Emissions Estimate Report

Chemtool Facility
1165 Prairie Hill Road,
Rockton, Illinois

Prepared for:

Chemtool, Inc.

Prepared by:

EHS Support℠

July 2022

Table of Contents

List of Tables

List of Figures

List of Appendices

Acronyms/Units/Chemical Formulae

CO	carbon monoxide
CO_2	carbon dioxide
cy	cubic yards
DSM	digital surface model
ft	foot/feet
ft^2	square feet
ft^3	cubic feet
gal	gallons
H_2O	water
IEPA	Illinois Environmental Protection Agency
lbs.	pounds
M	million
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NO_x	nitrogen oxides
PAHs	polycyclic aromatic hydrocarbons
PM	particulate matter
SG	specific gravity
SO_x	sulfur oxides
SVOC	semi-volatile organic compound
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

Executive Summary

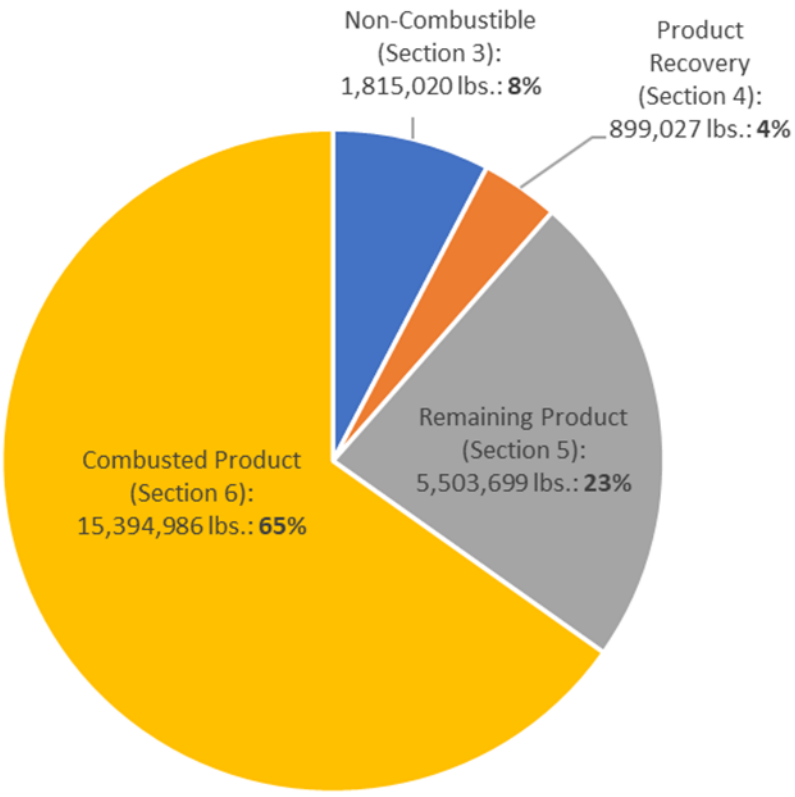
On June 14, 2021, a fire ("Fire") started at Chemtool, Inc.'s lubricant production facility located in Rockton, Illinois ("Site"). EHS Support LLC ("EHS Support") prepared this Emissions Estimate Report ("Report") to estimate:

1) Amount of product combusted during the Fire
2) Emissions that were a result of the Fire

Step 1 - Estimating Combusted Product

EHS Support developed a preliminary estimate of product combusted by the Fire (shown below in pounds [lbs.]) by excluding non-combustible chemicals, product recovered post-Fire, and product remaining at the Site:

Estimate	**Quantity**
• Inventory (**Section 2**):	23,612,732 lbs.
• Non-Combustible (**Section 3**):	-1,815,020 lbs.
• Product Recovered (**Section 4**)[1]:	-899,027 lbs.
• Product Remaining (**Section 5**)[1]:	- 5,503,699 lbs.
Product Combusted (Section 6) [1]***:***	***15,394,986 lbs.***



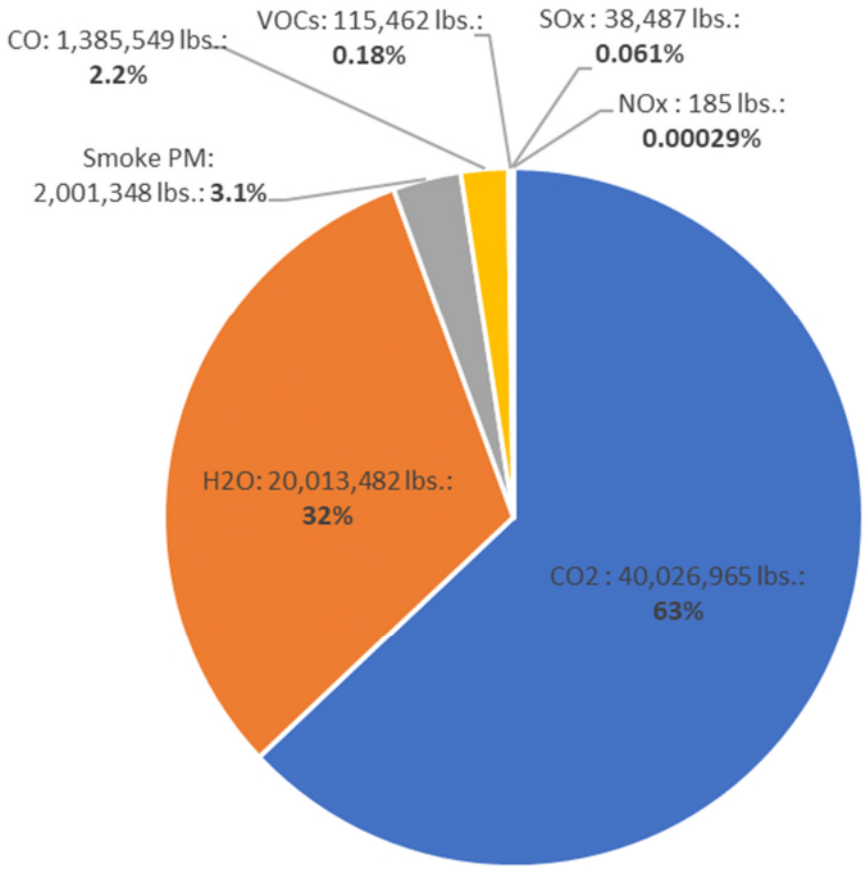
[1] Estimates are subject to change based on new information collected during demolition and/or Site investigation.

Step 2 - Estimating Emissions from Combusted Product

Using the preliminary estimate of product combusted in Step 1, EHS Support estimated the composition and quantity of emissions from the Fire based on literature-derived emission factors (**Section 7.1**) and Site-specific data (**Section 7.2** through **Section 7.4**). The emissions from the Fire were comprised of seven components:

- Carbon dioxide (CO_2)
- Water (H_2O)
- Smoke particulate matter (PM)
- Carbon monoxide (CO)
- Volatile organic compounds (VOCs)
- Sulfur oxides (SO_X)
- Nitrogen oxides (NO_X)

The composition of the emissions by component was:



The Site-specific data allowed for further refinement of two components into elements and/or compounds:

