PCB DETECTION DOG PILOT STUDY PHASE 2

FINAL REPORT

City of Seattle
Seattle Public Utilities
700 5th Avenue Seattle, WA 98104

In Consultation with:
University of Washington
Center for Conservation Biology
Conservation Canine

Submitted to Washington State Department of Ecology
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SUGGESTED CITATION

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GLOSSARY

- **Aroclors:** Monsanto Corporation, the major U.S. producer of PCBs from 1930 to 1977, marketed mixtures of PCBs under the trade name Aroclor. The Aroclors are identified by a four-digit numbering code in which the first two digits indicate the type of mixture (for Polychlorinated Biphenyls this is 12), and the last two digits indicate the approximate chlorine content by weight percent.

- **Background solids sample** (for this study only)**:** A sample of solid or mixed solid/liquid material (e.g., street/sidewalk dirt, inlet/catch basin solids, ground collected paint chips, moss, landscaping soils, etc.) that is taken in an area not identified as having a PCB source nearby that can contaminate the sample. These samples are used as a comparison to nearby field collected environmental solids samples.

- **Bench Sample Screening Exercises:** An alternative to doing a field evaluation to look for PCBs. Environmental and background solid samples are collected from multiple sources in an evaluation area and returned to the lab for quick odor screening by the detection dog. Samples that the dog indicates are a source of PCBs may be sent for laboratory analysis. One or more samples that the detection dog rejects as a PCB source may be included in the samples sent to the lab as a quality control.

- **Calibration Bench Sample Test (Calibration Test):** Is a daily test to determine confidence level in the detection dog prior to field evaluations. The dog is tested on a series of eight sample trials using one bench. Each bench holds 3 suspended jars: two control jars (i.e., containing clean material) and one target jar containing known PCB concentrations. The dog is tested to see if he can detect PCB across a range of concentrations and in different media. This may also serve as a warmup to get the detection dog targeted on PCB odor for the days field evaluation activities.

- **Detection Dog Confidence Leve**l: The subjective value of reliability in the detection dog's signal of odor recognition as interpreted by the dog handler. At very low levels of odor detection, the dog may have a fog of odor that makes it hard for the dog to pinpoint the exact location or that the odor is coming from a source. The dog may lack enough odor to signal a strong response, so it is up to the handler to detect the subtle signs of odor recognition in the dog. Confidence may also vary due to the dog detecting a source at a great distance on the wind rather than pinpointing the source at the tip of his/her nose.
    - **High Detection Dog confidence level**: The detection dog handler decides that the detection dog has found a source of PCBs by indicating a positive response as he was trained. This is typically by sitting. High confidence is almost always followed by odor recognition by the handler in the target area.
    - **Moderate Detection Dog confidence level** : The detection dog handler decides that the detection dog has found a possible source of PCBs by indicating a positive interest in a location. This is typically indicated by lengthy interest in a specific area or repeat visits to

the same location but no solid response such as sitting. Moderate confidence may be due to being unable to take the detection dog directly to the source on private property, but PCB odors may be recognizable by the handler and/or team members intermittently in or near the target area.
    - **Low Detection Dog confidence level:** The detection dog handler notices an unusual change in interest at a location, but it is not prolonged or focused. Low confidence is never followed by odor recognition by the handler in or near the target area.
    - **Very low/ Non-detect Detection Dog confidence level**: The detection dog handler notices no change in interest at a location. Very Low/ND confidence is never followed by odor recognition by the handler in or near the target area. This level of confidence is considered sufficient to clear the area of a significant PCB source.

- **Detection Dog Handler:** A CK9 employee who is responsible for the training of the detection dog and supervises and interprets the search process using the odor detection dog(s).

- **Detection Dog Inspector:** The SPU inspector who works alongside the detection dog handler during the field evaluations. This inspector tries to simulate the working relationship expected during use of the detection dog team for source tracing inspections.

- **Environmental Solids Sample** (for this study only): A sample of solid or mixed solid/liquid material (e.g., street/sidewalk dirt, inlet/catch basin solids, ground collected paint chips, moss, landscaping soils, etc.) that is taken as near to a suspected source of PCBs. The sample must have some connection between the suspected source and the location of the sample. Environmental samples may absorb and/or accumulate PCBs that are shed from the suspected source and should exclude other known or suspected sources of PCB impact. Environmental solids samples are never collected directly from a suspected source building/structure.

- **Environmental Solid Sample Analytical Results Categories:**
    - **Method Detection Limit / Non-Detect:** The Aroclor analyte is not detected above the reporting limit (RL) or if noted, not detected above the limit of detection (LOD). This level of Aroclor found in analysis of environmental solid samples is typically ≤ 20 ug/kg for method EPA SW8082A.
    - **Very Low:** Environmental solid sample results are considered **Very Low** with measurable Total PCB concentration of 20 – 99 ug/kg.
    - **Low:** Environmental solid sample results are considered **Low** with measurable Total PCB total concentration of 100 – 299 ug/kg.
    - **Moderate:** Environmental solid sample results are considered **Moderate** with measurable Total PCB concentration of 300 – 749 ug/kg.
    - **Screening Level:** Environmental solid sample results are considered **Screening Level** with measurable Total PCB concentration ≥ 750 ug/kg.

- **Field Evaluation Type:**
  - **Site access:** A target building verification search in which the detection dog team is used as a second method of verification of PCBs in exterior building materials. This may or may not include permission to access the property by the property owner(s). In cases where permission was not granted, the detection dog team stayed in the public right-of-way. The detection dog handler and inspector are aware of the target building.
  - **Perimeter search:** A geographic area search usually encompassing multiple city blocks of various commercial and industrial properties. Perimeter searches may or may not include a target building. The detection dog handler and inspector are unaware of the target building location or if there is a known target building(s).
  - **Drainage structure investigation:** A search focuses on drainage structures (e.g., inlets, catch basins, maintenance hole lids) in the right-of-way. The detection dog handler and inspector may be aware of the history of PCBs found in or near this drainage.

- **Field Survey Team**: The team of detection dog inspectors, SPU study staff, UW CK9 detection dog handler, and detection dog participating in a field investigation.

- **Possible PCB Building or Structure**: A building or structure identified during field evaluations solely through detection dog odor recognition with low to moderate confidence that PCB presence is detected. Materials associated with these buildings/structures are usually not odor detectable by SPU inspectors with known ability to differentiate PCB odor. Environmental solid samples taken near the building and downgradient have slightly elevated PCB levels relative to background solid samples.

- **Probable PCB Building or Structure**: A building or structure identified by 1) the detection dog during field evaluations through odor recognition with high confidence, 2) confirmed with high confidence by odor recognition of PCB in exterior building materials by SPU inspectors with known ability to differentiate PCB odor, and 3) elevated PCB levels from environmental solids samples taken near the building/structure, where results are relatively higher near the building/structure than background solids samples.

- **Target building:** A building identified as a probable source of PCBs by SPU prior to field evaluation searches by the detection dog team. This building is used during the detection dog area field evaluations to help confirm that the detection dog can find a probable PCB target during the field investigation. The building is defined as a probable source of PCBs based on 1) environmental solid samples taken by SPU near the building/structure and analyzed for PCB with results higher than other local comparable samples, and/or 2) by odor recognition of building materials by SPU inspectors with known ability to differentiate PCB odor.

- **Total PCBs**: The sum of Aroclors from sample analytical results, excluding Aroclors below the reportable limit. For sample analysis with all Aroclors below the Method Detection Limit (MDL), the Total PCBs are reported as the MDL. Total PCBs are reported in ug/kg (parts per billion: PPB)

- **Verification Testing:** To prove Jasper's accuracy and reliability in detecting PCBs at various levels, a testing protocol was used to evaluate his readiness. This consisted of a blind bench testing with media samples of various composition and concentration of PCBs. Additional outdoor hidden PCB target testing was done in a simulated working environment to see if Jasper could search and find PCB sources not presented as a sample jar.

ABBREVIATIONS

CB	Catch basin
City	City of Seattle
CK9	University of Washington Conservation Canines
dw	Dry weight
Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
EWW	East Waterway of the Duwamish (an operable unit of the Harbor Island Superfund site)
LDW	Lower Duwamish Waterway (a Superfund cleanup site)
LOD	Limit of detection
ND	Non-detect
PCB	Polychlorinated biphenyl
PPB	Parts per billion (ug/kg)
PPM	Parts per million (mg/kg)
RCB	Right-of-way catch basin
RL	Reporting limit
ROW	Right-of-Way
SDOT	Seattle Department of Transportation
SPU	Seattle Public Utilities

1.0 PROJECT DESCRIPTION AND OBJECTIVES

Seattle Public Utilities (SPU) received a Stormwater Financial Assistance grant (WQC-2018-SeaPUD-00233) from the Washington State Department of Ecology (Ecology) to continue evaluating and fine-tuning the use of a specially trained detection dog to aid SPU in locating sources of polychlorinated biphenyls (PCBs) impacting the City of Seattle (City) storm drainage system. This pilot study was accomplished through a cooperative effort involving SPU and University of Washington Conservation Canine (CK9).

1.1 BACKGROUND

This project is a continuation of previous work conducted under Ecology Grant WQC-2016-SeaPUD-00196, which found that a dog can be trained to detect PCBs by odor (Seattle Public Utilities, 2017). The prior pilot study also confirmed that some SPU inspectors could identify PCBs by odor. PCBs are a class of manmade chemicals that are commonly found in the environment due to their historic use in building materials (e.g., paint and caulk) (Ecology, 2011) and electrical equipment (e.g., transformers, capacitors, and fluorescent light ballasts) (EPA, 1994). PCBs are also one of the key human health risk drivers for the Lower Duwamish Waterway (LDW) Superfund site (ATSDR, 2000; EPA, 2014). SPU Source Control Inspectors regularly find PCBs in building materials from buildings constructed or renovated prior to 1980 (City of Seattle, 2020).

At the conclusion of the PCB Detection Dog Pilot Study in 2017, SPU created a final Data Report which was submitted to Ecology. In this study, the CK9 detection dog was Sampson, and his handler was Julianne Ubigau. Overall, the pilot study was a success, and both objectives identified as study goals were achieved (Table 1-1).

Table 1-1 Summary of results relative to study objectives

Objective	Outcome
1: Train a dog to detect PCBs.	Sampson was able to detect PCBs successfully, both in controlled tests (Phase 1) and in field testing (Phase 2/3).
2: Determine the potential utility of a detection dog to identify sources of PCBs in the LDW drainage basin.	Sampson's success at detecting PCBs at industrial sites in Phase 2/3 indicates that the use of a detection dog can be incorporated as an important tool in future SPU source control work.

Based on the results of the pilot study, the following steps were considered for future work to better understand the abilities of a detection dog to detect PCBs, and to determine how dogs could be incorporated into source control work:

- Conduct additional testing to better understand the effects of weather on detection dog searches.
- Revisit sites where source tracing was conducted during windy weather. Wind is a particularly difficult condition for detection dogs to contend with when buildings are present, as was the case at most of the industrial sites visited during Phase 2/3 of this study. Buildings complicate wind patterns, which impacts the detection dog's ability to trace odors.

- Conduct site visits during warmer weather to test whether this improves the detection dogs' ability to locate PCBs or whether cooler days are more effective. The majority of the Phase 2/3 tests were conducted on relatively cool days when temperatures ranged from 30°F to 60°F.
- Compare site characterization methods. Evaluate whether using the detection dog results in more rapid and more cost-effective characterization of a site and identification of hotspots than standard SPU practices (e.g., random sampling and/or sampling determined based on site characteristics/historical information)
- Incorporate detection dogs into source tracing. Based on the success of this pilot study, SPU will work to develop a plan for how to best incorporate a detection dog into its standard source tracing program.

Unfortunately, after the completion of the initial pilot study, Sampson passed away from an unrelated health issue at the age of 16. He had a long career as a detection dog for CK9. Through this new project, SPU and CK9 embarked on answering some of these legacy questions with a recently rescued detection dog, Jasper.

Figure 1.1: Jasper – photos courtesy of University of Washington Magazine

1.2 Study Objectives & Limitations

The primary objective of this pilot study is to 1) determine feasibility and effectiveness of use of a detection dog team and 2) establish protocols for integrating a detection dog team into SPU's routine PCB source tracing program for the Lower Duwamish Waterway (LDW) as well as other areas in the City.

This report is a subjective report and is a collection of our observations and opinions. SPU has not conducted a scientific review of data collected which could be further verified through more rigorous study methods before determining the accuracy of detection dog PCB verification. In each field evaluation event conducted for this study, the Detection Dog Team used best professional judgement using all evidence found for the presence (or absence) of PCBs to determine the probability of PCB presence at an individual property. SPU's interpretation of these results may not always be correct. It is also possible that SPU overlooked targets that did not present a strong response.

This study was based on a single detection dog/handler team and results of this process will likely vary considerably based on the composition of the detection dog/handler team, training methods for the dog, and the handler's ability to detect PCB odor. SPU's work in the past with this professional odor detection dog program gave SPU high confidence in the study results and that the detection dog was fully trained for the task and provided reliable information in all of the field events.

SPU is confident that strong evidence of PCBs at many buildings was found or confirmed during this study and will continue to pursue source control methods to mitigate these sources and work with property owners to find a way to remove or contain them until the source(s) can be removed.

1.3 Detection Dog – Handler Team

Julianne Ubigau has been a handler with the University of Washington CK9 program since November of 2006. She and her canine cohort named Sampson worked together from 2008-2018. In 2017, Sampson and Julianne completed PCB pilot study with SPU. Sampson demonstrated that dogs can consistently detect PCBs, at levels as low as 0.1 mg/kg (PPM) in controlled testing environments.

For this project, Julianne worked alongside Sampson's successor Jasper. Jasper is a 4-year-old Labrador mix who was rescued by the local animal shelter in April 2019 and began training for PCB detection work in November of 2019. He was selected for his high drive to play ball and his congenial, secure temperament which are both important attributes for PCB detection work. The high play-drive serves as training tool and reward for detection. Jasper's good temper ensures that he can work under the stresses of the urban environment. In addition to being trained to detect PCBs, Jasper is also trained to detect a variety of other targets, including wildlife scat (wolf, cougar, bobcat, fisher, marten, wolverine, coyote) plants (false brome, garlic mustard), and amphibian eggs.

As a detection dog, Jasper is trained to detect and alert to target odors. The dog communicates a high-confidence detection by sitting (Figure 1-3 Left and Middle). The dog is rewarded with a ball or toy if the handler is confident in the positive detection (Figure 1-3 Right).

Figure 1-3: Left: Jasper detects target odor in a drainage inlet. Middle: Jasper sits to convey detection of the target. Right: Jasper is rewarded for correctly detecting the target.

1.4 Study Overview

The detection dog grant phase 2 required that the focus be on the use of a detection dog team for source tracing efforts to find PCBs in the city of Seattle. Various methods were tested and assessed to develop a standard operating system for using detection dogs in PCB source tracing efforts. The detection dog was trained, verified as adequately trained, and then used in the field to conduct searches for sources of PCBs or to verify already suspect sources. These searches or evaluations were documented and used to help write a Standard Operating Guidance (SOG).

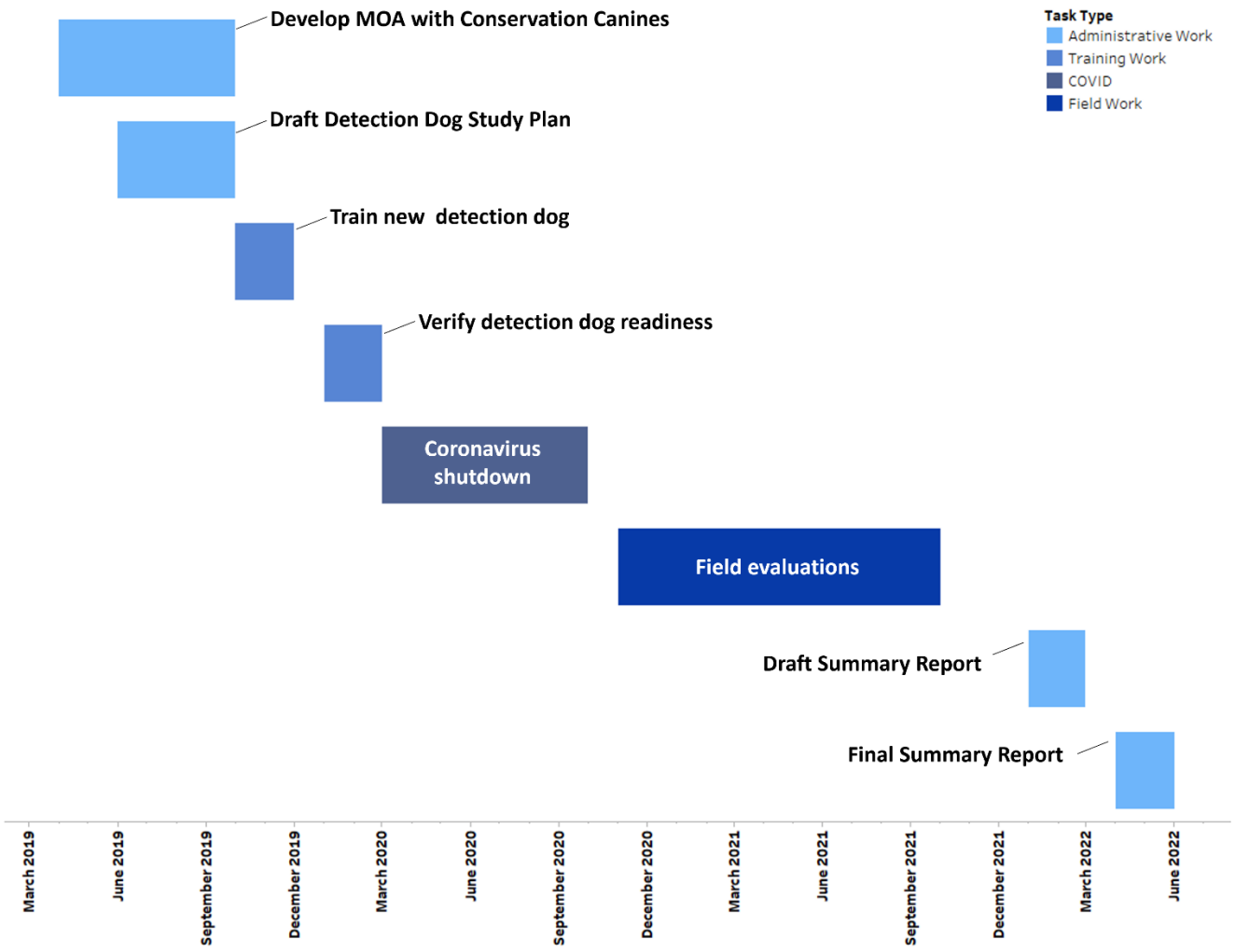


Figure 1-4: Study Timeline – The original timeline was to accomplish this project by EOY 2021. The project was interrupted by response to a PCB spill in mid-to-late 2019 and again was interrupted and constrained by Coronavirus pandemic from March 2020 to 2022.

1.5 Organization of the Report

This report is organized as follows:

- Section 2 – Detection Dog Training
- Section 3 – Detection Dog Verification Testing
- Section 4 – Field Work Evaluations
- Section 5 – Environmental Solid Sample Screening Evaluations
- Section 6 – Detection Dog Blood PCB Results
- Section 7 – Observations and Interpretations
- Section 8 – Discussion and Conclusions
- Section 9 – References

In addition, this report contains the following appendices:

- Appendix A – Work Plan
- Appendix B – Verification Testing Notes
- Appendix C – Field Evaluation Notes
- Appendix D – Summary Table of Analytical Results
- Appendix E – Sample letters for site access and site sampling
- Appendix F – Proposed Stand Operating Guideline for Source Tracing with Odor Detection Dog Team
- Appendix G – Jasper's Blood Test Results

2.0 DETECTION DOG TRAINING

2.1 Training Materials

Initial training was performed using a variety of PCB-contaminated materials obtained during the 2017 pilot study. The materials included both controlled training samples and environment solid samples collected locally in Seattle, WA. Controlled samples included both clean sand and forest soil that were spiked with specific concentrations of Aroclor 1254 and 1260. Environmental solid samples included catch basin solids, street dirt, paint chips and caulking that were analyzed to determine the type and concentration of PCB. When selecting training materials, the primary goal was to train Jasper on a variety of materials that represented the diversity of PCB targets and substrates encountered in the field.

2.1.1 Base Material for Spiking (Controlled Samples)

A key factor in designing training materials was to ensure that the dog is not unintentionally trained to look for PCBs in only a certain type of material. To minimize this potential issue, three types of materials were selected for use:

- Laboratory-grade clean silica sand (previously baked to remove contaminants)
- Forest soil collected from an undeveloped area of Bainbridge Island, Washington, that is presumed to be clean
- Liquid PCB Aroclor in methanol to create PCB-spiked wooden sticks (e.g., popsicle sticks)

The inclusion of two different soil/sand types, in addition to the wooden sticks, helped ensure that the dog was better prepared to detect PCBs in the variety of materials that will be encountered at an industrial site. Non-spiked (i.e., clean) silica sand, forest soil, and wooden sticks were also used to serve as controls.

2.1.2 Spiking Concentrations (Control Samples)

Sand and forest soil samples were spiked by Analytical Resources, LLC (ARI) with PCB Aroclor standards in 2016 for the previous detection dog study. Sand and soil samples were spiked to achieve the desired final concentrations of approximately 100 and 1,000 µg/kg dry weight (dw). For more information

about these methods refer to the study report from Phase 1 (Seattle Public Utilities, 2017). These concentrations were selected to evaluate the detectability of different concentrations of PCBs, while also limiting the exposure of the dog to high levels of PCBs.

2.1.3 Supplemental Training Materials (Environmental Solid Samples)

Aroclor is the trade name of commercial PCB mixtures sold in the United States. An Aroclor is a mixture of individual chlorinated biphenyl compounds. There are common PCB Aroclor mixtures (1221, 1242, 1016, 1248, 1254, and 1260) that were used in industry, and each can be identified by laboratory analysis. Sampson was initially trained to recognize both Aroclor 1254 and 1260 mixtures per the methodology developed during the Phase 1 study (Seattle Public Utilities, 2017).

When training Jasper, CK9 ensured that he was trained to generalize PCB target odor to include a variety of Aroclor mixtures in a variety of source materials. As described in Table 2-1, a variety of materials were spiked with PCBs for training, and supplemental materials were also identified.

Other possible complicating factors were considered by CK9, and supplemental materials were used in Jasper's training. Julianne was supplied with environmental media collected by SPU over the years that contain low levels of PCB mixtures of Aroclors. These samples included moss, catch basin sump solids, paint chips, and caulking material.

Table 2-1. Summary of training materials

Spiking Substance	Material to be Spiked		
	Ottawa Sand (Fisher Scientific)	**Forest Soil (Bainbridge Island, Washington)[b]**	**PCB-Soaked Wooden Sticks**
Primary training materials:			
Aroclor 1254[a]	- 16 oz spiked with 100 µg/kg dw - 16 oz spiked with 1,000 µg/kg dw[a]	- 16 oz spiked with 100 µg/kg dw - 16 oz spiked with 1,000 µg/kg dw[a]	- Sticks soaked in 40mL vial with 100 ug/L PCB standard in methanol
Aroclor 1260[a]	- 16 oz spiked with 100 µg/kg dw - 16 oz spiked with 1,000 µg/kg dw[a]	- 16 oz spiked with 100 µg/kg dw - 16 oz spiked with 1,000 µg/kg dw[a]	- Sticks soaked in 40mL vial with 100 ug/L PCB standard in methanol
Supplemental training materials:			
Methanol carrier solvent (control)	- 16 oz of sand spiked with only carrier solvent[a]	- 16 oz of soil spiked with only carrier solvent[a]	- Not calculated
Storm drain solids	- The analytical laboratory has archived a number of samples from SPU's source tracing program that contain a wide range of PCB concentrations		
Street dirt	- Street dirt collected by SPU		
Caulk	- PCB-contaminated caulk material collected by SPU		

Note: In addition to the spiked material described in this table, control material with no additive was supplied for training purposes.

a: Aroclor 1254 and 1260 were selected for training during the previous investigation because these 2 Aroclors comprise nearly 90 percent the PCBs measured in the storm drain solids samples collected by SPU.

b: Soil collected from a residential area that has never been landscaped or otherwise cultivated.

2.2 Training Methods

The process of training the second dog (Jasper) to detect PCBs was based off the training methods developed in the 2016 pilot study but the timeline for training Jasper was significantly shortened from the previous training regimen. For this study, three types of controlled training were performed: Bench training, basic field training, and advanced field training.

2.2.1 Bench Training

The bench training was used as the first stage of training. Each bench holds three suspended jars: two control jars (i.e., containing clean material) and one target jar containing sand or soil spiked with PCBs (Figure 2-1*).* Bench training is used when introducing detection dogs to new targets and quickly establishes a positive association between the target odor and the reward.

Figure 1-1: Jasper training at the University of Washington's Pack Forest, home to CK9 training facility.

2.1.3 Basic Field Training

Basic field training involved placing a variety of training samples in PCB-free natural and industrial sites. Like a game of hide-and-seek, this method acclimated Jasper to locating samples in realistic scenarios and under varying conditions. All samples (Aroclor 1254, Aroclor 1260, and miscellaneous source materials) were utilized during basic field training exercises.

Figure 2-2: Jasper training on planted target samples at an industrial site in Seattle, WA.

2.2.3 Advanced Field Training

The advanced field training phase took place at sites with previously confirmed PCB contamination, many of which were confirmed during the 2016 pilot study. This phase of training is the most important step in achieving a field-ready detection dog because it provides the opportunity for the dog to detect an unmanipulated source material and permits the dog handler to immediately reward the dog when the detection is made. This process provides positive learning experiences for the dog, provides important opportunities to see how the dog works with new media sources of PCBs, and builds confidence for both the detection dog and dog handler in detecting PCB contamination.

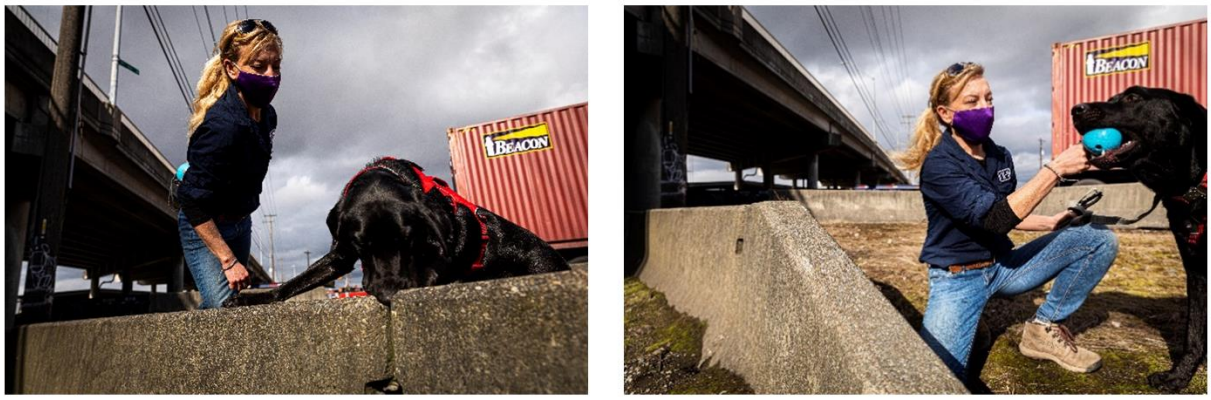


Figure 2-3: Jasper training at an industrial site in Seattle, WA.

2.3 Training Schedule

In November 2019, Jasper started on low intensity-controlled training on initial source targets of low PCB concentration. This entailed initial recognition of PCB odors and response. Intense training on various media targets commenced in February 2020 to prepare for validation testing and field

evaluations in the spring of 2020. The PCB detection training was increased in early 2020 to be ready for validation testing in March 2020.

In March 2020 training changed to focus on developing detection skills that address newly determined objectives. These include training Jasper to 1) detect and alert to PCB odors in the air at varying distances from the target, and 2) discern between high and low-concentration PCB samples (i.e., alert to sample with the highest concentration of PCB when presented with multiple PCB samples). Training then was reduced beginning in early 2020 due to the onset of the Coronavirus pandemic. Training increased toward the end of 2020 with the anticipation of conducting field work which had been curtailed while health precautions were imposed to prevent the spread of the Coronavirus. Continual low-level training was conducted throughout the project to maintain Jasper's proficiency in detecting PCB odor.

3.0 VERIFICATION TESTING

To prove Jasper's accuracy in detecting PCBs at various levels, a testing protocol was used to evaluate his readiness. One part of this testing involved controlled tests conducted at the SPU Wharf building parking garage, which is located at 4209 21st Ave W in Seattle, Washington. This location was selected because it provided outside but covered space for conducting the bench tests and was not likely to have been impacted previously by PCBs (i.e., a site where PCBs were not expected to be present due to age of the building). It was also important to conduct the testing outside due to the onset of the Coronavirus pandemic per the need to social distance per CDC guidelines.

3.1 Bench Testing

The objective of the bench target sample verification was to evaluate Jasper's ability to correctly identify PCBs in presented media samples of known concentration, and to test for both possible false negatives (i.e., when a PCB target item was not identified as such) and false positives (i.e., when a non-PCB item was signaled to contain PCBs). Testing was conducted only to a level that SPU was confident that Jasper was adequately skilled in detecting and consistent at PCB identification of samples at various PCB levels. Jasper's test results were not statistically evaluated or as rigorous as with the previous detection dog (Sampson). The bench testing was qualitative and did not rely on Jasper passing a set regiment of tests at a predetermined success rate.

Figure 3-1. Original bench test layout used during the 2019 training sessions.

3.1.1 Verification Methods

Each trial was conducted using four benches (arranged in a square as shown in Figure 3-1). Two methods of evaluation were conducted to determine his reliability, one in locating single samples in a field of blanks, and the other tested his ability to differentiate between high level and low level mixed Aroclor samples.

Each bench contained three holes for pint-sized Mason jars, for a total of up to 12 jars per trial. All 12 jars were used when testing Jasper, with 11 using clean sand/soil blanks and one a single target. When testing Jasper on mixed samples, the center sample in each bench was left empty to avoid carryover odor from nearby jars since they all had some level of PCB.

For the initial testing, one jar per trial contained sand or soil that was spiked with either 100 or 1000 ug/kg of Aroclor 1254 PCB, while the other 11 jars contained clean sand or soil (the same media as the target jar). Approximately 0.5 inches of sand or soil was placed in the bottom of each jar.

After the initial trials using clean sand or soil blanks, target samples were switched to actual field collected samples with mixed Aroclors. Blank samples were replaced with sand or soil samples that contained from 9 to 85ug/kg mixed Aroclors.

3.1.2 Bench Testing Results

Jasper was bench tested with 1254 Aroclor sand and soil targets between 100 and 1000 ug/kg and eleven clean blanks to see if he could identify the single PCB target. Jasper was allowed to make up to three passes around the bench layout before identifying a target. The more passes around the benches before target selection is thought to indicate lower confidence in selection of the target. 24 tests were conducted in this scenario. One test was inconclusive and disregarded due to Jasper's lack of focus. Of the 23 valid tests, Jasper selected the correct target 22 times. This clearly indicated that Jasper was accurate in differentiating PCB targets from clean targets.

To see if Jasper could differentiate between multiple targets at different PCB levels, a small number of tests (identified in Table 3-1 as 'mixed Aroclor') were conducted with an elevated PCB target surrounded by lower-level samples at 9 or 85 ug/kg. It was hoped that Jasper would select the higher sample over the lower-level samples and thus show his ability to hone into the hot zone of the target.

