DEPARTMENT OF ECOLOGY
State of Washington

Quality Assurance Project Plan

Spokane River

Urban Waters Investigation of PCBs in Soils and Stormwater Associated with Demolition Activities

August 2017

Publication No. 17-10-010

Publication Information

Each study conducted by the Washington State Department of Ecology (Ecology) must have an approved Quality Assurance Project Plan. The plan describes the objectives of the study and the procedures to be followed to achieve those objectives. After completing the study, Ecology will post the final report of the study to the Internet.

This Quality Assurance Project Plan is available on Ecology's website at https://fortress.wa.gov/ecy/publications/SummaryPages/1710010.html

Data for this project will be available on Ecology's Environmental Information Management (EIM) website at www.ecy.wa.gov/eim/index.htm. Search Study ID ABOR0001.

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Quality Assurance Project Plan

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March 2017

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2.0 Abstract

Ecology lacks information about how polychlorinated biphenyls (PCBs) in building materials in the Spokane area impact the Spokane River through the stormwater pathway. The objective of this screening-level study is to evaluate the potential for PCBs in building materials to impact soil and stormwater. This project involves testing soil samples prior to and following demolition activities of target properties to identify the effectiveness of current demolition practices. Stormwater will also be tested from a selected number of stormwater conveyances located in the study area and compared with results from previous Urban Waters studies for the purposes of trend evaluation.

The results of this study will help inform development of Best Management Practices for managing PCBs in building materials, which is Control Action 5.13 in the *2016 Comprehensive Plan to Reduce Polychlorinated Biphenyls (PCBs) in the Spokane River.*

3.0 Background

The Environmental Protection Agency (EPA) notes that there is potential widespread use of polychlorinated biphenyl (PCB)-containing building materials in schools and other buildings constructed or renovated between about 1950 and 1979.[1] Sources of PCBs in building materials include:

- Caulk put in place between 1950 and 1979, which may contain as much as 40 percent PCBs.
- Fluorescent lighting fixtures that still contain their original PCB-containing light ballasts.
- Paint, masonry walls, wood, and dust that has absorbed PCB emissions.

Numerous studies in cities around the country have found PCBs in window caulk (1 – 82,100 ppm), leachable PCBs in soil surrounding buildings where PCB-containing caulk was still in place (3- 320 ppm), joint sealants in concrete buildings (20 – 550,000 ppm), paint (1,940 – 3,970 ppm), and plaster (290 ppm).[2]

In Washington State, a survey of the Lower Duwamish Waterway concluded that "paints in the 1950s industrial, 1950s commercial, 1960s industrial, and 1970s industrial buildings contain relatively high concentrations of PCBs and metals. Samples from the area revealed PCBs in 39 percent of the paint samples (up to 61 ppm) and 47 percent of the caulk samples (with concentrations of up to 920 ppm). PCBs were more likely to be present in industrial than residential or commercial buildings.

In order to improve knowledge of PCBs associated with construction materials and their fate, the study recommended:

- Sufficient sampling to increase confidence in the results (there was difficulty obtaining access agreements from property owners).
- Discrete sampling of paint and caulk with corresponding onsite or downstream storm drain solids would help characterize PCB sources.
- Sampling buildings built between 1978 and 1988 in order to assess the use of PCBs in building materials after the PCB ban.

The Department of Ecology notes that a large reservoir of PCBs in old caulk and other building materials slowly releases into the environment. Activities such as remodeling and demolition increases the risk of PCB release to the environment. The use of best management practices during remodeling and demolition lowers the risk of release.[3]

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[1] *Polychlorinated Biphenyls (PCBs) in Building Materials* at https://www.epa.gov/pcbs/polychlorinated-biphenyls-pcbs-building-materials

[2] SAIC, *Lower Duwamish Waterway Survey of Potential PCB-Containing Building Material Sources: Summary Report*, June 2011.

[3] Department of Ecology and Washington State Department of Health, *Chemical Action Plan*, February 2015, https://fortress.wa.gov/ecy/publications/documents/1507002.pdf

Ecology lacks information about how polychlorinated biphenyls (PCBs) in building materials in the Spokane area impact the Spokane River through the stormwater pathway. In anticipation of proposed freeway construction, the Washington State Department of Transportation (WSDOT) plans to remove, residential and commercial structures within the freeway right-of-way.

Ecology currently has the opportunity to assess:
1) Whether PCB-containing building materials are impacting soils around existing structures.
2) The effectiveness of current demolition practices at preventing the release of PCBs to soils.
3) If there is evidence that PCBs in building materials may be reaching the Spokane River through the stormwater pathway.

The results of this screening-level study will inform the development of Best Management Practices for managing PCBs in building materials, which is Control Action 5.13 in the *2016 Comprehensive Plan to Reduce Polychlorinated Biphenyls (PCBs) in the Spokane River.*[4]

3.1 Study area and surroundings

The study area is located within the Spokane city limits in the area of the US 395 North Spokane Corridor right-of-way.[5] The final portion to be constructed runs north-south from the Francis-Freya interchange to the north and Interstate 90 to the south. A substantial inventory of residential and commercial buildings that have been or will be demolished exists. Many of these buildings were constructed between 1950 and 1979.

The subject properties are expected to be located within the Ralph basin, which was last sampled in 2011.[6]

See Figures 1 and 3 (Section 7.1.2).

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[4] LimnoTech, Inc. *2016 Comprehensive Plan to Reduce Polychlorinated Biphenyls (PCBs) in the Spokane River*, approved November 16, 2016 at http://srrttf.org/wp-content/uploads/2016/04/2016_Comp_Plan_Final_Approved.pdf

[5] WSDOT, 2006. *US 395 North Spokane Corridor, Connecting Washington, Eastern Region* at http://www.wsdot.wa.gov/NR/rdonlyres/341E3484-CB8E-48A3-A158-7B3EA26E6C8A/0/NSC_One_Page_with_Legend_January_2016.pdf

[6] Department of Ecology, *Spokane River Urban Waters Source Investigation and Data Analysis Progress Report,* 2012 at https://fortress.wa.gov/ecy/publications/SummaryPages/1204025.html

Figure 1. Study area for Spokane River Urban Waters investigation of PCBs in soils

3.1.1 Logistical problems

Prior to sampling, historical information about the properties will be obtained from available property records. To the extent possible, the set of sampled properties will be representative of the area by age, and include both commercial and industrial properties.

The properties included in this study are currently owned by the WSDOT, who will facilitate access. Ecology will obtain a "Right of Entry Permit" prior to sampling and coordinate entry procedures with WSDOT in accordance with the Site Safety Plan (Appendix B).

Timing of the study is dependent upon demolition schedules. Soil sampling will be performed before and after demolition activities. Stormwater will be collected opportunistically based on weather conditions using standard Urban Waters protocols. See Section 7.1.2 for sampling locations.[7]

The study is limited by the timing and availability of Urban Waters funding. The sampling and analysis work must be completed prior to May 30, 2017.

[7] Department of Ecology, *Spokane River Urban Waters Source Investigation and Data Analysis Progress Report,* 2012 at https://fortress.wa.gov/ecy/publications/SummaryPages/1204025.html

3.1.2 History of study area

The US 395 North Spokane Corridor right-of-way goes through the Hillyard, Chief Garry, and East Central neighborhoods. The Hillyard neighborhood began in 1892 as a railroad town, with many of the houses built between 1904 and 1912. Railyards are also potential sources of PCBs, although this study is not intended to address this source.

Approximately 30 percent of the homes in the Hillyard area were built between 1950 and 1979. The Chief Garry neighborhood is newer with approximately 42 percent of the homes built in this era. In East Spokane, 26 percent of the homes were built between 1950 and 1979. The City of Spokane as a whole is in the middle range of these neighborhoods with 36 percent of the homes in that age range. See Table 1.[8]

Currently, land use in the area is mixed, with a majority of the land zoned as heavy and light industrial as well as general commercial. Other zoning codes in the study area include center and corridor, residential multi- and single- family, and community business.[9]

Prior to sampling, WSDOT will provide Ecology with a set of structures that are scheduled for demolition within the timeframe of this project. This list will be entered into the Site Safety Plan (Appendix B). To the extent possible, the selected properties will be representative of properties in the study area with respect to age and use (residential vs. commercial).

Table 1. Age range of homes in study area

	Hillyard	**Chief Garry**	**East Central**	**Spokane**
Year	Number	Number	Number	Number
2005 plus	209	63	326	851
2000-2004	267	200	308	8618
1990-1999	126	138	590	7114
1980-1989	313	160	549	7599
1970-1979	388	412	830	14579
1960-1969	206	387	337	6682
1950-1959	452	482	428	13250
1940-1949	434	452	457	10071
pre 1939	1137	739	2197	27058
Total	**3532**	**3033**	**6022**	**95822**
1950-1979	1046	1281	1595	34511
percent	30	42	26	36

[8] *City Data.com* accessed June, 2016 at http://www.city-data.com/housing/houses-Spokane-Washington.html
[9] City of Spokane, *Map Spokane* accessed June, 2016 at http://maps.spokanecity.org/#

3.1.3 Parameters of interest

Polychlorinated biphenyls, or PCBs, are the pollutants of interest for this study. Ecology's *Spokane River PCB Source Assessment* notes that even though significant reductions in PCB levels have been measured in the Spokane River over the last two decades, achieving further reductions in PCBs will be a challenging long-term process that requires a strategic combination of activities to achieve water quality targets.[10]

Prior to December 27, 2016, the water quality standard for PCBs in Washington State, was 170 parts per quadrillion (ppq). On November 28, 2016, the Environmental Protection Agency (EPA) issued a final rule (effective December 28, 2016) that establishes a water quality criterion of 7 ppq for Washington State. The downstream Spokane Tribe of Indians water quality standard is 1.34 ppq.[11] The water quality criterion for PCBs applies to total PCBs, using the units of the analysis (e.g., the sum of all congener, or all isomer, or homolog, or Aroclor analyses).

PCBs were first produced for commercial use in 1929. Production continued until a 1979 ban on all PCB manufacturing, processing, and distribution due to evidence that PCBs build up in the environment and concerns about possible human carcinogenicity. The EPA has noted the potential widespread use of PCB-containing building materials in schools and other buildings constructed or renovated between about 1950 and 1979.

The Spokane River Regional Toxics Task Force (Task Force) *2016 Comprehensive Plan to Reduce Polychlorinated Biphenyls (PCBs) in the Spokane River*[12] (the Comprehensive Plan) estimates that within the Spokane River watershed, the total mass of PCBs in building materials ranges from a low estimate of 60 kilograms to a high estimate of 130,000 kilograms. PCBs can potentially be delivered to surrounding soils through demolition and renovation activities, ultimately impacting stormwater. PCBs in building materials can also be delivered to the sewer infrastructure via wash water. The exact amount of the PCB contribution through these delivery pathways, as well as the total mass of PCBs in building materials, is unknown.

The Comprehensive Plan identifies control actions that the Task Force will take to reduce inputs of PCBs to the Spokane River. Included in the actions are:

1. Adapt the San Francisco Estuary Institute Best Management Practices document to make it suitable for use as a guidance document for Spokane-area building contractors.

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[10] Department of Ecology, *Spokane River PCB Source Assessment, 2003-2007* at https://fortress.wa.gov/ecy/publications/documents/1103013.pdf

[11] "Revision of Certain Federal Water Quality Criteria Applicable to Washington," Final Rule. 81 *Federal Register* 85417, November 28, 2016 at https://www.gpo.gov/fdsys/pkg/FR-2016-11-28/pdf/2016-28424.pdf

[12] LimnoTech, Inc. *2016 Comprehensive Plan to Reduce Polychlorinated Biphenyls (PCBs) in the Spokane River,* approved November 16, 2016 at http://srrttf.org/wp-content/uploads/2016/04/2016_Comp_Plan_Final_Approved.pdf

2. Work with relevant local government agencies responsible for permitting to ensure that the guidance document be distributed as part of all building permits related to building demolition and renovation.[13, 14, 15]

An important goal of this study is to obtain Spokane specific data, which can help identify relevant Best Management Practices for building and renovation activities. Research shows that PCBs have been used in a wide variety of building materials.[16, 17] Washington State's *PCB Chemical Action Plan (CAP)*[18] identifies caulks and paints as the most significant sources. Due to time and budget constraints, it is not possible to comprehensively sample all materials. Therefore, this study focuses initially on soils which are most likely to be affected by caulks and paints used in building materials.

