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Pesticide Groundwater Sampling in the Sumas-Blaine Surficial Aquifer

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Introduction

The Washington State Department of Ecology (Ecology) began a long-term groundwater monitoring program in the Sumas-Blaine Aquifer (SBA) in 1997 due to elevated nitrate concentrations. The primary objective of the program is to assess changes in groundwater nitrate concentration over time. From 2009 to 2016, Ecology collected samples from between 16 and 25 water supply wells annually and analyzed the groundwater samples for nitrate, chloride, and bromide (Carey 2017). In 2019, Ecology and Washington State Department of Agriculture (WSDA) selected 17 domestic wells and one public well from Ecology's groundwater monitoring program to test for pesticides and pesticide-related chemicals. Prior to this project, WSDA had not conducted any groundwater pesticide sampling in the SBA.

Ecology identified the SBA as one of the most severely nitrate-contaminated aquifers in Washington (Erickson 2000). Other chemicals that are susceptible to leaching, such as water-soluble pesticides, have the potential to enter Washington's aquifers; however, groundwater pesticide data is currently too limited to confidently evaluate the risk or extent of any aquifer contamination.

The ongoing groundwater quality studies by Ecology and WSDA are building the groundwater pesticide datasets to assess aquifer susceptibility to contamination from various land-use activities. The primary goal of this study was to conduct a preliminary assessment of pesticide presence and concentration in the SBA. Groundwater pesticide concentration data would further the understanding of pesticide mobility in this agriculturally dense watershed and the potential for environmental and human health impacts. Groundwater pesticide concentrations were compared to Environmental Protection Agency (EPA) established drinking water criteria and benchmarks to evaluate if they posed a risk to human health.

Study Area

This project took place in the Sumas-Blaine Aquifer located in the Fraser and Nooksack Lowlands in Whatcom County, Washington (Figure 1). Land use in the area is predominantly agriculture in the forms of dairy farming and crop production. Major crops include grass hay, field corn, berry, pasture, and potato (WSDA 2019).

The aquifer covers an area of approximately 150 square miles (Tooley and Erickson 1996). The glacial outwash plain is composed of unconsolidated sand, silt, and gravel sediments that resulted from advancing and retreating continental glaciers (Cox and Kahle 1999). The unconsolidated water bearing zones are sandwiched between lower permeability silt and clay layers (Cox and Kahle 1999). The general flow direction of the aquifer is to the south towards the Nooksack River. The aquifer is hydraulically connected to surface water drainage networks, including Bertrand Creek (Erickson and Norton 1990). The depth to the water table is shallow (generally less than 10 feet) and the aquifer has a saturated thickness ranging between 25 and 75 feet (Tooley and Erickson 1996). The shallow depth to groundwater and connectivity to surface drainage (streams, rivers, lakes and ditches) make the SBA highly susceptible to contamination from the land use above.

