



Client: Newman Properties, Inc.

ATTN: Tim Boyle, Mike Lesakowski

Project#: 0369

Project name: 3701 River Road

Laboratory#: L2500497



April 3, 2025

Tim Boyle, Mike Lesakowski
Newman Properties, Inc.
2101 St Ritas Lane
Williamsville, NY 14221

CQ Project# 0369
Project Name: 3701 River Rd

Introduction

I am the principal at ChemQuants, LLC, an environmental forensics firm founded in Santa Barbara, and currently operating in Austin, Texas. I received a bachelor's degree in Chemistry, a second bachelor's degree in Environmental Science, and a Master's degree in Analytical Chemistry from Florida International University. My professional experience has focused on fossil fuel, emerging and legacy contamination environmental forensics. Specialties include petroleum release investigations on coastal waterways, subsurface environments at petroleum terminals and fueling stations, as well as "big environmental data" chemometrics and data visualization on all major chemical classes of environmental contaminants. Besides being chair at a scientific conference, I have authored numerous publications and presentations to my peers.

ChemQuants, LLC is gratified to provide you with this report that focuses on the chemical fingerprinting results conducted recently on behalf of Newman Properties. The chemical fingerprinting analysis was carried out on three samples. The client started the study to understand the chemical source nature of the chemical signature(s) exhibited in three soil samples at 3701 River Rd (TP-4 PIANO, TP-5 PIANO, and TP-10 PIANO) (Figure 1).

Site Characteristics and History (per communications by client)

- The 3.2-acre Site is currently developed with one vacant commercial building
- The eastern portion of the Site is currently used as a landscape supply company
- The Site is in an industrial area that uses the public water system for its potable drinking water supply
- Prior to current operations, the Site was used as a portion of a greater oil refinery. See Timeline section of this report and Figure 11 for a detailed discussion and timeline of parcel ownership transfers. The timeline in Figure 11 was constructed from the historical documents contained in Appendix A
- Appendix A contains site history documents that were shared by the client and retrieved from online literature search

Client ID	Lab ID	Date Collected	Date Received	Matrix	Alkylated PAHs 8270D (Mod.)	VOC PIANO 8260D (Mod.)	TEL & TML in Soils
TP-4 PIANO	L2500497-01	1/6/2025	1/6/2025	Soil	X	X	X
TP-5 PIANO	L2500497-02	1/6/2025	1/6/2025	Soil	X	X	X
TP-10 PIANO	L2500497-03	1/6/2025	1/6/2025	Soil	X	X	X

ChemQuants, LLC
1320 Arrow Point Dr. Ste. 501 #65
Cedar Park, TX 78613
www.ChemQuants.com





The three samples were delivered to 1) Alpha Pace (Mansfield, MA) and analyzed with the following analytical methods¹:

- 1) Alkylated PAHs by GC/MS (SIM) / EPA 8270D (Mod.)
- 2) VOC PIANO by GC/MS EPA 8260D (Mod.)
- 3) TEL and TML in Soils (Subcontracted)

Investigative method

The forensics quality chemical data employed data analysis techniques typically used in a hydrocarbons forensics investigation. Petroleum hydrocarbons lines of evidence (“LOEs”) were applied and based on Well-established petroleum fingerprinting methodologies were relied on to examine bulk chemical and molecular signatures for source characterization and evaluate their potential differentiations². The characterization of contaminants sampled from the Site relied on the diagnosis of petroleum (petrogenic) signatures and potential contributions of pyrolytic (pyrogenic) signatures. Multiple lines of evidence (“MLE”) were developed from a) review of GC/FID chromatograms, b) review of GC/MS total ion chromatograms (TIC), c) review of saturate hydrocarbons data, d) review of parent and alkylated PAHs – including relevant diagnostic ratios and bar graph presentations, e) review of petroleum biomarkers – including appropriate diagnostic ratios and bar graph presentations.

A collection of pyrogenic source samples were procured from the ChemQuants data archive to provide general context and reference data points only (Figures 3, 4). Also for context only, the report was bolstered with a reference set of over 30 middle distillate fuels (“MD”) that included #2 diesel, #2 fuel oils & heating oils (Figure 2). The characterization effort in this report applied key principles of hydrocarbon source recognition practices for differentiating petroleum “petrogenic” features and hydrocarbon signatures derived from exposure to thermolytic processes “heat stress” (pyrogenic signatures) from processing for the petroleum economy, industrial operation processes involving practical use of petroleum oils, and hydrocarbons exposed to higher temperature combustion processes in general. In the context of this report the source characteristics under scrutiny are chemical signatures related to 1) petrogenic characteristics, and 2) pyrogenic character that may be derived from a myriad of combustion derived sources and processes.

Three themes emerged from the chemical data, which afforded a defensible characterization of the saturated and aromatic hydrocarbon features in the project samples - TP-4 PIANO, TP-5 PIANO, and TP-10 PIANO. Theme 1 considered dominating fingerprint characteristics of middle distillate range petrogenic hydrocarbon characteristics (i.e., related to #2 diesel fuel, #2 fuel oil,

¹ Douglas, G.D., Emsbo-Mattingly, S.D., Stout, S.A., Uhler, A.D., and McCarthy, K.J. (2007) Chemical fingerprinting of hydrocarbons and polychlorinated biphenyls. In: *Introduction to Environmental Forensics, 2nd Ed.*, B. Murphy and R. Morrison, Eds., Academic Press, New York, pp. 317-459.

² Stout, Scott A., Allen D. Uhler, and Paul D. Boehm. "Recognition of and allocation among multiple sources of PAH in urban sediments." *Environmental Claims Journal* 13.4 (2001): 141-158.



heating oil) in the samples³. Theme 2 considered petrogenic character that included significant enrichment of naphtha range to kerosene range aviation fuel contribution to the overall fingerprint⁶. Theme 3 considered review of 4-6 ring PAH or high molecular weight "HMW-PAHs" distributions, specifically related to Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene, Indeno (1,2,3-cd) pyrene, and Benzo (g,h,i) perylene, to explore their potential exposure to thermal or pyrolytic regimes⁴. Diagnostic ratios derived from HMW-PAH (Specifically the ratio used in the investigation) were applied in this study for source tracking in the environment due to their high stability across a wide range of weathering and concentration⁵.

Themes 1 & 2 (Petrogenicity) – Petrogenicity means being related to oil and include uncombusted petroleum, coal, coke, and refined oils such as distillate fuel oils and lubricants. Petrogenic oils typically consists of thousands of hydrocarbons and heteroatomic compounds that consists of resolved chemistry – individual hydrocarbons that can be separated and measured (e.g., n-paraffins, isoparaffins, PAHs, etc.), and unresolved chemistry ("UCM") that consists of branched and cyclic hydrocarbons that are too numerous to be separated and measured (Figures 3, 5). Molecular boiling range & character are important gross factor for differentiating crude oils among themselves and from refined petroleum oils.

Crude oils are typified by high concentrations and enhanced proportions of n-paraffins, which in most high to moderate API crude oils span the lighter volatile organic carbon range ~nC3 to ~nC12 ("VOC") to the semi-volatile carbon range ~nC8 to ~nC42 ("SVOC"). On the other hand, refined petroleum oils are engineered fractions and reacted products of crude oils that are derived from a variety of processes that alter the composition of feedstock crude oils⁶. For example, distillation fractionates the crude oil into desirable molecular boiling range "cuts," and catalytic cracking subjects' larger molecules to reactions that splits them into valuable smaller molecule fractions for gasoline, kerosene, and industrial fuels. For instance, the effect of distillation on a crude oil is readily clear in a GC/FID fingerprint as narrower molecular boiling range distributions that span the heavy naphtha range to lubricating distillate range⁶. Also, the effects of "splitting" (and other thermal stress inducing refinery processes) are more complex, yet still calculable with skilled forensic source recognition practices, and will be the primary subject of theme 3.

Aside from certain fuel formulations that are more complex and wide spanning arrangement of refinery products, e.g., heavy fuel oils ("HFOs") and intermediate fuel oils ("IFOs"), an important gross characteristic of a refined petroleum material is its narrower boiling range specifications that are typically mixtures of refinery intermediate products, and resultant fingerprint expression in a GC/FID chromatogram. For instance, aviation gasoline, and aviation fuels are produced from a combination of processes that lead to a significant variability in its composition across VOC to light SVOC range (~nC8 to ~nC16)⁶. For instance, aviation gasoline is composed of paraffins and

³ Douglas, G.S., Stout, S.A., Uhler, A.D., McCarthy, K.J., Emsbo-Mattingly, S.D. 2007. Advantages of Quantitative Chemical Fingerprinting in Oil Spill Source Identification. In: "Oil Spill Environmental Forensics. Fingerprinting and Source Identification" Ed. By Zhendi Wang and Scott A. Stout, Academic Press, 257-292

⁴ Yunker, Mark B., et al. "PAHs in the Fraser River basin: a critical appraisal of PAH ratios as indicators of PAH source and composition." *Organic geochemistry* 33.4 (2002): 489-515.

⁵ Uhler, A. D., and S. D. Emsbo-Mattingly. "Environmental stability of PAH source indices in pyrogenic tars." *Bulletin of Environmental Contamination & Toxicology* 76.4 (2006).

⁶ Speight, James G. *The Chemistry and Technology of Petroleum*. CRC Press, 1991.



iso-paraffins (~50%-60%), moderate amounts of naphthene's from the straight run gasoline intermediate (~20%-30%), lesser amounts of aromatics (~10%), and usually no olefins⁶. Thus, aviation gasoline exhibits lower boiling fingerprint aspects that are manufactured from straight run naphtha aviation base stock, higher boiling iso-paraffins from alkylate blend stock, and C2 to C4 monoaromatics from catalytic reforming or similar source⁶. Aviation fuels comprises both gasoline range and kerosene range products meeting different specifications for use in aviation turbine power units⁶. In addition to more nuanced features of petroleum, themes 1 and 2 consider insights from boiling range qualities and refinery process diagnostics for source type characterization.

Theme 3 (Pyrogenicity) – Pyrogenicity is derived from the combustion processes of petroleum fuels, hydrocarbons in general, and thermal stress's that may be related to a myriad of refinery control and production residues, industrial process artifacts, and the urban environment and its runoff⁶. Figures 3 and 4 present the three project samples overlayed to a variety of reference samples from the peer reviewed literature and ChemQuants data archive. The list of samples shows a range of chemical sources that expose hydrocarbons to thermolytic stress, which lead to the production of pyrogenic hydrocarbon chemistry.

Figures 3 and 4 presents a panel of scatter plots of diagnostic HMW-PAH ratios. The figures overlay the project samples TP-4 PIANO, TP-5 PIANO, and TP-10 PIANO to an array of reference source samples. Elevated HMW-PAH ratios and their respective chemical abundances emphasize pyrogenicity and are effective for diagnosing hydrocarbon exposure to thermal stresses. Abundances of HMW-PAHs, specifically those with five membered rings increases with exposure to higher temperatures, which show the following trend⁶:

~Fossil Fuel: $0 \leq \text{FL0}/(\text{FL0}+\text{PY0}) < 0.33$; Low BA0/(BA0+C0); Low IND/(IND+GHI)

~Low Temperature Process: $0.33 < \text{FL0}/(\text{FL0}+\text{PY0}) \leq 0.5$

~High Temperature Process: $0.5 < \text{FL0}/(\text{FL0}+\text{PY0})$; High BA0/(BA0+C0); High IND/(IND+GHI)

Theme 3 LOEs focus on characterizing the project samples with respect to their potential exposure to thermal stress regimes.

Results and Discussion

Chemical Data Investigation

Objective for this investigation was to evaluate the chemical data related to the project soil samples TP-4 PIANO, TP-5 PIANO, and TP-10 PIANO with defensible techniques and methodologies. The three themes in this investigation summarize a systematic method conducted for the source characterization of the project soil samples collected from various locations and depths, while each theme corresponded to distinct discriminating attributes of the chemical signatures.



Themes 1 & 2 (Petrogenicity) – TP-4 PIANO, TP-5 PIANO exhibited petrogenic chemical signatures described by VOC to SVOC molecular boiling ranges as shown in the GC/MS (FS/TIC) chromatograms (Figures 5 and 7). In both samples the VOC range signature showed low expressions of paraffinic and isoparaffinic compounds as showed as blue bars and red bars respectively in the VOC PIANO bar graphs of Figures 5 and 7. In both project samples C3 to C4 monoaromatic hydrocarbons (green bars) are significantly more abundant than isoparaffins, and cyclic hydrocarbons called naphthene's in purple are prominent - methylcyclopentane (MCYP), cyclohexane (CYHX), and methylcyclohexane (MCYHX) (Figures 5, 7). Heavy naphtha range hydrocarbon chemistry is also exhibited in the very lightest segment of the SVOC range, and the gross presence of the hydrocarbons are evident in the clustering of chemical "peaks" that elute toward the "light-end" (left side) of the chemical chromatograms (Figures 5 and 7 – top).

Heavy Naphtha Range Signature in TP-4 PIANO - More specifically in the lighter end of the SVOC range, heavy naphtha range chemistry is more pronounced in TP-4 PIANO as enrichments of more biodegradation resistant nC8 to nC13 hydrocarbons (Figure 5), relative to depleted expressions of less biodegradation resistant n-paraffins (Figure 5). The severely depleted, i.e., biodegraded quality of the heavy naphtha range petroleum signature is expressed in a) ethylbenzene dominant C2 monoaromatics "BTEX" complex, whereas benzene toluene, and xylenes were removed from biodegradation (Figure 5), complete removal of nC8 to nC13 n-paraffins in the VOC range signature (Figure 5), and relative enrichments of branched hydrocarbons > biodegraded normal alkanes (Figure 5). Heavy naphtha range distributions of more biodegradation resistant and source diagnostic hydrocarbons are exhibited as: CH-2 to CH-4 alkylcyclohexanes (83 m/z) (Figure 6); significant enrichments of heavy naphtha range i-9 to i-14 isoparaffins; and relative enhancements of C1 > C2 alkylnaphthalenes & C4 monoaromatics > C1 alkylnaphthalenes (Figures 5).

Middle Distillate Range Fuel Signatures in TP-4 PIANO & TP-5 PIANO - The SVOC range signatures of the TP-4 PIANO, TP-5 PIANO chromatograms also showed prominence of middle distillate range hydrocarbon chemistry as showed by the UCM and n-paraffins spanning ~nC13 to nC22 (Figures 5, 7). TP-4 PIANO was significantly and preferentially more enriched with heavy naphtha range hydrocarbons (Figures 5), while TP-5 PIANO exhibited prominence of nC13 to nC22 middle distillate range hydrocarbons (Figures 7). A broad range of alkylated PAHs that extended beyond two to four ring alkylated PAHs and SPAHs (sulfur heterocyclics) that are representative for middle distillate range petroleum, occurred in TP-4 PIANO, TP-5 PIANO. For instance, TP-4 PIANO, TP-5 PIANO were enriched with lower amounts of three to four ringed alkylated PAHs and SPAHs, and five to six ring heavy molecular weight PAHs ("HMW-PAHs") (Figures 5, 7 – Y-axis Inset). In accordance with enrichments of higher ringed PAHs in the two samples the UCM signatures of the petroleum extended beyond the middle distillate range to the residual range (Figures 5, 7).

Hydrocarbon boiling range extension to the heavier residual range was greater in TP-5 PIANO as evident in the pronounced bi-modal UCM characteristic and significant enrichments of residual range petroleum biomarkers e.g., terpanes 191 m/z (Figures 6, 8). Along with general petrogenic source divergences between TP-4 PIANO and TP-5 PIANO, a detailed investigation of "specific chemical fingerprints" showed that the feedstock source properties of the petroleum were also



distinct. For example, a) the relative differences of bulk properties like UCM, the relative differences of alkylated phenanthrene PAHs and alkylated chrysenes, (Figures 5, 7) and the relative differences of middle distillate range biomarker fingerprints like bicyclanes were distinct (123 m/z) (Figures 6, 8). Forensic fingerprint analysis revealed that although the period of residence time in the subsurface were not significantly different, the middle distillate fuels expressed in TP-4 PIANO and TP-5 PIANO were from dissimilar sources and fugitive releases.

Unleaded Gasoline in TP-4 PIANO & TP-5 PIANO & Heavier Petroleum Signature in TP-5 PIANO

A more focused analysis of the less obvious chemical attributes of TP-5 PIANO, which included residual range chemistry, showed that the heavier component was an admixture from a completely different source. Also, minor admixture contributions of unleaded gasoline were evident in TP-4 PIANO and TP-5 PIANO as enrichments of alkylate feedstock derived attributes (Table 1 - #1), and occurrence of tert-amyl methyl ether ("TAME") in TP-5 PIANO. This data driven opinion of the heavier admixtures in TP-5 PIANO stemmed from shared diagnostic attributes that were conclusively derived from the Theme 3 study in the following section of TP-10 PIANO. For instance, a) similar heavier tail profiles of terpanes (191 m/z) were evident (Figures 6, 8), b) TP-5 PIANO and TP-10 PIANO were enriched with Retene - a biogenic PAH derived from conifer trees⁷, and c) TP-5 PIANO presented HMW-PAH ratios that were more expressive than TP-4 PIANO of exposure to higher temperature pyrogenic processes. For instance, HMW-PAH ratios of TP-5 PIANO presented exposure to higher temperature processes in line with 1) a reference mixture of petroleum and tar from a carbureted water gas ("CWG") process, 2) and a reference sample from a petroleum handling facility (Figure 4).

Source candidates and time of release estimations

Aviation Fuel in TP-4 PIANO - Refined petroleum products are the dominant characteristic for TP-4 PIANO and TP-5 PIANO samples. The detailed review of the fingerprint features of TP-4 PIANO showed that TP-4 was dominated by heavy naphtha range chemistry > middle distillate range chemistry, which leads to the two questions about the heavy naphtha range signature: 1) what type of fuel is it? 2) When was the fuel released? Multiple lines of evidence provided in the detailed discussion above and reconnaissance of historical documents in Appendix A (visually summarized in Figure 11) provided data driven support to address the first question. The detailed investigation of the hydrocarbon chemistry in TP-4 PIANO concluded that that the soil samples was enriched with a severely biodegraded heavy naphtha range source as expressed in the near complete removal of n-paraffins and C2-monoaromatics.

It was discussed that heavy straight run gasoline i.e., heavy naphtha is a dominant refinery intermediate product blended to manufacture some varieties of aviation fuels. In addition, reconnaissance of historical Site documents provided conclusive evidence that aviation fuels were stored in multiple tanks on parcel O with piping networks that extended to the adjacent parcel N of 3701 River Road where the soil samples were collected for this forensic investigation (Figure 1;

⁷ Wakeham, Stuart G., Christian Schaffner, and Walter Giger. "Poly cyclic aromatic hydrocarbons in Recent lake sediments—II. Compounds derived from biogenic precursors during early diagenesis." *Geochimica et Cosmochimica Acta* 44.3 (1980): 415-429.



Appendix A - Exhibit 1, 16, and 21). The 1979 survey of Exhibit 16 shows that aviation fuel was stored in parcel O since at least 1979. Addressing the first characterization question, multiple lines of evidence revealed that the heavy naphtha component in TP-4 PIANO was an aviation fuel. Regarding the second question of residence time in the subsurface, multiple lines of evidence were applied to estimate the time of release of the aviation fuel in TP-4 PIANO sample. The lines of evidence included a biodegradation model calibrated by subsurface weathering potential regimes that are functions of subsurface soil characteristics like depth to groundwater, overlying soil cover, lithology and texture of geology, and geochemical conditions of the soil⁸. Soil characteristics prevalent in the Site proximity are as stated by the client as having a deep-water table ranging from 12 to 24 feet and a clay dominant lithology.

Also, it is known that soils in Tonawanda near 3701 River Road⁹ are poorly drained soils with pH ranges from strongly to moderately acidic in the surface to subsoil layer. TP-4 PIANO was collected 3 feet below ground surface, which was well above the water table range. These conditions supported a characterization of the potential subsurface weathering regime as being weak. The classification of a weak weathering potential regime in the subsurface was based on subdued and limited biological activity due to a) significant overlying soil cover, b) soil sample collected from above the deep-water table, and c) soils with clay and silty lithology and texture. As discussed above the hydrocarbon profiles of TP-4 PIANO were near to completely depleted of n-paraffins from nC8 to nC13 and C2 monoaromatics "BTEX".

