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Surface Water Monitoring Program for Pesticides in Salmonid-Bearing Streams, 2013 Data Summary

A Cooperative Study by the Washington State Departments of Agriculture and Ecology

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Summary:

In 2003, the Washington State Departments of Agriculture and Ecology began a multi-year monitoring program to characterize pesticide concentrations in selected salmon-bearing streams during the typical pesticide application season (March – September) in Washington.

Monitoring in 2013 was conducted in seven WRIA's[1], five agricultural and two urban basins, for a total of 17 sample sites:

Agricultural basins:

- WRIA 1, Nooksack basin representing berry agriculture: Upper Bertrand Creek and Lower Bertrand Creek
- WRIA 3, Lower Skagit-Samish basin representing western Washington rotational agriculture: Indian Slough, Browns Slough, Samish River, Upper Big Ditch, and Lower Big Ditch
- WRIA 37, Lower Yakima basin representing irrigated agriculture: Marion Drain, Sulphur Creek Wasteway, and Spring Creek
- WRIA 40, Alkali-Squilchuck representing tree fruit agriculture: Stemilt Creek
- WRIA 45, Wenatchee basin representing tree fruit agriculture: Peshastin Creek, Mission Creek, Brender Creek, and Wenatchee River

Urban basins:

- WRIA 8, Cedar-Sammamish basin, representing urban land use: Thornton Creek
- WRIA 9, Green-Duwamish basin, representing urban land use: Longfellow Creek

This report summarizes data collected during the 2013 monitoring season. In 2013, surface water samples were analyzed for 174 pesticides and pesticide-related compounds including 68 insecticides, 60 herbicides, 34 pesticide degradates, 9 fungicides, 2 pesticide synergists, 1 wood preservative, as well as total suspended solids (TSS). Field measurements were also collected for streamflow, temperature, pH, dissolved oxygen, and conductivity at all site visits.

[1] Water Resource Inventory Area

Introduction:

The Washington State Departments of Agriculture (WSDA) and Ecology (Ecology) began a multi-year monitoring study to evaluate pesticide concentrations in surface waters in 2003. The study assesses pesticide-presence in salmon-bearing streams during the typical pesticide use season (March through September) in Washington State.

The data generated by the monitoring program is used by WSDA, the U.S. Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service, and the U.S. Fish and Wildlife Service (USFWS) to refine exposure assessments for pesticides registered for use in Washington State. Understanding the fate and transport of pesticides allows regulators to assess the potential effects of pesticides on endangered salmon species while minimizing the economic impacts to agriculture.

The purpose of this data report is to provide results from monitoring conducted in 2013, document changes in the monitoring program during the year, and provide a basis for potential modifications to the program in upcoming years.

Study Area:

This pesticide monitoring program has been ongoing since 2003. As the project progressed, additional sampling areas have been added. Additions for the 2013 monitoring season included two new monitoring sites in the Nooksack basin (WRIA 1), and one new monitoring site in the Alkali-Squilchuck basin (WRIA 40). The 2013 season also saw the removal of one monitoring site, Entiat River, in the Entiat Basin (WRIA 46) due to high streamflow and a low number of detections since the site was included in the program in 2007. The monitoring site in the Alkali-Squilchuck basin (Stemilt Creek) replaced the Entiat River as a site representative of tree fruit agriculture.

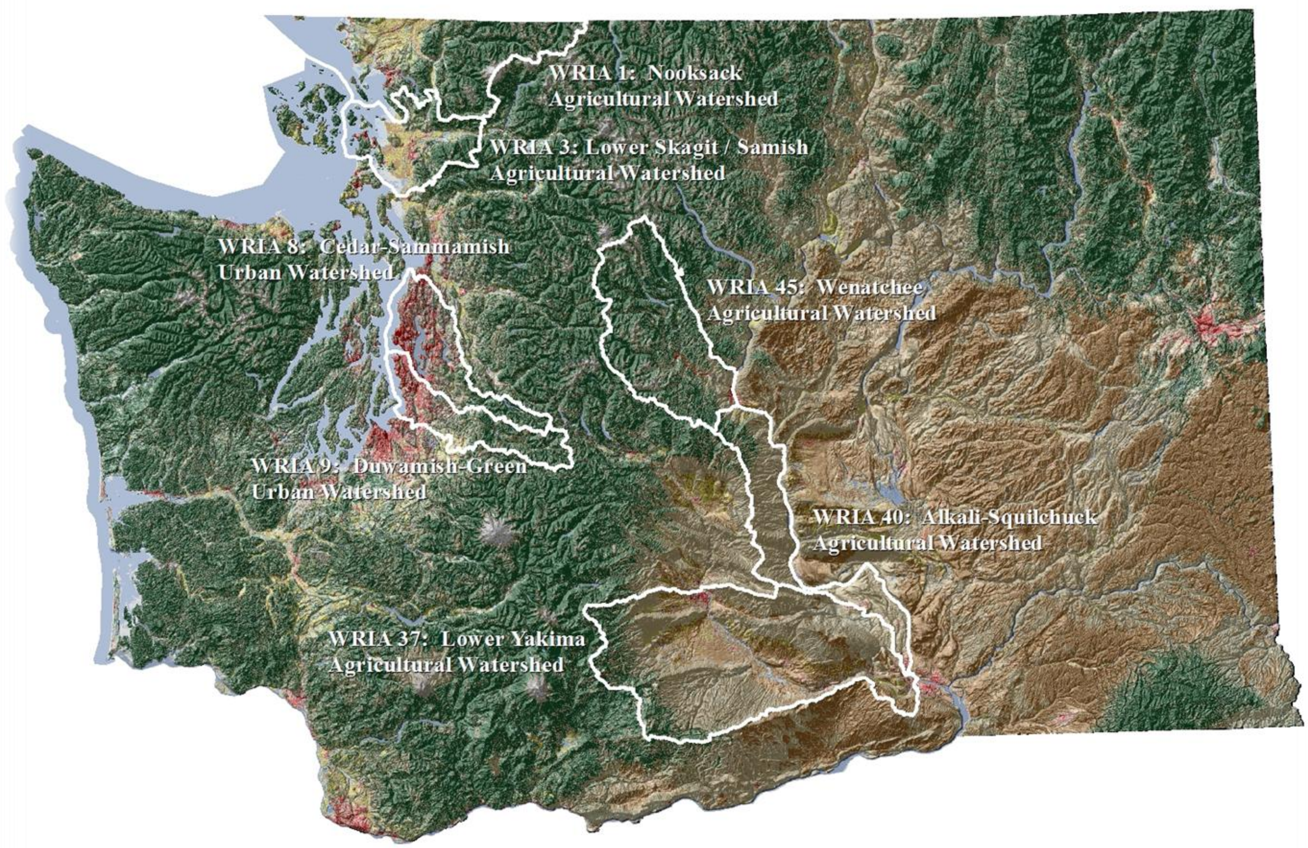

Figure 1: State map showing the five agricultural and two urban basins monitored during 2013.

Basins Monitored During 2013

The seven basins monitored in 2013 are presented in Figure 1: two urban and five agricultural. The urban basins were chosen due to land-use characteristics, history of pesticide detections, and habitat use by salmon. The agricultural basins were chosen because they support several salmonid populations, produce a variety of agricultural commodities, and have a high percentage of acres in agricultural production.

Monitoring locations, duration of sampling, and coordinates are described in Appendix A. Agricultural land use statistics, salmon fishery information, and climate information can be found in previous reports (Sargeant et al., 2011 and 2013).

Nooksack basin (WRIA 1)

Two new monitoring sites on Bertrand Creek in the Nooksack basin (WRIA 1), on the U.S. Canada border, were added for the 2013 monitoring season to represent berry growing agricultural land-use. WSDA wanted to capture data on pesticide residues from an intensely cultivated berry region to potentially represent changes in pesticide use with the emergence of new pest pressures. Approximately 61% of the land use in the Bertrand Creek subbasin is in agricultural production (the U.S. portion is approximately half of the entire watershed) including 20% which is currently producing blueberries, caneberries (raspberries, blackberries, and marionberries), and strawberries (WSDA, 2013). Two monitoring sites are located on Bertrand Creek.

- The Upper Bertrand monitoring site is located near the U.S. Canadian border.
- The Lower Bertrand monitoring site is located near the bottom of the watershed approximately 1 mile upstream where the tributary enters the Nooksack River.

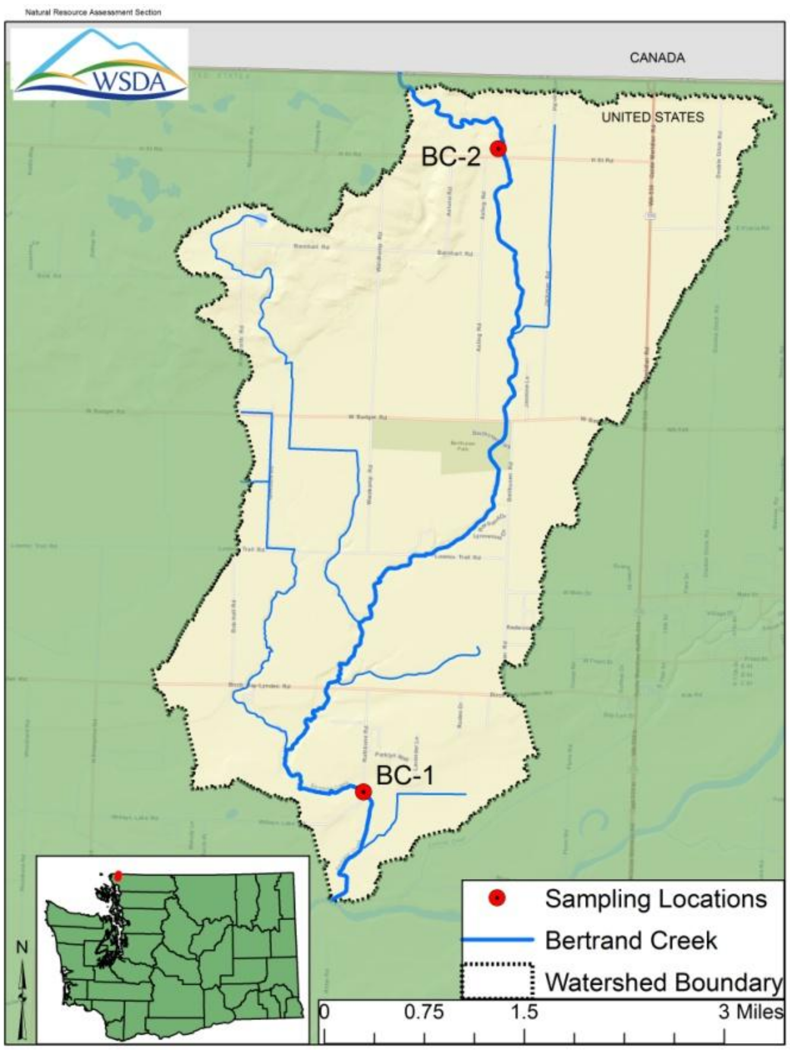

Figure 2: Map of Nooksack Basin Monitoring Locations

Lower Skagit-Samish basin (WRIA 3)

Five monitoring sites in four subbasins of the lower Skagit-Samish basin (WRIA 3) were selected to represent western Washington agricultural land-use practices. These sites have been monitored since 2006.

- The Upper Big Ditch monitoring site is located on the upstream side of the bridge at Eleanor Lane.
- The Lower Big Ditch monitoring site is located on the upstream side of the bridge at Milltown Road.
- The Browns Slough monitoring site is located downstream of the tidegate on Fir Island Road.
- The Indian Slough monitoring site is located on the upstream side of the tidegate at Bayview-Edison Road.
- The Samish River monitoring site is located under the bridge at Thomas Road.

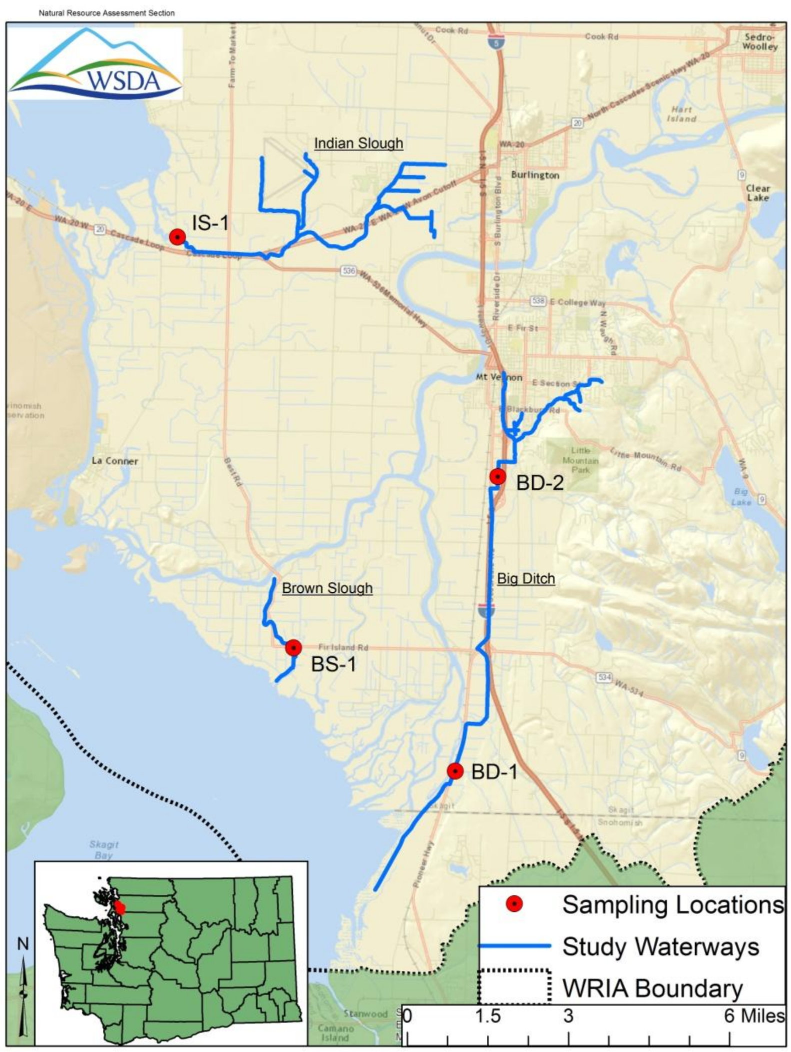

Figure 3: Map of Lower Skagit-Samish Basin Monitoring Locations

Cedar-Sammamish basin (WRIA 8)

The Thornton Creek subbasin is located in the Cedar-Sammamish basin (WRIA 8) and is an example of urban land-use. One to four sites have been sampled yearly on this creek from 2003 to the present. The site at the mouth of Thornton Creek was sampled in 2013.

- The Thornton Creek monitoring site is located downstream of the pedestrian footbridge near Matthews Beach Park.

Figure 4: Map of Cedar-Sammamish Basin Monitoring Location

Green-Duwamish basin (WRIA 9)

The Longfellow Creek subbasin is located in the Green-Duwamish basin (WRIA 9) and is another example of urban land-use. This monitoring site was added to the program in 2009 to investigate if pesticides could be contributing to storm water runoff that was causing pre-spawn mortality in salmon in the area.

- The Longfellow Creek monitoring site is located upstream of the culvert under the 12th fairway on the West Seattle Golf Course.

Figure 5: Map of Green-Duwamish Basin Monitoring Location

Lower Yakima basin (WRIA 37)

Three subbasins of the Lower Yakima basin (WRIA 37) were selected to represent eastern Washington irrigated crop-land agricultural practices. Three waterbodies have been sampled from 2003 to the present.

- The Marion Drain monitoring site is located approximately 15 meters upstream of the bridge at Indian Church Road.
- The Sulphur Creek monitoring site is located on the downstream side of the bridge at Holaday Road.
- The Spring Creek monitoring site is located on the downstream side of the culvert on McCreadie Road.

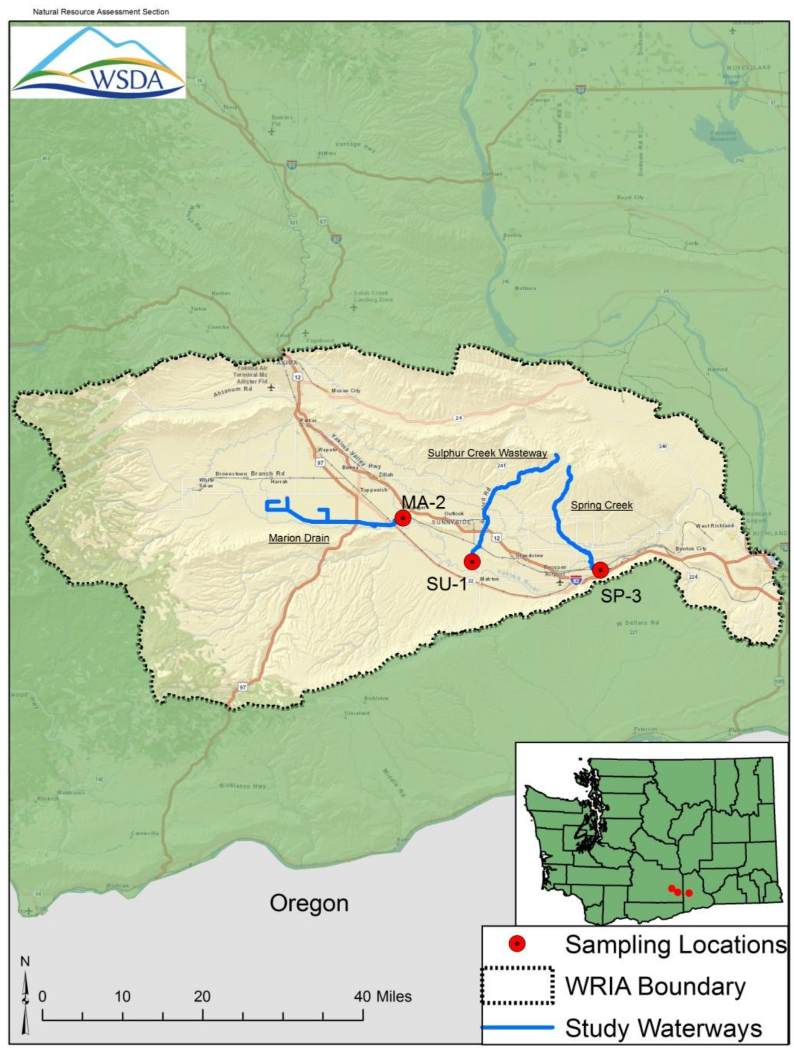

Figure 6: Map of Lower Yakima Basin Monitoring Locations

Alkali-Squilchuck basin (WRIA 40)

One site in the Alkali-Squilchuck basin (WRIA 40) was added to represent central Washington agricultural tree fruit practices in addition to the monitoring sites in the Wenatchee basin. The monitoring site is located at the mouth of Stemilt Creek.

- The Stemilt Creek monitoring site is located just upstream of where Stemilt Creek enters into the Columbia River.

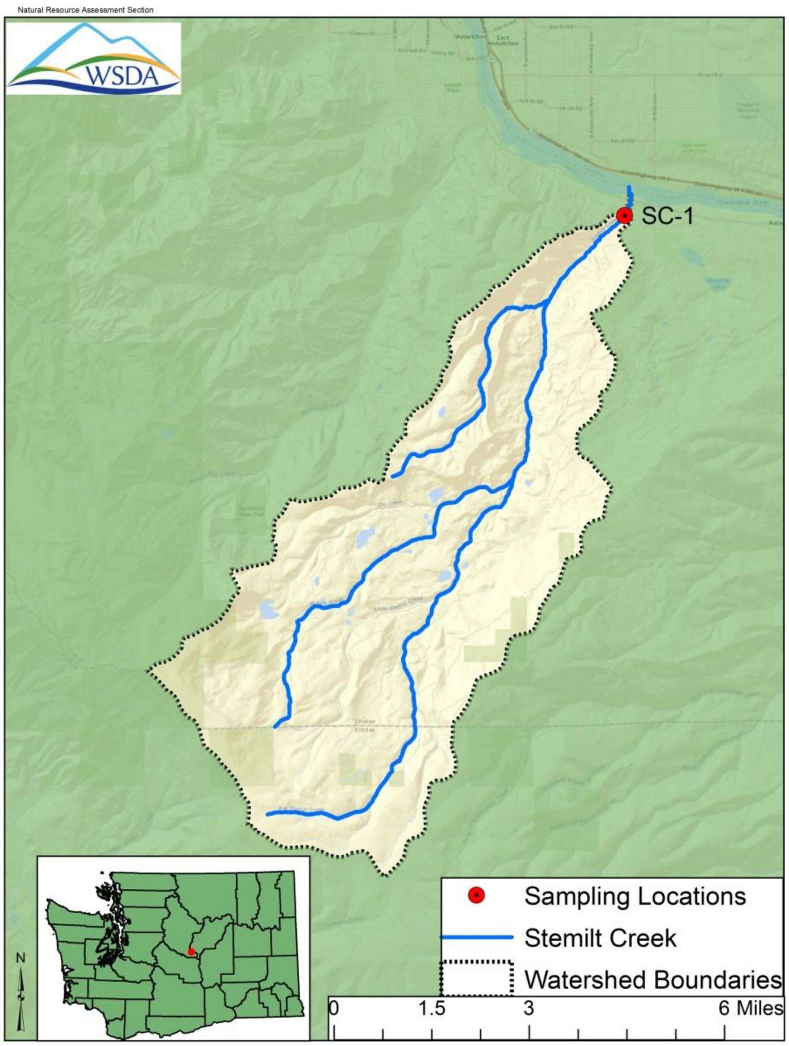

Figure 7: Map of Alkali-Squilchuck Basin Monitoring Location

Wenatchee basin (WRIA 45)

Four subbasins of the Wenatchee basin (WRIA 45) were selected to represent central Washington agricultural tree fruit practices. Four sites have been sampled from 2007 to the present.

- The Peshastin Creek monitoring site is located approximately 30 meters downstream of the bridge at Saunders Road.
- The Mission Creek monitoring site is located on Mission Creek Road off of Trip Canyon Road.
- The Brender Creek monitoring site is located on upstream side of the culvert at Evergreen Drive.
- The Wenatchee River monitoring site is located on the upstream side of the Sleepy Hollow Bridge.

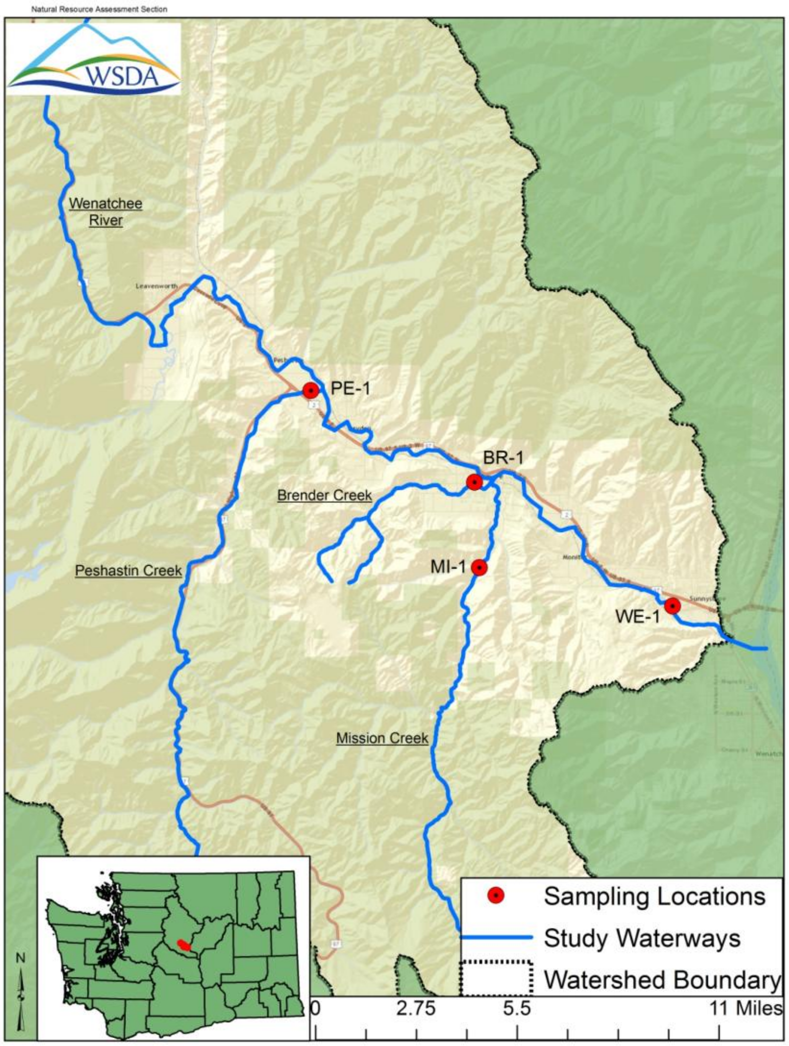

Figure 8: Map of Wenatchee Basin Monitoring Locations

Methodology:

Study Design and Methods

Sampling was designed to assess pesticide presence in salmonid-bearing streams during a typical pesticide-use period of March through September. The focus of monitoring is on currently registered pesticides, but laboratory analysis also included some historically used pesticides. Several conventional water quality parameters were measured: pH, conductivity, continuous temperature data (collected at 30-minute intervals), dissolved oxygen, and streamflow. Samples were collected and sent to the lab for total suspended solids (TSS). The conventional parameters provide information to help determine the factors influencing pesticide toxicity, fate and transport, and general water quality.

Detailed information on study design and methods are described in the Quality Assurance (QA) Project Plan (Johnson and Cowles, 2003), subsequent addendums (Burke and Anderson, 2006; Dugger et al., 2007; Anderson and Sargeant, 2009; Anderson, 2011; Anderson, 2012; Sargeant, 2013), and the triennial reports (Burke et al., 2006; Sargeant et al., 2010; Sargeant et al., 2013).

During 2013, samples collected for analysis of 174 pesticides and pesticide-related compounds included: 68 insecticides, 60 herbicides, 34 pesticide degradates, 9 fungicides, 2 pesticide synergists, and 1 wood preservative. See Table B- in Appendix B for the 2013 chemical analyte list.

Sampling Sites and Sampling Frequency

In 2013, sampling was conducted weekly at most monitoring locations for 27 consecutive weeks, beginning the second week in March and continuing through to the second week in September. The Peshastin Creek and Wenatchee River monitoring locations were sampled for 26 weeks beginning the second week in March, through to the first week in September. Marion Drain was sampled for 30 weeks from the second week in March until the end of Sept for due to late season organophosphate insecticide applications.

Field Procedures and Laboratory Analyses

A full description of field procedures and laboratory analysis is included in the QA Project Plan and subsequent addendums (Burke and Anderson, 2006; Dugger et al., 2007; Anderson and Sargeant, 2009; Anderson, 2011; Anderson, 2012; Sargeant, 2013).

Field methods for grab sampling are a direct application or modification of United States Geological Survey (USGS) or EPA procedures. Surface water samples were collected by hand-compositing grab samples from quarter-point transects across each stream following Ecology's Standard Operating Procedure for Sampling of Pesticides in Surface Waters, SOP EAP003

(Anderson and Sargeant, 2011). In situations where streamflow was vertically integrated, a one-liter transfer container was used to dip and pour water from the stream into sample containers.

Wenatchee River site samples were collected using depth integrating sampling equipment. Sample/transfer containers were delivered pre-cleaned by the manufacturer to EPA specifications (EPA, 1990). After collection, all samples were labeled and preserved according to the QA Project Plan (Johnson and Cowles, 2003).

Ecology's Manchester Environmental Laboratory (MEL) analyzed all pesticide samples, TSS samples, and conductivity QA samples. A list of target analytes for this study is presented in Table B-3 (Appendix B). Table 1 provides a summary of the extraction and analytical methods used by the MEL.

Table 1: Summary of laboratory methods, 2013.

Analytes	Analytical Method[1]		Reference
	Extraction	Analysis	
Pesticides	3535A	GC/MS	8270D
Herbicide Analysis	3535A/8151A	GC/MS	8270D
Carbamates	n/a	HPLC/MS/MS	8321B
TSS	n/a	Gravimetric	EPA 160.2
Conductivity	n/a	Electrode	SM 2510

[1]All analytical methods refer to EPA SW 846, unless otherwise noted.
n/a: not applicable
TSS: total suspended solids
HPLC/MS/MS: high performance liquid chromatography/triple quadrupole mass spectrometry
GC/MS: gas chromatography/mass spectrometry

Field meters were calibrated at the beginning of the field week according to manufacturers' specifications, using Ecology standard operating procedures (SOPs) (Swanson, 2010). Meters were post-checked at the end of the week using known standards. Dissolved oxygen meter measurements were compared to grab samples analyzed by Winkler Titration for dissolved oxygen following Ecology SOPs (Ward, 2007). Three to four Winkler grab samples were obtained during each sample week. Continuous, 30-minute interval, temperature data were collected year-round in 2013. Temperature instruments were calibrated against a National Institute of Standards and Technology (NIST) primary reference (Wagner et al., 2000). Data quality objectives for field meters are described in Anderson and Sargeant (2009).