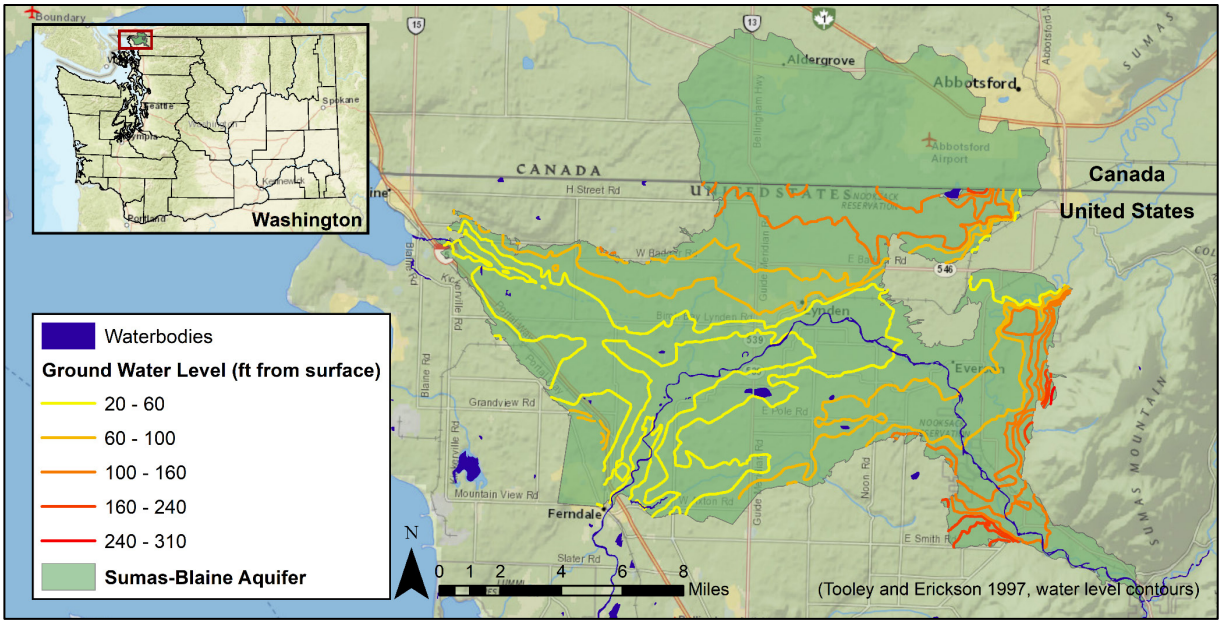

Figure 1: Map of study area in Whatcom County, Washington

Methods

In 2019, WSDA requested that Ecology collect additional water samples for pesticide analysis while they conducted their long-term groundwater monitoring in the SBA. Ecology collected these samples from 17 domestic water supply wells and one public well located near Lynden, Washington (Figure 2) from March 25 to March 28. All methods in this project followed Ecology's Sumas-Blaine Surficial Aquifer Long-Term Ambient Groundwater Monitoring Quality Assurance Project Plan (Daiber 2019), Ecology's Standard Operating Procedure EAP077 for purging and sampling water supply wells (Marti 2016), and WSDA's Standard Operating Procedure for Water Quality and Pesticides Monitoring (Bischof 2019).

Ecology's Manchester Environmental Laboratory analyzed the groundwater samples for 156 analytes (pesticides and pesticide-related chemicals). Analytes included insecticides, herbicides, fungicides, historical-use pesticides, pesticide degradates, and other pesticide-related chemicals such as an antimicrobial, an insect repellent, synergists, and a wood preservative. The full list of analytes is shown in Appendix A. Concentrations detected were compared to EPA's 2018 Edition of the Drinking Water Standards and Health Advisories (DWSHA) tables (EPA 2018). If an analyte was not listed in the DWSHA tables, then EPA's Human Health Benchmark for Pesticides (HHBP) chronic criteria were used (EPA 2017). If the pesticide was not listed in the DWSHA or HHBP tables, then the criteria was calculated based on the EPA established reference dose. The EPA established criteria and derived criteria are referred to as EPA drinking water criteria in this report.

Field quality control samples consisted of two field replicate samples, one transfer blank, and one matrix spike/matrix spike duplicate. No sample detections were qualified to non-detects due to field blank detections or field replicate results. Lab quality control samples consisted of two lab blanks and one laboratory control sample/laboratory control sample duplicate. Due to lab blank detections, one hexazinone detection, one 2,6-dichlorobenzamide detection, and two N,N-diethyl-m-toluamide detections were qualified to non-detects.

Results and Discussion

Out of the 18 wells sampled, 15 had at least one pesticide detection. The locations of the wells sampled are shown in Figure 2. Overall 22 different pesticide or pesticide-related chemicals were detected at trace levels, well below the EPA drinking water criteria (Table 1).

Fourteen wells had 2,6-dichlorobenzamide detections, making it the most frequently detected analyte in this project. This compound is a degradate of both dichobenil (an herbicide) and fluopicolide (a fungicide). Dichlobenil is labeled for use on crops grown in the region such as blueberries, raspberries and ornamental nurseries. It also has a variety of non-agricultural uses including fencerows, roadside right-of-ways, outdoor homeowner use, and several others. Labeled uses for fluopicolide relevant to this region include ornamental nurseries and sod farms.