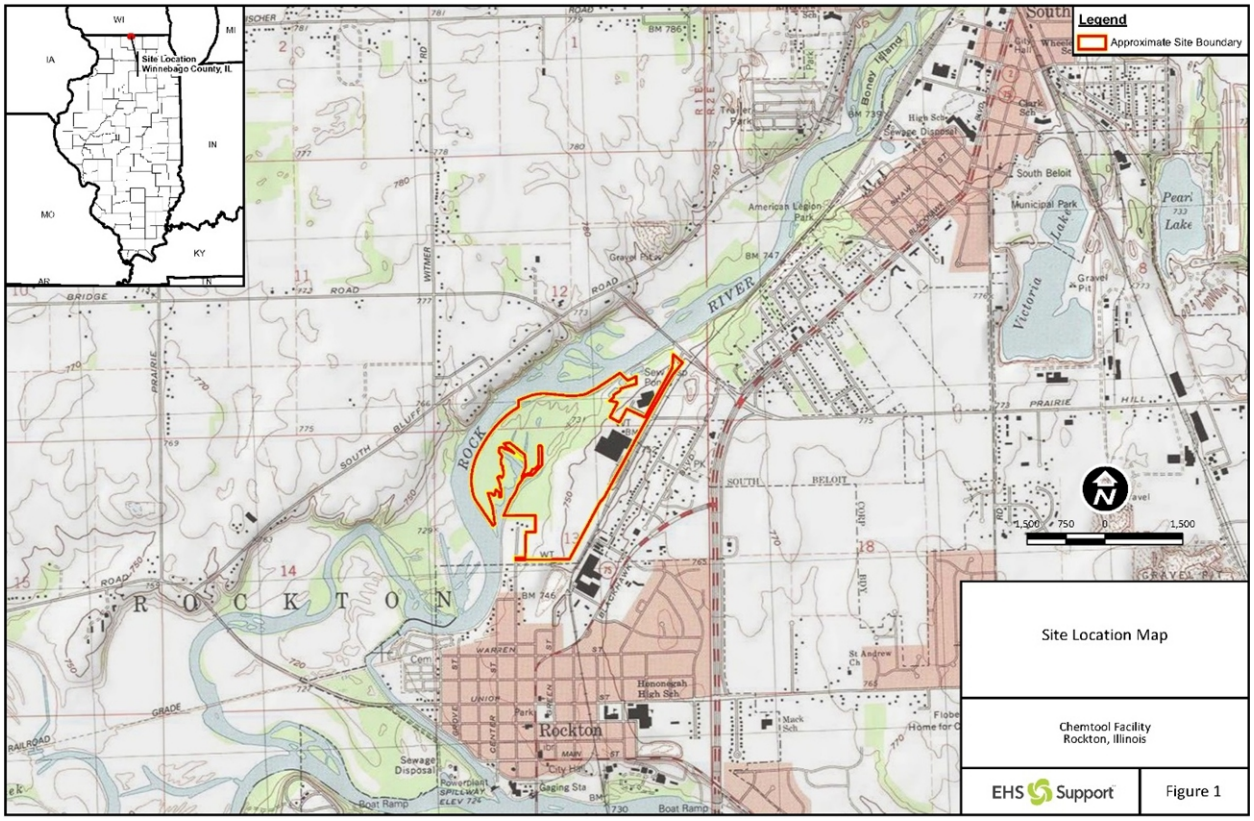
- Smoke PM contained:
  - Carbon (96.47%)
  - Calcium (0.93%)
  - Potassium (0.81%)
  - Sulfur (0.80%)
  - Molybdenum (0.33%)
  - Zinc (0.16%)
  - Phosphorus (0.16%)
  - Lithium (0.081%)
  - Sodium (0.065%)
  - Boron (0.047%)
  - Silicon (0.034%)
  - Aluminum (0.027%)
  - Iron (0.025%)
  - Titanium (0.016%)
  - Bismuth (0.014%)
  - Antimony (0.011%)
  - Copper (0.0045%)
  - Iodine (0.0012%)
  - Barium (0.00092%)
  - Zirconium (0.00090%)
  - Magnesium (0.00062%)
  - Nickel (0.00029%)
- VOCs contained:
  - Acetone[2] (77%)
  - Methyl Ethyl Ketone (12%)
  - Xylenes (3.60%)
  - Benzene (3.10%)
  - Styrene (1.60%)
  - Carbon Disulfide (1.20%)
  - Toluene (1.20%)
  - Ethylbenzene (0.67%)

[2] Acetone has been determined by U.S. EPA to have negilible photochemical reactivity and, therefore, is excluded from the definition of volatile organic compound (VOC) in 40 CFR §51.100(s)(1). Acetone is also excluded from the definition of "organic material" in 35 Ill. Adm. Code §211.4250(b). While acetone is not generally considered a VOC for air regulatory purposes, it was considered a VOC for purposes of this analysis because of its limited photochemical reactivity.

1 Introduction

EHS Support LLC ("EHS Support") prepared this Emissions Estimate Report ("Report") on behalf of Chemtool, Inc. ("Chemtool") for the lubricant production facility located at 1165 Prairie Hill Road in Rockton, Winnebago County, Illinois ("Site" for the entire property and "Facility" for the lubricant production plant) (see **Figure 1** for Site location). On June 14, 2021, a fire ("Fire") at the Facility started following an accidental pipe rupture and subsequent ignition of spilled mineral oil within the **Grease Manufacturing** area of the Facility (**Section 2**). This Report provides the steps used to estimate the amount of product combusted and the resulting emissions from the Fire at the Facility.

Figure 1. Site Location Map



1.1 Report Objectives

The objectives of the Report are as follows:

- Identify the quantity of product stored at the Facility at the time of the Fire.
- Identify non-combustible chemicals and eliminate these from the inventory.
- Estimate the amount of product:
  - Recovered at the Site
  - Remaining at the Site
  - Combusted during the Fire
- Evaluate the composition and quantify the emissions from the product that combusted during the Fire.

1.2 Report Organization

The Report is organized as follows:

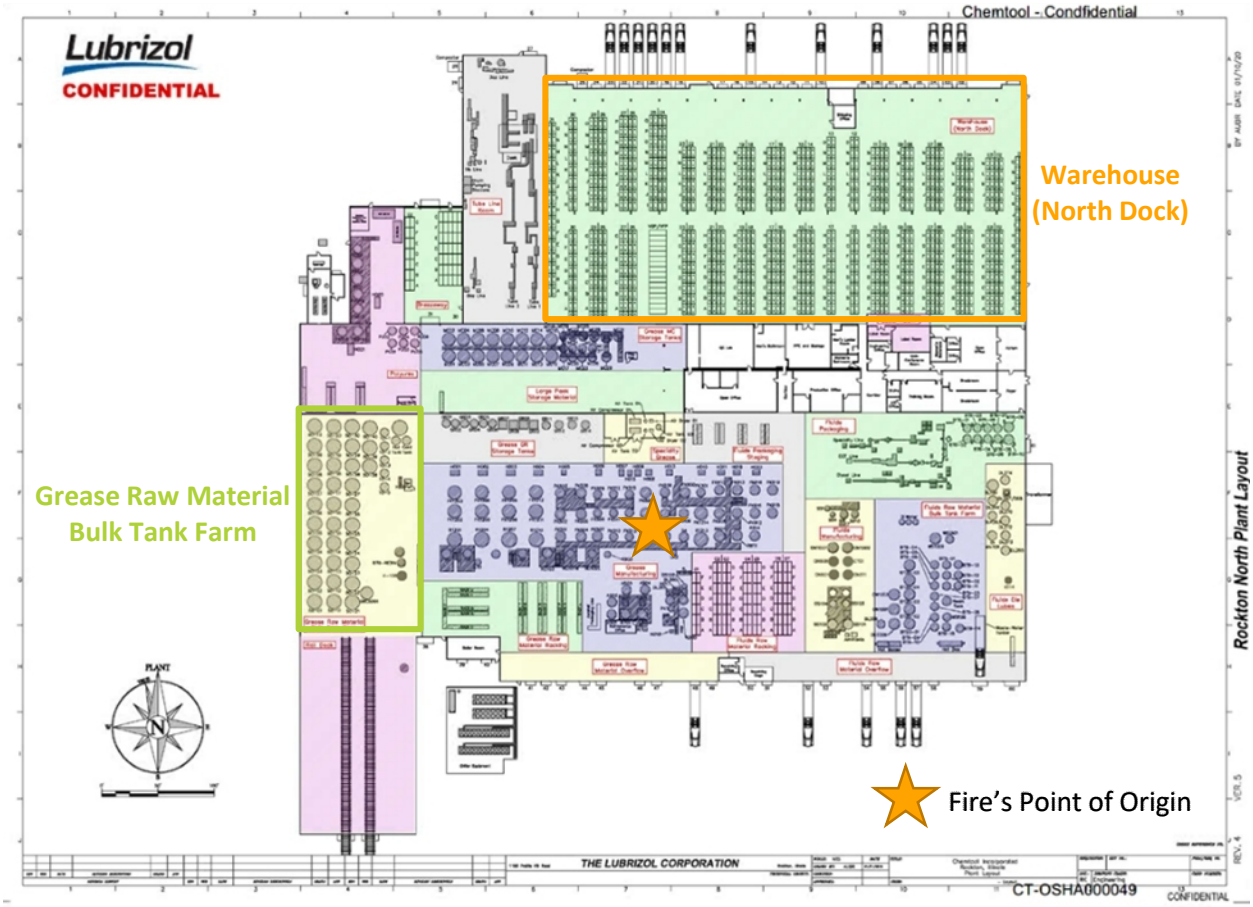
- **Introduction:**
  - **Section 1** – Introduces the Site and summarizes the Report, objectives, and Report organization.
- **Estimating Combusted Product:**
  - **Section 2** – Presents the Facility layout and estimated quantity of product present at the time of the Fire by operational area.
  - **Section 3** – Presents the estimated quantity of non-combustible chemicals present at the Facility at the time of the Fire.
  - **Section 4** – Presents the estimated quantity of product recovered from the Site after the Fire.
  - **Section 5** – Presents the estimated quantity of product remaining, as of March 2022, at the Facility.
  - **Section 6** – Presents the estimated quantity of product combusted during the Fire.
- **Estimating Emissions from Combusted Product:**
  - **Section 7** – Presents the estimated composition and quantity of emissions resulting from the combustion of products during the Fire.
- **References:**
  - **Section 8** – Lists the reference documents cited in this Report.

