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Ambient Monitoring for Pesticides in Washington State Surface Water: 2015 Technical Report

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Executive Summary:

The Washington State Department of Agriculture (WSDA) has been generating surface water monitoring data for pesticides since 2003 in an ongoing effort to assess the frequency and degree to which pesticides can be detected in surface water across a diverse cross section of land use patterns in Washington State.

This report provides a detailed summary of the surface water monitoring data that was collected at 14 separate monitoring sites in 2015. A total of 1,601 surface water samples were collected during weekly sampling events between March 9, 2015 and August 25, 2015 for a total of 340 sampling events. 87 pesticide active ingredients were detected in samples collected during sampling events out of the 208 pesticide active ingredients and break down products tested at the laboratory. Pesticide active ingredients and pesticide break down products were detected a total of 1,663 individual times. Over one third of those 1,663 individual detections were detections of 27 compounds that had been added to the 2015 laboratory analysis. Samples for total suspended solids as well as field measurements for pH, dissolved oxygen, conductivity and streamflow were also collected at sampling events. Continuous temperature measurements were collected in situ during the entire monitoring season.

Because glyphosate (active ingredient in Roundup™) containing products are believed to have significant use patterns in both urban[1] and agricultural settings, WSDA staff conducted a short pilot study collecting surface water samples for glyphosate at all 14 monitoring sites for five weeks in the spring. The analytical laboratory updated and developed a cost effective test methodology for glyphosate and glyphosate's primary breakdown product, aminomethylphosphoric acid (AMPA). Samples from weekly monitoring events were collected during the peak glyphosate usage period for five weeks (mid-April to mid-May). Samples were analyzed for glyphosate, AMPA, and glufosinate. Sample results indicated a mixture of glyphosate detections 77% of the time, and AMPA detections 65% of the time. All detections of glyphosate, AMPA, and glufosinate were at concentrations less than or equal to 1.5 parts per billion (ppb). That concentration is less than 466 times below EPA's maximum contaminant level for glyphosate in drinking water (700 ppb) and at least 1,200 times below EPA's most sensitive aquatic life benchmark for fish, aquatic invertebrates, and aquatic plants.

Maintaining the highest level of data quality is an essential component of the monitoring program. The WSDA staff closely adhere to detailed field procedures while the laboratory successfully produced high quality testing results to achieve the highest quality assurance standards recommended by the EPA. Appendix B: 2015 Quality Assurance Summary provides a detailed analysis of how the laboratory methods, quality assurance samples, and quality control samples performed over the season.

[1] Non-Agricultural Pesticide Use in Puget Sound Counties (WSDA, 2014), http://agr.wa.gov/FP/Pubs/docs/103-409PSReportfinal2014.pdf

Introduction:

Washington State Department of Agriculture (WSDA) has authority as a state lead agency to regulate the sale and use of pesticides in Washington State under federal regulation according to the Federal Insecticide, Fungicide, and Rodenticide Act[2], and state regulation according to RCW Chapter 15.58 (Washington Pesticide Control Act[3]) and Chapter 17.21 RCW (Washington Pesticide Application Act[4]).

Since 2003 WSDA has received funding from the Washington State Legislature and the U.S. Environmental Protection Agency (EPA) to administer a comprehensive program to assess the frequency and magnitude of pesticides detected in Washington State surface waters that support aquatic life. Ambient surface water monitoring was conducted weekly in 2015 from March through August.

It is of critical importance to ensure that the potential effects of pesticides on aquatic systems are minimized while also minimizing the economic impacts to agricultural systems that are responsible for providing a sustainable food supply. The data generated by this program helps regulators and the public to better understand the fate and transport of pesticides in the environment under varying regional environmental conditions and pesticide use patterns. The data is utilized by a wide range of governmental and non-governmental agencies and institutions including the EPA, the National Marine Fisheries Service (NMFS), and the U.S. Fish and Wildlife Service (USFWS) to refine threatened and endangered species exposure assessments for pesticides registered for use across the country. This dataset also allows the EPA and WSDA to determine if more protective measures should be required on pesticide labels, and if best management practices or restrictions are needed to safeguard water quality.

The technical report is intended to:

- Provide a summary of results from monitoring activities conducted in 2015.
- Provide a description of the data quality.
- Document changes in water quality over time.
- Identify subbasins that are impacted by pesticides.
- Provide data for the pesticides that are listed for agency ESA consultations.
- Monitor for Pesticides of Interest, and Pesticides of Concern.
- Support implementation of the agency's Pesticide Management Strategy[5].
- Provide support for education and outreach to pesticide applicators.
- Provide recommendations for the implementation of best management practices.
- Provide a basis for potential modifications to the program in upcoming years.

[2] https://www.epa.gov/laws-regulations/summary-federal-insecticide-fungicide-and-rodenticide-act
[3] http://apps.leg.wa.gov/RCW/default.aspx?cite=15.58
[4] http://apps.leg.wa.gov/RCW/default.aspx?cite=17.21
[5] http://agr.wa.gov/pestfert/natresources/docs/comprehensivepesticidemanagementstrategy.pdf

Study Area:

Since the surface water monitoring program for pesticides began in 2003, sampling sites and subbasins have been both added and removed based on pesticide detection history, changing pesticide use practices, site conditions, land use patterns, and the presence of listed threatened or endangered species. Hydrologic units[6] and their associated hydrologic unit codes (HUC) are used to describe each monitoring location position within the regional hydrologic system. Figure 1 shows the boundaries of the seven subbasins that were monitored in 2015 which are identified by their eight-digit HUC codes and corresponding subbasin names.

Figure 1: Subbasins Monitored in Washington State in 2015

All seven subbasins exist within the greater Pacific Northwest Region (HUC 17). One subbasin represented mixed urban and residential landscapes and was selected due to land-use characteristics, history of pesticide detections, and the habitat provided for endangered species including pacific salmonids. The other six subbasins represent a variety of agricultural landscapes. The agricultural subbasins were chosen because they produce different varieties of

[6] Hydrologic Units

agricultural commodities in close proximity to water bodies, they have a wide range in terms of the percentage of the total areas in agricultural production, and they are habitat for endangered species including pacific salmonids.

Subbasins Monitored in 2015

Fourteen sites located at private and public access points were monitored in 2015. Details including maps, latitude and longitudinal coordinates, and agricultural land use statistics are described in Appendix A: Monitoring Location Data. Brief descriptions of the subbasins and monitoring locations are provided below.

Nooksack Subbasin

The Nooksack River flows from the cascade mountain range to Bellingham bay. Bertrand Creek is located in the Nooksack subbasin (HUC 17110004) in Whatcom County. Approximately half of the watershed lies south of the U.S. Canadian border and as least 61% of the land use in the subbasin is in agricultural production. Grass hay, red raspberries, field corn, and blueberries make up a majority of the acreage grown in the subbasin. Roughly 20% of the agricultural acreage on the U.S. side is currently producing, blueberries, raspberries, blackberries, marionberries, and strawberries (WSDA, 2014).

Two monitoring sites have been established in the Nooksack subbasin. The Bertrand Creek 1 site, referred to as *Lower Bertrand Creek* (Figure 8), was selected to represent berry farming in western Washington and is located near the bottom of the watershed approximately 1 mile upstream of where the tributary enters the Nooksack River. The Bertrand Creek 7 site, referred to as *Upper Bertrand Creek* (Figure 8), is located near the U.S. Canadian border in order to distinguish between potential water quality issues originating from upstream of the U.S. border with Canada. Both sites have been monitored since 2013.

Strait of Georgia & Lower Skagit Subbasins

Within the greater Puget Sound subregion (HUC 1711) lies the Strait of Georgia subbasin (HUC 17110002) and the Lower Skagit subbasin (HUC 17110007). Both subbasins include sections of the Skagit valley which has a wide variety of landscapes and land use practices including extensive agricultural areas. The agricultural areas of the Skagit valley consists largely of diked flood plains which are characterized by a complex system of rotational agriculture that include several vegetable crops grown for seed and flower bulbs. In terms of acres the valley is dominated by the production of Potatoes, field corn, grass hay, and wheat.

In the Strait of Georgia subbasin, the Indian Slough 1 site, referred to as *Indian Slough* (Figure 11), is located on the upstream side of the tidegate at Bayview-Edison Road. In the Lower Skagit subbasin; the Big Ditch 2 site, referred to as *Upper Big Ditch* (Figure 9), is located on the upstream side of the bridge at Eleanor Lane, the Big Ditch 1 site, referred to as *Lower Big Ditch* (Figure 9), is located on the upstream side of the bridge at Milltown Road, and the Browns Slough 1 site, referred to as *Browns Slough* (Figure 10), is located downstream of the tidegate on

Fir Island Road. The sites in these two subbasins were selected to represent irrigated agricultural land-use practices in western Washington and have been monitored since 2006.

Lake Washington Subbasin

The Lake Washington subbasin (HUC 17110012) is also within the greater Puget Sound subregion, and is located within the greater Seattle area of King County, Washington.

Located in the Lake Washington subbasin, the Thornton Creek 3 monitoring site, referred to as *Thornton Creek* (Figure 12), lies to the west and just upstream from where the creek enters Lake Washington and downstream of the pedestrian footbridge near Matthews Beach Park. Thornton Creek was selected because the watershed has a mixture of residential and urban land-use that includes recreational turf grass. Between one and four sites have been sampled on Thornton Creek beginning in 2003.

Lower Yakima Subbasin

The Lower Yakima subbasin (HUC 17030003) of the Yakima subregion (HUC 1703) is characterized by an extensive irrigated agricultural system with over 100 different commodities grown, making it one of the most agriculturally diverse subbasins in the Pacific Northwest. Of the commodities grown in the Lower Yakima subbasin, the four dominant crops in terms of land cover include corn, grapes, hops and apples.

There are three monitoring sites within the Lower Yakima subbasin and Yakima County. The monitoring site Marion Drain 2, referred to as *Marion Drain* (Figure 13), is located approximately 15 meters upstream of the bridge at Indian Church Road. The Sulphur Creek Wasteway 1 site, referred to as *Sulphur Creek Wasteway* (Figure 14), is located on the downstream side of the bridge at Holaday Road. The Spring Creek 3 site, referred to as *Spring Creek* (Figure 15), is located approximately 44 meters upstream of the culvert under West Hess Road. All three sites in the Lower Yakima subbasin were selected to represent irrigated agricultural land practices in eastern Washington and have been sampled since 2003.

Wenatchee Subbasin

The Wenatchee subbasin (HUC 1702001) is located within the Upper Columbia subregion (HUC 1702) and is characterized by mountainous terrain. Tree fruit, range land, and forestry are the dominant agricultural land use patterns in that subregion.

Three monitoring site were sampled in the Wenatchee subbasin in 2015. The Peshastin Creek 1 site, referred to as *Peshastin Creek* (Figure 16), is located approximately 30 meters downstream of the bridge at Saunders Road. The Mission Creek 1 site, referred to as *Mission Creek* (Figure 17), is located on Mission Creek Road off of Trip Canyon Road. The Brender Creek 1 site, referred to as *Brender Creek* (Figure 18), is located on the upstream side of the culvert at Evergreen Drive. The three sites which are located in Chelan County were selected to represent agricultural tree fruit practices in central Washington and have all been sampled since 2007.

Upper Columbia-Entiat Subbasin

The Upper Columbia-Entiat subbasin (HUC 17020010) is also located within the Upper Columbia subregion (HUC 1702) which is characterized by mountainous terrain. Tree fruit, range land, and forestry are the dominant agricultural land use patterns in that subregion.

One monitoring site was sampled in the Upper Columbia-Entiat subbasin in 2015. The Stemilt Creek 1 site, referred to in this report as *Stemilt Creek* (Figure 19), is located upstream of where Stemilt Creek discharges into the Columbia River and is approximately 7 meters upstream of the Old West Malaga Road bridge. The Stemilt Creek site was selected to represent agricultural tree fruit practices in central Washington and has been sampled since 2013.

Study Methodology:

Study Design

The ambient surface water monitoring program was designed to identify when and where pesticides occur in surface water during typical pesticide use periods and to estimate what potential direct or indirect impacts there could be on endangered species including pacific salmonids. Surface water samples were collected weekly and analyzed for 209 pesticide active ingredients and pesticide breakdown products commonly found in the majority of homeowner and restricted use products. Weekly sampling was conducted at 12 of the 14 monitoring sites for 25 consecutive weeks, beginning the second week in March and continuing through the fourth week of August. Two of the 14 monitoring sites (Indian Slough and Browns Slough) were only sampled for 20 consecutive weeks and stopped after the third week of July due to insufficient water levels or non-flowing water.

In 2015 surface water grab samples were also collected to analyze for the presence of glyphosate, glufosinate, and aminomethylphosphonic acid (AMPA) at all 14 ambient surface water monitoring sites for five weeks starting the second week of April and sampling weekly until the second week in May. Sampling weeks were selected based on pesticide use data collected by WSDA and USDA-NASS that indicated these weeks were when growers were most likely to be using glyphosate-based herbicides.

Conventional water quality parameters were also monitored at all sampling events to account for their influence on the toxicity and fate and transport of pesticides in the environment. Measurements were collected in the field for pH, conductivity, dissolved oxygen, and streamflow at all sampling events. Samples were collected for total suspended solids (TSS) at all sampling events and sent to MEL for analyses. Continuous temperature data was collected at 30-minute intervals throughout the monitoring season.

Additional descriptions of field procedures and laboratory analysis are included in the EPA approved Quality Assurance Project Plan (QAPP) (Johnson and Cowles, 2003), subsequent QAPP 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; and Sargeant et al., 2013).

Laboratory Analyses

The Washington State Department of Ecology's Manchester Environmental Laboratory (MEL) analyzed surface water grab samples, for pesticides, TSS, and conductivity. Table 1 provides a summary of the extraction and analytical methods used by MEL.

Table 1: Summary of Laboratory Methods

Analysis method	Extraction method reference [1]	Analytical method reference [1]	Instrumentation
GCMS-Pesticides	3535A	8270D	GC/MS
GCMS-Herbicides (Derivitizable acid herbicides)	3535A	8270D	GC/MS
LCMS-Pesticides	n/a	8321B	LC/MS/MS
LCMS-Glyphosate	3535A	8321BM	LC/MS/MS
GCMS-Pesticides in Sediment	2007.01	8270D	GC/MS
TSS	n/a	SM 2540D	Gravimetric
Conductivity	n/a	SM 2510	Electrode

[1] 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

Glyphosate was analyzed by MEL using a modified version of the methods developed by Hanke et al. (Hanke et al., 2008) and USGS (Meyer et al., 2009). Using this method, analytes were first derivatizatized using 9-fluorenylmethylchloroformate (FMOC-Cl) prior to extraction and analysis. Derivatization was followed by solid-phase extraction (SPE) and quantification of the three derivatized analytes was determined by liquid chromatography with tandem mass spectrometry (LC-MS/MS). The reporting limit for all three chemicals following this method was 0.008 µg/L.

Field Procedures

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 using a one-liter glass transfer jar 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). When streamflow is vertically and horizontally integrated across the transect, as is the case under extreme low flow periods, a one-liter glass transfer container was used to dip and pour water from the stream center into sample containers. After collection, all samples were labeled and preserved according to the QA Project Plan (Johnson and Cowles, 2003).

Field meters were calibrated at the beginning of the week prior to sampling 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 week once sampling was completed using known standards. Dissolved oxygen meter measurements were compared to grab samples analyzed by Winkler Titration for dissolved oxygen following Ecology SOP (Ward, 2007). Three to five Winkler grab samples were obtained during each sample week, one at the beginning and end of each day and one replicate Winkler. Continuous, 30-minute interval temperature data were collected from the first week of March through the third week of September for eastern Washington monitoring sites. Continuous, 30-minute interval temperature data were collected from the last week in February, through the third week in September for western Washington monitoring sites with the exception of Upper Bertrand Creek where temperature loggers were installed the second week of March, through the third week of September. 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). The 2015 field data quality results are summarized in Appendix B of this report. Measurement quality objectives (MQOs) for meter post-checks, replicates, and Winkler DO comparisons are described in Anderson and Sargeant (2009). Data that did not meet MQOs were qualified.

Streamflow data in cubic feet per second (cfs) was measured for sites excluding Thornton Creek, Upper Bertrand Creek, Lower Bertrand Creek, Sulphur Creek Wasteway, and Peshastin Creek using an OTT MF pro flow meter and top-setting wading rod, as described in Ecology SOP EAP056 (Shedd, 2014). Streamflow data for Thornton Creek were obtained from a USGS gauging station located downstream of Sand Point Way NE (Station ID: 12128000). Upper Bertrand Creek flow data were obtained from a USGS gauging station located upstream at the Canadian border (Station ID: 12212390). Lower Bertrand Creek flow data were obtained from an Ecology gauging station located at Rathbone Road (Station ID: 01N060). Streamflow data for Sulphur Creek Wasteway were obtained from an adjacent U.S. Bureau of Reclamation gauging station at Holaday Road near Sunnyside. Streamflow data for Peshastin Creek were obtained from an Ecology gauging station located at Green Bridge Road (StationID: 45F070). Fifteen-minute discharges were provided by the gaging stations throughout the sampling season. The recorded streamflow closest to the actual sampling time was used in lieu of field measurements.

Data Quality and 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. In 2015, 11.8% of the samples collected in the field were QA samples. The full QA/QC analysis is contained in Appendix B: 2015 Quality Assurance Summary.

Data Qualifiers

Laboratory data was qualified according to the National Functional Guidelines for Organic Data Review (EPA, 2008). Data qualifiers describe the level of confidence associated with the data points and are defined according to Table 2.

Table 2: Data Qualification Definitions

Qualifier	Definition
D	The analyte was positively identified and was detected at the reported concentration.
E	Reported result is an estimate because it falls outside of 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.

Laboratory data points that were assigned a qualifier of “D” are equivalent to having “No qualifier” where “No qualifier” is the traditionally accepted method of assigning the highest level of confidence. Laboratory data assigned a qualifier of “D” “J” or “E” are considered confirmed pesticide detections. Laboratory data qualified with “NJ”, “U,” or “UJ” are considered non-detects.

Data qualifiers were assigned to field measurements only when one or more factors associated with the field procedure resulted in a decrease in the level of confidence associated with a data point.

All pesticide laboratory results assigned a qualifier of “D” “J” or “E” were compared to the assessment criteria that were developed for this report. The assessment criteria listed in Appendix C: Assessment Criteria for Pesticides of this report were derived by applying safety factors to ensure that the criteria is adequately protective of aquatic life and that potential water quality issues are detected before they become persistent. Table 13 relates the assessment criteria to the specific effects endpoints and water quality standards. "Non-detect" assigned a qualifier of "U", "UJ", "N", and "NJ" were not used for comparison to pesticide assessment criteria or water quality standards.

Replicate Values

Field and laboratory replicates were obtained to determine data quality. Field and laboratory replicate values were 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.

Assessment Criteria

Assessing the potential effects of pesticide exposure to aquatic life and endangered species is evaluated by comparing pesticide concentrations detected in surface water against referenced values. The assessment criteria for this report were derived by applying a 0.5x safety factor to all referenced values to ensure that the criteria is adequately protective of aquatic life and that potential water quality issues are detected early on. This report specifically references toxicity values and water quality criteria from the following three primary sources.

1) EPA's National Recommended Water Quality Criteria[7] (NRWQC) includes a list of approximately 150 pollutants that was created for the protection of aquatic life and human health in surface waters. These criteria are published pursuant to Section 304(a) of the Clean Water Act (CWA) by the Office of Water and provide guidance for states and tribes to use in adopting water quality standards.
2) Washington State maintains its own list of priority pollutants under the authority of WAC 173-201A: Water Quality Standards for Surface Waters of The State of Washington[8] which includes water quality standards for several pesticides and pesticide degradates. For the purposes of this report these numeric values will be referred to as "state water quality standards".
3) Data from studies that determine hazard to non-target organisms are used to fulfill the Data Requirements for Pesticide Registration[9] (Code of Federal Regulations - 40CFR Part 158: Subpart G 158.630 and 158.660). Toxicity data from these studies generated following Series 850 - Ecological Effects Test Guidelines[10] are commonly used to conduct screening-level risk assessments and EPA uses these values to develop aquatic life benchmarks for pesticide

[7] http://water.epa.gov/scitech/swguidance/standards/criteria/current
[8] http://apps.leg.wa.gov/wac/default.aspx?cite=173-201A-240
[9] https://www.epa.gov/pesticide-registration/data-requirements-pesticide-registration
[10] Designed to comply with toxicity testing requirements under TSCA, FIFRA and FFDCA, https://www.epa.gov/test-guidelines-pesticides-and-toxic-substances/series-850-ecological-effects-test-guidelines

active ingredients by applying a safety factor. For the purposes of this report, toxicity data from these studies will be referred to in this report as Acute and Chronic effect endpoints[11].

The primary effect endpoints used in this report are the:

- Lowest LC_{50}[12] or EC_{50}[13] values for freshwater fish, freshwater invertebrates or estuarine/marine fish and invertebrates.
- Lowest No Observable Adverse Effect Concentration[14] (NOAEC) values for freshwater fish, freshwater invertebrates and estuarine/marine fish and invertebrates from early life-stage or full life-cycle tests.

Assessment criteria for fish, invertebrates, and aquatic plants are presented in Appendix C: Assessment Criteria for Pesticides. Numeric exceedances of the values in Appendix C: Assessment Criteria for Pesticides 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.

Effect Endpoints

The acute toxicity of a pesticide is generally estimated using data generated from a standardized toxicity tests where members of a surrogate species at a specific life stage are exposed to a pesticide active ingredient or formulated pesticide product at a range of concentrations. Measured effects from acute tests may be lethality or sublethal effects. For fish, the LC_{50} is the final reported measurement from an acute toxicity test that is conducted over 96 hours where the biological endpoint is lethality and where the exposed groups are compared to a control group. For invertebrates the EC_{50} is the final reported measurement from an acute toxicity test conducted over 48 hours where the biological endpoint is mortality or immobility and where the exposed groups are compared to a control group. For aquatic plants the EC_{50} is the final reported measurement from an acute toxicity test conducted over 96 hours where the biological endpoint is reduction in growth and where the exposed groups are compared to a control group.

Chronic toxicity tests 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. In general the duration of chronic toxicity tests will last for 21 days for fish, 14

[11] See: Effect Endpoints

[12] 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.

[13] 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.

[14] The NOAEC is the highest concentration in the toxicity test not showing a statistically significant difference from the control.

days for invertebrates, and between 4 to 60 days for plants in order 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 effect endpoints, 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 are calculated by dividing a point estimate of environmental exposure by a point estimate of effect and are an expression of potential risk to non-target organisms.

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

Risk quotients are unit-less values that can be compared directly to an effect endpoint from a toxicity study or to a particular Level of Concern[15] (LOC) as defined by EPA. LOCs are commonly used by EPA and FIFRA state lead agencies to interpret the potential risk to non-target organisms. LOCs can also act as safety factors when used to estimate the concentration that would cause a particular effect by multiplying the LOC value by the effect concentration. Table 3 provides a list of LOCs and risk quotients referred to throughout this report.

Table 3: Risk Quotients and LOCs

Risk presumptions	Risk quotient[1]	LOC	Description of risk for aquatic life
Acute High Risk	$\frac{Exposure}{LC_{50} \text{ or } EC_{50}}$	≥0.5	Potential for acute risk to non-target organisms which may warrant regulatory action in addition to restricted use classification
Acute Restricted Use	$\frac{Exposure}{LC_{50} \text{ or } EC_{50}}$	≥0.1	Potential for acute risk to non-target organisms, but may be mitigated through restricted use classification

[15] EPA Technical Overview of Ecological Risk Assessment, https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/technical-overview-ecological-risk-assessment-risk#Deterministic

Acute Endangered Species	$\frac{\text{Exposure}}{LC_{50} \text{ or } EC_{50}}$	≥0.05	Endangered species may be potentially affected at this level
Chronic Risk	$\frac{\text{Exposure}}{\text{NOAEC}}$	≥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	$\frac{\text{Exposure}}{EC_{25}}$	≥1	May have indirect effects on aquatic vegetative cover for threatened and endangered fish.
Aquatic Plants - Acute Endangered Species	$\frac{\text{Exposure}}{EC_{05} \text{ or NOEC}}$	≥1	May have indirect effects on aquatic vegetative cover for threatened and endangered fish.

Information in this table was compiled from the EPA Technical Overview of Ecological Risk Assessment, https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/technical-overview-ecological-risk-assessment-risk#Deterministic

Applying LOC values as safety factors when developing regulatory guidelines can serve to protect non-target organisms from exposure to pesticides at concentrations that would be likely to cause adverse effects. The Acute Endangered Species LOC (ESLOC) is used as a comparative value to assess the potential risk to threatened or endangered salmonids for example. The endangered species risk quotient 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 last updated in 2006 (EPA 2006) and those criteria were used in the development of the assessment criteria which are presented in Appendix C: Assessment Criteria for Pesticides of this report.

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.

Acute and chronic numeric criteria for fish, invertebrates, and aquatic plants are presented in Appendix C: Assessment Criteria for Pesticides.

Toxicity Unit Analysis

Effects endpoints, 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 and the Endangered Species Act[16] 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 entitled *Assessing Risks to Endangered and Threatened Species from Pesticides*[17]. The review 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). TUs can be calculated for a

[16] https://www.epa.gov/laws-regulations/summary-endangered-species-act
[17] http://www.nap.edu/catalog/18344/assessing-risks-to-endangered-and-threatened-species-from-pesticides

multi-component mixture using the, concentration, the LC_{50} (lethal concentration to cause mortality in 50% of test species) for each pesticide, and the following equation:

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

The TU value is equal to the sum of the individual risk quotients where x_1 and x_2 are the concentrations (indicated by square brackets) of the mixture components x_1 and x_2, where $LC_{50}(x_1)$ and $LC_{50}(x_2)$ are the effect concentrations of the individual pesticides producing the combined effect. The effect concentrations in the denominator of the risk quotient can also be multiplied by the LOC value to conveniently assess if the LOC has been exceeded by the pesticide mixture. To assess the potential effect of the mixture at the LC_{50} level, the LOC will be equal to one. A TU value greater than or equal to one ($TU \geq 1$) means a lethal or sublethal effect may occur with an increasing likelihood depending on the degree to which the TU value exceeds 1. In the case where the LOC value is equal to one and the effect endpoints are LC50 values, any $TU \geq 1$ means that as much as 50% of the organisms exposed to those concentrations in combination may experience lethality. The same equation can be modified to calculate other effects measures or LOCs. The results section of this report displays the TU values for several different LOCs.

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

According to the Washington State water quality standards for conventional water quality parameters (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 and compared to the numeric criteria of the Washington State water quality standards according to the aquatic life uses as shown in Table 4. The 7-DADmax water temperature is defined as the average of the daily maximum temperature measured over a 7-day period.

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

Aquatic life uses	Temperature 7-DADMax (^{0}C)	Dissolved oxygen (lowest 1-day minimum)	pH (s.u.)	Western Washington sites	Eastern Washington sites
Freshwater - Core Summer Salmonid Habitat	16.0 ^{0}C	9.5 mg/L	6.5-8.5 *(with a human caused variation within the*	Thornton Creek	NA

			above range of <0.2 units)		
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	Marion Drain, Spring Creek, Sulphur Creek, Peshastin Creek, Brender Creek, Mission Creek, Stemilt Creek
Freshwater - Supplemental Spawning and Incubation Temperature Criteria - October 1-May 15	13.0 ^{0}C	NA	NA	Thornton Creek	NA
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	NA

Data Analysis

All field and laboratory data were compiled and organized utilizing Access® database software (Microsoft Corporation, 2010). Calculations and descriptive statistics were processed using Microsoft Excel® (Microsoft Corporation, 2010). Figures were generated using a combination of software products including:

- Microsoft Excel®
- PyScripter 2.6.0
- ggplot2 package for R (Wickham 2009).
- Python™ 2.7.5 for windows
- R (R Core Team 2016)[18]

[18] http://mirrors.nics.utk.edu/cran/

Results Summary:

Data presented in this section of the report only include results where pesticides were positively identified ("D", "J", or "E"). Data where pesticides were tentatively identified ("NJ"), rejected ("REJ"), or not detected ("U", or "UJ") may be referred to but are not specifically addressed in the results summary. Please refer to Appendix B: 2015 Quality Assurance Summary for further information on method performance.

Pesticide Detection Summary

Eighty different pesticide and pesticide related analytes were detected in 2015. Table 5 provides a statewide summary of the 1,663 individual detections across the 14 monitoring sites sampled in 2015.

Table 6 further summarizes the detections in 2015 by general use category.

Table 5: Statewide summary of pesticides with one or more detections in 2015

Pesticides detected in 2015	Detections	Max concentration (µg/L)*	Average concentration (µg/L)*	SD (µg/L)*	Detection Frequency
Degradates:					
Oxamyl oxime	41	0.18	0.08	0.04	12%
4,4'-DDE	36	0.06	0.02	0.01	11%
Tetrahydrophthalimide	8	1.20	0.28	0.40	2%
Malaoxon	7	0.01	0.00	0.00	2%
4,4'-DDD	2	0.02	0.01	0.01	0.6%
2,4,6-Trichlorophenol	1	0.01	0.01	n/a	0.3%
Fungicides:					
Boscalid	91	1.50	0.15	0.22	27%
Azoxystrobin	70	10.80	0.34	1.53	21%
Fludioxonil	53	2.20	0.45	0.56	16%
Propiconazole	39	0.08	0.02	0.02	11%
Difenoconazole	35	1.65	0.14	0.34	10%
Metalaxyl	33	3.30	0.20	0.56	10%
Pyraclostrobin	23	0.11	0.03	0.02	7%
Myclobutanil	20	0.12	0.02	0.03	6%
Cyprodinil	19	0.23	0.04	0.05	6%
Etridiazole	9	0.72	0.15	0.22	3%
Captan	8	1.20	0.66	0.38	2%
Pyrimethanil	6	0.02	0.01	0.01	2%
Trifloxystrobin	4	0.07	0.04	0.02	1%
Chlorothalonil	3	0.06	0.04	0.02	1%

Pesticides detected in 2015	Detections	Max concentration (µg/L)*	Average concentration (µg/L)*	SD (µg/L)*	Detection Frequency
Herbicides:					
Diuron	143	0.22	0.02	0.03	42%
2,4-D	87	1.20	0.11	0.16	26%
Dichlobenil	76	0.15	0.03	0.03	22%
Glyphosate	54	1.50	0.20	0.29	77%
Terbacil	52	0.70	0.14	0.13	15%
Metolachlor	48	2.70	0.13	0.40	14%
Aminomethylphosphoric acid	46	0.38	0.12	0.08	66%
Imazapyr	37	0.07	0.02	0.01	11%
Triclopyr	37	1.20	0.13	0.24	11%
Bentazon	30	0.46	0.19	0.14	9%
Dicamba	23	0.12	0.03	0.02	7%
Simazine	23	0.29	0.12	0.07	7%
Isoxaben	19	0.02	0.00	0.00	6%
Bromacil	18	0.11	0.05	0.02	5%
MCPA	17	0.41	0.09	0.10	5%
Chlorpropham	15	41.00	3.09	10.50	4%
MCPP	15	0.12	0.06	0.02	4%
Dacthal	14	0.48	0.16	0.14	4%
Picloram	13	0.28	0.11	0.07	4%
Sulfentrazone	12	0.22	0.09	0.05	4%
Pendimethalin	10	0.21	0.13	0.06	3%
Sulfometuron methyl	10	0.18	0.04	0.05	3%
Chlorsulfuron	8	0.15	0.05	0.04	2%
Monuron	8	0.02	0.00	0.00	2%
Bromoxynil	6	0.04	0.04	0.01	2%
Glufosinate-ammonium	5	0.28	0.10	0.11	7%
Diphenamid	3	0.03	0.03	0.00	1%
Cycloate	2	0.12	0.10	0.03	1%
Metsulfuron-methyl	2	0.08	0.05	0.04	1%
Oxadiazon	2	0.05	0.05	0.01	1%
Prometryn	2	0.02	0.02	0.00	1%
Tebuthiuron	2	0.09	0.08	0.03	1%
Imazapic	1	0.01	0.01	n/a	0.3%
Norflurazon	1	0.06	0.06	n/a	0.3%
Prometon	1	0.04	0.04	n/a	0.3%
Pronamide	1	0.04	0.04	n/a	0.3%
Propachlor	1	0.13	0.13	n/a	0.3%
Trifluralin	1	0.03	0.03	n/a	0.3%
Insect Repellents:					
N,N-Diethyl-m-toluamide	27	0.06	0.02	0.01	8%

Pesticides detected in 2015	Detections	Max concentration (µg/L)*	Average concentration (µg/L)*	SD (µg/L)*	Detection Frequency
Insecticides:					
Imidacloprid	65	0.43	0.03	0.06	19%
Thiamethoxam	55	0.14	0.03	0.02	16%
Oxamyl	43	0.30	0.11	0.07	13%
Dinotefuran	36	0.88	0.30	0.24	11%
Chlorpyrifos	18	0.11	0.04	0.02	5%
Carbaryl	13	0.38	0.05	0.10	4%
4,4'-DDT	6	0.07	0.03	0.02	2%
Bifenthrin	4	0.14	0.05	0.06	1%
Diazinon	3	0.06	0.05	0.02	1%
Methiocarb	3	0.04	0.04	0.00	1%
Methoxyfenozide	3	0.02	0.01	0.01	1%
Methomyl	2	0.01	0.01	0.00	1%
Acetamiprid	1	0.03	0.03	n/a	0.3%
Bifenazate	1	0.03	0.03	n/a	0.3%
Ethoprop	1	0.04	0.04	n/a	0.3%
Malathion	1	0.07	0.07	n/a	0.3%
Methoxychlor	1	0.04	0.04	n/a	0.3%
Monocrotophos	1	0.20	0.20	n/a	0.3%
Pyridaben	1	0.19	0.19	n/a	0.3%
Synergists:					
Piperonyl Butoxide	7	0.87	0.23	0.31	2%
Wood Preservatives:					
Pentachlorophenol	18	0.03	0.02	0.01	5%

* Values have been rounded to two decimal places for readability

n/a: Unable to calculate a standard deviation from a single detection

Table 6: Statewide Pesticide Detections Summarized by General Use Category

Pesticide general use category	Number of analytes detected	Number of individual detections	Percentage of total detections
Synergist	1	7	0.4%
Wood Preservative	1	18	1%
Insect Repellent	1	27	2%
Degradate	6	95	6%
Insecticide	19	258	16%
Fungicide	14	413	25%
Herbicide	38	845	51%
Grand Total	80	1663	100%

The number of pesticides detected at a given site can vary greatly from year to year due to several factors including the local and reginal meteorology, pest pressure, sampling schedule and other factors. Summary statistics for pesticide detections by monitoring location are presented in Table 7.

Table 7: Summary of Pesticide Detections by Monitoring Location in 2015

Monitoring locations	Total detections	Min[1]	25th percentile	Mean	75th percentile	Max[2]	SD[3]
Upper Big Ditch	304	4	9.0	12.2	14.0	22	4.4
Lower Bertrand	238	5	7.0	9.5	11.0	18	3.5
Lower Big Ditch	203	2	4.0	8.1	13.0	19	5.5
Upper Bertrand	176	1	3.0	7.0	12.0	17	4.9
Sulphur Creek Wasteway	148	2	5.0	5.9	7.0	8	1.7
Marion Drain	129	1	3.0	5.2	7.0	11	2.9
Indian Slough	124	1	2.8	6.2	9.3	12	3.7
Thornton Creek	92	0	1.0	3.7	6.0	12	3.4
Spring Creek	75	1	2.0	3.0	4.0	10	2.0
Browns Slough	64	0	0.0	3.2	6.0	9	3.0
Brender Creek	58	1	1.0	2.3	3.0	7	1.5
Stemilt Creek	36	0	1.0	1.4	2.0	5	1.3
Mission Creek	9	0	0.0	0.4	1.0	2	0.6
Peshastin Creek	7	0	0.0	0.3	0.0	2	0.5

[1] Smallest number of analyte detections from a single sampling event

[2] Largest number of analyte detections from a single sampling event

[3] Standard deviation

For comparison, there were 61 different pesticides detected with a total of 1,151 detections in 2014 across 15 monitoring sites. The increase in the number of analytes detected and the number of individual detections is mostly attributed to the addition of new analytes. Table 8 shows a breakout of the new analytes that were detected at least once during the 2015 monitoring season.

