

APPENDIX B

Data Quality Assurance Review Memoranda

Quality Assurance Review
Green/Duwamish Water Quality Assessment
Storm and Baseflow Sampling for Metals
Storm Sampling Events #1 through #7
Baseflow Sampling Events #1 through #6

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This quality assurance (QA) review has been prepared to provide data users with a tool for evaluating the usability of metals data from water samples collected for the Green/Duwamish Water Quality Assessment. These data were generated from seven storm and six baseflow sampling events conducted between November 2001 and October 2002. The QA review includes a summary table of quality control (QC) issues on a metal-by-metal basis followed by a more in-depth narrative discussion, by sampling event. Data usability has been evaluated based on the QC issues of completeness, field contamination, laboratory contamination, accuracy, precision, bias, and sample handling. Metals analyses discussed in this QA review were performed by the King County Environmental Laboratory.

Please note that this QA review is for all metal analyses except ultra-trace level mercury performed by cold vapor atomic fluorescence (CVAF). CVAF analysis of total and dissolved mercury was performed by Frontier Geosciences, a contract laboratory to the King County Environmental Laboratory. Quality control information for CVAF analysis (other than field blank contamination) was not included in the data packages sent for review.

Completeness

Each data set has been reviewed in terms of "completeness" or the number of parameters reported compared to a standard suite of analytes proposed for the project. The standard suite of analytes for this project includes 49 parameters; total and dissolved aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc, and hardness.

Field Contamination

Each data set has been reviewed to assess the potential impact of field contamination on sample analytical results. Analyte concentrations detected in field blanks have been compared to concentrations detected in associated samples. The sampling location of each field blank is provided in the narratives.

Laboratory Contamination

Each data set has been reviewed to assess the potential impact of laboratory contamination on sample analytical results. Laboratory contamination is assessed by reviewing analytical results for *method blanks*. A method blank is an aliquot of clean reference matrix, such as deionized distilled water for water samples, which is processed through the entire analytical procedure. Analysis of the method blank is used to evaluate the levels of contamination that might be associated with the processing and analysis of samples. Method blanks include *filter blanks* for dissolved metals. When an analyte is detected in a method blank, associated sample data for that analyte are qualified with a “B” flag if the reported sample concentration is less than 10 times the concentration detected in the method blank. Although these sample data are reported as positive results, they should be considered “less than the method detection limit” and the reported numeric method detection limit should be raised to a value that is 10 times the analyte concentration detected in the method blank.

Accuracy, Precision, and Bias

Accuracy is an estimate of the difference between the true value and the determined mean value. Precision is the agreement of a set of results among themselves and is a measure of the ability to reproduce a result. The accuracy of a result is affected by both systematic and random errors. Bias is a measure of the difference, due to a systematic factor, between an analytical result and the true value of an analyte. Precision, accuracy, and bias for analytical chemistry may be measured by one or more of the following QC procedures:

- A spike blank is an aliquot of clean reference matrix such as deionized distilled water for water samples to which a known concentration of target analyte(s) has been added. The spiked aliquot is processed through the entire analytical procedure. Analysis of the spike blank is used as an indicator of method performance and can be used in conjunction with matrix spike results as an indicator of sample matrix effects.
- A laboratory control sample is a solution of known analyte concentration(s) that is prepared separately from calibration standard solutions. An aliquot of the solution is processed as a sample through the complete analytical procedure. Analysis of a laboratory control sample is used as an indicator of method accuracy and long-term analytical precision.
- A standard reference material is a matrix specific material of known analyte concentration(s) that is certified by an outside source. An aliquot of the standard reference material is processed as a sample and processed through the complete analytical procedure. Analysis of a standard reference material is used as an indicator of method accuracy.
- A matrix spike is a known concentration of a target analyte(s) which is introduced into a second sample aliquot. The spiked sample is processed through the entire analytical procedure. Analysis of the matrix spike is used as an indicator of sample matrix effect on the recovery of target analyte(s).
- A lab duplicate is a second aliquot of a sample, processed concurrently and identically with the original sample. Analysis of the lab duplicate is used as an indicator of method precision and laboratory subsampling procedures. The lab duplicate can also be used to provide information regarding the homogeneity of the sample matrix.

The King County Environmental Laboratory does not assign qualifier flags to analytical data based on issues of accuracy, precision, and bias. These issues, and their impact on data usability, are discussed in the narrative sections.

Sample Handling Issues

The King County Environmental Laboratory qualifies analytical data with an “H” flag when one or more sample handling criteria have not been met. These sample handling criteria may include: incorrect sample containers; exceedence of the holding time for sample filtering or preservation; and exceedence of the holding time for sample analysis. These sample handling issues are discussed in the narrative sections.



The following table summarizes QC issues on a metal-by-metal basis and provides a thumbnail assessment of data usability. Full descriptions of QC issues, summarized by sampling event, are provided in the narratives following the table.

Summary Table of QC Issues

Metal	Total	Dissolved
Aluminum	Elevated matrix spike recovery associated with samples L23945-1 through -12 (Baseflow #3). These sample data possibly biased high. All other data may be used as reported.	No QC issues. All data may be used as reported.
Antimony	Data incomplete, not reported with every sample set. All available data may be used as reported.	No QC issues. All data may be used as reported.
Arsenic	Elevated relative percent difference for laboratory duplicate results associated with samples L22974-1 through -6, -8, -12, and -13 (Storm #3). These sample data should be considered “estimated.” All other data may be used as reported.	No QC issues. All data may be used as reported.
Barium	Data incomplete, not reported with every sample set. All available data may be used as reported.	Data incomplete, not reported with every sample set. All available data may be used as reported.
Beryllium	Data incomplete, not reported with every sample set. All available data may be used as reported.	Data incomplete, not reported with every sample set. All available data may be used as reported.
Cadmium	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Calcium	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Chromium	Detected frequently in field blanks when analyzed by low-level ICP-MS (9 out of 13 sampling events). See narratives under “field contamination” for sample-specific information. All regular ICP-MS data may be used as reported.	Detected in laboratory filter blanks for 4 of 13 sampling events when analyzed by low-level ICP-MS. All sample results flagged “B” should be considered “less than the method detection limit.” See narratives under “laboratory contamination” for sample-specific information on adjusted method detection limits.
Cobalt	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Copper	Detected in one field blank (analyzed by low-level ICP-MS) associated with samples L23472-1 through -16 (Baseflow #2). All other data may be used as reported.	No QC issues. All data may be used as reported.
Iron	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Lead	Detected in one field blank (analyzed by low-level ICP-MS) associated with samples L22828-1, -2, and -4 through -10 (Storm #2). All other data may be used as reported.	No QC issues. All data may be used as reported.

Metal	Total	Dissolved
Magnesium	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Manganese	Elevated matrix spike recoveries associated with samples L25054-1 through -3 and -5 through -9 (Baseflow #5) and L25055-1 through -6 and L25056-1, -2, and -4 through -6 (Baseflow #5). These sample data possibly biased high. All other data may be used as reported.	Elevated relative percent difference for laboratory duplicate results associated with sample L23944-3 (Baseflow #3). This sample result should be considered "estimated." All other data may be used as reported.
Mercury	Detected frequently in field blanks when analyzed by CVAF (10 out of 13 sampling events). See narratives under "field contamination" for sample-specific information. All CVAA data may be used as reported with the following exception: CVAA results flagged "H" for sample L23183-33 (Storm #4) and all samples from Baseflow #4 because sample analysis was not completed within the 28-day hold time.	CVAA results flagged "H" for sample L23183-33 (Storm #4) and all samples from Baseflow #4 because sample analysis was not completed within the 28-day hold time. All other data may be used as reported.
Molybdenum	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Nickel	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Potassium	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Selenium	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Silver	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Sodium	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Strontium	Only reported for one sampling event (Baseflow #4). All data may be used as reported.	Only reported for one sampling event (Baseflow #4). Elevated matrix spike recovery associated with samples L24475-1 through -16. These sample data possibly biased high. All other data may be used as reported.
Thallium	No QC issues. All data may be used as reported.	No QC issues. All data may be used as reported.
Vanadium	Data incomplete, not reported with every sample set. All available data may be used as reported.	Data incomplete, not reported with every sample set. All available data may be used as reported.
Zinc	Detected in field blanks associated with samples L23371-1, -3, -4, -8 through -14, 16, and -17 (Storm #5) and L23472-1 through -16 (Baseflow #2), both analyzed by low-level ICP-MS. Elevated matrix spike recovery associated with samples L23944-1 through -16 (Baseflow #3). These sample data possibly biased high. All other data may be used as reported.	Detected in laboratory filter blanks for 9 of 13 sampling events when analyzed by low-level ICP-MS. All sample results flagged "B" should be considered "less than the method detection limit." See narratives under "laboratory contamination" for sample-specific information on adjusted method detection limits.

Storm Sampling Event #1 – November 13 through 15, 2001
Samples L22697-2 through -5 and -7 through -10 and L22698-11 through -36
Field Blanks L22763-1 and -6

Completeness

Data are 100% complete with 49 parameters reported for each sample (24 total metals, 24 dissolved metals, hardness) and 24 total metals reported for each field blank.

