



Regional and Local Pesticide and Ground Water Monitoring Results, 2017

ISDA Technical Summary #56

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Abstract

The Idaho State Department of Agriculture (ISDA) Ground Water Program implements the Idaho Pesticide Management Plan (PMP) (2001), and the Rules Governing Pesticide Management Plans for Ground Water Protection (IDAPA 02.03.01) (Idaho PMP Rule). The Idaho PMP Rule requires the ISDA to conduct monitoring and response actions associated with pesticide detections in Idaho ground water, and to help prevent further contamination that may result in exceeding drinking water standards. ISDA staff collected samples from 257 wells from major aquifers throughout Idaho in 2017. These wells are primarily used for domestic drinking water. ISDA submitted ground water samples to be tested for more than 100 pesticides or their breakdown components at the Idaho Food Quality Assurance Laboratory (IFQAL), Twin Falls, ID. The testing methods at IFQAL allow pesticides to be detected at low levels; these pesticides detected in drinking water do not indicate a health risk until reference points are exceeded. A sub-set of select wells was also tested for 82 Volatile Organic Compounds (VOC).

There were measurable detections of pesticides in 123 of the 257 monitored wells. On average, at wells with pesticides detected, the concentrations were at 3% of the reference point, falling into the Level 1 response category. Over 98% of the wells tested fall into or below the Level 1 response category of the Idaho PMP Rule, which are at levels protective of human health. Five wells, and six pesticides, were found with pesticide concentrations above the Level 1 response category. One well had detectable pesticide concentrations that were greater than half the recommended levels (Level 3 category) for the measured Desethyl atrazine. There was also a Level 2 category detection of Atrazine near Ashton, ID. Two wells were greater than half the reference point for herbicide Triallate; both of these wells have known historical and site-specific problems. One well was south of Lewiston, ID, and the other was near Ashton, ID. Both of these wells fall into the Level 3 response category. The well near Lewiston, ID also had a Level 2 response category for Pentachlorophenol. All of these wells are discussed in more detail below and in Annual Technical Summaries. Other wells near these locations do not have these pesticide concentrations, indicating that these are isolated problems. In the Dacthal restriction area, monitoring results found one well in which Dacthal was identified above 20% of the reference point, thereby falling into the Level 2 response category. No well monitored in 2017 exceeded a drinking water standard or reference level.

In eastern Idaho, the project developed and initiated in 2015 changed into a long-term project to monitor for methyl bromide and its breakdown components and the potential ground water impacts at wells near locations within the Pale Cyst Nematode Eradication Program Area. There were no measured pesticides or their breakdown products associated with the nematode eradication program in these wells. The snowpack from the winter of 2016/2017 was significantly greater than average; it is suspected that this snowpack and subsequent ground water recharge may have affected some well water quality. Long-term data are required to confirm this initial observation.

Currently, there are no indications that appropriate and widespread application of pesticides are leading to contamination of the aquifers or impacting beneficial uses. However, there are widespread detections of pesticides in both shallow and deep wells throughout the State of Idaho. Additionally, data from 2017 suggest that there may be residual reservoirs of pesticides in the soil column. It is unknown to what extent or magnitude might be in these potential pesticide reservoirs and what their effects might be on the ground water quality. Long-term monitoring is required to ensure that the current application and management practices are effective.

Introduction

The Idaho State Department of Agriculture (ISDA) Ground Water Program implements the Idaho Pesticide Management Plan (PMP) (2001), and the Rules Governing Pesticide Management Plans for Ground Water Protection (IDAPA 02.03.01) (Idaho PMP Rule). The Idaho PMP Rule requires the state to conduct monitoring and response actions associated with pesticide detections in Idaho ground water, and to prevent contamination that may result in drinking water exceedances. Regional and local pesticide ground water monitoring has been conducted throughout numerous aquifers in Idaho. Monitoring of over two hundred wells occurred in 2017 for the following counties: Ada, Bingham, Bonneville, Canyon, Cassia, Elmore, Fremont, Gem, Gooding, Idaho, Jefferson, Jerome, Kootenai, Latah, Lewis, Lincoln, Madison, Minidoka, Nez Perce, Owyhee, Payette, Twin Falls, and Washington.

The goal of the monitoring is to statistically determine the potential impacts to ground water and to conduct response monitoring in areas where there have been frequent and elevated detections. Each project is designed to capture representative samples and data for that specific area. The response monitoring to implement the PMP rule has been accomplished to develop a better understanding of the impacts from registered active ingredients that have been detected in Idaho, in addition to protecting the drinking water of the citizens of Idaho.

The samples collected from 257 wells were tested for 107 pesticides at the Idaho Food Quality Assurance Laboratory (IFQAL) in Twin Falls, ID. ISDA has worked with the IFQAL to create a specialized list of analytes that are registered for use in Idaho and have potential to reach ground water. A 56 well subset was tested for 82 Volatile Organic Compounds (VOCs) at the Idaho Bureau of Laboratory (IBL). This VOC test suite is not limited to pesticides, but also includes other chemicals in the standard request. None of those identified non-pesticide chemicals (if any) are reported in this document. ISDA has water samples tested for a variety of pesticides; the term pesticides is used in a general sense and is inclusive of herbicides, insecticides, fungicides, etc.

The project instituted in 2015 in the Idaho Falls/Shelley Pale Cyst Nematode area has been expanded into a long-term project in response to concerns of methyl bromide application to eradicate the pale cyst nematode. ISDA is monitoring the ground water in wells near the application areas. Samples were submitted to IFQAL to analyze the pesticide suite and to the IBL for analysis for VOCs and various anions (bromide, chloride and sulfate). This is a United States Department of Agriculture led eradication program and ISDA's involvement is to monitor the ground water to ensure Rules Governing Pesticide Management Plans for Ground Water Protection (IDAPA 02.03.01) (Idaho PMP Rule) are being met.

Background

The Division of Agricultural Resources Ground Water Program is responsible for a variety of programs, laws and rules for protection of ground water from pesticides. ISDA has a cooperative agreement with US EPA to implement the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

The Idaho PMP and the Idaho PMP Rule require the state to respond to pesticide detections in Idaho ground water. The state response, as outlined in these two documents, is based on four distinct levels established by pesticide detection concentrations as they relate to a percentage of a reference point. A reference point is based on a health standard, such as a maximum contaminant level (MCL), lifetime health advisory level (HAL), drinking water equivalent level (DWEL), human health benchmark for pesticides (HHBP), or reference dose (RfD). Idaho has adopted the EPA's MCLs in the Idaho Ground Water Quality Rule (1997). An MCL is defined by US EPA as the highest level of a contaminant that is allowed in drinking water and is an enforceable standard. Appendix A details the reference point selection and sources used by ISDA.

The Idaho PMP Rule divides pesticide detections into the following levels:

Level 1: Detection above the laboratory detection limit to less than 20% of the reference point.

Level 2: Detection at 20% to less than 50% of the reference point.

Level 3: Detection at 50% to less than 100% of the reference point.

Level 4: Detection at or greater than 100% of the reference point.

ISDA response actions increase and become more comprehensive as the detection level increases. The majority of the detections are lower in concentration, therefore most response efforts are related to education and promoting Best Management Practices (BMPs) related to proper pesticide use, storage, disposal and protection of ground water quality. This report describes the monitoring results and the associated concentrations through time.

Regional and Local Pesticide Monitoring Results by Project

Regional and local pesticide ground water monitoring has been conducted throughout numerous aquifers in Idaho. There are currently 25 Project areas (Table 1). Two-hundred fifty-seven (257) wells were monitored in the following 23 counties in 2017: Ada, Bingham, Bonneville, Canyon, Cassia, Elmore, Fremont, Gem, Gooding, Idaho, Jefferson, Jerome, Kootenai, Latah, Lewis, Lincoln, Madison, Minidoka, Nez Perce, Owyhee, Payette, Twin Falls, and Washington. Pesticide concentrations were at measurable levels in the following 18 counties: Ada, Bingham, Bonneville, Canyon, Cassia, Elmore, Fremont, Gooding, Idaho, Jefferson, Jerome, Lincoln, Minidoka, Nez Perce, Owyhee, Payette, Twin Falls, and Washington.

Table 1. Summary of 2017 Pesticide Sampling of ISDA Regional Projects.

Project Number and Name	Number of Wells Sampled (257 total wells)
220: Lower Boise Regional Project	9*
300: Latah Regional Project	4
310: Owyhee County Local Project	6*
320: Ashton Area Local Project	2
330: Nez Perce County Local Project	2
340: Fruitland Area Local Project	6*
530: Eagle Area Local Project	7*
710: Washington and Payette Counties Regional Project	26
730: Minidoka County Shallow Aquifer Regional Project	21
740: Minidoka County Deep Aquifer Regional Project	7
750: Jerome-Gooding-Lincoln Counties Regional Project	9
770: Payette and Gem Counties Regional Project	9
780: Twin Falls County Regional Project	13
790: Cassia County Regional Project	23
805: Middle Henry's Fork Central Basin Regional Project	9
810: Elmore County Local Project	5
820: Rathdrum Prairie Regional Project	10
830: Mud Lake Regional Project	7
840: Bonneville Regional Project	12
842: Idaho Falls/Shelley PCN Project	19*
860: North Owyhee County Regional Project	9
865: Grand View and Bruneau Areas Regional Project	11
870: Northern Gooding County (Bliss) Regional Project	8
890: Hammett and Glens Ferry Areas Regional Project	6
950: Clearwater Plateau Aquifer Regional Project	17

* Volatile Organic Compounds also collected in this project area, EPA 532.2, Idaho Bureau of Laboratories.