Three elevated targets were used in this testing, 563 ug/kg, 5,950 ug/kg, and 14,000 ug/kg mixed PCBs. Jasper showed some confusion during this testing but generally chose the higher concentration samples. The greater the difference in concentration resulted in better performance by Jasper in choosing the higher concentration. When the highest sample of 14,000 ug/kg was used, Jasper selected the target in preference to the lower concentration samples every time.

Table 3-1. Summary of verification testing results March 2020

Aroclor	Media	PCBs (ug/kg dw)	# Blanks	Aroclor	Results
1254	Sand	1,000	11	1254	5 out of 6
1254	Sand	100	11	1254	6 out of 6
1254	Soil	1,000	11	1254	6 out of 6
1254	Soil	100	11	1254	6 out of 6
Mix[a]	CB	563	7[d]	mixed	Partial success
Mix[b]	CB	5,950	7[d]	mixed	Partial success
Mix[c]	CB	14,000	7[d]	mixed	Success

Notes

a. CEW-51518-2

b. MKJ-111016-1

c. CB247-050714

d. Removed middle jars from each bench to avoid carry over between jars. Used a mix of 85 ug/kg dw and 9 ug/kg dw samples. The dog handler worked to get him to select the higher target rather than lower-level targets.

3.2 Outdoor Hidden PCB Tests

The objective of the hidden-PCB tests was to create a transitional exercise that would help Jasper adjust to a more realistic type of scenario, comparable to what would be encountered at commercial or industrial sites.

3.2.1 Hidden Test Methods

Hidden-PCB tests were conducted outside at the SPU Wharf facility. The project team placed one to four PCB targets (typically the SPU archived media samples that were also used during training) in each area. In addition, a site with a suspected spill of low-level PCB on soil was also used to see if Jasper could find the hotspot in a real application scenario. Julianne and Jasper would enter the test area and conduct their search for the PCB targets and team members would record the outcome.

3.2.2 Hidden Test Results

Three outdoor hidden PCB test scenarios were run on March 10 and March 11, 2020. A total of 11 targets were placed during these verification tests. Jasper correctly alerted to 10 of the 11 PCB targets (~91% correct).

- ***March 10, 2020, Field Verification Test:***
  This test was conducted along the south side of the roadway between 2737 and 2805 W Commodore Way. The wind was mild with gusts to 17 mph and temperatures in the upper 40s and low 50s. The site was chosen because there is a suspected but unidentified PCB source along this section of roadway between the property lines of these two parcels. Two confirmation target samples were used in this search: caulking at 93,300 mg/kg and paint chips at 31.5 mg/kg. The target samples were hidden from view but retained in their sample jars with the lid removed. This prevented direct contact with the target by Jasper.

  Jasper easily found the target sample jars. These were hidden in concrete rubble and inside a log. He showed moderate response to the suspected PCB source and could not seem to pinpoint a source location. The PCB source was later investigated and soil samples in the area were as high as 32 mg/kg in soil but varied across an area of about 50 square feet between the fence and the catch basin on the Right-of-Way (ROW).

- ***March 11, 2020, Field Verification Test:***
  The first of two test scenarios were conducted in the SPU Wharf parking garage which is covered but open on three sides. The wind was mild with gusts to about 15 mph and temperatures in the upper 40s and low 50s. During this test, two types of targets were used. One target consisted of small strips, 3” to 6”, of caulking material verified by analysis at 93,300 mg/kg dw PCBs. The other targets used were small 3” cardboard strips that were soaked in a solution of 10 mg/kg Aroclor 1254 in hexane. The cardboard strips were allowed to dry to remove the hexane.

  During the first testing scenario the caulking and cardboard strips were placed under debris or hidden both on ground level and at elevated locations. The caulking strip was hidden behind a strip of duct tape and elevated on a wall and another strip placed on the windshield of a parked vehicle to see if he could find the odor from a strong source at a distance and track it to the location. Cardboard strips were hidden under debris at floor level. Jasper successfully found all targets except for the caulking strip on the windshield of

the vehicle. It is likely that the swirling wind in the garage was too chaotic and prevented his search. This did indicate that catching the scent on the wind and tracking it to a source could be difficult in moderate winds with inconsistent direction.

The second scenario was conducted along a pedestrian trail on the east side of 21st Ave W across the street from the SPU Wharf building. Three targets were placed along this trail for Jasper to find. The trail is bordered by a thick growth of ivy and there were numerous pieces of trash to confuse Jasper with other odors. The three samples used were: 1) A small fluorescent lamp ballast known to have leaked and dried PCBs, 2) A jar of catch basin solids analyzed at 34 mg/kg, and 3) Caulking material verified by analysis at 93,300 mg/kg.

Jasper was quickly able to find the light ballast buried in the ivy along trail, the sample jar at 34 mg/kg dw PCBs in pipe with the jar lid just loosened, and the caulking strip under a tarp. He was unable to find a sample of the caulking in ivy on hillside along trail about 5 feet off the ground.

3.3 Discussion of Controlled Testing Results

The results of the verification testing indicated that Jasper was able to consistently detect PCBs, even at levels as low as 0.1 mg/kg and in various media. Jasper could find samples hidden in various locations on the ground and elevated. Jasper's ability to locate samples on windy days was not always reliable but it was agreed that he showed clear ability to differentiate PCBs from other smells and locate targets consistently. There were no false positives in any of Jasper's searches.

4.0 FIELD EVALUATIONS

4.1 Downtown Area

Field Evaluation Area:	Downtown	
Date(s):	11/16/2020	8/11/2021
Duration:	2 hr. 15min	1 hr.
Weather:	46F overcast with steady rain and winds from the NW	Low 80Fs, Sunny with no winds
Personnel:	*UW Handler:* J. Ubigau SPU Inspector: L. Peterson Additional SPU staff: M. Jeffers, A. Bidwell	UW Handler: J. Ubigau SPU Inspector: L. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Commercial	
Bench calibration prior to field evaluation?	No (11/16/2020)	Yes (8/11/2021)
Activity type:	☒ Perimeter search ☐ Site access ☐ Drainage structure investigation	
Target Buildings in Evaluation Area?	1	
Discovered Probable PCB Structures?	0	
Discovered Possible PCB Structures?	0	

Evaluation Summary:

On November 16, 2020, the first field evaluation was conducted in the Downtown area. The area searched was approximately a four-by-four block area of commercial use (Figure 4-1-2). Many buildings in this area are tall or skyscraper in size. This neighborhood was chosen because one target building was identified as a PCB source and was known to have a strong odor of PCBs that was sometimes recognizable from a distance. The target building was first located by odor recognition by an SPU Inspector in 2019. Prior to this field evaluation, samples of sidewalk dirt and inlet solids near this target building were collected and analyzed for PCBs. Samples near this target building were taken on March 19, 2020. Results of the samples showed that the sidewalk dirt collected immediately near the target building had elevated PCB levels of 32,670 ug/kg PCB (D1). A sample taken from the stormwater inlet near this sidewalk sample and downstream of the building had PCB results of 3,035ug/kg (D2) while the samples taken a block downstream in another inlet had results of 2,614ug/kg PCB (D3).

The target building was within the four-by-four block search area but neither the SPU inspector nor the dog handler was aware of its' location. Additionally, this search area is one that the study team hoped to inspect both during the cooler winter months and again during warm weather to try to evaluate if temperature or other weather conditions would make a difference in use of the detection dog.

Prior to the scheduled field evaluation day, the SPU inspector was not given a map of the area or asked to prepare a plan for the field evaluation strategy. The SPU inspector was verbally instructed to try to determine the age of buildings in the area during the field evaluation to help the handler focus on older buildings and avoid newer structures. This building age evaluation would be left to the inspector and dog handler to determine during the investigation.

The field evaluation began at about 11:00 on a cold, windy, and rainy day with temperatures in the 40Fs and a moderate wind from the North/Northeast. The SPU inspector, in consultation with detection dog handler, decided to run the detection dog along the avenues from east to west and not concentrate on the streets running perpendicular unless a building looked of interest.

After running the detection dog over three fourths of the search area, Jasper showed moderate or low interest in two locations, but the handler was not convinced of a true detection. To keep Jasper interested, a small sample of PCB caulking material was placed in bushes along his path, and he recognized the target and showed a strong response. Continuing the search, Jasper showed a weak response to another building on his route, but no recognizable PCBs odors were noted by SPU inspectors or the handler at this location. A second small sample of PCB caulking was planted along his route and Jasper quickly identified this target with a strong response.

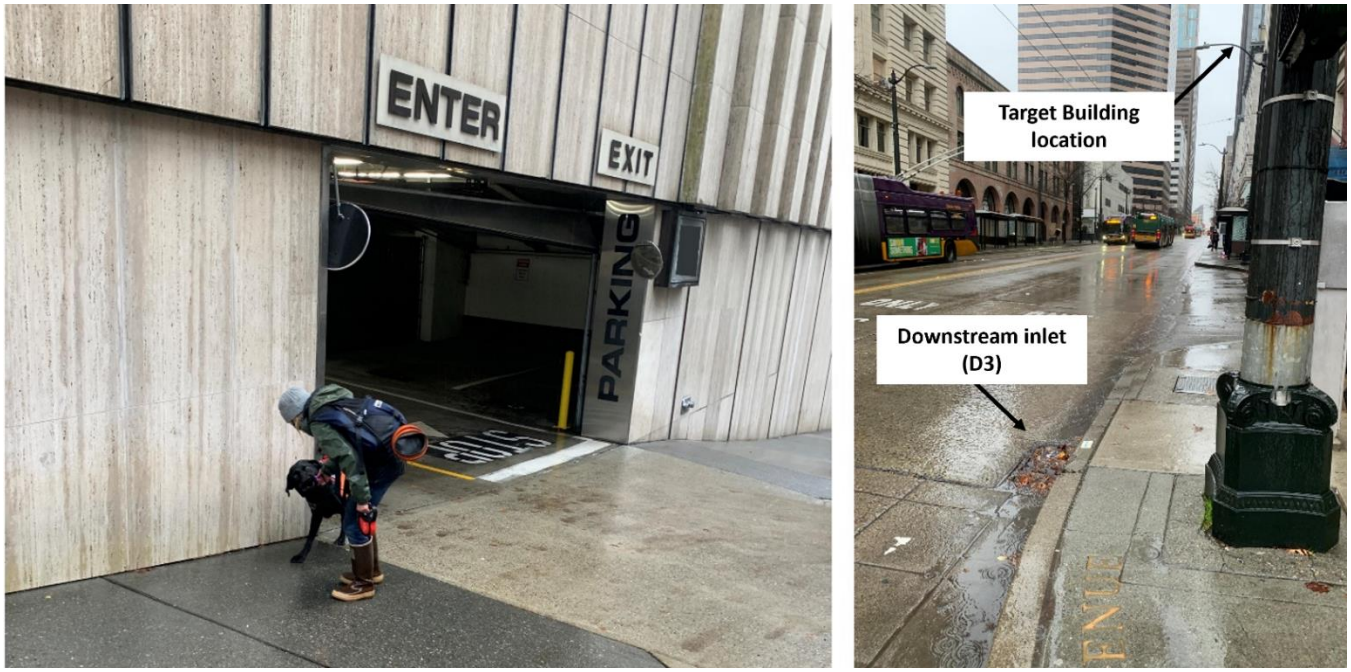


Figure 4-1-1: Left: Jasper positively identifying the cement seams of the target building. Right: Inlet located south of the building where Jasper indicated for PCBs.

As Jasper came closer to the target building from a down wind direction, he became less focused according to his handler. Due to the wind swirling around the tall buildings in this area, Jasper was drawn to a building across the street and to the west of the target building and identified this building with a moderate response. The team was advised to continue along their path to see if any further sources could be found. Once Jasper approached the target building it was obvious from his reaction that he was highly confident that the target building was a source. The caulking in the seams of the marble façade of this building had a clear odor of PCBs that was recognizable by all team members. The team discussed the reaction of Jasper in this area and his moderate response to the building across the street and speculated that the wind was casting the odor across the street where Jasper started to

show a moderate interest. The first field evaluation on November 16, 2020, was concluded after the target building was found at 13:30.

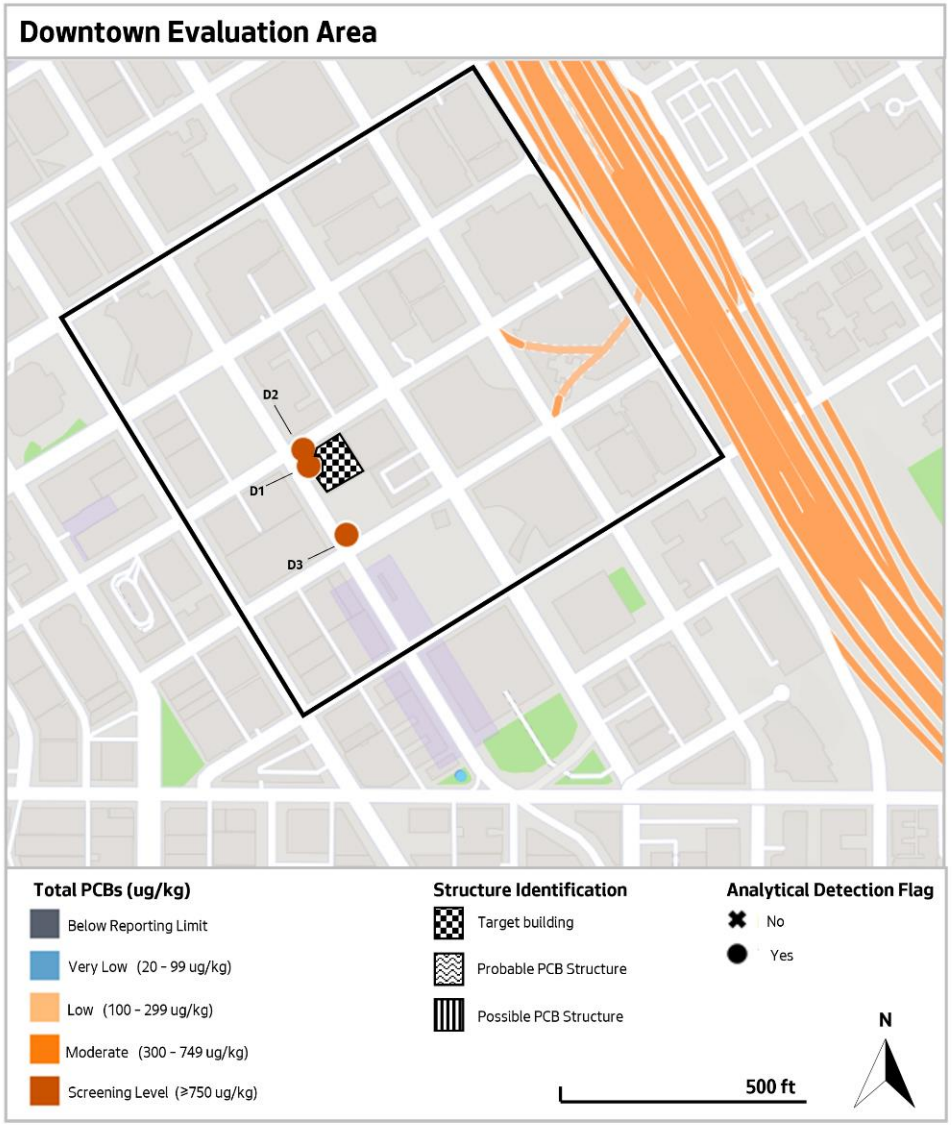
On August 11, 2021, the second field evaluation was conducted in the Downtown area. The area was previously searched in the Fall of 2020 during a cold and rainy day with temperatures in the 40Fs. The original search was an area search with an unknown target building. This summer evaluation was a target investigation of the building in which the inspector and the dog handler were aware of the target building. The purpose of the second visit was to see if temperature or other weather conditions would have a profound effect on use of the detection dog team.

The field evaluation was started at about 14:00 on a very warm and sunny day with temperatures in the 80s and a moderate but variable wind. Jasper casually walked toward the target building in the general direction coming from downwind. Jasper identified the building quickly, but it was clear that the heat was affecting him. At this temperature Jasper was really interested in laying down in the shade and his interest in searching was somewhat subdued. Under these conditions it was not clear if other weather conditions such as wind would have an effect. There was limited wind and limited interest by Jasper.

Downtown Evaluation Area Takeaways:

- The detection dog was able to identify the target building known to contain PCBs.
- The detection dog may be confused in areas where odor may be cast from a strong source due to wind.
- It was difficult for untrained inspectors to accurately determine the age of a building to screen it in or out based on 1980 criteria. A method is needed to determine age of buildings prior to going out so that the area search can be more efficient.
- The team focused on minor interest by the dog rather than searching for a strong response. This made the search longer than needed. There was worry by the handler and the SPU inspector that they could miss the target so every interest by the dog was scrutinized.
- Rain was steady during the first evaluation and likely dampened the odor, especially in the sidewalk where contaminated dirt was covered by fresh rain.
- Once a target is suspected it might be good to move away from the target and approach from another direction to see if the dog reacts differently. This could indicate that wind might be a factor and that the interest may be false.
- It might be good to take environmental solid samples from the target area during cold rainy weather and evaluate the samples in a dry warm place to additional verify. Also, sidewalk dirt near a strong source may not be detectable by the detection dog in the field if the odor from the target building is overpowering.
- Have the dog inspect downstream inlets or CBs near the target to see if the dog also shows strong positive response.
- For future field evaluations, consider taking samples from locations where the dog showed no interest as a background control.
- Hot days may liberate more PCB odor, but heat has a more direct effect on the detection dog than cold days. On hot days, dogs' breath through their mouth as they pant which may

diminish their ability to smell odors through their nose. Days with moderate temperatures are likely the best "Goldilocks environment" for detection dogs.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
D1	197.0	197.0	197.0	197.0	197.0	26,000	6,970	**32,970**
D2	100.0	100.0	100.0	100.0	100.0	2,540	495.0	**3,035**
D3	100.0	100.0	100.0	100.0	100.0	1,850	764.0	**2,614**

Figure 4-1-2: Map and Analytical Table for the Downtown Evaluation Area

4.2 NEVADA AREA

Field Evaluation Area:	Nevada St
Date(s):	11/20/2020
Duration:	1hr 45 min
Weather:	Low 50Fs, cloudy with occasional rain
Personnel:	UW Handler: J. Ubigau SPU Inspector: A. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Industrial
Bench calibration prior to field evaluation?	No
Activity type:	☒ Perimeter search ☐ Site access ☒ Drainage structure investigation
Target Buildings in Evaluation Area?	0
Discovered Possible PCB Structures?	3
Discovered Probable PCB Structures?	0

Evaluation Summary:

On November 20, 2020, a field evaluation was conducted in the industrial section of the Lower Duwamish Waterway area. The area searched was a single long block between a major arterial and the Duwamish Waterway. South Nevada Street runs east and west with a single large building along the north side of the street and numerous buildings along the south side (Figure 4-2-3). The north building abuts the sidewalk and can be accessed by the detection dog but the buildings on the south side sit a considerable distance from the sidewalk public space. This neighborhood was chosen because the area drains to a sediment remediation area and previous samples of soil and sediments in stormwater drainage had elevated levels of PCBs. There was no clear target building in this area and no prior history of odor recognition by SPU inspectors near any of the buildings on this block.

Surface dirt and catch basin (CB) solids were first sampled on this block in 2019. Two samples collected along the south side of the street in stormwater catch basins were analyzed for multiple chemicals of concern associated with the waterway cleanup to see if pollutants could be found in this short drainage area. The sample from the first catch basin had measurable levels of PCB but were relatively low with a result of 190 ug/kg (N1). The second catch basin sediment sample results were elevated at 725.7 ug/kg (N2) and very near the SPU action level for further investigation. An additional sample was taken from a maintenance hole in the middle of the street and came back as a non-detect (N3). A sample taken from a catch basin on the north side of the street had moderately levels of PCB at 394.1 ug/kg (N4).

Additional sampling in this area was conducted by SPU in June 2020 with even higher results in the previous two catch basins sampled in 2019 from the south side of the street. The PCB levels were 246.3 ug/kg (N5) and 933 ug/kg (N6). Two additional catch basin samples were taken from the south side of the street and the PCB levels were elevated at 1,300 ug/kg (N7) and 470 ug/kg (N8). On the northside of the street, two additional samples of sidewalk dirt were taken, and the PCB levels were relatively low at 158.7 ug/kg (N9) and 175.2 ug/kg (N10). Drainage structures in this area and the drainage line have been cleaned periodically to remove contaminants.

On November 20, 2020, a field evaluation was started at about 09:00 on a cold and rainy day with temperatures in the 40s and 50s. The SPU inspector, in consultation with dog handler, decided to run the detection dog at a fast pace through the area to see if a clear target could be found, then follow up with a more precise search in areas of elevated interest. During the initial search, two PCB samples were placed in hidden areas for the dog to find to test that Jasper was concentrating on PCBs and able to positively identify them during the field evaluation. Both samples were quickly found by Jasper during the initial search.

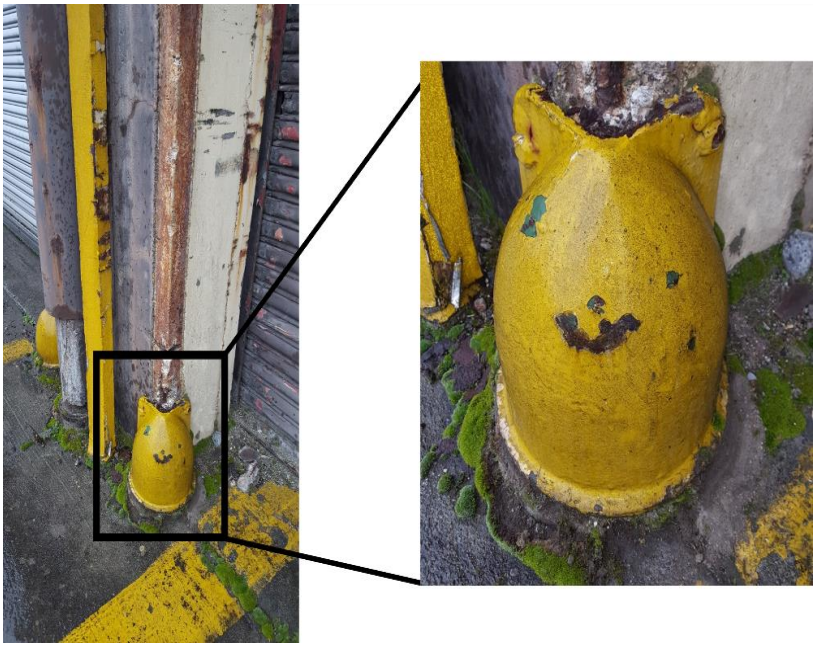


Figure 4-2-1: Yellow bollards found near garage doors on an industrial property

After running the detection dog over the search area, Jasper showed only moderate or low interest in three locations, but the handler was not convinced of a true detection. Continuing the search, Jasper showed a weak response to a building on his route, but no recognizable PCBs odors were noted by SPU inspectors or the dog handler at this location. Two moderate responses were noted by the handler from Jasper, one at the north building's iron protective column guards at the garage door entrances to this building (Structure #1 and Structure #2). These column guards were painted yellow and located at each side of 15 large garage doors on this building.

A second area of interest for the detection dog were four protective yellow steel bollards (Structure #3) on the south side of the street.

Both the bollards and the column protectors looked to be of the same era and owned by the same property owner. Because the detection dog had only moderate responses at most, the team concluded that this investigation likely discounted the chance of a PCB target being found.

Figure 4-2-2: Protective yellow bollards found on the southside of the street in the evaluation area

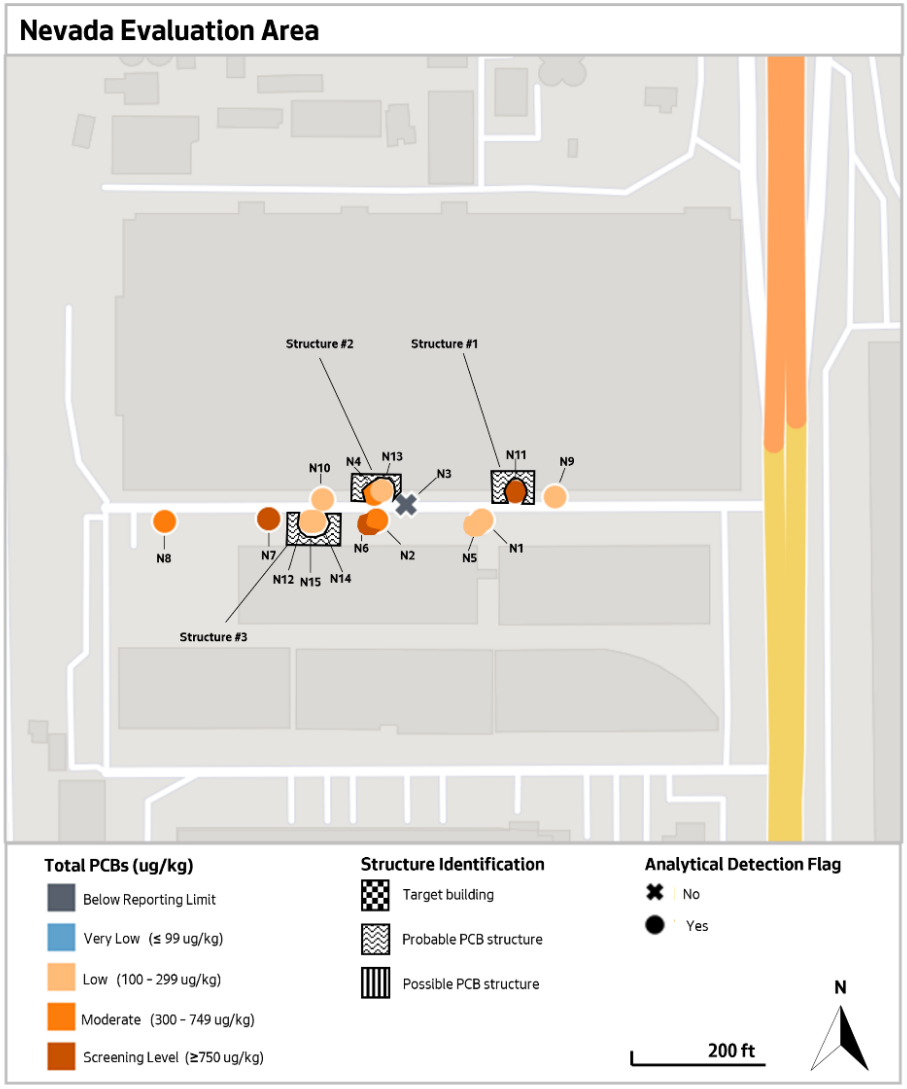
On December 8, 2020, samples of dirt/moss/and paint chips from the ground were collected near a garage door

bollard and at the protective bollards in the public right-of-way or sidewalk. Results from the sample near the garage door column protector had abnormally high PCB result of 3,560 ug/kg (N11). This may be due to a high number of small paint chips seen in the collected sample. The sample near the protective bollards was only slightly elevated but did have measurable levels of PCBs at 167.6 ug/kg (N12). In January 2021, three additional samples were again collected near these two structures of interest with results of 276.6 ug/kg (N13), 204.1 ug/kg (N14), and 240.2 ug/kg (N15).

Results from this investigation were provided to the property owner in this area. The property owner hired a consultant to further investigate our findings and confirmed that the metal column protector paint had levels of PCB above TSCA levels and that they would remove all these building materials and treat the metal bollards similarly. The property owner also cleaned the street surface and all public drainage assets along this one block area to the outfall in the river to remove residues. The building is slated for demolition and is being managed as a TSCA remediation site in compliance with PCB disposal regulations.

Nevada St Evaluation Area Takeaways:

- It appears that paint may be more difficult for the detection dog to identify as a strong source, especially at low levels in the paint.
- Due to this area being overlaid with a measurable level of PCBs, it may be difficult for the detection dog to find the hotspot if the hotspot is low level.
- Paint may contribute constant low levels of PCB, but at levels around background. This may indicate that even low levels of measurable PCB in samples can be derived from sources of paint.
- Collect environmental samples when the detection dog gives a moderate response. This might just be behavior change rather than a confident sit response. By learning to recognize the detection dog's response to low/moderate levels of PCB, the team can cut down on investigation times.
- Samples that return PCB values below our standard source tracing action level may indicate a source nearby. Samples should be compared to nearby background levels to determine differential values, rather than a regional or city wide standard to evaluate likelihood of a PCB source, but this process can be resource intensive. Using a detection dog may reduce this need for comparison sampling.
- Take video of the entire process of when the dog is working so that it can be reviewed later to see if there were any missed observations and observe dog-handler reactions in the field.
- Consider using “obedience to odor” training to pinpoint the target (to get the dog to stay on target and point). Currently the detection dog ‘alerts’ by sitting to indicate he has found something.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
N1	19.9	19.9	19.9	19.9	46.0	61.6	82.4	190.0
N2	19.7	19.7	19.7	19.7	77.7	146.0	502.0	725.7
N3	19.5	19.5	19.5	19.5	19.5	19.5	19.5	19.5
N4	19.9	19.9	19.9	19.9	81.1	111.0	202.0	394.1
N5	19.9	19.9	19.9	19.9	76.0	50.3	120.0	246.3
N6	20.0	20.0	20.0	20.0	90.0	136.0	707.0	933.0
N7	20.0	20.0	20.0	20.0	121.0	270.0	909.0	1,300
N8	20.0	20.0	20.0	20.0	119.0	163.0	188.0	470.0
N9	19.9	19.9	19.9	19.9	98.0	55.3	65.4	158.7
N10	20.0	20.0	20.0	20.0	29.6	64.8	80.8	175.2
N11	198.0	198.0	198.0	198.0	198.0	198.0	3,560	3,560
N12	20.0	20.0	20.0	20.0	20.0	46.6	232.0	167.6
N13	20.0	20.0	20.0	20.0	28.6	71.0	177.0	276.6
N14	19.8	19.8	19.8	19.8	24.0	44.1	136.0	204.1
N15	20.0	20.0	20.0	20.0	28.1	49.1	163.0	240.2

Figure 4-2-3: Map and Analytical Table for the Nevada Evaluation Area

4.3 HALLER LAKE AREA

Field Evaluation Area:	Haller Lake
Date(s):	11/18/2020
Duration:	2 hrs. 30 min
Weather:	High 40Fs/Low 50Fs, light rain with mild wind from South
Personnel:	UW Handler: J. Ubigau SPU Inspector: L. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	City-owned Properties
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☐ Site access ☐ Drainage structure investigation
Target Buildings in Evaluation Area?	2
Discovered Possible PCB Structures?	0
Discovered Probable PCB Structures?	0

Evaluation Summary:

On November 18, 2020, a field evaluation was conducted at three parcels near Haller Lake (Figure 4-3-3). All three parcels are owned by the City of Seattle. The parcels are referred to as South, North, and West. Two of these parcels - South and West - had a PCB target building previously identified by SPU inspectors as suspect based on odor recognition by an SPU inspector and nearby sampling of environmental media. The North parcel was the only parcel area without a known target building. Neither the dog handler nor the SPU detection dog inspector was aware of the target buildings.

Field evaluation began at approximately 9:00 on a cold and rainy day with temperatures in the 40s to low 50s. There was a slight wind from the south. The SPU dog team inspector, in consultation with dog handler, decided to run the detection dog on their own path while trying to cover a large area in a short period of time. The South parcel was a large area of land with multiple buildings and construction activities. The North parcel was about a quarter the size of the South parcel and had just one building and outside storage areas. The West parcel was a former four-story commercial building built in the 1960s with an adjoining parking lot for cars.

South parcel search:

The target building in this parcel was a large industrial type building with joint compound seams that had been identified previously in 2018 as likely having PCBs by detection of odor during an SPU inspection. Media samples were taken near this building in 2018 but were inconclusive with PCB results at 133 ug/kg (HL1) in a catch basin near the northeast corner of the building and 86.8 ug/kg (HL2) in a catch basin near the southwest corner of the building. The odor was so recognizable that this building was still highly suspected of having PCB in the joint compound in the concrete panel seams.