Field Contamination

Field blank results are less than the method detection limit with the following exception.

- Total mercury (analyzed by CVAF) was detected at concentrations of 0.000000900 and 0.000000780 mg/L in field blanks L22763-1 (A307) and L22763-6 (B322), respectively. These field blanks are associated with sample set L22697. Total mercury concentrations in these samples range from 0.00000741 to 0.000244 mg/L or approximately 8 to 271 times the highest field blank concentration.

Laboratory Contamination

All laboratory blank results are less than the method detection limit.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exception.

- The 22% relative percent difference for one set of ICP-MS total chromium laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate total chromium concentrations, however, are less than the reporting detection limit. Associated total chromium sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.

Sample Handling Issues

All analytical data for samples 22698-11 through -15, -21 through -25, and -31 through -36 have been flagged "H" because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

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Storm Sampling Event #2 – November 28 and 29, 2001
Samples L22828-1, -2, and -4 through -10, and L22829-1 through -8, -11 through -28, and -31 through -40
Field Blanks L22830-1 and -2, and L22831-1

Completeness

Data are 100% complete with 49 parameters reported for each sample (24 total metals, 24 dissolved metals, hardness) and 24 total metals reported for each field blank.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total mercury (analyzed by CVAF) was detected at a concentration of 0.000000576 mg/L in field blanks L22830-1 (E319) and L22830-2 (A317). These field blanks are associated with sample set L22828. Total mercury concentrations in these samples range from 0.000000903 to 0.0000207 mg/L or approximately 1.5 to 36 times the field blank concentration.
- Total lead (analyzed by low-level ICP-MS) was detected at a concentration of 0.000034 mg/L in field blank L22830-2 (A317). This field blank is associated with sample set L22828. Total lead concentrations in these samples range from 0.000080 to 0.00145 mg/L or approximately 2.5 to 43 times the field blank concentration.

Laboratory Contamination

All laboratory blank results are less than the method detection limit.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exception.

- The 21% relative percent difference for one set of ICP-MS total arsenic laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate total arsenic concentrations, however, are less than the reporting detection limit. Associated total arsenic sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.
- The 22% relative percent difference for one set of ICP-MS total chromium laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate total chromium concentrations, however, are less than the reporting detection limit. Associated total chromium sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.
- The 27% relative percent difference for one set of CVAA total mercury laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate total mercury concentrations, however, are less than the reporting detection limit. Associated total mercury sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.

Sample Handling Issues

All analytical data for samples 22829-1, -11, -12, -16, -17, -18, -21, -31, -32, -35, -36, -37, and -38 have been flagged “H” because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

Total and dissolved CVAA mercury data for samples L22829-7, -13, -19, and -27 have been flagged “H” because sample preservation (total and dissolved mercury) and filtration (dissolved mercury) was not completed within the recommended 24-hour hold time.

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Storm Sampling Event #3 – December 13 through 15, 2001
Samples L22974-1 through -6, -8, -12, and -13 and L22976-1 through -46
Field Blanks L22975-1 and -2 and L22977-1 through -4 and -6

Completeness

Data are 100% complete with 49 parameters reported for each sample (24 total metals, 24 dissolved metals, hardness) and 24 total metals reported for each field blank.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total mercury (analyzed by CVAF) was detected at concentrations of 0.00000015 and 0.000000640 mg/L in field blanks L22975-1 (Y320) and L22975-2 (E319), respectively. These field blanks are associated with sample set L22974. Total mercury concentrations in these samples range from 0.00000382 to 0.0000151 mg/L or approximately 6 to 25 times the highest field blank concentration.
- Total chromium (analyzed by low-level ICP-MS) was detected at concentrations of 0.000079 and 0.000077 mg/L in field blanks L22975-1 (Y320) and L22975-2 (E319), respectively. These field blanks are associated with sample set L22974. Total chromium concentrations in these samples range from 0.00024 to 0.000948 mg/L or approximately 3 to 12 times the highest field blank concentration.

Laboratory Contamination

Laboratory method blank results are less than the method detection limit with the following exception.

- Dissolved zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00031 mg/L in the filter blank associated with sample set L22974. Dissolved zinc sample results that are less than ten times the filter blank dissolved zinc concentration have been flagged "B" (samples L22974-6, -8, and -13). Dissolved zinc results for these three samples should be considered "less than the method detection limit" with the associated numeric method detection limit raised to 0.0031 mg/L.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exception.

- The 31% relative percent difference for one set of low-level ICP-MS total arsenic laboratory duplicate results exceeds the control limit of 20%. The sample total arsenic concentration is below but near the reporting detection limit and the laboratory duplicate concentration is greater than the reporting detection limit. This laboratory duplicate is associated with sample set L22974 and field blank set L22975. Total arsenic results for these nine samples and two field blanks should be considered "estimated."

Sample Handling Issues

All analytical data for samples L22976-1 through -6, -11 through -16, -21 through -26, and -31 through -36 have been flagged "H" because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

CVAF mercury analytical data for samples L22974-1 through -6, -8, -12, and -13 and field blanks L22975-1 and -2 have been flagged "H" because sample preservation (total and dissolved mercury) and filtration (dissolved mercury) was not completed within the recommended 24-hour hold time.

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Storm Sampling Event #4 – January 23 through 25, 2002

Samples L23182-1 through -10 and -12 through -16, L23183-1 through -37, and L23184-1 through -6

Field Blanks L23008-1 and -2 and L23234-1 through -3

Completeness

Data are 100% complete with 49 parameters reported for each sample (24 total metals, 24 dissolved metals, hardness) and 24 total metals reported for each field blank.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total mercury (analyzed by CVAF) was detected at concentrations of 0.00000104, 0.00000012, and 0.00000020 mg/L in field blanks L23234-1 (E319), L23234-2 (F321), and L23234-3 (A310), respectively. These field blanks are associated with sample set L23182. Total mercury concentrations in these samples range from 0.00000142 to 0.0000478 mg/L or approximately 1.5 to 50 times the highest field blank concentration.
- Total chromium (analyzed by low-level ICP-MS) was detected at concentrations of 0.000053 and 0.000085 mg/L in field blanks L23234-2 (F321) and L23234-3 (A310), respectively. These field blanks are associated with sample set L23182. Total chromium concentrations in these samples range from 0.00024 to 0.00367 mg/L or approximately 3 to 45 times the highest field blank concentration.

Laboratory Contamination

Laboratory method blank results are less than the method detection limit with the following exception.

- Dissolved zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00023 mg/L in the filter blank associated with sample set L23182. Dissolved zinc sample results that are less than ten times the filter blank concentration have been flagged "B" (samples L23182-3, -6, -7, -13, -14, and -16). Dissolved zinc results for these six samples should be considered "less than the method detection limit" with the associated numeric method detection limit raised to 0.0023 mg/L.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exception.

- The 22% relative percent difference for one set of ICP total potassium laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate total potassium concentrations, however, are less than the reporting detection limit and very near the method detection limit. Associated total potassium sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.
- The 21% relative percent difference for one set of low-level ICP-MS total zinc laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate total zinc concentrations, however, are less than the reporting detection. Associated total zinc sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.

Sample Handling Issues

All analytical data for samples L23183-1 through -6, -11 through -15, -21 through -26, and -31 through -35 and L23184-3 have been flagged “H” because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

Total and dissolved CVAA mercury data for sample L23183-33 have been flagged “H” also because sample analysis was not completed within the recommended 28-day hold time.

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Storm Sampling Event #5 – February 21 through 22, 2002

Samples L23371-1, -3, -4, -8 through -14, -16, and -17, L23372-1 through -9, -11 through -16, and -31 through -39, and L23373-1, -2, and -5 through -10

Field Blanks L23464-1 through -3 and L23465-1 through -4

Completeness

Total and dissolved barium and total vanadium have not been reported for sample set L23371. A total of 46 parameters (22 total metals, 23 dissolved metals, hardness) are reported for each sample in this set.

Dissolved metals have not been reported for sample L23372-1, with the exception of dissolved mercury (analyzed by CVAF). Data are 100% complete for the remainder of the samples in this set, with 49 parameters (24 total metals, 24 dissolved metals, hardness) reported for each sample.

Data are 100% complete for sample set L23373 with 49 parameters reported for each sample in this set (24 total metals, 24 dissolved metals, hardness).

Total barium and total vanadium have not been reported for field blank set L23464. A total of 22 total metals are reported for each field blank in this set.

Data are 100% complete for field blank set L23465 with 24 total metals reported for each field blank.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total mercury (analyzed by CVAF) was detected at a concentration of 0.00000158 mg/L in field blank L23464-3 (C317). This field blank is associated with sample set L23371. Total mercury concentrations in these samples range from 0.00000333 to 0.00000943 mg/L or approximately 2 to 6 times the field blank concentration.
- Total chromium (analyzed by low-level ICP-MS) was detected at concentrations of 0.00012, 0.00014, and 0.000098 mg/L in field blanks L23464-1 (A341), L23464-2 (A315), and L23464-3 (C317), respectively. These field blanks are associated with sample set L23371. Total chromium concentrations in these samples range from 0.000415 to 0.00305 mg/L or approximately 3 to 22 times the highest field blank concentration.
- Total zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00017 mg/L in field blanks L23464-1 (A341) and L23464-2 (A315), respectively. These field blanks are associated with sample set L23371. Total zinc concentrations in these samples range from 0.00205 to 0.0317 mg/L or approximately 12 to 186 times the field blank concentration.