Discharge (streamflow) for sites other than Lower Bertrand Creek, Sulphur Creek, Wenatchee River, and Peshastin Creek were measured using a Marsh-McBirney flow meter and top-setting wading rod, as described in Ecology SOP EAP056 (Shedd, 2011). Discharge data for Lower Bertrand Creek were obtained from an Ecology gauging station located at Rathbone Road (station ID: 01N060). Discharge data for Sulphur Creek were obtained from an adjacent U.S. Bureau of Reclamation gauging station on Sulphur Creek at Holaday Road near Sunnyside.

Wenatchee discharge data were obtained from USGS at the Wenatchee River at Monitor (Station 12462500). Discharge data for Peshastin Creek were obtained from an Ecology gauging station located at Green Bridge Road (StationID: 45F070). Fifteen-minute discharges were available during the sampling period. The recorded streamflow closest to the actual sampling time was used in lieu of field measurements.

Laboratory and Field Data Quality

QA/QC Measures

Performance of sample analyses is governed by quality assurance and quality control (QA/QC) protocols. The QA/QC protocol employs the use of blanks, replicates, and surrogate recoveries. Laboratory surrogate recovery, laboratory blanks, laboratory control samples (LCS), and laboratory control sample duplicates (LCSD) are analyzed as the laboratory component of QA/QC. Field blanks, field replicates, matrix spikes (MS), and matrix spike duplicates (MSD) integrate field and laboratory components. Fifteen percent of the field samples analyzed in 2013 were QA samples. Highlights of laboratory and field data quality are presented below and a full analysis of the QA/QC results is contained in Appendix B.

Field and Laboratory Blank Samples

Field blank or laboratory blank detections indicate that potential sample contamination in the field or potential false detections due to laboratory analytical error.

In 2013 there were no field blank detections for the pesticide GCMS or carbamate analysis. On April 22, 2013 there were field blank detections for 2,4-D in the herbicide analysis at all of the lower Yakima sites. All of the 2,4-D results for the lower Yakima for April 22, 2013 will be rejected. There was also a single TSS detection of 3 mg/L at Thornton Creek on August 27, 2013. Thornton Creek TSS results for August 27, 2013 will be qualified as tentatively undetected (UJ).

For 2013, there were no detections in laboratory blanks reported by MEL.

Field Replicate Samples

During 2013, field replicate sampling frequency for pesticides and TSS was 7.4% and 7.6%, respectively. Precision between replicate pairs was calculated using the relative percent difference (RPD) statistic. The RPD is calculated by dividing the absolute value of the difference between the replicates by their mean, then multiplying by 100 for a percent value. Precision, between detections consistently identified in both the grab sample and replicate sample are presented in Appendix B (Table B-5 for pesticide and Table B-6 for TSS). *Consistent identification* refers to compounds identified in both the original sample and field replicate.

For pesticides, the mean RPD of all consistently identified replicate pairs was 10.53% and of the 149 consistently identified replicate pairs, only four of the pairs exceeded the 40% RPD criterion due to a single analyte. Of the 40 inconsistently identified pairs, 33 were associated with a “J” or “UJ” (see ***Reporting Methods and Data Analysis*** in this section) qualifier due to non-detects on one of the two samples.

For TSS, 88% of the replicates were within the 20% RPD criterion and the average RPD of the consistently detected TSS replicates was 8.0%.

On average the RPD between detections in replicate samples was small. Table 4 shows the pooled average RPD where RPD values were averaged within an analytical suite of pesticides. All pesticide and TSS data for replicates are of acceptable data quality.

Table 2: Pooled average RPD of consistent field replicate pairs data in 2013.

Analytical Method	Pooled Average RPD	Number of Replicate Pairs[2]
Herbicides	12.9%	68
Carbamates	12.5%	25
Pesticide GCMS	6.8%	56
TSS	8.0%	34

Matrix Spike Samples

MS/MSDs provide an indication of bias due to interferences from components of the sample matrix. The duplicate spike can be used to estimate analytical precision at the concentration of the spiked samples. Statistics for analyte recoveries from MS/MSD samples are presented in Table B-7 in Appendix B as are the RPD for MS/MSD pairs. For most compounds, recovery and RPDs of MS/MSD pairs showed acceptable performance and were within defined limits for the project. Sample results were qualified as estimates if the MS/MSD recoveries did not meet MEL QC criteria (Table B-8).

Surrogates Compounds

Surrogates are used to evaluate recovery for a group of compounds. The majority of surrogate recoveries fell within the control limits established by MEL (2013). The percentage of time a surrogate recovery did or did not meet the quality control limits is described in Table B-10 of Appendix B. Sample results were qualified as estimates when surrogate recoveries did not meet MEL QC criteria.

Laboratory Control Samples

Laboratory control samples are composed of deionized water spiked with analytes at known concentrations and subjected to analysis. They are used to evaluate accuracy of pesticide residue recovery for a specific analyte. The average percent recovery for the LCS and the LCSD, and the average RPD between the LCS and duplicate pairs is presented in Table B-11 in Appendix B. For most compounds, recovery and RPDs of LCS and LCSD showed acceptable performance

[2] Replicate pairs including “NJ” and “J” qualified data

and were within limits for the project. Sample results were qualified as estimates if the LCS recoveries did not meet MEL QC criteria.

Field Data Quality

Field meters were calibrated at the beginning of the field day according to manufacturers' specifications, using Ecology SOP EAP033 *Standard Operating Procedure for Hydrolab DataSonde® and MiniSonde® Multiprobes* (Swanson, 2010). Field meters were post-checked at the end of the field week using known standards. Dissolved oxygen (DO) meter results were compared to results from grab samples analyzed using the Winkler laboratory titration method. DO grab samples and Winkler titrations were collected and analyzed according to the SOP (Ward, 2007). Two to three Winkler grab samples were obtained during each sampling day, one at the beginning of the day, one at the end and with one potential replicate Winkler. Measurement quality objectives (MQOs) for meter post-checks, replicates, and Winkler DO comparisons are described in Anderson and Sargeant (2009). The 2013 field data quality results are summarized in Appendix B of this report. Data that did not meet MQOs were qualified as described in Anderson and Sargeant (2009).

On June 5, 2013 a side-by-side field audit was conducted to determine comparability of the field equipment. Results of the field audit are described in Appendix B. All meter results were acceptable based on the MQOs described in Table B-14.

Reporting Methods and Data Analysis

Laboratory data were qualified as needed, and qualifiers are described in Table B-1 in Appendix B. Positive pesticide detections included "unqualified values" and values qualified with a "J" or "E". Values qualified with "NJ", "U," or "UJ" were considered non-detects.

The 2013 field and laboratory data were compiled and organized using Excel® spreadsheet software and Access® database software (Microsoft Corporation, 2007).

Graphs, plots, mass balance calculations, and some statistical analyses were made using Excel® software. The following guidelines were used in reporting and analyzing data for this report.

Comparison to Assessment Criteria and Water Quality Standards

Non-detect values are qualified ("U", "UJ", "N", and "NJ") and were not used for comparison to pesticide assessment criteria or water quality standards. When summing compound totals (such as total DDT, total endosulfan), the Toxic Studies Unit Guidance was used (Ecology, 2008). Non-detects ("U" or "UJ") were assigned a value of zero (as in the guidance). Unlike the guidance, "NJ" values (tentatively identified compounds) were also assigned a value of zero.

Replicate Values

Field and laboratory replicates were obtained to determine data quality. Field and laboratory replicates were arithmetically averaged for comparisons to pesticide assessment criteria and water quality standards. If the sample or the replicate sample was a non-detect value while the other was a positive detection, the positively detected value was used.

When a laboratory replicate was performed on a field replicate, the laboratory replicate mean was calculated before the field replicate mean.

Statistical Analysis

For the majority of analytes, concentrations were below the analytical reporting limit of the laboratory and were reported as "less than" the reporting limit. Substituting a value of zero or a value of half the detection limit is not defensible. Statistical analysis of pesticide data including nondetect values is conducted using an appropriate nondetect data analysis method as described in Helsel (2005).

For calculating summary statistics on data sets with nondetect values the following statistical tests were used based on the number of nondetects:

- For data sets with < 50% nondetects the nonparametric Kaplan-Meir test was used.
- For data sets with 50 – 80% nondetects the robust "regression on order statistics" (ROS) was used because it is more appropriate for smaller data sets versus maximum likelihood estimation test.

For ROS, data was assumed to follow a log-normal distribution. Both tests accept variable reporting limits. For all nondetects the reporting limit value was used for data analysis as opposed to the method detection limit. "J" and "NJ" qualified data were used as detected data for statistical tests.

Toxicity Unit Analysis

Pesticide registration toxicity data, risk assessment criteria, and regulatory standards apply to the effects of a single pesticide and its effects on aquatic life. However, organisms in the environment may experience many physical, biological, and chemical stressors simultaneously, changing the impact of exposure. Current criteria and standards do not take into account the effects of pesticide mixtures. Mixtures of two or more chemicals can be described as additive, where the effect of the co-exposure is anticipated to be the sum of their individual effects, synergistic (greater than additive toxicity), or antagonistic (less than additive toxicity). In addition to mixtures of pesticides, the effects of environmental stressors including high temperatures, low dissolved oxygen, or food source impacts are not taken into consideration in the criteria or standards.

How to address pesticide mixtures in the risk assessment process is a major source of uncertainty in the current risk assessment paradigm. The National Research Council (NRC) of the National Academy of Science convened a committee on Ecological Risk Assessment under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Endangered Species Act (ESA) to review the scientific and technical issues related to determining risks posed to listed species by pesticides. The NRC committee recently published their review of the risk assessment process[3] and provided recommendations to EPA and the services (US Fish and Wildlife Service and National Marine Fisheries Service). The NRC was specifically asked to assess the scientific information available for estimating effects of mixtures and inert ingredients; and to consider the use of uncertainty factors to account for gaps in data.

A study by Broderius and Kahl (1985) found when a large number of chemicals are included in mixture experiments, an additive response is typically found (Lydy et al., 2004). One of the most common methods of assessing the additive effects of pesticide mixtures is by using toxicity units (TUs) (Lydy et al., 2004).

For this report toxicity units (TUs) were used to estimate the additive effects of pesticide mixtures, as described by Faust et al. in 1993 (Lydy et al., 2004). As an example, TUs can be calculated for a two-component mixture using formula 1 and the LC_{50} (lethal concentration to cause mortality in 50% of test species) as an assessment endpoint:

$$\sum\left(\frac{x_1}{LC_{50}(x_1)}+\frac{x_2}{LC_{50}(x_2)}\right)=TU$$

In equation above, TU is equal to the sum of the individual risk quotients where x_1 and x_2 are the concentrations of the mixture components X_1 and X_2, $LC_{50}(X_1)$ and $LC_{50}(X_2)$ are the effect concentrations of the individual compounds that produce the same effect.

In this example, a TU value ≥ 1 means 50% or more of the organisms tested may experience lethality based on the lethality measure used. Lethality measures used in this report include: acute and chronic fish and invertebrate exposure assessment concentrations described in Appendix C. A TU value ≥ 1 means a lethal or sublethal (for chronic criteria) effect may occur with an increasing likelihood depending on the degree to which TUs exceed 1.0.

The effect concentrations in the denominator of the risk quotient can also be multiplied by the level of concern[4] (LOC) to conveniently assess if the level of concern has been exceeded by the pesticide mixture.

$$\sum\left(\frac{x_1}{LC_{50}(x_1)\times LOC}+\frac{x_2}{LC_{50}(x_2)\times LOC}\right)=TU$$

[3] Assessing Risks to Endangered and Threatened Species from Pesticides

[4] Seepage 32 in the ***Assessment Criteria and Washington State Water Quality Standards*** section of this report

Assessment Criteria and Washington State Water Quality Standards:

Assessment of pesticide effects to endangered salmonid species is evaluated by comparing detected pesticide concentrations against three criteria:

- In this report **Assessment Criteria** refer to:
    - *Data from Studies that Determine Hazard to Non-target Organisms* are used to fulfill the Data Requirements for Pesticide Registration (Code of Federal Regulations - 40CFR Part 158: Subpart G 158.630 and 158.660). Toxicity data from these studies are commonly used to conduct screening-level risk assessments and will be referred to in this report as **pesticide registration toxicity data**. Toxicity data used in this report include:
        - Lowest tested EC_{50} or LC_{50} values for freshwater fish, freshwater invertebrates and estuarine/marine fish and invertebrates from acute toxicity tests.
        - Lowest NOAEC values for freshwater fish, freshwater invertebrates and estuarine/marine fish and invertebrates from early life-stage or full life-cycle tests.
    - EPA's National Recommended Water Quality Criteria (NRWQC) for the protection of aquatic life and human health in surface water for approximately 150 pollutants. These criteria are published pursuant to Section 304(a) of the Clean Water Act (CWA) and provide guidance for states and tribes to use in adopting water quality standards.
- In this report **State Water Quality Standards** refer to
    - Numeric values from the Water Quality Standards For Surface Waters of The State of Washington (WAC 173-201A).

Pesticide registration toxicity data (acute and chronic) for fish, invertebrates, and aquatic plants are presented in Appendix C. Numeric exceedances of the values in Appendix C do not necessarily indicate water quality criteria have been exceeded as there is typically a temporal duration of exposure criteria associated with the numeric criteria. Assessment criteria and water quality standards are developed by evaluating the effects of a single chemical on a specific species and do not take into account the effects of multiple chemicals or pesticide mixtures on an organism.

Pesticide Registration Toxicity Data

Acute toxicity is calculated by standardized toxicity tests using lethality as the measured criteria. A properly conducted test will use a representative (sensitive) species, at a susceptible life stage (usually young, though not immature). The test also will subject the test species to a pesticide under a range of concentrations.

- The **No Observable Adverse Effect Concentration** (NOAEC) is the highest concentration in the toxicity test not showing a statistically significant difference from the control.

- The **Lowest Observable Adverse Effect Concentration** (LOEC) is the lowest concentration in a toxicity test showing a statistically significant difference from the control. The NOAEC is by definition the next concentration below the LOEC in the concentration series.

- The **LC_{50}** is the "lethal concentration" causing mortality in 50% of test species. This value is calculated by plotting the dose response curve and fitting a mathematical equation to the data and using that equation to calculate the concentration for any level of effect, in this case the 50% value.

- The **EC_{50}** is the "effect concentration" causing an effect in 50% of test species. This value is calculated by plotting the dose response curve and fitting a mathematical equation to the data and using that equation to calculate the concentration for any level of effect, in this case the 50% value.

For fish, the acute lethality test is conducted over 96 hours and the acute test for invertebrates is normally conducted over 48 hours, with the criteria being mortality (LC_{50}) or immobility (EC_{50}). The acute toxicity test for aquatic plants is conducted over 96 hours, and the biological endpoint is reduction in growth (EC_{50}).

Chronic fish tests normally use growth or developmental effects as the biological endpoint. A chronic toxicity test may assess a sublethal biological endpoint such as reproduction, growth, or development. It is generally longer than the acute tests (21 day for fish, 14 days for invertebrates, 4 to 60 days for plants) to simulate exposure resulting from a persistent chemical, or effect of repeated applications.

When comparing the monitoring data either to the aquatic life criteria or directly to the pesticide registration toxicity data, both the duration of exposure and the numeric toxicity value must be considered. It is not possible to determine if the toxicity values or criteria were exceeded based solely on an individual sample because the sampling frequency is usually weekly, not allowing for assessment of the temporal component of the criteria.

Pesticide concentrations in streams are constantly changing and may occur above aquatic life criteria for durations of time less than or greater than the test durations used to set the aquatic life criteria.

- If the stream concentration of a pesticide is above its aquatic life criterion for less time than the test duration, then comparison to the criterion may overestimate the risk.

- If the concentration for a pesticide is above its aquatic life criterion for a longer time than the test duration, then comparison to the criterion will likely underestimate the risk.

The EPA uses a deterministic approach to assess the potential risk of a pesticide to non-target organisms. In this approach risk quotients (RQ) are calculated by dividing a point estimate of environmental exposure by a point estimate of effect and are an expression of concentration over toxicity.

$$Risk\ Quotient = \frac{Pesticide\ Exposure}{Pesticide\ Toxicity}$$

The risk quotients are unit-less values that are compared to Levels of Concern (LOC). Levels of Concern provide an additional safety factor to increase the likelihood that non-target organisms exposed to a pesticide at a given concentration will not experience unreasonable adverse effects. The LOCs set by EPA are presented in Table 3.

Table 2: Risk Quotients and Levels of Concern.

Risk Presumptions	Risk Quotient	LOC	Description of Risk for Salmonids
Acute High Risk	EEC/LC_{50} or EC_{50}	≥0.5	Potential for acute risk to non-target organisms which may warrant regulatory action in addition to restricted use classification
Acute Restricted Use	EEC/LC_{50} or EC_{50}	≥0.1	Potential for acute risk to non-target organisms, but may be mitigated through restricted use classification
Acute Endangered Species	EEC/LC_{50} or EC_{50}	≥0.05	Endangered species may be potentially affected at this level
Chronic Risk	EEC/NOAEC	≥1	Potential for chronic risk may warrant regulatory action, endangered species may potentially be affected through chronic exposure including growth, reproduction, and effects on progeny.
Aquatic Plants - Acute High Risk	EEC/EC_{25}	≥1	May have indirect effects on aquatic vegetative cover for threatened and endangered fish.
Aquatic Plants - Acute Endangered Species	EEC/EC_{05} or NOEC	≥1	May have indirect effects on aquatic vegetative cover for threatened and endangered fish.

EEC = Estimated environmental concentration
Table 3 is adapted from EPA's Technical Overview of Ecological Risk Assessment

The endangered species LOC (≥0.05 for aquatic species) is used as a comparative value to assess potential risk to threatened or endangered salmonids. The endangered species RQ can also be expressed as 1/20th of the LC_{50}. To assess the potential risk of a pesticide to salmonids, the LC_{50} for rainbow trout is commonly used as a surrogate species. Thus the endangered species LOC presented in subsequent tables are 1/20th of the rainbow trout LC_{50}. When available, the endangered species LOC for specific salmonids is also presented.

National Recommended Water Quality Criteria

The NRWQC are established by the EPA Office of Water for the protection of aquatic life, as established under the Clean Water Act (33 U.S.C. 1251 et. seq.). The pesticide criteria established under the Clean Water Act are closely aligned with invertebrate acute and chronic toxicity criteria. States often adopt the NRWQC as their promulgated (legal) standards. The NRWQC was updated in 2006, and those criteria are used in this report (EPA 2006) and presented in Appendix C.

Washington State Water Quality Standards for Pesticides

Washington State water quality standards are established in the Washington Administrative Code (WAC), Chapter 173-201A. Washington State water quality standards include numeric pesticide criteria for the protection of aquatic life.

The aquatic life criteria are designed to protect for both short-term (acute) and long-term (chronic) effects of chemical exposure. The criteria are primarily intended to avoid direct lethality to fish and other aquatic life within the specified exposure periods. The chronic criteria for some of the chlorinated pesticides are to protect fish-eating wildlife from adverse effects due to bioaccumulation.

The exposure periods assigned to the acute criteria are expressed as: (1) an instantaneous concentration not to be exceeded at any time, or (2) a one-hour average concentration not to be exceeded more than once every three years on average. The exposure periods for the chronic criteria are either: (1) a 24-hour average not to be exceeded at any time, or (2) a four-day average concentration not to be exceeded more than once every three years on the average. For 303(d) listing purposes, measurements of instantaneous concentrations are assumed to represent the averaging periods specified in the water quality standards for both acute and chronic criteria, unless additional measurements are available to calculate averages (Ecology, 2012).

Aquatic life criteria, pesticide regulatory criteria, and toxicity (acute and chronic) results for fish, invertebrates, and aquatic plants are presented in Appendix C.

Numeric Water Quality Standards for Temperature, pH, and Dissolved oxygen

Washington State water quality standards for conventional water quality parameters are set forth in Chapter 173-201A of the WAC. Waterbodies are required to meet numeric water quality standards based on the beneficial uses of the waterbody. Conventional parameters including temperature, dissolved oxygen, and pH were measured in this study. The numeric criteria of the Washington State water quality standards are based on the aquatic life uses as shown in Table 4.

Table 4: Washington Aquatic Life Uses & Criteria for Conventional Water Quality Parameters

Aquatic Life Uses	Temperature Highest 7-DADMax (^{0}C)	Dissolved Oxygen (Lowest 1-day minimum)	pH (Standard Units)	Monitoring Locations	
				Western Washington	Eastern Washington
Freshwater - Core Summer Salmonid Habitat	16.0 ^{0}C	9.5 mg/L	6.5-8.5 *(with a human caused variation within the above range of <0.2 units)*	Thornton Creek	
Freshwater - Salmonid Spawning, Rearing, and Migration Habitat	17.5^{0}C	8.0 mg/L	6.5-8.5 *(with a human caused variation within the above range of <0.5 units)*	Upper and Lower Bertrand Creek, Upper and Lower Big Ditch, Indian Slough, Longfellow Creek, Sammish River	Marion Drain, Spring Creek, Sulphur Creek, Peshastin Creek, Brender Creek, Mission Creek, Wenatchee River, Stemilt Creek
Freshwater - Supplemental Spawning and Incubation Temperature Criteria - October 1-May 15	13.0^{0}C	NA	NA	Thornton Creek	Wenatchee River
Marine waters - Aquatic Life Excellent use	16.0^{0}C	6.0 mg/L	7.0-8.5 *(with a human caused variation within the above range of <0.5 units)*	Browns Slough	

7-DADmax: water temperature is measured by the 7-day average of the daily maximum temperature.
Freshwater - Core Summer Salmonid Habitat: The key identifying characteristics of this use are summer (June 15 - September 15) salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and subadult native char. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids.
Freshwater - Salmonid Spawning, Rearing, and Migration Habitat: The key identifying characteristic of this use is salmon or trout spawning and emergence that only occurs outside of the summer season (September 16 - June 14).

Results Summary:

Pesticide Detection Summary

A summary of the results from the 2013 monitoring season are described in this section. Data presented in this section of the report only include results where pesticides were positively identified ("Non-qualified" or "J" or "E"). Data where pesticides were tentatively identified ("NJ"), rejected ("REJ"), or not detected ("U", or "UJ") were not included in this summary section. Table 5 provides a statewide overview of the 67 positively identified pesticides detected in 2013 (organized by general use category). The minimum method detection limits and ESLOC values are provided for comparison.

Table 5: Summary of Pesticide Detections at All Monitoring Locations in 2013

Pesticides Detected in 2013 by Use Category	Total Number of Detections	Maximum Concentration (µg/L)	Average Concentration (µg/L)*	Standard Deviation (µg/L)*	Minimum Method Detection Limits (µg/L)	ESLOC for Freshwater Fish (µg/L)
HERBICIDES	1027					
2,4-D	147	2.4	0.1	0.26	0.012	21.4
Diuron	114	1.75	0.08	0.21	0.006	97.5
Dichlobenil	101	0.11	0.02	0.01	0.009	246.5
Triclopyr	84	0.47	0.06	0.08	0.007	95.0
Dicamba I	83	0.17	0.03	0.03	0.007	1400.0
MCPA	73	0.44	0.06	0.09	0.008	38.0
Metolachlor	63	1.1	0.1	0.2	0.007	190.0
Bromacil	50	0.091	0.05	0.02	0.012	1800.0
Mecoprop (MCPP)	40	0.48	0.07	0.09	0.008	6240.0
Simazine	34	0.37	0.13	0.09	0.012	2025.0
Terbacil	34	4.6	0.3	0.8	0.014	2310.0
Bentazon	32	0.53	0.08	0.09	0.006	5000.0
DCPA (Dacthal)	24	0.39	0.09	0.10	0.005	330.0
Tebuthiuron	23	0.13	0.06	0.02	0.016	7150.0
Atrazine	18	0.98	0.08	0.23	0.013	265.0
Norflurazon	13	0.44	0.08	0.11	0.012	405.0
Bromoxynil	13	0.52	0.06	0.14	0.006	2.5
Trifluralin	12	0.061	0.03	0.01	0.020	2.18
Eptam	12	0.2	0.06	0.05	0.008	700.0
Chlorpropham	10	1.8	0.42	0.64	0.013	285.0
Diphenamid	10	0.036	0.03	0.00	0.010	4850.0
Pendimethalin	8	0.31	0.09	0.09	0.028	6.9
Metribuzin	8	0.21	0.11	0.07	0.016	2100.0
Picloram	6	0.059	0.04	0.01	0.017	275.0
Napropamide	6	0.38	0.23	0.10	0.014	320.0
Prometon	3	0.04	0.03	0.01	0.015	600.0
Clopyralid	2	0.52	0.28	0.34	0.008	98400.0
Dichlorprop	2	0.088	0.06	0.04	0.009	10700.0
Triallate	1	0.015	0.02	n/a	0.014	no criteria
Monuron	1	0.034	0.03	n/a	0.006	no criteria

Pesticides Detected in 2013 by Use Category	Total Number of Detections	Maximum Concentration (µg/L)	Average Concentration (µg/L)*	Standard Deviation (µg/L)*	Minimum Method Detection Limits (µg/L)	ESLOC for Freshwater Fish (µg/L)
INSECTICIDES	211					
Imidacloprid	53	0.705	0.06	0.11	0.002	4150.0
Oxamyl	52	0.058	0.02	0.02	0.002	210.0
4,4'-DDT	21	0.038	0.03	0.01	0.028	
Chlorpyrifos	18	0.19	0.06	0.05	0.014	0.15
Diazinon	17	0.55	0.07	0.13	0.014	4.50
Carbaryl	15	0.1205	0.04	0.03	0.003	60.00
Endosulfan I	7	0.12	0.06	0.03	0.011	0.04
Ethoprop	7	0.76	0.30	0.25	0.014	51.0
Endosulfan II	5	0.078	0.05	0.03	0.010	0.04
Methomyl	4	0.0475	0.02	0.02	0.003	43.0
Propoxur	3	0.007	0.01	0.00	0.004	185.0
Malathion	2	0.069	0.06	0.02	0.007	1.64
Fenamiphos	1	0.038	0.04	n/a	0.013	3.4
Carbofuran	1	0.009	0.01	n/a	0.003	4.4
Bifenthrin	1	0.059	0.06	n/a	0.052	0.01
trans-Chlordane	1	0.017	0.02	n/a	0.030	no criteria
Fipronil	1	0.04	0.04	n/a	0.050	12.3
cis-Chlordane	1	0.016	0.02	n/a	0.022	no criteria
Dicofol	1	0.042	0.04	n/a	0.027	2.65
DEGRADATES	132					
Oxamyl oxime	27	0.49	0.07	0.11	0.002	no criteria
4,4'-DDE	26	0.046	0.03	0.01	0.023	no criteria
Malaoxon	23	0.01	0.01	0.00	0.001	1.64
Endosulfan Sulfate	21	0.14	0.05	0.03	0.011	0.07
Tetrahydrophthalimide	12	0.77	0.13	0.21	0.030	no criteria
4,4'-DDD	8	0.021	0.02	0.00	0.031	no criteria
3,5-Dichlorobenzoic Acid	5	0.0405	0.02	0.01	0.007	no criteria
4-Nitrophenol	5	0.52	0.21	0.19	0.022	200.0
Aldicarb Sulfoxide	3	0.036	0.02	0.02	0.004	357.0
Fipronil Sulfone	1	0.021	0.02	n/a	0.050	1.95
Heptachlor Epoxide	1	0.012	0.01	n/a	0.009	no criteria
FUNGICIDES	117					
Boscalid	72	0.77	0.18	0.15	0.034	135.0
Metalaxyl	37	2.6	0.15	0.42	0.025	920.0
Fenarimol	4	0.077	0.05	0.02	0.021	105.0
Chlorothalonil	2	0.31	0.18	0.19	0.009	2.12
Cyprodinil	2	0.018	0.01	0.00	0.003	12.05
WOOD PRESERVATIVES	81					
Pentachlorophenol	81	0.06	0.02	0.01	0.0070	0.75
SYNERGISTS	4					
Piperonyl butoxide	4	0.98	0.32	0.45	0.050	95.0
GRAND TOTAL	1572					

n/a: Unable to calculate a standard deviation from a single detection
n/c: No criteria available
*Values have been rounded to two decimal places for readability in this table

During 2013, there were 1,572 individual detections of 67 pesticides (and pesticide-related compounds) at 17 sites sampled statewide (Table 5 and Figure 9).