Table 8: Analytes added to the program in 2014 and 2015 with one or more detection

Analytes added to the program in 2014 and 2015	Number of detections in 2015	Detection frequency
Azoxystrobin	70	21%
Thiamethoxam	55	16%
Glyphosate	54	77%
Fludioxonil	53	16%
Aminomethylphosphoric acid	46	66%
Propiconazole	39	11%
Imazapyr	37	11%
Dinotefuran	36	11%
Difenoconazole	35	10%
N,N-Diethyl-m-toluamide	27	8%
Pyraclostrobin	23	7%
Myclobutanil	20	6%

Analytes added to the program in 2014 and 2015	Number of detections in 2015	Detection frequency
Isoxaben	19	6%
Sulfentrazone	12	4%
Sulfometuron methyl	10	3%
Etridiazole	9	3%
Chlorsulfuron	8	11%
Pyrimethanil	6	2%
Glufosinate-ammonium	5	7%
Trifloxystrobin	4	1.2%
Methoxyfenozide	3	1%
Metsulfuron-methyl	2	1%
Oxadiazon	2	1%
Acetamiprid	1	0.3%
Bifenazate	1	1%
Imazapic	1	0.3%
Pyridaben	1	0.3%
Total Number of Detections	579	n/a

Herbicide Detections

Herbicides were the most frequently detected use group making up approximately 51% of the total detections. Of the 38 herbicides detected; diuron, 2,4-D, and dichlobenil were the most frequently detected with 143, 87, and 76 detections respectively. Diuron, 2,4-D, and dichlobenil were also the most commonly detected herbicides in 2014. Of the 74 herbicides included in the laboratory analysis, 38 (51%) were detected in surface water. Metolachlor and sulfometuron methyl were the only herbicides that exceed the assessment criteria in 2015.

Fungicide Detections

Fungicides were the second most frequently detected group of pesticides making up 413 detections, or 25% of the total number of detections. For comparison, in 2014 the fungicides were the third most frequently detected group of pesticides making up only 8.3% of the total number of detections. The increase of total fungicide detections from 8.3% in 2014 to 25% in 2015 of the total detections is likely due to the addition of several new fungicides including fludioxonil, propiconazole, difenoconazole, myclobutanil, etridiazole, pyrimethanil, and trifloxystrobin. Out of 22 fungicides included in the laboratory analysis, 14 (64%) were detected in surface water. Of those, boscalid, azoxystrobin and fludioxonil were the most commonly detected fungicides with 59, 28, and 5 detections respectively. Captan and azoxystrobin were the only two fungicides to exceed the assessment criteria in 2015.

Insecticide Detections

Insecticides were the third most frequently detected group of pesticides representing 16% of the total detections. Of the 79 insecticides and isomers included in the laboratory analysis, 19 (24%) were detected in surface water. Imidacloprid, thiamethoxam, and oxamyl were the most commonly detected insecticides with 65, 55, and 43 detections respectively. Of the 19 current use insecticides that were detected in 2015; bifenthrin, chlorpyrifos, malathion, and pyridaben all exceeded the assessment criteria at least once in 2015. Detections of the legacy pesticide 4,4'-DDT also exceeded the assessment criteria at multiple monitoring locations.

Glyphosate Detections

In 2015, WSDA collected samples for glyphosate, glufosinate, and aminomethylphosphonic acid (AMPA), the primary metabolite of glyphosate. Samples were collected at all 14 ambient surface water monitoring sites for glyphosate, glufosinate, and AMPA during the five weeks starting the second week of April and sampling weekly until the second week in May. Sampling weeks were selected based on data collected by WSDA and USDA-NASS. Both glyphosate and AMPA were detected at all monitoring sites between one and all five sampling events. Out of the 70 individual sampling events, glyphosate was detected 54 times (77% of sampling events), AMPA was detected 46 times (65% of sampling events) and glufosinate was detected at five events (7% of sampling events). Glyphosate was found at an average concentration of 0.196 µg/L and the highest concentration detected was 1.5 µg/L. Although glyphosate was only monitored for during what is predicted to be its peak use period, glyphosate and its primary degradate AMPA were the two analytes detected in 2015 with the highest detection frequencies (77% and 66% respectively). Table 9: Detections of Glyphosate by LC/MS/MS in 2015 provides a summary of the detections for the three analytes.

Table 9: Detections of Glyphosate by LC/MS/MS in 2015

Analytes	Number of detections	Average concentration (µg/L)	Maximum concentration detected (µg/L)
Glyphosate	54	0.196	1.5
Aminomethylphosphoric acid (AMPA)	46	0.122	0.38
Glufosinate-ammonium	5	0.095	0.28
Total	105	-	1.5

Degradate Detections

There were 95 detections of pesticide degradates found in 2015 accounting for approximately 6% of the total detections. Of the 30 pesticide degradates included in the laboratory analysis, six (20%) were detected. The most frequently detected of those were oxamyl oxime (degradate of the carbamate insecticide oxamyl) with 41 detections, followed by 4,4'-DDE (degradate of 4,4'-DDT) with 36 detections, and tetrahydrophthalimide (degradate of captan) with 8 positive detections. The only pesticide degradates to exceed the criteria were 4,4’-DDE and 4,4'-DDD which are the primary breakdown products of the highly persistent legacy pesticide 4,4'-DDT.

Other Pesticide Detections

Other pesticide detections included the wood preservative pentachlorophenol which was detected 18 times, the insect repellent N,N-Diethyl-m-toluamide, commonly referred to as DEET, was detected 27 times, and the pesticide synergist piperonyl butoxide (PBO), was detected 7 times.

Pesticide Exceedances Summary

There were 76 instances where pesticide analytes were detected at concentrations that exceeded the assessment criteria listed in Appendix C: Assessment Criteria for Pesticides. The 11 different pesticide analytes that exceeded the assessment criteria on one or more occasions are listed in Table 10. Individual pesticide exceedances are also discussed in more detail in the Pesticide Calendars section in this report.

Table 10: Summary of Pesticide Exceedances of Assessment Criteria

Pesticide	Pesticide category	Detections	Detections above the assessment criteria	Monitoring locations where exceedances occurred
4,4'-DDE	Organochlorine Degradate	36	100%	Upper Bertrand Creek, Lower Bertrand Creek, Lower Big Ditch, Brender Creek, Marion Drain, Stemilt Creek, Spring Creek, Sulphur Creek Wasteway, Thornton Creek
4,4'-DDD	Organochlorine Degradate	2	100%	Brender Creek
4,4'-DDT	Legacy Organochlorine Insecticide	6	100%	Brender Creek
Azoxystrobin	Fungicide	70	1%	Lower Big Ditch
Bifenthrin	Pyrethroid Insecticide	4	100%	Lower Bertrand Creek, Lower Big Ditch, Upper Big Ditch
Captan	Fungicide	8	50%	Upper Big Ditch, Spring Creek, Sulphur Creek Wasteway
Chlorpyrifos	Organophosphate Insecticide	18	100%	Brender Creek, Marion Drain, Peshastin Creek, Stemilt Creek, Spring Creek, Sulphur Creek Wasteway
Malathion	Organophosphate Insecticide	1	100%	Lower Bertrand Creek
Metolachlor	Herbicide	48	4%	Lower Big Ditch
Pyridaben	Insecticide	1	100%	Mission Creek
Sulfometuron-methyl	Herbicide	10	10%	Thornton Creek

Pesticide	Pesticide category	Detections	Detections above the assessment criteria	Monitoring locations where exceedances occurred
All Analytes	n/a	1663	4.6%	n/a

Criteria Exceedances of Legacy Pesticides and Pesticide Degradates

Although products containing DDT were canceled by the US EPA in 1972, because of its persistence in soils DDT and degradates may be detected in areas where DDT containing products were historically used when soil enters surface water as a result of runoff or when DDT contaminated sediment is disturbed. 4,4’-DDT (the major component of products that contained DDT) and its degradates 4,4'-DDE, and 4,4'-DDD accounted for 57.9% of the total exceedances detected in 2015. Of the 44 combined exceedances, 43.4% were detected at the monitoring location on Brender Creek and accounted for 89.3% of the assessment criteria exceedances that occurred at that site. Although the detections of 4,4’-DDT, 4,4'-DDE, and 4,4'-DDD exceeded the state water quality criteria; these detections are not a result of current pesticide use patterns.

Criteria Exceedances of Current use Insecticides

Detections of current use insecticides accounted for 31.6% of all exceedances. The current use insecticides that were detected at concentrations above the assessment criteria were chlorpyrifos and malathion (organophosphates), bifenthrin (pyrethroid), and pyridaben (mitochondrial complex I electron transport inhibitor). Pyridaben was added to the program in 2015.

Criteria Exceedances of Herbicides

Although there were 845 total detections of herbicides, only two herbicides were detected above the assessment criteria accounting for 3.9% of the total exceedances in 2015. Metolachlor was the 6th most commonly detected herbicide and sulfometuron methyl the 22nd most commonly detected herbicide in 2015. Sulfometuron methyl was added to the program in 2015.

Criteria Exceedances of Fungicides

Of the 413 detections of fungicides in 2015, 5 (6.6%) exceeded the assessment criteria. Captan accounted for four exceedances and Azoxystrobin accounted for one exceedance. Azoxystrobin was added to the program in 2015.

Exceedances by Location

All pesticide detections were at concentrations below available pesticide assessment criteria and standards at Browns Slough and Indian Slough. There were a total of 76 detections that exceeded the assessment criteria at the other 12 monitoring locations. Of those 76, 31% were currently registered pesticides and the other 59% were detections of DDT or its degradates. Approximately 74% of exceedances occurred at monitoring locations in eastern Washington, and approximately 26% occurred at monitoring locations in western Washington (Table 11).

Table 11: Monitoring Locations Where Pesticide Exceedances Occurred

Monitoring stations	Exceedances for all analytes	Percentage of total in 2015	Exceedances of currently registered pesticides	Exceedances of DDT, DDD, and DDE	Percentage of exceedances for DDT, DDD, and DDE
Brender Creek	33	43%	4	29	88%
Spring Creek	7	9%	6	1	14%
Lower Big Ditch	6	8%	4	2	33%
Sulphur Creek	6	8%	3	3	50%
Upper Big Ditch	4	5%	4	0	0%
Marion Drain	4	5%	3	1	25%
Thornton Creek	4	5%	1	3	75%
Stemilt Creek	4	5%	3	1	25%
Lower Bertrand	3	4%	1	2	66%
Upper Bertrand	3	4%	1	2	66%
Mission Creek	1	1%	1	0	0%
Peshastin Creek	1	1%	1	0	0%
Indian Slough	0	0%	0	0	n/a
Browns Slough	0	0%	0	0	n/a
State-Wide Total	76	100%	31	45	59%

Pesticide Mixtures Analysis

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

The data from the 2015 monitoring season shows pesticide mixtures were found at more than half of the 340 sampling events. At least one pesticide mixture was detected at every monitoring location in 2015 and the frequency of mixtures detected varied greatly between locations. Of the 14 monitoring locations, pesticide mixtures were detected every week of the 25 week monitoring season for Upper and Lower Bertrand Creek in the Nooksack subbasin, Upper Big Ditch in the Lower Skagit-Samish watershed and Sulphur Creek in the Lower Yakima subbasin.

There were 242 sampling events (71.2%) where two or more pesticides were detected, 44 (12.9%) sampling events where only one pesticide was detected, and 54 sampling events (15.9%) where no pesticides were detected (Figure 2).

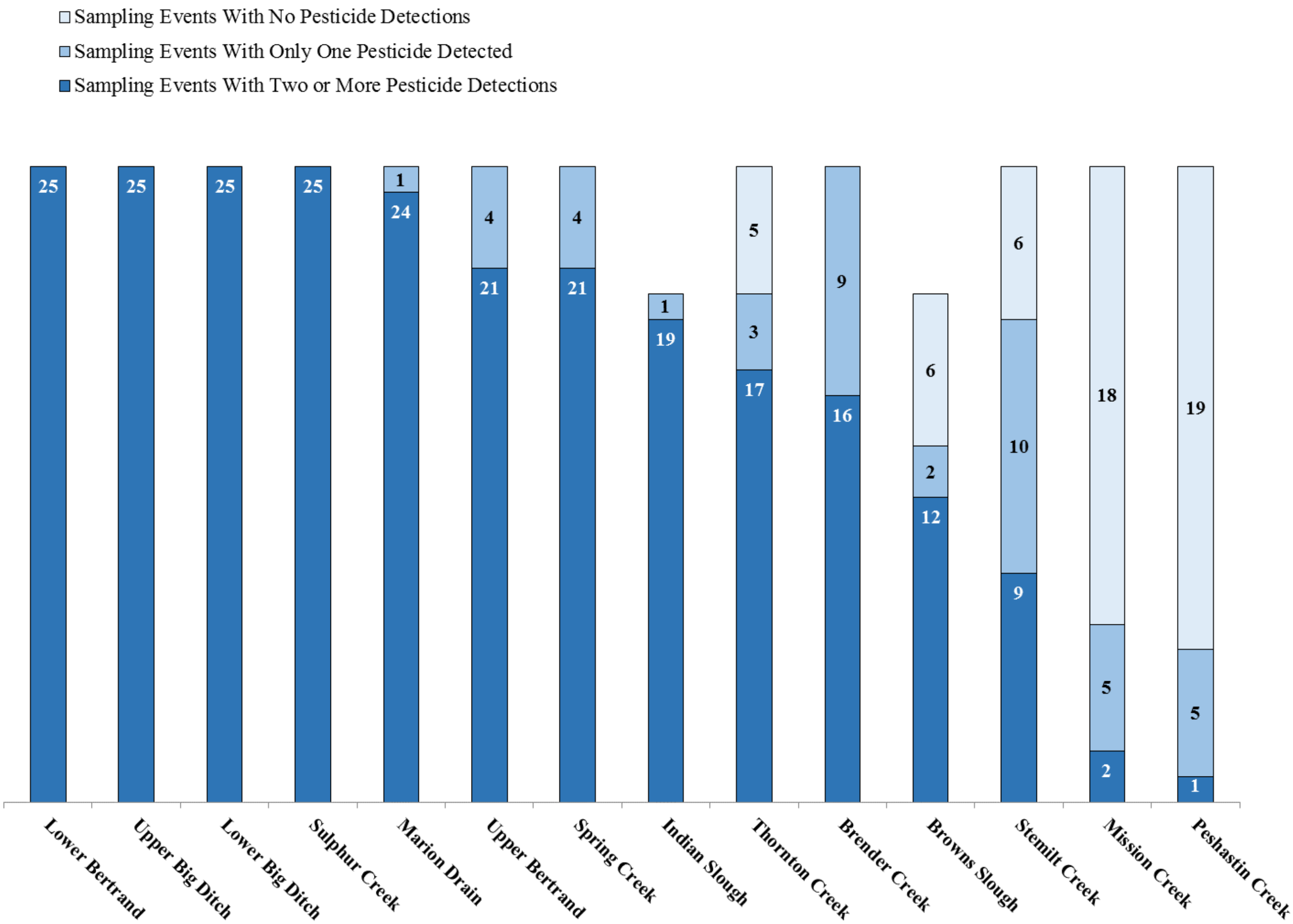

Figure 2: Number of weeks where mixtures were detected at sampling events

The average number of pesticide detections per sampling event for all sampling events was 4.89 and the greatest number of pesticides detected during a single sampling event over the whole season was 22 at Upper Big Ditch on April 20th. Figure 3 shows that the average number of detections per site ranged from 12.2 detections (Upper Big Ditch) to 0.3 detections per sampling event (Peshastin Creek).

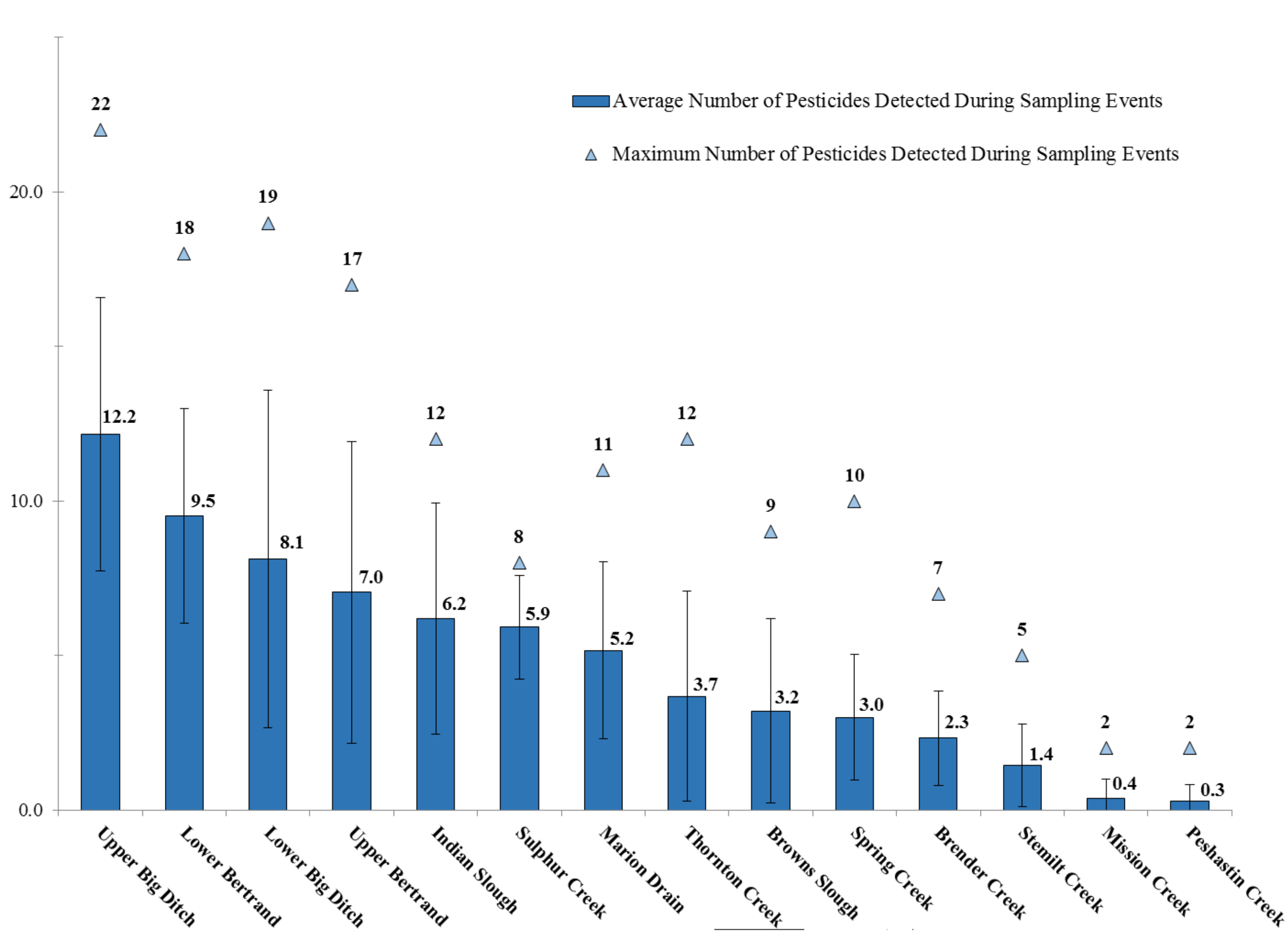

Figure 3: Average and maximum number of pesticides detected at sampling events

For comparison, the average number of detections for all sampling events was 2.84 detections and ranged from 6.4 detections (Lower Bertrand Creek) to 0.2 detections per sampling event (Peshastin Creek) in 2014.

Toxicity Unit Analysis Results

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 in the Toxicity Unit Analysis section of the report starting on 24. Table 12 provides a summary of the 24 sampling events with pesticide mixtures having an overall estimated toxicity above one of the LOCs (TU ≥ 1.0). The values in Table 12 that are highlighted in **bold and underlined** exceeded the LOC.

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 340 sampling events. Of the 340 sampling events in 2015, 24 were associated with occurrences where the toxicity units were greater than or equal to 1 (TU ≥ 1.0) when compared to each of the LOCs.

In 2015, 23 of 24 sampling events that had TUs that exceeded one or more of the five LOCs was primarily due to an elevated concentration of a single pesticide. The pesticides that contributed significantly (≥ 0.01 TU) to exceedances of TU values were chlorpyrifos, bifenthrin, captan, metolachlor, and malathion. The exceedances occurred at Lower and Upper Bertrand Creek, Lower and Upper Big Ditch, Brender Creek, Marion Drain, Stemilt Creek, Spring Creek, and Sulphur Creek.

Table 12: Toxicity Unit Analysis for Endangered Species, Acute, and Chronic LOCs

Monitoring site	Date	ESLOC [A,C]	Fisheries Acute LOC [A,C]	Fisheries chronic LOC [A,C]	Invertebrate acute LOC [A,C]	Invertebrate chronic LOC [A,C]	Number of pesticides	Pesticides in mixture with TU ≥ 0.01
Lower Bertrand	7/21	0.11	0.01	0.02	0.59	**<u>4.61</u>**	11	Malathion
Upper Bertrand	3/24	**<u>6.42</u>**	0.64	**<u>1.21</u>**	0.07	**<u>37.36</u>**	13	Bifenthrin
Lower Big Ditch	4/15	**<u>1.77</u>**	0.18	0.69	0.24	**<u>6.63</u>**	16	Metolachlor
Lower Big Ditch	4/29	0.11	0.01	0.08	0.02	**<u>1.59</u>**	15	Metolachlor
Lower Big Ditch	5/11	**<u>37.39</u>**	**<u>3.74</u>**	**<u>7.06</u>**	0.36	**<u>215.72</u>**	13	Bifenthrin
Upper Big Ditch	4/20	**<u>7.82</u>**	0.78	**<u>1.50</u>**	0.12	**<u>43.84</u>**	19	Bifenthrin
Upper Big Ditch	5/18	**<u>6.88</u>**	0.69	**<u>1.33</u>**	0.08	**<u>38.53</u>**	13	Bifenthrin
Upper Big Ditch	7/20	**<u>1.23</u>**	0.12	0.20	0.01	0.12	13	Captan
Upper Big Ditch	8/10	**<u>1.71</u>**	0.17	0.25	0.07	0.95	14	Captan
Brender Creek	3/25	0.78	0.08	0.12	**<u>1.40</u>**	**<u>1.75</u>**	2	Chlorpyrifos
Brender Creek	3/31	0.76	0.08	0.12	**<u>1.36</u>**	**<u>1.70</u>**	2	Chlorpyrifos
Brender Creek	4/21	0.76	0.08	0.12	**<u>1.37</u>**	**<u>1.73</u>**	5	Chlorpyrifos
Marion Drain	3/24	0.71	0.07	0.11	**<u>1.28</u>**	**<u>1.60</u>**	2	Chlorpyrifos
Marion Drain	3/30	0.60	0.06	0.10	**<u>1.08</u>**	**<u>1.35</u>**	2	Chlorpyrifos
Marion Drain	4/6	0.59	0.06	0.10	**<u>1.04</u>**	**<u>1.31</u>**	5	Chlorpyrifos

Monitoring site	Date	ESLOC [A,C]	Fisheries Acute LOC [A,C]	Fisheries chronic LOC [A,C]	Invertebrate acute LOC [A,C]	Invertebrate chronic LOC [A,C]	Number of pesticides	Pesticides in mixture with TU ≥ 0.01
Stemilt Creek	3/17	**<u>1.11</u>**	0.11	0.17	**<u>1.88</u>**	**<u>2.35</u>**	2	Chlorpyrifos
Spring Creek	3/16	**<u>1.18</u>**	0.12	0.20	**<u>2.05</u>**	**<u>2.55</u>**	6	Chlorpyrifos
Spring Creek	3/24	**<u>1.90</u>**	0.19	0.30	**<u>3.40</u>**	**<u>4.25</u>**	3	Chlorpyrifos
Spring Creek	3/30	**<u>2.44</u>**	0.24	0.39	**<u>4.40</u>**	**<u>5.50</u>**	2	Chlorpyrifos
Spring Creek	4/6	0.69	0.07	0.11	**<u>1.24</u>**	**<u>1.55</u>**	2	Chlorpyrifos
Spring Creek	4/20	0.64	0.06	0.11	**<u>1.13</u>**	**<u>1.42</u>**	9	Chlorpyrifos
Spring Creek	8/17	**<u>1.53</u>**	0.15	0.12	0.00	0.00	2	Captan
Sulphur Creek	3/24	**<u>1.54</u>**	0.15	0.25	**<u>2.72</u>**	**<u>3.40</u>**	7	Chlorpyrifos
Sulphur Creek	4/6	**<u>2.53</u>**	0.25	0.26	**<u>1.24</u>**	**<u>1.56</u>**	5	Captan and Chlorpyrifos

[A] Toxicity units where TU ≥ 1.0) are indicated by **<u>bold and underlined</u>** values and signify the additive toxicity was above the LOC.
[B] Indicates the LOC 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.

Monitoring Location Summaries

Lower Bertrand Creek

At Lower Bertrand Creek there was a total of 238 individual pesticide detections of 38 different analytes (Table 14). There were three detections in total that exceeded the assessment criteria at Lower Bertrand Creek. One detection of malathion (0.072 µg/L) on July 21st was greater than 50% of the CCC standard (0.1 µg/L). There were two detections of 4,4'-DDE, one on July 27th (0.01 µg/L), and another on August 24th (0.011 µg/L) that were greater than the WAC chronic standard (0.001 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average).

Upper Bertrand Creek

At Upper Bertrand Creek there was a total of 176 individual pesticide detections for 31 different analytes (Table 15). There were three detections in total that exceeded the assessment criteria at Upper Bertrand Creek. One detection of bifenthrin (0.024 µg/L) on March 24th was greater than 50% of the most sensitive NOAEC value for fish (0.04 µg/L). Two detections of 4,4'-DDE, one on June 29th (0.012 µg/L), and another on August 10th (0.01 µg/L) that were greater than the WAC chronic standard (0.001 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average).

Lower Big Ditch

At Lower Big Ditch there was a total of 203 individual pesticide detections of 33 different analytes (Table 16). There were six detections in total that exceeded the assessment criteria at Lower Big Ditch. One detection of bifenthrin (0.14 µg/L) on May 11th was greater than 25% of the most sensitive LC_{50} value for fish (0.04 µg/L). One detection of azoxystrobin on April 15th (10.8 µg/L) was greater than 50% of the most sensitive NOAEC for aquatic plants (20 µg/L). There were two detections of metolachlor, one on April 15th (2.7 µg/L) and another on April 29th (0.74 µg/L) that were greater than 50% of the most sensitive NOAEC for aquatic plants (1.5 µg/L). There were two detections of 4,4'-DDE, one on June 16th (0.012 µg/L) and another on August 17th (0.011 µg/L), both were greater than the WAC chronic standard (0.001 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average).

Upper Big Ditch

At Upper Big Ditch there was a total of 304 individual pesticide detections of 39 different analytes (Table 17). There were four detections in total that exceeded the assessment criteria at Upper Big Ditch. Two detections of bifenthrin, one on April 20th (0.028 µg/L), and another on May 18th (0.025 µg/L) were both greater than 50% of the most sensitive NOAEC value for fish (0.04 µg/L). There were two detections of captan, one on July 20th (0.74 µg/L), and another on August 10th (0.96 µg/L) that were both greater than 2.5% of the most sensitive LC_{50} value for fish (26.2 µg/L).

Brender Creek

At Brender Creek there was a total of 58 individual pesticide detections of 16 different analytes (Table 18). There were 33 detections in total that exceeded the assessment criteria at Brender Creek. There were four detections of chlorpyrifos (0.035 µg/L on March 25th, 0.034 µg/L on March 31st, 0.03 µg/L on April 7th, and 0.034 µg/L on April 21st) that were greater than 25% of the most sensitive EC_{50} value for invertebrates (0.1 µg/L). There were two detection of 4,4'-DDD with a mean concentration of 0.0125 µg/L, 21 detections of 4,4'-DDE with a mean concentration of 0.021 µg/L, and six detections of 4,4'-DDT with a mean concentration of 0.0342 µg/L. The average concentration for Total DDT (the sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT) was 0.021 µg/L and the maximum concentration for Total DDT was 0.049 µg/L. All individual detections of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were greater than the WAC chronic standard (0.001 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average).

Browns Slough

At Browns Slough there was a total of 64 individual pesticide detections of 20 different analytes (Table 19). All pesticide detections in Browns Slough were below the available pesticide assessment criteria and water quality standards.

Indian Slough

At Indian Slough there was a total of 124 individual pesticide detections of 29 different analytes (Table 20). All pesticide detections in Indian Slough were below the available pesticide assessment criteria and water quality standards.

Marion Drain

At Marion Drain there was a total of 129 individual pesticide detections of 24 different analytes (Table 21). There were four detections in total that exceeded the assessment criteria at Marion Drain. There were three detections of chlorpyrifos that were greater than 25% of the most sensitive EC_{50} value for invertebrates (0.1 µg/L), one on March 24th (0.032 µg/L), one on March 30th (0.027 µg/L), and one on April 6th (0.026 µg/L). There was one detection of 4,4'-DDE on August 24th (0.01 µg/L) that was greater than the WAC chronic standard (0.001 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average).

Mission Creek

At Mission Creek there was a total of 9 individual pesticide detections of 9 different analytes (Table 22). There was one detection in total that exceeded the assessment criteria at Mission Creek. The detection of pyridaben on July 7th (0.19 µg/L) was greater than 25% of the most sensitive LC_{50} value for fish (0.72 µg/L).

Peshastin Creek

At Peshastin Creek there was a total of 7 individual pesticide detections of 7 different analytes (Table 23). There was one detection in total that exceeded the assessment criteria at Peshastin Creek. The detection of chlorpyrifos on March 25th (0.026 µg/L) was greater than 25% of the most sensitive EC_{50} value for invertebrates (0.1 µg/L).

Stemilt Creek

At Stemilt Creek there was a total of 36 individual pesticide detections of 18 different analytes (Table 24). There were four detections in total that exceeded the assessment criteria at Stemilt Creek. Three detections of chlorpyrifos (0.047 µg/L on March 17th, 0.035 µg/L on March 31st, and 0.028 µg/L on April 7th) were greater than 25% of the most sensitive EC_{50} value for invertebrates (0.1 µg/L). In addition, the March 17th detection of chlorpyrifos (0.047 µg/L) was also greater than 2.5% of the most sensitive LC_{50} value for fish (1.8 µg/L). There was one detection of 4,4'-DDE on August 25th (0.01 µg/L) that was greater than the WAC chronic standard (0.001 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average).

Spring Creek

At Spring Creek there was a total of 75 individual pesticide detections of 19 different analytes (Table 25). There were seven detections in total that exceeded the assessment criteria at Spring Creek. Five detections of chlorpyrifos (0.051 µg/L on March 16th, 0.085 µg/L on March 24th, 0.11 µg/L on March 30th, 0.031 µg/L on April 6th, 0.028 µg/L on April 20th) were greater than

25% of the most sensitive EC_{50} value for invertebrates (0.1 µg/L). In addition, the three detections for chlorpyrifos in March were also greater than 2.5% of the most sensitive LC_{50} value for fish (1.8 µg/L). There was one detection of captan on August 17th (1 µg/L) that was greater than 2.5% of the most sensitive LC_{50} value for fish (26.2 µg/L). There was one detection of 4,4'-DDE on August 10th (0.01 µg/L) that was greater than the WAC chronic standard (0.001 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average).

Sulphur Creek Wasteway

At Sulphur Creek Wasteway there was a total of 148 individual pesticide detections of 26 different analytes (Table 26). There were six detections in total that exceeded the assessment criteria at Sulphur Creek Wasteway. Two detections of chlorpyrifos, one on March 24th (0.068 µg/L) and one on April 6th (0.031 µg/L) were greater than 25% of the most sensitive EC_{50} value for invertebrates (0.1 µg/L). In addition, the chlorpyrifos detection in April was also greater than 2.5% of the most sensitive LC_{50} value for fish (1.8 µg/L). There was one detection of captan on April 6th (1.2 µg/L) that was greater than 2.5% of the most sensitive LC_{50} value for fish (26.2 µg/L). There was one detection of 4,4'-DDE on March 24th (0.011 µg/L), one on August 10th (0.01 µg/L), and one on August 17th (0.011 µg/L) that were all greater than the WAC chronic standard (0.001 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average).

Thornton Creek

At Thornton Creek there was a total of 92 individual pesticide detections of 24 different analytes (Table 27). There were four detections in total that exceeded the assessment criteria at Thornton Creek. One detection of sulfometuron methyl (0.178 µg/L) on March 24th was grater then 50% of the most sensitive NOAEC for aquatic plants (0.207 µg/L). There were three detections of 4,4'-DDE, one on March 17th (0.013 µg/L), one on July 7th (0.012 µg/L), and another on August 24th (0.01 µg/L) that were all greater than the WAC chronic standard (0.001 µg/L, a 4-day average concentration not to be exceeded more than once every three years on the average).

Pesticide Calendars

Pesticide calendars provide a chronological overview of the pesticides detected during the 2015 monitoring season and a visual comparison to the assessment criteria. For specific values and information on the assessment criteria development please refer to Appendix C: Assessment Criteria for Pesticides.

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 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 contact the Pesticide Management Division for more information on regulatory issues, technical assistance, and compliance questions. Please contact the Natural Resources Assessment Section for more information on mitigation and how to protect surface water, sensitive areas, and endangered species from pesticide applications.

Table 13 presents the color codes used in Table 14 through Table 27 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 sampling event occurred and each column indicates the data associated with that event. Table 13 also relates the assessment criteria used in this report to the specific effects endpoints and water quality criteria. The assessment criteria were derived by applying safety factors to ensure that the criteria is adequately protective of aquatic life and that potential water quality issues are detected early on.