Water Quality Findings

In 2017, 257 wells were tested for pesticides in regional and local project areas. One-Hundred twenty-three (123) wells out of the 257 wells sampled had positive detections. There were 30 different pesticides, metabolites/breakdown products or VOCs detected in 2017 (Table 2).

Thirty (30) different types of pesticides or their metabolites were detected at IFQAL, or in the VOC samples tested at IBL (Table 2 and Figure 1). There were 210 pesticide detections in those 123 wells. Of the 123 wells found with measurable pesticide concentrations, 65 wells had 1 measurable pesticide. There were 38 wells that had two measurable pesticide concentrations, 13 wells with 3 measurable pesticide concentrations, 5 wells with 4 measurable pesticide concentrations, and 2 wells with 5 measurable pesticide concentrations (Figure 2).

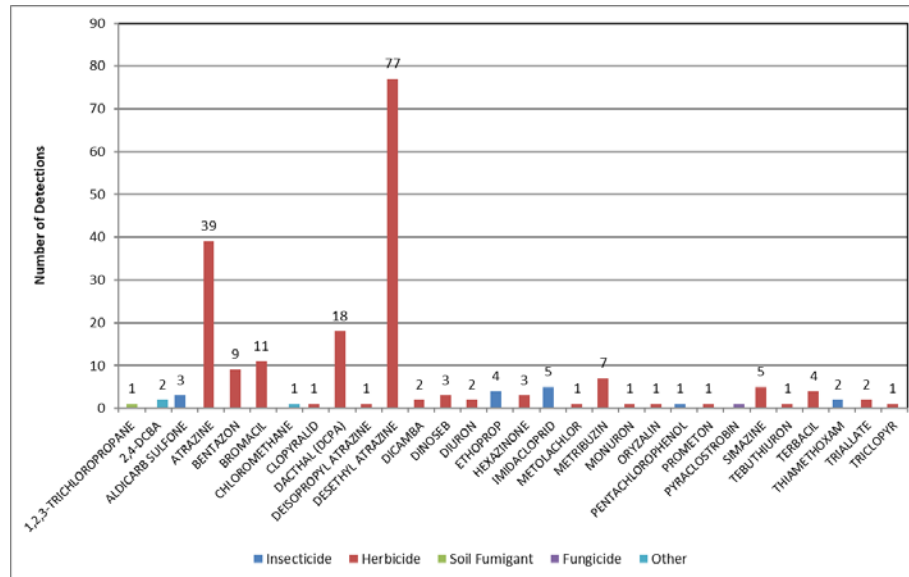


Figure 1. Breakdown of pesticide detections and type in Idaho's ground water.

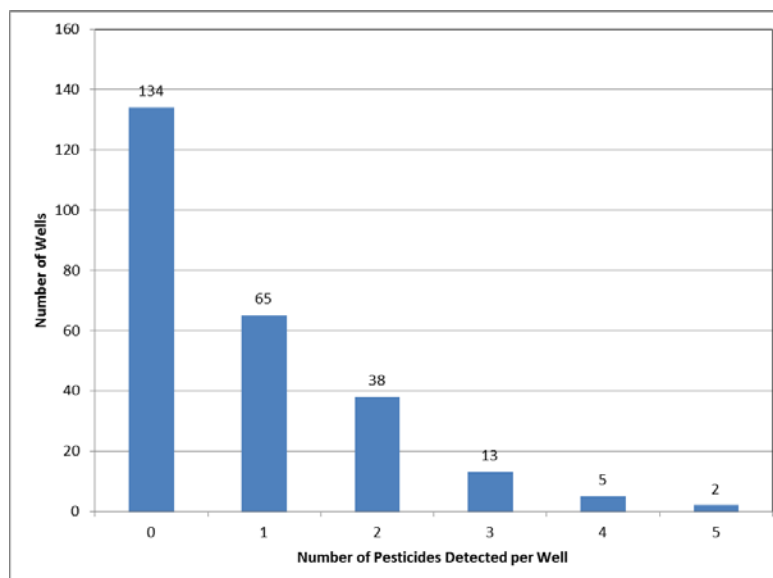


Figure 2. Number of pesticides detected in the 257 well monitored in 2017.

Table 2. Summary of Pesticide Detections from ISDA Regional Projects in 2017.

Pesticide	Number of Detections	Maximum (µg/L)	Average (µg/L)	Minimum Detection Limit (µg/L)	Reference Point (µg/L) and Source	County with Detection and Number
1,2,3-Trichloropropane	1	0.590	0.590	0.5	100 – DWEL	Ada (1)
2,4-DCBA	2	0.070	0.072	0.05	N/A	Bonneville (1), Minidoka (1)
Aldicarb Sulfone	3	0.090	0.130	0.05	2 – MCL	Ada (3), Ada (1)
Atrazine	39	0.073	0.230	0.025	3 – MCL	Ada (1), Canyon (3), Cassia (11), Elmore (3), Fremont (1), Gooding (1), Jefferson (1), Minidoka (3), Nez Perce (2), Owyhee (2), Payette (2), Twin Falls (6), Washington (3)
Atrazine (sum of products)*	92	2.210	0.164	---	--- **	---
Bentazon	9	0.314	1.600	0.05	200 – MCL	Ada (1), Elmore (1), Minidoka (1), Nez Perce (1), Owyhee (1), Payette (2), Washington (2)
Bromacil	11	0.379	1.300	0.05	3500 – DWEL	Elmore (3), Gooding (1), Minidoka (1), Twin Falls (3), Washington (3)
Chloromethane	1	0.550	0.550	0.5	N/A	Bingham (1)
Clopyralid	1	1.300	1.300	0.1	960 – HHBP	Fremont (1)
Total Dacthal (DCPA)	18	3.737	16.000	0.08	70 – HAL	Canyon (2), Owyhee (11), Payette (2), Washington (3)
Deisopropyl Atrazine	1	0.063	0.063	0.05	--- **	Minidoka (1)
Desethyl Atrazine	77	0.119	2.000	0.025	--- **	Ada (9), Canyon (4), Cassia (13), Elmore (5), Fremont (1), Gooding (2), Jefferson (1), Jerome (2), Lincoln (1), Minidoka (4), Nez Perce (2), Owyhee (6), Payette (4), Twin Falls (10), Washington (13)
Dicamba	2	2.325	4.500	0.1	4000 – HAL	Gooding (1), Payette (1)
Dinoseb	3	0.151	0.280	0.05	7 – MCL	Fremont (2), Owyhee (1)
Diuron	2	0.070	0.079	0.025	100 – DWEL	Minidoka (1), Nez Perce (1)
Ethoprop	4	0.187	0.590	0.025	11.4 – HHBP	Canyon (1), Owyhee (3)
Hexazinone	3	0.093	0.140	0.025	400 – HAL	Cassia (1), Jefferson (1), Minidoka (1)
Imidacloprid	5	0.056	0.110	0.025	360 – HHBP	Bonneville (1), Minidoka (3), Owyhee (1)
Metolachlor	1	0.100	0.100	0.05	700 – HAL	Payette (1)
Metribuzin	7	0.151	0.470	0.05	70 – HAL	Ada (1), Cassia (1), Fremont (1), Jefferson (2), Minidoka (1), Owyhee (1)
Monuron	1	0.034	0.034	0.025	N/A	Fremont (1)
Oryzalin	1	0.170	0.170	0.05	41.1 – HHBP	Bingham (1)
Pentachlorophenol	1	0.310	0.310	0.05	1 – MCL	Idaho (1)
Prometon	1	0.360	0.360	0.025	400 – HAL	Minidoka (1)
Pyraclostrobin	1	0.026	0.026	0.025	220 – HHBP	Idaho (1)
Simazine	5	0.053	0.100	0.025	4 – MCL	Cassia (1), Minidoka (4)
Tebuthiuron	1	0.110	0.110	0.025	500 – HAL	Fremont (1)
Terbacil	4	0.174	0.300	0.05	90 – HAL	Ada (4)
Thiamethoxam	2	0.164	0.240	0.05	77 – HHBP	Fremont (1), Owyhee (1)
Triallate	2	3.150	3.800	0.05	4.46 – HHBP	Fremont (1), Idaho (1)
Triclopyr	1	0.170	0.170			Fremont (1)

*Summation of Atrazine, Desethyl atrazine and Deisopropyl atrazine. All three are not always detected together.