Metalaxyl and sulfentrazone were detected at six wells each and were the next most frequently detected pesticides. Metalaxyl (fungicide) is labeled for use on crops in the region including blueberries, strawberries, ornamental nurseries, potatoes and sod farms. Sulfentrazone (herbicide) is labeled for use on many of the crops grown within this region including blueberries, strawberries, raspberries, field corn, potatoes and sod farms. Additionally, sulfentrazone is labeled for fallow land, fencerows, roadside right-of-ways and other non-agricultural uses.

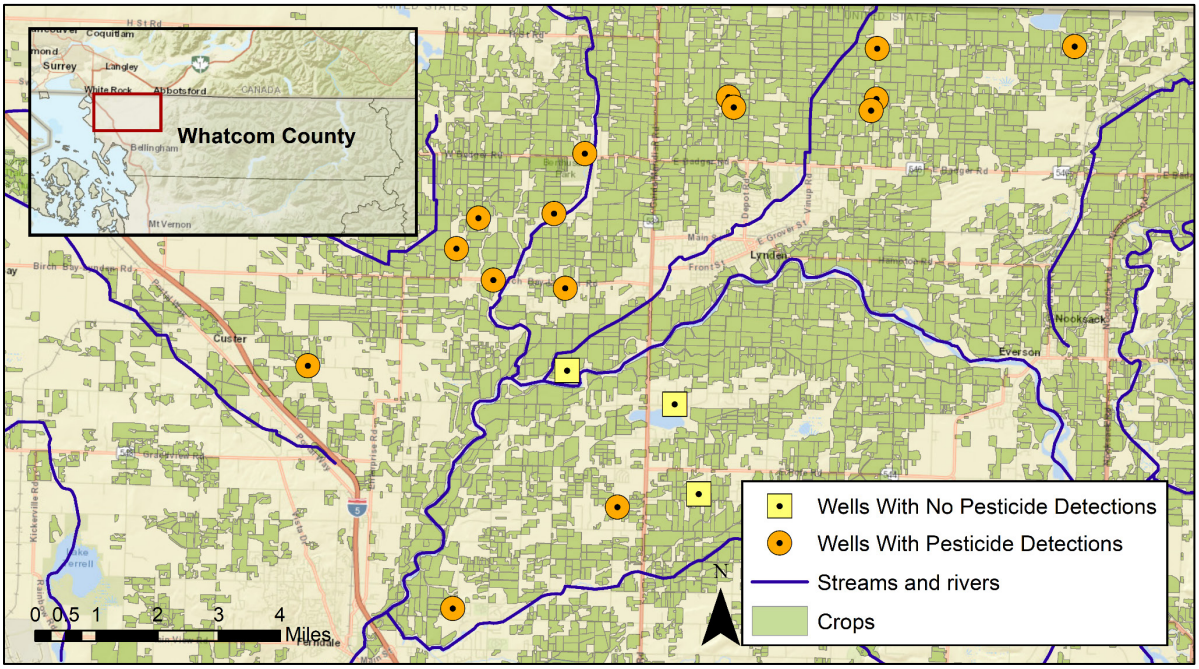

Figure 2: Well sampling locations

The maximum number of detections at one well was 11. Thirteen wells had a mixture of at least two pesticides or pesticide-related chemicals detected. Although the effects of pesticide mixtures on human health remain largely unknown, a growing number of studies are finding that pesticides can interact in various ways that may increase or decrease the individual pesticide's toxicity (Rizzati et al. 2016). To date, there is no EPA-approved method for assessing the cumulative health impacts of multiple pesticide compounds in drinking water. Most pesticides and pesticide parent compounds of degradates detected have groundwater advisories on many of their registered product labels. The detected pesticides and degradates without groundwater advisories include fenarimol, fipronil sulfide, prometon, and triclosan.

