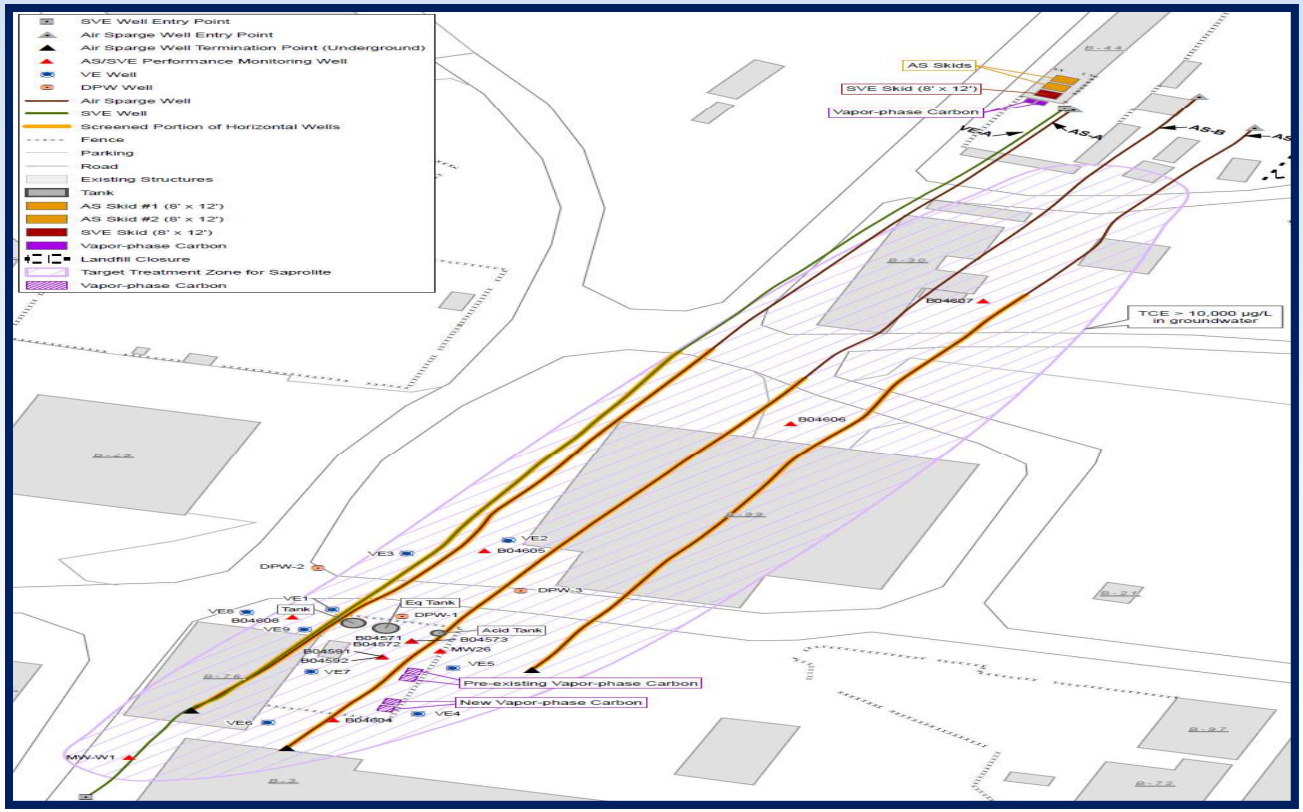
Large Areas

- Radius of Influence (ROI) greater in a HRW than a traditional vertical well
- HRW have more well screen



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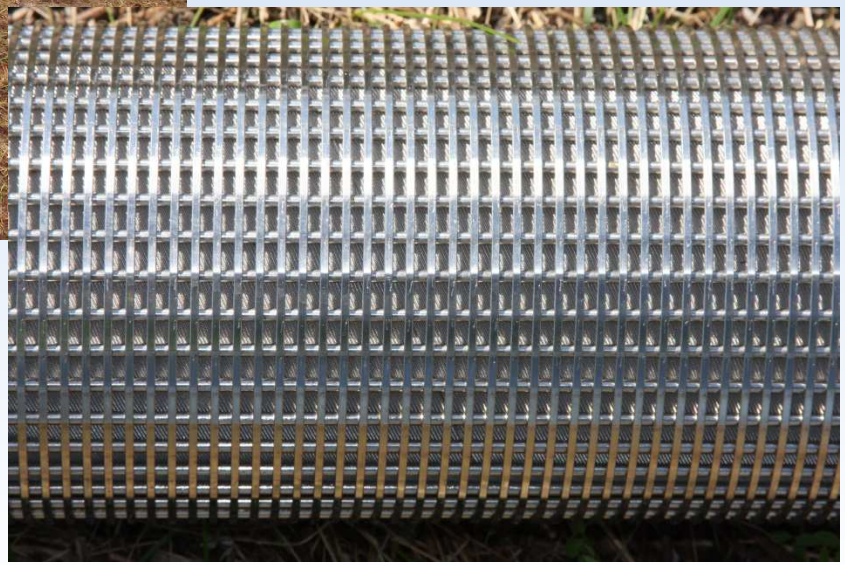
More Contact with Well Screen