Also, the more recalcitrant and biodegradation resistant CH₂ to CH₄ alkylcyclohexanes biomarkers were microbially altered to a significant extent. This heavy to severe stage of biodegradation attribution in the context of the weak weathering potential regime provided evidence that the aviation fuel experienced a residence time in the subsurface ranging of at least 40 years. The geochemically derived lower boundary time of release estimate was calibrated to a time range that was informed by two historical markers, a) the date of tank removal as shown in Exhibit 17 & 20 - 1987, and b) the dated survey indicating that aviation fuels and heating oils were stored on Parcels N and O from earlier than the survey's time stamp of 1979 in Exhibit 16. These historically weighted lines of evidence show that aviation fuel impacted the subsurface at least 40 years ago. Understandably, an upper time of release boundary can be further elucidated with additional historical and chemical lines of evidence extending to the mid-century when the tank infrastructure was first erected on Parcels N and O.

Heating Oils in TP-4 PIANO & TP-5 PIANO – As discussed in the last section of this report, the detailed review of the fingerprint features of TP-4 PIANO and TP-5 PIANO soil samples showed that 1) TP-4 PIANO, although dominated by the aviation fuel source component, exhibited significant enrichment of middle distillate range fuel chemistry, and 2) TP-5 PIANO exhibited a petroleum signature that was dominated by middle distillate range fuel chemistry. Furthermore, it was defensibly concluded in the last section that the middle distillate fuel in TP-4 PIANO originated from a different middle distillate fuel feedstock and thus a different fugitive release. As

⁸ Oudijk, Gil. "Age dating heating-oil releases, Part 2: Assessing weathering and release time frames through chemistry, geology and site history." *Environmental Forensics* 10.2 (2009): 120-131.

⁹ Official Series Description - TONAWANDA Series (USDA soilseries.sc.egov.usda.gov)



with the aviation gasoline source that dominated TP-4 PIANO soil sample, these significant petroleum enrichments in the soil samples lead to two questions about the middle distillate range signatures: 1) what type of middle distillate fuel is it? 2) and when were the fuels released?

Multiple lines of evidence provided in the detailed discussion above and reconnaissance of historical documents in Appendix A (visually summarized in Figure 11) provided data driven support to address the first and second questions. The detailed investigation of the hydrocarbon chemistry in TP-4 PIANO & TP-5 PIANO in the previous section concluded that that the soil samples were conclusively characterized as middle distillate range fuel products. Regarding the types of middle distillate fuel in the soil samples, organic sulfur diagnostics and historical site reconnaissance were concurrently applied. Organic sulfur diagnostics yielded insights to the formulation era of the middle distillate range fuel.

Different refinery eras in the U.S. are differentiated by sulfur reduction efforts that over the last 20+ years have been achieved through hydrodesulfurization (HDS)⁶, with effects of HDS reactions reflected in the hydrocarbons chemistry¹¹. As a consequence, different manufacturing eras of middle distillate range fuels are generally reflected in a) relationships of sulfur-containing alkylated dibenzothiophenes (green bars in Figures 5, 7) to alkylated phenanthrene PAH moieties (Table 1, Figure 2, and Figures 5, 7), b) changes to certain dibenzothiophenes (DBTs) isomers over others (in main data package), and c) abundance of alkylated decalins (blue bars in Figures 5, 7) relative to alkylated dibenzothiophenes.

Review of these critical organic sulfur diagnostics revealed that the middle distillate fuels in both soil samples TP-4 PIANO & TP-5 PIANO clustered with the highest sulfur enriched populations of middle distillate fuel oils and heating oils from ChemQuants data archive and peer reviewed literature (Figure 2). Based on the Figure 2 diagnostic ratios, this population of middle distillate range fuels exhibited diagnostic ratios and total sulfur attributes that exceeded non-road, locomotive, and certainly on-road U.S. regulatory diesel limits of 1993. In addition, the low abundances of alkylated decalins relative to alkylated dibenzothiophenes bolsters a defensible conclusion that the middle distillate range fuels in TP-4 PIANO & TP-5 PIANO were high sulfur fuels that were not subject to extensive desulfurization reactions at the refinery.

A more specific characterization of the high sulfur fuel was bolstered with additional lines of evidence from reconnaissance of historical Site documents. These historical lines of evidence concluded that heating oil was stored in a large tank in parcel N of 3701 River Road where the soil samples were collected for this forensic investigation (Figure 1; Appendix A - Exhibit 1, 16, and 22). The 1979 survey of Exhibit 16 shows that heating oil was stored in parcel N since at least 1979. Because of multiple lines of chemical and historical evidence, it is defensibly stated that the high-sulfur middle distillate fuels expressed in TP-4 PIANO & TP-4 PIANO soil samples were of the non-road heating oil variety.

Addressing the first characterization question, multiple lines of evidence revealed that the middle distillate fuels in TP-4 PIANO & TP-5 PIANO were heating oils from different feedstock sources. Regarding the second question of residence time in the subsurface, multiple lines of evidence were applied to estimate the time of release of the heating oils in TP-4 PIANO & TP-5 PIANO soil



samples. The lines of evidence included the organic sulfur diagnostics discussed in the last paragraph, and the biodegradation model calibrated by subsurface weathering potential regimes that was characterized as being weak⁸. As discussed in the previous section the time of release model considers biodegradation dynamics of a wide range of hydrocarbons, in addition to a biodegradation index based on the relationship between nC17 and Pristane^{8,10,11}.

A biodegradation-based index was used as an additional line of evidence to assess the middle distillate range fuels approximate age in both TP-4 PIANO and TP-5 PIANO samples. The well documented time-based model is a biodegradation index based on the relationship between nC17 and Pristane. The approximate nC17/Pristane ratio value of ~0.8 (TP-4 PIANO) / ~0.72 (TP-4 PIANO) indicates that the petroleum in both samples were appreciably depleted of n-paraffins (~>80%), thus heavily biodegraded. These historically weighted line of evidence show that aviation fuel impacted the subsurface at least 40 years ago.

The geochemically derived lower boundary time of release estimate was calibrated to a time range that was informed by two historical markers, a) the date of tank removal as shown in Exhibit 20 - 1987, and b) the dated survey indicating that aviation fuels and heating oils were stored on Parcels N and O from earlier than the survey's time stamp of 1979 in Exhibit 16. These historically weighted lines of evidence show that aviation fuel impacted the subsurface at least 40 years ago. Understandably, an upper time of release boundary can be further elucidated with additional historical and chemical lines of evidence extending to the mid-century when the tank infrastructure was first erected on Parcels N and O.

Theme 3 (Pyrogenicity) – As communicated in the last section, TP-10 PIANO (and to a minor extent in admixture TP-5 PIANO) showed lower concentration expressions of pyrogenicity. The primary question of this section explores the characteristics of pyrogenicity – what process(s) caused the pyrolysis of hydrocarbons in the TP-10 PIANO sample? And can time of release be estimated from the chemistry and preponderance of evidence? In this report pyrogenicity is evaluated with PAH fingerprint reviews and diagnostics of HMW-PAH abundances and ratio characteristics. Three diagnostic ratios derived from HMW-PAH were applied in this study for source characterizations of TP-10 PIANO due to their high stability across a wide range of weathering and concentration⁵. Furthermore, the HMW-PAH ratios were explored in a comparative fashion among a diverse population of candidate source samples assembled from the peer-reviewed literature and ChemQuants data archive (Figures 3, 4; Table 1).

HMW-PAH ratio values for TP-10 PIANO plotted on the top right quadrant of each scatter plot in Figures 3, 4, which are values associated to hydrocarbons that were exposed to significant pyrolysis. TP-10 PIANO expressed ratio values consistent with higher temperature pyrolysis characteristics since $FL/(FL+PY) > 0.5$, and values of $BA0/(BA0+C0)$ and $IND/(IND+GHI)$ were high. The HMW-PAHs of TP-10 PIANO. Among the reference candidate samples the strongest ratio

¹⁰ Schade, Thomas, Benedikte Roberz, and Jan T. Andersson. "Polycyclic aromatic sulfur heterocycles in desulfurized diesel fuels and their separation on a novel palladium (II)-complex stationary phase." *Polycyclic Aromatic Compounds* 22.3-4 (2002): 311-320.

¹¹ Wade, Michael J. "Age-dating diesel fuel spills: Using the European empirical time-based model in the USA." *Environmental Forensics* 2.4 (2001): 347-358.



correspondence was to a sample that was characterized as coke/clinker w/ trace of refined petroleum (Figures 3, 4). The next ranking candidate source were related to a set of tars from MGP sites (Figures 3, 4). Significant pyrogenicity was evident upon inspection of TP-10 PIANO parent and alkylated PAH bar graph. At first pass one may interpret this signature as a weathered MGP tar (Figure 9).

However, preponderance of evidence from HMW-PAH ratios in addition to the following factors indicate that the pyrogenicity expressed in TP-10 PIANO was not a weathered MGP tar: a) The chemical chromatogram of TP-10 PIANO exhibited a significant residual range UCM aspect without concomitant dominance of a resolved parent and alkylated pyrogenic PAH profile (Figure 9), b) The PAH bar graph of Figure 9 exhibits that TP-10 PIANO contains prominence of higher molecular weight and higher alkylated series of PAHs and SPAHs, c) furthermore the ion trace of n-paraffins (85 m/z) in TP-10 PIANO indicates the prominence of an odd to even pattern extending to nC35. In concert, these aspects provide robust evidence that the pyrogenicity of TP-10 PIANO is more likely consistent with carbonized coal ("Coke") and admixtures of uncombusted or uncarbonized particulate coal^{12,13}. In addition to the pyrogenic aspects TP-10 PIANO contained traces of alkylate gasoline feedstock derived attributes (Figure 9, Table 1 - #1), and leaded gasoline formulations (Figure 9, Table 1 - #3, 4).

Timeline of 3701 River Road with Detailed Ownership Transfers of Parcels

The timeline diagram meticulously tracks the ownership history of 3701 River Road parcels, with particular emphasis on the complex transfers between companies and the forensic evidence period related to subsurface contamination (Figure 1; Figure 11; Appendix A).

Detailed Ownership Transfer History of 3701 River Road Parcels

The diagram in Figure 11 presents a comprehensive visualization of the complex ownership transfers for 3701 River Road parcels, tracking each parcel's history separately before they were unified under common ownership

Parcels N & O Ownership Path

The ownership journey of parcels N and O began in 1927 when they were acquired from Wonalancet Company by Beacon Oil Company, which immediately developed petroleum infrastructure on the site:

1927: Beacon Oil Company Acquisition and Development

- Beacon Oil Company purchased Parcels N and O from Wonalancet Company

¹² Emsbo-Mattingly, S. D., and S. A. Stout. "Semivolatile hydrocarbon residues of coal and coal tar." *Coal and peat fires: A global perspective 1* (2011): 173-208.

¹³ Stout, Scott A., and Andrew P. Brey. "Appraisal of coal-and coke-derived wastes in soils near a former manufactured gas plant, Jacksonville, Florida." *International Journal of Coal Geology* 213 (2019): 103265.



- Erected a pump house on these parcels
- Installed 5-10,000-gallon oil storage tanks, pipelines, and dikes

1928: Corporate Merger

- Beacon Oil Company merged with Colonial Oil Company to form Colonial Beacon Oil Company
- Despite the merger, the petroleum infrastructure continued to operate on these parcels
- Additional improvements were made including tankage, pipelines, and sidetrack

1929: Change in Corporate Control

- Standard Oil of New Jersey acquired a controlling interest in Colonial Beacon Oil Company
- Despite this acquisition, Colonial Beacon Oil Company maintained its brand identity for marketing purposes in New England and New York
- Operational control of the parcels remained with Colonial Beacon Oil Company while Standard Oil of New Jersey influenced strategic decisions

1945-1947: Company N Ownership Period

- During this brief period, Colonial Beacon Oil Company owned all four parcels (N, O, P, and Q)
- This represented the first time all parcels were unified under a single entity

1947: Formal Takeover by Standard Oil of New Jersey

- Standard Oil of New Jersey, which had held controlling interest since 1929, formally took over the business
- All assets of Colonial Beacon Oil Company, including Parcels N and O, were transferred to Standard Oil of New Jersey
- This completed the corporate absorption that had begun almost two decades earlier

Shell Eastern Petroleum Products Incorporated & Shell Union Oil Corporation Ownership Path

The ownership history of Parcels P and Q followed a different and more complex path:

1930: Initial Acquisition by Shell Eastern Petroleum Products Incorporated

- Shell Eastern Petroleum Products Incorporated acquired Parcels P and Q from Wonalancet Company
- Unlike Parcels N and O, aerial imagery from 1938 showed no to minimal petroleum infrastructure erected on these parcels at that time

1936: Transfer to Shell Union Oil Corporation



- Shell Eastern Petroleum Products transferred Parcels P and Q to Shell Union Oil Corporation
- Still no significant petroleum infrastructure development based on 1938 aerial images

1938: Split Ownership Period

- Shell Union Oil Corporation transferred Parcel P to Shell Oil Company
- Parcel Q remained under Shell Union Oil Corporation ownership
- This created a period of split ownership between these adjacent parcels

1945: Reunification under Colonial Beacon Oil Company

- Shell Oil Company transferred Parcels P and Q to Colonial Beacon Oil Company
- This brought all four parcels (N, O, P, and Q) under Colonial Beacon Oil Company ownership
- The consolidation of ownership facilitated integrated operations across the 3701 River Road property

1947: Transfer to Standard Oil of New Jersey

- Parcels P and Q were transferred to Standard Oil of New Jersey
- This completed the unification of all parcels under Standard Oil of New Jersey

Unified Ownership Period (1947-1987)

After 1947, all parcels of 3701 River Road followed a common ownership trajectory:

1947: Complete Unification

- All parcels (N, O, P, and Q) were unified under Standard Oil of New Jersey ownership
- This allowed for integrated petroleum storage operations across the 3701 River Road property

1948: Corporate Rebranding

- Standard Oil of New Jersey changed its name to ESSO Standard Oil Company
- Ownership of the parcels remained unchanged; this was purely a corporate identity change

1951: Infrastructure Expansion

- Aerial imagery from this period revealed additional petroleum infrastructure had been erected between 1938 and 1951
- New facilities were developed across Parcels N, O, and P
- This expansion reflected growing demand for petroleum storage in the post-WWII period

1960: Corporate Merger

ChemQuants, LLC
1320 Arrow Point Dr. Ste. 501 #65
Cedar Park, TX 78613
www.ChemQuants.com





- ESSO Standard Oil Company merged with Carter Oil Company to form Humble Oil & Refining Company
- 3701 River Road continued to operate as a petroleum storage facility through this transition

1972: Acquisition by EXXON Corporation

- Humble Oil & Refining Company merged into Exxon Corporation
- EXXON Corporation maintained the petroleum storage operations at 3701 River Road
- As notable in the 1979 survey details - parcels N and O were used as a fuel storage terminal that stored "aviation fuel", "unleaded gasoline", and "heating oil" (middle distillate range fuel) since at least 1979. Also notable in the 1979 survey details was the pipeline network associated to the loading rack of parcel N
- This ownership period coincides with the lower end of the release period range of at least 1979 to 1987

1979: Sale to Ashland Oil, Inc.

- EXXON Corporation transferred all parcels to Ashland Oil, Inc.
- Ashland Oil, Inc. operated the site from 1979 to 1987
- As notable in the 1979 survey details - parcels N and O were used as a fuel storage terminal that stored "aviation fuel", "unleaded gasoline", and "heating oil" (middle distillate range fuel) since at least 1979. Also notable in the 1979 survey details was the pipeline network associated to the loading rack of parcel N
- This ownership period coincides with the lower end of the release period range of at least 1979 to 1987

1987: Final Transfer and Tank Removal

- Ashland Oil, Inc. transferred all parcels to NOCO Energy Corporation
- Within six months of acquisition, NOCO Energy Corporation removed all storage tanks (10-million-gallon capacity) that were labeled in the 1979 survey details and NOCO related aerial map document as containing "aviation fuel", "unleaded gasoline", and "heating oil" (middle distillate range fuel)
- This tank removal event of 1987 informed and calibrated the forensic investigation

Forensic Evidence and Ownership Timeline Correlation

The petroleum forensics investigation conducted on Parcel N of 3701 River Road revealed critical contamination evidence:

Contamination Characteristics

- TP-4 PIANO (L2500497-01): Mixture of aviation fuel and heating oil, with minor aspect of unleaded gasoline
- TP-5 PIANO (L2500497-02): Heating oil mixed with pyrogenic coke-related particles, with minor aspect of unleaded gasoline
- TP-10 PIANO (L2500497-03): Significantly lower concentration pyrogenic aspect in soil characterized as coke-like, with minor aspect of leaded gasoline



Time of Petroleum Release Analysis

The geochemically derived lower boundary time of release estimate was calibrated to a time range that was informed by two historical markers, a) the date of tank removal as shown in Exhibit 20 - 1987, and b) the dated survey indicating that aviation fuels and heating oils were stored on Parcels N and O from earlier than the survey's time stamp of 1979 in Exhibit 16. These historically weighted lines of evidence show that aviation fuel impacted the subsurface at least 40 years ago. Understandably, an upper boundary time of release estimate can be further elucidated with additional historical and chemical lines of evidence extending to the mid-century when the tank infrastructure was first erected on Parcels N and O.

- This lower boundary time range specifically overlaps with:
 - EXXON Corporation (1972 -1979)
 - The end of Ashland Oil, Inc. ownership (1979-1987)
 - The beginning of NOCO Energy Corporation ownership (1987 onward)

Significance of the Ownership-Contamination Correlation

The refined timeline offers crucial insights into potential responsibility for the contamination:

Critical Periods (pre-1979), (1980-1987) & (1987-1990)

- This period timeframe more appropriately captures the period of Exxon's ownership, Ashland's ownership, and NOCO tank removal.

Contamination Sources

- The heating oil, unleaded gasoline, and aviation fuel components in TP-4 PIANO (L2500497-01) and TP-5 PIANO (L2500497-02) originated from 3701 River Road petroleum storage operations



Conclusions

This investigation resulted in data driven opinions from applications of environmental forensic techniques and principles that included chemical analysis and reconnaissance of historical documents of the Site environs. The primary objective of this investigation was to assess the characteristics and subsurface residence time of the hydrocarbon's signatures enriched in three soil samples collected from parcel N of 3701 River Road. Review of multiple lines of evidence concluded the following dominant chemical source attributes of hydrocarbons in the soil samples: TP-4 PIANO soil sample was enriched with a mixture of aviation fuel and heating oil, TP-5 PIANO soil sample was enriched with a mixture of heating oil and relatively lower level of coke-like pyrogenic aspect, TP-10 PIANO soil sample exhibited a low concentration coke-like pyrogenic aspect. The combination of chemical analysis, review of subsurface conditions, and review of historical Site related documents showed that: the aviation fuel enriched in TP-4 PIANO soil sample, and heating oils enriched in TP-4 PIANO and TP-5 PIANO were released at least 40 years ago from historical tank(s) or pipeline network associated to heating oil handling on parcel N. An upper boundary time of release estimate can be further elucidated with additional historical and chemical lines of evidence extending to the mid-century when the tank infrastructure was first erected on Parcels N and O.

Upon receipt of additional information, I reserve the right to modify and supplement my opinions outlined in this report.

You may email any questions or concerns to markcejas@chemquants.com regarding chemistry data or interpretation.