Table 1: Summary of pesticides detected and corresponding drinking water criteria

Analyte	Use*	Detections (n)	Concentration range (µg/L)	EPA drinking water criteria (µg/L)	% of criteria#	Type of criteria†
2,6-Dichlorobenzamide	D	14	0.00558 – 1	29	3.45%	Chronic HHBP
Metalaxyl	F	6	0.0307 – 0.292	512	0.06%	Calculated HAL
Sulfentrazone	H	6	0.00701 – 0.231	900	0.03%	Chronic HHBP
Oxamyl	I	5	0.0335 – 0.514	200	0.26%	MCL
Hexazinone	H	5	0.00866 – 0.126	400	0.03%	Lifetime HAL
Oxamyl oxime	D	4	0.064 – 0.619	200	0.31%	MCL for oxamyl
Prometon	H	4	0.00633 – 0.0371	400	0.01%	Lifetime HAL
Norflurazon	H	4	0.00548 – 0.00649	96	0.01%	Chronic HHBP
Boscalid	F	4	0.0054 – 0.0582	1,400	0.00%	Chronic HHBP
Atrazine	H	2	0.00537 – 0.00856	3	0.29%	MCL
Thiamethoxam	I	2	0.19 – 0.202	77	0.26%	Chronic HHBP
Dacthal	H	2	0.0669 – 0.0731	70	0.10%	Lifetime HAL
Fenarimol	F	2	0.00905 – 0.00995	40	0.02%	Chronic HHBP
Triclopyr	H	2	0.0637 – 0.0642	300	0.02%	Chronic HHBP
Triclosan	A	2	0.0107 – 0.0113	2,000	0.00%	Chronic HHBP
Fipronil sulfide	D	1	0.007 – 0.007	1	0.70%	HHBP for fipronil
Deisopropyl atrazine	D	1	0.0208 – 0.0208	3	0.69%	MCL for atrazine
Bentazon	H	1	0.114 – 0.114	200	0.06%	Lifetime HAL
Bromacil	H	1	0.0201 – 0.0201	70	0.03%	Lifetime HAL
Terbacil	H	1	0.00761 – 0.00761	90	0.01%	Lifetime HAL
Metribuzin	H	1	0.00528 – 0.00528	70	0.01%	Lifetime HAL
Dinotefuran	I	1	0.0461 – 0.0461	6,000	0.00%	Chronic HHBP

* A: Antimicrobial, D: Degradate, F: Fungicide, H: Herbicide, I: Insecticide
# Percent of criteria of the highest concentration detected across all locations
† MCL: Maximum Contaminant Level, Lifetime HAL: Lifetime Health Advisory Level, Chronic HHBP: Chronic Human Health Benchmark for Pesticides, Calculated HAL: Calculated Health Advisory Level

WSDA compared all groundwater pesticide concentrations to EPA established drinking water criteria. The majority of pesticide detections were less than 1% of the EPA drinking water criteria. The highest concentration detected was 1 µg/L for 2,6-dichlorobenzamide, which is approximately 3.4% of the EPA drinking water criteria. All pesticides, degradates, and pesticide-related chemicals detected in this study were found at trace levels well below the EPA drinking water criteria.

Conclusions and Recommendations

This partnership between Ecology and WSDA provided an opportunity to investigate the presence and concentration of pesticides in the shallow SBA by collecting and analyzing samples from water supply wells. The Washington State Pesticide Management Strategy outlines WSDA's process to protect groundwater from pesticides and establishes response procedures by comparing the concentration of the pesticide detection to the drinking water criteria (Cook and

Cowles 2009). The first level of response for groundwater contamination is for pesticide detections with concentrations that fall between 10 and 20% of the drinking water criteria. All pesticide detections during the spring 2019 sampling event were well below this threshold. In the fall of 2019, WSDA worked with Ecology to notify the well owners of the presence of trace amounts of agricultural pesticides in their wells.

Given the vulnerable nature of the SBA to contamination from surface activities, additional research would be helpful in further investigating the influence of agricultural pesticides on groundwater quality. A future pesticide study with a broader distribution of wells, a greater number of sampling events, and sampling in both spring and fall seasons would be valuable in characterizing the groundwater quality of the SBA.