Water being pumped through horizontal remediation well to demonstrate uniform flow through well screen



Example of stainless steel well screen

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Case Studies

- Operating Gas Station
  - Horizontal Air Sparge and Soil Vapor Extraction
- Active Bulk Petroleum Terminal
  - Horizontal Air Sparge Wells
- Former Power Plant
  - Horizontal Soil Sampling

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Operating Gas Station

-
- Impacts from underground storage tanks at a retail gas station.
- Plume not only under station, but also migrated across the street and under a restaurant.
- Vapor intrusion concerns for restaurant across the street.
- Remediation needed to both treat the petroleum impacts and to mitigate vapor intrusion.

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Operating Gas Station

- Horizontal BioSparge (HBS) and Soil Vapor Extraction (HSVE)
  - 2x HBS wells, 280-ft screen, 24-ft BGS
  - 1x HSVE well, 280-ft screen, 10-ft BGS
- Blind well installation of 3” PVC well materials
- Wells drilled from restaurant property
- Additional header piping and electrical conduit installed

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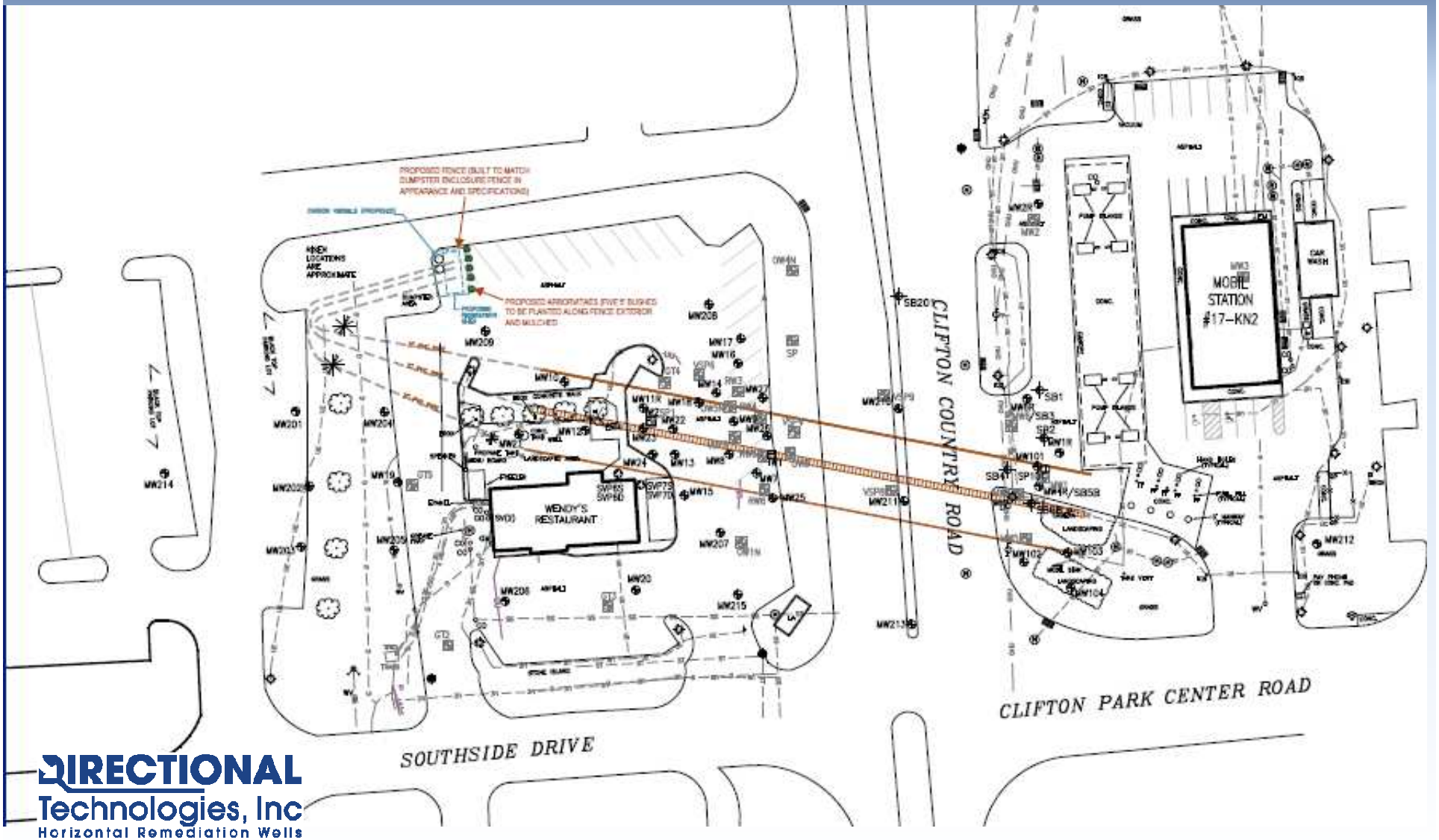
Operating Gas Station