**Breakdown product of Atrazine. No reference point available, MCL for Atrazine of 3 µg/L is used.

The Idaho PMP Rule outlines processes to protect ground water from pesticides and defines pesticide detections based on the concentration of the detection compared to a reference point. The reference points used by ISDA to implement the PMP Rule, and referred to throughout this document, are discussed in more detail in Appendix A. The PMP Rule divides the pesticide detections into detection levels as a percent of reference points. The majority of the detections can be classified into the Level 1 category (Table 3). Level 2 detections were identified for Pentachlorophenol, Dacthal and Desethyl atrazine (Table 3). The summation of the Atrazine and Desethyl atrazine did not change Levels in any wells. There were three (3) Level 3 detections identified, for the concentrations of Desethyl atrazine and two (2) wells with Triallate (Table 3). Atrazine and the Atrazine degradates (Deisopropyl atrazine and Desethyl atrazine) have similar toxicological effects. When they are identified in the same well, the detections can be combined together to determine health risk. The combined concentration of these pesticides should be below 3 µg/L to be under the reference point and be protective of human health. There were no Level 4 detections identified in 2017 (Table 3).

Table 3. Pesticide detected relative to concentration levels as a percent of Reference Points.

Ground Water Pesticide Concentration Level	Pesticides
Level 4 (> 100% of Reference Point)	<i>No measured pesticides at this level</i>
Level 3 (50% to < 100% of Reference Point)	Desethyl atrazine ¹ , Triallate
Level 2 (20 to < 50% of Reference Point)	Desethyl atrazine ² , Pentachlorophenol, Dacthal
Level 1 (< 20% of Reference Point)	1,2,3-Trichloropropane, 2,4-DCBA, Aldicarb sulfone, Atrazine, Bentazon, Bromacil, Chloromethane, Clopyralid, Dacthal (DCPA), Deisopropyl atrazine, Desethyl atrazine, Dicamba, Dinoseb, Diuron, Ethoprop, Hexazinone, Imidacloprid, Metolachlor, Metribuzin, Monuron, Oryzalin, Prometon, Pyraclostrobin, Simazine, Tebuthiuron, Terbacil, Thiamethoxam, Triclopyr

¹ Summation of the Atrazine and Desethyl atrazine, also as a Level 3 category for that well

² Summation of the Atrazine and Desethyl atrazine, also as a Level 2 category for that well

Pesticide Monitoring Results by Project

Idaho Falls/Shelley Pale Cyst Nematode Project (842)

In 2015, a project was established south of Idaho Falls in response to concerns from the application of methyl bromide to control Pale Cyst Nematodes. Ground water quality monitoring was instituted to determine if identifiable concentrations of methyl bromide or its breakdown products reached the ground water. This project was initiated with 16 wells and additional wells were added to reach 19 wells in 2016 and in 2017. Monitoring will continue on an annual basis as this project has been re-classified for long-term monitoring.

Results from the IFQAL pesticide analyte suite and the IBL VOC analyte standard suite indicate that there were no measurable concentrations of pesticides known as being used to control the Pale Cyst Nematode (Methyl Bromide or cis-1,3-Dichloropropene [Telone II]). Nor were there any detections of bromide. However, natural concentrations of bromide have been identified in nearby wells. These natural sources will need to be accounted for if bromide is ever measured in the ground water samples and wells associated within the Idaho Falls/Shelley Pale Cyst Nematode Project. However, there was a measurable concentration of Imidacloprid (0.041 µg/L) in one well, and Oryzalin (0.170 µg/L) was found another in 2017. Both of these concentrations are in the Level 1 category and are not associated with the pale cyst nematode eradication. Additionally, there was a VOC detection of Chloromethane (0.550 µg/L), this chemical is not classified as a pesticide, but was used historically as a refrigerant, and is also naturally occurring at low concentrations. In 2016 Imidacloprid was identified in the same well at 0.051 µg/L, the 2017 monitoring confirmed this detection. However, the Diuron detected in 2016 was not identified in any well in the Idaho Falls/Shelley Pale Cyst Nematode Project (842) in 2017.

Elmore County Local Project (810)

Five (5) wells were sampled for pesticides in the Elmore County Local Project. All detections were below any health standards set by the US EPA or other reference points; none were above the Level 1 category. The pesticides detected were Atrazine, Bentazon, Bromacil and Desethyl atrazine (Table 4). One of the five wells had no measurable levels of pesticides identified in the sample in 2017.

Table 4. Summary of 2017 Pesticide Results from the Elmore County Local Project.

Pesticide	Detection Count (%)	Maximum Concentration (µg/L)	Average Concentration (µg/L)	Lowest Detectable Concentration (µg/L)	Reference Point
Atrazine	2 (40 %)	0.051	0.039	0.025	3 – MCL (µg/L)
Bentazon	1 (20 %)	0.064	0.064	0.050	200 – MCL (µg/L)
Bromacil	3 (60 %)	1.200	0.740	0.050	3500 – DWEL (µg/L)
Desethyl atrazine*	4 (80 %)	0.310	0.113	0.025	3 – MCL (µg/L) *

*Breakdown product of Atrazine. No reference point available, MCL for Atrazine of 3 µg/L is used.

Eagle Area Local Project (530)

Seven (7) wells in the Eagle Area Local Project were sampled for pesticides and Volatile Organic Compounds (VOCs). The VOCs were tested due to historic detections of 1,2-Dichloropropane (1,2-DCP) and 1,2,3-Trichloropropane (1,2,3-TCP), which are breakdown products from an old formulation of a soil fumigant used in the area. The VOC 1,2,3-TCP was detected in one of the seven wells at less than 1 µg/L (Table 5). The US EPA Drinking Water Equivalent Level (DWEL) for 1,2,3-TCP is 100 µg/L (Table 5). Desethyl atrazine was detected in all seven wells, Terbacil in four wells, Aldicarb sulfone in three wells, Atrazine in one well, and Metribuzin in one well. All pesticide detections were within the Level 1 category established by the Idaho PMP Rule and below any health standards set by the EPA.

Table 5. Summary of 2017 Pesticide Results from the Eagle Local Project.

Pesticide	Detection Count (%)	Maximum Concentration (µg/L)	Average Concentration (µg/L)	Lowest Detectable Concentration (µg/L)	Reference Point
1,2,3-Trichloropropane	1 (14 %)	0.590	0.590	0.500	100 – DWEL (µg/L)
Aldicarb sulfone	3 (43 %)	0.130	0.090	0.050	2 – MCL (µg/L)
Atrazine	1 (14 %)	0.044	0.044	0.025	3 – MCL (µg/L)
Desethyl atrazine*	7 (100 %)	0.083	0.048	0.025	3 – MCL (µg/L) *
Metribuzin	1 (14 %)	0.056	0.056	0.050	70 – HAL (µg/L)
Terbacil	4 (57 %)	0.300	0.174	0.050	90 – HAL (µg/L)

*Breakdown product of Atrazine. No reference point available, MCL for Atrazine of 3 µg/L is used.

Ashton Area Local Project (320) and Middle Henry's Fork Central Basin Regional Project (805)

The Ashton Area Local Project (320) and Middle Henry's Fork Central Basin Regional Project (805) were developed to monitor baseline conditions in the ground water. However, the elevated concentrations of Triallate in one well east of Ashton led to the development of the Fremont County sub-project. Another well had detections with elevated concentrations of Atrazine and Desethyl atrazine requiring continued monitoring. Several wells in the area were selected in order to characterize the extent of elevated Triallate and Atrazine concentrations in the ground water.

Eleven (11) wells were sampled for pesticides in 2017 and four wells had positive detections (Table 6). All but two of the detections were below any of the health standards/reference point and were within the Level 1 category. Triallate was detected in a well that had no detections since 2011. This well once had elevated Triallate for a number of years, but in 2017 the Triallate concentration was in the Level 3 category. Atrazine and its breakdown product, Desethyl atrazine were in the Level 2 category. Both of these wells had historic concerns for these pesticides. A summary of the pesticide detections from the 2017 monitoring effort is presented in Table 6, and details of the two wells being specifically observed follow.

Table 6. Summary of 2017 Pesticide Results from the Fremont County sub-project.

Pesticide	Detection Count (%)	Maximum Concentration (µg/L)	Average Concentration (µg/L)	Lowest Detectable Concentration (µg/L)	Reference Point
Atrazine	1 (9 %)	0.220	0.220	0.025	3 – MCL (µg/L)
Clopyralid	1 (9 %)	1.300	1.300	0.100	960 – HHBP (µg/L)
Desethyl atrazine*	1 (9 %)	0.770	0.770	0.025	3 – MCL (µg/L) *
Dinoseb	2 (18 %)	0.120	0.086	0.050	7 – MCL (µg/L)
Metribuzin	1 (9 %)	0.470	0.470	0.050	70 – HAL (µg/L)
Monuron	1 (9 %)	0.034	0.034	0.025	N/A
Tebuthiuron	1 (9 %)	0.110	0.110	0.025	500 – HAL (µg/L)
Thiamethoxam	1 (9 %)	0.087	0.087	0.050	77 – HHBP (µg/L)
Triallate	1 (9 %)	2.500	2.500	0.050	4.46 – HHBP (µg/L)
Trichlopyr	1 (9 %)	0.170	0.170	0.100	300 – HHBP (µg/L)

*Breakdown product of Atrazine. No reference point available, MCL for Atrazine of 3 µg/L is used.

