Analyzing Water Quality Pesticide Monitoring Data with the Click of a Mouse

Look! Data Visualization

March 28th, 2019

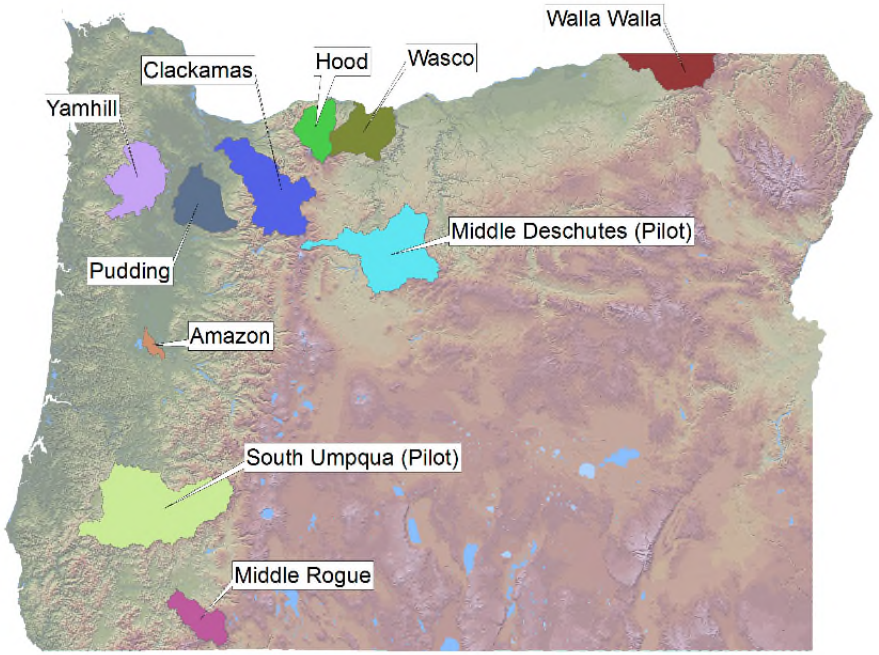
Denver, CO

Colin Donald | Oregon Department of Environmental Quality

Pesticide Stewardship Program (PSP)

Public/Private Partnerships across the state to address pesticide use:

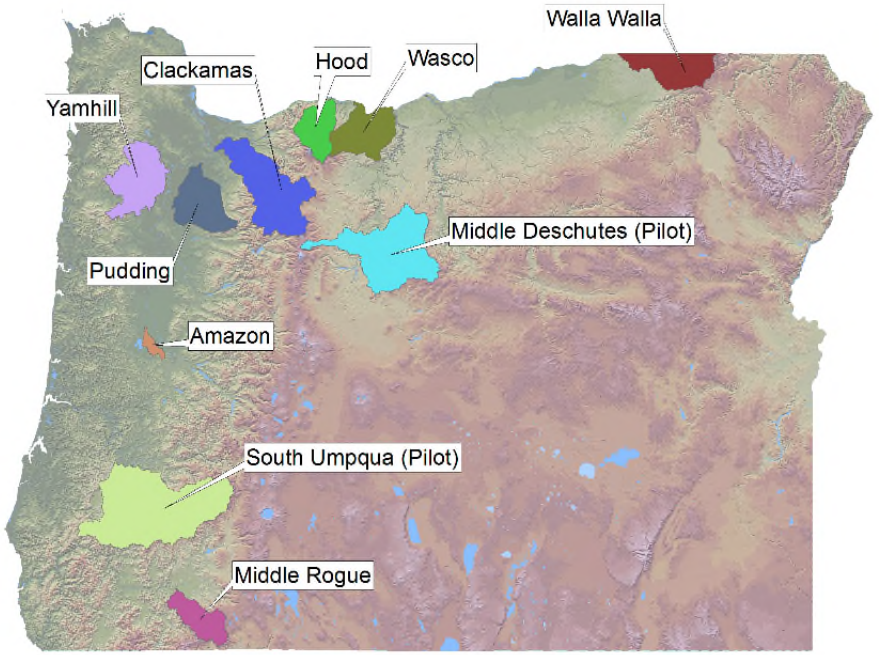
- Local growers and land owners
- Local tribes
- Soil and Water Conservation Districts
- Dept. of Agriculture
- Dept. of Environmental Quality
- Dept. of Forestry
- Oregon Health Authority
- Universities



Pesticide Stewardship Program (PSP)

Public/Private Partnerships across the state to address pesticide use:

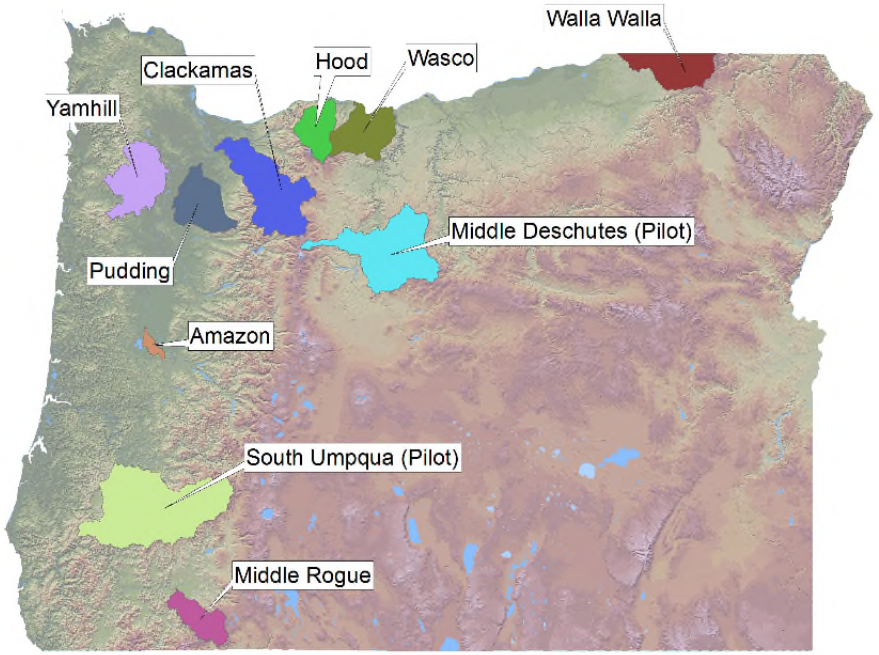
- Combines local expertise
- Identifies potential concerns
- Encourages voluntary changes in pesticide use and management practices
- Measures improvements in water quality and crop management



PSP Data Analysis

Challenges

- Over 140 analytes per sample
- Over 500 samples per year
- Differing toxicity levels
- Differing pesticides of interest/concern
- Diverse stakeholder groups



Why a data tool?

Excel flat files

Analyte	Station_ID	Project	Survey	Station_Description	Sampling_Date	Sampling_Time
2,4-d	28574	Wasco			4/13/2010	9:45
2,4-d	36296	South Yamhill			8/22/2013	9:18:00
2,4-d	25624	Amazon			11/1/2016	12:05:00
2,4-d	12012	Hood River			4/21/2009	12:00
2,4-d	13249	Hood River	2017 Spring	Odell Creek upstream of Odell WWTP outfall	5/2/2017	9:51:00
2,4-d	10000	Clackamas	2013 Spring	Blank - Transfer::TfB	5/28/2013	11:21:00
2,4-d	10000	Amazon	2015 Summer	Blank - Transfer::TfB	7/27/2015	9:26:00
2,4-d	10000	Pudding	2017 Fall	Blank - Transfer::TfB	9/19/2017	12:50:00
2,4-d	38831	South Umpqua	2018 Spring	NF Myrtle Creek D/S of Bilger Creek Confluence	4/18/2018	11:53:00
2,4-d	10000	Wasco	2016 Spring	Blank - Transfer::TfB	5/23/2016	13:05:00
2,4-d	30173	Wasco		South Fork Mill Creek at Reservoir Road	6/28/2011	12:30
2,4-d	25204	Wasco	2015 Spring	Threemile Creek at Hwy 197	4/6/2015	11:55:00
2,4-d	32074	Clackamas		Rock Creek at 172nd, Stony Brook Court	3/31/2009	10:10
2,4-d	34235	Yamhill		Middle Cozine at Old Sheridan Road		
2,4-d	10000	South Yamhill	2012 Spring	Blank - Transfer::TfB		
2,4-d	36297	South Yamhill	2012 Fall	Gold Creek at Gold Creek R		
2,4-d	10924	Yamhill	2013 Summer-Fall	Yamhill River at Marker #18		
2,4-d	31499	Hood River		Middle Neal Creek at Hwy 3		
2,4-d	36390	Amazon		Amazon Creek at Bond Roa		
2,4-d	36297	South Yamhill	2013 Summer-Fall	Gold Creek at Gold Creek R		
2,4-d	10868	Clackamas	2014 Spring	North Fork Deep Creek at H		
2,4-d	28574	Wasco		Mill Creek at 2nd Street, Th		
2,4-d	36391	Amazon	2016 Spring	A1 Channel at Awbrey Lane		
2,4-d	25624	Amazon	2016 Fall	Amazon Creek at 29th Stree		
2,4-d	36325	South Yamhill	2012 Spring	Rogue River @ Hwy. 18/Sal		
2,4-d	34232	Yamhill	2013 Summer-Fall	West Fork Palmer at Webfo		
2,4-d	36391	Amazon	2015 Fall	A1 Channel at Awbrey Lane		
2,4-d	37434	Wasco	2018 Spring	Fifteenmile Creek at Dufur		
2,4-d	34788	Hood River		Rogers Spring Creek at Red		
2,4-d	32012	Walla Walla		Little Walla Walla River at T		
2,4-d	36296	South Yamhill	2013 Spring	Agency CR at SW Grand Ron		
2,4-d	36296	South Yamhill	2014 Spring	Agency CR at SW Grand Ron		
2,4-d	36389	Amazon	2013 Summer-Fall	Amazon Creek at Beltline R		
2,4-d	10000	South Yamhill	2014 Spring	Blank - Transfer::TfB		
2,4-d	25204	Wasco	2012 Spring	Threemile Creek at Hwy 19		

