AB 1400 Draft Study Report

FEBRUARY 25, 2021

ToxStrategies

Innovative solutions
Sound science

AB 1400 Draft Study Report

FEBRUARY 25, 2021

PREPARED FOR:
State of California
Department of Industrial Relations
1515 Clay Street
Suite 1902
Oakland, CA 94612

PREPARED BY:
ToxStrategies, Inc.
27001 La Paz Road
Suite 260
Mission Viejo, California 92691

Table of Contents

Appendixes

List of Tables

List of Figures

Abbreviations

AB	California Assembly Bill
AFSCME	American Federation of State, County & Municipal Employees
BA	Breathing Apparatus
CHSWC	Commission on Health and Safety and Worker's Compensation
COPC	chemical of potential concern
Cr(VI)	hexavalent chromium
DIR	California Department of Industrial Relations
FEM	fire equipment mechanic
HR	human resources
IARC	International Agency for Research on Cancer
LA	Los Angeles
NIOSH	National Institute of Occupational Safety and Health
PAH	polycyclic aromatic hydrocarbon
PBZ	personal breathing zone
PCB	polychlorinated biphenyls
PCE	perchloroethylene/tetrachloroethylene
PCP	pentachlorophenol
PEL	Permissible Exposure Limit
PPE	personal protective equipment
RFP	request for proposal
SDS	safety data sheet
SEG	similar exposure group

1 Introduction and Summary

In October 2019, Assembly Bill (AB) 1400 was signed into law requiring the California Department of Industrial Relations (DIR) Commission on Health and Safety and Worker's Compensation (CHSWC) to submit a study to the Legislature, the Occupational Safety and Health Standards Board, and the Los Angeles County Board of Supervisors on the risk of exposure to carcinogenic materials and incidence of occupational cancer in mechanics who repair and clean firefighting vehicles. Specifically, AB 1400 required that the study include:

1. Site visits at a representative sample of facilities, including, but not limited to, facilities in the County of Los Angeles, where firefighting equipment is cleaned and repaired.
2. Interviews and surveys with current and former mechanics of firefighting equipment in a sample of facilities regarding the frequency of exposure to potential carcinogens, use and availability of safety equipment, and experience or knowledge of cancer incidence among current or former mechanics who cleaned or repaired firefighting equipment.
3. A measurement of the current levels of carcinogenic material exposure to mechanics who repair and clean firefighting vehicles in the County of Los Angeles and other facilities included in the study, in order to develop a baseline of carcinogenic material exposure.

The minimum scope of services, as stated in the request for proposal (RFP) #4479 "Assessment of Risk of Carcinogens Exposure and Incidents of Occupational Cancer among Mechanics and Cleaners of Firefighting Vehicles", further outlined the study requirements, including:

1. Conduct a thorough literature review of carcinogen exposures in fire stations and for firefighting vehicle mechanics and cleaners.
2. Site visits at a representative sample of facilities, including, but not limited to, facilities in the County of Los Angeles where firefighting equipment is cleaned and repaired;
3. Interviews and surveys with current and former mechanics of firefighting equipment in a sample of facilities regarding the frequency of exposure to potential carcinogens, use and availability of safety equipment, and experience or knowledge of cancer incidence among current or former mechanics who cleaned or repaired firefighting equipment. In particular, a detailed questionnaire administered in person to current and former mechanics and cleaners of firefighter equipment combined with industrial hygiene surveys should be employed as part of the study;
4. A measurement of the current levels of exposure to (unspecified) carcinogenic material among mechanics who repair and clean firefighting vehicles in the County of Los Angeles and other facilities included in the study, in order to develop a baseline of carcinogenic material exposure;

5. In addition to conducting an assessment of the risk of carcinogens exposure and incidents of occupational cancer among mechanics and cleaners of firefighting vehicles, the vendor will respond to DIR requests for technical assistance on legislative and/or regulatory issues related to the assessment of carcinogen exposures to mechanics and cleaners of firefighting equipment.

ToxStrategies, Inc., (ToxStrategies) was contracted by CHSWC, to conduct the study as outlined in AB 1400 and RFP #4479. This report summarizes the effort to complete the study since June 2020.

1.1 Summary of Study Activities

The following activities were performed to implement this study to address the questions raised in the legislation.

Task 1: Structured Literature Review of Potential Occupational Exposures and Cancers among Mechanics Who Repair and Clean Firefighting Vehicles — summary of available scientific literature on exposure to chemical carcinogens and studies of cancer risk among fire mechanics

Task 2: Qualitative Exposure Assessment — site visits at representative facilities

Task 3: Epidemiology Feasibility Study — feasibility study of cohort enumeration

Task 4: Quantitative Exposure Assessment — measurement of current occupational exposures to carcinogens

Task 5: Cancer Risk Assessment — calculation of theoretical excess cancer risks from occupational exposure to carcinogens

The subsequent sections of this report summarize the information obtained and results and conclusions developed for each of these tasks.

1.2 Summary of Overall Study Results

While epidemiologic studies of cancer risk among firefighters and mechanics have been reported, no study to date has evaluated the risk of cancer among mechanics who repair and clean firefighting vehicles. The number of fire mechanics in Los Angeles (LA) County alone, with records dating back to 1975, is insufficient to evaluate the risk of cancer among fire mechanics in an epidemiological study. However, such a study may be possible if the potential cohort was expanded to include fire mechanics in other large counties in California.

In addition to the epidemiology feasibility study and consistent with the RFP, ToxStrategies performed a detailed qualitative (e.g., site visits, interviews and surveys with current and former fire mechanics) and quantitative (e.g., measurements of carcinogenic material) evaluation to assess LA County fire mechanics' occupational exposure to chemical carcinogens. In September 2020, site visits were conducted at a representative sample of facilities in LA County, where firefighting equipment is cleaned and repaired:

1. Air Operations in Pacoima,
2. Breathing Apparatus Shop in Pacoima,
3. Eastern Fire Shop in Los Angeles, and
4. North County Fire Shop & Fire Station 129 in Lancaster

In November 2020, sampling of surface residues on fire equipment and personal breathing zone (PBZ) air samples were collected over two days at Air Operations, the Breathing Apparatus Shop, and the Eastern Fire Shop. Although the samples were collected on a single day at each location, worst-case exposure conditions were sampled to the extent possible (e.g., the most visibly contaminated surfaces were sampled). Toxicity criteria developed by California regulators were used in the assessment to estimate the theoretical increased cancer risk from the measured exposures.

Exposures to surface residues resulted in risks less than 1 in 10,000, which is the regulatory benchmark set by the National Institute of Occupational Safety and Health (NIOSH). The health risk assessment found that airborne exposures among fire mechanics in each of the studied operations resulted in a theoretical increased cancer risk that exceeds the NIOSH risk benchmark, and as such, improvements to working conditions in accordance with the NIOSH hierarchy of controls to reduce chemical exposures is recommended.

2 Structured Literature Review of Potential Occupational Exposures and Cancers among Mechanics Who Repair and Clean Firefighting Vehicles (Task 1)

The purpose of Task 1, Structured Literature Review, was to identify and review relevant published literature to understand the state of the science with respect to exposure to chemical carcinogens associated with repairing and cleaning firefighting vehicles and equipment, as well as studies of cancer risk among fire mechanics.

The objectives of the structured literature review were as follows:

1. Identify carcinogenic chemicals of potential concern (COPCs) for mechanics who repair and clean firefighting vehicles and equipment
2. Identify epidemiologic studies evaluating the risk of cancer among mechanics who repair and clean firefighting vehicles and equipment.

For the first objective of identifying studies reporting carcinogenic exposures experienced by fire mechanics, no occupational chemical exposure studies explicitly focused on fire mechanics, fire equipment cleaners, or firefighting vehicle maintenance workers. However, nine industrial hygiene studies presented data for fire stations and firefighting vehicles and/or gear, which likely overlap with the occupational exposures of fire mechanics who repair and clean firefighting vehicles. Figure 1 presents a flow diagram showing the sequential search results of the literature search.

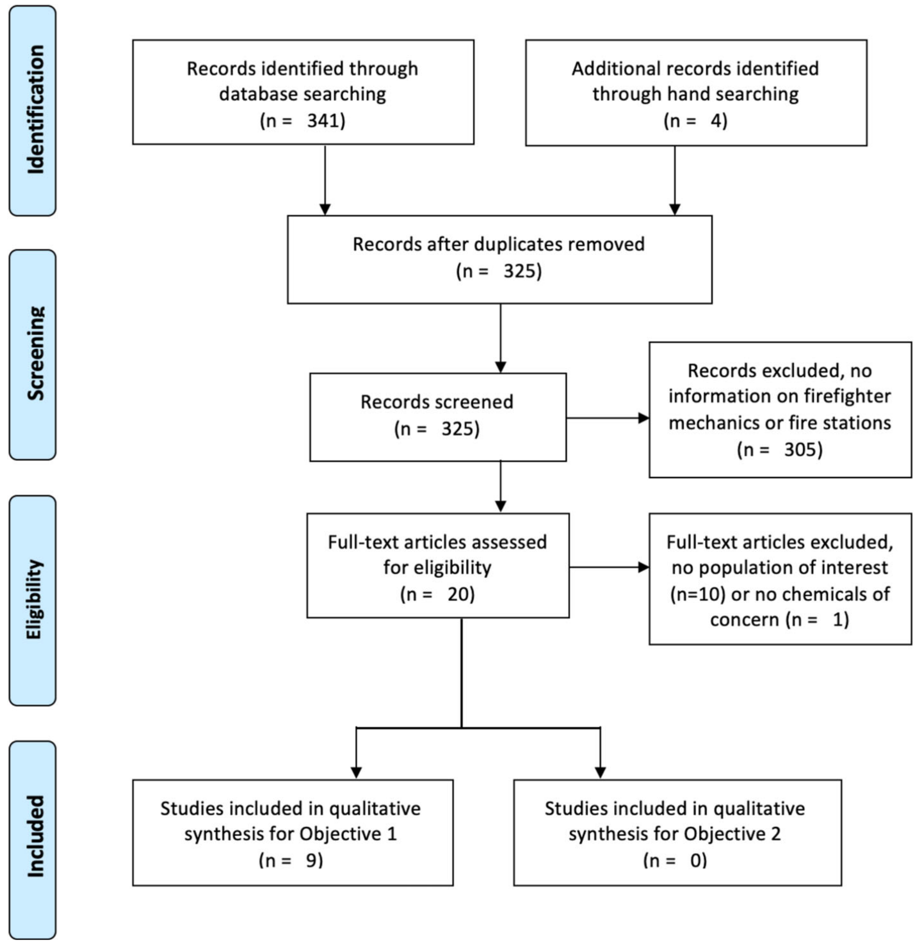

Figure 1. Literature search flow diagram.

The chemical carcinogens evaluated in these studies, which were included in the quantitative exposure assessment (Task 4), were benzene, diesel exhaust, polycyclic aromatic hydrocarbons (PAHs), crystalline silica, ethylbenzene, polychlorinated biphenyls (PCBs), acetaldehyde, formaldehyde, and styrene. A recent study, identified after the literature search was completed, identified chlorinated dioxins/furans; thus, chlorinated dioxins/furans were also included in the quantitative exposure assessment.

For the second objective of identifying studies of cancer risks or rates among fire mechanics, no epidemiologic studies were identified. A supplemental literature search was conducted to identify risk of cancer in the related occupations of firefighting and automotive maintenance and repair. Though a more thorough systematic review is necessary to fully characterize the risks in these occupations, our preliminary review of the International Agency for Research on Cancer (IARC) monographs and the supplemental literature demonstrated that certain cancers have been reported as increased in firefighters and automotive mechanics as shown in Table 1. While the studies of firefighters and automotive mechanics provide additional insight into the risks associated with these related occupations, the results of these studies may not be generalizable to the experience of fire mechanics.

Table 1. Reported cancer types potentially associated with occupation in firefighting and automotive maintenance and repair

Cancer Site or Type	Secondary Literature, Auto Mechanics	Nordic Cohorts, Auto Mechanics	IARC, Firefighters
Bladder	X		
Lung		X	
Mesothelioma		X	
Non-Hodgkin's Lymphoma		X	X
Pancreas		X	
Prostate			X
Testicular			X
Ureter and Urethra		X	

The findings from Task 1 structured literature review were informative with respect to potential chemical exposures that were evaluated in the qualitative (Task 2) and quantitative exposure assessments (Task 4).

The Task 1 report is attached as Appendix A.

3 Qualitative Exposure Assessment (Task 2)

The purpose of Task 2, Qualitative Exposure Assessment, was to determine similar exposure groups (SEGs) among the fire mechanics and prioritize/define the scope of the quantitative exposure assessment based on a risk ranking that incorporates the relative magnitude of the exposure potential, specifically for carcinogens[1]. Each job task was characterized in terms of relevant chemical product usage information and/or fire residues encountered. The overall risk ranking was determined based on an exposure rating and health effect rating of the product and/or residue encountered by fire mechanics, by job task. Figure 2 shows the matrix that combines the exposure rating and health effect rating.

1 AIHA (American Industrial Hygiene Association). 2015. A Strategy for Assessing and Managing Occupational Exposures. 4th Edition. American Industrial Hygiene Association, Falls Church, VA.

	Health Effect Rating				
Exposure Rating	**0**	**1**	**2**	**3**	**4**
4					Very High
3				High	
2			Moderate		
1		Low			
0	Trivial				

Figure 2. Risk ranking matrix

Task 2 was accomplished through site visits to representative facilities, interviews and surveys with current and former fire mechanics, review of safety data sheets (SDSs) for chemical products used by the fire mechanics and compilation of relevant toxicity data to determine which chemical substances are considered carcinogens and the availability of criteria to quantitatively evaluate the potential cancer risk from exposure to the substances.

Through email correspondence with the American Federation of State, County & Municipal Employees (AFSCME) Local 119 representatives, ToxStrategies identified the County of Los Angeles Fire Department mechanic classifications and three main sites of operation. The fire mechanic classifications (SEGs) are (1) Equipment Maintenance Worker, (2) Fire Equipment Mechanic (FEM), (3) Helicopter Mechanic, and (4) Helicopter Maintenance Inspector. We also recognized a category of Field Mechanics, who work across the county at local fire stations and at locations where fire equipment is dispatched, including wildfires. These mechanics do not work at the main facilities but have similar potential for exposure, because they contact the residue from fires that is on the surface of the equipment.

ToxStrategies conducted site visits at the three main sites of operation, which included:

- Eastern Fire Shop, located at 1104 N Eastern Avenue, Los Angeles, 90063
- North County Fire Shop, located at 42110 6th Street West, Lancaster, 93534
- Pacoima Air Operations & Breathing Apparatus (BA) Shop, located at 12605 Osborne Street, Pacoima 91331.

During the visits, ToxStrategies conducted 12 in-person interviews with current LA County fire mechanics and fire mechanic supervisors. We met with mechanics from all job classifications at all three locations to discuss their work activities and potential exposures. Three virtual interviews were conducted with current and former LA County fire mechanics and one virtual interview was conducted with a fire mechanic from the Menlo

Park Fire Protection District in Northern California. Continued correspondence/data-gathering occurred throughout the study period with AFSCME representatives.

The purpose of the site visits (walk-around surveys) and personnel interviews (in-person and conference calls that occurred after the in-person site visits) was to gather information regarding chemical exposures of fire mechanics by recording observations of potential sources of exposures to chemical carcinogens at each location, as well as the manner in which these exposures may occur. The survey approach included identifying chemical agents in the workplace and discussing the overall job and specific work tasks conducted by each of the fire mechanic classifications. The survey goals were to understand how and when workers are exposed to the chemical agents, ascertain information regarding the availability and use of exposure controls (personal protective equipment [PPE], engineering/administrative controls, work practice controls), and discuss the evolution of chemical usage and work practices over time.

ToxStrategies reviewed SDSs used at the Eastern Fire Shop and the North County Fire Shop. However, SDSs for products used at the Pacoima Air Operations and the Breathing Apparatus Shop were not available; therefore, chemical usage information was obtained through the site visits and personnel interviews only.

The risk ranking matrix (Figure 2 above) was used to identify and prioritize high-risk chemical exposures, which allowed ToxStrategies to target the DIR resources for Task 4 and focus on potential exposures with the highest potential chemical exposures to carcinogens.

Some specific concerns identified by the fire mechanics, that were also prioritized as high-risk chemical exposures, included:

- Diesel exhaust at the Eastern and North County Fire Shops
- Smoke and fire residue exposures at a wildfire base camp
- Fire residues on the underside and inside the mechanical compartments of the fire truck, including fire equipment (e.g., fire hoses)
- Hexavalent chromium residue on aircraft engines and other aircraft parts at Air Operations
- Fire residues on the aircraft at Air Operations
- Jet A fuel exhaust in the hangar at Air Operations
- Fire residues on the breathing apparatus and fire hoses at the Breathing Apparatus Shop.

Further, ToxStrategies identified strong gasoline odors when entering the small engine repair shop at the Breathing Apparatus Shop during one of the site visits. Therefore, this area was prioritized for the quantitative exposure assessment (Task 4).

Job titles, locations, tasks and associated chemicals and qualitative exposure ranking are presented in Table 2. The chemicals identified in Task 2 were reviewed and updated prior to collecting and analyzing samples in Task 4. Table 2 below shows the updated list as included in Task 4.

Table 2. Job titles, tasks, and relevant chemical carcinogens identified for quantitative analysis

Job Titles/Location	Tasks	PBZ Sample Chemicals	Surface Wipe Sample Chemicals
Very High Exposure Ranking			
Fire Equipment Mechanic at Wildfire Base Camp	Fire equipment repair in the field	Acetaldehyde Benzene Ethylbenzene Formaldehyde Polycyclic aromatic hydrocarbons (PAHs) Naphthalene Diesel particulate	Arsenic Chlorinated dioxins/furans Lead PAHs Pentachlorophenol Polychlorinated biphenyls (PCBs)
Helicopter Mechanic/Helicopter Maintenance Inspector at Air Operations	Heavy maintenance on aircraft, including the task of oil-leak checks	Crystalline Silica Hexavalent chromium	Arsenic Hexavalent chromium Chlorinated dioxins/furans Lead PAHs PCBs
High Exposure Ranking			
Equipment Maintenance Worker at Breathing Apparatus Shop Location	Repair and tune-up of power equipment and rescue tools	Acetaldehyde Benzene Ethylbenzene Formaldehyde Naphthalene Styrene	Arsenic Chlorinated dioxins/furans PAHs PCBs Pentachlorophenol Lead
Moderate Exposure Ranking			
Helicopter Mechanic/Helicopter Maintenance Inspector at Air Operations	1) painting/priming on the interior and exterior of the aircraft, (2) sanding helicopter blades, (3) painting helicopter blades, and (4) painting using aerosol paints and epoxy primers	4-Chlorobenzo-trifluoride Ethylbenzene Hexavalent chromium Methylene chloride	
Helicopter Mechanic/Helicopter Maintenance Inspector at Air Operations	Intermediate aircraft maintenance	Hexavalent chromium Naphthalene Benzene Ethylbenzene	Arsenic Chlorinated dioxins/furans Hexavalent chromium Lead PAHs PCBs
Equipment Maintenance Worker at Breathing Apparatus Shop Location	Repair and test fire hoses		Arsenic Lead PAHs

Job Titles/Location	Tasks	PBZ Sample Chemicals	Surface Wipe Sample Chemicals
Fire Equipment Mechanic at Eastern Fire Shop or North County Fire Shop or in the field	General maintenance and repair of the fire apparatus	Benzene Diesel particulate Ethylbenzene Naphthalene N,N-dimethyl-para-toluidine Tetrachloroethylene Welding fume metals (including hexavalent chromium)	Arsenic Chlorinated dioxins/furans PAHs PCBs Pentachlorophenol Lead Bulk sample of fiberglass strips for asbestos

The Task 2 report is attached as Appendix B.

4 Epidemiology Feasibility Study (Task 3)

The objective of Task 3 was to determine the feasibility of conducting an epidemiologic evaluation of risk of cancer in fire mechanics. ToxStrategies staff interviewed LA County fire equipment mechanics and a representative from LA County Fire human resources (HR) to determine the availability of information needed to conduct an epidemiologic study. The feasibility study consisted of four steps:

- Exposure verification (identify fire mechanics). Employees considered to be fire mechanics could be selected using a list of specific job classification codes obtained during a ToxStrategies site visit. Fire mechanics could be identified using these codes through LA County personnel records, which date back to 1975.
- Outcome ascertainment (track fire mechanics for cancer). Fire mechanics could be tracked for incidence cancer diagnoses using the California Cancer Registry, from 1988 forward (1972 forward if diagnosed in LA County), or for death due to cancer using the National Death Index, from 1979 forward. Employees could be linked to these registries using their social security number and/or date of birth, both of which are available in personnel records.
- Cohort enumeration (determine size of cohort). Using two systems of personnel records, LA County Fire HR determined there were 180 individual employees considered to be fire mechanics from September 1975 to January 2021.
- Confounding variables (evaluate characteristics that may confound the relationship between occupation and cancer). Fire mechanics complete a pre-employment physical at an occupational health clinic, where records of smoking history, alcohol consumption, and medical history are likely available. These records would need to be obtained from the occupational health clinic directly. Some variables may also be available in the registries.

While it would be feasible to assemble a cohort of fire mechanics in LA County and track participants' cancer diagnoses, the number of employees within this potential cohort would not likely be large enough to detect any significant increased risk of cancer. If the cancer risk in fire mechanics was similar to that of firefighters, approximately 1,000 fire mechanics, with an average of 10 years of follow-up each, would be necessary to detect a statistically significant increased risk of cancer. Evaluating the potential of expanding the cohort to fire mechanics throughout the State of California is recommended as a future activity.

The Task 3 report is attached as Appendix C.

5 Quantitative Exposure Assessment (Task 4)

The purpose of Task 4, Quantitative Exposure Assessment, was to conduct exposure monitoring of workers for airborne chemicals, as well as chemical analysis of surface residues, based on the findings from Tasks 1 and 2. Samples from each SEG were selected for PBZ air sampling and surface wipe sampling of equipment.

The chemical carcinogens identified during the literature review task (Task 1; Section 2 above) and selected for PBZ air sampling and/or surface wipe sampling were benzene, diesel exhaust, PAHs, crystalline silica, ethylbenzene, PCBs, acetaldehyde, formaldehyde, styrene, and chlorinated dioxins/furans.

The job tasks that were identified during the qualitative exposure assessment (Task 2; Section 3 above) as ranking moderate, high, and very high were selected for PBZ air sampling and/or surface wipe sampling. Further, ToxStrategies quantitatively assessed each of the fire mechanics' concerns listed in Section 3 above, with the exception of the smoke and fire residue exposures at a wildfire base camp since there were no active fires during the month of our sampling events and spray painting of aircraft because that activity is infrequent and not scheduled for the days of the assessment.

ToxStrategies collected PBZ air samples and surface wipe samples on November 3, 2020 at Air Operations (Pacoima) and the Breathing Apparatus Shop (Pacoima), and November 4, 2020 at the Eastern Fire Shop (Los Angeles). Please note that ToxStrategies did not conduct quantitative sampling at the North County Fire Shop (Lancaster) because fire equipment mechanics perform similar job tasks at both sites, and the North County Fire Shop is a much smaller facility than the Eastern Fire Shop. Therefore, the results obtained at the Eastern Fire Shop were assumed to be representative of the North County Fire Shop. To stay within the constraints of the budget and schedule and to minimize potential exposures between sampling personnel and fire mechanics in light of the COVID-19 in the fall 2020, sampling was conducted on one day at each of the locations.

Sampling was conducted with a focus on the highest exposure opportunities. For example, a fire engine was running inside the Eastern Fire Shop adjacent to where an area PBZ air sample was being collected; PBZ air samples were collected where gasoline odors were observed at the small engine repair shop (at the Breathing Apparatus Shop); surfaces were sampled where the highest amount of residue was observed; and surfaces were sampled on aircraft and fire trucks that had recently been in a wildfire.

Table 3 provides an overview of the PBZ sampling and analyses, and Table 4 provides an overview of the surface wipe samples and analyses. The quantitative exposure results from Task 4 were used subsequently in the cancer risk assessment (Task 5). In addition, four bulk samples of vermiculite-coated fiberglass strips used to wrap the fire apparatus exhaust were collected and analyzed for asbestos. Asbestos was not detected in any samples.

Table 3. Summary of Air Samples and Analyses[1] (PBZ[2] and Area Samples)

Location	Cr(VI)	Benzene	Acetal-dehyde	Formal-dehyde	PCE	Diesel Partic-ulates[3]	Welding Fumes[4]	Chemicals Not Detected[5]
Air Operations – Maintenance/Repair - PBZ	1/8	0/6	—[6]	—	—	—	—	0/6 (ethylbenzene, naphthalene, crystalline silica)
Air Operations - Area	—	0/2	—	—	—	—	—	0/2 (ethylbenzene, naphthalene)
Breathing Apparatus Shop - Small Engine Repair Shop - PBZ	—	2/2	2/2	2/2	—	—	—	0/2 (ethylbenzene, naphthalene, styrene)
Eastern Fire Shop - Maintenance/Repair - PBZ	—	0/6	—	—	6/6	1/6	—	0/6 (ethyl-benzene, naphthalene) 0/5 (N,N-dimethyl-para-toluidine)
Eastern Fire Shop-Welding - PBZ	0/2	—	—	—	—	—	1/2 (cobalt) 2/2 (nickel)	0/2 (arsenic, beryllium, cadmium, lead)
Eastern Fire Shop - Area	—	0/2	—	—	—	0/2	—	0/2 (ethylbenzene, naphthalene)
Total Samples	10	18	2	2	6	8	4	57

Notes:
1. Ratio indicates number of detections over total number of samples analyzed.
2. Each PBZ sample represents an 8-hour time-weighted average.
3. Diesel particulates measured as elemental carbon
4. Only carcinogenic welding fume chemicals are presented.
5. Chemicals not detected in any samples.
6. "—" indicates samples were not analyzed for this chemical.

Abbreviations:

Cr(VI) – hexavalent chromium, PCE – tetrachloroethylene.

Table 4. Summary of Surface Samples and Analyses[1]

Location	PAHs	Arsenic	Lead	Cr(VI)	PCBs	Dioxins/ Furans	PCP
Air Operations – Firehawk and Bell412 aircraft samples	0/12	0/12	10/12	—[2]	—	—	—
Air Operations – Firehawk and Bell412 aircraft engine samples	—	—	—	6/6	2/2	2/2	—
Air Operations – Mastinox-coated area on Bell412	—	—	—	2/2	—	—	—
Breathing Apparatus Shop - Air packs	3/6[3]	0/6	6/6	—	2/2	2/2	0/2
Breathing Apparatus Shop - Fire hoses	0/6	0/6	6/6	—	—	—	—
Eastern Fire Shop - Fire Apparatus	6/6	0/6	6/6	—	6/6	6/6	0/6
Total Samples	30	30	30	8	10	10	8

Notes:

1. Ratio indicates number of detections over total number of samples analyzed.
2. "—" indicates samples were not analyzed for this chemical.
3. PAHs were only detected on training air packs.

Abbreviations:

PAHs – polycyclic aromatic hydrocarbons (16 chemicals including naphthalene), Cr(VI) – hexavalent chromium, PCBs – polychlorinated biphenyls (162 congeners or congener groups), Dioxins/Furans – chlorinated dioxins and furans (17 congeners,) and PCP – pentachlorophenol

The Task 4 report is attached as Appendix D.

6 Cancer Risk Assessment (Task 5)

The Task 5 report provides a quantitative health risk assessment of potential increased cancer risk associated with exposure to carcinogens in the workplace. This risk assessment was prepared based on regulatory guidance used in the State of California for the purpose of assessing exposure and risk. Site-specific information gathered as part of Task 2, qualitative exposure assessment, was used to refine the exposure assumptions used in the risk assessment calculations.

The cancer risk assessment is an estimate of the theoretical increased risk of developing cancer as a result of exposure to chemicals present in the workplace. This approach involves varying degrees of conservatism and ensures that cancer risk is not underestimated, which makes it probable that the estimated risk will be overestimated. It is important to consider that these risks are theoretical because they are not measured directly among fire mechanics, which could only be done through use of an epidemiology study (as discussed in Task 3).

Consistent with regulatory guidance, the risk assessment was performed in a series of four steps:

Hazard Identification

During Task 4 quantitative exposure assessment, ToxStrategies conducted exposure monitoring of workers in each similar SEG for airborne chemicals, via PBZ air samples, as well as chemical analysis of surface residues via surface wipe samples. Samples were not collected for the field-assigned fire equipment mechanic at a wildfire base camp or for the helicopter maintenance inspector conducting painting/priming /sanding of aircraft parts because those activities were not on-going when sampling was performed.

Acetaldehyde, benzene, cobalt, formaldehyde, hexavalent chromium, nickel, and tetrachloroethylene were detected in at least one PBZ air sample. Hexavalent chromium, lead, PAHs, PCBs, and dioxins/furans were detected in at least one surface wipe sample. These chemicals were all considered to potentially increase the risk of cancer and were quantitatively evaluated in the risk assessment.

Exposure Assessment

In Task 2 qualitative exposure assessment, ToxStrategies provided an exposure ranking for each SEG exposed to carcinogens identified in the workplace in order to focus the Task 4 quantitative exposure assessment to those exposures (job tasks) that may pose the highest risk. Three primary scenarios were evaluated quantitatively in the risk assessment.

- Helicopter mechanic performing intermediate and heavy maintenance on the aircraft at Air Operations;
- Equipment maintenance worker performing repair and tune-up of power equipment at the small engine repair shop (Breathing Apparatus Shop); and
- FEM performing maintenance and repair of the fire apparatus at the Eastern Fire Shop.

Four additional SEGs, based on specific activities or contact with potentially contaminated materials were also included:

- Mastinox contact by the helicopter mechanic at Air Operations;

- Welding/grinding/cutting activities by the FEM at the Eastern Fire Shop;
- Repair and tune-up of the air packs at the Breathing Apparatus Shop; and
- Fire hose repair by the equipment maintenance worker at the fire hose repair shop (Breathing Apparatus Shop).

Exposure assumptions from regulatory guidance or based on site-specific information obtained during interviews during Task 2 were assigned to each SEG for the purpose of evaluating inhalation, dermal contact, and incidental ingestion exposures. Concentrations at the point of exposure were developed from the Task 4 data using averages when multiple samples were collected and maximum values when a few samples were collected. If an analyte was not detected in any samples at a location, it was not considered further in the risk assessment.

The air concentrations in each of these locations were below Permissible Exposure Limits (PELs), legal limits below which workers are allowed to be exposed; however, PELs are not always established to be protective of an increased cancer risk.

Toxicity Assessment

Toxicity criteria quantifying the relationship between chemical exposure and theoretical increased cancer risk were identified from regulatory references. Preference was given to criteria developed by a California regulatory agency or health agency. Other chemical-specific factors such as an adjustment to toxicity criteria based on ingestion exposures were made to quantify risk from dermal exposure. Some chemicals did not have regulatory toxicity criteria and were evaluated qualitatively.

Risk Characterization

Risk characterization is the integration of the exposure assessment and toxicity assessment to provide a quantitative estimate of theoretical risk. For the purpose of this risk assessment, excess cancer risks calculated to be less than 1 in 10,000 (recently adopted by the NIOSH) were considered *de minimus*.

Exposure via dermal contact and incidental ingestion exposure were much lower than inhalation exposure for all SEGs, and lower than the target criteria set by NIOSH. Theoretical excess cancer risks ranged from 0.0009 in 10,000 for fire hose repair to 0.2 in 10,000 for contact with Mastinox.

Based on the risk assessment process described herein, theoretical risks for inhalation exposure for the primary SEGs were as follows, with the primary chemical noted in the parentheses:

- 20 in 10,000 (0.2%) at Air Operations (hexavalent chromium)
- 30 in 10,000 (0.3%) at the Breathing Apparatus Shop, specifically measured at the small engine repair shop (benzene)
- 400 in 10,000 (4%) at the Eastern Fire Shop (tetrachloroethylene).

It is noteworthy that these risk estimates are based on current sampling data and may not be reflective of past exposures; however the assessment assumes that exposure occurs for a working lifetime of 45 years. As worker safety and health practices typically improve with time, it is reasonable to assume that exposures in the past may have been higher and different than those quantified herein.

In any risk assessment, estimates of potential carcinogenic risk are based on assumptions regarding exposure and toxicity, which have numerous associated uncertainties. Where possible, conservative assumptions were used to address uncertainty such that risks associated with the chemical exposures evaluated in this study are expected to be overestimated.

It is also noteworthy that while the theoretical increased cancer risks calculated for inhalation exposures exceed the current NIOSH benchmark of 1 in 10,000, these risks are far lower than that measured among firefighters. Increased cancer risks among firefighters have been documented in epidemiological studies. The IARC Working Group's analysis of firefighters found that the risk of testicular cancer was increased by ~50%, the risk of prostate cancer by ~30% and the risk of non-Hodgkin's lymphoma by ~20%[2]. As discussed in Task 1, similar studies of fire mechanics have not been performed, but the feasibility of such was assessed in Task 3 of this project.

To reduce theoretical cancer risk for the exposures identified above, a variety of control measures consistent with the NIOSH hierarchy of controls (eliminate, substitution, engineering controls, administrative controls, and use of PPE) could be considered. Examples include:

- Eliminate tetrachloroethylene-containing products, replacing them with products that do not contain carcinogens.
- Increase ventilation in the small engine repair shop to reduce benzene air concentrations.
- Identify work practices at Air Operations that increase the potential for airborne hexavalent chromium releases, and modify practices/procedures to reduce the release.

The Task 5 report is attached as Appendix E.

7 Technical Assistance to the DIR (Task 6)

Task 6 may include analyzing public comments, explaining the rationale for specific policy recommendations, and disseminating the study findings to the Governor, Legislature,

---

2 IARC (International Agency for Research on Cancer). 2010. IARC Monographs on the evaluation of carcinogenic risks to humans, Volume 98, Painting, firefighting, and shiftwork. Occupational Cancer Research Centre, https://www.occupationalcancer.ca/2010/iarc-monographs-volume-98-painting-firefighting-and-shiftwork/.

Occupational Safety and Health Standards Board, Los Angeles County Board of Supervisors, and stakeholders in the workers' compensation system.

APPENDIX A

Task 1: Structured Literature Review of Potential Occupational Exposures and Cancers among Mechanics Who Repair and Clean Firefighting Vehicles

Task 1: Structured Literature Review of Potential Occupational Exposures and Cancer among Mechanics Who Repair and Clean Firefighting Vehicles

FEBRUARY 25, 2021

ToxStrategies

Innovative solutions
Sound science

Task 1: Structured Literature Review of Potential Occupational Exposures and Cancer among Mechanics Who Repair and Clean Firefighting Vehicles

FEBRUARY 25, 2021

PREPARED FOR:
State of California
Department of Industrial Relations
1515 Clay Street
Suite 1902
Oakland, CA 94612

PREPARED BY:
ToxStrategies, Inc.
27001 La Paz Road
Suite 260
Mission Viejo, CA 92691

Table of Contents

List of Figures

List of Tables

1 Background and Rationale

The International Agency for Research on Cancer (IARC) and recent epidemiologic studies have suggested that firefighters may be at increased risk for certain cancers due to their occupational exposures to carcinogens found in fire gases and smoke (e.g., benzene, polycyclic aromatic hydrocarbons [PAHs], cadmium, crystalline silica [IARC, 2010]) as well as exposures to other agents (e.g., diesel exhaust [IARC, 2010]) (e.g., IARC, 2010; Tsai et al., 2015; LeMasters et al., 2006). Since January 1, 2012, firefighters have been included in the California Cancer Presumption for worker compensation purposes (California Labor Code §3212.1). With these benefits, a firefighter who develops cancer can be awarded compensation for medical treatment and disability benefits, if the individual demonstrates that he or she was exposed to a carcinogen during the course of their employment. In comparison, mechanics who repair and clean firefighting vehicles and equipment are not covered by this worker compensation program. Repairing and cleaning firefighting vehicles and equipment (trucks, helicopters, axes, hoses, etc.) at a fire station or offsite at a fire event may expose the mechanics to fire-related carcinogens, similar to those of the firefighters.[1] However, chemical data for fire mechanics are not readily available, and their occupational exposures are not well characterized, limiting the evaluation of their potential cancer risks.

As a result, California Assembly Bill (AB) 1400 was created to define the fire mechanic's risk of exposures to carcinogens in the course of employment. Specifically, AB 1400, Section 77.7, was added to the Labor Code on October 11, 2019, and requires the Commission on Health and Safety and Workers' Compensation (CHSWC), in partnership with the County of Los Angeles and relevant labor organizations, to submit a study to the Legislature, the Occupational Safety and Health Standards Board, and the Los Angeles County Board of Supervisors "on the risk of exposure to carcinogenic materials and incidence[2] of occupational cancer in mechanics who repair and clean firefighting vehicles."[3] The study components include:

- Site visits at representative facilities in Los Angeles County, California
- Interviews and surveys with current and former fire mechanics

1 California Legislative Information. 2019. AB-1400 Employment safety: Firefighting equipment: Mechanics (2019–2020). Bill Analysis. Senate Committee on Labor, Public Employment and Retirement. Hearing Date: July 10, 2019.

2 As discussed in Section 6, insufficient information currently exists to assess the incidence rate of cancer among firefighting mechanics. For this project, we will evaluate the available information and assess the feasibility of generating the data that could potentially be used in a future epidemiologic study.

3 California Legislative Information, 2019. AB-1400 Employment safety: Firefighting equipment: Mechanics (2019-2020). Assembly Bill No. 1400, Chapter 717, An act to add and repeal Section 77.7 of the Labor Code, relating to employee safety. October 11. https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201920200AB1400.

- Occupational exposure measurements of carcinogens found in the workplace, to evaluate potential exposure to carcinogenic materials
- Quantitative health risk assessment of potential increased cancer risk associated with exposure to carcinogens in the workplace.

ToxStrategies was contracted by the California Department of Industrial Relations (DIR), CHSWC, to conduct the study as outlined in AB 1400. ToxStrategies' approach to address these study components includes six tasks (provided in our proposal submitted to the DIR [ToxStrategies, Inc., 2020]):

- Task 1: Structured Literature Review— provided herein
- Task 2: Qualitative Exposure Assessment — site visits at representative facilities
- Task 3: Epidemiologic assessment — feasibility study of cohort enumeration
- Task 4: Quantitative Exposure Assessment — measurement of current occupational exposures to carcinogens
- Task 5: Cancer risk assessment — calculation of theoretical excess cancer risks from occupational exposure to carcinogens
- Task 6: Technical assistance to the DIR.

The purpose of Task 1, Structured Literature Review, is to identify and review relevant published literature to understand the state of the science with respect to exposure to chemical carcinogens associated with repairing and cleaning firefighting vehicles and equipment, as well as studies of cancer risk among fire mechanics.

The objectives, methods, results, and conclusions of Task 1, Structured Literature Review, are provided below. The remaining study tasks are described in Section 6.

2 Objectives

The objectives of this structured literature review were as follows:

1. Identify carcinogenic chemicals of potential concern (COPCs) for mechanics who repair and clean firefighting vehicles and equipment
2. Identify epidemiologic studies evaluating the risk of cancer among mechanics who repair and clean firefighting vehicles and equipment.

The structured literature review results will be used to guide the activities of the latter tasks.

3 Methods

Standard guidelines to conduct structured literature reviews, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, were followed in the conduct of this review (Moher et al., 2009). A protocol was developed *a priori* before the review was conducted to ensure clear documentation of methods and for transparency and reproducibility of our work (Attachment 1).

3.1 Study Eligibility

The inclusion and exclusion criteria used to assess study eligibility are presented in Tables 1 and 2 for Objectives 1 and 2, respectively. English-language articles published as either peer-reviewed journal articles or conference abstracts through the date of the search (August 15, 2020), with no lower date limit, were included in the review.

Table 1. Study eligibility criteria for Objective 1: Identify carcinogenic chemicals of potential concern for mechanics who repair and clean firefighting vehicles and equipment.

	Inclusion Criteria	Exclusion Criteria
Population	Mechanics who repair and clean firefighting vehicles	No exclusions
Exposure	Occupational exposures to potential chemical carcinogens	Non-occupational exposures to chemical carcinogens; occupational exposure to non-carcinogens
Comparator	General population, non-exposed worker populations (e.g., office workers within firefighting discipline), workers with lower exposures	No exclusions
Outcome	Any exposure measure or medical outcome	No exclusions
Study Design	Industrial hygiene studies, exposure studies	Opinion pieces, reviews

Table 2. Study eligibility criteria for Objective 2: Identify epidemiologic studies evaluating the risk of cancer among mechanics who repair and clean firefighting vehicles and equipment

	Inclusion Criteria	Exclusion Criteria
Population	Mechanics who repair and clean firefighting vehicles	No exclusions
Exposure	Occupational exposures to potential chemical carcinogens	Non-occupational exposures to chemical carcinogens
Comparator	General population, non-exposed worker populations (e.g., office workers within firefighting discipline), workers with lower exposures	No control group
Outcome	Cancer (any)	Non-cancer outcomes
Study Design	Cohort, case-control, case studies or case series	Opinion pieces, reviews

The bibliographies of relevant reviews and publications were hand-searched for additional citations of interest.

3.2 Initial Literature Search

We conducted a primary literature search on June 30, 2020, in the PubMed and Embase databases to 1) identify studies on occupational exposures of mechanics who repair and clean firefighting vehicles and equipment to carcinogenic chemicals of potential concern (COPCs) and 2) identify epidemiologic studies evaluating the risk of cancer among mechanics who repair and clean firefighting vehicles and equipment, using the search syntax presented in Table 3.

Table 3. Initial search syntax used for PubMed and Embase

Database	Search Syntax
PubMed	*("fire station" or "fire department" or "fire fighter*" or firefighter*) AND ("truck bay" or garage or maintenance or mechanic or helicopter or vehicle or "fire truck" OR “occupational exposure”) AND (exposure OR cancer[MeSH Terms] OR cancer OR carcinogen[MeSH Terms] or carcinogen*)*
Embase	*('fire station' OR 'fire department' OR 'fire fighter*' OR firefighter*) AND ('truck bay' OR 'garage'/exp OR garage OR 'maintenance'/exp OR maintenance OR 'mechanic'/exp OR mechanic OR 'vehicle'/exp OR helicopter OR vehicle OR 'fire truck' OR 'occupational exposure'/exp OR 'occupational exposure') AND ('exposure'/exp OR exposure OR 'cancer'/exp OR cancer OR carcinogen*)*

3.3 Initial Search Study Selection

Study selection was documented through DistillerSR, a specialized software program designed for tracking and managing literature reviews, resulting in a fully auditable and transparent review process. A PRISMA flow diagram is included in the results section, detailing the flow of study inclusion and exclusion at each study level.

The review of studies began at the level of title and abstract. Two reviewers screened the titles and abstracts of all de-duplicated studies resulting from the literature searches to determine their relevance for this review using the eligibility criteria (Tables 1 and 2).

Articles designated as relevant from the title and abstract review proceeded to full-text review, where two reviewers independently evaluated the full text of each article for relevance using the eligibility criteria (100% quality control [QC]). All disputes regarding study inclusion were resolved by consensus adjudication. The results were recorded, maintained, and assessed using DistillerSR.

3.4 Initial Search Data Abstraction

Data were abstracted in DistillerSR for all studies deemed relevant to the review by both reviewers in the full-text review stage.

Data abstraction elements were as follows:

- **General information**, including title, authors, and year of publication
- **Study characteristics:**
    - By person (demographics, job, confounders)
    - By place (geography, workplace/facility)
    - By time (calendar years of conducted study and follow-up)
- **Outcomes**
    - **Objective 1: Occupational exposures** (chemical, exposure levels)
    - **Objective 2: Cancer-related outcomes** (numbers, incidence rate, mortality rate, odds ratios, risk ratios, hazard ratios, standardized incidence ratios, standardized mortality ratios).

3.5 Supplemental Literature Search for Cancer Outcomes

To ensure that relevant occupational studies were not missed using the original search strings (Table 3), supplemental targeted literature searching was conducted. If the cancer outcomes were not statistically significantly associated with fire mechanics, they may not be captured in the abstract or keywords of the indexed publications and thus would not have been picked up by the original searches. Given the specificity of the fire mechanics occupation and previously established lack of research for these workers, we conducted additional searches to identify relevant literature that may not have been picked up by our original searches.

First, we reviewed the International Agency for Research on Cancer (IARC) monographs (2010) to identify cancers potentially associated with firefighting as an occupation. IARC is the World Health Organization agency that conducts and coordinates research into cancer. IARC working groups regularly review the carcinogenicity of chemicals and occupations using the available scientific literature and release monographs rating the carcinogenicity of the exposure based on the panel's scientific judgment. IARC published a monograph reviewing the carcinogenicity of firefighting in 2010 which included a list of cancers potentially associated with firefighting as an occupation (Non-Hodgkin's lymphoma, prostate cancer, and testicular cancer). Using this list of cancers, we expanded our PubMed and Embase search to identify epidemiologic studies of associations between these particular cancers and occupational groups to identify potentially missed research on cancer risk among fire mechanics (Table 4, cancer cohorts search).

Second, because there is no published IARC monograph for mechanics (automotive or other), and to provide additional context for potential cancers in the fire mechanic population, we conducted a targeted search in PubMed and Embase for epidemiologic studies of automotive mechanics and cancer (Table 4, mechanics and cancer search).

Finally, because Nordic registry-based cohort studies are known to provide robust analyses of cancer by occupation and are known to have high validity and statistical power due to large population size and complete follow-up, published literature from these cohorts was searched for fire mechanics or related occupations. Specifically, we reviewed data from Nordic cohort studies for elevated cancer risk among general mechanics, automotive mechanics, and fire mechanics (Table 4, Nordic cohorts search).

Table 4. Supplemental search syntax for PubMed

Query	Search Syntax	Date Last Searched	Number of Abstracts
Cancer cohorts	*(lymphoma OR prostate OR testicular) AND cancer AND "occupational exposure" AND (cohort or "case-control")*	August 15, 2020	668 (PubMed) 1,193 (Embase)
Mechanics and cancer	*[(automotive OR automobile OR truck OR motor vehicle OR bus OR helicopter OR garage) AND (maintenance OR repair OR mechanic) AND (occupation OR exposure) AND cancer]*	August 14, 2020	157 (PubMed) 44 (Embase)
Nordic cohorts	*(Nordic OR Scandinavian) AND cohort AND occupation AND cancer*	August 14, 2020	75 (PubMed) 67 (Embase)

3.6 Supplemental Study Data Abstraction

Studies identified during our supplemental searches (as described in Section 3.5) were reviewed for relevance at the title and abstract level; relevant full-text studies were searched for data for fire mechanics. Due to the volume of studies found in the cancer cohorts search (over 1,500), we used the Sciome Workbench for Interactive computer-Facilitated Text-mining (SWIFT-Review) interactive text-mining tool to further narrow these results by scanning titles, abstracts, keywords, MeSH annotations, and SWIFT-generated tags for the following syntax: “occupational AND cohort AND cancer AND occupations,” “fire AND (maintenance OR cleaning OR mechanic),” and “mechanic AND cohort.”

Relevant studies from the supplemental search were summarized and cited within the report but were not included in the data abstraction table, because while they provided contextual information that will help inform future work, they did not provide data that is specific to fire mechanics.

4 Results

The initial database search yielded 341 publications, and hand-searching of reviews and studies included for abstraction yielded another four. After de-duplication and screening of titles and abstracts, 20 papers were deemed relevant for full-text review. Upon full-text review, nine studies were found to be relevant for abstraction of exposure data, as shown in the PRISMA flow diagram (Figure 1).

This review was limited to peer-reviewed journal articles and conference abstracts published in English. Information published in the grey literature was excluded. The results of this review are generalizable only to the geographic areas and populations included in the studies.

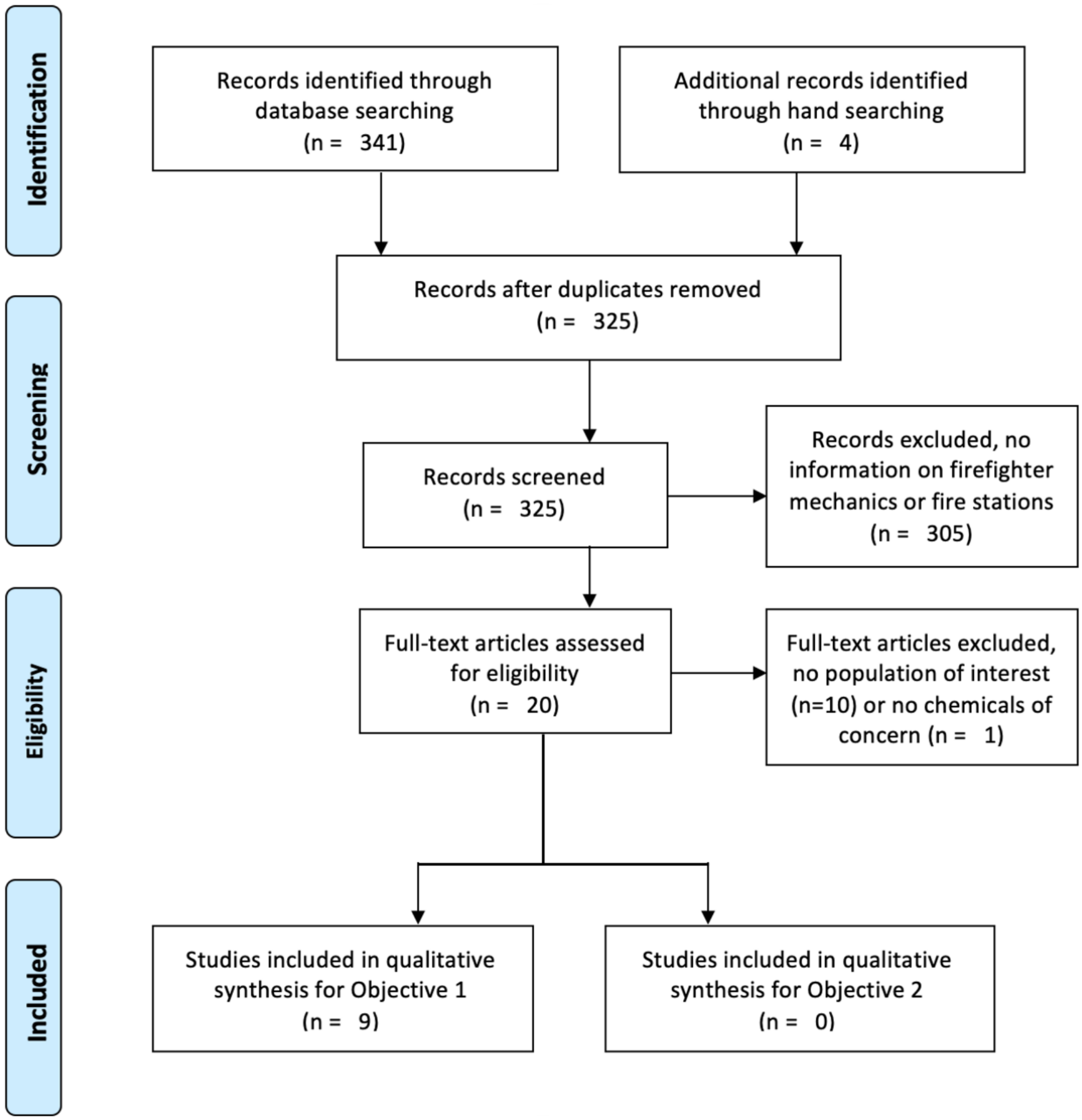

Figure 1. PRISMA flow diagram

4.1 Objective 1: Chemicals of Potential Concern (COPCs) for Fire Mechanics

The literature was extremely limited regarding exposures of mechanics who repair and clean firefighting vehicles and equipment (e.g., trucks, axes, hoses, etc.). No exposure studies explicitly mentioned fire mechanics, fire mechanic cleaners, or fire vehicle maintenance. However, we were able to identify nine industrial hygiene studies that presented data for exposures relating to fire stations and firefighting vehicles and/or gear, which likely overlap with exposures that fire mechanics encounter (Chung et al., 2020; Echt et al., 1995; Fent et al., 2015; Froines et al., 1987; Materna et al., 1992; Park et al., 2015; Shen et al., 2015; Shen et al., 2012; Sparer et al., 2017). The industrial hygiene studies are summarized in Table 5, including exposure findings related only to COPCs that are carcinogenic[4]; full study details for the nine included papers are included as Attachment 2 (Data Abstraction File). Whether a COPC was classified as a carcinogen was determined using Cal/OSHA's Hazard Communication Standard, which compiles listings from the following sources:[5]

- National Toxicology Program (NTP), "Report on Carcinogens" (NTP, 2016)
- International Agency for Research on Cancer (IARC) "Monographs on the Evaluation of Carcinogenic Risks to Humans" (IARC, 2020)
- Substances subject to regulation under the Occupational Carcinogen Control Act or that are regulated in Title 8, Article 110, Regulated Carcinogens (§5209, Carcinogens)
- Substances that meet the definition of "select carcinogen" in Title 8, Section 5191
- Where OSHA has included cancer as a health hazard to be considered by classifiers for a chemical covered by 29 CFR part 1910, Subpart Z.

---

4 A carcinogen is defined as "a substance or mixture of substances which induce cancer or increase its incidence" (Appendix A to §1910.1200 – Health Hazard Criteria).

5 Title 8 CCR §5194, Hazard Communication

Table 5. Summary of industrial hygiene (IH) studies of potential exposures in the fire mechanics occupation

Study	Study Period	Population	Carcinogen Exposures
Firefighters' Occupational Exposure Study (FOX) publications:			
Shen et al., 2015	2010–2011	Fire stations (IH sampling; N=20) in California	Polycyclic aromatic hydrocarbons (PAHs); polychlorinated biphenyls (PCBs)
Park et al., 2015	2010–2011	Firefighters in southern California (biomonitoring; N=101)	PCBs; organochlorine pesticides (OCPs)
Shen et al., 2012	2010–2011	Fire stations (IH sampling; N=20) in California	PAHs; PCBs
Other publications:			
Chung et al., 2020	July 2016 and February 2017	Fire stations (IH sampling; N=12) in Ontario, Canada	diesel engine exhaust
Sparer et al., 2017	Spring 2016	Fire stations (IH sampling; N=4) in Boston and Arlington, Massachusetts	PAHs; diesel exhaust
Fent et al., 2015	Not reported	Firefighters' personal protective equipment (PPE) (IH sampling) in Chicago, Illinois	benzene; 1,4-dichlorobenzene; ethylbenzene; styrene
Echt et al., 1995	June 1992	Fire stations (IH sampling; N=3), locations not reported	diesel exhaust
Materna et al., 1992	1987–1989	Wildland firefighters (IH sampling during active firefighting) in Northern California	crystalline silica; acetaldehyde; formaldehyde; PAHs; benzene
Froines et al., 1987	Not reported	Fire stations (IH sampling; N=10) in New York, Boston, and Los Angeles	diesel emissions

Five studies were conducted in California:

- Three studies used data collected from the Firefighter Occupational Exposures (FOX) study (Park et al., 2015; Shen et al., 2015; Shen et al., 2012) which measured polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and organochlorine pesticides (OCPs)
- One study conducted industrial hygiene sampling (crystalline silica, acetaldehyde, formaldehyde, PAHs, and benzene) among firefighters working at northern California wildland fires between 1987 and 1989 (Materna et al., 1992)
- One study measured total particulates as diesel emissions at three fire stations, one of which was in southern California (Los Angeles; discussed below) (Froines et al., 1987).

The FOX study (Shen et al., 2015, 2012) collected surface dust samples from fire stations in California between 2010 and 2011, and the authors reported the level of PAHs in fire stations as being higher than those found in California homes, and the level of PCBs as similar to California homes. In addition to surface dust samples, the FOX study also measured levels of PCBs and OCPs in firefighter serum; the study authors reported that firefighting is not a significant source of exposure to PCBs and OCPs (Park et al., 2015).

The firefighter industrial hygiene samples collected during wildland firefighting demonstrated potential for low-level exposures to carcinogens such as crystalline silica, acetaldehyde, formaldehyde, PAHs, and benzene (Materna et al., 1992).

Four studies investigated diesel emissions in fire stations:

- Froines et al. reported that fire vehicles were the major contributor of total particulates from diesel emissions after measuring exposures in ten fire stations in New York, Boston, and Los Angeles (1987). Further, firefighter exposure to total particulates increased with the number of runs conducted during an 8-hour period.
- Echt et al. found that the highest levels of elemental carbon (as a proxy for diesel exhaust) were measured in the fire station vehicle bays (maximum area sample measured up to 683 $\mu g/m^3$ of elemental carbon), which can travel to other areas of the fire station, such as the living quarters (1995).
- Sparer et al. found levels of particulate matter ($PM_{2.5}$; proxy for diesel exhaust) and PAHs in fire station truck bays to be higher than the outside measurements, although the authors acknowledged that tobacco smoke was a confounding factor on some days (2017).
- Chung et al. reported that the majority of respirable elemental carbon concentrations (proxy for diesel engine exhaust) came from the vehicle bays; higher concentrations were observed in the summer, potentially due to higher activity levels (2020).

Finally, Fent et al. (2015) measured off-gassing from firefighters' personal protective equipment (PPE) after being exposed to a controlled burn. The study results showed that the air concentrations of benzene, 1,4-dichlorobenzene, ethylbenzene, and styrene measured from the used PPE were higher than the measured background levels. Interestingly, brand new PPE had a higher measured off-gassing air concentration of 1,4-dichlorobenzene than that of the used PPE that had been exposed to a controlled burn.

The identified carcinogens in the exposure studies above are described in more detail below (Table 6). Each of the carcinogens is presented, along with the target cancer endpoint, and the carcinogen-identifying authoritative body (IARC, 2020; NTP, 2016; 29 CFR part 1910, Subpart Z [OSHA]). The evidence for chemical classification is based on a variety of animal and/or human studies and is not specific to observations among fire mechanics.

Table 6. Carcinogenic chemicals of potential concern (COPCs) identified in the literature review

Carcinogen Identified in Exposure Studies	Target Cancer Endpoints (IARC, 2020; NTP, 2016)	Identifying Authoritative Body
Polycyclic aromatic hydrocarbons (PAHs):		
Benzo[a]anthracene	Benign or malignant lung tumors (adenoma or adenocarcinoma); liver cancer (hepatocelluar carcinoma); tumors at the site of administration	NTP-R, IARC-2B
Benzo[a]pyrene	Lung tumors; forestomach and esophageal tumors, intestinal tumors, and mammary-gland tumors	NTP-R, IARC-1
Benzo[b]fluoranthene	Skin tumors; lung cancer (carcinoma)	NTP-R, IARC-2B
Benzo[k]fluoranthene	Lung cancer (squamous-cell carcinoma)	NTP-R, IARC-2B
Chrysene	Liver tumors	IARC-2B
Dibenzo[a,h]anthracene	Cancer of the lung (adenomatosis or alveologenic carcinoma) and mammary gland (carcinoma), benign or malignant tumors of the forestomach (squamous-cell papilloma or carcinoma), and tumors of the blood vessels (hemangioendothelioma)	NTP-R, IARC-2A
Indeno[1,2,3-c,d]pyrene	Benign and malignant skin tumors (papilloma and carcinoma); lung cancer (carcinoma)	NTP-R, IARC-2B

Carcinogen Identified in Exposure Studies	Target Cancer Endpoints (IARC, 2020; NTP, 2016)	Identifying Authoritative Body
Polychlorinated biphenyls (PCBs):		
PCB-28; PCB-52; PCB-66; PCB-74; PCB-99; PCB-101; PCB-138; PCB-153; PCB-170; PCB-180; PCB-183; PCB-187; PCB-194; PCB-203	Hepatocellular adenoma or carcinoma	NTP-R, IARC-1
PCB-105; PCB-118; PCB-156	Malignant melanoma, non-Hodgkin's lymphoma, breast cancer	IARC-1
Diesel exhaust:		
Diesel exhaust (measured as particulate matter or elemental carbon)	Cancer of the lung; cancer of the urinary bladder	NTP-R, IARC-1
Benzene:		
Benzene	Myeloid leukemia/ acute nonlymphocytic leukemia	NTP-K, IARC-1, OSHA 1910.1028
Organochlorine pesticides (OCPs):		
4,4'-DDT (dichlorodiphenyltrichloroethane)	Cancers of the liver and testis, and non-Hodgkin's lymphoma	NTP-R, IARC-2A
Lindane, Hexachlorocyclohexane (Technical Grade), and Other Hexachlorocyclohexane Isomers (e.g. β-BHC)	Non-Hodgkin's lymphoma	NTP-R, IARC-1
Hexachlorobenzene	Liver-cell tumors, renal tubular tumors; parathyroid adenomas, adrenal phaeochromocytomas, liver hemangioendotheliomas, thyroid follicular-cell adenomas	NTP-R, IARC-2B
Chlordane: trans-nonachlor and oxychlordane	Hepatocellular carcinomas	IARC-2B
Crystalline silica:		
Crystalline silica	Lung cancer	NTP-K, IARC-1, OSHA 1910.1053
Aldehydes:		
Acetaldehyde	Adenocarcinomas and squamous-cell carcinomas of the nasal mucosa; laryngeal carcinomas; hemolymphoreticular cancer; islet-cell adenoma; osteosarcoma	NTP-R, IARC-2B
Formaldehyde	Cancer of the nasopharynx and leukemia; sinonasal cancer; lymphohematopoietic cancer	NTP-K, IARC-1, OSHA 1910.1048

Carcinogen Identified in Exposure Studies	Target Cancer Endpoints (IARC, 2020; NTP, 2016)	Identifying Authoritative Body
Volatile organic compounds (VOCS):		
1,4-Dichlorobenzene	Liver tumors	NTP-R, IARC-2B
Ethylbenzene	Lung adenomas, liver adenomas, renal tubule adenomas and carcinomas	IARC-2B
Styrene	Lymphohaematopoietic malignancies	NTP-R, IARC-2A

Abbreviations: NTP = National Toxicology Program; NTP-K = known to be human carcinogens; NTP-R = reasonably anticipated to be human carcinogens; IARC = International Agency for Research on Cancer; IARC-1 = carcinogenic to humans; IARC-2A = probably carcinogenic to humans; IARC-2B = possibly carcinogenic to humans; OSHA = Occupational Safety and Health Administration

4.2 Objective 2: Epidemiologic Studies of Cancer Among Fire Mechanics

4.2.1 Initial Literature Search

The initial literature search did not identify any studies reporting on cancer risk, or rates of prevalent or incident cancers among fire mechanics. It is possible that the lack of findings is due to publication bias (i.e., groups without elevated or statistically significant results are less likely to be reported); thus to further ensure that relevant data were not missed, we conducted supplemental searches for related occupations (firefighters and auto mechanics) and compiled information from other sources for firefighters to further search for information specific to fire mechanics.

4.2.2 Supplemental Literature Search for Cancer Outcomes

The supplemental search for specific cancer types and occupational cohorts yielded over 1,500 references in PubMed and Embase (cancer cohorts query, Table 4); however, text mining in SWIFT-Review, as described in section 3.6, for related studies did not indicate that any studies included data for fire mechanics. While we acknowledge that there is still a small chance that this population has been mentioned in passing in a study with another focus, which would not be indexed in any searchable capacity, our supplemental searching and review of studies of related populations did not reveal any findings to support that relevant data had been missed with our original search strategy. In short, no studies quantifying cancer risk specifically among fire mechanics were identified even through the supplemental search strategy.

After conducting a meta-analysis of 42 studies of cancer in firefighters (19 cohorts, 11 case-control studies, and 14 “other” studies), the IARC Working Group reported that only testicular cancer, prostate cancer, and non-Hodgkin’s lymphoma showed significant summary risk estimates (2010). The Working Group identified indirect measurements of exposure (e.g., duration of employment) as a limitation of existing studies (IARC, 2010). Based on their review, the overall evaluation of occupational exposure as a firefighter was possibly carcinogenic to humans (2B), based on limited evidence in humans and inadequate evidence in experimental animals (IARC, 2010).

A systematic review of the literature of cancer risks associated with occupations in firefighting and motor vehicle maintenance and repair is necessary to thoroughly characterize the risk of cancer in these populations. Our preliminary review of the secondary literature for epidemiologic studies of automotive mechanics and cancer suggests occupational exposure may be associated with an increased risk for bladder cancer, and is likely not associated with lung cancer or leukemia (Muscat et al., 1995; Reulen et al., 2008).

Finally, our review of the Nordic cohort studies for general mechanics, automotive mechanics, and fire mechanics, showed statistically significant associations between mechanics[6] and several specific cancer types (e.g., bladder, cervix, colon, esophageal, etc.; Pukkala et al., 2009). However, it is worth noting that the definition of mechanics used in these studies was not specific to automotive mechanics and may include other occupations, and therefore the Pukkala et al. cancer types were not included in Table 7 (2009). Prior to that report, smaller Nordic studies of cohorts of automotive mechanics and bus garage workers showed elevated risks of non-Hodgkin's lymphoma, pancreatic cancer, urinary cancer outside the bladder (ureter and urethra), pleural mesothelioma, and lung cancer (Dryver et al., 2004; Hansen, 1989; Gustavsson et al., 1990). However, no results were found for fire mechanics in these studies, and the exposures and risks of all mechanics combined may not be generalizable to fire mechanics or automotive mechanics.

The various cancer sites and types reported in the primary literature for automotive mechanics and in the Nordic cohort studies specific to automotive mechanics are presented in Table 7. The cancer types associated with firefighters (as identified by the meta-analysis presented in IARC, 2010) are provided for additional context as to potential cancers that may have overlap with fire mechanics.

---

6 "Mechanics" was defined as "workers who make products of metal, and assemble and repair machines and motors" (Pukkala, et al., 2009).

Table 7. Reported cancer types potentially associated with occupation in firefighting and automotive maintenance and repair

Cancer Site or Type	Secondary Literature, Auto Mechanics	Nordic Cohorts, Auto Mechanics	IARC, Firefighters
Bladder	X		
Lung		X	
Mesothelioma		X	
Non-Hodgkin's Lymphoma		X	X
Pancreas		X	
Prostate			X
Testicular			X
Ureter and Urethra		X	

5 Discussion and Conclusions

This structured literature review illuminated the paucity of literature available for the characterization of potential carcinogenic exposures and cancer risks of fire mechanics. Occupation as a fire mechanic and risk of cancer has not been evaluated in the current scientific literature.

For the first objective of identifying studies reporting carcinogenic exposures experienced by fire mechanics, no occupational chemical exposure studies explicitly focused on fire mechanics, fire mechanic cleaners, or firefighting vehicle maintenance workers. However, nine industrial hygiene studies presented data for fire stations and firefighting vehicles and/or gear, which likely overlap with the occupational exposures of fire mechanics who repair and clean firefighting vehicles. The chemical carcinogens evaluated in these studies included benzene, diesel exhaust, PAHs, PCBs, OCPs, acetaldehyde, formaldehyde, crystalline silica, 1,4-dichlorobenzene, ethylbenzene, and styrene.

For the second objective of identifying studies of cancer risks or rates among fire mechanics, no epidemiologic studies were identified. A supplemental search was conducted to identify risk of cancer in the related occupations of firefighting and automotive maintenance and repair. Though a more thorough systematic review is necessary to fully characterize the risks in these occupations, our preliminary review of IARC monographs and the supplemental literature demonstrated that a number of cancers have been reported as increased in both firefighters and general or automotive mechanics. While the studies of firefighters and automotive mechanics provide additional insight into the risks associated with these related occupations, the results of these studies may not be generalizable to the experience of fire mechanics.

The findings from this literature are informative with respect to potential chemical exposures to be evaluated in the qualitative and quantitative exposure assessments that ToxStrategies will conduct (i.e., Tasks 2 and 4).

6 Next Steps

During the initial site visits, ToxStrategies will conduct a qualitative exposure assessment (Task 2) to determine similar exposure groups (SEGs) among the workers and prioritize/define the scope of the quantitative exposure assessment based on a risk ranking that incorporates the relative magnitude of the exposure potential (AIHA, 2015). A walk-around survey of the selected fire stations will be conducted, and observations will be made of the potential sources of exposures to chemical carcinogens at each location, as well as the manner in which those exposure may occur to characterize the exposures to fire mechanics who repair and clean firefighting vehicles.

Based on the findings from the literature and facilities records review (Tasks 1 and 2), employee records will be evaluated for completeness and suitability for a future cancer epidemiologic study (Task 3). As identified in the proposed scope of work submitted by ToxStrategies, due to the study timeline and scope, it is not feasible to calculate cancer incidence in this study population of fire mechanics. Interviews with current and former fire mechanics will provide observational information of cancer cases, but this information is not sufficient to demonstrate associations with chemical exposure, nor a causal relationship with the jobs of fire mechanic or firefighting vehicle cleaner.

The scope of the quantitative assessment (Task 4) will be determined from the results of the qualitative assessment, but we anticipate that exposure monitoring of workers for airborne chemicals, as well as chemical analysis of surface residues, will be included. SEGs will be assigned, and a representative number from each group will be selected for personal breathing-zone (PBZ) air sampling and surface/dermal wipe sampling of equipment.

Task 5 will include calculating the theoretical excess cancer risk from exposure to carcinogenic materials for each SEG determined from Tasks 2 and 4 and toxicity criteria relevant for California risk assessments. The risk assessment will result in an estimate of the probability of developing cancer as a result of exposure, expressed in terms of the numbers of people out of one million. Varying degrees of conservatism will be added to this approach to ensure that cancer risk is not underestimated, which makes it probable that potential risk will be overestimated.

Task 6 may include analyzing public comments, explaining the rationale for specific policy recommendations, and disseminating the study findings to the Governor, Legislature, Occupational Safety and Health Standards Board, Los Angeles County Board of Supervisors, and stakeholders in the workers' compensation system.

7 References

AIHA (American Industrial Hygiene Association). 2015. A Strategy for Assessing and Managing Occupational Exposures. 4th Edition. American Industrial Hygiene Association, Falls Church, Virginia.

Chung J, Demers PA, Kalenge S, Kirkham TL. 2020. Career fire hall exposures to diesel engine exhaust in Ontario, Canada. J Occup Environ Hyg 17(1):38–46, doi:10.1080/15459624.2019.1691729.

Dryver E, Brandt L, Kauppinen T, Olsson H. 2004. Occupational exposures and non-Hodgkin's lymphoma in Southern Sweden. Int J Occup Environ Health 10(1):13–21, doi:10.1179/oeh.2004.10.1.13

Echt A, Sheehy J, Blade L. 1995. Case studies: Exposure to diesel exhaust emissions at three fire stations: Evaluation and recommended controls. Appl Occup Environ Hyg 10(5):431–438.

Fent KW, Evans DE, Booher D, Pleil JD, Stiegel MA, Horn GP, Dalton J. 2015. Volatile organic compounds off-gassing from firefighters' personal protective equipment ensembles after use. J Occup Environ Hyg 12(6):404–414, doi:10.1080/15459624.2015.1025135.

Froines JR, Hinds WC, Duffy RM, Lafuente EJ, Liu WC. 1987. Exposure of firefighters to diesel emissions in fire stations. Am Ind Hyg Assoc J 48(3):202–207, doi:10.1080/15298668791384634.

Gustavsson P, Plato N, Lidström EB, Hogstedt C. 1990. Lung cancer and exposure to diesel exhaust among bus garage workers. Scand J Work Environ Health 16(5):348–354, doi:10.5271/sjweh.1780.

Hansen ES. 1989. Mortality of auto mechanics. A ten-year follow-up. Scand J Work Environ Health 15(1):43-46, doi:10.5271/sjweh.1883.

IARC (International Agency for Research on Cancer). 2010. IARC Monographs on the evaluation of carcinogenic risks to humans, Volume 98, Painting, firefighting, and shiftwork. Occupational Cancer Research Centre, https://www.occupationalcancer.ca/2010/iarc-monographs-volume-98-painting-firefighting-and-shiftwork/.

IARC (International Agency for Research on Cancer). 2020. IARC Monographs on the identification of carcinogenic hazards to humans, agents classified by the IARC Monographs, Volumes 1–127. Updated on June 26. https://monographs.iarc.fr/agents-classified-by-the-iarc/.

LeMasters GK, Genaidy AM, Succop P, Deddens J, Sobeih T, Barriera-Viruet H, Dunning K, Lockey J. 2006. Cancer risk among firefighters: A review and meta-analysis of 32 studies. JOEM 48(11):1189–1202.

Materna BL, Jones JR, Sutton PM, Rothman N, Harrison RJ. 1992. Occupational exposures in California wildland fire fighting. Am Ind Hyg Assoc J 53(1):69–76, doi:10.1080/15298669291359311.

Moher D, Liberati A, Tetzlaff J, Altman DG, The PG. 2009. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLOS Medicine 6(7):e1000097, doi:10.1371/journal.pmed.1000097.

Muscat JE, Wynder EL. 1995. Diesel engine exhaust and lung cancer: an unproven association. Environ Health Perspect 103(9):812-818, doi: 10.1289/ehp.95103812.

NTP (National Toxicology Program). 2016. Report on Carcinogens, Fourteenth Edition. Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service. https://ntp.niehs.nih.gov/go/roc14.

Park JS, Voss RW, McNeel S, Wu N, Guo T, Wang Y, et al. 2015. High exposure of California firefighters to polybrominated diphenyl ethers. Environ Sci Technol 49(5):2948–2958, doi:10.1021/es5055918.

Pukkala E, Martinsen JI, Lynge E, Gunnarsdottir HK, Sparen P, Tryggvadottir L. 2009. Occupation and cancer — Follow-up of 15 million people in five Nordic countries. Acta Oncol 48(5):646–790, doi:10.1080/02841860902913546.

Reulen RC, Kellen E, Buntinx F, Brinkman M, Zeegers MP. 2008. A meta-analysis on the association between bladder cancer and occupation. Scand J Urol Nephrol Suppl 218:64–78, doi:10.1080/03008880802325192.

Shen B, Whitehead TP, McNeel S, Brown FR, Das R, Israel L, et al. 2012. Measurements of PAHs, PBDEs, and PCBs in dust from California firehouses. Organohalogen Compounds 74:899–902.

Shen B, Whitehead TP, McNeel S, Brown FR, Dhaliwal J, Das R, et al. 2015. High levels of polybrominated diphenyl ethers in vacuum cleaner dust from California fire stations. Environ Sci Technol 49(8):4988–4994.

Sparer EH, Prendergast DP, Apell JN, Bartzak MR, Wagner GR, Adamkiewicz G, et al. 2017. Assessment of ambient exposures firefighters encounter while at the fire station: An exploratory study. J Occup Environ Med 59(10):1017–1023, doi:10.1097/JOM.0000000000001114.

ToxStrategies, Inc. 2020. Proposal in response to RFP #4479, Assessment of Risk of Carcinogens Exposure and Incidents of Occupational Cancer among Mechanics and Cleaners of Firefighting Vehicles Volume 1 – Proposal. February 13.

Tsai RJ, Luckhaupt SE, Schumacher P, Cress RD, Deapen DM and Calvert GM. 2015. Risk of cancer among firefighters in California, 1988-2007. Am J Ind Med 58(7):715–729, doi:10.1002/ajim.22466.

ATTACHMENT 1

Literature Search Protocol

Attachment 1
Literature Search Protocol

JULY 7, 2020

ToxStrategies

Innovative solutions
Sound science

Table of Contents

1 Background and Rationale

Cancer risks from occupational exposures associated with firefighting have been assessed and described in the literature (IARC, 2010), and firefighters are included in the California Cancer Presumption for worker compensation purposes (Labor Code §3212.1). In comparison, for firefighting equipment mechanics and cleaners, there is limited information on potential occupational exposures and cancers observed.

The purpose of Task 1 is to identify and review relevant published literature to understand the state of the science with respect to exposure to chemical carcinogens associated with repairing and cleaning firefighting vehicles and equipment, as well as studies of cancer risk among fire mechanics.

2 Objectives

The objectives of this literature review are as follows:

1. Identify carcinogenic chemicals of potential concern (COPCs) for mechanics who repair and clean firefighting vehicles and equipment
2. Identify epidemiologic studies evaluating the risk of cancer among mechanics who repair and clean firefighting vehicles and equipment.

The structured literature review results will be used to guide the activities of the latter tasks.

3 Methods for Data Collection

Standard guidelines to conduct structured literature reviews, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, will be followed in the conduct of this review (Moher et al., 2009). These guidelines are widely accepted as the standard for conducting and reporting systematic literature reviews (SLRs). More than 170 journals in the health sciences endorse and require PRISMA for the reporting of SLRs and meta-analyses.

3.1 Study Eligibility

Articles published through the date of the search with no lower date limit will be included in the review. Studies published in English as either peer-reviewed journal articles or conference abstracts will be eligible.

The following additional inclusion criteria will be employed to determine study eligibility for Objective 1:

- Population: Mechanics who repair and clean firefighting vehicles
- Exposure: Occupational exposures to potential chemical carcinogens
- Comparator: General population, non-exposed worker populations (e.g., office workers within firefighting discipline), workers with lower exposures
- Outcome: Any exposure measure or medical outcome
- Study Design: Industrial hygiene studies, exposure studies

The exclusion criteria to determine study eligibility are as follows:

- Population: No exclusions
- Exposure: Non-occupational exposures to chemical carcinogens; occupational exposure to non-carcinogens
- Comparator: No exclusions
- Outcome: No exclusions
- Study Design: Opinion pieces, reviews.

The following additional inclusion criteria will be employed to determine study eligibility for Objective 2:

- Population: Mechanics who repair and clean firefighting vehicles
- Exposure: Occupational exposures to potential chemical carcinogens
- Comparator: General population, non-exposed worker populations (e.g., office workers within firefighting discipline), workers with lower exposures
- Outcome: Cancer (any)
- Study Design: Cohort, case-control, case studies or case series

The exclusion criteria to determine study eligibility are as follows:

- Population: No exclusions
- Exposure: Non-occupational exposures to chemical carcinogens
- Comparator: No control group
- Outcome: Non-cancer outcomes
- Study Design: Opinion pieces, reviews.

The bibliographies of relevant reviews and publications will be hand-searched for additional citations of interest. If more than one article from the same study population was published, data from the publication with the longest follow-up or most specifically relevant population and/or outcomes will be extracted. For studies with overlapping data, those with the larger population size or specifically relevant population and/or outcomes will be considered.

3.2 Literature Searches

Databases to be searched include PubMed and Embase. The search strategy will be adapted to meet the search specifications of each included database. The search strategy includes search terms, language specifications, and other suitable filters for each database searched, and is designed such that outcomes of interest and possible stratification variables will be captured in the scope of the literature review. These will be translated into indexed Medical Subject Headings (MeSHs) and plain-language text-word terms using the National Library of Medicine MeSH thesaurus. The selected terms will be compared to index terms of related published studies to ensure that there are no gaps in the chosen search language. Boolean operators will be used to combine the final list of search terms into a comprehensive search strategy. As a final step, limit terms/filters will be added to the search strategy (e.g., English language) to ensure that only the most relevant studies are included in the final search yield. A draft search strategy is included as Section 3.3.

3.3 Search Strategy

Due to the extremely limited number of studies identified in a scoping search, the final search strategy will employ a two-pronged approach:

Step 1. Conduct a primary literature search in PubMed and Embase to identify studies on exposures in fire stations, as well as general firefighting exposures that have been linked with cancer outcomes, in order to identify potential chemicals of concern for vehicle mechanics, using the search syntax shown in Table A.

Table A. Search Syntax for Step 1.

Database	Search Syntax
PubMed	*("fire station" or "fire department" or "fire fighter*" or firefighter*) AND ("truck bay" or garage or maintenance or mechanic or helicopter or vehicle or "fire truck" OR "occupational exposure") AND (exposure OR cancer[MeSH Terms] OR cancer OR carcinogen[MeSH Terms] or carcinogen*)* *Pilot search on 6/25 yielded 203 results.*
Embase	*('fire station' OR 'fire department' OR 'fire fighter*' OR firefighter*) AND ('truck bay' OR 'garage'/exp OR garage OR 'maintenance'/exp OR maintenance OR 'mechanic'/exp OR mechanic OR 'vehicle'/exp OR helicopter OR vehicle OR 'fire truck' OR 'occupational exposure'/exp OR 'occupational exposure') AND ('exposure'/exp OR exposure OR 'cancer'/exp OR cancer OR carcinogen*)* *Pilot search on 6/25 yielded 148 results (138 potential duplicates from Medline)*

Step 2. Conduct a primary literature search in PubMed and Embase for epidemiological studies of specific cancers identified in Step 1, evaluating all occupations, which may include mechanics or other trades that could work on vehicles and/or in fire stations.

Typically, three types of epidemiologic studies are of interest for occupational cancer reviews:

1. Cohorts of specific occupations that evaluate the incidence of all cancers
2. Case-control studies of specific cancers that evaluate all occupations
3. Large-scale studies that evaluate all occupations and all cancers.

Standard search strings (as we have specified in Step 1 above) will pull relevant studies in the type 1 category. However, it is important to note that not all studies in the type 2 category would be identified from the search if the cancer outcome results for firefighting mechanics are not significantly elevated and are reported only in the tables of the published literature. Hence, for this project, we will include the additional strategy of identifying specific cancers of interest and subsequently searching for studies that evaluate the risk of these cancers by occupation (type 2 studies). Finally, we plan to evaluate the epidemiologic literature from reports by IARC, NIOSH, and other agencies, as well as large-scale occupational cohort studies from Nordic countries (type 3 studies). Search syntax for Step 2 are shown in Table B (pilot searching was not performed for these searches).

Table B. Search Syntax for Step 2.

Query	Search Syntax
Cancer cohorts	*(lymphoma OR prostate OR testicular) AND cancer AND "occupational exposure" AND (cohort or "case-control")*
Nordic cohorts	*(Nordic OR Scandinavian) AND cohort AND occupation AND cancer*

3.4 Study Selection

Study selection will be documented through DistillerSR, a specialized software program designed for tracking and managing literature reviews, resulting in a fully auditable and transparent review process. A PRISMA flow diagram will be included in the study report detailing the flow of study inclusion and exclusion at each study level, including reasons for exclusion at the level of full-text review.

Review of studies will begin at the level of title and abstract. Reviewers will screen the titles and abstracts of the studies produced by the literature searches (after de-duplication) to determine their relevance for this review. Studies will be screened against the inclusion and exclusion criteria for study population, interventions, outcomes, and study design for each objective.

Articles designated as relevant from the title and abstract review will proceed to full-text review, where researchers will evaluate the full text of the article for relevance. Studies will again be screened against the inclusion and exclusion criteria, excluding case reports, case series with <20 patients, opinion pieces, studies published in languages other than English, and reviews. Relevant reviews will be identified during the full-text review, and the bibliographies will be hand-searched for additional citations of interest. Each study will be evaluated at the level of full-text review, by two reviewers independently, to determine agreement on included articles (100% QC). All disputes will be resolved by consensus adjudication. The results will be recorded, maintained, and assessed using DistillerSR.

3.5 Data Abstraction for Step 1 Search.

Data will be abstracted in DistillerSR for all studies from Step 1 (as described in Section 3.3) deemed relevant to the review in the full-text review stage. The abstraction form will be reviewed prior to any data abstraction to ensure that all appropriate fields are captured, and an initial small sample of articles will be extracted to determine whether the form captures the appropriate information from the articles.

Anticipated data abstraction elements are as follows:

- **General information**, including title, authors, and year of publication
- **Study characteristics:**

        - By person (demographics, job, confounders)
        - By place (geography, workplace/facility)
        - By time (calendar years of conducted study and follow-up)

- **Outcomes**
    - **Objective 1: Occupational exposures** (chemical, exposure levels)
    - **Objective 2: Cancer-related outcomes** (numbers, incidence rate, mortality rate, odds ratios, risk ratios, hazard ratios, standardized incidence ratios, standardized mortality ratios).

3.6 Study Selection and Data Abstraction for Step 2 Search.

Studies identified during our supplemental searches (as described in Section 3.3, Step 2) will be reviewed for relevance at the title and abstract level; relevant full-text studies will be searched for data for fire mechanics. Due to the volume of studies anticipated for the cancer cohorts search, we will use the Sciome Workbench for Interactive computer-Facilitated Text-mining (SWIFT-Review) interactive text-mining tool to scan titles, abstracts, keywords, MeSH annotations, and SWIFT-generated tags for the following syntax: "occupational AND cohort AND cancer AND occupations," "fire AND (maintenance OR cleaning OR mechanic)," and "mechanic AND cohort."

Studies from the supplemental search that appear relevant but do not meet the objectives inclusion criteria will be summarized and cited within the report but not included in the data abstraction table.

3.7 Data Synthesis

A narrative summary of the review, including the methods and results for each outcome identified in the literature review, will be developed.

Possible elements include:

- Identification of COPCs
- Work tasks associated with exposures to COPCs
- Characterization of important confounding factors and biases
- Significant cancer outcomes associated with occupational exposures among this worker population
- Strengths and limitations of studies.

3.8 Limitations of Review

This review will be limited to peer-reviewed journal articles and conference abstracts published in English. Information published in the grey literature will be excluded. The results of this review may be generalizable only to the geographic areas and populations included in the studies.

3.9 Dissemination of Results

The results of this review will be submitted to the State of California Department of Industrial Relations under Assembly Bill No. 1400. Specifically, the deliverables will include:

- EndNote library of the relevant publications
- Data abstraction file of included studies
- Written summary of the state of science.

The summary will include a list of COPCs and descriptions of work tasks that may result in exposure to the substance(s), with citations to specific publications. Cancers reported in this worker population will be also described. The results may also be submitted as a conference abstract to a relevant conference.

4 References

International Agency for Research on Cancer (IARC). 2010. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 98, Painting, Firefighting, and Shiftwork. Occupational Cancer Research Centre, https://www.occupationalcancer.ca/2010/iarc-monographs-volume-98-painting-firefighting-and-shiftwork/

Moher D, Liberati A, Tetzlaff J, Altman DG, The PG. 2009. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLOS Medicine 6(7):e1000097, doi:10.1371/journal.pmed.1000097.

ATTACHMENT 2

Data Abstraction File

Attachment 2. Data abstraction file

Literature Search Data Abstraction Table				General study information			
Author	**Title**	**Year**	**Geographic location of study:**	**Author's objective**	**Author's conclusion**	**Study design:**	**Data collection methods used:**
Chung, J.,Demers, P. A.,Kalenge, S.,Kirkham, T. L.	Career fire hall exposures to diesel engine exhaust in Ontario, Canada	2020	Ontario, Canada	The study objective was to evaluate diesel engine exhaust (DEE) levels in career fire halls in Ontario, Canada.	The results show that firefighters may be at an increased risk of exposure to DEE when in fire halls and that local exhaust ventilation (LEV) units should be assessed regularly for efficiency. Although no occupational exposure limit for DEE is currently available for industrial/non-industrial workplaces in Ontario, fire departments should continue to implement DEE control strategies to reduce exposures to mitigate potential health risks.	The study population consisted of 12 career fire halls from six different cities ($City_1$-$City_6$) within the province of Ontario, Canada. Two fire halls were selected in each participating city through consultations with participating fire departments. The first hall selected in each city was the hall that responded to the highest number of emergency calls/runs (a surrogate for identifying the number of times the fire apparatus left the fire hall). The second hall selected was a hall with a different building design that had a moderate to high call volume.	Respirable elemental carbon (REC) was measured using a modified NIOSH analytical method (i.e., method 5040) for diesel particulate matter. Twenty-four hour air samples were collected at 2.5 L/min using A/C powered SKC (SKC Inc., PA USA) or BGI pumps (BGI Technologies, ON Canada) connected to SKC aluminum cyclones (SKC Inc., PA USA) and 37mm cassettes with quartz fiber filters. At each fire hall, three samples were collected at set locations: the vehicle bay, kitchen/common room area, and the sleeping quarters. Sampling was conducted between July 2016 and February 2017 in two sampling campaigns (i.e., summer and winter months), to assess potential seasonal differences. Local exhaust ventilation (LEV) units in the vehicle bays were assessed during both sampling campaigns if present. Lastly, a walkthrough was conducted at each fire hall to collect information about factors that may influence DEE exposure levels. The number of runs occurring during the measurement period were obtained from the fire department following sampling.
Echt, A.,Sheehy, J.,Blade, L.	Exposure to diesel exhaust emissions at three fire stations: Evaluation and recommended controls	1995	Not specified; authors are located in Ohio	The National Institute for Occupational Safety and Health (NIOSH) conducted a health hazard evaluation (HHE) at three engine houses of a municipal fire department to evaluate exposure to diesel exhaust emissions in the engine houses.	When diesel-powered equipment leaves or returns to an engine house, exhaust emissions containing diesel particulate are produced inside the apparatus bay. The diesel exhaust can then enter the living quarters. The agreement of current toxicological and epidemiological evidence suggests that occupational exposure to diesel exhaust is a potential carcinogen.	Personal breathing zone and general area air samples for elemental carbon were collected at all three engine houses.	At each engine house, samples were collected in the breathing zones of an officer and two other employees (either fire fighters, medic/fire fighters, medics, or medic trainees). To evaluate the exposures that occurred in the engine houses, and exclude those that occurred while riding the emergency vehicles, employees were asked to turn off the sampling pumps when their vehicle cleared the engine house doors, and turn the pumps on when the vehicle began backing into the engine house upon their return. Area samples were also collected at each engine house. Elemental carbon samples were collected and analyzed using the thermal-optical method.

Attachment 2. Data abstraction file

Literature Search Data Abstraction Table				Potential carcinogens identified in studies						Exposure details and relevant notes
Author	Title	Year	Geographic location of study:	What potential carcinogens are reported? -> Benzene	What potential carcinogens are reported? -> Diesel exhaust	What potential carcinogens are reported? -> Polycyclic aromatic Hydrocarbons (PAHs)	What potential carcinogens are reported? -> polychlorinated biphenyls (PCBs)	What potential carcinogens are reported? -> organochlorine pesticides (OCPs)	What potential carcinogens are reported? -> Other (specify)	What exposure information is reported?
Chung, J.,Demers, P. A.,Kalenge, S.,Kirkham, T. L.	Career fire hall exposures to diesel engine exhaust in Ontario, Canada	2020	Ontario, Canada		Respirable elemental carbon (REC) as a surrogate for diesel engine exhaust (DEE)					Of the 69 samples collected, 16% had detectable elemental carbon concentrations, where all but one was taken within the vehicle bay (range: <0.5 mg/m^3–2.7 mg/m^3). The data indicates vehicle bay exposures may be higher in halls with LEV units, those that respond to more emergencies, have a back-in vehicle bay design compared to drive-through design, and during the summer season. Three samples (4.3%) exceeded the 1.03 mg/m^3 proposed Dutch occupational exposure limit; however, the estimated exceedance fraction of the underlying vehicle bay exposure distribution was 17%. Eight halls had LEV units, where performance ranged from 3.6% to 85.3% (median= 54%) when compared to manufacturer recommendations.
Echt, A.,Sheehy, J.,Blade, L.	Exposure to diesel exhaust emissions at three fire stations: Evaluation and recommended controls	1995	Not specified; authors are located in Ohio		Elemental carbon (used as a surrogate measure of exposure to particulate diesel exhaust)					The highest levels of elemental carbon, ranging from 86 ug/m^3 (Engine House 3) to 683 ug/m^3 (Engine House 2) were measured in the apparatus bays of the three fire stations on Day 1 (general area samples).

Attachment 2. Data abstraction file

Literature Search Data Abstraction Table				General study information			
Author	**Title**	**Year**	**Geographic location of study:**	**Author's objective**	**Author's conclusion**	**Study design:**	**Data collection methods used:**
Fent, K. W., Evans, D. E.,Booher, D., Pleil, J. D., Stiegel, M. A., Horn, G. P., Dalton, J.	Volatile organic compounds off-gassing from firefighters' personal protective equipment ensembles after use	2015	Chicago, Illinois	The authors' objectives for this study were to measure the concentration and composition of volatile organic compounds (VOCs) off-gassing from firefighters' ensembles after being used for controlled-structure burns and to compare these results to air concentrations of VOCs measured during the burns, as well as those measured in firefighters' exhaled breath.	The overhaul and off-gas air concentrations were well below applicable short-term occupational exposure limits. Compared to pre-burn levels, the authors measured >2 fold increases in mean breath concentrations of benzene, toluene, and styrene after the burns. Air concentrations of benzene, toluene, ethylbenzene, xylenes, and styrene (BTEXS) measured off-gassing from firefighters' used PPE and in firefighters' postburn exhaled breath were significantly correlated.	This experiment consisted of three controlled structure burns that took place inside an intermodal metal container with two rooms made of drywall. New drywall was erected for each burn. The sampling performed included: air sampling inside the structure, off-gas sampling, and exhaled breath sampling. The main purpose of the sampling was to determine the magnitude and composition of VOCs that were generated during the fires, subsequently off-gassed from the firefighters' ensembles, and systemically absorbed by the firefighters and exhaled in their breath.	*Sampling VOCs Off-gassing from PPE Ensembles:* Approximately 25 minutes after completing overhaul for each controlled burn, the two ensembles (except for SCBA) were placed inside the clean enclosures along with evacuated canisters to collect off-gas samples over 15 minutes to permit comparison with short-term occupational exposure limits (OELs). Using the same method, they also investigated the off-gassing of brand-new turnout coats and trousers as the control. VOCs were sampled inside the structure (during active burn and during overhaul). Volatile compounds, including semi-volatile PAHs, were sampled in exhaled breath approximately 4-14 minutes after completion of overhaul for each burn (2-10 minutes after firefighters doffed their PPE).
Froines, J. R.,Hinds, W. C.,Duffy, R. M.,Lafuente, E. J.,Liu, W. C. V.	Exposure of firefighters to diesel emissions in fire stations	1987	New York, Boston, and Los Angeles	At the request of the International Association of Fire Fighters and the Los Angeles, Boston and New York fire departments, the authors conducted a study of firefighter exposure to diesel particulates in fire stations.	For the ten fire stations sampled, the major contributor to the measured levels of total particulates was the diesel emissions from the fire vehicles. Firefighter exposure to total particulates increased with the number of runs conducted during an 8-hour period.	Personal sampling of firefighters was used to measure exposure to total airborne particulates in the ten fire stations. Representative samples were collected at the exhaust pipes of eleven vehicles, five fire trucks and six fire engines. A real-time aerosol monitor (RAM-1, GCA Corp.) was used to measure the concentration of total airborne particulates on the vehicle floor between truck and engine at drivers' entry of a New York fire station.	Personal sampling was used to measure exposure to total airborne particulates in the fire stations: Du Pont P-2500 pumps (Du Pont Company) were used at a flow rate of 2 L/min. Teflon®-coated glass fiber filters were used to determine the methylene chloride soluble fraction of the total particulates. Pumps were calibrated before and after each 8-hr sampling period. There was a study team member in each fire station to observe pumps' performance continually. Stations in New York and Boston were sampled for 48-hr periods. Pumps and cassettes were changed after each 8-hr period. One New York station was sampled for 64 hr. About five firefighters were sampled during each 8-hr period. For safety and operational reasons, firefighters removed their pumps before leaving the fire station to respond to an alarm. Pumps were taken to an office that was located away from the fire station equipment floor and continued to operate in this area. Upon return to the station, each firefighter started wearing his pump again. In addition to the assessment of exposure to total particulates under normal operating conditions, the authors also estimated the most severe exposure to diesel particulates that a firefighter might encounter during an 8-hr period in a Los Angeles fire station. Both the truck and engine were turned on and allowed to idle to approximate exposure for the most active day on record of a selected fire station. It was determined that the two fire vehicles would idle for 1 min per half hour throughout an 8-hr period for a total of 16 min with all the windows and doors in the fire station remaining closed. No fire truck or engine left the station during this simulated exposure. Personal sampling of nine firefighters was conducted over the 8-hr shift to assess individual exposures.

Literature Search Data Abstraction Table				Potential carcinogens identified in studies						Exposure details and relevant notes
Author	Title	Year	Geographic location of study:	What potential carcinogens are reported? -> Benzene	What potential carcinogens are reported? -> Diesel exhaust	What potential carcinogens are reported? -> Polycyclic aromatic Hydrocarbons (PAHs)	What potential carcinogens are reported? -> polychlorinated biphenyls (PCBs)	What potential carcinogens are reported? -> organochlorine pesticides (OCPs)	What potential carcinogens are reported? -> Other (specify)	What exposure information is reported?
Fent, K. W., Evans, D. E.,Booher, D., Pleil, J. D., Stiegel, M. A., Horn, G. P., Dalton, J.	Volatile organic compounds off-gassing from firefighters' personal protective equipment ensembles after use	2015	Chicago, Illinois	Benzene					VOCs: 1,4-dichlorobenzene, ethylbenzene, styrene	Air Concentrations of VOCs Off-gassing from PPE Ensembles: The air concentrations measured from used PPE ensembles were generally higher than the background levels, with statistically significant differences ($P < 0.05$) observed for acetone, 1,4-dichlorobenzene, and cyclohexane. Of note, the off-gassing air concentration of 1,4-dichlorobenzene was higher for the brand new turnout coat and trousers than the used PPE ensembles. All air concentrations were well below any applicable short term OELs.
Froines, J. R.,Hinds, W. C.,Duffy, R. M.,Lafuente, E. J.,Liu, W. C. V.	Exposure of firefighters to diesel emissions in fire stations	1987	New York, Boston, and Los Angeles		Total airborne particulate matter (the major contributor to the measured levels of total particulates was the diesel emissions from the fire vehicles)					The data presented show that firefighters are exposed to increased levels of particulates from diesel emissions. The levels of total airborne particulates ranged from below 100 $\mu g/m^3$ to as high as 480 $\mu g/m^3$. Firefighter exposure to total particulates increased with the number of runs conducted during an 8-hr period. In New York and Boston where the response level ranged from 7 to 15 runs during an 8-hr shift, the resulting exposure levels of total airborne particulates from diesel exhaust were 170 to 480 $\mu g/m^3$ (TWA). Three important sources of particulates beyond those produced by the diesel-powered vehicles were cooking fumes, ambient aerosol and cigarette smoke. Methylene chloride extracts of the diesel particulates averaged 24% of the total. Smoking confounding: Fourteen percent of the firefighters sampled were smokers. Smokers averaged 62.6 $\mu g/m^3$ more total airborne particulates than their nonsmoking counterparts. No attempt was made to assess the contribution from side-stream smoking. Because of winter weather conditions, doors and windows of fire stations in New York and Boston were kept closed during the sampling periods except when vehicles were entering or leaving. In Los Angeles it was warmer, and doors and windows usually were left open. For safety and operational reasons, firefighters removed their air sampling equipment at the sound of an alarm, as previously described. Having the sampling equipment continue to operate away from the main floor during the period of highest concentration of diesel exhaust underestimates the personal exposure concentration. During this period, firefighters would be either on the vehicle or gathering equipment located next to the vehicle. Diesel exposure during travel to and from the station may represent another source of exposure.

Attachment 2. Data abstraction file

Literature Search Data Abstraction Table				General study information			
Author	**Title**	**Year**	**Geographic location of study:**	**Author's objective**	**Author's conclusion**	**Study design:**	**Data collection methods used:**
Materna, B. L.,Jones, J. R.,Sutton, P. M.,Rothman, N.,Harrison, R. J.	Occupational exposures in California wildland fire fighting	1992	Northern California	This paper describes industrial hygiene data from the 1987 through 1989 wildfire seasons	Results show that wildland fire fighters may at times be exposed to concentrations of carbon monoxide, total or respirable particulates, or silica at levels near or higher than recommended occupational exposure limits, although group means were generally well below the limits.	Industrial hygiene sampling was conducted at northern California wildland fires during three successive fire seasons (1987 to 1989).	Constant-flow sampling pumps were used for all high-flow sampling applications. Low-flow sampling was done with two types of low-flow sampling pumps: stroke counters and constant flow models. Calibration was performed in the field pre- and post-sampling, by using a rotameter, bubble meter, or electronic calibrator. An AIHA-accredited laboratory performed all analyses.
Park, J. S.,Voss, R. W.,McNeel, S.,Wu, N.,Guo, T.,Wang, Y.,Israel, L.,Das, R.,Petreas, M.	High exposure of California firefighters to polybrominated diphenyl ethers	2015	Southern California	The authors measured levels of persistent organic pollutants (POPs; polybrominated diphenyl ethers [PBDEs], polychlorinated biphenyls [PCBs], and organochlorine pesticides [OCPs]) in firefighter serum samples collected during 2010−11. They compared these levels to those from other occupationally exposed groups (e-waste workers and foam factory workers) as well as other populations, and attempted to elucidate potential chemical exposure pathways among firefighters.	High levels of PBDEs were measured in firefighters' serum in comparison to other populations in California during the same period. In addition, nearly one-third of subjects had particularly high serum levels of decabromodiphenyl ether (BDE-209), consistent with other recent results in firefighters; this pattern may be a marker of recent firefighting activity. In contrast, levels of PCBs and OCPs measured in firefighters' sera were not elevated compared to U.S. levels. Multivariable analysis indicated that lower levels of serum PBDEs were associated with turnout gear cleaning and storage practices after fires. Therefore, firefighting activities are likely to increase exposure to PBDEs and good housekeeping and personal hygiene practices may reduce exposure to these compounds.	A convenience sample of firefighters from a Southern California county was invited to take part in the Firefighter Occupational Exposures (FOX) study. Blood and urine samples were obtained for analysis of PBDEs, PCBs, and OCPs. Medical records and a self-administered exposure assessment questionnaire were utilized.	101 firefighters' blood and urine were analyzed for PBDEs, PCBs, and OCPs. Data were abstracted from medical records for the following: current job title, holding a second job, current health status, tobacco use, medical history, and self- reported yearly incident response frequency for different types of calls including hazardous materials spills (HAZMAT), house, commercial, industrial, brush, and car fires. Questionnaire responses included firefighting experience (years either as a volunteer or paid firefighter); past 24 h and 30 day incident response frequency; cleaning location and storage practices (personal locker vs open room) for protective clothing ("turnout gear", including trousers, jacket, boots, and helmet); professional decontamination of turnouts in previous year; and selected dietary and demographic information.

Attachment 2. Data abstraction file

Literature Search Data Abstraction Table				Potential carcinogens identified in studies						Exposure details and relevant notes
Author	Title	Year	Geographic location of study:	What potential carcinogens are reported? -> Benzene	What potential carcinogens are reported? -> Diesel exhaust	What potential carcinogens are reported? -> Polycyclic aromatic Hydrocarbons (PAHs)	What potential carcinogens are reported? -> polychlorinated biphenyls (PCBs)	What potential carcinogens are reported? -> organochlorine pesticides (OCPs)	What potential carcinogens are reported? -> Other (specify)	What exposure information is reported?
Materna, B. L.,Jones, J. R.,Sutton, P. M.,Rothman, N.,Harrison, R. J.	Occupational exposures in California wildland fire fighting	1992	Northern California	Benzene		Polycyclic aromatic Hydrocarbons (PAHs): benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenzo[a,h]anthracene, indeno[1,2,3-c,d]pyrene			Acetaldehyde; Formaldehyde; Crystalline silica	Fireline exposure monitoring demonstrated that wildland fire fighters may at times be exposed to carbon monoxide, total and respirable particulates, or crystalline silica at levels near or exceeding the OSHA PELs, although group means were always well below permissible limits. Formaldehyde was the predominant aldehyde detected in fire smoke, both at flaming and smoldering fires. Results of TWA sampling indicate that formaldehyde levels are likely to have excursions above 0.37 mg/m^3 (0.3 ppm), which may result in eye or respiratory irritation. Polycyclic aromatic hydrocarbons, some of them known to be carcinogenic, were detected in fire smoke at very low levels. Similarly, limited benzene sampling generally indicated low or nondetectable levels; however, one sample exceeded 0.1 ppm, which has recently been proposed as a new TLV because of benzene's carcinogenic potential.
Park, J. S.,Voss, R. W.,McNeel, S.,Wu, N.,Guo, T.,Wang, Y.,Israel, L.,Das, R.,Petreas, M.	High exposure of California firefighters to polybrominated diphenyl ethers	2015	Southern California				polychlorinated biphenyls (PCBs): PCB-66, PCB-74, PCB-99, PCB-118, PCB-138, PCB-153, PCB-156, PCB-170, PCB-180, PCB-183, PCB-187, PCB-194, PCB-203	Organochlorine pesticides (OCPs): β-BHC (Hexachlorocyclohexane), 4,4'-DDT, 4,4'-DDE, hexachlorobenzene, trans-nonachlor, oxychlordane (Chlordane is the parent compound of trans-nonachlor and oxychlordane)		Many PCB and OCP congeners correlated with each other but not with the major PBDEs, supporting the hypothesis that exposure pathways for PCBs and OCPs are different from those for PBDEs. This study suggests that firefighting is not a significant source of exposure to PCBs and OCPs. PBDEs may be transported back to fire stations on equipment (hoses, ladders, and SCBA) and clothing. Contact with soiled turnout gear (and possibly other PPE) may create a secondary exposure opportunity during cleaning and storage at the fire station. This research shows very high PBDE levels in fire station dust (e.g., median BDE-209 (ng/g) = 47,000 vs 2,500 in California residential house dust), which suggests that when firefighters return to the fire station, their turnout gear and equipment may transport fireborne dust. Levels of many individual PCBs and OCPs, but not PBDEs, were lower among firefighters whose turnout gear was professionally decontaminated in the past year. Decreases (and p values) for PCB-180, oxychlordane, and trans-nonachlor were as follows: 13% (0.051), 29% (0.003), and 27% (0.003), respectively. PCB-138 levels decreased 30% with more frequent hand-washing during a work shift. Firefighters who reported cleaning turnout gear at the firehouse or storing it in an open room (versus a personal locker) had lower serum levels of BDE-28, -47, -99, and -100.

Literature Search Data Abstraction Table				General study information			
Author	**Title**	**Year**	**Geographic location of study:**	**Author's objective**	**Author's conclusion**	**Study design:**	**Data collection methods used:**
Shen, B.,Whitehead, T. P., McNeel, S.,Brown, F. R.,Das, R.,Israel, L.,Park, J. S.,Petreas, M.	Measurements of PAHs, PBDEs, and PCBs in dust from California firehouses	2012	California	Firefighters are exposed to a unique profile of potentially fire-related chemical contaminants, including dioxins, antimony, and other metals, as demonstrated by bio-monitoring studies. In this pilot study, the authors measured concentrations of PAHs, PBDEs, and PCBs in dust from 20 California firehouses. It is possible that firefighters carry dust contaminated with PAHs and PBDEs into their firehouses on their boots and protective clothing after extinguishing fires.	Concentrations of PAHs and PBDEs are much higher in dust from California firehouses than in house dust from California homes, suggesting that firefighters may be exposed to unique chemical sources. Concentrations of PBDEs in dust from California firehouses were orders of magnitude higher than concentrations of PAHs and PCBs in the same samples.	Dust samples were collected from the vacuum cleaner bags used in the living quarters of 20 California firehouses in 2010 and in 2011.	Briefly, the samples were sieved to remove fibers and debris larger than 150 µm. The resulting fine dust was aliquotted (~0.2 g) and spiked with a mixture of labeled internal standards (1 PAH, 8 PBDEs, 15 PCBs, and 2 pesticides) and extracted by accelerated solvent extraction in an 11 mL cell (Dionex) with hydromatrix as the bulking agent. Extracts were analyzed for PAHs using low-resolution electron impact-gas chromatography-mass spectrometry (EI-GC-MS; Agilent Technologies). PBDEs and PCBs were analyzed using high resolution EI-GC-MS (ThermoFinngan MAT95). The National Institute of Standards and Technology Standard Reference Material (NIST SRM) No. 2585 was used in each run for additional quality control.
Shen, B.,Whitehead, T. P.,McNeel, S.,Brown, F. R.,Dhaliwal, J.,Das, R.,Israel, L.,Park, J. S.,Petreas, M.	High levels of polybrominated diphenyl ethers in vacuum cleaner dust from California fire stations	2015	California	Concentrations of polybrominated diphenyl ethers (PBDEs), polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) were measured in dust from 20 California fire stations. The chemical concentrations in fire station dust were compared to concentrations previously reported in dust from residences and other occupational settings worldwide.	BDE-209 concentrations in dust from California fire stations were among the highest of any previously documented homes or occupational settings in the world. Based on the findings of the pilot study, the authors hypothesize that possible sources of BDE-209 in fire stations include contaminated ash tracked back from fire events via boots, clothing, and other equipment as well as specialized equipment treated with BDE-209, including turnout gear and fire vehicles.	In 2010-2011, dust samples from used vacuum cleaner bags were collected from 20 fire stations in California and analyzed for polybrominated diphenyl ethers (PBDEs), polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) using gas chromatography−mass spectrometry.	Dust samples were collected from vacuum cleaners used in the living and administrative quarters of the fire stations; dust samples were sieved to remove large debris and then underwent chemical analysis. Extracts were analyzed for 22 PBDEs and 15 PCBs using high-resolution gas chromatography−mass spectrometry operated with electron impact ionization mode. In addition, during dust collection, a two part on-site survey was conducted.
Sparer, E. H.,Prendergast, D.,Apell, J. N.,Bartzak, M. R.,Wagner, G. R.,Adamkiewicz, G.,Hart, J. E.,Sorensen, G.	Assessment of Ambient Exposures Firefighters Encounter while at the Fire Station: An Exploratory Study	2017	Massachusetts	1) to provide preliminary data on the air quality within a few fire stations in and around Boston, Massachusetts; and, 2) to investigate some of the environmental and organizational factors that may influence the levels of contaminants in the air at the fire stations.	Levels of $PM_{2.5}$ and PAH inside fire stations may contribute to firefighter cancer risk. Through understanding contaminant variability, future studies can begin to design and test interventions that improve cancer prevention.	Air sampling of particulate matter less than 2.5 µm in diameter ($PM_{2.5}$) and particle-bound polycyclic aromatic hydrocarbons (PAHs) was completed at four fire stations in Spring, 2016. Three fire stations were located in Boston, Massachusetts, and one fire station was located in Arlington, just outside of Boston.	Sampling included integrated and continuous measurements of particulate matter ($PM_{2.5}$) and continuous measurements of particle-bound polycyclic aromatic hydrocarbons (PAHs) in three primary areas in and around the fire station: the truck bay, the kitchen, and outside. Gravimetric $PM_{2.5}$ samples were collected using Teflon filters (47mm, Pall Life Sciences, Port Washington, NY, USA) used with an impactor cassette to measure $PM_{2.5}$. Continuous-readings of $PM_{2.5}$ were measured with a SidePak Aerosol Monitor AM510 (TSI, Minneapolis, MN). Particle surface bound PAHs were monitored using an Ecochem PAS 2000CE (EcoChem Analytics, League City, TX). Interviews: The purpose of the interviews was to understand the daily activities of firefighters, along with the policies and practices (both written and enacted) regarding engine idle-time, return and washing of contaminated clothing, and any other station-related health and safety activities.

Literature Search Data Abstraction Table				Potential carcinogens identified in studies						Exposure details and relevant notes
Author	**Title**	**Year**	**Geographic location of study:**	**What potential carcinogens are reported? -> Benzene**	**What potential carcinogens are reported? -> Diesel exhaust**	**What potential carcinogens are reported? -> Polycyclic aromatic Hydrocarbons (PAHs)**	**What potential carcinogens are reported? -> polychlorinated biphenyls (PCBs)**	**What potential carcinogens are reported? -> organochlorine pesticides (OCPs)**	**What potential carcinogens are reported? -> Other (specify)**	**What exposure information is reported?**
Shen, B.,Whitehead, T. P., McNeel, S.,Brown, F. R.,Das, R.,Israel, L.,Park, J. S.,Petreas, M.	Measurements of PAHs, PBDEs, and PCBs in dust from California firehouses	2012	California			Polycyclic aromatic hydrocarbons (PAHs): benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, chrysene, dibenzo[a,h]anthracene, indeno[1,2,3-c,d]pyrene	polychlorinated biphenyls (PCBs): PCB-153, PCB-138, and PCB-180			California (CA) firehouses showed higher PAH concentrations as compared to CA residences; however, they did not show the highest PAH concentrations in North America. BDE-209 was the predominant PBDE congener measured in the California firehouses followed by BDE-99, BDE-47, BDE-100, BDE-153, BDE-206 and to a lesser extent, BDE-154, BDE-207, and BDE-208. The levels of BDE-209 measured in the California firehouses (maximum of 390 µg/g) are among the highest ever reported. PCB concentrations in California firehouses were more consistent across congeners and were dominated by 3 congeners: PCB-153, PCB-138, and PCB-180. PCB levels in California firehouses were comparable to PCB levels seen in Northern California residences.
Shen, B.,Whitehead, T. P.,McNeel, S.,Brown, F. R.,Dhaliwal, J.,Das, R.,Israel, L.,Park, J. S.,Petreas, M.	High levels of polybrominated diphenyl ethers in vacuum cleaner dust from California fire stations	2015	California			Polycyclic aromatic Hydrocarbons (PAHs): benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, indeno[1,2,3-c,d]pyrene, dibenzo[a,h]anthracene	polychlorinated biphenyls (PCBs): PCB-28, PCB-52, PCB-101, PCB-105, PCB-118, PCB-138, PCB-153, PCB-180			In general, concentrations of PBDEs were higher than concentrations of PAHs and concentrations of PAHs were higher than concentrations of PCBs in the fire stations. Each of three major PBDE congeners had median dust concentrations above 5000 ng/g (5,170 ng/g for BDE-47; 9,240 ng/g for BDE- 99; and 47,000 ng/g for BDE-209). BDE-209 was the predominant PBDE congener measured in the dust from these fire stations. Median concentrations of PBDEs and PAHs in the fire station dust samples were substantially higher than levels previously estimated for dust from California homes using the same laboratories and the same analytical protocols. Correlations with the number of fire or hazardous material incidents, or fire station age, are presented in Table 2. The correlation between chemicals and the number of vehicles in the fire station was not statistically significant. Observed positive relationships between PCB levels and fire station age are consistent with similar observations in California homes and suggest that the PCB-contaminated materials may still be present in fire stations built before the 1970s, when PCBs were banned.
Sparer, E. H.,Prendergast, D.,Apell, J. N.,Bartzak, M. R.,Wagner, G. R.,Adamkiewicz, G.,Hart, J. E.,Sorensen, G.	Assessment of Ambient Exposures Firefighters Encounter while at the Fire Station: An Exploratory Study	2017	Massachusetts		Particulate matter (PM) (proxy for diesel exhaust)	Polycyclic aromatic Hydrocarbons (PAHs): total				Mean and median daily levels of PAHs and $PM_{2.5}$ in the truck bay were higher than the outside measurements at each station and were similar across all stations. The results of the PAH regression model (Table 3) indicated that average daily PAH levels in the truck bays were higher when compared to outside, adjusting for station differences, and this association was statistically significant (β=23.68 ng/m^3; p-value <0.0001). The average daily $PM_{2.5}$ levels (using the gravimetric data) in the truck bay were also higher than outside, when adjusting for the other stations, and this association was statistically significant (β=10.74 µg/m^3; p-value = 0.028). The interviews also indicated that practices surrounding washing of bunker gear varied from station to station. Off-gassing from equipment post-fire might be another source of indoor air contaminants. Additional exposure data in figures; The elevated levels of PAH and $PM_{2.5}$ observed in the truck bay of Station #4 may have been the result of firefighters smoking cigars in the truck bay once a week. The tobacco policy in place at Station #4 allowed for some firefighters to smoke while at work. These firefighters had entered the department prior to 1988 and therefore were grandfathered in to the older department tobacco policy. These firefighters planned their shifts together and, while at work, smoked cigars inside the truck bay.

APPENDIX B

Task 2: Qualitative Exposure Assessment

Task 2: Qualitative Exposure Assessment

FEBRUARY 25, 2021

ToxStrategies

Innovative solutions
Sound science

Task 2: Qualitative Exposure Assessment

FEBRUARY 25, 2021

PREPARED FOR:
State of California
Department of Industrial Relations
1515 Clay Street
Suite 1902
Oakland, CA 94612

PREPARED BY:
ToxStrategies, Inc.
27001 La Paz Road
Suite 260
Mission Viejo, California 92691

Table of Contents

List of Figures

List of Tables

1 Background and Rationale

ToxStrategies was contracted by the California Department of Industrial Relations (DIR), Commission on Health and Safety and Workers' Compensation (CHSWC), to conduct the study as outlined in California Assembly Bill (AB) 1400. AB 1400 was created to define the fire mechanics' risk of exposures to carcinogens in the course of employment. The study components include:

- Site visits to representative facilities in Los Angeles County, California
- Interviews and surveys with current and former fire mechanics
- Feasibility study to assess cancer incidence among fire mechanics
- Occupational exposure measurements of carcinogens found in the workplace, to evaluate potential exposure to carcinogenic materials
- Quantitative health risk assessment of potential increased cancer risk associated with exposure to carcinogens in the workplace.

ToxStrategies' approach to address these study components includes six tasks (provided in our proposal submitted to the DIR [ToxStrategies, Inc., 2020a]):

- Task 1: Structured literature review — submitted and summarized below; ToxStrategies, Inc., 2020b
- Task 2: Qualitative exposure assessment — provided herein
- Task 3: Epidemiologic assessment — feasibility study of cohort enumeration for future epidemiologic study design
- Task 4: Quantitative exposure assessment — measurement of current occupational exposures to carcinogens
- Task 5: Cancer risk assessment — calculation of theoretical excess cancer risks from occupational exposure to carcinogens
- Task 6: Technical assistance to the DIR.

The results from Task 1, Structured literature review, demonstrated the paucity of literature available for characterizing potential carcinogenic exposures and cancer risks (epidemiologic studies) of fire mechanics. Occupation as a fire mechanic and risk of cancer has not been evaluated in the current scientific literature. No occupational chemical exposure studies explicitly focused on fire mechanics, fire mechanic cleaners, or firefighting vehicle maintenance workers. However, nine industrial hygiene studies presented data for fire stations and firefighting vehicles and/or gear, which likely overlap with the occupational exposures of fire mechanics who repair and clean firefighting vehicles. The chemical carcinogens evaluated in these studies included benzene, diesel exhaust, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), acetaldehyde, formaldehyde, crystalline silica, 1,4-dichlorobenzene, ethylbenzene, and styrene.

The purpose of Task 2, Qualitative Exposure Assessment, was to determine similar exposure groups (SEGs) among the fire mechanics and prioritize/define the scope of the quantitative exposure assessment, based on a risk ranking that incorporates the relative magnitude of the exposure potential, specifically for carcinogens (AIHA, 2015).

The objectives, methods, results, and conclusions of Task 2, Qualitative exposure assessment, are provided below. The remaining study tasks are described in Section 6.

2 Objectives

The objectives of this qualitative exposure assessment were as follows:

1. Identify the fire mechanics' main facilities of operation within the County of Los Angeles Fire Department
2. Determine SEGs among the fire mechanics and determine representative exposure parameters
3. Provide an exposure ranking for each SEG to carcinogens identified in the facilities in order to prioritize the quantitative exposure assessment to those exposures that may pose the highest risk.

3 Methods

ToxStrategies identified the County of Los Angeles Fire Department mechanics' classifications and three main facilities of operation with the assistance of member leaders from the American Federation of State, County & Municipal Employees (AFSCME) Local 119.[1] The member leaders of AFSCME Local 119 included Mr. Gary Hodge, President of Union Local 119; Mr. Andreas Jung, President of Southern California District Council 36; and Luis Del Cid, member of Union Local 119.

The three main facilities of operation include:

- Eastern Fire Shop, located at 1104 N Eastern Avenue, Los Angeles, 90063
- North County Fire Shop, located at 42110 6th Street West, Lancaster, 93534
- Pacoima Air Operations/Breathing Apparatus (BA) Shop, located at 12605 Osborne Street, Pacoima 91331.

1 AFSCME Local 119 union members include Automotive/Helicopter Mechanics and Equipment Maintenance Workers and Repairmen, employed by the County of Los Angeles (http://www.afscme36.org/afscme-local-119).

The four fire mechanic classifications are (1) Equipment Maintenance Worker, (2) Fire Equipment Mechanic (FEM), (3) Helicopter Mechanic, and (4) Helicopter Maintenance Inspector.

3.1 Site Visits and Personnel Interviews

Site visits were conducted on September 15 and 16, 2020, by Ms. Deborah Proctor and Ms. Stephanie Vivanco of ToxStrategies. The purpose of the site visits (walk-around surveys) and personnel interviews (in-person and conference calls that occurred after the in-person site visits) was to gather information regarding chemical exposures of fire mechanics by recording observations of potential sources of exposures to chemical carcinogens at each location, as well as the manner in which these exposures may occur. The survey approach included identifying chemical agents in the workplace and discussing the overall job and specific work tasks conducted by each of the fire mechanic classifications. The survey goals were to understand how and when workers are exposed to the chemical agents, ascertain information regarding the availability and use of exposure controls (personal protective equipment [PPE], engineering/administrative controls, work practice controls), and discuss the evolution of chemical usage and work practices over time.

On September 15, Ms. Proctor and Ms. Vivanco visited Pacoima Air Operations and the Eastern Fire Shop. At Pacoima Air Operations, ToxStrategies, accompanied by Mr. Hodge, Mr. Jung, and Mr. Del Cid of AFSCME, met with Mr. Dennis Blumenthal, Chief Helicopter Maintenance of the Air Operations Section, who provided the facility tour and information regarding the various job tasks of helicopter mechanics at Air Operations. After the facility tour, ToxStrategies conducted in-person interviews with Mr. Tyrone Mathis, Helicopter Mechanic, and Mr. Brian Uhl, Helicopter Maintenance Inspector. Both Mr. Mathis and Mr. Uhl work at Pacoima Air Operations.

At the Eastern Fire Shop, ToxStrategies met with Deputy Fire Chief Thomas Ewald, Acting Division Chief Chad Idol; and Mr. Hodge and Mr. Del Cid of AFSCME. Mr. Hodge and Mr. Del Cid, both Fire Equipment Mechanics (shop-assigned at the Eastern Fire Shop), provided the facility tour and qualitative information on the typical job tasks of a Fire Equipment Mechanic. We also met with sheet metal assembly workers at the Eastern Shop.

On September 16, ToxStrategies visited the North County Fire Shop in Lancaster, California, and BA Shop in Pacoima, California. At the North County Fire Shop, ToxStrategies met with Mr. Mitch Connett, Assistant Chief of the Fire Fleet Services Division, along with Mr. Phillip De La Tova, Acting Senior Fire Equipment Mechanic (shop-assigned). Both Mr. Connett and Mr. De La Tova provided a facility tour, along with qualitative information on the typical job tasks. After the facility tour, ToxStrategies conducted an in-person interview with Mr. Neill Niblett, Fire Equipment Mechanic (field-assigned), and Mr. Niblett provided a tour of the Fire Station located on the same property as the North County Fire Shop in Lancaster (Fire Station 129).

At the BA Shop site visit, ToxStrategies met with Mr. Jared Snyder, Senior Equipment Maintenance Worker, who provided a facility tour and information regarding the typical job tasks of an Equipment Maintenance Worker. The BA Shop includes mechanics who work on breathing apparatus and repair small engines and hoses.

On September 24, 2020, ToxStrategies conducted additional virtual interviews with the following personnel:

- Harry Wong, Fire Equipment Mechanic (field-assigned)
- Grant DeRose (known as “Sonny,” now deceased), retired Fire Equipment Mechanic (field-assigned)
- Luis Del Cid, Fire Equipment Mechanic (shop-assigned), Eastern Fire Shop.

3.2 Records Review

ToxStrategies was provided copies of Safety Data Sheets (SDSs) used by the Fire Equipment Mechanics at the Eastern Fire Shop and the North County Fire Shop. However, SDSs for products used at the Pacoima Air Operations and BA Shop were not available; therefore, chemical usage information was obtained through the site visits and personnel interviews only.