Table 13: Exceedance Descriptions and Relationship to Assessment Criteria

Calendar cell color	Exceedance description	Relationship to effect endpoints & water quality standards
	Magnitude was above the ESLOC	≥2.5% of the most protective LC_{50} for fish
	Magnitude was above the acute fisheries assessment criterion	≥25% of the most protective LC_{50} for fish
	Magnitude was above the acute invertebrate assessment criterion	≥25% of the most protective EC_{50} for invertebrates
	Magnitude was above the acute or chronic freshwater criteria of the WAC	≥50% of the WAC[A] acute or chronic criteria
	Magnitude was above the NRWQC Criterion Maximum Concentration	≥50% of the Criterion Maximum Concentration
	Magnitude was above the NRWQC Criterion Continuous Concentration	≥50% of the Criterion Continuous Concentration
	Magnitude was above the chronic fisheries assessment criterion	≥50% of the most protective NOAEC for fish
	Magnitude was above the chronic invertebrate assessment criterion	≥50% of the most protective NOAEC for invertebrates
	Magnitude was above the acute plant assessment criterion	≥50% of the most protective EC_{50} for aquatic plants
	Magnitude was above the chronic plant assessment criterion	≥50% of the most protective NOAEC for aquatic plants
	Magnitude was did not exceed any of the identified criteria	Below all identified assessment criteria
	No published criteria available	No comparison
	Not detected / below the minimum detection level	No comparison
	No sample collected / no data reported	No comparison

Table 14: Lower Bertrand Creek Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	10	17	24	31	7	14	21	28	5	12	19	26	1	9	15	23	29	7	14	21	27	4	10	17	24
2,4,6-Trichlorophenol	D-M															0.014										
2,4-D	H		0.05				0.052		0.054																	
4,4'-DDE	D-OC																					0.01				0.011
AMPA	H						0.081	0.046		0.073	0.07															
Boscalid	F		0.11	0.12	0.14	0.065	0.066		0.095	0.083		0.053			0.13		0.038		0.052	0.04	0.074	0.034	0.035	0.023		
Bromacil	H											0.047	0.073				0.041	0.04	0.041	0.039	0.037	0.035	0.029	0.03	0.031	
Chlorothalonil	F				0.034																					
Cyprodinil	F									0.019						0.062										
Diazinon	I-OP				0.062	0.026					0.051															
Dicamba	H		0.022																							
Dichlobenil	H	0.013	0.13	0.063	0.05	0.02	0.019	0.019	0.022	0.016	0.014	0.012														
Diuron	H				0.007		0.006	0.005		0.043					0.03	0.005			0.06		0.007	0.005				
Etridiazole	F		0.036																							
Glyphosate	H						0.056	0.022	0.054		0.021															
Imidacloprid	I-N	0.01	0.017	0.008		0.013	0.014	0.022	0.017	0.017	0.02															
Isoxaben	H			0.002			0.003	0.003																		
MCPA	H												0.052													
Malaoxon	D-OP	0.003			0.003		0.002														0.014	0.003				
Malathion	I-OP																				0.072					
Mecoprop (MCPP)	H		0.053						0.049																	
Metalaxyl	F			0.18	0.27		0.16	0.061	0.06		0.063	0.062	0.14	0.19	0.16		0.07	0.07	0.069	0.078	0.07	0.055	0.045	0.058	0.059	0.063
Methomyl	I-C														0.012											
Metolachlor	H		0.064	0.075	0.06	0.032	0.032	0.031	0.031	0.029			0.042													
Monuron	H																								0.004	
Myclobutanil	F							0.006																		
Oxadiazon	H						0.045																			
Oxamyl	I-C	0.278	0.113	0.223	0.164	0.183	0.17	0.243	0.143	0.16	0.089	0.09	0.082	0.088	0.087	0.11	0.11	0.14	0.14	0.13	0.19	0.11	0.15	0.14	0.14	0.13
Oxamyl oxime	D-C	0.159	0.089	0.074	0.067	0.078	0.095	0.184	0.093	0.12	0.075	0.09	0.083	0.085	0.097	0.1	0.1	0.12	0.15		0.16	0.082	0.12	0.11	0.11	0.11
Pentachlorophenol	WP		0.019																							
Propachlor	H														0.13											
Propiconazole	F		0.034	0.021	0.077	0.016	0.023	0.013	0.016																	
Pyraclostrobin	F			0.014					0.026							0.05										
Simazine	H		0.29	0.23	0.19		0.057					0.061	0.075		0.067											
Sulfentrazone	H											0.074		0.18	0.22		0.068	0.068	0.072	0.076	0.067		0.064	0.064	0.057	
Terbacil	H	0.055	0.11	0.11	0.13		0.093	0.06	0.07	0.06																
Tetrahydrophthalimide	D-F			0.17					0.096			0.046									0.049					
Thiamethoxam	I-N	0.02			0.013	0.021	0.011	0.022	0.013	0.022	0.016	0.022	0.026	0.024	0.027	0.039	0.035	0.034	0.041	0.047	0.041	0.047	0.045	0.05	0.037	0.043
Triclopyr acid	H					0.031																				
Streamflow	N/A	38.1	154.0	245.0	251.0	71.5	79.1	39.0	45.8	32.1	22.6	18.7	17.4	16.3	11.1	8.4	7.1	5.8	5.2	6.3	5.2	8.4	4.1	8.8	4.6	5.9
Total suspended solids	N/A	2	14	17	17	6	8	7	3	3	2	3	2	< 2	2	< 2	< 2	< 2	1	< 1	< 2	< 1	< 1	< 1	< 1	< 1

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable

†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 15: Upper Bertrand Creek Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	10	17	24	31	7	14	21	28	5	12	19	26	1	9	15	23	29	7	14	21	27	4	10	17	24
2,4-D	H			0.055			0.067		0.062																	
4,4'-DDE	D-OC																	0.012						0.01		
AMPA	H						0.15		0.16		0.16															
Bifenthrin	I-Py			0.024																						
Boscalid	F		0.14	0.16	0.11	0.08	0.095	0.064	0.12	0.16	0.091	0.077	0.16	0.15	0.14		0.049	0.045	0.043	0.046	0.04	0.05	0.041	0.033		0.031
Chlorothalonil	F				0.059																					
Cyprodinil	F									0.065																
Dicamba	H		0.022																							
Dichlobenil	H	0.022	0.15	0.1	0.068	0.023	0.029	0.024	0.021	0.017		0.014														
Diuron	H						0.006																			
Etridiazole	F		0.1																							
Fludioxonil	F									0.077																
Glyphosate	H						0.16	0.054	0.073	0.052	0.05															
Imidacloprid	I-N	0.01					0.02	0.03	0.019	0.02	0.029	0.011	0.02	0.015	0.009		0.007	0.007				0.03	0.014		0.01	
Isoxaben	H			0.012	0.002		0.003	0.005		0.003	0.003															
MCPA	H								0.057			0.41	0.16	0.021												
Malaoxon	D-OP		0.003		0.003																					
Mecoprop (MCPP)	H		0.052	0.057			0.06		0.066																	
Metalaxyl	F			0.3	0.16	0.101		0.052	0.044										0.012							
Metolachlor	H		0.039	0.19	0.045		0.052	0.032	0.034	0.03																
Myclobutanil	F							0.007							0.016	0.008						0.12	0.03			
DEET	IR						0.033								0.035							0.014				
Oxadiazon	H						0.054																			
Oxamyl	I-C	0.059	0.044	0.299	0.157	0.059	0.025	0.099	0.035	0.037	0.044	0.028	0.025	0.012	0.008	0.003						0.037				
Oxamyl oxime	D-C	0.054	0.019	0.053	0.046	0.034	0.022	0.091	0.029	0.039	0.055	0.062	0.071	0.053	0.032	0.034	0.015					0.11				
Propiconazole	F		0.036	0.03	0.077	0.019	0.037		0.018																	
Pyraclostrobin	F								0.027	0.025																
Simazine	H		0.24	0.17	0.15			0.083	0.071			0.11	0.17	0.073	0.077		0.097						0.13	0.06		
Terbacil	H	0.15	0.13	0.15	0.15	0.107	0.11	0.16	0.13	0.11	0.12	0.13	0.14	0.12	0.12							0.072	0.021			
Tetrahydrophthalimide	D-F								0.09																	
Triclopyr acid	H						0.049																			
Streamflow	N/A	10.1	73.8	97.0	87.0	26.7	37.6	12.1	15.0	14.0	6.4	4.5	4.3	3.0	2.7	2.3	1.9	1.9	1.7	1.6	1.0	2.7	0.2	0.3	0.5	0.6
Total suspended solids	N/A	1	6	13	9	4	4	5	3	4	< 2	3	2	2	6	11	2	2	3	11	13	2	3	2	< 2	< 1

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable

†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 16: Lower Big Ditch Pesticide Calendar

Month and Day		Mar			Apr					May				Jun					Jul				Aug			
Analyte Name †	Use‡	9	18	23	1	6	15	20	29	4	11	18	27	2	8	16	22	30	6	15	20	28	4	10	17	24
2,4-D	H		0.079	0.056	0.13		0.77		0.077		0.077															
4,4'-DDE	D-OC															0.012									0.011	
AMPA	H						0.17	0.19	0.28	0.12	0.38															
Azoxystrobin	F	0.291	0.49	0.271	7.05	0.377	10.8	0.879	0.319	0.22	0.14	0.086	0.11	0.052	0.039	0.037	0.02	0.02	0.024	0.012	0.02	0.023		0.009		0.018
Bifenthrin	I-Py										0.14															
Boscalid	F							0.076	0.083	0.081	0.1	0.062	0.12													
Captan	F			0.43																						
Chlorothalonil	F				0.029																					
Chlorpropham	H	0.21	0.16	0.07	1.8	0.094	41	1.4	0.73	0.25	0.11	0.061														
Chlorsulfuron	H						0.027																			
Cyprodinil	F						0.011																			
Dicamba	H		0.021																							
Dichlobenil	H		0.02	0.037	0.059		0.068	0.015	0.02	0.013	0.017	0.014														
Difenoconazole	F	0.112	0.105	0.07	1.26	0.155	1.65	0.355	0.17	0.15	0.1	0.047	0.041	0.033	0.039	0.025		0.009	0.008	0.01	0.02	0.024	0.01	0.009	0.007	0.01
Dinotefuran	I-N	0.072	0.055	0.211	0.119	0.116	0.105	0.085	0.098	0.12	0.17	0.051	0.052													
Diuron	H	0.017	0.013	0.009	0.033	0.019	0.029	0.015	0.016	0.014	0.013		0.008	0.005	0.004		0.003	0.003				0.006				0.005
Fludioxonil	F			0.22	0.94	0.33	1.3	0.59	0.34	0.24	0.27	0.17	0.17	0.099		0.049	0.05	0.079	0.045	0.032	0.044	0.027	0.014	0.019	0.015	0.025
Glufosinate-ammonium	H						0.017																			
Glyphosate	H						0.74	0.76	0.69	0.056	1.5															
Imazapyr	H		0.012		0.021		0.021	0.016	0.016	0.017																
Imidacloprid	I-N		0.029		0.43	0.008	0.021	0.016	0.02																	
MCPA	H			0.035					0.28																	
Mecoprop (MCPP)	H		0.056		0.071																					
Metolachlor	H	0.041	0.053	0.039	0.046	0.042	2.7	0.14	0.74	0.19	0.13	0.052	0.089						0.013							
Monuron	H							0.003		0.003																
DEET	IR										0.034							0.009	0.011	0.007						
Oxamyl	I-C																		0.004	0.001						
Pentachlorophenol	WP					0.023																				
Propiconazole	F				0.008		0.017	0.012																		
Pyraclostrobin	F							0.023																		
Sodium bentazon	H				0.11																					
Thiamethoxam	I-N		0.022		0.017		0.009		0.012				0.014													
Triclopyr acid	H		0.044				0.86	0.059	0.092		0.073	0.037														
Streamflow	N/A	12.8		17.7		16.2	15.1	15.1		10.9	13.7	20.5	9.7	28.4	14.6	16.4	16.7	15.5	14.9	19.5	12.7	13.0	26.1	23.9	23.4	8.8
Total suspended solids	N/A	17	35	12	19.5	18	38	23	13	7	25	26	22	23	26	30	33	14	41	21	31	25	37	126	43	49

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable

†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 17: Upper Big Ditch Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	9	18	23	31	6	14	20	28	4	12	18	26	1	8	16	22	30	6	14	20	27	4	10	17	24
2,4-D	H		0.093	0.051	0.2		1.2	0.078	0.07						0.12	0.057	0.6			0.155	0.06		0.026		0.075	
Acetamiprid	I-N								0.027																	
AMPA	H						0.27	0.18	0.19	0.18	0.17															
Azoxystrobin	F					0.065	0.018	0.035	0.072	0.083	0.01	0.053		0.018	0.059	0.11	0.03	0.04	0.11	0.02	0.026	0.012	0.036	1.1	0.082	0.2
Bifenthrin	I-Py							0.028				0.025														
Boscalid	F	0.052		0.13		0.39	0.069	0.21	0.76	0.23	0.14	0.27	0.13	0.4	1.5	0.62		0.41	0.76	0.024	0.31	0.095	0.31	0.56	0.12	0.75
Captan	F																				0.74		0.18	0.96		
Carbaryl	I-C						0.013																			
Cyprodinil	F					0.032	0.012	0.036	0.013							0.011			0.014		0.016	0.01	0.018	0.019	0.012	0.087
Dicamba	H		0.021																							
Dichlobenil	H	0.006	0.033	0.057	0.15	0.022	0.08	0.016	0.022	0.015		0.014														
Difenoconazole	F				0.029		0.021		0.164																	
Dinotefuran	I-N	0.485	0.369	0.744	0.492	0.67	0.258	0.428	0.614	0.31	0.69	0.495	0.18	0.19	0.74	0.27		0.14	0.53	0.076	0.079	0.077	0.88	0.34	0.12	0.24
Diuron	H				0.04	0.007	0.019	0.011	0.005				0.008	0.011	0.006	0.01	0.005	0.011	0.009	0.014	0.008	0.014		0.011	0.034	0.015
Etridiazole	F				0.028	0.18		0.05		0.033		0.028			0.17				0.72							
Fludioxonil	F			0.28	0.077	2.2	0.12	0.49		0.42	0.18	0.46	0.13	0.58	1.8	1.6		1.2	2.2		0.99	0.54	0.88	0.78	0.42	1
Glufosinate-ammonium	H						0.085	0.016	0.28	0.079																
Glyphosate	H						1.3	0.12	0.16	0.115	0.11															
Imazapic	H																					0.006				
Imazapyr	H	0.024	0.017	0.018	0.035	0.027	0.027	0.022	0.024	0.024								0.019								0.021
Imidacloprid	I-N			0.013		0.039	0.017	0.028	0.103	0.04		0.024		0.018	0.047	0.053	0.043	0.033	0.084	0.019	0.032		0.087	0.12	0.021	0.12
Isoxaben	H														0.02											
MCPA	H		0.071				0.059	0.052																		
Mecoprop (MCPP)	H		0.074	0.048	0.12		0.056																			
Metalaxyl	F					3.3						0.051				0.15			0.041				0.18			0.089
Methiocarb	I-C							0.033																0.039		0.038
Myclobutanil	F									0.008					0.013	0.01			0.028					0.036		0.031
DEET	IR			0.031																	0.011	0.042			0.007	
Pentachlorophenol	WP		0.023		0.028		0.026													0.028		0.028	0.016			
Picloram	H							0.28	0.12		0.091	0.22	0.095	0.088												
Piperonyl butoxide	Sy																				0.057			0.42		0.043
Prometon	H									0.037																
Prometryn	H																			0.02						
Propiconazole	F				0.013		0.023		0.013																	
Pyraclostrobin	F					0.032		0.028	0.034	0.027	0.025	0.025			0.067	0.023			0.01				0.005	0.009		0.11
Terbacil	H																			0.59						
Thiamethoxam	I-N				0.015	0.141	0.012	0.067	0.08	0.045	0.01	0.031		0.016	0.063	0.055	0.023	0.025	0.092	0.018	0.031		0.026	0.075	0.012	0.053
Triclopyr acid	H		0.039		0.075		1.2	0.13	0.13	0.042	0.044	0.036			0.12	0.043	0.55	0.056		0.175	0.1		0.046	0.026	0.078	0.036
Trifloxystrobin	F					0.044		0.034										0.018	0.073							
Streamflow	N/A	1.9	5.6	4.6	6.8	2.4	5.2	1.9	2.1	1.5	1.4	1.1	0.9	0.7	0.8	0.3	0.6	0.5	0.5	0.7	0.4	0.8	0.2	0.2	0.3	0.2
Total suspended solids	N/A	4	4	3	10	4	5	6	4	7	4.5	41	8	22	8	26	7	17		5	40	4	4	15	3	3

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable
†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 18: Brender Creek Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	10	17	25	31	7	14	21	28	5	12*	19	27	2	9	16	23	30	7	14	21	28	4	11	18	25
2,4-D	H		0.043																	0.041				0.02		
4,4'-DDD	D-OC							0.021											0.004							
4,4'-DDE	D-OC	0.018	0.02	0.011	0.012		0.01	0.06	0.016	0.015		0.024	0.008	0.026	0.019		0.027	0.02	0.039	0.015	0.019		0.023	0.014	0.021	0.025
4,4'-DDT	I-OC							0.044	0.022			0.029	0.034	0.072					0.004							
AMPA	H							0.01	0.009		0.01															
Carbaryl	I-C							0.02			0.38															
Chlorpyrifos	I-OP			0.035	0.034	0.03		0.034																		
Dichlobenil	H									0.014		0.012														
Glyphosate	H							0.024	0.03	0.015	0.037															
Imidacloprid	I-N								0.017							0.009						0.037	0.015			
DEET	IR																		0.006							
Norflurazon	H																			0.056						
Pentachlorophenol	WP		0.017																							
Piperonyl butoxide	Sy		0.14																							
Simazine	H																					0.092				
Thiamethoxam	I-N															0.048				0.024						
Streamflow	N/A	0.4	0.6	0.5	0.4	0.4	0.4	4.1	1.8	2.6	2.7	7.2	0.7	4.3	2.1	2.4	0.5	1.3	2.1	0.9	0.6	1.5	1.7	1.1	2.7	1.3
Total suspended solids	N/A	3	12	2	3	3	3	129	15	16	44	51	12	38	21	16.5	17	13	38	8	4	12	31	5	19	41

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable

†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 19: Browns Slough Pesticide Calendar

0		Mar			Apr					May				Jun					Jul		
Pesticide Name	Use*	9	18	23	1	6	15	20	29	4	11	18	27	2	8	16	22	30	6	15	20
2,4-D	H				0.082	0.054								0.14							
AMPA	H								0.12	0.245	0.22										
Azoxystrobin	F		0.052	0.024						0.008											
Boscalid	F												0.13			0.36					
Bromacil	H															0.039					
Dacthal (DCPA)	H	0.48	0.12	0.18	0.19	0.15	0.4	0.063	0.25	0.1	0.07			0.054							
Dichlobenil	H	0.006	0.051	0.016	0.013			0.015	0.013												
Difenoconazole	F		0.007																		
Diuron	H		0.005			0.005		0.005	0.006	0.005											
Fludioxonil	F							0.037								0.15					
Glyphosate	H						0.11	0.067	0.074	0.096	0.081										
Imazapyr	H							0.012	0.013	0.012											
Imidacloprid	I-N		0.011	0.016																	
Metalaxyl	F															0.07					
Metolachlor	H	0.029	0.053	0.046	0.038		0.11	0.52	0.041	0.033	0.032	0.031									
DEET	IR										0.036										
Simazine	H		0.22	0.068																	
Sodium bentazon	H		0.082																		
Sulfentrazone	H															0.068					
Tetrahydrophthalimide	D-F															0.49					
Streamflow	N/A	6.68	16.11	17.24	12.37	9.183	4.978		5.483	12.01	4.35	5.355	2.01	0.952							
Total suspended solids	N/A	10	9	7	6	5	6	12	16	12	17	11	15.5	12	30	19	11	7	11	8	13

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable

†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 20: Indian Slough Pesticide Calendar

Month and Day		Mar			Apr					May				Jun					Jul		
Analyte Name †	Use‡	9	18	23	1	6	15	20	29	4	11	18	27	2	8*	16	22	30	6	15	20
2,4-D	H						0.08		0.068								0.13				
AMPA	H						0.079	0.048	0.067	0.068	0.063										
Azoxystrobin	F			0.027		0.109	0.012	0.021	0.014	0.029		0.01								0.005	
Captan	F					0.2													0.6		
Chlorpropham	H					0.21		0.061	0.067	0.13											
Cyprodinil	F													0.23		0.033	0.01				
Dacthal (DCPA)	H																		0.056	0.054	
Dicamba	H																0.031				
Dichlobenil	H	0.006	0.012	0.018	0.017	0.014	0.027	0.014	0.016			0.013									
Difenoconazole	F		0.007		0.029	0.035	0.02			0.02											
Diphenamid	H	0.026				0.034				0.032											
Diuron	H		0.014	0.011	0.013	0.01	0.009	0.007	0.01	0.008			0.006	0.008		0.009	0.008	0.008		0.009	0.012
Fludioxonil	F					0.076								0.11	0.11						
Glyphosate	H						0.22	0.082	0.11	0.11	0.11										
Imazapyr	H	0.021	0.022	0.025	0.034		0.024	0.016	0.07	0.021	0.008										
Isoxaben	H										0.004										
MCPA	H										0.044		0.039				0.036				
Mecoprop (MCPP)	H																0.041				
Metolachlor	H	0.033	0.057	0.05	0.037				0.033	0.036	0.03	0.032	0.082								
Monocrotophos	I-OP	0.2																			
Monuron	H					0.003	0.003	0.002		0.002											
Pentachlorophenol	WP		0.022		0.023																
Propiconazole	F	0.007	0.018	0.018	0.028	0.018	0.022	0.013	0.032	0.019	0.018	0.014									0.033
Sodium bentazon	H														0.092						
Sulfometuron methyl	H								0.045												
Tebuthiuron	H	0.094	0.058																		
Tetrahydrophthalimide	D-F			0.13										1.2							
Thiamethoxam	I-N		0.02	0.018	0.014	0.01															
Triclopyr acid	H		0.031		0.038		0.073		0.071												
Streamflow	N/A	22.03		42.88		27.38	11.49	38.65	36.32	17.36	20.69	16.27	12.5	10.26	11.98	11.6	13.97	8.046			
Total suspended solids	N/A	18	20	8	8.5	9	26	8	6	7	14	6	4	5	21	7	8	8	13	27	61

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable
†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 21: Marion Drain Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	9	16	24	30	6	13	20	27	4	11	18	26	1	8	15	22	29	6	13	20	27	3	10	17	24
2,4-D	H					0.048	0.051		0.097		0.058	0.048	0.043	0.07	0.065		0.043	0.042			0.038		0.02	0.026		0.039
4,4'-DDE	D-OC																									0.01
AMPA	H	X	X	X	X	X	0.041		0.11	0.082	0.094	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Azoxystrobin	F							0.008		0.008	0.009	0.009	0.016	0.016	0.016	0.008		0.005			0.005					
Bromoxynil	H						0.04	0.042	0.038	0.033	0.038		0.027													
Chlorpyrifos	I-OP			0.032	0.027	0.026																				
Dicamba	H											0.019			0.016			0.019		0.015						
Diuron	H		0.004	0.008	0.021	0.01	0.018	0.012	0.038	0.023	0.012	0.016	0.013		0.008		0.005	0.006	0.003		0.005		0.004			
Fludioxonil	F					0.069	0.041																			
Glyphosate	H	X	X	X	X	X	0.11	0.16		0.15	0.17	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Imidacloprid	I-N									0.013																
MCPA	H								0.039											0.034						
Methomyl	I-C							0.008																		
Methoxyfenozide	I		0.005																							
Monuron	H		0.016																							
Myclobutanil	F										0.015		0.015	0.014	0.006											
DEET	IR														0.03											
Pendimethalin	H							0.071	0.1	0.2	0.15	0.086	0.18	0.21	0.21											
Propiconazole	F						0.017	0.016		0.013																
Pyrimethanil	F					0.016			0.009																	
Sodium bentazon	H	0.067						0.098	0.16	0.15	0.2	0.11	0.069	0.21	0.3	0.46	0.26	0.3	0.31	0.43	0.33	0.42	0.34	0.33	0.37	0.22
Terbacil	H							0.17	0.7	0.35	0.32	0.24	0.25	0.33	0.27	0.028	0.026	0.032	0.086		0.088	0.28	0.076	0.053	0.066	0.019
Thiamethoxam	I-N																								0.011	
Trifluralin	H										0.027															
Streamflow	N/A	169.4	163.0	227.5	286.6	348.3	38.1	20.1	29.3	18.1	17.7	74.6	38.4	20.8	6.4	2.5	10.4	11.0	8.2	5.5	13.2	6.9	10.1	16.1	17.0	23.0
Total suspended solids	N/A	14	26	28	30	27	7	5	12	5	5	15	9	2	2	< 1	1	1	2	< 1	1	2	1	2	2	3

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable
†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 22: Mission Creek Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	10	17	25	31	7	14	21	28	5	12	19	27	2	9	16	23	30	7	14	21	28	4	11	18	25
Carbaryl	I-C										0.014															
Cycloate	H			0.074																						
Difenoconazole	F	0.005																								
Glyphosate	H	X	X	X	X	X					0.069	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Imazapyr	H	0.011																								
DEET	IR														0.027											
Piperonyl butoxide	Sy		0.87																							
Pyraclostrobin	F							0.023																		
Pyridaben	I																		0.19							
Streamflow	N/A	23.9	57.2	37.4	32.3	24.5	21.3	18.0	15.7	13.2	11.8	21.4	15.0	11.2	9.4	7.6	5.8	4.2	3.4	3.5	1.6	2.1	1.1	0.7	0.7	0.3
Total suspended solids	N/A	8	108	17.5	11	8	4	4	3	11	5	28	12	19	12	8	8	10	8	5	2	2	5	2	2	3

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable

†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 23: Peshastin Creek Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	10	17	25	31	7	14	21	28	5	12	19	27	2	9	16	23	30	7	14	21	28	4	11	18	25
Boscalid	F																0.32									
Chlorpyrifos	I-OP			0.026																						
Difenoconazole	F	0.005																								
Fludioxonil	F																0.93									
Methoxychlor	I-OC											0.036														
DEET	IR																				0.016					
Propyzamide	H													0.04												
Streamflow	N/A	170	451	255	286	192	142	190	153	168	189	192	145	124	87.5	44.3	32.4	29	13.7	7.9	7.5	4.6	3.8	2.9	7.1	2.1
Total suspended solids	N/A	3	15	3	3	2	2	5	4	3	7	5	4	4	4	2	2	4	2	2	1	1	1	1	2	1

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable

†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 24: Stemilt Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	10	17	25	31	7	14	21	28	5	12	19	27	2	9	16	23	30	7	14	21	28	4	11	18	25
2,4-D	H												0.037													
4,4'-DDE	D-OC																									0.01
AMPA	H								0.009	0.009	0.013															
Bifenazate	I																		0.028							
Boscalid	F								0.067											0.037	0.023			0.023		
Carbaryl	I-C									0.011	0.082															
Chlorpyrifos	I-OP		0.047		0.035	0.028																				
Ethoprop	I-OP	0.042																								
Fludioxonil	F														0.1											
Glyphosate	H										0.032															
Methoxyfenozide	I									0.005	0.015															
Myclobutanil	F										0.014															
Pentachlorophenol	WP		0.026	0.018								0.031														
Picloram	H									0.094					0.13	0.068	0.067	0.06	0.055		0.054					
Piperonyl butoxide	Sy	0.045																								
Propiconazole	F															0.037										
Pyraclostrobin	F	0.014							0.029																	
Triclopyr acid	H																				0.028					
Streamflow	N/A	7.1	13.9	10.7	8.9	5.1	1.3	2.1	0.5	0.1	0.3	12.9	8.6	4.0	0.0	0.0	0.1	0.2	0.2	1.6	0.1	0.7	0.5	0.4	0.9	0.2
Total suspended solids	N/A	4	19	6	4	4	7	5	3	2	9	22	23	21	2	2	3	3	2	28	2	3	3	2	3	1

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable
†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 25: Spring Creek Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	9	16	24	30	6	13	20	27	4	11	18	26	1	8	15	22	29	6	13	20	27	3	10	17	24
2,4-D	H		0.051					0.078	0.083	0.069	0.073	0.16	0.064	0.082					0.043	0.047						0.037
4,4'-DDE	D-OC																							0.01		
AMPA	H									0.093	0.098															
Boscalid	F							0.076								0.034		0.042	0.036		0.032					
Bromacil	H		0.11					0.06																		
Captan	F																								1	
Carbaryl	I-C							0.012		0.01																
Chlorpyrifos	I-OP		0.051	0.085	0.11	0.031		0.028																		
Dicamba	H											0.12		0.024												
Dichlobenil	H	0.005	0.011	0.013	0.014		0.012																			
Diuron	H	0.072	0.215	0.068		0.015	0.015	0.049	0.012	0.012		0.028	0.02	0.008	0.006	0.008	0.005	0.11	0.008	0.011		0.006	0.005	0.005	0.008	0.006
Glyphosate	H						0.21	0.12	0.21	0.28	0.17															
Imidacloprid	I-N							0.015																		
Isoxaben	H		0.005				0.003	0.002		0.003									0.005							
Myclobutanil	F							0.006							0.006											
DEET	IR													0.029												
Pyraclostrobin	F	0.014																								
Pyrimethanil	F											0.023														
Triclopyr acid	H											0.068														
Streamflow	N/A	9.1	11.8	64.8	40.1	62.2	3.6	28.4	31.4	25.7	17.1	59.5	15.1	36.8	1.0	0.9	1.0	2.5	1.2	1.8	1.9	1.4	1.4	1.8	1.3	2.1
Total suspended solids	N/A	25	29	79	45	24	5	23	27.5	24	20	35	9	18	< 1	< 1	2	11	2	6	2	3	3	3	2	1

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable

†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 26: Sulphur Creek Wasteway Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	9	16	24	30	6	13	20	27	4	11	18	26	1	8	15	22	29	6	13	20	27	3	10	17	24
2,4-D	H		0.048	0.048		0.059	0.063	0.078	0.065	0.135	0.13	0.42	0.072	0.2	0.098	0.082	0.079	0.081	0.095	0.066	0.05	0.052	0.18	0.06	0.075	0.11
4,4'-DDE	D-OC			0.011																				0.01	0.011	
AMPA	H						0.13	0.057	0.19	0.18	0.23															
Azoxystrobin	F												0.019		0.008	0.005		0.029		0.009		0.007				
Boscalid	F														0.13	0.06	0.074	0.072	0.068	0.038	0.032	0.067	0.023	0.023	0.023	
Bromacil	H											0.046	0.065	0.081					0.024							
Captan	F					1.2																				
Carbaryl	I-C							0.021		0.037				0.018	0.01			0.01								
Chlorpyrifos	I-OP			0.068		0.031																				
Dacthal (DCPA)	H		0.04																							
Dicamba	H			0.023				0.028				0.038		0.023	0.027	0.022	0.026	0.022	0.019	0.019	0.026					
Dichlobenil	H	0.005	0.013	0.014	0.012	0.012																				
Diuron	H	0.022	0.223	0.104	0.024	0.033	0.028	0.023	0.017	0.022	0.033	0.073	0.033	0.04	0.022	0.014	0.007	0.019	0.011		0.008	0.016	0.007	0.006	0.01	
Glyphosate	H						0.12	0.14	0.18	0.22	0.31															
Imazapyr	H		0.012				0.012	0.012		0.013																
Imidacloprid	I-N														0.012		0.007			0.009	0.006	0.008			0.01	
MCPA	H											0.076		0.028												
Myclobutanil	F															0.026										
DEET	IR			0.034							0.032		0.028	0.03						0.004	0.01					
Pendimethalin	H							0.065	0.063																	
Prometryn	H																				0.02					
Propiconazole	F																0.006									
Pyrimethanil	F						0.009					0.015						0.009								
Sodium bentazon	H	0.059	0.055										0.047									0.057	0.039		0.026	0.021
Terbacil	H								0.097				0.06			0.047	0.035			0.14	0.033	0.066	0.034		0.023	
Triclopyr acid	H											0.041														
Streamflow	N/A	86.9	86.9	400.5	203.4	229.6	229.6	171.4	115.5	90.5	93.2	111.2	86.9	90.5	86.9	101.1	106.8	125.1	111.2	114.1	114.1	121.9	120.2	128.3	147.3	160.1
Total suspended solids	N/A	8	7	92	43	53.5	35	24	10	10	11	13	3	3	3	7	3	5	6	4	3	4	2	4	5	7

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable

†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

Table 27: Thornton Creek Pesticide Calendar

Month and Day		Mar				Apr				May				Jun					Jul				Aug			
Analyte Name †	Use‡	10	17	24	31	7	14	21	28	5	11	19	26	1	9	15	23	29	7	14	21	27	4	10	17	24
2,4-D	H		0.055		0.12		0.103			0.089																
4,4'-DDE	D-OC		0.013																0.012							0.01
AMPA	H						0.14		0.11	0.094	0.11															
Boscalid	F															0.053				0.17						
Chlorsulfuron	H			0.146	0.031	0.063	0.045	0.025	0.021	0.022																
Cycloate	H														0.12											
Dicamba	H		0.022																							
Dichlobenil	H		0.028	0.023	0.019	0.016	0.031	0.015	0.015	0.018	0.013															
Diuron	H		0.008	0.015	0.129	0.006	0.02	0.006	0.006	0.005				0.006		0.004			0.004	0.008	0.003		0.005		0.017	0.016
Fludioxonil	F																			0.9						
Glyphosate	H						0.32	0.036	0.044	0.21	0.044															
Imazapyr	H						0.012	0.012	0.012																	
Imidacloprid	I-N		0.01				0.015																			
Isoxaben	H		0.003	0.002			0.003																			
Mecoprop (MCPP)	H		0.054		0.071																					
Metsulfuron-methyl	H			0.08			0.027																			
DEET	IR			0.04																0.056		0.026			0.007	
Pentachlorophenol	WP		0.024		0.026																		0.013		0.017	
Piperonyl butoxide	Sy																			0.041						
Propiconazole	F				0.006		0.012	0.01																		
Pyraclostrobin	F			0.014																						
Simazine	H															0.058										
Sulfometuron methyl	H			0.178	0.03	0.022	0.033	0.013	0.011		0.012	0.01			0.01											
Triclopyr acid	H		0.026											0.11											0.099	0.026
Streamflow	N/A	7.1	18.2	19.8	10.6	6.0	11.8	6.2	5.9	5.9	4.3	4.2	3.7	4.8	3.0	2.8	2.6	2.5	2.2	2.4	2.3	3.8	2.2	2.0	3.7	2.4
Total suspended solids	N/A	6	7	10	11	4	5	8	4	8	7	4	4	18	4	4	3	3	5	3	3	3	2	5	4	4

‡ C: Carbamate, D: Degradate, M: Multiple, F: Fungicide, H: Herbicide, I: Insecticide, N: Neonicotinoid, PY: Pyrethroid, L: Legacy pesticide, OC: Organochlorine, OP: Organophosphate, WP: Wood preservative, N/A: Not applicable

†Units for pesticide detections are in in (µg/L), Streamflow measurments are in (cfs), and total suspended solids in (mg/L)

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 340 sampling events. TSS (mg/L) was collected in the field and analyzed by MEL.

Table 28: Summary of Conventional Water Quality Parameters

Site	Summary Statistic	TSS (mg/L)	Stream Discharge (cfs)	pH (s.u.)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)
Upper Bertrand Creek	Sampling events	25	25	23	23	25
	Mean	4.64	16.36	7.39	194.17	9.36
	Minimum	1.00	0.22	7.0	127.90	6.72
	Maximum	13.00	97.00	8.09	236.40	14.50
Lower Bertrand Creek	Sampling events	25	26	22	22	26
	Mean	4.12	43.02	7.15	250.81	9.38
	Minimum	1.00	4.10	6.73	161.40	8.23
	Maximum	17.00	251.00	7.41	285.90	11.16
Indian Slough	Sampling events	20	15	19	19	20
	Mean	14.23	20.10	7.22	4648.33	7.58
	Minimum	4.00	8.05	6.62	397.70	3.46
	Maximum	61.00	42.88	9.09	34848.00	11.73
Browns Slough	Sampling events	20	12	19	18	20
	Mean	11.88	8.06	7.42	13411.39	7.22
	Minimum	5.00	0.95	6.99	5296.00	3.55
	Maximum	30.00	17.24	7.90	27296.00	11.27
Upper Big Ditch	Sampling events	24	25	24	23	26
	Mean	10.89	1.65	6.83	341.17	6.29
	Minimum	3.00	0.18	6.51	198.8	0.24
	Maximum	41.00	6.78	7.46	439.30	9.88
Lower Big Ditch	Sampling events	25	22	24	24	25
	Mean	30.18	16.61	6.91	378.85	7.33
	Minimum	7.00	8.79	6.30	65.10	3.79
	Maximum	126.00	28.42	8.07	913.70	16.90
Thornton Creek	Sampling events	25	25	24	24	26
	Mean	5.56	5.61	7.71	226.26	9.67
	Minimum	2.00	2.00	7.38	154.30	8.68
	Maximum	18.00	19.79	7.93	243.70	11.20
Peshastin Creek	Sampling events	25	25	25	25	25
	Mean	3.32	115.99	8.12	129.57	10.64
	Minimum	1.00	2.10	7.91	94.20	9.18
	Maximum	15.00	451.00	8.41	178.30	12.41
Brender Creek	Sampling events	25	25	26	26	26
	Mean	22.26	1.76	8.16	251.99	9.98
	Minimum	2.00	0.38	7.89	149.30	8.82
	Maximum	129.00	7.19	8.37	382.50	11.47
Mission Creek	Sampling events	25	25	25	25	25

Site	Summary Statistic	TSS (mg/L)	Stream Discharge (cfs)	pH (s.u.)	Conductivity (umhos/cm)	Dissolved Oxygen (mg/L)
	Mean	12.22	13.73	8.50	249.33	11.07
	Minimum	2.00	0.26	8.15	204.70	9.73
	Maximum	108.00	57.21	8.83	295.00	12.96
Stemilt Creek	Sampling events	25	25	25	25	25
	Mean	7.32	3.20	8.31	307.54	9.95
	Minimum	1.00	0.03	8.04	130.90	8.57
	Maximum	28.00	13.86	8.52	557.20	11.98
Marion Drain	Sampling events	25	25	26	26	26
	Mean	8.16	63.28	8.40	274.06	13.98
	Minimum	1.00	2.54	7.57	197.20	10.12
	Maximum	30.00	348.30	9.43	363.60	21.29
Sulphur Creek Wasteway	Sampling events	25	25	25	25	25
	Mean	14.62	137.32	8.44	417.48	10.39
	Minimum	2.00	86.88	7.94	190.40	8.50
	Maximum	92.00	400.50	8.93	774.80	11.96
Spring Creek	Sampling events	25	25	25	25	25
	Mean	16.02	16.94	8.91	298.87	9.66
	Minimum	1.00	0.86	8.14	128.40	7.38
	Maximum	79.00	64.78	9.47	476.00	11.72

Differences in the number of weeks sampled across sites for conventional water quality parameters are due to the malfunctioning of water quality monitoring probes. Differences in the number of weeks sampled across sites for TSS and streamflow is due to dangerously high flows preventing a flow measurement from being collected or from weeks when streamflow was below an accurately measurable level.

Precipitation

Daily precipitation data was measured by WSU's AgWeatherNet weather stations located in close proximity to monitoring sites (Table 29).