2 Facility Layout and Product Location

As detailed in **Figure 2**, the Facility consists of multiple operational areas. The Fire's point of origin in the **Grease Manufacturing** area of the Facility is identified in **Figure 2** by the orange star. Based on the information provided by Chemtool (Chemtool, 2021a; Chemtool, 2021b; Chemtool, 2021e; Chemtool, 2021f), there were 23.61 million (M) pounds (lbs.) of product (raw materials and finished goods) present throughout the Facility at the time of the Fire, with the majority of the inventory located in the **Warehouse (North Dock)** and **Grease Raw Material Bulk Tank Farm**.

Location:	**Quantity:**
• Warehouse (North Dock):	9.42 M lbs. (40%)
• Grease Raw Material Bulk Tank Farm:	7.07 M lbs. (30%)
• Various (**Appendix A**):	7.12 M lbs. (30%)
• **Inventory:**	**23.61 M lbs.**

Figure 2. Facility layout highlighting areas of significant product storage (Chemtool, 2021d).



3 Exclusion of Non-Combustible Chemicals

To estimate the volume of product that would not have contributed to emissions because of the Fire, EHS Support excluded non-combustible chemicals from the product inventory based on the composition of products detailed by Chemtool (Chemtool, 2021c).

Non-Combustible Chemical:	**Quantity:**
• Water:	1.16 M lbs.
• Metallic Carbonates:	0.51 M lbs.
• Metallic Hydroxides:	0.12 M lbs.
• Metallic Oxides:	0.02 M lbs.
Total:	**1.81 M lbs.**

Calcium carbonate, an example of a chemical that would not combust during the Fire, was observed on a post-Fire Site walk (March 17, 2022) in the Grease Raw Material Racking area of the Facility (**Figure 3**). The exclusion of non-combustible chemicals (1.81 M lbs.) from the total inventory (23.61 M lbs.) yields 21.80 M lbs. of potentially combustible product present throughout the Facility at the time of the Fire.

Combustible Inventory:	**Quantity:**
• Total Inventory:	23.61 M lbs.
• Non-Combustible Chemicals:	-1.81 M lbs.
Combustible Inventory:	**21.80 M lbs.**

Accounting for this adjustment and the location[3] of non-combustible chemicals, EHS Support estimated the amount of potentially combustible product by operational area.

Location:	**Quantity (Total):**		**Quantity (Combustible):**
• Warehouse (North Dock):	9.42 M lbs. (40%)	→	8.51 M lbs. (39%)
• Grease Raw Material Bulk Tank Farm:	7.07 M lbs. (30%)	→	6.90 M lbs. (32%)
• Various (**Appendix A**):	7.12 M lbs. (30%)	→	6.39 M lbs. (29%)
Total:	23.61 M lbs.		**21.80 M lbs.**

Figure 3. Bags of calcium carbonate observed on March 2022 Site walk.

[3] Location of non-combustible chemicals based on the information provided by Chemtool (Chemtool, 2021a; Chemtool, 2021b; Chemtool, 2021d; Chemtool, 2021e; Chemtool, 2021f).

4 Product Recovery

Emergency response activities were initiated on June 14, 2021, immediately after the Fire started. Initially, fire suppression water and product pooled within the Facility's footprint and containment areas. Water and product were then observed to discharge from the western side of the Facility (near the **Grease Raw Material Bulk Tank Farm** [**Figure 4**]) as well as from the eastern side of the Facility. Chemtool recovered product from the Site by collecting product from product storage tanks (**Section 4.1**), collecting commingled fire suppression water and product (**Section 4.2**), and excavating visually impacted soils (**Section 4.3**). As of Fall 2021, the product recovery associated with the western side of the Site (**Grease Raw Material Bulk Tank Farm**) is 877,742 lbs. (approximately 12.7% [4] of the inventory in the **Grease Raw Material Bulk Tank Farm** at the time of the Fire) consisting of:

- Product Recovered from Storage Tanks (**Section 4.1**): 437,026 lbs.
- Product Recovered from Fire Suppression Water (**Section 4.2**): 347,554 lbs.
- Product Recovered from Soil - Western Side (**Section 4.3.1**): 93,162 lbs.
- **Total Product Recovered from Grease Raw Material Bulk Tank Farm: 877,742 lbs.**

As of Fall 2021, the product recovery from the western side (877,742 lbs.) and the eastern side (21,285 lbs. product recovered from soil, **Section 4.3.2**) of the Site totals 899,027 lbs. of product recovered.

Figure 4. A photograph of the Fire, as observed on June 14, 2021, showing discharges from the Grease Raw Material Bulk Tank Farm to the western side of the Facility (Chicago Tribune, 2021).

[4] Approximately **12.7%** of the product from the **Grease Raw Material Bulk Tank Farm** was recovered (877,742 lbs. ÷ 6,896,378 lbs. = **12.7%**). Note: 6,896,378 lbs. of product (excluding non-combustible chemicals) were stored in the **Grease Raw Material Bulk Tank Farm** [**Appendix A**]).

4.1 Product from Storage Tanks

Chemtool recovered 57,667 gallons (gal) of product from storage tanks in the **Grease Raw Material Bulk Tank Farm**. Using a product density of 7.5784 lbs./gal,[5] the quantity of product recovered from storage tanks in the **Grease Raw Material Bulk Tank Farm** was **437,026 lbs**.

4.2 Product in Fire Suppression Water

More than a million gallons of commingled fire suppression water and product were recovered and stored in 63 fractionation ("frac") tanks (**Appendix B**). Based on a photographic review of the Fire (**Figure 4**), the general location of the recovery (i.e., to the west of the Facility), and areas of product storage (**Appendix A** and **Figure 2**), the product in the recovered fire suppression water was likely sourced from the **Grease Raw Material Bulk Tank Farm**. EHS Support estimated the recovered free product (**Section 4.2.1**) and dissolved product (**Section 4.2.2**) totaled **347,554 lbs**. The steps used to derive this total estimate for recovered free product and dissolved product are presented in **Section 4.2.1** and **Section 4.2.2**, respectively.

4.2.1 Free Product Estimates (Undissolved)

Free product was observed in 14 of the 63 frac tanks. In those frac tanks, EHS Support calculated the following quantities of free (undissolved) product:

- 27,583 gal of free product with a specific gravity (SG) less than 1 (i.e., less dense than water) were present based on field measurements of the fraction of floatable product (**Appendix B**).
- 12,908 gal of free product with an SG greater than 1 (i.e., denser than water) were present based on field measurements of the fraction of sludge (**Appendix B**).

EHS Support calculated the quantity of recovered free product as follows.

Product Calculation:	**Quantity:**
• 27,583 gal of free product (SG < 1) @ 7.5784 lbs./gal: [5]	209,035 lbs.
• 12,908 gal of free product (SG > 1) @ 9.9933 lbs./gal: [6]	128,996 lbs.
• **Total Free Product:**	**338,031 lbs.**

4.2.2 Dissolved Product Estimates

Forty-five of the 63 frac tanks at the Site were sampled. Dissolved product was detected in all 45 sampled frac tanks (**Appendix B**). Since water in 18 of the frac tanks was not sampled, EHS Support estimated the dissolved product concentrations for all tanks based on the presence or absence of free product and the weighted average from the sampling results collected for those tanks with observed free product and those without:

[5] A weighted average of 7.5784 lbs./gal was calculated based on the densities of the four most abundant products (i.e., ERGON HYGOLD 750, AMERICASCORE 2500, AMERICASCORE 600, and Cross L-750) in the **Grease Raw Material Bulk Tank Farm**.

[6] The 9.9933 lbs./gal was based on the density of the most abundant product with an SG>1 in the **Grease Raw Material Bulk Tank Farm**.

- **Frac Tanks with Free Product:** There were 14 frac tanks with observed free product, 13 of which were sampled for dissolved product (i.e., total petroleum hydrocarbons [TPH][7] and/or Total Recoverable Oil & Grease[8]). Dissolved product concentrations in the 13 sampled frac tanks with observed free product were greater than 1,000 milligrams per liter (mg/L) (**Appendix B**), with a weighted average of 4,782 mg/L.
- **Frac Tanks without Free Product:** There were 49 frac tanks without observed free product, 32 of which were sampled for dissolved product. Dissolved product concentrations in the 32 sampled frac tanks without observed free product were less than 1,000 mg/L (**Appendix B**), with a weighted average of 140 mg/L.