Respectfully submitted,

Mark Jonathan Cejas

Principal



ChemQuants project ID	369	369	369
Project Name	3701 River Rd	3701 River Rd	3701 River Rd
Sample ID	TP-4 PIANO	TP-5 PIANO	TP-10 PIANO
Laboratory ID	L2500497-01	L2500497-02	L2500497-03
Sample Type	SOIL	SOIL	SOIL
Diagnostic SVOC Ratio (Biodegradation Properties)			
1) nC17/Pristane	0.81	0.71	
Diagnostic VOC Ratios (Refining Properties)			
2) 2,2,4-Trimethylpentane / (2,2,4-Trimethylpentane+Methylcyclohexane)	0.71	0.07	NR
Oxygenates & Other (ug/kg)			
3) Tert-amyl methyl ether (TAME)		49.5	
Lead Scavengers (ug/kg)			
4) 1,2-Dichloroethane (EDC)			22.7
Organic Lead Isomers (ug/kg)			
5) Tetraethyl Lead (%)			360
Total PAH Parameters (ug/kg)			
6) TPAH(50) (Parent, Alkylated, & HMW PAHs)	142469	24149	13086
7) TPAH(16) (Parent PAHs and HMW PAHs)	19955	1208	7571
Fraction of Pyrogenic PAHs			
8) (FL + Py) / (C2 + C3 + C4 P/As)	0.10	0.09	8.29
9) Σ 4-6 Ring PAHs / Σ PAHs	0.01	0.02	0.83
Pyrogenic & Petrogenic Ratios			
10) IND / (IND + GHI)	0.44	0.38	0.48
11) BA0 / (BA0 + C0)	0.45	0.35	0.52
12) (BBF+BJKF) / (BBF+BJKF+BA0)	0.70	0.75	0.64
13) BAP / (BAP + BEP)	0.48	0.42	0.59
14) C3 DBT / (C3 DBT + C3 BC)	0.93	0.88	0.10
15) C2 DBT / (C2 DBT + C2 BC)	0.98	0.95	0.15
16) C3 DBT / C3 P/A	0.70	0.86	0.51
17) C2 DBT / C2 P/A	0.62	0.67	0.29
Note: If field is "NR" a ratio was not calculable.			
FL=Fluoranthene			
Py=Pyrene			
C=Chrysenes			
P=Phenanthrene/Anthracenes			
DBT = Dibenzothiophenes			
BC = Benzantracenes / Chrysenes			
BA0 = Benzo(a)anthracene			
C0 - Chrysene			
BBF = Benzo(b)fluoranthene			
BJKF = Benzo(j)+(k)fluoranthene			
BAP = Benzo(a)pyrene			
IND - Indeno(1,2,3,-cd)Pyrene			
GHI - Benzo(g,h,i)Perylene			

Table 1. Diagnostic Properties for the Project Samples.



Abbreviation	SVOC Compound	Abbreviation	SVOC Compound
D0	cis/trans-Decalin	NBT1	C1-Naphthobenzothiophenes
D1	C1-Decalins	NBT2	C2-Naphthobenzothiophenes
D2	C2-Decalins	NBT3	C3-Naphthobenzothiophenes
D3	C3-Decalins	NBT4	C4-Naphthobenzothiophenes
D4	C4-Decalins	BA0	Benz(a)anthracene
N0	Naphthalene	C0	Chrysene/Triphenylene
N1	C1-Naphthalenes	BC1	C1-Chrysenes
N2	C2-Naphthalenes	BC2	C2-Chrysenes BS
N3	C3-Naphthalenes	BC3	C3-Chrysenes
N4	C4-Naphthalenes	BC4	C4-Chrysenes
BT0	Benzothiophene	BBF	Benzo(b)fluoranthene
BT1	C1-Benzo(b)thiophenes	BJKF	Benzo(j)+(k)fluoranthene
BT2	C2-Benzo(b)thiophenes	BAF	Benzo(a)fluoranthene
BT3	C3-Benzo(b)thiophenes	BEP	Benzo(e)pyrene
BT4	C4-Benzo(b)thiophenes	BAP	Benzo(a)pyrene
B	Biphenyl	PER	Perylene
DF	Dibenzofuran	IND	Indeno(1,2,3-cd)pyrene
ACY	Acenaphthylene	DA	Dibenz(a,h)+(a,c)anthracene
ACE	Acenaphthene	GHI	Benzo(g,h,i)perylene
F0	Fluorene	2MN	2-Methylnaphthalene
F1	C1-Fluorenes	1MN	1-Methylnaphthalene
F2	C2-Fluorenes	26DMN	2,6-Dimethylnaphthalene
F3	C3-Fluorenes	235TMN	2,3,5-Trimethylnaphthalene
DBT0	Dibenzothiophene	4MDT	4-Methyldibenzothiophene(4MDT)
DBT1	C1-Dibenzothiophenes BS	2MDT	2/3-Methyldibenzothiophene(2MDT)
DBT2	C2-Dibenzothiophenes	1MDT	1-Methyldibenzothiophene(1MDT)
DBT3	C3-Dibenzothiophenes	3MP	3-Methylphenanthrene (3MP)
DBT4	C4-Dibenzothiophenes	2MP	2-Methylphenanthrene (2MP)
P0	Phenanthrene	2MA	2-Methylantracene (2MA)
P1	C1-Phenanthrenes/Anthracenes	9MP	9/4-Methylphenanthrene (9MP)
P2	C2-Phenanthrenes/Anthr BS	1MP	1-Methylphenanthrene (1MP)
P3	C3-Phenanthrenes/Anthracenes	BbFl	Benzo(b)fluorene
P4	C4-Phenanthrenes/Anthracenes	BcFl	7H-Benzo(c)fluorene
A0	Anthracene	2MPy	2-Methylpyrene
CAR	Carbazole	4MPy	4-Methylpyrene
FL0	Fluoranthene	1MPy	1-Methylpyrene
PY0	Pyrene	R	Retene
FP1	C1-Fluoranthenes/Pyrenes		
FP2	C2-Fluoranthenes/Pyrenes		
FP3	C3-Fluoranthenes/Pyrenes		
FP4	C4-Fluoranthenes/Pyrenes		
NBT0	Naphthobenzothiophenes		

Table 2. Chemical Abbreviations for PAHs.



Abbreviation	VOC Compound	Abbreviation	VOC Compound	Abbreviation	VOC Compound
3M1B	3-Methyl-1-butene	ECYP	Ethylcyclopentane	IBCYHX	Isobutylcyclohexane
ISOP	Isopentane	223TMP	2,2,3-Trimethylpentane	1M2EB	1-Methyl-2-Ethylbenzene
1P	1-Pentene	234TMP	2,3,4-Trimethylpentane	C10	Decane (C10)
2M1B	2-Methyl-1-Butene	233TMP	2,3,3-Trimethylpentane	TBUTB	tert-Butylbenzene
C5	Pentane	23DMHX	2,3-Dimethylhexane	124TMB	1,2,4-Trimethylbenzene
T2P	trans-2-Pentene	2MHP	2-Methylheptane	IBUTB	Isobutylbenzene
IPE	Isoprene	4MHP	4-Methylheptane	SBUB	sec-Butylbenzene
C2P	cis-2-Pentene	3MHP	3-Methylheptane	1M3IPROPB	1-Methyl-3-Isopropylbenzene
TBA	Tertiary Butanol	3EHX	3-Ethylhexane	1M4IPROPB	1-Methyl-4-Isopropylbenzene
22DMB	2,2-Dimethylbutane	T	Toluene	123TMB	1,2,3-Trimethylbenzene
4M1P	4-Methyl-1-pentene	2MTHIO	2-Methylthiophene	1M2IPROPB	1-Methyl-2-Isopropylbenzene
CYP	Cyclopentane	T14DMCYHX	1,4-Dimethylcyclohexane (trans)	IA	Indane
23DMB	2,3-Dimethylbutane	3MTHIO	3-Methylthiophene	13DEB	1,3-Diethylbenzene
2MP	2-Methylpentane	1O	1-Octene	1M3PROPB	1-Methyl-3-N-Propylbenzene
MTBE	Methyl tert butyl ether	C8	Octane	IE	Indene
3MP	3-Methylpentane	12DMCYHX	1,2-Dimethylcyclohexane (trans)	1M4PROPB	1-Methyl-4-N-Propylbenzene
1H	1-Hexene	EDB	1,2-Dibromoethane	NBUB	n-Butylbenzene
C6	n-Hexane	C2O	cis-2-Octene	12DM4EB	1,2-Dimethyl-4-Ethylbenzene
IPROE	Isopropyl Ether	IPCYP	Isopropylcyclopentane	12DEB	1,2-Diethylbenzene
T2H	trans-2-Hexene	12DMCYHX	1,2-Dimethylcyclohexane (cis)	1M2PROPB	1-Methyl-2-N-Propylbenzene
2M2P	2-Methyl-2-pentene	25DMHP	2,5-Dimethylheptane	14DM2EB	1,4-Dimethyl-2-Ethylbenzene
C2H	cis-2-Hexene	35DMHP	3,5-Dimethylheptane	C11	Undecane
ETBE	Ethyl-Tert-Butyl-Ether	33DMHP	3,3-Dimethylheptane	13DM4EB	1,3-Dimethyl-4-Ethylbenzene
22DMP	2,2-Dimethylpentane	114TMCYHX	1,1,4-Trimethylcyclohexane	13DM5EB	1,3-Dimethyl-5-Ethylbenzene
MCYP	Methylcyclopentane	23DMHP	2,3-Dimethylheptane	13DM2EB	1,3-Dimethyl-2-Ethylbenzene
24DMP	2,4-Dimethylpentane	34DMHP	3,4-Dimethylheptane	12DM3EB	1,2-Dimethyl-3-Ethylbenzene
223TMP	2,2,3-Trimethylbutane	4MO	4-Methyloctane	1245TMB	1,2,4,5-Tetramethylbenzene
EDC	1,2-Dichloroethane	2MO	2-Methyloctane	1235TMB	1,2,3,5-Tetramethylbenzene
33DMP	3,3-Dimethylpentane	EB	Ethylbenzene	NPYB	N-Pentylbenzene
CYHX	Cyclohexane	2ETHIO	2-Ethylthiophene	1234TMB	1,2,3,4-Tetramethylbenzene
2MHX	2-Methylhexane	3MO	3-Methyloctane	13DM5TBUB	1,3-Dimethyl-5-tert-Butylbenzene
B	Benzene	33DEP	3,3-Diethylpentane	C12	Dodecane (C12)
23DMP	2,3-Dimethylpentane	PMX	p/m-Xylene	135TEB	1,3,5-Triethylbenzene
THIO	Thiophene	1N	1-Nonene	N	Naphthalene
11DMCYP	1,1-Dimethylcyclopentane	T3N	trans-3-Nonene	BTHIO	Benzothiophene
3MHX	3-Methylhexane	C3NE	cis-3-Nonene	124TEB	1,2,4-Triethylbenzene
TAME	Tertiary-Amyl Methyl Ether	C9	Nonane (C9)	HYB	Hexylbenzene
C13DMCYP	1,3-Dimethylcyclopentane (cis)	STRE	Styrene	MMT	MMT
3EP	3-Ethylpentane	OX	o-Xylene	C13	Tridecane
T13DMCYP/2M1HX	1,3-DMCP (trans)/2-Methyl-1-hexene	2N	2-Nonene	2MN	2-Methylnaphthalene
1HP/T12DMCYP	1-Heptene/1,2-DMCP (trans)	IPROCYHX	Isopropylcyclohexane	1MN	1-Methylnaphthalene
224TMP	Isooctane	IROPB	Isopropylbenzene	C14	Tetradecane (C14)
T3H	trans-3-Heptene	33DMO	3,3-Dimethyloctane	C15	Pentadecane
C7	Heptane	NPRPPB	n-Propylbenzene		
T2H	trans-2-Heptene	2MNON	2-Methylnonane		
C2H	cis-2-Heptene	3MNON	3-Methylnonane		
22DMHX	2,2-Dimethylhexane	1M3EB	1-Methyl-3-Ethylbenzene		
MCYHX	Methylcyclohexane	1M4EB	1-Methyl-4-Ethylbenzene		
25DMHX	2,5-Dimethylhexane	135TMB	1,3,5-Trimethylbenzene		
24DMHX	2,4-Dimethylhexane	1D	1-Decene		

Table 3. Chemical Abbreviations for VOC PIANO.

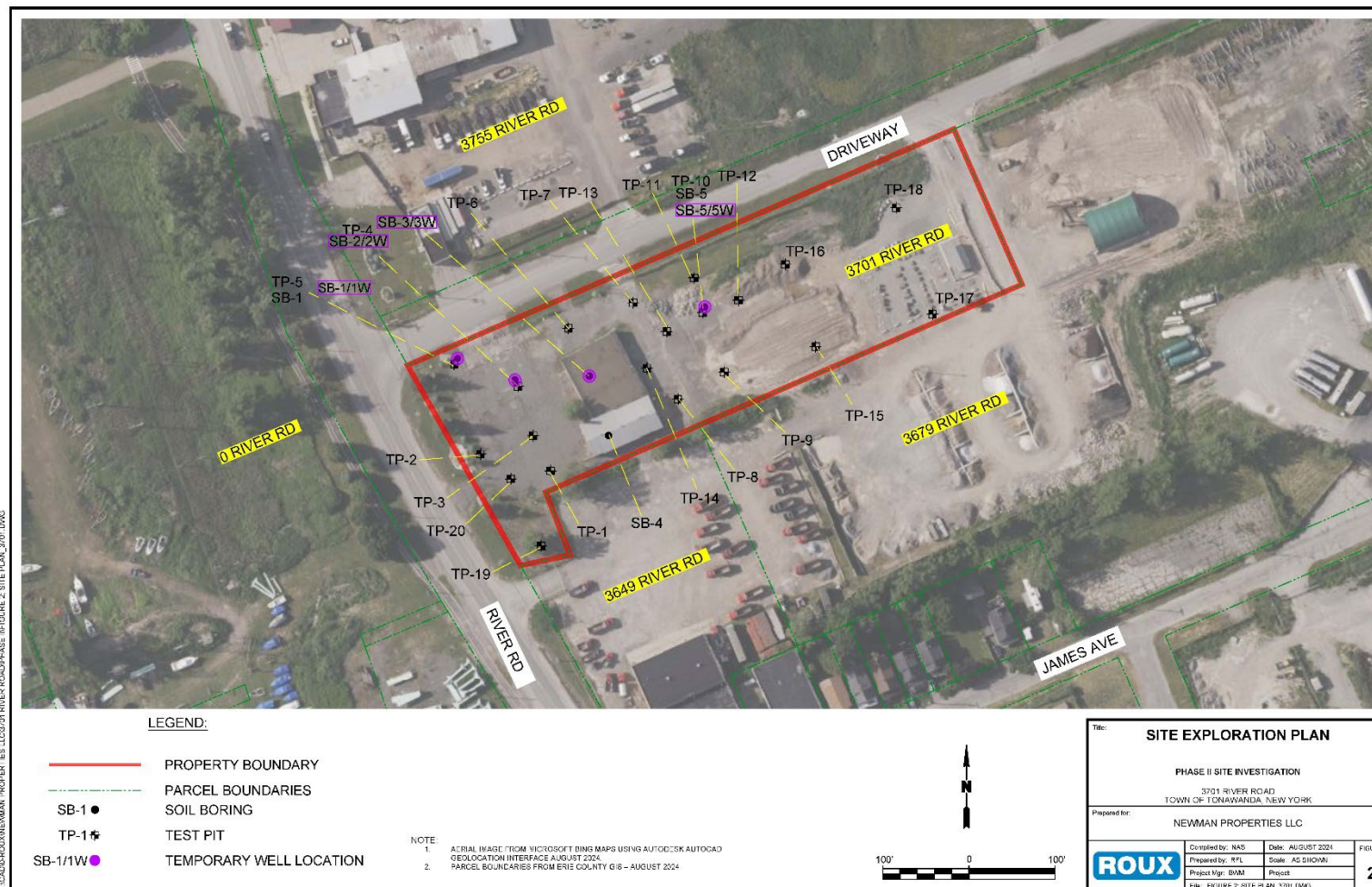


Figure 1. Site Plan.

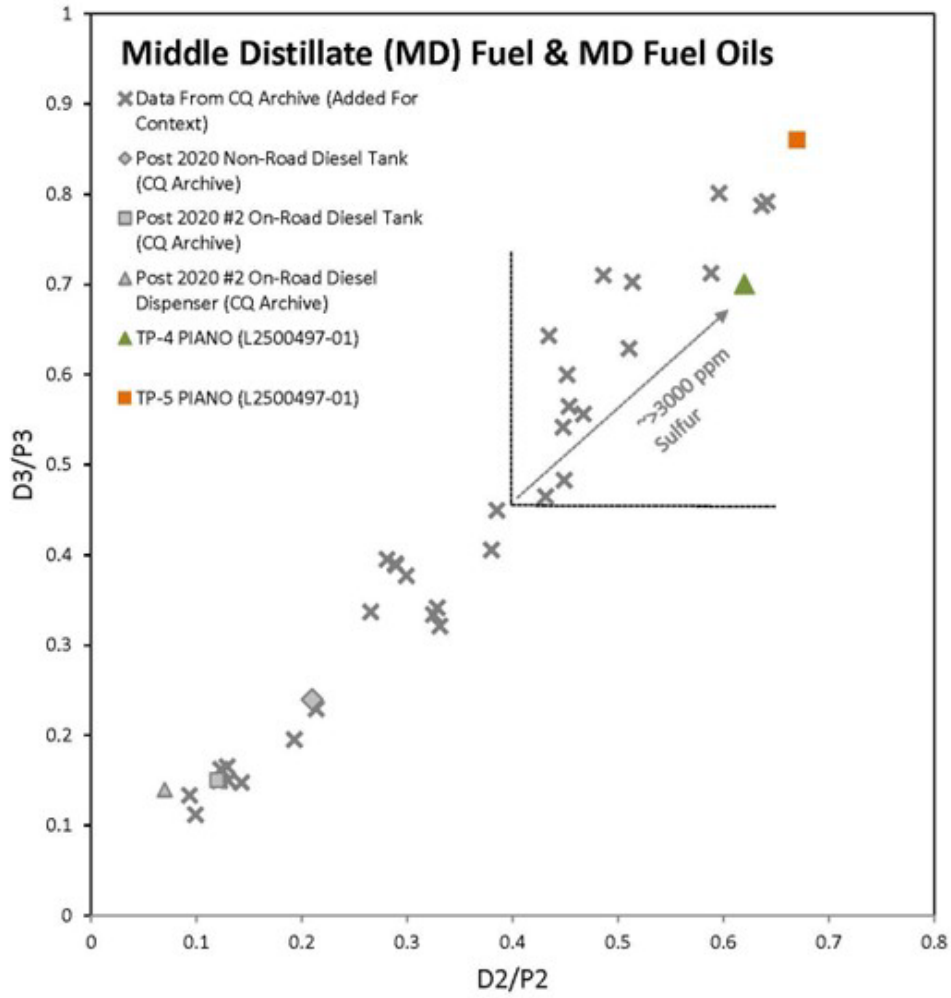


Figure 2. Diagnostic Ratios of Middle Distillate Fuels.

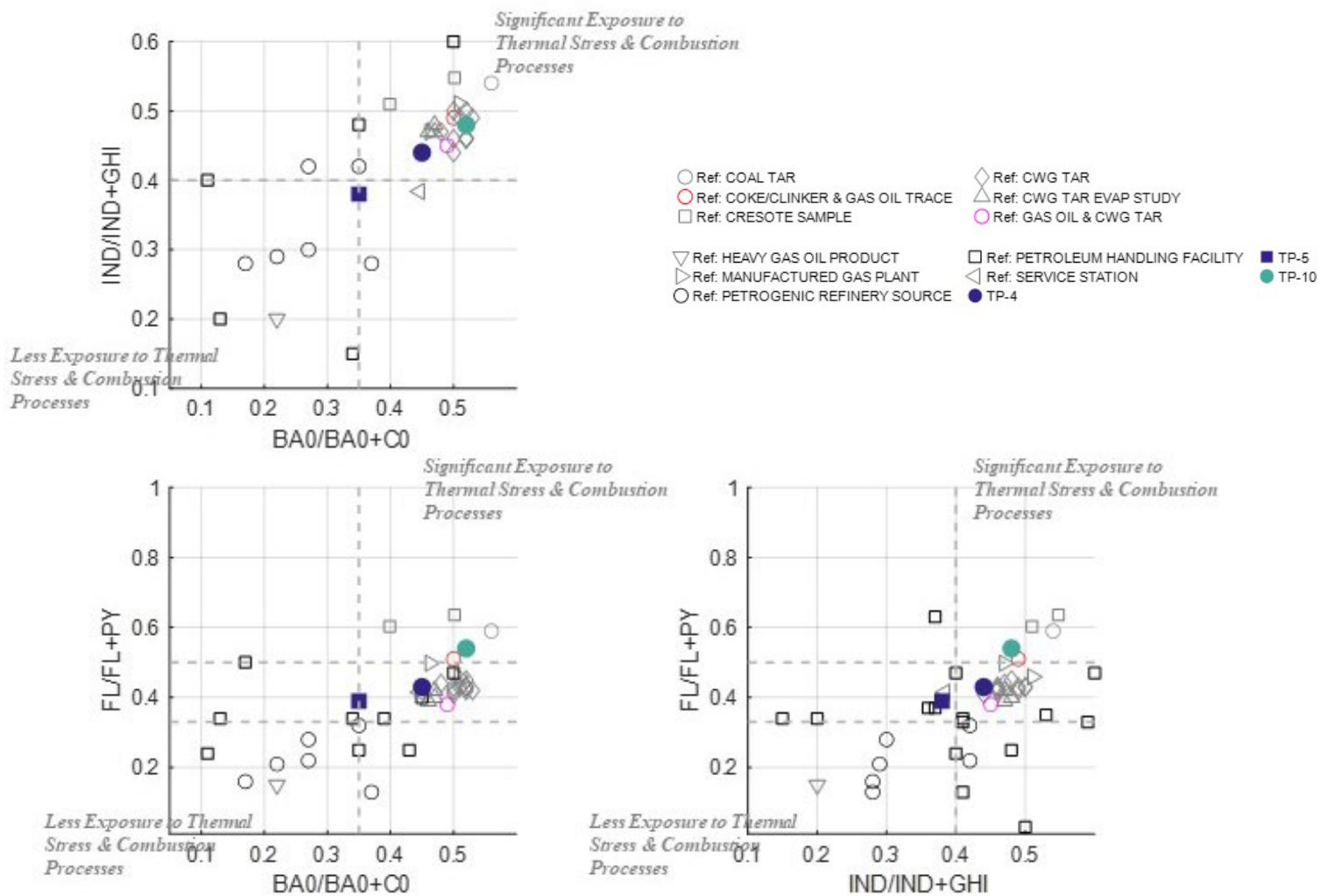


Figure 3. Diagnostic Ratio Plots of High Molecular Weight PAHs - Contextualized with Reference Samples from the Peer-reviewed Literature & CQ Data Archive.