Jasper went throughout the South parcel starting at the target building (Building #1) on the north end and progressing to the south of the property. Jasper found moderate interest in the west side of the

Figure 4-3-1: Detection Dog Team examining a caulking seam on the Target Building (Building 1)

target building but did not indicate at a level to convince the handler that this was a target, just enough to warrant another look at the end of the search. During the search of the property, two PCB samples (caulking samples) were secretly placed in Jasper's path to check his ability to find PCB sources and both samples were found and identified with a strong positive response. Two other areas of the property were noted as moderate responses, around an asphalt storage area and a trash can. Both were inspected and ruled out as a possible source through visual and odor.

On the return to the vehicles, Jasper was again instructed to inspect the north building and soon identified caulking around a door on the south side as likely PCB. Jasper further identified the joint compound between concrete panels as potentially PCB and this was confirmed by field staff through odor recognition. Although this building had numerous windows, Jasper did not identify the sealant around these windows as a potential PCB source. It is possible that the subtle reminder by the study team to look again at this building before returning to the cars may have biased the detection dog team in finding this target building.

On December 10, 2020, a sample of moss was collected directly below two vertical joint seams from this target building and a third sample was taken at a distance over 50 feet from the building of similar moss material. The samples were returned to the office and on March 5, 2021, Jasper was instructed to evaluate these samples for possible PCB using the bench screening method. Jasper identified the moss from below the joint compound seams as positive for PCB but did not indicate the same for the moss collected away from the building. The samples were sent to the lab for analysis and results confirmed higher levels of PCB in the moss at the base of the building seams at 892 ug/kg (HL3) and 753 ug/kg (HL4) PCB. The sample taken 50 feet from the building had a level of 71.4 ug/kg (HL5) PCB.

North parcel search:

The investigation moved to the North parcel at 11:00. This area consists of a large warehouse, office building and exterior paved storage yard for construction materials and equipment. This area did not have a target building to find and was thought to be clear of PCBs before this search. Jasper searched the entire parcel and had one area of interest. Jasper showed interest in a painted wall near the east entrance but did not indicate a strong response that this was a source and there were no other indications that this might be PCBs. The property was deemed to be clear of PCBs and no target found. A sample of surface dirt was taken and analyzed near the point where Jasper indicated interest at the east wall and PCB results were very low at 48.2 ug/kg (HL6).

Figure 4-3-2: Jasper sniffing the lower window panel caulking seams on a Target Building (Building #2)

West parcel search:

This parcel consisted of a multi-story commercial office building no longer in use. The target building (Building #2) was previously identified as a potential source of PCBs in 2018. An SPU inspector had identified PCB odor from this building while driving past the building on warm days. To confirm this suspicion, sampling and analysis of the stormwater catch basin solids near the building was conducted in 2018. A 2018 sample of the catch basin solids taken near the southwest corner of the building had PCB results of 1,839 ug/kg (HL7). An additional sample was taken from a catch basin in the south part of the building's parking lot and had a PCB result of 539 ug/kg (HL8). After this discovery, the catch basins on this property were cleaned and filter fabric placed in them to collect solids.

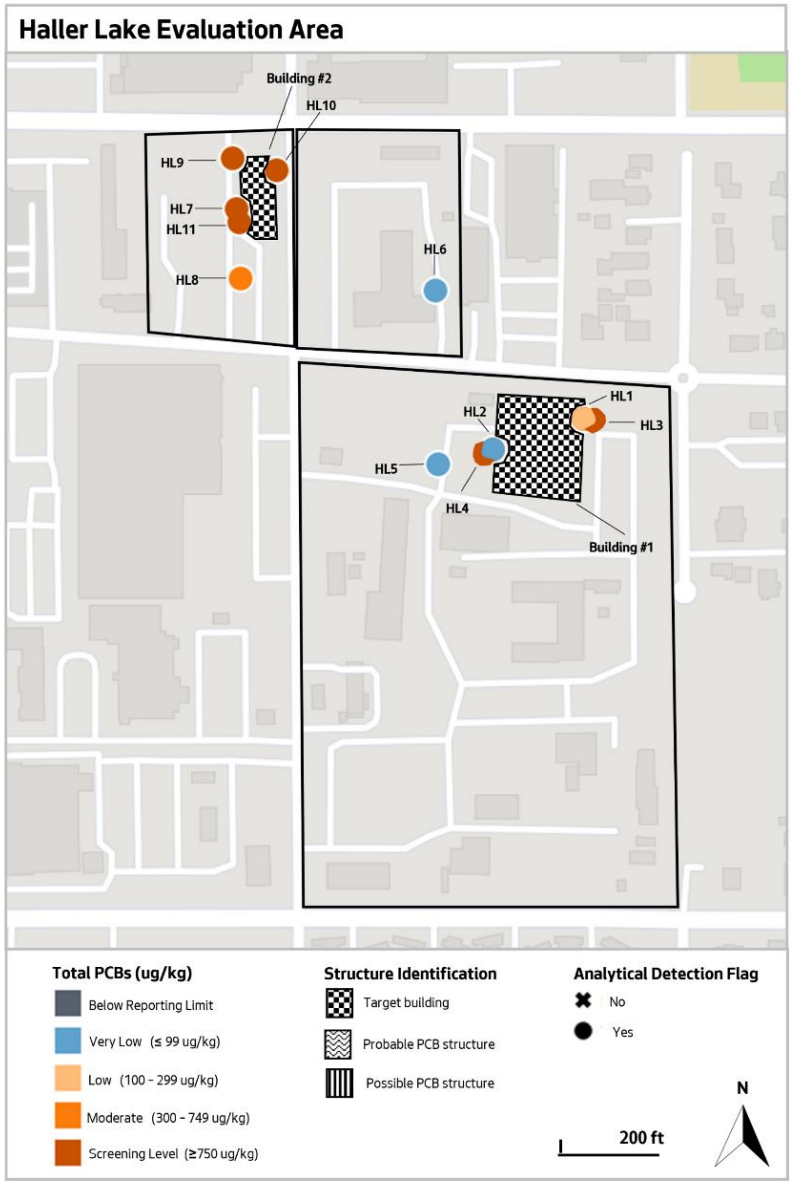
Jasper searched the perimeter of the building and almost immediately found a horizontal caulking strip along the base of the building on the north side. SPU inspectors and the dog handler were able to confirm PCB odor in the base caulking strip. It is likely that additional areas of the exterior of the building are sources of PCB but may be higher up the building and out of reach of the detection dog.

As a last evaluation, Jasper was instructed to inspect the stormwater catch basins on the property. A strip of PCB caulking was hung beneath the grate of one catch basin as a test and Jasper identified with a strong positive response at only this catch basin.

On December 10, 2020, samples were again collected from environmental media on this property. Solids from a catch basin near the northwest corner of the building had PCB results of 1,808 ug/kg (HL9). Surface dirt taken from cracks in the sidewalk on the east side of the building had the highest levels of PCB at 32,400 ug/kg (HL10). Surface dirt was also collected near a dumpster at the southwest corner of the building with PCB results of 4,700 ug/kg (HL11).

Haller Lake Evaluation Area Takeaways:

- This was an early field evaluation and Jasper was new at his job.
- Jasper sometimes moves rapidly past a building without thoroughly searching. Once Jasper does show a change of behavior it should be recognized that this could be a sign of odor recognition and more search is warranted.
- Jasper gets interested in some smells not necessarily associated with PCBs and can distract from the search. His attention at the asphalt berm and garbage can caused distraction but no results.
- It takes a fine balance and ability to differentiate an interest in an object and in targeted odor detection at low levels.
- Observers were keen to have the target building found while the SPU inspector/detection dog team were worried about overlooking any possible target. It is uncertain if Jasper would have returned to the north building in the South parcel without prompting from the observers. This was more useful as a learning site rather than a field inspection since this was one of the first uses of Jasper in the field.
- Samples collected beneath target building materials can be brought back to the office for a quick second verification by Jasper. Samples of non-PCB material similar to the target material should be collected and used as blanks in the sample verification process.
- Having a plan beforehand to focus the search is needed. It was determined that we needed to have a better flow with fewer interruptions during the search.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
HL1	19.3	19.3	19.3	19.3	36.6	63.1	33.3	133.0
HL2	19.8	19.8	19.8	19.8	19.8	65.2	21.6	86.8
HL3	20.0	20.0	20.0	20.0	20.0	620.0	272.0	892.0
HL4	19.9	19.9	19.9	19.9	19.9	565.0	188.0	753.0
HL5	20.0	20.0	20.0	20.0	20.0	51.1	20.3	71.4
HL6	19.9	19.9	19.9	19.9	19.9	27.5	20.7	48.2
HL7	19.0	19.0	19.0	19.0	395.0	1,010	434.0	1,839
HL8	143.0	143.0	143.0	143.0	143.0	366.0	173.0	539.0
HL9	99.4	99.4	99.4	99.4	99.4	901.0	907.0	1,808
HL10	987.0	987.0	987.0	987.0	987.0	16,100	16,300	32,400
HL11	199.0	199.0	199.0	199.0	199.0	950.0	3,750	4,700

Figure 4-3-3: Map and Analytical Table for the Haller Lake Evaluation Area

4.4 DIAGONAL AREA

Field Evaluation Area:	Diagonal
Date(s):	11/20/2020
Duration:	2 hrs.
Weather:	50Fs, overcast with intermittent rain
Personnel:	UW Handler: J. Ubigau SPU Inspector: A. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Industrial
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☐ Site access ☒ Drainage structure investigation
Target Buildings in Evaluation Area?	1
Discovered Probable PCB Structures?	0
Discovered Possible PCB Structures?	0

Evaluation Summary:

On November 20, 2020, a field investigation was conducted in the Industrial District area. The area searched was approximately a four-by-four block area of industrial use and encompassed a historic PCB spill area that was cleaned up in 2019 (Figure 4-4-4). The area also has a scrap metal yard that can present strong odors that could make it difficult to identify sources by odor. This neighborhood was chosen because one target building was identified as a PCB source, was known to have a moderately strong odor of PCBs, and is accessible in a public space.

The target building was first located by odor recognition by an SPU Inspector in 2017. At that time, samples were collected from four private stormwater catch basins along the perimeter of the building with permission. The samples were analyzed for the typical list of chemicals of concern as a routine process in the Duwamish Waterway sediment remediation area.

The four catch basin solids samples taken in 2017 near this target building were collected near the west wall at the office windows, at the west wall to the south near the warehouse loading dock door, at the base of the north vehicle ramp to the upper parking on the roof, and a catch basin near the northeast building corner between the building and the raised roadway of 1st Ave S. None of these catch basins would be affected by nearby buildings or other known sources of PCBs. Results of the samples showed that all catch basins had PCB levels above 1,000 ug/kg. The sample near the office windows was the most elevated at 4,492 ug/kg (DG1). The west wall PCB sample near the loading dock was 1,192 ug/kg (DG2). The catch basin at the base of the roof driveway was 1,219 ug/kg (DG3). And the catch basin at the northeast building corner had a result of 1,250 ug/kg (DG4).

The target building was within this search area but neither the SPU inspector nor the dog handler was aware of the location.

As part of this field investigation, one aspect of this day's search was to use the dog to confirm the effectiveness of a previous PCB spill cleanup along Denver Ave S. In 2019, an SPU inspector discovered a large PCB spill along this roadway by odor recognition as he was driving by the area with the vehicle windows rolled down. A sample taken at the time of discovery along the south shoulder of the road and analyzed for PCB Aroclors had results of 40,300,000 ug/kg of Aroclor 1242, an Aroclor that is rarely

found in media samples collected in this area (DG5). Aroclor 1242 is an Aroclor that Jasper had not been trained on. At the time of spill discovery in 2019 and during cleanup it was noted that this Aroclor had a similar but uniquely different odor compared to the typical odor of Aroclors 1254/1260. The spill was cleaned up in 2019. Nearly a block of roadway shoulder was excavated and disposed and paved over with asphalt, the street cleaned, and the drainage system jetted and cleaned repeatedly to remove this PCB all the way to the connection to a mainline drainage pipe tide gate. A sample was collected downstream of the spills in the mainline and it measured as high as 6,009 ug/kg PCB (DG6).

Prior to the scheduled field investigation day, the SPU inspector was not given a map of the area or asked to prepare a plan for the field evaluation strategy. The SPU inspector was verbally instructed to try to determine the age of buildings in the area during the event to help the handler focus on older buildings and avoid newer structures. This building age evaluation would be left to the inspector and dog handler to determine during the investigation. A printed map of the area was provided for the team to take notes.

The field investigation began with a quick surface area search of the spill area and drainage pickhole search of stormwater system that was cleaned during the spill response in 2019. After the evaluation of the spill area, an area search was conducted of properties to the south to see if any buildings in this area could be found to contain PCBs.

Spill area cleanup confirmation and drainage structure pickhole search:
The spill area searched was both sides of the roadway for a block as well as the drainage structures and surface dirt on the street. This area consisted of a newly paved south shoulder which covered over the cleaned-up spill area. This paved area has concrete Ecology Blocks in place to help exclude encampments and RV parking. During staging of supplies and exclusion fencing at the time of the spill, many of these Ecology Blocks were placed along the roadway and on the roadway shoulders in the contamination zone to keep the unhoused population from occupying this space. During spill cleanup, four of the concrete Ecology Blocks were deemed to be PCB contaminated at levels that could be detected by odor by SPU inspectors, and these four were sent for disposal.

During this detection dog field evaluation, Jasper screened these remaining Ecology Blocks along the roadway for any undetected contamination that initially escaped the inspectors notice and Jasper found three more concrete Ecology Blocks with slight detectable odor of PCB. The blocks detected by Jasper were also confirmed by odor recognition by the detection dog handler and dog team members. These concrete Ecology Blocks were marked with green paint and Seattle Department of Transportation was notified to dispose of these additional blocks. No samples were obtained from these blocks.

The remainder of the surface area on both sides of the street was inspected by Jasper and he found no additional significant PCB sources. He showed a low interest along the south fence line at the property line where the asphalt pavement transitions to gravel, but his interest was minor, and this area was considered insignificant. The surface area (paved and unpaved roadway shoulder and paved roadway surface) in the spill cleanup area was considered clean as a result of this detection dog inspection.

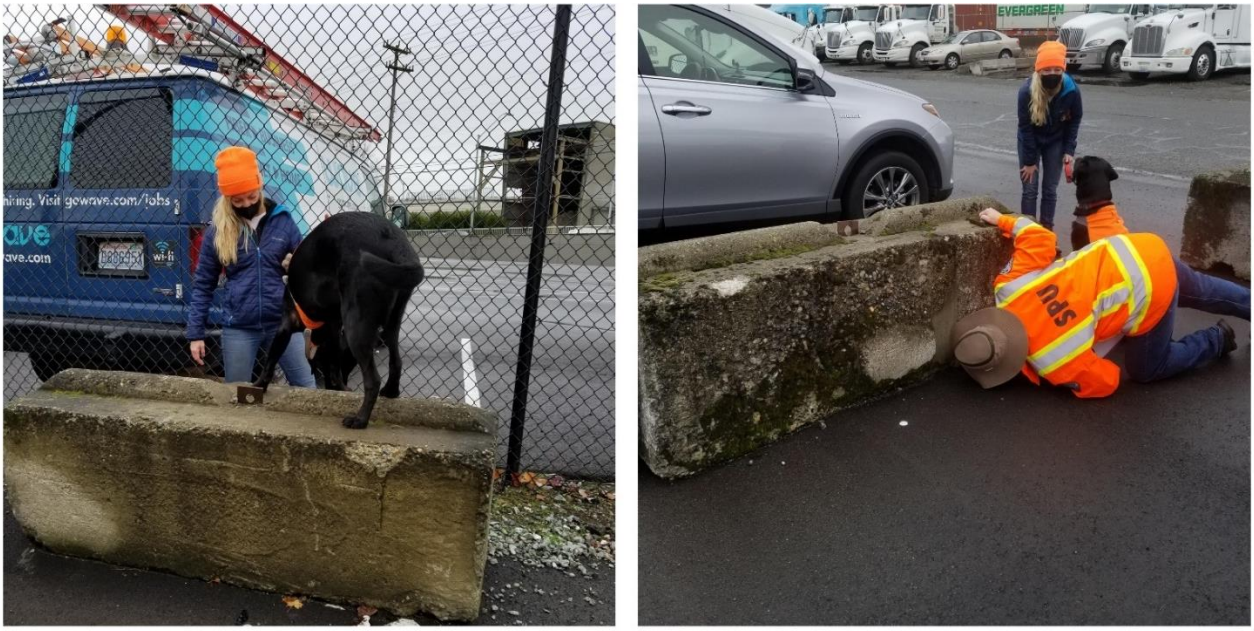


Figure 4-4-1: Left: Jasper inspecting cement block. Right: SPU Business Inspector confirmed PCB presence on a cement block Jasper identified.

The public drainage system was inspected next. The 2019 PCB spill happened along an avenue that runs SE to NW with a 36-inch drainage pipe beneath the centerline of the avenue. The drainage flows to the northwest about a quarter mile through this 36-inch diameter stormwater pipe and empties into a settling vault prior to entering a large ten-foot diameter stormwater mainline through a tide flap gate. Samples collected in the 36-inch pipe and the ten-foot mainline at the time of the spill clean-up process indicated that the PCBs stayed mainly in the smaller pipe behind the tide gate. PCB levels in the settling vault were measured as high as 62,561 ug/kg (DG7) Aroclor 1242 in 2019 and had been reduced to 9,300 ug/kg (DG9) in January 2021. The downstream samples in the large 10-foot drainage mainline had only minor impact during the spill and PCBs were only measured at 307 ug/kg PCBs (DG8) in 2019 just downstream of the tide gate. To inspect the drainage system, Jasper was directed to check all drainage structures from about a half block upstream of the original spill to just beyond the tide gate in the large mainline pipe.

Jasper began his drainage search a half block upstream of the spill origin and showed no interest in the initial maintenance hole odor. Further northwest, up the block at the origin of the spill, is a stormwater inlet on the spill side of the avenue which connects to a catch basin on the far side of the roadway before it enters the 36-inch drainage pipe in mid street. Although the inlet and catch basin were repeatedly cleaned during the remediation of the spill site, Jasper identified both structures as containing PCBs. No additional samples were taken of these structures at this time, but they are to be monitored yearly to assess the effective removal of the spilled PCBs and cleaned as needed.

Jasper continued up the street to the northwest (down the drainage pipe direction of flow) continuing to smell the pickholes in the street maintenance holes and the inlets and catch basins along the edge

of the roadway. About a block to the northwest of the spill, Jasper identified a maintenance hole and two catch basins on either side of the avenue as an area of interest but with low confidence by the dog handler. On January 14, 2021, these structures were sampled, and the solids analyzed for PCBs. The samples were collected from the two catch basins were 411.3 ug/kg PCBs (DG10) and 271 ug/kg PCBs (DG11). The maintenance hole sample were measured at 2,315 ug/kg PCBs (DG12) and 1,0437 ug/kg PCBS (DG13). Results from the two catch basin samples were reviewed and thought to be insignificant at the time but they are above the level that Jasper has been proven to identify.

Figure 4-4-2: Jasper sniffing the pickholes through a maintenance hole lid for PCBs in the mainline.

Jasper moved quickly up the street checking the drainage system at each maintenance hole and the catch basins along the edge of the avenue. This section of roadway was not in the spill contamination area and no PCBs were expected to be found in the catch basins along this section of roadway. Jasper did not identify any of these structures as containing PCBs.

Jasper finally arrived at the settling vault before the tide gate and signaled with a strong positive response at the pickhole of the vault. Detection dog team members could also recognize the odor of PCBs at this vault maintenance hole. Jasper checked the maintenance hole on the downstream side of the vault tide gate and had no response for PCB. It was clear that Jasper was detecting PCBs from this drainage system through the maintenance hole pickholes and not detecting it in the drainage system that was lesser exposed to PCBs. Although this was SPU's only real testing of use of detection dogs for drainage system inspection, this process looks promising in areas of potential high PCB sources.

Area Search:

The area search began along the northern edge of the target area and then worked south and to the east around industrial sites and commercial buildings. The businesses along this route were distant from the public space and the dog handler focused on Jasper's change in patterns to detect if he was picking up odor on the wind.

After a few blocks, Jasper arrived at the target building. It looked like he caught the odor on the wind just before he arrived at the building and then homed into the source quickly. He showed a strong positive interest in the vertical concrete joint caulking seams. These seams were easily identified as containing PCBs by the dog handler and dog team inspector.

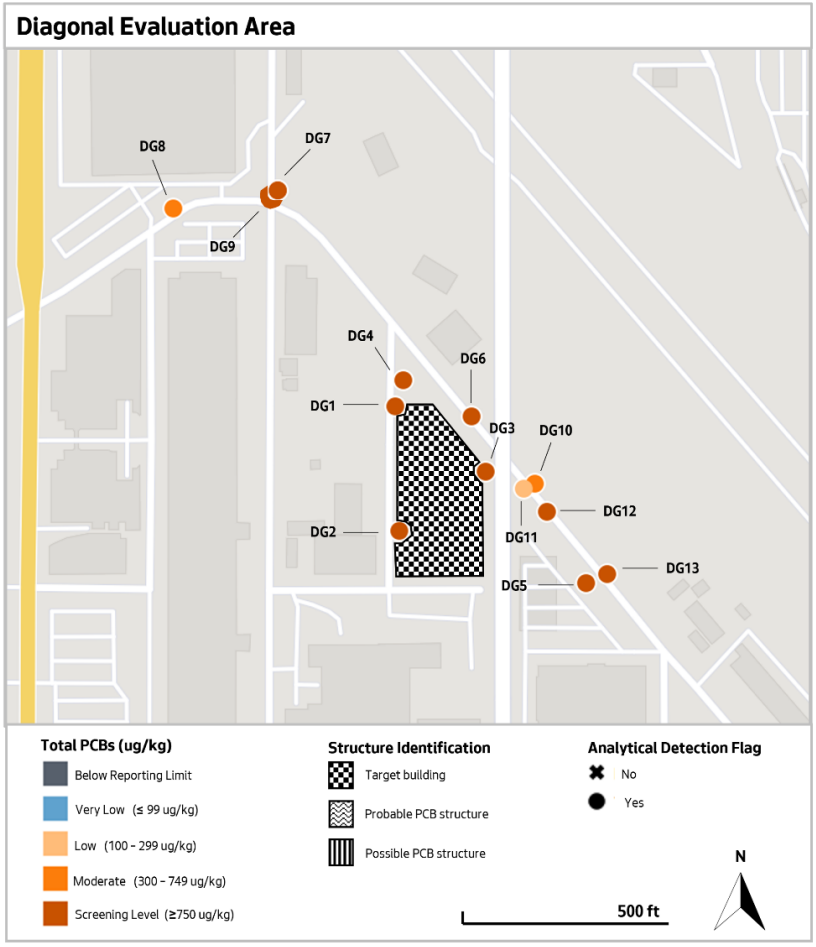
Figure 4-4-3: Left: Jasper sniffing the window caulk at the target building. Middle: Jasper displaying a definitive 'sit' confirming PCBs in the window caulking. Right: Jasper sniffing the joint caulking seams at the target building.

As Jasper progressed along the west building wall to the north, he encountered air conditioning units at the base of the office windows at about his nose level. He showed strong positive results along the top of the air conditioning unit at about the middle of the unit. This location was not adjacent to the caulking seams and the windows did not have caulking that interested Jasper. It was not until we looked up the wall above the window that we noticed the vertical joint seam ended just above the window at the point where Jasper showed the strongest interest in the top of the air conditioner. Water drips down the seam and splashes on the air conditioner top at this point and was likely associated with the odor detected by Jasper. In this instance, Jasper notified on a distant source that was carried by stormwater to this point of detection.

No further samples were collected from near the target building. The field investigation was concluded after the target building was found at 13:00.

Diagonal Evaluation Area Takeaways:

- Look up for the PCB source. Jasper smelled PCB in the middle of the windows at the target building. When we looked up, we found there was caulk along the wall right above the windows.
- Jasper can smell PCBs through the pick holes of maintenance holes. This is great for his safety, and we do not have to open the MH lid each time.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
DG1	18.8	18.8	18.8	18.8	342.0	1,850	2,300	4,492
DG2	18.8	18.8	18.8	18.8	227.0	425.0	540.0	1,192
DG3	19.3	19.3	19.3	19.3	174.0	512.0	533.0	1,219
DG4	19.2	19.2	19.2	19.2	217.0	516.0	517.0	1,250
DG5	194,000	194,000	194,000	40,300,000	194,000	194,000	372,000	40,300,000
DG6	99.5	99.5	99.5	4,860	99.5	950.0	199.0	6,009
DG7	499.0	499.0	499.0	61,600	499.0	499.0	961.0	62,561
DG8	19.8	19.8	19.8	307.0	19.8	19.8	19.8	307.0
DG9	200.0	200.0	200.0	200.0	4,750	3,140	1,410	9,300
DG10	20.0	20.0	20.0	20.0	87.6	230.0	93.7	411.3
DG11	20.0	20.0	20.0	20.0	98.4	78.9	93.2	270.5
DG12	99.5	99.5	99.5	99.5	1,280	712.0	323.0	2,315
DG13	19.9	19.9	19.9	19.9	722.0	224.0	97.9	1,043.7

Figure 4-4-4: Map and Analytical Table for the Diagonal Evaluation Area

4.5 Uptown Area

Field Evaluation Area:	Uptown	
Date(s):	3/3/2021	8/17/2021
Duration:	2 hrs.	1hr. 15 mins
Weather:	Low 50Fs, sunny with slight winds	Mid 60Fs, overcast with slight winds
Field Survey Team:	UW Handler: J. Ubigau SPU Inspector: L. Peterson Additional SPU staff: M. Jeffers, A. Bidwell	UW Handler: J. Ubigau SPU Inspector: A. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Commercial
Bench calibration prior to field evaluation?	Yes
Field evaluation type:	☒ Perimeter search ☐ Site access ☐ Drainage structure investigation
Target Buildings in Evaluation Area?	1
Discovered Probable PCB Structures?	2
Discovered Possible PCB Structures?	2

Evaluation Summary:

On March 3, 2021, the first field evaluation was conducted in the Lower Queen Anne area, or Uptown, as the neighborhood has been recently named. The area searched is approximately a four by three block area of commercial and residential use (Figure 4-5-5). This neighborhood was chosen because the general ages of buildings looked appropriate for the PCB era and there has been limited redevelopment since the 1980s. Also, a single known target building complex was located within this search area but neither the SPU inspector nor the dog handler would be aware of its' location. The target building was first identified in 2019 by odor recognition by SPU inspector from a block away. A sample of stormwater catch basin solids was taken next to the building on September 19, 2019, and analytical results for PCBs in this sample were extraordinarily high at 34,040 ug/kg (U1).

Figure 4-5-1: Map of Uptown evaluation area with building ages identified to simplify screening process

Prior to the scheduled field evaluation day, the SPU inspector was given a map of the area and asked to prepare a plan for the field evaluation strategy using the detection dog team. In this case, the SPU inspector mapped out each building in this search area and conducted research on the age of each building to display it on the map taken into the field. This process helped eliminate newer buildings from inspection and highlighted the more likely target buildings to investigate, which increased the search efficiency. Using the map, buildings built after 1980 were excluded from dog inspection.

Figure 4-5-2: Jasper smelling the window caulking of a probable PCB structure on March 3, 2021 (Building 1)

On the day of field evaluation and prior to departing for the field survey, Jasper was assessed for his PCB detection ability with a bench test protocol at the Wharf building. A single bench was used with three open sample slots. This sample evaluation process was to test Jasper's ability to evaluate samples that may have been collected in the field for a quick scan in a safer setting and at a more rapid evaluation pace. This was also thought to be a way to prepare Jasper for his field work and refresh his PCB recognition response. Jasper had been trained using this bench technique with a single target training sample of elevated PCBs and the other two samples in the bench clean. In the test this day, samples with known PCB levels were placed in the bench as a single target of the three, multiple targets in the same bench, or no targets in the test bench. Jasper had not been trained to identify more than one significant target in the bench and he had not been trained that there could be no target in the bench. These were new possibilities he was not be prepared for.

Figure 4-5-3: Target Building – Jasper indicating a positive identification of the Target building on March 3, 2021

Jasper's response to the bench testing was good when presented with a single target sample but he became confused with multiple targets and with a bench containing no PCB targets. This activity identified a possible need to have him trained to accept the possibility that no target was possible and that multiple targets could be possible. For testing using a single target, Jasper was able to confirm

samples as low as 85 ug/kg PCBs and proved ready for the day in the field. Though he was able to find very low levels of PCBs, it is still uncertain if this low level of PCB detection is a good attribute or could hinder work in finding the higher range targets. The testing did help Jasper focus to start the day and confirm that he would be operating as expected in searching for PCB sources.

The field evaluation was started at 13:00 on a sunny but cool day with temperatures in the 50s and a light wind from the south. The SPU inspector, in consultation with the dog handler, decided to run the detection dog on the north perimeter of the search area first, hoping to have the wind push air up the streets from south to north allowing detection of sources at the upwind end of each street. This technique did not result in any known detection from Jasper at the northern perimeter search. The rest of the grid was then systematically searched starting in the west moving to the east while focusing on the older buildings identified on the SPU inspector's map. About halfway through the search area and before finding the target building, Jasper identified strongly on a building built in 1958 (Building 1). The team was able to quickly determine that caulking around the window frames on this building did contain PCBs and Jasper was rewarded. This building was an unknown target and the first building identified by the detection dog that was an unknown PCB source.

Jasper also searched the opposite side of the street and did not indicate a source (later identified as Building 2). It was determined at this time that samples should be taken of soil at the sidewalk in front of the newly identified suspect building, at the stormwater catch basin immediately downstream of the suspect building, and soil from the sidewalk across the street in an area that Jasper did not identify as a PCB source. Samples would be collected on a later day and help better confirm if the building is a likely source of PCBs.

The search of the area was resumed, and Jasper was able to easily locate the target building. He was observed catching the scent of this target building at a slight distance from the suspected source of window caulking and joint compound caulking. The closer he came to the source the more positive his reaction.

On March 16, 2021, samples of sidewalk surface dirt, stormwater catch basin solids, and solid materials from street gutters were taken near the newly discovered building identified by the detection dog (Building 1). Sidewalk dirt nearest the building (U2) was elevated at 670 ug/kg PCBs, which confirmed the building as a likely source of PCBs. The nearby stormwater catch basin (U3) also had detectable PCBs but at a lower concentration of 115 ug/kg. The dirt sample taken across the street on the sidewalk (U4) also had detectable level of PCBs at 104 ug/kg (Building 2), causing some concern that the detection dog may have missed a low-level target at this location. It was decided later in the year that this area would be searched again to see what Jasper might find in a more focused investigation of this sidewalk.

On August 17, 2021, a second more focused evaluation was conducted in this neighborhood using the SPU detection dog team. This field evaluation was no longer an area search as it would focus specifically on multiple target buildings that were identified as possible sources due to their age, appearance, and nearby collected samples. The purpose of the investigation was to look at the site (Building 2) near the sidewalk dirt sample with elevated levels of PCB located across the street from

Building 1 identified by Jasper in the March 3, 2021, field investigation. The investigation would also look at two additional buildings (Building 3 and Building 4) that were outside the original search area on March 3, 2021. Buildings 2 and 3 were constructed in 1955, and Building 4 was constructed in 1972.

Jasper searched Building 2 near the previous sidewalk dirt sample (U4) that was detected at 104 ug/kg PCBs. He showed a mild to moderate interest in the building near this sample but no interest in buildings further up or down the street. His interest seemed to be focused on the painted walls of this building.

Figure 4-5-4: Exterior photos of the possible PCB structure identified by Jasper on August 17, 2021 (Building 3).