EHS Support calculated the quantity of recovered dissolved product as follows:

Product Calculation:	**Quantity:**
• 213,342 gal of frac tank water (with product, **Appendix B**) @ 4,782 mg/L:	8,514 lbs.
• 864,705 gal of frac tank water (without product, **Appendix B**) @ 140 mg/L:	1,009 lbs.
• **Total Dissolved Product:**	**9,523 lbs.**

4.3 Product in Soil

Chemtool recovered additional product in soil by scraping and removing visually impacted soils around the perimeter of the Site. The recovered soils, along with other impacted material, were stored in more than 80 roll-off boxes. As of Fall 2021, the total volume of recovered soils included 697 cubic yards (cy) from the western side (**Section 4.3.1**) and 302 cy from the eastern side (**Section 4.3.2**) of the Site.

4.3.1 Western Side (Grease Raw Material Bulk Tank Farm)

Similar to the recovered commingled fire suppression water and product (**Section 4.2**), the visually impacted soils from the western side of the Facility were likely sourced from the **Grease Raw Material Bulk Tank Farm**. As stated earlier, there were 697 cy of visually impacted soils; however, 117 cy of that amount was described as "sludge" (**Figure 5**). EHS Support calculated **93,162 lbs.** of product in the visually impacted soils based on an average/median TPH concentration of 48,500 milligrams per kilogram (mg/kg)[9] and a bulk density of 2,359.78 lbs./cy[10] for the 580 cy of visually impacted soils and a TPH concentration of 97,000 mg/kg [11] concentration for the 117 cy of "sludge."

[7] TPH as diesel range organics (C10 – C28) and oil range organics (C28 – C36).
[8] Note - the greater of the two results was used.
[9] The average/median TPH concentration of 48,500 mg/kg was based on the only two available visually impacted soil samples: "S004" collected on June 16, 2021 on the western side of the Site between interceptor trench 1 and 2 (**Appendix C**, top) had a TPH (C10 – C36) concentration of 52,000 mg/kg; and "Outside BT50s" collected on April 19, 2022 adjacent to the western side of the Facility (**Appendix C**, bottom) had a TPH (C10 – C34) concentration of 45,000 mg/kg.
[10] The general soil type at the Site is mixed clayey-silt and silty-fine sand loams, which has an average bulk density of 2,359.78 lbs./cy (USEPA, 1997).
[11] Given that the "sludge" had product above residual saturation, the TPH concentration was estimated to be twice the concentration of visually impacted soils (97,000 mg/kg) (**Figure 5**).

Figure 5. A photograph of product saturated soil ("sludge") contained in roll-off box SB1315.

4.3.2 Eastern Side

Product from the eastern side of the Facility flowed out of a roll-up door onto the eastern portion of the Site during the Fire. As stated above, 302 cy of impacted soils were excavated from the eastern portion of the Site; of the total 302 cy, 172 cy were visually impacted, with an additional 130 cy excavated generally from beneath the visually impacted soils. EHS Support estimated **21,285 lbs.** of product were recovered from the impacted soils based on an average/median TPH concentration of 48,500 mg/kg[12] and a bulk density of 2,359.78 lbs./cy[13] for the 172 cy of visually impacted soils and a TPH concentration of 5,214 mg/kg[14] for the remaining 130 cy of impacted soil.

[12] The average/median TPH concentration of 48,500 mg/kg was based on the only two available visually impacted soil samples: "S004" collected on June 16, 2021 on the western side of the Site between interceptor trench 1 and 2 (**Appendix C**, top) had a TPH (C10 – C36) concentration of 52,000 mg/kg; and "Outside BT50s" collected on April 19, 2022 adjacent to the western side of the Facility (**Appendix C**, bottom) had a TPH (C10 – C34) concentration of 45,000 mg/kg.

[13] The general soil type at the Site is mixed clayey-silt and silty-fine sand loams which has an average bulk density of 2,359.78 lbs./cy (USEPA, 1997).

[14] After removal of the visually impacted soils, post-excavation samples were collected. The median TPH (C6 – C34) concentration was 5,214 mg/kg (average TPH was 6,085 mg/kg). Note that the use of the median, which is lower than the average, results in a lower estimate of product recovery. A lower product recovery results in a higher emissions estimate.

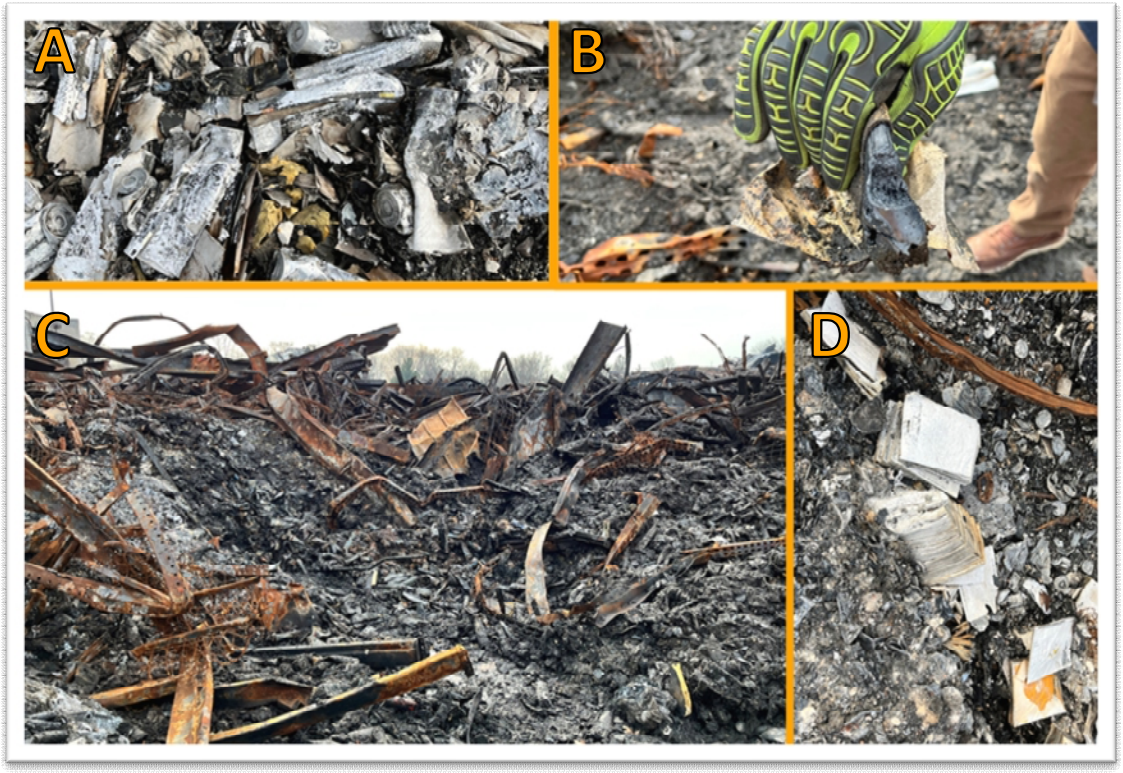
5 Remaining Product in Facility Post-Fire

Before the Fire, the majority of the product was contained in the **Warehouse (North Dock)** and **Grease Raw Material Bulk Tank Farm** (**Section 2** and **Section 3**). Given the significance of these two areas, EHS Support evaluated the **Warehouse (North Dock)** (**Section 5.1**) and the **Grease Raw Material Bulk Tank Farm** (**Section 5.2**) to estimate the mass of product present at the Facility post-Fire. Estimates from the **Grease Raw Material Bulk Tank Farm** were applied to other operational areas (**Section 5.3**). EHS Support developed a preliminary estimate of remaining product at the Facility totaling **5,503,699 lbs.**

5.1 Warehouse (North Dock)

During the March 2022 Site walk, it became evident that the **Warehouse (North Dock)** was less affected by the Fire than other areas of the Facility.[15] In the northwestern portion of the **Warehouse (North Dock)**, there were piles of cardboard tubes (**Figure 6A**); grease that visually appeared unaffected by the Fire (**Figure 6B**); commingled mounds of product,[16] packaging, and building materials that were more than 6 feet high (**Figure 6C**); and piles of papers (**Figure 6D**).

Figure 6. Observations of the northwestern portion of the Warehouse (North Dock) during the March 2022 Site walk.