Laboratory Contamination

Laboratory method blank results are less than the method detection limit with the following exceptions.

- Dissolved chromium (analyzed by low-level ICP-MS) was detected at a concentration of 0.00058 mg/L in the filter blank associated with sample set L23371. Dissolved chromium sample results that are less than ten times the filter blank concentration have been flagged “B” (all samples in this sample set). Dissolved chromium results for these 12 samples should be considered “less than the method detection limit” with the associated numeric method detection limit raised to 0.0058 mg/L.
- Dissolved zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00056 mg/L in the filter blank associated with sample set L23371. Dissolved zinc sample results that are less than ten times the filter blank dissolved zinc concentration have been flagged “B” (samples L23371-1, -3, -8, -11, -12, -13, and -16). Dissolved zinc results for these seven samples should be considered “less than the method detection limit” with the associated numeric method detection limit raised to 0.0056 mg/L.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exception.

- The 26% relative percent difference for one set of ICP-MS total arsenic laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate total arsenic concentrations, however, are less than the reporting detection limit and very near the method detection limit. Associated total arsenic sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.

Sample Handling Issues

All analytical data for samples L23372-2, -4, -11, and -31 through -34 have been flagged “H” because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

Low-level ICP-MS analytical data for samples L23371-9, -13 and -14 have been flagged "H" because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

ICP analytical data for samples L23371-13 and -14 have been flagged "H" because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

CVAA mercury analytical data for sample L23372-1 and field blank L23465-3 have been flagged "H" because sample preservation (total and dissolved mercury) and filtration (dissolved mercury) was not completed within the recommended 24-hour hold time.

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Storm Sampling Event #6 – June 28 through 29, 2002

Samples L23532-1, -2, and -4 through -11, L23533-1 through -20 and -31 through -40, and L23534-1 through -12

Field Blanks L24834-1 through -3 and L24835-1 through -4

Completeness

Total and dissolved barium and total antimony have not been reported for sample set L23532. A total of 46 parameters (22 total metals, 23 dissolved metals, hardness) are reported for each sample in this set.

Total beryllium has not been reported for samples L23533-1 through -12. Dissolved beryllium has not been reported for samples L23533-1 through -5, -11 through -16, and -31 through -36. All other parameters have been reported for sample set L23533.

Dissolved beryllium has not been reported for samples L23534-1, -3, -5, -7, -9, and -11. All other parameters have been reported for sample set L23534.

Total antimony has not been reported for field blank set L24834. A total of 23 total metals are reported for each field blank in this set.

Data are 100% complete for field blank set L24835 with 24 total metals reported for each field blank.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total mercury (analyzed by CVAF) was detected at concentrations of 0.00000011 and 0.00000021 mg/L in field blanks L24834-2 (A310) and L24834-3 (A320), respectively. These field blanks are associated with sample set L23532. Total mercury concentrations in these samples range from 0.00000236 to 0.0000106 mg/L or approximately 12 to 53 times the field blank concentration.
- Total chromium (analyzed by low-level ICP-MS) was detected at concentrations of 0.00016, 0.00023, and 0.00018 mg/L in field blanks L24834-1 (A341), L24834-2 (A310), and L24834-3 (A320), respectively. These field blanks are associated with sample set L23532. Total chromium concentrations in these samples range from 0.000488 to 0.00126 mg/L or approximately 2 to 5 times the highest field blank concentration.

Laboratory Contamination

Laboratory method blank results are less than the method detection limit with the following exceptions.

- Dissolved chromium (analyzed by low-level ICP-MS) was detected at a concentration of 0.000050 mg/L in the filter blank associated with sample set L23532. Dissolved chromium sample results that are less than ten times the filter blank concentration have been flagged “B” (all samples in this sample set). Dissolved chromium results for these 10 samples should be considered “less than the method detection limit” with the associated numeric method detection limit raised to 0.00050 mg/L.
- Dissolved zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00041 mg/L in the filter blank associated with sample set L23532. Dissolved zinc sample results that are less than ten times the filter blank concentration have been flagged “B” (samples L23532-2, -4, -8, and -11). Dissolved zinc results for these four samples should be considered “less than the method detection limit” with the associated numeric method detection limit raised to 0.0041 mg/L.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exceptions.

- The 21% relative percent difference for one set of ICP total aluminum laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate total aluminum concentrations, however, are less than the reporting detection limit and very near the method detection limit. Associated total aluminum sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.
- The 21% relative percent difference for another set of ICP total aluminum laboratory duplicate results also exceeds the control limit of 20%. Both sample and laboratory duplicate total aluminum concentrations, however, are less than the reporting detection limit and very near the method detection limit. Associated total aluminum sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.
- The 149% recovery for one ICP-MS total manganese matrix spike exceeds the upper control limit of 120%. This matrix spike is associated with field blanks L24834-1 through -3, however, total manganese was not detected in any of these field blanks.

Sample Handling Issues

All analytical data for samples L23533-1 through -7, -11 through -17, and -31 through -37 and L23534-1, -3, -5, -7, -9, and -11 have been flagged “H” because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

Low-level ICP-MS analytical data for samples L23532-2, -4, and -11 have been flagged “H” because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

ICP analytical data for samples L23532-1, -2, -4, -5, -6, -8, and -11 have been flagged “H” because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

Storm Sampling Event #7 – November 6 through 8, 2002

Samples L24889-1 through -3 and -5 through -12, L24890-1 through -14 and -21 through -36, and L24891-1, -2, -5, -6, -8, -11, and -12

Field Blanks L24893-1 through -3 and L24894-1 through -4

Completeness

Data are 100% complete with 49 parameters reported for each sample (24 total metals, 24 dissolved metals, hardness) and 24 total metals reported for each field blank.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total mercury (analyzed by CVAF) was detected at concentrations of 0.00000013 and 0.00000011 mg/L in field blanks L24893-2 (B317) and L24893-3 (A320), respectively. These field blanks are associated with sample set L24889. Total mercury concentrations in these samples range from 0.00000024 to 0.00000800 mg/L or approximately 2 to 62 times the highest field blank concentration.
- Total chromium (analyzed by low-level ICP-MS) was detected at concentrations of 0.000077, 0.00011, and 0.000085 mg/L in field blanks L24893-1 (S322), L24893-2 (B317), and L24893-3 (A320), respectively). These field blanks are associated with sample set L24889. Total chromium concentrations in these samples range from 0.00019 to 0.00141 mg/L or approximately 2 to 13 times the highest field blank concentration.

Laboratory Contamination

All laboratory blank results are less than the method detection limit.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exception.

- The 24% relative percent difference for one set of ICP dissolved potassium laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate dissolved potassium concentrations, however, are less than the reporting detection limit and very near the method detection limit. Associated dissolved potassium sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.

Sample Handling Issues

All analytical data for samples L24890-5 through -8, -21 through -27, -31, and -32 and L24891-11 have been flagged "H" because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

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Baseflow Sampling Event #1 – February 13 and 14, 2002

Samples L23007-1 through -16 and L23009-1 through -6 and -8 through -17

Field Blanks L23398-1 through -3 and L23399-1 through -4

Completeness

Total and dissolved vanadium have not been reported for sample set L23007. A total of 47 parameters (23 total metals, 23 dissolved metals, hardness) are reported for each sample in this set.

Total barium has not been reported for sample set L23009. A total of 48 parameters (23 total metals, 24 dissolved metals, hardness) are reported for each sample in this set.

Total barium has not been reported for field blank set L23398. A total of 23 total metals are reported for each field blank in this set.

Total antimony has not been reported for field blank set L23399. A total of 23 total metals are reported for each field blank in this set.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total mercury (analyzed by CVAF) was detected at a concentration of 0.00000010 mg/L in field blank L23398-3 (C317). This field blank is associated with sample set L23009. Total mercury concentrations in these samples range from 0.000000509 to 0.00000629 mg/L or approximately 5 to 63 times the field blank concentration.
- Total chromium (analyzed by low-level ICP-MS) was detected at concentrations of 0.000083, 0.000060, and 0.000079 mg/L in field blanks L23398-1 (0322), L23398-2 (Y320), and L23398-3 (C317), respectively. These field blanks are associated with sample set L23009. Total chromium concentrations in these samples range from 0.00013 to 0.000932 mg/L or approximately 1.5 to 11 times the highest field blank concentration.

Laboratory Contamination

Laboratory method blank results are less than the method detection limit with the following exceptions.

- Dissolved zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00016 mg/L in the filter blank associated with sample set L23009. All dissolved zinc results for these 16 samples are greater than 10 times the filter blank concentration so dissolved zinc sample data have not been flagged.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exception.

- The 32% relative percent difference for one set of ICP-MS total zinc laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate total zinc concentrations, however, are less than the reporting detection limit. Associated total zinc sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.