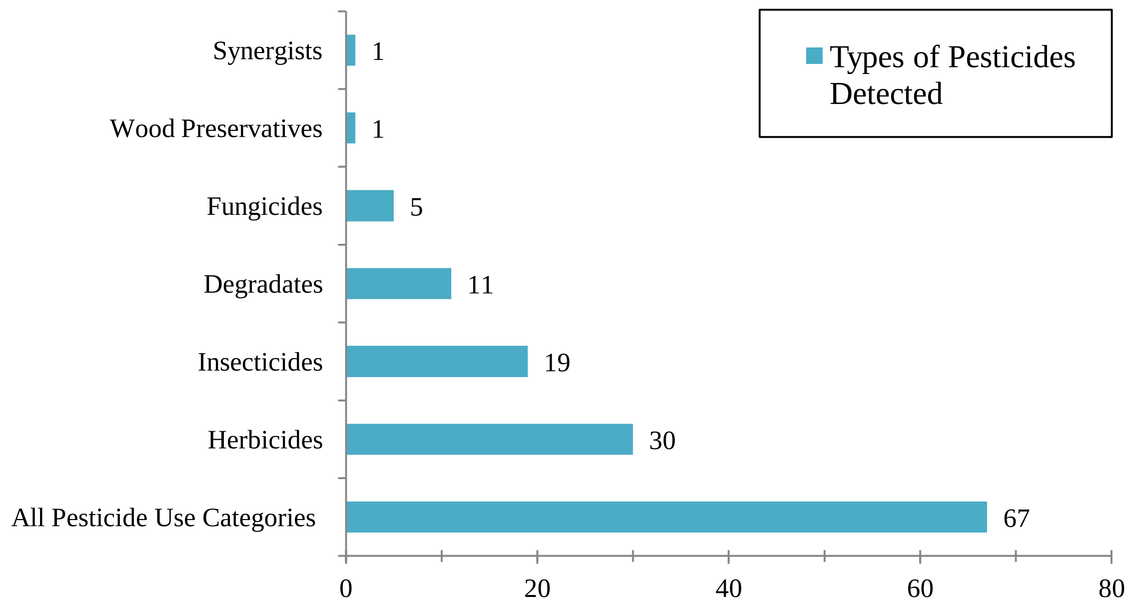

Figure 9: Types of Pesticides Detected in 2013

Herbicides were the most frequently detected class of pesticide, followed by insecticides, pesticide degradates, fungicides, wood preservatives, and then synergists (Figure 10). In 2012 (for comparison), there were 1,095 detections of 58 pesticides (and pesticide-related compounds) for the 15 sites sampled statewide.

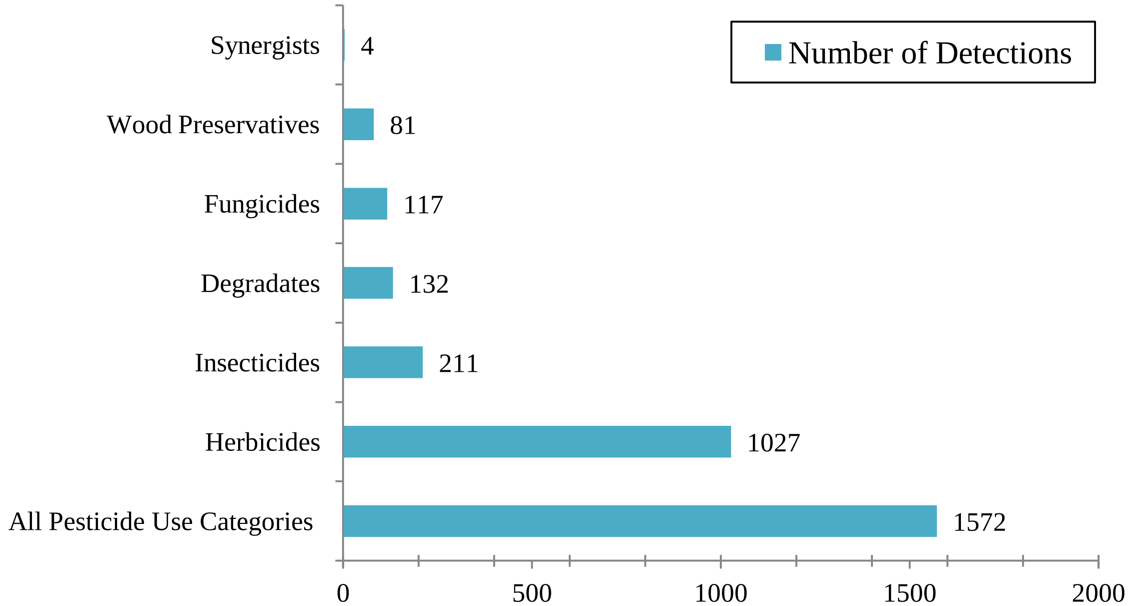

Figure 10: Pesticide Detections by Use Category in 2013

Herbicide Detections

Herbicides were the most frequently detected use group making up approximately 65.3% of the total detections. Out of the 60 herbicides included in the laboratory analysis, 30, or exactly half were positively identified in 2013. Diuron, 2,4-D, and dichlobenil were the most commonly detected pesticides with 147, 114, and 101 individual detections respectively. Metolachlor was the seventh most commonly detected herbicide (63 detections) and the only herbicide to exceed the assessment criteria in 2013.

Insecticide Detections

Insecticides were the second most frequently detected pesticides making up approximately 13.4% of the total detections. Out of the 68 insecticides and isomers included in the laboratory analysis, 19, or slightly less than one third were positively identified in 2013. Imidacloprid, oxamyl, and 4,4'-DDT were the most commonly detected pesticides with 53, 52, and 21 individual detections respectively.

Degradate Detections

There were 132 detections of pesticide degradates found in 2013 accounting for approximately 13.4% of the total detections. Oxamyl oxime (degradate of the carbamate insecticide/acaricide/nematicide oxamyl) was the most frequently found degradate with 27 detections, followed by 4,4'-DDE (degradate of 4,4'-DDT) with 26 detections, and malaoxon (a degradate of the organophosphate insecticide malathion) with 23 positive detections.

Comparison of Upper Bertrand Creek to Lower Bertrand Creek

During the 2013 sample season both the upstream (Upper) and downstream (Lower) Bertrand Creek monitoring sites were sampled weekly on the same day. Between March and September, 28 pesticides were detected between the two monitoring locations including one pesticide was detected only at the upstream site and three pesticides detected only at the downstream site (Table 6).

Table 6: Comparison between Upper Bertrand Creek and Lower Bertrand Creek Pesticide Detections

Pesticide	Number of Detections	
	Upper Bertrand Creek	Lower Bertrand Creek
2,4-D	9	7
Aldicarb Sulfoxide	1	1
Atrazine**	--	1
Boscalid	24	12
Bromacil**	--	12
Bromoxynil	1	2
Chlorothalonil**	--	1
Diazinon	1	6
Dicamba I	9	5
Dichlobenil	13	10
Dichlorprop*	2	--
Diuron	1	9
Imidacloprid	7	6
Malaoxon	8	11
MCPA	11	10
Mecoprop (MCPP)	13	7
Metalaxyl	11	22
Methomyl	1	1
Metolachlor	5	3
Napropamide	3	3
Oxamyl	17	27
Oxamyl oxime	6	21
Pentachlorophenol	2	2
Propoxur	1	1
Simazine	17	9
Terbacil	5	2
Tetrahydrophthalimide	3	9
Triclopyr	2	13
Total Number of Detections =	173	213

-- Pesticide was not detected at this monitoring station.
*Pesticides detected only at Upper Bertrand Creek: dichlorprop
**Pesticides detected only at Lower Bertrand Creek: atrazine, bromacil, and chlorothalonil

Comparison of Upper Big Ditch to Lower Big Ditch

During the 2013 sample season both the upstream (Upper) and downstream (Lower) Big Ditch sites were sampled weekly on the same day. Between March and September a total of 157 pesticides were detected at Upper Big Ditch and 153 pesticides were detected at Lower Big

Ditch. 29 pesticides were detected between two monitoring sites, including six pesticides detected only at the upstream site and eight pesticides detected only at the downstream site (Table 7).

Table 7: Comparison between Upper Big Ditch and Lower Big Ditch Pesticide Detections

Pesticide	Number of Detections	
	Upper Big Ditch	Lower Big Ditch
2,4-D	12	16
3,5-Dichlorobenzoic Acid*	3	--
4-Nitrophenol*	1	--
Atrazine**	--	5
Bentazon**	--	5
Bifenthrin	1	--
Boscalid	21	11
Bromacil	6	7
Carbaryl*	1	--
Carbofuran**	--	1
Chlorpropham**	--	7
Diazinon	1	1
Dicamba I	10	4
Dichlobenil	20	12
Diuron	5	14
Eptam**	--	5
Ethoprop**	--	2
Imidacloprid	14	6
MCPA	4	7
Mecoprop (MCPP)	6	1
Metalaxyl	2	2
Metolachlor	4	18
Metribuzin**	--	6
Oxamyl*	1	--
Pentachlorophenol	21	11
Prometon*	2	--
Simazine**	--	1
Tebuthiuron	8	1
Triclopyr	14	10
Total Number of Detections =	157	153

-- Pesticide was not detected at this monitoring station.
*Pesticides detected only at Upper Big Ditch: atrazine, bentazon, carbofuran, chlorpropham, eptam, ethoprop, metribuzin, and simazine
**Pesticides detected only at Lower Big Ditch: 3,5-dichlorobenzoic acid, 4-nitrophenol, bifenthrin, carbaryl, oxamyl, and prometon

Pesticides Exceedances Summary

Of the 1,527 positively identified pesticide detections in 2013, 4.83% (76) of those were found at levels above the assessment criteria and state water quality standards. Exceedances detected for ten different pesticides included one herbicide, five current use insecticides, one legacy insecticide and three different degradates of organochlorine insecticides (one current use and two historical uses). The pesticide exceedances identified during the 2013 monitoring season are summarized in Table 8.

Table 8: Summary of Pesticides in Exceedance of Assessment Criteria and State Water Quality Standards

Pesticide	Pesticide Use Category	Number of Detections in 2013	Number of Detections Above Criteria or Standards	Percentage of Detections Above Criteria or Standards	Monitoring Locations where Exceedances Occurred
Metolachlor	Herbicide	63	1	1.59%	Lower Big Ditch
Bifenthrin	Pyrethroid Insecticide	1	1	100.00%	Upper Big Ditch
Chlorpyrifos	Organophosphate Insecticide	18	7	38.89%	Stemilt Creek, Marion Drain, Spring Creek, Sulphur Creek
Diazinon	Organophosphate Insecticide	17	1	5.88%	Stemilt Creek
Malathion	Organophosphate Insecticide	2	1	50.00%	Stemilt Creek
Endosulfan I[A]	Organochlorine Insecticide	7	5	71.43%	Brender Creek, Mission Creek, Wenatchee River
Endosulfan II [A]	Organochlorine Insecticide	5	3	60.00%	Brender Creek
Endosulfan Sulfate [A]	Degradate (Organochlorine)	21	2	9.52%	Brender Creek
4,4'-DDT[B]	Organochlorine Insecticide	21	21	100.00%	Brender Creek
4,4'-DDE[B]	Degradate (Organochlorine)	26	26	100.00%	Brender Creek, Sulphur Creek
4,4'-DDD[B]	Degradate (Organochlorine)	8	8	100.00%	Brender Creek
	Total	1572 [C]	76	4.83%	

[A] Endosulfan is scheduled for full phase-out on all crops by July 31st, 2016.
[B] Detections of DDT and its degradates (4,4'-DDE, and 4,4'-DDD) are a result of sediment runoff in areas where DDT was historically used and are not a result of current pesticide use patterns.
[C] Total number of detections in 2013for all analytes.

Pesticide exceedances were found at 9 of the 17 monitoring locations; Lower Big Ditch, Upper Big Ditch, Stemilt Creek, Marion Drain, Spring Creek, Sulphur Creek, Brender Creek, Mission Creek, and Wenatchee River. Of the 76 exceedances, 65 (82%) occurred at Brender Creek and 54 (68% of the total) of those were DDT and its degradates DDE and DDD (Table 11). For comparison, there were 94 exceedances in 2012 for two herbicides, five current use insecticides, one legacy insecticide, and four different degradates of organochlorine insecticides (1 current use and 3 historical use).

At 8 of the 17 monitoring locations (Thornton Creek, Longfellow Creek, Upper and Lower Bertrand Creek, Browns Slough, Indian Slough, Peshastin Creek, and the Samish River), all pesticide detections were at concentrations below available pesticide assessment criteria and standards.

Of the 76 pesticide exceedances, 2 (2.53%) were at monitoring locations in Western Washington and the other 77 (97.47%) occurred at monitoring locations in Eastern Washington (Figure 11).

Exceedances by Legacy Insecticides

Of the 76 pesticide exceedances detected in 2013, DDT and its degradates accounted for 72.37% (Figure 11). Of the 55 DDT, DDD, and DDE detections, 100% exceeded the state water quality criteria. Because of its persistence in soils, DDT and its degradates (4,4'-DDE, and 4,4'-DDD) are detected because of either sediment entering surface water as a result of runoff in agricultural areas or stream sediment disturbance in areas where DDT was historically used. These detections are not a result of current pesticide use patterns.

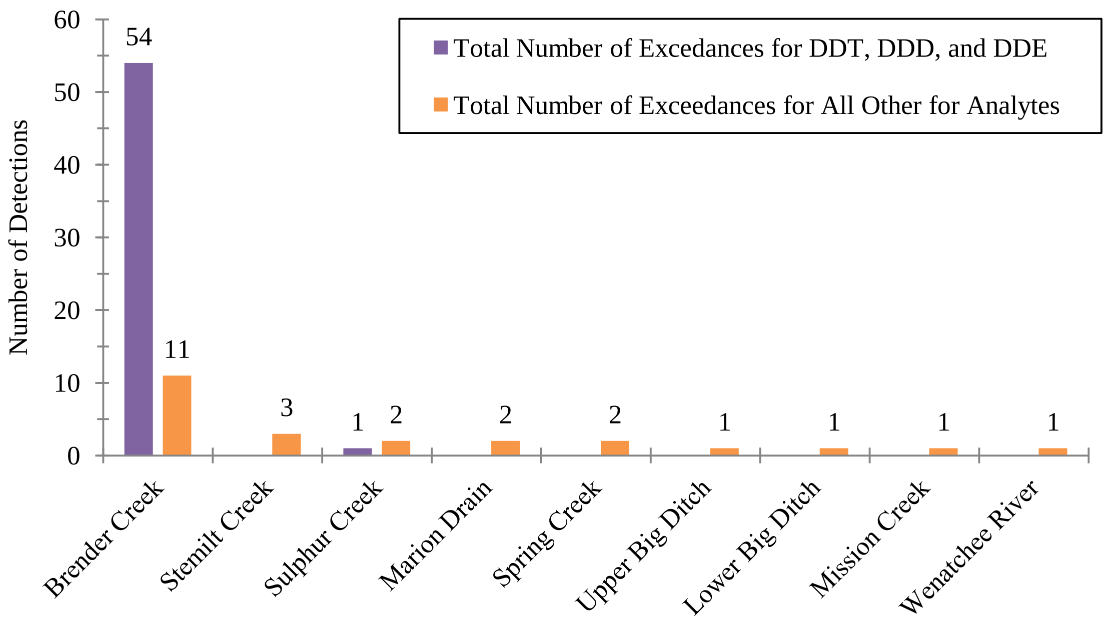

Figure 11: Monitoring Locations Where Pesticide Exceedances Occurred in 2013

Current use Insecticide Exceedances

Current use insecticides including three organophosphate insecticides (chlorpyrifos, diazinon, and malathion), one pyrethroid (bifenthrin), and one organochlorine insecticide (endosulfan and its primary degradate endosulfan sulfate) accounted for 26.32% of all exceedances. Exactly half (13.16%) of the exceedances from current use insecticides were due to endosulfan or endosulfan sulfate. Endosulfan is scheduled for full phase-out and will have no registered uses in the United States after July 31st, 2016.

Herbicide Exceedances

Although there were 1,027 total detections of herbicides, there was only one herbicide detection above the assessment criteria accounting for 1.32% of the total exceedances in 2013. Metolachlor was the seventh most commonly detected herbicide (63 detections) in 2013 and the only herbicide to exceed the assessment criteria.

Pesticide Mixtures Analysis

For the purposes of this report, *pesticide mixtures* will refer to environmental mixtures containing two or more pesticides. This term is different than pesticide tank mixtures that are a combination of one or more agricultural or non-agricultural chemicals that are intentionally mixed before pesticide application for a variety of reasons.

The data from the 2013 monitoring season shows pesticide mixtures were found at more than half of the 495 site visits. Two or more pesticides were detected 285 times (62%). There were 55 instances (12%) where only one pesticide was detected, and 119 site visits (26%) where no pesticides were detected (Figure 12).

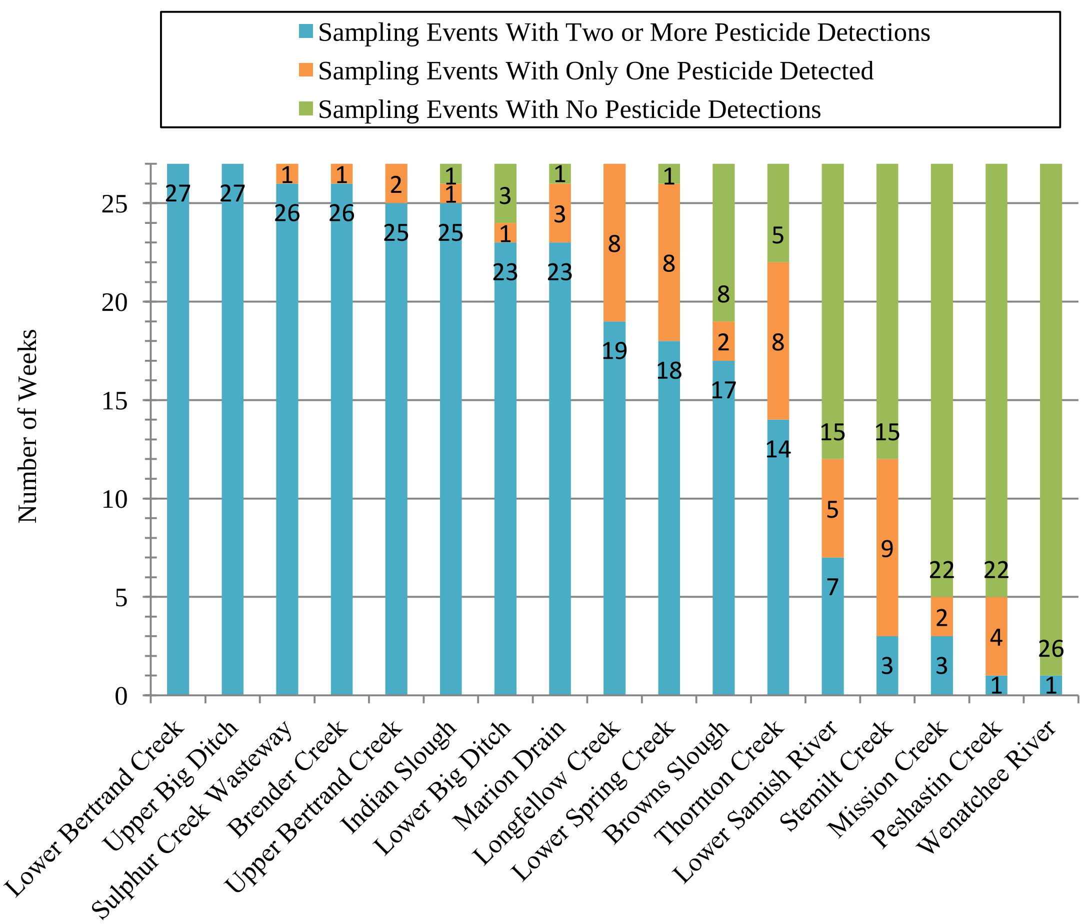

Figure 12: Number of Weeks Where Mixtures Were Detected at Site Visits in 2013

At least one pesticide mixture was detected at every monitoring location in 2013 and the frequency of mixtures detected varied greatly between locations. Of the 17 monitoring locations, pesticide mixtures were detected every week of the 27 week monitoring season for sites located in the Nooksack and Lower Skagit-Samish watersheds (WRIA's 1 and 3) In contrast, pesticide mixtures were detected in only one week at two of the monitoring sites located in the Wenatchee watershed (WRIA 45).

The average number of pesticides detected at site visits over the whole season for all sites was 3.43 and by site ranged from 0.1 detections per site visit at the Wenatchee River monitoring location to 7.9 detections per site visit at the at Lower Bertrand Creek monitoring location (Figure 13).

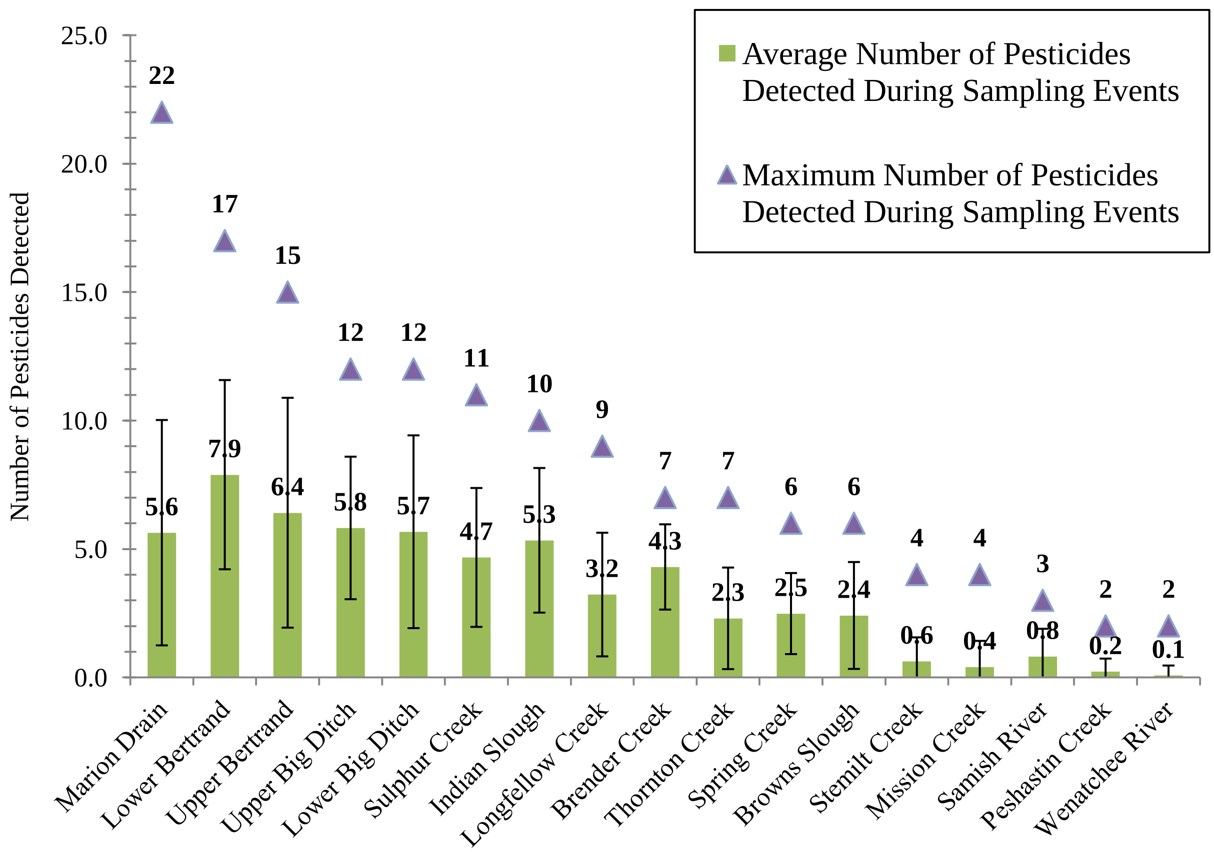

Figure 13: Average and Maximum Number of Pesticides Detected in 2013

The maximum number of pesticides detected at a single site visit over the whole season was 22 at Marion Drain. The mean for the maximum number of pesticides detected at a single site visit at all of the monitoring locations was nine.

Toxicity Unit Analysis

Although, there is currently no formal guidance from EPA on assessing risk to aquatic life from exposure to environmental mixtures containing two or more unrelated chemicals, it is possible to estimate the potential risk to aquatic species by making some assumptions using the same assessment criteria used to evaluate risk from a single chemical exposure.

In order to estimate the potential risk to aquatic life from exposure to pesticide mixtures a toxicity unit analysis was completed using the method discussed on pages 28-29 of this report. Table 9 provides a summary of the 20 site visits with pesticide mixtures having an overall estimated toxicity above one of the levels of concern (TU ≥ 1.0). Values in Table 9 exceeding the LOC are highlighted in bold.

The analysis used the same assessment criteria shown in Appendix C to evaluate risk from a single chemical exposure. Toxicity units were calculated for all 459 site visits. Of the 459 site visits, 20 were associated occurrences where the sum of the individual risk quotients (toxicity units) were greater than or equal to 1 (TU ≥ 1.0) as compared to 5 different LOCs for Endangered Species, Acute, and Chronic LOCs (discussed on pages 31-33 in the ***Assessment Criteria and Washington State Water Quality Standards*** section of this report).

Of the 20 site visits exceeding one or more of the five LOCs, 14 were primarily due to an elevated concentration of a single pesticide without the contribution of other pesticides in a mixture or were the only pesticide detected.

The most common pesticide representing a significant contribution to the Overall TU Values (≥ 0.01 TU) was chlorpyrifos. Other common pesticides representing a significant contribution to the Overall TU Values (≥ 0.01 TU) are listed in Table 9 and include endosulfan I and II, pentachlorophenol, and metolachlor.

Table 9: Toxicity Unit Analysis for Endangered Species, Acute, and Chronic LOCs.

Monitoring Site	Site visit Date	Level of Concern (LOC)[A,C]					Number of Pesticides in the Mixture	Pesticides Representing a Significant Contribution to the Overall TU Values (≥ 0.01 TU)
		Endangered Species	Fisheries Acute	Invertebrate Acute	Fisheries Chronic	Invertebrate Chronic		
Upper Big Ditch	9/9/2013	**7.90**	0.79	0.08	**1.49** [B]	**45.39** [B]	10	bifenthrin [B], pentachlorophenol
Brender Creek	3/20/2013	**6.34**	0.63	0.00	**1.99**	0.11	6	endosulfan I, endosulfan II, endosulfan sulfate
Brender Creek	4/23/2013	**5.69**	0.57	0.58	**1.45**	0.80	6	chlorpyrifos, endosulfan I, endosulfan II, endosulfan sulfate
Brender Creek	3/26/2013	**3.83**	0.38	0.66	**1.15**	0.88	6	chlorpyrifos, endosulfan I, endosulfan II, endosulfan sulfate
Brender Creek	5/1/2013	**2.30**	0.23	0.00	0.60	0.03	5	endosulfan I, endosulfan II, endosulfan sulfate
Brender Creek	4/3/2013	**1.85**	0.18	0.54	0.42	0.69	5	chlorpyrifos, endosulfan I, endosulfan II, endosulfan sulfate
Mission Creek	3/26/2013	**1.39**	0.14	0.00	0.57	0.06	2	endosulfan I, piperonyl butoxide
Sulfur Creek	3/27/2013	**1.30**	0.13	**4.01**	0.46	**5.26**	5	chlorpyrifos, diazinon, trifluralin
Wenatchee River	3/26/2013	**1.28** [B]	0.13	0.00	0.51	0.03	2	endosulfan I [B]
Brender Creek	4/8/2013	**1.06**	0.11	0.78	0.07	0.98	5	chlorpyrifos, endosulfan sulfate, pentachlorophenol
Spring Creek	3/27/2013	0.93	0.09	**2.80** [B]	0.25	**3.50** [B]	2	chlorpyrifos [B]
Spring Creek	4/2/2013	0.87	0.09	**2.60** [B]	0.23	**3.25** [B]	2	chlorpyrifos [B]
Sulfur Creek	4/2/2013	0.45	0.05	**1.32** [B]	0.13	**1.66** [B]	4	chlorpyrifos [B]
Stemilt Creek	4/3/2013	0.41	0.04	**2.24**	0.76	**4.31**	2	chlorpyrifos, diazinon
Marion Drain	6/4/2013	0.39	0.04	**1.14** [B]	0.11	**1.44** [B]	7	chlorpyrifos [B]
Marion Drain	5/22/2013	0.38	0.04	0.13	0.21	**1.02**	22	2,4-D, bromoxynil, diuron, ethoprop, fipronil sulfone, mcpa, pendimethalin, pentachlorophenol, trifluralin
Marion Drain	3/27/2013	0.37	0.04	**1.12** [B]	0.10	**1.40** [B]	2	chlorpyrifos [B]
Lower Big Ditch	5/28/2013	0.06	0.01	0.00	0.01	**1.10** [B]	11	metolachlor [B], pentachlorophenol
Stemilt Creek	7/1/2013	0.04	0.00	0.23	0.01	**1.15** [B]	2	malathion [B]
Lower Big Ditch	4/15/2013	0.04	0.00	0.01	0.01	**1.00**	12	metolachlor, ethoprop, pentachlorophenol

[A] Toxicity units where TU ≥ 1.0) are indicated by **bold** values and signify the additive toxicity was above a level of concern.
[B] Indicates the level of concern was exceeded primarily due to an elevated concentration of a single pesticide.
[C] The toxicity unit values could be slightly underestimated in some cases due to the lack of criteria for some pesticides and their metabolites.