[15] Possible reasons that the **Warehouse (North Dock)** was less affected include: 1) distance from the Fire's point of origin; 2) proximity to sprinkler system; and 3) access by firefighters (**Figure 4**).
[16] A sample collected on April 19, 2022, in this portion of the **Warehouse (North Dock)** had a TPH (C10 – C34) concentration greater than 100,000 mg/kg confirming the presence of product.

Additional observations in the northeastern (**Figure 7A**) and southern (**Figure 7B**) portions of the **Warehouse (North Dock)** show appreciable quantities of product,[17] ranging from 0.5 feet thick in the former warehouse aisles to more than several feet thick in the former warehouse racks.

Figure 7. Observations of the northeastern (A) and southern (B) portions of the Warehouse (North Dock) on March 2022 Site walk.

Based on a digital surface model (DSM) developed from a July 2021 drone survey (Aerial Inspection Team , 2021), there are approximately 10,000 cy of material (e.g., product, containers, building materials) in the **Warehouse (North Dock)**; however, given that the DSM estimate includes materials

[17] Two samples collected on April 19, 2022, in these areas of the **Warehouse (North Dock)** have TPH (C10 – C34) concentrations greater than 100,000 mg/kg confirming the presence of product.

other than product (e.g., building materials), the remaining amount of product is likely less than 10,000 cy. Based on Site observations, EHS Support conservatively assumed that if the product was evenly spread across the footprint of the **Warehouse (North Dock)** (80,000 square feet [ft^2]), it would be approximately 1 foot (ft) thick (1 ft x 80,000 ft^2 = 80,000 cubic feet [ft^3] or 2,963 cy).[18] Using a density of 7.87 lbs./gal (1,590 lbs./cy),[19] the amount of product remaining at the **Warehouse (North Dock)** is **4.71 M lbs.** Therefore approximately **55.4%** of the product from the **Warehouse (North Dock)** remains (4,711,436 lbs. ÷ 8,509,324 lbs. = **55.4%**).[20]

5.2 Grease Raw Material Bulk Tank Farm

Access issues limited the March 2022 Site walk in and around the **Grease Raw Material Bulk Tank Farm**. Unlike the **Warehouse (North Dock)**, the **Grease Raw Material Bulk Tank Farm** appeared to be significantly impacted by the Fire, likely in part due to its proximity to the Fire's point of origin (**Section 2**). Even though there is likely to be additional product remaining from the **Grease Raw Material Bulk Tank Farm** (e.g., observed product directly to the West of the Facility, **Appendix C**, bottom; potential product on the western portion of the Site will be investigated as part of the Site Investigation Work Plan), the basis for an estimate is limited by access issues at this time. Therefore it is conservatively[21] assumed that all product from **Grease Raw Material Bulk Tank Farm** was recovered (**Section 4**) or combusted (to be addressed in **Section 6** and **Section 7**). As described in **Section 4**, 12.7% of the product from the **Grease Raw Materials Bulk Tank Farm** was recovered.

5.3 Other Operational Areas

Given the general access issues for the rest of the Facility, the remaining product in the other operational areas was conservatively[22] assumed to be equal to the percent of product recovered from the **Grease Raw Material Bulk Tank Farm** (i.e., approximately 12.7% of the inventory in those areas at the time of the Fire, **Appendix A**). Excluding the **Warehouse (North Dock)** and **Grease Raw Material Bulk Tank Farm**, there were 6,392,010 lbs. of potentially combustible product in the remainder of the Facility (**Section 3** and **Appendix A**) at the time of the Fire. Applying the 12.7% remaining product estimate to the 6,392,010 lbs. of potentially combustible product in the remainder of the Facility yields 813,548 lbs. of product. This amount includes the 21,285 lbs. of product excavated from the eastern side of the Site (**Section 4.3.2**). Therefore it is estimated that **792,263 lbs.** of product remains in the other portions of the Facility.

[18] EHS Support's product estimate of 2,963 cy is conservative in that it assumes that less than a third of the DSM volume (2,963 cy ÷ 10,000 cy = 30%) is product.
[19] A weighted average of 7.87 lbs./gal was calculated based on the density of the five most abundant products (i.e., CHEMPLUS 2 EL GREEN, DURALUBE EP 2 RED, OPTITEMP 2LN 584 LO, DURALUBE EP 2 XRT, and GADUS S2 V220 2) in the **Warehouse (North Dock)**.
[20] Note that in **Section 3**, non-combustible chemicals were excluded from the product inventory. For the **Warehouse (North Dock)**, the main non-combustible chemical was water (0.73 M lbs. of 0.91 M lbs.). Given the water likely evaporated in the Fire, only a fraction of the non-combustible chemicals were likely present in the observed product.
[21] The estimate is conservative in that the remainder is assumed to have been combusted (**Section 6** and **Section 7**).
[22] Given the uncertainty, the 12.7% estimate of recovered material from the **Grease Raw Material Bulk Tank Farm** was conservatively chosen for use when estimating remaining product in other areas of the Facility over the 55.4% estimate of remaining product in the **Warehouse (North Dock)** area. Using the lower estimate results in a higher estimate of combusted product.

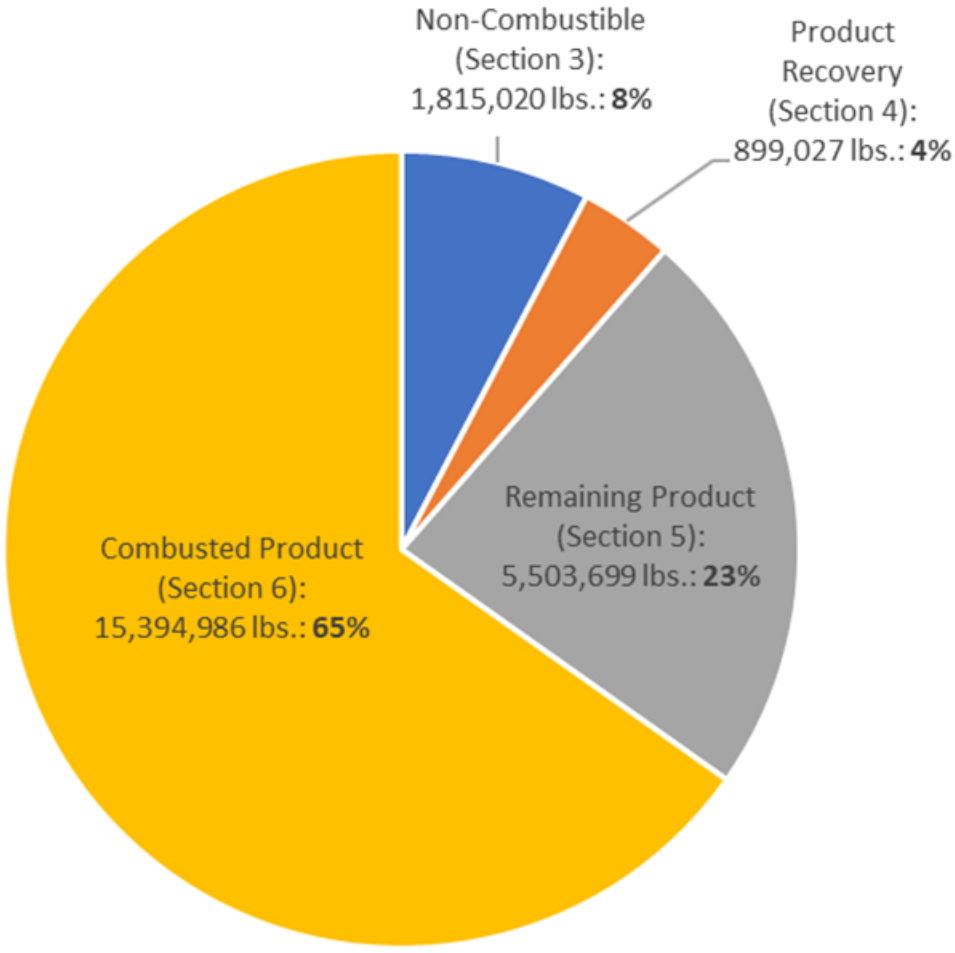
6 Combusted Product

Based on the preliminary estimates presented earlier, the following values were used to estimate the amount of product combusted during the Fire at the Facility.

	Estimate:	**Quantity:**
•	Inventory (**Section 2**):	23,612,732 lbs.
•	Non-Combustible (**Section 3**):	-1,815,020 lbs.
•	Product Recovered (**Section 4**):	-899,027 lbs.
•	Product Remaining (**Section 5**):	-5,503,699 lbs.
•	***Product Combusted:***	***15,394,986 lbs.***

Figure 8 summarizes the fate of product at the Facility.