No documentation regarding chemical usage changes over time was available for our review; however, anecdotal information was obtained through personnel interviews. The fire mechanic personnel who were interviewed for this project also stated that written process standards and operating procedures, health and safety programs, and employee exposure monitoring records are limited, and none could be provided to ToxStrategies. Therefore, our understanding of these issues is gleaned from personnel interviews.

3.3 Exposure Ranking for each SEG to Carcinogens

For jobs and tasks where potential exposure to a chemical carcinogen was identified, a qualitative exposure assessment tool was used to prioritize potential exposures, allowing ToxStrategies to target the DIR resources for Task 4 in the most cost-effective way. The tool was developed in accordance with the qualitative exposure assessment guidance from the National Institute for Occupational Safety and Health (NIOSH)[2,3] and the American Industrial Hygiene Association (AIHA, 2015). Information gathered from the site visits and personnel interviews was entered into a job task rating spreadsheet for each SEG (Attachment 1).

Each job task was characterized in terms of relevant chemical product usage information and/or fire residues encountered. The overall risk ranking was determined based on an exposure rating and health effect rating of the product and/or residue encountered by fire

---

2 https://www.cdc.gov/niosh/topics/oeb/default.html

3 https://www.cdc.gov/niosh/topics/ctrlbanding/default.html

mechanics, by job task. Figure 1 shows the matrix that combines the exposure rating and health effect rating.

	Health Effect Rating				
Exposure Rating	**0**	**1**	**2**	**3**	**4**
4					Very High
3				High	
2			Moderate		
1		Low			
0	Trivial				

Figure 1. Risk ranking matrix

Because carcinogen exposures were the focus of this assessment, only job tasks with carcinogen exposures are discussed below. Attachment 1-B presents the job task ranking spreadsheet for each SEG.

To calculate an overall risk rating, the following six steps were conducted:

1. The exposure rating was calculated by converting the job task frequency and duration to a points system, based on the matrix presented in Table 1. A low job task frequency and duration (e.g., >1/month and <15 minutes) yielded a lower point score (e.g., 1) than a job task with a higher job task frequency and duration. Columns B, C, and D of Attachment 1-B present the Task Duration, Task Frequency, and Frequency/Duration Rating, respectively.

Table 1. Job task frequency and duration rating system

Job Task Duration	**Frequency of Job Task**		
	>1/month	**>daily/ <monthly**	**daily**
<15 min	1	1	1
15 min – 1 hr	1	2	2
1–2 hrs	1	2	3

2–4 hrs	1	3	4
>4 hrs	1	4	5

Abbreviations: hr(s) = hour(s); min = minutes

2. A dispersion rating, indicative of a chemical's potential to be airborne, such that a worker could be exposed via inhalation, was determined by evaluating the vapor pressure of the individual carcinogens present in the product or identifying the carcinogen's dustiness factor (low, medium, or high, as described in Table 2). A low vapor pressure or "dustiness" (<25 mmHg [millimeters of mercury] or "low dustiness") yielded a lower dispersion rating than a high vapor pressure or "high dustiness," as shown on Table 2. In Attachment 1-B, column G presents the dispersion ratings for vapor pressure and dustiness for each job task.

Table 2. Dispersion rating system

Chemical Vapor Pressure at 20°C or Dustiness Factor	Dispersion Rating
<25 mmHg or 33 mbar	1
25–100 mmHg or 33–133 mbar	2
100–250 mmHg or 133–333 mbar	3
>250 mmHg or >333 mbar	4
High Dustiness†: fine, light powders	4
Medium Dustiness†: crystalline granular solids	2
Low Dustiness†: Pellet-like, non-friable solids	1

Abbreviations: mmHg = millimeters of mercury; mbar = millibar

† WHO, 1999.

3. An exposure control rating was determined by evaluating the job task engineering controls. Engineering controls are built into the workspace that protect the worker from harmful chemicals or contaminants by minimizing or eliminating its hazard (e.g., fume hood) (AIHA, 2015). For example, an open system with ineffective or no exposure controls yielded the highest control rating of "4," as shown on Table 3. Step 3 is also presented in columns H and I in Attachment 1-B.

Table 3. Level-of-control rating system

Level of Control	Level-of-Control Rating
Closed system; minimal potential for release to work environment	0
Semi-closed system; release potential at identified points; effective engineering controls in place at identified points	1
Open system; effective engineering controls in place to contain/remove airborne contaminants; effective use of administrative and PPE controls	2
Open system; some degree of engineering controls	3
Open system; ineffective or no exposure controls	4

4. The ratings from Steps 1 through 3 were multiplied to obtain a job task exposure rating (Column J of Attachment 1-B). Based on the range of the result, an overall exposure rating was determined, as shown on Table 4 (Columns K and L of Attachment 1-B).

Table 4. Exposure rating system

Multiplied† Total	Exposure Rating
<10	0
10–20	1
21–30	2
31–40	3
>40	4

† The multiplied total of the job task frequency/duration rating, carcinogen dispersion rating, and the level of control rating.

5. The health effect rating was determined by the Globally Harmonized System (GHS) Health Hazard Category, typically found on an SDS. Carcinogens are assigned either a Category 1 or 2 depending on the weight/strength of evidence, as determined by an identifying authoritative body (United Nations, 2011). Whether a chemical was classified as a carcinogen was determined using Cal/OSHA's

Hazard Communication Standard, which compiles listings from the following sources:[4]

- National Toxicology Program (NTP), "Report on Carcinogens" (NTP, 2016)
- International Agency for Research on Cancer (IARC) "Monographs on the Evaluation of Carcinogenic Risks to Humans" (IARC, 2020)
- Substances subject to regulation under the Occupational Carcinogen Control Act or that are regulated in Title 8, Article 110, Regulated Carcinogens (§5209, Carcinogens)
- Substances that meet the definition of "select carcinogen" in Title 8, Section 5191
- Where OSHA has included cancer as a health hazard to be considered by classifiers for a chemical covered by 29 CFR part 1910, Subpart Z.

The GHS category was converted to a health effect rating, as shown on Table 5 (and in columns M and N of Attachment 1-B).

Table 5. Health effects rating

GHS Health Hazard Category†	Health Effects Rating
Category 2	3
Category 1	4

† Carcinogens only.

6. The exposure rating from Step 4 and health effects rating from Step 5 were combined to yield an overall risk ranking, ranging from "trivial" to "very high." The risk ranking matrix is provided below in Table 6 (and in column O of Attachment 1-B).

Table 6. Risk ranking matrix

Health Effects Rating	Exposure Rating				
	0	**1**	**2**	**3**	**4**
4	***Trivial***	***Moderate***	***Moderate***	***High***	***Very High***
3	***Trivial***	***Moderate***	***Moderate***	***High***	***Very High***

4 Title 8 CCR §5194, Hazard Communication

4 Results

4.1 Determination of Representative Facilities

ToxStrategies corresponded by email and held two primary phone calls with AFSCME Local 119 representatives to determine which facilities would best represent the environment in which fire mechanics work. Specifically, we discussed the job titles of the personnel and the differences in the work tasks, as well as the physical locations where the fire mechanics work. Based on this information, ToxStrategies identified three main facilities of operation within the County of Los Angeles Fire Department as representative: the Eastern Fire Shop, the North County Fire Shop, and the Pacoima Air Operations/Breathing Apparatus (BA) Shop. Through interviews with mechanics and managers at these locations, we also recognized the category of field mechanics, who work across the county at local fire stations and at locations where fire equipment is dispatched, including wildfires. These mechanics do not work at the main facilities but have similar potential for exposure, because they contact the residue from fires that is on the surface of the apparatuses and equipment.

4.2 Determination of Similar Exposure Groups (SEGs)

The four fire mechanic classifications are (1) Equipment Maintenance Worker, (2) Fire Equipment Mechanic (FEM), (3) Helicopter Mechanic, and (4) Helicopter Maintenance Inspector. In fire mechanic classifications 1, 2, and 3, there is a further designation as either journey- or senior-level. The more experienced senior-level classification is the lead fire mechanic and typically performs more complicated tasks, and is responsible for providing technical guidance to the journey-level mechanics. However, we learned that journey- and senior-level mechanics have similar potential for exposure to carcinogens in the work environment. Approximately 72 mechanics are assigned to the Los Angeles Fire Department in the four classifications. Figure 1 presents the four fire mechanic classifications and their respective site locations. Of note, however, we recognize that there are other locations where fire mechanics work, including fire stations throughout the County, and these mechanics are designated as “field-assigned.”

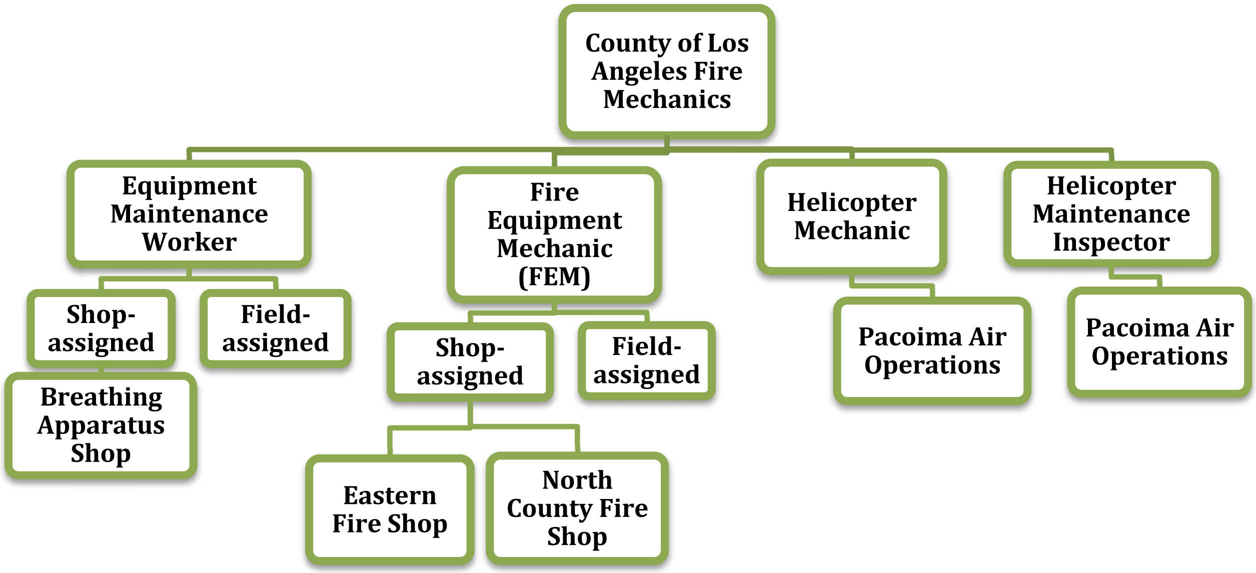

Figure 2. County of Los Angeles Fire Mechanics' four classifications and respective site locations

4.2.1 Equipment Maintenance Worker

The Equipment Maintenance Worker classification has a total of seven workers (six journey-level workers and one senior-level worker) with shop locations based in Pacoima (same site location as Pacoima Air Operations). Shifts are 40 hours per week, with overtime up to approximately 100 hours per year for each worker. Shop locations at Pacoima include the Breathing Apparatus (BA) Shop, Small Engine Repair Shop, and Fire Hose Repair Shop. These workers maintain and repair various types of equipment and tools at the Pacoima shops or in the field (other shop [Eastern Fire Shop or North County Fire Shop] or fire station locations). The Equipment Maintenance Workers will work in the field approximately 50% of their time, and any equipment that cannot be fixed in the field is sent to Pacoima.

Tasks include equipment examination and analysis of equipment malfunctions or mechanical failure. Other jobs include tuning up equipment used by the County fire stations, such as rescue tools, lawn mowers, vacuums, and generators, which can be performed in the Small Engine Repair Shop or in the field. Additionally, the workers are also responsible for repairing fire-truck hoses and completing the hose test, which takes place in the Fire Hose Repair Shop. Equipment such as firefighter BAs will typically be maintained and tested at the Pacoima BA Shop, while fit-testing of the BAs will typically be conducted at the fire station. BAs used during fire training in simulated structure burns, such as that conducted at the Los Angeles County Fire Department Fire Station 129 in Lancaster, California, are maintained at the BA Pacoima shop. These BAs reportedly off-gas after use and appeared to have considerably more black fire residue than the BAs used by firefighters in the normal line of duty.

4.2.2 Fire Equipment Mechanic (FEM)

Among the FEM classification, there are currently 48 mechanics, including eight at the senior level. The FEMs' shifts are 40 hours per week, plus overtime; typical overtime can sum to 200 hours over the course of one year for each FEM. Approximately half of the 48 mechanics are shop-assigned, and the other half are field-assigned: seven FEMs are assigned to the Lancaster Shop, 17 FEMs are assigned to the Eastern Shop, and 24 FEMs are assigned to the field. The mechanics that are shop-assigned work full time at either the Eastern Fire Shop or the North County Fire Shop. The field-assigned mechanics do not have an assigned work location, and their jobs can take place at any location, including a Los Angeles County fire station, wildfire base camp, roadside, or even at a fire site (known as the "red zone"). Because the field-assigned mechanics perform work wherever it is needed, they can spend a considerable amount of time in the car, driving to various locations.

Typically, field-assigned mechanics will work at a minimum of three fire stations but will have a base fire station where they conduct administrative tasks such as paperwork. Field duties typically include relatively minor repairs and service-scheduled items such as work on lights, sirens, batteries, and tires. However, based on personnel interviews, we understand that, recently, field-assigned mechanics have been assigned more major repairs, such as leaf spring changes, small transmission changes, fabrication of plumbing for pumps and supported equipment, seat change-outs, fluid changes, and water plumbing valve change-outs. Shop-assigned FEMs typically work on the major repairs such as engine and transmission changes, in-frame engine rebuilds, differential exchanges and rebuilds, major pump repair, plumbing issues, and water tank removal, and they are required to do more welding for significant parts repair and replacement. Additionally, field-assigned mechanics and shop-assigned mechanics have mandatory after-hours shifts throughout the year in which the field-assigned mechanic is the primary on-call mechanic and the shop-assigned mechanic is the backup.

The FEMs are responsible for the County-owned fleet from 175 fire stations/22 Battalions. The fleet consists of 217 total Engine Companies (Type I, Type III, and Type VI), 33 Truck Companies (Light Forces and Quints), 112 Paramedic Units (Air Squads, Assessment Engines, Assessment Quint/Light Force, Engines, and Squads), as well as reserve equipment (58 Engines, 10 Trucks/Quints, 31 Squads, and 21 Battalion SUVs).

4.2.3 Helicopter Mechanic

There are fifteen Helicopter Mechanics, including three at the senior level, who are based out of Pacoima Air Operations. All the Helicopter Mechanics are required to have an airframe and power plant mechanic's certificate issued by the Federal Aviation Administration (FAA). Their shifts are typically 9-hour days with one day off every other week (9/80) plus overtime up to 500 hours per year per mechanic. Similar to the FEM, there may be required 24-hour shifts where the mechanic is on call during that time. Their job role consists of mechanical maintenance, repairs, and alterations to airframes, engines, and other components of helicopters owned and operated by the County. Heavier maintenance includes disassembling and reassembling airframes, engines, and other components and parts. Routine daily inspection and maintenance typically takes place outdoors on the flight line or in a covered area off the flight line, while major helicopter repairs take place inside the hangar.

A Helicopter Mechanic may need to travel about once per month to the North County Fire Shop, because that site has a helicopter landing area. Otherwise, all maintenance and repairs are performed at Pacoima Air Operations. The Helicopter Mechanics are responsible for ten County-owned helicopters (five Bell 412s and five Firehawks).

4.2.4 Helicopter Maintenance Inspector

At Pacoima Air Operations, two Helicopter Maintenance Inspectors, with an Inspection Authorized Certificate issued by the FAA, work with the Helicopter Mechanics and perform all the inspections of completed repairs and alterations to ensure compliance with manufacturer's directives and federal regulations. About 60% of a Helicopter Maintenance Inspector's time is spent inspecting completed repairs and alterations, which may include airframes, power plant, propeller, or appliance, on both reciprocating and turbine-powered helicopters. The balance of their time is spent completing administrative tasks, such as ensuring that FAA-required reports and maintenance records are complete and in compliance with directives. Helicopter Maintenance Inspectors have a schedule similar to the Helicopter Mechanics (9/80) but may have more overtime hours than a helicopter mechanic (up to 650 hours per inspector per year). In addition, due to his specialty, one of the Helicopter Inspectors does most of the aircraft painting at the Pacoima Air Operations.

4.3 Exposure Ranking for Each SEG to Carcinogens

An overall risk ranking was calculated for each job task, for each SEG, as described in Section 3.3. The job task rating results are provided in Attachment 1-B, along with the Qualitative Summary in Attachment 1-A.

4.3.1 Equipment Maintenance Worker

The overall qualitative risk ranking for the Equipment Maintenance Worker ranged from "trivial" to "high." The highest risk ranking for the Equipment Maintenance Worker was the job task of repair and tune-up of power equipment and rescue tools in the Engine Repair Shop. During the site visit on September 16, ToxStrategies observed strong gasoline odors when entering this shop location. According to communication with the Senior Equipment Maintenance Worker, Mr. Snyder, one Equipment Maintenance Worker works at this location full time, and three other Equipment Maintenance Workers work there part time. Personal protective equipment (PPE) includes latex gloves and an apron. There is one door that provides ventilation in this shop, but we were told that future plans include installing additional ventilation. Based on SDS review, the gasoline used for the various power equipment stored in the Engine Repair Shop is expected to contain three carcinogens—benzene, ethylbenzene, and naphthalene—and if the engines are run in the shop, this worker would also be exposed to gasoline engine exhaust.

The fire hose repair had an overall risk ranking of "moderate" based on the potential for off-gassing of fire-related fumes and the potential presence of soot, which is considered carcinogenic, as well as other unknown contaminants. One Equipment Maintenance

Worker works at the Fire Hose Repair Shop part time (>4 hours per day). The Fire Hose Repair Shop has a front door and additional roll-up doors that stay open during warm-weather months. Personal protective equipment (PPE) includes latex gloves and an apron.

Equipment Maintenance Workers infrequently have to spray-paint equipment at their shops. PPE includes latex gloves and an apron. Based on review of the SDSs, the spray paints used by the workers may contain up to three carcinogens, depending on the specific product used. The carcinogens identified in the evaluated products are ethylbenzene, carbon black, and titanium dioxide. It should be noted that carbon black and titanium dioxide are considered carcinogenic only if they are "airborne, unbound particles of respirable size."[5] Given the presence of these substances in a paint matrix, neither carbon black nor titanium dioxide would be present as unbound particles. Additionally, carbon black and titanium dioxide have been shown to be carcinogenic in the lung only in rodent bioassays and by a mechanism of pulmonary insoluble particulate overload, which is highly unlikely from occasional use of spray paint (IARC, 2010a). Based on the short task duration (approximately 30 minutes) and the low frequency of the task (three to five times per month), the overall risk ranking for spray painting was "trivial."

Table 7 includes the list the carcinogens identified as a potential exposure concern for the Equipment Maintenance Worker.

Table 7. Carcinogenic chemicals of potential concern (COPCs) identified in the Equipment Maintenance Worker

Carcinogen Identified in Exposure Studies	Identifying Authoritative Body
Carbon black	IARC-2B
Titanium dioxide	IARC-2B
Engine exhaust, gasoline	IARC-2B
Benzene	NTP-K, IARC-1, OSHA 1910.1028
Soot	NTP-K; IARC-1
Ethylbenzene	IARC-2B
Naphthalene	NTP-R, IARC-2B

Abbreviations: NTP = National Toxicology Program; NTP-K = known to be human carcinogens; NTP-R = reasonably anticipated to be human carcinogens; IARC = International Agency for Research on Cancer; IARC-1 = carcinogenic to humans; IARC-2B = possibly carcinogenic to humans; OSHA = Occupational Safety and Health Administration

4.3.2 Fire Equipment Mechanic (FEM)

The overall qualitative risk ranking for the FEM ranged from "trivial" to "very high," as presented in Attachment 1.

5 As clarified by the California Office of Environmental Health Hazard Assessment.

The job task of repairing fire apparatus or other equipment at a wildfire base camp or fire site resulted in the "very high" risk ranking. Depending on the number of wildfires that occur each year, the field-assigned FEMs may get called to a wildfire base camp[6] for approximately 2-week durations, 24 hours per day. During this time, the assigned FEMs are required to stay onsite for the duration of the period and are responsible for repairing any fire apparatus or fire equipment that is needed. Further, field-assigned FEMs may also get called to a fire site. Although infrequent (occurring approximately once every three years), the field-assigned FEM is responsible for needed fire apparatus repairs anywhere, at any time. Therefore, there are no exposure bounds for this group of workers and the level of PPE provided (work boots, work uniform, gloves, eye protection, N95 respirator) is less than that provided to the firefighters. The carcinogenic exposures of this job task, not including any carcinogenic exposures from chemical products used for the repair work, include fire smoke in the air, off-gassing of fire-related fumes, soot/fire residue on the apparatus and equipment, and other unknown contaminants. IARC reported concentrations of chemicals during wildland firefighting operations to be acetaldehyde, benzene, formaldehyde, and particulate matter (IARC, 2010b).[7] Based on the data gathered from the County, and on professional judgment, ethylbenzene, naphthalene, PAHs, and diesel exhaust are also likely carcinogens of concern.

The shop-assigned FEMs at either the Eastern Fire Shop or the North County Fire Shop have facilities with roll-up doors and a diesel exhaust capture system that can be used when the apparatus is running inside the building, but those systems are not operating when the vehicles are moving in and out of the Shop. The Eastern Fire Shop also has side wall vents that exhaust air out of the building. ToxStrategies applied minimal levels of control assumptions (e.g., open system; some degree of engineering controls) when assessing an overall risk ranking for the field-assigned FEM, because the field-assigned FEMs do not have a standard maintenance work area, and the controls can be variable.

The highest risk ranking for the shop-assigned FEM of "moderate" was for daily maintenance of the fire apparatus, which is a highly variable job task and encompasses a wide range of products and tools. FEMs may use a combination of a face shield, gloves (rubber or latex), N95 respirator, and work boots when performing their job task. The daily maintenance of the fire apparatus occurs during the entire day, every day. The chemical ingredients of each product's SDS were evaluated for carcinogenicity and were included in the overall risk ranking. The carcinogens identified in the evaluated products include titanium dioxide, cumene, gasoline, benzene, ethylbenzene, naphthalene, carbon black, methyl isobutyl ketone, formaldehyde, diethanolamine, tetrachloroethylene, and N,N-dimethyl-p-toluidine. As discussed above, carbon black and titanium dioxide are not present in a matrix that would classify them as carcinogenic.

As described in Section 4.2.1, the fire hose, as well as other components of the fire apparatus, can have the potential for off-gassing of fire-related fumes and the potential

---

6 The outdoor base camps are a mobilization and staging area for firefighters and support personnel during a large wildfire.

7 Particulate matter is not considered an occupational carcinogen and, thus, is not discussed further.

presence of soot and other unknown contaminants. Diesel exhaust can also be a potential source of exposure for the FEMs when the apparatus is running. Therefore, soot and diesel exhaust were also included in the carcinogen list for this job task.

The other three job tasks with carcinogenic exposure yielded an overall risk ranking of "trivial," driven by the task duration and low vapor pressures/dustiness factors of the identified carcinogenic chemicals. These job tasks were (1) light welding and fabrication for the fire apparatus, (2) painting of fire apparatus components, and (3) wrapping the exhaust of the fire apparatus with vermiculite-coated fiberglass strips.

Light welding of sheet metal (stainless steel and aluminum) by shop-assigned FEMs may occur once per month for a maximum of one hour. PPE includes a welding helmet, welding gloves, and an N95 respirator. Carcinogens in welding fumes have the potential to be an exposure concern among FEMs, although, based on the short task duration and frequency, this job task resulted in a "trivial" risk rating.

Painting of fire apparatus components by the shop- or field-assigned FEMs takes place twice per month for a maximum of one hour total. PPE includes latex gloves, eye protection, and an N95 respirator. The potential carcinogens of concern identified in painting include titanium dioxide and methyl isobutyl ketone. However, as discussed above, titanium dioxide is not present in a matrix that is considered carcinogenic.

The job task of wrapping the exhaust of a fire apparatus with vermiculite-coated fiberglass strips may take up to one hour and may be performed every two weeks. The shop- or field-assigned FEM's PPE includes goggles (or other eye protection), latex gloves, and knee pads. Historically, vermiculite had the potential to contain traces of asbestos, which is a carcinogen. It is uncertain whether the vermiculite found in the currently used fiberglass strips contains trace asbestos and whether it is a potential exposure concern for the FEMs. Therefore, for the purposes of this risk ranking, it was conservatively assumed that the vermiculite-coated fiberglass strips used historically, and perhaps even the strips in current usage, contain trace asbestos. However, given the low dustiness of the fiberglass strips and the minimal duration and frequency of usage, this job task's overall risk ranking is considered "trivial."

Finally, exposure risk that was identified through the site visit and personnel interviews but was not attributable to use of a specific product includes the potential for exposure to diesel exhaust when the apparatuses enter or exit the shop, unknown potential for exposure to chemicals in the soot that exists on the equipment (e.g., hoses, ladders), off-gas from fire-contaminated equipment, and unknown contaminants on the underside and inside the mechanical compartments of the apparatus. As discussed above, field-assigned FEMs may be exposed to smoke at a fire, either by working at the wildfire base camp or at an actual fire.

Table 8 lists the carcinogens identified as potential exposure concerns for the FEM (shop- and field-assigned).

Table 8. Carcinogenic chemicals of potential concern (COPCs) identified in the FEM (shop- and field-assigned)

Carcinogen Identified in Exposure Studies	Identifying Authoritative Body
Carbon black	IARC-2B
Cumene	NTP-R, IARC-2B
Titanium dioxide	IARC-2B
Engine exhaust, gasoline	IARC-2B
Engine exhaust, diesel	NTP-R, IARC-1
Benzene	NTP-K, IARC-1, OSHA 1910.1028
Acetaldehyde	NTP-R, IARC-2B
Soot	NTP-K; IARC-1
Polycyclic aromatic hydrocarbons (PAHs) (Benzo[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Chrysene, Dibenzo[a,h]anthracene, Indeno[1,2,3-c,d]pyrene)	NTP-R, IARC (1, 2A, or 2B) [classification dependent on specific PAH compound]
Ethylbenzene	IARC-2B
Naphthalene	NTP-R, IARC-2B
Methyl isobutyl ketone	IARC-2B
Formaldehyde	NTP-K, IARC-1, OSHA 1910.1048
Diethanolamine	IARC-2B
Tetrachloroethylene	NTP-R, IARC-2A
N,N-dimethyl-p-toluidine	IARC-2B
Welding fumes	IARC-1
Asbestos	NTP-K, IARC-1, OSHA 1910.1001

Abbreviations: NTP = National Toxicology Program; NTP-K = known to be human carcinogens; NTP-R = reasonably anticipated to be human carcinogens; IARC = International Agency for Research on Cancer; IARC-1 = carcinogenic to humans; IARC-2A = probably carcinogenic to humans; IARC-2B = possibly carcinogenic to humans; OSHA = Occupational Safety and Health Administration

4.3.3 Helicopter Mechanic / Helicopter Maintenance Inspector

The overall relative risk ranking for the Helicopter Mechanic and Helicopter Maintenance Inspector ranged from “trivial” to “very high.” The highest risk ranking out of the identified job tasks for the Helicopter Mechanic was the heavy maintenance work on the aircraft, which yielded a ranking of “very high.” Heavy maintenance of the aircraft typically takes place inside the hangar, and the mechanics generally wear a uniform, work boots, goggles/safety glasses, hearing protection, gloves (type dependent on task), and knee pads. The carcinogens of potential exposure include hexavalent chromium and crystalline silica. Hexavalent chromium dust/powder is reported to exist on the hot side of the engine. It was recently announced (July 2020) that hexavalent chromium could be present on the engine and that the engine should not be cleaned by blowing air on to the surface. Prior to the announcement, the Helicopter Mechanic did not take special handling precautions when working with this piece of the engine. Therefore, exposure to hexavalent chromium during engine maintenance and repair may have been higher in the past. Based on the regularly scheduled service of the helicopters, it is very likely that the mechanic could routinely contact the dust on the engine, which might contain hexavalent chromium residues on a regular basis.

An additional exposure concern during the heavy maintenance work on the aircraft includes the talcum (talc) powder used on the surface of the fuel cells. The helicopter mechanics use the talc powder as an "anti-chaff" barrier between the rubber components and metal, such as in the case of the fuel cells. Talc is applied to a surface area of approximately 50 square feet, and based on the regularly scheduled service of the helicopters, the mechanics are exposed to fuel cells for approximately eight months of the year. Historically, talc contained the carcinogen asbestos, but asbestos has since been phased out. Currently, talc is known to contain 0.1% to 1% quartz, which is an exposure concern for the carcinogen, crystalline silica, but the percent composition is low.

A second opportunity for exposure to the talc powder on the fuel cells is when the mechanic has to check for oil leaks in the engine compartment, which requires the mechanic to crawl inside the aircraft's compartments where the deposited talc may be disturbed and become airborne in the confined area where air may be stagnant. This task occurs at a frequency of one hour (maximum), every three weeks. The PPE generally worn by the mechanic includes work boots, work uniform, and latex gloves. This job task yielded a risk ranking of "high," based on the potential for exposure to crystalline silica in the talc.

Several job tasks of the Helicopter Mechanic yielded a risk ranking of "moderate." These include the following: intermediate maintenance on the aircraft, painting/priming the interior/exterior of the aircraft, sanding and painting helicopter blades, and painting using aerosol paints and/or epoxy primers.

Intermediate maintenance on the aircraft takes place on a daily basis and can take approximately an hour to complete. This job is usually conducted outdoors on the flight line, and PPE includes work boots, work uniform, goggles/safety glasses, hearing protection, gloves (dependent on task), and knee pads. During the intermediate maintenance, a mechanic may potentially be exposed to carcinogens present in the various products used (e.g., Mastinox, Jet A fuel, Gunk Carburetor Cleaner, Bonderite Maintenance Cleaner), and could also be exposed to carcinogenic exhaust fumes and residues such as Jet A fuel exhaust and hexavalent chromium powder on the aircraft engine (discussed above). Soot and other residues are likely present on the aircraft exterior, especially during wildfire season, which can create an exposure concern for the helicopter mechanic. The carcinogenic chemicals of concern for this job task include hexavalent chromium, naphthalene, benzene, ethylbenzene, diethanolamine, and soot.

Painting, priming, and sanding of aircraft components can take place in the paint booth, inside the hangar, or outside in the open air, depending on the aircraft component. The mechanic may use a variety of different paints, paint strippers, primers, and enamels that contain the carcinogens methylene chloride, hexavalent chromium, carbon black, titanium dioxide, 4-chlorobenzotrifluoride, and ethylbenzene. Depending on the paint job, it could take 30 minutes or less and be performed once per week, or it could take 10 hours a week and be performed for 40 hours a month. For the major paint jobs, the Helicopter Maintenance Inspector is the primary painter. His work typically takes place in the paint booth, with installed exhaust filters, with the use of an airline respirator.

Other tasks that mechanics perform that ranked as “trivial” include metal etching of small components and metal grinding on stainless steel, aluminum, or titanium metal parts. Metal etching requires the use of Alodine, which contains the carcinogen hexavalent chromium. Hexavalent chromium is a respiratory carcinogen, and there is very limited opportunity for it to be airborne as a result of the use of Alodine in this process. This task typically takes place in the Composite/Sheet Metal Room inside the hangar, or could take place on the aircraft itself. The job task frequency and duration is approximately 30 minutes, every three days. PPE generally worn for this task includes work boots, work uniform, and latex gloves. Metal grinding is also considered a low-frequency and low-duration task, because it typically takes five minutes to complete on a daily basis. PPE includes work boots, work uniform, latex gloves, hearing protection, and an N95 respirator. The metal grinding may produce dust that contains carcinogens, including hexavalent chromium, nickel, and titanium dioxide; however, these exposures are expected to be of low concentration and infrequent.

Finally, exposures to carcinogens that were identified through the site visit and personnel interviews, but were not attributable to use of a specific product, include helicopter engine exhaust (Jet A fuel exhaust), unknown chemicals in the soot residue, and off-gassing volatile chemicals from wildfire residuals on the equipment and surface of the aircraft. One helicopter mechanic stated during the site visit that the indoor hangar frequently gets filled with helicopter exhaust during landing and takeoff, due to its proximity to the helipad. All helicopters return to Air Operations each day for their 24-hour inspection; therefore, the Helicopter Mechanic (or Helicopter Maintenance Inspector) has frequent opportunities to be exposed to these contaminants, because they have to climb onto the aircraft at various locations and inspect exterior surfaces, usually without the use of PPE.

Table 9 includes the list of carcinogens identified as potential exposure concerns for the Helicopter Mechanics and Helicopter Maintenance Inspectors.

Table 9. Carcinogenic chemicals of potential concern (COPCs) identified in the Helicopter Mechanics and Helicopter Maintenance Inspectors

Carcinogen Identified in Exposure Studies	Identifying Authoritative Body
Hexavalent chromium	NTP-K, IARC-1
Naphthalene	NTP-R, IARC-2B
Benzene	NTP-K, IARC-1, OSHA 1910.1028
Ethylbenzene	IARC-2B
Diethanolamine	IARC-2B
Methylene chloride	NTP-R, IARC-2A, OSHA 1910.1052
Tetrahydrofuran	IARC-2B
Crystalline silica	NTP-K, IARC-1, OSHA 1910.1053
4-Chlorobenzotrifluoride	IARC-2B
Carbon black	IARC-2B
Soot	NTP-K, IARC-1

Abbreviations: NTP = National Toxicology Program; NTP-K = known to be human carcinogens; NTP-R = reasonably anticipated to be human carcinogens; IARC = International Agency for Research on Cancer; IARC-1 = carcinogenic to humans; IARC-2A = probably carcinogenic to humans; IARC-2B = possibly carcinogenic to humans; OSHA = Occupational Safety and Health Administration

5 Conclusions

The qualitative assessment identified four SEGs: (1) Equipment Maintenance Worker, (2) Fire Equipment Mechanic (FEM), (3) Helicopter Mechanic, and (4) Helicopter Maintenance Inspector. Several carcinogenic chemicals were identified in the products used by the various SEGs, and in the vehicle and aircraft exhaust emissions. Additionally, findings from Task 1, Structured Literature Review, indicated that PAHs in surface dust at fire stations and diesel emissions in fire-station vehicle bays could be elevated (Shen et al., 2012, 2015, Chung et al., 2020, Sparer et al., 2017, Echt et al., 1995, Froines et al., 1987) and off-gassing of benzene, ethylbenzene, 1,4-dichlorobenzene, and styrene have been measured in PPE that had been exposed to a fire (Fent et al., 2015). Finally, firefighter industrial hygiene samples collected during wildland firefighting demonstrated potential for low-level exposures to carcinogens such as crystalline silica, acetaldehyde, formaldehyde, PAHs, and benzene (Materna et al., 1992). Therefore, carcinogens may be present in the surface residuals on various fire equipment vehicles, PPE, and the surfaces of the shops themselves, as well as in the field when working near or at a wildland fire.

To determine whether the theoretical cancer health risk is elevated among this group of workers, the magnitude of the fire mechanics' exposures must be determined. This qualitative exposure assessment was the first step in characterizing the potential exposures. Based on the outcome of the risk ranking, ToxStrategies recommends conducting quantitative exposure assessments (i.e., measurements) of crystalline silica and hexavalent chromium in personal breathing zone (pbz) air samples of the Helicopter Mechanics when (1) conducting heavy maintenance on the aircraft and (2) checking for oil leaks, which tasks received overall risk rankings of "very high" and "high," respectively. When the helicopter mechanics perform intermediate daily aircraft maintenance, ToxStrategies plans to collect pbz air samples to be analyzed for hexavalent chromium, naphthalene, benzene, and ethylbenzene. Although diethanolamine and tetrahydrofuran were also considered potential carcinogens of concern for this job task, these compounds will not be measured quantitatively, because they do not have published cancer potency measures. Thus, the cancer risk assessments for these chemicals will be qualitative. In addition to pbz air samples, surface samples will also be collected and analyzed for soot compounds for all three helicopter mechanic job tasks described above, as well as hexavalent chromium, when conducting intermediate daily aircraft maintenance.

For the Helicopter Mechanic/Helicopter Maintenance Inspector job tasks of (1) painting/priming on the interior and exterior of the aircraft, (2) sanding helicopter blades, (3) painting helicopter blades, and (4) painting using aerosol paints and epoxy primers, ToxStrategies plans to collect pbz air samples to be analyzed for hexavalent chromium, methylene chloride, 4-chlorobenzotrifluoride, and ethylbenzene. In addition to pbz samples, surface samples will also be collected during painting/priming on the interior and exterior of the aircraft and analyzed for hexavalent chromium. These four job tasks received an overall risk ranking of "moderate."

At the Engine Repair Shop located at the Breathing Apparatus Shop location, ToxStrategies plans to measure naphthalene, benzene, and ethylbenzene through pbz air samples, and soot compounds through surface samples. The Engine Repair Shop is where the equipment maintenance workers repair and tune up power equipment and rescue tools (e.g., weed trimmers, generators, and vacuums). This job task received an overall risk ranking of "high."

The Fire Hose Shop is also located at the Breathing Apparatus Shop location and is where the workers repair and complete the firefighting hose test. This job task received an overall risk ranking of "moderate." The plan is to collect surface samples at the Fire Hose Shop to be analyzed for soot compounds.

When the shop-assigned Fire Equipment Mechanic conducts general maintenance of the fire apparatus (overall risk ranking of "moderate"), ToxStrategies plans to collect pbz air samples of benzene, ethylbenzene, naphthalene, N,N-dimethyl-para-toluidine, tetrachloroethylene, diesel exhaust particulates, and welding fumes. Cumene and methyl isobutyl ketone were also considered potential carcinogens of concern for this job task; however, these compounds will not be measured quantitatively, because they do not have published cancer potency measures. Thus, their cancer risk assessment will be qualitative only. Surface samples will be collected and analyzed for soot compounds, and a bulk sample of the vermiculite-coated fiberglass strips will be analyzed for asbestos.

If possible, ToxStrategies also plans to collect pbz air samples from the field-assigned Fire Equipment Mechanics at a wildfire base camp, measuring acetaldehyde, benzene, ethylbenzene, formaldehyde, PAHs, naphthalene, and diesel exhaust particulates. Surface samples will also be collected and analyzed for soot compounds. This job task received an overall risk ranking of "very high."

Table 10 is a summary of the measurement strategy for use in quantifying exposures incurred by the Fire Mechanics. As shown, the strategy includes measurements of air concentrations and surface levels of the identified carcinogens.

Table 10. Quantitative assessment strategy by SEG and job task

	Job Task Description	Job Title	Exposure Media and Chemicals	
Site Location	**Job Task Name**	**SEG**	**Air**	**Surface Residue**
Air Operations, Pacoima	Heavy maintenance on aircraft (Cr[VI] on hot engine, talc powder on the surface of fuel cells)	Helicopter Mechanic/ Helicopter Maintenance Inspector	Crystalline silica, Cr(VI)	Cr(VI), soot
Air Operations, Pacoima	Intermediate maintenance on aircraft (Cr[VI] on hot engine; Mastinox on bolts/metal)	Helicopter Mechanic/ Helicopter Maintenance Inspector	Cr(VI), naphthalene, benzene, ethylbenzene,	Cr(VI), soot
Air Operations, Pacoima	Check for oil leaks (exposure to talc powder)	Helicopter Mechanic/ Helicopter Maintenance Inspector	Crystalline silica	Soot
Air Operations, Pacoima	Painting / priming on the interior and exterior of the aircraft	Helicopter Mechanic/ Helicopter Maintenance Inspector	Methylene chloride, Cr(VI)	Cr(VI)
Air Operations, Pacoima	Sanding helicopter blades	Helicopter Mechanic/ Helicopter Maintenance Inspector	Cr(VI)	
Air Operations, Pacoima	Painting helicopter blades	Helicopter Mechanic/ Helicopter Maintenance Inspector	4-Chlorobenzo-trifluoride, methylene chloride, Cr(VI)	
Air Operations, Pacoima	Painting using aerosol paints, epoxy primers	Helicopter Mechanic/ Helicopter Maintenance Inspector	Ethylbenzene, methylene chloride, Cr(VI)	
Breathing Apparatus Shop, Pacoima	Repair and tune-up of power equipment and rescue tools (e.g., weed trimmers, generators, vacuums)	Equipment Maintenance Worker	Naphthalene, benzene, ethylbenzene	Soot

Site Location	Job Task Description	Job Title	Exposure Media and Chemicals	
	Job Task Name	SEG	Air	Surface Residue
Breathing Apparatus Shop, Pacoima	Fire hose repair	Equipment Maintenance Worker		Soot
Eastern Fire Shop, Los Angeles; North County Fire Shop, Lancaster	Maintenance of fire apparatus	Shop/Field Fire Equipment Mechanic	Benzene, ethylbenzene naphthalene, N,N-dimethyl-para-toluidine, tetrachloroethyl-ene, diesel exhaust, welding fumes	Soot, bulk sample of fiberglass strips for asbestos
Wildfire base camp or fire site	Repair of fire apparatus or other equipment	Field Fire Equipment Mechanic	Acetaldehyde, benzene, ethylbenzene, formaldehyde, polycyclic aromatic hydrocarbons (PAHs), naphthalene, diesel exhaust	Soot

6 Next Steps

Task 4 will use the results of this study (Task 2) to conduct exposure monitoring of workers for airborne chemicals, as well as chemical analysis of surface residues, as summarized in Section 5 above. Samples from each SEG will be selected for personal breathing-zone air sampling and surface/dermal wipe sampling of equipment. Due to limitations of budget and schedule, sampling will focus on collecting data for the highest ranking possible exposure conditions.

Task 5 will use the results of Task 4 and will include calculating the theoretical excess cancer risk from exposure to carcinogenic materials for each SEG determined from Task 2 and toxicity criteria relevant for California risk assessments. The risk assessment will result in an estimate of the probability of developing cancer as a result of exposure, expressed in terms of the numbers of people out of one million. Varying degrees of conservatism will be added to this approach to ensure that cancer risk is not underestimated, which makes it probable that potential risk will be overestimated.

For Task 3, Epidemiologic assessment, employee records are being evaluated for completeness and suitability for a future cancer epidemiologic study.

Task 6 may include analyzing public comments, explaining the rationale for specific policy recommendations, and disseminating the study findings to the governor, state legislature, Occupational Safety and Health Standards Board, Los Angeles County Board of Supervisors, and stakeholders in the workers' compensation system.

7 References

AIHA (American Industrial Hygiene Association). 2015. A Strategy for Assessing and Managing Occupational Exposures. 4th Edition. American Industrial Hygiene Association, Falls Church, VA.

Chung J, Demers PA, Kalenge S, Kirkham TL. 2020. Career fire hall exposures to diesel engine exhaust in Ontario, Canada. J Occup Environ Hyg 17(1):38–46, doi:10.1080/15459624.2019.1691729.

Echt A, Sheehy J, Blade L. 1995. Case studies: Exposure to diesel exhaust emissions at three fire stations: Evaluation and recommended controls. Appl Occup Environ Hyg 10(5):431–438.

Fent KW, Evans DE, Booher D, Pleil JD, Stiegel MA, Horn GP, Dalton J. 2015. Volatile organic compounds off-gassing from firefighters' personal protective equipment ensembles after use. J Occup Environ Hyg 12(6):404–414, doi:10.1080/15459624.2015.1025135.

Froines JR, Hinds WC, Duffy RM, Lafuente EJ, Liu WC. 1987. Exposure of firefighters to diesel emissions in fire stations. Am Ind Hyg Assoc J 48(3):202–207, doi:10.1080/15298668791384634.

IARC (International Agency for Research on Cancer). 2010a. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 93, Carbon Black, Titanium Dioxide, and Talc. Occupational Cancer Research Centre, https://monographs.iarc.fr/wp-content/uploads/2018/06/mono93.pdf

IARC (International Agency for Research on Cancer). 2010b. IARC Monographs on the evaluation of carcinogenic risks to humans, Volume 98, Painting, firefighting, and shiftwork. Occupational Cancer Research Centre, https://www.occupationalcancer.ca/2010/iarc-monographs-volume-98-painting-firefighting-and-shiftwork/.

IARC (International Agency for Research on Cancer). 2020. IARC Monographs on the identification of carcinogenic hazards to humans, agents classified by the IARC Monographs, Volumes 1–127. Updated on June 26. https://monographs.iarc.fr/agents-classified-by-the-iarc/.

Materna BL, Jones JR, Sutton PM, Rothman N, Harrison RJ. 1992. Occupational exposures in California wildland fire fighting. Am Ind Hyg Assoc J 53(1):69–76, doi:10.1080/15298669291359311.

NTP (National Toxicology Program). 2016. Report on Carcinogens, Fourteenth Edition. Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service. https://ntp.niehs.nih.gov/go/roc14.

Shen B, Whitehead TP, McNeel S, Brown FR, Das R, Israel L, et al. 2012. Measurements of PAHs, PBDEs, and PCBs in dust from California firehouses. Organohalogen Compounds 74:899–902.

Shen B, Whitehead TP, McNeel S, Brown FR, Dhaliwal J, Das R, et al. 2015. High levels of polybrominated diphenyl ethers in vacuum cleaner dust from California fire stations. Environ Sci Technol 49(8):4988–4994.

Sparer EH, Prendergast DP, Apell JN, Bartzak MR, Wagner GR, Adamkiewicz G, et al. 2017. Assessment of ambient exposures firefighters encounter while at the fire station: An exploratory study. J Occup Environ Med 59(10):1017–1023, doi:10.1097/JOM.0000000000001114.

ToxStrategies, Inc. 2020a. Proposal in response to RFP #4479, Assessment of risk of carcinogens exposure and incidents of occupational cancer among mechanics and cleaners of firefighting vehicles, Volume 1 — Proposal. February 13.

ToxStrategies, Inc. 2020b. Structured literature review of potential occupational exposures and cancer among mechanics who repair and clean firefighting vehicles (Task 1). August 24.

United Nations. 2011. Globally Harmonized System of Classification and Labelling of Chemicals (GHS). Fourth revised edition. ST/SG/AC.10/30/Rev.4.

WHO (World Health Organization). 1999. Hazard prevention and control in the work environment: Airborne dust. WHO/SDE/OEH/99.14. Chapter 4, Recognizing and Evaluating the Problem—the Systematic Approach.

ATTACHMENT 1

Qualitative Summary and Job Task Rating

Attachment 1-A. Qualitative summary

	JOB TASK DESCRIPTION					EXPOSURE CONTROLS				JOB TITLE		CHEMICAL INVENTORY			
Site Location	Job Task Name [AUTOMATIC FILL]	Task Location Description	Chemical Product Used or Residue Encountered [AUTOMATIC FILL]	Job Task Description	Job Task Duration, Frequency, Variability	Engineering Controls (e.g., process enclosures, local exhaust ventilation, etc.)	Administrative Controls (e.g., job task rotation, chemical use limitations, etc.)	Personal Protective Equipment	Notes/ Observations	Job Title	No. of Employees with Job Title that perform Job Task	Usage Rate of Chemical Products Used during Job Task	Exposure Rating of Product or Residue [AUTOMATIC FILL]	Health Effect Rating of Product or Residue [AUTOMATIC FILL]	Overall Risk Ranking
Wildfire base camp or fire site	Repair of fire apparatus or other equipment	Outdoors at a wildfire base camp or fire site	Fire smoke in the air and soot/fire residue on the apparatus and/or equipment; unknown contaminants	Repairing fire apparatus or other equipment	Wildfire base camp: up to ~19 days, every day, once or twice a year (dependent on number of wildfires in a year). Duration at a fire site is infrequent (1 time every 3 years) and variable (depends on the extent of repair needed)	None (outside adjacent to burning fire)	None	Work boots, work uniform, latex gloves, eye protection, N95 respirator	PPE is not enforced and is used on a voluntary basis; not readily available.	Field Fire Equipment Mechanic	24	As needed	4	4	*Very High*
Air Operations, Pacoima	Heavy maintenance on aircraft (Cr[VI] on hot engine, talc powder on the surface of fuel cells)	Indoor Hangar	Chemical Commodities Agency Talc, Technical (Asbestos free); hexavalent chromium (Cr[VI]) residue	The talc is used as an "anti-chaff" barrier between rubber components and metal such as the fuel cells. The fuel cells have approximately 50 square feet of surface area which is all covered in talc.	Use of talc is <15 minutes; exposure to talc >6 hours; daily	Swamp coolers (four are operational), portable A/C generator	none	Work boots, work uniform, goggles/safety glasses, hearing protection, gloves (depends on task), knee pads	There is always a Bell 412 in for major service in the hangar, and 8 months of the year, the fuel cells are exposed. For those 8 months, the crew (about 5 mechanics) assigned to the task are exposed almost every day. However, that crew may shift and change over the period of inspection, and the crew is not the same from major service to major service. Mechanics frequently do not wear gloves, because the job requires feeling parts of aircraft for cracks, grooves, etc.	Helicopter Mechanic/ Helicopter Maintenance Inspector	17	Daily in prescribed quantities per need	4	4	*Very High*
Air Operations, Pacoima	Check for oil leaks (exposure to talc powder)	Indoor Hangar	Chemical Commodities Agency Talc, Technical (Asbestos free)	Check for oil leaks in engine	15 min - 1 hour every 3 weeks	None	None	Work boots, work uniform, gloves (latex)	The work space inside the engine area is tight and known as the "hell hole"	Helicopter Mechanic/ Helicopter Maintenance Inspector	17	As needed	3	4	*High*
Breathing Apparatus Shop, Pacoima	Repair and tune-up of power equipment and rescue tools (e.g., weed trimmers, generators, vacuums)	Engine Repair Shop	Gasoline exhaust/fumes	Workers repair and tune up power equipment	>4 hours per day; daily	None (just front door natural air ventilation); future ventilation is planned to be installed	None	Work boots, work uniform, latex gloves and apron (since last 2 years only)	The shop had noticeable gasoline fumes. Four workers are part-time in the small engine repair shop, and one worker is full-time.	Equipment Maintenance Worker	5	As needed	3	4	*High*
Air Operations, Pacoima	Intermediate maintenance on aircraft (Cr[VI] on hot engine; Mastinox on bolts/metal)	Outside on flight line	Soot, Mastinox, Jet A fuel exhaust, Gunk Carburetor Cleaner, Bonderite C-MC 5884 AERO Maintenance Cleaner, tetrahydrofuran, hexavalent chromium (Cr[VI]) residue	A mechanic will use and apply Mastinox once or twice a week. They will likely come into contact with Mastinox incidentally every day or most days at least. When performing an inspection or maintenance on components that do not have Mastinox, it is extremely likely that the adjacent component has it, or getting to the target component requires contact with parts that have it.	45 minutes to 1 hour and 15 minutes; daily	Work conducted outdoors in open air	none	Work boots, work uniform, goggles/safety glasses, hearing protection, gloves (depends on task), knee pads. [Frequently not wearing gloves, because the job requires feeling parts of aircraft for cracks, grooves, etc.]	Mechanic frequently contacts fire residue (even opening up helicopter door). Mastinox is used to coat bolts or metal that comes into contact with metal of another type.	Helicopter Mechanic/ Helicopter Maintenance Inspector	17	Daily in prescribed quantities per need	2	4	***Moderate***
Air Operations, Pacoima	Painting / priming on the interior and exterior of the aircraft	Paint Booth / Indoor Hangar / Outside in open air	Axalta Imron Industrial Strength Low VOC Polyurethane Primer - Black; 3M Scotch-Weld Epoxy Adhesive EC-2216, Rust-oleum Corporation Enamel, Henkel Bonderite S-ST 5351 AERO known as TURCO 5351 (paint stripper)	Spray painting using canned paint or aerosol paints	Depends on part size and need; generally 30 minutes or less/week	Paint booth exhaust filters and A/C inside the paint booth; swamp coolers and A/C in the hangar; outside open air	none	Work boots, work uniform, goggles, hearing protection, latex gloves, knee pads, supplied air respirator or N95 respirator		Helicopter Mechanic/ Helicopter Maintenance Inspector	17	Dependent on aircraft piece being painted	2	4	***Moderate***
Air Operations, Pacoima	Sanding helicopter blades	Major sanding (down to the metal) takes place in the Paint Booth while light sanding is performed outside (open air)	Dried paint	Sand blades or other aircraft pieces prior to painting	10 hours/week or 40 hours per month	Paint booth: exhaust filters, A/C; outside open air	none	Work boots, work uniform, goggles, hearing protection, latex gloves, knee pads, supplied air respirator	Between January and September 2020, the Helicopter Maintenance Inspector has spent ~20 hours to paint each blade and completed 8 blades so far (includes sanding and painting).	Helicopter Mechanic/ Helicopter Maintenance Inspector	17	Not applicable	1	4	***Moderate***
Air Operations, Pacoima	Painting helicopter blades	Paint booth	Axalta Imron Industrial Strength Low VOC Polyurethane Primer - Black; 3M Scotch-Weld Epoxy Adhesive EC-2216, Rust-oleum Corporation Enamel, Henkel Bonderite S-ST 5351 AERO known as TURCO 5351 (paint stripper)	Spray painting using canned paint or aerosol paints	30 minutes or less/week	Paint booth: exhaust filters, A/C	none	Work boots, work uniform, goggles, hearing protection, latex gloves, knee pads, supplied air respirator	The paint booth's exhaust filters and ventilation were not checked for efficiency. Between January and September 2020, the Helicopter Maintenance Inspector has spent ~20 hours to paint each blade and completed 8 blades so far (includes sanding and painting).	Helicopter Mechanic/ Helicopter Maintenance Inspector	17	Dependent on aircraft piece being painted	2	4	***Moderate***
Air Operations, Pacoima	Painting using aerosol paints, epoxy primers	Paint Booth / Indoor Hangar / Outside in open air	3M Scotch-Weld Epoxy Adhesive EC-2216, Rust-oleum Corporation Enamel, Henkel Bonderite S-ST 5351 AERO known as TURCO 5351 (paint stripper)	Spray painting using canned paint or aerosol paints	Depends on part size and need; generally 30 minutes or less/week	Paint booth exhaust filters and A/C inside the paint booth; swamp coolers and A/C in the hangar; outside open air	None	Work boots, work uniform, goggles, hearing protection, latex gloves, knee pads, supplied air respirator or N95 respirator	PPE is not enforced and is used on a voluntary basis	Helicopter Mechanic/ Helicopter Maintenance Inspector	17	Dependent on aircraft piece being painted	1	4	***Moderate***
Eastern Fire Shop, Los Angeles; North County Fire Shop, Lancaster	Maintenance of fire apparatus	Mechanic shop; outside; fire station bay	Soot; diesel exhaust; LOCTITE® 242® THREADLOCKER; CHEVRON and TEXACO MID-GRADE UNLEADED GASOLINES; Lead-Acid Battery Non-spillable; LOCTITE MR 5414 BLACK CONTACT ADHESIVE known as Loctite® Black Contact Adhesive; Kimball Midwest ANSI 61 GRAY Paint; Kimball Midwest GLOSS WHITE paint; Kimball Midwest NEW EQUIPMENT YELLOW paint; Industrial Grade Silicone – Acetoxy Cure – Clear, White & Colors, 3M™ Yellow Super Weatherstrip and Gasket Adhesive, 08001, 08016; Permabond HH190; NAPA CHAIN AND CABLE LUBE; Brakleen® Brake Parts Cleaner - Non-Chlorinated; NAPA® Lectra Clean® 3000 Energized Electrical Equipment Cleaner	Brake inspection; safety inspection of apparatus; oil filter changes; brake adjustments; maintenance on fuel/pump system; inspecting components; clean parts; engine maintenance; sanding surfaces to install new gaskets; torching metal; general apparatus plumbing maintenance	All day; daily	Side vents in shop; diesel exhaust capture area; shop has roll-up doors (natural air); fans	None	Face shield, gloves (rubber or latex), N95 respirator, uniform, work boots	PPE is not enforced and is used on a voluntary basis; not readily available.	Shop/Field Fire Equipment Mechanic	48	As needed	2	4	***Moderate***
Breathing Apparatus Shop, Pacoima	Fire hose repair	Fire Hose Repair shop	Off-gassing of fire-related fumes; soot; unknown contaminants	Worker repairs and completes the hose test; replace nozzles and shut-offs as needed.	>4 hours per day; daily	Doors and roll-up doors open during warm weather months; A/C provided by swamp cooler; heater available during cold-weather months	None	Work boots, work uniform, latex gloves and apron (since last 2 years only)	Only one worker at the hose repair shop; will spend half of the time in the field (fire station, shop, etc.)	Equipment Maintenance Worker	6	Not applicable	1	4	***Moderate***

	JOB TASK DESCRIPTION					EXPOSURE CONTROLS				JOB TITLE		CHEMICAL INVENTORY			
Site Location	Job Task Name [AUTOMATIC FILL]	Task Location Description	Chemical Product Used or Residue Encountered [AUTOMATIC FILL]	Job Task Description	Job Task Duration, Frequency, Variability	Engineering Controls (e.g., process enclosures, local exhaust ventilation, etc.)	Administrative Controls (e.g., job task rotation, chemical use limitations, etc.)	Personal Protective Equipment	Notes/ Observations	Job Title	No. of Employees with Job Title that perform Job Task	Usage Rate of Chemical Products Used during Job Task	Exposure Rating of Product or Residue [AUTOMATIC FILL]	Health Effect Rating of Product or Residue [AUTOMATIC FILL]	Overall Risk Ranking
Air Operations, Pacoima	Etching small components using Alodine	Composite/Sheet Metal Room	Bonderite M-CR 1201 AERO known as Alodine 1201	Place small components in plastic bag with Alodine solution (approximately <1 cup); larger pieces get placed in bin with Alodine solution. The process could take place in the Composite/Sheet Metal Room or on the helicopter itself. Exposure to Alodine from the time of opening the container to sealing the plastic bag is approximately ten minutes; exposure time from opening the bag, cleaning the metal, and disposing the Alodine is approximately 15 minutes. The Alodine is poured from a gallon-size container.	30 minutes, once every 3 days	None	None	Work boots, work uniform, gloves (latex)		Helicopter Mechanic/ Helicopter Maintenance Inspector	17	Approximately 8 ounces or less	0	4	*Trivial*
Air Operations, Pacoima	Metal grinding on stainless steel, aluminum, titanium	Indoor Hangar	Metal dust	Grind metal (aluminum, stainless steel); apply chemical treatment after grinding (Alodine, corrosion prevention compounds, or epoxy primer)	5 minutes; 1 per week or 1 per day	Swamp coolers and A/C in the hangar	None	Work boots, work uniform, gloves (latex), hearing protection, N95 respirator	PPE is not enforced and is used on a voluntary basis	Helicopter Mechanic/ Helicopter Maintenance Inspector	17	Not applicable	0	4	*Trivial*
Eastern Fire Shop, Los Angeles; North County Fire Shop, Lancaster	light welding & fabrication for fire apparatus	Mechanic shop	Welding metal fumes	Welding sheet metal (stainless steel & aluminum)	1 hour per month	Portable fan	None	Work boots, work uniform, welding helmet, welding gloves, N95 respirator	PPE is not enforced and is used on a voluntary basis; not readily available.	Shop Fire Equipment Mechanic	<48	Not applicable	0	4	*Trivial*
Eastern Fire Shop, Los Angeles; North County Fire Shop, Lancaster	wrapping exhaust	Mechanic shop; outside; fire station bay	McMaster Carr Supply Co Vermiculite Coated Fiberglass Strips 1/8' THI (historically contained asbestos)	Wrapping exhaust	15 min - 1 hour every 2 weeks to a month	None	None	Work boots, work uniform, goggles, hearing protection, latex gloves, knee pads	PPE is not enforced and is used on a voluntary basis; not readily available. Wrapping the exhaust with the fiberglass strips may cause dermal irritation.	Shop/Field Fire Equipment Mechanic	48	1 time every 2 weeks to a month	0	4	*Trivial*
Eastern Fire Shop, Los Angeles; North County Fire Shop, Lancaster	Painting of fire apparatus components	Mechanic shop	Kimball Midwest ANSI 61 GRAY Paint; Kimball Midwest GLOSS WHITE paint; Kimball Midwest NEW EQUIPMENT YELLOW paint	Painting	30 minutes, twice a month	None	None	Work boots, work uniform, latex gloves, eye protection, N95 respirator	PPE is not enforced and is used on a voluntary basis; not readily available.	Shop Fire Equipment Mechanic	<48	As needed	0	3	*Trivial*
Breathing Apparatus Shop, Pacoima	Spray painting equipment	Engine Repair Shop	Rust-Oleum Protective Enamel Satin Black Spray Paint; Rust-Oleum Protective Enamel Gloss White Spray Paint; Rust-Oleum Protective Enamel Satin American Red Spray Paint	Spray painting using aerosol paints	Up to 30 minutes, 3-5 times per month	None	None	Work boots, work uniform, latex gloves and apron (since last 2 years only)	When spray painting equipment, it takes 5-10 minutes at one time, depending on how many coats are applied. The workers let the paint cure for 5-15 minutes in between sprays. Equipment gets spray painted 3-5 times in a month.	Equipment Maintenance Worker	6	As needed	0	3	*Trivial*

Attachment 1-B. Job Task Rating

	Job Task Exposure Rating												Job Task Health Rating		Overall Risk Ranking
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Site Location	Job Task Name [FILL IN]	Task Duration [PICK ONE]	Task Frequency [PICK ONE]	Frequency/Duration Rating [AUTOMATIC FILL]	Product Name or Residue Encountered [FILL IN]	Vapor Pressure or Dustiness Factor [PICK ONE]	Chemical Product or Residue Dispersion Rating [AUTOMATIC FILL]	Level of Control [PICK ONE]	Level of Control Rating [AUTOMATIC FILL]	Job Task Exposure Rating (D x G x I) [AUTOMATIC FILL]	Multiplied Total [AUTOMATIC FILL]	Exposure Rating of Product or Residue (0-4) [AUTOMATIC FILL]	GHS Health Hazard Category (list lowest category on SDS) [PICK ONE]	Health Effect Rating of Product or Residue (0-4) [AUTOMATIC FILL]	Risk Ranking [AUTOMATIC FILL]
Wildfire base camp or fire site	Repair of fire apparatus or other equipment	>4 hrs	daily	5	Fire smoke in the air and soot/fire residue on the apparatus and/or equipment; unknown contaminants	High Dustiness: fine, light powders	4	open system; ineffective or no exposure controls	4	80	>40	4	Category 1	4	*Very High*
Air Operations, Pacoima	Heavy maintenance on aircraft (Cr[VI] on hot engine, talc powder on the surface of fuel cells)	>4 hrs	daily	5	Chemical Commodities Agency Talc, Technical (Asbestos free); hexavalent chromium (Cr[VI]) residue	High Dustiness: fine, light powders	4	Open system; some degree of engineering controls	3	60	>40	4	Category 1	4	*Very High*
Air Operations, Pacoima	Check for oil leaks (exposure to talc powder)	15 min-1 hr	>daily/<monthly	2	Chemical Commodities Agency Talc, Technical (Asbestos free)	High Dustiness: fine, light powders	4	Open system; ineffective or no exposure controls	4	32	31-40	3	Category 1	4	*High*
Breathing Apparatus Shop, Pacoima	Repair and tune-up of power equipment and rescue tools (e.g., weed trimmers, generators, vacuums)	>4 hrs	daily	5	Gasoline exhaust/fumes	25 - 100 mmHg or 33 - 133 mbar	2	Open system; ineffective or no exposure controls	4	40	31-40	3	Category 1	4	*High*
Air Operations, Pacoima	Intermediate maintenance on aircraft (Cr[VI] on hot engine; Mastinox on bolts/metal)	1-2 hrs	daily	3	Soot, Mastinox, Jet A fuel exhaust, Gunk Carburetor Cleaner, Bonderite C-MC 5884 AERO Maintenance Cleaner, tetrahydrofuran, hexavalent chromium (Cr[VI]) residue	100 - 250 mmHg or 133 - 333 mbar	3	Open system; some degree of engineering controls	3	27	21-30	2	Category 1	4	*Moderate*
Air Operations, Pacoima	Painting / priming on the interior and exterior of the aircraft	15 min-1 hr	>daily/<monthly	2	Axalta Imron Industrial Strength Low VOC Polyurethane Primer - Black; 3M Scotch-Weld Epoxy Adhesive EC-2216, Rust-oleum Corporation Enamel, Henkel Bonderite S-ST 5351 AERO known as TURCO 5351 (paint stripper)	>250 mmHg or >333 mbar	4	Open system; some degree of engineering controls	3	24	21-30	2	Category 1	4	*Moderate*
Air Operations, Pacoima	Sanding helicopter blades	>4 hrs	>daily/<monthly	4	Dried paint	Medium dustiness: crystalline granular solids	2	Open system; effective engineering controls in place to contain/remove airborne contaminants. Effective use of administrative and PPE controls	2	16	10-20	1	Category 1	4	*Moderate*
Air Operations, Pacoima	Painting helicopter blades	15 min-1 hr	>daily/<monthly	2	Axalta Imron Industrial Strength Low VOC Polyurethane Primer - Black; 3M Scotch-Weld Epoxy Adhesive EC-2216, Rust-oleum Corporation Enamel, Henkel Bonderite S-ST 5351 AERO known as TURCO 5351 (paint stripper)	>250 mmHg or >333 mbar	4	Open system; some degree of engineering controls	3	24	21-30	2	Category 1	4	*Moderate*
Air Operations, Pacoima	Painting using aerosol paints, epoxy primers	15 min-1 hr	daily	2	3M Scotch-Weld Epoxy Adhesive EC-2216, Rust-oleum Corporation Enamel, Henkel Bonderite S-ST 5351 AERO known as TURCO 5351 (paint stripper)	25 - 100 mmHg or 33 - 133 mbar	2	Open system; some degree of engineering controls	3	12	10-20	1	Category 1	4	*Moderate*
Eastern Fire Shop, Los Angeles; North County Fire Shop, Lancaster	Maintenance of fire apparatus	>4 hrs	daily	5	Soot; diesel exhaust; LOCTITE® 242® THREADLOCKER; CHEVRON and TEXACO MID-GRADE UNLEADED GASOLINES; Lead-Acid Battery Non-spillable; LOCTITE MR 5414 BLACK CONTACT ADHESIVE known as Loctite® Black Contact Adhesive; Kimball Midwest ANSI 61 GRAY Paint; Kimball Midwest GLOSS WHITE paint; Kimball Midwest NEW EQUIPMENT YELLOW paint; Industrial Grade Silicone – Acetoxy Cure – Clear, White & Colors, 3M™ Yellow Super Weatherstrip and Gasket Adhesive, 08001, 08016; Permabond HH190; NAPA CHAIN AND CABLE LUBE; Brakleen® Brake Parts Cleaner - Non-Chlorinated; NAPA® Lectra Clean® 3000 Energized Electrical Equipment Cleaner	25 - 100 mmHg or 33 - 133 mbar	2	Open system; some degree of engineering controls	3	30	21-30	2	Category 1	4	*Moderate*
Breathing Apparatus Shop, Pacoima	Fire hose repair	>4 hrs	daily	5	Off-gassing of fire-related fumes; soot; unknown contaminants	<25 mmHg or 33 mbar	1	Open system; ineffective or no exposure controls	4	20	10-20	1	Category 1	4	*Moderate*
Air Operations, Pacoima	Etching small components using Alodine	15 min-1 hr	>daily/<monthly	2	Bonderite M-CR 1201 AERO known as Alodine 1201	<25 mmHg or 33 mbar	1	Open system; ineffective or no exposure controls	4	8	<10	0	Category 1	4	*Trivial*
Air Operations, Pacoima	Metal grinding on stainless steel, aluminum, titanium	<15 min	>daily/<monthly	1	Metal dust	Medium Dustiness: crystalline granular solids	2	Open system; some degree of engineering controls	3	6	<10	0	Category 1	4	*Trivial*
Eastern Fire Shop, Los Angeles; North County Fire Shop, Lancaster	light welding & fabrication for fire apparatus	15 min-1 hr	> 1/month	1	Welding metal fumes	<25 mmHg or 33 mbar	1	Open system; some degree of engineering controls	3	3	<10	0	Category 1	4	*Trivial*
Eastern Fire Shop, Los Angeles; North County Fire Shop, Lancaster	wrapping exhaust	15 min-1 hr	>daily/<monthly	2	McMaster Carr Supply Co Vermiculite Coated Fiberglass Strips 1/8' THI (historically contained asbestos)	Low dustiness: pellet-like, non-friable solids	1	Open system; ineffective or no exposure controls	4	8	<10	0	Category 1	4	*Trivial*
Eastern Fire Shop, Los Angeles; North County Fire Shop, Lancaster	Painting of fire apparatus components	15 min-1 hr	>daily/<monthly	2	Kimball Midwest ANSI 61 GRAY Paint; Kimball Midwest GLOSS WHITE paint; Kimball Midwest NEW EQUIPMENT YELLOW paint	<25 mmHg or 33 mbar	1	Open system; ineffective or no exposure controls	4	8	<10	0	Category 2	3	*Trivial*
Breathing Apparatus Shop, Pacoima	Spray painting equipment	15 min-1 hr	>daily/<monthly	2	Rust-Oleum Protective Enamel Satin Black Spray Paint; Rust-Oleum Protective Enamel Gloss White Spray Paint; Rust-Oleum Protective Enamel Satin American Red Spray Paint	<25 mmHg or 33 mbar	1	Open system; ineffective or no exposure controls	4	8	<10	0	Category 2	3	*Trivial*

APPENDIX C

Task 3: Epidemiology Feasibility Study

Task 3: Epidemiology Feasibility Study

FEBRUARY 25, 2021

ToxStrategies

Innovative solutions
Sound science

Task 3: Epidemiology Feasibility Study

FEBRUARY 25, 2021

PREPARED FOR:

State of California
Department of Industrial Relations
1515 Clay Street
Suite 1902
Oakland, CA 94612

PREPARED BY:

ToxStrategies, Inc.
Johns Hopkins Campus
9601 Medical Center Dr.
Rockville, MD 20850

Table of Contents

List of Tables

1 Background and Rationale

The International Agency for Research on Cancer (IARC) and recent epidemiologic studies have suggested that firefighters may be at increased risk for certain cancers due to their occupational exposures to carcinogens found in fire gases and smoke (e.g., benzene, polycyclic aromatic hydrocarbons [PAHs], cadmium, crystalline silica), as well as exposures to other agents (e.g., diesel exhaust) (IARC, 2010; LeMasters et al., 2006; Tsai et al., 2015). Since January 1, 2012, firefighters have been included in the California Cancer Presumption for worker compensation purposes (California Labor Code §3212.1). With these benefits, a firefighter who develops cancer can be awarded compensation for medical treatment and disability benefits, if the individual demonstrates that he or she was exposed to a carcinogen during the course of their employment. In comparison, mechanics who repair and clean firefighting vehicles and equipment are not covered by this worker compensation program. Repairing and cleaning firefighting vehicles and equipment (trucks, helicopters, axes, hoses, etc.) at a fire station or offsite at a fire event may expose the mechanics to fire-related carcinogens, similar to those experienced by the firefighters.

As a result, California Assembly Bill (AB) 1400 was created to define the fire mechanic's risk of exposures to carcinogens in the course of employment (AB 1400, 2019). Specifically, AB 1400, Section 77.7, was added to the Labor Code on October 11, 2019, and requires the Commission on Health and Safety and Workers' Compensation (CHSWC), in partnership with the County of Los Angeles (LA County) and relevant labor organizations, to submit a study to the Legislature, the Occupational Safety and Health Standards Board, and the Los Angeles County Board of Supervisors "on the risk of exposure to carcinogenic materials and incidence of occupational cancer in mechanics who repair and clean firefighting vehicles" (Labor Code, 2019). The study components include:

- Site visits at representative facilities in Los Angeles County, California
- Interviews and surveys with current and former fire mechanics to assess potential exposures to carcinogens
- Occupational exposure measurements of carcinogens identified as potentially present in the workplace, to evaluate potential exposure to carcinogens
- Quantitative health risk assessment of potential increased cancer risk associated with exposure to carcinogens in the workplace.

ToxStrategies was contracted by the California Department of Industrial Relations (DIR), CHSWC, to conduct the study as outlined in AB 1400. ToxStrategies' approach to address these study components includes six tasks:

- Task 1: Structured Literature Review — summary of available scientific literature on exposure to chemical carcinogens and studies of cancer risk among fire mechanics
- Task 2: Qualitative Exposure Assessment — site visits at representative facilities

- **Task 3: Epidemiologic assessment** — feasibility study of cohort enumeration
- Task 4: Quantitative Exposure Assessment — measurement of current occupational exposures to carcinogens
- Task 5: Cancer risk assessment — calculation of theoretical excess cancer risks from occupational exposure to carcinogens
- Task 6: Technical assistance to the DIR.

The purpose of Task 3 (epidemiologic assessment) is to determine the feasibility of conducting an epidemiology study to assess the risk of cancer in fire mechanics. A feasibility study helps to determine whether a full epidemiologic study is warranted based on availability of data and potential number of participants. Conducting an epidemiologic study without this first step would likely waste limited resources and may not provide meaningful results. This report summarizes the objectives, methods, and results of the epidemiologic feasibility study and discusses recommendations for next steps.

2 Objectives

The objectives of Task 3 were as follows:

1. Evaluate employee records for completeness and suitability for a cancer study.
2. Ascertain availability of information in employee records for assessing disease confounders (e.g., smoking).
3. Develop recommendation for the appropriate epidemiology design.

3 Methods

Evaluating a potential risk of cancer for a specific occupation is most commonly conducted using a cohort study, which is an epidemiologic study design in which populations are assembled based on a common factor (e.g., employment as a fire mechanic), observed over time, evaluated for risk factors, and followed for a particular outcome. Cohort studies can be either prospective, where exposure to risk factors is evaluated as part of the study, and participants are followed forward in time, or retrospective, where exposures occurring in the past are used to define cohorts, and the outcomes have already occurred.

To assess the feasibility of assembling a retrospective cohort of fire mechanics in LA County to evaluate the risk of cancer, the following steps were taken:

1. Determine that occupation as an LA County fire mechanic can be ascertained and verified, typically through employment records (*exposure verification*).
2. Ensure that the outcome of cancer can be ascertained and verified through a relevant cancer registry or medical records that can be linked to cohort participants (*outcome ascertainment*).

3. Evaluate the size of the potential cohort by determining the number of people who ever held the occupation of interest (fire mechanics) during a specific timeframe (*cohort enumeration*).
4. Determine the availability of demographic and socioeconomic characteristics and medical history factors that may confound the relationship between occupation and cancer (*confounding variables*).

If a retrospective cohort of fire mechanics can be assembled and tracked for cancer outcomes, the incidence or mortality rates for certain cancers can be calculated within the cohorts and subsequently compared to the cancer rates of a comparable population to determine whether this occupation has higher (or lower) than expected rates of cancer.

ToxStrategies evaluated the feasibility of constructing a cohort of fire mechanics at LA County Fire and following them for cancer outcomes. ToxStrategies first conducted qualitative interviews with relevant LA County Fire personnel, including three fire equipment mechanics, the president of the American Federation of State, County and Municipal Employees (AFSCME) union local 119, and a representative from LA County Fire human resources (HR), to gauge the scope of available information needed for cohort assembly (Table 1). During the interviews, ToxStrategies staff members inquired as to the type of information captured in employee records, including personal identifying information and variables that may potentially confound the relationship between occupation and cancer, such as smoking and body mass index (BMI).

Table 1. Description of qualitative interviews

Interviewee	Position	Date of Interview
Luis del Cid	Fire equipment mechanic	9/24/2020
Grant "Sonny" DeRose	Fire equipment mechanic	9/24/2020
Harry Wong	Fire equipment mechanic	9/24/2020
Gary Hodge	President of the AFSCME union local; fire equipment mechanic	9/29/2020
Julia Kim	LA County Fire HR Chief Risk Manager	10/15/2020

After the interviews were completed, ToxStrategies worked with LA County Fire HR to obtain additional information needed for the feasibility study. Notably, the HR department was initially difficult to reach, and responses were often delayed for weeks due to the COVID-19 pandemic. On December 14, 2020, a letter was sent to the department on behalf of ToxStrategies from Assemblywoman Sydney Kamlager's office, one of the co-sponsors of the AB 1400 bill, to encourage response. If an epidemiologic study is pursued, a point person at the County HR will need to be identified to ensure timely response and participation as the County HR keeps the records necessary to conduct the study for LA County fire mechanics.

4 Results

4.1 Exposure Verification

LA County Fire employees are categorized by occupation using job classification codes. During one of ToxStrategies' site visits to LA County Fire, ToxStrategies was provided with a list of job classification codes for employees who would be considered fire mechanics, including equipment maintenance workers, fire equipment mechanics, helicopter mechanics, and helicopter maintenance inspectors (Table 2). Employees working in senior positions for these job titles conduct the same work as non-senior employees but they perform additional supervisory roles. All employees ever holding one of these job classification codes would be considered as part of the fire mechanic cohort.

Table 2. Job classification codes of fire mechanics

Job Classification Code	Description
6610	Equipment Maintenance Worker
7472	Fire Equipment Mechanic
7492	Helicopter Mechanic
7496	Helicopter Maintenance Inspector
6613	Senior Equipment Maintenance Worker
7473	Senior Fire Equipment Mechanic
7494	Senior Helicopter Mechanic

The job classification codes are included in various types of county records, including time sheets, personnel files, and union records. Each of these records could serve as a source for identifying participants in the cohort of fire mechanics, as well as determining the length of time employees held a particular position. LA County Fire keeps physical, original copies of official personnel files, as well as electronic records in the eHR system, a county-wide system of electronic personnel records. While personnel records are retained at the County for only five years after an employee's termination (voluntary or involuntary), a listing of employees by job classification code is available through the eHR system, which began in 2012, and the County-Wide Timekeeping and Payroll/Personnel System (CWTAPPS) system, which holds records from 1975 through 2012.

4.2 Outcome Ascertainment

The California Cancer Registry (CCR) is a comprehensive statewide cancer surveillance program that captures diagnoses of cancer in the state of California since 1988. Cancer reporting is required by state law. Approximately 5.8 million cancer cases are available for research in the CCR, and nearly 200,000 additional cases are added annually. The CCR has achieved gold certification from the North American Association of Central Cancer Registries, the highest achievable standard, requiring case ascertainment of ≥95% completeness (California Cancer Registry, 2018).

The LA County Cancer Surveillance Program, which reports data to the CCR, has population-based cancer data available beginning in 1972 (USC, 2020) Cancer cases that occurred in LA County specifically could be traced back to 1972, while cases occurring outside the county could be traced back to 1988.

Cancer mortality can be evaluated using the National Death Index (NDI), a comprehensive database of all deaths occurring in the US from 1979 through 2019 (latest available data). Multiple causes of death are recorded in NDI records, and deaths due to cancer can be identified (CDC, 2021).

Employees at LA County Fire can be linked to the CCR and/or the NDI using their social security number and/or their date of birth, both of which are available in employee official personnel files, as well as through the eHR system. Thus, fire mechanics can be tracked reliably for cancer diagnoses and/or cancer-related death, provided that the cancer was diagnosed within the state of California. Because social security number and date of birth are sensitive personal identifying information, any epidemiologic study would require an ethical evaluation and approval from an institutional review board (IRB). A project proposal would need to be approved by the CCR to receive individual-level data.

4.3 Cohort Enumeration

Using the CWTAPPS system (1975–2012 personnel records), as well as the eHR records (2012–2021), LA County Fire HR was able to provide the number of employees at LA County Fire who held the position of fire mechanic from September 1, 1975, through January 2021 (Table 3). September 1, 1975 was the earliest date available in the CWTAPPS system in order to identify employees holding one of these codes. Senior positions are often promoted internally, such that a single employee can have multiple job codes of interest. After removing duplicate listings of employees holding multiple job codes, a total of 180 individual employees were identified as having one of the fire mechanic classification codes. This is a preliminary estimate; employees holding the position for a short period of time (e.g., <90 days) may not be eligible for inclusion in the cohort.

Table 3. Number of LA County fire mechanics, 1975–2021

Job Classification Code	Description	Number of Employees
6610, 6613	Equipment Maintenance Worker, including promotion to Senior position	20
7472, 7473	Fire Equipment Mechanic, including promotion to Senior position	126
7492, 7494, 7496	Helicopter Mechanic, including promotion to Senior position; Helicopter Maintenance Inspector	34
	Total	**180**

4.4 Confounding Variables

Prior to beginning employment at LA County Fire, fire equipment mechanics, equipment maintenance workers, helicopter mechanics and helicopter maintenance inspectors must complete a medical clearance evaluation. Employees undergo a physical evaluation at a separate occupational health clinic. These records are not typically included in employee personnel files, but they could potentially be obtained through the clinic. It is likely that potential confounding variables would be captured during the pre-employment physical, including smoking history, alcohol consumption, BMI, and personal and family medical history.

Confounding variables are also available from linkage with the California Cancer Registry, including tobacco use, comorbidities, patient height and weight, race, and socioeconomic indicators. While some of these variables have been evaluated since the registry's inception in 1988 (comorbidities, race, socioeconomic variables), others are available only for cases diagnosed in 2011 and later (height, weight, tobacco use). Thus, these variables can be used only to validate available data from the pre-employment physical records. Additionally, age, sex, and race may be available using the National Death Index.

4.5 Potential Comparison Populations

As a first step, the cancer incidence rates in the fire mechanic cohort could be compared to the age- and sex-standardized cancer incidence and/or mortality rates in the state of California. An incidence rate is calculated by taking the number of newly diagnosed cancer cases over a period of time and dividing by the at-risk population during that time frame. This is usually calculated as a rate per person-time available, such as 10 per 100,000 person-years of cohort follow-up. The ratio of the observed cancer incidence to the expected incidence based on state rates (standardized incidence ratio, or SIR) would identify any differences in cancer rates between fire mechanics and California residents. While these types of studies are useful in identifying potential associations between occupational groups and cancer, they are often confounded by underlying factors, such as different rates of smoking between the cohort and the general population.

An ideal comparison population to evaluate the risk of cancer in fire mechanics would comprise a demographically similar population. A group of workers with similar distributions of age, sex, race, smoking history, and socioeconomic status would control for potentially confounding variables and isolate the risk factor of working as a fire mechanic. One potential comparison group could be other mechanics in LA County outside of the Fire Department. These employees would likely have demographics similar to those of the fire mechanics, without exposure to firefighting equipment and vehicles. The comparison group could be identified with job classification codes in the eHR system and linked to the CCR. However, it is unclear how many persons would make up a cohort of general mechanics and whether the sample would be large enough to detect statistically significant risks.

4.6 Additional Considerations

A theoretical calculation was conducted to estimate whether the potential cohort size (n=180) would be large enough to detect a significant risk of cancer compared to the general population. The CCR online analysis tool (CAL*Explorer) was used to determine the incidence rate of all cancers among residents of LA County (386.3 per 100,000). The risk of cancer among fire mechanics was assumed to be the same as the highest risk of a specific cancer site observed among firefighters (50% increased risk of testicular cancer, [IARC 2010], as no summary of the risk of all cancers was available). A power calculation was conducted and determined that approximately 10,000 person-years of time would be required. Assuming an average of 10 years of follow-up (time from beginning occupation as a fire mechanic to latest date cancer data is available), approximately 1000 fire mechanics would be needed to detect a significantly increased risk of cancer.

5 Conclusions and Recommendations

The epidemiologic feasibility study determined that a cohort of fire mechanics in LA County could be assembled, identifying employees holding relevant occupational positions since 1975 and linked to the California Cancer Registry and/or NDI for cancer outcomes. However, the size of the potential cohort would be relatively small (preliminary estimate of 180 employees from 1975–2021), limiting the ability to detect any risk of cancer in this population. Conducting an epidemiologic study in this potential cohort would not produce meaningful results. If the cancer risk in fire mechanics was similar to that of firefighters, at least 1000 fire mechanics would be needed to determine a significant increased risk of cancer.

5.1 Recommendation

Evaluate potential of expanding the cohort to fire mechanics throughout the state of California.

The cohort of fire mechanics could be reliably constructed using job classification codes and personnel records in LA County and could be tracked for cancer outcomes using the CCR and/or NDI. To increase statistical power and precision, the feasibility of expanding the cohort to fire mechanics throughout California could be explored. If other counties use the same personnel records system and job classification codes, including all fire mechanics in the State of California in the cohort, it would be straightforward. Cancer incidence and mortality rates could be calculated for the cohort and compared to rates in LA County and the State of California after standardizing the rates by age, sex, and race. A larger cohort size would increase the statistical ability to detect any significant cancer risk in these workers. Further, if an increased risk of one or more cancer sites is detected within the cohort, nested case-control studies can be conducted to evaluate specific risk factors within the cohort for these cancer types (e.g., certain job tasks, exposures, or demographic factors).

6 References

AB 1400 Employment safety: Firefighting equipment: Mechanics (2019–2020). In. Senate Committee on Labor, Public Employment and Retirement, 2019.

CAL*Explorer. 2020. An interactive website for California Cancer Registry (CCR) cancer statistics. California Department of Public Health.

California Cancer Registry. 2018. Learn About CCR. ccrcal.org/learn-about-ccr/. Accessed 2021.

CDC (Centers for Disease Control and Prevention). 2021. About the National Death Index. https://www.cdc.gov/nchs/ndi/about.htm.

IARC (International Agency for Research on Cancer) Working Group on the Evaluation of Carcinogenic Risks to Humans. Painting, firefighting, and shiftwork. 2010. IARC Monogr Eval Carcinog Risks Hum 98:9–764.

Labor Code. 2019. Employment safety: Firefighting equipment: Mechanics.

LeMasters GK, Genaidy AM, Succop P, et al. 2006. Cancer risk among firefighters: A review and meta-analysis of 32 studies. J Occup Environ Med 48(11):1189–1202.

National Cancer Institute: Surveillance, Epidemiology, and End Results Program. 2021. Cancer Stat Facts: Cancer of Any Site. https://seer.cancer.gov/statfacts/html/all.html

Tsai RJ, Luckhaupt SE, Schumacher P, Cress RD, Deapen DM, Calvert GM. 2015. Risk of cancer among firefighters in California, 1988–2007. Am J Indust Med 58(7):715–729.

USC (University of Southern California). 2020. Los Angeles County Cancer Surveillance Program. https://csp.usc.edu/about/.

APPENDIX D

Task 4: Quantitative Exposure Assessment

Task 4: Quantitative Exposure Assessment

FEBRUARY 25, 2021

ToxStrategies

Innovative solutions
Sound science

Task 4: Quantitative Exposure Assessment

FEBRUARY 25, 2021

PREPARED FOR:

State of California
Department of Industrial Relations
1515 Clay Street
Suite 1902
Oakland, California 94612

PREPARED BY:

ToxStrategies, Inc.
27001 La Paz Road
Suite 260
Mission Viejo, California 92691

Table of Contents

List of Tables

Acronyms

AB	Assembly Bill (California)
AIHA	American Industrial Hygiene Association
BA	breathing apparatus
CalOSHA	California Occupational Safety and Health Administration
CHSWC	Commission on Health and Safety and Workers’ Compensation
cm	centimeter
Cr(VI)	hexavalent chromium
DI	deionized (water)
DIR	California Department of Industrial Relations
DOSH	California Division of Occupational Safety and Health
FEM	Fire Equipment Mechanic
GC/HRMS	gas chromatography / high-resolution mass spectrometry
ID	identifier
$\mu g/cm^2$	micrograms per square centimeter
µm	micrometer
mg/m^3	milligrams per cubic meter of air
mm	millimeter
Mod.	modified
NaOHqz	sodium hydroxide–coated binderless quartz (fiber filter wipe)
NIOSH	National Institute for Occupational Safety and Health
OCP	organochlorine pesticide
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PBZ	personal breathing-zone (air samples)
PCB	polychlorinated biphenyl
PEL	permissible exposure limit
PPE	personal protective equipment
ppm	parts per million by volume
PVC	polyvinyl chloride
SEG	similar exposure group
TCDD	2,3,7,8-tetrachlorodibenzo-*p*-dioxin
TEF	toxicity equivalency factor
TEQ	toxic equivalence
TWA	time-weighted average

1 Background

ToxStrategies was contracted by the California Department of Industrial Relations (DIR), Commission on Health and Safety and Workers' Compensation (CHSWC), to conduct the study as outlined in California Assembly Bill (AB) 1400. AB 1400 was created to define the fire mechanics' risk of exposures to carcinogens in the course of employment.

The study components include:

- Site visits to representative facilities in Los Angeles County, California
- Interviews and surveys with current and former fire mechanics
- Feasibility study to assess cancer incidence among fire mechanics
- Occupational exposure measurements of carcinogens found in the workplace, to evaluate potential exposure to carcinogenic materials
- Quantitative health risk assessment of potential increased cancer risk associated with exposure to carcinogens in the workplace.

ToxStrategies' approach to address these study components includes six tasks (provided in our proposal submitted to the DIR [ToxStrategies, Inc., 2020a]):

- Task 1: Structured literature review — submitted; ToxStrategies, Inc. (2020b)
- Task 2: Qualitative exposure assessment — submitted; ToxStrategies, Inc. (2020c)
- Task 3: Epidemiologic assessment — feasibility study of cohort enumeration for future epidemiologic study design — ongoing
- Task 4: Quantitative exposure assessment — measurement of current occupational exposures to carcinogens; provided herein
- Task 5: Cancer risk assessment — calculation of theoretical excess cancer risks from occupational exposure to carcinogens
- Task 6: Technical assistance to the DIR.

The purpose of Task 4, Quantitative Exposure Assessment, was to conduct exposure monitoring of workers for airborne chemicals, as well as chemical analysis of surface residues, based on the findings from Tasks 1 and 2. Samples from each similar exposure group (SEG) were selected for personal breathing-zone (PBZ) air sampling and surface wipe sampling of equipment. The quantitative exposure results from Task 4 will be used subsequently in the cancer risk assessment (Task 5). The objectives, methods, results, and conclusions of Task 4 are provided herein. The remaining study tasks are described in Section 7.

2 Objectives

The objectives of this quantitative exposure assessment were as follows:

1. Prepare a quantitative exposure assessment work plan.
2. Collect PBZ air samples and surface wipe samples for analysis at an American Industrial Hygiene Association (AIHA)-accredited laboratory.
3. Present the analytical sample results (measurements) for each of the prioritized job tasks.

3 Methods of Selecting Carcinogens

The identification and selection of chemicals for analytical sampling, for each of the prioritized job tasks, included the evaluation of findings from Task 1, Task 2, and other sources, as summarized below.

3.1 Task 1 Findings

ToxStrategies identified chemicals in Task 1 (Structured Literature Review; ToxStrategies, Inc., 2020b) for consideration in the quantitative exposure assessment, and additional chemicals were added to the analysis plan following Task 2 (Qualitative Exposure Assessment). In Task 1, ToxStrategies found no occupational chemical exposure studies that explicitly focused on fire mechanics. However, nine industrial hygiene studies presented data for fire stations and firefighting vehicles and/or gear, which could overlap with occupational exposures of fire mechanics. The chemical carcinogens evaluated in those studies, or considered subsequently for inclusion, are benzene, diesel exhaust, polycyclic aromatic hydrocarbons (PAHs), crystalline silica, ethylbenzene, polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), acetaldehyde, formaldehyde, 1,4-dichlorobenzene, and styrene. Benzene, diesel exhaust, PAHs, crystalline silica, and ethylbenzene were identified in Task 2 for inclusion in the quantitative assessment. OCPs and 1,4-dichlorobenzene were not included in the analyses for Task 4, for the following reasons:

- OCPs were excluded from incorporation into the sampling plan, based on the results of the study by Park et al. (2015) and the findings presented in IARC (2010). Park et al. found that firefighting was not a significant source of exposure to OCPs. Further, IARC did not report OCPs in their list of chemicals measured during various firefighting operations (wildland, municipal, training, or arson investigation).
- 1,4-Dichlorobenzene was excluded from consideration in the sampling plan, because Fent et al. (2015) reported that firefighters' brand new personal protective equipment (PPE) had a higher measured off-gassing air concentration of 1,4-dichlorobenzene than that of the used PPE that had been exposed to a controlled burn. Therefore, off-gassing of 1,4-dichlorobenzene was not associ-

ated with the burn, but presumably, was associated with the chemicals used in manufacturing the PPE.

PCBs, styrene, acetaldehyde, and formaldehyde were included in the Task 4 investigation, for the following reasons:

- PCBs were not found to be a significant source of exposure among firefighters, when measured in firefighter serum in the study by Park et al. (2015). However, IARC (2010) reported PCBs in their list of chemicals measured during municipal firefighting operations. Therefore, PCBs were included in the sampling plan for surface wipe analysis.
- Styrene was reported to have higher measured off-gassing in used firefighters' PPE that had been exposed to a controlled burn than the measured background levels (Fent et al., 2015). Therefore, styrene was added to the air sampling plan for the SEG of equipment maintenance workers.
- Acetaldehyde and formaldehyde were measured at low levels during wildland firefighting by Materna et al. (1992); therefore, these aldehydes were both included in the PBZ air sampling plan for the SEG of equipment maintenance workers.

3.2 Task 2 Findings

ToxStrategies relied primarily on the findings from Task 2, Qualitative Exposure Assessment (ToxStrategies, Inc., 2020c), to prioritize the chemicals included in the PBZ air samples and surface wipe samples. A qualitative exposure assessment tool was used to rank potential exposures associated with jobs and tasks to carcinogens identified in the workplace. This tool allowed ToxStrategies to target the DIR resources for Task 4 most cost-effectively. Based on the outcome of the risk ranking results for all four SEGs, ToxStrategies prioritized the job tasks listed in Table 1 for the quantitative exposure assessment.

ToxStrategies identified the surface residue, soot, as a priority carcinogen to measure during the quantitative exposure assessment. Soot, ash, and char are considered fire residues and have the potential to pose an occupational exposure concern for fire mechanics who frequently contact fire apparatuses and equipment that have been exposed to a fire. The chemicals that make up this residue may include "heavy metals, PAHs, dioxins and furans" (AIHA, 2018). PAHs, dioxins, and furans were thus added to the sampling plan for surface sampling of fire residues. With regard to the heavy metals, ToxStrategies included arsenic and lead, because both have published cancer potency measures for the oral route, which can be evaluated for cancer risk through a surface wipe sample. ToxStrategies excluded cadmium, beryllium, nickel, and cobalt from the surface wipe sampling plan, because these chemicals are carcinogenic only by inhalation and do not have published cancer potency measures for other routes of exposure. Therefore, they were not evaluated in surface wipe samples.

Table 1. Job tasks prioritized for the quantitative exposure assessment

Job Task	Similar Exposure Group	Location
Heavy maintenance on aircraft, including the task of oil leak checks	Helicopter mechanic	Air Operations, Pacoima
Intermediate maintenance on aircraft	Helicopter mechanic	Air Operations, Pacoima
Painting/priming/sanding aircraft parts	Helicopter maintenance inspector	Air Operations, Pacoima
Repair and tune-up of power equipment and rescue tools	Equipment maintenance worker	Breathing Apparatus Shop, Pacoima
Fire hose repair	Equipment maintenance worker	Breathing Apparatus Shop, Pacoima
Maintenance and repair on fire apparatus	Shop-assigned fire equipment mechanic	Eastern Fire Shop, Los Angeles, & North County Fire Shop, Lancaster
Repair of fire apparatus or other equipment at a wildfire base camp	Field-assigned FEM	Wildfire base camp

3.3 Other Findings

A recent study by Fent et al. (2020) reported detections of the carcinogenic flame retardant, tetrabromobisphenol-A, and chlorinated and brominated dioxins/furans in wipe samples of firefighters' PPE subsequent to exposure to a simulated residential fire. Tetrabromobisphenol-A and chlorinated and brominated dioxins/furans were also detected in air samples collected during the active fire period of the simulated residential fire. Because tetrabromobisphenol-A does not have published cancer potency measures, it cannot be evaluated quantitatively, and therefore, it was not included in the sampling plan for wipe analysis. However, chlorinated dioxins and furans were added to the sampling plan for wipe analysis for all five SEGs based on the findings of this study.

ToxStrategies added the carcinogen pentachlorophenol to the sampling plan based on the data reported in IARC (2010). Pentachlorophenol was detected in air samples measured in municipal fires; thus, this chemical was suspected to be a fire residue in fire equipment and apparatuses. Therefore, pentachlorophenol was added to the sampling plan for wipe analysis for the SEGs of fire equipment mechanic and equipment maintenance workers.

4 Sampling Plan

The final sampling plan is summarized below for each SEG and job task (Table 2). Execution of the sampling plan for each job task is described in more detail below.

Table 2. Quantitative assessment plan by SEG and job task

	Job Task Description	Job Title	Exposure Media and Chemicals	
Site Location	**Job Task Name**	**SEG**	**Air**	**Surface Residue**
Air Operations, Pacoima	Heavy maintenance on aircraft, including the task of oil-leak checks	Helicopter Mechanic/ Helicopter Maintenance Inspector	Crystalline silica, Cr(VI)	Cr(VI), PAHs, arsenic, lead
Air Operations, Pacoima	Intermediate maintenance on aircraft	Helicopter Mechanic/ Helicopter Maintenance Inspector	Benzene, ethylbenzene, naphthalene, Cr(VI)	Cr(VI), chlorinated dioxins/furans, PCBs, PAHs, arsenic, lead
Air Operations, Pacoima	Painting/priming/sanding aircraft parts	Helicopter Mechanic/ Helicopter Maintenance Inspector	Ethylbenzene, Cr(VI), 4-chlorobenzo-trifluoride, methylene chloride	
Breathing Apparatus Shop, Pacoima	Repair and tune-up of power equipment and rescue tools	Equipment Maintenance Worker	Acetaldehyde, formaldehyde, benzene, ethylbenzene, naphthalene, styrene	PAHs, chlorinated dioxins/furans, PCBs, pentachlorophenol, arsenic, lead
Breathing Apparatus Shop, Pacoima	Fire hose repair	Equipment Maintenance Worker		PAHs, arsenic, lead
Eastern Fire Shop, Los Angeles; North County Fire Shop, Lancaster	Maintenance and repair on fire apparatus	Shop/Field Fire Equipment Mechanic	Benzene, ethylbenzene naphthalene, diesel particulate, N,N-dimethyl-para-toluidine, tetrachloroethylene, welding fume metals (including Cr(VI))	PAHs, chlorinated dioxins/furans, PCBs, pentachlorophenol, arsenic, lead, bulk sample of fiberglass strips for asbestos
Wildfire base camp or fire site	Repair of fire apparatus or other equipment	Field Fire Equipment Mechanic	Acetaldehyde, benzene, ethylbenzene, naphthalene, diesel particulate, formaldehyde, PAHs	PAHs, chlorinated dioxins/furans, PCBs, pentachlorophenol, arsenic, lead

Abbreviations: Cr(VI) = hexavalent chromium; PAHs = polycyclic aromatic hydrocarbons; PCBs = polychlorinated biphenyls

4.1 Air Operations, Pacoima

4.1.1 Heavy maintenance on aircraft, including the task of oil-leak checks

Heavy maintenance on the aircraft by helicopter mechanics typically takes place inside the hangar, and includes disassembling and reassembling airframes, engines, and other components and parts. The mechanics generally wear a uniform, work boots, goggles/safety glasses, hearing protection, gloves (type dependent on task), and knee pads.

Personal breathing zone air samples were collected from six helicopter mechanics and analyzed for the following chemicals:

- Crystalline silica by NIOSH 7500 (modified [Mod.]) and 0600 using a 5-µm (micrometer) polyvinyl chloride (PVC) membrane and tared 5-µm PVC membrane in a three-piece cassette with aluminum cyclone
- Hexavalent chromium by OSHA ID-215 (version 2) using a 5-µm PVC membrane in a 37-mm (millimeter) cassette.

Wipe samples of the helicopter surfaces were collected in accordance with NIOSH Method 9100 (NIOSH, 1996) using a 10- x 10-centimeter (cm) square template. One template and a new pair of gloves were used for each wipe sample. Six surfaces were sampled for the following chemicals:

- PAHs by NIOSH 5528 using hexane-extracted gauze
- Arsenic and lead by NIOSH 9102 Mod. using Ghost Wipes.

Two surfaces were sampled for hexavalent chromium by OSHA ID-215 using a 37-mm sodium hydroxide–coated binderless quartz (NaOHqz) fiber filter wipe.

The chemicals, sample identifiers (IDs), sampling locations, and observations/notes are summarized in Table 3 for the wipe samples collected on various surfaces of the aircrafts stationed in the hangar for heavy maintenance on November 3, 2020.

Table 3. Wipe samples collected on aircrafts in hangar

Chemicals	Sample ID	Sampling Location	Observations / Notes
PAHs	N190LA-01	Intermediate gear box of Firehawk	Fire residues/ dust
PAHs	N14LA-03	Right stabilator of Bell412	Fire residues/ dust
PAHs	N14LA-02	Right tailbone of Bell412	Fire residues/ dust

Chemicals	Sample ID	Sampling Location	Observations / Notes
PAHs	N14LA-01	Right side of nose of Bell412	Fire residues/ dust
PAHs	N190LA-02	Upper aft blade antenna, left side, of Firehawk	Fire residues/ dust
PAHs	N190LA-03	Transition access door, underside, of Firehawk	Fire residues/ dust
Arsenic and lead	N190LA-01-A	Intermediate gear box of Firehawk	Fire residues/ dust
Arsenic and lead	N190LA-02-A	Upper aft blade antenna, left side, of Firehawk	Fire residues/ dust
Arsenic and lead	N14LA-02-A	Right tailbone of Bell412	Fire residues/ dust
Arsenic and lead	N14LA-01-A	Right side of nose of Bell412	Fire residues/ dust
Arsenic and lead	N190LA-03-A	Transition access door, underside, of Firehawk	Fire residues/ dust
Arsenic and lead	N14LA-03-A	Right stabilator of Bell412	Fire residues/ dust
Hexavalent chromium	N14LA-05	Skid on right side of Bell412	Mastinox visible
Hexavalent chromium	N14LA-06	Mating surface of combining gear box trimount of Bell412	Mastinox visible

One field blank per analyte was collected for quality assurance.

4.1.2 Intermediate maintenance on aircraft

Intermediate maintenance includes routine daily inspection and maintenance on the aircraft by helicopter mechanics. This task is approximately an hour in duration and typically takes place outdoors on the flight line or in a covered area off the flight line. PPE includes work boots, work uniform, goggles/safety glasses, hearing protection, gloves (depending on task), and knee pads. Intermediate maintenance is performed at the start of the work shift. After the intermediate maintenance is completed each day, the helicopter mechanics return to the hangar and conduct heavy maintenance on the aircraft. The intermediate maintenance helicopter mechanics were measured during their entire work shift; therefore, the occupational exposure samples capture both intermediate maintenance and heavy maintenance on the aircraft, with the latter task constituting the bulk of the measurements.

PBZ air sampling was measured among six helicopter mechanics for the following chemicals:

- Benzene, ethylbenzene, and naphthalene using a 3M 3500/3520 organic vapor monitor
- Hexavalent chromium by OSHA ID-215 (version 2) using a 5-µm PVC membrane in a 37-mm cassette.

Wipe samples of the helicopter surfaces were collected in accordance with NIOSH Method 9100 (NIOSH, 1996) using a 10- x 10-cm square template. One template and a new pair of gloves were used for each wipe sample.

Six surfaces were sampled for the following chemicals:

- Polycyclic aromatic hydrocarbons (PAHs) by NIOSH 5528 using hexane-extracted gauze
- Arsenic and lead by NIOSH 9102 Mod. using Ghost Wipes
- Hexavalent chromium by OSHA ID-215 using a 37-mm NaOHqz fiber filter.

Two surfaces were sampled for the following chemicals:

- Chlorinated dioxins/furans by EPA 1613B and PCBs by EPA 1668C using swabs soaked in hexane.

The chemicals, sample IDs, sampling locations, and observations/notes are summarized in Table 4 for the wipe samples collected on various surfaces of the aircrafts parked on the flight line for intermediate maintenance on November 3, 2020.

Table 4. Wipe samples collected on aircraft on the flight line

Chemical	Sample ID	Sampling Location	Observations/ Notes
PAHs	N822LA-01	Right engine exhaust cowling of Firehawk	Firehawk had been to a recent wildfire (October 2020)
PAHs	N120LA-01	Tail of Bell412	Bell412 had not been cleaned since usage in wildfire
PAHs	N120LA-02	Blade antenna of Bell412	Bell412 had not been cleaned since usage in wildfire
PAHs	N822LA-03	Horizontal stabilator of Firehawk	Firehawk had been to a recent wildfire (October 2020)
PAHs	N822LA-02	Forward cowling, right side, of Firehawk	Firehawk had been to a recent wildfire (October 2020)
PAHs	N120LA-03	Glass "sun roof"/"greenhouse" of Bell412	Bell412 had not been cleaned since usage in wildfire
Arsenic and lead	N120LA-03-A	Glass "sun roof"/"greenhouse" of Bell412	Bell412 had not been cleaned since usage in wildfire
Arsenic and lead	N822LA-03-A	Horizontal stabilator of Firehawk	Firehawk had been to a recent wildfire (October 2020)
Arsenic and lead	N120LA-01-A	Tail of Bell412	Bell412 had not been cleaned since usage in wildfire
Arsenic and lead	N120LA-02-A	Blade antenna of Bell412	Bell412 had not been cleaned since usage in wildfire
Arsenic and lead	N822LA-01-A	Right engine exhaust cowling of Firehawk	Firehawk had been to a recent wildfire (October 2020)
Arsenic and lead	N822LA-02-A	Forward cowling, right side, of Firehawk	Firehawk had been to a recent wildfire (October 2020)
Hexavalent Chromium	N18LA-01	Hot part of left engine (seam) of Bell412	
Hexavalent Chromium	N17LA-04	Hot part of left engine (seam) of Bell412	
Hexavalent Chromium	N18LA-02	Hot part of right engine (seam) of Bell412	
Hexavalent Chromium	N120LA-01	Hot part of right engine (seam) of Bell412	

Chemical	Sample ID	Sampling Location	Observations/ Notes
Hexavalent Chromium	N120LA-02	Hot part of left engine (seam) of Bell412	
Hexavalent Chromium	N17LA-03	Hot part of left engine (seam) of Bell412	
Chlorinated dioxins/ furans & PCBs	356-4	Horizontal stabilator of Bell412	
Chlorinated dioxins/ furans & PCBs	356-5	Chin bubble of Bell412	

Field blanks were collected for quality assurance, as applicable.

Although diethanolamine and tetrahydrofuran were also considered potential carcinogens of concern for this job task, these compounds were not measured quantitatively, because they do not have published cancer potency measures. Thus, the cancer risk assessments conducted in Task 5 for these chemicals will be qualitative.

4.1.3 Painting/priming/sanding aircraft parts

For the helicopter maintenance inspector job task of painting/priming on the interior and exterior of the aircraft, sanding helicopter blades, painting helicopter blades, and painting using aerosol paints and epoxy primers, ToxStrategies planned to measure one helicopter maintenance inspector for the following chemicals through PBZ air sampling:

- Ethylbenzene using a 3M 3500/3520 organic vapor monitor
- Hexavalent chromium by OSHA ID-215 (version 2) using a 5-µm PVC membrane in a 37-mm cassette
- Methylene chloride using a 3M 3520 two-stage organic vapor monitor
- 4-Chlorobenzotrifluoride by NIOSH 1026 using a coconut shell charcoal sorbent tube.

However, ToxStrategies was informed by Air Operations shortly before the scheduled sampling event that this job task would not be performed and therefore could not be measured, because no paint jobs were needed at the time. Therefore, the cancer risk assessment (Task 5) for these chemicals in this job task will be qualitative.

4.1.4 Area samples

ToxStrategies collected two area PBZ air samples to be analyzed for the following chemicals:

- Benzene, ethylbenzene, and naphthalene using a 3M 3500/3520 organic vapor monitor.

Because a field blank had already been collected for each of these chemicals, no additional field blanks were collected.

4.2 Breathing Apparatus Shop, Pacoima

4.2.1 Repair and tune-up of power equipment and rescue tools

Shop locations at Pacoima include the Breathing Apparatus (BA) Shop, Small Engine Repair Shop, and Fire Hose Repair Shop. At the Small Engine Repair Shop, worker tasks include equipment examination and analysis of equipment malfunctions or mechanical failure. Other tasks include tuning up equipment used by the County fire stations, such as rescue tools, lawn mowers, vacuums, and generators. At the Fire Hose Repair Shop, the workers are responsible for repairing fire-truck hoses and completing the hose test. Equipment, such as firefighter BAs, is maintained and tested at the Pacoima BA Shop. BAs used during fire training in simulated structure burns, such as that conducted at the Los Angeles County Fire Department Fire Station 129 in Lancaster, are maintained at the BA Pacoima shop. The workers' PPE includes latex gloves and an apron.

At the Engine Repair Shop, PBZ air samples were collected among two equipment maintenance workers for the following chemicals:

- Benzene, ethylbenzene, naphthalene, and styrene using a 3M 3500/3520 organic vapor monitor
- Acetaldehyde and formaldehyde by EPA TO-11A using an SKC 500-100, UMEx 100 passive sampler.

Wipe samples of the air packs (exterior surfaces) were collected in accordance with NIOSH Method 9100 (NIOSH, 1996) using a 10- x 10-cm square template. One template and a new pair of gloves were used for each wipe sample. Six air packs were sampled for the following chemicals:

- PAHs by NIOSH 5528 using hexane-extracted gauze
- Arsenic and lead by NIOSH 9102 Mod. using Ghost Wipes.

Two air packs (exterior surfaces) were sampled for the following chemicals:

- Chlorinated dioxins/furans by EPA 1613B and PCBs by EPA 1668C using swabs soaked in hexane.

- Pentachlorophenol by OSHA 39 using sterile cotton gauze soaked in deionized (DI) water.

The chemicals, sample IDs, sampling locations, and observations/notes are summarized in Table 5 for the wipe samples collected on the field and training air packs in the BA shop on November 3, 2020.

Table 5. Wipe samples collected on air packs

Chemical	Sample ID	Sampling Location	Observations/ Notes
PAHs	A49996	Where air pump sits, northern location	Field air pack
PAHs	A50421 ENG-21-4	Where air pump sits, northern location	Field air pack
PAHs	A5014 Q-24-5	Where air pump sits, northern location	Field air pack
PAHs	ECTC-T-8	Where air pump sits, northern location	Training air pack
PAHs	ECTC-T-38	Where air pump sits, northern location	Training air pack
PAHs	NCSO-04	Where air pump sits, northern location	Training air pack
Arsenic and lead	ECTC-T-8-A	Where pump sits, southern location	Training air pack
Arsenic and lead	ECTC-T-38-A	Where pump sits, southern location	Training air pack
Arsenic and lead	A49996-QUT-185-4-A	Where pump sits, southern location	Field air pack
Arsenic and lead	A50143-Q-24-5-A	Where pump sits, southern location	Field air pack
Arsenic and lead	NC50-4-A	Where pump sits, southern location	Training air pack
Arsenic and lead	AS0421-ENG-21-4-A	Where pump sits, southern location	Field air pack
Chlorinated dioxins/ furans & PCBs	BA-1	Where pump sits, middle portion	Field air pack; AS0421-Eng-21-4

Chemical	Sample ID	Sampling Location	Observations/ Notes
Chlorinated dioxins/ furans & PCBs	BA-2	Where pump sits, middle portion	Training air pack; ECTC-T-42
Pentachlorophenol	A50143-Q-24-5	Where pump sits, middle portion	Field air pack
Pentachlorophenol	ECTC-T-7	Where pump sits, middle portion	Training air pack

Field blanks were collected for quality assurance, as applicable.

4.2.2 Fire hose repair

Wipe samples of used fire hoses (exterior surfaces) were collected in accordance with NIOSH Method 9100 (NIOSH, 1996) using a 10- x 10-cm square template. One template and a new pair of gloves were used for each wipe sample. Six fire hoses were sampled for the following chemicals:

- PAHs by NIOSH 5528 using hexane-extracted gauze
- Arsenic and lead by NIOSH 9102 Mod. using Ghost Wipes.

The chemicals, sample IDs, sampling locations, and observations/notes are summarized in Table 6 for the wipe samples collected on the fire hoses on November 3, 2020.

Table 6. Wipe samples collected on fire hoses

Chemical	Sample ID	Sampling Location	Observations/ Notes
PAHs	H-01	Exterior of hose	Fire hose, very dirty
PAHs	H-02	Exterior of hose	Fire hose
PAHs	H-03	Exterior of hose	Fire hose
PAHs	H-04	Exterior of hose	Fire hose, very dirty
PAHs	H-05	Exterior of hose	Fire hose, very dirty
PAHs	H-06	Exterior of hose	Fire hose
Arsenic and lead	H-01-A	Exterior of hose	Fire hose
Arsenic and lead	H-02-A	Exterior of hose	Fire hose
Arsenic and lead	H-03-A	Exterior of hose	Fire hose

Chemical	Sample ID	Sampling Location	Observations/ Notes
Arsenic and lead	H-04-A	Exterior of hose	Fire hose
Arsenic and lead	H-05-A	Exterior of hose	Fire hose
Arsenic and lead	H-06-A	Exterior of hose	Fire hose

Field blanks were collected for quality assurance, as applicable.

4.3 Eastern Fire Shop, Los Angeles

4.3.1 Maintenance and repair on fire apparatus

Shop-assigned Fire Equipment Mechanics (FEMs) typically work on the major repairs such as engine and transmission changes, in-frame engine rebuilds, differential exchanges and rebuilds, major pump repair, plumbing issues, and water tank removal, and they are required to do more welding for significant parts repair and replacement. PPE among the FEMs varies depending on task. For example, during welding, PPE includes a welding helmet, welding gloves, and an N95 respirator; when painting, PPE includes latex gloves, eye protection, and an N95 respirator. Goggles (or other eye protection), latex gloves, and knee pads are used for other FEM tasks.

PBZ air samples were collected among six FEMs for the following chemicals:

- Benzene, ethylbenzene, and naphthalene using a 3M 3500/3520 organic vapor monitor
- Diesel particulate (as elemental carbon) by NIOSH 5040 using a quartz-fiber filter in a three-piece 37-mm cassette
- Welding fume metals by NIOSH 7300 Mod. using 0.8-µm mixed cellulose ester membrane in a two-piece 37-mm cassette
- Hexavalent chromium (in welding fume) by OSHA ID-215 (version 2) using a 5-µm PVC membrane in a 37-mm cassette
- N,N-Dimethyl-para-toluidine by NIOSH 2002 (Issue 2) using an SKC 226-98, XAD-7 (phosphoric acid) sorbent tube
- Tetrachloroethylene by NIOSH 1003 using an SKC 226-01, charcoal tube (100/50 mg).

Wipe samples on the fire trucks were collected in accordance with NIOSH Method 9100 (NIOSH, 1996) using a 10- x 10-cm square template. One template and a new pair of gloves were used for each wipe sample. Six locations on the fire truck were sampled for the following chemicals:

- PAHs by NIOSH 5528 using hexane-extracted gauze
- Arsenic and lead by NIOSH 9102 Mod. using Ghost Wipes
- Pentachlorophenol by OSHA 39 using sterile cotton gauze soaked in DI water
- Chlorinated dioxins/furans by EPA 1613B and PCBs by EPA 1668C using swabs soaked in hexane.

The chemicals, sample IDs, sampling locations, and observations/notes are summarized in Table 7 for the wipe samples collected on various surfaces of the fire trucks at the Eastern Fire Shop on November 4, 2020.

Table 7. Wipe sample collected on fire trucks

Chemical	Sample ID	Sampling Location	Observations/ Notes
PAHs	ENG-558-PAH-01	Under captain's chair	Engine 558; 1998; F0561; very dusty
PAHs	ENG-159-PAH-01	Plumbing compartment	Engine 159; F2174; very dirty on piping
PAHs	ENG-583-PAH-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris
PAHs	ENG-583-PAH-01	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty
PAHs	ENG-558-PAH-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty
PAHs	ENG-168-PAH-01	Fuel cell directly beneath the stainless-steel water tank	Engine 168; F1567; dusty/dirty
Chlorinated dioxins/ furans & PCBs	ENG-558-DFP-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty
Chlorinated dioxins/ furans & PCBs	ENG-583-DFP-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris
Chlorinated dioxins/ furans & PCBs	ENG-168-DFP-01	Fuel cell directly beneath the stainless-steel water tank	Engine 168; F1567; dusty/dirty
Chlorinated dioxins/ furans & PCBs	ENG-159-DFP-1	Plumbing compartment	Engine 159; F2174; very dirty on piping

Chemical	**Sample ID**	**Sampling Location**	**Observations/ Notes**
Chlorinated dioxins/ furans & PCBs	ENG-583-DFP-01	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty
Chlorinated dioxins/ furans & PCBs	ENG-558-DFP-01	Under captain's chair	Engine 558; 1998; F0561; very dusty
Pentachlorophenol	ENG-168-PENTA-01	Fuel cell directly beneath the stainless-steel water tank	Engine 168; F1567; dusty/dirty
Pentachlorophenol	ENG-583-PENTA-01	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty
Pentachlorophenol	ENG-558-PENTA-01	Under captain's chair	Engine 558; 1998; F0561; very dusty
Pentachlorophenol	ENG-583-PENTA-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris
Pentachlorophenol	ENG159-PENTA-1	Plumbing compartment	Engine 159; F2174; very dirty on piping
Pentachlorophenol	ENG-558-PENTA-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty
Arsenic and lead	ENG583-A-1	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty
Arsenic and lead	ENG-558-A-01	Captain’s kick panel	Engine 558; 1998; F0561; very dusty
Arsenic and lead	ENG159-A-1	Plumbing compartment	Engine 159; F2174; very dirty on piping
Arsenic and lead	ENG-583-A-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris
Arsenic and lead	ENG-168-A-01	Fuel cell directly beneath the stainless-steel water tank	Engine 168; F1567; dusty/dirty
Arsenic and lead	ENG-558-A-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty

In addition, four bulk samples of the vermiculite-coated fiberglass strips were analyzed for asbestos.

One field blank was collected from each of the analyses listed above, except for the bulk samples.

4.3.2 Area samples

ToxStrategies collected two area PBZ air samples to be analyzed for the following chemicals:

- Benzene, ethylbenzene, and naphthalene using a 3M 3500/3520 organic vapor monitor
- Diesel particulate (as elemental carbon) by NIOSH 5040 using a quartz-fiber filter in a three-piece 37-mm cassette.

Because a field blank was collected for each of these chemicals, as described in Section 4.3.1, no additional field blanks were collected.

Cumene, tetrabromobisphenol-A, and methyl isobutyl ketone were also considered potential carcinogens of concern for the job task at the Eastern Fire Shop; however, these compounds were not measured quantitatively, because they do not have published cancer potency measures. Thus, their cancer risk assessment (Task 5) will be qualitative only.

4.4 Wildfire Base Camp, Los Angeles County

4.4.1 Repair of fire apparatus or other equipment

For the field-assigned FEM, the job task of repairing fire apparatuses or other equipment at a wildfire base camp ranked very high and was thus considered a high priority for Task 4. ToxStrategies planned to conduct PBZ air sampling among three field FEMs for the following chemicals:

- Acetaldehyde and formaldehyde by EPA TO-11A using an SKC 500-100, UMEx 100 passive sampler
- Benzene, ethylbenzene, and naphthalene using a 3M 3500/3520 organic vapor monitor
- Diesel particulates (as elemental carbon) by NIOSH 5040 using a quartz-fiber filter in a three-piece 37-mm cassette
- PAHs by NIOSH 5528 (draft) using a SKC 226-57, OSHA versatile sampler (XAD-7, glass fiber filter) tube.

Wipe samples on fire trucks and other field equipment that a field FEM would contact were planned to be collected for the following chemicals:

- PAHs by NIOSH 5528 using hexane-extracted gauze
- Arsenic and lead by NIOSH 9102 Mod. using Ghost Wipes
- Pentachlorophenol by OSHA 39 using sterile cotton gauze soaked in DI water
- Chlorinated dioxins/furans by EPA 1613B and PCBs by EPA 1668C using swabs soaked in hexane.

However, at the time of the study, there were no active fires in Los Angeles County; therefore, this job task will be assessed using the scientific literature for the cancer risk assessment in Task 5.

4.5 Calibration of PBZ Air Samples

Personal air sampling pumps were calibrated using a primary or secondary calibration device, with the tubing and sampling cassette connected in-line. Pre- and post-flow rates were measured directly before and after the PBZ air sample was collected; flow rates that had a difference of greater than 5% were identified as estimated. Each analytical method defines the recommended flow rates.

4.6 Laboratory Analysis

Most samples were analyzed by ALS Environmental, an AIHA-accredited laboratory, in Salt Lake City, Utah, under a standard turnaround time. The exception was the dioxins, furans, and PCB samples, which were shipped to ALS Environmental in Burlington, Ontario.

5 Results

The analytical results for the submitted samples are presented below for each SEG and job task, and the laboratory reports are included in Attachment 1.

5.1 Air Operations, Pacoima (November 3, 2020)

5.1.1 PBZ air samples

Hexavalent chromium was measured in one sample collected among helicopter mechanics performing intermediate and heavy maintenance on the aircraft. One sample from each of these job tasks had a personal sampling air pump that failed during the sampling event; therefore, these samples were discarded and not analyzed. The analytical results are provided in Table 8.

Respirable crystalline silica as quartz, cristobalite, and tridymite were sampled among helicopter mechanics performing heavy maintenance on the aircraft. The analytical results are provided in Table 9. Respirable crystalline silica as quartz, cristobalite, and tridymite were not measured in any sample (Table 9).

Benzene, ethylbenzene, and naphthalene were analyzed in samples collected among helicopter mechanics performing intermediate maintenance on the aircraft. Two area samples were also measured in the hanger. One area sample was collected along the southwest wall, and one sample was collected in the work area. The analytical results are provided in Table 10; benzene, ethylbenzene, and naphthalene were not detected in any sample (Table 10).

Table 8. Hexavalent chromium personal breathing zone (PBZ) air sampling results analyzed by OSHA ID-215

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (Liters)	Hexavalent Chromium (mg/m^3)
11/3/2020	Anthony Velletto	Intermediate & heavy maintenance on aircraft	HM-1103-01	438	876	<0.000068
11/3/2020	Alexander Gonzalez	Intermediate & heavy maintenance on aircraft	HM-1103-02	465	930	<0.000065
11/3/2020	Ruben Perez	Intermediate & heavy maintenance on aircraft	HM-1103-04	454	908	<0.000066
11/3/2020	Tyrone Mathis	Intermediate & heavy maintenance on aircraft	HM-1103-08	426	852	<0.000070
11/3/2020	Jose Murillo	Heavy maintenance on aircraft	HM-1103-10	385	770	<0.000078
11/3/2020	Kevin McDougall	Intermediate & heavy maintenance on aircraft	HM-1103-11	416	832	<0.000072
11/3/2020	James Ring	Heavy maintenance on aircraft	HM-1103-12	314	628	<0.000096
11/3/2020	Terry Apodaca	Heavy maintenance on aircraft	HM-1103-13	372	744	**0.000084**
Cal/OSHA 8-hr TWA PEL†						0.005
Cal/OSHA 8-hr TWA action level†						0.0025

† 8 CCR§5206

Abbreviations: < = not detected; Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; PEL = permissible exposure limit; mg/m^3 = milligrams per cubic meter of air; TWA = time-weighted average

Bold indicates detected result.