Table 29: Sites and Associated AgWeatherNet Weather Stations

Subbasins & Sites	Weather station name	Latitude and longitude
Nooksack:		
Upper & Lower Bertrand Creek	Lynden	48.94°, -122.51°
Lower Skagit-Samish:		
Upper Big Ditch & Indian Slough	WSU Mt Vernon	48.44°, -122.39°
Lower Big Ditch & Brown Slough	Fir Island	48.36°, -122.42°
Cedar-Sammamish:		
Thornton Creek	Seattle	47.66°, -122.29°
Wenatchee:		

Subbasins & Sites	Weather station name	Latitude and longitude
Peshastin	Peshastin	47.56°, -120.59°
Brender Creek & Mission Creek	N. Cashmere	47.51°, -120.43°
Alkali-Squilchuck:		
Stemilt Creek	Wenatchee Heights	47.37°, -120.31°
Lower Yakima:		
Marion Drain	Toppenish	46.37°, -120.39°
Spring Creek	WSU Prosser	46.26°, -119.74°
Sulphur Creek Wasteway	Port of Sunnyside	46.28°, -120.01°

Summary statistics for Daily precipitation between March 1st and September 30th is presented in Table 30.

Table 30: Summary of Precipitation (cm) Data between March 1st and September 30th, 2015

Subbasins & Sites	Summary Statistics	Seasonal Precipitation (cm) [1]	Precipitation (cm) from measurable events[2]
Nooksack:			
Upper & Lower Bertrand Creek	Days	214	66
	Mean (cm)	0.113	0.367
	Minimum (cm)	0.000	0.025
	Maximum (cm)	2.769	2.769
Lower Skagit-Samish:			
Upper Big Ditch & Indian Slough	Days	214	57
	Mean (cm)	0.106	0.396
	Minimum (cm)	0.000	0.025
	Maximum (cm)	2.489	2.489
Lower Big Ditch & Brown Slough	Days	214	56
	Mean (cm)	0.102	0.388
	Minimum (cm)	0.000	0.025
	Maximum (cm)	2.540	2.540
Cedar-Sammamish:			
Thornton Creek	Days	214	55
	Mean (cm)	0.144	0.559
	Minimum (cm)	0.000	0.025
	Maximum (cm)	6.045	6.045
Wenatchee:			
Peshastin Creek	Days	214	16
	Mean (cm)	0.019	0.248
	Minimum (cm)	0.000	0.025
	Maximum (cm)	0.889	0.889
Brender & Mission Creeks	Days	214	21
	Mean (cm)	0.030	0.310

Subbasins & Sites	Summary Statistics	Seasonal Precipitation (cm) [1]	Precipitation (cm) from measurable events[2]
	Minimum (cm)	0.000	0.025
	Maximum (cm)	1.651	1.651
Alkali –Squilchuck:			
Stemilt Creek	Days	214	20
	Mean (cm)	0.044	0.469
	Minimum (cm)	0.000	0.025
	Maximum (cm)	2.184	2.184
Lower Yakima:			
Marion Drain	Days	214	34
	Mean (cm)	0.032	0.199
	Minimum (cm)	0.000	0.025
	Maximum (cm)	2.057	2.057
Sulphur Creek Wasteway	Days	214	14
	Mean (cm)	0.023	0.354
	Minimum (cm)	0.000	0.025
	Maximum (cm)	3.404	3.404
Spring Creek	Days	214	14
	Mean (cm)	0.032	0.493
	Minimum (cm)	0.000	0.025
	Maximum (cm)	3.480	3.480

[1] "Seasonal Precipitation (cm)" includes data collected from March 1st through September 30th for all days, including days with no measurable precipitation.
[2] Measurable Precipitation (cm) Events" excludes days with no measurable precipitation.

There were noticeable regional differences in mean precipitation rates between sites located east and west of the Cascade Mountains, with average precipitation rates at western sites ranging from 0.102 – 0.144 cm, and eastern sites ranging from 0.019 – 0.044 cm. The Cascade Mountain Range runs from north to south in the state of Washington creating distinct differences in climatic conditions between western and eastern Washington, specifically differences in rainfall and temperature (Elsner et al. 2010). According to Elsner et al. 2010, Western Washington averages about 125.0 cm per year, compared to an annual average in Eastern Washington slightly above 31.0 cm. Data collected from the AgWeatherNet weather stations shows that the average total rainfall at eastern Washington sites (0.030 cm) was just about equal to 25% of the average total rainfall measured at western Washington sampling sites (0.116 cm). In addition, there were nearly twice as many days with measurable precipitation at western sampling sites than there were at eastern sites. There were 66 days where rainfall was measured at the Lynden station near the Bertrand Creek sites which was the greatest number of days with measurable rainfall at western Washington sites. There were 34 days where rainfall was measured at the Toppenish station near Marion Drain which was the greatest number of days with measurable rainfall at eastern Washington sites. In general, the maximum precipitation rates were comparable for all sites in eastern and western regions. Exceptions include a maximum daily precipitation rate of 6.05 cm on March 15th at Thornton Creek, and maximum daily precipitation rates less than 2.0

cm at Peshastin, Brender and Mission Creeks. Mean precipitation rates were also comparable for all eastern and western Washington sites. Exceptions include Marion Drain which was the only location to average less than 0.2 cm per day of measurable precipitation and Thornton Creek which was the only site to average above 0.5 cm per day. Figure 4 presents data for days where precipitation was measurable (cm); days where measurable precipitation was not observed were excluded from the data set and calculations.

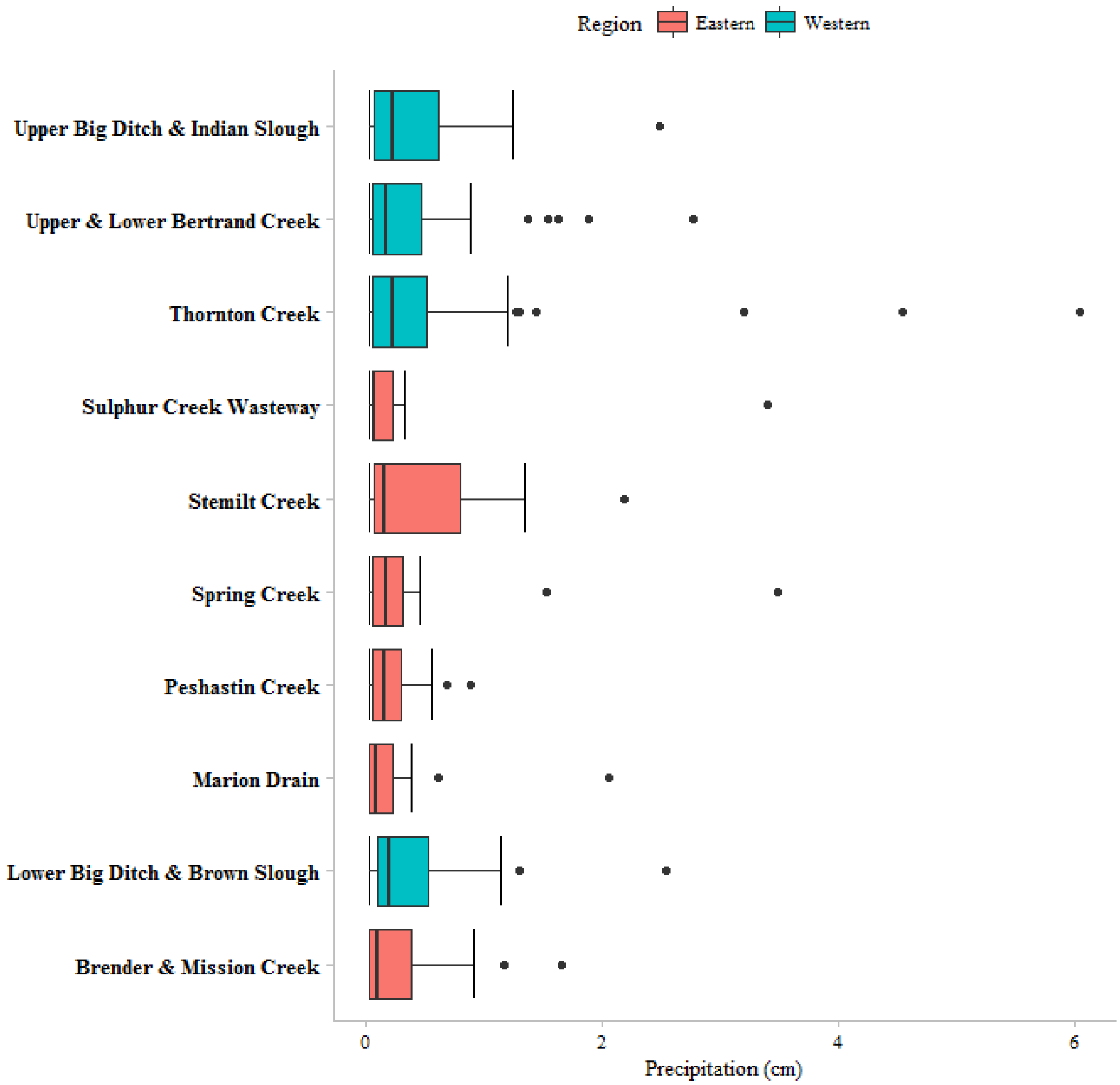

Figure 4: Measurable Daily Precipitation (cm) between March 1st and September 30th, 2015

Summary of Streamflow, Total Suspended Solids, and TSS Flux

Summary statistics for streamflow, TSS (mg/L) and TSS Flux (mg/sec) are presented in Table 31.

Table 31: Summary of Flow, TSS (mg/L), & TSS Flux (mg/second)

Subbasins & sites	Summary statistics	Flow (CFS)	TSS(mg/L)	TSS Flux (mg/sec)
Nooksack:				
Upper Bertrand Creek	Sampling events	25	25	25
	Mean	16.36	4.64	3454.22
	Minimum	0.22	1.00	15.29
	Maximum	97.00	13.00	35707.48
Lower Bertrand Creek	Sampling events	25	25	25
	Mean	44.46	4.12	14180.94
	Minimum	4.10	1.00	116.10
	Maximum	251.00	17.00	120827.79
Lower Skagit-Samish:				
Upper Big Ditch	Sampling events	24	24	24
	Mean	1.71	10.60	364.77
	Minimum	0.18	3.00	15.29
	Maximum	6.78	41.00	1919.88
Lower Big Ditch	Sampling events	22	22	22
	Mean	16.61	31.23	15765.96
	Minimum	8.79	7.00	2154.63
	Maximum	28.42	126.00	85201.85
Brown Slough	Sampling events	12	12	12
	Mean	8.06	10.54	2099.11
	Minimum	0.95	5.00	322.81
	Maximum	17.24	17.00	4105.65
Indian Slough	Sampling events	15	15	15
	Mean	20.10	10.33	5532.91
	Minimum	8.05	4.00	1415.84
	Maximum	42.88	26.00	11228.74
Cedar-Sammamish:				
Thornton Creek	Sampling events	25	25	25
	Mean	5.61	5.56	1075.40
	Minimum	2.00	2.00	124.59
	Maximum	19.79	18.00	5603.89
Wenatchee:				
Peshastin Creek	Sampling events	25	25	25
	Mean	115.99	3.32	17770.15
	Minimum	2.10	1.00	59.47
	Maximum	451.00	15.00	191563.15
Brender Creek	Sampling events	25	25	25
	Mean	1.76	22.26	1851.34
	Minimum	0.38	2.00	27.18
	Maximum	7.19	129.00	14794.11
Mission Creek	Sampling events	25	25	25
	Mean	13.73	12.22	10533.63
	Minimum	0.26	2.00	22.09
	Maximum	57.21	108.00	174960.45

Subbasins & sites	Summary statistics	Flow (CFS)	TSS(mg/L)	TSS Flux (mg/sec)
Alkali-Squilchuck:				
Stemilt Creek	Sampling events	25	25	25
	Mean	3.20	7.32	1190.76
	Minimum	0.03	1.00	1.70
	Maximum	13.86	28.00	8005.16
Lower Yakima:				
Marion Drain	Sampling events	25	25	25
	Mean	63.28	8.16	38076.16
	Minimum	2.54	1.00	71.92
	Maximum	348.30	30.00	266294.02
Sulphur Creek Wasteway	Sampling events	25	25	25
	Mean	137.32	14.62	93861.26
	Minimum	86.88	2.00	6809.62
	Maximum	400.50	92.00	1043360.81
Spring Creek	Sampling events	25	25	25
	Mean	16.94	16.02	16332.22
	Minimum	0.86	1.00	24.35
	Maximum	64.78	79.00	144914.62

Streamflow

Streams in Washington exhibit seasonal fluctuations in flow. Subbasins in high elevations and particularly on the eastern slopes of the Cascade Mountain Range, such as Peshastin and Mission Creeks, are highly influenced by snowpack formed in the winter due to typically below freezing temperatures. Stream water levels and flows generally increase in the spring and early summer months due to seasonal rain events and melting snowpack (Geller 2003, Hamlet and Lettenmaier 2007). Subbasins that reach into high elevations exhibit streamflows that generally decrease into the mid-late summer and fall months due to decreasing snow pack, and reduced frequency of precipitation events. Due to milder temperatures and generally lower elevation, flow patterns of subbasins in western Washington are more directly influenced by rain events, and will often exhibit increasing flows during the typically wet winter months (Elsner et al. 2010), such as Bertrand Creek. Subbasins located at mid-level elevations can be influenced by a combination of snow and rain events and depending on seasonal temperatures can experience two streamflow peaks, with one occurring in the winter due to rain/snow mix, and a second peak in the spring or early summer when the snowpack melts (Hamlet and Lettenmaier 2007, Elsner et al. 2010).

Peshastin Creek had the highest maximum flow of 451.00 CFS, but second highest average of 115.99 CFS. Sulphur Creek Wasteway had the second highest maximum flow of 400.50 CFS, but highest average at 137.32 CFS for the season. Marion Drain had the third highest maximum flow of 348.30 CFS, and seasonal average of 63.28 CFS. Big Ditch (Upper) and Brender Creek had the lowest maximum flows at 6.78, and 7.19 CFS respectively as well as the lowest averages of 1.71 and 1.76 CFS. Streamflow measurements (CFS) for each monitoring location are displayed in Figure 5.

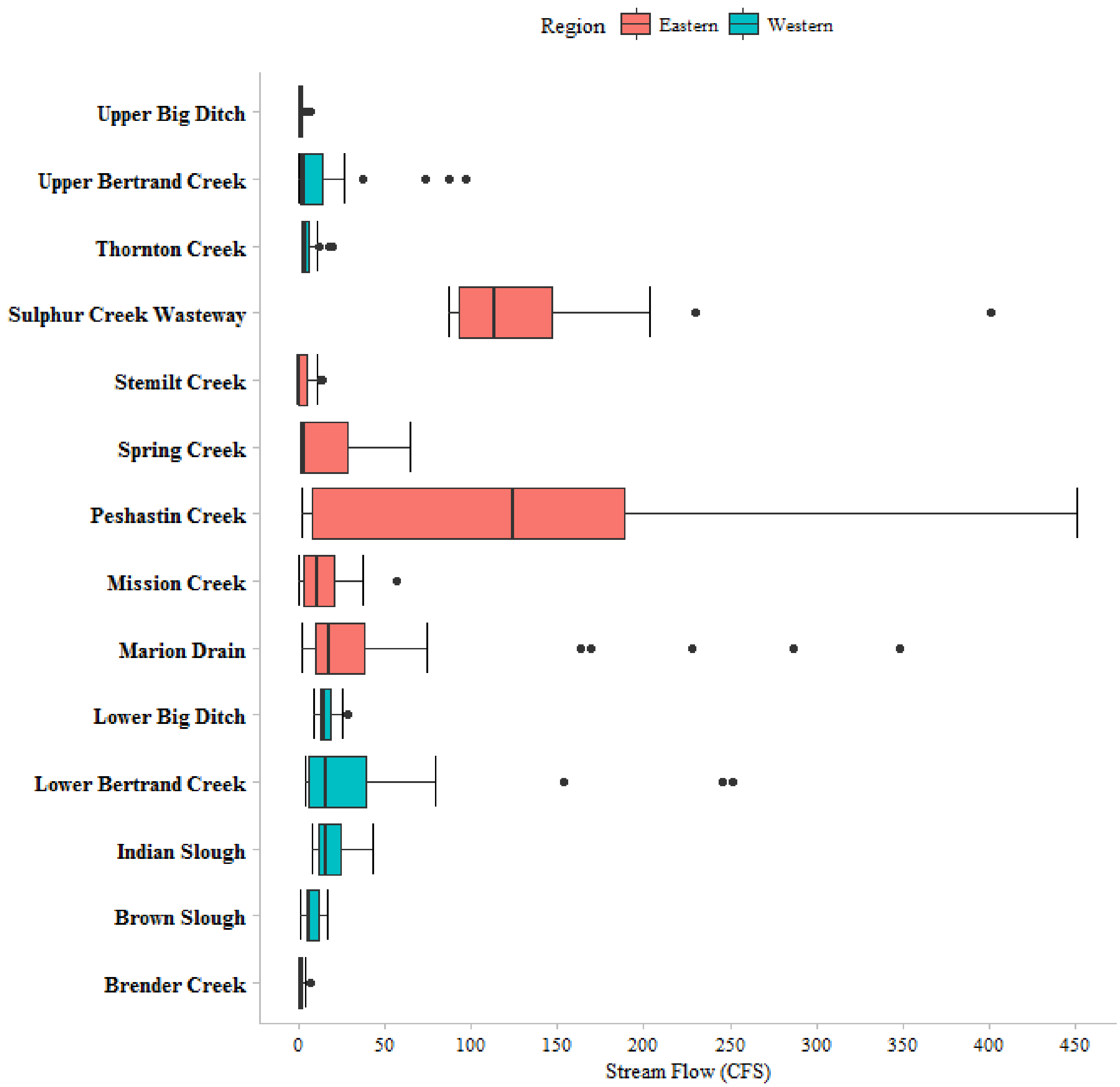

Figure 5: Weekly Streamflow Measurements

Total suspended solids

TSS samples were collected during weekly sampling events. TSS is monitored in streams because it provides a potential source of pesticide contamination to surface water through erosion and runoff from adjacent uplands. In particular, pesticides with low water solubility and a high affinity for soils (high Koc value), such as DDT can enter stream systems, and are often particle bound (Anderson 2007), entering surface water through runoff and erosion of contaminated upland soils (Johnson et al., 1988; Joy and Patterson, 1997). Brender Creek in particular, consistently has detectable levels of DDT and its associated degradates and relatively high TSS levels compared to other sites. Based on orchard soil samples collected by Washington State Department of Ecology in 2003 in the Brender Creek watershed, they estimated DDT levels at an average of 5.8 kg/hectare in the Brender Creek drainage due to historic use of the pesticide prior to its ban in 1972 (Anderson, 2007; Serdar and Era-Miller, 2004). According to the report as much as 75% of the DDT in the surface water is particle bound, suggesting that much of the DDT contamination was due to runoff and erosion (Serdar and Era-Miller, 2004). This suggests that by reducing runoff and erosion to streams, TSS levels would be reduced and therefore DDT contamination of surface water should also be reduced, as well as other particle bound pesticides. Land management practices that can be implemented to reduce runoff, erosion and TSS loading to streams includes maintaining vegetated ground cover on land adjacent to streams. This is particularly important in watershed where there is known pesticide contamination of upland soils. Land practices can include maintaining grass cover in orchards to retain upland soils, and is a common practice in the Brender and Mission Creek subbasins (Serdar and Era-Miller, 2004; personal observation). Riparian buffers can also be planted/maintained along wetland/stream margins to reduce bank erosion and also filter/uptake contaminants in runoff from adjacent uplands (Anderson, 2007).

Brender Creek had the highest TSS value of 129.00 mg/L, followed by Big Ditch (Lower) with a TSS value of 126.00 mg/L, however Big Ditch (Lower) had a higher TSS seasonal average of 31.23 mg/L, where Brender Creek averaged 22.26 mg/L. Data collected for TSS (mg/L) for each monitoring location are displayed in Figure 6.

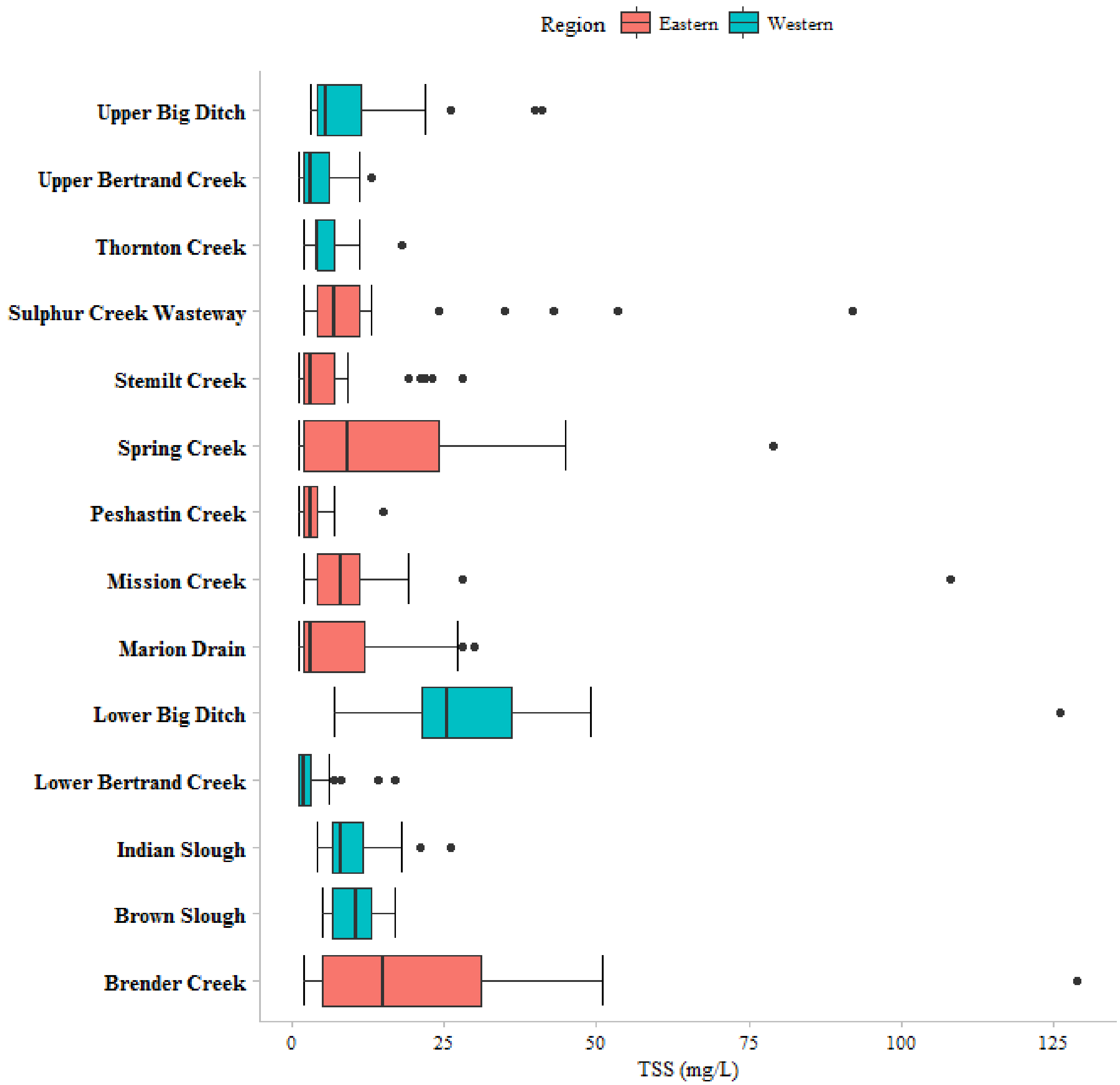

Figure 6: Weekly collected Total Suspended Solids

TSS Flux

TSS Flux was calculated using coinciding streamflow measurements and TSS samples. The loading rate or "flux" (e.g. Flux = flow (liters/sec) x TSS (mg/L)) is defined as the instantaneous loading rate of a substance at a single point in time, such as mg per second (Meals et al. 2013). Sulphur Creek Wasteway and Marion Drain had the highest average TSS flux of 93,861.26 and 38,076.16 mg/sec. respectively. The two waterbodies have some of the highest flows, behind only Peshastin Creek, and are subbasins in the Lower Yakima subbasin that contains some of the most diverse agriculture in the state. Instream TSS Flux (mg/sec) for each monitoring location is displayed in Figure 7.

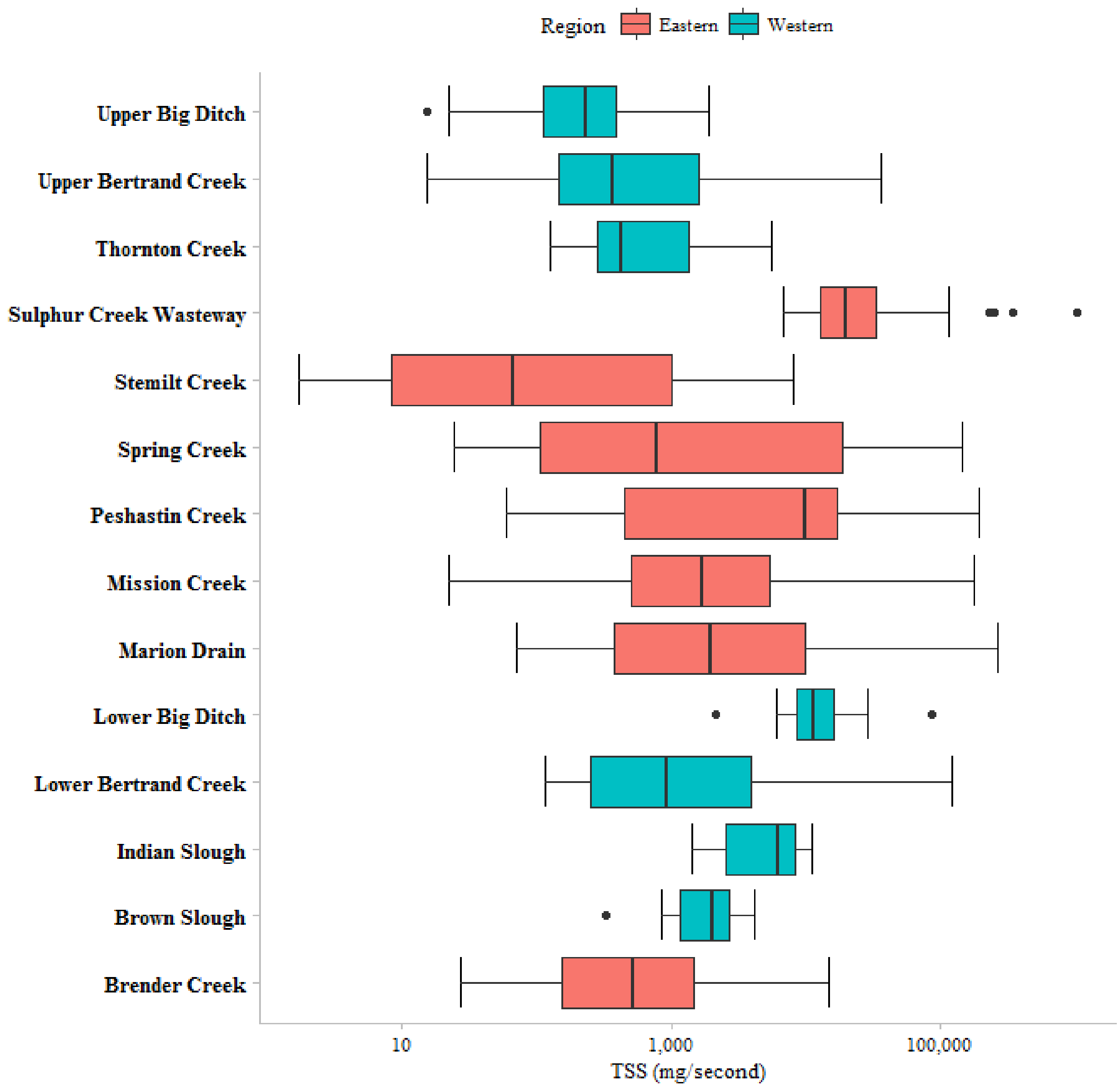

Figure 7: Weekly TSS Flux (mg/sec)

Conventional Water Quality Parameter 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

Continuous, 30-minute interval temperature data was collected during the sampling season from March, 7 – September 14, 2015 at eastern Washington monitoring locations and from March 8 – September 16, 2015 at western Washington monitoring locations. Table 32 provides a list of the time periods where the aquatic life temperature criteria were exceeded. Criteria are based on the designated aquatic life uses at each monitoring location. Water temperature criteria are listed in the standard as the highest allowable 7-day average of the daily maximum temperatures (7-DADMax).

Table 32: Water Temperatures Exceeding the Washington State Aquatic Life Criteria

Monitoring sites	Period of temperature exceedance (start - end)	Number of days	Maximum temperature	7-DADMax Range
Freshwater - Salmonid Spawning, Rearing, and Migration Habitat - (>17.5^{0}C) Exceedances:				
Upper Bertrand Creek	May 18 - 21	4	19.4	17.9 - 18.1
	May 28 - 31	4	19.6	17.7 - 17.9
	June 4 - August 25	83	22.8	17.7 – 22.4
Lower Bertrand Creek	June 26 - July 9	14	19.4	17.6 - 19.1
	July 16 - 21	6	19.0	17.6 - 17.9
	July 31 - August 2	3	18.0	17.7 - 17.8
Upper Big Ditch	June 6 – 16	11	19.1	17.6 – 18.7
	June 23 – August 29	68	20.6	17.7 – 20.0
Lower Big Ditch	April 18 - 19	2	18.6	17.8
	April 29 – September 2	127	29.0	17.6 – 28.2
	September 5 - 13	9	23.4	17.8 – 21.6
Freshwater - Salmonid Spawning, Rearing, and Migration Habitat - (>17.5^{0}C) Exceedances:				
Indian Slough	May 18 – 23	6	19.3	17.7 – 18.4
	May 26 – September 13	111	25.1	17.7 – 24.4
Marine Water - (>16^{0}C) Exceedances:				
Browns Slough	April 6 – 9	4	18.4	16.3 – 16.9
	April 15 – 24	10	23.4	16.4 – 20.8
	April 26 – September 13	141	31.8	16.1 – 30.7
Freshwater - Core Summer Salmonid Habitat - (>16^{0}C) Exceedances:				
Thornton Creek	May 20 – 21	2	17.6	16.1
	May 27 – September 2	99	21.7	16.3 – 21.3
	September 6 -12	7	18.0	16.1 – 17.5
Freshwater Supplemental Spawning and Incubation - [Sept. 15 - May 15] - (>13.0^{0}C) Exceedances:				
Thornton Creek	April 17 – 21	5	14.6	13.1 – 13.5
	April 26 – May 15	20	15.7	13.1 – 14.6
Freshwater - Salmonid Spawning, Rearing, and Migration Habitat - (>17.5^{0}C) Exceedances:				

Monitoring sites	Period of temperature exceedance (start - end)	Number of days	Maximum temperature	7-DADMax Range
Marion Drain	April 19 - 22	4	19.4	17.7 – 18.2
	April 25 – May 15	21	20.6	17.6 – 19.9
	May 17 – September 10	117	25.5	18.1 – 24.7
Spring Creek	April 16 – September 10	148	34.3	17.8 – 33.3
Sulphur Creek Wasteway	April 19 – September 10	145	26.1	17.8 – 25.7
Peshastin Creek	June 6 – August 13	69	31.4	18.3 – 23.7
Brender Creek	June 24 – July 23	30	21.5	17.9 – 20.8
	July 27 – August 17	22	20.3	17.6 – 19.1
Mission Creek	June 25 – July 24	30	21.4	17.7 – 20.8
	July 27 – August 30	35	25.1	17.8 – 21.6
Stemilt Creek	April 12 – June 18		No Data	No Data
	June 19 – August 30	73	23.5	17.9 – 23.1

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 21 time periods where the water temperature exceeded the aquatic life temperature criteria at western Washington monitoring locations. The range in length of period of water temperature exceedance at western Washington sites varied from 2 days at Thornton and Lower Big Ditch to as long as 141 days at Browns Slough. Western Washington monitoring locations averaged a total of 92 days above the aquatic life temperature criteria, with the lower Bertrand Creek monitoring location having the fewest days above the temperature criteria at 23, and Browns Slough having the most days at 155 days.

There were 11 time periods where the water temperature exceeded the aquatic life temperature criteria at eastern Washington monitoring locations. The periods of water temperature exceedance at eastern sites varied from 4 days at Marion Drain to 145 days at Sulphur Creek, and 148 days at Spring Creek. Eastern Washington monitoring locations averaged 99 days above the aquatic life temperature criteria with Brender Creek having the fewest days above the temperature criteria at 52, and Spring Creek having the most days, with a single period lasting 148 days.

All western and eastern Washington monitoring locations had periods where water temperature was in exceedance in 2015. It should be noted there is no data available for the following eastern Washington monitoring location and dates, due to equipment malfunction:

- Stemilt Creek, April 12 – June 18

For the following locations and dates, temperature data was obtained from other agencies with continuous temperature loggers on-site, to be used in lieu of missing, or anomalous data.

- Lower Bertrand Creek, February 28 – September 24 (Washington State Department of Ecology)
- Thornton Creek, June 2 – June 30 and July 11 – July 29 (King County Hydrologic Information Center)
- Peshastin Creek, March 7 – August 13 (Washington State Department of Ecology)

Dissolved Oxygen Measurements below the Acceptable Aquatic Life Criteria

Although the Water Quality Standards for Washington State lists dissolved oxygen criteria as the lowest 1-day minimum, dissolved oxygen measurements are considered point estimates (not continuous) taken at the time of sampling. Table 33 provides a list of occurrences where dissolved oxygen was at levels below the aquatic life criteria.

Table 33: Dissolved Oxygen Levels Not Meeting the Washington State Aquatic Life Criteria

Monitoring sites	Dissolved oxygen measurement dates	Dissolved oxygen measurements outside of criteria (mg/L)
Freshwater - salmonid spawning, rearing, and migration habitat - (<8.0 mg/L) exceedances:		
Upper Bertrand Creek	June 9, 23	7.47, 7.61
	July 7, 21	7.12, 6.72
	August 4, 10, 17, 24	7.62, 7.30, 7.80, 7.89
Upper Big Ditch	April 20	7.89
	May 12, 18, 26	7.53, 6.38, 6.55
	June 1, 8, 16, 22, 30	5.58, 6.91, 3.61, 5.90, 1.57
	July 6, 14, 20, 27	5.04, 5.35, 6.91, 7.83
	August 4, 10, 17, 24	5.66, 4.53, 3.20, 0.24
Lower Big Ditch	March 9, 18, 23	5.55, 5.13, 6.98
	April 1, 29	6.58, 6.75
	May 18, 27	7.63, 5.30
	June 2, 8, 16, 22, 30	5.25, 6.39, 6.09, 6.80, 3.79
	July 15, 20, 28	6.73, 7.87, 5.60
	August 4, 10, 17, 24	7.05, 4.18, 4.13,4.12
Indian Slough	March 9, 18, 23	3.46, 6.24, 6.63
	April 1, 6, 15, 20, 29	7.15, 5.42, 7.32, 6.27, 7.60
	May 4, 18	7.51, 7.91
	June 16, 30	6.08, 7.20
	July 20	5.21
Spring Creek	June 29	7.87
	July 6, 20	7.38, 7.90
Marine water - (<6.0 mg/L) exceedances:		
Browns Slough	March 18	3.55
	June 2, 8, 30	5.77, 4.29, 5.31
	July 6, 15, 20	4.32, 5.54, 5.85
Freshwater - core summer salmonid habitat - (<9.5 mg/L) exceedances:		
Thornton Creek	June 9, 15, 23, 29	8.68, 9.37, 9.20, 8.83
	July 7, 14, 21, 27	8.99, 9.39, 9.22, 9.34
	August 4, 10, 17, 24	9.03, 8.94, 9.06, 9.36
	September 16	9.17
Monitoring locations where sampling event meet the dissolved oxygen criteria during in 2015:		

Monitoring sites	Dissolved oxygen measurement dates	Dissolved oxygen measurements outside of criteria (mg/L)
Lower Bertrand, Brender Creek, Marion Drain, Mission Creek, Peshastin Creek, Stemilt Creek, and Sulphur Creek Wasteway	n/a	n/a

There were 77 individual occurrences where the dissolved oxygen levels were below the aquatic life criteria at western Washington monitoring locations. Bertrand Creek (Lower) was the only western Washington monitoring location that met the dissolved oxygen criteria for the entire monitoring season.

Six of the seven eastern Washington monitoring locations met the aquatic life criteria for dissolved oxygen throughout the 2015 monitoring season. Spring Creek was the only eastern site were dissolved oxygen levels were below the aquatic life criteria, which occurred three times during the season.

pH Measurements Outside of the Acceptable Aquatic Life Criteria

The Washington State Water Quality Standards lists acceptable ranges for pH values for each aquatic life use category. Table 34 provides a list of occurrences where pH measurements were below or above the aquatic life criteria.