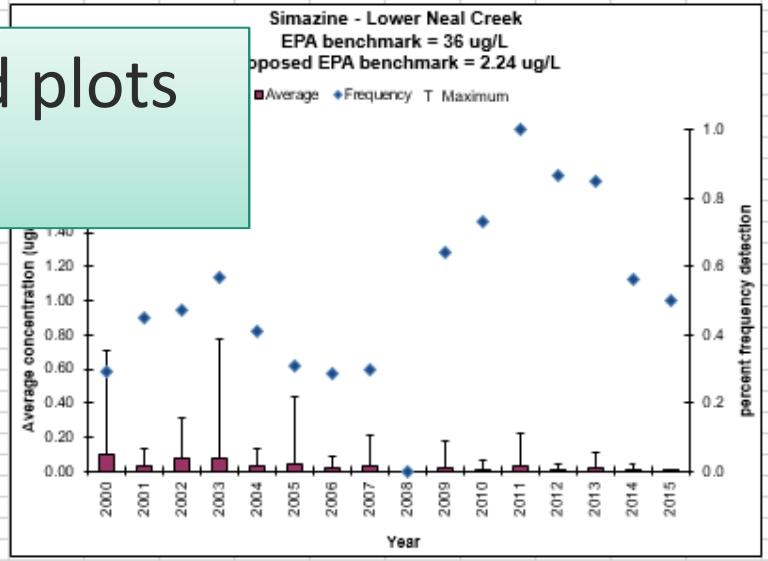
Manually created plots and summaries

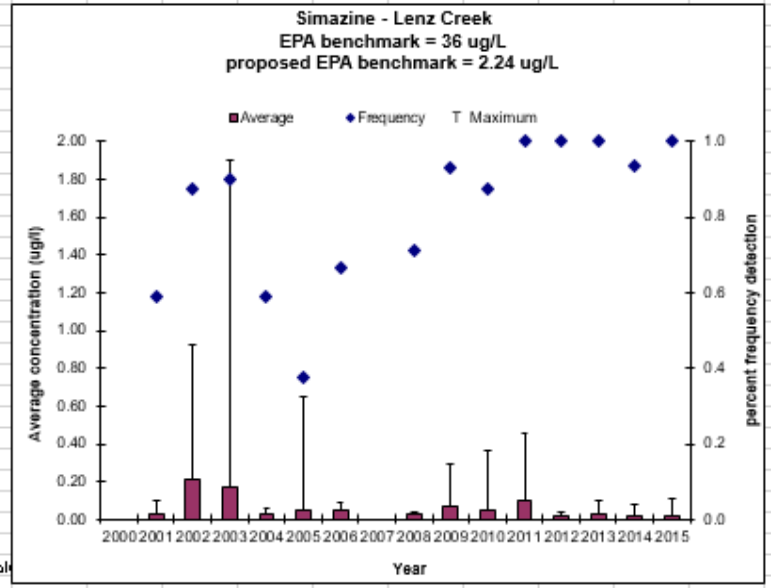
Simazine - Lower Neal Creek

	Average	Count	Hits	Frequency	Maximum	Maximum on graph
2000	0.03					
2001	0.0					
2002	0.0					
2003	0.0					
2005	0.04					
2006	0.02					
2007	0.0					
2008	0.00					
2009	0.02638	14.0000	3	0.64	0.1760	0.143
2010	0.01552	15.0000	11	0.73	0.0637	0.048
2011	0.03212	12.0000	12	1.00	0.226	0.194
2012	0.01274	15.0000	13	0.87	0.0405	0.028
2013	0.01716			0.85	0.113	0.096
2014	0.01087			0.56	0.0414	0.031
2015	0.00303	18	3	0	0.0605	0.051

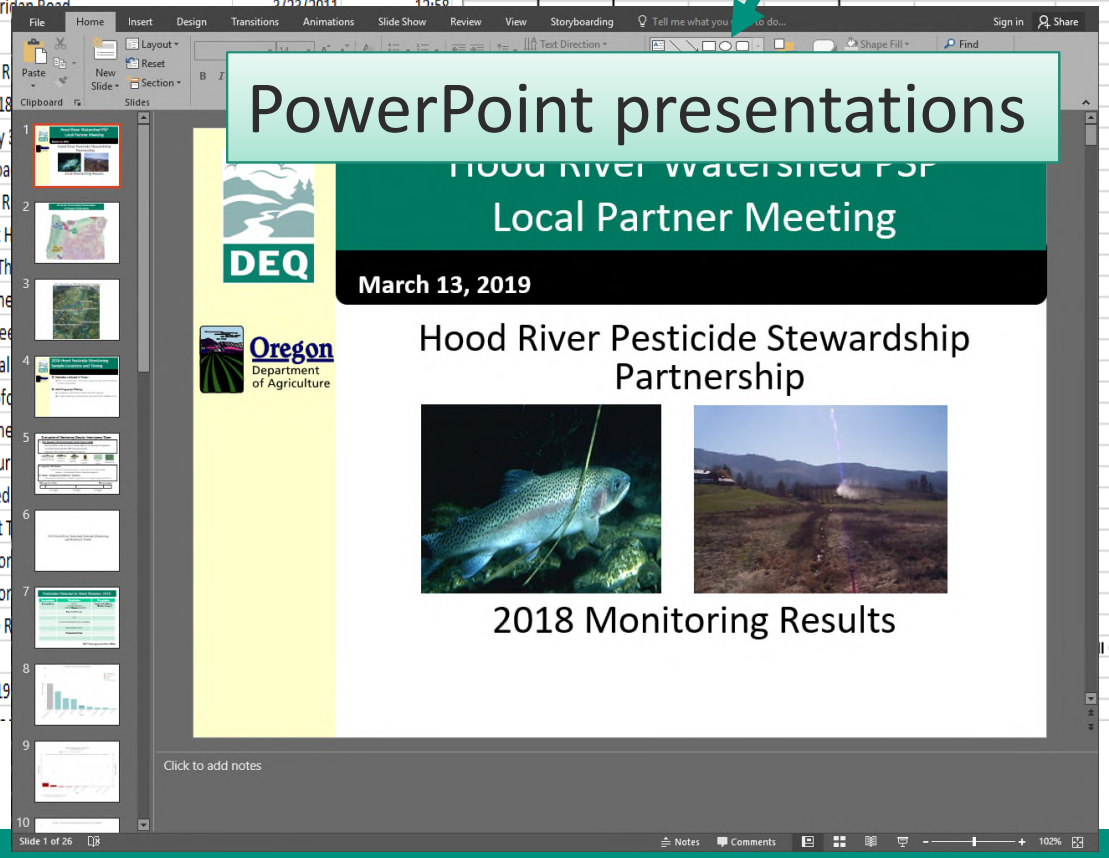
Simazine - Lenz Creek

	Average	Count	Hits	Frequency	Maximum	Maximum on graph
2000						
2001	0.0271	22	13	0.59	0.0370	0.070
2002	0.2179	16	1	0.88	0.3270	0.703





PowerPoint presentations



Drowning in sheets!!

