



Petroleum Fingerprinting and Environmental Sleuthing Identifies Archeological Contamination Not Associated with Site Activities... Site Achieves Closure saving Millions

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November 2017

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ACUITY ENVIRONMENTAL SOLUTIONS

Industrial Area in Northwest Indiana

Heavily Industrial

Long History of
Steel Mills and
Refineries

2 miles from Lake
Michigan



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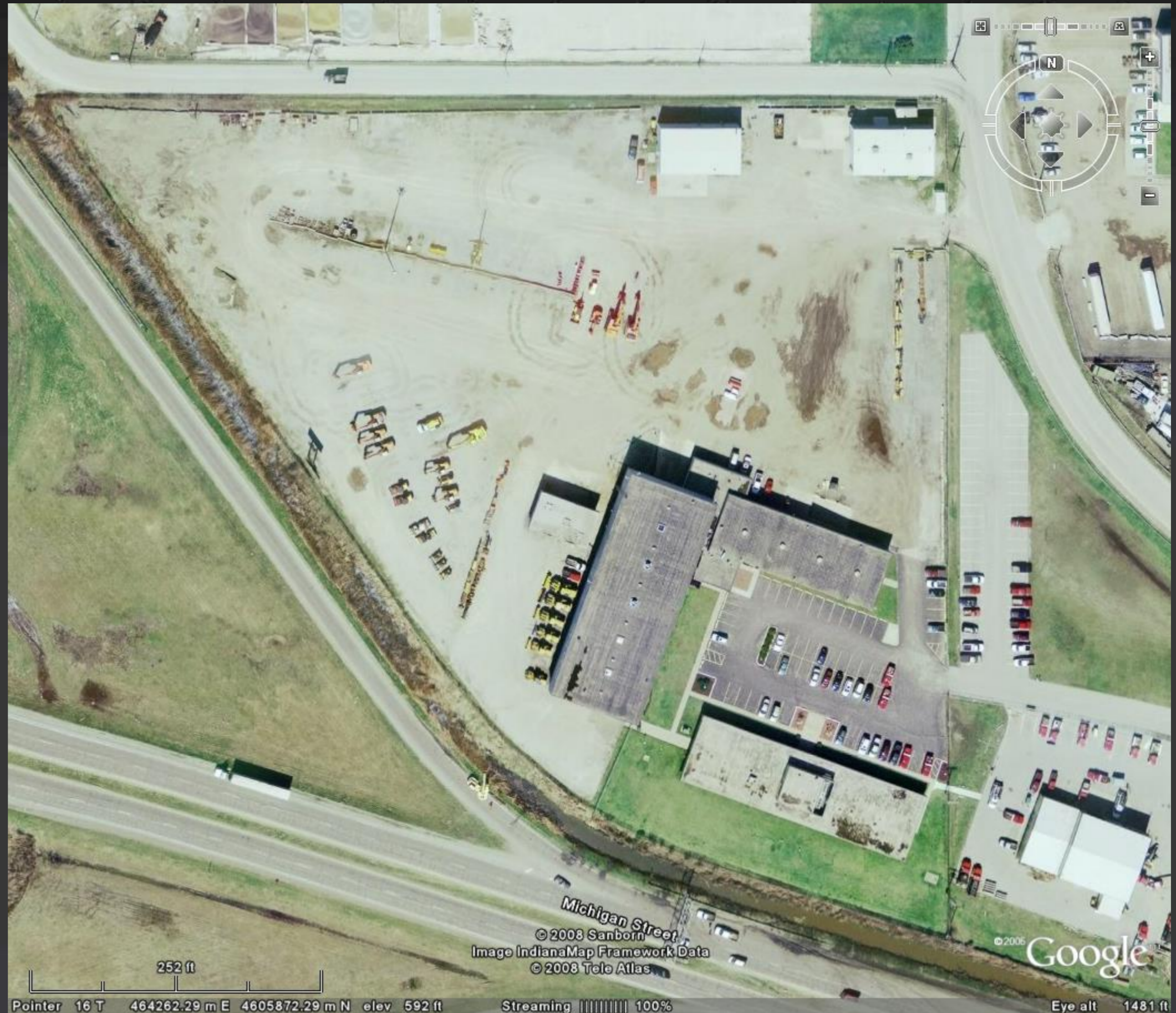
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Industrial Maintenance Facility

1987 to Present:
Tractor Equipment
Supplies & Repair

1967 – 1987
Steel Mill Contractor

- Flat Topography
- Covered with stone
- Underlain by sand
- GW: Approx. 5 ft bgl



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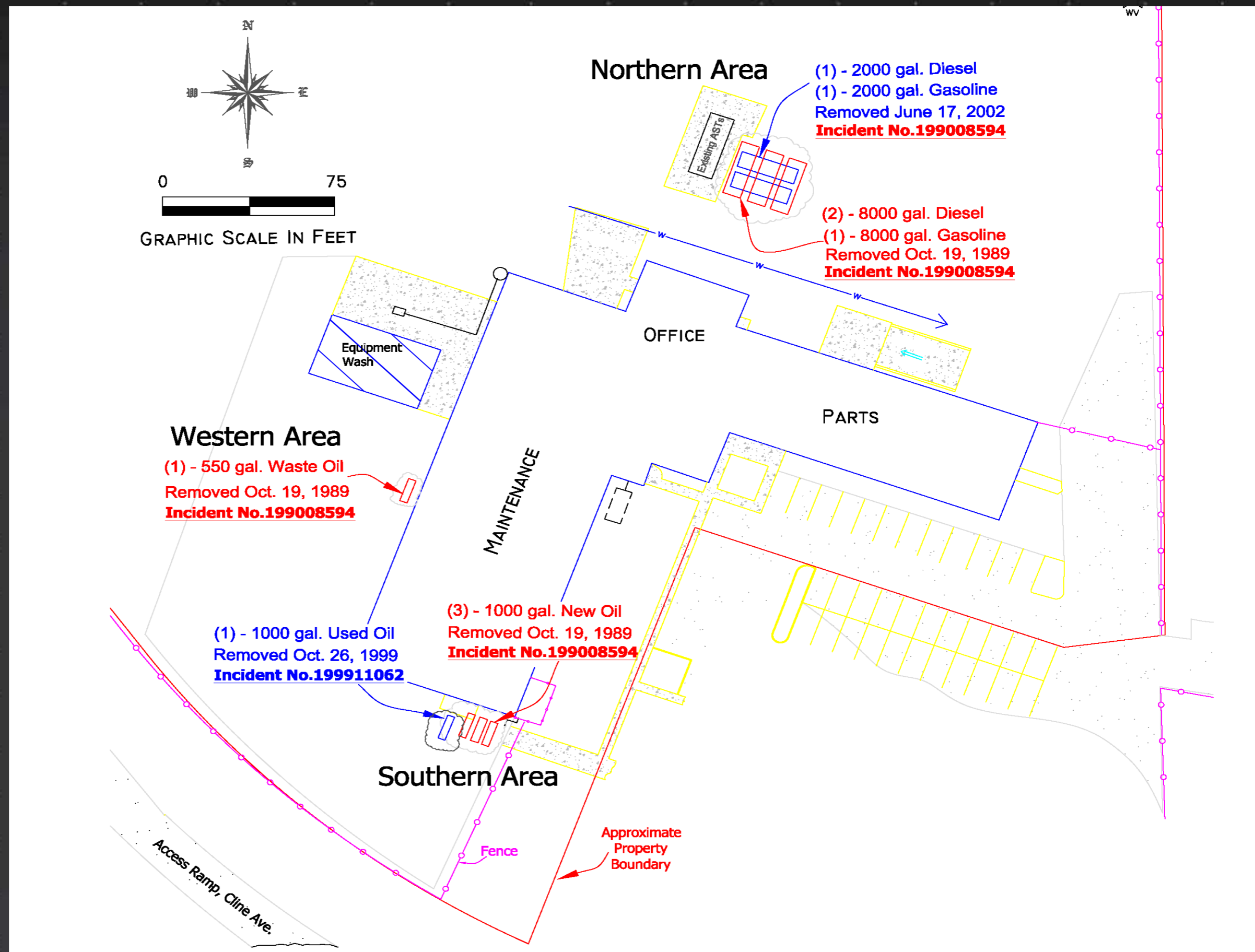
Historical UST Operations

Northern,
Western, &
Southern Areas
UST Releases

Total of 10 USTs

IDEM LUST
Program – 3x
1989
1990
1999

Southern &
Western USTs
NFA



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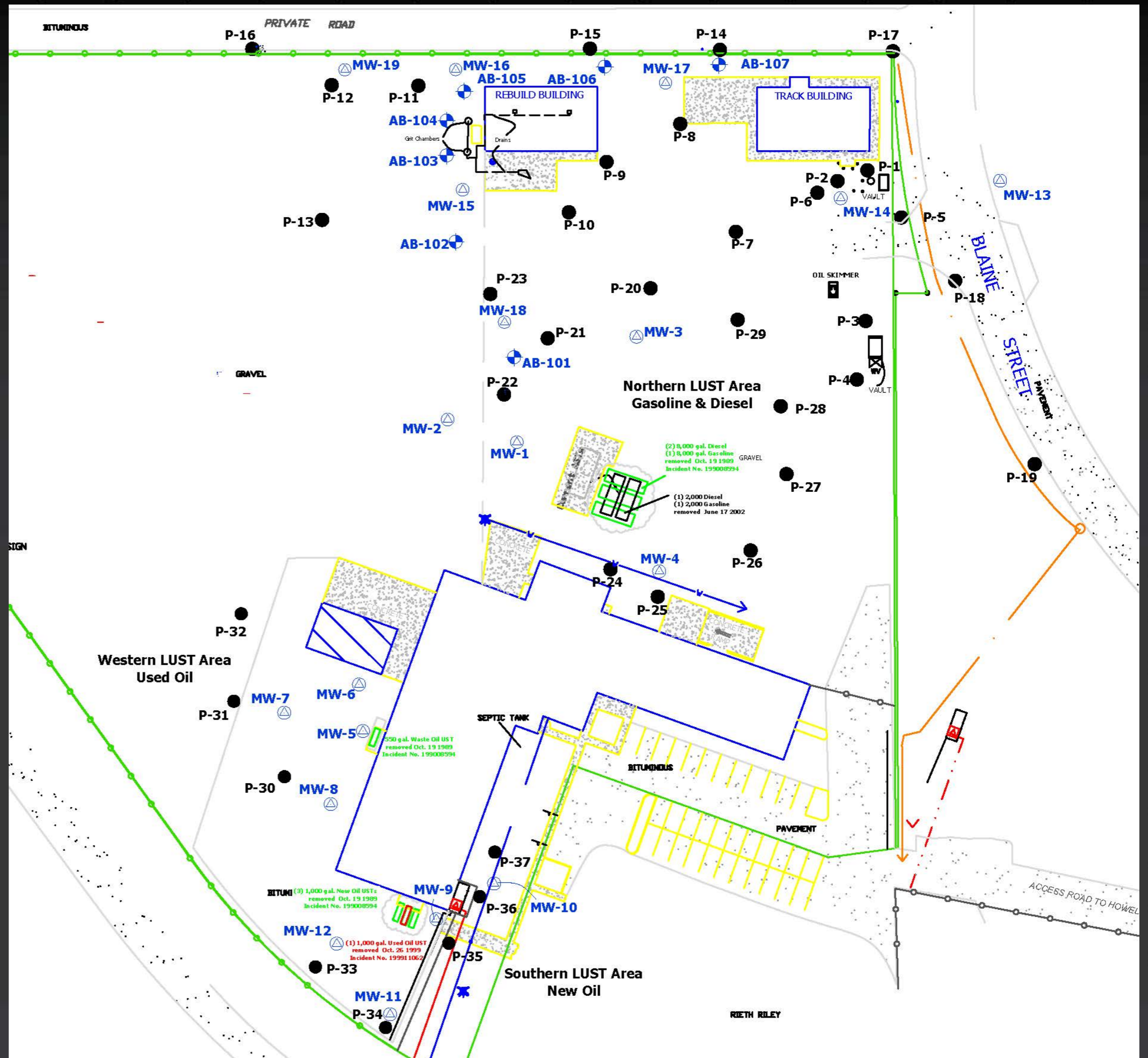
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NORTHERN UST