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Appendix A: Analyte Testing List with Reporting Limits

In the pesticide groundwater project, WSDA tested for 156 analytes (Table 2). For each analyte, the Manchester Environmental Laboratory reports the lower limit of quantitation (LLOQ), which is the lowest concentration at which the laboratory has demonstrated analytes can be reliably reported with a level of confidence. The LLOQ was adjusted for each individual sample according to sample volume and dilution (if needed). Results outside the instrument calibration range may be qualified as estimates. Mean LLOQ are listed in Table 2.

Table 2: Mean performance of reporting limits for analytes tested in µg/L

Analyte	CAS number	Analytical method	Pesticide type	Mean LLOQ
1-(3,4-Dichlorophenyl)-3-methylurea	3567-62-2	LCMS-Pesticides	Degradate	1.00E-02
2,4-D	94-75-7	GCMS-Herbicides	Herbicide	6.08E-02
2,6-Dichlorobenzamide	2008-58-4	GCMS-Pesticides	Degradate	6.50E-03
2-Hydroxyatrazine	2163-68-0	LCMS-Pesticides	Degradate	1.00E-02
3,5-Dichlorobenzoic acid	51-36-5	GCMS-Herbicides	Degradate	6.08E-02
4,4'-DDD	72-54-8	GCMS-Pesticides	Degradate	5.06E-03
4,4'-DDE	72-55-9	GCMS-Pesticides	Degradate	5.06E-03
4,4'-DDT	50-29-3	GCMS-Pesticides	Insecticide	5.06E-03
4-Nitrophenol	100-02-7	GCMS-Herbicides	Degradate	6.08E-02
Acephate	30560-19-1	LCMS-Pesticides	Insecticide	3.00E-02
Acetamiprid	135410-20-7	LCMS-Pesticides	Insecticide	2.00E-02
Acetochlor	34256-82-1	GCMS-Pesticides	Herbicide	5.06E-03
Acetochlor ESA	187022-11-3	LCMS-Pesticides	Degradate	4.00E-02
Afidopyropen	915972-17-7	LCMS-Pesticides	Insecticide	7.00E-02
Alachlor	15972-60-8	GCMS-Pesticides	Herbicide	5.06E-03
Aldicarb sulfoxide	1646-87-3	LCMS-Pesticides	Degradate	1.00E-02
Atrazine	1912-24-9	GCMS-Pesticides	Herbicide	5.06E-03
Azoxystrobin	131860-33-8	LCMS-Pesticides	Fungicide	2.00E-02
Baygon	114-26-1	LCMS-Pesticides	Insecticide	1.00E-02
Benefin	1861-40-1	GCMS-Pesticides	Herbicide	5.06E-03
Bensulide	741-58-2	LCMS-Pesticides	Herbicide	2.00E-02
Bentazon	25057-89-0	GCMS-Herbicides	Herbicide	6.08E-02
Bifenazate	149877-41-8	GCMS-Pesticides	Insecticide	5.06E-03
Bifenthrin	82657-04-3	GCMS-Pesticides	Insecticide	5.06E-03
Boscalid	188425-85-6	GCMS-Pesticides	Fungicide	5.06E-03
Bromacil	314-40-9	GCMS-Pesticides	Herbicide	5.06E-03
Bromoxynil	1689-84-5	GCMS-Herbicides	Herbicide	6.08E-02
Captan	133-06-2	GCMS-Pesticides	Fungicide	5.06E-03
Carbaryl	63-25-2	LCMS-Pesticides	Insecticide	2.00E-02
Carbendazim	10605-21-7	LCMS-Pesticides	Fungicide	1.00E-02
Chlorantraniliprole	500008-45-7	LCMS-Pesticides	Insecticide	2.00E-02
Chlorethoxyfos	54593-83-8	GCMS-Pesticides	Insecticide	1.01E-02
Chlorothalonil (Daconil)	1897-45-6	GCMS-Pesticides	Fungicide	5.06E-03
Chlorpropham	101-21-3	GCMS-Pesticides	Herbicide	5.06E-03
Chlorpyrifos	2921-88-2	GCMS-Pesticides	Insecticide	5.06E-03
Chlorsulfuron	64902-72-3	LCMS-Pesticides	Herbicide	5.00E-02
cis-Permethrin	54774-45-7	GCMS-Pesticides	Insecticide	5.06E-03
Clopyralid	1702-17-6	GCMS-Herbicides	Herbicide	6.08E-02
Clothianidin	210880-92-5	LCMS-Pesticides	Insecticide	1.00E-01