Max of percent.det.freq	Column Labels					
Row Labels	Lenz Creek at mout	Neal Creek at mouth (upstream of brid	Odell Creek upstream of Odell WWTP ou	Upper Neal Creek, downstream of Ef	Hood River at footbridge downstream of	Grand Total
2,4-D	66.66666667	66.66666667	50			66.66666667
2,6-Dichlorobenzamide	100	100	100			100
Carbaryl	22.22222222	16.66666667				22.22222222
Deisopropylatrazine	100	83.33333333	30			
Dichlobenil	11.11111111	5.555555556				
Diuron	100	94.44444444	10			
Hexazinone						
Propiconazole		5.555555556				
Pyraclostrobin	11.11111111					
Simazine	100	50				
Glyphosate	33.33333333	33.33333333	50			
Aminomethylphosphonic acid (AMPA	66.66666667	66.66666667				
Grand Total	**100**	**100**	**100**			

Early Spring Average Chlorpyrifos - Lower Ne

	Average	Count	Hits	Frequency	Maximum	Maximum	Chronic W	Acute WQ	Frequency
2000	0.0840	12	9	75	0.343	0.259	0.041	0.083	0.75
2001	0.0421	9	5	55.55555556	0.184	0.142	0.041	0.083	0.555556
2002	0.0128	9	3	33.33333333	0.047	0.034	0.041	0.083	0.333333
2003	0.0118				0.059	0.047	0.041	0.083	0.2
2004	0.0074				0.037	0.030	0.041	0.083	0.2
2005	0.0470				0.077	0.030	0.041	0.083	1
2006							0.041	0.083	
2007	0.0000	5	0	0	0.000	0.000	0.041	0.083	0
2008	0.0034	7	2	28.57142857	0.014	0.011	0.041	0.083	0.285714
2009	0.0000	9	0	0		#VALUE!	0.041	0.083	0
2010	0.004625	8	1	12.5	0.026	0.021	0.041	0.083	0.125
2011	0.0000	0	0	0	0.000	0.000	0.041	0.083	0
							0.041	0.083	0
							0.041	0.083	0
							0.041	0.083	0
							0.041	0.083	0
							hronic W	Acute WQS	
							0.041	0.083	
.0198	10.0000	4	40	0.0770	0.057		0.041	0.083	0.4
.0170	8.0000	2	25	0.1040	0.087		0.041	0.083	0.25

Using old DL in 2008

Chlorpyrifos

	average	max	mog	WQS acute = 0.083 ug/L	
2005	#REF!	#REF!	#REF!	0.083	
2006	#REF!	#REF!	#REF!	0.083	
2007	#REF!	#REF!	#REF!	0.083	
2008	#REF!	#REF!	#REF!	0.083	
2009			0	0.083	
2010			0	0.083	
2011			0	0.083	0.041
2012			0	0.083	0.041
2013			0	0.083	0.041

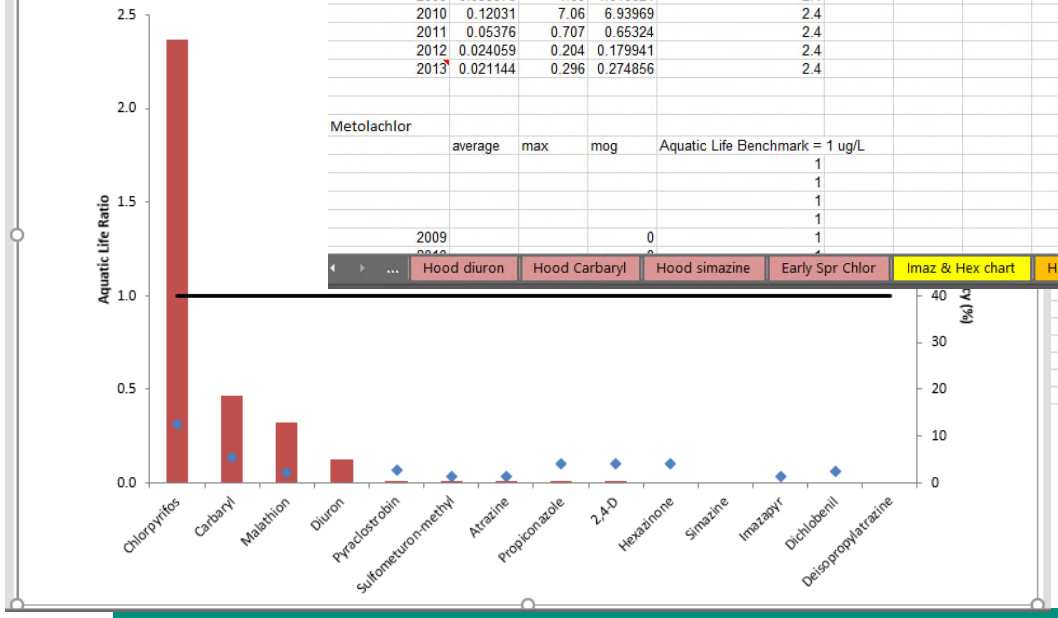
Diuron

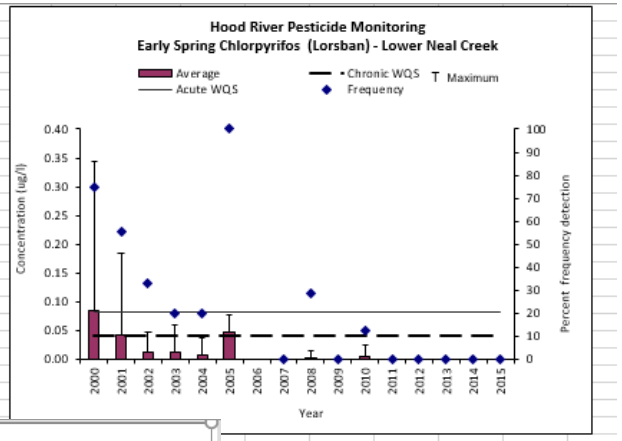
	average	max	mog	Aquatic Life Benchmark = 2.4 ug/L
				2.4
				2.4
				2.4
				2.4
2009	0.033376	1.68	1.646624	2.4
2010	0.12031	7.06	6.93969	2.4
2011	0.05376	0.707	0.65324	2.4
2012	0.024059	0.204	0.179941	2.4
2013	0.021144	0.296	0.274856	2.4

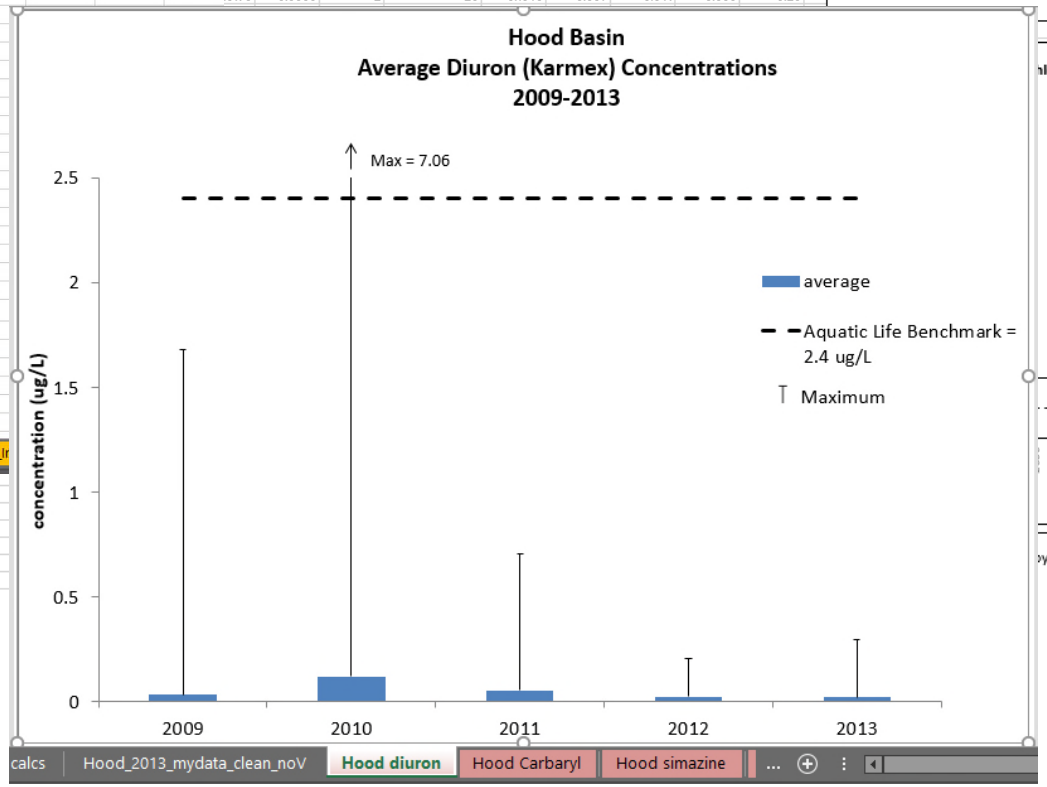
Metolachlor

	average	max	mog	Aquatic Life Benchmark = 1 ug/L
				1
				1
				1
				1
2009			0	1