Original Consultant
4 MWs & 19 SBs
(Not Delineated)

Second Consultant
29 SBs / GW
(Delineated but
no CSM)

Finally....
7 MWs
7 SBs / GW
Test Pits
Fingerprinting
Historical Research
-- CSM --



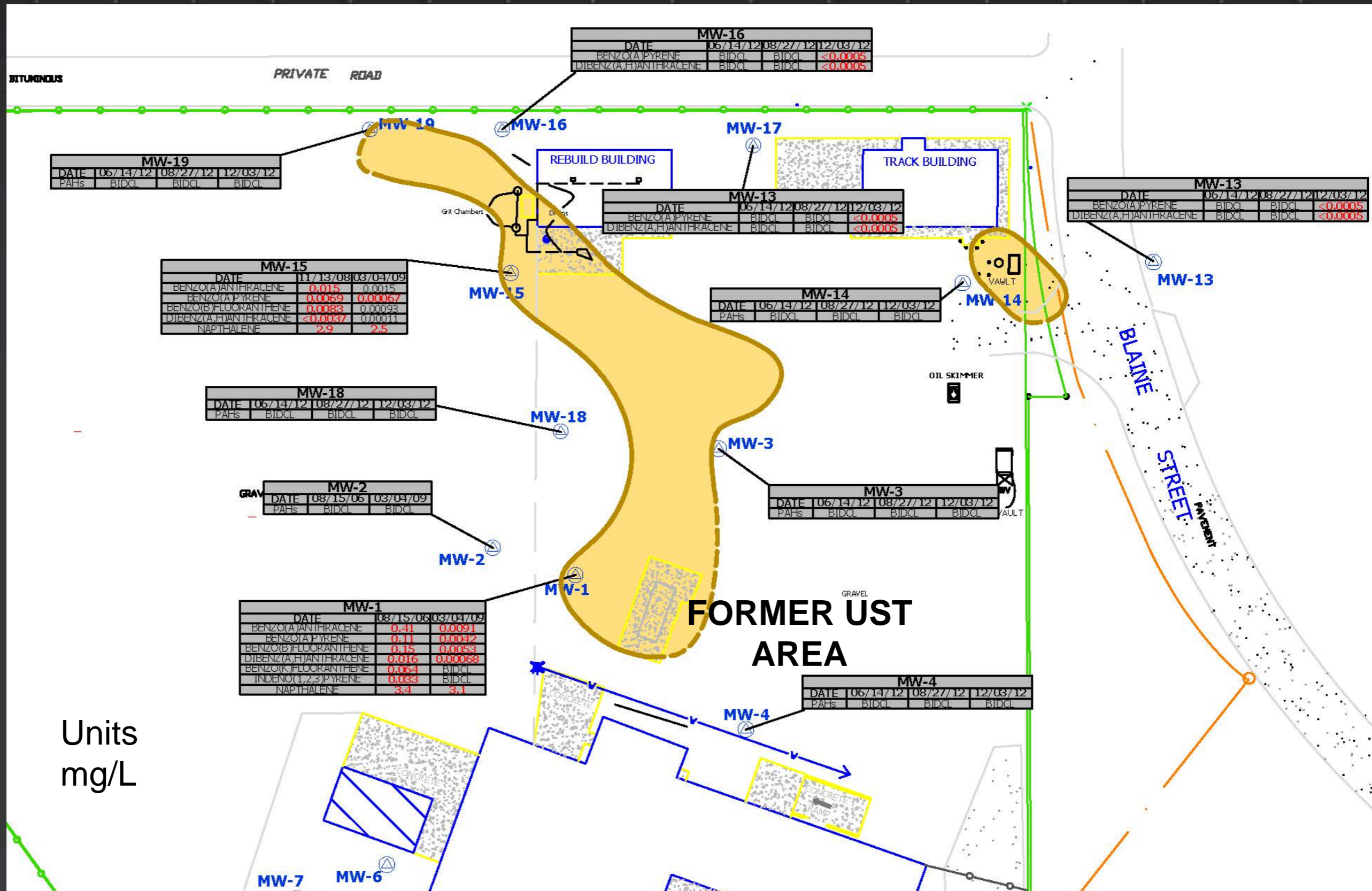
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Why the Difficulty with CSM?

Numerous GW Samples from Grab & Well Locations

Distribution of PAHs in GW

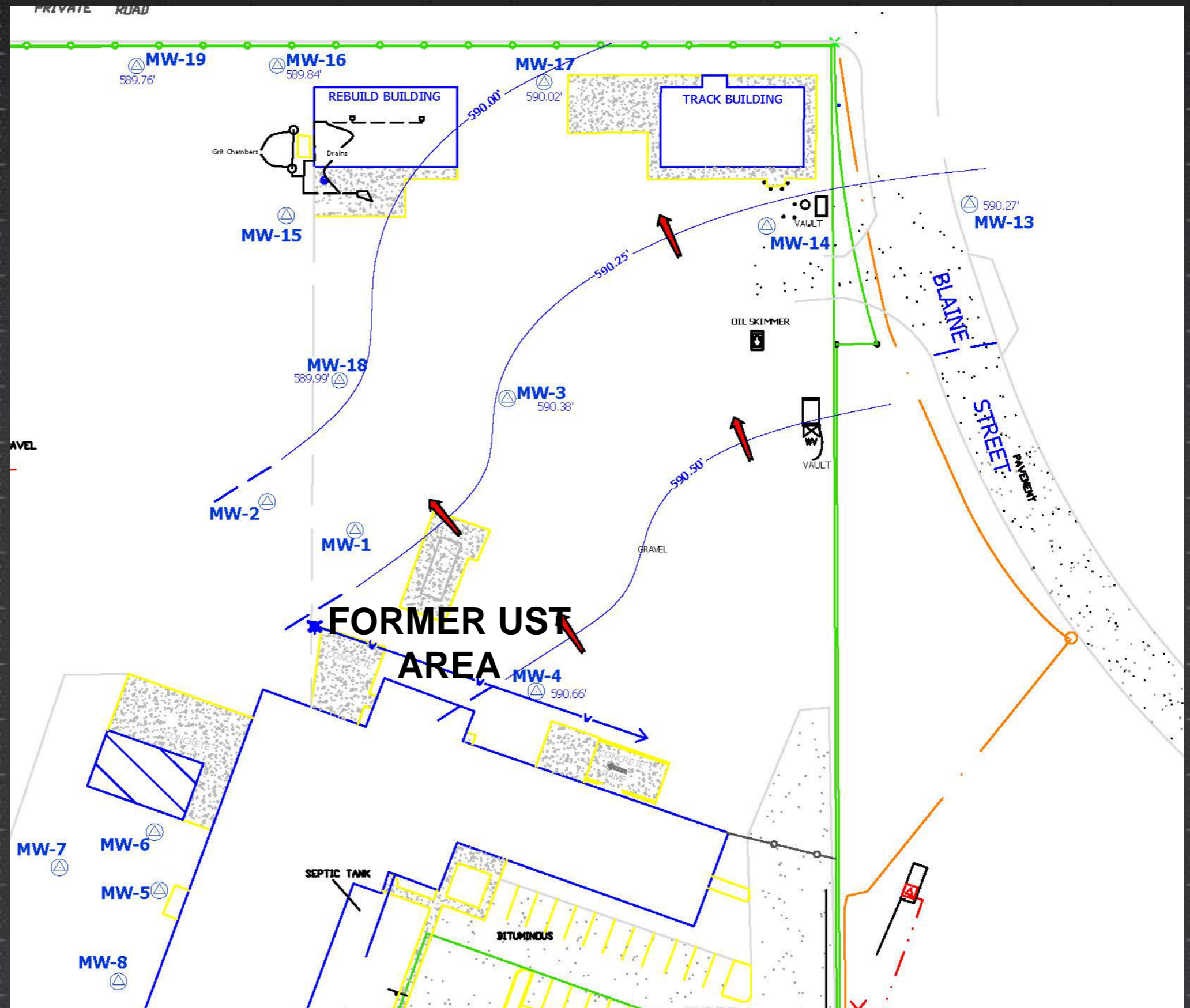


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Why the Difficulty with CSM?

PAH Distribution
in GW plume is
Consistent
with
GW Flow
Direction



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The Proverbial "wrench"

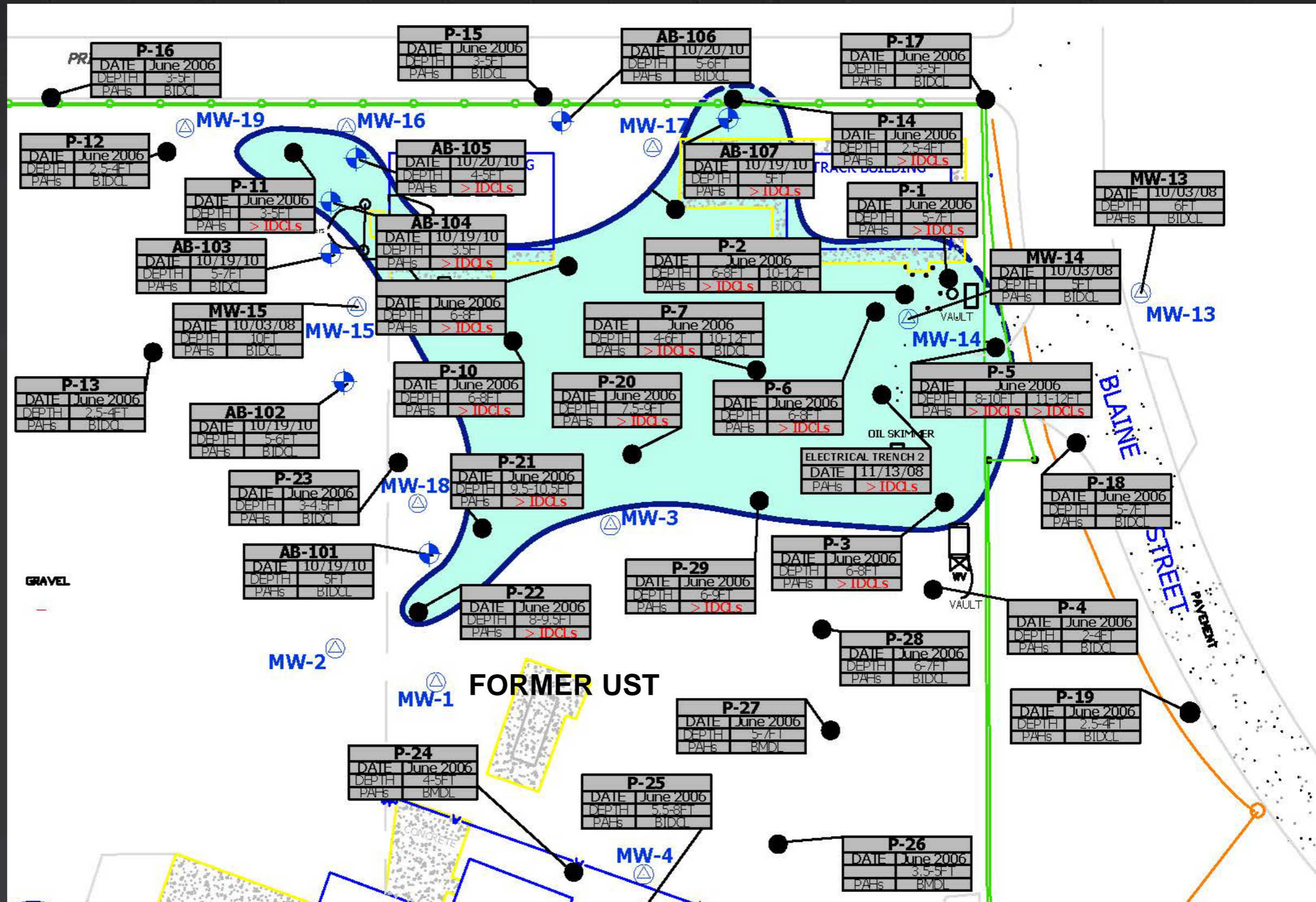
Distribution of PAHs in Soil

Vadose & Phreatic

Not Consistent with GW PAH Plume

Blue Area Exceeds Indiana IDCL

IDCL – Industrial Default Closure Level



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Inconsistencies at the Site

1. COC distribution in soil was not consistent with a single leaking UST source.
2. Concentrations of PAHs in soil were greatest along downgradient property boundaries.
3. Free product was encountered *downgradient* of the former leaking UST, not at the former leaking UST.
4. Free product was extremely viscous and not typical of gasoline or diesel fuel.