Table 9. Respirable crystalline silica personal breathing zone (PBZ) air sampling results analyzed by NIOSH 7500 Mod

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (Liters)	Quartz; cristobalite; tridymite (mg/m^3)
11/3/2020	Tyrone Mathis	Heavy maintenance on aircraft	40203	422	1,055	<0.0047; <0.0047; <0.019
11/3/2020	Adam Parra	Heavy maintenance on aircraft	40204	417	1,042.5	<0.0048; <0.0048; <0.019
11/3/2020	Jose Murillo	Heavy maintenance on aircraft	40174	393	982.5	<0.0051; <0.0051; <0.020
11/3/2020	Kevin McDougall	Heavy maintenance on aircraft	40173	379*	947.5	<0.0053; <0.0053; <0.021
11/3/2020	James Ring	Heavy maintenance on aircraft	40193	314	785	<0.0064; <0.0064; <0.025
11/3/2020	Terry Apodaca	Heavy maintenance on aircraft	40163	374	935	<0.0053; <0.0053; <0.021
Cal/OSHA 8-hr TWA PEL†						0.050
Cal/OSHA 8-hr TWA action level†						0.025

† 8 CCR§1532.3 for respirable crystalline silica (quartz, cristobalite, and/or tridymite)

* Sample duration is uncertain; personal sampling air pump faulted between the times of 1:30pm and 3:15pm. Sample duration is based on an estimated sample end time of 2:30pm. The results may be biased high, but they were all non-detect.

Abbreviations: < = not detected; Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; mg/m^3 = milligrams per cubic meter of air; TWA = time-weighted average

Table 10. Benzene, ethylbenzene, and naphthalene personal breathing zone (PBZ) air sampling results analyzed by 3M 3500/3520 POVM

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Benzene (mg/m^3)	Ethyl-benzene (mg/m^3)	Naph-thalene (mg/m^3)
11/3/2020	Anthony Velletto	Intermediate maintenance on aircraft	EL0042	546	<0.052	<0.67	<0.74
11/3/2020	Alexander Gonzalez	Intermediate maintenance on aircraft	EL0122	547	<0.051	<0.67	<0.74
11/3/2020	Joseph Martinez	Intermediate maintenance on aircraft	EL0053	547	<0.051	<0.67	<0.74
11/3/2020	Ruben Perez	Intermediate maintenance on aircraft	EL0089	542	<0.052	<0.68	<0.75
11/3/2020	Kevin McDougall	Intermediate maintenance on aircraft	EL0134	467	<0.060	<0.78	<0.87
11/3/2020	Tyrone Mathis	Intermediate maintenance on aircraft	EL0146	461	<0.061	<0.79	<0.88
11/3/2020	Area Sample #1 in Hangar (southwest wall in Hangar)	General work in Hangar	EL0086	487	<0.058	<0.75	<0.83
11/3/2020	Area Sample #2 in Hangar (Work Area)	General work in Hangar	EL0132	486	<0.058	<0.75	<0.84
Cal/OSHA 8-hr TWA PEL†					3.19	22	0.5
Cal/OSHA 8-hr TWA action level†					1.60	NA	NA

† 8 CCR§5218 for benzene (converted ppm units to mg/m^3 using molar volume in liters at normal temperature and pressure [0 °C, 760 mmHg]), Title 8, Table AC-1 for ethylbenzene and naphthalene

Abbreviations: < = not detected; Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; TWA = time-weighted average; mg/m^3 = milligrams per cubic meter of air; PEL = permissible exposure limit; ppm = parts per million by volume; NA = not available

5.1.2 Surface wipe samples (November 3, 2020)

A Firehawk and a Bell412 were parked inside the hangar for heavy maintenance. PAHs, arsenic, lead, and hexavalent chromium were analyzed for in wipe samples from various locations of these aircraft. The analytical results are provided in Table 11. Only hexavalent chromium and lead were measurable in any sample; no other chemicals were detected (Table 11).

Table 11. Wipe sample results on aircrafts in hangar

Chemical	Method	Sample ID	Sampling Location	Observations / Notes	Result ($\mu g/cm^2$)
PAHs	NIOSH 5528	N190LA-01	Intermediate gear box of Firehawk	Fire residues/ dust	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	N14LA-03	Right stabilator of Bell412	Fire residues/ dust	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050

Chemical	Method	Sample ID	Sampling Location	Observations / Notes	Result (µg/cm^2)
PAHs	NIOSH 5528	N14LA-02	Right tailbone of Bell412	Fire residues/ dust	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	N14LA-01	Right side of nose of Bell412	Fire residues/ dust	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	N190LA-02	Upper aft blade antenna, left side, of Firehawk	Fire residues/ dust	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050

Chemical	**Method**	**Sample ID**	**Sampling Location**	**Observations / Notes**	**Result (µg/cm^2)**	
PAHs	NIOSH 5528	N190LA-03	Transition access door, underside, of Firehawk	Fire residues/ dust	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050	
Arsenic / Lead	NIOSH 9102 Mod	N190LA-01-A	Intermediate gear box of Firehawk	Fire residues/ dust	Arsenic: <0.063	Lead: **0.019**
Arsenic / Lead	NIOSH 9102 Mod	N190LA-02-A	Upper aft blade antenna, left side, of Firehawk	Fire residues/ dust	Arsenic: <0.063	Lead: <0.0050
Arsenic / Lead	NIOSH 9102 Mod	N14LA-02-A	Right tailbone of Bell412	Fire residues/ dust	Arsenic: <0.063	Lead: **0.023**
Arsenic / Lead	NIOSH 9102 Mod	N14LA-01-A	Right side of nose of Bell412	Fire residues/ dust	Arsenic: <0.063	Lead: **0.028**
Arsenic / Lead	NIOSH 9102 Mod	N190LA-03-A	Transition access door, underside, of Firehawk	Fire residues/ dust	Arsenic: <0.063	Lead: **0.023**
Arsenic / Lead	NIOSH 9102 Mod	N14LA-03-A	Right stabilator of Bell412	Fire residues/ dust	Arsenic: <0.063	Lead: **0.033**

Chemical	Method	Sample ID	Sampling Location	Observations / Notes	Result (µg/cm²)
Hexavalent chromium	OSHA ID-215	N14LA-05	Skid on right side of Bell412	Mastinox visible	**0.080**
Hexavalent chromium	OSHA ID-215	N14LA-06	Mating surface of combining gear box trimount of Bell412	Mastinox visible	**0.54**

Abbreviations: < = not detected; µg/cm² = micrograms per square centimeter; * = not considered a carcinogen

Bold indicates detected result.

A combination of Firehawks and Bell412s were parked outside on the flight line. PAHs, arsenic, lead, hexavalent chromium, chlorinated dioxins/furans, and PCBs were analyzed for in wipe samples from various locations of the aircraft. The analytical results are provided in Table 12. The analytical results for chlorinated dioxins/furans and PCBs were converted to a 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) toxic equivalence (TEQ) concentration. Note that there are only 12 PCB congeners with published congener-specific toxicity equivalency factors (TEFs) (DTSC HERO, 2017; USEPA, 2010; van den Berg et al., 2006 [WHO report]). The TEQ is calculated by multiplying the TEF, which is an estimate of the congener-specific toxicity/potency relative to the toxicity/potency of TCDD (TEF value of 1), by the detected concentration of the dioxin or dioxin-like congener (DTSC HERO, 2017; USEPA, 2010; van den Berg et al., 2006 [WHO report]). The individual TEQ concentrations are then summed to yield the total TEQ concentration for that sample. Therefore, the calculated TEQs are presented for chlorinated dioxins/furans and PCBs, where applicable. The non-TEQ PCBs total is also presented for each sample, which is calculated by summing the individual congeners without a TEF. Congeners that were non-detects were assigned values equal to 50% of the reporting limit for calculating the dioxin/furan/PCB TEQ and non-TEQ PCB totals for each sample. The laboratory reports found in Attachment 1 present the analytical results for each congener. Attachment 2 contains the analytical results by PCB and dioxin/furan congener (µg/cm²), TEFs applied, and TEQ calculations by Sample ID. PAHs and arsenic were not measured in any sample.

Table 12. Wipe sample results on aircrafts on flight line

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result ($\mu g/cm^2$)
PAHs	NIOSH 5528	N822LA-01	Right engine exhaust cowling of Firehawk	Firehawk had been to a recent wildfire (October 2020)	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	N120LA-01	Tail of Bell412	Bell412 had not been cleaned since usage in wildfire	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result (µg/cm²)
PAHs	NIOSH 5528	N120LA-02	Blade antenna of Bell412	Bell412 had not been cleaned since usage in wildfire	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	N822LA-03	Horizontal stabilator of Firehawk	Firehawk had been to a recent wildfire (October 2020)	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	N822LA-02	Forward cowling, right side, of Firehawk	Firehawk had been to a recent wildfire (October 2020)	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050

Chemical	**Method**	**Sample ID**	**Sampling Location**	**Observations/ Notes**	**Result (µg/cm²)**	
PAHs	NIOSH 5528	N120LA-03	Glass "sun roof"/"greenhouse" of Bell412	Bell412 had not been cleaned since usage in wildfire	Naphthalene: *Acenaphthylene: *Acenaphthene: *Fluorene: *Phenanthrene: *Anthracene: *Fluoranthene: *Pyrene: Benzo(a)anthracene: Chrysene: Benzo(b)fluoranthene: Benzo(k)fluoranthene: Benzo(a)pyrene: Indeno(1,2,3-cd)pyrene: Dibenzo(a,h)anthracene: *Benzo(g,h,i)perylene:	<0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050
Arsenic / Lead	NIOSH 9102 Mod	N120LA-03-A	Glass "sun roof"/"greenhouse" of Bell412	Bell412 had not been cleaned since usage in wildfire	Arsenic: <0.063	Lead: **0.016**
Arsenic / Lead	NIOSH 9102 Mod	N822LA-03-A	Horizontal stabilator of Firehawk	Firehawk had been to a recent wildfire (October 2020)	Arsenic: <0.063	Lead: **0.0091**
Arsenic / Lead	NIOSH 9102 Mod	N120LA-01-A	Tail of Bell412	Bell412 had not been cleaned since usage in wildfire	Arsenic: <0.063	Lead: **0.0082**
Arsenic / Lead	NIOSH 9102 Mod	N120LA-02-A	Blade antenna of Bell412	Bell412 had not been cleaned since usage in wildfire	Arsenic: <0.063	Lead: **0.016**
Arsenic / Lead	NIOSH 9102 Mod	N822LA-01-A	Right engine exhaust cowling of Firehawk	Firehawk had been to a recent wildfire (October 2020)	Arsenic: <0.063	Lead: <0.0050
Arsenic / Lead	NIOSH 9102 Mod	N822LA-02-A	Forward cowling, right side, of Firehawk	Firehawk had been to a recent wildfire (October 2020)	Arsenic: <0.063	Lead: **0.0085**

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result (µg/cm^2)
Hexavalent Chromium	OSHA ID-215	N18LA-01	Hot part of left engine (seam) of Bell412		**0.0014**
Hexavalent Chromium	OSHA ID-215	N17LA-04	Hot part of left engine (seam) of Bell412		**0.00076**
Hexavalent Chromium	OSHA ID-215	N18LA-02	Hot part of right engine (seam) of Bell412		**0.0022**
Hexavalent Chromium	OSHA ID-215	N120LA-01	Hot part of right engine (seam) of Bell412		**0.0019**
Hexavalent Chromium	OSHA ID-215	N120LA-02	Hot part of left engine (seam) of Bell412		**0.0013**
Hexavalent Chromium	OSHA ID-215	N17LA-03	Hot part of left engine (seam) of Bell412		**0.0011**
PCBs	EPA 1668C	356-4	Horizontal stabilator of Bell412		PCB TEQ †: **8.6×10^{-10}** Non-TEQ PCB †: **2.9×10^{-6}**
Chlorinated dioxins/furans	EPA 1613B	356-4	Horizontal stabilator of Bell412		TEQ †: **1.3×10^{-8}**
PCBs	EPA 1668C	356-5	Chin bubble of Bell412		PCB TEQ †: **1.2×10^{-9}** Non-TEQ PCB †: **2.9×10^{-6}**
Chlorinated dioxins/furans	EPA 1613B	356-5	Chin bubble of Bell412		TEQ †: **1.5×10^{-8}**

Abbreviations: < = not detected; µg/cm^2 = micrograms per square centimeter; TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalence; TEQ concentrations are calculated by multiplying the toxic equivalency factor (TEF) by the detected concentration of the dioxin or dioxin-like congener (dioxin/furan/PCB); * = not considered a carcinogen

† Congeners that were non-detects were assigned values equal to 50% of the detection limit.

Bold indicates detected result.

5.2 Breathing Apparatus Shop, Pacoima (November 3, 2020)

5.2.1 PBZ air samples

Benzene, ethylbenzene, naphthalene, styrene, acetaldehyde, and formaldehyde were analyzed in PBZ air samples collected among equipment maintenance workers in the small-engine repair shop. The analytical results are provided in Table 13 for benzene, ethylbenzene, naphthalene, and styrene, and in Table 14 results for acetaldehyde and formaldehyde are presented. Benzene, acetaldehyde, and formaldehyde were detected.

Table 13. Benzene, ethylbenzene, naphthalene, and styrene personal breathing zone (PBZ) air sampling results analyzed by 3M 3500/3520 POVM

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Benzene (mg/m^3)	Ethyl-benzene (mg/m^3)	Naph-thalene (mg/m^3)	Styrene (mg/m^3)
11/3/2020	Ariel Orozco	Small engine repair shop equipment maintenance worker	EL0064	349	**0.68**	<1.0	<1.2	<0.99
11/3/2020	Pedro Zuniga	Small engine repair shop equipment maintenance worker	EL0139	349	**0.30**	<1.0	<1.2	<0.99
Cal/OSHA 8-hr TWA PEL†					3.19	22	0.5	215
Cal/OSHA 8-hr TWA action level†					1.60	NA	NA	NA

† 8 CCR§5218 for benzene (converted ppm units to mg/m^3 using molar volume in liters at normal temperature and pressure [0 °C, 760 mmHg]), Title 8, Table AC-1 for ethylbenzene, naphthalene, and styrene

Bold indicates detected result.

Abbreviations: < = not detected; Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; TWA = time-weighted average; mg/m^3 = milligrams per cubic meter of air; ppm = parts per million by volume; NA = not available

Table 14. Acetaldehyde and formaldehyde personal breathing zone (PBZ) air sampling results analyzed by EPA TO-11A

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Acetaldehyde (mg/m^3)	Formaldehyde (mg/m^3)
11/3/2020	Ariel Orozco	Small engine repair shop equipment maintenance worker	A295581	347	**0.027**	**0.026**
11/3/2020	Pedro Zuniga	Small engine repair shop equipment maintenance worker	A295575	347	**0.027**	**0.028**
Cal/OSHA 8-hr TWA PEL†					45	0.92
Cal/OSHA 8-hr TWA action level†					NA	0.61

† 8 CCR§5217 for formaldehyde (converted ppm units to mg/m^3 using molar volume in liters at normal temperature and pressure [0 °C, 760 mmHg]), Title 8, Table AC-1 for acetaldehyde

Bold indicates detected result.

Abbreviations: < = not detected; Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; TWA = time-weighted average; mg/m^3 = milligrams per cubic meter of air; PEL = permissible exposure limit; ppm = parts per million by volume; NA = not available

5.2.2 Surface wipe samples

PAHs, arsenic, lead, chlorinated dioxins/furans, PCBs, and pentachlorophenol were analyzed in wipe samples collected from training and field air packs. PAHs, lead, chlorinated dioxins/furans, and PCBs were detected. The analytical results are provided in Table 15. Chlorinated dioxin/furan and PCB TEQ and non-TEQ totals, where applicable, are presented below; the analytical results for each congener are presented in the laboratory reports (Attachment 1). Congeners that were non-detects were assigned values equal to 50% of the reporting limit for calculating the dioxin/furan/PCB TEQ and non-TEQ PCB totals for each sample. Attachment 2 contains the analytical results by PCB and dioxin/furan congener ($\mu g/cm^2$), TEFs applied, and TEQ calculations by Sample ID.

Table 15. Wipe sample results on air packs

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result ($\mu g/cm^2$)
PAHs	NIOSH 5528	A49996	Where air pump sits, northern location	Field air pack	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	A50421 ENG-21-4	Where air pump sits, northern location	Field air pack	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result ($\mu g/cm^2$)
PAHs	NIOSH 5528	A5014 Q-24-5	Where air pump sits, northern location	Field air pack	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	ECTC-T-8	Where air pump sits, northern location	Training air pack	Naphthalene: **0.018** *Acenaphthylene: **0.056** *Acenaphthene: <0.0050 *Fluorene: **0.020** *Phenanthrene: **0.14** *Anthracene: **0.030** *Fluoranthene: **0.12** *Pyrene: **0.090** Benzo(a)anthracene: **0.048** Chrysene: **0.050** Benzo(b)fluoranthene: **0.10** Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: **0.045** Indeno(1,2,3-cd)pyrene: **0.035** Dibenzo(a,h)anthracene: **0.0071** *Benzo(g,h,i)perylene: **0.038**
PAHs	NIOSH 5528	ECTC-T-38	Where air pump sits, northern location	Training air pack	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: **0.015** *Anthracene: <0.0050 *Fluoranthene: **0.018** *Pyrene: **0.015** Benzo(a)anthracene: **0.0098** Chrysene: **0.013** Benzo(b)fluoranthene: **0.020** Benzo(k)fluoranthene: **0.0070** Benzo(a)pyrene: **0.0083** Indeno(1,2,3-cd)pyrene: **0.0091** Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: **0.010**

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result ($\mu g/cm^2$)	
PAHs	NIOSH 5528	NCSO-04	Where air pump sits, northern location	Training air pack	Naphthalene: <0.0050 *Acenaphthylene: **0.013** *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: **0.055** *Anthracene: **0.010** *Fluoranthene: **0.078** *Pyrene: **0.061** Benzo(a)anthracene: **0.034** Chrysene: **0.035** Benzo(b)fluoranthene: **0.048** Benzo(k)fluoranthene: **0.016** Benzo(a)pyrene: **0.030** Indeno(1,2,3-cd)pyrene: **0.020** Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: **0.022**	
Arsenic / Lead	NIOSH 9102 Mod	ECTC-T-8-A	Where pump sits, southern location	Training air pack	Arsenic: <0.063	Lead: **0.017**
Arsenic / Lead	NIOSH 9102 Mod	ECTC-T-38-A	Where pump sits, southern location	Training air pack	Arsenic: <0.063	Lead: **0.016**
Arsenic / Lead	NIOSH 9102 Mod	A49996-QUT-185-4-A	Where pump sits, southern location	Field air pack	Arsenic: <0.063	Lead: **0.014**
Arsenic / Lead	NIOSH 9102 Mod	A50143-Q-24-5-A	Where pump sits, southern location	Field air pack	Arsenic: <0.063	Lead: **0.013**
Arsenic / Lead	NIOSH 9102 Mod	NC50-4-A	Where pump sits, southern location	Training air pack	Arsenic: <0.063	Lead: **0.027**
Arsenic / Lead	NIOSH 9102 Mod	AS0421-ENG-21-4-A	Where pump sits, southern location	Field air pack	Arsenic: <0.063	Lead: **0.048**
Pentachlorophenol	OSHA 39	A50143-Q-24-5	Where pump sits, middle portion	Field air pack	<0.0050	
Pentachlorophenol	OSHA 39	ECTC-T-7	Where pump sits, middle portion	Training air pack	<0.0050	

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result ($\mu g/cm^2$)
PCBs	EPA 1668C	BA-1	Where pump sits, middle portion	Field air pack; AS0421-Eng-21-4	PCB TEQ †: **$1.1x10^{-9}$** Non-TEQ PCB †: **$2.1x10^{-5}$**
Chlorinated dioxins/furans	EPA 1613B	BA-1	Where pump sits, middle portion	Field air pack; AS0421-Eng-21-4	TEQ †: **$1.7x10^{-8}$**
PCBs	EPA 1668C	BA-2	Where pump sits, middle portion	Training air pack; ECTC-T-42	PCB TEQ †: **$1.8x10^{-9}$** Non-TEQ PCB †: **$1.7x10^{-5}$**
Chlorinated dioxins/furans	EPA 1613B	BA-2	Where pump sits, middle portion	Training air pack; ECTC-T-42	TEQ †: **$3.0x10^{-8}$**

Abbreviations: < = not detected; $\mu g/cm^2$ = micrograms per square centimeter; TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalence; TEQ concentrations are calculated by multiplying the toxic equivalency factor (TEF) by the detected concentration of the dioxin or dioxin-like congener (dioxin/furan/PCB); * = not considered a carcinogen

† Congeners that were non-detects were assigned values equal to 50% of the detection limit.

Bold indicates detected result.

PAHs, arsenic, and lead were analyzed in wipe samples on exterior locations of the fire hose. Lead was detected in each of the six surface wipes collected; PAHs and arsenic were not detected in any of the samples. The analytical results are provided in Table 16 below.

Table 16. Wipe sample results on fire hoses

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result ($\mu g/cm^2$)
PAHs	NIOSH 5528	H-01	Exterior of hose	Fire hose, very dirty	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	H-02	Exterior of hose	Fire hose	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result ($\mu g/cm^2$)
PAHs	NIOSH 5528	H-03	Exterior of hose	Fire hose	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	H-04	Exterior of hose	Fire hose, very dirty	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	H-05	Exterior of hose	Fire hose, very dirty	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result ($\mu g/cm^2$)	
PAHs	NIOSH 5528	H-06	Exterior of hose	Fire hose	Naphthalene: *Acenaphthylene: *Acenaphthene: *Fluorene: *Phenanthrene: *Anthracene: *Fluoranthene: *Pyrene: Benzo(a)anthracene: Chrysene: Benzo(b)fluoranthene: Benzo(k)fluoranthene: Benzo(a)pyrene: Indeno(1,2,3-cd)pyrene: Dibenzo(a,h)anthracene: *Benzo(g,h,i)perylene:	<0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050 <0.0050
Arsenic / Lead	NIOSH 9102 Mod	H-01-A	Exterior of hose	Fire hose	Arsenic: <0.063	Lead: **0.0088**
Arsenic / Lead	NIOSH 9102 Mod	H-02-A	Exterior of hose	Fire hose	Arsenic: <0.063	Lead: **0.0095**
Arsenic / Lead	NIOSH 9102 Mod	H-03-A	Exterior of hose	Fire hose	Arsenic: <0.063	Lead: **0.0076**
Arsenic / Lead	NIOSH 9102 Mod	H-04-A	Exterior of hose	Fire hose	Arsenic: <0.063	Lead: **0.025**
Arsenic / Lead	NIOSH 9102 Mod	H-05-A	Exterior of hose	Fire hose	Arsenic: <0.063	Lead: **0.13**
Arsenic / Lead	NIOSH 9102 Mod	H-06-A	Exterior of hose	Fire hose	Arsenic: <0.063	Lead: **0.056**

Abbreviations: < = not detected; $\mu g/cm^2$ = micrograms per square centimeter; * = not considered a carcinogen;

Bold indicates detected result.

5.3 Eastern Fire Shop, Los Angeles (November 4, 2020)

5.3.1 PBZ air samples

Benzene, ethylbenzene, naphthalene, and diesel particulate as elemental carbon were analyzed in PBZ air samples among fire equipment mechanics performing maintenance on the fire apparatus. Two area samples were also analyzed for each of these chemicals in the Eastern Fire Shop. One area sample was collected in the center third aisle column (from the south entrance), and one sample was collected in the third bay along the west side (on the workbench) of the Eastern Fire Shop. The analytical results are provided in Table 17 for benzene, ethylbenzene, and naphthalene, and in Table 18 for diesel particulate matter as elemental carbon. Benzene, ethylbenzene, and naphthalene were not measured in any sample; diesel particulate matter as elemental carbon was detected in one sample.

Table 17. Benzene, ethylbenzene, and naphthalene personal breathing zone (PBZ) air sampling results analyzed by 3M 3500/3520 POVM

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Benzene (mg/m^3)	Ethyl-benzene (mg/m^3)	Naph-thalene (mg/m^3)
11/4/2020	Rafael Flores	Maintenance on fire apparatus	EL0128	422	<0.067	<0.87	<0.96
11/4/2020	Gary Hodge	Maintenance on fire apparatus	EL0110	433	<0.065	<0.85	<0.94
11/4/2020	Jairo Tapia	Maintenance on fire apparatus	EL0102	440	<0.064	<0.83	<0.92
11/4/2020	James Stolper	Maintenance on fire apparatus	EL0135	436	<0.065	<0.84	<0.93
11/4/2020	Luis Del Cid	Maintenance on fire apparatus	EL0129	427	<0.066	<0.86	<0.95
11/4/2020	Alfredo Sanchez	Maintenance on fire apparatus	EL0107	396	<0.071	<0.93	<1.0
11/4/2020	Area Sample #1; Aisle 3rd Column	General work in Eastern Fire Shop	EL0232	430	<0.066	<0.85	<0.95
11/4/2020	Area Sample #2; West Side 3rd Bay	General work in Eastern Fire Shop	EL0060	427	<0.066	<0.86	<0.95
Cal/OSHA 8-hr TWA PEL†					3.19	22	0.5
Cal/OSHA 8-hr TWA action level†					1.60	NA	NA

† 8 CCR§5218 for benzene (converted ppm units to mg/m^3 using molar volume in liters at normal temperature and pressure [0 °C, 760 mmHg]), Title 8, Table AC-1 for ethylbenzene and naphthalene

Abbreviations: < = not detected; Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; TWA = time-weighted average; mg/m^3 = milligrams per cubic meter of air; PEL = permissible exposure limit; ppm = parts per million by volume; NA = not available

Table 18. Diesel particulate as elemental carbon personal breathing zone (PBZ) air sampling results analyzed by NIOSH 5040

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (liters)	Elemental Carbon (mg/m^3)
11/4/2020	Rafael Flores	Maintenance on fire apparatus	11401	397	754.3	<0.0024
11/4/2020	Gary Hodge	Maintenance on fire apparatus	11402	408	816	<0.0022
11/4/2020	Jairo Tapia	Maintenance on fire apparatus	11403	416	832	<0.0022
11/4/2020	James Stolper	Maintenance on fire apparatus	11404	403	806	<0.0022
11/4/2020	Luis Del Cid	Maintenance on fire apparatus	11405	393	786	**0.180**
11/4/2020	Alfredo Sanchez	Maintenance on fire apparatus	11406	359	718	<0.0025
11/4/2020	Area Sample #1; Aisle 3rd Column	General work in Eastern Fire Shop	11407	429	858	<0.0021
11/4/2020	Area Sample #2; West Side 3rd Bay	General work in Eastern Fire Shop	11408	426	852	<0.0021
Cal/OSHA 8-hr TWA PEL†						NA

† No Cal/OSHA PEL established

Bold indicates detected result.

Abbreviations: < = not detected; Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; TWA = time-weighted average; mg/m^3 = milligrams per cubic meter of air; PEL = permissible exposure limit; ppm = parts per million by volume; NA = not available

PBZ air samples for two fire equipment mechanics were analyzed for welding-fume metals, including hexavalent chromium. During the welding activity, the fire equipment mechanics wore a half-face P-100 respirator with a face shield. The total welding time was approximately 30 to 45 minutes, and the grinding/cutting time was approximately 4 hours. Both fire equipment mechanics performed MIG (metal inert gas) welding. Only cobalt and nickel were detected. The welding-fume metals and hexavalent chromium exposure results are presented in Tables 19 and 20, respectively.

Table 19. Welding-fume metals personal breathing zone (PBZ) air sampling results analyzed by NIOSH 7300 Mod

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Arsenic (mg/m^3)	Beryllium (mg/m^3)	Cadmium (mg/m^3)	Cobalt (mg/m^3)	Lead (mg/m^3)	Nickel (mg/m^3)
11/4/2020	Luis del Cid	Maintenance on fire apparatus	MET01	391	<0.0032	<0.000016	<0.000096	**0.00018**	<0.00064	**0.0019**
11/4/2020	Paul Patao	Maintenance on fire apparatus	MET02	294	<0.0043	<0.000021	<0.00013	<0.00013	<0.00085	**0.00052**
Cal/OSHA 8-hr TWA PEL†					0.01	0.0002	0.005	0.020	0.05	0.5
Cal/OSHA 8-hr TWA action level†					0.005	0.0001	0.0025	NA	0.03	NA

† 8 CCR§5214 for arsenic, 8 CCR§5205 for beryllium, 8 CCR§5207 for cadmium, 8 CCR§5198 for lead, Title 8, Table AC-1 for cobalt and nickel

Bold indicates detected result.

Abbreviations: < = not detected; Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; TWA = time-weighted average; mg/m^3 = milligrams per cubic meter of air; PEL = permissible exposure limit; NA = not available

Table 20. Hexavalent chromium in welding personal breathing zone (PBZ) air sampling results analyzed by OSHA ID-215

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (Liters)	Hexavalent chromium (mg/m^3)
11/4/2020	Luis del Cid	Maintenance on fire apparatus	FM-002	389	778	<0.000077
11/4/2020	Paul Patao	Maintenance on fire apparatus	FM-001	293	586	<0.00010
Cal/OSHA 8-hr TWA PEL†						0.005
Cal/OSHA 8-hr TWA action level†						0.0025

† 8 CCR§5206

Abbreviations: < = not detected; Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; PEL = permissible exposure limit; TWA = time-weighted average; mg/m^3 = milligrams per cubic meter of air

N,N-dimethyl-para-toluidine was analyzed in the PBZ air among six fire equipment mechanics performing maintenance on the fire apparatus; however, one personal sampling air pump failed during the sampling event; therefore, this sample was discarded and not analyzed. Sample ID 01875 had a measured pre- and post-flow rate that was different by approximately 13%; therefore, the reporting limit in the table is an estimate. The true reporting limit is between 0.00047 and 0.00055 mg/m^3, assuming the pre-flow rate (minimum reporting limit value of <0.00047 mg/m^3) and the post-flow rate (maximum reporting limit value of <0.00055 mg/m^3) as the average flow rates used to calculate exposure. The analytical results for the remaining five samples are provided in Table 21 below; no samples were detected above the reporting limit.

Table 21. N,N-dimethyl-para-toluidine personal breathing zone (PBZ) air sampling results analyzed by IH by GC-MS Scan

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (Liters)	N,N-Dimethyl-Para-Toluidine (mg/m^3)
11/4/2020	Rafael Flores	Maintenance on fire apparatus	01872	346	124.56	<0.00040
11/4/2020	Jairo Tapia	Maintenance on fire apparatus	01392	372	133.73	<0.00037
11/4/2020	James Stolper	Maintenance on fire apparatus	01871	331	117.51	<0.00043
11/4/2020	Paul Patao	Maintenance on fire apparatus	01875	308	98.41	<0.00051*
11/4/2020	Alfredo Sanchez	Maintenance on fire apparatus	01823	301	107.76	<0.00046
Cal/OSHA 8-hr TWA PEL†						NA

† No Cal/OSHA PEL established

* The pre- and post- flow rate was different by approximately 13%; therefore, this reporting limit is an estimate (the true reporting limit is between 0.00047 and 0.00055 mg/m^3).

Abbreviations: < = not detected; Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; mg/m^3 = millograms per cubic meter of air; PEL = permissible exposure limit; TWA = time-weighted average

Tetrachloroethylene was analyzed and detected in the PBZ air among six fire equipment mechanics performing maintenance on the fire apparatus on November 4, 2020. Three samples had a pre- and post-flow rate difference of greater than 5%. The samples and their estimated values are described below:

- Sample ID 72775 had a measured pre- and post-flow rate that was different by approximately 11%; therefore, the result in the table is an estimate. The true result is between 15 and 17 mg/m^3, assuming the pre-flow rate (minimum value of 15 mg/m^3) and the post-flow rate (maximum value of 17 mg/m^3) as the average flow rates used to calculate exposure.
- Sample ID 72780 had a measured pre- and post-flow rate that was different by approximately 8%; therefore, the result in the table is an estimate. The true result is between 17 and 18 mg/m^3, assuming the pre-flow rate (minimum value of 17 mg/m^3) and the post-flow rate (maximum value of 18 mg/m^3) as the average flow rates used to calculate exposure.
- Sample ID 72779 had a measured pre- and post-flow rate that was different by approximately 28%; therefore, the result in the table is an estimate. The true result is between 64 and 90 mg/m^3, assuming the pre-flow rate (minimum value of 64 mg/m^3) and the post-flow rate (maximum value of 90 mg/m^3) as the average flow rates used to calculate exposure.

The exposure results for all six samples are provided in Table 22.

Table 22. Tetrachloroethylene personal breathing zone (PBZ) air sampling results analyzed by NIOSH 1003

Sampling Date	Employee Name	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (liters)	Tetrachloro-ethylene (mg/m^3)
11/4/2020	Paul Patao	Maintenance on fire apparatus	72773	310	38.44	**67**
11/4/2020	Gary Hodge	Maintenance on fire apparatus	72775	331	42.20	**16***
11/4/2020	James Stolper	Maintenance on fire apparatus	72776	332	49.30	**12**
11/4/2020	Alfredo Sanchez	Maintenance on fire apparatus	72780	298	45.30	**17****
11/4/2020	Dennis Farrell	Maintenance on fire apparatus	72781	306	47.58	**27**
11/4/2020	Rafael Flores	Maintenance on fire apparatus	72779	298	38.59	**75*****
Cal/OSHA 8-hr TWA PEL†						170

† Title 8, Table AC-1

* The pre- and post- flow rate was different by approximately 11%; therefore, this result is an estimate (the true result is between 15 and 17 mg/m^3).

** The pre- and post- flow rate was different by approximately 8%; therefore, this result is an estimate (the true result is between 17 and 18 mg/m^3).

*** The pre- and post- flow rate was different by approximately 28%; therefore, this result is an estimate (the true result is between 64 and 90 mg/m^3).

Bold indicates detected result.

Abbreviations: Cal/OSHA = California Division of Occupational Safety and Health (DOSH); CCR = California Code of Regulations; hr = hour; PEL = permissible exposure limit; TWA = time-weighted average; mg/m^3 = millograms per cubic meter of air

5.3.2 Surface wipe samples

PAHs, pentachlorophenol, lead, arsenic, chlorinated dioxins/furans and PCBs were analyzed in wipe samples from various locations on the fire truck. Only lead, chlorinated dioxins/furans, and PCBs were detected. The analytical results are provided in Table 23. Chlorinated dioxin/furan and PCB TEQ and non-TEQ totals, where applicable, are presented below; the analytical results for each congener are presented in the laboratory reports (Attachment 1). Congeners that were non-detects were assigned values equal to 50% of the reporting limit for calculating the dioxin/furan/PCB TEQ and non-TEQ PCB totals for each sample. Attachment 2 contains the analytical results by PCB and dioxin/furan congener (µg/cm^2), TEFs applied, and TEQ calculations by Sample ID.

Table 23. Wipe sample results on fire trucks

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result (µg/cm^2)
PAHs	NIOSH 5528	ENG-558-PAH-01	Under captain's chair	Engine 558; 1998; F0561; very dusty	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	ENG-159-PAH-01	Plumbing compartment	Engine 159; F2174; very dirty on piping	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result (µg/cm^2)
PAHs	NIOSH 5528	ENG-583-PAH-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	ENG-583-PAH-01	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
PAHs	NIOSH 5528	ENG-558-PAH-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result (µg/cm²)
PAHs	NIOSH 5528	ENG-168-PAH-01	Fuel cell directly underneath the stainless steel water tank	Engine 168; F1567; dusty/dirty	Naphthalene: <0.0050 *Acenaphthylene: <0.0050 *Acenaphthene: <0.0050 *Fluorene: <0.0050 *Phenanthrene: <0.0050 *Anthracene: <0.0050 *Fluoranthene: <0.0050 *Pyrene: <0.0050 Benzo(a)anthracene: <0.0050 Chrysene: <0.0050 Benzo(b)fluoranthene: <0.0050 Benzo(k)fluoranthene: <0.0050 Benzo(a)pyrene: <0.0050 Indeno(1,2,3-cd)pyrene: <0.0050 Dibenzo(a,h)anthracene: <0.0050 *Benzo(g,h,i)perylene: <0.0050
Pentachlorophenol	OSHA 39	ENG-168-PENTA-01	Fuel cell directly underneath the stainless steel water tank	Engine 168; F1567; dusty/dirty	<0.0050
Pentachlorophenol	OSHA 39	ENG-583-PENTA-01	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty	<0.0050
Pentachlorophenol	OSHA 39	ENG-558-PENTA-01	Under captain's chair	Engine 558; 1998; F0561; very dusty	<0.0050
Pentachlorophenol	OSHA 39	ENG-583-PENTA-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris	<0.0050
Pentachlorophenol	OSHA 39	ENG159-PENTA-1	Plumbing compartment	Engine 159; F2174; very dirty on piping	<0.0050
Pentachlorophenol	OSHA 39	ENG-558-PENTA-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty	<0.0050

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result ($\mu g/cm^2$)	
Arsenic / Lead	NIOSH 9102 Mod	ENG583-A-1	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty	Arsenic: <0.063	Lead: **0.54**
Arsenic / Lead	NIOSH 9102 Mod	ENG-558-A-01	Captain's kick panel	Engine 558; 1998; F0561; very dusty	Arsenic: <0.063	Lead: **0.059**
Arsenic / Lead	NIOSH 9102 Mod	ENG159-A-1	Plumbing compartment	Engine 159; F2174; very dirty on piping	Arsenic: <0.063	Lead: **0.25**
Arsenic / Lead	NIOSH 9102 Mod	ENG-583-A-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris	Arsenic: <0.063	Lead: **0.035**
Arsenic / Lead	NIOSH 9102 Mod	ENG-168-A-01	Fuel cell directly underneath the stainless steel water tank	Engine 168; F1567; dusty/dirty	Arsenic: <0.063	Lead: **0.046**
Arsenic / Lead	NIOSH 9102 Mod	ENG-558-A-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty	Arsenic: <0.063	Lead: **0.030**
PCBs	EPA 1668C	ENG-558-DFP-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty	PCB TEQ †: **1.2×10^{-9}** Non-TEQ PCB †: **2.9×10^{-5}**	
Chlorinated dioxins/furans	EPA 1613B	ENG-558-DFP-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty	TEQ †: **1.8×10^{-8}**	
PCBs	EPA 1668C	ENG-583-DFP-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris	PCB TEQ †: **1.6×10^{-9}** Non-TEQ PCB †: **3.6×10^{-5}**	
Chlorinated dioxins/furans	EPA 1613B	ENG-583-DFP-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris	TEQ †: **1.6×10^{-8}**	

Chemical	Method	Sample ID	Sampling Location	Observations/ Notes	Result (µg/cm^2)
PCBs	EPA 1668C	ENG-168-DFP-01	Fuel cell directly underneath the stainless steel water tank	Engine 168; F1567; dusty/dirty	PCB TEQ †: **1.5×10^{-9}** Non-TEQ PCB †: **3.3×10^{-5}**
Chlorinated dioxins/furans	EPA 1613B	ENG-168-DFP-01	Fuel cell directly underneath the stainless steel water tank	Engine 168; F1567; dusty/dirty	TEQ †: **2.0×10^{-8}**
PCBs	EPA 1668C	ENG-159-DFP-1	Plumbing compartment	Engine 159; F2174; very dirty on piping	PCB TEQ †: **4.4×10^{-9}** Non-TEQ PCB †: **2.3×10^{-5}**
Chlorinated dioxins/furans	EPA 1613B	ENG-159-DFP-1	Plumbing compartment	Engine 159; F2174; very dirty on piping	TEQ †: **2.2×10^{-8}**
PCBs	EPA 1668C	ENG-583-DFP-01	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty	PCB TEQ †: **5.1×10^{-9}** Non-TEQ PCB †: **9.4×10^{-5}**
Chlorinated dioxins/furans	EPA 1613B	ENG-583-DFP-01	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty	TEQ †: **3.0×10^{-8}**
PCBs	EPA 1668C	ENG-558-DFP-01	Under captain's chair	Engine 558; 1998; F0561; very dusty	PCB TEQ †: **3.2×10^{-9}** Non-TEQ PCB †: **3.0×10^{-5}**
Chlorinated dioxins/furans	EPA 1613B	ENG-558-DFP-01	Under captain's chair	Engine 558; 1998; F0561; very dusty	TEQ †: **2.1×10^{-8}**

Abbreviations: < = not detected; µg/cm^2 = micrograms per square centimeter; TEQ = 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalence; TEQ concentrations are calculated by multiplying the toxic equivalency factor (TEF) by the detected concentration of the dioxin or dioxin-like congener (dioxin/furan/PCB); * = not considered a carcinogen

† Congeners that were non-detects were assigned values equal to 50% of the detection limit.

Bold indicates detected result.

5.3.3 *Asbestos bulk samples*

Four bulk samples of the vermiculite-coated fiberglass strips used to wrap the exhaust of a fire apparatus were analyzed for asbestos (chrysotile, amosite, crocidolite, actinolite/ tremolite, and anthophyllite). Historically, vermiculite had the potential to contain traces of asbestos, which is a carcinogen. Based on the results from the four samples, presented in Table 24, no asbestos was detected. The wrap samples were taken from a brand new roll, as well as from a 1998, a 2006, and a 1995 fire truck.

Table 24. Asbestos bulk sample results of vermiculite-coated fiberglass strips analyzed by NIOSH 9002 Mod

Chemical	Sample ID	Sample Description	Result (%)
Asbestos	#1	New roll	Chrysotile <1.0 Amosite <1.0 Crocidolite <1.0 Actinolite/ Tremolite <1.0 Anthophyllite <1.0
Asbestos	#2	Truck 532A (1998)	Chrysotile <1.0 Amosite <1.0 Crocidolite <1.0 Actinolite/ Tremolite <1.0 Anthophyllite <1.0
Asbestos	#3	Truck (Emergency Fire Service) F1484 (2006)	Chrysotile <1.0 Amosite <1.0 Crocidolite <1.0 Actinolite/ Tremolite <1.0 Anthophyllite <1.0
Asbestos	#4	Truck 5166 F0181 (1995)	Chrysotile <1.0 Amosite <1.0 Crocidolite <1.0 Actinolite/ Tremolite <1.0 Anthophyllite <1.0

Abbreviations: < = not detected; % = percent

6 Conclusions

Of the samples collected at Air Operations, hexavalent chromium, lead, PCBs, and chlorinated dioxins/furans were measured in the following samples:

- Hexavalent chromium was detected in the PBZ air sample from a helicopter mechanic performing heavy aircraft maintenance in the hangar (sample ID HM-1103-13); the exposure result was one order of magnitude below the Cal/OSHA action level and permissible exposure limit (PEL).
- Hexavalent chromium was detected in the two wipe samples collected from Mastinox-coated surfaces on the Bell412 aircraft located inside the hangar; the results were 0.080 $\mu g/cm^2$ for sample ID N14LA-05 and 0.54 $\mu g/cm^2$ for sample ID N14LA-06.
- Hexavalent chromium was detected in all six surface wipe samples collected on the hot part of the Bell412 engines parked on the flight line[1] (sample IDs N18LA-01, N17LA-04, N18LA-02, N120LA-01, N120LA-02, N17LA-03). The results ranged between 0.00076 and 0.0022 $\mu g/cm^2$.
- Lead was detected in five of six surface wipe samples collected on various locations of the aircraft parked on the flight line (sample IDs N120LA-03-A, N822LA-03-A, N120LA-01-A, N120LA-02-A, N822LA-02-A). The detected results ranged between 0.0082 and 0.016 $\mu g/cm^2$.
- Lead was detected in five of six surface wipe samples collected on various locations of the aircraft parked in the hangar (sample IDs N190LA-01-A, N14LA-02-A, N14LA-01-A, N190LA-03-A, N14LA-03-A). The detected results ranged between 0.019 and 0.033 $\mu g/cm^2$.
- PCBs and chlorinated dioxins/furans were detected in the surface wipe samples collected on the horizontal stabilator (sample ID 356-4) and the chin bubble (sample ID 356-5) of the Bell412 parked on the flight line. The PCB TEQ maximum result was 1.2×10^{-9} $\mu g/cm^2$, the non-TEQ PCB maximum result was 4.2x10 $\mu g/cm^2$, and the chlorinated dioxin/furan TEQ maximum result was 1.5×10^{-8} $\mu g/cm^2$.

In the samples collected at the Breathing Apparatus Shop in Pacoima, benzene, acetaldehyde, formaldehyde, PAHs, lead, PCBs, and chlorinated dioxins/furans were detected:

- Benzene was detected in the PBZ air samples collected from both equipment maintenance workers working in the small-engine repair shop (0.68 mg/m^3 in

---

[1] Recent communication (July 2020) from Pratt Whitney stated that hexavalent chromium could be present on the engine, and that the engine should not be cleaned by blowing air onto the surface.

sample ID EL0064 and 0.30 mg/m^3 in sample ID EL0139); the exposures were below the Cal/OSHA action level and PEL.

- Acetaldehyde and formaldehyde were detected in the PBZ air samples collected from both equipment maintenance workers working in the small engine repair shop (sample IDs A295581 and A295575). Acetaldehyde detected results (0.027 mg/m^3) were three orders of magnitude below the Cal/OSHA PEL, and formaldehyde detected results (0.026 and 0.028 mg/m^3 for sample IDs A295581 and A295575, respectively) were one order of magnitude below the Cal/OSHA PEL.
- PAHs were detected in the surface wipe samples from the training air packs (sample IDs ECTC-T-8, ECTC-T-38, NCSO-04), but not from the field air packs.
- PCBs and chlorinated dioxins/furans were detected in the surface wipe samples from the field and training air packs (sample IDs BA-1 and BA-2, respectively). The PCB TEQ maximum result was 1.8×10^{-9} µg/cm^2 (training air pack), the non-TEQ PCB maximum result was 2.1×10^{-5} µg/cm^2 (field air pack), and the chlorinated dioxin/furan TEQ maximum result was 3.0×10^{-8} µg/cm^2 (training air pack).
- Lead was detected on all six surface wipe samples from the training and field air packs (sample IDs ECTC-T-8-A, ECTC-T-38-A, A49996-QUT-185-4-A, A50143-Q-24-5-A, NC50-4-A, AS0421-ENG-21-4-A). The results ranged between 0.013 and 0.048 µg/cm^2. On the fire hoses, lead was detected on all six surface wipe samples (sample IDs H-01-A, H-02-A, H-03-A, H-04-A, H-05-A, H-06-A). The results ranged between 0.0076 and 0.13 µg/cm^2.

In the surface wipe samples collected at the Eastern Fire Shop, lead, PCBs, and chlorinated dioxins/furans were detected:

- Lead was detected on all six surface wipe samples collected on various locations of the fire apparatus (sample IDs ENG583-A-1, ENG-558-A-01, ENG159-A-1, ENG-583-A-02, ENG-168-A-01, ENG-558-A-02). The results ranged between 0.030 and 0.54 µg/cm^2.
- PCBs and chlorinated dioxins/furans were detected in the surface wipe samples collected on various locations of the fire apparatus (sample IDs ENG-558-DFP-02, ENG-583-DFP-02, ENG-168-DFP-01, ENG-159-DFP-1, ENG-583-DFP-01, ENG-558-DFP-01). The PCB TEQ maximum result was 5.1×10^{-9} µg/cm^2, the non-TEQ PCB maximum result was 9.4×10^{-5} µg/cm^2, and the chlorinated dioxin/furan TEQ maximum result was 3.0×10^{-8} µg/cm^2, all from sample ID ENG-583-DFP-01 (sampling location: left rear frame at differential).

Of the PBZ air samples collected at the Eastern Fire Shop, the detections included the following:

- Tetrachloroethylene was detected in all six PBZ air samples collected from the fire equipment mechanics, results ranging between 12 and 75 mg/m^3. All of the measurements were below the Cal/OSHA PEL.
- Cobalt and nickel in welding fumes were detected between two and three orders of magnitude below the Cal/OSHA PEL.
- Diesel particulate as elemental carbon was detected in one PBZ air sample (0.180 mg/m^3; sample ID 11405); however, Cal/OSHA has not published a PEL for diesel particulate matter.

The detection of diesel particulate as elemental carbon was the only measured analyte in the eight samples analyzed (six employee PBZ and two area PBZ air samples). Elemental carbon is considered a conservative measure of diesel particulate matter. This result was two orders of magnitude greater than the other sample results. Because elemental carbon is a surrogate for diesel particulate, it is uncertain whether the exposure was caused by diesel emissions or another source of elemental carbon.

Chemicals were not measured in the field blanks above the detection limit or minimum level of quantitation, as applicable to PCBs. The data validation of the analytical data is provided in Attachment 3.

7 Next Steps

Task 5 will build on the results of Task 4 and will include calculating the theoretical excess cancer risk from exposure to carcinogenic materials for each SEG determined from Task 2 and toxicity criteria relevant to California risk assessments. The risk assessment will result in an estimate of the increased risk of developing cancer as a result of exposure. This approach involves varying degrees of conservatism, ensuring that cancer risk is not underestimated, which makes it probable that the estimated risk will be overestimated.

For Task 3, Epidemiologic Assessment, employee records are being evaluated for completeness and suitability for a future cancer epidemiology study.

Task 6 may include analyzing public comments, explaining the rationale for specific policy recommendations, and disseminating the study findings to the governor, state legislature, Occupational Safety and Health Standards Board, Los Angeles County Board of Supervisors, and stakeholders in the workers' compensation system.

8 References

AIHA (American Industrial Hygiene Association). 2018. Technical guide for wildfire impact assessments for the OEHS professional.

DTSC HERO (California Department of Toxic Substances Control, Human and Ecological Risk Office). 2017. Human health risk assessment (HHRA), Note Number 2. April.

Fent KW, Evans DE, Booher D, Pleil JD, Stiegel MA, Horn GP, Dalton J. 2015. Volatile organic compounds off-gassing from firefighters' personal protective equipment ensembles after use. J Occup Environ Hyg 12(6):404–414, doi:10.1080/15459624.2015.1025135.

Fent KW, LaGuardia M, Luellen D, McCormick S, Mayer A, Chen IC, Kerber S, Smith D, Horn GP. 2020. Flame retardants, dioxins, and furans in air and on firefighters' protective ensembles during controlled residential firefighting. Environ Int 140:105756, doi: https://doi.org/10.1016/j.envint.2020.105756.

IARC (International Agency for Research on Cancer). 2010. IARC Monographs on the evaluation of carcinogenic risks to humans, Volume 98, Painting, firefighting, and shiftwork. Occupational Cancer Research Centre, https://www.occupationalcancer.ca/2010/iarc-monographs-volume-98-painting-firefighting-and-shiftwork/.

Materna BL, Jones JR, Sutton PM, Rothman N, Harrison RJ. 1992. Occupational exposures in California wildland fire fighting. Am Ind Hyg Assoc J 53(1):69–76, doi:10.1080/15298669291359311.

Park JS, Voss RW, McNeel S, Wu N, Guo T, Wang Y, et al. 2015. High exposure of California firefighters to polybrominated diphenyl ethers. Environ Sci Technol 49(5):2948–2958, doi:10.1021/es5055918.

ToxStrategies, Inc. 2020a. Proposal in response to RFP #4479, Assessment of risk of carcinogens exposure and incidents of occupational cancer among mechanics and cleaners of firefighting vehicles, Volume 1 — Proposal. February 13.

ToxStrategies, Inc. 2020b. Structured literature review of potential occupational exposures and cancer among mechanics who repair and clean firefighting vehicles (Task 1). August 24.

ToxStrategies, Inc. 2020c. Qualitative exposure assessment (Task 2). October 9.

NIOSH (National Institute for Occupation Safety and Health). 1996. Lead in surface wipe samples: Method 9100. NIOSH Manual of Analytical Methods (NMAM), Fourth Edition. Issue 2, May 15.

USEPA (United States Environmental Protection Agency). 2010. Recommended toxicity equivalence factors (TEFs) for human health risk assessments of 2,3,7,8-tetrachlorodibenzo-p-dioxin and dioxin-like compounds. U.S. Environmental Protection Agency, Office of Science Advisor, Risk Assessment Forum. EPA/100/R 10/1005. December.

van den Berg M, Birnbaum LS, Denison M, et al. 2006. Review: The 2005 World Health Organization reevaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds. Toxicol Sci 93(2):223–241.

ATTACHMENT 1

Laboratory Reports

ANALYTICAL REPORT

Report Date: November 09, 2020

Stephanie Vivanco
ToxStragies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: s.vivanco@toxstragies.com

Workorder: **34-2031166**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **HM-1103-07** Collected: 11/03/2020
Lab ID: 2031166001 Sampling Location: LA Fire Received: 11/06/2020

Method: OSHA ID-215 **Media:** PVC Filter **Instrument:** IC08
Sampling Parameter: Air Volume Not Provided **Analyzed:** 11/06/2020 (271074)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	NA	0.060

Sample ID: **HM-1103-04** Collected: 11/03/2020
Lab ID: 2031166002 Sampling Location: LA Fire Received: 11/06/2020

Method: OSHA ID-215 **Media:** PVC Filter **Instrument:** IC08
Sampling Parameter: Air Volume 908 L **Analyzed:** 11/06/2020 (271074)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	<0.066	0.060

Sample ID: **HM-1103-11** Collected: 11/03/2020
Lab ID: 2031166003 Sampling Location: LA Fire Received: 11/06/2020

Method: OSHA ID-215 **Media:** PVC Filter **Instrument:** IC08
Sampling Parameter: Air Volume 832 L **Analyzed:** 11/06/2020 (271074)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	<0.072	0.060

Sample ID: **HM-1103-10** Collected: 11/03/2020
Lab ID: 2031166004 Sampling Location: LA Fire Received: 11/06/2020

Method: OSHA ID-215 **Media:** PVC Filter **Instrument:** IC08
Sampling Parameter: Air Volume 770 L **Analyzed:** 11/06/2020 (271074)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	<0.078	0.060

ANALYTICAL REPORT

Workorder: **34-2031166**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **HM-1103-02** | Collected: 11/03/2020
Lab ID: 2031166005 | Sampling Location: LA Fire | Received: 11/06/2020
Method: OSHA ID-215 | **Media:** PVC Filter | **Sampling Parameter: Air Volume 930 L** | **Instrument:** IC08 | **Analyzed:** 11/06/2020 (271074)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	<0.065	0.060

Sample ID: **HM-1103-12** | Collected: 11/03/2020
Lab ID: 2031166006 | Sampling Location: LA Fire | Received: 11/06/2020
Method: OSHA ID-215 | **Media:** PVC Filter | **Sampling Parameter: Air Volume 628 L** | **Instrument:** IC08 | **Analyzed:** 11/06/2020 (271074)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	<0.096	0.060

Sample ID: **HM-1103-13** | Collected: 11/03/2020
Lab ID: 2031166007 | Sampling Location: LA Fire | Received: 11/06/2020
Method: OSHA ID-215 | **Media:** PVC Filter | **Sampling Parameter: Air Volume 744 L** | **Instrument:** IC08 | **Analyzed:** 11/06/2020 (271074)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	**0.062**	**0.084**	0.060

Sample ID: **HM-1103-08** | Collected: 11/03/2020
Lab ID: 2031166008 | Sampling Location: LA Fire | Received: 11/06/2020
Method: OSHA ID-215 | **Media:** PVC Filter | **Sampling Parameter: Air Volume 852 L** | **Instrument:** IC08 | **Analyzed:** 11/06/2020 (271074)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	<0.070	0.060

Sample ID: **HM-1103-01** | Collected: 11/03/2020
Lab ID: 2031166009 | Sampling Location: LA Fire | Received: 11/06/2020
Method: OSHA ID-215 | **Media:** PVC Filter | **Sampling Parameter: Air Volume 876 L** | **Instrument:** IC08 | **Analyzed:** 11/06/2020 (271074)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	<0.068	0.060

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
OSHA ID-215	/S/ Daryka Gress 11/09/2020 10:26	/S/ Christopher Winter 11/09/2020 12:07

ANALYTICAL REPORT

Workorder: **34-2031166**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter.
Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
	Utah (TNI)	UT00953	http://lams.nelac-institute.org/search
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L17-507-R1	http://www.pjlabs.com

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

W 2031166

ANALYTICAL REQUEST FORM

1. [X] REGULAR Status 2031166

[ ] RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ______________ DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/5/2020 Purchase Order No. ______

3. Company Name : Toxstrategies ~~corp~~

Address: 27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Person to Contact: Stephanie Vivanco

Telephone (949) 382-1534

Fax Telephone ( ) ______

E-mail Address: svivanco@toxstrategies.com

Billing Address (if different from above)

4. Quote No. ______

ALS Project Manager: Jessica Helland

5. **Sample Collection**

Sampling Site LA Fire

Industrial Process: ______

Date of Collection 11/03/2020

Time Collected ______

Date of Shipment ______

Chain of Custody No.: ______

6. How did you first learn about ALS?

7. **REQUEST FOR ANALYSES**

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
HM-1103-07	PVC	—	OSHA ID215 (Hex Chrom)	1	
HM-1103-04	PVC	908 L	" "	5	
HM-1103-11	PVC	832 L	" "	5	
HM-1103-10	PVC	770 L	" "	5	
HM-1103-02	PVC	930 L	" "	5	
HM-1103-12	PVC	628 L	" "	5	
HM-1103-13	PVC	744 L	" "	5	
HM-1103-08	PVC	852 L	" "	5	
HM-1103-01	PVC	876 L	" "	5	

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. $\mu g/m^3$ 6._____ (other) Please indicate one or more units in the column entitled Units**

Comments ______

Possible Contamination and/or Chemical Hazards ______

7. **Chain of Custody (Optional)**

Relinquished by	Stephanie Vivanco	Date/Time	11/05/2020 15:00
Received by	[signature]	Date/Time	11.6.2020 0910
Relinquished by		Date/Time	
Received by		Date/Time	

ANALYTICAL REPORT

Report Date: November 12, 2020

Stephanie Vivanco
ToxStrategies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: svivanco@toxstrategies.com

Workorder: **34-2031169**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N18LA-01** — Collected: 11/03/2020
Lab ID: 2031169001 — Sampling Location: LA Fire — Received: 11/06/2020

Method: OSHA ID-215 — **Media:** Wipe — **Instrument:** IC08
Sampling Parameter: Volume Not Provided — **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	RL (ug/sample)
Hexavalent Chromium	**0.14**	0.060

Sample ID: **N17LA-04** — Collected: 11/03/2020
Lab ID: 2031169002 — Sampling Location: LA Fire — Received: 11/06/2020

Method: OSHA ID-215 — **Media:** Wipe — **Instrument:** IC08
Sampling Parameter: Volume Not Provided — **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	RL (ug/sample)
Hexavalent Chromium	**0.076**	0.060

Sample ID: **N18LA-02** — Collected: 11/03/2020
Lab ID: 2031169003 — Sampling Location: LA Fire — Received: 11/06/2020

Method: OSHA ID-215 — **Media:** Wipe — **Instrument:** IC08
Sampling Parameter: Volume Not Provided — **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	RL (ug/sample)
Hexavalent Chromium	**0.22**	0.060

Sample ID: **N120LA-01** — Collected: 11/03/2020
Lab ID: 2031169004 — Sampling Location: LA Fire — Received: 11/06/2020

Method: OSHA ID-215 — **Media:** Wipe — **Instrument:** IC08
Sampling Parameter: Volume Not Provided — **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	RL (ug/sample)
Hexavalent Chromium	**0.19**	0.060

ANALYTICAL REPORT

Workorder: **34-2031169**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N14LA-05**		Collected: 11/03/2020
Lab ID: 2031169005	Sampling Location: LA Fire	Received: 11/06/2020
Method: OSHA ID-215	**Media:** Wipe **Sampling Parameter: Volume Not Provided**	**Instrument:** IC08 **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	RL (ug/sample)
Hexavalent Chromium	**8.0**	0.060

Sample ID: **N120LA-02**		Collected: 11/03/2020
Lab ID: 2031169006	Sampling Location: LA Fire	Received: 11/06/2020
Method: OSHA ID-215	**Media:** Wipe **Sampling Parameter: Volume Not Provided**	**Instrument:** IC08 **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	RL (ug/sample)
Hexavalent Chromium	**0.13**	0.060

Sample ID: **N17LA-03**		Collected: 11/03/2020
Lab ID: 2031169007	Sampling Location: LA Fire	Received: 11/06/2020
Method: OSHA ID-215	**Media:** Wipe **Sampling Parameter: Volume Not Provided**	**Instrument:** IC08 **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	RL (ug/sample)
Hexavalent Chromium	**0.11**	0.060

Sample ID: **N14LA-06**		Collected: 11/03/2020
Lab ID: 2031169008	Sampling Location: LA Fire	Received: 11/06/2020
Method: OSHA ID-215	**Media:** Wipe **Sampling Parameter: Volume Not Provided**	**Instrument:** IC08 **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	RL (ug/sample)
Hexavalent Chromium	**54**	0.060

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
OSHA ID-215	/S/ Daryka Gress 11/12/2020 12:10	/S/ Thomas Bosch 11/12/2020 14:52

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

ANALYTICAL REPORT

Workorder: **34-2031169**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter.
Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
	Utah (TNI)	UT00953	http://lams.nelac-institute.org/search
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L17-507-R1	http://www.pjlabs.com

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

W 2031169

ANALYTICAL REQUEST FORM

2031169

1. [X] REGULAR Status

[ ] RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ______________
DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/5/2020 Purchase Order No. ______

3. Company Name : Toxstrategies
Address: 27001 La Paz Rd - Suite 260
Mission Viejo, CA 92691
Person to Contact: Stephanie Vivanco
Telephone (949) 382-1534
Fax Telephone ( )
E-mail Address: svivanco@toxstrategies.com
Billing Address (if different from above)

4. Quote No. ______
ALS Project Manager: Jessica Hellard

5. **Sample Collection**
Sampling Site LA fire
Industrial Process: ______
Date of Collection 11/3/2020
Time Collected ______
Date of Shipment ______
Chain of Custody No.: ______

6. How did you first learn about ALS?

7. **REQUEST FOR ANALYSES**

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
N18LA-01	QFF Wipe	—	OSHA ID 215 (Hex Chrom)	1	
N17LA-04	"	—	" "	1	
N18LA-02	"	—	" "	1	
N120LA-01	"	—	" "	1	
N14LA-05	"	—	" "	1	
N120LA-02	"	—	" "	1	
N17LA-03	"	—	" "	1	
N14LA-06	"	—	" "	1	

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. µg/m^3 6. ______ (other) Please indicate one or more units in the column entitled Units**

Comments ______

Possible Contamination and/or Chemical Hazards ______

7. **Chain of Custody (Optional)**

Relinquished by	[signature]	Date/Time	11/05/2020 15:00
Received by	[signature]	Date/Time	11·6·2020 0910
Relinquished by		Date/Time	
Received by		Date/Time	

ANALYTICAL REPORT

Report Date: November 13, 2020

Stephanie Vivanco
ToxStrategies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: svivanco@toxstrategies.com

Workorder: **34-2031177**
Client Project ID: La Fire 110420
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **FM-002** Collected: 11/04/2020
Lab ID: 2031177001 Sampling Location: La Fire Received: 11/06/2020

Method: OSHA ID-215 **Media:** PVC Filter **Instrument:** IC08
Sampling Parameter: Air Volume 778 L **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	<0.077	0.060

Sample ID: **FM-003** Collected: 11/04/2020
Lab ID: 2031177002 Sampling Location: La Fire Received: 11/06/2020

Method: OSHA ID-215 **Media:** PVC Filter **Instrument:** IC08
Sampling Parameter: Air Volume Not Provided **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	NA	0.060

Sample ID: **FM-001** Collected: 11/04/2020
Lab ID: 2031177003 Sampling Location: La Fire Received: 11/06/2020

Method: OSHA ID-215 **Media:** PVC Filter **Instrument:** IC08
Sampling Parameter: Air Volume 586 L **Analyzed:** 11/11/2020 (271154)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Hexavalent Chromium	<0.060	<0.10	0.060

Sample ID: **MET01** Collected: 11/04/2020
Lab ID: 2031177004 Sampling Location: La Fire Received: 11/06/2020

Method: NIOSH 7300 Mod., MCE **Media:** MCE Filter **Instrument:** ICP12
Sampling Parameter: Air Volume 782 L **Prepared:** 11/09/2020 (271134)
Analyzed: 11/11/2020 (271312)

Analyte	Result (ug/sample)	Result (mg/m³)	RL (ug/sample)
Aluminum	**24**	**0.031**	5.0

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031177**
Client Project ID: La Fire 110420
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **MET01** Collected: 11/04/2020
Lab ID: 2031177004 Sampling Location: La Fire Received: 11/06/2020

Method: **NIOSH 7300 Mod., MCE** **Media:** MCE Filter **Instrument:** ICP12
Sampling Parameter: **Air Volume 782 L** **Prepared:** 11/09/2020 (271134)
Analyzed: 11/11/2020 (271312)

Analyte	Result (ug/sample)	Result (mg/m³)	RL (ug/sample)
Arsenic	<2.5	<0.0032	2.5
Barium	**50**	**0.064**	0.25
Beryllium	<0.013	<0.000016	0.013
Cadmium	<0.075	<0.000096	0.075
Calcium	**71**	**0.091**	15
Chromium	<1.3	<0.0016	1.3
Cobalt	**0.14**	**0.00018**	0.075
Copper	**12**	**0.015**	0.50
Iron	**770**	**0.98**	5.0
Lead	<0.50	<0.00064	0.50
Lithium	<1.0	<0.0013	1.0
Magnesium	**9.2**	**0.012**	1.3
Manganese	**13**	**0.017**	0.13
Molybdenum	<0.38	<0.00048	0.38
Nickel	**1.5**	**0.0019**	0.13
Phosphorus	<5.0	<0.0064	5.0
Selenium	<2.5	<0.0032	2.5
Silver	<0.25	<0.00032	0.25
Sodium	**28**	**0.036**	3.8
Tellurium	<1.3	<0.0016	1.3
Thallium	<1.3	<0.0016	1.3
Titanium	**1.1**	**0.0014**	0.075
Vanadium	<0.075	<0.000096	0.075
Yttrium	<0.075	<0.000096	0.075
Zinc	**5.1**	**0.0065**	0.50
Zirconium	<0.50	<0.00064	0.50

Sample ID: **MET02** Collected: 11/04/2020
Lab ID: 2031177005 Sampling Location: La Fire Received: 11/06/2020

Method: **NIOSH 7300 Mod., MCE** **Media:** MCE Filter **Instrument:** ICP12
Sampling Parameter: **Air Volume 588 L** **Prepared:** 11/09/2020 (271134)
Analyzed: 11/11/2020 (271312)

Analyte	Result (ug/sample)	Result (mg/m³)	RL (ug/sample)
Aluminum	**40**	**0.068**	5.0
Arsenic	<2.5	<0.0043	2.5
Barium	**1.6**	**0.0027**	0.25
Beryllium	<0.013	<0.000021	0.013

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031177**
Client Project ID: La Fire 110420
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **MET02** | Collected: 11/04/2020
Lab ID: 2031177005 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 7300 Mod., MCE** | **Media:** MCE Filter | **Sampling Parameter:** **Air Volume 588 L** | **Instrument:** ICP12 | **Prepared:** 11/09/2020 (271134) | **Analyzed:** 11/11/2020 (271312)

Analyte	Result (ug/sample)	Result (mg/m^3)	RL (ug/sample)
Cadmium	<0.075	<0.00013	0.075
Calcium	<15	<0.026	15
Chromium	<1.3	<0.0021	1.3
Cobalt	<0.075	<0.00013	0.075
Copper	**1.4**	**0.0025**	0.50
Iron	**130**	**0.23**	5.0
Lead	<0.50	<0.00085	0.50
Lithium	<1.0	<0.0017	1.0
Magnesium	**2.2**	**0.0038**	1.3
Manganese	**9.2**	**0.016**	0.13
Molybdenum	<0.38	<0.00064	0.38
Nickel	**0.30**	**0.00052**	0.13
Phosphorus	<5.0	<0.0085	5.0
Selenium	<2.5	<0.0043	2.5
Silver	<0.25	<0.00043	0.25
Sodium	**18**	**0.031**	3.8
Tellurium	<1.3	<0.0021	1.3
Thallium	<1.3	<0.0021	1.3
Titanium	**2.0**	**0.0034**	0.075
Vanadium	<0.075	<0.00013	0.075
Yttrium	<0.075	<0.00013	0.075
Zinc	**150**	**0.25**	0.50
Zirconium	<0.50	<0.00085	0.50

Sample ID: **MET03** | Collected: 11/04/2020
Lab ID: 2031177006 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 7300 Mod., MCE** | **Media:** MCE Filter | **Sampling Parameter:** **Air Volume Not Provided** | **Instrument:** ICP12 | **Prepared:** 11/09/2020 (271134) | **Analyzed:** 11/11/2020 (271312)

Analyte	Result (ug/sample)	Result (mg/m^3)	RL (ug/sample)
Aluminum	<5.0	NA	5.0
Arsenic	<2.5	NA	2.5
Barium	<0.25	NA	0.25
Beryllium	<0.013	NA	0.013
Cadmium	<0.075	NA	0.075
Calcium	<15	NA	15
Chromium	<1.3	NA	1.3

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031177**
Client Project ID: La Fire 110420
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **MET03** | Collected: 11/04/2020
Lab ID: 2031177006 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 7300 Mod., MCE** | **Media:** MCE Filter | **Sampling Parameter:** **Air Volume Not Provided** | **Instrument:** ICP12 | **Prepared:** 11/09/2020 (271134) | **Analyzed:** 11/11/2020 (271312)

Analyte	Result (ug/sample)	Result (mg/m³)	RL (ug/sample)
Cobalt	<0.075	NA	0.075
Copper	<0.50	NA	0.50
Iron	<5.0	NA	5.0
Lead	<0.50	NA	0.50
Lithium	<1.0	NA	1.0
Magnesium	<1.3	NA	1.3
Manganese	<0.13	NA	0.13
Molybdenum	<0.38	NA	0.38
Nickel	<0.13	NA	0.13
Phosphorus	<5.0	NA	5.0
Selenium	<2.5	NA	2.5
Silver	<0.25	NA	0.25
Sodium	<3.8	NA	3.8
Tellurium	<1.3	NA	1.3
Thallium	<1.3	NA	1.3
Titanium	<0.075	NA	0.075
Vanadium	<0.075	NA	0.075
Yttrium	<0.075	NA	0.075
Zinc	<0.50	NA	0.50
Zirconium	<0.50	NA	0.50

Sample ID: **#1** | Collected: 11/04/2020
Lab ID: 2031177007 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9002 Mod.** | **Media:** Bulk | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** MSCP04 | **Analyzed:** 11/13/2020 (271373)

Analyte	Result (%)	RL (%)
Chrysotile	ND	1.0
Amosite	ND	1.0
Crocidolite	ND	1.0
Actinolite/Tremolite	ND	1.0
Anthophyllite	ND	1.0

ANALYTICAL REPORT

Workorder: **34-2031177**
Client Project ID: La Fire 110420
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **#2** | Collected: 11/04/2020
Lab ID: 2031177008 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9002 Mod.** | **Media:** Bulk | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** MSCP04 | **Analyzed:** 11/13/2020 (271373)

Analyte	Result (%)	RL (%)
Chrysotile	ND	1.0
Amosite	ND	1.0
Crocidolite	ND	1.0
Actinolite/Tremolite	ND	1.0
Anthophyllite	ND	1.0

Sample ID: **#3** | Collected: 11/04/2020
Lab ID: 2031177009 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9002 Mod.** | **Media:** Bulk | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** MSCP04 | **Analyzed:** 11/13/2020 (271373)

Analyte	Result (%)	RL (%)
Chrysotile	ND	1.0
Amosite	ND	1.0
Crocidolite	ND	1.0
Actinolite/Tremolite	ND	1.0
Anthophyllite	ND	1.0

Sample ID: **#4** | Collected: 11/04/2020
Lab ID: 2031177010 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9002 Mod.** | **Media:** Bulk | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** MSCP04 | **Analyzed:** 11/13/2020 (271373)

Analyte	Result (%)	RL (%)
Chrysotile	ND	1.0
Amosite	ND	1.0
Crocidolite	ND	1.0
Actinolite/Tremolite	ND	1.0
Anthophyllite	ND	1.0

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
NIOSH 7300 Mod., MCE	/S/ Joanna C. Sanchez 11/11/2020 16:05	/S/ Kristie F. Bitner 11/12/2020 10:10
NIOSH 9002 Mod.	/S/ Chandler Griffith 11/13/2020 15:03	/S/ Peter P. Steen 11/13/2020 15:12
OSHA ID-215	/S/ Daryka Gress 11/12/2020 12:10	/S/ Thomas Bosch 11/12/2020 14:52

ANALYTICAL REPORT

Workorder: **34-2031177**
Client Project ID: La Fire 110420
Purchase Order: NA
Project Manager: Jessica Helland

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter.
Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
	Utah (TNI)	UT00953	http://lams.nelac-institute.org/search
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L17-507-R1	http://www.pjlabs.com

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

W 2031177

2031177

ANALYTICAL REQUEST FORM

1. [X] **REGULAR Status**

[ ] **RUSH Status Requested - ADDITIONAL CHARGE**
RESULTS REQUIRED BY ____________ DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/05/2020 Purchase Order No. ____________ **4.** Quote No. ____________

3. Company Name : Toxstrategies
ALS Project Manager: J Helland
Address: 27001 La Paz Rd Suite 260
Mission Viejo CA 92691
Person to Contact: Stephanie Vivanco
Telephone (949) 382-1534
Fax Telephone ( ) ____________
E-mail Address: svivanco@toxstrategies.com
Billing Address (if different from above)

5. Sample Collection
Sampling Site LA fire
Industrial Process: ____________
Date of Collection 11/4/2020
Time Collected ____________
Date of Shipment ____________
Chain of Custody No.: ____________

6. How did you first learn about ALS?

7. REQUEST FOR ANALYSES

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments	
FM-002	PVC	778 L	OSHA ID 215 - Hex chrome	5		4
FM-003	PVC	—	OSHA ID215 - Hex chrome	1		
FM-001	PVC	586 L	OSHA ID215 - Hex chrome	5		
MET01	MCE	782 L	NIOSH 7300/7303 welding fume panel B	5		17
MET02	MCE	588 L	NIOSH 7300/7303 "	5		
MET03	MCE	—	NIOSH 7300/7303 "	1		
#1	bulk	—	NIOSH 9002 - Asbestos	1		20
#2	bulk	—	NIOSH 9002 - Asbestos	1		
#3	bulk	—	NIOSH 9002 - Asbestos	1		
#4	bulk	—	NIOSH 9002 - Asbestos	1		

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. $\mu g/m^3$ 6._____ (other) Please indicate one or more units in the column entitled Units**

Comments ____________

Possible Contamination and/or Chemical Hazards ____________

7. Chain of Custody (Optional)

Relinquished by	[signature]	Date/Time	11/05/2020 1500
Received by	[signature]	Date/Time	11-06-20 ~~10~~: 9:10
Relinquished by		Date/Time	
Received by		Date/Time	

ANALYTICAL REPORT
Amended-20201216

Report Date: December 16, 2020

Stephanie Vivanco
ToxStrategies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: svivanco@toxstrategies.com

Workorder: **34-2031255**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N120LA-03-A** | Collected: 11/03/2020
Lab ID: 2031255001 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**1.6**	0.50

Sample ID: **N190LA-01-A** | Collected: 11/03/2020
Lab ID: 2031255002 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**1.9**	0.50

Sample ID: **N822LA-03-A** | Collected: 11/03/2020
Lab ID: 2031255003 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**0.91**	0.50

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031255**

Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: N120LA-01-A Collected: 11/03/2020
Lab ID: 2031255004 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** **Media:** Wipe **Sampling Parameter:** **Volume Not Provided** **Instrument:** ICP13 **Prepared:** 11/09/2020 (271142) **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**0.82**	0.50

Sample ID: N120LA-02-A Collected: 11/03/2020
Lab ID: 2031255005 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** **Media:** Wipe **Sampling Parameter:** **Volume Not Provided** **Instrument:** ICP13 **Prepared:** 11/09/2020 (271142) **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**1.6**	0.50

Sample ID: HM-Blank-Arsenic Collected: 11/03/2020
Lab ID: 2031255006 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** **Media:** Wipe **Sampling Parameter:** **Volume Not Applicable** **Instrument:** ICP13 **Prepared:** 11/09/2020 (271142) **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	<0.50	0.50

Sample ID: N822LA-01-A Collected: 11/03/2020
Lab ID: 2031255007 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** **Media:** Wipe **Sampling Parameter:** **Volume Not Provided** **Instrument:** ICP13 **Prepared:** 11/09/2020 (271142) **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	<0.50	0.50

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031255**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N190LA-02-A** Collected: 11/03/2020
Lab ID: 2031255008 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe **Media:** Wipe **Instrument:** ICP13
Sampling Parameter: Volume Not Provided **Prepared:** 11/09/2020 (271142)
Analyzed: 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	<0.50	0.50

Sample ID: **N14LA-02-A** Collected: 11/03/2020
Lab ID: 2031255009 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe **Media:** Wipe **Instrument:** ICP13
Sampling Parameter: Volume Not Provided **Prepared:** 11/09/2020 (271142)
Analyzed: 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**2.3**	0.50

Sample ID: **N14LA-01-A** Collected: 11/03/2020
Lab ID: 2031255010 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe **Media:** Wipe **Instrument:** ICP13
Sampling Parameter: Volume Not Provided **Prepared:** 11/09/2020 (271142)
Analyzed: 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**2.8**	0.50

Sample ID: **N822LA-02-A** Collected: 11/03/2020
Lab ID: 2031255011 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe **Media:** Wipe **Instrument:** ICP13
Sampling Parameter: Volume Not Provided **Prepared:** 11/09/2020 (271142)
Analyzed: 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**0.85**	0.50

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031255**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N190LA-03-A** Collected: 11/03/2020
Lab ID: 2031255012 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** **Media:** Wipe **Instrument:** ICP13
Sampling Parameter: **Volume Not Provided** **Prepared:** 11/09/2020 (271142)
Analyzed: 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**2.3**	0.50

Sample ID: **N14LA-03-A** Collected: 11/03/2020
Lab ID: 2031255013 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** **Media:** Wipe **Instrument:** ICP13
Sampling Parameter: **Volume Not Provided** **Prepared:** 11/09/2020 (271142)
Analyzed: 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**3.3**	0.50

Comments

Workorder: 2031255

Amended(12/16/2020): Report amended to include lead data per client request.

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
NIOSH 9102 Mod, Ghost Wipe	/S/ Peter P. Steen 12/16/2020 09:27	/S/ Rex Bagley 11/11/2020 15:17

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031255**

Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter.
Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

W 2031255

ANALYTICAL REQUEST FORM

2031255

1. [X] REGULAR Status

[ ] RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ______________ DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/5/2020 Purchase Order No. ______

3. Company Name : ToxStrategies
Address: 27001 La Paz Rd Suite 260
Mission Viejo CA 92691
Person to Contact: Stephanie Vivanco
Telephone (949) 382-1534
Fax Telephone ( )
E-mail Address: svivanco@toxstrategies.com
Billing Address (if different from above)

4. Quote No. ______
ALS Project Manager: Jessica Helland

5. **Sample Collection**
Sampling Site LA fire
Industrial Process: ______
Date of Collection 11/3/2020
Time Collected ______
Date of Shipment ______
Chain of Custody No.: ______

6. How did you first learn about ALS?

7. REQUEST FOR ANALYSES

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
N120LA-03-A	ghost wipe	—	NIOSH 9102-arsenic	1	
N190LA-01-A	"	—			
N822LA-03-A	"	—			
N120LA-01-A	"	—			
N120LA-02-A	"	—			
HM-Blank-arsenic	"	—			
~~N28~~ N822LA-01-A	"	—			
N190LA-02-A	"	—			
N14LA-02-A	"	—			
N14LA-01-A	"	—			
N822LA-02-A	"	—			
N190LA-03-A	"	—			
N14LA-03-A	"	—			
		—			

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. μg/sample 2. mg/m^3 3. ppm 4. % 5. $\mu g/m^3$ 6. _____ (other) Please indicate one or more units in the column entitled Units**

Comments ______

Possible Contamination and/or Chemical Hazards ______

7. Chain of Custody (Optional)

Relinquished by	[signature]	Date/Time	11/05/2020 15:00
Received by	[signature]	Date/Time	11-06-20 9:10
Relinquished by		Date/Time	
Received by		Date/Time	

ANALYTICAL REPORT

Amended-20201216

Report Date: December 16, 2020

Stephanie Vivanco
ToxStrategies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: svivanco@toxstrategies.com

Workorder: **34-2031257**
Client Project ID: La Fire 110320
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **ECTC-T-8-A** | Collected: 11/03/2020
Lab ID: 2031257001 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** | **Media:** Ghost Wipe | **Sampling Parameter:** **Area Not Provided** | **Instrument:** ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**1.7**	0.50

Sample ID: **ECTC-T-38-A** | Collected: 11/03/2020
Lab ID: 2031257002 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** | **Media:** Ghost Wipe | **Sampling Parameter:** **Area Not Provided** | **Instrument:** ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**1.6**	0.50

Sample ID: **A49996-QUT-185-4-A** | Collected: 11/03/2020
Lab ID: 2031257003 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** | **Media:** Ghost Wipe | **Sampling Parameter:** **Area Not Provided** | **Instrument:** ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**1.4**	0.50

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031257**

Client Project ID: La Fire 110320
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **A50143-Q-24-5-A** | Collected: 11/03/2020
Lab ID: 2031257004 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** | **Media:** Ghost Wipe | **Sampling Parameter:** **Area Not Provided**
Instrument: ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**1.3**	0.50

Sample ID: **NC50-4-A** | Collected: 11/03/2020
Lab ID: 2031257005 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** | **Media:** Ghost Wipe | **Sampling Parameter:** **Area Not Provided**
Instrument: ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**2.7**	0.50

Sample ID: **AS0421-ENG-21-4-A** | Collected: 11/03/2020
Lab ID: 2031257006 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** | **Media:** Ghost Wipe | **Sampling Parameter:** **Area Not Provided**
Instrument: ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**4.8**	0.50

Sample ID: **A-BLANK** | Collected: 11/03/2020
Lab ID: 2031257007 | Sampling Location: La Fire | Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** | **Media:** Ghost Wipe | **Sampling Parameter:** **Area Not Applicable**
Instrument: ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	<0.50	0.50

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031257**

Client Project ID: La Fire 110320
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **H-01-A** — Collected: 11/03/2020
Lab ID: 2031257008 — Sampling Location: La Fire — Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** — **Media:** Ghost Wipe — **Sampling Parameter:** **Area Not Provided**
Instrument: ICP13 — **Prepared:** 11/09/2020 (271142) — **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**0.88**	0.50

Sample ID: **H-02-A** — Collected: 11/03/2020
Lab ID: 2031257009 — Sampling Location: La Fire — Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** — **Media:** Ghost Wipe — **Sampling Parameter:** **Area Not Provided**
Instrument: ICP13 — **Prepared:** 11/09/2020 (271142) — **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**0.95**	0.50

Sample ID: **H-03-A** — Collected: 11/03/2020
Lab ID: 2031257010 — Sampling Location: La Fire — Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** — **Media:** Ghost Wipe — **Sampling Parameter:** **Area Not Provided**
Instrument: ICP13 — **Prepared:** 11/09/2020 (271142) — **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**0.76**	0.50

Sample ID: **H-04-A** — Collected: 11/03/2020
Lab ID: 2031257011 — Sampling Location: La Fire — Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** — **Media:** Ghost Wipe — **Sampling Parameter:** **Area Not Provided**
Instrument: ICP13 — **Prepared:** 11/09/2020 (271142) — **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**2.5**	0.50

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031257**
Client Project ID: La Fire 110320
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **H-05-A** Collected: 11/03/2020
Lab ID: 2031257012 Sampling Location: La Fire Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** **Media:** Ghost Wipe **Instrument:** ICP13
Sampling Parameter: **Area Not Provided** **Prepared:** 11/09/2020 (271142)
Analyzed: 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**13**	0.50

Sample ID: **H-06-A** Collected: 11/03/2020
Lab ID: 2031257013 Sampling Location: La Fire Received: 11/06/2020

Method: **NIOSH 9102 Mod, Ghost Wipe** **Media:** Ghost Wipe **Instrument:** ICP13
Sampling Parameter: **Area Not Provided** **Prepared:** 11/09/2020 (271142)
Analyzed: 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**5.6**	0.50

Comments

Workorder: 2031257

Amended(12/16/2020): Report amended to include lead data per client request.

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
NIOSH 9102 Mod, Ghost Wipe	/S/ Peter P. Steen 12/16/2020 09:27	/S/ Rex Bagley 11/11/2020 15:17

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031257**
Client Project ID: La Fire 110320
Purchase Order: NA
Project Manager: Jessica Helland

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter. Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

W 2031257

ALS

ANALYTICAL REQUEST FORM

2031257

1. [X] REGULAR Status

[ ] RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ______________ DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/5/2020 Purchase Order No. ______

3. Company Name: Toxstrategies.

Address: 27001 LA PAZ RD Suite 260
MISSION VIEJO, CA 92691

Person to Contact: Stephanie Vivanco

Telephone (949) 382-1534

Fax Telephone ( ) ______

E-mail Address: svivanco@toxstrategies.com

Billing Address (if different from above)

4. Quote No. ______

ALS Project Manager: Jessica Helland

5. **Sample Collection**

Sampling Site: LA fire

Industrial Process: ______

Date of Collection: 11/3/2020

Time Collected: ______

Date of Shipment: ______

Chain of Custody No.: ______

6. How did you first learn about ALS?

7. **REQUEST FOR ANALYSES**

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
ECTC-T-8-A	ghost wipe	—	NIOSH 9102 - Arsenic	1	
ECTC-T-38-A	"	—			
A49996-QUT-185-4-A	"	—			
A50143-Q-24-5-A	"	—			
NCSO-4-A	"	—			
A50421-ENG-21-4-A	"	—			
A-BLANK	"	—			
H-01-A	"	—			
H-02-A	"	—			
H-03-A	"	—			
H-04-A	"	—			
H-05-A	"	—			
H-06-A	"	—			

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. µg/m^3 6. _____ (other) Please indicate one or more units in the column entitled Units**

Comments ______

Possible Contamination and/or Chemical Hazards ______

7. **Chain of Custody (Optional)**

Relinquished by	Stephanie V	Date/Time	11/05/2020 15:00
Received by	Jonathan Russell	Date/Time	11-06-20 9:10
Relinquished by		Date/Time	
Received by		Date/Time	

ANALYTICAL REPORT

Report Date: November 13, 2020

Stephanie Vivanco
ToxStrategies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: svivanco@toxstrategies.com

Workorder: **34-2031258**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **Pent-Blank** | Collected: 11/03/2020
Lab ID: 2031258001 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **OSHA 39** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Applicable** | **Instrument:** HPLC14 | **Analyzed:** 11/12/2020 (271358)

Analyte	Result (ug/sample)	RL (ug/sample)
Pentachlorophenol	<0.50	0.50

Sample ID: **A50143-Q-24-5** | Collected: 11/03/2020
Lab ID: 2031258002 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **OSHA 39** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** HPLC14 | **Analyzed:** 11/12/2020 (271358)

Analyte	Result (ug/sample)	RL (ug/sample)
Pentachlorophenol	<0.50	0.50

Sample ID: **ECTC-T-7** | Collected: 11/03/2020
Lab ID: 2031258003 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **OSHA 39** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** HPLC14 | **Analyzed:** 11/12/2020 (271358)

Analyte	Result (ug/sample)	RL (ug/sample)
Pentachlorophenol	<0.50	0.50

Sample ID: **ENG-168-Penta-01** | Collected: 11/03/2020
Lab ID: 2031258004 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **OSHA 39** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** HPLC14 | **Analyzed:** 11/12/2020 (271358)

Analyte	Result (ug/sample)	RL (ug/sample)
Pentachlorophenol	<0.50	0.50

ANALYTICAL REPORT

Workorder: **34-2031258**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **ENG-583-Penta-01** | Collected: 11/03/2020
Lab ID: 2031258005 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **OSHA 39** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** HPLC14 | **Analyzed:** 11/12/2020 (271358)

Analyte	Result (ug/sample)	RL (ug/sample)
Pentachlorophenol	<0.50	0.50

Sample ID: **ENG-558-Penta-01** | Collected: 11/03/2020
Lab ID: 2031258006 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **OSHA 39** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** HPLC14 | **Analyzed:** 11/12/2020 (271358)

Analyte	Result (ug/sample)	RL (ug/sample)
Pentachlorophenol	<0.50	0.50

Sample ID: **ENG-583-Penta-02** | Collected: 11/03/2020
Lab ID: 2031258007 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **OSHA 39** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** HPLC14 | **Analyzed:** 11/12/2020 (271358)

Analyte	Result (ug/sample)	RL (ug/sample)
Pentachlorophenol	<0.50	0.50

Sample ID: **ENG159-Penta-1** | Collected: 11/03/2020
Lab ID: 2031258008 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **OSHA 39** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** HPLC14 | **Analyzed:** 11/12/2020 (271358)

Analyte	Result (ug/sample)	RL (ug/sample)
Pentachlorophenol	<0.50	0.50

Sample ID: **Penta-Blank** | Collected: 11/03/2020
Lab ID: 2031258009 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **OSHA 39** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Applicable** | **Instrument:** HPLC14 | **Analyzed:** 11/12/2020 (271358)

Analyte	Result (ug/sample)	RL (ug/sample)
Pentachlorophenol	<0.50	0.50

ANALYTICAL REPORT

Workorder: **34-2031258**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **ENG-558-Penta-02**		Collected: 11/03/2020
Lab ID: 2031258010	Sampling Location: LA Fire	Received: 11/06/2020
Method: OSHA 39	**Media:** Wipe **Sampling Parameter: Volume Not Provided**	**Instrument:** HPLC14 **Analyzed:** 11/12/2020 (271358)

Analyte	Result (ug/sample)	RL (ug/sample)
Pentachlorophenol	<0.50	0.50

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
OSHA 39	/S/ Thomas Bosch 11/13/2020 11:50	/S/ Christopher Winter 11/13/2020 14:04

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter.
Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
	Utah (TNI)	UT00953	http://lams.nelac-institute.org/search
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L17-507-R1	http://www.pjlabs.com

ANALYTICAL REPORT

Workorder: **34-2031258**

Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

2031258

ANALYTICAL REQUEST FORM

2031258

1. [X] REGULAR Status

[ ] RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ____________ DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/05/2020 Purchase Order No. ____________

3. Company Name : Toxstrategies

Address: 27001 La Paz Rd Suite 260
Mission Viejo CA 92691

Person to Contact: Stephanie Vivanco

Telephone (949) 382-1534

Fax Telephone ( ) ____________

E-mail Address: svivanco@toxstrategies.com

Billing Address (if different from above)

4. Quote No. ____________

ALS Project Manager: J Helland

5. **Sample Collection**

Sampling Site: LA Fire

Industrial Process: ____________

Date of Collection: 11/3/2020 - 11/4/2020

Time Collected ____________

Date of Shipment ____________

Chain of Custody No.: ____________

6. How did you first learn about ALS?

7. **REQUEST FOR ANALYSES**

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
Pent-Blank-1	gauze	—	OSHA 39 - Pentachlorophenol	1	
A50143-Q-24-S	↓	—	↓	↓	
ECTC-T-7	↓	—	↓	↓	
ENG-168-Penta-01	↓	—	↓	↓	
ENG-583-Penta-01	↓	—	↓	↓	
ENG-558-Penta-01	↓	—	↓	↓	
ENG-583-Penta-02	↓	—	↓	↓	
ENG159-Penta-1	↓	—	↓	↓	
PENTA-BLANK	↓	—	↓	↓	
ENG-558-Penta-02	↓	—	↓	↓	

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. $\mu g/m^3$ 6. _____ (other) Please indicate one or more units in the column entitled Units**

Comments ____________

Possible Contamination and/or Chemical Hazards ____________

7. **Chain of Custody (Optional)**

Relinquished by	[signature]	Date/Time	11/05/2020 1500
Received by	[signature]	Date/Time	11-06-20 9:10
Relinquished by		Date/Time	
Received by		Date/Time	

ANALYTICAL REPORT

Report Date: November 12, 2020

Stephanie Vivanco
ToxStrategies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: svivanco@toxstrategies.com

Workorder: **34-2031261**
Client Project ID: La Fire 110320
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **EL0000** Collected: 11/03/2020
Lab ID: 2031261001 Sampling Location: La Fire Received: 11/06/2020

Method: 3M 3500/3520 POVM **Media:** 3M 3500 ORGANIC POVM **Instrument:** GCI37
Sampling Parameter: Exposure Not Provided **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m³)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	NA	NA	0.0010
Ethyl benzene	<0.010	NA	NA	0.010
Naphthalene	<0.010	NA	NA	0.010
Styrene	<0.010	NA	NA	0.010

Sample ID: **EL0064** Collected: 11/03/2020
Lab ID: 2031261002 Sampling Location: La Fire Received: 11/06/2020

Method: 3M 3500/3520 POVM **Media:** 3M 3500 ORGANIC POVM **Instrument:** GCI37
Sampling Parameter: Exposure 349 Minutes **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m³)	Result (ppm)	RL (mg/sample)
Benzene	**0.0084**	**0.68**	**0.21**	0.0010
Ethyl benzene	<0.010	<1.0	<0.24	0.010
Naphthalene	<0.010	<1.2	<0.22	0.010
Styrene	<0.010	<0.99	<0.23	0.010

Sample ID: **EL0139** Collected: 11/03/2020
Lab ID: 2031261003 Sampling Location: La Fire Received: 11/06/2020

Method: 3M 3500/3520 POVM **Media:** 3M 3500 ORGANIC POVM **Instrument:** GCI37
Sampling Parameter: Exposure 349 Minutes **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m³)	Result (ppm)	RL (mg/sample)
Benzene	**0.0037**	**0.30**	**0.093**	0.0010
Ethyl benzene	<0.010	<1.0	<0.24	0.010
Naphthalene	<0.010	<1.2	<0.22	0.010
Styrene	<0.010	<0.99	<0.23	0.010

ANALYTICAL REPORT

Workorder: **34-2031261**
Client Project ID: La Fire 110320
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **EL0207** | Collected: 11/03/2020
Lab ID: 2031261004 | Sampling Location: La Fire | Received: 11/06/2020

Method: **3M 3500/3520 POVM** | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: **Exposure Not Provided** | **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	NA	NA	0.0010
Ethyl benzene	<0.010	NA	NA	0.010
Naphthalene	<0.010	NA	NA	0.010

Sample ID: **EL0089** | Collected: 11/03/2020
Lab ID: 2031261005 | Sampling Location: La Fire | Received: 11/06/2020

Method: **3M 3500/3520 POVM** | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: **Exposure 542 Minutes** | **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.052	<0.016	0.0010
Ethyl benzene	<0.010	<0.68	<0.16	0.010
Naphthalene	<0.010	<0.75	<0.14	0.010

Sample ID: **EL0053** | Collected: 11/03/2020
Lab ID: 2031261006 | Sampling Location: La Fire | Received: 11/06/2020

Method: **3M 3500/3520 POVM** | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: **Exposure 547 Minutes** | **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.051	<0.016	0.0010
Ethyl benzene	<0.010	<0.67	<0.15	0.010
Naphthalene	<0.010	<0.74	<0.14	0.010

Sample ID: **EL0132** | Collected: 11/03/2020
Lab ID: 2031261007 | Sampling Location: La Fire | Received: 11/06/2020

Method: **3M 3500/3520 POVM** | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: **Exposure 486 Minutes** | **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.058	<0.018	0.0010
Ethyl benzene	<0.010	<0.75	<0.17	0.010
Naphthalene	<0.010	<0.84	<0.16	0.010

ANALYTICAL REPORT

Workorder: **34-2031261**
Client Project ID: La Fire 110320
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **EL0122** | Collected: 11/03/2020
Lab ID: 2031261008 | Sampling Location: La Fire | Received: 11/06/2020

Method: 3M 3500/3520 POVM | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: Exposure 547 Minutes | **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.051	<0.016	0.0010
Ethyl benzene	<0.010	<0.67	<0.15	0.010
Naphthalene	<0.010	<0.74	<0.14	0.010

Sample ID: **EL0086** | Collected: 11/03/2020
Lab ID: 2031261009 | Sampling Location: La Fire | Received: 11/06/2020

Method: 3M 3500/3520 POVM | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: Exposure 487 Minutes | **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.058	<0.018	0.0010
Ethyl benzene	<0.010	<0.75	<0.17	0.010
Naphthalene	<0.010	<0.83	<0.16	0.010

Sample ID: **EL0134** | Collected: 11/03/2020
Lab ID: 2031261010 | Sampling Location: La Fire | Received: 11/06/2020

Method: 3M 3500/3520 POVM | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: Exposure 467 Minutes | **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.060	<0.019	0.0010
Ethyl benzene	<0.010	<0.78	<0.18	0.010
Naphthalene	<0.010	<0.87	<0.17	0.010

Sample ID: **EL0146** | Collected: 11/03/2020
Lab ID: 2031261011 | Sampling Location: La Fire | Received: 11/06/2020

Method: 3M 3500/3520 POVM | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: Exposure 461 Minutes | **Analyzed:** 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.061	<0.019	0.0010
Ethyl benzene	<0.010	<0.79	<0.18	0.010
Naphthalene	<0.010	<0.88	<0.17	0.010

ANALYTICAL REPORT

Workorder: **34-2031261**
Client Project ID: La Fire 110320
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **EL0042**		Collected: 11/03/2020
Lab ID: 2031261012	Sampling Location: La Fire	Received: 11/06/2020
Method: 3M 3500/3520 POVM	Media: 3M 3500 ORGANIC POVM Sampling Parameter: **Exposure 546 Minutes**	Instrument: GCI37 Analyzed: 11/12/2020 (271369)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.052	<0.016	0.0010
Ethyl benzene	<0.010	<0.67	<0.15	0.010
Naphthalene	<0.010	<0.74	<0.14	0.010

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
3M 3500/3520 POVM	/S/ Katelyn Hinman 11/12/2020 15:44	/S/ Steven J. Sagers 11/12/2020 17:04

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter.
Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
	Utah (TNI)	UT00953	http://lams.nelac-institute.org/search
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L17-507-R1	http://www.pjlabs.com

ANALYTICAL REPORT

Workorder: **34-2031261**
Client Project ID: La Fire 110320
Purchase Order: NA
Project Manager: Jessica Helland

Defini i n

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method media instrument sensiti ity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A erified alue of method media instrument sensiti ity.
ND = Not Detected, Testing result not detected abo e the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical alue.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than alues at or abo e the LOQ.

W 2031261

2031261

ALS

ANALYTICAL REQUEST FORM

1. [X] REGULAR Status

[ ] RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ____________ DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/05/2020 Purchase Order No. ____________

3. Company Name : Toxstrategies
Address: 27001 La Paz Rd Suite 260
Mission Viejo CA 92691
Person to Contact: Stephanie Vivanco
Telephone (949) 382-1534
Fax Telephone ( ) ____________
E-mail Address: svivanco@toxstrategies.com
Billing Address (if different from above)

4. Quote No. ____________
ALS Project Manager: J Helland

5. **Sample Collection**
Sampling Site: LA fire
Industrial Process: ____________
Date of Collection: 11/3/2020
Time Collected: ____________
Date of Shipment: ____________
Chain of Custody No.: ____________

6. How did you first learn about ALS? ____________

7. REQUEST FOR ANALYSES

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
* EL 0000	badge	—	NIOSH 1501 - benzene, ethylbenzene, naphthalene, styrene	1	
* EL 0064		349 min		5	
* EL 0139		349 min		5	
EL 0207		—	NIOSH 1501 - benzene, ethylbenzene, naphthalene	1	
EL 0089		542 min	NIOSH 1501 - benzene, ethylbenz, naphth	5	
EL 0053		547 min			
EL 0132		486 min			
EL 0122		547 min			
EL 0086		487 min			
EL 0134		467 min			
EL 0146		461 min			
EL 0042		546 min			

14

3

3

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. µg/m^3 6. _____ (other) Please indicate one or more units in the column entitled Units**

Comments
* First 3 samples include styrene

Possible Contamination and/or Chemical Hazards ____________

7. **Chain of Custody (Optional)**

Relinquished by	[signature]	Date/Time	11/05/2020 1500
Received by	[signature]	Date/Time	11.6.2020 0910
Relinquished by		Date/Time	
Received by		Date/Time	

ANALYTICAL REPORT

Report Date: November 13, 2020

Stephanie Vivanco
ToxStrategies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: svivanco@toxstrategies.com

Workorder: **34-2031263**
Client Project ID: La Fire 110420
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: EL0232 Collected: 11/04/2020
Lab ID: 2031263001 Sampling Location: La Fire Received: 11/06/2020

Method: 3M 3500/3520 POVM **Media:** 3M 3500 ORGANIC POVM **Instrument:** GCI37
Sampling Parameter: Exposure 430 Minutes **Analyzed:** 11/13/2020 (271418)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.066	<0.021	0.0010
Ethyl benzene	<0.010	<0.85	<0.20	0.010
Naphthalene	<0.010	<0.95	<0.18	0.010

Sample ID: EL0107 Collected: 11/04/2020
Lab ID: 2031263002 Sampling Location: La Fire Received: 11/06/2020

Method: 3M 3500/3520 POVM **Media:** 3M 3500 ORGANIC POVM **Instrument:** GCI37
Sampling Parameter: Exposure 396 Minutes **Analyzed:** 11/13/2020 (271418)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.071	<0.022	0.0010
Ethyl benzene	<0.010	<0.93	<0.21	0.010
Naphthalene	<0.010	<1.0	<0.20	0.010

Sample ID: EL0102 Collected: 11/04/2020
Lab ID: 2031263003 Sampling Location: La Fire Received: 11/06/2020

Method: 3M 3500/3520 POVM **Media:** 3M 3500 ORGANIC POVM **Instrument:** GCI37
Sampling Parameter: Exposure 440 Minutes **Analyzed:** 11/13/2020 (271418)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.064	<0.020	0.0010
Ethyl benzene	<0.010	<0.83	<0.19	0.010
Naphthalene	<0.010	<0.92	<0.18	0.010

ANALYTICAL REPORT

Workorder: **34-2031263**
Client Project ID: La Fire 110420
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **EL0031** | Collected: 11/04/2020
Lab ID: 2031263004 | Sampling Location: La Fire | Received: 11/06/2020

Method: 3M 3500/3520 POVM | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: Exposure Not Provided | **Analyzed:** 11/13/2020 (271418)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	NA	NA	0.0010
Ethyl benzene	<0.010	NA	NA	0.010
Naphthalene	<0.010	NA	NA	0.010

Sample ID: **EL0110** | Collected: 11/04/2020
Lab ID: 2031263005 | Sampling Location: La Fire | Received: 11/06/2020

Method: 3M 3500/3520 POVM | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: Exposure 433 Minutes | **Analyzed:** 11/13/2020 (271418)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.065	<0.020	0.0010
Ethyl benzene	<0.010	<0.85	<0.19	0.010
Naphthalene	<0.010	<0.94	<0.18	0.010

Sample ID: **EL0060** | Collected: 11/04/2020
Lab ID: 2031263006 | Sampling Location: La Fire | Received: 11/06/2020

Method: 3M 3500/3520 POVM | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: Exposure 427 Minutes | **Analyzed:** 11/13/2020 (271418)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.066	<0.021	0.0010
Ethyl benzene	<0.010	<0.86	<0.20	0.010
Naphthalene	<0.010	<0.95	<0.18	0.010

Sample ID: **EL0128** | Collected: 11/04/2020
Lab ID: 2031263007 | Sampling Location: La Fire | Received: 11/06/2020

Method: 3M 3500/3520 POVM | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: Exposure 422 Minutes | **Analyzed:** 11/13/2020 (271418)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.067	<0.021	0.0010
Ethyl benzene	<0.010	<0.87	<0.20	0.010
Naphthalene	<0.010	<0.96	<0.18	0.010

ANALYTICAL REPORT

Workorder: **34-2031263**
Client Project ID: La Fire 110420
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: EL0129 | Collected: 11/04/2020
Lab ID: 2031263008 | Sampling Location: La Fire | Received: 11/06/2020

Method: **3M 3500/3520 POVM** | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: **Exposure 427 Minutes** | **Analyzed:** 11/13/2020 (271418)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.066	<0.021	0.0010
Ethyl benzene	<0.010	<0.86	<0.20	0.010
Naphthalene	<0.010	<0.95	<0.18	0.010

Sample ID: EL0135 | Collected: 11/04/2020
Lab ID: 2031263009 | Sampling Location: La Fire | Received: 11/06/2020

Method: **3M 3500/3520 POVM** | **Media:** 3M 3500 ORGANIC POVM | **Instrument:** GCI37
Sampling Parameter: **Exposure 436 Minutes** | **Analyzed:** 11/13/2020 (271418)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Benzene	<0.0010	<0.065	<0.020	0.0010
Ethyl benzene	<0.010	<0.84	<0.19	0.010
Naphthalene	<0.010	<0.93	<0.18	0.010

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
3M 3500/3520 POVM	/S/ Katelyn Hinman 11/13/2020 16:15	/S/ Matthew Roberts 11/13/2020 16:20

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

ANALYTICAL REPORT

Workorder: **34-2031263**
Client Project ID: La Fire 110420
Purchase Order: NA
Project Manager: Jessica Helland

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter. Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
	Utah (TNI)	UT00953	http://lams.nelac-institute.org/search
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L17-507-R1	http://www.pjlabs.com

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

W 2031263

ANALYTICAL REQUEST FORM

2031263

1. [X] REGULAR Status

[ ] RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ______________ DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/05/2020 Purchase Order No. ______

3. Company Name : Toxstrategies

Address: 27001 La Paz Rd Suite 260 Mission Viejo CA 92691

Person to Contact: Stephanie Vivanco

Telephone (949) 382-1534

Fax Telephone ( )

E-mail Address: svivanco@toxstrategies.com

Billing Address (if different from above)

4. Quote No. ______

ALS Project Manager: J Helland

5. **Sample Collection**

Sampling Site: LA fire

Industrial Process:

Date of Collection: 11/4/2020

Time Collected:

Date of Shipment:

Chain of Custody No.:

6. How did you first learn about ALS?

7. REQUEST FOR ANALYSES

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
EL0232	badge	430 min	NIOSH 1501 - benzene, ethylbenzene, naphthalene	5	
EL0107		396 min		5	
EL0102		440 min		5	
EL-0031		—		1	
EL0110		433 min		5	
EL0060		427 min		5	
EL0128		422 min		5	
EL0129		427 min		5	
EL0135		436 min		5	

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. µg/m^3 6. _____ (other) Please indicate one or more units in the column entitled Units**

Comments

Possible Contamination and/or Chemical Hazards

7. Chain of Custody ~~(Optional)~~

Relinquished by	[signature]	Date/Time	11/05/2020 1500
Received by	[signature]	Date/Time	11.6.2020 0910
Relinquished by		Date/Time	
Received by		Date/Time	

ANALYTICAL REPORT

Amended-20201216

Report Date: December 16, 2020

Stephanie Vivanco
ToxStrategies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: svivanco@toxstrategies.com

Workorder: **34-2031264**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **ENG583-A-1** | Collected: 11/04/2020
Lab ID: 2031264001 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe | **Media:** Wipe | **Sampling Parameter: Volume Not Provided** | **Instrument:** ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**54**	0.50

Sample ID: **ENG-558-A-01** | Collected: 11/04/2020
Lab ID: 2031264002 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe | **Media:** Wipe | **Sampling Parameter: Volume Not Provided** | **Instrument:** ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**5.9**	0.50

Sample ID: **ENG159-A-1** | Collected: 11/04/2020
Lab ID: 2031264003 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe | **Media:** Wipe | **Sampling Parameter: Volume Not Provided** | **Instrument:** ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**25**	0.50

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031264**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **ENG-583-A-02** | Collected: 11/04/2020
Lab ID: 2031264004 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe | **Media:** Wipe | **Sampling Parameter:** Volume Not Provided
Instrument: ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**3.5**	0.50

Sample ID: **A-Blank** | Collected: 11/04/2020
Lab ID: 2031264005 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe | **Media:** Wipe | **Sampling Parameter:** Volume Not Applicable
Instrument: ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	<0.50	0.50

Sample ID: **ENG-168-A-01** | Collected: 11/04/2020
Lab ID: 2031264006 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe | **Media:** Wipe | **Sampling Parameter:** Volume Not Provided
Instrument: ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**4.6**	0.50

Sample ID: **ENG-558-A-02** | Collected: 11/04/2020
Lab ID: 2031264007 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 9102 Mod, Ghost Wipe | **Media:** Wipe | **Sampling Parameter:** Volume Not Provided
Instrument: ICP13 | **Prepared:** 11/09/2020 (271142) | **Analyzed:** 11/11/2020 (271304)

Analyte	Result (ug/sample)	RL (ug/sample)
Arsenic	<6.3	6.3
Lead	**3.0**	0.50

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031264**

Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **40203** — Collected: 11/04/2020
Lab ID: 2031264008 — Sampling Location: LA Fire — Received: 11/06/2020

Method: **NIOSH 0600 Mod., MW PVC Filter** — **Media:** PVC Filter — **Instrument:** GRAV01
Sampling Parameter: **Air Volume 1055 L** — **Analyzed:** 11/12/2020 (271348)

Analyte	Result (mg/sample)	Result (mg/m³)	RL (mg/sample)
Respirable Dust	**0.038**	**0.036**	0.020

Method: **NIOSH 7500 Mod.** — **Media:** PVC Filter — **Instrument:** XRAY01
Sampling Parameter: **Air Volume 1055 L** — **Analyzed:** 11/13/2020 (271448)

Analyte	Result (ug/sample)	Result (ug/m³)	Result (%)	RL (ug/sample)
Quartz	<5.0	<4.7	<13	5.0
Cristobalite	<5.0	<4.7	<13	5.0
Tridymite	<20	<19	<53	20
Total Silica	ND			

Sample ID: **40204** — Collected: 11/04/2020
Lab ID: 2031264009 — Sampling Location: LA Fire — Received: 11/06/2020

Method: **NIOSH 0600 Mod., MW PVC Filter** — **Media:** PVC Filter — **Instrument:** GRAV01
Sampling Parameter: **Air Volume 1042.5 L** — **Analyzed:** 11/12/2020 (271348)

Analyte	Result (mg/sample)	Result (mg/m³)	RL (mg/sample)
Respirable Dust	**0.030**	**0.029**	0.020

Method: **NIOSH 7500 Mod.** — **Media:** PVC Filter — **Instrument:** XRAY01
Sampling Parameter: **Air Volume 1042.5 L** — **Analyzed:** 11/13/2020 (271448)

Analyte	Result (ug/sample)	Result (ug/m³)	Result (%)	RL (ug/sample)
Quartz	<5.0	<4.8	<17	5.0
Cristobalite	<5.0	<4.8	<17	5.0
Tridymite	<20	<19	<67	20
Total Silica	ND			

Sample ID: **40174** — Collected: 11/04/2020
Lab ID: 2031264010 — Sampling Location: LA Fire — Received: 11/06/2020

Method: **NIOSH 0600 Mod., MW PVC Filter** — **Media:** PVC Filter — **Instrument:** GRAV01
Sampling Parameter: **Air Volume 982.5 L** — **Analyzed:** 11/12/2020 (271348)

Analyte	Result (mg/sample)	Result (mg/m³)	RL (mg/sample)
Respirable Dust	<0.020	<0.020	0.020

Results Continued on Next Page

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031264**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **40174** Collected: 11/04/2020
Lab ID: 2031264010 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 7500 Mod.** **Media:** PVC Filter **Instrument:** XRAY01
Sampling Parameter: **Air Volume 982.5 L** **Analyzed:** 11/13/2020 (271448)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Quartz	<5.0	<5.1	5.0
Cristobalite	<5.0	<5.1	5.0
Tridymite	<20	<20	20
Total Silica	ND		

Sample ID: **40193** Collected: 11/04/2020
Lab ID: 2031264011 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 0600 Mod., MW PVC Filter** **Media:** PVC Filter **Instrument:** GRAV01
Sampling Parameter: **Air Volume 785 L** **Analyzed:** 11/12/2020 (271348)

Analyte	Result (mg/sample)	Result (mg/m³)	RL (mg/sample)
Respirable Dust	<0.020	<0.025	0.020

Method: **NIOSH 7500 Mod.** **Media:** PVC Filter **Instrument:** XRAY01
Sampling Parameter: **Air Volume 785 L** **Analyzed:** 11/13/2020 (271448)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Quartz	<5.0	<6.4	5.0
Cristobalite	<5.0	<6.4	5.0
Tridymite	<20	<25	20
Total Silica	ND		

Sample ID: **40183** Collected: 11/04/2020
Lab ID: 2031264012 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 0600 Mod., MW PVC Filter** **Media:** PVC Filter **Instrument:** GRAV01
Sampling Parameter: **Air Volume Not Provided** **Analyzed:** 11/12/2020 (271348)

Analyte	Result (mg/sample)	Result (mg/m³)	RL (mg/sample)
Respirable Dust	<0.020	NA	0.020

Method: **NIOSH 7500 Mod.** **Media:** PVC Filter **Instrument:** XRAY01
Sampling Parameter: **Air Volume Not Provided** **Analyzed:** 11/13/2020 (271448)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Quartz	<5.0	NA	5.0
Cristobalite	<5.0	NA	5.0
Tridymite	<20	NA	20
Total Silica	ND		

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031264**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **40173** — Collected: 11/04/2020
Lab ID: 2031264013 — Sampling Location: LA Fire — Received: 11/06/2020

Method: NIOSH 0600 Mod., MW PVC Filter — **Media:** PVC Filter — **Instrument:** GRAV01
Sampling Parameter: Air Volume 947.5 L — **Analyzed:** 11/12/2020 (271348)

Analyte	Result (mg/sample)	Result (mg/m³)	RL (mg/sample)
Respirable Dust	<0.020	<0.021	0.020

Method: NIOSH 7500 Mod. — **Media:** PVC Filter — **Instrument:** XRAY01
Sampling Parameter: Air Volume 947.5 L — **Analyzed:** 11/13/2020 (271448)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Quartz	<5.0	<5.3	5.0
Cristobalite	<5.0	<5.3	5.0
Tridymite	<20	<21	20
Total Silica	ND		

Sample ID: **40163** — Collected: 11/04/2020
Lab ID: 2031264014 — Sampling Location: LA Fire — Received: 11/06/2020

Method: NIOSH 0600 Mod., MW PVC Filter — **Media:** PVC Filter — **Instrument:** GRAV01
Sampling Parameter: Air Volume 935 L — **Analyzed:** 11/12/2020 (271348)

Analyte	Result (mg/sample)	Result (mg/m³)	RL (mg/sample)
Respirable Dust	**0.040**	**0.043**	0.020

Method: NIOSH 7500 Mod. — **Media:** PVC Filter — **Instrument:** XRAY01
Sampling Parameter: Air Volume 935 L — **Analyzed:** 11/13/2020 (271448)

Analyte	Result (ug/sample)	Result (ug/m³)	Result (%)	RL (ug/sample)
Quartz	<5.0	<5.3	<13	5.0
Cristobalite	<5.0	<5.3	<13	5.0
Tridymite	<20	<21	<50	20
Total Silica	ND			

Comments

Workorder: 2031264

Amended(12/16/2020): Report amended to include lead data per client request.