Depending on the outcome of this study, additional studies may include sampling and analysis of building materials in the Spokane area.

Prior to sampling, historic building plans will be reviewed, and Ecology will identify soil sample locations for each property. Ecology will selectively sample soil areas around existing buildings in the vicinity of windows and doors and where caulk or paint are visibly present in the soil. A minimum of four soil samples will be collected around the building exteriors. Additionally, samples collected on the perimeter of the site will be composited into a single soil sample.

While on-site, a visual inspection for stained concrete and old transformer pads will be made. If found, a sample of concrete will be obtained by removing with a chisel and hammer and managed in the same manner as a soil sample.

See Section 7, Sampling Process and Design, for information on how the data collected from this project will be evaluated and used.

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[13] San Francisco Bay Estuary Partnership, *PCBs in Caulk Project* at http://www.sfestuary.org/taking-action-for-clean-water-pcbs-in-caulk-project/

[14] Geosyntec Consultants, *San Francisco Bay Estuary Program PCBs in Caulk*, September 15, 2011 at http://www.sfestuary.org/wp-content/uploads/2013/01/7_ResearchMemoFinal20110915.pdf

[15] Geosyntec Consultants, *PCBs in Caulk Project, Model Implementation Model,* November 2011 at http://www.sfestuary.org/wp-content/uploads/2013/01/5_FinalMIPNov142011.pdf

[16] Besides caulk, paint and FLBs, other building materials or components may have been manufactured with PCBs. For example, window glazing, ceiling tiles and acoustic boards, spray-on fireproofing, mastics and adhesives, and floor finish. *PCBs in Building Materials: Questions and Answers* at https://www.epa.gov/pcbs/questions-and-answers-about-polychlorinated-biphenyls-pcbs-building-materials

[17] USEPA, *PCBs in Building Materials: Questions and Answers*, July 28, 2015 at https://www.epa.gov/sites/production/files/201603/documents/pcbs_in_building_materials_questions_and_answers.pdf

[18] Department of Ecology, *PCB Chemical Action Plan*, February 2015 at https://fortress.wa.gov/ecy/publications/SummaryPages/1507002.html

3.1.4 Results of previous studies

This project builds upon the work of the Urban Waters program[19] and the City of Spokane Stormwater Management Program[20].

The Department of Ecology's "Spokane River Urban Waters Source Investigation and Data Analysis Progress Report (2009-2011)," September 2012[21] evaluated the City of Spokane's stormwater basins, identifying PCB sources and indications of diffuse sources within the study area. Concentrations of PCBs in stormwater and Combined Sewer Overflows (CSOs) were highly variable, ranging from 4-460 ng/L. A single sample from the Ralph basin, which will be sampled as part of this study, had a concentration of 7 ng/L. As a comparison, stormwater from the Liberty Lake Pilot study ranged from <1 to 8 ng/L.

The homolog patterns in the Urban Waters reports provide useful information for the purposes of source identification. Although outside the scope of this project, the Urban Waters data, and the information from this study are potentially useful in the future for positive matrix factorization (PMF), a fingerprinting method used to identify source factors present in environmental samples.

The study concluded:

- PCB sources to the Spokane River are more diffuse than originally suspected.
- Basin field observation, historical research of past activity, and homolog pattern work can be useful for PCB source tracing.
- Within a basin, methods such as positive matrix factorization could assist with source tracing.

The City of Spokane's stormwater drainage system is a large, complex network of conveyances that are designed to take rainfall and direct it away from roads, buildings, and other public and private property. PCBs are a contaminant of concern in the Spokane River. A history of PCB detections in the Union and Cochran basins resulted in the City of Spokane prioritizing these areas for further study and remedial actions. [22]

PCB concentrations were the highest in the industrial Union stormwater basin, especially in the upstream sample location located near a PCB cleanup site. PCB concentrations in the commercial Washington stormwater basin were over four times lower than the Union basin. Cochran basin PCB samples were slightly lower than in the Washington basin.[23]

[19] Department of Ecology, *Urban Waters Initiative* at http://www.ecy.wa.gov/urbanwaters/

[20] City of Spokane, *Stormwater* at https://my.spokanecity.org/publicworks/stormwater/

[21] Department of Ecology, *Spokane River Urban Waters Source Investigation and Data Analysis Progress Report*, 2012 at https://fortress.wa.gov/ecy/publications/SummaryPages/1204025.html

[22] City of Spokane, City of Spokane Stormwater Management Program (SWMP), 2015 at https://static.spokanecity.org/documents/publicworks/stormwater/management/2015-stormwater-management-program.pdf

[23] Reports that include detailed sampling and analysis information can be downloaded from my.spokanecity.org/publicworks/stormwater/

The City of Tacoma identified a 1975 road construction crack sealant as a source of the PCBs to stormwater. While the PCB-contaminated sealant is mostly worn away now, the soil underneath the sealant is likely contaminated with PCBs as a result of the breakdown and disintegration of the sealant over the past 38 years. The City of Tacoma noted that PCB-contaminated soil enters the storm sewer system through short, two-inch drain pipes located under the gutter line and the contaminated sealant material.[24]

Although PCBs in building materials were implicated in Tacoma as contributing to stormwater loading, currently no data exists about how PCBs in building materials in the Spokane area impact the Spokane River through the stormwater pathway.

3.1.5 Regulatory criteria or standards

The Toxic Substances Control Act (TSCA) of 1976 (15 USC 2601 et seq). gives EPA the authority to regulate PCBs. TSCA prohibited the manufacture of PCBs by 1979, but allows continued use of PCBs if the activity does not present an unreasonable risk of injury to health or the environment. Title 40 of the Code of Federal Regulations, Part 761 contains the PCB regulations. An overview can be found in the Department of Ecology's *PCB Chemical Action Plan*.[25]

Briefly the following regulatory criteria may be relevant to this project:

- 50 ppm: maximum limit for PCBs in bulk products that are not totally enclosed. (Transformers or capacitors that are totally enclosed may contain greater than 50 ppm PCBs).
- Many forms of PCB waste may be disposed of as municipal solid waste. Examples include:
  - Small non-leaking PCB capacitors.
  - Plastics (such as plastic insulation from wire or cable; radio, television and computer casings; vehicle parts; or furniture laminates); preformed or molded rubber parts and components; applied dried paints, varnishes, waxes or other similar coatings or sealants; caulking; Galbestos; non-liquid building demolition debris; or non-liquid PCB bulk product waste from the shredding of automobiles or household appliances from which PCB small capacitors have been removed (shredder fluff).
- Any of these may also be disposed as landfill daily cover or as roadbed under asphalt.
- Other PCB bulk product waste may be disposed of as municipal solid waste if it passes a leachate test for other toxic components (Dangerous Waste codes D018 through D043) and the leachate is collected from the landfill unit and monitored for PCBs.
- 50 ppm and 25 ppm annual average: maximum limits of inadvertently generated PCBs in products, including recycled paper.
- 10 ppm: maximum limit for releases to ambient air.

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[24] City of Tacoma, PCB Investigation as https://www.cityoftacoma.org/government/city_departments/environmentalservices/surface_water/restoration_and_monitoring/thea_foss_waterway_cleanup/pcb_investigation

[25] Department of Ecology, *PCB Chemical Action Plan*, February 2015 at https://fortress.wa.gov/ecy/publications/SummaryPages/1507002.html

- 170 ppq: Washington State Water Quality standard for PCBs under the National Toxics Rule.
- 7 ppq: EPA Final Water Quality Criterion for PCBs in Washington State, effective December 28, 2016.
- 1.34 ppq: Spokane Tribe of Indians Water Quality Standard for PCBs under the National Toxics Rule.
- > 2 ppm PCB: Washington State Limit for dangerous waste.
- > 100 ppm PCB: Washington State Limit for persistent waste.
- > 10,000 ppm PCB: Washington State Limit for extremely hazardous waste.

EPA's recommended Best Management Practices for PCB-containing waste identifies actions that minimize spreading dust. This includes consideration of the following[26]:

- Separate work areas from non-work areas, and select appropriate personal protection equipment and tools.
- Construct a containment area so that all dust or debris generated by the work remains within the area whenever potentially hazardous material is disturbed and could generate dust.
- Avoid working in high winds.

4.0 Project Description

The EPA has identified PCBs in building materials as a potential source of PCBs in stormwater and the Spokane River. LimnoTech has estimated that the estimated mass of PCBs contained in building materials in the Spokane watershed ranges from 60 to 130,000 kilograms.[27] To date, no data has been collected in the Spokane area that would help understand how PCBs present in these materials can impact stormwater and reach the Spokane River.

Because of the US 395 North Spokane Corridor construction project, a unique opportunity exists to gather on-the-ground information. This project proposes to survey and collect soil samples from representative properties within the construction area. Soil samples that are collected before and after demolition will be used to characterize the potential for PCBs in building materials to reach the soil and subsequently Spokane River through the stormwater pathway.

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[26] USEPA, *Steps to Safe Renovation and Repair Activities* at https://www.epa.gov/pcbs/steps-safe-renovation-and-repair-activities

[27] LimnoTech, Inc. *2016 Comprehensive Plan to Reduce Polychlorinated Biphenyls (PCBs) in the Spokane River,* approved November 16, 2016 at http://srrttf.org/wp-content/uploads/2016/04/2016_Comp_Plan_Final_Approved.pdf

4.1 Project goals

The overall project goal is to obtain a better understanding of the potential for PCBs in building to impact the Spokane River through the stormwater pathway. The key questions to be answered by this project are:

1) Are PCBs in building materials in the Spokane area potentially being released to soils?
2) If PCBs are released from construction materials during demolition activities, are post-demolition soil concentrations of regulatory concern?
3) Does collected data indicate evidence that PCBs in building materials could reach the Spokane River through the stormwater pathway?
4) Is there evidence of environmental trends associated with PCB congener distributions and concentrations in City of Spokane stormwater?

4.2 Project objectives

To answer the project objectives Ecology will:

- Select and survey representative properties from the WSDOT list of projects identified for demolition.
- Characterize the prevalence of PCBs in soils and stormwater using chemical analysis.

To evaluate if current demolition practices protective for PCB inputs to stormwater, the project tasks include:

- Pre- and post- demolition sampling and PCB analysis of soils from representative properties.

To evaluate the potential for PCBs in building materials to impact the Spokane River through the stormwater pathway the project tasks include:

- Conduct opportunistic sampling and analysis of stormwater from conveyances in the project area.

This project involves the following basic steps:

1) Prior to demolition, collect samples of site soils and perform chemical analysis for PCBs. Emphasis will be placed on selecting soil sampling locations that are potentially affected by PCB-containing building materials such as caulks, and exterior paints.
2) Following demolition, collect and analyze soil samples from the same locations as the pre-demolition samples.
3) Collect stormwater samples from the project area and analyze for PCB congeners.
4) Evaluate the data and prepare a report.

4.3 Information needed and sources

Prior to field work, Ecology will evaluate WSDOT's list of properties for this project. Ecology will collect available information about the properties and identify, to the extent possible:

- If the property was built or remodeled between the years 1950 – 1979.
- The use and type of building being demolished (residential, commercial, etc.)
- Property-specific information about the presence of asbestos, lead, or other contaminants.
- The location of storm drains with respect to the property and identification of stormwater basin.
- Existing and new data for PCBs in stormwater.
- New data for PCBs in soil samples collected near demolition sites.