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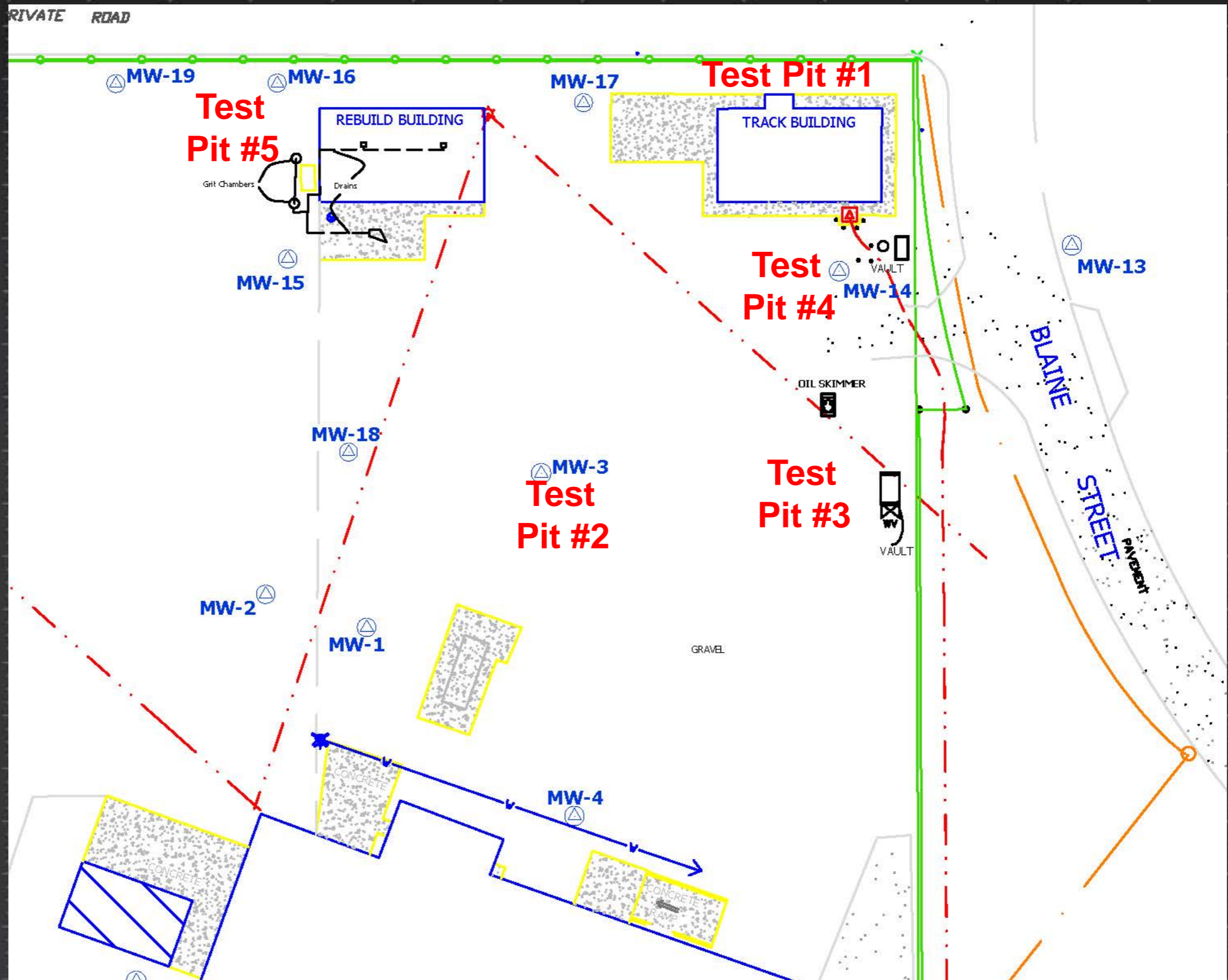
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OLD SCHOOL: GPB Investigation

Ground Penetrating Backhoe

5 Test Pits at suspect Locations - vaults, skimmers, etc.

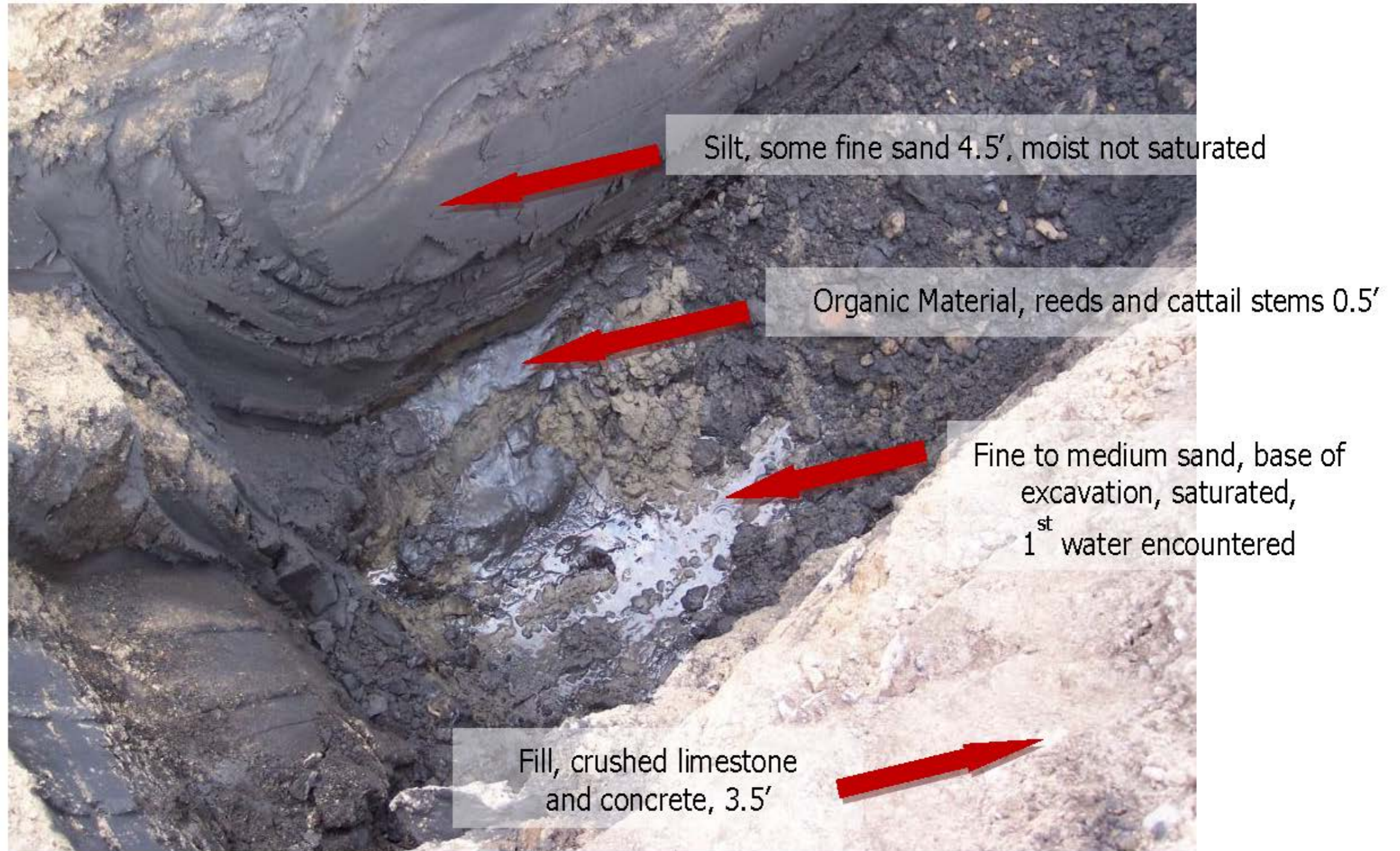
No Source Found -- Additional characterization



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GPB Test Pit No.2 (Center of Site)



Excavation of Test Pit 2 - 1



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GPB Test Pit No.3 (East Side of Site)



Black sand, contains relic industrial debris and grease

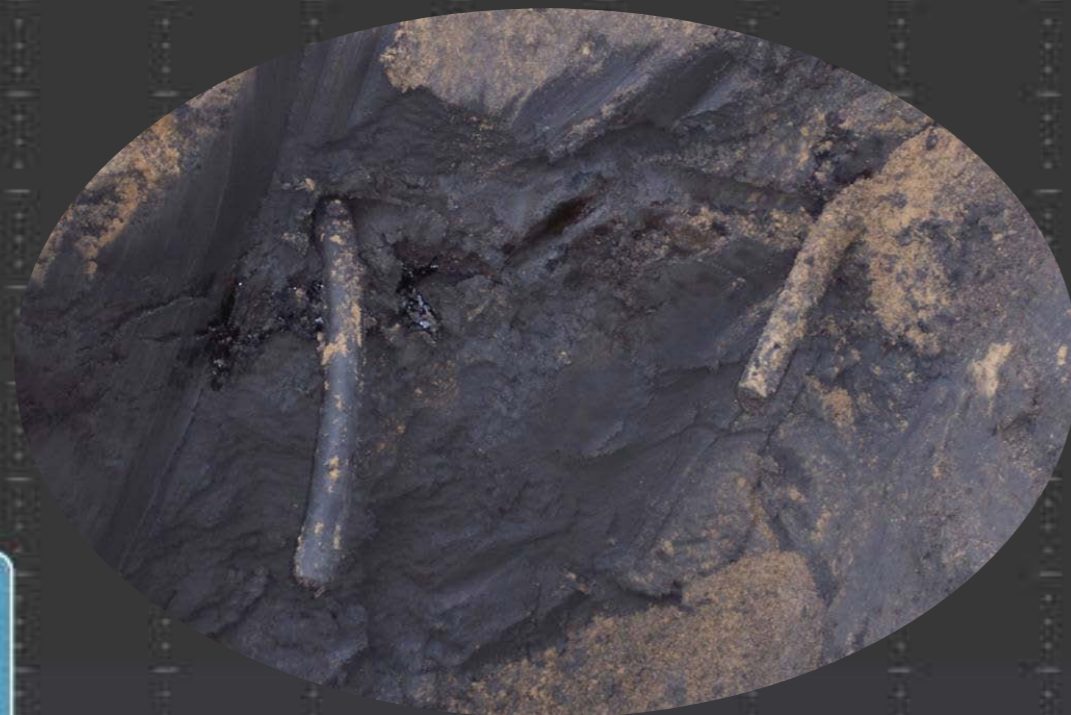
Fill, brown sand, gravel, cinder or crushed concrete

Excavation of Test Pit 3 - 1

GPB Relics / Discoveries



Debris Associated with Steel Mill Operations:
Slag, Piping Flanges, Rubber Hoses, Glass, Pipes, etc.