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
NIOSH 0600 Mod., MW PVC Filter	/S/ Rex Bagley 11/12/2020 13:37	/S/ Emilee Sandoval 11/12/2020 15:24
NIOSH 7500 Mod.	/S/ Kim Clymer 11/13/2020 17:44	/S/ Paul M. Megerdichian 11/13/2020 18:31
NIOSH 9102 Mod, Ghost Wipe	/S/ Peter P. Steen 12/16/2020 09:27	/S/ Rex Bagley 11/11/2020 15:17

ANALYTICAL REPORT

Amended-20201216

Workorder: **34-2031264**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter.
Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

W 2031264

ANALYTICAL REQUEST FORM

2031264

1. [X] REGULAR Status

[ ] RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ______________ DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/05/2020 Purchase Order No. ______

3. Company Name : Toxstrategies ~~CO~~

Address: 27001 La Paz Rd suite 260
Mission Viejo CA 92691

Person to Contact: Stephanie Vivanco

Telephone (949) 382-1534

Fax Telephone ( ) ______

E-mail Address: svivanco@toxstrategies.com

Billing Address (if different from above)

4. Quote No. ______

ALS Project Manager: J Helland

5. **Sample Collection**

Sampling Site: LA fire

Industrial Process: ______

Date of Collection: 11/4/2020

Time Collected ______

Date of Shipment ______

Chain of Custody No.: ______

6. How did you first learn about ALS?

7. **REQUEST FOR ANALYSES**

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
ENG583-A-1	Ghost wipe	—	NIOSH 9102-arsenic	1	12
ENG-558-A-01		—			
ENG159-A-1		—			
ENG-583-A-02		—			
A-blank		—			
Eng-168-A-01		—			
Eng-558-A-02		—			
40203	PVC	1055 L	NIOSH 7500 + NIOSH 0600 cryst silica	5	5
40204		1042.5 L		5	
40174		982.5 L		5	
40193		785 L		5	
40183		—		1	
40173		947.5 L		5	
40163		935 L		5	

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. $\mu g/m^3$ 6. _____ (other) Please indicate one or more units in the column entitled Units**

Comments ______

Possible Contamination and/or Chemical Hazards ______

7. **Chain of Custody (Optional)**

Relinquished by	[signature]	Date/Time	11/05/2020 1500
Received by	[signature]	Date/Time	11-06-20 9:10
Relinquished by		Date/Time	
Received by		Date/Time	

ANALYTICAL REPORT

Report Date: November 17, 2020

Stephanie Vivanco
ToxStrategies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: svivanco@toxstrategies.com

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N822LA-01** Collected: 11/03/2020
Lab ID: 2031269001 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 Media: Wipe Instrument: 5975-B
Sampling Parameter: **Volume Not Provided** Analyzed: 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **N120LA-01** Collected: 11/03/2020
Lab ID: 2031269002 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 Media: Wipe Instrument: 5975-B
Sampling Parameter: **Volume Not Provided** Analyzed: 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N120LA-01** Collected: 11/03/2020
Lab ID: 2031269002 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **N120LA-02** Collected: 11/03/2020
Lab ID: 2031269003 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N190LA-01**
Lab ID: 2031269004
Sampling Location: LA Fire
Collected: 11/03/2020
Received: 11/06/2020

Method: **NIOSH 5528**
Media: Wipe
Sampling Parameter: **Volume Not Provided**
Instrument: 5975-B
Analyzed: 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **N822LA-03**
Lab ID: 2031269005
Sampling Location: LA Fire
Collected: 11/03/2020
Received: 11/06/2020

Method: **NIOSH 5528**
Media: Wipe
Sampling Parameter: **Volume Not Provided**
Instrument: 5975-B
Analyzed: 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N822LA-03** Collected: 11/03/2020
Lab ID: 2031269005 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 5528** **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **N14LA-03** Collected: 11/03/2020
Lab ID: 2031269006 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 5528** **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **N822LA-02** Collected: 11/03/2020
Lab ID: 2031269007 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 5528** **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N822LA-02** Collected: 11/03/2020
Lab ID: 2031269007 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Sampling Parameter:** **Volume Not Provided** **Instrument:** 5975-B **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **N120LA-03** Collected: 11/03/2020
Lab ID: 2031269008 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Sampling Parameter:** **Volume Not Provided** **Instrument:** 5975-B **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **HM-Blank-PAH** Collected: 11/03/2020
Lab ID: 2031269009 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Applicable **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **N14LA-02** Collected: 11/03/2020
Lab ID: 2031269010 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N14LA-02** Collected: 11/03/2020
Lab ID: 2031269010 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **N14LA-01** Collected: 11/03/2020
Lab ID: 2031269011 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **N190LA-02** Collected: 11/03/2020
Lab ID: 2031269012 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **N190LA-02**
Lab ID: 2031269012
Sampling Location: LA Fire
Collected: 11/03/2020
Received: 11/06/2020

Method: NIOSH 5528
Media: Wipe
Sampling Parameter: Volume Not Provided
Instrument: 5975-B
Analyzed: 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **N190LA-03**
Lab ID: 2031269013
Sampling Location: LA Fire
Collected: 11/03/2020
Received: 11/06/2020

Method: NIOSH 5528
Media: Wipe
Sampling Parameter: Volume Not Provided
Instrument: 5975-B
Analyzed: 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **ENG-558-PAH-01** Collected: 11/04/2020
Lab ID: 2031269014 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 5528** **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **ENG-159-PAH-01** Collected: 11/04/2020
Lab ID: 2031269015 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 5528** **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **ENG-159-PAH-01** Collected: 11/04/2020
Lab ID: 2031269015 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **ENG-558-PAH-02** Collected: 11/04/2020
Lab ID: 2031269016 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **ENG-583-PAH-01** Collected: 11/04/2020
Lab ID: 2031269017 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **ENG-583-PAH-01** Collected: 11/04/2020
Lab ID: 2031269017 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 5528** **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **ENG-583-PAH-02** Collected: 11/04/2020
Lab ID: 2031269018 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 5528** **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **ENG-168-PAH-01** Collected: 11/04/2020
Lab ID: 2031269019 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 5528** **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **H-06** Collected: 11/04/2020
Lab ID: 2031269020 Sampling Location: LA Fire Received: 11/06/2020

Method: **NIOSH 5528** **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: H-06 | Collected: 11/04/2020
Lab ID: 2031269020 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 5528 | **Media:** Wipe | **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided | **Analyzed:** 11/13/2020 (271392)

Analyte	Result (ug/sample)	RL (ug/sample)
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: H-01 | Collected: 11/04/2020
Lab ID: 2031269021 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 5528 | **Media:** Wipe | **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided | **Analyzed:** 11/13/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: H-03 | Collected: 11/04/2020
Lab ID: 2031269022 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 5528 | **Media:** Wipe | **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided | **Analyzed:** 11/13/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **H-03**   Collected: 11/04/2020
Lab ID: 2031269022   Sampling Location: LA Fire   Received: 11/06/2020

Method: **NIOSH 5528**   **Media:** Wipe   **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided**   **Analyzed:** 11/13/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **H-04**   Collected: 11/04/2020
Lab ID: 2031269023   Sampling Location: LA Fire   Received: 11/06/2020

Method: **NIOSH 5528**   **Media:** Wipe   **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided**   **Analyzed:** 11/13/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **H-05**
Lab ID: 2031269024
Sampling Location: LA Fire
Collected: 11/04/2020
Received: 11/06/2020

Method: NIOSH 5528
Media: Wipe
Sampling Parameter: Volume Not Provided
Instrument: 5975-B
Analyzed: 11/13/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **H-02**
Lab ID: 2031269025
Sampling Location: LA Fire
Collected: 11/04/2020
Received: 11/06/2020

Method: NIOSH 5528
Media: Wipe
Sampling Parameter: Volume Not Provided
Instrument: 5975-B
Analyzed: 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **H-02** | Collected: 11/04/2020
Lab ID: 2031269025 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **NIOSH 5528** | **Media:** Wipe | **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** | **Analyzed:** 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **A49996** | Collected: 11/03/2020
Lab ID: 2031269026 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **NIOSH 5528** | **Media:** Wipe | **Instrument:** 5975-B
Sampling Parameter: **Volume Not Provided** | **Analyzed:** 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **PAH-Blank** | Collected: 11/03/2020
Lab ID: 2031269027 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **NIOSH 5528** | **Media:** Wipe | **Instrument:** 5975-B
Sampling Parameter: **Volume Not Applicable** | **Analyzed:** 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **PAH-Blank** | Collected: 11/03/2020
Lab ID: 2031269027 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **NIOSH 5528** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Applicable** | **Instrument:** 5975-B | **Analyzed:** 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **A50421 ENG-21-4** | Collected: 11/03/2020
Lab ID: 2031269028 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **NIOSH 5528** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** 5975-B | **Analyzed:** 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **A5014 Q-24-5** Collected: 11/03/2020
Lab ID: 2031269029 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 Media: Wipe Instrument: 5975-B
Sampling Parameter: **Volume Not Provided** Analyzed: 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	<0.50	0.50
Anthracene	<0.50	0.50
Fluoranthene	<0.50	0.50
Pyrene	<0.50	0.50
Benzo(a)anthracene	<0.50	0.50
Chrysene	<0.50	0.50
Benzo(b)fluoranthene	<0.50	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	<0.50	0.50
Indeno(1,2,3-cd)pyrene	<0.50	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	<0.50	0.50

Sample ID: **ECTC-T-8** Collected: 11/03/2020
Lab ID: 2031269030 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 Media: Wipe Instrument: 5975-B
Sampling Parameter: **Volume Not Provided** Analyzed: 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	**1.8**	0.50
Acenaphthylene	**5.6**	0.50
Acenaphthene	<0.50	0.50
Fluorene	**2.0**	0.50
Phenanthrene	**14**	0.50
Anthracene	**3.0**	0.50
Fluoranthene	**12**	0.50
Pyrene	**9.0**	0.50
Benzo(a)anthracene	**4.8**	0.50
Chrysene	**5.0**	0.50
Benzo(b)fluoranthene	**10**	0.50
Benzo(k)fluoranthene	<0.50	0.50
Benzo(a)pyrene	**4.5**	0.50
Indeno(1,2,3-cd)pyrene	**3.5**	0.50
Dibenzo(a,h)anthracene	**0.71**	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **ECTC-T-8** Collected: 11/03/2020
Lab ID: 2031269030 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Benzo(g,h,i)perylene	**3.8**	0.50

Sample ID: **ECTC-T-38** Collected: 11/03/2020
Lab ID: 2031269031 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	<0.50	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	**1.5**	0.50
Anthracene	<0.50	0.50
Fluoranthene	**1.8**	0.50
Pyrene	**1.5**	0.50
Benzo(a)anthracene	**0.98**	0.50
Chrysene	**1.3**	0.50
Benzo(b)fluoranthene	**2.0**	0.50
Benzo(k)fluoranthene	**0.70**	0.50
Benzo(a)pyrene	**0.83**	0.50
Indeno(1,2,3-cd)pyrene	**0.91**	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	**1.0**	0.50

Sample ID: **NCSO-04** Collected: 11/03/2020
Lab ID: 2031269032 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5528 **Media:** Wipe **Instrument:** 5975-B
Sampling Parameter: Volume Not Provided **Analyzed:** 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Naphthalene	<0.50	0.50
Acenaphthylene	**1.3**	0.50
Acenaphthene	<0.50	0.50
Fluorene	<0.50	0.50
Phenanthrene	**5.5**	0.50
Anthracene	**1.0**	0.50
Fluoranthene	**7.8**	0.50

Results Continued on Next Page

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **NCSO-04** | Collected: 11/03/2020
Lab ID: 2031269032 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **NIOSH 5528** | **Media:** Wipe | **Sampling Parameter:** **Volume Not Provided** | **Instrument:** 5975-B | **Analyzed:** 11/14/2020 (271394)

Analyte	Result (ug/sample)	RL (ug/sample)
Pyrene	**6.1**	0.50
Benzo(a)anthracene	**3.4**	0.50
Chrysene	**3.5**	0.50
Benzo(b)fluoranthene	**4.8**	0.50
Benzo(k)fluoranthene	**1.6**	0.50
Benzo(a)pyrene	**3.0**	0.50
Indeno(1,2,3-cd)pyrene	**2.0**	0.50
Dibenzo(a,h)anthracene	<0.50	0.50
Benzo(g,h,i)perylene	**2.2**	0.50

Sample ID: **A295575** | Collected: 11/03/2020
Lab ID: 2031269033 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **EPA TO-11A** | **Media:** SKC 500-100, UMEx100 Passive Sampler | **Sampling Parameter:** **Exposure 347 Minutes** | **Instrument:** HPLC12 | **Analyzed:** 11/11/2020 (271190)

Analyte	Result (ug/sample)	Result (mg/m^3)	Result (ppm)	RL (ug/sample)
Formaldehyde	**0.27**	**0.028**	**0.022**	0.15
Acetaldehyde	**0.22**	**0.027**	**0.015**	0.15

Sample ID: **A295583** | Collected: 11/03/2020
Lab ID: 2031269034 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **EPA TO-11A** | **Media:** SKC 500-100, UMEx100 Passive Sampler | **Sampling Parameter:** **Exposure Not Provided** | **Instrument:** HPLC12 | **Analyzed:** 11/11/2020 (271190)

Analyte	Result (ug/sample)	Result (mg/m^3)	Result (ppm)	RL (ug/sample)
Formaldehyde	<0.15	NA	NA	0.15
Acetaldehyde	<0.15	NA	NA	0.15

Sample ID: **A295581** | Collected: 11/03/2020
Lab ID: 2031269035 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **EPA TO-11A** | **Media:** SKC 500-100, UMEx100 Passive Sampler | **Sampling Parameter:** **Exposure 347 Minutes** | **Instrument:** HPLC12 | **Analyzed:** 11/11/2020 (271190)

Analyte	Result (ug/sample)	Result (mg/m^3)	Result (ppm)	RL (ug/sample)
Formaldehyde	**0.26**	**0.026**	**0.021**	0.15
Acetaldehyde	**0.22**	**0.027**	**0.015**	0.15

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **72775** | Collected: 11/04/2020
Lab ID: 2031269036 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 1003 | **Media:** SKC 226-01, Charcoal Tube 100/50mg | **Instrument:** GCI44
Sampling Parameter: Air Volume 42.2 L | **Analyzed:** 11/12/2020 (271375)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Tetrachloroethene	**0.69**	**16**	**2.4**	0.010

Sample ID: **72780** | Collected: 11/04/2020
Lab ID: 2031269037 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 1003 | **Media:** SKC 226-01, Charcoal Tube 100/50mg | **Instrument:** GCI44
Sampling Parameter: Air Volume 45.3 L | **Analyzed:** 11/12/2020 (271375)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Tetrachloroethene	**0.78**	**17**	**2.6**	0.010

Sample ID: **72773** | Collected: 11/04/2020
Lab ID: 2031269038 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 1003 | **Media:** SKC 226-01, Charcoal Tube 100/50mg | **Instrument:** GCI44
Sampling Parameter: Air Volume 38.44 L | **Analyzed:** 11/12/2020 (271375)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Tetrachloroethene	**2.6**	**67**	**9.9**	0.20

Sample ID: **72779** | Collected: 11/04/2020
Lab ID: 2031269039 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 1003 | **Media:** SKC 226-01, Charcoal Tube 100/50mg | **Instrument:** GCI44
Sampling Parameter: Air Volume 38.59 L | **Analyzed:** 11/12/2020 (271375)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Tetrachloroethene	**2.9**	**75**	**11**	0.20

Sample ID: **72781** | Collected: 11/04/2020
Lab ID: 2031269040 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 1003 | **Media:** SKC 226-01, Charcoal Tube 100/50mg | **Instrument:** GCI44
Sampling Parameter: Air Volume 47.58 L | **Analyzed:** 11/12/2020 (271375)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Tetrachloroethene	**1.3**	**27**	**4.1**	0.20

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **72778**		Collected: 11/04/2020
Lab ID: 2031269041	Sampling Location: LA Fire	Received: 11/06/2020
Method: NIOSH 1003	**Media:** SKC 226-01, Charcoal Tube 100/50mg	**Instrument:** GCI44
	Sampling Parameter: Air Volume Not Provided	**Analyzed:** 11/12/2020 (271375)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Tetrachloroethene	<0.010	NA	NA	0.010

Sample ID: **72776**		Collected: 11/04/2020
Lab ID: 2031269042	Sampling Location: LA Fire	Received: 11/06/2020
Method: NIOSH 1003	**Media:** SKC 226-01, Charcoal Tube 100/50mg	**Instrument:** GCI44
	Sampling Parameter: Air Volume 49.3 L	**Analyzed:** 11/12/2020 (271375)

Analyte	Result (mg/sample)	Result (mg/m^3)	Result (ppm)	RL (mg/sample)
Tetrachloroethene	**0.58**	**12**	**1.7**	0.010

Sample ID: **01392**		Collected: 11/04/2020
Lab ID: 2031269043	Sampling Location: LA Fire	Received: 11/06/2020
Method: IH by GC-MS Scan	**Media:** SKC 226-98, XAD-7 (Phosphoric Acid) 40/80mg	**Instrument:** 5975-D
	Sampling Parameter: Air Volume 133.73 L	**Analyzed:** 11/16/2020 (271472)

Analyte	Result (ug/sample)	Result (ug/m^3)	RL (ug/sample)
N,N-Dimethyl-p-toluidine	<0.050	<0.37	0.050

Sample ID: **01875**		Collected: 11/04/2020
Lab ID: 2031269044	Sampling Location: LA Fire	Received: 11/06/2020
Method: IH by GC-MS Scan	**Media:** SKC 226-98, XAD-7 (Phosphoric Acid) 40/80mg	**Instrument:** 5975-D
	Sampling Parameter: Air Volume 98.41 L	**Analyzed:** 11/16/2020 (271472)

Analyte	Result (ug/sample)	Result (ug/m^3)	RL (ug/sample)
N,N-Dimethyl-p-toluidine	<0.050	<0.51	0.050

Sample ID: **01823**		Collected: 11/04/2020
Lab ID: 2031269045	Sampling Location: LA Fire	Received: 11/06/2020
Method: IH by GC-MS Scan	**Media:** SKC 226-98, XAD-7 (Phosphoric Acid) 40/80mg	**Instrument:** 5975-D
	Sampling Parameter: Air Volume 107.76 L	**Analyzed:** 11/16/2020 (271472)

Analyte	Result (ug/sample)	Result (ug/m^3)	RL (ug/sample)
N,N-Dimethyl-p-toluidine	<0.050	<0.46	0.050

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **01872** | Collected: 11/04/2020
Lab ID: 2031269046 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **IH by GC-MS Scan** | **Media:** SKC 226-98, XAD-7 (Phosphoric Acid) 40/80mg | **Instrument:** 5975-D
Sampling Parameter: **Air Volume 124.56 L** | **Analyzed:** 11/16/2020 (271472)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
N,N-Dimethyl-p-toluidine	<0.050	<0.40	0.050

Sample ID: **01871** | Collected: 11/04/2020
Lab ID: 2031269047 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **IH by GC-MS Scan** | **Media:** SKC 226-98, XAD-7 (Phosphoric Acid) 40/80mg | **Instrument:** 5975-D
Sampling Parameter: **Air Volume 117.51 L** | **Analyzed:** 11/16/2020 (271472)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
N,N-Dimethyl-p-toluidine	<0.050	<0.43	0.050

Sample ID: **01878** | Collected: 11/04/2020
Lab ID: 2031269048 | Sampling Location: LA Fire | Received: 11/06/2020

Method: **IH by GC-MS Scan** | **Media:** SKC 226-98, XAD-7 (Phosphoric Acid) 40/80mg | **Instrument:** 5975-D
Sampling Parameter: **Air Volume Not Provided** | **Analyzed:** 11/16/2020 (271472)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
N,N-Dimethyl-p-toluidine	<0.050	NA	0.050

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
EPA TO-11A	/S/ Daryka Gress 11/11/2020 12:08	/S/ Thomas Bosch 11/16/2020 16:52
IH by GC-MS Scan	/S/ David Teynor 11/17/2020 10:09	/S/ Thomas J. Masoian 11/17/2020 13:59
NIOSH 1003	/S/ Katelyn Hinman 11/13/2020 10:44	/S/ Matthew Roberts 11/13/2020 14:24
NIOSH 5528	/S/ David Teynor 11/17/2020 15:13	/S/ Thomas J. Masoian 11/17/2020 16:25

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

ANALYTICAL REPORT

Workorder: **34-2031269**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter.
Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
	Utah (TNI)	UT00953	http://lams.nelac-institute.org/search
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L17-507-R1	http://www.pjlabs.com

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

2031269

ANALYTICAL REQUEST FORM

2031269

1. [X] REGULAR Status

[ ] RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ______ DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/05/2020 Purchase Order No. ______
3. Company Name: Toxstrategies
Address: 27001 La Paz Rd Suite 260
Mission Viejo CA 92691
Person to Contact: Stephanie Vivanco
Telephone (949)382-1534
Fax Telephone ( ) ______
E-mail Address: svivanco@toxstrategies.com
Billing Address (if different from above) ______

4. Quote No. ______
ALS Project Manager: J Helland
5. **Sample Collection**
Sampling Site LA fire
Industrial Process: ______
Date of Collection 11/3/2020
Time Collected ______
Date of Shipment ______
Chain of Custody No.: ______
6. How did you first learn about ALS? ______

7. REQUEST FOR ANALYSES

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
N822LA-01	gauze	—	NIOSH 5528 - PAHs	1	11
N120LA-01		—			
N120LA-02		—			
N190LA-01		—			
N822LA-03		—			
N14LA-03		—			
N822LA-02		—			
N120LA-03		—			
HM-BLANK-PAH		—			
N14LA-02		—			
N14LA-~~02~~01		—			
N190LA-02		—			
N190LA-03		—			

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. $\mu g/m^3$ 6._____ (other) Please indicate one or more units in the column entitled Units**

Comments ______

Possible Contamination and/or Chemical Hazards ______

7. Chain of Custody (Optional)

Relinquished by	[signature]	Date/Time	11/05/2020 1800
Received by	Jan VanFassell	Date/Time	11-06-20 9:10
Relinquished by		Date/Time	
Received by		Date/Time	

☒ For lab use only ☒

ALS

ANALYTICAL REQUEST FORM

1. ☑ REGULAR Status

☐ RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ____________
DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/05/2020 Purchase Order No. ____________

3. Company Name : Toxstrategies

Address: 27001 La Paz Rd Suite 260
Mission Viejo CA 92691

Person to Contact: Stephanie Vivanco

Telephone 949 382-1534

Fax Telephone ( ) ____________

E-mail Address: svivanco@toxstrategies.com

Billing Address (if different from above)

4. Quote No. ____________

ALS Project Manager: J Helland

5. **Sample Collection**

Sampling Site LA fire

Industrial Process: ____________

Date of Collection 11/4/2020, 11/3/2020

Time Collected ____________

Date of Shipment ____________

Chain of Custody No.: ____________

6. How did you first learn about ALS?

7. **REQUEST FOR ANALYSES**

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
Eng-558-PAH-01	gauze	—	NIOSH 5528 - PAHs	1	"
Eng-159-PAH-01		—			
* Eng-583-PAH-02		—			
Eng-583-PAH-01		—			
Eng-583-PAH-02		—			
Eng-168-PAH-01		—			
H-06		—			
H-01		—			
H-03		—			
H-04		—			
H-05		—			
H-02		—			

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. μg/sample 2. mg/m^3 3. ppm 4. % 5. $\mu g/m^3$ 6. _____ (other) Please indicate one or more units in the column entitled Units**

Comments * Sample rcv'd as Eng-558-PAH-02. gc

Possible Contamination and/or Chemical Hazards ____________

7. **Chain of Custody (Optional)**

Relinquished by	[signature]	Date/Time	11/05/2020 1500
Received by	[signature]	Date/Time	11-06-20 9:10
Relinquished by		Date/Time	
Received by		Date/Time	

☒ For lab use only ☒

ALS

ANALYTICAL REQUEST FORM

1. ☒ REGULAR Status

☐ RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ______________________
DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/05/2020 Purchase Order No. ______________

3. Company Name : Toxstrategies

Address: 27001 La Paz Rd Suite 260
Mission Viejo CA 92691

Person to Contact: Stephanie Vivanco

Telephone (949) 382-1534

Fax Telephone ( )

E-mail Address: svivanco@toxstrategies.com

Billing Address (if different from above)

4. Quote No. ______________

ALS Project Manager: J Helland

5. **Sample Collection**

Sampling Site: CA fire

Industrial Process: ______________

Date of Collection: 11/3/2020

Time Collected: ______________

Date of Shipment: ______________

Chain of Custody No.: ______________

6. How did you first learn about ALS?

7. **REQUEST FOR ANALYSES**

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
A49996	gauze	—	NIOSH 5528 - PAHs	1	11
PAH-blank		—			
AS0421 Eng-21-4		—			
AS014 Q-24-5		—			
ECTC-T-8		—			
ECTC-T-38		—			
NCSO-04		—			
A295575	badge	347 min	EPA-TO-11A acetaldehyde formaldehyde	5	13
A295583	500-106	—		1	
A295581		347 min		5	

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. µg/m^3 6._____ (other) Please indicate one or more units in the column entitled Units**

Comments ______________

Possible Contamination and/or Chemical Hazards ______________

7. **Chain of Custody (Optional)**

Relinquished by	[signature]	Date/Time	11/05/2020 1600
Received by	[signature]	Date/Time	11/06/20 9:10
Relinquished by		Date/Time	
Received by		Date/Time	

☒ For lab use only ☒

ANALYTICAL REQUEST FORM

1. ☒ REGULAR Status

☐ RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ____________ DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/05/2020 Purchase Order No. ____________
3. Company Name: ToxStrategies
Address: 27001 La Paz Rd Suite 260
Mission Viejo CA 92691
Person to Contact: Stephanie Vivanco
Telephone (949) 382-1534
Fax Telephone ( ) ____________
E-mail Address: svivanco@toxstrategies.com
Billing Address (if different from above) ____________

4. Quote No. ____________
ALS Project Manager: J Helland
5. **Sample Collection**
Sampling Site LA fire
Industrial Process: ____________
Date of Collection 11/4/2020
Time Collected ____________
Date of Shipment ____________
Chain of Custody No.: ____________
6. How did you first learn about ALS? ____________

7. **REQUEST FOR ANALYSES**

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
72775	Charcoal 226-01	42.20 L	NIOSH 1003 - Tetrachloroethylene	5	19
72780	226-01	45.30 L		5	
72773		38.44 L		5	
72779		38.59 L		5	
72781		47.58 L		1	
72778		—		5	
72776		49.30 L		5	
01392	XAD-7	133.73 L	NIOSH 2002 - N,N-dimethyl-para-toluidine	5	18
01875	226-98	98.41 L		5	
01823		107.76 L		5	
01872		124.56 L		5	
01871		117.51 L		5	
01878		—		1	

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other
** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. µg/m^3 6. _____ (other) Please indicate one or more units in the column entitled Units**

Comments ____________

Possible Contamination and/or Chemical Hazards ____________

7. **Chain of Custody (Optional)**

Relinquished by	[signature]	Date/Time	11/05/2020 1600
Received by	[signature]	Date/Time	11-06-20 9:10
Relinquished by		Date/Time	
Received by		Date/Time	

ANALYTICAL REPORT

Report Date: November 13, 2020

Stephanie Vivanco
ToxStrategies
27001 La Paz Road, Suite 260
Mission Viejo, CA 92691

Phone: 949-382-1534

E-mail: svivanco@toxstrategies.com

Workorder: **34-2031281**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **11409** | Collected: 11/04/2020
Lab ID: 2031281001 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 5040 | **Media:** Quartz Fiber Filter | **Instrument:** ECOC01
Sampling Parameter: Air Volume Not Provided | **Analyzed:** 11/11/2020 (271284)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Organic Carbon	**14**	NA	5.2
Elemental Carbon	<1.8	NA	1.8
Total Carbon	**14**		

Sample ID: **11403** | Collected: 11/04/2020
Lab ID: 2031281002 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 5040 | **Media:** Quartz Fiber Filter | **Instrument:** ECOC01
Sampling Parameter: Air Volume 832 L | **Analyzed:** 11/11/2020 (271284)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Organic Carbon	**72**	**86**	5.2
Elemental Carbon	<1.8	<2.2	1.8
Total Carbon	**72**	**86**	

Sample ID: **11401** | Collected: 11/04/2020
Lab ID: 2031281003 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 5040 | **Media:** Quartz Fiber Filter | **Instrument:** ECOC01
Sampling Parameter: Air Volume 754.3 L | **Analyzed:** 11/11/2020 (271284)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Organic Carbon	**120**	**160**	5.2
Elemental Carbon	<1.8	<2.4	1.8
Total Carbon	**120**	**160**	

ANALYTICAL REPORT

Workorder: **34-2031281**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **11405** Collected: 11/04/2020
Lab ID: 2031281004 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5040 **Media:** Quartz Fiber Filter **Instrument:** ECOC01
Sampling Parameter: Air Volume 786 L **Analyzed:** 11/11/2020 (271284)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Organic Carbon	**440**	**550**	5.2
Elemental Carbon	**140**	**180**	1.8
Total Carbon	**580**	**730**	

Sample ID: **11406** Collected: 11/04/2020
Lab ID: 2031281005 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5040 **Media:** Quartz Fiber Filter **Instrument:** ECOC01
Sampling Parameter: Air Volume 718 L **Analyzed:** 11/11/2020 (271284)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Organic Carbon	**75**	**100**	5.2
Elemental Carbon	<1.8	<2.5	1.8
Total Carbon	**75**	**100**	

Sample ID: **11407** Collected: 11/04/2020
Lab ID: 2031281006 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5040 **Media:** Quartz Fiber Filter **Instrument:** ECOC01
Sampling Parameter: Air Volume 858 L **Analyzed:** 11/11/2020 (271284)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Organic Carbon	**48**	**56**	5.2
Elemental Carbon	<1.8	<2.1	1.8
Total Carbon	**48**	**56**	

Sample ID: **11404** Collected: 11/04/2020
Lab ID: 2031281007 Sampling Location: LA Fire Received: 11/06/2020

Method: NIOSH 5040 **Media:** Quartz Fiber Filter **Instrument:** ECOC01
Sampling Parameter: Air Volume 806 L **Analyzed:** 11/11/2020 (271284)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Organic Carbon	**55**	**68**	5.2
Elemental Carbon	<1.8	<2.2	1.8
Total Carbon	**55**	**68**	

ANALYTICAL REPORT

Workorder: **34-2031281**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

Analytical Results

Sample ID: **11402** | Collected: 11/04/2020
Lab ID: 2031281008 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 5040 | **Media:** Quartz Fiber Filter | **Instrument:** ECOC01
Sampling Parameter: Air Volume 816 L | **Analyzed:** 11/11/2020 (271284)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Organic Carbon	**85**	**100**	5.2
Elemental Carbon	<1.8	<2.2	1.8
Total Carbon	**85**	**100**	

Sample ID: **11408** | Collected: 11/04/2020
Lab ID: 2031281009 | Sampling Location: LA Fire | Received: 11/06/2020

Method: NIOSH 5040 | **Media:** Quartz Fiber Filter | **Instrument:** ECOC01
Sampling Parameter: Air Volume 852 L | **Analyzed:** 11/11/2020 (271284)

Analyte	Result (ug/sample)	Result (ug/m³)	RL (ug/sample)
Organic Carbon	**42**	**49**	5.2
Elemental Carbon	<1.8	<2.1	1.8
Total Carbon	**42**	**49**	

Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Method	Analyst	Peer Review
NIOSH 5040	/S/ Matthew Roberts 11/12/2020 08:32	/S/ Max Allred 11/13/2020 13:22

Laboratory Contact Information

ALS Environmental
960 W Levoy Drive
Salt Lake City, Utah 84123

Phone: (801) 266-7700
Email: alslt.lab@ALSGlobal.com
Web: www.alsslc.com

ANALYTICAL REPORT

Workorder: **34-2031281**
Client Project ID: LA Fire
Purchase Order: NA
Project Manager: Jessica Helland

General Lab Comments

The results provided in this report relate only to the items tested.
Samples were received in acceptable condition unless otherwise noted.
The following was provided by the client: Sample ID, Collection Date, Sampling Location, Media Type, Sampling Parameter.
Collection Date, Media Type, and Sampling Parameter can potentially affect the validity of the results.
Samples have not been blank corrected unless otherwise noted.
This test report shall not be reproduced, except in full, without written approval of ALS.

ALS provides professional analytical services for all samples submitted. ALS is not in a position to interpret the data and assumes no responsibility for the quality of the samples submitted.

All quality control samples processed with the samples in this report yielded acceptable results unless otherwise noted.

ALS is accredited for specific fields of testing (scopes) in the following testing sectors. The quality system implemented at ALS conforms to accreditation requirements and is applied to all analytical testing performed by ALS. The following table lists testing sector, accreditation body, accreditation number and website. Please contact these accrediting bodies or your ALS project manager for the current scope of accreditation that applies to your analytical testing.

Testing Sector	Accreditation Body (Standard)	Certificate Number	Website
Environmental	PJLA (DoD ELAP)	L20-57	http://www.pjlabs.com
	PJLA (ISO 17025)	L20-58	http://www.pjlabs.com
	Utah (TNI)	UT00953	http://lams.nelac-institute.org/search
Industrial Hygiene	AIHA (ISO 17025 & AIHA IHLAP)	101574	http://www.aihaaccreditedlabs.org
	DOECAP-AP	L20-59	http://www.pjlabs.com
	Washington	C596	https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Laboratory-Accreditation
Dietary Supplements	PJLA (ISO 17025)	L17-507-R1	http://www.pjlabs.com

Definitions

LOD = Limit of Detection = MDL = Method Detection Limit, A statistical estimate of method/media/instrument sensitivity.
LOQ = Limit of Quantitation = RL = Reporting Limit, A verified value of method/media/instrument sensitivity.
ND = Not Detected, Testing result not detected above the LOD or LOQ.
NA = Not Applicable.
** No result could be reported, see sample comments for details.
< Means this testing result is less than the numerical value.
( ) This testing result is between the LOD and LOQ and has higher analytical uncertainty than values at or above the LOQ.

W 2031281

ANALYTICAL REQUEST FORM

2031281

1. [X] REGULAR Status

[ ] RUSH Status Requested - ADDITIONAL CHARGE
RESULTS REQUIRED BY ____________
DATE
CONTACT ALS SALT LAKE PRIOR TO SENDING SAMPLES

2. Date 11/05/2020 Purchase Order No. ____

3. Company Name : Toxstrategies
Address: 27001 La Paz Rd Suite 260
Mission Viejo CA 92691
Person to Contact: Stephanie Vivanco
Telephone (949) 382-1534
Fax Telephone ( ) ____
E-mail Address: svivanco@toxstrategies.com
Billing Address (if different from above)

4. Quote No. ____
ALS Project Manager: J Helland

5. **Sample Collection**
Sampling Site LA fire
Industrial Process: ____
Date of Collection 11/04/2020
Time Collected ____
Date of Shipment ____
Chain of Custody No.: ____

6. How did you first learn about ALS?

7. REQUEST FOR ANALYSES

Client Sample Number	Matrix*	Sample/Area Volume	ANALYSES REQUESTED - Use method number if known	Units**	Lab Comments
114-09	QFF	—	NIOSH 5040 - diesel particulate	1	
11403		832 L		5	
11401		754.3 L			
11405		786 L			
11406		718 L			
11407		858 L			
11404		806 L			
11402		816 L			
11408		852 L			

* Specify: Solid sorbent tube, e.g. Charcoal; Filter type; Impinger solution; Bulk sample; Blood; Urine; Tissue; Soil; Water; Other

** 1. µg/sample 2. mg/m^3 3. ppm 4. % 5. µg/m^3 6._____ (other) Please indicate one or more units in the column entitled Units**

Comments ____

Possible Contamination and/or Chemical Hazards ____

7. Chain of Custody (Optional)

Relinquished by	[signature]	Date/Time	11/05/2020 1500
Received by	[signature]	Date/Time	11-06-20 9:10
Relinquished by		Date/Time	
Received by		Date/Time	

1435 Norjohn Court, Unit 1, Burlington, ON, Canada L7L 0E6
Phone: 905-331-3111, FAX: 905-331-4567

Certificate of Analysis

ALS Project Contact:	Lynne Wrona	**Client Name:**	ToxStrategies
ALS Project ID:	TOXS100	**Client Address:**	27001 La Paz Road, Suite 260
ALS WO#:	L2526958		Mission Viejo, CA 92691
Date of Report	22-Dec-20		United States
Date of Sample Receipt	6-Nov-20	**Client Contact:**	Stephanie Vivanco
		Client Project ID:	LA FIRE

COMMENTS: **PCDD/F by EPA 1613B via Isotope Dilution**

Some Extraction (internal) Standards gave recovery below the method acceptance criteria. Native results calculated by Isotope Dilution are inherently recovery corrected so no impact to overall data quality is expected.

Certified by:

Bradley Reimer
GC/MS Laboratory Senior Technical Specialist

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	**BA-1**	**BA-2**	**BA-3-BLANK**	**356-4**	**356-5**	**ENG-558-DFP-02**
ALS Sample ID	L2526958-1	L2526958-2	L2526958-3	L2526958-4	L2526958-5	L2526958-6
Sample Size	1	1	1	1	1	1
Sample size units	Swab	Swab	Swab	Swab	Swab	Swab
Percent Moisture	n/a	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Swab	Swab	Swab	Swab	Swab	Swab
Sampling Date	3-Nov-20	3-Nov-20	3-Nov-20	3-Nov-20	3-Nov-20	4-Nov-20
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
2,3,7,8-TCDD	<1.2	<1.4	<1.0	<0.92	<1.1	<1.1
1,2,3,7,8-PeCDD	<0.88	<2.1	<0.77	<0.75	<0.97	<1.0
1,2,3,4,7,8-HxCDD	<1.3	<2.8	<0.74	<0.68	<1.2	<1.1
1,2,3,6,7,8-HxCDD	<1.1	<2.6	<0.65	<0.59	<1.1	<1.0
1,2,3,7,8,9-HxCDD	<1.1	<3.2	<0.66	<0.60	<1.1	<1.0
1,2,3,4,6,7,8-HpCDD	7.97	<22	<1.5	<1.8	<3.3	12.0
OCDD	35.6	<56	<2.2	<3.6	6.53	68.0
2,3,7,8-TCDF	<1.2	<1.5	<1.0	<0.89	<1.1	<0.93
1,2,3,7,8-PeCDF	<0.97	<1.3	<0.64	<0.69	<0.63	<0.87
2,3,4,7,8-PeCDF	<0.73	<0.97	<0.47	<0.55	<0.49	<0.70
1,2,3,4,7,8-HxCDF	<1.0	<2.1	<0.45	<0.53	<0.71	<0.71
1,2,3,6,7,8-HxCDF	<0.86	<1.9	<0.43	<0.49	<0.66	<0.81
2,3,4,6,7,8-HxCDF	<0.87	<1.7	<0.45	<0.54	<0.72	<1.4
1,2,3,7,8,9-HxCDF	<1.3	<2.3	<0.67	1.02	<1.2	<1.1
1,2,3,4,6,7,8-HpCDF	<3.1	<4.3	<1.3	<1.1	<1.2	<4.7
1,2,3,4,7,8,9-HpCDF	<2.9	<9.3	<2.0	<1.8	<1.8	<2.7
OCDF	<5.2	12.0	<2.3	<3.3	<4.6	11.0
Extraction Standards	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
13C12-2,3,7,8-TCDD	60	47	50	67	55	66
13C12-1,2,3,7,8-PeCDD	54	30	52	60	52	55
13C12-1,2,3,4,7,8-HxCDD	49	28	57	75	64	72
13C12-1,2,3,6,7,8-HxCDD	56	30	61	77	67	74
13C12-1,2,3,4,6,7,8-HpCDD	50	29	59	67	57	59
13C12-OCDD	44	30	53	54	44	41
13C12-2,3,7,8-TCDF	58	50	49	65	53	64
13C12-1,2,3,7,8-PeCDF	57	36	52	62	52	59
13C12-2,3,4,7,8-PeCDF	58	36	53	61	51	57
13C12-1,2,3,4,7,8-HxCDF	50	28	51	71	60	70
13C12-1,2,3,6,7,8-HxCDF	64	35	64	88	75	86
13C12-2,3,4,6,7,8-HxCDF	67	42	62	81	70	77
13C12-1,2,3,7,8,9-HxCDF	59	38	57	72	59	69
13C12-1,2,3,4,6,7,8-HpCDF	57	29	63	74	63	69
13C12-1,2,3,4,7,8,9-HpCDF	45	19	62	72	59	63
Cleanup Standard						
37Cl4-2,3,7,8-TCDD (Cleanup)	47	35	37	49	39	53
Homologue Group Totals	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
Total-TCDD	<1.2	<1.4	<1.0	<0.92	<1.1	<1.1
Total-PeCDD	<0.88	<2.1	<0.77	<0.75	<0.97	<1.0
Total-HxCDD	<1.3	8.68	<0.74	<0.68	<1.2	<1.1
Total-HpCDD	21.7	34.1	<1.5	<1.8	<3.3	25.2
Total-TCDF	<1.2	<1.5	<1.0	<0.89	<1.1	<0.93
Total-PeCDF	<0.97	<1.3	<0.64	<0.69	<0.63	<0.87
Total-HxCDF	2.35	2.49	<0.67	1.02	<1.2	4.32
Total-HpCDF	<2.9	<9.3	<2.0	<1.8	<1.8	<2.7
Toxic Equivalency - (WHO 2005)						
Lower Bound PCDD/F TEQ (WHO 2005)	0.0904	0.00360	0.00	0.102	0.00196	0.144
Mid Point PCDD/F TEQ (WHO 2005)	1.74	3.29	1.24	1.27	1.54	1.89
Upper Bound PCDD/F TEQ (WHO 2005)	3.35	6.02	2.48	2.44	3.08	3.36

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	ENG-583-DFP-02	ENG-168-DFP-01	DFP-BLANK	ENG-159-DFP-1	ENG-583-DFP-01	ENG-558-DFP-01
ALS Sample ID	L2526958-7	L2526958-8	L2526958-9	L2526958-10	L2526958-11	L2526958-12
Sample Size	1	1	1	1	1	1
Sample size units	Swab	Swab	Swab	Swab	Swab	Swab
Percent Moisture	n/a	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Swab	Swab	Swab	Swab	Swab	Swab
Sampling Date	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
2,3,7,8-TCDD	<1.1	<1.4	<1.2	<1.4	<1.6	<1.1
1,2,3,7,8-PeCDD	<0.87	<1.2	<0.82	<1.3	<1.6	<1.2
1,2,3,4,7,8-HxCDD	<1.5	<1.5	<1.0	<1.4	<1.7	<1.4
1,2,3,6,7,8-HxCDD	<1.3	<1.3	<0.92	<1.2	<1.6	<1.5
1,2,3,7,8,9-HxCDD	<1.3	<1.3	<0.92	<1.2	<1.8	<1.6
1,2,3,4,6,7,8-HpCDD	<6.9	<4.8	<2.2	<9.3	<24	18.1
OCDD	<30	57.4	<4.1	93.8	184	135
2,3,7,8-TCDF	<0.95	<1.1	<0.90	<1.1	<1.5	<0.85
1,2,3,7,8-PeCDF	<0.73	<1.3	<0.79	<0.96	<1.4	<1.1
2,3,4,7,8-PeCDF	<0.60	<0.97	<0.59	<0.76	<1.1	<0.87
1,2,3,4,7,8-HxCDF	<0.73	<0.79	<0.62	<1.0	<1.7	<0.96
1,2,3,6,7,8-HxCDF	<0.74	<0.90	<0.60	1.48	2.00	<0.82
2,3,4,6,7,8-HxCDF	<0.78	<0.83	<0.64	<1.0	<1.8	<0.88
1,2,3,7,8,9-HxCDF	<1.3	<1.5	<0.96	<1.6	<2.8	<1.3
1,2,3,4,6,7,8-HpCDF	3.56	<3.7	<1.5	5.17	15.8	11.0
1,2,3,4,7,8,9-HpCDF	<2.1	<6.2	<2.3	<5.2	<5.4	<6.5
OCDF	<5.3	10.5	<5.0	17.1	<21	14.1
Extraction Standards	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
13C12-2,3,7,8-TCDD	53	51	54	54	47	57
13C12-1,2,3,7,8-PeCDD	51	48	50	44	39	43
13C12-1,2,3,4,7,8-HxCDD	59	69	64	60	56	57
13C12-1,2,3,6,7,8-HxCDD	72	70	64	67	59	56
13C12-1,2,3,4,6,7,8-HpCDD	56	54	56	47	52	46
13C12-OCDD	48	36	42	28	42	34
13C12-2,3,7,8-TCDF	59	55	54	52	50	55
13C12-1,2,3,7,8-PeCDF	53	50	50	45	42	46
13C12-2,3,4,7,8-PeCDF	53	50	52	45	40	44
13C12-1,2,3,4,7,8-HxCDF	64	69	59	67	61	58
13C12-1,2,3,6,7,8-HxCDF	73	84	70	74	65	64
13C12-2,3,4,6,7,8-HxCDF	70	77	65	72	63	64
13C12-1,2,3,7,8,9-HxCDF	57	60	60	62	54	57
13C12-1,2,3,4,6,7,8-HpCDF	65	63	62	54	53	49
13C12-1,2,3,4,7,8,9-HpCDF	60	53	57	47	52	41
Cleanup Standard						
37Cl4-2,3,7,8-TCDD (Cleanup)	40	38	43	45	39	47
Homologue Group Totals	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
Total-TCDD	<1.1	<1.4	<1.2	<1.4	28.0	<1.1
Total-PeCDD	<0.87	<1.2	<0.82	<1.3	4.90	<1.2
Total-HxCDD	<1.5	<1.5	<1.0	2.94	3.82	<1.4
Total-HpCDD	<2.5	13.0	<2.2	<5.1	35.5	18.1
Total-TCDF	<0.95	<1.1	<0.90	<1.1	<1.5	<0.85
Total-PeCDF	<0.73	<1.3	<0.79	<0.96	<1.4	<1.1
Total-HxCDF	<1.3	<1.5	<0.96	3.13	6.15	4.28
Total-HpCDF	3.56	<6.2	<2.3	8.17	15.8	11.0
Toxic Equivalency - (WHO 2005)						
Lower Bound PCDD/F TEQ (WHO 2005)	0.0356	0.0204	0.00	0.233	0.413	0.336
Mid Point PCDD/F TEQ (WHO 2005)	1.64	2.11	1.47	2.26	3.21	2.29
Upper Bound PCDD/F TEQ (WHO 2005)	3.17	4.02	2.94	4.18	5.58	3.93

ALS Life Sciences

Quality Control Summary Report

Sample Name	Method Blank	Method Blank	Laboratory Control Sample
ALS Sample ID	WG3440853-1	WG3440853-4	WG3440853-2
Sample Size	1	1	1
Sample size units	Swab	Reagent	n/a
Percent Moisture	n/a	n/a	n/a
Sample Matrix	QC	QC	QC
Sampling Date	n/a	n/a	n/a
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**% Rec**
2,3,7,8-TCDD	<1.5	<1.2	83
1,2,3,7,8-PeCDD	<1.1	<0.94	110
1,2,3,4,7,8-HxCDD	<1.3	<0.91	104
1,2,3,6,7,8-HxCDD	<1.0	<0.72	96
1,2,3,7,8,9-HxCDD	<1.1	<0.76	99
1,2,3,4,6,7,8-HpCDD	<3.0	<2.0	103
OCDD	6.88	4.48	88
2,3,7,8-TCDF	<1.4	<1.1	88
1,2,3,7,8-PeCDF	<1.1	<0.83	108
2,3,4,7,8-PeCDF	<0.78	<0.63	98
1,2,3,4,7,8-HxCDF	<0.87	<0.49	101
1,2,3,6,7,8-HxCDF	0.870	<0.57	101
2,3,4,6,7,8-HxCDF	<0.94	<0.51	100
1,2,3,7,8,9-HxCDF	<1.4	<0.73	108
1,2,3,4,6,7,8-HpCDF	<1.4	1.43	103
1,2,3,4,7,8,9-HpCDF	<2.3	<1.8	108
OCDF	8.88	<3.4	103
Extraction Standards	**% Rec**	**% Rec**	**% Rec**
13C12-2,3,7,8-TCDD	56	57	55
13C12-1,2,3,7,8-PeCDD	52	59	52
13C12-1,2,3,4,7,8-HxCDD	58	58	69
13C12-1,2,3,6,7,8-HxCDD	69	71	72
13C12-1,2,3,4,6,7,8-HpCDD	61	62	57
13C12-OCDD	48	56	41
13C12-2,3,7,8-TCDF	58	56	55
13C12-1,2,3,7,8-PeCDF	55	59	52
13C12-2,3,4,7,8-PeCDF	56	60	51
13C12-1,2,3,4,7,8-HxCDF	58	57	73
13C12-1,2,3,6,7,8-HxCDF	78	75	74
13C12-2,3,4,6,7,8-HxCDF	69	69	71
13C12-1,2,3,7,8,9-HxCDF	62	61	66
13C12-1,2,3,4,6,7,8-HpCDF	64	67	67
13C12-1,2,3,4,7,8,9-HpCDF	59	65	59
Cleanup Standard			
37Cl4-2,3,7,8-TCDD (Cleanup)	42	45	45
Homologue Group Totals	**pg**	**pg**	
Total-TCDD	<1.5	<1.2	
Total-PeCDD	<1.1	<0.94	
Total-HxCDD	<1.3	<0.91	
Total-HpCDD	<3.0	<2.0	
Total-TCDF	<1.4	<1.1	
Total-PeCDF	<1.1	<0.83	
Total-HxCDF	<1.4	<0.73	
Total-HpCDF	<2.3	<1.8	
Toxic Equivalency - (WHO 2005)			
Lower Bound PCDD/F TEQ (WHO 2005)	0.0917	0.0156	
Mid Point PCDD/F TEQ (WHO 2005)	1.96	1.53	
Upper Bound PCDD/F TEQ (WHO 2005)	3.83	2.99	

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-1**	Sampling Date	3-Nov-20
ALS Sample ID	L2526958-1	Extraction Date	25-Nov-20
Analysis Method	EPA 1613B	Sample Size	1 Swab
Analysis Type	Sample	Percent Moisture	n/a
Sample Matrix	Swab	Split Ratio	2

Approved:
T.Patterson
--e-signature--
21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A08
Run Date	18-Dec-20 19:11
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.2	1.2	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<0.88	0.88	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.3	1.3	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<1.1	1.1	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<1.1	1.1	U		50
1,2,3,4,6,7,8-HpCDD	0.01	35.30	7.97	2.5	M,J		50
OCDD	0.0003	36.75	35.6	4.6	M,J,B		100
2,3,7,8-TCDF	0.1	NotFnd	<1.2	1.2	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<0.97	0.97	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.73	0.73	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<1.0	1.0	U		50
1,2,3,6,7,8-HxCDF	0.1	NotFnd	<0.86	0.86	U		50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.87	0.87	U		50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<1.3	1.3	U		50
1,2,3,4,6,7,8-HpCDF	0.01	34.75	<3.1	1.5	M,J,R	3.1	50
1,2,3,4,7,8,9-HpCDF	0.01	35.53	<2.9	2.9	M,U	2.1	50
OCDF	0.0003	36.85	<5.2	3.4	M,J,R	5.2	100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.80	60	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.51	54	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.65	49	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.71	56	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.30	50	23-140
13C12-OCDD	4000	36.74	44	17-157
13C12-2,3,7,8-TCDF	2000	25.89	58	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.48	57	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.27	58	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.13	50	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.21	64	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.55	67	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.97	59	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.75	57	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.53	45	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	47	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0.00	<1.2	1.2	U	10
Total-PeCDD	0.00	<0.88	0.88	U	50
Total-HxCDD	0.00	<1.3	1.3	U	50
Total-HpCDD	2.00	21.7	2.5		50
Total-TCDF	0.00	<1.2	1.2	U	10
Total-PeCDF	0.00	<0.97	0.97	U	50
Total-HxCDF	1.00	2.35	1.3		50
Total-HpCDF	0.00	<2.9	2.9	U	50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.0904
Mid Point PCDD/F TEQ (WHO 2005)	1.74
Upper Bound PCDD/F TEQ (WHO 2005)	3.35

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor — TEQ Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-2**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-2	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A09
Run Date	18-Dec-20 19:53
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.4	1.4	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<2.1	2.1	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<2.8	2.8	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<2.6	2.6	U		50
1,2,3,7,8,9-HxCDD	0.1	33.83	<3.2	2.6	M,J,R	3.2	50
1,2,3,4,6,7,8-HpCDD	0.01	35.31	<22	5.6	M,J,R	22	50
OCDD	0.0003	36.76	<56	12	M,J,R	56	100
2,3,7,8-TCDF	0.1	NotFnd	<1.5	1.5	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<1.3	1.3	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.97	0.97	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<2.1	2.1	U		50
1,2,3,6,7,8-HxCDF	0.1	33.21	<1.9	1.9	M,U	1.1	50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<1.7	1.7	U		50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<2.3	2.3	U		50
1,2,3,4,6,7,8-HpCDF	0.01	34.75	<4.3	4.3	M,U	3.7	50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<9.3	9.3	U		50
OCDF	0.0003	36.83	12.0	7.1	M,J,B		100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.80	47	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.51	30	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.65	28	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.71	30	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.30	29	23-140
13C12-OCDD	4000	36.75	30	17-157
13C12-2,3,7,8-TCDF	2000	25.88	50	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.48	36	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.27	36	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.13	28	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.21	35	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.55	42	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.97	38	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.75	29	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.53	19	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	35	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0.00	<1.4	1.4	U	10
Total-PeCDD	0.00	<2.1	2.1	U	50
Total-HxCDD	1.00	8.68	2.8		50
Total-HpCDD	1.00	34.1	5.6		50
Total-TCDF	0.00	<1.5	1.5	U	10
Total-PeCDF	0.00	<1.3	1.3	U	50
Total-HxCDF	1.00	2.49	2.3		50
Total-HpCDF	0.00	<9.3	9.3	U	50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.00360
Mid Point PCDD/F TEQ (WHO 2005)	3.29
Upper Bound PCDD/F TEQ (WHO 2005)	6.02

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor — TEQ Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-3-BLANK**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-3	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A10
Run Date	18-Dec-20 20:35
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.0	1.0	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<0.77	0.77	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<0.74	0.74	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<0.65	0.65	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<0.66	0.66	U		50
1,2,3,4,6,7,8-HpCDD	0.01	NotFnd	<1.5	1.5	U		50
OCDD	0.0003	36.74	<2.2	2.2	M,U	1.8	100
2,3,7,8-TCDF	0.1	NotFnd	<1.0	1.0	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<0.64	0.64	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.47	0.47	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.45	0.45	U		50
1,2,3,6,7,8-HxCDF	0.1	NotFnd	<0.43	0.43	U		50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.45	0.45	U		50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<0.67	0.67	U		50
1,2,3,4,6,7,8-HpCDF	0.01	NotFnd	<1.3	1.3	U		50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<2.0	2.0	U		50
OCDF	0.0003	NotFnd	<2.3	2.3	U		100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.80	50	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.50	52	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.64	57	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.70	61	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.30	59	23-140
13C12-OCDD	4000	36.74	53	17-157
13C12-2,3,7,8-TCDF	2000	25.88	49	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.47	52	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.27	53	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.13	51	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.21	64	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.55	62	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.97	57	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.74	63	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.53	62	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.81	37	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0.00	<1.0	1.0	U	10
Total-PeCDD	0.00	<0.77	0.77	U	50
Total-HxCDD	0.00	<0.74	0.74	U	50
Total-HpCDD	0.00	<1.5	1.5	U	50
Total-TCDF	0.00	<1.0	1.0	U	10
Total-PeCDF	0.00	<0.64	0.64	U	50
Total-HxCDF	0.00	<0.67	0.67	U	50
Total-HpCDF	0.00	<2.0	2.0	U	50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.00
Mid Point PCDD/F TEQ (WHO 2005)	1.24
Upper Bound PCDD/F TEQ (WHO 2005)	2.48

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor — TEQ: Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**356-4**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-4	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A11
Run Date	18-Dec-20 21:17
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<0.92	0.92	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<0.75	0.75	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<0.68	0.68	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<0.59	0.59	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<0.60	0.60	U		50
1,2,3,4,6,7,8-HpCDD	0.01	NotFnd	<1.8	1.8	U		50
OCDD	0.0003	36.75	<3.6	3.6	M,U	2.8	100
2,3,7,8-TCDF	0.1	NotFnd	<0.89	0.89	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<0.69	0.69	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.55	0.55	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.53	0.53	U		50
1,2,3,6,7,8-HxCDF	0.1	NotFnd	<0.49	0.49	U		50
2,3,4,6,7,8-HxCDF	0.1	33.55	<0.54	0.54	M,U	0.45	50
1,2,3,7,8,9-HxCDF	0.1	33.97	1.02	0.83	M,J		50
1,2,3,4,6,7,8-HpCDF	0.01	NotFnd	<1.1	1.1	U		50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<1.8	1.8	U		50
OCDF	0.0003	NotFnd	<3.3	3.3	U		100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.80	67	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.50	60	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.64	75	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.70	77	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.29	67	23-140
13C12-OCDD	4000	36.74	54	17-157
13C12-2,3,7,8-TCDF	2000	25.88	65	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.47	62	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.27	61	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.13	71	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.21	88	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.55	81	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.97	72	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.74	74	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.53	72	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	49	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0.00	<0.92	0.92	U	10
Total-PeCDD	0.00	<0.75	0.75	U	50
Total-HxCDD	0.00	<0.68	0.68	U	50
Total-HpCDD	0.00	<1.8	1.8	U	50
Total-TCDF	0.00	<0.89	0.89	U	10
Total-PeCDF	0.00	<0.69	0.69	U	50
Total-HxCDF	1.00	1.02	0.83		50
Total-HpCDF	0.00	<1.8	1.8	U	50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.102
Mid Point PCDD/F TEQ (WHO 2005)	1.27
Upper Bound PCDD/F TEQ (WHO 2005)	2.44

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor — TEQ Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**356-5**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-5	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A12
Run Date	18-Dec-20 22:00
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.1	1.1	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<0.97	0.97	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.2	1.2	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<1.1	1.1	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<1.1	1.1	U		50
1,2,3,4,6,7,8-HpCDD	0.01	NotFnd	<3.3	3.3	U		50
OCDD	0.0003	36.74	6.53	5.3	M,J,B		100
2,3,7,8-TCDF	0.1	NotFnd	<1.1	1.1	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<0.63	0.63	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.49	0.49	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.71	0.71	U		50
1,2,3,6,7,8-HxCDF	0.1	NotFnd	<0.66	0.66	U		50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.72	0.72	U		50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<1.2	1.2	U		50
1,2,3,4,6,7,8-HpCDF	0.01	34.76	<1.2	1.2	M,U	1.1	50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<1.8	1.8	U		50
OCDF	0.0003	NotFnd	<4.6	4.6	U		100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.81	55	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.51	52	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.65	64	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.71	67	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.31	57	23-140
13C12-OCDD	4000	36.76	44	17-157
13C12-2,3,7,8-TCDF	2000	25.89	53	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.48	52	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.28	51	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.15	60	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.22	75	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.56	70	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.98	59	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.75	63	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.54	59	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	39	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0.00	<1.1	1.1	U	10
Total-PeCDD	0.00	<0.97	0.97	U	50
Total-HxCDD	0.00	<1.2	1.2	U	50
Total-HpCDD	0.00	<3.3	3.3	U	50
Total-TCDF	0.00	<1.1	1.1	U	10
Total-PeCDF	0.00	<0.63	0.63	U	50
Total-HxCDF	0.00	<1.2	1.2	U	50
Total-HpCDF	0.00	<1.8	1.8	U	50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.00196
Mid Point PCDD/F TEQ (WHO 2005)	1.54
Upper Bound PCDD/F TEQ (WHO 2005)	3.08

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-558-DFP-02**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-6	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A13
Run Date	18-Dec-20 22:42
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.1	1.1	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<1.0	1.0	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.1	1.1	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<1.0	1.0	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<1.0	1.0	U		50
1,2,3,4,6,7,8-HpCDD	0.01	35.31	12.0	3.1	J		50
OCDD	0.0003	36.77	68.0	5.7	J,B		100
2,3,7,8-TCDF	0.1	NotFnd	<0.93	0.93	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<0.87	0.87	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.70	0.70	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.71	0.71	U		50
1,2,3,6,7,8-HxCDF	0.1	33.22	<0.81	0.66	M,J,R	0.81	50
2,3,4,6,7,8-HxCDF	0.1	33.57	<1.4	0.75	M,J,R	1.4	50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<1.1	1.1	U		50
1,2,3,4,6,7,8-HpCDF	0.01	34.76	<4.7	1.6	M,J,R	4.7	50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<2.7	2.7	U		50
OCDF	0.0003	36.83	11.0	5.4	M,J,B		100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.81	66	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.51	55	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.65	72	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.71	74	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.31	59	23-140
13C12-OCDD	4000	36.76	41	17-157
13C12-2,3,7,8-TCDF	2000	25.89	64	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.48	59	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.28	57	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.15	70	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.22	86	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.56	77	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.98	69	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.75	69	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.54	63	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	53	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0.00	<1.1	1.1	U	10
Total-PeCDD	0.00	<1.0	1.0	U	50
Total-HxCDD	0.00	<1.1	1.1	U	50
Total-HpCDD	2.00	25.2	3.1		50
Total-TCDF	0.00	<0.93	0.93	U	10
Total-PeCDF	0.00	<0.87	0.87	U	50
Total-HxCDF	2.00	4.32	1.1		50
Total-HpCDF	0.00	<2.7	2.7	U	50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.144
Mid Point PCDD/F TEQ (WHO 2005)	1.89
Upper Bound PCDD/F TEQ (WHO 2005)	3.36

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-583-DFP-02**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-7	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A14
Run Date	18-Dec-20 23:24
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.1	1.1	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<0.87	0.87	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.5	1.5	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<1.3	1.3	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<1.3	1.3	U		50
1,2,3,4,6,7,8-HpCDD	0.01	35.30	<6.9	2.5	M,J,R	6.9	50
OCDD	0.0003	36.74	<30	3.9	M,J,R	30	100
2,3,7,8-TCDF	0.1	NotFnd	<0.95	0.95	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<0.73	0.73	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.60	0.60	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.73	0.73	U		50
1,2,3,6,7,8-HxCDF	0.1	33.20	<0.74	0.74	M,U		50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.78	0.78	U		50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<1.3	1.3	U		50
1,2,3,4,6,7,8-HpCDF	0.01	34.74	3.56	1.2	M,J		50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<2.1	2.1	U		50
OCDF	0.0003	36.82	<5.3	4.2	M,J,R	5.3	100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.80	53	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.50	51	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.64	59	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.70	72	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.29	56	23-140
13C12-OCDD	4000	36.74	48	17-157
13C12-2,3,7,8-TCDF	2000	25.88	59	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.47	53	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.27	53	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.13	64	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.20	73	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.55	70	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.96	57	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.74	65	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.53	60	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.81	40	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0.00	<1.1	1.1	U	10
Total-PeCDD	0.00	<0.87	0.87	U	50
Total-HxCDD	0.00	<1.5	1.5	U	50
Total-HpCDD	0.00	<2.5	2.5	U	50
Total-TCDF	0.00	<0.95	0.95	U	10
Total-PeCDF	0.00	<0.73	0.73	U	50
Total-HxCDF	0.00	<1.3	1.3	U	50
Total-HpCDF	1.00	3.56	2.1		50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.0356
Mid Point PCDD/F TEQ (WHO 2005)	1.64
Upper Bound PCDD/F TEQ (WHO 2005)	3.17

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-168-DFP-01**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-8	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A15
Run Date	19-Dec-20 00:06
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.4	1.4	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<1.2	1.2	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.5	1.5	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<1.3	1.3	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<1.3	1.3	U		50
1,2,3,4,6,7,8-HpCDD	0.01	35.30	<4.8	3.9	M,J,R	4.8	50
OCDD	0.0003	36.76	57.4	9.0	M,J,B		100
2,3,7,8-TCDF	0.1	NotFnd	<1.1	1.1	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<1.3	1.3	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.97	0.97	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.79	0.79	U		50
1,2,3,6,7,8-HxCDF	0.1	33.22	<0.90	0.77	M,J,R	0.90	50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.83	0.83	U		50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<1.5	1.5	U		50
1,2,3,4,6,7,8-HpCDF	0.01	34.75	<3.7	3.4	M,J,R	3.7	50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<6.2	6.2	U		50
OCDF	0.0003	36.84	10.5	7.4	M,J,B		100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.80	51	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.50	48	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.64	69	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.70	70	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.30	54	23-140
13C12-OCDD	4000	36.74	36	17-157
13C12-2,3,7,8-TCDF	2000	25.88	55	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.47	50	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.27	50	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.13	69	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.21	84	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.55	77	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.97	60	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.75	63	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.53	53	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	38	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**	**Flags**	**LQL**
Total-TCDD	0.00	<1.4	1.4	U	10
Total-PeCDD	0.00	<1.2	1.2	U	50
Total-HxCDD	0.00	<1.5	1.5	U	50
Total-HpCDD	1.00	13.0	3.9		50
Total-TCDF	0.00	<1.1	1.1	U	10
Total-PeCDF	0.00	<1.3	1.3	U	50
Total-HxCDF	0.00	<1.5	1.5	U	50
Total-HpCDF	0.00	<6.2	6.2	U	50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.0204
Mid Point PCDD/F TEQ (WHO 2005)	2.11
Upper Bound PCDD/F TEQ (WHO 2005)	4.02

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**DFP-BLANK**	Sampling Date	4-Nov-20
ALS Sample ID	L2526958-9	Extraction Date	25-Nov-20
Analysis Method	EPA 1613B	Sample Size	1 Swab
Analysis Type	Sample	Percent Moisture	n/a
Sample Matrix	Swab	Split Ratio	2

Approved:
T.Patterson
--e-signature--
21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A16
Run Date	19-Dec-20 00:49
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	TEF (WHO 2005)	Ret. Time	Conc. pg	EDL pg	Flags	EMPC pg	LQL
2,3,7,8-TCDD	1	NotFnd	<1.2	1.2	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<0.82	0.82	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.0	1.0	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<0.92	0.92	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<0.92	0.92	U		50
1,2,3,4,6,7,8-HpCDD	0.01	NotFnd	<2.2	2.2	U		50
OCDD	0.0003	NotFnd	<4.1	4.1	U		100
2,3,7,8-TCDF	0.1	NotFnd	<0.90	0.90	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<0.79	0.79	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.59	0.59	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.62	0.62	U		50
1,2,3,6,7,8-HxCDF	0.1	NotFnd	<0.60	0.60	U		50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.64	0.64	U		50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<0.96	0.96	U		50
1,2,3,4,6,7,8-HpCDF	0.01	NotFnd	<1.5	1.5	U		50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<2.3	2.3	U		50
OCDF	0.0003	NotFnd	<5.0	5.0	U		100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.81	54	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.51	50	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.65	64	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.71	64	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.31	56	23-140
13C12-OCDD	4000	36.76	42	17-157
13C12-2,3,7,8-TCDF	2000	25.89	54	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.49	50	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.28	52	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.15	59	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.22	70	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.56	65	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.98	60	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.75	62	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.54	57	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	43	35-197

Homologue Group Totals	# peaks	Conc. pg	EDL pg		
Total-TCDD	0.00	<1.2	1.2	U	10
Total-PeCDD	0.00	<0.82	0.82	U	50
Total-HxCDD	0.00	<1.0	1.0	U	50
Total-HpCDD	0.00	<2.2	2.2	U	50
Total-TCDF	0.00	<0.90	0.90	U	10
Total-PeCDF	0.00	<0.79	0.79	U	50
Total-HxCDF	0.00	<0.96	0.96	U	50
Total-HpCDF	0.00	<2.3	2.3	U	50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.00
Mid Point PCDD/F TEQ (WHO 2005)	1.47
Upper Bound PCDD/F TEQ (WHO 2005)	2.94

EDL Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF Indicates the Toxic Equivalency Factor — TEQ Indicates the Toxic Equivalency

U Indicates that this compound was not detected above the EDL.

LQL Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-159-DFP-1**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-10	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A22
Run Date	19-Dec-20 05:09
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.4	1.4	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<1.3	1.3	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.4	1.4	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<1.2	1.2	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<1.2	1.2	U		50
1,2,3,4,6,7,8-HpCDD	0.01	35.31	<9.3	5.1	M,J,R	9.3	50
OCDD	0.0003	36.75	93.8	15	M,J		100
2,3,7,8-TCDF	0.1	NotFnd	<1.1	1.1	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<0.96	0.96	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.76	0.76	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<1.0	1.0	U		50
1,2,3,6,7,8-HxCDF	0.1	33.24	1.48	0.91	M,J,B		50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<1.0	1.0	U		50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<1.6	1.6	U		50
1,2,3,4,6,7,8-HpCDF	0.01	34.76	5.17	2.8	M,J		50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<5.2	5.2	U		50
OCDF	0.0003	36.85	17.1	12	M,J,B		100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.80	54	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.50	44	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.65	60	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.71	67	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.30	47	23-140
13C12-OCDD	4000	36.77	28	17-157
13C12-2,3,7,8-TCDF	2000	25.88	52	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.48	45	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.27	45	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.13	67	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.21	74	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.55	72	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.97	62	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.75	54	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.53	47	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	45	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	0.00	<1.4	1.4	U	10
Total-PeCDD	0.00	<1.3	1.3	U	50
Total-HxCDD	1.00	2.94	1.4		50
Total-HpCDD	0.00	<5.1	5.1	U	50
Total-TCDF	0.00	<1.1	1.1	U	10
Total-PeCDF	0.00	<0.96	0.96	U	50
Total-HxCDF	2.00	3.13	1.6		50
Total-HpCDF	2.00	8.17	5.2		50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.233
Mid Point PCDD/F TEQ (WHO 2005)	2.26
Upper Bound PCDD/F TEQ (WHO 2005)	4.18

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-583-DFP-01**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-11	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A23
Run Date	19-Dec-20 05:51
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.6	1.6	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<1.6	1.6	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.7	1.7	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<1.6	1.6	U		50
1,2,3,7,8,9-HxCDD	0.1	33.86	<1.8	1.6	M,J,R	1.8	50
1,2,3,4,6,7,8-HpCDD	0.01	35.33	<24	5.1	M,J,R	24	50
OCDD	0.0003	36.76	184	8.7	M		100
2,3,7,8-TCDF	0.1	NotFnd	<1.5	1.5	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<1.4	1.4	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<1.1	1.1	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<1.7	1.7	U		50
1,2,3,6,7,8-HxCDF	0.1	33.23	2.00	1.6	M,J,B		50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<1.8	1.8	U		50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<2.8	2.8	U		50
1,2,3,4,6,7,8-HpCDF	0.01	34.76	15.8	3.5	M,J		50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<5.4	5.4	U		50
OCDF	0.0003	36.84	<21	7.6	M,J,R	21	100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.81	47	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.51	39	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.65	56	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.71	59	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.31	52	23-140
13C12-OCDD	4000	36.76	42	17-157
13C12-2,3,7,8-TCDF	2000	25.89	50	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.49	42	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.28	40	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.15	61	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.22	65	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.56	63	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.98	54	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.76	53	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.54	52	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	39	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		
Total-TCDD	2.00	28.0	1.6		10
Total-PeCDD	1.00	4.90	1.6		50
Total-HxCDD	1.00	3.82	1.7		50
Total-HpCDD	1.00	35.5	5.1		50
Total-TCDF	0.00	<1.5	1.5	U	10
Total-PeCDF	0.00	<1.4	1.4	U	50
Total-HxCDF	3.00	6.15	2.8		50
Total-HpCDF	1.00	15.8	5.4		50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.413
Mid Point PCDD/F TEQ (WHO 2005)	3.21
Upper Bound PCDD/F TEQ (WHO 2005)	5.58

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-558-DFP-01**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-12	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A24
Run Date	19-Dec-20 06:33
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.1	1.1	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<1.2	1.2	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.4	1.4	U		50
1,2,3,6,7,8-HxCDD	0.1	33.72	<1.5	1.3	M,J,R	1.5	50
1,2,3,7,8,9-HxCDD	0.1	33.85	<1.6	1.3	M,J,R	1.6	50
1,2,3,4,6,7,8-HpCDD	0.01	35.32	18.1	2.5	M,J		50
OCDD	0.0003	36.77	135	10	M		100
2,3,7,8-TCDF	0.1	NotFnd	<0.85	0.85	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<1.1	1.1	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.87	0.87	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.96	0.96	U		50
1,2,3,6,7,8-HxCDF	0.1	NotFnd	<0.82	0.82	U		50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.88	0.88	U		50
1,2,3,7,8,9-HxCDF	0.1	33.97	<1.3	1.3	M,U	1.2	50
1,2,3,4,6,7,8-HpCDF	0.01	34.76	11.0	3.7	M,J		50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<6.5	6.5	U		50
OCDF	0.0003	36.86	14.1	7.5	M,J,B		100

Extraction Standards	**pg**		**% Rec**	**Limits**
13C12-2,3,7,8-TCDD	2000	26.81	57	25-164
13C12-1,2,3,7,8-PeCDD	2000	31.51	43	25-181
13C12-1,2,3,4,7,8-HxCDD	2000	33.65	57	32-141
13C12-1,2,3,6,7,8-HxCDD	2000	33.71	56	28-130
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.31	46	23-140
13C12-OCDD	4000	36.77	34	17-157
13C12-2,3,7,8-TCDF	2000	25.89	55	24-169
13C12-1,2,3,7,8-PeCDF	2000	30.48	46	24-185
13C12-2,3,4,7,8-PeCDF	2000	31.28	44	21-178
13C12-1,2,3,4,7,8-HxCDF	2000	33.15	58	26-152
13C12-1,2,3,6,7,8-HxCDF	2000	33.22	64	26-123
13C12-2,3,4,6,7,8-HxCDF	2000	33.56	64	28-136
13C12-1,2,3,7,8,9-HxCDF	2000	33.98	57	29-147
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.76	49	28-143
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.54	41	26-138
Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	47	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		**LQL**
Total-TCDD	0.00	<1.1	1.1	U	10
Total-PeCDD	0.00	<1.2	1.2	U	50
Total-HxCDD	0.00	<1.4	1.4	U	50
Total-HpCDD	1.00	18.1	2.5		50
Total-TCDF	0.00	<0.85	0.85	U	10
Total-PeCDF	0.00	<1.1	1.1	U	50
Total-HxCDF	2.00	4.28	1.3		50
Total-HpCDF	1.00	11.0	6.5		50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.336
Mid Point PCDD/F TEQ (WHO 2005)	2.29
Upper Bound PCDD/F TEQ (WHO 2005)	3.93

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a	
ALS Sample ID	WG3440853-1	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Swab	*T.Patterson*
Analysis Type	Blank	Percent Moisture	n/a	--e-signature--
Sample Matrix	QC	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A06
Run Date	18-Dec-20 17:46
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.5	1.5	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<1.1	1.1	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<1.3	1.3	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<1.0	1.0	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<1.1	1.1	U		50
1,2,3,4,6,7,8-HpCDD	0.01	NotFnd	<3.0	3.0	U		50
OCDD	0.0003	36.75	6.88	5.5	M,J		100
2,3,7,8-TCDF	0.1	NotFnd	<1.4	1.4	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<1.1	1.1	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.78	0.78	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.87	0.87	U		50
1,2,3,6,7,8-HxCDF	0.1	33.22	0.870	0.83	M,J		50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.94	0.94	U		50
1,2,3,7,8,9-HxCDF	0.1	33.98	<1.4	1.4	M,U	1.1	50
1,2,3,4,6,7,8-HpCDF	0.01	NotFnd	<1.4	1.4	U		50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<2.3	2.3	U		50
OCDF	0.0003	36.84	8.88	6.5	M,J		100

Extraction Standards	**pg**		**% Rec**	**Limits**	
13C12-2,3,7,8-TCDD	2000	26.81	56	25-164	
13C12-1,2,3,7,8-PeCDD	2000	31.51	52	25-181	
13C12-1,2,3,4,7,8-HxCDD	2000	33.65	58	32-141	R
13C12-1,2,3,6,7,8-HxCDD	2000	33.71	69	28-130	
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.30	61	23-140	
13C12-OCDD	4000	36.76	48	17-157	
13C12-2,3,7,8-TCDF	2000	25.89	58	24-169	
13C12-1,2,3,7,8-PeCDF	2000	30.48	55	24-185	
13C12-2,3,4,7,8-PeCDF	2000	31.28	56	21-178	
13C12-1,2,3,4,7,8-HxCDF	2000	33.15	58	26-152	
13C12-1,2,3,6,7,8-HxCDF	2000	33.22	78	26-123	
13C12-2,3,4,6,7,8-HxCDF	2000	33.56	69	28-136	
13C12-1,2,3,7,8,9-HxCDF	2000	33.97	62	29-147	
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.75	64	28-143	
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.54	59	26-138	

Cleanup Standard	**pg**			
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.84	42	35-197

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		**LQL**
Total-TCDD	0.00	<1.5	1.5	U	10
Total-PeCDD	0.00	<1.1	1.1	U	50
Total-HxCDD	0.00	<1.3	1.3	U	50
Total-HpCDD	0.00	<3.0	3.0	U	50
Total-TCDF	0.00	<1.4	1.4	U	10
Total-PeCDF	0.00	<1.1	1.1	U	50
Total-HxCDF	0.00	<1.4	1.4	U	50
Total-HpCDF	0.00	<2.3	2.3	U	50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.0917
Mid Point PCDD/F TEQ (WHO 2005)	1.96
Upper Bound PCDD/F TEQ (WHO 2005)	3.83

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a	
ALS Sample ID	WG3440853-4	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 Reagent	*T.Patterson*
Analysis Type	Blank	Percent Moisture	n/a	--e-signature--
Sample Matrix	QC	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A07
Run Date	18-Dec-20 18:28
Final Volume	10 uL
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
2,3,7,8-TCDD	1	NotFnd	<1.2	1.2	U		10
1,2,3,7,8-PeCDD	1	NotFnd	<0.94	0.94	U		50
1,2,3,4,7,8-HxCDD	0.1	NotFnd	<0.91	0.91	U		50
1,2,3,6,7,8-HxCDD	0.1	NotFnd	<0.72	0.72	U		50
1,2,3,7,8,9-HxCDD	0.1	NotFnd	<0.76	0.76	U		50
1,2,3,4,6,7,8-HpCDD	0.01	35.32	<2.0	2.0	M,U	1.4	50
OCDD	0.0003	36.77	4.48	3.0	M,J		100
2,3,7,8-TCDF	0.1	NotFnd	<1.1	1.1	U		10
1,2,3,7,8-PeCDF	0.03	NotFnd	<0.83	0.83	U		50
2,3,4,7,8-PeCDF	0.3	NotFnd	<0.63	0.63	U		50
1,2,3,4,7,8-HxCDF	0.1	NotFnd	<0.49	0.49	U		50
1,2,3,6,7,8-HxCDF	0.1	33.23	<0.57	0.46	M,J,R	0.57	50
2,3,4,6,7,8-HxCDF	0.1	NotFnd	<0.51	0.51	U		50
1,2,3,7,8,9-HxCDF	0.1	NotFnd	<0.73	0.73	U		50
1,2,3,4,6,7,8-HpCDF	0.01	34.75	1.43	1.1	M,J		50
1,2,3,4,7,8,9-HpCDF	0.01	NotFnd	<1.8	1.8	U		50
OCDF	0.0003	36.83	<3.4	3.4	M,U	3.3	100

Extraction Standards	**pg**		**% Rec**	**Limits**	
13C12-2,3,7,8-TCDD	2000	26.81	57	25-164	
13C12-1,2,3,7,8-PeCDD	2000	31.51	59	25-181	
13C12-1,2,3,4,7,8-HxCDD	2000	33.65	58	32-141	R
13C12-1,2,3,6,7,8-HxCDD	2000	33.71	71	28-130	
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.30	62	23-140	
13C12-OCDD	4000	36.75	56	17-157	
13C12-2,3,7,8-TCDF	2000	25.89	56	24-169	
13C12-1,2,3,7,8-PeCDF	2000	30.48	59	24-185	
13C12-2,3,4,7,8-PeCDF	2000	31.28	60	21-178	
13C12-1,2,3,4,7,8-HxCDF	2000	33.15	57	26-152	
13C12-1,2,3,6,7,8-HxCDF	2000	33.22	75	26-123	
13C12-2,3,4,6,7,8-HxCDF	2000	33.56	69	28-136	
13C12-1,2,3,7,8,9-HxCDF	2000	33.98	61	29-147	
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.75	67	28-143	
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.54	65	26-138	
Cleanup Standard	**pg**				
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.82	45	35-197	

Homologue Group Totals	**# peaks**	**Conc. pg**	**EDL pg**		**LQL**
Total-TCDD	0.00	<1.2	1.2	U	10
Total-PeCDD	0.00	<0.94	0.94	U	50
Total-HxCDD	0.00	<0.91	0.91	U	50
Total-HpCDD	0.00	<2.0	2.0	U	50
Total-TCDF	0.00	<1.1	1.1	U	10
Total-PeCDF	0.00	<0.83	0.83	U	50
Total-HxCDF	0.00	<0.73	0.73	U	50
Total-HpCDF	0.00	<1.8	1.8	U	50

Toxic Equivalency - (WHO 2005)	**pg**
Lower Bound PCDD/F TEQ (WHO 2005)	0.0156
Mid Point PCDD/F TEQ (WHO 2005)	1.53
Upper Bound PCDD/F TEQ (WHO 2005)	2.99

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor — TEQ: Indicates the Toxic Equivalency.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that a target analyte was detected below the calibrated range.
R	Indicates that the ion abundance ratio for this compound did not meet the acceptance criterion.
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Laboratory Control Sample Analysis Report

Sample Name	**Laboratory Control Sample**	Sampling Date	n/a	
ALS Sample ID	WG3440853-2	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1613B	Sample Size	1 n/a	*T.Patterson*
Analysis Type	LCS	Percent Moisture	n/a	--e-signature--
Sample Matrix	QC	Split Ratio	2	21-Dec-2020

Run Information	**Run 1**
Filename	10-201218A03
Run Date	18-Dec-20 15:39
Final Volume	10 uL
Dilution Factor	1
Analysis Units	%
Instrument - Column	HRMS-10 DB5MSUSO287833H

Target Analytes	**pg**	**Ret. Time**	**% Rec**	**Limits**	**Flags**
2,3,7,8-TCDD	200	26.81	83	67-158	
1,2,3,7,8-PeCDD	1000	31.51	110	70-142	
1,2,3,4,7,8-HxCDD	1000	33.65	104	70-164	
1,2,3,6,7,8-HxCDD	1000	33.71	96	76-134	
1,2,3,7,8,9-HxCDD	1000	33.83	99	64-162	
1,2,3,4,6,7,8-HpCDD	1000	35.30	103	70-140	
OCDD	2000	36.75	88	78-144	
2,3,7,8-TCDF	200	25.91	88	75-158	
1,2,3,7,8-PeCDF	1000	30.48	108	80-134	
2,3,4,7,8-PeCDF	1000	31.27	98	68-160	
1,2,3,4,7,8-HxCDF	1000	33.15	101	72-134	
1,2,3,6,7,8-HxCDF	1000	33.21	101	84-130	
2,3,4,6,7,8-HxCDF	1000	33.55	100	70-156	
1,2,3,7,8,9-HxCDF	1000	33.97	108	78-130	
1,2,3,4,6,7,8-HpCDF	1000	34.75	103	82-122	
1,2,3,4,7,8,9-HpCDF	1000	35.53	108	78-138	
OCDF	2000	36.82	103	63-170	
Extraction Standards	**pg**		**% Rec**	**Limits**	
13C12-2,3,7,8-TCDD	2000	26.80	55	20-175	
13C12-1,2,3,7,8-PeCDD	2000	31.50	52	21-227	
13C12-1,2,3,4,7,8-HxCDD	2000	33.64	69	21-193	
13C12-1,2,3,6,7,8-HxCDD	2000	33.70	72	25-163	
13C12-1,2,3,4,6,7,8-HpCDD	2000	35.29	57	26-166	
13C12-OCDD	4000	36.74	41	13-138	
13C12-2,3,7,8-TCDF	2000	25.88	55	22-152	
13C12-1,2,3,7,8-PeCDF	2000	30.47	52	21-192	
13C12-2,3,4,7,8-PeCDF	2000	31.25	51	13-328	
13C12-1,2,3,4,7,8-HxCDF	2000	33.13	73	19-202	
13C12-1,2,3,6,7,8-HxCDF	2000	33.20	74	21-159	
13C12-2,3,4,6,7,8-HxCDF	2000	33.54	71	22-176	
13C12-1,2,3,7,8,9-HxCDF	2000	33.96	66	17-205	
13C12-1,2,3,4,6,7,8-HpCDF	2000	34.74	67	21-158	
13C12-1,2,3,4,7,8,9-HpCDF	2000	35.53	59	20-186	
Cleanup Standard	**pg**				
37Cl4-2,3,7,8-TCDD (Cleanup)	40	26.81	45	31-191	

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

~~COC Number:~~ 17 - 792336

L2526958-COFC

Page of

Report To — Contact and company name below will appear on the final report

Company:	Toxstrategies
Contact:	Stephanie Viranco
Phone:	949-382-1534
Company address below will appear on the final report	
Street:	27001 La Paz Rd Suite 260
City/Province:	Mission Viejo CA
Postal Code:	92691

Invoice To

Same as Report To: [X] YES [ ] NO

Copy of Invoice with Report: [X] YES [ ] NO

Company:

Contact:

Report Format / Distribution

Select Report Format: [X] PDF [X] EXCEL [X] EDD (DIGITAL)

Quality Control (QC) Report with Report: [X] YES [ ] NO

[ ] Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: [X] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax: svivanco@toxstrategies.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: [X] EMAIL [ ] MAIL [ ] FAX

Email 1 or Fax: svivanco@toxstrategies.com

Email 2

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] [X] Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] [ ] 3 day [P3-25%] [ ] 2 day [P2-50%] [ ]

EMERGENCY: 1 Business day [E - 100%] [ ] Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] [ ]

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: LA Fire ALSEQ20-280

Job #:

PO / AFE:

LSD:

~~Oil and Gas Required Fields (client use)~~

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only):

ALS Contact:

Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Chlorinated dioxins / furans M1613B	PCB (Total + 209 cong)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
1	BA-1	11/03/2020		Wipe	1	X	X		
2	BA-2	11/03/2020		Wipe	1	X	X		
3	BA-3-Blank	11/03/2020		Wipe	1	X	X		
4	356-4	11/03/2020		Wipe	1	X	X		
5	356-5	11/03/2020		Wipe	1	X	X		
6	ENG-558-DFP-02	11/04/2020		Wipe	1	X	X		
7	ENG-583-DFP-02	11/04/2020		Wipe	1	X	X		
8	ENG-168-DFP-01	11/04/2020		Wipe	1	X	X		
9	DFP-BLANK	11/04/2020		Wipe	1	X	X		
10	ENG159-DFP-1	11/04/2020		Wipe	1	X	X		
11	ENG-583-DFP-01	11/04/2020		Wipe	1	X	X		
12	ENG-558-DFP-01	11/04/2020		Wipe	1	X	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? [ ] YES [X] NO

Are samples for human consumption/ use? [ ] YES [X] NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen [ ] SIF Observations Yes [ ] No [X]

Ice Packs [X] Ice Cubes [ ] ~~Custody seal intact~~ Yes [X] No [ ]

Cooling Initiated [X]

INITIAL COOLER TEMPERATURES °C: 8.3°C

FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: S. Vivanco	Date: 11/05/2020	Time: 1600	Received by: Aaron Burton	Date: 6-Nov-2020	Time: 13:50	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION ~~WHITE - LABORATORY COPY~~ ~~YELLOW - CLIENT COPY~~

JUNE 2014 FRONT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

1435 Norjohn Court, Unit 1, Burlington, ON, Canada L7L 0E6
Phone: 905-331-3111, FAX: 905-331-4567

Certificate of Analysis

ALS Project Contact:	Lynne Wrona	**Client Name:**	ToxStrategies
ALS Project ID:	TOXS100	**Client Address:**	27001 La Paz Road, Suite 260
ALS WO#:	L2526958		Mission Viejo, CA
Date of Report Revision	2-Feb-21		92691
Date of Sample Receipt	6-Nov-20	**Client Contact:**	Stephanie Vivanco
		Client Project ID:	LA FIRE

COMMENTS: **PCB Congeners by EPA 1668C**

PCB Congener Group Totals and Total PCB are a sum of detected values, including EMPC values, consistent with USEPA CLP SOW CBC1.2

PCB-209 was detected in the method blanks above the method control limit. Reported sample data for this target may be elevated as a result.

***** REVISED REPORT ***** **(22-Dec-20)**

This report supersedes all prior reports for the above-noted workorder and test. The report has been revised as follows:
The Laboratory Control Sample (LCS) was corrected for the levels in the Method Blank (elevated background level of PCB-209 caused marginal QC failure for native PCB-209 recovery)'

***** REVISED REPORT #2 ***** **(2-Feb-21)**

This report supersedes all prior reports for the above-noted workorder and test. The report has been revised as follows:
The recovery of 13C-PCB-209 Extraction (internal) Standard in the Laboratory Control Sample was below the method acceptance criterion. Native results calculated by Isotope Dilution are inherently recovery corrected so no significant impact to overall data quality is expected. The client samples demonstrated control within the method criteria for all Extraction Standards and were not impacted.

Certified by:

Bradley Reimer
GC/MS Laboratory Senior Technical Specialist

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	BA-1	BA-2	BA-3-BLANK	356-4	356-5	ENG-558-DFP-02
ALS Sample ID	L2526958-1	L2526958-2	L2526958-3	L2526958-4	L2526958-5	L2526958-6
Sample Size	1	1	1	1	1	1
Sample size units	Sample	Sample	Sample	Sample	Sample	Sample
Percent Moisture	n/a	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Swab	Swab	Swab	Swab	Swab	Swab
Sampling Date	3-Nov-20	3-Nov-20	3-Nov-20	3-Nov-20	3-Nov-20	4-Nov-20
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
PCB-001	<5.0	<3.2	2.28	<2.0	<1.6	<1.4
PCB-002	6.47	7.71	3.29	2.43	<1.3	4.04
PCB-003	<7.9	8.07	4.51	3.73	<2.5	5.05
PCB-004	7.30	7.11	<3.4	<2.2	<2.8	<4.0
PCB-010	<0.99	<1.6	<2.3	<1.4	<1.5	<0.99
PCB-009	<0.99	<1.6	<2.3	<1.4	<1.5	<1.0
PCB-007	7.12	17.3	<2.2	<1.3	<1.4	4.69
PCB-006	<8.3	10.1	<2.3	<1.4	<1.5	<3.5
PCB-005	<1.6	<1.9	<2.6	<1.6	<1.7	<1.1
PCB-008	<0.92	18.9	<2.1	<7.1	8.58	20.5
PCB-014	<1.0	<1.5	<2.9	<1.7	<2.0	<1.7
PCB-011	329	445	46.0	69.1	77.6	762
PCB-012/013	22.7	20.1	<3.0	<1.8	<2.0	<10
PCB-015	24.5	<9.4	<3.6	<3.6	<2.4	20.8
PCB-019	<1.3	2.93	<1.3	<1.0	<1.1	<2.3
PCB-018/030	16.3	17.4	<4.0	7.35	8.54	26.5
PCB-017	8.11	7.31	<1.6	<3.6	4.17	13.1
PCB-027	<0.62	<1.1	<1.2	<0.85	<1.1	<1.1
PCB-024	<0.52	<1.1	<1.2	<0.85	<1.1	<0.52
PCB-016	7.90	<8.0	<1.9	3.38	<4.0	<13
PCB-032	4.43	<4.4	<1.1	2.32	2.58	10.8
PCB-034	<0.65	<1.1	<1.3	<1.1	<1.5	<1.0
PCB-023	<0.61	<1.0	<1.2	<1.0	<1.4	<0.97
PCB-026/029	<5.3	4.79	<1.2	2.64	<1.4	8.75
PCB-025	<2.5	1.94	<1.1	<0.91	<1.3	<4.4
PCB-031	28.7	<19	7.47	12.9	11.0	53.6
PCB-020/028	34.2	23.3	<1.2	<1.0	<1.4	74.6
PCB-021/033	20.9	<14	5.22	10.2	8.53	43.5
PCB-022	12.8	9.68	<2.0	5.57	5.22	28.1
PCB-036	<0.61	<1.0	<1.2	<1.0	<1.4	<4.0
PCB-039	<0.62	<1.0	<1.2	<1.0	<1.4	<0.99
PCB-038	<0.67	<1.1	<1.3	<1.1	<1.5	<1.1
PCB-035	11.1	9.12	<1.4	<1.2	<1.6	<12
PCB-037	22.9	<7.8	<3.0	7.81	<3.4	36.2
PCB-054	<0.26	<0.35	<0.58	<0.44	<0.55	<0.30
PCB-050/053	2.81	3.52	<1.5	<0.95	0.992	6.03
PCB-045/051	5.23	15.7	2.05	2.39	2.46	12.1
PCB-046	<0.92	<1.1	<1.8	<0.82	<0.97	2.97
PCB-052	36.5	32.3	<5.2	8.53	<7.6	65.2
PCB-073	<0.30	<0.74	<1.2	<0.54	<0.64	<0.45
PCB-043	<1.0	<1.3	<2.0	<0.93	<1.1	<1.2
PCB-049/069	14.6	11.8	2.57	3.80	<3.2	27.4
PCB-048	<4.9	4.58	<1.6	<1.6	<0.90	11.2
PCB-044/047/065	40.8	58.7	<6.4	9.65	8.19	66.8
PCB-059/062/075	<2.2	<1.8	<1.2	<0.56	<0.66	4.84
PCB-042	<6.4	5.84	<1.8	1.99	<1.9	16.2
PCB-040/041/071	16.5	11.8	<1.8	4.36	4.83	34.1
PCB-064	13.2	9.10	<2.0	3.22	2.78	27.1
PCB-072	<0.57	<0.94	<0.92	<0.65	<0.83	<0.86
PCB-068	4.12	10.6	<0.86	<0.70	<0.78	4.51
PCB-057	<0.61	<1.0	<0.98	<0.69	<0.89	<0.92
PCB-058	<0.55	<0.91	<0.89	<0.63	<0.81	1.67
PCB-067	<0.51	<0.84	<0.82	<0.58	<0.75	1.68
PCB-063	<0.56	<0.93	<0.91	<0.64	<0.82	<1.8
PCB-061/070/074/076	82.0	33.4	6.47	10.1	<8.4	105
PCB-066	38.4	12.7	<2.4	<4.0	5.26	58.3
PCB-055	<0.62	<1.0	<1.0	<0.71	<0.90	2.45
PCB-056	26.2	12.3	<3.5	8.91	8.41	39.0
PCB-060	12.6	3.75	<0.99	1.70	0.918	<20
PCB-080	<0.53	<0.88	<0.86	<0.61	<0.78	<0.81
PCB-079	<0.73	<0.93	<0.91	<0.65	<0.83	<1.2
PCB-078	<0.67	<1.1	<1.1	<0.76	<0.98	<1.0
PCB-081	<0.70	<1.3	<1.2	<0.80	<1.1	<1.1
PCB-077	11.3	6.85	<1.3	1.89	<1.5	14.3
PCB-104	<0.38	<0.85	<0.87	<0.87	<0.90	<0.48
PCB-096	<0.36	<0.95	<0.87	<0.83	<0.90	<0.49
PCB-103	<0.72	<1.6	<1.5	<0.97	<1.1	<0.87
PCB-094	<0.84	<1.9	<1.7	<1.1	<1.3	<1.0
PCB-095	45.3	25.8	<2.7	3.63	5.34	49.5
PCB-093/098/100/102	<2.2	<1.8	<1.6	<1.1	<1.2	3.25

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	BA-1	BA-2	BA-3-BLANK	356-4	356-5	ENG-558-DFP-02
ALS Sample ID	L2526958-1	L2526958-2	L2526958-3	L2526958-4	L2526958-5	L2526958-6
Sample Size	1	1	1	1	1	1
Sample size units	Sample	Sample	Sample	Sample	Sample	Sample
Percent Moisture	n/a	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Swab	Swab	Swab	Swab	Swab	Swab
Sampling Date	3-Nov-20	3-Nov-20	3-Nov-20	3-Nov-20	3-Nov-20	4-Nov-20
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
PCB-088/091	8.67	4.45	<1.7	<1.1	<1.2	10.1
PCB-084	20.7	9.96	<1.9	<2.1	<1.4	19.5
PCB-089	<1.2	<2.1	<1.9	<1.2	<1.4	<1.1
PCB-121	<0.61	<1.4	<1.3	<0.81	<0.93	<0.73
PCB-092	13.8	8.60	<1.9	<1.2	<1.4	12.9
PCB-090/101/113	80.4	38.2	<3.6	6.47	6.11	77.5
PCB-083/099	46.5	<16	<1.9	<2.2	<2.8	43.0
PCB-112	<0.64	<1.4	<1.3	<0.85	<0.98	<0.77
PCB-086/087/097/109/119/125	77.1	29.6	<1.6	<6.0	<1.8	65.4
PCB-085/110/115/116/117	160	61.2	<3.4	8.71	8.72	136
PCB-082	<15	<6.5	<2.4	<1.6	<1.8	14.5
PCB-111	<0.66	<1.5	<1.4	<0.88	<1.0	<0.79
PCB-120	<0.65	<1.5	<1.4	<0.87	<1.0	<0.78
PCB-108/124	5.09	<2.0	<1.5	<1.2	<1.5	3.13
PCB-107	<6.6	<1.8	<1.3	<1.1	<1.3	<4.6
PCB-123	<1.7	<2.4	<1.6	<1.4	<1.7	1.76
PCB-106	<1.2	<2.1	<1.5	<1.3	<1.6	<1.1
PCB-118	118	46.9	<1.5	8.44	<5.8	97.6
PCB-122	2.44	<2.3	<1.6	<1.4	<1.7	<1.2
PCB-114	3.39	<2.2	<1.5	<1.3	<1.6	2.55
PCB-105	54.3	<17	<1.6	3.33	<1.7	44.8
PCB-127	<1.3	<2.2	<1.6	<1.4	<1.7	<1.1
PCB-126	<1.7	<3.1	<1.9	<1.5	<2.0	<2.1
PCB-155	<0.45	<1.1	<0.62	<0.73	<0.75	<2.4
PCB-152	<0.41	<0.87	<0.60	<0.46	<0.58	<0.40
PCB-150	<0.40	<0.84	<0.57	<0.45	<0.55	<0.39
PCB-136	8.67	7.54	<0.64	<1.0	<0.60	9.67
PCB-145	<0.43	<0.91	<0.62	<0.49	<0.60	<0.42
PCB-148	<0.61	<1.3	<0.88	<0.68	<0.85	<0.60
PCB-135/151	25.9	16.6	<0.93	<1.4	<0.90	29.4
PCB-154	<0.50	<1.1	<0.73	<0.57	<0.70	<0.49
PCB-144	4.66	2.72	<0.95	<0.74	<0.92	3.69
PCB-147/149	74.5	45.3	<2.0	<5.9	<4.7	84.9
PCB-134/143	<5.7	<2.0	<1.7	<1.0	<1.5	5.77
PCB-139/140	<2.4	<1.6	<1.4	<0.84	<1.3	2.70
PCB-131	<1.6	<2.0	<1.7	<1.1	<1.6	<1.2
PCB-142	<1.3	<2.0	<1.7	<1.0	<1.5	<1.1
PCB-132	43.6	25.3	<1.6	<1.0	<2.8	45.3
PCB-133	<1.4	<1.9	<1.6	<0.97	<1.5	<1.1
PCB-165	<0.98	<1.4	<1.2	<0.74	<1.1	<0.82
PCB-146	14.2	<7.7	<1.4	<1.1	<1.3	13.5
PCB-161	<0.94	<1.4	<1.2	<0.72	<1.1	<0.78
PCB-153/168	85.3	50.3	<2.5	6.28	5.75	83.9
PCB-141	26.8	12.4	<1.6	1.30	<1.5	24.3
PCB-130	<7.3	<4.3	<1.9	<1.2	<1.8	<7.4
PCB-137/164	<14	10.3	<1.4	<0.85	<1.3	15.9
PCB-129/138/163	148	75.7	<3.3	11.4	<8.3	144
PCB-160	<1.0	<1.5	<1.3	<0.78	<1.2	<0.86
PCB-158	15.2	9.90	<1.0	<0.90	<0.96	14.6
PCB-128/166	<20	11.9	<1.4	<0.88	<1.3	20.7
PCB-159	<0.99	<1.4	<1.2	<0.75	<1.1	<0.82
PCB-162	<1.0	<1.5	<1.3	<0.78	<1.2	<0.86
PCB-167	<5.3	3.00	<1.0	<0.62	<0.96	5.21
PCB-156/157	<15	<3.5	<1.4	<2.1	<1.3	13.5
PCB-169	<1.1	<1.4	<1.3	<0.65	<1.0	<0.84
PCB-188	<0.49	<1.1	<0.63	<0.58	<0.89	<0.77
PCB-179	6.30	5.49	<0.66	<0.48	<0.83	8.09
PCB-184	<0.55	<0.86	<0.59	<0.43	<0.75	<3.0
PCB-176	<1.4	2.12	<0.67	<0.49	<0.85	2.64
PCB-186	<0.60	<1.0	<0.68	<0.50	<0.87	<0.86
PCB-178	<4.1	<4.7	<1.0	<0.74	<1.3	5.18
PCB-175	<0.87	<1.5	<1.0	<0.73	<1.3	<1.3
PCB-187	20.3	18.8	<0.85	<1.6	<2.0	24.4
PCB-182	<0.81	<1.4	<0.93	<0.68	<1.2	<1.2
PCB-183	12.0	12.8	<0.94	<0.69	<1.2	15.1
PCB-185	<1.7	<1.4	<0.96	<0.70	<1.2	<1.2
PCB-174	20.8	19.2	<1.0	<0.84	<1.3	23.3
PCB-177	10.2	<6.3	<1.1	<0.81	<1.4	12.7
PCB-181	<0.88	<1.5	<1.0	<0.74	<1.3	<1.3
PCB-171/173	6.74	6.42	<1.1	<0.81	<1.4	<6.3
PCB-172	3.89	<3.1	<1.1	<0.81	<1.4	<4.2

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	BA-1	BA-2	BA-3-BLANK	356-4	356-5	ENG-558-DFP-02
ALS Sample ID	L2526958-1	L2526958-2	L2526958-3	L2526958-4	L2526958-5	L2526958-6
Sample Size	1	1	1	1	1	1
Sample size units	Sample	Sample	Sample	Sample	Sample	Sample
Percent Moisture	n/a	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Swab	Swab	Swab	Swab	Swab	Swab
Sampling Date	3-Nov-20	3-Nov-20	3-Nov-20	3-Nov-20	3-Nov-20	4-Nov-20
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
PCB-192	<0.74	<1.2	<0.85	<0.62	<1.1	<1.1
PCB-180/193	44.6	51.0	<1.1	4.89	<2.0	45.4
PCB-191	<1.4	<1.0	<0.72	<0.53	<0.91	<0.90
PCB-170	17.4	<14	<0.83	<0.78	1.56	17.3
PCB-190	<3.4	<2.8	<0.52	<0.38	<0.66	3.09
PCB-189	1.46	<0.88	<0.64	<0.47	<0.57	<1.2
PCB-202	<2.4	2.17	<0.97	<0.87	<0.82	<2.7
PCB-201	2.03	<0.98	<1.0	<0.74	<0.80	<1.8
PCB-204	<0.49	<0.97	<1.0	<0.74	<0.79	<0.58
PCB-197	<0.54	<0.95	<0.98	<0.72	<0.77	<0.57
PCB-200	<0.50	<0.99	<1.0	<0.75	<0.81	<1.3
PCB-198/199	6.94	7.94	<0.98	<0.72	<0.77	8.94
PCB-196	<3.5	3.34	<0.96	<0.71	<0.76	<2.6
PCB-203	5.42	<3.2	<0.95	<0.70	<0.75	5.15
PCB-195	<3.0	<2.6	<0.95	<0.87	<0.89	<3.2
PCB-194	10.4	<6.5	1.70	<1.9	<1.0	9.71
PCB-205	<0.92	<0.86	<0.92	<0.71	<0.81	<0.76
PCB-208	<2.5	<5.1	<2.0	3.43	<2.1	5.19
PCB-207	<1.8	<2.6	<2.0	<1.7	<1.9	<2.6
PCB-206	9.73	11.5	<2.8	4.34	7.41	12.1
PCB-209	38.8	222	134	116	<130	103
Extraction Standards	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
13C12-PCB-001	54	66	56	52	54	64
13C12-PCB-003	61	61	48	51	53	59
13C12-PCB-004	67	73	56	54	56	68
13C12-PCB-015	59	62	50	51	51	59
13C12-PCB-019	69	70	56	53	55	72
13C12-PCB-037	65	71	53	57	54	65
13C12-PCB-054	81	90	66	67	69	83
13C12-PCB-081	71	74	63	70	61	73
13C12-PCB-077	69	70	63	70	60	70
13C12-PCB-104	88	106	75	83	77	91
13C12-PCB-123	67	70	61	68	61	68
13C12-PCB-118	65	67	62	68	60	67
13C12-PCB-114	70	72	64	72	63	70
13C12-PCB-105	69	68	65	73	64	71
13C12-PCB-126	63	62	60	71	59	68
13C12-PCB-155	78	43	52	39	44	68
13C12-PCB-167	75	84	71	79	70	76
13C12-PCB-156/157	77	85	72	81	71	78
13C12-PCB-169	77	85	71	89	77	80
13C12-PCB-188	93	63	70	55	61	86
13C12-PCB-189	74	90	70	85	75	78
13C12-PCB-202	76	60	69	61	66	78
13C12-PCB-205	104	138	82	95	84	111
13C12-PCB-208	82	47	61	44	51	73
13C12-PCB-206	92	96	80	95	86	93
13C12-PCB-209	88	29	34	26	27	45
Cleanup Standards						
13C12-PCB-028	70	82	64	67	65	73
13C12-PCB-111	72	77	67	73	64	74
13C12-PCB-178	90	113	76	81	73	92

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	BA-1	BA-2	BA-3-BLANK	356-4	356-5	ENG-558-DFP-02
ALS Sample ID	L2526958-1	L2526958-2	L2526958-3	L2526958-4	L2526958-5	L2526958-6
Sample Size	1	1	1	1	1	1
Sample size units	Sample	Sample	Sample	Sample	Sample	Sample
Percent Moisture	n/a	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Swab	Swab	Swab	Swab	Swab	Swab
Sampling Date	3-Nov-20	3-Nov-20	3-Nov-20	3-Nov-20	3-Nov-20	4-Nov-20
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
Homologue Group Totals						
Total MonoCB	19.4	19.0	10.1	8.16	5.40	10.5
Total DiCB	401	528	46.0	79.8	89.0	825
Total TriCB	177	130	21.7	55.8	47.4	332
Total TetraCB	320	235	32.4	63.8	57.3	525
Total PentaCB	662	264	9.70	40.9	30.6	588
Total HexaCB	520	286	8.44	31.4	21.6	527
Total HeptaCB	156	147	1.10	8.92	5.56	172
Total OctaCB	35.2	25.8	1.70	1.90	1.00	36.2
Total NonaCB	14.0	16.6	<2.0	7.77	7.41	19.9
DecaCB	38.8	222	134	116	130	103
Total PCB	2340	1870	265	414	395	3140
Toxic Equivalency - (WHO 2005)						
Lower Bound PCB TEQ	0.00644	0.00218	0.00	0.000542	0.00	0.00639
Mid Point PCB TEQ	0.109	0.179	0.115	0.0855	0.116	0.229
Upper Bound PCB TEQ	0.210	0.355	0.230	0.170	0.231	0.242

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	**ENG-583-DFP-02**	**ENG-168-DFP-01**	**DFP-BLANK**	**ENG-159-DFP-1**	**ENG-583-DFP-01**	**ENG-558-DFP-01**
ALS Sample ID	L2526958-7	L2526958-8	L2526958-9	L2526958-10	L2526958-11	L2526958-12
Sample Size	1	1	1	1	1	1
Sample size units	Sample	Sample	Sample	Sample	Sample	Sample
Percent Moisture	n/a	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Swab	Swab	Swab	Swab	Swab	Swab
Sampling Date	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
PCB-001	<1.7	<1.4	<1.6	<3.1	16.9	<4.7
PCB-002	5.95	<2.8	<2.4	<3.6	70.5	33.6
PCB-003	5.25	4.40	<3.3	<3.7	69.9	<22
PCB-004	<3.9	<3.7	<2.7	<12	<12	<5.2
PCB-010	<1.3	<1.1	<1.8	<8.3	<2.9	<3.2
PCB-009	<1.3	<1.1	<1.8	<8.3	<3.0	<3.2
PCB-007	<1.2	4.09	<1.7	<8.1	10.8	<3.1
PCB-006	4.30	<2.9	2.29	<8.5	<13	<3.3
PCB-005	<1.5	<1.3	<2.0	<9.6	<3.5	<3.7
PCB-008	15.8	13.1	<4.8	<9.6	47.1	9.24
PCB-014	<1.2	<1.7	<1.8	<10	<2.8	<2.4
PCB-011	1050	136	38.7	948	894	1400
PCB-012/013	<19	5.62	<1.9	<10	<30	<2.4
PCB-015	17.0	<13	<2.2	<14	<42	<5.5
PCB-019	1.83	<0.87	<0.85	<4.9	<3.9	<1.2
PCB-018/030	11.0	12.1	<2.5	<8.4	32.3	<6.9
PCB-017	6.31	5.92	<1.1	<5.7	18.1	3.60
PCB-027	<0.70	<0.74	<0.84	<4.2	<2.3	<0.93
PCB-024	<0.61	<0.72	<0.84	<4.2	<1.1	<0.94
PCB-016	6.08	6.81	<2.0	<6.9	<15	<3.2
PCB-032	3.83	4.45	<1.5	<4.0	10.5	3.07
PCB-034	<0.76	<1.1	<1.2	<5.2	<1.2	<1.4
PCB-023	<0.72	<1.0	<1.1	<4.9	<1.1	<1.3
PCB-026/029	4.16	<3.6	<1.1	<4.9	<12	3.39
PCB-025	<2.1	<2.1	<1.0	<4.4	<8.5	<1.2
PCB-031	19.0	21.5	5.02	17.3	62.7	11.7
PCB-020/028	22.6	26.5	<5.3	<4.8	78.9	13.5
PCB-021/033	<14	18.1	<2.7	<4.7	<50	<8.0
PCB-022	9.91	10.8	2.28	<5.1	32.4	5.33
PCB-036	<2.9	<1.0	<1.1	<4.8	16.6	<1.3
PCB-039	<0.73	<1.0	<1.1	<4.9	<1.1	<1.3
PCB-038	<0.79	<1.1	<1.2	<5.3	<1.2	<1.4
PCB-035	23.3	<3.8	<1.3	<7.4	42.9	12.1
PCB-037	16.4	17.0	<1.8	17.3	67.7	6.25
PCB-054	<0.42	<0.48	<0.58	<2.0	<0.49	<0.56
PCB-050/053	2.14	<2.5	<1.1	<2.9	8.55	<1.1
PCB-045/051	12.0	10.3	<1.1	<3.0	71.3	<4.4
PCB-046	1.38	<0.85	<1.3	<3.5	<3.9	<1.1
PCB-052	55.2	110	<1.1	26.2	270	26.9
PCB-073	<0.66	<0.56	<0.85	<2.3	<0.56	<0.69
PCB-043	<1.3	<0.97	<1.5	<4.0	<2.1	<1.2
PCB-049/069	<15	27.1	<1.2	<8.6	79.7	7.20
PCB-048	4.04	<5.4	<1.2	<3.1	18.6	1.77
PCB-044/047/065	81.6	95.7	<4.6	20.3	506	28.0
PCB-059/062/075	<1.6	<2.0	<0.88	<2.4	10.6	<0.73
PCB-042	<5.4	9.36	<1.3	<3.6	<25	<3.0
PCB-040/041/071	14.2	19.6	<1.2	9.92	60.8	<6.8
PCB-064	13.6	22.6	1.26	8.37	61.2	<5.7
PCB-072	<0.91	<0.99	<0.99	<2.9	<1.1	<0.77
PCB-068	7.74	<5.1	<0.93	<2.7	50.1	4.58
PCB-057	<0.97	<1.1	<1.1	<3.1	<1.2	<0.82
PCB-058	<0.89	<0.97	<0.97	<2.8	<1.1	<0.75
PCB-067	<0.81	<0.89	<0.89	<2.6	<2.9	<0.71
PCB-063	<0.90	<0.98	<0.98	<2.9	<4.8	<0.76
PCB-061/070/074/076	90.5	150	<3.0	54.5	419	36.2
PCB-066	31.4	49.2	<1.3	23.1	144	<12
PCB-055	<0.99	<1.1	<1.1	<3.2	<1.2	<0.83
PCB-056	23.0	<19	<2.0	<15	62.5	<9.0
PCB-060	11.1	13.0	<1.1	9.44	38.0	3.81
PCB-080	<0.85	<0.93	<0.93	<2.7	<1.0	<0.71
PCB-079	<1.7	<2.6	<0.99	<2.9	<6.5	<0.76
PCB-078	<1.1	<1.2	<1.2	<3.4	<1.8	<0.89
PCB-081	<1.1	<1.3	<1.3	<3.3	<1.4	<0.94
PCB-077	16.1	<9.5	<1.4	<8.7	47.1	<5.0
PCB-104	<0.73	<0.69	<0.70	<2.5	<0.63	<0.59
PCB-096	<0.71	<1.2	<0.71	<2.1	2.54	<0.57
PCB-103	<1.6	<1.5	<1.1	<3.4	2.39	<2.1
PCB-094	<1.9	<1.8	<1.3	<3.9	<2.2	<2.4
PCB-095	85.7	172	<1.3	26.3	475	37.7
PCB-093/098/100/102	4.68	6.68	<1.2	<3.7	17.3	<2.3

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	ENG-583-DFP-02	ENG-168-DFP-01	DFP-BLANK	ENG-159-DFP-1	ENG-583-DFP-01	ENG-558-DFP-01
ALS Sample ID	L2526958-7	L2526958-8	L2526958-9	L2526958-10	L2526958-11	L2526958-12
Sample Size	1	1	1	1	1	1
Sample size units	Sample	Sample	Sample	Sample	Sample	Sample
Percent Moisture	n/a	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Swab	Swab	Swab	Swab	Swab	Swab
Sampling Date	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
PCB-088/091	15.9	26.4	<1.2	<3.8	71.7	6.44
PCB-084	33.4	62.6	<1.4	<10	163	15.5
PCB-089	<2.1	<2.0	<1.4	<4.3	<5.2	<2.6
PCB-121	<1.4	<1.3	<0.91	<2.8	<1.6	<1.8
PCB-092	24.9	43.1	<1.3	<4.2	112	10.4
PCB-090/101/113	144	242	2.25	47.7	657	57.6
PCB-083/099	107	117	<1.3	26.5	331	31.1
PCB-112	<17	<1.4	<0.96	<3.0	<7.4	<2.4
PCB-086/087/097/109/119/125	119	172	<1.1	45.2	491	50.3
PCB-085/110/115/116/117	266	328	<2.5	96.7	934	123
PCB-082	<24	28.3	<1.8	<12	87.8	<6.9
PCB-111	<1.5	<1.4	<0.98	<3.1	<1.6	<1.8
PCB-120	<1.5	<1.4	<0.98	<3.0	<1.6	29.5
PCB-108/124	7.13	<8.1	<1.2	<4.3	23.7	<4.4
PCB-107	9.48	<9.9	<1.1	<5.8	30.6	<3.8
PCB-123	<2.8	2.61	<1.3	<4.4	10.1	<4.9
PCB-106	<2.2	<2.0	<1.3	<4.5	<2.1	<4.5
PCB-118	165	196	<1.3	89.4	524	<69
PCB-122	<2.3	<2.1	<1.4	<4.8	<8.5	<4.9
PCB-114	<3.2	5.73	<1.3	<4.2	<11	<4.6
PCB-105	63.0	68.7	<1.4	<33	182	32.7
PCB-127	<2.3	<2.1	<1.3	<4.7	<2.2	<4.6
PCB-126	<2.7	<2.6	<1.7	<7.6	<9.3	<5.8
PCB-155	<0.54	<0.72	<0.44	<2.3	<1.1	<0.78
PCB-152	<0.38	<0.45	<0.53	<1.2	<0.55	<0.52
PCB-150	<0.36	<0.43	<0.51	<1.1	0.668	<0.50
PCB-136	<17	30.5	<0.55	<6.2	61.2	8.52
PCB-145	<0.39	<0.47	<0.55	<1.2	<0.51	<0.54
PCB-148	<0.55	<0.66	<0.78	<1.7	<0.71	<0.76
PCB-135/151	45.2	61.0	<0.83	20.5	139	19.6
PCB-154	<0.72	<0.54	<0.65	<1.4	<0.58	<0.62
PCB-144	<6.6	10.5	<0.84	3.21	22.3	3.91
PCB-147/149	158	190	<1.9	66.0	353	55.3
PCB-134/143	<10	<12	<0.97	<6.5	31.5	5.19
PCB-139/140	4.13	<5.3	<0.80	<5.4	10.6	<1.6
PCB-131	<2.9	<4.3	<1.0	<6.7	8.92	<2.1
PCB-142	<1.5	<1.3	<0.97	<6.5	<1.3	<2.0
PCB-132	76.9	84.6	<0.96	<30	177	32.0
PCB-133	<1.9	<1.9	<0.92	<6.2	5.15	<1.9
PCB-165	<1.1	<0.93	<0.71	<4.8	<0.96	<1.4
PCB-146	21.9	22.0	<0.80	14.5	<46	10.6
PCB-161	<1.1	<0.89	<0.68	<4.6	<0.92	<1.4
PCB-153/168	135	134	1.73	79.0	297	61.4
PCB-141	40.0	38.5	<0.93	<21	75.5	17.9
PCB-130	<14	15.6	<1.1	10.1	<24	6.43
PCB-137/164	26.8	26.3	<0.81	<14	48.9	13.6
PCB-129/138/163	234	208	<1.3	127	454	117
PCB-160	<1.2	<0.98	<0.75	<5.0	<0.93	<1.4
PCB-158	22.0	21.1	<0.61	<13	<42	11.4
PCB-128/166	33.8	27.1	<0.83	20.7	63.2	17.9
PCB-159	1.40	<1.0	<0.71	<4.8	<2.0	5.39
PCB-162	<1.2	<0.98	<0.74	<5.0	<1.0	<1.5
PCB-167	<7.5	<4.2	<0.65	5.41	15.2	<5.2
PCB-156/157	17.0	14.3	<0.90	13.4	37.9	18.0
PCB-169	<1.0	<0.84	<0.79	<4.0	<1.1	<1.5
PCB-188	<1.2	<0.93	<0.54	<2.9	<0.55	<1.3
PCB-179	<9.1	14.2	<0.59	<6.1	25.3	6.41
PCB-184	<0.94	<0.66	<0.53	<1.8	1.70	<0.94
PCB-176	3.93	3.72	<0.60	<2.1	8.24	2.20
PCB-186	<1.1	<0.77	<0.61	<2.1	<0.52	<1.1
PCB-178	<6.6	<4.8	<0.90	<3.2	12.5	3.06
PCB-175	<1.6	<1.1	<0.90	<3.1	3.57	<1.6
PCB-187	38.8	36.2	<0.77	32.7	73.7	22.3
PCB-182	<1.5	<1.1	<0.84	<2.9	<0.71	<1.5
PCB-183	16.9	13.5	<0.84	<8.5	35.0	<11
PCB-185	2.86	<1.6	<0.86	<3.0	5.25	<1.8
PCB-174	29.2	<23	<0.91	<21	50.3	21.7
PCB-177	<13	14.7	<0.96	13.9	28.2	11.4
PCB-181	<1.6	<1.1	<0.90	<3.2	<1.0	<1.6
PCB-171/173	<8.5	9.55	<0.99	10.0	17.0	<4.7
PCB-172	9.11	<2.9	<0.99	<3.6	<8.6	<2.6

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	ENG-583-DFP-02	ENG-168-DFP-01	DFP-BLANK	ENG-159-DFP-1	ENG-583-DFP-01	ENG-558-DFP-01
ALS Sample ID	L2526958-7	L2526958-8	L2526958-9	L2526958-10	L2526958-11	L2526958-12
Sample Size	1	1	1	1	1	1
Sample size units	Sample	Sample	Sample	Sample	Sample	Sample
Percent Moisture	n/a	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Swab	Swab	Swab	Swab	Swab	Swab
Sampling Date	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
PCB-192	<1.4	<0.95	<0.76	<2.7	<0.68	<1.4
PCB-180/193	64.8	53.6	<0.75	<63	115	204
PCB-191	<2.3	<1.4	<0.64	<2.3	<3.3	<1.3
PCB-170	20.5	17.9	<0.75	22.2	50.6	34.0
PCB-190	<3.1	2.96	<0.47	3.92	11.2	5.83
PCB-189	<0.60	<0.69	<0.50	<1.1	<1.9	<1.3
PCB-202	<7.4	9.47	<0.88	7.83	18.5	<1.8
PCB-201	<2.8	2.62	<0.90	<2.5	5.88	<1.1
PCB-204	<0.87	<0.90	<0.90	<2.5	<0.71	<1.1
PCB-197	<0.85	<0.88	<0.88	<2.5	<1.0	<1.0
PCB-200	<1.7	<2.6	<0.92	<2.6	6.09	<1.1
PCB-198/199	14.8	12.9	<0.88	20.2	47.0	16.9
PCB-196	<4.3	<4.0	<0.86	6.35	15.1	6.80
PCB-203	10.1	<7.2	<0.85	9.06	30.5	<8.4
PCB-195	3.17	3.21	<0.71	<3.0	8.84	4.78
PCB-194	14.0	12.2	<1.5	14.2	28.8	17.9
PCB-205	<0.76	<0.84	<0.68	<1.6	<1.6	<1.1
PCB-208	9.77	7.88	<1.6	23.0	21.9	<5.3
PCB-207	<5.0	<2.7	<1.7	<11	8.07	4.40
PCB-206	16.6	<10	4.75	31.9	53.4	<21
PCB-209	141	133	59.5	<5300	89.4	218
Extraction Standards	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**	**% Rec**
13C12-PCB-001	57	74	54	51	67	40
13C12-PCB-003	59	71	53	44	60	62
13C12-PCB-004	65	79	61	54	69	64
13C12-PCB-015	55	64	53	49	64	58
13C12-PCB-019	69	80	64	63	79	65
13C12-PCB-037	62	72	57	54	74	65
13C12-PCB-054	77	89	73	65	84	76
13C12-PCB-081	69	83	67	68	82	68
13C12-PCB-077	67	81	66	66	78	64
13C12-PCB-104	82	100	84	71	95	81
13C12-PCB-123	66	82	66	75	78	66
13C12-PCB-118	66	80	66	73	76	67
13C12-PCB-114	70	85	68	77	80	70
13C12-PCB-105	69	84	69	78	81	68
13C12-PCB-126	65	77	64	75	78	64
13C12-PCB-155	38	40	71	34	76	42
13C12-PCB-167	72	89	76	79	86	75
13C12-PCB-156/157	73	91	77	82	88	76
13C12-PCB-169	78	96	78	93	95	87
13C12-PCB-188	52	55	85	45	89	58
13C12-PCB-189	71	91	74	90	92	77
13C12-PCB-202	49	55	76	53	81	57
13C12-PCB-205	95	125	90	100	111	90
13C12-PCB-208	40	44	74	38	82	41
13C12-PCB-206	80	106	89	91	99	90
13C12-PCB-209	25	29	62	0	70	25
Cleanup Standards						
13C12-PCB-028	67	75	64	66	76	72
13C12-PCB-111	69	82	72	83	84	73
13C12-PCB-178	74	89	83	86	92	80

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	ENG-583-DFP-02	ENG-168-DFP-01	DFP-BLANK	ENG-159-DFP-1	ENG-583-DFP-01	ENG-558-DFP-01
ALS Sample ID	L2526958-7	L2526958-8	L2526958-9	L2526958-10	L2526958-11	L2526958-12
Sample Size	1	1	1	1	1	1
Sample size units	Sample	Sample	Sample	Sample	Sample	Sample
Percent Moisture	n/a	n/a	n/a	n/a	n/a	n/a
Sample Matrix	Swab	Swab	Swab	Swab	Swab	Swab
Sampling Date	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20	4-Nov-20
Extraction Date	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**	**pg**	**pg**	**pg**	**pg**
Homologue Group Totals						
Total MonoCB	12.9	7.20	5.70	<3.1	157	55.6
Total DiCB	1110	178	45.8	958	1050	1410
Total TriCB	144	133	23.1	50.4	454	77.0
Total TetraCB	389	553	13.4	184	1890	155
Total PentaCB	1090	1490	6.05	400	4160	473
Total HexaCB	877	912	4.93	444	1920	409
Total HeptaCB	229	200	<0.47	185	452	331
Total OctaCB	58.3	54.2	1.50	60.6	163	56.6
Total NonaCB	31.4	20.6	4.75	65.9	83.4	30.7
DecaCB	141	133	59.5	<5300	89.4	218
Total PCB	4080	3680	165	2350	10400	3220
Toxic Equivalency - (WHO 2005)						
Lower Bound PCB TEQ	0.00896	0.00862	0.00	0.00325	0.0278	0.00152
Mid Point PCB TEQ	0.160	0.153	0.0972	0.826	0.975	0.317
Upper Bound PCB TEQ	0.310	0.295	0.194	0.886	0.992	0.630

ALS Life Sciences

Quality Control Summary Report

Sample Name	**Method Blank**	**Method Blank**
ALS Sample ID	WG3440853-1	WG3440853-4
Sample Size	1	1
Sample size units	Blank	Blank
Percent Moisture	n/a	n/a
Sample Matrix	Swab	Reagent
Sampling Date	n/a	n/a
Extraction Date	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**
PCB-001	2.60	<1.1
PCB-002	<3.4	<2.0
PCB-003	<4.6	<2.5
PCB-004	<4.3	<2.5
PCB-010	<2.8	<1.7
PCB-009	<2.8	<1.7
PCB-007	<2.8	<1.7
PCB-006	<2.9	<1.7
PCB-005	<3.3	<1.9
PCB-008	5.96	<3.5
PCB-014	<2.2	<1.8
PCB-011	<27	22.7
PCB-012/013	<2.2	<1.9
PCB-015	<2.6	<2.3
PCB-019	<1.3	<0.92
PCB-018/030	3.27	<0.94
PCB-017	<2.0	<1.1
PCB-027	<1.2	<0.82
PCB-024	<1.2	<0.82
PCB-016	<1.9	<1.3
PCB-032	<1.2	<0.77
PCB-034	<1.7	<1.0
PCB-023	<1.6	<0.94
PCB-026/029	<1.6	<0.94
PCB-025	<1.4	<0.85
PCB-031	5.93	3.65
PCB-020/028	<1.6	<0.93
PCB-021/033	<3.3	<1.9
PCB-022	<1.7	2.34
PCB-036	<1.6	<0.94
PCB-039	<1.6	<0.96
PCB-038	<1.8	<1.0
PCB-035	<1.8	<1.1
PCB-037	<2.5	1.81
PCB-054	<0.66	<0.39
PCB-050/053	<1.2	<0.78
PCB-045/051	1.48	<0.81
PCB-046	<1.4	<0.94
PCB-052	2.96	3.01
PCB-073	<0.93	<0.62
PCB-043	<1.6	<1.1
PCB-049/069	<1.3	<1.3
PCB-048	<1.3	<0.84
PCB-044/047/065	5.13	<4.4
PCB-059/062/075	<0.97	<0.64
PCB-042	<1.5	<0.97
PCB-040/041/071	1.36	<0.89
PCB-064	<1.0	1.16
PCB-072	<1.4	<0.69
PCB-068	<1.3	<0.65
PCB-057	<1.5	<0.73
PCB-058	<1.4	<0.67
PCB-067	<1.3	<0.61
PCB-063	<1.4	<0.68
PCB-061/070/074/076	<2.8	<3.4
PCB-066	<1.4	<0.80
PCB-055	<1.5	<0.75
PCB-056	1.89	<0.78
PCB-060	<1.5	<0.74
PCB-080	<1.3	<0.65
PCB-079	<1.4	<0.68
PCB-078	<1.7	<0.81
PCB-081	<1.9	<0.89
PCB-077	<2.1	<0.94
PCB-104	<0.94	<0.75
PCB-096	<1.0	<0.70
PCB-103	<1.7	<0.96
PCB-094	<1.9	<1.1
PCB-095	<1.8	<1.0
PCB-093/098/100/102	<1.8	<1.1

ALS Life Sciences

Quality Control Summary Report

Sample Name	**Method Blank**	**Method Blank**
ALS Sample ID	WG3440853-1	WG3440853-4
Sample Size	1	1
Sample size units	Blank	Blank
Percent Moisture	n/a	n/a
Sample Matrix	Swab	Reagent
Sampling Date	n/a	n/a
Extraction Date	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**
PCB-088/091	<1.9	<1.1
PCB-084	<2.1	<1.2
PCB-089	<2.1	<1.2
PCB-121	<1.4	<0.81
PCB-092	<2.1	<1.2
PCB-090/101/113	3.82	1.94
PCB-083/099	<2.1	<1.2
PCB-112	<1.5	<0.85
PCB-086/087/097/109/119/125	<1.8	<1.0
PCB-085/110/115/116/117	<1.7	2.93
PCB-082	<2.7	<1.6
PCB-111	<1.5	<0.87
PCB-120	<1.5	<0.87
PCB-108/124	<1.7	<1.1
PCB-107	<1.5	<1.0
PCB-123	<2.0	<1.2
PCB-106	<1.8	<1.2
PCB-118	<1.8	<1.2
PCB-122	<1.9	<1.3
PCB-114	<1.9	<1.2
PCB-105	<1.9	<1.3
PCB-127	<1.9	<1.3
PCB-126	<2.4	<1.5
PCB-155	<1.2	<0.67
PCB-152	<0.76	<0.49
PCB-150	<0.73	<0.47
PCB-136	<0.79	<0.51
PCB-145	<0.80	<0.51
PCB-148	<1.1	<0.72
PCB-135/151	<1.2	<0.77
PCB-154	<0.93	<0.60
PCB-144	<1.2	<0.78
PCB-147/149	4.64	<1.4
PCB-134/143	<1.5	<1.4
PCB-139/140	<1.2	<1.2
PCB-131	<1.6	<1.5
PCB-142	<1.5	<1.4
PCB-132	<1.5	<1.4
PCB-133	<1.4	<1.4
PCB-165	<1.1	<1.0
PCB-146	<1.3	<1.2
PCB-161	<1.1	<1.0
PCB-153/168	4.17	1.81
PCB-141	<1.5	<1.4
PCB-130	<1.7	<1.7
PCB-137/164	<1.3	<1.2
PCB-129/138/163	2.90	<2.6
PCB-160	<1.2	<1.1
PCB-158	<0.95	<0.90
PCB-128/166	<1.3	<1.2
PCB-159	<1.1	<1.1
PCB-162	<1.2	<1.1
PCB-167	<0.88	<0.88
PCB-156/157	1.57	<1.2
PCB-169	<1.1	<0.99
PCB-188	<1.5	<0.69
PCB-179	<1.2	<0.63
PCB-184	<1.1	<0.57
PCB-176	<1.2	<0.64
PCB-186	<1.2	<0.66
PCB-178	<1.8	<0.97
PCB-175	<1.8	<0.97
PCB-187	2.24	<0.82
PCB-182	<1.7	<0.90
PCB-183	<1.7	<0.91
PCB-185	<1.7	<0.93
PCB-174	<1.8	<0.98
PCB-177	<1.9	<1.0
PCB-181	<1.8	<0.97
PCB-171/173	<2.0	<1.1
PCB-172	<2.0	<1.1