4.4 Target population

Prior to sampling, WSDOT will provide Ecology with a set of structures that are scheduled for demolition within the timeframe of this project. This list will be entered into the Site Safety Plan (Appendix B). To the extent possible, the selected properties will be representative of properties in the study area with respect to age and use (residential vs. commercial).

4.5 Study boundaries

For study boundaries, see Figure 1.

This project takes place within the Washington State Water Resource Inventory Area (WRIA) 57, Middle Spokane, and seven-digit Hydrologic Unit Code (HUC) number 1701030.

4.6 Tasks required

1) Obtain list of properties to be demolished by WSDOT and evaluate characteristics.
2) Complete Site Safety Plan.
3) Opportunistically collect stormwater samples from the project area and analyze for PCB congeners.
4) Prior to demolition, coordinate site access with WSDOT.
5) Conduct site evaluation and pre-demolition sampling in accordance with QAPP and Site Safety Plan.
6) Submit samples to analytical laboratory for analysis and archive individual samples for future reference.
7) Following demolition, coordinate site access with WSDOT and conduct post demolition soil sampling in accordance with the QAPP and Site Safety Plan.
8) Receive data, perform Quality Assurance evaluation and data review.
9) Analyze results relative to the stated study objectives.

10) Prepare draft report.
11) Submit report for review and comments.
12) Revise and finalize report.

4.7 Practical constraints

Practical considerations for this project include:

- Coordination of site access with WSDOT and safety considerations.
- Seasonal considerations prior to and after demolition, such as frozen ground, excess snow or rain, or other weather factors.
- Project funding ends June 30, 2017.

4.8 Systematic planning process

The systematic planning under this QAPP is adequate for a project of this size and a formalized systematic planning process is not required.

5.0 Organization and Schedule

5.1 Key individuals and their responsibilities

Table 2. Organization of project staff and responsibilities

Staff	Title	Responsibilities
Adriane Borgias, Ecology Water Quality Unit Eastern Regional Office Phone: 509 329-3515 Email: abor461@ecy.wa.gov	Project Manager	Clarifies scope of the project. Prepares QAPP, SAP, and Safety Plan. Provides for review and approval of project documents. Performs final data review, prepares draft and final report. Conducts QA review of data, analyzes and interprets data, and enters data into EIM. Writes the draft report and final report.
Ted Hamlin, Ecology Urban Waters Water Quality Unit Eastern Regional Office Phone: 509-329-3573 Email: tham461@ecy.wa.gov	Field Manager	Reviews and approves project documents. Oversees field sampling, compositing of samples, and transportation of samples to the laboratory.
Tammie Williams, WSDOT Spokane Phone: 509-324-6134 Email: WILLIAMT@wsdot.wa.gov	Cooperating Agency	Clarifies and provides input into scope of the project. Reviews and approves project documents. Assists with coordination of site access. Reviews and provides comment on final reports.
Dave Knight, Ecology Eastern Regional Office Phone: 509-329-3950 Email: dkni461@ecy.wa.gov	Unit Supervisor for the Project Manager	Provides internal review of the QAPP, and approves the final QAPP.
Sara Hunt Ecology Water Quality Unit Eastern Regional Office Phone 509-329-3534 Email: sarh461@ecy.wa.gov	Acting Section Manager for the Project Manager	Provides internal review of the QAPP, approves the budget, and approves the final QAPP.
Joel Bird, Manchester Environmental Laboratory Phone: 360-871-8801 Email: jbir461@ ecy.wa.gov	Director	Reviews and approves the final QAPP. Performs chemical analysis and data quality assurance activities.
Ginna Grepo-Grove, Manchester Environmental Laboratory Phone: 360-871-8829 Email: ggro461@ ecy.wa.gov	MEL Data Quality Assurance Coordinator	Data validation
William R. Kammin Environmental Assessment Program Phone: 360-407-6964 Email: wkam461@ecy.wa.gov	Ecology Quality Assurance Officer	Provides internal review of the QAPP and approves the final QAPP.

EIM: Environmental Information Management database
QAPP: Quality Assurance Project Plan

5.2 Special training and certifications

No special training or certifications are required for this project.

Project Manager

Adriane P. Borgias, MSEM, CHMM has the following qualifications and certifications:

- BS Chemistry, MS Environmental Management.
- Certified Hazardous Materials Manager.
- 38 years in environmental field including chemistry, sampling, remedial actions, regulatory monitoring; author and editor of hazardous materials management texts.
- 5 years of experience as water quality specialist, Spokane River, toxics.

Field Manager

Ted Hamlin has the following qualifications and certifications:

- AAS Environmental Technician.
- 30 years of water quality sampling experience.
- 27 years Ecology Spill Response team and hazardous materials sampling.
- Ecology Compliance and Enforcement Inspector
- 10 years on Urban Waters assignment.
- Collected more than 300 samples (water, stormwater, CSO, groundwater, and sediments) in the Spokane area.
- Inventor of the Hamlin Stormwater Sediment Sampler.

5.3 Organization chart

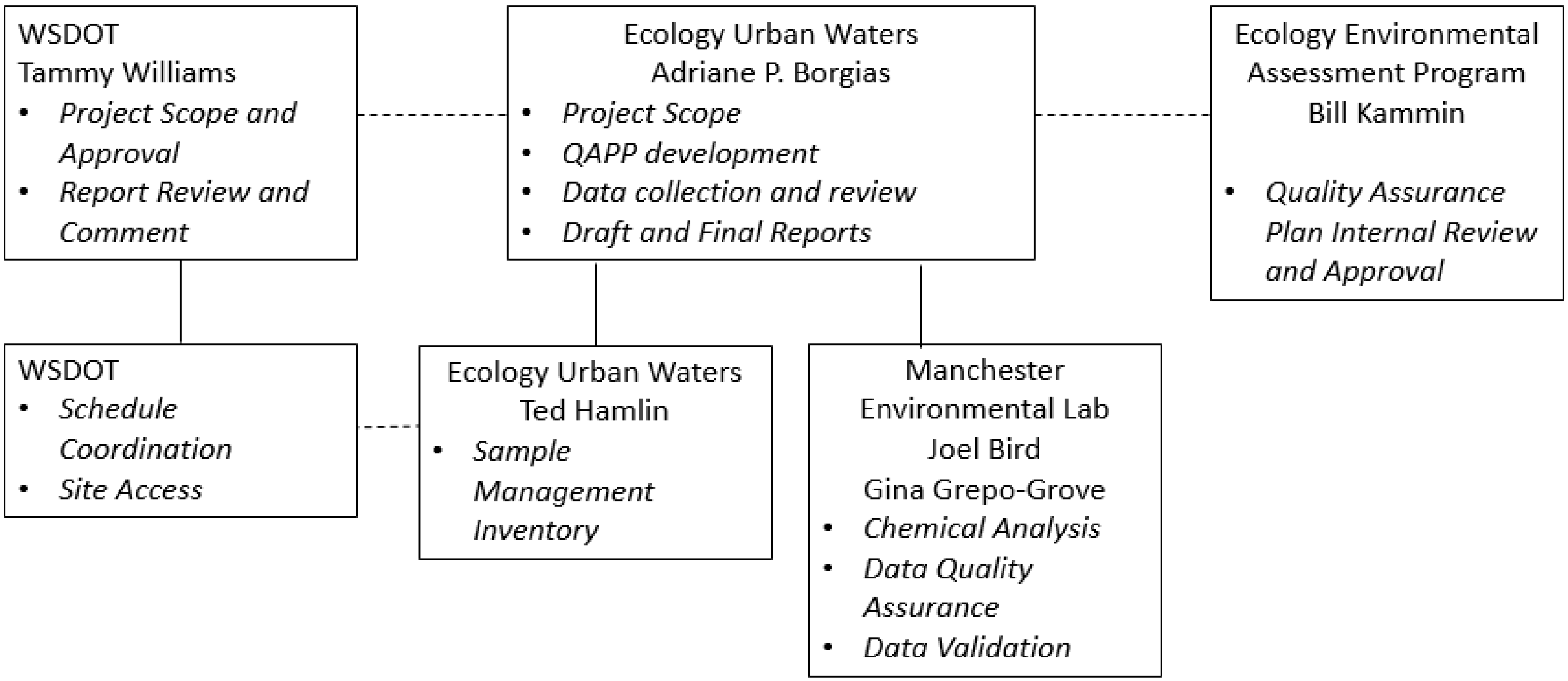

Figure 2. Project Organizational Chart

5.4 Project schedule

Table 3. Proposed schedule for completing field and laboratory work, data entry into EIM

Pre-Demolition Work	Due (Latest) Date	Lead Staff
Complete Quality Assurance Project Plan and Site Safety Plan	March 2017	Adriane Borgias
Property selection and preliminary survey	March 2017	Ted Hamlin
Field work (soil and stormwater sampling, screening, inventory)	April 2017	Ted Hamlin
Post-Demolition Work		
Field work (soil sampling)	May 2017	Ted Hamlin
Laboratory work	Due date	Lead staff
Laboratory analyses completed	June 2017	
Environmental Information System (EIM) database		
EIM Study ID: To be provided	ID number: To be provided	
Product	Due date	Lead staff
EIM data loaded	December 2017	Adriane Borgias
EIM data entry review	December 2017	Adriane Borgias
EIM complete	December 2017	Adriane Borgias
Final report		
Author lead / Support staff	Adriane Borgias / Ted Hamlin	
Schedule		
Draft due to supervisor	August 2017	
Draft due to cooperating agency/peer reviewer	August 2017	
Draft due to external reviewer(s)	September 2017	
Final (all reviews done) due to publications coordinator	November 2017	
Final report due on web	December 2017	

5.5 Limitations on schedule

Potential limitations on schedule include:

- QAPP approval.
- Availability of WSDOT personnel for coordination of site access and safety considerations.
- Availability of Ecology field personnel and equipment for sampling activities.
- Seasonal considerations prior to and after demolition, such as frozen ground, excess snow or water, or other weather factors.
- Laboratory schedule.

5.6 Budget and funding

Project funding is provided by Ecology's Urban Waters budget. Funding availability ends June 30, 2017.

The total project costs depend on the number of properties available for sampling during the project period. Table 4 estimates the project budget at $51,770 assuming there are a total of 167 samples from 16 target properties and 21 Quality Assurance samples.

Table 4. Project budget and funding

Parameter	Number of Samples	Number of QA Samples	Total Number of Samples	Cost Per Sample	MEL Subtotal
Sampling					
Sampling equipment and supplies				$50	
				Sampling Subtotal	*$50*
Laboratory Analysis-PCB Aroclors, Method 8082					
Pre demo soil[1]	80	5	85	$200	$ 17,000
Post demo soil[1]	80	5	85	$200	$ 17,000
Rinsate blanks[2]		4	4	$200	$ 800
Matrix Spikes[3]		2	2	$200	$ 400
Matrix Spike Duplicates[3]		2	2	$200	$ 400
Stormwater[4]	7	3	10	$750	$ 7,500
				Laboratory Subtotal	*$ 43,100*
				Level 4 MEL Data Validation	*$ 8,620*
				Grand Total	**$51,770**

[1] Based on 16 properties available for sampling. Actual number of properties may be revised (up to 20 properties, maximum). Estimated at up to 5 samples/property x 16 properties + 1 duplicate property.
[2] Estimated at 4 (1 before and 1 after initial sampling event; 1 before and 1 after final sampling event)
[3] 1 for pre demo soil and 1 for post demo soil.
[4] Stormwater estimated as 7 locations plus 1 field blank; 1 trip blank, and 1 duplicate sample.

6.0 Quality Objectives

6.1 Decision Quality Objectives (DQOs)

This study does not require Decision Quality Objectives.

6.2 Measurement Quality Objectives

Measurement Quality Objectives (MQOs) specify how well the data meets the objectives of the project. The MQOs for this project were obtained from the laboratory, as defined by the capabilities of EPA Method 8082 for soils and Method 1668C for stormwater samples.