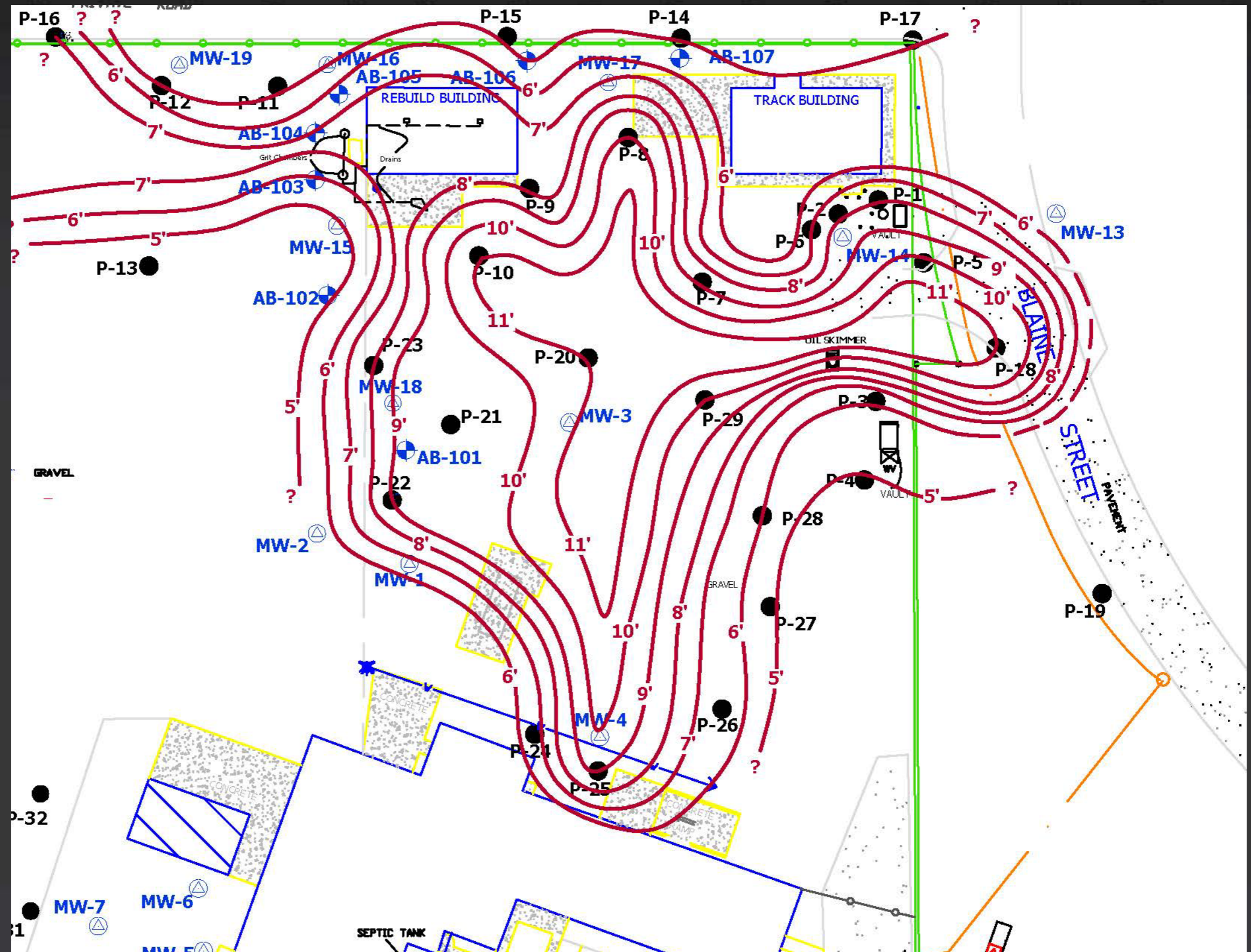
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Evaluation of Fill Thickness

Fill is not confined to property boundaries

Varied significantly in thickness



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Refinement of CSM

- Identified that some of the PAH impacts in the central and eastern portions of the Site were associated with fill material. No source was identified.
- PAH impacts were also associated with the historical UST release.



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Differentiation of Petroleum

- Utilization of High Resolution Gas Chromatography (HRGC) petroleum fingerprinting to:
 1. Differentiate petroleum impacts at the Site.
 2. Identify nature of petroleum impacting fill material.
- Worked with Dr. Paul Philp of the University of Oklahoma
- Submitted various soil / groundwater/ free phase oil samples from 15 separate locations.



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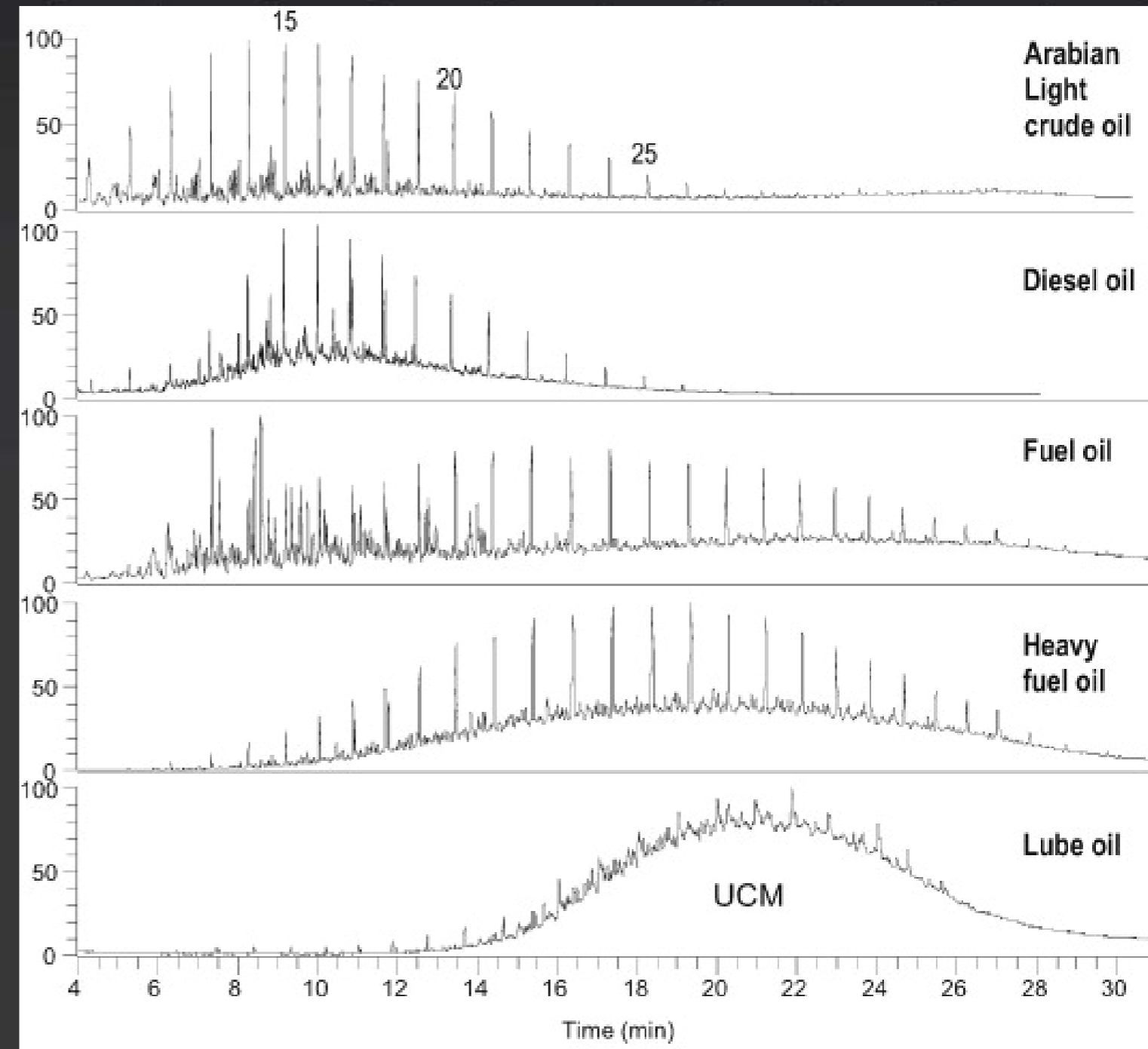
Simplified Basics of HRGC

Use GCMS (gas chromatography and mass spectrophotometry).

Through the use of the GC separation column and the ionization of the MS, individual constituents of various petroleum mixtures are readily identified.

Various petroleum mixtures have specific "fingerprints".

Subsequent comparison of individual samples can aid to identify similar parent material.