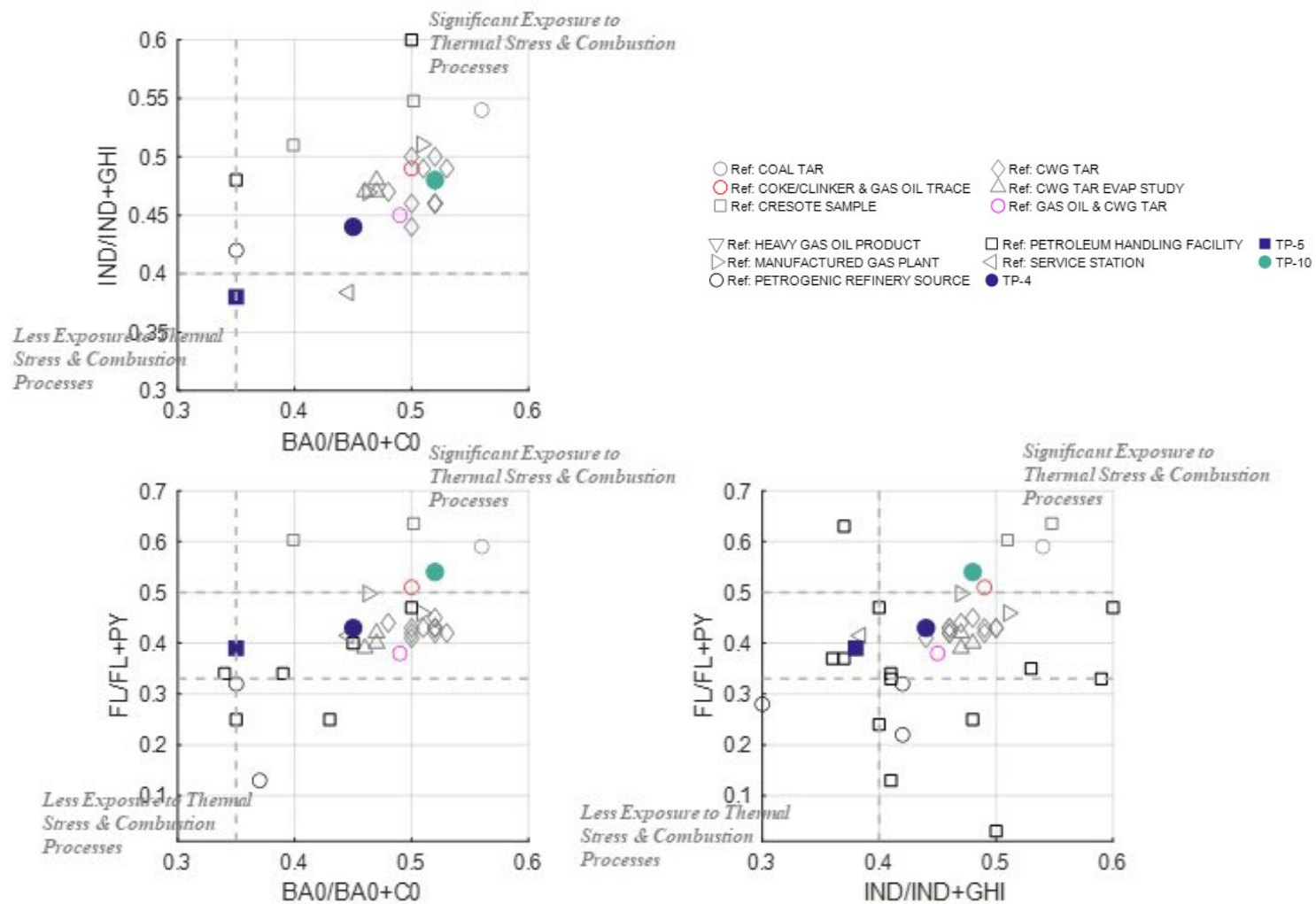
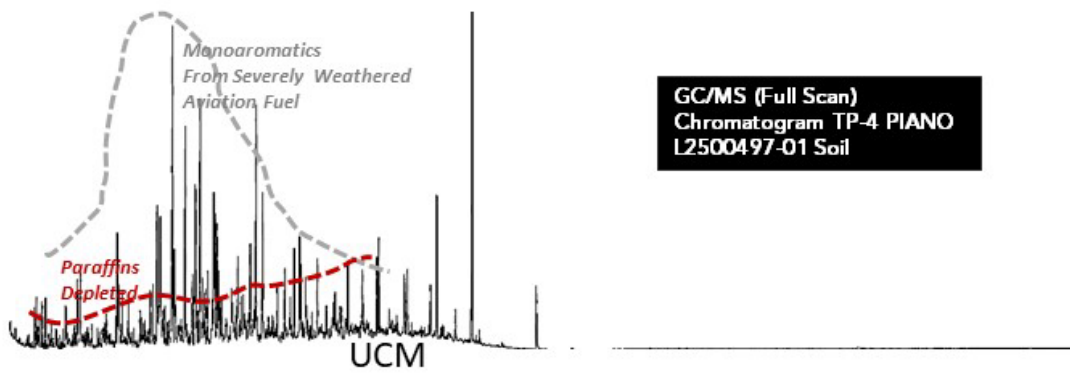
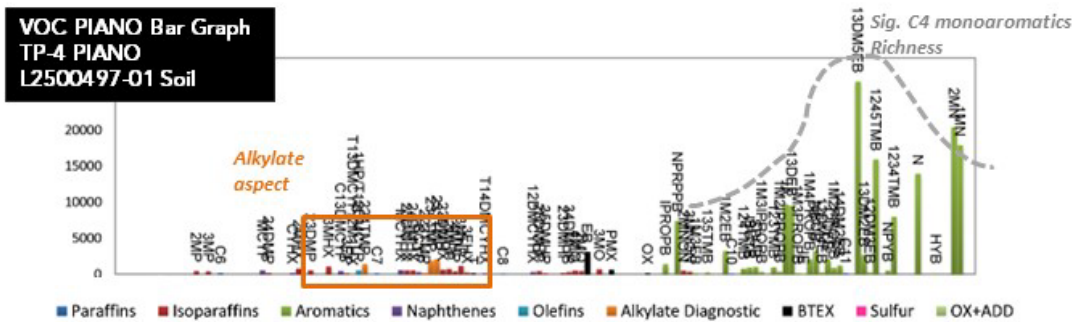


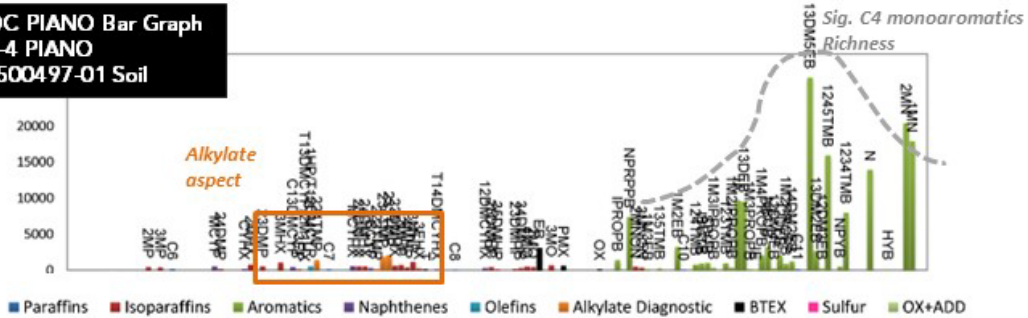
Figure 4. Diagnostic Ratio Plots of High Molecular Weight PAHs (Zoomed) - Contextualized with Reference Samples from the Peer-reviewed Literature & CQ Data Archive.



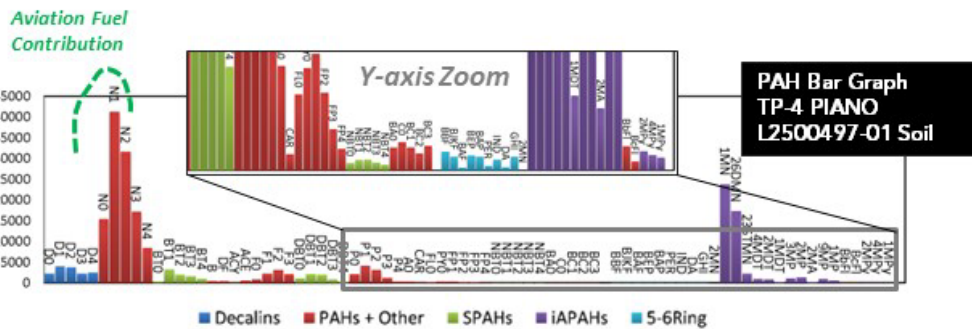
**GC/MS (Full Scan)
Chromatogram TP-4 PIANO
L2500497-01 Soil**



**VOC PIANO Bar Graph
TP-4 PIANO
L2500497-01 Soil**



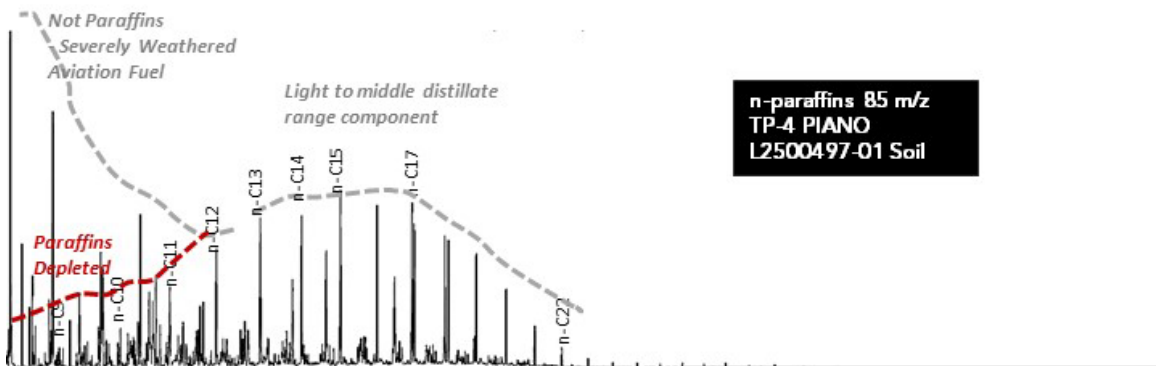
■ Paraffins ■ Isoparaffins ■ Aromatics ■ Naphthenes ■ Olefins ■ Alkylate Diagnostic ■ BTEX ■ Sulfur ■ OX+ADD



**Aviation Fuel
Contribution**

**PAH Bar Graph
TP-4 PIANO
L2500497-01 Soil**

■ Decalins ■ PAHs + Other ■ SPAHs ■ iPAHs ■ 5-6Ring



**n-paraffins 85 m/z
TP-4 PIANO
L2500497-01 Soil**

Figure 5. Fingerprint Mosaics – TP-4 PIANO L2500497-01.

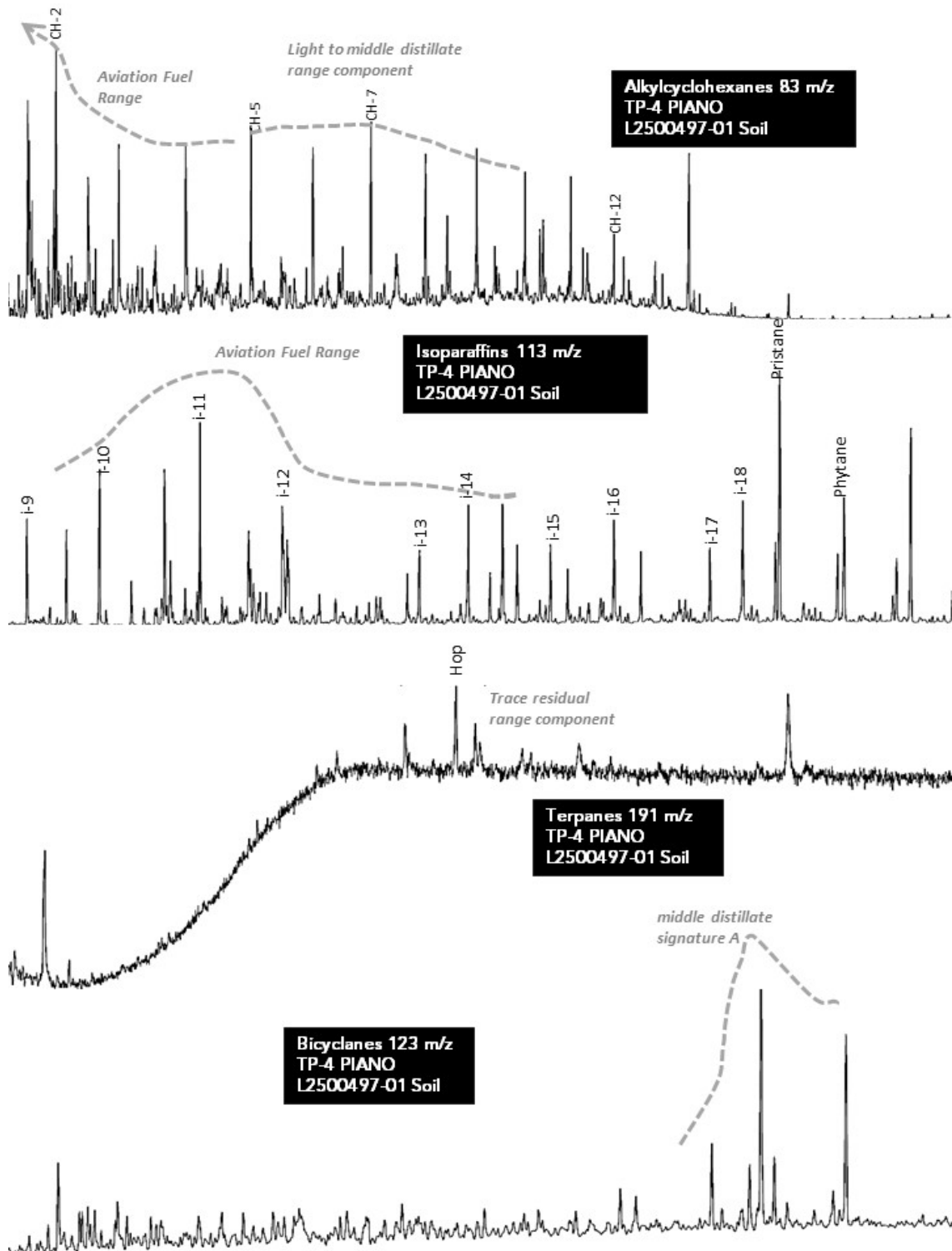


Figure 6. Fingerprint Mosaics – TP-4 PIANO L2500497-01.

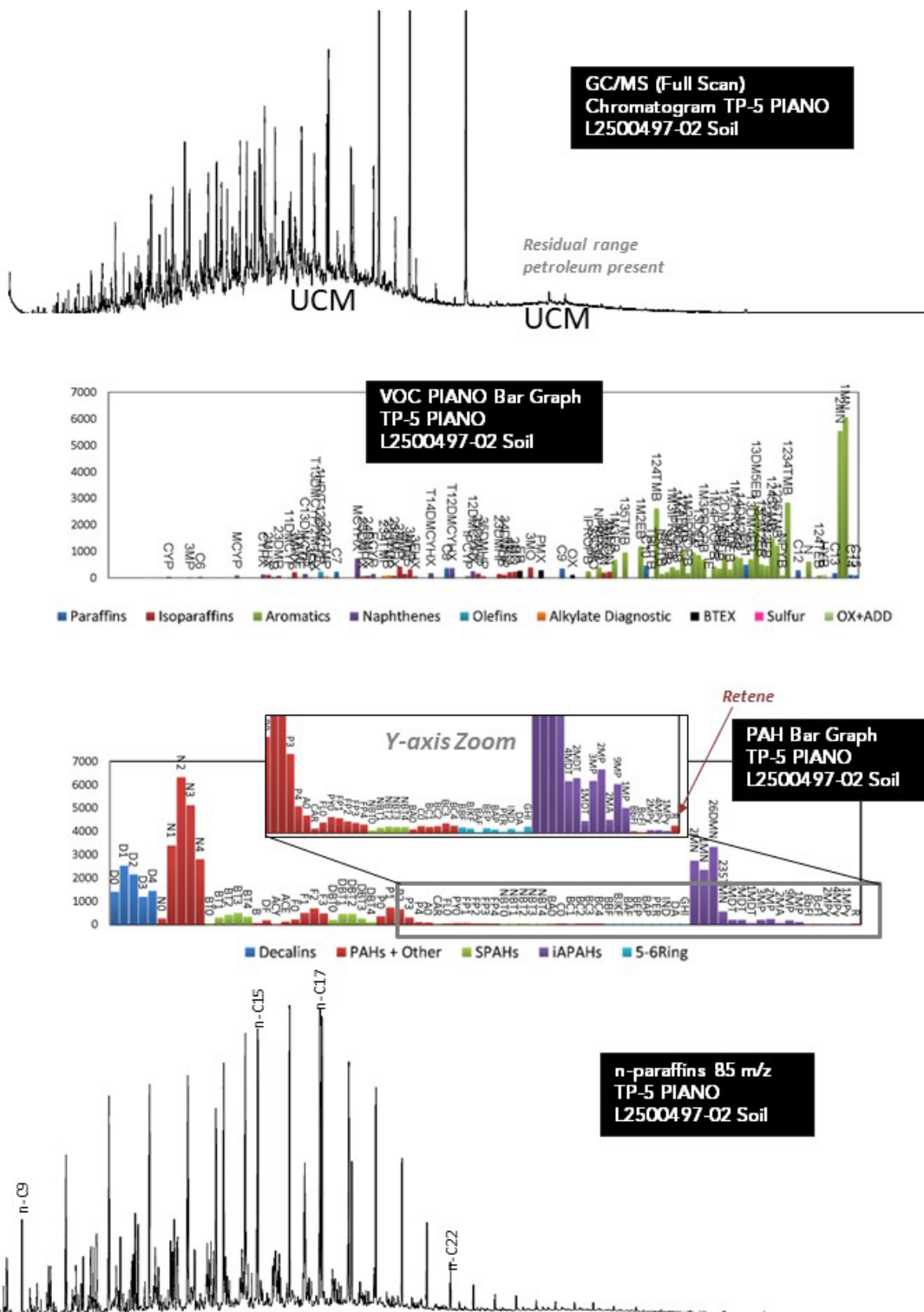


Figure 7. Fingerprint Mosaics – TP-5 PIANO L2500497-02.