Sample Handling Issues

All analytical data for samples L23007-4, -7, and -10 and L23009-17 have been flagged "H" because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

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Baseflow Sampling Event #2 – March 25 and 26, 2002

**Samples L23472-1 through -16, L23473-1 through -12, and L23474-1 through -6
Field Blanks L23811-1 through -3 and L23814-2 and -3**

Completeness

Total and dissolved barium have not been reported for sample set L23472. A total of 47 parameters (23 total metals, 23 dissolved metals, hardness) are reported for each sample in this set.

Data are 100% complete for sample sets L23473 and L23474 with 49 parameters reported for each sample (24 total metals, 24 dissolved metals, hardness).

Total barium has not been reported for field blank set L23811. A total of 23 total metals are reported for each field blank in this set.

Data are 100% complete for field blank set L23814 with 24 total metals reported for each field blank.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total mercury (analyzed by CVAF) was detected at concentrations of 0.00000028 and 0.00000011 mg/L in field blanks L23811-2 (A307) and L23811-3 (B322), respectively. These field blanks are associated with sample set L23472. Total mercury concentrations in these samples range from 0.00000101 to 0.00000398 mg/L or approximately 4 to 14 times the highest field blank concentration.
- Total chromium (analyzed by low-level ICP-MS) was detected at concentrations of 0.000051 and 0.000057 mg/L in field blanks L23811-2 (A307) and L23811-3 (B322), respectively. These field blanks are associated with sample set L23472. Total chromium concentrations in these samples range from 0.00018 to 0.000597 mg/L or approximately 3.5 to 12 times the highest field blank concentration.
- Total copper (analyzed by low-level ICP-MS) was detected at a concentration of 0.00039 in field blank L23811-1 (A341). This field blank is associated with sample set L23472. Total copper concentrations in these samples range from 0.00019 to 0.00185 mg/L or approximately 0.5 to 5 times the field blank concentration.
- Total zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00017 in field blank L23811-1 (A341). This field blank is associated with sample set L23472. Total zinc concentrations in these samples range from 0.00039 to 0.0195 mg/L or approximately 2 to 115 times the field blank concentration.

Laboratory Contamination

Laboratory method blank results are less than the method detection limit with the following exceptions.

- Dissolved chromium (analyzed by low-level ICP-MS) was detected at a concentration of 0.000074 mg/L in the filter blank associated with sample set L23472. Dissolved chromium sample results that are less than ten times the filter blank concentration have been flagged “B” (all samples in this set). Dissolved chromium results for these 16 samples should be considered “less than the method detection limit” with the associated numeric method detection limit raised to 0.00074 mg/L.
- Dissolved zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00024 mg/L in the filter blank associated with sample set L23472. Dissolved zinc sample results that are less than ten times the filter blank concentration have been flagged “B” (samples L23472-1, -2, -3, -4, -5, -8, -9, -10, -11, -13, -14, and -16). Dissolved zinc results for these 12 samples should be considered “less than the method detection limit” with the associated numeric method detection limit raised to 0.0024 mg/L.

Accuracy, Precision, and Bias

All spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits.

Sample Handling Issues

All analytical data for samples L23473-1, -4, -7, and -10 have been flagged “H” because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

ICP-MS analytical data for samples L23472-1, -2, -4, and -14 have been flagged “H” because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

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Baseflow Sampling Event #3 – April 24 and 25, 2002

Samples L23944-1 through -16, L23945-1 through -12, and L23947-1 through -6

Field Blanks L24094-2 and -3 and L24095-1 through -4

Completeness

Total barium has not been reported for sample set L23944. A total of 48 parameters (23 total metals, 24 dissolved metals, hardness) are reported for each sample in this set.

Data are 100% complete for sample set L23945 with 49 parameters reported for each sample (24 total metals, 24 dissolved metals, hardness).

Total beryllium has not been reported for sample set L23947. A total of 48 parameters (23 total metals, 24 dissolved metals, hardness) are reported for each sample in this set.

Total barium has not been reported for field blank set L24094. A total of 23 total metals are reported for each field blank in this set.

Total beryllium has not been reported for field blank set L24095. A total of 23 total metals are reported for each field blank in this set.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total mercury (analyzed by CVAF) was detected at concentrations of 0.00000021 and 0.00000013 mg/L in field blanks L24094-2 (Y320) and L24094-3 (A320), respectively. These field blanks are associated with sample set L23944. Total mercury concentrations in these samples range from 0.00000122 to 0.0000127 mg/L or approximately 6 to 60 times the highest field blank concentration.
- Total chromium (analyzed by low-level ICP-MS) was detected at concentrations of 0.00019 and 0.00020 mg/L in field blanks L24094-2 (Y320) and L24094-3 (A320), respectively. These field blanks are associated with sample set L23944. Total chromium concentrations in these samples range from 0.00011 to 0.000767 mg/L or approximately 0.5 to 38 times the highest field blank concentration.
- Total cadmium (analyzed by ICP-MS) was detected at a concentration of 0.00105 mg/L in field blank L24095-2 (A307). This field blank is associated with samples L23945-1 through -3 (sequential autosampler). Total cadmium was not detected in these three samples.

Laboratory Contamination

Laboratory method blank results are less than the method detection limit with the following exception.

- Dissolved zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00023 mg/L in the filter blank associated with sample set L23944. Dissolved zinc sample results that are less than ten times the filter blank concentration have been flagged “B” (samples L23472-1, -2, -3, -4, -5, -7, -8, -11, -12, -14, and -16). Dissolved zinc results for these 11 samples should be considered “less than the method detection limit” with the associated numeric method detection limit raised to 0.0023 mg/L.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exceptions.

- The 31% relative percent difference for one set of ICP-MS dissolved manganese laboratory duplicate results exceeds the control limit of 20%. Dissolved manganese results for the only associated sample, L23944-3, should be considered estimated.
- The 143% recovery for one ICP-MS total aluminum matrix spike exceeds the upper control limit of 120%. This matrix spike is associated with sample set L23945. Total aluminum results for these 12 samples may be biased high.
- The 150% recovery for one low-level ICP-MS total zinc matrix spike exceeds the upper control limit of 120%. This matrix spike is associated with sample set L23944. Total zinc results for these 16 samples may be biased high.

Sample Handling Issues

All analytical data for samples L23945-1, -4, -7, and -10 have been flagged “H” because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

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Baseflow Sampling Event #4 – June 12 and 13, 2002

**Samples L24475-1 through -16, L24476-1 through -12, and L24477-1 through -6
Field Blanks L24400-1 through -4**

Completeness

Total beryllium has not been reported for sample set L24475. A total of 50 parameters (24 total metals, 25 dissolved metals, hardness) are reported for each sample in this set. Total and dissolved strontium are reported for this sampling event.

Data are 100% complete for sample sets L24476 and L24477 with 51 parameters reported for each sample (25 total metals, 25 dissolved metals, hardness). Total and dissolved strontium are reported for this sampling event.

Data are 100% complete for field blank set L24400. A total of 25 total metals are reported for each field blank, including total strontium.

Field Contamination

All field blank results are less than the method detection limit.

Laboratory Contamination

Laboratory method blank results are less than the method detection limit with the following exceptions.

- Dissolved chromium (analyzed by low-level ICP-MS) was detected at a concentration of 0.000056 mg/L in the filter blank associated with sample set L24475. Dissolved chromium sample results that are less than ten times the filter blank concentration have been flagged “B” (all samples in this set). Dissolved chromium results for these 16 samples should be considered “less than the method detection limit” with the associated numeric method detection limit raised to 0.00056 mg/L.
- Dissolved zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00024 mg/L in the filter blank associated with sample set L24475. Dissolved zinc sample results that are less than ten times the filter blank zinc concentration have been flagged “B” (samples L24475-1, -2, -3, -4, -8, -9, -12, -13, and -16). Dissolved zinc results for these nine samples should be considered “less than the method detection limit” with the associated numeric method detection limit raised to 0.0024 mg/L.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exception.

- The 143% recovery for one ICP-MS dissolved strontium matrix spike exceeds the upper control limit of 120%. This matrix spike is associated with sample set L24475. Dissolved strontium results for these 16 samples may be biased high.

Sample Handling Issues

All analytical data for samples L24476-1, -4, -7, and -10 have been flagged “H” because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

Mercury (CVAA) analytical data for samples L24476-1 through -12 and L24477-1 through -6 and field blanks L24400-1 through -4 have been flagged "H" because sample analysis was not completed within the recommended 28-day hold time.

ICP analytical data for sample L24475-15 have been flagged "H" because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 6-month hold time.

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Baseflow Sampling Event #5 – August 6 and 7, 2002

Samples L25054-1 through -3, -5 through -9, and -11 through -16, L25055-1 through -6, and L25056-1, -2, and -4 through -6

Field Blanks L25057-1 through -3 and L25058-1 and -3

Completeness

Data are 100% complete with 49 parameters reported for each sample (24 total metals, 24 dissolved metals, hardness) and 24 total metals reported for each field blank.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total chromium (analyzed by low-level ICP-MS) was detected at concentrations of 0.00014, 0.00011, and 0.00011 mg/L in field blanks L25057-1 (0322), L25057-2 (B317), and L25057-3 (A320), respectively. These field blanks are associated with sample set L25054. Total chromium concentrations in these samples range from 0.000082 to 0.000564 mg/L or approximately 0.5 to 4 times the highest field blank concentration.