ALS Life Sciences

Quality Control Summary Report

Sample Name	Method Blank	Method Blank
ALS Sample ID	WG3440853-1	WG3440853-4
Sample Size	1	1
Sample size units	Blank	Blank
Percent Moisture	n/a	n/a
Sample Matrix	Swab	Reagent
Sampling Date	n/a	n/a
Extraction Date	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**
PCB-192	<1.5	<0.82
PCB-180/193	<1.5	<0.81
PCB-191	<1.3	<0.69
PCB-170	<1.5	<0.80
PCB-190	<0.94	<0.50
PCB-189	<0.67	<0.48
PCB-202	<1.9	<0.89
PCB-201	<1.7	<0.83
PCB-204	<1.6	<0.82
PCB-197	<1.6	<0.81
PCB-200	<1.7	<0.84
PCB-198/199	<1.6	<0.80
PCB-196	<1.6	<0.79
PCB-203	<1.6	<0.78
PCB-195	<1.7	<0.76
PCB-194	<2.1	<0.80
PCB-205	<1.4	<0.67
PCB-208	<3.7	<2.6
PCB-207	<3.0	<2.3
PCB-206	<3.3	<2.7
PCB-209	270	112
Extraction Standards	**% Rec**	**% Rec**
13C12-PCB-001	64	55
13C12-PCB-003	56	54
13C12-PCB-004	63	62
13C12-PCB-015	56	54
13C12-PCB-019	63	59
13C12-PCB-037	58	59
13C12-PCB-054	78	72
13C12-PCB-081	70	69
13C12-PCB-077	67	69
13C12-PCB-104	91	81
13C12-PCB-123	67	67
13C12-PCB-118	68	68
13C12-PCB-114	70	70
13C12-PCB-105	70	71
13C12-PCB-126	66	66
13C12-PCB-155	33	41
13C12-PCB-167	77	76
13C12-PCB-156/157	77	78
13C12-PCB-169	78	81
13C12-PCB-188	47	59
13C12-PCB-189	76	77
13C12-PCB-202	52	62
13C12-PCB-205	89	91
13C12-PCB-208	39	49
13C12-PCB-206	84	88
13C12-PCB-209	20	29
Cleanup Standards		
13C12-PCB-028	70	69
13C12-PCB-111	71	71
13C12-PCB-178	78	80

ALS Life Sciences

Quality Control Summary Report

Sample Name	**Method Blank**	**Method Blank**
ALS Sample ID	WG3440853-1	WG3440853-4
Sample Size	1	1
Sample size units	Blank	Blank
Percent Moisture	n/a	n/a
Sample Matrix	Swab	Reagent
Sampling Date	n/a	n/a
Extraction Date	25-Nov-20	25-Nov-20
Target Analytes	**pg**	**pg**
Homologue Group Totals		
Total MonoCB	10.6	5.60
Total DiCB	33.0	26.2
Total TriCB	15.7	9.70
Total TetraCB	17.9	14.9
Total PentaCB	3.82	4.87
Total HexaCB	13.3	5.81
Total HeptaCB	2.24	<0.48
Total OctaCB	2.10	<0.67
Total NonaCB	<3.0	<2.3
DecaCB	270	112
Total PCB	369	179
Toxic Equivalency - (WHO 2005)		
Lower Bound PCB TEQ	0.0000471	0.00
Mid Point PCB TEQ	0.257	0.0901
Upper Bound PCB TEQ	0.274	0.180

ALS Life Sciences

Sample Analysis Summary Report

Sample Name	Laboratory Control Sample
ALS Sample ID	WG3440853-2
Sample Size	1
Sample size units	n/a
Percent Moisture	n/a
Sample Matrix	QC
Sampling Date	n/a
Extraction Date	25-Nov-20

Target Analytes	**% Rec**
PCB-001	109
PCB-003	108
PCB-004	100
PCB-015	131
PCB-019	93
PCB-037	132
PCB-054	95
PCB-081	109
PCB-077	108
PCB-104	88
PCB-123	119
PCB-118	118
PCB-114	118
PCB-105	113
PCB-126	115
PCB-155	94
PCB-167	103
PCB-156/157	100
PCB-169	102
PCB-188	97
PCB-189	119
PCB-202	96
PCB-205	101
PCB-208	91
PCB-206	92
PCB-209	131
Extraction Standards	**% Rec**
13C12-PCB-001	58
13C12-PCB-003	54
13C12-PCB-004	60
13C12-PCB-015	54
13C12-PCB-019	87
13C12-PCB-037	68
13C12-PCB-054	84
13C12-PCB-081	65
13C12-PCB-077	63
13C12-PCB-104	67
13C12-PCB-123	63
13C12-PCB-118	58
13C12-PCB-114	60
13C12-PCB-105	61
13C12-PCB-126	75
13C12-PCB-155	50
13C12-PCB-167	86
13C12-PCB-156/157	98
13C12-PCB-169	92
13C12-PCB-188	59
13C12-PCB-189	102
13C12-PCB-202	97
13C12-PCB-205	75
13C12-PCB-208	54
13C12-PCB-206	77
13C12-PCB-209	30
Cleanup Standards	
13C12-PCB-028	71
13C12-PCB-111	60
13C12-PCB-178	71

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-1**	Sampling Date	3-Nov-20
ALS Sample ID	L2526958-1	Extraction Date	25-Nov-20
Analysis Method	EPA 1668C	Sample Size	1 Sample
Analysis Type	Sample	Percent Moisture	n/a
Sample Matrix	Swab	Split Ratio	2

Approved:
E. Sabljic
--e-signature--
01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B25
Run Date	01-Dec-20 03:06
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	TEF (WHO 2005)	Ret. Time	Conc. pg	EDL pg	Flags	EMPC pg	LQL
PCB-001		9.05	<5.0	2.8	M,J,R	5.0	50
PCB-002		10.48	6.47	0.94	J		50
PCB-003		10.59	<7.9	0.51	M,J,R	7.9	50
PCB-004		10.73	7.30	1.6	J		50
PCB-010		NotFnd	<0.99	0.99	U		50
PCB-009		NotFnd	<0.99	0.99	U		50
PCB-007		12.06	7.12	0.97	J		50
PCB-006		12.23	<8.3	1.0	J,R	8.3	50
PCB-005		12.43	<1.6	1.1	M,J,R	1.6	50
PCB-008		NotFnd	<0.92	0.92	U		50
PCB-014		NotFnd	<1.0	1.0	U		50
PCB-011		13.97	329	1.0			50
PCB-012/013		14.17	22.7	1.0	J		50
PCB-015		14.35	24.5	1.1	J		50
PCB-019		12.69	<1.3	0.61	J,R	1.3	50
PCB-018/030		13.77	16.3	0.60	J,B		50
PCB-017		14.01	8.11	0.70	J		50
PCB-027		14.15	<0.62	0.52	J,R	0.62	50
PCB-024		NotFnd	<0.52	0.52	U		50
PCB-016		14.31	7.90	0.84	M,J		50
PCB-032		14.58	4.43	0.49	J		50
PCB-034		NotFnd	<0.65	0.65	U		50
PCB-023		NotFnd	<0.61	0.61	U		50
PCB-026/029		15.55	<5.3	0.61	J,R	5.3	50
PCB-025		15.68	<2.5	0.55	J,R	2.5	50
PCB-031		15.86	28.7	0.57	J,B		50
PCB-020/028		16.03	34.2	0.61	J		50
PCB-021/033		16.16	20.9	0.60	J		50
PCB-022		16.41	12.8	0.64	J		50
PCB-036		NotFnd	<0.61	0.61	U		50
PCB-039		NotFnd	<0.62	0.62	U		50
PCB-038		NotFnd	<0.67	0.67	U		50
PCB-035		18.04	11.1	0.70	J		50
PCB-037		18.27	22.9	0.86	J		50
PCB-054		NotFnd	<0.26	0.26	U		50
PCB-050/053		15.69	2.81	0.38	J		50
PCB-045/051		16.11	5.23	0.40	J,B		50
PCB-046		16.28	<0.92	0.46	J,R	0.92	50
PCB-052		17.01	36.5	0.41	J		50
PCB-073		NotFnd	<0.30	0.30	U		50
PCB-043		17.15	<1.0	0.52	J,R	1.0	50
PCB-049/069		17.28	14.6	0.37	J		50
PCB-048		17.44	<4.9	0.41	J,R	4.9	50
PCB-044/047/065		17.57	40.8	0.38	J,B		50
PCB-059/062/075		17.75	<2.2	0.31	J,R	2.2	50
PCB-042		17.87	<6.4	0.47	J,R	6.4	50
PCB-040/041/071		18.13	16.5	0.44	J		50
PCB-064		18.25	13.2	0.32	J		50
PCB-072		NotFnd	<0.57	0.57	U		50
PCB-068		18.81	4.12	0.53	J		50
PCB-057		NotFnd	<0.61	0.61	U		50
PCB-058		NotFnd	<0.55	0.55	U		50
PCB-067		NotFnd	<0.51	0.51	U		50
PCB-063		NotFnd	<0.56	0.56	U		50
PCB-061/070/074/076		19.60	82.0	0.58	M		50
PCB-066		19.78	38.4	0.57	M,J		50
PCB-055		NotFnd	<0.62	0.62	U		50
PCB-056		20.16	26.2	0.63	J		50
PCB-060		20.28	12.6	0.61	J		50
PCB-080		NotFnd	<0.53	0.53	U		50
PCB-079		21.24	<0.73	0.57	J,R	0.73	50
PCB-078		NotFnd	<0.67	0.67	U		50
PCB-081	0.0003	NotFnd	<0.70	0.70	U		50
PCB-077	0.0001	22.13	11.3	0.76	J		50
PCB-104		NotFnd	<0.38	0.38	U		50
PCB-096		NotFnd	<0.36	0.36	U		50
PCB-103		NotFnd	<0.72	0.72	U		50
PCB-094		NotFnd	<0.84	0.84	U		50
PCB-095		19.13	45.3	0.76	J		50
PCB-093/098/100/102		19.31	<2.2	0.79	M,J,R	2.2	50

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-1**	Sampling Date	3-Nov-20			
ALS Sample ID	L2526958-1	Extraction Date	25-Nov-20			Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample		*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a			--e-signature--
Sample Matrix	Swab	Split Ratio	2			01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B25
Run Date	01-Dec-20 03:06
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	TEF (WHO 2005)	Ret. Time	Conc. pg	EDL pg	Flags	EMPC pg	LQL
PCB-088/091		19.59	8.67	0.81	J		50
PCB-084		19.74	20.7	0.92	J		50
PCB-089		19.99	<1.2	0.92	J,R	1.2	50
PCB-121		NotFnd	<0.61	0.61	U		50
PCB-092		20.34	13.8	0.90	J		50
PCB-090/101/113		20.64	80.4	0.73			50
PCB-083/099		20.96	46.5	0.89	J		50
PCB-112		NotFnd	<0.64	0.64	U		50
PCB-086/087/097/109/119/125		21.31	77.1	0.76	M		50
PCB-085/110/115/116/117		21.72	160	0.72	M		50
PCB-082		21.92	<15	1.2	J,R	15	50
PCB-111		NotFnd	<0.66	0.66	U		50
PCB-120		NotFnd	<0.65	0.65	U		50
PCB-108/124		22.90	5.09	1.2	J		50
PCB-107		23.03	<6.6	1.0	M,J,R	6.6	50
PCB-123	0.00003	23.09	<1.7	1.3	M,J,R	1.7	50
PCB-106		NotFnd	<1.2	1.2	U		50
PCB-118	0.00003	23.26	118	1.2			50
PCB-122		23.47	2.44	1.3	J		50
PCB-114	0.00003	23.56	3.39	1.2	J		50
PCB-105	0.00003	23.91	54.3	1.3			50
PCB-127		24.64	<1.3	1.3	U	0.36	50
PCB-126	0.1	25.51	<1.7	1.7	M,U	1.4	50
PCB-155		20.50	<0.45	0.32	J,R	0.45	50
PCB-152		NotFnd	<0.41	0.41	U		50
PCB-150		NotFnd	<0.40	0.40	U		50
PCB-136		20.97	8.67	0.43	J		50
PCB-145		NotFnd	<0.43	0.43	U		50
PCB-148		NotFnd	<0.61	0.61	U		50
PCB-135/151		22.20	25.9	0.64	M,J		50
PCB-154		22.28	<0.50	0.50	M,U	0.42	50
PCB-144		22.46	4.66	0.66	J		50
PCB-147/149		22.66	74.5	1.1			50
PCB-134/143		22.79	<5.7	1.3	J,R	5.7	50
PCB-139/140		22.96	<2.4	1.1	J,R	2.4	50
PCB-131		23.10	<1.6	1.4	J,R	1.6	50
PCB-142		NotFnd	<1.3	1.3	U		50
PCB-132		23.35	43.6	1.3	J		50
PCB-133		23.54	<1.4	1.3	J,R	1.4	50
PCB-165		NotFnd	<0.98	0.98	U		50
PCB-146		23.87	14.2	1.1	J		50
PCB-161		NotFnd	<0.94	0.94	U		50
PCB-153/168		24.18	85.3	0.98			50
PCB-141		24.31	26.8	1.3	J		50
PCB-130		24.54	<7.3	1.5	J,R	7.3	50
PCB-137/164		24.71	<14	1.1	M,J,R	14	50
PCB-129/138/163		24.87	148	1.3			50
PCB-160		NotFnd	<1.0	1.0	U		50
PCB-158		25.07	15.2	0.84	J		50
PCB-128/166		25.57	<20	1.2	J,R	20	50
PCB-159		25.99	<0.99	0.99	U	0.43	50
PCB-162		26.14	<1.0	1.0	U		50
PCB-167	0.00003	26.39	<5.3	0.94	J,R	5.3	50
PCB-156/157	0.00003	27.02	<15	1.3	J,R	15	100
PCB-169	0.03	28.67	<1.1	1.1	U	0.57	50
PCB-188		NotFnd	<0.49	0.49	U		50
PCB-179		23.71	6.30	0.57	J		50
PCB-184		23.94	<0.55	0.51	J,R	0.55	50
PCB-176		24.16	<1.4	0.58	J,R	1.4	50
PCB-186		NotFnd	<0.60	0.60	U		50
PCB-178		25.06	<4.1	0.88	J,R	4.1	50
PCB-175		25.42	<0.87	0.87	U	0.70	50
PCB-187		25.53	20.3	0.74	J,B		50
PCB-182		NotFnd	<0.81	0.81	U		50
PCB-183		25.85	12.0	0.82	J		50
PCB-185		25.92	<1.7	0.84	M,J,R	1.7	50
PCB-174		26.00	20.8	0.89	M,J		50
PCB-177		26.23	10.2	0.94	J		50
PCB-181		26.42	<0.88	0.88	U		50
PCB-171/173		26.57	6.74	0.96	J		50
PCB-172		27.33	3.89	0.96	J		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-1**	Sampling Date	3-Nov-20			
ALS Sample ID	L2526958-1	Extraction Date	25-Nov-20			Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample		*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a			--e-signature--
Sample Matrix	Swab	Split Ratio	2			01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B25
Run Date	01-Dec-20 03:06
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<0.74	0.74	U		50
PCB-180/193		27.68	44.6	0.73	J		50
PCB-191		27.87	<1.4	0.63	J,R	1.4	50
PCB-170		28.37	17.4	0.73	J		50
PCB-190		28.65	<3.4	0.46	J,R	3.4	50
PCB-189	0.00003	29.96	1.46	0.72	J		50
PCB-202		26.27	<2.4	0.51	J,R	2.4	50
PCB-201		26.74	2.03	0.49	J		50
PCB-204		NotFnd	<0.49	0.49	U		50
PCB-197		27.20	<0.54	0.48	J,R	0.54	50
PCB-200		NotFnd	<0.50	0.50	U		50
PCB-198/199		28.69	6.94	0.48	J		50
PCB-196		29.01	<3.5	0.47	J,R	3.5	50
PCB-203		29.12	5.42	0.46	J		50
PCB-195		29.85	<3.0	0.71	J,R	3.0	50
PCB-194		31.06	10.4	0.75	J		50
PCB-205		31.35	<0.92	0.65	J,R	0.92	50
PCB-208		29.68	<2.5	1.1	J,R	2.5	50
PCB-207		30.15	<1.8	1.2	J,R	1.8	50
PCB-206		32.40	9.73	1.8	J		50
PCB-209		33.53	38.8	1.6	J,B		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	9.01	54	5-145
13C12-PCB-003	2000	10.58	61	5-145
13C12-PCB-004	2000	10.72	67	5-145
13C12-PCB-015	2000	14.34	59	5-145
13C12-PCB-019	2000	12.67	69	5-145
13C12-PCB-037	2000	18.26	65	5-145
13C12-PCB-054	2000	14.50	81	5-145
13C12-PCB-081	2000	21.81	71	10-145
13C12-PCB-077	2000	22.11	69	10-145
13C12-PCB-104	2000	17.51	88	10-145
13C12-PCB-123	2000	23.08	67	10-145
13C12-PCB-118	2000	23.25	65	10-145
13C12-PCB-114	2000	23.55	70	10-145
13C12-PCB-105	2000	23.90	69	10-145
13C12-PCB-126	2000	25.51	63	10-145
13C12-PCB-155	2000	20.48	78	10-145
13C12-PCB-167	2000	26.38	75	10-145
13C12-PCB-156/157	4000	27.02	77	10-145
13C12-PCB-169	2000	28.67	77	10-145
13C12-PCB-188	2000	23.48	93	10-145
13C12-PCB-189	2000	29.95	74	10-145
13C12-PCB-202	2000	26.25	76	10-145
13C12-PCB-205	2000	31.33	104	10-145
13C12-PCB-208	2000	29.67	82	10-145
13C12-PCB-206	2000	32.39	92	10-145
13C12-PCB-209	2000	33.50	88	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.01	70	5-145
13C12-PCB-111	2000	22.01	72	10-145
13C12-PCB-178	2000	25.05	90	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-1**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-1	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B25
Run Date	01-Dec-20 03:06
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			19.4	0.51	J		200
Total DiCB			401	0.92	J		400
Total TriCB			177	0.49	J		400
Total TetraCB			320	0.26	J		800
Total PentaCB			662	0.36	J		800
Total HexaCB			520	0.32	J		800
Total HeptaCB			156	0.46	J		400
Total OctaCB			35.2	0.46	J		400
Total NonaCB			14.0	1.1	J		200
DecaCB			38.8	1.6	J		200
Total PCB			2340		J		1600
Toxic Equivalency - (WHO 2005)							
Lower Bound PCB TEQ			0.00644				
Mid Point PCB TEQ			0.109				
Upper Bound PCB TEQ			0.210				

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-2**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-2	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B26
Run Date	01-Dec-20 03:48
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		8.95	<3.2	0.65	M,J,R	3.2	50
PCB-002		10.37	7.71	0.71	J		50
PCB-003		10.49	8.07	0.71	J		50
PCB-004		10.65	7.11	2.6	M,J		50
PCB-010		NotFnd	<1.6	1.6	U		50
PCB-009		NotFnd	<1.6	1.6	U		50
PCB-007		12.01	17.3	1.6	J		50
PCB-006		12.16	10.1	1.7	J		50
PCB-005		NotFnd	<1.9	1.9	U		50
PCB-008		12.44	18.9	1.5	M,J,B		50
PCB-014		NotFnd	<1.5	1.5	U		50
PCB-011		13.95	445	1.5			50
PCB-012/013		14.14	20.1	1.5	J		50
PCB-015		14.32	<9.4	1.7	J,R	9.4	50
PCB-019		12.64	2.93	1.2	J		50
PCB-018/030		13.73	17.4	1.3	J,B		50
PCB-017		13.98	7.31	1.5	J		50
PCB-027		14.11	<1.1	1.1	U	0.92	50
PCB-024		14.21	<1.1	1.1	U	0.40	50
PCB-016		14.28	<8.0	1.8	J,R	8.0	50
PCB-032		14.55	<4.4	1.0	J,R	4.4	50
PCB-034		NotFnd	<1.1	1.1	U		50
PCB-023		NotFnd	<1.0	1.0	U		50
PCB-026/029		15.53	4.79	1.0	J		50
PCB-025		15.67	1.94	0.93	J		50
PCB-031		15.85	<19	0.96	M,J,R	19	50
PCB-020/028		16.02	23.3	1.0	M,J		50
PCB-021/033		16.16	<14	1.0	M,J,R	14	50
PCB-022		16.40	9.68	1.1	J		50
PCB-036		NotFnd	<1.0	1.0	U		50
PCB-039		NotFnd	<1.0	1.0	U		50
PCB-038		NotFnd	<1.1	1.1	U		50
PCB-035		18.02	9.12	1.2	J		50
PCB-037		18.28	<7.8	1.5	J,R	7.8	50
PCB-054		NotFnd	<0.35	0.35	U		50
PCB-050/053		15.69	3.52	0.93	J		50
PCB-045/051		16.10	15.7	0.98	J		50
PCB-046		16.27	<1.1	1.1	U	1.0	50
PCB-052		17.00	32.3	1.0	J		50
PCB-073		NotFnd	<0.74	0.74	U		50
PCB-043		NotFnd	<1.3	1.3	U		50
PCB-049/069		17.26	11.8	0.90	J		50
PCB-048		17.43	4.58	1.0	J		50
PCB-044/047/065		17.57	58.7	0.94			50
PCB-059/062/075		17.74	<1.8	0.77	J,R	1.8	50
PCB-042		17.85	5.84	1.2	J		50
PCB-040/041/071		18.12	11.8	1.1	M,J,B		50
PCB-064		18.25	9.10	0.78	J		50
PCB-072		NotFnd	<0.94	0.94	U		50
PCB-068		18.81	10.6	0.88	J		50
PCB-057		NotFnd	<1.0	1.0	U		50
PCB-058		NotFnd	<0.91	0.91	U		50
PCB-067		NotFnd	<0.84	0.84	U		50
PCB-063		NotFnd	<0.93	0.93	U		50
PCB-061/070/074/076		19.60	33.4	0.95	J		50
PCB-066		19.78	12.7	0.94	J		50
PCB-055		NotFnd	<1.0	1.0	U		50
PCB-056		20.16	12.3	1.0	J,B		50
PCB-060		20.29	3.75	1.0	J		50
PCB-080		NotFnd	<0.88	0.88	U		50
PCB-079		NotFnd	<0.93	0.93	U		50
PCB-078		NotFnd	<1.1	1.1	U		50
PCB-081	0.0003	NotFnd	<1.3	1.3	U		50
PCB-077	0.0001	22.16	6.85	1.4	M,J		50
PCB-104		NotFnd	<0.85	0.85	U		50
PCB-096		NotFnd	<0.95	0.95	U		50
PCB-103		NotFnd	<1.6	1.6	U		50
PCB-094		NotFnd	<1.9	1.9	U		50
PCB-095		19.13	25.8	1.7	J		50
PCB-093/098/100/102		NotFnd	<1.8	1.8	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-2**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-2	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B26
Run Date	01-Dec-20 03:48
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-088/091		19.60	4.45	1.8	J		50
PCB-084		19.74	9.96	2.1	J		50
PCB-089		NotFnd	<2.1	2.1	U		50
PCB-121		NotFnd	<1.4	1.4	U		50
PCB-092		20.35	8.60	2.0	J		50
PCB-090/101/113		20.65	38.2	1.6	J,B		50
PCB-083/099		20.96	<16	2.0	J,R	16	50
PCB-112		NotFnd	<1.4	1.4	U		50
PCB-086/087/097/109/119/125		21.31	29.6	1.7	M,J		50
PCB-085/110/115/116/117		21.73	61.2	1.6	M		50
PCB-082		21.92	<6.5	2.6	J,R	6.5	50
PCB-111		NotFnd	<1.5	1.5	U		50
PCB-120		NotFnd	<1.5	1.5	U		50
PCB-108/124		NotFnd	<2.0	2.0	U		50
PCB-107		NotFnd	<1.8	1.8	U		50
PCB-123	0.00003	NotFnd	<2.4	2.4	U		50
PCB-106		NotFnd	<2.1	2.1	U		50
PCB-118	0.00003	23.26	46.9	2.3	J		50
PCB-122		NotFnd	<2.3	2.3	U		50
PCB-114	0.00003	NotFnd	<2.2	2.2	U		50
PCB-105	0.00003	23.93	<17	2.5	J,R	17	50
PCB-127		NotFnd	<2.2	2.2	U		50
PCB-126	0.1	NotFnd	<3.1	3.1	U		50
PCB-155		NotFnd	<1.1	1.1	U		50
PCB-152		NotFnd	<0.87	0.87	U		50
PCB-150		NotFnd	<0.84	0.84	U		50
PCB-136		20.97	7.54	0.91	J		50
PCB-145		NotFnd	<0.91	0.91	U		50
PCB-148		NotFnd	<1.3	1.3	U		50
PCB-135/151		22.18	16.6	1.4	M,J		50
PCB-154		22.28	<1.1	1.1	U	0.83	50
PCB-144		22.46	2.72	1.4	J		50
PCB-147/149		22.66	45.3	1.6	J,B		50
PCB-134/143		NotFnd	<2.0	2.0	U		50
PCB-139/140		NotFnd	<1.6	1.6	U		50
PCB-131		NotFnd	<2.0	2.0	U		50
PCB-142		NotFnd	<2.0	2.0	U		50
PCB-132		23.37	25.3	1.9	J		50
PCB-133		NotFnd	<1.9	1.9	U		50
PCB-165		NotFnd	<1.4	1.4	U		50
PCB-146		23.88	<7.7	1.6	J,R	7.7	50
PCB-161		NotFnd	<1.4	1.4	U		50
PCB-153/168		24.19	50.3	1.4			50
PCB-141		24.32	12.4	1.9	J		50
PCB-130		24.54	<4.3	2.3	M,J,R	4.3	50
PCB-137/164		24.72	10.3	1.6	M,J		50
PCB-129/138/163		24.88	75.7	1.9			50
PCB-160		NotFnd	<1.5	1.5	U		50
PCB-158		25.07	9.90	1.2	J		50
PCB-128/166		25.58	11.9	1.7	J		50
PCB-159		26.02	<1.4	1.4	U	1.2	50
PCB-162		NotFnd	<1.5	1.5	U		50
PCB-167	0.00003	26.39	3.00	1.2	J		50
PCB-156/157	0.00003	27.02	<3.5	1.7	J,R	3.5	100
PCB-169	0.03	NotFnd	<1.4	1.4	U		50
PCB-188		NotFnd	<1.1	1.1	U		50
PCB-179		23.72	5.49	0.96	J		50
PCB-184		NotFnd	<0.86	0.86	U		50
PCB-176		24.17	2.12	0.97	J		50
PCB-186		NotFnd	<1.0	1.0	U		50
PCB-178		25.06	<4.7	1.5	J,R	4.7	50
PCB-175		NotFnd	<1.5	1.5	U		50
PCB-187		25.53	18.8	1.2	J,B		50
PCB-182		NotFnd	<1.4	1.4	U		50
PCB-183		25.86	12.8	1.4	M,J		50
PCB-185		NotFnd	<1.4	1.4	U		50
PCB-174		26.02	19.2	1.5	M,J		50
PCB-177		26.25	<6.3	1.6	J,R	6.3	50
PCB-181		NotFnd	<1.5	1.5	U		50
PCB-171/173		26.57	6.42	1.6	J		50
PCB-172		27.36	<3.1	1.6	J,R	3.1	50

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-2**	Sampling Date	3-Nov-20		
ALS Sample ID	L2526958-2	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B26
Run Date	01-Dec-20 03:48
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<1.2	1.2	U		50
PCB-180/193		27.68	51.0	1.2			50
PCB-191		NotFnd	<1.0	1.0	U		50
PCB-170		28.38	<14	1.2	J,R	14	50
PCB-190		28.64	<2.8	0.76	J,R	2.8	50
PCB-189	0.00003	NotFnd	<0.88	0.88	U		50
PCB-202		26.25	2.17	1.3	J		50
PCB-201		NotFnd	<0.98	0.98	U		50
PCB-204		NotFnd	<0.97	0.97	U		50
PCB-197		NotFnd	<0.95	0.95	U		50
PCB-200		NotFnd	<0.99	0.99	U		50
PCB-198/199		28.70	7.94	0.95	J		50
PCB-196		29.04	3.34	0.93	J		50
PCB-203		29.13	<3.2	0.92	J,R	3.2	50
PCB-195		29.85	<2.6	1.2	J,R	2.6	50
PCB-194		31.06	<6.5	1.2	J,R	6.5	50
PCB-205		NotFnd	<0.86	0.86	U		50
PCB-208		29.71	<5.1	3.3	J,R	5.1	50
PCB-207		30.17	<2.6	2.6	M,U	2.3	50
PCB-206		32.41	11.5	2.9	M,J		50
PCB-209		33.54	222	12	B		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.94	66	5-145
13C12-PCB-003	2000	10.49	61	5-145
13C12-PCB-004	2000	10.63	73	5-145
13C12-PCB-015	2000	14.32	62	5-145
13C12-PCB-019	2000	12.62	70	5-145
13C12-PCB-037	2000	18.26	71	5-145
13C12-PCB-054	2000	14.47	90	5-145
13C12-PCB-081	2000	21.82	74	10-145
13C12-PCB-077	2000	22.13	70	10-145
13C12-PCB-104	2000	17.51	106	10-145
13C12-PCB-123	2000	23.09	70	10-145
13C12-PCB-118	2000	23.26	67	10-145
13C12-PCB-114	2000	23.56	72	10-145
13C12-PCB-105	2000	23.91	68	10-145
13C12-PCB-126	2000	25.51	62	10-145
13C12-PCB-155	2000	20.49	43	10-145
13C12-PCB-167	2000	26.39	84	10-145
13C12-PCB-156/157	4000	27.02	85	10-145
13C12-PCB-169	2000	28.69	85	10-145
13C12-PCB-188	2000	23.49	63	10-145
13C12-PCB-189	2000	29.95	90	10-145
13C12-PCB-202	2000	26.26	60	10-145
13C12-PCB-205	2000	31.33	138	10-145
13C12-PCB-208	2000	29.68	47	10-145
13C12-PCB-206	2000	32.39	96	10-145
13C12-PCB-209	2000	33.51	29	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.00	82	5-145
13C12-PCB-111	2000	22.02	77	10-145
13C12-PCB-178	2000	25.06	113	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-2**	Sampling Date	3-Nov-20		
ALS Sample ID	L2526958-2	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B26
Run Date	01-Dec-20 03:48
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			19.0	0.65	J		200
Total DiCB			528	1.5	J		400
Total TriCB			130	0.93	J		400
Total TetraCB			235	0.35	J		800
Total PentaCB			264	0.85	J		800
Total HexaCB			286	0.84	J		800
Total HeptaCB			147	0.76	J		400
Total OctaCB			25.8	0.86	J		400
Total NonaCB			16.6	2.6	J		200
DecaCB			222	12	J		200
Total PCB			1870		J		1600
Toxic Equivalency - (WHO 2005)							
Lower Bound PCB TEQ			0.00218				
Mid Point PCB TEQ			0.179				
Upper Bound PCB TEQ			0.355				

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-3-BLANK**	Sampling Date	3-Nov-20		
ALS Sample ID	L2526958-3	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B23
Run Date	01-Dec-20 01:42
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		8.94	2.28	0.50	M,J,B		50
PCB-002		10.37	3.29	0.60	J		50
PCB-003		10.49	4.51	0.66	J		50
PCB-004		NotFnd	<3.4	3.4	U		50
PCB-010		NotFnd	<2.3	2.3	U		50
PCB-009		NotFnd	<2.3	2.3	U		50
PCB-007		NotFnd	<2.2	2.2	U		50
PCB-006		NotFnd	<2.3	2.3	U		50
PCB-005		NotFnd	<2.6	2.6	U		50
PCB-008		NotFnd	<2.1	2.1	U		50
PCB-014		NotFnd	<2.9	2.9	U		50
PCB-011		13.97	46.0	2.9	J		50
PCB-012/013		NotFnd	<3.0	3.0	U		50
PCB-015		NotFnd	<3.6	3.6	U		50
PCB-019		NotFnd	<1.3	1.3	U		50
PCB-018/030		13.73	<4.0	1.3	J,R	4.0	50
PCB-017		13.98	<1.6	1.6	J,R	1.6	50
PCB-027		NotFnd	<1.2	1.2	U		50
PCB-024		NotFnd	<1.2	1.2	U		50
PCB-016		14.29	<1.9	1.9	J,R	1.9	50
PCB-032		NotFnd	<1.1	1.1	U		50
PCB-034		NotFnd	<1.3	1.3	U		50
PCB-023		NotFnd	<1.2	1.2	U		50
PCB-026/029		NotFnd	<1.2	1.2	U		50
PCB-025		NotFnd	<1.1	1.1	U		50
PCB-031		15.85	7.47	1.1	J,B		50
PCB-020/028		NotFnd	<1.2	1.2	U		50
PCB-021/033		16.17	5.22	1.2	J		50
PCB-022		16.39	<2.0	1.3	J,R	2.0	50
PCB-036		NotFnd	<1.2	1.2	U		50
PCB-039		NotFnd	<1.2	1.2	U		50
PCB-038		NotFnd	<1.3	1.3	U		50
PCB-035		NotFnd	<1.4	1.4	U		50
PCB-037		18.30	<3.0	1.8	M,J,R	3.0	50
PCB-054		NotFnd	<0.58	0.58	U		50
PCB-050/053		NotFnd	<1.5	1.5	U		50
PCB-045/051		16.10	2.05	1.5	J,B		50
PCB-046		NotFnd	<1.8	1.8	U		50
PCB-052		17.00	<5.2	1.6	M,J,R	5.2	50
PCB-073		NotFnd	<1.2	1.2	U		50
PCB-043		NotFnd	<2.0	2.0	U		50
PCB-049/069		17.27	2.57	1.4	J		50
PCB-048		NotFnd	<1.6	1.6	U		50
PCB-044/047/065		17.56	<6.4	1.5	J,R	6.4	50
PCB-059/062/075		NotFnd	<1.2	1.2	U		50
PCB-042		17.86	<1.8	1.8	U	0.92	50
PCB-040/041/071		18.12	<1.8	1.7	J,R	1.8	50
PCB-064		18.26	<2.0	1.2	J,R	2.0	50
PCB-072		NotFnd	<0.92	0.92	U		50
PCB-068		NotFnd	<0.86	0.86	U		50
PCB-057		NotFnd	<0.98	0.98	U		50
PCB-058		NotFnd	<0.89	0.89	U		50
PCB-067		NotFnd	<0.82	0.82	U		50
PCB-063		NotFnd	<0.91	0.91	U		50
PCB-061/070/074/076		19.61	6.47	0.93	M,J		50
PCB-066		19.78	<2.4	0.92	J,R	2.4	50
PCB-055		NotFnd	<1.0	1.0	U		50
PCB-056		20.16	<3.5	1.0	M,J,R	3.5	50
PCB-060		NotFnd	<0.99	0.99	U		50
PCB-080		NotFnd	<0.86	0.86	U		50
PCB-079		NotFnd	<0.91	0.91	U		50
PCB-078		NotFnd	<1.1	1.1	U		50
PCB-081	0.0003	NotFnd	<1.2	1.2	U		50
PCB-077	0.0001	NotFnd	<1.3	1.3	U		50
PCB-104		NotFnd	<0.87	0.87	U		50
PCB-096		NotFnd	<0.87	0.87	U		50
PCB-103		NotFnd	<1.5	1.5	U		50
PCB-094		NotFnd	<1.7	1.7	U		50
PCB-095		19.13	<2.7	1.6	M,J,R	2.7	50
PCB-093/098/100/102		NotFnd	<1.6	1.6	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-3-BLANK**	Sampling Date	3-Nov-20		
ALS Sample ID	L2526958-3	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B23
Run Date	01-Dec-20 01:42
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-088/091		NotFnd	<1.7	1.7	U		50
PCB-084		NotFnd	<1.9	1.9	U		50
PCB-089		NotFnd	<1.9	1.9	U		50
PCB-121		NotFnd	<1.3	1.3	U		50
PCB-092		NotFnd	<1.9	1.9	U		50
PCB-090/101/113		20.65	<3.6	1.5	M,J,R	3.6	50
PCB-083/099		20.96	<1.9	1.9	M,J,R	1.9	50
PCB-112		NotFnd	<1.3	1.3	U		50
PCB-086/087/097/109/119/125		NotFnd	<1.6	1.6	U		50
PCB-085/110/115/116/117		21.73	<3.4	1.5	J,R	3.4	50
PCB-082		NotFnd	<2.4	2.4	U		50
PCB-111		NotFnd	<1.4	1.4	U		50
PCB-120		NotFnd	<1.4	1.4	U		50
PCB-108/124		NotFnd	<1.5	1.5	U		50
PCB-107		NotFnd	<1.3	1.3	U		50
PCB-123	0.00003	NotFnd	<1.6	1.6	U		50
PCB-106		NotFnd	<1.5	1.5	U		50
PCB-118	0.00003	NotFnd	<1.5	1.5	U		50
PCB-122		NotFnd	<1.6	1.6	U		50
PCB-114	0.00003	NotFnd	<1.5	1.5	U		50
PCB-105	0.00003	NotFnd	<1.6	1.6	U		50
PCB-127		NotFnd	<1.6	1.6	U		50
PCB-126	0.1	25.53	<1.9	1.9	M,U	1.3	50
PCB-155		NotFnd	<0.62	0.62	U		50
PCB-152		NotFnd	<0.60	0.60	U		50
PCB-150		NotFnd	<0.57	0.57	U		50
PCB-136		20.98	<0.64	0.62	M,J,R	0.64	50
PCB-145		NotFnd	<0.62	0.62	U		50
PCB-148		NotFnd	<0.88	0.88	U		50
PCB-135/151		NotFnd	<0.93	0.93	U		50
PCB-154		NotFnd	<0.73	0.73	U		50
PCB-144		NotFnd	<0.95	0.95	U		50
PCB-147/149		22.66	<2.0	1.4	J,R	2.0	50
PCB-134/143		NotFnd	<1.7	1.7	U		50
PCB-139/140		NotFnd	<1.4	1.4	U		50
PCB-131		NotFnd	<1.7	1.7	U		50
PCB-142		NotFnd	<1.7	1.7	U		50
PCB-132		NotFnd	<1.6	1.6	U		50
PCB-133		NotFnd	<1.6	1.6	U		50
PCB-165		NotFnd	<1.2	1.2	U		50
PCB-146		NotFnd	<1.4	1.4	U		50
PCB-161		NotFnd	<1.2	1.2	U		50
PCB-153/168		24.19	<2.5	1.2	M,J,R	2.5	50
PCB-141		NotFnd	<1.6	1.6	U		50
PCB-130		NotFnd	<1.9	1.9	U		50
PCB-137/164		NotFnd	<1.4	1.4	U		50
PCB-129/138/163		24.88	<3.3	1.6	M,J,R	3.3	50
PCB-160		NotFnd	<1.3	1.3	U		50
PCB-158		NotFnd	<1.0	1.0	U		50
PCB-128/166		NotFnd	<1.4	1.4	U		50
PCB-159		NotFnd	<1.2	1.2	U		50
PCB-162		NotFnd	<1.3	1.3	U		50
PCB-167	0.00003	NotFnd	<1.0	1.0	U		50
PCB-156/157	0.00003	NotFnd	<1.4	1.4	U		100
PCB-169	0.03	NotFnd	<1.3	1.3	U		50
PCB-188		NotFnd	<0.63	0.63	U		50
PCB-179		NotFnd	<0.66	0.66	U		50
PCB-184		NotFnd	<0.59	0.59	U		50
PCB-176		NotFnd	<0.67	0.67	U		50
PCB-186		NotFnd	<0.68	0.68	U		50
PCB-178		NotFnd	<1.0	1.0	U		50
PCB-175		NotFnd	<1.0	1.0	U		50
PCB-187		NotFnd	<0.85	0.85	U		50
PCB-182		NotFnd	<0.93	0.93	U		50
PCB-183		NotFnd	<0.94	0.94	U		50
PCB-185		NotFnd	<0.96	0.96	U		50
PCB-174		NotFnd	<1.0	1.0	U		50
PCB-177		NotFnd	<1.1	1.1	U		50
PCB-181		NotFnd	<1.0	1.0	U		50
PCB-171/173		NotFnd	<1.1	1.1	U		50
PCB-172		NotFnd	<1.1	1.1	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-3-BLANK**	Sampling Date	3-Nov-20		
ALS Sample ID	L2526958-3	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B23
Run Date	01-Dec-20 01:42
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<0.85	0.85	U		50
PCB-180/193		27.70	<1.1	0.84	J,R	1.1	50
PCB-191		NotFnd	<0.72	0.72	U		50
PCB-170		NotFnd	<0.83	0.83	U		50
PCB-190		NotFnd	<0.52	0.52	U		50
PCB-189	0.00003	NotFnd	<0.64	0.64	U		50
PCB-202		NotFnd	<0.97	0.97	U		50
PCB-201		NotFnd	<1.0	1.0	U		50
PCB-204		NotFnd	<1.0	1.0	U		50
PCB-197		NotFnd	<0.98	0.98	U		50
PCB-200		NotFnd	<1.0	1.0	U		50
PCB-198/199		28.67	<0.98	0.98	M,U	0.63	50
PCB-196		NotFnd	<0.96	0.96	U		50
PCB-203		NotFnd	<0.95	0.95	U		50
PCB-195		NotFnd	<0.95	0.95	U		50
PCB-194		31.06	1.70	1.0	M,J		50
PCB-205		NotFnd	<0.92	0.92	U		50
PCB-208		NotFnd	<2.0	2.0	U		50
PCB-207		NotFnd	<2.0	2.0	U		50
PCB-206		NotFnd	<2.8	2.8	U		50
PCB-209		33.53	134	7.0	B		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.94	56	5-145
13C12-PCB-003	2000	10.48	48	5-145
13C12-PCB-004	2000	10.62	56	5-145
13C12-PCB-015	2000	14.33	50	5-145
13C12-PCB-019	2000	12.62	56	5-145
13C12-PCB-037	2000	18.27	53	5-145
13C12-PCB-054	2000	14.47	66	5-145
13C12-PCB-081	2000	21.83	63	10-145
13C12-PCB-077	2000	22.13	63	10-145
13C12-PCB-104	2000	17.50	75	10-145
13C12-PCB-123	2000	23.09	61	10-145
13C12-PCB-118	2000	23.26	62	10-145
13C12-PCB-114	2000	23.56	64	10-145
13C12-PCB-105	2000	23.91	65	10-145
13C12-PCB-126	2000	25.52	60	10-145
13C12-PCB-155	2000	20.48	52	10-145
13C12-PCB-167	2000	26.39	71	10-145
13C12-PCB-156/157	4000	27.03	72	10-145
13C12-PCB-169	2000	28.69	71	10-145
13C12-PCB-188	2000	23.48	70	10-145
13C12-PCB-189	2000	29.95	70	10-145
13C12-PCB-202	2000	26.26	69	10-145
13C12-PCB-205	2000	31.33	82	10-145
13C12-PCB-208	2000	29.67	61	10-145
13C12-PCB-206	2000	32.39	80	10-145
13C12-PCB-209	2000	33.51	34	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.00	64	5-145
13C12-PCB-111	2000	22.02	67	10-145
13C12-PCB-178	2000	25.06	76	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**BA-3-BLANK**	Sampling Date	3-Nov-20		
ALS Sample ID	L2526958-3	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B23
Run Date	01-Dec-20 01:42
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			10.1	0.50	J		200
Total DiCB			46.0	2.1	J		400
Total TriCB			21.7	1.1	J		400
Total TetraCB			32.4	0.58	J		800
Total PentaCB			9.70	0.87	J		800
Total HexaCB			8.44	0.57	J		800
Total HeptaCB			1.10	0.52	J		400
Total OctaCB			1.70	0.92	J		400
Total NonaCB			<2.0	2.0	U		200
DecaCB			134	7.0	J		200
Total PCB			265		J		1600
Toxic Equivalency - (WHO 2005)							
Lower Bound PCB TEQ			0.00				
Mid Point PCB TEQ			0.115				
Upper Bound PCB TEQ			0.230				

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor — TEQ: Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**356-4**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-4	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B27
Run Date	01-Dec-20 04:30
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		8.94	<2.0	0.42	M,J,R	2.0	50
PCB-002		10.37	2.43	0.48	J		50
PCB-003		10.49	3.73	0.49	J		50
PCB-004		NotFnd	<2.2	2.2	U		50
PCB-010		NotFnd	<1.4	1.4	U		50
PCB-009		NotFnd	<1.4	1.4	U		50
PCB-007		NotFnd	<1.3	1.3	U		50
PCB-006		NotFnd	<1.4	1.4	U		50
PCB-005		NotFnd	<1.6	1.6	U		50
PCB-008		12.44	<7.1	1.3	M,J,R	7.1	50
PCB-014		NotFnd	<1.7	1.7	U		50
PCB-011		13.96	69.1	1.7			50
PCB-012/013		NotFnd	<1.8	1.8	U		50
PCB-015		14.33	<3.6	2.0	J,R	3.6	50
PCB-019		NotFnd	<1.0	1.0	U		50
PCB-018/030		13.73	7.35	0.97	J,B		50
PCB-017		13.98	<3.6	1.1	M,J,R	3.6	50
PCB-027		14.11	<0.85	0.85	U	0.58	50
PCB-024		NotFnd	<0.85	0.85	U		50
PCB-016		14.28	3.38	1.4	J		50
PCB-032		14.56	2.32	0.79	J		50
PCB-034		NotFnd	<1.1	1.1	U		50
PCB-023		NotFnd	<1.0	1.0	U		50
PCB-026/029		15.53	2.64	1.0	J		50
PCB-025		NotFnd	<0.91	0.91	U		50
PCB-031		15.85	12.9	0.95	J,B		50
PCB-020/028		NotFnd	<1.0	1.0	U		50
PCB-021/033		16.15	10.2	0.99	J		50
PCB-022		16.40	5.57	1.1	J		50
PCB-036		NotFnd	<1.0	1.0	U		50
PCB-039		NotFnd	<1.0	1.0	U		50
PCB-038		NotFnd	<1.1	1.1	U		50
PCB-035		18.04	<1.2	1.2	U	0.42	50
PCB-037		18.28	7.81	1.4	J		50
PCB-054		NotFnd	<0.44	0.44	U		50
PCB-050/053		15.69	<0.95	0.68	J,R	0.95	50
PCB-045/051		16.10	2.39	0.71	J,B		50
PCB-046		NotFnd	<0.82	0.82	U		50
PCB-052		16.99	8.53	0.73	J,B		50
PCB-073		NotFnd	<0.54	0.54	U		50
PCB-043		NotFnd	<0.93	0.93	U		50
PCB-049/069		17.27	3.80	0.65	J		50
PCB-048		17.44	<1.6	0.74	J,R	1.6	50
PCB-044/047/065		17.57	9.65	0.68	J,B		50
PCB-059/062/075		NotFnd	<0.56	0.56	U		50
PCB-042		17.88	1.99	0.84	M,J		50
PCB-040/041/071		18.12	4.36	0.77	M,J,B		50
PCB-064		18.25	3.22	0.56	J		50
PCB-072		NotFnd	<0.65	0.65	U		50
PCB-068		18.81	<0.70	0.61	J,R	0.70	50
PCB-057		NotFnd	<0.69	0.69	U		50
PCB-058		NotFnd	<0.63	0.63	U		50
PCB-067		NotFnd	<0.58	0.58	U		50
PCB-063		NotFnd	<0.64	0.64	U		50
PCB-061/070/074/076		19.61	10.1	0.66	J		50
PCB-066		19.78	<4.0	0.65	J,R	4.0	50
PCB-055		NotFnd	<0.71	0.71	U		50
PCB-056		20.16	8.91	0.71	J,B		50
PCB-060		20.26	1.70	0.70	J		50
PCB-080		NotFnd	<0.61	0.61	U		50
PCB-079		NotFnd	<0.65	0.65	U		50
PCB-078		NotFnd	<0.76	0.76	U		50
PCB-081	0.0003	NotFnd	<0.80	0.80	U		50
PCB-077	0.0001	22.14	1.89	0.87	J		50
PCB-104		NotFnd	<0.87	0.87	U		50
PCB-096		NotFnd	<0.83	0.83	U		50
PCB-103		NotFnd	<0.97	0.97	U		50
PCB-094		NotFnd	<1.1	1.1	U		50
PCB-095		19.13	3.63	1.0	J		50
PCB-093/098/100/102		NotFnd	<1.1	1.1	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**356-4**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-4	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B27
Run Date	01-Dec-20 04:30
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-088/091		NotFnd	<1.1	1.1	U		50
PCB-084		19.74	<2.1	1.2	J,R	2.1	50
PCB-089		NotFnd	<1.2	1.2	U		50
PCB-121		NotFnd	<0.81	0.81	U		50
PCB-092		NotFnd	<1.2	1.2	U		50
PCB-090/101/113		20.64	6.47	0.98	J,B		50
PCB-083/099		20.97	<2.2	1.2	J,R	2.2	50
PCB-112		NotFnd	<0.85	0.85	U		50
PCB-086/087/097/109/119/125		21.25	<6.0	1.0	M,J,R	6.0	50
PCB-085/110/115/116/117		21.73	8.71	0.96	M,J		50
PCB-082		NotFnd	<1.6	1.6	U		50
PCB-111		NotFnd	<0.88	0.88	U		50
PCB-120		NotFnd	<0.87	0.87	U		50
PCB-108/124		NotFnd	<1.2	1.2	U		50
PCB-107		NotFnd	<1.1	1.1	U		50
PCB-123	0.00003	NotFnd	<1.4	1.4	U		50
PCB-106		NotFnd	<1.3	1.3	U		50
PCB-118	0.00003	23.27	8.44	1.3	J		50
PCB-122		NotFnd	<1.4	1.4	U		50
PCB-114	0.00003	NotFnd	<1.3	1.3	U		50
PCB-105	0.00003	23.93	3.33	1.3	J		50
PCB-127		NotFnd	<1.4	1.4	U		50
PCB-126	0.1	25.53	<1.5	1.5	M,U	0.38	50
PCB-155		NotFnd	<0.73	0.73	U		50
PCB-152		NotFnd	<0.46	0.46	U		50
PCB-150		NotFnd	<0.45	0.45	U		50
PCB-136		20.98	<1.0	0.48	M,J,R	1.0	50
PCB-145		NotFnd	<0.49	0.49	U		50
PCB-148		NotFnd	<0.68	0.68	U		50
PCB-135/151		22.18	<1.4	0.73	M,J,R	1.4	50
PCB-154		NotFnd	<0.57	0.57	U		50
PCB-144		NotFnd	<0.74	0.74	U		50
PCB-147/149		22.66	<5.9	0.83	J,R	5.9	50
PCB-134/143		NotFnd	<1.0	1.0	U		50
PCB-139/140		NotFnd	<0.84	0.84	U		50
PCB-131		NotFnd	<1.1	1.1	U		50
PCB-142		NotFnd	<1.0	1.0	U		50
PCB-132		NotFnd	<1.0	1.0	U		50
PCB-133		NotFnd	<0.97	0.97	U		50
PCB-165		NotFnd	<0.74	0.74	U		50
PCB-146		23.88	<1.1	0.84	J,R	1.1	50
PCB-161		NotFnd	<0.72	0.72	U		50
PCB-153/168		24.19	6.28	0.74	J,B		50
PCB-141		24.32	1.30	0.98	J		50
PCB-130		NotFnd	<1.2	1.2	U		50
PCB-137/164		NotFnd	<0.85	0.85	U		50
PCB-129/138/163		24.88	11.4	0.97	M,J,B		50
PCB-160		NotFnd	<0.78	0.78	U		50
PCB-158		25.06	<0.90	0.64	J,R	0.90	50
PCB-128/166		25.53	<0.88	0.88	U	0.76	50
PCB-159		NotFnd	<0.75	0.75	U		50
PCB-162		NotFnd	<0.78	0.78	U		50
PCB-167	0.00003	NotFnd	<0.62	0.62	U		50
PCB-156/157	0.00003	27.02	<2.1	0.84	J,R	2.1	100
PCB-169	0.03	NotFnd	<0.65	0.65	U		50
PCB-188		NotFnd	<0.58	0.58	U		50
PCB-179		NotFnd	<0.48	0.48	U		50
PCB-184		NotFnd	<0.43	0.43	U		50
PCB-176		NotFnd	<0.49	0.49	U		50
PCB-186		NotFnd	<0.50	0.50	U		50
PCB-178		NotFnd	<0.74	0.74	U		50
PCB-175		NotFnd	<0.73	0.73	U		50
PCB-187		25.52	<1.6	0.63	J,R	1.6	50
PCB-182		NotFnd	<0.68	0.68	U		50
PCB-183		NotFnd	<0.69	0.69	U		50
PCB-185		NotFnd	<0.70	0.70	U		50
PCB-174		26.02	<0.84	0.74	J,R	0.84	50
PCB-177		26.25	<0.81	0.79	M,J,R	0.81	50
PCB-181		NotFnd	<0.74	0.74	U		50
PCB-171/173		NotFnd	<0.81	0.81	U		50
PCB-172		NotFnd	<0.81	0.81	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**356-4**	Sampling Date	3-Nov-20
ALS Sample ID	L2526958-4	Extraction Date	25-Nov-20
Analysis Method	EPA 1668C	Sample Size	1 Sample
Analysis Type	Sample	Percent Moisture	n/a
Sample Matrix	Swab	Split Ratio	2

Approved:
E. Sabljic
--e-signature--
01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B27
Run Date	01-Dec-20 04:30
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	TEF (WHO 2005)	Ret. Time	Conc. pg	EDL pg	Flags	EMPC pg	LQL
PCB-192		NotFnd	<0.62	0.62	U		50
PCB-180/193		27.68	4.89	0.61	M,J		50
PCB-191		NotFnd	<0.53	0.53	U		50
PCB-170		28.37	<0.78	0.61	J,R	0.78	50
PCB-190		NotFnd	<0.38	0.38	U		50
PCB-189	0.00003	NotFnd	<0.47	0.47	U		50
PCB-202		NotFnd	<0.87	0.87	U		50
PCB-201		NotFnd	<0.74	0.74	U		50
PCB-204		NotFnd	<0.74	0.74	U		50
PCB-197		NotFnd	<0.72	0.72	U		50
PCB-200		NotFnd	<0.75	0.75	U		50
PCB-198/199		NotFnd	<0.72	0.72	U		50
PCB-196		NotFnd	<0.71	0.71	U		50
PCB-203		NotFnd	<0.70	0.70	U		50
PCB-195		NotFnd	<0.87	0.87	U		50
PCB-194		31.06	<1.9	0.92	J,R	1.9	50
PCB-205		NotFnd	<0.71	0.71	U		50
PCB-208		29.69	3.43	2.2	M,J		50
PCB-207		30.17	<1.7	1.7	J,R	1.7	50
PCB-206		32.43	4.34	1.9	M,J		50
PCB-209		33.53	116	7.8	B		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.94	52	5-145
13C12-PCB-003	2000	10.48	51	5-145
13C12-PCB-004	2000	10.62	54	5-145
13C12-PCB-015	2000	14.32	51	5-145
13C12-PCB-019	2000	12.62	53	5-145
13C12-PCB-037	2000	18.26	57	5-145
13C12-PCB-054	2000	14.47	67	5-145
13C12-PCB-081	2000	21.82	70	10-145
13C12-PCB-077	2000	22.12	70	10-145
13C12-PCB-104	2000	17.50	83	10-145
13C12-PCB-123	2000	23.09	68	10-145
13C12-PCB-118	2000	23.26	68	10-145
13C12-PCB-114	2000	23.56	72	10-145
13C12-PCB-105	2000	23.91	73	10-145
13C12-PCB-126	2000	25.51	71	10-145
13C12-PCB-155	2000	20.48	39	10-145
13C12-PCB-167	2000	26.39	79	10-145
13C12-PCB-156/157	4000	27.02	81	10-145
13C12-PCB-169	2000	28.69	89	10-145
13C12-PCB-188	2000	23.48	55	10-145
13C12-PCB-189	2000	29.95	85	10-145
13C12-PCB-202	2000	26.26	61	10-145
13C12-PCB-205	2000	31.33	95	10-145
13C12-PCB-208	2000	29.67	44	10-145
13C12-PCB-206	2000	32.39	95	10-145
13C12-PCB-209	2000	33.51	26	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.00	67	5-145
13C12-PCB-111	2000	22.01	73	10-145
13C12-PCB-178	2000	25.06	81	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**356-4**	Sampling Date	3-Nov-20		
ALS Sample ID	L2526958-4	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B27
Run Date	01-Dec-20 04:30
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			8.16	0.42	J		200
Total DiCB			79.8	1.3	J		400
Total TriCB			55.8	0.79	J		400
Total TetraCB			63.8	0.44	J		800
Total PentaCB			40.9	0.81	J		800
Total HexaCB			31.4	0.45	J		800
Total HeptaCB			8.92	0.38	J		400
Total OctaCB			1.90	0.70	J		400
Total NonaCB			7.77	1.7	J		200
DecaCB			116	7.8	J		200
Total PCB			414		J		1600

Toxic Equivalency - (WHO 2005)

Lower Bound PCB TEQ	0.000542
Mid Point PCB TEQ	0.0855
Upper Bound PCB TEQ	0.170

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**356-5**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-5	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B28
Run Date	01-Dec-20 05:13
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		8.94	<1.6	0.45	M,J,R	1.6	50
PCB-002		10.35	<1.3	0.53	J,R	1.3	50
PCB-003		10.48	<2.5	0.56	J,R	2.5	50
PCB-004		10.63	<2.8	2.2	J,R	2.8	50
PCB-010		NotFnd	<1.5	1.5	U		50
PCB-009		NotFnd	<1.5	1.5	U		50
PCB-007		NotFnd	<1.4	1.4	U		50
PCB-006		NotFnd	<1.5	1.5	U		50
PCB-005		NotFnd	<1.7	1.7	U		50
PCB-008		12.43	8.58	1.4	M,J,B		50
PCB-014		NotFnd	<2.0	2.0	U		50
PCB-011		13.95	77.6	2.0			50
PCB-012/013		NotFnd	<2.0	2.0	U		50
PCB-015		NotFnd	<2.4	2.4	U		50
PCB-019		NotFnd	<1.1	1.1	U		50
PCB-018/030		13.73	8.54	1.3	J,B		50
PCB-017		13.97	4.17	1.5	J		50
PCB-027		NotFnd	<1.1	1.1	U		50
PCB-024		NotFnd	<1.1	1.1	U		50
PCB-016		14.27	<4.0	1.8	J,R	4.0	50
PCB-032		14.56	2.58	1.0	J		50
PCB-034		NotFnd	<1.5	1.5	U		50
PCB-023		NotFnd	<1.4	1.4	U		50
PCB-026/029		15.53	<1.4	1.4	U	1.4	50
PCB-025		NotFnd	<1.3	1.3	U		50
PCB-031		15.84	11.0	1.3	J,B		50
PCB-020/028		NotFnd	<1.4	1.4	U		50
PCB-021/033		16.15	8.53	1.4	J		50
PCB-022		16.39	5.22	1.4	J		50
PCB-036		NotFnd	<1.4	1.4	U		50
PCB-039		NotFnd	<1.4	1.4	U		50
PCB-038		NotFnd	<1.5	1.5	U		50
PCB-035		NotFnd	<1.6	1.6	U		50
PCB-037		18.27	<3.4	2.1	M,J,R	3.4	50
PCB-054		NotFnd	<0.55	0.55	U		50
PCB-050/053		15.67	0.992	0.80	J		50
PCB-045/051		16.09	2.46	0.84	M,J,B		50
PCB-046		NotFnd	<0.97	0.97	U		50
PCB-052		16.98	<7.6	0.86	J,R	7.6	50
PCB-073		NotFnd	<0.64	0.64	U		50
PCB-043		NotFnd	<1.1	1.1	U		50
PCB-049/069		17.26	<3.2	0.77	J,R	3.2	50
PCB-048		17.43	<0.90	0.87	J,R	0.90	50
PCB-044/047/065		17.55	8.19	0.80	J,B		50
PCB-059/062/075		NotFnd	<0.66	0.66	U		50
PCB-042		17.86	<1.9	1.0	J,R	1.9	50
PCB-040/041/071		18.12	4.83	0.91	M,J,B		50
PCB-064		18.25	2.78	0.66	J		50
PCB-072		NotFnd	<0.83	0.83	U		50
PCB-068		NotFnd	<0.78	0.78	U		50
PCB-057		NotFnd	<0.89	0.89	U		50
PCB-058		NotFnd	<0.81	0.81	U		50
PCB-067		NotFnd	<0.75	0.75	U		50
PCB-063		NotFnd	<0.82	0.82	U		50
PCB-061/070/074/076		19.60	<8.4	0.84	J,R	8.4	50
PCB-066		19.79	5.26	0.84	M,J		50
PCB-055		NotFnd	<0.90	0.90	U		50
PCB-056		20.16	8.41	0.92	J,B		50
PCB-060		20.29	0.918	0.90	J		50
PCB-080		NotFnd	<0.78	0.78	U		50
PCB-079		NotFnd	<0.83	0.83	U		50
PCB-078		NotFnd	<0.98	0.98	U		50
PCB-081	0.0003	NotFnd	<1.1	1.1	U		50
PCB-077	0.0001	22.13	<1.5	1.2	J,R	1.5	50
PCB-104		NotFnd	<0.90	0.90	U		50
PCB-096		NotFnd	<0.90	0.90	U		50
PCB-103		NotFnd	<1.1	1.1	U		50
PCB-094		NotFnd	<1.3	1.3	U		50
PCB-095		19.13	5.34	1.2	J		50
PCB-093/098/100/102		NotFnd	<1.2	1.2	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**356-5**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-5	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B28
Run Date	01-Dec-20 05:13
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-088/091		NotFnd	<1.2	1.2	U		50
PCB-084		NotFnd	<1.4	1.4	U		50
PCB-089		NotFnd	<1.4	1.4	U		50
PCB-121		NotFnd	<0.93	0.93	U		50
PCB-092		NotFnd	<1.4	1.4	U		50
PCB-090/101/113		20.63	6.11	1.1	J,B		50
PCB-083/099		20.96	<2.8	1.4	J,R	2.8	50
PCB-112		NotFnd	<0.98	0.98	U		50
PCB-086/087/097/109/119/125		21.30	<1.8	1.2	M,J,R	1.8	50
PCB-085/110/115/116/117		21.72	8.72	1.1	M,J		50
PCB-082		NotFnd	<1.8	1.8	U		50
PCB-111		NotFnd	<1.0	1.0	U		50
PCB-120		NotFnd	<1.0	1.0	U		50
PCB-108/124		NotFnd	<1.5	1.5	U		50
PCB-107		NotFnd	<1.3	1.3	U		50
PCB-123	0.00003	NotFnd	<1.7	1.7	U		50
PCB-106		NotFnd	<1.6	1.6	U		50
PCB-118	0.00003	23.26	<5.8	1.7	J,R	5.8	50
PCB-122		NotFnd	<1.7	1.7	U		50
PCB-114	0.00003	NotFnd	<1.6	1.6	U		50
PCB-105	0.00003	NotFnd	<1.7	1.7	U		50
PCB-127		NotFnd	<1.7	1.7	U		50
PCB-126	0.1	NotFnd	<2.0	2.0	U		50
PCB-155		NotFnd	<0.75	0.75	U		50
PCB-152		NotFnd	<0.58	0.58	U		50
PCB-150		NotFnd	<0.55	0.55	U		50
PCB-136		NotFnd	<0.60	0.60	U		50
PCB-145		NotFnd	<0.60	0.60	U		50
PCB-148		NotFnd	<0.85	0.85	U		50
PCB-135/151		NotFnd	<0.90	0.90	U		50
PCB-154		NotFnd	<0.70	0.70	U		50
PCB-144		NotFnd	<0.92	0.92	U		50
PCB-147/149		22.64	<4.7	1.3	J,R	4.7	50
PCB-134/143		NotFnd	<1.5	1.5	U		50
PCB-139/140		NotFnd	<1.3	1.3	U		50
PCB-131		NotFnd	<1.6	1.6	U		50
PCB-142		NotFnd	<1.5	1.5	U		50
PCB-132		23.36	<2.8	1.5	J,R	2.8	50
PCB-133		NotFnd	<1.5	1.5	U		50
PCB-165		NotFnd	<1.1	1.1	U		50
PCB-146		NotFnd	<1.3	1.3	U		50
PCB-161		NotFnd	<1.1	1.1	U		50
PCB-153/168		24.18	5.75	1.1	J,B		50
PCB-141		24.31	<1.5	1.5	U		50
PCB-130		NotFnd	<1.8	1.8	U		50
PCB-137/164		24.72	<1.3	1.3	U	0.74	50
PCB-129/138/163		24.88	<8.3	1.5	J,R	8.3	50
PCB-160		NotFnd	<1.2	1.2	U		50
PCB-158		25.07	<0.96	0.96	U	0.73	50
PCB-128/166		NotFnd	<1.3	1.3	U		50
PCB-159		NotFnd	<1.1	1.1	U		50
PCB-162		NotFnd	<1.2	1.2	U		50
PCB-167	0.00003	NotFnd	<0.96	0.96	U		50
PCB-156/157	0.00003	NotFnd	<1.3	1.3	U		100
PCB-169	0.03	NotFnd	<1.0	1.0	U		50
PCB-188		NotFnd	<0.89	0.89	U		50
PCB-179		NotFnd	<0.83	0.83	U		50
PCB-184		NotFnd	<0.75	0.75	U		50
PCB-176		NotFnd	<0.85	0.85	U		50
PCB-186		NotFnd	<0.87	0.87	U		50
PCB-178		NotFnd	<1.3	1.3	U		50
PCB-175		NotFnd	<1.3	1.3	U		50
PCB-187		25.53	<2.0	1.1	J,R	2.0	50
PCB-182		NotFnd	<1.2	1.2	U		50
PCB-183		NotFnd	<1.2	1.2	U		50
PCB-185		NotFnd	<1.2	1.2	U		50
PCB-174		26.00	<1.3	1.3	M,J,R	1.3	50
PCB-177		NotFnd	<1.4	1.4	U		50
PCB-181		NotFnd	<1.3	1.3	U		50
PCB-171/173		NotFnd	<1.4	1.4	U		50
PCB-172		NotFnd	<1.4	1.4	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**356-5**	Sampling Date	3-Nov-20	
ALS Sample ID	L2526958-5	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B28
Run Date	01-Dec-20 05:13
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<1.1	1.1	U		50
PCB-180/193		27.68	<2.0	1.1	J,R	2.0	50
PCB-191		NotFnd	<0.91	0.91	U		50
PCB-170		28.38	1.56	1.1	J		50
PCB-190		NotFnd	<0.66	0.66	U		50
PCB-189	0.00003	NotFnd	<0.57	0.57	U		50
PCB-202		NotFnd	<0.82	0.82	U		50
PCB-201		NotFnd	<0.80	0.80	U		50
PCB-204		NotFnd	<0.79	0.79	U		50
PCB-197		NotFnd	<0.77	0.77	U		50
PCB-200		NotFnd	<0.81	0.81	U		50
PCB-198/199		NotFnd	<0.77	0.77	U		50
PCB-196		NotFnd	<0.76	0.76	U		50
PCB-203		NotFnd	<0.75	0.75	U		50
PCB-195		NotFnd	<0.89	0.89	U		50
PCB-194		31.05	<1.0	0.94	J,R	1.0	50
PCB-205		NotFnd	<0.81	0.81	U		50
PCB-208		NotFnd	<2.1	2.1	U		50
PCB-207		NotFnd	<1.9	1.9	U		50
PCB-206		32.39	7.41	2.4	M,J		50
PCB-209		33.53	<130	7.4	R	130	50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.92	54	5-145
13C12-PCB-003	2000	10.48	53	5-145
13C12-PCB-004	2000	10.62	56	5-145
13C12-PCB-015	2000	14.32	51	5-145
13C12-PCB-019	2000	12.61	55	5-145
13C12-PCB-037	2000	18.26	54	5-145
13C12-PCB-054	2000	14.46	69	5-145
13C12-PCB-081	2000	21.82	61	10-145
13C12-PCB-077	2000	22.12	60	10-145
13C12-PCB-104	2000	17.49	77	10-145
13C12-PCB-123	2000	23.08	61	10-145
13C12-PCB-118	2000	23.25	60	10-145
13C12-PCB-114	2000	23.55	63	10-145
13C12-PCB-105	2000	23.91	64	10-145
13C12-PCB-126	2000	25.51	59	10-145
13C12-PCB-155	2000	20.48	44	10-145
13C12-PCB-167	2000	26.38	70	10-145
13C12-PCB-156/157	4000	27.02	71	10-145
13C12-PCB-169	2000	28.67	77	10-145
13C12-PCB-188	2000	23.48	61	10-145
13C12-PCB-189	2000	29.93	75	10-145
13C12-PCB-202	2000	26.25	66	10-145
13C12-PCB-205	2000	31.31	84	10-145
13C12-PCB-208	2000	29.67	51	10-145
13C12-PCB-206	2000	32.39	86	10-145
13C12-PCB-209	2000	33.50	27	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.00	65	5-145
13C12-PCB-111	2000	22.01	64	10-145
13C12-PCB-178	2000	25.05	73	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**356-5**	Sampling Date	3-Nov-20		
ALS Sample ID	L2526958-5	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B28
Run Date	01-Dec-20 05:13
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			5.40	0.45	J		200
Total DiCB			89.0	1.4	J		400
Total TriCB			47.4	1.0	J		400
Total TetraCB			57.3	0.55	J		800
Total PentaCB			30.6	0.90	J		800
Total HexaCB			21.6	0.55	J		800
Total HeptaCB			5.56	0.57	J		400
Total OctaCB			1.00	0.75	J		400
Total NonaCB			7.41	1.9	J		200
DecaCB			130	7.4	J		200
Total PCB			395		J		1600
Toxic Equivalency - (WHO 2005)							
Lower Bound PCB TEQ			0.00				
Mid Point PCB TEQ			0.116				
Upper Bound PCB TEQ			0.231				

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-558-DFP-02**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-6	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B29
Run Date	01-Dec-20 05:55
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		8.99	<1.4	1.3	M,J,R	1.4	50
PCB-002		10.41	4.04	0.73	J		50
PCB-003		10.54	5.05	0.49	J		50
PCB-004		10.68	<4.0	1.6	J,R	4.0	50
PCB-010		NotFnd	<0.99	0.99	U		50
PCB-009		NotFnd	<1.0	1.0	U		50
PCB-007		12.02	4.69	0.97	J		50
PCB-006		12.18	<3.5	1.0	J,R	3.5	50
PCB-005		NotFnd	<1.1	1.1	U		50
PCB-008		12.46	20.5	0.92	M,J,B		50
PCB-014		NotFnd	<1.7	1.7	U		50
PCB-011		13.95	762	1.7			50
PCB-012/013		14.14	<10	1.7	J,R	10	50
PCB-015		14.33	20.8	1.9	J		50
PCB-019		12.65	<2.3	0.79	J,R	2.3	50
PCB-018/030		13.74	26.5	0.59	J,B		50
PCB-017		13.98	13.1	0.69	J		50
PCB-027		14.13	<1.1	0.52	J,R	1.1	50
PCB-024		NotFnd	<0.52	0.52	U		50
PCB-016		14.28	<13	0.83	M,J,R	13	50
PCB-032		14.55	10.8	0.48	J		50
PCB-034		NotFnd	<1.0	1.0	U		50
PCB-023		NotFnd	<0.97	0.97	U		50
PCB-026/029		15.52	8.75	0.97	J		50
PCB-025		15.65	<4.4	0.88	J,R	4.4	50
PCB-031		15.84	53.6	0.91	B		50
PCB-020/028		16.01	74.6	0.97			50
PCB-021/033		16.15	43.5	0.95	J		50
PCB-022		16.39	28.1	1.0	J		50
PCB-036		17.22	<4.0	0.97	J,R	4.0	50
PCB-039		17.44	<0.99	0.99	U	0.36	50
PCB-038		NotFnd	<1.1	1.1	U		50
PCB-035		18.03	<12	1.1	J,R	12	50
PCB-037		18.26	36.2	1.4	J		50
PCB-054		NotFnd	<0.30	0.30	U		50
PCB-050/053		15.68	6.03	0.56	J		50
PCB-045/051		16.09	12.1	0.59	J,B		50
PCB-046		16.27	2.97	0.68	J		50
PCB-052		16.99	65.2	0.60			50
PCB-073		NotFnd	<0.45	0.45	U		50
PCB-043		17.10	<1.2	0.78	J,R	1.2	50
PCB-049/069		17.26	27.4	0.54	J		50
PCB-048		17.43	11.2	0.61	J		50
PCB-044/047/065		17.56	66.8	0.56			50
PCB-059/062/075		17.74	4.84	0.46	J		50
PCB-042		17.86	16.2	0.70	J		50
PCB-040/041/071		18.13	34.1	0.64	J		50
PCB-064		18.24	27.1	0.47	J		50
PCB-072		NotFnd	<0.86	0.86	U		50
PCB-068		18.80	4.51	0.81	J		50
PCB-057		NotFnd	<0.92	0.92	U		50
PCB-058		19.14	1.67	0.84	J		50
PCB-067		19.25	1.68	0.77	J		50
PCB-063		19.40	<1.8	0.85	J,R	1.8	50
PCB-061/070/074/076		19.59	105	0.87			50
PCB-066		19.76	58.3	0.86			50
PCB-055		19.87	2.45	0.93	J		50
PCB-056		20.15	39.0	0.94	J		50
PCB-060		20.27	<20	0.93	J,R	20	50
PCB-080		NotFnd	<0.81	0.81	U		50
PCB-079		21.27	<1.2	0.85	J,R	1.2	50
PCB-078		NotFnd	<1.0	1.0	U		50
PCB-081	0.0003	NotFnd	<1.1	1.1	U		50
PCB-077	0.0001	22.12	14.3	1.2	J		50
PCB-104		NotFnd	<0.48	0.48	U		50
PCB-096		NotFnd	<0.49	0.49	U		50
PCB-103		NotFnd	<0.87	0.87	U		50
PCB-094		NotFnd	<1.0	1.0	U		50
PCB-095		19.13	49.5	0.91	J		50
PCB-093/098/100/102		19.29	3.25	0.95	M,J		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-558-DFP-02**	Sampling Date	4-Nov-20
ALS Sample ID	L2526958-6	Extraction Date	25-Nov-20
Analysis Method	EPA 1668C	Sample Size	1 Sample
Analysis Type	Sample	Percent Moisture	n/a
Sample Matrix	Swab	Split Ratio	2

Approved:
E. Sabljic
--e-signature--
01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B29
Run Date	01-Dec-20 05:55
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	TEF (WHO 2005)	Ret. Time	Conc. pg	EDL pg	Flags	EMPC pg	LQL
PCB-088/091		19.58	10.1	0.97	J		50
PCB-084		19.74	19.5	1.1	J		50
PCB-089		NotFnd	<1.1	1.1	U		50
PCB-121		NotFnd	<0.73	0.73	U		50
PCB-092		20.33	12.9	1.1	J		50
PCB-090/101/113		20.63	77.5	0.88			50
PCB-083/099		20.95	43.0	1.1	J		50
PCB-112		NotFnd	<0.77	0.77	U		50
PCB-086/087/097/109/119/125		21.30	65.4	0.91	M		50
PCB-085/110/115/116/117		21.71	136	0.87	M		50
PCB-082		21.92	14.5	1.4	M,J		50
PCB-111		NotFnd	<0.79	0.79	U		50
PCB-120		NotFnd	<0.78	0.78	U		50
PCB-108/124		22.89	3.13	1.0	J		50
PCB-107		23.03	<4.6	0.91	M,J,R	4.6	50
PCB-123	0.00003	23.07	1.76	1.2	M,J		50
PCB-106		NotFnd	<1.1	1.1	U		50
PCB-118	0.00003	23.26	97.6	1.1			50
PCB-122		NotFnd	<1.2	1.2	U		50
PCB-114	0.00003	23.56	2.55	1.1	J		50
PCB-105	0.00003	23.91	44.8	1.1	J		50
PCB-127		NotFnd	<1.1	1.1	U		50
PCB-126	0.1	25.52	<2.1	1.4	M,J,R	2.1	50
PCB-155		20.49	<2.4	0.38	J,R	2.4	50
PCB-152		NotFnd	<0.40	0.40	U		50
PCB-150		NotFnd	<0.39	0.39	U		50
PCB-136		20.96	9.67	0.42	J		50
PCB-145		NotFnd	<0.42	0.42	U		50
PCB-148		NotFnd	<0.60	0.60	U		50
PCB-135/151		22.16	29.4	0.63	J		50
PCB-154		NotFnd	<0.49	0.49	U		50
PCB-144		22.45	3.69	0.65	J		50
PCB-147/149		22.64	84.9	0.91			50
PCB-134/143		22.79	5.77	1.1	J		50
PCB-139/140		22.95	2.70	0.92	J		50
PCB-131		NotFnd	<1.2	1.2	U		50
PCB-142		NotFnd	<1.1	1.1	U		50
PCB-132		23.35	45.3	1.1	J		50
PCB-133		23.53	<1.1	1.1	U	0.85	50
PCB-165		NotFnd	<0.82	0.82	U		50
PCB-146		23.87	13.5	0.92	J		50
PCB-161		NotFnd	<0.78	0.78	U		50
PCB-153/168		24.18	83.9	0.81			50
PCB-141		24.31	24.3	1.1	J		50
PCB-130		24.53	<7.4	1.3	J,R	7.4	50
PCB-137/164		24.70	15.9	0.93	M,J		50
PCB-129/138/163		24.87	144	1.1			50
PCB-160		NotFnd	<0.86	0.86	U		50
PCB-158		25.07	14.6	0.70	J		50
PCB-128/166		25.57	20.7	0.96	J		50
PCB-159		26.00	<0.82	0.82	U	0.65	50
PCB-162		NotFnd	<0.86	0.86	U		50
PCB-167	0.00003	26.39	5.21	0.74	J		50
PCB-156/157	0.00003	27.02	13.5	1.0	J,B		100
PCB-169	0.03	NotFnd	<0.84	0.84	U		50
PCB-188		NotFnd	<0.77	0.77	U		50
PCB-179		23.70	8.09	0.82	J		50
PCB-184		23.94	<3.0	0.74	J,R	3.0	50
PCB-176		24.16	2.64	0.84	J		50
PCB-186		NotFnd	<0.86	0.86	U		50
PCB-178		25.06	5.18	1.3	J		50
PCB-175		NotFnd	<1.3	1.3	U		50
PCB-187		25.53	24.4	1.1	J		50
PCB-182		NotFnd	<1.2	1.2	U		50
PCB-183		25.83	15.1	1.2	J		50
PCB-185		NotFnd	<1.2	1.2	U		50
PCB-174		26.00	23.3	1.3	M,J		50
PCB-177		26.23	12.7	1.3	J		50
PCB-181		NotFnd	<1.3	1.3	U		50
PCB-171/173		26.56	<6.3	1.4	J,R	6.3	50
PCB-172		27.36	<4.2	1.4	J,R	4.2	50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-558-DFP-02**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-6	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B29
Run Date	01-Dec-20 05:55
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<1.1	1.1	U		50
PCB-180/193		27.68	45.4	1.1	J		50
PCB-191		27.85	<0.90	0.90	U	0.77	50
PCB-170		28.37	17.3	1.0	J		50
PCB-190		28.64	3.09	0.66	M,J		50
PCB-189	0.00003	29.95	<1.2	0.48	J,R	1.2	50
PCB-202		26.26	<2.7	0.59	J,R	2.7	50
PCB-201		26.73	<1.8	0.58	J,R	1.8	50
PCB-204		NotFnd	<0.58	0.58	U		50
PCB-197		27.20	<0.57	0.57	U	0.43	50
PCB-200		27.29	<1.3	0.59	J,R	1.3	50
PCB-198/199		28.69	8.94	0.56	J		50
PCB-196		29.03	<2.6	0.55	J,R	2.6	50
PCB-203		29.11	5.15	0.55	J		50
PCB-195		29.83	<3.2	0.59	J,R	3.2	50
PCB-194		31.05	9.71	0.62	J		50
PCB-205		31.33	<0.76	0.54	J,R	0.76	50
PCB-208		29.68	5.19	1.5	J		50
PCB-207		30.15	<2.6	1.5	J,R	2.6	50
PCB-206		32.40	12.1	2.2	J		50
PCB-209		33.53	103	4.1	B		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.98	64	5-145
13C12-PCB-003	2000	10.52	59	5-145
13C12-PCB-004	2000	10.66	68	5-145
13C12-PCB-015	2000	14.32	59	5-145
13C12-PCB-019	2000	12.64	72	5-145
13C12-PCB-037	2000	18.25	65	5-145
13C12-PCB-054	2000	14.47	83	5-145
13C12-PCB-081	2000	21.80	73	10-145
13C12-PCB-077	2000	22.11	70	10-145
13C12-PCB-104	2000	17.50	91	10-145
13C12-PCB-123	2000	23.08	68	10-145
13C12-PCB-118	2000	23.25	67	10-145
13C12-PCB-114	2000	23.55	70	10-145
13C12-PCB-105	2000	23.90	71	10-145
13C12-PCB-126	2000	25.50	68	10-145
13C12-PCB-155	2000	20.48	68	10-145
13C12-PCB-167	2000	26.38	76	10-145
13C12-PCB-156/157	4000	27.01	78	10-145
13C12-PCB-169	2000	28.67	80	10-145
13C12-PCB-188	2000	23.48	86	10-145
13C12-PCB-189	2000	29.93	78	10-145
13C12-PCB-202	2000	26.25	78	10-145
13C12-PCB-205	2000	31.31	111	10-145
13C12-PCB-208	2000	29.67	73	10-145
13C12-PCB-206	2000	32.39	93	10-145
13C12-PCB-209	2000	33.50	45	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.00	73	5-145
13C12-PCB-111	2000	22.00	74	10-145
13C12-PCB-178	2000	25.05	92	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-558-DFP-02**	Sampling Date	4-Nov-20		
ALS Sample ID	L2526958-6	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B29
Run Date	01-Dec-20 05:55
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			10.5	0.49	J		200
Total DiCB			825	0.92	J		400
Total TriCB			332	0.48	J		400
Total TetraCB			525	0.30	J		800
Total PentaCB			588	0.48	J		800
Total HexaCB			527	0.38	J		800
Total HeptaCB			172	0.48	J		400
Total OctaCB			36.2	0.54	J		400
Total NonaCB			19.9	1.5	J		200
DecaCB			103	4.1	J		200
Total PCB			3140		J		1600
Toxic Equivalency - (WHO 2005)							
Lower Bound PCB TEQ			0.00639				
Mid Point PCB TEQ			0.229				
Upper Bound PCB TEQ			0.242				

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-583-DFP-02**	Sampling Date	4-Nov-20			
ALS Sample ID	L2526958-7	Extraction Date	25-Nov-20		Approved:	
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*	
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--	
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020	

Run Information	**Run 1**
Filename	5-201130B30
Run Date	01-Dec-20 06:37
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		8.97	<1.7	0.98	M,J,R	1.7	50
PCB-002		10.40	5.95	0.75	J		50
PCB-003		10.51	5.25	0.56	J		50
PCB-004		10.65	<3.9	1.9	M,J,R	3.9	50
PCB-010		NotFnd	<1.3	1.3	U		50
PCB-009		NotFnd	<1.3	1.3	U		50
PCB-007		NotFnd	<1.2	1.2	U		50
PCB-006		12.18	4.30	1.3	J		50
PCB-005		12.39	<1.5	1.5	M,U	0.97	50
PCB-008		12.44	15.8	1.2	M,J,B		50
PCB-014		NotFnd	<1.2	1.2	U		50
PCB-011		13.95	1050	1.3	M		50
PCB-012/013		14.11	<19	1.3	M,J,R	19	50
PCB-015		14.33	17.0	1.5	M,J		50
PCB-019		12.64	1.83	1.0	J		50
PCB-018/030		13.73	11.0	0.70	J,B		50
PCB-017		13.98	6.31	0.81	J		50
PCB-027		14.11	<0.70	0.61	J,R	0.70	50
PCB-024		NotFnd	<0.61	0.61	U		50
PCB-016		14.28	6.08	0.98	M,J		50
PCB-032		14.55	3.83	0.57	M,J		50
PCB-034		NotFnd	<0.76	0.76	U		50
PCB-023		NotFnd	<0.72	0.72	U		50
PCB-026/029		15.52	4.16	0.72	J		50
PCB-025		15.66	<2.1	0.65	J,R	2.1	50
PCB-031		15.84	19.0	0.67	J,B		50
PCB-020/028		16.01	22.6	0.71	J		50
PCB-021/033		16.15	<14	0.70	J,R	14	50
PCB-022		16.39	9.91	0.75	J		50
PCB-036		17.22	<2.9	0.72	J,R	2.9	50
PCB-039		NotFnd	<0.73	0.73	U		50
PCB-038		NotFnd	<0.79	0.79	U		50
PCB-035		18.03	23.3	0.82	J		50
PCB-037		18.26	16.4	1.1	J		50
PCB-054		NotFnd	<0.42	0.42	U		50
PCB-050/053		15.67	2.14	0.83	J		50
PCB-045/051		16.09	12.0	0.87	J,B		50
PCB-046		16.27	1.38	1.0	J		50
PCB-052		16.99	55.2	0.89			50
PCB-073		NotFnd	<0.66	0.66	U		50
PCB-043		17.12	<1.3	1.1	J,R	1.3	50
PCB-049/069		17.26	<15	0.80	J,R	15	50
PCB-048		17.42	4.04	0.90	J		50
PCB-044/047/065		17.56	81.6	0.83			50
PCB-059/062/075		17.74	<1.6	0.68	J,R	1.6	50
PCB-042		17.86	<5.4	1.0	J,R	5.4	50
PCB-040/041/071		18.12	14.2	0.95	J		50
PCB-064		18.24	13.6	0.69	J		50
PCB-072		NotFnd	<0.91	0.91	U		50
PCB-068		18.80	7.74	0.86	J		50
PCB-057		NotFnd	<0.97	0.97	U		50
PCB-058		NotFnd	<0.89	0.89	U		50
PCB-067		NotFnd	<0.81	0.81	U		50
PCB-063		NotFnd	<0.90	0.90	U		50
PCB-061/070/074/076		19.59	90.5	0.92			50
PCB-066		19.77	31.4	0.91	J		50
PCB-055		NotFnd	<0.99	0.99	U		50
PCB-056		20.15	23.0	1.0	J		50
PCB-060		20.27	11.1	0.98	J		50
PCB-080		NotFnd	<0.85	0.85	U		50
PCB-079		21.30	<1.7	0.90	J,R	1.7	50
PCB-078		NotFnd	<1.1	1.1	U		50
PCB-081	0.0003	NotFnd	<1.1	1.1	U		50
PCB-077	0.0001	22.13	16.1	1.2	J		50
PCB-104		NotFnd	<0.73	0.73	U		50
PCB-096		NotFnd	<0.71	0.71	U		50
PCB-103		NotFnd	<1.6	1.6	U		50
PCB-094		NotFnd	<1.9	1.9	U		50
PCB-095		19.13	85.7	1.7			50
PCB-093/098/100/102		19.32	4.68	1.8	M,J		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-583-DFP-02**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-7	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B30
Run Date	01-Dec-20 06:37
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	TEF (WHO 2005)	Ret. Time	Conc. pg	EDL pg	Flags	EMPC pg	LQL
PCB-088/091		19.58	15.9	1.8	J		50
PCB-084		19.74	33.4	2.1	J		50
PCB-089		19.99	<2.1	2.1	U		50
PCB-121		NotFnd	<1.4	1.4	U		50
PCB-092		20.33	24.9	2.0	J		50
PCB-090/101/113		20.63	144	1.6			50
PCB-083/099		20.95	107	2.0			50
PCB-112		21.06	<17	1.4	J,R	17	50
PCB-086/087/097/109/119/125		21.30	119	1.7	M		50
PCB-085/110/115/116/117		21.71	266	1.6	M		50
PCB-082		21.92	<24	2.6	M,J,R	24	50
PCB-111		NotFnd	<1.5	1.5	U		50
PCB-120		NotFnd	<1.5	1.5	U		50
PCB-108/124		22.89	7.13	2.1	J		50
PCB-107		23.03	9.48	1.8	M,J		50
PCB-123	0.00003	23.07	<2.8	2.3	M,J,R	2.8	50
PCB-106		NotFnd	<2.2	2.2	U		50
PCB-118	0.00003	23.26	165	2.2			50
PCB-122		NotFnd	<2.3	2.3	U		50
PCB-114	0.00003	23.55	<3.2	2.1	J,R	3.2	50
PCB-105	0.00003	23.91	63.0	2.2			50
PCB-127		NotFnd	<2.3	2.3	U		50
PCB-126	0.1	25.51	<2.7	2.7	U	2.2	50
PCB-155		NotFnd	<0.54	0.54	U		50
PCB-152		NotFnd	<0.38	0.38	U		50
PCB-150		NotFnd	<0.36	0.36	U		50
PCB-136		20.96	<17	0.39	J,R	17	50
PCB-145		NotFnd	<0.39	0.39	U		50
PCB-148		NotFnd	<0.55	0.55	U		50
PCB-135/151		22.16	45.2	0.59	M,J		50
PCB-154		22.27	<0.72	0.46	J,R	0.72	50
PCB-144		22.46	<6.6	0.60	J,R	6.6	50
PCB-147/149		22.64	158	1.3			50
PCB-134/143		22.79	<10	1.5	J,R	10	50
PCB-139/140		22.96	4.13	1.3	J		50
PCB-131		23.10	<2.9	1.6	J,R	2.9	50
PCB-142		NotFnd	<1.5	1.5	U		50
PCB-132		23.35	76.9	1.5			50
PCB-133		23.51	<1.9	1.5	J,R	1.9	50
PCB-165		NotFnd	<1.1	1.1	U		50
PCB-146		23.85	21.9	1.3	J		50
PCB-161		NotFnd	<1.1	1.1	U		50
PCB-153/168		24.18	135	1.1			50
PCB-141		24.31	40.0	1.5	J		50
PCB-130		24.53	<14	1.8	J,R	14	50
PCB-137/164		24.71	26.8	1.3	M,J		50
PCB-129/138/163		24.87	234	1.5			50
PCB-160		NotFnd	<1.2	1.2	U		50
PCB-158		25.07	22.0	0.96	J		50
PCB-128/166		25.57	33.8	1.3	J		50
PCB-159		26.00	1.40	1.1	J		50
PCB-162		NotFnd	<1.2	1.2	U		50
PCB-167	0.00003	26.39	<7.5	0.92	J,R	7.5	50
PCB-156/157	0.00003	27.02	17.0	1.3	J		100
PCB-169	0.03	NotFnd	<1.0	1.0	U		50
PCB-188		NotFnd	<1.2	1.2	U		50
PCB-179		23.72	<9.1	1.1	J,R	9.1	50
PCB-184		23.94	<0.94	0.94	U	0.55	50
PCB-176		24.16	3.93	1.1	J		50
PCB-186		NotFnd	<1.1	1.1	U		50
PCB-178		25.06	<6.6	1.6	J,R	6.6	50
PCB-175		25.39	<1.6	1.6	U	1.2	50
PCB-187		25.52	38.8	1.4	J		50
PCB-182		NotFnd	<1.5	1.5	U		50
PCB-183		25.83	16.9	1.5	J		50
PCB-185		25.92	2.86	1.5	J		50
PCB-174		26.00	29.2	1.6	J		50
PCB-177		26.23	<13	1.7	J,R	13	50
PCB-181		NotFnd	<1.6	1.6	U		50
PCB-171/173		26.56	<8.5	1.8	J,R	8.5	50
PCB-172		27.33	9.11	1.8	J		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-583-DFP-02**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-7	Extraction Date	25-Nov-20	
Analysis Method	EPA 1668C	Sample Size	1	Sample
Analysis Type	Sample	Percent Moisture	n/a	
Sample Matrix	Swab	Split Ratio	2	

Approved:
E. Sabljic
--e-signature--
01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B30
Run Date	01-Dec-20 06:37
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	TEF (WHO 2005)	Ret. Time	Conc. pg	EDL pg	Flags	EMPC pg	LQL
PCB-192		NotFnd	<1.4	1.4	U		50
PCB-180/193		27.68	64.8	1.3			50
PCB-191		27.85	<2.3	1.2	J,R	2.3	50
PCB-170		28.37	20.5	1.3	J		50
PCB-190		28.65	<3.1	0.84	J,R	3.1	50
PCB-189	0.00003	NotFnd	<0.60	0.60	U		50
PCB-202		26.27	<7.4	1.1	J,R	7.4	50
PCB-201		26.73	<2.8	0.88	J,R	2.8	50
PCB-204		NotFnd	<0.87	0.87	U		50
PCB-197		NotFnd	<0.85	0.85	U		50
PCB-200		27.29	<1.7	0.89	M,J,R	1.7	50
PCB-198/199		28.67	14.8	0.85	J		50
PCB-196		29.03	<4.3	0.83	J,R	4.3	50
PCB-203		29.12	10.1	0.82	J		50
PCB-195		29.85	3.17	0.96	J		50
PCB-194		31.06	14.0	1.0	J		50
PCB-205		NotFnd	<0.76	0.76	U		50
PCB-208		29.68	9.77	2.8	J		50
PCB-207		30.15	<5.0	2.4	J,R	5.0	50
PCB-206		32.40	16.6	2.8	M,J		50
PCB-209		33.53	141	7.2	B		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.95	57	5-145
13C12-PCB-003	2000	10.49	59	5-145
13C12-PCB-004	2000	10.65	65	5-145
13C12-PCB-015	2000	14.32	55	5-145
13C12-PCB-019	2000	12.62	69	5-145
13C12-PCB-037	2000	18.25	62	5-145
13C12-PCB-054	2000	14.47	77	5-145
13C12-PCB-081	2000	21.81	69	10-145
13C12-PCB-077	2000	22.11	67	10-145
13C12-PCB-104	2000	17.50	82	10-145
13C12-PCB-123	2000	23.08	66	10-145
13C12-PCB-118	2000	23.25	66	10-145
13C12-PCB-114	2000	23.55	70	10-145
13C12-PCB-105	2000	23.90	69	10-145
13C12-PCB-126	2000	25.51	65	10-145
13C12-PCB-155	2000	20.48	38	10-145
13C12-PCB-167	2000	26.38	72	10-145
13C12-PCB-156/157	4000	27.02	73	10-145
13C12-PCB-169	2000	28.67	78	10-145
13C12-PCB-188	2000	23.48	52	10-145
13C12-PCB-189	2000	29.93	71	10-145
13C12-PCB-202	2000	26.25	49	10-145
13C12-PCB-205	2000	31.31	95	10-145
13C12-PCB-208	2000	29.67	40	10-145
13C12-PCB-206	2000	32.39	80	10-145
13C12-PCB-209	2000	33.50	25	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.00	67	5-145
13C12-PCB-111	2000	22.00	69	10-145
13C12-PCB-178	2000	25.05	74	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-583-DFP-02**	Sampling Date	4-Nov-20		
ALS Sample ID	L2526958-7	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B30
Run Date	01-Dec-20 06:37
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			12.9	0.56	J		200
Total DiCB			1110	1.2	J		400
Total TriCB			144	0.57	J		400
Total TetraCB			389	0.42	J		800
Total PentaCB			1090	0.71	J		800
Total HexaCB			877	0.36	J		800
Total HeptaCB			229	0.60	J		400
Total OctaCB			58.3	0.76	J		400
Total NonaCB			31.4	2.4	J		200
DecaCB			141	7.2	J		200
Total PCB			4080		J		1600
Toxic Equivalency - (WHO 2005)							
Lower Bound PCB TEQ			0.00896				
Mid Point PCB TEQ			0.160				
Upper Bound PCB TEQ			0.310				

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-168-DFP-01**	Sampling Date	4-Nov-20		
ALS Sample ID	L2526958-8	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B31
Run Date	01-Dec-20 07:19
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		NotFnd	<1.4	1.4	U		50
PCB-002		10.42	<2.8	0.84	J,R	2.8	50
PCB-003		10.54	4.40	0.57	J		50
PCB-004		10.69	<3.7	1.7	M,J,R	3.7	50
PCB-010		NotFnd	<1.1	1.1	U		50
PCB-009		NotFnd	<1.1	1.1	U		50
PCB-007		12.04	4.09	1.1	J		50
PCB-006		12.19	<2.9	1.2	M,J,R	2.9	50
PCB-005		12.39	<1.3	1.3	M,U	0.83	50
PCB-008		12.46	13.1	1.1	M,J,B		50
PCB-014		NotFnd	<1.7	1.7	U		50
PCB-011		13.97	136	1.7	M		50
PCB-012/013		14.13	5.62	1.8	M,J		50
PCB-015		14.34	<13	2.1	J,R	13	50
PCB-019		NotFnd	<0.87	0.87	U		50
PCB-018/030		13.75	12.1	0.83	J,B		50
PCB-017		13.99	5.92	0.97	J		50
PCB-027		14.12	<0.74	0.72	J,R	0.74	50
PCB-024		NotFnd	<0.72	0.72	U		50
PCB-016		14.29	6.81	1.2	J		50
PCB-032		14.57	4.45	0.68	J		50
PCB-034		NotFnd	<1.1	1.1	U		50
PCB-023		NotFnd	<1.0	1.0	U		50
PCB-026/029		15.54	<3.6	1.0	J,R	3.6	50
PCB-025		15.66	<2.1	0.90	J,R	2.1	50
PCB-031		15.85	21.5	0.94	J,B		50
PCB-020/028		16.03	26.5	0.99	J		50
PCB-021/033		16.16	18.1	0.98	J		50
PCB-022		16.40	10.8	1.0	J		50
PCB-036		17.25	<1.0	1.0	U	0.70	50
PCB-039		NotFnd	<1.0	1.0	U		50
PCB-038		NotFnd	<1.1	1.1	U		50
PCB-035		18.06	<3.8	1.2	J,R	3.8	50
PCB-037		18.27	17.0	1.4	J		50
PCB-054		NotFnd	<0.48	0.48	U		50
PCB-050/053		15.69	<2.5	0.71	J,R	2.5	50
PCB-045/051		16.10	10.3	0.74	J,B		50
PCB-046		16.27	<0.85	0.85	U	0.73	50
PCB-052		17.00	110	0.76			50
PCB-073		NotFnd	<0.56	0.56	U		50
PCB-043		NotFnd	<0.97	0.97	U		50
PCB-049/069		17.27	27.1	0.68	J		50
PCB-048		17.42	<5.4	0.77	J,R	5.4	50
PCB-044/047/065		17.57	95.7	0.71			50
PCB-059/062/075		17.75	<2.0	0.58	J,R	2.0	50
PCB-042		17.86	9.36	0.88	J		50
PCB-040/041/071		18.13	19.6	0.81	M,J		50
PCB-064		18.25	22.6	0.59	J		50
PCB-072		NotFnd	<0.99	0.99	U		50
PCB-068		18.81	<5.1	0.93	J,R	5.1	50
PCB-057		NotFnd	<1.1	1.1	U		50
PCB-058		NotFnd	<0.97	0.97	U		50
PCB-067		NotFnd	<0.89	0.89	U		50
PCB-063		NotFnd	<0.98	0.98	U		50
PCB-061/070/074/076		19.60	150	1.0			50
PCB-066		19.78	49.2	1.0	J		50
PCB-055		NotFnd	<1.1	1.1	U		50
PCB-056		20.16	<19	1.1	J,R	19	50
PCB-060		20.28	13.0	1.1	J		50
PCB-080		NotFnd	<0.93	0.93	U		50
PCB-079		21.25	<2.6	0.99	M,J,R	2.6	50
PCB-078		NotFnd	<1.2	1.2	U		50
PCB-081	0.0003	NotFnd	<1.3	1.3	U		50
PCB-077	0.0001	22.13	<9.5	1.3	J,R	9.5	50
PCB-104		NotFnd	<0.69	0.69	U		50
PCB-096		17.76	<1.2	0.64	M,J,R	1.2	50
PCB-103		NotFnd	<1.5	1.5	U		50
PCB-094		NotFnd	<1.8	1.8	U		50
PCB-095		19.13	172	1.6			50
PCB-093/098/100/102		19.31	6.68	1.7	J		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-168-DFP-01**	Sampling Date	4-Nov-20		
ALS Sample ID	L2526958-8	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B31
Run Date	01-Dec-20 07:19
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-088/091		19.60	26.4	1.7	J		50
PCB-084		19.74	62.6	2.0			50
PCB-089		19.99	<2.0	2.0	U	1.6	50
PCB-121		NotFnd	<1.3	1.3	U		50
PCB-092		20.34	43.1	1.9	J		50
PCB-090/101/113		20.64	242	1.6			50
PCB-083/099		20.96	117	1.9			50
PCB-112		NotFnd	<1.4	1.4	U		50
PCB-086/087/097/109/119/125		21.31	172	1.6	M		50
PCB-085/110/115/116/117		21.72	328	1.5	M		50
PCB-082		21.92	28.3	2.5	J		50
PCB-111		NotFnd	<1.4	1.4	U		50
PCB-120		NotFnd	<1.4	1.4	U		50
PCB-108/124		22.90	<8.1	1.9	J,R	8.1	50
PCB-107		23.03	<9.9	1.6	M,J,R	9.9	50
PCB-123	0.00003	23.08	2.61	2.1	M,J		50
PCB-106		NotFnd	<2.0	2.0	U		50
PCB-118	0.00003	23.26	196	2.0			50
PCB-122		NotFnd	<2.1	2.1	U		50
PCB-114	0.00003	23.56	5.73	1.9	J		50
PCB-105	0.00003	23.93	68.7	2.1			50
PCB-127		NotFnd	<2.1	2.1	U		50
PCB-126	0.1	25.51	<2.6	2.6	M,U	1.5	50
PCB-155		NotFnd	<0.72	0.72	U		50
PCB-152		NotFnd	<0.45	0.45	U		50
PCB-150		NotFnd	<0.43	0.43	U		50
PCB-136		20.97	30.5	0.46	J		50
PCB-145		NotFnd	<0.47	0.47	U		50
PCB-148		NotFnd	<0.66	0.66	U		50
PCB-135/151		22.18	61.0	0.70	M		50
PCB-154		NotFnd	<0.54	0.54	U		50
PCB-144		22.47	10.5	0.71	J		50
PCB-147/149		22.66	190	1.0			50
PCB-134/143		22.79	<12	1.3	J,R	12	50
PCB-139/140		22.97	<5.3	1.0	J,R	5.3	50
PCB-131		23.10	<4.3	1.3	J,R	4.3	50
PCB-142		NotFnd	<1.3	1.3	U		50
PCB-132		23.36	84.6	1.3			50
PCB-133		23.54	<1.9	1.2	J,R	1.9	50
PCB-165		NotFnd	<0.93	0.93	U		50
PCB-146		23.87	22.0	1.1	J		50
PCB-161		NotFnd	<0.89	0.89	U		50
PCB-153/168		24.18	134	0.93			50
PCB-141		24.31	38.5	1.2	J		50
PCB-130		24.54	15.6	1.5	J		50
PCB-137/164		24.71	26.3	1.1	M,J		50
PCB-129/138/163		24.87	208	1.2			50
PCB-160		NotFnd	<0.98	0.98	U		50
PCB-158		25.07	21.1	0.79	J		50
PCB-128/166		25.57	27.1	1.1	J		50
PCB-159		26.00	<1.0	0.94	J,R	1.0	50
PCB-162		NotFnd	<0.98	0.98	U		50
PCB-167	0.00003	26.40	<4.2	0.77	J,R	4.2	50
PCB-156/157	0.00003	27.02	14.3	1.0	J,B		100
PCB-169	0.03	NotFnd	<0.84	0.84	U		50
PCB-188		NotFnd	<0.93	0.93	U		50
PCB-179		23.71	14.2	0.74	J		50
PCB-184		23.94	<0.66	0.66	U	0.60	50
PCB-176		24.16	3.72	0.75	J		50
PCB-186		NotFnd	<0.77	0.77	U		50
PCB-178		25.06	<4.8	1.1	J,R	4.8	50
PCB-175		NotFnd	<1.1	1.1	U		50
PCB-187		25.53	36.2	0.96	J		50
PCB-182		NotFnd	<1.1	1.1	U		50
PCB-183		25.85	13.5	1.1	J		50
PCB-185		25.93	<1.6	1.1	M,J,R	1.6	50
PCB-174		26.02	<23	1.1	M,J,R	23	50
PCB-177		26.23	14.7	1.2	J		50
PCB-181		NotFnd	<1.1	1.1	U		50
PCB-171/173		26.56	9.55	1.2	J		50
PCB-172		27.33	<2.9	1.2	J,R	2.9	50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-168-DFP-01**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-8	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B31
Run Date	01-Dec-20 07:19
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	TEF (WHO 2005)	Ret. Time	Conc. pg	EDL pg	Flags	EMPC pg	LQL
PCB-192		NotFnd	<0.95	0.95	U		50
PCB-180/193		27.68	53.6	0.94			50
PCB-191		27.88	<1.4	0.81	J,R	1.4	50
PCB-170		28.37	17.9	0.94	J		50
PCB-190		28.64	2.96	0.59	M,J		50
PCB-189	0.00003	29.96	<0.69	0.69	M,U	0.59	50
PCB-202		26.27	9.47	1.3	J		50
PCB-201		26.75	2.62	0.91	J		50
PCB-204		NotFnd	<0.90	0.90	U		50
PCB-197		NotFnd	<0.88	0.88	U		50
PCB-200		27.31	<2.6	0.92	J,R	2.6	50
PCB-198/199		28.69	12.9	0.88	J		50
PCB-196		29.03	<4.0	0.87	J,R	4.0	50
PCB-203		29.12	<7.2	0.86	J,R	7.2	50
PCB-195		29.86	3.21	1.2	J		50
PCB-194		31.06	12.2	1.2	J		50
PCB-205		NotFnd	<0.84	0.84	U		50
PCB-208		29.68	7.88	2.8	J		50
PCB-207		30.15	<2.7	2.1	J,R	2.7	50
PCB-206		32.40	<10	2.2	J,R	10	50
PCB-209		33.53	133	8.7	B		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.95	74	5-145
13C12-PCB-003	2000	10.54	71	5-145
13C12-PCB-004	2000	10.68	79	5-145
13C12-PCB-015	2000	14.33	64	5-145
13C12-PCB-019	2000	12.64	80	5-145
13C12-PCB-037	2000	18.26	72	5-145
13C12-PCB-054	2000	14.48	89	5-145
13C12-PCB-081	2000	21.82	83	10-145
13C12-PCB-077	2000	22.12	81	10-145
13C12-PCB-104	2000	17.51	100	10-145
13C12-PCB-123	2000	23.08	82	10-145
13C12-PCB-118	2000	23.25	80	10-145
13C12-PCB-114	2000	23.55	85	10-145
13C12-PCB-105	2000	23.90	84	10-145
13C12-PCB-126	2000	25.51	77	10-145
13C12-PCB-155	2000	20.48	40	10-145
13C12-PCB-167	2000	26.38	89	10-145
13C12-PCB-156/157	4000	27.02	91	10-145
13C12-PCB-169	2000	28.67	96	10-145
13C12-PCB-188	2000	23.48	55	10-145
13C12-PCB-189	2000	29.95	91	10-145
13C12-PCB-202	2000	26.26	55	10-145
13C12-PCB-205	2000	31.33	125	10-145
13C12-PCB-208	2000	29.67	44	10-145
13C12-PCB-206	2000	32.39	106	10-145
13C12-PCB-209	2000	33.50	29	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.01	75	5-145
13C12-PCB-111	2000	22.01	82	10-145
13C12-PCB-178	2000	25.05	89	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-168-DFP-01**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-8	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B31
Run Date	01-Dec-20 07:19
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			7.20	0.57	J		200
Total DiCB			178	1.1	J		400
Total TriCB			133	0.68	J		400
Total TetraCB			553	0.48	J		800
Total PentaCB			1490	0.64	J		800
Total HexaCB			912	0.43	J		800
Total HeptaCB			200	0.59	J		400
Total OctaCB			54.2	0.84	J		400
Total NonaCB			20.6	2.1	J		200
DecaCB			133	8.7	J		200
Total PCB			3680		J		1600
Toxic Equivalency - (WHO 2005)							
Lower Bound PCB TEQ			0.00862				
Mid Point PCB TEQ			0.153				
Upper Bound PCB TEQ			0.295				

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**DFP-BLANK**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-9	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B24
Run Date	01-Dec-20 02:24
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		NotFnd	<1.6	1.6	U		50
PCB-002		10.40	<2.4	1.2	J,R	2.4	50
PCB-003		10.52	<3.3	0.92	J,R	3.3	50
PCB-004		NotFnd	<2.7	2.7	U		50
PCB-010		NotFnd	<1.8	1.8	U		50
PCB-009		NotFnd	<1.8	1.8	U		50
PCB-007		NotFnd	<1.7	1.7	U		50
PCB-006		12.19	2.29	1.8	J		50
PCB-005		NotFnd	<2.0	2.0	U		50
PCB-008		12.46	<4.8	1.6	M,J,R	4.8	50
PCB-014		NotFnd	<1.8	1.8	U		50
PCB-011		13.97	38.7	1.8	J		50
PCB-012/013		NotFnd	<1.9	1.9	U		50
PCB-015		NotFnd	<2.2	2.2	U		50
PCB-019		NotFnd	<0.85	0.85	U		50
PCB-018/030		13.74	<2.5	0.96	J,R	2.5	50
PCB-017		13.99	<1.1	1.1	M,U	0.98	50
PCB-027		NotFnd	<0.84	0.84	U		50
PCB-024		NotFnd	<0.84	0.84	U		50
PCB-016		14.29	<2.0	1.4	M,J,R	2.0	50
PCB-032		14.57	<1.5	0.78	J,R	1.5	50
PCB-034		NotFnd	<1.2	1.2	U		50
PCB-023		NotFnd	<1.1	1.1	U		50
PCB-026/029		15.54	<1.1	1.1	U	1.0	50
PCB-025		NotFnd	<1.0	1.0	U		50
PCB-031		15.86	5.02	1.1	J,B		50
PCB-020/028		16.03	<5.3	1.1	J,R	5.3	50
PCB-021/033		16.17	<2.7	1.1	J,R	2.7	50
PCB-022		16.40	2.28	1.2	J		50
PCB-036		NotFnd	<1.1	1.1	U		50
PCB-039		NotFnd	<1.1	1.1	U		50
PCB-038		NotFnd	<1.2	1.2	U		50
PCB-035		NotFnd	<1.3	1.3	U		50
PCB-037		18.29	<1.8	1.7	J,R	1.8	50
PCB-054		NotFnd	<0.58	0.58	U		50
PCB-050/053		15.67	<1.1	1.1	U		50
PCB-045/051		NotFnd	<1.1	1.1	U		50
PCB-046		NotFnd	<1.3	1.3	U		50
PCB-052		NotFnd	<1.1	1.1	U		50
PCB-073		NotFnd	<0.85	0.85	U		50
PCB-043		NotFnd	<1.5	1.5	U		50
PCB-049/069		17.26	<1.2	1.0	J,R	1.2	50
PCB-048		NotFnd	<1.2	1.2	U		50
PCB-044/047/065		17.57	<4.6	1.1	J,R	4.6	50
PCB-059/062/075		NotFnd	<0.88	0.88	U		50
PCB-042		17.86	<1.3	1.3	U	0.72	50
PCB-040/041/071		NotFnd	<1.2	1.2	U		50
PCB-064		18.26	1.26	0.89	J		50
PCB-072		NotFnd	<0.99	0.99	U		50
PCB-068		NotFnd	<0.93	0.93	U		50
PCB-057		NotFnd	<1.1	1.1	U		50
PCB-058		NotFnd	<0.97	0.97	U		50
PCB-067		NotFnd	<0.89	0.89	U		50
PCB-063		NotFnd	<0.98	0.98	U		50
PCB-061/070/074/076		19.61	<3.0	1.0	J,R	3.0	50
PCB-066		19.80	<1.3	1.0	M,J,R	1.3	50
PCB-055		NotFnd	<1.1	1.1	U		50
PCB-056		20.19	<2.0	1.1	J,R	2.0	50
PCB-060		NotFnd	<1.1	1.1	U		50
PCB-080		NotFnd	<0.93	0.93	U		50
PCB-079		NotFnd	<0.99	0.99	U		50
PCB-078		NotFnd	<1.2	1.2	U		50
PCB-081	0.0003	NotFnd	<1.3	1.3	U		50
PCB-077	0.0001	NotFnd	<1.4	1.4	U		50
PCB-104		NotFnd	<0.70	0.70	U		50
PCB-096		NotFnd	<0.71	0.71	U		50
PCB-103		NotFnd	<1.1	1.1	U		50
PCB-094		NotFnd	<1.3	1.3	U		50
PCB-095		19.14	<1.3	1.1	J,R	1.3	50
PCB-093/098/100/102		NotFnd	<1.2	1.2	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**DFP-BLANK**	Sampling Date	4-Nov-20		
ALS Sample ID	L2526958-9	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B24
Run Date	01-Dec-20 02:24
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-088/091		NotFnd	<1.2	1.2	U		50
PCB-084		NotFnd	<1.4	1.4	U		50
PCB-089		NotFnd	<1.4	1.4	U		50
PCB-121		NotFnd	<0.91	0.91	U		50
PCB-092		NotFnd	<1.3	1.3	U		50
PCB-090/101/113		20.65	2.25	1.1	M,J,B		50
PCB-083/099		NotFnd	<1.3	1.3	U		50
PCB-112		NotFnd	<0.96	0.96	U		50
PCB-086/087/097/109/119/125		NotFnd	<1.1	1.1	U		50
PCB-085/110/115/116/117		21.73	<2.5	1.1	J,R	2.5	50
PCB-082		NotFnd	<1.8	1.8	U		50
PCB-111		NotFnd	<0.98	0.98	U		50
PCB-120		NotFnd	<0.98	0.98	U		50
PCB-108/124		NotFnd	<1.2	1.2	U		50
PCB-107		NotFnd	<1.1	1.1	U		50
PCB-123	0.00003	NotFnd	<1.3	1.3	U		50
PCB-106		NotFnd	<1.3	1.3	U		50
PCB-118	0.00003	NotFnd	<1.3	1.3	U		50
PCB-122		NotFnd	<1.4	1.4	U		50
PCB-114	0.00003	NotFnd	<1.3	1.3	U		50
PCB-105	0.00003	NotFnd	<1.4	1.4	U		50
PCB-127		NotFnd	<1.3	1.3	U		50
PCB-126	0.1	NotFnd	<1.7	1.7	U		50
PCB-155		NotFnd	<0.44	0.44	U		50
PCB-152		NotFnd	<0.53	0.53	U		50
PCB-150		NotFnd	<0.51	0.51	U		50
PCB-136		NotFnd	<0.55	0.55	U		50
PCB-145		NotFnd	<0.55	0.55	U		50
PCB-148		NotFnd	<0.78	0.78	U		50
PCB-135/151		NotFnd	<0.83	0.83	U		50
PCB-154		NotFnd	<0.65	0.65	U		50
PCB-144		NotFnd	<0.84	0.84	U		50
PCB-147/149		22.67	<1.9	0.79	J,R	1.9	50
PCB-134/143		NotFnd	<0.97	0.97	U		50
PCB-139/140		NotFnd	<0.80	0.80	U		50
PCB-131		NotFnd	<1.0	1.0	U		50
PCB-142		NotFnd	<0.97	0.97	U		50
PCB-132		NotFnd	<0.96	0.96	U		50
PCB-133		NotFnd	<0.92	0.92	U		50
PCB-165		NotFnd	<0.71	0.71	U		50
PCB-146		NotFnd	<0.80	0.80	U		50
PCB-161		NotFnd	<0.68	0.68	U		50
PCB-153/168		24.18	1.73	0.71	J,B		50
PCB-141		NotFnd	<0.93	0.93	U		50
PCB-130		NotFnd	<1.1	1.1	U		50
PCB-137/164		NotFnd	<0.81	0.81	U		50
PCB-129/138/163		24.88	<1.3	0.92	J,R	1.3	50
PCB-160		NotFnd	<0.75	0.75	U		50
PCB-158		NotFnd	<0.61	0.61	U		50
PCB-128/166		NotFnd	<0.83	0.83	U		50
PCB-159		NotFnd	<0.71	0.71	U		50
PCB-162		NotFnd	<0.74	0.74	U		50
PCB-167	0.00003	NotFnd	<0.65	0.65	U		50
PCB-156/157	0.00003	NotFnd	<0.90	0.90	U		100
PCB-169	0.03	NotFnd	<0.79	0.79	U		50
PCB-188		NotFnd	<0.54	0.54	U		50
PCB-179		NotFnd	<0.59	0.59	U		50
PCB-184		NotFnd	<0.53	0.53	U		50
PCB-176		NotFnd	<0.60	0.60	U		50
PCB-186		NotFnd	<0.61	0.61	U		50
PCB-178		NotFnd	<0.90	0.90	U		50
PCB-175		NotFnd	<0.90	0.90	U		50
PCB-187		NotFnd	<0.77	0.77	U		50
PCB-182		NotFnd	<0.84	0.84	U		50
PCB-183		NotFnd	<0.84	0.84	U		50
PCB-185		NotFnd	<0.86	0.86	U		50
PCB-174		NotFnd	<0.91	0.91	U		50
PCB-177		NotFnd	<0.96	0.96	U		50
PCB-181		NotFnd	<0.90	0.90	U		50
PCB-171/173		NotFnd	<0.99	0.99	U		50
PCB-172		NotFnd	<0.99	0.99	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**DFP-BLANK**	Sampling Date	4-Nov-20		
ALS Sample ID	L2526958-9	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B24
Run Date	01-Dec-20 02:24
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<0.76	0.76	U		50
PCB-180/193		NotFnd	<0.75	0.75	U		50
PCB-191		NotFnd	<0.64	0.64	U		50
PCB-170		NotFnd	<0.75	0.75	U		50
PCB-190		NotFnd	<0.47	0.47	U		50
PCB-189	0.00003	NotFnd	<0.50	0.50	U		50
PCB-202		NotFnd	<0.88	0.88	U		50
PCB-201		NotFnd	<0.90	0.90	U		50
PCB-204		NotFnd	<0.90	0.90	U		50
PCB-197		NotFnd	<0.88	0.88	U		50
PCB-200		NotFnd	<0.92	0.92	U		50
PCB-198/199		NotFnd	<0.88	0.88	U		50
PCB-196		NotFnd	<0.86	0.86	U		50
PCB-203		NotFnd	<0.85	0.85	U		50
PCB-195		NotFnd	<0.71	0.71	U		50
PCB-194		31.08	<1.5	0.75	M,J,R	1.5	50
PCB-205		NotFnd	<0.68	0.68	U		50
PCB-208		NotFnd	<1.6	1.6	U		50
PCB-207		NotFnd	<1.7	1.7	U		50
PCB-206		32.43	4.75	2.6	J		50
PCB-209		33.54	59.5	3.5	B		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.94	54	5-145
13C12-PCB-003	2000	10.51	53	5-145
13C12-PCB-004	2000	10.66	61	5-145
13C12-PCB-015	2000	14.34	53	5-145
13C12-PCB-019	2000	12.64	64	5-145
13C12-PCB-037	2000	18.27	57	5-145
13C12-PCB-054	2000	14.48	73	5-145
13C12-PCB-081	2000	21.83	67	10-145
13C12-PCB-077	2000	22.14	66	10-145
13C12-PCB-104	2000	17.51	84	10-145
13C12-PCB-123	2000	23.09	66	10-145
13C12-PCB-118	2000	23.26	66	10-145
13C12-PCB-114	2000	23.56	68	10-145
13C12-PCB-105	2000	23.91	69	10-145
13C12-PCB-126	2000	25.52	64	10-145
13C12-PCB-155	2000	20.49	71	10-145
13C12-PCB-167	2000	26.39	76	10-145
13C12-PCB-156/157	4000	27.03	77	10-145
13C12-PCB-169	2000	28.69	78	10-145
13C12-PCB-188	2000	23.49	85	10-145
13C12-PCB-189	2000	29.95	74	10-145
13C12-PCB-202	2000	26.26	76	10-145
13C12-PCB-205	2000	31.33	90	10-145
13C12-PCB-208	2000	29.68	74	10-145
13C12-PCB-206	2000	32.40	89	10-145
13C12-PCB-209	2000	33.51	62	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.01	64	5-145
13C12-PCB-111	2000	22.02	72	10-145
13C12-PCB-178	2000	25.06	83	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**DFP-BLANK**	Sampling Date	4-Nov-20
ALS Sample ID	L2526958-9	Extraction Date	25-Nov-20
Analysis Method	EPA 1668C	Sample Size	1 Sample
Analysis Type	Sample	Percent Moisture	n/a
Sample Matrix	Swab	Split Ratio	2

Approved:
E. Sabljic
--e-signature--
01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B24
Run Date	01-Dec-20 02:24
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			5.70	0.92	J		200
Total DiCB			45.8	1.6	J		400
Total TriCB			23.1	0.78	J		400
Total TetraCB			13.4	0.58	J		800
Total PentaCB			6.05	0.70	J		800
Total HexaCB			4.93	0.44	J		800
Total HeptaCB			<0.47	0.47	U		400
Total OctaCB			1.50	0.68	J		400
Total NonaCB			4.75	1.6	J		200
DecaCB			59.5	3.5	J		200
Total PCB			165		J		1600

Toxic Equivalency - (WHO 2005)

Lower Bound PCB TEQ	0.00
Mid Point PCB TEQ	0.0972
Upper Bound PCB TEQ	0.194

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-159-DFP-1**	Sampling Date	4-Nov-20		
ALS Sample ID	L2526958-10	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B32
Run Date	01-Dec-20 08:02
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		NotFnd	<3.1	3.1	U		50
PCB-002		NotFnd	<3.6	3.6	U		50
PCB-003		NotFnd	<3.7	3.7	U		50
PCB-004		NotFnd	<12	12	U		50
PCB-010		NotFnd	<8.3	8.3	U		50
PCB-009		NotFnd	<8.3	8.3	U		50
PCB-007		NotFnd	<8.1	8.1	U		50
PCB-006		NotFnd	<8.5	8.5	U		50
PCB-005		NotFnd	<9.6	9.6	U		50
PCB-008		12.44	<9.6	7.7	M,J,R	9.6	50
PCB-014		NotFnd	<10	10	U		50
PCB-011		13.97	948	10	M		50
PCB-012/013		NotFnd	<10	10	U		50
PCB-015		NotFnd	<14	14	U		50
PCB-019		NotFnd	<4.9	4.9	U		50
PCB-018/030		13.74	<8.4	4.9	J,R	8.4	50
PCB-017		NotFnd	<5.7	5.7	U		50
PCB-027		NotFnd	<4.2	4.2	U		50
PCB-024		NotFnd	<4.2	4.2	U		50
PCB-016		NotFnd	<6.9	6.9	U		50
PCB-032		NotFnd	<4.0	4.0	U		50
PCB-034		NotFnd	<5.2	5.2	U		50
PCB-023		NotFnd	<4.9	4.9	U		50
PCB-026/029		NotFnd	<4.9	4.9	U		50
PCB-025		NotFnd	<4.4	4.4	U		50
PCB-031		15.86	17.3	4.5	J,B		50
PCB-020/028		NotFnd	<4.8	4.8	U		50
PCB-021/033		NotFnd	<4.7	4.7	U		50
PCB-022		16.40	<5.1	5.1	M,U	3.6	50
PCB-036		NotFnd	<4.8	4.8	U		50
PCB-039		NotFnd	<4.9	4.9	U		50
PCB-038		NotFnd	<5.3	5.3	U		50
PCB-035		18.08	<7.4	5.6	J,R	7.4	50
PCB-037		18.30	17.3	7.4	M,J		50
PCB-054		NotFnd	<2.0	2.0	U		50
PCB-050/053		15.69	<2.9	2.9	U	1.9	50
PCB-045/051		NotFnd	<3.0	3.0	U		50
PCB-046		NotFnd	<3.5	3.5	U		50
PCB-052		17.00	26.2	3.1	J,B		50
PCB-073		NotFnd	<2.3	2.3	U		50
PCB-043		NotFnd	<4.0	4.0	U		50
PCB-049/069		17.28	<8.6	2.8	J,R	8.6	50
PCB-048		17.43	<3.1	3.1	U	2.2	50
PCB-044/047/065		17.58	20.3	2.9	J,B		50
PCB-059/062/075		NotFnd	<2.4	2.4	U		50
PCB-042		17.89	<3.6	3.6	U		50
PCB-040/041/071		18.17	9.92	3.3	M,J,B		50
PCB-064		18.25	8.37	2.4	J		50
PCB-072		NotFnd	<2.9	2.9	U		50
PCB-068		NotFnd	<2.7	2.7	U		50
PCB-057		NotFnd	<3.1	3.1	U		50
PCB-058		NotFnd	<2.8	2.8	U		50
PCB-067		NotFnd	<2.6	2.6	U		50
PCB-063		NotFnd	<2.9	2.9	U		50
PCB-061/070/074/076		19.61	54.5	3.0			50
PCB-066		19.79	23.1	2.9	J		50
PCB-055		NotFnd	<3.2	3.2	U		50
PCB-056		20.17	<15	3.2	M,J,R	15	50
PCB-060		20.29	9.44	3.1	M,J		50
PCB-080		NotFnd	<2.7	2.7	U		50
PCB-079		NotFnd	<2.9	2.9	U		50
PCB-078		NotFnd	<3.4	3.4	U		50
PCB-081	0.0003	NotFnd	<3.3	3.3	U		50
PCB-077	0.0001	22.15	<8.7	3.6	J,R	8.7	50
PCB-104		NotFnd	<2.5	2.5	U		50
PCB-096		NotFnd	<2.1	2.1	U		50
PCB-103		NotFnd	<3.4	3.4	U		50
PCB-094		NotFnd	<3.9	3.9	U		50
PCB-095		19.13	26.3	3.6	J		50
PCB-093/098/100/102		NotFnd	<3.7	3.7	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-159-DFP-1**	Sampling Date	4-Nov-20
ALS Sample ID	L2526958-10	Extraction Date	25-Nov-20
Analysis Method	EPA 1668C	Sample Size	1 Sample
Analysis Type	Sample	Percent Moisture	n/a
Sample Matrix	Swab	Split Ratio	2