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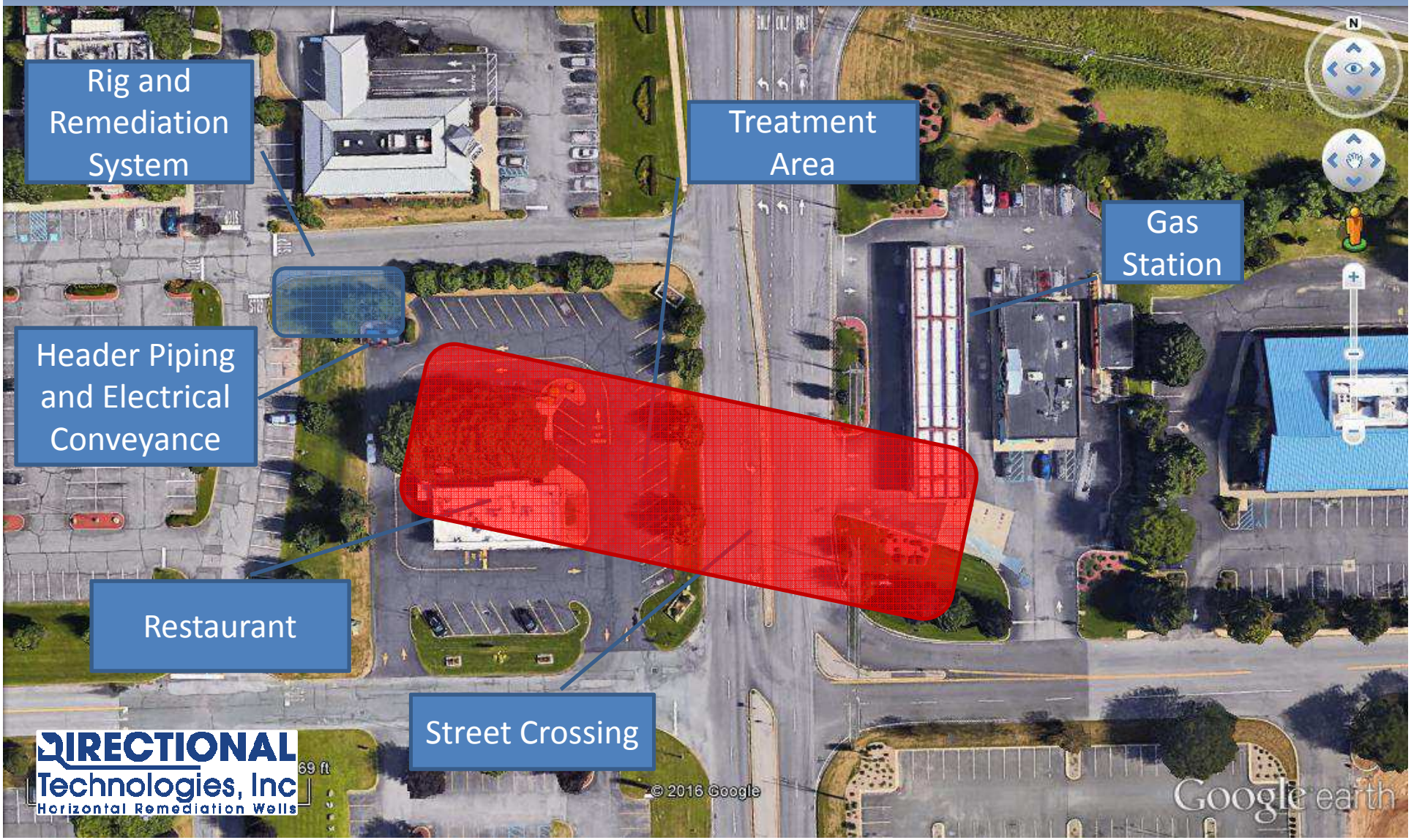
Operating Gas Station



Operating Gas Station

- Avoided disruption to operating businesses
  - No loss to client revenue
  - Worked in back corner of parking lot
- Avoided costly restoration by entry/exit in grass
- Avoided traffic by drilling under roads
- Active vapor mitigation to protect restaurant

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Active Bulk Petroleum Terminal

- Terminal Operates 24hrs, 7 days a week
- Petroleum impacts stretched on-site and off-site
- On-site impacts are below bulk fueling racks, roads, buildings/ offices, above ground storage tanks.
- Off-site impacts travel below busy roads (4 lanes of traffic), and operating gas station, and a building supply warehouse.