Laboratory Contamination

Laboratory method blank results are less than the method detection limit with the following exception.

- Dissolved zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00029 mg/L in the filter blank associated with sample set L25054. Dissolved zinc sample results that are less than ten times the filter blank concentration have been flagged "B" (samples L25054-1, -2, -3, -6, -7, -9, -12, -13, -14, and -15). Dissolved zinc results for these 10 samples should be considered "less than the method detection limit" with the associated numeric method detection limit raised to 0.0029 mg/L.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exception.

- The 149% recovery for one ICP-MS total manganese matrix spike exceeds the upper control limit of 120%. This matrix spike is associated with samples L25054-1 through -3 and -5 through -9. Total manganese results for these eight samples may be biased high.
- The 132% recovery for a second ICP-MS total manganese matrix spike also exceeds the upper control limit of 120%. This matrix spike is associated with sample sets L25055 and L25056. Total manganese results for these 11 samples may be biased high.

Sample Handling Issues

All analytical data for samples L25055-1 and -4 have been flagged "H" because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.



Baseflow Sampling Event #6 – October 22 and 23, 2002

Samples L25933-1, -4 through -12, -14, and -16 through -18, L25934-1 through -10, and L25935-3 through -6

Field Blanks L25933-19 through -21 and L25934-13 through -16

Completeness

Data are 100% complete with 49 parameters reported for each sample (24 total metals, 24 dissolved metals, hardness) and 24 total metals reported for each field blank.

Field Contamination

Field blank results are less than the method detection limit with the following exceptions.

- Total chromium (analyzed by low-level ICP-MS) was detected at concentrations of 0.000078, 0.000095, and 0.00013 mg/L in field blanks L25933-19 (E319), L25933-20 (B317), and L25933-21 (F321), respectively. These field blanks are associated with sample set L25933. Total chromium concentrations in these samples range from 0.000056 to 0.00018 mg/L or approximately 0.5 to 2 times the highest field blank concentration.

Laboratory Contamination

Laboratory method blank results are less than the method detection limit with the following exceptions.

- Dissolved calcium (analyzed by ICP) was detected at a concentration of 0.053 in the filter blank associated with sample set L25933. All dissolved calcium results for these 14 samples are greater than 10 times the filter blank concentration so dissolved calcium sample data have not been flagged.
- Dissolved zinc (analyzed by low-level ICP-MS) was detected at a concentration of 0.00021 mg/L in the filter blank associated with sample set L25933. Dissolved zinc sample results that are less than ten times the filter blank concentration have been flagged "B" (samples L25933-1, -5, -6, -7, -8, -9, -10, -12, -14, -16, -17, and -18). Dissolved zinc results for these 12 samples should be considered "less than the method detection limit" with the associated numeric method detection limit raised to 0.0021 mg/L.

Accuracy, Precision, and Bias

Spike blank, laboratory control sample, standard reference material, matrix spike, and laboratory duplicate results are within established control limits with the following exception.

- The 26% relative percent difference for one set of ICP-MS total zinc laboratory duplicate results exceeds the control limit of 20%. Both sample and laboratory duplicate total zinc concentrations, however, are less than the reporting detection limit. Associated total zinc sample data have not been flagged based on laboratory duplicate results, due to the inherent variability of results at or near the limit of detection.

Sample Handling Issues

All analytical data for samples L25934-1, -4, and -7 have been flagged "H" because sample preservation (total and dissolved metals) and filtration (dissolved metals) was not completed within the recommended 24-hour hold time.

MAY 8 2003

Technical Memorandum

Date: January 31, 2003**To:** Doug Henderson
Jim Simmonds**From:** Scott Mickelson **Subj:** Data Analysis for Trace Organic Compounds
Green/Duwamish Water Quality Assessment

I've completed analysis of trace organics data associated with fresh and storm water samples collected for the Green/Duwamish Water Quality Assessment (G/DWQA). This analysis is based on data downloaded from LIMS as of January 28, 2003 and represents four baseflow or ambient sampling events, collected in February, May, August, and November 2002, and two storm sampling events, collected in June and November 2002. The following narrative includes discussions of data quality, detected compounds by analytical category, and detected compounds by sampling station.

The attached Excel[®] spreadsheets summarize all G/DWQA trace organics data and include the following information:

- compound name;
- method detection limit, MDL, which is the *average* MDL for all samples;
- number of samples, N(T), which is the *total* number of samples;
- number of samples, N(S), which is the number of *storm* samples;
- frequency of detection, FOD(T), for the total number of samples;
- frequency of detection, FOD(S), for storm samples;
- minimum, maximum, mean, and median concentrations, and standard deviation; and
- ambient (AWQC) and chronic (CWQC) water quality criteria from Chapter 173-201A WAC.

Detected chemicals are highlighted in yellow on the spreadsheet and water quality criteria that are exceeded, either by a detected concentration or an average MDL, are printed in red. The MDL values for four phthalate compounds are highlighted in green and the range of values represent blank-corrected MDLs. The following section on data quality will describe the blank correction process.

Data Quality

Data quality was evaluated by reviewing laboratory quality control (QC) results for method blanks, spike blanks, matrix spikes, matrix spike duplicates, and surrogates.

- A method blank is an aliquot of clean reference matrix (reagent water for this study) that is carried through the entire analytical process. It is used as an indicator of laboratory contamination imparted to the sample during processing and/or analysis. Contamination is indicated by a positive result for an analyte. Four phthalate compounds were detected in every

method blank; Benzyl Butyl Phthalate, Bis(2-ethylhexyl) Phthalate, Diethyl Phthalate, and Di-N-butyl Phthalate.

- A spike blank is a known concentration of target analyte(s) introduced into clean reference matrix (reagent water) and then carried through the entire analytical process. It is used as an indicator of analytical method performance. Performance is indicated by percent recovery of the introduced target analyte(s). The recovery of 2,4-Dinitrotoluene in two spike blanks, associated with storm samples collected June 28, 2002 and baseflow samples collected February 26, 2002, was greater than the upper control limit, possibly indicating a high bias for this compound. 2,4-Dinitrotoluene, however, was not detected in any samples. The recovery of N-Nitrosodi-N-propylamine in the spike blank associated with baseflow samples collected August 6, 2002 was greater than the upper control limit. This compound was also not detected in any samples.
- A matrix spike/matrix spike duplicate is a known concentration of target analyte(s) introduced into a second and third sample aliquot prior to processing. These QC samples are used as an indicator of both sample matrix effect and as an indicator of method performance. Performance is indicated both by percent recovery of target analytes and relative percent difference in matrix spike/matrix spike duplicate results. The recovery of 2,4-Dinitrotoluene in two matrix spikes and matrix spike duplicates, associated with storm samples collected June 28, 2002 and baseflow samples collected February 26, 2002, was greater than the upper control limit, again possibly indicating a high bias for this compound. The recovery of 1,2,4-Trichlorobenzene in one matrix spike duplicate, associated with storm samples collected November 7, 2002, was greater than the upper control limit. This compound, however, was not detected in any samples. Calculated relative percent difference values for all matrix spike/matrix spike duplicate pairs indicate acceptable method performance for all samples in this study.
- Surrogates are non-target analytes added to each sample prior to processing. They are used as a sample-specific indicator of both matrix and method bias for target compounds. Performance is indicated by percent recovery of the surrogate compounds. With the exception of one sample, all surrogate recoveries were within method control limits. The recovery of one of four surrogate compounds, d5-Nitrobenzene, in one replicate baseflow sample collected August 6, 2002 from station A310 exceeded the upper control limit by 1%. No data were qualified based on this surrogate recovery.

The King County Environmental Laboratory routinely qualifies sample results that may have been impacted by laboratory contamination, indicated by positive method blank results. Sample results for an analyte that are less than five times the analyte concentration detected in the associated method blank are flagged "B." Accepted data validation practices (EPA 1991) raise the method detection limit (MDL) for all affected samples to five times the method blank analyte concentration and consider these sample results "undetected." It is also common practice to use a MDL adjustment of "ten times the method blank concentration" for common laboratory contaminants such as phthalates. That approach has been used in this data analysis.

- Benzyl Butyl Phthalate was detected in every method blank at concentrations ranging from 0.058 to 0.20 µg/L. Based on these method blank results, the MDL for this compound was raised to 0.58 to 2.0 µg/L and, as a result, all Benzyl Butyl Phthalate sample results are considered "undetected."
- Bis(2-ethylhexyl) Phthalate was detected in every method blank at concentrations ranging from 0.26 to 2.3 µg/L. Based on these method blank results, the MDL for this compound was raised

to 2.6 to 23 µg/L and, as a result, all Bis(2-ethylhexyl) Phthalate sample results are considered “undetected.”