The time series data for Triallate in well 3200101 is displayed in Figure 3. Triallate is a commonly used herbicide for grain crops in eastern Idaho. Triallate had not been detected between 2011 through 2016 after being elevated since the first sampling in 1998. There is not a Drinking Water Standard (or known as the Maximum Contaminant Level [MCL]) for Triallate. The reference level is based on its carcinogenic properties; each state can determine their acceptable risk factor between 10^{-6} and 10^{-4} . Idaho has proposed a 10^{-5} risk factor for carcinogens. The 10^{-5} risk factor would lead to a HHBP reference level of 4.46 µg/L. More information about the Triallate reference point is included in Appendix A.

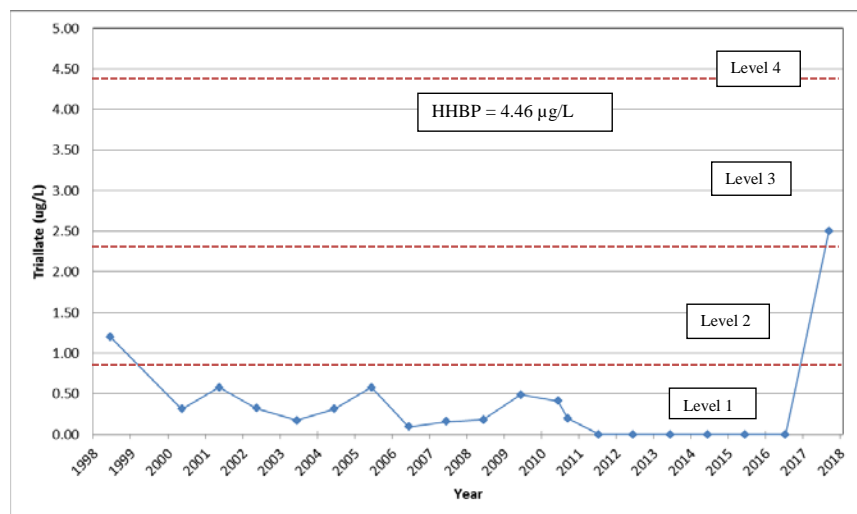


Figure 3. Time series for Triallate in well 3200101 east of Ashton, Idaho, 2017.

Atrazine, Desethyl atrazine and Deisopropyl atrazine were first detected in well 8053501 in 2003, east of Ashton, ID (Figure 4). The original detections were considered Level 1 detections. In 2006 the concentrations detected were Level 3 Atrazine and Level 2 Desethyl atrazine detections. The combined concentrations were Level 4 concentrations. The concentrations were found to be lower in 2007 and were Level 1 detections. The concentrations were Level 1 between 2007 and 2016. In previous years, other pesticides have been detected, including Monuron and 2,4-D. In 2017, in addition to the Atrazine, Clopyralid and Monuron were also detected. In 2017 the Desethyl atrazine concentrations were in the Level 2 category. The Atrazine and Desethyl atrazine concentrations are displayed in Figure 4.

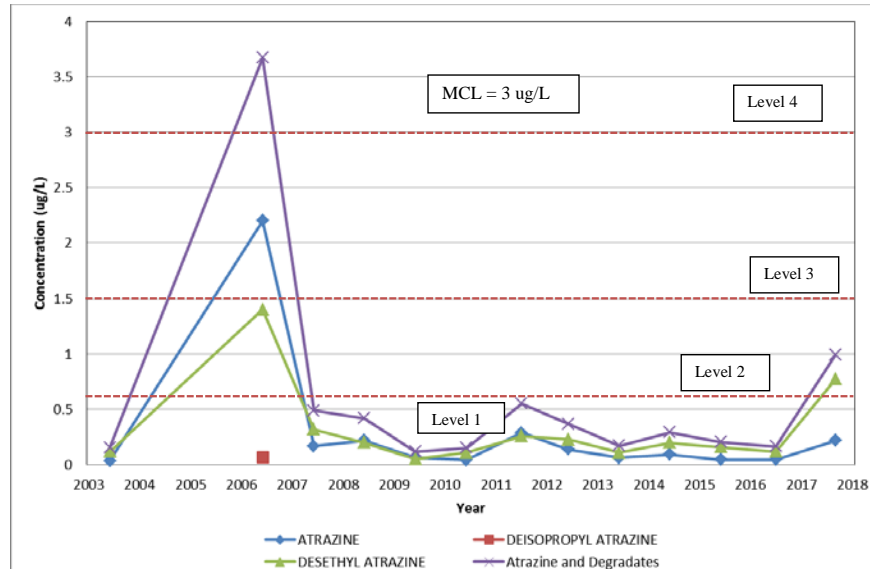


Figure 4. Time series for Atrazine, Desethyl atrazine, Deisopropyl atrazine and combined concentrations in well 8053501, east of Ashton, Idaho through 2017.

Fruitland Area Local Project (340)

Six wells were sampled for pesticides for the Fruitland Area Local Project in 2017. Previous elevated detections of Atrazine and Desethyl atrazine have been of concern. Four wells had positive detections of pesticides in 2017. Two wells studied over time continue to have Atrazine and Desethyl atrazine detections at low concentrations within the Level 1 category (Table 7). Access to well 3400101 was not possible in 2017 therefore no current data are available.

Table 7. Summary of 2017 Pesticide Results from sampling five wells for the Fruitland Area Local Project.

Pesticide	Detection Count (%)	Maximum Concentration (µg/L)	Average Concentration (µg/L)	Lowest Detectable Concentration (µg/L)	Reference Point
Atrazine	2 (33 %)	0.130	0.104	0.025	3 – MCL (µg/L)
Dacthal (DCPA)	2 (33 %)	2.100	1.110	0.080	70 – HAL (µg/L)
Desethyl atrazine*	2 (33 %)	0.190	0.155	0.025	3 – MCL (µg/L) *
Dicamba	1 (17 %)	4.500	4.500	0.100	4000 – HAL (µg/L)

*Breakdown product of Atrazine. No reference point available, MCL for Atrazine of 3 µg/L is used.

The Atrazine (Figure 5) and Desethyl atrazine (Figure 6) concentrations in wells 3400101, 3400501 and 3400801 have been tracked over time to determine if the concentrations have decreased. Atrazine and Desethyl atrazine concentrations in all three wells have decreased into the Level 1 category in 2008 and 2009 and have stayed at Level 1 since 2010. Atrazine, Desethyl atrazine, Deisopropyl atrazine (when present) and the

summation of the Atrazine and degradates/breakdown products are presented for well 3400101 in Figure 7 and for well 3400501 in Figure 8. Well 3400101 was not monitored in 2017. Well 3400801 data are presented in Figure 9. Access was limited at well 3400801 in 2015 and 2016, and there is a break in the data, but was monitored in 2017.

In general, a similar pattern of degradation and decrease in concentration has been observed for the three wells. There is not sufficient evidence to determine if this is a statistical decreasing trend using a Mann-Kendall Trend Test. The area is vulnerable to pesticide leaching due to sandy and sandy loam soils and shallow ground water.

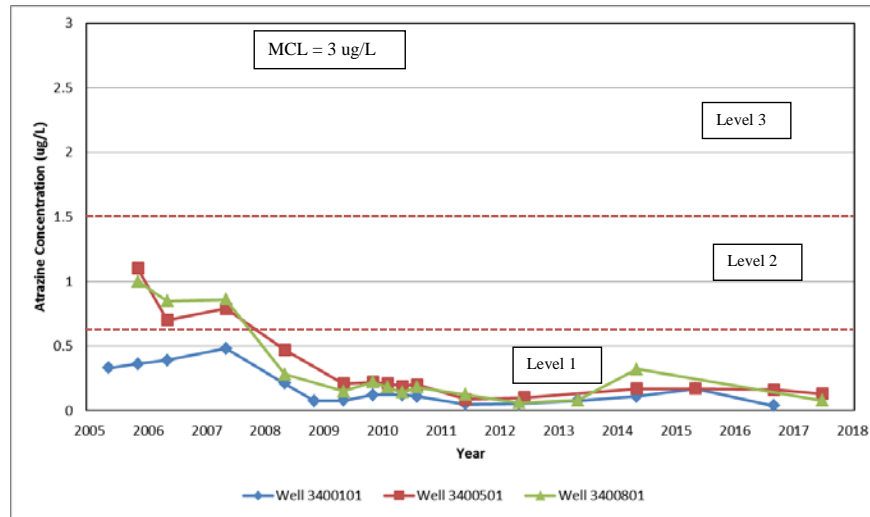


Figure 5. Time series for Atrazine in three wells sampled over time near Fruitland, Idaho.