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Active Bulk Petroleum Terminal

- 21 Horizontal Air Sparge Wells
- All wells “blind” (no exit)
- Over 10,000 linear feet of boring/wells
- 3” diameter HDPE wells, with screens at 35 ft BGS
- Horizontal screen lengths varied between 400 – 840 ft
- Complimentary horizontal SVE system trenched on site

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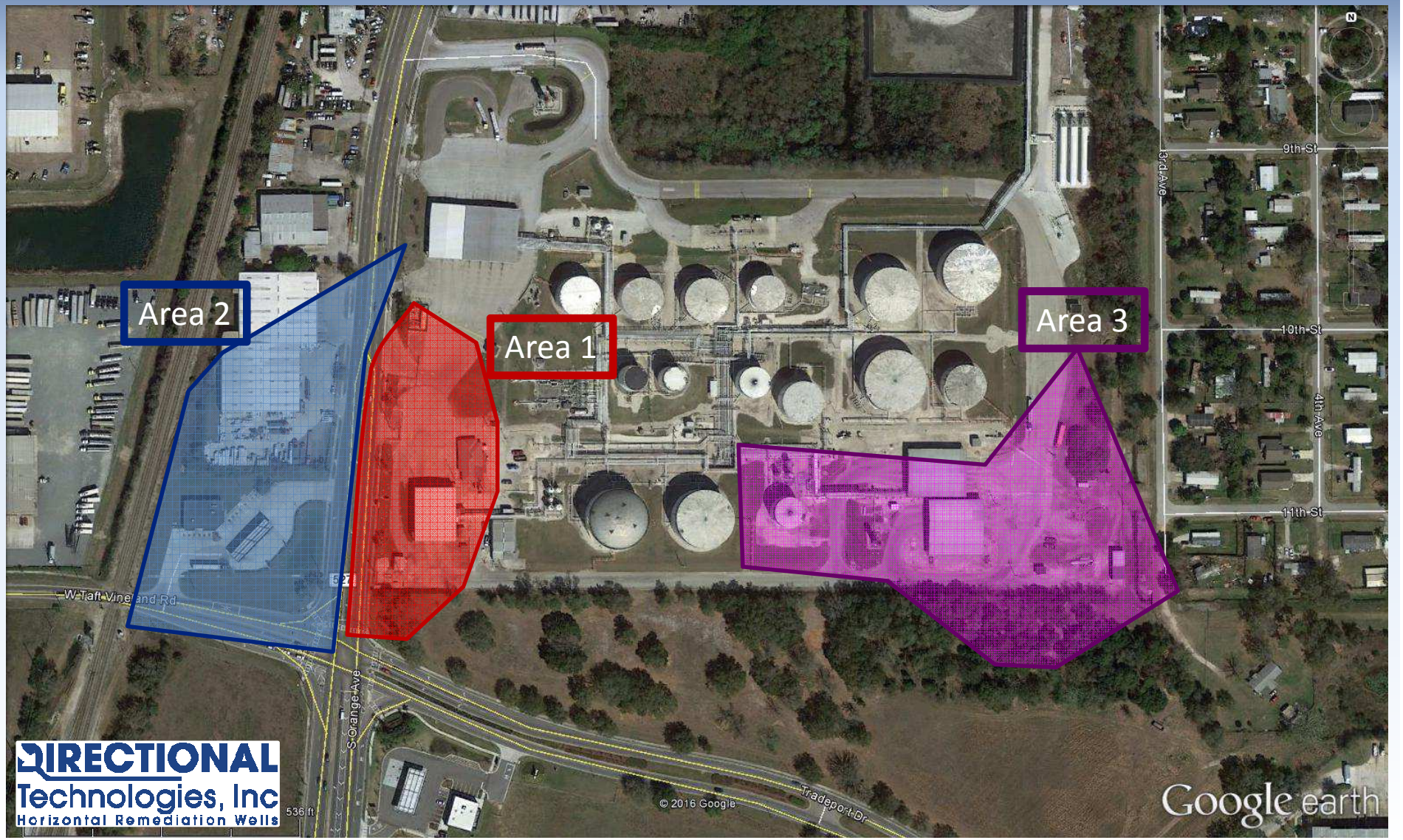
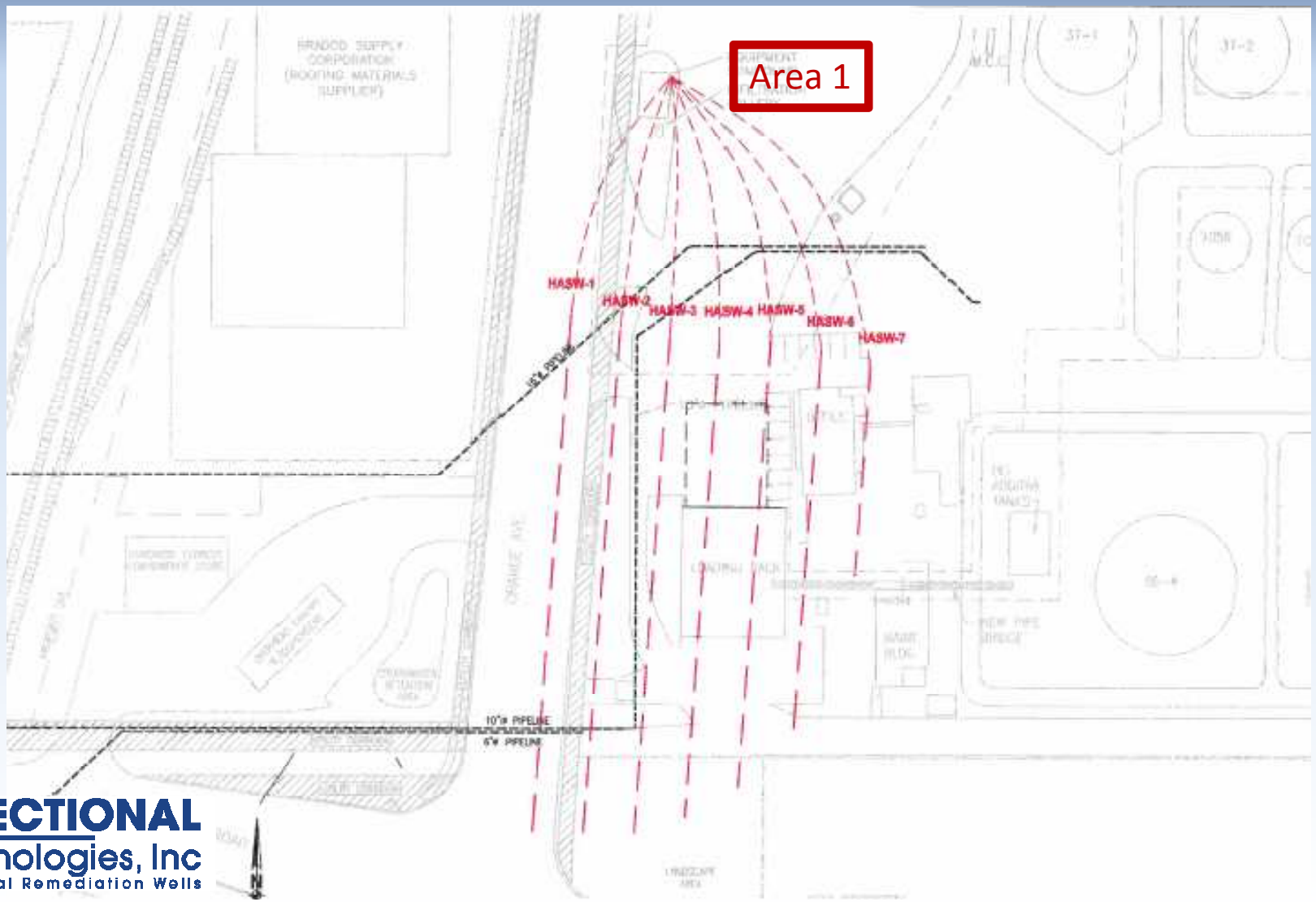
Active Bulk Petroleum Terminal