- Diethyl Phthalate was detected in every method blank at concentrations ranging from 0.017 to 0.027 µg/L. Based on these method blank results, the MDL for this compound was raised to 0.17 to 0.27 µg/L and, as a result, all but two Diethyl Phthalate sample results are considered “undetected.” Diethyl Phthalate concentrations of 0.236 and 0.270 µg/L were reported for two samples that were associated with a method blank, for which the Diethyl Phthalate concentration was reported as 0.021 µg/L. For data validation purposes, these two sample concentrations are greater than the adjusted MDL of 0.21 µg/L. The sample results, however, are less than the highest adjusted MDL for this compound and should be viewed in light of this information.
- Di-N-butyl Phthalate was detected in every method blank at concentrations ranging from 0.043 to 0.85 µg/L. Based on these method blank results, the MDL for this compound was raised to 0.43 to 0.85 µg/L and, as a result, all Di-N-butyl Phthalate sample results are considered “undetected.”

Detected Chemicals by Analytical Category

The following section discusses detected trace organic chemicals and is organized into the following analytical categories: base/neutral/acid extractable semivolatile compounds, chlorinated pesticides, herbicides, organophosphorus pesticides, and polychlorinated biphenyls.

Base/Neutral/Acid Extractable Semivolatile Compounds

Base/neutral/acid extractable semivolatile compound (BNA) analysis was performed on a total of 44 samples for the base/neutral fraction, of which 12 were collected during storm events. BNA analysis was performed on 36 samples for the acid fraction, of which 12 were collected during storm events. Analytes included 52 base/neutral compounds and 14 acid compounds and average method detection limits ranged from 0.010 to 1.6 µg/L. **Fourteen BNA compounds were detected in one or more samples.** The following table lists the compounds along with the frequency of detection, for both total samples and storm samples (FOD(T) and FOD(S)), and minimum and maximum concentrations.

Analyte	FOD(T)	FOD(S)	Min (µg/L)	Max (µg/L)
Acenaphthene	3/44	0/12	0.014	0.023
Anthracene	2/44	2/12	0.014	0.016
Benzo(b)fluoranthene	1/44	0/12	0.020	0.020
Benzo(k)fluoranthene	1/44	0/12	0.013	0.013
Caffeine	21/44	9/12	0.018	1.74
Carbazole	2/44	2/12	0.043	0.0526
Diethyl Phthalate	2/44	2/12	0.236	0.270
Dimethyl Phthalate	5/44	4/12	0.014	0.0714
Fluoranthene	9/44	5/12	0.010	0.273
Naphthalene	2/44	0/12	0.029	0.033
Pentachlorophenol	2/36	1/12	0.15	0.21
Phenanthrene	8/44	5/12	0.011	0.0265
Phenol	7/36	1/12	0.11	0.541
Pyrene	9/44	5/12	0.012	0.0330

A Washington State water quality criterion is available only for Pentachlorophenol and both acute and chronic criteria are pH-dependent. The Pentachlorophenol baseflow sample concentration of 0.15 µg/L, coupled with a sample pH of 7.1, should be compared to a chronic water quality criterion

of 0.61 µg/L. The Pentachlorophenol storm sample concentration of 0.21 µg/L, coupled with a sample pH of 6.6, should be compared to a chronic water quality criterion of 0.29 µg/L.

A brief synopsis of detected BNA compounds is provided below.

- Acenaphthene was detected three times, all in baseflow samples collected from station A317, on February 26, August 6, and November 25, 2002. Acenaphthene concentrations ranged from 0.014 to 0.023 µg/L, compared to an average MDL of 0.010 µg/L.
- Anthracene was detected twice, both times at station A315, in replicate storm samples collected on June 28, 2002. Anthracene concentrations ranged from 0.014 to 0.016 µg/L, compared to an average MDL of 0.010 µg/L.
- Benzo(b)fluoranthene was detected once, in a baseflow sample collected from station C317 on May 1, 2002. The Benzo(b)fluoranthene concentration of 0.020 µg/L compares to an average MDL of 0.010 µg/L.
- Benzo(k)fluoranthene was detected once, in a baseflow sample collected from station C317 on May 1, 2002. The Benzo(k)fluoranthene concentration of 0.013 µg/L compares to an average MDL of 0.010 µg/L.
- Caffeine was detected in 48% of all samples and 75% of storm samples. The two highest concentrations (1.41 and 1.74 µg/L) were detected in storm samples collected from stations A317 and C317 on November 7, 2002. Caffeine concentrations ranged from 0.018 to 1.74 µg/L, compared to an average MDL of 0.010 µg/L.
- Carbazole was detected twice, both times at station A315, in replicate storm samples collected on June 28, 2002. Carbazole concentrations ranged from 0.043 to 0.0526 µg/L, compared to an average MDL of 0.026 µg/L.
- Diethyl Phthalate was detected twice, at concentrations greater than the associated method blank-adjusted MDL, in storm samples collected June 28, 2002 from stations A317 and C317. Both of these concentrations are lower, however, than the highest method blank-adjusted MDL reported during this study and these results should be considered in light of that information.
- Dimethyl Phthalate was detected five times; twice in replicate storm samples collected June 28, 2002 from station A315, twice in replicate storm samples collected November 7, 2002 from station A310, and once in a baseflow sample collected August 6, 2002 from station 0322. Dimethyl Phthalate concentrations ranged from 0.014 to 0.0714 µg/L, compared to an average MDL of 0.010 µg/L.
- Fluoranthene was detected nine times; five times in storm samples collected June 28 and November 7, 2002 and four times in baseflow samples collected February 26, May 1, and November 25, 2002. Fluoranthene concentrations ranged from 0.010 to 0.0273 µg/L, compared to an average MDL of 0.010 µg/L. Fluoranthene was detected at four stations – A310, A315, A317, and C317 and was generally detected concurrently with Phenanthrene and Pyrene.
- Naphthalene was detected twice, once in a baseflow sample collected February 26, 2002 from station A317 and once in a baseflow sample collected November 25, 2002 from station A310. Naphthalene concentrations ranged from 0.029 to 0.033, compared to an average MDL of 0.026 µg/L.
- Pentachlorophenol was detected twice, once in a storm sample collected on November 7, 2002 and once in a baseflow sample collected on August 6, 2002, both from station A317. Pentachlorophenol concentrations ranged from 0.15 to 0.21 µg/L, compared to an average MDL of 0.13 µg/L.

- Phenanthrene was detected eight times; five times in storm samples collected June 28 and November 7, 2002 and three times in baseflow samples collected May 1 and November 25, 2002. Phenanthrene concentrations ranged from 0.011 to 0.0265 µg/L, compared to an average MDL of 0.010 µg/L. Phenanthrene was detected at four stations – A310, A315, A317, and C317, and was generally detected concurrently with Fluoranthene and Pyrene.
- Phenol was detected seven times; in one storm sample collected June 28, 2002 from station E319, in one baseflow sample collected August 6, 2002 from station 0322, and in five baseflow samples collected May 1, 2002 from stations 0322, A315, A317, A320, and C317. Phenol concentrations ranged from 0.11 to 0.541 µg/L compared to an average MDL of 0.10 µg/L.
- Pyrene was detected nine times; five times in storm samples collected June 28 and November 7, 2002 and four times in baseflow samples collected February 26, May 1, and November 25, 2002. Pyrene concentrations ranged from 0.012 to 0.0330 µg/L, compared to an average MDL of 0.010 µg/L. Pyrene was detected at four stations – A310, A315, A317, and C317, and was generally detected concurrently with Fluoranthene and Phenanthrene.

Chlorinated Pesticides

Chlorinated pesticide analysis was performed on a total of 56 samples, of which 24 were collected during storm events. Analytes included 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Aldrin, BHC (alpha-, beta-, delta-, and gamma-), Chlordane, Dieldrin, Endosulfan (I, II, and Sulfate), Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, Methoxychlor, and Toxaphene and average detection limits ranged from 0.0052 to 0.052 µg/L. **Endosulfan I was detected in one sample at a concentration of 0.0174 µg/L.** This chlorinated pesticide was detected in a sample collected from station A315 during the storm sampling event of June 28, 2002. All other chlorinated pesticide results were less than the method detection limit.

The Endosulfan I concentration of 0.0174 µg/L does not exceed the Washington State chronic water quality criterion of 0.056 µg/L for "Endosulfan." The following average method detection limits (MDL) exceed Washington State chronic water quality criteria (CWQC).

Analyte(s)	Avg. MDL (µg/L)	CWQC (µg/L)	Criterion Name
4,4'-DDD, 4,4'-DDE, 4,4'-DDT	0.0052	0.001	DDT (and metabolites)
Aldrin	0.0052	0.0019	Aldrin/Dieldrin
Chlordane	0.026	0.0043	Chlordane
Dieldrin	0.0052	0.0019	Dieldrin/Aldrin
Endrin, Endrin Aldehyde	0.0052	0.0023	Endrin
Heptachlor, Heptachlor Epoxide	0.0052	0.0038	Heptachlor
Toxaphene	0.052	0.0002	Toxaphene

Herbicides

Herbicide analysis was performed on a total of 27 samples, of which 11 were collected during storm events. Analytes included 2,4,5-T, 2,4,5-TP (Silvex), 2,4-D, 2,4-DB, Dalapon, Dicamba, Dichloroprop, Dinoseb, MCPA, and MCPP and average detection limits ranged from 0.014 to 0.056 µg/L. **2,4-D was detected in two samples at concentrations of 0.0894 and 0.0917 µg/L.** This herbicide was detected in samples collected from stations 0322 and A315 during the storm sampling event of June 28, 2002. All other herbicide results were less than the method detection limit.