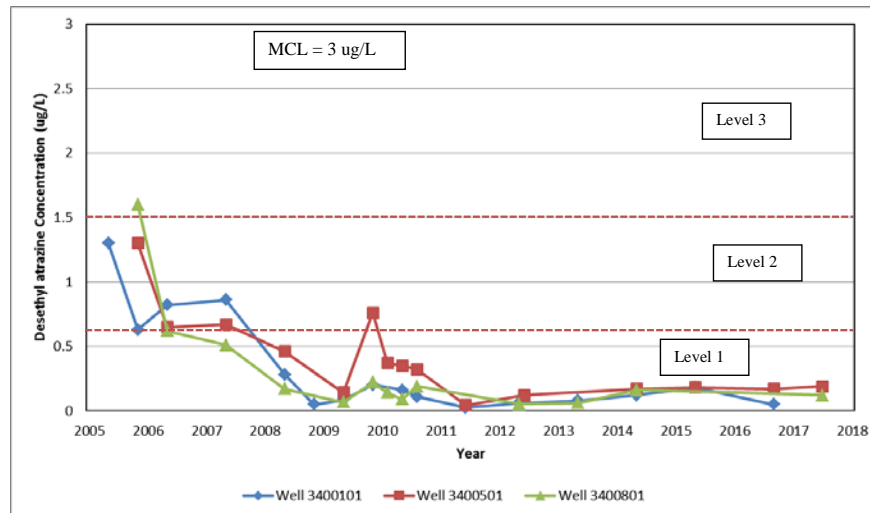


Figure 6. Time series for Desethyl atrazine in three wells sampled over time near Fruitland, Idaho.

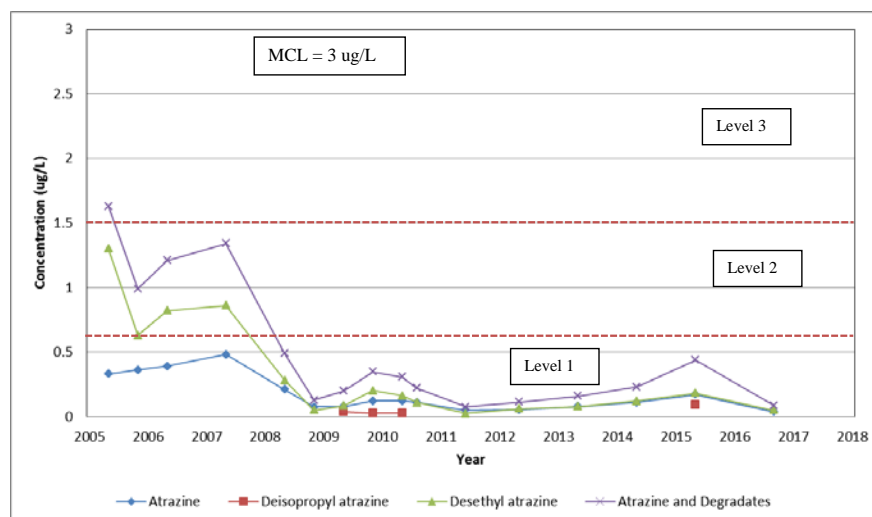


Figure 7. Time series for Atrazine and breakdown products for well 3400101 near Fruitland, Idaho.

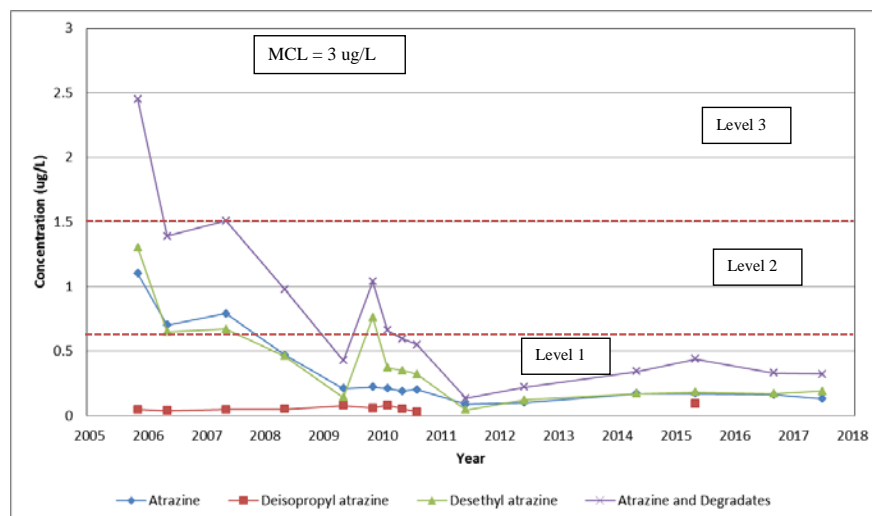


Figure 8. Time series for Atrazine and breakdown products for well 3400501 near Fruitland, Idaho.

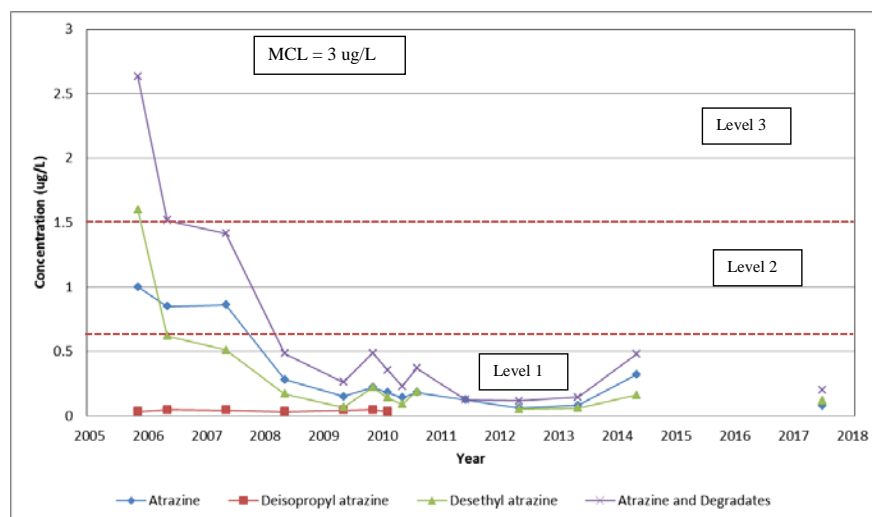


Figure 9. Time series for Atrazine and breakdown products for well 3400801 near Fruitland, Idaho.

Washington County and Payette County Project (710)

The project is located in both Washington County and Payette County and designed to evaluate well water quality in the shallow ground water. This area has had historic Dacthal (DCPA) use with detections in 3 wells in 2017. Half of the 26 wells monitored were found to have some level of Atrazine or the breakdown product of Desethyl atrazine. All detections were below reference points (Table 8). There were detections in 16 of the 26 wells monitored, and 10 wells had no detectable pesticide concentrations.

Table 8. Summary of 2017 Pesticide Results from sampling wells for the Washington/Payette Project.

Pesticide	Detection Count (%)	Maximum Concentration (µg/L)	Average Concentration (µg/L)	Lowest Detectable Concentration (µg/L)	Reference Point
Atrazine	3 (12 %)	0.088	0.048	0.025	3 – MCL (µg/L)
Bentazon	2 (8 %)	0.350	0.213	0.050	200 – MCL (µg/L)
Bromacil	3 (12 %)	0.130	0.069	0.050	3500 – DWEL (µg/L)
Dacthal (DCPA)	3 (12 %)	9.700	3.633	0.080	70 – HAL (µg/L)
Desethyl atrazine*	13 (50 %)	0.160	0.066	0.025	3 – MCL (µg/L) *
Metolachlor	1 (4 %)	0.100	0.100	0.050	700 – HAL (µg/L)

*Breakdown product of Atrazine. No reference point available, MCL for Atrazine of 3 µg/L is used.

Owyhee Local Project (310) and North Owyhee County Regional Project (860)

The projects located in northwest Owyhee County are designed to evaluate well water quality and specifically Dacthal (DCPA) concentrations over time. This area is associated with the evaluation region for the Dacthal (DCPA) PMP restricted use area that was established in 2007. Wells southwest of Homedale have been sampled in response to the elevated detections of Dacthal (Figure 10). Dacthal was prohibited from use in an area south of Homedale, near well 8601101 (Figure 11). In the Dacthal restriction area, monitoring results were inconclusive in 2016 and there is a break in the data however monitoring in 2017 confirmed that the identifiable Dacthal chemical form has degraded into the di-acid form (Figure 10 and Figure 11). Therefore, 2017 monitoring is for a Total Dacthal form, which includes the original product and the various metabolites/break-down products.

Six wells were monitored in the Owyhee Local Project (310), four of those wells had detectable levels of Dacthal. All the detections were below 20% of the reference point. The greatest detection was at 4.2 µg/L, which is approximately 6% of the reference point of 70 µg/L (Table 9 and Figure 10).