Pesticide Calendars

The calendars provide a chronological overview of the pesticides detected during 2013 monitoring season as well as a visual comparison to the assessment criteria (pesticide registration toxicity data and NRWQC) and state water quality standards (numeric Washington State Water Quality Standards). For specific values and information on assessment criteria development refer to Appendix C: Assessment Criteria and Water Quality Standards.

Table 10 presents the color codes used in Tables 11 through 26 to compare detected pesticide concentrations to assessment criteria and state water quality standards. In the calendars, the number below the months indicate the week of the year the site visit occurred and each column indicates the data associated with that event.

Table 10: Color codes for comparison to assessment criteria in the pesticide calendars.

(white)	No pesticide residue detected.
(crossed box)	Analysis not completed
(gray)	Pesticide residue detected. No state water quality standard or assessment criteria available
(green)	Magnitude of detection is below the assessment criteria and state water quality standard
(yellow)	Magnitude of detection is above an acute or chronic invertebrate assessment criteria
(orange)	Magnitude of detection is above an acute or chronic water quality standard (WAC[1] or NRWQC[2])
(red)	Magnitude of detection above Endangered Species Level of Concern for fish (1/20th of the acute toxicity criteria for fish)

[1] WAC: Washington Administrative Code
[2] NRWQC: EPA's National Recommended Water Quality Criteria

Detection of a pesticide concentration above the assessment criteria does not necessarily indicate an exceedance has occurred because the temporal component of the criteria must also be exceeded. The Washington State Department of Agriculture (WSDA) advises pesticide user groups and other stakeholders on the results of this study and determines if assessment criteria are exceeded. If an exceedance is determined, WSDA advises stakeholders of appropriate measures to reduce pesticide concentrations. Please visit the WSDA Pesticide Management Division for information on mitigation, compliance, or technical assistance.

Nooksack basin (WRIA 1) Pesticide Calendars

Upper Bertrand Creek 2013 Pesticide Calendar

In 2013, there was a total of 173 pesticide detections at Upper Bertrand Creek for 25 pesticides or pesticide related compounds (Table 11). All pesticides detected in Upper Bertrand Creek were below the pesticide assessment criteria and water quality standards.

Table 11: Upper Bertrand Creek, 2013 Comparison to Freshwater Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H					0.045	0.041	0.069	0.210		0.590		0.120	0.039			0.071	0.110										
Aldicarb Sulfoxide	D-C															0.036												
Boscalid	F	X	X	0.029		0.120	0.110	0.130	0.100	0.072	0.210	0.100	0.210	0.100	0.110	0.110	0.255	0.180	0.180	0.110	0.160	0.120	0.170	0.093	0.081	0.080	0.080	0.060
Bromoxynil	H										0.042																	
Diazinon	I-OP										0.061																	
Dicamba I	H					0.014	0.028	0.025	0.092		0.120	0.023	0.053	0.015			0.020											
Dichlobenil	H	0.028	0.021	0.019	0.016	0.045	0.031	0.026	0.023	0.014	0.027		0.012				0.017	0.006										
Dichlorprop	H																0.032	0.088										
Diuron	H																			0.014								
Imidacloprid	I-N					0.014			0.013					0.023			0.056	0.102	0.012						0.006			
Malaoxon	D-OP	0.003	0.010	0.010	0.003		0.004				0.010		0.010				0.004											
MCPA	H					0.095	0.038	0.020	0.025		0.310	0.069	0.225	0.027	0.037	0.100	0.110											
Mecoprop (MCPP)	H					0.049	0.051	0.075	0.230	0.028	0.480	0.012	0.140	0.025	0.017	0.010	0.076	0.030										
Metalaxyl	F			0.042		0.065	0.044				0.070							0.039	0.170	0.058			0.170	0.045			0.083	0.075
Methomyl	I-C															0.014												
Metolachlor	H					0.070	0.039	0.023	0.032		0.022																	
Napropamide	H					0.380			0.115		0.220																	
Oxamyl	I-C	0.011	0.006	0.022	0.018	0.008	0.011	0.009	0.010	0.016	0.011	0.010	0.007	0.013		0.012	0.009	0.018	0.012									
Oxamyl oxime	D-C				0.022					0.038		0.009				0.036		0.023	0.055									
Pentachlorophenol	WP						0.012										0.020											
Propoxur	I-C															0.007												
Simazine	H					0.250	0.150	0.070	0.255		0.210	0.088	0.370	0.130	0.100	0.072	0.060	0.088	0.150	0.071	0.098			0.057	0.046			
Terbacil	H					0.280	0.190	0.072	0.080				0.140															
Tetrahydrophthalimide	D-F	X	X				0.220				0.770		0.047															
Triclopyr	H												0.053				0.042											
Total Suspended Solids	NA	1.0	5.0	3.0	2.0	7.0	3.0	< 2	2.0	2.0	22.0	1.0	4.0	1.0	< 1	1.0	4.0	1.0	1.0	1.0	1.0	< 1	< 1	< 1	< 1	< 1	< 1	< 1

C: Carbamate, D: Degradate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, OP: Organophosphate, WP: Wood preservative

Lower Bertrand Creek 2013 Pesticide Calendar

In 2013, there was a total of 213 pesticide detections at Lower Bertrand Creek for 27 pesticides or pesticide related compounds (Table 12). All pesticides detected in Lower Bertrand Creek were below the pesticide assessment criteria and water quality standards.

Table 12: Lower Bertrand Creek 2013, Comparison to Freshwater Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H					0.042	0.034	0.047	0.180		0.350		0.087				0.036											
Aldicarb Sulfoxide	D-C															0.006												
Atrazine	H																						0.016					
Boscalid	F	X	X			0.069	0.065				0.125	0.062	0.170				0.210	0.140	0.150	0.070		0.110	0.110			0.075		
Bromacil	H											0.027				0.031			0.036	0.035	0.037	0.038	0.046	0.048	0.048	0.048	0.046	0.034
Bromoxynil	H										0.030						0.017											
Chlorothalonil	F	0.042																										
Diazinon	I-OP							0.041	0.031		0.110	0.026	0.021	0.016														
Dicamba I	H					0.011		0.024	0.048		0.052		0.036															
Dichlobenil	H	0.017	0.018	0.015	0.013	0.029	0.020	0.025	0.012	0.011	0.016																	
Diuron	H				0.007		0.028	0.034	0.013		0.047						0.062		0.101	0.037						0.011		
Imidacloprid	I-N						0.021		0.010		0.020						0.025		0.016	0.030								
Malaoxon	D-OP	0.002	0.010	0.010	0.002	0.010					0.010	0.010					0.004		0.003	0.004			0.002					
MCPA	H					0.063	0.036	0.010			0.028	0.035	0.140	0.018		0.054	0.047			0.019								
Mecoprop (MCPP)	H					0.048	0.043	0.069	0.150		0.250		0.110				0.023											
Metalaxyl	F	0.079		0.061	0.057	0.069	0.053	0.061	0.055	0.061		0.061		0.051		0.065	0.045	0.060	0.140	0.071		0.110	0.280	0.100	0.120	0.120	0.120	0.095
Methomyl	I-C																		0.010									
Metolachlor	H					0.069	0.031						0.022															
Napropamide	H					0.310	0.120				0.225																	
Oxamyl	I-C	0.030	0.033	0.044	0.036	0.030	0.039	0.026	0.034	0.038	0.026	0.033	0.021	0.029	0.013	0.031	0.021	0.024	0.030	0.037	0.045	0.045	0.054	0.054	0.051	0.058	0.051	0.053
Oxamyl oxime	D-C		0.019	0.021	0.031				0.035	0.047	0.032	0.031		0.035	0.017	0.044	0.042	0.052	0.057	0.027	0.045	0.072	0.048	0.026		0.051	0.490	0.412
Pentachlorophenol	WP																0.019				0.015							
Propoxur	I-C																	0.007										
Simazine	H					0.120		0.059	0.120		0.105	0.061	0.230	0.077	0.059				0.068									
Terbacil	H					0.110							0.054															
Tetrahydrophthalimide	D-F	X	X				0.150	0.055			0.062	0.023	0.062			0.023	0.032		0.068		0.026							
Triclopyr	H										0.051		0.036	0.021	0.014	0.014	0.053	0.019		0.017	0.014	0.016		0.014		0.015		0.012
Total Suspended Solids	NA	6.0	17.0	7.0	4.0	17.0	6.0	7.0	4.0	4.0	13.0	3.0	7.0	6.0	2.0	2.0	5.0	4.0	1.0	1.0	< 1	< 2	< 2	< 1	< 1	1.0	1.0	< 1

C: Carbamate, D: Degradate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, OP: Organophosphate, WP: Wood preservative

Lower Skagit-Samish Basin (WRIA 3) Pesticide Calendars

Upper Big Ditch 2013 Pesticide Calendar

In 2013, there was a total of 157 pesticide detections at Upper Big Ditch for 21 pesticides or pesticide related compounds (Table 13). There was a single detection of bifenthrin on September 9th above the ESLOC. All other pesticides detected in Upper Big Ditch were below the pesticide assessment criteria and water quality standards.

Table 13: Upper Big Ditch 2013, Comparison to Freshwater Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H					0.150	0.092	0.038	0.140		0.150	0.570	0.048	0.160									0.099	0.230		0.210		0.053
3,5-Dichlorobenzoic Acid	D-M					0.010													0.041			0.012						
4-Nitrophenol	D-M								X			0.170																
Bifenthrin	I-Py																											0.059
Boscalid	F	X	X	0.110	0.190		0.065	0.140	0.084	0.340	0.110	0.087		0.400	0.210	0.215		0.770	0.450	0.710	0.570	0.660	0.570	0.150	0.250		0.160	0.230
Bromacil	H		0.044	0.040			0.028				0.043											0.040	0.048					
Carbaryl	I-C													0.043														
Diazinon	I-OP											0.021																
Dicamba I	H					0.044	0.057	0.026	0.041	0.034	0.029	0.093	0.023	0.021	0.018													
Dichlobenil	H	0.110	0.047	0.018	0.013	0.076	0.040	0.025	0.017	0.013	0.020	0.035	0.024	0.027	0.006	0.007	0.016	0.006								0.015	0.006	0.010
Diuron	H			0.009								0.014								0.019						0.306		0.073
Imidacloprid	I-N				0.022					0.104				0.226	0.705	0.069	0.035	0.235	0.120	0.275	0.029		0.015			0.028	0.053	0.244
MCPA	H					0.082	0.024		0.024			0.430																
Mecoprop (MCPP)	H					0.094	0.040		0.027		0.011	0.096	0.011															
Metalaxyl	F				0.067																							2.60
Metolachlor	H									0.032	0.029	0.036	0.018															
Oxamyl	I-C							0.002																				
Pentachlorophenol	WP	0.054	0.024		0.025	0.028	0.023	0.019	0.027	0.015	0.035	0.060	0.024	0.023		0.018	0.024	0.023			0.021	0.022	0.021			0.039	0.030	0.022
Prometon	H						0.033						0.015															
Tebuthiuron	H									0.058	0.038		0.036			0.043	0.047	0.053							0.080			0.066
Triclopyr	H					0.078	0.044	0.028	0.099		0.110	0.330	0.053	0.025			0.033						0.093	0.230		0.210	0.023	0.100
Total Suspended Solids	NA	62.0	9.0	6.0	5.0	6.0	4.0	5.0	5.0	5.0	3.5	23.0	4.0	5.0	4.0	4.0	72.0	6.0	6.0	6.0	8.0	8.0	6.0	5.0	4.0	15.0	5.0	6.0

C: Carbamate, D: Degradate, F: Fungicide, H: Herbicide, I: Insecticide, M: Multiple, N: Neonicotinoid, NA: Not applicable, OP: Organophosphate, Py: Pyrethroid, WP: Wood preservative

Lower Big Ditch 2013 Pesticide Calendar

In 2013, there was a total of 153 pesticide detections at Lower Big Ditch for 23 pesticides or pesticide related compounds (Table 14). There was a single detection of metolachlor on May 28th above the chronic invertebrate assessment criterion. All other pesticides detected in Lower Big Ditch were below the pesticide assessment criteria and water quality standards.

Table 14: Lower Big Ditch 2013, Comparison to Freshwater Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H		0.940		0.060	0.230	0.091		0.078		0.235		0.099				0.042	0.040		0.039		0.035	0.170	0.040		0.033	0.036	0.053
Atrazine	H		0.021											0.039		0.019	0.057	0.016										
Bentazon	H					0.032			0.077			0.072					0.076											0.150
Boscalid	F	X	X						0.100	0.140	0.067		0.120		0.120		0.100						0.330	0.086		0.150	0.094	0.071
Bromacil	H	0.064		0.043		0.091	0.077	0.044					0.059														0.035	
Carbofuran	I-C													0.009														
Chlorpropham	H	0.430	0.066	0.047			0.038																			0.100	1.40	1.80
Diazinon	I-OP										0.039																	
Dicamba I	H						0.037	0.026			0.020			0.044														
Dichlobenil	H	0.021	0.023	0.013	0.011	0.041	0.030	0.014	0.010	0.010	0.010		0.009															0.007
Diuron	H	0.034	0.051	0.029		0.074	0.039	0.028	0.021	0.019	0.021		0.020	0.017			0.008										0.015	0.115
Eptam	H			0.043		0.049	0.053		0.036					0.042														
Ethoprop	I-OP						0.097				0.130																	
Imidacloprid	I-N														0.083		0.010			0.046				0.004		0.014	0.026	
MCPA	H					0.048		0.031			0.060	0.240	0.220	0.180													0.019	
Mecoprop (MCPP)	H					0.044																						
Metalaxyl	F																	0.083										0.092
Metolachlor	H	0.160	0.240	0.056	0.041	0.380	0.880	0.180	0.071	0.030	0.150	0.100	1.10	0.490	0.061	0.025	0.120	0.027										0.190
Metribuzin	H					0.047	0.110					0.210	0.210	0.150			0.079											
Pentachlorophenol	WP	0.009	0.024		0.023	0.028	0.020	0.018	0.015			0.022	0.029	0.026														0.019
Simazine	H							0.081																				
Tebuthiuron	H												0.033															
Triclopyr	H					0.070	0.042		0.040		0.083		0.054				0.024						0.086	0.018			0.028	0.030
Total Suspended Solids	NA	32.0	44.0	22.0	26.0	50.0	39.5	33.0	10.0	14.0	9.0	11.0	10.0	16.0	12.0	4.0	8.0	4.0	11.0	15.0	16.0	5.0	4.0	7.0	4.0	2.0	2.5	3.0

C: Carbamate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, OP: Organophosphate, WP: Wood preservative

Indian Slough 2013 Pesticide Calendar

In 2013, there was a total of 144 pesticide detections at Indian Slough for 23 pesticides or pesticide related compounds (Table 15). All pesticides detected in Indian Slough were below the available pesticide assessment criteria and water quality standards.

Table 15: Indian Slough 2013, Comparison to Freshwater Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H							0.053	0.280		0.560	0.160	0.310	0.059	0.034		0.120	0.039					0.048	0.051			0.085	0.210
3,5-Dichlorobenzoic Acid	D-M																					0.011						0.027
4-Nitrophenol	D-M								X		0.072															0.065		
Aldicarb Sulfoxide	D-C															0.004												
Bentazon	H													0.035	0.036				0.037	0.041						0.038		
Bromacil	H	0.088	0.077	0.048		0.052	0.047	0.038	0.061			0.055	0.055	0.035		0.038					0.033						0.040	
Chlorpropham	H	0.110		0.035	0.140																							
Dicamba I	H						0.026				0.029																0.026	0.059
Dichlobenil	H	0.021	0.014	0.013	0.011	0.026	0.018	0.010	0.030	0.014	0.038		0.023				0.010										0.007	0.029
Diphenamid	H	0.036	0.025	0.025					0.020					0.023	0.021	0.022			0.031	0.024						0.027		
Diuron	H		0.014			0.016	0.017	0.014	0.010				1.75	0.519	0.042	0.043	0.083	0.100	0.016			0.020						
Eptam	H									0.037																		
Ethoprop	I-OP					0.110	0.760	0.490																				
Imidacloprid	I-N																										0.014	0.039
MCPA	H								0.014								0.051											
Mecoprop (MCPP)	H										0.047																0.012	0.029
Metolachlor	H	0.039	0.051	0.022		0.034	0.031	0.020			0.023	0.018	0.045	0.025			0.030	0.024			0.027							0.068
Monuron	H																											0.034
Pentachlorophenol	WP	0.008	0.024		0.019	0.022	0.016	0.013	0.014							0.017												
Prometon	H										0.040																	
Simazine	H					0.320	0.094								0.079													
Tebuthiuron	H		0.088		0.073		0.035	0.043	0.080		0.078	0.085	0.042	0.074				0.088		0.061				0.100		0.130		
Triclopyr	H					0.021	0.015	0.030	0.130		0.290	0.140	0.470	0.090	0.020		0.110	0.039									0.071	0.240
Total Suspended Solids	NA	12.0	7.5	7.0	8.0	10.0	9.0	8.0	7.0	16.0	11.0	8.5	7.0	6.0	6.0	6.0	5.0	4.0	4.0	4.0	3.0	6.0	5.0	2.0	2.0	< 2	< 2	2.0

C: Carbamate, D: Degradate, H: Herbicide, I: Insecticide, M: Multiple, N: Neonicotinoid, NA: Not applicable, OP: Organophosphate, WP: Wood preservative

Browns Slough 2013 Pesticide Calendar

In 2013, there was a total of 65 pesticide detections at Browns Slough for 14 pesticides or pesticide related compounds (Table 16). All pesticides detected in Browns Slough were below the available pesticide assessment criteria and water quality standards.

Table 16: Browns Slough 2013, Comparison to Freshwater and Marine Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H				0.066	0.530	0.290				0.068				0.038			0.088										
Atrazine	H					0.025								0.980	0.028	0.027	0.029	0.033										
Bentazon	H					0.051	0.062							0.035														
Boscalid	F	X	X														0.120											
Cyprodinil	F											0.011																
DCPA	H	0.260	0.180	0.240	0.082		0.010	0.390	0.190	0.150	0.029	0.075	0.050	0.066	0.022	0.029	0.056	0.130							0.030			0.021
Diuron	H		0.017			0.011	0.011											0.011										
Eptam	H											0.022	0.200	0.063	0.022													
Imidacloprid	I-N		0.019			0.027																						
MCPA	H									0.100																		
Metolachlor	H	0.037	0.140	0.021		0.067	0.070	0.024	0.039	0.110	0.054	0.021	0.024	0.019	0.015	0.025	0.025	0.052										
Metribuzin	H														0.066													
Simazine	H		0.320																									
Triclopyr	H										0.022																	
Total Suspended Solids	NA	8.0	17.0	17.0	10.5	13.0	15.0	16.0	25.0	19.0	14.0	5.0	7.0	8.0	8.0	7.0	5.0	5.0	6.0	5.0	8.0	8.0	9.0	10.0	13.0	9.0	14.0	17.0

F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable

Samish River 2013 Pesticide Calendar

In 2013, there was a total of 22 pesticide detections at Samish River for 8 pesticides or pesticide related compounds (Table 17). All pesticides detected in Samish River were below the available pesticide assessment criteria and water quality standards.

Table 17: Samish River 2013, Comparison to Freshwater and Marine Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H		1.10						0.025		0.069	0.047	0.039													0.031	0.040	
DCPA	H																										0.011	
Dichlobenil	H							0.009	0.007																			
MCPA	H					0.035						0.017	0.016															
Metolachlor	H	0.037					0.020																					
Oxamyl	I-C																		0.002									
Pentachlorophenol	WP		0.026																							0.021		
Triclopyr	H								0.013		0.025	0.021	0.023															
Total Suspended Solids	NA	30.0	28.0	16.0	11.0	32.0	39.0	34.0	16.0	9.0	12.0	11.0	13.0	8.0	8.0	5.0	9.0	4.0	3.0	5.0	3.0	3.5	4.0	3.0	2.0	7.0	3.0	3.0

C: Carbamate, H: Herbicide, I: Insecticide, NA: Not applicable, WP: Wood preservative

Cedar-Sammamish Basin (WRIA 8) Pesticide Calendar

Thornton Creek 2013 Pesticide Calendar

In 2013, there was a total of 62 pesticide detections at Thornton Creek for 12 pesticides or pesticide related compounds (Table 18). All pesticides detected in Thornton Creek were below the available pesticide assessment criteria and water quality standards.

Table 18: Thornton Creek 2013, Comparison to Freshwater and Marine Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H							0.058	0.095		0.061		0.058				0.150	0.040					0.064				0.180	
4-Nitrophenol	D-M								0.220																		0.520	
Bromacil	H													0.030														
Dicamba I	H										0.026																	
Dichlobenil	H	0.018	0.009	0.017		0.037	0.020	0.022	0.034	0.013	0.011		0.017				0.020	0.006						0.007			0.018	0.009
Diuron	H		0.007			0.009	0.007				0.008		0.018															
MCPA	H							0.021																			0.035	
Mecoprop (MCPP)	H					0.024		0.043									0.023						0.008				0.056	
Metolachlor	H													0.025														
Pentachlorophenol	WP					0.027	0.016		0.017			0.020	0.022		0.018	0.017	0.034	0.018				0.018		0.027	0.018		0.058	0.020
Tebuthiuron	H													0.063														
Triclopyr	H					0.027		0.048	0.053								0.079	0.016									0.088	0.031
Total Suspended Solids	NA	8.0	4.0	3.0	4.0	11.0	5.0	6.0	15.0	5.0	8.0	4.0	45.0	4.0	7.0	5.0	40.0	5.0	4.0	4.0	4.0	3.0	5.0	5.0	13.0	< 1	147.0	3.0

D: Degradate, H: Herbicide, M: Multiple, NA: Not applicable, WP: Wood preservative

Green-Duwamish Basin (WRIA 9) Pesticide Calendar

Longfellow Creek 2013 Pesticide Calendar

In 2013, there was a total of 87 pesticide detections at Longfellow Creek for 11 pesticides or pesticide related compounds (Table 19). All pesticides detected in Longfellow Creek were below the available pesticide assessment criteria and water quality standards.

Table 19: Longfellow Creek 2013, Comparison to Freshwater Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H						0.018		0.087		0.084		0.120				0.440											
Carbaryl	I-C						0.008																					
Chlorothalonil	F																0.310											
Dicamba I	H					0.031	0.023										0.100											0.014
Dichlobenil	H	0.014	0.010	0.018	0.013	0.045	0.015	0.014	0.018	0.010	0.009		0.018				0.025	0.007										0.008
Diuron	H	0.023	0.025		0.016	0.036	0.021	0.086	0.085	0.013	0.039	0.019	0.607	0.060	0.015	0.007	0.497	0.028					0.006			0.065	0.052	0.021
Imidacloprid	I-N															0.021			0.018	0.048			0.014					0.014
MCPA	H					0.100	0.019				0.034						0.039	0.033								0.015		0.040
Mecoprop (MCPP)	H						0.027		0.048		0.014		0.022				0.180											
Pentachlorophenol	WP					0.024	0.014	0.011	0.016	0.010			0.026			0.018	0.035	0.020		0.016		0.016		0.017			0.034	0.017
Triclopyr	H					0.023	0.012						0.044				0.059				0.030		0.072	0.040	0.013	0.120	0.095	0.052
Total Suspended Solids	NA	8.0	4.0	3.0	4.0	19.0	9.0	3.0	3.0	3.0	5.0	5.0	23.0	8.0	10.0	8.0	256.0	9.5	8.0	10.0	11.0	8.0	5.5	8.0	6.0	16.0	20.0	5.0

C: Carbamate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, WP: Wood preservative

Lower Yakima Basin (WRIA 37) Pesticide Calendars

Marion Drain 2013 Pesticide Calendar

In 2013, there was a total of 156 pesticide detections at Marian Drain for 27 pesticides or pesticide related compounds (Table 20). There were two detections of chlorpyrifos on March 27th and June 29th above the chronic freshwater criteria of the state water quality standard (0.041 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average). All other pesticides detected in Marian Drain were below the available pesticide assessment criteria and water quality standards.

Table 20: Marion Drain 2013, Comparison to Freshwater Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep				
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
2,4-D	H					0.027	0.021	X	0.062	0.065	0.350	0.640	0.088	0.061	0.050	0.048	0.048	0.120	0.037	0.220	0.130	0.039	0.039	0.078		0.076	0.033	0.029	X	X	X
Atrazine	H											0.028																	X	X	X
Bentazon	H		0.033								0.040	0.530		0.052	0.078	0.058	0.069	0.035	0.046	0.074	0.080	0.140	0.150	0.140	0.089	0.086	0.093	0.073	X	X	X
Boscalid	F	X	X									0.081																	X	X	X
Bromacil	H										0.024	0.058																	X	X	X
Bromoxynil	H						0.015	0.027	0.055	0.026	0.033	0.520	0.017		0.016		0.016												X	X	X
Carbaryl	I-C									0.027		0.020																	X	X	X
Chlorpyrifos	I-OP			0.056				0.024						0.057																	
Clopyralid	H									0.033		0.520																	X	X	X
Dicamba I	H							0.021	0.033	0.044	0.097	0.170	0.013	0.013	0.017	0.019	0.030	0.055	0.015	0.016	0.020	0.018	0.017	0.032					X	X	X
Diuron	H			0.008	0.010	0.011	0.013	0.012	0.032	0.015	0.114	0.765			0.010			0.022											X	X	X
Eptam	H									0.074		0.120																	X	X	X
Ethoprop	I-OP											0.130																			0.350
Fipronil	I-Py											0.040																	X	X	X
Fipronil Sulfone	D-Py											0.021																	X	X	X
Imidacloprid	I-N											0.220														0.014	0.011	0.016	X	X	X
MCPA	H						0.030		0.019	0.024	0.044	0.440			0.017		0.019		0.024	0.018	0.015	0.018	0.020	0.016					X	X	X
Methomyl	I-C													0.004							0.048								X	X	X
Metribuzin	H							0.044																					X	X	X
Norflurazon	H										0.037	0.160																	X	X	X
Pendimethalin	H								0.066	0.081	0.079	0.310	0.033	0.060	0.051		0.035												X	X	X
Pentachlorophenol	WP											0.021																	X	X	X
Simazine	H										0.059	0.170																	X	X	X
Terbacil	H						0.079		0.210	0.360	0.230	4.60		0.110	0.140	0.091	0.075	0.058	0.400	0.160	0.160	0.150	0.140	0.080		0.035	0.098	0.099	0.660	0.440	0.510
Triallate	H																					0.015							X	X	X
Triclopyr	H								0.012																				X	X	X
Trifluralin	H								0.026	0.043	0.035	0.061			0.025	0.022													X	X	X
Total Suspended Solids	NA	15.0	11.0	49.0	51.0	32.0	32.0	22.5	18.0	33.0	47.0	160.0	20.0	13.0	11.0	3.0	5.0	10.0	3.0	2.0	2.5	4.0	7.0	8.0	163.0	12.0	3.0	34.0	28.5	30.0	27.0

C: Carbamate, D: Degradate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, OP: Organophosphate, Py: Pyrethroid, WP: Wood preservative

Spring Creek 2013 Pesticide Calendar

In 2013, there was a total of 67 pesticide detections at Spring Creek for 13 pesticides or pesticide related compounds (Table 21). There were two detections of chlorpyrifos on March 27th and April 2nd above the acute freshwater criteria of the state water quality standard (0.083 µg/L, a 1-hour average concentration not to be exceeded more than once every three years on the average). These concentrations were near, but did not exceed the ESLOC (.015 µg/L). All other pesticides detected in Spring Creek were below the available pesticide assessment criteria and water quality standards.