There are no Washington State water quality criteria for herbicides.

Organophosphorus Pesticides

Organophosphorus pesticide analysis was performed on a total of 56 samples, of which 24 were collected during storm events. Analytes included Chlorpyrifos, Diazinon, Disulfoton, Malathion, Ethyl-parathion, Methyl-parathion, and Phorate and average detection limits ranged from 0.028 to 0.050 µg/L. **All organophosphorus pesticide results were less than the method detection limit.**

The average method detection limits of 0.047 and 0.037 µg/L for, respectively, Ethyl-parathion and Methyl-parathion exceed the Washington State chronic water quality criterion of 0.013 µg/L for "Parathion."

Polychlorinated Biphenyls

Polychlorinated biphenyl (PCB) analysis was performed on a total of 56 samples, of which 24 were collected during storm events. Analytes included Aroclors[®] 1016, 1221, 1232, 1242, 1248, 1254, and 1260 and the average detection limit for each was 0.052 µg/L. **All PCB results were less than the method detection limit.**

The average Aroclor[®] method detection limit of 0.052 µg/L exceeds the Washington State chronic water quality criterion of 0.014 µg/L for "Polychlorinated Biphenyls (PCBs)."

Detected Chemicals by Sampling Station

The following section discusses detected chemicals organized by sampling station.

Station 0322 – Newaukum Creek

- 2,4-D was detected once, at a concentration of 0.0894 µg/L, in a storm sample collected June 28, 2002.
- Caffeine was detected twice, at concentrations of 0.0598 and 0.0503 µg/L, in, respectively, a storm sample collected June 28, 2002 and a baseflow sample collected August 6, 2002.
- Dimethyl Phthalate was detected once, at a concentration of 0.014 µg/L, in a baseflow sample collected August 6, 2002.
- Phenol was detected twice, at concentrations of 0.12 and 0.541 µg/L, in baseflow samples collected, respectively, May 1 and August 6, 2002.

Station A310 – Green River (Fort Dent Park)

- Caffeine was detected three times, at concentrations of 0.0408, 0.156, and 0.170 µg/L, in storm samples collected, respectively, June 28, 2002 and November 7, 2002 (replicate samples).
- Dimethyl Phthalate was detected twice, at concentrations of 0.0432 and 0.0407 µg/L, in replicate storm samples collected November 7, 2002.
- Fluoranthene was detected once, at a concentration of 0.012 µg/L, in a storm sample collected June 28, 2002.
- Naphthalene was detected once, at a concentration of 0.033 µg/L, in a baseflow sample collected November 25, 2002.
- Phenanthrene was detected once, at a concentration of 0.011 µg/L, in a storm sample collected June 28, 2002.
- Pyrene was detected once, at a concentration of 0.012 µg/L, in a storm sample collected June 28, 2002.

Station A315 – Mill Creek

- 2,4-D was detected once, at a concentration of 0.0917 µg/L, in a storm sample collected June 28, 2002.
- Anthracene was detected twice, at concentrations of 0.014 and 0.016 µg/L, in replicate storm samples collected June 28, 2002.
- Caffeine was detected five times, at concentrations of 0.425 and 0.485 µg/L, in replicate storm samples collected June 28, 2002 and, at concentrations of 0.0462, 0.018, and 0.132 µg/L, in baseflow samples collected, respectively, February 26, May 1, and August 6, 2002.
- Carbazole was detected twice, at concentrations of 0.043 and 0.0526 µg/L, in replicate storm samples collected June 28, 2002.
- Dimethyl Phthalate was detected twice, at concentrations of 0.0618 and 0.0714 µg/L, in replicate storm samples collected June 28, 2002.
- Endosulfan I was detected once, at a concentration of 0.0174 µg/L, in one of two replicate storm samples collected June 28, 2002.
- Fluoranthene was detected twice, at concentrations of 0.012 and 0.017 µg/L, in replicate storm samples collected June 28, 2002.
- Phenanthrene was detected twice, at concentrations of 0.024 and 0.0265 µg/L, in replicate storm samples collected June 28, 2002.
- Phenol was detected once, at a concentration of 0.13 µg/L, in a baseflow sample collected May 1, 2002.
- Pyrene was detected twice, at concentrations of 0.016 and 0.018 µg/L, in replicate storm samples collected June 28, 2002.

Station A317 – Springbrook Creek

- Acenaphthene was detected three times, at concentrations of 0.014, 0.023, and 0.018 µg/L, in baseflow samples collected, respectively, February 26, August 6, and November 25, 2002.
- Caffeine was detected five times, at a concentration of 1.41 µg/L, in a storm sample collected November 7, 2002 and, at concentrations of 0.0661, 0.0271, 0.0397, and 0.0819 µg/L, in baseflow samples collected, respectively, February 26, May 1, August 6, and November 25, 2002.
- Diethyl Phthalate was detected once (above blank-adjusted method detection limits), at a concentration of 0.236 µg/L, in a storm sample collected November 7, 2002.
- Fluoranthene was detected twice, at a concentration of 0.017 µg/L, in a storm sample collected November 7, 2002 and, at a concentration of 0.010 µg/L, in a baseflow sample collected February 26, 2002.
- Naphthalene was detected once, at a concentration of 0.029 µg/L, in a baseflow sample collected February 26, 2002.
- Pentachlorophenol was detected twice, at a concentration of 0.21 µg/L, in a storm sample collected November 7, 2002 and, at a concentration of 0.15 µg/L, in a baseflow sample collected August 6, 2002.
- Phenanthrene was detected twice, at a concentration of 0.018 µg/L, in a storm sample collected November 7, 2002 and, at a concentration of 0.012 µg/L, in a baseflow sample collected November 25, 2002.
- Phenol was detected once, at a concentration of 0.14 µg/L, in a baseflow sample collected May 1, 2002.

- Pyrene was detected twice, at a concentration of 0.0269 µg/L, in a storm sample collected November 7, 2002 and, at a concentration of 0.014 µg/L, in a baseflow sample collected February 26, 2002.

Station A320 – Soos Creek

- Caffeine was detected once, at a concentration of 0.0349 µg/L, in a storm sample collected June 28, 2002.
- Phenol was detected once, at a concentration of 0.37 µg/L, in one of a pair of replicate baseflow samples collected May 1, 2002.

Station C317 – Black River Pump Station

- Benzo(b)fluoranthene was detected once, at a concentration of 0.020 µg/L, in a baseflow sample collected May 1, 2002.
- Benzo(k)fluoranthene was detected once, at a concentration of 0.013 µg/L, in a baseflow sample collected May 1, 2002.
- Caffeine was detected five times, at a concentration of 1.74 µg/L, in a storm sample collected November 7, 2002 and, at concentrations of 0.0602, 0.0274, 0.0331, and 0.0748 µg/L, in baseflow samples collected, respectively, February 26, May 1, August 6, and November 25, 2002.
- Diethyl Phthalate was detected once (above blank-adjusted method detection limits), at a concentration of 0.270 µg/L, in a storm sample collected November 7, 2002.
- Fluoranthene was detected four times, at a concentration of 0.018 µg/L, in a storm sample collected November 7, 2002 and, at concentrations of 0.012, 0.0273, and 0.011 µg/L, in baseflow samples collected, respectively, February 26, May 1, and November 25, 2002.
- Phenanthrene was detected three times, at a concentration of 0.021 µg/L, in a storm sample collected November 7, 2002 and, at concentrations of 0.018 and 0.011 µg/L, in baseflow samples collected, respectively, May 1 and November 25, 2002.
- Phenol was detected once, at a concentration of 0.11 µg/L, in a baseflow sample collected May 1, 2002.
- Pyrene was detected four times, at a concentration of 0.033 µg/L, in a storm sample collected November 7, 2002 and, at concentrations of 0.018, 0.0313, and 0.015 µg/L, in baseflow samples collected, respectively, February 26, May 1, and November 25, 2002.

Station E319 – Green River (Howard Hansen Dam)

- Phenol was detected once, at a concentration of 0.11 µg/L, in a storm sample collected November 7, 2002.

Reference

EPA 1991. *National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration (OLM01.0) and Low Concentration Water (OLC01.0)*. United States Environmental Protection Agency. Washington, D.C.

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Should you have any questions regarding this data analysis, please let me know. All sample data are also available electronically, QC data are available in hard copy only.