There were three occurrences where the pH measurement was outside of the range listed in the aquatic life pH criteria at one western Washington location (the lower sampling location on Big Ditch), and 54 occurrences were outside of the range listed at four eastern Washington locations (Mission Creek, Marion Drain, Spring Creek, and Sulphur Creek Wasteway).

Six western Washington monitoring locations and three eastern Washington monitoring locations had pH measurements within the acceptable range listed for the aquatic life pH criteria during the 2015 monitoring season.

Table 34: pH Levels Not Meeting the Washington State Aquatic Life Criteria

Monitoring sites	Dates of pH measurements	pH measurements outside of criteria (s.u.)
Freshwater – Salmonid Spawning, Rearing, and Migration – pH: 6.5-8.5:		
Lower Big Ditch	July 28	6.30
	August 17, 24	6.37, 6.32
Marion Drain	April 13, 20, 27	8.93, 9.34, 9.13
	May 4, 11, 18, 26	8.94, 8.89,8.69,8.78
	June 1, 8	8.92, 9.30
	July 27	9.43
	August 24	8.66
Spring Creek	March 9, 16, 30	8.87, 8.94, 8.87
	April 6, 13, 20, 27	9.01, 9.35, 9.47, 8.98
	May 26	8.83,
	June 1, 8, 15, 22, 29	8.78, 9.20, 9.21, 8.91, 8.61
	July 6, 13, 20, 27	8.98, 8.93, 9.09, 8.83
	August 3, 10, 17, 24	9.10, 9.16, 9.00, 9.16
Sulphur Creek Wasteway	March 16	8.57
	April 6, 13, 20, 27	8.76, 8.56, 8.80, 8.81
	May 4, 11, 18, 26	8.62, 8.60, 8.70, 8.70
	June 8	8.93
Mission Creek	April 21	8.58
	May 27	8.55
	June 16, 23, 30	8.58, 8.63, 8.58
	July 7, 21, 28	8.65, 8.60, 8.56
	August 4, 11, 18, 25	8.61, 8.77, 8.83, 8.75
Monitoring locations where all measurements were within the pH criteria:		
Thornton Creek, Upper Bertrand Creek, Lower Bertrand Creek, Upper Big Ditch, Indian Slough, Browns Slough, Brender Creek, Peshastin Creek, and Stemilt Creek	n/a	n/a

Conclusions:

The number of pesticide detections and the number of detections that exceed the assessment criteria were greater in 2015 than in 2014. There was an increase of 44% in the number of pesticide detections from 1,151 detections in 2014 to 1,663 detections in 2015. There was also an increase of 60% in the number of detections that exceed the assessment criteria, rising from 48 exceedances in 2014 to 76 exceedances in 2015. Three factors that likely contributed to these increases are the addition of the new laboratory analytes, the reduction of all assessment criteria by a factor of one-half, and the prolonged regional drought that preceded the start of sampling and persisted through the season. A large proportion of the total number of pesticide detections in 2015 were detections of recently added pesticide active ingredients and pesticide degradates. The addition of the more than 40 new laboratory analytes was a result of thorough review of pesticide registration activity and available pesticide use information by NRAS staff between 2013 and 2015. Meteorological conditions also likely contributed to the observed increases in detections and exceedances in one or more ways. One way is that pesticides which reach surface water from overspray, drift or irrigation runoff become more concentrated and easier to detect when the volume of water in a waterbody is smaller and streamflows across the state were at historically low levels due to severe drought conditions[19] in 2015. It is also plausible that the warmer and drier than normal weather pattern of 2015 would have prompted an increase in pesticide use to help manage higher than average early season pest pressures.

Approximately 4.6% of the pesticide detections in 2015 exceeded the assessment criteria. Despite a decreasing trend in the number of annual detections of DDT and its breakdown products, those detections accounted for almost two thirds of the exceedances in 2015. The seven current use pesticides: azoxystrobin, bifenthrin, captan, chlorpyrifos, malathion, metolachlor, pyridaben, and sulfometuron-methyl accounted for the remaining one third of the exceedances and all seven are now currently classified as Pesticides of Concern (POC). A pesticide is considered a POC when it is detected at or above the assessment criteria at least once in the most recent three years of monitoring data. NRAS staff update WSDA's POC list annually and add or remove pesticides from the list at that time. The most important purpose of classifying pesticides as POCs is to help make pesticide users aware of the fact that those pesticides are more likely to contribute to ground or surface water contamination due to their chemical properties, physical properties, and pesticide use practices. The POC list is a valuable tool to keep track of which chemicals are a priority for additional outreach and education efforts. In addition to being listed as POCs, insecticides chlorpyrifos and malathion are currently undergoing evaluation as part of a federal Endangered Species Act consultation between the EPA and the services that may result in changing use restrictions in the coming years.

[19] Final Report: 2015 Drought and Agriculture (WSDA, 2017), http://agr.wa.gov/FP/Pubs/docs/495-2015DroughtReport.pdf

The 2015 monitoring data indicates that mixtures of pesticides in surface water are common in many watersheds of Washington. There were four sites in 2015 that had two or more pesticide detections at every sampling event over the entire field season. Although EPA does not provide formal guidance on the evaluation of mixtures of pesticides in surface water, this report conducted a TU analysis for all sampling events in order to identify where mixtures may represent a risk to aquatic life (TU $\geq$ 1). The TU analysis indicated that there were 24 sampling events where pesticides mixtures had a TU value $\geq$ 1. All 24 of the sampling events that had a TU value $\geq$ 1 were associated with a detection of at least one of the following pesticides; captan, metolachlor, bifenthrin, malathion, and chlorpyrifos. Chlorpyrifos was detected in 14 of the 24 mixtures that had a TU value $\geq$ 1. Only one of the sampling events contained two or more pesticides that contributed grater then 0.01 units to the TU value of the mixture. The other 24 sampling events were all associated with a single pesticide that was present in the mixture that contributed to the TU value being $\geq$ 1 on by itself. Based on this dataset the TU analysis indicates that although complex pesticide mixtures occur often in the surface waters of Washington State, these mixtures of pesticides do not automatically represent a risk to the aquatic environment that clearly greater their individual components.

The ambient monitoring program is also an important platform for designing targeted studies that focus on particular pesticide fate and transport properties such as deposition from pesticide drift, runoff, and sediment toxicity investigations. In 2015, the ambient monitoring program collected field data on the presence of glyphosate in surface water. The laboratory method used to analyze samples collected for the glyphosate pilot project achieved a lower reporting limit of 0.008 ppb and at a cost of $150 per sample, proving it was a far more cost effective method than traditional analytical methods used to test for glyphosate. Glyphosate was detected at 54 of the 70 sampling events during the five-week pilot project and the highest concentration detected for glyphosate was 1.5 ppb. Glyphosate at a concentration of 1.5 ppb is 466 times lower then EPA's maximum contaminant level for glyphosate in drinking water (700 ppb) and approximately 1,200 times lower then EPA's most sensitive aquatic life benchmark for fish, aquatic invertebrates, and aquatic plants. Another pilot project assessed pesticide concentrations in sediment at several sites in eastern and western Washington that will be summarized in a separate report. NRAS also conducted its first edge-of-field study in 2015. The 2015 edge-of-field study specifically assessed aerial pesticide applications of malathion on blueberry farms in Whatcom County[20] and the ability of streamside vegetation to reduce pesticide loading into surface water by intercepting pesticide drift. The findings from the edge of field study will be submitted to a peer-reviewed journal in 2017.

WSDA's ambient monitoring program provides a non-regulatory framework for addressing off target pesticide movement into streams and rivers that is proactive and dovetails nicely with technical assistance and outreach efforts from other private and public organizations. The

[20] Data Report: The Effectiveness of Riparian Vegetation at Intercepting Drift from Aerial Pesticide Application (WSDA, 2016), http://agr.wa.gov/FP/Pubs/docs/103-601Malathion_Data_Report_2016.pdf

monitoring program keeps the agricultural community, regulatory community, and the public informed about trends in the occurrence of pesticides detected in surface water via numerous public presentations, reports, and fact sheets. In addition to this report, watershed-specific fact sheets for 2015 are available to share data and improve awareness of simple BMPs that can protect surface water. A new example of where additional outreach and education efforts are being implemented is in the area surrounding Upper Big Ditch in Skagit County. The surrounding area consists of mostly urban, residential, highway right-of-way, and nursery/greenhouse facilities where high numbers of pesticide detections and exceedances were found in 2014 and 2015. When pesticide use patterns lead to persistent contamination of surface water or ground water, WSDA can implement its EPA approved Pesticide Management Strategy[21]. Following the Pesticide Management Strategy NRAS and the Pesticide Management Division of WSDA are utilizing adaptive management techniques including voluntary BMPs, voluntary use prohibition, technical assistance, stakeholder outreach, and monitoring to investigate and eliminate surface water contamination of chlorpyrifos and diazinon in Grays Harbor and Pacific counties[22] and groundwater contamination from dacthal[23]. Overall WSDA's ambient monitoring program provides valuable opportunities to gain insight into the real world fate, transport, and potential effects of pesticides in the environment; allowing regulators to refine exposure assessments for pesticides registered for use in Washington State, and providing a feedback loop to the pesticide user community.

[21] http://agr.wa.gov/pestfert/natresources/docs/comprehensivepesticidemanagementstrategy.pdf
[22] Cranberry Report 2013 (http://agr.wa.gov/FP/Pubs/docs/401-2013CranberryReportFinal.pdf) and 2014 Cranberry Report (http://agr.wa.gov/FP/Pubs/docs/401-2013CranberryReportFinal.pdf)
[23] Dacthal Report 2014 (http://agr.wa.gov/FP/Pubs/docs/103-410DacthalReport2014.pdf)

Recommendations:

Eleven new compounds will be added to the analyte list for the 2016 sampling season. The list of new compounds and their associated chemical abstracts numbers include chlorantraniliprole (500008-45-7), pyriproxyfen (95737-68-1), spirotetramat (203313-25-1), chlorethoxyfos (54593-83-8), dithiopyr (97886-45-8), prallethrin (23031-36-9), pyrethrins (8003-34-7), tefluthrin (79538-32-2), tetramethrin (7696-12-0), prodiamine (29091-21-2), desethyl atrazine (6190-65-4), desisopropyl atrazine (1007-28-9), 2,6-dichlorobenzamide (2008-58-4), and triclosan (3380-34-5).

A total of 71 analytes will be removed from the program prior to the start of the 2016 sampling season due to new use restrictions, changes in pesticide registration or lack of detections in surface water. The analytes being removed include 34 insecticides, 17 herbicides, three fungicides, and 16 pesticide degradates.

Several site changes will be made prior to the start of the 2016 monitoring season in Western Washington. Changes include the addition of Clarks Creek in the Puyallup-White watershed, the removal of Browns Slough located in the Lower Skagit-Samish basin, and the removal of Thornton Creek, located in the Cedar-Sammamish basin. The Puyallup-White watershed supports small agricultural production including vegetables and berries, as well as supporting residential and commercial development. The removal of Browns Slough from the program is due to tidal influence, low flows, and lack of pesticide exceedances. Thornton Creek will be removed due to its long history (since 2003) of being monitored and lack of exceedances.

Site changes in Eastern Washington for 2016 includes the removal of Peshastin Creek, located in the Wenatchee basin, due to high flows and a low number of pesticide detections. Sampling locations will be moved further downstream from original sampling locations in Mission Creek (located in Wenatchee basin) and Spring Creek (located in Lower Yakima basin) in order to capture a larger area of the subbasins.

Continuous flow data will be collected by WSDA at all sites in 2016 that do not have a permanent gauging station. Continuous flow data will be collected in order to identify where on the hydrograph the weekly samples were collected.

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Appendix A: Monitoring Location Data

Watershed and Monitoring Locations Maps

Table 35: 2015 Monitoring Location Details

WRIA	Ten-digit HUC	Site name	Site ID	Duration	Latitude, longitude	Location description
WRIA 3: Lower Skagit-Samish	1711000702	Lower Big Ditch	BD-1	March-September	48.3085, -122.347	Upstream side of bridge at Milltown Road.
	1711000702	Upper Big Ditch	BD-2	March-September	48.3882, -122.333	Upstream side of bridge at Eleanor Lane.
	1711000203	Indian Slough	IS-1	March-September	48.4506, -122.465	Inside upstream side of tidegate at Bayview-Edison Road.
	1711001911	Browns Slough	BS-1	March-July	48.3406, -122.4139	About 50 meters downstream of the tidegate at Fir Island Road.
WRIA 1: Nooksack	1711000405	Lower Bertrand	BC-1	March-September	48.9241, -122.53	Upstream side of the bridge over the creek on Rathbone Road. Parallel to staff gauge.
	1711000405	Upper Bertrand	BC-7	March-September	48.9935, -122.509	Upstream side of the bridge over the creek on H Street Road.
WRIA 8: Cedar-Sammamish	1711001204	Thornton Creek	TC-3	March-August	47.6959, -122.2757	At pedestrian footbridge over Thornton Creek North of NE 93rd St and directly south of the King County Metro Matthews Beach Park pumping station.
WRIA 37: Lower Yakima	1703000304	Marion Drain	MA-2	March-September	46.3307, -120.2	About 50 meters upstream of bridge at Indian Church Road.
	1703000310	Spring Creek	SP-3	March-August	46.2342, -119.6854	About 44 meters upstream of the culvert under West Hess Road, and about 1.5 meters downstream of the Chandler Canal overpass of Spring Creek.
	1703000309	Sulphur Creek	SU-1	March-September	46.251, -120.02	Downstream side of bridge at Holaday Road.
WRIA 45: Wenatchee basin	1702001106	Mission Creek	MI-1	March-September	47.4874, -120.484	Mission Creek Road off of Trip Canyon Road.
	1702001106	Brender Creek	BR-1	March-September	47.521, -120.487	Upstream side of culvert at Evergreen Drive and the footbridge.
	1702001105	Peshastin Creek	PE-1	March-August	47.5572, -120.5817	About 50 meters downstream of the bridge at Saunders Road.
WRIA 40: Alkali-Squilchuck basin	1702001003	Stemilt Creek	SC-1	March-September	47.3748, -120.25	About 7 meters upstream of the bridge over the creek on Old West Malaga Road.

Datum in north American Datum (NAD) 83

Figure 8: Upper and Lower Bertrand Creek

Figure 9: Upper and Lower Big Ditch

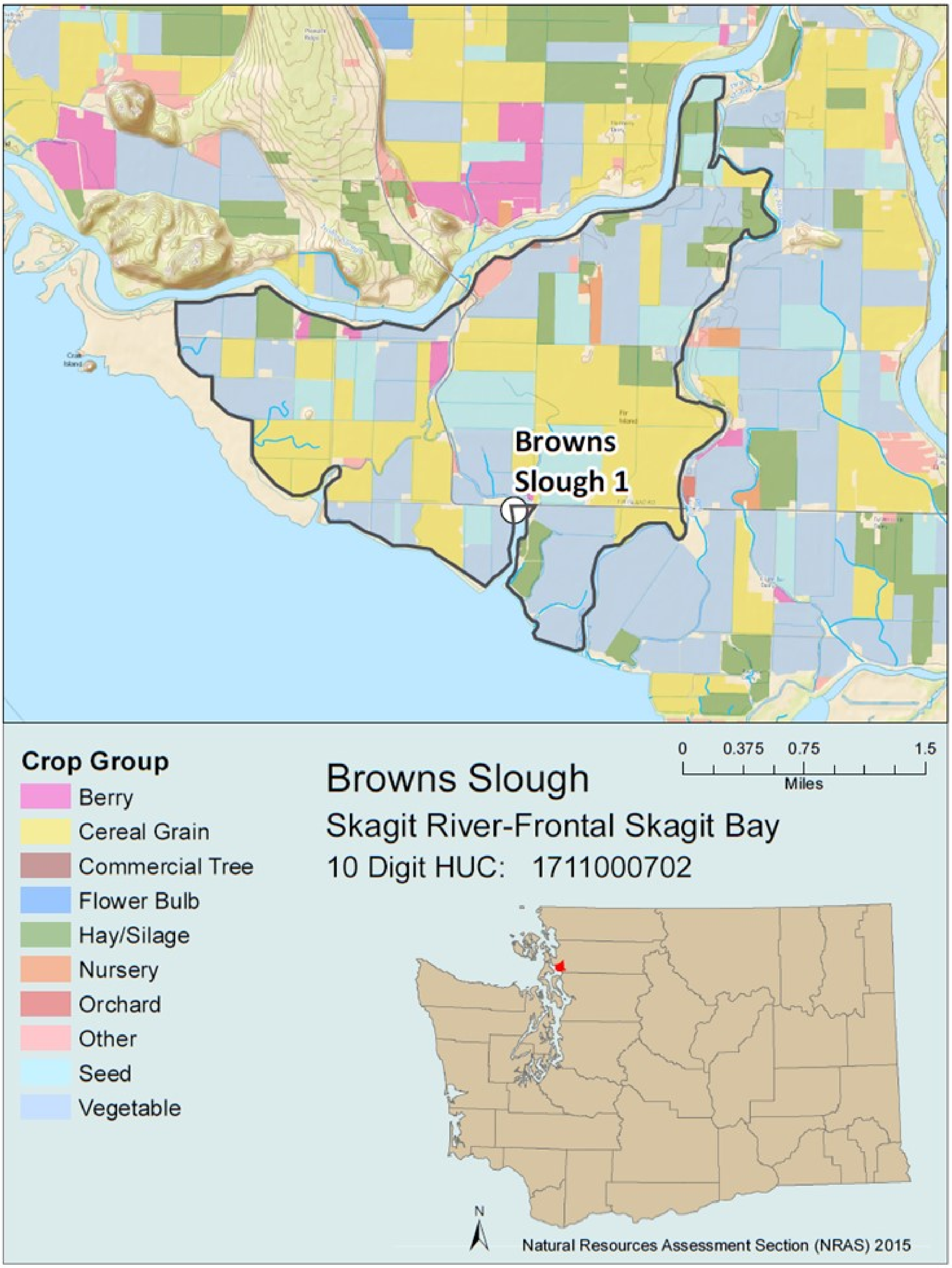

Figure 10: Browns Slough

Figure 11: Indian Slough

Figure 12: Thornton Creek

Figure 13: Marion Drain

Figure 14: Sulphur Creek Wasteway

Figure 15: Spring Creek

Figure 16: Peshastin Creek

Figure 17: Mission Creek

Figure 18: Brender Creek

Figure 19: Stemilt Creek

Appendix B: 2015 Quality Assurance Summary

Laboratory Data Performance Measures

Performance measures are used by the laboratory and field staff to determine when data should be qualified. Percent recovery is used as a performance measure to represent the bias of the analysis by comparing the difference between the concentration of compounds that have been added to samples and the concentration that was measured by the instrument and reporting it relative to 100% of the concentration that was added initially. Relative percent difference (RPD) is a second performance measure used to represent the precision of the analysis by comparing the difference between replicate pairs including matrix spike sample pairs, laboratory control sample pairs and field replicates. RPD and % Recovery are used by the analyst to qualify the results of the grab samples when quality assurance (QA) and quality control (QC) samples fall below the lower control limits or fall above the upper control limits. Control limits can either be default limits specified by the EPA method or analyte specific control limits as determined by the analyst. Upper and lower analyte specific control limits are calculated from the mean of the most recent one hundred pairs, ± three standard deviations. Performance measures for QA and QC samples are presented in Table 36.

Table 36: Performance measures for quality assurance and quality control

Parameter Name	Parameter Type	Analysis Method	RPD Upper Control Limit (%)	Recovery Lower Limit[1] (%)	Recovery Upper Limit[1] (%)
2,4'-DDD	Degradate	GCMS-Pesticides	≥40	29	132
2,4'-DDE	Degradate	GCMS-Pesticides	≥40	37	127
2,4'-DDT	Insecticide	GCMS-Pesticides	≥40	25	118
4,4'-DDD	Degradate	GCMS-Pesticides	≥40	49	143
4,4'-DDE	Degradate	GCMS-Pesticides	≥40	40	140
4,4'-DDT	Insecticide	GCMS-Pesticides	≥40	42	148
4,4'-Dichlorobenzophenone	Degradate	GCMS-Pesticides	≥40	30	130
Acetochlor	Herbicide	GCMS-Pesticides	≥40	30	130
Alachlor	Herbicide	GCMS-Pesticides	≥40	13	184
Aldrin	Insecticide	GCMS-Pesticides	≥40	30	141
alpha-BHC	Insecticide	GCMS-Pesticides	≥40	71	165
Atrazine	Herbicide	GCMS-Pesticides	≥40	13	178
Azinphos-Ethyl	Insecticide	GCMS-Pesticides	≥40	10	330
Azinphos-methyl	Insecticide	GCMS-Pesticides	≥40	10	503
Benfluralin	Herbicide	GCMS-Pesticides	≥40	44	151
beta-BHC	Insecticide	GCMS-Pesticides	≥40	36	230
Bifenazate	Insecticide	GCMS-Pesticides	≥40	50	150
Bifenthrin	Insecticide	GCMS-Pesticides	≥40	30	130
Boscalid	Fungicide	GCMS-Pesticides	≥40	50	150
Bromacil	Herbicide	GCMS-Pesticides	≥40	55	181
Butachlor	Herbicide	GCMS-Pesticides	≥40	30	130
Butylate	Herbicide	GCMS-Pesticides	≥40	41	147
Captan	Fungicide	GCMS-Pesticides	≥40	10	219
Chlorothalonil	Fungicide	GCMS-Pesticides	≥40	57	227

Parameter Name	Parameter Type	Analysis Method	RPD Upper Control Limit (%)	Recovery Lower Limit[1] (%)	Recovery Upper Limit[1] (%)
Chlorpropham	Herbicide	GCMS-Pesticides	≥40	53	181
Chlorpyrifos	Insecticide	GCMS-Pesticides	≥40	52	152
Chlorpyrifos O.A.	Degradate	GCMS-Pesticides	≥40	30	130
Chlorpyrifos-methyl	Insecticide	GCMS-Pesticides	≥40	50	144
cis-Chlordane	Insecticide	GCMS-Pesticides	≥40	45	161
cis-Nonachlor	Insecticide	GCMS-Pesticides	≥40	25	107
cis-Permethrin	Insecticide	GCMS-Pesticides	≥40	17	201
Coumaphos	Insecticide	GCMS-Pesticides	≥40	10	487
Cyanazine	Herbicide	GCMS-Pesticides	≥40	14	268
Cycloate	Herbicide	GCMS-Pesticides	≥40	49	151
delta-BHC	Insecticide	GCMS-Pesticides	≥40	78	176
Deltamethrin	Insecticide	GCMS-Pesticides	≥40	30	130
Di-allate	Herbicide	GCMS-Pesticides	≥40	30	130
Diazinon	Insecticide	GCMS-Pesticides	≥40	59	168
Dichlobenil	Herbicide	GCMS-Pesticides	≥40	34	153
Dichlorvos (DDVP)	Insecticide	GCMS-Pesticides	≥40	27	169
Dicofol	Insecticide	GCMS-Pesticides	≥40	10	265
Dieldrin	Insecticide	GCMS-Pesticides	≥40	52	168
Dimethoate	Insecticide	GCMS-Pesticides	≥40	48	217
Diphenamid	Herbicide	GCMS-Pesticides	≥40	52	170
Disulfoton sulfone	Insecticide	GCMS-Pesticides	≥40	30	130
Disulfoton Sulfoxide	Degradate	GCMS-Pesticides	≥40	40	130
Diuron	Herbicide	GCMS-Pesticides	≥40	40	130
Endosulfan I	Insecticide	GCMS-Pesticides	≥40	58	195
Endosulfan II	Insecticide	GCMS-Pesticides	≥40	58	160
Endosulfan Sulfate	Degradate	GCMS-Pesticides	≥40	77	142
Endrin	Insecticide	GCMS-Pesticides	≥40	61	149
Endrin Aldehyde	Degradate	GCMS-Pesticides	≥40	32	134
Endrin Ketone	Degradate	GCMS-Pesticides	≥40	34	119
EPN	Insecticide	GCMS-Pesticides	≥40	36	190
Eptam	Herbicide	GCMS-Pesticides	≥40	41	159
Ethalfluralin	Herbicide	GCMS-Pesticides	≥40	31	243
Ethion	Insecticide	GCMS-Pesticides	≥40	41	132
Ethoprop	Insecticide	GCMS-Pesticides	≥40	10	263
Etoxazole	Insecticide	GCMS-Pesticides	≥40	50	150
Etridiazole	Fungicide	GCMS-Pesticides	≥40	30	150
Fenamiphos	Insecticide	GCMS-Pesticides	≥40	10	375
Fenamiphos Sulfone	Degradate	GCMS-Pesticides	≥40	30	130
Fenarimol	Fungicide	GCMS-Pesticides	≥40	30	130
Fipronil	Insecticide	GCMS-Pesticides	≥40	30	130
Fipronil Disulfinyl	Degradate	GCMS-Pesticides	≥40	30	130
Fipronil Sulfide	Degradate	GCMS-Pesticides	≥40	30	130
Fipronil Sulfone	Degradate	GCMS-Pesticides	≥40	30	130
Fludioxonil	Fungicide	GCMS-Pesticides	≥40	30	150
Flumioxazin	Herbicide	GCMS-Pesticides	≥40	30	150
Fluridone	Herbicide	GCMS-Pesticides	≥40	10	375
Fluroxypyr 1-methylheptyl ester	Herbicide	GCMS-Pesticides	≥40	30	150

Parameter Name	Parameter Type	Analysis Method	RPD Upper Control Limit (%)	Recovery Lower Limit[1] (%)	Recovery Upper Limit[1] (%)
Fonofos	Insecticide	GCMS-Pesticides	≥40	30	130
Heptachlor	Insecticide	GCMS-Pesticides	≥40	43	159
Heptachlor Epoxide	Degradate	GCMS-Pesticides	≥40	73	167
Hexachlorobenzene	Fungicide	GCMS-Pesticides	≥40	33	120
Hexazinone	Herbicide	GCMS-Pesticides	≥40	41	183
Lindane	Insecticide	GCMS-Pesticides	≥40	70	182
Malathion	Insecticide	GCMS-Pesticides	≥40	50	147
Metalaxyl	Fungicide	GCMS-Pesticides	≥40	56	153
Methidathion	Insecticide	GCMS-Pesticides	≥40	52	186
Methoxychlor	Insecticide	GCMS-Pesticides	≥40	15	181
Methyl Paraoxon	Degradate	GCMS-Pesticides	≥40	37	269
Methyl Parathion	Insecticide	GCMS-Pesticides	≥40	35	170
Metolachlor	Herbicide	GCMS-Pesticides	≥40	55	180
Metribuzin	Herbicide	GCMS-Pesticides	≥40	30	130
Mevinphos	Insecticide	GCMS-Pesticides	≥40	10	448
MGK264	Synergist	GCMS-Pesticides	≥40	49	193
Mirex	Insecticide	GCMS-Pesticides	≥40	16	97
Monocrotophos	Insecticide	GCMS-Pesticides	≥40	10	196
N,N-Diethyl-m-toluamide	Insect Repellent	GCMS-Pesticides	≥40	30	150
Naled	Insecticide	GCMS-Pesticides	≥40	10	220
Napropamide	Herbicide	GCMS-Pesticides	≥40	70	180
Norflurazon	Herbicide	GCMS-Pesticides	≥40	70	168
Oryzalin	Herbicide	GCMS-Pesticides	≥40	10	277
Oxadiazon	Herbicide	GCMS-Pesticides	≥40	30	150
Oxychlordane	Degradate	GCMS-Pesticides	≥40	41	116
Oxyfluorfen	Herbicide	GCMS-Pesticides	≥40	42	154
Parathion	Insecticide	GCMS-Pesticides	≥40	29	235
Pebulate	Herbicide	GCMS-Pesticides	≥40	45	162
Pendimethalin	Herbicide	GCMS-Pesticides	≥40	39	163
Pentachloronitrobenzene	Fungicide	GCMS-Pesticides	≥40	30	150
Phenothrin	Insecticide	GCMS-Pesticides	≥40	20	95
Phorate	Insecticide	GCMS-Pesticides	≥40	12	130
Phosmet	Insecticide	GCMS-Pesticides	≥40	32	203
Piperonyl butoxide	Synergist	GCMS-Pesticides	≥40	30	130
Prometon	Herbicide	GCMS-Pesticides	≥40	55	164
Prometryn	Herbicide	GCMS-Pesticides	≥40	60	165
Propachlor	Herbicide	GCMS-Pesticides	≥40	10	189
Propargite	Insecticide	GCMS-Pesticides	≥40	30	130
Propazine	Herbicide	GCMS-Pesticides	≥40	56	161
Propyzamide	Herbicide	GCMS-Pesticides	≥40	63	169
Pyraflufen-ethyl	Herbicide	GCMS-Pesticides	≥40	30	150
Pyridaben	Insecticide	GCMS-Pesticides	≥40	30	150
Resmethrin	Insecticide	GCMS-Pesticides	≥40	10	65
Simazine	Herbicide	GCMS-Pesticides	≥40	72	192
Simetryn	Herbicide	GCMS-Pesticides	≥40	44	171
Sulfentrazone	Herbicide	GCMS-Pesticides	≥40	30	150
Sulfotepp	Insecticide	GCMS-Pesticides	≥40	57	139

Parameter Name	Parameter Type	Analysis Method	RPD Upper Control Limit (%)	Recovery Lower Limit[1] (%)	Recovery Upper Limit[1] (%)
Tebuthiuron	Herbicide	GCMS-Pesticides	≥40	10	94
Terbacil	Herbicide	GCMS-Pesticides	≥40	27	237
Tetrachlorvinphos	Insecticide	GCMS-Pesticides	≥40	70	196
Tetrahydrophthalimide	Degradate	GCMS-Pesticides	≥40	50	150
Thiobencarb	Herbicide	GCMS-Pesticides	≥40	54	144
Tokuthion	Insecticide	GCMS-Pesticides	≥40	28	145
Total Cyfluthrin	Insecticide	GCMS-Pesticides	≥40	30	150
Total Cypermethrin	Insecticide	GCMS-Pesticides	≥40	30	130
Total Fenvalerate	Insecticide	GCMS-Pesticides	≥40	30	130
Total Fluvalinate	Insecticide	GCMS-Pesticides	≥40	30	150
Tralomethrin	Insecticide	GCMS-Pesticides	≥40	40	130
trans-Chlordane	Insecticide	GCMS-Pesticides	≥40	42	150
trans-Nonachlor	Insecticide	GCMS-Pesticides	≥40	35	178
trans-Permethrin	Insecticide	GCMS-Pesticides	≥40	40	130
Triadimefon	Fungicide	GCMS-Pesticides	≥40	61	178
Triallate	Herbicide	GCMS-Pesticides	≥40	52	128
Trichloronate	Insecticide	GCMS-Pesticides	≥40	34	135
Triclopyr butoxyethyl ester	Herbicide	GCMS-Pesticides	≥40	30	150
Tricyclazole	Fungicide	GCMS-Pesticides	≥40	30	130
Trifluralin	Herbicide	GCMS-Pesticides	≥40	41	174
LCMS-Glyphosate analytes	Herbicide	LCMS-Glyphosate	≥40	40*	130*
LCMS-Pesticides analytes	Pesticides	LCMS-Pesticides	≥40	40*	130*
GCMS-Herbicides analytes	Herbicides	GCMS-Herbicides	≥40	40*	130*
TSS	TSS	TSS	≥20	40*	130*

[1] Control limits can be either be analyte specific control limits, or (*) default limits specified by the EPA method.

Data Reporting

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 calculating the average of the method detection limit (MDL) per analyte for all batches over the study period. The MDL is defined by the Federal code of Regulation 40 Appendix B to Part 136 as, “the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.” In addition to the MDL, the lab also reports the method reporting limit (MRL) which is the lowest concentration standard in the calibration range of each parameter. The concentration of the result reported by the laboratory that fall above the MDL but below the MRL are estimates because they fall outside of the calibration range. LPQL data for 2015 are presented in Table 37.