To reconfirm a previous investigation, Jasper indicated with a strong positive response at Building 1 discovered on March 3, 2021, located across the street from Building 2. The difference in Jasper's responses between the two buildings was noticeable. At the second building to be investigated (Building 3), Jasper had a mild to moderate response on the east side of the building as it abutted the sidewalk. As with Building 2, Jasper's interest was in the painted wall of Building 3.

At the third building of the day (Building 4), Jasper had a strong positive response, and this building was also confirmed by odor recognition by the dog team and study team to have PCB in the window caulking.

Samples near the buildings of interest were taken on August 20, 2021, and on August 23, 2021. A sample of sidewalk dirt (U5) was taken directly south of Building 1 and had elevated PCB levels of 169.8 ug/kg.

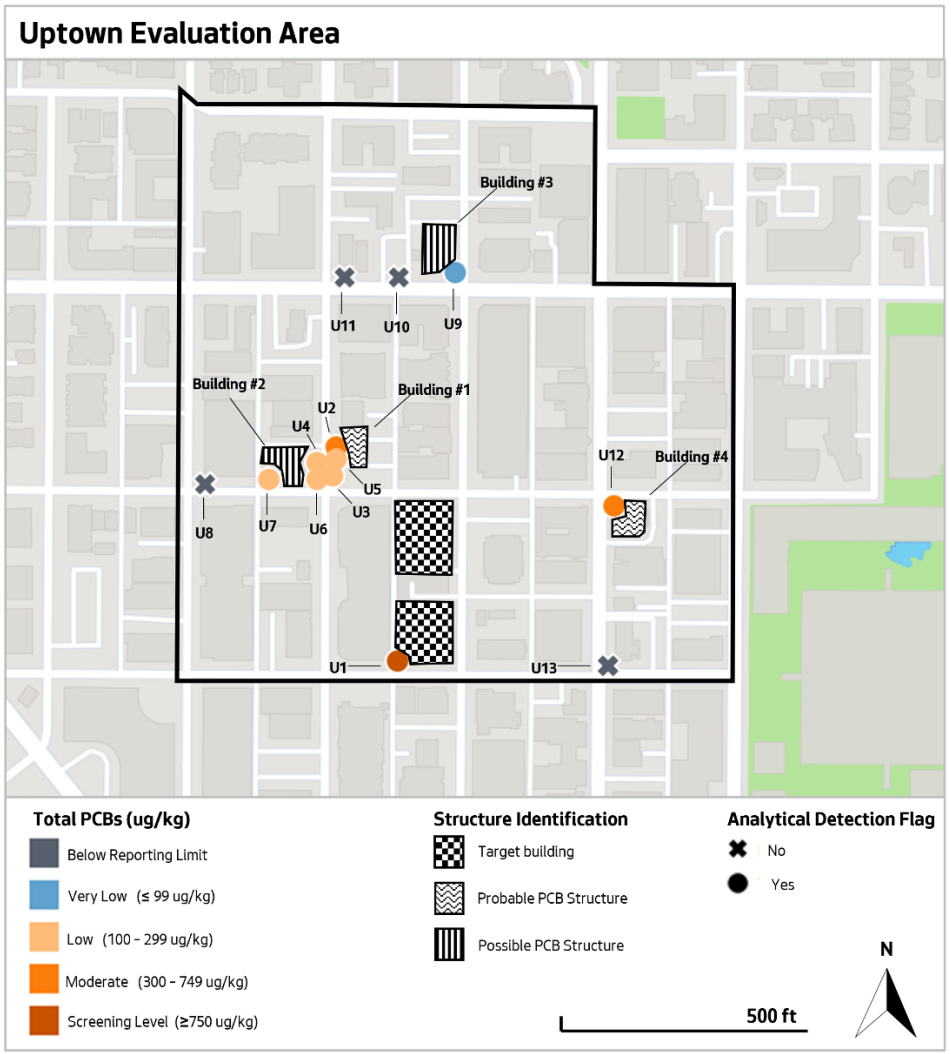
Results of the samples showed that Building 2 located across the street from the known PCB source (Building 1), had elevated PCB levels of 168.1 ug/kg PCBs in the sidewalk dirt (U6) immediately downstream and within feet of the wall of the building while the sample taken just downstream from this building in the street gutter (U7) was 152.3 ug/kg PCB. The sampling results reinforce that this building is a possible source of PCBs. The nearest downstream stormwater inlet (U8) about a half block away was also sampled and came back as not detected above the reporting limit of 20 ug/kg.

Samples taken nearest to the east wall of Building 3 in the storm drain catch basin (U9) were slightly elevated at 79.8 ug/kg PCBs, while the samples taken downstream of this building at a half block and a full block away were not detected above the reporting limit of 20 ug/kg (U10) and 19.9 ug/kg (U11) PCB. Though the sample taken nearest to the building was only slightly elevated, it could not be ruled out as a possible source due to the definite difference between samples taken in the immediate vicinity of this building.

Samples taken near Building 4 in the sidewalk nearest the windows (U12) were elevated for PCBs at 359 ug/kg, indicating that this building is a likely source of the PCBs and likely confirms the detection dog finding. A final sample was taken down the street from Building 4 and came back as not detected above the reporting limit of 19.9 ug/kg. This last sample was heavily impacted by construction activities nearby and was unreliable for measuring impact from Building 4.

Uptown Evaluation Area Takeaways:

- The detection dog was able to locate previously unknown probable and possible PCB buildings.
- The detection dog was able to locate known target buildings.
- The detection dog may miss lower-level sources from painted buildings.
- Use of a predetermined area map with building ages displayed can speed up the search process.
- Even low-level detection of PCBs in samples near a source could indicate that a PCB source is present nearby. Samples as low as 80 ug/kg found in an area with background samples in the non-reportable range could mean that a building source is nearby.
- When the detection dog and humans can smell PCBs at a source, nearby dirt or catch basin solids are relatively higher than surrounding samples near no known sources.
- How do we classify buildings that we find or suspect (Likely Source, Probable Source, Possible Source)?



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
U1	2,220	2,220	2,220	2,220	2,220	28,300	5,740	34,040
U2	99.7	99.7	99.7	99.7	99.7	251.0	419.0	670.0
U3	19.9	19.9	19.9	19.9	19.9	68.4	46.6	115.0
U4	19.7	19.7	19.7	19.7	19.7	74.5	29.8	104.3
U5	20.0	20.0	20.0	20.0	20.0	85.1	84.7	169.8
U6	20.0	20.0	20.0	20.0	20.0	132.0	36.1	168.1
U7	20.0	20.0	20.0	20.0	20.0	75.6	76.7	152.3
U8	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
U9	20.0	20.0	20.0	20.0	20.0	49.5	30.3	79.8
U10	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
U11	19.9	19.9	19.9	19.9	19.9	19.9	19.9	19.9
U12	19.9	19.9	19.9	19.9	19.9	223.0	126.0	349.0
U13	19.9	19.9	19.9	19.9	19.9	19.9	19.9	19.9

Figure 4-5-5: Map and Analytical Table for the Uptown Evaluation Area

4.6 First Hill Area

Field Evaluation Area:	First Hill
Date(s):	3/4/2021
Duration:	2 hrs.
Weather:	Low 50Fs, dry with slight winds
Personnel:	UW Handler: J. Ubigau SPU Inspector: A. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Commercial, Residential
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☐ Site access ☐ Drainage structure investigation
Target Buildings in Evaluation Area?	2
Discovered Possible PCB Structures?	0
Discovered Probable PCB Structures?	1

Evaluation Summary:

On March 4, 2021, a field evaluation was conducted on First Hill, a commercial and multi-tenant residential area of the city (Figure 4-6-3). Many of the commercial businesses in this area are associated with health care and most buildings in the area are tall. The residential areas consist of apartments and condominium buildings. About half the buildings in this area are set back a short distance from the public space sidewalk and were not directly accessible by the dog unless permission was granted. There were two target buildings in this search area that were discovered by odor recognition by an SPU inspector in previous years.

Both target buildings were discovered due to the strong odor of PCB recognizable by the inspector a great distance from the buildings. In the original discovery of these target buildings, odor from both buildings was noticeable across the street and downwind of the buildings. In 2018 and 2019, samples of solids from stormwater structures on or next to these two target properties were obtained and analyzed for PCB Aroclors. Building 1 had an onsite stormwater catch basin on the northside of the property sampled and reported at 54,210 ug/kg (FH1) PCBs. Two additional samples were taken near this building, one from an onsite stormwater catch basin located in the south parking lot with a reported PCB level of 1,404 ug/kg (FH2), and one from the street gutter downstream of the property with a reported PCB level of 591 ug/kg (FH3).

Near Building 2, a sample was taken off-property in a public catch basin with a reported PCB level of 1,750 ug/kg (FH 7). The off-property sample would only be impacted by the target building and no other fixed source. Both odor and sample analysis results are strong indicators that the properties are a source of PCBs.

Since taking samples in 2018, one of the target buildings was remodeled, removing, and replacing windows in this multi-story building. The second target building had minor remodeling of the exterior shell of the building that may have impacted the caulking on or around the windows.

Neither the SPU inspector nor the dog handler were aware of the two target building locations or how many targets could be in the search area. Prior to the start of the search in this area, the SPU inspector

was asked to map the search area and identify buildings built after 1980 to assist in screening out buildings not likely to contain PCBs. The purpose of this pre-screening was to make the search event quicker and more focused.

Figure 4-6-1: Building 1 – Caulking seams identified by Jasper

The property manager of one of the target buildings was contacted to seek permission to run the detection dog on the property during the search and permission was granted. Though the permission was given to access the property, during the search the team decided to stay on the public sidewalk as much as possible and to not enter private property.

The detection dog team started the search at approximately 11:00 and almost immediately encountered one of the target buildings (Building 1). Jasper showed a strong positive response on the south side of the building along the sidewalk which was separated from the building by a hedge. The odor of PCB was discernable from this property at the sidewalk, but it was faint and intermittent. It was decided to return later and take a sample of the sidewalk dirt in the sidewalk expansion joints along this wall of the building to again verify PCBs at this location.

The search continued to the south and at a commercial building complex (Building 2 – multiple buildings by the same tenant and owner) Jasper alerted with moderate interest along the northwest corner of one of the buildings and then again along windows on the south side of one of the buildings. The easiest location to take a sample was the northeast corner of the property where stormwater striking the building would sheet flow to the street inlet and catch basin. A sample was obtained from this location on another day.

As the search progressed, it was noted that at an intersection along the search path that there was no interest in PCBs by Jasper. SPU later sampled from this "clean" area to determine if PCBs were not present in the area as indicated by the detection dog and if clean, how low of a background level of PCBs were present in the area. The intent was that this could help assess other samples taken in the area as to whether they were elevated above the background/dog identified clean zone.

The search moved back again to the north and then east across a main roadway arterial to a neighborhood of mostly large multi-tenant residential buildings. This area was searched moving from north to south and most buildings in this area were close to the sidewalk and accessible by the detection dog from the public space. The second target building (Building 3) was identified by Jasper with a strong positive response at the sidewalk. The odor from this building was only faintly recognizable by dog handler and SPU inspector but enough to confirm the building as a target. Two

more sample areas near Building 3 were identified for a later sampling event to verify this source. At this time, the search was concluded.

On March 16, 2021, samples were collected from the identified sample locations noted during the search.

A sample was taken from the sidewalk dirt on the south side of Building 1 near the hedge line. Results from the analysis of this sample came back with 16,300 ug/kg PCB (FH 4) to confirm this site as a source of PCBs.

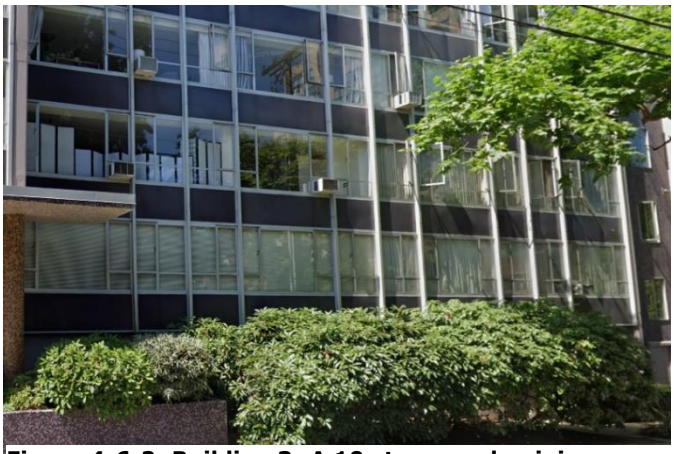


Figure 4-6-2: Building 3- A 10 story condominium complex built in 1960

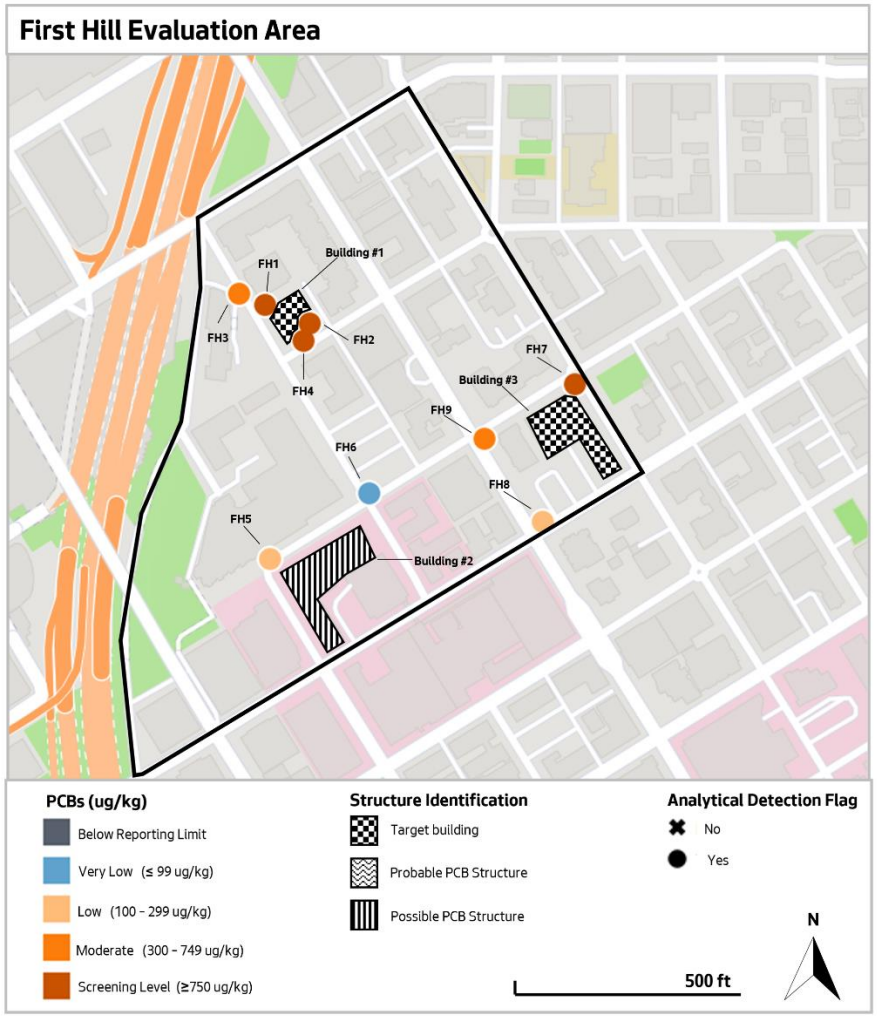
The sample collected at the northwest corner of Building 2 had PCB results of 179.1 ug/kg (FH 5) which was considered low. However, the sample collected a block away and upgradient from this location at the "clean area" showed a measurable but very low presence of PCBs and was quantified at 36 ug/kg (FH 6) total PCBs. SPU theorizes that this may indicate that Building 2 may be a low-level source or that something is contributing PCBs at low levels to the sample location for Building 2.

Two more samples were collected and analyzed near Building 3, each taken a block to the west and down gradient from the building. Results from analysis of these samples were 297 ug/kg (FH 8) and 378.8 ug/kg (FH 9) PCBs and would be impacted, but not significantly, by stormwater from this property.

First Hill Evaluation Area Takeaways:

- A sample was taken in an area suspected to be clean, screened by the detection dog as clean, and it was the lowest level of PCB in samples collected from this area. Any PCB levels in samples above this background could indicate a source of PCBs influencing the sample location.
- A sample taken near a moderate detection dog response was elevated at 179.1 ug/kg PCBs which is low. However, this sample was above the clean sample level taken only a block away. It is thought that this could be the signature of PCB paint on the building or another unknown source.
- One target was clearly identified by a strong response by the dog, odor detection by humans, and samples taken adjacent to the building. The results from this target building clearly demonstrated the ability of both human and detection dog odor recognition of a PCB source building.
- One target building was detected strongly by the detection dog, mildly by human recognition of PCB odor, and sample results taken downhill of the target building were measurable.
- Pre-screening the area to rule out newer building helped speed up the process of investigation. Having the SPU inspector direct the detection dog handler to ignore buildings built in 1980 or

newer helped the dog handler focus on the dog and the SPU inspector control the flow of the search.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
FH1	1,980	1,980	1,980	1,980	12,200	32,700	9,310	54,210
FH2	19.8	19.8	19.8	19.8	19.8	941.0	463.0	1,404
FH3	20.0	20.0	20.0	20.0	107.0	351.0	133.0	591.0
FH4	993.0	993.0	993.0	993.0	993.0	13,500	2,800	16,300
FH5	20.0	20.0	20.0	20.0	20.0	120.0	59.1	179.1
FH6	20.0	20.0	20.0	20.0	20.0	36.0	20.0	36.0
FH7	19.3	19.3	19.3	19.3	19.3	1,040	710.0	1,750
FH8	20.0	20.0	20.0	20.0	20.0	149.0	148.0	297.0
FH9	19.9	19.9	19.9	19.9	19.9	292.0	86.8	378.8

Figure 4-6-3: Map and Analytical Table for the First Hill Evaluation Area

4.7 BALLARD AREA

Field Evaluation Area:	Ballard
Date(s):	3/5/2021
Duration:	2 hours
Weather:	Low 50Fs, light rain with no winds
Personnel:	UW Handler: J. Ubigau SPU Inspector: A. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Commercial, Residential
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☐ Site access ☐ Drainage structure investigation
Target Buildings in Evaluation Area?	1
Discovered Possible PCB Structures?	2
Discovered Probable PCB Structures?	1

Evaluation Summary:

On March 5, 2021, a field evaluation was conducted in the Ballard area. The area searched was an approximately five-block area of commercial use (Figure 4-7-5). This neighborhood was chosen because one target building was tentatively identified as a PCB source and was known to have a faint odor of PCBs. The target building was located within this search area but neither the SPU inspector nor the dog handler was aware of its' location. The target building was found in 2018 by a SPU inspector by odor recognition while on a walk. This inspector returned to the office and asked two other SPU inspectors known to have the ability to smell PCBs to search this commercial area using their sense of smell to locate any possible buildings with PCBs as a random experiment. Both inspectors found the same building as the initial inspector.

Figure 4-7-1: Building 1 – A commercial property built in the 1970s

Prior to the scheduled field evaluation day, the SPU inspector was not given a map of the area or asked to prepare a plan for the field evaluation strategy. The SPU inspector was verbally instructed to try to determine the age of buildings in the area during the event to help the handler focus on older buildings and avoid newer structures. This building age assessment would be left to the SPU inspector and dog handler to determine during the investigation. Buildings in this area are mostly built to the property line and accessible from the sidewalk.

Prior to field evaluation, Jasper "warmed up" using bench testing methods at the Wharf building (see section 5 for bench testing details). Various target samples were presented to Jasper using the bench method to see how well he chose targets with detectable levels of PCB. Samples used would consist of clean sand or dirt spiked with low levels of PCB or field collected samples that had been analyzed to determine their PCB concentrations. This testing before departing for the field seems to help focus Jasper and get him

honed into the scent for the day. The field evaluation was started at about 11:00 am on a cold, windy, and rainy day with temperatures in the low 50s and a light wind from the south. At the end of the first street searched, Jasper strongly identified a building set back from the sidewalk about five feet as a potential PCB source (Building 1).

Jasper clearly picked up the scent from the sidewalk and made repeated attempts to approach the windows of the building. The SPU inspector and dog handler were able to confirm the odor of PCB at this location. This building, built in 1970, was not previously known to the team as a PCB building and was a unique find by Jasper. A confirmation sample of sidewalk dirt was taken near this building on March 25, 2021. Results from the PCB analysis were slightly elevated at 236.2 ug/kg (BA 1). The sample was collected from an area that had only a slight exposure to the building material at this location. The building has an overhang and landscaping that separates the building from the sidewalk sample area.

The next building that was indicated by Jasper to possibly contain PCBs was a building built in the 1920s and had retail shops at the ground floor that abut the sidewalk (Building 2). Jasper showed a moderate interest in the panels below the front retail shop windows and in the sidewalk near these windows.

Figure 4-7-2: Building 2 – Jasper only showed interest in the seams around the lower blue panels at this commercial property

No odor of PCBs was noticed by the dog handler or SPU detection dog inspector at this site. Jasper's interest was significant enough to warrant taking a confirmation sample. A confirmation sample of sidewalk dirt was taken in front of this building on March 25, 2021. Results from the PCB analysis were elevated at 295 ug/kg (BA 2). The sample was collected from an area that had only an exposure to the building material at this location. This building was considered to be a possible source of PCBs.

Continuing down this sidewalk another block west, Jasper strongly identified a concrete pillar at the site of a recent structure fire that had destroyed a large storefront area of the block (Building 3). The pillar was damaged by fire and subsequent demolition of the fire damaged building which had left the pillar with multi-layers of exposed paint. The deeper paint layers had a recognizable odor of PCBs.

Though SPU inspectors had previously commented that PCBs could be smelled near this area before the fire, this building, built in 1927, was not previously known to the team as a source and was also a unique find by Jasper. A confirmation sample of sidewalk dirt was taken adjacent to this building pillar on March 25, 2021. Results from the PCB analysis were highly elevated at 7,560 ug/kg (BA 3). The

sample was collected from an area that only had an exposure to the building material at this location. Another sample was collected from a catch basin in the street adjacent to the property but distant from the pillar. Results from the PCB analysis were below the reportable detection limit and considered non-detectable (BA 4). This catch basin had been thoroughly cleaned after the fire to remove fire debris and possible PCB residues suspected to at or near this fire damaged building.

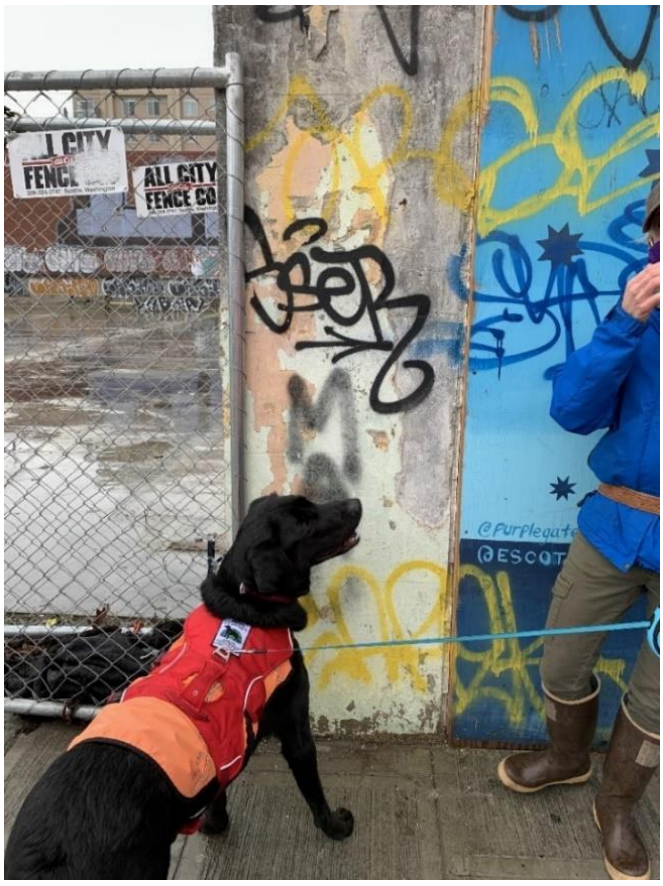


Figure 4-7-3: Building 3- Jasper indicating a positive confirmation of an exposure paint layer

Jasper continued to investigate retail shops and showed a low interest in paint in front of a store (Building 4), but his response was not considered to indicate a likely source though it was marked for sampling for confirmation. A confirmation sample of sidewalk dirt (BA 5) was taken near this building on April 9, 2021. Results from the PCB analysis were below the reportable detection limit and considered non-detectable. The sample was collected from an area that only had an exposure to the building material. This building was considered to not be a source of PCBs.

Jasper again showed a curiosity at another retail shop and the sidewalk in front of the store (Building 5), but showed no strongly positive indication and it too was marked for sampling. A confirmation sample of sidewalk dirt (BA 6) was taken near this building on March 25, 2021. Results from the PCB analysis were 28 ug/kg. The sample was collected from an area that had only an exposure to the building material at this location. An additional sample was collected from a nearby catch basin (BA 7) and the PCB results were below the reportable detection limit and considered non-detectable. This building was considered to not be a source of PCBs.

A sample of sidewalk dirt was taken between Building 3 & 4 from a spot Jasper showed no interest to verify as a negative control (BA 8).

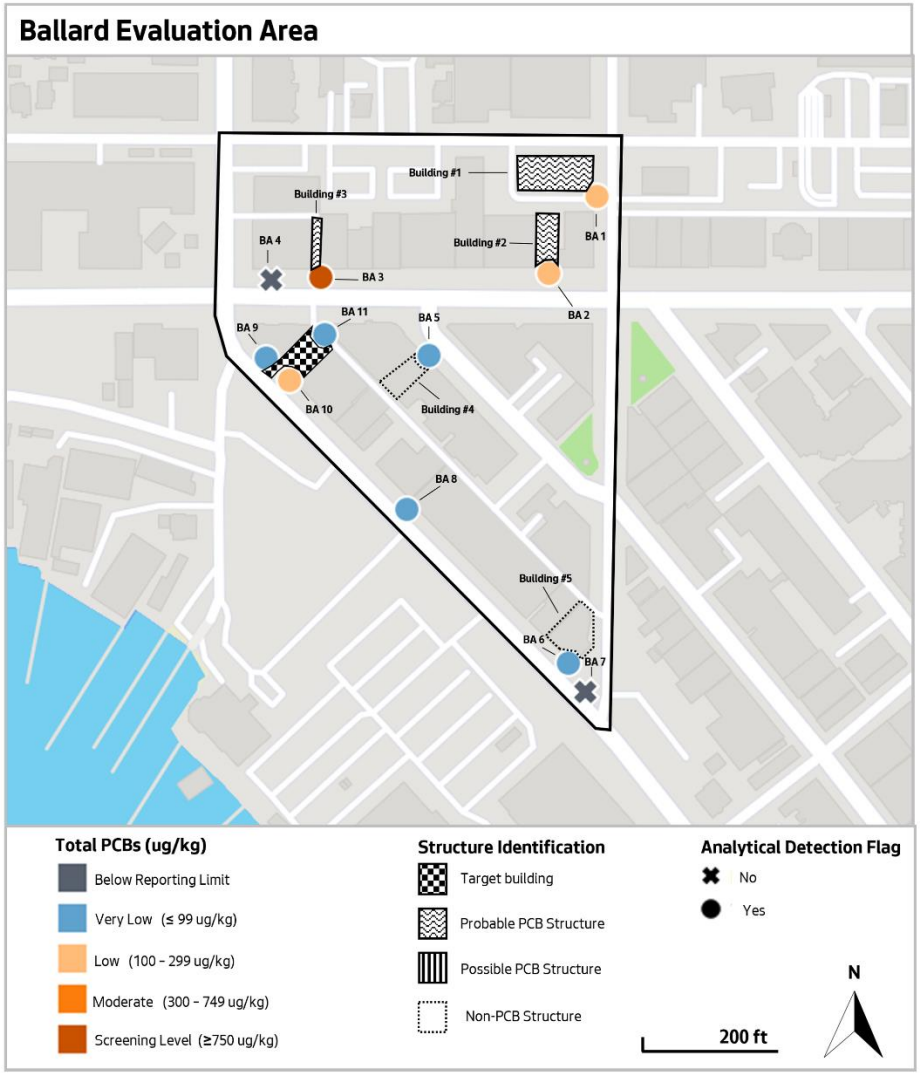
The final building of interest was the target building. The building was first detected by an SPU inspector on a warm day which also may have helped in the original detection. Between the time that the building was identified by SPU inspectors and the field evaluation, the building had been painted, and additional wood siding was placed over the original masonry wall which made the odor less pronounced.

During this field investigation with Jasper, the team was unable to detect the odor of PCBs from this building. Jasper identified this location with a moderate response. It took Jasper numerous passes by this building for the handler to feel confident that this was a possible source. Two confirmation samples of sidewalk dirt were taken near this building on March 25, 2021. One sample was taken downstream of the building in the sidewalk and one sample was taken uphill of the building in the sidewalk. Results from the PCB analysis from the uphill sample was slightly elevated at 48.5 ug/kg (BA 9). The sample taken downhill was higher than the uphill sample at 153 ug/kg (BA 10). Samples taken near this target building may be low due to a large gap between the building and the sidewalk where stormwater that impacts the building would drop into the gap and infiltrate into the ground and not run across the sidewalk. Lastly, a sample of surface dirt was taken near the backside of the building in the alley (B11) and the results from PCB analysis came in at 21.6 ug/kg. The field investigation was concluded after the target building was found at 13:00.

Figure 4-7-4: Target Building – previously identified building.

Ballard Evaluation Area Takeaways:

- The detection dog was able to locate the known target building and able to discover previously unknown buildings of interest.
- One building of interest was distant from the sidewalk due to landscaping yet the dog picked up the scent on the wind and readily identified the source.
- It was difficult for untrained inspectors to accurately determine the age of a building in the field to screen it in or out based on 1980 criteria. This causes the search to be longer than needed.
- The team focused on minor interest by the dog rather than searching for a strong response, which lengthened the search. There was worry by the handler and the inspector that they could miss the target so every interest by the dog was scrutinized. It may be best to mark the spot and return for follow-up at the end of the day.
- Finding painted buildings may be difficult unless the underlying paint from PCB era is exposed. Building 3 had damaged paint with exposed PCB layers and was easy to locate. Building 6 (known target) was enclosed in wood siding over the suspected paint layers and was nearly impossible for field personnel to verify by odor, after this siding was installed.
- Searches may be biased with the presence of inspectors who know the location of target buildings.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
BA1	20.0	20.0	20.0	20.0	20.0	192.0	44.2	236.2
BA2	20.0	20.0	20.0	20.0	20.0	140.0	155.0	295.0
BA3	498.0	498.0	498.0	498.0	7,560	498.0	498.0	7,560
BA4	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
BA5	20.0	20.0	20.0	20.0	20.0	22.6	20.0	22.6
BA6	20.0	20.0	20.0	20.0	20.0	28.0	20.0	28.0
BA7	19.8	19.8	19.8	19.8	19.8	19.8	19.8	19.8
BA8	19.7	19.7	19.7	19.7	19.7	22.3	19.7	22.3
BA9	19.8	19.8	19.8	19.8	19.8	45.0	108.0	153.0
BA10	20.0	20.0	20.0	20.0	20.0	21.1	27.4	48.5
BA11	20.0	20.0	20.0	20.0	20.0	21.6	20.0	21.6

Figure 4-7-5: Map and Analytical table for the Ballard Evaluation Area

4.8 DAKOTA AREA

Field Evaluation Area:	Dakota
Date(s):	5/17/2021
Duration:	2 hrs.
Weather:	55F and overcast
Personnel:	UW Handler: J. Ubigau SPU Inspector: A. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Industrial
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☒ Site access ☐ Drainage structure investigation
Target Buildings in Evaluation Area?	4
Discovered Probable PCB Structures?	0
Discovered Possible PCB Structures?	0

Evaluation Summary:

On May 17, 2021, a field evaluation of individual buildings was conducted in the Industrial District of Seattle (Figure 4-8-3). This search was focused on individual suspect properties to help strengthen PCB evidence in exterior building materials or to help prove that specific target buildings do not have PCBs. The searches were attempted at four buildings built prior to 1980 in the industrial zone. All buildings had been previously identified by SPU as suspected or potential PCB sources.