Figure 8. Fate of product at the Facility.



7 Estimated Composition and Quantity of Emissions

Due to the nature of the Fire,[23] EHS Support relied on a published study that evaluated air emissions from freely burning petroleum hydrocarbons (Booher, et al., 1997), instead of AP-42 emission factors which would have underestimated emissions (**Section 7.1**). Additionally, EHS Support used Site-specific data to refine the emissions estimates (**Section 7.2** through **Section 7.4)**. The finalized emissions estimates[24] are summarized in **Section 7.5**.

7.1 General Emissions

Applying the literature-derived emission factors (Booher, et al., 1997) to the preliminary estimate of product combusted by the Fire (15,394,986 lbs., **Section 6**) yields emission estimates for eight components (**Table 1**). The following three components[25] are classes of chemicals that require further refinement based on their complexity and potential contributions to emissions:

- **Section 7.2** addresses smoke particulate matter (PM)
- **Section 7.3** addresses volatile organic compounds (VOCs)
- **Section 7.4** addresses polycyclic aromatic hydrocarbons (PAHs)

Table 1. Initial petroleum hydrocarbon fire emissions estimates[24] (Booher, et al., 1997).

Component	Emission Factor (lbs./lbs.)*	Emissions (lbs.)
CO_2	2.6	40,026,965
H_2O	1.3	20,013,482
Smoke PM	0.13	2,001,348
CO	0.09	1,385,549
VOCs	0.0075	115,462
SO_x	0.0025	38,487
PAHs	0.001	15,395
NO_x	0.000012	185

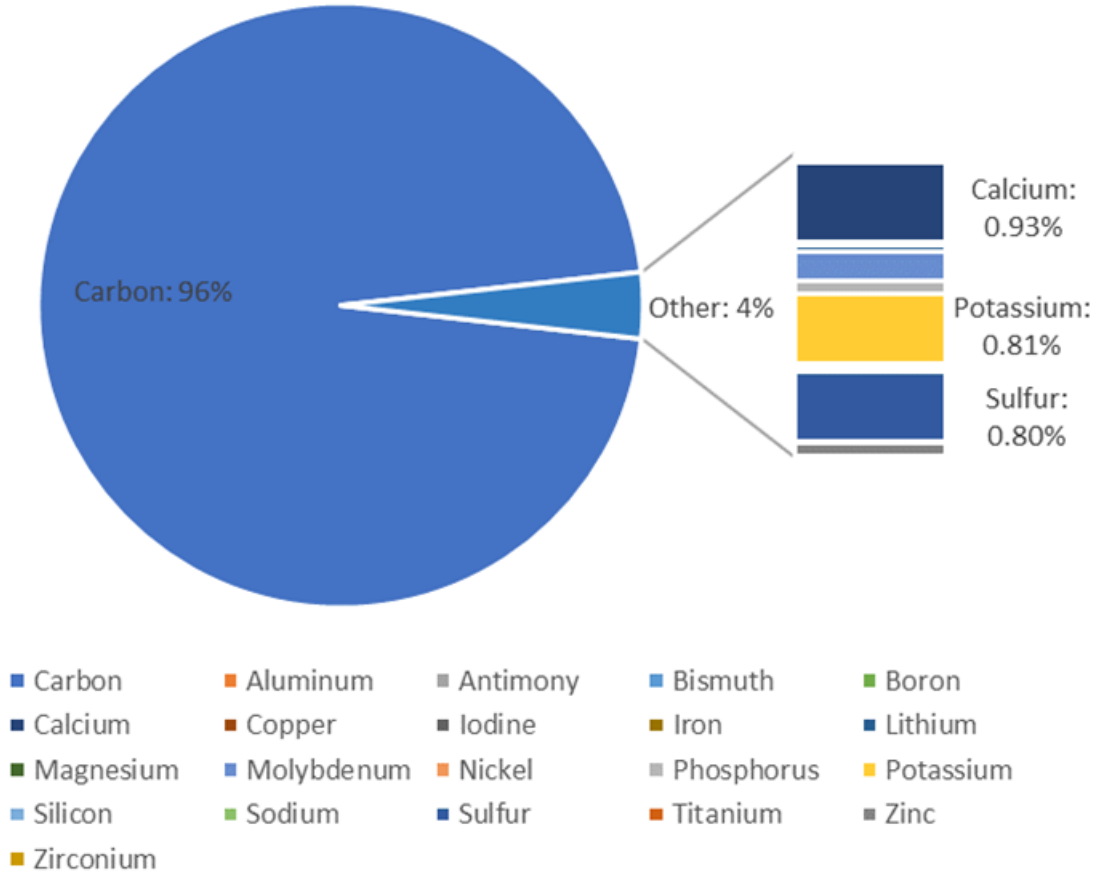
*Mass of component emitted per mass of hydrocarbon consumed by the fire.
lbs. = pounds
CO_2 = carbon dioxide
H_2O = water
Smoke PM = smoke particulate matter
CO = carbon monoxide
VOC = volatile organic compound
SO_X = sulfur oxides
PAH = polycyclic aromatic hydrocarbon
NO_X = nitrogen oxides

[23] The vast majority of combusted product was petroleum-based; no emission control equipment, and there was evidence of incomplete combustion (i.e., visible black smoke [**Figure 4**]).
[24] Estimates are subject to change based on new information collected during demolition and/or Site investigation.
[25] The other five components (CO_2, H_2O, CO, SO_x, and NO_x) are specific compounds.

7.2 Smoke Particulate Matter

Based on emission factors from Booher et al. (1997), approximately 2.0 M lbs. of smoke PM were potentially emitted during the Fire (**Table 1**). Determining the chemical composition of smoke PM requires Site-specific data. The National Guard collected ash samples from the Fire that were analyzed for metals by the Illinois Environmental Protection Agency (IEPA) (IEPA, 2022). According to IEPA (2022), "***all [ash] samples were non-detect or below threshold levels.***" The analytical results from the ash samples cannot be used to determine the composition of smoke PM because certain analytes were not considered (e.g., carbon). Instead of environmental data, product elemental compositions provided by Chemtool (Chemtool, 2021c) were used to determine the elemental composition[26] for the combustible products (**Figure 9**).

Figure 9. Elemental composition of combustible products.



The majority of the elemental composition is carbon (96%), which is consistent with Booher et al. (1997).[27] After carbon, calcium and potassium are the most dominant elements (**Figure 9**), which is consistent with the analytical results from the ash samples (IEPA, 2021). Application of the elemental composition (**Figure 9**) to the 2.0 M lbs. of smoke PM (**Section 7.1**) results in an estimate of particulate emissions (**Table 2**).

[26] Excluding elements that are gas at room temperature: chlorine, fluorine, hydrogen, nitrogen, and oxygen.
[27] Booher et al. (1997) states that "*smoke emission (soot aerosol) is predominantly elemental carbon (>90% of the smoke mass) with a composition and consistency similar to carbon black...*"

Table 2. Particulate emissions estimates.

Element	Composition	Emissions (lbs.)
Carbon	96.47%	1,930,655
Calcium	0.93%	18,608
Potassium	0.81%	16,233
Sulfur	0.80%	16,099
Molybdenum	0.33%	6,630
Zinc	0.16%	3,277
Phosphorus	0.16%	3,275
Lithium	0.081%	1,619
Sodium	0.065%	1,309
Boron	0.047%	936
Silicon	0.034%	687
Aluminum	0.027%	539
Iron	0.025%	492
Titanium	0.016%	314
Bismuth	0.014%	276
Antimony	0.011%	229
Copper	0.0045%	91
Iodine	0.0012%	24
Barium	0.00092%	19
Zirconium	0.00090%	18
Magnesium	0.00062%	13
Nickel	0.00029%	6
	Total	***2,001,348***