Approved:
E. Sabljic
--e-signature--
01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B32
Run Date	01-Dec-20 08:02
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-088/091		NotFnd	<3.8	3.8	U		50
PCB-084		19.74	<10	4.3	J,R	10	50
PCB-089		NotFnd	<4.3	4.3	U		50
PCB-121		NotFnd	<2.8	2.8	U		50
PCB-092		NotFnd	<4.2	4.2	U		50
PCB-090/101/113		20.65	47.7	3.4	J		50
PCB-083/099		20.95	26.5	4.2	J		50
PCB-112		NotFnd	<3.0	3.0	U		50
PCB-086/087/097/109/119/125		21.30	45.2	3.6	M,J		50
PCB-085/110/115/116/117		21.72	96.7	3.4	M		50
PCB-082		21.92	<12	5.5	M,J,R	12	50
PCB-111		NotFnd	<3.1	3.1	U		50
PCB-120		NotFnd	<3.0	3.0	U		50
PCB-108/124		NotFnd	<4.3	4.3	U		50
PCB-107		23.03	<5.8	3.7	M,J,R	5.8	50
PCB-123	0.00003	NotFnd	<4.4	4.4	U		50
PCB-106		NotFnd	<4.5	4.5	U		50
PCB-118	0.00003	23.26	89.4	4.2			50
PCB-122		NotFnd	<4.8	4.8	U		50
PCB-114	0.00003	NotFnd	<4.2	4.2	U		50
PCB-105	0.00003	23.93	<33	4.4	J,R	33	50
PCB-127		NotFnd	<4.7	4.7	U		50
PCB-126	0.1	25.54	<7.6	5.2	M,J,R	7.6	50
PCB-155		NotFnd	<2.3	2.3	U		50
PCB-152		NotFnd	<1.2	1.2	U		50
PCB-150		NotFnd	<1.1	1.1	U		50
PCB-136		20.97	<6.2	1.2	J,R	6.2	50
PCB-145		NotFnd	<1.2	1.2	U		50
PCB-148		NotFnd	<1.7	1.7	U		50
PCB-135/151		22.19	20.5	1.8	M,J		50
PCB-154		NotFnd	<1.4	1.4	U		50
PCB-144		22.46	3.21	1.8	J		50
PCB-147/149		22.66	66.0	5.3			50
PCB-134/143		22.78	<6.5	6.5	U	4.4	50
PCB-139/140		NotFnd	<5.4	5.4	U		50
PCB-131		NotFnd	<6.7	6.7	U		50
PCB-142		NotFnd	<6.5	6.5	U		50
PCB-132		23.36	<30	6.4	J,R	30	50
PCB-133		NotFnd	<6.2	6.2	U		50
PCB-165		NotFnd	<4.8	4.8	U		50
PCB-146		23.87	14.5	5.4	J		50
PCB-161		NotFnd	<4.6	4.6	U		50
PCB-153/168		24.18	79.0	4.7			50
PCB-141		24.32	<21	6.3	M,J,R	21	50
PCB-130		24.54	10.1	7.5	J		50
PCB-137/164		24.71	<14	5.4	M,J,R	14	50
PCB-129/138/163		24.88	127	6.2			50
PCB-160		NotFnd	<5.0	5.0	U		50
PCB-158		25.07	<13	4.1	J,R	13	50
PCB-128/166		25.57	20.7	5.6	J		50
PCB-159		NotFnd	<4.8	4.8	U		50
PCB-162		NotFnd	<5.0	5.0	U		50
PCB-167	0.00003	26.40	5.41	4.0	J		50
PCB-156/157	0.00003	27.01	13.4	5.3	J,B		100
PCB-169	0.03	NotFnd	<4.0	4.0	U		50
PCB-188		NotFnd	<2.9	2.9	U		50
PCB-179		23.72	<6.1	2.1	J,R	6.1	50
PCB-184		NotFnd	<1.8	1.8	U		50
PCB-176		NotFnd	<2.1	2.1	U		50
PCB-186		NotFnd	<2.1	2.1	U		50
PCB-178		NotFnd	<3.2	3.2	U		50
PCB-175		NotFnd	<3.1	3.1	U		50
PCB-187		25.52	32.7	2.7	J		50
PCB-182		NotFnd	<2.9	2.9	U		50
PCB-183		25.85	<8.5	3.0	J,R	8.5	50
PCB-185		NotFnd	<3.0	3.0	U		50
PCB-174		26.00	<21	3.2	J,R	21	50
PCB-177		26.23	13.9	3.4	J		50
PCB-181		NotFnd	<3.2	3.2	U		50
PCB-171/173		26.57	10.0	3.5	J		50
PCB-172		27.35	<3.6	3.5	J,R	3.6	50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-159-DFP-1**	Sampling Date	4-Nov-20
ALS Sample ID	L2526958-10	Extraction Date	25-Nov-20
Analysis Method	EPA 1668C	Sample Size	1 Sample
Analysis Type	Sample	Percent Moisture	n/a
Sample Matrix	Swab	Split Ratio	2

Approved:
E. Sabljic
--e-signature--
01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B32
Run Date	01-Dec-20 08:02
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<2.7	2.7	U		50
PCB-180/193		27.68	<63	2.6	R	63	50
PCB-191		27.84	<2.3	2.3	U	2.0	50
PCB-170		28.38	22.2	2.6	J		50
PCB-190		28.64	3.92	1.6	M,J		50
PCB-189	0.00003	NotFnd	<1.1	1.1	U		50
PCB-202		26.26	7.83	3.4	J		50
PCB-201		NotFnd	<2.5	2.5	U		50
PCB-204		NotFnd	<2.5	2.5	U		50
PCB-197		NotFnd	<2.5	2.5	U		50
PCB-200		NotFnd	<2.6	2.6	U		50
PCB-198/199		28.69	20.2	2.5	J		50
PCB-196		29.01	6.35	2.4	J		50
PCB-203		29.12	9.06	2.4	J		50
PCB-195		29.85	<3.0	2.1	J,R	3.0	50
PCB-194		31.06	14.2	2.2	J		50
PCB-205		NotFnd	<1.6	1.6	U		50
PCB-208		29.69	23.0	8.0	J		50
PCB-207		30.15	<11	5.9	M,J,R	11	50
PCB-206		32.40	31.9	6.4	J		50
PCB-209		NotFnd	<5300	5300	U		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**	
13C12-PCB-001	2000	8.95	51	5-145	R
13C12-PCB-003	2000	10.49	44	5-145	
13C12-PCB-004	2000	10.63	54	5-145	
13C12-PCB-015	2000	14.36	49	5-145	
13C12-PCB-019	2000	12.62	63	5-145	
13C12-PCB-037	2000	18.30	54	5-145	
13C12-PCB-054	2000	14.46	65	5-145	
13C12-PCB-081	2000	21.83	68	10-145	
13C12-PCB-077	2000	22.13	66	10-145	
13C12-PCB-104	2000	17.50	71	10-145	
13C12-PCB-123	2000	23.08	75	10-145	
13C12-PCB-118	2000	23.25	73	10-145	
13C12-PCB-114	2000	23.55	77	10-145	
13C12-PCB-105	2000	23.91	78	10-145	
13C12-PCB-126	2000	25.52	75	10-145	
13C12-PCB-155	2000	20.48	34	10-145	
13C12-PCB-167	2000	26.39	79	10-145	
13C12-PCB-156/157	4000	27.02	82	10-145	
13C12-PCB-169	2000	28.69	93	10-145	
13C12-PCB-188	2000	23.48	45	10-145	
13C12-PCB-189	2000	29.95	90	10-145	
13C12-PCB-202	2000	26.26	53	10-145	
13C12-PCB-205	2000	31.33	100	10-145	
13C12-PCB-208	2000	29.67	38	10-145	
13C12-PCB-206	2000	32.39	91	10-145	
13C12-PCB-209	2000	33.66	0	10-145	

Cleanup Standards				
13C12-PCB-028	2000	16.02	66	5-145
13C12-PCB-111	2000	22.01	83	10-145
13C12-PCB-178	2000	25.05	86	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-159-DFP-1**	Sampling Date	4-Nov-20		
ALS Sample ID	L2526958-10	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B32
Run Date	01-Dec-20 08:02
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			<3.1	3.1	U		200
Total DiCB			958	7.7	J		400
Total TriCB			50.4	4.0	J		400
Total TetraCB			184	2.0	J		800
Total PentaCB			400	2.1	J		800
Total HexaCB			444	1.1	J		800
Total HeptaCB			185	1.1	J		400
Total OctaCB			60.6	1.6	J		400
Total NonaCB			65.9	5.9	J		200
DecaCB			<5300	5300	U		200
Total PCB			2350		J		1600
Toxic Equivalency - (WHO 2005)							
Lower Bound PCB TEQ			0.00325				
Mid Point PCB TEQ			0.826				
Upper Bound PCB TEQ			0.886				

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor — TEQ: Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-583-DFP-01**	Sampling Date	4-Nov-20
ALS Sample ID	L2526958-11	Extraction Date	25-Nov-20
Analysis Method	EPA 1668C	Sample Size	1 Sample
Analysis Type	Sample	Percent Moisture	n/a
Sample Matrix	Swab	Split Ratio	2

Approved:
E. Sabljic
--e-signature--
01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B15
Run Date	30-Nov-20 19:54
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		8.98	16.9	1.0	M,J,B		50
PCB-002		10.40	70.5	0.91			50
PCB-003		10.51	69.9	0.78			50
PCB-004		10.66	<12	4.9	J,R	12	50
PCB-010		NotFnd	<2.9	2.9	U		50
PCB-009		NotFnd	<3.0	3.0	U		50
PCB-007		12.02	10.8	2.9	J		50
PCB-006		12.18	<13	3.1	J,R	13	50
PCB-005		NotFnd	<3.5	3.5	U		50
PCB-008		12.44	47.1	2.8	J,B		50
PCB-014		NotFnd	<2.8	2.8	U		50
PCB-011		13.95	894	2.9			50
PCB-012/013		14.14	<30	2.9	J,R	30	50
PCB-015		14.34	<42	3.1	J,R	42	50
PCB-019		12.65	<3.9	1.2	J,R	3.9	50
PCB-018/030		13.74	32.3	1.3	J,B		50
PCB-017		13.99	18.1	1.5	J		50
PCB-027		14.12	<2.3	1.1	J,R	2.3	50
PCB-024		NotFnd	<1.1	1.1	U		50
PCB-016		14.28	<15	1.7	J,R	15	50
PCB-032		14.56	10.5	1.0	J		50
PCB-034		NotFnd	<1.2	1.2	U		50
PCB-023		NotFnd	<1.1	1.1	U		50
PCB-026/029		15.53	<12	1.1	J,R	12	50
PCB-025		15.66	<8.5	1.0	J,R	8.5	50
PCB-031		15.85	62.7	1.0			50
PCB-020/028		16.02	78.9	1.1			50
PCB-021/033		16.16	<50	1.1	J,R	50	50
PCB-022		16.40	32.4	1.1	J		50
PCB-036		17.22	16.6	1.1	J		50
PCB-039		NotFnd	<1.1	1.1	U		50
PCB-038		17.85	<1.2	1.2	U		50
PCB-035		18.04	42.9	1.3	J		50
PCB-037		18.27	67.7	1.5			50
PCB-054		NotFnd	<0.49	0.49	U		50
PCB-050/053		15.68	8.55	0.72	J		50
PCB-045/051		16.10	71.3	0.75			50
PCB-046		16.27	<3.9	0.87	J,R	3.9	50
PCB-052		17.00	270	0.76			50
PCB-073		NotFnd	<0.56	0.56	U		50
PCB-043		17.12	<2.1	0.99	J,R	2.1	50
PCB-049/069		17.27	79.7	0.68			50
PCB-048		17.43	18.6	0.77	J		50
PCB-044/047/065		17.57	506	0.72			50
PCB-059/062/075		17.74	10.6	0.59	J		50
PCB-042		17.86	<25	0.87	J,R	25	50
PCB-040/041/071		18.13	60.8	0.81			50
PCB-064		18.25	61.2	0.60			50
PCB-072		NotFnd	<1.1	1.1	U		50
PCB-068		18.81	50.1	1.0			50
PCB-057		NotFnd	<1.2	1.2	U		50
PCB-058		NotFnd	<1.1	1.1	U		50
PCB-067		19.26	<2.9	1.0	J,R	2.9	50
PCB-063		19.41	<4.8	1.1	J,R	4.8	50
PCB-061/070/074/076		19.60	419	1.1			50
PCB-066		19.78	144	1.1			50
PCB-055		NotFnd	<1.2	1.2	U		50
PCB-056		20.15	62.5	1.2			50
PCB-060		20.28	38.0	1.2	J		50
PCB-080		NotFnd	<1.0	1.0	U		50
PCB-079		21.26	<6.5	1.1	J,R	6.5	50
PCB-078		21.63	<1.8	1.3	J,R	1.8	50
PCB-081	0.0003	NotFnd	<1.4	1.4	U		50
PCB-077	0.0001	22.13	47.1	1.5	J		50
PCB-104		NotFnd	<0.63	0.63	U		50
PCB-096		17.77	2.54	0.62	M,J		50
PCB-103		18.74	2.39	1.9	J		50
PCB-094		18.89	<2.2	2.2	U	1.6	50
PCB-095		19.13	475	2.1			50
PCB-093/098/100/102		19.30	17.3	2.0	J		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-583-DFP-01**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-11	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B15
Run Date	30-Nov-20 19:54
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	TEF (WHO 2005)	Ret. Time	Conc. pg	EDL pg	Flags	EMPC pg	LQL
PCB-088/091		19.59	71.7	2.1			50
PCB-084		19.74	163	2.4			50
PCB-089		19.99	<5.2	2.4	J,R	5.2	50
PCB-121		NotFnd	<1.6	1.6	U		50
PCB-092		20.34	112	2.3			50
PCB-090/101/113		20.64	657	1.9			50
PCB-083/099		20.96	331	2.2	M		50
PCB-112		21.06	<7.4	1.6	M,J,R	7.4	50
PCB-086/087/097/109/119/125		21.31	491	1.9	M		50
PCB-085/110/115/116/117		21.72	934	1.8	M		50
PCB-082		21.93	87.8	2.9			50
PCB-111		NotFnd	<1.6	1.6	U		50
PCB-120		NotFnd	<1.6	1.6	U		50
PCB-108/124		22.91	23.7	2.1	J		50
PCB-107		23.03	30.6	1.8	M,J		50
PCB-123	0.00003	23.08	10.1	2.4	M,J		50
PCB-106		NotFnd	<2.1	2.1	U		50
PCB-118	0.00003	23.27	524	2.2			50
PCB-122		23.48	<8.5	2.3	J,R	8.5	50
PCB-114	0.00003	23.58	<11	2.2	J,R	11	50
PCB-105	0.00003	23.93	182	2.2			50
PCB-127		NotFnd	<2.2	2.2	U		50
PCB-126	0.1	25.52	<9.3	2.6	M,J,R	9.3	50
PCB-155		20.49	<1.1	0.52	J,R	1.1	50
PCB-152		20.67	<0.55	0.50	J,R	0.55	50
PCB-150		20.73	0.668	0.48	J		50
PCB-136		20.97	61.2	0.51			50
PCB-145		NotFnd	<0.51	0.51	U		50
PCB-148		NotFnd	<0.71	0.71	U		50
PCB-135/151		22.18	139	0.75			50
PCB-154		NotFnd	<0.58	0.58	U		50
PCB-144		22.46	22.3	0.76	J		50
PCB-147/149		22.66	353	1.1			50
PCB-134/143		22.80	31.5	1.3	J		50
PCB-139/140		22.97	10.6	1.1	J		50
PCB-131		23.10	8.92	1.4	J		50
PCB-142		NotFnd	<1.3	1.3	U		50
PCB-132		23.36	177	1.3			50
PCB-133		23.54	5.15	1.3	J		50
PCB-165		23.72	<0.96	0.96	U	0.88	50
PCB-146		23.87	<46	1.1	J,R	46	50
PCB-161		NotFnd	<0.92	0.92	U		50
PCB-153/168		24.19	297	0.95			50
PCB-141		24.32	75.5	1.2			50
PCB-130		24.54	<24	1.5	J,R	24	50
PCB-137/164		24.71	48.9	1.1	M,J		50
PCB-129/138/163		24.88	454	1.2			50
PCB-160		NotFnd	<0.93	0.93	U		50
PCB-158		25.09	<42	0.84	J,R	42	50
PCB-128/166		25.57	63.2	1.1			50
PCB-159		26.00	<2.0	0.99	J,R	2.0	50
PCB-162		NotFnd	<1.0	1.0	U		50
PCB-167	0.00003	26.40	15.2	0.99	J		50
PCB-156/157	0.00003	27.02	37.9	1.4	J		100
PCB-169	0.03	NotFnd	<1.1	1.1	U		50
PCB-188		NotFnd	<0.55	0.55	U		50
PCB-179		23.72	25.3	0.50	J		50
PCB-184		23.94	1.70	0.45	J		50
PCB-176		24.18	8.24	0.51	J		50
PCB-186		NotFnd	<0.52	0.52	U		50
PCB-178		25.07	12.5	0.75	J		50
PCB-175		25.39	3.57	0.75	J		50
PCB-187		25.53	73.7	0.65			50
PCB-182		NotFnd	<0.71	0.71	U		50
PCB-183		25.85	35.0	0.73	M,J		50
PCB-185		25.94	5.25	0.74	M,J		50
PCB-174		26.00	50.3	0.77	M		50
PCB-177		26.25	28.2	0.83	J		50
PCB-181		26.45	<1.0	0.77	J,R	1.0	50
PCB-171/173		26.57	17.0	0.85	J		50
PCB-172		27.36	<8.6	0.86	J,R	8.6	50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-583-DFP-01**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-11	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B15
Run Date	30-Nov-20 19:54
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<0.68	0.68	U		50
PCB-180/193		27.68	115	0.70			50
PCB-191		27.88	<3.3	0.64	J,R	3.3	50
PCB-170		28.38	50.6	0.94			50
PCB-190		28.65	11.2	0.59	J		50
PCB-189	0.00003	29.96	<1.9	0.60	J,R	1.9	50
PCB-202		26.27	18.5	0.80	J		50
PCB-201		26.74	5.88	0.70	J		50
PCB-204		NotFnd	<0.71	0.71	U		50
PCB-197		27.19	<1.0	0.67	J,R	1.0	50
PCB-200		27.30	6.09	0.73	J		50
PCB-198/199		28.70	47.0	1.0	J		50
PCB-196		29.03	15.1	1.0	J		50
PCB-203		29.13	30.5	0.94	J		50
PCB-195		29.86	8.84	0.82	J		50
PCB-194		31.06	28.8	0.77	J		50
PCB-205		31.34	<1.6	0.61	J,R	1.6	50
PCB-208		29.68	21.9	1.5	J		50
PCB-207		30.15	8.07	1.5	J		50
PCB-206		32.40	53.4	2.2			50
PCB-209		33.54	89.4	3.7	B		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.95	67	5-145
13C12-PCB-003	2000	10.51	60	5-145
13C12-PCB-004	2000	10.65	69	5-145
13C12-PCB-015	2000	14.32	64	5-145
13C12-PCB-019	2000	12.62	79	5-145
13C12-PCB-037	2000	18.26	74	5-145
13C12-PCB-054	2000	14.47	84	5-145
13C12-PCB-081	2000	21.82	82	10-145
13C12-PCB-077	2000	22.12	78	10-145
13C12-PCB-104	2000	17.51	95	10-145
13C12-PCB-123	2000	23.08	78	10-145
13C12-PCB-118	2000	23.26	76	10-145
13C12-PCB-114	2000	23.56	80	10-145
13C12-PCB-105	2000	23.91	81	10-145
13C12-PCB-126	2000	25.51	78	10-145
13C12-PCB-155	2000	20.48	76	10-145
13C12-PCB-167	2000	26.39	86	10-145
13C12-PCB-156/157	4000	27.02	88	10-145
13C12-PCB-169	2000	28.69	95	10-145
13C12-PCB-188	2000	23.48	89	10-145
13C12-PCB-189	2000	29.95	92	10-145
13C12-PCB-202	2000	26.26	81	10-145
13C12-PCB-205	2000	31.33	111	10-145
13C12-PCB-208	2000	29.67	82	10-145
13C12-PCB-206	2000	32.39	99	10-145
13C12-PCB-209	2000	33.51	70	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.00	76	5-145
13C12-PCB-111	2000	22.02	84	10-145
13C12-PCB-178	2000	25.06	92	10-145

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-583-DFP-01**	Sampling Date	4-Nov-20
ALS Sample ID	L2526958-11	Extraction Date	25-Nov-20
Analysis Method	EPA 1668C	Sample Size	1 Sample
Analysis Type	Sample	Percent Moisture	n/a
Sample Matrix	Swab	Split Ratio	2

Approved:
E. Sabljic
--e-signature--
01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B15
Run Date	30-Nov-20 19:54
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			157	0.78	J		200
Total DiCB			1050	2.8	J		400
Total TriCB			454	1.0	J		400
Total TetraCB			1890	0.49	J		800
Total PentaCB			4160	0.62	J		800
Total HexaCB			1920	0.48	J		800
Total HeptaCB			452	0.45	J		400
Total OctaCB			163	0.61	J		400
Total NonaCB			83.4	1.5	J		200
DecaCB			89.4	3.7	J		200
Total PCB			10400		J		1600

Toxic Equivalency - (WHO 2005)

Lower Bound PCB TEQ	0.0278
Mid Point PCB TEQ	0.975
Upper Bound PCB TEQ	0.992

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-558-DFP-01**	Sampling Date	4-Nov-20		
ALS Sample ID	L2526958-12	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a		--e-signature--
Sample Matrix	Swab	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B16
Run Date	30-Nov-20 20:36
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		NotFnd	<4.7	4.7	U		50
PCB-002		10.51	33.6	1.7	J		50
PCB-003		10.62	<22	0.82	J,R	22	50
PCB-004		NotFnd	<5.2	5.2	U		50
PCB-010		NotFnd	<3.2	3.2	U		50
PCB-009		NotFnd	<3.2	3.2	U		50
PCB-007		NotFnd	<3.1	3.1	U		50
PCB-006		NotFnd	<3.3	3.3	U		50
PCB-005		NotFnd	<3.7	3.7	U		50
PCB-008		12.51	9.24	3.0	J,B		50
PCB-014		NotFnd	<2.4	2.4	U		50
PCB-011		13.98	1400	2.4			50
PCB-012/013		NotFnd	<2.4	2.4	U		50
PCB-015		14.37	<5.5	2.6	J,R	5.5	50
PCB-019		NotFnd	<1.2	1.2	U		50
PCB-018/030		13.78	<6.9	1.1	J,R	6.9	50
PCB-017		14.03	3.60	1.2	J		50
PCB-027		NotFnd	<0.93	0.93	U		50
PCB-024		NotFnd	<0.94	0.94	U		50
PCB-016		14.32	<3.2	1.4	J,R	3.2	50
PCB-032		14.59	3.07	0.86	J		50
PCB-034		NotFnd	<1.4	1.4	U		50
PCB-023		NotFnd	<1.3	1.3	U		50
PCB-026/029		15.57	3.39	1.3	J		50
PCB-025		15.69	<1.2	1.2	U	0.84	50
PCB-031		15.87	11.7	1.2	J,B		50
PCB-020/028		16.04	13.5	1.3	J		50
PCB-021/033		16.17	<8.0	1.3	J,R	8.0	50
PCB-022		16.41	5.33	1.3	J		50
PCB-036		NotFnd	<1.3	1.3	U		50
PCB-039		NotFnd	<1.3	1.3	U		50
PCB-038		NotFnd	<1.4	1.4	U		50
PCB-035		18.05	12.1	1.5	M,J		50
PCB-037		18.28	6.25	1.8	J		50
PCB-054		NotFnd	<0.56	0.56	U		50
PCB-050/053		15.71	<1.1	0.89	J,R	1.1	50
PCB-045/051		16.12	<4.4	0.93	J,R	4.4	50
PCB-046		NotFnd	<1.1	1.1	U		50
PCB-052		17.02	26.9	0.94	J,B		50
PCB-073		NotFnd	<0.69	0.69	U		50
PCB-043		NotFnd	<1.2	1.2	U		50
PCB-049/069		17.29	7.20	0.85	J		50
PCB-048		17.45	1.77	0.95	J		50
PCB-044/047/065		17.58	28.0	0.89	J,B		50
PCB-059/062/075		17.75	<0.73	0.73	U	0.47	50
PCB-042		17.88	<3.0	1.1	J,R	3.0	50
PCB-040/041/071		18.14	<6.8	1.0	J,R	6.8	50
PCB-064		18.26	<5.7	0.74	J,R	5.7	50
PCB-072		NotFnd	<0.77	0.77	U		50
PCB-068		18.81	4.58	0.72	J		50
PCB-057		NotFnd	<0.82	0.82	U		50
PCB-058		NotFnd	<0.75	0.75	U		50
PCB-067		NotFnd	<0.71	0.71	U		50
PCB-063		NotFnd	<0.76	0.76	U		50
PCB-061/070/074/076		19.61	36.2	0.79	J		50
PCB-066		19.79	<12	0.77	J,R	12	50
PCB-055		NotFnd	<0.83	0.83	U		50
PCB-056		20.16	<9.0	0.85	J,R	9.0	50
PCB-060		20.29	3.81	0.83	J		50
PCB-080		NotFnd	<0.71	0.71	U		50
PCB-079		21.30	<0.76	0.76	U	0.68	50
PCB-078		NotFnd	<0.89	0.89	U		50
PCB-081	0.0003	NotFnd	<0.94	0.94	U		50
PCB-077	0.0001	22.14	<5.0	1.0	J,R	5.0	50
PCB-104		NotFnd	<0.59	0.59	U		50
PCB-096		NotFnd	<0.57	0.57	U		50
PCB-103		NotFnd	<2.1	2.1	U		50
PCB-094		NotFnd	<2.4	2.4	U		50
PCB-095		19.14	37.7	2.4	J		50
PCB-093/098/100/102		NotFnd	<2.3	2.3	U		50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-558-DFP-01**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-12	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B16
Run Date	30-Nov-20 20:36
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-088/091		19.60	6.44	2.4	J		50
PCB-084		19.74	15.5	2.7	J		50
PCB-089		NotFnd	<2.6	2.6	U		50
PCB-121		NotFnd	<1.8	1.8	U		50
PCB-092		20.35	10.4	2.5	J		50
PCB-090/101/113		20.65	57.6	2.1			50
PCB-083/099		20.96	31.1	2.5	M,J		50
PCB-112		21.06	<2.4	1.8	M,J,R	2.4	50
PCB-086/087/097/109/119/125		21.31	50.3	2.2	M		50
PCB-085/110/115/116/117		21.72	123	2.0	M		50
PCB-082		21.92	<6.9	3.2	J,R	6.9	50
PCB-111		NotFnd	<1.8	1.8	U		50
PCB-120		22.27	29.5	1.8	J		50
PCB-108/124		22.90	<4.4	4.4	M,U	3.4	50
PCB-107		23.04	<3.8	3.8	M,U	2.6	50
PCB-123	0.00003	NotFnd	<4.9	4.9	U		50
PCB-106		NotFnd	<4.5	4.5	U		50
PCB-118	0.00003	23.26	<69	4.5	R	69	50
PCB-122		NotFnd	<4.9	4.9	U		50
PCB-114	0.00003	NotFnd	<4.6	4.6	U		50
PCB-105	0.00003	23.91	32.7	5.0	J		50
PCB-127		NotFnd	<4.6	4.6	U		50
PCB-126	0.1	NotFnd	<5.8	5.8	U		50
PCB-155		20.51	<0.78	0.78	U	0.73	50
PCB-152		NotFnd	<0.52	0.52	U		50
PCB-150		NotFnd	<0.50	0.50	U		50
PCB-136		20.97	8.52	0.54	M,J		50
PCB-145		NotFnd	<0.54	0.54	U		50
PCB-148		NotFnd	<0.76	0.76	U		50
PCB-135/151		22.17	19.6	0.79	M,J		50
PCB-154		NotFnd	<0.62	0.62	U		50
PCB-144		22.48	3.91	0.81	J		50
PCB-147/149		22.67	55.3	1.6			50
PCB-134/143		22.80	5.19	2.0	J		50
PCB-139/140		NotFnd	<1.6	1.6	U		50
PCB-131		NotFnd	<2.1	2.1	U		50
PCB-142		NotFnd	<2.0	2.0	U		50
PCB-132		23.36	32.0	1.9	J		50
PCB-133		NotFnd	<1.9	1.9	U		50
PCB-165		NotFnd	<1.4	1.4	U		50
PCB-146		23.87	10.6	1.6	J		50
PCB-161		NotFnd	<1.4	1.4	U		50
PCB-153/168		24.19	61.4	1.4			50
PCB-141		24.32	17.9	1.9	J		50
PCB-130		24.53	6.43	2.2	J		50
PCB-137/164		24.71	13.6	1.6	M,J		50
PCB-129/138/163		24.88	117	1.9			50
PCB-160		NotFnd	<1.4	1.4	U		50
PCB-158		25.07	11.4	1.3	J		50
PCB-128/166		25.57	17.9	1.7	J		50
PCB-159		25.97	5.39	1.5	J		50
PCB-162		NotFnd	<1.5	1.5	U		50
PCB-167	0.00003	26.40	<5.2	1.4	J,R	5.2	50
PCB-156/157	0.00003	27.02	18.0	1.9	J		100
PCB-169	0.03	NotFnd	<1.5	1.5	U		50
PCB-188		NotFnd	<1.3	1.3	U		50
PCB-179		23.72	6.41	1.0	J		50
PCB-184		23.95	<0.94	0.94	U		50
PCB-176		24.16	2.20	1.1	J		50
PCB-186		NotFnd	<1.1	1.1	U		50
PCB-178		25.07	3.06	1.6	J		50
PCB-175		NotFnd	<1.6	1.6	U		50
PCB-187		25.53	22.3	1.4	J,B		50
PCB-182		NotFnd	<1.5	1.5	U		50
PCB-183		25.85	<11	1.5	J,R	11	50
PCB-185		25.93	<1.8	1.5	J,R	1.8	50
PCB-174		26.00	21.7	1.6	M,J		50
PCB-177		26.25	11.4	1.7	J		50
PCB-181		NotFnd	<1.6	1.6	U		50
PCB-171/173		26.56	<4.7	1.8	J,R	4.7	50
PCB-172		27.36	<2.6	1.8	J,R	2.6	50

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-558-DFP-01**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-12	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B16
Run Date	30-Nov-20 20:36
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<1.4	1.4	U		50
PCB-180/193		27.73	204	1.5			50
PCB-191		NotFnd	<1.3	1.3	U		50
PCB-170		28.37	34.0	1.9	J		50
PCB-190		28.65	5.83	1.2	J		50
PCB-189	0.00003	29.96	<1.3	1.3	M,U	0.66	50
PCB-202		26.27	<1.8	1.4	J,R	1.8	50
PCB-201		26.75	<1.1	1.1	M,U	0.86	50
PCB-204		NotFnd	<1.1	1.1	U		50
PCB-197		NotFnd	<1.0	1.0	U		50
PCB-200		NotFnd	<1.1	1.1	U		50
PCB-198/199		28.70	16.9	1.6	J		50
PCB-196		29.03	6.80	1.6	J		50
PCB-203		29.12	<8.4	1.5	J,R	8.4	50
PCB-195		29.85	4.78	1.5	J		50
PCB-194		31.06	17.9	1.4	J		50
PCB-205		NotFnd	<1.1	1.1	U		50
PCB-208		29.69	<5.3	2.6	J,R	5.3	50
PCB-207		30.15	4.40	1.9	M,J		50
PCB-206		32.37	<21	2.1	J,R	21	50
PCB-209		33.53	218	9.4	B		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**	
13C12-PCB-001	2000	8.97	40	5-145	R
13C12-PCB-003	2000	10.62	62	5-145	R
13C12-PCB-004	2000	10.75	64	5-145	
13C12-PCB-015	2000	14.36	58	5-145	
13C12-PCB-019	2000	12.69	65	5-145	
13C12-PCB-037	2000	18.27	65	5-145	
13C12-PCB-054	2000	14.51	76	5-145	
13C12-PCB-081	2000	21.81	68	10-145	
13C12-PCB-077	2000	22.11	64	10-145	
13C12-PCB-104	2000	17.52	81	10-145	
13C12-PCB-123	2000	23.08	66	10-145	
13C12-PCB-118	2000	23.25	67	10-145	
13C12-PCB-114	2000	23.55	70	10-145	
13C12-PCB-105	2000	23.91	68	10-145	
13C12-PCB-126	2000	25.51	64	10-145	
13C12-PCB-155	2000	20.49	42	10-145	
13C12-PCB-167	2000	26.38	75	10-145	
13C12-PCB-156/157	4000	27.02	76	10-145	
13C12-PCB-169	2000	28.69	87	10-145	
13C12-PCB-188	2000	23.48	58	10-145	
13C12-PCB-189	2000	29.95	77	10-145	
13C12-PCB-202	2000	26.26	57	10-145	
13C12-PCB-205	2000	31.33	90	10-145	
13C12-PCB-208	2000	29.67	41	10-145	
13C12-PCB-206	2000	32.39	90	10-145	
13C12-PCB-209	2000	33.51	25	10-145	
Cleanup Standards					
13C12-PCB-028	2000	16.03	72	5-145	
13C12-PCB-111	2000	22.02	73	10-145	
13C12-PCB-178	2000	25.05	80	10-145	

ALS Life Sciences

Sample Analysis Report

Sample Name	**ENG-558-DFP-01**	Sampling Date	4-Nov-20	
ALS Sample ID	L2526958-12	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Sample	*E. Sabljic*
Analysis Type	Sample	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B16
Run Date	30-Nov-20 20:36
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			55.6	0.82	J		200
Total DiCB			1410	2.4	J		400
Total TriCB			77.0	0.86	J		400
Total TetraCB			155	0.56	J		800
Total PentaCB			473	0.57	J		800
Total HexaCB			409	0.50	J		800
Total HeptaCB			331	0.94	J		400
Total OctaCB			56.6	1.0	J		400
Total NonaCB			30.7	1.9	J		200
DecaCB			218	9.4	J		200
Total PCB			3220		J		1600

Toxic Equivalency - (WHO 2005)

Lower Bound PCB TEQ	0.00152
Mid Point PCB TEQ	0.317
Upper Bound PCB TEQ	0.630

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor
TEQ	Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
B	Indicates that this target was detected in the blank at greater than 10% of the sample concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a		Approved:
ALS Sample ID	WG3440853-1	Extraction Date	25-Nov-20		*E. Sabljic*
Analysis Method	EPA 1668C	Sample Size	1	Blank	--e-signature--
Analysis Type	Blank	Percent Moisture	n/a		01-Dec-2020
Sample Matrix	Swab	Split Ratio	2		

Run Information	**Run 1**
Filename	5-201130B21
Run Date	01-Dec-20 00:17
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		8.94	2.60	0.62	M,J		50
PCB-002		10.37	<3.4	0.72	J,R	3.4	50
PCB-003		10.49	<4.6	0.76	J,R	4.6	50
PCB-004		NotFnd	<4.3	4.3	U		50
PCB-010		NotFnd	<2.8	2.8	U		50
PCB-009		NotFnd	<2.8	2.8	U		50
PCB-007		NotFnd	<2.8	2.8	U		50
PCB-006		NotFnd	<2.9	2.9	U		50
PCB-005		NotFnd	<3.3	3.3	U		50
PCB-008		12.44	5.96	2.6	J		50
PCB-014		NotFnd	<2.2	2.2	U		50
PCB-011		13.97	<27	2.2	J,R	27	50
PCB-012/013		NotFnd	<2.2	2.2	U		50
PCB-015		NotFnd	<2.6	2.6	U		50
PCB-019		NotFnd	<1.3	1.3	U		50
PCB-018/030		13.73	3.27	1.3	M,J		50
PCB-017		13.99	<2.0	1.6	J,R	2.0	50
PCB-027		NotFnd	<1.2	1.2	U		50
PCB-024		NotFnd	<1.2	1.2	U		50
PCB-016		14.27	<1.9	1.9	U	1.1	50
PCB-032		14.56	<1.2	1.1	J,R	1.2	50
PCB-034		NotFnd	<1.7	1.7	U		50
PCB-023		NotFnd	<1.6	1.6	U		50
PCB-026/029		15.55	<1.6	1.6	U	0.96	50
PCB-025		NotFnd	<1.4	1.4	U		50
PCB-031		15.85	5.93	1.5	J		50
PCB-020/028		NotFnd	<1.6	1.6	U		50
PCB-021/033		16.16	<3.3	1.6	J,R	3.3	50
PCB-022		16.41	<1.7	1.7	M,U	1.6	50
PCB-036		NotFnd	<1.6	1.6	U		50
PCB-039		NotFnd	<1.6	1.6	U		50
PCB-038		NotFnd	<1.8	1.8	U		50
PCB-035		NotFnd	<1.8	1.8	U		50
PCB-037		NotFnd	<2.5	2.5	U		50
PCB-054		NotFnd	<0.66	0.66	U		50
PCB-050/053		NotFnd	<1.2	1.2	U		50
PCB-045/051		16.09	1.48	1.2	M,J		50
PCB-046		NotFnd	<1.4	1.4	U		50
PCB-052		16.99	2.96	1.3	J		50
PCB-073		NotFnd	<0.93	0.93	U		50
PCB-043		NotFnd	<1.6	1.6	U		50
PCB-049/069		17.26	<1.3	1.1	M,J,R	1.3	50
PCB-048		NotFnd	<1.3	1.3	U		50
PCB-044/047/065		17.57	5.13	1.2	J		50
PCB-059/062/075		NotFnd	<0.97	0.97	U		50
PCB-042		NotFnd	<1.5	1.5	U		50
PCB-040/041/071		18.14	1.36	1.3	J		50
PCB-064		18.24	<1.0	0.97	J,R	1.0	50
PCB-072		NotFnd	<1.4	1.4	U		50
PCB-068		NotFnd	<1.3	1.3	U		50
PCB-057		NotFnd	<1.5	1.5	U		50
PCB-058		NotFnd	<1.4	1.4	U		50
PCB-067		NotFnd	<1.3	1.3	U		50
PCB-063		NotFnd	<1.4	1.4	U		50
PCB-061/070/074/076		19.62	<2.8	1.4	M,J,R	2.8	50
PCB-066		19.80	<1.4	1.4	U	0.69	50
PCB-055		NotFnd	<1.5	1.5	U		50
PCB-056		20.15	1.89	1.5	M,J		50
PCB-060		NotFnd	<1.5	1.5	U		50
PCB-080		NotFnd	<1.3	1.3	U		50
PCB-079		NotFnd	<1.4	1.4	U		50
PCB-078		NotFnd	<1.7	1.7	U		50
PCB-081	0.0003	NotFnd	<1.9	1.9	U		50
PCB-077	0.0001	NotFnd	<2.1	2.1	U		50
PCB-104		NotFnd	<0.94	0.94	U		50
PCB-096		NotFnd	<1.0	1.0	U		50
PCB-103		NotFnd	<1.7	1.7	U		50
PCB-094		NotFnd	<1.9	1.9	U		50
PCB-095		NotFnd	<1.8	1.8	U		50
PCB-093/098/100/102		NotFnd	<1.8	1.8	U		50

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a	
ALS Sample ID	WG3440853-1	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Blank	*E. Sabljic*
Analysis Type	Blank	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B21
Run Date	01-Dec-20 00:17
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	TEF (WHO 2005)	Ret. Time	Conc. pg	EDL pg	Flags	EMPC pg	LQL
PCB-088/091		NotFnd	<1.9	1.9	U		50
PCB-084		NotFnd	<2.1	2.1	U		50
PCB-089		NotFnd	<2.1	2.1	U		50
PCB-121		NotFnd	<1.4	1.4	U		50
PCB-092		NotFnd	<2.1	2.1	U		50
PCB-090/101/113		20.63	3.82	1.7	M,J		50
PCB-083/099		NotFnd	<2.1	2.1	U		50
PCB-112		NotFnd	<1.5	1.5	U		50
PCB-086/087/097/109/119/125		NotFnd	<1.8	1.8	U		50
PCB-085/110/115/116/117		NotFnd	<1.7	1.7	U		50
PCB-082		NotFnd	<2.7	2.7	U		50
PCB-111		NotFnd	<1.5	1.5	U		50
PCB-120		NotFnd	<1.5	1.5	U		50
PCB-108/124		NotFnd	<1.7	1.7	U		50
PCB-107		NotFnd	<1.5	1.5	U		50
PCB-123	0.00003	NotFnd	<2.0	2.0	U		50
PCB-106		NotFnd	<1.8	1.8	U		50
PCB-118	0.00003	NotFnd	<1.8	1.8	U		50
PCB-122		NotFnd	<1.9	1.9	U		50
PCB-114	0.00003	NotFnd	<1.9	1.9	U		50
PCB-105	0.00003	NotFnd	<1.9	1.9	U		50
PCB-127		NotFnd	<1.9	1.9	U		50
PCB-126	0.1	25.56	<2.4	2.4	M,J,R	2.4	50
PCB-155		NotFnd	<1.2	1.2	U		50
PCB-152		NotFnd	<0.76	0.76	U		50
PCB-150		NotFnd	<0.73	0.73	U		50
PCB-136		NotFnd	<0.79	0.79	U		50
PCB-145		NotFnd	<0.80	0.80	U		50
PCB-148		NotFnd	<1.1	1.1	U		50
PCB-135/151		NotFnd	<1.2	1.2	U		50
PCB-154		NotFnd	<0.93	0.93	U		50
PCB-144		NotFnd	<1.2	1.2	U		50
PCB-147/149		22.66	4.64	1.2	J		50
PCB-134/143		NotFnd	<1.5	1.5	U		50
PCB-139/140		NotFnd	<1.2	1.2	U		50
PCB-131		NotFnd	<1.6	1.6	U		50
PCB-142		NotFnd	<1.5	1.5	U		50
PCB-132		NotFnd	<1.5	1.5	U		50
PCB-133		NotFnd	<1.4	1.4	U		50
PCB-165		NotFnd	<1.1	1.1	U		50
PCB-146		NotFnd	<1.3	1.3	U		50
PCB-161		NotFnd	<1.1	1.1	U		50
PCB-153/168		24.18	4.17	1.1	M,J		50
PCB-141		NotFnd	<1.5	1.5	U		50
PCB-130		NotFnd	<1.7	1.7	U		50
PCB-137/164		NotFnd	<1.3	1.3	U		50
PCB-129/138/163		24.88	2.90	1.4	J		50
PCB-160		NotFnd	<1.2	1.2	U		50
PCB-158		NotFnd	<0.95	0.95	U		50
PCB-128/166		NotFnd	<1.3	1.3	U		50
PCB-159		NotFnd	<1.1	1.1	U		50
PCB-162		NotFnd	<1.2	1.2	U		50
PCB-167	0.00003	NotFnd	<0.88	0.88	U		50
PCB-156/157	0.00003	27.03	1.57	1.2	M,J		100
PCB-169	0.03	NotFnd	<1.1	1.1	U		50
PCB-188		NotFnd	<1.5	1.5	U		50
PCB-179		NotFnd	<1.2	1.2	U		50
PCB-184		NotFnd	<1.1	1.1	U		50
PCB-176		NotFnd	<1.2	1.2	U		50
PCB-186		NotFnd	<1.2	1.2	U		50
PCB-178		NotFnd	<1.8	1.8	U		50
PCB-175		NotFnd	<1.8	1.8	U		50
PCB-187		25.54	2.24	1.5	J		50
PCB-182		NotFnd	<1.7	1.7	U		50
PCB-183		NotFnd	<1.7	1.7	U		50
PCB-185		NotFnd	<1.7	1.7	U		50
PCB-174		NotFnd	<1.8	1.8	U		50
PCB-177		NotFnd	<1.9	1.9	U		50
PCB-181		NotFnd	<1.8	1.8	U		50
PCB-171/173		NotFnd	<2.0	2.0	U		50
PCB-172		NotFnd	<2.0	2.0	U		50

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a	
ALS Sample ID	WG3440853-1	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Blank	*E. Sabljic*
Analysis Type	Blank	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B21
Run Date	01-Dec-20 00:17
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<1.5	1.5	U		50
PCB-180/193		NotFnd	<1.5	1.5	U		50
PCB-191		NotFnd	<1.3	1.3	U		50
PCB-170		NotFnd	<1.5	1.5	U		50
PCB-190		NotFnd	<0.94	0.94	U		50
PCB-189	0.00003	NotFnd	<0.67	0.67	U		50
PCB-202		NotFnd	<1.9	1.9	U		50
PCB-201		NotFnd	<1.7	1.7	U		50
PCB-204		NotFnd	<1.6	1.6	U		50
PCB-197		NotFnd	<1.6	1.6	U		50
PCB-200		NotFnd	<1.7	1.7	U		50
PCB-198/199		NotFnd	<1.6	1.6	U		50
PCB-196		NotFnd	<1.6	1.6	U		50
PCB-203		29.13	<1.6	1.6	U	1.1	50
PCB-195		NotFnd	<1.7	1.7	U		50
PCB-194		31.06	<2.1	1.8	J,R	2.1	50
PCB-205		NotFnd	<1.4	1.4	U		50
PCB-208		NotFnd	<3.7	3.7	U		50
PCB-207		NotFnd	<3.0	3.0	U		50
PCB-206		NotFnd	<3.3	3.3	U		50
PCB-209		33.54	270	17			50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.92	64	5-145
13C12-PCB-003	2000	10.48	56	5-145
13C12-PCB-004	2000	10.62	63	5-145
13C12-PCB-015	2000	14.33	56	5-145
13C12-PCB-019	2000	12.62	63	5-145
13C12-PCB-037	2000	18.28	58	5-145
13C12-PCB-054	2000	14.47	78	5-145
13C12-PCB-081	2000	21.83	70	10-145
13C12-PCB-077	2000	22.14	67	10-145
13C12-PCB-104	2000	17.50	91	10-145
13C12-PCB-123	2000	23.09	67	10-145
13C12-PCB-118	2000	23.26	68	10-145
13C12-PCB-114	2000	23.56	70	10-145
13C12-PCB-105	2000	23.91	70	10-145
13C12-PCB-126	2000	25.52	66	10-145
13C12-PCB-155	2000	20.48	33	10-145
13C12-PCB-167	2000	26.39	77	10-145
13C12-PCB-156/157	4000	27.03	77	10-145
13C12-PCB-169	2000	28.70	78	10-145
13C12-PCB-188	2000	23.48	47	10-145
13C12-PCB-189	2000	29.95	76	10-145
13C12-PCB-202	2000	26.26	52	10-145
13C12-PCB-205	2000	31.33	89	10-145
13C12-PCB-208	2000	29.67	39	10-145
13C12-PCB-206	2000	32.39	84	10-145
13C12-PCB-209	2000	33.51	20	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.01	70	5-145
13C12-PCB-111	2000	22.01	71	10-145
13C12-PCB-178	2000	25.06	78	10-145

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a	
ALS Sample ID	WG3440853-1	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Blank	*E. Sabljic*
Analysis Type	Blank	Percent Moisture	n/a	--e-signature--
Sample Matrix	Swab	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B21
Run Date	01-Dec-20 00:17
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			10.6	0.62	J		200
Total DiCB			33.0	2.2	J		400
Total TriCB			15.7	1.1	J		400
Total TetraCB			17.9	0.66	J		800
Total PentaCB			3.82	0.94	J		800
Total HexaCB			13.3	0.73	J		800
Total HeptaCB			2.24	0.67	J		400
Total OctaCB			2.10	1.4	J		400
Total NonaCB			<3.0	3.0	U		200
DecaCB			270	17	J		200
Total PCB			369		J		1600
Toxic Equivalency - (WHO 2005)							
Lower Bound PCB TEQ			0.0000471				
Mid Point PCB TEQ			0.257				
Upper Bound PCB TEQ			0.274				

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a		
ALS Sample ID	WG3440853-4	Extraction Date	25-Nov-20		Approved:
Analysis Method	EPA 1668C	Sample Size	1	Blank	*E. Sabljic*
Analysis Type	Blank	Percent Moisture	n/a		--e-signature--
Sample Matrix	Reagent	Split Ratio	2		01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B22
Run Date	01-Dec-20 01:00
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-001		8.94	<1.1	0.44	M,J,R	1.1	50
PCB-002		10.37	<2.0	0.49	J,R	2.0	50
PCB-003		10.48	<2.5	0.49	M,J,R	2.5	50
PCB-004		NotFnd	<2.5	2.5	U		50
PCB-010		NotFnd	<1.7	1.7	U		50
PCB-009		NotFnd	<1.7	1.7	U		50
PCB-007		NotFnd	<1.7	1.7	U		50
PCB-006		NotFnd	<1.7	1.7	U		50
PCB-005		NotFnd	<1.9	1.9	U		50
PCB-008		12.43	<3.5	1.6	M,J,R	3.5	50
PCB-014		NotFnd	<1.8	1.8	U		50
PCB-011		13.95	22.7	1.9	J		50
PCB-012/013		NotFnd	<1.9	1.9	U		50
PCB-015		NotFnd	<2.3	2.3	U		50
PCB-019		NotFnd	<0.92	0.92	U		50
PCB-018/030		NotFnd	<0.94	0.94	U		50
PCB-017		13.98	<1.1	1.1	U	1.0	50
PCB-027		NotFnd	<0.82	0.82	U		50
PCB-024		NotFnd	<0.82	0.82	U		50
PCB-016		14.28	<1.3	1.3	M,U	0.71	50
PCB-032		14.56	<0.77	0.77	U		50
PCB-034		NotFnd	<1.0	1.0	U		50
PCB-023		NotFnd	<0.94	0.94	U		50
PCB-026/029		NotFnd	<0.94	0.94	U		50
PCB-025		NotFnd	<0.85	0.85	U		50
PCB-031		15.85	3.65	0.88	J		50
PCB-020/028		NotFnd	<0.93	0.93	U		50
PCB-021/033		16.14	<1.9	0.92	M,J,R	1.9	50
PCB-022		16.40	2.34	0.98	J		50
PCB-036		NotFnd	<0.94	0.94	U		50
PCB-039		NotFnd	<0.96	0.96	U		50
PCB-038		NotFnd	<1.0	1.0	U		50
PCB-035		NotFnd	<1.1	1.1	U		50
PCB-037		18.27	1.81	1.4	J		50
PCB-054		NotFnd	<0.39	0.39	U		50
PCB-050/053		NotFnd	<0.78	0.78	U		50
PCB-045/051		NotFnd	<0.81	0.81	U		50
PCB-046		NotFnd	<0.94	0.94	U		50
PCB-052		16.99	3.01	0.83	J		50
PCB-073		NotFnd	<0.62	0.62	U		50
PCB-043		NotFnd	<1.1	1.1	U		50
PCB-049/069		17.26	<1.3	0.75	M,J,R	1.3	50
PCB-048		17.44	<0.84	0.84	U		50
PCB-044/047/065		17.56	<4.4	0.78	J,R	4.4	50
PCB-059/062/075		NotFnd	<0.64	0.64	U		50
PCB-042		NotFnd	<0.97	0.97	U		50
PCB-040/041/071		NotFnd	<0.89	0.89	U		50
PCB-064		18.24	1.16	0.64	J		50
PCB-072		NotFnd	<0.69	0.69	U		50
PCB-068		18.81	<0.65	0.65	U	0.37	50
PCB-057		NotFnd	<0.73	0.73	U		50
PCB-058		NotFnd	<0.67	0.67	U		50
PCB-067		NotFnd	<0.61	0.61	U		50
PCB-063		NotFnd	<0.68	0.68	U		50
PCB-061/070/074/076		19.60	<3.4	0.69	M,J,R	3.4	50
PCB-066		19.79	<0.80	0.69	J,R	0.80	50
PCB-055		NotFnd	<0.75	0.75	U		50
PCB-056		20.16	<0.78	0.75	J,R	0.78	50
PCB-060		NotFnd	<0.74	0.74	U		50
PCB-080		NotFnd	<0.65	0.65	U		50
PCB-079		NotFnd	<0.68	0.68	U		50
PCB-078		NotFnd	<0.81	0.81	U		50
PCB-081	0.0003	NotFnd	<0.89	0.89	U		50
PCB-077	0.0001	22.14	<0.94	0.94	U	0.93	50
PCB-104		NotFnd	<0.75	0.75	U		50
PCB-096		NotFnd	<0.70	0.70	U		50
PCB-103		NotFnd	<0.96	0.96	U		50
PCB-094		NotFnd	<1.1	1.1	U		50
PCB-095		NotFnd	<1.0	1.0	U		50
PCB-093/098/100/102		NotFnd	<1.1	1.1	U		50

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a
ALS Sample ID	WG3440853-4	Extraction Date	25-Nov-20
Analysis Method	EPA 1668C	Sample Size	1 Blank
Analysis Type	Blank	Percent Moisture	n/a
Sample Matrix	Reagent	Split Ratio	2

Approved:
E. Sabljic
--e-signature--
01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B22
Run Date	01-Dec-20 01:00
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-088/091		NotFnd	<1.1	1.1	U		50
PCB-084		19.74	<1.2	1.2	U	0.82	50
PCB-089		NotFnd	<1.2	1.2	U		50
PCB-121		NotFnd	<0.81	0.81	U		50
PCB-092		NotFnd	<1.2	1.2	U		50
PCB-090/101/113		20.63	1.94	0.97	M,J		50
PCB-083/099		NotFnd	<1.2	1.2	U		50
PCB-112		NotFnd	<0.85	0.85	U		50
PCB-086/087/097/109/119/125		NotFnd	<1.0	1.0	U		50
PCB-085/110/115/116/117		21.72	2.93	0.96	J		50
PCB-082		NotFnd	<1.6	1.6	U		50
PCB-111		NotFnd	<0.87	0.87	U		50
PCB-120		NotFnd	<0.87	0.87	U		50
PCB-108/124		NotFnd	<1.1	1.1	U		50
PCB-107		NotFnd	<1.0	1.0	U		50
PCB-123	0.00003	NotFnd	<1.2	1.2	U		50
PCB-106		NotFnd	<1.2	1.2	U		50
PCB-118	0.00003	NotFnd	<1.2	1.2	U		50
PCB-122		NotFnd	<1.3	1.3	U		50
PCB-114	0.00003	NotFnd	<1.2	1.2	U		50
PCB-105	0.00003	NotFnd	<1.3	1.3	U		50
PCB-127		NotFnd	<1.3	1.3	U		50
PCB-126	0.1	25.50	<1.5	1.5	M,U	1.0	50
PCB-155		NotFnd	<0.67	0.67	U		50
PCB-152		NotFnd	<0.49	0.49	U		50
PCB-150		NotFnd	<0.47	0.47	U		50
PCB-136		NotFnd	<0.51	0.51	U		50
PCB-145		NotFnd	<0.51	0.51	U		50
PCB-148		NotFnd	<0.72	0.72	U		50
PCB-135/151		NotFnd	<0.77	0.77	U		50
PCB-154		NotFnd	<0.60	0.60	U		50
PCB-144		NotFnd	<0.78	0.78	U		50
PCB-147/149		22.66	<1.4	1.2	J,R	1.4	50
PCB-134/143		NotFnd	<1.4	1.4	U		50
PCB-139/140		NotFnd	<1.2	1.2	U		50
PCB-131		NotFnd	<1.5	1.5	U		50
PCB-142		NotFnd	<1.4	1.4	U		50
PCB-132		NotFnd	<1.4	1.4	U		50
PCB-133		NotFnd	<1.4	1.4	U		50
PCB-165		NotFnd	<1.0	1.0	U		50
PCB-146		NotFnd	<1.2	1.2	U		50
PCB-161		NotFnd	<1.0	1.0	U		50
PCB-153/168		24.19	1.81	1.0	J		50
PCB-141		NotFnd	<1.4	1.4	U		50
PCB-130		NotFnd	<1.7	1.7	U		50
PCB-137/164		NotFnd	<1.2	1.2	U		50
PCB-129/138/163		24.89	<2.6	1.4	M,J,R	2.6	50
PCB-160		NotFnd	<1.1	1.1	U		50
PCB-158		NotFnd	<0.90	0.90	U		50
PCB-128/166		NotFnd	<1.2	1.2	U		50
PCB-159		NotFnd	<1.1	1.1	U		50
PCB-162		NotFnd	<1.1	1.1	U		50
PCB-167	0.00003	NotFnd	<0.88	0.88	U		50
PCB-156/157	0.00003	NotFnd	<1.2	1.2	U		100
PCB-169	0.03	28.70	<0.99	0.99	U	0.56	50
PCB-188		NotFnd	<0.69	0.69	U		50
PCB-179		NotFnd	<0.63	0.63	U		50
PCB-184		NotFnd	<0.57	0.57	U		50
PCB-176		NotFnd	<0.64	0.64	U		50
PCB-186		NotFnd	<0.66	0.66	U		50
PCB-178		NotFnd	<0.97	0.97	U		50
PCB-175		NotFnd	<0.97	0.97	U		50
PCB-187		NotFnd	<0.82	0.82	U		50
PCB-182		NotFnd	<0.90	0.90	U		50
PCB-183		NotFnd	<0.91	0.91	U		50
PCB-185		NotFnd	<0.93	0.93	U		50
PCB-174		NotFnd	<0.98	0.98	U		50
PCB-177		NotFnd	<1.0	1.0	U		50
PCB-181		NotFnd	<0.97	0.97	U		50
PCB-171/173		NotFnd	<1.1	1.1	U		50
PCB-172		NotFnd	<1.1	1.1	U		50

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a	
ALS Sample ID	WG3440853-4	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Blank	*E. Sabljic*
Analysis Type	Blank	Percent Moisture	n/a	--e-signature--
Sample Matrix	Reagent	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B22
Run Date	01-Dec-20 01:00
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
PCB-192		NotFnd	<0.82	0.82	U		50
PCB-180/193		NotFnd	<0.81	0.81	U		50
PCB-191		NotFnd	<0.69	0.69	U		50
PCB-170		NotFnd	<0.80	0.80	U		50
PCB-190		NotFnd	<0.50	0.50	U		50
PCB-189	0.00003	NotFnd	<0.48	0.48	U		50
PCB-202		NotFnd	<0.89	0.89	U		50
PCB-201		NotFnd	<0.83	0.83	U		50
PCB-204		NotFnd	<0.82	0.82	U		50
PCB-197		NotFnd	<0.81	0.81	U		50
PCB-200		NotFnd	<0.84	0.84	U		50
PCB-198/199		NotFnd	<0.80	0.80	U		50
PCB-196		NotFnd	<0.79	0.79	U		50
PCB-203		NotFnd	<0.78	0.78	U		50
PCB-195		NotFnd	<0.76	0.76	U		50
PCB-194		NotFnd	<0.80	0.80	U		50
PCB-205		NotFnd	<0.67	0.67	U		50
PCB-208		NotFnd	<2.6	2.6	U		50
PCB-207		NotFnd	<2.3	2.3	U		50
PCB-206		NotFnd	<2.7	2.7	U		50
PCB-209		33.53	112	8.0	M		50

Extraction Standards	**pg**	**Time**	**% Rec**	**Limits**
13C12-PCB-001	2000	8.94	55	5-145
13C12-PCB-003	2000	10.48	54	5-145
13C12-PCB-004	2000	10.62	62	5-145
13C12-PCB-015	2000	14.32	54	5-145
13C12-PCB-019	2000	12.61	59	5-145
13C12-PCB-037	2000	18.26	59	5-145
13C12-PCB-054	2000	14.46	72	5-145
13C12-PCB-081	2000	21.82	69	10-145
13C12-PCB-077	2000	22.12	69	10-145
13C12-PCB-104	2000	17.50	81	10-145
13C12-PCB-123	2000	23.08	67	10-145
13C12-PCB-118	2000	23.25	68	10-145
13C12-PCB-114	2000	23.55	70	10-145
13C12-PCB-105	2000	23.91	71	10-145
13C12-PCB-126	2000	25.51	66	10-145
13C12-PCB-155	2000	20.48	41	10-145
13C12-PCB-167	2000	26.38	76	10-145
13C12-PCB-156/157	4000	27.02	78	10-145
13C12-PCB-169	2000	28.69	81	10-145
13C12-PCB-188	2000	23.48	59	10-145
13C12-PCB-189	2000	29.95	77	10-145
13C12-PCB-202	2000	26.26	62	10-145
13C12-PCB-205	2000	31.33	91	10-145
13C12-PCB-208	2000	29.67	49	10-145
13C12-PCB-206	2000	32.39	88	10-145
13C12-PCB-209	2000	33.50	29	10-145
Cleanup Standards				
13C12-PCB-028	2000	16.00	69	5-145
13C12-PCB-111	2000	22.01	71	10-145
13C12-PCB-178	2000	25.05	80	10-145

ALS Life Sciences

Laboratory Method Blank Analysis Report

Sample Name	**Method Blank**	Sampling Date	n/a	
ALS Sample ID	WG3440853-4	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 Blank	*E. Sabljic*
Analysis Type	Blank	Percent Moisture	n/a	--e-signature--
Sample Matrix	Reagent	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B22
Run Date	01-Dec-20 01:00
Final Volume	25 ul
Dilution Factor	1
Analysis Units	pg
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**TEF (WHO 2005)**	**Ret. Time**	**Conc. pg**	**EDL pg**	**Flags**	**EMPC pg**	**LQL**
Homologue Group Totals							
Total MonoCB			5.60	0.44	J		200
Total DiCB			26.2	1.6	J		400
Total TriCB			9.70	0.77	J		400
Total TetraCB			14.9	0.39	J		800
Total PentaCB			4.87	0.70	J		800
Total HexaCB			5.81	0.47	J		800
Total HeptaCB			<0.48	0.48	U		400
Total OctaCB			<0.67	0.67	U		400
Total NonaCB			<2.3	2.3	U		200
DecaCB			112	8.0	J		200
Total PCB			179		J		1600
Toxic Equivalency - (WHO 2005)							
Lower Bound PCB TEQ			0.00				
Mid Point PCB TEQ			0.0901				
Upper Bound PCB TEQ			0.180				

EDL	Indicates the Estimated Detection Limit, based on the measured background noise for this target in this sample.
TEF	Indicates the Toxic Equivalency Factor TEQ Indicates the Toxic Equivalency
LQL	Lower Quantification Limit, based on the lowest calibration level corrected for sample size, splits and dilutions.
M	Indicates that a peak has been manually integrated.
U	Indicates that this compound was not detected above the EDL.
J	Indicates that the analyte was positively identifed. The associated numerical result is an estimate.
R	Indicates that the ion abundance ratio for this analyte did not meet the control limit. The reported value represents an estimated concentration.
EMPC	Estimated Maximum Possible Concentration – elevated detection limit due to interference or positive id criterion failure

ALS Life Sciences

Laboratory Control Sample Analysis Report

Sample Name	**Laboratory Control Sample**	Sampling Date	n/a	
ALS Sample ID	WG3440853-2	Extraction Date	25-Nov-20	Approved:
Analysis Method	EPA 1668C	Sample Size	1 n/a	*E. Sabljic*
Analysis Type	LCS	Percent Moisture	n/a	--e-signature--
Sample Matrix	QC	Split Ratio	2	01-Dec-2020

Run Information	**Run 1**
Filename	5-201130B19
Run Date	30-Nov-20 22:53
Final Volume	25 ul
Dilution Factor	1
Analysis Units	% Rec
Instrument - Column	HRMS-5 SPBOCTYL256001-01

Target Analytes	**pg**	**Ret. Time**	**% Rec**	**Limits**	**Flags**
PCB-001	1000	8.95	109	60-135	
PCB-003	1000	10.49	108	60-135	
PCB-004	1000	10.65	100	60-135	
PCB-015	1000	14.34	131	60-135	
PCB-019	1000	12.64	93	60-135	
PCB-037	1000	18.28	132	60-135	
PCB-054	1000	14.49	95	60-135	
PCB-081	1000	21.84	109	60-135	
PCB-077	1000	22.15	108	60-135	
PCB-104	1000	17.53	88	60-135	
PCB-123	1000	23.10	119	60-135	
PCB-118	1000	23.27	118	60-135	
PCB-114	1000	23.59	118	60-135	
PCB-105	1000	23.94	113	60-135	
PCB-126	1000	25.53	115	60-135	
PCB-155	1000	20.51	94	60-135	
PCB-167	1000	26.42	103	60-135	
PCB-156/157	2000	27.04	100	60-135	
PCB-169	1000	28.71	102	60-135	
PCB-188	1000	23.50	97	60-135	
PCB-189	1000	29.96	119	60-135	
PCB-202	1000	26.28	96	60-135	
PCB-205	1000	31.35	101	60-135	
PCB-208	1000	29.69	91	60-135	
PCB-206	1000	32.41	92	60-135	
PCB-209	1000	33.54	131	60-135	
Extraction Standards		**Time**	**% Rec**	**Limits**	
13C12-PCB-001	2000	8.94	58	15-145	
13C12-PCB-003	2000	10.48	54	15-145	
13C12-PCB-004	2000	10.63	60	15-145	
13C12-PCB-015	2000	14.33	54	15-145	
13C12-PCB-019	2000	12.62	87	15-145	
13C12-PCB-037	2000	18.27	68	15-145	
13C12-PCB-054	2000	14.47	84	15-145	
13C12-PCB-081	2000	21.83	65	40-145	
13C12-PCB-077	2000	22.14	63	40-145	
13C12-PCB-104	2000	17.51	67	40-145	
13C12-PCB-123	2000	23.09	63	40-145	
13C12-PCB-118	2000	23.26	58	40-145	
13C12-PCB-114	2000	23.58	60	40-145	
13C12-PCB-105	2000	23.93	61	40-145	
13C12-PCB-126	2000	25.52	75	40-145	
13C12-PCB-155	2000	20.49	50	40-145	
13C12-PCB-167	2000	26.40	86	40-145	
13C12-PCB-156/157	4000	27.03	98	40-145	
13C12-PCB-169	2000	28.70	92	40-145	
13C12-PCB-188	2000	23.49	59	40-145	
13C12-PCB-189	2000	29.96	102	40-145	
13C12-PCB-202	2000	26.27	97	40-145	
13C12-PCB-205	2000	31.34	75	40-145	
13C12-PCB-208	2000	29.68	54	40-145	
13C12-PCB-206	2000	32.40	77	40-145	
13C12-PCB-209	2000	33.51	30	40-145	
Cleanup Standards					
13C12-PCB-028	2000	16.01	71	15-145	
13C12-PCB-111	2000	22.03	60	40-145	
13C12-PCB-178	2000	25.06	71	40-145	

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

COC Number: 17 - 792336

L2526958-COFC

Page of

Report To	Contact and company name below will appear on the final report
Company:	Toxstrategies
Contact:	Stephanie Viranco
Phone:	949-382-1534
	Company address below will appear on the final report
Street:	27001 La Paz Rd Suite 260
City/Province:	Mission Viejo CA
Postal Code:	92691
Invoice To	Same as Report To ☒ YES ☐ NO
	Copy of Invoice with Report ☒ YES ☐ NO
Company:	
Contact:	

Report Format / Distribution

Select Report Format: ☒ PDF ☒ EXCEL ☒ EDD (DIGITAL)

Quality Control (QC) Report with Report ☒ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: svivanco@toxstrategies.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: svivanco@toxstrategies.com

Email 2

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ 3 day [P3-25%] ☐ 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E - 100%] ☐ Same Day, Weekend or Statutory holiday [E2 -200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: LA Fire ALSEQ20-280

Job #:

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: | PO#

Major/Minor Code: | Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only):

ALS Contact: | Sampler:

Analysis Request — Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	NUMBER OF CONTAINERS	Chlorinated dioxins / furans M1613	PCB (Total + 209 cong)	SAMPLES ON HOLD	SUSPECTED HAZARD (see Special Instructions)
1	BA-1	11/03/2020		wipe	1	X	X		
2	BA-2	11/03/2020		wipe	1	X	X		
3	BA-3-Blank	11/03/2020		wipe	1	X	X		
4	356-4	11/03/2020		wipe	1	X	X		
5	356-5	11/03/2020		wipe	1	X	X		
6	ENG-558-DFP-02	11/04/2020		wipe	1	X	X		
7	ENG-583-DFP-02	11/04/2020		wipe	1	X	X		
8	ENG-168-DFP-01	11/04/2020		wipe	1	X	X		
9	DFP-BLANK	11/04/2020		wipe	1	X	X		
10	ENG159-DFP-1	11/04/2020		wipe	1	X	X		
11	ENG-583-DFP-01	11/04/2020		wipe	1	X	X		
12	ENG-558-DFP-01	11/04/2020		wipe	1	X	X		

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☒ NO

Are samples for human consumption/ use? ☐ YES ☒ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☒

Ice Packs ☒ Ice Cubes ☐ Custody seal intact Yes ☒ No ☐

Cooling Initiated ☒

INITIAL COOLER TEMPERATURES °C: 8.3°C

FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: S. Vivanco	Date: 11/05/2020	Time: 1600	Received by: Aaron Burton	Date: 6-Nov-2020	Time: 13:50	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY

JUNE 2014 FRONT

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ATTACHMENT 2

PCB TEQ, Non-TEQ PCB, and Dioxin/Furan TEQ Calculations

Sample Name	TEF	BA-1				BA-2				BA-3-BLANK				356-4				356-5			
		All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)
PCB-001		-5.0		-5.0E-08		-3.2		-3.2E-08		2.28		2.3E-08		-2		-2.0E-08		-1.6		-1.6E-08	
PCB-002		-6.47		-6.5E-08		7.71		7.7E-08		3.29		3.3E-08		-2.43		-2.4E-08		-1.3		-1.3E-08	
PCB-003		-7.9		-7.9E-08		-8.07		-8.1E-08		4.51		4.5E-08		-3.73		-3.7E-08		-2.5		-2.5E-08	
PCB-004		7.3		7.3E-08		7.11		7.1E-08		-3.4		-3.4E-08		-2.2		-2.2E-08		-2.8		-2.8E-08	
PCB-010		-0.99		-9.9E-09		-1.6		-1.6E-08		-2.3		-2.3E-08		-1.4		-1.4E-08		-1.5		-1.5E-08	
PCB-009		-0.99		-9.9E-09		-1.6		-1.6E-08		-2.3		-2.3E-08		-1.4		-1.4E-08		-1.5		-1.5E-08	
PCB-007		7.12		7.1E-08		17.3		1.7E-07		-2.2		-2.2E-08		-1.3		-1.3E-08		-1.4		-1.4E-08	
PCB-006		-8.3		-8.3E-08		10.1		1.0E-07		-2.3		-2.3E-08		-1.4		-1.4E-08		-1.5		-1.5E-08	
PCB-005		-1.6		-1.6E-08		-1.9		-1.9E-08		-2.6		-2.6E-08		-1.6		-1.6E-08		-1.7		-1.7E-08	
PCB-008		-0.92		-9.2E-09		18.9		1.9E-07		-2.1		-2.1E-08		-7.1		-7.1E-08		-8.58		-8.6E-08	
PCB-014		-1		-1.0E-08		-1.5		-1.5E-08		-2.9		-2.9E-08		-1.7		-1.7E-08		-2		-2.0E-08	
PCB-011		329		3.3E-06		445		4.5E-06		46		4.6E-07		-69.1		-6.9E-07		-77.6		-7.8E-07	
PCB-012/013		22.7		2.3E-07		20.1		2.0E-07		-3		-3.0E-08		-1.8		-1.8E-08		-2		-2.0E-08	
PCB-015		24.5		2.5E-07		-9.4		-9.4E-08		-3.6		-3.6E-08		-3.6		-3.6E-08		-2.4		-2.4E-08	
PCB-019		-1.3		-1.3E-08		2.93		2.9E-08		-1.3		-1.3E-08		-1		-1.0E-08		-1.1		-1.1E-08	
PCB-018/030		16.3		1.6E-07		17.4		1.7E-07		-4		-4.0E-08		7.35		7.4E-08		8.54		8.5E-08	
PCB-017		8.11		8.1E-08		7.31		7.3E-08		-1.6		-1.6E-08		-3.6		-3.6E-08		4.17		4.2E-08	
PCB-027		-0.62		-6.2E-09		-1.1		-1.1E-08		-1.2		-1.2E-08		-0.85		-8.5E-09		-1.1		-1.1E-08	
PCB-024		-0.52		-5.2E-09		-1.1		-1.1E-08		-1.2		-1.2E-08		-0.85		-8.5E-09		-1.1		-1.1E-08	
PCB-016		7.9		7.9E-08		-8		-8.0E-08		-1.9		-1.9E-08		3.38		3.4E-08		-4		-4.0E-08	
PCB-032		4.43		4.4E-08		-4.4		-4.4E-08		-1.1		-1.1E-08		2.32		2.3E-08		2.58		2.6E-08	
PCB-034		-0.65		-6.5E-09		-1.1		-1.1E-08		-1.3		-1.3E-08		-1.1		-1.1E-08		-1.5		-1.5E-08	
PCB-023		-0.61		-6.1E-09		-1		-1.0E-08		-1.2		-1.2E-08		-1		-1.0E-08		-1.4		-1.4E-08	
PCB-026/029		-5.3		-5.3E-08		4.79		4.8E-08		-1.2		-1.2E-08		2.64		2.6E-08		-1.4		-1.4E-08	
PCB-025		-2.5		-2.5E-08		1.94		1.9E-08		-1.1		-1.1E-08		-0.91		-9.1E-09		-1.3		-1.3E-08	
PCB-031		28.7		2.9E-07		-19		-1.9E-07		7.47		7.5E-08		-12.9		-1.3E-07		-11		-1.1E-07	
PCB-020/028		34.2		3.4E-07		23.3		2.3E-07		-1.2		-1.2E-08		-1		-1.0E-08		-1.4		-1.4E-08	
PCB-021/033		20.9		2.1E-07		-14		-1.4E-07		5.22		5.2E-08		-10.2		-1.0E-07		-8.53		-8.5E-08	
PCB-022		12.8		1.3E-07		9.68		9.7E-08		-2		-2.0E-08		5.57		5.6E-08		5.22		5.2E-08	
PCB-036		-0.61		-6.1E-09		-1		-1.0E-08		-1.2		-1.2E-08		-1		-1.0E-08		-1.4		-1.4E-08	
PCB-039		-0.62		-6.2E-09		-1		-1.0E-08		-1.2		-1.2E-08		-1		-1.0E-08		-1.4		-1.4E-08	
PCB-038		-0.67		-6.7E-09		-1.1		-1.1E-08		-1.3		-1.3E-08		-1.1		-1.1E-08		-1.5		-1.5E-08	
PCB-035		11.1		1.1E-07		9.12		9.1E-08		-1.4		-1.4E-08		-1.2		-1.2E-08		-1.6		-1.6E-08	
PCB-037		22.9		2.3E-07		-7.8		-7.8E-08		-3		-3.0E-08		7.81		7.8E-08		-3.4		-3.4E-08	
PCB-054		-0.26		-2.6E-09		-0.35		-3.5E-09		-0.58		-5.8E-09		-0.44		-4.4E-09		-0.55		-5.5E-09	
PCB-050/053		2.81		2.8E-08		3.52		3.5E-08		-1.5		-1.5E-08		-0.95		-9.5E-09		0.992		9.9E-09	
PCB-045/051		5.23		5.2E-08		15.7		1.6E-07		2.05		2.1E-08		-2.39		-2.4E-08		-2.46		-2.5E-08	
PCB-046		-0.92		-9.2E-09		-1.1		-1.1E-08		-1.8		-1.8E-08		-0.82		-8.2E-09		-0.97		-9.7E-09	
PCB-052		36.5		3.7E-07		32.3		3.2E-07		-5.2		-5.2E-08		8.53		8.5E-08		-7.6		-7.6E-08	
PCB-073		-0.3		-3.0E-09		-0.74		-7.4E-09		-1.2		-1.2E-08		-0.54		-5.4E-09		-0.64		-6.4E-09	
PCB-043		-1		-1.0E-08		-1.3		-1.3E-08		-2		-2.0E-08		-0.93		-9.3E-09		-1.1		-1.1E-08	
PCB-049/069		14.6		1.5E-07		11.8		1.2E-07		2.57		2.6E-08		-3.8		-3.8E-08		-3.2		-3.2E-08	
PCB-048		-4.9		-4.9E-08		4.58		4.6E-08		-1.6		-1.6E-08		1.6		1.6E-08		-0.9		-9.0E-09	
PCB-044/047/065		40.8		4.1E-07		58.7		5.9E-07		-6.4		-6.4E-08		-9.65		-9.7E-08		-8.19		-8.2E-08	
PCB-059/062/075		-2.2		-2.2E-08		-1.8		-1.8E-08		-1.2		-1.2E-08		-0.56		-5.6E-09		-0.66		-6.6E-09	
PCB-042		-6.4		-6.4E-08		5.84		5.8E-08		-1.8		-1.8E-08		1.99		2.0E-08		-1.9		-1.9E-08	
PCB-040/041/071		16.5		1.7E-07		11.8		1.2E-07		-1.8		-1.8E-08		4.36		4.4E-08		4.83		4.8E-08	
PCB-064		13.2		1.3E-07		9.1		9.1E-08		-2		-2.0E-08		3.22		3.2E-08		2.78		2.8E-08	
PCB-072		-0.57		-5.7E-09		-0.94		-9.4E-09		-0.92		-9.2E-09		-0.65		-6.5E-09		-0.83		-8.3E-09	
PCB-068		4.12		4.1E-08		10.6		1.1E-07		-0.86		-8.6E-09		-0.7		-7.0E-09		-0.78		-7.8E-09	
PCB-057		-0.61		-6.1E-09		-1		-1.0E-08		-0.98		-9.8E-09		-0.69		-6.9E-09		-0.89		-8.9E-09	
PCB-058		-0.55		-5.5E-09		-0.91		-9.1E-09		-0.89		-8.9E-09		-0.63		-6.3E-09		-0.81		-8.1E-09	
PCB-067		-0.51		-5.1E-09		-0.84		-8.4E-09		-0.82		-8.2E-09		-0.58		-5.8E-09		-0.75		-7.5E-09	
PCB-063		-0.56		-5.6E-09		-0.93		-9.3E-09		-0.91		-9.1E-09		-0.64		-6.4E-09		-0.82		-8.2E-09	
PCB-061/070/074/076		82		8.2E-07		33.4		3.3E-07		6.47		6.5E-08		-10.1		-1.0E-07		-8.4		-8.4E-08	
PCB-066		38.4		3.8E-07		12.7		1.3E-07		-2.4		-2.4E-08		-4		-4.0E-08		5.26		5.3E-08	
PCB-055		-0.62		-6.2E-09		-1		-1.0E-08		-1		-1.0E-08		-0.71		-7.1E-09		-0.9		-9.0E-09	
PCB-056		26.2		2.6E-07		12.3		1.2E-07		-3.5		-3.5E-08		8.91		8.9E-08		8.41		8.4E-08	
PCB-060		12.6		1.3E-07		3.75		3.8E-08		-0.99		-9.9E-09		1.7		1.7E-08		0.918		9.2E-09	
PCB-080		-0.53		-5.3E-09		-0.88		-8.8E-09		-0.86		-8.6E-09		-0.61		-6.1E-09		-0.78		-7.8E-09	
PCB-079		-0.73		-7.3E-09		-0.93		-9.3E-09		-0.91		-9.1E-09		-0.65		-6.5E-09		-0.83		-8.3E-09	
PCB-078		-0.67		-6.7E-09		-1.1		-1.1E-08		-1.1		-1.1E-08		-0.76		-7.6E-09		-0.98		-9.8E-09	
PCB-077	0.0001	11.3	0.00113	NA	1.13E-11	6.85	0.000685	NA	6.85E-12	-1.3	-0.00013	NA	-1.30E-12	1.89	0.000189	NA	1.89E-12	-1.5	-0.00015	NA	-1.50E-12
PCB-081	0.0003	-0.7	-0.00021	NA	-2.10E-12	-1.3	-0.00039	NA	-3.90E-12	-1.2	-0.00036	NA	-3.60E-12	-0.8	-0.00024	NA	-2.40E-12	-1.1	-0.00033	NA	-3.30E-12
PCB-104		-0.38		-3.8E-09		-0.85		-8.5E-09		-0.87		-8.7E-09		-0.87		-8.7E-09		-0.9		-9.0E-09	
PCB-096		-0.36		-3.6E-09		-0.95		-9.5E-09		-0.87		-8.7E-09		-0.83		-8.3E-09		-0.9		-9.0E-09	
PCB-103		-0.72		-7.2E-09		-1.6		-1.6E-08		-1.5		-1.5E-08		-0.97		-9.7E-09		-1.1		-1.1E-08	
PCB-094		-0.84		-8.4E-09		-1.9		-1.9E-08		-1.7		-1.7E-08		-1.1		-1.1E-08		-1.3		-1.3E-08	

Sample Name	TEF	BA-1 All PCBs (pg)	BA-1 PCB TEQ (pg)	BA-1 Non-TEQ PCBs (µg/cm²)	BA-1 PCB TEQ (µg/cm²)	BA-2 All PCBs (pg)	BA-2 PCB TEQ (pg)	BA-2 Non-TEQ PCBs (µg/cm²)	BA-2 PCB TEQ (µg/cm²)	BA-3-BLANK All PCBs (pg)	BA-3-BLANK PCB TEQ (pg)	BA-3-BLANK Non-TEQ PCBs (µg/cm²)	BA-3-BLANK PCB TEQ (µg/cm²)	356-4 All PCBs (pg)	356-4 PCB TEQ (pg)	356-4 Non-TEQ PCBs (µg/cm²)	356-4 PCB TEQ (µg/cm²)	356-5 All PCBs (pg)	356-5 PCB TEQ (pg)	356-5 Non-TEQ PCBs (µg/cm²)	356-5 PCB TEQ (µg/cm²)
PCB-095		45.3		4.5E-07		25.8		2.6E-07		-2.7		-2.7E-08		3.63		3.6E-08		5.34		5.3E-08	
PCB-093/098/100/102		-2.2		-2.2E-08		-1.8		-1.8E-08		-1.6		-1.6E-08		-1.1		-1.1E-08		-1.2		-1.2E-08	
PCB-088/091		8.67		8.7E-08		4.45		4.5E-08		-1.7		-1.7E-08		-1.1		-1.1E-08		-1.2		-1.2E-08	
PCB-084		20.7		2.1E-07		9.96		1.0E-07		-1.9		-1.9E-08		-2.1		-2.1E-08		-1.4		-1.4E-08	
PCB-089		-1.2		-1.2E-08		-2.1		-2.1E-08		-1.9		-1.9E-08		-1.2		-1.2E-08		-1.4		-1.4E-08	
PCB-121		-0.61		-6.1E-09		-1.4		-1.4E-08		-1.3		-1.3E-08		-0.81		-8.1E-09		-0.93		-9.3E-09	
PCB-092		13.8		1.4E-07		8.6		8.6E-08		-1.9		-1.9E-08		-1.2		-1.2E-08		-1.4		-1.4E-08	
PCB-090/101/113		80.4		8.0E-07		38.2		3.8E-07		-3.6		-3.6E-08		-6.47		-6.5E-08		-6.11		-6.1E-08	
PCB-083/099		46.5		4.7E-07		-16		-1.6E-07		-1.9		-1.9E-08		-2.2		-2.2E-08		-2.8		-2.8E-08	
PCB-112		-0.64		-6.4E-09		-1.4		-1.4E-08		-1.3		-1.3E-08		-0.85		-8.5E-09		-0.98		-9.8E-09	
PCB-086/087/097/109/119/125		77.1		7.7E-07		29.6		3.0E-07		-1.6		-1.6E-08		-6		-6.0E-08		-1.8		-1.8E-08	
PCB-085/110/115/116/117		160		1.6E-06		61.2		6.1E-07		-3.4		-3.4E-08		8.71		8.7E-08		8.72		8.7E-08	
PCB-082		-15		-1.5E-07		-6.5		-6.5E-08		-2.4		-2.4E-08		-1.6		-1.6E-08		-1.8		-1.8E-08	
PCB-111		-0.66		-6.6E-09		-1.5		-1.5E-08		-1.4		-1.4E-08		-0.88		-8.8E-09		-1		-1.0E-08	
PCB-120		-0.65		-6.5E-09		-1.5		-1.5E-08		-1.4		-1.4E-08		-0.87		-8.7E-09		-1		-1.0E-08	
PCB-108/124		5.09		5.1E-08		-2		-2.0E-08		-1.5		-1.5E-08		-1.2		-1.2E-08		-1.5		-1.5E-08	
PCB-107		-6.6		-6.6E-08		-1.8		-1.8E-08		-1.3		-1.3E-08		-1.1		-1.1E-08		-1.3		-1.3E-08	
PCB-105	0.00003	54.3	0.001629	NA	1.63E-11	-17	-0.00051	NA	-5.10E-12	-1.6	-4.8E-05	NA	-4.80E-13	3.33	9.99E-05	NA	9.99E-13	-1.7	-5.1E-05	NA	-5.10E-13
PCB-106		-1.2		-1.2E-08		-2.1		-2.1E-08		-1.5		-1.5E-08		-1.3		-1.3E-08		-1.6		-1.6E-08	
PCB-114	0.00003	3.39	0.000102	NA	1.02E-12	-2.2	-6.6E-05	NA	-6.60E-13	-1.5	-4.5E-05	NA	-4.50E-13	-1.3	-3.9E-05	NA	-3.90E-13	-1.6	-4.8E-05	NA	-4.80E-13
PCB-122		2.44		2.4E-08		-2.3		-2.3E-08		-1.6		-1.6E-08		-1.4		-1.4E-08		-1.7		-1.7E-08	
PCB-118	0.00003	118	0.00354	NA	3.54E-11	46.9	0.001407	NA	1.41E-11	-1.5	-4.5E-05	NA	-4.50E-13	8.44	0.000253	NA	2.53E-12	-5.8	-0.00017	NA	-1.74E-12
PCB-123	0.00003	-1.7	-5.1E-05	NA	-5.10E-13	-2.4	-7.2E-05	NA	-7.20E-13	-1.6	-4.8E-05	NA	-4.80E-13	-1.4	-4.2E-05	NA	-4.20E-13	-1.7	-5.1E-05	NA	-5.10E-13
PCB-127		-1.3		-1.3E-08		-2.2		-2.2E-08		-1.6		-1.6E-08		-1.4		-1.4E-08		-1.7		-1.7E-08	
PCB-126	0.1	-1.7	-0.17	NA	-1.70E-09	-3.1	-0.31	NA	-3.10E-09	-1.9	-0.19	NA	-1.90E-09	-1.5	-0.15	NA	-1.50E-09	-2	-0.2	NA	-2.00E-09
PCB-155		-0.45		-4.5E-09		-1.1		-1.1E-08		-0.62		-6.2E-09		-0.73		-7.3E-09		-0.75		-7.5E-09	
PCB-152		-0.41		-4.1E-09		-0.87		-8.7E-09		-0.6		-6.0E-09		-0.46		-4.6E-09		-0.58		-5.8E-09	
PCB-150		-0.4		-4.0E-09		-0.84		-8.4E-09		-0.57		-5.7E-09		-0.45		-4.5E-09		-0.55		-5.5E-09	
PCB-136		8.67		8.7E-08		7.54		7.5E-08		-0.64		-6.4E-09		-1		-1.0E-08		-0.6		-6.0E-09	
PCB-145		-0.43		-4.3E-09		-0.91		-9.1E-09		-0.62		-6.2E-09		-0.49		-4.9E-09		-0.6		-6.0E-09	
PCB-148		-0.61		-6.1E-09		-1.3		-1.3E-08		-0.88		-8.8E-09		-0.68		-6.8E-09		-0.85		-8.5E-09	
PCB-135/151		25.9		2.6E-07		16.6		1.7E-07		-0.93		-9.3E-09		-1.4		-1.4E-08		-0.9		-9.0E-09	
PCB-154		-0.5		-5.0E-09		-1.1		-1.1E-08		-0.73		-7.3E-09		-0.57		-5.7E-09		-0.7		-7.0E-09	
PCB-144		4.66		4.7E-08		2.72		2.7E-08		-0.95		-9.5E-09		-0.74		-7.4E-09		-0.92		-9.2E-09	
PCB-147/149		74.5		7.5E-07		45.3		4.5E-07		-2		-2.0E-08		-5.9		-5.9E-08		-4.7		-4.7E-08	
PCB-134/143		-5.7		-5.7E-08		-2		-2.0E-08		-1.7		-1.7E-08		-1		-1.0E-08		-1.5		-1.5E-08	
PCB-139/140		-2.4		-2.4E-08		-1.6		-1.6E-08		-1.4		-1.4E-08		-0.84		-8.4E-09		-1.3		-1.3E-08	
PCB-131		-1.6		-1.6E-08		-2		-2.0E-08		-1.7		-1.7E-08		-1.1		-1.1E-08		-1.6		-1.6E-08	
PCB-142		-1.3		-1.3E-08		-2		-2.0E-08		-1.7		-1.7E-08		-1		-1.0E-08		-1.5		-1.5E-08	
PCB-132		43.6		4.4E-07		25.3		2.5E-07		-1.6		-1.6E-08		-1		-1.0E-08		-2.8		-2.8E-08	
PCB-133		-1.4		-1.4E-08		-1.9		-1.9E-08		-1.6		-1.6E-08		-0.97		-9.7E-09		-1.5		-1.5E-08	
PCB-165		-0.98		-9.8E-09		-1.4		-1.4E-08		-1.2		-1.2E-08		-0.74		-7.4E-09		-1.1		-1.1E-08	
PCB-146		14.2		1.4E-07		-7.7		-7.7E-08		-1.4		-1.4E-08		-1.1		-1.1E-08		-1.3		-1.3E-08	
PCB-161		-0.94		-9.4E-09		-1.4		-1.4E-08		-1.2		-1.2E-08		-0.72		-7.2E-09		-1.1		-1.1E-08	
PCB-153/168		85.3		8.5E-07		50.3		5.0E-07		-2.5		-2.5E-08		-6.28		-6.3E-08		-5.75		-5.8E-08	
PCB-141		26.8		2.7E-07		12.4		1.2E-07		-1.6		-1.6E-08		1.3		1.3E-08		-1.5		-1.5E-08	
PCB-130		-7.3		-7.3E-08		-4.3		-4.3E-08		-1.9		-1.9E-08		-1.2		-1.2E-08		-1.8		-1.8E-08	
PCB-137/164		-14		-1.4E-07		10.3		1.0E-07		-1.4		-1.4E-08		-0.85		-8.5E-09		-1.3		-1.3E-08	
PCB-129/138/163		148		1.5E-06		75.7		7.6E-07		-3.3		-3.3E-08		11.4		1.1E-07		-8.3		-8.3E-08	
PCB-160		-1		-1.0E-08		-1.5		-1.5E-08		-1.3		-1.3E-08		-0.78		-7.8E-09		-1.2		-1.2E-08	
PCB-158		15.2		1.5E-07		9.9		9.9E-08		-1		-1.0E-08		-0.9		-9.0E-09		-0.96		-9.6E-09	
PCB-128/166		-20		-2.0E-07		11.9		1.2E-07		-1.4		-1.4E-08		-0.88		-8.8E-09		-1.3		-1.3E-08	
PCB-159		-0.99		-9.9E-09		-1.4		-1.4E-08		-1.2		-1.2E-08		-0.75		-7.5E-09		-1.1		-1.1E-08	
PCB-162		-1		-1.0E-08		-1.5		-1.5E-08		-1.3		-1.3E-08		-0.78		-7.8E-09		-1.2		-1.2E-08	
PCB-156/157	0.00003	-15	-0.00045	NA	-4.50E-12	-3.5	-0.00011	NA	-1.05E-12	-1.4	-4.2E-05	NA	-4.20E-13	-2.1	-6.3E-05	NA	-6.30E-13	-1.3	-3.9E-05	NA	-3.90E-13
PCB-167	0.00003	-5.3	-0.00016	NA	-1.59E-12	3	0.00009	NA	9.00E-13	-1	-0.00003	NA	-3.00E-13	-0.62	-1.9E-05	NA	-1.86E-13	-0.96	-2.9E-05	NA	-2.88E-13
PCB-169	0.03	-1.1	-0.033	NA	-3.30E-10	-1.4	-0.042	NA	-4.20E-10	-1.3	-0.039	NA	-3.90E-10	-0.65	-0.0195	NA	-1.95E-10	-1	-0.03	NA	-3.00E-10
PCB-188		-0.49		-4.9E-09		-1.1		-1.1E-08		-0.63		-6.3E-09		-0.58		-5.8E-09		-0.89		-8.9E-09	
PCB-179		6.3		6.3E-08		5.49		5.5E-08		-0.66		-6.6E-09		-0.48		-4.8E-09		-0.83		-8.3E-09	
PCB-184		-0.55		-5.5E-09		-0.86		-8.6E-09		-0.59		-5.9E-09		-0.43		-4.3E-09		-0.75		-7.5E-09	
PCB-176		-1.4		-1.4E-08		2.12		2.1E-08		-0.67		-6.7E-09		-0.49		-4.9E-09		-0.85		-8.5E-09	
PCB-186		-0.6		-6.0E-09		-1		-1.0E-08		-0.68		-6.8E-09		-0.5		-5.0E-09		-0.87		-8.7E-09	
PCB-178		-4.1		-4.1E-08		-4.7		-4.7E-08		-1		-1.0E-08		-0.74		-7.4E-09		-1.3		-1.3E-08	
PCB-175		-0.87		-8.7E-09		-1.5		-1.5E-08		-1		-1.0E-08		-0.73		-7.3E-09		-1.3		-1.3E-08	
PCB-187		20.3		2.0E-07		18.8		1.9E-07		-0.85		-8.5E-09		-1.6		-1.6E-08		-2		-2.0E-08	
PCB-182		-0.81		-8.1E-09		-1.4		-1.4E-08		-0.93		-9.3E-09		-0.68		-6.8E-09		-1.2		-1.2E-08	
PCB-183		12		1.2E-07		12.8		1.3E-07		-0.94		-9.4E-09		-0.69		-6.9E-09		-1.2		-1.2E-08	
PCB-185		-1.7		-1.7E-08		-1.4		-1.4E-08		-0.96		-9.6E-09		-0.7		-7.0E-09		-1.2		-1.2E-08	

Sample Name	TEF	BA-1 All PCBs (pg)	BA-1 PCB TEQ (pg)	BA-1 Non-TEQ PCBs (µg/cm²)	BA-1 PCB TEQ (µg/cm²)	BA-2 All PCBs (pg)	BA-2 PCB TEQ (pg)	BA-2 Non-TEQ PCBs (µg/cm²)	BA-2 PCB TEQ (µg/cm²)
PCB-174		20.8		2.1E-07		19.2		1.9E-07	
PCB-177		10.2		1.0E-07		-6.3		-6.3E-08	
PCB-181		-0.88		-8.8E-09		-1.5		-1.5E-08	
PCB-171/173		6.74		6.7E-08		6.42		6.4E-08	
PCB-172		3.89		3.9E-08		-3.1		-3.1E-08	
PCB-192		-0.74		-7.4E-09		-1.2		-1.2E-08	
PCB-180/193		44.6		4.5E-07		51		5.1E-07	
PCB-191		-1.4		-1.4E-08		-1		-1.0E-08	
PCB-170		17.4		1.7E-07		-14		-1.4E-07	
PCB-190		-3.4		-3.4E-08		-2.8		-2.8E-08	
PCB-189	0.00003	1.46	4.38E-05	NA	4.38E-13	-0.88	-2.6E-05	NA	-2.64E-13
PCB-202		-2.4		-2.4E-08		2.17		2.2E-08	
PCB-201		2.03		2.0E-08		-0.98		-9.8E-09	
PCB-204		-0.49		-4.9E-09		-0.97		-9.7E-09	
PCB-197		-0.54		-5.4E-09		-0.95		-9.5E-09	
PCB-200		-0.5		-5.0E-09		-0.99		-9.9E-09	
PCB-198/199		6.94		6.9E-08		7.94		7.9E-08	
PCB-196		-3.5		-3.5E-08		3.34		3.3E-08	
PCB-203		5.42		5.4E-08		-3.2		-3.2E-08	
PCB-195		-3		-3.0E-08		-2.6		-2.6E-08	
PCB-194		10.4		1.0E-07		-6.5		-6.5E-08	
PCB-205		-0.92		-9.2E-09		-0.86		-8.6E-09	
PCB-208		-2.5		-2.5E-08		-5.1		-5.1E-08	
PCB-207		-1.8		-1.8E-08		-2.6		-2.6E-08	
PCB-206		9.73		9.7E-08		11.5		1.2E-07	
PCB-209		-38.8		-3.9E-07		-222		-2.2E-06	
Non-TEQ PCBs (ND = 0)				**1.9E-05**				**1.4E-05**	
Non-TEQ PCBs (ND = 1/2 DL)*				**2.1E-05**				**1.7E-05**	
Non-TEQ PCBs (ND = DL)				**2.2E-05**				**1.9E-05**	
Lower Bound PCB TEQ (ND = 0)					**6.4E-11**				**2.2E-11**
Mid Point PCB TEQ (ND = 1/2 DL)*					**1.1E-09**				**1.8E-09**
Upper Bound PCB TEQ (ND = DL)					**2.1E-09**				**3.6E-09**

Sample Name	BA-3-BLANK All PCBs (pg)	BA-3-BLANK PCB TEQ (pg)	BA-3-BLANK Non-TEQ PCBs (µg/cm²)	BA-3-BLANK PCB TEQ (µg/cm²)	356-4 All PCBs (pg)	356-4 PCB TEQ (pg)	356-4 Non-TEQ PCBs (µg/cm²)	356-4 PCB TEQ (µg/cm²)	356-5 All PCBs (pg)	356-5 PCB TEQ (pg)	356-5 Non-TEQ PCBs (µg/cm²)	356-5 PCB TEQ (µg/cm²)
PCB-174	-1		-1.0E-08		-0.84		-8.4E-09		-1.3		-1.3E-08	
PCB-177	-1.1		-1.1E-08		-0.81		-8.1E-09		-1.4		-1.4E-08	
PCB-181	-1		-1.0E-08		-0.74		-7.4E-09		-1.3		-1.3E-08	
PCB-171/173	-1.1		-1.1E-08		-0.81		-8.1E-09		-1.4		-1.4E-08	
PCB-172	-1.1		-1.1E-08		-0.81		-8.1E-09		-1.4		-1.4E-08	
PCB-192	-0.85		-8.5E-09		-0.62		-6.2E-09		-1.1		-1.1E-08	
PCB-180/193	-1.1		-1.1E-08		4.89		4.9E-08		-2		-2.0E-08	
PCB-191	-0.72		-7.2E-09		-0.53		-5.3E-09		-0.91		-9.1E-09	
PCB-170	-0.83		-8.3E-09		-0.78		-7.8E-09		1.56		1.6E-08	
PCB-190	-0.52		-5.2E-09		-0.38		-3.8E-09		-0.66		-6.6E-09	
PCB-189	-0.64	-1.9E-05	NA	-1.92E-13	-0.47	-1.4E-05	NA	-1.41E-13	-0.57	-1.7E-05	NA	-1.71E-13
PCB-202	-0.97		-9.7E-09		-0.87		-8.7E-09		-0.82		-8.2E-09	
PCB-201	-1		-1.0E-08		-0.74		-7.4E-09		-0.8		-8.0E-09	
PCB-204	-1		-1.0E-08		-0.74		-7.4E-09		-0.79		-7.9E-09	
PCB-197	-0.98		-9.8E-09		-0.72		-7.2E-09		-0.77		-7.7E-09	
PCB-200	-1		-1.0E-08		-0.75		-7.5E-09		-0.81		-8.1E-09	
PCB-198/199	-0.98		-9.8E-09		-0.72		-7.2E-09		-0.77		-7.7E-09	
PCB-196	-0.96		-9.6E-09		-0.71		-7.1E-09		-0.76		-7.6E-09	
PCB-203	-0.95		-9.5E-09		-0.7		-7.0E-09		-0.75		-7.5E-09	
PCB-195	-0.95		-9.5E-09		-0.87		-8.7E-09		-0.89		-8.9E-09	
PCB-194	1.7		1.7E-08		-1.9		-1.9E-08		-1		-1.0E-08	
PCB-205	-0.92		-9.2E-09		-0.71		-7.1E-09		-0.81		-8.1E-09	
PCB-208	-2		-2.0E-08		3.43		3.4E-08		-2.1		-2.1E-08	
PCB-207	-2		-2.0E-08		-1.7		-1.7E-08		-1.9		-1.9E-08	
PCB-206	-2.8		-2.8E-08		-4.34		-4.3E-08		-7.41		-7.4E-08	
PCB-209	134		1.3E-06		-116		-1.2E-06		-130		-1.3E-06	
Non-TEQ PCBs (ND = 0)			**2.2E-06**				**9.3E-07**				**5.9E-07**	
Non-TEQ PCBs (ND = 1/2 DL)*			**3.2E-06**				**2.9E-06**				**2.9E-06**	
Non-TEQ PCBs (ND = DL)			**4.3E-06**				**4.9E-06**				**5.1E-06**	
Lower Bound PCB TEQ (ND = 0)				**0.0E+00**				**5.4E-12**				**0.0E+00**
Mid Point PCB TEQ (ND = 1/2 DL)*				**1.1E-09**				**8.6E-10**				**1.2E-09**
Upper Bound PCB TEQ (ND = DL)				**2.3E-09**				**1.7E-09**				**2.3E-09**

Notes/Abbreviations

"-" = "<" (reported less than the detection limit).

Highlighted cells indicate a blank adjustment was made (see Appendix C).

* = used in report tables

NA = not applicable; PCB TEQ calculated.

Sample Name	TEF	ENG-558-DFP-02				ENG-583-DFP-02				ENG-168-DFP-01				DFP-BLANK				ENG-159-DFP-1			
		All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)
PCB-001		-1.4		-1.4E-08		-1.7		-1.7E-08		-1.4		-1.4E-08		-1.6		-1.6E-08		-3.1		-3.1E-08	
PCB-002		-4.04		-4.0E-08		-5.95		-6.0E-08		-2.8		-2.8E-08		-2.4		-2.4E-08		-3.6		-3.6E-08	
PCB-003		-5.05		-5.1E-08		-5.25		-5.3E-08		-4.4		-4.4E-08		-3.3		-3.3E-08		-3.7		-3.7E-08	
PCB-004		-4		-4.0E-08		-3.9		-3.9E-08		-3.7		-3.7E-08		-2.7		-2.7E-08		-12		-1.2E-07	
PCB-010		-0.99		-9.9E-09		-1.3		-1.3E-08		-1.1		-1.1E-08		-1.8		-1.8E-08		-8.3		-8.3E-08	
PCB-009		-1		-1.0E-08		-1.3		-1.3E-08		-1.1		-1.1E-08		-1.8		-1.8E-08		-8.3		-8.3E-08	
PCB-007		4.69		4.7E-08		-1.2		-1.2E-08		4.09		4.1E-08		-1.7		-1.7E-08		-8.1		-8.1E-08	
PCB-006		-3.5		-3.5E-08		-4.3		-4.3E-08		-2.9		-2.9E-08		2.29		2.3E-08		-8.5		-8.5E-08	
PCB-005		-1.1		-1.1E-08		-1.5		-1.5E-08		-1.3		-1.3E-08		-2		-2.0E-08		-9.6		-9.6E-08	
PCB-008		20.5		2.1E-07		15.8		1.6E-07		13.1		1.3E-07		-4.8		-4.8E-08		-9.6		-9.6E-08	
PCB-014		-1.7		-1.7E-08		-1.2		-1.2E-08		-1.7		-1.7E-08		-1.8		-1.8E-08		-10		-1.0E-07	
PCB-011		762		7.6E-06		1050		1.1E-05		136		1.4E-06		38.7		3.9E-07		948		9.5E-06	
PCB-012/013		-10		-1.0E-07		-19		-1.9E-07		5.62		5.6E-08		-1.9		-1.9E-08		-10		-1.0E-07	
PCB-015		20.8		2.1E-07		17		1.7E-07		-13		-1.3E-07		-2.2		-2.2E-08		-14		-1.4E-07	
PCB-019		-2.3		-2.3E-08		1.83		1.8E-08		-0.87		-8.7E-09		-0.85		-8.5E-09		-4.9		-4.9E-08	
PCB-018/030		26.5		2.7E-07		11		1.1E-07		12.1		1.2E-07		-2.5		-2.5E-08		-8.4		-8.4E-08	
PCB-017		13.1		1.3E-07		6.31		6.3E-08		5.92		5.9E-08		-1.1		-1.1E-08		-5.7		-5.7E-08	
PCB-027		-1.1		-1.1E-08		-0.7		-7.0E-09		-0.74		-7.4E-09		-0.84		-8.4E-09		-4.2		-4.2E-08	
PCB-024		-0.52		-5.2E-09		-0.61		-6.1E-09		-0.72		-7.2E-09		-0.84		-8.4E-09		-4.2		-4.2E-08	
PCB-016		-13		-1.3E-07		6.08		6.1E-08		6.81		6.8E-08		-2		-2.0E-08		-6.9		-6.9E-08	
PCB-032		10.8		1.1E-07		3.83		3.8E-08		4.45		4.5E-08		-1.5		-1.5E-08		-4		-4.0E-08	
PCB-034		-1		-1.0E-08		-0.76		-7.6E-09		-1.1		-1.1E-08		-1.2		-1.2E-08		-5.2		-5.2E-08	
PCB-023		-0.97		-9.7E-09		-0.72		-7.2E-09		-1		-1.0E-08		-1.1		-1.1E-08		-4.9		-4.9E-08	
PCB-026/029		8.75		8.8E-08		4.16		4.2E-08		-3.6		-3.6E-08		-1.1		-1.1E-08		-4.9		-4.9E-08	
PCB-025		-4.4		-4.4E-08		-2.1		-2.1E-08		-2.1		-2.1E-08		-1		-1.0E-08		-4.4		-4.4E-08	
PCB-031		53.6		5.4E-07		19		1.9E-07		21.5		2.2E-07		5.02		5.0E-08		17.3		1.7E-07	
PCB-020/028		74.6		7.5E-07		22.6		2.3E-07		26.5		2.7E-07		-5.3		-5.3E-08		-4.8		-4.8E-08	
PCB-021/033		43.5		4.4E-07		-14		-1.4E-07		18.1		1.8E-07		-2.7		-2.7E-08		-4.7		-4.7E-08	
PCB-022		28.1		2.8E-07		9.91		9.9E-08		10.8		1.1E-07		2.28		2.3E-08		-5.1		-5.1E-08	
PCB-036		-4		-4.0E-08		-2.9		-2.9E-08		-1		-1.0E-08		-1.1		-1.1E-08		-4.8		-4.8E-08	
PCB-039		-0.99		-9.9E-09		-0.73		-7.3E-09		-1		-1.0E-08		-1.1		-1.1E-08		-4.9		-4.9E-08	
PCB-038		-1.1		-1.1E-08		-0.79		-7.9E-09		-1.1		-1.1E-08		-1.2		-1.2E-08		-5.3		-5.3E-08	
PCB-035		-12		-1.2E-07		23.3		2.3E-07		-3.8		-3.8E-08		-1.3		-1.3E-08		-7.4		-7.4E-08	
PCB-037		36.2		3.6E-07		16.4		1.6E-07		17		1.7E-07		-1.8		-1.8E-08		17.3		1.7E-07	
PCB-054		-0.3		-3.0E-09		-0.42		-4.2E-09		-0.48		-4.8E-09		-0.58		-5.8E-09		-2		-2.0E-08	
PCB-050/053		6.03		6.0E-08		2.14		2.1E-08		-2.5		-2.5E-08		-1.1		-1.1E-08		-2.9		-2.9E-08	
PCB-045/051		12.1		1.2E-07		12		1.2E-07		10.3		1.0E-07		-1.1		-1.1E-08		-3		-3.0E-08	
PCB-046		2.97		3.0E-08		1.38		1.4E-08		-0.85		-8.5E-09		-1.3		-1.3E-08		-3.5		-3.5E-08	
PCB-052		65.2		6.5E-07		55.2		5.5E-07		110		1.1E-06		-1.1		-1.1E-08		26.2		2.6E-07	
PCB-073		-0.45		-4.5E-09		-0.66		-6.6E-09		-0.56		-5.6E-09		-0.85		-8.5E-09		-2.3		-2.3E-08	
PCB-043		-1.2		-1.2E-08		-1.3		-1.3E-08		-0.97		-9.7E-09		-1.5		-1.5E-08		-4		-4.0E-08	
PCB-049/069		27.4		2.7E-07		-15		-1.5E-07		27.1		2.7E-07		-1.2		-1.2E-08		-8.6		-8.6E-08	
PCB-048		11.2		1.1E-07		4.04		4.0E-08		-5.4		-5.4E-08		-1.2		-1.2E-08		-3.1		-3.1E-08	
PCB-044/047/065		66.8		6.7E-07		81.6		8.2E-07		95.7		9.6E-07		-4.6		-4.6E-08		20.3		2.0E-07	
PCB-059/062/075		4.84		4.8E-08		-1.6		-1.6E-08		-2		-2.0E-08		-0.88		-8.8E-09		-2.4		-2.4E-08	
PCB-042		16.2		1.6E-07		-5.4		-5.4E-08		9.36		9.4E-08		-1.3		-1.3E-08		-3.6		-3.6E-08	
PCB-040/041/071		34.1		3.4E-07		14.2		1.4E-07		19.6		2.0E-07		-1.2		-1.2E-08		9.92		9.9E-08	
PCB-064		27.1		2.7E-07		13.6		1.4E-07		22.6		2.3E-07		1.26		1.3E-08		8.37		8.4E-08	
PCB-072		-0.86		-8.6E-09		-0.91		-9.1E-09		-0.99		-9.9E-09		-0.99		-9.9E-09		-2.9		-2.9E-08	
PCB-068		4.51		4.5E-08		7.74		7.7E-08		-5.1		-5.1E-08		-0.93		-9.3E-09		-2.7		-2.7E-08	
PCB-057		-0.92		-9.2E-09		-0.97		-9.7E-09		-1.1		-1.1E-08		-1.1		-1.1E-08		-3.1		-3.1E-08	
PCB-058		1.67		1.7E-08		-0.89		-8.9E-09		-0.97		-9.7E-09		-0.97		-9.7E-09		-2.8		-2.8E-08	
PCB-067		1.68		1.7E-08		-0.81		-8.1E-09		-0.89		-8.9E-09		-0.89		-8.9E-09		-2.6		-2.6E-08	
PCB-063		-1.8		-1.8E-08		-0.9		-9.0E-09		-0.98		-9.8E-09		-0.98		-9.8E-09		-2.9		-2.9E-08	
PCB-061/070/074/076		105		1.1E-06		90.5		9.1E-07		150		1.5E-06		-3		-3.0E-08		54.5		5.5E-07	
PCB-066		58.3		5.8E-07		31.4		3.1E-07		49.2		4.9E-07		-1.3		-1.3E-08		23.1		2.3E-07	
PCB-055		2.45		2.5E-08		-0.99		-9.9E-09		-1.1		-1.1E-08		-1.1		-1.1E-08		-3.2		-3.2E-08	
PCB-056		39		3.9E-07		23		2.3E-07		-19		-1.9E-07		-2		-2.0E-08		-15		-1.5E-07	
PCB-060		-20		-2.0E-07		11.1		1.1E-07		13		1.3E-07		-1.1		-1.1E-08		9.44		9.4E-08	
PCB-080		-0.81		-8.1E-09		-0.85		-8.5E-09		-0.93		-9.3E-09		-0.93		-9.3E-09		-2.7		-2.7E-08	
PCB-079		-1.2		-1.2E-08		-1.7		-1.7E-08		-2.6		-2.6E-08		-0.99		-9.9E-09		-2.9		-2.9E-08	
PCB-078		-1		-1.0E-08		-1.1		-1.1E-08		-1.2		-1.2E-08		-1.2		-1.2E-08		-3.4		-3.4E-08	
PCB-077	0.0001	14.3	0.00143	NA	1.43E-11	16.1	0.00161	NA	1.61E-11	-9.5	-0.00095	NA	-9.50E-12	-1.4	-0.00014	NA	-1.40E-12	-8.7	-0.00087	NA	-8.70E-12
PCB-081	0.0003	-1.1	-0.00033	NA	-3.30E-12	-1.1	-0.00033	NA	-3.30E-12	-1.3	-0.00039	NA	-3.90E-12	-1.3	-0.00039	NA	-3.90E-12	-3.3	-0.00099	NA	-9.90E-12
PCB-104		-0.48		-4.8E-09		-0.73		-7.3E-09		-0.69		-6.9E-09		-0.7		-7.0E-09		-2.5		-2.5E-08	
PCB-096		-0.49		-4.9E-09		-0.71		-7.1E-09		-1.2		-1.2E-08		-0.71		-7.1E-09		-2.1		-2.1E-08	
PCB-103		-0.87		-8.7E-09		-1.6		-1.6E-08		-1.5		-1.5E-08		-1.1		-1.1E-08		-3.4		-3.4E-08	
PCB-094		-1		-1.0E-08		-1.9		-1.9E-08		-1.8		-1.8E-08		-1.3		-1.3E-08		-3.9		-3.9E-08	

Sample Name	TEF	ENG-558-DFP-02				ENG-583-DFP-02				ENG-168-DFP-01				DFP-BLANK				ENG-159-DFP-1			
		All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)
PCB-095		49.5		5.0E-07		85.7		8.6E-07		172		1.7E-06		-1.3		-1.3E-08		26.3		2.6E-07	
PCB-093/098/100/102		3.25		3.3E-08		4.68		4.7E-08		6.68		6.7E-08		-1.2		-1.2E-08		-3.7		-3.7E-08	
PCB-088/091		10.1		1.0E-07		15.9		1.6E-07		26.4		2.6E-07		-1.2		-1.2E-08		-3.8		-3.8E-08	
PCB-084		19.5		2.0E-07		33.4		3.3E-07		62.6		6.3E-07		-1.4		-1.4E-08		-10		-1.0E-07	
PCB-089		-1.1		-1.1E-08		-2.1		-2.1E-08		-2		-2.0E-08		-1.4		-1.4E-08		-4.3		-4.3E-08	
PCB-121		-0.73		-7.3E-09		-1.4		-1.4E-08		-1.3		-1.3E-08		-0.91		-9.1E-09		-2.8		-2.8E-08	
PCB-092		12.9		1.3E-07		24.9		2.5E-07		43.1		4.3E-07		-1.3		-1.3E-08		-4.2		-4.2E-08	
PCB-090/101/113		77.5		7.8E-07		144		1.4E-06		242		2.4E-06		2.25		2.3E-08		47.7		4.8E-07	
PCB-083/099		43		4.3E-07		107		1.1E-06		117		1.2E-06		-1.3		-1.3E-08		26.5		2.7E-07	
PCB-112		-0.77		-7.7E-09		-17		-1.7E-07		-1.4		-1.4E-08		-0.96		-9.6E-09		-3		-3.0E-08	
PCB-086/087/097/109/119/125		65.4		6.5E-07		119		1.2E-06		172		1.7E-06		-1.1		-1.1E-08		45.2		4.5E-07	
PCB-085/110/115/116/117		136		1.4E-06		266		2.7E-06		328		3.3E-06		-2.5		-2.5E-08		96.7		9.7E-07	
PCB-082		14.5		1.5E-07		-24		-2.4E-07		28.3		2.8E-07		-1.8		-1.8E-08		-12		-1.2E-07	
PCB-111		-0.79		-7.9E-09		-1.5		-1.5E-08		-1.4		-1.4E-08		-0.98		-9.8E-09		-3.1		-3.1E-08	
PCB-120		-0.78		-7.8E-09		-1.5		-1.5E-08		-1.4		-1.4E-08		-0.98		-9.8E-09		-3		-3.0E-08	
PCB-108/124		3.13		3.1E-08		7.13		7.1E-08		-8.1		-8.1E-08		-1.2		-1.2E-08		-4.3		-4.3E-08	
PCB-107		-4.6		-4.6E-08		9.48		9.5E-08		-9.9		-9.9E-08		-1.1		-1.1E-08		-5.8		-5.8E-08	
PCB-105	0.00003	44.8	0.001344	NA	1.34E-11	63	0.00189	NA	1.89E-11	68.7	0.002061	NA	2.06E-11	-1.4	-4.2E-05	NA	-4.20E-13	-33	-0.00099	NA	-9.90E-12
PCB-106		-1.1		-1.1E-08		-2.2		-2.2E-08		-2		-2.0E-08		-1.3		-1.3E-08		-4.5		-4.5E-08	
PCB-114	0.00003	2.55	7.65E-05	NA	7.65E-13	-3.2	-9.6E-05	NA	-9.60E-13	5.73	0.000172	NA	1.72E-12	-1.3	-3.9E-05	NA	-3.90E-13	-4.2	-0.00013	NA	-1.26E-12
PCB-122		-1.2		-1.2E-08		-2.3		-2.3E-08		-2.1		-2.1E-08		-1.4		-1.4E-08		-4.8		-4.8E-08	
PCB-118	0.00003	97.6	0.002928	NA	2.93E-11	165	0.00495	NA	4.95E-11	196	0.00588	NA	5.88E-11	-1.3	-3.9E-05	NA	-3.90E-13	89.4	0.002682	NA	2.68E-11
PCB-123	0.00003	1.76	5.28E-05	NA	5.28E-13	-2.8	-8.4E-05	NA	-8.40E-13	2.61	7.83E-05	NA	7.83E-13	-1.3	-3.9E-05	NA	-3.90E-13	-4.4	-0.00013	NA	-1.32E-12
PCB-127		-1.1		-1.1E-08		-2.3		-2.3E-08		-2.1		-2.1E-08		-1.3		-1.3E-08		-4.7		-4.7E-08	
PCB-126	0.1	-2.1	-0.21	NA	-2.10E-09	-2.7	-0.27	NA	-2.70E-09	-2.6	-0.26	NA	-2.60E-09	-1.7	-0.17	NA	-1.70E-09	-7.6	-0.76	NA	-7.60E-09
PCB-155		-2.4		-2.4E-08		-0.54		-5.4E-09		-0.72		-7.2E-09		-0.44		-4.4E-09		-2.3		-2.3E-08	
PCB-152		-0.4		-4.0E-09		-0.38		-3.8E-09		-0.45		-4.5E-09		-0.53		-5.3E-09		-1.2		-1.2E-08	
PCB-150		-0.39		-3.9E-09		-0.36		-3.6E-09		-0.43		-4.3E-09		-0.51		-5.1E-09		-1.1		-1.1E-08	
PCB-136		9.67		9.7E-08		-17		-1.7E-07		30.5		3.1E-07		-0.55		-5.5E-09		-6.2		-6.2E-08	
PCB-145		-0.42		-4.2E-09		-0.39		-3.9E-09		-0.47		-4.7E-09		-0.55		-5.5E-09		-1.2		-1.2E-08	
PCB-148		-0.6		-6.0E-09		-0.55		-5.5E-09		-0.66		-6.6E-09		-0.78		-7.8E-09		-1.7		-1.7E-08	
PCB-135/151		29.4		2.9E-07		45.2		4.5E-07		61		6.1E-07		-0.83		-8.3E-09		20.5		2.1E-07	
PCB-154		-0.49		-4.9E-09		-0.72		-7.2E-09		-0.54		-5.4E-09		-0.65		-6.5E-09		-1.4		-1.4E-08	
PCB-144		3.69		3.7E-08		-6.6		-6.6E-08		10.5		1.1E-07		-0.84		-8.4E-09		3.21		3.2E-08	
PCB-147/149		84.9		8.5E-07		158		1.6E-06		190		1.9E-06		-1.9		-1.9E-08		66		6.6E-07	
PCB-134/143		5.77		5.8E-08		-10		-1.0E-07		-12		-1.2E-07		-0.97		-9.7E-09		-6.5		-6.5E-08	
PCB-139/140		2.7		2.7E-08		4.13		4.1E-08		-5.3		-5.3E-08		-0.8		-8.0E-09		-5.4		-5.4E-08	
PCB-131		-1.2		-1.2E-08		-2.9		-2.9E-08		-4.3		-4.3E-08		-1		-1.0E-08		-6.7		-6.7E-08	
PCB-142		-1.1		-1.1E-08		-1.5		-1.5E-08		-1.3		-1.3E-08		-0.97		-9.7E-09		-6.5		-6.5E-08	
PCB-132		45.3		4.5E-07		76.9		7.7E-07		84.6		8.5E-07		-0.96		-9.6E-09		-30		-3.0E-07	
PCB-133		-1.1		-1.1E-08		-1.9		-1.9E-08		-1.9		-1.9E-08		-0.92		-9.2E-09		-6.2		-6.2E-08	
PCB-165		-0.82		-8.2E-09		-1.1		-1.1E-08		-0.93		-9.3E-09		-0.71		-7.1E-09		-4.8		-4.8E-08	
PCB-146		13.5		1.4E-07		21.9		2.2E-07		22		2.2E-07		-0.8		-8.0E-09		14.5		1.5E-07	
PCB-161		-0.78		-7.8E-09		-1.1		-1.1E-08		-0.89		-8.9E-09		-0.68		-6.8E-09		-4.6		-4.6E-08	
PCB-153/168		83.9		8.4E-07		135		1.4E-06		134		1.3E-06		1.73		1.7E-08		79		7.9E-07	
PCB-141		24.3		2.4E-07		40		4.0E-07		38.5		3.9E-07		-0.93		-9.3E-09		-21		-2.1E-07	
PCB-130		-7.4		-7.4E-08		-14		-1.4E-07		15.6		1.6E-07		-1.1		-1.1E-08		10.1		1.0E-07	
PCB-137/164		15.9		1.6E-07		26.8		2.7E-07		26.3		2.6E-07		-0.81		-8.1E-09		-14		-1.4E-07	
PCB-129/138/163		144		1.4E-06		234		2.3E-06		208		2.1E-06		-1.3		-1.3E-08		127		1.3E-06	
PCB-160		-0.86		-8.6E-09		-1.2		-1.2E-08		-0.98		-9.8E-09		-0.75		-7.5E-09		-5		-5.0E-08	
PCB-158		14.6		1.5E-07		22		2.2E-07		21.1		2.1E-07		-0.61		-6.1E-09		-13		-1.3E-07	
PCB-128/166		20.7		2.1E-07		33.8		3.4E-07		27.1		2.7E-07		-0.83		-8.3E-09		20.7		2.1E-07	
PCB-159		-0.82		-8.2E-09		1.4		1.4E-08		-1		-1.0E-08		-0.71		-7.1E-09		-4.8		-4.8E-08	
PCB-162		-0.86		-8.6E-09		-1.2		-1.2E-08		-0.98		-9.8E-09		-0.74		-7.4E-09		-5		-5.0E-08	
PCB-156/157	0.00003	13.5	0.000405	NA	4.05E-12	17	0.00051	NA	5.10E-12	14.3	0.000429	NA	4.29E-12	-0.9	-2.7E-05	NA	-2.70E-13	13.4	0.000402	NA	4.02E-12
PCB-167	0.00003	5.21	0.000156	NA	1.56E-12	-7.5	-0.00023	NA	-2.25E-12	-4.2	-0.00013	NA	-1.26E-12	-0.65	-2E-05	NA	-1.95E-13	5.41	0.000162	NA	1.62E-12
PCB-169	0.03	-0.84	-0.0252	NA	-2.52E-10	-1	-0.03	NA	-3.00E-10	-0.84	-0.0252	NA	-2.52E-10	-0.79	-0.0237	NA	-2.37E-10	-4	-0.12	NA	-1.20E-09
PCB-188		-0.77		-7.7E-09		-1.2		-1.2E-08		-0.93		-9.3E-09		-0.54		-5.4E-09		-2.9		-2.9E-08	
PCB-179		8.09		8.1E-08		-9.1		-9.1E-08		14.2		1.4E-07		-0.59		-5.9E-09		-6.1		-6.1E-08	
PCB-184		-3		-3.0E-08		-0.94		-9.4E-09		-0.66		-6.6E-09		-0.53		-5.3E-09		-1.8		-1.8E-08	
PCB-176		2.64		2.6E-08		3.93		3.9E-08		3.72		3.7E-08		-0.6		-6.0E-09		-2.1		-2.1E-08	
PCB-186		-0.86		-8.6E-09		-1.1		-1.1E-08		-0.77		-7.7E-09		-0.61		-6.1E-09		-2.1		-2.1E-08	
PCB-178		5.18		5.2E-08		-6.6		-6.6E-08		-4.8		-4.8E-08		-0.9		-9.0E-09		-3.2		-3.2E-08	
PCB-175		-1.3		-1.3E-08		-1.6		-1.6E-08		-1.1		-1.1E-08		-0.9		-9.0E-09		-3.1		-3.1E-08	
PCB-187		24.4		2.4E-07		38.8		3.9E-07		36.2		3.6E-07		-0.77		-7.7E-09		32.7		3.3E-07	
PCB-182		-1.2		-1.2E-08		-1.5		-1.5E-08		-1.1		-1.1E-08		-0.84		-8.4E-09		-2.9		-2.9E-08	
PCB-183		15.1		1.5E-07		16.9		1.7E-07		13.5		1.4E-07		-0.84		-8.4E-09		-8.5		-8.5E-08	
PCB-185		-1.2		-1.2E-08		2.86		2.9E-08		-1.6		-1.6E-08		-0.86		-8.6E-09		-3		-3.0E-08	

Sample Name	TEF	ENG-558-DFP-02				ENG-583-DFP-02				ENG-168-DFP-01				DFP-BLANK				ENG-159-DFP-1			
		All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs ($\mu g/cm^2$)	PCB TEQ ($\mu g/cm^2$)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs ($\mu g/cm^2$)	PCB TEQ ($\mu g/cm^2$)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs ($\mu g/cm^2$)	PCB TEQ ($\mu g/cm^2$)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs ($\mu g/cm^2$)	PCB TEQ ($\mu g/cm^2$)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs ($\mu g/cm^2$)	PCB TEQ ($\mu g/cm^2$)
PCB-174		23.3		2.3E-07		29.2		2.9E-07		-23		-2.3E-07		-0.91		-9.1E-09		-21		-2.1E-07	
PCB-177		12.7		1.3E-07		-13		-1.3E-07		14.7		1.5E-07		-0.96		-9.6E-09		13.9		1.4E-07	
PCB-181		-1.3		-1.3E-08		-1.6		-1.6E-08		-1.1		-1.1E-08		-0.9		-9.0E-09		-3.2		-3.2E-08	
PCB-171/173		-6.3		-6.3E-08		-8.5		-8.5E-08		9.55		9.6E-08		-0.99		-9.9E-09		10		1.0E-07	
PCB-172		-4.2		-4.2E-08		9.11		9.1E-08		-2.9		-2.9E-08		-0.99		-9.9E-09		-3.6		-3.6E-08	
PCB-192		-1.1		-1.1E-08		-1.4		-1.4E-08		-0.95		-9.5E-09		-0.76		-7.6E-09		-2.7		-2.7E-08	
PCB-180/193		45.4		4.5E-07		64.8		6.5E-07		53.6		5.4E-07		-0.75		-7.5E-09		-63		-6.3E-07	
PCB-191		-0.9		-9.0E-09		-2.3		-2.3E-08		-1.4		-1.4E-08		-0.64		-6.4E-09		-2.3		-2.3E-08	
PCB-170		17.3		1.7E-07		20.5		2.1E-07		17.9		1.8E-07		-0.75		-7.5E-09		22.2		2.2E-07	
PCB-190		3.09		3.1E-08		-3.1		-3.1E-08		2.96		3.0E-08		-0.47		-4.7E-09		3.92		3.9E-08	
PCB-189	0.00003	-1.2	-3.6E-05	NA	-3.60E-13	-0.6	-1.8E-05	NA	-1.80E-13	-0.69	-2.1E-05	NA	-2.07E-13	-0.5	-1.5E-05	NA	-1.50E-13	-1.1	-3.3E-05	NA	-3.30E-13
PCB-202		-2.7		-2.7E-08		-7.4		-7.4E-08		9.47		9.5E-08		-0.88		-8.8E-09		7.83		7.8E-08	
PCB-201		-1.8		-1.8E-08		-2.8		-2.8E-08		2.62		2.6E-08		-0.9		-9.0E-09		-2.5		-2.5E-08	
PCB-204		-0.58		-5.8E-09		-0.87		-8.7E-09		-0.9		-9.0E-09		-0.9		-9.0E-09		-2.5		-2.5E-08	
PCB-197		-0.57		-5.7E-09		-0.85		-8.5E-09		-0.88		-8.8E-09		-0.88		-8.8E-09		-2.5		-2.5E-08	
PCB-200		-1.3		-1.3E-08		-1.7		-1.7E-08		-2.6		-2.6E-08		-0.92		-9.2E-09		-2.6		-2.6E-08	
PCB-198/199		8.94		8.9E-08		14.8		1.5E-07		12.9		1.3E-07		-0.88		-8.8E-09		20.2		2.0E-07	
PCB-196		-2.6		-2.6E-08		-4.3		-4.3E-08		-4		-4.0E-08		-0.86		-8.6E-09		6.35		6.4E-08	
PCB-203		5.15		5.2E-08		10.1		1.0E-07		-7.2		-7.2E-08		-0.85		-8.5E-09		9.06		9.1E-08	
PCB-195		-3.2		-3.2E-08		3.17		3.2E-08		3.21		3.2E-08		-0.71		-7.1E-09		-3		-3.0E-08	
PCB-194		9.71		9.7E-08		14		1.4E-07		12.2		1.2E-07		-1.5		-1.5E-08		14.2		1.4E-07	
PCB-205		-0.76		-7.6E-09		-0.76		-7.6E-09		-0.84		-8.4E-09		-0.68		-6.8E-09		-1.6		-1.6E-08	
PCB-208		5.19		5.2E-08		9.77		9.8E-08		7.88		7.9E-08		-1.6		-1.6E-08		23		2.3E-07	
PCB-207		-2.6		-2.6E-08		-5		-5.0E-08		-2.7		-2.7E-08		-1.7		-1.7E-08		-11		-1.1E-07	
PCB-206		12.1		1.2E-07		16.6		1.7E-07		-10		-1.0E-07		4.75		4.8E-08		31.9		3.2E-07	
PCB-209		-103		-1.0E-06		-141		-1.4E-06		-133		-1.3E-06		59.5		6.0E-07		Rejected data		--	
Non-TEQ PCBs (ND = 0)				**2.7E-05**				**3.4E-05**				**3.1E-05**				**1.2E-06**				**1.9E-05**	
Non-TEQ PCBs (ND = 1/2 DL)*				**2.9E-05**				**3.6E-05**				**3.3E-05**				**2.0E-06**				**2.3E-05**	
Non-TEQ PCBs (ND = DL)				**3.0E-05**				**3.9E-05**				**3.4E-05**				**2.9E-06**				**2.6E-05**	
Lower Bound PCB TEQ (ND = 0)					**6.4E-11**				**9.0E-11**				**8.6E-11**				**0.0E+00**				**3.2E-11**
Mid Point PCB TEQ (ND = 1/2 DL)*					**1.2E-09**				**1.6E-09**				**1.5E-09**				**9.7E-10**				**4.4E-09**
Upper Bound PCB TEQ (ND = DL)					**2.4E-09**				**3.1E-09**				**3.0E-09**				**1.9E-09**				**8.9E-09**

Notes/Abbreviations

"-" = "<" (reported less than the detection limit).