Active Bulk Petroleum Terminal



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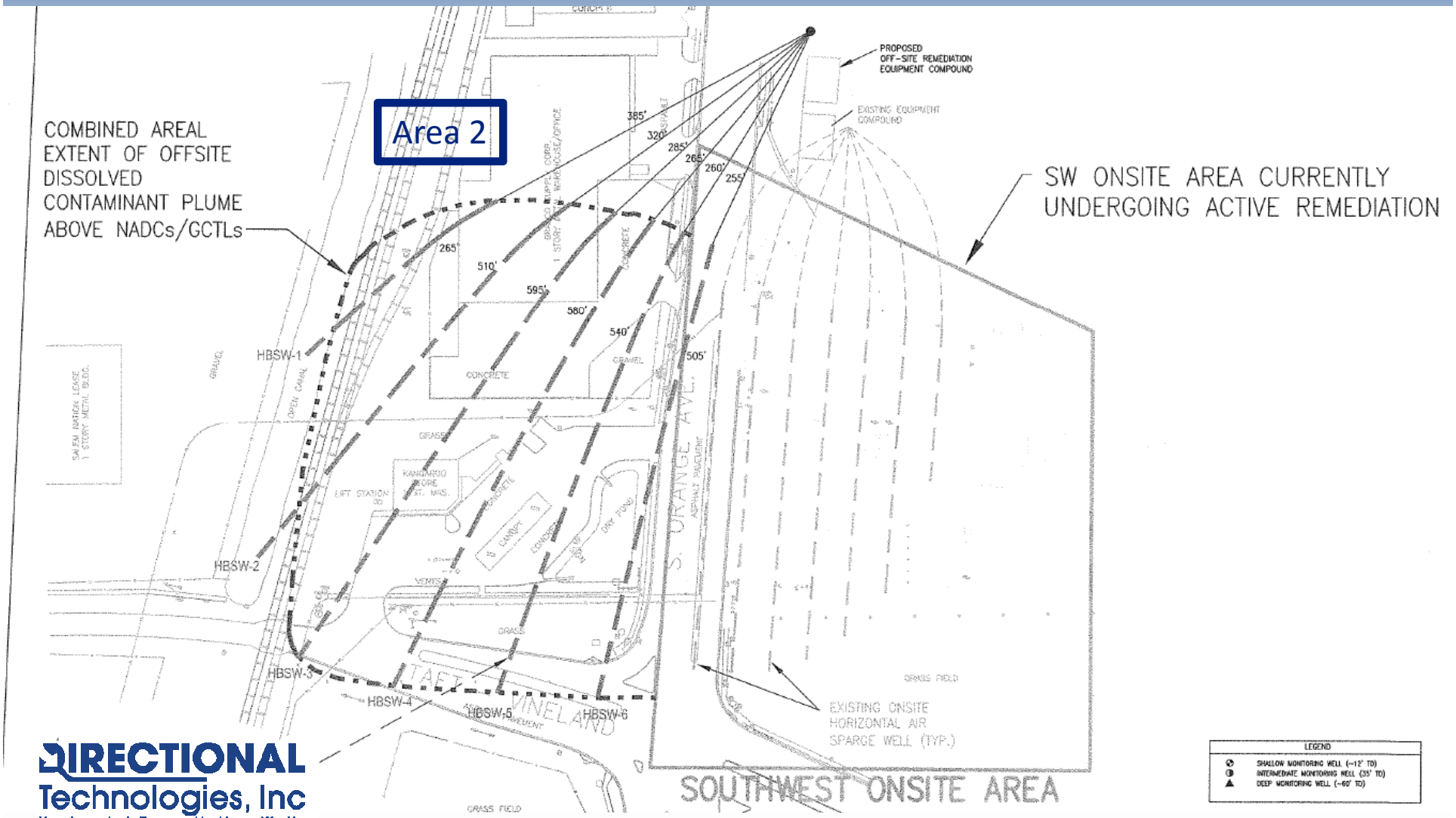
Active Bulk Petroleum Terminal