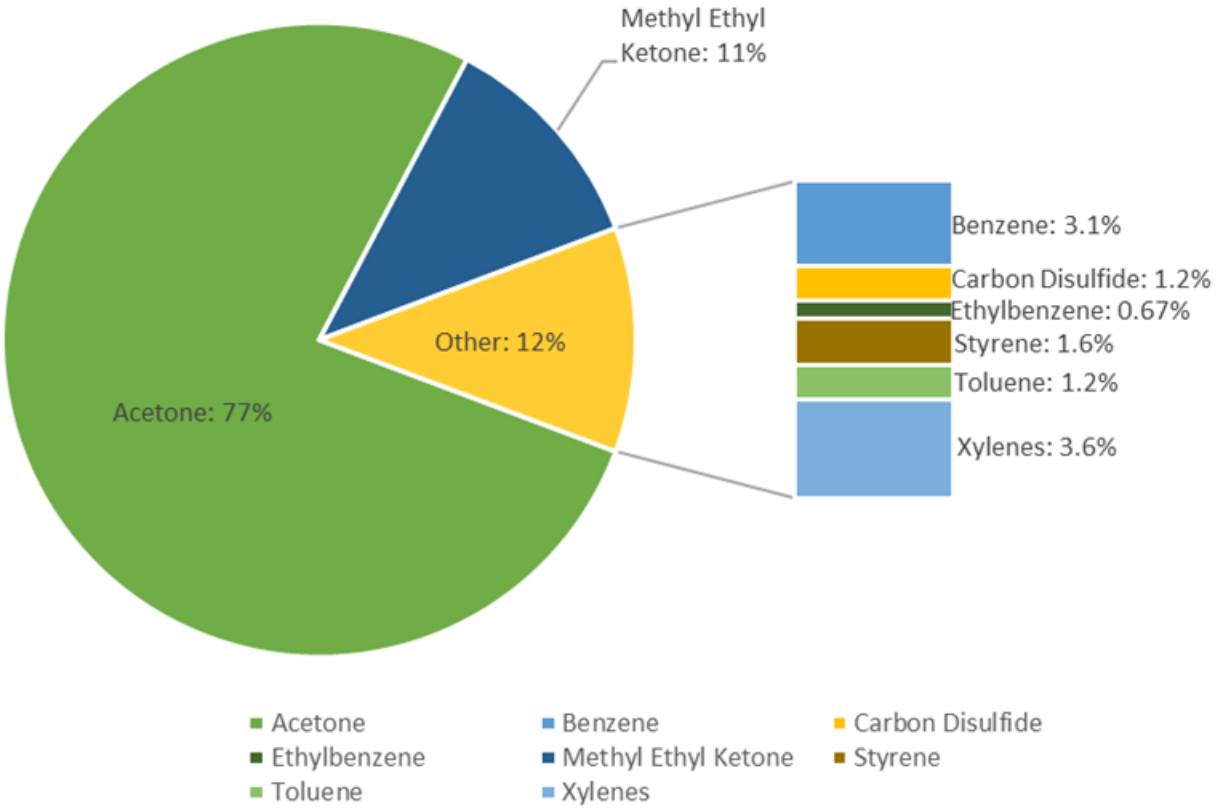
Note: Elements with emissions greater than 1 lb. are summarized.
lbs. = pounds

7.3 Volatile Organic Compounds

Based on emission factors from Booher et al. (1997), approximately 115,462 lbs. of VOCs were potentially emitted during the Fire. Again, determining the composition requires Site-specific data. As part of the response actions to the Fire, Chemtool retained CTEH to evaluate air quality on-Site and off-Site (CTEH, 2021). Even though CTEH conducted air monitoring for VOCs, the inability to establish

background concentrations of VOCs[28] prevents the usage of the data in this Report. As an alternative, analytical data from the recovered fire suppression water,[29] which came into direct contact with VOC emissions from the Fire, was used to determine the emitted VOCs. Contribution from fire suppression water sourced from the Rock River has not been evaluated; therefore, the source of the detected VOCs was conservatively assumed to be from the Fire. **Figure 10** shows the composition of VOCs in the recovered fire suppression water.

Figure 10. VOC composition in recovered fire suppression water.



Application of the elemental composition (**Figure 10**) to the 115,462 lbs. of VOCs (**Section 7.1**) results in an estimate of VOC emissions (**Table 3**).

[28] Establishing upwind (i.e., background) samples was complicated by variable wind direction. Even when wind direction appeared relatively constant, the "upwind" sample had elevated detections, possibly to other sources (e.g., vehicles, urban areas, hand sanitizer).

[29] Using available analytical data (five samples analyzed for the entire United States Environmental Protection Agency [USEPA] Method 8270E [SVOCs] and USEPA Method 8260 [VOCs] suite) from the recovered fire suppression water, EHS Support calculated the median concentrations. The median concentration was used to avoid assigning a value to samples without analyte detections. The median concentrations were then normalized to the total to determine percent contribution.

Table 3. VOC emissions estimates.

Analyte	Composition	Emissions (lbs.)
Acetone[30]	77%	88,897
Methyl Ethyl Ketone	12%	13,335
Xylenes	3.60%	4,149
Benzene	3.10%	3,556
Styrene	1.60%	1,896
Carbon Disulfide	1.20%	1,437
Toluene	1.20%	1,422
Ethylbenzene	0.67%	770
	Total:	***115,462***

lbs. = pounds

7.4 Polycyclic Aromatic Hydrocarbons

Based on emission factors from Booher et al. (1997), approximately 15,395 lbs. of PAHs were potentially emitted during the Fire. Determining if PAHs were emitted requires Site-specific data. Based on all the available Site-specific data, there is no evidence of PAH emissions as noted by:

- The National Guard collected wipe and water samples from the Fire that were analyzed for semi-volatile organic compounds (SVOCs) by IEPA (IEPA, 2022). According to IEPA (2022), "***all samples were non-detect.***"
- The recovered fire suppression water, discussed in **Section 7.3**, did not have detectable PAHs.
- The CTEH air sampling data, discussed in **Section 7.3**, contains only one low detection of a PAH out of approximately two dozen samples. The detection is questionable given that it was collected side-gradient to the emission plume and there was no detection in a duplicate sample.

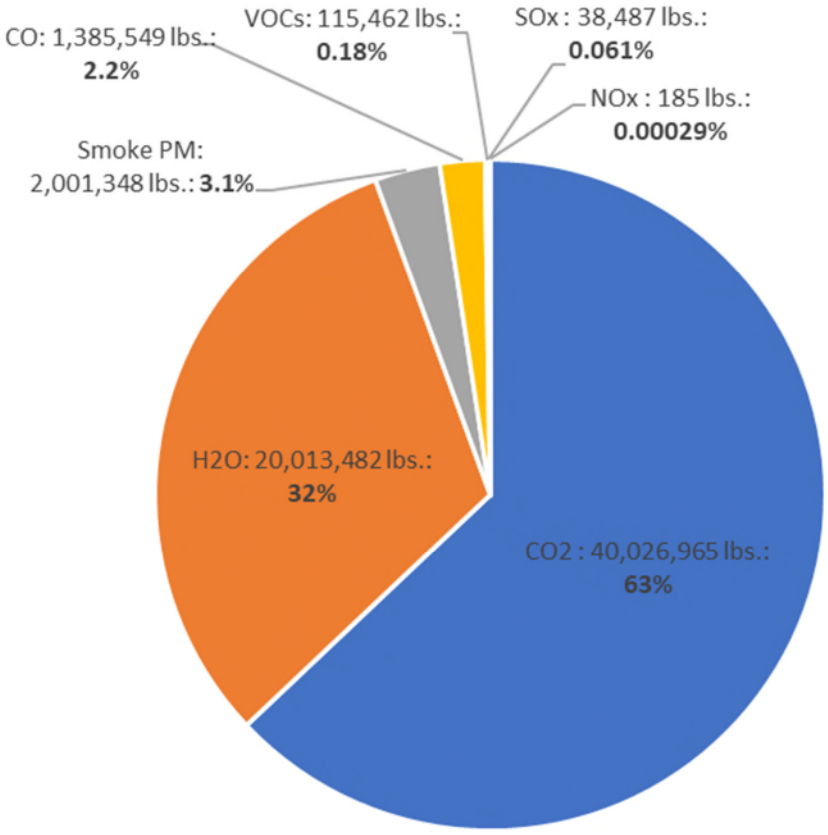
Given there is no evidence of PAH emissions, PAHs were removed from the emissions estimate.

7.5 Final Fire Emissions Estimates[31]

Based on the analysis described above, emissions were comprised of seven components (**Figure 11)**. The composition and quantity for two of these components are summarized in **Table 2** for smoke PM and **Table 3** for VOCs.

[30] While Acetone is not generally regulated as a VOC for purposes of air emission regulations, it has been included in this analysis given its limited photochemical reactivity.
[31] Estimates are subject to change based on new information collected during demolition and/or Site investigation.

Figure 11. Final petroleum hydrocarbon Fire emissions estimates.[32]



[32] Estimates are subject to change based on new information collected during demolition and/or Site investigation.