Table 9. Summary of 2017 Pesticide Results from the Owyhee Local Project (310).

Pesticide	Detection Count (%)	Maximum Concentration (µg/L)	Average Concentration (µg/L)	Lowest Detectable Concentration (µg/L)	Reference Point
Bentazon	1 (17 %)	0.340	0.340	0.050	200 – MCL (µg/L)
Dacthal (DCPA)	4 (67 %)	4.200	1.398	0.080	70 – HAL (µg/L)
Ethoprop	1 (17 %)	0.590	0.590	0.025	11.4 – HHBP (µg/L)

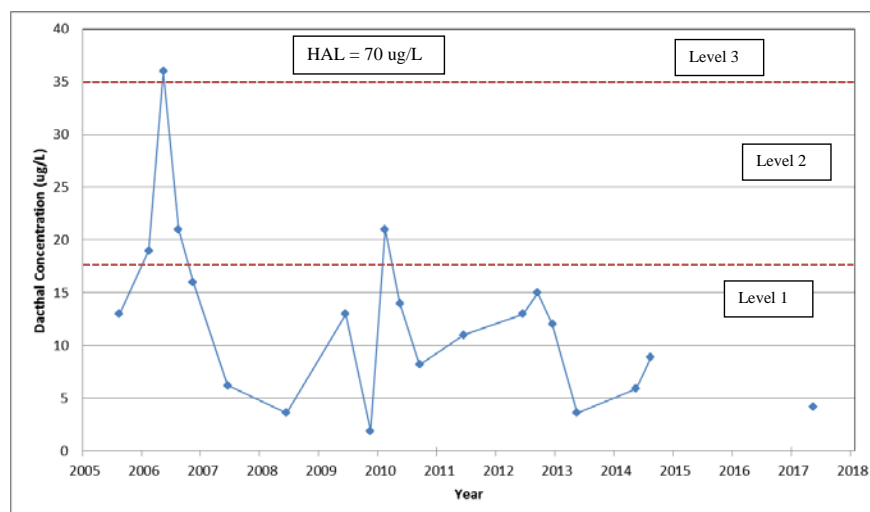


Figure 10. Time series of Dacthal (DCPA) concentrations in well 3100201 southwest of Homedale, Idaho.

Nine wells were monitored in the North Owyhee County Regional Project (860), seven of those wells had detectable levels of Dacthal. All but one of the detections were below 20% of the reference point. The greatest detection was at 16 $\mu\text{g/L}$, which is approximately 23% of the reference point of 70 $\mu\text{g/L}$ and is classified into a Level 2 response category (Table 10 and Figure 11).

Table 10. Summary of 2017 Pesticide Results from the Owyhee County Regional Project (860).

Pesticide	Detection Count (%)	Maximum Concentration ($\mu\text{g/L}$)	Average Concentration ($\mu\text{g/L}$)	Lowest Detectable Concentration ($\mu\text{g/L}$)	Reference Point
Dacthal (DCPA)	7 (78 %)	16.000	6.497	0.080	70 – HAL ($\mu\text{g/L}$)
Ethoprop	2 (22 %)	0.065	0.061	0.025	11.4 – HHBP ($\mu\text{g/L}$)

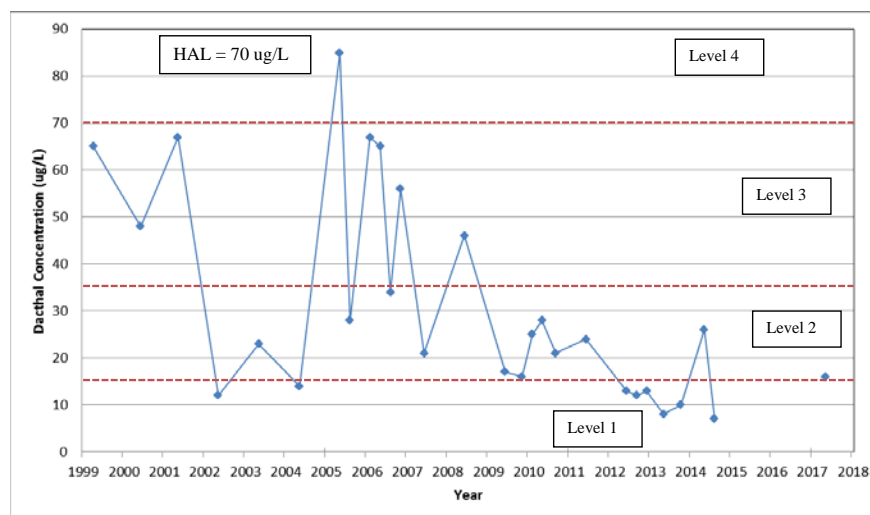


Figure 11. Time series of Dacthal (DCPA) concentrations in well 8601101 southwest of Homedale, Idaho.

Nez Perce County Local Project (330)/Clearwater Plateau Aquifer Regional Project (950)

The Nez Perce County Local Project (330)/Clearwater Plateau Aquifer Regional Project (950) have wells interspersed from near Lewiston, ID to Grangeville ID. The vast majority of these wells have not had measurable levels of pesticides. In 2017, 2 wells were tested in the Nez Perce Local Project (330) and 17 wells were tested in the Clearwater Plateau Aquifer Regional Project (950). There were no pesticides identified with measurable concentrations in the two wells associated with the Nez Perce County Local Project (330). Four wells in the Clearwater Plateau Aquifer Regional Project (950) were identified with pesticide residues (Table 11).

Table 11. Summary of 2017 Pesticide Results from the Clearwater Plateau Aquifer Regional Project (950).

Pesticide	Detection Count (%)	Maximum Concentration (µg/L)	Average Concentration (µg/L)	Lowest Detectable Concentration (µg/L)	Reference Point
Atrazine	2 (12 %)	0.210	0.125	0.025	3 – MCL (µg/L)
Bentazon	1 (6 %)	0.120	0.120	0.050	200 – MCL (µg/L)
Desethyl atrazine*	2 (12 %)	2.000	1.043	0.025	3 – MCL (µg/L) *
Diuron	1 (6 %)	0.060	0.060	0.025	100 – DWEL (µg/L)
Pentachlorophenol	1 (6 %)	0.310	0.310	0.050	1 – MCL (µg/L)
Pyraclostrobin	1 (6 %)	0.026	0.026	0.025	220 – HHBP (µg/L)
Triallate	1 (6 %)	3.800	3.800	0.050	4.46 – HHBP (µg/L)

*Breakdown product of Atrazine. No reference point available, MCL for Atrazine of 3 µg/L is used.

Greencreek Triallate sub-project

The wells in the Greencreek Triallate sub-project are a sub-set of the Clearwater Plateau Regional Project and are specific to concerns surrounding well 9501401. Four wells north of Greencreek were sampled for pesticides in 2017 as part of the Greencreek Triallate sub-project. Triallate detection in well 9501401 was at a Level 3 detection (a detection below the reference point). Pentachlorophenol, which was also detected previously, increased to a Level 2 detection in 2017. The 2017 monitoring results for this well are presented in Table 12. It has not been concluded if these detections are due to a point or nonpoint contamination of the ground water located near the well. Triallate has not been detected in the other wells sampled in the near vicinity and along the same road.

Table 12. Summary of 2017 Pesticide Results from the Greencreek Triallate sub-project.

Pesticide	Detection Count (%)	Maximum Concentration (µg/L)	Average Concentration (µg/L)	Lowest Detectable Concentration (µg/L)	Reference Point
Pentachlorophenol	1 (25 %)	0.310	0.310	0.050	1 – MCL (µg/L)
Triallate	1 (25 %)	3.800	3.800	0.050	4.46 – HHBP (µg/L)

The Triallate time series plot since July 2001 is displayed in Figure 12. The concentrations were not detected for two years after the new well was completed in 2002. However, since 2004, the Triallate concentration increased to over 1 µg/L, then decreased to less than 0.8 µg/L in 2013, and then increased to near 4 µg/L in 2017 (Figure 12). This is considered a Level 3 detection, which does not exceed the recommended levels, but concentrations have been increasing. Triallate is listed by the US EPA as a potential carcinogen; however, these are only recommended levels. It should be noted that the reference point chosen for this assessment, 4.46 µg/L, is based on a carcinogenic risk factor of 10^{-5} . This updated risk factor is based upon data from the Human Health Benchmarks for Pesticides.