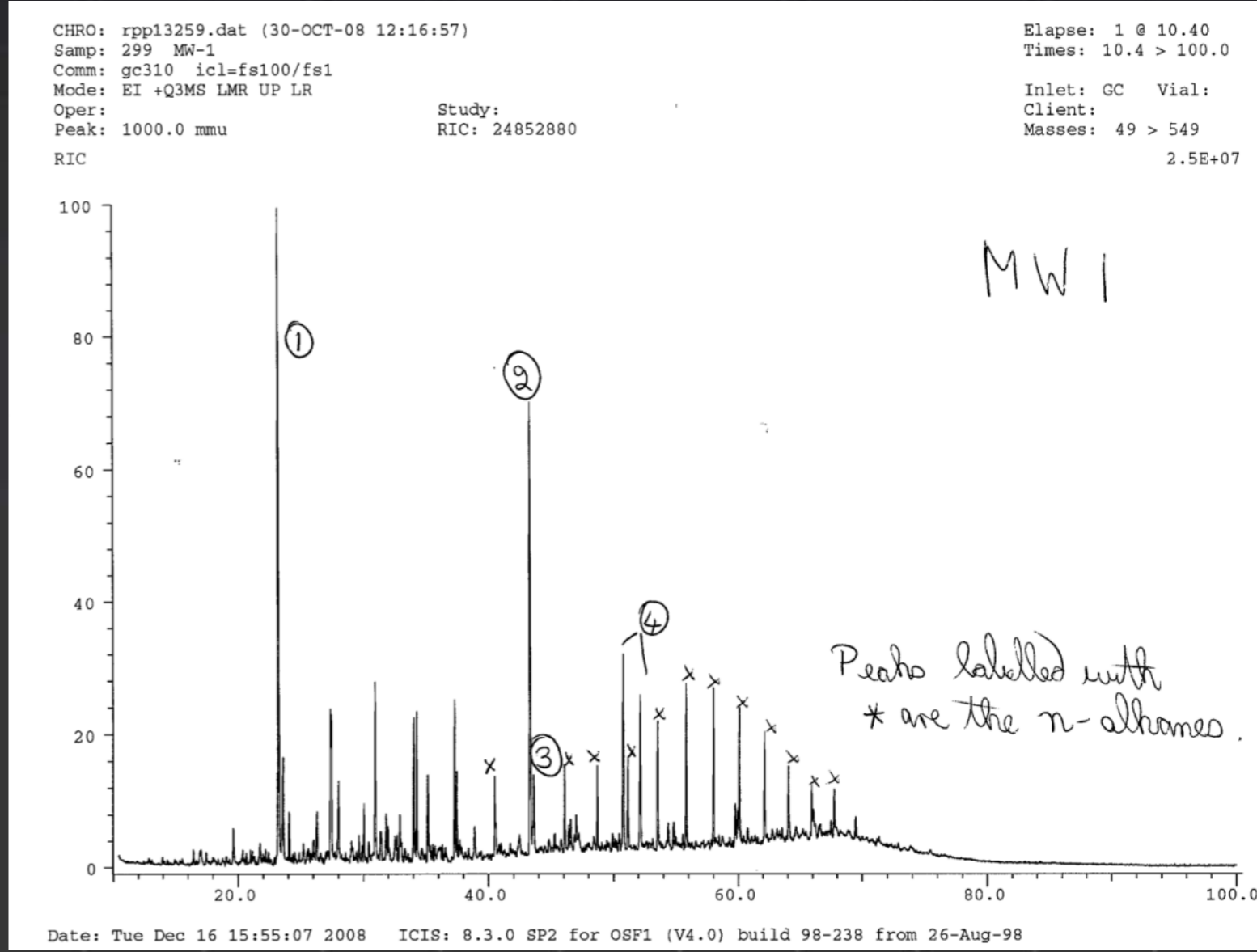
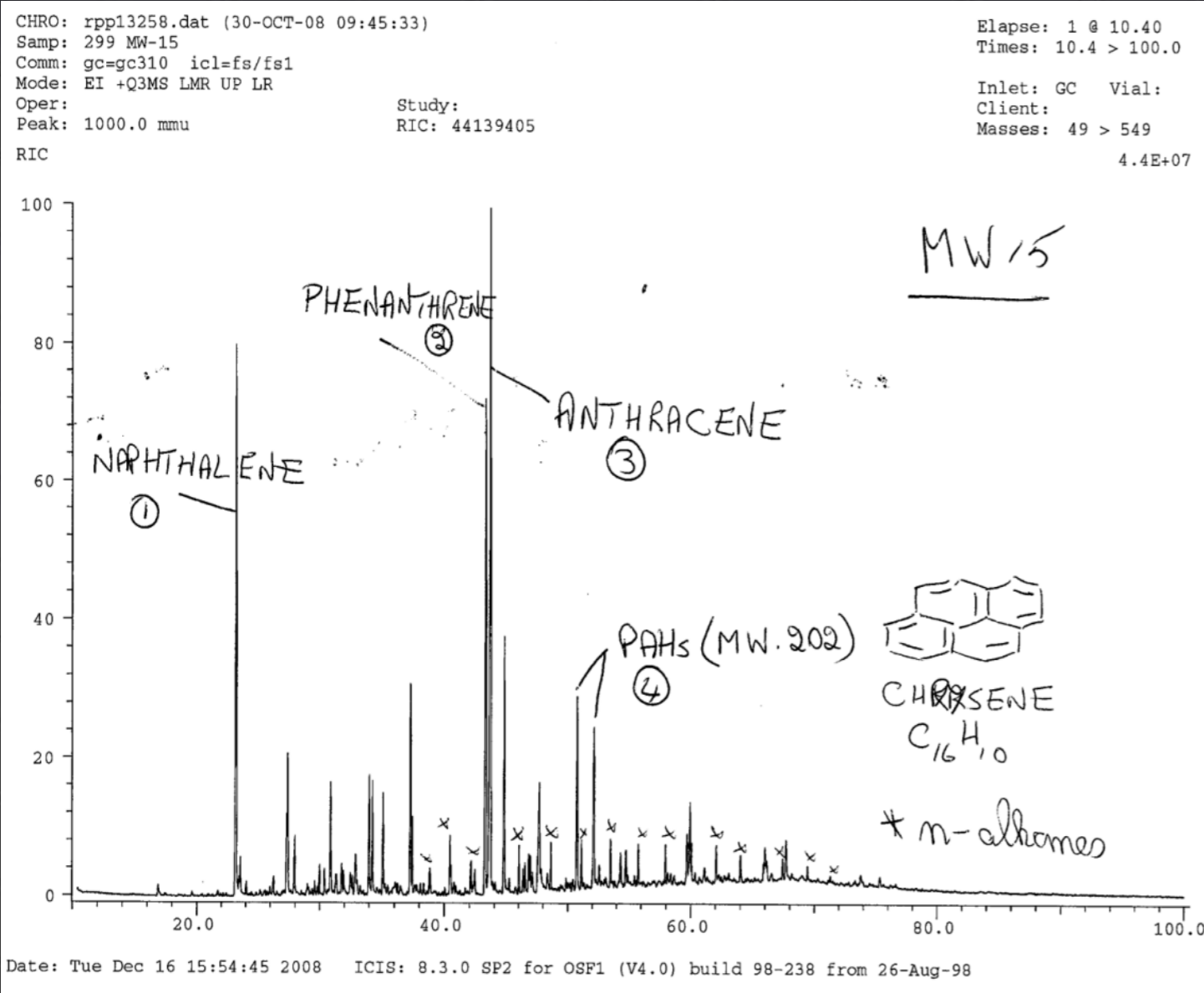
Example of various fuel "fingerprints"



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Site HRGC Fingerprinting



- Strong HRGC correlation between MW-15 & MW-1
- Numerous PAH peaks consistent with motor fuels

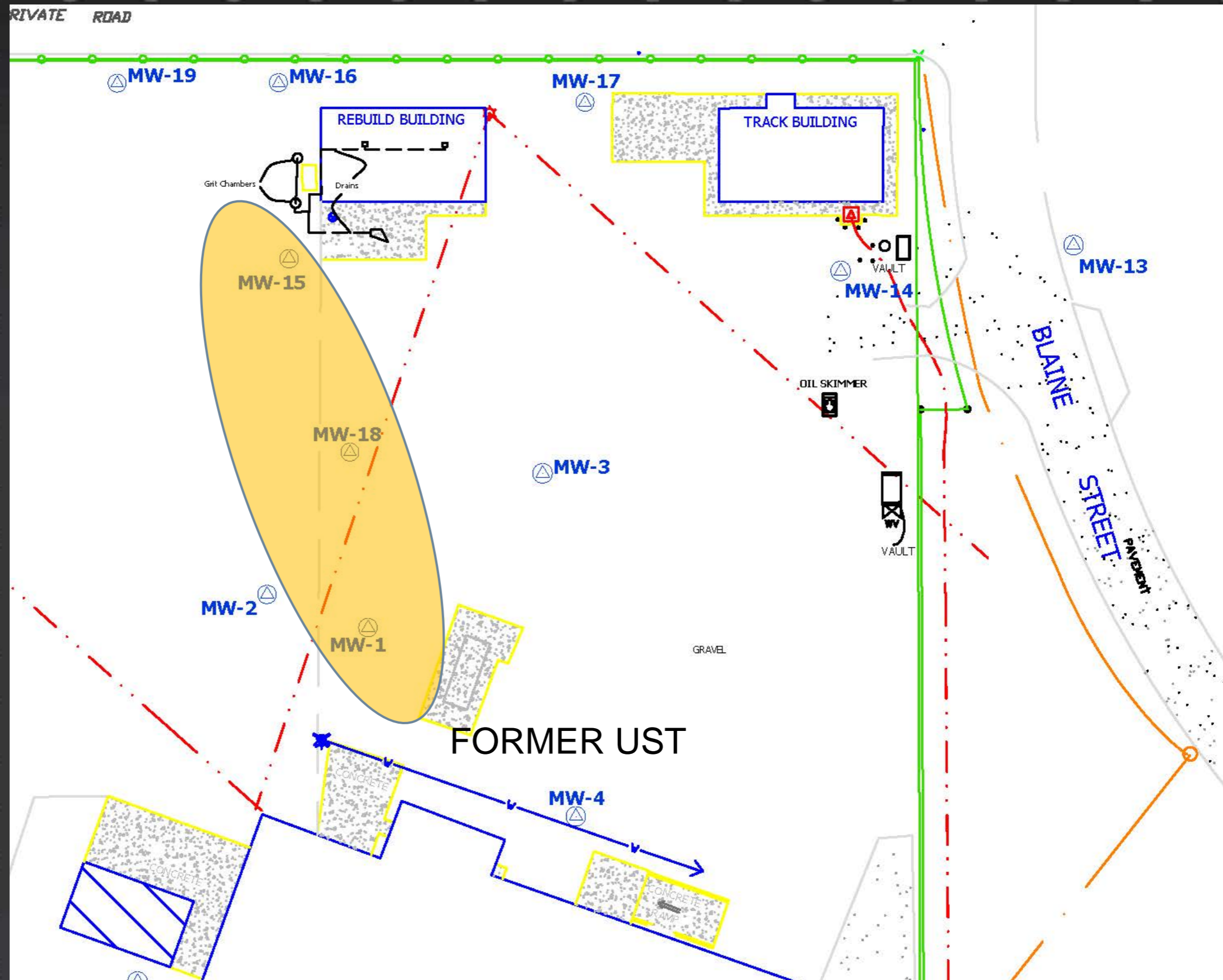


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HRGC Correlation MW-15 & MW-1