Table 21: Spring Creek 2013, Comparison to Freshwater Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H							X	0.082	0.052	0.120	0.094	0.041	0.051	0.046	0.054	0.075	0.044	0.031	0.032	0.036	0.035	0.036	0.037		0.040	0.050	0.044
Atrazine	H					0.016								0.013														
Carbaryl	I-C								0.032	0.029							0.008											
Chlorpyrifos	I-OP			0.140	0.130	0.039	0.025	0.030																				
Diazinon	I-OP															0.048						0.084						
Dicamba I	H							0.020	0.032	0.029	0.018	0.018	0.020		0.012		0.027											0.021
Diuron	H	0.011	0.019	0.029	0.023	0.021	0.014	0.026	0.017		0.016	0.030	0.017		0.009	0.104												
Imidacloprid	I-N															0.022			0.033	0.045								
Malaoxon	D-OP															0.010												
Malathion	I-OP																0.046											
MCPA	H							0.010	0.028	0.010		0.021					0.015											
Oxamyl	I-C																		0.003									
Triclopyr	H								0.024			0.013	0.010															
Total Suspended Solids	NA	34.0	35.0	131.0	30.0	28.0	3.0	40.0	11.0	31.0	38.5	79.0	25.0	8.0	22.0	97.0	14.0	2.0	8.0	2.0	< 1	6.0	14.0	20.0	13.0	18.0	18.0	29.0

C: Carbamate, D: Degradate, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, OP: Organophosphate

Sulphur Creek 2013 Pesticide Calendar

In 2013, there was a total of 126 pesticide detections at Sulphur Creek for 22 pesticides or pesticide related compounds (Table 22). Chlorpyrifos was detected once above the ESLOC (.015 µg/L) on March 27th, and once above the chronic freshwater criteria of the state water quality standard (0.041 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average) on April 2nd. There was also one detection of 4,4'-DDE (a degradate of DDT) above the chronic freshwater criteria of the state water quality standard (0.001 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average). All other pesticides detected in Sulphur Creek were below the available pesticide assessment criteria and water quality standards.

Table 22: Sulphur Creek 2013, Comparison to Freshwater Criteria for pesticides (µg/L) and Total Suspended Solids (mg/L)

Month		Mar			Apr					May				Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H						0.028	0.035	0.130	1.20	0.091	0.360	0.068	0.140	0.160	2.40	0.088	0.190	0.048	0.220	0.072	0.160	0.072	0.100	0.047	0.089	0.053	0.042
4,4'-DDE	D-OC			0.021																								
Atrazine	H		0.017								0.012								0.016									
Bentazon	H																		0.014									
Boscalid	F	X	X													0.110												
Bromacil	H	0.078	0.061						0.028	0.029		0.051						0.036	0.026				0.035				0.034	
Carbaryl	I-C								0.059	0.027	0.034	0.077				0.018		0.007										
Chlorpyrifos	I-OP			0.190	0.066	0.025	0.024		0.021																			
DCPA	H		0.017														0.009	0.021										
Diazinon	I-OP			0.084																						0.039		
Dicamba I	H						0.036	0.025	0.040	0.031	0.023	0.033	0.019	0.014	0.014	0.071	0.034	0.065	0.014	0.015	0.018	0.014		0.039		0.021		0.015
Diuron	H	0.024	0.020	0.047	0.201	0.043	0.034	0.024	0.033	0.062	0.036	0.790	0.037		0.015	0.297	0.007	0.023		0.022	0.028							
Imidacloprid	I-N															0.024				0.009								
Malaoxon	D-OP															0.010												
MCPA	H							0.014	0.027	0.009	0.019	0.038			0.018		0.016	0.015										
Norflurazon	H									0.052						0.074												
Oxamyl	I-C						0.029	0.009	0.003	0.006		0.004																
Pentachlorophenol	WP															0.020											0.017	0.016
Simazine	H											0.053																
Terbacil	H				0.049							0.081				0.090				0.048								0.087
Triclopyr	H							0.016	0.019			0.020																
Trifluralin	H			0.040	0.021					0.035	0.034					0.027			0.028									
Total Suspended Solids	NA	13.0	12.0	235.0	36.0	79.0	29.0	84.0	17.0	11.0	63.0	200.0	51.0	14.0	24.0	91.0	55.0	21.5	14.0	16.0	11.0	14.0	15.0	28.0	21.5	31.0	13.0	31.0

C: Carbamate, D: Degradate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative

Alkali-Squilchuck basin (WRIA 40) Pesticide Calendar

Stemilt Creek 2013 Pesticide Calendar

In 2013, there was a total of 17 pesticide detections at Stemilt Creek for 9 pesticides or pesticide related compounds (Table 23). On April 3rd, chlorpyrifos was detected above the chronic freshwater criteria of the state water quality standard (0.041 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average) and diazinon was detected above the NRWQC Criteria Maximum Concentration[5] (0.17 µg/L). A single detection of malathion was above the chronic freshwater invertebrate assessment criteria (NOAEC[6] = 0.06 µg/L) on July 1st. All other pesticides detected in Stemilt Creek were below the available pesticide assessment criteria and water quality standards.

Table 23: Stemilt Creek 2013 – Freshwater Criteria (pesticides in ug/L, Total Suspended Solids in mg/L)

Month		Mar			Apr				May					Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Boscalid	F	X	X																				0.150					
Chlorpyrifos	I-OP				0.043																							
Diazinon	I-OP				0.550	0.041	0.027	0.026																				
Imidacloprid	I-N																						0.009					
Malaoxon	D-OP																						0.002					
Malathion	I-OP																	0.069										
Picloram	H																		0.059	0.038				0.028	0.051	0.023	0.039	
Propoxur	I-C																	0.005										
Triclopyr	H																						0.016					
Total Suspended Solids	NA	2.0	5.0	4.0	11.0	13.0	6.0	4.0	17.0	50.0	327.0	13.0	61.0	35.0	30.0	13.5	43.0	9.0	3.0	2.0	7.0	4.0	28.0	2.0	3.0	3.0	2.0	214.0

C: Carbamate, D: Degradate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, OP: Organophosphate

[5] Criteria Maximum Concentration (CMC) is an estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.

[6] No Observable Adverse Effect Concentration derived from a chronic toxicity test.

Wenatchee and Entiat Basins (WRIA 45) Pesticide Calendars

Peshastin Creek 2013 Pesticide Calendar

In 2013, there was a total of 6 pesticide detections at Peshastin Creek for 3 pesticides or pesticide related compounds (Table 24). All pesticides detected in Peshastin Creek were below the available pesticide assessment criteria and water quality standards.

Table 24: Peshastin Creek 2013 – Freshwater Criteria (pesticides in ug/L, Total Suspended Solids *in mg/L)*

Month		Mar			Apr				May					Jun				Jul					Aug				Sep
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Dicofol	I-OC															0.042											
Fenamiphos	I-OP								0.038																		
Fenarimol	F					0.068				0.077						0.041		0.032									
Total Suspended Solids	NA	1.0	2.0	< 1	10.0	8.0	2.0	2.0	3.0	10.0	19.0	5.0	2.0	3.0	2.0	2.0	2.0	34.0	5.0	3.0	2.0	1.0	18.0	2.0	3.0	1.0	1.0

F: Fungicide, I: Insecticide, NA: Not applicable, OC: Organochlorine, OP: Organophosphate

Mission Creek 2013 Pesticide Calendar

In 2013, there was a total of 11 pesticide detections at Mission Creek for 11 pesticides or pesticide related compounds (Table 25). Endosulfan I was detected above the ESLOC (0.04 µg/L) on March 26th. Endosulfan is scheduled for phase-out for all crops by July 31st, 2016. All other pesticides detected in Mission Creek were below the available pesticide assessment criteria and water quality standards.

Table 25: Mission Creek 2013 – Freshwater Criteria (pesticides in ug/L, Total Suspended Solids in mg/L)

Month		Mar			Apr				May					Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Bromoxynil	H									X										0.017								
cis-Chlordane	I-OC		0.016																									
Cyprodinil	F									0.018																		
DCPA	H									X										0.008								
Endosulfan I	I-OC			0.055																								
Heptachlor Epoxide	D-OC		0.012																									
Imidacloprid	I-N																			0.014								
Malaoxon	D-OP																						0.002					
Pentachlorophenol	WP									X										0.015								
Piperonyl butoxide	Sy			0.980																								
trans-Chlordane	I-OP		0.017																									
Total Suspended Solids	NA	4.0	7.0	2.0	22.0	31.0	9.0	5.0	5.0	13.0	15.0	19.5	12.0	9.0	7.0	11.0	8.0	551.0	76.0	23.0	23.0	11.0	467.0	58.0	15.0	10.0	19.0	133.0

D: Degradate, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, NA: Not applicable, OC: Organochlorine, OP: Organophosphate, Sy: Synergist, WP: Wood preservative

Wenatchee River 2013 Pesticide Calendar

In 2013, there was a total of 2 pesticide detections at Wenatchee River for 2 pesticides or pesticide related compounds (Table 26). Endosulfan I was detected above the ESLOC (0.04 µg/L) on March 26th. Endosulfan is scheduled for phase-out for all crops by July 31st, 2016. All other pesticides detected in Wenatchee River were below the available pesticide assessment criteria and water quality standards.

Table 26: Wenatchee River 2013 – Freshwater Criteria (pesticides in ug/L, Total Suspended Solids in mg/L)

Month		Mar			Apr				May					Jun				Jul					Aug				Sep
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Endosulfan I	I-OC			0.051																							
Piperonyl butoxide	Sy			0.045																							
Total Suspended Solids	NA	2.0	3.0	2.0	8.0	8.0	3.0	2.0	2.0	12.0	40.0	11.0	7.0	14.0	6.5	8.0	5.0	31.0	6.0	3.0	3.0	2.0	7.0	2.0	2.0	2.0	2.0

I: Insecticide, NA: Not applicable, OC: Organochlorine, Sy: Synergist

Brender Creek 2013 Pesticide Calendar

In 2013, there was a total of 111 pesticide detections at Brender Creek for 17 pesticides or pesticide related compounds (Table 27). 4,4'-DDT and its degradates, 4,4'-DDE and 4,4'-DDD were detected throughout the monitoring season, March through September. There were 21 detections of 4,4'-DDT (Average =0.027 µg/L, Maximum = 0.038 µg/L), 25 detections of 4,4'-DDE (Average =0.028 µg/L, Maximum = 0.046 µg/L), and 8 detections of 4,4'-DDD (Average =0.018 µg/L, Maximum = 0.021 µg/L). All detections exceeded the chronic freshwater criteria of the state water quality standard (0.001 µg/L, 4-day average concentration not to be exceeded more than once every three years on the average). Concentrations of "endosulfan total" representing the sum of the alpha (I) and beta (II) stereoisomers were detected above the acute state water quality standard (0.22 µg/L, an instantaneous concentration not to be exceeded at any time) and the ESLOC (0.04 µg/L) on March 20th , March 26th, and April 23rd. The endosulfan sulfate (degradate of endosulfan) was detected above the ESLOC (0.07 µg/L) on March 12th and April 17th.

Table 27: Brender Creek 2013 – Freshwater Criteria (pesticides in ug/L, Total Suspended Solids *in mg/L)*

Month		Mar			Apr				May					Jun				Jul					Aug				Sep	
Calendar Week	Use	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
2,4-D	H											0.036							0.033									
4,4'-DDD	D-OC													0.015		0.015					0.019	0.019	0.021	0.019			0.020	0.017
4,4'-DDE	D-OC		0.030		0.016	0.018	0.017	0.039	0.039	0.038	0.030	0.046	0.034	0.039	0.013	0.031	0.037	0.026	0.022	0.016	0.026	0.025	0.036	0.018	0.011	0.027	0.017	0.040
4,4'-DDT	I-OC					0.025		0.038	0.030	0.033	0.028	0.038	0.027	0.027	0.021	0.025	0.031	0.026	0.024		0.023	0.024	0.029	0.021	0.019	0.027	0.023	0.026
Carbaryl	I-C										0.104	0.121																
Chlorpyrifos	I-OP			0.033	0.027	0.039		0.029																				
DCPA	H																			0.007								
Dicamba I	H																		0.013									
Dichlobenil	H	0.011																										
Diuron	H											0.128																
Endosulfan I	I-OC		0.120	0.063	0.028			0.065	0.032																			
Endosulfan II	I-OC		0.078	0.046	0.009			0.075	0.028																			
Endosulfan Total	I-OC		0.198	0.109	0.037			0.14	0.06																			
Endosulfan Sulfate	D-OC		0.097	0.062	0.052	0.055	0.057	0.140	0.056	0.062	0.052	0.063			0.026	0.034	0.021	0.026	0.020	0.022	0.023	0.022	0.027	0.020	0.015			
Norflurazon	H			0.033						0.042		0.440		0.034	0.025		0.040		0.065	0.045					0.030			
Pentachlorophenol	WP					0.014																			0.015			
Piperonyl butoxide	Sy		0.240	0.034																								
Triclopyr	H		0.062																									
Total Suspended Solids	NA	4.0	8.0	5.0	4.0	10.5	6.0	61.0	46.0	49.0	42.0	55.0	57.0	70.0	12.0	51.0	61.0	248.0	32.0	13.0	36.0	24.0	41.0	20.0	45.0	54.0	41.0	75.0

C: Carbamate, D: Degradate, H: Herbicide, I: Insecticide, NA: Not applicable, OC: Organochlorine, OP: Organophosphate, Sy: Synergist, WP: Wood preservative

Conventional Water Quality Parameters Summary

Table 28 provides a statewide overview of the conventional water quality parameters not including temperature. Measurements for streamflow, pH, dissolved oxygen, and conductivity were collected in the field during all site visits. Total Suspended Solids (mg/L) was collected in the field and analyzed by the Manchester Environmental Lab.

Table 28: Summary of Conventional Water Quality Parameters for 2013 Site Visits

Watershed	Monitoring Location	Total Suspended Solids (mg/L)	Stream Discharge (cfs)	pH (s.u.)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)
WRIA 1: Nooksack Basin (Agricultural Watershed)	**Upper Bertrand Creek**					
	Weeks Sampled	27	27	27	27	27
	Mean	2.67	22.03	7.42	185.36	10.29
	Minimum	1.00	0.96	6.82	122.50	8.05
	Maximum	22.00	86.58	8.12	240.00	13.21
	Lower Bertrand Creek					
	Weeks Sampled	27	27	27	27	27
	Mean	4.67	59.34	6.99	241.96	9.73
	Minimum	1.00	8.80	6.52	162.00	8.18
	Maximum	17.00	288.00	7.38	294.00	11.09
WRIA 3: Lower Skagit-Samish Basin (Agricultural Watershed)	**Samish River**					
	Weeks Sampled	27	26	27	27	27
	Mean	11.93	219.87	7.15	100.40	10.10
	Minimum	2.00	31.84	6.35	57.00	8.51
	Maximum	39.00	819.05	7.86	136.00	11.40
	Indian Slough					
	Weeks Sampled	27	25	27	27	27
	Mean	6.33	24.00	7.08	2377.44	7.84
	Minimum	2.00	0.11	6.55	197.00	3.53
	Maximum	16.00	60.30	8.19	15530.00	12.91
	Browns Slough					
	Weeks Sampled	27	25	27	27	27
	Mean	11.07	6.40	7.66	9383.15	12.70
	Minimum	5.00	0.26	6.94	1471.00	3.07
	Maximum	25.00	22.48	8.90	23296.00	120.40
	Lower Big Ditch					
	Weeks Sampled	27	27	27	27	27
	Mean	11.04	3.18	6.89	303.50	7.25
	Minimum	4.00	0.91	6.58	149.00	4.48
	Maximum	72.00	12.49	7.34	369.00	10.24
	Upper Big Ditch					
	Weeks Sampled	27	23	27	27	27
	Mean	15.37	14.05	7.08	450.64	7.61
	Minimum	2.00	4.51	6.38	53.00	2.49
	Maximum	50.00	50.83	7.93	875.00	13.56
WRIA 8: Cedar-Sammamish (Urban Watershed)	**Thornton Creek**					
	Weeks Sampled	27	27	27	27	27
	Mean	13.63	9.17	7.77	217.62	9.98
	Minimum	1.00	4.06	7.38	119.10	8.41
	Maximum	147.00	34.84	8.07	244.90	11.83

Watershed	Monitoring Location	Total Suspended Solids (mg/L)	Stream Discharge (cfs)	pH (s.u.)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)
WRIA 9: Green-Duwamish (Urban Watershed)	**Longfellow Creek**					
	Weeks Sampled	27	27	27	27	27
	Mean	17.74	1.84	7.95	286.17	10.49
	Minimum	3.00	0.67	7.62	172.00	8.98
	Maximum	256.00	13.13	8.22	316.00	12.21
WRIA 45: Wenatchee (Agricultural Watershed)	**Peshastin Creek**					
	Weeks Sampled	26	26	26	26	26
	Mean	5.54	232.32	8.10	111.50	11.13
	Minimum	1.00	14.90	7.78	71.30	8.80
	Maximum	34.00	855.50	8.35	182.80	13.50
	Brender Creek					
	Weeks Sampled	27	27	27	27	27
	Mean	43.41	4.28	8.13	219.40	10.40
	Minimum	4.00	0.33	7.84	112.00	9.36
	Maximum	248.00	11.25	8.48	391.00	12.10
	Mission Creek					
	Weeks Sampled	27	26	27	27	27
	Mean	58	17.21	8.48	211.91	11.32
	Minimum	2	2.65	8.14	159.50	9.40
	Maximum	551	47.53	8.76	258.00	13.70
	Wenatchee River					
	Weeks Sampled	26	26	26	26	26
	Mean	7.46	4719.42	8.15	47.63	11.39
	Minimum	2.00	686.00	7.32	27.70	9.45
	Maximum	40.00	17100.00	9.11	77.70	13.84
WRIA 40: Alkali-Squilchuck Basin (Agricultural Whatershed)	**Stemilt Creek**					
	Weeks Sampled	27	26	27	27	27
	Mean	33.78	5.83	8.26	241.47	10.29
	Minimum	2.00	0.03	7.92	84.40	8.89
	Maximum	327.00	36.46	8.51	543.00	12.89
WRIA 37: Lower Yakima (Agricultural Watershed)	**Marion Drain**					
	Weeks Sampled	30	25	30	30	30
	Mean	28.60	127.67	7.77	239.52	10.98
	Minimum	2.00	22.56	7.25	187.30	8.64
	Maximum	163.00	289.15	8.30	366.70	13.30
	Sulphur Creek					
	Weeks Sampled	27	27	27	27	27
	Mean	45.59	259.93	8.38	318.17	10.30
	Minimum	11.00	76.52	7.87	202.20	8.86
	Maximum	235.00	537.60	8.87	767.80	12.31
	Spring Creek					
	Weeks Sampled	27	27	27	27	27
	Mean	28.11	30.24	8.79	248.94	9.67
	Minimum	1.00	4.04	8.04	143.40	8.44
	Maximum	131.00	79.79	9.52	463.60	11.57

Conventional Water Quality Parameters Exceedances

The Aquatic life criteria of the Washington State Water Quality Standards are location dependent based on aquatic life uses. Aquatic life uses are based on the presence of salmonid species, or the intent to provide protection for all indigenous fish and non-fish aquatic species.

Temperature Exceedances above the Aquatic Life Criteria

Air and water temperature was monitored continuously at monitoring locations in 2013. Table 29 provides a list of the time periods where the aquatic life temperature criteria were exceeded. Criteria are based on the designated aquatic life usesat each monitoring location. Water temperature criteria are listed in the standard as the highest 7-day average of the daily maximum temperatures (7-DADMax) allowable.

Table 29: Water Temperatures Not Meeting the Washington State Aquatic Life Criteria

Washington State Aquatic Life Criteria			
Freshwater water quality standard for Core Summer Salmonid Habitat - Highest 7-DADMax = 16.0^{0}C Freshwater water quality standard for Salmonid Spawning, Rearing, and Migration Habitat - Highest 7-DADMax = 17.5^{0}C Freshwater Supplemental Spawning and Incubation criteria - October 1-May 15 - Highest 7-DADMax =13.0^{0}C Marine water quality standard for Aquatic Life Excellent use - Highest 7-DADMax = 16^{0}C			
Water Temperature Exceedances During 2013			
Aquatic Life Uses	Site and Period of Temperature Exceedance	Maximum Temperature During Period	7-DADMax Range During Period (Minimum - Maximum)
Freshwater - Salmonid Spawning, Rearing, and Migration Habitat (>17.5^{0}C)	**Upper Bertrand Creek**		
	June 24 - September 16	21.89	17.55 - 20.45
	Lower Bertrand Creek		
	June 26 - July 8	19.40	17.51 - 18.17
	July 17 - July 30	18.20	17.51 - 17.59
	Upper Big Ditch		
	no exceedances	--	--
	Lower Big Ditch		
	April 29 - May 22	22.08	17.70 - 20.33
	May 28 - September 25	27.51	17.58 - 24.32
Marine Water (>16^{0}C)	**Browns Slough**		
	March 24 - April 4	19.46	16.40 - 17.47
	April 19-September 27	30.70	16.03 - 29.70
Freshwater - Salmonid Spawning, Rearing, and Migration Habitat (>17.5^{0}C)	**Indian Slough**		
	May 4 - May 12	18.72	17.65 - 17.80
	May 30 - September 25	28.17	17.90 - 27.01
	Longfellow Creek		
	June 25 - July 8	19.29	17.52 - 18.33
	August 26 - September 4	19.32	17.54 - 17.69
	Samish River		
	June 25 - July 8	20.46	17.62 - 19.01
	July 30 - September 15	20.77	17.59 - 20.07
Freshwater - Core Summer Salmonid Habitat - (>16^{0}C)	**Thornton Creek**		
	June 16 - September 21	19.31	16.08 - 19.31
Freshwater Supplemental Spawning and Incubation [Oct. 1-May 15] (>13.0^{0}C)	**Thornton Creek**		
	April 29 - May 15	16.25	13.34 - 15.37

Aquatic Life Uses	Site and Period of Temperature Exceedance (Start - End)	Maximum Temperature During Period (°C)	7-DADmax Range During Period (Minimum - Maximum)
Freshwater - Salmonid Spawning, Rearing, and Migration Habitat (>17.5^{0}C)	**Marion Drain**		
	May 2 - 14	19.25	17.71 - 18.89
	May 30 - September 22	24.80	17.68 - 23.78
	Spring Creek		
	April 20 - 28	19.94	17.55 - 17.85
	April 30 - September 25	28.69	17.62 - 27.50
	Sulphur Creek		
	April 30 - May 16	22.08	17.67 - 20.81
	May 28 - September 24	24.87	17.55 - 23.42
	Peshastin Creek		
	July 1 - September 19	24.17	17.53 - 22.92
	Brender Creek		
	July 14 - August 17	19.91	17.61 - 18.68
	August 19 - 25	18.99	17.54 - 17.54
	August 28 - September 18	18.91	17.53 - 18.34
	Mission Creek		
	July 14 - August 23	20.10	17.57 - 19.31
	Wenatchee River		
	July 9 - September 21	24.00	17.52 - 23.46
Freshwater Supplemental Spawning and Incubation [Oct. 1-May 15] (>13.0^{0}C)	**Wenatchee River**		
	no exceedances	--	--
Freshwater - Salmonid Spawning, Rearing, and Migration Habitat (>17.5^{0}C)	**Stemilt Creek**		
	June 30 - September 30	21.51	17.51 - 20.95

7-DADMax: Water temperature measured by the 7-day average of the daily maximum temperature in degrees centigrade.
7-DADMax Range: Lists the minimum 7-DADMax and the maximum 7-DADMax values that occurred during the period of temperature exceedance

There were 16 time periods where the water temperature exceeded the aquatic life temperature criteria at western Washington monitoring locations. The only western Washington monitoring location that did not have a temperature exceedance in 2013 was Upper Big Ditch.

There were 13 time periods where the water temperature exceeded the aquatic life temperature criteria at eastern Washington monitoring locations. The only eastern Washington monitoring location that did not have a temperature exceedance in 2013 was the Wenatchee River during the supplemental salmonid spawning and incubation period from October 1-May 15.

Dissolved Oxygen Measurements Below the Acceptable Aquatic Life Criteria

Dissolved oxygen was measured at all monitoring locations in 2013. Table 30 provides a list of occurrences where dissolved oxygen was measured at levels below the aquatic life dissolved oxygen criteria. Dissolved oxygen criteria are listed in the standard as the lowest 1-day minimum. Dissolved oxygen measurements are point estimates (not continuous) taken at the time of sampling.

Table 30: Dissolved Oxygen Levels Not Meeting the Washington State Aquatic Life Criteria

<table>
<tr><th colspan="3">Washington State Aquatic Life Criteria for Dissolved Oxygen</th></tr>
<tr><td colspan="3">Freshwater water quality standard for Core Summer Salmonid Habitat - Dissolved Oxygen minimum: 9.5 mg/L
Freshwater water quality standard for Salmonid Spawning, Rearing, and Migration Habitat - Dissolved Oxygen minimum: 8.0 mg/L
Marine water quality standard for Aquatic Life Excellent use - Dissolved Oxygen minimum: 6.0 mg/L</td></tr>
<tr><th colspan="3">Monitoring Locations Meeting The Dissolved Oxygen Criteria</th></tr>
<tr><td>Western Washington</td><td colspan="2">Eastern Washington</td></tr>
<tr><td>Upper Bertrand Creek</td><td colspan="2">Brender Creek</td></tr>
<tr><td>Lower Bertrand Creek</td><td colspan="2">Marion Drain</td></tr>
<tr><td>Longfellow Creek</td><td colspan="2">Mission Creek</td></tr>
<tr><td>Samish River</td><td colspan="2">Peshastin Creek</td></tr>
<tr><td></td><td colspan="2">Stemilt Creek</td></tr>
<tr><td></td><td colspan="2">Spring Creek</td></tr>
<tr><td></td><td colspan="2">Sulphur Creek</td></tr>
<tr><td></td><td colspan="2">Wenatchee River</td></tr>
<tr><th colspan="3">Monitoring Locations With Dissolved Oxygen Measurements Below Criteria During 2013</th></tr>
<tr><td>Aquatic Life Uses</td><td>Locations and Dates of DO levels below Criteria</td><td>DO Measurements</td></tr>
<tr><td rowspan="15">Freshwater - Salmonid Spawning, Rearing, and Migration Habitat - (<8.0 mg/L)</td><td colspan="2">Upper Big Ditch</td></tr>
<tr><td>April 1</td><td>7.9</td></tr>
<tr><td>May 14, 28</td><td>7.4, 7.7</td></tr>
<tr><td>June 4, 10, 18, 24</td><td>7.1, 7.0, 6.3, 6.3</td></tr>
<tr><td>July 2, 8, 16, 22, 30</td><td>5.7, 6.5, 5.8, 6.9, 6.2</td></tr>
<tr><td>August 5, 16, 19, 29</td><td>6.2, 5.6, 7.1, 4.5</td></tr>
<tr><td>September 3, 9</td><td>6.1, 4.8</td></tr>
<tr><td colspan="2">Lower Big Ditch</td></tr>
<tr><td>March 12, 18, 26</td><td>6.1, 6.3 5.2</td></tr>
<tr><td>April 1, 9, 15, 23, 29</td><td>7.6, 6.2, 5.7, 7.8, 7.6</td></tr>
<tr><td>May 7, 21</td><td>6.9, 5</td></tr>
<tr><td>July 2, 8, 16, 30</td><td>4.6, 7.3, 5.0, 6.4</td></tr>
<tr><td>August 16, 29</td><td>3.9, 2.5</td></tr>
<tr><td>September 3</td><td>7.8</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td rowspan="4">Marine Water - (<6.0 mg/L)</td><td colspan="2">Browns Slough</td></tr>
<tr><td>June 18, 24</td><td>3.1, 5.2</td></tr>
<tr><td>July 2, 16, 22, 30</td><td>4.8, 3.5, 5.9, 4.9</td></tr>
<tr><td>August 16, 19, 29</td><td>3.5, 5.6, 4.7</td></tr>
<tr><td rowspan="6">Freshwater - Salmonid Spawning, Rearing, and Migration Habitat - (<8.0 mg/L)</td><td colspan="2">Indian Slough</td></tr>
<tr><td>March 12, 18, 26</td><td>6.7, 7.9, 4.6</td></tr>
<tr><td>April 1, 9, 15, 23, 29</td><td>4.7, 7.5, 7.6, 4.4, 6.7</td></tr>
<tr><td>May 7, 21, 28</td><td>7.7, 7.2, 6.9</td></tr>
<tr><td>June 4, 10, 18, 24</td><td>3.5, 5.1, 5.9, 6.6</td></tr>
<tr><td>July 2, 8</td><td>6.9, 7.9</td></tr>
<tr><td rowspan="5">Freshwater - Core Summer Salmonid Habitat - (<9.5 mg/L)</td><td colspan="2">Thornton Creek</td></tr>
<tr><td>June 25</td><td>8.4</td></tr>
<tr><td>July 1, 9</td><td>8.6, 9.4</td></tr>
<tr><td>August 6, 13, 20, 27</td><td>8.9, 9.4, 9.3, 9.2</td></tr>
<tr><td>September 5, 10</td><td>9.3, 9.1</td></tr>
</table>

DO: Dissolved Oxygen

There were 70 individual occurrences where the dissolved oxygen level was measured below the aquatic life criteria at western Washington monitoring locations. The western Washington monitoring locations that met the dissolved oxygen criteria for the entire 2013 monitoring season were Upper and Lower Bertrand Creek, Longfellow Creek, and the Samish River.