Table 5. Measurement Quality Objectives

Analyte	Laboratory Check Standards		Matrix Spike		Duplicates				
Method 8082	**Percent Recovery Limits**	**Relative Percent Difference (RPD)**	**Percent Recovery Limits**	**Relative Percent Difference (RPD)**	**Relative Percent Difference (RPD)**	**Surrogates**	**Method Detection Limit**	**Units**	**Method Reporting Limit**
PCB-aroclor-1016	50 – 150	40	50 - 150	40	40		0.50	mg/Kg ww	2.5
PCB-aroclor-1221					40		0.25	mg/Kg ww	1.25
PCB-aroclor-1232					40		0.50	mg/Kg ww	2.5
PCB-aroclor-1242					40		0.25	mg/Kg ww	1.25
PCB-aroclor-1248					40		0.25	mg/Kg ww	1.25
PCB-aroclor-1254					40		0.25	mg/Kg ww	1.25
PCB-aroclor-1260	50 - 150	40	50 - 150	40	40		0.25	mg/Kg ww	1.25
PCB-aroclor-1262					40		0.25	mg/Kg ww	1.25
PCB-aroclor-1268					40		0.25	mg/Kg ww	1.25
PCB-008	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-018	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-028	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-044	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-052	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-066	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-101	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-077	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-118	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-153	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-105	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-138	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-126	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-128	50 - 150	40	50 - 150	50	40		0.50	mg/Kg ww	1.0
PCB-180	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-169	50 - 150	40	50 - 150	50	40		0.50	mg/Kg ww	1.0
PCB-170	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-187	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-195	50 - 150	40	50 - 150	50	40		0.50	mg/Kg ww	1.0
PCB-206	50 - 150	40	50 - 150	50	40		0.25	mg/Kg ww	0.50
PCB-209	50 - 150	40	50 - 150	50	40		0.50	mg/Kg ww	1.0
surr: PCB-050						50 - 150			
surr: Tetrachloro-m-xylene						50 - 150			
surr: HBBP						50 - 150			

Method 1668C	**Laboratory Check Standards**	**Matrix Spike**		**Duplicates**				
	% Recovery Limits	**% Recovery Limits**	**Relative Percent Difference (RPD)**	**Relative Percent Difference (RPD)**	**Surrogates**	**Laboratory Detection Limit[b]**	**Units of Measurement**	
PCB Congeners in water	50-150[†]	NA	NA	<50	25-150[a]	1-50	pg/L	

[†] Per Method for Ongoing Precision and Recovery (OPR), internal standards, and labeled compounds

[a] Labeled congeners

[b] Per congener

6.2.1 Targets for Precision, Bias, and Sensitivity

6.2.1.1 Precision

Precision is a measure of the variability in the results of replicate measurements due to random error.

Laboratory analysis precision will be assessed through Blank Spike/Blank Spike Duplicate, and Matrix Spike/Matrix Spike Duplicate. Precision is assessed by the BS/BSD (process precision w/o matrix) and MS/MSD (effect of matrix on precision). Table 5 shows the MQOs for laboratory duplicates.

Field sampling precision will be evaluated with field duplicate samples. A total of 11 duplicate samples will be submitted to the laboratory for analysis (one set of five duplicate soil samples at a pre-demolition location and one set of five duplicate soil samples at a post-demolition location plus one stormwater duplicate). See Table 4.

6.2.1.2 Bias

Bias is the difference between the population mean and the true value.

Laboratory analysis bias will be assessed through laboratory control samples (blank spikes and blank spike duplicates), matrix spikes and matrix spike duplicates. MQOs for these tests are included in Table 5.

6.2.1.3 Sensitivity

Sensitivity is a measure of the capability of a method to detect a substance above background noise.

Laboratory analysis sensitivity is defined for the study as the Lower Limit of Quantification. See Table 8 for quantitation (laboratory reporting) limits.

6.2.2 Targets for Comparability, Representativeness, and Completeness

6.2.2.1 Comparability

Comparability is the degree to which different methods, data sets and/or decisions agree or can be represented as similar. Standard operating procedures (SOP) help ensure comparability between results from previous and future sampling events.

Stormwater samples will be collected in accordance with Urban Waters protocols[28].

Section 8.1 discusses SOPs followed for this study.

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[28] Fernandez and Hamlin, 2008. *Quality Assurance Project Plan (QAPP) for the Liberty Lake Source Trace Study Regarding PCB, PBDE, Metals, and Dioxin/Furan*.

6.2.2.2 Representativeness

A result is representative of a population when it reflects accurately the desired characteristic of that population. A set of representative samples is said to be valid if it provides a true representation of the temporal and spatial variations of the population characteristic.

WSDOT will provide to Ecology the list of available properties, which represent a range of ages and land use types in Spokane. If available, target properties will be a mixture of homes and commercial properties that at a minimum includes buildings built or renovated between 1950 and 1979. Buildings built between 1978 and 1988 will assess the use of PCBs in building materials after the PCB ban.

Representativeness of the sample set for each property will be ensured by collecting samples that are characteristic of soils impacted by building materials used at the property. A survey of each target property conducted prior to the sampling event will be used to determine the sampling approach for each location. See Section 7 for details about the sampling process design.

A composite sample will also be prepared of soils sampled at the property's perimeter. This sample represents the average concentrations of PCBs in soils at the perimeter. In some cases, the perimeter sample may be representative of soils not impacted by building materials.

Stormwater samples will be collected in accordance with Urban Waters protocols[29].

6.2.2.3 Completeness

The project manager will consider the study to have achieved completeness if 95 percent of the samples are analyzed acceptably.

[29] Fernandez and Hamlin, 2008. *Quality Assurance Project Plan (QAPP) for the Liberty Lake Source Trace Study Regarding PCB, PBDE, Metals, and Dioxin/Furan*.

7.0 Sampling Process Design (Experimental Design)

7.1 Study Design

This study focuses on the impact of demolition activities on PCB concentrations in soils. The *2016 Comprehensive Plan to Reduce Polychlorinated Biphenyls (PCBs) in the Spokane River* identifies "legacy fixed building sources" as one of the largest source areas of PCBs in the Spokane area. Demolition and renovation activities can deliver PCBs to surrounding soils. Soil erosion and wash-off during storm events can deliver PCBs to the river. In the study area, the City stormwater conveyance is the primary delivery pathway to the river.

Ecology will use the results of this study to gain a better understanding about how PCBs in building materials can impact the Spokane River through the stormwater pathway. The project will also compare stormwater PCB data with previous Urban Waters studies in order to evaluate environmental trends.

Soils. Ecology will collect pre- and post-demolition soil samples from WSDOT-owned properties that are scheduled for demolition and removal. Prior to sampling, Ecology will survey each property and prepare property-specific sampling plans. The plans will identify at least four soil sampling locations at each property that are most likely to represent worst-case concentrations for PCB derived from construction materials releases.

For each property, Ecology will collect samples around the perimeter of existing buildings. Ecology will focus on areas most likely to be impacted by building materials, such as adjacent to window areas where caulks have been used or in areas with peeling paint. Ecology will also create one composite soil sample representative of the perimeter conditions for each property. Ecology will archive the individual soil samples in the event future analysis of the individual samples is needed.

Manchester Environmental Laboratory will analyze the soils using EPA Method 8082. Ecology chose Method 8082 because it is a cost-effective way to obtain PCB concentrations as Aroclors and also as a limited set of PCB congeners. See Table 6. The reporting limit for this method is 0.25 – .50 ug/Kg, depending on the matrix. See Table 8.

Ecology plans to compare Method 8082 analytical results with pre- and post-demolition conditions as well as the regulatory criteria relevant to building demolition and disposal.

Stormwater. Ecology will collect stormwater samples from conveyances in the target area using standard Urban Waters protocols. Stormwater samples will be sent to AXYS Analytical Services, Ltd. for analysis using EPA Method 1668C. This method provides PCB data at the congener level data that is comparable with previous studies. The per-congener reporting limit for this method is 1 pg\liter, in water. See Table 8.

Ecology will compare stormwater data with the soil results and previous Urban Waters studies to evaluate trends in PCB congener patterns and concentrations in the City stormwater system.

7.1.1 Field measurements

No field measurements will be made as part of this project.

7.1.2 Sampling location and frequency

A “Field Sheet” (Appendix A) will be used for each property to document the site and sample conditions. Sampling locations will be noted as a drawing on the Field Sheet.

A preliminary site survey will be used to identify soil sampling locations that are representative of the building conditions. See also Section 8.

Individual and composite soil samples will be collected in 8-oz. labelled glass jars and uniquely identified. See Section 8 and Appendix C.

Stormwater samples will be collected from conveyances based on their proximity to the target properties. Sample locations will be identified by the City of Spokane manhole cover numbers and the GPS coordinates will be recorded. At least one sample will collected at Manhole Number 1600124 ST, discharge 16000 200ND. This location (at the intersection of North Ralph Street and Upriver Drive) receives stormwater from the project area and is the last manhole opening prior to discharge to the Spokane River.

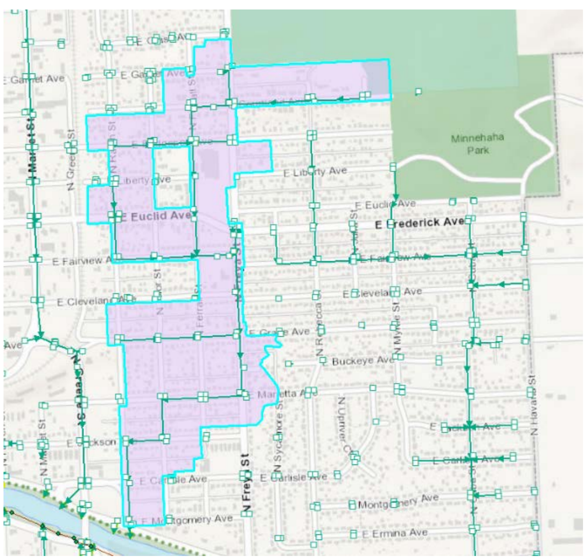

Figure 3. Ralph Street Basin

7.1.3 Parameters to be determined

Soil samples will be analyzed using EPA Method 8082 for select PCB congeners and Aroclors (Table 6).

Stormwater samples will be analyzed using Method 1668C Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS.

Table 6. EPA Method 8082 PCB Congeners and Aroclors List

Chemical Abstracts Number	Constituent
34883-43-7	PCB-008
37680-65-2	PCB-018
7012-37-5	PCB-028
41464-39-5	PCB-044
35693-99-3	PCB-052
32598-10-0	PCB-066
32598-13-3	PCB-077
37680-73-2	PCB-101
32598-14-4	PCB-105
31508-00-6	PCB-118
57465-28-8	PCB-126
38380-07-3	PCB-128
35065-28-2	PCB-138
35065-27-1	PCB-153
32774-16-6	PCB-169
35065-30-6	PCB-170
35065-29-3	PCB-180
52663-68-0	PCB-187
52663-78-2	PCB-195
40186-72-9	PCB-206
2051-24-3	PCB-209
12674-11-2	PCB-aroclor-1016
11104-28-2	PCB-aroclor-1221
11141-16-5	PCB-aroclor-1232
53469-21-9	PCB-aroclor-1242
12672-29-6	PCB-aroclor-1248
11097-69-1	PCB-aroclor-1254
11096-82-5	PCB-aroclor-1260
37324-23-5	PCB-aroclor-1262
11100-14-4	PCB-aroclor-1268

7.2 Maps or diagram

See Figure 1.

7.3 Assumptions underlying design

This studies assumes that the target population of samples is representative of the Spokane area.

7.4 Relation to objectives and site characteristics

Objectives of the project are supported by the study design.

7.5 Characteristics of existing data

See Section 3.0.

8.0 Sampling Procedures

8.1 Field measurement and field sampling SOPs

8.1.1 Field Measurements

Not applicable.