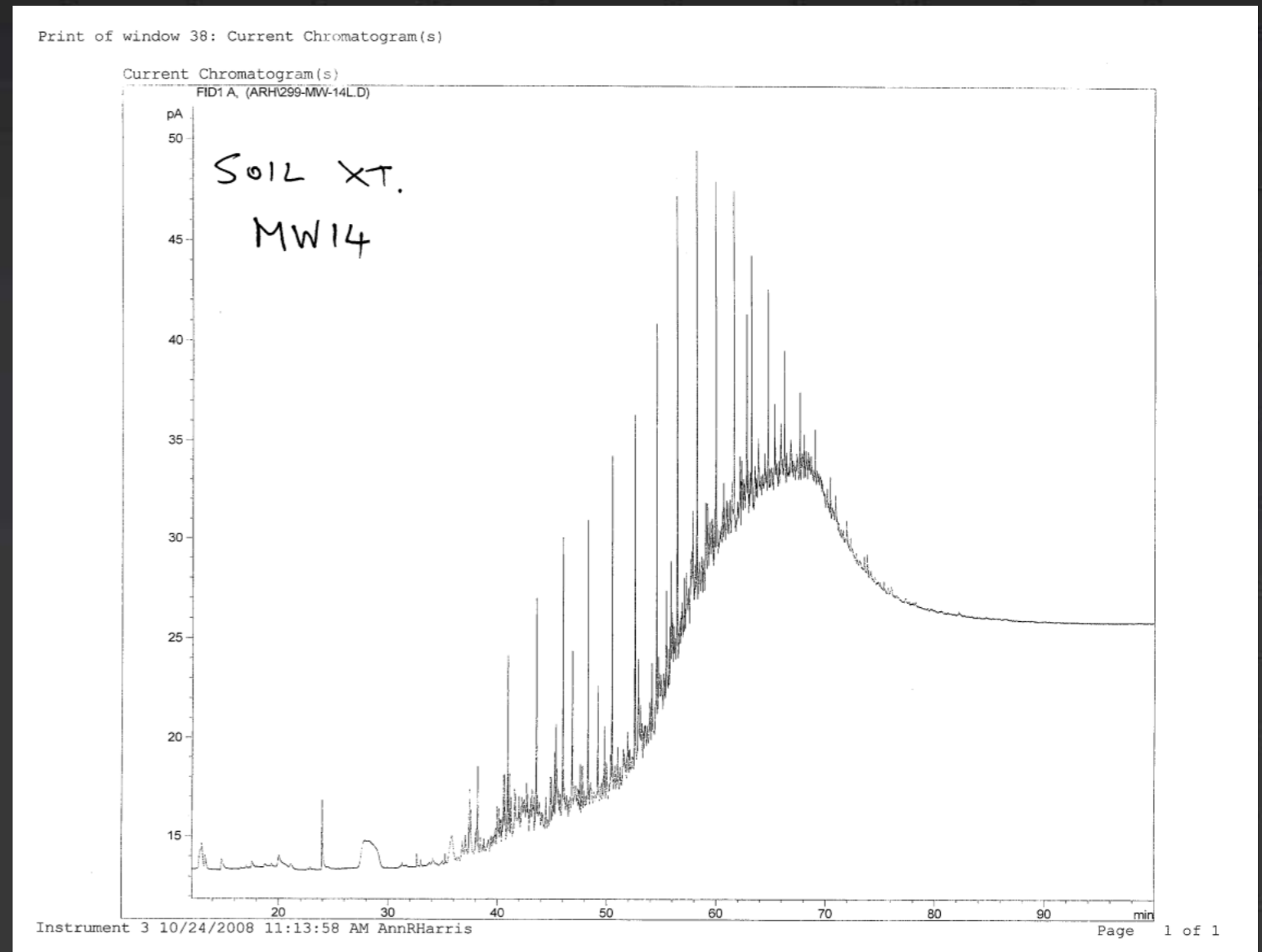
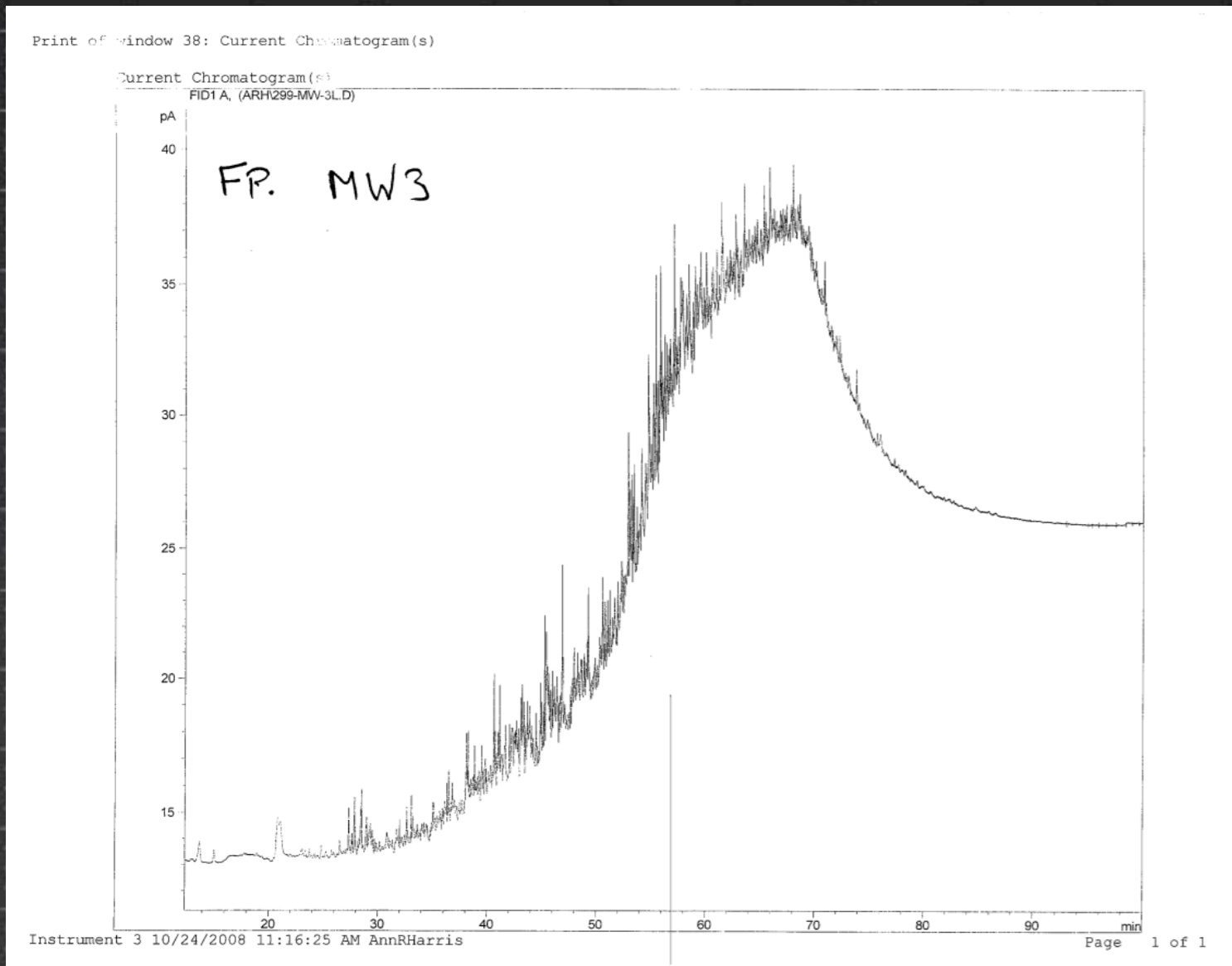
HRGC Profile
Consistent with
Motor Fuels



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Site HRGC Fingerprinting



- Strong HRGC correlation between free-phase in MW-3 and soil at MW-14
- Peaks and distribution are consistent with lubricating oil

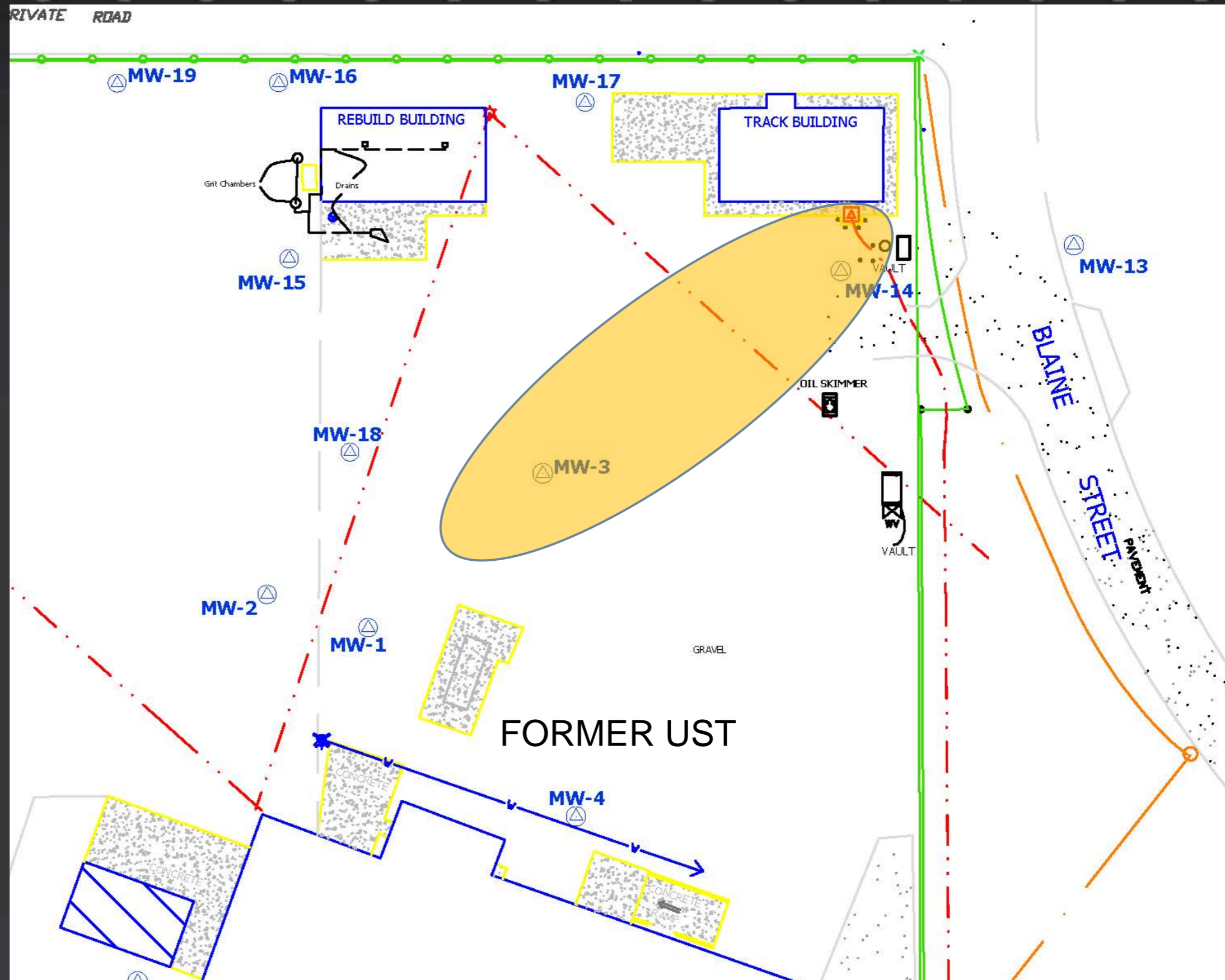


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HRGC Correlation MW-3 & MW-14

HRGC Profile
Consistent with
Lubricating Oil



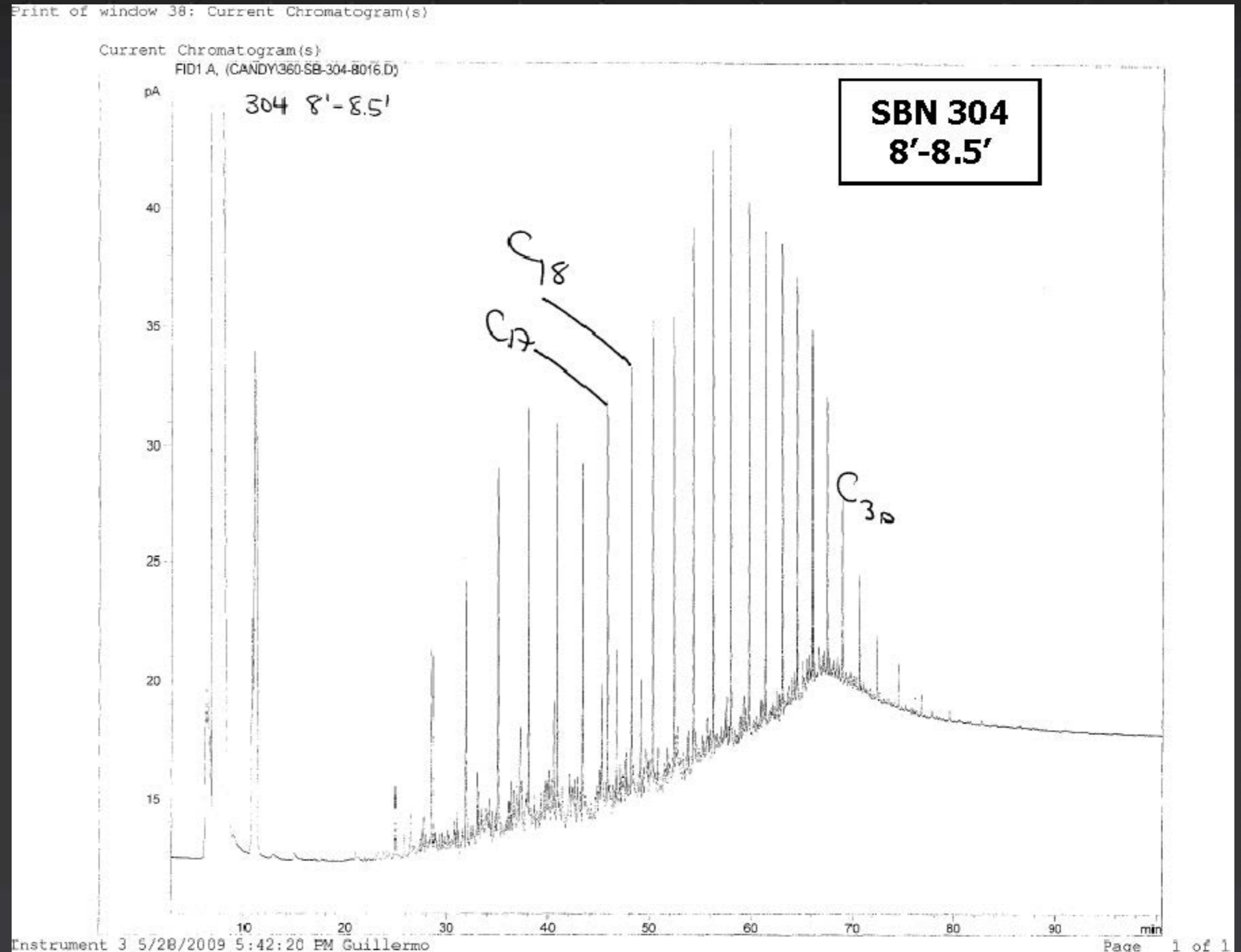
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Site HRGC Fingerprinting