Attachment (Excel® Spreadsheets)

Data Analysis for Organic Compounds (all values in µg/L)

BNA Compounds	MDL	N(T)	N(S)	FOD(T)	FOD(S)	MIN	MAX	MEAN	MED	STDEV	AWQC	CWQC
1,2,4-Trichlorobenzene	0.010	44	12	0	0							
1,2-Dichlorobenzene	0.053	44	12	0	0							
1,3-Dichlorobenzene	0.053	44	12	0	0							
1,4-Dichlorobenzene	0.053	44	12	0	0							
2,4,5-Trichlorophenol	0.13	36	12	0	0							
2,4,6-Trichlorophenol	0.053	36	12	0	0							
2,4-Dichlorophenol	0.010	36	12	0	0							
2,4-Dimethylphenol	1.6	36	12	0	0							
2,4-Dinitrophenol	1.0	36	12	0	0							
2,4-Dinitrotoluene	0.053	44	12	0	0							
2,6-Dinitrotoluene	0.053	44	12	0	0							
2-Chloronaphthalene	0.010	44	12	0	0							
2-Chlorophenol	0.10	36	12	0	0							
2-Methylnaphthalene	0.10	44	12	0	0							
2-Methylphenol	0.27	36	12	0	0							
2-Nitroaniline	0.10	44	12	0	0							
2-Nitrophenol	0.053	36	12	0	0							
3,3'-Dichlorobenzidine	0.79	44	12	0	0							
3-Nitroaniline	0.53	44	12	0	0							
4,6-Dinitro-O-cresol	1.0	36	12	0	0							
4-Bromophenyl Phenyl Ether	0.026	44	12	0	0							
4-Chloro-3-methylphenol	0.27	36	12	0	0							
4-Chloroaniline	0.26	44	12	0	0							
4-Chlorophenyl Phenyl Ether	0.026	44	12	0	0							
4-Methylphenol	0.27	36	12	0	0							
4-Nitroaniline	0.53	44	12	0	0							
4-Nitrophenol	0.53	36	12	0	0							
Acenaphthene	0.010	44	12	7% (3/44)	0	0.014	0.023	0.018	0.018	0.005		
Acenaphthylene	0.010	44	12	0	0							
Anthracene	0.010	44	12	5% (2/44)	17% (2/12)	0.014	0.016	0.015	0.015	0.001		
Benzo(a)anthracene	0.026	44	12	0	0							
Benzo(a)pyrene	0.010	44	12	0	0							
Benzo(b)fluoranthene	0.010	44	12	2% (1/44)	0	0.020	0.020	0.020	0.020	0		
Benzo(g,h,i)perylene	0.059	44	12	0	0							
Benzo(k)fluoranthene	0.010	44	12	2% (1/44)	0	0.013	0.013	0.013	0.013	0		
Benzyl Butyl Phthalate	0.58 - 2.0	44	12	0	0							
Bis(2-chloroethoxy) Methane	0.010	44	12	0	0							
Bis(2-chloroethyl) Ether	0.010	44	12	0	0							
Bis(2-chloroisopropyl) Ether	0.010	44	12	0	0							
Bis(2-ethylhexyl) Phthalate	2.6 - 23	44	12	0	0							
Caffeine	0.010	44	12	48% (21/44)	75% (9/12)	0.018	1.74	0.258	0.063	0.462		
Carbazole	0.026	44	12	5% (2/44)	17% (2/12)	0.043	0.0526	0.048	0.048	0.007		
Chrysene	0.026	44	12	0	0							
Dibenzo(a,h)anthracene	0.053	44	12	0	0							
Dibenzofuran	0.010	44	12	0	0							
Diethyl Phthalate	0.17 - 0.27	44	12	5% (2/44)	17% (2/12)	0.236	0.270	0.253	0.253	0.024		
Dimethyl Phthalate	0.010	44	12	11% (5/44)	33% (4/12)	0.014	0.0714	0.0462	0.0432	0.0221		
Di-N-butyl Phthalate	0.43 - 0.85	44	12	0	0							
Di-N-octyl Phthalate	0.010	44	12	0	0							
Fluoranthene	0.010	44	12	20% (9/44)	42% (5/12)	0.010	0.0273	0.015	0.012	0.005		
Fluorene	0.010	44	12	0	0							
Hexachlorobenzene	0.026	44	12	0	0							
Hexachlorobutadiene	0.053	44	12	0	0							
Hexachloroethane	0.026	44	12	0	0							
Indeno(1,2,3-c,d)pyrene	0.059	44	12	0	0							
Isophorone	0.010	44	12	0	0							
Naphthalene	0.026	44	12	5% (2/44)	0	0.029	0.033	0.031	0.031	0.003		
Nitrobenzene	0.010	44	12	0	0							
N-Nitrosodimethylamine	0.026	44	12	0	0							
N-Nitrosodi-N-propylamine	0.10	44	12	0	0							
N-Nitrosodiphenylamine	0.26	44	12	0	0							
Pentachlorophenol	0.13	36	12	6% (2/36)	8% (1/12)	0.15	0.21	0.18	0.18	0.04	0.59,0.84	0.29,0.61
Phenanthrene	0.010	44	12	18% (8/44)	42% (5/12)	0.011	0.0265	0.018	0.018	0.006		
Phenol	0.10	36	12	19% (7/36)	8% (1/12)	0.11	0.541	0.22	0.14	0.17		
Pyrene	0.010	44	12	20% (9/44)	42% (5/12)	0.012	0.0330	0.020	0.018	0.008		

Green/Duwamish Water Quality Assessment
Data Analysis for Organic Compounds (all values in µg/L)

Chlorinated Pesticides	MDL	N(T)	N(S)	FOD(T)	FOD(S)	MIN	MAX	MEAN	MED	STDEV	AWQC	CWQC
4,4'-DDD	0.0052	56	24	0	0						1.1	0.001
4,4'-DDE	0.0052	56	24	0	0						1.1	0.001
4,4'-DDT	0.0052	56	24	0	0						1.1	0.001
Aldrin	0.0052	56	24	0	0						2.5	0.0019
Alpha-BHC	0.0052	56	24	0	0							
Beta-BHC	0.0052	56	24	0	0							
Chlordane	0.026	56	24	0	0						2.4	0.0043
Delta-BHC	0.0052	56	24	0	0							
Dieldrin	0.0052	56	24	0	0						2.5	0.0019
Endosulfan I	0.0052	56	24	2% (1/56)	4% (1/24)	0.0174	0.0174	0.0174	0.0174	0	0.22	0.056
Endosulfan II	0.0052	56	24	0	0						0.22	0.056
Endosulfan Sulfate	0.0052	56	24	0	0						0.22	0.056
Endrin	0.0052	56	24	0	0						0.18	0.0023
Endrin Aldehyde	0.0052	56	24	0	0						0.18	0.0023
Gamma-BHC (Lindane)	0.0052	56	24	0	0						2.0	0.08
Heptachlor	0.0052	56	24	0	0						0.52	0.0038
Heptachlor Epoxide	0.0052	56	24	0	0						0.52	0.0038
Methoxychlor	0.026	56	24	0	0							
Toxaphene	0.052	56	24	0	0						0.73	0.0002

Data Analysis for Organic Compounds (all values in µg/L)

Herbicides	MDL	N(T)	N(S)	FOD(T)	FOD(S)	MIN	MAX	MEAN	MED	STDEV	AWQC	CWQC
2,4,5-T	0.056	27	11	0	0							
2,4,5-TP (Silvex)	0.028	27	11	0	0							
2,4-D	0.028	27	11	7% (2/27)	18% (2/11)	0.0894	0.0917	0.0906	0.0906	0.0016		
2,4-DB	0.053	27	11	0	0							
Dalapon	0.019	27	11	0	0							
Dicamba	0.026	27	11	0	0							
Dichloroprop	0.014	27	11	0	0							
Dinoseb	0.030	27	11	0	0							
MCPA	0.017	27	11	0	0							
MCPP	0.014	27	11	0	0							

Green/Duwamish Water Quality Assessment
Data Analysis for Organic Compounds (all values in µg/L)

Organophosphorus Pest.	MDL	N(T)	N(S)	FOD(T)	FOD(S)	MIN	MAX	MEAN	MED	STDEV	AWQC	CWQC
Chlorpyrifos	0.035	56	22	0	0						0.083	0.041
Diazinon	0.045	56	22	0	0							
Disulfoton	0.028	56	22	0	0							
Malathion	0.050	56	22	0	0							
Parathion-Ethyl	0.047	56	22	0	0						0.065	0.013
Parathion-Methyl	0.037	56	22	0	0						0.065	0.013
Phorate	0.034	56	22	0	0							

Data Analysis for Organic Compounds (all values in µg/L)

PCB Aroclors	MDL	N(T)	N(S)	FOD(T)	FOD(S)	MIN	MAX	MEAN	MED	STDEV	AWQC	CWQC
Aroclor 1016	0.052	56	24	0	0						2.0	0.014
Aroclor 1221	0.052	56	24	0	0						2.0	0.014
Aroclor 1232	0.052	56	24	0	0						2.0	0.014
Aroclor 1242	0.052	56	24	0	0						2.0	0.014
Aroclor 1248	0.052	56	24	0	0						2.0	0.014
Aroclor 1254	0.052	56	24	0	0						2.0	0.014
Aroclor 1260	0.052	56	24	0	0						2.0	0.014