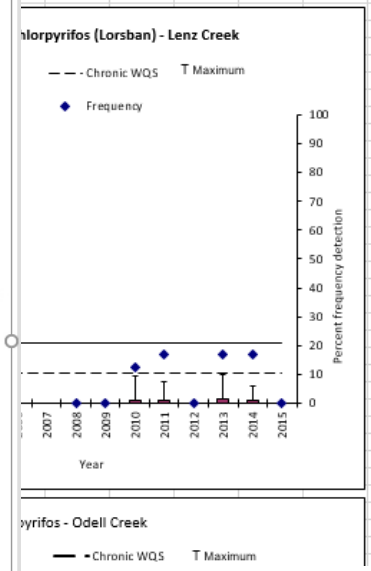
Hood diuron | Hood Carbaryl | Hood simazine | Early Spr Chlor | Imaz & Hex chart | Hex_Ir







calcs | Hood_2013_mydata_clean_noV | Hood diuron | Hood Carbaryl | Hood simazine



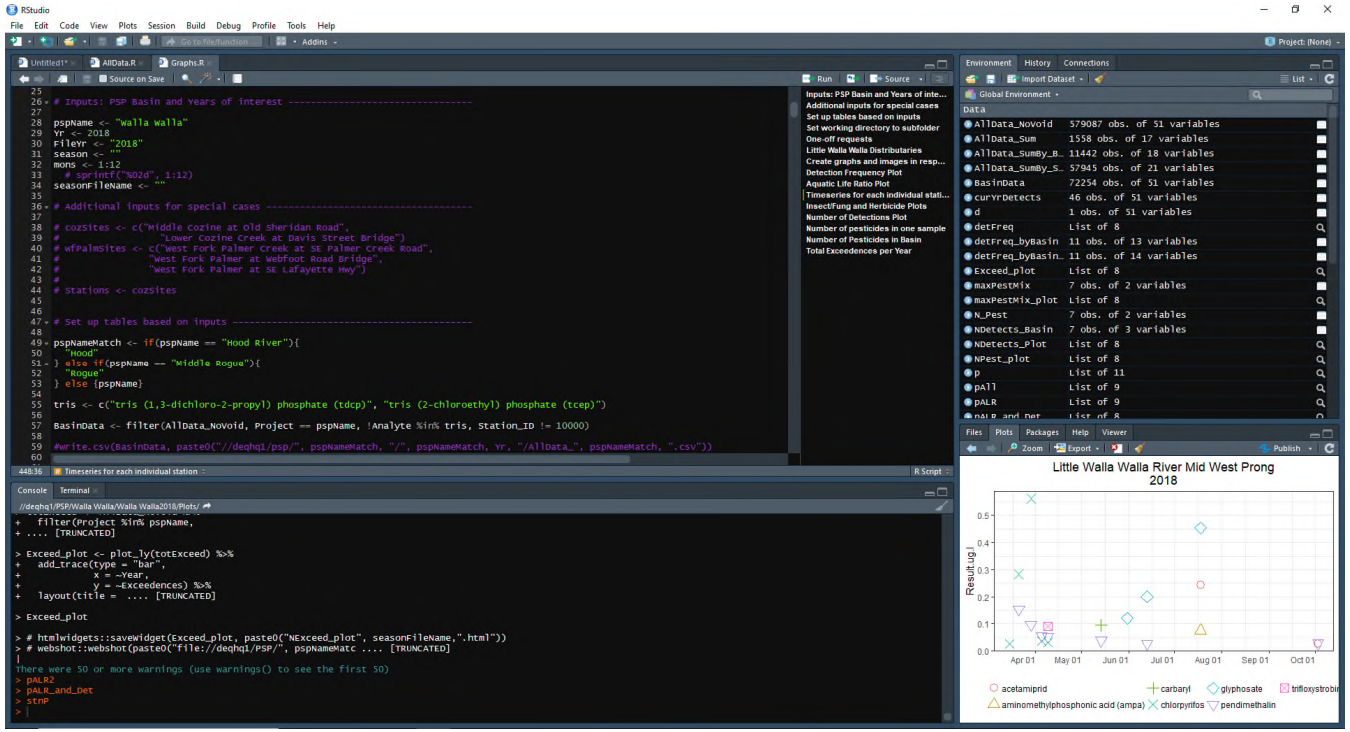
Enter R

Advantage

- Streamlined
- Standardized
- Documented
- Automated
- Open source framework

Problem

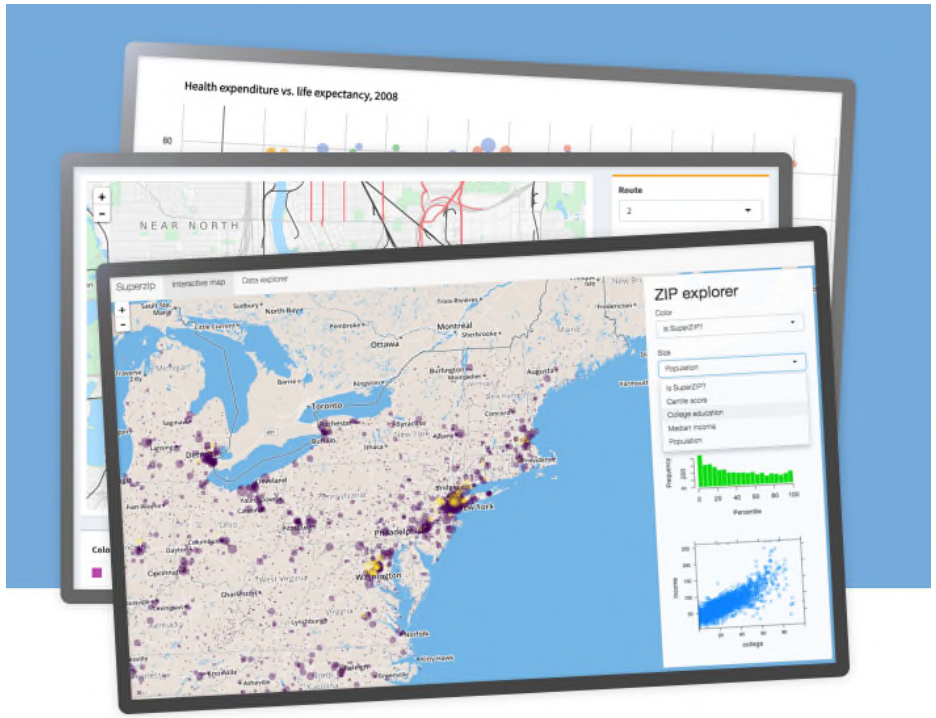
- Requires R proficiency
- Less customizeable