Sample 304:
Located between
MW-1 (Motor Fuel)
&
MW-3 (Lube Oil)

HRGC detections
of both VOCs and
PAHs were identified



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Overall HRGC Interpretation

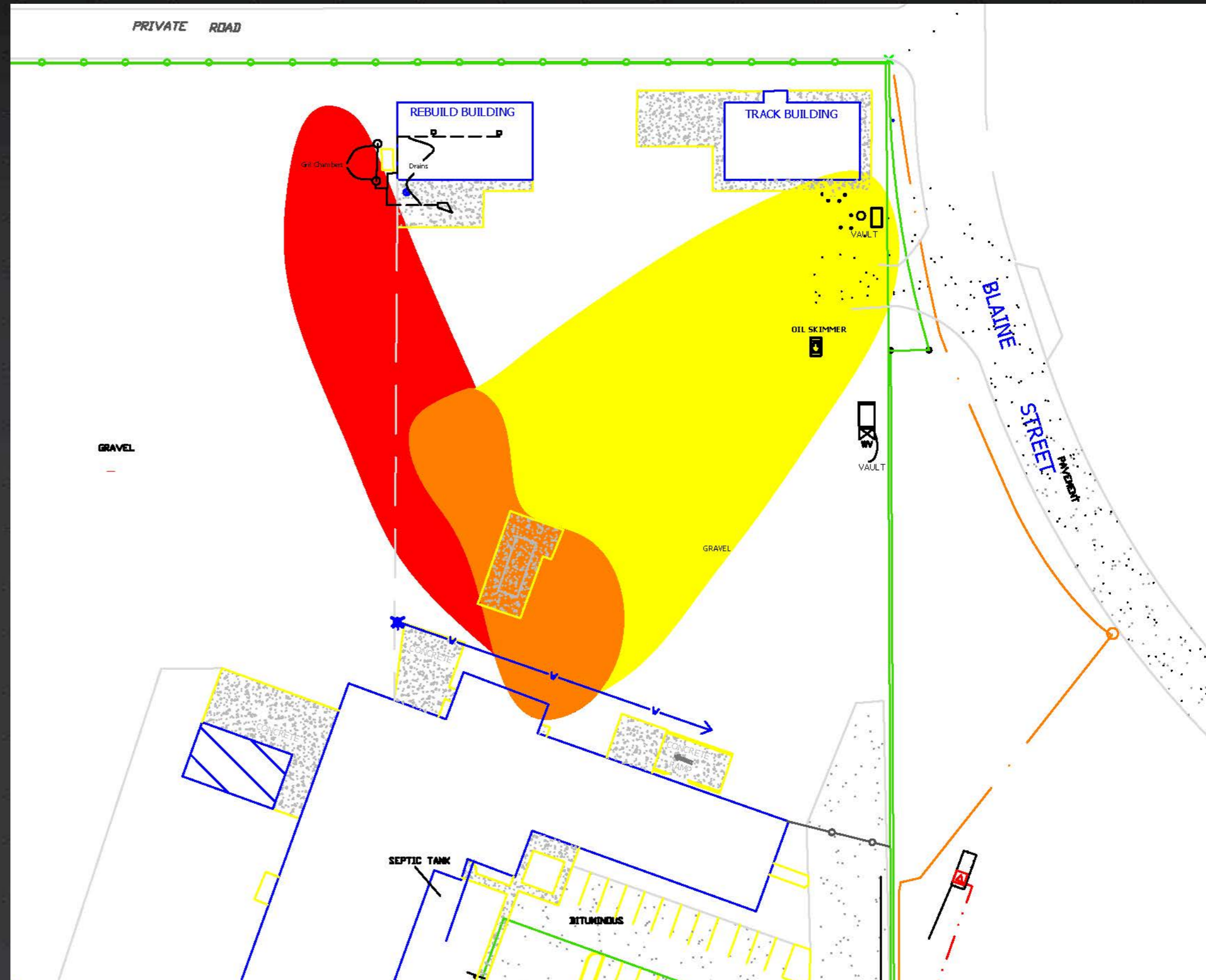
Yellow Fill = HRGC correlation indicative of lubricating oils; primarily high molecular weight compounds

Orange Fill = HRGC correlation indicative of lubricating oils; including PAHs and high molecular weight compounds

Red Fill = HRGC correlation indicative of fuels; including VOCs & PAHs

HRGC = High Resolution Gas Chromatography

Inclusive of all HRGC samples



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The Source of Lubrication Oil?

Impacts go
off-Site to the
North and
East

No significant/
adjacent
source areas

Surrounded by
these linear
landforms

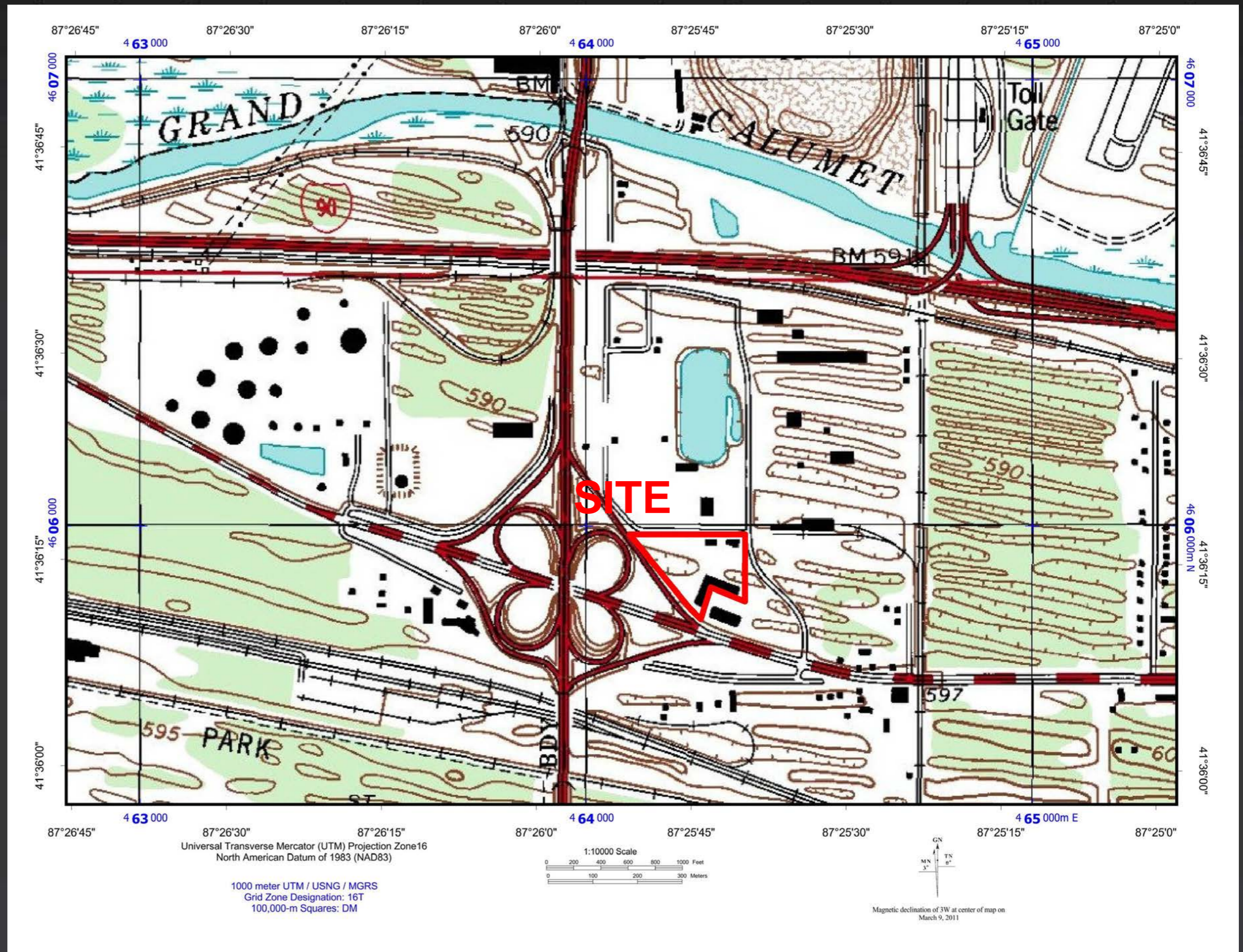


Geomorphology (landforms)