Prior to field evaluation, Jasper was “warmed up” using bench testing methods at the Wharf building (see section 5 for bench testing details). Various target samples were presented to Jasper using the bench method to see how well he chose targets with detectable levels of PCB. Samples used consisted of clean sand or dirt spiked with low levels of PCB or field collected samples that had been analyzed to determine their concentrations. This testing before departing for the field work sems to help focus Jasper and get him honed into the scent for the day.

During this bench testing, different methods of testing were evaluated to see if certain methods would be useful techniques for quickly screening samples collected in the field.

Modifications of the bench testing sequence included leaving the first test hole in the bench blank so that Jasper would not immediately be distracted by the first odor he encountered whether it was a target, blank, or control. It had been observed that Jasper sometimes would signal on the first sample before evaluating the other target samples. It was thought that Jasper should get into the routine of searching all samples once before he is reintroduced to the samples for a final decision. For this method utilizing two benches with three sample slots per bench, the targets were placed in either target holes 2, 3 or 4. This was seen as possibly an improvement in starting the day so that Jasper would be more focused on all targets rather than jumping to select the first sample encountered in the first bench. This was hoped to be a calming strategy to help him judge the samples against each other before selection of the target.

In this process we continued to use two benches in an “L” configuration. The second bench was then modified to include only clean samples so that after checking the three samples in the first bench,

Jasper would clear his nose and reset him before resuming a second run by the samples before selecting.

To date, Jasper had routinely been tested with a single target sample using this bench method. In this testing, up to two target samples were placed in the first bench to see if Jasper would identify more than one as a target. The two targets selected for this test were extremely low level of PCB at 48 and 96 ug/kg. Jasper was able to identify both as PCB targets while excluding the clean sample.
Later in the process, the blank samples used were of clean forest soil. This tended to cause Jasper's confusion and his detection accuracy declined with these soils.

It was determined from these experiments that his first bench screen test of the day should be a single target of elevated levels of PCB (above 1 ppm) to help with his confidence and set his focus on PCBs better.

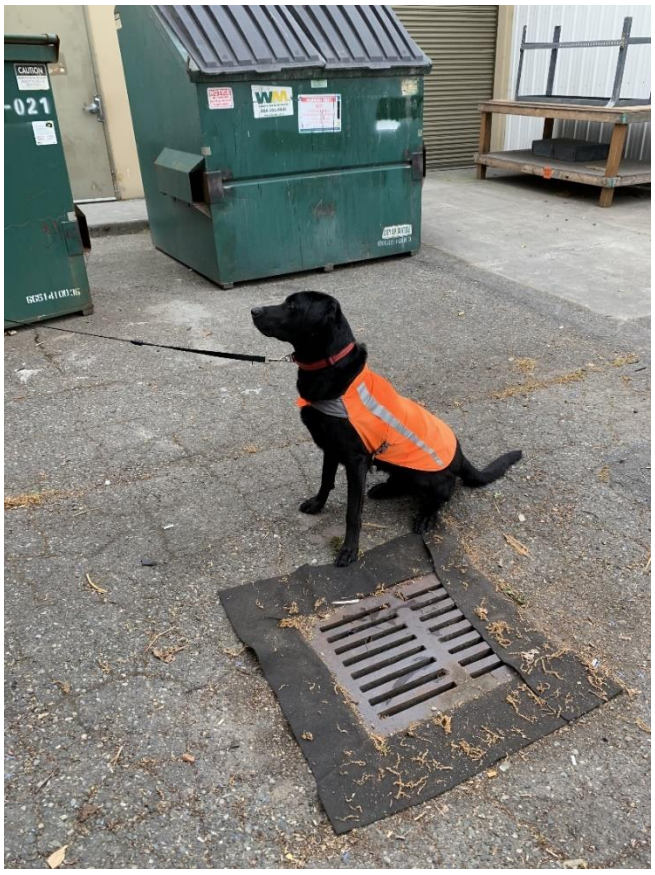


Figure 4-8-1: Jasper sitting at a catch basin at Building #1.

The field evaluations began at 11:00. The first target (Building #1) of the day was an industrial building previously confirmed to be a source of PCBs through drainage and surface sampling as well as being previous verification by the initial PCB odor detection dog, Sampson, in 2016. Five solid samples were taken in 2016 near this target building. The catch basin solid sample taken from the building's loading area was elevated at 7,630 ug/kg (DA1). A sample taken from the west wall near the loading dock was 5,950 ug/kg (DA2). A sample collected along the base of the north wall was 545 ug/kg PCB (DA3) and a sample from the base of the south wall was 312 ug/kg PCB (DA4). A solid sample collected from the eastern parking lot was taken and was a non-detect at 372 ug/kg (DA5) due to instrumentation interference.

The team was granted permission to search the property with the use of the detection dog. Jasper was able to identify the catch basin in the back loading dock area as potential PCB which mirrored previous investigations at this site.

Jasper showed only mild interest in areas of the building that Sampson had shown high to moderate interest in. It was evident that he was tracking some PCBs in the back loading dock area, but they may have been degraded over the last five years and washed into the catch basin. This building was thought to be of moderate use in evaluating Jasper and no samples were collected at this site for this study.

The second target building (Building #2) investigated was a commercial repair shop with attached offices. The building was a tilt up concrete panel structure with wood siding covering a portion of the exterior concrete panels. The building was previously identified as a potential PCB source from past SPU inspections and odor recognition during the inspections. As a follow-up to the odor recognition by the SPU inspector, the inspector received permission from the property owner to take samples of the drainage structures near the building on the property. In 2017, two samples were obtained from the site, one in the center of the parking lot on the north side of the building, and one from the southeast stormwater catch basin near the corner of the building. Results from these samples were low with measured PCBs of 125 ug/kg (DA6) from the north lot and 164.8 ug/kg (DA7) from the southeast catch basin. When these sample results came back, the SPU inspector thought the levels to be insignificant and not indicative of a PCB source at this site. Though the results were low, the PCB odor at this building was very distinct, and the building was still considered a PCB source that was not impacting the drainage system.

In 2017, another SPU inspector gathered catch basin solids samples from the adjacent parcel to the west of Building #2 for chemical analysis, including PCBs. This parcel next door was not suspected of having PCBs and the drainage on the property did not appear to take stormwater from the target building parcel. Sample results from the neighboring property's two catch basins were 41.2 ug/kg PCB (DA8) and 30.5 ug/kg PCB (DA9). These results were much lower than the target property and gave no indication of a source of PCBs from the neighboring site.

Figure 4-8-2: Left: Caulking seams on Building #2. Right: Jasper sniffing caulking seams near the garage door at Building #2.

For this detection dog investigation, permission was granted by the target property owner to inspect the property using the detection dog. Jasper investigated the building and showed a strong positive interest in the panel joint compound on the north and south walls. All locations that Jasper identified

with a strong response for the presence of PCB were confirmed by odor recognition by the SPU dog team and detection dog handler.

In reviewing the previously collected sample data for this area and with two positive confirmations of PCB odor from dog and human, the samples taken in 2017 may show a significant difference that indicates a source of PCB at the target property is affecting the target property drainage system but at very low levels. The sample results from samples collected on this property in 2017 are three to four times higher than the levels of PCBs from the samples collected on the clean adjoining property. This may indicate that sample results in the range between 100 and 200 parts per billion may, at times, indicate a source, if other samples taken nearby are non-detect or very near the minimum reporting limit.

A third industrial building (Building #3) was intended to be evaluated, but permission was not granted to access the property. This property was identified as a potential PCB source previously, by an SPU inspector walking the area on a warm day for the purpose of finding PCB sources by smell. During that SPU inspector search, a sample was taken of surface dirt and moss in the public parking area to the north of this building and the analytical results were some of the highest PCB levels in this drainage at 148,000 ug/kg PCB (DA10).

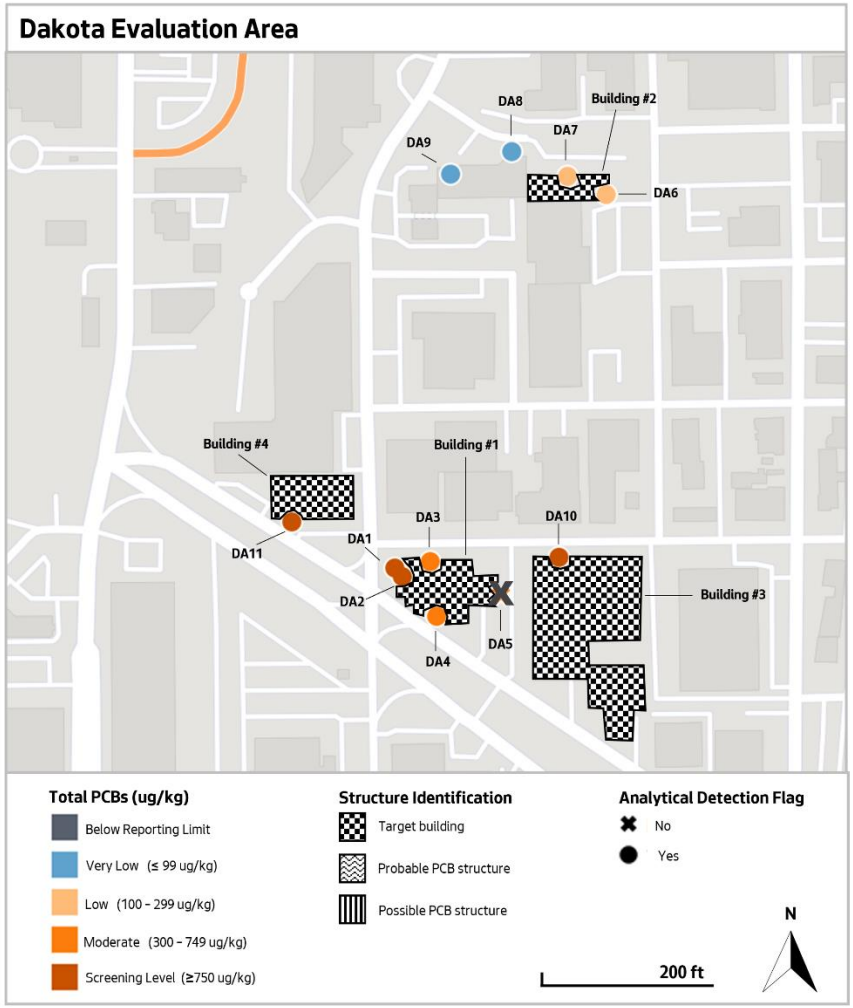
During the use of the detection dog this day, the parking area near this building wall was full of cars limiting access to the public area. Without access to the property, this site was nearly impossible to evaluate due to wind direction and the inability to approach the building walls. The available access to this building was on the north side of the building but the strong wind this day carried the scent to the south. The southern end of the property was a considerable distance from the public sidewalk and provided no inspection access. This inspection showed one of the limitations of investigating a building at a distance using detection dogs. Unless the wind is in the right direction, odor detection may be limited.

The fourth target building (Building #4) investigated was a tilt up concrete panel building with a recent coat of paint. The owner had stated that this paint was applied in the last few years and was the first time that the building had been painted. This property has a single catch basin in the south parking lot near to the building. This catch basin was sampled previously by SPU and PCB results were 1,430 ug/kg (DA11). During previous inspections and sampling at this property, SPU inspectors were unable to confirm any PCB odor from this building.

SPU was granted access to the property to use the detection dog and the property owner was notified of our presence. Jasper searched the exterior and was slightly interested in the roof downspout near the catch basin. It looked like the downspout may be obstructed beneath the ground and overflow to the parking lot surface against the building from a small sinkhole. On the parking lot surface at the sinkhole were roof granules, indicating that the roof drainage is surfacing through the sinkhole.

Jasper showed no interest in the catch basin itself. Jasper did show low interest near the sinkhole and at the base of the building near the downspout. It may be possible that there is a layer of paint (waterproofing) on the foundation that might have PCBs or there is a source coming from the roof, but

no odor of PCB was detectable by detection dog inspector or handler to confirm the dog's interest. Based on the limited evidence from this inspection, there is no evidence that this building contains PCBs, but SPU will ask to sample this catch basin in the coming years to monitor trends of this pollutant at this site. This detection dog investigation will be used to consider this building not a likely source of PCBs.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
DA1	7.7	7.7	7.7	7.7	193.0	5,820	1,810	7,630
DA2	387.0	387.0	387.0	387.0	387.0	5,950	1,360	5,950
DA3	19.2	19.2	19.2	19.2	47.9	412.0	133.0	545.0
DA4	372.0	372.0	372.0	372.0	372.0	372.0	1,670	372.0
DA5	95.7	95.7	95.7	95.7	95.7	312	95.7	312.0
DA6	18.5	18.5	18.5	18.5	18.5	55.8	109.0	164.8
DA7	18.7	18.7	18.7	18.7	22.5	44.0	58.5	125.0
DA8	7.4	7.4	7.4	7.4	7.4	16.6	13.9	30.5
DA9	7.6	7.6	7.6	7.6	7.6	22.4	18.8	41.2
DA10	189.0	189.0	189.0	189.0	189.0	148,000	362.0	148,000
DA11	8.0	8.0	8.0	8.0	8.0	8.0	1,430	1,430

Figure 4-8-3: Map and Analytical table for the Dakota Evaluation Area

4.9 INDUSTRIAL DISTRICT AREA

Field Evaluation Area:	Industrial District
Date(s):	3/18/2021
Duration:	2hrs.
Weather:	Low 50Fs, sunny with slight winds
Personnel:	UW Handler: J. Ubigau SPU Inspector: A. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Commercial & Industrial
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☒ Site access ☒ Drainage structure investigation
Target Buildings in Evaluation Area?	3
Discovered Probable PCB Structures?	0
Discovered Possible PCB Structures?	0

Evaluation Summary:

On May 18, 2021, a field evaluation was conducted in the Industrial District area of Seattle (Figure 4-9-2). This search focused on individual suspect properties to help strengthen PCB evidence in exterior building materials as well as help prove that specific target buildings do not have PCBs. The searches were at three buildings built prior to 1980. All three buildings had been previously identified by SPU as potential PCB sources.

Prior to field investigation, Jasper "warmed up" using bench testing methods at the Wharf building (see section 5 for bench testing details). Various target samples were presented to Jasper using the bench method to see how well he chose targets with detectable levels of PCB. Samples used consisted of clean sand or dirt spiked with low levels of PCB or field collected samples that had been analyzed to determine their concentrations. This testing before departing for the field work seems to help focus Jasper and get him honed into the scent for the day. Bench testing was very brief and consisted of only three target searches. Jasper was quick to identify all three targets and seemed ready to work.

The first stop of the day was at a commercial building with a large window enclosed entrance. This property was previously identified in 2016 as a probable PCB source by the initial odor detection dog, Sampson. Access to the property was granted and Jasper was able to immediately identify the front window area as a PCB source. It appeared that he caught the smell of PCB on the wind as he approached the windows from the north. Though the smell was intermittent, Jasper showed a change in behavior as he picked up the odor a short distance from the windows and followed it to the caulking. The caulking was confirmed to have PCBs by SPU inspector and detection dog handler odor recognition, and it was thought that the PCBs were in the caulking that joins the windows to the brick. It was not clear if the caulking within the window frame system also has PCBs, however this source was doubtful. The soil beneath the window was also of interest to Jasper and any PCBs coming off this building window caulking may have contaminated the soil beneath the windows. No samples were collected at this site.

The second target building investigated was a distribution warehouse with an attached office annex. The target building was a tilt-up concrete panel structure with water resistant joint compound

between the panels as well as caulking around the office windows and doors. The owner of the property met us on site and granted permission for Jasper to investigate the site as well as granting permission for SPU to collect samples from the private drainage system for PCB analysis.
Jasper confidently identified a PCB odor from the joint compound caulking in the tilt-up concrete panel seams on the west side of the property. This odor was confirmed by the dog handler and other team members as containing PCBs. The seams are between the exposed aggregate concrete panels and are very worn and cracked.

Caulking around the windows and doors on the office area were also investigated and Jasper indicated with a strong positive response that this material too likely contained PCBs. A sample of accumulated solids in the sump of the stormwater catch basin nearest the exposed caulking and joint compound was collected by SPU and later submitted for PCB analysis. Results from analysis of this sample were 1,253 ug/kg PCBs (ID3). A second sample was taken at a location less likely to be affected by potential PCB sources from the building, and results from this sample were much less than the other sample, 221 ug/kg PCBs (ID4). This second sample was collected at the catch basin in the Northeast loading dock area where Jasper showed a much lower interest.

Figure 4-9-1: 1- Jasper outside of Building #1 indicating window caulking as a PCB source. 2- Jasper sitting at a catch basin outside of Building #3. 3- Exterior photo of Building #3. 4- Exterior photo of Building #2.

The third target building investigated was a commercial multi-tenant building with offices and loading docks. The office area had a large window structure and glass entrance doors. In 2014, SPU inspectors took samples of catch basin solids throughout this drainage area due to a large increase in PCB measured in the public drainage system just downstream of this site. In 2014, three samples were collected on the property: two samples from the north parking lot catch basins and one sample from a catch basin in the south parking lot that accepts stormwater from two catch basins nearer the building.

The samples collected in the north catch basins had similar PCB levels of 377 ug/kg (ID5) and 270 ug/kg (ID6) and at the time were not considered evidence of a PCB source. The sample taken from the south parking lot was elevated above the level of concern, at 1,570 ug/kg PCB (ID7)

In 2016, SPU trained the first odor detection dog, Sampson, to find PCBs by their odor. Sampson searched this drainage area and indicated moderately near, but not at the back door. As a follow-up to Sampson's search, a solids sample was taken from the south catch basin closest to this back door with a PCB of 791 ug/kg (ID8). This elevated level possibly indicates a source of PCBs near the back door, but the source remained unknown.

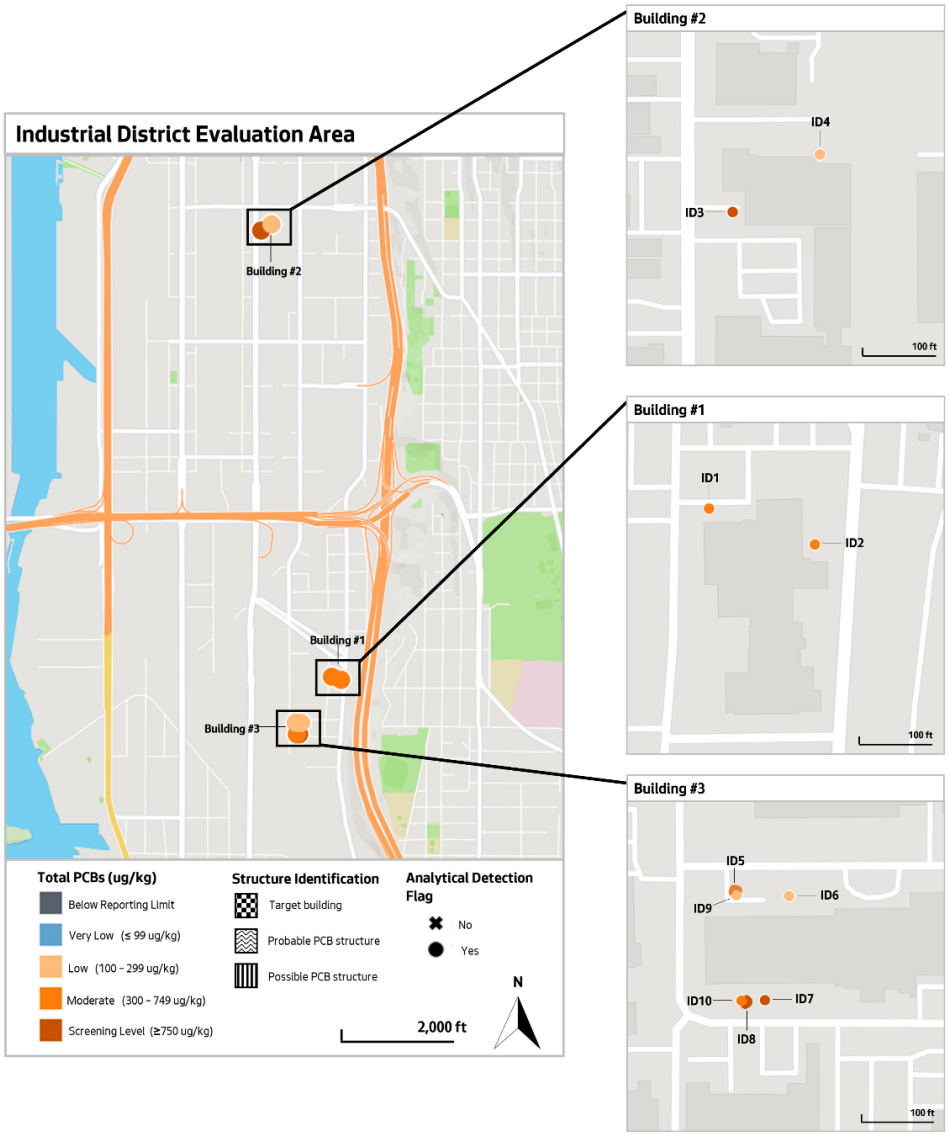
During an inspection of the tenant at this location in 2019, an SPU inspector noticed the odor of PCBs at both the front and back employee doors at this business, coming from the caulking that connects the glass doors and window structure to the masonry building. The odor was not coming from the central window glazing/spline material, it was the adhesive caulking around the perimeter of the window structure. Samples of the catch basin solids were again taken for analysis for PCBs with results of 173 ug/kg (ID9) in the north catch basin and 634 ug/kg PCB (ID 10) in the south. It was hypothesized that since the predominate winds are from the south during rain events that the south door would be more impacted by stormwater than the north and the stormwater off this building material would carry the PCBs into the drain.

The property owners of this target building granted SPU permission to enter the property to conduct a search using the detection dog. Jasper quickly identified, with strong confidence, the caulking around the exterior of the door/window system at each entrance to this tenant space as containing PCBs. The smell was more easily confirmed on caulking that had not been painted.

Jasper also identified with a positive response, the north parking lot stormwater catch basin, but he did not identify the south parking lot catch basin as potentially PCB contaminated. The stormwater drains were not sampled again because this property had been sampled previously.

Industrial District Evaluation Area Takeaways:

- The use of Jasper at known suspect buildings can help reinforce other detection sources to strengthen confidence in PCB designation.
- Detection dogs may sometimes alert on materials that do not readily appear to be sources of PCB, but they may be historical contaminated.
- Samples of drainage solids at the second building helped confirm Jasper's ability to differentiate areas on a property that were highly suspect for PCBs and areas that were least suspect.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
ID1	97.0	97.0	97.0	97.0	120.0	240.0	100.0	340.0
ID2	18.0	18.0	18.0	18.0	230.0	420.0	210.0	630.0
ID3	18.6	18.6	18.6	18.6	18.6	935.0	318.0	1,253
ID4	8.0	8.0	8.0	8.0	8.0	117.0	104.0	221.0
ID5	19.0	19.0	19.0	19.0	67.0	180.0	130.0	377.0
ID6	20.0	20.0	20.0	20.0	58.0	130.0	82.0	270.0
ID7	20.0	20.0	20.0	20.0	98.0	1,300	270.0	1,570
ID8	19.3	19.3	19.3	19.3	145.0	574.0	217.0	791.0
ID9	7.7	7.7	7.7	7.7	23.2	85.3	70.8	179.3
ID10	7.8	7.8	7.8	7.8	7.8	474.0	160.0	634.0

Figure 4-9-2: Map and Analytical table for the Industrial District Evaluation Area

4.10 CAPITOL HILL AREA

Field Evaluation Area:	Capitol Hill
Date(s):	5/19/2021
Duration:	1 hour
Weather:	Low 50Fs, sunny with slight winds
Personnel:	UW Handler: J. Ubigau SPU Inspector: L. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Single property search – Fire Station
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☒ Site access ☐ Drainage structure investigation
Target Buildings in Evaluation Area?	1
Discovered Probable PCB Structures?	0
Discovered Possible PCB Structures?	0

Evaluation Summary:

On March 19, 2021, a field evaluation was conducted at a single target property on Capitol Hill. This target building had been previously identified in 2018 as a possible PCB source during a routine Source Control business inspection when the SPU inspector had noticed a strong odor of PCB near the front and back glass panel doors and windows. Prior to this day's detection dog investigation, a sample of stormwater solids had been collected and analyzed from the public drainage catch basin near the front door area of this building. This catch basin was in the street and was separated from the building by a considerable distance and a rain garden that would have minimal exposure to the building but was hoped to show some evidence of the suspected PCB source. The results from this sample showed very low but measurable levels of PCBs above the detection limit, 72.1 ug/kg PCBs (CH1).

Prior to today's field work, Jasper "warmed up" using bench testing methods at the Wharf building (see Section 5 for bench testing details). Various target samples were presented to Jasper using the bench method to see how well he chose targets with detectable levels of PCB when presented also with clean samples. Samples used for the testing would consist of clean sand or dirt spiked with low levels of PCB or field collected samples that had been analyzed to determine their PCB concentrations. This testing of the detection dog before departing for the field work seems to help focus Jasper and get him honed into the scent for the day. As a result of today's warm-up testing, the dog handler thought that his awareness and accuracy was not normal and that he was a little unfocussed.

When the detection dog team arrived at site, the property owner provided access to the property to take samples and to have the detection dog search exterior portions of the property. Starting at the front of the building, Jasper identified the caulking material around doors and windows on the south, west, and north sides of the office area. This caulking was the waterproofing sealant at the connection between the window/door assembly and the building masonry. Detection dog team members were also able to recognize the odor of PCB at these locations. Seams of caulking were identified as moderate to low by the detection dog along the large rollup garage doors on the northeast and southeast sides of the building.

Jasper searched the north parking lot to verify if concrete panel seams in the lot also contained PCB and if stormwater catch basins on this property had an odor of PCB. Jasper did not indicate that the surface joint caulking seams contained PCBs. Jasper did show a strong positive at the stormwater catch basin near the back door/windows previously indicated to have an odor of PCB. Jasper did not indicate the presence of PCB in the far stormwater catch basin east and north of the building at the back of the parking lot. This far catch basin would be considerably farther from the suspected PCB source than the near catch basin by the windows.

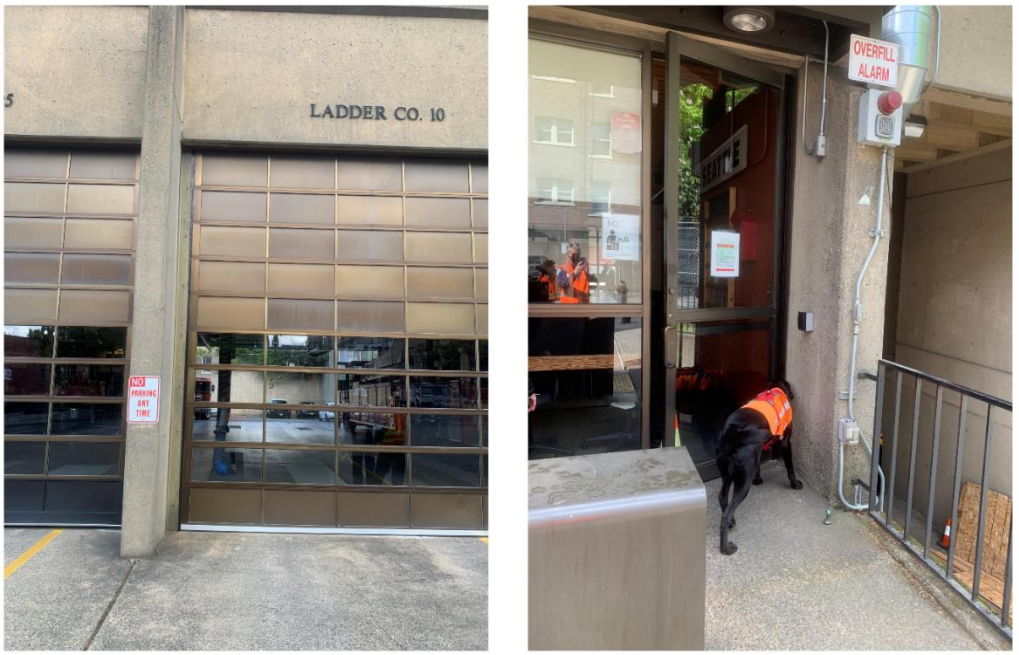


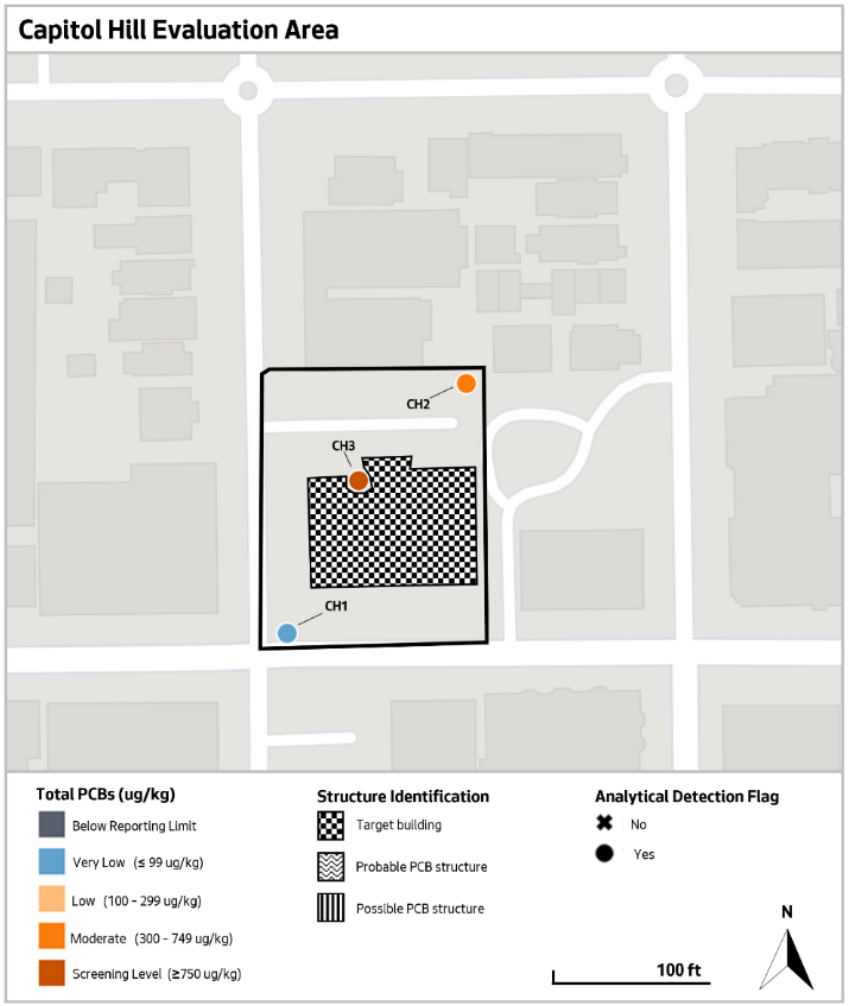
Figure 4-11-1: Jasper identifying caulking seams around the door frames as a probable source of PCBs onsite

On June 4, 2021, sump solids samples were collected from the two stormwater catch basins in the north parking area, one from the catch basin near the building and one from the catch basin distant from the building. Results of the two samples were considerably different. The near catch basin results were 24,300 ug/kg PCB (CH2) while the distant catch results were considerably less, but measurable, at 336 ug/kg PCB (CH3).