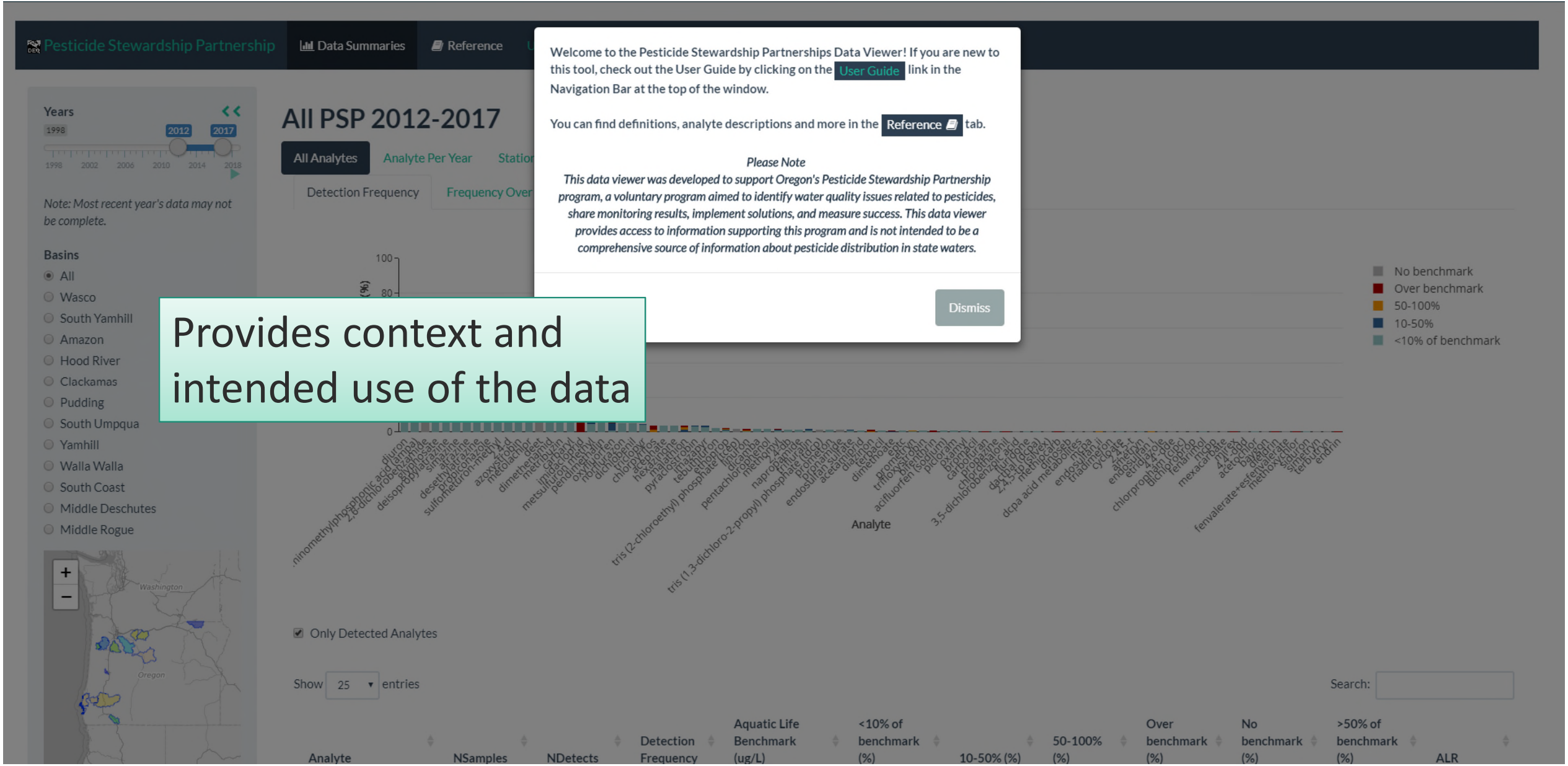


Shiny from RStudio

Advantage

- Access (ran via web browser)
- Transparency
- Context
- Consistency
- No R knowledge required





Provides context and intended use of the data

Years

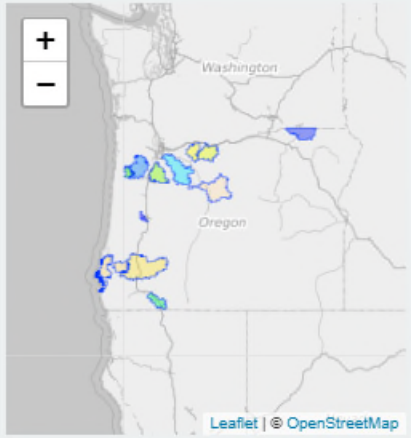
1998 2012 2017

1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018

Note: Most recent year's data may not be complete.

Basins

- All
- Wasco
- South Yamhill
- Amazon
- Hood River
- Clackamas
- Pudding
- South Umpqua
- Yamhill
- Walla Walla
- South Coast
- Middle Deschutes
- Middle Rogue



All Analytes | Analyte Per Year | Station Summary | Detection Map

Inputs:

Station ID: All

Analyte: chlorpyrifos

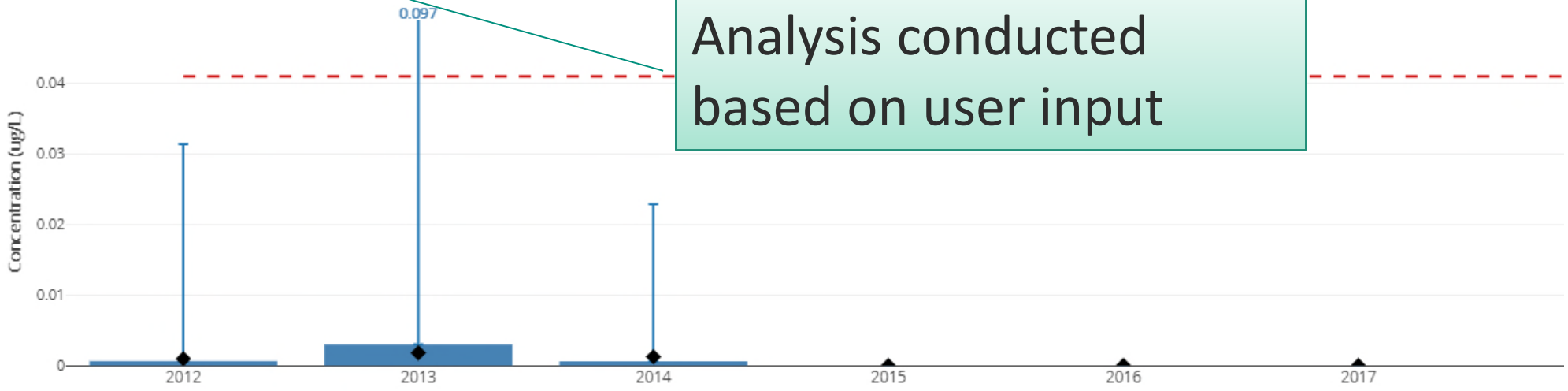
chlordane
chlorobenzilate
chloroneb
chlorothalonil
chlorpropham (cipc)
chlorpyrifos
chlorpyrifos oxon

All Stations in the Hood River Basin: Chlorpyrifos Summary

Average/Max | Detection Frequency | Detections by Station

Variable: Average

Click to enter Plot title



Analysis conducted based on user input

Pesticide Stewardship Partnership | Data Summaries | Reference | User Guide

Interactive, downloadable visuals

Years

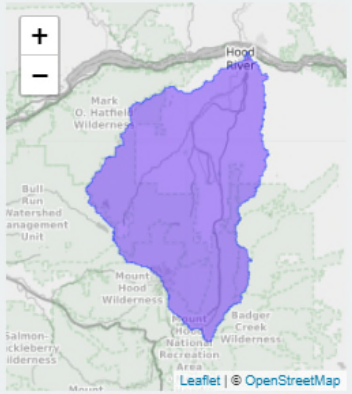
1998 2012 2018

1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018

Note: Most recent year's data may not be complete.

Basins

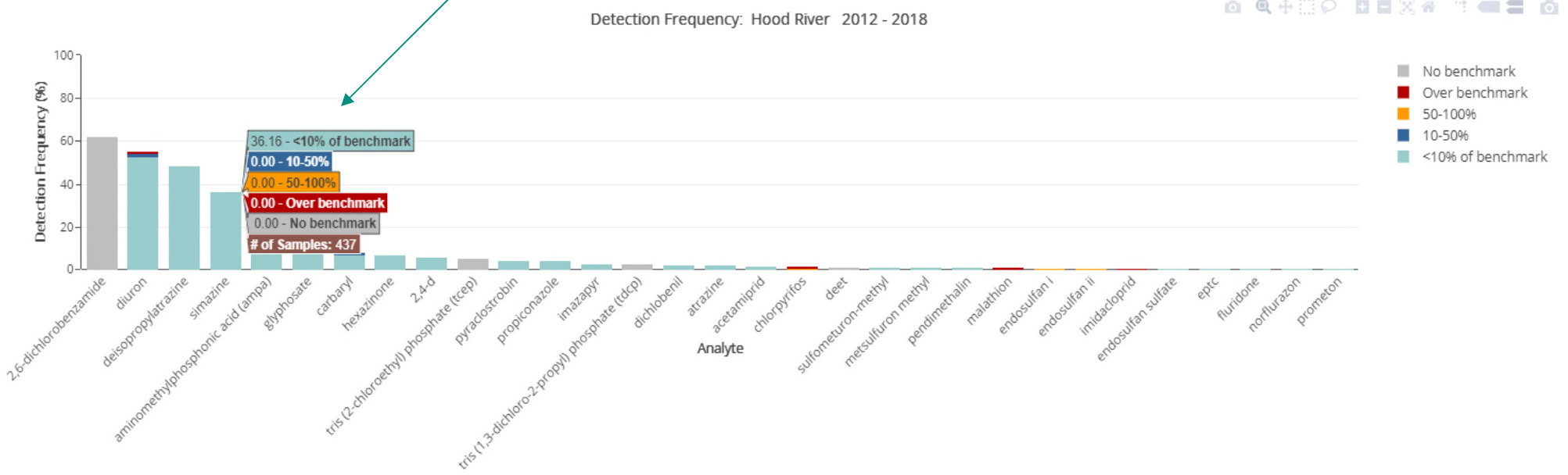
- All
- Wasco
- South Yamhill
- Amazon
- Hood River
- Clackamas
- Pudding
- South Umpqua
- Yamhill
- Walla Walla
- South Coast
- Middle Deschutes
- Middle Rogue