Table 37: Mean performance lower practical quantitation limits (LPQL) in µg/L

CAS Number	Parameter	Use / Type	Analysis Method	LPQL	Standard Deviation
90-15-3	1-Naphthol	Degradate	LCMS-Pesticides	0.1226	4.4E-03

CAS Number	Parameter	Use / Type	Analysis Method	LPQL	Standard Deviation
4901-51-3	2,3,4,5-Tetrachlorophenol	Degradate	GCMS-Herbicides	0.0040	4.7E-05
58-90-2	2,3,4,6-Tetrachlorophenol	Degradate	GCMS-Herbicides	0.0070	4.3E-10
93-76-5	2,4,5-T	Herbicide	GCMS-Herbicides	0.0090	4.7E-05
93-72-1	2,4,5-TP (Silvex)	Herbicide	GCMS-Herbicides	0.0100	4.7E-05
95-95-4	2,4,5-Trichlorophenol	Fungicide	GCMS-Herbicides	0.0080	1.3E-04
88-06-2	2,4,6-Trichlorophenol	Degradate	GCMS-Herbicides	0.0110	6.7E-05
94-75-7	2,4-D	Herbicide	GCMS-Herbicides	0.0121	2.9E-04
94-82-6	2,4-DB	Herbicide	GCMS-Herbicides	0.0080	1.3E-04
53-19-0	2,4'-DDD	Degradate	GCMS-Pesticides	0.0300	4.1E-04
3424-82-6	2,4'-DDE	Degradate	GCMS-Pesticides	0.0253	4.6E-04
789-02-6	2,4'-DDT	Insecticide	GCMS-Pesticides	0.0061	2.4E-04
51-36-5	3,5-Dichlorobenzoic Acid	Degradate	GCMS-Herbicides	0.0070	4.3E-10
16655-82-6	3-Hydroxycarbofuran	Degradate	LCMS-Pesticides	0.0030	3.5E-10
72-54-8	4,4'-DDD	Degradate	GCMS-Pesticides	0.0312	4.3E-04
72-55-9	4,4'-DDE	Degradate	GCMS-Pesticides	0.0239	3.6E-04
50-29-3	4,4'-DDT	Insecticide	GCMS-Pesticides	0.0281	3.4E-04
90-98-2	4,4'-Dichlorobenzophenone	Degradate	GCMS-Pesticides	0.0500	6.7E-04
100-02-7	4-Nitrophenol	Degradate	GCMS-Herbicides	0.0213	4.9E-04
135410-20-7	Acetamiprid	Insecticide	LCMS-Pesticides	0.0080	7.5E-10
34256-82-1	Acetochlor	Herbicide	GCMS-Pesticides	0.0500	6.7E-04
62476-59-9	Acifluorfen, sodium salt	Herbicide	GCMS-Herbicides	0.0538	6.7E-04
15972-60-8	Alachlor	Herbicide	GCMS-Pesticides	0.0040	4.9E-05
116-06-3	Aldicarb	Insecticide	LCMS-Pesticides	0.0100	1.7E-09
1646-88-4	Aldicarb Sulfone	Degradate	LCMS-Pesticides	0.0190	1.8E-09
1646-87-3	Aldicarb Sulfoxide	Degradate	LCMS-Pesticides	0.0030	3.5E-10
309-00-2	Aldrin	Insecticide	GCMS-Pesticides	0.0122	3.7E-04
319-84-6	alpha-BHC	Insecticide	GCMS-Pesticides	0.0100	4.8E-05
1066-51-9	Aminomethylphosphoric acid	Herbicide	LCMS-Glyphosate	0.008	n/a
1912-24-9	Atrazine	Herbicide	GCMS-Pesticides	0.0130	1.8E-04
2642-71-9	Azinphos-Ethyl	Insecticide	GCMS-Pesticides	0.0180	1.2E-04
86-50-0	Azinphos-methyl	Insecticide	GCMS-Pesticides	0.0226	5.1E-04
131860-33-8	Azoxystrobin	Fungicide	LCMS-Pesticides	0.0053	4.7E-03
1861-40-1	Benfluralin	Herbicide	GCMS-Pesticides	0.0279	4.4E-04
319-85-7	beta-BHC	Insecticide	GCMS-Pesticides	0.0100	6.8E-05
149877-41-8	Bifenazate	Insecticide	GCMS-Pesticides	0.0203	4.66E-04
82657-04-3	Bifenthrin	Insecticide	GCMS-Pesticides	0.0500	6.7E-04
188425-85-6	Boscalid	Fungicide	GCMS-Pesticides	0.0350	7.3E-03
314-40-9	Bromacil	Herbicide	GCMS-Pesticides	0.0129	3.0E-04
1689-84-5	Bromoxynil	Herbicide	GCMS-Herbicides	0.0060	6.2E-10
23184-66-9	Butachlor	Herbicide	GCMS-Pesticides	0.0996	8.3E-04
2008-41-5	Butylate	Herbicide	GCMS-Pesticides	0.0115	5.0E-04
133-06-2	Captan	Fungicide	GCMS-Pesticides	0.0163	1.6E-03
63-25-2	Carbaryl	Insecticide	LCMS-Pesticides	0.0090	1.0E-09
1563-66-2	Carbofuran	Insecticide	LCMS-Pesticides	0.0040	3.7E-10
1897-45-6	Chlorothalonil	Fungicide	GCMS-Pesticides	0.0090	4.8E-05
101-21-3	Chlorpropham	Herbicide	GCMS-Pesticides	0.0161	6.3E-02
2921-88-2	Chlorpyrifos	Insecticide	GCMS-Pesticides	0.0147	4.7E-04
5598-15-2	Chlorpyrifos O.A.	Degradate	GCMS-Pesticides	0.0500	6.7E-04

CAS Number	Parameter	Use / Type	Analysis Method	LPQL	Standard Deviation
5598-13-0	Chlorpyrifos-methyl	Insecticide	GCMS-Pesticides	0.0080	1.8E-04
64902-72-3	Chlorsulfuron	Herbicide	LCMS-Pesticides	0.0210	2.4E-09
5103-71-9	cis-Chlordane	Insecticide	GCMS-Pesticides	0.0217	4.9E-04
5103-73-1	cis-Nonachlor	Insecticide	GCMS-Pesticides	0.0443	5.6E-04
54774-45-7	cis-Permethrin	Insecticide	GCMS-Pesticides	0.0249	3.6E-04
1702-17-6	Clopyralid	Herbicide	GCMS-Herbicides	0.0082	4.2E-04
210880-92-5	Clothianidin	Insecticide	LCMS-Pesticides	0.0140	7.7E-10
56-72-4	Coumaphos	Insecticide	GCMS-Pesticides	0.0359	5.8E-04
21725-46-2	Cyanazine	Herbicide	GCMS-Pesticides	0.0090	4.7E-05
1134-23-2	Cycloate	Herbicide	GCMS-Pesticides	0.0090	1.3E-09
121552-61-2	Cyprodinil	Fungicide	LCMS-Pesticides	0.0050	8.7E-10
1861-32-1	Dacthal	Herbicide	GCMS-Herbicides	0.0050	1.3E-04
319-86-8	delta-BHC	Insecticide	GCMS-Pesticides	0.0070	5.1E-10
52918-63-5	Deltamethrin	Insecticide	GCMS-Pesticides	0.0102	3.6E-04
2303-16-4	Di-allate	Herbicide	GCMS-Pesticides	0.0098	3.8E-04
333-41-5	Diazinon	Insecticide	GCMS-Pesticides	0.0139	2.9E-04
1918-00-9	Dicamba	Herbicide	GCMS-Herbicides	0.0070	4.3E-10
1194-65-6	Dichlobenil	Herbicide	GCMS-Pesticides	0.0090	4.8E-05
120-36-5	Dichlorprop	Herbicide	GCMS-Herbicides	0.0083	4.8E-04
62-73-7	Dichlorvos	Insecticide	GCMS-Pesticides	0.0110	1.1E-04
51338-27-3	Diclofop-Methyl	Herbicide	GCMS-Herbicides	0.0169	2.8E-04
115-32-2	Dicofol	Insecticide	GCMS-Pesticides	0.0271	3.4E-04
60-57-1	Dieldrin	Insecticide	GCMS-Pesticides	0.0171	2.5E-04
119446-68-3	Difenoconazole	Fungicide	LCMS-Pesticides	0.0042	3.6E-03
35367-38-5	Diflubenzuron	Insecticide	LCMS-Pesticides	0.0600	9.3E-09
60-51-5	Dimethoate	Insecticide	GCMS-Pesticides	0.0302	4.3E-04
88-85-7	Dinoseb	Herbicide	GCMS-Herbicides	0.0409	5.9E-04
165252-70-0	Dinotefuran	Insecticide	LCMS-Pesticides	0.0080	7.5E-10
957-51-7	Diphenamid	Herbicide	GCMS-Pesticides	0.0100	1.1E-04
2497-06-5	Disulfoton sulfone	Insecticide	GCMS-Pesticides	0.0500	6.9E-04
2497-07-6	Disulfoton Sulfoxide	Degradate	GCMS-Pesticides	0.0500	6.7E-04
330-54-1	Diuron	Herbicide	GCMS-Pesticides	0.0030	3.5E-10
959-98-8	Endosulfan I	Insecticide	GCMS-Pesticides	0.0118	3.9E-04
33213-65-9	Endosulfan II	Insecticide	GCMS-Pesticides	0.0100	4.8E-05
1031-07-8	Endosulfan Sulfate	Degradate	GCMS-Pesticides	0.0116	5.0E-04
72-20-8	Endrin	Insecticide	GCMS-Pesticides	0.0153	4.4E-04
7421-93-4	Endrin Aldehyde	Degradate	GCMS-Pesticides	0.0327	5.4E-04
53494-70-5	Endrin Ketone	Degradate	GCMS-Pesticides	0.0130	1.2E-04
2104-64-5	EPN	Insecticide	GCMS-Pesticides	0.0200	2.0E-04
759-94-4	Eptam	Herbicide	GCMS-Pesticides	0.0081	2.4E-04
55283-68-6	Ethalfluralin	Herbicide	GCMS-Pesticides	0.0172	3.8E-04
563-12-2	Ethion	Insecticide	GCMS-Pesticides	0.0143	4.4E-04
13194-48-4	Ethoprop	Insecticide	GCMS-Pesticides	0.0141	2.4E-04
153233-91-1	Etoxazole	Insecticide	GCMS-Pesticides	0.0207	4.8E-04
2593-15-9	Etridiazole	Fungicide	GCMS-Pesticides	0.0120	5.0E-05
22224-92-6	Fenamiphos	Insecticide	GCMS-Pesticides	0.0130	1.7E-04
31972-44-8	Fenamiphos Sulfone	Degradate	GCMS-Pesticides	0.0500	6.7E-04
60168-88-9	Fenarimol	Fungicide	GCMS-Pesticides	0.0210	2.0E-04
114369-43-6	Fenbuconazole	Fungicide	LCMS-Pesticides	0.0080	7.5E-10

CAS Number	Parameter	Use / Type	Analysis Method	LPQL	Standard Deviation
120068-37-3	Fipronil	Insecticide	GCMS-Pesticides	0.0500	6.7E-04
205650-65-3	Fipronil Disulfinyl	Degradate	GCMS-Pesticides	0.0500	6.7E-04
120067-83-6	Fipronil Sulfide	Degradate	GCMS-Pesticides	0.0500	6.7E-04
120068-36-2	Fipronil Sulfone	Degradate	GCMS-Pesticides	0.0500	6.7E-04
131341-86-1	Fludioxonil	Fungicide	GCMS-Pesticides	0.0233	1.4E-02
103361-09-7	Flumioxazin	Herbicide	GCMS-Pesticides	0.0458	6.0E-04
59756-60-4	Fluridone	Herbicide	GCMS-Pesticides	0.0343	4.9E-04
81406-37-3	Fluroxypyr 1-methylheptyl ester	Herbicide	GCMS-Pesticides	0.0329	4.9E-04
944-22-9	Fonofos	Insecticide	GCMS-Pesticides	0.0090	1.3E-09
77182-82-2	Glufosinate-ammonium	Herbicide	LCMS-Glyphosate	0.008	n/a
1071-83-6	Glyphosate	Herbicide	LCMS-Glyphosate	0.008	n/a
76-44-8	Heptachlor	Insecticide	GCMS-Pesticides	0.0121	3.1E-04
1024-57-3	Heptachlor Epoxide	Degradate	GCMS-Pesticides	0.0090	1.2E-04
118-74-1	Hexachlorobenzene	Fungicide	GCMS-Pesticides	0.0070	6.8E-05
51235-04-2	Hexazinone	Herbicide	GCMS-Pesticides	0.0127	4.7E-04
104098-48-8	Imazapic	Herbicide	LCMS-Pesticides	0.004	n/a
81334-34-1	Imazapyr	Herbicide	LCMS-Pesticides	0.004	n/a
138261-41-3	Imidacloprid	Insecticide	LCMS-Pesticides	0.0060	7.0E-10
1689-83-4	Ioxynil	Herbicide	GCMS-Herbicides	0.0160	8.1E-05
82558-50-7	Isoxaben	Herbicide	LCMS-Pesticides	0.0020	1.9E-10
58-89-9	Lindane	Insecticide	GCMS-Pesticides	0.0116	5.0E-04
330-55-2	Linuron	Herbicide	LCMS-Pesticides	0.0610	5.6E-09
1634-78-2	Malaoxon	Degradate	LCMS-Pesticides	0.0020	1.9E-10
121-75-5	Malathion	Insecticide	GCMS-Pesticides	0.0071	3.2E-04
94-74-6	MCPA	Herbicide	GCMS-Herbicides	0.0080	7.3E-10
93-65-2	Mecoprop (MCPP)	Herbicide	GCMS-Herbicides	0.0080	4.7E-05
57837-19-1	Metalaxyl	Fungicide	GCMS-Pesticides	0.0256	1.1E-02
950-37-8	Methidathion	Insecticide	GCMS-Pesticides	0.0110	1.2E-04
2032-65-7	Methiocarb	Insecticide	LCMS-Pesticides	0.0220	3.6E-10
16752-77-5	Methomyl	Insecticide	LCMS-Pesticides	0.0030	3.5E-10
13749-94-5	Methomyl Oxime	Degradate	LCMS-Pesticides	0.0220	3.6E-10
72-43-5	Methoxychlor	Insecticide	GCMS-Pesticides	0.0358	5.8E-04
161050-58-4	Methoxyfenozide	Insecticide	LCMS-Pesticides	0.004	n/a
950-35-6	Methyl Paraoxon	Degradate	GCMS-Pesticides	0.0097	4.7E-04
298-00-0	Methyl Parathion	Insecticide	GCMS-Pesticides	0.0097	4.6E-04
51218-45-2	Metolachlor	Herbicide	GCMS-Pesticides	0.0073	3.3E-03
21087-64-9	Metribuzin	Herbicide	GCMS-Pesticides	0.0156	5.0E-04
74223-64-6	Metsulfuron-methyl	Herbicide	LCMS-Pesticides	0.0150	2.3E-09
7786-34-7	Mevinphos	Insecticide	GCMS-Pesticides	0.0217	4.9E-04
113-48-4	MGK264	Synergist	GCMS-Pesticides	0.0170	1.5E-04
2385-85-5	Mirex	Insecticide	GCMS-Pesticides	0.0130	1.8E-04
6923-22-4	Monocrotophos	Insecticide	GCMS-Pesticides	0.0172	3.7E-04
150-68-5	Monuron	Herbicide	LCMS-Pesticides	0.0020	1.9E-10
88671-89-0	Myclobutanil	Fungicide	LCMS-Pesticides	0.0030	3.5E-10
134-62-3	N,N-Diethyl-m-toluamide	Repellent	GCMS-Pesticides	0.0160	1.0E-04
300-76-5	Naled	Insecticide	GCMS-Pesticides	0.0220	2.0E-04
15299-99-7	Napropamide	Herbicide	GCMS-Pesticides	0.0140	1.2E-04
555-37-3	Neburon	Herbicide	LCMS-Pesticides	0.0070	3.8E-10

CAS Number	Parameter	Use / Type	Analysis Method	LPQL	Standard Deviation
27314-13-2	Norflurazon	Herbicide	GCMS-Pesticides	0.0120	1.1E-04
19044-88-3	Oryzalin	Herbicide	GCMS-Pesticides	0.0259	3.6E-04
19666-30-9	Oxadiazon	Herbicide	GCMS-Pesticides	0.0442	6.3E-04
23135-22-0	Oxamyl	Insecticide	LCMS-Pesticides	0.0010	9.4E-11
30558-43-1	Oxamyl oxime	Degradate	LCMS-Pesticides	0.0100	1.7E-09
27304-13-8	Oxychlordane	Degradate	GCMS-Pesticides	0.0180	1.7E-04
42874-03-3	Oxyfluorfen	Herbicide	GCMS-Pesticides	0.0581	7.8E-04
56-38-2	Parathion	Insecticide	GCMS-Pesticides	0.0080	6.9E-05
1114-71-2	Pebulate	Herbicide	GCMS-Pesticides	0.0080	1.2E-04
40487-42-1	Pendimethalin	Herbicide	GCMS-Pesticides	0.0286	5.3E-04
82-68-8	Pentachloronitrobenzene	Fungicide	GCMS-Pesticides	0.0170	1.5E-04
87-86-5	Pentachlorophenol	Wood Preservative	GCMS-Herbicides	0.0070	4.3E-10
26002-80-2	Phenothrin	Insecticide	GCMS-Pesticides	0.0207	4.7E-04
298-02-2	Phorate	Insecticide	GCMS-Pesticides	0.0100	4.7E-05
732-11-6	Phosmet	Insecticide	GCMS-Pesticides	0.0110	4.8E-05
1918-02-1	Picloram	Herbicide	GCMS-Herbicides	0.0179	3.5E-04
51-03-6	Piperonyl butoxide	Synergist	GCMS-Pesticides	0.0500	6.7E-04
2631-37-0	Promecarb	Insecticide	LC/MS/MS	0.0060	7.0E-10
1610-18-0	Prometon	Herbicide	GCMS-Pesticides	0.0140	1.2E-04
7287-19-6	Prometryn	Herbicide	GCMS-Pesticides	0.0093	4.4E-04
1918-16-7	Propachlor	Herbicide	GCMS-Pesticides	0.0110	1.0E-04
2312-35-8	Propargite	Insecticide	GCMS-Pesticides	0.0490	6.7E-04
139-40-2	Propazine	Herbicide	GCMS-Pesticides	0.0131	2.4E-04
60207-90-1	Propiconazole	Fungicide	LCMS-Pesticides	0.0050	8.7E-10
114-26-1	Propoxur	Insecticide	LCMS-Pesticides	0.0060	7.0E-10
23950-58-5	Propyzamide (Pronamide)	Herbicide	GCMS-Pesticides	0.0091	2.4E-04
175013-18-0	Pyraclostrobin	Fungicide	LCMS-Pesticides	0.0040	3.7E-10
129630-19-9	Pyraflufen-ethyl	Herbicide	GCMS-Pesticides	0.0170	1.1E-04
96489-71-3	Pyridaben	Insecticide	GCMS-Pesticides	0.0460	6.3E-04
53112-28-0	Pyrimethanil	Fungicide	LCMS-Pesticides	0.0080	7.5E-10
10453-86-8	Resmethrin	Insecticide	GCMS-Pesticides	0.0140	1.5E-04
122-34-9	Simazine	Herbicide	GCMS-Pesticides	0.0120	1.8E-04
1014-70-6	Simetryn	Herbicide	GCMS-Pesticides	0.0102	3.8E-04
25057-89-0	Sodium Bentazon	Herbicide	GCMS-Herbicides	0.0068	4.3E-04
122836-35-5	Sulfentrazone	Herbicide	GCMS-Pesticides	0.0372	5.4E-04
74222-97-2	Sulfometuron methyl	Herbicide	LCMS-Pesticides	0.0070	3.8E-10
3689-24-5	Sulfotepp	Insecticide	GCMS-Pesticides	0.0110	1.1E-04
946578-00-3	Sulfoxaflor	Insecticide	LCMS-Pesticides	0.009	n/a
34014-18-1	Tebuthiuron	Herbicide	GCMS-Pesticides	0.0163	4.4E-04
5902-51-2	Terbacil	Herbicide	GCMS-Pesticides	0.0148	3.9E-04
961-11-5	Tetrachlorvinphos	Insecticide	GCMS-Pesticides	0.0091	3.1E-04
27813-21-4	Tetrahydrophthalimide	Degradate	GCMS-Pesticides	0.0303	4.1E-03
111988-49-9	Thiacloprid	Insecticide	LCMS-Pesticides	0.0070	3.8E-10
153719-23-4	Thiamethoxam	Insecticide	LCMS-Pesticides	0.009	n/a
28249-77-6	Thiobencarb	Herbicide	GCMS-Pesticides	0.0500	6.5E-04
34643-46-4	Tokuthion	Insecticide	GCMS-Pesticides	0.0611	8.0E-04
68359-37-5	Total Cyfluthrin	Insecticide	GCMS-Pesticides	0.0609	7.5E-04
52315-07-8	Total Cypermethrin	Insecticide	GCMS-Pesticides	0.0500	6.7E-04

CAS Number	Parameter	Use / Type	Analysis Method	LPQL	Standard Deviation
51630-58-1	Total Fenvalerate	Insecticide	GCMS-Pesticides	0.0209	3.4E-04
102851-06-9	Total Fluvalinate	Insecticide	GCMS-Pesticides	0.0149	2.7E-04
66841-25-6	Tralomethrin	Insecticide	GCMS-Pesticides	0.0102	3.9E-04
5103-74-2	trans-Chlordane	Insecticide	GCMS-Pesticides	0.0291	3.5E-04
39765-80-5	trans-Nonachlor	Insecticide	GCMS-Pesticides	0.0369	5.6E-04
61949-77-7	trans-Permethrin	Insecticide	GCMS-Pesticides	0.0249	3.7E-04
43121-43-3	Triadimefon	Fungicide	GCMS-Pesticides	0.0080	6.8E-10
2303-17-5	Triallate	Herbicide	GCMS-Pesticides	0.0140	1.2E-04
327-98-0	Trichloronate	Insecticide	GCMS-Pesticides	0.0171	2.5E-04
55335-06-3	Triclopyr acid	Herbicide	GCMS-Herbicides	0.0070	6.7E-05
64700-56-7	Triclopyr butoxyethyl ester	Herbicide	GCMS-Pesticides	0.0252	3.9E-04
41814-78-2	Tricyclazole	Fungicide	GCMS-Pesticides	0.0607	7.8E-04
141517-21-7	Trifloxystrobin	Fungicide	LCMS-Pesticides	0.0090	1.0E-09
1582-09-8	Trifluralin	Herbicide	GCMS-Pesticides	0.0200	2.0E-04
156052-68-5	Zoxamide	Fungicide	LCMS-Pesticides	0.0050	8.7E-10

Quality Assurance and Quality Control Samples

Quality assurance (QA) samples are collected alongside grab samples in the field and analyzed. Quality control (QC) samples are generated by the laboratory for every batch of field samples submitted. QA and QC samples assure consistency and accuracy throughout sample collection, sample analysis, and the data reporting process.

For this project, QA samples include: field replicates, field blanks, and matrix spike and matrix spike duplicates (MS/MSD). Laboratory control samples (LCS), LCS duplicates (LCSD), surrogate spikes, and method blanks are included as QC samples in each batch of samples analyzed for pesticides as are method blanks and split sample duplicates for each batch of TSS and conductivity samples.

Quality Assurance Sample Performance

In 2015, QA samples were equal to 11.8% of all the samples collected in the field. There were 188 QA samples in total which included 60 field replicates, 60 field blanks, 56 MS/MSD samples and 13 conductivity samples.

Field Replicates Results

During 2015, sampling frequency of field replicate samples was 3.7% for pesticides and TSS samples. 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.

In 2015 there were 66 consistently identified pairs for pesticide analysis and 11 consistently identified pairs for TSS analysis (Table 38). *Consistent identification* refers to analytes identified in both the original sample and field replicate. Conversely, inconsistently identified replicate pairs refer to when an analyte was positively identified in either the replicate sample or the grab sample but not in both.

Table 38 presents the results, data qualification, and relative percent difference (RPD) for analytes consistently identified in both the grab sample and replicate sample.

Table 38: Consistently detected pairs within field replicate results

Sample Date	Parameter	Site-ID	Averaged Result	Reporting Limit	Units	Sample and Replicate Sample Details	RPD (%)
5/4	Aminomethylphosphoric acid	BS-1	0.245	0.008	µg/L	0.33 µg/L "D" & 0.16 µg/L "D"	69
5/4	Glyphosate	BS-1	0.096	0.008	µg/L	0.098 µg/L "D" & 0.094 µg/L "D"	4
5/11	Aminomethylphosphoric acid	MA-2	0.094	0.008	µg/L	0.095 µg/L "D" & 0.093 µg/L "D"	2
5/11	Glyphosate	MA-2	0.17	0.008	µg/L	0.17 µg/L "D" & 0.17 µg/L "D"	0
3/10	TSS	BC-1	2	1	mg/L	2 mg/L "D" & 2 mg/L "D"	0
4/1	TSS	BD-1	19.5	3	mg/L	20 mg/L "D" & 19 mg/L "D"	5
5/12	TSS	BD-2	4.5	2	mg/L	5 mg/L "D" & 4 mg/L "D"	22
6/16	TSS	BR-1	16.5	2	mg/L	17 mg/L "D" & 16 mg/L "D"	6
5/27	TSS	BS-1	15.5	2	mg/L	15 mg/L "D" & 16 mg/L "D"	6
4/1	TSS	IS-1	8.5	3	mg/L	9 mg/L "D" & 8 mg/L "D"	12
3/25	TSS	MI-1	17.5	2	mg/L	17 mg/L "D" & 18 mg/L "D"	6
4/28	TSS	SC-1	3	1	mg/L	3 mg/L "D" & 3 mg/L "D"	0
4/27	TSS	SP-3	27.5	2	mg/L	28 mg/L "D" & 27 mg/L "D"	4
4/6	TSS	SU-1	53.5	2	mg/L	56 mg/L "D" & 51 mg/L "D"	9
7/21	TSS	TC-3	3	2	mg/L	3 mg/L "D" & 3 mg/L "D"	0
5/26	Oxamyl	BC-1	0.082	0.02	µg/L	0.079 µg/L "D" & 0.084 µg/L "D"	6
5/26	Oxamyl oxime	BC-1	0.083	0.02	µg/L	0.071 µg/L "D" & 0.095 µg/L "D"	29
5/26	Thiamethoxam	BC-1	0.026	0.02	µg/L	0.025 µg/L "D" & 0.027 µg/L "D"	8
6/1	Imidacloprid	BC-7	0.015	0.02	µg/L	0.016 µg/L "J" & 0.013 µg/L "J"	21

Sample Date	Parameter	Site-ID	Averaged Result	Reporting Limit	Units	Sample and Replicate Sample Details	RPD (%)
6/1	Oxamyl	BC-7	0.012	0.02	µg/L	0.011 µg/L "J" & 0.012 µg/L "J"	9
6/1	Oxamyl oxime	BC-7	0.053	0.02	µg/L	0.052 µg/L "D" & 0.054 µg/L "D"	4
4/29	Azoxystrobin	BD-1	0.319	0.01	µg/L	0.299 µg/L "D" & 0.339 µg/L "D"	13
4/29	Difenoconazole	BD-1	0.17	0.02	µg/L	0.164 µg/L "D" & 0.176 µg/L "D"	7
4/29	Dinotefuran	BD-1	0.098	0.01	µg/L	0.097 µg/L "D" & 0.099 µg/L "D"	2
4/29	Diuron	BD-1	0.016	0.01	µg/L	0.016 µg/L "D" & 0.016 µg/L "D"	0
4/29	Imazapyr	BD-1	0.016	0.1	µg/L	0.014 µg/L "J" & 0.017 µg/L "J"	19
4/29	Imidacloprid	BD-1	0.02	0.02	µg/L	0.019 µg/L "J" & 0.02 µg/L "J"	5
4/29	Thiamethoxam	BD-1	0.012	0.01	µg/L	0.012 µg/L "D" & 0.012 µg/L "J"	0
5/18	Azoxystrobin	BD-2	0.053	0.02	µg/L	0.066 µg/L "D" & 0.04 µg/L "D"	49
5/18	Dinotefuran	BD-2	0.495	0.02	µg/L	0.37 µg/L "D" & 0.62 µg/L "D"	51
5/18	Thiamethoxam	BD-2	0.031	0.02	µg/L	0.036 µg/L "D" & 0.026 µg/L "D"	32
4/6	Azoxystrobin	IS-1	0.109	0.01	µg/L	0.11 µg/L "D" & 0.108 µg/L "D"	2
4/6	Difenoconazole	IS-1	0.035	0.03	µg/L	0.034 µg/L "D" & 0.035 µg/L "D"	3
4/6	Diuron	IS-1	0.01	0.01	µg/L	0.01 µg/L "D" & 0.01 µg/L "J"	0
4/6	Monuron	IS-1	0.003	0.01	µg/L	0.003 µg/L "J" & 0.003 µg/L "J"	0
4/6	Propiconazole	IS-1	0.018	0.01	µg/L	0.017 µg/L "D" & 0.018 µg/L "D"	6
3/24	Diuron	MA-2	0.008	0.01	µg/L	0.008 µg/L "J" & 0.008 µg/L "J"	0
4/13	Diuron	SP-3	0.015	0.01	µg/L	0.014 µg/L "D" & 0.015 µg/L "D"	7
4/13	Isoxaben	SP-3	0.003	0.01	µg/L	0.003 µg/L "J" & 0.003 µg/L "J"	0
6/8	Azoxystrobin	SU-1	0.008	0.01	µg/L	0.007 µg/L "J" & 0.008 µg/L "J"	13
6/8	Carbaryl	SU-1	0.01	0.01	µg/L	0.009 µg/L "J" & 0.011 µg/L "D"	20
6/8	Diuron	SU-1	0.022	0.01	µg/L	0.02 µg/L "D" & 0.023 µg/L "D"	14

Sample Date	Parameter	Site-ID	Averaged Result	Reporting Limit	Units	Sample and Replicate Sample Details	RPD (%)
6/8	Imidacloprid	SU-1	0.012	0.01	µg/L	0.01 µg/L "J" & 0.014 µg/L "D"	33
5/11	Sulfometuron methyl	TC-3	0.012	0.02	µg/L	0.012 µg/L "J" & 0.011 µg/L "J"	9
7/14	2,4-D	BD-2	0.155	0.062	µg/L	0.16 µg/L "D" & 0.15 µg/L "D"	6
7/14	Triclopyr	BD-2	0.175	0.062	µg/L	0.18 µg/L "D" & 0.17 µg/L "D"	6
6/8	2,4-D	MA-2	0.065	0.062	µg/L	0.063 µg/L "D" & 0.066 µg/L "D"	5
6/8	Bentazon	MA-2	0.3	0.062	µg/L	0.29 µg/L "D" & 0.31 µg/L "D"	7
5/4	2,4-D	SU-1	0.135	0.063	µg/L	0.14 µg/L "D" & 0.13 µg/L "D"	7
4/14	2,4-D	TC-3	0.103	0.062	µg/L	0.095 µg/L "J" & 0.11 µg/L "J"	15
5/19	Bromacil	BC-1	0.047	0.032	µg/L	0.046 µg/L "J" & 0.047 µg/L "J"	2
5/19	Dichlobenil	BC-1	0.012	0.032	µg/L	0.012 µg/L "J" & 0.012 µg/L "J"	0
5/19	Metalaxyl	BC-1	0.062	0.032	µg/L	0.061 µg/L "J" & 0.062 µg/L "J"	2
5/19	Simazine	BC-1	0.061	0.032	µg/L	0.054 µg/L "D" & 0.068 µg/L "D"	23
5/19	Tetrahydrophthalimide	BC-1	0.046	0.098	µg/L	0.044 µg/L "J" & 0.047 µg/L "J"	7
4/7	Boscalid	BC-7	0.08	0.099	µg/L	0.078 µg/L "J" & 0.082 µg/L "J"	5
4/7	Dichlobenil	BC-7	0.023	0.033	µg/L	0.023 µg/L "J" & 0.023 µg/L "J"	0
4/7	Metalaxyl	BC-7	0.101	0.033	µg/L	0.11 µg/L "J" & 0.092 µg/L "J"	18
4/7	Terbacil	BC-7	0.107	0.033	µg/L	0.094 µg/L "D" & 0.12 µg/L "D"	24
3/31	Dichlobenil	BD-2	0.15	0.033	µg/L	0.14 µg/L "D" & 0.16 µg/L "D"	13
3/31	Etridiazole	BD-2	0.028	0.05	µg/L	0.026 µg/L "J" & 0.029 µg/L "J"	11
3/31	Fludioxonil	BD-2	0.077	0.05	µg/L	0.078 µg/L "D" & 0.075 µg/L "D"	4
5/27	4,4'-DDE	BR-1	0.008	0.033	µg/L	0.009 µg/L "J" & 0.007 µg/L "J"	25
5/27	4,4'-DDT	BR-1	0.034	0.033	µg/L	0.039 µg/L "D" & 0.028 µg/L "J"	33
4/20	Dichlobenil	BS-1	0.015	0.033	µg/L	0.015 µg/L "J" & 0.014 µg/L "J"	7

Sample Date	Parameter	Site-ID	Averaged Result	Reporting Limit	Units	Sample and Replicate Sample Details	RPD (%)
4/20	Fludioxonil	BS-1	0.037	0.051	µg/L	0.037 µg/L "J" & 0.037 µg/L "J"	0
4/20	Metolachlor	BS-1	0.52	0.033	µg/L	0.52 µg/L "D" & 0.52 µg/L "D"	0
5/18	Dichlobenil	IS-1	0.013	0.032	µg/L	0.013 µg/L "J" & 0.012 µg/L "J"	8
5/18	Metolachlor	IS-1	0.032	0.032	µg/L	0.033 µg/L "D" & 0.031 µg/L "J"	6
6/29	Terbacil	MA-2	0.032	0.033	µg/L	0.035 µg/L "D" & 0.029 µg/L "J"	19
4/20	Bromacil	SP-3	0.06	0.033	µg/L	0.06 µg/L "D" & 0.059 µg/L "D"	2
4/20	Chlorpyrifos	SP-3	0.028	0.033	µg/L	0.026 µg/L "J" & 0.03 µg/L "J"	14
4/27	Pendimethalin	SU-1	0.063	0.033	µg/L	0.068 µg/L "D" & 0.057 µg/L "D"	18
4/27	Terbacil	SU-1	0.097	0.033	µg/L	0.095 µg/L "D" & 0.099 µg/L "D"	4
5/4	Aminomethylphosphoric acid	BD-2	0.18	0.008	µg/L	0.17 µg/L "D" & 0.19 µg/L "D"	11
5/4	Glufosinate-ammonium	BD-2	0.079	0.008	µg/L	0.079 µg/L "D" & 0.079 µg/L "D"	0
5/4	Glyphosate	BD-2	0.115	0.008	µg/L	0.11 µg/L "D" & 0.12 µg/L "D"	9

For pesticides, the average RPD of the consistently identified replicates pairs was 11.3%. For TSS, the average RPD of the consistently detected replicates was 3.4%.

Three of the 66 consistently identified pairs for pesticide exceeded the 40% RPD criterion. There were no RPD exceedances for TSS. It is important to note that No results associated with the three exceedances will be requalified because the 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. The remaining data for pesticide and TSS field replicates are of acceptable data quality.

In 2015 there were 20 inconsistently identified replicate pairs for pesticides and two inconsistently identified replicate pairs for TSS (Table 39). The majority of the inconsistently identified pairs were due to the detections being very close to the detection limit. The RPD also exceeded the 40% criterion for eight of the 22 replicate pairs. In most cases the detections were at or below the reporting limit but above the detection limit.

Table 39: Inconsistent field replicate detections

Sample Date	Parameter	Site-ID	Averaged Result	Reporting Limit	Units	Sample and Replicate Sample Details	RPD (%)
6/23	TSS	BC-7	2	1	mg/L	2 mg/L “D” & 2 mg/L “D”	0
7/13	TSS	MA-2	1	1	mg/L	1 mg/L “U” & 1 mg/L “U”	0
4/29	Propiconazole	BD-1	0.012	0.01	µg/L	0.01 µg/L “U” & 0.013 µg/L “D”	26.09
5/18	Imidacloprid	BD-2	0.024	0.02	µg/L	0.028 µg/L “D” & 0.02 µg/L “U”	33.33
5/18	Pyraclostrobin	BD-2	0.025	0.02	µg/L	0.02 µg/L “U” & 0.029 µg/L “J”	36.73
4/6	Imazapyr	IS-1	0.062	0.1	µg/L	0.023 µg/L “J” & 0.1 µg/L “U”	125.2
4/6	Thiamethoxam	IS-1	0.01	0.01	µg/L	0.01 µg/L “D” & 0.01 µg/L “U”	0
5/11	Diuron	TC-3	0.013	0.02	µg/L	0.02 µg/L “U” & 0.006 µg/L “J”	107.69
5/11	Imidacloprid	TC-3	0.016	0.02	µg/L	0.02 µg/L “U” & 0.011 µg/L “J”	58.06
7/14	Pentachlorophenol	BD-2	0.028	0.062	µg/L	0.028 µg/L “NJ” & 0.028 µg/L “J”	0
6/8	Dicamba	MA-2	0.016	0.062	µg/L	0.015 µg/L “J” & 0.016 µg/L “NJ”	6.45
6/30	Picloram	SC-1	0.06	0.064	µg/L	0.057 µg/L “J” & 0.063 µg/L “U”J	10
5/19	Boscalid	BC-1	0.053	0.098	µg/L	0.054 µg/L “NJ” & 0.052 µg/L “J”	3.77
5/19	Sulfentrazone	BC-1	0.074	0.098	µg/L	0.099 µg/L “U” & 0.048 µg/L “J”	69.39
5/19	Terbacil	BC-1	0.052	0.032	µg/L	0.052 µg/L “NJ” & 0.051 µg/L “D”	1.94
4/7	Metolachlor	BC-7	0.031	0.033	µg/L	0.032 µg/L “NJ” & 0.03 µg/L “J”	6.45
4/7	Simazine	BC-7	0.044	0.033	µg/L	0.055 µg/L “D” & 0.033 µg/L “U”	50
6/8	Fludioxonil	BD-1	0.072	0.05	µg/L	0.05 µg/L “U” & 0.093 µg/L “D”	60.14
6/8	Metolachlor	BD-1	0.034	0.033	µg/L	0.033 µg/L “U” & 0.034 µg/L “D”	2.99
5/19	Methoxychlor	PE-1	0.036	0.049	µg/L	0.022 µg/L “J” & 0.05 µg/L “U”	77.78
4/20	Boscalid	SP-3	0.076	0.1	µg/L	0.052 µg/L “J” & 0.1 µg/L “U”	63.16
4/27	Bromacil	SU-1	0.037	0.033	µg/L	0.041 µg/L “D” & 0.033 µg/L “U”	21.62

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 2015, there was one field blank detection for the pesticide analysis. Diuron was detected on May 30th at Sulphur Creek Wasteway at a concentration of 0.036 µg/L. The analyte was positively identified in the field blank and the concentration was detected at the detection limit. The detection limit was of 0.036 µg/L. The reported concentration is an approximation. Although Diuron was detected in the grab sample associated with that sampling event it is unlikely that the detection in the sample and the detection in the blank are related as Diuron is detected at Sulphur Creek Wasteway on most weeks in 2015.

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 40 presents the mean, maximum, and minimum percent recovery for the MS/MSD for the three types of analysis as well as the RPD for the MS and MSDs in 2015.