All eight of the eastern Washington monitoring locations had dissolved oxygen measurements above the aquatic life criteria throughout the 2013 monitoring season.

pH Measurements Outside The Acceptable Aquatic Life Criteria

Measurements were collected for pH at all monitoring locations in 2013. Table 31 (page 71) provides a list of occurrences where dissolved oxygen was measured at levels below or above the aquatic life criteria for pH. The pH criteria are listed in the standard as ranges (between a minimum and maximum) of acceptable pH values for each aquatic life use category.

There were five occurrences where the pH measurement were outside of the range listed in the aquatic life pH criteria at three western Washington locations (Samish River, Lower Big Ditch, and Browns Slough) and 45 occurrences were outside of the range listed at four eastern Washington locations (Mission Creek, Spring Creek, Sulpher Creek, and Wenatchee River).

The other six western Washington monitoring locations and four eastern Washington monitoring locations had pH measurements within the acceptable range listed for the aquatic life pH criteria during the 2013 monitoring season.

Table 31: pH Levels Not Meeting the Washington State Aquatic Life Criteria

Washington State Aquatic Life Criteria for pH		
Freshwater water quality standard for Core Summer Salmonid Habitat - pH: 6.5-8.5 (allowable human-caused variation within listed range of <0.2 units) Freshwater water quality standard for Salmonid Spawning, Rearing, and Migration Habitat - pH: 6.5-8.5 (allowable human-caused variation within listed range of <0.5 units) Marine water quality standard for Aquatic Life Excellent use - pH 7.0-8.5 (allowable human-caused variation within listed range of <0.5 units)		
Monitoring Locations That Meet The pH Criteria During 2013		
Western Washington	Eastern Washington	
Upper Big Ditch	Brender Creek	
Upper Bertrand Creek	Marion Drain	
Lower Bertrand Creek	Peshastin	
Indian Slough	Stemilt Creek	
Long Fellow Creek		
Thornton Creek		
Monitoring Locations With pH Measurements Outside Criteria Range During 2013		
Aquatic Life Uses	Locations and Date of pH Measurement	pH Measurements
Freshwater - Salmonid Spawning, Rearing, and Migration - pH: 6.5-8.5	**Samish River**	
	April 15	6.4
	Lower Big Ditch	
	July 8	6.4
Marine Water - pH 7.0-8.5	**Browns Slough**	
	July 8	8.9
	August 16	6.9
	September 9	8.8
Freshwater - Salmonid Spawning, Rearing, and Migration - pH: 6.5-8.5	**Mission Creek**	
	April 23	8.7
	May 1	8.6
	June 17, 25	8.7, 8.7
	July 22, 31	8.6, 8.7
	August 14, 19, 26	8.7, 8.8, 8.7
	September 4	8.6
	Spring Creek	
	March 14, 18	8.7, 8.8
	April 17, 22, 30	9.5, 9.5, 9.3
	May 8	8.9
	June 4, 12	8.7, 8.7
	July 22, 9, 16, 24, 30	8.7, 9, 9.2, 9.2, 9.3
	August 7, 12, 20, 28	9.2, 9.1, 9, 8.7
	September 3	8.8
	Sulphur Creek	
	March 18	8.7
	April 2, 9, 17, 22, 30	8.7, 8.6, 8.8, 8.9, 8.7
	May 8	8.7
	June 4	8.6
	Wenatchee River	
	March 11, 26	8.7, 8.8
	April 23	9
	May 1	8.6
	August 5, 14, 19, 26	8.6, 9, 9, 8.9
	September 4	9.1

* maximum exceedance pH value of listed date range

Summary Conclusions and Program Changes for 2014:

Summary Conclusions

Compared to findings the 2012 monitoring season, there was an overall 44% increase in the total number of detections in 2013 (1,095 in 2012 to 1,572 in 2013). There was also an overall 19% reduction in the total number of exceedances of a threshold value (94 in 2012 to 76 in 2013) from 2012 to 2013. It should be noted that sites were added and dropped between the 2012 and 2013 sampling seasons, and this may partially account for the increase in detections and decrease in exceedances. With the completion of the 2014 monitoring season NRAS will be issuing its fourth triennial report for the monitoring conducted from 2012 to 2014. The 2012-2014 triennial report will present new data from the 2014 monitoring season and summarize data from all three years. Triennial reports include a more in-depth analysis of the data including detailed site descriptions, additional statistical analysis, modeling, trends analysis, pesticide use analysis, and geospatial analysis with comparison against agricultural and urban land use data. The data generated by this program helps to keep the agricultural community and the general public informed through report publication and through numerous public presentations.

There is considerable value in continuing an ambient monitoring program. The ambient monitoring program is an invaluable tool for identifying state specific pesticide issues and addressing them according to WSDA's EPA-approved Pesticide Management Strategy. The ambient monitoring program can also be used in conjunction with the adaptive management strategy as a mechanism for investigating and addressing concerns regarding pesticide use patterns leading to surface water or ground water contamination problems. NRAS is currently working with the Pesticide Management Division on two separate projects under the adaptive management strategy; dacthal contamination of groundwater in specific areas of Washington[7] and surface water contamination of chlorpyrifos and diazinon in Grays Harbor and Pacific counties[8].

The state-wide surface water monitoring program also forms the groundwork for designing additional studies focusing on particular scientific questions of interest regarding pesticide fate and transport. This can include runoff, drift and deposition from various application methods, and sediment toxicity investigation. These targeted studies along with technical assistance efforts can help to further reduce the frequency and potential risk for off target pesticide movement.

WSDA will continue to monitor the phase-out of older chemistries. The remaining registered use of azinphos-methyl on apples will be phased out by September 30, 2014. Endosulfan use on pears will be phased-out by July 31st, 2013, and both blueberry and apples will be phased-out by December 31, 2014. WSDA will continue to monitor for endosulfan through the end of the

[7] Dacthal Report 2014
[8] Cranberry Report 2013

monitoring season in 2016. Endosulfan end-use products have been amended to include a table on the label showing the exact dates when it will become unlawful to use the product on the labeled crops[9].

WSDA will continue to add new chemistries to the list of chemicals included in the monitoring program. Eleven new pesticides will be added to the pesticide analyses for 2014 including five neonicotinoid insecticides, four other current use insecticides, and two new herbicides.

Program Changes for 2014

Changes in Sites

Program changes for the 2014 sampling season include discontinuing monitoring on the Wenatchee River and Samish River sites due to limited detections and high streamflow. Sampling should continue at all long-term monitoring sites as well as the three sites added in 2013, two on Bertrand Creek and the Stemilt Creek site.

Changes in Parameters

In 2014, pesticide parameters will include the following analytes: thiamethoxam, acetamiprid, dinotefuran, thiacloprid, clothianidin in the neonicotinoid class of insecticides; sulfoxaflor representing a novel class of systemic insecticide, the sulfoximines; methoxyfenozide in the diacylhydrazine class of insecticide; etoxazole in the diphenyloxazoline class of acaricide /insecticide; bifenazate in the the carbazate class of acaricide /insecticide; and the herbicides imazapic and imazapyr.

[9] Endosulfan Phase-out

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Appendix A: Monitoring Location Data

Monitoring Locations in 2013

Table A-1: 2013 Monitoring Location Details

Ten-Digit HUC	Site Name	Site ID	Duration	Latitude	Longitude	Location Description
Cedar-Sammamish basin (WRIA 8):						
1711001204	Thornton Creek	TC-3	March-September	47.695	-122.2757	Downstream of pedestrian footbridge near Matthews Beach Park.
Green-Duwamish basin (WRIA 9):						
1711001303	Longfellow Creek	LC-1	March-September	47.5625	-122.3670	Upstream of the culvert under the 12th fairway on the West Seattle Golf Course.
Lower Skagit-Samish basin (WRIA 3):						
1711000702	Lower Big Ditch	BD-1	March-September	48.3085	-122.3474	Upstream side of bridge at Milltown Road.
1711000702	Upper Big Ditch	BD-2	March-September	48.3882	-122.3330	Upstream side of bridge at Eleanor Lane.
1711000702	Browns Slough	BS-1	March-September	48.3407	-122.4139	Downstream of tidegate on Fir Island Road.
1711000203	Indian Slough	IS-1	March-September	48.4506	-122.4650	Inside upstream side of tidegate at Bayview-Edison Road.
1711000202	Samish River	SR-1	March-September	48.5210	-122.4113	Under bridge at Thomas Road.
Nooksack basin (WRIA 1):						
1711000405	Lower Bertrand	BC-1	March-September	48.9241	-122.5302	Upstream side of the bridge over the creek on Rathbone Road. Parallel to staff gauge.
1711000405	Upper Bertrand	BC-2	March-September	48.9944	-122.5105	Approximately 122 meters upstream of bridge on H Street Road.
Lower Yakima basin (WRIA 37):						
1703000304	Marion Drain	MA-2	March-September	46.3307	-120.2000	Approximately 50 meters upstream of bridge at Indian Church Road.
1703000310	Spring Creek	SP-2	March-September	46.2571	-119.7113	Downstream side of culvert on McCreadie Road.
1703000309	Sulphur Creek	SU-1	March-September	46.2510	-120.0202	Downstream side of bridge at Holaday Road.
Wenatchee basin (WRIA 45):						
1702001107	Wenatchee River	WE-1	March-September	47.4724	-120.3716	Upstream side of Sleepy Hollow bridge.
1702001106	Mission Creek	MI-1	March-September	47.4874	-120.4835	Mission Creek Road off of Trip Canyon Road.
1702001105	Peshastin	PE-1	March-	47.5573	-120.5818	Approximately 30 meters

Ten-Digit HUC	Site Name	Site ID	Duration	Latitude	Longitude	Location Description
	Creek		September			downstream of bridge at Saunders Road.
1702001106	Brender Creek	BR-1	March-September	47.5210	-120.4868	Upstream side of culvert at Evergreen Drive and the footbridge.
Alkali-Squilchuck basin (WRIA 40):						
1702001003	Stemilt Creek	SC-1	March-September	47.3748	-120.2496	About 7 meters upstream of the bridge over the creek on Old West Malaga Road.

HUC = Hydrologic Unit Code (USGS)
Datum in North American Datum (NAD) 83.

Appendix B: 2013 Quality Assurance Summary

Laboratory Data Quality

Data may be qualified if one or more analytical factors affect confidence in the prescribed data value. Manchester Environmental Laboratory (MEL) qualifies data according to the National Functional Guidelines for Organic Data Review (EPA, 2008). Definitions of data qualifiers are presented in Table B-1.

Table B-1: Data Qualification Definitions.

Qualifier	Definition
(No qualifier)	The analyte was detected at the reported concentration. Data are not qualified.
E	Reported result is an estimate because it exceeds the calibration range.
J	The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
NJ	The analysis indicates the presence of an analyte that has been "tentatively identified," and the associated numerical value represents its approximate concentration.
NAF	Not analyzed for.
NC	Not calculated.
REJ	The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.
U	The analyte was not detected at or above the reported sample quantitation limit.
UJ	The analyte was not detected at or above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately measure the analyte in the sample.

MEL, 2000, 2008; EPA, 2008

Performance measures for quality assurance (QA) and quality control (QC) are presented in Table B-2.

Table B-2: Performance measures for quality assurance and quality control.

Analysis Method[1]	Analysis[2]	Field/Lab Replicates, MS/MSD[3], and Lab Control Samples	MS/MSD[3], Surrogates, and Lab Control Samples
		RPD[4]	% Recovery
GCMS	Pesticide-C-l	±40	Variable depending on analyte
	Pesticide-OP	±40	Variable depending on analyte
	Pesticide-Py	±40	Variable depending on analyte
GCMS-H	Herbicides	±50	40-130
LCMS/MS	Pesticide-C	±40	40-130
	Pesticide-N	±40	40-130
TSS	TSS	±20	80-120

[1] GCMS: Gas chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8270M.
GCMS-H: Derivitizable acid herbicides by GCMS, EPA method (modified) SW 846 3535M/8270M.
LCMS/MS: Liquid chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8321AM.
TSS: Total suspended solids, EPA method 2540D.
[2]C-l: chlorinated, N: neonicotinoid, OP: organophosphorus, Py: pyrethroid, C: carbamate.
[3]MS/MSD: Matrix spike and matrix spike duplicate.
[4]RPD: Relative percent difference.

Detections quantified below reporting limits are qualified as estimates according to Table B-1 (page 78).

Lower Practical Quantitation Limits

Lower practical quantitation limits (LPQLs) are the lowest concentrations at which laboratories may report data without classifying the concentration as an estimate below the lowest calibration standard. The LPQL is determined by averaging the lower reporting limits, per analyte, for all batches over each study period. LPQL data for 2013 are presented in Table B-3.

Table B-3: Mean performance lower practical quantitation limits (LPQL) (ug/L), 2013.

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL 2013
1-Naphthol	D-C		GCMS	0.309
2,3,4,5-Tetrachlorophenol	D-M		GCMS-H	0.064
2,3,4,6-Tetrachlorophenol	D-M		GCMS-H	0.064
2,4,5-T	H		GCMS-H	0.064
2,4,5-TP (Silvex)	H		GCMS-H	0.064
2,4,5-Trichlorophenol	D-M		GCMS-H	0.064
2,4,6-Trichlorophenol	D-M		GCMS-H	0.064
2,4-D	H		GCMS-H	0.065
2,4-DB	H		GCMS-H	0.064
2,4'-DDD	D-OC	DDT	GCMS	0.034
2,4'-DDE	D-OC	DDT	GCMS	0.034
2,4'-DDT	D-OC	DDT	GCMS	0.034
3,5-Dichlorobenzoic Acid	D-M		GCMS-H	0.064
3-Hydroxycarbofuran	D-C	Carbofuran	LCMS\MS	0.011
4,4'-DDD	D-OC	DDT	GCMS	0.034
4,4'-DDE	D-OC	DDT	GCMS	0.034
4,4'-DDT	I-OC		GCMS	0.034
4,4'-Dichlorobenzophenone	D		GCMS	0.103
4-Nitrophenol	D-H		GCMS-H	0.064
Acetochlor	H		GCMS	0.103
Acifluorfen, Sodium Salt	H		GCMS-H	0.064
Alachlor	H		GCMS	0.034
Aldicarb	I-C		LCMS\MS	0.037
Aldicarb Sulfone	D-C	Aldicarb	LCMS\MS	0.021
Aldicarb Sulfoxide	D-C	Aldicarb	LCMS\MS	0.014
Aldrin	I-OC		GCMS	0.034
Alpha-BHC	I-OC		GCMS	0.034
Atrazine	H		GCMS	0.034
Azinphos Ethyl	I-OP		GCMS	0.034
Azinphos Methyl	I-OP		GCMS	0.034
Benfluralin (Benefin)	H		GCMS	0.034
Bentazon	H		GCMS-H	0.064
Beta-BHC	I-OC		GCMS	0.034
Bifenthrin	I-Py		GCMS	0.103
Bolstar (Sulprofos)	I-OP		GCMS	0.050
Boscalid	F		GCMS	0.103
Bromacil	H		GCMS	0.034
Bromoxynil	H		GCMS-H	0.064
Butachlor	H		GCMS	0.309
Butylate	H		GCMS	0.034
Captan	F		GCMS	0.034
Carbaryl	I-C		LCMS/MS	0.026
Carbofuran	I-C		LCMS/MS	0.012

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL 2013
Chlorothalonil	F		GCMS	0.034
Chlorpropham	H		GCMS	0.034
Chlorpyrifos	I-OP		GCMS	0.034
Chlorpyrifos O.A.	D-OP		GCMS	0.103
Cis-Chlordane	I-OC		GCMS	0.034
Cis-Nonachlor	I-OC		GCMS	0.052
Cis-Permethrin	I-Py		GCMS	0.052
Clopyralid	H		GCMS-H	0.064
Coumaphos	I-OP		GCMS	0.052
Cyanazine	H		GCMS	0.034
Cycloate	H		GCMS	0.034
Cypermethrin	I-Py		GCMS	0.103
Cyprodinil	F		LCMS\MS	0.013
DCPA (Dacthal)	H		GCMS-H	0.064
DDVP	I-OP		GCMS	0.052
Delta-BHC	I-OC		GCMS	0.034
Deltamethrin	I-Py		GCMS	0.103
Diallate	H		GCMS	0.034
Diazinon	I-OP		GCMS	0.034
Diazoxon	D-OP	Diazinon	GCMS	0.103
Dicamba I	H		GCMS-H	0.064
Dichlobenil	H		GCMS	0.034
Dichlorprop	H		GCMS-H	0.064
Diclofop-Methyl	H		GCMS-H	0.064
Dicofol (Kelthane)	I-OC		GCMS	0.309
Dieldrin	I-OC		GCMS	0.052
Dimethoate	I-OP		GCMS	0.034
Dinoseb	H		GCMS-H	0.064
Diphenamid	H		GCMS	0.034
Disulfoton Sulfone	I-OP		GCMS	0.103
Disulfoton Sulfoxide	D-OP		GCMS	0.103
Diuron	H		LCMS\MS	0.012
Endosulfan I	I-OC		GCMS	0.052
Endosulfan II	I-OC		GCMS	0.052
Endosulfan Sulfate	D-OC	Endosulfan	GCMS	0.034
Endrin	I-OC		GCMS	0.052
Endrin Aldehyde	D-OC	Endrin	GCMS	0.052
Endrin Ketone	D-OC	Endrin	GCMS	0.034
EPN	I-OP		GCMS	0.034
Eptam	H		GCMS	0.034
Ethalfluralin	H		GCMS	0.034
Ethion	I-OP		GCMS	0.034
Ethoprop	I-OP		GCMS	0.034
Fenamiphos	I-OP		GCMS	0.034
Fenamiphos Sulfone	D-OP		GCMS	0.103
Fenarimol	F		GCMS	0.034
Fenitrothion	I-OP		GCMS	0.050
Fensulfothion	I-OP		GCMS	0.033
Fenthion	I-OP		GCMS	0.033
Fenvalerate (2 isomers)	I-Py		GCMS	0.034
Fipronil	I-Pyra		GCMS	0.103
Fipronil Disulfinyl	D-Pyra		GCMS	0.103
Fipronil Sulfide	D-Pyra		GCMS	0.103

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL 2013
Fipronil Sulfone	D-Pyra		GCMS	0.103
Fluridone	H		GCMS	0.103
Fonofos	I-OP		GCMS	0.034
Heptachlor	I-OC		GCMS	0.034
Heptachlor Epoxide	D-OC	Heptachlor	GCMS	0.034
Hexachlorobenzene	F		GCMS	0.034
Hexazinone	H		GCMS	0.052
Imidacloprid	I-N		LCMS\MS	0.017
Imidan (Phosmet)	I-OP		GCMS	0.034
Ioxynil	H		GCMS-H	0.064
Lindane (BHC-gamma)	I-OC		GCMS	0.034
Linuron	H		LCMS\MS	0.035
Malaoxon	D-OP		LSMS\MS	0.010
Malathion	I-OP		GCMS	0.034
MCPA	H		GCMS-H	0.064
MCPP (Mecoprop)	H		GCMS-H	0.064
Metalaxyl	F		GCMS	0.034
Methidathion	I-OP		GCMS	0.309
Methiocarb	I-C		LCMS\MS	0.024
Methomyl	I-C		LCMS\MS	0.011
Methomyl oxime	D-C	Thiodicarb	LCMS\MS	0.070
Methoxychlor	I-OC		GCMS	0.052
Methyl Paraoxon	D-OP	Methyl parathion	GCMS	0.103
Methyl Parathion	I-OP		GCMS	0.034
Metolachlor	H		GCMS	0.034
Metribuzin	H		GCMS	0.034
Mevinphos	I-OP		GCMS	0.052
MGK-264	Sy		GCMS	0.052
Mirex	I-OC		GCMS	0.034
Monocrotophos	I-OP		GCMS	0.052
Monuron	H		LCMS\MS	0.010
Naled	I-OP		GCMS	0.034
Napropamide	H		GCMS	0.052
Neburon	H		LCMS\MS	0.024
Norflurazon	H		GCMS	0.034
Oryzalin	H		GCMS	0.103
Oxamyl	I-C		LCMS\MS	0.011
Oxamyl Oxime	D-C	Oxamyl	LCMS\MS	0.026
Oxychlordane	D-OC	Chlordane	GCMS	0.034
Oxyfluorfen	H		GCMS	0.103
Parathion	I-OP		GCMS	0.034
Pebulate	H		GCMS	0.034
Pendimethalin	H		GCMS	0.034
Pentachlorophenol	WP		GCMS-H	0.064
Phenothrin	I-Py		GCMS	0.034
Phorate	I-OP		GCMS	0.309
Phorate O.A.	D-OP		GCMS	0.103
Picloram	H		GCMS-H	0.064
Piperonyl Butoxide	Sy		GCMS	0.103
Promecarb	I-C		LCMS\MS	0.022
Prometon	H		GCMS	0.034
Prometryn	H		GCMS	0.034
Pronamide	H		GCMS	0.034

Chemical	[1]Use	Parent	[2]Analysis Method	LPQL 2013
Propachlor	H		GCMS	0.034
Propargite	I-SE		GCMS	0.052
Propazine	H		GCMS	0.034
Propoxur	I-C		LCMS\MS	0.011
Resmethrin	I-Py		GCMS	0.034
Silvex	H		GCMS-H	0.064
Simazine	H		GCMS	0.034
Simetryn	H		GCMS	0.103
Sulfotepp	I-OP		GCMS	0.034
Tebuthiuron	H		GCMS	0.034
Terbacil	H		GCMS	0.035
Tetrachlorvinphos	I-OP		GCMS	0.052
Tetrahydrophthalimide	D-F		GCMS	0.103
Thiobencarb (Benthiocarb)	H		GCMS	0.103
Tokuthion (Prothiofos)	I-OP		GCMS	0.103
Total Suspended Solids	n/a		TSS	1.9 mg/L
Tralomethrin	I-Py		GCMS	0.103
Trans-Chlordane	I-OP		GCMS	0.034
Trans-Nonachlor	I-OC		GCMS	0.052
Trans-Permethrin	I-Py		GCMS	0.103
Triadimefon	F		GCMS	0.034
Triallate	H		GCMS	0.034
Trichloronat	I-OP		GCMS	0.052
Triclopyr	H		GCMS-H	0.064
Tricyclazole	F		GCMS	0.103
Trifluralin	H		GCMS	0.034

[1] C: Carbamate, D: Degradate, F: Fungicide, I: Insecticide, H: Herbicide, OC: Organochlorine, OP: Organophosphorus, Py: Pyrethroid, SE: Sulfite Ester, Sy: Synergist, WP: Wood Preservative.
[2] GCMS: Gas chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8270M.
GCMS-H: Derivitizable acid herbicides by GCMS, EPA method (modified) SW 846 3535M/8270M.
LCMS\MS: Liquid chromatography/mass spectroscopy, EPA method (modified) SW 846 3535M/8321AM.

Quality Assurance Samples

QA samples are collected and analyzed each year to assure consistency and accuracy of sample analysis.

For this project, QA samples include: field replicates, field blanks, and matrix spike and matrix spike duplicates (MS/MSD). QA samples for the laboratory included split sample duplicates, laboratory control samples (LCS) and LCS duplicates (LCSD), surrogate spikes, and method blanks.

In 2013, 15% of the field samples obtained were for QA. In 2013, QA samples included 34 field replicates each for carbamate, herbicide, and pesticide gas chromatography/mass spectroscopy (GCMS) analysis; and 35 field replicates for total suspended solids (TSS). QA also included 17 field blanks for each of the following: carbamate, herbicide, pesticide GCMS, and TSS analysis. There were also 17 MS/MSD samples each for carbamates, herbicides, and pesticide GCMS analysis.

Field Quality Assurance Sample Results

Field Replicates Results

During 2013, field replicate sampling frequency for pesticides and TSS were 7.4% and 7.6%, respectively. Precision between replicate pairs was calculated using the relative percent difference (RPD) statistic. The RPD is calculated by dividing the absolute value of the difference between the replicates by their mean, then multiplying by 100 for a percent value.

Excluding TSS, there were 149 consistently identified analytes and 40 inconsistently identified analytes detected in replicate pairs. *Consistent identification* refers to compounds identified in both the original sample and field replicate. Of the consistently identified replicate pairs, only four of the 149 consistently identified pairs exceeded the 40% RPD criterion. All exceedances of the 40% RPD criterion were for the herbicide analysis and are as follows:

- April 22, 2013 Upper Bertrand Creek a replicate pair for 2,4-D had a RPD of 44%
- April 29, 2013 Browns Slough a replicate pair for dacthal had a RPD of 167%
- May 14, 2013 Browns Slough a replicate pair for dacthal had a RPD of 48%
- June 25, 2013 Thornton Creek a replicate pair for MCPP had a RPD of 70%

With the exception of the April 29, 2013 dacthal results, all of results for replicate pairs were at or below the LPQL. It is important to note that RPD statistic has limited effectiveness in assessing variability at low levels (Mathieu, 2006) because the RPD statistic can become large even though the actual difference between the pairs is low when the concentrations of analytes are very small. With the exception of the April 29th dacthal results, all results are considered of acceptable data quality.

Table B-5: Presents the data, data qualification (if assigned), and relative percent difference (RPD) for analytes consistently identified in both the grab sample and replicate sample.

Table B-5: Consistently detected pairs within field replicate results (ug/L).