Analyte	CAS number	Analytical method	Pesticide type	Mean LLOQ
Coumaphos	56-72-4	GCMS-Pesticides	Insecticide	5.06E-03
Cycloate	1134-23-2	GCMS-Pesticides	Herbicide	1.52E-02
Cyfluthrin	68359-37-5	GCMS-Pesticides	Insecticide	5.06E-03
Cypermethrin	52315-07-8	GCMS-Pesticides	Insecticide	5.06E-03
Cyprodinil	121552-61-2	LCMS-Pesticides	Fungicide	1.00E-02
Dacthal	1861-32-1	GCMS-Herbicides	Herbicide	6.08E-02
Deisopropyl atrazine	1007-28-9	LCMS-Pesticides	Degradate	1.00E-02
Deltamethrin	52918-63-5	GCMS-Pesticides	Insecticide	5.06E-03
Desethylatrazine	6190-65-4	LCMS-Pesticides	Degradate	1.00E-02
Diazinon	333-41-5	GCMS-Pesticides	Insecticide	5.06E-03
Dicamba	1918-00-9	GCMS-Herbicides	Herbicide	6.08E-02
Dichlobenil	1194-65-6	GCMS-Pesticides	Herbicide	5.06E-03
Dichlorprop	120-36-5	GCMS-Herbicides	Herbicide	6.08E-02
Dichlorvos (DDVP)	62-73-7	GCMS-Pesticides	Insecticide	5.06E-03
Difenoconazole	119446-68-3	LCMS-Pesticides	Fungicide	1.00E-02
Diflubenzuron	35367-38-5	LCMS-Pesticides	Insecticide	7.00E-02
Dimethoate	60-51-5	GCMS-Pesticides	Insecticide	5.06E-03
Dinotefuran	165252-70-0	LCMS-Pesticides	Insecticide	2.00E-02
Dithiopyr	97886-45-8	GCMS-Pesticides	Herbicide	5.06E-03
Diuron	330-54-1	LCMS-Pesticides	Herbicide	1.00E-02
Eptam	759-94-4	GCMS-Pesticides	Herbicide	5.06E-03
Ethalfluralin (Sonalan)	55283-68-6	GCMS-Pesticides	Herbicide	5.06E-03
Ethoprop	13194-48-4	GCMS-Pesticides	Insecticide	5.06E-03
Etoxazole	153233-91-1	GCMS-Pesticides	Insecticide	1.52E-02
Etridiazole	2593-15-9	GCMS-Pesticides	Fungicide	5.06E-03
Fenarimol	60168-88-9	GCMS-Pesticides	Fungicide	5.06E-03
Fenbuconazole	114369-43-6	LCMS-Pesticides	Fungicide	2.00E-02
Fenbutatin oxide	13356-08-6	LCMS-Pesticides	Insecticide	2.00E-02
Fenvalerate	51630-58-1	GCMS-Pesticides	Insecticide	5.06E-03
Fipronil	120068-37-3	GCMS-Pesticides	Insecticide	5.06E-03
Fipronil desulfinyl	205650-65-3	GCMS-Pesticides	Degradate	5.06E-03
Fipronil sulfide	120067-83-6	GCMS-Pesticides	Degradate	5.06E-03
Fipronil sulfone	120068-36-2	GCMS-Pesticides	Degradate	1.01E-02
Fludioxonil	131341-86-1	GCMS-Pesticides	Fungicide	5.06E-03
Flumioxazin	103361-09-7	GCMS-Pesticides	Herbicide	2.53E-02
Fluroxypyr-meptyl	81406-37-3	GCMS-Pesticides	Herbicide	2.53E-02
Hexazinone	51235-04-2	GCMS-Pesticides	Herbicide	5.06E-03
Hexythiazox	78587-05-0	LCMS-Pesticides	Insecticide	1.00E-02
Imazapic	104098-48-8	LCMS-Pesticides	Herbicide	1.00E-01
Imazapyr	81334-34-1	LCMS-Pesticides	Herbicide	1.00E-01
Imidacloprid	138261-41-3	LCMS-Pesticides	Insecticide	2.00E-02
Imidan	732-11-6	GCMS-Pesticides	Insecticide	5.06E-03
Indaziflam	950782-86-2	LCMS-Pesticides	Herbicide	1.00E-02
Isoxaben	82558-50-7	LCMS-Pesticides	Herbicide	1.00E-02
Kelthane	115-32-2	GCMS-Pesticides	Insecticide	2.53E-02
Linuron	330-55-2	LCMS-Pesticides	Herbicide	7.00E-02
Malaoxon	1634-78-2	LCMS-Pesticides	Degradate	1.00E-02
Malathion	121-75-5	GCMS-Pesticides	Insecticide	5.06E-03
MCPA	94-74-6	GCMS-Herbicides	Herbicide	6.08E-02
MCPP	93-65-2	GCMS-Herbicides	Herbicide	6.08E-02