Highlighted cells indicate a blank adjustment was made (see Appendix C).

* = used in report tables

NA = not applicable; PCB TEQ calculated.

Sample Name	TEF	ENG-583-DFP-01 All PCBs (pg)	ENG-583-DFP-01 PCB TEQ (pg)	ENG-583-DFP-01 Non-TEQ PCBs (µg/cm^2)	ENG-583-DFP-01 PCB TEQ (µg/cm^2)	ENG-558-DFP-01 All PCBs (pg)	ENG-558-DFP-01 PCB TEQ (pg)	ENG-558-DFP-01 Non-TEQ PCBs (µg/cm^2)	ENG-558-DFP-01 PCB TEQ (µg/cm^2)
PCB-001		16.9		1.7E-07		-4.7		-4.7E-08	
PCB-002		70.5		7.1E-07		33.6		3.4E-07	
PCB-003		69.9		7.0E-07		-22		-2.2E-07	
PCB-004		-12		-1.2E-07		-5.2		-5.2E-08	
PCB-010		-2.9		-2.9E-08		-3.2		-3.2E-08	
PCB-009		-3		-3.0E-08		-3.2		-3.2E-08	
PCB-007		10.8		1.1E-07		-3.1		-3.1E-08	
PCB-006		-13		-1.3E-07		-3.3		-3.3E-08	
PCB-005		-3.5		-3.5E-08		-3.7		-3.7E-08	
PCB-008		47.1		4.7E-07		-9.24		-9.2E-08	
PCB-014		-2.8		-2.8E-08		-2.4		-2.4E-08	
PCB-011		894		8.9E-06		1400		1.4E-05	
PCB-012/013		-30		-3.0E-07		-2.4		-2.4E-08	
PCB-015		-42		-4.2E-07		-5.5		-5.5E-08	
PCB-019		-3.9		-3.9E-08		-1.2		-1.2E-08	
PCB-018/030		32.3		3.2E-07		-6.9		-6.9E-08	
PCB-017		18.1		1.8E-07		3.6		3.6E-08	
PCB-027		-2.3		-2.3E-08		-0.93		-9.3E-09	
PCB-024		-1.1		-1.1E-08		-0.94		-9.4E-09	
PCB-016		-15		-1.5E-07		-3.2		-3.2E-08	
PCB-032		10.5		1.1E-07		3.07		3.1E-08	
PCB-034		-1.2		-1.2E-08		-1.4		-1.4E-08	
PCB-023		-1.1		-1.1E-08		-1.3		-1.3E-08	
PCB-026/029		-12		-1.2E-07		3.39		3.4E-08	
PCB-025		-8.5		-8.5E-08		-1.2		-1.2E-08	
PCB-031		62.7		6.3E-07		-11.7		-1.2E-07	
PCB-020/028		78.9		7.9E-07		13.5		1.4E-07	
PCB-021/033		-50		-5.0E-07		-8		-8.0E-08	
PCB-022		32.4		3.2E-07		5.33		5.3E-08	
PCB-036		16.6		1.7E-07		-1.3		-1.3E-08	
PCB-039		-1.1		-1.1E-08		-1.3		-1.3E-08	
PCB-038		-1.2		-1.2E-08		-1.4		-1.4E-08	
PCB-035		42.9		4.3E-07		12.1		1.2E-07	
PCB-037		67.7		6.8E-07		6.25		6.3E-08	
PCB-054		-0.49		-4.9E-09		-0.56		-5.6E-09	
PCB-050/053		8.55		8.6E-08		-1.1		-1.1E-08	
PCB-045/051		71.3		7.1E-07		-4.4		-4.4E-08	
PCB-046		-3.9		-3.9E-08		-1.1		-1.1E-08	
PCB-052		270		2.7E-06		26.9		2.7E-07	
PCB-073		-0.56		-5.6E-09		-0.69		-6.9E-09	
PCB-043		-2.1		-2.1E-08		-1.2		-1.2E-08	
PCB-049/069		79.7		8.0E-07		7.2		7.2E-08	
PCB-048		18.6		1.9E-07		1.77		1.8E-08	
PCB-044/047/065		506		5.1E-06		28		2.8E-07	
PCB-059/062/075		10.6		1.1E-07		-0.73		-7.3E-09	
PCB-042		-25		-2.5E-07		-3		-3.0E-08	
PCB-040/041/071		60.8		6.1E-07		-6.8		-6.8E-08	
PCB-064		61.2		6.1E-07		-5.7		-5.7E-08	
PCB-072		-1.1		-1.1E-08		-0.77		-7.7E-09	
PCB-068		50.1		5.0E-07		4.58		4.6E-08	
PCB-057		-1.2		-1.2E-08		-0.82		-8.2E-09	
PCB-058		-1.1		-1.1E-08		-0.75		-7.5E-09	
PCB-067		-2.9		-2.9E-08		-0.71		-7.1E-09	
PCB-063		-4.8		-4.8E-08		-0.76		-7.6E-09	
PCB-061/070/074/076		419		4.2E-06		36.2		3.6E-07	
PCB-066		144		1.4E-06		-12		-1.2E-07	
PCB-055		-1.2		-1.2E-08		-0.83		-8.3E-09	
PCB-056		62.5		6.3E-07		-9		-9.0E-08	
PCB-060		38		3.8E-07		3.81		3.8E-08	
PCB-080		-1		-1.0E-08		-0.71		-7.1E-09	
PCB-079		-6.5		-6.5E-08		-0.76		-7.6E-09	
PCB-078		-1.8		-1.8E-08		-0.89		-8.9E-09	
PCB-077	0.0001	47.1	0.00471	NA	4.71E-11	-5	-0.0005	NA	-5.00E-12
PCB-081	0.0003	-1.4	-0.00042	NA	-4.20E-12	-0.94	-0.00028	NA	-2.82E-12
PCB-104		-0.63		-6.3E-09		-0.59		-5.9E-09	
PCB-096		2.54		2.5E-08		-0.57		-5.7E-09	
PCB-103		2.39		2.4E-08		-2.1		-2.1E-08	
PCB-094		-2.2		-2.2E-08		-2.4		-2.4E-08	

Sample Name	TEF	ENG-583-DFP-01				ENG-558-DFP-01			
		All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)
PCB-095		475		4.8E-06		37.7		3.8E-07	
PCB-093/098/100/102		17.3		1.7E-07		-2.3		-2.3E-08	
PCB-088/091		71.7		7.2E-07		6.44		6.4E-08	
PCB-084		163		1.6E-06		15.5		1.6E-07	
PCB-089		-5.2		-5.2E-08		-2.6		-2.6E-08	
PCB-121		-1.6		-1.6E-08		-1.8		-1.8E-08	
PCB-092		112		1.1E-06		10.4		1.0E-07	
PCB-090/101/113		657		6.6E-06		57.6		5.8E-07	
PCB-083/099		331		3.3E-06		31.1		3.1E-07	
PCB-112		-7.4		-7.4E-08		-2.4		-2.4E-08	
PCB-086/087/097/109/119/125		491		4.9E-06		50.3		5.0E-07	
PCB-085/110/115/116/117		934		9.3E-06		123		1.2E-06	
PCB-082		87.8		8.8E-07		-6.9		-6.9E-08	
PCB-111		-1.6		-1.6E-08		-1.8		-1.8E-08	
PCB-120		-1.6		-1.6E-08		29.5		3.0E-07	
PCB-108/124		23.7		2.4E-07		-4.4		-4.4E-08	
PCB-107		30.6		3.1E-07		-3.8		-3.8E-08	
PCB-105	0.00003	182	0.00546	NA	5.46E-11	32.7	0.000981	NA	9.81E-12
PCB-106		-2.1		-2.1E-08		-4.5		-4.5E-08	
PCB-114	0.00003	-11	-0.00033	NA	-3.30E-12	-4.6	-0.00014	NA	-1.38E-12
PCB-122		-8.5		-8.5E-08		-4.9		-4.9E-08	
PCB-118	0.00003	524	0.01572	NA	1.57E-10	-69	-0.00207	NA	-2.07E-11
PCB-123	0.00003	10.1	0.000303	NA	3.03E-12	-4.9	-0.00015	NA	-1.47E-12
PCB-127		-2.2		-2.2E-08		-4.6		-4.6E-08	
PCB-126	0.1	-9.3	-0.93	NA	-9.30E-09	-5.8	-0.58	NA	-5.80E-09
PCB-155		-1.1		-1.1E-08		-0.78		-7.8E-09	
PCB-152		-0.55		-5.5E-09		-0.52		-5.2E-09	
PCB-150		0.668		6.7E-09		-0.5		-5.0E-09	
PCB-136		61.2		6.1E-07		8.52		8.5E-08	
PCB-145		-0.51		-5.1E-09		-0.54		-5.4E-09	
PCB-148		-0.71		-7.1E-09		-0.76		-7.6E-09	
PCB-135/151		139		1.4E-06		19.6		2.0E-07	
PCB-154		-0.58		-5.8E-09		-0.62		-6.2E-09	
PCB-144		22.3		2.2E-07		3.91		3.9E-08	
PCB-147/149		353		3.5E-06		55.3		5.5E-07	
PCB-134/143		31.5		3.2E-07		5.19		5.2E-08	
PCB-139/140		10.6		1.1E-07		-1.6		-1.6E-08	
PCB-131		8.92		8.9E-08		-2.1		-2.1E-08	
PCB-142		-1.3		-1.3E-08		-2		-2.0E-08	
PCB-132		177		1.8E-06		32		3.2E-07	
PCB-133		5.15		5.2E-08		-1.9		-1.9E-08	
PCB-165		-0.96		-9.6E-09		-1.4		-1.4E-08	
PCB-146		-46		-4.6E-07		10.6		1.1E-07	
PCB-161		-0.92		-9.2E-09		-1.4		-1.4E-08	
PCB-153/168		297		3.0E-06		61.4		6.1E-07	
PCB-141		75.5		7.6E-07		17.9		1.8E-07	
PCB-130		-24		-2.4E-07		6.43		6.4E-08	
PCB-137/164		48.9		4.9E-07		13.6		1.4E-07	
PCB-129/138/163		454		4.5E-06		117		1.2E-06	
PCB-160		-0.93		-9.3E-09		-1.4		-1.4E-08	
PCB-158		-42		-4.2E-07		11.4		1.1E-07	
PCB-128/166		63.2		6.3E-07		17.9		1.8E-07	
PCB-159		-2		-2.0E-08		5.39		5.4E-08	
PCB-162		-1		-1.0E-08		-1.5		-1.5E-08	
PCB-156/157	0.00003	37.9	0.001137	NA	1.14E-11	18	0.00054	NA	5.40E-12
PCB-167	0.00003	15.2	0.000456	NA	4.56E-12	-5.2	-0.00016	NA	-1.56E-12
PCB-169	0.03	-1.1	-0.033	NA	-3.30E-10	-1.5	-0.045	NA	-4.50E-10
PCB-188		-0.55		-5.5E-09		-1.3		-1.3E-08	
PCB-179		25.3		2.5E-07		6.41		6.4E-08	
PCB-184		1.7		1.7E-08		-0.94		-9.4E-09	
PCB-176		8.24		8.2E-08		2.2		2.2E-08	
PCB-186		-0.52		-5.2E-09		-1.1		-1.1E-08	
PCB-178		12.5		1.3E-07		3.06		3.1E-08	
PCB-175		3.57		3.6E-08		-1.6		-1.6E-08	
PCB-187		73.7		7.4E-07		22.3		2.2E-07	
PCB-182		-0.71		-7.1E-09		-1.5		-1.5E-08	
PCB-183		35		3.5E-07		-11		-1.1E-07	
PCB-185		5.25		5.3E-08		-1.8		-1.8E-08	

Sample Name	TEF	ENG-583-DFP-01				ENG-558-DFP-01			
		All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)	All PCBs (pg)	PCB TEQ (pg)	Non-TEQ PCBs (µg/cm^2)	PCB TEQ (µg/cm^2)
PCB-174		50.3		5.0E-07		21.7		2.2E-07	
PCB-177		28.2		2.8E-07		11.4		1.1E-07	
PCB-181		-1		-1.0E-08		-1.6		-1.6E-08	
PCB-171/173		17		1.7E-07		-4.7		-4.7E-08	
PCB-172		-8.6		-8.6E-08		-2.6		-2.6E-08	
PCB-192		-0.68		-6.8E-09		-1.4		-1.4E-08	
PCB-180/193		115		1.2E-06		204		2.0E-06	
PCB-191		-3.3		-3.3E-08		-1.3		-1.3E-08	
PCB-170		50.6		5.1E-07		34		3.4E-07	
PCB-190		11.2		1.1E-07		5.83		5.8E-08	
PCB-189	0.00003	-1.9	-5.7E-05	NA	-5.70E-13	-1.3	-3.9E-05	NA	-3.90E-13
PCB-202		18.5		1.9E-07		-1.8		-1.8E-08	
PCB-201		5.88		5.9E-08		-1.1		-1.1E-08	
PCB-204		-0.71		-7.1E-09		-1.1		-1.1E-08	
PCB-197		-1		-1.0E-08		-1		-1.0E-08	
PCB-200		6.09		6.1E-08		-1.1		-1.1E-08	
PCB-198/199		47		4.7E-07		16.9		1.7E-07	
PCB-196		15.1		1.5E-07		6.8		6.8E-08	
PCB-203		30.5		3.1E-07		-8.4		-8.4E-08	
PCB-195		8.84		8.8E-08		4.78		4.8E-08	
PCB-194		28.8		2.9E-07		17.9		1.8E-07	
PCB-205		-1.6		-1.6E-08		-1.1		-1.1E-08	
PCB-208		21.9		2.2E-07		-5.3		-5.3E-08	
PCB-207		8.07		8.1E-08		4.4		4.4E-08	
PCB-206		53.4		5.3E-07		-21		-2.1E-07	
PCB-209		-89.4		-8.9E-07		-218		-2.2E-06	
Non-TEQ PCBs (ND = 0)				**9.1E-05**				**2.7E-05**	
Non-TEQ PCBs (ND = 1/2 DL)*				**9.4E-05**				**3.0E-05**	
Non-TEQ PCBs (ND = DL)				**9.6E-05**				**3.2E-05**	
Lower Bound PCB TEQ (ND = 0)					**2.8E-10**				**1.5E-11**
Mid Point PCB TEQ (ND = 1/2 DL)*					**5.1E-09**				**3.2E-09**
Upper Bound PCB TEQ (ND = DL)					**9.9E-09**				**6.3E-09**

Notes/Abbreviations

"-" = "<" (reported less than the detection limit).

Highlighted cells indicate a blank adjustment was made (see Appendix C).

* = used in report tables

NA = not applicable; PCB TEQ calculated.

Sample Name		BA-1	BA-2	BA-3-BLANK	356-4	356-5		ENG-558-DFP-02
ALS Sample ID		L2526958-1	L2526958-2	L2526958-3	L2526958-4	L2526958-5		L2526958-6
Target Analytes	TEFs	pg	pg	pg	pg	pg	Qualifier	pg
2,3,7,8-TCDD	1	<1.2	<1.4	<1.0	<0.92	<1.1		<1.1
1,2,3,7,8-PeCDD	1	<0.88	<2.1	<0.77	<0.75	<0.97		<1.0
1,2,3,4,7,8-HxCDD	0.1	<1.3	<2.8	<0.74	<0.68	<1.2		<1.1
1,2,3,6,7,8-HxCDD	0.1	<1.1	<2.6	<0.65	<0.59	<1.1		<1.0
1,2,3,7,8,9-HxCDD	0.1	<1.1	<3.2	<0.66	<0.60	<1.1		<1.0
1,2,3,4,6,7,8-HpCDD	0.01	7.97	<22	<1.5	<1.8	<3.3		12.0
OCDD	0.0003	35.6	<56	<2.2	<3.6	<6.53 U	non-detect U	68.0
2,3,7,8-TCDF	0.1	<1.2	<1.5	<1.0	<0.89	<1.1		<0.93
1,2,3,7,8-PeCDF	0.03	<0.97	<1.3	<0.64	<0.69	<0.63		<0.87
2,3,4,7,8-PeCDF	0.3	<0.73	<0.97	<0.47	<0.55	<0.49		<0.70
1,2,3,4,7,8-HxCDF	0.1	<1.0	<2.1	<0.45	<0.53	<0.71		<0.71
1,2,3,6,7,8-HxCDF	0.1	<0.86	<1.9	<0.43	<0.49	<0.66		<0.81
2,3,4,6,7,8-HxCDF	0.1	<0.87	<1.7	<0.45	<0.54	<0.72		<1.4
1,2,3,7,8,9-HxCDF	0.1	<1.3	<2.3	<0.67	1.02	<1.2		<1.1
1,2,3,4,6,7,8-HpCDF	0.01	<3.1	<4.3	<1.3	<1.1	<1.2		<4.7
1,2,3,4,7,8,9-HpCDF	0.01	<2.9	<9.3	<2.0	<1.8	<1.8		<2.7
OCDF	0.0003	<5.2	12.0	<2.3	<3.3	<4.6		11.0

Sample Name		BA-1	BA-2	BA-3-BLANK	356-4	356-5	ENG-558-DFP-02
ALS Sample ID		L2526958-1	L2526958-2	L2526958-3	L2526958-4	L2526958-5	L2526958-6
Target Analytes	TEFs	pg	pg	pg	pg	pg	pg
2,3,7,8-TCDD	1	0.6	0.7	0.5	0.46	0.55	0.55
1,2,3,7,8-PeCDD	1	0.44	1.05	0.385	0.375	0.485	0.5
1,2,3,4,7,8-HxCDD	0.1	0.065	0.14	0.037	0.034	0.06	0.055
1,2,3,6,7,8-HxCDD	0.1	0.055	0.13	0.0325	0.0295	0.055	0.05
1,2,3,7,8,9-HxCDD	0.1	0.055	0.16	0.033	0.03	0.055	0.05
1,2,3,4,6,7,8-HpCDD	0.01	0.0797	0.11	0.0075	0.009	0.0165	0.12
OCDD	0.0003	0.01068	0.0084	0.00033	0.00054	0.0009795	0.0204
2,3,7,8-TCDF	0.1	0.06	0.075	0.05	0.0445	0.055	0.0465
1,2,3,7,8-PeCDF	0.03	0.01455	0.0195	0.0096	0.01035	0.00945	0.01305
2,3,4,7,8-PeCDF	0.3	0.1095	0.1455	0.0705	0.0825	0.0735	0.105
1,2,3,4,7,8-HxCDF	0.1	0.05	0.105	0.0225	0.0265	0.0355	0.0355
1,2,3,6,7,8-HxCDF	0.1	0.043	0.095	0.0215	0.0245	0.033	0.0405
2,3,4,6,7,8-HxCDF	0.1	0.0435	0.085	0.0225	0.027	0.036	0.07
1,2,3,7,8,9-HxCDF	0.1	0.065	0.115	0.0335	0.102	0.06	0.055
1,2,3,4,6,7,8-HpCDF	0.01	0.0155	0.0215	0.0065	0.0055	0.006	0.0235
1,2,3,4,7,8,9-HpCDF	0.01	0.0145	0.0465	0.01	0.009	0.009	0.0135
OCDF	0.0003	0.00078	0.0036	0.000345	0.000495	0.00069	0.0033
Total TEQ using 1/2 DL (pg)		**1.7E+00**	**3.0E+00**	**1.2E+00**	**1.3E+00**	**1.5E+00**	**1.8E+00**
Total TEQ using 1/2 DL (µg)		**1.7E-06**	**3.0E-06**	**1.2E-06**	**1.3E-06**	**1.5E-06**	**1.8E-06**
Total TEQ using 1/2 DL (µg/cm^2)		**1.7E-08**	**3.0E-08**	**1.2E-08**	**1.3E-08**	**1.5E-08**	**1.8E-08**

Sample Name		BA-1	BA-2	BA-3-BLANK	356-4	356-5	ENG-558-DFP-02
ALS Sample ID		L2526958-1	L2526958-2	L2526958-3	L2526958-4	L2526958-5	L2526958-6
Target Analytes	TEFs	pg	pg	pg	pg	pg	pg
2,3,7,8-TCDD	1	1.2	1.4	1	0.92	1.1	1.1
1,2,3,7,8-PeCDD	1	0.88	2.1	0.77	0.75	0.97	1
1,2,3,4,7,8-HxCDD	0.1	0.13	0.28	0.074	0.068	0.12	0.11
1,2,3,6,7,8-HxCDD	0.1	0.11	0.26	0.065	0.059	0.11	0.1
1,2,3,7,8,9-HxCDD	0.1	0.11	0.32	0.066	0.06	0.11	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.0797	0.22	0.015	0.018	0.033	0.12
OCDD	0.0003	0.01068	0.0168	0.00066	0.00108	0.001959	0.0204
2,3,7,8-TCDF	0.1	0.12	0.15	0.1	0.089	0.11	0.093
1,2,3,7,8-PeCDF	0.03	0.0291	0.039	0.0192	0.0207	0.0189	0.0261
2,3,4,7,8-PeCDF	0.3	0.219	0.291	0.141	0.165	0.147	0.21
1,2,3,4,7,8-HxCDF	0.1	0.1	0.21	0.045	0.053	0.071	0.071
1,2,3,6,7,8-HxCDF	0.1	0.086	0.19	0.043	0.049	0.066	0.081
2,3,4,6,7,8-HxCDF	0.1	0.087	0.17	0.045	0.054	0.072	0.14
1,2,3,7,8,9-HxCDF	0.1	0.13	0.23	0.067	0.102	0.12	0.11
1,2,3,4,6,7,8-HpCDF	0.01	0.031	0.043	0.013	0.011	0.012	0.047
1,2,3,4,7,8,9-HpCDF	0.01	0.029	0.093	0.02	0.018	0.018	0.027
OCDF	0.0003	0.00156	0.0036	0.00069	0.00099	0.00138	0.0033
Total TEQ using DL (pg)		**3.4E+00**	**6.0E+00**	**2.5E+00**	**2.4E+00**	**3.1E+00**	**3.4E+00**
Total TEQ using DL (µg)		**3.4E-06**	**6.0E-06**	**2.5E-06**	**2.4E-06**	**3.1E-06**	**3.4E-06**
Total TEQ using DL (µg/cm^2)		**3.4E-08**	**6.0E-08**	**2.5E-08**	**2.4E-08**	**3.1E-08**	**3.4E-08**

Sample Name		BA-1	BA-2	BA-3-BLANK	356-4	356-5	ENG-558-DFP-02
ALS Sample ID		L2526958-1	L2526958-2	L2526958-3	L2526958-4	L2526958-5	L2526958-6
Target Analytes	TEFs	pg	pg	pg	pg	pg	pg
2,3,7,8-TCDD	1	0	0	0	0	0	0
1,2,3,7,8-PeCDD	1	0	0	0	0	0	0
1,2,3,4,7,8-HxCDD	0.1	0	0	0	0	0	0
1,2,3,6,7,8-HxCDD	0.1	0	0	0	0	0	0
1,2,3,7,8,9-HxCDD	0.1	0	0	0	0	0	0
1,2,3,4,6,7,8-HpCDD	0.01	0.0797	0	0	0	0	0.12
OCDD	0.0003	0.01068	0	0	0	0	0.0204
2,3,7,8-TCDF	0.1	0	0	0	0	0	0
1,2,3,7,8-PeCDF	0.03	0	0	0	0	0	0
2,3,4,7,8-PeCDF	0.3	0	0	0	0	0	0
1,2,3,4,7,8-HxCDF	0.1	0	0	0	0	0	0
1,2,3,6,7,8-HxCDF	0.1	0	0	0	0	0	0
2,3,4,6,7,8-HxCDF	0.1	0	0	0	0	0	0
1,2,3,7,8,9-HxCDF	0.1	0	0	0	0.102	0	0
1,2,3,4,6,7,8-HpCDF	0.01	0	0	0	0	0	0
1,2,3,4,7,8,9-HpCDF	0.01	0	0	0	0	0	0
OCDF	0.0003	0	0.0036	0	0	0	0.0033
Total TEQ using DL =0 (pg)		**9.0E-02**	**3.6E-03**	**0.0E+00**	**1.0E-01**	**0.0E+00**	**1.4E-01**
Total TEQ using DL =0 (µg)		**9.0E-08**	**3.6E-09**	**0.0E+00**	**1.0E-07**	**0.0E+00**	**1.4E-07**
Total TEQ using DL =0 (µg/cm^2)		**9.0E-10**	**3.6E-11**	**0.0E+00**	**1.0E-09**	**0.0E+00**	**1.4E-09**

Sample Name		ENG-583-DFP-02	ENG-168-DFP-01	DFP-BLANK	ENG-159-DFP-1	ENG-583-DFP-01	ENG-558-DFP-01
ALS Sample ID		L2526958-7	L2526958-8	L2526958-9	L2526958-10	L2526958-11	L2526958-12
Target Analytes	TEFs	pg	pg	pg	pg	pg	pg
2,3,7,8-TCDD	1	<1.1	<1.4	<1.2	<1.4	<1.6	<1.1
1,2,3,7,8-PeCDD	1	<0.87	<1.2	<0.82	<1.3	<1.6	<1.2
1,2,3,4,7,8-HxCDD	0.1	<1.5	<1.5	<1.0	<1.4	<1.7	<1.4
1,2,3,6,7,8-HxCDD	0.1	<1.3	<1.3	<0.92	<1.2	<1.6	<1.5
1,2,3,7,8,9-HxCDD	0.1	<1.3	<1.3	<0.92	<1.2	<1.8	<1.6
1,2,3,4,6,7,8-HpCDD	0.01	<6.9	<4.8	<2.2	<9.3	<24	18.1
OCDD	0.0003	<30	57.4	<4.1	93.8	184	135
2,3,7,8-TCDF	0.1	<0.95	<1.1	<0.90	<1.1	<1.5	<0.85
1,2,3,7,8-PeCDF	0.03	<0.73	<1.3	<0.79	<0.96	<1.4	<1.1
2,3,4,7,8-PeCDF	0.3	<0.60	<0.97	<0.59	<0.76	<1.1	<0.87
1,2,3,4,7,8-HxCDF	0.1	<0.73	<0.79	<0.62	<1.0	<1.7	<0.96
1,2,3,6,7,8-HxCDF	0.1	<0.74	<0.90	<0.60	1.48	2.00	<0.82
2,3,4,6,7,8-HxCDF	0.1	<0.78	<0.83	<0.64	<1.0	<1.8	<0.88
1,2,3,7,8,9-HxCDF	0.1	<1.3	<1.5	<0.96	<1.6	<2.8	<1.3
1,2,3,4,6,7,8-HpCDF	0.01	3.56	<3.7	<1.5	5.17	15.8	11.0
1,2,3,4,7,8,9-HpCDF	0.01	<2.1	<6.2	<2.3	<5.2	<5.4	<6.5
OCDF	0.0003	<5.3	10.5	<5.0	17.1	<21	14.1

Sample Name		ENG-583-DFP-02	ENG-168-DFP-01	DFP-BLANK	ENG-159-DFP-1	ENG-583-DFP-01	ENG-558-DFP-01
ALS Sample ID		L2526958-7	L2526958-8	L2526958-9	L2526958-10	L2526958-11	L2526958-12
Target Analytes	TEFs	pg	pg	pg	pg	pg	pg
2,3,7,8-TCDD	1	0.55	0.7	0.6	0.7	0.8	0.55
1,2,3,7,8-PeCDD	1	0.435	0.6	0.41	0.65	0.8	0.6
1,2,3,4,7,8-HxCDD	0.1	0.075	0.075	0.05	0.07	0.085	0.07
1,2,3,6,7,8-HxCDD	0.1	0.065	0.065	0.046	0.06	0.08	0.075
1,2,3,7,8,9-HxCDD	0.1	0.065	0.065	0.046	0.06	0.09	0.08
1,2,3,4,6,7,8-HpCDD	0.01	0.0345	0.024	0.011	0.0465	0.12	0.181
OCDD	0.0003	0.0045	0.01722	0.000615	0.02814	0.0552	0.0405
2,3,7,8-TCDF	0.1	0.0475	0.055	0.045	0.055	0.075	0.0425
1,2,3,7,8-PeCDF	0.03	0.01095	0.0195	0.01185	0.0144	0.021	0.0165
2,3,4,7,8-PeCDF	0.3	0.09	0.1455	0.0885	0.114	0.165	0.1305
1,2,3,4,7,8-HxCDF	0.1	0.0365	0.0395	0.031	0.05	0.085	0.048
1,2,3,6,7,8-HxCDF	0.1	0.037	0.045	0.03	0.148	0.2	0.041
2,3,4,6,7,8-HxCDF	0.1	0.039	0.0415	0.032	0.05	0.09	0.044
1,2,3,7,8,9-HxCDF	0.1	0.065	0.075	0.048	0.08	0.14	0.065
1,2,3,4,6,7,8-HpCDF	0.01	0.0356	0.0185	0.0075	0.0517	0.158	0.11
1,2,3,4,7,8,9-HpCDF	0.01	0.0105	0.031	0.0115	0.026	0.027	0.0325
OCDF	0.0003	0.000795	0.00315	0.00075	0.00513	0.00315	0.00423
Total TEQ using 1/2 DL (pg)		**1.6E+00**	**2.0E+00**	**1.5E+00**	**2.2E+00**	**3.0E+00**	**2.1E+00**
Total TEQ using 1/2 DL (µg)		**1.6E-06**	**2.0E-06**	**1.5E-06**	**2.2E-06**	**3.0E-06**	**2.1E-06**
Total TEQ using 1/2 DL (µg/cm^2)		**1.6E-08**	**2.0E-08**	**1.5E-08**	**2.2E-08**	**3.0E-08**	**2.1E-08**

Sample Name		ENG-583-DFP-02	ENG-168-DFP-01	DFP-BLANK	ENG-159-DFP-1	ENG-583-DFP-01	ENG-558-DFP-01
ALS Sample ID		L2526958-7	L2526958-8	L2526958-9	L2526958-10	L2526958-11	L2526958-12
Target Analytes	TEFs	pg	pg	pg	pg	pg	pg
2,3,7,8-TCDD	1	1.1	1.4	1.2	1.4	1.6	1.1
1,2,3,7,8-PeCDD	1	0.87	1.2	0.82	1.3	1.6	1.2
1,2,3,4,7,8-HxCDD	0.1	0.15	0.15	0.1	0.14	0.17	0.14
1,2,3,6,7,8-HxCDD	0.1	0.13	0.13	0.092	0.12	0.16	0.15
1,2,3,7,8,9-HxCDD	0.1	0.13	0.13	0.092	0.12	0.18	0.16
1,2,3,4,6,7,8-HpCDD	0.01	0.069	0.048	0.022	0.093	0.24	0.181
OCDD	0.0003	0.009	0.01722	0.00123	0.02814	0.0552	0.0405
2,3,7,8-TCDF	0.1	0.095	0.11	0.09	0.11	0.15	0.085
1,2,3,7,8-PeCDF	0.03	0.0219	0.039	0.0237	0.0288	0.042	0.033
2,3,4,7,8-PeCDF	0.3	0.18	0.291	0.177	0.228	0.33	0.261
1,2,3,4,7,8-HxCDF	0.1	0.073	0.079	0.062	0.1	0.17	0.096
1,2,3,6,7,8-HxCDF	0.1	0.074	0.09	0.06	0.148	0.2	0.082
2,3,4,6,7,8-HxCDF	0.1	0.078	0.083	0.064	0.1	0.18	0.088
1,2,3,7,8,9-HxCDF	0.1	0.13	0.15	0.096	0.16	0.28	0.13
1,2,3,4,6,7,8-HpCDF	0.01	0.0356	0.037	0.015	0.0517	0.158	0.11
1,2,3,4,7,8,9-HpCDF	0.01	0.021	0.062	0.023	0.052	0.054	0.065
OCDF	0.0003	0.00159	0.00315	0.0015	0.00513	0.0063	0.00423
Total TEQ using DL (pg)		**3.2E+00**	**4.0E+00**	**2.9E+00**	**4.2E+00**	**5.6E+00**	**3.9E+00**
Total TEQ using DL (µg)		**3.2E-06**	**4.0E-06**	**2.9E-06**	**4.2E-06**	**5.6E-06**	**3.9E-06**
Total TEQ using DL (µg/cm^2)		**3.2E-08**	**4.0E-08**	**2.9E-08**	**4.2E-08**	**5.6E-08**	**3.9E-08**

Sample Name		ENG-583-DFP-02	ENG-168-DFP-01	DFP-BLANK	ENG-159-DFP-1	ENG-583-DFP-01	ENG-558-DFP-01
ALS Sample ID		L2526958-7	L2526958-8	L2526958-9	L2526958-10	L2526958-11	L2526958-12
Target Analytes	TEFs	pg	pg	pg	pg	pg	pg
2,3,7,8-TCDD	1	0	0	0	0	0	0
1,2,3,7,8-PeCDD	1	0	0	0	0	0	0
1,2,3,4,7,8-HxCDD	0.1	0	0	0	0	0	0
1,2,3,6,7,8-HxCDD	0.1	0	0	0	0	0	0
1,2,3,7,8,9-HxCDD	0.1	0	0	0	0	0	0
1,2,3,4,6,7,8-HpCDD	0.01	0	0	0	0	0	0.181
OCDD	0.0003	0	0.01722	0	0.02814	0.0552	0.0405
2,3,7,8-TCDF	0.1	0	0	0	0	0	0
1,2,3,7,8-PeCDF	0.03	0	0	0	0	0	0
2,3,4,7,8-PeCDF	0.3	0	0	0	0	0	0
1,2,3,4,7,8-HxCDF	0.1	0	0	0	0	0	0
1,2,3,6,7,8-HxCDF	0.1	0	0	0	0.148	0.2	0
2,3,4,6,7,8-HxCDF	0.1	0	0	0	0	0	0
1,2,3,7,8,9-HxCDF	0.1	0	0	0	0	0	0
1,2,3,4,6,7,8-HpCDF	0.01	0.0356	0	0	0.0517	0.158	0.11
1,2,3,4,7,8,9-HpCDF	0.01	0	0	0	0	0	0
OCDF	0.0003	0	0.00315	0	0.00513	0	0.00423
Total TEQ using DL =0 (pg)		**3.6E-02**	**2.0E-02**	**0.0E+00**	**2.3E-01**	**4.1E-01**	**3.4E-01**
Total TEQ using DL =0 (µg)		**3.6E-08**	**4.1E-02**	**0.0E+00**	**2.3E-07**	**4.1E-07**	**3.4E-07**
Total TEQ using (µg/cm^2)		**3.6E-10**	**8.1E-02**	**0.0E+00**	**2.3E-09**	**4.1E-09**	**3.4E-09**

ATTACHMENT 3

Data Validation

Attachment 3: Data Validation

ToxStrategies performed data validation to assess “data quality and usability” in general accordance with USEPA’s National Functional Guidelines (USEPA, 2017), as well as the use of professional judgment. All of the data were considered acceptable, with the following exceptions noted in the data review comments for ALS Workorders L2526958 and L2526958. Data review comments organized by ALS Workorder are provided below.

<u>ALS Workorder: 2031166</u>

Hexavalent chromium was not detected in the laboratory method blank; the laboratory control sample / laboratory control sample duplicate (LCS/LCSD) percent recoveries and relative percent difference (RPD) were within quality control (QC) limits.

<u>ALS Workorder: 2031169</u>

Hexavalent chromium was not detected in the laboratory method blank; the LCS/LCSD percent recoveries and RPD were within QC limits.

<u>ALS Workorder: 2031177</u>

No metals were detected in the laboratory method blanks; the LCS/LCSD percent recoveries and RPDs were within QC limits.

<u>ALS Workorder: 2031255</u>

Arsenic and lead were not detected in the laboratory method blanks; the LCS/LCSD percent recoveries and RPDs were within QC limits.

<u>ALS Workorder: 2031257</u>

Arsenic and lead were not detected in the laboratory method blanks; the LCS/LCSD percent recoveries and RPDs were within QC limits.

<u>ALS Workorder: 2031258</u>

Pentachlorophenol was not detected in the laboratory method blank; the LCS/LCSD percent recoveries and RPD were within QC limits.

<u>ALS Workorder: 2031261</u>

Benzene, ethylbenzene, naphthalene, and styrene were not detected in the laboratory method blank; the LCS/LCSD percent recoveries and RPDs were within QC limits.

ALS Workorder: 2031263

Benzene, ethylbenzene, and naphthalene were not detected in the laboratory method blank; the LCS/LCSD percent recoveries and RPDs were within QC limits.

ALS Workorder: 2031264

The LCS/LCSD percent recoveries and RPD were within QC limits for respirable dust.

ALS Workorder: 2031269

Tetrachloroethylene was not detected in the laboratory method blank; the LCS/LCSD percent recoveries and RPD were within QC limits.

ALS Workorder: 2031269

Organic and elemental carbon were not detected in the laboratory method blanks; the LCS/LCSD percent recoveries and RPD for organic carbon were within QC limits.

For the above-listed workorders, chemicals were not measured in the field blanks above the detection limit.

ALS Workorder: L2526958

The analytical method (Method 1668C) developed by USEPA (2010) provides guidance for evaluating the quality assurance/quality control results for the PCB analysis. Method 1668C indicates that "interferences and laboratory background levels"—not laboratory instruments—cause sample detections that are not otherwise observed in other chemical analyses (USEPA, 2010). As a result, the process for setting acceptable blank sample measurements is different from that for other analyses. For PCBs, the blank acceptance limit is calculated using the congener-specific minimum levels of quantitation (MLs; units of picograms [pg] per microliter [µL]) found in Table 2 of USEPA's Method 1668C (2010). Therefore, the congener-specific MLs represent the level at which the instrument can identify and quantify sample-specific analytes "based on the levels of contamination normally found in laboratories" (USEPA, 2010).

For each congener, the ML was calculated by multiplying the congener-specific ML (for an extract matrix in pg/µL) by 25 µL (final analysis volume), by a factor of 2 (as stated in the method), and by a second factor of 2 (because the samples were split for two analyses: PCBs and dioxins/furans). For example, the extract matrix for PCB-001 is 1 pg/µL. Using the formula, the ML for the analysis was:

$$ML_{analysis}(pg) = ML_{extract}(pg/\mu\mathrm{L}) \times 25\ (\mu\mathrm{L}) \times 2 \times 2$$

$$= 1\frac{pg}{\mu\mathrm{L}} \times 25\mu\mathrm{L} \times 2 \times 2$$

$$= 100\ pg$$

The two field blanks (Sample IDs BA-3-BLANK and DFP-BLANK) and the two laboratory method blanks (swab and reagent matrix) were compared to their congener-specific MLs. Any detections below the ML are considered potentially to be related to laboratory contamination and not relevant to the sample itself.

All of the PCB congeners detected in the two laboratory method blanks and two field blanks were below their respective congener-specific ML, with the exception of PCB-209 measured at 270 pg in the swab blank matrix, which exceeded the congener-specific ML of 250 pg. Table 1 presents the field and method blank results for PCB-209.

Table 1. Field and method blank results for PCB-209

Sample ID	Sample Result (pg)	Congener-specific ML (pg)
Field blanks		
BA-3-BLANK	134	250
DFP-BLANK	59.5	250
Method blanks		
Swab blank	270*	250
Reagent blank	112	250

*The swab blank sample result for PCB-209 exceeded the congener-specific ML of 250 pg.

The extraction percent recoveries for the PCB congeners were evaluated for each sample, and all were within limits, with the exception of the extraction standard for PCB-209 in sample ENG-159-DFP-1 (0% recovery). Therefore, PCB-209 in sample ENG-159-DFP-1 was qualified as unusable.

The extraction percent recoveries of the PCB congeners for the laboratory control sample (LCS) were all within limits, with the exception of PCB-209. As indicated by the laboratory, the method blank detection of PCB-209 above the ML caused the extraction percent recovery (30%) to be below the acceptable limits (40%–145%). Professional judgment was used, and no additional data qualification was considered necessary.

A summary of the PCB-209 results for each sample and their resulting data review qualification are presented in Table 2.

Table 2. Summary of the sample results for PCB-209 and resulting data review qualification

Sample ID	Sample Result (pg)	Congener-specific ML (pg)	Qualification based on ML
BA-1	38.8	250	No qualification required
BA-2	222	250	No qualification required
356-4	116	250	No qualification required
356-5	<130	250	No qualification required
ENG-558-DFP-02	103	250	No qualification required
ENG-583-DFP-02	141	250	No qualification required
ENG-168-DFP-01	133	250	No qualification required
ENG-159-DFP-1	<5300	250	Unusable
ENG-583-DFP-01	89.4	250	No qualification required
ENG-558-DFP-01	218	250	No qualification required

Blank Adjustments for PCB Data

If a PCB congener was detected in a blank sample (field blank [sample IDs BA-3-BLANK, DFP-BLANK] and/or laboratory blank [swab and reagent matrix]), the maximum blank result was compared to the result for field samples. If the field sample was non-detect, no change was made. If the field sample was detected at a concentration less than two times the maximum blank sample result, the field sample result was considered a non-detect at the value reported. If the field sample was detected at a concentration more than two times the maximum blank sample, no change was made. Data that were qualified are noted in the Attachment 2-A calculations. Table 3 lists the maximum blank concentrations for each congener.

Table 3. Maximum concentration detected in a blank sample

Congener	Congener Concentration (pg)
PCB-001	2.6
PCB-002	3.29
PCB-003	4.51
PCB-006	2.29
PCB-008	5.96
PCB-011	46
PCB-018/030	3.27
PCB-031	7.47
PCB-021/033	5.22
PCB-022	2.34
PCB-037	1.81
PCB-045/051	2.05
PCB-052	3.01
PCB-049/069	2.57
PCB-044/047/065	5.13
PCB-040/041/071	1.36
PCB-064	1.26
PCB-061/070/074/076	6.47
PCB-056	1.89
PCB-090/101/113	3.82
PCB-085/110/115/116/117	2.93
PCB-147/149	4.64
PCB-153/168	4.17
PCB-129/138/163	2.9
PCB-156/157	1.57
PCB-187	2.24
PCB-194	1.7
PCB-206	4.75
PCB-209	270

ALS Workorder: L2526958

In general, chlorinated dioxins/furans were not detected in the two field blanks (sample IDs BA-3-BLANK and DFP-BLANK) or in the laboratory method blanks (swab and reagent matrix), with the following exceptions:

- OCDD was detected at 6.88 pg in the swab blank, slightly above the detection limit of 5.5 pg
- OCDD was detected at 4.48 pg in the reagent blank, slightly above the detection limit of 3.0 pg
- 1,2,3,6,7,8-HxCDF was detected at 0.870 pg in the swab blank, slightly above the detection limit of 0.83 pg
- 1,2,3,4,6,7,8-HpCDF was detected at 1.43 pg in the reagent blank, slightly above the detection limit of 1.1 pg
- OCDF was detected at 8.88 pg in the swab blank slightly, above the detection limit of 6.5 pg.

In general accordance with USEPA's National Functional Guidelines (USEPA, 2017), no qualification is required if there is a detection in the method blank when the sample result is non-detect. Therefore, all sample results that were non-detect were not qualified.

When the sample result exceeded the maximum detected method blank result, the sample result was not qualified, based on professional judgement. The detections found in the method blanks were not considered likely to affect the detected sample results. In most cases, the minimum detected concentration was almost twice the blank detection; only the minimum concentration of OCDF was comparable to the blank concentration. Also, chlorinated dioxins/furans were not detected in the two field blanks (Sample IDs BA-3-BLANK and DFP-BLANK), suggesting that OCDF in blanks was not interfering with field sample analysis. Thus, none of the analytes detected above the detections in the blank samples were qualified.

Only sample ID 356-5 had a detection of OCDD (6.53 pg) that was less than the maximum detected blank result (6.88 pg). For this sample, ToxStrategies qualified the result with a "U" qualifier, and the sample result was revised to <6.53 pg, in general accordance with USEPA (2017).

A summary of the resulting sample qualifications, based on the laboratory method blank detections, is presented in Table 4.

Table 4. Summary of the sample results for selected dioxin/furan congeners and resulting data review qualification

Sample ID	Congener	Sample Result (pg)	Maximum Detected Blank Result (pg)	Qualification
BA-1	OCDD	35.6	6.88	Professional judgment was used and no qualification was required
BA-2	OCDD	<56	6.88	No qualification required
356-4	OCDD	<3.6	6.88	No qualification required
356-5	OCDD	6.53	6.88	Sample result qualified as non-detect (U); Revised value <6.53 pg
ENG-558-DFP-02	OCDD	68.0	6.88	Professional judgment was used and no qualification was required
ENG-583-DFP-02	OCDD	<30	6.88	No qualification required
ENG-168-DFP-01	OCDD	57.4	6.88	Professional judgment was used and no qualification was required
ENG-159-DFP-1	OCDD	93.8	6.88	Professional judgment was used and no qualification was required
ENG-583-DFP-01	OCDD	184	6.88	Professional judgment was used and no qualification was required
ENG-558-DFP-01	OCDD	135	6.88	Professional judgment was used and no qualification was required
BA-1	1,2,3,6,7,8-HxCDF	<0.86	0.870	No qualification required
BA-2	1,2,3,6,7,8-HxCDF	<1.9	0.870	No qualification required
356-4	1,2,3,6,7,8-HxCDF	<0.49	0.870	No qualification required
356-5	1,2,3,6,7,8-HxCDF	<0.66	0.870	No qualification required
ENG-558-DFP-02	1,2,3,6,7,8-HxCDF	<0.81	0.870	No qualification required
ENG-583-DFP-02	1,2,3,6,7,8-HxCDF	<0.74	0.870	No qualification required
ENG-168-DFP-01	1,2,3,6,7,8-HxCDF	<0.90	0.870	No qualification required
ENG-159-DFP-1	1,2,3,6,7,8-HxCDF	1.48	0.870	Professional judgment was used and no qualification was required
ENG-583-DFP-01	1,2,3,6,7,8-HxCDF	2.00	0.870	Professional judgment was used and no qualification was required
ENG-558-DFP-01	1,2,3,6,7,8-HxCDF	<0.82	0.870	No qualification required
BA-1	1,2,3,4,6,7,8-HpCDF	<3.1	1.43	No qualification required
BA-2	1,2,3,4,6,7,8-HpCDF	<4.3	1.43	No qualification required

Sample ID	Congener	Sample Result (pg)	Maximum Detected Blank Result (pg)	Qualification
356-4	1,2,3,4,6,7,8-HpCDF	<1.1	1.43	No qualification required
356-5	1,2,3,4,6,7,8-HpCDF	<1.2	1.43	No qualification required
ENG-558-DFP-02	1,2,3,4,6,7,8-HpCDF	<4.7	1.43	No qualification required
ENG-583-DFP-02	1,2,3,4,6,7,8-HpCDF	3.56	1.43	Professional judgment was used and no qualification was required
ENG-168-DFP-01	1,2,3,4,6,7,8-HpCDF	<3.7	1.43	No qualification required
ENG-159-DFP-1	1,2,3,4,6,7,8-HpCDF	5.17	1.43	Professional judgment was used and no qualification was required
ENG-583-DFP-01	1,2,3,4,6,7,8-HpCDF	15.8	1.43	Professional judgment was used and no qualification was required
ENG-558-DFP-01	1,2,3,4,6,7,8-HpCDF	11.0	1.43	Professional judgment was used and no qualification was required
BA-1	OCDF	<5.2	8.88	No qualification required
BA-2	OCDF	12.0	8.88	Professional judgment was used and no qualification was required
356-4	OCDF	<3.3	8.88	No qualification required
356-5	OCDF	<4.6	8.88	No qualification required
ENG-558-DFP-02	OCDF	11.0	8.88	Professional judgment was used and no qualification was required
ENG-583-DFP-02	OCDF	<5.3	8.88	No qualification required
ENG-168-DFP-01	OCDF	10.5	8.88	Professional judgment was used and no qualification was required
ENG-159-DFP-1	OCDF	17.1	8.88	Professional judgment was used and no qualification was required
ENG-583-DFP-01	OCDF	<21	8.88	No qualification required
ENG-558-DFP-01	OCDF	14.1	8.88	Professional judgment was used and no qualification was required

The extraction percent recoveries for the dioxins/furan sample results were within limits, with the exception of the following:

- The extraction standard's percent recovery of 28% was less than the minimum control limit of 32% in sample BA-2
- The extraction standard's percent recovery of 19% was less than the minimum control limit of 26% in sample BA-2

Because the concentration data in the samples are recovery corrected based on the extraction standard result, no additional action was required.

The extraction percent recoveries of the dioxin/furan congeners for the laboratory control sample (LCS) were all within limits.

The quality control (QC) sample reports are found in Attachment D-3-1, with the exception of those for PCBs and chlorinated dioxins/furans, for which the QC report is embedded in the laboratory report (see Attachment 1).

References

USEPA (U.S. Environmental Protection Agency). 2010. Method 1668C, Chlorinated biphenyl congeners in water, soil, sediment, biosolids, and tissue by HRGC/HRMS. EPA-820-R-10-005, April.

USEPA (U.S. Environmental Protection Agency). 2017. National functional guidelines for organic superfund methods data review. Office of Superfund Remediation and Technology Innovation (OSRTI). EPA-540-R-2017-002, January.

ATTACHMENT D-3-1

Quality Control (QC) Sample Reports

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031166

Limits:	Historical/Performance	**Preparation:**	NA	**Analysis:**	OSHA ID-215
Basis:	ALS Laboratory Group	**Batch:**	NA	**Batch:**	ILC/26381 (HBN: 271074)
		Prepared By:	NA	**Analyzed By:**	Daryka Gress

Blank

LMB: 722118
Analyzed: 11/06/2020 00:00
Units: ug/sample

Analyte	Result	MDL	RL
Hexavalent Chromium	ND	NA	0.0600

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722119
Analyzed: 11/06/2020 00:00
Dilution: 1
Units: ug/sample

LCSD: 722120
Analyzed: 11/06/2020 00:00
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Hexavalent Chromium	19.2	20.0	96.0	56.2	133.9	18.6	93.0	3.15	0.0	30.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Daryka Gress 11/09/2020 10:26	/S/ Christopher Winter 11/09/2020 12:07

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- Sample and Matrix Duplicate less than 5 times the reporting limit
- Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031169

Limits:	Historical/Performance	**Preparation:**	NA	**Analysis:**	OSHA ID-215
Basis:	ALS Laboratory Group	**Batch:**	NA	**Batch:**	ILC/26383 (HBN: 271154)
		Prepared By:	NA	**Analyzed By:**	Daryka Gress

Blank

LMB: 722343
Analyzed: 11/11/2020 00:00
Units: ug/sample

Analyte	Result	MDL	RL
Hexavalent Chromium	ND	NA	0.0600

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722344
Analyzed: 11/11/2020 00:00
Dilution: 1
Units: ug/sample

LCSD: 722345
Analyzed: 11/11/2020 00:00
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Hexavalent Chromium	19.7	20.0	98.6	56.2	133.9	19.6	98.2	0.417	0.0	30.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Daryka Gress 11/12/2020 12:10	/S/ Thomas Bosch 11/12/2020 14:52

Symbols and Definitions

- ✱ - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- ⬣ - Sample and Matrix Duplicate less than 5 times the reporting limit
- ⬣ - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031177

Limits:	Historical/Performance	**Preparation:**	IH Metals, MCE Prep	**Analysis:**	IH Metals, MCE QC
Basis:	ALS Laboratory Group	**Batch:**	IIPX/28413 (HBN: 271134)	**Batch:**	IICP/17110 (HBN: 271312)
		Prepared By:	Phillip Rich	**Analyzed By:**	Joanna C. Sanchez

Blank

LRB: 722285
Analyzed: 11/11/2020 12:11
Units: ug/sample

Analyte	Result	MDL	RL
Aluminum	ND	NA	5.00
Arsenic	ND	NA	2.50
Barium	ND	NA	0.250
Beryllium	ND	NA	0.0125
Cadmium	ND	NA	0.0750
Calcium	ND	NA	15.0
Chromium	ND	NA	1.25
Cobalt	ND	NA	0.0750
Copper	ND	NA	0.500
Iron	ND	NA	5.00
Lead	ND	NA	0.500
Lithium	ND	NA	1.00
Magnesium	ND	NA	1.25
Manganese	ND	NA	0.125
Molybdenum	ND	NA	0.375
Nickel	ND	NA	0.125
Phosphorus	ND	NA	5.00
Selenium	ND	NA	2.50
Silver	ND	NA	0.250
Sodium	ND	NA	3.75
Tellurium	ND	NA	1.25
Thallium	ND	NA	1.25
Titanium	ND	NA	0.0750
Vanadium	ND	NA	0.0750
Yttrium	ND	NA	0.0750
Zinc	ND	NA	0.500
Zirconium	ND	NA	0.500

LMB: 722286
Analyzed: 11/11/2020 12:12
Units: ug/sample

Analyte	Result	MDL	RL
Aluminum	ND	NA	5.00
Arsenic	ND	NA	2.50
Barium	ND	NA	0.250
Beryllium	ND	NA	0.0125
Cadmium	ND	NA	0.0750
Calcium	ND	NA	15.0

Quality Control Sample Batch Report

Analysis Information

Workorder: 2031177

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: IH Metals, MCE Prep
Batch: IIPX/28413 (HBN: 271134)
Prepared By: Phillip Rich

Analysis: IH Metals, MCE QC
Batch: IICP/17110 (HBN: 271312)
Analyzed By: Joanna C. Sanchez

Blank

LMB: 722286
Analyzed: 11/11/2020 12:12
Units: ug/sample

Analyte	Result	MDL	RL
Chromium	ND	NA	1.25
Cobalt	ND	NA	0.0750
Copper	ND	NA	0.500
Iron	ND	NA	5.00
Lead	ND	NA	0.500
Lithium	ND	NA	1.00
Magnesium	ND	NA	1.25
Manganese	ND	NA	0.125
Molybdenum	ND	NA	0.375
Nickel	ND	NA	0.125
Phosphorus	ND	NA	5.00
Selenium	ND	NA	2.50
Silver	ND	NA	0.250
Sodium	ND	NA	3.75
Tellurium	ND	NA	1.25
Thallium	ND	NA	1.25
Titanium	ND	NA	0.0750
Vanadium	ND	NA	0.0750
Yttrium	ND	NA	0.0750
Zinc	ND	NA	0.500
Zirconium	ND	NA	0.500

LRB: 722290
Analyzed: 11/11/2020 12:59
Units: ug/sample

Analyte	Result	MDL	RL
Aluminum	ND	NA	5.00
Arsenic	ND	NA	2.50
Barium	ND	NA	0.250
Beryllium	ND	NA	0.0125
Cadmium	ND	NA	0.0750
Calcium	ND	NA	15.0
Chromium	ND	NA	1.25
Cobalt	ND	NA	0.0750
Copper	ND	NA	0.500
Iron	ND	NA	5.00
Lead	ND	NA	0.500
Lithium	ND	NA	1.00

Quality Control Sample Batch Report

Analysis Information

Workorder: 2031177

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: IH Metals, MCE Prep
Batch: IIPX/28413 (HBN: 271134)
Prepared By: Phillip Rich

Analysis: IH Metals, MCE QC
Batch: IICP/17110 (HBN: 271312)
Analyzed By: Joanna C. Sanchez

Blank

LRB: 722290
Analyzed: 11/11/2020 12:59
Units: ug/sample

Analyte	Result	MDL	RL
Magnesium	ND	NA	1.25
Manganese	ND	NA	0.125
Molybdenum	ND	NA	0.375
Nickel	ND	NA	0.125
Phosphorus	ND	NA	5.00
Selenium	ND	NA	2.50
Silver	ND	NA	0.250
Sodium	ND	NA	3.75
Tellurium	ND	NA	1.25
Thallium	ND	NA	1.25
Titanium	ND	NA	0.0750
Vanadium	ND	NA	0.0750
Yttrium	ND	NA	0.0750
Zinc	ND	NA	0.500
Zirconium	ND	NA	0.500

LMB: 722291
Analyzed: 11/11/2020 13:04
Units: ug/sample

Analyte	Result	MDL	RL
Aluminum	ND	NA	5.00
Arsenic	ND	NA	2.50
Barium	ND	NA	0.250
Beryllium	ND	NA	0.0125
Cadmium	ND	NA	0.0750
Calcium	ND	NA	15.0
Chromium	ND	NA	1.25
Cobalt	ND	NA	0.0750
Copper	ND	NA	0.500
Iron	ND	NA	5.00
Lead	ND	NA	0.500
Lithium	ND	NA	1.00
Magnesium	ND	NA	1.25
Manganese	ND	NA	0.125
Molybdenum	ND	NA	0.375
Nickel	ND	NA	0.125
Phosphorus	ND	NA	5.00
Selenium	ND	NA	2.50

Quality Control Sample Batch Report

Analysis Information

Workorder: 2031177

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: IH Metals, MCE Prep
Batch: IIPX/28413 (HBN: 271134)
Prepared By: Phillip Rich

Analysis: IH Metals, MCE QC
Batch: IICP/17110 (HBN: 271312)
Analyzed By: Joanna C. Sanchez

Blank

LMB: 722291
Analyzed: 11/11/2020 13:04
Units: ug/sample

Analyte	Result	MDL	RL
Silver	ND	NA	0.250
Sodium	ND	NA	3.75
Tellurium	ND	NA	1.25
Thallium	ND	NA	1.25
Titanium	ND	NA	0.0750
Vanadium	ND	NA	0.0750
Yttrium	ND	NA	0.0750
Zinc	ND	NA	0.500
Zirconium	ND	NA	0.500

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722287
Analyzed: 11/11/2020 12:14
Dilution: 1
Units: ug/sample

LCSD: 722288
Analyzed: 11/11/2020 12:16
Dilution: 1
Units: ug/sample

Analyte	LCS Result	Target	% Rec	QC Limits		LCSD Result	% Rec	RPD	QC Limits	
Aluminum	95.2	100	95.2	86.6	116.0	95.4	95.4	0.235	0.0	15.0
Arsenic	97.0	100	97.0	88.4	107.7	97.9	97.9	0.908	0.0	15.0
Beryllium	10.4	10.0	104	90.4	116.1	10.4	104	0.520	0.0	15.0
Calcium	103	100	103	90.2	126.8	104	104	0.532	0.0	15.0
Cadmium	10.1	10.0	101	91.7	114.3	10.2	102	0.375	0.0	15.0
Cobalt	10.7	10.0	107	95.8	117.8	10.7	107	0.103	0.0	15.0
Chromium	105	100	105	90.9	117.0	105	105	0.0191	0.0	15.0
Copper	10.7	10.0	107	94.8	122.2	10.7	107	0.0466	0.0	15.0
Iron	105	100	105	92.8	116.4	105	105	0.363	0.0	15.0
Lithium	103	100	103	88.7	115.5	103	103	0.399	0.0	15.0
Magnesium	98.3	100	98.3	90.4	113.1	98.6	98.6	0.314	0.0	15.0
Manganese	105	100	105	93.4	113.0	106	106	0.606	0.0	15.0
Molybdenum	10.8	10.0	108	91.1	121.2	10.9	109	0.645	0.0	15.0
Nickel	10.8	10.0	108	97.0	120.8	10.9	109	0.498	0.0	15.0
Lead	104	100	104	92.4	116.7	105	105	0.527	0.0	15.0
Phosphorus	102	100	102	86.7	118.1	102	102	0.0883	0.0	15.0
Selenium	103	100	103	90.0	110.1	103	103	0.350	0.0	15.0
Silver	98.7	100	98.7	80.0	118.0	98.9	98.9	0.201	0.0	15.0
Sodium	110	100	110	92.9	116.4	111	111	0.308	0.0	15.0
Tellurium	102	100	102	90.3	115.5	102	102	0.588	0.0	15.0
Thallium	106	100	106	87.7	114.5	107	107	0.805	0.0	15.0
Titanium	10.3	10.0	103	90.1	115.3	10.4	104	0.966	0.0	15.0

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031177

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: IH Metals, MCE Prep
Batch: IIPX/28413 (HBN: 271134)
Prepared By: Phillip Rich

Analysis: IH Metals, MCE QC
Batch: IICP/17110 (HBN: 271312)
Analyzed By: Joanna C. Sanchez

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722287
Analyzed: 11/11/2020 12:14
Dilution: 1
Units: ug/sample

LCSD: 722288
Analyzed: 11/11/2020 12:16
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Vanadium	101	100	101	92.8	115.3	102	102	0.482	0.0	15.0
Yttrium	10.3	10.0	103	93.9	113.8	10.4	104	0.484	0.0	15.0
Zinc	103	100	103	95.2	117.5	103	103	0.223	0.0	15.0
Zirconium	101	100	101	88.8	114.2	102	102	1.21	0.0	15.0
Barium	102	100	102	92.1	113.7	102	102	0.157	0.0	15.0

LCS: 722292
Analyzed: 11/11/2020 13:06
Dilution: 1
Units: ug/sample

LCSD: 722293
Analyzed: 11/11/2020 13:07
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Aluminum	92.9	100	92.9	86.6	116.0	91.3	91.3	1.75	0.0	15.0
Arsenic	95.4	100	95.4	88.4	107.7	93.5	93.5	2.02	0.0	15.0
Beryllium	10.1	10.0	101	90.4	116.1	9.91	99.1	2.15	0.0	15.0
Calcium	101	100	101	90.2	126.8	99.2	99.2	1.97	0.0	15.0
Cadmium	9.97	10.0	99.7	91.7	114.3	9.80	98.0	1.77	0.0	15.0
Cobalt	10.4	10.0	104	95.8	117.8	10.3	103	1.46	0.0	15.0
Chromium	103	100	103	90.9	117.0	101	101	2.18	0.0	15.0
Copper	10.5	10.0	105	94.8	122.2	10.2	102	2.51	0.0	15.0
Iron	103	100	103	92.8	116.4	100	100	2.34	0.0	15.0
Lithium	99.9	100	99.9	88.7	115.5	98.1	98.1	1.87	0.0	15.0
Magnesium	95.7	100	95.7	90.4	113.1	93.8	93.8	2.01	0.0	15.0
Manganese	103	100	103	93.4	113.0	101	101	2.12	0.0	15.0
Molybdenum	10.6	10.0	106	91.1	121.2	10.7	107	0.516	0.0	15.0
Nickel	10.6	10.0	106	97.0	120.8	10.5	105	1.72	0.0	15.0
Lead	102	100	102	92.4	116.7	100	100	2.05	0.0	15.0
Phosphorus	97.9	100	97.9	86.7	118.1	100	100	2.45	0.0	15.0
Selenium	101	100	101	90.0	110.1	98.7	98.7	2.07	0.0	15.0
Silver	97.5	100	97.5	80.0	118.0	95.0	95.0	2.61	0.0	15.0
Sodium	106	100	106	92.9	116.4	104	104	1.66	0.0	15.0
Tellurium	100	100	100	90.3	115.5	100	100	0.0299	0.0	15.0
Thallium	105	100	105	87.7	114.5	104	104	1.66	0.0	15.0
Titanium	10.0	10.0	100	90.1	115.3	10.1	101	0.417	0.0	15.0
Vanadium	99.5	100	99.5	92.8	115.3	97.3	97.3	2.17	0.0	15.0
Yttrium	10.1	10.0	101	93.9	113.8	9.85	98.5	2.02	0.0	15.0
Zinc	102	100	102	95.2	117.5	99.3	99.3	2.76	0.0	15.0
Zirconium	98.7	100	98.7	88.8	114.2	99.4	99.4	0.663	0.0	15.0
Barium	100	100	100	92.1	113.7	97.6	97.6	2.51	0.0	15.0

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031177

Limits: Historical/Performance	**Preparation:** IH Metals, MCE Prep	**Analysis:** IH Metals, MCE QC
Basis: ALS Laboratory Group	**Batch:** IIPX/28413 (HBN: 271134)	**Batch:** IICP/17110 (HBN: 271312)
	Prepared By: Phillip Rich	**Analyzed By:** Joanna C. Sanchez

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Joanna C. Sanchez 11/11/2020 16:05	/S/ Kristie F. Bitner 11/12/2020 10:10

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- Sample and Matrix Duplicate less than 5 times the reporting limit
- Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031177

Limits:	Historical/Performance	**Preparation:**	NA	**Analysis:**	OSHA ID-215
Basis:	ALS Laboratory Group	**Batch:**	NA	**Batch:**	ILC/26383 (HBN: 271154)
		Prepared By:	NA	**Analyzed By:**	Daryka Gress

Blank

LMB: 722343
Analyzed: 11/11/2020 00:00
Units: ug/sample

Analyte	Result	MDL	RL
Hexavalent Chromium	ND	NA	0.0600

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722344
Analyzed: 11/11/2020 00:00
Dilution: 1
Units: ug/sample

LCSD: 722345
Analyzed: 11/11/2020 00:00
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Hexavalent Chromium	19.7	20.0	98.6	56.2	133.9	19.6	98.2	0.417	0.0	30.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Daryka Gress 11/12/2020 12:10	/S/ Thomas Bosch 11/12/2020 14:52

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- - Sample and Matrix Duplicate less than 5 times the reporting limit
- - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: **2031255**

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: IH Metals, Ghost Wipe Prep
Batch: IIPX/28414 (HBN: 271142)
Prepared By: Emilee Sandoval

Analysis: IH Metals, Ghost Wipe QC
Batch: IICP/17109 (HBN: 271304)
Analyzed By: Peter P. Steen

Blank

☐ **LRB:** 722313
Analyzed: 11/11/2020 10:38
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

☐ **LMB:** 722314
Analyzed: 11/11/2020 10:40
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

☐ **LRB:** 722318
Analyzed: 11/11/2020 11:27
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

☐ **LMB:** 722319
Analyzed: 11/11/2020 11:32
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722315
Analyzed: 11/11/2020 10:42
Dilution: 1
Units: ug/sample

LCSD: 722316
Analyzed: 11/11/2020 10:43
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Arsenic	115	100	115	96.0	137.7	118	118	2.74	0.0	30.0
Lead	92.3	100	92.3	78.8	115.4	92.4	92.4	0.151	0.0	30.0

LCS: 722320
Analyzed: 11/11/2020 11:34
Dilution: 1
Units: ug/sample

LCSD: 722321
Analyzed: 11/11/2020 11:35
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Arsenic	116	100	116	96.0	137.7	117	117	0.861	0.0	30.0
Lead	91.3	100	91.3	78.8	115.4	92.1	92.1	0.883	0.0	30.0

Quality Control Sample
Batch Report

Analysis Information

Workorder: **2031255**

Limits:	Historical/Performance	**Preparation:**	IH Metals, Ghost Wipe Prep	**Analysis:**	IH Metals, Ghost Wipe QC
Basis:	ALS Laboratory Group	**Batch:**	IIPX/28414 (HBN: 271142)	**Batch:**	IICP/17109 (HBN: 271304)
		Prepared By:	Emilee Sandoval	**Analyzed By:**	Peter P. Steen

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Peter P. Steen 12/16/2020 09:27	/S/ Rex Bagley 12/16/2020 11:27

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲- Sample result is greater than 4 times the spike added
- ● - Sample and Matrix Duplicate less than 5 times the reporting limit
- ● - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)

ND - Not Detected (U - Qualifier also flags analyte as not detected)

NA - Not Applicable

QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031257

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: IH Metals, Ghost Wipe Prep
Batch: IIPX/28414 (HBN: 271142)
Prepared By: Emilee Sandoval

Analysis: IH Metals, Ghost Wipe QC
Batch: IICP/17109 (HBN: 271304)
Analyzed By: Peter P. Steen

Blank

☐

LRB: 722313
Analyzed: 11/11/2020 10:38
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

☐

LMB: 722314
Analyzed: 11/11/2020 10:40
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

☐

LRB: 722318
Analyzed: 11/11/2020 11:27
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

☐

LMB: 722319
Analyzed: 11/11/2020 11:32
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722315
Analyzed: 11/11/2020 10:42
Dilution: 1
Units: ug/sample

LCSD: 722316
Analyzed: 11/11/2020 10:43
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Arsenic	115	100	115	96.0	137.7	118	118	2.74	0.0	30.0
Lead	92.3	100	92.3	78.8	115.4	92.4	92.4	0.151	0.0	30.0

LCS: 722320
Analyzed: 11/11/2020 11:34
Dilution: 1
Units: ug/sample

LCSD: 722321
Analyzed: 11/11/2020 11:35
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Arsenic	116	100	116	96.0	137.7	117	117	0.861	0.0	30.0
Lead	91.3	100	91.3	78.8	115.4	92.1	92.1	0.883	0.0	30.0

Quality Control Sample Batch Report

Analysis Information

Workorder: **2031257**

Limits:	Historical/Performance	**Preparation:**	IH Metals, Ghost Wipe Prep	**Analysis:**	IH Metals, Ghost Wipe QC
Basis:	ALS Laboratory Group	**Batch:**	IIPX/28414 (HBN: 271142)	**Batch:**	IICP/17109 (HBN: 271304)
		Prepared By:	Emilee Sandoval	**Analyzed By:**	Peter P. Steen

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Peter P. Steen 12/16/2020 09:27	/S/ Rex Bagley 12/16/2020 11:27

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- Sample and Matrix Duplicate less than 5 times the reporting limit
- Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)

ND - Not Detected (U - Qualifier also flags analyte as not detected)

NA - Not Applicable

QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031258

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: OSHA 39
Batch: ILC/26391 (HBN: 271358)
Analyzed By: Thomas Bosch

Blank

LMB: 722880
Analyzed: 11/12/2020 00:00
Units: ug/sample

Analyte	Result	MDL	RL
Pentachlorophenol	ND	NA	0.100

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722881
Analyzed: 11/12/2020 00:00
Dilution: 1
Units: ug/sample

LCSD: 722882
Analyzed: 11/12/2020 00:00
Dilution: 1
Units: ug/sample

Analyte	LCS Result	Target	% Rec	QC Limits		LCSD Result	% Rec	RPD	QC Limits	
Pentachlorophenol	25.7	25.0	103	67.3	146.3	26.0	104	1.12	0.0	20.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Thomas Bosch 11/13/2020 11:50	/S/ Christopher Winter 11/13/2020 14:04

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- Sample and Matrix Duplicate less than 5 times the reporting limit
- Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031261

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: 3M 3500/3520 POVM
Batch: IFID/12282 (HBN: 271369)
Analyzed By: Katelyn Hinman

Blank

MB: 722896
Analyzed: 11/11/2020 00:00
Units: mg/sample

Analyte	Result	MDL	RL
Benzene	ND	NA	0.00100
Ethyl benzene	ND	NA	0.0100
Naphthalene	ND	NA	0.0100
Styrene	ND	NA	0.0100

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722893
Analyzed: 11/11/2020 00:00
Dilution: 1
Units: mg/sample

LCSD: 722894
Analyzed: 11/11/2020 00:00
Dilution: 1
Units: mg/sample

Analyte	LCS Result	Target	% Rec	QC Limits		LCSD Result	% Rec	RPD	QC Limits	
Benzene	0.0198	0.0200	99.1	80.0	120.0	0.0199	99.6	0.589	0.0	20.0
Ethyl benzene	0.197	0.200	98.7	80.0	120.0	0.199	99.3	0.561	0.0	20.0
Naphthalene	0.203	0.200	102	80.0	120.0	0.207	104	1.84	0.0	20.0
Styrene	0.200	0.200	99.8	80.0	120.0	0.201	101	0.759	0.0	20.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Katelyn Hinman 11/12/2020 15:44	/S/ Steven J. Sagers 11/12/2020 17:04

Symbols and Definitions

- ✱ - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- ● - Sample and Matrix Duplicate less than 5 times the reporting limit
- ● - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031263

Limits:	Historical/Performance	**Preparation:**	NA	**Analysis:**	3M 3500/3520 POVM
Basis:	ALS Laboratory Group	**Batch:**	NA	**Batch:**	IFID/12284 (HBN: 271418)
		Prepared By:	NA	**Analyzed By:**	Katelyn Hinman

Blank

MB: 723015
Analyzed: 11/13/2020 00:00
Units: mg/sample

Analyte	Result	MDL	RL
Benzene	ND	NA	0.00100
Ethyl benzene	ND	NA	0.0100
Naphthalene	ND	NA	0.0100

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 723012
Analyzed: 11/13/2020 00:00
Dilution: 1
Units: mg/sample

LCSD: 723013
Analyzed: 11/13/2020 00:00
Dilution: 1
Units: mg/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Benzene	0.0200	0.0200	100	80.0	120.0	0.0200	100	0.0200	0.0	20.0
Ethyl benzene	0.200	0.200	100	80.0	120.0	0.200	100	0.0550	0.0	20.0
Naphthalene	0.216	0.200	108	80.0	120.0	0.215	107	0.566	0.0	20.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Katelyn Hinman 11/13/2020 16:15	/S/ Matthew Roberts 11/13/2020 16:20

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- ● - Sample and Matrix Duplicate less than 5 times the reporting limit
- ● - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031264

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: NIOSH 0500/0600 Mod.
Batch: IGRV/9292 (HBN: 271348)
Analyzed By: Rex Bagley

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722840
Analyzed: 11/12/2020 12:06
Dilution: 1
Units: mg

LCSD: 722841
Analyzed: 11/12/2020 12:06
Dilution: 1
Units: mg

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Respirable Dust	15.9	15.8	101	99.0	101.0	15.9	101	0.0063	0.0	10.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Rex Bagley 11/12/2020 13:37	/S/ Emilee Sandoval 11/12/2020 15:24

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- Sample and Matrix Duplicate less than 5 times the reporting limit
- Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031264

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: IH Metals, Ghost Wipe Prep
Batch: IIPX/28414 (HBN: 271142)
Prepared By: Emilee Sandoval

Analysis: IH Metals, Ghost Wipe QC
Batch: IICP/17109 (HBN: 271304)
Analyzed By: Peter P. Steen

Blank

☐

LRB: 722313
Analyzed: 11/11/2020 10:38
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

☐

LMB: 722314
Analyzed: 11/11/2020 10:40
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

☐

LRB: 722318
Analyzed: 11/11/2020 11:27
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

☐

LMB: 722319
Analyzed: 11/11/2020 11:32
Units: ug/sample

Analyte	Result	MDL	RL
Arsenic	ND	NA	6.25
Lead	ND	NA	0.500

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722315
Analyzed: 11/11/2020 10:42
Dilution: 1
Units: ug/sample

LCSD: 722316
Analyzed: 11/11/2020 10:43
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Arsenic	115	100	115	96.0	137.7	118	118	2.74	0.0	30.0
Lead	92.3	100	92.3	78.8	115.4	92.4	92.4	0.151	0.0	30.0

LCS: 722320
Analyzed: 11/11/2020 11:34
Dilution: 1
Units: ug/sample

LCSD: 722321
Analyzed: 11/11/2020 11:35
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Arsenic	116	100	116	96.0	137.7	117	117	0.861	0.0	30.0
Lead	91.3	100	91.3	78.8	115.4	92.1	92.1	0.883	0.0	30.0

Quality Control Sample
Batch Report

Analysis Information

Workorder: **2031264**

Limits:	Historical/Performance	**Preparation:**	IH Metals, Ghost Wipe Prep	**Analysis:**	IH Metals, Ghost Wipe QC
Basis:	ALS Laboratory Group	**Batch:**	IIPX/28414 (HBN: 271142)	**Batch:**	IICP/17109 (HBN: 271304)
		Prepared By:	Emilee Sandoval	**Analyzed By:**	Peter P. Steen

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Peter P. Steen 12/16/2020 09:27	/S/ Rex Bagley 12/16/2020 11:27

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- Sample and Matrix Duplicate less than 5 times the reporting limit
- Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: **2031264**

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: NIOSH 7500, Air Prep
Batch: IRA/14207 (HBN: 271390)
Prepared By: Rosabel Nzambi

Analysis: NIOSH 7500 QC
Batch: IRA/14210 (HBN: 271448)
Analyzed By: Kim Clymer

Blank

LMB: 722926
Analyzed: 11/13/2020 00:00
Units: ug

Analyte	Result	MDL	RL
Quartz	ND	NA	5.00
Cristobalite	ND	NA	5.00
Tridymite	ND	NA	20.0
Total Silica	0.00	NA	NA

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722927
Analyzed: 11/13/2020 00:00
Dilution: 1
Units: ug

LCSD: 722928
Analyzed: 11/13/2020 00:00
Dilution: 1
Units: ug

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Quartz	140	145	96.3	50.3	128.1	140	96.3	0.00	0.0	20.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Kim Clymer 11/13/2020 17:44	/S/ Paul M. Megerdichian 11/13/2020 18:31

Symbols and Definitions

- ✱ - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- ⬣ - Sample and Matrix Duplicate less than 5 times the reporting limit
- ● - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031269

Limits:	Historical/Performance	**Preparation:**	NA	**Analysis:**	IH GC-FID QC
Basis:	ALS Laboratory Group	**Batch:**	NA	**Batch:**	IFID/12283 (HBN: 271375)
		Prepared By:	NA	**Analyzed By:**	Katelyn Hinman

Blank

MB: 722904
Analyzed: 11/11/2020 00:00
Units: mg/sample

Analyte	Result	MDL	RL
Tetrachloroethene	ND	NA	0.0100

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722901
Analyzed: 11/11/2020 00:00
Dilution: 1
Units: mg/sample

LCSD: 722902
Analyzed: 11/11/2020 00:00
Dilution: 1
Units: mg/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Tetrachloroethene	0.184	0.200	91.8	80.0	120.0	0.185	92.6	0.846	0.0	20.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Katelyn Hinman 11/13/2020 10:44	/S/ Matthew Roberts 11/13/2020 14:24

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- ● - Sample and Matrix Duplicate less than 5 times the reporting limit
- ● - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031269

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: EPA TO-11A
Batch: ILC/26388 (HBN: 271190)
Analyzed By: Daryka Gress

Blank

LMB: 722422
Analyzed: 11/11/2020 04:11
Units: ug/sample

Analyte	Result	MDL	RL
Formaldehyde	ND	NA	0.150
Acetaldehyde	ND	NA	0.150

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722423
Analyzed: 11/11/2020 04:34
Dilution: 1
Units: ug/sample

LCSD: 722424
Analyzed: 11/11/2020 04:58
Dilution: 1
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Formaldehyde	1.54	1.50	103	80.0	120.0	1.52	101	1.44	0.0	20.0
Acetaldehyde	1.50	1.50	100	80.0	120.0	1.53	102	1.70	0.0	20.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Daryka Gress 11/11/2020 12:08	/S/ Thomas Bosch 11/16/2020 16:52

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- Sample and Matrix Duplicate less than 5 times the reporting limit
- Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031269

Limits:	Historical/Performance	**Preparation:**	NA	**Analysis:**	IH by GC-MS Scan
Basis:	ALS Laboratory Group	**Batch:**	NA	**Batch:**	ISPC/2310 (HBN: 271472)
		Prepared By:	NA	**Analyzed By:**	David Teynor

Blank

MB: 723123
Analyzed: 11/16/2020 17:50
Units: ug/sample

Analyte	Result	MDL	RL
N,N-Dimethyl-p-toluidine	ND	NA	0.0500

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 723124
Analyzed: 11/16/2020 18:06
Dilution: 1
Units: ug/sample

LCSD: 723125
Analyzed: 11/16/2020 18:23
Dilution: 1
Units: ug/sample

Analyte	LCS Result	Target	% Rec	QC Limits		LCSD Result	% Rec	RPD	QC Limits	
N,N-Dimethyl-p-toluidine	5.04	5.00	101	50.0	150.0	4.96	99.3	1.52	0.0	50.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ David Teynor 11/17/2020 10:09	/S/ Thomas J. Masoian 11/17/2020 13:59

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- Sample and Matrix Duplicate less than 5 times the reporting limit
- Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031269

Limits:	Historical/Performance	**Preparation:**	NA	**Analysis:**	NIOSH 5528
Basis:	ALS Laboratory Group	**Batch:**	NA	**Batch:**	ISVO/5156 (HBN: 271392)
		Prepared By:	NA	**Analyzed By:**	David Teynor

Blank

LMB: 722938
Analyzed: 11/13/2020 11:00
Units: ug/sample

Analyte	Result	MDL	RL
Naphthalene	ND	NA	0.500
Acenaphthylene	ND	NA	0.500
Acenaphthene	ND	NA	0.500
Fluorene	ND	NA	0.500
Phenanthrene	ND	NA	0.500
Anthracene	ND	NA	0.500
Fluoranthene	ND	NA	0.500
Pyrene	ND	NA	0.500
Benzo(a)anthracene	ND	NA	0.500
Chrysene	ND	NA	0.500
Benzo(b)fluoranthene	ND	NA	0.500
Benzo(k)fluoranthene	ND	NA	0.500
Benzo(a)pyrene	ND	NA	0.500
Indeno(1,2,3-cd)pyrene	ND	NA	0.500
Dibenzo(a,h)anthracene	ND	NA	0.500
Benzo(g,h,i)perylene	ND	NA	0.500

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722939
Analyzed: 11/13/2020 11:25
Dilution: 10
Units: ug/sample

LCSD: 722940
Analyzed: 11/13/2020 11:50
Dilution: 10
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Naphthalene	20.1	20.0	101	30.0	170.0	20.4	102	1.61	0.0	20.0
Acenaphthylene	20.6	20.0	103	30.0	170.0	21.0	105	1.62	0.0	20.0
Acenaphthene	20.1	20.0	101	30.0	170.0	20.3	102	1.04	0.0	20.0
Fluorene	20.4	20.0	102	30.0	170.0	20.7	103	1.36	0.0	20.0
Phenanthrene	20.0	20.0	100	30.0	170.0	20.2	101	0.983	0.0	20.0
Anthracene	20.6	20.0	103	30.0	170.0	20.8	104	0.977	0.0	20.0
Fluoranthene	20.7	20.0	104	30.0	170.0	20.9	104	0.813	0.0	20.0
Pyrene	20.6	20.0	103	30.0	170.0	20.9	105	1.33	0.0	20.0
Benzo(a)anthracene	20.5	20.0	102	30.0	170.0	20.9	104	1.84	0.0	20.0
Chrysene	19.6	20.0	97.9	30.0	170.0	19.8	98.9	1.07	0.0	20.0
Benzo(b)fluoranthene	21.7	20.0	108	30.0	170.0	21.9	109	0.794	0.0	20.0
Benzo(k)fluoranthene	19.5	20.0	97.7	30.0	170.0	19.5	97.7	0.0819	0.0	20.0
Benzo(a)pyrene	20.6	20.0	103	30.0	170.0	20.8	104	1.08	0.0	20.0
Indeno(1,2,3-cd)pyrene	20.9	20.0	104	30.0	170.0	20.8	104	0.0192	0.0	20.0
Dibenzo(a,h)anthracene	20.9	20.0	105	30.0	170.0	21.0	105	0.220	0.0	20.0

Quality Control Sample
Batch Report

Analysis Information

Workorder: **2031269**

Limits: Historical/Performance
Basis: ALS Laboratory Group

Preparation: NA
Batch: NA
Prepared By: NA

Analysis: NIOSH 5528
Batch: ISVO/5156 (HBN: 271392)
Analyzed By: David Teynor

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722939
Analyzed: 11/13/2020 11:25
Dilution: 10
Units: ug/sample

LCSD: 722940
Analyzed: 11/13/2020 11:50
Dilution: 10
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Benzo(g,h,i)perylene	21.0	20.0	105	30.0	170.0	21.1	106	0.722	0.0	20.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ David Teynor 11/17/2020 15:05	/S/ Thomas J. Masoian 11/17/2020 16:20

Symbols and Definitions

- * - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- ⬣ - Sample and Matrix Duplicate less than 5 times the reporting limit
- ● - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031269

Limits: Historical/Performance	**Preparation:** NA	**Analysis:** NIOSH 5528
Basis: ALS Laboratory Group	**Batch:** NA	**Batch:** ISVO/5157 (HBN: 271394)
	Prepared By: NA	**Analyzed By:** David Teynor

Blank

LMB: 722942
Analyzed: 11/13/2020 20:47
Units: ug/sample

Analyte	Result	MDL	RL
Naphthalene	ND	NA	0.500
Acenaphthylene	ND	NA	0.500
Acenaphthene	ND	NA	0.500
Fluorene	ND	NA	0.500
Phenanthrene	ND	NA	0.500
Anthracene	ND	NA	0.500
Fluoranthene	ND	NA	0.500
Pyrene	ND	NA	0.500
Benzo(a)anthracene	ND	NA	0.500
Chrysene	ND	NA	0.500
Benzo(b)fluoranthene	ND	NA	0.500
Benzo(k)fluoranthene	ND	NA	0.500
Benzo(a)pyrene	ND	NA	0.500
Indeno(1,2,3-cd)pyrene	ND	NA	0.500
Dibenzo(a,h)anthracene	ND	NA	0.500
Benzo(g,h,i)perylene	ND	NA	0.500

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722943
Analyzed: 11/13/2020 21:11
Dilution: 10
Units: ug/sample

LCSD: 722944
Analyzed: 11/13/2020 21:36
Dilution: 10
Units: ug/sample

Analyte	Result	Target	% Rec	QC Limits		Result	% Rec	RPD	QC Limits	
Naphthalene	19.6	20.0	98.0	30.0	170.0	21.4	107	8.97	0.0	20.0
Acenaphthylene	20.2	20.0	101	30.0	170.0	21.7	109	7.36	0.0	20.0
Acenaphthene	19.6	20.0	97.9	30.0	170.0	21.1	105	7.30	0.0	20.0
Fluorene	20.1	20.0	100	30.0	170.0	21.5	108	7.04	0.0	20.0
Phenanthrene	19.5	20.0	97.3	30.0	170.0	20.9	104	7.03	0.0	20.0
Anthracene	20.1	20.0	101	30.0	170.0	21.6	108	7.14	0.0	20.0
Fluoranthene	20.1	20.0	101	30.0	170.0	21.5	108	6.70	0.0	20.0
Pyrene	20.1	20.0	101	30.0	170.0	20.5	103	1.90	0.0	20.0
Benzo(a)anthracene	20.3	20.0	102	30.0	170.0	21.7	108	6.47	0.0	20.0
Chrysene	18.9	20.0	94.7	30.0	170.0	20.4	102	7.62	0.0	20.0
Benzo(b)fluoranthene	19.9	20.0	99.3	30.0	170.0	21.4	107	7.32	0.0	20.0
Benzo(k)fluoranthene	19.9	20.0	99.3	30.0	170.0	21.1	106	6.25	0.0	20.0
Benzo(a)pyrene	20.1	20.0	100	30.0	170.0	21.6	108	7.19	0.0	20.0
Indeno(1,2,3-cd)pyrene	20.2	20.0	101	30.0	170.0	21.6	108	6.82	0.0	20.0
Dibenzo(a,h)anthracene	20.2	20.0	101	30.0	170.0	21.7	109	7.12	0.0	20.0

Quality Control Sample
Batch Report

Analysis Information

Workorder: **2031269**

Limits:	Historical/Performance	**Preparation:**	NA	**Analysis:**	NIOSH 5528
Basis:	ALS Laboratory Group	**Batch:**	NA	**Batch:**	ISVO/5157 (HBN: 271394)
		Prepared By:	NA	**Analyzed By:**	David Teynor

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722943
Analyzed: 11/13/2020 21:11
Dilution: 10
Units: ug/sample

LCSD: 722944
Analyzed: 11/13/2020 21:36
Dilution: 10
Units: ug/sample

Analyte	LCS Result	Target	% Rec	QC Limits		LCSD Result	% Rec	RPD	QC Limits	
Benzo(g,h,i)perylene	20.5	20.0	102	30.0	170.0	21.9	110	6.85	0.0	20.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ David Teynor 11/17/2020 15:13	/S/ Thomas J. Masoian 11/17/2020 16:25

Symbols and Definitions

- ✱ - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- ⬣ - Sample and Matrix Duplicate less than 5 times the reporting limit
- ⬣ - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

Quality Control Sample
Batch Report

Analysis Information

Workorder: 2031281

Limits:	Historical/Performance	**Preparation:**	NA	**Analysis:**	NIOSH 5040 QC
Basis:	ALS Laboratory Group	**Batch:**	NA	**Batch:**	ICBN/3365 (HBN: 271284)
		Prepared By:	NA	**Analyzed By:**	Matthew Roberts

Blank

IB: 722661
Analyzed: 11/11/2020 12:19
Units: ug/cm²

Analyte	Result	MDL	RL
Organic Carbon	ND	NA	0.600
Elemental Carbon	ND	NA	0.200
Total Carbon			

Laboratory Control Sample - Laboratory Control Sample Duplicate

LCS: 722662
Analyzed: 11/11/2020 12:19
Dilution: 1
Units: ug/cm²

LCSD: 722663
Analyzed: 11/11/2020 12:19
Dilution: 1
Units: ug/cm²

Analyte	LCS Result	Target	% Rec	QC Limits		LCSD Result	% Rec	RPD	QC Limits	
Organic Carbon	24.5	26.4	92.9	79.5	121.8	27.6	105	11.9	0.0	20.0

QC Report Authorization (/S/ is an electronic signature that complies with 21 CFR Part 11)

Analyst	Peer Review
/S/ Matthew Roberts 11/12/2020 08:32	/S/ Max Allred 11/13/2020 13:22

Symbols and Definitions

- ✱ - Analyte above reporting limit or outside of control limits
- ▲ - Sample result is greater than 4 times the spike added
- ⬣ - Sample and Matrix Duplicate less than 5 times the reporting limit
- ● - Result is above the calibration range
- # - The Matrix Spike, Matrix Spike duplicate or Matrix Duplicate is reported for your information only. The sample matrix may be inappropriate for the method selected.

RPD - Relative % Difference (Spike / Spike Duplicate)
ND - Not Detected (U - Qualifier also flags analyte as not detected)
NA - Not Applicable
QC results are not adjusted for moisture correction, where applicable

APPENDIX E

Task 5: Cancer Risk Assessment

Task 5: Cancer Risk Assessment

FEBRUARY 25, 2021

ToxStrategies

Innovative solutions
Sound science

Task 5: Cancer Risk Assessment

FEBRUARY 25 , 2021

PREPARED FOR:

State of California
Department of Industrial Relations
1515 Clay Street
Suite 1902
Oakland, California 94612

PREPARED BY:

ToxStrategies, Inc.
27001 La Paz Road
Suite 260
Mission Viejo, California 92691

Table of Contents

List of Tables

Tables are found in a separate section following the References.

List of Attachments

Acronyms

AB	California Assembly Bill
CAS No.	Chemical Abstracts Service Registry Number
CCR	California Code of Regulations
CHSWC	Commission on Health and Safety and Workers' Compensation
COPC	chemical of potential concern
DIR	California Department of Industrial Relations
DPM	diesel particulate matter
FEM	fire equipment mechanic
GIABS	fraction of contaminant absorbed in gastrointestinal tract
HEAST	Health Effects Assessment Summary Tables
IARC	International Agency for Research on Cancer
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
LAC_i	lifetime average concentration for chemical "i"
LADD-$derm_i$	lifetime average daily dose from dermal exposure for chemical "i"
LADD-$ing_{i.}$	lifetime average daily dose from ingestion exposure for chemical "i"
m^3	cubic meter
µg/mg	microgram per milligram
mg/kg-day	milligram per kilogram-day
$(\mu g/m^3)^{-1}$	per (microgram per cubic meter)
$\mu g/m^3$	microgram per cubic meter
$(mg/kg\text{-}day)^{-1}$	per (milligram per kilogram-day)
MIG	metal inert gas (welding)
MSDS	Material Safety Data Sheet
NIOSH	National Institute of Occupational Safety and Health
OEHHA	Office of Environmental Health Hazard Assessment
OEL	Occupational Exposure Level
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PBZ	personal breathing zone
PCB	polychlorinated biphenyls
PEL	Permissible Exposure Limit
PPE	personal protective equipment
RBA	relative bioavailability
RELs	Recommended Exposure Limits
SDS	safety data sheet
SEG	similar exposure group
SF	slope factor
SFO	slope factor for oral exposure
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TEF	toxic equivalency factor
TEQ	toxic equivalence
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency

1 Introduction

ToxStrategies was contracted by the California Department of Industrial Relations (DIR), Commission on Health and Safety and Workers' Compensation (CHSWC), to conduct the study described herein, as outlined in California Assembly Bill (AB) 1400. AB 1400 was created to define fire mechanics' risk from exposures to carcinogens in the course of their employment as fire mechanics.

The study components include:

- Site visits to representative facilities in Los Angeles County, California
- Interviews and surveys with current and former fire mechanics to assess potential exposures to carcinogens
- Feasibility study to assess the data available to calculate cancer incidence among fire mechanics
- Occupational exposure measurements of carcinogens identified as potentially present in the workplace, to evaluate potential exposure to carcinogens
- Quantitative health risk assessment of potential increased cancer risk associated with exposure to carcinogens in the workplace.

ToxStrategies' approach to address these study components includes six tasks (provided in our proposal submitted to the DIR [ToxStrategies, Inc., 2020a]):

- Task 1: Structured literature review — submitted; ToxStrategies, Inc., 2020b
- Task 2: Qualitative exposure assessment — submitted; ToxStrategies, Inc., 2020c
- Task 3: Epidemiologic assessment — feasibility study of cohort enumeration for future epidemiologic study design — on-going
- Task 4: Quantitative exposure assessment — submitted; ToxStrategies, Inc. 2020d
- Task 5: Cancer risk assessment — calculation of theoretical excess cancer risks from occupational exposure to carcinogens; provided herein
- Task 6: Technical assistance to the DIR.

The purpose of Task 5, Cancer Risk Assessment, was to use the quantitative results from Task 4 to calculate the theoretical excess cancer risk from exposure to carcinogenic materials for workers with similar work activities (identified as similar exposure groups [SEGs]) and primary job tasks (as determined from the qualitative assessment in Task 2), using toxicity criteria relevant to California risk assessments. A summary of the five fire mechanic SEGs and their respective job tasks are provided in Table 1 (attached).

The cancer risk assessment is an estimate of the theoretical increased risk of developing cancer as a result of exposure to chemicals present in the workplace. This approach involves varying degrees of conservatism and ensures that cancer risk is not underestimated, which makes it probable that the estimated risk will be overestimated. It is important to consider that these risks are theoretical because they are not measured directly among fire mechanics, which could only be done through use of an epidemiology study (as discussed further in Task 3). The objectives, methods, results, and conclusions of Task 5 are provided herein.

1.1 Objectives

The objectives of this cancer risk assessment were as follows:

1. Provide a qualitative summary of work practices and quantitative exposure assumptions used to define each of the relevant SEGs and exposures related to primary job tasks.
2. Estimate the theoretical probability of an increased risk of cancer as a result of exposure for each SEG and job task.
3. Discuss qualitatively potential exposures and risks for SEGs and job tasks for which sufficient quantitative information was not available to calculate risks.
4. Discuss areas of uncertainty affecting the quantification of risks.

1.2 Scope

This risk assessment was prepared using the guidance of California health and regulatory agencies. In cases where such guidance was not available or not applicable, other sources of information, such as the United States Environmental Protection Agency (USEPA), the Occupational Safety and Health Administration (OSHA), and the National Institute of Occupational Safety and Health (NIOSH) were used. Site-specific information was used to develop the exposure assumptions used in the risk assessment calculations.

Quantitative risk assessments consist of four parts (National Research Council, 1983):

- Hazard Identification — Identify the hazardous chemicals that are present and may result in exposure.
- Exposure Assessment — Develop an understanding of the applicable exposure pathways, which include the exposure media, exposure points, exposure routes, and receptors. This also includes developing quantitative estimates for various exposure assumptions and exposure-point concentrations.
- Toxicity Assessment — Review regulatory references to identify quantitative criteria that relate exposure to potential health risk.
- Risk Characterization — Integrate the exposure and toxicity assessments to develop quantitative estimates of potential health risks. Risk characterization

also includes discussion of qualitative evaluations where quantitative evaluations were not possible, and assessing uncertainty in the underlying assumptions.

2 Hazard Identification/Data Evaluation

ToxStrategies collected personal breathing zone (PBZ) air samples and surface wipe samples on November 3 and 4, 2020, at Air Operations (Pacoima), the Breathing Apparatus Shop (Pacoima), and the Eastern Fire Shop (Los Angeles). The selection of the chemicals of potential concern (COPCs), analytical sampling methods, and quantitative results of this exposure assessment are provided in the Task 4 report (ToxStrategies, Inc., 2020d). A summary of the results is provided below.

Chemicals related to two SEGs—(1) helicopter maintenance inspector painting/priming/sanding aircraft parts at Air Operations, and (2) the field-assigned fire equipment mechanic repairing fire apparatus or other equipment at a wildfire base camp—were not measured, because these activities did not occur during the period when sampling occurred. These potential exposures have been evaluated qualitatively (Section 5.2).

Additionally, six chemicals were not measured, because, although they have been identified as potential carcinogens, regulatory toxicity criteria were not available. Diethanolamine and tetrahydrofuran are present in chemicals used for helicopter maintenance at Air Operations. Cumene, tetrabromobisphenol-A, methyl isobutyl ketone, and diethanolamine are present in chemicals used by fire equipment mechanics at the Eastern Fire Shop. These chemicals are also addressed in the qualitative assessment (Section 5.2).

For chlorinated dioxins/furans and polychlorinated biphenyls (PCBs), 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalence (TEQ) values were calculated for reporting purposes. TEQs are calculated as the product of the congener-specific toxic equivalency factor (TEF) and the measured concentration for each relevant congener. Congener results in each sample that were non-detects were assigned values equal to 50% of the reporting limit for calculating the dioxin/furan/PCB TEQs. The concentrations of PCB congeners that do not have a TEF were summed for each sample (including 50% of non-detect values) for evaluation separately. The laboratory reports and calculations of the TEQ and non-TEQ totals are presented in the Task 4 quantitative exposure assessment (ToxStrategies, Inc., 2020d). Results in this section are presented only as TEQs or the sum for PCBs without TEFs.

2.1 Air Sampling

PBZ air samples were collected for workers at Air Operations, the Breathing Apparatus Repair Shop, and the Eastern Fire Shop, to characterize their potential inhalation exposures during a typical shift.

On November 3, 2020, ToxStrategies collected PBZ air samples at Air Operations in Pacoima, California. The results of the air sampling at Air Operations are provided in Attachment 1.

- PBZ air samples for eight helicopter mechanics performing intermediate and/or heavy maintenance on the aircraft were analyzed for hexavalent chromium. Hexavalent chromium was detected in only one of eight samples (0.084 $\mu g/m^3$) just above the detection limit (<0.081 $\mu g/m^3$ [ToxStrategies, Inc., 2020d]; Attachment 1-A).
- PBZ air samples for six helicopter mechanics performing heavy maintenance on aircraft were analyzed for respirable crystalline silica, as quartz, cristobalite, and tridymite (Attachment 1-B). Crystalline silica was not detected in these samples.
- PBZ air samples for six helicopter mechanics performing intermediate maintenance on the aircraft were analyzed for benzene, ethylbenzene, and naphthalene. These chemicals were not detected in any samples (Attachment 1-C).
- Two area air samples were collected to assess general concentrations in the hangar compared to those for the specific workers: one in the hangar along the southwest wall and one in the work area (Attachment 1-C); the samples were analyzed for benzene, ethylbenzene, and naphthalene. These chemicals were not detected in either sample (Attachment 1-C).

On November 3, 2020, PBZ air samples for two equipment maintenance workers in the small engine repair shop, which is part of the Breathing Apparatus Shop, were analyzed for benzene, ethylbenzene, naphthalene, styrene, acetaldehyde, and formaldehyde. Only benzene, acetaldehyde, and formaldehyde were detected in both samples analyzed (Attachment 2-A).

On November 4, 2020, ToxStrategies collected PBZ air samples at the Eastern Fire Shop. The results of the air sampling at the Eastern Fire Shop are provided in Attachment 3.

- PBZ air samples for six fire equipment mechanics performing maintenance on the fire apparatus were analyzed for benzene, ethylbenzene, naphthalene, tetrachloroethylene, and diesel particulate matter (DPM). (Note that elemental carbon is the surrogate analyte for DPM.) Benzene, ethylbenzene, and naphthalene were not detected. Elemental carbon was detected in one sample at 180 $\mu g/m^3$ but was not detected in any of the other samples at detection limits <2.5 $\mu g/m^3$. It is likely that this single detection of elemental carbon does not represent diesel particulates but, rather, reflects the grinding of carbon in the steel during that day by the specific employee on which the sample was collected. For this reason, this concentration will not be evaluated in the risk assessment, because elemental carbon is not classified as a carcinogen. These results are presented in Attachment 3-A. Tetrachloroethylene was detected in all six samples, and these results are presented in Attachment 3-B.

- PBZ air samples for two fire equipment mechanics were analyzed for welding-fume metals[1] and hexavalent chromium during MIG (metal inert gas) welding, grinding, and cutting. Of the six metals included in the welding-fume panel, only cobalt and nickel were detected. The sample results are provided in Attachment 3-C for welding-fume metals and Attachment 3-D for hexavalent chromium.
- PBZ air samples for fire equipment mechanics performing maintenance on the fire apparatus were analyzed for N,N-dimethyl-para-toluidine, which was not detected in either sample (Attachment 3-E).
- Two area samples[2] at the Eastern Fire Shop were analyzed for benzene, ethylbenzene, naphthalene, and DPM, which were not detected (Attachment 3-A).

2.2 Surface Sampling

Surface wipe sampling at Air Operations and the Breathing Apparatus Shop was conducted on November 3, 2020.

At Air Operations:

- PAHs, arsenic, and lead were analyzed in wipe samples from 12 random locations on Firehawk and Bell412 aircraft, which were parked inside the hangar for heavy maintenance and outside on the flight line. Only lead was measurable in any of these samples (Attachment 1-D-1 and 1-D-3).
- Smaller numbers of additional wipe samples were collected from various locations on Firehawk and Bell412 aircraft parked outside on the flight line. The samples were analyzed for hexavalent chromium (six samples from the aircraft engine; two samples from Mastinox-coated surfaces) and chlorinated dioxins/furans and PCBs (two samples). Hexavalent chromium, chlorinated dioxins/furans, and PCBs were detected in all samples analyzed (Attachment 1-D-2 and 1-D-4).

At the Breathing Apparatus Shop, wipe samples were collected from the air packs and fire hoses that were being repaired.

- A total of six samples were collected from field air packs and training air packs. These samples were analyzed for arsenic, lead, naphthalene, and PAHs; lead, naphthalene and PAHs were detected (Attachment 2-B-1 and 2-B-3). Two samples were analyzed for pentachlorophenol, chlorinated dioxins/furans, and

---

[1] The welding-fume metals that are carcinogens include arsenic, beryllium, cadmium, cobalt, lead, and nickel.

[2] One area sample was collected in the center third aisle column (from the south entrance), and one sample was collected in the third bay along the west side (on the work bench).

PCBs (Attachments 2-B-1 and 2-B-2). Chlorinated dioxins/furans and PCBs were detected in both samples. Lead, chlorinated dioxins/furans, and PCBs were detected in both the training and field air packs; PAHs were detected in the training air packs only. Arsenic and pentachlorophenol were not detected in any of the wipe samples collected on the air packs.

- Wipe samples were also collected on the exterior locations of used fire hoses at six locations. PAHs, arsenic, and lead were analyzed in wipe samples, but only lead was detected (in all six samples). The results are presented in Attachment 2-C-1 and 2-C-2.

Surface wipe sampling at the Eastern Fire Shop was conducted on November 4, 2020. PAHs, chlorinated dioxins/furans, PCBs, pentachlorophenol, lead, and arsenic were analyzed in wipe samples from various locations on the fire truck. Only lead, chlorinated dioxins/furans, and PCBs were detected. The results are presented in Attachment 3-F-1, 3-F-2, and 3-F-3.

2.3 Chemicals of Potential Concern

For fire mechanics, COPCs are those carcinogenic chemicals that are associated with exposure related to the work activities. COPCs for this project were identified by location/SEG combination and by each medium (air or surfaces). Chemicals detected in at least one sample were identified as COPCs for a specific location and medium. Chemicals that were analyzed but not detected in any samples were evaluated in the uncertainty assessment.

2.3.1 Air Operations

Hexavalent chromium was detected in one or more samples and is considered a COPC in air at this location for this risk assessment. Hexavalent chromium, lead, PCBs, and dioxin/furans were detected and are considered COPCs on various equipment surfaces for this location. In addition, hexavalent chromium was detected on Mastinox-coated surfaces on the aircraft.

2.3.2 Breathing Apparatus Shop

Benzene, acetaldehyde, and formaldehyde were detected in one or more samples and are considered COPCs in air at the small engine repair shop. Lead, PAHs, PCBs, and dioxins/furans were detected and are considered COPCs on air-pack surfaces for this location/SEG. Only lead was detected on fire hoses, which will be evaluated as a COPC for this location/SEG.

2.3.3 Eastern Fire Shop

Tetrachloroethylene was detected in one or more air samples and is considered a COPC in air for this location. In addition, PBZ air samples were collected to characterize inhalation exposure for a welder. Cobalt and nickel were detected in one or more air samples and are considered COPCs in air for this location/SEG. Lead, PCBs, and dioxins/furans were detected on surfaces and are considered COPCs on surfaces for this location.

3 Exposure Assessment

Exposure assessment is the process by which the sources of chemicals, their transport mechanisms, relevant exposure routes, and receptors are identified. The receptors in this analysis are the workers in each of the SEGs. The sources of chemicals are the products used or the equipment with which the workers have contact or otherwise interact when conducting maintenance tasks. The chemicals may be released to air and onto surfaces related to worker activities. Exposure routes for helicopter mechanics, equipment maintenance workers, and fire equipment mechanics are inhalation, dermal absorption, and incidental ingestion.

3.1 Similar Exposure Groups

Each of the primary SEGs identified in the qualitative exposure assessment report (Task 2; ToxStrategies, Inc., 2020c) applicable to this exposure assessment is described in general in this section.

3.1.1 Helicopter Mechanic / Helicopter Maintenance Inspector

Heavy maintenance of the aircraft typically takes place inside the hangar, and the mechanics generally wear a uniform, work boots, goggles/safety glasses, hearing protection, gloves (type dependent on task), and knee pads.

Intermediate maintenance on the aircraft takes place on a daily basis and can take approximately an hour to complete. This job is usually conducted outdoors on the flight line, and personal protective equipment (PPE) includes work boots, work uniform, goggles/safety glasses, hearing protection, gloves (dependent on task), and knee pads.

Painting, priming, and sanding of aircraft components can take place in the paint booth, inside the hangar, or outside in the open air, depending on the aircraft component. The mechanic may use a variety of different paints, paint strippers, primers, and enamels. Depending on the paint job, it could take 30 minutes or less and be performed once per week, or it could take 10 hours a week and be performed for 40 hours a month. For the major paint jobs, the Helicopter Maintenance Inspector is the primary painter. His work typically takes place in the paint booth, with installed exhaust filters, using an airline respirator.

3.1.2 Equipment Maintenance Worker

At the small engine repair shop, worker tasks include equipment examination and analysis of equipment malfunctions or mechanical failure. Other tasks include tuning up equipment used by the County fire stations, such as rescue tools, lawn mowers, vacuums, and generators.

At the fire hose repair shop, the workers are responsible for repairing fire-truck hoses and completing the hose test. Equipment, such as firefighter air packs, is maintained and tested at the Breathing Apparatus Shop (Pacoima). Air packs used during fire training in simulated structure burns, such as that conducted at the Los Angeles County Fire Department Fire Station 129 in Lancaster, are maintained at the Breathing Apparatus Shop. The workers' PPE includes latex gloves and an apron.

3.1.3 Fire Equipment Mechanic

The shop-assigned fire equipment mechanics (FEMs) at either the Eastern Fire Shop or the North County Fire Shop conduct daily maintenance of the fire apparatus, which is a highly variable job task and encompasses a wide range of products and tools. Shop-assigned FEMs typically work on the major repairs such as engine and transmission changes, in-frame engine rebuilds, differential exchanges and rebuilds, major pump repair, plumbing issues, and water tank removal, and they are required to do a significant amount of welding to repair or replace some parts. Both shop locations have facilities with roll-up doors and a diesel exhaust capture system that can be used when the apparatus is running inside the building, but those systems do not operate when the vehicles are moving in and out of the shop. The Eastern Fire Shop also has side-wall vents that exhaust air out of the building. FEMs may use a combination of a face shield, gloves (rubber or latex/nitrile), N95 respirator, and work boots when performing their job task. The daily maintenance of the fire apparatus occurs during the entire workday, every day.

Depending on the number of wildfires that occur each year, the field-assigned FEMs may get called to a wildfire base camp[3] for approximately 2-week durations, 24 hours per day. During this time, the assigned FEMs are required to stay onsite for the assigned period and are responsible for repairing any fire apparatus or fire equipment that is needed. Further, field-assigned FEMs may also get called to a fire site. Although this occurs infrequently (approximately once every three years), the field-assigned FEM is responsible for needed fire apparatus repairs anywhere, at any time. Therefore, there are no exposure bounds for this group of workers, and the level of PPE provided (work boots, work uniform, gloves, eye protection, N95 respirator) is less than that provided to the firefighters.

3.2 Exposure Points and Exposure Pathways

The following primary SEGs and locations were evaluated to quantify exposure:

- Intermediate and heavy maintenance on aircraft at Air Operations
- Repair and tune-up of power equipment at the small engine repair shop (Breathing Apparatus Shop)
- Maintenance/repair on fire apparatus at the Eastern Fire Shop.

[3] The outdoor base camps are a mobilization and staging area for firefighters and support personnel during a large wildfire.

For each of these SEGs, there are three relevant exposure pathways:

- Inhalation of air in the workplace, which is based on measurements from PBZ air samplers
- Dermal contact with residues on surfaces, which is based on measurements from relevant surfaces
- Incidental ingestion of residues on surfaces, which is based on measurements from relevant surfaces.

In addition, exposures were evaluated for SEGs that addressed specific activities that were not addressed by the SEGs described above. Typically, these additional exposures were different, because exposure rates were lower than for the primary SEGs, based on lower exposure frequencies or lower surface concentrations. The following activities/SEGs were evaluated separately.

- Contact with Mastinox during intermediate and heavy maintenance on aircraft at Air Operations, resulting in dermal contact and incidental ingestion exposures
- Fire hose repair at the fire hose repair shop (Breathing Apparatus Shop), resulting in dermal contact and incidental-ingestion exposures (air samples were not collected)
- Air pack repair at the Breathing Apparatus Shop, resulting in dermal contact and incidental-ingestion exposures (air samples were not collected)
- Welding/grinding/cutting activities during maintenance and repair on fire apparatus at the Eastern Fire Shop, resulting in inhalation exposures (air samples were collected for welding workers during the work day).

3.3 Exposure Quantification

Exposure was quantified for each of the exposure pathways based on assumptions relevant to the SEGs. Because the cancer potency values are developed for continuous exposure over the course of a lifetime, it is appropriate to calculate the fraction of a lifetime that mechanics are exposed for each SEG. Table 2 summarizes exposure assumptions for each exposure pathway discussed further in this section.

3.3.1 Inhalation Exposure

Inhalation exposure was calculated using the following equation:

$$Inhalation\ Exposure = \frac{Ca}{PF} \times ET\_f \times EF \times ED$$

Assumptions for each parameter are described below.

Inhalation Exposure (micrograms per cubic meter ($\mu g/m^3$)): Average air concentration based on frequency and duration of exposure.

Concentration in air (Ca; $\mu g/m^3$): Concentration in air was measured for each SEG. These are discussed further in Section 2.1, above.

Protection Factor (PF; unitless): A protection factor is used to adjust inhalation exposure when a respirator is used to protect the employee from exposure. An N95 half-mask respirator is used for welding activities, and thus, a protection factor of 10 was used for this exposure (CCR, Title 8, §5144. Respiratory Protection). All other SEGs were evaluated assuming that no respirator was used (a protection factor of 1).

Exposure Time Ratio (ET_f; hours/hours): This is the time that a worker spends per day exposed to chemicals in air. The exposure time ratio for SEGs at Air Operations and the Eastern Fire Shop is 9 hours per 24-hour day, based on the standard work week at these locations, resulting in an exposure time ratio of approximately 0.38. The exposure time ratio for SEGs at the Breathing Apparatus Repair Shop was 8 hours per 24-hour day based on the standard work week, resulting in an exposure time ratio of approximately 0.33.

Daily Exposure Frequency Ratio (EF; days/days): Exposure frequency is the number of days averaged over one year that a worker is exposed. For air exposures, exposure frequency is considered to be the number of days exposed out of a 365-day year. Three SEGs had different exposure frequencies based on site-specific information provided to ToxStrategies:

- Exposure frequency for Air Operations (EF_1) was based on working 9 days over 2 weeks (9 days/2 weeks * 50 weeks, or 225 days per year). The 50 weeks total excludes 2 weeks of vacation. Air Operations SEGs also put in up to 500 hours of overtime, which is approximately an additional 55 nine-hour days, for a total of 280 days per year, resulting in an exposure frequency ratio of 0.77.
- Exposure frequency for the Breathing Apparatus Shop (EF_2) was based on working 5 days per week for one year (5 days/week * 50 weeks, or 250 days). Breathing Apparatus Shop SEGs also put in up to 100 hours of overtime, which is approximately twelve 8-hour days, for a total of 262 days per year, resulting in an exposure frequency ratio of 0.72.
- Exposure frequency for the Eastern Fire Shop (EF_3) was based on working 9 days per 2 weeks (9 days/2 weeks * 50 weeks, or 225 days). Eastern Fire Shop SEGs also put in up to 200 hours of overtime, which is approximately twenty-two 9-hour days, for a total of 247 days per year, resulting in an exposure frequency ratio of 0.68.

Exposure Duration Ratio (ED; years/years): Workers are assumed to work for 45 years out of a 70-year lifetime (0.64) (NIOSH, 2017). This may be an overestimation for the working tenure of most mechanics evaluated as part of our survey of Los Angeles County because the County hires trained mechanics, e.g., in Air Operations, all mechanics had at least 10 years of experience before qualifying to work for the county Fire Department.

3.3.2 Dermal Contact

Dermal contact occurs when mechanics contact surfaces covered with residues containing chemicals of interest. Site-specific assumptions (Table 2) and chemical-specific dermal absorption factors selected from the scientific literature (Table 3) were used to evaluate potential dermal absorption through the skin. Potential dermal contact was calculated as:

$$Dermal\ Contact\ Exposure = \left(\frac{Csw \times CF \times SAf \times Abs \times EV \times EF \times ED\_y}{ATca \times BW}\right)$$

Dermal Contact Exposure (milligram per kilogram per day [mg/kg-day]): Amount of daily chemical exposure per kilogram body weight.

Concentration on surface wipe (Csw; micrograms per square centimeter [µg/cm^2 - event]): Potential concentrations on the surface of the skin were estimated using surface wipe sample results. The results are discussed in Section 2.2, above.

Conversion Factor (CF; milligrams per micrograms [mg/µg]): Concentrations on the surface wipes were converted from µg to mg using a factor of 0.001.

Surface area of fingers (SAf; square centimeters [cm^2]): All SEGs wear gloves while working. However, there are tasks for which gloves may not worn, and gloves also can tear. To estimate the surface area for the portion of the hand subject to dermal exposure, we used 19 cm^2, based on assumptions provided by the Office of Environmental Health Hazard Assessment (OEHHA) in their interpretive guidelines for safe use determinations concerning lead fishing weights (OEHHA, 2008). The area is equal to the surface area of the first three fingers of the palmar surface for both male adult hands.