Hood River 2012-2018

All Analytes | Analyte Per Year | Station Summary | Detection Map

Detection Frequency | Frequency Over 50% | Aquatic Life Ratio



☑ Only Detected Analytes

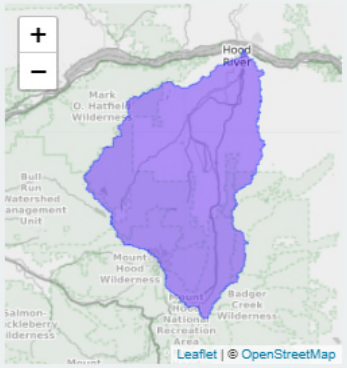
Show 25 entries

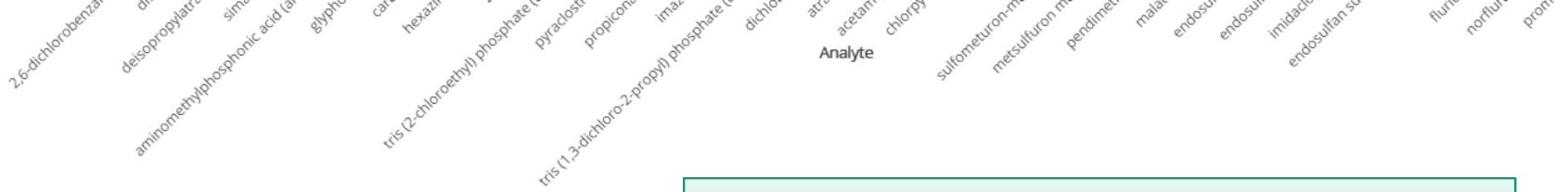
Search:

Analyte	NSamples	NDetects	Detection Frequency	Aquatic Life Benchmark (ug/L)	<10% of benchmark (%)	10-50% (%)	50-100% (%)	Over benchmark (%)	No benchmark (%)	>50% of benchmark (%)	ALR
2,6-dichlorobenzamide	356	220	61.80		0.000000	0.000000	0.00	0.00	61.80	0.00	-Inf
diuron	437	239	54.69	2.400e+00	52.630544	1.372971	0.23	0.46	0.00	0.69	1.62

DEQ

- Walla Walla
- South Coast
- Middle Deschutes
- Middle Rogue





Interactive summary tables

☑ Only Detected Analytes

Show 25 entries

Search:

Analyte	NSamples	NDetects	Detection Frequency	Aquatic Life Benchmark (ug/L)	<10% of benchmark (%)	10-50% (%)	50-100% (%)	Over benchmark (%)	No benchmark (%)	>50% of benchmark (%)	ALR
imidacloprid	437	2	0.46	1.000e-02	0.000000	0.000000	0.00	0.46	0	0.46	9.26
chlorpyrifos	435	6	1.38	4.100e-02	0.000000	0.000000	0.92	0.46	0	1.38	2.37
diuron	437	239	54.69	2.400e+00	52.630544	1.372971	0.23	0.46	0	0.69	1.62
malathion	423	2	0.47	1.000e-01	0.000000	0.235000	0.00	0.24	0	0.24	1.35
endosulfan i	435	2	0.46	5.600e-02	0.000000	0.000000	0.46	0.00	0	0.46	0.87
endosulfan ii	435	2	0.46	5.600e-02	0.000000	0.230000	0.23	0.00	0	0.23	0.72
carbaryl	437	35	8.01	5.000e-01	6.865714	1.144286	0.00	0.00	0	0.00	0.47
simazine	437	158	36.16	2.240e+00	36.160000	0.000000	0.00	0.00	0	0.00	0.08
sulfometuron-methyl	437	5	1.14	4.800e-01	1.140000	0.000000	0.00	0.00	0	0.00	0.06
atrazine	437	8	1.83	1.000e+00	1.830000	0.000000	0.00	0.00	0	0.00	0.04
metsulfuron methyl	269	2	0.74	3.600e-01	0.740000	0.000000	0.00	0.00	0	0.00	0.04
endosulfan sulfate	435	1	0.23	1.900e+00	0.230000	0.000000	0.00	0.00	0	0.00	0.03
hexazinone	435	28	6.44	7.000e+00	6.440000	0.000000	0.00	0.00	0	0.00	0.01
2,4-d	199	11	5.53	2.992e+02	5.530000	0.000000	0.00	0.00	0	0.00	0.01
pyraclostrobin	433	17	3.93	1.500e+00	3.930000	0.000000	0.00	0.00	0	0.00	0.01
propiconazole	437	17	3.89	2.100e+01	3.890000	0.000000	0.00	0.00	0	0.00	0.01
acetamiprid	437	7	1.60	2.100e+00	1.600000	0.000000	0.00	0.00	0	0.00	0.01
pendimethalin	435	3	0.69	5.200e+00	0.690000	0.000000	0.00	0.00	0	0.00	0.01

Pesticide Stewardship Partnership | Data Summaries | Reference | User Guide

Years

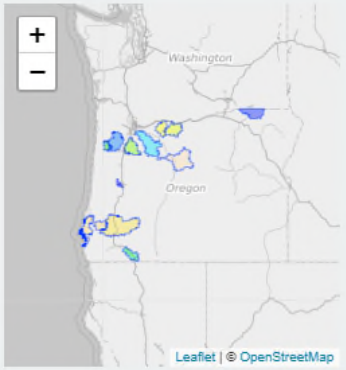
1998 2012 2018

1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018

Note: Most recent year's data may not be complete.

Basins

- All
- Wasco
- South Yamhill
- Amazon
- Hood River
- Clackamas
- Pudding
- South Umpqua
- Yamhill
- Walla Walla
- South Coast
- Middle Deschutes
- Middle Rogue