8.1.2 Bulk Solid Samples

Sampling equipment will be decontaminated prior to sampling using Ecology's Standard Operating Procedures as guidance. See Section 8.4. [30]

Individual soil samples will be collected from each side of the building, to the extent possible. One composite soil sample will be made to characterize perimeter concentrations by placing equal aliquots from each sampling location into a single 8-ounce container. A minimum of 250 grams of soil will be collected. The locations of the aliquots, condition of the soil (clean, stained, disturbed, etc.), and whether or not fragments of weathered caulk are present will be noted on the Field Sheet at the time of sampling.

See Appendix C for sample collection and compositing procedures.

8.1.3 Stormwater Samples

Stormwater samples will be collected in accordance with Urban Waters protocols[31].

8.2 Containers, preservation methods, holding times

Table 7. Containers, sample size, preservation methods, and holding times

Matrix	Minimum Quantity	Container (certified, precleaned)	Field Preservation	Holding Time
Pre-demo soil	250 grams	8 oz. glass jar	cool to 4° C	1-year extraction
Post-demo soil	250 grams	8 oz. glass jar	cool to 4° C	1-year extraction
Water[1]	1 liter	1 liter amber	cool to 4° C	1-year extraction

[1] Stormwater, equipment blank, field blank, and transfer blank.

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[30] Department of Ecology, Environmental Assessment Program, *Standard Operating Procedures for Decontaminating Field Equipment for Sampling Toxics in the Environment*, 2014.
[31] Fernandez and Hamlin, 2008. *Quality Assurance Project Plan (QAPP) for the Liberty Lake Source Trace Study Regarding PCB, PBDE, Metals, and Dioxin/Furan*.

8.3 Invasive species evaluation

Not applicable.

8.4 Equipment decontamination

Field staff will clean sampling equipment prior to field collection using Ecology's SOP Number EAP090, *Decontaminating Field Equipment for Sampling Toxics in the Environment* (Friese, 2017), as guidance. Sampling equipment will be scrubbed with Liquinox and hot tap water, followed by sequential rinses with deionized water and acetone[32]. Equipment will be air dried and then wrapped in aluminum foil (shiny side out) prior to transport to the field location.

Decontamination equipment will also be available in the sampling van for decontamination in the field, if needed. Safety associated with decontamination procedures used in the field (e.g., minimizing exposure to harmful chemicals) will be addressed in the Safety Plan.

8.5 Sample ID

Ecology will uniquely identify each sample as follows:

- Date and time sample was taken
- Field station identification
    - First 4 digits of street address
    - First 2 letters of street name
    - Sample type identifier
        - C = Composite
        - S = Single
        - D = Duplicate
    - Matrix identifier
        - S = Soil
        - W = Water
        - O = Other
    - Lab sample number
        - Unique identifier for individual sample container

8.6 Chain of custody

Chain of custody will be maintained for all samples throughout the project. Samples will be stored in a cooler or freezer, and shipped immediately to the laboratories or stored in Ecology's locked chain of custody room in Spokane. MEL's chain of custody form will be used for documentation of shipment to both laboratories.

[32] Previous Urban Waters investigations did not use a hexane rinse. Based on previous Urban Waters investigations results, it does not appear to be needed for this study. Equipment blanks will verify the adequacy of the decontamination procedure.

8.7 Field log requirements

Field data will be recorded on a "Field Sheet" (See Appendix A) using permanent, waterproof ink for all entries.

The following data will be included on each Field Sheet will contain the following information:

- Name of project.
- Street address, with latitude/longitude, and/or GPS coordinates.
- Date/time of sampling.
- Field personnel.
- Map/diagram of sampling locations/photo log.
- Notes:
  - **Any changes or deviations from the QAPP.**
  - Environmental conditions.
  - Field measurement results.
- Identity of QC samples collected.
- Unusual circumstances that might affect interpretation of results.

8.8 Other activities

- Confirm sampling locations and schedule with WSDOT.
- Coordinate sample handling and composite procedures with MEL.

9.0 Measurement Methods

9.1 Field procedures table/field analysis table

Not applicable.

9.2 Lab procedures table

Soil samples will be analyzed by MEL using EPA Method 8082. With this method, MEL is capable of analyzing for a select set of congeners and Aroclors. See Table 6.

Water samples will be analyzed by AXYS Analytical Services, Ltd. using EPA Method 1668C. This method is capable of identifying the complete set of PCB congeners.

Table 8. Measurement methods (laboratory)

Analyte/ EPA Method	Sample Matrix (Volume in g, 100% solids)	Number of Samples (Expected Arrival Date)	Expected Range of Results	Reporting Limit		Lab Prep/ Extraction Method
				Congener	Aroclor	
PCB/8082*	Soil (“Sediment”, 250 g)	80 5 duplicates (3/28/2017)	< 1 ppm to 5 ppm	0.25- 0.50 (ug/kg)	1.25 – 2.50 (ug/kg)	3541
PCB/8082*	Equipment Blank (“Water”, 1 liter)	2 (3/28/2017)	< 1 ppm	0.005-0.100 (ug/L)	0.025 -0.050 (ug/L)	3510C
PCB/8082*	Soil (“Sediment”, 20 g)	80 5 duplicates (5/16/2017)	<1 ppm to 5 ppm	0.25 -0.50 (ug/kg)	1.25 – 2.50 (ug/kg)	3541
PCB/8082*	Equipment Blank (“Water”, 1 liter)	2 (5/16/2017)	< 1 ppm	0.005-0.100 (ug/L)	0.025 -0.050 (ug/L)	3510C
PCB/1668C	Stormwater (“Water”, 1 liter)	7 1 duplicate (3/14/2017)	0.5 – 50 pg/L per congener	1 pg/L	NA	3510C
PCB /1668C	Transfer Blank (“Water”, 1 liter)	1 (3/14/2017)	0.5 – 50 pg/L per congener	1 pg/L	NA	3510C
PCB/1668C	Trip Blank (“Water”, 1 liter)	1 (3/14/2017)	0.5 – 50 pg/L per congener	1 pg/L	NA	3510C

* Selected PCB congeners and Aroclors, see Table 6.

9.3 Sample preparation method(s)

All soil samples will be prepared prior to shipment to the laboratory as described in the Standard Operating Procedure for Sample Collection and Compositing. (Appendix C).

Water samples will be prepared in accordance with Urban Waters protocols (Appendix C) prior to shipment to the laboratory.

The laboratories will prepare the samples for analysis (homogenization, extraction, and preparation) in accordance with standard laboratory methods associated with EPA Methods 8082 and 1668C (see Table 8).

9.4 Special method requirements

The concentrations of PCBs in the samples are unknown. See Table 8 for expected ranges of concentrations.

9.5 Lab(s) accredited for method(s)

Manchester Environmental Laboratory (MEL) will be used for this project. MEL is accredited by Washington State for Method 8082.

AXYS Analytical Services, Ltd. will be used for Method 1668C. AXYS is accredited by Washington State for Method 1668C.

10.0 Quality Control (QC) Procedures

10.1 Table of field and lab QC required

Table 9. QC samples, types, and frequency

Parameter	Field		Laboratory				
	Blanks	Replicates	Laboratory Control Spike	Laboratory Control Spike Duplicate	Method Blank	Matrix Spike	Matrix Spike Duplicate
Soil-PCB 8082		10	1/batch	1/batch	1/batch	1/batch	1/batch
Stormwater -PCB 1668		1	1/batch	1/batch	1/batch		
Rinsate Blank	4		1/batch	1/batch	1/batch	1/batch	1/batch
Transfer Blank	1						
Trip Blank	1						

Field Sampling.
Rinsate blanks will be used to indicate if there is bias in the sampling results due to contamination of the sampling equipment. Rinsate blanks will be prepared following the cleaning procedure at the beginning and end of the pre- and post-demolition sampling, for a total number of four blanks.

One transfer blank will be prepared for the stormwater samples as a check for cross contamination during sampling. The transfer blank, which contains laboratory grade purified water, will be opened during the sampling event and closed following completion of the sampling activity.

One trip blank will be prepared for the stormwater samples as a check for contamination of the laboratory water/container. The trip blank, which contains laboratory grade purified water, is carried during the sampling event but is not opened.

Field replicate results will indicate a combination of field variability and analytical precision. Laboratory replicates will be used as an indication of analytical precision. For the soil samples, ten replicates will be prepared and submitted to the laboratory for analysis.

For the stormwater sample, one replicate will be prepared and submitted to the laboratory for analysis.

Laboratory Analysis.

Quality control samples will be in accordance with EPA Methods 8082 and 1668C as well as and MEL AXYS Analytical Services, Ltd. standard operating procedures.

10.2 Corrective action processes

The project manager will work closely with the contract laboratory and MEL staff conducting the data review to examine data that fall outside of QC criteria. The project manager will determine whether data should be re-analyzed, rejected, or used with appropriate qualification.

11.0 Data Management Procedures

11.1 Data recording/reporting requirements

All field data and observations will be recorded on the Field Sheets. See Appendix A.

Field and laboratory data for the project will be entered into Ecology's EIM system. Laboratory data will be uploaded into EIM, using the EIM XML results template.

11.2 Laboratory data package requirements

AXYS Analytical Services, Ltd. will provide laboratory analytical results in the format that matches Appendix B or the Spokane River Quality Assurance Plan, dated July 23, 2014[33]. The final data package will be delivered to the Ecology Project Manager and MEL and will include:

- All raw data (EPA Tier 4 deliverables) in a fully bookmarked PDF file.
- All results in an electronic deliverable (EDD) format compatible with Ecology's EIM database.
- Case narratives, which discuss any problems encountered with the analyses, corrective action taken, changes to the requested analytical method, and a glossary for data qualifiers.

Laboratory QC results will also be included in the data package. This will include results for check standards, labeled compounds, laboratory duplicates, and blanks. The information will be used to evaluate data quality, determine if the MQOs were met, and act as acceptance criteria for project data.

In PCB congener analysis not all of the 209 congeners in a sample are above reporting limits. The laboratory will qualify data as follows:[34]

- "J" – The analyte was positively identified. The associated numerical result is an estimate.
- "U" – The analyte was not detected at or above the estimated reporting limit. (This qualifier will likely be used only for total homologs, since all analytes are to be reported down to the level of the EDL)
- "UJ" – The analyte was not detected at or above the estimated reporting limit.
- "NJ" – The analysis indicates the presence of an analyte that has been "tentatively identified" and the associated numerical value represents its approximate concentration. (The laboratory will calculate and report the Estimated Maximum Possible Concentration

[33] Limnotech, Inc. *Quality Assurance Project Plan, Spokane River Toxics Reduction Strategy*, July 23, 2014. http://srrttf.org/wp-content/uploads/2013/05/QAPP_FINAL_081114.pdf
[34] Limnotech, Inc. *Quality Assurance Project Plan, Spokane River Toxics Reduction Strategy*, July 23, 2014. http://srrttf.org/wp-content/uploads/2013/05/QAPP_FINAL_081114.pdf

(EMPC) value for results that do not meet ion abundance ratio criteria. Qualify these results with “NJ”. Provide an example calculation if the result value is adjusted.)

The laboratory case narratives will include:

- Reference to the standard laboratory methods, associated with EPA Methods 8082 and 1668C, used to prepare the samples for analysis (homogenization, extraction, and preparation). Any deviations from the standards from the standard sample preparation methods will be noted.
- The qualified results and whether or not they are included in the summing of total homolog results and total PCBs or Aroclors.

MEL will provide a Tier 4 Data Validation with the complete raw laboratory dataset. MEL will provide case narratives to the project manager with the final qualified results and a description of the quality of the laboratory data.

The method used for censoring low level PCBs will be discussed in the project report.

11.3 Electronic transfer requirements

MEL and AXYS Analytical Services, Ltd. will deliver case narratives in PDF format, and electronic data deliverable (EDD) in an Excel spreadsheet format to the project manager via email. Data generated by MEL (analyses done in-house) will be delivered to the project manager as an EIM-ready EDD.