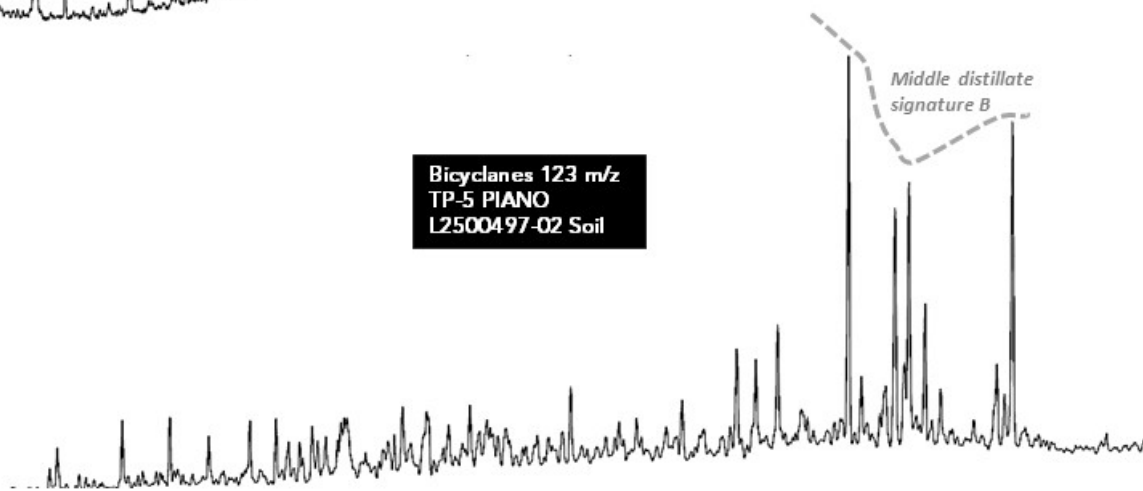
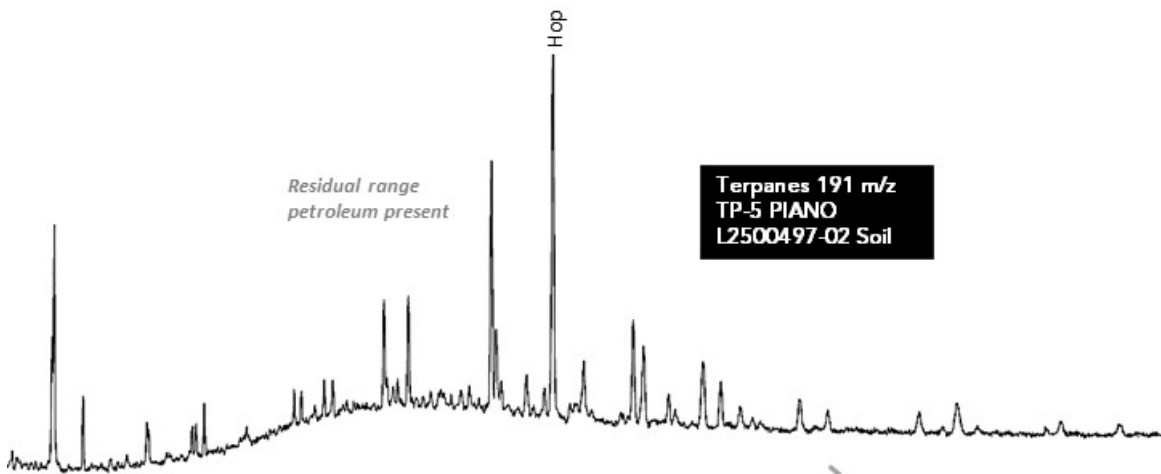
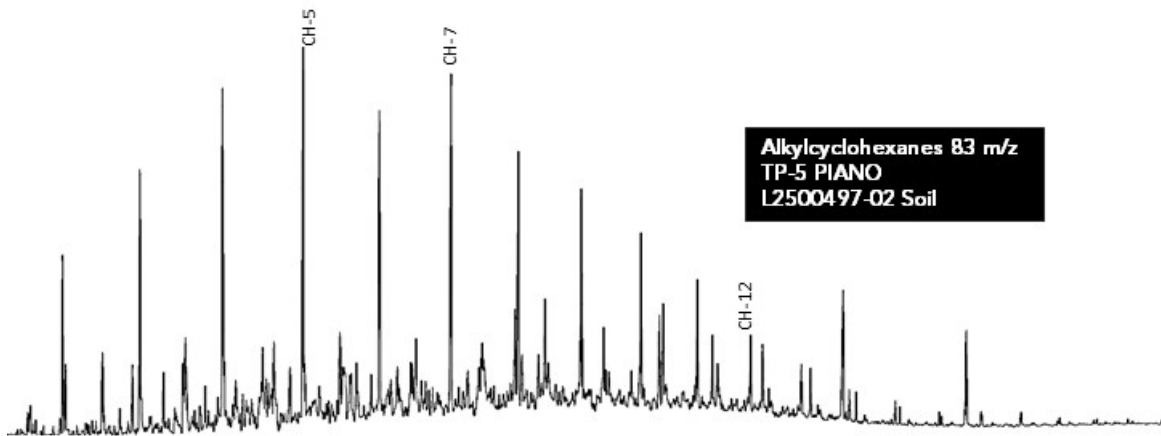


Figure 8. Fingerprint Mosaics – TP-5 PIANO L2500497-02.

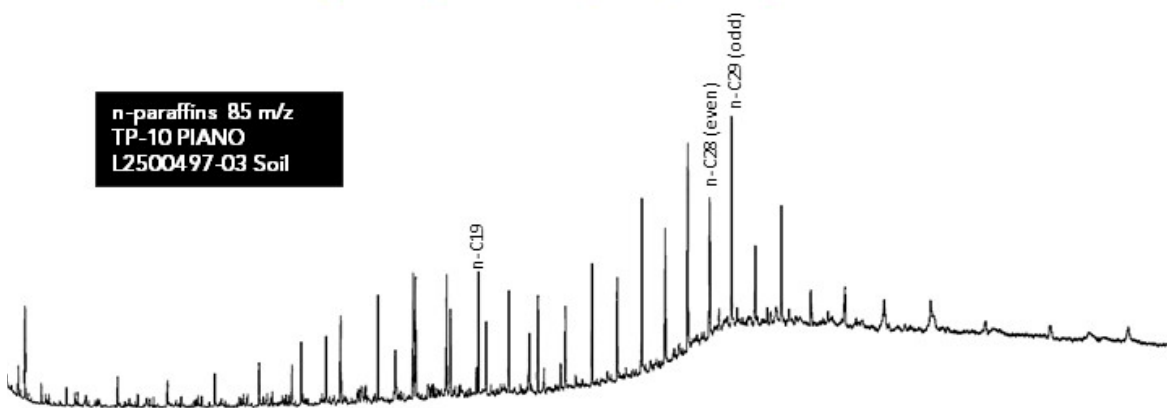
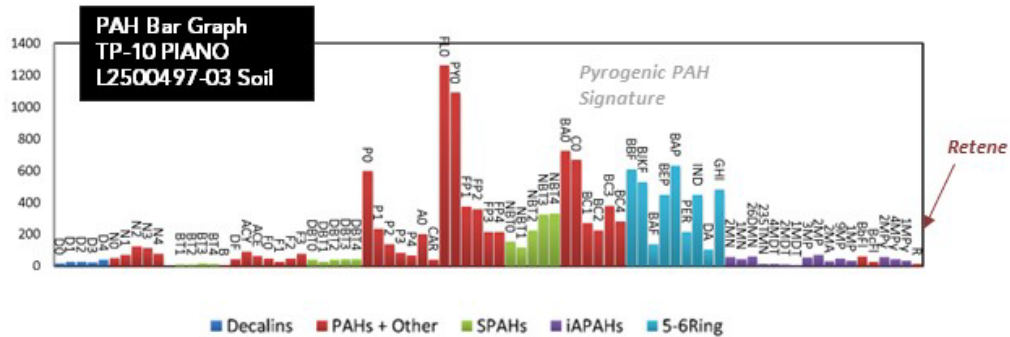
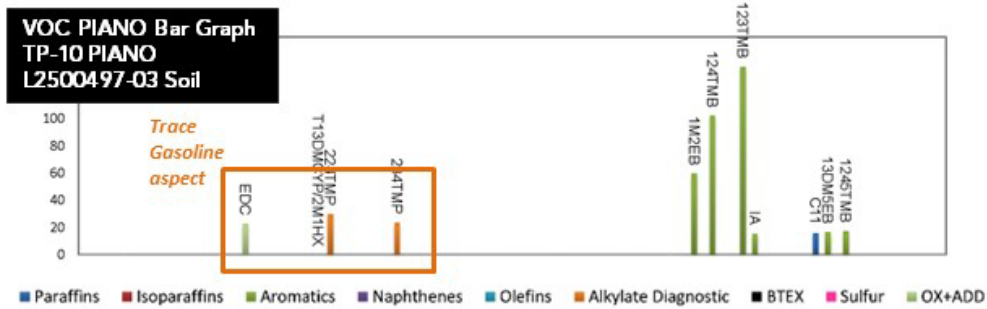
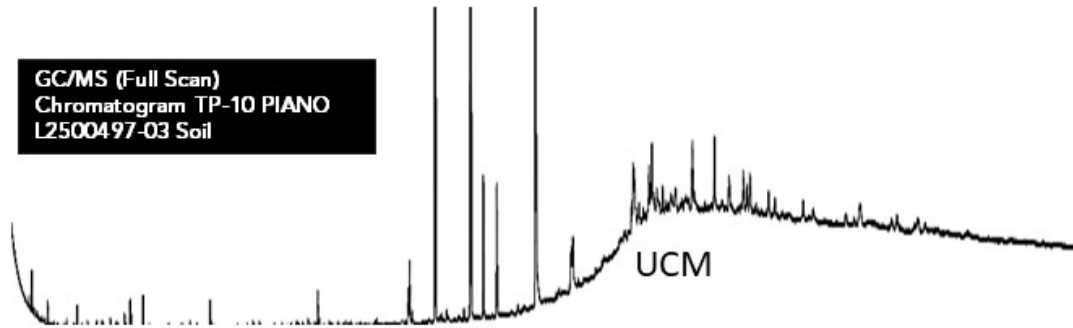


Figure 9. Fingerprint Mosaics – TP-10 PIANO L2500497-03.

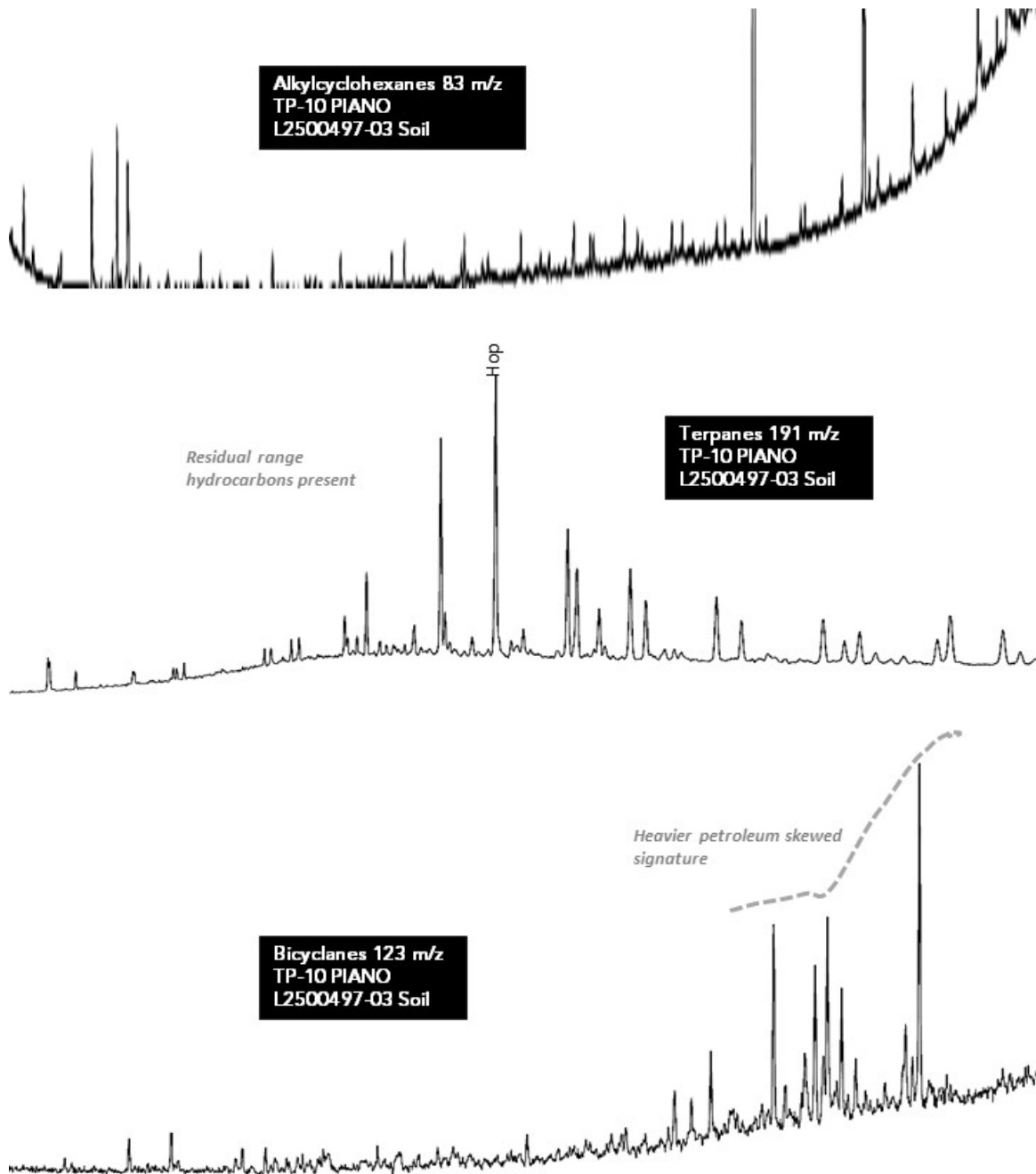


Figure 10. Fingerprint Mosaics – TP-10 PIANO L2500497-03.

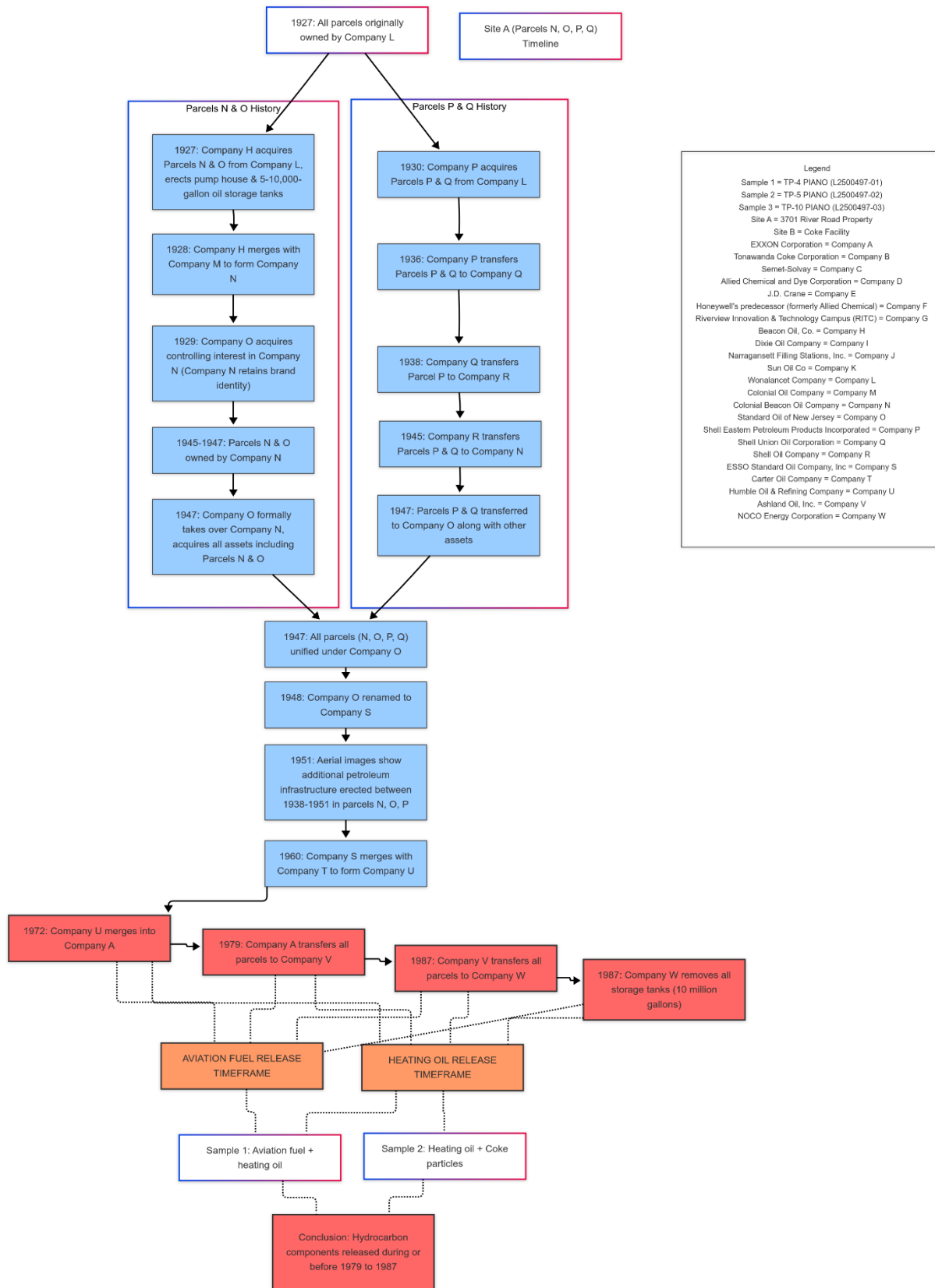


Figure 11. Time line of 3701 River Road and coke facility with forensic evidence analysis.

Appendix A

Historical Site Documents

3679 River Road

3679 River Road

Tonawanda, NY 14150

Inquiry Number: 7522356.8

December 15, 2023

The EDR Aerial Photo Decade Package



6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

Site Name:

3679 River Road
 3679 River Road
 Tonawanda, NY 14150
 EDR Inquiry # 7522356.8

Client Name:

Roux Associates Inc.
 2558 Hamburg Turnpike Suite 300
 Buffalo, NY 14218
 Contact: Nick Suraci



Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

Search Results:

<u>Year</u>	<u>Scale</u>	<u>Details</u>	<u>Source</u>
2019	1"=500'	Flight Year: 2019	USDA/NAIP
2015	1"=500'	Flight Year: 2015	USDA/NAIP
2011	1"=500'	Flight Year: 2011	USDA/NAIP
2008	1"=500'	Flight Year: 2008	USDA/NAIP
1995	1"=500'	Acquisition Date: March 28, 1995	USGS/DOQQ
1985	1"=500'	Flight Date: May 03, 1985	USDA
1983	1"=500'	Flight Date: March 17, 1983	USDA
1978	1"=500'	Flight Date: October 31, 1978	USDA
1970	1"=500'	Flight Date: June 23, 1970	USGS
1966	1"=500'	Flight Date: June 12, 1966	USDA
1962	1"=500'	Flight Date: November 26, 1962	USGS
1959	1"=500'	Flight Date: May 08, 1959	USDA
1951	1"=500'	Flight Date: October 14, 1951	USDA
1938	1"=500'	Flight Date: August 03, 1938	USDA

When delivered electronically by EDR, the aerial photo images included with this report are for ONE TIME USE ONLY. Further reproduction of these aerial photo images is prohibited without permission from EDR. For more information contact your EDR Account Executive.

Disclaimer - Copyright and Trademark Notice

This Report contains certain information obtained from a variety of public and other sources reasonably available to Environmental Data Resources, LLC. It cannot be concluded from this Report that coverage information for the target and surrounding properties does not exist from other sources. This Report is provided on an "AS IS", "AS AVAILABLE" basis. NO WARRANTY EXPRESS OR IMPLIED IS MADE WHATSOEVER IN CONNECTION WITH THIS REPORT.