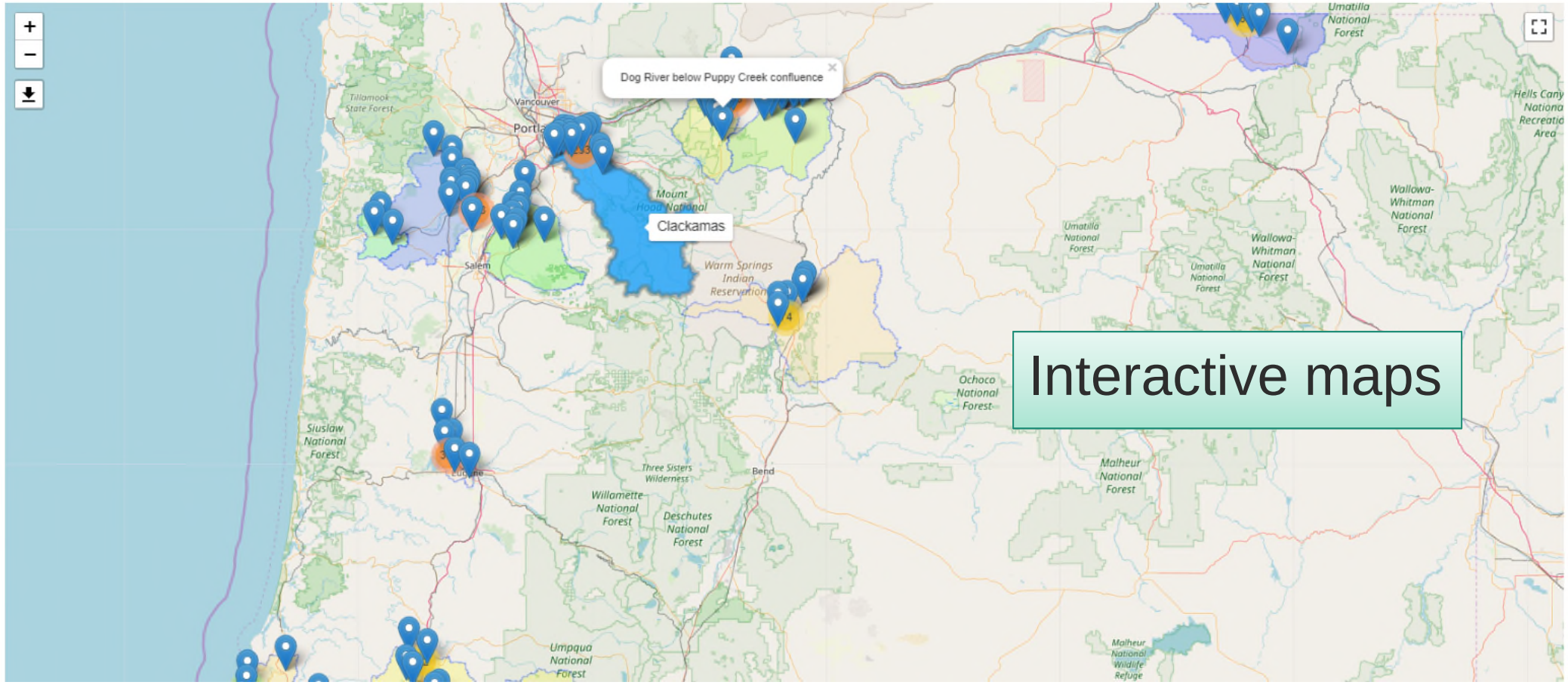
All PSP 2012-2018

All Analytes | Analyte Per Year | Station Summary | Detection Map

Analyte: diuron

Aquatic Life Ratio: above 0

Opaque Basins? | NLCD Legend | Crop Legend | Collapse



Interactive maps

DEQ

Pesticide Stewardship Partnership | Data Summaries | Reference | User Guide

Years

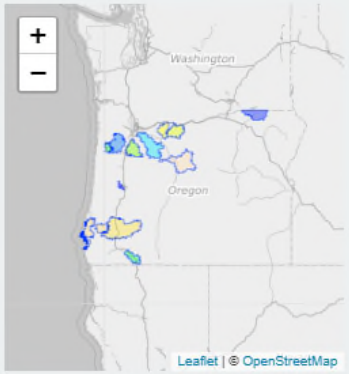
1998 2012 2018

1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018

Note: Most recent year's data may not be complete.

Basins

- All
- Wasco
- South Yamhill
- Amazon
- Hood River
- Clackamas
- Pudding
- South Umpqua
- Yamhill
- Walla Walla
- South Coast
- Middle Deschutes
- Middle Rogue



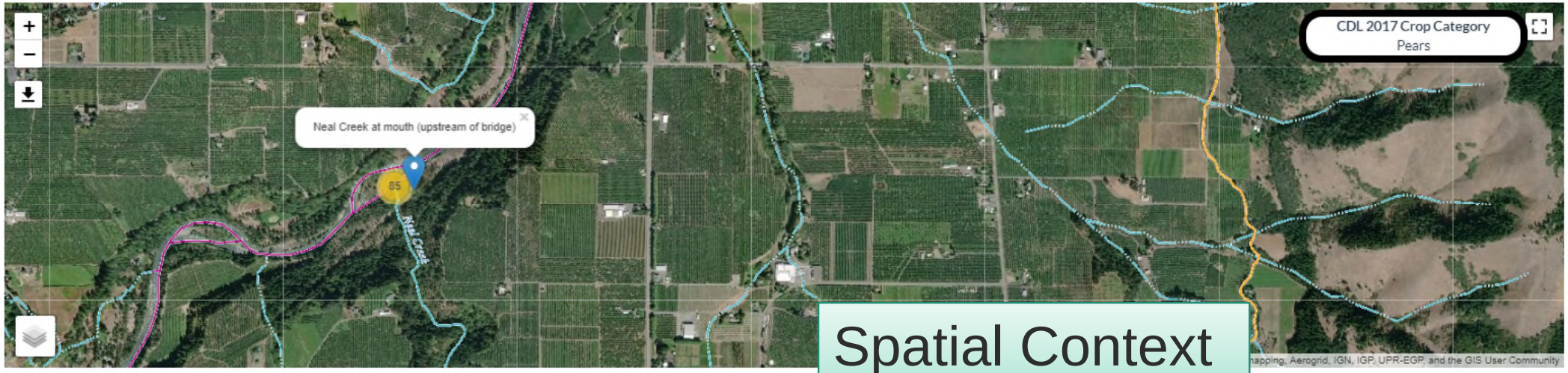
All PSP 2012-2018

All Analytes | Analyte Per Year | Station Summary | Detection Map

Analyte: diuron

Aquatic Life Ratio: above 0

Opaque Basins? | NLCD Legend | Crop Legend | Expand

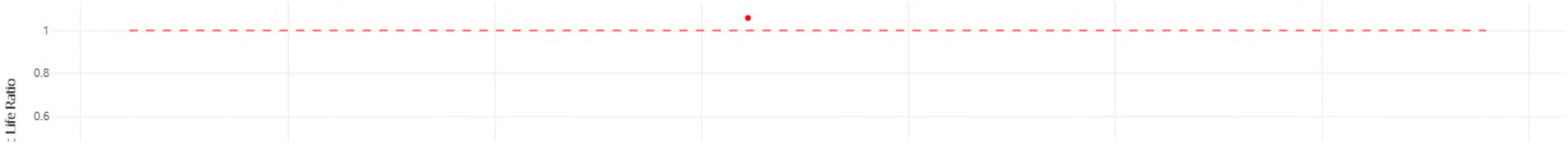


Spatial Context

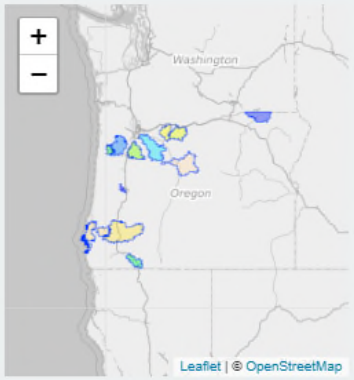
click on an individual station, basin, or detection to view

Detection Plot | Upstream Land Use

Neal Creek at mouth (upstream of bridge)

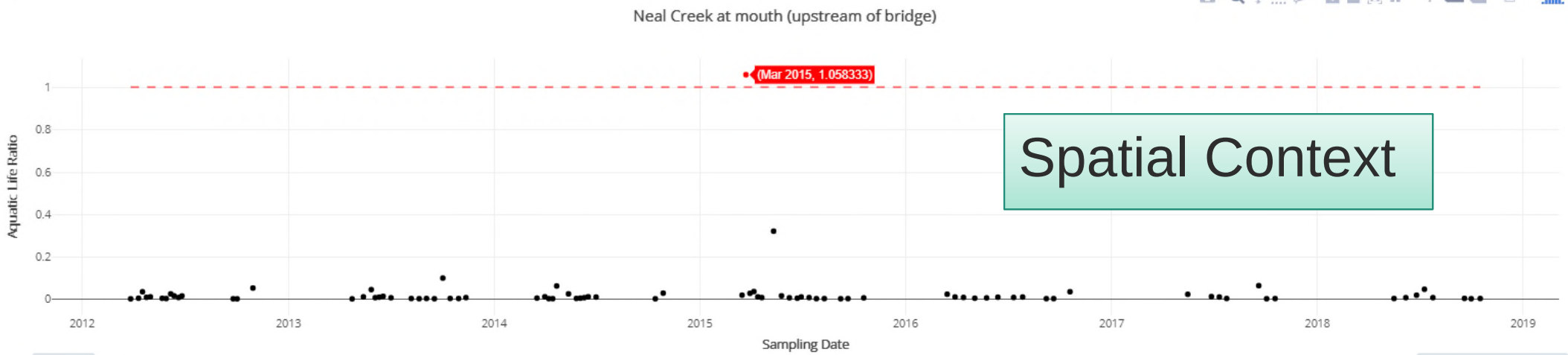


- Walla Walla
- South Coast
- Middle Deschutes
- Middle Rogue



click on an individual station, basin, or detection to view

Detection Plot | Upstream Land Use



Spatial Context

Show 25 entries

Search:

Analyte	AQL_Ratio	Sampling_Date	Station_Description	Project
diuron	0.003504167	2017-07-24	Neal Creek at mouth (upstream of bridge)	Hood River
diuron	0.015750000	2015-05-26	Neal Creek at mouth (upstream of bridge)	Hood River
diuron	0.003133333	2012-05-29	Neal Creek at mouth (upstream of bridge)	Hood River
diuron	0.004791667	2016-05-03	Neal Creek at mouth (upstream of bridge)	Hood River
diuron	0.002658333	2016-09-07	Neal Creek at mouth (upstream of bridge)	Hood River
diuron	0.006833333	2013-07-02	Neal Creek at mouth (upstream of bridge)	Hood River
diuron	0.006666667	2015-06-09	Neal Creek at mouth (upstream of bridge)	Hood River
diuron	0.034958333	2012-04-17	Neal Creek at mouth (upstream of bridge)	Hood River

Pesticide Stewardship Partnership | Data Summaries | Reference | User Guide

Glossary of Terms | Analyte Descriptions | Station Reference

Definitions

References

Show 25 entries

Search:

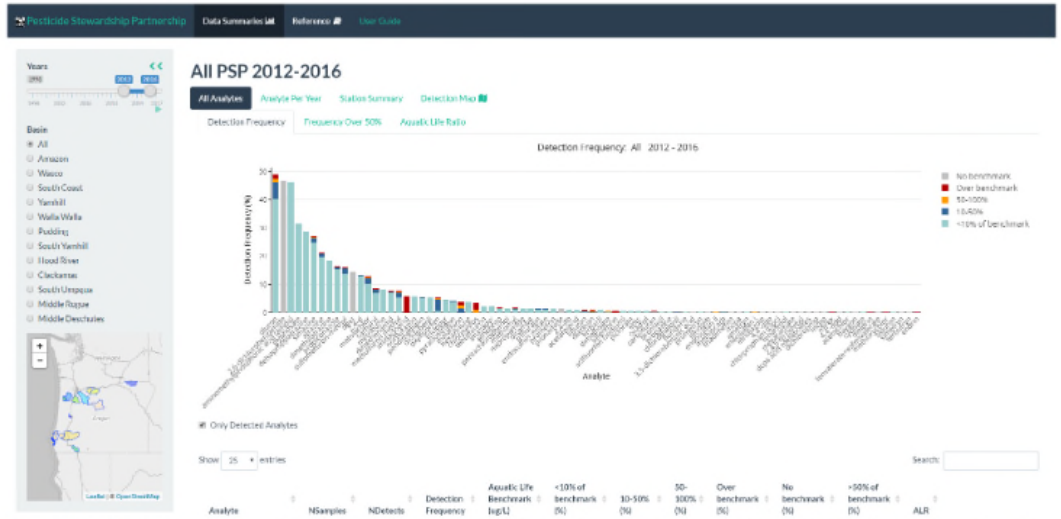
Term	Definition	Additional Information
Aquatic life benchmarks (ALBs)	The aquatic life benchmarks (ALB) are determined by the EPA based on acute and chronic toxicity values and used for environmental risk assessment. The environmental risks are based on studies done under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in addition to laboratory and field studies published in public scientific literature. The Oregon DEQ's Pesticide Stewardship Program uses the lowest ALB available for each pesticide to show the detection levels in relation to the most sensitive group of organisms. This allows the PSP to identify and prioritize pesticides and locations of concern. To compare results among a variety of pesticides, all ALBs are generally converted to micrograms per liter (µg/L).	https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-pesticide-registration
Aquatic life ratios (ALRs)	The aquatic life ratio (ALR) is a factor representing the concentration of the detected pesticide to its ALB. The ALR is calculated by dividing the maximum detection concentration (µg/L) by its ALB. Pesticides shown with ALRs greater than or equal to 1 have been detected at or above the aquatic life benchmark and require further attention.	(maximum concentration of analyte)/(ALB of analyte)
Detection Frequency	The frequency of detection value represents the percent of samples analyzed for that pesticide that contained measured concentrations above the method detection limit (MDL).	(# of detections of analyte)/(# of samples analyzed for that analyte)
Average Concentration of Detections	The average concentration of the analyte for all samples analyzed for that analyte	(sum of all concentrations of the analyte)/(number of samples analyzed for that analyte)
Analyte	A substance whose chemical constituents are being identified and measured	
Insecticide	A pesticide used to kill, repel or mitigate one or more species of insect	https://www.epa.gov/caddis-vol2/insecticides
Herbicide	A pesticide used to kill or control unwanted plants	https://www.epa.gov/caddis-vol2/caddis-volume-2-sources-stressors-responses-herbicides
Fungicide	A pesticide used to kill or control fungi or fungal spores	http://npic.orst.edu/ingred/ptype/fungicide.html
Pesticide	A substance used to control or destroy organisms that affect the cultivation of crops.	http://cru66.cahe.wsu.edu/labels/Labels.php?SrchType=C&SrchFld=INGR&join=AND&yrFld=undefined&stateFld=undefined
Detection	When a sample has a measurable concentration of an analyte (above the measurable detection limit or MDL)	
Measurable detection limit (MDL)	The minimum concentration that is measurable by the lab method used	
Sampling Date	The date the sample was taken from the sampling location	
The Pesticide Stewardship Partnership (PSP)	A voluntary partnership between state agencies, tribal governments, local land owners, universities, soil and water conservation districts and watershed and other natural resource groups with the purpose of identifying potential concerns and improve water quality affected by pesticide use around Oregon	http://www.oregon.gov/ODA/programs/Pesticides/Water/Pages/PesticideStewardship.aspx
Basin	An area drained by a river and all of its tributaries	

Background info

DEQ

Navbar
Data Analysis
References

PSP App User Guide



User Guide

This guide will provide documentation on some of the available functions in the application. The following sections describe the various ways to view, filter and maneuver around the data to aide in analysis.

Navbar

The navbar allows users to navigate between the data analysis and reference information panes. Click on "Data Summaries" or "References" to choose which pane is active. Any changes to your parameter selections will not be lost while navigating between navbar panes.

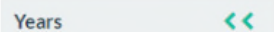
Clicking on the title, "Pesticide Stewardship Partnerships", will open a new window with the main PSP project page on the Oregon Department of Agriculture website.

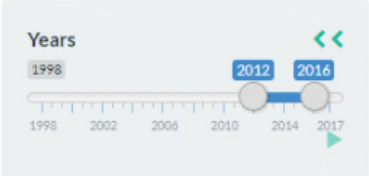
Data Analysis

Sidebar

The sidebar allows users to filter the data shown in the data analysis panes. To hide the sidebar, click the << button. The following sections describe the inputs available in the sidebar.

Years





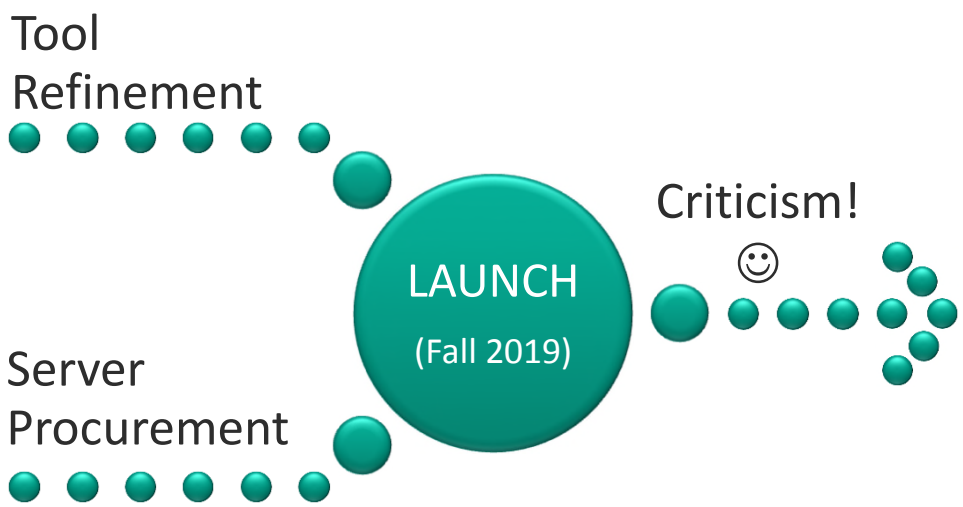
TL:DR

PSP Data Viewer Shiny App

- Interactive! Users can customize analysis
- Standardizes format
- Provides context on how to interpret data and analyses
- Provides analysis in a timely manner
- Educational tool with references and additional resources
- Requires only a web browser and internet access

Current Status

- Still in beta
- Available to program partners
- Procurement process for hosting service
- Publicly available by fall 2019



Questions?

Colin Donald

Oregon DEQ

Email: Donald.Colin@deq.state.or.us

Phone: (503) 229-6571

DEQ can provide documents in an alternate format or in a language other than English upon request. Call DEQ at 800-452-4011 or email deqinfo@deq.state.or.us.