11.4 Acceptance criteria for existing data

Existing data may be used in evaluating the results of this study. Data that has been collected under and approved Quality Assurance Project Plan is considered acceptable. If other types of data are used, the source of the data will be referenced and the associated data quality will be noted in the report.

11.5 EIM/STORET data upload procedures

All laboratory data will be uploaded to Ecology’s EIM database following internal procedures, including a review process.

12.0 Audits and Reports

12.1 Number, frequency, type, and schedule of audits

MEL and AXYS Analytical Services, Ltd. are routinely audited by the Laboratory Accreditation Unit to maintain its Washington State Accreditation and also participate in EPA QSR audits. No audits are planned specifically for this project.

12.2 Responsible personnel

Not applicable. No audits are planned for this study.

12.3 Frequency and distribution of report

A draft report of the annual sampling results will be completed in August 2017 and a final report will be published by December 2017. See Table 4 for the report schedule. Reports will include, at a minimum, the following:

- A map showing sampling locations.
- A brief description of field and laboratory methods.
- A discussion of data quality.
- Summary tables of contaminant concentrations in soils and stormwater.
- A discussion of the results, including:
    - Scope and extent of PCBs in Spokane soils prior to and following demolition activities.
    - Assessment of current demolition techniques effective for managing PCB-containing materials.
- Conclusions and recommendations based on the sampling results.

12.4 Responsibility for reports

The project manager will be the lead responsible for the final report.

13.0 Data Verification

13.1 Field data verification, requirements, and responsibilities

Field notes will be verified by the field lead before leaving each sampling site, and then by the project manager, including data generated in the field.

13.2 Lab data verification

Data verification involves examining the data for errors, omissions, and compliance with QC acceptance criteria. MEL's SOPs for data reduction, review, and reporting will meet the needs of the project. Data packages will be assessed by MEL's QA Officer using the EPA Functional Guidelines for Organic Data Review (EPA, 2014).

MEL staff will provide a written report of their data review which will include a discussion of whether:
1) MQOs were met.
2) Proper analytical methods and protocols were followed.
3) Calibrations and controls were within limits.
4) Data were consistent, correct, and complete, without errors or omissions.

The principal investigator/project manager is responsible for the final acceptance of the project data. The complete data package, along with MEL's written report, will be assessed for completeness and reasonableness. Based on these assessments, the data will either be accepted, accepted with qualifications, or rejected and re-analysis considered.

Accuracy of data entered into EIM will be verified by someone other than the data engineer per the Environmental Assessment Program's EIM data entry business rules.

13.3 Validation requirements, if necessary

MEL will provide independent data validation for the stormwater data. See Section 11.2 for details.

14.0 Data Quality (Usability) Assessment

14.1 Process for determining whether project objectives have been met

After the project data have been reviewed and validated, the principal investigator/project manager will determine if the data are of sufficient quality to make determinations and decisions for which the study was conducted. The data from the laboratory's QC procedures will provide information to determine if MQOs have been met. Laboratory and QA staff familiar with assessment of data quality may be consulted. The project final report will discuss data quality and whether the project objectives were met. If limitations in the data are identified, they will be noted.

Some analytes will be reported near the detection capability of the selected methods. MQOs may be difficult to achieve for these results. MEL's SOP for data qualification and best professional judgment will be used in the final determination of whether to accept, reject, or accept the results with qualification. The assessment will be based on a review of laboratory QC results. This will include assessment of laboratory precision, contamination (blanks), accuracy, matrix interferences, and the success of laboratory QC samples meeting MQOs.

14.2 Data analysis and presentation methods

A summary of the data will be presented in the final report. Other components to be included in the final report are described in Section 12.3.

14.3 Treatment of non-detects

Laboratory data will be reported down to the method detection limit, with an associated "U" or "UJ" qualifier for non-detected results. When calculating total PCB values (T-PCBs), non-detects will be assigned a value of zero. Summed values in the final report will include only detected congener results that are unqualified and/or that have been qualified with a "J" (indicating that the analyte was positively identified and the associated numerical value is approximate) or an "NJ" (indicating that the analyte has been "tentatively identified" and the associated value represents its approximate concentration). If a sample is comprised of all non-detected congener results, then the final T-PCB value will be assigned "ND" for not detected. T-PCB values will be qualified "J" if more than 10 percent of the total result is composed of congener values containing "J" qualifiers.

For summed total-PCB values in the final report, results will be censored for blank contamination using a 3 or 10 times rule. A congener will be considered a non-detect if the concentration is less than 3 or 10 times the concentration of the associated laboratory method blank. The choice of censoring method will be described in the project report.

14.4 Sampling design evaluation

The number and type of samples collected for this study will be sufficient to meet the objectives of this screening-level survey.

14.5 Documentation of assessment

Documentation of assessment will occur in the final report.

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16.0 Figures

The figures in this QAPP are inserted after they're first mentioned in the text.

17.0 Tables

The tables in this QAPP are inserted after they're first mentioned in the text.

18.0 Appendices

Appendix A. Field Sheet

DEPARTMENT OF ECOLOGY
State of Washington

Field Sheet

PROJECT: WSDOT Survey of Potential PCB-Containing Building Material Sources

Street Address: Click here to enter text.

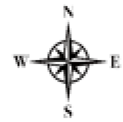
Sampled by: Click here to enter text. **Date:** Click here to enter a date.

Building Type/Age: Click here to enter text. ☐ Discrete ☐ Composite ☐ Both

MATRIX: Soil	**Discrete Sample 1**		**Time: ________**	**Comments:**
	Color/Type	*Building Condition*	*Substrate/Location*	Click here to enter text.
	☐ Light ☐ Dark ☐ Beige ☐ Tan ☐ Brown ☐ Grey ☐ Black ☐ Other ☐ Sand ☐ Gravel ☐ Mud ☐ Other	☐ Fresh ☐ Chipping ☐ Peeling ☐ Good ☐ Poor ☐ Moderate	☐ Brick ☐ Concrete ☐ Metal ☐ Siding ☐ Wood ☐ Window ☐ Door ☐ *Other:*	**COC Field St ID#:** Click here to enter text.
MATRIX: Soil	**Discrete Sample 2**		**Time: ________**	**Comments:**
	Color	*Building Condition*	*Substrate/Location*	Click here to enter text.
	☐ Light ☐ Dark ☐ Beige ☐ Tan ☐ Brown ☐ Grey ☐ Black ☐ Other ☐ Sand ☐ Gravel ☐ Mud ☐ Other	☐ Fresh ☐ Chipping ☐ Peeling ☐ Good ☐ Poor ☐ Moderate	☐ Brick ☐ Concrete ☐ Metal ☐ Siding ☐ Wood ☐ Window ☐ Door ☐ *Other:*	**COC Field St ID#:** Click here to enter text.
MATRIX: Soil	**Discrete Sample 3**		**Time: ________**	**Comments:**
	Color	*Condition*	*Substrate/Location*	Click here to enter text.
	☐ Light ☐ Dark ☐ Beige ☐ Tan ☐ Brown ☐ Grey ☐ Black ☐ Other ☐ Sand ☐ Gravel ☐ Mud ☐ Other	☐ Fresh ☐ Chipping ☐ Peeling ☐ Good ☐ Poor ☐ Moderate	☐ Brick ☐ Concrete ☐ Metal ☐ Siding ☐ Wood ☐ Window ☐ Door ☐ *Other:*	**COC Field St ID#:** Click here to enter text.
MATRIX: Soil	**Discrete Sample 4**		**Time: ________**	**Comments:**
	Color	*Condition*	*Substrate/Location*	Click here to enter text.
	☐ Light ☐ Dark ☐ Beige ☐ Tan ☐ Brown ☐ Grey ☐ Black ☐ Other ☐ Sand ☐ Gravel ☐ Mud ☐ Other	☐ Fresh ☐ Chipping ☐ Peeling ☐ Good ☐ Poor ☐ Moderate	☐ Brick ☐ Concrete ☐ Metal ☐ Siding ☐ Wood ☐ Window ☐ Door ☐ *Other:*	**COC Field St ID#:** Click here to enter text.
MATRIX: Soil	**Composite Sample**	**# of Aliquots**	**Time: ________**	**Comments:** Click here to enter text.
	☐ Sand ☐ Gravel ☐ Mud ☐ Other			**COC Field St ID#:** Click here to enter text.

(Check all descriptors that apply to sample.) **NOTE: Commercial buildings include schools, churches, apartment buildings and park buildings.

Site map:



Recorded by: ______________________________ **Date:** ______________________

Reviewed by: ______________________________ **Date:** ______________________

Appendix B. Site Safety Plan

Contact information:

Name	Role	Phone Number(s)
Ted Hamlin	Field Lead	(509) 329-3573
Adriane Borgias	Field Assistant(s)	(509) 329-3515
Mike McCain	ERO Safety Consultant	(509) 329-3457
	24-Hour Med Mon Physician consultant in case of staff chemical exposure	911
Tammie Williams	WSDOT Contact	(509) 324-6134
	Law Enforcement	911

Property Access:
Ecology will notify WSDOT 48 hours prior to expected entry of property. Following access to the property, Ecology will secure the property, and leave it in its original condition. Ecology will notify WSDOT upon completion of sampling activities.

Address	Survey Date	Expected Hours On Site	Sampling Date	Expected Hours On Site

Nearest hospital:

- Sacred Heart Emergency Center, 101 W 8th Ave, Spokane, WA 99204 (Figure B-1)
- Deaconess Hospital, 800 W 5th Ave, Spokane, WA 99204 (Figure B-2)

Map of site and hospital location and route attached. Emergency numbers Statewide - 911

Is the site currently active? Yes___ **No X** Will the buddy system be used? **Yes X** No ___

Site description: This project involves access to vacant properties with buildings scheduled for demolition. Buildings will be boarded up and assumed to be empty.

Potential safety concerns include unauthorized occupation and/or use. Buildings may also be vandalized and have questionable structural integrity.

Scope/objective of field work: Collect representative soil samples external to the buildings.

Known contaminants: Undetermined. If samplers identify contaminants that pose a safety concern, the sampling will cease and appropriate notifications made to Ecology and WSDOT. Potential contaminants in sampled materials include PCBs, lead, and asbestos.

Routes of chemical exposure: Inhalation____X___ Dermal___X_____ No exposure______

Overall risk of chemical exposure: Serious____ Moderate_____ Low__X_____

Physical hazards: Confined space_____ Noise______ Heat/cold stress_______

Describe any area on site that could function as a confined/enclosed space:
Confined space is a space that is **all** of the following:
(a) Large enough and arranged so an employee could fully enter the space and work.
(b) Has limited or restricted entry or exit. Examples of spaces with limited or restricted entry are tanks, vessels, silos, storage bins, hoppers, vaults, excavations, and pits.
(c) Not primarily designed for human occupancy.

Permit-required confined space or permit space. A confined space that has one or more of the following characteristics capable of causing death or serious physical harm:
(a) Contains or has a potential to contain a hazardous atmosphere.
(b) Contains a material with the potential for engulfing someone who enters.
(c) Has an internal configuration that could allow someone entering to be trapped or asphyxiated by inwardly converging walls or by a floor, which slopes downward and tapers to a smaller cross section.
(d) Contains any physical hazard. This includes any recognized health or safety hazards including engulfment in solid or liquid material, electrical shock, or moving parts.
(e) Contains any other recognized serious safety or health hazard that could either:
(i) Impair the ability to self-rescue.
(ii) Result in a situation that presents an immediate danger to life or health.

Sampling will not be performed in confined spaces or permit-required confined spaces.

Will air monitoring be conducted? Yes___ No X

Personal protection level required A B **C** **D**

Personal protective equipment required: Gloves.

Other (specify): An assessment of the site safety hazards will be made during the initial building surveys. The assessment will include potential for confined space areas, and evidence of hazardous materials requiring more than Level D protection. Site specific sampling plans assessments will be used to prevent entry into confined spaces. If the property is deemed to require more than Level D protection, then sampling will stop and appropriate notifications will be made to Ecology and WSDOT.