Analyte	CAS number	Analytical method	Pesticide type	Mean LLOQ
Metalaxyl	57837-19-1	GCMS-Pesticides	Fungicide	1.01E-02
Methamidophos	10265-92-6	LCMS-Pesticides	Insecticide	3.00E-02
Methidathion	950-37-8	LCMS-Pesticides	Insecticide	1.00E-02
Methiocarb	2032-65-7	LCMS-Pesticides	Insecticide	3.00E-02
Methomyl	16752-77-5	LCMS-Pesticides	Insecticide	1.00E-02
Methomyl oxime	13749-94-5	LCMS-Pesticides	Degradate	1.00E-01
Methoxyfenozide	161050-58-4	LCMS-Pesticides	Insecticide	1.00E-02
Methyl chlorpyrifos	5598-13-0	GCMS-Pesticides	Insecticide	5.06E-03
Metolachlor	51218-45-2	GCMS-Pesticides	Herbicide	5.06E-03
Metribuzin	21087-64-9	GCMS-Pesticides	Herbicide	5.06E-03
Metsulfuron-methyl	74223-64-6	LCMS-Pesticides	Herbicide	5.00E-02
MGK264	113-48-4	GCMS-Pesticides	Synergist	5.06E-03
Myclobutanil	88671-89-0	LCMS-Pesticides	Fungicide	1.00E-02
N,N-Diethyl-m-toluamide	134-62-3	GCMS-Pesticides	Insect Repellent	5.06E-03
Naled	300-76-5	GCMS-Pesticides	Insecticide	5.06E-02
Napropamide	15299-99-7	GCMS-Pesticides	Herbicide	5.06E-03
Norflurazon	27314-13-2	GCMS-Pesticides	Herbicide	5.06E-03
Oryzalin	19044-88-3	GCMS-Pesticides	Herbicide	2.53E-02
Oxadiazon	19666-30-9	GCMS-Pesticides	Herbicide	5.06E-03
Oxamyl	23135-22-0	LCMS-Pesticides	Insecticide	1.00E-02
Oxamyl oxime	30558-43-1	LCMS-Pesticides	Degradate	3.00E-02
Oxyfluorfen	42874-03-3	GCMS-Pesticides	Herbicide	5.06E-02
Paclobutrazol	76738-62-0	LCMS-Pesticides	Fungicide	1.00E-02
Pendimethalin	40487-42-1	GCMS-Pesticides	Herbicide	5.06E-03
Pentachloronitrobenzene	82-68-8	GCMS-Pesticides	Fungicide	5.06E-03
Pentachlorophenol	87-86-5	GCMS-Herbicides	Wood Preservative	6.08E-02
Phenothrin	26002-80-2	GCMS-Pesticides	Insecticide	1.01E-02
Phorate	298-02-2	GCMS-Pesticides	Insecticide	1.01E-01
Picloram	1918-02-1	GCMS-Herbicides	Herbicide	3.04E-01
Piperonyl butoxide (PBO)	51-03-6	GCMS-Pesticides	Synergist	5.06E-03
Prallethrin	23031-36-9	GCMS-Pesticides	Insecticide	5.06E-03
Prodiamine	29091-21-2	GCMS-Pesticides	Herbicide	2.53E-02
Prometon	1610-18-0	GCMS-Pesticides	Herbicide	5.06E-03
Prometryn	7287-19-6	GCMS-Pesticides	Herbicide	1.01E-02
Pronamide (Kerb)	23950-58-5	GCMS-Pesticides	Herbicide	5.06E-03
Propargite	2312-35-8	GCMS-Pesticides	Insecticide	1.01E-02
Propiconazole	60207-90-1	LCMS-Pesticides	Fungicide	5.00E-02
Pyraclostrobin	175013-18-0	LCMS-Pesticides	Fungicide	5.00E-02
Pyraflufen-ethyl	129630-19-9	GCMS-Pesticides	Herbicide	5.06E-03
Pyrethrins	121-21-1	GCMS-Pesticides	Insecticide	1.01E-01
Pyridaben	96489-71-3	GCMS-Pesticides	Insecticide	5.06E-03
Pyrimethanil	53112-28-0	LCMS-Pesticides	Fungicide	1.00E-02
Pyriproxyfen	95737-68-1	GCMS-Pesticides	Insecticide	1.01E-02
Simazine	122-34-9	GCMS-Pesticides	Herbicide	1.01E-02
Simetryn	1014-70-6	GCMS-Pesticides	Herbicide	2.53E-02
Spirotetramat	203313-25-1	LCMS-Pesticides	Insecticide	2.00E-02
Sulfentrazone	122836-35-5	GCMS-Pesticides	Herbicide	5.06E-03
Sulfometuron-methyl	74222-97-2	LCMS-Pesticides	Herbicide	2.00E-02
Tau-fluvalinate	102851-06-9	GCMS-Pesticides	Insecticide	5.06E-03
Tebuthiuron	34014-18-1	GCMS-Pesticides	Herbicide	1.01E-02