Parameter	Sample	Q	Replicate	Q	RPD
2,4-D	0.044	J	0.069		44.2%
	0.100		0.140		33.3%
	0.250		0.220		12.8%
	0.038	NJ	0.038	NJ	0.0%
	0.050	J	0.045	J	10.5%
	0.068		0.064	J	6.1%
	0.050	J	0.055	J	9.5%
	0.062	J	0.055	J	12.0%
	0.085		0.091		6.8%
	0.047	J	0.048	J	2.1%
	0.022	NJ	0.023	NJ	4.4%
	0.028	NJ	0.028	NJ	0.0%
	0.050	J	0.054	J	7.7%
	0.045	J	0.046	J	2.2%
	0.025	J	0.030	NJ	18.2%
	0.034	J	0.036	J	5.7%

Parameter	Sample	Q	Replicate	Q	RPD
	0.089		0.092		3.3%
	0.030	NJ	0.030	NJ	0.0%
	0.140		0.160		13.3%
				Mean =	**10.1%**
4,4'-DDD	0.019	J	0.019	J	0.0%
4,4'-DDE	0.019	J	0.016	J	17.1%
	0.031	J	0.029	J	6.7%
				Mean =	**11.9%**
4,4'-DDT	0.021	J	0.020	J	4.9%
	0.028	J	0.027	J	3.6%
				Mean =	**4.3%**
3,5-Dichlorobenzoic Acid	0.012	NJ	0.011	NJ	8.7%
Atrazine	0.030	J	0.026	J	14.3%
Bentazon	0.072		0.067	NJ	7.2%
	0.037	J	0.033	J	11.4%
	0.070		0.067		4.4%
				Mean =	**7.7%**
Boscalid	0.120		0.130		8.0%
	0.100	J	0.100	J	0.0%
	0.250		0.260		3.9%
	0.150		0.130		14.3%
	0.210		0.220		4.7%
	0.580	J	0.560	J	3.5%
				Mean =	**5.7%**
Bromacil	0.052		0.052		0.0%
	0.035		0.030	J	15.4%
				Mean =	**7.7%**
Bromoxynil	0.017	J	0.016	J	6.1%
	0.016	J	0.016	J	0.0%
				Mean =	**3.0%**
Carbaryl	0.123		0.118		4.1%
Carbofuran	0.009	J	0.006	NJ	40.0%
Dacthal (DCPA)	0.190		0.017	J	167.1%
	0.036	J	0.022	J	48.3%
				Mean =	**108%**
Diazinon	0.110		0.110		0.0%
	0.026	J	0.025	J	3.9%
	0.026	J	0.025	J	3.9%
				Mean =	**2.6%**
Dicamba	0.025	J	0.025	J	0.0%
	0.049	J	0.056	J	13.3%
	0.020	J	0.019	NJ	5.1%
	0.015	NJ	0.016	NJ	6.5%
	0.023	J	0.022	J	4.4%
	0.018	NJ	0.019	NJ	5.4%
	0.013	J	0.013	J	0.0%
	0.032	J	0.028	J	13.3%
	0.028	J	0.029	J	3.5%
	0.012	J	0.012	J	0.0%
	0.024	J	0.025	J	4.1%
	0.021	J	0.024	J	13.3%
	0.023	NJ	0.027	NJ	16.0%
				Mean =	**6.5%**
Dichlobenil	0.017	J	0.015	J	12.5%
	0.021	J	0.025	J	17.4%
	0.015	J	0.019	J	23.5%
	0.010	J	0.010	J	0.0%

Parameter	Sample	Q	Replicate	Q	RPD
	0.007	J	0.007	J	0.0%
	0.026	J	0.025	J	3.9%
	0.009	J	0.008	J	11.8%
	0.035	J	0.032	J	9.0%
	0.006	J	0.006	J	0.0%
				Mean=	**8.7%**
Diuron	0.039	J	0.035	J	10.8%
	0.018		0.021		15.4%
	0.014		0.019		30.3%
	0.013		0.014		7.4%
	0.142		0.113		22.7%
	0.009	J	0.011		20.0%
	0.018		0.019		5.4%
	0.104		0.124		17.5%
	0.103	J	0.104	J	1.0%
	0.208		0.193		7.5%
	0.016		0.014		13.3%
	0.017		0.018		5.7%
				Mean =	**13.1%**
Endosulfan Sulfate	0.020	J	0.019	J	5.1%
	0.049		0.054		9.7%
				Mean =	**7.4%**
Eptam	0.068		0.080		**16.2%**
Ethoprop	0.110		0.110		**0.0%**
Imidacloprid	0.028	J	0.032	J	13.3%
	0.036	J	0.033	J	8.7%
	0.024		0.019		23.3%
				Mean=	**15.1%**
Malaoxon	0.004	J	0.004	J	0.0%
	0.004	J	0.004	J	0.0%
				Mean =	**0.0%**
MCPA	0.019	J	0.021	J	10.0%
	0.200		0.250		22.2%
	0.063	J	0.056	J	11.8%
	0.230		0.250		8.3%
	0.018	J	0.019	J	5.4%
	0.010	J	0.010	J	0.0%
	0.013	J	0.015	J	14.3%
	0.016	NJ	0.019	J	17.1%
				Mean=	**11.1%**
MCPP	0.074		0.076		2.7%
	0.140		0.140		0.0%
	0.012	J	0.010	J	18.2%
	0.015	J	0.031	J	69.6%
				Mean=	**22.6%**
Metalaxyl	0.066		0.056		**16.4%**
Methomyl	0.047		0.048		**2.1%**
Metolachlor	0.030	J	0.033	J	9.5%
	0.029	J	0.030	J	3.4%
	0.110		0.110		0.0%
	0.015	J	0.015	J	0.0%
	0.034	J	0.033	J	3.0%
	0.020	J	0.020	J	0.0%
				Mean=	**2.6%**
Metribuzin	0.065		0.066		**1.5%**
Napropamide	0.230		0.220		4.4%
	0.130		0.100		26.1%

Parameter	Sample	Q	Replicate	Q	RPD
				Mean=	**15.3%**
Oxamyl	0.039		0.035		10.8%
	0.057		0.051		11.1%
	0.011	J	0.011	J	0.0%
				Mean=	**7.3%**
Oxamyl oxime	0.025	J	0.029	J	14.8%
	0.029	J	0.022	J	27.5%
				Mean=	**21.1%**
Pendimethalin	0.083		0.078		6.2%
	0.049		0.053		7.8%
				Mean=	**7.0%**
Pentachlorophenol	0.022	J	0.023	NJ	4.4%
	0.025	J	0.023	J	8.3%
	0.021	NJ	0.019	NJ	10.0%
	0.018	J	0.017	J	5.7%
	0.020	J	0.018	NJ	10.5%
	0.032	J	0.036	J	11.8%
				Mean=	**8.5%**
Simazine	0.100		0.110		9.5%
	0.057		0.065		13.1%
	0.230		0.280		19.6%
	0.059		0.060		1.7%
	0.330		0.310		6.3%
				Mean=	**10.0%**
Tebuthiuron	0.042	NJ	0.043	J	2.4%
Terbacil	0.079		0.080		1.3%
	0.370		0.350		5.6%
	0.140		0.140		0.0%
	0.049	NJ	0.061	NJ	21.8%
	0.440		0.440		0.0%
				Mean=	**5.7%**
Tetrahydrophthalimide	0.063	J	0.060	J	4.9%
Treflan (Trifluralin)	0.043		0.043		0.0%
	0.025	J	0.024	J	4.1%
				Mean=	**2.0%**
Triclopyr	0.019	J	0.019	J	0.0%
	0.049	J	0.057	J	15.1%
	0.083		0.063	J	27.4%
	0.054	J	0.051	J	5.7%
	0.022	NJ	0.022	J	0.0%
	0.029	J	0.030	J	3.4%
	0.090		0.089		1.1%
	0.012	NJ	0.013	J	8.0%
	0.014	J	0.017	J	19.4%
	0.056	J	0.079		34.1%
				Mean=	**11.4%**

Inconsistently identified replicate pairs are those in which the compound was identified in one sample but not the other. For inconsistently identified pairs, 33 of the 40 (83%) had a "less than reporting limit" value ("U" or "UJ" qualifier) paired with a detection. The remaining seven pairs included a detection paired with a tentative detection or detection close to the reporting limit (Table B-6 on page 88).

Table B-6: Inconsistent field replicate detections (ug/L), 2013.

Parameter	Sample replicate result below detection limit	Detected replicate result	Result ≤ reporting limit
2,4-D	0.066 U	0.067 J	No
2,4-DB	0.066 U	0.067 NJ	No
3,5-Dichlorobenzoic Acid	0.041 UJ	0.040 J	Yes
4-Nitrophenol	0.065 U	0.087 NJ	No
Atrazine	0.033 U	0.013 J	Yes
Bentazon	0.066 U	0.030 NJ	Yes
	0.065 U	0.027 NJ	Yes
Boscalid	0.1 U	0.062 J	Yes
	0.1 U	0.058 NJ	Yes
Bromacil	0.037 U	0.036 NJ	Yes
	0.033 U	0.027 J	Yes
Carbaryl	0.03 U	0.008 J	Yes
Chlorpyriphos	0.033 U	0.02 NJ	Yes
Clopyralid	0.066 U	0.028 NJ	Yes
Delta-BHC	0.035 UJ	0.035 J	Yes
Dichlobenil	0.036 UJ	0.040	No
Diuron	0.01 U	0.06	No
	0.01 U	0.01	Yes
Eptam	0.034 U	0.022 J	Yes
Fenarimol	0.035 U	0.035	Yes
Imidacloprid	0.010 UJ	0.027 J	No
Malaoxon	0.01 U	0.01 J	Yes
MCPA	0.064 U	0.013 NJ	Yes
MCPP	0.065 U	0.022 NJ	Yes
	0.066 U	0.009 NJ	Yes
Methyl Chlorpyrifos	0.035 U	0.035	Yes
Metolachlor	0.023 U	0.022 J	Yes
Pentachlorophenol	0.02 U	0.02 NJ	Yes
	0.062 U	0.015 J	Yes
	0.065 U	0.013 J	Yes
	0.069 U	0.010 J	Yes
	0.065 U	0.016 NJ	Yes
	0.065 U	0.018 NJ	Yes
Picloram	0.063 UJ	0.038 J	Yes
Prometon	0.038 U	0.042	No
Sulfotepp	0.035 U	0.035	Yes
Tetrahydrophthalimide	0.1 U	0.023 J	Yes
Triadimefon	0.035 U	0.035 NJ	Yes
Triclopyr	0.066 U	0.02 NJ	Yes
	0.064 U	0.01 NJ	Yes

TSS was consistently detected in 34 of the 35 replicate pairs. For the one inconsistent detection, a less than reporting limit value ("U") was paired with a result at the reporting limit (1 mg/L). The average RPD of the consistently detected TSS replicates was 8.0%. A total of 88% of the replicates were within the 20% RPD criterion. Pairs with > 20% RPD were close to the detection limit and the RPD statistic has limited effectiveness in assessing variability at low levels (Mathieu, 2006).

Data for pesticide and TSS field replicates are of acceptable data quality. April 29, 2013 Browns Slough dacthal results should be used with caution.

Field Blank Results

Field blank detections indicate the potential for sample contamination in the field and laboratory and the potential for false detections due to analytical error. In 2013, there were no field blank detections for the pesticide or carbamate analysis. There was a field blank detection for herbicide analysis and TSS. The two field blank detections occurred at the following sites and dates and for the following laboratory analysis:

- Marion Drain on April 22, 2013, 2,4-D was detected in the herbicide field blank.
- Thornton Creek on August 27, 2013, TSS was detected at 3 mg/L.

On April 22, 2013 2,4-D was detected at all of the lower Yakima sites. All results were less than five times the detected value in the herbicide blank (2,4-D=0.09 mg/L in the blank). All lower Yakima 2,4-D results for April 22, 2013 will be rejected.

The August 27, 2013 TSS sample result for Thornton Creek was < 1 mg/L indicating TSS was below the detection limit. It is likely the blank and sample TSS bottles were mislabeled. Thornton Creek TSS results for August 27, 2013 will be qualified as tentatively undetected (UJ).

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Results

MS/MSD results reflect the process of sample duplication (field), analyte degradation, matrix interaction (sample/standard), extraction efficiency, and analyte recovery. This measure is the best overall indicator of accuracy and reproducibility in the sampling process.

Table B-7 presents the mean, minimum, and maximum percent recovery for the MS/MSD for the three types of analysis as well as the RPD for the MS and MSDs for 2013.

Table B-7: Summary Statistics for MS/MSD Recoveries and RPD, 2013.

Analysis	MS\MSD Recovery			RPD for MS\MSD		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
LCMS\MS	99%	0%	270%	14%	0%	200%
GCMS-Herbicides	86%	0%	171%	11%	0%	200%
GCMS-Pesticides	105%	0%	287%	8%	0%	63%

The percentage of MS\MSD samples with percent recoveries that fell within the target range were:

- LCMS\MS analysis: 86% fell within the 40-130% target recovery range.
- GCMS-Herbicide analysis: 94% fell within the 40-130% target recovery range.
- GCMS-Pesticide analysis: 95% fell within the target recovery range.

Analytes not meeting the target recovery range and the percentage of occurrences are described in Table B-8. Table B-8 also describes the number of detections for each analyte not meeting the target recovery range. Detections of analytes not meeting MS/MSD target recoveries and/or analyte results were qualified as estimates (qualified with a 'J').

Table B-8: MS/MSD Analytes outside of target limits and percentage of occurrences, 2013.

Analysis	Analyte	Percentage of samples outside target limits	Fell below or exceeded target limits?	Pesticide detected in 2013?
LCMS\MS	3-Hydroxycarbofuran	15%	Exceeded	No
	Aldicarb	9%	Exceeded	No
	Aldicarb Sulfone	59%	Exceeded	No
	Aldicarb Sulfoxide	41%	Exceeded	3 detections
	Cyprodinil	38%	Fell below	2 detections
	Diuron	12%	Exceeded	115 detections
	Imidacloprid	24%	Exceeded	53 detections
	Linuron	24%	Both	No
	Methiocarb	6%	Exceeded	No
	Methomyl	3%	Exceeded	4 detections
	Methomyl oxime	38%	Both	No
	Monuron	3%	Exceeded	1 detection
	Oxamyl	3%	Exceeded	53 detections
	Oxamyl oxime	24%	Exceeded	28 detections
GCMS-Herbicides	2,4-D	9%	Fell below	153 detections
	2,4-DB	6%	Exceeded	No
	4-Nitrophenol	12%	Fell below	5 detections
	Acifluorfen	26%	Both	No
	Clopyralid	35%	Fell below	2 detection
	Diclofop-Methyl	15%	Exceeded	No
	Dinoseb	15%	Both	No
	Picloram	47%	Fell below	6 detections
GCMS-Pesticides	1,3-Dimethyl-2-nitrobenzene	6%	Exceeded	No
	1-Naphthol	28%	Exceeded	No
	Alpha-BHC	28%	Fell below	No
	Benthiocarb	11%	Exceeded	No
	Di-allate (Avadex)	11%	Exceeded	No
	Diazinon	11%	Exceeded	18 detections

Analysis	Analyte	Percentage of samples outside target limits	Fell below or exceeded target limits?	Pesticide detected in 2013?
	Dichlorvos (DDVP)	6%	Exceeded	No
	Endrin	17%	Exceeded	No
	Ethion	22%	Exceeded	No
	Fenarimol	43%	Exceeded	4 detections
	Fenvalerate	43%	Exceeded	No
	Fonofos	11%	Exceeded	No
	Gamma-BHC	11%	Fell below	No
	Imidan	6%	Exceeded	No
	Metalaxyl	11%	Exceeded	38 detections
	Methidathion	11%	Exceeded	No
	Methyl Chlorpyrifos	11%	Exceeded	No
	Metribuzin	19%	Exceeded	8 detection
	Mirex	21%	Exceeded	No
	Oryzalin	57%	Fell below	No
	Oxychlordane	7%	Exceeded	No
	Oxyfluorfen	6%	Exceeded	No
	Phenothrin	17%	Exceeded	No
	Phorate	6%	Exceeded	No
	Propargite	22%	Exceeded	No
	Resmethrin	22%	Fell below	No
	Tetrahydrophthalimide	34%	Both	12 detections
	Tokuthion	6%	Exceeded	No
	Trichloronate	11%	Exceeded	No

Laboratory Quality Assurance Results

Laboratory Duplicates

MEL uses laboratory split sample duplicates to ensure consistency of TSS and conductivity analyses. In 2013, there were 127 laboratory replicate pairs for TSS and 10 replicate pairs for conductivity.

For TSS the pooled average RPD was 4.2%; the maximum RPD was 29%. Four out of 127 replicate pairs exceeded the 20% RPD criterion. For these replicates, results were low, and the RPD statistic has limited effectiveness in assessing variability at low levels (Mathieu, 2006).

For conductivity the pooled average RPD was 0.1%; the maximum RPD was 0.3%. The RPD for conductivity pairs is excellent.

Laboratory Blanks

MEL uses laboratory blanks to assess the precision of equipment and the potential for internal laboratory contamination. If lab blank detections occur, the sample LPQL may be increased, and detections may be qualified as estimates. For 2013 no laboratory blank detections were reported.

Surrogates

Surrogates are compounds spiked into field samples at the laboratory. They are used to check recovery for a group of compounds. For instance, triphenyl phosphate is a surrogate for organophosphorus insecticides (Table B-9).

Table B-9: Pesticide surrogates.

Surrogate Compound	Surrogate for:
2,4,6-tribromophenol	Acid-derivitizable herbicides
2,4-dichlorophenylacetic acid	
Carbaryl C13	Carbamate pesticides
4,4'-DDE-13C12	Chlorinated pesticides
Decachlorobiphenyl (DCB)	
Atrazine-D5	Chlorinated and nitrogen pesticides
1,3-dimethyl-2-nitrobenzene	Nitrogen pesticides
Trifluralin-D-14	
Chlorpyrifos-D10	Organophosphorus pesticides
Triphenyl phosphate	

The majority of 2013 surrogate recoveries fell within the QC limits established by MEL for all compounds. The percentage of time a surrogate recovery did not meet the QC limits is described in Table B-10. High and low pesticide surrogate recovery requires all related data to be qualified as estimates (qualified with a 'J').

Table B-10: Surrogate Compound Recovery Results for2013.

Surrogate compound	Surrogate for:	Percentage of surrogate compound results that met surrogate recovery targets
2,4,6-tribromophenol	Acid-derivitizable herbicides	99.1%
2,4-dichlorophenylacetic acid		99.2%
Carbaryl C13	Carbamate pesticides	Met surrogate recovery targets
4,4'-DDE-13C12	Chlorinated pesticides	98.8%
Decachlorobiphenyl (DCB)		99.7%
Atrazine-D5	Chlorinated and nitrogen pesticides	99.7%
1,3-dimethyl-2-nitrobenzene	Nitrogen pesticides	97.2%
Trifluralin-D-14		99.8%
Chlorpyrifos-D10	Organophosphorus pesticides	99.8%
Triphenyl phosphate		97.6%

Laboratory Control Samples:

Laboratory control samples (LCS) are analyte compounds spiked into deionized water at known concentrations and subjected to analysis. They are used to evaluate accuracy of pesticide residue recovery for a specific analyte. Detections may be qualified based on low recovery and/or high RPD between the paired LCS and LCSD.

Table B-11 presents the mean, minimum, and maximum percent recovery for the LCS and LCSD for the three types of analysis, as well as the RPD between the LCS and the paired LCSD for 2013.

Table B-11: Summary Statistics for LCS and LCSD Recovery and RPD.

Analysis	LCS Recovery			%RPD for LCS\LCSD		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
LCMS\MS	97%	0%	268%	14%	0%	200%
GCMS-Herbicides	82%	0%	141%	14%	0%	200%
GCMS-Pesticides	100%	27%	315%	8%	0%	113%
TSS	96%	92%	101%	2%	0%	4%
Conductivity	101%	101%	102%	n/a	n/a	n/a

The percentage of LCS and LCSD samples having percent recoveries that fell within the target range were:

- LCMS\MS analysis: 93% fell within the 40-130% target recovery range.
- GCMS-Herbicide analysis: 96% fell within the 40-130% target recovery range.
- GCMS-Pesticide analysis: 91% fell within the target recovery range (target recovery range varies by analyte).
- For TSS and conductivity, all recoveries were within the target recovery range.

Analytes for LCS and LCSD samples not meeting the target recovery range and the percentage of occurrences are described in Table B-12. Table B-12 also describes the number of detections for each analyte not meeting the target recovery range. When analytes did not meet LCS and LCSD target recoveries field sample results were qualified as estimates for that site visit.

Table B-12: Analytes for LCS and LCSD samples outside of target recoveries in 2013.

Analysis	Analyte	Percentage of samples outside target limits	Fell below or exceeded target limits?	Pesticide detected in 2013?
LCMS\MS	Aldicarb	9%	Exceeded	No
	Aldicarb sulfone	41%	Exceeded	No
	Aldicarb sulfoxide	19%	Exceeded	3 detections
	Carbaryl	7%	Exceeded	15 detections
	Cyprodinil	9%	Fell below	2 detections
	Diuron	7%	Exceeded	115 detections
	Imidacloprid	4%	Exceeded	53 detections
	Linuron	27%	Both	No

Analysis	Analyte	Percentage of samples outside target limits	Fell below or exceeded target limits?	Pesticide detected in 2013?
	Methiocarb	7%	Exceeded	No
	Methomyl oxime	10%	Both	No
	Oxamyl oxime	2%	Exceeded	28 detections
	Promecarb	7%	Exceeded	No
GCMS-Herbicides	2,3,4,6-Tetrachlorophenol	2%	Fell below	No
	2,4,6-Trichlorophenol	4%	Fell below	No
	2,4-DB	4%	Exceeded	No
	4-Nitrophenol	7%	Fell below	5 detections
	Acifluorfen, sodium salt	20%	Both	No
	Clopyralid	14%	Fell below	2 detection
	Diclofop-Methyl	4%	Exceeded	No
	Dinoseb	25%	Fell below	No
	Ioxynil	4%	Fell below	No
	Picloram	32%	Fell below	6 detections
GCMS-Pesticides	1-Naphthol	10%	Both	No
	Alpha-BHC	12%	Fell below	No
	Azinphos Ethyl	25%	Exceeded	No
	Benthiocarb	8%	Exceeded	No
	Captan	12%	Fell below	No
	Chlorothalonil (Daconil)	3%	Fell below	2 detection
	Coumaphos	3%	Exceeded	No
	Delta-BHC	4%	Fell below	No
	Di-allate (Avadex)	8%	Exceeded	No
	Diazinon	7%	Exceeded	18 detections
	Dimethoate	3%	Fell below	No
	Disulfoton Sulfone	7%	Fell below	No
	Endosulfan I	12%	Fell below	7 detections
	Endosulfan Sulfate	8%	Fell below	22 detections
	Endrin	8%	Exceeded	No
	Endrin Ketone	8	Exceeded	No
	Ethion	17	Exceeded	No
GCMS-Pesticides	Fenamiphos	2	Exceeded	1 detection
	Fenarimol	20	Exceeded	4 detections
	Fensulfothion	100	Exceeded	No
	Fenvalerate	17	Exceeded	No
	Fluridone	33	Exceeded	No
	Fonofos	3	Exceeded	No
	Gamma-BHC	8	Fell below	No
	Heptachlor Epoxide	4	Fell below	1 detection
	Imidan	3	Fell below	No
	Metalaxyl	8	Exceeded	38 detections

Analysis	Analyte	Percentage of samples outside target limits	Fell below or exceeded target limits?	Pesticide detected in 2013?
	Methidathion	7	Exceeded	No
	Methyl Chlorpyrifos	7	Exceeded	No
	Methyl Paraoxon	17	Fell below	No
	Metribuzin	12	Exceeded	8 detections
	Norflurazon	10	Exceeded	13 detection
	Phenothrin	50	Exceeded	No
	Phorate	11	Exceeded	No
	Propargite	12	Exceeded	No
	Resmethrin	96	Exceeded	No
	Simazine	20	Fell below	34 detections
	Sulfotepp	10	Fell below	No
	Tebuthiuron	57	Exceeded	23 detections
	Tetrahydrophthalimide	13	Both	12 detections
	Tokuthion	3	Exceeded	No

Field Meter Data Quality

Quality Control Procedures

Field meters were calibrated at the beginning of the field day according to manufacturers' specifications, using Ecology SOP EAP033 *Standard Operating Procedure for Hydrolab DataSonde® and MiniSonde® Multiprobes* (Swanson, 2010). Field meters were post-checked, using known standards, at the end of the sampling week.

Dissolved oxygen (DO) meter results were compared to results from grab samples analyzed using the Winkler laboratory titration method. DO grab samples for Winkler titrations were collected and analyzed according to the SOP (Ward, 2007). Winkler grab samples are collected separately for eastern Washington and western Washington locations. Winkler grab samples are collected at one site at the beginning of the day and at one site the end of the day. Additionally one replicate Winkler grab sample is collected per week at either the beginning or the end of one of the sampling days.

To check conductivity meter results, grab water samples were obtained and sent to MEL for conductivity analysis. Approximately 4% of the conductivity meter readings were checked with MEL conductivity results.

Measurement quality objectives (MQOs) for meter post-checks, replicates, and Winkler DO comparisons are described in Anderson and Sargeant (2009).

2013 Field Data Quality Results

The Hydrolab field meter met MQOs including post-checks, DO Winkler comparisons and laboratory conductivity comparisons in both Eastern Washington and Western Washington locations (Table 13).

Table B-13: Quality control results for field meter and Winkler replicates, 2013.

Replicate Meter Parameter	Western Washington Sites		Eastern Washington Sites	
	Average	Maximum	Average	Maximum
Winkler and meter DO	1.1 % RSD	9.8% RSD	1.4% RSD	6.7% RSD
Replicate Winkler's for DO	Met ±0.2 mg/L MQO		Met ±0.2 mg/L MQO	
Conductivity meter/laboratory comparisons	3.0% RSD	4.5% RSD	3.6% RSD	6.6% RSD
Streamflow	3.8% RSD	16.3% RSD	4.6% RSD	26.0% RSD

DO: dissolved oxygen.

Hydrolab field meter results were acceptable based on the Measurement Quality Objectives (MQO) described in Anderson and Sargeant (2009). The MQOs for conventional field parameters are shown in Table 14.

Table B-14: Measurement Quality Objectives for Conventional Parameters Measured by Field Meters or Determined by a Standard Method.

Parameter	Method/Equipment	Field Replicate MQO	Reporting Limits
Discharge Volume	Marsh-McBirney Flow-Mate Flowmeter	10% RSD	0.1 ft/s
Water Temperature	Hydrolab MiniSonde®	±0.2° C	0.1° C
Conductivity	Hydrolab MiniSonde®	10% RSD	0.1 µS/cm
pH	Hydrolab MiniSonde®	10% RSD	0.1 s.u.
Dissolved Oxygen	Hydrolab MiniSonde®	10 % RSD	0.1 mg/L
Dissolved Oxygen	SM4500OC	±0.2 mg/L	0.1 mg/L

MQO: measurement quality objective
RSD: relative standard deviation
s.u.: standard units

The 2013 streamflow replicate results for both the eastern and western Washington sites met MQOs (Table 13) except for the following sites and dates:

- Brender Creek, July 31, 2013 (3.3 and 2.7 cfs).
- Brender Creek, September 9, 2013 (11.0 and 13.5 cfs).
- Spring Creek, March 27, 2013 (25.4, 17.5, 21.6 cfs) Field notes indicate water levels in the creek were not stable, dropping after the first streamflow transect.

- Upper Big Ditch, August 20, 2013 (1.3 and 1.0 cfs).

Streamflow replicates for Brender Creek (July 31, 2013) and Upper Big Ditch occurred during low-flow conditions when the percent RSD statistic produces higher variability (Mathieu, 2006). Streamflow results for these days are acceptable.

For the March 27, 2013 streamflow measurement of Spring Creek two replicate streamflows were obtained. Field notes indicate the water level in Spring Creek appeared to be fluctuating during sampling. Fluctuation in streamflow was likely due to overflow from the Sunnyside Canal upstream of the Spring Creek site. The three streamflows obtained for this day will be averaged, and the averaged streamflow will be reported and qualified as an estimate.

The September 9, 2013 Brender Creek streamflow replicate has a 14.7% RSD. This streamflow will be qualified as an estimate.

2013 Field Audit

The purpose of the field audit was to ensure sampling methodologies were consistent. For field audits, both the western and eastern Washington field teams met at a surface water location. The teams measured Hydrolab field parameters and streamflow and obtained samples for measuring Winkler DO. Results and methods were compared to ensure field teams were using consistent sampling methodologies resulting in comparable data.

On June 5, 2013, a field audit was conducted at Mission Creek in Chelan County. The Westside team calibrated their Hach Hydrolab Multi-Meter at the Department of Ecology Operations Center (OC), located in Lacey, on June 4, 2013. The Eastside team calibrated their Hach Hydrolab Multi-Meter on June 5, 2013 at the Department of Ecology Central Regional Office (CRO), located in Yakima. Both teams met at the Mission Creek sample site to perform the field audit simultaneously. Table 15 shows the results.

Table B-15: June 5, 2013 Hydrolab meter readings, streamflow measurements, and Winkler results for dissolved oxygen from Mission Creek.

Meter or Method	Temp (°C)	pH (s.u.)	Conductivity (µS/cm)	DO (mg/L)	DO (% sat)
Westside Hydrolab Meter	11.18	8.48	194	11.35	103.8
Eastside Hydrolab Meter	11.15	8.48	194	11.49	108.4
Winkler Dissolved Oxygen (Westside)	-	-	-	11.3	-
Winkler Dissolved Oxygen (Eastside)	-	-	-	11.3	-
Streamflow Results	Discharge (cfs)				
	Westside	Eastside	-	-	-
Marsh McBirney Flow Meter	19.9	18.76	-	-	-

cfs: cubic feet per second

All meter results were acceptable based on the Measurement Quality Objectives (MQO) described in Anderson and Sargeant (2009). Table 14 shows the MQOs for conventional field parameters.

Quality Assurance Summary References

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Ward, W., 2007. Standard Operating Procedures (SOP) for the Collection and Analysis of Dissolved Oxygen (Winkler Method). Washington State Department of Ecology, Olympia, WA. SOP Number EAP023. www.ecy.wa.gov/programs/eap/quality.html

Appendix C: Assessment Criteria and Water Quality Standards for Pesticides

EPA Toxicity Criteria

In this Report, *Assessment Criteria* include data taken from studies determining hazard to non-target organisms and refer to acute and chronic hazard levels for fish, invertebrates, and aquatic plants. Various Environmental Fate and Effects Division (EFED) risk assessments (including: Pesticide Effects Determinations, Reregistration Eligibility Decisions (RED), and ecological risk assessments) were reviewed to determine the most comparable and up-to-date toxicity guidelines for freshwater (Table C-1) and marine species (Table C-2).