Overall risk of physical hazards: Serious____ Moderate_____ Low__X___ Unknown______

Expected parameters/contaminants to be sampled: PCBs in caulk, paint, and soil and stormwater.

Sampling matrix: Soil, stormwater

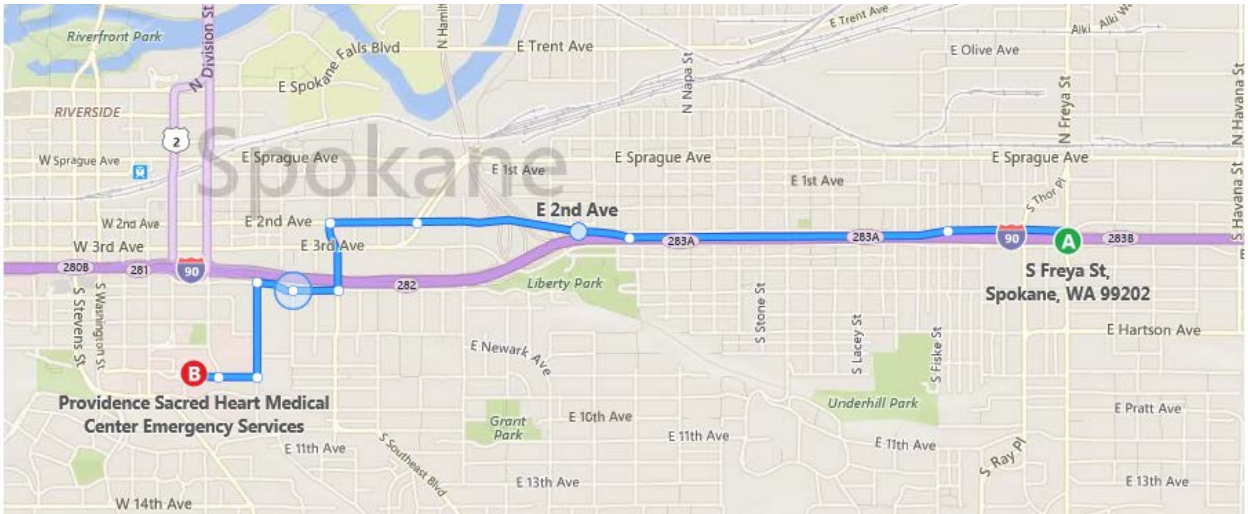


Figure B-1. Directions to Providence Sacred Heart Medical Emergency Center

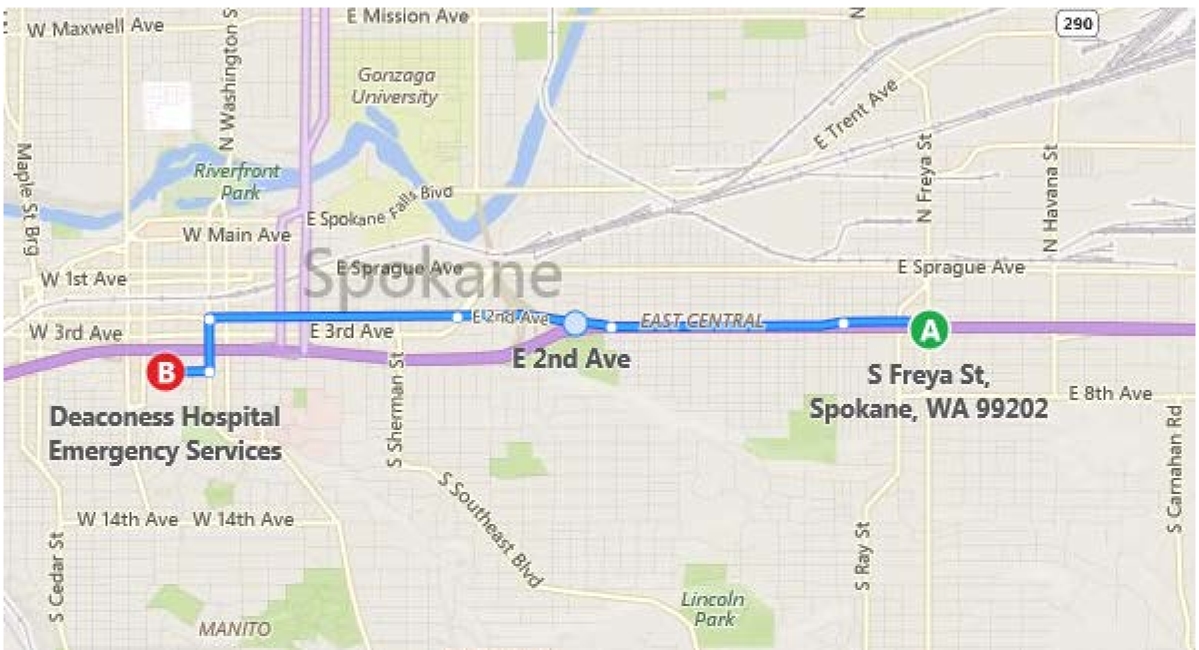


Figure B-2. Directions to Deaconess Hospital Emergency Services

Appendix C. Standard Operating Procedure for Sampling Collection and Compositing

C-1. Selection of Sampling Locations

C-1.1 Pre-Demolition Soil

Prior to sampling, a survey will be made to identify soil sampling areas on the outside of the building.

A minimum of four individual samples will be collected around the building. Additional samples may be collected if the soil has caulk pieces, paint chips, or staining. Individual sampling locations and the conditions of the soils documented.

Soils samples will be collected along the property perimeter and composited into a single sample for chemical analysis.

C-1.2 Post-Demolition Soil

Prior to sampling the post-demolition soils, the pre-demolition analytical results will be evaluated for the presence of PCBs. If PCB concentrations are below levels of regulatory concern, then the soil sampling protocol below will be used.

Following building demolition, post-demolition soils will be collected in the approximate locations of the pre-demolition samples. A minimum of four individual samples will be collected around the building footprint.

Soils samples will be collected along the property perimeter and composited into a single sample for chemical analysis.

If PCB concentrations are above levels of regulatory concern, then the post-demolition sampling protocol will be re-evaluated and may be modified.

C-1.3 Stormwater

Stormwater samples will be collected from conveyances based on their proximity to the target properties. Sample locations will be identified by the City of Spokane manhole cover numbers and the GPS coordinates will be recorded. At least one sample will collected at Manhole Number 1600124 ST, discharge 16000 200ND. This location receives stormwater from the project area and is the last manhole opening prior to discharge to the Spokane River.

C-2. Procedure for Collecting Samples

C-2.1 Pre- and Post- Demolition Soils

Soil samples will be collected from each side of the building using a clean, decontaminated scoop. Soil samples will also be collected along the perimeter of the property and will be composited on-site by placing equal aliquots from each sampling location into a single 8-ounce container. A minimum of 250 grams of soil will be collected. The locations of the aliquots, condition of the soil (clean, stained, disturbed, etc.) and whether or not fragments of weathered caulk or paint are present will be noted on the Field Sheet at the time of sampling.

C-2.2 Stormwater

Stormwater samples will be collected from the City of Spokane stormwater conveyance system through manhole access points or catch basins.[35]

To collect the sample, a sampling pole with a sample bottle attached to the pole will be lowered into the water facing the flow. To avoid cross contamination, care will be taken used to avoid touching the sides of the manhole with the sample bottle.

C-3. Compositing the Sample

Compositing is a method of combining several samples of a specific type from nearby locations for a single chemical analysis. The single chemical analysis of a composite sample results in an averaging of the concentrations of its component samples.

Composite samples will be prepared from individually collected discrete samples using the following decision protocols.

C-3.3 Pre-demolition Soil

Composite samples will be created by measuring equal volumes (approximately 5 grams) of the individual perimeter soil samples into a clean stainless steel bowl and mixing thoroughly using a clean steel putty knife. Each well-mixed composite sample will be placed into a clean 8-ounce sample jar. Approximately 250 grams of sample are needed for the laboratory to measure the concentration of PCBs with sufficient analytical detection sensitivity.

[35] Fernandez, Arianne. *Spokane Basin Sampling and Analysis Plan (SAP) and Quality Assurance Project Plan (QAPP) for the Spokane River Source Trace Study regarding PCB, PBDE, Metal, and Dioxins/Furan Contamination.* April, 2009.

C-3.3 Post-demolition Soil

The composite will be created by measuring equal volumes (approximately 5 grams) of perimeter soil samples into a clean stainless steel bowl and mixing thoroughly using a clean steel putty knife. Each well-mixed composite sample will be placed into a clean 8-ounce sample jar. Approximately 250 grams of sample are needed for the laboratory to measure the concentration of PCBs with sufficient analytical detection sensitivity.

C-4. Sample Documentation

C-4.1 Field Sheets

A “Field Sheet” (Appendix A) will be used for each property to document the site and sample conditions. Sampling locations will be noted as a drawing on the Field Sheet.

C-4.2 Photographs

Photographs will be taken of the sampling locations and documented in a photolog.

C-4.3 Sample Identification

Ecology will uniquely identify each sample as follows:

- Date and time sample was taken
- Field station identification
    - First 4 digits of street address
    - First 2 letters of street name
    - Sample type identifier
        - C = Composite
        - S = Single
        - D = Duplicate
    - Matrix identifier
        - S = Soil
        - W = Water
        - O = Other
    - Lab sample number
        - Unique identifier for individual sample container

C-4.4 Chain of Custody

Chain of Custody will be maintained and documented using the Manchester Environmental Laboratory form.

C-4.5 Sample Archive

Individual samples will be archived by the Department of Ecology until completion of the laboratory analysis.

Laboratory samples will be maintained by Manchester Environmental Laboratory and AXYS Analytical Services, Ltd. in accordance with laboratory standard procedures.

Appendix D. Glossaries, Acronyms, and Abbreviations

Glossary of General Terms

Clean Water Act: A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

Combined Sewer Overflow (CSO): A combined sewer system (CSS) collects rainwater runoff, domestic sewage, and industrial wastewater into one pipe. Under normal conditions, it transports all of the wastewater it collects to a sewage treatment plant for treatment, then discharges to a water body. The volume of wastewater can sometimes exceed the capacity of the CSS or treatment plant (e.g., during heavy rainfall events or snowmelt). When this occurs, untreated stormwater and wastewater discharges directly to nearby streams, rivers, and other water bodies resulting in a combined sewer overflow. CSOs contain untreated or partially treated human and industrial waste, toxic materials, and debris as well as stormwater

Effluent: An outflowing of water from a natural body of water or from a human-made structure. For example, the treated outflow from a wastewater treatment plant.

Municipal separate storm sewer systems (MS4): A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains):
(1) Owned or operated by a state, city, town, borough, county, parish, district, association, or other public body having jurisdiction over disposal of wastes, stormwater, or other wastes, and (2) designed or used for collecting or conveying stormwater; (3) which is not a combined sewer; and (4) which is not part of a Publicly Owned Treatment Works (POTW) as defined in the Code of Federal Regulations at 40 CFR 122.2.

National Pollutant Discharge Elimination System (NPDES): National program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

Nonpoint source: Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface-water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Point source: Source of pollution that discharges at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial waste treatment facilities, and construction sites where more than five acres of land have been cleared.

Pollution: Contamination or other alteration of the physical, chemical, or biological properties of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or are likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, salt waters, wetlands, and all other surface waters and water courses within the jurisdiction of Washington State.

303(d) list: Section 303(d) of the federal Clean Water Act, requiring Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality-limited estuaries, lakes, and streams that fall short of state surface water quality standards and are not expected to improve within the next two years.

Acronyms and Abbreviations

Following are acronyms and abbreviations used frequently in this report.