Analyte	CAS number	Analytical method	Pesticide type	Mean LLOQ
Tefluthrin	79538-32-2	GCMS-Pesticides	Insecticide	5.06E-03
Terbacil	5902-51-2	GCMS-Pesticides	Herbicide	5.06E-03
Tetrachlorvinphos	961-11-5	GCMS-Pesticides	Insecticide	5.06E-03
Tetrahydrophthalimide	27813-21-4	GCMS-Pesticides	Degradate	5.06E-03
Tetramethrin	7696-12-0	GCMS-Pesticides	Insecticide	5.06E-03
Thiacloprid	111988-49-9	LCMS-Pesticides	Insecticide	1.00E-02
Thiamethoxam	153719-23-4	LCMS-Pesticides	Insecticide	2.00E-02
Tralomethrin	66841-25-6	GCMS-Pesticides	Insecticide	5.06E-03
trans-Permethrin	61949-77-7	GCMS-Pesticides	Insecticide	5.06E-03
Treflan (Trifluralin)	1582-09-8	GCMS-Pesticides	Herbicide	5.06E-03
Triadimefon	43121-43-3	GCMS-Pesticides	Fungicide	5.06E-03
Triallate	2303-17-5	GCMS-Pesticides	Herbicide	5.06E-03
Triclopyr	55335-06-3	GCMS-Herbicides	Herbicide	6.08E-02
Triclopyr-butoxyl	64700-56-7	GCMS-Pesticides	Herbicide	1.01E-02
Triclosan	3380-34-5	GCMS-Pesticides	Antimicrobial	1.01E-02
Trifloxystrobin	141517-21-7	LCMS-Pesticides	Fungicide	2.00E-02
Zoxamide	156052-68-5	LCMS-Pesticides	Fungicide	1.00E-02