Capitol Hill Evaluation Area Takeaways:

- Jasper confirmed the suspicion of the inspectors that PCB odors could be detected near the window and door frames of the building.
- Jasper identified the catch basin most likely to be affected by PCBs from the building as a source of PCB odor. Jasper did not indicate the presence of PCB at the far catch basin though it had elevated levels of PCB. It is possible that he was just focusing on such a high level of PCB odor near the building that he failed to recognize the odor at the far CB as PCBs.
- It could be that Jasper was able to find high level PCB sources today but was deficient in finding low level targets which was documented in his bench testing prior to going out in the field.
- If using just the detection dog odor recognition, SPU would have only sampled and tested the near catch basin and might exclude the catch basin that had a negative response from Jasper. This might have missed a low level, but significant, concentration of PCB in the far catch basin.

- Again, it was evident that the window glazing and Spline material in the around the window glass was not a likely source of PCB, rather it is the waterproofing caulk adhesive used to seal the window and door assembly to the building masonry structure.
- In high areas of PCB odor, Jasper becomes less reliable for the lower-level sources that are significant.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
CH 1	19.8	19.8	19.8	19.8	19.8	47.7	24.4	72.1
CH 2	249.0	249.0	249.0	249.0	249.0	24,300	249.0	24,300
CH 3	20.0	20.0	20.0	20.0	20.0	265.0	71.0	336.0

Figure 4-10-2: Map and Analytical table for the Capitol Hill Evaluation Area

4.11 NORTH GEORGETOWN AREA

Field Evaluation Area:	North Georgetown
Date(s):	5/19/2021
Duration:	1 hr.
Weather:	Low 50Fs, sunny with slight winds
Personnel:	UW Handler: J. Ubigau SPU Inspector: L. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Commercial & Industrial
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☐ Site access ☒ Drainage structure investigation
Target Buildings in Evaluation Area?	1
Discovered Probable PCB Structures?	0
Discovered Possible PCB Structures?	0

Evaluation Summary:

The target building in this evaluation was a distribution warehouse with combined offices (Figure 4-11-2). The office area has a brick façade and banks of windows along both the west and south side of the building. The west windows face the street and beneath these windows are landscaping areas. The south windows face the parking lot and have asphalt up to the building wall beneath these windows. SPU was not granted permission to enter this property for the detection dog search and the building sits about 30 feet back from the public space at the roadway gravel shoulder.

In a previous source tracing investigation of this drainage area in 2013, SPU inspectors took a sample of solid material from the drainage pipe about a block to the northwest of this target building. Results from this sample were 6,000 ug/kg PCB (GT1) which indicated a source of PCB nearby that was affecting the public drainage system. The point of sample in the drainage system was near the top of the drainage line.

During an inspection of the business operating at this target building in 2017, the SPU inspector took a sample of solids from the catch basin on the property near the south window wall parking lot. This catch basin is the upper most drainage structure on this branch of the drainage area and a block from the previous sample collected in 2013 (GT1). A second sample was taken from the first maintenance hole (flush chamber) in the public drainage system adjacent to of this property and both were analyzed for a suite of chemicals including PCBs. Results from analyzing these samples were high in PCBs. The sample near the windows on the target building property was 2,294 ug/kg PCB (GT2). The sample taken in the drainage line maintenance hole was 1,413 ug/kg PCB (GT3).

A month later (November 2017), the SPU inspector took a solids sample at the maintenance hole where the target property drainage lateral entered the public drainage. This location was just five feet downstream of the flush chamber. The results from this sample were greatly higher at 9,730 ug/kg PCB (D4). Since the only drainage entering this system above this sample location was from the target property, it was likely to be the source of PCBs.

As a follow-up to this sampling event, SPU inspectors returned to the property and could easily detect the odor of PCBs from the window caulking on the south windows. There was no odor detected along

the west windows that face the street, but they are identical to the other set of windows with PCB odor. SPU suspected that the west windows might have been re-caulked, and the older PCB caulking removed and replaced with non-PCB material.

In 2021, the property owner of this building was alerted by SPU Source Control that the building was suspected to contain PCBs in the south windows. SPU Source Control requested permission to have the detection dog investigate the exterior of the building, but the request was ignored.

Figure 4-11-1: Samples of caulking collected from the roadside shoulder

Jasper walked down the roadway shoulder in front of this building to see if he could pick up a scent of PCBs in this area. The wind was from the southeast and blowing across the window area toward the roadway. It was obvious from Jaspers continued attempts to run toward the building that Jasper could smell the building from the street. He made many attempts to enter the property toward the suspected PCB source around the windows but was restrained to avoid entering onto the property. During Jaspers investigation, the odor of PCB was detected intermittently by SPU inspectors and the detection dog handler in this area.

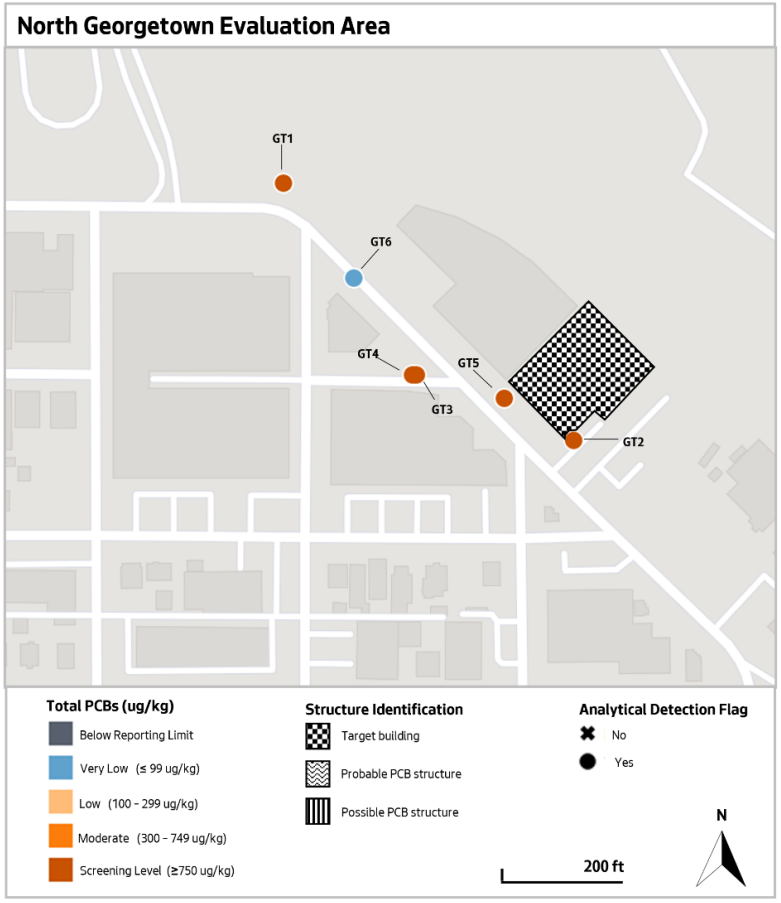
As Jasper was walking along the gravel roadway shoulder parallel to the building, he unexpectantly identified small black strips of rubber on the roadway shoulder as a source of PCBs. By odor recognition, our party was able to confirm this as PCB and it appeared to be resembled possible window caulking material. A total of six pieces were found along the east side of the roadway near the building and each had a strong PCBs smell.

The finding of small particles of caulking like material along the roadway reinforced the suspicion of caulking removal from the west windows. A portion of the collected samples were sent for PCB analysis. PCB levels in the collected roadway samples were measured at 132,400,000 ug/kg (GT5), or 13.24% PCB Aroclors. Though this does not prove the theory of caulking replacement, it may indicate that improper maintenance activities of building materials containing PCBs can spread from the source and be difficult to identify and control or remove. For background comparison, a sample was taken from a catch basin where Jasper showed no interest, and it was low at 61 ug/kg PCB (GT6).

At the end of the day, the team attempted to see if Jasper could investigate the drainage system in the area, to scan the system for PCB odors through the maintenance lid pick-holes. Jasper was confused by the lingering odor of PCB being blown off the building almost half a block away. Jasper's attention to task was waning and he only identified on maintenance hole as mildly positive, but it could not be confirmed with sampling due to lack of material to collect in the maintenance hole.

North Georgetown Evaluation Area Takeaways:

- Jasper was able to find remnants of possible caulking replacement that had blown to the roadway. This indicates that if buildings are not properly identified as a potential PCB source, then maintenance activities could contaminate landscaping, street surfaces, and drainage systems.
- Use of Jasper at determining PCBs through pick hole search was inconclusive.
- Detection dogs may sometimes alert on materials that do not readily appear to be sources of PCBs, but they may be historical contamination.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
GT1	87.0	87.0	87.0	87.0	3,200	2,100	700.0	6,000
GT2	98.8	98.8	98.8	98.8	98.8	1,560	734.0	2,294
GT3	97.9	97.9	97.9	97.9	97.9	945.0	468.0	1,413
GT4	39.5	39.5	39.5	39.5	39.5	7,830	1,900	9,730
GT5	-	-	-	-	-	117,000,000	15,400,000	132,400,000
GT6	20.0	20.0	20.0	20.0	20.0	40.4	20.6	61.0

Figure 4-11-2: Map and Analytical table for the North Georgetown Evaluation Area

4.12 ATLANTIC AREA

Field Evaluation Area:	Atlantic
Date(s):	9/11/2021
Duration:	1 hr.
Weather:	Low 80Fs, overcast with slight winds
Personnel:	UW Handler: J. Ubigau SPU Inspector: L. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Single property search
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☒ Site access ☐ Drainage structure investigation
Target Buildings in Evaluation Area?	1
Discovered Probable PCB Structures?	0
Discovered Possible PCB Structures?	0

Evaluation Summary:

On August 11, 2021, a field evaluation was conducted in the Atlantic neighborhood area of Seattle. This area is composed of generally older industrial and commercial buildings (Figure 4-12-2). This search was a focused investigation of a single target building suspected of containing PCBs in exterior joint caulking between concrete panels. This building was discovered previously by an SPU inspector by odor recognition while driving by on a warm day. The inspector contacted the property owner during discovery and was allowed to investigate the building to assess the possibility of PCBs in the exterior building materials. The SPU inspector asked the owner for permission to bring the odor detection dog and take solids samples from the on-site private stormwater catch basins and the owner gave his permission.

On July 22, 2021, prior to the field evaluation of this site, a sample of solids was collected from both the street inlet and the catch basin nearest to this target building. Neither of these structures have been cleaned in years and contained a large amount of beauty bark from landscaping activities nearby. Results from the two structures were almost identical with 28.8 ug/kg PCB (A1) from the inlet solids and 29.7 ug/kg PCB (A2) from the catch basin. These levels were just above the method detection level. It was clear that these would have limited exposure to stormwater from the suspect property but could be mildly impacted by tire track out.

At the start of the field work on August 11, 2021, Jasper was evaluated for his readiness to search for PCBs. Jasper "warmed up" using bench testing methods in the shade on the side of the road with a standard set of eight bench tests (see Section 5 for bench testing details). The location was far enough from the target building to ensure odor from the building would not interfere with his sample testing. Various target samples were presented to Jasper using the bench method to see how well he chose targets with detectable levels of PCB. Samples used consisted of clean sand or dirt spiked with low levels of PCB or field collected samples that had been analyzed to determine their concentrations. Jasper was able to select the correct target sample six of eight times. Jasper was a bit distracted and the heat that day may have affected his attention and sense of smell.

The target building was built in the 1960s and it has a slight roof overhang that prevents most rainwater from striking the building in the area that was searched. The owner of the building had

granted us permission to enter the property for the dog search and to take samples of the stormwater catch basins. Jasper quickly identified the joint compound caulking along this portion of the building and was interested in the soil in the landscaping beneath these caulking seams. Jasper showed a strong positive response at the caulking around the window frames, vertical joints between concrete panels, and caulking at the base of the panels joining to the foundation.

Figure 4-12-1: Jasper sniffing a caulking seam and catch basin on the target building property.

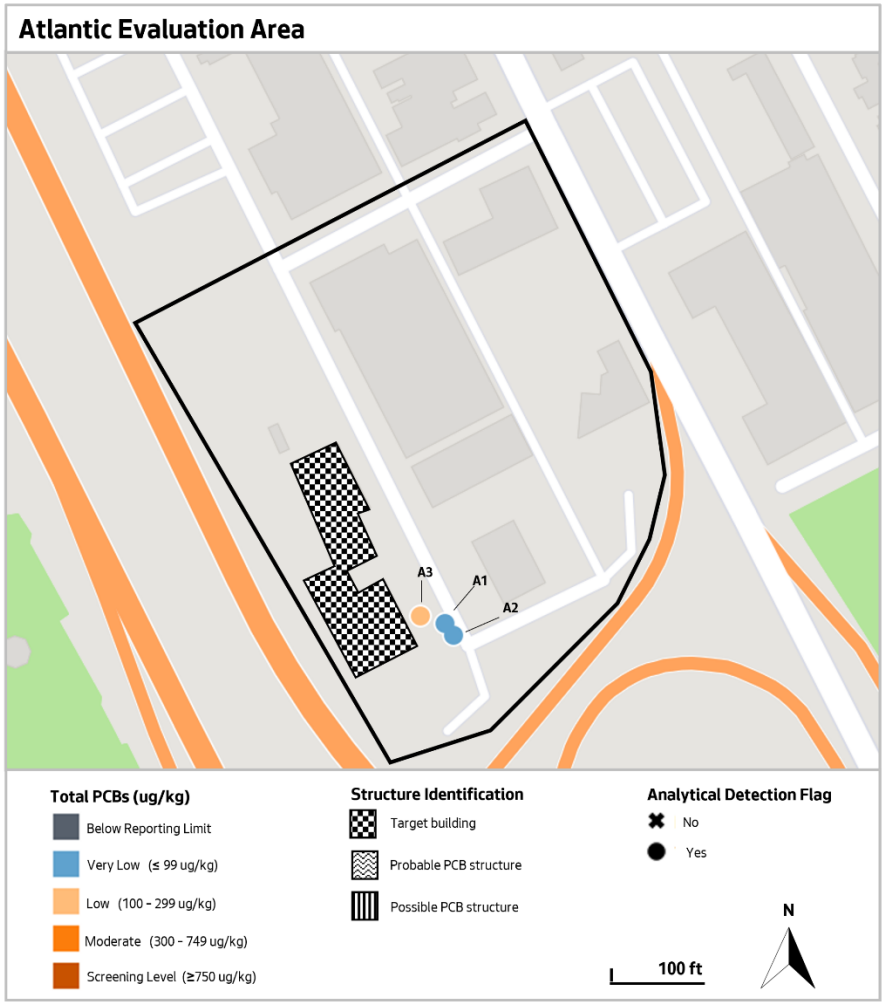
Drainage on this property near the search area consists of two private catch basins, one located near the windows and east wall and the other in the loading dock between a newer wing of the building and the 1960s structure. Both drains go to the combined sewer. Jasper showed little interest in these structures. A single public stormwater inlet and catch basin are located just east of the property but would receive limited stormwater coming off this property due to the surface gradient on the property. Jasper showed no interest in either of these private drains. The public storm drains were sampled and analyzed as previously mentioned and had extremely low levels of PCB. A sample of solids was taken from sump in the private catch basin nearest the east wall on August 19, 2021. Results from the analysis of this on-site sample were 286.5 ug/kg PCB (A3), although at a low level it was considerably higher than the sample taken in the street drainage and indicates a potential source of PCBs from this building.

Atlantic Evaluation Area Takeaways:

- This was the first day that we used a set pattern of samples to test Jasper on before we started work. The number of bench tests was limited to a set of eight. The same set and order of samples will be used each day to assure Jasper's reliability. The detection dog handler was not made aware that the same set of samples will be tested.
- The detection dog did not indicate on the catch basin though it was later analyzed to have 286.5 ug/kg PCB. The CB also had a high level of oil, garbage, and hypodermic needles.

Comparing the onsite sample to the street sample clearly points to a source on the property affecting the drainage but at low levels.

- Aroclor results in the onsite drainage sample matched the street drainage samples. The onsite sample did have Aroclor 1260 present, but the level was not above the RDL in the more dilute street samples, so it was not identified in the street samples.
- The day was hot and Jasper was already panting when field work began. Though kept in the shade, Jasper's accuracy on the eight bench test samples was lower than normal.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
A1	19.9	19.9	19.9	19.9	19.9	28.8	19.9	28.8
A2	20.0	20.0	20.0	20.0	20.0	29.7	20.0	29.7
A3	20.0	20.0	20.0	20.0	20.0	242.0	44.5	286.5

Figure 4-12-2: Map and Analytical table for the Atlantic Evaluation Area

4.13 SODO AREA

Field Evaluation Area:	SODO
Date(s):	8/11/2021
Duration:	1 hr. 30 mins
Weather:	Low 50Fs, sunny with slight winds
Personnel:	UW Handler: J. Ubigau SPU Inspector: L. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Commercial
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☐ Site access ☐ Drainage structure investigation
Target Buildings in Evaluation Area?	0
Discovered Probable PCB Structures?	1
Discovered Possible PCB Structures?	1

Evaluation Summary:

On August 11, 2021, a field evaluation was conducted in the SODO area of Seattle. This area is composed of generally older industrial and commercial buildings (Figure 4-13-4). This area was chosen because it did not have a known target building and would be blind to all participants as to whether a PCB structure would be found. The area was chosen at random and consisted of about 0.8 miles of a single main roadway with commercial properties on both sides of the street.

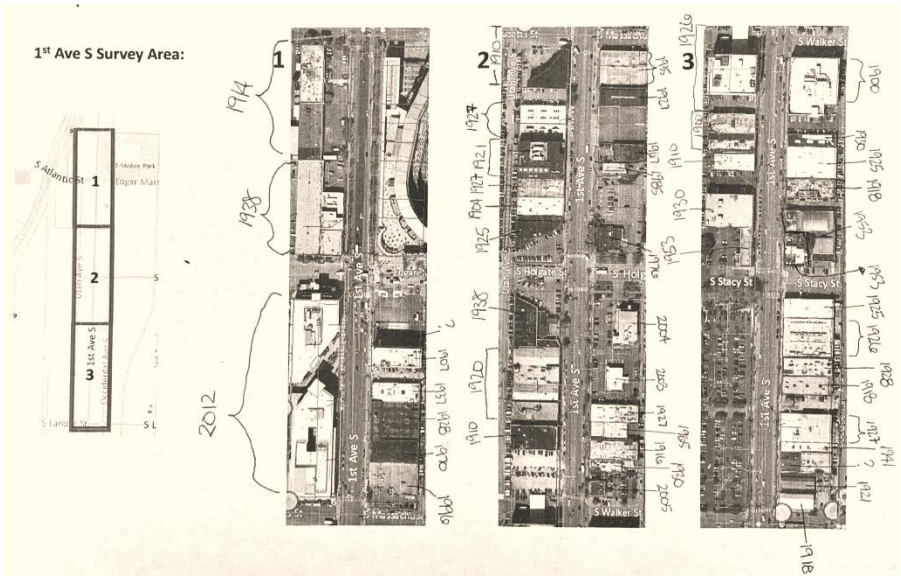


Figure 4-13-1: Map of the evaluation area with building ages identified prior to the field screening process.

At the start of the day, Jasper was evaluated and calibrated outside at the first site to be visited for field search on this day (see Atlantic Evaluation Area for details of his warm-up). The area was mapped ahead of time by the SPU inspector to delineate the age of each building in the search area. This technique has been useful in reducing the unnecessary investigation of buildings built after 1980 that would not have used PCB materials in construction or renovation.

The SPU inspector, in coordination with the dog handler, decided the course of the investigation and tried to inspect all accessible buildings along this section of roadway. There is a public sidewalk on both sides of the street that afforded direct access to building walls for nearly every structure along this roadway.

Figure 4-13-2: Building 1 – Commercial building in 1953

A building was identified as a strong probable PCB building (Building 1) by Jasper and confirmed by odor recognition by the dog handler and SPU inspector. This building is a brick structure and has windows attached to the brick with caulking adhesive that had a moderately strong PCB odor. Additional structures were attached to the exterior wall of the building with similar caulking adhesive which also had a strong odor of PCBs.

Stormwater striking the south wall of this building drains across the sidewalk to the street gutter on a cross street. The street gutter flows to the west and enters a catch basin at the northeast corner of the next intersection.

Just north of this building was a painted masonry building (Building 2) that Jasper showed a medium-low interest in. His main interest at this building was the painted wall along the sidewalk with more interest in areas of flaking paint. Near this wall is a catch basin in the street that likely receives stormwater runoff from the side of this building though the runoff from this building likely insignificant compared to the roadway surface and sidewalk.

No other buildings were identified in the rest of the inspection area.

On August 19, 2021, SPU returned to the area and took samples in the public space near the two buildings to determine if PCBs were present. Three samples were taken near Building 1. One sample was taken on the sidewalk out from the building windows on the south side. The sample was composed of sidewalk surface dirt and dirt taken from the concrete expansion joints of the public sidewalk. Results from the analysis of this sample were slightly elevated at 244 ug/kg PCB (FA-1). Stormwater crossing this sidewalk flows down the street gutter and enters a stormwater catch basin at the northeast corner of the next intersections. A catch basin sump solid sample was collected and analyzed from this northeast corner with results of 221 ug/kg PCB (FA-2). The third sample was taken from a stormwater catch basin on the far side of the

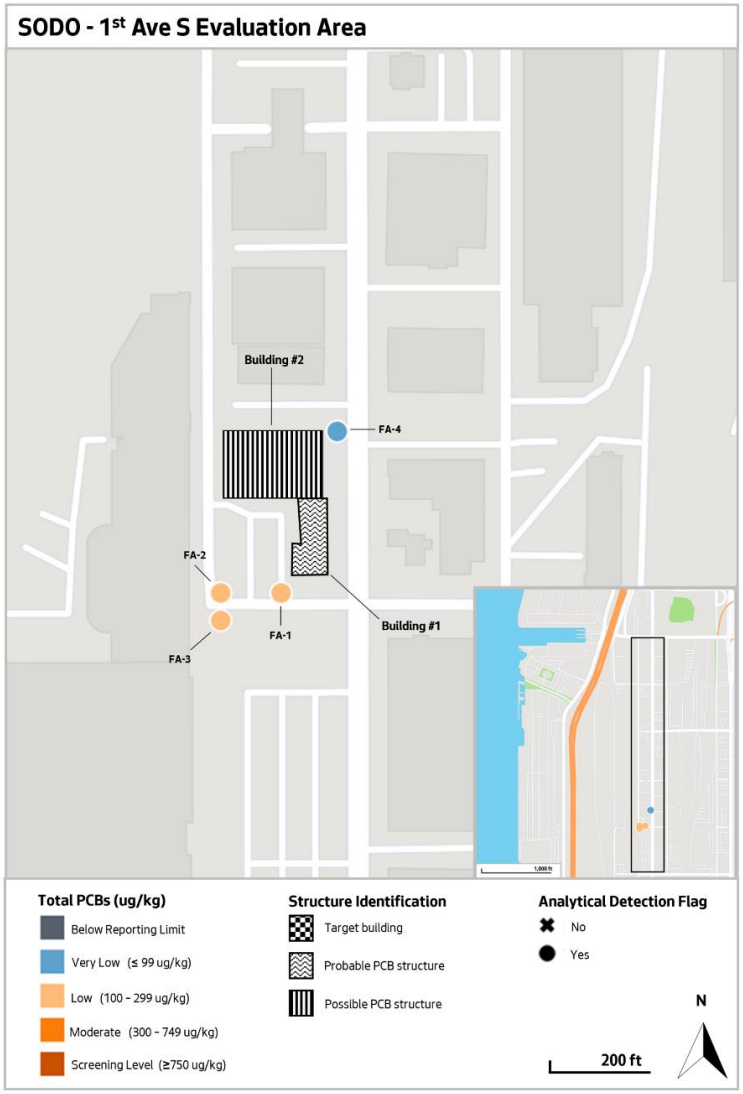
Figure 4-13-3: Mailbox slot with probable PCB caulking on Building 1

south cross-street at the intersection to the east. Results from the analysis of this sample were 219.6 ug/kg PCB (FA-3).

A fourth sample was taken near building 2 in the street catch basin along the sidewalk. Results from this sample were measurable but low at 87.6 ug/kg PCB (FA-4).

SODO West - Evaluation Area Takeaways:

- This was the first time that an arbitrary area of the city was searched without a known target building. Jasper was successful in finding one building and one suspected building with PCBs and able to screen out the remainder of the commercial area as PCB free.
- Although samples around the building were considered low, they could indicate some source of PCBs from this building.
- PCB results near Building 1 decreased as the samples were taken further from the suspected source.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
FA 1	8.0	8.0	8.0	8.0	8.0	140.0	104.0	244.0
FA 2	8.0	20.0	20.0	20.0	20.0	140.0	81.5	221.5
FA 3	14.9	14.9	14.9	14.9	14.9	153.0	66.6	219.6
FA 4	8.0	8.0	8.0	8.0	8.0	50.9	36.7	87.6

Figure 4-13-4: Map and Analytical Table for the Sodo Evaluation Area

4.14 BELLTOWN AREA

Field Evaluation Area:	Belltown
Date(s):	8/17/2021
Duration:	2 hr. 30 min
Weather:	Low 70Fs, overcast with slight winds
Personnel:	UW Handler: J. Ubigau SPU Inspector: A. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Commercial, Residential
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☐ Site access ☐ Drainage structure investigation
Target Buildings in Evaluation Area?	0
Discovered Probable PCB Structures?	1
Discovered Possible PCB Structures?	0

Evaluation Summary:

On August 17, 2021, a field investigation was conducted in the Belltown area of Seattle. This area is composed of generally older buildings with a larger portion being masonry construction compared to other areas of the city (Figure 4-14-3). This area was chosen because it did not have a known target building and would be blind to all participants as to whether a PCB target would be found. The area was chosen at random and consisted of about 16 square blocks.

Figure 4-13-1: Map of Belltown evaluation area with building ages identified to simplify screening process

At the start of the day, Jasper was evaluated and calibrated at the Wharf building using the bench testing method and target sample jars. As was done on August 11, 2021, the same set of eight sequences of sample tests were administered to see how accurate Jasper was in picking out the target samples. Jasper was able to select the correct sample 8 of 8 times (100 % accuracy).

The area was mapped ahead of time by the SPU inspector to delineate the age of each building in the search area. This technique has been useful in reducing the unnecessary investigation of buildings built after 1980 that would not have used PCB materials in construction or renovation.

The SPU inspector, in coordination with the dog handler, decided the course of the investigation and generally progressed from north to south in a path designed to cover the entire area. About halfway through the search, a building was identified as a strong target by Jasper and confirmed by odor recognition by the dog handler and SPU inspector. The discovered probable PCB building was a tall residential building with commercial space on the ground floor (Building 1). Jasper identified the caulking that joins the window frames to the building as the PCB source. It is uncertain if the caulking is the same on the upper floors.

Near the south side of the building is an underground electrical transformer vault. This vault had a grated top in the sidewalk and Jasper also strongly identified this space as containing PCBs. An odor of PCB was noticed coming from this grate, but it was very faint and intermittent. No other buildings were identified in the rest of the inspection area.

Figure 4-13-2: Left: A 26 story apartment building that was built in 1974. Middle: A Seattle City Light transformer utility vault found outside the probable PCB building. Right: Jasper indicating at a caulking seam from the buildings lower commercial tenant space.

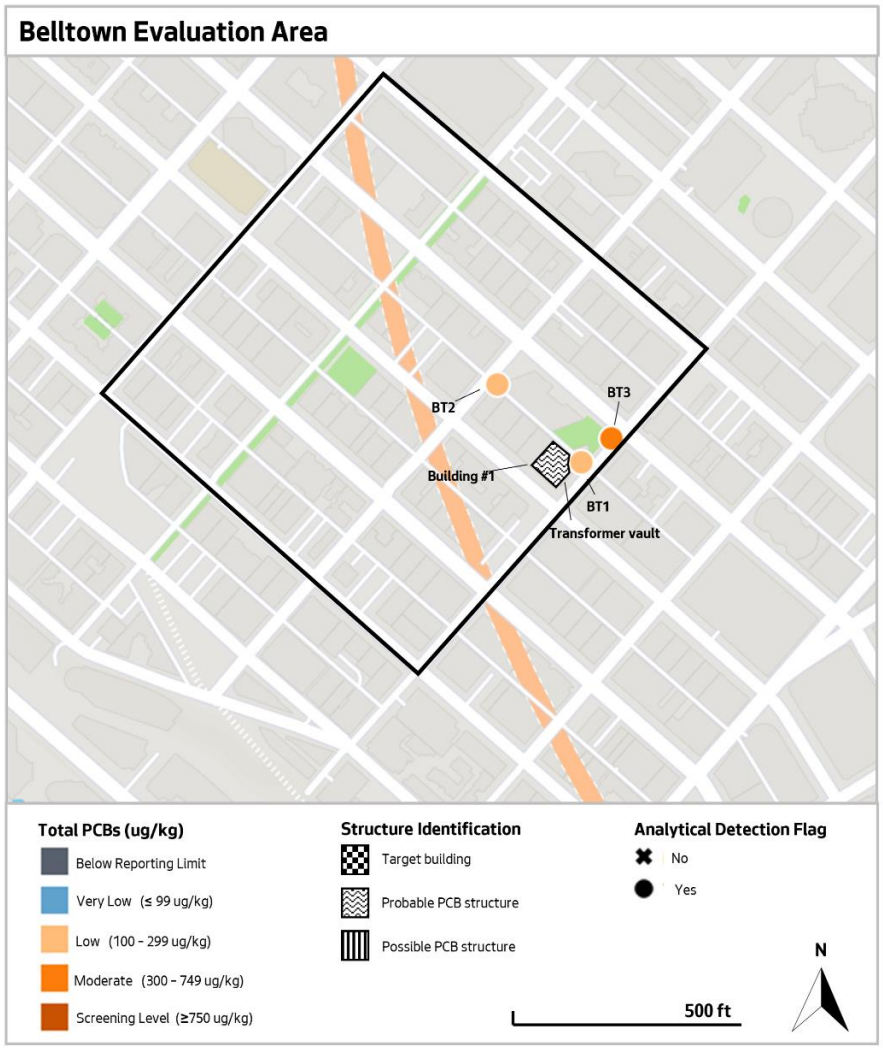
On August 19, 2021, SPU returned to the building and took samples in the public space near the building to see if PCBs were present. Three samples were taken. One sample was taken from the alley immediately east of the building. The sample was surface dirt and dirt taken from expansion joint in the concrete panels of the alley roadway. The PCB results from the analysis of this sample were slightly elevated at 107.9 ug/kg (BT1). The alley flows north one block and enters a stormwater inlet at the next street intersection. A sample taken from this stormwater inlet was slightly higher at 207 ug/kg (BT2). The third sample was taken downhill from the building in the street stormwater inlet on the south side of the property. This sample consisted of mostly fist sized decorative landscaping rocks and heavy sand with little to no fine material. The large rocks were removed from the sample. This inlet sample was analyzed with PCB results of 310 ug/kg (BT3). No sample could be taken in the transformer vault due to the equipment being energized and the vault a confined space.

Seattle City Light was contacted to gather information about the transformer vault. City Light stated that transformers in the vault were changed in 1983 and that the transformers were tested for PCB

and results for the two transformers were 17,900 ug/kg and 5,800 ug/kg total PCBs. These transformers remain in this vault and are currently in use.