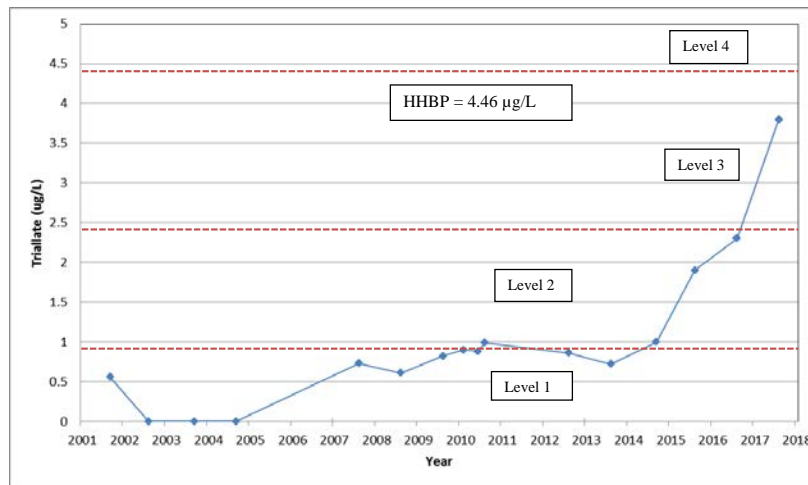


Figure 12. Time-series plot of Triallate concentrations detected in well 9501401.

Nez Perce County Atrazine sub-project

The Nez Perce County Atrazine sub-project area is located south of Lewiston and Lewiston Orchards along Waha Road. The project was initiated in response to an elevated detection of Atrazine in a well from the Clearwater Plateau Regional Project. Multiple wells were sampled in this area in 2017 including well 9501901 (formerly 3300101), which historically has had elevated Atrazine and Desethyl atrazine concentrations. Wells up or down gradient were not identified with pesticide concentrations near those found in well 9501901. Also identified in well 9501901 was Bentazon and Diuron, but neither was detected at a concentration near the reference point (Table 13).

Table 13. Summary of 2017 Pesticide Results from the Clearwater Plateau Aquifer Regional Project (950).

Pesticide	Detection Count (%)	Maximum Concentration (µg/L)	Average Concentration (µg/L)	Lowest Detectable Concentration (µg/L)	Reference Point
Atrazine	2 (12 %)	0.210	0.125	0.025	3 – MCL (µg/L)
Bentazon	1 (6 %)	0.120	0.120	0.050	200 – MCL (µg/L)
Desethyl atrazine*	2 (12 %)	2.000	1.043	0.025	3 – MCL (µg/L) *
Diuron	1 (6 %)	0.060	0.060	0.025	100 – DWEL (µg/L)

*Breakdown product of Atrazine. No reference point available, MCL for Atrazine of 3 µg/L is used.

Atrazine and its breakdown products are known to persist in ground water significantly longer than in surface water, which may account for some of these long-term concentrations. Atrazine, and the Atrazine breakdown products (Deisopropyl atrazine and Desethyl atrazine) have similar toxicological effects. When they are found in the same well, the detections can be combined together to determine health risk. The combined concentration of these pesticides should be below 3 µg/L to be under the MCL reference point to be protective of human health. Individually in 2017, Atrazine is a Level 1 category and Desethyl atrazine is a Level 3 detection, and the combined concentrations are in the Level 3 category (Figure 13). In 2016, both Atrazine and Desethyl atrazine were in the Level 2 category, with a combined concentration in the Level 3 category. In 2010, the combined concentrations were in the Level 4 category but have decreased since that time (Figure 13). Long-term data collection is required to determine if recent increases in concentrations persist. There is annual monitoring of this well, but the surrounding well data suggest that these concentrations are from an isolated source that remains unidentified. At this time the water quality does not exceed the drinking water standard. If concentrations continue to increase, there is concern that this water may no longer be a suitable drinking water source and an alternate drinking water source should be

identified. However, Atrazine can be removed from drinking water by using Granular Activated Carbon systems.

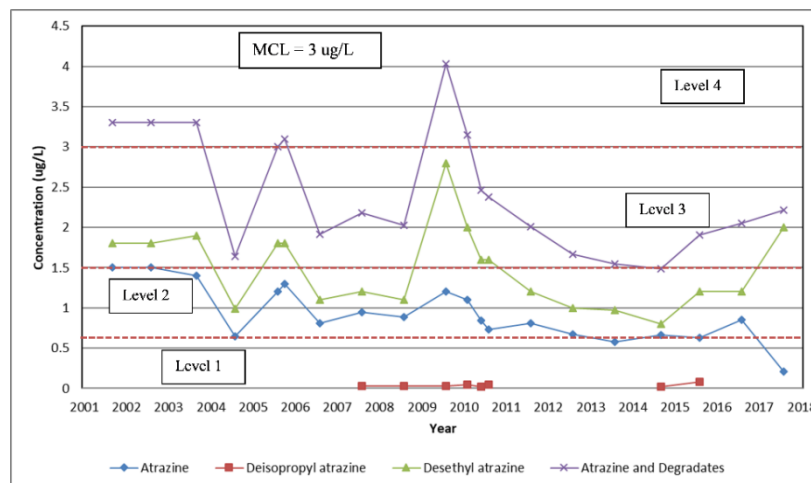


Figure 13. Time-series plot of Atrazine, Deisopropyl atrazine and Desethyl atrazine concentrations detected in well 9501901.

Summary

The ISDA Ground Water Program implemented a wide variety of ground water monitoring projects and protection activities related to agriculture for the State of Idaho during 2017. There are numerous distinct and active ground water projects ongoing across the state, including regional monitoring projects, local monitoring projects and Pesticide Management Plan (PMP) response monitoring projects. ISDA follows the Idaho PMP Rule to determine response actions following detections. Idaho Code requires ISDA to monitor and respond to any pesticide concentrations identified in the ground waters of Idaho, with response levels related to the percentage of the drinking water standards or reference points. Most response levels based on the identified pesticide levels are to continue monitoring, inform the homeowner and educate the public.

Of the 257 monitored wells in 2017, there were no measurable detections of pesticide residues in 134 wells, there were low-level detections in 118 wells, and 5 wells had pesticide concentrations at concerning levels. Testing of regional, local and PMP projects resulted in detections of pesticides in ground water throughout Idaho. Frequent detections of pesticides occur from sampling domestic wells, especially in vulnerable aquifer areas. As previously discussed, the Atrazine-breakdown products and Triallate are the only pesticides detected over 50% of a health-based reference point. Dacthal, Atrazine-breakdown products and Pentachlorophenol were detected above 20% of a reference point. ISDA is responding to those situations with education, use inspections, promotion of management techniques, and locally intensive monitoring.

There were 30 different pesticides, metabolites/breakdown products, or VOCs detected in 2017. Most were detected at low concentrations. Several pesticides appear to have increasing concentrations, such as Atrazine, in multiple wells across the state. Long-term monitoring is required to determine the magnitude and longevity of those increases. Statewide response processes have been implemented, primarily consisting of educational outreach and continued monitoring. There are concerns in certain areas where multiple low level pesticides are detected in individual wells. Some wells also have detections of multiple active ingredients and breakdown products that may have similar, but unknown human health toxicological effects in their combination. Except for the five wells with pesticide concentrations at levels of concern, pesticide concentrations are significantly below drinking water standards and recommendations. These pesticide detection data may be used to make regulatory and/or voluntary changes related to applications of pesticides.

Testing of regional, local and PMP projects resulted in detections of pesticides in ground water throughout Idaho. Frequent detections of pesticides occur from sampling domestic wells, especially in vulnerable aquifer areas. The most frequent detections occur in the shallow alluvial and basalt aquifers in Ada, Cassia, Elmore, Fremont, Idaho, Minidoka, Nez Perce, Owyhee, Payette and Washington Counties. There were numerous wells with multiple low level detections of pesticides. There are concerns in certain areas where multiple low level pesticides are detected in individual wells. Some wells also have detections of multiple active ingredients and breakdown products that may have similar, but unknown human health toxicological effects in their combination.

Currently, there are no indications that appropriate and widespread application of pesticides are leading to contamination of the aquifers or impacting beneficial uses. However, there are widespread detections of pesticides in both shallow and deep wells throughout the State of Idaho. Additionally, data from 2017 suggest that there may be residual reservoirs of pesticides in the soil column. It is unknown to what extent or magnitude might be in these potential pesticide reservoirs and what their effects might be on the ground water quality. Long-term monitoring is required to ensure that the current application and management practices are effective.

ISDA is conducting annual evaluations of pesticides to determine which pesticides are of greatest concern. ISDA utilizes the monitoring data, the pesticide evaluation process and the Idaho PMP Rule to determine response measures. ISDA utilizes the US EPA POINTs data assessment process during the implementation and education planning phases. Monitoring results are provided to the various state coordination committees and are being formatted for entry in the Idaho Department of Water Resources Environmental Data Management System and the US EPA STORET databases.

Recommendations

ISDA will respond to the pesticide detections from this project in accordance with the response section of IDAPA 02.03.01 Rules Governing Pesticide Management Plans for Ground Water Protection. ISDA will continue to follow-up and conduct monitoring in 2018. ISDA personnel will continue to educate the pesticide applicators on the importance of adhering to label requirements and to apply all pesticides according to federal and state laws. ISDA personnel will continue to educate home and well owners. ISDA shares our data with the Idaho Department of Environmental Quality (DEQ), US EPA, our cooperators and inspectors. ISDA will continue to monitor ground water and aquifers throughout the State of Idaho.