Table 40: Summary Statistics for MS/MSD Recoveries and RPD

Analytical Method and Parameter Name	Number of Results	Average Recovery (%)	Maximum Recovery (%)	Minimum Recovery (%)	Mean RPD	Maximum RPD	Minimum RPD
GCMS-Herbicides							
2,3,4,5-Tetrachlorophenol	8	73	81	67	6	10	1
2,3,4,6-Tetrachlorophenol	8	77	99	62	6	11	0
2,4,5-T	8	66	77	53	6	10	1
2,4,5-Trichlorophenol	8	79	96	68	5	7	3
2,4,6-Trichlorophenol	8	66	87	52	7	11	3
2,4-D	8	49	72	12	9	13	4
2,4-DB	8	105	118	94	7	12	2
3,5-Dichlorobenzoic Acid	8	73	87	63	5	10	0
4-Nitrophenol	8	84	131	54	20	43	3
Acifluorfen, sodium salt	8	165	206	22	40	148	3
Bentazon	8	72	88	57	8	15	5
Bromoxynil	8	67	79	63	5	13	1
Clopyralid	8	28	42	22	29	60	8
Dacthal	8	88	103	79	7	12	4
Dicamba	8	61	71	49	7	13	0
Dichlorprop	8	69	75	59	4	8	0
Diclofop-Methyl	8	136	145	124	4	12	0
Dinoseb	8	133	179	0	5	6	5
Ioxynil	8	87	94	79	5	7	1
MCPA	8	66	79	53	4	11	0
MCPP	8	71	80	57	5	9	2
Pentachlorophenol	8	71	82	65	4	10	0

Analytical Method and Parameter Name	Number of Results	Average Recovery (%)	Maximum Recovery (%)	Minimum Recovery (%)	Mean RPD	Maximum RPD	Minimum RPD
Picloram	8	36	62	13	46	126	11
Silvex	8	80	88	69	8	14	3
Triclopyr	8	69	83	42	4	7	2
GCMS-Pesticides							
1-Naphthol	4	112	134	91	17	18	15
2,4'-DDD	10	44	83	0	14	33	3
2,4'-DDE	10	32	64	0	18	33	8
2,4'-DDT	10	37	104	0	16	21	6
4,4'-DDD	10	42	80	0	13	26	3
4,4'-DDE	10	31	62	0	19	41	4
4,4'-DDT	10	30	66	0	18	29	5
4,4'-Dichlorobenzophenone	4	110	115	100	8	12	3
Acetochlor	4	138	157	120	14	14	14
Alachlor	4	133	141	119	7	12	1
Aldrin	10	29	60	0	14	24	6
Alpha-BHC	10	44	88	0	7	15	3
Atrazine	4	95	109	77	14	20	8
Azinphos-ethyl	8	50	102	1	6	13	2
Azinphos-methyl	10	76	153	1	5	13	0
Benefin	10	53	92	0	7	12	1
Benthiocarb	14	41	71	0	14	33	1
Beta-BHC	10	46	86	0	10	25	3
Bifenazate	14	97	180	0	14	52	1
Bifenthrin	4	115	129	105	12	15	9
Boscalid	4	151	174	132	2	4	0
Bromacil	4	128	157	94	15	21	8
Butachlor	4	145	151	132	8	12	4
Butylate	4	98	116	72	23	34	12
Captan	10	30	69	0	14	28	4
Chlorothalonil	10	37	76	0	15	27	2
Chlorpropham	4	114	123	94	14	24	3
Chlorpyrifos	10	46	89	0	7	15	3
Chlorpyrifos O.A.	4	135	144	120	6	10	1
cis-Chlordane	10	35	66	0	13	29	5
Cis-Nonachlor	10	36	71	0	13	25	2
cis-Permethrin	10	48	108	0	20	35	7
Coumaphos	10	71	146	1	6	11	1
Cyanazine	14	71	131	0	8	17	1
Cycloate	4	136	157	109	18	24	12
Cyfluthrin	14	83	143	0	27	74	13
Cypermethrin	4	152	163	130	12	20	4
Delta-BHC	10	47	91	0	8	18	2
Deltamethrin	14	92	215	0	17	33	10
Di-allate (Avadex)	10	48	99	0	8	16	1
Diazinon	10	47	99	0	7	11	3
Dichlobenil	10	39	76	0	7	18	0

Analytical Method and Parameter Name	Number of Results	Average Recovery (%)	Maximum Recovery (%)	Minimum Recovery (%)	Mean RPD	Maximum RPD	Minimum RPD
Dichlorvos (DDVP)	10	50	108	0	12	25	4
Dieldrin	10	38	71	0	7	11	1
Dimethoate	4	132	152	103	9	17	0
Diphenamid	4	110	117	100	9	16	2
Disulfoton Sulfoxide	4	110	126	89	16	22	10
Endosulfan I	10	40	78	0	21	35	9
Endosulfan II	10	40	78	0	13	26	1
Endosulfan Sulfate	10	47	91	0	7	16	0
Endrin	10	45	90	0	9	17	2
Endrin Aldehyde	10	46	89	0	7	16	1
Endrin Ketone	10	48	106	0	8	21	0
EPN	4	237	245	227	2	3	1
Eptam	4	115	143	91	13	14	12
Ethalfluralin (Sonalan)	10	58	104	0	7	15	2
Ethion	10	51	104	0	9	20	1
Ethoprop	10	51	109	0	9	13	1
Etoxazole	14	78	156	0	10	18	0
Etridiazole	4	108	126	83	8	15	0
Fenamiphos	14	85	140	0	5	16	1
Fenamiphos Sulfone	4	251	279	200	12	23	1
Fenarimol	4	171	178	154	8	15	1
Fenvalerate	10	69	152	0	17	34	3
Fipronil	4	160	179	115	23	40	5
Fipronil Disulfinyl	4	107	130	83	16	19	13
Fipronil Sulfide	4	103	111	90	9	13	5
Fipronil Sulfone	4	49	52	45	6	9	3
Fludioxonil	14	61	104	0	7	18	0
Flumioxazin	14	71	126	0	8	22	1
Fluridone	4	148	177	124	4	7	1
Fluroxypyr-meptyl	14	65	120	0	9	17	1
Fonofos	10	47	100	0	14	23	1
Gamma-BHC	10	43	84	0	10	26	2
Heptachlor	10	39	70	0	7	13	2
Heptachlor Epoxide	10	42	83	0	8	14	1
Hexachlorobenzene	10	33	58	0	10	18	3
Hexazinone	4	134	141	120	6	11	1
Imidan	10	58	118	0	4	9	0
Kelthane	4	52	55	49	9	9	9
Malathion	4	139	154	113	17	26	7
Metalaxyl	10	51	105	0	9	28	1
Methidathion	10	57	112	0	3	6	1
Methoxychlor	10	35	72	0	6	13	3
Methyl Chlorpyrifos	10	48	96	0	8	19	2
Methyl Paraoxon	4	206	235	173	13	16	9
Methyl Parathion	10	48	96	0	8	19	2
Metolachlor	4	135	148	119	11	14	7
Metribuzin	14	55	95	0	8	23	1
Mevinphos	10	52	115	0	4	10	0

Analytical Method and Parameter Name	Number of Results	Average Recovery (%)	Maximum Recovery (%)	Minimum Recovery (%)	Mean RPD	Maximum RPD	Minimum RPD
MGK264	4	104	110	95	5	9	1
Mirex	10	31	63	0	28	54	6
Monocrotophos	14	68	153	0	21	56	5
N,N-Diethyl-m-toluamide	14	61	108	0	12	29	1
Naled	10	35	83	0	23	47	7
Napropamide	4	142	151	124	9	15	2
Norflurazon	4	143	150	131	9	13	5
Oryzalin	2	0	0	0	23	23	23
Oxadiazon	14	62	99	0	10	17	3
Oxychlordane	10	38	71	0	17	30	5
Oxyfluorfen	10	67	121	1	10	15	7
Parathion	4	195	215	164	11	18	4
Pebulate	4	90	114	69	23	23	23
Pendimethalin	10	59	102	1	6	11	3
Pentachloronitrobenzene	14	75	130	0	10	16	4
Phenothrin	10	47	101	0	19	37	1
Phorate	14	63	125	1	9	20	0
Piperonyl Butoxide	4	146	156	131	11	17	5
Prometon	4	116	131	96	14	20	8
Prometryn	4	107	119	85	16	26	6
Pronamide	4	117	129	99	13	19	6
Propachlor	14	71	146	0	7	15	2
Propargite	10	38	82	0	22	66	3
Propazine	4	98	117	79	14	16	11
Pyraflufen-ethyl	14	79	132	0	8	16	1
Pyridaben	14	70	126	0	10	22	2
Resmethrin	14	18	70	0	19	37	5
Simazine	4	101	127	76	24	25	22
Simetryn	4	102	118	83	15	20	10
Sulfentrazone	14	91	159	0	8	20	2
Sulfotepp	4	110	119	97	11	16	6
Tau-fluvalinate	14	66	118	0	17	33	4
Tebuthiuron	4	105	118	84	14	23	5
Terbacil	4	168	188	139	14	21	6
Tetrachlorvinphos	10	58	121	0	6	9	1
Tetrahydrophthalimide	4	168	223	124	14	18	10
Thiamethoxam	14	60	112	0	8	13	4
Tokuthion	10	42	88	0	16	33	3
trans-Chlordane	10	36	65	0	12	30	3
Trans-Nonachlor	10	33	65	0	20	29	7
Trifluralin	4	196	224	170	15	15	14
Triadimefon	4	133	144	110	11	21	0
Triallate	10	43	87	0	5	14	1
Trichloronate	10	41	88	0	10	19	0
Triclopyr-butoxyl	14	79	133	0	6	18	0
Tricyclazole	4	171	178	158	7	9	4

LC/MS/MS-Glyphosate

Analytical Method and Parameter Name	Number of Results	Average Recovery (%)	Maximum Recovery (%)	Minimum Recovery (%)	Mean RPD	Maximum RPD	Minimum RPD
Aminomethylphosphoric acid	6	98	108	86	4	7	0
Glufosinate-ammonium	10	110	120	101	10	12	9
Glyphosate	6	109	115	97	4	5	3
LC/MS/MS							
3-Hydroxycarbofuran	26	67	107	0	3	10	0
Acetamiprid	26	70	115	0	4	12	1
Aldicarb	26	74	131	0	7	18	1
Aldicarb Sulfone	26	83	152	1	6	13	2
Aldicarb Sulfoxide	26	60	98	0	5	18	0
Azoxystrobin	26	70	116	0	4	12	0
Baygon	26	68	103	0	4	11	0
Carbaryl	26	74	124	0	7	13	1
Carbofuran	26	65	102	0	4	8	1
Chlorsulfuron	26	53	120	0	7	20	0
Clothianidin	26	62	101	0	5	18	0
Cyprodinil	26	74	146	1	4	15	0
Difenoconazole	26	38	72	0	10	21	0
Diflubenzuron	26	65	127	1	10	29	0
Dinotefuran	26	64	102	0	5	13	0
Diuron	26	68	112	0	4	10	1
Fenbuconazole	26	55	110	0	6	13	1
Imazapic	26	54	94	0	4	15	0
Imazapyr	26	47	81	0	4	16	1
Imidacloprid	26	68	124	0	6	12	0
Isoxaben	26	70	122	0	4	13	0
Linuron	26	67	109	0	15	37	1
Malaoxon	26	65	105	0	4	13	1
Methiocarb	26	77	130	1	5	15	0
Methomyl	26	56	93	0	4	12	0
Methomyl oxime	26	59	108	0	7	22	0
Methoxyfenozide	26	74	137	0	5	14	1
Metsulfuron-methyl	26	53	123	0	7	16	0
Monuron	26	68	133	0	5	12	0
Myclobutanil	26	61	109	0	4	11	0
Neburon	26	72	119	0	4	12	0
Oxamyl	26	59	93	0	4	11	0
Oxamyl oxime	26	60	105	1	3	12	0
Promecarb	26	72	114	0	6	14	0
Propiconazole	26	55	96	0	4	11	0
Pyraclostrobin	26	75	147	0	6	15	1
Pyrimethanil	26	69	130	0	4	12	0
Sulfometuron methyl	26	55	96	0	4	14	0
Sulfoxaflor	26	61	104	0	6	16	0
Thiacloprid	26	64	109	0	4	13	0
Thiamethoxam	26	69	124	1	4	13	0
Trifloxystrobin	26	59	113	0	6	15	0

Analytical Method and Parameter Name	Number of Results	Average Recovery (%)	Maximum Recovery (%)	Minimum Recovery (%)	Mean RPD	Maximum RPD	Minimum RPD
Zoxamide	26	63	102	0	4	16	0

Table 41 describes the frequency of MS/MSD recoveries that were above or below the laboratory control limits set for each analyte. Table 41 also shows how often recoveries for each analyte were outside of the control limits and the number of detections from grab samples for each analyte.

Table 41: Frequency of MS/MSD Recoveries Falling Outside of the Laboratory Control Limits

Parameter Name	Percentage of Recoveries Outside Control Limits (%)	Number of MS/MSD Samples	MS/MSD Recoveries Below Control Limits	MS/MSD Recoveries Above Control Limits	Lower Control Limit (%)	Upper Control Limit (%)	Number of Detections
1-Naphthol	25	4	0	1	40	130	0
2,3,4,5-Tetrachlorophenol	0	8	0	0	40	130	0
2,3,4,6-Tetrachlorophenol	0	8	0	0	40	130	0
2,4,5-T	0	8	0	0	40	130	0
2,4,5-Trichlorophenol	0	8	0	0	40	130	0
2,4,6-Trichlorophenol	0	8	0	0	40	130	1
2,4-D	25	8	2	0	40	130	87
2,4-DB	0	8	0	0	40	130	0
2,4'-DDD	40	10	4	0	29	125	0
2,4'-DDE	40	10	4	0	37	116	0
2,4'-DDT	40	10	4	0	25	118	0
3,5-Dichlorobenzoic Acid	0	8	0	0	40	130	0
3-Hydroxycarbofuran	31	26	8	0	40	130	0
4,4'-DDD	40	10	4	0	49	143	2
4,4'-DDE	50	10	5	0	40	130	36
4,4'-DDT	60	10	6	0	42	120	6
4,4'-Dichlorobenzophenone	0	4	0	0	30	130	0
4-Nitrophenol	13	8	0	1	40	130	0
Acetamiprid	31	26	8	0	40	130	1
Acetochlor	75	4	0	3	30	130	0
Acifluorfen, sodium salt	100	8	1	7	40	130	0
Alachlor	0	4	0	0	16	181	0
Aldicarb	35	26	8	1	40	130	0
Aldicarb Sulfone	46	26	8	4	40	130	0
Aldicarb Sulfoxide	31	26	8	0	40	130	0
Aldrin	40	10	4	0	30	141	0
Alpha-BHC	80	10	8	0	83	162	0
Aminomethylphosphoric acid	0	6	0	0	40	130	46
Atrazine	0	4	0	0	13	172	0
Azinphos-ethyl	50	8	4	0	10	330	0
Azinphos-methyl	40	10	4	0	10	503	0
Azoxystrobin	31	26	8	0	40	130	70

Parameter Name	Percentage of Recoveries Outside Control Limits (%)	Number of MS/MSD Samples	MS/MSD Recoveries Below Control Limits	MS/MSD Recoveries Above Control Limits	Lower Control Limit (%)	Upper Control Limit (%)	Number of Detections
Baygon	31	26	8	0	40	130	0
Benefin	40	10	4	0	50	151	0
Bentazon	0	8	0	0	40	130	30
Benthiocarb	57	14	8	0	54	144	0
Beta-BHC	80	10	8	0	83	172	0
Bifenazate	64	14	4	5	50	150	1
Bifenthrin	0	4	0	0	30	130	4
Boscalid	50	4	0	2	50	150	91
Bromacil	0	4	0	0	55	181	18
Bromoxynil	0	8	0	0	40	130	6
Butachlor	100	4	0	4	30	130	0
Butylate	0	4	0	0	41	147	0
Captan	40	10	4	0	10	219	8
Carbaryl	31	26	8	0	40	130	13
Carbofuran	31	26	8	0	40	130	0
Chlorothalonil	40	10	4	0	57	227	3
Chlorpropham	0	4	0	0	53	181	15
Chlorpyrifos	40	10	4	0	52	152	18
Chlorpyrifos O.A.	75	4	0	3	30	130	0
Chlorsulfuron	31	26	8	0	40	130	8
cis-Chlordane	40	10	4	0	45	161	0
Cis-Nonachlor	40	10	4	0	25	105	0
cis-Permethrin	40	10	4	0	17	201	0
Clopyralid	88	8	7	0	40	130	0
Clothianidin	31	26	8	0	40	130	0
Coumaphos	40	10	4	0	10	487	0
Cyanazine	29	14	4	0	14	268	0
Cycloate	25	4	0	1	49	151	2
Cyfluthrin	29	14	4	0	50	150	0
Cypermethrin	75	4	0	3	30	130	0
Cyprodinil	38	26	8	2	40	130	19
Dacthal	0	8	0	0	40	130	14
Delta-BHC	80	10	8	0	81	173	0
Deltamethrin	57	14	4	4	30	130	0
Di-allate (Avadex)	40	10	4	0	30	130	0
Diazinon	40	10	4	0	59	168	3
Dicamba	0	8	0	0	40	130	23
Dichlobenil	40	10	4	0	34	153	76
Dichlorprop	0	8	0	0	40	130	0
Dichlorvos (DDVP)	40	10	4	0	27	169	0
Diclofop-Methyl	63	8	0	5	40	130	0
Dieldrin	80	10	8	0	69	143	0
Difenoconazole	31	26	8	0	40	130	35
Diflubenzuron	31	26	8	0	40	130	0
Dimethoate	0	4	0	0	65	217	0
Dinoseb	88	8	1	6	40	130	0

Parameter Name	Percentage of Recoveries Outside Control Limits (%)	Number of MS/MSD Samples	MS/MSD Recoveries Below Control Limits	MS/MSD Recoveries Above Control Limits	Lower Control Limit (%)	Upper Control Limit (%)	Number of Detections
Dinotefuran	31	26	8	0	40	130	36
Diphenamid	0	4	0	0	52	170	3
Disulfoton Sulfoxide	0	4	0	0	30	130	0
Diuron	31	26	8	0	40	130	143
Endosulfan I	60	10	6	0	58	195	0
Endosulfan II	80	10	8	0	72	146	0
Endosulfan Sulfate	70	10	7	0	77	140	0
Endrin	40	10	4	0	62	145	0
Endrin Aldehyde	40	10	4	0	32	134	0
Endrin Ketone	40	10	4	0	34	119	0
EPN	100	4	0	4	43	185	0
Eptam	0	4	0	0	41	159	0
Ethalfluralin	40	10	4	0	6	243	0
Ethion	40	10	4	0	41	132	0
Ethoprop	40	10	4	0	10	263	1
Etoxazole	36	14	4	1	50	150	0
Etridiazole	0	4	0	0	50	150	9
Fenamiphos	29	14	4	0	10	375	0
Fenamiphos Sulfone	100	4	0	4	30	130	0
Fenarimol	100	4	0	4	30	130	0
Fenbuconazole	31	26	8	0	40	130	0
Fenvalerate	50	10	4	1	30	130	0
Fipronil	75	4	0	3	30	130	0
Fipronil Disulfinyl	0	4	0	0	30	130	0
Fipronil Sulfide	0	4	0	0	30	130	0
Fipronil Sulfone	0	4	0	0	30	130	0
Fludioxonil	29	14	4	0	50	150	53
Flumioxazin	29	14	4	0	50	150	0
Fluridone	0	4	0	0	10	375	0
Fluroxypyr-meptyl	29	14	4	0	50	150	0
Fonofos	40	10	4	0	30	130	0
Gamma-BHC	80	10	8	0	78	177	0
Glufosinate-ammonium	0	10	0	0	40	130	5
Glyphosate	0	6	0	0	40	130	54
Heptachlor	40	10	4	0	43	157	0
Heptachlor Epoxide	70	10	7	0	73	167	0
Hexachlorobenzene	40	10	4	0	33	120	0
Hexazinone	0	4	0	0	41	183	0
Imazapic	31	26	8	0	40	130	1
Imazapyr	31	26	8	0	40	130	37
Imidacloprid	31	26	8	0	40	130	65
Imidan	40	10	4	0	32	203	0
Ioxynil	0	8	0	0	40	130	0
Isoxaben	31	26	8	0	40	130	19
Kelthane	0	4	0	0	10	265	0
Linuron	31	26	8	0	40	130	0

Parameter Name	Percentage of Recoveries Outside Control Limits (%)	Number of MS/MSD Samples	MS/MSD Recoveries Below Control Limits	MS/MSD Recoveries Above Control Limits	Lower Control Limit (%)	Upper Control Limit (%)	Number of Detections
Malaoxon	31	26	8	0	40	130	7
Malathion	25	4	0	1	50	147	1
MCPA	0	8	0	0	40	130	17
MCPP	0	8	0	0	40	130	15
Metalaxyl	40	10	4	0	56	149	33
Methidathion	40	10	4	0	52	186	0
Methiocarb	31	26	8	0	40	130	3
Methomyl	31	26	8	0	40	130	2
Methomyl oxime	38	26	10	0	40	130	0
Methoxychlor	40	10	4	0	15	181	1
Methoxyfenozide	35	26	8	1	40	130	3
Methyl Chlorpyrifos	40	10	4	0	50	144	0
Methyl Paraoxon	0	4	0	0	37	269	0
Methyl Parathion	40	10	4	0	35	170	0
Metolachlor	0	4	0	0	55	180	48
Metribuzin	29	14	4	0	30	130	0
Metsulfuron-methyl	31	26	8	0	40	130	2
Mevinphos	40	10	4	0	10	448	0
MGK264	0	4	0	0	49	193	0
Mirex	40	10	4	0	16	97	0
Monocrotophos	29	14	4	0	10	196	1
Monuron	35	26	8	1	40	130	8
Myclobutanil	31	26	8	0	40	130	20
N,N-Diethyl-m-toluamide	29	14	4	0	50	150	27
Naled	40	10	4	0	10	220	0
Napropamide	0	4	0	0	70	180	0
Neburon	31	26	8	0	40	130	0
Norflurazon	0	4	0	0	70	168	1
Oryzalin	100	2	2	0	10	230	0
Oxadiazon	29	14	4	0	50	150	2
Oxamyl	31	26	8	0	40	130	43
Oxamyl oxime	31	26	8	0	40	130	41
Oxychlordane	40	10	4	0	41	111	0
Oxyfluorfen	40	10	4	0	51	153	0
Parathion	50	4	0	2	29	204	0
Pebulate	0	4	0	0	45	162	0
Pendimethalin	40	10	4	0	39	163	10
Pentachloronitrobenzene	29	14	4	0	50	150	0
Pentachlorophenol	0	8	0	0	40	130	18
Phenothrin	40	10	4	0	22	130	0
Phorate	29	14	4	0	12	130	0
Picloram	63	8	5	0	40	130	13
Piperonyl Butoxide (PBO)	100	4	0	4	30	130	7
Promecarb	31	26	8	0	40	130	0
Prometon	0	4	0	0	55	164	1
Prometryn	0	4	0	0	62	165	2

Parameter Name	Percentage of Recoveries Outside Control Limits (%)	Number of MS/MSD Samples	MS/MSD Recoveries Below Control Limits	MS/MSD Recoveries Above Control Limits	Lower Control Limit (%)	Upper Control Limit (%)	Number of Detections
Pronamide	0	4	0	0	63	169	1
Propachlor	29	14	4	0	13	189	1
Propargite	40	10	4	0	30	130	0
Propazine	0	4	0	0	56	161	0
Propiconazole	31	26	8	0	40	130	39
Pyraclostrobin	42	26	8	3	40	130	23
Pyraflufen-ethyl	29	14	4	0	50	150	0
Pyridaben	29	14	4	0	50	150	1
Pyrimethanil	31	26	8	0	40	130	6
Resmethrin	71	14	8	2	10	65	0
Silvex	0	8	0	0	40	130	0
Simazine	0	4	0	0	72	192	23
Simetryn	0	4	0	0	61	171	0
Sulfentrazone	50	14	4	3	50	150	12
Sulfometuron methyl	31	26	8	0	40	130	10
Sulfotepp	0	4	0	0	57	139	0
Sulfoxaflor	31	26	8	0	40	130	0
Tau-fluvalinate	29	14	4	0	50	150	0
Tebuthiuron	0	4	0	0	10	235	2
Terbacil	0	4	0	0	27	237	52
Tetrachlorvinphos	40	10	4	0	70	196	0
Tetrahydrophthalimide	50	4	0	2	50	150	8
Thiacloprid	31	26	8	0	40	130	0
Thiamethoxam	31	26	8	0	40	130	63
Thiamethoxam	29	14	4	0	50	150	63
Tokuthion	40	10	4	0	28	141	0
trans-Chlordane	40	10	4	0	42	148	0
Trans-Nonachlor	40	10	4	0	35	178	0
Trifluralin	75	4	0	3	58	174	1
Triadimefon	0	4	0	0	61	178	0
Triallate	40	10	4	0	52	128	0
Trichloronate	40	10	4	0	34	131	0
Triclopyr	0	8	0	0	40	130	37
Triclopyr-butoxyl	29	14	4	0	50	150	0
Tricyclazole	100	4	0	4	30	130	0
Trifloxystrobin	31	26	8	0	40	130	4
Zoxamide	31	26	8	0	40	130	0

The percentage of analyte recoveries from MS\MSD samples that were above, below, or fell within the laboratory control limits are as follows:

- 30% of analyte recoveries fell below the laboratory control limits for MS/MSD samples
- 66% of analyte recoveries were within the laboratory control limits for MS/MSD samples
- 4% of analyte recoveries were above the laboratory control limits for MS/MSD samples.

Some analytes tend to be associated with a higher frequency of MS/MSD recoveries that are outside of the control limits due to effects that are associated with the sample matrix and not method. Percentages of MS/MSD sample recoveries that were reported as above or below the control limits that were associated with analytes that were frequently outside of the control limits were:

- 7.5% of recoveries from MS/MSDs were associated with analytes that were outside of the control limits between 50% and 74% of the time.
- 3.9% of recoveries from MS/MSDs were associated with analytes that were outside of the control limits between 75% and 99% of the time.
- 1.4% of recoveries from MS/MSDs were associated with analytes that were outside of the control limits 100% of the time.

Analytes detections for specified analytes were qualified as estimates (‘J’) by the laboratory analyst for all analytical batches whenever the MS/MSD recoveries fell outside the target recovery range for a specific analyte.

Quality Control Sample Performance

Quality control (QC) samples are analyzed each year by the Laboratory to assure consistency and accuracy of sample analysis and to assess the accuracy and percussion of the results.

Laboratory Duplicates

MEL uses laboratory split sample duplicates to ensure consistency of TSS and conductivity analyses. In 2015 there were 115 laboratory duplicate pairs for TSS and nine duplicate pairs for conductivity.

For the TSS duplicates the pooled average RPD was 6.9%, and the highest RPD was 30%. There were 61 duplicate pairs where the RPD was greater than 5% and nine that exceeded the 20% RPD criterion.

For the conductivity duplicates the pooled average RPD was 6.9% and the highest RPD was 14%. All of the conductivity pairs are below the 20% RPD exceedance criterion.

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. In 2015 no analytes were detected above the detection limit in the laboratory blanks.

Surrogates

Surrogates are analytes spiked into field samples at the laboratory. Surrogates are used to assess recovery for a group of structurally related analytes. For instance, triphenyl phosphate is a surrogate for organophosphate insecticides. Summary statistics for surrogate recoveries are presented in Table 42: Pesticide surrogates.

Table 42: Pesticide surrogates

Parameters by Structurally Related Group	Analytical Method	Number of Results	Average Recovery	Standard Deviation	Results within control limits
Carbamate pesticides:					
Carbaryl C13	Pesticides by LC/MS	465	101%	13	99.6%
Acid-derivitizable herbicides:					
2,4,6-Tribromophenol	Herbicides by GC/MS	451	63%	10	97.3%
2,4-Dichlorophenylacetic acid	Herbicides by GC/MS	451	58%	7	99.1%
Nitrogen containing pesticides:					
1,3-Dimethyl-2-nitrobenzene	Pesticides by GC/MS	455	86%	19	98.7%
Chlorinated pesticides:					
4,4'-DDE-13C12	Pesticides by GC/MS	455	62%	11	99.8%
Decachlorobiphenyl (DCB)	Pesticides by GC/MS	455	56%	15	99.1%
Organophosphate pesticides:					
Chlorpyrifos-D10	Pesticides by GC/MS	455	89%	14	99.6%
Triphenyl Phosphate	Pesticides by GC/MS	455	95%	18	99.6%
Chlorine and nitrogen containing pesticides:					
Trifluralin-D14	Pesticides by LC/MS	455	100%	22	99.6%
Atrazine-D5	Pesticides by LC/MS	455	104%	17	99.6%
Summary for all Surrogate Results		4552	82%	24	99.2%

In 2015 the overall average for surrogate recoveries was 82% and 99.2%. All surrogate recoveries fell within the QC limits. Surrogate recovery requires all related data to be qualified as estimates (qualified with a ‘J’).

Laboratory Control Samples:

Laboratory control samples (LCS) are created in the laboratory before beginning the sample extraction process by the addition of analytes at known concentrations to purified water free of all organics. These samples are then subjected to extraction and analysis conditions along side the field samples and other QC samples. 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 43 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 2015.

Table 43: Summary Statistics for LCS/LCSD Recoveries and RPD

Analytical method and analyte	Number of recovery results	Average recovery (%)	Standard deviation of recoveries (%)	Average RPDs (%)	Standard deviation of RPDs (%)
Pesticides by LC/MS	2064	93	14	7	11
3-Hydroxycarbofuran	48	98	6	6	10
Acetamiprid	48	102	7	6	10
Aldicarb	48	103	14	9	13
Aldicarb Sulfone	48	103	12	7	10
Aldicarb Sulfoxide	48	87	8	6	11
Azoxystrobin	48	98	8	6	10
Baygon	48	96	4	5	10
Carbaryl	48	101	9	7	8
Carbofuran	48	96	4	6	11
Chlorsulfuron	48	79	18	7	11
Clothianidin	48	98	7	8	10
Cyprodinil	48	98	11	7	13
Difenoconazole	48	64	13	8	13
Diflubenzuron	48	97	17	12	11
Dinotefuran	48	91	7	7	12
Diuron	48	97	6	7	10
Fenbuconazole	48	81	14	7	12
Imazapic	48	86	9	6	11
Imazapyr	48	82	12	7	10
Imidacloprid	48	97	10	7	11
Isoxaben	48	98	9	6	10
Linuron	48	99	14	14	15
Malaoxon	48	94	5	6	10
Methiocarb	48	107	9	8	10
Methomyl	48	96	10	6	11
Methomyl oxime	48	92	12	8	11
Methoxyfenozide	48	102	8	7	11
Metsulfuron-methyl	48	79	18	7	11
Monuron	48	98	11	6	11
Myclobutanil	48	87	13	6	11
Neburon	48	101	8	6	11
Oxamyl	48	95	5	6	10
Oxamyl oxime	48	89	10	7	10
Promecarb	48	101	6	6	10
Propiconazole	48	76	12	7	12
Pyraclostrobin	48	92	13	7	12
Pyrimethanil	48	94	11	6	11
Sulfometuron methyl	48	83	7	6	11
Sulfoxaflor	48	93	7	7	13

Analytical method and analyte	Number of recovery results	Average recovery (%)	Standard deviation of recoveries (%)	Average RPDs (%)	Standard deviation of RPDs (%)
Thiacloprid	48	97	9	6	10
Thiamethoxam	48	104	7	6	10
Trifloxystrobin	48	82	13	8	11
Zoxamide	48	87	6	7	10
Glyphosate by LC/MS	36	110	8	5	4
Aminomethylphosphoric - acid	12	109	7	7	4
Glufosinate-ammonium	12	111	7	4	4
Glyphosate	12	111	10	6	4
Herbicides by GC/MS	1250	68	25	14	20
2,3,4,5-Tetrachlorophenol	50	67	7	8	8
2,3,4,6-Tetrachlorophenol	50	62	9	11	16
2,4,5-T	50	55	12	22	23
2,4,5-Trichlorophenol	50	68	10	13	19
2,4,6-Trichlorophenol	50	55	13	19	26
2,4-D	50	50	12	24	24
2,4-DB	50	88	9	7	6
3,5-Dichlorobenzoic Acid	50	59	7	9	7
4-Nitrophenol	50	94	30	19	34
Acifluorfen, sodium salt	50	100	56	39	46
Bentazon	50	74	7	6	5
Bromoxynil	50	63	6	7	5
Clopyralid	50	30	10	16	12
Dacthal	50	77	7	6	4
Dicamba	50	57	7	11	10
Dichlorprop	50	61	8	10	9
Diclofop-Methyl	50	108	18	12	9
Dinoseb	50	92	51	18	24
Ioxynil	50	73	8	7	6
MCPA	50	58	10	16	14
MCPP	50	63	7	9	5
Pentachlorophenol	50	64	7	7	7
Picloram	50	46	15	38	36
Silvex	50	67	7	9	7
Triclopyr	50	66	9	12	14
Pesticides by GC/MS	3810	94	26	12	15
1-Naphthol	24	65	25	24	47
2,4'-DDD	25	89	11	11	12
2,4'-DDE	25	74	10	10	12
2,4'-DDT	25	77	16	9	9
4,4'-DDD	25	83	12	11	14
4,4'-DDE	25	72	11	10	10

Analytical method and analyte	Number of recovery results	Average recovery (%)	Standard deviation of recoveries (%)	Average RPDs (%)	Standard deviation of RPDs (%)
4,4'-DDT	25	86	16	10	10
4,4'-Dichlorobenzophenone	24	84	14	11	4
Acetochlor	24	101	15	8	7
Alachlor	24	97	15	9	6
Aldrin	25	59	10	14	14
Alpha-BHC	25	84	15	13	19
Atrazine	24	86	11	10	7
Azinphos-ethyl	8	98	14	10	6
Azinphos-methyl	25	136	36	10	20
Benefin	25	98	17	11	13
Benthiocarb	47	60	16	12	15
Beta-BHC	25	86	14	14	21
Bifenazate	47	79	31	13	16
Bifenthrin	24	89	17	15	12
Boscalid	24	118	24	9	6
Bromacil	24	97	20	8	6
Butachlor	24	106	17	9	7
Butylate	24	78	14	16	14
Captan	25	71	22	19	23
Chlorothalonil	25	87	18	17	29
Chlorpropham	24	86	12	9	9
Chlorpyrifos	25	90	13	12	14
Chlorpyrifos O.A.	24	107	13	8	7
cis-Chlordane	25	77	9	11	10
Cis-Nonachlor	25	78	11	12	10
cis-Permethrin	25	103	21	7	7
Coumaphos	25	131	30	13	17
Cyanazine	49	103	21	11	14
Cycloate	24	102	14	13	11
Cyfluthrin	47	107	25	14	10
Cypermethrin	24	118	20	15	15
Delta-BHC	25	92	17	13	20
Deltamethrin	47	138	47	12	11
Di-allate	25	93	18	14	19
Diazinon	25	93	18	14	18
Dichlobenil	25	83	19	15	20
Dichlorvos	25	89	21	16	20
Dieldrin	25	82	14	16	14
Dimethoate	24	98	18	12	9
Diphenamid	24	94	12	11	7
Disulfoton Sulfoxide	24	91	17	9	9
Endosulfan I	25	81	10	17	18
Endosulfan II	25	79	13	19	24
Endosulfan Sulfate	25	92	15	14	20
Endrin	25	91	16	12	15
Endrin Aldehyde	25	86	18	19	16

Analytical method and analyte	Number of recovery results	Average recovery (%)	Standard deviation of recoveries (%)	Average RPDs (%)	Standard deviation of RPDs (%)
Endrin Ketone	25	93	14	13	14
EPN	24	127	29	11	7
Eptam	24	83	14	16	10
Ethalfluralin (Sonalan)	25	103	21	13	14
Ethion	25	103	18	9	12
Ethoprop	25	94	19	15	21
Etoxazole	47	101	19	10	9
Etridiazole	24	90	23	16	15
Fenamiphos	47	105	23	9	13
Fenamiphos Sulfone	24	132	45	13	12
Fenarimol	24	105	39	10	6
Fenvalerate	25	134	28	9	5
Fipronil	24	114	19	8	7
Fipronil Disulfinyl	24	97	13	9	7
Fipronil Sulfide	24	92	12	12	8
Fipronil Sulfone	24	103	21	11	7
Fludioxonil	47	90	16	11	18
Flumioxazin	47	82	22	16	18
Fluridone	24	132	61	13	12
Fluroxypyr-meptyl	47	89	20	11	9
Fonofos	25	93	17	18	17
Gamma-BHC	25	84	15	14	20
Heptachlor	25	85	20	13	14
Heptachlor Epoxide	25	81	10	15	17
Hexachlorobenzene	25	65	13	15	12
Hexazinone	24	103	23	16	10
Imidan	25	99	24	12	18
Kelthane	24	120	26	19	12
Malathion	24	104	16	7	5
Metalaxyl	25	101	18	15	17
Methidathion	25	108	18	10	18
Methoxychlor	25	94	19	12	12
Methyl Chlorpyrifos	25	96	21	15	20
Methyl Paraoxon	24	117	27	10	10
Methyl Parathion	25	104	41	15	20
Metolachlor	24	97	16	7	6
Metribuzin	47	71	13	10	13
Mevinphos	25	105	27	12	14
MGK264	24	84	13	12	5
Mirex	25	72	12	11	7
Monocrotophos	47	101	36	15	15
N,N-Diethyl-m-toluamide	47	85	17	12	17
Naled	25	103	31	13	21
Napropamide	24	111	18	10	8
Norflurazon	24	109	17	10	6
Oryzalin	14	70	15	36	56
Oxadiazon	47	87	20	11	14

Analytical method and analyte	Number of recovery results	Average recovery (%)	Standard deviation of recoveries (%)	Average RPDs (%)	Standard deviation of RPDs (%)
Oxychlordane	25	79	12	17	22
Oxyfluorfen	25	122	22	7	14
Parathion	24	123	19	9	5
Pebulate	24	79	16	18	15
Pendimethalin	25	111	23	10	14
Pentachloronitrobenzene	47	90	20	13	15
Phenothrin	25	86	18	10	9
Phorate	49	78	18	13	16
Piperonyl Butoxide	24	107	18	9	5
Prometon	24	86	21	8	8
Prometryn	24	90	16	10	9
Pronamide	24	95	13	7	7
Propachlor	49	91	20	11	16
Propargite	25	84	23	14	14
Propazine	24	81	11	11	8
Pyraflufen-ethyl	47	108	21	10	11
Pyridaben	47	97	21	11	9
Resmethrin	49	75	18	12	9
Simazine	24	89	13	14	11
Simetryn	24	85	26	21	38
Sulfentrazone	47	101	35	19	25
Sulfotepp	24	90	13	10	8
Tau-fluvalinate	47	97	20	12	10
Tebuthiuron	24	80	20	22	16
Terbacil	24	109	20	7	7
Tetrachlorvinphos	25	110	17	11	19
Tetrahydrophthalimide	24	65	32	16	17
Tokuthion	25	90	14	9	7
trans-Chlordane	25	81	11	12	13
Trans-Nonachlor	25	72	10	11	11
Trifluralin	24	107	28	7	9
Triadimefon	24	96	23	20	37
Triallate	25	84	16	15	19
Trichloronate	25	85	12	11	12
Triclopyr-butoxyl	47	108	26	13	15
Tricyclazole	24	99	38	11	5
Summary for all results	7160	89	25	11	15

The recoveries for 97% of the LCS and LCSD samples were above the lower control limit and the recoveries for 97% of the LCS and LCSD samples were below the upper control limit. The RPD for 95% of the LCS and LCSD samples were below the upper control limit. Each time the RPD statistic or analyte recoveries fell outside of the control limits for a given analyte; all detections from field samples associated with that analytical batch were qualified as estimates.