BMP	Best Management Practice
CSO	Combined Sewer Overflow
Ecology	Washington State Department of Ecology
e.g.	For example
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
et al.	And others
GIS	Geographic Information System software
GPS	Global Positioning System
i.e.	In other words
MEL	Manchester Environmental Laboratory
MQO	Measurement quality objective
PBT	persistent, bioaccumulative, and toxic substance
PCBs	polychlorinated biphenyls
QA	Quality assurance
RM	River mile
RPD	Relative percent difference
RSD	Relative standard deviation
SOP	Standard operating procedures
SRM	Standard reference materials
WQA	Water Quality Assessment
WRIA	Water Resource Inventory Area
WSTMP	Washington State Toxics Monitoring Program
WWTP	Wastewater treatment plant

Units of Measurement

°C	degrees centigrade
cfs	cubic feet per second
cfu	colony forming units
cms	cubic meters per second, a unit of flow
dw	dry weight
ft	feet
g	gram, a unit of mass
kcfs	1000 cubic feet per second
kg	kilograms, a unit of mass equal to 1,000 grams
kg/d	kilograms per day
km	kilometer, a unit of length equal to 1,000 meters
l/s	liters per second (0.03531 cubic foot per second)
m	meter
mm	millimeter

mg	milligram
mgd	million gallons per day
mg/d	milligrams per day
mg/Kg	milligrams per kilogram (parts per million)
mg/L	milligrams per liter (parts per million)
mg/L/hr	milligrams per liter per hour
mL	milliliter
mmol	millimole or one-thousandth of a mole
mole	an International System of Units (IS) unit of matter
ng/g	nanograms per gram (parts per billion)
ng/Kg	nanograms per kilogram (parts per trillion)
ng/L	nanograms per liter (parts per trillion)
NTU	nephelometric turbidity units
pg/g	picograms per gram (parts per trillion)
pg/L	picograms per liter (parts per quadrillion)
psu	practical salinity units
s.u.	standard units
ug/g	micrograms per gram (parts per million)
ug/Kg	micrograms per kilogram (parts per billion)
ug/L	micrograms per liter (parts per billion)
um	micrometer
uM	micromolar (a chemistry unit)
umhos/cm	micromhos per centimeter
uS/cm	microsiemens per centimeter, a unit of conductivity
ww	wet weight

Quality Assurance Glossary

Accreditation: A certification process for laboratories, designed to evaluate and document a lab's ability to perform analytical methods and produce acceptable data. For Ecology, it is "Formal recognition by (Ecology)…that an environmental laboratory is capable of producing accurate analytical data." [WAC 173-50-040] (Kammin, 2010)

Accuracy: The degree to which a measured value agrees with the true value of the measured property. USEPA recommends that this term not be used, and that the terms "precision" and "bias" be used to convey the information associated with the term accuracy. (USGS, 1998)

Analyte: An element, ion, compound, or chemical moiety (pH, alkalinity) which is to be determined. The definition can be expanded to include organisms; e.g., fecal coliform, Klebsiella. (Kammin, 2010)

Bias: The difference between the population mean and the true value. Bias usually describes a systematic difference reproducible over time, and is characteristic of both the measurement system, and the analyte(s) being measured. Bias is a commonly used data quality indicator (DQI). (Kammin, 2010; Ecology, 2004)

Blank: A synthetic sample, free of the analyte(s) of interest. For example, in water analysis, pure water is used for the blank. In chemical analysis, a blank is used to estimate the analytical response to all factors other than the analyte in the sample. In general, blanks are used to assess possible contamination or inadvertent introduction of analyte during various stages of the sampling and analytical process. (USGS, 1998)

Calibration: The process of establishing the relationship between the response of a measurement system and the concentration of the parameter being measured. (Ecology, 2004)

Check standard: A substance or reference material obtained from a source independent from the source of the calibration standard; used to assess bias for an analytical method. This is an obsolete term, and its use is highly discouraged. See Calibration Verification Standards, Lab Control Samples (LCS), Certified Reference Materials (CRM), and/or spiked blanks. These are all check standards, but should be referred to by their actual designator; e.g., CRM, LCS. (Kammin, 2010; Ecology, 2004)

Comparability: The degree to which different methods, data sets and/or decisions agree or can be represented as similar. A data quality indicator. (USEPA, 1997)

Completeness: The amount of valid data obtained from a project compared to the planned amount; usually expressed as a percentage. A data quality indicator. (USEPA, 1997)

Continuing Calibration Verification Standard (CCV): A QC sample analyzed with samples to check for acceptable bias in the measurement system. The CCV is usually a midpoint calibration standard that is re-run at an established frequency during the course of an analytical run. (Kammin, 2010)

Control chart: A graphical representation of quality control results demonstrating the performance of an aspect of a measurement system. (Kammin, 2010; Ecology 2004)

Control limits: Statistical warning and action limits calculated based on control charts. Warning limits are generally set at +/- 2 standard deviations from the mean, action limits at +/- 3 standard deviations from the mean. (Kammin, 2010)

Data Integrity: A qualitative DQI that evaluates the extent to which a data set contains data that is misrepresented, falsified, or deliberately misleading. (Kammin, 2010)

Data Quality Indicators (DQI): Commonly used measures of acceptability for environmental data. The principal DQIs are precision, bias, representativeness, comparability, completeness, sensitivity, and integrity. (USEPA, 2006)

Data Quality Objectives (DQO): Qualitative and quantitative statements derived from systematic planning processes that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.
(USEPA, 2006)

Data set: A grouping of samples organized by date, time, analyte, etc. (Kammin, 2010)

Data validation: An analyte-specific and sample-specific process that extends the evaluation of data beyond data verification to determine the usability of a specific data set. It involves a detailed examination of the data package, using both professional judgment, and objective criteria, to determine whether the MQOs for precision, bias, and sensitivity have been met. It may also include an assessment of completeness, representativeness, comparability and integrity, as these criteria relate to the usability of the data set. Ecology considers four key criteria to determine if data validation has actually occurred. These are:
- Use of raw or instrument data for evaluation.
- Use of third-party assessors.
- Data set is complex.
- Use of EPA Functional Guidelines or equivalent for review.

Examples of data types commonly validated would be:
- Gas Chromatography (GC).
- Gas Chromatography-Mass Spectrometry (GC-MS).
- Inductively Coupled Plasma (ICP).

The end result of a formal validation process is a determination of usability that assigns qualifiers to indicate usability status for every measurement result. These qualifiers include:
- No qualifier, data is usable for intended purposes.

- J (or a J variant), data is estimated, may be usable, may be biased high or low.
- REJ, data is rejected, cannot be used for intended purposes (Kammin, 2010; Ecology, 2004).

Data verification: Examination of a data set for errors or omissions, and assessment of the Data Quality Indicators related to that data set for compliance with acceptance criteria (MQOs). Verification is a detailed quality review of a data set. (Ecology, 2004)

Detection limit (limit of detection)**:** The concentration or amount of an analyte which can be determined to a specified level of certainty to be greater than zero. (Ecology, 2004)

Duplicate samples: Two samples taken from and representative of the same population, and carried through and steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variability of all method activities including sampling and analysis. (USEPA, 1997)

Field blank: A blank used to obtain information on contamination introduced during sample collection, storage, and transport. (Ecology, 2004)

Initial Calibration Verification Standard (ICV): A QC sample prepared independently of calibration standards and analyzed along with the samples to check for acceptable bias in the measurement system. The ICV is analyzed prior to the analysis of any samples. (Kammin, 2010)

Laboratory Control Sample (LCS): A sample of known composition prepared using contaminant-free water or an inert solid that is spiked with analytes of interest at the midpoint of the calibration curve or at the level of concern. It is prepared and analyzed in the same batch of regular samples using the same sample preparation method, reagents, and analytical methods employed for regular samples. (USEPA, 1997)

Matrix spike: A QC sample prepared by adding a known amount of the target analyte(s) to an aliquot of a sample to check for bias due to interference or matrix effects. (Ecology, 2004)

Measurement Quality Objectives (MQOs)**:** Performance or acceptance criteria for individual data quality indicators, usually including precision, bias, sensitivity, completeness, comparability, and representativeness. (USEPA, 2006)

Measurement result: A value obtained by performing the procedure described in a method. (Ecology, 2004)

Method: A formalized group of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, data analysis), systematically presented in the order in which they are to be executed. (EPA, 1997)

Method blank: A blank prepared to represent the sample matrix, prepared and analyzed with a batch of samples. A method blank will contain all reagents used in the preparation of a sample, and the same preparation process is used for the method blank and samples. (Ecology, 2004; Kammin, 2010)

Method Detection Limit (MDL): This definition for detection was first formally advanced in 40CFR 136, October 26, 1984 edition. MDL is defined there as the minimum concentration of an analyte that, in a given matrix and with a specific method, has a 99 percent probability of being identified, and reported to be greater than zero. (Federal Register, October 26, 1984)

Percent Relative Standard Deviation (%RSD): A statistic used to evaluate precision in environmental analysis. It is determined in the following manner:

$$\%RSD = (100 * s)/x$$

where "s" is the sample standard deviation and "x" is the mean of results from more than two replicate samples (Kammin, 2010)

Parameter: A specified characteristic of a population or sample. Also, an analyte or grouping of analytes. Benzene and nitrate + nitrite are all "parameters." (Kammin, 2010; Ecology, 2004)

Population: The hypothetical set of all possible observations of the type being investigated. (Ecology, 2004)

Precision: The extent of random variability among replicate measurements of the same property; a data quality indicator. (USGS, 1998)

Quality Assurance (QA): A set of activities designed to establish and document the reliability and usability of measurement data. (Kammin, 2010)

Quality Assurance Project Plan (QAPP): A document that describes the objectives of a project, and the processes and activities necessary to develop data that will support those objectives. (Kammin, 2010; Ecology, 2004)

Quality Control (QC): The routine application of measurement and statistical procedures to assess the accuracy of measurement data. (Ecology, 2004)

Relative Percent Difference (RPD): RPD is commonly used to evaluate precision. The following formula is used:

$$[Abs(a-b)/((a + b)/2)] * 100$$

where "Abs()" is absolute value and "a" and "b" are results for the two replicate samples. RPD can be used only with two values. Percent Relative Standard Deviation is (%RSD) is used if there are results for more than two replicate samples. (Ecology, 2004)

Replicate samples: Two or more samples taken from the environment at the same time and place, using the same protocols. Replicates are used to estimate the random variability of the material sampled. (USGS, 1998)

Representativeness: The degree to which a sample reflects the population from which it is taken; a data quality indicator. (USGS, 1998)

Sample (field): A portion of a population (environmental entity) that is measured and assumed to represent the entire population. (USGS, 1998)

Sample (statistical): A finite part or subset of a statistical population. (USEPA, 1997)

Sensitivity: In general, denotes the rate at which the analytical response (e.g., absorbance, volume, meter reading) varies with the concentration of the parameter being determined. In a specialized sense, it has the same meaning as the detection limit. (Ecology, 2004)

Spiked blank: A specified amount of reagent blank fortified with a known mass of the target analyte(s); usually used to assess the recovery efficiency of the method. (USEPA, 1997)

Spiked sample: A sample prepared by adding a known mass of target analyte(s) to a specified amount of matrix sample for which an independent estimate of target analyte(s) concentration is available. Spiked samples can be used to determine the effect of the matrix on a method's recovery efficiency. (USEPA, 1997)

Split sample: A discrete sample that is further subdivided into portions, usually duplicates. (Kammin, 2010)

Standard Operating Procedure (SOP): A document which describes in detail a reproducible and repeatable organized activity. (Kammin, 2010)

Surrogate: For environmental chemistry, a surrogate is a substance with properties similar to those of the target analyte(s). Surrogates are unlikely to be native to environmental samples. They are added to environmental samples for quality control purposes, to track extraction efficiency and/or measure analyte recovery. Deuterated organic compounds are examples of surrogates commonly used in organic compound analysis. (Kammin, 2010)

Systematic planning: A step-wise process which develops a clear description of the goals and objectives of a project, and produces decisions on the type, quantity, and quality of data that will be needed to meet those goals and objectives. The DQO process is a specialized type of systematic planning. (USEPA, 2006)

References for QA Glossary

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