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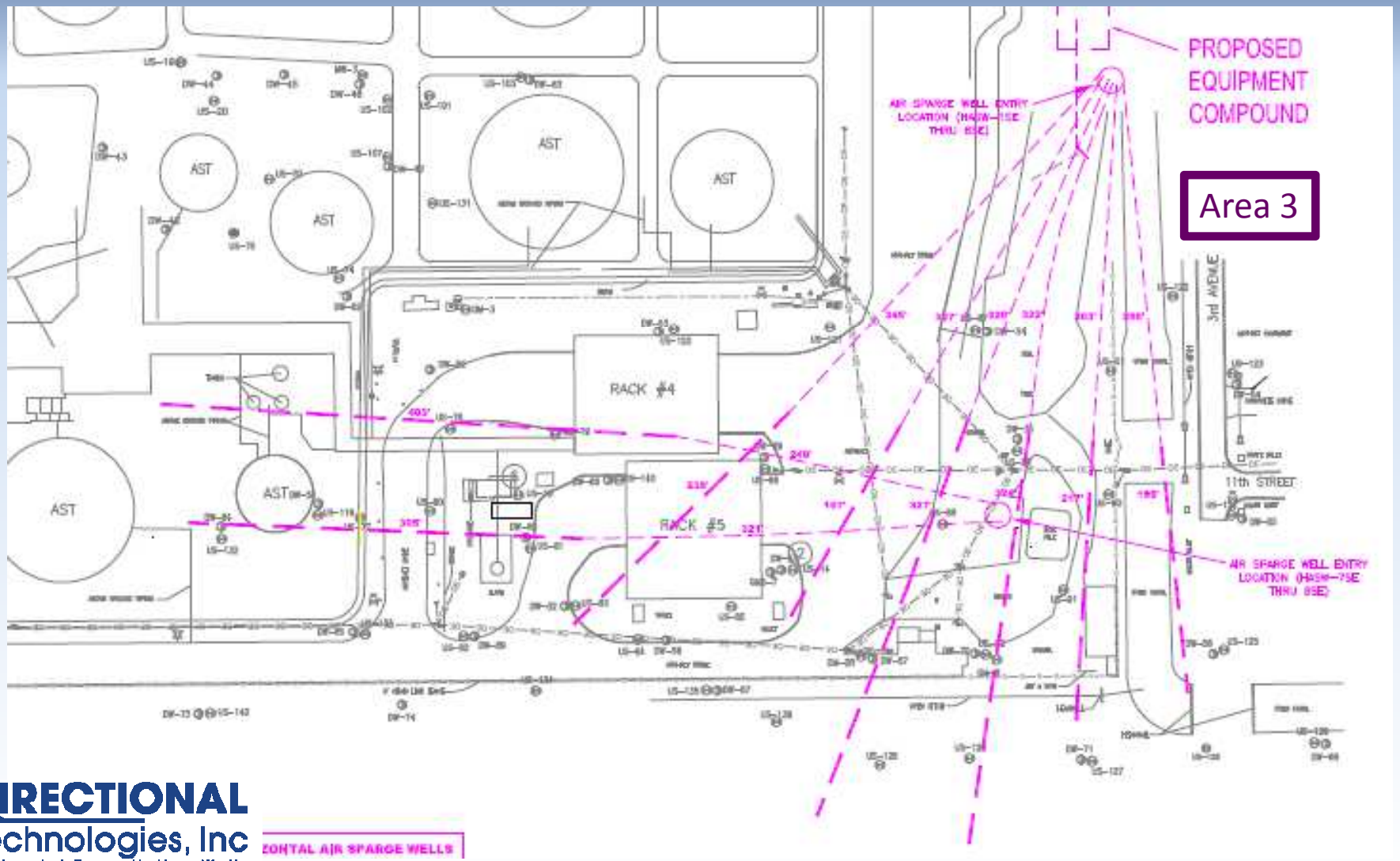
Active Bulk Petroleum Terminal