Field Data Performance Measures

Field meters were calibrated the evening before, or the morning of the first field day of the week according to manufacturer 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 the first sampling site each day and at the last sampling site each 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, surface water grab 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).

Field Data Collection Performance

The Hydrolab field meter met MQOs for laboratory conductivity comparisons for all monitoring locations for eastern and western Washington locations (Table 44).

Table 44: Quality control results for field meters and Winkler replicates

Replicate Meter Parameter	MQO	Western Washington		Eastern Washington	
		Average	Maximum	Average	Maximum
Winkler and meter DO	10% RSD	3.6% RSD	88.8% RSD	1.7% RSD	6.8% RSD
Replicate Winkler's for DO	±0.2 mg/L	0.06 mg/L	0.35 mg/L	0.04 mg/L	0.18 mg/L
Conductivity (field meter vs. laboratory)	10% RSD	3.0% RSD	5.1% RSD	2.3% RSD	3.5% RSD
Streamflow	10% RSD	9.5% RSD	46.2% RSD	6.5% RSD	19.7% RSD

DO: dissolved oxygen
MQO: measurement quality objective

Hydrolab field meter results exceeded MQOs for DO Winkler comparisons four times in western Washington for the following sampling events:

- Indian Slough, 12.31% RSD, March 9, 2015 (3.46 and 4.12 mg/L)
- Upper Big Ditch, 10.35% RSD, June 16, 2015 (3.61 and 4.18 mg/L)
- Upper Big Ditch, 10.81% RSD, June 30, 2015 (1.57 and 1.83 mg/L)
- Upper Big Ditch, 88.8% RSD, August 24, 2015 (0.24 and 1.05 mg/L)

Winkler and DO exceedances for all western sites occurred during low dissolved oxygen conditions when the percent RSD statistic produces higher variability (Mathieu, 2006). This relationship is particularly obvious for the HydroLab/Winkler comparison at Upper Big Ditch on August 24, 2015, with a Hydrolab reading of 0.24 mg/L and a Winkler result of 1.05 mg/L, both of which are extremely low DO values. Winkler results for these days are acceptable.

Winkler and DO results for Indian Slough, and Upper Big Ditch will be reported and qualified as estimates for the listed dates.

During 2015, no MQO exceedances occurred between the Hydrolab field meter and DO Winkler analysis in eastern Washington, however, low dissolved oxygen conditions were also not observed. The lowest recorded DO value at an eastern site was 7.38 mg/L, at Spring Creek, which is well above the lowest DO values in western, WA.

2015 Winkler replicate values for both eastern and western Washington locations met the MQOs with the exception of the following sampling event:

- Thornton Creek, difference 0.35, March 24, 2015 (10.4 and 10.75 mg/L).

In western Washington, equipment malfunction led to partial loss of calibration data during the periods of May 11-15, May 18-22, and May 25-29, therefore the pH and conductivity values will be reported as estimates for those weeks. General water chemistry results for western sites were not recorded during the weeks of May 25-29, and July 6-10 due to malfunction of the Hydrolab field meter.

Acceptance of Hydrolab field meter results were based on the Measurement Quality Objectives (MQO) described in Anderson and Sargeant (2009). The MQOs for conventional field parameters are shown in Table 45.

Table 45: 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	OTT MF pro flow meter	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 2015 streamflow replicate results for both the eastern and western Washington sites met MQOs (Table 44) except for the following sites visits:

- Brender Creek, 13.1% RSD, April 28, 2015 (1.77 and 2.13 cfs)
- Brender Creek, 13.3% RSD, May 27, 2015 (0.27 and 0.87 cfs)
- Mission Creek, 15.1 % RSD, June 30, 2015 (4.24 and 5.25 cfs)
- Mission Creek, 12.93% RSD, July 21, 2015 (1.59 and 1.91 cfs)
- Brender Creek, 19.68% RSD, August 4, 2015 (1.67 and 2.21 cfs)
- Brender Creek, 16.05% RSD, August 25, 2015 (1.25 and 1.57 cfs)
- Upper Big Ditch, 21.84% RSD, June 16, 2015 (0.29 and 0.40 cfs)
- Upper Big Ditch, 23.08% RSD, August 4, 2015 (0.20 and 0.28 cfs)

A majority of the streamflow replicates not meeting the MQOs for Brender Creek, Mission Creek, Lower Big Ditch, Upper Big Ditch, and Indian Slough occurred during low-flow conditions when the percent RSD statistic produces higher variability (Mathieu, 2006). Streamflow results for these days are acceptable. Streamflow replicate results for the dates listed above will be averaged and reported as an estimate based on higher statistical variability coupled with difficulty measuring consistent streamflow during periods of low-flow.

There were several streamflow replicates that were measured during conditions that would not be considered low-flow conditions that did not meet the MQO for streamflow replicates at the following sites visits:

- Marion Drain, 15.79% RSD, July 27, 2015 (6.92 and 8.66 cfs)
- Lower Big Ditch, 11.1% RSD, April 20, 2015 (15.09 and 12.90 cfs)
- Lower Big Ditch, 30.19% RSD, June 2, 2015 (28.42 and 18.42 cfs)
- Indian Slough, 10.09% RSD, June 22, 2015 (13.97 and 12.11 cfs)
- Lower Big Ditch, 13.97% RSD, July 15, 2015 (19.46 and 15.96 cfs)
- Lower Big Ditch, 15.23% RSD, July 20, 2015 (12.70 and 10.23 cfs)
- Lower Big Ditch, 46.19% RSD, August 24, 2015 (8.79 and 4.46 cfs)

Site characteristics of the streams listed above which can increase the difficulty of measuring consistent streamflow includes fluctuating stages and/or an unconsolidated streambed. Marion Drain will periodically receive irrigation water upstream of the sampling location which can lead to a fluctuating stream stage. The extreme drought during the 2015 sampling season caused unusually low streamflow. Typically the stream stage is measured before and after measuring streamflow, however the unusually low streamflow resulted in the staff gage at Marion Drain being dry, and there for we were unable to monitor the stream stage throughout the flow measurement. The Lower Big Ditch and Indian Slough sampling locations are tidally influenced which can lead to a fluctuating stream stage. Both sites also have a very soft streambed. These two characteristics can increase difficulty of measuring consistent streamflow replicates. Field notes for the June 22, 2015 streamflow replicate at Indian Slough indicates that the water level in

Indian Slough was fluctuating during the flow measurement. Streamflow replicate results for the dates listed above will be averaged and reported as an estimate based on higher statistical variability coupled with difficulty measuring consistent streamflow.

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, streamflow, and Winkler grab samples. Results and methods were compared to ensure field teams were using consistent sampling methodologies resulting in comparable data.

On July 30, 2015, a field audit was conducted at Fishtrap Creek near the town of Lynden in Whatcom County, WA. The Westside team calibrated their Hach Hydrolab Multi-Meter at the field audit site on July 30th 2015. The Eastside team calibrated their Hach Hydrolab Multi-Meter on July 27, 2015 at the WSDA building, located in Yakima, WA. Both teams met at Fishtrap Creek to perform the field audit simultaneously. Results displayed in Table 46.

Table 46: July 30, 2015 Hydrolab meter readings, streamflow measurements, and Winkler results for dissolved oxygen from Fishtrap Creek.

Meter or Method	Temp (°C)	pH (s.u.)	Conductivity (µS/cm)	DO (mg/L)	DO (% sat)	Streamflow (cfs)
Westside Hydrolab Meter	17.53	6.84	213.9	9.11	94.6	
Eastside Hydrolab Meter	17.48	7.34	211.9	9.03	97.8	
Winkler Dissolved Oxygen (Westside)				8.97		
Winkler Dissolved Oxygen (Eastside)				9.10		
OTT MF pro Westside						2.52
OTT MF pro Eastside						2.78

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

Quality Assurance Summary References

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Appendix C: Assessment Criteria for Pesticides

In this Report, *Assessment Criteria* include data taken from studies determining hazards 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, and ecological risk assessments were reviewed to determine the most comparable and up-to-date toxicity guidelines for freshwater and marine species. 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.

The most recent versions of WAC 173-201A and EPA's NRWQC were included in the development of the assessment criteria.

Pesticide detections at Browns Slough were evaluated using marine assessment criteria listed in Table 48 because of its location within an estuary. Pesticide detections at all other monitoring sites were evaluated using the freshwater assessment criteria listed in Table 47.

Assessment Criteria Tables:

Table 47: Freshwater Assessment Criteria

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]
1-Naphthol	35	350	50	RT/ FM	10	175		DM	10	550		SC	10				
2,4'-DDD														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
2,4'-DDE														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
2,4'-DDT														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
2,4-D[m]	10.7	107	39.6	BS	1	850	100	DM	1	165		DW	1				
3-Hydroxycarbofuran	2.2	22	2.85	RT/ BS	54/ 60	0.5575	0.375	CD/ DM	54								
4,4'-DDD														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
4,4'-DDE														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
4,4'-DDT														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
4-Nitrophenol	100	1000		RT	69	1250		DM	69								
Acetamiprid	250	2500	9600	RT/ FM	101	5.25	1.05	CR/ ACR	101	500		LG	101				
Acetochlor	9.5	95	65	RT	70	2050	11.05	DM	70	0.715		SC	70				
Alachlor	45	450	93.5	RT	2	1925	55	DM	2	0.82	0.175	SC	2				
Aldicarb	1.3	13	0.23	BS	3	5	1.5	CT	3	2500		MD	3				
Aldicarb Sulfone	1050	10500		RT	3	70	1.5	DM	3								
Aldicarb Sulfoxide	178.5	1785		RT	3	10.75	1.5	DM	3								
Aminomethyl-phosphoric acid	12475	124750		RT	114	170750		DM	114								
Atrazine	132.5	1325	32.5	RT/ BT	4	875	70	DM	4	24.5		SC	4				
Azinphos-Ethyl	0.5	5		RT	71	1		DM	71								
Azinphos-methyl	0.0725	0.725	0.22	RT	5	0.2825	0.125	DM	5								0.005
Azoxystrobin	11.75	117.5	73.5	RT/ FM	116	65	22	DM	116	24.5	10	NP	116				
Bifenazate	14.5	145		BS	103	125	75	DM	103	445		SC	103				
Bifenthrin	0.0038	0.0375	0.02	RT/ FM	72	0.4	0.00065	DM	72								
Boscalid	67.5	675	58		94	266.5	395		94	670			94				
Bromacil	900	9000	1500	RT	7	30250	4100	DM	7	3.4	550	SC	7				

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]
Bromoxynil	0.725	7.25	9	RT/ FM	8	2.75	1.25	DM	8	25.5		NP	83				
Captan	0.655	6.55	8.25	BrT/ FM	73	2100	280	DM	73	985	100	SC	73				
Carbaryl	30	300	105	RT/ FM	9/ 10	1.4	0.75	DM	10	550	185	SC	10				
Carbofuran	2.2	22	2.85	RT/ BS	54/ 60	0.5575	4.9	CD/ DM	54/ 60								
Carboxin	57.5	575		RT	74	21100		DM	74	185	55	SC	74				
Chlorantraniliprole	29.75	297.5	55	BG/ RT		1.775	2.235	DM		890		SC					
Chlorothalonil	1.0575	10.575	1.5	RT/ FM	46	17	19.5	DM	46	95		SC	46				
Chlorpropham	75.25	752.5		RT	47	927.5		DM	47								
Chlorpyrifos	0.045	0.45	0.285	RT/ FM	11/ 12	0.025	0.02	DM	11					0.042	0.0205	0.0415 D	0.0205[E]
Chlorsulfuron	7500	75000	16000	RT	117	92500	10000	DM	117	0.175		LG	117				
Clopyralid	49200	492000		BS	64	28250		DM	64	3450	6.5	SC	64				
Clothianidin	2537.5	25375	4850	RT/ FM	104	5.5	0.55	CR	104								
Cycloate	112.5	1125		RT	87	6000		DM	87								
Cyprodinil	6.025	60.25	115		96	80	4.1		96	1125			96				
DDT-Total														0.55	0.0005	0.55	0.0005
Dacthal (DCPA)	165	1650		RT	56	4505		DM	56								
Diazinon	2.25	22.5	0.4	RT/ BT	13/ 14	0.2	0.085	DM	13	1850		SC	13			0.085	0.085
Dicamba	700	7000		RT	15	25000		DM	15	30.5		AF	15				
Dichlobenil	123.25	1232.5	166.5	RT	16	1550	280	DM	16	15	3	LG	16				
Dichlorprop	5350	53500	7350	RT	76	139500	37450	DM	76	38.5	6.5	NP	76				
Dichlorvos (DDVP)	4.575	45.75	2.6	LT/ RT	75	0.0175	0.0029	DM	75	7000		ND	75				
Dicofol	1.325	13.25	1.375		97/ 98	35	9.5		98	2500							
Difenoconazole	20.25	202.5	4.35	RT/ FM	118	192.5	2.8	DM	118	49		NP	118				
Dimethoate	155	1550	215	RT	29	830	20	DM	29	18000		SC	29				
Dinotefuran	2477.5	24775		Carp	105	242075	47650	DM	106	488000		SC	106				
Diphenamid	2425	24250		RT	59	14500		DM	59								
Disulfoton Sulfoxide	1500	15000		RT	19	16	0.765	DM	19								

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]
Disulfoton sulfone	230	2300		RT	19	8.75	0.07	DM	19								
Diuron	5	50	13.2	SB/ FM	21/ 22	40	100	GF/ DM	21/ 22	1.2		SC	21/ 22				
EPN	3.575	35.75		RT	84												
Endosulfan I	0.02	0.2	0.05	RT	23	41.5	1	DM	23					0.11[I]	0.028[I]	0.11[B,F]	0.028[C,F]
Endosulfan II	0.02	0.2	0.05	RT	23	41.5	1	DM	23					0.11[I]	0.028[I]	0.11[B,F]	0.028[C,F]
Endosulfan Sulfate	0.035	0.35		RT	82	145		DM	23								
Endosulfan-Total	0.02	0.2	0.05			41.5	1							0.11	0.028	0.11	0.028
Eptam	350	3500		BS	24	1625	405	DM	24	700	450	SC	24				
Ethoprop	25.5	255	90	RT/ FM	25	11	0.4	DM	25								
Etoxazole	9.25	92.5	7.5	RT	107	1.825	0.065	DM	107	25.95		NP	107				
Etridiazole	30.25	302.5	60	RT	119	770	185	DM	119	36	1	SC	119				
Fenamiphos	1.7	17	1.9	RT	77	0.325	0.06	DM	77								
Fenarimol	52.5	525	435	RT	67	1700	56.5	DM	67		50	SC	67				
Fipronil	6.15	61.5	3.3	RT	78	47.5	4.9	DM	78	70	70	SC	78				
Fipronil Sulfide	2.075	20.75	3.3	ND	78	25	0.055	DM/ ND	78	70	70	ND					
Fipronil Sulfone	0.975	9.75	0.335	RT/ ND	78	7.25	0.0185	DM/ ND	78	70	70	ND					
Fludioxonil	11.75	117.5	9.5	RT/ FM	125	225	9.5	DM	125								
Glufosinate-ammonium	7800	78000	25000	RT	115	162750	15500	DM	115		36	AF	115				
Glyphosate	1075	10750	12850	BS/ FM	114	13300	24950	CP/ DM	114	5950		LG	114				
Hexachlorobenzene	0.75	7.5	1.84	RT	26	7.5	8	DM	26	15		SC	26				
Hexazinone	4500	45000	8500	RT/ FM	27/ 28	37900	10000	DM	27	3.5	2	SC	27				
Imazapic	2500	25000	48000	RT/ FM	108	25000	48000	DM	108	3.11		LM	108				
Imazapyr	2500	25000	59000	RT/ FM	109	25000	48550	DM	109	9		LM	109				
Imidacloprid	2075	20750	600	RT	61	17.25	650	CT/ DM	61	5000		ND	61				
Isoxaben	25	250	200	RT	120	325	345	DM	120	5		LG	120				
Linuron	75	750	2.79	RT	48	30	0.045	DM	48	33.5		SC	49				
MCPA	19	190	6000		100	45	5500		100	10		SC	32				

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]
Malaoxon	0.82	8.2	4.3	RT	31	0.1475	0.03	DM	31	1200			99				
Malathion	0.82	8.2	4.3	RT	31	0.1475	0.0175	DM	31	1200			99				0.05
Mecoprop (MCPP)	3120	31200		RT	65	25000	25400	DM	65/93	7	4.5	SC	93				
Metalaxyl	460	4600	4550	RT/FM	51	3000	635	DM	51	50000		SC	51				
Methiocarb	10.9	109	25	ND	30	1.75	0.05	ND	30								
Methomyl	21.5	215	28.5	RT/FM	57	1.25	0.35	DM	57								
Methoxychlor	0.475	4.75		BT	135	0.35		PC	135								
Methoxyfenozide	105	1050	265	FM	110	12.5	3.15	CR	110	1700		SC	110				
Metolachlor	95	950	1250	RT	33	275	0.5	DM	33	4	0.75	SC	33				
Metribuzin	1050	10500	1500	RT	52	1050	645	DM	52	5.95	4.45	NP	52				
Metsulfuron-methyl	2287.5	22875	14800	RT	121	22550	850	DM	121	0.32	0.095	LG	121				
Myclobutanil	60	600	490	BS/FM	122	2750		DM	122	415		SC	122				
N,N-Diethyl-m-toluamide (DEET)	1875	18750		RT	123	18750		DM	123								
Napropamide	160	1600	550	RT	80	3575	550	DM	80	1700	35.5	SC/LM	80				
Norflurazon	202.5	2025	385	RT	34	3750	500	DM	34	4.85	1.6	SC	34				
Oryzalin	81.5	815	230	RT	85	375	179	DM	85	26	6.9	SC	85				
Oxadiazon	30	300	16.5	RT/FM	124	545	16.5	DM	124	4	2.8	SC	124				
Oxamyl	105	1050	385	RT	62	45	6	DM/ACR	62	60	15000	SC	62				
Oxamyl oxime					62				62				62				
Oxyfluorfen	6.25	62.5	19	RT/FM	35	20	6.5	DM	35	0.145	0.05	SC	35				
Pendimethalin	3.45	34.5	3.15	RT/FM	37	70	7.25	DM	37	2.7	1.5	SC	37				
Pentachlorophenol	0.375	3.75	5.5	RT	38	112.5	120	DM	38	25		SC	38	4.1[J]	2.6[K]	3.95[D,G]	3.05[E,H]
Phosmet	5.75	57.5	1.5	RT	79	1.5	0.4	DM	79	75		SC	79				
Picloram	137.5	1375	275	RT	53	8600	5900	DM	53	17450	9000	SC	53				
Piperonyl butoxide	47.5	475	20	RT	81	127.5	15	DM	81								
Prometon	300	3000	4750	RT/FM	68	6425	1750	DM	68	49	16	SC	68				
Prometryn	72.75	727.5	310	RT/FM	126	2425	500	DM	136	0.52	0.144	NP	126				

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]
Propachlor																	
Propargite	2.95	29.5	8	RT/ FM	40	18.5	4.5	DM	40	33.1	2.5	SC	40				
Propazine	109.5	1095	280	BS/ FM	20	1330	23.5	DM	20	12.45	3.25	NP	20				
Propiconazole	21.25	212.5	47.5	RT/ FM	127	325	130	DM	127	10.5	9	ND	127				
Propoxur	92.5	925		RT	63	2.75		DM	63								
Propyzamide (Pronamide)	1800	18000	3850	RT	66	1400	300	DM	66	2000	195	AF	66				
Pyraclostrobin	0.155	1.55	1.175	RT	128	3.925	2	DM	128	0.75	0.59	NP	128				
Pyridaben	0.018	0.18	0.0435	RT	129	0.1325	0.022	DM	129	8.1	8.1	LG	129				
Pyrimethanil	252.5	2525	10	RT	130	750	500	DM	130	900	150	ND	130				
Simazine	160	1600	480	FM	41	250	20	DM/ ACR	41	0.307		SC	41				
Sodium Bentazon	4750	47500	4915	RT/ FM	6	15575	50600	CR/ DM	6	2250		SC	6				
Sulfentrazone	2345	23450	1475	RT	132	15100	100	DM	132	15.5	8	SC	132				
Sulfometuron methyl	3700	37000		RT	133	37500	48500	DM	133	0.225	0.1035	LG	133				
Sulfoxaflor	9675	96750	330	RT/ FM	111	100000	25250	DM	111	40600		NP	111				
Tebuthiuron	2650	26500	4650	FM	42	74250	10900	DM	42	65	25	LG	42				
Terbacil	1155.5	11555	600	RT	43	16250	320	DM	43	5.5	3.5	NP	43				
Tetrahydrophthalimide	3000	30000		RT	73	28250		DM	73								
Thiacloprid	630	6300	459	BS/ RT	112	9.45	0.485	HA	112	22500		SC	112				
Thiamethoxam	2500	25000	10000	BS/ RT	113	8.75	25000	CT	113	4500		LM	113				
Total Cypermethrin	0.0098	0.0975	0.07		95	0.105	0.195		95								
Triadimefon	102.5	1025	20.5	RT	55	400	26	DM	55	855	50	SC	55				
Triclopyr acid	2925	29250	52000	RT/ FM	86	33225	40350	DM	86	16250	3500	SC	86				
Trifloxystrobin	0.3575	3.575	2.15	RT	134	6.325	1.38	DM	134	18.55	5.25	SC	134				
Trifluralin	1.09	10.9	1.09	RT	45	62.75	1.2	DM	45	3.76	2.685	SC	45				
cis-Permethrin[N]	0.0198	0.1975	0.15	BS/ FM	58	0.26	0.0195	DM	58								
trans-Permethrin	0.0725	0.725	0.15			0.025	0.0195			0.0195							

[1]Values are reported in µg/L

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]

[2] Fisheries species have been abbreviated as follows: 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.
[3] In cases where the acute and chronic toxicity studies used to develop of the assessment criteria for this report were not conducted using the same test species, the abbreviation for the tests species associated with the acute assessment criteria is listed before the forward-slash and the abbreviation for the tests species associated with the chronic assessment criteria is listed after the forward-slash.
[4] Numbers are associated with the list of referenced studies included at the end of this addendum which are organized according to the reference
[5] Invertebrate species have been abbreviated as follows: CD-Ceriodaphnia dubia, CT-Chironomus tentans (midge), DM-Daphnia magna, ND-Not Described
[6] Plant species have been abbreviated as follows: 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)
[7] Promulgated standards according to Chapter 173-201A WAC.
[8] EPA National Recommended Water Quality Criteria (EPA-822-R-02-047).
CMC: Criteria Maximum Concentration
CCC: Criteria Continuous Concentration
[A] Criteria applies to the sun of DDT and its metabolites.
[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.
[M] 2,4-D criteria in this table are in acid equivalents. Toxicity values for the individual forms 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 48: Marine Assessment Criteria

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]
1-Naphthol	30	600		SM	10	50		MS	10								
2,4'-DDD														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
2,4'-DDE														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
2,4'-DDT														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
2,4-D[M]	3.91	78.2	27.75	TS	1	23		GS	1	76		MD	1				
3-Hydroxycarbofuran	0.825	16.5	1.3			1.15	0.2										
4,4'-DDD														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
4,4'-DDE														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
4,4'-DDT														0.55[A]	0.0005[A]	0.55[A,B]	0.0005[A,C]
4-Nitrophenol																	
Acetamiprid	2500	50000		SM	101	16.5	1.25	MS	101	500		Skc	101				
Acetochlor																	
Alachlor																	
Aldicarb																	
Aldicarb Sulfone																	
Aldicarb Sulfoxide																	
Aminomethyl-phosphoric acid																	
Atrazine	50	1000	550	SM	4	23.5	50	AT/PO	4	11		IG	4				
Azinphos-Ethyl																	
Azinphos-methyl																	0.005
Azoxystrobin	16.75	335	105	SM	116	14	4.75	MS	116								
Bifenazate	10.4	208		SM	103	14.5		MS	103								
Bifenthrin																	
Boscalid	96.5	1930			94	255			94								
Bromacil	4.05	81				32.5											
Bromoxynil	4.25	85		SM	8	16.25		MS	8	70		SkC	83				
Captan	48.15	963		SM	73	0.825		EO	73	84.5	16.15	SkC	73				
Carbaryl	6.25	125		AS	9;10	1.425		MS	10								
Carbofuran	0.825	16.5	1.3	AS/SM	54	1.15	0.2	PS/MS	54								

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]
Carboxin						3500											
Chlorantraniliprole	300	6000	640	SM		9.975	482.5	EO/ MS		7300		SkC					
Chlorothalonil	0.8	16				0.9	0.6										
Chlorpropham																	
Chlorpyrifos	6.75	135	0.14	SM/ AS	11	0.0087 5	0.0023	MS	11					0.042	0.0028	0.0055[D]	0.0028[E]
Chlorsulfuron	24500	490000		SM	117	22250											
Clopyralid																	
Clothianidin	2285	45700		SM	104	13.25	2.55	MS	104								
Cycloate																	
Cyprodinil	31.25	625	65		96	2.035	0.95		96								
DDT-Total														0.55	0.0005	0.55	0.0005
Dacthal (DCPA)	25	500		SM	56	155		EO	56	5500		SkC	56				
Diazinon	3.75	75	0.235	SM	14	6.25	0.115	MS	14							0.41	0.41
Dicamba																	
Dichlobenil	317.5	6350		SM	16	407.5		EO	16								
Dichlorprop																	
Dichlorvos (DDVP)																	
Dicofol	9.25	185		SM	97	3.775		EO	97								
Difenoconazole	20.475	409.5		SM	118	37.5	0.0575	MS	118								
Dimethoate	2775	55500		SM	18	3750		MS	18								
Dinotefuran	272.5	5450		SM	106	197.5		MS	106								
Diphenamid																	
Disulfoton Sulfoxide																	
Disulfoton sulfone																	
Diuron	167.5	3350	220	SM	21	1225	135	EO/ MS	21								
EPN																	
Endosulfan I														0.11[I]	0.028[I]	0.11[B,F]	0.028[C,F]
Endosulfan II														0.11[I]	0.028[I]	0.11[B,F]	0.028[C,F]
Endosulfan Sulfate	0.0775	1.55		SM	82		0.19	MS	82								
Endosulfan-Total														0.11[I]	0.028[I]	0.11[B,F]	0.028[C,F]
Eptam																	
Ethoprop																	

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]
Etoxazole	4	80		SM	107	0.275	0.16	MS/ EO	107								
Etridiazole	100	2000		SM	119	625		MS	119								
Fenamiphos						1.55											
Fenarimol																	
Fipronil																	
Fipronil Sulfide																	
Fipronil Sulfone																	
Fludioxonil	30	600	12.5	SM/ ACR	125	57.5	2.85	MS/ ACR	125	35		SC	125				
Glufosinate-ammonium	24075	481500		SM	115	1925		EO	115	11000		SkC	115				
Glyphosate	6000	120000		SM	114	10000		MS	114								
Hexachlorobenzene																	
Hexazinone																	
Imazapic	2467.5	49350		SM	108	24425		MS	108								
Imazapyr	4600	92000		SvM	109	33000		EO	109								
Imidacloprid	4075	81500		SM	61	9.25	0.3	MS	61								
Isoxaben	21.5	430	480	SM	120	240	119	MM	120								
Linuron	22.25	445				222.5											
MCPA	67.5	1350		AS	32	32.5		EO	32	7.5		SkC	32				
Malaoxon	0.675	13.5	8.65		31/ 99	0.55	0.065		31								
Malathion	0.675	13.5	8.65		31/ 99	0.55	0.065		31								0.05
Mecoprop (MCPP)																	
Metalaxyl						1100		EO	51								
Methiocarb																	
Methomyl	29	580	130	SM	50	57.5	14.5	MS	50								
Methoxychlor	0.8	16		SM	135	0.9		BrS	135								
Methoxyfenozide	70	1400		SM	110	300	12.5	MS/ EO	110								
Metolachlor	245	4900	1800	SM	33	400	350	EO	33	30.5	0.85	SkC	33				
Metribuzin	2125	42500		SM	52	10500		EO	52	4.35	2.9	SkC	52				
Metsulfuron-methyl	2625	52500		SM	121	25000		EO	121	49000	18900	SkC	121				
Myclobutanil																	

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]
N,N-Diethyl-m-toluamide																	
Napropamide	350	7000				350											
Norflurazon																	
Oryzalin																	
Oxadiazon	37.5	750		SM	124	67.5		MS	124	2.6	0.7	SkC	124				
Oxamyl	65	1300		SM	62	100		EO	62								
Oxamyl oxime					62				62				62				
Oxyfluorfen																	
Pendimethalin																	
Pentachlorophenol	6	120	32	SM	38	12		PO	38	13.5		SkC	38	4.1[J]	3.95[K]		
Phosmet																	
Picloram																	
Piperonyl butoxide																	
Prometon	1182.5	23650				4500											
Prometryn	128.5	2570		SM	126	580		MS	126	3.91	10.1	SkC	126				
Propachlor																	
Propargite																	
Propazine	96.75	1935	670	SM	20	1050	133	MS	20								
Propiconazole	56.1	1122		LX	127	28.25	102.5	EO/ MS	127								
Propoxur																	
Propyzamide																	
Pyraclostrobin	1.9225	38.45	5.4	SM	128	1.04	0.25	MS	128								
Pyridaben	0.43	8.6	1.05	SM	129	0.1675	0.065	MS	129								
Pyrimethanil	70	1400		SM	130	850	125	MS	130								
Simazine	104.75	2095	312.5	SB/ ACR	41	925		EO	41	300	125	SkC	36				
Sodium Bentazon	2.5	50		BG	6	27250		PS/ EO	6								
Sulfentrazone	2850	57000		AS	132	250	1.5	MS/ CR	132	900	675	SkC	132				
Sulfometuron methyl	1125	22500		FM	133	9550		EO	133	205	205	SkC	133				
Sulfoxaflor	6650	133000	600	SM	111	160	55	MS	111								
Tebuthiuron	2450	49000		SM	42	15500	2325	PS/ ACR	42	25	19	SkC	42				

Pesticide	Fisheries					Invertebrates				Aquatic Plants				WAC[1,7]		NRWQC[1,8]	
	ESLOC[1]	Acute[1]	Chronic[1]	Sp.[2,3]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,5]	Ref.[3,4]	Acute[1]	Chronic[1]	Sp.[3,6]	Ref.[3,4]	Acute[1]	Chronic[1]	CMC[1]	CCC[1]
Terbacil	2712.5	54250	1400	SM	43	1225		EO	43								
Tetrahydrophthalimide																	
Thiacloprid	492.5	9850	299	SM	112	7.825	0.55	MS	112								
Thiamethoxam	2775	55500		SM	113	1725		MS	113								
Total Cypermethrin	0.0238	0.475	0.17		95	0.001188	0.000391		95								
Triadimefon																	
Triclopyr acid	3250	65000		TS	86	14500		EO	86								
Trifloxystrobin	1.95	39		SM	134	2.155		MS	134								
Trifluralin	6	120	0.65	SM	45	34	69	MS/ GS	45	14	2.3	SkC	45				
cis-Permethrin[N]	0.055	1.1	0.415			0.00475	0.0055										
trans-Permethrin	0.055	1.1	0.415			0.00475	0.0055										

[1] Values are reported in µg/L

[2] Fisheries species have been abbreviated as follows: 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.

[3] In cases where the acute and chronic toxicity studies used to develop of the assessment criteria for this report were not conducted using the same test species, the abbreviation for the tests species associated with the acute assessment criteria is listed before the forward-slash and the abbreviation for the tests species associated with the chronic assessment criteria is listed after the forward-slash.

[4] Numbers are associated with the list of referenced studies included at the end of this addendum which are organized according to the reference

[5] Invertebrate species have been abbreviated as follows: CD-Ceriodaphnia dubia, CT-Chironomus tentans (midge), DM-Daphnia magna, ND-Not Described

[6] Plant species have been abbreviated as follows: 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)

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

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

CMC: Criteria Maximum Concentration

CCC: Criteria Continuous Concentration

[A] Criteria applies to the sun of DDT and its metabolites.

[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.

[M] 2,4-D criteria in this table are in acid equivalents. Toxicity values for the individual forms 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 (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 pesticides 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.

Criterion Continuous Concentration: An 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.

Criteria Maximum Concentration: 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.

Degradate: Pesticide breakdown product.

Dissolved oxygen: A measure of the amount of oxygen dissolved in water.

Exceedance: An analyte concentration or other measurement is classified as an exceedance when it is found to be above the assessment criteria or other regulatory standard identified in this report.

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.

Flux: Instantaneous loading rate (e.g. kg/sec)

Freshwater - Core Summer Salmonid Habitat: 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). Other common characteristic aquatic life uses for waters in this category include rearing and migration by salmonids.

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

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.

Laboratory control sample (LCS(s)): Laboratory control samples are a type of quality control samples in which a known amount of pure analytical grade compound is intentionally introduced, or "spiked", into pure water. LCSs are included with every batch of samples and are treated in exactly the same manner as the field samples throughout the sample extraction and sample analysis processes. LCSs are used in conjunction with LCSDs to evaluate the performance of the analytical method. Analyte recoveries are used to assess the accuracy of the analytical method and, the relative standard difference between LCS and LCSD recoveries is used to assess the precision of the analytical method. LCS and LCSDs are used to assess the reproducibility between batches and can also be compared to MS and MSD recoveries to assess if results that fall outside of the acceptance criteria may be due to matrix effects and not due to the analytical method itself.

Laboratory control sample duplicate (LCSD(s)): Laboratory control sample duplicates are a type of quality control sample and are an exact duplicate of the laboratory control sample. Like the LCS samples, LCSD samples are included with every batch of field samples and like the LCS samples they are treated in exactly the same manner as the field samples throughout the sample extraction and sample analysis processes.

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

Load: Mass of substance passing a specified point (e.g., Kg)

Loading: The input of pollutants into a waterbody.

Lowest Observable Adverse Effect Concentration (LOAEC): The lowest concentration in a toxicity test showing a statistically significant difference from the control.

Marine water: in the context of this report refers seawater or to areas where freshwater has mixed with salt water such as an estuary.

No Observable Adverse Effect Concentration (NOAEC): The highest concentration in the toxicity test not showing a statistically significant difference from the control. The NOAEC is by definition the next concentration below the LOEC in the concentration series.

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.

Quality Assurance & Quality Control (QA/QC): Quality Assurance and Quality Control refer to the combined process of evaluating the performance of laboratory and field methods. Quality Assurance refers to aspects of the monitoring program that are designed to evaluate the monitoring as a whole including field methods and other process outside of the laboratory analysis. Quality control relates specifically to aspects of the monitoring program that are designed to evaluate laboratory performance and ensure that the laboratory data is of reliable quality.

Effect endpoints: 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 (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: A risk quotient 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.

Sampling event: 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.

Streamflow: the volume of water found in a stream at any given time.

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

7-DADMax: is the 7-day average of the daily maximum temperatures or the arithmetic average of seven consecutive measurements 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
CCC	Criterion Continuous Concentration
CMC	Criteria Maximum Concentration
DDD	Dichloro-diphenyl-dichloroethane
DDE	Dichloro-diphenyl-dichloroethylene
DDT	Dichloro-diphenyl-trichloroethane
DO	Dissolved oxygen
EPA	United States Environmental Protection Agency
ESLOC	Endangered species LOC(s) (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(s) 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
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
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
µg/L	Micrograms per liter (parts per billion)
mg/L	Milligrams per liter (parts per million)
s.u.	Standard units