ENVIRONMENTAL DATA RESOURCES, LLC AND ITS SUBSIDIARIES, AFFILIATES AND THIRD PARTY SUPPLIERS DISCLAIM ALL WARRANTIES, OF ANY KIND OR NATURE, EXPRESS OR IMPLIED, ARISING OUT OF OR RELATED TO THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT, INCLUDING WITHOUT LIMITATION, ANY WARRANTIES REGARDING ACCURACY, QUALITY, CORRECTNESS, COMPLETENESS, COMPREHENSIVENESS, SUITABILITY, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON-INFRINGEMENT, MISAPPROPRIATION, OR OTHERWISE. ALL RISK IS ASSUMED BY THE USER. IN NO EVENT SHALL ENVIRONMENTAL DATA RESOURCES, LLC OR ITS SUBSIDIARIES, AFFILIATES OR THIRD PARTY SUPPLIERS BE LIABLE TO ANYONE FOR ANY DIRECT, INCIDENTAL, INDIRECT, SPECIAL, CONSEQUENTIAL OR OTHER DAMAGES OF ANY TYPE OR KIND (INCLUDING BUT NOT LIMITED TO LOSS OF PROFITS, LOSS OF USE, OR LOSS OF DATA), ARISING OUT OF OR IN ANY WAY CONNECTED WITH THIS REPORT OR ANY OF THE DATA AND INFORMATION PROVIDED IN THIS REPORT.

Any analyses, estimates, ratings, environmental risk levels, or risk codes provided in this Report are provided for illustrative purposes only, and are not intended to provide, nor should they be interpreted as providing any facts regarding, or prediction or forecast of, any environmental risk for any property. Only an assessment performed by a qualified environmental professional can provide findings, opinions or conclusions regarding the environmental risk or conditions in, on or at any property.

Copyright 2023 by Environmental Data Resources, Inc. All rights reserved. Reproduction in any media or format, in whole or in part, of any report or map of Environmental Data Resources, Inc., or its affiliates, is prohibited without prior written permission.

EDR and its logos (including Sanborn and Sanborn Map) are trademarks of Environmental Data Resources, LLC or its affiliates. All other trademarks used herein are the property of their respective owners.



Exhibit 2

INQUIRY #: 7522356.8

YEAR: 2019

— = 500'





Exhibit 3

INQUIRY #: 7522356.8

YEAR: 2015

— = 500'





Exhibit 4

INQUIRY #: 7522356.8

YEAR: 2011

— = 500'





Exhibit 5

INQUIRY #: 7522356.8

YEAR: 2008

— = 500'





Exhibit 6

INQUIRY #: 7522356.8

YEAR: 1995

— = 500'





Exhibit 7

INQUIRY #: 7522356.8

YEAR: 1985

— = 500'



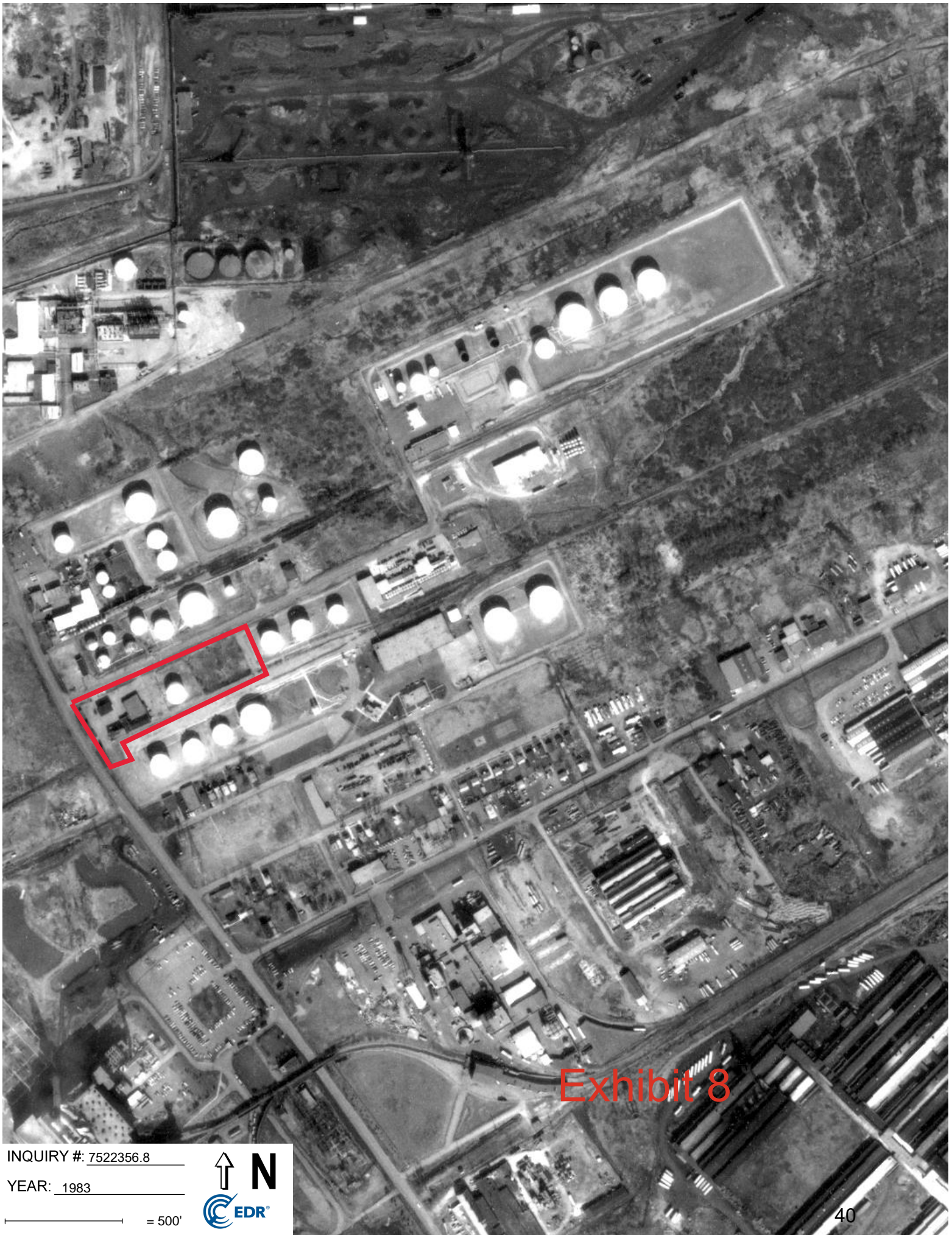


Exhibit 8

INQUIRY #: 7522356.8

YEAR: 1983

— = 500'



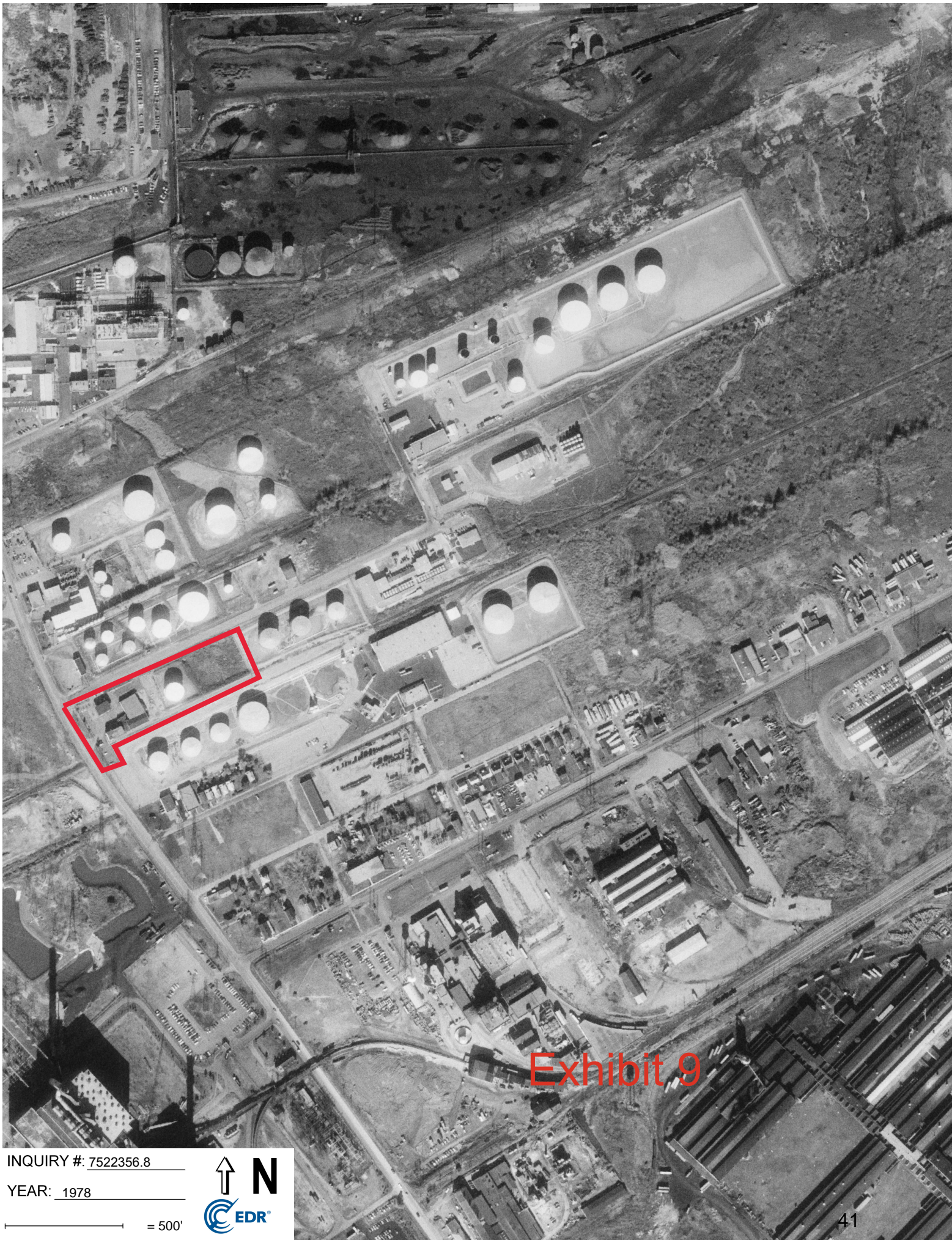


Exhibit 9

INQUIRY #: 7522356.8

YEAR: 1978

— = 500'





Exhibit 10

INQUIRY #: 7522356.8

YEAR: 1970

— = 500'



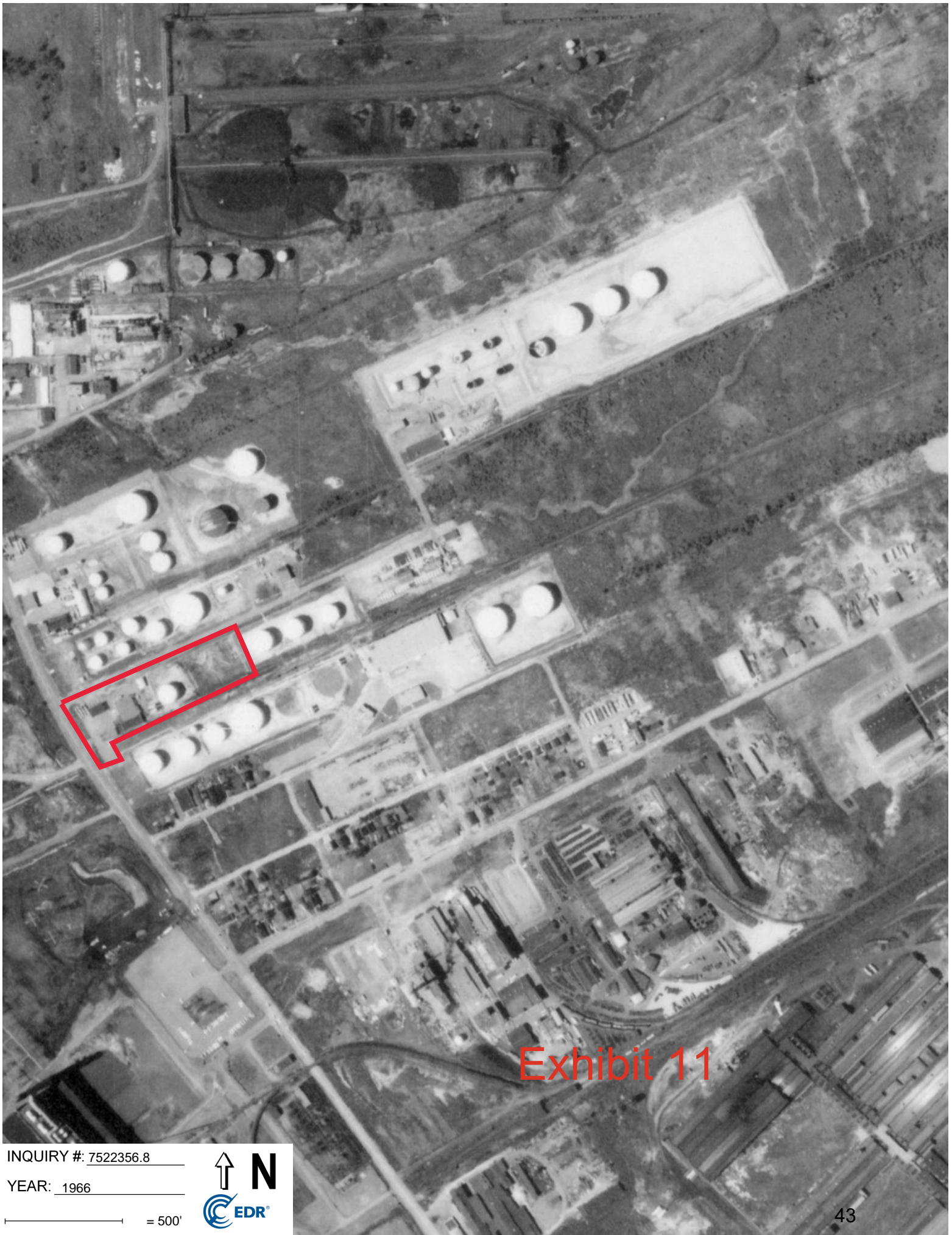


Exhibit 11

INQUIRY #: 7522356.8

YEAR: 1966

— = 500'





Exhibit 12

INQUIRY #: 7522356.8

YEAR: 1962

— = 500'





Exhibit 13

INQUIRY #: 7522356.8

YEAR: 1959

— = 500'





Exhibit 14

INQUIRY #: 7522356.8

YEAR: 1951

— = 500'





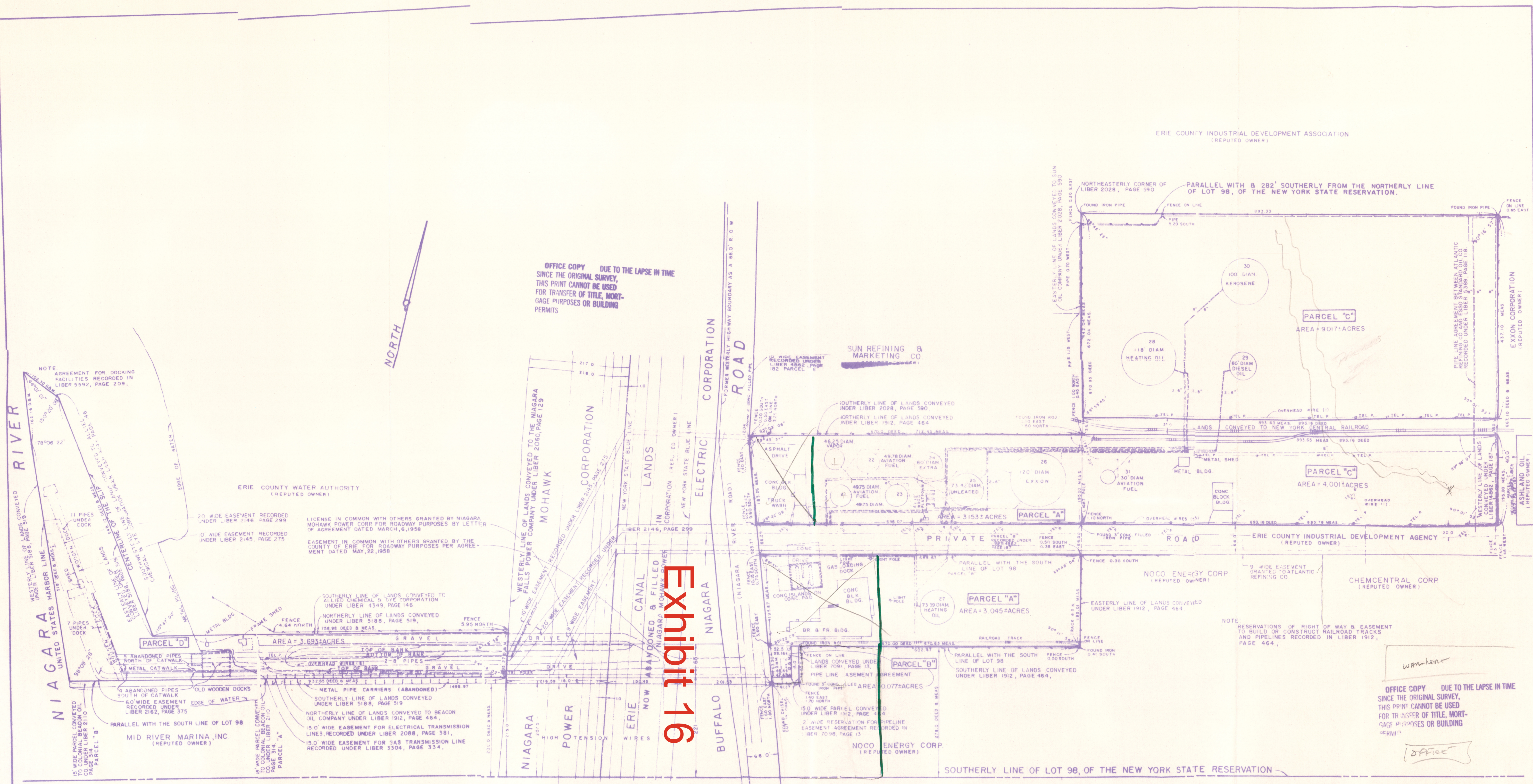
Exhibit 15

INQUIRY #: 7522356.8

YEAR: 1938

— = 500'





OFFICE COPY DUE TO THE LAPSE IN TIME SINCE THE ORIGINAL SURVEY, THIS PRINT CANNOT BE USED FOR TRANSFER OF TITLE, MORTGAGE PURPOSES OR BUILDING PERMITS

ERIE COUNTY INDUSTRIAL DEVELOPMENT ASSOCIATION (REPUTED OWNER)

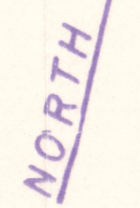


Exhibit 16

OFFICE COPY DUE TO THE LAPSE IN TIME SINCE THE ORIGINAL SURVEY, THIS PRINT CANNOT BE USED FOR TRANSFER OF TITLE, MORTGAGE PURPOSES OR BUILDING PERMITS

NOTE
PARCEL "A" "B" "C" "D"
PARCEL DESIGNATIONS REFERENCED TO TITLE REPORT N° B-83347

AREA
PARCEL "A" 6.198 ACRES
PARCEL "B" 0.077 ACRES
PARCEL "C" 13.018 ACRES
PARCEL "D" 3.693 ACRES

I HEREBY CERTIFY TO:
TICOR TITLE GUARANTEE COMPANY
THAT THIS SURVEY WAS PREPARED IN ACCORDANCE WITH THE CURRENT CODE OF PRACTICE FOR LAND SURVEYS ADOPTED BY THE NEW YORK STATE ASSOCIATION OF PROFESSIONAL LAND SURVEYORS AND AS AMENDED BY THE SURVEYORS' BOARD IN TIME TO BE EFFECTIVE ON THE DATE OF THIS SURVEY.
THIS SURVEY IS VALID FOR ALL PURPOSES UNLESS THIS SURVEY HAS BEEN RECALLED BY THE SURVEYOR.
DATE OF THIS SURVEY: DECEMBER 8, 1986
DATE OF TRANSFER OF TITLE, MORTGAGE PURPOSES OR BUILDING PERMITS:

REVISED JAN 21, 1987 ADDED EASEMENTS & TITLE DATA
CERTIFIED DECEMBER 23, 1986
RESURVEYED DECEMBER 8, 1986 CH
ADDED DEED INFORMATION FOR PARCELS "C" & "D", ALSO DIMENSIONS, SEPT. 28, 1979
ADDED REMAINING INTERIOR ANGLES AND DIMENSIONS, AUG. 2, 1979
ADDED ADJACENT PROPERTY OWNERS NAMES, JULY, 20, 1978

OFFICE COPY DUE TO THE LAPSE IN TIME SINCE THE ORIGINAL SURVEY, THIS PRINT CANNOT BE USED FOR TRANSFER OF TITLE, MORTGAGE PURPOSES OR BUILDING PERMITS

WARNING: IT IS A VIOLATION OF THE STATE EDUCATION LAW TO ALTER THIS DOCUMENT

OFFICE COPY DUE TO THE LAPSE IN TIME SINCE THE ORIGINAL SURVEY, THIS PRINT CANNOT BE USED FOR TRANSFER OF TITLE, MORTGAGE PURPOSES OR BUILDING PERMITS

SURVEY OF PART OF LOT 98 OF THE NEW YORK STATE RESERVATION

TOWN OF TONAWANDA, ERIE COUNTY, NEW YORK STATE

KREHBIEL ASSOCIATES
ENGINEERS - SURVEYORS

1868 NIAGARA FALLS BLVD., TONAWANDA, N.Y. 14150

DATE: 8/19/79

OFFICE COPY DUE TO THE LAPSE IN TIME SINCE THE ORIGINAL SURVEY, THIS PRINT CANNOT BE USED FOR TRANSFER OF TITLE, MORTGAGE PURPOSES OR BUILDING PERMITS

COMPARABLE PROPERTY SALE NO. _____

ADDRESS: 3701 River Road

PROPERTY TYPE: Petroleum Terminal

Exhibit 17

2
6
SALE PRICE: 218,293 DATE: 3-18-87
GRANTOR: Ashland Oil, Inc.