1983 USGS
Topomap

Can't forget the
past

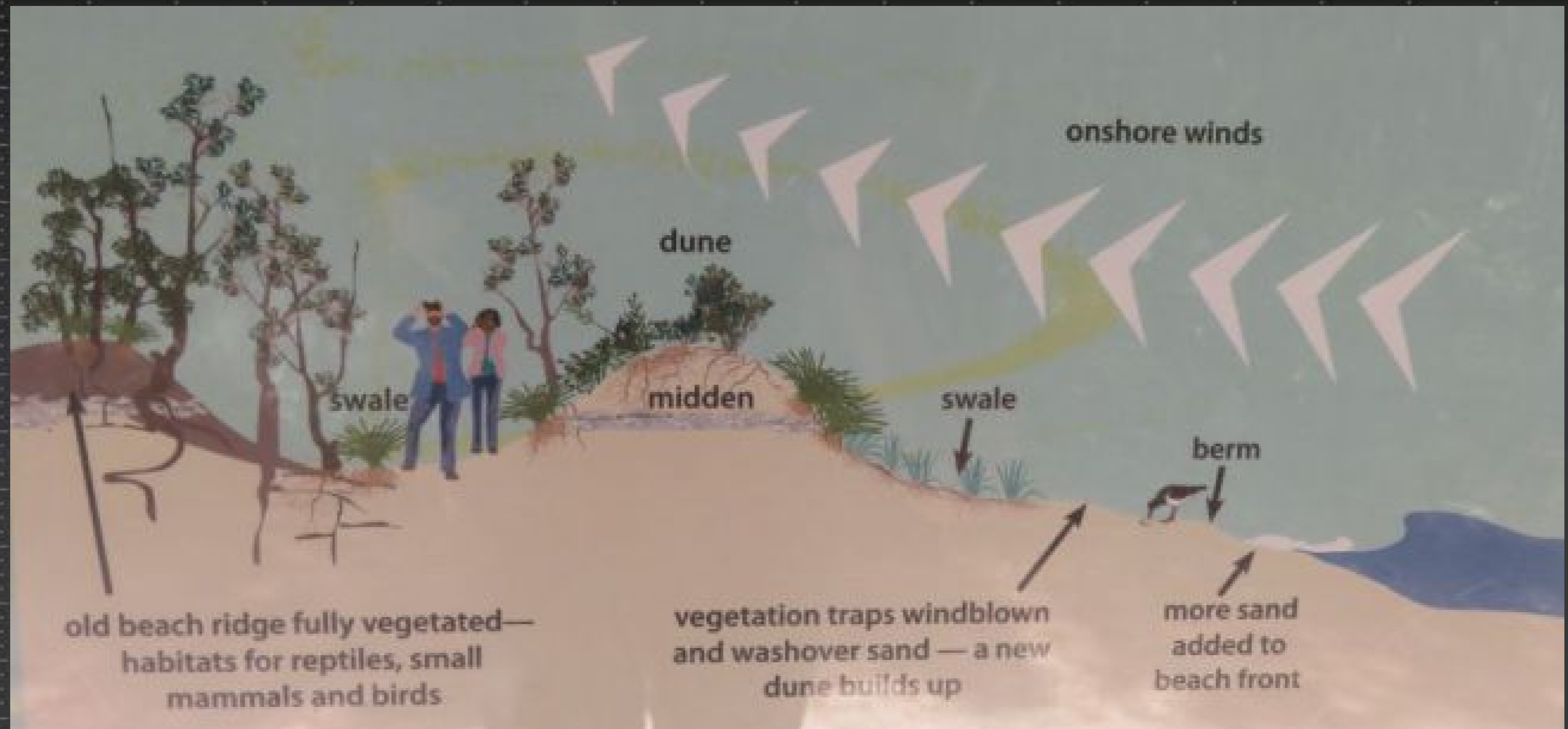
Look at the bigger
picture



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Back to Basics – GEO 101



SOURCE: <https://candeloblooms.com/category/coast/>

Dune Swell & Swale

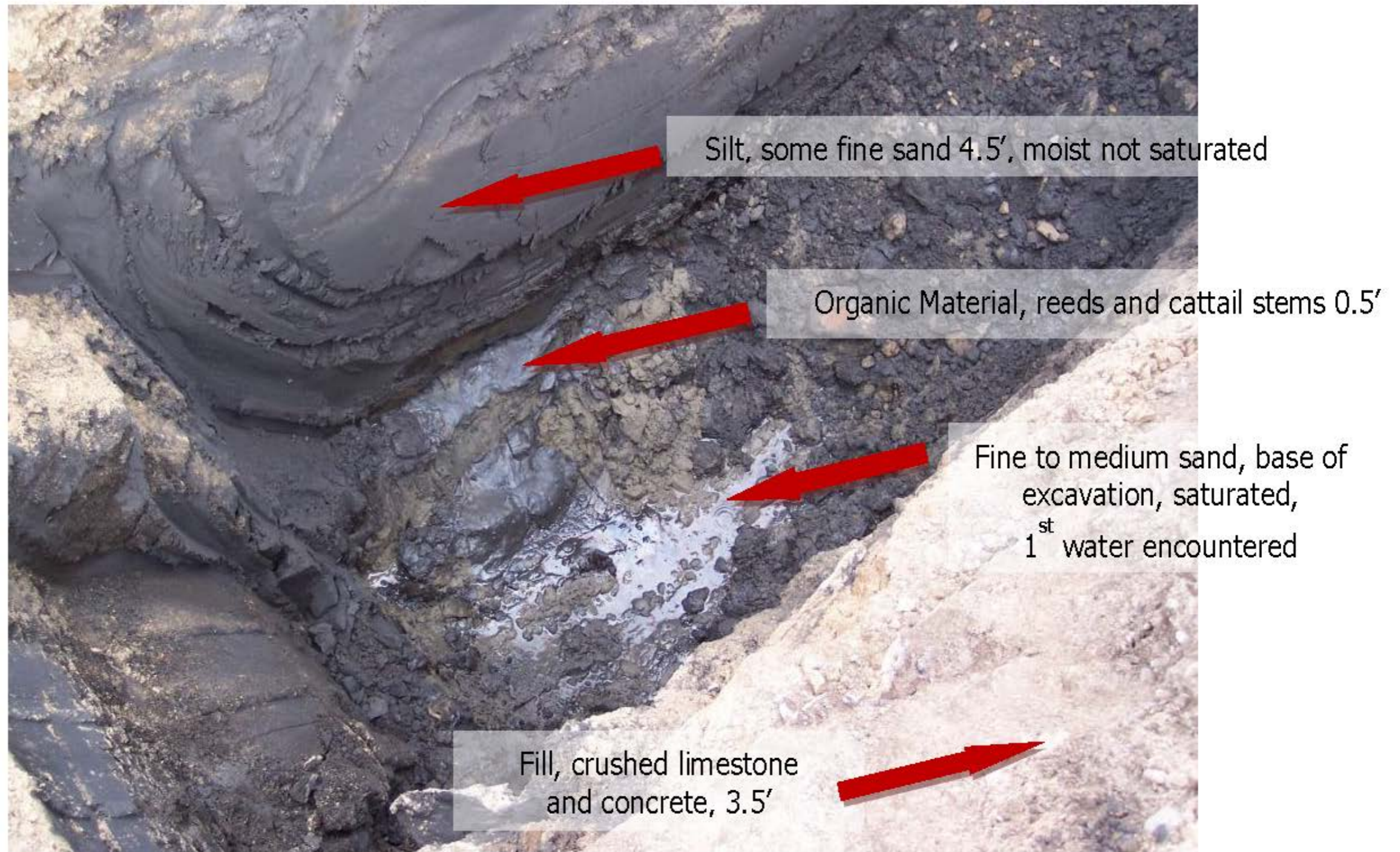
- Alternating low sand ridges with marshy zones
- Laid down as off-shore deposits of Lake Michigan



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GPB TEST PIT No.2 (Center of Site)



Excavation of Test Pit 2 - 1



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1958 Aerial of Site Region



Significant fill activity noted in area of Site.

Swale land features on the property have been filled in.

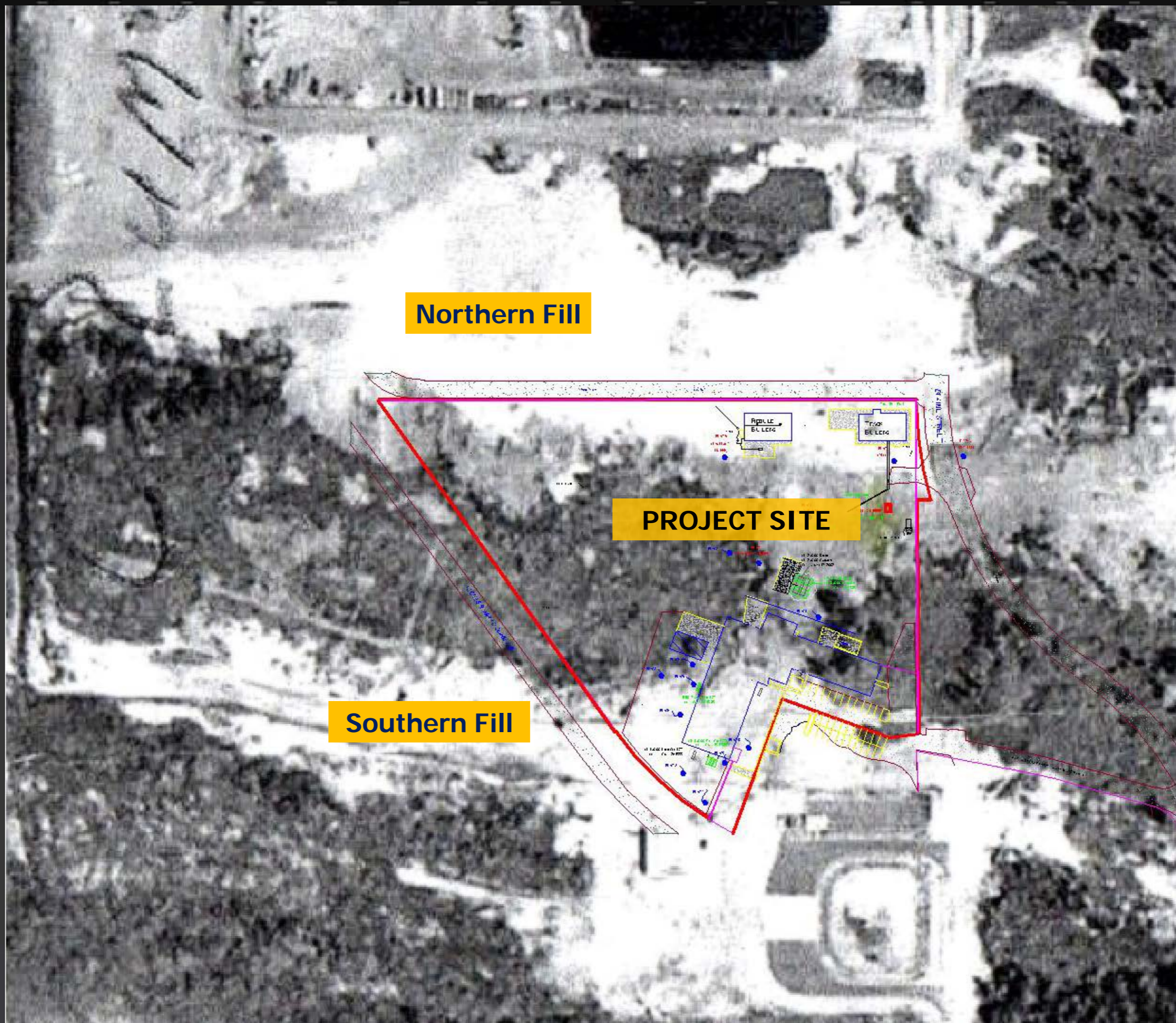


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1958 Aerial Photo

(with Site
Overlay)



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Putting it All Together...

- Petroleum impacts at the Site result from the following:
 1. Western impacts: Historical release from the northern UST.
 2. Central / Eastern impacts: Historical fill operations.
- Pre-1958, an unknown entity filled in regional dune swales with petroleum contaminated steel mill debris. Confirmed by the type of debris material and the nature of the petroleum (i.e., rolling mill and/or lube oils).
- The pre-1958 fill activities were wide spread and laterally extensive across a number of properties in the region.



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The End Game...

- Findings presented to the State of Indiana.
 - Hesitant of findings at first because it implied a much bigger issue.
- The Site was environmentally divided into two separate “regulatory parcels”.
 1. The UST impacted area was closed out via the Leaking UST program.
 2. Historical fill impacted area was placed in the State VRP.
 - Risk based closure (no complete risk-based pathways).
 - No responsibility for off-Site impacts.
 - Only obligation is to maintain fill cap across Site.
 - Site received a *Covenant Not to Sue Closure* via the VRP.



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Indiana Department of Environmental Management



Certificate of Completion

Issued to

FOR The successful completion of the Voluntary Remediation Work Plan for the Equipment Company site, IDEM #6080102, located at 408 N. Blaine St., Gary, (Lake County), Indiana, as more specifically described in the attached Exhibits 1-3, which are incorporated herein by reference. The issuance of a Certificate of Completion under IC 13-25-5 is a final agency action for purposes of IC 4-21.5.



GIVEN UNDER MY HAND IN THE CITY OF INDIANAPOLIS
THIS 9th DAY OF March, 2016

Carol S. Comer, Commissioner
Department of Environmental Management



A State that Works



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Lessons Learned...

1. It's important to not be so myopic that we lose sight of the bigger picture.
 - Our "Regional Geology" section of our environmental reports are there for a good reason.
2. We can't forget the temporal nature of our Sites.
 - Environmental impairments can occur prior to any operations begin on a piece of property.
3. As technology advances, we can't forget the importance of *old school* technology.
 - One trench can tell a story that a dozen soil borings can not.



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QUESTIONS?

Thank you!

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