Percent absorption (Abs; %): Percent absorption is a chemical-specific property. Details from the literature review used to develop these values is presented in Attachment 4. Table 3 summarizes these chemical-specific factors.

Event frequency (EV; events per day): To be conservative in this assessment, we have assumed that dermal contact occurs once per hour. Based on observations during visits to the facilities, torn gloves or activities that are performed without gloves that allow for direct contact with surfaces may not occur as often as once per hour. At the rate of one contact per hour, SEGs at Air Operations and the Eastern Fire Shop who work 9 hours per day would have 9 contacts per day. SEGs at the Breathing Apparatus Shop who work 8 hours per day would have 8 contacts per day. SEGs who contact Mastinox at Air Operations would have one contact per day, based on information provided to ToxStrategies.

Exposure Frequency (EF; days per year): Consistent with the discussion of inhalation exposures, exposure frequency is a combination of typical work schedules and overtime hours. As described for inhalation exposure (Section 3.3.1), the exposure frequencies are as follows:

- Air Operations — 280 days per year

- Breathing Apparatus Shop — 262 days per year
- Eastern Fire Shop — 247 days per year.

Additionally, SEG-specific exposure parameters were developed for the purpose of assessing dermal exposure to Mastinox on aircraft parts at Air Operations. Based on information provided to ToxStrategies, exposure frequency for contacting Mastinox is estimated to be 14 days per month for 12 months, resulting in 168 days per year.

Exposure Duration (ED; years): Workers are assumed to work for 45 years (NIOSH, 2017).

Body weight (BW: kilograms [kg]): Body weight for an adult worker is assumed to be 80 kg (DTSC, 2019).

Averaging Time for carcinogens (ATca; days): The averaging time for carcinogenic risk assessments is 70 years, or 25,550 days (70 years * 365 days) (DTSC, 2019).

3.3.3 Incidental Ingestion Exposure

Incidental ingestion occurs when fire mechanics contact surfaces with residues on the surface that contain chemicals of interest and then touch their hands to their mouths. Those chemicals from the residues can adhere to their hands, and subsequently, the particles can be ingested. Site-specific and general assumptions were used to evaluate potential incidental ingestion (Table 2). Chemical-specific relative bioavailability (RBA) via ingestion exposure was also included (Table 3). Incidental ingestion in this scenario is based on the same residue levels estimated for dermal absorption. A portion of the chemical (up to 25% depending on the chemical; Table 3) is potentially absorbed through the skin based on the chemical-specific dermal absorption factors. The remaining 75% is available for incidental ingestion, which is greater than the approximately 50% that is estimated to transfer from the fingers to the mouth. Therefore, the residue on the fingertips is sufficient for both the dermal and incidental ingestion pathways.

Potential incidental ingestion was calculated as follows:

$$Incidental\ Ingestion\ Exposure = \left(\frac{Csw \times CF \times SAf \times Fdirect \times RBA \times \mathrm{\gamma - d} \times \mathrm{ET_{hours}} \times EF \times ED\_y}{ATca\ \times BW}\right)$$

Incidental Ingestion Exposure (mg/kg-day): Daily exposure amount per kilogram body weight.

Concentration on surface wipe (Csw; micrograms per square centimeter [µg/cm²]): Potential concentration on the surface of the skin was measured using surface wipe sampling. The results are discussed in Section 2.2.

Conversion Factor (CF; milligrams per micrograms [mg/µg]): Concentrations on the surface wipes were converted from µg to mg using a factor of 0.001.

Surface area of fingers (SAf; square centimeters [cm^2]): Consistent with the assumptions for dermal exposure, all SEGs wear gloves while working. However, there are tasks for which gloves may not be worn, and gloves can tear. To estimate the surface area for the portion of the hand subject to dermal exposure and subsequent ingestion, we used 19 cm^2, based on assumptions provided by OEHHA in their interpretive guidelines for safe use determinations for lead fishing weights (OEHHA, 2008). The area is equal to the surface area of the first three fingers of the palmar surface for both male adult hands.

Direct Transfer Factor (Fdirect): OEHHA's interpretive guideline estimates that 50% (0.5) of the chemical on the relevant part of the hand is transferred from the hands to the mouth (OEHHA, 2008).

Relative bioavailability (RBA): Relative bioavailability is a chemical-specific property that relates the amount of a chemical that is systemically available after ingestion to the amount of chemical that was systemically available in the oral toxicity testing. USEPA has developed default RBAs for arsenic and lead in soil (USEPA, 2021a,b) that have been applied herein. The RBA for all other chemicals was assumed to be 100%.

Number of Contacts per Hour (γ-d): Consistent with the assumptions for dermal exposure, we have assumed that dermal contact occurs once per hour, which assumes that gloves aren't worn or are torn once per hour. This is conservative, based on observations during visits to the facilities: torn gloves or activities that are performed without gloves may not occur as often as once per hour.

Exposure Time (ET; hours per day): SEGs at Air Operations and the Eastern Fire Shop work 9 hours per day, and at one contact per hour, would have nine contacts per day. SEGs at the Breathing Apparatus Shop work 8 hours per day, and at one contact per hour, would result in eight contacts per day. SEGs that contact Mastinox at Air Operations would have one contact per day, based on the information provided to ToxStrategies.

Exposure Frequency (EF; days per year): Consistent with the discussion for dermal contact exposures, exposure frequency is a combination of typical work schedules and overtime hours. As described for dermal contact exposure (Section 3.3.2), the exposure frequencies are as follows:

- Air Operations — 280 days per year
- Breathing Apparatus Shop — 262 days per year
- Eastern Fire Shop — 247 days per year.

Additionally, for the purpose of assessing dermal exposure, surface samples were collected from Mastinox on aircraft parts at Air Operations. Based on information provided to ToxStrategies, exposure frequency for contacting Mastinox is estimated to be 168 days per year.

Exposure Duration (ED; years): Workers are assumed to work for 45 years (NIOSH, 2017).

Body weight (BW: kilograms [kg]): Body weight for an adult worker is assumed to be 80 kg (DTSC, 2019).

Averaging Time for carcinogens (ATca; days): The averaging time for carcinogenic risk assessments is 70 years or 25,550 days (70 years * 365 days) (DTSC, 2019).

3.4 Exposure-Point Concentrations

Exposure-point concentrations for each medium (air and surfaces) were developed for each SEG/location. Chemicals that were detected in at least one sample of air or one surface wipe were considered COPC for the purpose of this risk assessment. Chemicals that were never detected were evaluated separately for the uncertainty assessment, to understand whether the detection limits were sufficiently low for eliminating the need to further evaluate risk (Section 5.1.3)

Exposure point concentrations were calculated as follows:

- If a chemical was detected in at least one sample and analyzed in at least five samples, the exposure-point concentration was the average of all the sample results. One-half the detection limit was used to substitute for non-detect values when calculating the average (AIHA, 2015).
- If a chemical was detected in at least one sample and analyzed in fewer than five samples of a specific medium, the maximum detected concentration was used as the exposure-point concentration in the absence of sufficient data to calculate a representative average.

A summary of the exposure-point concentrations is presented in Table 4 for personal breathing-zone samples and in Table 5 for surface wipe samples.

4 Toxicity Assessment

This toxicity assessment provides the quantitative measures, termed cancer potency or unit risks, used to estimate the increased risk of developing cancer based on the cumulative exposure to carcinogens estimated over the working lifetime of fire mechanics, as quantified in Section 3. The DIR requested that cancer potency and unit risk estimates be developed using guidance from California agencies as the first preference For some of the COPCs, cancer potency criteria were readily available for potential carcinogenic health effects. For others, a review of regulatory references did not provide information that was appropriate for use in a quantitative estimate of potential cancer risks.

4.1 Chemicals with Available Cancer Potency Criteria

Toxicological values and information regarding the potential for carcinogenic effects in humans were obtained from a hierarchy of regulatory references, beginning with California's regulations for toxicity criteria for human health risk assessment (California Code of Regulations, Title 22, Sections 68400.5, 69020-69022), followed by other California guidance and USEPA references. These references provide chemical-specific toxicity data that represent consensus within the regulatory agency. In cases for which insufficient data were available from California sources, guidance from the federal EPA, OSHA and NIOSH were used.

The complete hierarchy of sources reviewed is as follows:

1. California's Toxicity Criteria for Human Health Risk Assessment (California Code of Regulations [CCR], Title 22, Sections 68400.5, 69020-69022)
2. OEHHA, 2011a, Technical Support Document for Cancer Potency Factors: Methodologies for derivation, listing of available values, and adjustments to allow for early life stage exposures.
3. OEHHA, Public Health Goals (e.g., 2011b)
4. OEHHA, Expedited Cancer Potency Factor (1992)
5. USEPA's IRIS database (USEPA, 2020b)
6. USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs) (e.g., USEPA, 2008)
7. Other toxicity values — includes additional USEPA and non-USEPA sources of toxicity information. Non-USEPA sources include the ATSDR (https://www.atsdr.cdc.gov). USEPA sources include the most current Health Effects Assessment Summary Tables (HEAST; USEPA, 1997).

In risk assessment, quantitative values are used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen. Specifically, for inhalation exposures, an inhalation unit risk value (IUR) is developed similarly and represents the risk associated with exposure to 1 $\mu g/m^3$ of a chemical in air; IURs are expressed in units of $(\mu g/m^3)^{-1}$. For non-inhalation pathways, a slope factor (SF) is a plausible upper-bound estimate of the probability of a response per unit intake of a chemical over a lifetime, which is the 95% upper confidence limit (UCL) of the slope of the dose-response curve expressed in units of the inverse of milligrams per kilogram-day $(mg/kg\text{-}day)^{-1}$. Tables 6 and 7 present the cancer toxicity criteria for inhalation and oral/dermal exposures, respectively.

4.2 Adjustment to Oral Slope Factors for Dermal Exposure

For dermal exposure, the exposure assessment results in an estimate of absorbed dose. However, oral toxicity criteria, which are typically used to assess risk from dermal exposure, are typically based on administered dose. The difference between administered and absorbed dose in the development of oral toxicity criteria can result in an underestimation of potential health risks from dermal exposure (USEPA, 2004). Oral toxicity criteria based on an administered dose may therefore need to be adjusted to account for the difference between the administered dose in the critical study (which formed the basis of the toxicity criterion) and the absorption efficiency of the chemical in question. The oral toxicity criteria can be adjusted and applied appropriately to dermal exposures. Table 3 presents the oral-to-dermal adjustment factor (fraction of contaminant absorbed in gastrointestinal tract; GIABS) for the COPCs.

5 Risk Characterization

In this section of the risk assessment, toxicity and exposure assessments are integrated into quantitative expressions of theoretical increased carcinogenic risks. Increased cancer risk estimates are quantified for SEGs based on the estimated exposures to measured carcinogens. An uncertainty analysis is included to address areas of the risk estimates that may over- or underestimate risks. Qualitative discussions of SEGs that could not be evaluated are also included.

5.1 Quantitative Estimate of Theoretical Increased Cancer Risks

The estimates of increased risk for individual COPCs and exposure pathways are presented in spreadsheets contained in Attachment 5. Risks are characterized by location and SEG (e.g., Eastern Fire Shop, welding). For quantitative estimates of potential increased cancer risk, the calculated risk associated with exposure to surface dust and air are summed to estimate cumulative risk. Theoretical excess cancer risks were calculated for each carcinogen where detectable concentrations of a chemical were measured and quantitative cancer potency values were available. Cases where one or the other of these factors were unavailable are discussed in Section 5.2. Consistent with regulatory policy, our risk assessment assumes no threshold for carcinogenicity, meaning there is no exposure level at which there is no increased risk of cancer. These risks are not measurable and therefore only theoretical model-based estimates. As such, the calculated increased risks estimates developed herein are compared with risk ranges that have been considered acceptable by regulatory agencies charged with risk management.

Typically, excess cancer risk for occupational exposures is determined to be significant if the risk for a working population exceeds 1 in 1,000. This threshold for significance has been used by OSHA for nearly 20 years following the Supreme Court decision in *American Petroleum Institute v. Industrial Union Department* [448 U.S. 607 (1980)] (commonly referred to as the Benzene decision), wherein the court concluded that a reasonable person might regard a lifetime cancer risk of 1 in 1,000 as significant, yet might regard a risk of 1 in 1,000,000,000 as trivial. As such, current regulatory occupational exposure limits (OELs) for carcinogenic substances such as the OSHA PELs were developed with the 1 in 1000 threshold. Recent NIOSH Recommended Exposure Limits (RELs), including that hexavalent chromium (NIOSH, 2013) and titanium dioxide (NIOSH, 2011) have been based on an excess cancer risk rate of 1 in 1,000 but also considered technical feasibility.

While the Supreme Court decision established that cancer risk greater than 1 in 1,000 is significant, it did not conclude that risks between 1 in 1,000 and 1 in 1,000,000,000 are insignificant. Risk managers often judge "acceptable risks" to be those in the range of 1 in 10,000 to 1 in 1,000,000. Recently, NIOSH updated its Chemical Carcinogen Policy and will establish Risk Management Limits for Carcinogens at air concentrations that correspond to the 95th percentile lower confidence limit of the 1 in 10,000 risk estimate (NIOSH, 2017). Similarly, DIR indicated that their goal is 1 in 10,000 (personal communication, Eric Berg, January 26, 2021). Therefore, for the purpose of this risk assessment, excess cancer risks calculated to be less than 1 in 10,000 have been judged *de minimus*.

5.1.1 Quantifying Increased Cancer Risk

The calculated increase cancer risks are estimated as the additional probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. For example, the same potential risk could be described as one additional case out of ten thousand people exposed under the assumptions evaluated, e.g., 1 of 10,000 workers with SEG exposures for 45 years. For consistency with the target level discussed above, cancer risk is presented in terms of the number of cases out of 10,000 people exposed. Predicted carcinogenic risk estimates are generally an upper-bound value, because assumptions are typically made to intentionally overestimate potential exposure and toxicity.

For inhalation pathways, the average daily air concentration is converted to estimates of risk using the IUR value. Estimated daily intakes averaged over a lifetime of exposure are converted to estimates of risk using the slope factor for oral exposures (SFO) for non-inhalation pathways $(mg/kg\text{-}day)^{-1}$.

For inhalation exposures, cancer risk is calculated as follows:

$$\text{Lifetime Excess Cancer Risk – inhalation}_i = \text{LAC}_i \times \text{IUR}_i$$

where:

LAC_i = lifetime average concentration for chemical "i" ($\mu g/m^3$)

IUR_i = inhalation unit risk value for chemical "i" $(\mu g/m^3)^{-1}$

For non-inhalation exposures, cancer risk is calculated as follows for the dermal and ingestion pathways, respectively:

$$\text{Lifetime Excess Cancer Risk} - \text{derm}_i = \text{LADD-dermal}_i \times \text{SFO}_i/\text{GIABS}_i$$
$$\text{Lifetime Excess Cancer Risk} - \text{ing}_i = \text{LADD-ing}_i \times \text{SFO}_i$$

where:

LADD-derm_i	= lifetime average daily dose from dermal exposure for chemical “i” (mg/kg-day)
LADD-ing_i	= lifetime average daily dose from ingestion exposure for chemical “i” (mg/kg-day)
SFO_i	= slope factor (oral) for chemical “i” $(\text{mg/kg-day})^{-1}$
GIABS_i	= fraction of contaminant absorbed in gastrointestinal tract for chemical “i” (unitless)

The excess cancer risks for each chemical and exposure route are summed, regardless of tumor site (e.g., stomach cancer, lung cancer) to estimate the total excess cancer risk for the exposed individual:

$$\begin{aligned} &Cumulative\ Lifetime\ Excess\ Cancer\ Risk \\ &\quad = \sum_{\text{i}=1}^{n} (Lifetime\ Excess\ Cancer\ Risk - inhalation_i \\ &\quad + Lifetime\ Excess\ Cancer\ Risk - non - inhalation_i) \end{aligned}$$

5.1.2 Results of Carcinogenic Risk Assessment

Potential cancer risks were estimated for the inhalation, dermal, and incidental ingestion pathways, and cumulative lifetime excess cancer risk was summed as described in Section 5.1.1. The results are summarized in Table 8, and the detailed calculations are presented in Attachment 5. As shown in Table 8, the highest predicted risks resulted from inhalation exposure. Predicted risks from dermal contact and incidental ingestion were well below a target level of 1 excess cancer case in 10,000 workers in a 45-year working lifetime.

5.1.2.1 Predicted Cancer Risks for Primary SEGs

Predicted theoretical excess cancer risks for inhalation exposure over a 45-year working lifetime for the primary SEGs as follows, with the primary chemical noted in the parentheses:

- 20 in 10,000 (0.2%) at Air Operations (hexavalent chromium)
- 30 in 10,000 (0.3%) at the small engine repair shop at the Breathing Apparatus Shop (benzene)

- 400 in 10,000 (4%) at the Eastern Fire Shop (tetrachloroethylene).

Another way to put these risks in context is to compare them to IARC's monograph that reviewed the carcinogenicity of firefighting (IARC, 2010). After the IARC Working Group summarized 42 epidemiologic studies of firefighting occupation and cancer risk (19 cohorts, 11 case-control studies, and 14 "other" studies) using meta-analyses for specific tumor types, persons who had ever held the occupation of a firefighter were found to be at a statistically significant increased risk of testicular cancer, prostate cancer, and non-Hodgkin's lymphoma compared to persons who had never been a firefighter (2010). The IARC Working Group's analysis of firefighters found that:

- There was an approximately ~50% increased risk of testicular cancer among firefighters compared with non-firefighters
- There was an approximately ~30% increased risk of prostate cancer among firefighters compared with non-firefighters
- There was an approximately ~20% increased risk of non-Hodgkin's lymphoma among firefighters compared with non-firefighters (IARC, 2010).

These estimates represent risk of cancer calculated using observational data of cancer rates among firefighters, rather than the theoretical risk estimates calculated herein for helicopter mechanics, equipment maintenance workers, and fire equipment mechanics. The theoretical estimated risks for the workers identified in this study are considerably lower than that measured among firefighters (0.2%-4% vs. 20-50%). As a point of reference, the risk of developing cancer at some point during their lifetime for persons in the US is approximately 39.5% (NCI, 2020). Note that this risk is baseline, not increased risk which is above baseline.

5.1.2.2 Predicted Cancer Risks for Specific Activities

In addition to calculating risks for primary SEGs, some activity-specific risks were also calculated (Table 8). Theoretical excess cancer risks over a 45-year working lifetime were calculated by specific exposure routes for the following additional activities:

- Contact with Mastinox at Air Operations — 0.3 in 10,000
- Inhalation of particles from welding/grinding/cutting activities at the Eastern Fire Shop — 0.02 in 10,000
- Contact with residue on air packs at the Breathing Apparatus Shop — 0.2 in 10,000
- Contact with residue on fire hoses at the fire-hose repair shop (part of the Breathing Apparatus Shop) — 0.001 in 10,000

In all four cases, exposure was below the target level of 1 in 10,000.

5.1.3 Uncertainties in the Quantitative Cancer Risk Assessment

In any risk assessment, estimates of potential carcinogenic risk and noncarcinogenic health effects have numerous associated uncertainties. Uncertainty is part of all four areas of risk assessment: the hazard identification/data evaluation, exposure assessment, toxicity assessment, and risk characterization. In this section, these uncertainties are discussed qualitatively, including whether the uncertainty may result in overestimation or underestimation of risk. For example, there is uncertainty in the toxicity criteria for the various COPCs, but those toxicity criteria are developed using conservative assumptions to ensure they are protective, and they are likely to overestimate actual risk.

5.1.3.1 Hazard Identification/Data Evaluation

The focus of this risk assessment was on exposure to chemicals identified as carcinogens based on the evaluations in Tasks 1 and 2 and analyzed in Task 4 (ToxStrategies, 2020b,c,d). Specific chemicals of interest were evaluated for each SEG and location based on the *qualitative* risk ranking results conducted in Task 2. Specifically, all chemicals considered to present a qualitatively very high, high, or moderate potential risk were included in the assessment, and those considered trivial were not. However, given the very low potential for exposure to the excluded chemicals, the theoretical excess cancer risks have not been underestimated significantly.

Risks potentially associated with exposure to some chemicals identified in Task 2 could not be calculated because of the absence of regulatory toxicity criteria. Potential exposure to these chemicals is discussed qualitatively in Section 5.2.4.

5.1.3.2 Exposure Assessment

Chemicals of potential concern were identified as those chemicals detected in at least one sample. Many chemicals were not detected in any samples and were reported as below a detection limit. To evaluate whether the detection limit was adequate for assessing potential risk, the same risk calculations applied to the detected concentrations were applied to the detection limits for those chemicals that were not detected in any samples (Attachment 5). The limits of detection used in this analysis are identified as exposure point concentrations in Attachment 1. As shown in Attachment 5-A, estimated risks for chemicals in PBZ samples at the detection limit ranged from 1 in 10,000 (diesel particulate matter) to 60 in 10,000 (naphthalene). This comparison demonstrates the very conservative nature of this assessment. Risk estimates associated with the detection limits are much lower than the maximum calculated risks, such that this uncertainty would not affect the conclusions of this report. For chemicals in surface wipe samples, only arsenic detection limits correspond to incidental ingestion risks (2 in 10,000) that are slightly above 1 in 10,000.[4]

---

[4] N,N-dimethyl-para-toluidine was not included in the evaluation of other chemicals that were not detected because an inhalation unit risk value was not available in the regulatory references for this chemical.

Crystalline silica was not detected in any of the PBZ air samples and did not have a IUR in the regulatory references. The lower bound of the detection limit for quartz ranged from 4.7 to 6.4 μg/m^3 which is approximately a factor of 10-fold lower than the OSHA PEL of 50 μg/m^3. Theoretical excess cancer risk at the OSHA PEL for a working lifetime was calculated by OSHA as 5-23 cancers per 1,000 workers. As such the potential excess cancer risk at the limit of detection is approximately 5-23 in 10,000 workers (Federal Register, 2016).

Chemical concentrations were measured in multiple samples that were collected on the same day. This sampling approach addresses variability between workers and job tasks on a given day, but does not provide information on variability over time (e.g., different days). For example, the tetrachloroethylene concentrations are related to use of a specific NAPA® Lectra Clean® 3000 Energized Electrical Equipment Cleaner. Tetrachloroethylene contributed significantly to the calculated increased risk (360 in 10,000 in the Eastern Fire Shop). It is not known whether the use of the product on the sampling day was high, low, or equivalent compared to its use over time.

Exposure-point concentrations were the maximum detected concentrations for several chemicals because of the limited number of samples that were collected. These are identified in bold font in Tables 4 and 5. Use of the maximum concentration may overestimate potential exposures. For example, the maximum concentration of benzene used to estimate risk was detected in one of two samples at the Breathing Apparatus Shop (680 μg/m^3), which was more than twice the value of the other sample (300 μg/m^3).

Exposure assumptions were developed for the dermal contact and incidental ingestion exposure pathways that likely overestimated potential risk, because gloves are worn by the helicopter mechanics, equipment maintenance workers, and fire equipment mechanics when performing their tasks. Gloves may actually reduce the risk to 0, if there is no direct contact with the skin or opportunity for incidental ingestion. In the risk estimates, we assumed that the surfaces of three fingertips were uncovered eight to nine times per day (depending on the shift length). Even considering this overestimate for potential contact frequency, dermal contact and incidental ingestion were not considered significant exposure pathways with respect to potential carcinogenic risk.

One unique feature of the dioxin/furan and PCB TEQ concentrations used to estimate risk is that the total value for all congeners was calculated using one-half the detection limit to estimate the concentrations of congeners that were not detected. For many samples, the contribution to the TEQ from the congeners that were not detected was as high or higher than the contribution from the congeners that were detected. In general, this reflects the relatively low concentrations of these chemicals, which did not contribute significantly to theoretical risk.

Potential exposure for some SEGs could not be sampled, because the activities (specifically, painting/priming/sanding aircraft parts by a helicopter maintenance inspector at Air Operations and repair of fire apparatus by field-assigned mechanics at a wildfire base camp) are intermittent and weren't occurring during sampling activities. These activities are discussed qualitatively in Section 5.2.

5.1.3.3 Toxicity Assessment

Toxicity criteria used in this assessment are not measured precisely, like a measurement of distance, but are based on extrapolation of data from high concentrations at which an effect can be observed in humans or animals to much lower concentrations comparable to those present in the environment. To illustrate the variability in that interpretation, Table 9 presents the predicted risks for the three key chemicals contributing to inhalation risk (benzene, tetrachloroethylene, and hexavalent chromium) using the California criteria (Cal/EPA; basis for risk calculations in Attachment 5) and alternative potency measures. The risks are predicted using up to three different regulatory references for toxicity criteria: California's Environmental Protection Agency (Cal/EPA; basis for risk calculations in Attachment 5), USEPA, and NIOSH (22 CCR § 68400.5, 69020-69022, USEPA, 2020a; NIOSH, 2013). As shown in Table 9, risks estimated using Cal/EPA's toxicity criteria are approximately 4 to 20 times higher than risks using toxicity criteria from USEPA. NIOSH published an inhalation unit risk value for hexavalent chromium, and the predicted risk is approximately 5-times lower than risks predicted using Cal/EPA's toxicity criteria. It should be noted that although exposure frequency and duration are not consistent between the NIOSH unit risk estimate and our exposure scenarios, we corrected for the difference in our calculations to predict the risk estimates in Table 9.

Further, it is noteworthy that the NIOSH cancer potency estimate for hexavalent chromium was developed in 2013 using a robust data set (more than 2000 workers exposed from 1950-1980s) for whom exposures were characterized using an extensive exposure monitoring data set, and NIOSH quantitatively addressed the risk associated with smoking behavior. By comparison the California potency estimate, which was used in this evaluation, was developed in 1985, based on a very limited data set of fewer than 300 workers, exposed in the 1930s, and for which, no measures of hexavalent chromium were collected (CDHS, 1985). The NIOSH assessment is far superior technically than the highly dated assessment used in California, and it expected that the cancer risk associated with hexavalent chromium calculated using the California potency estimate is overestimated because of the dated analysis used to derive the California unit risk value. The cancer risk calculated using the NIOSH unit risk estimate is 5 in 10,000 (Table 9), and it is noteworthy that hexavalent chromium was only measurable in one sample from our study.

5.1.3.4 Risk Characterization

These hypothetical risk calculations are based on estimates of both exposure and toxicity that, when combined, may compound the uncertainty in the risk estimates. As with any risk assessment, assumptions are required to quantify potential human exposure and risk. Most assumptions were conservative and overestimate potential exposure and risk. Those assumptions that potentially underestimated potential exposure and risk typically resulted in low or insignificant effects to the predictions.

It is also important to recognize the difference between calculated probabilities in the risk assessment and observed cancer incidence. The calculated risk probabilities are predictors of the likelihood of cancer based on numerous assumptions and models, many of which are designed to overestimate risk rather than underestimate it. This is not the same as identifying actual incidences of cancer in a specific population.

5.2 Qualitative Discussion of Cancer Risks

This section discusses various potential exposures that could not be quantified. During sampling activities, representative concentrations could not be collected for a field-assigned fire equipment mechanic working at a wildfire base camp or a helicopter maintenance inspector at Air Operations painting/priming/sanding aircraft parts. During our visit to the Eastern Fire Shop on November 4, 2020, brake pads were observed with a Proposition 65 warning for the presence of carcinogens, but information regarding the chemical composition of the brake pads was not available for assessing potential exposure risks. Finally, some chemicals were not analyzed in the sampling effort, because regulatory toxicity criteria were not available to quantify potential risk. In the absence of those quantitative data, a qualitative discussion of potential carcinogenic risks is presented for each of these scenarios.

5.2.1 Field-Assigned Fire Equipment Mechanic at a Wildfire Base Camp

As described in the Task 2 report (ToxStrategies, 2020c), the job of repairing fire apparatus or other equipment at a wildfire base camp or at a municipal fire site resulted in a "very high" risk ranking and was thus prioritized for the evaluation of cancer risk. Depending on the number of wildfires that occur each year, field mechanics may be called to a wildfire base camp for approximately 2-week durations, 24 hours per day. During these events, the mechanic wears work boots, a work uniform, gloves, eye protection, and N95 respirators. So, while this exposure may be more intense than daily work at the fire shop, it is also much less frequent (7.7% of their total year if they work for 28 days in the field per year and if they pull two shifts every fire season). There is also a great deal of variability in this potential exposure, depending on where the base camp is set up, which direction the wind is blowing, how far the base camp is from the active fire, and how many fires are contributing to air quality conditions. Given the infrequent occurrence (possibly 7.7% of a year) and shorter exposure duration (once every three years for 45 years), the potential exposures of field mechanics is not expected to be as high as exposures in the shop.

The carcinogens that were prioritized for the quantitative assessment (Task 4; ToxStrategies, 2020d) were acetaldehyde, benzene, ethylbenzene, naphthalene, diesel particulate, formaldehyde, and PAHs in air; and PAHs, chlorinated dioxins/furans, PCBs, pentachlorophenol, arsenic, and lead in surface wipes. Although the field-assigned fire equipment mechanic's exposure could not be assessed for these chemicals, Materna et al. (1992), characterized firefighters' exposures to acetaldehyde, benzene formaldehyde, and PAHs in air while working at northern California wildland fires between 1987 and 1989. These authors found that firefighter industrial hygiene samples collected during wildland firefighting demonstrated potential for low-level exposures to these carcinogens (Materna et al., 1992). As a point of comparison, benzene was sampled for at the Eastern Fire Shop

(PBZ air samples and area samples) and benzene was not detected (<71 $\mu g/m^3$), while Materna et al., measured approximately 1,600 $\mu g/m^3$ at the active fire site. As such, it is recognized that exposure concentrations at active fires may exceed that which occurs at the shops, even though mechanics do not spend a significant fraction of their working lifetime at an active fire.

ToxStrategies estimates that the concentrations measured on the surface of a fire apparatus at a wildfire base camp would not likely result in risk above 1 in 10,000, based on the following rationales:

- The surface wipe samples collected at the Eastern Fire Shop on the fire apparatus that had been to a recent wildfire had detections that did not exceed the 1-in-10,000 risk level for the dermal or ingestion pathway.
- The surface wipe locations on the fire apparatus collected from the Eastern Fire Shop were areas that are not cleaned regularly and are not easily accessible; therefore, the dust that was captured on the wipe sample was an accumulation of fire residues from, presumably, several fire events (wildfires and/or municipal fires).
- The surface wipe samples collected on the aircraft that had recently been to a wildfire had detections that did not exceed the 1-in-10,000 risk level for the dermal or ingestion pathway.

5.2.2 Helicopter Maintenance Inspector at Air Operations

In addition to the heavy and intermediate maintenance tasks, the helicopter maintenance inspector performs painting, priming, and sanding of aircraft components. This work can take place in the paint booth, inside the hangar, or outside in the open air, depending on the aircraft component. The carcinogenic chemicals associated with the painting tasks include methylene chloride, hexavalent chromium, 4-chlorobenzotrifluoride, and ethylbenzene. Based on discussions with the Air Operations staff, the painting work performed by the helicopter maintenance inspector typically takes place in the paint booth, and with the use of an airline respirator. The airline respirator effectively eliminates the inhalation pathway for exposure, because it supplies clean breathing air to the inspector. Although air concentrations of the chemicals could not be measured, because this activity was not conducted on the days of the exposure assessment, a supplied-air respirator, when properly fitted, has a protection factor of 1000, meaning that it reduces by 1000-fold the air concentrations of chemicals to which the wearer is exposed. Given the performance of the painting operations inside a ventilated paint booth and the use of a supplied-air respirator, the possibility for significant inhalation exposure is extremely low.

5.2.3 Brake Pad Repair by a Shop-Assigned Fire Equipment Mechanic

During the quantitative exposure assessment site visit to the Eastern Fire Shop in Los Angeles on November 4, 2020, ToxStrategies observed Proposition 65 warning labels or generic “caution” labels on the packaging of some friction materials (e.g., brake pads, shoes, linings) used to maintain heavy-duty vehicles. These labels warned of potential cancer risk and/or reproductive harm. ToxStrategies subsequently requested copies of

Material Safety Data Sheets (MSDSs) or Safety Data Sheets (SDSs) for each of the friction materials. We received an MSDS for a brake lining supplied by Meritor Genuine, Product No. 292, dated January 7, 2013. This MSDS did not identify any potential for cancer risk or that the product was regulated under Proposition 65 (California Safe Drinking Water and Toxic Enforcement Act of 1986). In contrast, the packaging for other Meritor Genuine products observed during the site visit included a caution label regarding possible cancer risk. We have not received MSDSs or SDSs for the remaining friction products, nor were these documents readily available in the public domain. Accordingly, we have not included the potential cancer risk, if any, from exposure to friction material components in our evaluation. This issue could be investigated further as part of future health evaluations of fire equipment mechanics.

5.2.4 Chemicals Without Regulatory Toxicity Criteria

Exposure to six chemicals was not measured, because, although they have been identified as potential carcinogens, toxicity criteria were not available from the regulatory references evaluated. Specifically, diethanolamine and tetrahydrofuran are present in chemicals used for helicopter maintenance at Air Operations, and cumene, tetrabromobisphenol-A, methyl isobutyl ketone, and diethanolamine are present in chemicals used by fire equipment mechanics at the Eastern Fire Shop. Hence, theoretical excess cancer risks associated with exposure to these chemicals have not been assessed, and therefore, it is unknown what additional excess cancer risk, if any, would be posed by these chemicals.

6 Conclusions

A quantitative estimate of carcinogenic risk was calculated based on measurements and assumptions regarding chemicals of potential concern, exposure, and quantitative measures of carcinogenic potency. Several air and surface wipe samples were collected on a single day at each of three locations (Air Operations, the Breathing Apparatus Shop, and the Eastern Fire Shop) for the purpose of measuring exposure to chemicals from workplace exposures. Several chemicals were detected in one or more samples, which were identified as COPCs for the purpose of this evaluation. SEGs were identified in Task 2 of this project, which categorized the workers based on how they may be exposed during their workday. Exposure assumptions were developed for each SEG to quantify exposure rates. Inhalation, dermal contact, and incidental ingestion routes of exposure were evaluated for each of the SEGs.

Based on the results of the exposure and risk calculations performed herein, inhalation was identified as the exposure route that contributed most significantly to potential exposure and risk, although all measured concentrations were below PELs for all chemicals. A single chemical in air at each of the locations for each SEG was identified as contributing most significantly to risk estimates above the threshold of 1 in 10,000: hexavalent chromium at Air Operations (20 in 10,000), benzene at the Breathing Apparatus Shop (30 in 10,000), and tetrachloroethylene at the Eastern Fire Shop (400 in 10,000). Estimated risks for other SEGs and tasks were below 1 in 10,000. Data were not collected for field-assigned fire equipment mechanics and helicopter maintenance inspectors, because those activities did not occur at the time of sampling. These SEGs are considered to have relatively low exposure potential because of the short duration and the use of personal protective equipment.

It is noteworthy that these risk estimates are based on current sampling data and are not reflective of past exposures. As worker safety and health practices typically improve with time, it is reasonable to assume that exposures in the past were higher and different than those quantified in this study.

The measured air concentrations of carcinogenic chemicals to which the helicopter mechanics, equipment maintenance workers, and fire equipment mechanics are exposed did not exceed the Cal/OSHA PELs; however, PELs are not always set to be protective of an increased cancer risk. Nevertheless, to reduce potential cancer risk, a variety of control measures consistent with the NIOSH hierarchy of controls (eliminate, substitution, engineering controls, administrative controls, and use of personal protective equipment) could be considered. Examples include:

- Eliminate tetrachloroethylene-containing products, replacing them with products that do not contain carcinogens.
- Increase ventilation in the Breathing Apparatus Shop to reduce benzene air concentrations.
- Identify work practices at Air Operations that increase the potential for airborne hexavalent chromium releases, and modify practices/procedures to reduce the exposure.

7 Next Steps

For Task 3, Epidemiologic Assessment, employee records are being evaluated for completeness and suitability for a future cancer epidemiology study.

Task 6 may include analyzing public comments, explaining the rationale for specific policy recommendations, and disseminating the study findings to the governor, state legislature, Occupational Safety and Health Standards Board, Los Angeles County Board of Supervisors, and stakeholders in the workers' compensation system.

8 References

AIHA (American Industrial Hygiene Association). 2015. A strategy for assessing and managing occupational exposures. Fourth Edition.

CDHS (California Department of Health Services). 1985. Health Assessment for Chromium. California Department of Health Services (later OEHHA, California Environmental Protection Agency), Berkeley and Sacramento, CA.

Cruzan et al. 2001. Chronic Toxicity/Oncogenicity Study of Styrene in CD-1 Mice by Inhalation Exposure for 104 Weeks. Journal of Applied Toxicology. 21: 185-198.

DTSC (Department of Toxic Substances Control). 2019. Human Health Risk Assessment (HHRA) Note Number 1. Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Hazardous Waste Sites and Permitted Facilities. April 9.

IARC (International Agency for Research on Cancer). 2010. IARC Monographs on the evaluation of carcinogenic risks to humans, Volume 98, Painting, firefighting, and shiftwork. Occupational Cancer Research Centre, https://www.occupationalcancer.ca/2010/iarc-monographs-volume-98-painting-firefighting-and-shiftwork/.

Federal Register. 2016. Occupational exposure to respirable crystalline silica; final rule. Department of Labor, Occupational Safety and Health Administration, 29 CFR Parts 1910, 1915, and 1926, March 25.

Knudsen GA, Hughes MF, McIntosh KL, Sanders JM, Birnbaum LS. 2015. Estimation of tetrabromobisphenol A (TBBPA) percutaneous uptake in humans using the parallelogram method. Toxicol Appl Pharmacol 1;289(2):323-329.

Kraeling ME, Yourick JJ, Bronaugh RL. 2004. In vitro human skin penetration of diethanolamine. Food Chem Toxicol 42:1553-1561.

Materna et al. 1992. Occupational exposures in California wildland fire fighting. Am Ind Hg Assoc J. 53(1): 69-76. January.

NCI (National Cancer Institute), 2020, Cancer statistics. September. Available at: https://www.cancer.gov/about-cancer/understanding/statistics

National Research Council. 1983. Risk Assessment in the Federal Government: Managing the Process. National Academy Press. Washington, D.C.

NIOSH (National Institute of Occupational Safety and Health). 2011. Current Intelligence Bulletin 63, Occupational Exposure to Titanium Dioxide. DHHS (NIOSH) Publication No. 2011-160, April.

NIOSH. 2013. Criteria for a recommended standard occupational exposure to hexavalent chromium. DHHS (NIOSH) Publication No. 2013-128, September.

NIOSH. 2017. Current intelligence bulletin 68: NIOSH chemical carcinogen policy. Publication 2017-100. July.

OEHHA (Office of Environmental Health Hazard Assessment). 2008. Proposition 65, Interpretive Guideline No. 2008-001, Guideline for hand-to-mouth transfer of lead through exposure to fishing tackle products. March.

OEHHA. 2010. Public Health Goals for Chemicals in Drinking Water: Styrene. Office of Environmental Health Hazard Assessment, California Environmental Protection Agency, Sacramento, CA.

OEHHA (Office of Environmental Health Hazard Assessment). 2011a. Technical support document for cancer potency factors: Methodologies for derivation, listing of available values, and adjustments to allow for early life stage exposures, Appendix B. January (update; original, 2009).

OEHHA (Office of Environmental Health Hazard Assessment). 2011b. Public health goals for chemicals in drinking water, Hexavalent chromium (CrVI). July.

OEHHA. (Office of Environmental Health Hazard Assessment). 2012. Air Toxics Hot Spots Program Risk Assessment Guidelines, Technical Support Document for Exposure Assessment and Stochastic Analysis, August.

Riviere JE, Brooks JD, Monteiro-Riviere NA, Budsaba K, Smith CE. 1999. Dermal absorption and distribution of topically dosed jet fuels Jet-A, JP-8, and JP-8(100). Toxicol Appl Pharmacol 160:60–75.

ToxStrategies, Inc. 2020a. Proposal in response to RFP #4479, Assessment of risk of carcinogens exposure and incidents of occupational cancer among mechanics and cleaners of firefighting vehicles, Volume 1 — Proposal. February 13.

ToxStrategies, Inc. 2020b. Structured literature review of potential occupational exposures and cancer among mechanics who repair and clean firefighting vehicles (Task 1). August 24.

ToxStrategies, Inc. 2020c. Qualitative exposure assessment (Task 2). October 9.

ToxStrategies, Inc. 2020d. Quantitative exposure assessment (Task 4). December 11.

USEPA (U.S. Environmental Protection Agency). 1997. Health Effects Assessment Summary Tables (HEAST). U.S. Environmental Protection Agency, Washington, D.C., 1997.

USEPA (U.S. Environmental Protection Agency). 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).

USEPA (U.S. Environmental Protection Agency). 2008. Provisional peer reviewed toxicity values for cobalt (CASRN 7440-48-4), August 25.

USEPA (U.S. Environmental Protection Agency). 2020a. Regional Screening Levels (RSLs), November. Accessed at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

USEPA (U.S. Environmental Protection Agency). 2020b. Integrated Risk Information System (IRIS), December 14.

USEPA (U.S. Environmental Protection Agency). 2021a. Fact sheet: Arsenic RBA and IVBA, relative bioavailability and in vitro bioaccessibility of arsenic in soil. January 4. Accessed at: https://semspub.epa.gov/work/HQ/100002716.pdf

USEPA (U.S. Environmental Protection Agency). 2021b. Fact sheet: Lead RBA and IVBA, relative bioavailability and in vitro bioaccessibility of lead in soil. January 4. Accessed at: https://semspub.epa.gov/work/HQ/100002717.pdf

Wester RC, Maibach HI, Sedik L, Melendres J, Wade M, DiZio S. 1993. Percutaneous absorption of pentachlorophenol from soil. Fundam Appl Toxicol 20(1):68–71.

Tables 1–9

Table 1. Job tasks and similar exposure groups evaluated in the cancer risk assessment

Similar Exposure Group (SEG)	Job Task	Location
Helicopter mechanic	Heavy maintenance on aircraft, including the task of oil leak checks	Air Operations, Pacoima
	Intermediate maintenance on aircraft	Air Operations, Pacoima
Helicopter maintenance inspector	Painting/priming/sanding aircraft parts	Air Operations, Pacoima
Equipment maintenance worker	Repair and tune-up of power equipment and rescue tools	Breathing Apparatus Shop, Pacoima
	Fire-hose repair	Breathing Apparatus Shop, Pacoima
Shop-assigned fire equipment mechanic	Maintenance/repair on fire apparatus	Eastern Fire Shop, Los Angeles, & North County Fire Shop, Lancaster
Field-assigned fire equipment mechanic	Repair of fire apparatus or other equipment at a wildfire base camp	Wildfire base camp

Table 2. Exposure assumptions for similar exposure groups

Description	Parameter	Units	Value	Reference
Inhalation Exposure Parameters				
Respirator protection factor (welding only)	PF	(--)	10	CCR, Title 8, §5144. Respiratory Protection
Exposure time (Air Operations_ratio)	ET_AO_f	9 hours/24 hours	0.38	Site-specific
Exposure time (Eastern Fire Shop_ratio)	ET_FS_f	9 hours/24 hours	0.38	Site-specific
Exposure time	ET	8 hours/24 hours	0.33	Site-specific
Exposure frequency 1 (Air Operations)	EF_1	280 days/365 days	0.77	Site-specific
Exposure frequency 2 (Breathing Apparatus Shop)	EF_2	262 days/365 days	0.72	Site-specific
Exposure frequency 3 (Eastern Fire Shop)	EF_3	247 days/365 days	0.68	Site-specific
Exposure frequency 4 (welding at the Eastern Fire Shop)	EF_4	12 days/365	0.033	Site-specific
Exposure duration	ED	45 years/70 years	0.64	NIOSH, 2017
Dermal Contact and incidental Ingestion Parameters				
Surface area of the fingers	SAf	cm^2	19	OEHHA, 2008
Event Frequency (Air Operations)	EV_AO	events per day	9	Site-specific; one contact per hour for 9 hours
Event Frequency (Eastern Fire Shop)	EV_FS	events per day	9	Site-specific; one contact per hour for 9 hours
Event Frequency (Breathing Apparatus Shop)	EV	events per day	8	Site-specific; one contact per hour for 8 hours
Event Frequency (Air Operations - Mastinox)	EV_M	events per day	1	Site-specific; one contact per day
Percent absorption	Abs	%	Chemical-specific	Chemical specific
Fraction of contaminant absorbed in gastrointestinal tract	GIABS	unitless	Chemical-specific	Chemical specific
Direct transfer factor	Fdirect	ratio	0.5	OEHHA, 2008
Relative bioavailability (arsenic and lead only)	RBA	%	Chemical-specific	USEPA, 2021a and 2021b
Contacts per hour	γ-d	per hour	1	Site-specific; one contact per hour
Exposure time (Air Operations)	ET_AO	hours per day	9	Site-specific; 9-80 work week
Exposure time (Eastern Fire Shop)	ET_FS	hours per day	9	Site-specific; 9-80 work week
Exposure time (Breathing Apparatus Shop)	ET_hours	hours per day	8	Site-specific; 40-hour, 5-day work week
Exposure time_Mastinox	ET_M	hours per day	1	Site-specific; one contact per day
Exposure frequency 1 (Air Operations)	EF_AO	days/year	280	Site-specific; 225 9-hour days and 500 hours of overtime
Exposure frequency 2 (Breathing Apparatus Shop)	EF_BA	days/year	262	Site-specific; 250 8-hour days and 100 hours of overtime
Exposure frequency 3 (Eastern Fire Shop)	EF_FS	days/year	247	Site-specific; 250 8-hour days and 200 hours of overtime
Exposure frequency 4 (Air Operations - Mastinox)	EF_M	days/year	168	Site-specific; contact with Mastinox 14 times per month
Exposure duration	ED_y	years	45	NIOSH, 2017
Averaging time	ATca	days	25550	DTSC, 2019
Body weight	BW	kilograms	80	DTSC, 2019

References

DTSC (Department of Toxic Substances Control). 2019. Human Health Risk Assessment (HHRA) Note Number 1. Recommended DTSC Default Exposure Factors for Use in Risk Assessment at California Hazardous Waste Sites and Permitted Facilities. April 9.

NIOSH. 2017. Current intelligence bulletin 68: NIOSH chemical carcinogen policy. Publication 2017-100. July.

OEHHA (Office of Environmental Health Hazard Assessment). 2008. Proposition 65, Interpretive Guideline No. 2008-001, Guideline for hand-to-mouth transfer of lead through exposure to fishing tackle products. March.

USEPA (US Environmental Protection Agency). 2021a. Fact sheet: Arsenic RBA and IVBA, relative bioavailability and in vitro bioaccessibility of arsenic in soil. January 4. Accessed at: https://semspub.epa.gov/work/HQ/100002716.pdf

USEPA (US Environmental Protection Agency). 2021b. Fact sheet: Lead RBA and IVBA, relative bioavailability and in vitro bioaccessibility of lead in soil. January 4. Accessed at: https://semspub.epa.gov/work/HQ/100002716.pdf

Table 3. Chemical-specific exposure factors

Chemical	RBA (%)	Reference	GIABS (unitless)	Reference	Dermal Absorption (%)	Reference
Arsenic	60	USEPA, 2021a	1	USEPA, 2020a	6	OEHHA, 2012
Benzo(a)pyrene and PAHs	100	Default	1	USEPA, 2020a	13	OEHHA, 2012
Diethanolamine	100	Default	1	USEPA, 2020a	1	Kraeling et al., 2004
Hexavalent chromium	100	Default	0.025	USEPA, 2020a	2	OEHHA, 2012
Lead	60	USEPA, 2021b	1	USEPA, 2020a	3	OEHHA, 2012
Naphthalene	100	Default	1	USEPA, 2020a	1.17	Riviere et al., 1999
Pentachlorophenol	100	Default	1	USEPA, 2020a	25	Wester et al., 1993
PCBs (Total)	100	Default	1	USEPA, 2020a	14	OEHHA, 2012
Tetrabromobisphenol-A	100	Default	1*	USEPA, 2020a	6	Knudsen et al., 2015
2,3,7,8-Tetrachlorodibenzo-p-dioxin	100	Default	1	USEPA, 2020a	3	OEHHA, 2012

Notes

GIABS = Fraction of contaminant absorbed in gastrointestinal tract (unitless)

RBA = Relative bioavailability

* = Bisphenol A selected as surrogate chemical for selection of GIABS

References

Knudsen GA, Hughes MF, McIntosh KL, Sanders JM, Birnbaum LS. 2015. Estimation of tetrabromobisphenol A (TBBPA) percutaneous uptake in humans using the parallelogram method. Toxicol Appl Pharmacol 1;289(2):323-329.

Kraeling ME, Yourick JJ, Bronaugh RL. 2004. In vitro human skin penetration of diethanolamine. Food Chem Toxicol 42:1553-1561.

OEHHA. 2012. Air Toxics Hot Spots Program Risk Assessment Guidelines, Technical Support Document for Exposure Assessment and Stochastic Analysis, August.

Riviere JE, Brooks JD, Monteiro-Riviere NA, Budsaba K, Smith CE. 1999. Dermal absorption and distribution of topically dosed jet fuels Jet-A, JP-8, and JP-8(100). Toxicol Appl Pharmacol 160:60–75.

USEPA. 2020a. Regional Screening Levels (RSLs), November.

USEPA. 2021a. Fact Sheet: Arsenic RBA and IVBA, Relative Bioavailability and In Vitro Bioaccessibility of Arsenic in Soil. January 4.

USEPA. 2021b. Fact Sheet: Lead RBA and IVBA, Relative Bioavailability and In Vitro Bioaccessibility of Lead in Soil. January 4.

Wester RC, Maibach HI, Sedik L, Melendres J, Wade M, DiZio S. 1993. Percutaneous absorption of pentachlorophenol from soil. Fundam Appl Toxicol 20(1):68-71.

Table 4. Representative concentrations for exposure evaluations based on personal breathing zone samples (µg/m^3)

Job Task	Location	Number of Samples for Exposure Point Calculations	Acetaldehyde	Benzene	Ethylbenzene	Formaldehyde	Naphthalene	Styrene	Tetra-chloroethylene	Diesel Particulate as Elemental Carbon	Hexavalent Chromium
Intermediate & heavy maintenance on aircraft	Air Operations	5	--	--	--	--	--	--	--	--	<0.072
Heavy maintenance on aircraft	Air Operations	3	--	--	--	--	--	--	--	--	**0.084**
Intermediate maintenance on aircraft	Air Operations	6	--	<61	<790	--	<880	--	--	--	--
General work in hangar	Air Operations	2	--	<58	<750	--	<840	--	--	--	--
Repair and tune-up of power equipment in the small-engine repair shop	Breathing Apparatus Shop	2	**27**	**680**	<1000	**28**	<1,200	<990	--	--	--
Maintenance and repair on fire apparatus	Eastern Fire Shop	6	--	<71	<930	--	<1000	--	35,667	<2.5	--
Maintenance and repair on fire apparatus - Welding	Eastern Fire Shop	2	--	--	--	--	--	--	--	--	<0.10
General work in Eastern Fire Shop	Eastern Fire Shop	2	--	<66	<860	--	<950	--	--	<2.1	--

Job Task	Location	Number of Samples for Exposure Point Calculations	Arsenic	Beryllium	Cadmium	Cobalt	Lead	Nickel	N,N-Dimethyl-Para-Toluidine	Respirable Crystalline Silica		
										Quartz	Cristobalite	Tridymite
Intermediate & heavy maintenance on aircraft	Air Operations	--	--	--	--	--	--	--	--	--	--	--
Heavy maintenance on aircraft	Air Operations	6	--	--	--	--	--	--	--	<6.4	<6.4	<25
Intermediate maintenance on aircraft	Air Operations	--	--	--	--	--	--	--	--	--	--	--
General work in hangar	Air Operations	--	--	--	--	--	--	--	--	--	--	--
Repair and tune-up of power equipment in the small-engine repair shop	Breathing Apparatus Shop	--	--	--	--	--	--	--	--	--	--	--
Maintenance and repair on fire apparatus	Eastern Fire Shop	5	--	--	--	--	--	--	<0.51	--	--	--
Maintenance and repair on fire apparatus - Welding	Eastern Fire Shop	2	<4.3	<0.021	<0.13	**0.18**	<0.85	**1.9**	--	--	--	--
General work in Eastern Fire Shop	Eastern Fire Shop	--	--	--	--	--	--	--	--	--	--	--

Notes
Bold font indicates maximum value used as representative concentration when fewer than five samples collected.
Regular font represents detection limits or average values for data sets with more than five detections.

Abbreviations
-- = data not collected
µg/m^3 = microgram per cubic meter

Table 5. Representative concentrations for exposure evaluations based on surface wipe samples ($\mu g/cm^2$)

Job Task	Location	Sample Description	Number of Samples for Exposure Point Calculations	Hexavalent Chromium (CrVI)	Arsenic (As)	Lead (Pb)	Pentachloro-phenol (PCP)	PCB-TEQ[1]	Non-TEQ PCB[2]	Dioxin/ Furan (D/F) TEQ[1]
Intermediate & heavy maintenance on aircraft	Air Operations	Various engine or aircraft parts	As/Pb - 12 Cr(VI) - 6 PCB & D/F - 2	0.0014	<0.063	0.016	--	**1.2E-09**	**2.9E-06**	**1.5E-08**
Intermediate & heavy maintenance on aircraft	Air Operations	Mastinox on aircraft parts	2	**0.54**	--	--	--	--	--	--
Repair of air packs	Breathing Apparatus Shop	Air Packs	As/Pb - 6 PCP - 2 PCB & D/F - 2	--	<0.063	0.023	<0.0050	**1.8E-09**	**2.1E-05**	**3.0E-08**
Fire hose repair	Breathing Apparatus Shop	Fire hose	As/Pb - 6	--	<0.063	0.039	--	--	--	--
Maintenance and repair on fire apparatus	Eastern Fire Shop	Fire Apparatus	As/Pb/PCP - 6 PCB & D/F - 6	--	<0.063	0.16	<0.0050	2.8E-09	4.1E-05	2.1E-08

Job Task	Location	Sample Description	Number of Samples for Exposure Point Calculations	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzo(a)-pyrene	Indeno (1,2,3-cd)pyrene	Dibenzo (a,h)anthracene	Naphthalene
Intermediate & heavy maintenance on aircraft	Air Operations	Various engine or aircraft parts	12	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Intermediate & heavy maintenance on aircraft	Air Operations	Mastinox on aircraft parts	--	--	--	--	--	--	--	--	--
Repair of air packs	Breathing Apparatus Shop	Air Packs	6	0.017	0.018	0.029	0.0055	0.015	0.012	0.003	0.0051
Fire hose repair	Breathing Apparatus Shop	Fire hose	6	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Maintenance and repair on fire apparatus	Eastern Fire Shop	Fire Apparatus	6	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Notes

1. The analytical results for dioxins/furans and 12 PCB congeners with a toxicity equivalency factor (TEF) were converted to a 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) toxic equivalence (TEQ) concentration. Congeners that were non-detects were assigned values equal to 50% of the reporting limit for calculating the dioxin/furan/PCB TEQ totals for each sample.
2. The non-TEQ PCBs total are calculated by summing the individual congeners without a TEF. Congeners that were non-detects were assigned values equal to 50% of the reporting limit for calculating the non-TEQ PCB totals for each sample.

Bold font indicates maximum value used as representative concentration when fewer than five samples collected.
Regular font represents detection limits or average values for data sets with more than five detections.

Abbreviations

PCB = polychlorinated biphenyl
TEQ = toxicity equivalency
-- = data not collected
$\mu g/cm^2$ = microgram per square centimeter

Table 6. Toxicity criteria for carcinogenic effects based on inhalation exposure

Chemical	CAS #	Cancer Endpoint			
		IUR $(\mu g/m^3)^{-1}$	Source	Toxicologic Endpoint	Target Organ(s)
Quantitatively Assessed Chemicals (analyzed chemicals)					
Acetaldehyde	75-07-0	2.7E-06	22 CCR § 68400.5, 69020-69022	Nasal tumors in rats	Respiratory system
Arsenic	7440-38-2	4.3E-03	IRIS (USEPA, 2020b)	Lung cancer in humans	Respiratory system
Benzene	71-43-2	2.9E-05	22 CCR § 68400.5, 69020-69022	Leukemia in humans	Lymphatic system/ Nervous system
Beryllium	7440-41-7	2.4E-03	IRIS (USEPA, 2020b)	Lung cancer in humans	Respiratory system
Cadmium	7440-43-9	4.2E-03	22 CCR § 68400.5, 69020-69022	Lung cancer in humans	Respiratory system
Cobalt	7440-48-4	9.0E-03	PPRTV (USEPA, 2008)	Lung tumors in rats and mice	Respiratory system
Crystalline silica	14808–60–7	--	--	--	--
Diesel particulate	E17136615	3.0E-04	OEHHA (2011a)	Lung cancer in humans	Respiratory system
Ethylbenzene	100-41-4	2.5E-06	OEHHA (2011a)	Renal tumors in rats	Urinary system
Formaldehyde	50-00-0	1.3E-05	IRIS (USEPA, 2020b)	Nasal tumors in rats	Respiratory system
Hexavalent chromium	18540-29-9	1.5E-01	22 CCR § 68400.5, 69020-69022	Lung cancer in humans	Respiratory system
Lead	7439-92-1	1.2E-05	OEHHA (2011a)	Kidney tumors in rats	Urinary system
Nickel	7440-02-0	2.6E-04	22 CCR § 68400.5, 69020-69022	Lung cancer in humans	Respiratory system
N,N-dimethyl-para-toluidine	99-97-8	--	--	--	--
Styrene	100-42-5	7.4E-06	ToxStrategies derived (OEHHA, 2010; Cruzan et al., 2001)	Lung tumors in mice	Respiratory system
Tetrachloroethylene	127-18-4	6.1E-06	22 CCR § 68400.5, 69020-69022	Liver tumors in mice	Digestive system
PAHs					
Naphthalene	91-20-3	3.4E-05	OEHHA (2011a)	Nasal tumors and nasal olfactory tumors in rats	Respiratory system
Benzo(a)anthracene	56-55-3	1.1E-04	22 CCR § 68400.5, 69020-69022	Respiratory tract tumors in hamsters	Respiratory system
Chrysene	218-01-9	1.1E-05	22 CCR § 68400.5, 69020-69022	Respiratory tract tumors in hamsters	Respiratory system
Benzo(b)fluoranthene	205-99-2	1.1E-04	22 CCR § 68400.5, 69020-69022	Respiratory tract tumors in hamsters	Respiratory system
Benzo(k)fluoranthene	207-08-9	1.1E-04	22 CCR § 68400.5, 69020-69022	Respiratory tract tumors in hamsters	Respiratory system
Benzo(a)pyrene	50-32-8	1.1E-03	22 CCR § 68400.5, 69020-69022	Respiratory tract tumors in hamsters	Respiratory system
Indeno(1,2,3-cd)pyrene	193-39-5	1.1E-04	22 CCR § 68400.5, 69020-69022	Respiratory tract tumors in hamsters	Respiratory system
Dibenzo(a,h)anthracene	53-70-3	1.2E-03	22 CCR § 68400.5, 69020-69022	Alveolar cell carcinoma in mice	Respiratory system

Abbreviations

CAS # = Chemical Abstracts Service Registry Number
CCR = California Code of Regulations
IUR = Inhalation Unit Risk
IRIS = Integrated Risk Information System
OEHHA = California Office of Environmental Health Hazard Assessment
PAHs = polycyclic aromatic hydrocarbons
PPRTV = Provisional Peer-Reviewed Toxicity Values
$(\mu g/m^3)^{-1}$ = risk per micrograms per cubic meter of air
-- = not available

Table 7. Toxicity criteria for carcinogenic effects based on oral and dermal exposure

		Cancer Endpoint			
Chemical	**CAS #**	**SFO $(mg/kg\text{-}d)^{-1}$**	**Source**	**Toxicologic Endpoint**	**Target Organ(s)**
Quantitatively Assessed Chemicals (analyzed chemicals)					
Hexavalent chromium	18540-29-9	5.0E-01	22 CCR § 68400.5, 69020-69022	Tumors of the small intestine in mice	Digestive system
Arsenic	7440-38-2	9.5E+00	22 CCR § 68400.5, 69020-69022	Lung and bladder cancer in humans	Respiratory and urinary systems
Lead	7439-92-1	8.5E-03	OEHHA (2011a)	Kidney tumors in rats	Urinary system
Pentachlorophenol	87-86-5	4.0E-01	IRIS (USEPA, 2020b)	Liver tumors and adrenal gland tumors in mice	Digestive and endocrine systems
Dioxins/Furans					
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	1.3E+05	OEHHA (2011a)	Liver tumors in mice	Digestive system
PCBs					
PCBs (Total)	1336-36-3	2.0E+00	IRIS (USEPA, 2020b)	Liver tumors and bile duct tumors in rats	Digestive system
PAHs					
Naphthalene	91-20-3	1.2E-01	OEHHA (2011a)	Nasal tumors and nasal olfactory tumors in rats	Respiratory and olfactory system
Benzo(a)anthracene	56-55-3	1.0E-01	USEPA (2020a)	Alimentary tract tumors in mice	Digestive system
Chrysene	218-01-9	1.0E-03	USEPA (2020a)	Alimentary tract tumors in mice	Digestive system
Benzo(b)fluoranthene	205-99-2	1.0E-01	USEPA (2020a)	Alimentary tract tumors in mice	Digestive system
Benzo(k)fluoranthene	207-08-9	1.0E-02	USEPA (2020a)	Alimentary tract tumors in mice	Digestive system
Benzo(a)pyrene	50-32-8	1.0E+00	IRIS (USEPA, 2020b)	Alimentary tract tumors in mice	Digestive system
Indeno(1,2,3-cd)pyrene	193-39-5	1.0E-01	USEPA (2020a)	Alimentary tract tumors in mice	Digestive system
Dibenzo(a,h)anthracene	53-70-3	4.1E+00	22 CCR § 68400.5, 69020-69022	Alveolar cell carcinoma in mice	Respiratory system

Abbreviations

CAS # = Chemical Abstracts Service Registry Number
CCR = California Code of Regulations
IRIS = Integrated Risk Information System
$(mg/kg\text{-}d)^{-1}$ = per (milligram per kilogram-day)
OEHHA = Office of Environmental Health Hazard Assessment
PAHs = polycyclic aromatic hydrocarbons
PCBs = polychlorinated biphenyls
SFO = oral slope factor
USEPA = United States Environmental Protection Agency

Table 8. Summary of estimated risks by location/SEG

Location	Inhalation	Dermal Contact	Incidental Ingestion	Total Risk
Primary Scenarios	**Cancer Risk per 10,000**			
Air Operations - intermediate and heavy maintenance on aircraft	20	0.01	0.02	20
Breathing Apparatus Shop - small engine repair shop - repair and tune-up of power equipment	30	--	--	30
Eastern Fire Shop - maintenance/ repair on fire apparatus	400	0.001	0.02	400
Additional Scenarios				
Air Operations - Mastinox contact only	--	0.2	0.2	0.3
Eastern Fire Shop - Welding/ grinding/ cutting activities only	0.02	--	--	0.02
Breathing Apparatus Shop - air pack repair	--	0.04	0.2	0.2
Breathing Apparatus Shop - fire hose repair shop - fire hose repair	--	0.00009	0.0009	0.001

Notes
Risks exceeding 1 in 10,000 (1E-04).

Abbreviations
SEG - similar exposure group

Table 9. Sensitivity analysis of potential inhalation risk estimates

Risk calculations based on detected concentrations of chemicals of potential concern (COPCs)[1]

Location/Specialized task	Benzene			Tetrachloroethylene			Hexavalent Chromium		
	Cal/EPA[2]	USEPA[3]	NIOSH	Cal/EPA[2]	USEPA[3]	NIOSH	Cal/EPA[2]	USEPA[3]	NIOSH[4]
Inhalation Unit Risk (IUR) $(\mu g/m^3)^{-1}$	0.000029	0.000008	NA	0.0000061	0.00000026	NA	0.15	0.012	0.006
Air Operations	--	--	--	--	--	--	2.3E-03	1.9E-04	5.0E-04
Breathing Apparatus Shop	3.0E-03	8.2E-04	NA	--	--	--	--	--	--
Eastern Fire Shop	--	--	--	3.5E-02	1.5E-03	NA	--	--	--

Cancer Risk = Ca/PF * ET * EF * ED * IUR

Description	Parameter	Units	Value
Concentration in Air	Ca	$\mu g/m^3$	Chemical-specific/ measured
Inhalation unit risk	IUR	$(\mu g/m^3)^{-1}$	Chemical-specific
Respirator protection factor (welding only)	PF	(--)	10
Exposure time (Air Operations_fraction)	ET_AO_f	9 hours/24 hours	0.38
Exposure time (Eastern Fire Shop_fraction)	ET_FS_f	9 hours/24 hours	0.38
Exposure time	ET	8 hours/24 hours	0.33
Exposure frequency 1 (Air Operations)	EF_1	280 days/365 days	0.77
Exposure frequency 2 (Breathing Apparatus Shop)	EF_2	262 days/365 days	0.72
Exposure frequency 3 (Eastern Fire Shop)	EF_3	247 days/365 days	0.68
Exposure frequency 4 (welding at the Eastern Fire Shop)	EF_4	12 days/365	0.033
Exposure duration	ED	45 years/70 years	0.64

Notes

1. Risk calculation based on maximum detected concentration in air (Ca).
2. DTSC HERO. 2019. Human Health Risk Assessment (HHRA) Note Number 10, Toxicity Criteria. Accessed at https://dtsc.ca.gov/human-health-risk-hero/.
3. USEPA. 2020. Regional Screening Levels (RSLs) - Generic Tables. As of November 2020. Accessed at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.
4. NIOSH. 2013. Criteria for a Recommended Standard Occupational Exposure to Hexavalent Chromium, DHHS (NIOSH) Publication No. 2013-128, September.

Abbreviations

Cal/EPA = California Environmental Protection Agency (DTSC)
COPC = chemical of potential concern
USEPA = US Environmental Protection Agency
IUR = inhalation unit risk
-- = chemical not measured
NA = not available or not applicable
NIOSH = National Institute for Occupational Safety and Health
Chemical of potential concern (COPC) not measured and not relevant to this location.
Red shading indicates risks greater than 1 in 10,000 (1E-04)

ATTACHMENT 1

Summary of Personal Breathing-Zone and Surface Wipe Samples at Air Operations

Attachment 1-A. Personal breathing-zone samples at Air Operations - hexavalent chromium

Sampling Date	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (Liters)	Hexavalent Chromium (μg/m^3)
11/3/20	Intermediate & heavy maintenance on aircraft	HM-1103-01	438	876	<0.068
11/3/20	Intermediate & heavy maintenance on aircraft	HM-1103-02	465	930	<0.065
11/3/20	Intermediate & heavy maintenance on aircraft	HM-1103-04	454	908	<0.066
11/3/20	Intermediate & heavy maintenance on aircraft	HM-1103-08	426	852	<0.070
11/3/20	Intermediate & heavy maintenance on aircraft	HM-1103-11	416	832	<0.072
11/3/20	Heavy maintenance on aircraft	HM-1103-10	385	770	<0.078
11/3/20	Heavy maintenance on aircraft	HM-1103-12	314	628	<0.096
11/3/20	Heavy maintenance on aircraft	HM-1103-13	372	744	**0.084**
EPC - Intermediate & heavy maintenance[1]					<0.072
EPC - Heavy maintenance[1]					0.084

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations

EPC = exposure point concentration

μg/m^3 = micrograms per cubic meter

Bold indicates detected result.

Shaded represents the EPC

Attachment 1-B. Personal breathing zone samples at Air Operations - respirable crystalline silica

Sampling Date	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (Liters)	Quartz ($\mu g/m^3$)	Cristobalite ($\mu g/m^3$)	Tridymite ($\mu g/m^3$)
11/3/20	Heavy maintenance on aircraft	40203	422	1,055	<4.7	<4.7	<19
11/3/20	Heavy maintenance on aircraft	40204	417	1,042.50	<4.8	<4.8	<19
11/3/20	Heavy maintenance on aircraft	40174	393	982.5	<5.1	<5.1	<20
11/3/20	Heavy maintenance on aircraft	40173	379*	947.5	<5.3	<5.3	<21
11/3/20	Heavy maintenance on aircraft	40193	314	785	<6.4	<6.4	<25
11/3/20	Heavy maintenance on aircraft	40163	374	935	<5.3	<5.3	<21
Exposure Point Concentration (EPC)[1]					<6.4	<6.4	<25

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

* Sample duration is uncertain; personal sampling air pump faulted between the times of 1:30pm and 3:15pm.
Sample duration is based on an estimated sample end time of 2:30pm. The results may be biased high, but the results were non-detect.

Abbreviations

$\mu g/m^3$ = micrograms per cubic meter
Shaded represents the EPC

Attachment 1-C. Personal breathing zone samples at Air Operations - volatile organic compounds

Sampling Date	Job Task	Sample ID	Sample Duration (minutes)	Benzene (mg/m^3)	Ethylbenzene (mg/m^3)	Naph-thalene (mg/m^3)
11/3/20	Intermediate maintenance on aircraft	EL0042	546	<0.052	<0.67	<0.74
11/3/20	Intermediate maintenance on aircraft	EL0122	547	<0.051	<0.67	<0.74
11/3/20	Intermediate maintenance on aircraft	EL0053	547	<0.051	<0.67	<0.74
11/3/20	Intermediate maintenance on aircraft	EL0089	542	<0.052	<0.68	<0.75
11/3/20	Intermediate maintenance on aircraft	EL0134	467	<0.060	<0.78	<0.87
11/3/20	Intermediate maintenance on aircraft	EL0146	461	<0.061	<0.79	<0.88
11/3/20	General work in Hangar	EL0086	487	<0.058	<0.75	<0.83
11/3/20	General work in Hangar	EL0132	486	<0.058	<0.75	<0.84
Exposure Point Concentration (EPC) - Intermediate maintenance (mg/m^3)[1]				<0.061	<0.79	<0.88
EPC - General work in Hangar (mg/m^3)[1]				<0.058	<0.75	<0.84
EPC - Intermediate maintenance ($\mu g/m^3$)[2]				<61	<790	<880
EPC - General work in Hangar ($\mu g/m^3$)[2]				<58	<750	<840

Notes
1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.
2. The units were converted from mg/m^3 to $\mu g/m^3$.

Abbreviations
mg/m^3 = milligrams per cubic meter
$\mu g/m^3$ = micrograms per cubic meter
Shaded represents the EPC

Attachment 1-D-1. Surface Wipe Samples at Air Operations - arsenic and lead in units of µg/cm²

Sampling Date	Sampling Location	Observations / Notes	Sample ID	Arsenic	Lead
11/3/20	Intermediate gear box of Firehawk	Fire residues/ dust	N190LA-01-A	<0.063	**0.019**
11/3/20	Right stabilator of Bell412	Fire residues/ dust	N14LA-03-A	<0.063	**0.033**
11/3/20	Right tailbone of Bell412	Fire residues/ dust	N14LA-02-A	<0.063	**0.023**
11/3/20	Right side of nose of Bell412	Fire residues/ dust	N14LA-01-A	<0.063	**0.028**
11/3/20	Upper aft blade antenna, left side, of Firehawk	Fire residues/ dust	N190LA-02-A	<0.063	<0.0050
11/3/20	Transition access door, underside, of Firehawk	Fire residues/ dust	N190LA-03-A	<0.063	**0.023**
11/3/20	Right engine exhaust cowling of Firehawk	Firehawk had been to a recent wildfire (October 2020)	N822LA-01-A	<0.063	<0.0050
11/3/20	Tail of Bell412	Bell412 had not been cleaned since usage in wildfire	N120LA-01-A	<0.063	**0.0082**
11/3/20	Blade antenna of Bell412	Bell412 had not been cleaned since usage in wildfire	N120LA-02-A	<0.063	**0.016**
11/3/20	Horizontal stabilator of Firehawk	Firehawk had been to a recent wildfire (October 2020)	N822LA-03-A	<0.063	**0.0091**
11/3/20	Forward cowling, right side, of Firehawk	Firehawk had been to a recent wildfire (October 2020)	N822LA-02-A	<0.063	**0.0085**
11/3/20	Glass "sun roof"/"greenhouse" of Bell412	Bell412 had not been cleaned since usage in wildfire	N120LA-03-A	<0.063	**0.016**
			Exposure Point Concentration (EPC)[1]	<0.063	0.016

Attachment 1-D-2. Surface Wipe Samples at Air Operations - hexavalent chromium (Cr[VI]) in units of µg/cm^2

Sampling Date	Sampling Location	Observations / Notes	Sample ID	Cr(VI)
11/3/20	Hot part of left engine (seam) of Bell412	--	N18LA-01	**0.0014**
11/3/20	Hot part of left engine (seam) of Bell412	--	N17LA-04	**0.00076**
11/3/20	Hot part of right engine (seam) of Bell412	--	N18LA-02	**0.0022**
11/3/20	Hot part of right engine (seam) of Bell412	--	N120LA-01	**0.0019**
11/3/20	Hot part of left engine (seam) of Bell412	--	N120LA-02	**0.0013**
11/3/20	Hot part of left engine (seam) of Bell412	--	N17LA-03	**0.0011**
			Exposure Point Concentration (EPC)[1]	0.0014
11/3/20	Skid on right side of Bell412	Mastinox visible	N14LA-05	**0.080**
11/3/20	Mating surface of combining gear box trimount of Bell412	Mastinox visible	N14LA-06	**0.54**
			EPC[1]	0.54

Notes
1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations
µg/cm^2 = micrograms per square centimeter
Shaded represents the EPC
Bold indicates detected result.

Attachment 1-D-3. Surface Wipe Samples at Air Operations - polycyclic aromatic hydrocarbons (PAHs) in units of µg/cm²

Sample ID	Sampling Location	Naphthalene	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzo(a)-pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)-anthracene
N190LA-01	Intermediate gear box of Firehawk	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N14LA-03	Right stabilator of Bell412	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N14LA-02	Right tailbone of Bell412	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N14LA-01	Right side of nose of Bell412	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N190LA-02	Upper aft blade antenna, left side, of Firehawk	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N190LA-03	Transition access door, underside, of Firehawk	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N822LA-01	Right engine exhaust cowling of Firehawk	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N120LA-01	Tail of Bell412	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N120LA-02	Blade antenna of Bell412	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N822LA-03	Horizontal stabilator of Firehawk	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N822LA-02	Forward cowling, right side, of Firehawk	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
N120LA-03	Glass "sun roof"/"greenhouse" of Bell412	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	EPC[1]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Attachment 1-D-4. Surface Wipe Samples at Air Operations - PCBs and Dioxin/Furans in units of µg/cm²

Sampling Date	Sampling Location	Sample ID	PCB TEQ	Non-TEQ PCB	Dioxin/ Furan TEQ
11/3/20	Horizontal stabilator of Bell412	356-4	**8.6E-10**	**2.9E-06**	**1.3E-08**
11/3/20	Chin bubble of Bell412	356-5	**1.2E-09**	**2.9E-06**	**1.5E-08**
		EPC[1]	1.2E-09	2.9E-06	1.5E-08

Notes
1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations
µg/cm² = micrograms per square centimeter
Shaded represents the EPC
PCBs = polychlorinated biphenyls
TEQ = toxic equivalence
Bold indicates detected result.

ATTACHMENT 2

Summary of Personal Breathing-Zone and Surface Wipe Samples at the Breathing Apparatus Shop

Attachment 2-A. Personal breathing-zone samples at the Small Engine Repair Shop - volatile organic compounds

Sampling Date	Job Task	Sample ID	Sample Duration (minutes)	Ethyl-benzene (mg/m^3)	Naph-thalene (mg/m^3)	Styrene (mg/m^3)	Benzene (mg/m^3)	Sample ID	Acetalde-hyde (mg/m^3)	Formalde-hyde (mg/m^3)
11/3/20	Small engine repair shop equipment maintenance worker	EL0064	349	<1.0	<1.2	<0.99	**0.68**	A295581	**0.027**	**0.026**
11/3/20	Small engine repair shop equipment maintenance worker	EL0139	349	<1.0	<1.2	<0.99	**0.30**	A295575	**0.027**	**0.028**
Exposure point concentration (EPC) (mg/m^3)[1]				<1.0	<1.2	<0.99	0.68	**EPC (mg/m^3)[1]**	0.027	0.028
EPC ($\mu g/m^3$)[2]				<1000	<1,200	<990	680	**EPC ($\mu g/m^3$)[2]**	27	28

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

2. The units were converted from mg/m^3 to $\mu g/m^3$.

Abbreviations

mg/m^3 = milligrams per cubic meter

$\mu g/m^3$ = micrograms per cubic meter

Shaded represents the EPC

Bold indicates detected result.

Attachment 2-B-1. Surface Wipe Samples at the Breathing Apparatus Shop - arsenic, lead, and pentachlorophenol in units of μg/cm²

Sampling Date	Sample ID	Sampling Location	Observations/ Notes	Arsenic	Lead	Pentachloro-phenol
11/3/20	ECTC-T-8-A	Where pump sits, southern location	Training air pack	<0.063	**0.017**	--
11/3/20	ECTC-T-38-A	Where pump sits, southern location	Training air pack	<0.063	**0.016**	--
11/3/20	A49996-QUT-185-4-A	Where pump sits, southern location	Field air pack	<0.063	**0.014**	--
11/3/20	A50143-Q-24-5-A	Where pump sits, southern location	Field air pack	<0.063	**0.013**	--
11/3/20	NC5O-4-A	Where pump sits, southern location	Training air pack	<0.063	**0.027**	--
11/3/20	AS0421-ENG-21-4-A	Where pump sits, southern location	Field air pack	<0.063	**0.048**	--
11/3/20	A50143-Q-24-5	Where pump sits, middle portion	Field air pack	--	--	<0.0050
11/3/20	ECTC-T-7	Where pump sits, middle portion	Training air pack	--	--	<0.0050
Exposure Point Concentration (EPC)[1]				<0.063	0.023	<0.0050

Attachment 2-B-2. Surface Wipe Samples at the Breathing Apparatus Shop - PCBs and Dioxin/Furans in units of μg/cm²

Sample ID	Sampling Location	PCB TEQ	Non-TEQ PCB	Dioxin/ Furan TEQ
BA-1	Where pump sits, middle portion	**1.1E-09**	**2.1E-05**	**1.7E-08**
BA-2	Where pump sits, middle portion	**1.8E-09**	**1.7E-05**	**3.0E-08**
EPC[1]		1.8E-09	2.1E-05	3.0E-08

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations

μg/cm² = micrograms per square centimeter
Shaded represents the EPC
Bold indicates detected result.
PCBs = polychlorinated biphenyls
TEQ = toxic equivalence

Attachment 2-B-3. Surface Wipe Samples at the Breathing Apparatus Shop - polycyclic aromatic hydrocarbons (PAHs) in units of µg/cm²

Sample ID	Sampling Location	Observations/ Notes	Naphthalene	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzo(a)-pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)-anthracene
A49996	Where air pump sits, northern location	Field air pack	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
A50421 ENG-21-4	Where air pump sits, northern location	Field air pack	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
A5014 Q-24-5	Where air pump sits, northern location	Field air pack	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
ECTC-T-8	Where air pump sits, northern location	Training air pack	**0.018**	**0.048**	**0.050**	**0.10**	<0.0050	**0.045**	**0.035**	**0.0071**
ECTC-T-38	Where air pump sits, northern location	Training air pack	<0.0050	**0.0098**	**0.013**	**0.020**	**0.0070**	**0.0083**	**0.0091**	<0.0050
NCSO-04	Where air pump sits, northern location	Training air pack	<0.0050	**0.034**	**0.035**	**0.048**	**0.016**	**0.030**	**0.020**	<0.0050
Exposure Point Concentration (EPC)[1]			0.0051	0.017	0.018	0.029	0.0055	0.015	0.012	0.0033

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations

µg/cm² = micrograms per square centimeter

Bold indicates detected result.

Shaded represents the EPC

Attachment 2-C-1. Surface Wipe Samples of Fire Hoses - arsenic and lead in units of μg/cm²

Sampling Date	Sample ID	Sampling Location	Observations/ Notes	Arsenic	Lead
11/3/20	H-01-A	Exterior of hose	Fire Hose	<0.063	**0.0088**
11/3/20	H-02-A	Exterior of hose	Fire Hose	<0.063	**0.0095**
11/3/20	H-03-A	Exterior of hose	Fire Hose	<0.063	**0.0076**
11/3/20	H-04-A	Exterior of hose	Fire Hose	<0.063	**0.025**
11/3/20	H-05-A	Exterior of hose	Fire Hose	<0.063	**0.13**
11/3/20	H-06-A	Exterior of hose	Fire Hose	<0.063	**0.056**
Exposure Point Concentration (EPC)[1]				<0.063	0.039

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations

μg/cm² = micrograms per square centimeter

Shaded represents the EPC

Bold indicates detected result.

Attachment 2-C-2. Surface Wipe Samples of Fire Hoses - polycyclic aromatic hydrocarbons (PAHs) in units of µg/cm²

Sample ID	Observations/ Notes	Naphthalene	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzo(a)-pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)-anthracene
H-01	Fire hose, very dirty	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
H-02	Fire hose	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
H-03	Fire hose	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
H-04	Fire hose, very dirty	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
H-05	Fire hose, very dirty	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
H-06	Fire hose	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
	EPC[1]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations

EPC = exposure point concentration

µg/cm² = micrograms per square centimeter

Shaded represents the EPC

Bold indicates detected result.

ATTACHMENT 3

Summary of Personal Breathing-Zone and Surface Wipe Samples at the Eastern Fire Shop

Attachment 3-A. Personal breathing-zone and area samples at the Eastern Fire Shop - volatile organic compounds and diesel particulate as elemental carbon

Sampling Date	Job Task	Sample ID	Sample Duration (minutes)	Benzene (mg/m^3)	Ethyl-benzene (mg/m^3)	Naph-thalene (mg/m^3)	Sample ID	Diesel particulate as elemental carbon ($\mu g/m^3$)
11/4/20	Maintenance on fire apparatus	EL0128	422	<0.067	<0.87	<0.96	11401	<2.4
11/4/20	Maintenance on fire apparatus	EL0110	433	<0.065	<0.85	<0.94	11402	<2.2
11/4/20	Maintenance on fire apparatus	EL0102	440	<0.064	<0.83	<0.92	11403	<2.2
11/4/20	Maintenance on fire apparatus	EL0135	436	<0.065	<0.84	<0.93	11404	<2.2
11/4/20	Maintenance on fire apparatus	EL0129	427	<0.066	<0.86	<0.95	11405	**180**
11/4/20	Maintenance on fire apparatus	EL0107	396	<0.071	<0.93	<1.0	11406	<2.5
11/4/20	General work in Eastern Fire Shop	EL0232	430	<0.066	<0.85	<0.95	11407	<2.1
11/4/20	General work in Eastern Fire Shop	EL0060	427	<0.066	<0.86	<0.95	11408	<2.1
EPC - Maintenance on fire apparatus (mg/m^3)[1]				<0.071	<0.93	<1.0	--	--
EPC - Maintenance on fire apparatus ($\mu g/m^3$)[1,2,3]				<71	<930	<1000	--	<2.5
EPC - General work in Eastern Fire Shop (mg/m^3)[1]				<0.066	<0.86	<0.95	--	--
EPC - General work in Eastern Fire Shop ($\mu g/m^3$)[1,2]				<66	<860	<950	--	<2.1

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.
2. The units were converted from mg/m^3 to $\mu g/m^3$.
3. Diesel particulate as elemental carbon measured in Sample EL0129 was determined to be an outlier and removed from the dataset.

Abbreviations

EPC = exposure point concentration
mg/m^3 = milligrams per cubic meter
$\mu g/m^3$ = micrograms per cubic meter
Bold indicates detected result.
Shaded represents the EPC
-- = not applicable

Attachment 3-B. Personal breathing-zone samples at the Fire Shop - tetrachloroethylene

Sampling Date	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (liters)	Tetrachloro-ethylene (mg/m^3)
11/4/20	Maintenance on fire apparatus	72773	310	38.44	**67**
11/4/20	Maintenance on fire apparatus	72775	331	42.2	**16***
11/4/20	Maintenance on fire apparatus	72776	332	49.3	**12**
11/4/20	Maintenance on fire apparatus	72780	298	45.3	**17****
11/4/20	Maintenance on fire apparatus	72781	306	47.58	**27**
11/4/20	Maintenance on fire apparatus	72779	298	38.59	**75*****
Exposure Point Concentration (EPC) (mg/m^3)[1]					36
EPC ($\mu g/m^3$)[2]					35,667

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

2. The units were converted from mg/m^3 to $\mu g/m^3$.

* The pre- and post- flow rate was different by approximately 11%; therefore, this result is an estimate (the true result is between 15 and 17 mg/m^3).

** The pre- and post- flow rate was different by approximately 8%; therefore, this result is an estimate (the true result is between 17 and 18 mg/m^3).

*** The pre- and post- flow rate was different by approximately 28%; therefore, this result is an estimate (the true result is between 64 and 90 mg/m^3).

Abbreviations

mg/m^3 = milligrams per cubic meter

$\mu g/m^3$ = micrograms per cubic meter

Bold indicates detected result.

Attachment 3-C. Personal breathing-zone samples at the Fire Shop - welding-fume metals

Sampling Date	Job Task	Sample ID	Sample Duration (minutes)	Arsenic ($\mu g/m^3$)	Beryllium ($\mu g/m^3$)	Cadmium ($\mu g/m^3$)	Cobalt ($\mu g/m^3$)	Lead ($\mu g/m^3$)	Nickel ($\mu g/m^3$)
11/4/20	Maintenance on fire apparatus	MET01	391	<3.2	<0.016	<0.096	**0.18**	<0.64	**1.9**
11/4/20	Maintenance on fire apparatus	MET02	294	<4.3	<0.021	<0.13	<0.13	<0.85	**0.52**
Exposure Point Concentration (EPC) ($\mu g/m^3$)[1]				<4.3	<0.021	<0.13	0.18	<0.85	1.9

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations

$\mu g/m^3$ = micrograms per cubic meter

Bold indicates detected result.

Shaded represents the EPC

Attachment 3-D. Personal breathing-zone samples at the Fire Shop - hexavalent chromium in welding fumes

Sampling Date	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (Liters)	Hexavalent chromium (µg/m³)
11/4/20	Maintenance on fire apparatus	FM002	389	778	<0.077
11/4/20	Maintenance on fire apparatus	FM001	293	586	<0.10
Exposure Point Concentration (EPC) (µg/m³)[1]					<0.10

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations

µg/m³ = micrograms per cubic meter

Shaded represents the EPC

Attachment 3-E. Personal breathing-zone samples at the Fire Shop - N,N-dimethyl-para-toluidine

Sampling Date	Job Task	Sample ID	Sample Duration (minutes)	Air Volume (Liters)	N,N-Dimethyl-Para-Toluidine (μg/m^3)
11/4/20	Maintenance on fire apparatus	1872	346	124.56	<0.40
11/4/20	Maintenance on fire apparatus	1392	372	133.73	<0.37
11/4/20	Maintenance on fire apparatus	1871	331	117.51	<0.43
11/4/20	Maintenance on fire apparatus	1875	308	98.41	<0.51*
11/4/20	Maintenance on fire apparatus	1823	301	107.76	<0.46
Exposure Point Concentration (EPC) (μg/m^3)[1]					<0.51

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

* The pre- and post- flow rate was different by approximately 13%; therefore, this reporting limit is an estimate (the true reporting limit is between 0.47 and 0.55 μg/m^3).

Abbreviations

μg/m^3 = micrograms per cubic meter

Shaded represents the EPC

Attachment 3-F-1. Surface Wipe Samples at the Fire Shop - arsenic, lead, and pentachlorophenol in units of µg/cm^2

Sampling Date	Sample ID	Sampling Location	Observations/ Notes	Arsenic	Lead	Sample ID	Sampling Location	Pentachloro-phenol
11/4/20	ENG583-A-1	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty	<0.063	**0.54**	ENG-583-PENTA-01	Left rear frame at differential	<0.0050
11/4/20	ENG-558-A-01	Captain's kick panel	Engine 558; 1998; F0561; very dusty	<0.063	**0.059**	ENG-558-PENTA-01	Under captain's chair	<0.0050
11/4/20	ENG159-A-1	Plumbing compartment	Engine 159; F2174; very dirty on piping	<0.063	**0.25**	ENG159-PENTA-1	Plumbing compartment	<0.0050
11/4/20	ENG-583-A-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris	<0.063	**0.035**	ENG-583-PENTA-02	Truck bed where the hoses sit	<0.0050
11/4/20	ENG-168-A-01	Fuel cell directly underneath the stainless steel water tank	Engine 168; F1567; dusty/dirty	<0.063	**0.046**	ENG-168-PENTA-01	Fuel cell directly underneath the stainless steel water tank	<0.0050
11/4/20	ENG-558-A-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty	<0.063	**0.030**	ENG-558-PENTA-02	Foam pump compartment	<0.0050
			Exposure Point Concentration (EPC)[1]	<0.063	0.16		**EPC[1]**	<0.0050

Notes
1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations
µg/cm^2 = micrograms per square centimeter
Shaded represents the EPC
Bold indicates detected result.

Attachment 3-F-2. Surface Wipe Samples at the Fire Shop - polycyclic aromatic hydrocarbons (PAHs) in units of µg/cm²

Sampling Date	Sample ID	Sampling Location	Observations/ Notes	Naphthalene	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluoranthene	Benzo(k)-fluoranthene	Benzo(a)-pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h)-anthracene
11/4/20	ENG-558-PAH-01	Under captain's chair	Engine 558; 1998; F0561; very dusty	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
11/4/20	ENG-159-PAH-01	Plumbing compartment	Engine 159; F2174; very dirty on piping	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
11/4/20	ENG-583-PAH-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
11/4/20	ENG-583-PAH-01	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
11/4/20	ENG-558-PAH-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
11/4/20	ENG-168-PAH-01	Fuel cell directly underneath the stainless steel water tank	Engine 168; F1567; dusty/dirty	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
			EPC[1]	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050

Notes
1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations
EPC = exposure point concentration
µg/cm² = micrograms per square centimeter
Shaded represents the EPC
Bold indicates detected result.

Attachment 3-F-3. Surface Wipe Samples at the Fire Shop - PCBs and Dioxin/Furans in units of µg/cm^2

Sample ID	Sampling Location	Observations/ Notes	PCB TEQ	Non-TEQ PCB	Dioxin/ Furan TEQ
ENG-558-DFP-02	Foam pump compartment	Engine 558; 1998; F0561; dusty/dirty	**1.2E-09**	**2.9E-05**	**1.8E-08**
ENG-583-DFP-02	Truck bed where the hoses sit	Engine 583; 1998; F0581; used in Bobcat fire; some ashy debris	**1.6E-09**	**3.6E-05**	**1.6E-08**
ENG-168-DFP-01	Fuel cell directly underneath the stainless steel water tank	Engine 168; F1567; dusty/dirty	**1.5E-09**	**3.3E-05**	**2.0E-08**
ENG-159-DFP-1	Plumbing compartment	Engine 159; F2174; very dirty on piping	**4.4E-09**	**2.3E-05**	**2.2E-08**
ENG-583-DFP-01	Left rear frame at differential	Engine 583; 1998; F0581; used in Bobcat fire; very dirty	**5.1E-09**	**9.4E-05**	**3.0E-08**
ENG-558-DFP-01	Under captain's chair	Engine 558; 1998; F0561; very dusty	**3.2E-09**	**3.0E-05**	**2.1E-08**
		EPC[1]	2.8E-09	4.1E-05	2.1E-08

Notes

1. For data sets with more than five samples, the EPC was either (1) the average of the samples where the non-detects were treated as one-half of the detection limit, or (2) the maximum detection limit if the chemical was not detected in any sample. For data sets with fewer than five samples, the EPC was either (1) the maximum detected value, or (2) the maximum detection limit.

Abbreviations

EPC = Exposure Point Concentration

µg/cm^2 = micrograms per square centimeter

Shaded represents the EPC

Bold indicates detected result.

PCBs = polychlorinated biphenyls

TEQ = toxic equivalence

ATTACHMENT 4

Dermal Absorption Factors

Attachment 4

Dermal Absorption Factors

Summaries of the scientific studies used to derive the dermal absorption percentages are presented below.

Arsenic

A value of 6% was used as the percent of arsenic absorbed through the skin. This value is based on the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines: Technical Support Document for Exposure Assessment and Stochastic Analysis, Appendix F (OEHHA, 2012). OEHHA derived this value from the results of a study by Wester et al. (1993a).

Wester et al. (1993a) studied the *in vivo* percutaneous absorption of radiolabeled soluble arsenic (as $H_3{}^{73}AsO_4$) from soil (180–300 µm). Doses of 0.00004 and 0.6 µg/cm^2 arsenic skin concentration were dermally applied to the abdomens of female rhesus monkeys (n=3 or 4 per dose group) in soil loadings of 40 mg soil/cm^2 for 24 hours. Urine samples were collected during the exposure period and for the subsequent six days. Percutaneous absorption was estimated as the ratio of urinary excretion following exposure to intravenous administration, the latter of which was radiolabeled ^{73}As in water administered in four monkeys. Percutaneous absorption for the low and high doses was reported to be 4.5±3.2% and 3.2±0.9%, respectively.

OEHHA noted several limitations to the Wester et al. (1993a) study that may have led to an underestimation of absorption, including (1) the large soil particle fraction used in the study compared to a particle size typically used in soil dermal absorption studies [<150 µm], (2) not investigating the mass of arsenic retained in the skin, and (3) the uncertainty of whether the soil remained in contact with the skin throughout the entire exposure period.

OEHHA averaged the low- and high-dose percutaneous absorption percentages (3.9%) from Wester et al. (1993a) and applied a factor of 1.63 to account for the increase in absorption potential from soil particles <150 µm compared to the larger particles used in the study, based on evidence from Nico et al. (2006). The percutaneous absorption percentage was rounded to the nearest whole number (3.9% × 1.63 = 6.4% = 6%).

Benzo(a)pyrene and PAHs

A value of 13% was used as the percent of PAHs as benzo[a]pyrene (BaP) absorbed through the skin. This value is based on the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines: Technical Support Document for Exposure Assessment and Stochastic Analysis, Appendix F (OEHHA, 2012). OEHHA derived this value from the results of a study by Wester et al. (1990).

Wester et al. (1990) evaluated the *in vivo* dermal uptake of BaP in rhesus monkeys (n = 4). Soil (180–320 μm) containing 10 ppm BaP was loaded (40 mg/cm^2) to abdominal skin with a non-occluded protector for 24 hours. Urine was collected throughout the exposure period and for the six days following exposure. The dermal absorption percentage, corrected by taking into account absorption among a group of monkeys with intravenously administered BaP, was 13.2±3.4%.

OEHHA adopted an absorption factor of 13%, given that Wester et al. (1990) was an *in vivo* animal study and considered mass balance with the intravenous group. This adoption was supported with a study by Moody et al. (2007) that found a dermal absorption of 14.8% following human *in vitro* dermal exposure for 24 hours.

Hexavalent chromium

A value of 2% was used as the percent of hexavalent chromium absorbed through the skin. This value is based on the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines: Technical Support Document for Exposure Assessment and Stochastic Analysis, Appendix F (OEHHA, 2012). OEHHA derived this value from the results of a study by Czernielewski et al. (1965).

Czernielewski et al. (1965) evaluated the whole-body absorption of radiolabeled hexavalent chromium (as Cr^{51}) dermally applied to guinea pigs (n = 9) for 24 hours. One dose of a sodium chromate solution (15 μg in 0.1 mL) was applied to a 4-cm^2 shaved area. Following the exposure period, samples were taken from urine, feces, blood, heart, liver, spleen, adrenals, kidneys, lungs, lymphatics, and skin. A total absorbed dose of 2.9% was estimated, of which 1.6% was in blood, 1.1% in excreta, and 0.2% in the remaining organs and tissues.

To estimate an absorption factor associated with a soil vehicle, OEHHA applied a factor of 0.83, based on the maximum bioaccessibility of hexavalent chromium in synthetic sweat (Wainman et al., 1994). The soil vehicle absorption was rounded to the nearest whole number ($2.9\% \times 0.83 = 2.41\% = 2\%$).

Lead

A value of 3% was used as the percent of lead absorbed through the skin. This value is based on the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines: Technical Support Document for Exposure Assessment and Stochastic Analysis, Appendix F (OEHHA, 2012). OEHHA derived this value from the results of a study by Filon et al., 2006.

Filon et al. (2006) assessed the *in vitro* absorption of lead oxide (PbO) powder (<10 μm) in human abdominal skin via diffusion cells 3.14 cm^2 in area (5 mg PbO/cm^2 and 2 mL synthetic sweat at pH 5.0). Following 24 hours, authors reported 0.06% fractional absorption into the skin and 6.4% (median) fractional absorption into the skin after surface decontamination. When PbO was removed with soap after 30 minutes, the mass of lead absorbed over 24 hours was not reduced, suggesting that lead is absorbed rapidly through human skin.

OEHHA assumed that the fraction of lead absorbed in the skin was available for systemic absorption and applied a factor of 0.41 to correct for lead solubility in soil based on a study of heavily contaminated soil with a pH of 5.0 (Zhang et al., 1998). The absorption factor was rounded to the nearest whole number (6.4% × 0.41 = 2.6% = 3%).

Naphthalene

A value of 1.17% was used as the percent of naphthalene absorbed through the skin. This value is based on the results of a study by Riviere et al. (1999).

Riviere et al. (1999) used radiolabeled ^{14}C-naphthalene in an *in vitro* porcine skin flaps study measuring percutaneous absorption and cutaneous disposition of jet fuels. Naphthalene is a primary aromatic constituent of jet fuel at 1.1%, and the addition of radiolabeled ^{14}C-naphthalene as a marker compound only marginally increased the total naphthalene concentration to 1.21%. Researchers applied three formulations (Jet-A, JP-8, and JP-8(100)), in doses of 25 µL of jet fuel containing 2 µCi of ^{14}C-naphthalene, directly to the skin flap and then monitored the absorption, penetration, and distribution. Perfusate samples (3 mL) were collected every 5 minutes for the first 40 minutes, then every 10 minutes until 1.5 hours, and then every 15 minutes until termination at 5 hours. Naphthalene showed peak absorption at less than one hour, with a mean percent dose absorbed of 1.17 (n = 4) in one formulation. This study showed evidence that naphthalene is absorbed and has a minimal propensity to remain in the skin, although it tends to partition into subcutaneous fat after absorption.

Pentachlorophenol

A value of 25% was used as the percent of pentachlorophenol (PCP) absorbed through the skin. This value is based on the USEPA Regional Screening Levels (USEPA, 2020) and USEPA Supplemental Guidance for Dermal Risk Assessment (USEPA, 2004). USEPA derived this value from the results of a study by Wester et al. (1993c).

Wester et al. (1993c) evaluated the *in vivo* percutaneous absorption of radiolabeled PCP (^{14}C) in soil. Soil containing 0.7 µg PCP/cm^2 was loaded to a 12-cm^2 abdominal area on rhesus monkeys (n = 4) for 24 hours. The abdominal area was protected by a non-occluded cover. Urine was collected during the exposure period and for the subsequent six days. Percutaneous absorption was estimated as the ratio of urinary excretion following exposure to intravenous administration, the latter of which was radiolabeled ^{14}C administered in four monkeys. A resulting percutaneous absorption of PCP from a soil vehicle was estimated to be 24.4±6.4% following a 24-hour exposure. An average of 38% PCP was recovered in the test chamber, residue, and surface washes. USEPA adopted 25% as the PCP absorption factor from soil.

PCBs (Total)

A value of 14% was used as the percent of total PCBs absorbed through the skin. This value is based on the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines: Technical Support Document for Exposure Assessment and Stochastic Analysis, Appendix F (OEHHA, 2012). OEHHA derived this value from the results of a study by Wester et al. (1993b).

Wester et al. (1993b) evaluated the *in vivo* dermal uptake of Aroclor 1242 (68% tri- and tetra- congeners) and Aroclor 1254 (83% penta- and hexa- congeners) in female rhesus monkeys (n = 4). Soils containing 44 ppm Aroclor 1242 and 23 ppm Aroclor 1254 were applied to a 12 cm^2 area of abdominal skin with a non-occluded patch for 24 hours. Soil loads were 40 mg/cm^2. After 24 hours of exposure, systemic absorption was measured through urine and feces samples, with samples being collected for an additional 34 days after the exposure period. Corrected dermal absorption percentages, taking into account absorption among a group of monkeys with intravenously administered PCBs, were 13.9% and 14.1% for Aroclor 1242 and Aroclor 1254, respectively. Authors compared their results to an *in vitro* assay using human skin, and the amount of absorption was found to vary by dosing vehicle, with partition coefficients of 13.8 and 14.1 for Aroclor 1242 and Aroclor 1254, respectively, when administered in soil.

OEHHA adopted an absorption factor of 14%, given that the Wester et al. (1993b) was an *in vivo* animal study and considered mass balance with the intravenous group.

2,3,7,8-Tetrachlorodibenzo-p-dioxin

A value of 3% was used as the percent of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) absorbed through the skin. This value is based on the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines: Technical Support Document for Exposure Assessment and Stochastic Analysis, Appendix F (OEHHA, 2012). OEHHA derived this value from the analysis and results of studies by USEPA (1992) and Roy et al. (2008).

USEPA (1992) and Roy et al. (2008) studied the absorption of TCDD from low organic soils (LOS) in rats *in vitro*, human *in vitro*, and rats *in vivo*. Exposures occurred in intervals for up to 96 hours. The LOS contained 1 ppm TCDD, and the soil loading on rat and human skin was 10 and 6 mg/cm^2, respectively. Following 24-hours, the percent of TCDD absorbed by rat skin *in vitro* was 1.17%, by human skin *in vitro* was 0.28%, and by rats *in vivo* was 7.9%. Steady-state dermal absorption was achieved after 24 hours in the *in vitro* studies; therefore, it was expected that the dose in the skin sample at 96 hours, after wiping, may be added to the percent absorbed after 24 hours to estimate a total percent absorbed. The percent in the skin sample at 96 hours, after wiping, was 1.4% in rats *in vitro* and 0.2% in human *in vitro*.

To estimate a 24-hour percent absorption in humans, OEHHA multiplied the 24-hour rat *in vivo* percent absorption by the ratio of the total percent absorbed in humans *in vitro* to absorbed in rats *in vitro*. This results in a human absorption percentage of 1.4% (7.9% × [0.48% / 2.75%] = 1.4%). To account for the difference of soil loading in the human *in* *vitro* study (6 mg/cm^2) and a monolayer loading (3 mg/cm^2), OEHHA included a factor of 2 in the absorption derivation. The absorption factor was rounded to the nearest whole number (1.4% × 2 = 2.8% = 3%).

References

Czernielewski A, Brykalski D, Depczyk D. 1965. Experimental investigations on penetration of radioactive chromium (Cr^{51}) through the skin. Dermatologica 131(5):384–396.

Kraeling ME, Yourick JJ, Bronaugh RL. 2004. In vitro human skin penetration of diethanolamine. Food Chem Toxicol 42:1553–1561.

Moody RP, Joncas J, Richardson M, Chu I. 2007. Contaminated soils (I): In vitro dermal absorption of benzo[a]pyrene in human skin. J Toxicol Environ Health A 70(21):1858–1865.

Nico PS, Ruby MV, Lowney YW, Holm SE. 2006. Chemical speciation and bioaccessibility of arsenic and chromium in chromated copper arsenate-treated wood and soils. Environ Sci Technol 40(1):402–408.

Office of Environmental Health Hazard Assessment (OEHHA). 2012. Air Toxics Hot Spots Program Risk Assessment Guidelines, Technical Support Document for Exposure Assessment and Stochastic Analysis, August.

Riviere JE, Brooks JD, Monteiro-Riviere NA, Budsaba K, Smith CE. 1999. Dermal absorption and distribution of topically dosed jet fuels Jet-A, JP-8, and JP-8(100). Toxicol Appl Pharmacol 160:60–75.

Roy TA, Hammerstrom K, Schaum J. 2008. Percutaneous absorption of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) from soil. J Toxicol Environ Health A 71(23):1509–1515.

USEPA (U.S. Environmental Protection Agency). 1992. Dermal exposure assessment: Principles and applications. Interim Report. U.S. Environmental Protection Agency, Washington D.C. January 1992. EPA/600/8-91/011B.

USEPA (U.S. Environmental Protection Agency). 2004. Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). U.S. Environmental Protection Agency, Washington D.C. July 2004. EPA/540/R/99/005.

USEPA (U.S. Environmental Protection Agency). 2020. Regional Screening Levels (RSLs) - Generic Tables. As of November 2020. Accessed at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

Wester RC, Maibach HI, Bucks DA, Sedik L, Melendres J, Liao C, DiZio S. 1990. Percutaneous absorption of [14C]DDT and [14C]benzo[a]pyrene from soil. Fundam Appl Toxicol 15(3):510–516.

Wester RC, Maibach HI, Sedik L, Melendres J, Wade M. 1993a. In vivo and in vitro percutaneous absorption and skin decontamination of arsenic from water and soil. Fundam Appl Toxicol 20(3):336–340.

Wester RC, Maibach HI, Sedik L, Melendres J, Wade M. 1993b. Percutaneous absorption of PCBs from soil: In vivo rhesus monkey, in vitro human skin, and binding to powdered human stratum corneum. J Toxicol Environ Health 39(3):375–382.

Wester RC, Maibach HI, Sedik L, Melendres J, Wade M, DiZio S. 1993c. Percutaneous absorption of pentachlorophenol from soil. Fundam Appl Toxicol 20(1):68–71.

Zhang P, Ryan JA, Yang J. 1998. In vitro soil Pb solubility in the presence of hydroxyapatite. Environ Sci Technol 32(18):2763–2768.

ATTACHMENT 5

Risk Calculations

Attachment 5-A. Risk calculations for inhalation exposures

Risk calculations based on detected concentrations of chemicals of potential concern (COPCs)[1]

Location/Specialized task	Benzene	Ethylbenzene	Naphthalene	Styrene	Acetaldehyde	Formalde-hyde	Tetrachloro-ethylene	Diesel Particulates[2] as elemental carbon	Hexavalent Chromium	Arsenic	Beryllium	Cadmium	Cobalt	Nickel	Lead	N,N-Dimethyl-Para-Toluidine	Respirable crystalline silica	Total Risk
Inhalation Unit Risk (IUR) $(\mu g/m^3)^{-1}$	0.000029	0.0000025	0.000034	0.0000074	0.0000027	0.000013	0.0000061	0.00030	0.15	0.0043	0.0024	0.0042	0.0090	0.00026	0.000012	--	NE[3]	--
Air Operations	--	--	--	--	--	--	--	--	2.3E-03	--	--	--	--	--	--	--	--	2E-03
Breathing Apparatus Shop - Small Engine Repair Shop	3.0E-03	--	--	--	1.1E-05	5.6E-05	--	--	--	--	--	--	--	--	--	--	--	3E-03
Eastern Fire Shop	--	--	--	--	--	--	3.6E-02	--	--	--	--	--	--	--	--	--	--	4E-02
Eastern Fire Shop - Welding/grinding/cutting activities	--	--	--	--	--	--	--	--	--	--	--	--	1.3E-06	3.9E-07	--	--	--	2E-06

Screening risk calculations based on detection limits for chemicals of potential concern (COPCs)[4]

Location	Benzene	Ethylbenzene	Naphthalene	Styrene[5]	Acetaldehyde	Formalde-hyde	Tetrachloro-ethylene	Diesel Particulates[2] as elemental carbon	Hexavalent Chromium	Arsenic	Beryllium	Cadmium	Cobalt	Nickel	Lead	N,N-Dimethyl-Para-Toluidine	Respirable crystalline silica
Inhalation Unit Risk (IUR) $(\mu g/m^3)^{-1}$	0.000029	0.0000025	0.000034	0.0000074	0.0000027	0.000013	0.0000061	0.00030	0.15	0.0043	0.0024	0.0042	0.0090	0.00026	0.000012	NE[3]	NE[3]
Air Operations	3.3E-04	3.7E-04	5.5E-03	--	--	--	--	--	NA	--	--	--	--	--	--	--	--
Breathing Apparatus Shop	NA	3.9E-04	6.3E-03	1.1E-03	NA	NA	--	--	--	--	--	--	--	--	--	--	--
Eastern Fire Shop	3.4E-04	3.8E-04	5.6E-03	--	--	--	NA	1.2E-04	--	--	--	--	--	--	--	--	--
Eastern Fire Shop - Welding/grinding/cutting activities	--	--	--	--	--	--	--	--	2.4E-04	3.0E-04	8.2E-07	8.9E-06	NA	NA	1.7E-07	--	--

Cancer Risk = Ca/PF * ET * EF * ED * IUR

Description	Parameter	Units	Value
Concentration in Air	Ca	$\mu g/m^3$	Chemical-specific/measured
Inhalation unit risk	IUR	$(\mu g/m^3)^{-1}$	Chemical-specific
Respirator protection factor (welding only)	PF	(--)	10
Exposure time (Air Operations_ratio)	ET_AO_f	9 hours/24 hours	0.38
Exposure time (Eastern Fire Shop_ratio)	ET_FS_f	9 hours/24 hours	0.38
Exposure time (Breathing Apparatus Shop_ratio)	ET	8 hours/24 hours	0.33
Exposure frequency ratio 1 (Air Operations)	EF_1	280 days/365 days	0.77
Exposure frequency ratio 2 (Breathing Apparatus Shop)	EF_2	262 days/365 days	0.72
Exposure frequency ratio 3 (Eastern Fire Shop)	EF_3	247 days/365 days	0.68
Exposure frequency ratio 4 (welding at the Eastern Fire Shop)	EF_4	12 days/365	0.033
Exposure duration ratio	ED	45 years/70 years	0.64

Notes
1. Risk calculation based on maximum detected concentration in air (Ca).
2. There was one detection of diesel particulate as elemental carbon but it was determined to be an outlier and removed from the dataset. Therefore, the risk calculation is based on the detection limit (see screening risk calculation).
3. No inhalation unit risk (IUR) factor available, therefore, cancer risk via inhalation exposure could not be calculated. However, all samples were non-detect.
4. Screening risk calculation based on maximum detection limit.
5. ToxStrategies derived the IUR for styrene using OEHHA, 2010 and Cruzan et al., 2001.

Abbreviations
CCR = California Code of Regulations
COPC = chemical of potential concern
IUR = inhalation unit risk
-- = chemical not measured
NE = inhalation unit risk not established
NA = not applicable; chemical detected so screening risk calculations were performed using the detected concentration.
$(\mu g/m^3)^{-1}$ = per (micrograms per cubic meter of air)
Chemical of potential concern (COPC) not measured and not relevant to this location.
Red shading indicates risks greater than 1 in 10,000 (1E-04)

Attachment 5-B. Risk calculations for dermal exposures

Risk calculations based on detected concentrations of chemicals of potential concern (COPCs)[1]

Job Task	Location	Sample Description	Naphthalene	Hexavalent Chromium	Arsenic	Lead	Pentachloro-phenol	Benzo(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(a) pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h) anthracene	PCB-TEQ	Non-TEQ PCB	Dioxin/Furan TEQ	Total Risk
		Oral Slope Factor (SFO) (mg/kg-day)$^{-1}$	**1.2E-01**	**5.0E-01**	**9.5E+00**	**8.5E-03**	**4.0E-01**	**1.0E-01**	**1.0E-03**	**1.0E-01**	**1.0E-02**	**1.0E+00**	**1.0E-01**	**4.1E+00**	**1.3E+05**	**2.0E+00**	**1.3E+05**	
		Dermal Absorption Factor (Abs) (%)	**1.17%**	**2.0%**	**6.0%**	**3.0%**	**25%**	**13%**	**13%**	**13%**	**13%**	**13%**	**13%**	**13%**	**3.0%**	**14%**	**3.0%**	
		Fraction of contaminant absorbed in gastrointestinal tract (GIABS) (unitless)	**1**	**0.025**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	
Intermediate & heavy maintenance on aircraft	Air Operations	Various engine or aircraft parts	--	6.1E-07	--	4.2E-09	--	--	--	--	--	--	--	--	4.9E-09	8.6E-10	6.2E-08	7E-07
Intermediate & heavy maintenance on aircraft	Air Operations	Mastinox on parts	--	1.5E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	2E-05
Repair and tune-up of air packs	Breathing Apparatus Shop	Air packs	6.3E-09	--	--	5.1E-09	--	1.9E-07	2.0E-09	3.3E-07	6.3E-09	1.7E-06	1.4E-07	1.5E-06	6.2E-09	5.2E-09	1.0E-07	4E-06
Fire hose repair	Breathing Apparatus Shop	Fire hose	--	--	--	8.7E-09	--	--	--	--	--	--	--	--	--	--	--	9E-09
Maintenance/repair on fire apparatus	Eastern Fire Shop	Fire apparatus	--	--	--	3.8E-08	--	--	--	--	--	--	--	--	1.0E-08	1.1E-08	7.7E-08	1E-07

Screening risk calculations based on detection limits for chemicals of potential concern (COPCs)[2]

Job Task	Location	Sample Description	Naphthalene	Hexavalent Chromium	Arsenic	Lead	Pentachloro-phenol	Benzo(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(a) pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h) anthracene	PCB-TEQ[2]	Non-TEQ PCB[3]	Dioxin/Furan TEQ[4]
		Oral Slope Factor (SFO) (mg/kg-day)$^{-1}$	**1.2E-01**	**5.0E-01**	**9.5E+00**	**8.5E-03**	**4.0E-01**	**1.0E-01**	**1.0E-03**	**1.0E-01**	**1.0E-02**	**1.0E+00**	**1.0E-01**	**4.1E+00**	**1.3E+05**	**2.0E+00**	**1.3E+05**
		Dermal Absorption Factor (Abs) (%)	**1.17%**	**2.0%**	**6.0%**	**3.0%**	**25%**	**13%**	**13%**	**13%**	**13%**	**13%**	**13%**	**13%**	**3.0%**	**14%**	**3.0%**
		Fraction of contaminant absorbed in gastrointestinal tract (GIABS) (unitless)	**1**	**0.025**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Intermediate & heavy maintenance on aircraft	Air Operations	Various engine or aircraft parts	7.4E-09	NA	3.8E-05	NA	--	6.9E-08	6.9E-10	6.9E-08	6.9E-09	6.9E-07	6.9E-08	2.8E-06	NA	NA	NA
Intermediate & heavy maintenance on aircraft	Air Operations	Mastinox on parts	--	NA	--	--	--	--	--	--	--	--	--	--	--	--	--
Repair and tune-up of air packs	Breathing Apparatus Shop	Air packs	NA	--	3.1E-05	NA	4.4E-07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fire hose repair	Breathing Apparatus Shop	Fire hose	6.2E-09	--	3.1E-05	NA	--	5.7E-08	5.7E-10	5.7E-08	5.7E-09	5.7E-07	5.7E-08	2.3E-06	--	--	--
Maintenance/repair on fire apparatus	Eastern Fire Shop	Fire apparatus	6.5E-09	--	3.3E-05	NA	4.6E-07	6.0E-08	6.0E-10	6.0E-08	6.0E-09	6.0E-07	6.0E-08	2.5E-06	NA	NA	NA

Cancer Risk = [Csw * CF * SAf * Abs* EV * EF * ED_y * (SFO/GIABS)] / (ATca * BW)

Description	Parameter	Units	Value
Concentration on surface wipe	Csw	μg/cm^2-event	Chemical-specific/measured
Surface area of the fingers	SAf	cm^2	19
Percent absorption	Abs	%	Chemical-specific
Event Frequency (Air Operations)	EV_AO	events/day	9
Event Frequency (Eastern Fire Shop)	EV_FS	events/day	9
Event Frequency (Breathing Apparatus Shop)	EV	events/day	8
Event Frequency (Air Operations_Mastinox)	EV_M	events/day	1
Exposure frequency 1 (Air Operations)	EF_AO	days/year	280
Exposure frequency 2 (Breathing Apparatus Shop)	EF_BA	days/year	262
Exposure frequency 3 (Eastern Fire Shop)	EF_FS	days/year	247
Exposure frequency 4 (Air Operations_Mastinox)	EF_M	days/year	168
Exposure duration	ED_y	years	45
Averaging time	ATca	days	25550
Body weight	BW	kilograms	80
Oral slope factor	SFO	(mg/kg-day)$^{-1}$	Chemical-specific
Fraction of contaminant absorbed in gastrointestinal tract	GIABS	unitless	Chemical-specific
Conversion factor	CF	mg/μg	0.001

Notes
1. Risk calculation based on representative concentration on surface wipe (Csw).
2. Screening risk calculation based on maximum detection limit.

Abbreviations
COPC = chemical of potential concern
GIABS = fraction of contaminant absorbed in gastrointestinal tract (unitless)
NA = not applicable; chemical detected, so screening risk calculations were performed using the detected concentration
PCB = polychlorinated biphenyl
SFO = oral slope factor
TEQ = toxic equivalence
μg/cm^2-event = micrograms per square centimeters per event
cm^2 = square centimeters
% = percent
(mg/kg-day)$^{-1}$ = per (milligrams per kilogram-day)
mg/μg = milligram per micrograms
-- = chemical not measured
Chemical of potential concern (COPC) not measured and not relevant to this location.

Attachment 5-C. Risk calculations for ingestion exposures

Risk calculations based on detected concentrations of chemicals of potential concern (COPCs)[1]

Job Task	Location	Sample Description	Naphthalene	Hexavalent Chromium	Arsenic	Lead	Pentachloro-phenol	Benzo(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(a) pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h) anthracene	PCB-TEQ	Non-TEQ PCB	Dioxin/Furan TEQ	Total Risk
		Oral Slope Factor (SFO) (mg/kg-day)$^{-1}$	**1.2E-01**	**5.0E-01**	**9.5E+00**	**8.5E-03**	**4.0E-01**	**1.0E-01**	**1.0E-03**	**1.0E-01**	**1.0E-02**	**1.0E+00**	**1.0E-01**	**4.1E+00**	**1.3E+05**	**2.0E+00**	**1.3E+05**	
		Relative Bioavailability[2] (RBA) (%)	**100%**	**100%**	**60%**	**60%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	
Intermediate & heavy maintenance on aircraft	Air Operations	Various engine or aircraft parts	--	3.8E-07	--	4.2E-08	--	--	--	--	--	--	--	--	8.2E-08	3.1E-09	1.0E-06	2E-06
Intermediate & heavy maintenance on aircraft	Air Operations	Mastinox on parts	--	1.6E-05	--	--	--	--	--	--	--	--	--	--	--	--	--	2E-05
Repair and tune-up of air packs	Breathing Apparatus Shop	Air packs	2.7E-07	--	--	5.1E-08	--	7.3E-07	7.7E-09	1.3E-06	2.4E-08	6.6E-06	5.2E-07	5.9E-06	1.0E-07	1.8E-08	1.7E-06	2E-05
Fire hose repair	Breathing Apparatus Shop	Fire hose	--	--	--	8.7E-08	--	--	--	--	--	--	--	--	--	--	--	9E-08
Maintenance/ repair on fire apparatus	Eastern Fire Shop	Fire apparatus	--	--	--	3.8E-07	--	--	--	--	--	--	--	--	1.7E-07	3.8E-08	1.3E-06	2E-06

Screening risk calculations based on detection limits for chemicals of potential concern (COPCs)[3]

Job Task	Location	Sample Description	Naphthalene	Hexavalent Chromium	Arsenic	Lead	Pentachloro-phenol	Benzo(a) anthracene	Chrysene	Benzo(b) fluoranthene	Benzo(k) fluoranthene	Benzo(a) pyrene	Indeno(1,2,3-cd)pyrene	Dibenzo(a,h) anthracene	PCB-TEQ	Non-TEQ PCB	Dioxin/Furan TEQ
		Oral Slope Factor (SFO) (mg/kg-day)$^{-1}$	**1.2E-01**	**5.0E-01**	**9.5E+00**	**8.5E-03**	**4.0E-01**	**1.0E-01**	**1.0E-03**	**1.0E-01**	**1.0E-02**	**1.0E+00**	**1.0E-01**	**4.1E+00**	**1.3E+05**	**2.0E+00**	**1.3E+05**
		Relative Bioavailability[2] (RBA) (%)	**100%**	**100%**	**60%**	**60%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Intermediate & heavy maintenance on aircraft	Air Operations	Various engine or aircraft parts	3.2E-07	NA	1.9E-04	NA	--	2.6E-07	2.6E-09	2.6E-07	2.6E-08	2.6E-06	2.6E-07	1.1E-05	NA	NA	NA
Intermediate & heavy maintenance on aircraft	Air Operations	Mastinox on parts	--	NA	--	--	--	--	--	--	--	--	--	--	--	--	--
Repair and tune-up of air packs	Breathing Apparatus Shop	Air packs	NA	--	1.6E-04	NA	8.8E-07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fire hose repair	Breathing Apparatus Shop	Fire hose	2.6E-07	--	1.6E-04	NA	--	2.2E-07	2.2E-09	2.2E-07	2.2E-08	2.2E-06	2.2E-07	9.0E-06	--	--	--
Maintenance/ repair on fire apparatus	Eastern Fire Shop	Fire apparatus	2.8E-07	--	1.7E-04	NA	9.3E-07	2.3E-07	2.3E-09	2.3E-07	2.3E-08	2.3E-06	2.3E-07	9.5E-06	NA	NA	NA

Cancer Risk = (Csw * CF * SAf * Fdirect * RBA * γ-d * ET_hours * EF * ED_y * SFO)/(ATca * BW)

Description	**Parameter**	**Units**	**Value**
Concentration on surface wipe	Csw	μg/cm^2	Chemical-specific/measured
Surface area of fingers	SAf	cm^2	19
Direct transfer factor	Fdirect	ratio	0.5
Relative bioavailability	RBA	%	Chemical-specific
Contacts per hour	γ-d	per hour	1
Exposure time (Air Operations)	ET_AO	hours/day	9
Exposure time (Eastern Fire Shop)	ET_FS	hours/day	9
Exposure time	ET_hours	hours/day	8
Exposure time_Mastinox	ET_M	hours/day	1
Exposure frequency 1 (Air Operations)	EF_AO	days/year	280
Exposure frequency 2 (Breathing Apparatus Shop)	EF_BA	days/year	262
Exposure frequency 3 (Eastern Fire Shop)	EF_FS	days/year	247
Exposure frequency 4 (Air Operations Mastinox)	EF_M	days/year	168
Exposure duration	ED_y	years	45
Oral slope factor	SFO	(mg/kg-day)$^{-1}$	Chemical-specific
Averaging time	ATca	days	25550
Body weight	BW	kilograms	80
Conversion factor	CF	mg/μg	0.001

Notes
1. Risk calculation based on maximum detected concentration on surface wipe (Csw).
2. The USEPA recommends a default value of 60% for relative bioavailability (RBA) of arsenic and lead in soil (U.S. EPA, 2021a and 2021b). All other COPCs have a default RBA of 100%.
3. Screening risk calculation based on maximum detection limit.

Abbreviations
COPC = chemical of potential concern
RBA = relative bioavailability (%)
NA = not applicable; chemical detected, so screening risk calculations were performed using the detected concentration.
PCB = polychlorinated biphenyl
SFO = oral slope factor
TEQ = toxic equivalence
μg/cm^2 = micrograms per square centimeters
cm^2 = square centimeters
% = percent
(mg/kg-day)$^{-1}$ = per (milligrams per kilogram-day)
mg/μg = milligram per micrograms
-- = chemical not measured
Chemical of potential concern (COPC) not measured and not relevant to this location.
Red shading indicates risks greater than 1 in 10,000 (1E-04)