GRANTEE: Noco Energy Corp.

LIBER: 9690 PAGE: 283

LOT SIZE: 19.2± Acres ZONING: G-I General Industrial

Barrel Capacity:
~~GROSS BUILDING AREA~~ 348,000 NET BUILDING AREA: _____

BUILDING AGE: 50-30 CONDITION: Fair

DESCRIPTION: The sale is a petroleum terminal with a 348,000 barrel capacity. The tanks range from poor to avg. condition. The facility

does not have vapor recovery or bottom loading system. The property has rail access. The sale also included 1/5 interest to a dock on the River.

~~SALE PRICE PER SQ. FT. OF BUILDING~~ _____ The dock is in fair condition.

SALE PRICE PER BARREL: .63

SREA MEMBER # 117

1-3 1/2 M. Gal. 21,000

1-17

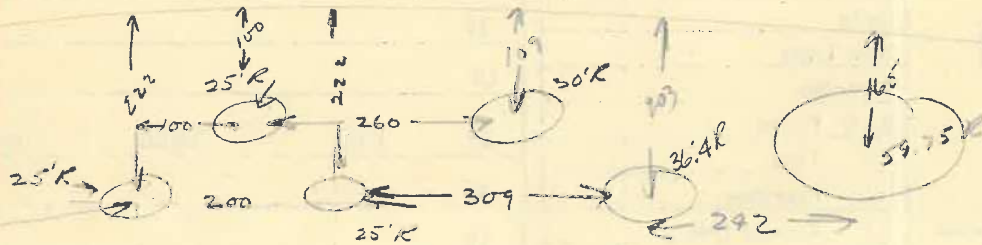
9,500

30,500

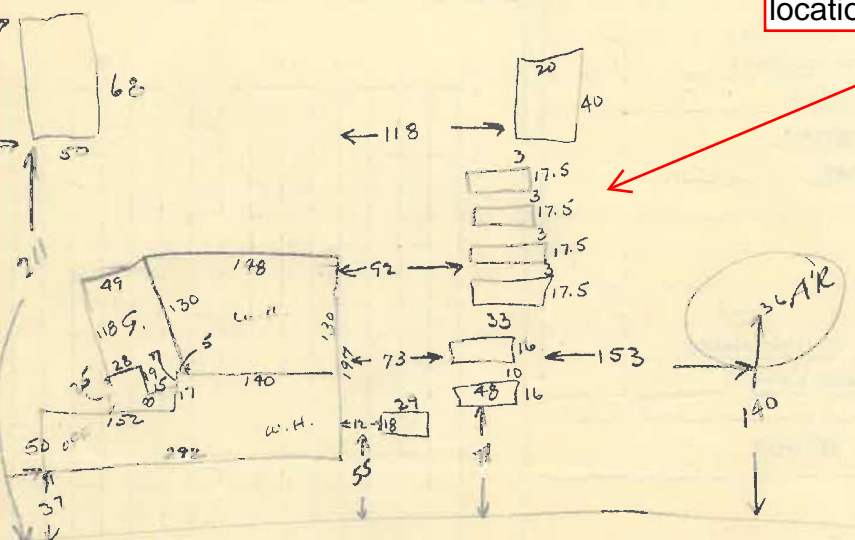
18,300 Sand.

162

34,500



Various tank locations



5/19/09
1970 #42059 185,000
1992

3-21-73 Fire Damage \$5000.
(Roof & inside of oil)

55698 10-12-87 \$30,000 Removal of 11 Tanks
(total gallonage approx. 10million)

1993 #5593

59547 1-30-92 \$1,845 Remove (1) Tank 1000gal

12/2/95 \$300,000 Heating oil
Ent. Alter. Addition to warehouse
Canopy 25x70 Addition

1995 2200,000 T-230000

1996 REVIEW 260,000

2004 BAR NIC 330,400

2006 300,000

2011 BAR NE 300,000

2012 BAR NIC 300,000

9/30/96 \$500 above
ground 1000gal
propane tank

BP2002-590 8/22/02 \$10,000
Communication Tower
BP2004-709 9/27/04 \$20,000
Demo 2 story bldg

Exhibit 18

1" = 60' N

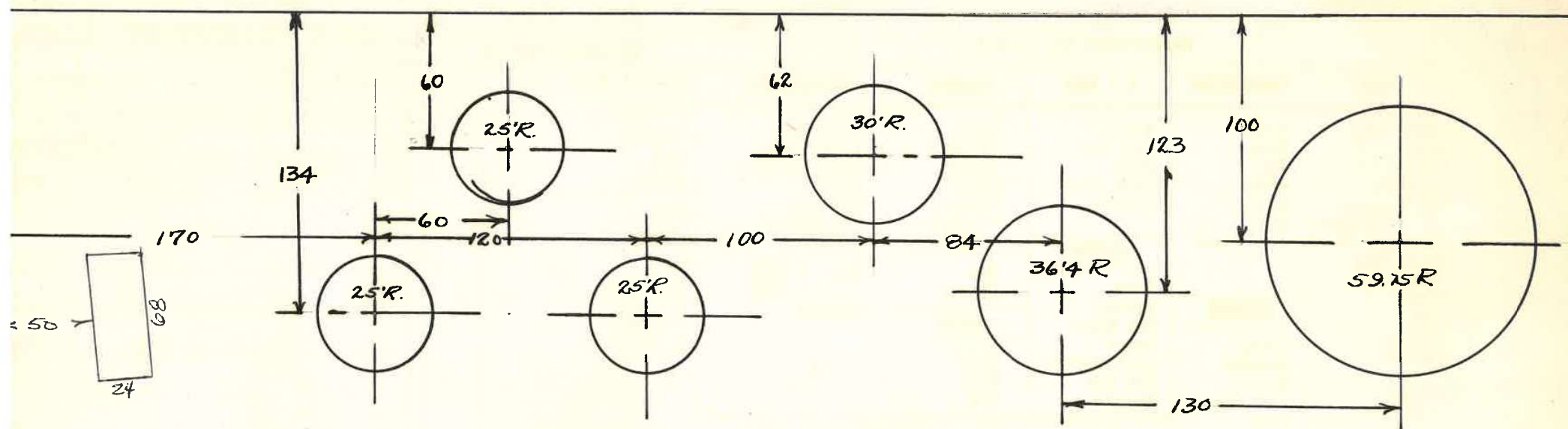
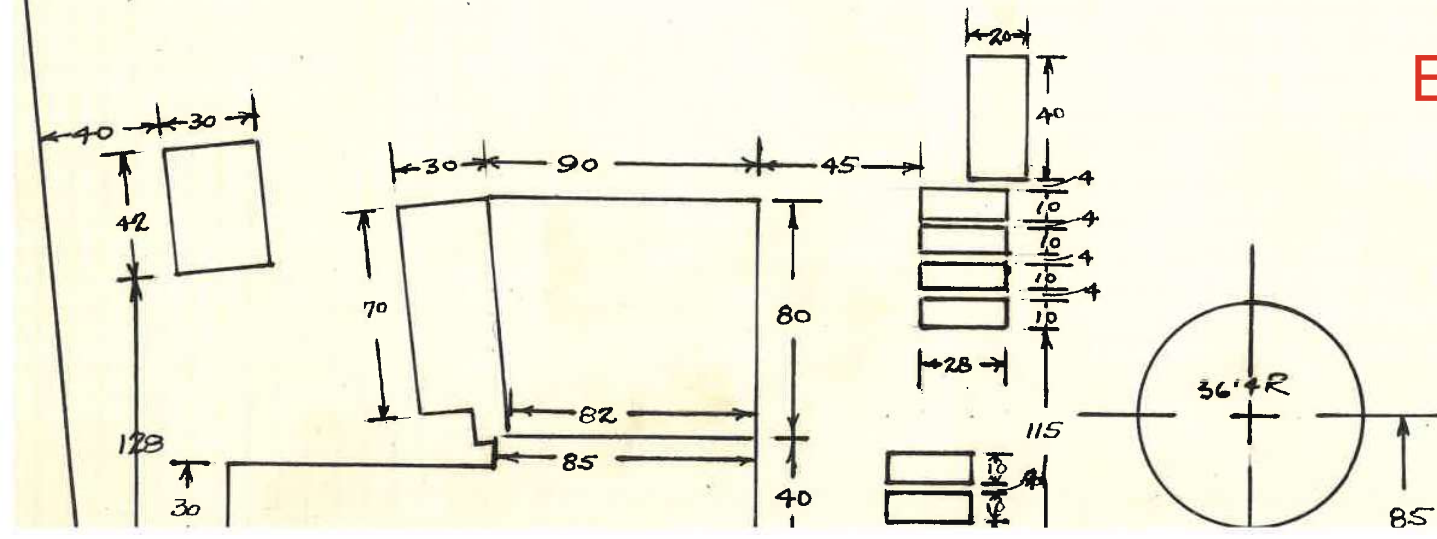


Exhibit 19



55698

BUILDING PERMIT

Estimated Cost.....\$30,000.00.....

Town of Tonawanda, N. Y. October 19, 1987.....

Permission is hereby granted to.....Noco Energy Corp.....to erect a.....Removal of 11 Tanks
(total gallonage approx. 10 million)

to be constructed of.....to be located.....feet from one side Lot line
as per plot plan.

not less than.....feet from the other side Lot line, and to be occupied by.....famil.....to be located on the.....of
Storage Terminal

No. 64.12-1-15.....on the.....side of River Rd.

Use No. 3701.....feet from.....Lot line, completed building to be.....feet wide,feet long,feet
high, in accordance with plans and specifications submitted and all driveways must be on the same side of house in the same
block; see Zoning Ordinance for regulations.

All trenches for sewer connections shall remain open until approved by Town Plumbing Inspector.

All water connections to main lines shall be made by the Water Department. Any water fee paid is for construction purpose only.

Water shut-off boxes shall be placed at curb or where directed by the Superintendent of Water Department.

This permit is granted on the express condition that the owner or his agent shall in all respects conform to the Zoning Ordinance and Building Code, Plumbing Code and Water Ordinance of the Town of Tonawanda, relating to the construction of buildings and may be revoked at any time upon the violation of any of the provisions of said Zoning Ordinance and Building Code, Plumbing Code and Water Ordinance, or the above named plans and specifications.

No building materials can be placed on street without permission of Supervising Building Official.

Supervising Building Official to be notified when foundation is completed, fire stops are in, chimneys completed and all pipes installed. Certificate must be issued by Supervising Building Official before concealing same.

Permit Fee.....\$140.00..... By Order of Town Board,

Water Fee..... Signed.....
Supervising Building Official

Remarks

Check Telephone, Power and Gas Companies before using this permit. If there is any chance of a conflict in locations, ask utility involved for an inspector to be on the job.

Exhibit 20

LOADING RACK AND
TANKS TO BE
DEMOLISHED

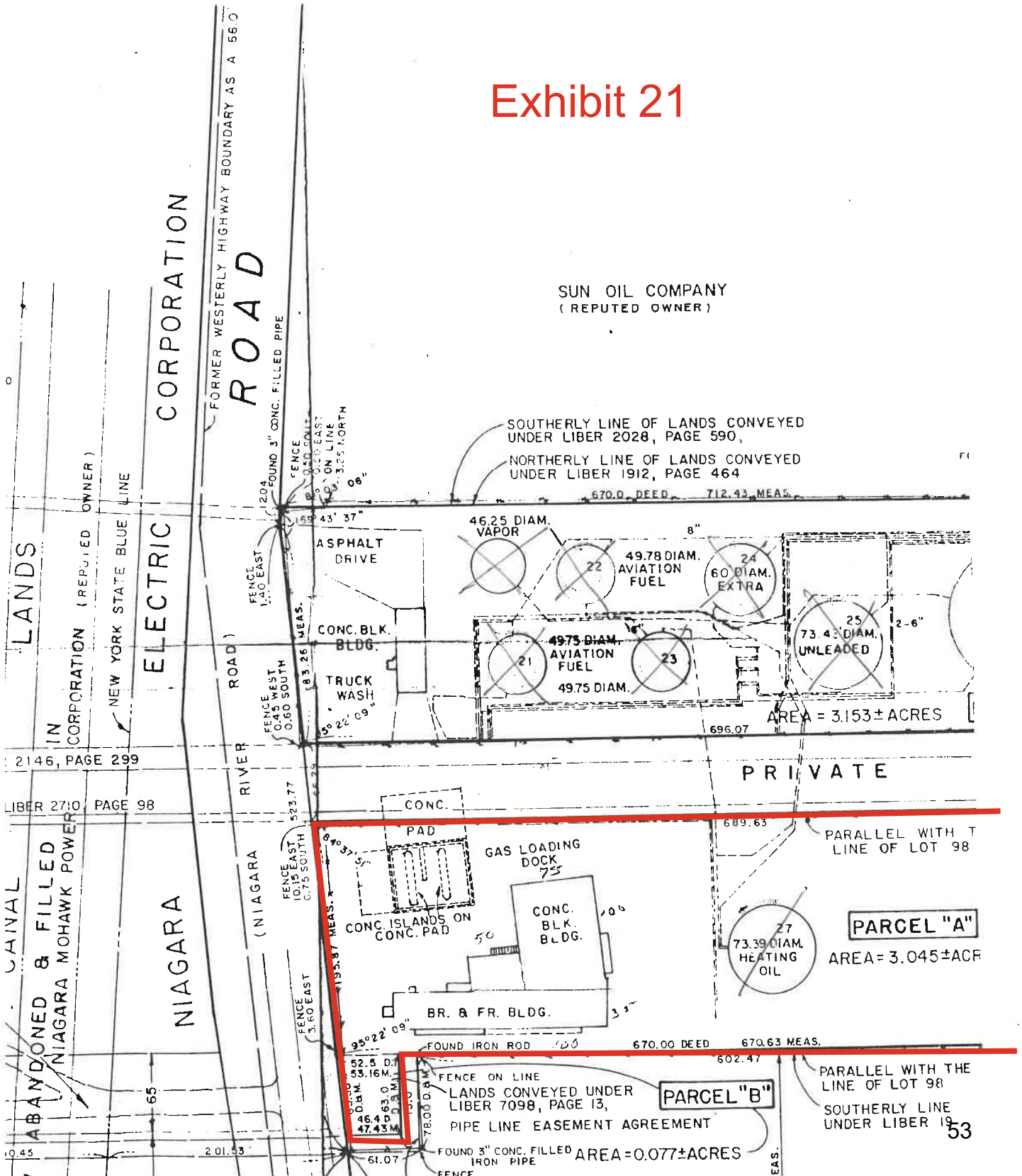


Gary G. Roesch
OPERATIONS MANAGER

NOCO ENERGY CORP.
700 GRAND ISLAND BLVD.
P.O. BOX 86
TONAWANDA, N.Y. 14151-0086

(716) 874 6200
TWX 510 101 2792

Exhibit 21



COLONIAL BEACON OIL COMPANY
(INCORPORATED)

BOSTON, MASS.

September 28, 1942

PLEASE ADDRESS YOUR REPLY TO
REAL ESTATE DEPARTMENT
26 BROADWAY
NEW YORK, N. Y.

Mr. Ray H. Heiss
Tax Assessor
Town of Tonawanda
Municipal Building
Kenmore, New York

Dear Sir:

I wish to acknowledge and thank you for your letter of September 24 regarding the assessment on our plant in Tonawanda.

It is noted that you advise that since 1933 we erected a 25,000-barrel tank and a 40' x 100' warehouse. You also refer to the four tanks recently erected consisting of one 80,000-barrel, two 30,000-barrel, and one 20,000-barrel tank, and a 10' x 70' extension to the garage. The above is correct, with the exception of the 25,000-barrel tank, which seems to be in error, as we have no record of this item.

For your information, we are listing below the tankage at this plant:

✓ 3 - 10 M Bbl. Tanks
1 - 80 M " Tank
2 - 30 M " Tanks
1 - 20 M " Tank

6 - ~~2 - 20,000-Gallon Tanks~~
2 - 18,000- " "

In 1929 our assessment was increased \$1,000.00, which increase was undoubtedly due to the two 18,000-gallon tanks erected during the previous year. In 1934 our assessment was increased \$10,000, which we cannot account for, unless it was due to the completion of the community dock and possibly to the misunderstanding that a 25,000-barrel tank had been erected. In 1936 the assessment was increased \$5,000.00, which no doubt was due to the warehouse addition. This year there has been an increase of \$43,000.00 covering the four new tanks and extension to the garage.

Exhibit 22

Appendix B

curriculum vitae – Mark Jonathan Cejas



Mark Jonathan Cejas

Current Position

Principal/Founder –
ChemQuants, LLC.

Markcejas@chemquants.
com

www.ChemQuants.com

Years Experience

12+ Years –
Environmental Forensics
Consultant & Expert

20+ Years – Analytical
Chemist

Education

MS, Analytical
Chemistry, Florida
International
University, 2009

B.S., Chemistry &
Biochemistry, Florida
International
University, 2003

B.S., Environmental
Science, Florida
International
University, 2003

Professional Affiliations

Environmental
Forensics Session
Chair SCIX 2019,
Palm Springs, CA

Editorial Board for
Environmental
Forensics Journal

American Chemical
Society (ACS)

Society of
Environmental
Toxicology &
Chemistry (SETAC)

Mr. Cejas specializes in problem-solving with environmental forensics tools for client teams at contaminated sites. Client teams include environmental consultants, litigation experts, oil and gas companies, property developers, regulators, and insurance companies. Mr. Cejas's experience with contaminated sites spans most U.S. states, and in all instances, his efforts led to defensible outcomes from the principal Environmental Forensics questions – Who or what caused the contamination, how did the contamination occur, are the test results valid, and wherever possible when did the contamination occur?

Mr. Cejas's specialties include chemical release investigations on coastal waterways, subsurface environments at petroleum terminals, fueling stations, airports, dry cleaners, brownfield reclamation properties, and industrial sites. Mr. Cejas has directed client teams to favorable outcomes in pollution liability management problems and, in many instances, success from litigious disputes at contaminated sites with the country's highest-tier environmental forensics experts and legal teams.

Expert Advisory

Mr. Cejas routinely services client teams with expert testimonials that involve chemical fingerprinting, fuel release age dating, and "big environmental data" chemometrics and data visualization. Mr. Cejas has written over one hundred petroleum forensics expert reports regarding fugitive releases of gasoline, distillate fuels, heavy fuel oils, residual petroleum products, waste oils, solvents, coal tars, renewable fuels, crude oils, petroleum vapors, and residues from Manufactured Gas Plants (MGPs). A specific type of forensics report may be available in redacted form upon request. Specifically related to petroleum fuels, Mr. Cejas is an expert in the characterization and time of fugitive release of gasoline and other fuels in subsurface soil and groundwater. Mr. Cejas firmly adheres to scientific principles to support reasonably accurate conclusions. His approach to petroleum forensics has yielded a proven history of success.

Beyond petroleum contamination, Mr. Cejas has driven successful outcomes for client teams in aquatic sediments and waterways impacted by legacy contaminants such as PCBs, Dioxins/Furans, etc., from industrial process sources. Mr. Cejas often collaborates with client teams to objectively unravel chemical mixtures for chemical source differentiation and cost allocation in pollution liability disputes among multiple potentially responsible parties.