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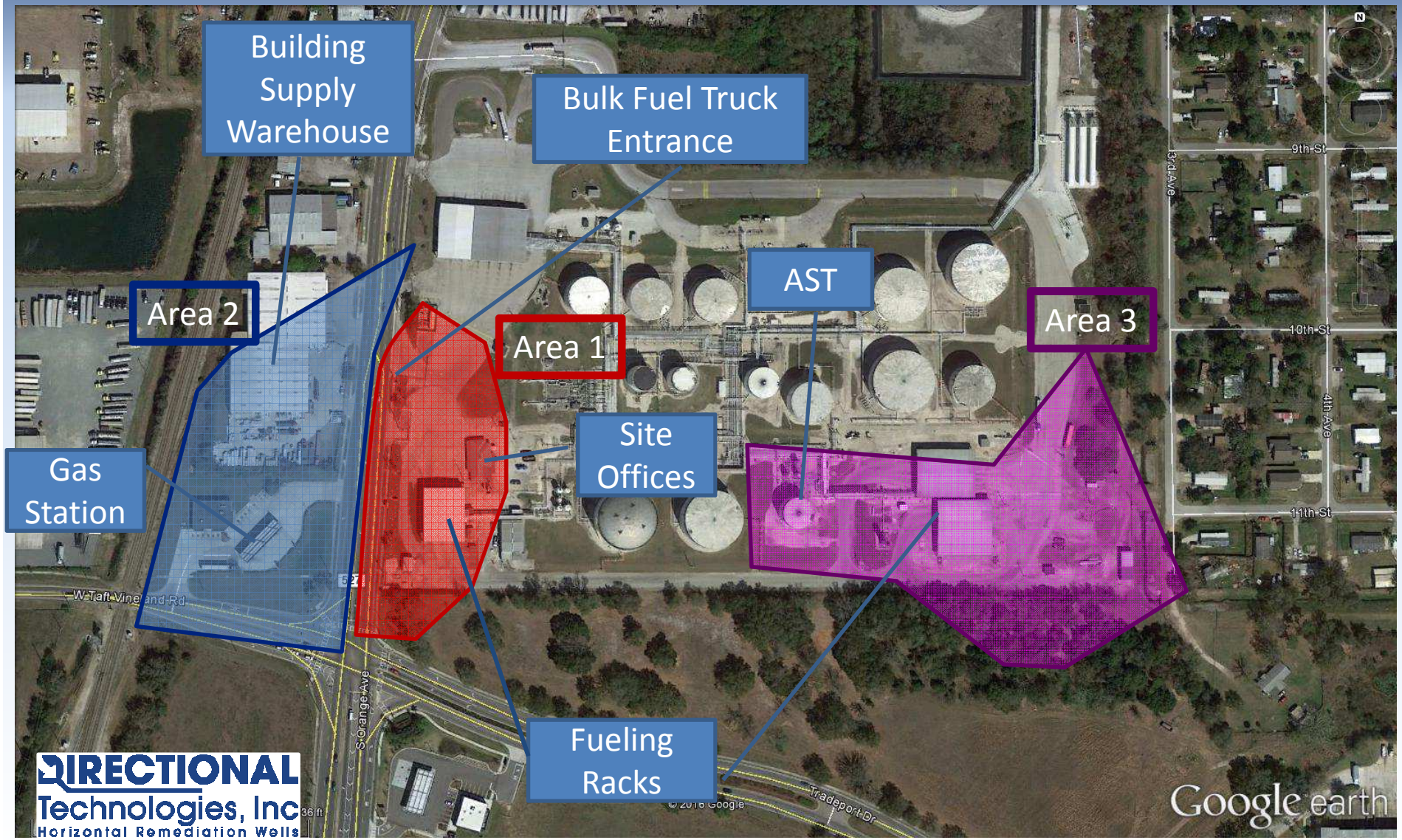
ZONTAL AIR SPARGE WELLS

Active Bulk Petroleum Terminal



Active Bulk Petroleum Terminal

- Avoided disruption to on-site operations and truck traffic, which were continuous (24/7)
- Avoided disruption to businesses affected by impacts
  - No loss to client revenue
  - Worked out of sight of customers
- Avoided costly restoration by entry/exit in grass
- Wireline navigation allowed drilling under roads with no disruption to traffic from above ground locator