Rainbow trout (*Oncorhynchus mykiss*) are a surrogate for freshwater endangered and threatened species. *Daphnia magna* (invertebrate) and *Pseudokirchneria subcapitata* (green algae formerly called *Selenastrum capriocornutum*) represent components of the aquatic food web that may be affected by pesticide use. Alternative species are used only if no data are available for rainbow trout, *Daphnia magna*, or *Pseudokirchneria subcapitata.*

Marine toxicity criteria were evaluated for detections at Browns Slough in the Skagit watershed, a site with estuarine influence. Criteria were generated for marine species including (1) sheepshead minnow (*Cyprinodon variegatus*) and tidewater silverside (*Menidia beryllina*) for fish; (2) Pink shrimp (*Penaeus duorarum*), Eastern and Pacific Oysters (*Crassostrea virginica* and *gigas* respectively), Grass shrimp (*Palaemonetes pugio*), *Acartia tonsa* (copepod), and mysid (*Americamysis bahia*) for invertebrates; and (3) *Isochrysis galbana*, and a diatom, *Skeletonema costatum*.

EPA classifies a laboratory study as 'core' if it meets guidelines appropriate for inclusion in pesticide registration eligibility decision. Usually a core designation may be made if the study is appropriately designed, monitored, and conditions controlled, and duration of exposure is consistent with other studies. Core study criteria are used in the assessment table. Keeping with pesticide review precedent, the most toxic, acceptable criteria from core studies are used.

Water Quality Standards and Assessment Criteria

The most recent versions of the Water Quality Standards For Surface Waters of The State of Washington (WAC 173-201A) and EPA National Recommended Water Quality Criteria (NRWQC) were applied for this report. The NRWQC remained largely unchanged from the 2003 update through 2008. The toxic standards for Washington State waters were also used. These remain essentially unchanged following the 1997 rule and 2003 updates (Washington Administrative Code (WAC), Chapter 173-201A).

Table C-1: Freshwater toxicity and regulatory guideline values. (All values reported in ug/L)

Chemical Name	Pesticide Registration Toxicity Data for Freshwater[1]													NRWQC for Fresh Water[3]		Washingtom State Water Quality Standards for Freshwater[2]		Maximum Conc. Limit for Salmon from Bilogical Opinion (NMFS)	
	Fisheries					Invertebrate				Aquatic Plant									
	ESLOC	Acute	Chronic	Spp.	Ref.	Acute	Chronic	Spp.	Ref.	Acute	Chronic	Spp.	Ref.	CMC	CCC	Acute	Chronic	Acute	Ref.
1-Naphthol	70	1400	100	RT-A; FM-C	10	700		DM	10	1100		SC	10						
2,4-D[m]	21.4	428	14200	RT; FM; BS	1	4970	200	DM	1	3880	1440	ND	1					100	91
2,4'-DDD														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]		
2,4'-DDE														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]		
2,4'-DDT														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]		
3-Hydroxycarbofuran	4.4	88	5.7	RT; BS	54, 60	2.23	0.75	CD; DM	54										
4,4'-DDD														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]		
4,4'-DDE														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]		
4,4'-DDT														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]		
4-Nitrophenol	200	4000		RT	69	5000		DM	69										
Acetochlor	19	380	130	RT	70	8200	22.1	DM	70	1.43		SC	70						
Alachlor	90	1800	187	RT	2	7700	110	DM	2	1.64	0.35	SC	2						
Aldicarb	2.6	52	0.46	BS	3	20	3	CT	3	5000		MD	3						
Aldicarb Sulfone	2100	42000		RT	3	280	3	DM	3										
Aldicarb Sulfoxide	357	7140		RT	3	43	3	DM	3										
Atrazine	265	5300	65	RT-A; BT-C	4	3500	140	DM	4	49		SC	4						
Azinphos Ethyl	1	20		RT	71	4		DM	71										
Azinphos-methyl	0.145	2.9	0.44	RT	5	1.13	0.25	DM	5						0.01				90
Bentazon	5000	100000		RT	6	100000		DM	6	4500		SC	6						
Bifenthrin	0.0075	0.15	0.04	RT-A; FM-C	72	1.6	0.0013	DM	72										
Boscalid	135	2700	116			1066	790			1340									
Bromacil	1800	36000	3000	RT	7	121000	8200	DM	7	6.8	1100	SC	7						
Bromoxynil	2.5	50	9	RT-A; FM-C	8	11	2.5	DM	8	80		SC	83						
Captan	1.31	26.2	16.5	BrT-A; FM-C	73	8400	560	DM	73	1770		SC	73						91
Carbaryl	60	1200	210	RT-A; FM-C	9, 10	5.6	1.5	DM	10	1100	370	SC	10						89
Carbofuran	4.4	88	5.7	RT; BS	54, 60	2.23	9.8	CD; DM	54, 60										89
Carboxin	115	2300		RT	74	84400		DM	74	370	110	SC	74						
Chlorothalonil	2.115	42.3	3	RT; FM	46	68	39	DM	46	190		SC	46					1.05	91
Chlorpropham	285	5700		RT	47	3700	770	DM	47										
Chlorpyrifos	0.15	3	0.57	RT; FM	11; 12	0.1	0.04	DM	11					0.083[d]	0.041[e]	0.083	0.041	1.122	88
cis-Permethrin[n]	0.0395	0.79	0.3	BS-A; FM-C	58	1.04	0.039	DM	58										
Clopyralid	98400	1968000		BS	64	113000		DM	64	6900	13	SC	64						
Cycloate	225	4500		RT	87	24000		DM	87										
Cypermethrin	0.0195	0.39	0.14			0.42	0.069												
Cyprodinil	12.05	241	230			320	8.2			2250									
DCPA	330	6600		RT	56	27000		DM	56	12380		SC	56						
DDT-Total														1.1	0.001	1.1	0.001		
DDVP	9.15	183	5.2	LT-A; RT-C	75	0.07	0.0058	DM	75	14000		ND	75						

Table C-1 (continued): Freshwater toxicity and regulatory guideline values. (All values reported in ug/L)

Chemical Name	Pesticide Registration Toxicity Data for Freshwater[1]													NRWQC for Fresh Water[3]		Washingtom State Water Quality Standards for Freshwater[2]		Maximum Conc. Limit for Salmon from Bilogical Opinion (NMFS)	
	Fisheries					Invertebrate				Aquatic Plant									
	ESLOC	Acute	Chronic	Spp.	Ref.	Acute	Chronic	Spp.	Ref.	Acute	Chronic	Spp.	Ref.	CMC	CCC	Acute	Chronic	Acute	Ref.
Diazinon	4.5	90	0.8	RT; BT	13; 14	0.8	0.17	DM	13	3700		SC	13	0.17	0.17			1.122	88
Dicamba I	1400	28000		RT	15	34600	16400	DM	15	3700	3700	SC	15						
Dichlobenil	246.5	4930	330	RT	16; 17	6200	560	DM	17	1500	160	SC	17						
Dichlorprop	10700	214000	14700	RT	76	558000	74900	DM	76	77	13	NP	76						
Dicofol	2.65	53	2.75			140	19			5000									
Dimethoate	310	6200	430	RT	29	3320	40	DM	29	36000		SC	29					60	90
Diphenamid	4850	97000		RT	59	58000		DM	59										
Disulfoton (Di-Syston)	92.5	1850	220	RT	19	13	0.037	DM	19										90
Disulfoton sulfone	460	9200		RT	19	35	0.14	DM	19										
Disulfoton Sulfoxide	3000	60000		RT	19	64	1.53	DM	19										
Diuron	97.5	1950	26.4	RT-A; FM-C	21, 22	1400	200	DM	21, 22	2.4		SC	21, 22					5	91
Endosulfan I	0.04	0.8	0.1	RT	23	166	2	DM	23					0.22[b,f]	0.056[c,f]	0.22[i]	0.056[i]		
Endosulfan II	0.04	0.8	0.1	RT	23	166	2	DM	23					0.22[b,f]	0.056[c,f]	0.22[i]	0.056[i]		
Endosulfan Sulfate	0.07	1.4		RT	82	580		DM	23										
Endosulfan-Total	0.04	0.8	0.1			166	2							0.22	0.056	0.22	0.056		
EPN	7.15	143		RT	84														
Eptam	700	14000		BS	24	6500	810	DM	24	1400	900	SC	24						
Ethoprop	51	1020	180	RT; FM	25	44	0.8	DM	25									20	90
Fenamiphos	3.4	68	3.8	RT	77	1.3	0.12	DM	77										90
Fenarimol	105	2100	870	RT	67	6800	113	DM	67		100	SC	67						
Fipronil	12.3	246	6.6	RT	78	190	9.8	DM	78	140	140	SC	78						
Fipronil Sulfide	4.15	83	6.6	ND	78	100	0.11	DM-A; ND-C	78	140	140	ND							
Fipronil Sulfone	1.95	39	0.67	RT-A; ND-C	78	29	0.037	DM-A; ND-C	78	140	140	ND							
Hexachlorobenzene	1.5	30	3.68	RT	26	30	16	DM	26	30		SC	26						
Hexazinone	9000	180000	17000	RT; FM	27; 28	151600	20000	DM	27	7	4	SC	27						
Imidacloprid	4150	83000	1200	RT	61	69	1300	CT-A; DM-C	61	10000		ND	61						
Imidan	11.5	230	3	RT	79	6	0.8	DM	79	150		SC	79						
Linuron	150	3000	5.58	RT	48	120	0.09	DM	48	67		SC	49						91
Malaoxon	1.64	32.8	8.6			0.59	0.06		31	2400									
Malathion	1.64	32.8	8.6	RT	31	0.59	0.06	DM	31	2400					0.1			1.122	88
MCPA	38	760	12000			180	11000			20		SC	32						
Mecoprop (MCPP)	6240	124800		RT	65	100000	50800	DM	65; 93	14	9	SC	93						
Metalaxyl	920	18400	9100	RT-A; FM-C	51	12000	1270	DM	51	100000		SC	51						
Methiocarb	21.8	436	50	ND	30	7	0.1	ND	30										
Methomyl	43	860	57	RT-A; FM-C	57	5	0.7	DM	57										89
Metolachlor	190	3800	2500	RT	33	1100	1	DM	33	8	1.5	SC	33						
Metribuzin	2100	42000	3000	RT	52	4200	1290	DM	52	11.9	8.9	NP	52						

Table C-1 (continued): Freshwater toxicity and regulatory guideline values. (All values reported in ug/L)

Chemical Name	Pesticide Registration Toxicity Data for Freshwater[1]													NRWQC for Fresh Water[3]		Washingtom State Water Quality Standards for Freshwater[2]		Maximum Conc. Limit for Salmon from Bilogical Opinion (NMFS)	
	Fisheries					Invertebrate				Aquatic Plant									
	ESLOC	Acute	Chronic	Spp.	Ref.	Acute	Chronic	Spp.	Ref.	Acute	Chronic	Spp.	Ref.	CMC	CCC	Acute	Chronic	Acute	Ref.
Napropamide	320	6400	1100	RT	80	14300	1100	DM	80	3400	71	SC-A; LM-C	80						
Norflurazon	405	8100	770	RT	34	15000	1000	DM	34	9.7	3.2	SC	34						
Oryzalin	163	3260	460	RT	85	1500	358	DM	85	52	13.8	SC	85					10	92
Oxamyl	210	4200	770	RT	62	420	27	DM	62	120	30000	SC	62						
Oxyfluorfen	12.5	250	38	RT-A; FM-C	35	80	13	DM	35	0.29	0.1	SC	35						
Pendimethalin	6.9	138	6.3	RT-A; FM-C	37	280	14.5	DM	37	5.4	3	SC	37					1	92
Pentachlorophenol	0.75	15	11	RT	38	450	240	DM	38	50		SC	38	7.9[d,g]	6.1[e,h]	8.2[j]	5.2[k]		
Picloram	275	5500		RT	53	34400		DM	53										
Piperonyl butoxide	95	1900	40	RT	81	510	30	DM	81										
Prometon	600	12000	9500	RT-A; FM-C	68	25700	3500	DM	68	98	32	SC	68						
Pronamide (Kerb)	3600	72000	7700	RT	66	5600	600	DM	66	4000	390	AF	66						
Propargite	5.9	118	16	RT-A; FM-C	40	74	9	DM	40	66.2	5	SC	40						
Propazine			720	FM-C	20	5320	47	DM	20	29	12	SC	20						
Propoxur	185	3700		RT	63	11		DM	63										
Simazine	2025	40500	2500	RT	36, 41	1000		DM	41	36	5.4	SC	36						
Tebuthiuron	7150	143000	26000	RT	42	297000	21800	DM	42	50	13	SC	42						
Terbacil	2310	46220	1200	RT	43	65000	640	DM	43	11	7	NP	43						
trans-Permethrin	0.145	2.9	0.3			0.1	0.039			0.039									
Triadimefon	205	4100	41	RT	55	1600	52	DM	55	1710	100	SC	55						
Triclopyr	95	1900	19	RT	44	13400	25000	DM	44	2300	2	SC-A; NP-	44						91
Trifluralin	2.18	43.6	2.18	RT	45	251	2.4	DM	45	7.52	5.37	SC	45					1	92

*Values are not analytically qualified. Non-asterisk values have been J-qualified as estimates, normally below the practical quantitation limit.

[1]Criteria identified in EPA reregistration and review documents or peer reviewed literature. References listed separately.
Time component of standards are explained in body of report.

ESLOC refers to Endangered Species Level of Concern: A refers to acute, and C refers to chronic.

Fish species abbreviated in table: BS-Bluegill Sunfish; BT-Brook Trout, BrT-Browns Trout, Coho-Coho Salmon, Chinook-Chinook salmon, FM- Fathead Minnow, LT-Lake Trout, RT-Rainbow Trout, ND-Not Described, Sockeye-Sockeye Salmon.

Invertebrate species abbreviated in table: CD-Ceriodaphnia dubia, CT-Chironomus tentans (midge), DM-Daphnia magna, ND-Not Described

Plant species abbreviated in table: AF-*Anabaena flos-aquae*, LM-*Lemma minor*, MD-marine diatom, NP-*Navicula pelliculosa*, ND-Not Described, SC-*Pseudokirchneriella subcapitata* formerly *Selenastrum capricornutum* (aka; *Pseudokirchneria subcapitata*),

[2]WAC: Promulgated standards according to Chapter 173-201A WAC.

[3]EPA National Recommended Water Quality Criteria (EPA-822-R-02-047).

(continued on next page)

CMC: Criteria Maximum Concentration; estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly without resulting in an unacceptable effect.

CCC: Criteria Continuous Concentration; estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely without resulting in an unacceptable effect.

a-Criteria applies to DDT and its metabolites (ΣDDT).

b-An instantaneous concentration not to be exceeded at any time.
c-A 24-hour average not to be exceeded.
d-A 1-hour average concentration not to be exceeded more than once every three years on average.
e-A 4-day average concentration not to be exceeded more than once every three years on average.
f-Chemical form of endosulfan is not defined in WAC 173-201A. Endosulfan sulfate may be applied in this instance.
g≤ e[1.005(pH)-4.830], pH range of 6.9 to 9.5 shown.
h≤ e[1.005(pH)-5.29], pH range of 6.9 to 9.5 shown.
i-Value refers to ∑α and β-endosulfan.
j≤ e[1.005(pH)-4.869], pH range of 6.9 to 9.5 shown.
k≤ e[1.005(pH)-5.134], pH range of 6.9 to 9.5 shown.
m-There are many forms of 2,4-D that include acids, salts, amines, and esters all of which have unique toxicity values. The criteria presented are in acid equivalents and are intended to provide a range of possible effects. Toxicity values for each form of 2,4-D are available in the referenced document.
n-Assessment criteria for permethrin are based on a formulation of cis and trans-permethrin isomers. Manchester Laboratory analysis includes only the cis-permethrin isomer,
the more toxic of the two; and cis-permethrin concentrations are compared to the assessment criteria for permethrin.

Table C-2: Marine toxicity and regulatory guideline values for the Browns Slough site. (All values reported in ug/L)

Chemical Name	Pesticide Registration Toxicity Data for Marine Water[1]													NRWQC for Marine Water[3]		Washingtom State Water Quality Standards for Marine Water[2]	
	Fisheries					Invertebrate				Aquatic Plant							
	ESLOC	Acute	Chronic	Spp.	Ref.	Acute	Chronic	Spp.	Ref.	Acute	Chronic	Spp.	Ref.	CMC	CCC	Acute	Chronic
1-Naphthol	60	1200		SM	10	200		MS	10								
2,4-D[m]	4000	80000		TS	1	57000		EO	1								
2,4'-DDD														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]
2,4'-DDE														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]
2,4'-DDT														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]
3-Hydroxycarbofuran	1.65	33	2.6			4.6	0.4										
4,4'-DDD														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]
4,4'-DDE														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]
4,4'-DDT														1.1[a,b]	0.001[a,c]	1.1[a]	0.001[a]
Atrazine	100	2000	1100	SM	4	94	100	AT-A; PO-	4	22		IG	4				
Azinphos-methyl																0.01	
Bentazon	6.8	136		SM	6	109		PS; EO	6								
Boscalid	190.5	3860				1020											
Bromacil	8.1	162				130											
Bromoxynil	8.5	170		SM	8	65		MS	8	140		SkC	83				
Carbaryl	12.5	250		AS	9, 10	5.7		MS	10								
Carbofuran	1.65	33	2.6	AS-A; SM-	54	4.6	0.4	PS-A; MS-	54								
Carboxin						14000											
Chlorothalonil	1.6	32				3.6	1.2										
Chlorpyrifos	13.5	270	0.28	SM-A; AS-C	11	0.035	0.0046	MS	11					0.011[c]	0.011[d]	0.0056	0.0056
cis-Permethrin[n]	0.11	2.2	0.83			0.019	0.011										
Cypermethrin	0.00475	0.95	0.34			0.00475	0.000781										
Cyprodinil	62.5	1250	130			8.14	1.9										
DCPA	50	1000		SM	56	620		EO	56	11000		SkC	56				
DDT-Total														1.1	1.1	0.001	0.001
Diazinon	7.5	150	0.47	SM	14	25	0.23	MS	14						0.82	0.82	
Dicamba I	9000	180000		SM	15												
Dichlobenil	700	14000		SM	16	1000		PS; EO	16								
Dicofol	18.5	370				15.1											
Dimethoate	5550	111000		SM	18	15000		MS	18								
Diuron	335	6700	440	SM	21	4900	270	EO-A; MS-	21								
Endosulfan I														0.22	0.22	0.056	0.056
Endosulfan II														0.22	0.22	0.056	0.056
Endosulfan Sulfate	0.155	3.1		SM	82		0.38	MS	82								
Endosulfan-Total														0.22	0.22	0.056	0.056
Fenamiphos						6.2											
Imidacloprid	8150	163000		SM	61	37	0.6	MS	61								
Linuron	44.5	890				890											

Table C-2 (continued): Marine toxicity and regulatory guideline values for the Browns Slough site. (All values are reported in ug/L)

Chemical Name	Pesticide Registration Toxicity Data for Marine Water[1]													NRWQC for Marine Water[3]		Washingtom State Water Quality Standards for Marine Water[2]	
	Fisheries					Invertebrate				Aquatic Plant							
	ESLOC	Acute	Chronic	Spp.	Ref.	Acute	Chronic	Spp.	Ref.	Acute	Chronic	Spp.	Ref.	CMC	CCC	Acute	Chronic
Malaoxon	1.35	27	17.3			2.2	0.13										
Malathion	1.35	27	17.3			2.2	0.13									0.1	
MCPA	135	2700		AS	32	130		EO	32	15		SkC	32				
Metalaxyl						4400		EO	51								
Methomyl	58	1160	260	SM	50	230	29	MS	50								
Metolachlor	490	9800	3600	SM	33	1600	700	EO	33	61	1.7	SkC	33				
Metribuzin	4250	85000		SM	52	42000		EO	52	8.7	5.8	SkC	52				
Napropamide	700	14000				1400											
Oxamyl	130	2600		SM	62	400		EO	62								
Pentachlorophenol	12	240	64	SM	38	48		PO	38	27		SkC	38	13[c]	7.9[d]		
Prometon	2365	47300				18000											
Simazine	215	4300		SM	41	3700		PS; EO	41	600	250	SkC	36				
Tebuthiuron						62000		PS	42	31	50	SkC	42				
Terbacil	5425	108500	2800	SM	43	4900		EO	43								
trans-Permethrin	0.11	2.2	0.83			0.019	0.011										
Triadimefon																	
Triclopyr	6500	130000		TS	86	58000		EO	86	6700	400	SkC	86				
Trifluralin	12	240	1.3	SM	45	136	138	MS-A; GS-	45	28	4.6	SkC	45				

*Values are not analytically qualified. Non-asterisk values have been J-qualified as estimates, normally below the practical quantitation limit.
[1] Criteria identified in EPA reregistration and review documents or peer reviewed literature. References listed separately.
Time component of standards are explained in body of report.
ESLOC refers to Endangered Species Level of Concern: A refers to acute, and C refers to chronic.
Fish species abbreviated in table: AS-Atlantic silverside, ND-Not Described, SM-Sheepshead Minnow, TS-Tidewater silverside.
Invertebrate species abbreviated in table: AT-Acartia tonsa (copepod), EO-Eastern Oyster, GS-Grass Shrimp, MS-Mysid shrimp, ND-Not Described, PO-Pacific Oyster, PS-Pink Shrimp.
Plant species abbreviated in table: IG-*Isochrysis galbana*, SkC-*Skeletonema costatum*
[2] WAC: Promulgated standards according to Chapter 173-201A WAC.
[3] EPA National Recommended Water Quality Criteria (EPA-822-R-02-047).
CMC: Criteria Maximum Concentration; estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed briefly
without resulting in an unacceptable effect.
CCC: Criteria Continuous Concentration; estimate of the highest concentration of a material in surface water to which an aquatic community can be exposed indefinitely
without resulting in an unacceptable effect.
a-Criteria applies to DDT and its metabolites (ΣDDT).
b-An instantaneous concentration not to be exceeded at any time.
c-A 24-hour average not to be exceeded.
d-A 1-hour average concentration not to be exceeded more than once every three years on average.
e-A 4-day average concentration not to be exceeded more than once every three years on average.
f-Chemical form of endosulfan is not defined in WAC 173-201A. Endosulfan sulfate may be applied in this instance.

g≤ e[1.005(pH)-4.830], pH range of 6.9 to 9.5 shown.
h≤ e[1.005(pH)-5.29], pH range of 6.9 to 9.5 shown.
i-Value refers to ∑α and β-endosulfan.
j≤ e[1.005(pH)-4.869], pH range of 6.9 to 9.5 shown.
k≤ e[1.005(pH)-5.134], pH range of 6.9 to 9.5 shown.
(continued on next page)
m-There are many forms of 2,4-D that include acids, salts, amines, and esters all of which have unique toxicity values. The criteria presented are in acid equivalents
and are intended to provide a range of possible effects. Toxicity values for each form of 2,4-D are available in the referenced document.
n-Assessment criteria for permethrin are based on a formulation of cis- and trans-permethrin isomers. Manchester Laboratory analysis includes only the cis-permethrin isomer,
the more toxic of the two; and cis-permethrin concentrations are compared to the assessment criteria for Permethrin.

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Appendix D: Glossary, Acronyms, and Abbreviations

Glossary

Analyte: Chemical being measured by a laboratory method.

Assessment criteria: Assessment criteria in this report are non-regulatory values used to assess risk to aquatic species and include a combination of toxicity data acquired from EPA pesticide registration documents and numeric criteria acquired from NRWQC (see Appendix C).

Basin: Watershed. A drainage area in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

Bioaccumulation: Progressive increase in the amount of a substance in an organism or part of an organism which occurs because the rate of intake exceeds the organism's ability to remove the substance from the body.

Carbamate insecticide: N-methyl carbamate insecticides are similar to organophosphate insecticides in that they are nerve agents that inhibit acetylcholinesterase enzymes. However they differ in action from the organophosphate compounds in that the inhibitory effect on cholinesterase is brief.

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.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Degradate: Pesticide breakdown product.

Dissolved oxygen: A measure of the amount of oxygen dissolved in water.
Exceeded criteria: Did not meet criteria.

EC_{50}: The "effect concentration" causing an effect in 50% of test species. This value is calculated by plotting the dose response curve and fitting a mathematical equation to the data and using that equation to calculate the concentration for any level of effect, in this case the 50% value.

Grab sample: A discrete sample from a single point in the water column or sediment surface.

Herbicide: A substance used to kill plants or inhibit their growth.

LC_{50}: The "lethal concentration" causing mortality in 50% of test species. This value is calculated by plotting the dose response curve and fitting a mathematical equation to the data and using that equation to calculate the concentration for any level of effect, in this case the 50% value.

Legacy pesticide: A pesticide that is no longer registered for use, but persists in the environment.

Loading: The input of pollutants into a waterbody.

Lowest Observable Adverse Effect Concentration (LOEC): The lowest concentration in a toxicity test showing a statistically significant difference from the control. The NOAEC is by definition the next concentration below the LOEC in the concentration series.

Marine water (seawater): Salt water.

No Observable Adverse Effect Concentration (NOAEC): The highest concentration in the toxicity test not showing a statistically significant difference from the control.

Organophosphate pesticide: Pesticide derived from phosphoric acid and are highly neurotoxic, typically inhibiting cholinesterase.

Parameter: Water quality constituent being measured. A physical, chemical, or biological property whose values determine environmental characteristics or behavior.

Pesticide: Any substance or mixture of substances intended for killing, repelling or mitigating any pest. Pests include nuisance microbes, plants, fungus, and animals.

Pesticide registration toxicity data: Includes toxicity data from laboratory studies generated to fulfill the Data Requirements for Pesticide Registration (Code of Federal Regulations - 40CFR Part 158: Subpart G 158.630 and 158.660). Toxicity data used in this study are acquired from pesticide registration documents including EPA risk assessment documents and are not acquired directly from the toxicity studies (see Appendix C).

Pesticide Synergist (Synergist): A natural or synthetic chemical which increases the lethality and effectiveness of currently available pesticides.

pH: A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Risk Quotient (RQ): A risk quotient (RQ) is calculated by dividing a point estimate of environmental exposure by a point estimate of effect. Risk quotients are an expression of concentration over toxicity and are used by EPA and others to assess risk given just two pieces of information for screening level risk assessments.

Site visit: A single event where samples and field measurements were collected from a single monitoring location on a single day and may refer to all of the sample data and field data from that event.

Salmonid: Fish that belong to the family *Salmonidae*. Any species of salmon, trout, or char. www.fws.gov/le/ImpExp/FactSheetSalmonids.htm

Suspended sediment: Solid fragmented material (soil and organic matter) in the water column.

Total suspended solids (TSS): The suspended particulate matter in a water sample as retained by a filter.

Water quality standards: Washington State water quality standards.

Watershed: Basin. A drainage area in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

303(d) list: Section 303(d) of the federal Clean Water Act requires Washington State periodically to 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 Washington State surface water quality standards and are not expected to improve within the next two years.

7-DADMax or 7-day average of the daily maximum temperatures: The arithmetic average of seven consecutive measures of daily maximum temperatures. The 7-DADMax for any individual day is calculated by averaging that day's daily maximum temperature with the daily maximum temperatures of the three days prior and the three days after that date.

Acronyms and Abbreviations

7-DADMax	7-day Average of the Daily Maximum Temperatures
DDD	Dichloro-diphenyl-dichloroethane
DDE	Dichloro-diphenyl-dichloroethylene
DDT	Dichloro-diphenyl-trichloroethane
DO	Dissolved oxygen
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESLOC	Endangered species level of concern (EPA)
FIFRA	Federal Insecticide Fungicide and Rodenticide Act
GCMS	Gas chromatograph coupled with mass spectrometer
LC50	Lethal concentration to cause mortality in 50% of test species
LCMS	Liquid chromatograph coupled with mass spectrometer
LCMS/MS	Liquid chromatograph coupled with tandem mass spectrometer
LCS	Laboratory control sample

LOC	Level of concern
LPQL	Lower practical quantitation limit
MEL	Manchester Environmental Laboratory
MQO	Measurement quality objective
MS	Mass spectrometer
MS/MSD	Matrix spike/matrix spike duplicate
NAD	North American Datum
n	Number
NRWQC	National Recommended Water Quality Criteria (EPA)
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOEC	No observable effect concentration
QA	Quality assurance
QC	Quality control
RPD	Relative percent difference
RQ	Risk quotient
RSD	Relative standard deviation
SOP	Standard operation procedures
TSS	(See Glossary above)
TU	Toxicity units
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WAC	Washington Administrative Code
WRIA	Water Resource Inventory Area
WSDA	Washington State Department of Agriculture

Units of Measurement

°C	Degrees centigrade
cfs	Cubic feet per second
m	Meter
mg/L	Milligrams per liter (parts per million)
s.u.	Standard units
ug/L	Micrograms per liter (parts per billion)