Water Program Notes

Several project areas are being condensed, therefore there may be slight variations in the manner data are reported, but there is no alteration to the underlying data.

Acknowledgments

ISDA Water Program staff would like to thank the homeowners in the Project areas who allowed us to access and sample their wells. Without their participation and cooperation, these Projects would not be possible. Prevention is the key to protecting Idaho's aquifers and maintaining pesticide registrations and uses in Idaho. We would also like to recognize the United States Environmental Protection Agency and our various grant supporters, without whose contribution, these reports would not be possible.

The program also thanks the pesticide organizations, applicators, UICES, Sherm Takatori (ISDA), ISDA enforcement staff, DEQ, SWCDs, USGS, IDWR, Idaho Water Users Association and other groups for participating in and supporting the program. We appreciate the opportunity to directly participate in educational sessions with applicators, dealers and others in the pesticide industry. Prevention is the key to protecting Idaho's aquifers and maintaining pesticide registrations and uses in Idaho.

A very special thank you goes to the ISDA Field Staff and to IFQAL staff, all of whom went above and beyond to work with the ISDA Division of Agricultural Resources staff to meet project goals. The author would like to thank Chuck Hawley, Joey Carter, Brad Farrar and Elizabeth Palmateer of ISDA for editorial review of this document. The Idaho State Department of Agriculture would like to continue to extend its gratitude to Gary Bahr, who has changed positions and left ISDA. His dedication and ceaseless work to improve the drinking water of the citizens of Idaho is greatly appreciated.

Appendix A. Reference Points

Reference Points are used to determine level of concern with detected pesticides found in the ground waters. A pesticide detection is not necessarily detrimental to the use of that water for domestic and drinking water uses, depending on how those concentrations compare to the drinking water standard or a determined reference point. ISDA uses a variety of sources to determine reference points as not all pesticides (or their breakdown products) have drinking water standards, or a maximum contaminant level (MCL). An MCL is defined by the US EPA as the highest level of a contaminant that is allowed in drinking water and is an enforceable standard (US EPA, 2012).

Where no MCL exists, the ISDA will use US EPA Lifetime Health Advisories (HAL), if they exist. A Health Advisory is defined by US EPA as an estimate of acceptable drinking water levels for a chemical substance based on health effects information and is not a legally enforceable standard. The Lifetime Health Advisory (HAL) is the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for a lifetime of exposure (based on a 70kg-adult consuming two liters of water per day) (EPA, 2012).

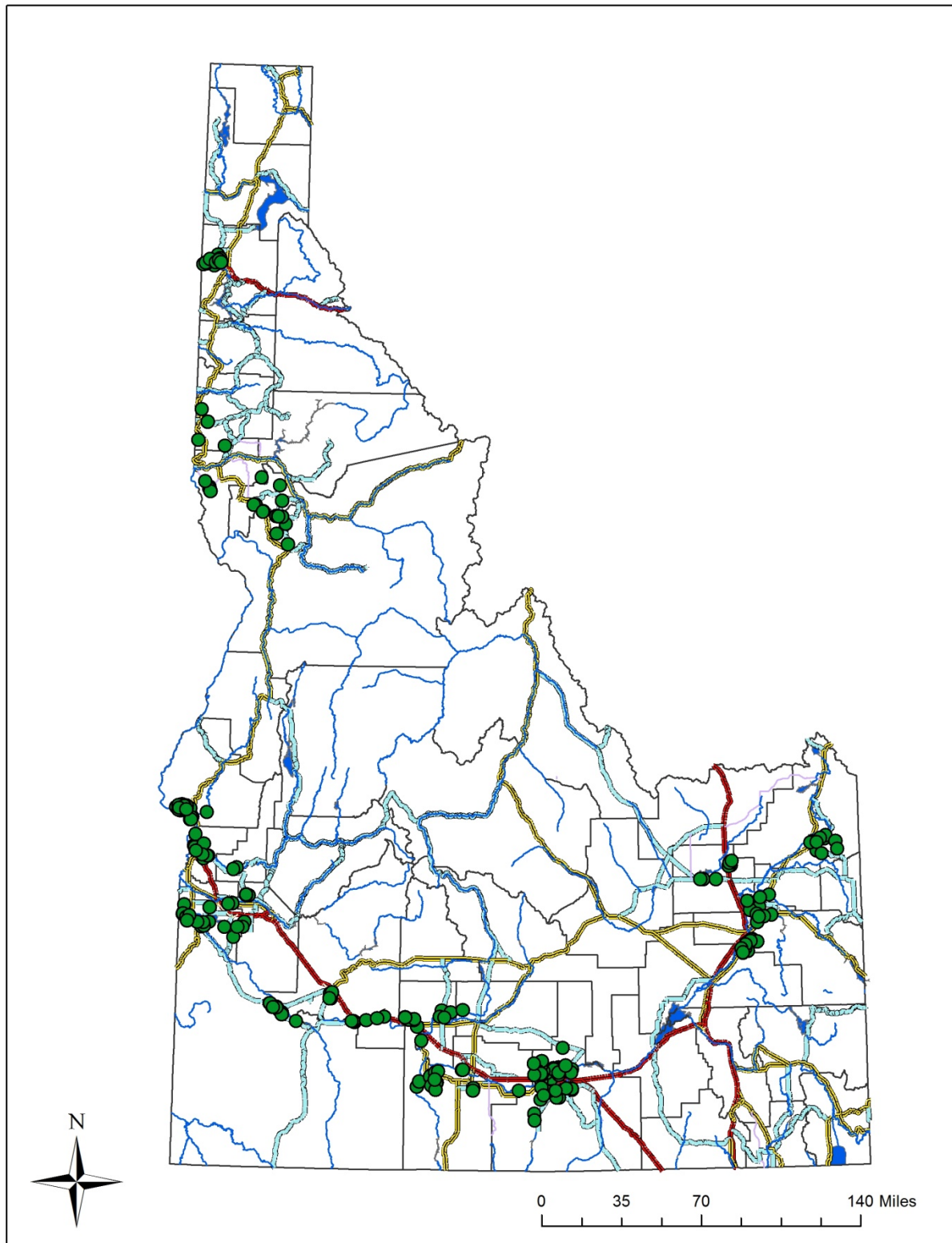
If the HAL does not exist then a US EPA Drinking Water Equivalent Level (DWEL) will be used, which assumes that over a lifetime the only exposure is from the drinking water. If the DWEL does not exist, then the Human Health Benchmark for Pesticides (HHBP), will be referred to for a reference point. If a HHBP does not exist, then a US EPA Reference Dose (RfD) number is used. The US EPA defines a RfD as an estimate (with uncertainty spanning perhaps an order of magnitude) of daily oral exposure to the human population that is likely to be without an appreciable risk of deleterious effects during a lifetime (EPA, 2012). Reference points can be found in numerous documents.

Historically, ISDA examined Triallate data using the Food Quality Protection Act Drinking Water Level of Comparison (FQPA DWLOC) reference point listed in the 2001 US EPA RED. However, based on the more recent HHBP values, Triallate is listed as having a carcinogenic drinking water level recommendation between 0.446 and 44.6 µg/L depending on the acceptable carcinogenic risk level between 10^{-6} and 10^{-4} . Currently the Idaho Department of Environmental Quality has a proposed 10^{-5} level. Therefore, Triallate data are now being compared against a 4.46 µg/L reference point.

Primary sources of information include:

- US EPA 2012 Edition of the Drinking Water Standards and Health Advisories (<https://www.epa.gov/sites/production/files/2015-09/documents/dwstandards2012.pdf>)
- Human Health Benchmarks for Pesticides (<https://iaspub.epa.gov/apex/pesticides/f?p=HHBP:home>).

Appendix B. Idaho Map of 2017 Monitoring Wells



Appendix C. Abbreviations

BMP – Best Management Practice

DCPA – Dacthal or the chemical name: Dimethyl tetrachloroterephthalate

DEQ – Idaho Department of Environmental Quality

DWEL – EPA Drinking Water Equivalent Level

FIFRA – Federal Insecticide, Fungicide, and Rodenticide Act

FQPA DWLOC – Food Quality Protection Act Drinking Water Level of Comparison

HAL – EPA Lifetime Health Advisory

HHBP – Human Health Benchmarks for Pesticides

IBL – Idaho Bureau of Laboratory

IFQAL – Idaho Food Quality Assurance Laboratory

ISDA – The Idaho State Department of Agriculture

MCL – EPA Maximum Contaminant Level

PMP – Idaho Pesticide Management Plan (PMP)

RfD – Reference Dose

USDA – United States Department of Agriculture

US EPA – United States Environmental Protection Agency

VOC – Volatile Organic Compounds

µg/L or microgram per liter is approximately equivalent to parts per billion

*For additional information about this program or projects, please contact
Curtis Cooper, Idaho State Department of Agriculture at
(208) 332-8597 or email at WaterQuality@isda.idaho.gov*