Belltown Evaluation Area Takeaways:

- This was the second time that a totally arbitrary area of the city was searched without a known target building. Jasper was successful in finding one building and one transformer vault with PCBs and able to screen out the remainder of the commercial area as PCB free.
- Jasper was able to identify low levels of PCB in a below ground transformer vault. It is possible that Jasper was smelling minor leaks from this equipment or the previous equipment that was in this vault.
- Although samples around the building were considered low, they do indicate some source of PCB in the area.
- Without access to the higher floors of the building it is impossible to determine if the upper window frames have the same caulking material as the commercial space on the ground floor.
- This building recently had all windows and sliding patio doors replaced and may not have checked the caulking for the presence of PCBs. In review of the building permit for the window and door replacement, checking the caulking for PCBs was not required.



Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
BT 1	20.0	20.0	20.0	20.0	20.0	71.4	36.5	107.9
BT 2	20.0	20.0	20.0	20.0	20.0	106.0	101.0	207.0
BT 3	200.0	200.0	200.0	200.0	200.0	200.0	310.0	310.0

Figure 4-14-3: Map and Analytical Table for the Belltown Evaluation Area

4.15 MAGNOLIA AREA

Field Evaluation Area:	Magnolia
Date(s):	9/17/2021
Duration:	1 hr. 45min
Weather:	Mid 50Fs, overcast with intermittent showers
Personnel:	UW Handler: J. Ubigau SPU Inspector: A. Peterson Additional SPU staff: M. Jeffers, A. Bidwell

Zoning type:	Commercial and Industrial
Bench calibration prior to field evaluation?	Yes
Activity type:	☒ Perimeter search ☐ Site access ☐ Drainage structure investigation
Target Buildings in Evaluation Area?	1
Discovered Probable PCB Structures?	0
Discovered Possible PCB Structures?	0

Evaluation Summary:

On September 17, 2021, a field evaluation was conducted in the Magnolia industrial area of Seattle. This area is composed of generally older industrial and commercial buildings with generally associated with the fishing industry (Figure 4-15-2). This area was chosen because it had a known target building that was easily accessible from a public space. The building was located by SPU business inspectors while walking past the structure. Two or more inspectors were able to confirm, by odor recognition, the smell of PCBs in the concrete panel joint compound of this building.

A second location along this search area was a known PCB spill along the roadway right-of-way previously discovered by SPU and recently cleaned up by Seattle Department of Transportation. This spill area was originally discovered by odor recognition by an SPU spill responder/inspector at the site of a possible illegal wire stripping activity. To confirm the odor was from a PCB source, SPU collected samples of solids from the stormwater catch basin closet to this spill. The catch basin was within 15 feet of the suspected spill. Samples of this catch basin were collected and analyzed in 2019 and 2020. During the sampling in 2020, a sample of the catch basin across the street was also collected and analyzed. The farther catch basin is about 50 feet from the spill site and across a two-lane road. The results for the solids taken from the nearest catch basin were 268.7 ug/kg PCB (MG1) in 2019 and had increased to 2,189 ug/kg PCB (MG2) in 2020. The sample taken across the street from the spill in the stormwater catch basin in 2020 had a level of 95 ug/kg PCB (MG3). The spill area was cleaned in spring 2021. This detection dog investigation was used to verify if the cleaning effort was successful.

At the start of the day, Jasper was evaluated and calibrated at the wharf building. Jasper “warmed up” using bench testing methods with a standard set of eight tests (see section 5 for bench testing details). Various target samples were presented to Jasper using the bench method to see how well he chose targets with detectable levels of PCB. Samples used consisted of clean sand or dirt spiked with low levels of PCB or field collected samples that had been analyzed to determine their concentrations. A set of eight sequences of sample tests were administered to see how accurate Jasper was in picking out the target samples. Jasper was able to select the correct sample eight of eight times on the first pass.

The area was mapped ahead of time by the SPU inspector to delineate the age of each building in the search area. The SPU inspector, in coordination with the dog handler, decided the course of the investigation and tried to inspect all accessible buildings along this section of roadway. There is a public sidewalk intermittently on both sides of the street and afforded direct access to building walls less than half the time. Most buildings were distant from the street, making it difficult for the detection dog to get a good scent.

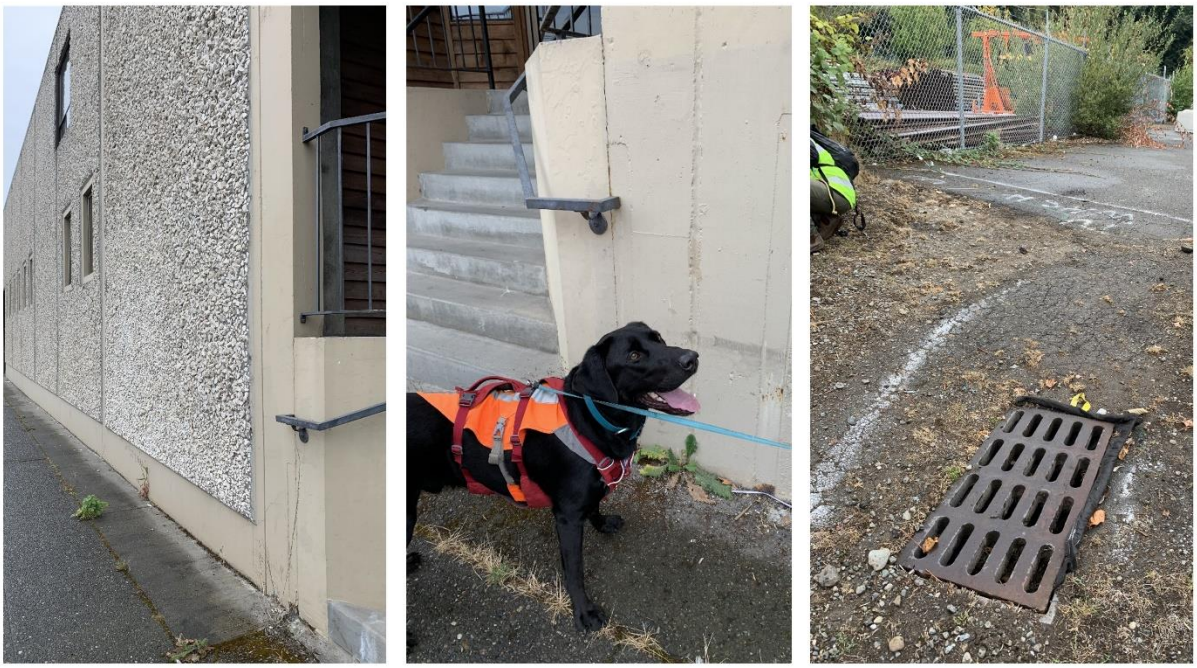


Figure 4-15-1: Left - Target building composed of concrete tilt panels (POI 5) Middle- Jasper altering to the caulking seams at the Target Building. Right – Contaminated catch basin previous spill area (POI 6)

In searching this area, the dog team stayed on the south side of the roadway outbound and returned along the north side of the roadway. The search area was about 1.2 miles total distance. During this search there were nine points of interest (POI) identified by the dog/handler team.

- **POI 1**: This building had low windows along an asphalt parking lot and sidewalk. Jasper showed low but persistent interest near these windows, but no odor was detectable by the team. No sample could be taken from this area due to a lack of access to this property and clean pavement.
- **POI 2:** This was a purposely hidden test target placed along the path of the dog. The test target was a broken lamp ballast with a slight PCB odor. It was placed in grass near a roadway sign and Jasper recognized this target immediately with a strong positive response.
- **POI 3:** Jasper identified with a low response alert along a short concrete wall on the edge of a parking lot. The odor of PCB was faintly noticeable in this area, but it was unclear if the source was from a distance or nearby. On October 1, 2021, a sample of soil was taken from near this wall for PCB analysis (MG4). Results from this analysis were below the method reporting limits (MRL).

- **POI 4:** Jasper showed a low interest at a driveway to a distant building. The building sits about 50 feet from the sidewalk and could not be investigated and no sample was possible from the public space.
- **POI 5:** This location was the target building and is an exposed aggregate tilt up concrete panel building with expansion joints. The joint compound between the panels had a distinctive odor of PCB and had been discovered by SPU inspectors previously. Neither the dog handler nor SPU inspector were aware of these previous findings. Jasper quickly identified the expansion joint compound as containing PCBs and the odor could be confirmed by the team members. On October 1, 2021, two samples were taken near this target building. One sample of stormwater solids was taken at the nearest stormwater catch basin in the street approximately 50 feet to the east of the building. Results from this analysis were below the method reporting limits (MRL) (MG5). A second sample of moss was taken along the sidewalk near one of the joints in the building about five feet from the building. This sample was positive for PCBs at very low levels of 62.3 ug/kg PCB (MG6). Although this is an extremely low level of PCB, it is the only sample collected for this field event that had quantifiable levels of PCB and happens to be located near a building of high confidence of being a PCB source by odor recognition by both dog and humans. Further samples need to be taken to confirm this source with higher confidence. The inability to sample next to the wall makes it difficult to more definitively confirm this as a source of PCBs.
- **POI 6:** This was the site of a previous PCB spill along the roadway shoulder. Jasper searched the area and confirmed that the area was not clean, and that further work is needed to remove more of the PCB contamination. Team members could also smell PCB faintly in this area and it appeared the cleaning crew may have left a small area of this spill in a hard to clean area of blackberry bushes. This area and nearby catch basin were cleaned again after this detection dog field investigation and no odor (human detected) of PCBs remained after cleaning.
- **POI 7:** This was a building undergoing external cleaning with a pressure washer. Jasper showed a low interest in the wall. On October 1, 2021, a sample of soil was taken from near this wall for PCB analysis. Results from this analysis were below the method reporting limits (MRL), however, the MRL for this sample was much higher than previous samples at 63.9 ug/kg PCB (MG7). This sample result MRL is higher than the only other positive sample collected in this area at target 5. This building may be considered unverified but suspect until further investigation sampling can be completed.
- **POI 8:** Jasper showed a moderate interest in the wall beneath some high windows and a catch basin near the street about 25 feet from this building. A catch basin solids sample was collected from the catch basin at the street and results from this analysis were below the method reporting limits (MRL) (MG8).
- **POI 9:** This POI was comprised of a painted wall with flaking paint. Jasper showed a low but more persistent interest in this wall. There was no other indication that this could be a significant source, so samples were not collected.

A final sample was collected at a catch basin in an area with no buildings built prior to 1980 and no known possible sources as a means to quantify background PCB levels in drainage solids. The results from this sample were below the method reporting limits (MRL) as well (MG9).

Magnolia Evaluation Area Takeaways:

- A positive sample below 100 ug/kg PCBs may still be indicative of a nearby source of PCBs. If many samples taken in a neighborhood area are below the MRL and one or more are quantifiable, this may indicate that the neighborhood is fairly clean, and a source could be indicated by even a small PCB result. Relative sample results may be a clue to a source rather than a threshold level developed for more contaminated areas. A sample of 100 ug/kg in an area with numerous results in the MRL range of 20 ug/kg could indicate a source. This might be resampled, or permission requested from the property owner to take samples on the property.
- Some samples have a higher MRL than others (due to other pollutants and materials in the sample interfered with a standard result).
- Sampling low or medium interest sites usually results in very low analytical results. This may still indicate a source, but the source is not contributing a high level of PCB now.
- Some low to moderate indications from Jasper may be for PCB odor carried from afar and not necessarily from adjacent structures.
- It remains difficult to access properties when Jasper shows interest from a distance.

Sample Name	Aroclor Concentration (ug/kg)							Total PCBs (ug/kg)
	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	
MG1	19.8	19.8	19.8	19.8	208.0	60.7	19.8	268.7
MG2	19.9	19.9	19.9	19.9	1,360	711.0	118.0	2,189
MG3	19.9	19.9	19.9	19.9	27.2	38.5	29.3	95.0
MG4	19.9	19.9	19.9	19.9	19.9	19.9	19.9	19.9
MG5	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
MG6	20.0	20.0	20.0	20.0	20.0	35.7	26.6	62.3
MG7	63.9	63.9	63.9	63.9	63.9	63.9	63.9	63.9
MG8	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
MG9	55.7	55.7	55.7	55.7	55.7	55.7	55.7	55.7

Figure 4-15-2: Map and Analytical Table for the Magnolia Evaluation Area

5.0 ENVIRONMENTAL SOLID SAMPLE SCREENING

5.1 METHODS

Bench training is a method used to familiarize CK9 detection dogs to an odor target. The bench apparatus is also effective for conducting controlled testing and comparison analyses. This study investigated using the bench testing method to conduct canine screening of multiple samples of environmental solids taken from the field. In theory, using the bench to screen samples reduces the need to bring the dog into the field, which would improve safety, accuracy, and efficiency of source tracing efforts.

With the sample screening method, environmental solids samples are collected and presented to the dog in a controlled bench testing area. The results from the canine screening are then used to narrow sampling efforts to areas where positive detections were made. This method could reduce the number of samples that are needed to be sent to the lab for analysis and reduce the analytical costs associated with traditional sampling and analyses.

The evaluation process for this method was fluid, providing an opportunity to explore some of the strengths and limitations of using detection dogs to screen a variety of environmental solids samples in different arrangements and combinations. The practices were eventually integrated into the beginning of each survey day, serving as an effective "warm-up" activity prior to going out in the field. In the end, the bench screening method was developed to both 1) calibrate the detection dog, and 2) screen samples as a source tracing method.

In a simple setup, a single bench holds three suspended jars: two control jars (i.e., empty, or blank soil samples), and one target jar that contains sand or soil spiked with the target PCB Aroclor mixture. The dog works its way down the bench, sniffing each jar, and alerts to the target sample by sitting at the target jar. The bench set-up can vary in complexity depending on the training or assessment goal and number of samples being screened. The setups used for the screening evaluation included the single setup (3 sample capacity), or the L-shaped setup (6 sample capacity). For verification testing, the square bench setup (12 sample capacity) was implemented.

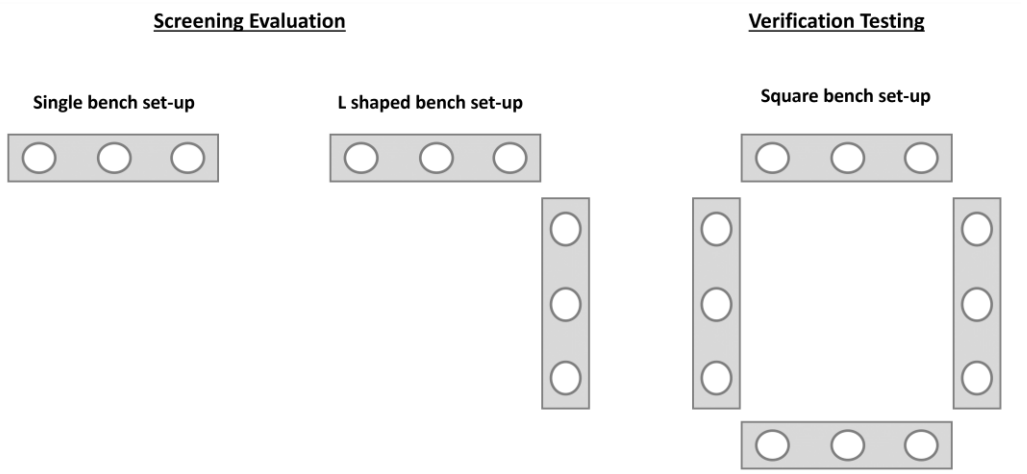


Figure 5-1: Bench set-ups for screening and verification testing

The samples used during these assessments were environmental solids samples, previously collected by SPU and stored in a refrigerator at the Wharf building. These samples included catch basin solids (wet and dry), street dirt, sidewalk dirt, moss, and combinations of these media. All samples were previously analyzed to determine PCB levels and characteristics. PCB levels range from non-detect (ND) to nearly 33,000 ug/kg total PCBs.

SPU envisioned a lengthy process of studying a wide range of archived samples during the bench screening evaluation. Ultimately, a small number of samples were used to establish improved repeatability. Our evaluation of these methods is based on a limited number of trials. Further evaluation in the future is needed to establish confidence conclusions regarding the success of the remote sampling and screening methods.

5.2 Environmental Solid Sample Screening Evaluations

5.2.1 Initial Trial of Sample Screening Method (November 2020)

By November of 2020, Jasper had been trained and had been verified to reliably identify PCB odors from collected samples with known PCB concentrations. During the second field evaluation exercise, Jasper identified a building with PCB odor in the joint compound at several vertical seams. The SPU inspectors collected environmental solids samples from the ground beneath these joint seams. The samples were brought back to the Wharf building for canine evaluation.

Three environmental solids samples were collected at the site. The first two samples were from the area beneath two joint seams, near to the building. The third sample was a background solids sample that was collected about 50 feet from the building. Jasper had made no indication that there were PCBs in this specific area, so this sample served as a “negative control”.

Jasper then screened the samples at the Wharf building using the single bench setup. Two of the three sample jars contained blank media (non-targets). The third sample jar contained one of the three samples collected from the field earlier that day. Samples were rotated and repositioned for each trial. The dog handler and the dog did not know the identity of the samples during these trials. Jasper alerted to both of the environmental solid samples that had been collected beneath the building seams, but he did not alert to the background solids sample (negative control). The results of this initial evaluation showed promise for the sample screening method.

5.2.2 Informal Calibrations Before Field Evaluations (March 2021)

On March 3, 2021, prior to the field surveys, Jasper was assessed using the bench screening method. The primary purpose of this evaluation was to “calibrate” Jasper’s detection skills; to warm up his responses, evaluate his level of confidence, and get him “on target” prior to starting the day’s field work. Another purpose for the evaluations was see if Jasper’s would get confused if presented with a bench setup that held no targets or multiple PCB targets, as opposed to the single target scenario.

The evaluation took place in the mud room of the Wharf building. A single bench with three samples was used. These were blind trials for the CK9 handler. Only the SPU team knew the details of the PCB levels of the target samples and their location on the bench.

Since the mud room was used to hold PCB environmental solid samples and field equipment, the dog team was asked to screen the room to rule out PCB contamination. Before Jasper screened the room, a suspected PCB source object was placed on a storage rack to see if he could locate this in his search. The handler was unaware of this target. While screening the room, Jasper alerted to the planted target (grocery bag with possible PCB contamination), but he did not locate any other PCB targets during his search.

Up to this point, only a single target sample was presented to Jasper during bench training and testing. The remainder of the sample jars contained "blank" or clean, non-target materials. Without the knowledge of the handler, SPU arranged this day's screenings to include a variety of target and non-target arrangements in the single bench setup. Some trials included zero target PCB samples (all blank). Other trials included one, two or three PCB target samples in the three-sample lineup. Jasper had not been rigorously trained for this scenario; therefore, detection rates were not recorded. This testing was a non-routine evaluation, providing an opportunity to observe how the dog and the handler would respond to these new scenarios. This was done to see if there was a bias in finding a target when none were presented, and if he would identify the strongest target when presented with multiple PCB target samples of varying concentrations.

When Jasper was presented with three blank samples, he always chose one of the three as a target. This showed that further training might be needed to get him to only identify a true target and eliminate his bias toward always finding a target in the bench. When presented with a target, he was able to detect samples as low as 85 ug/kg PCBs in relation to clean samples which clearly showed he had not lost the ability to detect low levels of PCB targets.

On March 5, 2021, additional bench screening exercises were conducted at the Wharf building prior to field evaluations. In this procedure, two benches with six sample jars were presented in an "L-shaped" bench set-up. This evaluation acted as a qualitative calibration series, providing an opportunity to do warm up trials, and assess Jasper's focus and confidence before going into the field. Four environmental solids sample targets were used for these trials. Three of the samples were below 100 ug/kg and one elevated sample was 1,613 ug/kg PCB. Twenty-one iterations of trials were conducted using the four target PCB samples in combination with blank, or "non-target" samples. Two of the trials consisted of all blanks (no targets). These test results were recorded.

To start, Jasper had a false-positive alert at a non-target (blank) sample instead of the 85 ug/kg PCB target sample. His confidence and accuracy then improved with subsequent trials runs. When the high-level PCB target was introduced to the lineup, he had another false-positive response to a non-target sample and seemed confused or frustrated. By the end of this series of assessments, he and his handler had regained confidence. The last two trials of the series were "no target" trials (all blanks). Jasper was confused but he did not identify falsely, which was an improvement. Throughout this

screening process, the CK9 handler became more aware that "no target" was an option. This helped her to discern Jasper's confusion and properly recognize that perhaps no target was presented.

5.2.3 Warm-Up Calibration Exercises Prior to Field evaluations (May 2021)

Field evaluations were conducted on May 17, 18, and 19, 2021. Prior to these field evaluations Jasper was "calibrated" with bench test exercises in the mud room at the Wharf building. Two benches were used to present six samples at a time. Since these exercises were intended as a warmup activity, the process of presenting the samples was adjusted to facilitate his recognition and not to test his ability. Notes were taken to track his performance during these warm-up evaluations.

5.2.4 Sample Screening trials In The Office (March 2021 – May 2021)

Environmental solids samples were used to evaluate the potential of using remote sample screening to source trace or screen out geographic areas. By bringing the samples to a controlled testing facility, the dog would not need to travel to the field. These evaluations commenced on March 3, 2021. Below is a list of the standard parameters for the sample screening assessments.

- **Presentation**
  - Two benches were in an "L" configuration, providing total of six sample locations.
  - For the six sample locations, the target(s) were presented in the following variations:
    - No targets in any of the six sample jars (0/6)
    - A single target presented with five non-targets (1/6)
    - Two targets of different PCB levels presented with four non-targets (2/6)
    - Three targets of different PCB levels presented with three non-targets (3/6)

- **Non-target (blank) samples**
  - All non-target (blank) samples used in the screening were analyzed and determined to be ND (no PCBs detected) or have extremely low PCB concentrations (18 ug/kg).
  - Types of non-target media included: clean catch basin solids, clean forest soil, clean sand, and empty "controls" jars with no media.

- **Target samples**
  - Concentrations ranged from 48 to 32,670 ug/kg PCB
  - Environmental solids samples included: catch basin wet and dry solids, inline solids, moss/dirt mixed solids, street dirt, sidewalk dirt, spiked forest soil, spiked sand, and parking lot dirt.

A total of 35 bench screening tests were conducted (see Tables 5.2.1 -5.2.4). Of the 35 tests, Jasper selected the wrong target (false-positive detection) on only four tests. When presented with multiple PCB targets in the lineup, he usually alerted the higher concentration target first before selecting the lower concentration target samples. In trials where there were zero targets presented, the detection

dog had difficulty and wanted to continue searching, but the handler was able to read through these behavior responses to avoid making false-positive detections.

The following is a summary of the screening tests and canine performance:

- 6 bench tests with 0 targets (17% of the screening tests)
    - 83% accurate with 1 false-positive alert on bench set-up with 18 ug/kg samples
- 20 bench tests with 1 target (57% of the screening tests)
    - 90% accurate with 2 false-positive alerts: one on a 753 on 753 ug/kg sample, and one on 71 ug/kg sample
- 7 bench tests with 2 targets (20% of the screening tests)
    - 100% accurate with no false-positive of the non-target samples
    - Typically picked higher sample first
- 2 bench tests with 3 targets (~6% of the screening tests)
    - 100% accurate with no false-negative alerts
    - Typically picked in order from high to low (e.g., 1,808 ug/kg → 753 ug/kg → 48 ug/kg)

In all, it appears that Jasper and his handler can screen samples quickly and efficiently with minimum errors. The sample screening method shows potential to streamline sampling and analyzing efforts. For example, SPU can use canines to prescreen samples and determine which ones should be sent to the lab for PCB analysis. The idea would also be to send along several samples that the dog did not alert on to serve as negative controls.

These evaluations also helped identify several areas where specific training could improve canine accuracy and efficiency. For example, it seems feasible to train the dog to search the bench and return to the handler if no targets are present. This would reduce false-positive results in bench testing as well as in the field. Preliminary observations also indicate that the dog could be trained to discriminate between different PCB concentrations when presented with multiple targets in a lineup. The dog could be trained to alert to the sample with the highest concentration first. Once that sample is removed from the lineup, the dog can then detect the next highest PCB sample again, until all target samples have been identified.

Although there is a cost to the utility to have inspectors collect field samples, this activity could occur during business inspection activities or when collecting other field samples required under our Municipal Stormwater Permit. It would save billable time for the dog team and make their process more streamlined and safer. The savings could be considerable for use of the detection dog team where travel is required.

Table 5-2-1: Sample screening testing trial results from March 3rd, 2021. The color scale indicates the Total PCB concentration with: gray representing concentrations < 20 ug/kg, light blue representing concentrations 20-99 ug/kg, orange representing concentrations 300-749 ug/kg, and red representing concentrations ≥750 ug/kg.

Date	Trail	Bench Layout: Total PCBs Concentration (µg/kg) Aroclor concentration (µg/kg) Sample material description	# of Targets	Trial Results: Correctly Altered?
3/3/2021	1	18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid 591 µg/kg: Aroclor 1248: 107; Aroclor 1254: 351; Aroclor 1260: 133; Mixture of street dirt and inlet 0 µg/kg: Aroclor 1248: 0; Aroclor 1254: 0; Aroclor 1260: 0; Clean forest soil	1	Y
	2	18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid 18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid 18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid	0	N
	3	32,670 µg/kg: Aroclor 1248: 0; Aroclor 1254: 25,700; Aroclor 1260: 6,970; Sidewalk dirt 18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid 18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid	1	Y
	4	422.8 µg/kg: Aroclor 1248: 0; Aroclor 1254: 331; Aroclor 1260: 91.8; Catch basin solid 0 µg/kg: Aroclor 1248: 0; Aroclor 1254: 0; Aroclor 1260: 0; Clean forest soil 18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid	1	Y
	5	18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid 18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid 18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid	0	N
	6	18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid 591 µg/kg: Aroclor 1248: 107; Aroclor 1254: 351; Aroclor 1260: 133; Mixture of inlet solid and street dirt 0 µg/kg: Aroclor 1248: 0; Aroclor 1254: 0; Aroclor 1260: 0; Clean forest soil	1	Y
	7	18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid 0 µg/kg: Aroclor 1248: 0; Aroclor 1254: 0; Aroclor 1260: 0; Clean forest soil 591 µg/kg: Aroclor 1248: 107; Aroclor 1254: 351; Aroclor 1260: 133; Mixture of inlet solid and street dirt	1	Y
	8	85 µg/kg: Aroclor 1248: 0; Aroclor 1254: 0; Aroclor 1260: 85; Spiked forest soil 18 µg/kg: Aroclor 1248: 18; Aroclor 1254: 18; Aroclor 1260: 18; Clean catch basin solid 1,613 µg/kg: Aroclor 1248: 0; Aroclor 1254: 1,300; Aroclor 1260: 313; Sidewalk dirt	2	Y

Table 5-2-2: Sample screening testing trial results from March 5th, 2021. The color scale indicates the Total PCB concentration with: gray representing concentrations < 20 ug/kg, light blue representing concentrations 20-99 ug/kg, orange representing concentrations 300-749 ug/kg, and red representing concentrations ≥750 ug/kg.

Date	Trail	Bench Layout: Total PCBs Concentration (µg/kg) Aroclor concentration (µg/kg) Sample material description	# of Targets	Trial Results: Correctly Altered?
3/5/2021	9	0 µg/kg | 422.8 µg/kg | 0 µg/kg Aroclor 1248: 0 | 0 | 0 Aroclor 1254: 0 | 331 | 0 Aroclor 1260: 0 | 91.8 | 0 Clean forest soil | Catch basin solids | Clean sand	1	Y
	10	18 µg/kg | 892 µg/kg | 18 µg/kg Aroclor 1248: 18 | 0 | 18 Aroclor 1254: 18 | 620 | 18 Aroclor 1260: 18 | 272 | 18 Clean catch basin solid | Mixture of moss and dirt | Clean catch basin solid	1	Y
	11	0 µg/kg | 18 µg/kg | 753 µg/kg Aroclor 1248: 0 | 18 | 0 Aroclor 1254: 0 | 18 | 565 Aroclor 1260: 0 | 18 | 188 Clean forest soil | Clean catch basin solid | Mixture of moss and dirt	1	N
	12	48.2 µg/kg | 18 µg/kg | 18 µg/kg Aroclor 1248: 0 | 18 | 18 Aroclor 1254: 27.5 | 18 | 18 Aroclor 1260: 20.7 | 18 | 18 Street dirt | Clean catch basin solid | Clean catch basin solid	1	Y
	13	48.2 µg/kg | 1,808 µg/kg | 753 µg/kg Aroclor 1248: 0 | 0 | 0 Aroclor 1254: 27.5 | 901 | 565 Aroclor 1260: 20.7 | 907 | 188 Parking lot dirt | Catch basin solid | Mixture of moss and dirt	3	Y
	14	91 µg/kg | 0 µg/kg | 0 µg/kg Aroclor 1248: 0 | 0 | 0 Aroclor 1254: 91 | 0 | 0 Aroclor 1260: 0 | 0 | 0 Spiked sand | Clean forest soil | Clean forest soil	1	Y

Table 5-2-3: Sample screening testing trial results from May 17th, 2021. The color scale indicates the Total PCB concentration with: gray representing concentrations < 20 ug/kg, light blue representing concentrations 20-99 ug/kg, orange representing concentrations 300-749 ug/kg, and red representing concentrations ≥750 ug/kg.

Date	Trail	Bench Layout: Total PCBs Concentration (µg/kg) Aroclor concentration (µg/kg) Sample material description	# of Targets	Trial Results: Correctly Altered?
5/17/2021	15	71.4 µg/kg | 18 µg/kg | 18 µg/kg Aroclor 1248: 0 | 18 | 18 Aroclor 1254: 51.1 | 18 | 18 Aroclor 1260: 20.3 | 18 | 18 Mixture of moss and soil | Clean catch basin solid | Clean catch basin solid	1	N
	16	48.2 µg/kg | 18 µg/kg | 96 µg/kg Aroclor 1248: 0 | 18 | 0 Aroclor 1254: 27.5 | 18 | 96 Aroclor 1260: 20.7 | 18 | 0 Parking lot dirt | Clean catch basin solid | Spiked sand	2	Y
	17	Control | Control | 96 µg/kg Aroclor 1248: - | - | 0 Aroclor 1254: - | - | 96 Aroclor 1260: - | - | 0 Empty glass mason jar | Empty glass mason jar | Spiked sand	1	Y
	18	0 µg/kg | 1,808 µg/kg | 0 µg/kg Aroclor 1248: 0 | 0 | 0 Aroclor 1254: 0 | 901 | 0 Aroclor 1260: 0 | 907 | 0 Clean forest soil | Catch basin soil | Clean forest soil	1	Y
	19	18 µg/kg | 18 µg/kg | 4,700 µg/kg Aroclor 1248: 18 | 18 | 0 Aroclor 1254: 18 | 18 | 950 Aroclor 1260: 18 | 18 | 3,750 Clean catch basin solid | Clean catch basin solid | Catch basin solid	1	Y
	20	Control | 18 µg/kg | 4,700 µg/kg Aroclor 1248: - | 18 | 0 Aroclor 1254: - | 18 | 950 Aroclor 1260: - | 18 | 3,750 Empty glass mason jar | Clean catch basin solid | Catch basin solid	1	Y
	21	0 µg/kg | 0 µg/kg | 18 µg/kg Aroclor 1248: 0 | 0 | 18 Aroclor 1254: 0 | 0 | 18 Aroclor 1260: 0 | 0 | 18 Clean forest soil | Clean forest soil | Clean catch basin solid	0	Y
	22	1,808 µg/kg | 18 µg/kg | 4,700 µg/kg Aroclor 1248: 0 | 18 | 0 Aroclor 1254: 901 | 18 | 950 Aroclor 1260: 907 | 18 | 3,750 Wet catch basin soil | Clean catch basin solid | Dry catch basin solid	2	Y
	23	1,808 µg/kg | 18 µg/kg | Control Aroclor 1248: 0 | 18 | - Aroclor 1254: 901 | 18 | - Aroclor 1260: 907 | 18 | - Wet catch basin soil | Clean catch basin solid | Empty glass mason jar	1	Y
	24	0 µg/kg | 18 µg/kg | 32,400 µg/kg Aroclor 1248: 0 | 18 | 0 Aroclor 1254: 0 | 18 | 16,100 Aroclor 1260: 0 | 18 | 16,300 Clean forest soil | Clean catch basin solid | Sidewalk dirt	1	Y

Table 5-2-4: Sample screening testing trial results from May 17th, 2021. The color scale indicates the Total PCB concentration with: gray representing concentrations < 20 ug/kg, light blue representing concentrations 20-99 ug/kg, orange representing concentrations 300-749 ug/kg, and red representing concentrations ≥750 ug/kg.