8 References

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Appendix A. Product Distribution within Facility

Location	Total		Excluding Non-Combustible Chemicals	
	Quantity (lbs.)	Percent	Quantity (lbs.)	Percent
Warehouse (North Dock)	9,416,287	40%	8,509,324	39%
Grease Raw Material Bulk Tank Farm	7,072,764	30%	6,896,378	32%
Grease Raw Material Racking	1,182,419	5.0%	1,041,854	4.8%
Fluids Raw Material Bulk Tank Farm	1,066,466	4.5%	1,026,342	4.7%
Grease MC Storage Tanks	1,043,143	4.4%	1,005,676	4.6%
Rail Dock	711,735	3.0%	665,407	3.1%
Fluids Raw Material Overflow	658,181	2.8%	611,027	2.8%
Fluids Raw Material Racking	579,693	2.5%	494,804	2.3%
Grease Raw Material Overflow	440,196	1.9%	369,776	1.7%
Polyurea	263,125	1.1%	251,556	1.2%
Grease Manufacturing	256,528	1.1%	244,579	1.1%
Fluids Packaging	237,335	1.0%	204,493	0.9%
Fluids Packaging Staging	142,889	0.61%	97,437	0.45%
Various locations	141,342	0.60%	20,795	0.10%
Fluids Die Lubes	136,180	0.58%	99,329	0.46%
Large Pack Material Storage	128,071	0.54%	126,872	0.58%
Grease GR Storage Tanks	113,660	0.48%	109,963	0.50%
Lean-to	11,419	0.048%	11,419	0.052%
Tube Line Room	7,393	0.031%	7,381	0.034%
PALLETS	1,700	0.0072%	1,700	0.0078%
Specialty Grease	1,198	0.0051%	1,198	0.0055%
Fluids Manufacturing	1,008	0.0043%	402	0.0018%
Total:	***23,612,732***		***21,797,712***	

lbs = pounds

Appendix B. Product in Frac Tanks

Dissolved Product Sample Date	Total Volume (gal)	Frac Tank ID#	Product (SG < 1)		Product (SG > 1)		Product (Dissolved)	
			Estimated Product (%)	Product Volume (gal)	Estimated Product (%)	Product Volume (gal)	Concentration (µg/L)	Water Volume (gal)
7/27/2021	18,750	1082063	3.75%	703	20%	3,750	1,050,000	14,297
6/18/2021	16,338	254242	0.5%	82	2.5%	408	14,600,000	15,848
6/18/2021	14,358	257730	0.5%	72	2.5%	359	2,357,000	13,927
6/18/2021	16,716	265677	0.5%	84	2.5%	418	4,050,000	16,215
7/27/2021	20,000	FM1248	17.5%	3,500	12.5%	2,500	1,500,000	14,000
6/21/2021	20,000	N48645	0.05%	10	2.5%	500	3,040,000	19,490
6/23/2021	20,000	N45761	0.05%	10	2.5%	500	1,490,000	19,490
NS	20,400	SV22509RLM	95%	19,380	0%	0	NS	1,020
6/21/2021	18,818	SV26452LM	1.25%	235	2.5%	470	1,340,000	18,112
6/20/2021	17,232	SV23137L	1.25%	215	7.5%	1,292	13,430,000	15,724
6/18/2021	16,452	SV2783IL	0.5%	82	2.5%	411	15,500,000	15,958
7/27/2021	15,867	SV31019L	12.5%	1,983	2.5%	397	1,460,000	13,487
6/21/2021	20,311	SV31034L	3.75%	762	2.5%	508	2,060,000	19,042
6/21/2021	18,591	SV35190L	2.5%	465	7.5%	1,394	1,160,000	16,732
6/21/2021	20,311	2V25665L	-	-	-	-	124,000	20,311
7/27/2021	18,647	A 864	-	-	-	-	4,200	18,647
6/23/2021	20,451	FM1129	-	-	-	-	254,000	20,451
6/19/2021	11,373	FT-259260	-	-	-	-	712,000	11,373
6/19/2021	15,864	FT-259517	-	-	-	-	126,600	15,864

Dissolved Product Sample Date	Total Volume (gal)	Frac Tank ID#	Product (SG < 1)		Product (SG > 1)		Product (Dissolved)	
			Estimated Product (%)	Product Volume (gal)	Estimated Product (%)	Product Volume (gal)	Concentration (µg/L)	Water Volume (gal)
6/19/2021	17,358	FT-A4744	-	-	-	-	97,200	17,358
6/19/2021	18,095	FT-A4756	-	-	-	-	69,600	18,095
6/19/2021	14,413	FT-A5770	-	-	-	-	122,500	14,413
6/19/2021	17,174	FT-A5871	-	-	-	-	137,100	17,174
6/19/2021	16,257	FT-SV24036L	-	-	-	-	149,500	16,257
6/18/2021	19,384	FT-SV25462LM	-	-	-	-	84,600	19,384
6/18/2021	15,120	FT-SV26074LM	-	-	-	-	239,000	15,120
6/20/2021	20,311	FT-SV26830L	-	-	-	-	291,400	20,311
6/18/2021	13,213	FT-SV28526L	-	-	-	-	82,200	13,213
6/20/2021	20,129	FT-SV30692L	-	-	-	-	259,500	20,129
6/18/2021	16,842	FT-SV30938L	-	-	-	-	88,300	16,842
6/19/2021	17,037	FT-SV33645L	-	-	-	-	148,600	17,037
6/18/2021	14,895	FT-SV34199L	-	-	-	-	58,500	14,895
6/18/2021	17,037	FT-SV35138L	-	-	-	-	144,600	17,037
6/18/2021	15,087	FT-SV35139L	-	-	-	-	164,700	15,087
6/18/2021	18,791	FT-SV36099L	-	-	-	-	142,200	18,791
6/23/2021	19,000	N43512	-	-	-	-	24,000	19,000
6/21/2021	20,129	N7351	-	-	-	-	495,000	20,129
6/23/2021	20,303	SFVP4383L	-	-	-	-	33,400	20,303
6/23/2021	19,157	SFVP4623L	-	-	-	-	47,200	19,157
7/27/2021	18,500	SV22209L	-	-	-	-	131,000	18,500

Dissolved Product Sample Date	Total Volume (gal)	Frac Tank ID#	Product (SG < 1)		Product (SG > 1)		Product (Dissolved)	
			Estimated Product (%)	Product Volume (gal)	Estimated Product (%)	Product Volume (gal)	Concentration (µg/L)	Water Volume (gal)
6/23/2021	19,757	SV25353LC	-	-	-	-	51,400	19,757
6/23/2021	20,451	SV26516LM	-	-	-	-	32,100	20,451
7/27/2021	18,986	SV30080L	-	-	-	-	10,900	18,986
6/21/2021	20,491	SV31029L	-	-	-	-	96,700	20,491
6/23/2021	16,051	SV34226L	-	-	-	-	42,500	16,051
7/27/2021	20,129	SV34703L	-	-	-	-	171,000	20,129
NS	19,850	SV24591LM	-	-	-	-	NS	19,850
NS	17,622	SV342232L	-	-	-	-	NS	17,622
NS	17,622	SV30703L	-	-	-	-	NS	17,622
NS	18,831	A5455	-	-	-	-	NS	18,831
NS	16,452	SV27794C	-	-	-	-	NS	16,452
NS	19,729	A5450	-	-	-	-	NS	19,729
NS	20,234	A6522SC	-	-	-	-	NS	20,234
NS	4,501	A1755	-	-	-	-	NS	4,501
NS	17,900	A6532SC	-	-	-	-	NS	17,900
NS	20,068	A754	-	-	-	-	NS	20,068
NS	16,806	A3916	-	-	-	-	NS	16,806
NS	12,904	A3770IM	-	-	-	-	NS	12,904
NS	17,726	A4025IM	-	-	-	-	NS	17,726
NS	17,174	A3951	-	-	-	-	NS	17,174
NS	19,000	A766	-	-	-	-	NS	19,000

Dissolved Product Sample Date	Total Volume (gal)	Frac Tank ID#	Product (SG < 1)		Product (SG > 1)		Product (Dissolved)	
			Estimated Product (%)	Product Volume (gal)	Estimated Product (%)	Product Volume (gal)	Concentration (µg/L)	Water Volume (gal)
NS	19,303	A595	-	-	-	-	NS	19,303
NS	18,240	A884	-	-	-	-	NS	18,240
Total:	**1,118,538**			**27,583**		**12,908**		**1,078,047**

µg/L = micrograms per liter
gal = gallons
NS = Dissolved Product Not Sampled
SG = specific gravity
- = no free product

Appendix C. Visually Impacted Soil Samples

Photograph showing visually impacted soil between interceptor trenches 1 and 2.

Photograph showing visually impacted soil adjacent to the western side of the Facility.