Selected Projects

Homefed Village III Master, LLC v. Recycling International Inc. 3:20-cv-0784-L-JLB (U.S. District Court for the Southern District of California, 2024) – Retained Expert

Mr. Cejas was retained as environmental forensics testifying expert on behalf of a plaintiff, a prominent developer of master-planned communities. Provided Expert Report, Deposition, Rebuttals, and Declaration prior to settlement.

Homefed Village III Master, LLC v. Otay Landfill, Inc. 3:20-cv-0784-L-JLB (U.S. District Court for the Southern District of California, 2024) – Retained Expert

Mr. Cejas is retained as environmental forensics testifying expert on behalf of a plaintiff, a prominent developer of master-planned communities. Provided Expert Report, Deposition, Rebuttals, and Declaration – Case Ongoing



Traveler's Insurance – Lenice Morgan v. Hawkwood Energy Operating, LLC, and Hawkwood Energy Midstream, LLC, 20-000091-CV-85 (85th Judicial District Brazos County, Texas) – Retained Expert

Mr. Cejas applied petroleum forensics and geochemistry principles to estimate the onset of a natural gas pipeline release that impacted a residential property zone, causing vapor intrusions and groundwater contamination risks. Compound Specific Isotope Analysis (CSIA) of light gasses was applied for contaminant source characterization. First-order kinetics principles were applied to estimate when the natural gas pipeline failed. The result of the objective investigation was utilized for decision-making in an insurance claim. Provided Expert Report.

Greenberg Traurig, LLP – Chemometrics of PCBs in Bay Sediments – Confidential Location – Retained Expert

A forensic evaluation was performed to determine potential Polychlorinated Biphenyls (PCB) sources in marine sediments. Mr. Cejas developed data analysis and interpretation strategies to assess the potential contributions of multiple PRPs. Mr. Cejas conducted industrial source characterization for remedial cost apportionment with an integrated multivariate analysis approach, using Polytopic Vector Analysis (PVA) for data exploration and t-Distributed Stochastic Neighbor Embedding (t-SNE) for data visualization. Provided Expert Report.

Cox – Colvin & Associates – Petroleum Contamination Dispute Among Oil & Gas Companies – Retained Expert

A forensic evaluation is being performed to determine the composition, spatial distribution, and time of release of petroleum contamination at a refinery previously owned by a different Oil and gas company. Mr. Cejas is a retained expert who supports significant cost allocation among stakeholders. Provided Expert Report.

Neuner Pate – Chemical Forensics in a Salt Dome – Napoleonville, Louisiana – Retained Expert

The client was a midstream oil and gas company allegedly responsible for causing catastrophic damage to a salt dome reservoir on an adjacent property. Mr. Cejas was a retained forensic expert for the client. Expert objectives included evaluating historical environmental conditions and chemical data, developing chemical databases, overseeing laboratory coordination for light gas stable isotopes analysis, conducting forensic investigations, and developing expert opinions. His expert report supplied factual evidence that led to his client's success. Provided Expert Report.

JHA Consulting Engineers – Jet Fuel Forensics at a Main Airport – Los Angeles, CA – Retained Expert

The client was a major international airline allegedly responsible for contaminating the airport's groundwater. Mr. Cejas applied defensible environmental forensics techniques to historical Site-related and chemical data, including all available Jet Fuel records and groundwater samples. Mr. Cejas generated multiple lines of evidence in the investigation that delineated historical releases with minimal relationship to a recently suspected fugitive release of Jet Fuel. The objective and unbiased forensic investigation led to a favorable outcome for the client team. Provided Expert Report.

Linebach & Funkhouser – Forensic Study of Petroleum Vapor Intrusion to a Residential Community – Harlan, Kentucky – Retained Expert

Mr. Cejas applied petroleum forensics and geochemistry principles to evaluate vapor phase hydrocarbons from indoor, sub-slab, and outdoor air samples. The forensic investigation



generated multiple lines of evidence that presented an objective fingerprinting model supporting multiple (primarily unexpected) vapor phase hydrocarbon sources and pathways to indoor air. The forensic study provided data-driven insights, which enabled a targeted approach to addressing and mitigating vapor intrusion risk to the community. Mr. Cejas's forensic report enabled the client team to work effectively with the KYDEP in their objective position. Consequently, Mr. Cejas's report was critical in Kentucky's Brownfield Program issues. Provided Expert Report.

Givaudan – Chemical Source and Transport Assessment / Passaic River– Retained Expert

Mr. Cejas was retained as a forensic expert, providing alternative interpretations of conditions and contaminant sources of PCDD/Fs along the Passaic River. Mr. Cejas developed novel data analysis and interpretation strategies to assess the potential of upstream contributions based on chemical forensics, multivariate ordination and classification techniques, GIS, and 3D data visualization perspectives. Mr. Cejas's expert work was among the most comprehensive forensic studies of PCDD/Fs in the history of contaminant studies in the Passaic River. Provided Expert Reports.

Stantec – Application of Petroleum Forensics to Inform Finite-difference Flow Models for Remedial Cost Apportionment among Multiple Stakeholders – Philadelphia, PA – Retained Expert

Mr. Cejas is the petroleum forensics expert supporting refinery-wide delineations of subsurface contamination plumes. Multiple lines of evidence are applied to include VOC and SVOC range molecular chemistry methods, compound-specific isotope (CSIA) methods for conventional and non-conventional analytes, and source-specific wastewater tracers, e.g., sucralose. The primary objectives for the forensics investigations were to inform Finite-difference Flow Models to enhance pollution source diagnostics for cost allocation strategies in one of the largest refinery redevelopment projects in the nation. Mr. Cejas is the resident Environmental Forensic expert supporting multiple stakeholders in a refinery-wide remedial cost apportionment. Provided Expert Reports.

Krazan-VEIR – Aqueous Phase Hydrocarbons Forensics at Two Gasoline Stations – Wofford Heights & Orange Cove, California – Expert Advisory

In response to alleged fugitive fuel releases, forensic evaluations of groundwater samples were undertaken at two gasoline station sites. Both projects only sampled groundwater samples, so Mr. Cejas developed similar chemical analysis strategies to explore VOC and SVOC hydrocarbon range signatures. For both projects, the comprehensive forensic studies revealed that the groundwater contamination originated not from the gasoline station but from off-site industrial and car wash facilities adjacent to the properties. Mr. Cejas's report gave the client team the information to recommend alternative actions and eliminated a significant cost burden of remediation for the client. Provided Expert Report.

EA Engineering, S & T – Sources of PAHs in Surface Soil at Eielson Air Force Base – Expert Advisory

Mr. Cejas applied petroleum forensics and geochemistry principles to evaluate the range of PAH concentrations on Eielson AFB and nearby areas. PAH compositions were assessed with multivariate statistics—PVA & t-SNE—and diagnostic ratio analysis to support a multiple-lines-of-evidence approach for characterizing sources and their geospatial distributions on and off-site. Results from the investigation provided convincing evidence that dominant PAH sources on-site were unassociated with specific release events. Provided Expert Report.

Wood – Sitewide Characterization and Age Dating of Diesel Fuel at Amtrak Maintenance Facility – Ivy City Railyard – Washington, D.C. – Expert Advisory



Mr. Cejas led a sitewide forensic investigation at an Amtrak maintenance facility. The initiative was driven by the need to understand the nature and extent of diesel fuel contamination, specifically the historical and potentially recent subsurface impacts of fuel by all diesel combustion engines utilized on-site. Mr. Cejas's expert report addressed concerns about potential environmental risks from historical and current activities. Provided Expert Report.

Pilot Geological, PLLC – Two Dry Cleaners, a Client's Property, & One Major Plume – Who Did It? – Durham, North Carolina - Expert Advisory

Mr. Cejas applied environmental forensics techniques in a groundwater pollution liability dispute between a Site represented by the client team and two adjacent Dry Cleaners facilities with different operational histories. Mr. Cejas's forensic report proved the contamination was migrating from one dry-cleaning facility, absolving the client team from pollution liability and remediation cost burden. Provided Expert Report.

Orion Environmental, Inc. - A Gasoline Station, A Large Historic Gasoline Plume & Questions of Natural Source Zone Depletion – Long Beach, California - Expert Advisory

Mr. Cejas conducted a forensic evaluation focused on characterizing the extent of a significant historical plume of gasoline from a gasoline station. In addition to assessing the potential presence of a recent fugitive release of gasoline on-site, Mr. Cejas undertook a molecular forensic-focused assessment of natural source ozone depletion (NSZD) on the client team's Site. Mr. Cejas's forensic report ruled out recent gasoline releases during a critical period in question. Also, the forensic report provided an additional line of evidence that NSZD was occurring at the Site. The report successfully supported the client team on both fronts. Provided Expert Report.

Alta Science & Engineering, Inc. – A Fueling Stations, a Known Historic Release, & Questions of a Recent Fugitive Release – Lewiston, Idaho - Expert Advisory

Forensic evaluations of groundwater samples were undertaken at a fueling station in response to alleged gasoline releases. Mr. Cejas developed a laboratory methods and chemical analysis strategy to explore VOC hydrocarbon range signatures. The comprehensive forensic studies revealed that the groundwater contamination was not from any fugitive gasoline release during the 11 years of groundwater monitoring at the Site. Instead, the forensic investigation led to defensible conclusions that the elevated concentrations of regulated gasoline hydrocarbons occurring in the wells were associated with a documented historical gasoline release. Mr. Cejas's report aided the client team with a clean-up approach that significantly reduced the cost burden on the property owner. Provided Expert Report.

EarthNet – Age Dating of Petro/Bio-Diesel Fuel – Glade Spring, VA - Expert Advisory

Mr. Cejas applied environmental forensics techniques to determine the release time for a service station's mixed biodiesel/Petro diesel fuel. The principal question posed by the client team, financed by the insurance carrier, was whether the groundwater contamination derived from a historic release of the mixed fuel or an ongoing slow leak. Mr. Cejas's forensic report indicated that a leaking system did not cause the contamination. Instead, it was determined that the release of biodiesel/Petro diesel fuel mixture from an earlier documented system failure caused the contamination. Mr. Cejas's report enabled the client team, which included the client, the Virginia Department of Environmental Quality (VDEQ), and the insurance carrier, to move forward confidently with data-driven objectivity to achieve practical remediation at the Site. Provided Expert Report.

Core – Forensics at a Gasoline Station – Fingerprinting Source Diagnostics Leading to 100% Coverage by Insurance Claim, Carnegie, PA - Expert Advisory



Mr. Cejas led the client team to success with applications of environmental forensics techniques that included powerful molecular and isotope-based fingerprinting diagnostics for gasoline station forensics and deep reviews of historical records that included decades of routine chemical monitoring. The forensic objective involved determining the origin and time of gasoline release in a dispute between two gasoline station properties and an insurance carrier. Mr. Cejas's forensic report was instrumental in removing the remediation cost burden from the client team and maintaining 100% coverage by the insurance carrier. In addition, Mr. Cejas's report paved an expedited path toward regulatory closure by year-end. Provided Expert Report.

Stantec – Condensate Crude Oil Forensics at a Major Crude Oil Hub in North America – Hardisty Terminal – Canada – Expert Advisory

Mr. Cejas led the client to success in differentiating condensate crude oil releases at a significant crude oil hub and storage facility in North America. Mr. Cejas designed a chemistry methods strategy with sophisticated methods for hydrocarbon fingerprinting that involved PIANO molecular fingerprinting and custom compound-specific isotope analysis (CSIA). Regarding data science, Mr. Cejas applied advanced chemometric techniques that involved integrated multivariate and high-dimensional data visualization techniques. Mr. Cejas's expert report effectively differentiated chemical sources at a large site involving many condensates crude oil releases. Provided Expert Report.

Infinity Solutions Group – Chemometrics of PCBs in Sediments (Swan Lake) – Portland, Oregon – Retained Expert

A forensic evaluation was performed to determine potential Polychlorinated Biphenyls (PCB) sources in lake sediments. Mr. Cejas conducted source characterization and their mixing apportionment with an integrated multivariate analysis approach, using Polytopic Vector Analysis (PVA) for data exploration and t-Distributed Stochastic Neighbor Embedding (t-SNE) for data visualization. Provided Expert Report.

Haley & Aldrich– PAH Source Differentiation Between Historical MGP and Significant Urban Influences for Sediments in San Francisco Bay – Expert Advisory

A forensic evaluation was performed to determine sources of polycyclic aromatic hydrocarbons (PAHs) in nearshore sediments in a portion of the northern waterfront of San Francisco Bay, California. The focus of the evaluation was PAH composition in sediments and the presence of potential point and nonpoint petrogenic and pyrogenic source types from contaminants associated with manufactured gas plant (MGP) operations. Mr. Cejas conducted source characterization with an integrated multivariate analysis approach, using Polytopic Vector Analysis (PVA) for data exploration and t-Distributed Stochastic Neighbor Embedding (t-SNE) for data visualization. Mr. Cejas's results provided the client team with a statistically based "map" of different contaminant source types and their mixing profiles in the bay sediments. Provided Expert Report.

Pinnacle Engineering – Discovery of a Historic Waste Plume, not the Suspected Gasoline Plume from a UST Release, Montana – Expert Advisory

Mr. Cejas's forensic objective was to characterize the free product of automotive gasoline that mysteriously re-emerged after being undetected in the subsurface for five years. A comprehensive chemical characterization of gasoline range hydrocarbons and an exploration of unknown chemistry led to the discovery of specific industry tracers that identified a waste plume from a historic asphalt refinery. Consequently, the client was absolved from the significant cost burden of remediation. *Provided Expert Report.*

Cardno – Age Constraining a Remobilized LNAPL – Santa Barbara, California – Retained Expert



An earthquake caused a tank rupture in the mid-1980s. More than twenty years later, the re-emergence of LNAPL triggered a forensic age-constraining investigation. Mr. Cejas served as the third-party expert in the matter. His expert report supplied factual evidence that led to his client team's success. *Provided Expert Report.*

B.P. – Petroleum Geochemistry Review of Deepwater Sediments Subjected to Toxicity Tests – NRDA – Retained Expert

Mr. Cejas conducted a petroleum geochemistry review of deep sediment chemistry near an offshore oil well. The data analysis strategy included a review of petroleum biomarker biodegradation potential, geospatial visualization of diagnostic chemical ratios, traditional oil fingerprinting techniques, and toxicity test comparisons with *Leptocheirus plumulosus*. The report was for Cardno's Natural Resource Damage Assessment on behalf of B.P. for the Deepwater Horizon incident in the Gulf of Mexico. Provided Expert Report.

B.P. – Spatial and Temporal Distribution of PAH Fingerprints in Oysters – NRDA – Retained Expert

Mr. Cejas developed a data analysis strategy to investigate PAH fingerprints' spatial and temporal distribution in oyster tissue. Polytopic Vector Analysis (PVA) was applied to discover chemical source' end members' and their mixing proportions in natural samples. The report was conducted for Cardno's Natural Resource Damage Assessment on behalf of B.P. for the Deepwater Horizon incident in the Gulf of Mexico. Provided Expert Report.

Cardno –Environmental Forensics Data Scientist – Deepwater Horizon Oil Spill - Gulf of Mexico, Louisiana – Retained Expert

Mr. Cejas was the chief data scientist for Petroleum Forensics investigations for Cardno on the Deepwater Horizon Oil Spill in support of B.P. Mr. Cejas collaborated with multidisciplinary teams of scientists and engineers for the Natural Resource Damage Assessment (NRDA). As the principal environmental forensics data scientist, Mr. Cejas's responsibilities spanned the design and management of analytical chemistry data coordination through the complete life cycle of the largest oil spill in U.S. history - chemical sampling, chemical data acquisition, chemistry database management, quality assurance, and control, and chemometrics investigations. Furthermore, Mr. Cejas supported Cardno's principal forensic expert in designing statistical data analysis techniques to differentiate spilled petroleum from other environmental hydrocarbon signatures. Mr. Cejas's interpretive reports and presentations were critical tools for communicating facets of oil contamination to the client, other stakeholders, and litigation teams from the context of environmental forensics. Provided Expert Reports.

Publications

- Time of Release Estimate for Contained Gas in the Subsurface – A Chemical Data Strategy Environmental Forensics, 1-10.
- PAH Source Differentiation between Historical MGP and Significant Urban Influences for Sediments in San Francisco Bay. Marine Pollution Bulletin 166 (2021): 112248.
- Integrated Chemometric Assessment PCDD/F Contamination and Sources in the Passaic River, New Jersey. (Article in Review) Environmental Forensics.
- Chemometric Mapping of Polychlorinated Dibenzo-p-Dioxin (PCDD) and Dibenzofuran (PCDF) Congeners from the Passaic River, NJ: Integrated Application of RSIMCA, PVA, and t-SNE. Environmental Forensics 22.1-2 (2021): 155-171.
- Sources and Reference Concentrations of PAHs in Surface Soil at Eielson Air Force Base. Battelle 2024 Chlorinated Conference (2024). June 2-6, Denver, Colorado
- Forensic Problem-solving in the Subsurface with Multiple Lines of Evidence – 3 Case Studies. SCIX 2019. October 13-18, Palm Springs, CA.



- Integrated Application of RSIMCA, tSNE, and PVA for Chemometric mapping of PCDD/F congeners. Battelle Tenth International Conference on the Remediation and Management of Contaminated Sediments (2019). February 11-14, New Orleans, LA.
- Integrated Chemometric Assessment PCDD/F Contamination and Sources Passaic River, NJ. Battelle Tenth International Conference on the Remediation and Management of Contaminated Sediments (2019). February 11-14, New Orleans, LA.
- Integrated Application of RSIMCA, tSNE, and PVA for Chemometric mapping of PCDD/F congeners. International Network of Environmental Forensics (INEF 2018). Annual Meeting – Salt Lake City, UT.
- Nearshore Sediment Exposure to Louisiana Crude Oil: Spatial and Temporal Patterns in the northern Gulf of Mexico. 33rd SETAC Annual Meeting, Long Beach, California.
- Post-Deepwater Horizon Toxicity Study of Gulf of Mexico Sediments using the Amphipod *Leptocheirus Plumulosus*. 33rd SETAC Annual Meeting – Long Beach, California.
- Confirmation of non-MC-252 Oil in Water Column Samples Southwest of the Wellhead using Hydrocarbon Biomarkers and PAH ratios. SETAC Focused Topic Meeting 2011, Pensacola Beach, FL.
- Determining Optimal Electrospray Ionization of Sucralose – An Application of Response Surface Modeling and Weighted Least Squares Regression for a Robust Determination of Detection and Quantification Limits. FAME 2009, Orlando, Florida.
- Improved analytical method for determining unstable organophosphorus pesticides in organic-rich soil/sediment and fish tissue matrices. American Chemical Society 80th Florida Annual Meeting and Exposition FAME 2004, Orlando, Florida.
- Paleo-reconstruction of hydrocarbon sources and their contribution to the pollution loads of wetlands in the Florida Keys and the Southern Everglades. 24th SETAC Annual Meeting - Austin, Texas.
- Endosulfan Sulfate in Fish Tissue from Everglades National Park: Tales of an Unregulated Pesticide Metabolite. GEER 2008—Naples, FL.
- Microconstituents in Surface Waters from South Florida: Occurrence, Persistence, and Relevance concerning Water Reuse GEER 2008 – Naples, FL.
- Regional Distribution of Organic Contaminants in Water and Sediments in Everglades National Park. GEER 2008—Naples, FL.
- Multivariate Analysis of Selected Microconstituents in Coastal Environments of Southeast Florida. 29th SETAC Annual Meeting - Austin, Texas

Relevant Work Experience

- Principal / Founder – ChemQuants, LLC. May 2020 - Current
- Chief Data Officer / Co-Founder – CitiQuants Corporation Feb 2017 to April 2024
- Technical Director/Petroleum Forensics – Pace Analytical Energy Services – Formerly Zymax Forensics - July 2015-June 2020
- Managing Scientist – Infinity Solutions Group - June 2014-February 2018
- Senior Project Scientist/Applied Chemistry & Data Sciences - Cardno - January 2012-November 2017
- Senior Project Scientist – Entrix - January 2011-January 2012
- Project Manager – Southeast Environmental Research Center - June 2010-January 2011
- Senior Chemist - TDI Brooks International - August 2004 – July 2006