Date	Trail	Bench Layout: Total PCBs Concentration (µg/kg) Aroclor concentration (µg/kg) Sample material description	# of Targets	Trial Results: Correctly Altered?
5/19/2021	25	0 µg/kg | 1,043.7 µg/kg | 0 µg/kg Aroclor 1248: 0 | 722 | 0 Aroclor 1254: 0 | 224 | 0 Aroclor 1260: 0 | 97.7 | 0 Clean sand | Catch basin solid | Clean sand	1	Y
	26	0 µg/kg | 0 µg/kg | 0 µg/kg Aroclor 1248: 0 | 0 | 0 Aroclor 1254: 0 | 0 | 0 Aroclor 1260: 0 | 0 | 0 Clean sand | Clean sand | Clean sand	0	Y
	27	48.2 µg/kg | 1,043.7 µg/kg | 71.4 µg/kg Aroclor 1248: 0 | 722 | 0 Aroclor 1254: 28 | 224 | 51.1 Aroclor 1260: 20.7 | 97.7 | 20.3 Parking lot dirt | Catch basin solid | Mixture of moss and dirt	3	Y
	28	48.2 µg/kg | Control | 71.4 µg/kg Aroclor 1248: 0 | - | 0 Aroclor 1254: 28 | - | 51.1 Aroclor 1260: 20.7 | - | 20.3 Parking lot dirt | Empty glass mason jar | Mixture of moss and dirt	2	Y
	29	591 µg/kg | 18 µg/kg | 2,315 µg/kg Aroclor 1248: 107 | 18 | 1,280 Aroclor 1254: 351 | 18 | 712 Aroclor 1260: 133 | 18 | 323 Mixture of street dirt and inlet | Clean catch basin solid | Inline sample	2	Y
	30	0 µg/kg | 0 µg/kg | 0 µg/kg Aroclor 1248: 0 | 0 | 0 Aroclor 1254: 0 | 0 | 0 Aroclor 1260: 0 | 0 | 0 Clean sand | Clean sand | Clean sand	0	N
	31	0 µg/kg | 0 µg/kg | 0 µg/kg Aroclor 1248: 0 | 0 | 0 Aroclor 1254: 0 | 0 | 0 Aroclor 1260: 0 | 0 | 0 Clean sand | Clean sand | Clean sand	0	N
	32	0 µg/kg | 0 µg/kg | 411.3 µg/kg Aroclor 1248: 0 | 0 | 87.6 Aroclor 1254: 0 | 0 | 230 Aroclor 1260: 0 | 0 | 93.7 Clean sand | Clean sand | Catch basin solid	1	Y
	33	270.5 µg/kg | 18 µg/kg | 85 µg/kg Aroclor 1248: 98.4 | 18 | 0 Aroclor 1254: 78.9 | 18 | 0 Aroclor 1260: 93.2 | 18 | 85 Catch basin solid | Clean catch basin solid | Spiked forest soil	2	Y
	34	18 µg/kg | 270.5 µg/kg | 18 µg/kg Aroclor 1248: 18 | 98.4 | 18 Aroclor 1254: 18 | 78.9 | 18 Aroclor 1260: 18 | 93.2 | 18 Clean catch basin solid | Catch basin solid | Clean catch basin solid	1	Y
	35	591 µg/kg | 9,300 µg/kg | 18 µg/kg Aroclor 1248: 107 | 4,750 | 18 Aroclor 1254: 351 | 3,140 | 18 Aroclor 1260: 133 | 1,410 | 18 Mixture of street dirt and inlet | Inline sample | Clean catch basin solid	2	Y

5.3 Standardized Calibration Bench Sample Screening

On August 11, 2021, a warm-up routine was introduced to the beginning of each field day. The assessment was used to evaluate the detection dog using a consistent bench testing protocol throughout the final three field evaluation exercises. Each day, Jasper ran eight bench trials. Each day's trial was identical, using the same samples and same layout sequence as the day before and each set of trials was conducted before the field survey. A single bench setup was used for this calibration assessment to make it easier to implement in the field or office. This evaluation was designed to be a consistent test that could be easily administered before field work. Its purpose was to help identify variability in canine accuracy from day to day. It also served as a good warm-up activity for the canine team at the start of each field day.

During these calibration sessions, the dog handler was not informed of this change and thought that the testing was a continuation of the warm-up activities perform in the past. Also, the handler did not know that the trials were repeat trials using the same samples each day.

All target samples had significant levels of PCBs, with none below 270 ug/kg. Higher concentration PCB target samples were used because they provided Jasper with the opportunity to have confident detections and a positive experience. This was less a test and more a calibration process, providing an opportunity to observe and assess the handler team's confidence at the start of each day.

The calibration test results were documented to also include the number of times the dog walked past the targets and how many passes it took for the handler to declare which sample was believed to be the target sample. If the dog found the target on the first pass, it was considered a high-confidence detection. In the three days of calibration, Jasper only had two errors in finding the target and generally showed a high confidence in finding targets.

Table 5-3-1: Calibration testing trial results. The color scale indicates the Total PCB concentration with: gray representing concentrations < 20 ug/kg, light blue representing concentrations 20-99 ug/kg, light orange representing concentrations 100-299 ug/kg, and red representing concentrations ≥750 ug/kg.

Trial #	Bench Layout: Total PCBs Concentration (µg/kg) Aroclor concentration (µg/kg) Sample material description									Trial Results: Correctly Identified?		
										8/11/2021	8/17/2021	9/17/2021
1	32,670 µg/kg			0 µg/kg			18 µg/kg			Yes	Yes	Yes
	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260			
	0	25,700	6,970	0	0	0	18	18	18			
	Sidewalk dirt			Clean forest soil			Clean catch basin solid					
2	18 µg/kg			85.1 µg/kg			1,043.7 µg/kg			Yes	Yes	Yes
	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260			
	18	18	18	13.8	26.1	45.2	722	224	97.7			
	Clean catch basin solid			Catch basin solid			Catch basin solid					
3	0 µg/kg			753 µg/kg			85.1 µg/kg			No	Yes	Yes
	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260			
	18	18	18	0	620	272	13.8	26.1	45.2			
	Soil			Dirt from directly dripline of a caulking seam			Catch basin solid					
4	0 µg/kg			0 µg/kg			270.5 µg/kg			No	Yes	Yes
	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260			
	18	18	18	0	0	0	98.4	78.9	93.2			
	Soil			Clean sand			Catch basin solid					
5	0 µg/kg			1,613 µg/kg			Control			Yes	Yes	Yes
	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260			
	18	18	18	0	1,300	313	n.a.	n.a.	n.a.			
	Soil			Sidewalk dirt			Empty glass mason jar					
6	9,300 µg/kg			0 µg/kg			0 µg/kg			Yes	Yes	Yes
	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260			
	4,750	3,140	1,410	0	0	0	0	0	0			
	Inline sediment solid			Clean sand			Clean forest soil					
7	0 µg/kg			1,808 µg/kg			Control			Yes	Yes	Yes
	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260			
	0	0	0	0	901	907	0	0	0			
	Clean sand			Catch basin solid			Empty glass mason jar					
8	Control			54 µg/kg			17,910 µg/kg			Yes	Yes	Yes
	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260	Aroclor 1248	Aroclor 1254	Aroclor 1260			
	0	0	0	18	18	18	0	1,610	16,300			
	Empty glass mason jar			Clean catch basin solid			Sidewalk dirt					

6.0 DETECTION DOG BLOOD PCB RESULTS

To monitor for any potential negative health impacts associated with Jasper's exposure to PCBs, the University of Washington veterinary services collected samples of his blood and analyzed them for a subset of PCB congeners[11] prior to the start of the study (i.e., baseline testing) and at the completion of field evaluations (final testing). None of the congeners analyzed were detected in either sample.

Table 6-1. Blood test results for Jasper

PCB Congener	Baseline and Final Maximum Values from Jasper's Blood Test Samples (mcg/L)	Blood Level Concentrations in the Human Population (mcg/L)	
		95th Percentile in the US Population (NHANES 2003-2004)[a]	95th Percentile in the Canadian Population (Health Canada 2007-2009)[a]
PCB 28	0.020 U	0.068	0.05
PCB 44	0.010 U	0.032	not available
PCB 52	0.010 U	0.044	not available
PCB 66	0.010 U	0.025	0.03
PCB 74	0.020 U	0.15	0.10
PCB 101	0.010 U	0.033	0.03
PCB 118	0.020 U	0.22	0.12
PCB 138	0.040 U	0.48[b]	0.28
PCB 153	0.080 U	0.63	0.54
PCB 156	0.010 U	0.10	0.07
PCB 180	0.080 U	0.54	0.49

a Values as provided in blood test analytical reports from the University of Washington veterinary services (NMS 2020, NMS 2022) and as reported by the CDC 2009 and Health Canada 2010.

b Value reported is for a combination of PCB 138 and PCB 158.

NHANES National Health and Nutrition Examination Survey

U Not detected at the concentration shown

6.1 Interpreting Jasper's Blood Test Results

6.1.1 Blood Concentrations Relative to Human Population

Along with the test results shown in Table 6-1, University of Washington veterinary services provided information regarding the 95th percentile of PCB concentrations in human blood for the populations in both the United States and Canada (NMS 2020, NMS 2022). Concentrations detected in Jasper's blood and/or the RLs for the congeners were lower (not detectable at the method detection limit) in all cases relative to these 95th percentile PCB concentrations reported for the general population in the United States and Canada (Table 6-1).

6.1.2 Literature Review

To further evaluate any potential health effects associated with Jasper's exposure to PCBs, a literature review was conducted in the previous detection dog pilot study to find additional information regarding 1) PCB concentrations in blood associated with effects, 2) toxicity of PCBs via inhalation, and 3) other information regarding PCB toxicity to dogs. The information collected as part of this search is summarized in the following bullets:

- **PCB concentrations in blood and effects** – Toxicity reference values (i.e., thresholds above which adverse health effects are expected) were not available for PCBs in blood samples, so the link between the PCB concentrations in the blood tests and potential toxicity could not be directly evaluated.

- **PCB toxicity via inhalation** – Limited data is available regarding the effects of exposure to PCBs via inhalation (Lehmann et al. 2015), particularly exposures similar to those experienced by Jasper in this study. Results from a few relevant studies are as follows:
    - Although diet is generally assumed to be the primary route of PCB exposure, several studies have assessed overall PCB exposure in humans and have concluded that exposure via indoor inhalation may be an important source of PCBs (Ampleman et al. 2015; Lehmann et al. 2015). This finding indicates that given sufficient duration of exposure or concentration of PCBs, inhalation may be an important exposure pathway for PCBs. However, insufficient information was available to link these exposure studies with the results of Jasper's blood tests from this study.
    - Studies of rats exposed to PCBs through "nose-only" inhalation found that health effects were minimal, both for shorter-term exposure to higher concentrations (Hu et al. 2010) and intermediate-term exposure to lower concentrations (Hu et al. 2012). Details are described as follows:
        - Shorter-term exposure– Rats were exposed via inhalation to either acutely (total of 2 hours at a concentration of 2.4 mg/m^3) or sub-acutely (2 hours per day for 10 days at a concentration of 8.2 mg/m^3) elevated levels of PCBs (Hu et al. 2010).
        - Intermediate-duration exposure– Rats were exposed for 1.6 hours/day for four weeks at a concentration of 520 $\mu g/m^3$ (± 10 $\mu g/m^3$) (Hu et al. 2012).
    - Although air concentrations were not measured as part of the pilot study, it is anticipated that Jasper's exposure in this study would likely be more similar to the 2012 study (i.e., intermediate duration exposure to lower concentrations.

- **Other information regarding dogs and PCB exposure** – Schilling et al. (1988) evaluated PCB concentrations in dogs in both contaminated and uncontaminated areas. For dogs living in the contaminated area of Indiana where the average concentration of PCBs in soil was 9,000 mg/kg, the authors found the median blood concentration of Aroclor 1260 PCBs in dogs to be 3.0 parts per billion (ppb) (approximately 3.0 µg/L).[12] For dogs living in an uncontaminated location (Atlanta, Georgia; average soil concentration not reported), dogs were found to have median blood concentration of Aroclor 1260 PCB of 1.7 ppb (approximately 1.7 µg/L). PCB contamination was present in the soil in Indiana in this study, so exposure was expected to

have occurred through several exposure routes (i.e., inhalation, dermal exposure, and incidental ingestion).

6.2 Blood Test Summary

During this study, Jasper's exposure to PCBs can be characterized as follows:

- Exposure was short-term (the study duration was approximately 24 months) and occurred only periodically (i.e., during training and field evaluation visits).
- Concentrations were generally less than 1 mg/kg; exposure to higher concentrations (e.g., more than 10 mg/kg) was limited to select target buildings and some training materials.
- Exposure occurred primarily via inhalation. Limited dermal exposure and incidental ingestion may have occurred also, although these pathways were minimized to the extent possible (e.g., through bathing, wiping off Jasper's face, and use of protective gear such as booties in the field).

Based on the results of Jasper's blood tests, the type of exposure, and the available literature summarized in Section 6.1, the overall risk associated with Jasper's exposure to PCBs is extremely low and shows no lasting exposure to PCBs.

7.0 OBSERVATIONS AND INTERPRETATIONS

This is a subjective study where SPU took observations and noted our interpretations of how an odor detection dog might work as a member of a team conducting source control tracing investigations for the presence of PCBs. Below are a list of observations and opinions SPU made during the sample screening and field evaluations. These helped modify SPU's approach and helped define both positive and negative aspects of using detection dogs for source tracing efforts.

7.1 Attributes of the Detection Dog & Handler

- Jasper was able to locate all known and approachable PCB target buildings presented in field evaluations across the city in diverse neighborhoods. One target building was distant from the public space and wind direction was unfavorable for odor recognition and was not found by Jasper.
- Jasper proved he could locate unknown PCB buildings.
- It is theorized that Jasper may miss lower-level sources from painted buildings.
- Jasper was sometimes able to locate buildings of interest distant from the sidewalk by scent on the wind.
- Jasper was able to find small remnants of possible caulking material that had blown to the roadway and collected on the gravel shoulder. This may indicate that previous building maintenance on PCB materials can remain in the environment if not properly identified and managed for disposal. Detection dogs may sometimes alert on materials that do not readily appear to be sources of PCB but contain historical contamination.

- Jasper can screen an area of unknown PCB sources and find meaningful PCB sources. This could indicate his ability to screen out the remainder of the commercial area as PCB free.
- Jasper was successful in finding a below ground transformer vault with known levels of PCBs in the transformers that was close to a PCB contaminated building. It is possible that Jasper was smelling minor leaks from the transformer equipment or the previous contaminated equipment that was in the vault.
- Some low to moderate indications from Jasper may be for PCB odor carried from afar and not necessarily from adjacent structures. It is difficult to determine the source for these locations. These could also indicate paint on a building whose odor is not noticeable to the handler.
- At the beginning of a search, Jasper sometimes moves rapidly past buildings without thoroughly searching. Initial areas of the search should be taken slowly and with more careful observations.
- If Jasper shows a change of behavior, it should be recognized that this could be a sign of odor recognition and more search is warranted.
- Jasper can be interested in smells not necessarily associated with PCBs which can distract from the search and may result in ineffective sampling.
- It takes a fine balance and ability to differentiate an interest in an object and targeted odor detection at low levels. A well-trained handler is necessary to interpret these signals with high confidence.
- If an area contains a measurable but low level of PCB across its entirety, it may be difficult for the detection dog to find the hotspot if the hotspot is also a relatively low concentration.
- In areas of high PCB odor, Jasper becomes less reliable for lower-level sources that are important to identify, such as adjacent catch basins.
- Using “obedience to odor” training to pinpoint the target (nose stays on target) may better define strong responses from Jasper and cut out some of the uncertainty of the detection dog’s low confidence responses.
- Samples taken from an area suspected to be clean, screened by the detection dog as clean and where analysis indicates the lowest levels of PCBs in samples collected may indicate a background level for a particular area. Any PCB levels above this sample result level could indicate a nearby source of PCBs.
- Make sure to check with the handler to be sure that a location is not suspect before taking a “clean” area media sample. You need a high confidence of cleanliness to take a clean sample.
- With preparation beforehand, a 16-block area can be searched in about 2 hours.
- About 4 hours of searching a day is optimum for the detection dog.
- It remains difficult to assess potential PCB properties/structures when Jasper shows interest from a distance and property access permission to enter is denied.

7.2 Attributes of the SPU Inspector

- Pre-screening the area to rule out searching of newer buildings helped speed up the investigation process. Having the SPU inspector direct the dog handler to ignore the building built in 1980 or newer helped the handler focus on the dog while the SPU inspector controls the flow of the search.
- The SPU inspector should direct the dog handler through the process to stay on the plan. If the dog handler is focused on minor interests by the dog rather than searching for a strong response, then the SPU inspector should advise to move on. There was worry by the dog handler that they could miss a target so every interest by the dog is scrutinized. This screening method should be quick and look for significant sources as the goal.
- Having a plan beforehand to focus the search is needed. This will provide a better flow with fewer interruptions during the search. This plan is communicated at the start of the process, and it is the SPU inspector's responsibility to keep to the plan.
- Have confidence in the dog when humans can't confirm by their own recognition sources by odor and take samples where the handler identifies that the dog responds moderately.

7.3 Attributes of the Study Team

- Observers were keen to have the target building found while the SPU inspector/detection dog team were worried about overlooking any possible target. This may have contributed bias on one or two searches.
- It was not clear if SPU inspectors were unaware of a couple of these target buildings included in the field evaluations. SPU inspectors tried not to influence the handler to look at targets and mostly took notes of their observations. Some searches may be biased with the presence of SPU inspectors who knew the location of target buildings.

7.4 Attributes of the Weather

- The detection dog may be confused in areas where odor may be cast from a strong source due to wind. The odor can swirl around a distant building and confuse the dog in identifying this distant building as a source.
- Rain likely dampens the odor of exterior PCB building materials and contaminated media, especially in the sidewalk where contaminated dirt was covered by fresh rain. However, the detection dog does a good job of locating sources even in cold rainy weather.
- As a secondary means of target confirmation, it might be good to take samples from the target area during cold rainy weather and evaluate the samples in a dry warm place. Negative and positive samples should be obtained.
- On hot days, Jasper may be less energetic and want to rest more often. If he is panting, this may decrease Jasper's ability to smell the odor if he is taking air through his mouth and not his nose.

- Hot days may liberate more PCB odor, but heat has a more direct effect on the detection dog than cold weather conditions. Days with moderate temperatures are likely the best environment for detection dogs.
- Once a target is suspected it is good to move away from the target and approach from another direction to see if the dog reacts differently or the same. Changes in reaction could indicate that wind might be a factor and that the interest may be false.

7.5 Attributes of the Environmental Solid Sampling Methods

- Samples of media should be taken as near to high-to-moderate indicated sources as possible. At least one sample should be taken in an area that the dog screens as no PCB source. The relative difference in PCB concentrations is important rather than the absolute value of the sample PCB result.
- When taking samples near a suspected PCB contaminated building, take some close to the building and progressively distant. If the results decreased the further from the source, then this might confirm this building as the source.
- A positive sample below 100 ppb PCB may still be indicative of a source of PCB nearby. If many samples taken in a neighborhood area are below the MRL/MDL and one or more are quantifiable, this may indicate that the neighborhood is fairly clean and a source could be indicated by even a small PCB result.
- Samples collected beneath suspected PCB building materials can be brought back to the office for a quick second verification by the detection dog. Samples of non-PCB material, similar to the target material, should be collected at a distance from the suspected source and used as blanks in the sample verification process.
- If "clean" samples in an area are below the MDL, then any sample with measurable PCBs may indicate a source nearby.
- Always choose samples based on stormwater flow direction. If you take a sample near a source, be sure that stormwater striking that source would reach the sample location.
- Sampling low or medium interest sites usually results in very low analytical results. This may still indicate a source, but the source is not contributing a high level of PCB at this time. These should be marked as suspect PCB sources and pursued after other probable PCB sources are addressed.
- This study did not evaluate samples for total carbon or grain size. Some samples may be arbitrarily low due to the lack of fine particles of organic matter or other non-normalizing measurements.
- Sidewalk dirt near a strong source and downstream of sheet flow from the building is a good location to sample to verify a source from a public space. This material may not be detectable by the detection dog if the target building is close and overpowering.

7.6 Techniques, Discoveries & Improvements

- Once a target is identified, have the dog inspect downstream stormwater inlets or catch basins near the target to see if the dog also shows strong positive response.
- To make the search more efficient, create a map of the search area with building overlay in advance. Use parcel information to find the year the building was built so that post 1980 buildings can be excluded during the search. This building age search is done by using the King County Department of Assessments website (https://blue.kingcounty.com/Assessor/eRealProperty/default.aspx). Properties can be searched by address or by using the map feature. This map feature can be used to find the ages of the buildings in the search area quickly. The property report will instantly display on the screen by clicking on the property of interest (https://localscape.property/#kingcountyassessor/My-Property). The property report includes information such as the year the building was built, photo of the building, building use (e.g., condominium, school, retail), and building net square footage.
- Paint may be more difficult for the detection dog to identify as a strong source, especially at low levels in the paint. Any low to moderate response should be investigated as possible paint.
- Paint may contribute constant low levels of PCBs at levels that are considered background. A building that was previously painted with PCB paint may have shed PCBs in the past and then been repainted with clean paint that has since encapsulated the PCBs. The PCB residue that was shed during the exposed PCB paint is still on the ground near the building, but slowly dissipating over time as it washes away. Even low levels of measurable PCB in samples can be derived from sources of paint.
- Finding painted buildings may be difficult unless the underlying paint from PCB era is exposed.
- Record video of the entire search process when the detection dog is working so that it can be reviewed later to see if there were any missed observations and observe dog-handler reactions in the field.
- For low to moderate responses, it may be best to mark the spot and move along and then return for follow-up at the end of the day if needed.
- The use of a detection dog at a previously suspect building can contribute to the evidence provided by other detection sources to strengthen confidence in PCB designation of a building.
- Use of Jasper at determining PCB through pick hole search was not fully developed but there were some positive observations. This technique might be best used for finding strong sources in the drainage system, but lower-level contamination might escape this method.
- Although glazing materials around a window may have measurable PCBs, the highest level of PCB detection was always in the periphery caulking that attached the frame to the building, or in expansion joints in concrete wall panels. Internal window caulking or spline materials may be contaminated from this more concentrated caulking along the edge of the frame.
- Using a set pattern of test samples to calibrate Jasper before we started work helped reinforce his focus on the days odor and confirm his current ability. Just like humans, dogs have good

and bad days, and this is a way to see how well he is doing for the day. The handler should be blind to the samples presented to ensure a proper evaluation of the dog.

- Without access to the higher floors of a building, it is impossible to determine if upper levels of the building contain PCB materials.

8.0 SUMMARY AND CONCLUSIONS

8.1 SUMMARY

This section discusses the overall project highlights and what evolved from the use of the detection dog team in field evaluations in an effort to find sources of PCBs around the City of Seattle. As with most studies, the work led SPU to be more sensitive to locating PCBs, develop new sampling tactics to prove our verification methods, and assisted in reinterpreting sampling data results to the subtle hints of PCB in our environment that may be attributed to building materials. SPU developed a standard operating guidance to create a more consistent method of use which can be adopted or modified by other investigators looking for a new way to locate PCB sources from commercial buildings.

The study started in 2019 with the University of Washington Conservation Canines training a new detection dog, Jasper, that they rescued from a shelter in Lacey, WA. Jasper underwent initial basic training as a new odor detection dog and then was further specialized on multiple scent targets which included low level PCB Aroclors. Training is an ongoing process to refine detection skills and additional training was needed to transition to look for targets in an urban environment on vertical walls and structures. During the first week of March 2020, Jasper was deemed ready for verification of his skills. He was verified by SPU using a standard bench sample testing and then with simulated field exercises where he was required to find hidden PCB samples in outdoor settings. Jasper proved he was ready and passed all verification tests.

In mid-March 2020, the Coronavirus pandemic shut down the project. CK9 continued to refine Jasper's PCB finding abilities until we could resume our project under new constraints in the Fall of 2020. During this period, SPU contacted the owners of properties where PCBs were suspected in buildings to request permission to access the property for a detection dog search and collection of environmental solids samples. Access was denied or ignored by most property owners. A few properties allowed access onto their private property when field evaluations resumed.

In the Fall of 2020, SPU began scheduling field evaluations throughout the city. These field evaluations would vary in complexity, size, and the number of known probable PCB targets or searches that lacked a known target building. Various methods of using the odor detection dog team were proposed and these methods tested in the field to see what worked best. In all these field evaluations there are constants in our methodology:

- It is known that some humans, including many SPU inspectors, can clearly smell PCBs at very low levels, and at times, even at a distance from the source.

- The detection dog and handler can both smell PCBs at very low levels. The detection dog is able to smell PCBs at levels unverifiable by human odor detection.
- No matter the PCB Aroclor, PCBs have an odor that is unique and distinguishable as PCB.
- PCBs on the exterior of buildings shed PCB into the storm drainage system and can be analytically measured in the solids collected from these drainage assets.
- The dog handler and SPU inspector should be unaware of any target buildings or other PCB known sources in a search area to eliminate bias.

Methods utilized during this study included:

- ✓ Searching a commercial area of the city with a known target building to see if the dog/handler could find the unknown site or any other source of PCBs in the search area.
- ✓ Searching a commercial area of the city with multiple targets to complicate the search and prove the ability of the dog team to find PCBs in a more complex environment.
- ✓ Searching an area of the city where no known target buildings was thought to be present to determine if the dog team could truly find PCB sources in buildings in which the entire team was unaware of.
- ✓ Searching the drainage structures in an area to see if PCBs could be detected from the odor emitting from the open access points into the drainage system.
- ✓ Evaluating effectiveness of use- of the detection of team during different weather conditions.
- ✓ Re-evaluating overlooked areas where PCB evidence is minimal but still present.
- ✓ Using the detection dog to verify suspect buildings to increase the confidence in verifying that the building is a likely PCB source.
- ✓ Taking environmental media samples near and further from suspect buildings identified by the detection dog. These collected samples can be used for screening buildings at a distance. If the nearer sample is higher in PCBs than the far sample helps confirm the suspect source contributing PCBs to the environment.

In all, SPU and CK9 conducted 15 field evaluation exercises where SPU business inspectors had previously identified 19 target buildings. The detection dog was able to find 18 out of 19 known target buildings. One target building was distant from the public space and the wind did not allow a decent approach for scent recognition and Jasper was unable to indicate a positive response for this distant building. We were able to downgrade one target building to non-significant after the detection dog search of the property and Jasper had a limited positive response. Jasper found four additional probable PCB-contaminated buildings during these searches and an additional two buildings that are suspect of having PCBs. In addition, Jasper found two other sources of PCBs not clearly associated with buildings - traffic collision bollards and scraps of possible window caulking waste in the street.

In searches where previously known PCB buildings or targets were found, Jasper was able to exclude the remainder of the area as clean of significant PCB sources. His investigations not only found new sources, but SPU is confident that the areas he searched do not have additional significant sources. It is possible that less significant source from buildings may be in these areas, such as painted buildings with PCB paint layers covered by newer paintings that are preventing additional shedding of PCB to the

environment. Underlying and sequestered PCB paints on buildings still pose a problem in discovery by detection dog use since field verification by human odor recognition or environmental media samples tend to be inconclusive.

On a few of field investigations, the detection dog team returned to the same area for a second search under different weather conditions to see if hot or cold, rain or sunshine helped or hindered the searches. Hot days might liberate more odor from the PCB source and the winds may be calmer on hot days. On rainy days, the PCB source might be covered in moisture and reduce the emission of odor. For the most part, weather did not greatly affect the detection dog when a source was locatable, but stamina diminished more on hot days. Hot days hindered more than helped as the detection dog tired quickly and tended to pant rather than inhale through the nose. On hot days, Jasper wanted to find shade and rest frequently. Mild pleasant days allowed for longer use of the dog and a more enjoyable search than cold and rainy days or hot days. The detection dog works best on a four-hour hunt and not a long eight-hour day.

Field evaluations during this study also looked at two historical PCB spill cleanup areas in the city. One area was a significant source spread across a city block that had been cleaned up in 2019 prior to the start of this study. The dog and handler verified the area was adequately cleaned except for three concrete Ecology blocks used as parking obstructions. These concrete Ecology blocks were used during the spill cleanup to prevent encampments, and some were placed within the hot zone of the spill and could have been contaminated during the cleanup actions. The three concrete Ecology blocks were verified by the dog and team members were also able to smell PCBs at the location indicated by the detection dog. The concrete Ecology blocks were marked for disposal and Seattle Department of Transportation (SDOT) completed the cleanup process in this area by removing these items. The second spill area was significantly smaller, and Jasper identified the need for further cleanup. The area was cleaned a second time and no PCB odor remains.

As supporting proof of the PCB sources identified in the study, SPU collected 77 media samples for analysis in and around PCB suspect properties to verify that PCBs are elevated near the source and that PCBs were less likely to be found in areas that the dog team identified as non-sources. The analytical results of sampling near these targets changed, over time, how SPU interpreted the level of PCBs in the analytical results to potentially indicate that a PCB source might be nearby. Some sample results below 100 ppb PCBs with potential impact from a suspect source could be indicative of a source if compared to other nearby media samples results showing no detectable PCBs above reporting limits. Sample results in the range of 200 ppb PCBs or more became more likely to indicate a source. These levels are not always indicative of a PCB source and should always be compared with other samples in the neighborhood for interpretation.

SPU achieved many samples collected during this and previous studies. The archived samples were used to test if the detection dog could quickly screen these samples to indicate a source rather than taking the dog to the source. This method allowed environmental samples from the area to be used for a quick verification screening in a more controlled environment. Jasper was very effective in verifying samples containing PCBs and excluding clean samples. He was usually able to screen samples to find the higher-level sample over lower-level ones. This method could allow an agency to find

significant targets and to screen out clean samples quickly and could potentially screen a large geographic commercial area in a shorter time period than field use of the dog team.

SPU tended to conduct the bench sample screening process prior to field verification work later in the day. As SPU conducted these sample screening exercises, SPU realized that this was a way to help focus the detection dog onto the scent for the work in the field to follow. SPU began instituting this screening process more formally before field work to not only focus the dog but to verify his accuracy for the day. SPU began doing a daily sample verification protocol using the same eight tests to record how well Jasper was working. This calibration and scent focus before each days' work was set as a standard procedure by the end of the study.

8.2 CONCLUSION

The detection dog team proved to be an effective and powerful tool to discover and verify PCB sources when access to the buildings' exterior was possible. At further distance, the effectiveness of the method deteriorates but indication of a PCB source is still possible in the right weather conditions. The detection dog team was able to find sources of PCBs that could be easily overlooked. A detection dog showed promise in screening drainage structures to look for high levels of PCBs in the drainage system, to track contamination upstream to where the PCBs diminish, and then find the source through a ground search. The detection dog team found previously unknown PCB sources during these searches and proved effective as a method of PCB discovery for source tracing.

A detection dog team is not always successful. Many times, they provide clues that SPU did not have before, but the source tracing team should investigate further. Taking samples near the suspect target can provide better confirmation but samples need to be taken distant from the source for a good comparison.

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