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Former Power Plant

- Former power plant site (demolished and removed)
  - Operating substation on site
- Impacts from arsenic discovered on-site
- Delineation required to determine off-site impacts
- Off-Site area is a residential neighborhood

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Former Power Plant

- Needed to avoid disturbance to neighboring homes in the area of concern
- Horizontal drilling and sampling from on-site area was selected due to low impact on community
- 6 discrete horizontal soil samples were obtained from 3 borings under homes

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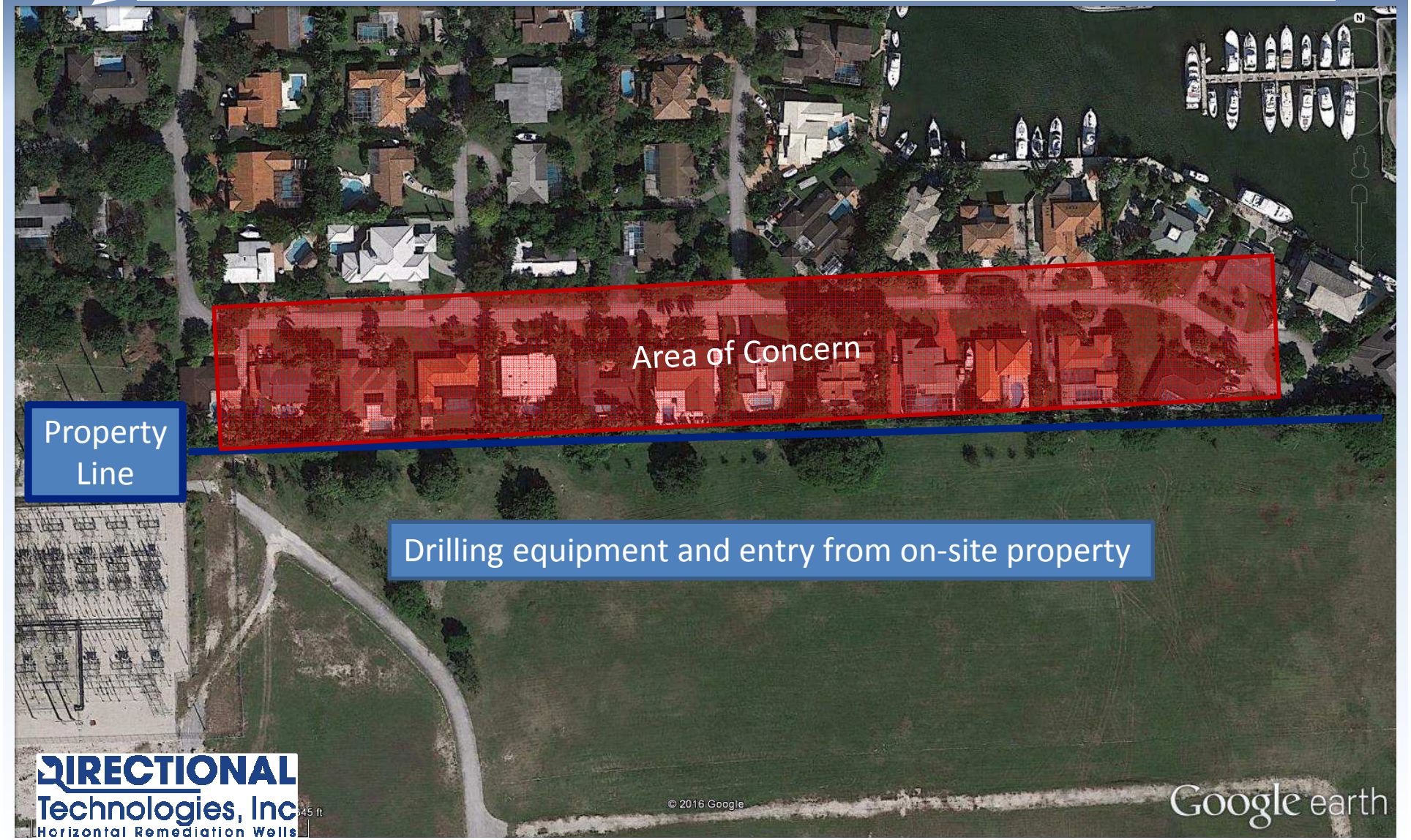
Former Power Plant

Former Power Plant



Former Power Plant

- Horizontal Soil Sampling (HSS) can reduce impact to residential homes.
- HSS can be used to avoid obstructions like buildings, roads, or sensitive facilities.
- HSS allows for samples from multiple points within a single bore-path

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Summary

- Horizontal Remediation Wells (HRWs) systems are mature technology with 24+ years of case studies and site closures
- HRWs are flexible, adjustable and allow for a creative placement to avoid obstructions and minimize disruptions
- HRW can lower project costs… if planning five (5) or more vertical wells

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Questions?

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